Varian, Inc.
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PRODUCT DISCONTINUED

This manual is provided for customer convenience.

3300 and Star 3400 CX Gas Chromatograph

Operator's Manual

QUALITY SYSTEM ISO 9001 CERTIFIED

 Printed in U.S.A. 03-914461-00:6₁

Safety Information

Operating Instructions

This instruction manual is provided to help you establish operating conditions which will permit safe and efficient use of your equipment. Special considerations and precautions are also described in the manual, which appear in the form of **NOTES**, **CAUTIONS**, and **WARNINGS** as described below. It is important that you operate your equipment in accordance with this instruction manual and any additional information which may be provided by Varian. Address any questions regarding the safe and proper use of your equipment to your local Varian office.

NOTE
Information to aid you in obtaining optimal performance from your instrument.

CAUTION
Alerts you to situations that may cause moderate injury and/or equipment damage, and how to avoid these situations.

WARNING
Alerts you to potentially hazardous situations that could result in serious injury, and how to avoid these situations.

Warning Symbol	Warning Description
WARNING: SHOCK HAZARD	Hazardous voltages are present inside instrument. Disconnect from main power before removing screw-attached panels.
WARNING: CHEMICAL HAZARD	Hazardous chemicals may be present. Avoid contact, especially when replenishing reservoirs. Use proper eye and skin protection.
WARNING: BURN HAZARD	Very hot or cryogenically cold surfaces may be exposed. Use proper skin protection.
WARNING: EYE HAZARD	Eye damage could occur either from flying particles, chemicals, or UV radiation. Use proper eye and face protection.
WARNING: FIRE HAZARD	The potential for fire may be present. Follow manual instructions for safe operation.
WARNING: EXPLOSION HAZARD	The potential for explosion may exist because of type of gas or liquid used.
WARNING: RADIATION SOURCE	Ionizing radiation source is present. Follow manual instructions for safe operation.
WARNING: MOVING PARTS	Keep hands and fingers away.

General Safety Precautions

Follow these safety practices to ensure safe equipment operation.

- Perform periodic leak checks on all supply lines and pneumatic plumbing.
- Do not allow gas lines to become kinked or punctured. Place lines away from foot traffic and extreme heat or cold.
- Store organic solvents in fireproof, vented and clearly labeled cabinets so they are easily identified as toxic and/or flammable materials.
- Do not accumulate waste solvents. Dispose of such materials through a regulated disposal program and not through municipal sewage lines.

NOTICE: This instrument has been tested per applicable requirements of EMC Directive as required to carry the European Union CE Mark. As such, this equipment may be susceptible to radiation/interference levels or frequencies which are not within the tested limits.

⚠ WARNING This instrument is designed for chromatographic analysis of appropriately prepared samples. It must be operated using appropriate gases and/or solvents and within specified maximum ranges for pressure, flows, and temperatures as described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

⚠ WARNING It is the responsibility of the Customer to inform Varian Customer Support Representatives if the instrument has been used for the analysis of hazardous biological, radioactive, or toxic samples, prior to any instrument service being performed or when an instrument is being returned to the Service Center for repair.

Electrical Hazards

- Disconnect the instrument from all power sources before removing protective panels to avoid exposure to potentially dangerous voltages.
- When it is necessary to use a non-original power cord plug, make sure the replacement cord adheres to the color coding and polarity described in the manual and all local building safety codes.
- Replace blown fuses with fuses of the size and rating stipulated on the fuse panel or in the manual.
- Replace faulty or frayed power cords immediately with the same type and rating.
- Make sure that voltage sources and line voltage match the value for which the instrument is wired.

Compressed Gas Cylinders

- Store and handle compressed gases carefully and in strict adherence to safety codes.
- Secure cylinders to an immovable structure or wall.
- Store and move cylinders in an upright, vertical position. Before transport, remove regulators and install cylinder cap.
- Store cylinders in a well-ventilated area away from heat, direct sunshine, freezing temperatures, and ignition sources.
- Mark cylinders clearly so there is no doubt as to their contents.
- Use only approved regulators and connections.
- Use only connector tubing that is chromatographically clean (Varian Part Number 03-918326-00) and has a pressure rating significantly greater than the highest outlet pressure from the regulator.

GC Safety Practices

Exhaust System

No special exhaust ducting is necessary for GC detectors installed in a well-ventilated room except when the detectors are used to test hazardous chemicals. If you do install ducting:

- Use only fireproof ducting.
- Install a blower at the duct outlet.
- Locate duct intakes such that their vibration or air movement does not effect detector operation.
- Check periodically for proper operation of the duct.
- Ensure proper ventilation in lab area.

Radioactive Source Detectors

- Read carefully and comply with all NOTES, CAUTIONS, and WARNINGS in the Ni^{63} ECD manual.
- Perform the tests for removable radioactive contamination described in the Ni^{63} ECD manual.
- Comply with leak test schedules and procedures.

Burn Hazard

Heated or cryogenically cooled zones of gas chromatographs can remain hot or cold for a considerable time after instrument power is turned off. To prevent painful burns, ensure that all heated or cooled areas have returned to room temperature or wear adequate hand protection before you touch potentially hot or cold surfaces.

LC Safety Practices

High Pressure Hazard

- If a line ruptures, a relief device opens, or a valve opens accidentally under pressure, potentially hazardous high liquid pressures can be generated by the pump causing a high velocity stream of volatile and/or toxic liquids.

- Wear face protection when you inject samples or perform routine maintenance.
- Never open a solvent line or valve under pressure. Stop the pump first and let the pressure drop to zero.
- Use shatter-proof reservoirs capable of operating at 50-60 psi.
- Keep the reservoir enclosure closed when the reservoir is under pressure.
- Read and adhere to all NOTES, CAUTIONS, and WARNINGS in the manual.

Flash Chromatography

The operator should be familiar with the physico-chemical properties of the components of the mobile phase.

Keep solvents from direct contact with the polyurethane supply tubing as certain solvents will cause weakening and leaks with possible bursting.

All components of the system should be connected to a common power supply and common ground. This ground must be a true ground rather than a floating ground.

Non-polar solvents can develop a static charge when pumped through the system. All vessels that contain mobile phase (including tubing and collection vessels) must be grounded to dissipate static electricity.

Employ static measuring and static discharge devices (e.g., air ionizers) to safeguard against the buildup of static electricity.

Ultraviolet Radiation

Liquid chromatograph detectors that use an ultraviolet light source have shielding to prevent radiation exposure to personnel.

For continued protection:

- Ensure that protective lamp covers of variable and fixed wavelength detectors are in place during operation.
- Do not look directly into detector fluid cells or at the UV light source. When inspecting the light source or fluid cell, always use protective eye covering such as borosilicate glass or polystyrene.

Spare Parts Availability

It is the policy of Varian to provide operational spare parts for any instrument and major accessory for a period of five (5) years after shipment of the final production run of that instrument. Spare parts will be available after this five (5) year period but on an *as available* basis. Operational spare parts are defined as those individual electrical or mechanical parts that are susceptible to failure during their normal operation. Examples include relays, lamps, temperature probes, detector elements, motors, etc. Sheet metal parts, structural members or assemblies and castings, printed circuit boards, and functional modules are normally capable of being rebuilt to like-new condition throughout their useful life and therefore will be supplied only on an *as available* basis after the final production run of the instrument.

Service Availability

Varian provides a variety of services to support its customers after warranty expiration. Repair service can be provided by attractively priced service contracts or on a time and material basis. Technical support and training can be provided by qualified personnel on both a contractual or as-needed basis.

Varian, Inc. Analytical Instruments Sales Offices

For Sales or Service assistance and to order Parts and Supplies, contact your local Varian office.

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Sicherheitsinformationen

Arbeitsanleitungen

Diese Arbeitsanleitung will Ihnen bei der Aufstellung solcher Arbeitsbedingungen helfen, die einen sicheren und wirkungsvollen Gebrauch Ihrer Geräte ermöglichen. Besondere Überlegungen und Vorsichtsmaßnahmen erscheinen in diesem Handbuch in Form von **HINWEIS**, **ACHTUNG** und **WARNUNG,** wie unten beschrieben. Es ist wichtig, daß Sie Ihr Gerät in Übereinstimmung mit dieser Arbeitsanleitung und allen möglichen zusätzlichen Informationen von Varian betreiben. Alle Fragen bezüglich Sicherheit und Handhabung Ihres Gerätes richten Sie an Ihr Varian Büro.

HINWEIS

Eine Information, um einen optimalen Wirkungsgrad Ihres Instruments zu erzielen.

ACHTUNG

Weist auf Situationen, die zu mäßiger Beeinträchtigung und/oder zu Geräteschäden führen und auf die Vermeidung dieser Situationen hin.

WARNUNG

Weist auf mögliche Gefahrensituationen, die zu ernsthaften Verletzungen führen können und auf die Vermeidung dieser Situationen hin.

Warnungssymbol	**Warnungsbeschreibung**
WARNUNG ELEKTRISCHER SCHLAG	Gefährliche Spannungen bestehen innerhalb des Instruments. Trennen Sie das Gerät vom Netz, bevor Sie abschraubbare Paneele entfernen.
WARNUNG CHEMISCHE GEFAHR	Gefährliche Chemikalien können vorhanden sein. Vermeiden Sie jeden Kontakt, besonders beim Auffüllen der Reservoirs. Benutzen Sie wirksamen Augen und Hautschutz.
WARNUNG VERBRENNUNGSGEFAHR	Sehr heiße oder tiefstgekühlte Oberflächen können freigelegt sein. Benutzen Sie einen wirksamen Hautschutz.
WARNUNG AUGENVERLETZUNG	Herumfliegende Partikel, Chemikalien oder UV-Strahlung können Augenschäden verursachen. Tragen Sie deshalb einen geeigneten Schutz für Augen und Gesicht.
WARNUNG FEUERGEFAHR	Es besteht eine mögliche Feuergefahr. Beachten Sie die Vorschriften im Handbuch für eine gefahrlose Benutzung.
WARNUNG EXPLOSIONSGEFAHR	Eine mögliche Explosionsgefahr besteht infolge der benutzten Gas- oder Flüssigkeitsart.
WARNUNG STRAHLUNGSQUELLE	Es besteht eine ionisierende Strahlungsquelle. Beachten Sie die Vorschriften im Handbuch für eine gefahrlose Benutzung.
WARNUNG BEWEGTE TEILE	Bleiben Sie mit Ihren Händen und Fingern weg.

Allgemeine Sicherheitsmaßnahmen

Befolgen Sie diese Sicherheitspraktiken für eine gefahrlose Gerätebenutzung.

- Prüfen Sie regelmäßig alle Versorgungs und Pneumatikleitungen auf Lecks.
- Gasleitungen dürfen nicht geknickt oder angestochen werden. Verlegen Sie die Leitungen außerhalb von Laufwegen und abseits von extremer Hitze oder Kälte.
- Lagern Sie organische Lösungsmittel in feuerfesten, belüfteten und eindeutig bezeichneten Schränken, damit sie leicht als toxische und/oder brennbare Materialien erkannt werden.
- Sammeln Sie keine Lösungsmittelabfälle. Entsorgen Sie solche Materialien über ein geregeltes Entsorgungsprogramm und nicht über die öffentlichen Abwasserleitungen.

HINWEIS: Dies Instrument wurde nach den zutreffenden Vorschriften der EMC Direktive getestet, die zum Führen des CE Zeichens der Europäischen Union berechtigen. Dieses Gerät kann an sich auf Strahlungs-/Störpegel oder Frequenzen außerhalb der getesteten Grenzen reagieren.

WARNUNG Dies Instrument ist für chromatographische Analysen entsprechend präparierter Proben gedacht. Es muß mit geeigneten Gasen und/oder Lösungsmitteln und innerhalb der im Handbuch spezifizierten maximalen Werte für Druck, Flüsse und Temperaturen betrieben werden.

WARNUNG Der Kunde ist vor der Durchführung irgendeines Geräteservices verpflichtet den Varian Kundendienstvertreter zu informieren, wenn das Instrument für Analysen gefährlicher biologischer, radioaktiver oder toxischer Proben benutzt worden ist.

Elektrische Gefahren

- Lösen Sie das Instrument von allen Stromquellen, bevor Sie Schutzpaneele entfernen, damit Sie nicht mit potentiell gefährlichen Spannungen in Berührung kommen.
- Wenn ein Nicht-Original Netzkabelstecker benutzt werden muß, muß das Austauschkabel die im Handbuch beschriebene Farbcodierung und Polarität beibehalten und alle örtlichen Sicherheitsvorschriften erfüllen.
- Ersetzen Sie durchgebrannte Sicherungen nur mit Sicherungen der Werte, die am Sicherungspaneel oder im Handbuch angegeben sind.
- Ersetzen Sie fehlerhafte oder durchgescheuerte Netzkabel sofort durch Kabel gleicher Art.
- Sorgen Sie dafür, daß Spannungsquellen und die Netzspannung den gleichen Wert haben, für den das Instrument verdrahtet ist.

Gasdruckflaschen

- Lagern und handhaben Sie komprimierte Gase vorsichtig und in strikter Einhaltung der Sicherheitsvorschriften.
- Befestigen Sie die Gasflaschen an feststehenden Aufbauten oder an Wänden.
- Lagern und transportieren Sie Gasflaschen in aufrechter Stellung. Druckregler zuvor abnehmen.
- Lagern Sie Gasflaschen in gut durchlüfteten Räumen, weit genug weg von Heizungen, direktem Sonnenschein, Frosttemperaturen und Entzündungszonen.
- Kennzeichnen Sie die Flaschen so eindeutig, daß kein Zweifel über deren Inhalt bestehen kann.
- Benutzen Sie nur geprüfte Druckminderer und Verbindungsstücke.
- Benutzen Sie nur chromatographisch reines Verbindungsrohr (Varian Part Number 03-918326-00), das wesentlich höheren Druck als den höchsten Ausgangsdruck des Druckminderers aushält.

GC Sicherheitspraktiken

Abgassystem

Für GC Detektoren, die in einem gut durchlüfteten Raum installiert sind, ist keine spezielle Abgasführung erforderlich, außer wenn die Detektoren zum Testen gefährlicher Chemikalien benutzt werden. Wenn Sie eine Abgasführung installieren:

- Benutzen Sie nur feuerfeste Führungen.
- Installieren Sie ein Gebläse am Ausgang.
- Ordnen Sie die Ansaugöffnung so an, daß ihre Erschütterungen oder Luftströmungen nicht die Detektorfunktion beeinträchtigen.
- Prüfen Sie regelmäßig die einwandfreie Arbeitsweise der Abgasführung.
- Sorgen Sie für gute Entlüftung im Laborbereich.

Radioaktive Detektoren

- Lesen Sie sorgfältig und befolgen Sie alle **HINWEISE**, **ACHTUNGEN** und **WARNUNGEN** im Ni^{63} ECD Handbuch.
- Führen Sie die Tests für zu beseitigende radioaktive Kontamination durch, die im Ni^{63} ECD Handbuch beschrieben sind.
- Erfüllen Sie die Zeitpläne und Verfahren zur Dichtigkeitsprüfung.

Verbrennungsgefahr

Beheizte oder tieftemperaturgekühlte Zonen des Gaschromatographen können beträchtlich lange heiß oder kalt bleiben, nachdem das Instrument bereits abgeschaltet ist. Zur Vermeidung schmerzhafter Verbrennungen müssen Sie darauf achten, daß alle beheizten oder gekühlten Zonen auf Raumtemperatur zurückgegangen sind oder Sie müssen ausreichenden Handschutz benutzen, bevor Sie möglicherweise heiße oder kalte Oberflächen berühren.

LC Sicherheitspraktiken

Gefahr durch hohen Druck

Wenn eine Leitung bricht, eine Entlüftungseinheit sich öffnet oder ein Ventil sich unbeabsichtigt unter Druck öffnet, kann durch die Pumpe möglicherweise ein gefährlich hoher Flüssigkeitsdruck entstehen, der einen Strahl flüchtiger und/oder toxischer Flüssigkeiten von hoher Stömungsgeschwindigkeit verursacht.

- Tragen Sie einen Gesichtsschutz, wenn Sie Proben injizieren oder Routinewartungen durchführen.
- Öffnen Sie niemals eine unter Druck stehende Lösungsmittelleitung oder ein Ventil. Halten Sie zuerst die Pumpe an und lassen Sie den Druck auf Null abfallen.
- Benutzen Sie splittersichere Reservoirs, die für einen Druck von 3,4 bis 4,1 bar ausgelegt sind.
- Halten Sie die Reservoirverkleidung geschlossen, wenn die Reservoirs unter Druck stehen.
- Lesen Sie und befolgen Sie alle **HINWEISE**, **ACHTUNGEN** und **WARNUNGEN** im Handbuch.

Blitzlicht-Chromatographie

Der Bediener sollte mit den physikalisch-chemischen Eigenschaften der Komponenten vertraut sein, aus denen sich die mobile Phase zusammensetzt.

Vermeiden Sie direkten Kontakt der Lösungsmittel mit den Zuführungsleitungen aus Polyurethan, da einige Lösungsmittel das Material der Leitungen schwächen und damit Undichtigkeiten oder Brüche hervorrufen können.

Alle Systemkomponenten sollten an der gleichen Netzstromquelle und einer gemeinsamen Erdung angeschlossen sein. Dabei muss es sich um eine echte, nicht um eine schwebende Erdung handeln.

Nicht-polare Lösungsmittel können sich beim Pumpen durch das System statisch aufladen. Alle Gefäße, die mobile Phase enthalten (einschließlich Leitungen und Sammelgefäße), müssen zur Ableitung elektrostatischer Aufladungen geerdet sein.

Setzen Sie Geräte zur Messung und Ableitung elektrostatischer Aufladungen (z.B. Geräte zur Luftionisierung) als Maßnahmen gegen den Aufbau statischer Elektrizität ein.

Ultraviolette Strahlung

Detektoren in Liquidchromatographen, die eine ultraviolette Lichtquelle benutzen, besitzen eine Abschirmung, die das Bedienungspersonal gegen Abstrahlungen schützt. Zum ständigen Schutz:

- Achten Sie darauf, daß die schützende Lampenabdeckung der Detektoren mit variablen und festen Wellenlängen während des Betriebs an ihrem Platz ist.
- Schauen Sie nicht direkt in die Flüssigkeitszellen im Detektor oder in die UV Lampe. Zum Inspizieren der Lichtquelle oder der Flüssigkeitszelle benutzen Sie immer einen wirksamen Augenschutz, wie er durch Borsilikatglas oder Polystyrol gewährleistet wird.

Verfügbarkeit von Ersatzteilen

Es ist Varian's Grundsatz, Ersatzteile für alle Instrumente und die wichtigsten Zubehöre für einen Zeitraum von fünf (5) Jahren nach dem Fertigungsauslauf dieser Geräteserie verfügbar zu haben. Nach diesem Zeitraum von fünf (5) Jahren können Ersatzteile auf der Basis *solange vorhanden* bezogen werden. Als Ersatzteil werden hier solche elektrischen und mechanischen Einzelteile verstanden, die unter normalen Bedingungen ausfallen können. Beispiele sind Relais, Lampen, Temperaturfühler, Detektorelemente, Motore usw. Metallbleche, Formteile oder Baugruppen und Gußteile, PC Boards und Funktionsmodule können normalerweise neuwertähnlich für eine brauchbare Lebensdauer instandgesetzt werden und werden deshalb nur auf der Basis *solange vorhanden* nach dem Produktionsauslauf des Instruments geliefert werden.

Serviceverfügbarkeit

Varian bietet seinen Kunden auch nach dem Auslaufen der Garantie eine Vielfalt von Serviceleistungen an. Reparaturservice kann zu attraktiven Preisen über eine Wartungsvereinbarung oder nach Zeit- und Materialaufwand zur Verfügung gestellt werden. Technische Unterstützung und Training bieten wir Ihnen durch qualifizierte Chemiker sowohl auf einer Kontraktbasis als auch nach Ihren Erfordernissen an.

Varian Analytical Instruments Verkaufsbüros

Für Verkaufs oder Servicehilfe und zum Bestellen von Teilen und Zubehören setzen Sie sich bitte mit Ihrem Varian Büro in Verbindung.

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Informations et mesures de sécurité

Instructions de fonctionnement

Ce manuel d'instruction est conçu pour aider l'utilisateur à créer des conditions opératoires lui permettant de faire fonctionner le matériel efficacement et en toute sécurité. Il contient entre autres certaines observations spéciales présentées sous forme de **NOTES, MISES EN GARDE** et **AVERTISSEMENTS.** Il est important de faire fonctionner ce matériel conformément aux instructions du présent manuel et à toute autre information émanant de Varian. S'adresser au bureau régional Varian pour toute question relative à la sécurité ou à l'utilisation correcte du matériel.

NOTE

Information destinée à tirer le meilleur parti du matériel sur le plan des performances

MISE EN GARDE

Attire l'attention sur une situation pouvant occasionner des dommages corporels légers et/ou des dégâts mineurs à l'appareil et indique comment remédier à cette situation

AVERTISSEMENT

Attire l'attention sur une situation potentiellement dangereuse pouvant occasionner des dommages corporels importants et indique comment remédier à cette situation

Symboles d'avertissement	Description
ATTENTION RISQUE D'ELECTROCUTION	Exposition à des tensions dangereuses. Débrancher le matériel du secteur avant de dévisser les panneaux protecteurs.
ATTENTION SUBSTANCES CHIMIQUES DANGER	Présence éventuelle de substances chimiques dangereuses. Eviter tout contact, en particulier lors du remplissage des réservoirs. Prendre les mesures de protection adéquates pour les yeux et la peau.
ATTENTION RISQUE DE BRÛLURES	Exposition à des surfaces chaudes ou traitées cryogéniquement. Prendre les mesures de protection adéquates pour la peau.
ATTENTION DANGER POUR LES YEUX	Les dommages causées aux yeux sont de deux natures différentes : jet de particules et de produits chimiques ou radiations UV. Utiliser des protections du visage et des yeux appropriées.
ATTENTION RISQUE D'INCENDIE	Risque potentiel d'incendie. Se conformer aux instructions du manuel pour faire fonctionner le matériel en toute sécurité.
ATTENTION RISQUE D'EXPLOSION	Risque potentiel d'explosion en raison du type de gaz ou de liquide utilisé.
ATTENTION SOURCE DE RADIATION	Présence d'une source de radiation ionisante. Se conformer aux instructions du manuel pour faire fonctionner le matériel en toute sécurité.
ATTENTION PIECES EN MOUVEMENT	Garder les mains et les doigts hors de portée.

Précautions générales en matière de sécurité

Les pratiques suivantes garantissent une utilisation sans risques du matériel:

- Effectuer régulièrement des essais d'étanchéité de tous les conduits d'alimentation et de tous les tuyaux du système pneumatique.
- Ne pas travailler avec des conduits de gaz déformés ou percés. Installer les conduits de gaz à l'écart des allées et venues et à l'abri du chaud ou du froid.
- Conserver les solvants organiques dans des récipients à l'épreuve du feu, bien ventilés et portant mention de la nature de leur contenu, en particulier lorsque lesdits solvants sont toxiques et/ou inflammables.
- Ne pas accumuler les solvants de rebut. Les éliminer conformément à un programme agréé d'élimination des déchets et non via les égouts municipaux.

NOTE: Ce matériel a été testé conformément aux dispositions de la directive CME afin de pouvoir porter le sigle CE de l'Union européenne. Il en résulte qu'il peut être sensible à des niveaux de radiation/d'interférence ou à des fréquences se situant hors des limites testées.

ATTENTION Ce matériel est conçu pour effectuer des analyses chromatographiques d'échantillons préparés selon des méthodes appropriées. Il convient de le faire fonctionner avec les gaz et/ou les solvants adéquats et dans les limites des pressions, des débits et des températures maximales spécifiées dans le présent manuel.

ATTENTION Le client est tenu d'informer le service Varian d'assistance à la clientèle que son matériel a été utilisé pour l'analyse d'échantillons biologiques dangereux, radioactifs ou toxiques avant que n'en soit effectué la maintenance.

Risques de chocs électriques

- Déconnecter le matériel de toute source d'alimentation avant d'en démonter les panneaux de protection, sous peine de s'exposer à des tensions dangereuses.
- En cas d'utilisation d'un cordon d'alimentation n'étant pas d'origine, s'assurer que celui-ci soit conforme à la polarité et au codage des couleurs décrits dans le manuel d'utilisation ainsi qu'à toutes les normes régionales de sécurité régissant le secteur de la construction.
- Remplacer les fusibles sautés par des fusibles de même type que ceux stipulés sur le panneau des fusibles ou dans le manuel d'utilisation.
- Remplacer les cordons d'alimentation défectueux ou dénudés par des cordons d'alimentation de même type.
- S'assurer que les sources de tension et la tension de secteur correspondent à la tension de fonctionnement du matériel.

Bouteilles à gaz comprimé

- Ranger et manipuler les bouteilles à gaz comprimé avec précaution et conformément aux normes de sécurité.
- Fixer les bouteilles à gaz comprimé à un mur ou à une structure inamovible.
- Ranger et déplacer les bouteilles à gaz comprimé en position verticale. Avant de transporter les bouteilles à gaz comprimé, retirer leur régulateur.
- Ranger les bouteilles dans un endroit bien ventilé et à l'abri de la chaleur, des rayons directs du soleil, du gel ou des sources d'allumage.
- Marquer les bouteilles de manière à n'avoir aucun doute quant à leur contenu.
- N'utiliser que des connexions et régulateurs agréés.
- N'utiliser que des tuyaux de raccordement propres sur le plan chromatographique (Varian P/N 03-918326-00) et pouvant supporter des pressions sensiblement plus élevées que la plus haute pression de sortie du régulateur.

Mesures de sécurité en CPG

Système d'échappement

Les détecteurs CPG installés dans une pièce bien ventilée ne nécessitent pas de conduits spéciaux d'échappement excepté lorsqu'ils sont destinés à analyser des substances chimiques dangereuses. Lors de l'installation de tels conduits:

- N'utiliser que des conduits à l'épreuve du feu
- Installer un ventilateur à la sortie du conduit.
- Placer les orifices d'aspiration de manière à ce que les vibrations ou les mouvements d'air n'affectent pas le fonctionnement du détecteur.
- Vérifier périodiquement l'état du conduit.
- S'assurer que le laboratoire est correctement ventilé.

Détecteurs à source radioactive

- Se conformer au manuel d'utilisation de l'ECD Ni^{63}, en particulier à ses **NOTES**, **MISES EN GARDE ET AVERTISSEMENTS**.
- Effectuer les tests de décontamination radioactive décrits dans le manuel d'utilisation de l'ECD Ni^{63}.
- Se conformer aux procédures et au calendrier des essais d'étanchéité.

Risque de brûlures

Les zones des chromatographes à gaz chauffées ou traitées cryogéniquement peuvent rester très chaudes ou très froides durant une période plus ou moins longue après la mise hors tension du matériel. Pour éviter les brûlures, s'assurer que ces zones sont revenues à température ambiante ou utiliser un dispositif adéquat de protection des mains avant de les toucher.

Mesures de sécurité en CPL

Risques liés aux hautes pressions

En cas de rupture d'un tuyau ou en cas d'ouverture accidentelle d'une vanne alors que le système est sous pression, la pompe peut occasionner des dommages en expulsant à grande vitesse des jets de liquides volatiles et/ou toxiques.

- Mettre un masque de protection lors de l'injection des échantillons ou en effectuant les opérations de maintenance de routine.
- Ne jamais déconnecter un conduit de solvant ou une vanne sous pression. Arrêter préalablement la pompe et laisser la pression descendre à zéro.
- Utiliser des réservoirs incassables à 50-60 psi.
- Laisser l'enceinte du réservoir fermée lorsque le réservoir est sous pression.
- Se conformer aux **NOTES**, **MISES EN GARDE ET AVERTISSEMENTS** du manuel d'utilisation**.**

Chromatographie Flash

L'utilisateur aura la connaissance des propriétés physico-chimiques des constituants de la phase mobile.

Eviter le contact direct des solvants avec les tuyaux en polyuréthane : certains solvants sont susceptibles de provoquer des faiblesses et des fuites avec risques d'explosion.

Tous les constituants du système devront être connectés à une source de courant commune et à une prise de terre commune. Cette prise de terre devra être fixe et non mobile.

Les solvants non-polaires peuvent produire de l'électricité statique lorsqu'ils passent au travers du système. Les bouteilles qui contiennent la phase mobile (incluant les tuyaux et les flacons de collecte de fractions) doivent être mises à la terre pour éliminer l'électricité statique.

Utiliser des appareils de mesure et de décharge d'électricité statique (par exemple des ionisateurs d'air) pour combattre la formation d'électricité statique.

Radiations ultraviolettes

Les détecteurs CPL utilisant une source lumineuse ultraviolette comportent un écran destiné à se prémunir contre les expositions aux rayonnements.

Pour s'assurer une protection permanente:

- Vérifier que le couvercle de protection de la lampe des détecteurs opérant à des longueurs d'onde variables et fixes soit bien en place durant le fonctionnement du matériel.
- Ne pas regarder directement les cellules du détecteur ou la source d'UV. Se protéger systématiquement les yeux lors du contrôle de la source lumineuse ou des cellules, par exemple au moyen de verres borosilicatés ou en polystyrène.

Disponibilité des pièces de rechange

La politique de Varian consiste à fournir des pièces de rechange pour tous les appareils et accessoires majeurs durant une période de cinq (5) ans après livraison de leur production finale. Les pièces de rechange ne sont fournies au terme de cette période de cinq (5) ans que suivant les disponibilités. Il faut entendre par pièces de rechange les pièces individuelles électriques ou mécaniques susceptibles de défaillance au cours de leur utilisation normale. Par exemple, les relais, les lampes, les sondes thermiques, les éléments de détecteur, les moteurs, etc. Les parties en tôles, les éléments ou assemblages structurels et les pièces de fonderie, les cartes à circuits imprimés et les modules fonctionnels sont normalement susceptibles d'être remis à l'état neuf pendant toute la durée de leur vie utile et ne sont dès lors fournies, au terme de la production finale des appareils, que suivant les disponibilités.

Service d'assistance à la clientèle

Varian fournit divers services destinés à aider sa clientèle après expiration de la garantie: service de réparation sur base de contrats de maintenance à prix attractifs ou sur base d'accords à durée limitée portant sur du matériel spécifique; support technique et service de formation assurés par des chimistes qualifiés sur base contractuelle ou en fonction des besoins spécifiques.

Points de vente des instruments analytiques Varian

Contactez votre point de vente régional Varian pour toute question commerciale ou de service d'assistance à la clientèle ou pour passer commande de pièces et de fournitures.

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(LC)

VARIAN

www.varianinc.com

Informazioni sulla Sicurezza

Instruzioni per l'Uso

Questo manuale ha lo scopo di aiutare l'operatore ad utilizzare lo strumento in modo sicuro ed efficiente. Le considerazioni e le precauzioni speciali vengono presentate in questo manuale sotto forma di avvisi di **NOTA**, **CAUTELA** e **ATTENZIONE**. E' importante che lo strumento venga utilizzato rispettando le istruzioni fornite in questo manuale o che verranno fornite successivamente dalla Varian. Per ogni eventuale chiarimento sull'uso o sulla sicurezza, si prega di contattare la Varian di Leinì (TO).

NOTA

Sono informazioni utili ad ottenere le prestazioni migliori da parte dello strumento.

ATTENZIONE

Allerta l'operatore su situazioni che potrebbero causare ferite leggere e danni limitati allo strumento ed il modo di evitarle.

ATTENZIONE

Allerta l'operatore su situazioni potenzialmente pericolose che possono causare danni molto seri ed il modo di evitarle.

Segnali di ATTENZIONE	Descrizione del Pericolo
ATTENZIONE Pericolo di folgorazioni	Nello strumento sono presenti tensioni pericolose. Scollegare il cavo di alimentazione prima di togliere il pannello fissato con le viti.
ATTENZIONE ESPOSIZIONE A SOSTANZA CHIMICHE	Possono essere presenti composti chimici pericolosi. Evitare il contatto, specialmente quando si riempiono i contenitori. Usare protezioni opportune per la pelle e per gli occhi.
ATTENZIONE Pericolo di scottature	Pericolo di esposizione a superfici molto calde o raffreddate criogenicamente. Usare protezioni opportune per la pelle.
ATTENZIONE PERICOLO PER GLI OCCHI	Particelle volanti, agenti chimici o radiazioni UV possono danneggiare gli occhi. Vanno quindi utilizzate le opportune protezioni per gli occhi e per il volto.
ATTENZIONE Pericolo di incendio	Pericolo potenziale di incendio. Seguire le istruzioni del manuale per lavorare con una maggiore sicurezza.
ATTENZIONE Pericolo di esplosioni	C'è pericolo di esplosioni a causa del tipo di gas o liquido utilizzato.
ATTENZIONE Pericolo di radiazioni	E' presente una radiazione ionizzante. Seguire le istruzioni del manuale per lavorare con una maggiore sicurezza.
ATTENZIONE Parti in movimento	Non tenere le mani o le dita vicino.

Norme di Sicurezza

Per lavorare in modo sicuro sullo strumento, Vi consigliamo si adottare le seguenti procedure.

- Verificare periodicamente che non ci siano perdite sulle linee e sui raccordi pneumatici.
- Evitare che le linee dei gas vengano piegate o forate. Le linee vanno posizionate in modo tale da non essere calpestate e lontane da sorgenti o troppo calde o troppo fredde.
- I solventi organici vanno conservati in armadi speciali antiincendio, ventilati e con indicazioni chiare sul contenuto di materiali tossici e/o infiammabili.
- Non accumulare i solventi utilizzati. Adottare un programma regolare di smaltimento, ma mai nelle acque di scarico.

AVVERTENZA: Questo strumento è stato testato secondo le Direttive EMC allo scopo di poter utilizzare il Marchio CE della Comunità Europea. Questo strumento può essere suscettibile a radiazioni/interferenze o frequenze che non sono entro i limiti collaudati.

ATTENZIONE Questo strumento è progettato per l'analisi cromatografica di campioni opportunamente preparati. Deve essere utilizzato usando gas e solventi adatti a questo scopo ed entro i limiti massimi di pressione, flusso e temperatura riportati in questo manuale. Se lo strumento non viene utilizzato secondo le modalità specificate dal costruttore, le condizioni di sicurezza previste potranno non essere sufficienti.

ATTENZIONE E' responsabilità del Cliente informare il Servizio Tecnico Varian, prima di qualsiasi intervento di riparazione, se lo strumento è stato utilizzato per l'analisi di campioni biologicamente pericolosi, radioattivi o tossici.

Pericoli Elettrici

- Prima di togliere i pannelli di protezione, scollegare lo strumento da tutte le alimentazioni elettriche in modo da evitare l'esposizione a voltaggi potenzialmente pericolosi.
- Quando si rende necessario sostituire il cavo di alimentazione, assicurarsi che il nuovo cavo rispetti sia le codifiche di colore e di polarità riportate nel manuale di istruzioni che quelle stabilite dalle norme di sicurezza del laboratorio.
- Sostituire i fusibili bruciati solo con fusibili che abbiano le stesse caratteristiche; queste ultime sono riportate sul pannello dei fusibili e/o nel manuale di istruzioni.
- Sostituire immediatamente i cavi di alimentazione difettosi o consumati con cavi dello stesso tipo e con le stesse caratteristiche.
- Assicurarsi che il voltaggio del pannello di alimentazione corrisponda a quello dello strumento da collegare.

Bombole dei Gas

- Occorre prestare molta attenzione quando si spostano bombole di gas compressi. Rispettare tutte le norme di sicurezza.
- Assicurare le bombole ad una parete o ad una struttura fissa.
- Spostare e conservare le bombole sempre in posizione verticale. Togliere i manometri prima di spostare le bombole.
- Conservare le bombole in un'area ben ventilata, non infiammabile, lontana da sorgenti di calore, non esposta a temperature troppo fredde o alla luce diretta del sole.
- Evidenziare in modo chiaro e che non lasci dubbi il contenuto di ogni bombola.
- Usare solo manometri e raccordi di qualità.
- Usare solo tubazioni cromatograficamente pulite (Numero di Parte Varian 03-918326-00) e calibrate per pressioni superiori a quella massima di uscita dal manometro.

Procedure di Sicurezza in GC

Scarico dei Gas

Per i rivelatori GC non è richiesto alcun sistema particolare di scarico dei gas, se lo strumento è installato in una stanza ben ventilata e se non viene utilizzato per l'analisi di sostanze chimiche pericolose. Se si deve installare un sistema di scarico dei gas:

- Usare condutture non infiammabili
- Installare un aspiratore in uscita
- Posizionare la presa d'aria in modo che le vibrazioni e il movimento dell'aria non disturbino il rivelatore.
- Eseguire verifiche periodiche per garantire un funzionamento corretto.
- Garantire una buona ventilazione nel laboratorio.

Rivelatori a Sorgente Radioattiva

- Leggere e rispettare tutte gli avvisi di **NOTA**, **CAUTELA** e **ATTENZIONE** riportati nel manuale del rivelatore ECD al Ni^{63}.
- Eseguire tutti i test di contaminazione radioattiva rimovibile descritti nel manuale dell'ECD al Ni^{63}.
- Rispettare tutte le procedure e le scadenze di verifica per eventuali perdite.

Pericolo di Scottature

Le zone calde o raffreddate criogenicamente del gascromatografo possono mantenere la loro temperatura per parecchio tempo, dopo aver spento lo strumento. Per evitare scottature, assicurarsi che le zone riscaldate o raffreddate siano a temperatura ambiente oppure indossare delle protezioni adeguate prima di toccare tali superfici.

Procedure di Sicurezza in LC

Pericolo di Alte Pressioni

In caso di rottura di una linea o di apertura accidentale di una valvola, quando il sistema è sotto pressione, la pompa può liberare liquidi tossici e/o volatili molto pericolosi.

- E' opportuno adottare un sistema di protezione del viso quando si inietta il campione o si esegue una manutenzione routinaria del sistema.
- Non smontare mai una linea del solvente od una valvola quando il sistema è sotto pressione. Fermare prima la pompa ed aspettare che la pressione scenda a zero.
- Usare dei contenitori per solventi infrangibili ed in grado di lavorare a 50-60 psi.
- Quando i contenitori sono sotto pressione, usare una protezione esterna.
- Leggere e rispettare tutti gli avvisi di **NOTA**, **CAUTELA** e **ATTENZIONE.**

Cromatografia Flash

L'operatore deve conoscere le proprietà fisico-chimiche delle componenti della fase mobile.

I solventi non vanno messi in contatto diretto con il tubo di erogazione in poliuretano, dal momento che alcuni solventi possono causare indebolimento e perdite con possibili scoppi.

Tutte le componenti del sistema vanno collegate ad una fonte di alimentazione e ad una messa a terra comuni. E' meglio che per quest'ultima venga utilizzata una spina con polo di terra.

I solventi non-polari possono sviluppare una carica statica quando vengono pompati attraverso il sistema. Tutti i recipienti che contengono la fase mobile (inclusi i tubi e i recipienti di raccolta) devono avere una messa a terra per disperdere l'elettricità statica.

Vanno utilizzati dispositivi di misurazione e scarico (ad esempio ionizzatori d'aria) per evitare l'aumento di elettricità statica.

Radiazioni Ultraviolette

I rivelatori di cromatografia liquida che usano sorgenti a luce ultravioletta montano degli schermi di protezione per evitare che gli operatori siano esposti a radiazioni pericolose.

Per una protezione sicura:

- Assicurarsi che i coperchi delle lampade dei rivelatori a lunghezza fissa e variabile siano sempre al loro posto, quando si lavora.
- Non guardare mai direttamente dentro le celle o alla sorgente di luce UV. Quando si vuole ispezionare la lampada o le celle, usare sempre delle protezioni adatte per gli occhi, quali vetro in borosilicato e polistirolo.

Disponibilità delle Parti di Ricambio

E' politica della Varian il fornire le parti di ricambio per lo strumento ed i suoi accessori per un periodo di cinque (5) anni a partire dalla data di produzione dell'ultima unità della serie. Le parti di ricambio saranno disponibili anche dopo questo periodo di cinque (5) anni ma solo in base alla disponibilità delle stesse. Per parti di ricambio si intendono i componenti elettrici e meccanici soggetti ad usura durante l'uso, in condizioni normali, dello strumento. Come esempio, citiamo i relay, le lampade, i probe di temperatura , i componenti del rivelatore, i motorini, ecc. Le parti strutturali o da fusione, le schede elettroniche ed i moduli funzionali possono essere ricostruiti e rimessi a nuovo durante tutto il loro periodo di vita e perciò sarà possibile acquistarli, dopo la produzione dell'ultima unità delle serie, solo in base alla loro disponibilità.

Servizi Tecnico

La Varian, alla scadenza del periodo di garanzia, è in grado di fornire ai suoi clienti un'ampia scelta di opzioni. Le riparazioni possono essere effettuate sulla base di contratti di manutenzione particolarmente vantaggiosi od in base ad una tariffa oraria piu' il costo delle parti. A richiesta, si possono avere corsi per operatori sia sotto forma di contratto che a tariffe da concordare.

Uffici Vendite della Divisione Strumenti Analitici della Varian

Per informazioni relative alla Vendita, al Servizio Tecnico o all'acquisto di Parti di ricambio, si prega di contattare l'ufficio Varian piu' vicino.

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Instrucciones de Seguridad

Instrucciones de Operación

Este Manual de Instrucciones está diseñado para ayudarle a establecer las condiciones de operación que le permitan operar su instrumento de forma segura y eficaz. Así mismo, se describen consideraciones especiales ó precauciones, que aparecen en forma de **NOTA**, **PRECAUCION**, y **ATENCION** como se indica más abajo.Es importante que utilice el instrumento de acuerdo con este Manual de Operación y cualquier otra información que le proporcione Varian. Remita a la Oficina Local de Varian cualquier cuestión que tenga respecto al correcto uso de su equipo.

NOTA

Información para ayudarle a obtener unas prestaciones óptimas de su instrumento.

¡PRECAUCION!

Le alerta de situaciónes que pueden causar daños moderados a la salud ó al equipo, y cóm evitar esas situaciones.

ATENCIÓN

Le alerta de potenciales situaciones peligrosas que pueden causar serios daños, y cómo evitar esas situaciones.

Símbolo	Descripción
ATENCIÓN PELIGRO DE DESCARGA ELÉCTRICA	El instrumento utiliza voltages peligrosos. Desconecte el interruptor general antes de retirar los paneles atornillados.
ATENCIÓN PELIGRO QUÍMICO	Peligro de productos químicos. Evite el contacto, especialmente cuando rellene los depósitos. utilice protección de ojos y piel.
ATENCIÓN PELIGRO DE QUEMADURAS	Superficies posiblemente calientes ó frías (criogénico). Utilice protección para la piel.
ATENCIÓN PELIGRO PARA LOS OJOS	Las partículas volátiles, productos químicos o radiación UV pueden causar daños en los ojos. Usar las debidas protecciones para la cara y los ojos.
ATENCIÓN PELIGRO DE FUEGO	Peligro potencial de fuego. Siga las instrucciones del Manual de Operación para su seguro funcionamiento.
ATENCIÓN PELIGRO DE EXPLOSIÓN	Peligro potencial de explosión debido al tipo de gas ó líquido empleado.
ATENCIÓN PELIGRO DE RADIACIÓN	Peligro por Fuente de radiación. Siga las instrucciones del Manual de Operación para su seguro funcionamiento.
ATENCIÓN PARTES EN MOVIMIENTO	Mantenga alejados los dedos y las manos.

Precauciones Generales de Seguridad

Siga estas indicaciones de seguridad para una correcta operación del equipo.

- Realice verificaciones periódicas de fugas en todas las líneas de suministro y tuberías.
- No permita que las líneas de gas se doblen ó pinchen. Manténgalas alejadas de zonas de paso y del calor ó frío excesivo.
- Guarde los disolventes orgánicos en cabinas ventiladas, a prueba de fuego, y etiquetadas para que puedan ser fácilmente identificadas como material tóxico y/ó inflamable.
- No acumule disolventes inservibles. Deseche todo el material inservible a través de un programa especial de desechos y no a través del sistema convencional.

NOTA: Este instrumento ha sido testado bajo las normas de la Directiva EMC según requerimientos de la Marca CE de la Unión Europea. Por lo tanto, este equipo puede ser sensible a niveles de radiaciones / interferencias ó frecuencias que no estén incluidas dentro de los límites testados.

ATENCIÓN Este instrumento está diseñado para análisis cromatográfico de muestras preparadas apropiadamente. Debe ser operado usando gases y/ó disolventes apropiados y con unos niveles máximos de presión, flujos y temperaturas, según se describe en este manual.

ATENCIÓN El Usuario tiene la obligación de informar al Servicio Técnico de Varian cuando el instrumento vaya a ser empleado para análisis de muestras peligrosas de origen biológico, radioactivo ó tóxico, antes de comenzar a realizar cualquier análisis.

Peligros Eléctricos

- Desconecte el instrumento de todos las conexiones eléctricas a la red antes de retirar los paneles para evitar la posible exposición a peligrosos voltages.
- Cuando sea necesario emplear una clavija eléctrica no original, asegurese de colocar los cables de acuerdo con el código de colores y polaridades descritos en el manual y los códigos de seguridad de la red eléctrica.
- Sustituya los fusibles fundidos con fusibles del tipo y tamaño estipulados en el panel de fusibles ó en el manual.
- Sustituya los cables deteriorados inmediatamente con cables del mismo tipo y graduación.
- Asegureses de que los valores de las líneas de electricidad se ajustan a los valores para los que el Instrumento ha sido preparado.

Botellas de Gas Comprimido

- Guarde y maneje las botellas de gas con cuidado y de acuerdo con las normas de seguridad.
- Asegure las botellas a una estructura inmovil ó a la pared.
- Guarde y mueva las botellas en posición vertical. Retire los reguladores antes de transportarlas.
- Guarde las botellas en un área ventilada, lejos de fuentes de calor, de luz solar directa y de temperaturas extremadamente bajas.
- Identifique las botellas claramente para evitar cualquier duda sobre su contenido.
- Utilice sólamente reguladores y conexiones aprobadas.
- Utilice sólo tubos de conexión cromatográficamente límpios (Varian p/n 03-918326-00) y que tengan una graduación de presión significativamente mayor que la mayor presión del regulador.

GC Prácticas de Seguridad

Sistema de Extracción

No se necesita un sistema de extracción para los detectores GC instalados en un laboratorio bien ventilado, excepto cuando se analicen muestras químicas peligrosas. Si instala un sistema de extracción:

- Utilice conductos a prueba de fuego.
- Instale un ventilador al final del sistema.
- Instale entradas de aire cuya vibración no afecte al trabajo del detector.
- Compruebe periódicamente el correcto funcionamiento del sistema.
- Asegurese de una correcta ventilación del laboratorio.

Detectores con fuentes radioctivas

- Lea con cuidado y cumpla todas las **NOTAS**, **PRECAUCION**, y **ATENCION** del Manual del Detector Ni^{63} ECD.
- Realice los test de contaminación radioactiva descritos en el Manual del Detector Ni^{63} ECD.
- Cumpla con los plazos y procedimientos de test de fugas.

Peligro de Quemaduras

Las zonas de calor ó frío (criogénicas) del Cromatógrafo de Gases pueden permanecer calientes ó frías durante bastante tiempo después de apagar el instrumento. Para evitar quemaduras asegureses de que todas las áreas que se calienten ó enfríen han vuelto a la temperatura ambiente, ó protejase adecuadamente las manos, antes de tocar las superficies potencialmente calientes ó frías.

LC Prácticas de Seguridad

Peligro de Alta Presión

Si se rompe una línea de presión, ó se abre una válvula de seguridad accidentalmente bajo presión, la bomba puede generar líquidos a alta presión potencialmente peligrosos, produciendo un chorro a alta velocidad de líquidos volátiles y/ó tóxicos.

- Lleve protección facial cuando inyecte muestras ó realice mantenimiento de rutina.
- Nunca abra una línea ó una válvula bajo presión. Apague la bomba antes y deje que la presión baje a cero.
- Utilice depósitos irrompibles que sean capaces de operar a 50-60 psi.
- Mantenga cerrada la junta del depósito cuando se haye bajo presión.
- Lea y cumpla todas las **NOTA**, **PRECAUCION**, y **ATENCION** del manual.

Cromatografía Flash

El operador debe familiarizarse con las propiedades físico-químicas de los componentes de la fase móvil.

Alejar los disolventes del contacto directo con los tubos de poliuretano ya que ciertos disolventes pueden causar reblandecimiento de los tubos o posibles fugas con riesgo de explosión.

Todos los componentes del sistema deben estar conectados a un enchufe común con toma de tierra común. Esta toma de tierra debe ser una toma de tierra verdadera en lugar de flotante.

Los disolventes no-polares pueden originar carga estática cuando son bombeados por el sistema. Todos los recipientes que contienen fase móvil (incluyendo los tubos y los recipientes de recogida) deben estar conectados a tierra para disipar la electricidad estática.

Utilizar medidores de carga estática y los debidos dispositivos de descarga (por Ej., ionizadores de aire) para salvaguardarse contra la creación de electricidad estática.

Radiación Ultravioleta

Los detectores del Cromatógrafo de Líquidos que utilizan una fuente de luz ultravioleta disponen de protección para prevenir exposiciones radioactivas al personal.

Para una correcta protección:

- Asegurese de que las cubiertas de protección de la lámpara de los detectores está correctamente situada durante su funcionamiento.
- No mire directamente a las celdas del detector ó a la fuente de luz UV. Cuando inspeccione la fuente de luz ó la celda, utilice siempre una protección para los ojos como gafas de borosilicato ó poliestireno.

Disponibilidad de Recambios

Es Política de Varian disponer de Recambios para cualquier instrumento y la mayoría de los accesorios por un periodo de cinco (5) años después del último instrumento fabricado. Los recambios durante esos cinco años estarán disponibles, pero siempre bajo el sistema *"Según disponibilidad"*. Los Recambios están definidos como todas aquellas partes individuales mecánicas ó eléctricas que son susceptibles de fallo durante su normal proceso de operación. Por ejemplo, relés, lámparas, sondas de temperatura, elementos del detector, motores, etc. Las planchas de metal, partes de la estructura, placas de circuitos integrados, y otros módulos funcionales son normalmente susceptibles de reparación y por lo tanto sólo estarán disponibles bajos el sistema *"Según disponibilidad"* después del último instrumento fabricado.

Disponibilidad de Servicio

Varian ofrece una gran variedad de sistemas de Servicio para mantener el soporte a sus usuarios tras el periodo de garantía. El Soporte de Servicio se ofrece a través de atractivos Contratos de Servicio ó bajo un sistema de facturación de mano de obra y materiales. El mantenimiento y el entrenamiento se realiza por ingenieros cualificados bajo Contrato ó petición.

Oficinas de Instrumentación Analítica Varian

Para cualquier consulta sobre Instrumentación Analítica, Servicio Técnico ó Recambios y Accesorios, contacte con su oficina local:

Argentina
Buenos Aires
Tel. +54.11.4.783.5306

Australia
Mulgrave, Victoria
Tel. +61.3.9566.1134

Austria
Vösendorf bei Wien
Tel. +43.1.699.9669

Benelux
Bergen Op Zoom
Tel. +31.164.282.800

Brazil and Latin America (S)
São Paulo
Tel. +55.11.820.0444

Canada
Mississauga, Ontario
Tel. 800.387.2216

China
Beijing
Tel. +86.106209.1727

Europe
Middelburg, The Netherlands
Tel. +31.118.671.000

France
Les Ulis Cédex
Tel. +33.1.6986.3838

Germany
Darmstadt
Tel. +49.6151.7030

India
Mumbai
Tel. +91.22.857.0787/88/89

Italy
Torino
Tel. +39.011.997.9111

Japan
Tokyo
Tel. +81.3.5232.1211

Korea
Seoul
Tel. +82.2.345.22452

Mexico and Latin America (N)
Mexico City
Tel. +52.5.523.9465

Russian Federation
Moscow
Tel. +7.095.937.4280

Spain
Madrid
Tel. +34.91.472.7612

Sweden
Solna
Tel. +46.8.445.1620

Switzerland
Varian AG
Tel. +41.848.803.800

Taiwan
Taipei Hsien
Tel. +886.2.698.9555

United Kingdom and Ireland
Walton-on-Thames
Tel. +44.1932.898000

Venezuela
Valencia
Tel. +58.41.257.608

United States
Walnut Creek, California, USA
Tel. +1.800.926.3000
(GC and GC/MS)

Tel. +1.800.367.4752
(LC)

VARIAN
www.varianinc.com

Introduction

1 General

The Varian 3300 Gas Chromatograph (GC) and the Star 3400 CX GC (see Figures 1 and 2) guide you through operation via their one line display. These GCs accommodate standard and capillary injectors and the 8200 CX AutoSampler (Star 3400 CX GC only) for automated operation. Two ionization detectors or one TCD may be installed. The column oven accepts packed or fused silica capillary columns.

The GCs have inboard diagnostics that allow you to test instrument conditions and to detect and identify faulty circuitry. In addition, the instrument continuously tests itself for possible electronic failures. If such failures are found, the instrument automatically takes action to protect itself from further damage and notifies you through its display.

2 Use of This Manual

This manual guides you through the operation of the GCs. Method building exercises are provided to familiarize you with the instrument.

There are two manuals included with your GC: the Operator's Manual and the Options/Accessories Manual. The Operator's Manual contains basic information on the installation, operation, and troubleshooting of the GC. The Options/Accessories Manual contains information on the installation and operation of the GC detectors, injectors, and accessories.

The Operator's Manual uses several important conventions, such as warnings, cautions, and notes. This information is emphasized throughout the manual. Please follow these recommendations for your protection and to ensure the optimum performance of the instrument.

3 Instrument Description

Figures 1 and 2 show the locations of switches, fuses, connectors, gas inlets, and various options. Use Figure 2 as a quick reference to other manual sections where detailed information is located.

4 Before You Begin

If you are installing the GC yourself, follow the installation procedures given in the ***Installation*** section before proceeding further.

If your instrument is installed, turn to the ***Operation*** section to begin.

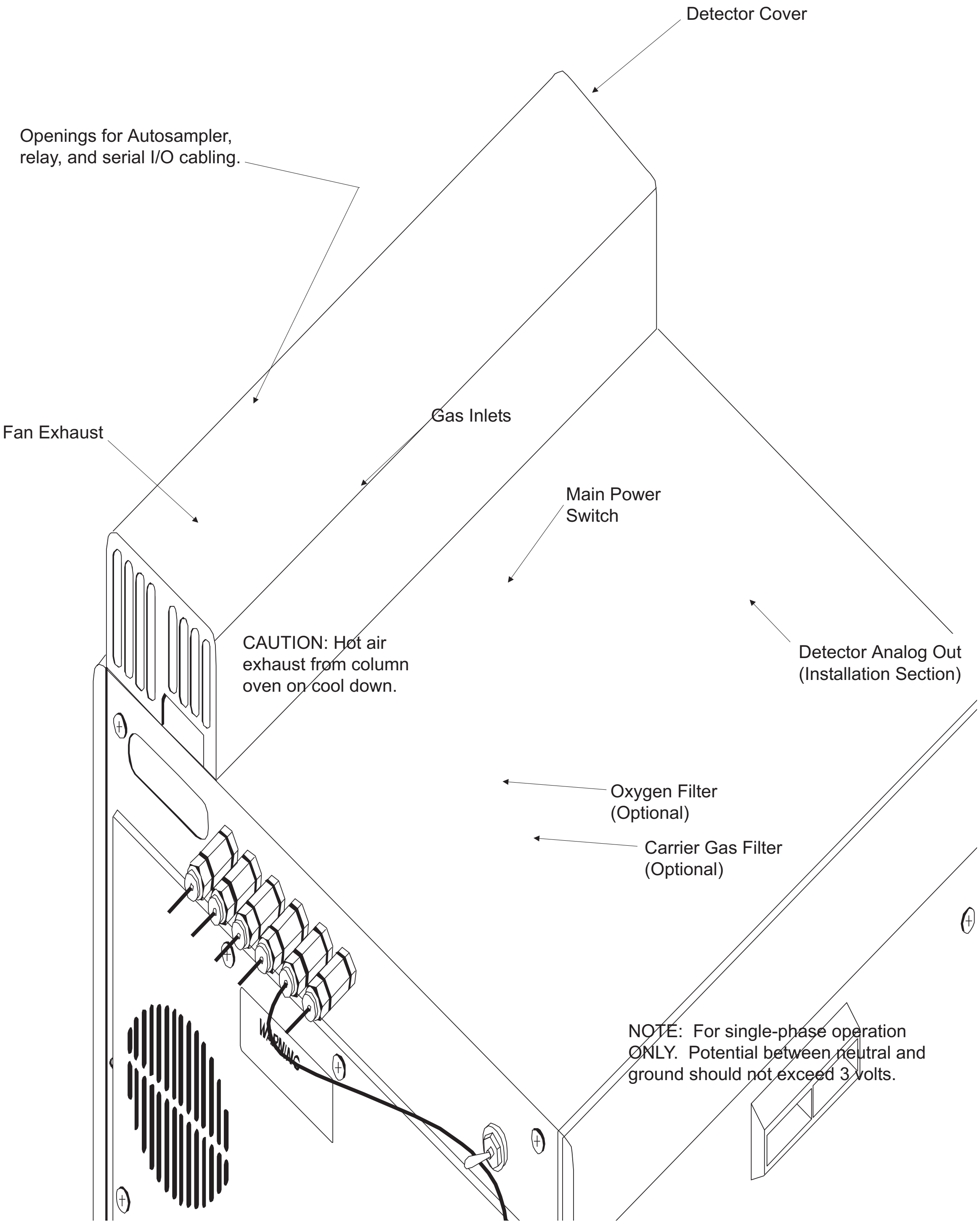


Figure 1 Rear View of GC

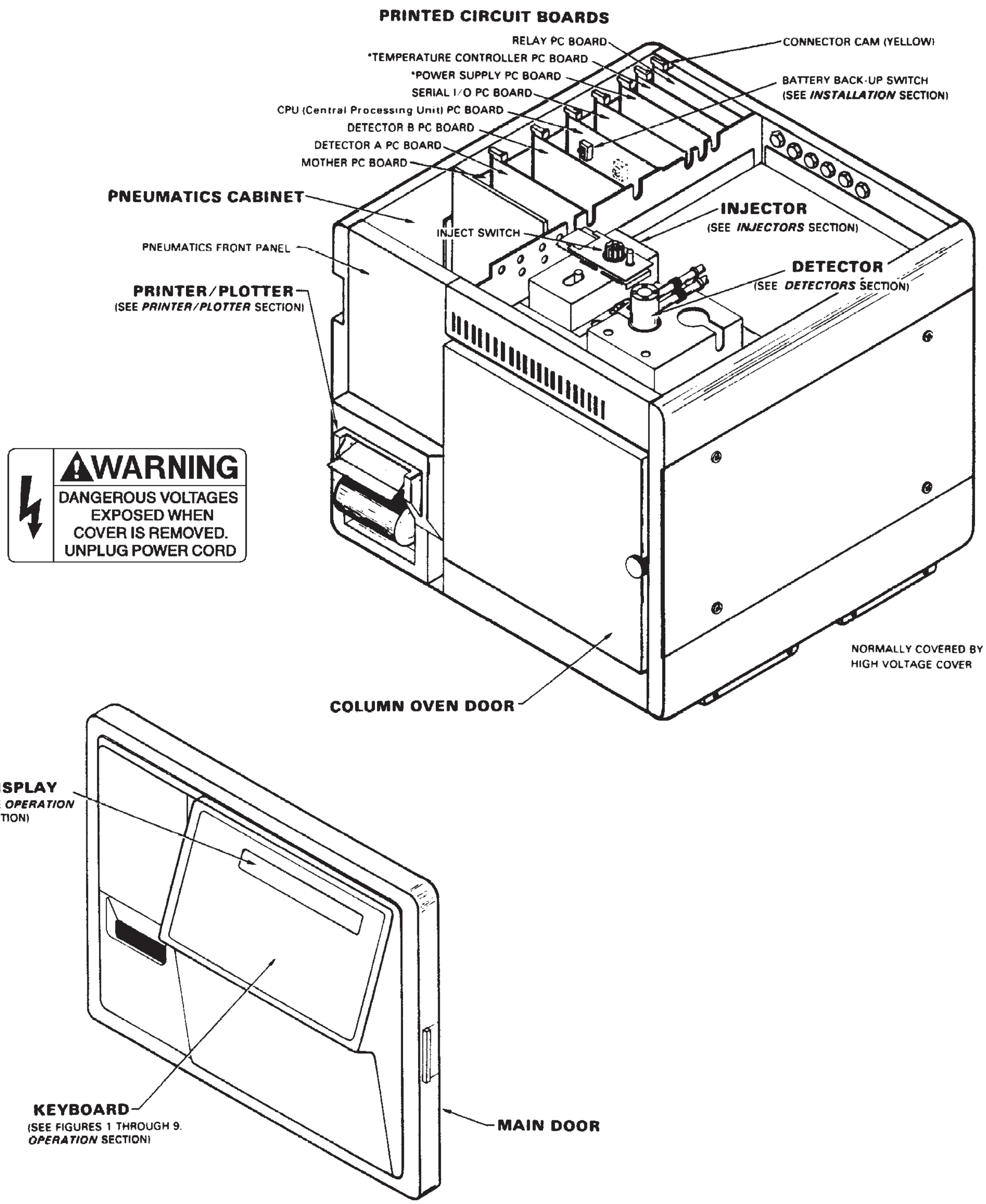


Figure 2 Front View of GC

5 Specifications

Detector Specifications

Detector Type	FID	TSD	ECD	FPD	TCD	ELCD	PID
Linear Dynamic Range	10^7	10^5 (N) 10^4 (P)	10^4 (N_2 carrier gas	10^5 (P) 10^3 (S)	10^6 (butane)	>106 (Halogens) 10^5 (N) 10^4 (S)	10^4
Detectivity	>2 pg C/sec	>0.2 pg N/sec (azobenzene) >0.1 pg P/sec (malathion)	0.05 pg (Lindane)	1 pg P/sec (in Tributylphosphate) 0.1 ng S/sec (in n-hexane thiol)	$3x10^{-10}$ g/mL (butane)	2.5 pg (Halogens, heptachlor) 10 pg (N, azobenzene) 10 pg (S, ethion)	10 pg (benzene)
Noise	At 50 msec: <4 x 10^{-14}A At 270 msec: <2 x 10^{-14}A	At 50 msec: <2 x 10^{-14}A At 270 msec: <1 x 10^{-14}A		At 50 msec: <10 x 10^{-12}A At 1 sec: <2x 10^{-12}A	<1.0 μV	<2 x 10^{-13}A	<1 x 10^{-13}A
Sensitivity	15 mCoul/g carbon (N_2 carrier gas)						
Specificity		P/N 2:1 N/C 5 x 10^4:1 P/C 1 x 10^5:1		P/C 10^5:1 S/C >10^3		Cl/HC >106 N/HC >10^7 S/HC >10^5	
Temperature Range (⊃C)	120 to 420	120 to 420	120 to 420	120 to 350	120 to 300	120 to 350	120 to 280

Injector Specifications

Injector Type	1075/1077	1093/1094 (SPI)	1041	1061	1040	1060
	Split/Splitless	Capillary Septum-Equipped Programmable Injector	Large Bore Capillary	Large Bore Capillary Flash	Packed Column	Packed Flash
Operation Mode	Split/splitless (vaporizing)	Temperature programmable	On-column (vaporizing)	Flash	On-column	Flash
Column ID	│100 μm	│320-530 μm	530 μm	530 μm	1/8" OD or 1/4" OD packed	1/8" OD or 1/4" OD packed
Syringe	Conventional	Conventional	Conventional	Conventional	Conventional	Conventional
Temperature Range	Ambient to 420⊃C	-99 (LN_2 coolant) to 420⊃C	Ambient to 420⊃C	Ambient to 420⊃C	Ambient to 420⊃C	Ambient to 420⊃C
Temperature Programming Rate		0.3 to 180⊃C/min				
Automation	Yes: 8200 CX	Yes: 8200 CX	Yes: 8200 CX	Yes: 8200 CX	Yes: 8200 CX	Yes: 8200 CX

Installation

1 General

The following instructions guide you through the installation of the 3300 Gas Chromatograph (GC) and the Star 3400 CX GC. Should you experience problems during installation, please contact your Customer Support Representative at the Varian National Sales and Service Center: 800-926-3000. Please specify whether you are installing a 3300 GC or a Star 3400 CX GC.

2 Unpacking and Inspection

Unpack the GC and check it carefully for damage or for signs of rough handling. Immediately report any damage to the carrier and to:

Varian Chromatography Systems
2700 Mitchell Drive
Walnut Creek, Ca 94598-1675
Attention: Manager of Customer Service
Phone (510) 939-2400

Outside of the U.S.A., notify the nearest International Sales Office listed at the beginning of this manual.

Check the contents of the accessory package against the enclosed list. Report any discrepancies or missing items to Varian at the above address.

2.1 Remove Shipping Dowel

Before operating the GC, remove the shipping dowel from the column oven fan motor. The dowel can be reached from the hole in the rear GC panel. Save the dowel. If you need to return the GC to Varian at some later date, reinstall the shipping dowel prior to shipment.

2.2 Remove Shipping Caps and Plugs

Remove the plastic or paper caps or plugs located under the detector cover, the GC top cover, and at the rear of the GC. Do not remove the caps from the injector fittings, detector fittings or the fittings at the rear of the GC until you are ready to install a column or connect the gas supplies to the GC. If you do remove these caps, cap the fittings with Swagelok® plugs to prevent contamination of the system.

2.3 Remove PC Board Packing Foam

Before operating the gas chromatograph, remove the foam strip attached to the underside of the GC top cover.

> CAUTION: Carefully inspect the oven interior and remove all plastic and/or paper shipping caps and restraints before you heat the column oven.

3 Prepare Site for Instrument

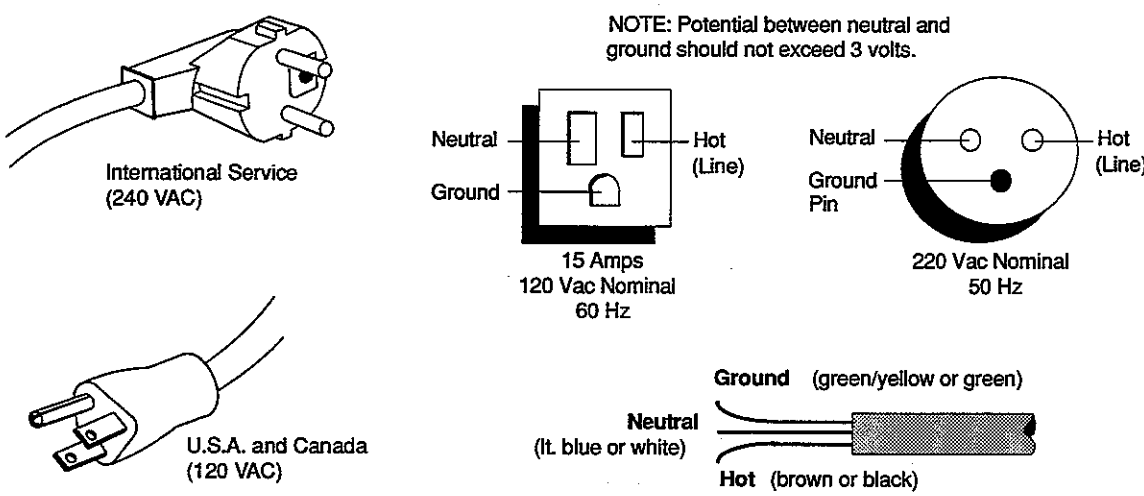
The area in which you plan to install the GC should have been prepared ahead of time according to the 3000 CX Series GC Pre-Installation Instructions (P/N 03-913962-00). Remember to allocate enough bench space to accommodate peripheral instrumentation such as data systems or recorders.

> CAUTION: Heat from the column oven is vented through the rear of the GC. Make certain that the hot column oven exhaust is not directed onto other electronic instruments.

4 Power Requirements

Each GC requires a 50 or 60 Hz SINGLE PHASE power source that provides up to 15 Amps at 99-132 VAC or 8 Amps at 198-264 VAC (see Figure 1). A diagnostic message is displayed if the AC line polarity is reversed or if the ground connection is faulty. Should this message appear, refer to the Diagnostics/Troubleshooting section.

Your GC is equipped with a polarized receptacle that accepts one of two possible removable power cords: 120 VAC for use within the continental U.S. and Canada; or, 220 VAC for use outside the continental U.S. and Canada (see Figure 1).



The grounded 2-prong plug (CEE 7-7 was developed to accommodate both the "Schuko" socket (CEE 7-4) used in Germany, Austria, Netherlands, Sweden, Norway, and Finland, and the polarized socket used in France and Belgium. It has a dual grounding system with grounding clips on both top and bottom to mate with the CEE 7-4 socket and with a female socket to accept the grounding contact of the French/Belgium socket.

Figure 1 Power Cord Wiring

> CAUTION: The following work should be done only by an experienced electrician.

Refer to Figure 2, Details A, B, and C when operating the GC on split phase power.

① Install the CEE 7/7 connector (see Figure 2, Detail A) to the bare wire end of the modified cable (P/N 81-821552-00). Carefully follow the color code of CEE 7/7.

② Punch out two knockouts in the transformer (see Figure 2, Detail B). Cut the modified cable (P/N 81-821552-00) at midpoint or at a convenient location.

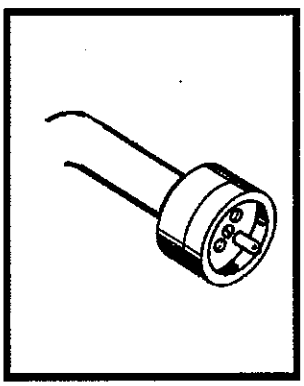
③ Place a cable clamp on the cut end of each piece of the modified cable (see Figure 2, Detail C). Attach the ends of the cables to the appropriate transformer wires in 4 places (see Figure 2, Detail C). Use approved splice terminals. Attach both green/yellow ground wires to the transformer case. Tighten the cable clamps that hold the power cables.

④ IMPORTANT! Make certain that the ground wire is connected only at the transformer to the secondary neutral wire.

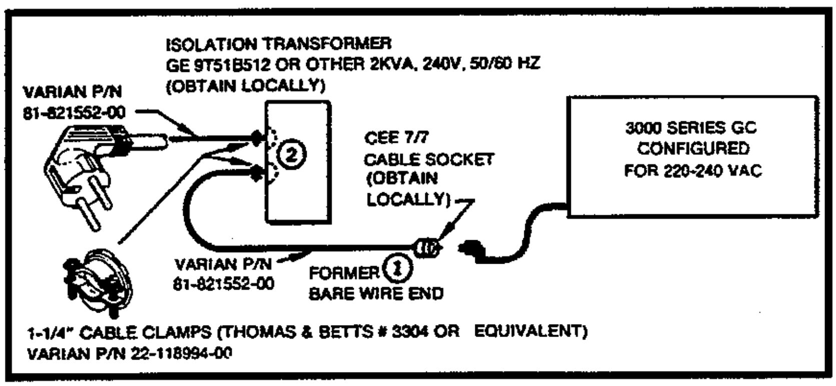
5. If you use a transformer other than General Electric Model 9T51B512, make sure that it is wired 240 VAC to 240 VAC, 50/60 Hz, and has an adequate KVA rating.

6. If you use a male connector other than CEE 7/7, the alternate must be a polarized connector and must be a grounding type.

DETAIL A
CEE 7/7 CONNECTOR



DETAIL B
ISOLATION TRANSFORMER



DETAIL C
ISOLATION TRANSFORMER FOR USE IN SPLIT PHASE POWER
(GE 9T51B512 Shown)

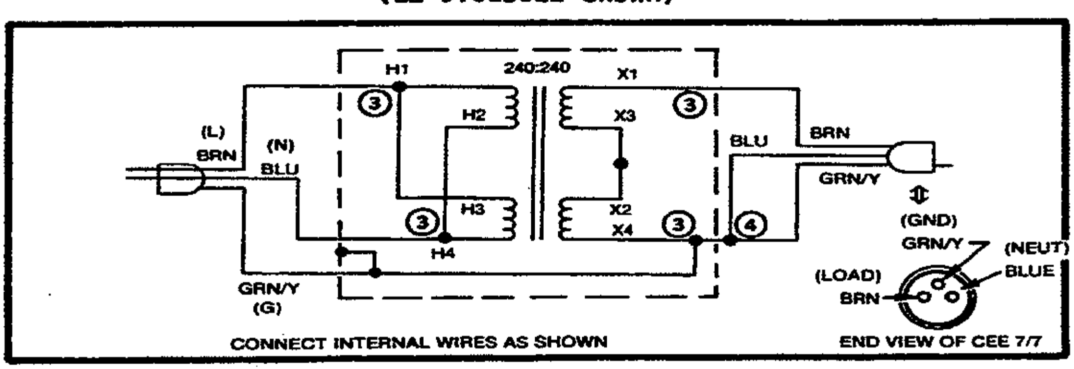


Figure 2 Isolation Transformer

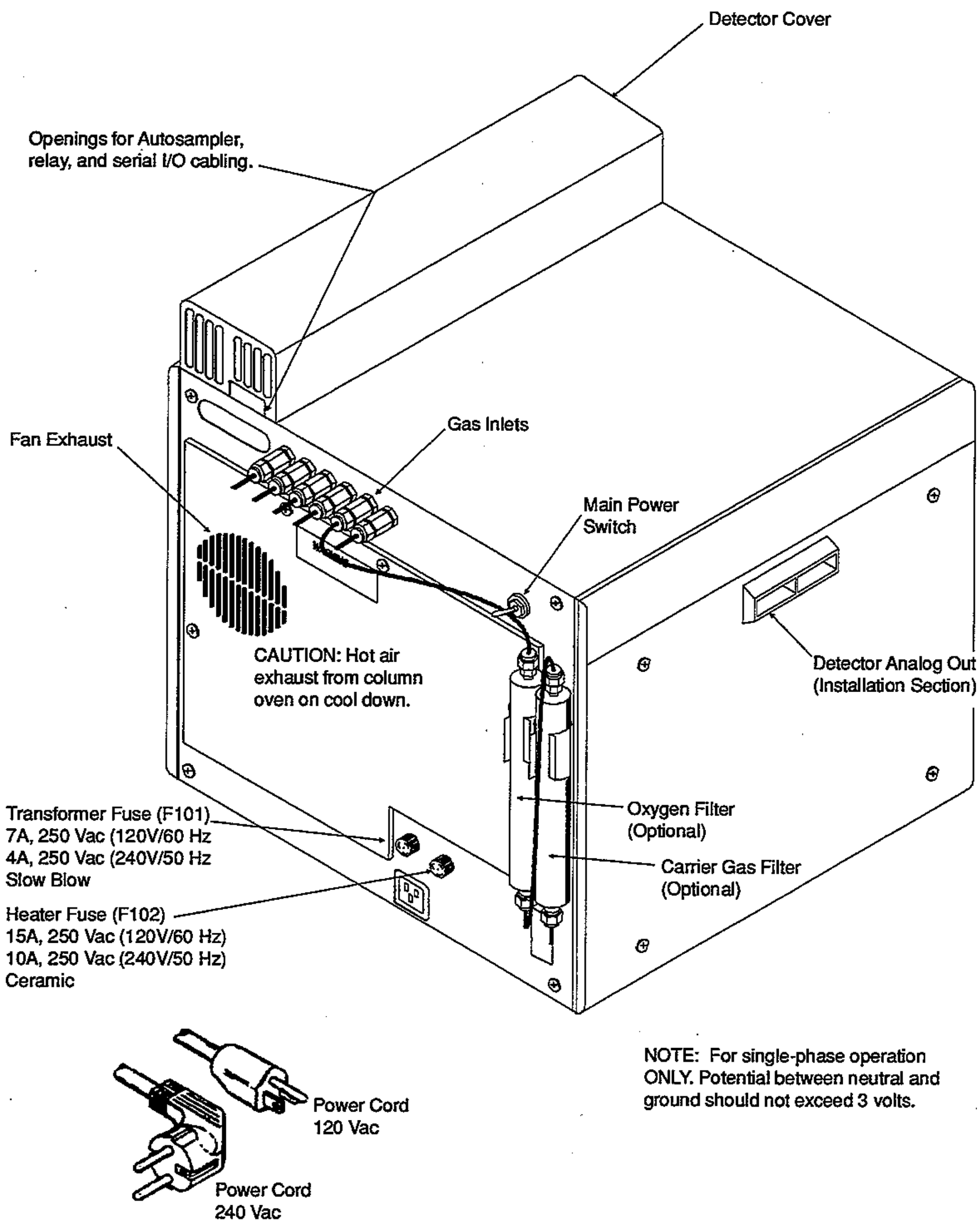


Figure 3 Rear View of GC

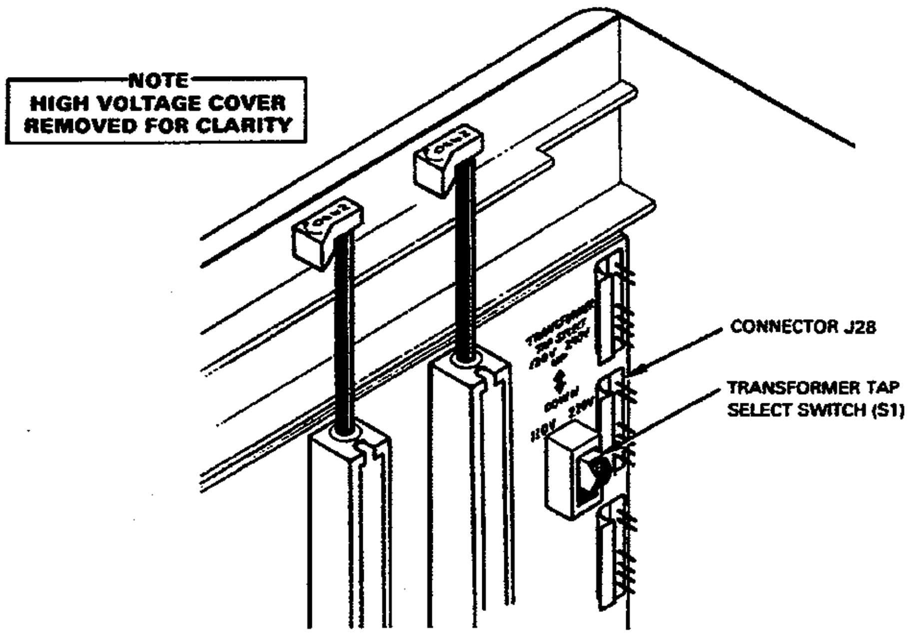


Figure 4 Transformer Tap Switch (S1) on Mother PC Board

4.1 Transformer Tap Selection

The transformer tap select switch (S1) is located near the rear of the Mother Printed Circuit Board (PCB). See Figure 4. For a GC configured for 110/120V operation, UP (high) is 120V nominal and DOWN is 110V nominal. For a a GC configured for 220/240V operation, UP is 240V nominal and DOWN (low) is 220V nominal. Instruments are shipped with this switch in the high voltage (UP) position. These two voltage configurations permit operation of the GC at most sites.

The specified tolerance for the line voltage is ±10% around the nominal value, but short-term drops of 20% or more below nominal are typically tolerated. If the line voltage falls to a level where operation is impaired, the GC shuts down, and a POWER FAIL fault message and the time of the failure appears. Leave switch S1 in the high (UP) position unless there are indications that the power line voltage is below 120V (e.g., power failures). While the GC can operate with the switch in the low position, even if the line voltage is above 110% of the nominal value, the internal temperature of the GC may increase thereby affecting the reliability of the GC.

If it is necessary to change the position of this switch because the line voltage at your location is low, proceed as follows:

1. Over a 24-hour period, determine the full range of line voltage variations. If the voltage is between 99V and 121V (or 198V and 242V), set the switch to the low position. If the voltage is between 108V and 132V (or 216V and 264V), select the high (UP) setting. If the voltage is not within either of these ranges, consult Customer Support to see if you will require a power line conditioner.

⚠WARNING
DANGEROUS VOLTAGES EXPOSED WHEN COVER IS REMOVED. UNPLUG POWER CORD

2. To change the switch setting, disconnect the GC from all power, remove the detector cover, the GC top cover, and the high voltage cover.

3. Locate switch S1 on the Mother PCB (see Figure 4). It is shipped in the correct position for your voltage range. If there is a problem in the low position, contact Customer Support to see if you require a power line conditioner.

> CAUTION: The GC warranty may be voided if a GC configured for the 110/120V range is changed to the 220/240V range, or vice versa. DO NOT attempt to reconfigure the GC.

4.2 Power Switch

The GC power switch is at the top left rear of the GC (see Figure 3). Up is ON and down is OFF.

4.3 Fuse Requirements

Fuses for the GC are located on the GC back panel, the Mother Printed Circuit (PC) Board, and on individual PC boards inside the GC. Refer to Table 1 for the ratings and locations of fuses used in the GC.

Table 1 Instrument Fuses

Fuse Number	Fuse Rating	Part Number	Location	Circuit
F101	7 A* S/B 4 A**S/B	67-137470-00 67-135440-00	Back panel Back panel	Primary transformer Primary transformer
F102	15 A* or 10 A** Cer	67-130515-00 67-130510-00	Back panel Back panel	Heater power Heater power
F1	15 A Cer	67-130515-00	Mother PCB	+5 VDC supply
F2	6 A	67-133460-00	Mother PCB	Autotransformer loads
F3	8 A* or 4 A**	67-133480-00 67-135440-00	Mother PCB Mother PCB	Line-powered loads Line-powered loads
F1	1 A, S/B	67-135410-00	Power Supply PCB	±15 VDC supply
F2	1 A, S/B	67-135410-00	Power Supply PCB	±15 VDC supply
F1	3 A	67-132430-00	External Events PCB	24 VAC for solenoids
"	5 A, S/B	67-137450-00	FID PCB	Ignitor
"	5 A, S/B	67-137450-00	FPD PCB	Ignitor
"	5 A, S/B	67-137450-00	FID/TSD PCB	Ignitor
F2	2 A, S/B	67-135420-00	FID/TSD PCB	Bead supply
F1	1/4 A, S/B	67-135325-00	ECD PCB	Pulser supply
"	1 A, S/B	67-135410-00	TCD PCB	Bridge supply
F2	1/16 A	67-132262-00	TCD PCB	Bridge supply
F1	2 A, S/B	67-135420-00	P/P PCB	Head & motor supply

* Nominal 110-120 VAC line voltage
** Nominal 220-240 VAC line voltage

5 Battery Back-up and Power Up

Methods and automation sequences are retained in the memory of the GC even when the GC is turned off, disconnected from power, or during an unexpected power outage. A battery provides the power to maintain the memory of the GC. However, the battery switch must be in the ON position.

The GC is shipped with the battery switch in the ON (up) position (see Figure 5 or Figure 6). If the GC is to be disconnected from power for long periods of time or if it is to be stored, move the battery switch to the OFF position (see Figure 5 or Figure 6). If the battery switch is turned OFF, GC methods in memory are lost.

03-917762-02 (3300)

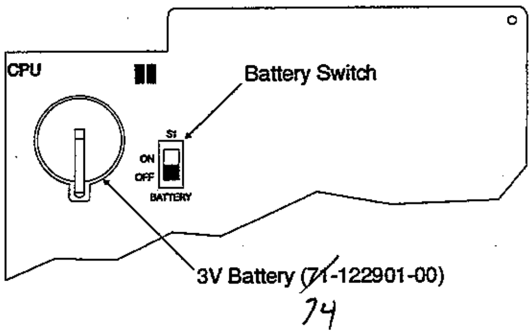


Figure 5 Battery Back-up Switch: 3300 GC

925867-31
03-~~917950-00~~ (3400)

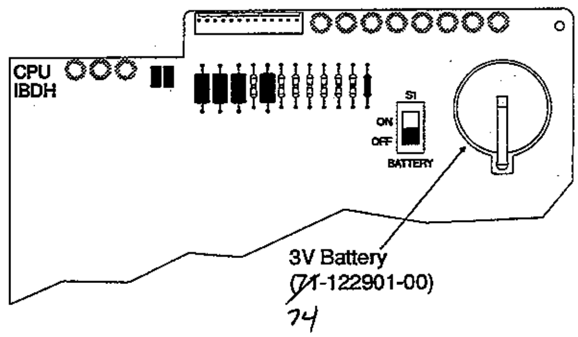


Figure 6 Battery Back-up Switch: Star 3400 CX GC

5.1 Power Up

To power up the GC, proceed as follows:

1. The main power (toggle) switch of the GC is located on the upper left rear of the GC. Flip the toggle switch UP to turn on the power.
2. The GC runs through the Automatic tests. The GC turns solenoids, valves, and fans off and on. The front panel lights turn on in sequence from left to right and the printer/plotter generates a test pattern.
3. After the Automatic tests are complete, the message TESTS OK is displayed. If this message does not appear within 40 seconds, or if any fault messages are displayed, or if the GC does not start or is not operating normally, refer to the Diagnostics/Troubleshooting section. Other diagnostic tests may be performed at any time to test specific GC functions.

6 Gas Requirements and Gas Connections

Refer to the 3000 Series GC Pre-Installation Instructions (P/N 03-913962-00) for recommended flow rates, gas supply filters, and gas line fittings.

7 Connection of Peripherals

The detector signal output panel is located on the left side of the GC (see Figure 7, Detail A). Output jacks are available for Detector A and Detector B and can by connected to chart recorders (RCDR, 1 mV), integrators (INTEG, 1V), or data systems and computers (CMPTR, 10V).

When connecting a data system or integrator to the GC, refer to the Data Systems section in the Options/Accessories Manual.

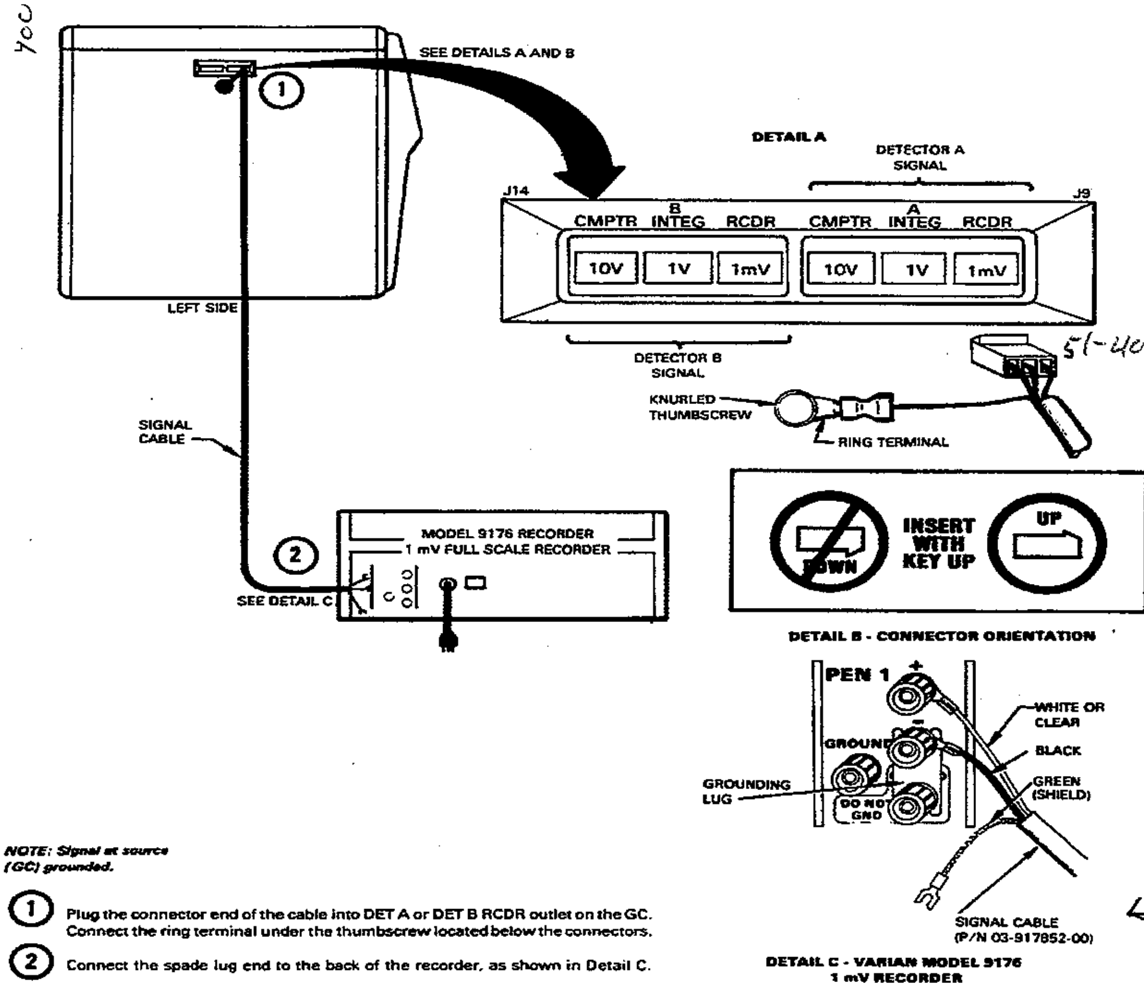


Figure 7 Chart Recorder Connection to the GC

7.1 Chart Recorder Connections

Orient the recorder cable connector properly when connecting the chart recorder to the GC (see Figure 7, Detail B).

The results and test procedures described in this manual are for chart recorders configured as 1 mV full-scale. If you use a recorder with a different span and want to compare your results with the results given in this manual, scale the results to 1 mV.

7.2 Accessing the GC Remote Status Input and GC Status Output

The GC controls remote devices through the GC STATUS OUTPUT. The GC is controlled remotely by an external device through the REMOTE STATUS INPUT.

When using the REMOTE STATUS INPUT, you can have the GC wait in the NOT READY state until the Ready contact closure is closed (remote device goes READY). To do this, press the GC Configure key and scroll to the prompt: WAIT FOR EXT DEVICE READY?. Then, press Yes. The GC goes to READY when the contact is closed.

1. To install the GC Status Output cable, proceed as follows:
   a. Turn off the GC. Remove the GC top covers. Remove detector PC boards to access the GC STATUS OUTPUT (J23) on the Mother PC Board. Refer to Figure 8.
   b. Route the GC Status Output cable (P/N 03-917849-00) into the electronics cabinet through the first guide slot (see Figure 8, Detail A).
   c. Route the cable down along the side of the card guide panel.
   d. Connect the cable to J23 on the Mother PC Board (see Figure 8).
2. If you are connecting only the GC Status Output cable, skip to Step 4.
3. To connect the Remote Status Input Cable, proceed as follows:
   a. Remove the Serial I/O PC Board to access the REMOTE STATUS INPUT (J16) on the Mother PC Board.
   b. Route the Remote Status Input cable (P/N 03-917850-00) into the electronics cabinet through the third card guide slot (see Figure 8, Detail B).
   c. Connect to J16 on the Mother PC Board (see Figure 8).
4. Route the opposite end (or ends) of either (or both) of these cables out through the back of the GC, clamping and grounding as shown in Figure 7.

   NOTE: If several options are installed, the cable clamp will hold several cables.

> FCC WARNING: Cables used to connect the GC to external devices must be shielded to insure compliance with the FCC regulations. The shield must be connected directly to the chassis of the GC. Before connecting the cable, remove the outer insulating jacket of the cable where it passes through the cable clamp at the rear of the GC.

5. Connect the opposite end of either or both of these cables to the peripheral.
6. Replace the GC top covers.

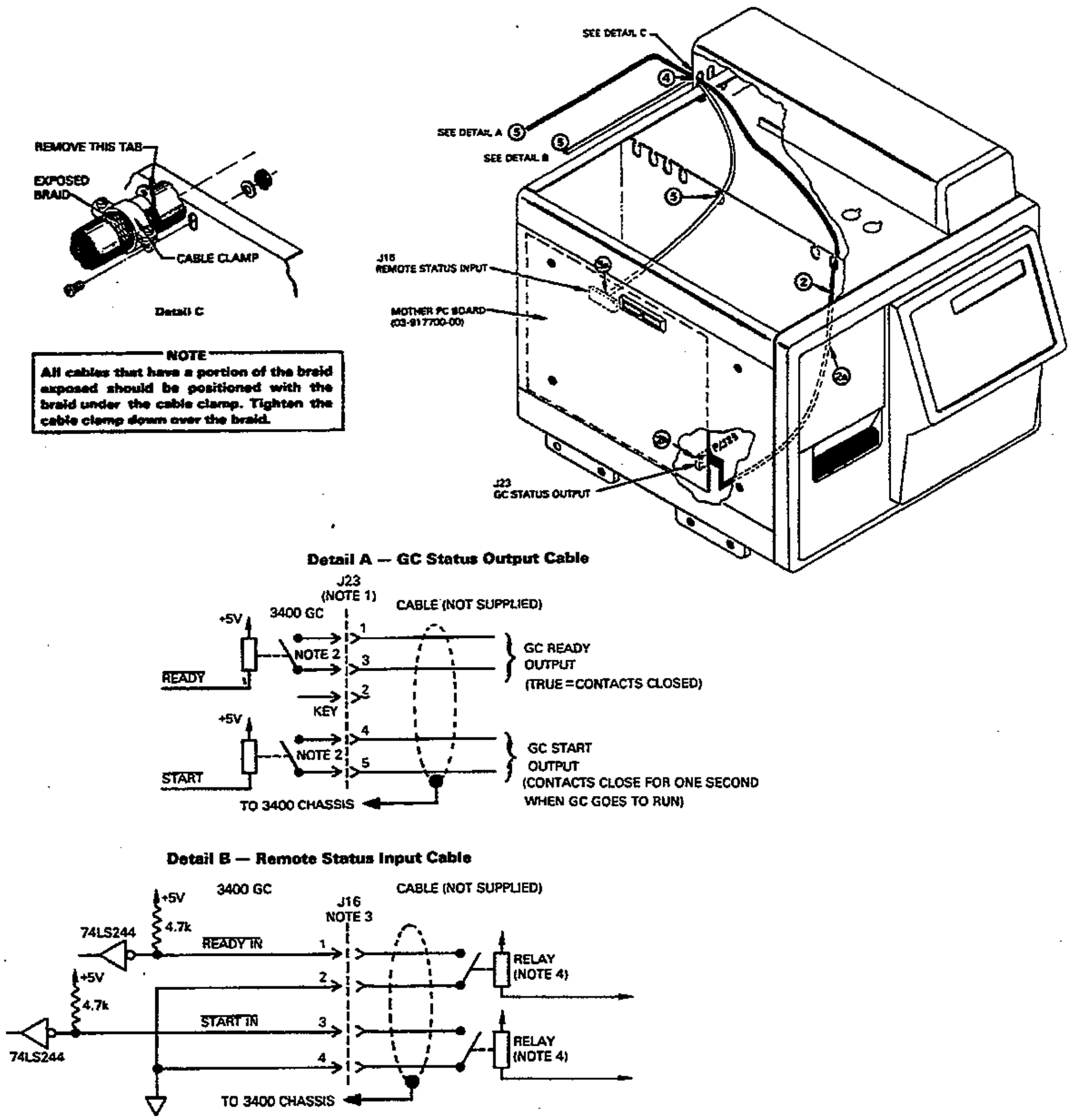


Figure 8 GC Remote Status Input and GC Status Output

NOTES:

1. Connector J23 is located on the Mother PCB. Use the GC Status Output cable (P/N 03-917849-00) or Molex® connector (P/N 09-50-3051; Varian P/N 51-407016-00), or Molex contact (P/N 08-56-0106; Varian P/N 51-407011-00), and Molex key (P/N 15-04-0219; Varian P/N 51-407012-00). The cable and parts are not supplied with the GC and must be ordered separately.
2. Relay contact rating: 10 watts DC, 0.5 Amps (maximum), 50V (maximum).
3. Connector J16 is located on the Mother PCB. Use the Remote Status Input cable (P/N 03-917850-00) or Molex connector (P/N 09-05-3041; Varian P/N 51-407013-00) and Molex contact (P/N 08-56-0106; Varian P/N 51-407011-00). The cable and parts are not supplied with peripheral instrument and must be ordered separately.

4. A relay (shown) or an optoisolator is required to isolate the electrical ground between an external device or instrument and the GC. Install these parts. (If a relay or optoisolator is not furnished with the external device or peripheral instrument, you must provide this part yourself.)

8 Checking for Leaks

The GC is checked for leaks at the factory and should not require you to check for leaks prior to operation. However, it is recommended that you check for leaks after you install a column in the GC (see paragraph 8.1 or 8.2).

Perhaps the easiest check for gas leaks in the chromatographic system is to run the test sample and compare it to the test chromatogram in the manual. If you notice a difference, refer to the Diagnostics/Troubleshooting section.

8.1 Quick Check for Leaks

A quick way to check for leaks around fittings and connections that does not contaminate the system is to use the GC detector(s) to detect the leak. To check for leaks in this manner, proceed as follows:

1. Direct a small jet of gas (which can be detected by the detector) at the fitting or connection to be tested. For example, use methane for FID, use SF_6 or Freon 12 for ECD, or use carbon disulfide vapor for FPD.

2. Set the detector at its minimum attenuation (maximum sensitivity).

The gas is drawn into the system if a leak is present. The response is rapid at points downstream of the column. When testing points upstream of the column, the response time is delayed by the elution time of the gas in the column.

3. Tighten or replace each fitting or connection as a leak is found.

> NOTE: Because of their low leak rate, Viton® ferrules with aluminum washers are used for all the pneumatic connections, except at the rear bulkhead and in the heated zones. If leaks are detected at Viton ferrules, check the ferrule and fitting seat for scratches or distortions. If required, replace the ferrule or fitting (see Figure 9).

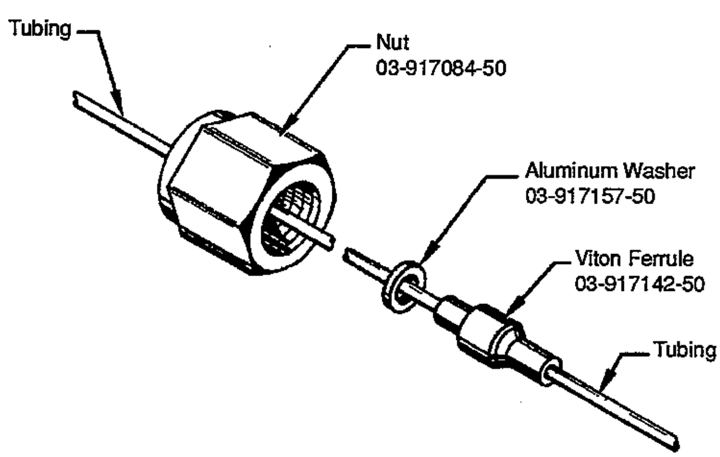


Figure 9 Installation of Viton Ferrule

For long capillary columns (50 meters or longer), place a drop of isopropyl alcohol or iso-octane on the fitting or connection to be tested. Bubbles indicate a leak.

> CAUTION: DO NOT use commercial soap type leak detection fluids at any point in a capillary system, as the fluid will penetrate and contaminate the system if a leak is present. Column performance may be degraded and a substantial period of time may be required to achieve a clean system.

NOTE: Metal compression fittings are used at the bulkhead fittings at the rear of the GC, on the carrier gas and oxygen filters, and on the fittings in the column oven. When you discover leaks in these types of fittings, tighten the fittings only enough to stop the leak. Unnecessary and excessive tightening can distort the ferrules and fitting seats. In such cases, the ferrules and fitting seats must be replaced.

8.2 Detecting Helium Leaks

Another way to check for leaks in fittings and connections without contaminating the system is to use a helium detector. To check for leaks in this manner, proceed as follows:

1. Set up the system with helium as the carrier gas.
2. Start the carrier gas flow (helium) into the system.
3. Point the helium detector probe at the fittings to be tested. An audible tone or deflection of the meter needle (depending on the type of helium detector) indicates a leak.

9 Pneumatic Configurations

The GC can be equipped with digital or non-digital flow controllers. The Star 3400 CX capillary GC can have a pressure gauge or the optional electronic pressure sensor. The 3300 capillary GC is only available with the 0-60 psi pressure gauge. The pneumatics and connections required for either of these flow control options are installed in the GC at the factory.

Digital flow controllers are factory-calibrated and do not require a calibration check when installing the GC. Should you need to calibrate the digital flow controller, refer to paragraph 9.2.

9.1 Inlet and Outlet Manifolds

Gases are plumbed through the rear bulkhead fittings into the inlet manifold, then to the flow controllers and valves in the pneumatic compartment (see Figure 1 and Figure 2, Introduction). The outlet from the flow controllers and valves are plumbed to outlet manifolds (located behind the detectors) which are used as couplings to the injectors and detectors. Unused manifold ports must always be plugged with Viton ferrules and pins to keep the unused ports clean and to prevent direct gas leakage.

⚠WARNING

EXPLOSION HAZARD

When using H_2 gas, plug the manifold ports to avoid an explosion.

9.2 Pressure Transducer, Split Ratio Transducer, and Digital Flow Controller

The GC can be equipped with digital flow controllers (P/N 03-917146-00) or pressure regulators installed in the heated pneumatics compartment. Pressure transducers and split ratio transducers are located in the pressure transducer compartment.

The GC pressure transducer, spit ratio transducer, and digital flow controller are calibrated at the factory and do not require a calibration check when installing the GC. Should you need to calibrate the digital flow controller, refer to paragraph 9.2.3. In particular, the digital flow controller is calibrated to deliver a flow from 0 to 100 mL/min for helium with an inlet pressure of 80 psig. Under these conditions, the dial of the digital flow controller indicates the flow to within ±3%.

An optional 0-10 mL/min flow cartridge (P/N 03-908511-00) can be installed for 0-10 mL/min high precision flow control. Values read from the flow controller dial are a factor of ten greater than the actual flow.

The flow controller (P/N 03-917146-01) for H_2 flow to the Thermionic Specific Detector (TSD) is between 0-11.9 mL/min (for hydrogen with an inlet pressure of 40 psig).

The H_2 flow to the Flame Photometric Detector (FPD) is equipped with a 0-200 mL/min digital flow controller (P/N 03-917146-02). The flow controller is calibrated at the factory to deliver flows between 0-200 mL/min (for H_2 with an inlet pressure of 40 psig). Values read from the dial on the flow controller are a factor of five greater than the actual flow. As an example, if the dial reads 900, the actual flow is 180 mL/min.

To convert the TSD pneumatics to Flame Ionization Detector (FID) pneumatics, change the 0-10 mL/min frit for the TSD H_2 digital flow controller to a 0-100 mL/min frit (P/N 00-997424-00). To convert a digital flow controller on a packed column GC for use with capillary columns, install the 0-10 mL/min frit (P/N 03-908511-00).

Before you remove a digital flow controllers, lock the dial (see Figure 10) to retain the numbers on the digital dial. Then, remove the flow controller carefully so that the shaft does not turn.

When first received and pressurized, flow controllers require up to 48 hours to stabilize to their specified accuracy. The extent of this stabilization period is a function of the flow controller and the inlet pressure regulator. The stability and accuracy of the inlet pressure regulator is particularly important. Flow stability depends on the stability of the inlet pressure. The inlet pressure itself must be accurate to within 2 psig in order to yield an accurately controlled flow. Do not attempt to calibrate the flow controller until the flow has stabilized.

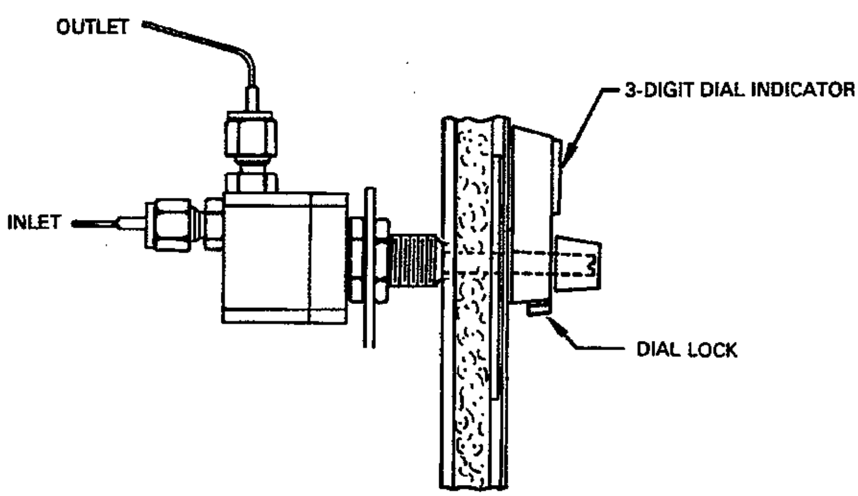


Figure 10 Digital Flow Controller

> NOTE: Turn flow controllers off (set to zero) when the GC is not being used; however, **maintain pressure to the controller to avoid another stabilization period** when the GC is used again.

The digital flow controller requires a minimum pressure drop of 10 psi across it to perform to specification. Therefore, to maintain a well controlled flow, the column head pressure must not exceed 70 psig. The system can be operated with higher head pressure if the inlet pressure is raised (up to a maximum of 250 psig); however, the flow control dial does not read the true flow rate.

9.2.1 Calibrating the Pressure Transducer

The pressure transducer is calibrated at the factory and should not require recalibration by you. However, if you must recalibrate the pressure transducer, proceed as follows:

1. Locate the following:
   - Swagelok® Tee (for split/splitless injector only)
   - 2 6" pieces of 1/16" tubing
   - 4 Viton® ferrules and 1/8" brass nuts
   - Pressure gauge (P/N 29-000082-00, recommended) and adapter
   - Small flat blade screwdriver
   - Digital voltmeter with clip leads
   - No-hole ferrule (P/N 28-694503-01)
2. Turn off the GC power.
3. Remove the GC top covers and the high voltage cover.
4. Remove the AutoSampler/External Events PC Board.
5. Disconnect the split ratio transducer cable from J102 on the AutoSampler/External Events PC Board. You cannot accurately calibrate the pressure transducer with the split ratio transducer connected AutoSampler/External Events PC Board.
6. Reinstall the AutoSampler/External Events PC Board.
7. Turn on the GC power.
8. Disconnect the column from the injector and install a no-hole ferrule in the injector. Close the septum purge valve.
9. Enter the following in the GC Configure Table:

   COL A INSTALLED YES　　COL DIAMETER 320 microns
   COL LENGTH 4 meters

   The pressure transducer does not read a value for pressure unless the GC is configured for column installation.
10. Set the digital voltmeter to a range that brackets 3.906V. To calibrate the Column A pressure, connect the hot (red) lead to Test Point 2 (TP2) and attach the ground (blk) to TP3. [Use TP1 (red) and TP3 (blk) for Column B.] The test points are metal coated holes in the AutoSampler/External Events PC Board (see Figure 11).

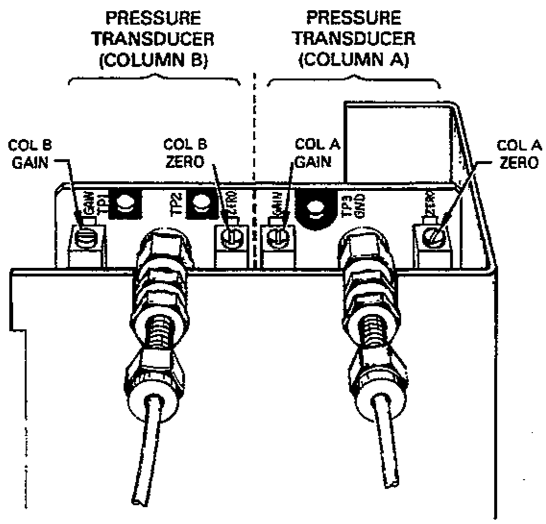


Figure 11 Dual Pressure Transducer

11. Install septum and column no-hole ferrules. Check that the system does not exhibit extraneous pressure drops by setting the splitter flow to less than 10 mL/min.

    Use a Swagelok® Tee fitting to attach an accurate pressure gauge onto the pressure transducer output (see Figure 11).

12. Turn off the injector flow controller. Open the pressure regulator (CW) to vent the head pressure (for on-column injectors, disconnect the gauge). Adjust the Column A ZERO adjustment screw (potentiometer) to 0.00 ±5 mV (0.005V).
13. Connect the hot (red) lead of the digital voltmeter to TP1. Connect the ground (blk) to TP3.
14. Adjust the ZERO potentiometer for Column B to 0.00 ±5 mV (0.005V).
15. Reconnect the digital voltmeter hot lead to TP2. Reconnect the ground lead to TP3.
16. Turn on the flow controller and turn on the pressure regulator (CW) to apply 50 psig through Column A.
17. Adjust the GAIN down (CCW) to a 3.906V.
18. Go to step 14 and check that zero did not change. Repeat step 14 through step 17 until the zero reading and the 50 psig reading do not change.
19. After you have calibrated the Column A pressure transducer, repeat the above procedure for Column B (if an injector is installed). Remember to configure the GC for a column in the Injector B position (GC Configure Table).

    Both Column A and B pressure transducer outputs must be within the range of 0 to +5 VDC to ensure proper GC display values.

20. Remove the pressure gauge, tube, and tee fitting.
21. Reconnect the split ratio transducer cable to J102 on the AutoSampler/External Events PC Board.
22. Replace the high voltage cover and the GC top covers. Turn GC power on.

9.2.2 Calibrating the Split Ratio Transducer

The split ratio transducer is calibrated at the factory and should not require recalibration. However, should you need to recalibrate the split ratio transducer (i.e., if you use a gas pressure other than 80 psig), proceed as follows:

1. Locate the following:
   - Bubble flowmeter
   - Flat blade screwdriver
   - Small flashlight
2. Before you calibrate the split ratio transducer, you must first calibrate the pressure transducer (see paragraph 9.2.1, Calibrating the Pressure Transducer). Make sure that the split ratio transducer is reconnected. Close the septum purge valve.
3. Check that the head pressure at the carrier gas inlet is 80 psig. If you find that the carrier gas inlet head pressure cannot be set to 80 psig, you must recalibrate the flowmeter; however, this should not be necessary since the carrier gas inlet pressure is set to 80 psig at the factory.

   In the GC Configure Table, enter the carrier gas Type and the Column Parameters. Refer to the Operation section for instructions on building the GC Configure Table.
4. If you have not installed a column or injector on either channel A or channel B, you must simulate a flow rate for the channel. For channel A (or channel B), turn the ZERO potentiometer clockwise (CW) on the Pressure Transducer PC Board until the flow reads (on the front panel of the GC) between 1 and 3 mL/min. This ensures that the split ratio transducer for the channel is correctly calibrated.

   > **IMPORTANT: If you must do this, go back to the pressure transducer calibration procedure (paragraph 9.2.1, step 14 through step 17) to rezero the channel on the pressure transducer. HOWEVER, REZERO THE CHANNEL AFTER COMPLETING THE SPLIT RATIO TRANSDUCER CALIBRATION.**

   There is no need to go through the entire procedure; just make sure the zero is correctly set (i.e., turn off the pressure and the flow to the transducer and rezero the potentiometer until the voltage reading is zero).
5. Check the split ratio (in the COLUMN status section) for channel A and channel B. The split ratio for both channels should be greater than zero. If the split ratio for either channel is not greater than zero, locate the ZERO potentiometer for the channel that reads zero. Adjust this potentiometer clockwise (CW) until the display reads greater than zero. If the split ratio cannot be adjusted above zero, switch to the other channel and try to adjust this split ratio above zero.

   If neither channel can be adjusted above zero, there may be a problem with the split ratio electronics. Refer to the Split Ratio Transducer Troubleshooting Table in the Diagnostics/ Troubleshooting section.
6. Monitor the flow (in the COLUMN status section), then use the back pressure regulator to set the column pressure to 3 mL/min.

   If the flow is 3.1 mL/min and the resolution is 0.2 mL/min for your column, adjust the column temperature to a higher temperature until the flow is 3 mL/min.

7. Zero Calibration: Attach a bubble flowmeter to the exit vent of the splitter. Make sure that the fitting that attaches the exit tube to the back pressure regulator is not leaking. The splitter exit vent is on the side of the GC (see Figure 12). The upper vent is the A side and the lower vent is the B side. Turn down the splitter flow controller until the flow out of the splitter exit vent measures 9 mL/min flow (6.7 sec/1 mL).
8. Check that the flow (in the COLUMN status section) is still 3 mL/min. If not, go to step 2 and repeat the procedure.
9. Remove the GC top cover and the insulation over the pneumatics compartment.
10. Locate the appropriate ZERO potentiometer on the split ratio transducer (see Figure 13). Use a small flashlight to illuminate the access hole.

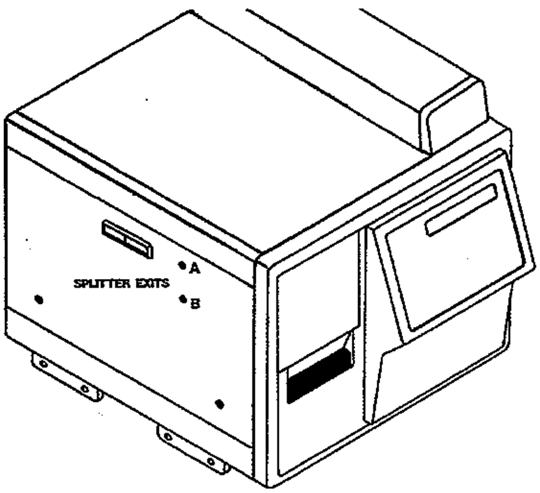


Figure 12 Splitter Exit Vent Locations

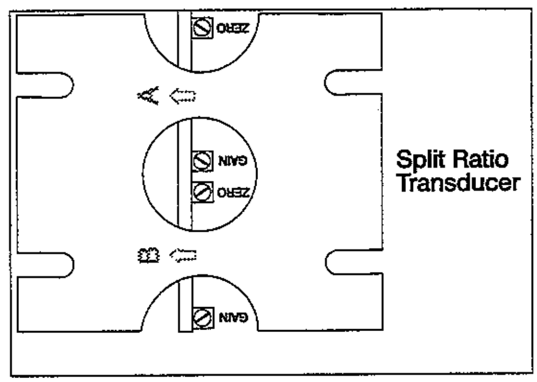


Figure 13 Split Ratio Transducer Adjustment Locations

11. Check the split ratio (in the COLUMN status section). Adjust the zero potentiometer on the split ratio transducer as you observe the split ratio display. Adjust the potentiometer until the split ratio is 4.
12. Gain Calibration: Adjust the splitter flow controller so that there is 146 mL/min flow out the vent (4.1 sec/10 mL). Check that the flow is still 3 mL/min. If not, go to step 2 and repeat the procedure.
13. Check the split ratio (in the COLUMN status section). Return to the split ratio transducer and adjust the GAIN (see Figure 13) as you observe the split ratio display. Adjust the GAIN until the split ratio is 50.
14. Repeat step 5 through step 13 until the flow and split ratio do not change.

9.2.3 Calibrating the Digital Flow Controller

To calibrate digital flow controllers, proceed as follows:

1. Turn on the GC power with the GC top covers in place.
2. Set the pressure at the gas supply cylinder to 80 psig for He or 77 psig for N_2.

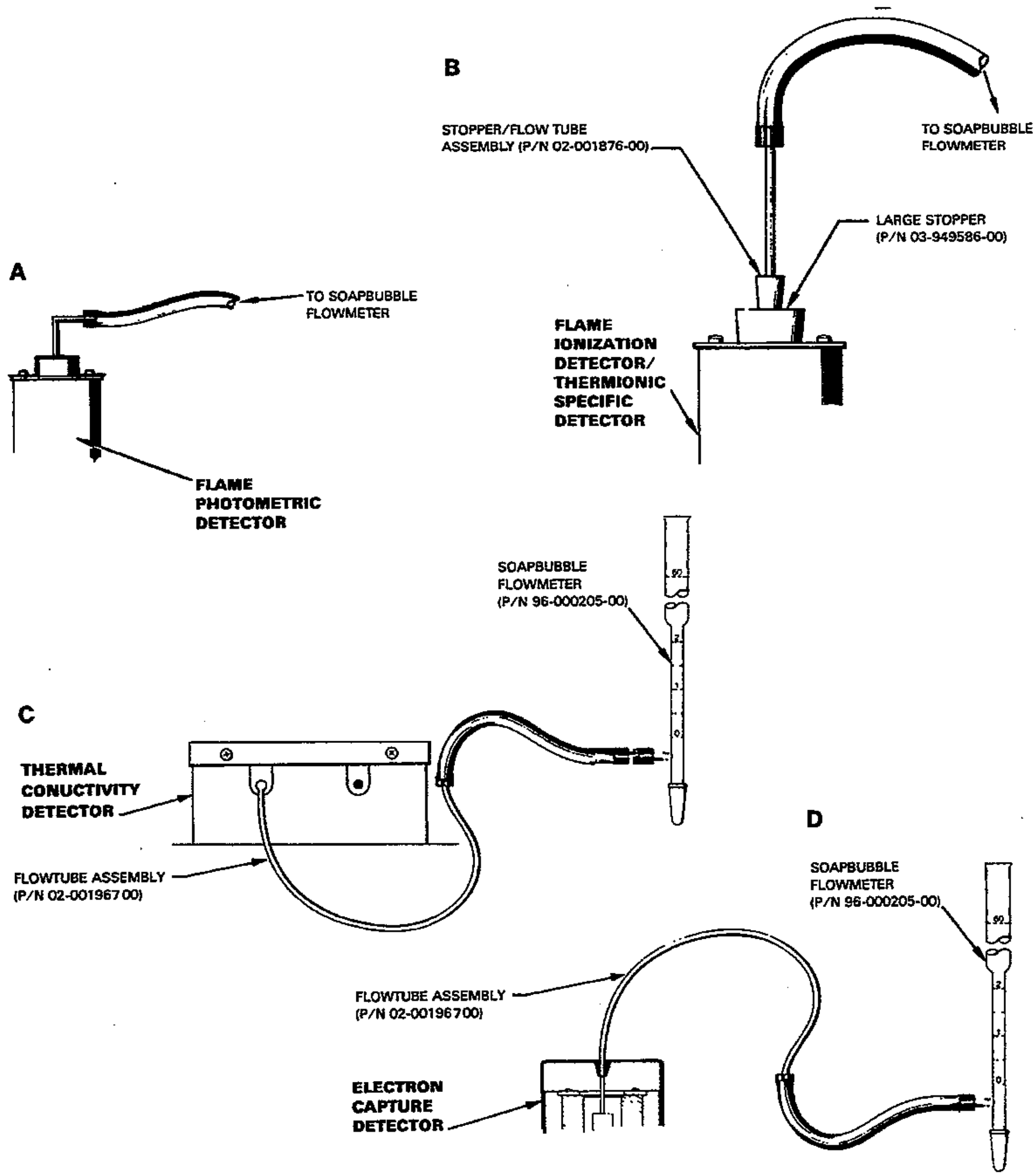


Figure 14 Flowmeter Configurations for Flow Rate Measurement

3. Set flow controller to 900 (9 turns) and allow the controller and pneumatics oven to stabilize at least 4 hours before calibrating.

> NOTE: Always adjust the flow controller down from **above** the desired flow. This procedure ensures greater reproducibility. Also, below a reading of 100 (one turn), the actual flow may not correlate well with the reading on the dial. The dial may read between 000 to 030 when the flow controller is off.

4. Measure the flow downstream of the flow controller at the exit port. Record the flow reading. The flow should read between 87.144 and 92.9 mL/min.
5. If the flow is outside this range, readjust the flow controller shaft and dial so that the dial will indicate the actual flow. Refer to Figure 10. To readjust the flow controller shaft, proceed as follows:
   a. Pull the controller knob straight up and off.
   b. To prevent the shaft from rotating, insert a flat blade screwdriver on the shaft top to lock the shaft in position.
   c. Loosen the two set screws to disengage the knob collar from the controller shaft. Maintain the position of the shaft in the flow controller.
   d. While locking the controller shaft position in place with the screwdriver, turn the knob collar until the digital dial reads the flow you measured previously.
   e. Tighten the knob shaft set screw and remove the screwdriver.
   f. Replace the controller knob.
6. Set the flow controller to 100 (one turn). Allow the controller to stabilize for at least ten minutes before proceeding.
7. Measure the flow and record it. The flow should read between 9.7 and 10.3 mL/min.
8. If the flow is outside this range, follow the procedure described in step 5.
9. Set the flow controller to 900 (9 turns). Allow the controller to stabilize for at least ten minutes before proceeding.
10. Measure the flow and record it. The flow should read between 87.1 and 92.9 mL/min. If the flow is outside this range, carefully check:
    a. The inlet pressure is stable at 80 ±2 psig for He and 77 ±2 psig for N_2.
    b. You have expressed the measured flows with respect to standard conditions (21.1°C, 1 atm).
    c. The system does not have leaks or clogs.
    d. The knob collar is securely fastened around the controller shaft.

If the flow controller dial still does not read the actual flow (within ±3 mL/min), the flow cartridge may be clogged or damaged. If you cannot correct the problem, call a Varian Customer Support Representative.

NOTE: In order to ensure the accurate display of column pressure, both Column A and Column B pressure transducer outputs must be within 0 VDC to +5 VDC.

10 Setting Flow Rates

The carrier gas (nitrogen) flow rate for the GC is set at the factory and should not require readjustment for typical operating conditions. Refer to Table 2 for gas flow rates for the detectors available with the GC. If the test sample chromatogram for your particular configuration does not compare to the test chromatogram in the manual, check the flow rates listed in Tables 4-7.

10.1 Bubble Flowmeter Adjustment Factors

If a check of the flow rate is performed using a bubble flowmeter, it must be adjusted for temperature and pressure variations by using the following formula:

$$\frac{273^{\circ}K + \textit{lab temp}\ (^{\circ}C)}{294.1^{\circ}K} \times \frac{760\ mm\ (\text{or } 29.92\ in)}{\textit{local adjusted barometer}} \times \textit{altitude factor}^{*}$$

= bubble flowmeter reading (2 to 5% bubble flowmeter accuracy)

* Altitude (ft.)	Altitude Factor
1000	1.041
2000	1.083
3000	1.127
4000	1.174
5000	1.221

10.2 Setting Detector Flow Rates

Before adjusting flow rates, install the appropriate gases, filters, and regulators as described in the Pre-Installation Instructions.

Flow rates for these valve cartridges are set with the flow adjust needle valve (interior screw) of the valve cartridge knob. The valve cartridges are color-coded for particular flow rate ranges and gases. Refer to Table 3 for a list of the flow ranges and the approximate rate of flow per turn for each of the cartridges.

Table 2 Instrument Gas Requirements

Detector	Inlet Pressure	Purity[1] (See Note)	Packed Column Non-Capillary Flow Rate (mL/min)	Capillary Flow Rate in cc/min: Split/ Splitless[2]	530µ On-Column	On-Column Capillary	Notes
TCD							He ~~N_2~~: ≤3 ppm H_2O; 5 ppm O_2. Carrier gas and oxygen filters recommended.
Carrier Gas to injector:							
He, N_2, H_2, Ar	80 psig	99.995%	10-80		<30		
ECD							N_2: ≤0.02 ppm H_2O; ≤1ppm O_2. Hydrogen may be used in cleaning ECD cell. Carrier gas and oxygen filters recommended.
Carrier Gas to injector:							
~~He~~ N_2	80 psig	99.998%	20-60	<500	<30	<10	
FID							Carrier gas filter recommended.
Carrier Gas to injector:							
He, N_2, H_2	80 psig	99.998%	20-60	<500	<30	<10	
Detector Gas:							
H_2	40 psig	99.995%	30	30	30	30	
Air	60 psig	Breathing Quality	300	300	300	300	
TSD							Carrier gas and oxygen filters recommended.
Carrier Gas to injector:							
He or N_2	80 psig	99.998%	20-60	<500	<30	<10	
Detector Gas:							
H_2	40 psig	99.995%	4.0 ±0.2	4.0 ±0.2	4.0 ±0.2	4.0 ±0.2	
Air	60 psig	Breathing Quality	165-185	165-185	165-185	165-185	
FPD							Two air flows required for dual flame. Carrier gas and oxygen filters recommended.
Carrier gas to injector:							
He or N_2	80 psig	99.998%	20-60	<500	<30	<10	
Detector Gas:							
H_2	40 psig	99.995%	140 ±5	140 ±5	140 ±5	140 ±5	
Air	60 psig	Breathing Quality	#1: 75-85 #2: 170-180	75-85 170-180	75-85 170-180	75-85 170-180	
ELCD							Carrier gas filter recommended.
Carrier Gas to injector:							
He	80 psig	99.998%	15-35	<500	<30	<10	
Reaction Gas:							
H_2[3]	40 psig	99.995%	20-60	20-60	20-60	20-60	
Air[4]	40 psig	Breathing Quality	20-60	20-60	20-60	20-60	
PID							Carrier gas filter recommended.
Carrier Gas to injector:							
He or N_2	80 psig	99.998%	20-60	<500	<30	<10	

[1] Typical Impurities:

He-CO_2	<0.25 ppm	N_2-O_2	<1 ppm	H_2-O_2	<5 ppm	Air-O_2	20-25%
Ar	<0.1 ppm	H_2O	<5 ppm	H_2O	<1 ppm	CO	<10 ppm
Ne	<10 ppm	Hydro-carbons	<1 ppm	Hydro-carbons	<1 ppm	CO_2	<500 ppm
N_2	<10 ppm					Oil	<0.02 ppm
H_2	<2.5 ppm					H_2O	<0.02 ppm
						CH_2	<20 ppm

[2] Column plus split flow rates
[3] H_2 in N_2 or Cl mode
[4] Air in S mode

***IMPORTANT NOTE:** Obtain gases for chromatographic use from a supplier who is aware of your requirements. An analysis of selected impurities is used to determine the "purity" rating for a given gas. If your supplier does not establish purity based on an analysis of appropriate chromatographic contaminants, a purity rating of 99.998% may not be suitable for GC use. A quality supplier of gas and the regular use of filters will minimize system contamination problems.*

57-000291-0X

Table 3 Valve Cartridge Color Coding and Flow Rate Ranges

Knob Color	Gas	Flow at Full Open	Capacity	Description
Black	Air	450 cc, 60 psig	Less than 150 cc/turn; flow range 100-450 cc/min	450 cc/min Air 23°C
Red	Hydrogen	60 cc, 40 psig	Less than 15 cc/turn; flow range 10-60 cc/min	60 cc/min H_2/23°C
Green	Helium	40 cc, 60 psig	Less than 15 cc/turn; flow range 15-40 cc/min	40 cc/min He/23°C
Blue	Nitrogen	130 cc, 60 psig	Less than 25 cc/turn; flow range 30-130 cc/min	130 cc/min N_2/23°C
Red with silver stripe	Hydrogen	200 cc, 40 psig	Less than 50 cc/turn; flow range 90-200 cc/min	200 cc/min H_2/23°C
Silver			ON/OFF *only*	

To set the detector flow rates, proceed as follows:

1. Turn on the GC power with the GC top covers in place and allow the pneumatics to warm and their temperature to stabilize. Valves for the make-up gas, air, and H_2 pneumatics are temperature sensitive.

   NOTE: Accuracy of the flow measurement for the FID depends upon a good seal between the FID base and tower. Refer to the ***Flame Ionization Detector*** *section in the Options/Accessories Manual for details.*

2. If carrier gas has been flowing through the system, set the carrier gas flow rate to zero and allow several minutes for the carrier gas to bleed out of the column before beginning to set flow rates for the air, H_2, or make-up valves.

3. All gas flow rates (carrier and detector) are adjusted at the pneumatics panel. Set the flow rates for the air, hydrogen, or detector gas flows separately to avoid compounding errors in the flow rate measurement.

4. Extinguish detector flames (if lighted).

5. Set air, hydrogen, or detector gas inlet pressure (on the second stage regulator of the gas supply cylinder). See the 3000 Series GC Pre-Installation Instructions, Table 3.

6. Connect a soap bubble flowmeter (P/N 96-000205-00, 0-60 cc) to the detector (see Figure 14). For the TSD, refer to the instructions in the *Thermionic Specific Detector* section in the Options/Accessories Manual to measure the 4.0 mL/min H_2 flow.

7. Force a bubble above the inlet of the flowmeter. Using a stopwatch, measure the time it takes the bubble to move from zero to a particular volume mark. Calculate the rate in cc/min. To improve the accuracy of the flow rate measurement, select volumes that give at least 10 to 20 seconds elapsed time.

8. Adjust the needle valve to the recommended gas flow rate for the detector. Refer to the specific detector section of the manual for recommended gas flow rates.

   CAUTION: To avoid contamination of the detector, do not allow soap solution from the flowmeter to enter the detector exit tube.

9. Follow steps 1 through 6 to set flows for the other valve cartridges of the air, H_2, and make-up valves.

⚠WARNING

EXPLOSION HAZARD

Unless the hydrogen is to be ignited, shut off the hydrogen flow immediately after making the flow adjustment. Hydrogen gas escaping to the environment is a hazard.

10.3 Injector and Column Flows

For recommended injector and column flow rates, refer to the specific Injector manual for recommended gas flow rates.

11 Installing a Column

Refer to the Injector manual for instructions on installing a gas chromatographic column in the 3300 GC or the Star 3400 CX GC equipped with certain injectors. Refer to the appropriate sections in the Options/Accessories Manual for your injector:

1077 Split/Splitless Capillary Injector	P/N 03-914039-00
1075 Split/Splitless Capillary Injector	P/N 03-914092-00
1093/1094 Septum-equipped Programmable Injector	P/N 03-914218-00
1041 Universal Injector	P/N 03-914243-00
1061 Universal Flash Injector (for 530 micron Columns)	P/N 03-914275-00

12 Installing an Injector and Detector

The GC is shipped with the injectors and detectors installed. If you need to install or remove an injector or detector, refer to the appropriate detector or injector sections in the Options/Accessories Manual.

13 Final Check of Installation

Before you run the test chromatograms, check the following:

SHIPPING RESTRAINTS/CAPS

- ☐ Column oven fan motor shipping dowel is removed (paragraph 2.1).
- ☐ Plastics or paper caps, plugs, or tie downs are removed (paragraph 2.1).

ELECTRICAL

- ☐ Power cord is correctly wired (paragraph 4, Figure 1).
- ☐ Line voltage is correct (paragraph 4.1).
- ☐ Cables correctly connect the GC to peripheral instruments (paragraph 7).

PNEUMATICS

- ☐ Cylinder and regulator do not leak.
- ☐ Regulators are set to recommended pressures (Table 2).
- ☐ Cylinders are chained or strapped securely.
- ☐ Gas supplies are correctly plumbed to the GC. (Table 2).
- ☐ Inlet gas filter/traps are installed and tagged.
- ☐ Flow rates are correct (paragraph 10).
- ☐ Connecting lines and fittings do not leak (paragraph 8).

COLUMN

- ☐ Correct column is properly installed (ref. Column section) and does not leak (paragraph 8).

POWER

- ☐ Battery switch is ON (paragraph 5, Figure 5 and Figure 6).
- ☐ Power switch is ON (paragraph 4.2, 5.1, Figure 2).

14 Running the Test Chromatogram

Prior to running a test chromatogram, bake-out the chromatographic column and system overnight. Follow the procedure described in the Installation of Packed and Capillary Columns section. If you suspect some other problem, refer to the Diagnostics/Troubleshooting section.

Following the bake-out period, set the GC to the test conditions and gas flow rates listed in Tables 4-7. Locate your injector type using Tables 4-7. Set method parameters and flow rates based on detector types. Run a test chromatogram for each detector installed in the GC. Test the FID before you test the other detectors.

NOTE: To order additional test samples, refer to the following part numbers:

Non-Capillary Test Sample	Part Number	Compound Concentrations
FID	82-005048-00	300 ng ±1%/µL of C_{14}, C_{15}, C_{16} in iso-octane
TCD	82-005048-01	3.00 µg ±1%/µL of C_{14}, C_{15}, C_{16} in iso-octane
ECD	82-005048-02	33.0 pg ±1%/µL of lindane & aldrin in iso-octane
FPD	82-005048-03	20.0 ng ±1%/µL of n-dodecanethiol tributylphosphate, methyl parathion; 4000 ng ±1%/µL of n-pentadecane in iso-octane
TSD	82-005048-04	2.00 ng ±1%/µL of azobenzene, methyl parathion; 4 ng ±1%/µL malathion & 4.00 µg ±1%/µL C_{17} in iso-octane
ELCD	82-005048-08	300 pg ±1%/µL of azobenzene, thimet, heptachlor; 150 ng ±1%/µL of octadecane in hexane
PID	82-005048-09	4 ng ±1%/µL of naphthalene, 1,2,3-Trichlorobenzene in hexane

NOTE: Due to airline regulations, test samples are not shipped outside the U.S. If you cannot obtain the test samples, refer to the compound concentrations listed in the Test Sample Table and make your own.

Table 4 Test Conditions - Packed Columns (1040/1060 Injectors)

	ECD	ELCD	FID	FPD	PID	TCD	TSD
GC Configure Table							
Column Temp Limit	250	250	250	250	250	250	250
Injector Temp Limit	250	250	250	250	250	250	250
Detector Temp Limit	300	300	300	300	300	300	300
Plotter (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Chart Recorder (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Gas Flow Rates							
Carrier Gas	N_2: 30±1	N_2 or He: 30±1	N_2 or He: 30±1	N_2 or He: 30±1	N_2 or He: 30±1	He: 30±1	N_2 or He: 30±1
Air 1	—	—	300±10	80±10	—	—	175±10
Air 2	—	—	—	170±15	—	—	—
Hydrogen	—	Reactor: 30±1	30±1	140±5	—	—	4.0±0.2
TCD Reference Cell	—	—	—	—	—	He: 30±1	—
Make-up Gas	—	—	—	—	—	—	—
Split Ratio							
Split Flow (at vent)							
GC Bake Out Conditions							
Column Temp	250	220	250	250	200	250	250
Injector Temp	250	250	250	250	250	250	250
Detector Temp	320	250	320	300	250	300	320
All gas flows and flame, as applicable	On	On	On	On	On	On	On
TCD Filament Temp	—	—	—	—	—	320	—
TSD Bead Current	—	—	—	—	—	—	3.0±0.2
Reactor Temp	—	850	—	—	—	—	—
Detector Response Test Conditions							
Column							
Initial Column Temp	190	190	140	180	90	140	175
Initial Column Hold Time (min)	4 (isothermal)	5 (isothermal)	5 (isothermal)	5 (isothermal)	5 (isothermal)	5 (isothermal)	5 (isothermal)
Program 1 Final Temp							
Program 1 Rate							
Program 1 Hold Time (min)							
Injector							
Initial Injector Temp	220	220	220	220	220	220	220
Detector							
Detector Temp	300	250	300	220	250	220	220
Time Constant (Switch Setting)	Norm	Norm	Norm	Norm	Norm	Norm	Norm
Attenuation	32	4	4	256 (P) 16 (S)	1	16	128
Range	10	1	10	10	11	0.05	12
Autozero	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TCD Filament Temp	—	—	—	—	—	270±20	—
TCD Filament Current	—	—	—	—	—	200±10	—
TCD Polarity Positive	—	—	—	—	—	Yes	—
TSD Bead Current (Amps)	—	—	—	—	—	—	3.0±0.3

NOTE: ELCD

Vent Program	Initial	Time=0.00, Attenuation=4, vent open=no
	Program 1	Time=0.01, Attenuation=4, vent open=yes
	Program 2	Time=0.50, Attenuation=4, vent open=no
Solvent Flow	40 (read on pump module)	

Table 5 Test Conditions - 530 Micron Columns (1041/1061 Injectors)

	ECD	ELCD	FID	FPD	PID	TCD	TSD
GC Configure Table							
Column Temp Limit	250	250	250	250	250	250	250
Injector Temp Limit	250	250	250	250	250	250	250
Detector Temp Limit	300	300	300	300	300	300	300
Plotter (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Chart Recorder (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Gas Flow Rates							
Carrier Gas	N_2: 7±1	N_2 or He: 7±1	N_2 or He: 7±1	N_2 or He: 7±1	N_2 or He: 7±1	He: 7±1	N_2 or He: 7±1
Air 1	—	—	300±10	80±3	—	—	175±10
Air 2	—	—	—	170±15	—	—	—
Hydrogen	—	Reactor: 30±1	30±1	140±5	—	—	4.0±0.2
TCD Reference Cell	—	—	—	—	—	He: 30±2	—
Make-up Gas	N_2: 23±2	N_2 or He: 23±2	N_2 or He: 23±2	N_2 or He: 23±2	N_2 or He: 23±2	He: 23±2	N_2 or He: 23±2
Split Ratio							
Split Flow (at vent)							
GC Bake Out Conditions							
Column Temp	250	220	250	250	200	250	250
Injector Temp	250	250	250	250	250	250	250
Detector Temp	320	250	320	300	250	300	320
All gas flows and flame, as applicable	On	On	On	On	On	On	On
TCD Filament Temp	—	—	—	—	—	320	—
TSD Bead Current	—	—	—	—	—	—	3.0±0.2
Reactor Temp	—	850	—	—	—	—	—
Detector Response Test Conditions							
Column							
Initial Column Temp	80	80	80	80	80	80	80
Initial Column Hold Time (min)	1	1	1	1	1	1	1
Program 1 Final Temp	200	200	200	200	200	200	200
Program 1 Rate	20°C/min	20°C/min	20°C/min	20 °C/min	20°C/min	20°C/min	20 °C/min
Program 1 Hold Time (min)	2	2	2	2	2	2	2
Injector							
Initial Injector Temp	220	220	220	220	220	220	220
Detector							
Detector Temp	300	250	300	220	250	220	300
Time Constant (Switch Setting)	Norm	Norm	Norm	Norm	Norm	Norm	Norm
Attenuation	128	8	32	128 (P) 64(S)	8	64	16
Range	10	1	11	10	11	0.05	11
Autozero	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TCD Filament Temp	—	—	—	—	—	270	—
TCD Filament Current	—	—	—	—	—	200±10	—
TCD Polarity Positive	—	—	—	—	—	Yes	—
TSD Bead Current (Amps)	—	—	—	—	—	—	3.0±0.3

NOTE: ELCD

Vent Program	Initial	Time=0.00, Attenuation=4, vent open=no
	Program 1	Time=0.01, Attenuation=4, vent open=yes
	Program 2	Time=0.50, Attenuation=4, vent open=no
Solvent Flow	40 (read on pump module)	

Table 6 Test Conditions - 320 Micron x 4 Meter Columns (1077 Injector)

	ECD	ELCD	FID	FPD	PID	TCD	TSD
GC Configure Table							
Column Temp Limit	250	250	250	250	250	250	250
Injector Temp Limit	250	250	250	250	250	250	250
Detector Temp Limit	300	300	300	300	300	300	300
Plotter (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Chart Recorder (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Gas Flow Rates							
Carrier Gas	N_2: 3±0.2	N_2 or He: 2±0.2	N_2 or He: 2±0.2	N_2 or He: 2±0.2	N_2 or He: 2±0.2	He: 2±0.2	N_2 or He: 2±0.2
Air 1	—	—	300±10	80±3	—	—	175±10
Air 2	—	—	—	170±15	—	—	—
Hydrogen	—	Reactor: 30±1	30±1	140±5	—	—	4.0 ±0.2
TCD Reference Cell	—	—	—	—	—	He: 30±2	—
Make-up Gas	N_2: 28±2	N_2 or He: 28±2	N_2 or He: 28±2	N_2 or He: 28±2	N_2 or He: 28±2	He: 28±2	N_2 or He: 28±2
Split Ratio	50	50	50	50	50	50	50
Split Flow (at vent)	100±5	100±5	100±5	100 ±5	100±5	100±5	100±5
GC Bake Out Conditions							
Column Temp	250	220	250	250	200	250	250
Injector Temp	250	250	250	250	250	250	250
Detector Temp	320	250	320	300	250	300	320
All gas flows and flame, as applicable	On	On	On	On	On	On	On
TCD Filament Temp	—	—	—	—	—	320	—
TSD Bead Current	—	—	—	—	—	—	3.0±0.2
Reactor Temp	—	850	—	—	—	—	—
Detector Response Test Conditions							
Column							
Initial Column Temp	80	80	80	80	80	80	80
Column Hold Time (minutes)	1	1	1	1	1	1	1
Program 1 Final Temp	200	200	200	200	200	200	200
Program 1 Rate	20°C/min	20°C/min	20°C/min	20 °C/min	20°C/min	20°C/min	20 °C/min
Program 1 Hold Time (min)	2	2	2	2	2	2	2
Injector							
Initial Injector Temp	220	220	220	220	220	220	220
Detector							
Detector Temp	300	250	300	220	250	220	300
Time Constant (Switch Setting)	Norm	Norm	Norm	Norm	Norm	Norm	Norm
Attenuation	128	8	32	64 (P) 64 (S)	16	32	8
Range	10	1	11	10	11	0.05	11
Autozero	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TCD Filament Temp	—	—	—	—	—	270	—
TCD Filament Current	—	—	—	—	—	200±10	—
TCD Polarity Positive	—	—	—	—	—	Yes	—
TSD Bead Current (Amps)	—	—	—	—	—	—	3.0±0.3
Relay							
Initial Relay	+1 (splitless)						
Prgm 1 Relay Time in min	0.75 min						
Prgm 1 Relay	-1 (split)						

NOTE: ELCD

Vent Program	Initial	Time=0.00, Attenuation=4, vent open=no
	Program 1	Time=0.01, Attenuation=4, vent open=yes
	Program 2	Time=0.50, Attenuation=4, vent open=no
Solvent Flow	40 (read on pump module)	

Table 7 Test Conditions - 320 Micron x 4 Meter Columns (1075 Injector)

	ECD	ELCD	FID	FPD	PID	TCD	TSD
GC Configure Table							
Column Temp Limit	250	250	250	250	250	250	250
Injector Temp Limit	250	250	250	250	250	250	250
Detector Temp Limit	300	300	300	300	300	300	300
Plotter (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Chart Recorder (Optional)							
Chart Speed	1	1	1	1	1	1	1
Recorder Zero Offset	10	10	10	10	10	10	10
Gas Flow Rates							
Carrier Gas	N_2: 2±2	N_2 or He: 2±0.2	N_2 or He: 2±0.2	N_2 or He: 2±0.2	N_2 or He: 2±0.2	He: 2±0.2	N_2 or He: 2±0.2
Air 1	—	—	300±10	80±3	—	—	175±10
Air 2	—	—	—	170±15	—	—	—
Hydrogen	—	Reactor: 30±1	30±1	140±5	—	—	4.0±0.2
TCD Reference Cell	—	—	—	—	—	He: 30±2	—
Make-up Gas	N_2: 28±2	N_2 or He: 23±2	N_2 or He: 23±2	N_2 or He: 28±2	N_2 or He: 28±2	He: 28±2	N_2 or He: 28±2
Split Ratio	50	50	50	50	50	50	50
Split Flow (at vent)	100±5	100±5	100±5	100±5	100±5	100±5	100±5
GC Bake Out Conditions							
Column Temp	250	220	250	250	200	250	250
Injector Temp	250	250	250	250	250	250	250
Detector Temp	320	250	320	300	250	300	320
All gas flows and flame, as applicable	On	On	On	On	On	On	On
TCD Filament Temp	—	—	—	—	—	320	—
TSD Bead Current	—	—	—	—	—	—	3.0±0.2
Reactor Temp	—	850	—	—	—	—	—
Detector Response Test Conditions							
Column							
Initial Column Temp	80	80	80	80	80	80	80
Column Hold Time (minutes)	1	1	1	1	1	1	1
Program 1 Final Temp	200	200	200	200	200	200	200
Program 1 Rate	20°C/min	20°C/min	20°C/min	20 °C/min	20°C/min	20°C/min	20 °C/min
Program 1 Hold Time (min)	2	2	2	2	2	2	2
Injector							
Initial Injector Temp	220	220	220	220	220	220	220
Detector							
Detector Temp	300	250	300	220	250	220	300
Time Constant (Switch Setting)	Norm	Norm	Norm	Norm	Norm	Norm	Norm
Attenuation	128	8	32	64 (P) 64 (S)	16	32	8
Range	10	1	11	10	11	0.05	11
Autozero	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TCD Filament Temp	—	—	—	—	—	270	—
TCD Filament Current	—	—	—	—	—	200±10	—
TCD Polarity Positive	—	—	—	—	—	Yes	—
TSD Bead Current (Amps)	—	—	—	—	—	—	3.0±0.3
Relay							
Initial Relay	-1 (splitless)						
Prgm 1 Relay Time in min	0.75 min						
Prgm 1 Relay	+1 (split)						

NOTE: ELCD

Vent Program	Initial	Time=0.00, Attenuation=4, vent open=no
	Program 1	Time=0.01, Attenuation=4, vent open=yes
	Program 2	Time=0.50, Attenuation=4, vent open=no
Solvent Flow	40 (read on pump module)	

Retain the initial test chromatogram as a benchmark of the current detector performance. If you suspect the sensitivity of the detector has degraded, run the test chromatogram again and compare it to the benchmark test chromatogram. If the test chromatogram differs from the test chromatogram shown in the manual, refer to the Diagnostics/Troubleshooting section for assistance.

The following procedures utilize the test column(s) and test sample(s) shipped with the GC. If the test column has been removed, reinstall it to run the test chromatogram.

> NOTE: When using helium rather than nitrogen as the carrier gas, the size of peaks in the test chromatogram are reduced by about half.

14.1 FID Test Chromatogram

To test the performance of the Flame Ionization Detector (FID), proceed as follows:

1. Set up the test conditions and gas flow rates and bake-out the GC as described in Tables 4-7.
2. Press [IGNITE A] (or [SHIFT] [IGNITE B] if the FID is Detector B) to ignite the FID flame.
3. Operate the GC for at least 30 minutes so that the FID flame and electronics are stable.

   If the detector exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the FID. Cap the FID inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

   Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector.

   For additional information, refer to the Diagnostics/Troubleshooting section.
4. Inject 1.0 µL of the FID Test Sample. Refer to the appropriate injector manual for recommended injection techniques. An injection automatically disables Autozero and advances the GC to RUN.
5. Monitor the detector response on printer/plotter or chart recorder. If C_{14} (first peak after the solvent peak) did not elute at 1 ±0.2 minutes, readjust the column temperature (lower if C_{14} retention time is under 0.8 minutes).

> NOTE: The range and attenuation settings used to check the performance of the FID have been selected to provide the optimum signal to the printer/plotter. The test chromatograms are generated with these range and attenuation settings as well. Use these settings if you intend to compare the test chromatogram you generate with the test chromatogram in the manual for the FID.

6. Compare the test chromatogram for peak separation, peak heights, and retention times with the chromatogram in Figures 15a-15c.

7. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.

14.2 ECD Test Chromatogram

To test the performance of the Electron Capture Detector (ECD), proceed as follows:

1. Set up the test conditions and gas flow rates and bake-out the GC as described in Tables 4-7.
2. Operate the GC for at least 30 minutes so that the ECD and electronics are stable.

   If the ECD exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the ECD. Cap the ECD inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

   Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector and repeat step 3.

   For additional information, refer to the Diagnostics/Troubleshooting section.
3. Inject 1.0 µL of the ECD Test Sample. Refer to the appropriate injector manual for recommended injection techniques. An injection automatically disables Autozero and advances the GC to RUN.
4. Compare the test chromatogram for peak separation, peak heights, and retention times with the chromatogram in Figures 16a-16c.
5. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.

14.3 FPD Test Chromatogram

To test the performance of the Flame Photometric Detector (FPD), proceed as follows:

1. Set up the test conditions and gas flow rates and bake-out the GC as described in Tables 4-7.
2. Press [IGNITE A] (or [SHIFT] [IGNITE B] if the FPD is Detector B) to ignite the FPD flame.
3. Operate the GC for at least 1 hour so that the FPD and electronics are stable.

   If the detector exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the FPD. Cap the FPD inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

   Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector.

   For additional information, refer to the Diagnostics/Troubleshooting section.

> NOTE: Check the performance of the FPD in the phosphorus mode first.
>
> The phosphorus-mode filter (P/N 03-905948-01) is **shipped in the detector** and must be in place for this check. If the phosphorus-mode filter has been removed, refer to the **FPD** detector section (Optical Filter Changing) for instructions to reinstall the phosphorus-mode filter.

4. Inject 1.0 µL of the FPD Test Sample. Refer to the appropriate injector manual for recommended injection techniques. An injection automatically disables Autozero and advances the GC to RUN.
5. Monitor detector response on the printer/plotter or chart recorder. Adjust the column temperature such that the tributylphosphate peak elutes at 1 ±0.2 minutes. Readjust the column temperature (lower if time is under 0.8 minutes) if the retention time is out of the range. Repeat steps 4 and 5.
6. Compare the test chromatogram for peak separation, peak heights, and retention times with the chromatogram in Figures 17a-17c.
7. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.
8. To check the performance of the FPD in the sulfur-mode, replace the phosphorus-mode filter with the sulfur-mode filter:
   a. Turn off detector in GC Configure table (turns detector high voltage off).
   b. Remove the GC top covers.
   c. Refer to the FPD detector section (Optical Filter Changing) for instructions on changing the optical filter. Remove the phosphorus-mode filter and install the sulfur-mode filter.
   d. Replace the GC top covers and turn the detector on.
9. Set the test conditions as described in Tables 4-7.
10. Operate the GC for at least 30 minutes so that the FPD electronics are stable.

    If the detector exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the FPD. Cap the FPD inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

    Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector.

    For additional information, refer to the Diagnostics/Troubleshooting section.
11. Inject 1.0 µL of the FPD Test Sample. Refer to the appropriate injector manual for recommended injection techniques. An injection automatically disables Autozero and advances the GC to RUN.

12. Monitor detector response on the printer/plotter or chart recorder.

    Compare the test chromatogram for peak separation, peak heights, and retention times with the chromatogram in Figures 17d-17f.

    Readjust the column temperature (lower if time is less than 2.3 minutes) if the retention time is out of the range. Repeat steps 11 and 12.

13. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.

14.4 TCD Test Chromatogram

To test the performance of the Thermal Conductivity Detector (TCD), proceed as follows:

1. Set the test conditions and gas flow rates (see Tables 4-7) before raising the temperature of the detector. Bake-out the GC.
2. Adjust the zero offset to 10% of full-scale. Turn the Autozero ON.
3. Operate the GC for at least 30 minutes so that the TCD and electronics are stable.

   If the detector exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the TCD. Cap the TCD inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

   Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector.

   For additional information, refer to the Diagnostics/Troubleshooting section.
4. Inject 1.0 µL of the TCD Test Sample. An injection automatically disables Autozero and advances the GC to run.
5. Compare the test chromatogram for peak separation, peak heights, and retention times with the chromatogram in Figures 18a-18c.
6. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.

14.5 TSD Test Chromatogram

To test the performance of the Thermionic Specific Detector (TSD), proceed as follows:

1. Set the test conditions and the gas flow rates as described in Tables 4-7. The hydrogen flow rate is critical to the optimum performance of the TSD. Set the hydrogen flow rate with the high resolution digital flow controller. The hydrogen flow rate must be 4.0 ±0.2 cc/min. Measure the flow rate with the bubble flowmeter (P/N 96-000205-00) only. Bake-out the GC.
2. Operate the GC for at least 30 minutes so that the TSD and electronics are stable.

   If the detector exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the TSD. Cap the TSD inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector.

For additional information, refer to the Diagnostics/Troubleshooting section.

3. Set bead current to 3.4 A. The background signal should increase. Autozero the background current and adjust the zero offset to 10% of full-scale for the printer/plotter or chart recorder.
4. Inject 1.0 µL of the TSD Test Sample. Refer to the appropriate injector manual for recommended injection techniques. An injection automatically disables the Autozero and advances the GC to RUN.
5. Observe the chromatogram on the printer/plotter or chart recorder. Reset the GC and reduce the bead current (at 0.1 A per step with an injection of 1.0 µL of test sample) after the bead temperature stabilizes (about 10 to 15 minutes).
6. Repeat step 5 until the bead current setting yields the test chromatogram shown in Figures 19a-19c.
7. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.

14.6 PID Test Chromatogram

To test the performance of the Photoionization Detector (PID), proceed as follows:

1. Set the test conditions and gas flow rates as described in Tables 4-7 and bake-out the GC.
2. Operate the GC for at least 30 minutes so that the PID and electronics are stable.

   If the detector exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the PID. Cap the PID inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

   Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector.

   For additional information, refer to the Diagnostics/Troubleshooting section.
3. Inject 1.0 µL of the PID Test Sample. Refer to the appropriate injector manual for recommended injection techniques. An injection automatically disables Autozero and advances the GC to RUN.
4. Compare the test chromatogram for peak separation, peak heights, and retention times with the chromatogram in Figures 20a-20c.
5. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.

14.7 ELCD Test Chromatogram

To test the performance of the Electrolytic Conductivity Detector (ELCD), proceed as follows:

1. Set the test conditions and gas flow rates as described in Tables 4-7 and bake-out the GC.
2. Operate the GC for at least 30 minutes so that the ELCD and electronics are stable.

   If the detector exhibits excessive noise, check the electrical connections to the chart recorder. If this does not reduce the noise, cool the column oven and disconnect the column from the ELCD. Cap the ELCD inlets. Check the glass wool plug in the column. If wool plug is missing, replace the column with a column that has a glass wool plug. Reconnect the column to the injector but not to the detector. Cap the column-to-detector connection.

   Set the oven temperature to 240°C and the detector temperature to 350°C. Operate the GC for at least 4 hours, then cool the oven to 50°C. Reconnect the column to the detector.

   For additional information, refer to the Diagnostics/Troubleshooting section.
3. Inject 2.0 µL of the ELCD Test Sample. Refer to the appropriate injector manual for recommended injection techniques. An injection automatically disables Autozero and advances the GC to RUN.
4. Compare the test chromatogram for peak separation, peak heights, and retention times with the chromatogram in Figures 21a-21c.
5. If the test chromatogram compares well to the test chromatogram in the manual, remove the test column and install the column to be used for your particular application. Set the chromatographic conditions for your application. If necessary, check the column connections for leaks as described in paragraph 8.

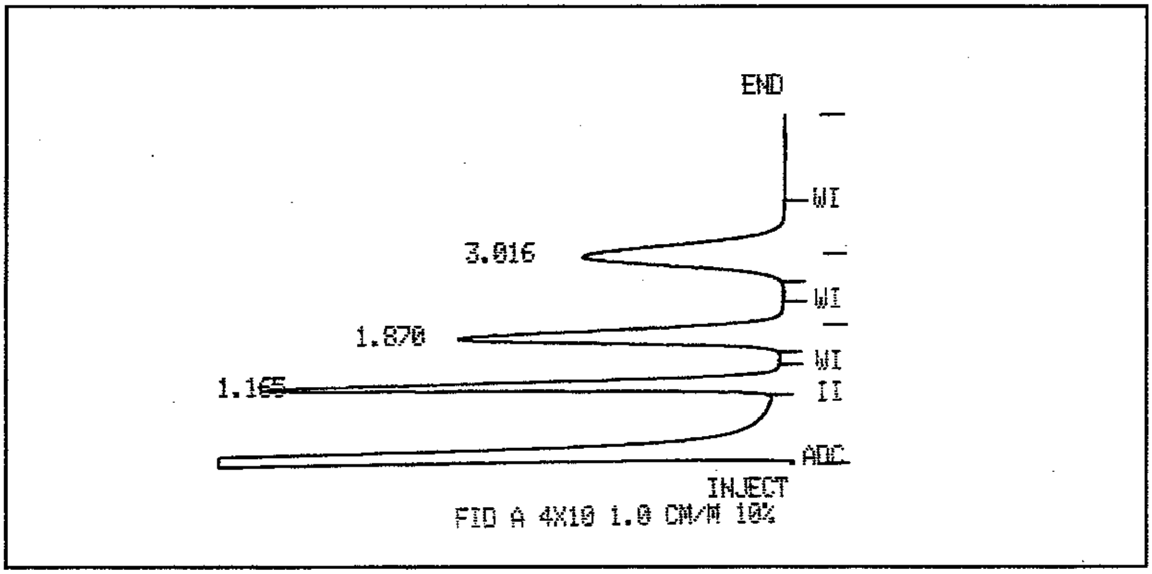


Figure 15a Packed Column (FID)

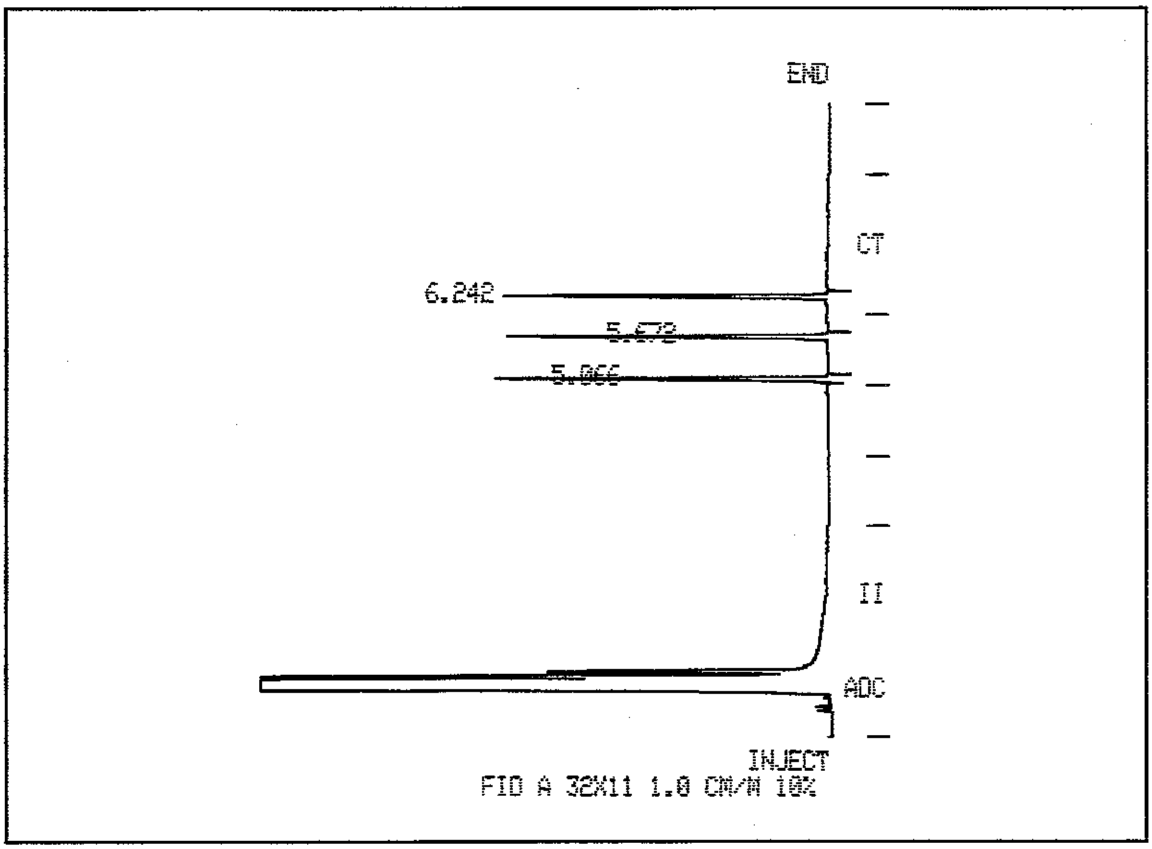


Figure 15b 530 Micron (FID)

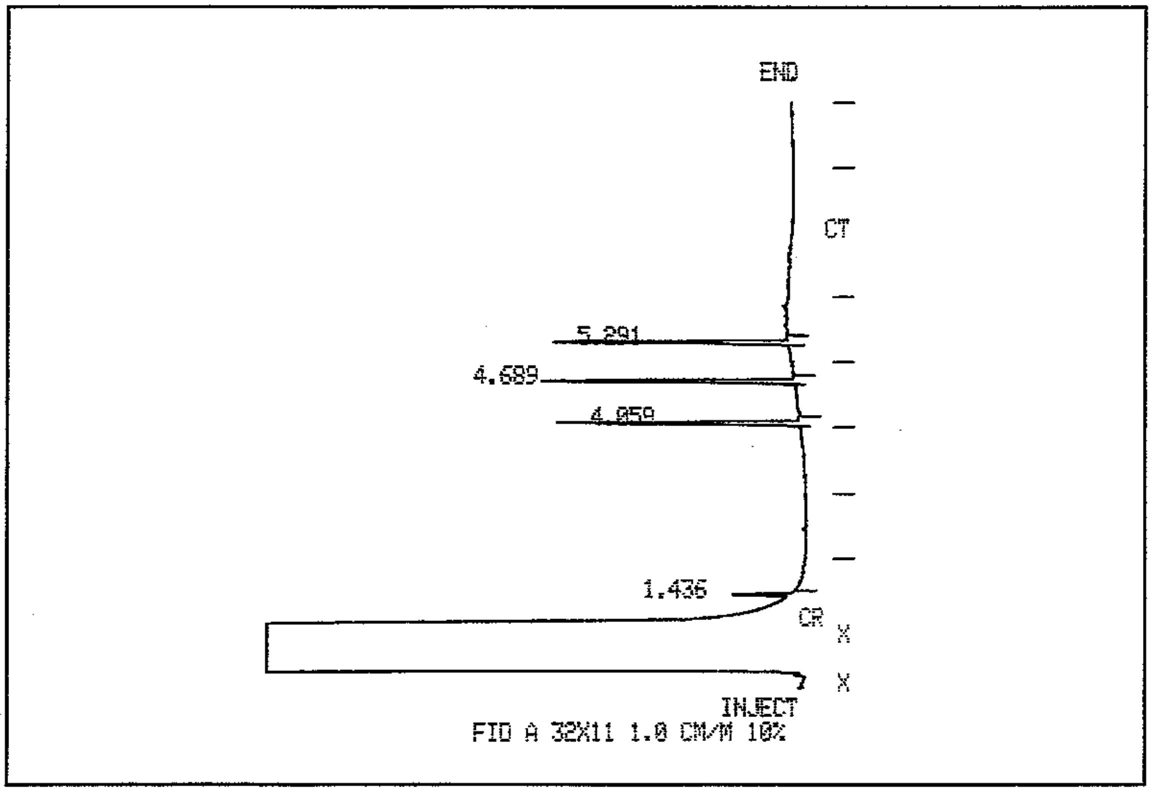


Figure 15c 1075/1077 (FID)

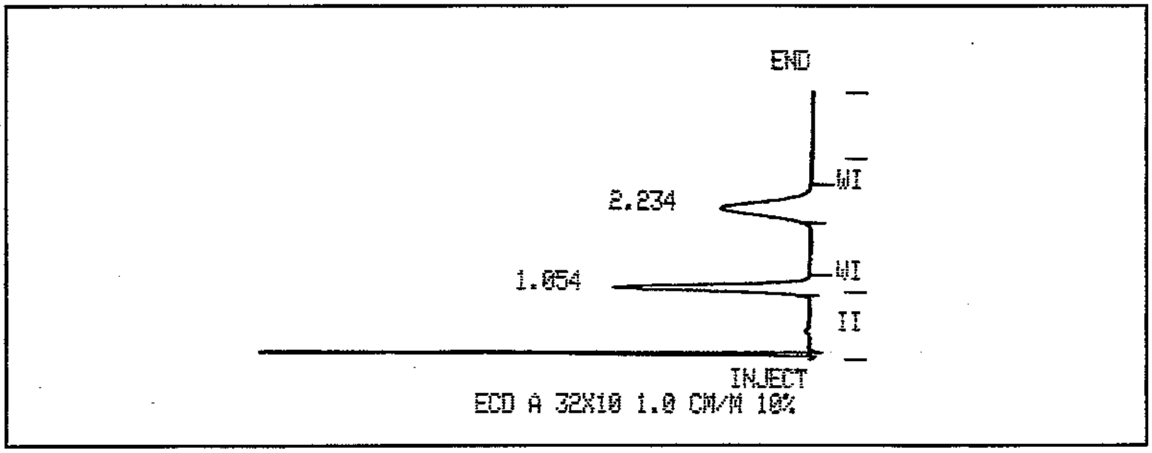


Figure 16a Packed Column (ECD)

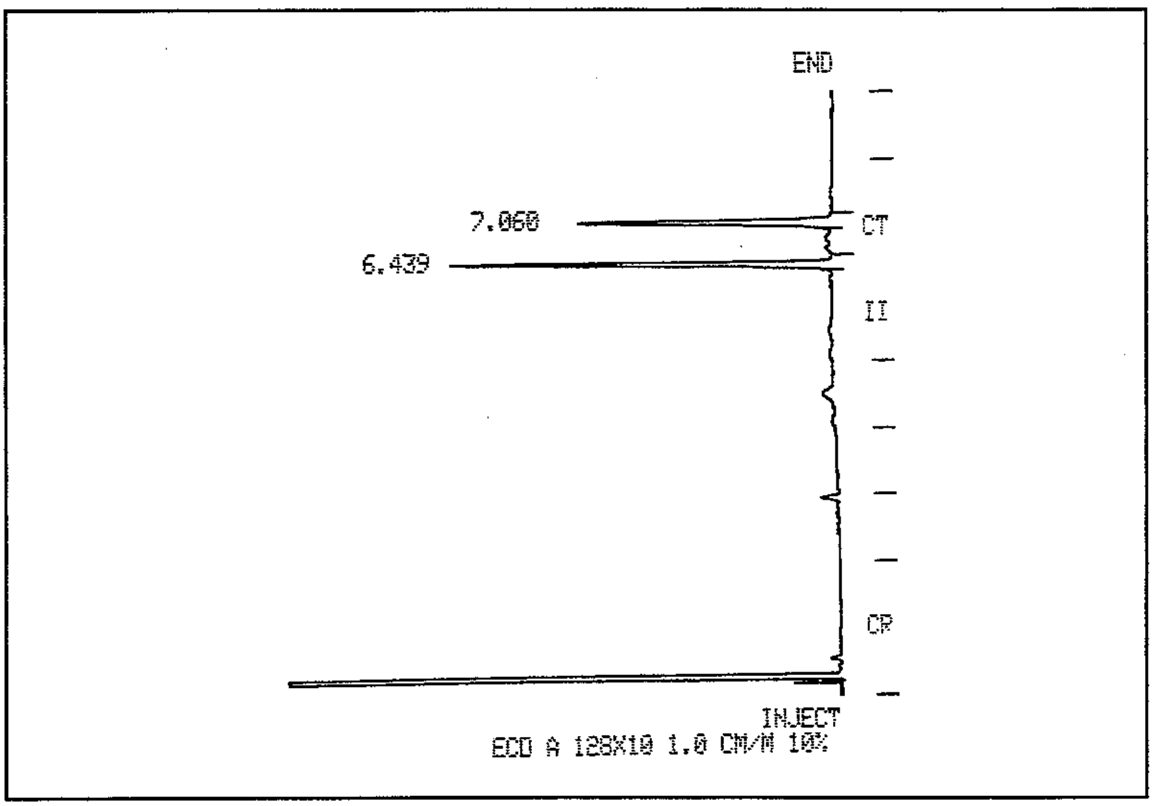


Figure 16b 530 Micron (ECD)

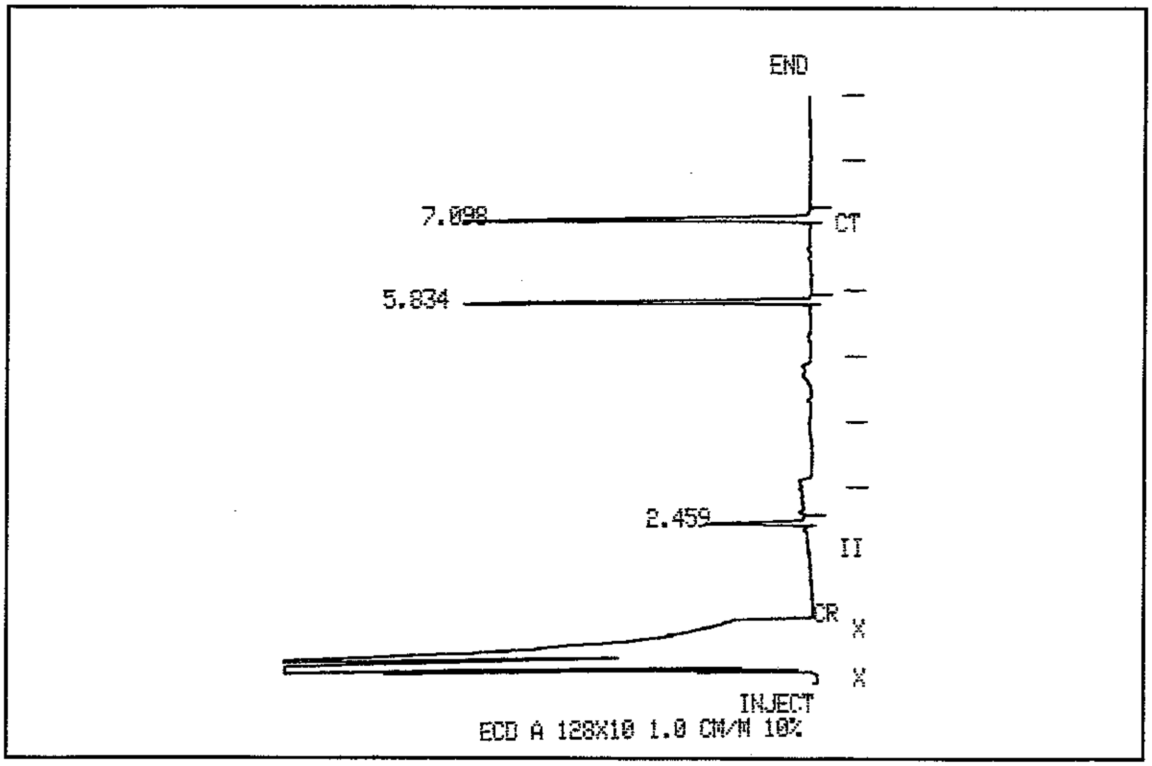


Figure 16c 1075/1077 (ECD)

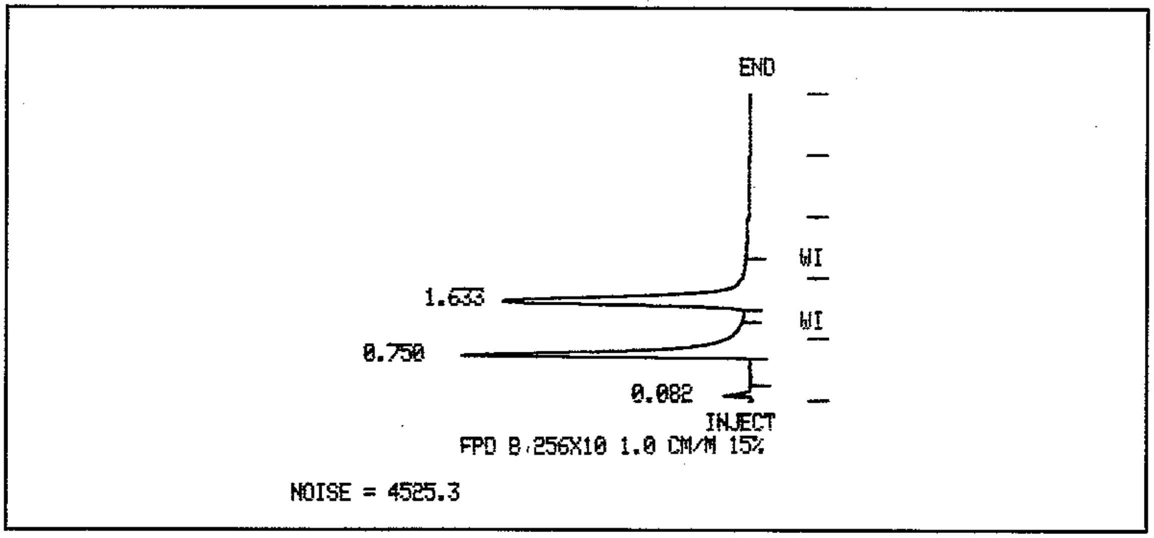


Figure 17a Packed Column (FPD Phosphorus)

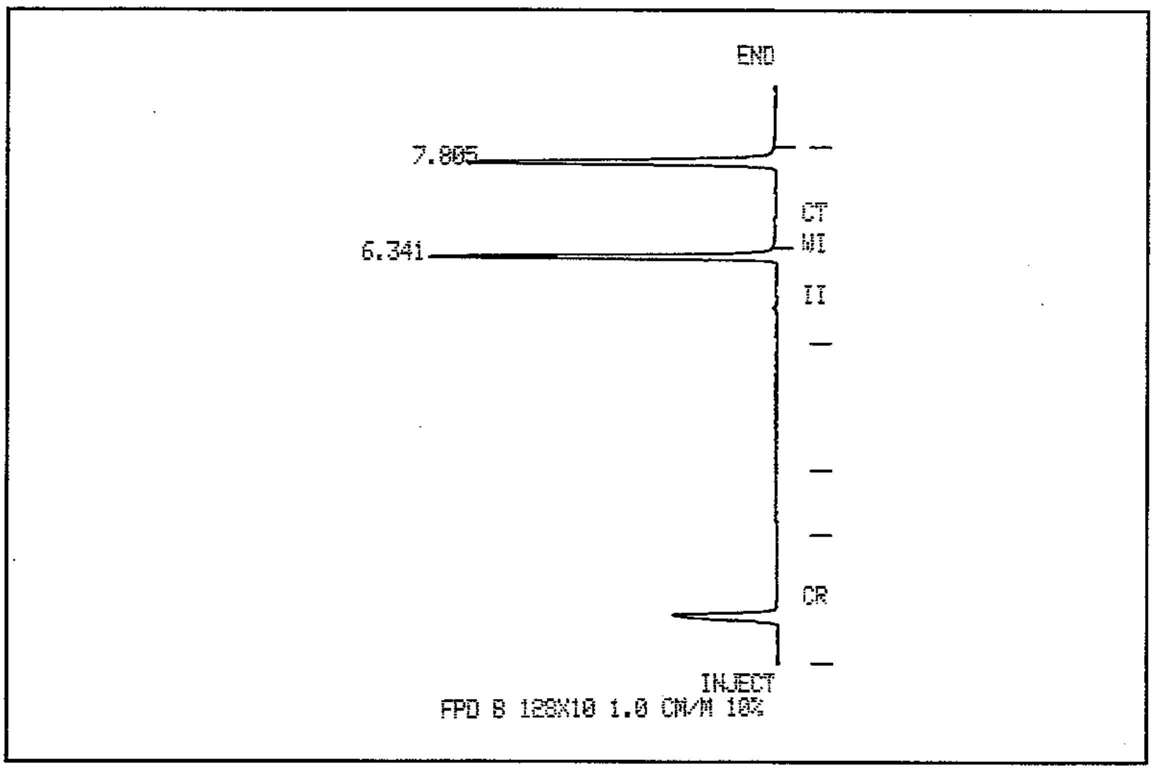


Figure 17b 530 Micron (FPD Phosphorus)

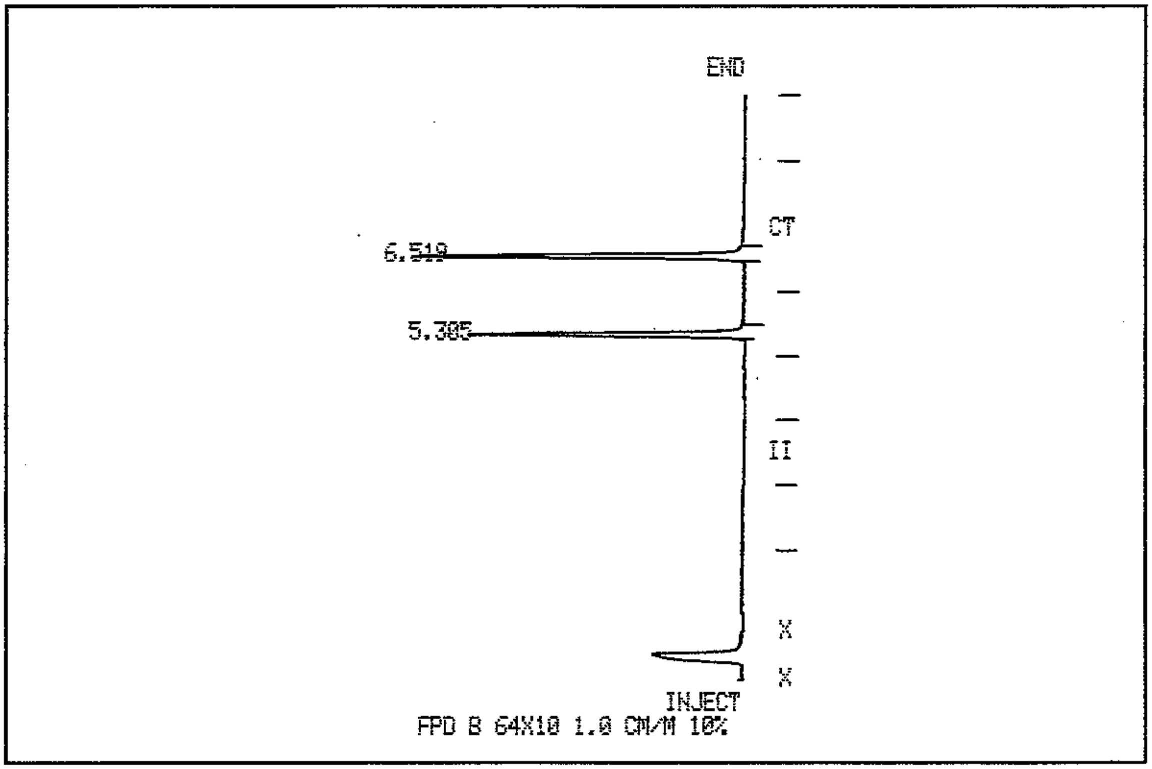


Figure 17c 1075/1077 (FPD Phosphorus)

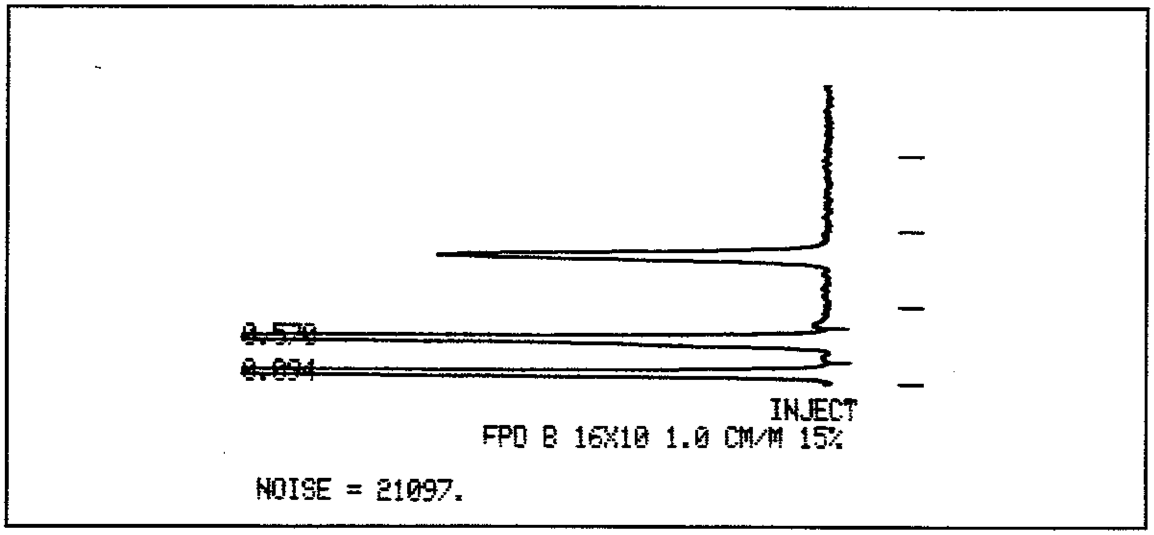


Figure 17d Packed Column (FPD Sulfur)

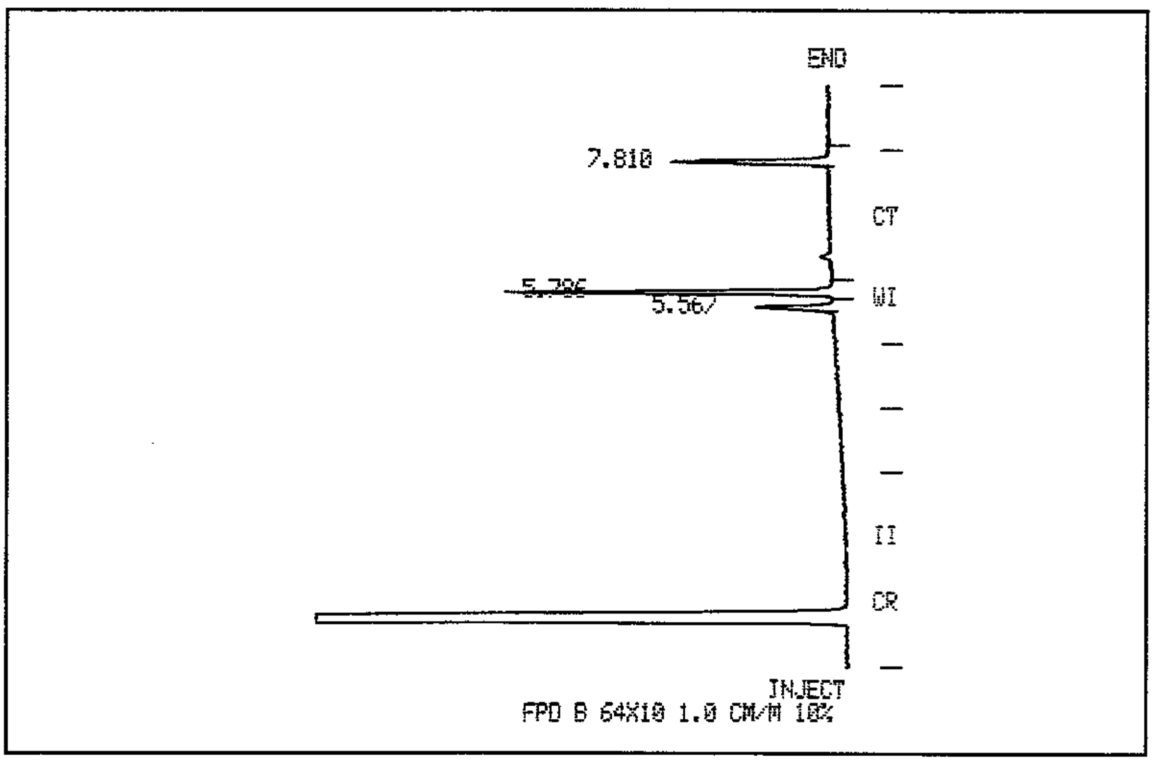


Figure 17e 530 Micron (FPD Sulfur)

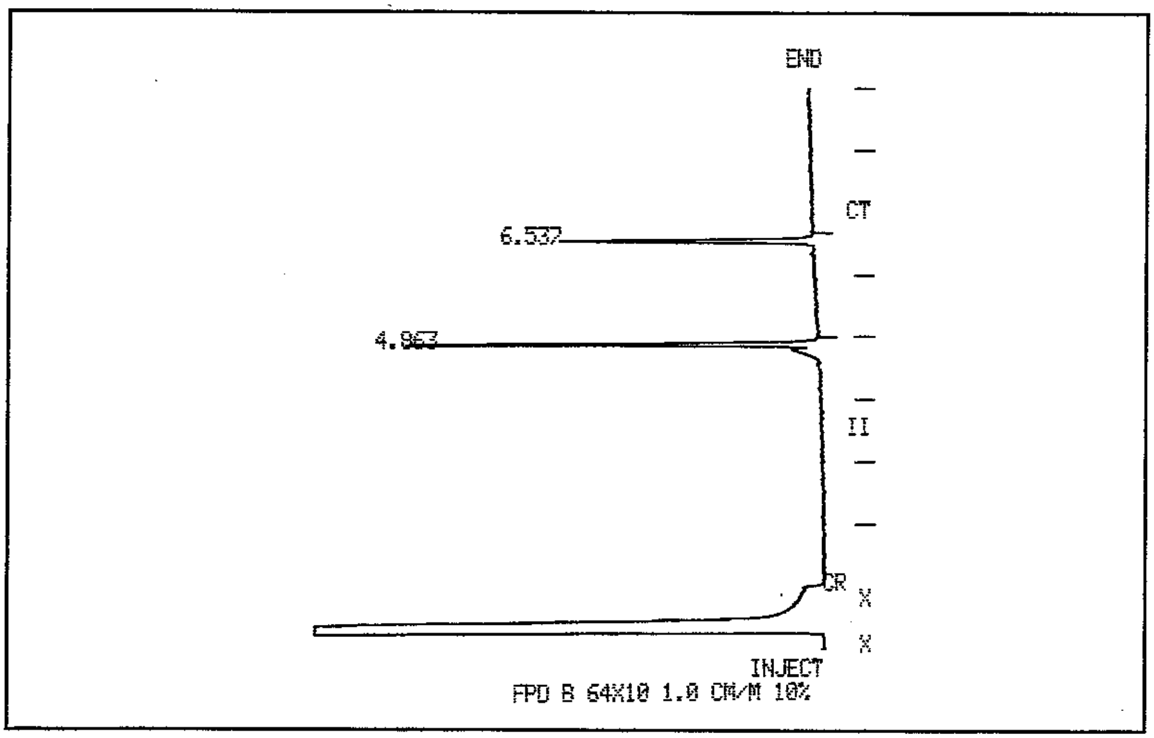


Figure 17f 1075/1077 (FPD Sulfur)

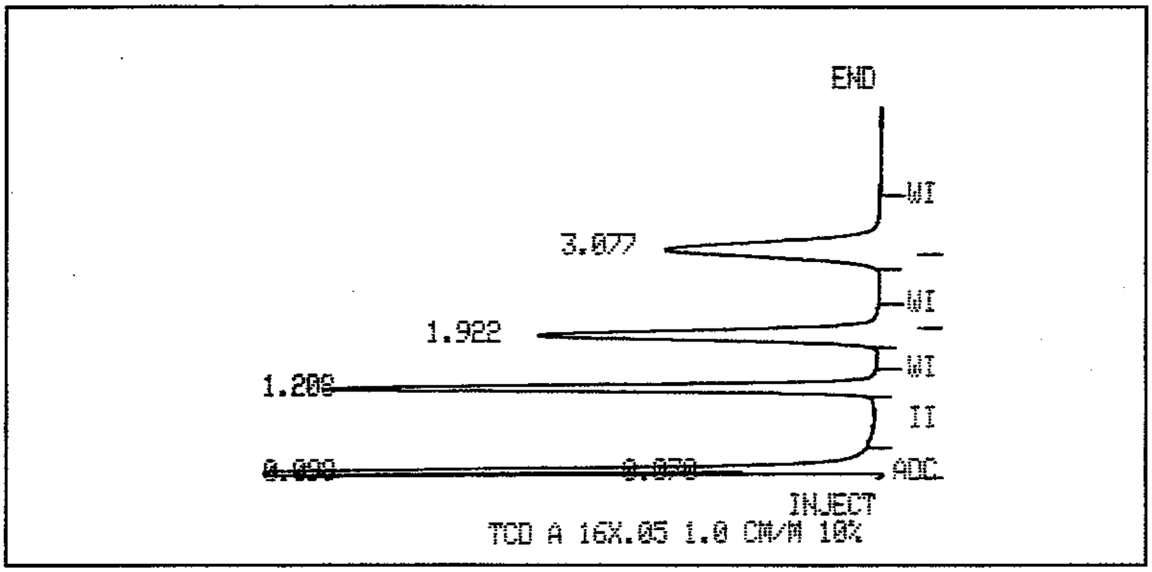


Figure 18a Packed Column (TCD)

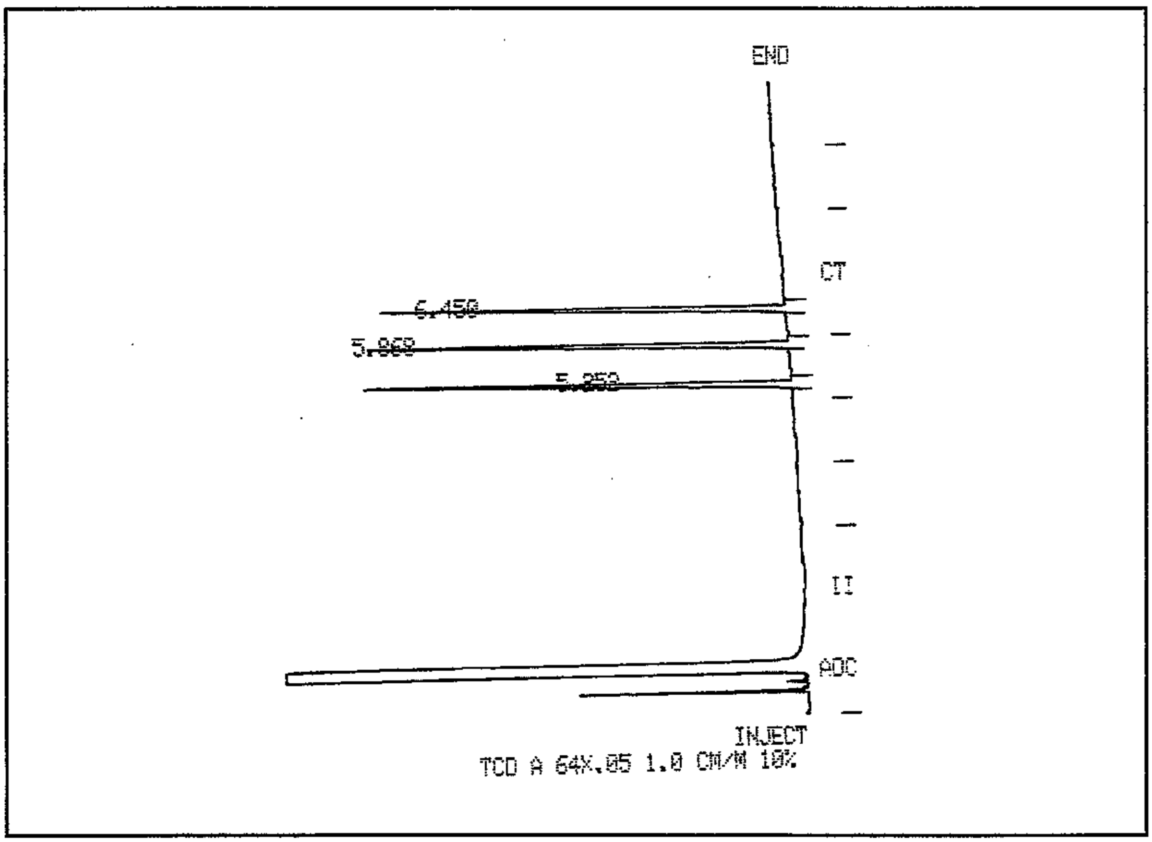


Figure 18b 530 Micron (TCD)

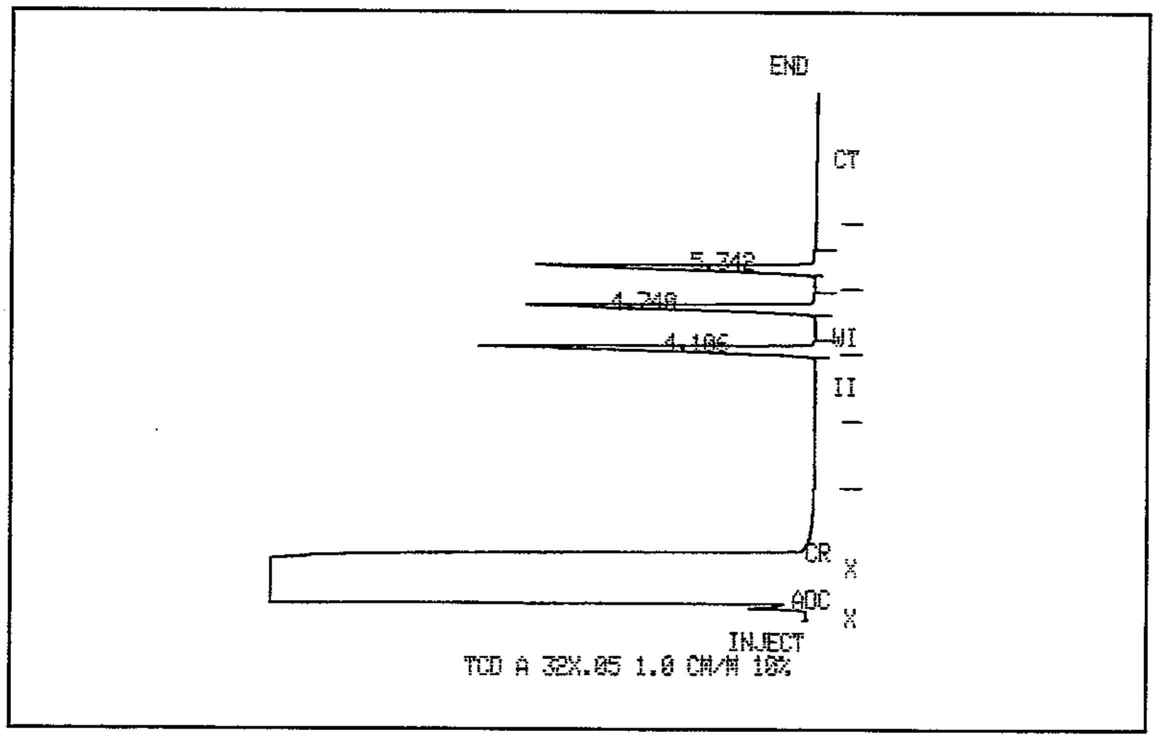


Figure 18c 1075/1077 (TCD)

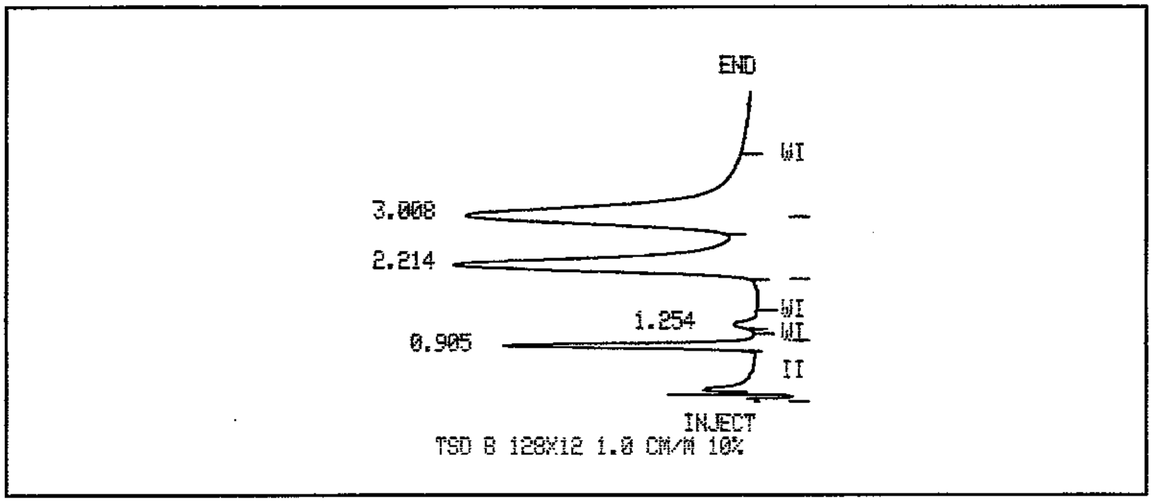


Figure 19a Packed Column (TSD)

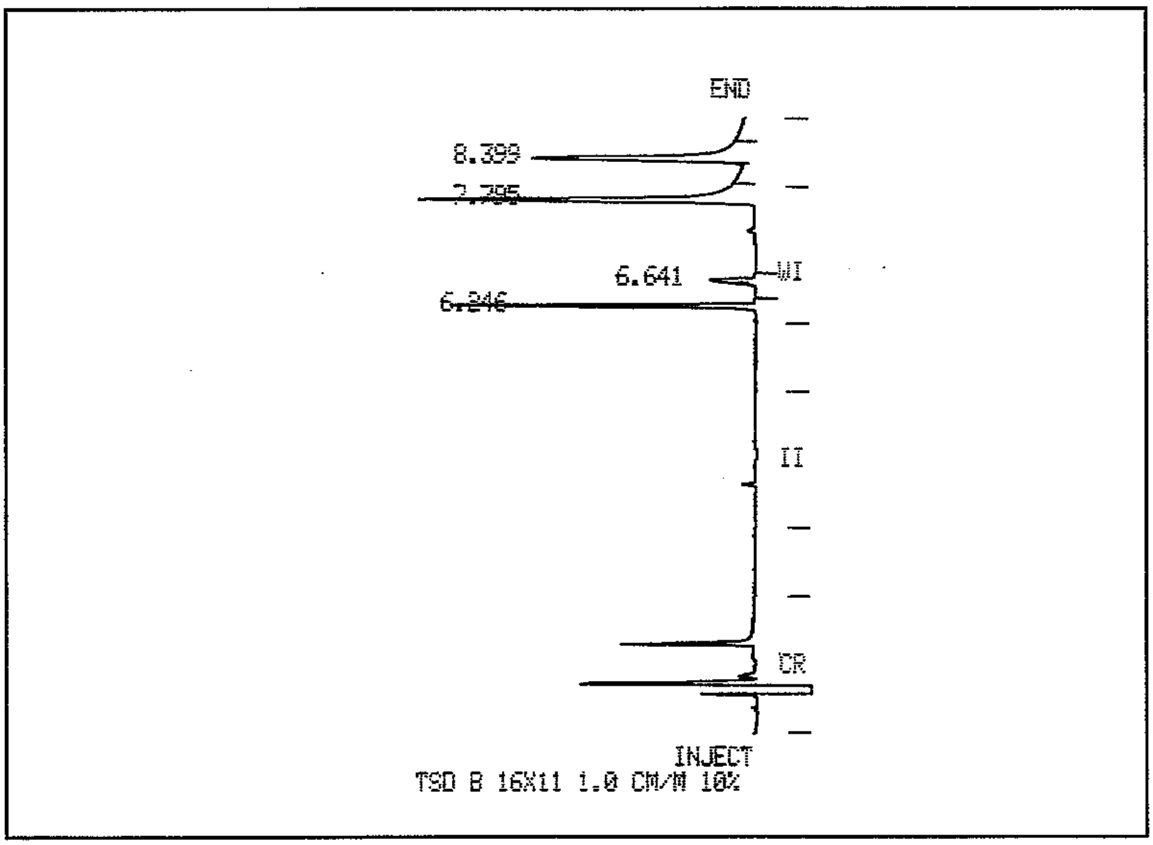


Figure 19b 530 Micron (TSD)

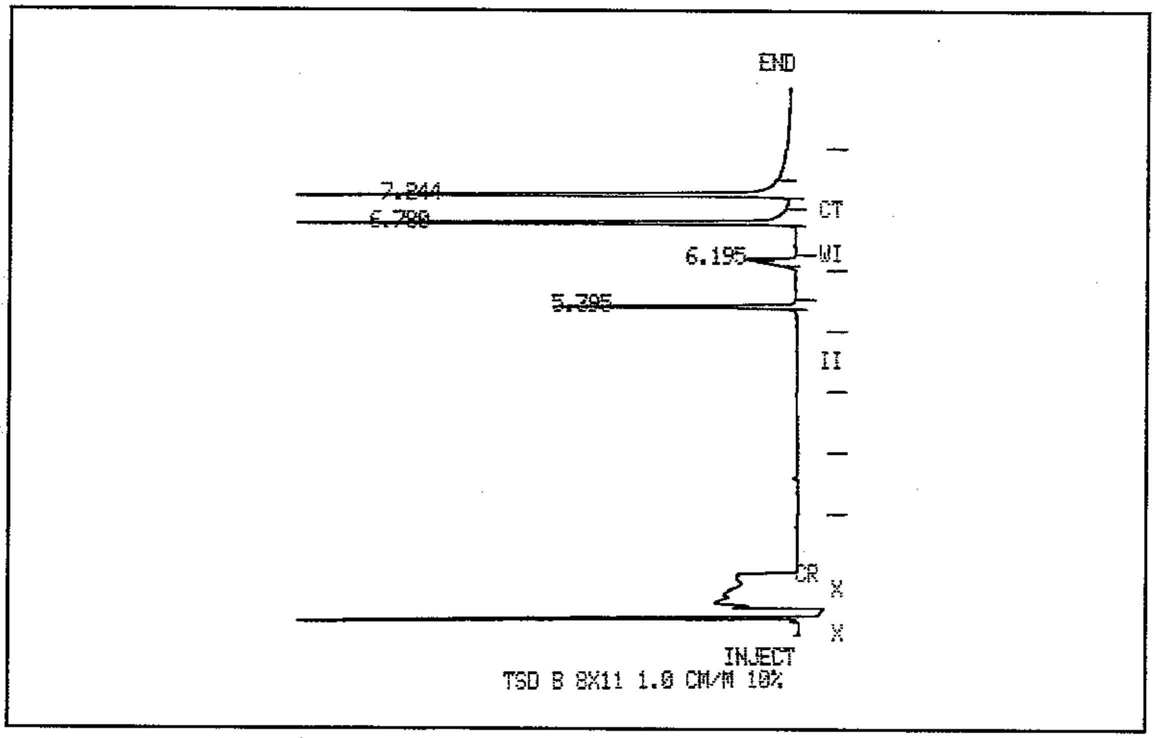


Figure 19c 1075/1077 (TSD)

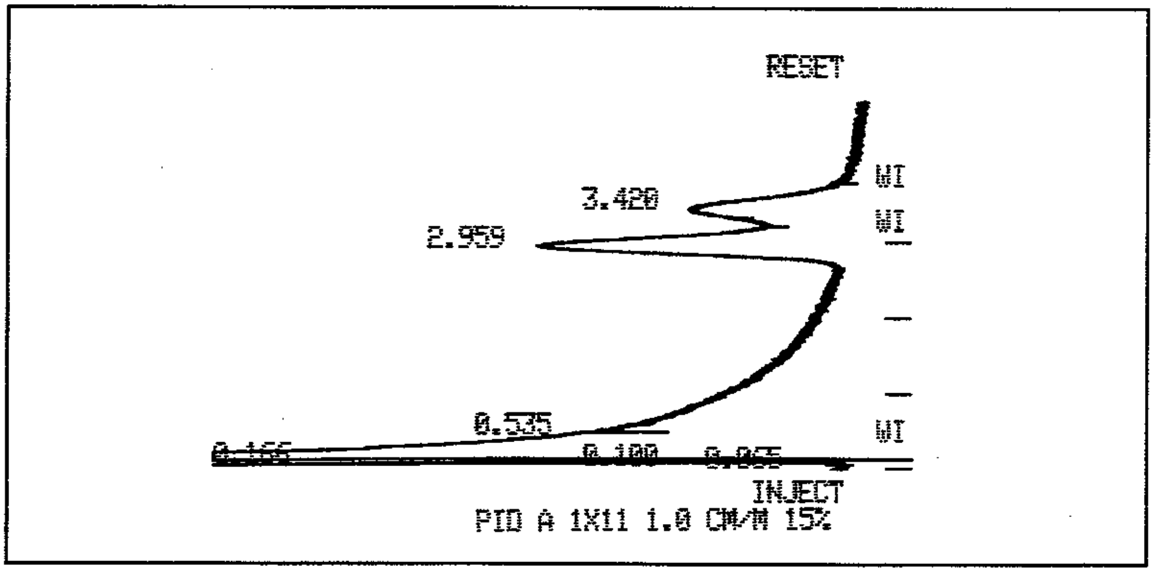


Figure 20a Packed Column (PID)

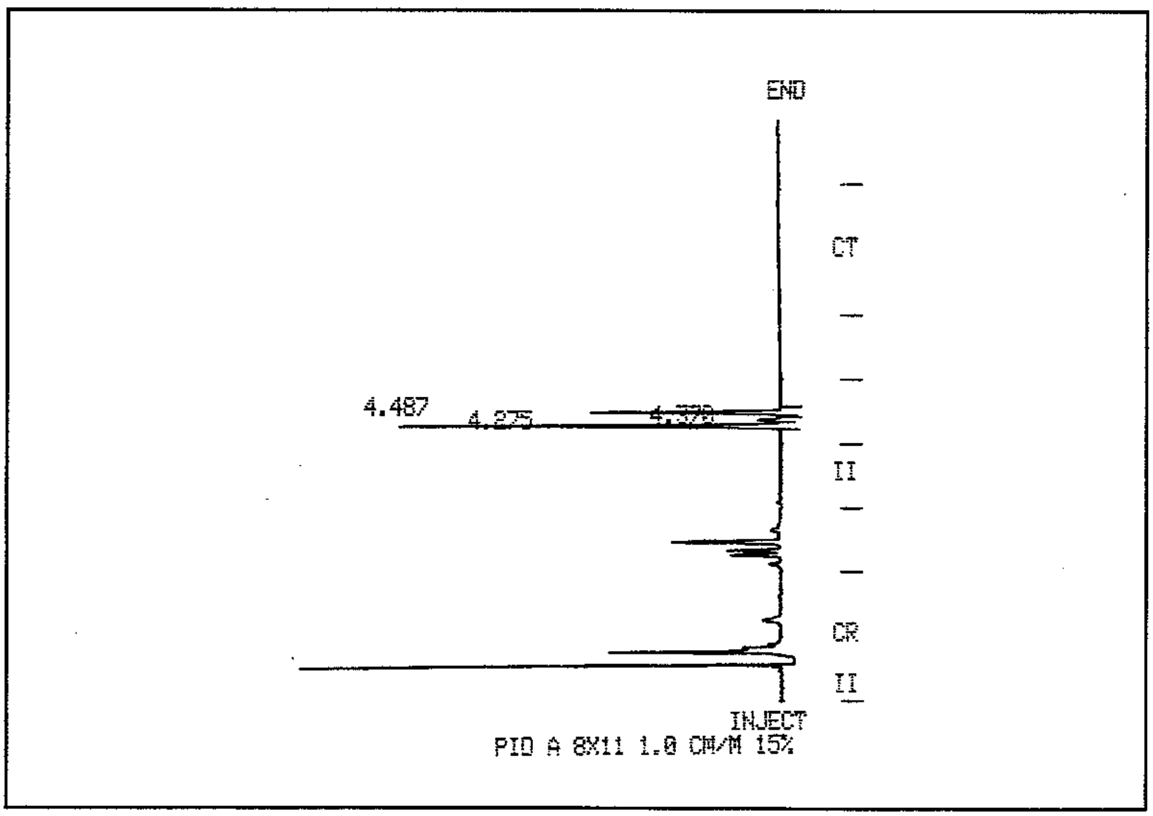


Figure 20b 530 Micron (PID)

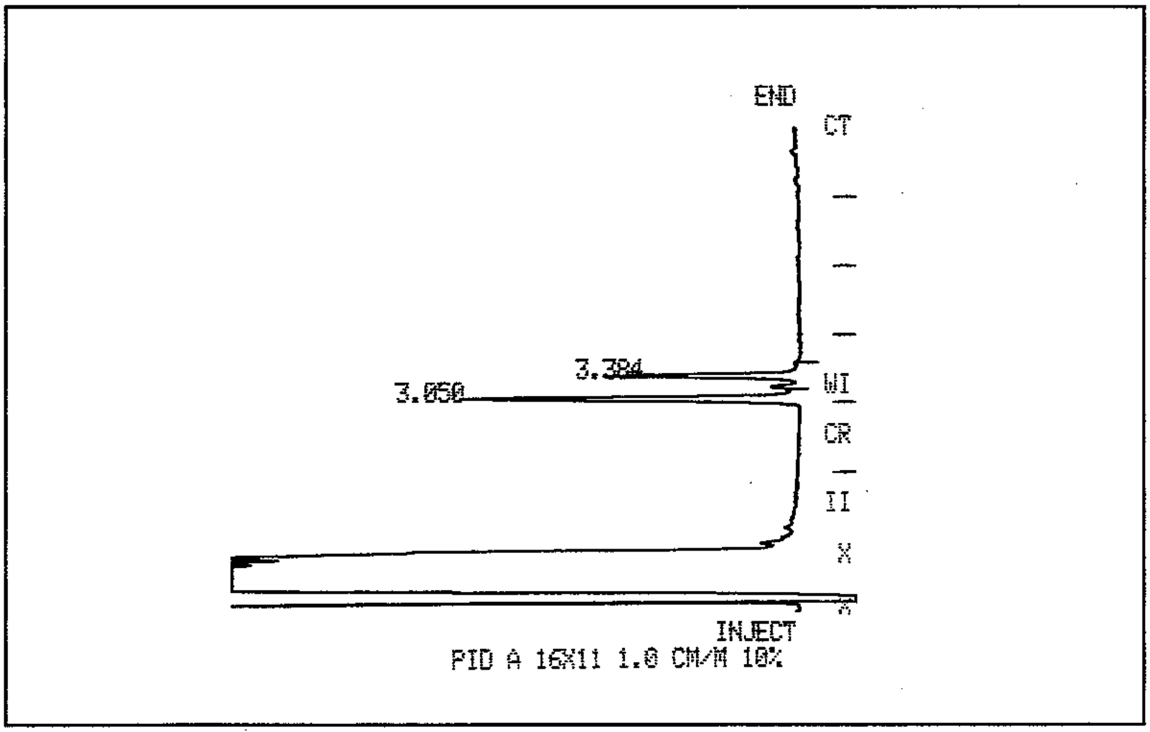


Figure 20c 1075/1077 (PID)

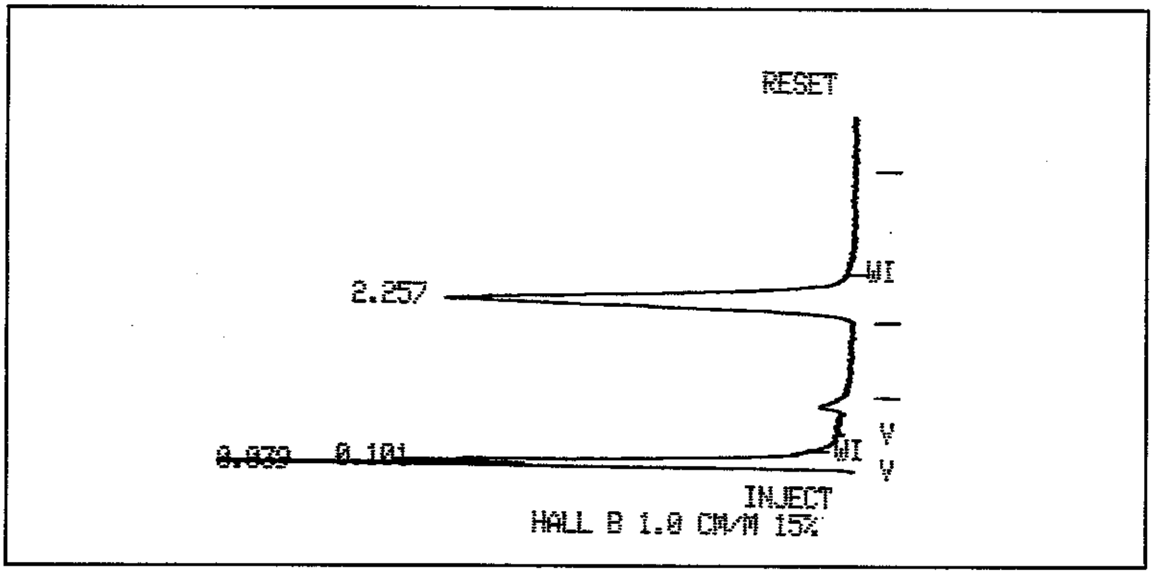


Figure 21a Packed Column (ELCD)

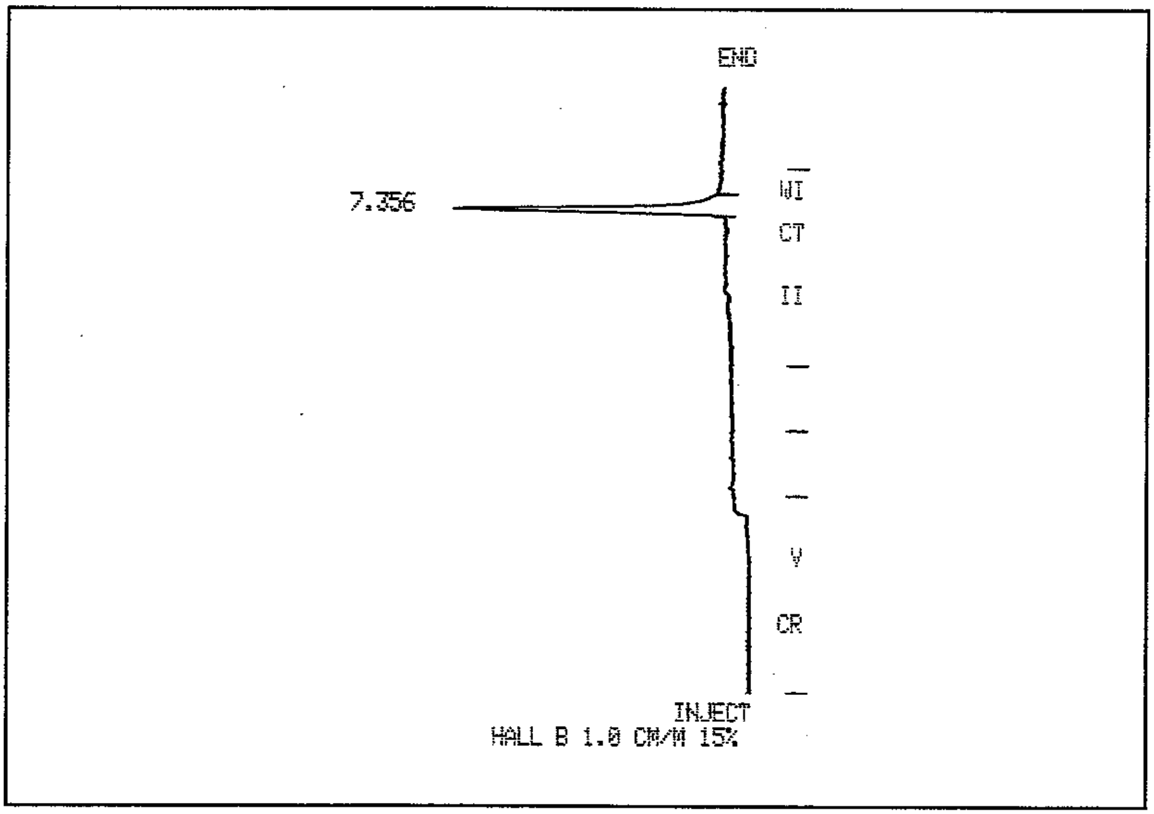


Figure 21b 530 Micron (ELCD)

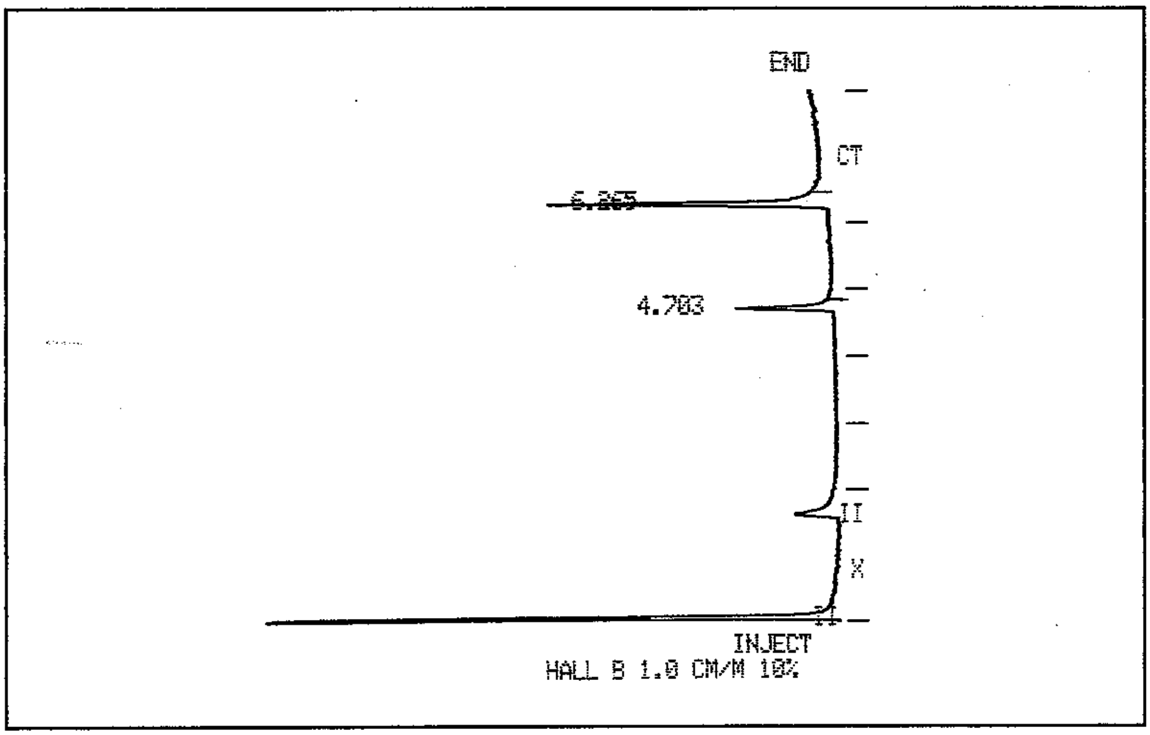


Figure 21c 1075/1077 (ELCD)

Operation

1 GC Keypad

The 3300 Gas Chromatograph (GC) and the Star 3400 CX GC are controlled through the keypad and single-line display on the front panel of the GC. The basic functions of each key are described in Figure 1 through Figure 9. In general, the keypad consists of six sections:

- GC CONTROL keys control basic operations of the GC such as starting or resetting a run, adjusting the detector attenuation, igniting a detector flame, or turning the column oven on or off.
- OPERATIONS keys concern the GC method itself and control such operations as building, deleting, or copying GC methods.
- AUTOMATION CONTROL keys control the automation sequence such as specifying rack table or sequence table automation sequences (Star 3400 CX GC only).
- METHOD keys access the sections that compose a GC method, such as the COLUMN or INJECTOR sections.
- DISPLAY CONTROL keys control the display itself. The Left/Right and Up/Down arrows move you through the various displays and sections and subsections of a GC method.
- ENTRY keys are used to enter the alphanumeric characters and commands that are part of building a GC method and controlling the GC.

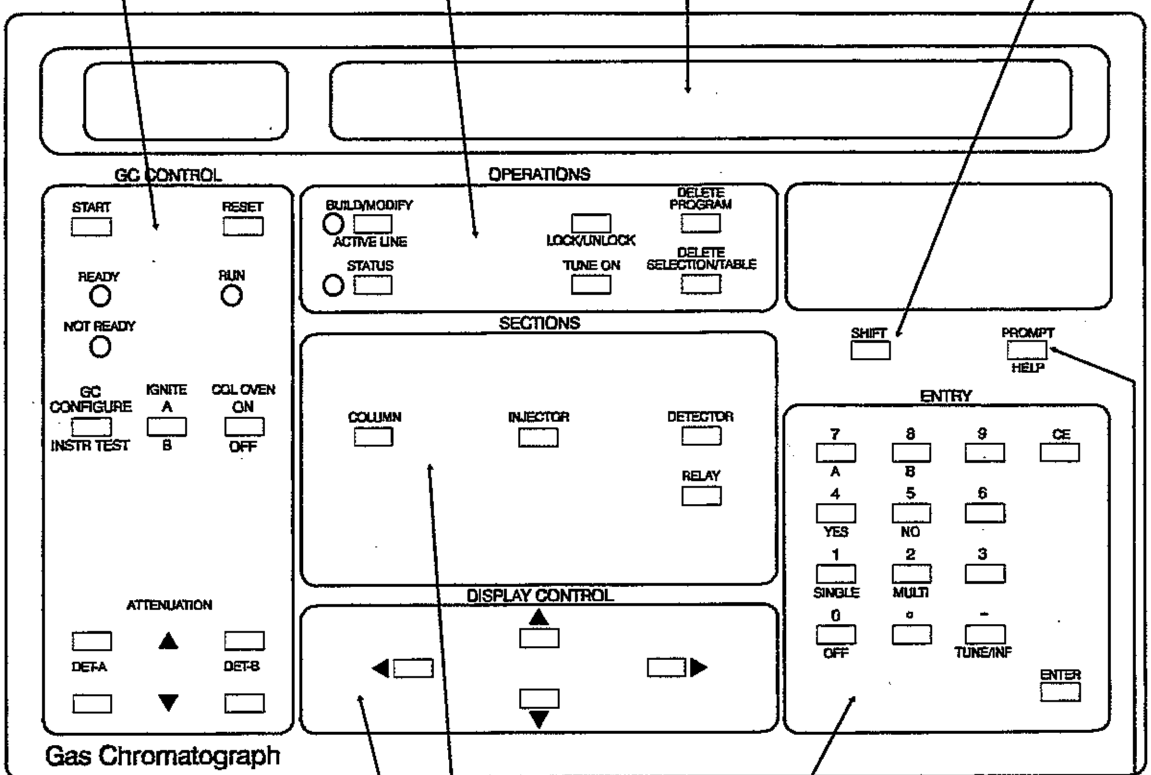
GC CONTROL Section These keys provide a variety of GC control functions.

The lights in this section show the state of the GC and whether it is under remote control by an external data system.

DISPLAY The display presents information and is always active.

OPERATIONS Section Use these keys to initiate GC functions. The lights indicate the mode, **BUILD/MODIFY** or **STATUS.**

SHIFT Use **SHIFT** to access the second (orange) function of dual function keys.



DISPLAY CONTROL Section Use the **DISPLAY CONTROL** keys for quick movement through methods and tables. (Refer to Figure 6 for use of these keys.

SECTIONS Section Use the **SECTION CONTROL** keys to select the method section wanted.

PROMPT and **HELP** Press and *hold* **PROMPT** to display legal ranges for values that may be entered for the current display.

HELP Press **SHIFT** then *hold* **HELP** to display a number reference in the **HELP** section of this manual where additional information about the current display is located.

ENTRY Section **ENTER** must be pressed to complete an entry. **ENTER** also advances the display.

When keys have more than one label, the entry expected by the GC is accepted.

Figure 1 3300 GC Keypad

GC CONTROL Section These keys provide a variety of GC control functions.

The lights in this section show the state of the GC and whether it is under remote control by an external data system.

ENTRY Section **ENTER** must be pressed to complete an entry. **ENTER** also advances the display.

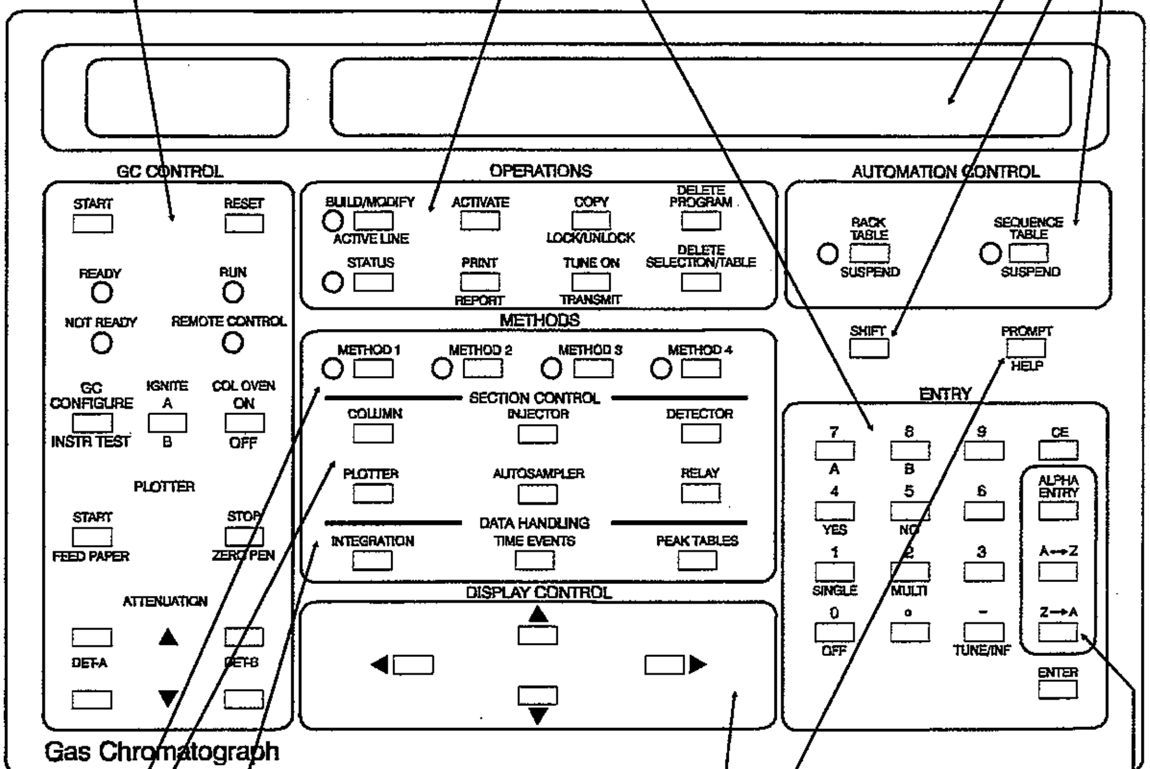
When keys have more than one label, the entry expected by the GC is accepted.

AUTOMATION CONTROL Section Use these keys to select one of the two automation tables. The lights indicate if a table is active or inactive or if a table entry is being displayed.

SHIFT Use **SHIFT** to access the second (orange) function of dual function keys.

OPERATIONS Section Use these keys to initiate GC functions. The lights indicate the mode, **BUILD/MODIFY** or **STATUS**.

DISPLAY The display presents information and is always active.



DATA HANDLING Section Use the **DATA HANDLING** keys (see Figure 5) to select the specific data handling section to build. (Used with IBDH option)

PROMPT and **HELP** Press and *hold* **PROMPT** to display legal ranges for values that may be entered for the current display.

HELP Press **SHIFT** then *hold* **HELP** to display a number reference in the **HELP** section of this manual where additional information about the current display is located.

DISPLAY CONTROL Section Use the **DISPLAY CONTROL** keys for quick movement through methods and tables. (Refer to Figure 6 for use of these keys.

METHODS and **SECTION CONTROL Section** Use the **METHOD** keys to select the method wanted. Inactive as well as active methods can be examined and modified. The light by the currently displayed method is ON.

Use the **SECTION CONTROL** keys to select the method section wanted.

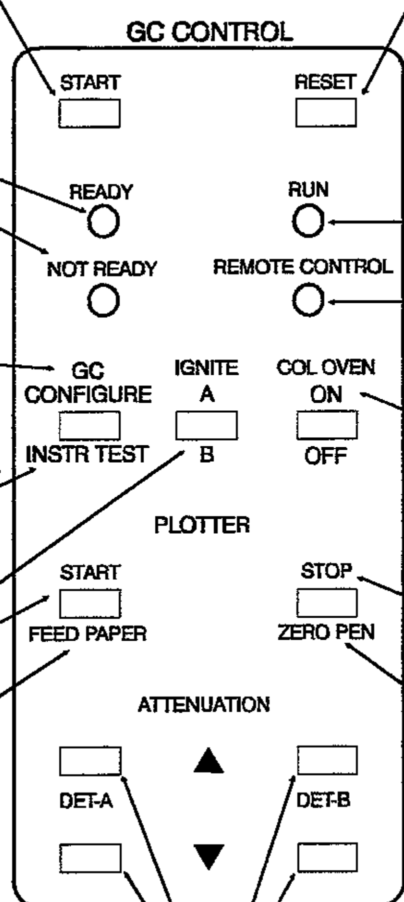
ALPHA ENTRY Section **ALPHA ENTRY** keys are used only when the inboard data handling (IBDH) option is present. Refer to Figure 9 for additional information.

Figure 2 Star 3400 CX GC Keypad

START*
Press to immediately start GC run. Starts automation and AutoSampler when GC is **READY.**

READY and **NOT READY Light**
Light is ON if GC is **READY** or **NOT READY** for injection. See para. 6 for run states.

RESET*
Press to end run, stop AutoSampler and automation operation, and restore initial conditions of active method.



RUN LIGHT
ON only when GC in **RUN**.

GC CONFIGURE*
Automatically puts GC in **BUILD** mode. Press to access a table of GC control parameters *that are not part of the methods.*

REMOTE CONTROL Light
Star 3400 CX GC ONLY
ON whenever GC under serial control of remote computer.

(SHIFT) INSTR TEST
Press to access GC test functions. If the GC is in **RUN** or if an automation table is active, GC test mode cannot be accessed. See *Diagnostics/ Troubleshooting* section for detailed use.

COL OVEN ON and **(SHIFT) COL OVEN OFF**
Use to turn column oven heater and fan **ON** or **OFF**. If cryogenics installed, enables or disables coolant.

IGNITE A and **(SHIFT) IGNITE B**
Press and *hold* to power detector A or B ignitor coil for FID and FPD. Ignitor times out after 10 seconds.

(PLOTTER) STOP
Star 3400 CX GC ONLY
Press to Stop printing or plotting.

(PLOTTER) START*
Star 3400 CX GC ONLY
Press to Start plotter.

(SHIFT) ZERO PLAN*
Star 3400 CX GC ONLY
Press to shift plot from current location to zero offset value on plotter.

(SHIFT) FEED PAPER
Star 3400 CX GC ONLY
Press and hold to feed plotter paper. When loading paper, paper runs for 2 minutes after pressing **FEED PAPER**.

ATTENUATION KEYS*
Each keystroke raises or lowers plotter and recorder attenuation by a factor of two for A or B detectors.

Press **SHIFT** to access the second (orange labeled) function of double function keys.

Figure 3 GC Control Keys

BUILD/MODIFY Key and Light Adjacent light comes ON when key is pressed. Entries can be made into all methods. GC Configure table, and automation tables when light is on.

(SHIFT) ACTIVE LINE* Press to display the method program presently in progress. The **BUILD** light comes ON. Allows quick real time updates to active method.

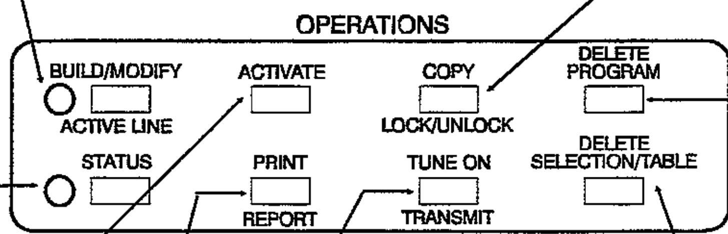
DELETE PROGRAM
Use to delete temperature, time, or automation PRGMs.

COPY ***Star 3400 CX GC ONLY***
Use to copy one method to another. Copy action prohibited if method locked. A copy can be made *from* a running method.

(SHIFT) LOCK/UNLOCK* Use to lock or unlock individual methods or tables via numerical code entry. The code is user-set in GC Configure table.

STATUS Key and Light
Press **STATUS** to monitor the current GC parameters. The Status light and method light for the active method or automation table comes ON. No entries are allowed.

Press **ENTER** to advance through **STATUS** displays. Press specific **SECTION CONTROL** or **AUTOMATION CONTROL** keys for more Status displays. Light blinks if GC error.



ACTIVATE ***Star 3400 CX GCs ONLY***
Activate a method (METHOD 1, 2, 3, or 4) or automation table (RACK or SEQUENCE) to check for completeness.

DELETE SECTION/TABLE*
Use to (1) delete optional method sections or automation tables, or (2) restore required method sections to presets with single keystroke.

Deletes all PRGMs built with the selected method section or table.

PRINT ***Star 3400 CX GC ONLY***
Initiates printing of methods, sections of methods, or tables. See also the *Printer/Plotter* section.

(SHIFT) REPORT* ***Star 3400 CX GC ONLY***
Press to print report and run log for current or most recent run.

The report function is augmented when used with in-board data handling (IBDH). Refer to *IBDH Operation in the Options/Accessories Manual for detailed operation information.*

TUNE ON Tune mode allows user to immediately execute any time-programmable programs and simultaneously enter execution time into method during run.

(SHIFT) TRANSMIT Functional only when the Serial Communications option is used with inboard data handling (IBDH). Press to have the result report transmitted to an external computer, or to abort transmission if transmitting.

Refer to *IBDH Operation in the Options/Accessories Manual for detailed operation information.*

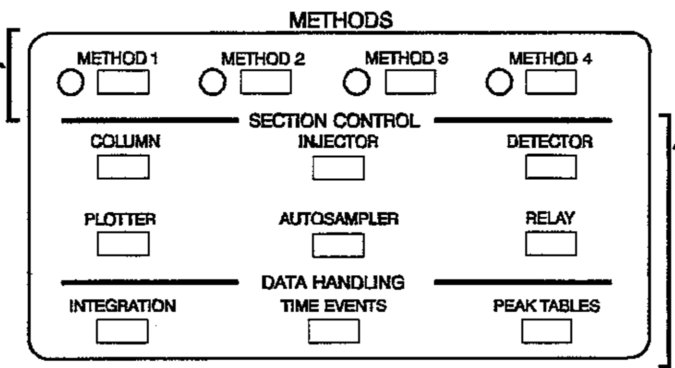
Press **SHIFT** to access the second (orange labeled) function of double function keys.

Figure 4 Operations Keys

METHODS 1, 2, 3, and 4 Keys and Lights
Star 3400 CX GC ONLY
Press to select the method to control the GC, as specified by an **OPERATIONS** key. Light is ON whenever method is being monitored or built.

SECTION CONTROL
If **BUILD/MODIFY** light is ON, all 4 methods can be examined and modified. If **STATUS** light is ON, each **SECTION** displays only the current setpoint and actual information for the active method. (The light by the active method is ON.)

The 3300 GC method is always active.



REQUIRED METHOD SECTIONS

COLUMN
Use to select:
- Column oven temperature
- 4 temperature program ramps
- Optional pressure setpoint.

INJECTOR
The *Star 3400 CX GC* has only a single injector position. Use to select:
- Injector temperature
- 2 temperature program ramps
- Temperature control and programming of auxiliary zone

DETECTOR
Use to select Detector A or Detector B control of:
- Detector temperature
- Recorder and plotter attenuation
- Range
- Autozero
- Data System channel select (A or B)
- Entries specific to each detector
- Up to 5 time programs per detector to control functions during the run

*OPTIONAL METHOD SECTIONS

PLOTTER ***Star 3400 CX GC ONLY***
Use to select/control:
- Plot speed
- Zero offset
- Plot signal A or B
- Enable time ticks
- Plot annotations
- Printing Run Log at run end
- Up to 5 time programs for changing plot speed and signal A or B during run
- Printing of the IBDH result report

AUTOSAMPLER
Star 3400 CX GC ONLY
Use to select/control:
- 8200 CX AutoSampler
- Sampling mode: OFF, SINGLE, MULTI
- Number of injections per vial
- Sample volume
- Number of purge pulses
- Injection time
- Timed sampling start

RELAY*
Use to select/control:
- Time-programmed relays during run
- AC power switches to operate sampling valves or capillary splitter vent
- Low level contact closure
- Up to 20 time programs

*OPTIONAL DATA HANDLING SECTIONS

INTEGRATION**
Star 3400 CX GC ONLY
A required section for the inboard data handling (IBDH) function to be active. Use to:
- Set post run calculations
- Enable blank baseline subtraction
- Set the report format
- Enables report transmission at run end.

TIME EVENTS**
Star 3400 CX GC ONLY
A required section for the inboard data handling (IBDH) function to be active. Use to:
- Control peak integration

PEAK TABLE**
Star 3400 CX GC ONLY
An optional inboard data handling (IBDH) section, required only when peak names and certain result calculations (IS, ES, N%) are required. Use to:
- Set peak identification factors

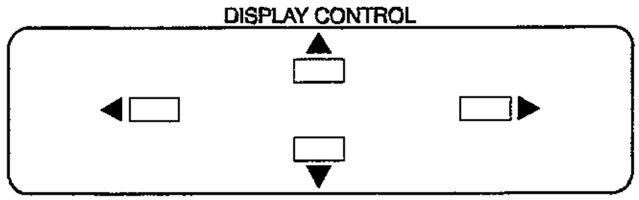
* Only 1 relay is available on the 3300 GC.
**Refer to *IBDH Operation in the Options/Accessories Manual for detailed operation information.*

Figure 5 Methods, Sections, and Entry Keys

DISPLAY CONTROL keys provide *quick access* in method sections and tables. In this manual, these keys are referred to as back (◀), forward (▶), PRGM back (▲), and PRGM forward (▼).

Press ▶ to advance to the *next* display in a section or table. Press ◀ to reverse to the previous display. Pressing ◀ at the beginning of a section loops to the end of that section. Use these keys to quickly loop forward or back through the displays in a given section or table. (Press the appropriate SECTION key to advance to another section.)

▲ and ▼ are used within PRGM lines *only.* ▲ and ▼ *loop* at the first and last display within a PRGM.



Pressing ▶ when this line is displayed moves *forward* to:
TEMP PROGRAM COLUMN? NO

INITIAL COL TEMP 50

INITIAL COL HOLD TIME

Pressing ▲ when this PRGM line is displayed loops back to:
PRGM 4 COL RATE IN °/MIN

TEMP PROGRAM COLUMN? NO (PRESS **YES ENTER** TO BUILD PRGMs)

PRGM 1 FINAL COL TEMP	PRGM 1 COL RATE IN °/MIN	PRGM 1 COL HOLD TIME
PRGM 2 FINAL COL TEMP	PRGM 2 COL RATE IN °/MIN	PRGM 2 COL HOLD TIME
PRGM 3 FINAL COL TEMP	PRGM 3 COL RATE IN °/MIN	PRGM 3 COL HOLD TIME
PRGM 4 FINAL COL TEMP	PRGM 4 COL RATE IN °/MIN	PRGM 4 COL HOLD TIME

Pressing ▼ when this line is displayed loops back to:
PRGM 1 FINAL COL TEMP

Pressing ▶ when this line is displayed loops back to:
INITIAL COL TEMP 50

***NOTE:** The **ADD** displays (i.e., ADD NEXT COLUMN PROGRAM? NO, etc.) are only seen when advancing forward through the displays and only when no following programs have been added.*

Figure 6 Display Control Keys

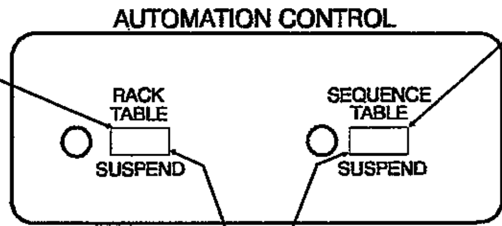
RACK TABLE ***Star 3400 CX GC ONLY***
Use for AutoSampler(A/S) automation. Entries are rack numbers and associated method numbers. Only one method can be assigned to a specific rack number; however, one method can be run on several racks. Set A/S mode to MULTI.

Light is ON whenever method is being monitored or built.

SEQUENCE TABLE* ***Star 3400 CX GC ONLY***
Use with an AutoSampler (A/S) or sampling valves.

This table lists methods in the order to be executed by automation. Specify number of times to run each method.

Light is ON whenever method is being monitored or built.



(SHIFT)
(RACK TABLE or SEQUENCE TABLE*)
SUSPEND

Press to suspend automation at end of current run.

Press **START** to resume automation.

Press **SHIFT** to access the second (orange labeled) function of double function keys.

Figure 7 Automation Control Keys

PROMPT
Press and *hold* to display entry ranges and other information for current display. Legal entry ranges, in particular, change with GC configuration and are adjusted as entries are made to display currently legal values. Preceding display returns upon release of HELP.

SHIFT
Press this key, then the desired orange labeled key to access the second (orange labeled) function of a key.

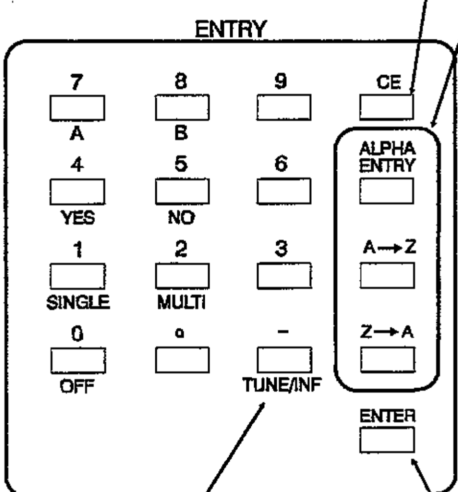
Shift function active for only the next keystroke.

(SHIFT) HELP
Press **SHIFT** then *hold* **HELP** to display a number reference to the HELP section of this manual explaining use of the parameter or more information about display contents.

Figure 8 Shift, Prompt, and Help Keys

ENTRY KEYS
When a number key also has a word/letter beneath it, the appropriate response is recognized by the GC. Displayed prompts inform the user of word or number choices.

None of the Entry keys are used with ***SHIFT***.



CE (Clear Entry)
Press to clear the parameter value from entry field.

ALPHA ENTRY Section ***(Star 3400 CX GC ONLY)***
Use the **ALPHA ENTRY** keys to create a name entry or use in combination with the numeric keys for input requiring alphanumeric entry.

To enter a name:

1. Press either the **A→Z** or **Z→A** key until the display scrolls to the desired letter.
2. Press the **ALPHA ENTRY** key to fix that letter in the display.
3. When a number is required as part of the name entry, press the desired number, then return to the appropriate **A→Z** or **Z→A** key to scroll to the next letter. Fix that letter in the display by pressing **ALPHA ENTRY**.

   DO NOT PRESS ***ENTER*** after a number entry within an alphanumeric entry or the display is considered complete and the GC advances to the next display.

   Continue in this manner until your word is spelled in the display.
4. Press **ENTER** to enter the complete word and advance to the next display.

TUNE/INF
Use **TUNE/INF** as the entry when building a method or table with parameters that can be "tuned" (detector, printer/plotter, relay, etc.) during a run.

ENTER
Use to accept entered values and move to next display. Tests are performed on entered values and, if an entry is illegal, the display informs the user.

If an entry is not completed by pressing **ENTER**, the previous entry is retained.

Pressing **ENTER** advances to the next display and, following the last display of a section, advances to the *next section*. Pressing **ENTER** for the *last display* of the last method section displays METHOD COMPLETE—END TIME XXXXX.

Figure 9 Data Entry Keys

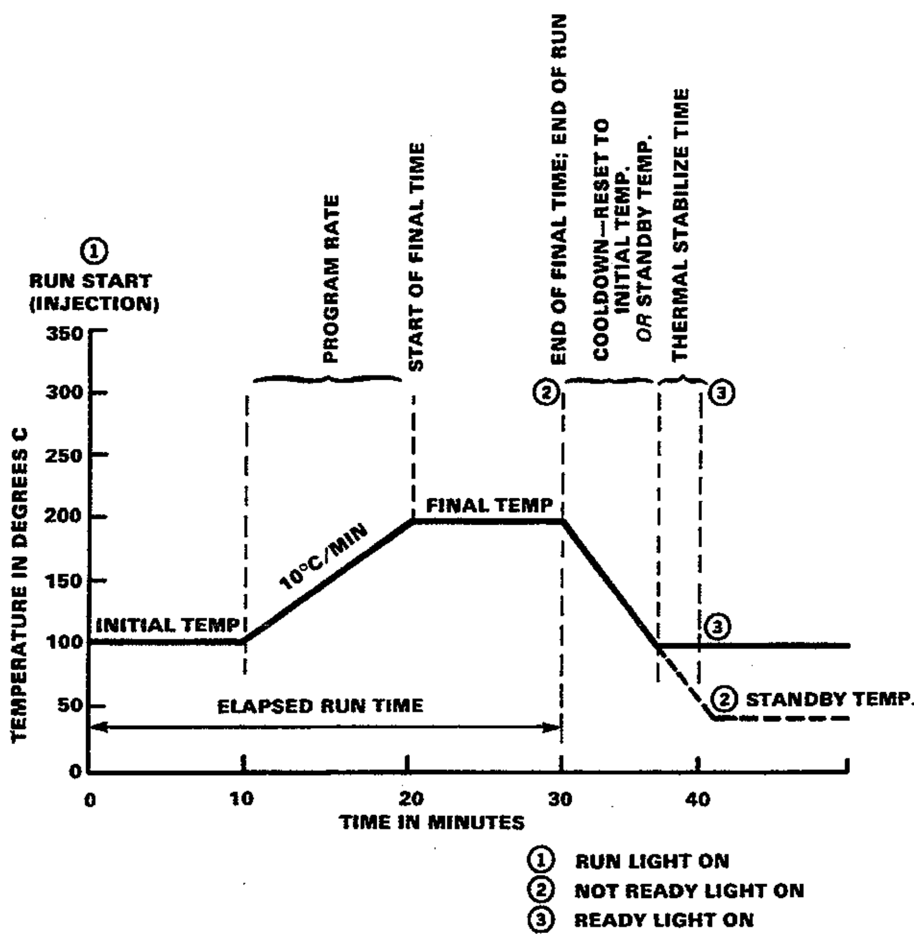
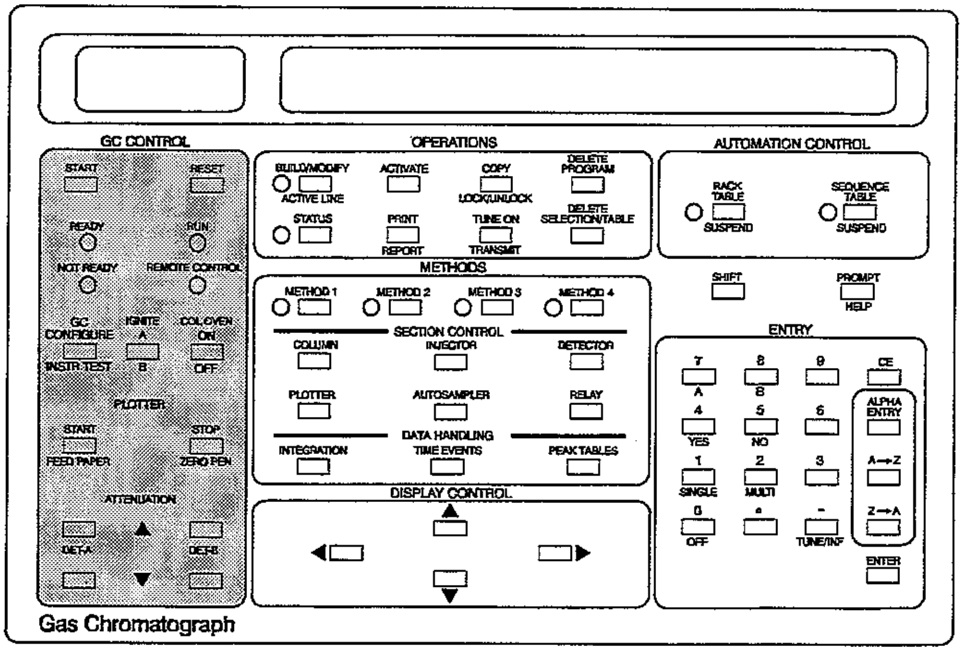


Figure 10 GC States for a Typical Temperature Programmed Chromatographic Run

The tables presented in this section contain four columns:

- KEY column directs you to those keys used to access certain information which appear in the single-line display on the GC front panel
- DISPLAY column lists the displays that guide you through building or modifying a GC method or checking the status of a GC method or automation sequence
- DEFAULT column lists the pre-set default value for a particular GC method parameter
- RANGE column lists the range of values that you can enter for a particular GC method parameter

GC CONTROL



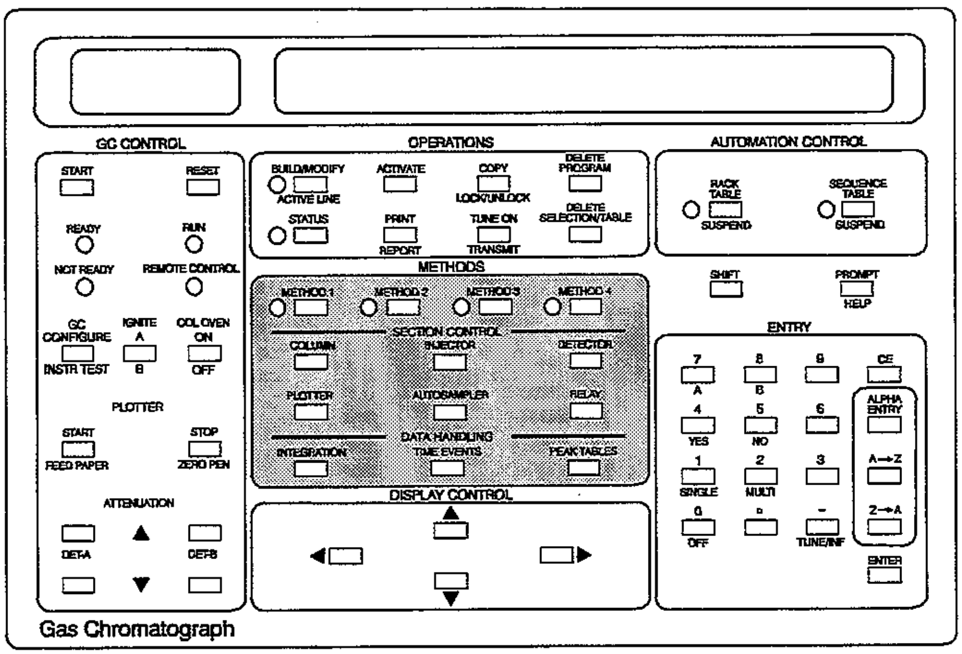
KEY	DISPLAY	DEFAULT	RANGE
GC CONFIGURE	SET TIMES OR DATE? (YES / NO)		
	THERMAL STABILIZE TIME	2.00	0.00 TO 650.00
	ENTER TIME OF DAY		24 HR CLOCK-4 DIGIT NUMBER
	ENTER DATE-DAY MONTH		4 DIGIT NUMBER-DAY FIRST
	ENTER DATE-YEAR		2 DIGIT NUMBER
	COOLANT TIME OUT IN MIN INF		0.00 TO 650.00 OR INF
	SET TEMP LIMITS? (YES / NO)		
	COLUMN TEMP LIMIT	250	50 TO 420
	INJECTOR TEMP LIMIT	250	50 TO 420
	AUXILIARY TEMP LIMIT	52	50 TO 420
	DETECTOR TEMP LIMIT	300	50 TO 420
	COLUMN STANDBY TEMP?	50	20 TO LIMIT
	ENABLE COLUMN STANDBY TEMP?	NO	YES ENABLES STANDBY TEMP CONTROL

KEY	DISPLAY	DEFAULT	RANGE
GC CONFIGURE	SET CHECKS FOR GC READY?		
	NO / YES		
	WAIT FOR INJ TEMP READY?	YES	NO IGNORES
	WAIT FOR AUX TEMP READY?	NO	NO IGNORES
	WAIT FOR DET TEMP READY?	YES	NO IGNORES
	WAIT FOR FLOW READY?	NO	NO IGNORES
	WAIT FOR SPLIT RATIO READY?	NO	NO IGNORES
	WAIT FOR VELOCITY READY?	NO	NO IGNORES
	WAIT FOR PRESSURE READY?	NO	NO IGNORES
	WAIT IF PAPER OUT?	YES	NO IGNORES
	WAIT FOR EXT DEVICE READY?	NO	NO IGNORES
	WAIT IF FAULTS PRESENT?	NO	NO IGNORES
	INITIAL RELAYS AT RUN END?	YES	NO RESETS RELAYS AT GC READY
	SET LOCK CODE?		
	NO / YES		
	CURRENT LOCK CODE	[][][][]	ENTER CURRENT LOCK CODE TO ACCESS NEW LOCK CODE
	NEW LOCK CODE		0 OR USER CODE
	TURN HARDWARE ON-OFF?		
	NO / YES		
	SPT CRYO TRAP INSTALLED?	NO	NO IF NOT INSTALLED
	DETECTOR A ON?	YES	YES TURNS HARDWARE ON
	DETECTOR B ON?	YES	YES TURNS HARDWARE ON
	DETECTOR OVEN ON?	YES	YES TURNS HARDWARE ON
	INJECTOR OVEN ON?	YES	YES TURNS HARDWARE ON
	AUXILIARY OVEN ON?	NO	YES TURNS HARDWARE ON
	COOLANT TO COLUMN?	NO	YES TURNS HARDWARE ON
	COOLANT TO INJ/AUX?	NO	YES TURNS HARDWARE ON
	SET COLUMN PARAMETERS?		
	NO / YES		

KEY	DISPLAY	DEFAULT	RANGE
GC CONFIGURE			
	COLUMN A INSTALLED?		
	NO / YES		
	COLUMN A LENGTH IN METERS	0.0	0.0 TO 99.9
	COLUMN A ID IN MICRONS	0	0 TO 1000
	COLUMN A CARRIER GAS	1	1=HE 2=N2 3=H2
	COLUMN B INSTALLED?		
	NO / YES		
	COLUMN B LENGTH IN METERS	0.0	0.0 TO 99.9
	COLUMN B ID IN MICRONS	0	0 TO 1000
	COLUMN B CARRIER GAS	1	1=HE 2=N2 3=H2
	OTHER CONFIGURATIONS?		
NO	YES		
	STANDARD SAMPLING MODE?		
	YES / NO		
	1=VOL (VOLATILE)		
	2=NEAT (NEAT)		
	3=VISC (VISCOUS)		
	4=USER DEF (USER DEFINED)		
	A/S SOLVENT FLUSH SAMPLING	YES	NO FOR NEAT SAMPLING
	A/S FAST INJ RATE IN UL/SEC	5.0	0.2 TO 10
	A/S SLOW INJ RATE IN UL/SEC	2.0	0.2 TO 10
	A/S VIAL NEEDLE DEPTH (%)	90	0 TO 100
A/S SOLVENT SELECT	A/S SOLVENT SELECT	1	1=A 2=B 3=A THEN B 4=NONE
	A/S UPPER AIR GAP	YES	NO FOR NONE
	A/S LOWER AIR GAP	YES	NO FOR NONE
	A/S SYRINGE WASH TIME IN SEC	20	5 TO 180
A/S START AT RACK 1 VIAL 1	A/S START AT RACK 1 VIAL 1	YES	NO FOR CURRENT VIAL
	A/S HOT NEEDLE TIME (MIN)	0.00	0.00 TO 1.00
	A/S UPTAKE SPEED (UL/SEC)	5.0	1.0 TO 5.0
	A/S PAUSE TIME IN SEC	2	1 TO 10

KEY	DISPLAY	DEFAULT	RANGE
GC CONFIGURE			
NEXT RUN NUMBER?	NEXT RUN NUMBER?		1 TO 9999
	SOUND KEYSTROKES?	YES	NO TURNS OFF KEYBRD BEEP
	HALT AUTOMATION		
	ON TRANS FAILURE?	YES	YES HALTS AUTOMATION
	SIGNAL SWITCHING TO DS?	NO	YES TO ENTER CHANGES
	GC CONFIGURE TABLE COMPLETE		

METHODS



KEY	DISPLAY	DEFAULT	RANGE
COLUMN			
	INITIAL COLUMN TEMP	50	-99 TO Col Temp Limits in Configuration Table
	INITIAL COL HOLD TIME	20.00	0.00 TO 650 OR INF
	TEMP PROGRAM COLUMN?		

NO

YES

KEY	DISPLAY	DEFAULT	RANGE
COLUMN			
	PRGM 1 FINAL COL TEMP	250	(Initial Col Temp + 1) TO Col Temp Limit in Configuration Table
	PRGM 1 COL RATE IN °/MIN		0.1 TO 50.
	PRGM 1 COL HOLD TIME		0 TO 650-(Sum of Hold Times + Delta Temperature x Rate)
	FLOW A/B IN ML/MIN	0.0	0 TO 100
	PRESSURE A/B IN PSIG	0.0	0 TO 60 PS
	COLUMN A/B VELOCITY CM/SEC	0.0	0.0 TO 300
	ADD NEXT COLUMN PROGRAM?		
INJECTOR (Standard Injector)	INJECTOR TEMP	50	-99 TO LIMIT
(SPI Injector)	INITIAL INJECTOR TEMP	50	-99 TO xxx
	INITIAL INJ HOLD TIME	0.00	0.00 TO 650 OR INF
	TEMP PROGRAM INJECTOR?		

NO / YES

PRGM 1 FINAL INJ TEMP -		(Initial Injector Temperature + 1) TO Limit in Configuration Table
PRGM 1 INJ RATE IN °/MIN -		01 TO 300 OR INF
PRGM 1 HOLD TIME		0.00 TO (Sum of Hold Times + Rate x Delta Temperature) OR INF
PRGM 1 FINAL INJ TEMP -		Final Injector Temperature
ADD NEXT INJECTOR PROGRAM?		

NO / YES

BUILDS PRGM n+1

ADD AUXILIARY SECTION?

NO / YES

INITIAL AUX TEMP	50	-99 TO LIMIT
INITIAL AUX HOLD TIME	0.00	0.00 TO 650.00 MIN OR INF

TEMP PROGRAM AUXILIARY?

NO / YES

KEY	DISPLAY	DEFAULT	RANGE
INJECTOR			
	PRGM 1 FINAL AUX TEMP -		(Initial Aux Temp + 1) TO Limit
	PRGM 1 AUX RATE IN °/MIN -		01 TO 300 OR INF
	PRGM 1 AUX HOLD TIME		0.00 TO (Sum of Hold Times + Rate x Delta Temperature) OR INF
	ADD NEXT AUXILIARY PROGRAM?		

NO

YES

BUILDS PRGM n+1

KEY	DISPLAY	DEFAULT	RANGE
DETECTOR			
	DETECTOR TEMP	50	20 TO LIMIT
	DETECTOR A OR B?	A	SELECT A OR B
	ADD ddd x SECTION		

NO

YES

KEY	DISPLAY	DEFAULT	RANGE
	ddd x INITIAL ATTEN	16	1 TO 1024 POWERS OF 2 INF
	ddd x INITIAL RANGE	10	ECD: 1, 10
	ddd x INITIAL RANGE	11	FID: 8, 9, 10, 11, 12
	ddd x INITIAL RANGE	9	FPD: 8, 9, 10
	ddd x INITIAL RANGE	11	PID: 8, 9, 10, 11, 12
	ddd x INITIAL RANGE	11	TSD: 8, 9, 10, 11, 12
	ddd x INITIAL RANGE	.5	TCD: 0.05, 0.5, 5
	ddd x INITIAL RANGE	10	SFPD: 1, 10, 100
	ddd x AUTOZERO?	NO	YES AUTOZEROS AT GC READY
	TCD x FILAMENT TEMP	OFF	50 TO 390 OR OFF 50 TO 490 OR OFF
	TCD x POLARITY POSITIVE?	YES	NO REVERSES SIGNAL POLARITY
	TSD x BEAD POWER ON?	NO	NO TURNS BEAD CURRENT OFF
	TSD x BEAD CURRENT IN AMPS	2.400	2.400 TO 3.800
	SIGNAL A OR B TO DATA SYSTEM	A	SELECT A OR B
	HALL x VENT OPEN?	YES	YES TO OPEN VENT
	HALL x ATTEN	1	1 TO 1024 POWERS OF 2 OR INF

KEY	DISPLAY	DEFAULT	RANGE
DETECTOR			
	ddd AUTOZERO ON?	NO	YES TO AUTOZERO
	TIME PROGRAM ddd x?		

NO ← / YES ↓

DISPLAY	DEFAULT	RANGE
PRGM 1 ddd x TIME IN MIN -	0.01	0.01 TO 650.00 OR TUNE
PRGM 1 ddd x ATTEN x	16	1 TO 1024 IN POWERS OF 2 INF
PRGM 1 ddd x RANGE x		As for initial range conditions
PRGM 1 ddd x AUTOZERO?	NO	YES AUTOZEROS AT GC READY
PRGM 1 TCD x POLARITY POS?	YES	NO REVERSES SIGNAL POLARITY
PRGM 1 TSD x BEAD POWER ON?	NO	NO TURNS BEAD CURRENT
PRGM 1 DET x TIME IN MIN -		0.00 TO 650.00 OR TUNE
PRGM 1 HALL x TIME IN MIN -		0.00 TO 650.00 OR TUNE
PRGM 1 ddd x ATTEN	1	1 TO 1024 POWERS OF 2 OR INF
PRGM 1 HALL x ATTEN	1	1 TO 1024 POWERS OF 2 OR INF
PRGM 1 HALL x VENT OPEN?	NO	YES TO OPEN VENT
PRGM 1 SIGNAL TO DATA SYSTEM		SELECT A OR B
ADD NEXT ddd x PROGRAM?	NO	

NO ← / YES ↓

BUILDS PRGM n+1

PLOTTER

ADD PLOTTER SECTION?

NO ← / YES ↓

DISPLAY	DEFAULT	RANGE
INITIAL PLOT SPEED IN CM/MIN	1.0	0.0 TO 30.0
ZERO OFFSET IN PERCENT	15	0 TO 100
PLOT SIGNAL A OR B?	A	SELECT A OR B
TIME TICKS?	YES	YES PRINTS ON PLOT
INSTRUMENT EVENT CODES?	YES	YES PRINTS ON PLOT
FIRST USER NUMBER? -	0	1 TO 4 DIGITS
LAST USER NUMBER? -	0	1 TO 4 DIGITS
PRINT USER NUMBER?	NO	YES TO PRINT USER NUMBER
PRINT REPORT AT RUN END?	YES	YES TO PRINT REPORT
PRINT RUN LOG AT RUN END?	NO	YES PRINTS HISTORY OF RUN

KEY	DISPLAY	DEFAULT	RANGE

PLOTTER

TIME PROGRAM PLOTTER?

NO / YES

DISPLAY	DEFAULT	RANGE
PRGM 1 PLOTTER TIME IN MIN -		0.01 TO 650.00 OR TUNE
PRGM 1 PLOT SPEED IN CM/MIN	1.0	0.0 TO 30.0
PRGM 1 PLOT SIGNAL A OR B?	A	SELECT A OR
ADD NEXT PLOTTER PROGRAM?		

NO / YES

BUILDS PRGM n+1

AUTOSAMPLER

ADD AUTOSAMPLER SECTION?

NO / YES

DISPLAY	DEFAULT	RANGE
A/S VIAL MODE	OFF	OFF OR SINGLE OR MULTI
A/S SAMPLE VOLUME IN UL	1.0	0.1 TO 5.0
A/S SOLVENT PLUG SIZE (UL)	1.0	0.1 TO 3.0 OR OFF
FAST INJECTION RATE?	YES	NO FOR SLOW
A/S RESIDENCE TIME IN MIN	0.00	0.00 TO 10.00
NUMBER INJ/CALIB VIAL	1	1 TO 20
INJ PER ANALYSIS VIAL	1	1 TO 20

SAMPLE TABLE?

NO / YES

DISPLAY	DEFAULT	RANGE
PRGM n A/S RACK NUMBER		1 TO 4
PRGM n A/S VIAL NUMBER		1 TO 12
PRGM n RUN MODE		1=ANAL 2=CALIB 3=BLANK
PRGM n SAMPLE ID		SAMPLE NAME (12 characters)
PRGM n AMOUNT STANDARD	1.000	0.000001 TO 1000000.
PRGM n MULTIPLIER	1.000	0.000001 TO 1000000.
PRGM n DIVISOR	1.000	0.000001 TO 9999999.
ADD NEXT SAMPLE PROGRAM?		

NO / YES

BUILDS PRGM n+1

KEY	DISPLAY	DEFAULT	RANGE
RELAY			
	ADD RELAY SECTION?	NO	NO MOVES TO NEXT SECTION
	INITIAL RELAYS	-1 -2 -3 -4	1234 FOR ON/-1-2-3-4 FOR OFF
	TIME PROGRAMMABLE RELAYS?		

NO
YES

DISPLAY	DEFAULT	RANGE
PRGM 1 RELAY TIME IN MIN -		xxxxx MIN OR TUNE
PRGM 1 RELAYS xxxx		1234 FOR ON/-1-2-3-4 FOR OFF
ADD NEXT RELAY PRGM?		

NO
YES

DISPLAY	DEFAULT	RANGE
PRGM 1 n+1 RELAY TIME IN MIN -		1234 FOR ON/-1-2-3-4 FOR OFF
PRGM n+1 RELAYS xxxx		1234 FOR ON/-1-2-3-4 FOR OFF
PRGM n+1 RELAY TIME IN MIN xxxxx		TO 650.00 OR TUNE
METHOD COMPLETE - END TIME	xxxxx	SELECT NEXT OPERATION

INTEGRATION

DISPLAY	DEFAULT	RANGE
ADD INTEGRATION SECTION?		

NO
YES

DISPLAY	DEFAULT	RANGE
RUN MODE?	1	1=ANAL 2=CALIB 3=BLANK
PEAK MEASUREMENT PARAMETER?	1	1=AREA 2=HEIGHT 3=SQ RT
LONG REPORT FORMAT?	NO	YES PRINTS LONG REPORT
RESULT CALCULATION TYPE	1	1=A% 2=N% 3=IS 4=ES
DIVISOR	1.00000	0.000001 TO 9999999.
AMOUNT STANDARD	1.00000	0.000001 TO 9999999.
MULTIPLIER	1.00000	0.000001 TO 1000000.
RESULT UNITS	8 ALPHANUMERIC CHARACTERS	
REPORT UNIDENTIFIED PEAKS?	YES	NO REPORTS TOTAL AREA
UNIDENTIFIED PEAK FACTOR	0.00000	0.000000 TO 999999.0
SAMPLE ID	12 ALPHANUMERIC CHARACTERS	
TRANSMIT REPORT?	NO	YES - TRANSMITS AT RUN END
SUBTRACT BLANK BASELINE?	NO	YES SUBTRACTS BASELINE

NO

TIME EVENTS

DISPLAY	DEFAULT	RANGE
ADD TIME EVENTS SECTION?		

NO
YES

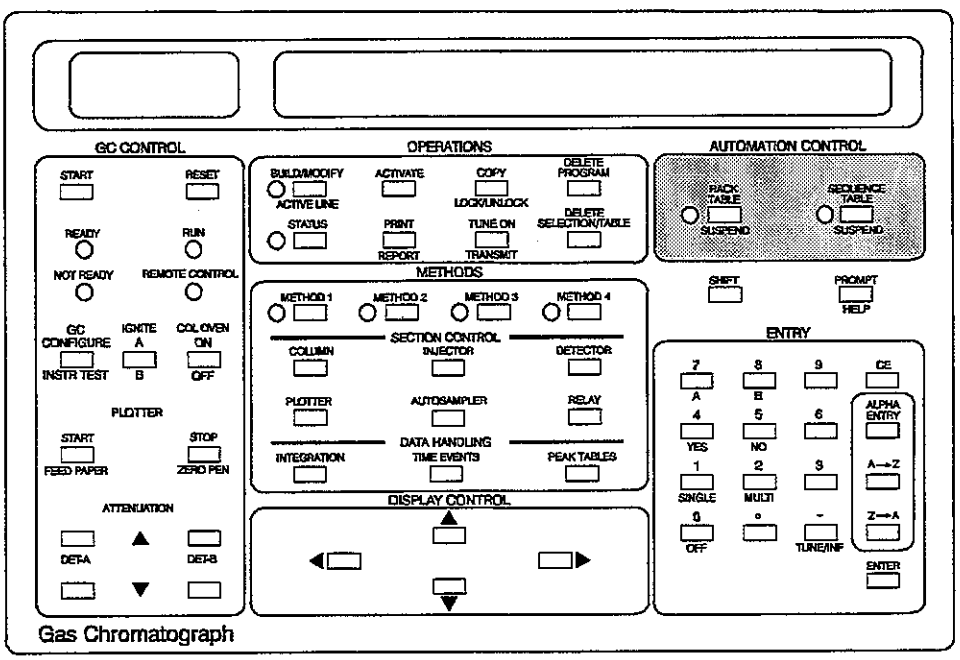
KEY	DISPLAY	DEFAULT	RANGE
TIME EVENTS			
	PEAK REJECT VALUE	1000	0 TO 10000000
	SIGNAL TO NOISE VALUE	5	2 TO 255
	TANGENT PEAK HEIGHT	10	0 TO 100
	INITIAL PEAK WIDTH IN SEC	2	0.5 TO 256 IN POWERS OF 2
	CREATE TIME EVENTS TABLE?		

NO ← YES

DISPLAY	RANGE
PRGM n EVENT	1=WI 2=II 3=SR 4=GR 5=VB
PRGM n START TIME	0.00 TO 650.00
PRGM n END TIME	0.00 TO 650.00
PRGM n PEAK WIDTH IN SEC	0.5 TO 256 IN POWERS OF 2
ADD NEXT TIME EVENT?	

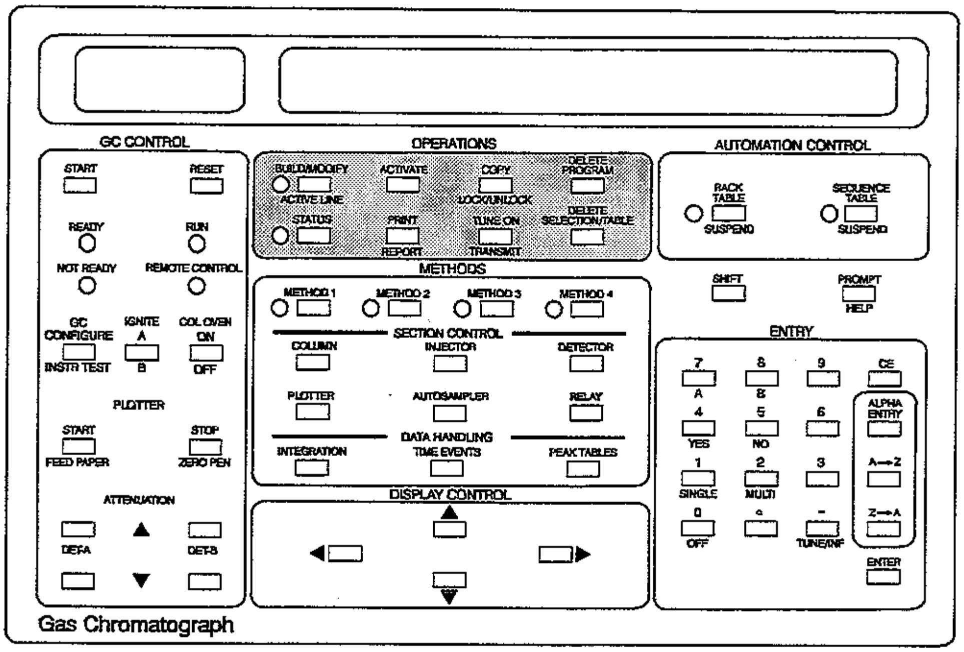
NO ← ADD NEXT TIME EVENT? → YES → BUILDS PRGM n+1

AUTOMATION CONTROL



KEY	DISPLAY	DEFAULT	RANGE
RACK TABLE			
	NO AUTOSAMPLER		SELECT NEXT OPERATION
	STOP AUTOMATION AFTER ERROR	0	0 TO 99
	PRGM n RACK NUMBER -		1 TO 4
	PRGM n USE METHOD NUMBER -		1 TO 4
	ADD NEXT RACK TABLE PROGRAM?		
	NO → RACK TABLE COMPLETED; YES → BUILDS PRGM n+1		
	RACK TABLE COMPLETED		SELECT NEXT OPERATION
SEQUENCE TABLE			
	RUNS OF TABLE	SINGLE	SINGLE OR MULTI
	STOP AUTOMATION AFTER ERROR	0	0 TO 99
	PRGM n RUN METHOD -		1 TO 4
	PRGM n NUMBER OF RUNS -		1 TO 99
	ADD NEXT SEQ TABLE PROGRAM?		
	NO → RACK TABLE COMPLETED; YES → BUILDS PRGM n+1		
	RACK TABLE COMPLETED		
	SEQ TABLE COMPLETED		SELECT NEXT OPERATION
STATUS - RACK TABLE			
	RACK AUTOMATION SUSPENDED		
	STOP AUTOMATION AFTER ERROR	0	0 TO 99
	NO AUTOSAMPLER		
	RACK TABLE NOT ACTIVE		
	TABLE SUSPENDED		
	PRGM x RACK nn VIAL nn INJ n		
STATUS - SEQUENCE TABLE			
	SEQ TABLE NOT ACTIVE		
	PRGM x RUN nn		
	PRGM x RUN nn INJ nn		
	SEQUENCE AUTOMATION SUSPENDED		

OPERATIONS



KEY	DISPLAY	DEFAULT	RANGE
STATUS			
	METHOD x INACTIVE - END TIME xxxxx		
	METHOD x COMPUTING		
	METHOD x STABILIZE xxxxx MIN		
	METHOD x MONITOR		
	METHOD x WAITING FOR EXT DEVICE		
	METHOD x A/S WAITING xxxxx		
	METHOD x A/S SAMPLING		
	METHOD x RUN xxxxx END xxxxx MIN		
	NO xxxxxxx SECTION IN METHOD		
	COL aaa° INJ aaa° AUX aaa° DET aaa°		
	ILLEGAL METHOD x		
	TRANSMITTING		
STATUS - COLUMN			
	COL aaa° SET sss or OFF		
	COL aaa° SET sss HOLD xxx.xx		
	COL aaa° SET sss RATE rr.r		
	COL aaa° SET sss STABILIZE		
	COL aaa° SET sss COOLING		
	COL aaa° SET sss STANDBY		
	FLOW A/B aaa [ ] SET xxx		
	PRESSURE A/B aaa [ ] SET xxx		
	SPLIT RATIO A/B aaa [ ] SET xxx		
	COLUMN A/B VELOCITY aaa [ ] SET xxx		

KEY	DISPLAY	DEFAULT	RANGE
STATUS - INJECTOR			
	INJ aaa° SET sss or OFF		
	INJ aaa° SET sss HOLD xxx.xx		
	INJ aaa° SET sss RATE rr.r		
	INJ aaa° SET sss STABILIZE		
	INJ aaa° SET sss COOLING		
	AUX aaa° SET sss or OFF		
	AUX aaa° SET sss HOLD xxx.xx		
	AUX aaa° SET sss RATE rr.r		
	AUX aaa° SET sss STABILIZE		
	AUX aaa° SET sss COOLING		
STATUS - DETECTOR			
	DET aaa° SET sss or OFF		
	DETECTOR A OR B?		
	DET x OFF		
	TCD x FIL TEMP sss CUR sss MA		
	TCD x POLARITY POSITIVE (NEGATIVE)		
	FPD x PM TUBE xxx VOLTS		
	FPD x PM TUBE xxx VOLTS		
	ddd x BASELINE xxxxx.xx MV (A/Z)		
	ddd x ATTEN aaa RANGE R		
	TSD x s.sss AMP w.v VOLT BIAS		
	HALL x ATTEN aaaa VENT OPEN (CLOSED)		
STATUS - PLOTTER			
	PLOT ddd x AT w.v C/M ZERO xxx		
	NO PLOTTER SECTION IN METHOD		
STATUS - AUTOSAMPLER			
	NO AUTOSAMPLER		
	NO A/S SECTION IN METHOD		
	A/S VIAL MODE OFF (SINGLE) (MULTI)		
	A/S SEARCHING RACK nn VIAL nn		
	A/S SAMPLING RACK nn VIAL nn		
	A/S INJECTING RACK nn VIAL nn		
	A/S RACK nn VIAL nn INJ n		
STATUS - RELAY			
	RELAYS xxxx		
	NO RELAY SECTION IN METHOD		
BUILD/MODIFY			
	SELECT METHOD/SECTION OR TABLE		METH 1-4/SECTION/TABLE

KEY	DISPLAY	DEFAULT	RANGE
ACTIVE LINE			
	DET A OR B?		SPECIFY A OR B
	AUXILIARY SECTION?	NO	YES SELECTS AUX SECTION NO SELECTS INJ SECTION
	NOT IN RUN		SELECT NEXT OPERATION
	NOT IN AUTOMATION		SELECT NEXT OPERATION
	ILLEGAL SECTION		SELECT NEXT OPERATION
	SECTION NOT IN METHOD		SELECT NEXT OPERATION
	TABLE NOT ACTIVE		SELECT NEXT OPERATION
ACTIVATE			
	SELECT METHOD OR TABLE		METHOD 1-4/TABLE
	TABLE ACTIVATED		SELECT NEXT OPERATION
	TABLE NOT BUILT		SELECT NEXT OPERATION
	METHOD RUNNING		SELECT NEXT OPERATION
	UNDER REMOTE CONTROL		SELECT NEXT OPERATION
	METHOD ACTIVATED		SELECT NEXT OPERATION
	AUTOMATION ACTIVE		SELECT NEXT OPERATION
	TABLE ACTIVE		SELECT NEXT OPERATION
COPY			
	SELECT METHOD TO COPY FROM		METH 1-4
	SELECT METHOD TO COPY TO		METH 1-4
	COPY COMPLETE		SELECT NEXT OPERATION
	METHOD LOCKED		SELECT NEXT OPERATION
	METHOD RUNNING		SELECT NEXT OPERATION
LOCK/UNLOCK			
	ENTER LOCK CODE	[][][][]	0 OR USER CODE
	SELECT METHOD OR TABLE		METH 1-4/TABLE
	METHOD LOCKED		SELECT NEXT OPERATION
	METHOD UNLOCKED		SELECT NEXT OPERATION
	TABLE LOCKED		SELECT NEXT OPERATION
	TABLE UNLOCKED		SELECT NEXT OPERATION
PRINT and REPORT			
	SELECT METHOD/SECTION OR TABLE		METH 1-4/SECTION/TABLE
	SELECT SECTION OR ENTER FOR ALL		METHOD SECTION OR ENTER
	PLOTTER BUSY		SELECT NEXT OPERATION
	PAPER OUT		
	PRINTING - SELECT NEXT OPERATION		SELECT NEXT OPERATION
	TRANSMITTING		SELECT NEXT OPERATION

KEY	DISPLAY	DEFAULT	RANGE
DELETE PROGRAM **DELETE SECTION** **DELETE TABLE**			
	SELECT METHOD/SECTION OR TABLE		METH 1-4/SECTION/TABLE
	SELECT METHOD/SECTION OR TABLE		METH/SECT OR TABLE TO
	ENTER PROGRAM NO. TO DELETE -		ENTER PROGRAM NUMBER
	PROGRAM DELETED		SELECT NEXT OPERATION
	SECTION DELETED		SELECT NEXT OPERATION
	TABLE DELETED		SELECT NEXT OPERATION
	METHOD LOCKED		SELECT NEXT OPERATION
	TABLE LOCKED		SELECT NEXT OPERATION
	DELETE DETECTOR A OR B? -		SPECIFY A OR B
	DELETE AUX SECTION ONLY?	YES	NO DELETES AUX AND
	METHOD RUNNING		SELECT NEXT OPERATION
	TABLE ACTIVE		SELECT NEXT OPERATION
	SELECT SECTION		METHOD SECTION
	PROGRAMS NOT BUILT		SELECT NEXT OPERATION
	SECTION CLEARED		SELECT NEXT OPERATION
	INJ CLEARED/AUX DELETED		SELECT NEXT OPERATION
	PROGRAM NOT IN TABLE		SELECT NEXT OPERATION
	DETECTOR A OR B?		SPECIFY A OR B
	SECTION NOT IN METHOD		SELECT NEXT OPERATION
	AUXILIARY SECTION?	NO	YES SELECTS AUX NO SELECTS INJ
	PROGRAM NOT IN METHOD		SELECT NEXT OPERATION
	SELECT SECTION TO DELETE		METHOD SECTION
	TABLE NOT BUILT		SELECT NEXT OPERATION
TRANSMIT			
	METHOD RUNNING		SELECT NEXT OPERATION
	COMPUTING		SELECT NEXT OPERATION
	TRANSMISSION STARTED		SELECT NEXT OPERATION
	TRANSMISSION ABORTED		SELECT NEXT OPERATION
TUNE ON			
	SELECT SECTION TO TUNE		PRESS METHOD SECTION TO
	DETECTOR A OR B?		SPECIFY A OR B
	TUNE DET A/B PRGM n		PRESS ENTER TO TUNE
	TUNE PLOTTER PRGM n		PRESS ENTER TO TUNE
	TUNE RELAY PRGM n		PRESS ENTER TO TUNE
	NO TUNE ENTRIES		PRESS METHOD SECTION TO
	ILLEGAL SECTION		PRESS METHOD SECTION TO
	NOT IN RUN		SELECT NEXT OPERATION
	METHOD LOCKED		SELECT NEXT OPERATION

KEY	DISPLAY	DEFAULT	RANGE
HELP			
	HELP number		Refer to the HELP section of 3000 Series GC Operator's Manual
Fault Messages			
	See the Diagnostic Troubleshooting section in the 3300 GC and the Star 3400 CX GC Operator's Manual		
3300 and Star 3400 CX Operation			
	INCOMPLETE PROGRAM-DELETE?	NO	YES DELETES PROGRAM
	ILLEGAL ENTRY - PRESS PROMPT		
	METHOD LOCKED		SELECT NEXT OPERATION
	TABLE LOCKED		SELECT NEXT OPERATION
	ADD xxxxxxx SECTION?		NO MOVES TO NEXT
	ILLEGAL METHOD x		
	TABLE SUSPENDED		SELECT NEXT OPERATION

2 Additional Functions of Keys

This section contains additional information about the function of keys on the front panel of the GC. Certain keys are active for particular GCs and GC configurations and may or may not apply to your specific application.

2.1 GC Control Keys

Additional functions of specific GC CONTROL keys follow.

Pressing the START KEY

- Begins the active method, the active automation table or the automation sequence
- Has no effect if the GC is in RUN or autosampling has started, or the automation table is in progress

> NOTE: Pressing the inject switch also starts the method for a manual injection but does not start automation or the AutoSampler.

Pressing the RESET KEY when the GC is in the RUN state

- Stops the GC run
- Turns the REMOTE CONTROL light OFF
- Clears fault messages (blinking STATUS light)
- Restarts the coolant time-out timer
- Clears attenuation changes made via the ATTENUATION keys
- Clears plotter "zero pen" action
- Terminates the thermal stabilize timer and allows the GC to go immediately to READY

- Returns column oven temperature to the initial conditions from the standby temperature
- RUN light goes OFF
- GC resets to the initial conditions of the active method Tune mode is exited

Pressing the RESET key when the GC is in the AUTOMATION state

- Stops automation and deactivates the active automation table
- Interrupts AutoSampler sampling cycle

Pressing the GC CONFIGURE Key

- Updates to the GC CONFIGURE table are not entered in the Run Log

Pressing the (PLOTTER) START Key

- Starts the plotter at the current conditions of the active method
- Pressing the (PLOTTER) START when printing or plotting is in progress has no affect

Pressing the ZERO PEN Key

- Brings a drifting baseline back on scale when autozero is undesirable. (The pen is returned to the zero offset value. The analog outputs are not affected.)
- The zero pen offset remains until (a) RESET is pressed; (b) the plot signal is switched to the other detector; or, (c) the end of the run
- Zero pen offset is not cleared by autozero actions

Pressing the ATTENUATION Key

All attenuation changes made during a GC run via the keyboard remain in effect until:

- RESET is pressed
- End of the run
- Time-programmed step resets attenuation
- Another method is activated

Changes made via the ATTENUATION keys do not update the method but changes are included in the INSTR EVENTS code annotations (specified in the PLOTTER method section) and in the Run Log.

2.2 Operations Keys

Additional functions of specific OPERATIONS keys follow.

ACTIVE LINE (SHIFT, ACTIVE LINE)

ACTIVE LINE is used to display during a run the controlling step within a method section or automation table and is useful for quick program access to make updates to the method.

ACTIVATE

Illegal methods can be activated, but the STATUS light blinks and the GC remains NOT READY.

LOCK/UNLOCK

The lock/unlock feature protects the method through a lock code entered in the GC Configure table.

A code of one to four digits is used to lock or unlock a method or table. The lock code is zero (0) if never changed in the GC Configure table.

PRINT

If a table is selected, printing begins immediately. If a method is selected, you may choose to print a single section or the entire method. While printing, the display shows that printing is in progress. This display remains until the next operation is selected.

If you want to print but the plotter is (1) busy or (2) out of paper or runs out of paper during printing, the display immediately shows an error. After you have loaded paper, restart printing by pressing PRINT.

REPORT (SHIFT, REPORT)

Use the REPORT key to print a report after a run. In this way, you can print a report for a chromatogram even if you declined PRINT REPORT AT RUN END in the PLOTTER method section. The error log is part of the report. If you request a report while a chromatogram is being plotted, the display shows that the printer is busy. If a report is requested while another report is being transmitted, the display shows TRANSMITTING.

Refer to the Printer/Plotter section for Report/Error Log and Run Log formats. Refer to the IBDH Operation section for augmented functions with the in-board data handling option.

TUNE ON

TUNE ON is used to activate the Tune mode.

Using Tune Mode

Tune mode allows you to enter a program time during a run if it was not entered in advance. Program times can be tuned for the detector, printer/plotter, and relay sections.

1. Specifying Tune Entries: Build the method section(s) as usual. For each program to be tuned, press [TUNE/INF] and then [ENTER] when the display asks for the program time. "TUNE" appears in place of a time entry.
2. Activating Tune Mode: Before starting the run, press [TUNE ON] and the appropriate SECTION CONTROL key (DETECTOR, PLOTTER, or RELAY). The GC is now in Tune mode. Check that the program entry to be tuned first is displayed. If no tunable programs are present in the selected section, "NO TUNE ENTRIES" is displayed. All of the tunable programs in the section may be viewed by scrolling with the DISPLAY CONTROL keys.
3. Executing Tune Mode: Start the run and press [ENTER] when the tunable program is to be activated.

   The current run time is entered into the program in the method, the program is executed immediately, and the next tunable program is displayed. "NO TUNE ENTRIES" is displayed after all tunable programs in the section have been sorted according to time.

You may tune programs in more than one section during a run. However, since only one section can be selected at a time, more than one run may be required to tune programs in different sections when program times are similar.

TRANSMIT

Press [SHIFT] [TRANSMIT] to transmit the results report (TRANSMISSION STARTED displayed) or to abort transmission (TRANSMISSION ABORTED displayed).

Under certain circumstances transmission is not allowed. At these times, the display reads: METHOD RUNNING or COMPUTING.

> NOTE: When aborting a transmission, there could be a 30 second delay from the time the key is pressed to the time TRANSMISSION ABORTED is displayed. For example, this can occur when the host stops responding. In this case, do not start a new transmission right away; otherwise, there are additional delays.

DELETE SECTION/TABLE

The function of this key depends on the method section or table that is being deleted.

- If the method section is required (COLUMN, INJECTOR, DETECTOR), pressing DELETE SECTION/TABLE returns the section displays to their preset values and deletes all PRGM lines.
- If a method has two detector sections and you request the DELETE DETECTOR SECTION, you must delete the Detector B section before you delete the Detector A section.

You can delete certain sections of a method, e.g., you can delete only the auxiliary section of the injector.

- The GC Configure table cannot be deleted.
- If the GC is in RUN, active method sections or tables cannot be deleted.

2.3 Automation Control Keys

Movement within tables is the same as within method sections. When the required hardware is not installed, a beep sounds but an action does not occur.

SEQUENCE TABLE

Sequence automation is halted when RESET is pressed or if an illegal method is encountered.

If SINGLE is chosen for RUNS OF TABLE, you must reactivate the table for each single pass of the table.

(SEQUENCE TABLE) SUSPEND

If sequence automation has been suspended, you may resume automation by pressing [START], except when the autosampler is in the middle of an autosampler sequence. When (SEQUENCE TABLE) SUSPEND is pressed in the middle of a sampling sequence, the GC responds as if RESET had been pressed.

2.4 Data Entry Keys

Additional functions of specific ENTRY keys follow.

TUNE/INF

TUNE/INF is used instead of a time entry when building a table that you wish to tune.

For infinity entries for time and attenuation, use TUNE/INF as required. The GC recognizes the appropriate response.

3 Running A Chromatogram

Before running a chromatogram on the GC, check the following:

- ☐ Hardware properly installed (Installation section).
- ☐ Analytical column installed (Column section), flows adjusted (Installation section), and flames lighted (FID and FPD detector sections).
- ☐ Chart recorder (Installation section) and/or external data system (Data Systems tabbed section) connected.
- ☐ Main power ON (Installation, paragraph 5.1). Main power (toggle) switch is located on the rear of the GC.
- ☐ Build the GC Configure Table (paragraph 3.1). (Specify GC configuration, including temperature limits.)

When building/editing methods:

- Follow the display.
- Press [PROMPT] to view allowable entries.
- Press [SHIFT]+[HELP] for a number that references a HELP section.

☐ Build the desired method (paragraph 3.2).

a. Press [BUILD/MODIFY].

b. Press appropriate [METHOD] key (METHOD 1, 2, 3, or 4).

c. Build the COLUMN, INJECTOR, and DETECTOR method sections (ref. Operation section).

d. Build desired optional method sections if hardware present: PLOTTER, AUTOSAMPLER, or RELAYS.

☐ Activate the method (paragraph 3.3).

a. Press [ACTIVATE], then the [METHOD] key (METHOD 1, 2, 3, or 4).

☐ Check GC Status (paragraph 4) by pressing [STATUS]. Press [ENTER] to view additional messages.

a. If a temperature is out of tolerance, the degree symbol for that display flashes and the NOT READY (Operation, 5.2) light is ON.

b. A blinking STATUS light indicates a problem with the GC. Press [STATUS] (paragraph 4.1) to display the fault number associated with the problem. Press [ENTER] to display any additional faults plus GC status information. See the Diagnostics/Troubleshooting section to diagnose faults.

☐ Inject the sample when the READY light (paragraph 5.1) comes ON.

Before beginning an automation sequence with the GC, check the following:

- ☐ To use an AutoSampler with the currently active method, build the AUTOSAMPLER method section and enter [SINGLE] or [MULTI] for mode (**Automation Control**). Put vials in carousel. Check that AutoSampler air is present. Press [START]. The AutoSampler samples and injects into the first vial encountered when the GC is READY.

  AutoSampler continues to rerun the same method until:

  a. [RESET] is pressed,

  b. after last injection/vial, if A/S mode is SINGLE.

- ☐ To select methods for the different AutoSampler rack numbers, build RACK TABLE by pressing [BUILD/MODIFY] [RACK TABLE]. Follow the displays. Build the AUTOSAMPLER Method Section for each of the methods to be used (**Automation Control**). Specify MULTI for AutoSampler mode.

  a. Press [ACTIVATE] (3.3) [RACK TABLE].

  b. Press [START] to start the automation. The first vial encountered determines which Rack program is run first.

  c. Rack automation continues until the [RESET] key is pressed.

  d. Press [STATUS] [RACK TABLE] **or** [STATUS] [AUTOSAMPLER] to view current automation status. Press [ENTER] to display additional Status.

- ☐ To run sequence automation, build SEQUENCE TABLE (**Automation Control**) by pressing [BUILD/MODIFY] [SEQUENCE TABLE]. Programs are executed in number order. This is intended for sample valve operation controlled in the RELAY section of each method (but can also be used with an AutoSampler). Build each of the methods to be used.

  a. Press [ACTIVATE] (3.3) [SEQUENCE TABLE].

  b. Press [START] to start automation. The first run starts at GC READY using Sequence Table PRGM 1.

  c. Sequence automation continues until:
  (1) [RESET] is pressed, or
  (2) the last PRGM in sequence table is completed for SINGLE pass.

3.1 Configuring the GC

Prior to building a method, you must set up the configuration of your GC through the GC Configure table. This table provides access to a variety of GC control parameters, among them the time and date, and **temperature limits**.

The displays that are part of the GC Configure are listed on a single display. To access a specific display, enter [YES]. To bypass a display, enter [NO].

> NOTE: If want further explanation of the parameter in question, press [SHIFT] and hold [HELP]. A number appears that directs you to a specific section of HELP.

EXERCISE

1. Press [BUILD/MODIFY] GC CONFIGURE to display:

   SET TIMES OR DATE? NO

2. Press [YES] [ENTER] to display:

   THERMAL STABILIZE TIME 2.00

   Enter a stabilization time or press [ENTER] to accept the preset of 2.00 minutes. This is the thermal equilibration time that the GC is held in the NOT READY state after all thermal zones have reached their setpoint values.

   > NOTE: Pressing [ENTER] in response to SET TIMES OR DATE? NO bypasses the time and date.

3. Upon entry, the display advances to:

   ENTER TIME OF DAY AS HHMM XXXX

   This is a 24-hour clock, so, if it is 2:25 in the afternoon, press [1] [4] [2] [5] [ENTER]. Enter the time of day.

4. Display advances to:

   ENTER DATE-DAY MONTH 0503

   Enter the day and month as a 4-digit number without punctuation.

5. Display to:

   ENTER DATE-YEAR XX

   Enter the YEAR as a 2-digit number without punctuation.

6. Display: **COOLANT TIME OUT IN MIN INF**

   Enter the desired coolant time-out (shut off time after GC READY) or ignore if coolant is not being used.

7. When you see the following display:

   SET TEMP LIMITS? NO

   Press [YES] [ENTER].

8. Display advances to:

   COLUMN TEMP LIMIT 52

   Enter the upper temperature limit for the column you have installed.

9. Display advances to:

   INJECTOR TEMP LIMIT 52

   Enter the upper temperature limit for the injector you have installed.

10. Display advances to:

    AUXILIARY TEMP LIMIT 52

If you are using the auxiliary temperature zone for a second injector, enter the **upper** temperature limit for that zone.

If you do not have an auxiliary zone, press [ENTER] to advance the display to:

`DETECTOR TEMP LIMIT 52`

11. Enter the **upper** temperature limit for the detector you have installed.

12. Display advances to:

    `COLUMN STANDBY TEMP? 50`

    Enter a temperature here **only if you wish to override the active initial column temperature at run end or automation end.** Use this feature when you do not want to leave the column at the initial column temperature of the active method for long periods of time when you are not present to adjust the active method temperature.

    This temperature control is initiated by entering [YES] for the ENABLE COLUMN STANDBY TEMP? display.

13. Display advances to:

    `SET CHECKS FOR GC READY? NO`

    Enter [YES] to access a list of GC functions that you want to monitor or ignore as part of the GC READY criteria. When a WAIT FOR... entry is NO, that zone need not be within tolerance for the GC to become READY. **In this way, you can operate the GC easily when hardware is present but is not being used.**

    The WAIT FOR FLOW, WAIT FOR SPLIT RATIO, WAIT FOR VELOCITY, or WAIT FOR PRESSURE displays appear for in the same manner. These functions are set in the COLUMN method section and a YES is entered in this WAIT FOR... section, the STATUS light blinks when the value is less than 50% of the setpoint value. If for example, FLOW is set to 5.0 mL/min in the COLUMN method section and YES is entered for WAIT FOR FLOW READY, the STATUS light blinks when the flow drops below 2.5 mL/min.

14. Enter [YES] or [NO] for these displays. Continue making entries until you see the following display:

    `INITIAL RELAYS AT RUN END? YES`

    This entry determines when the relays return to the initial relay conditions at the end of the run. A YES entry returns the relays to their initial conditions at run end or RESET. A NO entry holds the relays in their final state until the GC is READY. **For splitless capillary injector use, this entry should be NO.**

15. Display advances to:

    `SET LOCK CODE?  NO`

    If you want to enter a personal keypad lockout code, do so; otherwise, press [ENTER].

16. Display advances to:

    `SET COLUMN PARAMETERS?  NO`

    Enter [YES] to access displays related to electronic pressure-flow read-out (or to select the type of gas for the TCD). If the [NO] key is pressed, there STATUS displays do not contain information on the pressure and flow.

17. Display advances to:

    `COLUMN A/B LENGTH IN METERS`

    Enter the column length in meters.

18. Display advances to:

    `COLUMN A/B ID IN MICRONS`

    Enter the column inner diameter in microns.

19. Display advances to:

    `COLUMN A/B CARRIER GAS 1`

    Enter the carrier gas type (He = 1, N_2 = 2, H_2 = 3). When you select N_2 for the TCD, filament protection is OFF.

20. Continue making entries for the remaining GC Configure displays until the display advances to:

    `GC CONFIGURE TABLE COMPLETE`

3.2 Building a Method

A method is a set of conditions used by the GC to run an analysis. Four methods (default methods) are always present in the GC. One method is present in the GC.

At power up Methods 1 through 4 are identical **minimum methods,** containing preset entries in the following method sections: COLUMN, INJECTOR, and DETECTOR. Rarely are minimum methods suitable for chromatographic analysis. However, you can modify these basic methods to create more sophisticated methods for your particular application.

The following exercise provides you with hands-on experience in building a basic method. Use this exercise whether you intend to operate the GC for isothermal or temperature programmed separations. Follow the prompts that appear on the display. This information guides you through the operation of the GC.

For detailed descriptions of each display, press [SHIFT] [HELP]. Refer to the number in the HELP section that corresponds to the number that is displayed.

EXERCISE

> NOTE: For the 3300 GC, disregard all references to pressing [METHOD] keys.

1. Press [BUILD/MODIFY], located in the OPERATIONS section of the keypad. The BUILD light goes ON and the display instructs you to

   `SELECT METHOD/SECTION OR TABLE`

COLUMN Section

2. Press [METHOD 1] on the GC. METHOD 1 light goes ON. (the 3300 GC goes directly to the following display.)

   Display: `INITIAL COLUMN TEMP 50`

3. Enter the initial column temperature you intend to use.

4. Continue through the COLUMN displays, entering values appropriate to your chromatographic analysis.

   When you see the following display: `TEMP PROGRAM COLUMN? NO`

a. Press [YES] [ENTER] to select temperature programming.

or

b. Press [ENTER] if the GC is to operate isothermally. You are taken to the first display of the INJECTOR section.

INJECTOR Section

5. Display to: `INJECTOR TEMP 50`
6. Enter an injector temperature.

   This is the only available entry for standard (STD) injectors. The display moves to the ADD AUXILIARY SECTION display and then to the first display in the DETECTOR section.
7. The Septum-equipped Programmable Injector (SPI) has additional injector displays for temperature programming the injector. Enter values for your analysis. Be sure you have set switch S2 on the Temperature Control PC Board to OCI.

DETECTOR Section

8. When you see the following display, you have reached the first display in the DETECTOR section:

   `DETECTOR TEMP 50`

   Detector displays vary depending on the type and number of detectors that are installed. Enter a detector temperature for your application.
9. Advance through the DETECTOR displays by setting all values for your detector.
10. Continue building the method in this way for all of the method sections possible for the particular hardware installed in your GC. **Remember to use the [HELP] key!**

    When all method sections have been built, the last display iss

    `METH X COMPLETE-END TIME XXXXX`

    Press any SECTION CONTROL key for access to the section at any time. RACK and SEQUENCE tables are built in the same manner. Rack tables are used with the AutoSampler and sequence tables with gas sampling valves. (Refer to the **Automation Control** section.)

3.3 Activating the Method or Table

After you have built a method or table, you must **activate** the method or table before it can be used. When you activate a method or table you designate which method or table in memory is used to run the next analysis. Only one method or table can be active at any time.

To activate a method or table **for the GC, proceed as follows:**

1. Press [ACTIVATE], then the [METHOD] key (METHOD 1, 2, 3, or 4) **or** the appropriate table key ([RACK TABLE] or [SEQUENCE TABLE]).
2. If the method or table is ready to be used, the display reads:

   `METHOD ACTIVATED or TABLE ACTIVATED`

   If the method or table is NOT ready to be used, the display shows the reason (such as METHOD RUNNING, NO AUTOSAMPLER, TABLE NOT BUILT, etc.).
3. Once the method or table is active, begin the automation by pressing [START] or by making a manual injection.

4 GC Status

When [STATUS] is pressed, the STATUS light goes ON, and the active method light goes on (the Star 3400 CX GC). Press the [STATUS] key when you want: (a) to monitor the active method and any of its method sections; (b) to display a fault condition (see paragraph 4.1); or c) to display a NOT READY condition (see paragraph 4.2). **The display of fault conditions takes priority over the display of other Status information.** Press [ENTER] to scroll all status displays. Press SECTION CONTROL keys to view the status of a particular section. When the STATUS light is ON, pressing [PROMPT] always displays:

`INSTR STATUS—NO USER ENTRY`

You receive status information only for the options that are installed in the GC.

- Monitoring the STATUS of an Inactive Method (Star 3400 CX GC only)

When in the STATUS mode, you can press the [METHODS] key to view the end time of one of the **inactive methods:**

`METHOD X INACTIVE—END TIME XXXXX`

This is the only Status display for an inactive method.

- Monitoring Elapsed Run Time.

If the GC is in RUN, the Elapsed Run Time can be monitored by pressing [STATUS] [ENTER] to display:

METH X	RUN	1.35 END	22.00 MIN
METHOD NUMBER	INSTR STATE	ELAPSED RUN TIME	METHOD END TIME

If the GC is not in RUN, the RUN time displayed is 00.00.

4.1 STATUS Light and Fault Messages

A **blinking STATUS light** indicates that the GC has detected a problem or fault. A fault may result from a mismatch in the hardware configuration, from temperature zones out of range, or from the GC being out of plotter paper, etc.

When the Status light is blinking, press [STATUS] to display the initial fault message. Press [ENTER] to display additional fault messages.

Display example: `ILLEGAL METHOD`

This message informs you that the active method contains an illegal method section. The STATUS light blinks and the GC is held NOT READY. Press [STATUS] [ENTER] to display the fault(s). You can create an illegal method by changing the GC configuration after the method section was previously built, i.e., standard injector removed and a programmable capillary injector installed. Refer to the **Diagnostics/Troubleshooting** section for a complete listing of fault messages.

> NOTE: Correct an illegal method by correcting the hardware configuration or deleting the illegal method section.

Also, this fault condition may require you to repair the hardware. Refer to the **Diagnostics/ Troubleshooting** section for a complete listing of fault messages and assistance.

4.2 STATUS Key and NOT READY Conditions

If the NOT READY light is ON, one or more NOT READY conditions exist. Press [STATUS]. You can always display two or more status conditions by pressing [ENTER].

If one of the following four conditions is applicable, it is displayed first.

```
METHOD X STABILIZE XXXXX MIN
METHOD X WAITING FOR EXT DEVICE
METHOD X A/S WAITING XXXXX MIN
METHOD X A/S SAMPLING
```

Pressing [ENTER] continues the standard STATUS displays for your GC configuration. A flashing value or symbol in any STATUS display indicates that the zone is out of its setpoint tolerance. Refer to paragraph 4.3, **Setpoint Errors**.

4.3 Setpoint Errors

Setpoint errors indicate an error between the value you enter and the actual values of a parameter. When an out-of-tolerance setpoint is detected, the degree symbol for that zone's STATUS display flashes.

Setpoint errors for the GC follow:

Parameter	Setpoint Window/Cause
Column oven temp	±1.3°C
Injector oven temp. (STD)	±4.5°C
Injector oven temp. (SPI)	+10/-30°C
Auxiliary oven temp.	±4.5°C
Detector (ionization) oven temp.	±2.5°C
TCD oven temp.	±1.5°C
Pressure, flow	< 50% of its setpoint

5 GC States

While operating, the GC may be in one of several states: READY, NOT READY, or RUN. A set of state lights on the front panel of the GC indicates the status of the GC. The following paragraphs describe the conditions whereby the GC goes from one state to another and what operations can be performed in these states. See Figure 10.

5.1 READY State

When the GC is in the READY state, the READY light is ON and the GC is awaiting an injection. All GC temperatures are at their setpoints, the plotter is available, and the GC is clear of error conditions.

If an AutoSampler is used, the READY light does not need to be ON to start the AutoSampler, but the AutoSampler does not inject until the GC is READY.

An external ready input is available on the Mother PC Board for operation of the GC with peripheral GCs. Refer to the **Installation** section for specific cabling connections.

5.2 NOT READY State

When the NOT READY light is ON, one or more Not Ready conditions exist. To find the problem, press [STATUS]. The METHODS light for the active method turns ON. Press [ENTER] to display the Not Ready conditions.

For a list of setpoint errors, refer to paragraph 4.3.

If required for peripheral GCs, you can generate a Not Ready signal through connections made on the Mother PC Board. Refer to the **Installation** section for specific cabling connections.

5.3 STABILIZE State

The STABILIZE state is a period during which the GC checks the actual temperatures of its heated zones against the temperatures set in the GC method. The STABILIZE state begins after the temperature of the last zone checked comes within its setpoint tolerance. The THERMAL STABILIZE TIME is two minutes, unless changed in the GC Configure table.

If any setpoint goes out of tolerance before the GC goes to READY, the STABILIZE timer restarts. The NOT READY light remains ON until temperatures stabilize, at which time the GC goes to READY (READY light goes ON). Pressing [RESET] during the STABILIZE period causes the GC to immediately advance to READY.

- Monitoring the Stabilization Count Down

After the GC has reached its setpoints and prior to the GC going to READY, you can monitor the time remaining before the GC advances to READY. This countdown is from the stabilization time. Press [STATUS] to display:

METH X	STABILIZE	2.00 MIN
METHOD NUMBER	INSTR STATE	STABILIZE COUNTDOWN TIME

> NOTE: You cannot distinguish the STABILIZE state from the NOT READY state **by looking at the run state lights**. Press [STATUS] to display the run state (as above). Pressing [RESET] when in the STABILIZATION state cancels the stabilization time that remains and advances the GC to READY.

5.4 MONITOR State

The MONITOR state is a period during which the baseline noise is sampled to determine the peak detection threshold. This state generally lasts 10 seconds or less. When a IBDH method is activated, the GC advances to the MONITOR state after the STABILIZE state.

5.5 RUN State

The GC advances to RUN at injection, irrespective of READY/NOT READY conditions. The GC remains in RUN until method reaches the method END TIME or until you press the [RESET] key.

Both GC READY/START OUTPUT and REMOTE READY/START INPUT are available on the Mother PC Board, allowing the GC to control remote devices. Refer to the **Installation** section for specific cabling connections.

6 Method and Real Time Updates

A Real Time Update is any change you make to the currently active method. You may make a real time update during or after a GC run. Examples of real time updates include: changing thermal zone temperatures, or adding or modifying temperature and timed events programs.

If the GC is not in RUN, changes you make to the initial conditions for any active method section are executed immediately. Temperature and time programs are executed only when the GC is in RUN, but may be added and modified at any time.

- Real Time Updates With the GC in RUN

A change to any line in the method means that the GC recalculates the END TIME. If a real time update results in the END TIME being less than the current RUN TIME, the GC immediately resets. Real time updates are recorded in the Run Log with the time the change occurred. All changes remain in the method except attenuation updates made via the ATTENUATION keys.

When the active method is in RUN, you may quickly display what is being executed by pressing [SHIFT]+ACTIVE LINE, then the desired method section or automation table key.

Entries to method sections with no program steps are immediately executed. Real time update entries may not be immediately executed if the method has time programmed steps, actions, or events. Display the currently active program by pressing [SHIFT]+ACTIVE LINE.

- Modifying Temperature Programs

The following temperature zones can be updated with real time updates: column, injector(s), detector(s), and auxiliary zones. **The values of the real time updates to these temperature zones are limited to ranges set as TEMP LIMIT values in the GC Configure table. Also, real time updates to the temperature zones may be limited by temperature programs that are part of the method.**

Real time updates are not executed if the update decrease any temperature in a run; instead, the temperature at the time the lower temperature was entered is maintained. A higher temperature real time update is executed. Changes to temperature program rates and hold times are noted immediately and can affect the run END TIME if other method sections do not require longer times.

- Modifying Time Programs

Changes in the parameters appearing in the DETECTOR, PLOTTER, and RELAY method sections are executed during the run at the run time specified for each in time program. Programs with an indefinite "tune" time are not automatically executed, but are executed by the user during the run.

Changes to the currently active time program line are executed immediately upon entry, such as detector range or plot speed.

7 Warm Start

In the advent of a power failure, **warm start** retains the information stored in the methods and tables you built.

To activate the warm start feature, move the battery switch position to the **up** or ON position.

Besides retaining the methods, warm start also returns the GC to the place in the PRGM when the power failure occurred and continues the run from there.

If the power was off for an extended period and the thermal zones cooled, automation resumes when thermal zones have restabilized.

If the battery was removed or the battery switch position was **down** or in the OFF position, the GC **cold starts** when power is turned on. All methods and tables appear as their preset values. You may need to perform a cold start as part of a diagnostic procedure. Refer to the **Diagnostics/Troubleshooting** section for **Cold Starting the GC**.

Automation Control

1 Introduction

3000 Series GCs (except 3300 GCs) may be operated with autosamplers or sampling valves to provide unattended and automatic chromatographic analyses. Automated analyses can be set up in one of two ways: as rack driven sequences or as method driven sequences. If a GSV (gas sample valve) is used for sample introduction, the automation sequence can only be driven by a method.

2 Rack Table Automation

Rack table automation can only be used in conjunction with a Varian AutoSampler. A GC method number is assigned to each AutoSampler rack. Any method can be assigned to a rack and can be used more than once. Rack numbers are displayed in the RACK TABLE along with the GC method assigned to a particular rack. The automation sequence begins with the rack in which the first sample vial is encountered by the AutoSampler. The GC method associated with that rack is then activated and all vials in that sample rack are injected. The instrument will complete the first rack encountered, then continue through the remaining racks in the same manner.

If more than one method number is listed for the same rack number, the method number for the first rack found in the rack table will be the only one used even if other method numbers are listed.

2.1 Building a RACK TABLE

EXERCISE: Building a RACK TABLE

1. Press [BUILD/MODIFY] [RACK TABLE] to display

STOP AUTOMATION AFTER ERROR

or

PRGM 1 RACK NUMBER XXX

> *NOTE: STOP AUTOMATION AFTER ERROR is displayed only if the IBDH option is present. Refer to HELP 24 for additional information.*

2. Continue through the RACK TABLE displays, entering the necessary information. When the “ADD” display for the next PRGM is displayed, enter YES to continue building PRGMs *or* NO to display

RACK TABLE COMPLETED

3. The RACK TABLE is now built. Activate the table as described in the *Operation* section. Build the appropriate chromatographic methods for the samples to be analyzed. Make certain that the AUTOSAMPLER section of each method has the AutoSampler MODE set to MULTI. A rack that calls for a method that does not have an AutoSampler section, **or** has its MODE set to OFF, **or** a rack not listed in the table, will be skipped.

   After you have built the GC methods, you can then build the automation table. Press BUILD/MODIFY RACK TABLE. The first program will request the rack number. Enter a number from 1 to 4. Next, you will be prompted to enter the GC method number you want to assign to that particular rack. Enter a number from 1 to 4. (Use keys from the ENTRY pad only). You can enter a total of 16 different rack automation routines. These routines will be executed in the order that the rack numbers are encountered in the AutoSampler. Refer to paragraph 4 for running with rack table automation.

3 Sequence Table Automation (AutoSampler and Valve Control)

Sequence table automation is used to create automation routines that depend on the execution of GC methods in the order that they are entered into the Sequence table. Sequence table automation routines can be created that use the following sample injection or delivery devices: Varian AutoSamplers, sampling valves, or relays activated through the RELAY section of the GC method.

In order to use these various sample delivery devices, you must have installed in your GC the appropriate hardware, such as valves, relays, and controllers.

3.1 Building a SEQUENCE TABLE

EXERCISE: Building a SEQUENCE TABLE for Relay Control

1. Build the GC methods that are to be used in the automation sequence. If you are using sampling devices that must be activated by relays (e.g., gas sampling valves), build the RELAY section of the GC method.
2. Press [BUILD/MODIFY] [SEQUENCE TABLE]

   Display:

   RUNS OF TABLE? SINGLE (MULTI)

   > *NOTE: STOP AUTOMATION AFTER ERROR is displayed only if the IBDH option is present. Refer to HELP 24 for additional information.*

   Enter the GC method numbers in the order they are to be run.

   When the “ADD” display for the next PRGM is displayed, enter YES to continue building PRGMs **or** NO to display:

   SEQ TABLE COMPLETED
3. The SEQUENCE TABLE is now built.

EXERCISE: Building SEQUENCE TABLE For Use With the AutoSampler

This example demonstrates how an automation sequence executes Method 1 then Method 2 on alternate vials.

1. Press [BUILD/MODIFY] [SEQUENCE TABLE].

Display:

RUNS OF TABLE? SINGLE (MULTI)

2. Enter MULTI.

Display:

STOP AUTOMATION AFTER ERROR* or PRGM n RUN METHOD

> *NOTE: STOP AUTOMATION AFTER ERROR is displayed only if the IBDH option is present. Refer to HELP 24 for additional information.*

For RUN METHOD enter 1. For NUMBER OF RUNS enter 1.

3. Add the next sequence table program and build SEQ PRGM 2. For RUN METHOD enter 2. For NUMBER OF RUNS enter 1..

For ADD NEXT SEQ TABLE PROGRAM enter NO. SEQ TABLE COMPLETED will be displayed.

4. *In the AUTOSAMPLER method section,* build Method 1 with AutoSampler mode MULTI.

5. *In the AUTOSAMPLER method section,* build Method 2 with AutoSampler mode MULTI. The number of injections per vial are done on the first vial, then Method 2 is run on the second vial. Since we had only two methods, it then goes back to the top of the Sequence table and runs the Sequence table again.

> *NOTE: If the AutoSampler mode is OFF when the START key is pressed, the GC goes to RUN without activating the AutoSampler, i.e., no Auto Injection occurs. The AUTOSAMPLER Method Section mode determines whether runs are MULTI, SINGLE, or OFF.*

Build the methods that are entered in this table. Make sure that the AutoSampler mode in the AUTOSAMPLER section is set to MULTI. An incomplete method with valve control or AutoSampler or with AutoSampler mode set to OFF, will be skipped when automation is running.

The number of injections per vial (INJ/VIAL) and the NUMBER OF RUNS must be combined to give the total number of injections from both a given vial and the program. As an example, if the INJ/VIAL in the method was set to 3 and the NUMBER OF RUNS as 2, the total program would be repeated 6 times before proceeding to the next method. Any number of programs from 1 to 16 can be repeated up to 99 times. When the AutoSampler is used, make certain that you do not create an automation routine that injects a total volume (injection volume x number of runs x number of automation sequences) that exceeds the volume of sample in the vial. Refer to paragraph 4 for running with sequence table automation.

4 Running with Rack Table or Sequence Table Automation

Now that you have prepared the samples, loaded them into their respective racks in the AutoSampler carrousel, and completed building the GC methods and automation tables, you can start a run.

Press ACTIVATE RACK TABLE *or* ACTIVATE SEQUENCE TABLE.

Pressing START will begin the vial search in the first rack encountered. When the method listed in the first rack or sequence routine has been activated and the status of the GC is Ready, the injection sequences begin. This automation routine will continue until you press RESET or until the automation sequence is complete. If you want to halt the automation sequence at the end of the current run, press SHIFT (RACK TABLE) SUSPEND *or* SHIFT (SEQUENCE TABLE) SUSPEND. To re-activate this automation process, press START again.

SUSPEND FUNCTION CAUTION: Do Not try to suspend the operation of the AutoSampler during its inject cycle.

You may eliminate a program from the automation sequence at any time by pressing [DELETE PROGRAM]. If you want to eliminate the entire table, press [DELETE SECTION/TABLE] and specify the table to be deleted.

NOTE: Refer to the following HELP numbers for:

for	*HELP Number for BUILD/MODIFY*	*HELP Number STATUS*
AutoSampler	*19*	*20*
Rack Automation	*24*	*25*
Sequence Automation	*26*	*27*

External Events

1 Introduction

For 3000 Series GCs (except 3300s), the External Events PCB must be installed to provide 4 external event relays. For 3300 GCs, the External Event PCB must be installed to provide one relay for use with the split/splitless capillary injector, for example.

These external event relays must be cabled correctly for the application desired (see paragraph 3). Relays are controlled in the RELAY method section. A brief exercise on setting up the RELAY section precedes the hardware cabling connections.

2 Building The Relay Method Section

The optional GC relays may be used to automate valves, to operate split/splitless capillary injectors, or to drive auxiliary functions.

EXERCISE

1. Press BUILD/MODIFY, the appropriate METHODS key, then RELAY to display

   ADD RELAY SECTION? NO

2. Press YES ENTER to add the RELAY section to the method and advance too

   INITIAL RELAY STATES -1-2-3-4

   The minus sign in front of each number indicates that the numbered relay is OFF.

Þ IMPORTANT Refer to the appropriate Split/Splitless Capillary Injector Manual for setting splitless relays.

3. Continue through the RELAY displays, entering values for your particular application. If you have a question or problem, press SHIFT+HELP for additional assistance.

4. After the final PRGM is built

METHOD X COMPLETE — END TIME XXXXX

is displayed and remains displayed until you select another action.

3 External Events: Installation and Cabling Connections

Refer to Figure 1 or 2 (Star 3600 CX only) and install the appropriate External Events PCB, if it is not already installed.

Refer to Table 1 for the maximum amperages supported by external events.

Table 1 Maximum Amperages Supported by External Events

Voltage of TB1 (on External Events PCB)	Maximum Amperages Supported
24 VAC	2 A maximum for any 1 event or a total of 3 A for all 4 events
Options:	
120 VAC (power from autotransformer winding) 120/240 VAC (line voltage)	Contact your local Varian Customer Support Representative for assistance.

Ö NOTE

In parallel with Event 3 (EV. 3) is a double-pole, double-throw relay used for detector channel switching. This relay is used to switch between Detector A and Detector B analog signal during a run. The relay is controlled by timed events in the method. This relay is always present on Event 3. CAUTION: Switching power loads with this relay will ruin the contacts for analog switching.

In parallel with Event 4 (EV. 4) is a single-pole, double-throw auxiliary relay (J96 AUX). The auxiliary relay contacts are rated for 3 watts DC, 0.25 A max and 28 VDC. This relay is also controlled by timed events in the method. This relay is always present on Event 4.

3.1 External Events PC Board

To install the External Events PC Board in a GC, proceed as follows:

WARNING

[illegible]
UNPLUG POWER CORD

1. Remove the GC top covers and high voltage cover. Locate and remove the External Events PCB.

2. Changing the Voltage of Barrier Strip TB1: Refer to Detail A. Standard voltage on TB1 is 24 VAC. This voltage may be changed to either 120 VAC or to 120/240 VAC by your local Varian Customer Support Representative.

3. Installing the External Event Wiring: Valve actuators may be wired into any of four external event (EV) positions of TB1 for Star 3400 CX GCs. For 3300 GCs, hook-up to EV 1 only.

   a. Strip back about 0.25" of the insulation from the wires to be connected to TB1.

   b. Insert the exposed ends of the wires into the desired EV position and secure using the screws along the front of TB1. See Detail B.

4. Signal Switching with External Events (Star 3400 CX only): If, for example, you want to switch between the Detector A integrator output (INTEG A, J10) and the Detector B integrator output (INTEG B, J13). Connect an interface cable (03-917853-01) between Detector A Integrator (INTEG A, J10) and Channel A input (CHAN A, J99) on the External Events PCB. Connect a second Interface cable between Detector B integrator (INTEG B, J13) and Channel B input (CHAN B, J97) on the External Events PCB. Then connect a Signal cable (02-001954-00) from the output (J98) on the External Events PCB to the integrator analog input. Figure 1 illustrates this connection. Install the cable clamp to the back of the GC (see Detail D).

5. Connect the Auxiliary cable (P/N 03-917856-00, not supplied) to J96 on the External Events PCB (Star 3400 CX only). Route the opposite end of the cable through back of the GC. Position the clamp over the exposed braid on the cable. Attach the cable and screws per Detail E, then screw the clamp to back of GC. Tighten the clamp down over the cable.

6. Replace the high voltage cover, making sure the tab on cover fully depresses the interlock switch (S1) on the Power Supply PCB. Replace the GC top covers.

3.2 External Events PC Board - Star 3600 CX GC

WARNING

[illegible]

1. Remove the GC top covers and high voltage cover. Locate and remove the External Events PCB.

2. Changing the Voltage of Barrier Strip TB1: Refer to Detail A. Standard voltage on TB1 is 24 VAC. This voltage may be changed to either 120 VAC or to 120/240 VAC by your local Varian Customer Support Representative.

3. Installing the External Event Wiring: Valve actuators may be wired into any of four external event (EV) positions of TB1 for Star 3600 CX GCs.

   a. Strip back about 0.25" of the insulation from the wires to be connected to TB1.

   b. Insert the exposed ends of the wires into the desired EV position and secure using the screws along the front of TB1. See Detail B.

4. Signal Switching with External Events: If, for example, you want to switch between the Detector A integrator output (INTEG A, J10) and the Detector B integrator output (INTEG B, J13). Connect an interface cable (03-917853-01) between Detector A Integrator (INTEG A, J10) and Channel A input (CHAN A, J99) on the External Events PCB. Connect a second Interface cable between Detector B integrator (INTEG B, J13) and Channel B input (CHAN B, J97) on the External Events PCB. Then connect a Signal cable (02-001954-00) from the output (J98) on the External Events PCB to the integrator analog input. Figure 2 illustrates this connection. Install the cable clamp to the back of the GC (see Detail D).

5. Connect the Auxiliary cable (P/N 03-917856-00, not supplied) to J96 on the External Events PCB. Route opposite end of cable through the back of the GC. Position the clamp over the exposed braid on the cable. Attach the cable and screws per Detail E, then screw clamp to the back of the GC. Tighten the clamp down over the cable.

6. Replace the high voltage cover, making sure the tab on the cover fully depresses the interlock switch (S1) on the Power Supply PCB. Replace the GC top covers.

3.3 Signal Switching with External Events

In addition to the 4 ac external events, the External Events PCB has one general purpose detector switching relay and one general purpose single-pole, double-throw auxiliary relay. The connector assignments for the auxiliary and detector relays are as follows:

J96	Auxiliary (AUX) (SPDT)
J97	Channel B Input (CHAN B)
J98	A or B Output (OUTPUT)
J99	CHANNEL A INPUT (CHAN A)

The single-pole, double-throw auxiliary relay (J96 AUX) contacts are rated for 3 watts DC, 0.25 A max and 28 VDC. This relay is controlled by timed events in the method and is always present on Event 4. The auxiliary relay is intended for those applications where a contact closure is needed during the GC run. The auxiliary relay could be used to 1) provide a delayed start for an integrator, 2) provide an integrator enable/disable function, or 3) provide a contact closure when using an Auxiliary cable (03-917856-00). See Figure 1 or 2. The Auxiliary cable is not supplied with the GC.

The detector relay is intended to allow the operator to switch between Detector A and Detector B signals, located on the left side of the GC (J9 through J14). See Detail C of Figure 1 or 2. The detector switching relay is controlled by timed events in the method and is always present on Event 3.

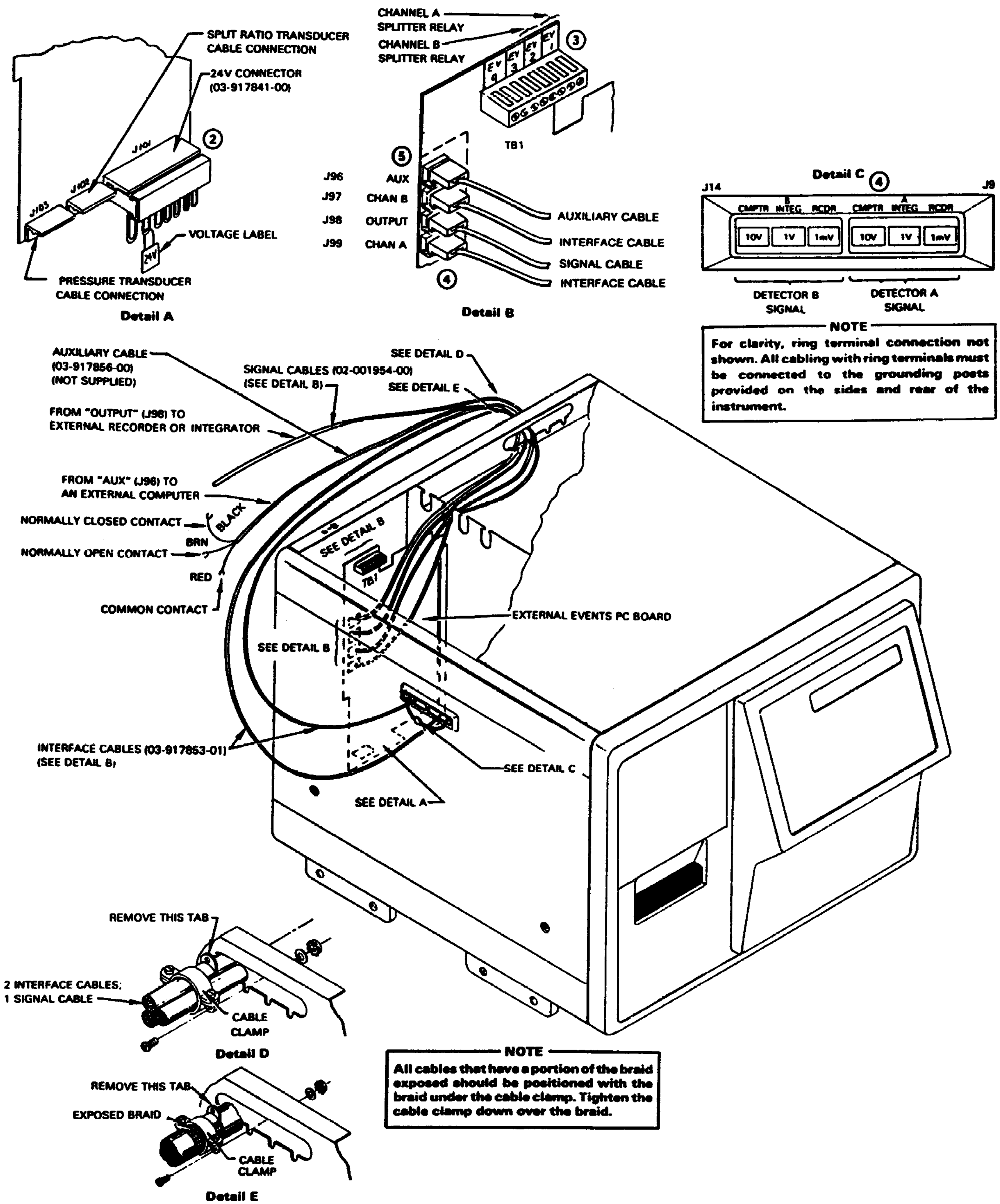


Figure 1 External Event Cabling and Installation (3300, Star 3400 CX GCs)

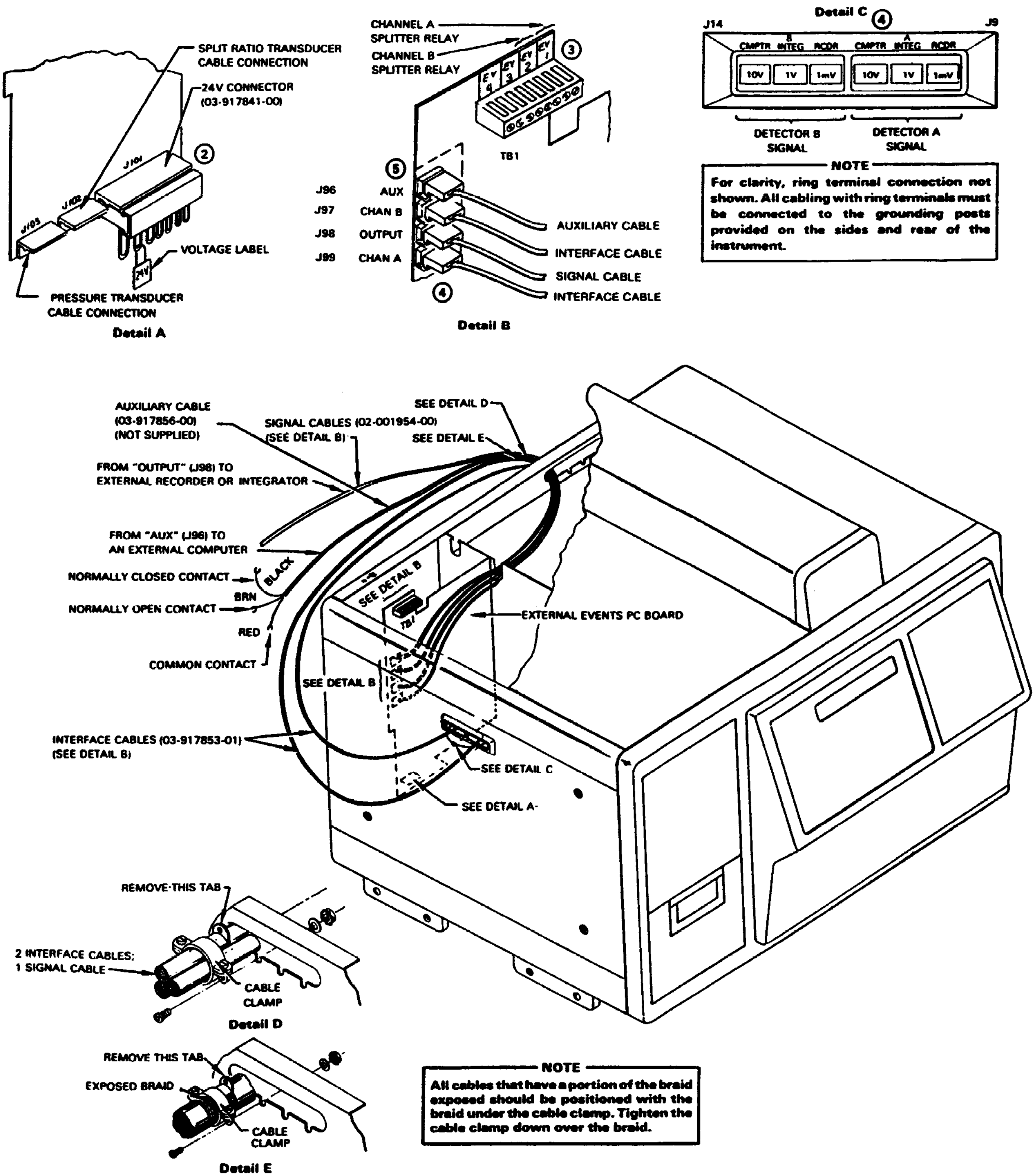


Figure 2 External Event Cabling and Installation (Star 3600 CX GCs)

Installation of Packed and Capillary Columns

1 Introduction

The following installation instructions are for packed columns (paragraph 3) and capillary columns, including 530 columns (paragraph 2) for 3000 Series GCs.

2 Installation of a Fused Silica Capillary Column

To ensure reproducible peak shapes, make certain that you install the column correctly. Failure to install the column correctly can result in: excessive tailing due to the adsorption of analyte onto the polyimide coating; and, noise spikes from particles of graphite ferrule entering the flame (for flame detectors).

The thin polymeric coating on fused silica columns offers some protection against breakage; however, fused silica columns are fragile and must be handled with care. *DO NOT remove the polymeric coating from the fused silica column*.

> *NOTE: For exploded and cross-sectional views of the detector, refer to the injectors section in the Options/Accessories Manual.*

2.1 Preparation of the Ends of a Capillary Column

To prevent the adsorption of analyte onto the polyimide coating, use a proper scoring tool (e.g., tungsten carbide pencil, P/N 29-900613-00) to squarely and smoothly cut the ends of the column. You can also use a fine cut or jewelers file. *Do not use coarse files to cut the columns. Coarse cut files leave rough edges that can affect chromatographic performance*.

To prepare the capillary column ends, proceed as follows:

1. Before cutting the sealed ends of the column, slide the capillary column nut over the column end.
2. Install the appropriate Vespel® or Graphite ferrule onto the column. Make certain that the tapered edge is toward the upper end of the column. This prevents contaminating the column with ferrule material. See Figure 1.

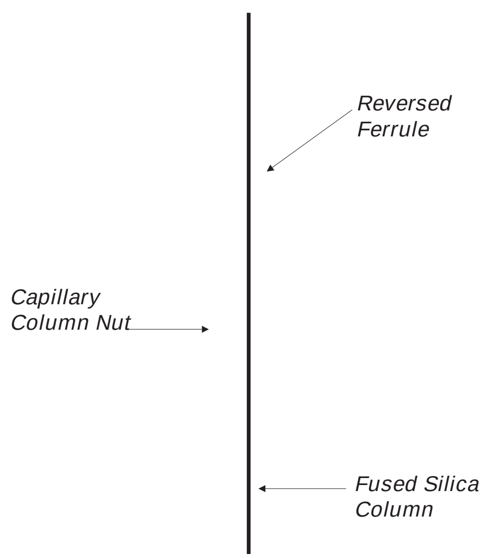


Figure 1
Position of Nut and Ferrule

Refer to Tables 1, 2, and 3 for part numbers for common column ferrules.

Table 1
Ferrules for Fused Silica Capillary Columns

Size (Column ID)	Vespel®	40% Graphite/ 60% Vespel®	Graphite
1/16" no hole	28-694503-01	28-694590-01	N/A
0.4 mm (0.25 mm)	28-694586-01	28-694580-01	28-694583-01
0.5 mm (0.32 mm)	03-908361-01	28-694581-01	28-694561-01
0.8 mm (530) (0.53 mm)	28-694552-01	28-694582-01	28-694042-01

Table 2
Ferrules for Packed Columns or Injectors

Size	Vespel®	Graphite	Graphite Vespel®	Stainless Steel	Brass
1/16"	28-694043-01	16-000714-00	28-694538-01	Front 28-693996-01 Back 28-693997-01	Front 16-000194-01 Back 16-000195-01
1/8"	28-694539-01	16-000715-00	28-694539-01	Front 28-693995-01 Back 28-693 998-01	Front 28-694027-01 Back 28-694 028-01
1/4"	28-694049-01	28-694046-01	28-694523-01	Front 28-693986-01 Back 16-000046-01	Front 28-694584-01 Back 28-694585-01

Table 3
Special Reducing Ferrules

Size	Vespel®	Graphite	Graphite/Vespel®
1/4" nut to 1/8" tube	28-694543-01	28-694048-00	28-694540-01
1/8" nut to 1/16" tube	28-694541-01	28-694500-00	28-694536-01

3. Hold the column securely between the thumb and forefinger of one hand. Score the column *once* lightly with the cutting tool about 1 to 2 cm from the sealed end. See Figure 2.
4. Grasp the column between thumb and forefinger (see Figure 3). Bend the column slightly until it breaks at the score mark. Use a magnifying lens (e.g., 20X magnifier, P/N 00-997369-00) to examine the cut. See Figure 3.
5. If you observe small splinters of silica or some of the outer coating on the column end, repeat the above procedure and make a fresh cut.

Figure 2
Creating a Clean Column Cut

Figure 3
Correct and Incorrect Column Cuts

2.2 Connection of a Capillary Column to an Injector

The following section presents instructions for connecting a capillary column to different types of injectors. Refer to paragraph 2.2.1 through paragraph 2.2.4 for the injector installed on the GC.

2.2.1 Capillary Column to the 1075/1077 Split/Splitless Capillary Injector

To connect a capillary column to the 1075 or 1077 Split/Splitless Capillary Injector, proceed as follows:

1. Check that the capillary column nut and the reversed ferrule are installed on the column as described in paragraph 2.1. See Figure 1.
2. Uncoil about 20 cm of the injector end of the column.
3. Move the column nut and ferrule to within 5 cm of the column end. Measure the correct distance from the end of the column and mark this distance with a felt pen. Refer to Figure 4 for the correct distances. *NOTE: DO NOT let the column nut and ferrule fall past this mark. The marking medium can contaminate the ferrule.*
4. Insert the column partially into the lower end of the injector. Thread the capillary column nut and ferrule finger tight.

Figure 4
Required Column Connection Dimensions for Detectors
and the 1075/1077 Split/Splitless Capillary Injector

5. Gently push the column into the injector until the mark on the column aligns with the bottom edge of the column nut.

Insert the column the full 5.7 cm distance. Failure to insert the column the full distance results in poor injector performance.

6. Continue to hold the column as you tighten the column nut carefully. Tighten the column nut just enough to hold the column firmly in place and to create a good seal.

7. Go to paragraph 2.3, Connection of the Capillary Column to a Detector. To determine the distance the column is to be inserted into a particular detector (see Figure 4).

2.2.2 530 Micron Column to the 1041 530 Micron Injector

To connect a 530 column to the 1041 530 Injector, proceed as follows:

1. Check that the capillary column nut and the reversed ferrule are installed on the column as described in paragraph 2.1. See Figure 1.

2. Uncoil about 20 cm of the injector end of the column.

3. Insert the column into the injector. Gently push the column into the injector until the column stops (about 3-1/2 inches). This positions the column against the upper end of the 530 insert. Make certain that the column is inserted the full distance. Failure to insert the column the full distance results in poor injector performance.

4. Continue to hold the column as you tighten the column nut carefully. Tighten the column nut just enough to hold the column firmly in place and to create a good seal.
5. After the column is installed at the injector end, make several dry injections to ensure that the needle enters the column easily.
6. Go to paragraph 2.3, Connection of the Capillary Column to a Detector. To determine the distance the column is to be inserted into a particular detector (see Figure 4).

2.2.3 530 Micron Column to the 1093/1094 Septum Equipped Programmable (SPI) Injector

To connect a capillary column to the 1093/1094 Septum Equipped Programmable Injector, proceed as follows:

1. Check that the capillary column nut and the reversed ferrule are installed on the column as described in paragraph 2.1. See Figure 1.
2. Uncoil about 20 cm of the injector end of the column.
3. Move the nut and ferrule to within 5 cm of the column end.
4. Partially insert the column into the lower end of the injector. Thread up the capillary column nut and ferrule **finger tight.**
5. Insert the column into the injector. Gently push the column into the injector until the column stops. This positions the column against the upper end of the 530 insert. Make certain that the column is inserted the full distance. Failure to insert the column the full distance results in poor injector performance. The column must be properly seated. If it is not, the injector will not function properly.
6. Continue to hold the column as you tighten the column nut carefully. Tighten the column nut just enough to hold the column firmly in place and to create a good seal.

   After the column is installed at the injector end, make several dry injections to ensure that the needle enters the column easily.
7. Go to paragraph 2.3, Connection of the Capillary Column to a Detector. To determine the distance the column is to be inserted into a particular detector (see Figure 4).

2.2.4 530 Micron Column to the 1061 Injector

To connect a capillary column to the 1061 Injector, proceed as follows:

1. Check that the capillary column nut and the reversed ferrule are installed on the column as described in paragraph 2.1. See Figure 1.
2. Uncoil about 20 cm of the injector end of the column.
3. Move the nut and ferrule to within 5 cm of the column end.
4. Partially insert the column into the lower end of the injector. Thread up the capillary column nut and ferrule **finger tight.**
5. Insert the column into the injector. Gently push the column into the injector until the column stops (about 2 inches). This positions the column against the upper end of the insert. Make certain that the column is inserted the full distance. Failure to insert the column the full distance results in poor injector performance.
6. Continue to hold the column as you tighten the column nut carefully. Tighten the column nut just enough to hold the column firmly in place and to create a good seal.

   After the column is installed at the injector end, make several dry injections to ensure that the needle enters the column easily.

7. Go to paragraph 2.3, Connection of the Capillary Column to a Detector. To determine the distance the column is to be inserted into a particular detector (see Figure 4).

2.3 Connection of a Capillary Column to a Detector

To connect a capillary column to a detector, proceed as follows:

1. Check that the capillary column nut and the reversed ferrule are installed on the column as described in paragraph 2.1. See Figure 1.
2. Uncoil about 20 cm of the detector end of the column.
3. Move the column nut and ferrule to within 5 cm of the column end. Measure the correct distance from the end of the column and mark this distance with a felt pen. Refer to Figure 4 for the correct distances. *DO NOT let the column nut and ferrule fall past this mark. The marking medium can contaminate the ferrule.*

> *NOTE: DO NOT use graphite ferrules with the ECD.*

4. Partially insert the column into the lower end of the detector. Thread the capillary column nut and ferrule *finger tight*.
5. Gently push the column into the detector until the mark on the column aligns with the bottom edge of the column nut.

   Insert the column the full distance. Failure to insert the column the full distance (within 2 mm) results in poor detector performance.
6. Continue to hold the column as you tighten the column nut carefully. Tighten the column nut just enough to hold the column firmly in place and to create a good seal.

3 Installation of a Packed Column

Both glass and metal packed columns can be used with 3000 Series GCs. The following section presents instructions for installing different types of packed columns in the GC. Refer to paragraph 3.1 or paragraph 3.2 for the packed column to be installed in the GC.

3.1 Installation of a Metal Packed Column

To install a metal packed column, proceed as follows:

1. Metal packed columns are usually installed with a metal two-piece ferrule. Place nuts and ferrules on both ends of column as shown in Figure 5.

> *NOTE: For exploded and cross-sectional views of the detector, refer to the Injectors section in the Options/Accessories Manual.*

2. Insert the column into both the injector and detector oven fittings and push each end until the column bottoms out in the injector and detector.
3. Hold the column in place and thread the column nuts by hand. Avoid cross-threading the fitting.
4. Use a small wrench to tighten the column nut on each fitting. For 1/8" columns, tighten the column nut 3/4-turn past finger tight. For 1/4" columns, tighten the column nut 3/4-turns past finger tight.

Except for the initial installation of a metal column, always tighten the column nut 1/4- to 1/2-turn past finger tight.

> *CAUTION: Use care when installing stainless steel assemblies. Stainless steel-to-stainless steel unions are subject to galling when over tightened and operated at high temperatures. A galled or stripped thread can require costly repairs to the GC.*

3.2 Installation of a Glass Packed Column

Use particular care when unpacking and installing glass packed columns. Use graphite ferrules in the column nut when you install glass columns. *NEVER use metal ferrules to install glass columns*.

To install a glass packed column, proceed as follows:

1. Place the nuts and ferrules on the detector and injector ends as shown in Figure 6.
2. Slowly insert the column into both the injector and detector oven fittings and *gently* push each end into the fittings until the column just bottoms out in the injector and detector.
3. Hold the column in place and thread the column nuts by hand. Avoid cross-threading the fitting.
4. Before you tighten the nut with a wrench, withdraw each column end approximately 1/32" from the internal restriction. This gap prevents fracturing the end of the glass column when the nut is tightened into place.

> *NOTE: Tightening the nut and ferrule tends to "draw" the column against the shoulder. If the glass column is butted against the shoulder, the glass column can shatter.*

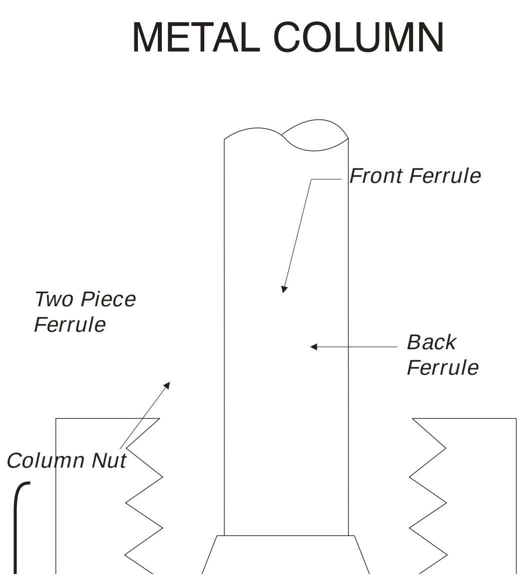


Figure 5
Position of Nut and Ferrules on End of Metal Column

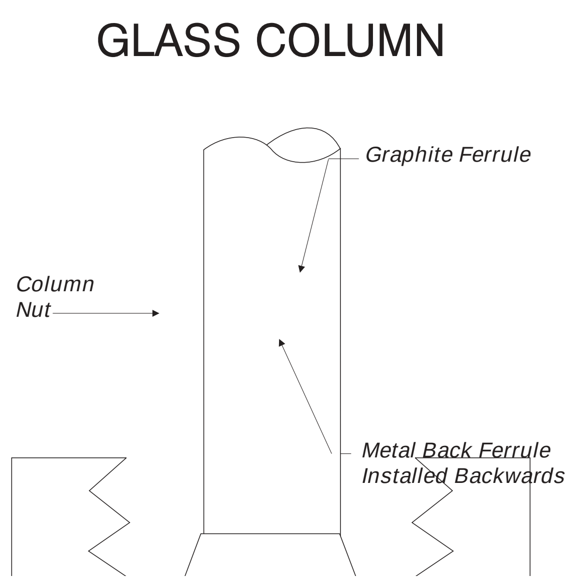


Figure 6
Position of Nut and Ferrules on End of Glass Column

5. Use a small open end wrench to tighten the column nut 3/4-turn past finger tight. *Tighten the nut just enough to get a good gas tight seal*. If you over tighten the nut, you can break the column or distort the ferrules which can then result in poor chromatographic performance.

> *GLASS COLUMNS — SPECIAL PRECAUTIONS*
> *Always work carefully in or around an oven containing mounted glass columns. When glass columns are hot, do not use liquids to check for leaks around the column fittings. The cool liquid can thermally shock the glass and break the column.*

4 Electronic Press-Split Flow Readout Option

The pressure-split flow readout is a factory installed option to the Star 3400 CX GC.

If you have the pressure-split flow option installed in your Star 3400 CX GC, refer to **Section 4.1, Operation With Electronic Pressure-Split Flow Readout**, for details on measuring and adjusting the volumetric flow rate of your Star 3400 CX GC.

If you do not have the electronic pressure-split flow readout option installed in your Star 3400 CX GC, refer to **Section 4.2, Operation Without Electronic Pressure-Split Flow Readout**, for details on measuring and adjusting the volumetric flow rate of your Star 3400 CX GC.

The electronic pressure-split flow readout option is composed of two separate options: electronic pressure readout (P/N 03-917563-01) and electronic split flow readout (P/N 03-917564-00). The electronic pressure readout option uses a pressure transducer to convert pressure to an electrical signal that is subsequently displayed as a digital value on the GC front panel. In addition, the electronic pressure readout option provides the column linear velocity and volumetric flow rate. These digital values are displayed on the GC front panel as well. The column linear velocity and volumetric flow rate are calculated based on parameters entered in the GC Configuration Table.

The electronic split flow readout option uses a flow transducer to calculate the split ratio and is displayed as a digital value on the GC front panel. In order for the 3000 Series GC to calculate a split ratio value, it must be equipped with both the electronic pressure readout and electronic split flow readout options.

The electronic pressure readout option can be used with any capillary injector. The electronic split flow readout option is used exclusively with the 1077 Split/Splitless Capillary Injector (P/N 03-917552-00).

4.1 Operation With Electronic Pressure-Split Flow Readout

A Star GC equipped with electronic pressure-flow readout provides continuous electronic readout of column pressure and volumetric flow rate. To enable this option, you must add a Column Parameter section to the GC Configure Table. The Column Parameter section sets the following column parameters: column length, column diameter, and carrier gas. To set the column parameters, proceed as follows:

1. Press the GC Configure key.

   Display reads: **`SET TIMES OR DATE?  NO`**

2. Press the Left Display Control key (Left Arrow) twice.

   Display reads: **`SET COLUMN PARAMETERS?  NO`**

3. Press the Yes key (key 4) of the alphanumeric keypad and then press the Enter key.

Display reads: **`COLUMN A INSTALLED?  NO`**

4. Press the Yes key (key 4) of the alphanumeric keypad and then press the Enter key. Or, press the Enter key if column A is not installed. If NO is entered, pressure and flow status is not displayed.

   Display reads: **`COLUMN A LENGTH IN METERS`**

5. Enter a value using the alphanumeric keypad and then press the Enter key.

   Display reads: **`COLUMN A ID IN MICRONS`**

6. Enter a value using the alphanumeric keypad and then press the Enter key.

   Display reads: **`COLUMN A CARRIER GAS`**

7. Use the alphanumeric keypad to enter 1 (He), 2 (N_2), or 3 (H_2), then press the Enter key.

   Display reads: **`COLUMN B INSTALLED?  NO`**

8. Press the Yes key (key 4) of the alphanumeric keypad and then press the Enter key. Or, press the Enter key if column B is not installed.

   Display reads: **`COLUMN B LENGTH IN METERS`**

9. Enter a value using the alphanumeric keypad and then press the Enter key.

   Display reads: **`COLUMN B ID IN MICRONS`**

10. Enter a value using the alphanumeric keypad and then press the Enter key.

    Display reads: **`COLUMN B CARRIER GAS`**

11. Use the alphanumeric keypad to enter 1 (He), 2 (N_2), or 3 (H_2), then press the Enter key.

    Display reads: **`OTHER CONFIGURATIONS?  NO`**

12. Press the Enter key.

    Display reads: **`GC CONFIGURE TABLE COMPLETE`**

The COLUMN status section of the Star GC method displays the following: column temperature (COL), volumetric flow rate (FLOW), column head pressure (PRESSURE), split ratio (SPLIT RATIO), and column average linear velocity (COLUMN VELO). To access the Column Status information, proceed as follows:

1. Press the Status key.
2. Press the Column key.
3. Press the Left Display Control key (Left Arrow) to review the column parameters and view the status of each parameter:

   COL 00 SET 00 (C)
   FLOW A 0.0 SET 0.0 (mL/min)
   FLOW B 0.0 SET 0.0
   PRESSURE A 0.0 SET 0.0 (psig)
   PRESSURE B 0.0 SET 0.0
   SPLIT RATIO A 0 SET 0
   SPLIT RATIO B 0 SET 0
   COL A VELO 0.0 CM/SEC SET 0.0 (cm/sec)
   COL B VELO 0.0 CM/SEC SET 0.0

The back pressure regulator controls the column inlet pressure. The column flow and average linear velocity are then calculated using the column parameters entered in the GC Configure Table.

The total flow into the system is measured with a transducer that requires an inlet pressure of 80 psig. If the inlet pressure **is not 80 psig**, follow the calibration procedure in Section 2, paragraph 2.5.2 of the 1077 Split/Splitless Capillary Injector Operator's Manual (P/N 03-914039-00) to calibrate the split ratio transducer. The total flow rate is divided by the calculated column flow rate to obtain the split ratio displayed on the GC front panel.

The 1077 Split/Splitless Capillary Injector provides a split ratio based on a carefully controlled flow rate. A back pressure regulator is used to control column head pressure. The flow controller sets the total flow into the system (see Figure 1).

1. Turn the splitter flow controller (FLOW) on the pneumatics panel a few turns to a flow rate greater than 10 mL/min.
2. To obtain the desired linear velocity, turn the back pressure regulator to the desired pressure. Monitor the PRESSURE display or FLOW display in the COLUMN status section.

Adjusting the flow controller will not change the pressure and, therefore, will not change the flow through the column.

3. Set the splitter flow controller to provide a flow at the desired split ratio. Monitor the SPLIT RATIO display in the COLUMN status section.

4.2 Operation Without Electronic Pressure-Split Flow Readout

Follow these instructions to set the gas flows for 3400 GCs (without electronic pressure-split flow readout) equipped with a 1077 Split/Splitless Capillary Injector.

The 1077 Split/Splitless Capillary Injector uses a flow controlled split ratio with a back pressure regulator for controlling head pressure. The flow controller sets the total flow into the system.

To set flows properly, the flow controller, if it has been closed, must be opened. Then set the column flow using the pressure regulator. Finally, set the exact split ratio with the flow controller.

The column flow is not measured directly. Instead, measure the **linear velocity** of the carrier gas through the column by injecting a component that is not retained. As an example, use a flame ionization detector and inject an unretained component, such as butane. Calculate the average linear velocity using Equation 1-1.

$$\mathit{Linear\,Velocity}\;(\quad) = \frac{\mathit{Length\ of\ column\ (cm)}}{t_0\ \mathit{Butane\ (sec)}}$$

Equation 1-1

The normal range for linear velocity is 30-80 cm/sec. For the 0.32 mm ID test column, a linear velocity of 40 cm/sec corresponds to a flow rate of   2 mL/min.

Calculate the split ratio using Equation 1-2.

$$\mathit{Split\ Ratio}\qquad \frac{\mathit{Column\ Flow}\quad \mathit{Vent\ Flow}}{\mathit{Column\ Flow}}$$

Equation 1-2

For example, a split ratio of 20:1 requires a split vent flow of 38 mL/min when the column flow rate is 2 mL/min.

1. Turn the splitter flow controller (FLOW) on the pneumatics panel a few turns to reach a flow greater than 10 mL/min. Measure this flow at the vent outlet on the left side of the GC. See Figure 1.
2. Adjust the back pressure regulator to a pressure that gives the linear velocity you require. Monitor the pressure on the accompanying pressure gauge.

3. Return to the splitter flow controller. Adjust the flow to the desired split ratio, measuring the flow at the vent location shown in Figure 1. Use Equation 1-2 to calculate the split ratio. Adjustment of the flow controller will not change the pressure, and therefore will not affect the flow through the column.

Column Cryogenics

1 Introduction

Cryogenic operation is used in gas chromatography to improve retention and separation of volatile components. Two types of coolants are used in 3000 Series GCs, liquid carbon dioxide (LCO_2) and liquid nitrogen (LN_2). Operation at temperatures as low as -65   C can be achieved with LCO_2, while -99   C can be achieved with LN_2.

> *NOTE: Due to hardware and plumbing differences between the LCO_2 and LN_2 cryogenic systems, neither coolant can be used with the other system.*

2 Operation Considerations

The choice between LCO_2 and LN_2 depends upon the lower temperature limit you want, the availability of the coolant, and how often you will use the cryogenic system.

2.1 Plumbing and Hardware

If LCO_2 is used, you must use the high pressure valve. Any other valve may rupture.

The LCO_2 (siphon-type) cylinder is connected directly from the tank to the inlet on the gas chromatograph via a 1/8" OD line (see Figure 1). There is no pressure regulator between the cylinder and GC. The control valve in the GC can handle the 1000 psi pressure directly from the cylinder without stepping down the pressure. You should never replace the control valve installed in your GC with another type of valve.

The LN_2 tank is connected directly to the GC as well, but a 1/4" OD tube is used. *The valve on the GC for* LN_2 is a special liquid control valve and should not be replaced with another valve. The reversed LN_2 valve acts as its own pressure relief valve if the pressure exceeds 65 psig.

> *NOTE: In high humidity areas, condensation from the LN_2 valve may quickly fill the drip tray. Check the instrument periodically for moisture build-up (see Detail A, Figure 2).*

2.2 Coolant Consumption

The amount of coolant needed to maintain a certain oven or injector temperature below the ambient temperature depends on the length of the GC column, the temperatures of injectors and detectors, and the ambient temperatures. Table 1 gives estimates (20%) of the amount of LCO_2 or LN_2 you can expect to use at different isothermal oven temperatures.

Table 1
Coolant Consumption at Varying Oven Temperatures

	Isothermal Temperature		
Coolant	-20 C	-60 C	-99 C
LN_2 lbs./hour	7	9	12
LCO_2 lbs./hour	8	10	N/A

Coolant is disabled above 60 C. Cool-down from 50 to -99 C takes about 3 to 4 pounds of LN_2.

2.3 Coolant Safety, Purity, and Ice Build-Up

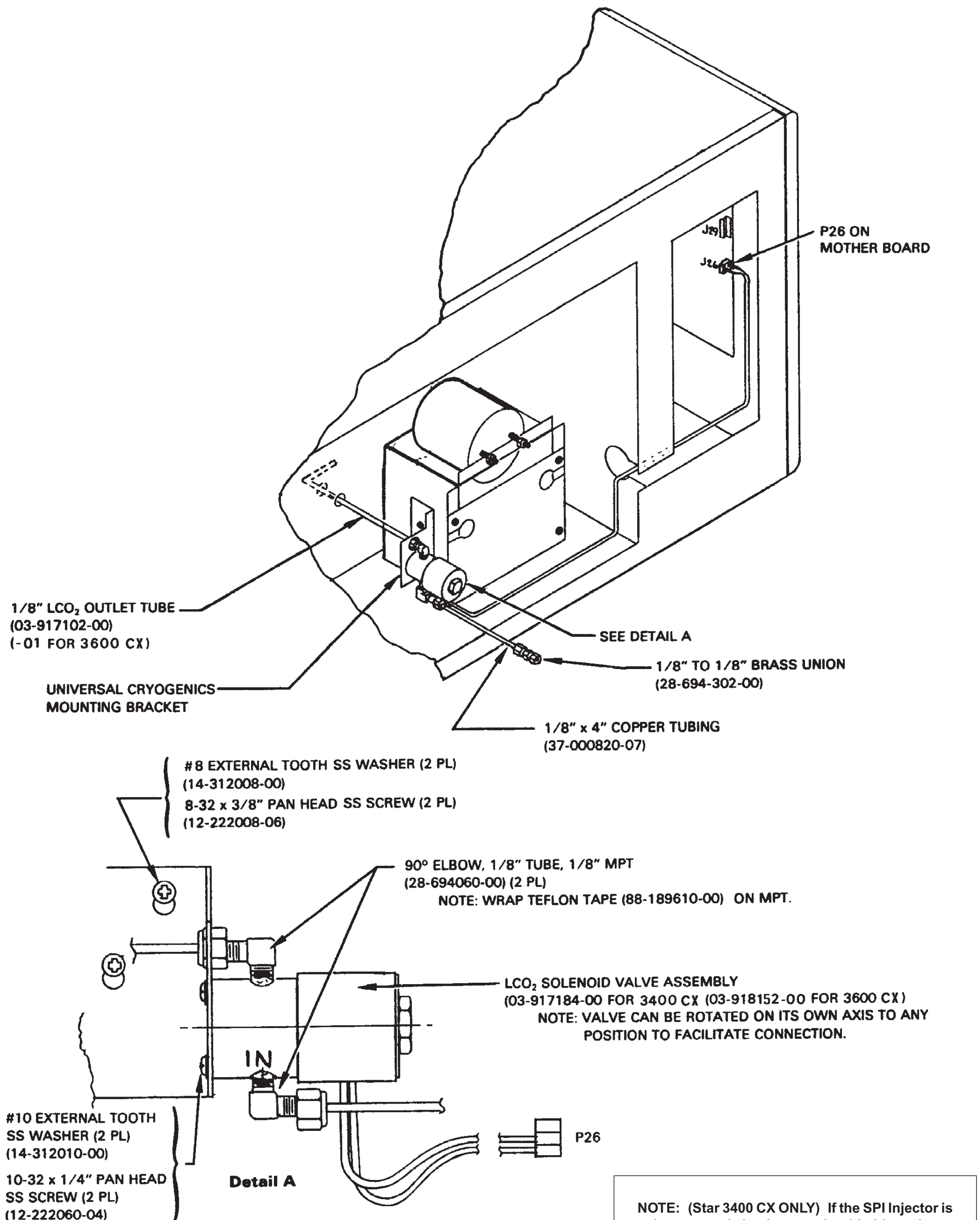
It is also important to consider the safety of coolants. Both LN_2 and LCO_2 give burn-like effects on brief contact with the skin. Furthermore, it is easy to freeze the skin to some metal part that has been cooled down to LN_2 or LCO_2 temperatures.

Avoid contact with freezing surfaces that can result in severe skin burns.

NOTE: **DO NOT** *open the column oven door when oven is at subambient temperatures, as immediate condensation will occur and saturate oven insulation.*

Never trap a liquified gas in tubing without a pressure relief valve. The tubing could explode.

The reversed LN_2 valve acts as its own pressure relief valve and opens when the pressure exceeds 65 psig.



NOTE: (Star 3400 CX ONLY) If the SPI Injector is to be operated simultaneously with this option, a special Temperature Control PC Board is required. Consult your Customer Support Representative.

Figure 1 LCO_2 Installation

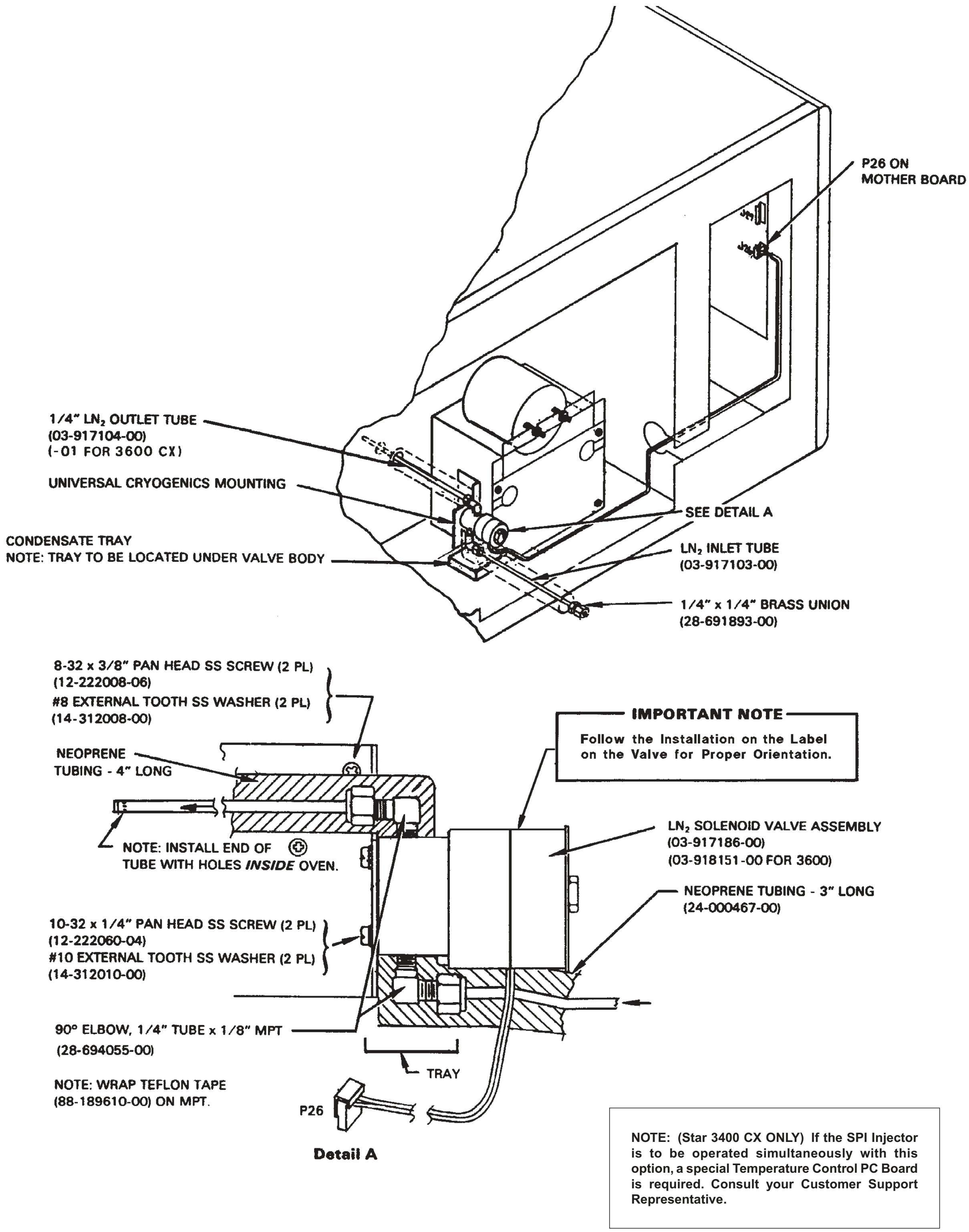


Figure 2 LN$_2$ Installation

3 Installation and Cabling Connections

For subambient temperature operation, either the LCO_2 or the LN_2 assembly is installed at the factory. Should you need to replace fittings, connections, or need to remove the cryogenic option, refer to Figure 1 (LCO_2) or Figure 2 (LN_2).

If you have occasion to remove then reinstall the cryogenic gas outlet tube to the column oven, proceed with care. You want to make certain: (1) that oven insulation material is not blocking the outlet tube, and (2) you do not enlarge the hole in the insulation.

4 Cryogenic Method Configuration

To build a GC method that includes cryogenic cooling of the chromatographic column, proceed as follows:

1. Press the GC Configure key. Press the left (or right) arrow key until the following are displayed:

COOLANT TO COLUMN? NO

COOLANT TO INJECTOR? NO

> *NOTE: The GC display reads: COOLANT TO INJECTOR only when a Septum-Equipped Programmable Injector (SPI) is installed in the GC.*

2. Enter YES.

The desired cryogenic hardware turns ON.

The other GC Configure display related to cryogenics is

COOLANT TIME OUT IN MIN INF

The column (or injector) is continuously cooled when the GC is READY. If for some reason the GC fails to go from READY to RUN, the GC can use large amounts of coolant. To conserve coolant, you can enter a TIME OUT period. The time out is the period of time (in minutes) the GC waits after going READY before it shuts off the coolant. If the GC does not go to RUN before the time out is reached, the coolant is shut off.

If INF (infinite time) is entered, the coolant never shuts off. Once the time out period is reached and the coolant is shut off, press RESET to re-activate the coolant and restart the coolant timer.

Help

HOW TO USE THIS MANUAL

When there is a question about what appears on the instrument display, press SHIFT then **hold** *[HELP]. This displays a number that refers to a specific section in this Help manual. Turn to that number, locate the line(s) in question, and read the accompanying information.*

Upon release of HELP, you return to the display and can proceed with building, running, or checking the status of a GC method.

To find a particular display, use the index at the back of this manual.

* *

If you are not yet familiar with the operation of your instrument, first review the **Operation** *section. Here you will find descriptions of the function of the keys, and exercises designed to familiarize you with building chromatographic methods and operating the GC.*

Operation Keys

[BUILD/MODIFY]

Display: **SELECT METHOD/SECTION OR TABLE**

The Build/Modify light is on. Active or inactive methods and tables can be built and modified. 1

Press:

one of the four Method keys (not digits on the number pad), *or*

a SECTION CONTROL key, such as COLUMN, *or*

[GC CONFIGURE], *or*

[RACK TABLE] or [SEQUENCE TABLE] automation keys.

[SHIFT] [ACTIVE LINE]

Display: **SELECT SECTION OR TABLE**

Active line provides quick access to display and modify the controlling program (or initial conditions) within an active method section or automation table. 2

The BUILD/MODIFY and active method lights are ON. The GC or automation must be running.

Note that the GC is operating and therefore control can pass to the next program. The displayed program is not updated since the instrument is in Build/Modify mode.

Other possible displays are:

Displays: **DETECTOR A OR B?** **NOT IN RUN**
SECTION NOT IN METHOD **NOT IN AUTOMATION**
ILLEGAL SECTION
TABLE NOT ACTIVE
INJ A-INJ B OR AUX?
AUXILIARY (INJ B) SECTION? NO
INJECTOR A/B OFF IN GC CONFIGURE
AUXILIARY OFF IN GC CONFIGURE
DETECTOR A/B OFF IN GC CONFIGURE

Auxiliary is part of the INJECTOR method section. See HELP 13. For a description of ILLEGAL SECTION, see HELP 35.

[ACTIVATE]

Display: **SELECT METHOD OR TABLE**

The activate operation is used to change which method controls the GC, i.e., the active method. Press the desired method number key. The light beside the method key comes on, the GC immediately assumes the conditions of the new method, and the display informs: 3

Display: **METHOD ACTIVATED or TABLE ACTIVATED**

ACTIVATE is also used to set up for automation. Build the desired Rack or Sequence automation table, activate the table, and begin automation by pressing START.

Press STATUS at any time to find out which method and table is currently active. The light by the active method number key and table key will be ON.

Under certain conditions the activate operation is denied:

Displays: **METHOD RUNNING**
AUTOMATION ACTIVE
TABLE ACTIVE
TABLE NOT BUILT
UNDER REMOTE CONTROL

[COPY]

Display: **SELECT METHOD TO COPY FROM**

The copy action is used to copy one entire method over another. Press one of the four METHODS keys.

Display: **SELECT METHOD TO COPY TO**

Press the METHODS key for the method that is to be the copy. Copies *to* locked methods or running methods are not allowed.

NOTE: The original contents of the copy will be lost.

Displays: **COPY COMPLETE**
METHOD LOCKED
METHOD RUNNING

[SHIFT] [LOCK/UNLOCK]

Display: **ENTER LOCK CODE [] [] []**

Locked methods and tables cannot be modified. Any or all can be locked, one at a time. The user lock code is first required. Enter the same lock code that was entered in the GC Configure table. If it was never changed in the GC Configure table, the lock code is 0 (zero). Incorrect codes will not be accepted.

Display: **SELECT METHOD OR TABLE**

After entry of the correct lock code, press the desired method number key, RACK TABLE, SEQUENCE TABLE, or GC CONFIGURE.

Display: **METHOD LOCKED (OR UNLOCKED) or**
TABLE LOCKED (OR UNLOCKED)

If the selected method or table was not locked, this action locked it. If it was locked, it becomes unlocked.

[DELETE PROGRAM]

Display: **SELECT METHOD/SECTION OR TABLE**

DELETE PROGRAM is used to delete individual programs that have been built into method sections or automation tables. Only entries labeled PRGM are deleted, one at a time, by requesting the specific program by number.

4
5
6

Press the method, method section, or table key containing the program to delete. Follow the displays where applicable:

Displays: **SELECT SECTION**
DETECTOR A OR B?
AUXILIARY (INJECTOR B) SECTION? NO
INJ A-INJ B OR AUX?

Display: **ENTER PROGRAM NO. TO DELETE —-**

Enter the desired program number to be deleted.

Display: **PROGRAM (OR TABLE) DELETED**

Remaining programs are renumbered if necessary. Upon deletion of the last line of either the Rack or Sequence tables, the entire table is deleted.

Sometimes deletion is not performed:

Displays: **METHOD RUNNING**
METHOD (or TABLE) LOCKED
PROGRAM NOT IN METHOD
PROGRAMS NOT BUILT
PROGRAM NOT IN TABLE
TABLE NOT BUILT
SECTION NOT IN METHOD
TABLE ACTIVE

If the method section is illegal, see HELP 35.

[DELETE SECTION/TABLE]

Display: **SELECT METHOD/SECTION OR TABLE**

Specified method sections or entire automation tables can be deleted. Entire methods cannot be deleted at once. The GC Configure table cannot be deleted. Method sections are always deleted from the method whose light is on.

7

Display: **SELECT SECTION TO DELETE**

Press the key for the Method section to delete.

Displays: **SECTION (or TABLE) DELETED or**
SECTION CLEARED or
INJ A CLEARED/INJ B DELETED or
DET OVEN A OR B OR DET A OR B?

Required method sections (COLUMN, INJECTOR, and DETECTOR) sections are not deleted, but are cleared (returned to the preset values of an unmodified method section with no programs).

Display: **DELETE DETECTOR A OR B?**

The instrument has two detectors. Delete Detector B first then delete Detector A.

Display: **DELETE AUX (INJECTOR B) SECTION ONLY? YES or**
INJ A-INJ B OR AUX?

Optional auxiliary zone or INJECTOR B control is part of the INJECTOR method section. Press [YES] [ENTER] to delete just the auxiliary/INJECTOR B part, or [NO] [ENTER] to delete the Auxiliary or INJECTOR B section and clear the INJECTOR section to presets. The Injector B section is used only on the Star 3600 CX GC.

Under certain conditions deletion cannot be performed:

Display: **SECTION NOT IN METHOD** **METHOD RUNNING**
METHOD (OR TABLE) LOCKED **TABLE NOT BUILT**

[TUNE ON] and [SHIFT] [TRANSMIT]

Display: **SELECT SECTION TO TUNE**

Press [DETECTOR], or [PLOTTER], or [RELAY] and [ENTER].

8

TUNE is specified as the program time during method building of these sections. That program can then be executed under user control during the method run using Tune mode. The current run time is inserted into the method. Temperature programs cannot be tuned.

Press [TUNE ON] to enter Tune mode. The instrument remains in Tune mode until another OPERATIONS key is pressed. When a tunable method section is selected, the first tunable program is:

Display: **TUNE FID A/B PRGM n** **TUNE RELAY PRGM n**
TUNE PLOTTER PRGM n

DISPLAY CONTROL keys [♦] and [♦] can be used to display the programs in that section that have TUNE entered for the program time. Tune mode can be entered at any time, but to actually tune a program, the GC must be in RUN.

Display the chosen program and press ENTER at the appropriate time to execute the program and replace TUNE in the method with the current run time. The program will then be inserted in the proper sequence, according to the time of the tune event, and programs will be renumbered. Tunable programs are not renumbered until they are tuned. Other programs in the method are executed at their program times.

When a program is tuned, the next TUNE program in the section will be displayed. The user can select another section to tune at any point in tune mode.

Display: **DETECTOR A OR B?**

Detector A and B sections are tuned independently. To tune the other detector section, press TUNE ON and DETECTOR again.

Display: **NO MORE TUNE ENTRIES**

All programs in that section have been tuned. Select another method section to tune, or press an OPERATIONS key to exit tune mode.

Under certain circumstances, tuning is not allowed. The display informs and the instrument exits Tune mode:

Display: **NOT IN RUN** **METHOD LOCKED** **ILLEGAL SECTION**

If the method section is illegal, see HELP 35.

NOTE: Disconnecting the Serial Cable while the instrument is TRANSMITTING may cause the instrument to halt.

[SHIFT] [TRANSMIT]

Press [SHIFT] [TRANSMIT] to transmit the results report (TRANSMISSION STARTED displayed) or to abort transmission (TRANSMISSION ABORTED displayed).

Under certain circumstances transmission is not allowed. The displays METHOD RUNNING or COMPUTING inform the user.

> *NOTE: When aborting a transmission, there could be a 30 second delay from the time the key is pressed to the time TRANSMISSION ABORTED is displayed. This is the case where the host stops responding. In this instance, a new transmission should not be started right away; otherwise, more delays will be experienced. The delay is due to the instrument sending the required retries defined in the protocol.*

[PRINT] and [SHIFT] [REPORT]

Display: **SELECT METHOD/SECTION OR TABLE**

Press one of the four METHODS keys, [GC CONFIGURE], [RACK TABLE] or [SEQUENCE TABLE] to print the current entries. If a method section key is chosen, that section will be printed for the method whose light is ON (currently displayed method).

Display: **SELECT SECTION OR ENTER FOR ALL**

A method key was selected for printing. Press ENTER to print the entire method, or a SECTION CONTROL key for a single section.

Display: **PRINTING - SELECT NEXT OPERATION**

Printing is in progress. This display remains until another OPERATIONS key is pressed.

Display: **PLOTTER BUSY and PAPER OUT**

The print or plot operation is not executed. The print request must be repeated when the plotter is free or after paper is loaded.

Display: **TRANSMITTING**

While the report is being transmitted, the report cannot be printed, since a recalculation of the results would be done. TRANSMITTING is displayed.

[SHIFT] [REPORT]

Press [PRINT] [SHIFT] [REPORT] to print the report of the most recent GC run. To print the run log as well, enable it in that method, even if the run is over. The information is retained until the GC goes to RUN again.

Diagnostic faults that are detected are added to the report when they occur, even if the instrument is not in RUN. Thus diagnostic results can be printed at any time by pressing [PRINT] [SHIFT] [REPORT]. If the total report is not wanted, press [(PLOTTER)] [STOP] as soon as the diagnostics portion is printed. Pressing [RESET] clears diagnostic messages from the report.

[STATUS]

Status displays include overall GC Status, actual temperatures, NOT READY conditions, fault messages, and elapsed run time clock. The STATUS light and active method light are ON. Entries cannot be made into any status display. All STATUS displays have the prompt:

INSTR STATUS - NO USER ENTRY.

Pressing [ENTER] advances the display to additional Status messages. Press SECTION CONTROL or AUTOMATION CONTROL keys for individual status.

Displays: **STANDBY TEMPERATURE ACTIVATED**
(Above displayed only while in STANDBY)
COL aaa INJ aaa DET aaa
COL aaa INJ aaa AUX aaa DET aaa
INJ B aaa DET B aaa AUX aaa
PRES A/B aaa VEL A/B aa SPLITRA A/B aaa

Current actual temperatures for column, injector, auxiliary and detector ovens are displayed. (Auxiliary is part of the INJECTOR section and must be enabled in GC Configure). If an actual temperature differs from its setpoint by more than a tolerated amount, the degree symbol by that zone blinks. To view setpoints as well, press a SECTION CONTROL key.

Display: **METHOD x RUN xxxxx END xxxxx MIN**

Display shows the currently active method number, the current run time, and the method end time.

Display: **TRANSMITTING**

While transmitting the results report, TRANSMITTING is displayed.

Display: **METHOD x COMPUTING**

Display indicates that the method is processing peaks in preparation for printing a report. While in this state, you may modify this or another method, examine status, or change instrument setpoints without interfering with the computation. The printer/plotter will not print or plot while in the COMPUTING state. The display will be PLOTTER BUSY.

Display: **METHOD x STABILIZE xxxxx MIN**

When all thermal zones have reached their setpoint values, the instrument advances from NOT READY to STABILIZE, the NOT READY light remains ON, and the THERMAL STABILIZE TIME entered in the GC Configure table counts down to GC READY.

Certain conditions, for example detector baseline out of the Autozero range, prevent the instrument from advancing to READY. The displayed stabilize time will show 0.00. Press RESET and the GC will go to READY. To avoid this problem, turn the detector initial autozero off and back on during a stable region of the baseline.

Display: **METHOD x MONITOR**

MONITOR state exists between the end of STABILIZATION and READY, during which time the baseline noise is evaluated. At the end of MONITOR, the noise value is printed and the method goes READY. Baseline noise is MONITORed each time a method is manually activated or activated by automation.

Since the baseline noise value is used to set the sensitivity of the peak detection logic, it is important not to introduce extraneous noise during the MONITOR state, such as by pressing RESET, changing detector parameters, opening the column oven, and making sure detectors have stabilized before putting the GC in the MONITOR state. If an erroneous noise value is detected, a new noise monitor can be achieved by reactivating the same method, after removing the cause of the original error.

Display: **METHOD x A/S WAITING xxxxx MIN**

The active method contains the AUTOSAMPLER section and is waiting to start the next sampling cycle. If the method AUTOSAMPLER section specifies a time for START A/S AFTER RUN START, then this waiting time countdown is displayed between injections.

Display: **METHOD x A/S SAMPLING**

The AutoSampler is in the sampling cycle.

Display: **METHOD x WAITING FOR EXT DEVICE**

The GC is NOT READY because it is waiting for a ready signal from an external device. This wait is enabled in the GC Configure table.

Display: **METHOD x INACTIVE - END TIME xxxxx**

Pressing an inactive METHODS key while the STATUS light is ON displays the inactive status plus method end time.

Display: **FAULT XX**

The STATUS light is blinking to indicate that fault(s) have been detected by the instrument background diagnostics. Refer to the Diagnostics/Troubleshooting Section for a complete listing of fault messages and assistance.

Display: **ILLEGAL METHOD x**

The active method contains an illegal method section, caused by changing the instrument configuration after the method section was built, i.e., std. injector removed and SPI injector installed. The STATUS light blinks and the GC is held NOT READY. Press STATUS ENTER to display the fault(s). Refer to the Diagnostics section for a listing of fault messages.

> *NOTE: Correct an illegal method by correcting the hardware configuration or deleting the illegal method section.*

COLUMN Method Section

(BUILD/MODIFY) COLUMN

Display: **INITIAL COLUMN TEMP**

Enter the isothermal column oven temperature, or the initial temperature for temperature programming. Temperatures are in degrees C. The entry range given in the prompt is from -99 C to the COLUMN TEMP LIMIT entered in the GC Configure table or 1 C less than the next temperature if a temperature program follows.

Temperatures can be changed while the method is running, but oven will not cool down below the current actual value until the last column temp. hold time has expired.

If COLUMN STANDBY TEMP is enabled in the GC Configure table, the active method temperature setpoint will not be effective and the GC will be held NOT READY until RESET is pressed or STANDBY TEMP is disabled.

If optional cryogenic control is to be used, column coolant must be enabled in the GC Configure table.

Display: **INITIAL COL HOLD TIME**

Enter the time that the initial column temp. is to be held before the first temp. program starts in the run. For isothermal operation, this determines the End Time of the GC Run unless other method sections have time or temp. programs which take a longer time to complete.

The range of time entries allowed is from 0 to 650 minutes for isothermal operation. If column temperature programs follow, the maximum hold time is reduced to 650 minutes minus the time required for the programs. These values are calculated and displayed when PROMPT is pressed. INF is infinite time, and will keep the GC in RUN until RESET is pressed.

Display: **TEMP PROGRAM COLUMN? NO**

If column temp. programming is required, enter YES. A total of 4 column temperature programs can be built.

> *NOTE: No programs can be added after an infinite hold time, and any which are already present will be deleted. If a temperature entry is equal to the COLUMN TEMP LIMIT, then no further programs may be added. No value is displayed in the entry field when adding new programs, and the program is considered incomplete until a legal value is entered. When modifying a program already built, the previously entered value is displayed.*

Display: **PRGM 1 FINAL COL TEMP**

Allowable entries range from 1 C above the INITIAL COLUMN TEMP (or previous program temperature) to 1 C less than the final temperature of a following program, or, if this in the last program built, the COLUMN TEMP LIMIT. Press PROMPT to display these calculated values.

Display: **PRGM 1 COL RATE IN /MIN**

Enter desired programming rate, from 0.1 to 50.0 C per minute, or the lowest rate which fits into the remaining run time. Press PROMPT to display legal values.

Display: **PRGM 1 COL HOLD TIME**

Enter the time that the final temperature of this same program number is to be held until the next program begins. If this is the last program, the column oven cools down at the end of this final hold time.

> *IMPORTANT NOTE: The following 4 displays* **ARE NOT** *CONTROLLING KEYS. They allow readout of values set manually and can also be used to cause the instrument to go NOT READY if pneumatics drift away from setpoints.*

Display: **FLOW A/B IN ML/MIN**

Only on instruments with electronic pressure readout. Enter the desired column flow rate for column A or column B and adjust the carrier gas flow rate at the pneumatics panel while observing flow status.

Display: **PRESSURE A/B IN PSIG**

Displayed only on GCs equipped with electronic pressure readout for column A or B. Enter desired column head pressure in psi, and adjust pressure regulator at the pneumatics panel while observing pressure status.

Display: **SPLIT RATIO A/B x TO**

Displayed on GCs (except the 3300 GC) with a 1077 Split/Splitless Capillary Injector and electronic pressure flow readout. Enter the desired split ratio xx:1 as “xx”. Adjust the splitter flow while observing split ratio status until the correct split ratio is achieved.

Display: **COLUMN IN CM/SEC VELOCITY A/B**

Enter the average linear velocity for the carrier gas in use, then adjust the gas flow rate while observing status. Optimum velocity for best separation efficiency can be determined from Van Deemter plots. Refer to the Columns section for setting velocity.

12

([STATUS]) [COLUMN]

Displays: **COL aaa SET sss or OFF**
COL aaa SET sss STABILIZE
COL aaa SET sss RATE rr.r
COL aaa SET sss HOLD xxx.xx
COL aaa SET sss EQUILIBRATING
COL aaa SET sss STANDBY

The actual column oven temperature in degrees Celsius is displayed, followed by its current setpoint in the active method. The right-hand field updates to give additional current information:

The GC is in the STABILIZE state.

RATE and rate setpoint are displayed during a temp. program. The displayed temperatures are updated according to the rate.

HOLD times are displayed counting down.

EQUILIBRATING indicates that the temp. program(s) are completed while the GC is still in run.

STANDBY flags that the setpoint temperature is the COLUMN STANDBY TEMP set in the Configure table (see HELP 29), and the GC stays NOT READY. Return control to the active method by pressing [RESET].

If the actual temperature is out of tolerance of its setpoint value, the degree symbol flashes, the NOT READY light comes on, and a column temperature error message is generated if the GC is in RUN.

Display: **FLOW A/B aaa SET xxx**

Displayed only on GCs equipped with electronic pressure readout. Actual and setpoint flow for column A or B is displayed in mL/minute. If WAIT FOR FLOW READY? is YES in the GC Configure table, and the actual flow drops to half of the setpoint value, the actual value blinks, and the GC goes NOT READY.

Display: **PRESSURE A/B aaa SET 10**

Displayed only on GCs equipped with electronic pressure readout. The pressure for column A or B is displayed in psig. If WAIT FOR PRESSURE READY? is YES in the GC Configure table, the GC goes NOT READY if the actual pressure falls to half the setpoint value, the display blinks, and the GC goes NOT READY.

Display: **SPLIT RATIO A/B aa SET ss**

Actual split ratio aa:1 and method setpoint value ss:1 are displayed for col. A or B. If WAIT FOR SPLIT RATIO READY? is YES in the GC Configure table, then if the actual value is less than half the setpoint, the GC goes NOT READY and the actual value blinks on the display.

Display: **COL A/B VELO aa CM/SEC ss**

Column A or B average linear velocity is displayed for the carrier gas in use (entered in the GC Configure table). If WAIT FOR VELOCITY READY? is YES in the GC Configure table, then if the velocity falls to less than half the setpoint value, the instrument goes NOT READY and the display blinks.

INJECTOR Method Section

13

([BUILD/MODIFY]) [INJECTOR]

Display: **INJECTOR A/B OFF IN GC CONFIGURE**

Injector, detector, and auxiliary ovens are turned ON or OFF in the GC Configure table. Refer to HELP 31 for the appropriate INJ, DET, or AUX zone ON/OFF displays. The Injector B section is used only on the Star 3600 CX GC.

Display: **INJECTOR A/B TEMP**

Injector temperature is part of every method. The allowable entry range is displayed by pressing PROMPT. The maximum temperature that can be entered is the INJECTOR TEMP LIMIT set in the GC Configure table.

Septum-Equipped Temperature Programmable Injector (SPI)

If the GC is equipped with the Septum-equipped Temperature Programmable Injector (SPI), the injector switch (INJ) on the Temperature Control PC Board must be in the O.C.I. position. This enables displays and control for temperature programming this injector. Up to two injector temperature programs can be built.

COOLANT TO INJECTOR? must be enabled in the GC Configure table for correct operation and rapid cooldown of this injector.

> *NOTE: The control parameters for the STD and O.C.I. injector switch positions are optimized for the two modes. Use the correct position for the injector type installed to obtain stable and reliable control.*

Displays: **INITIAL INJECTOR A TEMP**
INITIAL INJ A HOLD TIME
TEMP PROGRAM INJECTOR A? NO
PRGM 1 FINAL INJ A TEMP —-
PRGM 1 INJ A RATE IN /MIN —-
PRGM 1 HOLD TIME
ADD NEXT INJECTOR PROGRAM? NO

See COLUMN Help (HELP 11) for a description of temperature programming. The column, injector, and auxiliary zones are handled in the same way.

([BUILD/MODIFY]) [INJECTOR]

Display: **AUXILIARY OFF IN GC CONFIGURE**

Injector, detector, and auxiliary ovens are turned ON or OFF in the GC Configure table. Refer to HELP 31 for the appropriate INJ, DET, or AUX zone ON/OFF displays.

Display: **ADD AUXILIARY SECTION? NO**

The Temperature Control PC Board has a connector which can be used to control the temperature of an auxiliary zone (e.g., sampling valve, ionization oven for TCD/FID) or a second injector. Auxiliary control is enabled in the GC Configure table (TURN HARDWARE ON-OFF?). This adds displays to the injector section of methods and reports the actual auxiliary zone temperature in STATUS.

Up to two auxiliary temperature programs can be built. Control of an auxiliary cryogenic valve is not provided.

Displays: **INITIAL AUX TEMP**
INITIAL AUX HOLD TIME
TEMP PROGRAM AUXILIARY? NO
PRGM 1 FINAL AUX TEMP —-
PRGM 1 AUX RATE IN /MIN —-
PRGM 1 AUX HOLD TIME
ADD NEXT AUXILIARY PROGRAM? NO

See COLUMN HELP (HELP 11) for a description of temperature programming entries and prompts. The column, injector, and auxiliary zones are handled in the same way.

([STATUS]) [INJECTOR]

Displays: **INJ aaa SET 100 or OFF**
INJ aaa SET sss STABILIZE
INJ aaa SET sss RATE rrrr
INJ aaa SET sss HOLD xxx.xx
INJ aaa SET ss (EQUILIBRATING)

The actual injector temperature in degrees Celsius is displayed followed by its current setpoint in the active method.

The right-hand field updates to give additional current information:

The GC is in the STABILIZE state,

RATE and rate setpoint are displayed during a temperature program. The displayed temperatures are updated according to the rate.

HOLD times are displayed counting down.

EQUILIBRATING indicates that the temperature program(s) are completed while the GC is still in run.

If the actual temperature is out of tolerance of its setpoint value, the degree sign flashes, the Not Ready light comes on, and an ‘Inj Temp’ error message is generated if the GC is in Run.

Displays: **AUX aaa SET sss or OFF**
AUX aaa SET sss STABILIZE
AUX aaa SET sss RATE rrrr
AUX aaa SET sss HOLD xxx.xx
AUX aaa SET ss (EQUILIBRATING)

Status for the auxiliary temperature controlled zone is displayed by pressing [Status]+[Injector]+[Enter]. Auxiliary control must first be enabled in GC Configure. Display descriptions are the same as above for Injector.

DETECTOR Method Section

15

([BUILD/MODIFY]) [DETECTOR]

DETECTOR HELP: A variety of detector types are available and can be mounted in position A or B. This information is included in each detector display. Help information for each detector type is treated separately in the following pages. Descriptions include detector method building (HELP 15) and detector status (HELP 16).

Display: **DET OVEN A OFF IN GC CONFIGURE**

Detectors are turned ON or OFF in the GC Configure table. Refer to HELP 16 for the appropriate DET ON/OFF displays.

Display: **DETECTOR A TEMP**

Enter the desired detector temperature in degrees Celsius. There is a single detector thermal zone for one or more detectors. The detector temperature should be set higher than that of the column oven to prevent condensation in the detector towers. Temperatures higher than the DETECTOR TEMP LIMIT set in the GC Configure table cannot be entered, as reflected by the Prompt, unless the GC Configure table value is first changed.

Dual Detector Instruments

Display: **DETECTOR A/B OFF IN GC CONFIGURE**

Injector, detector, and auxiliary ovens are turned ON or OFF in the GC Configure table. Refer to HELP 31 for the appropriate INJ, DET, or AUX zone ON/OFF displays.

Display: **DETECTOR A OR B? A**

Choose the detector A or B to be edited.

Display: **ADD DET B SECTION?**

YES adds method control of the indicated detector type. The method must contain at least one DETECTOR section.

Display: **SIGNAL A OR B TO DATA SYSTEM**

This display is part of the Detector A method section in dual detector instruments, and is seen only if the Serial I/O option is present, and if SIGNAL SWITCHING TO DATA SYSTEM is enabled in the GC Configure table. (See the *External Data Systems* section for Serial I/O cabling connections.) Enter the desired detector, A or B, to be selected for the single control station line to the data system. Signal selection is time programmable in the DETECTOR A method section.

Display: **PRGM 1 SIGNAL TO DATA SYSTEM**

Detector A method section can time program signal switching. Thus both detectors can be monitored during the run on a single chromatogram by switching between the detector A and B signals during the run.

To build detector time programs, refer to the displays that correspond to the detector type installed.

([BUILD/MODIFY])[DETECTOR]

Display: **FID/PID INITIAL ATTEN**

Entries are powers of 2: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024. Larger values mean a smaller output signal. INF (Infinite) means no signal out. The RCDR (recorder) and local printer/plotter signals are affected. The INTEG (Integrator) and CMPTR (Computer) outputs are not attenuated. The initial value stays effective until changed during the run by a time program for the same detector, or by pressing the ATTENUATION keys. ATTENUATION keys override the method; the method initial attenuation value is restored at RESET.

Display: **FID/PID A/B INITIAL RANGE**

FID/PID range entries are 8, 9, 10, 11, 12. Range 8 is the least sensitive, used when peaks are very large; range 12 is the most sensitive, used to detect small signals. Each range is a power of ten in output signal. For example, range 12 means 10^{-12} Amperes of detected signal gives 1 mV deflection at the recorder (RCDR signal). Detector range setting effects RCDR, INTEG, and CMPTR outputs.

Display: **FID/PID A/B AUTOZERO ON? NO**

When autozero is ON, an offset voltage is subtracted from the detector signal to give approximately zero volts at each output. Thus, the initial chromatogram baseline is at electrical zero. An autozero effects RCDR, INTEG, and CMPTR outputs.

Autozero is performed only when the GC is in STABILIZE or READY, or as a time programmed event during RUN. The value of autozero adjustment is displayed as BASELINE in millivolts by pressing [STATUS] [DETECTOR] [ENTER]. The baseline value varies with detector range, column type, temperature, and overall contamination, and can be used as an estimate of system cleanliness.

Autozero is automatically disabled during RUN to avoid zeroing out peaks. When initial autozero is turned off, the last autozero offset value remains until the autozero is again turned on.

Display: **TIME PROGRAM FID/PID A/B? NO**

Time programs execute run time changes to detector parameters such as range, attenuation, and autozero. This function is useful when you are interested in several peaks of different sizes in the chromatogram. You can build up to five time programs for each detector.

Display: **PRGM 1 FID/PID A/B TIME IN MIN —-**

Enter the time during the GC Run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the following program. If the exact time is unknown, but is to be determined during the chromatographic run, enter TUNE for the time and press [TUNE ON] during the run to execute the program and record the time into the method.

Display: **PRGM 1 FID/PID A/B ATTEN x**

Legal entries are the same as INITIAL ATTEN (see above). The displayed attenuation in the entry field when a new step is added is the same value as in the previous program. Time programmed attenuation modifications override updates made with the ATTENUATION keys.

Display: **PRGM 1 FID/PID A/B RANGE x**

Legal entries are the same as INITIAL RANGE (see above). The displayed range in the entry field when a new step is added is the same value as in the previous program.

Display: **PRGM 1 FID/PID A/B AUTOZERO? NO**

A time programmed autozero is used when you need to correct an offset due to changes in the detector range or attenuation, or due to a drifting baseline.

Display: **ADD NEXT FID/PID A/B PROGRAM? NO**

Up to five detector time programs can be added.

(BUILD/MODIFY) DETECTOR

Display: **TSD A/B INITIAL ATTEN**

Entries are powers of 2: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, and 1024. Larger values mean a smaller output signal. INF (Infinite) means no signal out. The RCDR (recorder) and local printer/plotter signals are affected.

The INTEG (Integrator) and CMPTR (Computer) outputs are not attenuated. The initial value stays effective until changed during the run by a time program for the same detector, or by pressing an ATTENUATION key. ATTENUATION keys override the method. The method initial attenuation value is restored at RESET.

Display: **TSD A/B INITIAL RANGE**

TSD range entries are 8, 9, 10, 11, 12. Range 8 is the least sensitive, used when peaks are very large; range 12 is the most sensitive, used to detect small signals. Each range is a power of ten in output signal. For example, range 12 means 10^{-12} Amperes of detected signal gives 1 mV deflection at the recorder (RCDR signal). Detector range setting effects RCDR, INTEG, and CMPTR outputs.

Display: **TSD A/B AUTOZERO ON? NO**

When autozero is ON, an offset voltage is subtracted from the detector signal to give approximately zero volts at each output. Thus, the initial chromatogram baseline is at electrical zero. The autozero function effects RCDR, INTG, and CMPTR outputs.

Autozero is performed only when the GC is in STABILIZE or READY, or as a time programmed event during RUN. The value of the autozero adjustment is displayed as BASELINE in millivolts by pressing STATUS DETECTOR ENTER. The baseline value varies with detector range, column type, temperature, and overall contamination, and can be used as an estimate of system cleanliness.

Autozero is automatically disabled during RUN to avoid zeroing out peaks. When initial autozero is turned off, the last autozero offset value remains until the autozero is turned on again.

Display: **TSD A/B BEAD POWER ON? NO**

Press YES to enable bead current supply. Bead power is also time programmable.

Display: **TSD A/B BEAD CURRENT IN AMPS**

Enter the desired bead current from 2.400 to 3.800 Amperes. For extended bead life, use the lowest current that will yield the required sensitivity for the analysis.

Display: **TIME PROGRAM TSD A/B? NO**

Time programs execute run time changes to detector parameters, such as range, attenuation, and autozero. This is useful when different parts of the chromatogram have different peak sizes.

Display: **PRGM 1 TSD A/B TIME IN MIN —-**

Enter the time during the GC Run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the following program. If the exact time is unknown, but is to be determined during the chromatographic run, enter TUNE for the time and press TUNE ON during the run to execute the program and record the time into the method.

Display: **PRGM 1 TSD A/B ATTEN x**

Legal entries are the same as Initial Attenuation (see above). The displayed attenuation in the entry field when a new step is added is the same value as in the previous program. Time programmed attenuation changes override updates made with the ATTENUATION keys.

Display: **PRGM 1 TSD A/B RANGE x**

Legal entries are the same as Initial Range (see above). The displayed range in the entry field when a new step is added is the same value as in the previous program.

Display: **PRGM 1 TSD A/B AUTOZERO? NO**

Time programmed Autozero action during the run is useful to correct offset due to detector range change or to bring a drifting baseline back on scale.

Display: **PRGM 1 TSD A/B BEAD POWER ON? NO**

Time programmed bead power can be used to turn the bead off to prevent large solvent peaks from overcooling and quenching or possibly cracking the bead. Turn the bead power back on in the next time program after the solvent has eluted.

Display: **ADD NEXT TSD A/B PROGRAM? NO**

Up to five detector time programs can be added.

([BUILD/MODIFY]) [DETECTOR]
Display: **ECD A/B INITIAL ATTEN**

Entries are powers of 2: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024. Larger values mean a smaller output signal. INF (Infinite) means no signal out. The RCDR (recorder) and local printer/plotter signals are affected. The INTEG (Integrator) and CMPTR (Computer) outputs are not attenuated. The initial value stays effective until changed during run by a time program for the same detector, or by pressing an ATTENUATION key. The ATTENUATION keys override the method. The method initial attenuation value is restored at RESET.

Display: **ECD A/B INITIAL RANGE**

ECD range entries are 1 and 10. Range 10 is the least sensitive, used when peaks are very large. Range 1 is ten times more sensitive, used to detect small signals. Detector range setting affects RCDR, INTEG, and CMPTR outputs.

Display: **ECD A/B AUTOZERO ON? NO**

When autozero is ON, an offset voltage is subtracted from the detector signal to give approximately zero volts at each output. Thus, the initial chromatogram baseline is at electrical zero. The autozero function effects RCDR, INTG, and CMPTR outputs.

An autozero is performed only when the GC is in STABILIZE or READY, or as a time programmed event during RUN. The value of the autozero adjustment is displayed as BASELINE in millivolts by pressing [STATUS] [DETECTOR] [ENTER].

The baseline value varies with detector range, column type, temperature, and overall contamination, and can be used as an estimate of system cleanliness.

Autozero is automatically disabled during RUN to avoid zeroing out peaks. When initial autozero is turned off, the last autozero offset value remains until the autozero is turned on again.

Display: **TIME PROGRAM ECD A/B?**

Time programs execute run time changes to detector parameters such as range, attenuation, and autozero. This is useful when different parts of the chromatogram have different peak sizes. Up to five time programs can be built separately for each detector.

Display: **PRGM x ECD A/B TIME IN MIN —-**

Enter the time during the GC Run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the following program. If the exact time is unknown, but is to be determined during the chromatographic run, enter TUNE for the time and press [TUNE ON] during the run to execute the program and record the time into the method.

Display: **PRGM 1 ECD A/B ATTEN x**

Legal entries are the same as INITIAL ATTEN (see above). The displayed attenuation in the entry field when a new step is added is the same value as in the previous program. Time programmed attenuation changes override updates made with the ATTENUATION keys.

Display: **PRGM 1 ECD A/B RANGE x**

Legal entries are the same as INITIAL RANGE (see above). The displayed range in the entry field when a new step is added is the same value as in the previous program.

Display: **PRGM 1 ECD A/B AUTOZERO? NO**

Time programmed Autozero action during the run is useful to correct offset due to detector range change or to bring a drifting baseline back on scale.

Display: **ADD NEXT ECD A/B PROGRAM? NO**

Up to five detector time programs can be added.

([BUILD/MODIFY]) [DETECTOR]
Enter the GC Configure display TCD CARRIER GAS HELIUM? to set up correct filament control and protection circuitry for Helium or Nitrogen carrier gas.

Display: **TCD A/B INITIAL ATTEN x**

Entries are powers of 2: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024. Larger values mean a smaller output signal. INF (Infinite) means no signal out. The RCDR (recorder) and local printer/plotter signals are affected. The INTEG (Integrator) and CMPTR (Computer) outputs are not attenuated. The initial value stays effective until changed during run by a time program for the same detector, or by pressing an

ATTENUATION key. ATTENUATION keys override the method. The method initial attenuation value is restored at RESET or run end.

Display: **TCD A/B INITIAL RANGE x**

TCD range entries are 5, 0.5, and 0.05. Range 5 is the least sensitive, used when peaks are very large. Range 0.05 is the most sensitive, used to detect small signals. Each range is a power of ten in output signal. Detector range setting affects RCDR, INTEG, and CMPTR signal outputs.

Display: **TCD A/B AUTOZERO ON? NO**

When autozero is ON, an offset voltage is subtracted from the detector signal to give approximately zero volts at each output. Thus, the initial chromatogram baseline is at electrical zero. The autozero function effects RCDR, INTG, and CMPTR outputs.

An autozero is performed only when the GC is in STABILIZE or READY, or as a time programmed event during RUN. The value of the autozero adjustment is displayed as BASELINE in millivolts by pressing [STATUS] [DETECTOR] [ENTER].

The baseline value varies with detector range, column type, temperature, and overall contamination, and can be used as an estimate of system cleanliness.

Autozero is automatically disabled during RUN to avoid zeroing out peaks. When initial autozero is turned off, the last autozero offset value remains until the autozero is turned on again.

Display: **TCD A/B FILAMENT TEMP OFF**

Enter a filament temperature at least 20 C higher than the block DETECTOR TEMP, or enter 0 for OFF. The maximum FIL TEMP (filament temperature) that can be entered is normally 390 C. If extremely high sensitivity is needed, the filament protection switch on the TCD controller can be set to allow a maximum filament temperature entry of 490 C. Operation at these high filament temperatures will greatly reduce filament lifetime. For minimum baseline drift and prolonged filament life, it is best to operate with the lowest DETECTOR TEMP and FIL TEMP (i.e., minimum filament current) that will produce the required sensitivity. To display actual filament current in milliamperes, press STATUS DETECTOR ENTER.

Display: **TCD A/B POLARITY POSITIVE? YES**

Enter YES for most injections into the analytical (left) cell. If an injection is made into the reference column of the TCD (right) cell rather than the analytical column, or if a hydrogen peak is detected, peaks will be negative or down-scale. Negative peaks are reversed by entering NO. For chromatograms containing both positive and negative peaks, polarity reversal can be time programmed in the DETECTOR section of the method without additional hardware. Normally, data acquisition systems require that all peaks have positive polarity.

Display: **TIME PROGRAM TCD A/B? NO**

Time programs execute run time changes to detector parameters such as range, attenuation, and autozero, useful when different parts of the chromatogram have different peak sizes. Up to five time programs can be built separately for each detector.

Display: **PRGM 1 TCD A/B TIME IN MIN—-**

Enter the time during the GC Run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the following program. If the exact time is unknown, but is to be determined during the chromatographic run, enter TUNE for the time and press TUNE ON during the run to execute the program and record the time into the method.

Display: **PRGM 1 TCD A/B ATTEN x**

Legal entries are the same as INITIAL ATTEN (see above). The displayed attenuation in the entry field when a new step is added is the same value as in the previous program. Time programmed attenuation changes override updates made with the ATTENUATION keys.

Display: **PRGM 1 TCD A/B RANGE x**

Legal entries are the same as INITIAL RANGE (see above). The displayed range in the entry field when a new step is added is the same value as in the previous program.

Display: **PRGM 1 TCD A/B AUTOZERO? NO**

Time programmed autozero action during the run is useful to correct offset due to detector range change or to bring a drifting baseline back on scale.

Display: **PRGM 1 TCD A/B POLARITY POS?**

When both positive and negative peaks are present, the detector output polarity can be reversed to yield all peaks with the same polarity. If a peak to be detected is negative, enter NO to reverse the peak polarity.

Display: **ADD NEXT TCD A/B PROGRAM? NO**

Up to five detector time programs can be added.

15 FPD

([BUILD/MODIFY]) [DETECTOR]

If the FPD is operating in the square root mode, the detector type displays SFPD. Since keyboard entries for the two modes are so similar, only FPD displays are listed here. Use the square root mode when the FPD is in the sulfur mode only.

Display: **FPD A/B INITIAL ATTEN x**

Entries are powers of 2: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024. Larger values mean a smaller output signal. INF (Infinite) means no signal out. The RCDR (recorder) and local printer/plotter signals are affected. The INTEG (Integrator) and CMPTR (Computer) outputs are not attenuated. The initial value stays effective until changed during run by a time program for the same detector, or by pressing an ATTENUATION key. ATTENUATION keys override the method. The method initial attenuation value is restored at RESET.

Display: **FPD A/B INITIAL RANGE x**

FPD range entries are 8, 9, 10. Range 8 is the least sensitive, used when peaks are very large. Range 10 is the most sensitive, used to detect small signals. Each range is a power of ten in output signal. For example, range 9 means 10^{-9} Amperes of detected signal gives 1 mV deflection at the recorder (RCDR signal). Detector range setting affects RCDR, INTEG, and CMPTR outputs. SFPD ranges are 100, 10, and 1, in order of increasing sensitivity.

Display: **FPD A/B AUTOZERO ON? NO**

When autozero is ON, an offset voltage is subtracted from the detector signal to give approximately zero volts at each output. Thus, the initial chromatogram baseline is at electrical zero. The autozero function effects RCDR, INTG, and CMPTR outputs.

An autozero is performed only when the GC is in STABILIZE or READY, or as a time programmed event during RUN. The value of the autozero adjustment is displayed as BASELINE in millivolts by pressing [STATUS] [DETECTOR] [ENTER].

The baseline value varies with detector range, column type, temperature, and overall contamination, and can be used as an estimate of system cleanliness.

Autozero is automatically disabled during RUN to avoid zeroing out peaks. When initial autozero is turned off, the last autozero offset value remains until the autozero is turned on again.

Display: **TIME PROGRAM FPD A/B? NO**

Time programs execute run time changes to detector parameters such as range, autozero, and attenuation, useful when different parts of the chromatogram have different peak sizes. Up to five time programs can be built separately for each detector.

Display: **PRGM 1 FPD A/B TIME IN MIN —-**

Enter the time during the GC Run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the following program. If the exact time is unknown, but is to be determined during the chromatographic run, enter TUNE for the time and press TUNE ON during the run to execute the program and record the time into the method.

Display: **PRGM 1 FPD A/B ATTEN x**

Legal entries are the same as INITIAL ATTEN (see above). The displayed attenuation in the entry field when a new step is added is the same value as in the previous program. Time programmed attenuation changes override updates made with the ATTENUATION keys.

Display: **PRGM 1 FPD A/B RANGE x**

Legal entries are the same as INITIAL RANGE (see above). The displayed range in the entry field when a new step is added is the same value as in the previous program.

Display: **PRGM 1 FPD A/B AUTOZERO? NO**

Time programmed autozero action during the run is useful to correct offset due to detector range change or to bring a drifting baseline back on scale.

Display: **ADD NEXT FPD A/B PROGRAM? NO**

Up to five detector time programs can be added.

15
HALL

([BUILD/MODIFY]) [DETECTOR]

Display: **HALL A/B INITIAL ATTEN x**

Attenuation entries are powers of 2: 1, 2, 4 ,8,16, 32, 64, 128, 256, 512, 1024. Each factor of 2 doubles or halves the plotted signal amplitude. Larger values mean smaller signals. INF means no signal out. **Only** the in-board printer/plotter signal is affected. Initial values stay effective until changed during RUN by a time program for the same detector, or by pressing an ATTENUATION key, which will override the method. The method initial attenuation is restored at RESET.

Display: **HALL A/B VENT OPEN? YES**

The Hall detector solvent vent is normally open until the solvent has passed the detector during the run. The vent is then closed with a detector time program. Enter YES to open the vent or NO to close it.

Display: **TIME PROGRAM HALL A/B? NO**

Time programs execute run time changes to plotter attenuation or solvent vent.

Display: **PRGM 1 HALL A/B TIME IN MIN —-**

Enter the time during the GC run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the following program. If exact time is unknown, but is to be determined during the run, enter TUNE for the time and press TUNE ON during the run to execute the program and record the time into the method.

Display: **PRGM 1 HALL A/B ATTEN x**

Legal entries are the same as INITIAL ATTEN (see above). The displayed attenuation in the entry field when a new step is added is the same value as in the previous program. Time programmed attenuation changes override updates made with the ATTENUATION keys.

Display: **PRGM 1 HALL A/B VENT OPEN? NO**

The Hall detector vent can be opened or closed at any time during the run. Enter YES to open the vent, or NO to close it.

Display: **ADD NEXT HALL A/B PROGRAM? NO**

Up to five detector time programs can be added.

DETECTOR STATUS Displays

16

([STATUS]) [DETECTOR]

Display: **DET aaa SET sss or** *OFF*

The actual detector temperature followed by the active method setpoint value is displayed by pressing [STATUS] [DETECTOR]. When the actual temperature is out of tolerance of its setpoint value, the degree symbol flashes, the NOT READY light is ON, and a detector temperature error message results if the GC is in RUN. Press [ENTER] to view additional detector Status displays.

16

FID/PID

Display: **FID/PID A/B BASELINE xxxxx.xx MV (A/Z)**

BASELINE is the applied autozero correction in millivolts. The value decreases by a factor of ten with each decrease in detector range. A/Z is displayed only when autozero is actually ON. When autozero is OFF, this field is blank. See description of FID A AUTOZERO ON? above.

Display: **FID/PID A/B ATTEN aaaa RANGE xxx**

The FID/PID is operating at attenuation aaaa and range 10^{-xxx} A/mV. The display updates to reflect run time changes in detector status.

Display: **DET A/B OFF**

Detector A has been turned off via TURN HARDWARE ON-OFF? in the GC Configure table. This will be the only detector status display, but the detector method section can be fully displayed and edited.

16

ECD

([STATUS]) [DETECTOR]

Display: **ECD A/B BASELINE xxxxx.xx MV (A/Z)**

BASELINE is the applied autozero correction in millivolts. The value decreases by a factor of ten with detector range change from 1 to 10. A/Z is displayed only when autozero is actually ON. When autozero is OFF, this field is blank. See description of ECD A AUTOZERO ON?

Display: **ECD A/B ATTEN aaaa RANGE xxx**

The ECD is operating at attenuation aaaa and range xxx. The display updates to reflect run time changes in detector status.

([STATUS]) [DETECTOR]

Display: **DET A/B OFF**

Detector A has been turned OFF via TURN HARDWARE ON-OFF? in the GC Configure table. This will be the only detector status display, but the detector method section can be fully displayed and edited.

16
TCD

([STATUS]) [DETECTOR]

Display: **TCD A/B BASELINE xxxxx.xx MV (A/Z)**

BASELINE is the applied autozero correction in millivolts. The value decreases by a factor of ten with each decrease in detector range. A/Z is displayed only when autozero is actually ON. When autozero is OFF, this field is blank. See description of TCD x AUTOZERO ON?

Once the block and filament temperatures have equilibrated, balance the TCD bridge: set detector range to the desired value, set autozero ON, and adjust the TCD balance control on the TCD PC Board until the displayed baseline is near zero.

Display: **TCD A/B ATTEN aaaa RANGE xxx**

The TCD is operating at attenuation aaaa and range xxx. The display updates to reflect run time changes in detector status.

Display: **TCD A/B FIL TEMP sss CUR sss MA**

The TCD filament temperature setpoint in the active method is displayed followed by the actual resultant filament current in milliamperes.

Display: **TCD A/B POLARITY POSITIVE (NEGATIVE)**

Status of current TCD polarity reversal mode. Display updates if polarity reversed by time programs.

Display: **DET A/B OFF**

Detector A has been turned OFF via TURN HARDWARE ON-OFF? in the GC Configure table. This will be the only detector status display, but the detector method section can be fully displayed and edited.

16
TSD

([STATUS]) [DETECTOR]

Display: **TSD A/B BASELINE xxxxx.xx MV (A/Z)**

BASELINE is the applied autozero correction in millivolts. The value decreases by a factor of ten with each decrease in detector range. A/Z is displayed only when autozero is actually ON. When autozero is OFF, this field is blank. See description of TSD x AUTOZERO ON?

Display: **TSD A/B ATTEN aaaa RANGE xxx**

The TSD is operating at attenuation aaaa and range 10^{-xxx} A/mV. The display updates to reflect run time changes in detector status.

Display: **TSD A/B s.sss AMP vv.v VOLT BIAS**

This status display shows the TSD bead current setpoint and the actual negative bias voltage. Bias voltage is set by turning the TSD Bias slot adjustment (R34) on the FID/TSD PC Board while observing this display.

Display: **DET A/B OFF**

Detector A/B has been turned OFF via TURN HARDWARE ON-OFF? in the GC Configure table. This will be the only detector status display, but the detector method section can be fully displayed and edited.

16
FPD

[(STATUS]) [DETECTOR]

Display: **FPD A/B BASELINE xxxxx.xx MV (A/Z)**

BASELINE is the applied autozero correction in millivolts. The value decreases by a factor of ten with each decrease in detector range. A/Z is displayed only when autozero is actually ON. When autozero is OFF, this field is blank. See description of FPD A/B AUTOZERO ON?

Display: **FPD A/B ATTEN aaaa RANGE xxx**

The FPD is operating at attenuation aaaa and range 10^{-xxx} A/mV. The display updates to reflect run time changes in detector status.

Displays: **FPD A/B PM TUBE xxx VOLTS**
SFPD A/B PM TUBE xxx VOLTS

This status display shows the FPD (or SFPD) photomultiplier voltage. The FPD photomultiplier voltage is displayed with 10 volt resolution. The photomultiplier tube voltage is set by turning the PMT Sensitivity Adjustment Potentiometer (R36) on the FPD PC Board while observing this display.

Display: **DET A/B OFF**

Detector A/B has been turned OFF via TURN HARDWARE ON-OFF? in the GC Configure table. This will be the only detector status display, but the detector method section can be fully displayed and edited.

16
HALL

([STATUS]) [DETECTOR]

Displays: **HALL A/B VENT OPEN (CLOSED)**
HALL A/B ATTEN aaaa VENT OPEN (CLOSED)

The display updates to show run time changes in attenuation or solvent vent state. Attenuation is only displayed when the PLOTTER section is in the active method.

PLOTTER Method Section

17

([BUILD/MODIFY]) [PLOTTER]

Display: **ADD PLOTTER SECTION? NO**

Provides the opportunity to include plotting and/or printing report and run log as part of the method. The active method must have a PLOTTER section to plot with the ([PLOTTER]) [START] key.

Display: **INITIAL PLOT SPEED IN CM/MIN**

Enter the desired plotting speed from 0 (Off) to 30.0 cm/minute. Plotting begins when (START) PLOTTER is pressed or an injection made.

Display: **ZERO OFFSET IN PERCENT**

Enter the plotter electrical zero offset in percent. Range is 0 to 100 percent offset. Zero percent offset is at the right hand paper edge.

Display: **PLOT SIGNAL A OR B?**

Choose the detector signal to be plotted by entering [A] or [B]. The detector analog outputs of the instrument are not affected.

Display: **TIME TICKS? NO**

Time ticks are printed along the right hand edge of the paper and are synchronized with GC Run time. Ticks are spaced 1 minute apart for plot speeds of 1 cm/min or faster, otherwise they are 5 minutes apart.

Display: **INSTRUMENT EVENT CODES? NO**

Codes annotate instrument events (changes to the GC) along the plot as they occur. The lower edge of the code letters are aligned with the event time. A description of these codes is contained in Table 1 in the *Printer/Plotter* section. For IBDH unique annotations, refer to Figure 4 in the *IBDH Operation* section of the Options/Accessories Manual. Zero offset must be at least 15% to allow space for printing annotations.

Display: **FIRST USER NUMBER?**

Enter any number up to four digits as the first part of the user number to be printed on methods and reports.

Display: **LAST USER NUMBER?—-**

Enter any number up to four digits that will be printed as the second part of the user number.

Display: **PRINT USER NUMBER? NO**

When the method report is printed, the two part hyphenated user number is printed beside the GC method number. For example METHOD 1 324-6999, where 324-6999 is the user number. This is useful to label the method with an analytical process number or operator identification.

Display: **PRINT REPORT AT RUN END? YES**

If entry is YES, then the run report will be printed at the run end. The report contains information such as method number, time of injection, run number, and AutoSampler rack and vial number. If entry is NO, the report will be suppressed, but may be printed for the most recent run by pressing [SHIFT] [REPORT].

Display: **PRINT RUN LOG AT RUN END? NO**

The Run Log lists actual initial conditions at the time the GC went to run, injection, all instrument changes during run, and run end or reset. To print the Run Log along with the method report when the run ends, enter YES.

NOTE: The Run Log is only printed if PRINT REPORT AT RUN END? is also [YES].

The Run Log is always recorded. If printout was not requested in the most recent GC run and is now wanted, change PRINT REPORT AT RUN END? to YES and print the report and Run Log by pressing [SHIFT] [REPORT].

Display: **TIME PROGRAM PLOTTER? NO**

Time programs automatically execute changes in plot speed or which detector, A or B, is plotted during the GC run. Enter YES to add up to five plotter time programs to the method.

Display: **PRGM 1 PLOTTER TIME IN MIN —-**

Enter the time during the GC Run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the following program. If exact time is unknown, but is to be determined during the chromatographic run, enter TUNE for the time and press [TUNE ON] during the run to execute the program and record the time into the method.

Display: **PRGM 1 PLOT SPEED IN CM/MIN**

It is useful to change plot speed during the run when only widely separated regions of the chromatogram have peaks of interest. Enter desired plot speed, from 0 (off) to 30.0 cm/min. The default plot speed when plotter programs are added is the speed in the previous step.

Display: **PRGM 1 PLOT SIGNAL A OR B?**

Choose detector signal A or B to be plotted at this program time. The default signal when programs are added is the same as in the previous program. The detector analog outputs are unaffected.

Display: **ADD NEXT PLOTTER PROGRAM? NO**

Enter YES to add another time program to the method PLOTTER section. Up to 5 time programs can be built.

([STATUS]) [PLOTTER] **18**

Display: **PLOT ddd A/B AT vv.v CM/MIN ZERO xxx**

The default plotter parameters are to plot detector A at 1 cm/min with a 15 percent zero offset. These plot parameters are valid and displayed even when not actually plotting. The displayed parameters are updated when time programmed plotter changes occur during the run.

Display: **NO PLOTTER SECTION IN METHOD**

Active method does not contain PLOTTER method section.

AUTOSAMPLER Method Section

([BUILD/MODIFY]) [AUTOSAMPLER] **19**

Display: **ADD AUTOSAMPLER SECTION?**

Enter [YES] if the AutoSampler is to be used with this method. See the **Automation Control** section for operation.

To use the AutoSampler for repeated injections with the same method, build the AUTOSAMPLER section, activate the method, then press [START]. The AutoSampler can also be used to run different methods using Rack or Sequence Table automation. See the **Operation** and **Automation Control** sections for automation operation.

Display: **A/S VIAL MODE OFF**

Upon entry of OFF, the AutoSampler is ignored and the GC goes to RUN when START is pressed. Upon entry of SINGLE, AutoSampler injections are performed on a single vial with no carousel advance after the last injection/vial. Upon entry of

MULTI, multiple vials are to be analyzed and the carousel moves to the next vial after the last injection per vial has been made.

Display: **A/S SAMPLE VOLUME IN UL**

Enter the number of microliters (to the first decimal place) to be drawn from the sample vial and injected.

Display: **A/S SOLVENT PLUG SIZE (UL)**

Enter the volume (in microliters) of the solvent plug used in the solvent flush syringe loading technique. The solvent used for the solvent plug is drawn from solvent reservoir A. If the solvent plug size parameter is set to OFF, a solvent plug is not drawn into the syringe during the sample loading sequence. The air gaps used in solvent flush syringe loading technique are set in the GC CONFIGURE table.

Display: **FAST INJECTION RATE?**

Enter [YES] to inject the sample at the fast rate set in the GC CONFIGURE table. Enter [NO] to injec the sample at the slow rate set in the GC CONFIGURE table. With sample sizes of 1 microliter or less, the default injection rate (5 microliter/sec) is generally appropriate regardless of the type of injector used. With larger sample sizes, you may need to use a slower injection rate to prevent solvent flashback with vaporizing injectors. For solute focusing applications with non-vaporizing injectors, use a slow injection rate. To prevent the broadening of early eluting chromatographic peaks with split injectors, use a fast injection rate (near 10 microliter/sec).

Display: **A/S RESIDENCE TIME IN MIN**

Enter the time (in minutes) that the needle is to remain in the injector after the sample is expelled from the syringe. The A/S RESIDENCE TIME differs from the hot needle time in that the residence time refers to the time following injection of the sample. Needle residence time can reduce the effects of molecular weight discrimination for vaporizing injectors.

Display: **NUMBER OF INJ/CALIB VIAL**

Number of consecutive injections for each vial identified as a calibration vial or a blank baseline vial by the Run Mode entry in the Sample Table. For calibration runs, if more than one injection/calibration vial is specified and the calculation type is not A%, then a calibration factor is calculated for each identified peak in the peak table, and if the factors are within tolerance (see HELP 40, RESPONSE FACTOR TOLERANCE) is added to a moving average factor that is used in subsequent calculations.

> *NOTE: A large number of injections/vial coupled with a large number of purge pulses/injection and a large purge volume can deplete the sample volume before the last injection, making that analysis invalid.*

Display: **INJ PER ANALYSIS VIAL**

Number of consecutive injections for each vial identified as an analysis vial in the Sample Table or by the default Run Mode entered in the INTEGRATION section of the method.

Display: **SAMPLE TABLE?**

Enter [YES] to build the Sample Table. To build a Sample Table, you must specify the type of run (analysis, calibration, or blank baseline) to be performed for each vial entered into the Sample Table. All vials that are not identified by a rack and vial number in the Sample Table are assigned the run mode calculation entered in the INTEGRATION section of the method.

Display: **PRGM n A/S RACK NUMBER**

Selects the rack assigned to the sample program. Refer to the 8200 CX AutoSampler Operator's Manual (P/N 03-914405-00) for a description of vial numbers.

Display: **PRGM n A/S VIAL NUMBER**

Selects the vial within the vial assigned the sample program. Refer to the 8200 CX AutoSampler Operator's Manual (P/N 03-914405-00) for a description of vial numbers.

Display: **PRGM n RUN MODE**

Analysis mode uses the relative response factors (RRF) entered by hand or by a calibration run to calculate the amounts of each identified peak in the chromatogram based on the area or height of the detected peaks. If the Peak Table does not exist, then results are reported as Area Percent. Refer to the **IBDH Operation** section for a detailed description of the calculations used by each calculation type.

Calibration mode is used to determine the relative response factor (RRF) or calibration factor (CF) for peaks identified in the Peak Table for calculation types N%, IS, and ES. The calculation requires the Amount Standard, Multiplier, and Divisor from the Sample Table, and the Calibration Amount for each identified peak from the Peak Table. If they are within tolerance, the calculated response factors are automatically inserted in the Relative Response Factor column of the Peak Table for examination, modification, and later use by the Analysis mode.

Blank Baseline mode causes the method to store a time/amplitude profile of the current run. Make certain that this profile contains only the baseline due to background, such as column bleed, since it is subtracted for all subsequent non-blank runs by this method before plotting and peak integration are done. You may want to run several practice temperature programs before you run the blank baselline to make certain that the column is free of contaminants that might produce an artificially high baseline. This technique is generally used to compensate for an unusually large baseline offset during temperature programming of a high bleed column.

Display: **PRGM n SAMPLE ID**

Enter up to 12 characters, which will be printed on the report when this sample is run.

Display: **PRGM n AMOUNT STANDARD**

This entry allows you to specify different levels of internal standard in different samples so that the calculations can correct for a standard level different than that used during calibration. Not used for A%.

If you do not plan to use this feature, it is safest to enter a value of 1 wherever Amount Standard is asked for.

For example, you might wish to increase the concentration of internal standard when analyzing high level samples so that the standard and sample peaks remain at about the same size. Refer to the **IBDH Operation** section for a more detailed description of the function of amount standard in the various calculation types.

Display: **PRGM n MULTIPLIER**

This is a factor by which the results for all reported peaks will be multiplied in the report. This factor can be used to correct for dilutions of the sample during preparation, or to convert from the units used in calibration to other units during analyses. It can also be used in conjunction with the divisor to correct actual sample weights to nominal sample weight.

Refer to the **IBDH Operation** section for examples using the Multiplier and Divisor.

Display: **PRGM n DIVISOR**

See above.

Display: **ADD NEXT SAMPLE PROGRAM?**

Enter YES to build another program (PRGM) in the Sample Table or NO if you do not wish to make more entries at this time.

(STATUS) AUTOSAMPLER 20

Display: **A/S VIAL MODE OFF (SINGLE) (MULTI)**

The AutoSampler vial mode of the currently active method is displayed. (See building the AUTOSAMPLER section above for meanings of modes). Press ENTER for additional messages about current AutoSampler activity.

Displays: **A/S RACK 1 VIAL 3 INJ 1**
A/S SEARCHING
A/S SAMPLING RACK 1 VIAL 3
A/S INJECTING RACK 1 VIAL 3

Displayed Rack and Vial numbers reflect the current position of the carousel, not necessarily the present GC run.

Display: **NO A/S SECTION IN METHOD**

The active method has no AUTOSAMPLER section.

Display: **NO AUTOSAMPLER**

The AutoSampler is not detected.

RELAY Method Section

(BUILD/MODIFY) RELAY

Display: **ADD RELAY SECTION? NO** 21

Enter YES to add the RELAY (external events) control section to the method. The External Events PC Board must be present. Four relays and 20 time programmable events are available to control: 4 AC switches to control sampling valves (relays 1, 2, 3,4), one low level contact closure (simultaneous action with relay 4), one signal switching relay (simultaneous action with relay 3). See the tabbed section **Relays** for additional details and required connections.

Display: **INITIAL RELAYS xxxx**

Enter positive numbers to turn relays ON, negative numbers to turn them OFF. Example: 1-2-34 turns relays 1 and 4 on, 2 and 3 off. It is only necessary to enter the relay numbers that require a change of state. **Relays remain at their setpoint until they are changed by the active method**. See also INITIAL RELAYS AT RUN END? display in the SET CHECKS FOR GC READY? category in the GC Configure table.

Display: **TIME PROGRAM RELAYS? NO**

Time programs execute changes to the relays during the GC run, for example, to open and then close a sampling valve for injection.

Display: **PRGM 1 RELAY TIME IN MIN——**

Enter the time during the GC Run that the program is to be executed. Allowable entry is 0.01 to 650.00 minutes, or 0.01 minutes greater than the time in the previous program to 0.01 minutes less than the time in the next program. If the exact time is unknown, but is to be determined during the chromatographic run, enter TUNE for the time and press TUNE ON during the run to execute the program and record the time into the method.

Display: **PRGM 1 RELAYS xxxx**

Allowable entry is the same as initial relays. The value in the entry field when a new program is added is the same as in the previous program.

Display: **ADD NEXT RELAY PRGM? NO**

Up to 20 relay time programs can be added.

(STATUS) RELAY

Display: **RELAYS ON xxxx**

22

Relays currently ON are displayed as positive numbers 1 to 4.

Display: **NO RELAY SECTION IN METHOD**

The active method contains no RELAY section. Relays may be ON if they were left on from a previous method.

Display: **METHOD COMPLETE—END TIME xxxxx**

This is the last display when a method is built. The method end time in minutes is equal to the longest time required by an event in the method, either a temperature program or hold time, or a time program. TUNE time entries are not considered. 23

Method end time can also be displayed by pressing STATUS then the appropriate method number key.

RACK TABLE Displays

24

(BUILD/MODIFY) RACK TABLE
In Rack Automation, specified methods are run according to the AutoSampler rack number. See the **Automation Control** section.

Running RACK AUTOMATION:

See the 8200 CX AutoSampler Operator's Manual (P/N 03-914405-00) installation instructions and the **Automation Control** section for automation operation.

Press BUILD/MODIFY RACK TABLE and follow the displays (see below), specifying which method to run with the desired rack numbers. Rack numbers present in the carousel that are not in the Rack Table are skipped and the AutoSampler continues searching. Rack Table programs are not necessarily executed in the order they appear in the table; they are executed in the order that the racks are encountered in the carousel.

Adjust the AUTOSAMPLER section of each method that will be used (see HELP 19). **Enter A/S MODE=MULTI**. If the method has no AUTOSAMPLER section or has A/S Mode OFF, that rack will be skipped.

Press ACTIVATE RACK TABLE to set up for automation. Press START to start automation and begin the carousel search. Injection will be made when the GC is READY.

Rack automation continues until RESET is pressed or the last vial is sampled, then the table is deactivated.

Display: **STOP AUTOMATION AFTER ERROR**

During automated runs, the system will detect and report any errors which could invalidate the results of the analysis, such as factors out of tolerance, etc. (Refer to the **IBDH Operation** section for a list of fatal and non-fatal errors.)

The STOP AUTOMATION AFTER ERROR specifies the total number of such non-fatal flawed runs you will permit before the data system is required to terminate that method. If the system successfully completes the samples of one method without exceeding the error number, the counter will be reset to zero before the next method is begun.

If fatal errors are detected in a method, regardless of the error number specified in the method, the flawed method will be stopped.

Display: **PRGM n RACK NUMBER**

Enter the rack number (1-4) that contains the sample(s) to be analyzed. The entry field cannot be left blank. The same rack number can be entered into additional rack table program steps, but only the first program containing that rack number will be executed.

Display: **PRGM n USE METHOD NUMBER——**

Enter method 1-4 **from the keypad** (not the dedicated Methods keys).

Display: **ADD NEXT RACK TABLE PROGRAM? NO**

Up to 4 programs can be built, allowing specification for all 4 rack numbers.

Display: **RACK TABLE COMPLETED**

RACK TABLE is built and contains at least one program. Press an OPERATIONS key for the next desired action.

Display: **TABLE SUSPENDED.**

Automation can be temporarily interrupted during sampling, while in run, or at the end of the current run by pressing SHIFT (RACK TABLE) SUSPEND. Use to pause automation to modify the table or methods, or to change sample vials and has a less drastic effect than pressing RESET. Resume automation by pressing START.

> *NOTE: Do NOT suspend operation of the AutoSampler during a sampling or injection sequence. The automation sequence is terminated if you press the Suspend when the autosampler is sampling or injecting a sample. Press RESET to clear the suspension. Following the suspension of an automation sequence, you may need to modify the sequence or rack table before continuing the next injection in the method.*

Display: **NO AUTOSAMPLER**

Prompt appears if the autosampler is turned OFF. (No response to RACK TABLE keystroke.) You cannot build a RACK TABLE if the AutoSampler is turned OFF.

(STATUS) RACK TABLE

Display: **PRGM x RACK nn VIAL vv INJ i**

Rack automation is active. In this example it is running PRGM x for A/S rack number nn, vial vv and is the i^{th} injection of the number of injections per vial specified in the AUTOSAMPLER section. When searching for a new vial, the INJ status resets to zero.

Display: **RACK TABLE NOT ACTIVE**

Rack automation is not in progress. An active Rack Table becomes inactive when RESET is pressed or an AutoSampler fault, such as a jam, is detected.

Display: **RACK AUTOMATION SUSPENDED**

The on going Rack automation has been interrupted with the SUSPEND key. Current Rack program, rack, vial, and injection number information remains available by pressing ENTER. Resume automation with START.

Display: **NO AUTOSAMPLER**

To run Rack Automation, the AutoSampler must be installed on the GC. If the 8200 CX AutoSampler is installed and this prompt appears, check the autosampler cables.

SEQUENCE TABLE Displays

26

(BUILD/MODIFY) SEQUENCE TABLE
The Sequence Automation table is a list of methods to be run in order. See the Automation Control section.

RUNNING SEQUENCE AUTOMATION

Sample injection can be facilitated with time programmed relay control of a sampling valve or the AutoSampler can be used (see **Automation Control**). Verify that the AUTOSAMPLER or RELAY section is built.

Press BUILD/MODIFY SEQUENCE TABLE; follow the displays (see below). Specify in order in each program the next method to be run and the number of times to run it.

Press ACTIVATE SEQUENCE TABLE to set up for automated mode. Press START to begin automation. The GC goes to RUN at GC READY. With AutoSampler operation, the first vial encountered is injected at GC READY.

Sequence automation continues until: RESET is pressed, after completion of the last SEQUENCE TABLE program, completion of a SINGLE pass, or after the last vial in the carousel has been sampled.

Display: **RUNS OF TABLE? SINGLE (MULTI)**

Enter SINGLE and SEQUENCE TABLE will be executed once during the automation and then stopped. For MULTI runs, the table will be repeated from the beginning until RESET is pressed.

Display: **STOP AUTOMATION AFTER ERROR**

See same display under HELP number 24.

Display: **PRGM n RUN METHOD**

Enter the first method number to be run in the automation sequence. Use ENTRY keypad. (METHODS keys do not work here and entry field cannot be left blank).

Display: **PRGM n NUMBER OF RUNS——**

The number of times the method is to be run before automation proceeds to the next programmed method.

> *NOTE: If the AutoSampler is used, the number of injections/vial specified in the method are run for each SEQUENCE TABLE program run. For example, if NUMBER OF RUNS? equals 3, and A/S INJECTIONS/VIAL equals 2, then this method will be run 6 times before proceeding to the next SEQUENCE TABLE program.*

Display: **ADD NEXT SEQ TABLE PROGRAM? NO**

YES allows addition of up to 4 sequence table programs.

Display: **SEQ TABLE COMPLETED**

The Sequence Automation Table has been built and contains at least one program. Press an OPERATIONS key for the next desired action.

Display: **TABLE SUSPENDED**

Automation can be temporarily interrupted during a run, or at the end of the current run by pressing SHIFT (RACK TABLE) SUSPEND. Use to pause automation to modify the table or methods, or to change sample vials and has a less drastic effect than pressing RESET. Resume automation by pressing START.

> *NOTE: Do NOT suspend operation of the AutoSampler during a sampling or injection sequence. The automation sequence is terminated if you press the Suspend when the autosampler is sampling or injecting a sample. Press RESET to clear the suspension. Following the suspension of an automation sequence, you may need to modify the sequence or rack table before continuing the next injection in the method.*

(STATUS) SEQUENCE TABLE

Display: **PRGM x RUN nn INJ nn**

Sequence automation is active and the light by the Sequence Table key is ON. The current program number and number of runs of that program are displayed. If the AutoSampler is in use, then the current injection count is also displayed.

Display: **SEQ TABLE NOT ACTIVE**

Sequence automation is not in progress. The table is deactivated at automation end.

Display: **SEQ AUTOMATION SUSPENDED**

The on going Sequence automation has been interrupted with the SUSPEND action. Current Sequence Table program Status can be displayed by pressing ENTER. Resume automation where it left off by pressing START.

> *NOTE: Do NOT suspend operation of the AutoSampler during a sampling or injection sequence. The automation sequence is terminated if you press the Suspend when the autosampler is sampling or injecting a sample. Press RESET to clear the suspension. Following the suspension of an automation sequence, you may need to modify the sequence or rack table before continuing the next injection in the method.*

GC CONFIGURE Displays

Display: **SET TIMES OR DATE? NO**

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Enter YES to access the time/date category of GC Configure displays.

Display: **THERMAL STABILIZE TIME**

This time provides an equilibration period for the GC to reach a stable thermal state after one or more zones have changed temperature. It applies to all temperature zones in use. When all GC thermal zones are in tolerance of the method setpoint values, the stabilization countdown begins and can be observed in Status. The GC NOT READY light stays ON. Pressing RESET will end the STABILIZE period, and the GC will show READY.

A stabilize time of 2 minutes is adequate for most operations. If large temperature changes are made as part of a method, a longer period may be desired.

Display: **ENTER TIME OF DAY AS HHMM xxxx**

This is a 24-hour clock, so, if it is 2:25 pm, press 1 4 2 5 ENTER. Once set, time is maintained unless the GC is turned off or a power failure occurs.

Display: **ENTER DATE—DAY MONTH XXXX**

Enter the present day and month as a 4-digit number with no punctuation. Use zeros to fill spaces. For example, enter 0503 for 5 March.

Display: **ENTER DATE—YEAR xx**

Enter the last two digits for the current year.

Display: **COOLANT TIME OUT IN MIN INF**

Provides for coolant conservation if coolant is being used for either the column or injector zones. Enter the time that the GC waits during STABILIZE/NOT READY or after READY before automatically shutting off the coolant to both zones if the GC does not go to RUN. The timer is also reset and reactivated when the GC advances from STABILIZE/NOT READY to READY.

Enter INF (infinite time) and the coolant will never be timed out. Once coolant has timed out, press RESET to re-enable coolant and restart the coolant timer. Coolant use is enabled via TURN HARDWARE ON-OFF in the GC Configure table.

> *NOTE: Coolant time out should be set longer than the expected STABILIZE/NOT READY or READY times so that the cooled zone will remain ready during STABILIZE/NOT READY or READY.*

Display: **SET TEMP LIMITS? NO**

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Enter YES to access displays where protective upper temperature limits for each thermal zone are set. The temp limits for column, injector, auxiliary, and detector ovens are entered separately. The upper value in prompts for method temperature displays will be adjusted so that temperatures higher than the respective TEMP LIMITS cannot be entered.

Temperature limits can be raised at any time, but cannot be reduced below the highest temperature for that zone in the method. This will be reflected in the lower value of the prompt for each TEMP LIMIT display. The minimum temperature limit is 50 C.

Display: **COLUMN TEMP LIMIT**

Enter a safe upper temperature limit for the columns currently installed. Do not exceed the highest operating temperature recommended by the column manufacturer.

Display: **INJECTOR TEMP LIMIT**

The maximum safe temperature for the injector(s) is determined by the maximum temperature recommended for the septum and column you installed in the GC. The temperature should not be so high that degradation and/or excessive bleed can occur.

Display: **AUXILIARY TEMP LIMIT**

See HELP 13 for a description of the auxiliary thermal zone.

Display: **DETECTOR TEMP LIMIT**

The maximum safe operating temperature of the detector is limited by the column that is inserted into the detector and by the ferrules in use. Vespel® ferrules may crack at temperatures over 320 C; graphite ferrules can withstand 420 C.

Display: **COLUMN STANDBY TEMP?**

The allowable range for the COLUMN STANDBY TEMP is from 20 C to the COLUMN TEMP LIMIT. See next display.

Display: **ENABLE COLUMN STANDBY TEMP? NO**

Upon entry of YES, the COLUMN STANDBY TEMP entered in the previous display will override the active initial column temperature at run end or automation end. This is intended for use when it is undesirable to leave the column at the initial column temperature of the active method for long periods of time and no user is present to adjust the active method temperature.

When the column oven is held at the standby temperature, the GC is held NOT READY and STANDBY is displayed in column status. Press RESET to re-enable column temperature control by the active method.

Display: **SET CHECKS FOR GC READY? NO**

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Enter YES to access the category of displays allowing selection of certain GC functions to be watched or ignored in GC READY criteria. When a WAIT FOR... entry is NO, that zone need not be within the required tolerance band of its method setpoint for the GC to become READY. This offers flexibility when particular hardware is present but is not being used in the current analysis. Since the zone is not checked for READY, no Error Log entry is generated during RUN.

The column oven temperature must be at its setpoint for the GC to go to READY. The displays are:

WAIT FOR INJ A TEMP READY? YES
WAIT FOR AUX TEMP READY? NO
WAIT FOR DET A TEMP READY? YES
WAIT FOR FLOW READY? NO
WAIT FOR SPLIT RATIO READY? NO
WAIT FOR VELOCITY READY? NO
WAIT FOR PRESSURE READY? NO

Flow related displays are only in instruments with electronic flow and/or pressure readout. Velocity refers to the average linear velocity of the carrier gas.

Display: **WAIT IF PAPER OUT? YES**

YES prevents the system from responding to a GC READY if the inboard printer/plotter is out of paper.

Display: **WAIT FOR EXT DEVICE READY? NO**

YES holds the GC NOT READY until a ready signal is received from some external device (e.g., GC Workstation or other data system). See the tabbed section **External Data Systems** for cable connections.

Display: **WAIT IF FAULTS PRESENT? NO**

Enter YES and the GC is held NOT READY if background faults are detected. **Thus, automation does not continue if faults occur**.

Display: **INITIAL RELAYS AT RUN END? YES**

The External Events (relay) PC Board must be installed. This entry determines when the relays return to the initial relay conditions of the active method after time programmed changes during the run. A YES entry causes the relays to set to their initial conditions immediately at run end or RESET. A NO entry holds the relays in their existing state until the GC is READY and the READY light is ON. If operating in the splitless capillary mode, enter NO.

Display: **TURN HARDWARE ON-OFF? NO**

YES accesses a set of displays to individually turn selected hardware ON and OFF. Hardware turned off has no power supplied to the zone, but methods remain unchanged. Status displays for each show setpoints OFF.

Display: **DETECTOR A ON? YES**

The detector must be turned on to get a chromatogram; however, it is recommended to turn it off before working on the tower. When the detector is turned off, the autozero offset (BASELINE value in DETECTOR Status) is cleared to zero until the next autozero action. The following specify detector functions are turned off: FID polarizing voltage, TSD bead current and bias voltage, TCD filament current, ECD pulse voltage, and FPD PM tube high voltage.

Displays: **DETECTOR OVEN ON? YES**

INJECTOR OVEN ON? YES

AUXILIARY OVEN ON? YES

NO interrupts heater power to the indicated zone. Turning the Septum-equipped Programmable Injector (SPI) oven OFF also turns off its cryogenic coolant valve. Column oven control is turned on (COL OVEN ON) or off (SHIFT, COL OVEN OFF), via a key in the GC CONTROL keyboard section.

Displays: **COOLANT TO COLUMN? NO**

COOLANT TO INJECTOR? NO

YES enables the cryogenic valve for the column oven or the SPI. If only one zone is configured for cryogenic cooling, the display for the other is invisible. Column actual temperature must be less than 50 C for coolant to come on. Coolant for the SPI is supplied whenever needed to quickly lower or maintain temperature.

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> *NOTE: For optimum temperature control and fastest cool-down of the column oven below 50 C (near ambient), do not enable column coolant if cryogenics is not present (column temperature and vent control are different).*

The COOLANT TIME OUT can be used to conserve coolant by shutting off all coolant valves at the specified time after GC READY. See GC Configure category SET TIMES OR DATE?

Display: **SET COLUMN PARAMETERS? NO**

Enter YES to access displays related to electronic flow readout. This data is combined with values from the pressure transducer and split flow transducer. These data are then used to calculate column flow, column average linear velocity, and split ratio, all displayed in Column STATUS.

Display: **COLUMN A/B INSTALLED?**

Enter YES for column A or B that is in use. This enables displays in the COLUMN section of the method and Column STATUS related to pressure and flow.

Display: **COLUMN A/B LENGTH IN METERS**

Enter the column length in meters. If the length of a coiled column is unknown, it can be estimated by multiplying the (coil diameter) x (p) x (the number of loops in the coil). (Use p=3.14.)

Display: **COLUMN A/B ID IN MICRONS**

Enter the internal diameter of the column in microns. If it is unknown, measure the flow with a bubble flowmeter and adjust the value until the display equals the value measured. This will give you the actual diameter.

Display: **COLUMN A/B CARRIER GAS**

Specify carrier gas in use: HE, N_2, or H_2, by using the values shown when the PROMPT key is pressed.

Display: **OTHER CONFIGURATIONS? NO**

Enter YES to access other parameters that affect the GC and GC method.

Display: **Standard Sampling Mode**

Enter YES to select the standard sampling mode. Enter NO to select the non-standard sampling modes: Volatile, Neat, Viscous, or User Defined.

Display: **Sample Type**

Select the appropriate sample type to optimize the sampling procedure for a particular type of sample. Enter 1 (Volatile), 2 (Neat), 3 (Viscous), or 4 (User Defined). The Volatile mode is best for solvents with high vapor pressures at room temperature. The Neat mode is best for solvents that are pure samples with minimum dilution by wash solvent. The Viscous mode is best for samples that are more viscous than water. The User Defined mode is used to adjust sampling parameters for a unique sample that does not clearly conform to any other mode.

Display: **A/S Solvent Flush Sampling**

Enter YES to sample using the solvent flush technique. Enter NO to sample using the neat sampling technique. The solvent flush sampling technique adds a plug of solvent above the sample in the syringe to wash or push all the sample into the injector. The solvent flush sampling technique also adds air gaps above and below the sample.

Display: **A/S FAST INJ RATE IN UL/SEC**

Accessed when the AutoSampler section of the GC method has the Fast Injection Rate set to YES. The injection rate (L/sec) is the rate at which the the sample is expelled from the syringe into the injector. For sample sizes of 1 microliter or less, the default injection rate (5   L/sec) is adequate regardless of the type of injector used. If you are using a vaporizing injector with sample sizes larger than 1   L, use a slower injection rate to prevent flashback. If you are using a non-vaporizing injector for solute focusing, use a slow injection rate. When performing split injections, use a fast injection rate (10   L/sec) to prevent broadening of the early eluting chromatographic peaks.

Display: **A/S SLOW INJ RATE IN UL/SEC**

Accessed when the AutoSampler section of the GC method has the Fast Injection Rate set to NO. The injection rate (L/sec) is the rate at which the the sample is expelled from the syringe into the injector. For sample sizes of 1 microliter or less, the default injection rate (5   L/sec) is adequate regardless of the type of injector used. If you are using a vaporizing injector with sample sizes larger than 1   L, use a slower injection rate to prevent flashback. If you are using a non-vaporizing injector for solute focusing, use a slow injection rate.

Display: **A/S VIAL NEEDLE DEPTH (%)**

Specifies the depth (% of depth of vial) that the needle tip extends into the sample vial. Enter a vial needle depth between 0 to 100%. The default value is 90%. A value of 0% determines that the needle tip just penetrates the septum. A value of 100% determines that the needle tip extends into the vial and stops just above the bottom of a 2 mL standard vial. Needle depths may vary slightly for different types of vials (e.g., a vial needle depth of 90% places the needle just at the bottom of a machined (P/N 66-000121-00) conical glass microvial). Refer to the 8200 CX AutoSampler Operator's Manual for needle depths recommended for other types of sample vials.

Display: **A/S SOLVENT SELECT**

Specifies which one of the three (3) solvent reservoirs is used for the washing and injection cycles. Enter 1 to select the solvent in Reservoir A; enter 2 to select the solvent in Reservoir B; enter 3 for a sequential wash (solvent first from Reservoir A then solvent from Reservoir B); enter 4 if you do not want a wash cycle. Solvents from Reservoir A or B are used as the solvent plugs during the injection cycle as well. When you select 3 or 4 as the A/S solvent, the autosampler uses solvent from Reservoir A for the solvent plugs. Refer to the 8200 CX AutoSampler Operator's Manual for a description of the solvent flush injection technique and its applications.

Display: **A/S AIR DRY AFTER WASH?**

Specifies whether or not the syringe is dried by air following the wash cycle. The length of time the syringe is dried is set according to the length of the wash time. Enter YES to air dry the syringe. The default is NO air dry step.

Display: **A/S UPPER AIR GAP?**

Specifies whether or not an air gap is included between the sample plug and the upper solvent plug during the solvent flush injection technique. The upper air gap volume is 0.5   L. Enter YES (default) to include an upper air gap. When using vaporizing injectors, eliminate the upper air gap (NO) and increase the size of the solvent plug to reduce discrimination between components in wide boiling point mixtures. Refer to the 8200 CX AutoSampler Operator’s Manual for a description of the solvent flush injection technique.

Display: **A/S LOWER AIR GAP?**

Specifies whether or not an air gap is included between the sample plug and the lower solvent plug during the solvent flush injection technique. The lower air gap volume is 0.8 L. Enter YES (default) to include an lower air gap. Because an empty needle is heated before injection in the hot needle technique, you must include a lower air gap to avoid inefficient vaporization of the sample. Refer to the 8200 CX AutoSampler Operator’s Manual for a description of the solvent flush technique.

Display: **A/S SYRINGE WASH TIME IN SEC**

Specifies the duration of the wash cycle during the sampling sequence. Enter an A/S wash time between 5 and 180 seconds.

Display: **A/S START AT RACK 1 VIAL 1**

Specifies whether or not to begin the sampling sequence at the home position vial (Rack 1/Vial 1). Enter NO if you want the sampling sequence to begin with the vial positioned under the needle or to begin with the first vial the autosampler finds (when the needle is placed over an empty vial position in the carousel).

Display: **A/S HOT NEEDLE TIME (MIN)**

Specifies the length of time the needle resides in the hot injector before the sample is expelled from the syringe. Enter an A/S hot needle time between 0.00 to 1.00 minutes. the default is to inject the sample without (0.00 minutes) a hot needle delay time.

Display: **A/S Uptake Speed (UL/sec)**

Specifies the speed at which the sample is drawn into the syringe during sampling. Enter an A/S uptake speed between 1.0 to 5.0 L/sec. Viscous and some neat samples require a slower speed to allow ample time for the sample to be drawn into the syringe. A slow speed is used for volatile solvents to prevent the formation of bubbles.

Display: **A/S Pause Time (sec)**

The equilibration time after the sample is drawn into the syringe and before the needle is removed from the vial. Enter an A/S pause time between 1 to 10 seconds. A longer pause time provides more precise sampling of viscous samples.

Display: **NEXT RUN NUMBER**

The run number printed on the report of the next GC run can be changed. The run number counter increases from that run number. The next run number can be between 1 and 9999.

Display: **NEXT RUN NUMBER?**

The run number to be printed on the report of the next GC run can be changed. The run number counter increments from there. The next run number can be from 1 to 9999, as shown in the prompt.

Display: **SOUND KEYSTROKES?**

Allows keystroke “beep” to be turned off or on.

Display: **HALT AUTOM ON TRANS FAILURE? YES**

If the report can’t be sent due to no response from the host, automation is halted and the above message displayed.

Display: **SIGNAL SWITCHING TO DS?**

Refers to serial I/O control station feature. A single analog channel to the data system can be switched between GC detectors A and B under method control if YES is entered. This adds displays to the Detector A method section for designating the detectors and times when they are to be switched. The Serial I/O PC Board must be installed. Refer to the tabbed section **External Data Systems** for board installation.

Display: **SET LOCK CODE?**

YES allows the instrument lock code to be modified by the user, provided he knows the existing code. This only enters the code to be used for locking, and does not itself lock anything. The code is used with the LOCK/UNLOCK key in the OPERATIONS section of the keyboard to protect methods, automation, and GC Configure tables one-at-a-time. **Locked methods and tables cannot be modified**. (The TURN HARDWARE ON-OFF section of the GC Configure table remains unlocked). Both lock and unlock operations require knowledge of the code. See HELP 5.

Display: **CURRENT LOCK CODE**

The current lock code must be re-entered before the code can be changed. An incorrect code will be flagged as an illegal entry. The preset code on instrument power-up is 0.

Display: **NEW LOCK CODE xxxx**

Allowable lock code is 0 to 9999. Verify that the new code is correctly typed before pressing ENTER, since displaying it again requires knowing it. **Do not forget the code**: the intended recovery procedure is instrument cold start, in which case all methods and tables are lost.

Display: **GC CONFIGURE TABLE COMPLETE**

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This is the last display in the GC Configure table. Select the next desired operation.

3400 Miscellaneous Operations

Display: **INCOMPLETE PROGRAM—DELETE IT? NO**

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This display is only seen when adding new programs to a method section or automation table. Attempt has been made to change the display before a valid entry of time, temperature, or rate. The program is considered incomplete. Only displays with blank entry fields cause this display.

Display: **ILLEGAL ENTRY—PRESS PROMPT**

Illegal entries are not allowed. Press and **hold** PROMPT to view legal entries for each parameter. When PROMPT is released, the original display with the illegal value is displayed again. Displayed Prompt values (e.g., temperature ranges) can change and are updated as other entries are made.

> *NOTE: If the field contains an illegal value and a key other than ENTER is pressed that changes the display, the previous legal value is retained.*

Display: **METHOD LOCKED or TABLE LOCKED** 35

Methods, Rack Table, Sequence Table, or the GC Configure table will not accept entries if they are locked. They may be completely examined, but parameters cannot be changed.

Display: **ILLEGAL SECTION**

A fault condition exists. For example, a PC board was removed after the method section was built. Certain operations on illegal sections are not allowed. Either correct the hardware or delete the section. If the illegal section is in the active method, the STATUS light blinks and the GC is held NOT READY. Press STATUS to display the fault and refer to the **Diagnostics/Troubleshooting** Section.

Displays: **TEST OK**
FAULT XXX
RETURN TO TEST MENU? NO 36
VENT TEST?
RELAY TEST?
KEY ECHO TEST?
DESTRUCTIVE RAM TEST?
TEST SESSION COMPLETED
INSTR BUSY—CANNOT ENTER TEST

These displays and a few others are part of instrument diagnostics, initiated by pressing SHIFT INSTR TEST. Instrument test is automatically performed on cold start. See the **Diagnostics/Troubleshooting** section for use of diagnostics.

Display: **POWER FAIL/WARM START OCCURRED** 37

Instrument power was lost, but battery back-up saved all methods and tables. Update the time and date in the GC Configure table. The display remains until RESET is pressed.

Integration Displays

Display: **ADD INTEGRATION SECTION?** 38

The INTEGRATION section serves two purposes: (1) it allows you to enter calculation parameters such as run mode, amount standard, sample ID, etc., to be used by the method when you are not using an AutoSampler and Sample Table, and (2) it also stores information such as calculation type, report format, whether or not to subtract the stored blank baseline, etc., which do not change from run to run in an automated sequence and thus do not need to be included in the Sample Table.

Deleting **either** the TIME EVENTS or INTEGRATION section will delete **both** sections from the method.

> *NOTE: If you are using an AutoSampler, the values for Run Mode, Sample ID, Amount Standard, Multiplier, and Divisor entered in the Sample Table for each vial identified by rack and vial number will overwrite and replace the corresponding values entered in the INTEGRATION section. Thus, only the values from the Sample Table will be used in calculations and reports for those specific vials.*

Display: **RUN MODE?**

The run mode entered here will be used for all vials **not** identified by rack and vial numbers in the sample table. The run mode takes three forms: Analysis, Calibration, or Blank Baseline.

Display: **PEAK MEASUREMENT PARAMETER?**

The value entered here (1 = peak area; 2 = peak height; or 3 = square root of peak height) determines what measure of peak size will be used in calibration and analysis runs. While it is possible to calibrate a method using peak heights and then change the method to calculate analysis results by peak area, the results would have very little meaning.

In general, peak area is most useful in quantitating well-resolved peaks, while peak height may be more reliable for poorly resolved or low level peaks. The square root of height mode is only useful in correcting for the square law response of the flame photometric detector (FPD) to sulfur compounds. Refer to the **FPD** section of this manual for more details on square root mode.

Display: **LONG REPORT FORMAT?**

Enter [[YES]] to print the long report, which includes all information found in the short report as well as information on the peak widths found, retention time offsets, total unidentified peak area or height, and relative retention times.

The long report is very useful during method development, as everything the system has determined about the chromatogram is printed out. The short report is usually chosen for more routine analyses, when brevity is desired.

Display: **RESULT CALCULATION TYPE**

Enter the calculation type:

1=A% (Area Percent)
2=N% (Normalized Area Percent)
3=IS (Internal Standard)
4=ES (External Standard)

Area Percent (A%) is the simplest type calculation, as it does not require identification of peaks in the chromatogram, calibration standards, or anything beyond a suitably prepared sample and adequate detector sensitivity. The area or height of all selected peaks is summed, and the amount of each individual peak is expressed as a percentage of this sum in the report. A% is a useful way of presenting data on all peaks in a chromatogram, known or unknown. A% is not suitable for most quantitative applications, as an increase in the percentage of any one peak results in a relative decrease in percentage of all other peaks.

Normalized Area Percent (N%) is similar to A% except that the area of each identified peak is multiplied by a response factor before the summation and determination of percentages. This allows for variations in detector response to different compounds in the sample. The factors can be entered into the Peak Table by hand if they are known or, more commonly, are determined by running a standard in a calibration run mode. Refer to the **IBDH Operation** section for details.

The **Internal Standard (IS)** calculation type requires the addition of a standard substance to the sample to serve as an internal yardstick for detector response against which the sample peaks can be compared. The standard must be pure, easily resolved from all sample components, never occur naturally in the sample, and, ideally, should behave very similarly to the sample components during the preparation of the sample, e.g. extraction or derivatization.

IS can be the most reliable mode of analysis, but it also requires the most time for method development.

The **External Standard (ES)** calculation type relies on the injection of known amounts of standard compounds to calibrate the detector response. Once these calibration factors have been determined and stored in the Peak Table, subsequent injections in the analysis mode combine the peak area or height information from the chromatogram with the calibration factor information from the Peak Table to calculate the amount of each identified peak present.

The precision obtained by ES depends greatly on the stability of the chromatographic system and the injection technique used. ES calculation type is particularly suited to automated operation.

Display: **DIVISOR**

See HELP 19, display **PRGM n DIVISOR**.

Display: **AMOUNT STANDARD**

See HELP 19, display **PRGM n AMOUNT STANDARD**.

Display: **MULTIPLIER**

See HELP 19, display **PRGM n MULTIPLIER**.

Display: **RESULT UNITS**

Enter an 8 character header to be printed above the result column in the report. This has no effect on the calculations.

Display: **REPORT UNIDENTIFIED PEAKS**

Unidentified peaks are those which are detected by peak processing, are not rejected by peak reject or solvent reject, and are not listed in the current Peak Table.

If you request that unidentified peaks be reported (by entering [[YES]]), each peak that is not listed in the Peak Table will be multiplied by the unidentified peak factor (UPF, see below) and the result reported in chronological order along with the identified peak results.

If you request NO unidentified peaks, their retention times, areas/heights, etc. will not appear individually in the report. Only the total unidentified peak area/height for the chromatogram as a whole will be reported.

If there is no Peak Table in the current method (A% only), there can be no unidentified peaks in the method.

Display: **UNIDENTIFIED PEAK FACTOR**

The unidentified peak factor (UPF) is used to scale peaks which have not been listed in the Peak Table and which therefore do not have individual response factors. A large factor will cause any unidentified peaks to stand out in the report for easy detection, while a very small factor will allow the area and retention time to appear in the report without influencing the results for the identified peaks. This factor is not used in the Area Percent calculation.

Another application of the UPF is the case where a number of peaks for which individual calibration standards are not available must be analyzed. If this group of peaks can be represented by one typical compound for which a response factor is known, then application of this factor to all members of the group may permit reasonable quantitation.

Display: **SAMPLE ID**

See HELP 19, display **PRGM n SAMPLE ID**.

Display: **TRANSMIT REPORT? NO**

Enables report transmission at run end.

Display: **SUBTRACT BLANK BASELINE?**

Entering [[YES]] allows the blank baseline currently stored in memory to be subtracted from chromatograms run by this method.

When there is a rising baseline due to increasing column bleed with increasing temperature during a temperature-programmed method, subtracting blank baseline may permit more accurate quantitation, particularly of smaller peaks eluting during the later, steeper portions of the chromatogram.

Since the stored baseline is not automatically deleted when the temperature program is altered, it is important to re-equilibrate the system and collect a new blank baseline whenever the parameters of a temperature program are modified.

This function should not be used to attempt to correct for a randomly wandering baseline due to insufficient column equilibration time, contamination, etc. Instead, the cause of the baseline instability should be corrected before attempting to run samples.

TIME EVENTS Displays

Display: **ADD TIME EVENTS SECTION?**

Press [[YES]] [[ENTER]] to add the TIME EVENTS section, which is used for controlling the parameters the method will use to collect data for calculations. If you do not build this section (by pressing [[NO]] [[ENTER]], the preset values of signal/noise ratio and initial peak width will be used. **Deleting <u>either</u> the TIME EVENTS or INTEGRATION section will delete <u>both</u> sections from the method**.

Display: **PEAK REJECT VALUE**

This value is the smallest height or area (see HELP 38, PEAK MEASUREMENT PARAMETER) which will be included in the calculations and report. Peaks smaller than the current peak reject value can be detected and stored in memory and included in a recalculated report by lowering the peak reject value and pressing [[SHIFT]] [[REPORT]].

Display: **SIGNAL TO NOISE RATIO**

At the beginning of each manual run and each automation sequence, the data system measures the baseline noise of the detector specified in that method. This noise value is multiplied by the signal to noise ratio to obtain the integration sensitivity which will be used by the method. The larger the signal to noise ratio, the larger a peak must be before it will be detected.

Values of 2 to 5 are commonly used for high sensitivity analyses, while values of 10 to 20 may be used when integration of only larger peaks is desired, or when it is desirable to have the data system detect baseline frequently during the run.

Display: **TANGENT PEAK HEIGHT**

When two or more adjacent peaks are not completely baseline resolved, the data system must decide how to divide the area or height of the combined peaks so that the contribution of each component to the total is accurately reflected in the report.

In general, if the earlier eluting of the fused peaks is much larger than the later eluting component, it's reasonable to divide the area or height by drawing a tangent under the later peak and adding any residual area to the area of the earlier peak. For fused peaks of similar size, division of the area by dropping a perpendicular to baseline from the valley point between them may be more reasonable. Tangent percent is used by the data system to determine which calculation to use.

For example, if a tangent percent of 10 is entered, any later eluting peaks in a fused group that are less than 10% as large as the "mother" peak will have a tangent peak drawn under them and the residual area added to the mother peak. If a fused peak is detected which is more than 10% as large as the mother peak, a perpendicular is dropped from the valley point between it and the mother peak, and the later peak becomes the new mother peak for subsequent tangent calculations. If a tangent percent of 0% is selected, all fused peaks will be calculated by perpendicular drop, while a value of 100% will force calculation of all fused peaks as tangents.

Display: **INITIAL PEAK WIDTH IN SEC**

This entry is used to adjust the effective sampling rate of the data system to changing peak shapes during a chromatogram. The data system calculates the width at half height of all detected peaks. If no time-programmed peak width events have been entered in the method, the initial peak width will be used to set the sampling rate until after a resolved peak with a half height width more than 50% greater than the current peak width parameter is detected, at which time the peak width parameter will be automatically doubled. In the case of a group of fused peaks, the average peak width of the group is used in deciding whether to update the bunch.

Less commonly, the half height peak width may decrease during a run, in which case the detection of a resolved peak with a width less than 75% of the current peak width parameter will cause the system to halve the peak width parameter for subsequent data collection. The peak width parameter is not automatically updated when a time-programmed peak width event is entered in the GC method.

Any change in the width, user-programmed or automatic, will be indicated in the run log and if the user selects, as an annotation on the plot.

Display: **CREATE TIME EVENTS TABLE?**

Press [[YES]] [[ENTER]] if you wish to use the time events to change the way in which data is collected and calculated during the run. Press [[NO]] [[ENTER]] if the initial values are suitable for the entire run.

Display: **PRGM n EVENT**

This entry selects the type of the next event to be entered in the Time Events Table.

> *NOTE: Once an event type (WI, II, GR, SR, or VB) is entered, it cannot be changed unless this program step is deleted (using the DELETE PROGRAM key) then rebuilt with the new event type.*

WI event: Used to adjust the effective sampling rate and slope sensitivity of the system to match the width at half height of the peaks in the chromatogram.

II event: Used to force the data system to designate event start and stop times as baseline points, and prevent any collection of peak data between those times. Commonly used to reset baseline after a detector range change or column switching valve upset.

> *NOTE: If the II event is activated at time 0.00 minutes (Run Start), the II end start should not be set earlier than 0.02 minutes, or the end event may be missed and the II function will not be turned off during the run.*

GR event: Sums the response for all peaks with retention times between the start and stop time of the event and assigns the total area to a peak with a retention time which is the average of those two times. The "group" peak is treated like any other peak in the calculations but is identified by a separation code "GR" in the report.

SR event: Used to reject the area or height of the solvent or other extraneous peaks from the calculated results of a run. Any peaks with retention times between the start and stop time of the event are excluded from the calculations.

VB event: Designates every valley as baseline points integration purposes. VB can be used when the chromatogram complexity prevents a data system from detecting baseline during a run, but should be used with caution, since even a valley point near the apex of a major peak could be defined as a baseline point, and a major peak could be almost completely lost from the calculations.

Display: **PRGM n START TIME and PRGM n END TIME**

The program start and end times define the time window during which the current time event will be in effect. In the case of the peak width event, only the start time is used, the stop time being replaced by the desired value of the parameter.

Display: **PRGM n PEAK WIDTH IN SEC**

Sets the value of the peak width parameter from the current time onward. When a peak width event is added to the time-program, automatic peak width updating is turned off. Include enough peak width events to maintain the peak width parameter about equal to the width at half height of the peaks of interest in the chromatogram.

Display: **ADD NEXT TIME EVENT?**

Press [[YES]] [[ENTER]] to add other timed events or [[NO]] [[ENTER]] to exit to other method sections.

PEAK TABLE Displays

Display: **ADD PEAK TABLE SECTION?**

40

You must add the PEAK TABLE section to do Internal Standard (IS), External Standard (ES), or Normalized Percent (N%) calculations, or to identify peaks in any type of calculation.

If you want only an Area Percent (A%) report without identified peaks, no PEAK TABLE section is required.

Display: **TABLE NUMBER OF STANDARD PK**

The Internal Standard (IS) method of calculation requires that one peak in the chromatogram be identified as the standard peak. This entry points to the peak number in the Peak Table which has the retention time and other information pertaining to the standard peak. Note that this is the **number** of the standard peak in the Peak Table only. Early eluting unidentified peaks or identified peaks missing from the chromatogram may change the number of the peak in the report, but this will not influence the identification of the standard peak, since it is identified by comparison with its peak number listed in the Peak Table.

Display: **TABLE NUMBER OF REL RETENTION PK**

Identifies which peak in the Peak Table is to be used by the system in calculating relative retention times. If peak is not identified in the chromatogram, the expected retention time listed for it in the Peak Table will be used in the calculation. If the peak is detected, its actual retention time is used. In either case, the unretained peak time will be subtracted from the retention times of all peaks to correct for column dead volume. If the relative retention peak is identified as peak 0 in the method, the calculation will be skipped.

Display: **UNRETAINED PEAK TIME**

The time it would take a totally unretained sample component to elute from the column under the conditions of the method. This time can be determined by injecting air, methane, or some other very weakly retained sample which will cause an observable detector response.

Display: **RESPONSE FACTOR TOLERANCE—%**

When a calibration mode run is specified, the data system calculates the response factor for each identified peak and compares the calculated value with the value currently listed in the Peak Table entry for that peak. If the calculated value is within the response factor tolerance percentage of the table value, the new factor is considered valid, otherwise the new value will be considered out of tolerance and that fact will be noted in the error log at the end of the report.

In either case, the newly calculated value of the factor will appear in the report. Refer to HELP number 19, PRGM n RUN MODE, for further information on automatic updating and averaging of response factors.

Displays: **REF PEAK WINDOW—MIN**
REF PEAK WINDOW—%
NON-REF PEAK WINDOW—MIN
NON-REF PEAK WINDOW—%

The sum of these 2 parameters determines the time window within which a reference peak can be identified. Using 2 parameters allows more flexibility in setting time window size for both early and late eluting ref. peaks.

For example, a 2% window would represent a very reasonable æ0.2 minutes for a peak eluting at 10 minutes, but would provide only æ0.01 minutes window (0.6 seconds) for a peak eluting at æ0.5 minutes. By adding 0.05 minutes through the REF PEAK WINDOW—MIN entry, the window at 0.5 minutes can be widened to allow for some variation in injection timing without unduly broadening the window at 10 minutes.

Note that the only difference between the REF PEAK WINDOW and the NON-REF PEAK WINDOW entries is that the largest peak within the REF PEAK WINDOW is identified as the reference peak, whereas the peak closest to the listed retention time in the NON-REF PEAK WINDOW, regardless of size, is identified as the non-reference peak for that window. Thus it is possible to make the windows for reference peaks somewhat wider to ensure that the reference peaks are found, since only the largest peak in the window will be considered.

Display: **CREATE PEAK TABLE?**

Press [[YES]] [[ENTER]] if you wish to identify peaks on the basis of retention time and quantitate them by Internal Standard (IS), External Standard (ES), or Normalized Percent (N%) methods.

You may create a table of identified peaks for use with Area Percent (A%) calculation, but it is not required.

Display: **PEAK n EXPECTED TIME**

This is the expected retention time of the component identified on this line of the Peak Table. Only peaks detected within the appropriate reference or non-reference windows around the listed retention time will be considered for identification as the listed peak, regardless of their order or number in the report.

Display: **PEAK n PEAK NAME**

Up to 8 alphanumeric characters may be entered to be used as the name of the peak in the report.

Display: **PEAK n REL RESP FACTOR**

This factor represents the relative response of the detector to the compound identified in this line of the Peak Table, typically based on injection of known amounts of the components of interest in a calibration mode run, although relative response factors can be calculated and entered by hand if desired.

Entering a value of 0 for the relative response factor of one or more peaks in the peak table causes the data system to enter the response factor calculated for those peaks in a **calibration run** table without testing for factor tolerance. This is recommended at the beginning of each automated sequence to ensure that new samples are not calculated using old leftover calibration factors.

If this factor is 0.0 in an **analysis run**, the result will be 0.0. If all factors are 0 in an analysis run, that is an error which will cause the calculation to default to A%.

Display: **PEAK n CALIB AMOUNT**

This entry is the amount of the current component which is contained in the calibration sample which will be used to calibrate this method. The amount should be expressed in the units you wish to appear in the report, i.e. enter amounts in parts-per-million (ppm) if you wish the report to be interpreted as ppm.

Display: **PEAK n REFERENCE PEAK?**

Reference peaks are components of your sample which are always present, are reasonable well-resolved from adjacent peaks, and are the largest peaks in their immediate vicinity of the chromatogram. Peaks which satisfy these criteria are readily identifiable by the data system, and can therefore be used as milestones or internal time signals by the data system as it attempts to correctly identify the peaks in your chromatogram.

The IBDH system does this by first identifying the reference peaks in the chromatogram and noting how their actual retention times differ from their listed retention times. It then uses these deviations to adjust the expected retention times of the interspersed non-reference peaks. Thus, if the carrier gas flow rate has decreased 2% since retention times were last determined, the retention times of the reference peaks will have increased 2%, and the data system will use that 2% factor to increase the expected retention time of the non-reference peaks by the same factor, helping to assure proper identification despite the flow rate change.

Display: **ADD NEXT PEAK?**

Press [[YES]] [[ENTER]] if you wish to add more peaks to the Peak Table.

Diagnostics/Troubleshooting

1 Introduction

This section includes the information needed to troubleshoot and repair the electronic and chromatographic parts of 3000 Series GCs. The work described here can be performed by a person with no experience in electronic service, but only if all warnings are read and understood and all procedures are followed. For your own safety, and to avoid unnecessary and costly repairs, read all of the information on this page before you begin to troubleshoot or repair your instrument. More information on the use of the diagnostic system can be found in paragraphs 1.1, 1.2, and 2.

Certain diagnostic and safety procedures are used frequently in troubleshooting your instrument. These procedures will not be repeated each time they are needed. Rather, you will be referred to the proper paragraphs as necessary. A summary is provided in Table 1 of this section. The last page of this section is a convenient reference to electronic hardware locations cited herein.

Be sure you thoroughly understand all of the cautions and warnings in Table 1 and in paragraph 2.1 before proceeding. Skim over the Common Procedures and Always Check lists in Table 1 and in paragraphs 2.2 and 2.3, so you will know where to find this information when you need it.

The Automatic tests should always be run before doing anything else, regardless of whether you are just doing a routine “confidence check” or you suspect some electronic or chromatographic problem. Press [SHIFT] [INSTR TEST] anytime the GC is not in RUN to initiate the tests. If the message TESTS OK is displayed, but you still believe that there is something wrong, go to Troubleshooting Procedures, paragraph 7. For more information on the use of Automatic tests, refer to paragraphs 1.2 and 2.4.

If a FAULT message is displayed at the end of the Automatic tests, go to Automatic Tests, paragraph 4, and find the displayed fault in the numerical listing. After checking that the symptoms described in the accompanying tables match the behavior of your instrument, follow the procedure shown for that fault. Disregard “E” code error messages, such as “Exx”, as they are for service center repair only.

If the Automatic tests fail to run properly, or the GC is not responding to keyboard entries, cold start the instrument (paragraph 2.2). If this does not solve your problem, do the Core Tests described in paragraph 3.

Read and go through the Final Checks of paragraph 2.5 before you conclude your repairs.

Table 1
References to Common Diagnostic Procedures and Diagnostic Cautions and Warnings

Using Diagnostics: (reference paragraphs 1.2 and 2.4)

- Did you press [SHIFT] [INSTR TEST] after you noticed an error?
- Displayed fault consistent with symptoms?
- Fix first fault displayed before starting others?
- Repeat test each time something is changed?

Common Procedures:

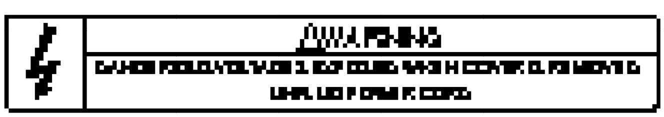
- Safety precautions (2.1)
- Removing, replacing, and adjusting the high voltage cover (2.2)
- Removal and replacement of printed circuit boards (2.2)
- Fuse replacement (2.2)
- Connecting/disconnecting cables (2.2)
- Cold starting the instrument (2.2)

Always Check: (reference paragraph 2.3)

- Required hardware installed?
- Dirty connector contacts?
- Proper cable connections?
- Air intakes open?
- Shorting on PC Boards?
- Connector cams closed?

Final Checks: (reference paragraph 2.5)

CAUTION: To avoid damage to the instrument, turn power OFF before you remove or install PC boards, cables, or fuses, or open or close connector cams.



Turn off the instrument and allow it to cool before you remove, or install injectors, detectors, or columns.

NOTE: Refer to paragraph 9 for locations of electronic hardware.

1.1 General Description of Diagnostics

This paragraph provides an overview of the operation of the diagnostic system. Continue to the **Automatic Test Description**, paragraph 1.2, for a description of how to perform a routine confidence check of your instrument. You will need the remaining portions of this section only if a problem is encountered. Read them in the order indicated as you carry out the troubleshooting and repair procedures.

All of the electronic circuitry is diagnosed through the diagnostic system. The GC itself is used as a test instrument, eliminating the need for special test equipment, such as voltmeters and oscilloscopes. If repairs are required, you simply replace components or modules, such as printed circuit boards, heaters, fuses, or temperature sensors. You can replace the parts or components with common hand tools. A kit of spare modules is not required, although it will speed repair and may sometimes speed diagnosis of a problem. Most electronic problems can be diagnosed and repaired within minutes if you have a replacement module. The diagnostic procedures are based on a “core expansion” technique, in which each function tested requires only its own dedicated circuitry and previously tested circuitry to operate properly. The core circuitry consists of the power supply, CPU, instrument bus, and keyboard/display, which are tested in that order. Each remaining function (temperature control, FID electronics, etc.) is implemented entirely on a single PC Board, making it easy to localize a problem once the core is working.

Use the diagnostic features in the intended sequence **only** and perform the operations according to the instructions and the conditions as they are described. If you deviate from a specific procedure you may obtain misleading or erroneous results.

The diagnostic tests are divided into four categories: core, automatic, extended, and background.

Core tests verify operation of the core circuitry. Use these tests when the instrument is completely unresponsive or responds intermittently.

Automatic tests are run by the internal microprocessor and are initiated automatically on cold start or manually from the keyboard and run in less than a minute. Operating conditions are disturbed only momentarily, so run these tests any time the instrument is not in RUN. Run the automatic tests daily as a confidence check on instrument operation.

Extended tests are not included with the automatic tests because they either disturb the operating conditions of the instrument or they require you to interact with the instrument. Access these tests from the menu displayed after the automatic tests have run.

Background tests run continuously during normal operation of the instrument. They ensure safe operating conditions and overall integrity of the instrument. The blinking STATUS light (reference paragraph 5.1 of the **Operation** section) reports the results of these tests along with various numbered fault messages. Press [STATUS] to display the initial fault message. Press [ENTER] to display additional fault messages. A list of the background faults and the corresponding procedures are described in paragraph 4.1 of this section.

If a test detects a hazardous condition, the GC will take the necessary action to minimize the danger. When non-hazardous faults are displayed, you can continue the diagnostic process if you choose, e.g., in the event of a failure in the diagnostic system or in an unused feature.

1.2 Description of the Automatic Tests

The Automatic tests are the heart of the diagnostic system in the 3000 Series GCs. You can run these tests as a confidence check anytime the instrument is not in RUN. The GC will be READY at the end of the tests if it was READY before the tests were started. Because many of the diagnostic procedures are based upon the results of the Automatic tests, always run these tests before starting the Troubleshooting procedures, even if you think the problem is not electronic. If you cannot run the Automatic tests because the display is blank or the keyboard is not working properly, go directly to **Electronic Procedures**, paragraph 2, and proceed with the Core Tests according to the directions there.

The Automatic tests, along with the automatic portion of the core tests, are normally initiated by pressing [SHIFT][INSTR TEST]. They are also initiated automatically whenever the instrument is cold started (see paragraph 2.2). In order to prevent you from disrupting a chromatographic run, you are not permitted to begin the tests when the GC is in RUN**.** If you find during a run that you need to run the Automatic tests, press [RESET] to take the GC out of RUN. While the instrument is waiting for you to make another entry, press any OPERATIONS key to leave the test mode. Once you have exited the test mode, the operation you selected will start.

When the Automatic tests begin, the display goes blank for a few seconds while the microprocessor and other core circuitry are tested. Various test messages and patterns are displayed, and the printer/plotter (if present) prints a test pattern. The detector electronics, temperature controls and options are also checked at this time. Relays, solenoids, and motors are turned on and off, and the chart recorder pen should move. The tests take less than a minute (depending on the hardware installed), and the message “TESTS OK” is displayed upon completion. If any FAULT messages appear, or if no messages appear within 60 seconds, go directly to **Electronic Procedures**, paragraph 2 unless the word “ADVISORY” appears in the display.

An ADVISORY message may also appear when the hardware is operating properly but: (1) the hardware could not run a test, or (2) one of the control settings is out of adjustment. The descriptions of ADVISORY messages are listed along with the numbered faults in paragraph 4. Press Enter to see if there are any other messages.

If a printer/plotter is installed in your instrument, you can obtain a permanent record of the results of diagnostic tests by pressing [SHIFT] [REPORT].

If the diagnostics have not detected a problem, but you believe that there is something wrong, go to **Troubleshooting Procedures**, paragraph 7.

2 Electronic Procedures

This paragraph describes the procedures you will follow to troubleshoot and repair the electronic circuitry in the 3000 Series GCs. Important safety information is included as well. Be sure that you understand the information in this paragraph and the preceding paragraphs before you begin to troubleshoot or repair the electronics.

Although the diagnostics have been designed so that they can be used by someone with no experience in electronic maintenance and repair, certain procedures describe the use of simple test equipment. Use the alternative procedures if the appropriate test equipment is not available. You can accomplish most repairs with only a screwdriver and a wrench. For those who have access to electronic technicians, descriptions of more complicated jobs are included. Contact your Varian Customer Support representative for those repairs which you or someone in your facility cannot handle.

2.1 Safety Precautions

Many of the diagnostic procedures in this section can be safely done with the instrument running. However, you should observe a few safety precautions. Do not operate the instrument with any of the side or rear panels removed. In addition to exposing yourself to dangerous voltages, you disrupt the air flow that cools the instrument. Always turn off the power and unplug the GC from the power receptacle before you remove these panels.

The Power Supply, Temperature Control, and External Events PC Boards are located under the high voltage cover at the rear of the electronics compartment. To access these boards and other components mounted at the rear of the Mother PC Board, remove the high voltage cover. See paragraph 2.2 for the procedure.

To avoid injury and damage to the instrument, always observe the WARNINGS and CAUTIONS in Table 1. Refer to this page frequently while working on the electronics or as you remove panels, boards, or covers of the instrument.

2.2 Common Procedures Referenced By Diagnostics

- **Removing the High Voltage Cover**

  Turn off and unplug the instrument. Refer to the cautions and warnings in Table 1. Remove the screw and lockwasher holding the high voltage cover. Lift and remove the cover. The interlock switch (S1) immediately turns OFF the high voltage supply. If you remove the cables/boards that are beneath this cover, refer to the cabling connections in the appropriate section of this manual to reroute/reconnect them. Close the yellow connector cams after reinstalling boards.

- **Replacing the High Voltage Cover**

  When you reinstall the high voltage cover, make sure the tab on the cover fully depresses the interlock switch (S1) on the Power Supply PC Board.

- **High Voltage Cover Adjustment Procedure**

  Observe warnings in Table 1. If the tab on the high voltage cover has not fully depressed the interlock switch (S1), there will be no line voltage or power to the heaters, motors, etc. If you run an instrument test when the interlock switch is not fully depressed, Fault 10 (Safety Interlock Switch Open) is displayed.

  To actuate S1, fully depress S1 by holding the cover down while tightening the cover’s hold down screw. If S1 cannot be activated, remove the cover and check to see if the switch or leaf spring is broken or distorted.

- **Removal and Replacement of Printed Circuit Boards**

  Removal**:** Observe warnings and cautions in Table 1. Disconnect cables from the PC Board. Turn the yellow connector cam clockwise 90• to release the board.

  Ease the PC Board straight up and out of the plastic guide slots in the cabinet. Do not touch the edge connectors. Place the PC Board in a clean envelope.

  Installation: Insert the PC Board into the card guide on the right and then lower the board into the connector on the left. Never force the board into the cabinet. Make sure that all cables are out of the way before you insert the board. Close the connector cam. Reconnect any cables to the board. Check that the connectors mate. NOTE: Before installing a new CPU PCB, remove the tag under the battery clip.

NOTE: Plastic cover strips are locked into unused board connectors. Do not open unused connectors unless a PC Board is to be installed. Remove these plastic strips before you insert a PC Board. If you remove an optional PC Board from the instrument and plan to store it for an extended period, place a plastic cover strip in the connector to keep the contacts clean.

- **Fuse Replacement**

  Before you replace any fuse, turn off the power and unplug the instrument. Many of the fuses in the GC are mounted in spring clips on the PC boards. To remove them, insert the blade of a small screwdriver (or similar tool) under the metal end cap of the fuse from the outside end and pry **up.** See Figure 1. When you replace a fuse, center it between the clips.

  Often it is impossible to tell if a fuse is good just by examining it. When you think you need to replace a fuse, save time by checking the old fuse with an ohmmeter (if one is available) first. If the fuse is good, the resistance measured between the end caps should be less than 100 ohms.

- **Connecting/Disconnecting Cables**

  Use care when you connect and disconnect cables. Make sure that both halves of the connector are properly aligned. To avoid connecting a cable to the wrong connector, refer to the cabling figures in the appropriate sections of this manual.

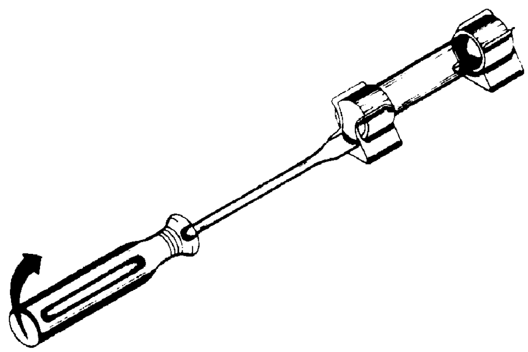


Figure 1
Fuse Removal Procedure

To disconnect the flat ribbon cable which goes between the Mother PC Board, Keyboard/Display PC Board, and the printer/plotter, push outward on the locking tabs. Then lift the plug from the socket. When you replace the cable, make sure that the plug is firmly seated and the locking tabs are locked in place.

- **Cold Starting the Instrument**

  Occasionally, you may need to cold start the instrument. To cold start the instrument, set the battery switch (S1 on the CPU PC Board, see QRM or paragraph 9) to OFF and turn off the main power switch of the instrument. Wait 30 seconds and turn the power back on. The microprocessor will re-initialize the instrument and replace all method and configuration parameters which were entered earlier. You then may turn the battery switch back on.

2.3 Always Check the Following

The following items should be checked routinely when any problem occurs.

- **Required Hardware Installed?**

  The diagnostics will check only those options which it can sense, so faults will not be found on optional boards whose connector cams are open. Each printed circuit board must be installed in the proper slot on the Mother PC Board, and the yellow connector cams must be in the closed position.

- **Dirty Connector Contacts?**

  Dirt or corrosion on the PC Board edge connector contacts or the mating connector on the Mother PC Board can result in poor electrical contact that can lead to problems with the operation of your instrument. Remove the PC Board and wipe off the contacts. Brush or blow any loose material out of the mating connector. If there is an accumulation of material on pcb contacts, clean them with isopropyl alcohol. The contacts can also be polished gently with a pencil eraser, but take great care that you do not remove the soft gold plating on the contacts.

- **Proper Cable Connections?**

  All cables must be seated firmly in the proper mating connectors. Wiggle the cables gently to check their connection. This sometimes reveals a cable that is not seated properly. Attach ground wires to the chassis with screw and lockwasher.

- **Air Intakes Unobstructed?**

  The electronic circuits are cooled by a flow of air drawn over and around the circuit boards. Be sure that the air intake slots on the bottom of the electronics compartment are not obstructed and all rear and side panels are in place. The cooling fan on the rear panel must be running and its exhaust must not be obstructed.

- **Shorting on PC Boards?**

  Inspect the PC Boards:

  a. Remove any bits of wire, solder or other foreign material which could cause a short between the conductors.

  b. Check the integrated circuits (IC) to see if there are pins folded under the body of the circuit or if they are not making proper contact in the socket. If necessary, pry the IC out of its socket with the flat blade of a screwdriver and straighten the pin.

- **Connector Cam Closed?**

  Check that the yellow connector cam is in the closed position.

2.4 Using Diagnostics

The “core expansion” technique used by 3000 Series GC diagnostics requires that the tests be done in a specific order**.** For the results of a test to be valid, the instrument must have passed all of the previous tests. The test results and fault messages are displayed in the order tested. The following section lists the fault messages in the order they appear during a test. Because the later faults may disappear or may be altered when you have fixed the basic problem, you must correct the first fault you encounter in the diagnostic sequence before you go on to other problems.

For example, the 15 volt power supply is used by several circuits in the instrument. A failure in this supply will cause the diagnostic system to report many faults in the detector and temperature control circuits, even when there is not a problem with these circuits.

The faults displayed at any time reflect the conditions that existed when the tests were first run. If a problem is corrected, the displays will not change until the tests are run again. Always correct the first problem listed, then rerun the tests.

If the keyboard and display are responding normally, the core circuitry is probably all right. In this case, you can use the Automatic tests without first doing the core tests. However, if the Automatic test results are inconsistent or questionable, repeat the diagnostic sequence but this time run the core tests to see if a problem is detected within the core circuitry. If the instrument has entered an illegal state where it cannot execute commands entered at the keyboard, you may need to perform a Cold Start (see paragraph 2.2) to restore the instrument to proper operation.

All the hardware tests are run each time you request the tests, even if a test fails. In this way, the instrument can detect faults in the diagnostic system itself. If the symptoms typically associated with a specific fault are not observed, and the instrument seems to be working properly, the diagnostic hardware may have failed. In this case, you can operate the instrument without repairing the diagnostics. Likewise, you do not necessarily need to correct immediately the hardware which is not in use, such as a detector attenuator in a setup without a chart recorder.

The results you obtain from the diagnostic system may sometimes vary if you run the diagnostics several times. If a fault is reported during one diagnostic sequence but not another, and the fault corresponds to a problem you have identified, the fault may reflect an intermittent problem with the electronics. In this case, follow the procedures listed for diagnosis and repair. A single occurrence of a fault message which does not correspond to any operational problem was probably caused by a momentary “glitch” and can be ignored. Sometimes, variations in diagnostic results are caused by changes in the operating conditions, such as ambient or internal temperatures, or disturbances in line voltage. Try varying those conditions which are under your control. Note correlations between failures and the conditions you observe. Since the Background tests log the time of occurrence of a fault, they may help you in this situation.

The entries in the diagnostic tables that follow consist of four parts. First, the form of the fault is described, such as a fault message that appears on the display or a diagnostic LED indicator. Second, the fault is described. Third, the symptoms which are expected to accompany the fault are listed. Last, the procedures necessary to repair the problem (including further diagnostic procedures, if needed) are described. Before doing any repairs, check that the fault determined by the diagnostic system is valid by comparing the expected symptoms with the actual behavior of the GC. When several consecutive faults share similar information, they are listed as a group. Be sure to read the text which applies to all of the faults in the group as well as the specific information for the fault of interest.

Before you conclude the repair procedures described in the tables, alwaysread paragraph 2.5, Final Checks and Instructions After Completing Diagnostics. There you will find information on returning PC Boards for repair or replacement, ways to verify that your repairs are complete and appropriate, as well as other important information.

The diagnostic tables are divided into three parts: Core tests, Automatic tests, and Extended tests. The Core tests can be found in paragraph 3, the Background tests in paragraph 4.1, the Automatic tests in paragraph 4.2, and the Extended tests in paragraph 5. Go to the beginning of the appropriate paragraph. There you will find further instructions for specific tests.

2.5 Final Checks and Instructions After Completing Diagnostics

When you have completed the necessary repairs, verify that you have replaced the correct PC Boards by temporarily putting the defective PC Boards back into the instrument. The original symptoms should return. If they do not, see the comments on intermittent fault indications in paragraph 2.4. You can sometimes clear faults by simply moving things around and turning the power off and on. This can lead you to conclude incorrectly that you repaired the instrument by replacing a particular module. It is also a good idea to do the core tests as well as the Automatic tests after a repair has been made, even if the repair was in an area covered by the Automatic tests. **Before returning to the instrument to normal operation, be sure that you have restored everything to its proper operating condition:**

Final Checks:

- ❑ All PC Boards are in their proper slots
- ❑ Yellow connector cams are closed on PC Boards
- ❑ Plastic strips have been inserted in all connectors without PC Boards
- ❑ Cables are properly connected
- ❑ Switches are set to the desired positions
- ❑ Correct fuses are installed
- ❑ Cables are not interfering with PC Boards
- ❑ Covers are in place

2.5.1 Returning Defective Printed Circuit Boards

Replacement boards, as well as the boards in service kits, are packed in special shipping boxes. Use these boxes when returning defective boards to Varian. Follow the directions included with the shipping box.

Do not attempt to repair any printed circuit boards which you may want Varian to service in the future or which you may decide to return for credit. Boards which have been damaged by a customer will not be accepted for return credit.

3 Core Tests

Run the core tests if the instrument does not respond, if its operation is erratic, if the automatic tests give erroneous results, or if a repair has just been made. The power supply, microprocessor, display, and keyboard are tested in that order. **Start from the beginning and do all of the tests until you have solved the problem.**

Since there may be times when the problem is with the keyboard and display, the diagnostic system displays most of the test results by LEDs on the printed circuit boards. The normal state for each of these indicators is listed at the beginning of a paragraph, followed by a description of the problem, additional diagnostic procedures (if needed), and a repair procedure. If the normal state of the indicator is displayed, the remainder of the paragraph may be skipped, including any subparagraphs within it.

3.1 Power Supply PC Board: +5 V Supply, Power Line Voltage, Control Circuits

Turn the instrument ON. Observe the LED indicators on CR1 on the Power Supply PC Board **from above as much as possible**, without removing the high voltage cover. The LEDs may vary in brightness. When viewed from the side of the LED, the glow from the dimmer ones may not be visible in bright light. If all 4 LEDs are ON, there are no faults. Continue to paragraph 3.2.

3.1.1 “+5 V FUSE OK” (CR1A) LED Not Lighted

If the +5 V FUSE OK LED on CR1 is not lighted, power is not reaching the regulator circuit on the Power Supply PC Board. The instrument will be completely inoperative.

For an overview of the procedures described in this paragraph, see Figure 2. Check off the boxes provided in the figure as you complete each step described in the text.

Step 1: Verify that the power cord is plugged into a live outlet and the power switch is ON. Check whether the cooling fan on the rear panel is running. If it is not, skip ahead to Step 6. If it is, continue on to Step 2.

Step 2: Replace fuse F1 on the mother PCB with a 10A, 250V ceramic fuse (15A, 250V ceramic for Star 3600 CX). Check the connections at E1 and E2 on the mother PC Board for corrosion, damage, or looseness. Call Customer Support if there is a problem. Clean the Power Supply PC Board card edge contacts (see paragraph 2.3). If the "+5V Fuse OK" (CR1A) now lights normally when the power is turned on, your problem is solved. If not, continue on to Step 3.

Step 3: Remove the Power Supply PC Board and open the yellow connector cams of the remaining plug-in PC Boards. Disconnect the plug from J30 on the mother PC Board. Replace fuse F1. If a voltmeter is available, turn on the power and measure the voltage at TP5 (TP3 on Star 3600 CX) on the mother PCB with the meter negative lead on TP2. If the voltage is less than 10 volts DC (11V, Star 3600 CX only), replace the mother PC Board. If it is at least 10 volts (11V, Star 3600 CX only), or if a meter is not available, continue on to Step 4.

Step 4: Reinstall the Power Supply PC Board only. If the "+5V Fuse OK" LED (CR1A) does not remain lighted when the power is turned on, skip ahead to Step 5.

If the LED remains lighted, turn off the power and close the yellow connector cam for the CPU PC Board. If the "+5V Fuse OK" LED (CR1A) does not remain lighted for at least 30 seconds when power is turned back on, the CPU PC Board is defective. If the CPU is not defective, continue to connect and test the remaining plug-in boards one at a time in this manner until a defective board is found.

If no defective boards are found, disconnect the flat ribbon cable from the Keyboard/ Display PC Board at J80 and from the PCL/ADC PC Board at J61 (if printer/plotter installed). Reconnect the cable first at J30 on the mother PC Board, then at J80 on the Keyboard/Display PC Board, and finally at J61 on the PCL/ADC PC Board, following the above procedure each time, to find a defective cable, Keyboard/Display, or printer/plotter.

Replace the PC Board, cable, or printer that was found to be defective. Replace F1 (10 A, 250 V ceramic), close all open connector cams, and reconnect all of the flat ribbon cable connectors.

Step 5: (From the beginning of Step 4 only — CR1A does not remain lighted.) Replace the Power Supply PC Board and fuse F1. If the "+5V Fuse OK" LED (CR1A) still does not remain lighted when power is applied, the original Power Supply PC Board was probably good. Replace the Mother PC Board.

Close all of the connector cams, reconnect the flat ribbon cable at J30 on the Mother PC Board, and replace fuse F1 (if necessary) before returning to normal operation.

Step 6: (From Step 1 only — fan not running.) Check fuse F101 on the rear panel (see Figure 2 in the **Installation** section for location). If it is blown, skip ahead to Step 7. If not, check that there are plugs securely fastened to J27, J28, and J29 on the Mother PC Board, and that the fan has a power cable attached to it. If these checks do not solve the problem, call Customer Support.

Step 7: Replace fuse F101 with the proper type [7 A (8 A, Star 3600 CX GCs), 250 V slow blow for 110/120 VAC line, or 4A, 250V slow blow for 220/240 VAC line]. If the fan does not continue to run after the power is turned on, F101 has blown again. Call Varian Customer Support. Otherwise, the problem should be solved.

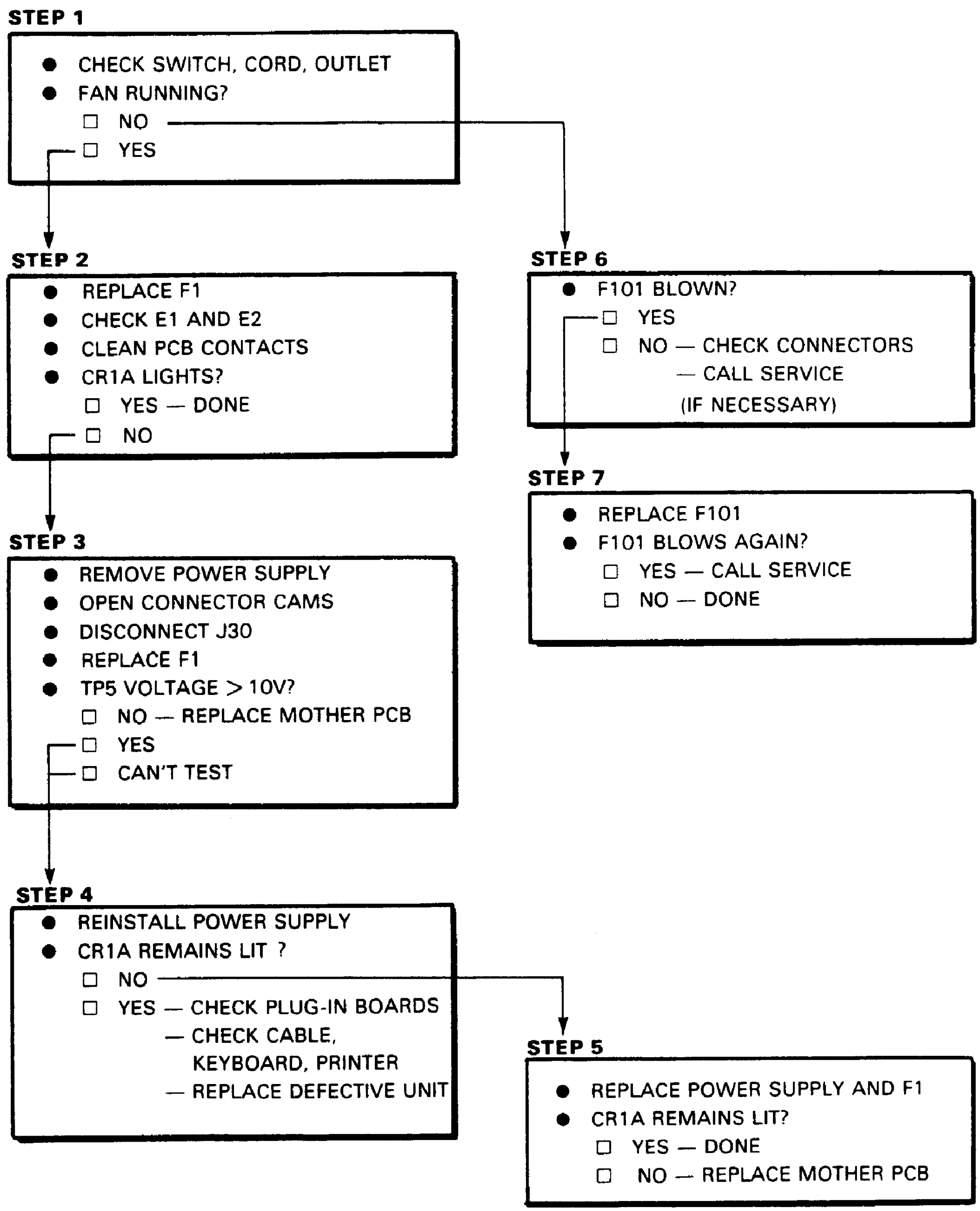


Figure 2
+5v Fuse Tests (ref. Paragraph 3.1.1)

3.1.2 "+5 V OK" (CR1B) Not Lit

The +5 V power supply voltage is not in tolerance if this LED is not lighted. Operation of the instrument may be erratic or it may not operate at all.

Be sure the rear cooling fan is running, its air flow is not blocked, and the side and rear panels are in place. If the +5 V regulator has overheated and shut down due to lack of air flow, it should return to normal operation in a few minutes when the instrument cools.

Star 3600 CX GCs Only: If CR1A and CR1D are lighted, this condition could have been due to the detection of a +5 V OVERVOLTAGE. To clear this condition, turn off the instrument power for about 5-30 seconds, then turn the power back on. If the same fault condition persists, continue with the following procedures.

This fault can also be caused by a severe drop in line voltage (typically below 65% of the nominal value). Contact Customer Support if you need help in correcting a line voltage problem.

Turn off power, open the yellow connector cams for all plug-in boards except the Power Supply PC Board. Disconnect J30 on the Mother PC Board. Turn the power back on. If CR1B is still not lighted, replace the Power Supply PC Board.

If the "+5 V OK" LED (CR1B) is now glowing, turn off the power and close the yellow connector cam for the CPU PC Board. If the LED does not light when the power is turned back on, the CPU PC Board is defective. If the CPU is not defective, continue to connect and test the remaining plug-in boards one at a time in this manner until you locate the defective board(s).

If you do not locate a defective board(s), disconnect the flat ribbon cable from the Keyboard/Display PC Board at J80 and from the PCL/ADC PC Board at J61 (if printer/plotter installed). Reconnect the cable first at J30 on the Mother PC Board, then at J80 on the Keyboard/Display, and finally at J61 on the PCL/ADC PC Board (following the above procedure each time) to find a defective cable, Keyboard/Display, or printer/plotter, respectively.

Replace the PC Board, cable, or printer that you found to be defective. Close all open connector cams, and reconnect all of the flat ribbon cable connectors.

3.1.3 "Line Voltage OK" (CR1D) LED Not Lighted

The AC power line voltage is below 90% of its nominal value. Operation of the instrument will be possible until the voltage is above this threshold.

The transformer tap select switch, S1, on the Mother PC Board may be in the wrong position. See paragraph 4.1 in the **Installation** section for details on setting this switch.

3.1.4 "System Run" (CR1C) LED Not Lighted

The microprocessor is being held in a reset condition, preventing operation, when this LED is not lighted. This indicator should be off only when the +5 V supply or the line voltage is out of tolerance (CR1B or CR1D not lighted). Turn off the instrument and open the connector cams for all PC Boards which are installed, except for the Power Supply PC Board, and disconnect the plug from J30 on the Mother PC Board. Turn the power back ON. If CR1C is still off, replace the Power Supply PC Board.

If the "System Run" LED (CR1C) is now lighted, turn off the power and close the yellow connector cam for the CPU PC Board. If the LED does not light when the power is turned back on, the CPU PC Board is defective. If the CPU is not defective, continue to connect and test the remaining plug-in boards one at a time in this manner until you locate a defective board(s).

If you do not locate a defective board(s), disconnect the flat ribbon cable from the Keyboard/Display PC Board at J80 and from the PCL/ADC PC Board at J61 (if printer/plotter installed). Reconnect the cable first at J30 on the Mother PC Board, then at J80 on the Keyboard/Display, and finally at J61 on the PCL/ADC PC Board (following the above procedure each time) to find a defective cable, Keyboard/Display, or printer/plotter.

Replace the PC Board, cable, or printer that you found to be defective. Close all open connector cams, and reconnect all of the flat ribbon cable connectors.

3.2 CPU: Microprocessor, RAM and ROM Memories, Associated Circuitry, and Instrument Bus

Faults tested in this paragraph will generally prevent the instrument from operating at all, but they may also cause erratic or intermittent operation.

You initiate the CPU tests by pressing [SHIFT] [INSTRUMENT TEST] (if the GC is responding to keyboard entries) or by cold-starting the instrument. If the results obtained by pressing [SHIFT] [INSTRUMENT TEST] are not satisfactory, repeat the test from **cold start**. (See paragraph 2.2 for a description of the cold start procedure.)

1.

   a. Press [SHIFT] [INSTR TEST] while you look at CR1 and CR2 LEDs on the CPU PC Board.

   or

   b. Cold start the instrument while you look at CR1 and CR2 LEDs on the CPU PC Board.

2. Both LEDs should blink "ON" momentarily when the test begins (if the test is initiated from cold start) and then turn off for approximately 2 to 5 seconds, after which they will light and remain lighted. If CR1 and CR2 follow this pattern, the CPU is working, so you should go directly to paragraph 3.3.

3. Any other behavior indicates a fault which can be identified in this section. Paragraphs 3.2.1 through 3.2.5 concern five deviations from the proper pattern. Follow the procedure in the **first** paragraph with a heading that corresponds to the behavior of the LEDs you observed.

   To ensure the validity of these tests, be certain that all 4 LED indicators, CR1A through CR1D, on the Power Supply PC Board are lighted, as described in paragraph 3.1.

3.2.1 CR1 and/or CR2 (CPU PC Board) Fail to Blink ON at Cold Start

If either or both indicators CR1 and CR2 on the CPU PC Board fail to blink ON momentarily at cold start, the indicators or their drive circuits are faulty. If there are no other fault indications, and the instrument operates normally, you may to continue operation.

The CPU PC Board must be replaced to restore the operation of these indicators.

3.2.2 CR1 and/or CR2 (CPU PC Board) Fail to Turn OFF

If either or both indicators CR1 and CR2 fail to turn OFF, the CPU PC Board is malfunctioning and must be replaced.

3.2.3 "CPU OK" (CR2) LED Does Not Light Within 5 Seconds

If CR2 fails to light within 5 seconds, the CPU PC Board is malfunctioning and must be replaced. Various codes may appear on the display during the test which can help a Customer Support Representative localize the problem on the board. Make a note of any displays which appear, and return them with the board.

3.2.4 "BUS OK" (CR1) LED Remains OFF After "CPU OK" (CR1) Lights

If CR1 remains OFF after CR2 lights, the CPU PC Board cannot transmit and receive data correctly over the instrument bus.

For an overview of the procedure described in this paragraph, see Figure 3. Check off the boxes provided in the figure as you complete each step described in the text.

Step 1: Turn off the instrument power and open the yellow cam connectors for all of the PC Boards which are installed, **except for the Power Supply PC Board and the CPU PC Board.** Cold start the instrument and look to see if CR1 "Bus OK" light comes on. If it does not, skip to Step 2. If it does come on, turn off the instrument power and close one of the open connector cams. Cold start the instrument (see paragraph 2.2) and look to see if CR1 LED still lights. Continue this way through the remaining printed circuit boards until you find the board that **prevents** the LED from turning on. Replace that PC Board.

Step 2: If the "BUS OK" LED did not come on after opening the connector cams, turn off the instrument power and unplug the connector from J30 on the Mother PC Board. Cold start the instrument (paragraph 2.2). If CR1 LED begins to blink after CR2 LED lights, skip to Step 3. If CR1 LED remains off, there is either a problem with the CPU PC Board (most probable) or a short on the instrument bus (less probable). The Mother PC Board, Power Supply PC Board, and CPU PC Boards should be examined for foreign material that might cause a short. If you do not find the problem, replace the CPU PC Board and then the Power Supply PC Board. Consult your Varian Customer Support representative if this does not correct the problem.

Step 3: If the "BUS OK" LED began blinking with J30 disconnected, turn off the power, reconnect J30, and disconnect the flat cable from the PCL/ADC PC Board at J61 (if printer/plotter installed). Cold start the instrument. If the "Bus OK" LED remains OFF, skip ahead to Step 4. If it begins to blink or turns on continuously, replace either the entire printer/plotter assembly or (if the facilities allow) the plotter's PCL/ADC PC Board (P/N 03-917602-00). If CR1 is blinking, go to paragraph 3.3.

Step 4: If the LED is still OFF, turn off the power and disconnect the flat cable from the Keyboard/Display PC Board at J80. Cold start the instrument. If the "BUS OK" LED (CR1) now begins to blink when the "CPU OK" LED turns on, the Keyboard/Display PC Board is defective and must be replaced. If the LED remains OFF, the flat cable (P/N 03-917816-00 or 03-917817-00, if P/P installed) must be replaced.

STEP 1

- OPEN CONNECTOR CAMS
- CHECK CR1 STATE
  - ☐ OFF
  - ☐ ON - CLOSE CAMS ONE BY ONE
    - REPLACE DEFECTIVE PCB

STEP 2

- UNPLUG J30
- CHECK CR1 STATE
  - ☐ BLINKING
  - ☐ OFF- CHECK FOR SHORTS
    - REPLACE CPU OR POWER SUPPLY

STEP 3

- RECONNECT J30
- CHECK CR1 STATE
  - ☐ OFF
  - ☐ ON OR BLINKING
    - REPLACE PRINTER
    - GO TO PARA. 9.3.3 IF CR1 BLINKING

STEP 4

- DISCONNECT J80
- CHECK CR1 STATE
  - ☐ BLINKING - REPLACE KEYBOARD/DISPLAY
  - ☐ OFF - REPLACE CABLE

Figure 3
"BUS OK" LED (C12) OFF (Para. 3.2.4)

3.2.5 "BUS OK" (CR1) LED Blinks After "CPU OK" (CR2) LED Turns ON

If the CR1 LED blinks after CR2 LED turns on, the CPU is not able to communicate with the Keyboard/Display controller.

Step 1: Turn off the instrument power and open the yellow connector cams for all of the PC Boards which are installed, except for the Power Supply PC Board and the CPU PC Board**.** Cold start the instrument and see if the "BUS OK" LED comes on normally. If it does not, skip to Step 2. If it does, turn off the power and close one of the open board locks. Cold start the instrument and see if the "Bus OK" LED still turns on after the "CPU OK" LED turns on. Continue in this way through the remaining printed circuit boards until one is found which prevents the LED from remaining lighted. Replace that PC Board.

Step 2: If the "BUS OK" LED did not operate normally with the connector cams open, turn off the power and disconnect the flat cable from the PCL/ADC PC Board at J61 (if printer/plotter installed). Cold start the instrument. If the "BUS OK" LED now comes on continuously after the "CPU OK" LED turns on, replace either the complete printer/plotter or (if the facilities allow) the plotter's PCL/ADC printed circuit board (P/N 03-917602-00).

If the "BUS OK" LED is still not operating normally, there is a fault in the Keyboard/Display PC Board (P/N 03-917708-00) or the flat cable. These must be replaced individually to determine which one is bad.

3.3 Display: Alphanumeric Display and LED Indicators on Keyboard

The display test is initiated by pressing [SHIFT] [INSTR TEST] (if the GC is responding to keyboard entries) or by cold-starting the instrument. If the results obtained by pressing [SHIFT] [INSTR TEST] are not satisfactory, repeat the test from cold start. See paragraph 2.2 for a description of the cold start procedure.

The display and the LEDs should turn off for a few seconds during the CPU tests. After both LEDs on the CPU PC Board have turned on (see paragraph 3.2), the words DISPLAY TEST should be displayed for one second. Segment A (see Figure 4) should then light up in all 32 character positions, followed by segments B, C, D, E, F, G, L, I, K, H, M, J, N, and the decimal point. All of the segments in the left-most character position should then turn on, with all remaining characters off. The remaining characters will then be turned on one at a time from left to right.

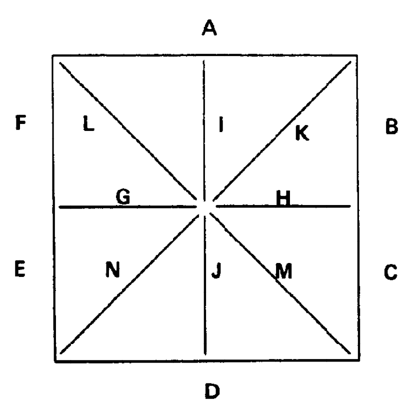


Figure 4
Segment Locations within a Display Character

The keyboard LEDs should remain off until the display segment test described above begins after the DISPLAY TEST message. All 12 of the keyboard LEDs should be lighted throughout the duration of the segment test. They will then be turned on one at a time during the segment test in the following sequence: READY, NOT READY, REMOTE CONTROL, RUN, BUILD/MODIFY, STATUS, METHOD 1, METHOD 2, METHOD 3, METHOD 4, RACK TABLE, and SEQUENCE TABLE.

Any deviation from the specified sequences indicates a fault in the Keyboard/Display PC Board, which should then be replaced.

3.4 Keyboard

If any key gives an improper response or no response at all, the Keycode Echo Test (paragraph 5) should be run, if possible. Four keys are required to initiate the Keycode Echo Test: SHIFT, GC CONFIGURE/INSTR TEST, ENTER, and 4/YES. If any of these keys fail to respond, use this section to isolate the problem to the Keyboard/Display PC Board or the keyboard touch panel. If these keys respond improperly, the problem is probably in the Keyboard/Display PC Board, which should be replaced.

The following procedure can be used to identify the cause of a completely unresponsive key. Figure 5 gives an overview of the procedure. Check off the boxes provided in the figure as you complete the steps described in the text.

Step 1: Enable the keyboard audible response feature by cold starting the instrument. Do not press any keys. If the keyboard “beep” does not sound within 5 seconds of cold start, skip ahead to Step 2. If the beep does sound without any keys having been pressed, turn off the instrument power and disconnect the keyboard touch panel from the Keyboard/Display PC Board at J81. Turn the instrument power back on and listen for the beep. If the beep still sounds, the Keyboard/Display PC Board is defective and must be replaced. If no beep is heard, the keyboard touch panel (P/N 03-917803-00) must be replaced. Contact Varian Customer Support.

Step 2: If the instrument did not generate a beep without pressing any key, press a key which was not responding. If no beep is heard, skip to Step 3. If the beep sounds, press the same key again. If the beep does not sound the second time, replace the Keyboard/Display PC Board. If the keyboard continues to respond with a beep each time a key is pressed, no problem is indicated in this section. The CPU and Display Tests (paragraphs 3.2 and 3.3) should be repeated.

Step 3: If the first key tested did not produce a beep, try pressing other keys on the keyboard. If none of them respond, replace the Keyboard/Display PC Board. If some of the keys are working, the problem could be in either the PC Board or the keyboard touch panel. First, try replacing the Keyboard/Display PC Board. If there is still no response, the old Keyboard/Display PC Board was probably good. The keyboard touch panel must be replaced. Contact Customer Support.

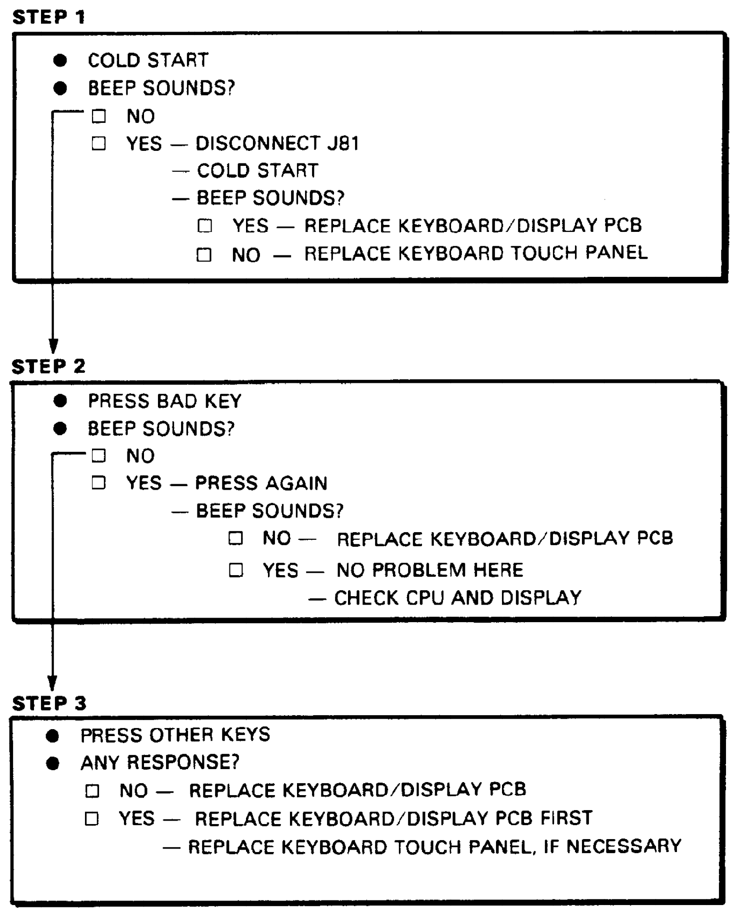


Figure 5
Unresponsive Key Test (para. 3.4)

4 Background Test and Automatic Tests

Background tests continuously monitor the operating conditions of the instrument. If a problem is found, the STATUS light will blink. Press [STATUS] to display the first fault message, and then press [ENTER] to display any additional fault messages. The normal Status displays will appear after all of the fault messages have been displayed. Continuing to press [ENTER] will return the display to the first background fault message.

Automatic tests are run without operator assistance. They are initiated automatically on cold start or from the keyboard by pressing [SHIFT] [INSTR TEST]. Automatic tests are run in less than a minute and operating conditions are disturbed only momentarily. It is recommended that the automatic tests be run daily as a **confidence check** on the instrument operation.

4.1 Background Tests

The background test fault messages are either transient or latched. Transient messages disappear as soon as the instrument stops detecting the fault, and the STATUS light stops blinking. Latched messages continue to be displayed, and the STATUS light continues to blink, even if the condition disappears by itself.

Pressing [RESET] clears all of the background test fault messages and stops the STATUS light from blinking. Any functions which have been disabled as a result of detecting the faults are turned back on. If a fault is still present, however, the indication will generally come back on as soon as it is detected. (The exceptions to this rule are noted in the list of background faults below.) As long as [RESET] is not pressed, the fault messages will continue to be the first displays seen when [STATUS] is pressed. The results of the background tests, along with the results of the Automatic and Extended tests, can be printed on the printer/plotter by pressing [SHIFT] [REPORT].

Some of the background faults represent simple operational problems, such as inconsistent method parameters or an extinguished detector flame. If the information provided in the list of faults below is not sufficient to solve the problem, refer to the appropriate section of this manual.

Other background fault messages indicate hardware malfunctions. Follow the instructions below for all of the faults which are displayed, and make a note of the fault numbers for future reference. The Automatic tests (paragraph 4.2) and the Extended tests (paragraph 5) will help in correcting most of these problems.

Background faults are sometimes generated by transient conditions such as power line disturbances. Fault messages which occur rarely and do not correspond to any observed operational problems can safely be ignored.

Background Faults

Error Code	Fault or Error	Possible Cause	Suggested Remedy
1	IIlegal method (transient)	The current method is not consistent with the hardware present or with the configuration table entries. Since illegal methods cannot be built, the error must have been caused by a change in a table entry or in the hardware installed. NOTE: If your GC is configured with a SPI Injector and an SPT, Fault Code #1 will occur on cold start. DO NOT set the SPT temperature limit until you have deleted the SPI Injector section.	Press [ENTER] to display the remaining background faults and the instrument status for help in finding the inconsistent entries.
2	Hardware change (transient)	Injector (switch S2, S3, or S4, as appropriate, on the Temperature Control PC Board). A change has been detected in the configuration of the electronics installed in the instrument. Be sure that the desired printed circuit boards are installed and all switches are in the proper positions.	
3	A change has been detected in the configuration of the Detector A electronics installed in the instrument.		
4	A change has been detected in the configuration of the Detector B electronics installed in the instrument.		

Error Code	Fault or Error	Possible Cause	Suggested Remedy
5	A change has been detected in the configuration of the External Events electronics installed in the instrument.		
6	A change has been detected in the configuration of the AutoSampler electronics installed in the instrument.		
7	A change has been detected in the configuration of the Printer/plotter electronics installed in the instrument.		
8	Inject switch stuck closed (transient). The inject switch was held down for the entire duration of a run.	This can be caused by overtightening the injector nut. See the entry for Fault 248 in paragraph 4.2 for more information.	Be sure that the GC can be taken out of RUN by pressing [RESET] and put back into RUN by pressing the inject switch before continuing operation.
9	Power supply failure (latched)	One of the system power supplies went out of tolerance. If the fault is still present, many other faults will result.	Run the diagnostics.
10	Memory error (latched)	An error was found in the program memory of the instrument. If this fault persists, erratic operation or random failures may occur.	Run the diagnostics.
11	Memory error (latched)	An error was found in the read/write memory of the instrument. If this fault persists, erratic operation or random failures may occur.	Run the diagnostics. Run the Destructive RAM test in paragraph 5 if this fault persists.
12	RAM battery low or off (latched)	The battery which maintains the instrument memory when power is off is either low or turned off at S1 on the CPU PC Board.	See the entry for Fault 201 in paragraph 4.2 for information on correcting the problem. Once this fault has been cleared by pressing [RESET], it will not be displayed again until the Automatic tests are run, so the STATUS light will not blink continuously until a new battery is installed. Press [SHIFT] [INSTR TEST] to run the Automatic tests after replacing the battery, and the test will be enabled again.
13	Power fail occurred (latched)	AC power to the instrument was interrupted, either by a power failure or by turning off the main power switch.	

Error Code	Fault or Error	Possible Cause	Suggested Remedy
14	Temperature setpoint above limit (transient)	A temperature setpoint in the current method for the Injector (Injector A for Star 3600 CX) heated zone is greater than the limit entered in the configuration table.	One of the entries must be changed before the method can be activated.
15	Temperature setpoint above limit (transient)	A temperature setpoint in the current method for the Column heated zone is greater than the limit entered in the configuration table.	One of the entries must be changed before the method can be activated.
16	Temperature setpoint above limit (transient)	A temperature setpoint in the current method for the Auxiliary heated zone is greater than the limit entered in the configuration table.	One of the entries must be changed before the method can be activated.
17	Temperature setpoint above limit (transient)	A temperature setpoint in the current method for the Detector (Detector A for Star 3600 CX) heated zone is greater than the limit entered in the configuration table.	One of the entries must be changed before the method can be activated.
18	Temperature Control ADC fault (latched)	The analog-to-digital converter used to measure temperatures failed. Because of the danger of thermal runaway, the AC power for the heaters (and other devices) is turned off. The Temperature Control PC Board is probably defective.	Run the diagnostics.
19	Primary fuse blown (transient)	Fuse F2 on the Mother PC Board is blown. If Fault 19 and Fault 20 occur together, it is more likely that the main power contact is open for some reason.	See if any other background faults are displayed which turn off the AC power. Also, see if the high voltage cover is depressing the interlock switch properly. Running the Automatic tests described in paragraph 4.2 will provide more information on the source of the problem and repair procedures.
20	Primary fuse blown (transient)	Fuse F3 on the Mother PC Board is blown. If Fault 19 and Fault 20 occur together, it is more likely that the main power contact is open for some reason.	See if any other background faults are displayed which turn off the AC power. Also, see if the high voltage cover is depressing the interlock switch properly. Running the Automatic tests described in paragraph 4.2 will provide more information on the source of the problem and repair procedures.
21	Column oven fan motor overheated (latched)	The fan motor can overheat because of a defect in the motor or fan, or because of a lack of cooling air around the motor.	Run the Automatic tests, and see the entry for Fault 247 in paragraph 4.2. When this fault is detected, the column oven vents are closed and the heaters are turned off to allow the motor to cool. Operation can be restored by pressing [RESET]. If the motor has cooled sufficiently, the Automatic tests may not detect the fault.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
22	Heated zone overheated (latched)	One of the heated zones has a temperature reading above 429°C. The main power contact is turned off to prevent further heating.	Check the Status displays to see which zone is overheated, assuming that it has not had time to cool since the fault was detected. Run the Automatic tests and see the entry for Fault 207 in paragraph 4.2 to find the source of the problem. To ensure safe operation, be sure that there is no problem remaining before pressing [RESET] to return to normal operation.
23	Thermal runaway (latched)	The Column heated zone has continued to heat above 250°C even though the instrument has tried to turn the heater off. The main power contact is turned off to prevent further heating.	Run the Automatic tests described in Section 15 to find the source of the problem. If no problem is found, press [RESET] to return to normal operation for a few minutes, watching for any abnormal behavior. Run the Automatic tests again after the instrument has warmed up to see if the problem has returned. To ensure safe operation, be sure that there is no problem remaining before continuing normal operation.
24	Thermal runaway (latched)	The Injector (Injector A for Star 3600 CX) heated zone has continued to heat above 250°C• even though the instrument has tried to turn the heater off. The main power contact is turned off to prevent further heating.	Run the Automatic tests described in Section 15 to find the source of the problem. If no problem is found, press [RESET] to return to normal operation for a few minutes, watching for any abnormal behavior. Run the Automatic tests again after the instrument has warmed up to see if the problem has returned. To ensure safe operation, be sure that there is no problem remaining before continuing normal operation.
25	Thermal runaway (latched)	The Auxiliary heated zone has continued to heat above 250°C even though the instrument has tried to turn the heater off. The main power contact is turned off to prevent further heating.	Run the Automatic tests described in Section 15 to find the source of the problem. If no problem is found, press [RESET] to return to normal operation for a few minutes, watching for any abnormal behavior. Run the Automatic tests again after the instrument has warmed up to see if the problem has returned. To ensure safe operation, be sure that there is no problem remaining before continuing normal operation.
26	Thermal runaway (latched)	The Detector (Detector A for Star 3600 CX) heated zone has continued to heat above 250°C even though the instrument has tried to turn the heater off. The main power contact is turned off to prevent further heating.	Run the Automatic tests described in Section 15 to find the source of the problem. If no problem is found, press [RESET] to return to normal operation for a few minutes, watching for any abnormal behavior. Run the Automatic tests again after the instrument has warmed up to see if the problem has returned. To ensure safe operation, be sure that there is no problem remaining before continuing normal operation.
27	Temperature sensor probe fault (latched)	The instrument has detected a shorted (or partially shorted) temperature sensor probe in the Column Oven zone. Power to the affected zone is turned off.	Pressing [RESET] will turn the zone back on and clear the fault message. These faults will also be displayed if a probe simulator is used on a zone that has not been turned off in the GC Configure table.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Run the Automatic tests described in paragraph 4.2. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced. Replace Column oven probe harness with P/N 03-917813-00 (3300/Star 3400 CX) or P/N 03-918101-00 (Star 3600 CX).
28	Temperature sensor probe fault (latched)	The instrument has detected a shorted (or partially shorted) temperature sensor probe in the Injector (Injector A for Star 3600 CX) zone. Power to the affected zone is turned off.	Pressing [RESET] will turn the zone back on and clear the fault message. These faults will also be displayed if a probe simulator is used on a zone that has not been turned off in the GC Configure table. Run the Automatic tests described in paragraph 4.2. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
29	Temperature sensor probe fault (latched)	The instrument has detected a shorted (or partially shorted) temperature sensor probe in the Auxiliary zone. Power to the affected zone is turned off.	Pressing [RESET] will turn the zone back on and clear the fault message. These faults will also be displayed if a probe simulator is used on a zone that has not been turned off in the GC Configure table. Run the Automatic tests described in paragraph 4.2. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
30	Temperature sensor probe fault (latched)	The instrument has detected a shorted (or partially shorted) temperature sensor probe in the Detector (Detector A for Star 3600 CX) zone. Power to the affected zone is turned off.	Pressing [RESET] will turn the zone back on and clear the fault message. These faults will also be displayed if a probe simulator is used on a zone that has not been turned off in the GC Configure table.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
30	*(Continued)*		Run the Automatic tests described in paragraph 4.2. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
31	Temperature sensor probe fault (latched)	The instrument has detected a shorted (or partially shorted) temperature sensor probe in the Detector Pneumatics zone. Power to the affected zone is turned off.	Pressing [RESET] will turn the zone back on and clear the fault message. These faults will also be displayed if a probe simulator is used on a zone that has not been turned off in the GC Configure table. Run the Automatic tests described in paragraph 4.2. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
32	Temperature control ADC overrange (latched)	The analog-to-digital converter used to measure the temperature of the Column zone read an overrange value. Power to the affected zone (see the fault list below) is turned off.	If one of these faults occurs in conjunction with Fault 22, follow the instructions for Fault 22. Press [RESET] to turn the zone back on and clear the fault message. Run the Automatic tests. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
33	Temperature control ADC overrange (latched)	The analog-to-digital converter used to measure the temperature of the Injector (Injector A for Star 3600 CX) zone read an overrange value. Power to the affected zone (see the fault list below) is turned off.	If one of these faults occurs in conjunction with Fault 22, follow the instructions for Fault 22. Press [RESET] to turn the zone back on and clear the fault message.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Run the Automatic tests. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C degrees. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
34	Temperature control ADC overrange (latched)	The analog-to-digital converter used to measure the temperature of the Auxiliary zone read an overrange value. Power to the affected zone (see the fault list below) is turned off.	If one of these faults occurs in conjunction with Fault 22, follow the instructions for Fault 22. Press [RESET] to turn the zone back on and clear the fault message.
			Run the Automatic tests. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
35	Temperature control ADC overrange (latched)	The analog-to-digital converter used to measure the temperature of the Detector (Detector A for Star 3600 CX) zone read an overrange value. Power to the affected zone (see the fault list below) is turned off.	If one of these faults occurs in conjunction with Fault 22, follow the instructions for Fault 22. Press [RESET] to turn the zone back on and clear the fault message.
			Run the Automatic tests. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
36	Temperature control ADC overrange (latched)	The analog-to-digital converter used to measure the temperature of the Pneumatics zone read an overrange value. Power to the affected zone (see the fault list below) is turned off.	If one of these faults occurs in conjunction with Fault 22, follow the instructions for Fault 22. Press [RESET] to turn the zone back on and clear the fault message.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
36	*(Continued)*		Run the Automatic tests. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PC Board and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15°C and +15°C. If it is not, replace the Temperature Control PC Board. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
37	Power line ground fault (latched)	The polarization of the power line connection is reversed, or the ground connection through the power cord is missing. Normal chromatographic functions are not affected, but the risk of electrical shock is increased for certain maintenance operations and in case of some component failures.	If the instrument is wired for 220 V operation with a non-polarized line plug, reverse the plug in the wall outlet. If this does not correct the problem, or if the cord is equipped with a polarized plug, try another wall outlet or have an electrician check the outlet for proper polarization and grounding. Once this fault has been cleared by pressing [RESET], it will not be displayed again until the Automatic tests are run, so the STATUS light will not blink continuously while the fault remains. After the problem has been corrected, press [SHIFT] [INSTR TEST] to verify proper operation, and the background test will be enabled again.
38	Main power contact open (transient)	AC power is turned off to the heaters, motors, and solenoids.	Check for any other background faults which could cause this condition, and make sure that the high voltage cover is fully depressing the interlock switch. Pressing [SHIFT] [INSTR TEST] to run the Automatic tests should identify the cause of this fault.
39	Cryogenic coolant timer elapsed (transient)	The cryogenic coolant timer which was set in the GC Configure table has elapsed.	Press RESET to re-enable the coolant and restart the timer.
40	Detector A A/D converter fault (latched)	The analog-to-digital converter used for autozero, Status displays, and diagnostics for Detector A failed. Some of these functions may not operate properly.	Run the Automatic tests to verify the problem. Replace the Detector A PC Board to correct the problem.
41	Detector A ignitor fuse blown (transient)	The ignitor coil will not heat to light the flame.	See the entry for Fault 289 in paragraph 4. This test is performed only when [IGNITE A] is pressed, so the display will be turned on or off only when the key is pressed.
42	Detector A ignitor relay fault (latched)	The ignitor coil will not heat to light the flame.	See the entry for Fault 290 in paragraph 4.2.
43	Detector A polarizer fault (latched)	The polarizing voltage is out of tolerance.	Run the Automatic tests to determine the cause of this problem. Check FID polarizer voltage fuse (F103) inside back panel of instrument.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
44	Detector A TCD filament temperature limited (transient)	The instantaneous filament protection circuit has reduced the bridge voltage to prevent an excessive filament temperature rise. This may occur in normal operation when a large sample concentration, such as a solvent peak, is present in the cell. The only problem which this creates is reduced height and area of the overloaded peak.	If quantitative results are required for the affected peak, a smaller sample must be injected, or the detector operating conditions must be changed. Refer to the TCD detector section for more information on selecting TCD operating conditions.
45	Detector A TCD carrier gas not flowing (latched)	This fault is detected only when Helium carrier gas has been selected in the configuration table. It is reported when either a large cell imbalance or an abnormally high cell temperature has been detected continuously for three minutes. Power to the cell is turned off to prevent oxidation of the filaments until the fault display is cleared by pressing [RESET].	One cause of this fault is a loss of carrier gas through both sides of the bridge. Check for obstructions in the gas lines, and be sure that the appropriate valves are open and the gas supply is not depleted. The other cause is a large bridge imbalance. Check for a missing or perforated septum, a broken column, or a leaking connection. Balance the bridge with the TCD balance control to bring the baseline value within range of the autozero correction.
46	Detector A autozero exceeded (transient)	The detector background could not be canceled well enough.	The background level may exceed the range of the autozero (1300 mv or 160 mv on the most sensitive range, depending on the detector type), or the background signal may be too noisy or unstable for the autozero to track. If neither of these conditions is true, run the Automatic tests to check for a hardware fault. This fault may be reported during initial conditioning when background noise is exceptionally large, particularly with an ECD or FPD detector or a new column.
47	Detector A flame extinguished (transient)	The background level for the detector flame or faulty TSD bead was below the minimum normal value for an operating detector.	This condition is checked only once per run when the instrument goes into the STABILIZE state, so lighting or extinguishing the flame will not be reflected in this fault message immediately.
48	Detector A TCD out of balance (transient)	The autozero correction is above 70% of its maximum available range.	The TCD balance control should be adjusted to return the baseline value closer to zero for optimum noise performance and to ensure that the autozero correction will be able to compensate for further drift in the cell.
49	Detector A ECD switched to test mode (transient)	Switch S3 on the ECD PC Board is in the TEST position.	See the troubleshooting procedures in paragraph 8.10 for the use of this switch. It must be in the NORM position for proper operation whenever the cell is connected.
50	Detector A TSD bead power off (transient)	The DETECTOR section in the active method has been set to turn bead current off.	Change that entry to clear the fault and to resume normal operation.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
51	Detector A TCD bridge power off (transient)	The DETECTOR section in the active method has been set to turn the cell voltage off.	Change that entry to clear the fault and to resume normal operation.
52	Detector B A/D converter fault (latched)	See Fault 40	
53	Detector B ignitor fuse blown (transient)	See Fault 41	
54	Detector B ignitor relay fault (latched)	See Fault 42	
55	Detector B polarizer fault (latched)	See Fault 43	
56	Detector B TCD filament temperature limited (transient)	See Fault 44	
57	Detector B TCD carrier gas not flowing (latched)	See Fault 45	
58	Detector B autozero exceeded (transient)	See Fault 46	
59	Detector B flame extinguished (transient)	See Fault 47	
60	Detector B TCD out of balance (transient)	See Fault 48	
61	Detector B ECD switched to test mode (transient)	See Fault 49	
62	Detector B TSD bead power off (transient)	See Fault 50	
63	Detector B TCD bridge power off (transient)	See Fault 51	
64	Serial Interface switched to test mode (transient)	Switch S1 and/or switch S2 on the Serial Interface PC Board is in the TEST position.	Both switches must be in the NORM position for communication with a data system. When they are in the TEST position, the Automatic tests (paragraph 4.2) will check the line drivers and receivers on the Serial Interface PC Board.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
65	Data system disconnected (transient)	Communication to the data system connected through the Serial Interface PC Board has been interrupted.	This test is enabled by turning on the instrument power or running the Automatic tests while a data system is connected. The fault will then be displayed as soon as the GC tries to communicate with the data system after the cable has been discon-nected or the data system has been turned off. If the fault display is cleared by pressing [RESET], it will not be displayed again until communication has been reestablished with the data system and then broken again.
78	Pressure A/D converter fault (latched)	The analog-to-digital converter used to measure column head pressures failed. Pressure readings will be inaccurate.	Replace the External Events PC Board to correct the problem.
79	External Events 24 VAC fuse blown (transient)	The fuse for the 24 VAC power which supplies the External Event relays is blown.	Refer to the entry for Fault 411 in paragraph 4.2 to correct the problem.
80	Printer/plotter power supply failure (latched)	The printer/plotter power supply is not within its voltage tolerance. This will be indicated by the STATUS LED on the PCL/ADC PC Board being off.	Verify that the power cable is plugged into J69 on the Printer/Plotter Power Supply PC Board. Check if the green LED FUSE OK indicator is lighted. If it is, the power supply has failed. Replace the printer assembly. If the green LED FUSE OK indicator is not lighted, then fuse F1 on the Printer/Plotter Power Supply PC Board is blown. Replace fuse F1 (2 A, 250 V, slow blow). If the fuse blows again, replace the printer assembly.
81	Printer communication failure (latched)	The command/data protocol was violated by the GC or the printer/plotter. This will be indicated by distorted peaks because of lost data.	The fault is self-correcting and no action is taken.
82	Printer paper out (transient)	The paper supply in the printer is exhausted.	Replace the paper.
83	Buffer overflow in GC (latched)	The signal was changing too fast for the plotter to keep up with the ADC data rate and caused a buffer overflow in the GC. This will be indicated by distorted or missing peaks because of lost data. The specifications call for a maximum of 10 full scale peaks in a row of 0.7 seconds peak width at half height or 1 Hz noise at 10% full scale plotted continuously without distortion.	Reduce the number of peaks in a row or reduce the amplitude or frequency of the noise.
84	Command not taken (latched)	The GC sent a command to the printer and the printer did not accept the command within 10 seconds. This will be indicated by missing peaks or an incomplete printout.	If this fault is detected, the GC will reset the printer and try to resume normal operation. Printing will be aborted and plotting will be continued after the reset. If any error is detected after the reset, the printer/plotter will be logged out of service. This fault will be cleared at the start of the next run.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
85	Data not returned (latched)	The GC was expecting ADC data from the printer and data was not received within 6 seconds. This will be indicated by missing peaks or an incomplete printout.	If this fault is detected, the GC will reset the printer and try to resume normal operation. Printing will be aborted and plotting will be continued after the reset. If any error is detected after the reset, the printer/plotter will be logged out of service. This fault will be cleared at the start of the next run.
86	Left edge sensor failure (latched)	The plotter's thermal head is under full power against the left stop, usually accompanied by an audible groaning noise from the motor.	Run the Automatic tests.
87	ADC failed to calibrate (latched)	Offset or reference errors in the plotter ADC were greater than the range for internal calibration.	Run the Automatic tests.
88	Zero pen range exceeded (transient)	The ±3 chart range was exceeded in attempting to zero the baseline. This will be indicated by the plot not returning to baseline when the Zero Pen function is requested.	
89	AC test timer bad (latched)	The internal timer used to check for the presence of AC voltages failed. Normal chromatographic functions are not affected.	To restore the operation of the diagnostic tests, replace the CPU PC Board.
108	Thermal runaway (latched; Star 3600 CX only)	The Injector heated zone has continued to heat above 250 degrees even though the instrument has tried to turn the heater off. The main power contact is turned off to prevent further heating.	Run the Automatic tests described in Section 15 to find the source of the problem. If no problem is found, press [RESET] to return to normal operation for a few minutes, watching for any abnormal behavior. Run the Automatic tests again after the instrument has warmed up to see if the problem has returned. To ensure safe operation, be sure that there is no problem remaining before continuing normal operation.
109	Thermal runaway (latched; Star 3600 CX only)	The Detector heated zone has continued to heat above 250 degrees even though the instrument has tried to turn the heater off. The main power contact is turned off to prevent further heating.	Run the Automatic tests described in Section 15 to find the source of the problem. If no problem is found, press [RESET] to return to normal operation for a few minutes, watching for any abnormal behavior. Run the Automatic tests again after the instrument has warmed up to see if the problem has returned. To ensure safe operation, be sure that there is no problem remaining before continuing normal operation.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
110	Temperature sensor probe fault (latched; Star 3600 CX only)	The GC has detected a shorted (or partially shorted) temperature sensor probe for the Injector B heated zone.	Power to the Injector B zone is turned off. Pressing [RESET] turns the zone back on and clears the fault message. These faults will also be displayed if a probe simulator is used on a zone that has not been turned off in the GC Configure table. Run the Automatic tests described in paragraph 1.2. If that does not locate the problem, disconnect the probe from its connector on the Temp. Control PCB and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15 and +15 degrees. If it is not, replace the Temp. Control PCB. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
111	Temperature sensor probe fault (latched; Star 3600 CX only)	The GC has detected a shorted (or partially shorted) temperature sensor probe for the Detector B heated zone.	Power to the Detector B zone is turned off. Pressing [RESET] turns the zone back on and clears the fault message. These faults will also be displayed if a probe simulator is used on a zone that has not been turned off in the GC Configure table. Run the Automatic tests described in paragraph 1.2. If that does not locate the problem, disconnect the probe from its connector on the Temp. Control PCB and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15 and +15 degrees. If it is not, replace the Temp. Control PCB. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
112	Temperature control ADC overrange (latched; Star 3600 CX only)	The analog-to-digital converter used to measure temperatures read an overrange value for the Injector B zone.	Power to the Injector B zone is turned off. If one of these faults occurs in conjunction with Fault 22, follow the instructions for Fault 22. Press [RESET] to turn the zone back on and clear the fault message. Run the Automatic tests. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PCB and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15 and +15 degrees. If it is not, replace the Temperature Control PCB. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
113	Temperature control ADC overrange (latched; Star 3600 CX only)	The analog-to-digital converter used to measure temperatures read an overrange value for the Detector B zone.	Power to the Detector B zone is turned off. If one of these faults occurs in conjunction with Fault 22, follow the instructions for Fault 22. Press [RESET] to turn the zone back on and clear the fault message.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
113	*(Continued)*		Run the Automatic tests. If that does not locate the problem, disconnect the probe from its connector on the Temperature Control PCB and replace it with a probe simulator plug. The temperature reading for the zone should now be between -15 and +15 degrees. If it is not, replace the Temperature Control PCB. If it is, the temperature sensor probe is faulty, and the entire probe harness for that zone must be replaced.
114	Temperature setpoint above limit (transient; Star 3600 CX only)	A temperature setpoint in the current method for the Injector B heated zone is greater than the limit entered in the configuration table.	One of the entries must be changed before the method can be activated.
115	Temperature setpoint above limit (transient; Star 3600 CX only)	A temperature setpoint in the current method for the Detector B heated zone is greater than the limit entered in the configuration table.	One of the entries must be changed before the method can be activated.
116	Injector B hardware change (transient; Star 3600 CX only)	A change has been detected in the configuration of Injector B..	Check the position of S4 on the Temperature Control PC Board.
117	Pneumatic heater runaway (latched; Star 3600 CX only)	The heated zone has continued to heat above 60 degrees even though the instrument has tried to turn the heater off. The main power contact is turned off to prevent further heating.	Run the Automatic tests described in Section 15 to find the source of the problem. If no problem is found, press [RESET] to return to normal operation for a few minutes, watching for any abnormal behavior. Run the Automatic tests again after the instrument has warmed up to see if the problem has returned. To ensure safe operation, be sure that there is no problem remaining before continuing normal operation.
118	Reserved for factory use only.		
119	IBDH fatal error	This error indicates that IBDH has issued an automation halt command. This is caused by 1) the error counter for non-fatal errors reaching the user-defined limit, or 2) the occurrence of a single IBDH fatal error. See the description of fatal and non-fatal errors (Table 5) in the IBDH Operation section in the Options/Accessories Manual.	
120	Failure to send report	Occurs when the GC has sent a request to transmit an IBDH result report to an external computer via the serial communications port and the external computer does not acknowledge the request. The GC waits one minute before generating this fault.	

Error Code	Fault or Error	Possible Cause	Suggested Remedy
121	8200 CX AutoSampler command not executed		
122	8200 CX Autosampler: Vial missing. During a multi-injection sequence, a vial was expected and not found.	A vial has been removed from the carrousel during operation.	Check the carrousel to determine if all vials are accounted for.
		The carriage flex cable is unplugged.	Check cable connections.
		The IR.LED is defective, or not plugged in, or the PC Board is defective.	Check the IR.LED connection. Call Customer Support for board replacement.
		The Position Sensor PC Board is defective.	Call Customer Support for board replacement.
123	8200 CX Autosampler: Valve Driver bad. One of the valve drivers or the Stop Solenoid driver has been detected as bad.	One of the valves, or the Stop Solenoid is not plugged into the Controller PC Board.	Check all solenoid electrical lead connections for proper connections at J8.
		One of the valves or Stop Solenoid is defective.	Call Customer Support for replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
124	8200 CX Autosampler: Triac driver bad.	The Position Sensor PC Board is defective.	Call Customer Support for board replacement.
125	8200 CX Autosampler: Storage Module door open. The Storage Module latch sensor is indicating that the Storage Module is unlatched.	The Storage Module is not properly closed.	Check that latch is securely closed.
		The latch sensor is defective.	Call Customer Support for latch replacement.
		The latch sensor is not plugged into the Controller PC Board.	Check that the latch electrical lead is plugged into P6 on the Controller PC Board.
126	8200 CX Autosampler: Vial tray removed. The vial tray sensor has detected that there is no vial tray present.	Vial tray is removed or not correctly mounted.	Check for proper installation of the vial tray.
		Vial/Home Sensor PC Board is defective.	Call Customer Support for board replacement.
		Position Sensor ribbon cable is unplugged or defective.	Check cable connection or call Customer Support for ribbon cable replacement.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
127	8200 CX Autosampler: 24 VAC bad. The 24 volt power supply to the vial tray rotation and translation motors has been detected as absent.	Position Sensor ribbon cable is unplugged or defective.	Check cable connection or call Customer Support for cable replacement.
		Position Sensor PC Board is defective.	Call Customer Support for board replacement.
		Controller PC Board is defective.	Call Customer Support for board replacement.
		Transformer is defective.	Call Customer Support for transformer replacement.
128	Not Used.		
129	8200 CX air pressure low.	Air supply pressure low.	Air pressure regulated at 40-60 psig is available.
		Air pressure sensor tube/fittings are restricted.	Check all lines for restrictions.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
130	8200 CX memory bad. The AutoSampler has done an internal memory test and found the memory defective.	8200 CX Controller PC Board defective.	Call Customer Support for board replacement.
131	8200 CX motor time out. One of the motors in the AutoSampler has been detected as jammed or faulty.	Part of the 8200 CX mechanism has jammed.	If no obvious problem can be found, run the GC diagnostics to obtain additional information.
132	Illegal command. The 8200 CX received an illegal command from the GC.	The 8200 CX Serial Interface cable shield is not properly grounded.	Check for good grounding contact with the bared shield.
		Defective or improperly installed Serial Interface cable.	Check for proper installation of the cable, or call Customer Support for replacement if defective.
		8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
		The GC CPU PC Board is defective.	Call Customer Support for board replacement.
		The ROM set in the GC CPU and the 8200 CX Controller PC Board are incompatible.	Call Customer Support for upgrade.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
133	Wrong position for vial sense. The GC has requested the 8200 CX to find the next vial position when the vial tray is not in the correct position to detect vials.	The vial tray is in the wrong position for vial detection. *This error can only occur if the device controlling the AutoSampler has defective software.*	Reposition the vial tray.
134	8200 CX has been reset.	Power glitch to the 8200 CX. Power has been interrupted to the 8200 CX. The GC has reset the 8200 CX.	
135	Not Used.		
136	8200 CX power off. The GC electronics has detected that there is no power in the 8200 CX AutoSampler.	8200 CX is not turned on or has no power available to it.	Check power cord connection. Check power source.
		The 8200 CX fuse is blown.	Replace 8200 CX fuse.
		The 8200 CX Serial Interface cable is defective or not plugged in correctly.	Check the interface cable for proper connection at the AutoSampler and GC. Replace if found defective.
137	No response from 8200 CX. The GC electronics has attempted to communicate with the 8200 CX and has failed to detect a response.	8200 CX power failure has occurred.	Check 8200 CX power fuse, power cable connection.
138	8200 CX Serial Communication Checksum error. Some data that was sent between the 8200 CX AutoSampler and the GC was detected as bad. This may have been a one time occurrence.	The 8200 CX Serial Interface cable shield is not correctly connected to ground.	Check that the bared shield is firmly clamped in the grounded clamp.
		The 8200 CX Serial Interface Cable is defective or not properly installed.	Check cable installation and replace if defective. Call Customer Support for cable replacement. Call Customer Support for board replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
		The GC CPU PC Board is defective.	

Error Code	Fault or Error	Possible Cause	Suggested Remedy
139	8200 CX AutoSampler: Vial Tray Home Sensor bad. An attempt was made to rotate the vial tray to Rack 1, Vial 1 and detect the vial tray Home slot at the location. The Home slot was not detected.	Vial tray mechanism not correctly aligned.	Call Customer Support for realignment.
		Vial/Home Sensor PC Board defective.	Call Customer Support for board replacement.
		Position Sensor ribbon cable unplugged or defective.	Check cable connection or call Customer Support for ribbon cable replacement.
		The Position Sensor to Controller PC Board ribbon cable is defective.	Check cable connection. Call Customer Support for ribbon cable replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
140	Not Used.		
141	Automation Abort - General.	Indicates a Dual AutoSampler fault.	Press ENTER for additional codes.
142	Automation Abort - Warm Start.	Indicates a Dual AutoSampler fault.	Press ENTER for additional codes.
143	Dual AutoSampler Vial Mismatch.	When BOTH is selected, this error indicates that vials are loaded in the carrousels such that the 8200 CX AutoSamplers attempt to sample from different vial numbers.	Check that the vials are loaded in the carrousel such that the 8200 CX AutoSamplers sample from the same vial.
144	Left AutoSampler Not Available.	When BOTH or LEFT is selected, this error indicates that the power has not been turned on to the AutoSampler, or if the Left 8200 CX AutoSampler cable is not plugged into the Dual AutoSampler Cable Control Module.	Turn the power on to the AutoSamplers. Check that the Left 8200 CX AutoSampler cable is connected properly to the Dual AutoSampler Cable Control Module.
145	Right AutoSampler Not Available.	When BOTH or RIGHT is selected, this error indicates that the power has not been turned on to the AutoSampler, or if the Right 8200 CX AutoSampler cable is not plugged into the Dual AutoSampler Cable Control Module.	Turn the power on to the AutoSamplers. Check that the Left 8200 CX AutoSampler cable is connected properly to the Dual AutoSampler Cable Control Module.
146	Error from Left AutoSampler.	Indicates an internal error with the Left 8200 CX AutoSampler.	
147	Error from Right AutoSampler.	Indicates an internal error with the Right 8200 CX AutoSampler.	
148	Left AutoSampler Time-out.	Indicates that communication between the Star 3600 CX GC and the Left 8200 CX AutoSampler has failed following a 1.5 minute Time-out period.	

Error Code	Fault or Error	Possible Cause	Suggested Remedy
149	Right AutoSampler Time-out.	Indicates that communication between the Star 3600 CX GC and the Right 8200 CX AutoSampler has failed following a 1.5 minute Time-out period.	
197		The 8200 CX Serial Interface cable is defective or not plugged in correctly.	Check connections or replace cable.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
		The GC CPU PC Board is defective.	Call Customer Support for board replacement.

4.2 Automatic Tests

The results of all of the automatic tests are reported by numbered messages on the front panel display. The DISPLAY CONTROL keys can be used to view all of the faults which were found, but only the lowest numbered fault indication should be considered reliable. Find that fault number in the list below, and follow the procedures for it. **Refer to paragraph 9 for electronic hardware locations.**

Faults 250-310 apply to Detector A. Faults 312-372 apply to Detector B..

If a printer/plotter is installed, the test pattern, Figure 6, will be printed. If the pattern does not look right, see **Troubleshooting Procedures,** paragraph 7. If the Automatic Test results are inconsistent or questionable, do the core tests described in paragraph 3.

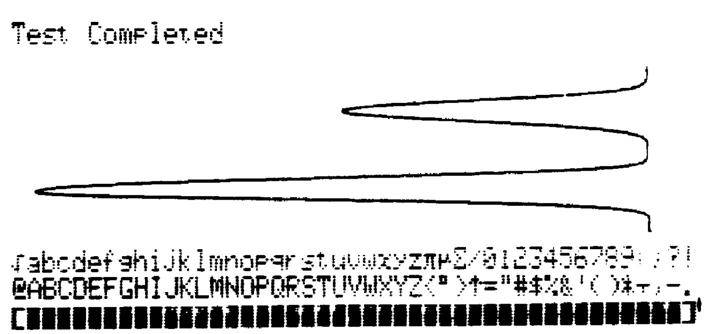


Figure 6
Printer/Plotter Test Pattern

Error Code	Fault or Error	Possible Cause	Suggested Remedy
201	Indicates low battery voltage for memory protection when the power is OFF. Instrument operating conditions and stored methods may be lost during a power failure or when the instrument is turned off.	RAM Battery switch (S1 on the CPU PCB) is in the OFF position.	Return S1 to the ON position.
		The battery holder is making poor contact with the battery (BT1 on the CPU PCB).	Using the eraser end of a pencil, rotate the battery in its holder. (This may be safely done without removing pc boards or turning off power.) In severe cases of corrosion or contamination, it may be necessary to remove the battery from its holder and clean both the battery and the contacts of the holder.
		Battery BT1 on the CPU PCB is weak or dead.	Replace the battery with an equivalent type or use Varian P/N 74-122901-00. Install the new battery with the “+” mark facing away from the board.
		The nickel-cadmium batteries used with the In-Board Data Handling option or in Star 3600 CX GCs are discharged.	Allow the GC to remain turned on for several hours and retest.
202	Indicates ac test timer malfunction.	The diagnostics which check fuses, relays, and the ac power controls on the Temperature Control and AutoSampler/ External Events PCBs will not operate correctly. No other instrument functions are affected.	Replace the CPU PCB.

Refer to paragraph 9 for electronic hardware locations.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
203	Fuse F2 on the Power Supply PCB is blown.	If faults 203 and 204 occur together, the +15 V and -15 V power supplies will be disabled, inhibiting the operation of detectors, temperature control, and other functions. If only one fuse is blown, either power supply may go out of tolerance intermittently, resulting in erratic operations.	It is also possible that power is not reaching the Mother PCB from the transformer. Be sure that J24 on the Mother PCB is making good contact with its mating plug.
			Step 1: Turn off the instrument power and replace the blown fuse or fuses. If the replacements also blow, turn off the power and open the yellow connector cams for all of the pc boards which are installed, except the ones for the Power Supply and CPU PCBs. Replace the fuses and turn on the power. If the fuses have not blown after 30 seconds of operation, skip to Step 3. If the fuses have blown, the Power Supply PCB must be replaced, unless a printer/plotter is installed.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Step 2: If a printer/plotter is installed, turn off the power and disconnect it at J61 on the PCL/ADC PC Board. Replace the fuses and turn on the power. If the fuses no longer blow, replace the entire printer/plotter assembly or (if facilities allow) the PCL/ADC PCB. If the fuses continue to blow, replace the Power Supply PCB. Step 3: (From Step 1 only.) If the fuses did not blow with the connector cams open, turn off the power and close one of the open connector cams. Turn the power back on and see if the fuses hold for at least 30 seconds. Continue in this manner through the remaining connector cams until one is found which causes the fuse to blow. Replace that pcb. Step 4: Be sure that all cables, connector cams, and fuses are restored to their normal conditions before proceeding.
204	Fuse F1 on the Power Supply PCB is blown.		See Fault 203.
205	The +15 V supply is out of tolerance.	Operation of detectors, temperature control, and other functions will be inhibited.	Step 1: Turn off the power and open the yellow connector cams for all of the pc boards which are installed, except the ones for the Power Supply and CPU PCBs. Turn the power back on and run the Automatic tests. If Faults 205 and 206 no longer appear, skip ahead to Step 3. If the fault is still present, the Power Supply PCB must be replaced, unless a printer/plotter is installed. Step 2: If a printer/plotter is installed, turn off the power and disconnect cable at J61 on the PCL/ADC PCB. If the fault does not return when the tests are run, replace the entire printer/plotter assembly or (if facilities allow) the PCL/ADC PCB. If the fault is still present, replace the Power Supply PCB. Step 3: (From Step 1 only.) If the faults were not present with the connector cams open, turn off the power and close one of the open connector cams. Turn the power back on and see if the fault returns when the tests are run. Continue in this manner through the remaining open connector cams until one is found which causes the fault to appear. Replace that pcb. Step 4: Be sure that all connectors, connector cams, and fuses are restored to their normal conditions before proceeding.
206	The -15 V supply is out of tolerance.	Operation of detectors, temperature control, and other functions will be inhibited.	See Fault 205.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
207	Main contact is turned off. AC power is not being supplied to heaters, motors, or solenoid valves.	Column, Detectors, Injectors, Auxiliary Oven Over 430°C, or Pneumatics Oven Over 75°C.	Step 1: The specific zone which is overheated, if found by examining the temperature of the zones using STATUS. If no zone registers 423°C or higher and the instrument has a pneumatic heater, then go to Step 2. Otherwise, go to Step 3.
			Step 2: Remove the high voltage cover. Install a probe simulator plug (P/N 03-917846-00) on J74 on the Temperature Control PC Board. Replace the high voltage cover. Rerun the Automatic Tests. If Fault 207 is still present, then there is a fault on the Temperature Control PCB and it should be replaced. If Fault 207 is no longer present, then the pneumatic heater and probe assembly is defective and should be replaced.
			Step 3: Remove the high voltage cover. Unplug the heater and probe connector corresponding to the overheated zone (J70, J71, J72, J73, J78, or J79 on the Temperature Control PCB), and replace it with the probe simulator plug. Replace the high voltage cover, plug in the GC, and turn on the power. The temperature reading for the zone should be between -15^{o} and +15^{o}C. If it is not, replace the Temperature Control PCB. If the reading is correct, reconnect the heater and probe connector that was removed and put the high voltage cover back on.
			Step 4: Allow the instrument to cool with the power off for at least one hour. Turn on the power and check the temperature of the faulty zone. If it is still above 422^{o}C, the temperature sensor for that zone is defective, and the heater/probe assembly should be replaced.
			For detectors, refer to the appropriate paragraph in the specific detector section of this manual. For column oven, replace column oven probe harness assembly with 03-917813-00 (3300/Star 3400 CX GCs) or 03-918101-00 (Star 3600 CX GCs).
			Step 5: If the temperature reading has fallen below 425^{o}C, a thermal runaway has occurred. Because of the redundant protection system in the instrument, at least two independent faults must have occurred simultaneously on the CPU and Temperature Control PCBs. Although these may be found using test procedures in this manual, Varian Customer Support should be contacted due to the hazardous nature of this problem and the possibility of damage to other parts of the system.
208	+15 VDC or -15 VDC Power Supply Fault Detected		Correct Fault 205 or 206 in this section first if it is present. If not, replace the Power Supply PCB. If that does not cure the problem, the Temperature Control PCB or CPU PCB may have to be replaced.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
209	Contact Drive Circuit Fault		Replace the Temperature Control PCB.
210	Safety Interlock Switch (S1 on Power Supply PCB) Open		Be sure the high voltage cover is properly installed over the rear of the electronics compartment, with the tab on the cover depressing the lever of the interlock switch (S1). If the cover is on and the fault remains, depress the interlock switch lever manually with a screwdriver or other convenient tool. If the instrument now operates normally (contact clicks "ON," column oven fan runs, diagnostics pass), follow the procedure described in paragraph 2.2 for adjusting the tab on the high voltage cover. Otherwise, replace the Power Supply PCB. If that does not solve the problem, replace the Temperature Control PCB.
211	Main Contact Does Not Turn OFF Properly		
212	Main Contact Does Not Turn OFF Properly	Normal chromatographic functions are not affected, but the built-in protection against thermal runaway caused by other faults may not work.	Because of the hazard involved, all heaters are turned off when this fault is detected. Operation can be restored by pressing RESET to clear the fault display, but the protection against overheating will be impaired. Correct both of these faults by replacing the Temperature Control PCB.
213	Contact Stuck "ON"		
214	Contact Stuck "ON"	Normal chromatographic functions are not affected, but the built-in protection against thermal runaway caused by other faults may not work.	Because of the hazard involved, all heaters are turned off when this fault is detected. Operation can be restored by pressing RESET to clear the fault display, but the protection against overheating will be impaired. Correct both of these faults by replacing the Mother PCB.
215	Contact Stuck "ON"	The polarization of the power line connection is reversed, or the ground connection through the power cord is missing. Normal chromatographic functions are not affected, but the risk of electrical shock is increased for certain maintenance operations and in case of some component failures.	Because of the hazard involved, all devices operated directly from line voltage (heaters, motors, etc.) are disabled when this fault is detected. Operation can be restored by pressing RESET to clear the fault display, but the risk of electrical shock will be increased. Detection of this fault by the Background tests will be inhibited if the fault is cleared by pressing RESET.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
215	*(Continued)*		If the instrument is wired for 220 V operation with a non-polarized line plug, reverse the plug in the wall outlet. If this does not correct the problem, or if the cord is equipped with a polarized plug, try another wall outlet or have an electrician check the outlet for proper polarization and grounding.

Refer to paragraph 9 for electronic hardware locations.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
216	Fuse F2 on Mother PCB Blown	120 VAC power from the transformer is not reaching the Temperature Control PCB. Heaters, motors, and solenoids will be inoperative.	Step 1: Remove F2 (6 A, 250 V) and see if it is actually blown (using an ohmmeter, if available). If it is blown, skip to Step 2..
			If the fuse is not blown, check that there are cables securely connected at J27 and J29 on the Mother PCB, and the proper plug for the line voltage being used is installed at J28 on the Mother PCB. If those are in order, the problem is probably on the Mother PCB. Replace the Mother PCB. If that does not help, have Customer Support check the instrument.
			Step 2: If F2 is blown, disconnect the 120 VAC loads. First, remove the AutoSampler/ External Events PCB. Then, remove the Temperature Control PCB. Replace the blown fuse F2 (6 A, 250 V). Remove F3 on the Mother PCB. Disconnect cables from J22 and J26 on the Mother PCB. Disconnect cables from J75 and J76 (if present) on the Temperature Control PCB. On a Star 3400 CX Temperature Control PCB, disconnect the cable from J70, install a probe simulator plug on J70, and move S2 to the OCI position. On a Star 3600 CX Temperature Control PCB, disconnect the cable from J70 and J74, install a probe simulator plug on J70 and J74, and move S3 and S4 to the OCI position.
			If F2 does not blow when power is applied, skip to Step 3. The fuse must be checked visually or with an ohmmeter, since the diagnostics will not work properly with the Temperature Control PCB removed.
			If F2 blows when power is applied, the fault is probably on the Mother PCB or in the wiring harness. If replacing the Mother PCB does not help, call Varian Customer Support.
			Step 3: If F2 does not blow, reinstall the Temperature Control PCB only. If the fuse now blows when power is applied, replace the Temperature Control PCB. Otherwise, go to Step 4.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Step 4: Reconnect the loads that were disconnected in Step 2, one at a time**.** Isolate the defective load. First, reconnect the load. (A list of the loads being tested and the means of reconnecting them follows.). Put on the high voltage cover and turn the instrument on. Set up the GC operating conditions (e.g., temperatures, etc.) so the load under test will be turned on. Run diagnostics to see if the fuse has blown. If it has, the load which was just connected is defective. Replace the defective load and the fuse. Otherwise, go on to the next load. Loads Being Tested: • Pneumatic heater: J74. This device is chassis-mounted and normally requires Varian Customer Support. • Auxiliary heater: J70, Temperature Control PCB (Replace Auxiliary Heater) • Injector Coolant: J75, Temperature Control PCB [Replace LN_2 Valve Assy., P/N 03-917186-00 or LCO_2 Valve Assy., P/N 03-917184-00] Injector heaters: On the Temperature Control PCB, move switch S2 (3400) **or** S3 and S4 (Star 3600 CX) to STD if it was originally in STD. Replace 3300/Star 3400 CX injector harnesses with 03-917811-00 and Star 3600 CX GCs with 03-918112-00. • Column coolant: J26, Mother PCB [Replace LN_2 Valve Assy., P/N 03-917186-00 (P/N 03-918151-00 for **Star 3600 CX GCs**) **or** LCO_2 Valve Assy., P/N 03-917184-00 (P/N 03-918152-00 for **Star 3600 CX GCs**)] • Column fan/column vent motor: J22, Mother PCB These devices are chassis-mounted and normally require Varian Customer Support. If the facilities to service them are available, the motors may be individually disconnected from the wiring harness to determine which one is defective. Step 5: If a defective load has still not been found, reinstall the AutoSampler/External Events PCB. Disconnect the inject module from the AutoSampler/External Events PCB at P601, and disconnect any devices driven by the External Event relays if 120 V operation has been selected by the jumper plug on J101. Reconnect each of these devices one by one, following the procedure described in Step 4, to determine which one is defective. Reinstall F3 on the Mother PCB and be sure that all cables and switch S2 on the Temperature Control PCB are in their original configuration before proceeding.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
217	Fuse F3 on Mother PCB Blown or Fuse F102 on Rear Panel Blown (ref. Figure 2 in the Installation section)	Power line voltage is not reaching the Temperature Control PCB. Heaters and other line-operated devices will not function. Refer to Figure 2 in the installation section for fuse F102 location.	Step 1: Remove F3 (8 A, 250 V for 120 VAC GCs; 4 A, 250 V for 240 VAC GCs), and F102 (15 A, 250 V, ceramic for 120 VAC GCs, except Star 3600 CX GCs; 20 A, 250 V, ceramic for 120 VAC Star 3600 CX GCs; 10 A, 250 V, ceramic for 240 VAC GCs), and see if either one is actually blown (using an ohmmeter if available). If either fuse is blown, skip to Step 2. If neither fuse is blown, check that there is a cable securely connected at J21 on the Mother PCB. If this is in order, the problem is probably on the Mother PCB or a loose connection in the wiring harness. Have a Customer Support check the instrument if replacing the Mother PCB does not help. Step 2: If one of the fuses was blown, replace the blown fuse. (Replace both if it is not known which one is blown.) Check the setting of S1 (S1 and S2 on Star 3600 CX GCs) on the Temperature Control PCB to be sure that the right line voltage has been selected. Examine the heater coils inside the column oven. If the wire is broken or touching the column oven at any point besides the support insulators, replace the heater. If neither of these procedures fix your problem, continue. Step 3: Disconnect the loads powered directly from the AC line. First, remove the detector heater cable from J71 (J71 and J78 on Star 3600 CX GCs) on the Temperature Control PCB and replace it with a probe simulator plug (P/N 03-917846-00). Then, replace blown fuse F3 or F102. Move the appropriate switch on the Temperature Control PCB to STD if it was in the OCI position. S2 on 3300/Star 3400 CX GCs; S3 and S4 on Star 3600 CX GCs. Unplug the column oven heater cable from J19 or J20 on the Mother PCB by pressing down the lock tab on the top of the connector, noting which connector it was plugged into. Reinstall the Temperature Control PCB. Remove the AutoSampler/External Events PCB, if present. Replace the high voltage cover, turn on the power, and run the automatic tests by pressing [SHIFT] [INSTR TEST]. If F102 blows, there is probably a short on the Mother PCB. If F3 blows, the problem is probably on the Temperature Control PCB. These can be replaced one at a time to isolate and correct the problem.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Step 4: Reconnect loads that were disconnected in Step 3, one at a time. Isolate defective load(s). First, reconnect the load. (A list of the loads being tested and the means of reconnecting them follows the procedure.). Be sure to connect the injectors to their proper location on the Temperature Control PCB. Then, put on the high voltage cover and turn the instrument on. Set up the GC operating conditions (e.g., temperatures, etc.) so the load under test will be turned on. Run diagnostics to see if the fuse has blown. If the fuse is blown, the load that was just connected is defective. Replace the defective load and the fuse. Otherwise, go on to the next load. Loads Being Tested: • Detector heaters: J71, (and J78 on Star 3600 CX GCs), Temp. Control PCB. Ion Oven Harness Assembly: (3300/Star 3400 CX: 03-917857-00 for 120 VAC GCs; 03-917858-00 for 240 VAC GCs. TCD Heater and Probe Assembly, 03-917812-01. Star 3600 CX: Ion Oven Harness Assy., 03-918113-00; TCD Heater and Probe Assy., 03-917812-01.). • Injector heaters: (3300/Star 3400 CX: J72 (only if S2 on the Temp. Control PCB was originally in the OCI position). Set S2 to the OCI position. For 120 VAC GCs, replace SPI Heater/Probe Assy., 03-918334-00. For 240 VAC GCs, replace SPI Heater/Probe Assy., 03-918334-01. Star 3600 CX: J72 and J79 (only if S3 an/or S4 on the Temp. Control PCB was originally in the OCI position). Set S3 and/or S4 back to the OCI position. For 120 VAC GCs, replace the SPI Heater/Probe Assy., 03-918334-00. For 240 VAC GCs, replace the SPI Heater/Probe Assy., 03-918334-01.). • Column oven heater: J19 or J20, Mother PCB. Be sure to connect plug to connector it originally came from, corresponding to the line voltage in use. (Contact Customer Support.) Step 5: If a defective load still has not been found, unplug any device which might be plugged into the rear accessory outlet (if an AutoSampler is in use). Disconnect any devices being driven from the external events relays, if 120/240 V operation has been selected by the jumper plug on J101 on the AutoSampler/External Events PCB. Reinstall the AutoSampler/External Events PCB. Reconnect each of the devices removed in this step, one by one, following the procedure in Step 4, to determine which one is defective. Be sure that all cables and switches are in their original configuration before proceeding.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
218-220	Temperature Control Analog-to-Digital Converter Failure	Temperatures cannot be measured or controlled accurately. Because of the hazard involved, all devices operated directly from line voltage are disabled when these faults are detected. Operation can be restored by pressing RESET to clear the fault display, but the instrument will shut down again if the faults are detected in the Background tests during normal operation.	Replace the Temperature Control PCB to correct any of these faults.
221-229	An AC Power Control For a Heater, Coolant Valve, or Motor is Stuck "ON"	Because of the hazard involved, all devices operated directly from line voltage are disabled when these faults are detected. Operation can be restored by pressing RESET, but one of the temperature-controlled zones may go beyond its normal range. Do not run the instrument in this condition unless you are absolutely sure that the faulty control is for an unused zone (such as a coolant valve or auxiliary heater) or that the fault indication is erroneous.	If the problem is in the column oven control (as indicated by a column temperature which rises above its setpoint in normal operation), the fault may be either on the Temperature Control PCB or on the Mother PCB. To isolate the problem, replace the column oven probe cable at J73 on the Temperature Control PCB with a probe simulator plug. If this eliminates the fault display when diagnostics are run, replace the Mother PCB. If not, replace the Temperature Control PCB. If the fault is not in the column oven control, replace the Temperature Control PCB to correct the fault. This problem may be intermittent. In this case, it will be worse when the instrument is hot. Avoid false conclusions by allowing the instrument to remain at its normal operating conditions for some time and then running the diagnostic tests before reaching any final conclusions.
230	AC power control for Column Heater stuck "OFF".	Devices whose control are "OFF" will not function at all, while intermittent controls may result in slow heating, poor temperature stability, or intermittent operation.	Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
231	AC power control for Column Heater intermittent.	Devices whose control are "Intermittent" may result in slow heating, poor temperature stability, or intermittent operation.	Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
232	AC power control for Column Oven Fan stuck "OFF".	Devices whose control are "OFF" will not function at all.	Replace the Temp. Control PCB. Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
233	AC power control for Column Oven Fan intermittent.	Devices whose control are “Intermittent” may result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
234	AC power control for Injector A Heater stuck “OFF”.	Devices whose control are “OFF” will not function at all.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
235	AC power control for Injector A Heater intermittent.	Devices whose control are “Intermittent” may result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
236	AC power control for Detector A Heater Off	Devices whose control are “OFF” will not function at all.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
237	AC power control for Detector Heater A intermittent.	Devices whose control are “Intermittent” may result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
238	AC power control for Auxiliary Heater Off	Devices whose control are “OFF” will not function at all.	Replace the Temp. Control PCB.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
239	AC power control for Auxiliary Heater intermittent	Devices whose control are “Intermittent” may result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
240	AC power control for Column/Injector Coolant Valve Off	Devices whose control are “OFF” will not function at all.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
241	AC power control for Column/Injector Coolant Valve intermittent.	Devices whose control are “Intermittent” may result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
242	AC power control for Injector Coolant Valve Off(Only if two valves present).	Devices whose control are “OFF” will not function at all.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
243	AC power control for Injector Coolant Valve intermittent (Only if two valves are present)	Devices whose control are “Intermittent” may result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temp. Control PCB.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
244	AC power control for Pneumatics Heater Off	Devices whose control are "OFF" will not function at all.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
245	AC power control for Pneumatics Heater Intermittent	Devices whose control are "Intermittent" may result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temp. Control PCB.
			Special controls (injector coolant, pneumatics heater) will not be checked unless they are installed. Faults in controls for options (auxiliary heater, column/injector coolant) will always be reported, but need not be repaired if the option is not in use.
246	Column Oven Vent Control Faulty	Some part of the vent control system (motor, limit switches, or control electronics) is defective. Column oven temperature control may not work properly.	Run the "Colum Oven Vents" extended test (see paragraph 5) to isolate the defective part.
247	Column Oven Fan Motor Overheated	The column oven fan will stop running and the GC will turn off the power to all of its heaters. Normal operation of the heaters can be restored by pressing RESET to clear the fault display, but they will be disabled again as soon as the background tests discover the condition. When the fan motor cools, the fault indication will disappear.	Check first for cooling air flow. Fan on rear panel should be running and unobstructed. Rear and side panels must always be in place during operation.
			The fan motor will overheat if the rotor is stalled. Be sure fan blade is not touching any part of the column oven. If the fan still does not turn freely, the motor bearings are bad and the motor must be replaced.
			When the column oven temperature is set well above ambient, the vents at the rear of the oven should be tightly closed. The intake vent can be seen through the perforations in the top of the instrument, beneath the detector cover. The exhaust vent can be seen by temporarily removing the right side panel. Be sure column oven was set at an elevated temperature before turning off power and removing side panel.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			If the fault appears while the fan is still running, replace the Temperature Control PCB. If the fault remains with the fan motor completely cool, replace the fan motor.
248	Inject Switch Closed	The inject switch is being held down for some reason. The GC will go back into run immediately at the end of a run or if RESET is pushed.	This condition is usually caused by overtightening the injector nut. Loosen it and see if anything else is holding the mechanism down. If the fault remains when the switch actuator is completely free, there is a problem in the switch, the injector harness, or the Temp. Control PCB, or the cable. Disconnect the switch from the harness. If the fault goes away, replace the switch. Otherwise, disconnect the injector harness from the Temp. Control PCB and install a spare Probe Simulator plug. (Note that all four connectors along the top of the board must have harnesses or Probe Simulators on them.) If this cures the problem, replace the injector harness. Otherwise, replace the Temp. Control PCB.
249	Factory Use Only		
250-252	Detector A: Analog-to-digital converter fault	The microprocessor cannot read some detector voltages. Autozero may not work, displayed values of TSD bias or FPD high voltage may be wrong, and the remaining detector diagnostics may be invalid.	Replace the Detector pc board to correct the problem.
253	Detector A: TCD analog-to-digital converter fault	Bridge current and voltage cannot be read accurately. Displayed current values may be wrong, “no flow” detection may work incorrectly, and diagnostic tests will be invalid.	Replace the TCD PC Board to correct the problem.
254	Advisory: Detector A too noisy to check	The detector signal is too noisy or unstable for some of the subsequent tests to be valid. The noise may be coming from the detector, rather than the electronics.	Disconnect the signal cable and run the test again. If the fault persists, replace the detector pc board. Otherwise, correct the chromatographic conditions which are causing the noise or drift.
255	Detector A supply voltage won’t turn off	The FID polarizer, TSD bead current, ECD pulser, FPD photomultiplier supply, or TCD bridge supply cannot be turned off. Normal operation will not be affected, but voltages will still be present when the detector has been turned off. Some protection features may be defeated.	Replace the detector pc board.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
256	Advisory: Detector A FID/TSD balance misadjusted	The zero-signal level on the chart recorder will shift when changing ranges. Small adjustment errors will not produce any other undesirable effects. See the following paragraph for the balance adjustment procedure. This indication can also be caused by an extremely large detector background signal if the detector is connected.	Disconnect the signal cable and run the test again to be sure that the detector is not affecting the reading.
			The FID balance potentiometer (R17) is adjusted through the hole in the top of the metal can at the top of the FID PCB. Adjust the balance as follows: • Autozero the FID at range 12. Turn autozero OFF. Change to ranges 10, 9, and 8. If the baseline moves more than 3 to 5%, you may want to adjust the balance to maintain a constant baseline throughout the ranges. • Cap the FID electrometer input (cap P/N 58-039800-00). Wait a few minutes until the electrometer settles. (Capping input is best, but not required.) • Turn FID detector ON in the GC Configure table. • Set range to 10^{-8}. Turn autozero on (YES). Wait until the GC goes to READY. • Advance to the autozero display in the DETECTOR section. “A/Z” after the mV reading indicates that autozero is enabled. • Slowly turn the FID/TSD balance potentiometer CCW until a reading of .01 mV is just obtained. Do not set the display for 0.0 mV. Set it only to .01 mV while coming down from a higher value. The display will update faster if you repetitively press RESET while adjusting the potentiometer. • Reconnect the signal cable, wait for the electrometer to settle, and run the Instrument Test. If the balance cannot be corrected by the adjustment procedure, replace the pc board.
257/319	Detector A: Detector output signal inaccurate for the following ranges: FID/TSD (12), FPD (10), SFPD (1), ECD (1), TCD (0.05)		

Error Code	Fault or Error	Possible Cause	Suggested Remedy
258/ 320	Detector A: Detector output signal inaccurate for the following ranges: FID/TSD (11), FPD (9), SFPD (10), ECD (10), TCD (0.5)		
259/ 321	Detector A: Detector output signal inaccurate for the following ranges: FID/TSD (10), FPD (8), SFPD (100), TCD (5)		
260/ 322	Detector A: Detector output signal inaccurate for the following ranges: FID/TSD (9)		
261/ 323	Detector A: Detector output signal inaccurate for the following ranges: FID/TSD (8)	Peak amplitudes should be wrong for the faulty ranges. If all of the ranges for the detector in use fail the test, the real problem may be in the internal signal source used for the tests (which is the autozero bucking source). In this case, the fault indications can be ignored if the ranges appear to be working properly.	Replace the detector pcb to correct any of these faults.
262- 278	Detector A: Autozero fault	Autozero may not work at all, it may be noisy or erratic, or it may work only over limited ranges of signal values, depending on the specific fault or combination of faults.	Replace the detector pcb to restore proper autozero operation.
279/ 341	Detector A: Chart recorder attenuation value incorrect for attenuation ranges 1 & 64.		
280/ 342	Detector A: Chart recorder attenuation value incorrect for attenuation ranges 2 & 128.		
281/ 343	Detector A: Chart recorder attenuation value incorrect for attenuation ranges 4 & 256		
282/ 344	Detector A: Chart recorder attenuation value incorrect for attenuation ranges 448 & 512		

Error Code	Fault or Error	Possible Cause	Suggested Remedy
283/ 345	Detector A: Chart recorder attenuation value incorrect for attenuation ranges 16 & 1024		
284/ 346	Detector A: Chart recorder attenuation value incorrect for attenuation range 32		
285/ 347	Detector A: Chart recorder attenuation value incorrect for attenuation range 64 (64-1024 if 1-32 okay)		
286/ 348	Detector A: Chart recorder attenuation value incorrect for attenuation range Infinity	These faults affect the chart recorder (1 mv) output only. The printer/plotter is not affected. Attenuation errors can be caused by a faulty load or short circuit on the chart recorder output.	Disconnect any cable connected to this output and rerun the test. If the fault persists, replace the detector pcb to restore the attenuator function.
287	Detector A: No AC voltage for FID polarizer supply	The FID polarization voltage will be zero, leading to small or inverted peaks.	If this fault is not accompanied by fault 288/350, there is a diagnostic system failure which can be corrected by replacing the detector pcb. The AC power from the transformer could be interrupted at J24 on the Mother PCB or at the detector card edge connector. Be sure that the cable on J24 is securely connected, and clean the card edge contacts as described in paragraph 2.3. Contact your Customer Support representative if these measures do not clear the fault. Check FID polarizer voltage fuse (F103) inside back panel of instrument.
288	Detector A: Detector power supply failure • FID: polarizing voltage incorrect • FPD/SFPD: -300 to -900 volt photo-multiplier tube supply failure • ECD: -50 volt pulser supply failure	Peaks may be inverted, missing, or the wrong height, and the signal may be noisy or drifting.	Detector supply voltage errors can be caused by shorts in the ignitor cable (FID), pulser cable (ECD), or high voltage cable (FPD), or in the detector assembly. Disconnect cable from detector and run INSTR TEST. If the fault no longer appears, replace the ignitor probe arm if the detector is an FID, or call Varian Customer Support to find the short in the ECD or FPD assembly. If Fault 288/350 is still present, disconnect the cable at the detector pc board. If the fault disappears when the test is run again, replace the cable. If this fault remains, replace the detector pc board. Check FID polarizer voltage fuse (F103) inside back panel of instrument.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
289	Detector A: Ignitor fuse bad	AC voltage is not available for the flame ignitor coil. The coil will not glow when the appropriate IGNITE key is pressed.	Disconnect the ignitor cable at J83 (FID PC Board) or J94 (FPD PC Board) and replace fuse F1 on the detector pcb (5 A, 250 V, slow blow). Turn on the GC and press the appropriate IGNITE key for 10 seconds. Run the tests again. If the fault is still present, replace the detector pc board. If not, reconnect the cable to the pc board without having the other end connected. Press the appropriate IGNITE key for 10 seconds, and then run the test again. Replace the cable if the test fails. If not, repeat the procedure after connecting the cable to the probe arm (FID) or the detector (FPD). If the test fails, replace the FID probe arm or the FPD flame tower. Be sure the blown fuse has been replaced before returning to normal operation.
290	Detector A: Ignitor relay bad	There is no voltage supplied to the ignitor coil when [IGNITE A] or [IGNITE B] is pressed, so the coil will not glow.	Replace the detector pc board.
291	Detector A: Ignitor relay won't turn off	The ignitor coil will be turned on all of the time, resulting in a large background signal and a noisy baseline.	Replace the detector pc board.
292	Detector A: ECD pulser supply fuse bad	No pulses will be generated, and there will be no signal output.	Replace fuse F1 on the ECD PC Board (1/4 A, 250 V, slow blow) and rerun the test. If the fuse blows again, replace the ECD PC Board.
293	Detector A: TSD bead current supply fuse bad	No heating power will be supplied to the bead, and there will be no signal output.	Replace fuse F2 on the FID/TSD PC Board (2 A, 250 V, slow blow). A bead might rarely develop a fault which could cause the fuse to blow, so replace the bead also if possible. Set the bead current to your normal operating value and rerun the test. If the fuse still blows, replace the FID/TSD PC Board.
294	Advisory: Detector A TSD bead open	This is the normal response if the pc board is being tested with no bead connected. The remaining tests will still be valid, and no corrective action needs to be taken.	The performance of the electronics under operating load conditions can be tested by connecting a bead. If a bead is connected, it has an abnormally high resistance, and is probably open. Replace the bead.
295	Detector A TSD bead shorted	Normal sensitivity will probably not be attainable even at the highest bead currents.	Disconnect the TSD bead cable at J84 on the FID/TSD PC Board and rerun the test. If the fault is still present, replace the FID/TSD PC Board. If not, reconnect the cable to the pc board with the other end of the cable not connected. If the fault returns when the test is run, replace the cable. Otherwise, reconnect the cable to the bead probe. If the fault returns when the test is run, replace the bead.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
296-299	Detector A TSD bead supply fault	The measured bead current does not correspond to the tested setpoint values. There may be no signal at all, or the bead current may not vary correctly as the setpoint is adjusted.	Replace the FID/TSD PC Board.
300	Detector A TCD signal polarity switch bad	The TCD output signal polarity will not change when requested from the front panel.	Replace the TCD PC Board.
301	Detector A TCD bridge power supply fuse bad	There will be no bridge current regardless of filament temperature setpoint.	Disconnect the TCD bridge cable from the pc board at J105, and replace Fuse F1 on the TCD PCB (1 A, 250 V, slow blow). Turn on the instrument and enter your normal TCD operating parameters. If Fault 301/363 appears again when you run the test, replace the TCD PC Board. If not, replace the TCD cell.
302	Advisory: Detector A TCD bridge power supply control checks not valid	The filament temperature protection circuit is limiting the output voltage, making Faults 303-307/365-369 invalid. This is caused by a high resistance in the bridge, which is normal if the bridge is not connected. To check for Faults 303-307/365-369, connect a detector which has helium carrier gas flowing through it to the TCD pc board.	This Advisory may also occur when nitrogen carrier gas is in use or there is no gas flow through the bridge. In this case, only Faults 306/368 and 307/369 are likely to be affected. If none of the lower-numbered faults are present, the power supply circuits are probably working properly. A more complete test can be done as noted in the previous paragraph, if desired.
303-307	Detector A TCD bridge power supply inaccurate	Some or all filament temperature settings will be inaccurate or unstable, resulting in improper sensitivity, no signal output, or drift and noise.	Replace the TCD PCB Board.
308	Advisory: Detector A SFPD square root zero inaccurate	The linear range of the output will be decreased, and small peaks may be missing or distorted. This problem is normally caused by a misadjustment of the Square Root Zero control on the FPD PC Board.	See the **FPD** detector section for a description of the adjustment procedure. If this advisory cannot be corrected by the appropriate adjustment, replace the FPD PC Board.
309	Detector A SFPD square root output out of tolerance	The scale factor for the square root output of the SFPD is inaccurate. Peaks will be the wrong height or missing altogether.	Replace the FPD PC Board.
310	Advisory: Detector A Attenuation not checked	Attenuation could not be checked because the FPD was in square root output mode. Move S2 on the FPD PC Board from the SFPD position to the FPD position and rerun the test to check the attenuator.	
311	Detector A: Not used		
312-314	Detector B Analog-to-digital converter fault	See Faults 250-252.	

Error Code	Fault or Error	Possible Cause	Suggested Remedy
315	Detector B TCD analog-to-digital converter fault	See Fault 253.	
316	Advisory: Detector B Detector too noisy to check	See Fault 254.	
317	Detector B Detector supply voltage won't turn off	See Fault 255.	
318	Advisory: Detector B FID/TSD balance misadjusted	See Fault 256.	
319-323	Detector B Detector ranges inaccurate	See Faults 257-261.	
324-340	Detector B: Autozero fault	See Faults 262-278.	
341-348	Detector B: Chart recorder attenuator fault	See Faults 279-286.	
349	Detector B No AC voltage for FID polarizer supply	See Fault 287.	
350	Detector B Detector power supply failure	See Fault 288.	
351	Detector B Ignitor fuse bad	See Fault 289.	
352	Detector B Ignitor relay bad	See Fault 290.	
353	Detector B Ignitor relay won't turn off	See Fault 291.	
354	Detector B ECD pulser supply fuse bad	See Fault 292.	
355	Detector B TSD bead current supply fuse bad	See Fault 293.	
356	Advisory: Detector B TSD bead open	See Fault 294.	
357	Detector B: TSD bead shorted	See Fault 295.	

Error Code	Fault or Error	Possible Cause	Suggested Remedy
358-361	Detector B TSD bead supply fault	See Faults 296-299.	
362	Detector B TCD signal polarity switch bad	See Fault 300.	
363	Detector B TCD bridge power supply fuse bad	See Fault 301.	
364	Advisory: Detector B TCD bridge power supply control checks not valid	See Fault 302.	
365-369	Detector B TCD bridge power supply inaccurate	See Faults 303-307.	
370	Advisory: Detector B SFPD square root zero inaccurate	See Fault 308.	
371	Detector B SFPD square root output out of tolerance	See Fault 309.	
372	Advisory: Detector B Attenuation not checked	See Fault 310.	
373	Detector B Not used		
411	External Events 24 VAC Fuse Bad	The 24 VAC fuse is open or that 24 VAC is missing. If the External Events board is configured for 24 VAC (plug 03-917841-00 24 VAC plugged into J101 on the bottom of the PCB) then all valves and solenoids connected to TB1 will not function. If the External Events is not being used or the External Events is configured to use 120 volts AC or 120/240 volts AC, then the instrument can be run temporarily with this fault.	If the 24 volts AC is being used, turn the instrument off. Remove the high voltage cover. Check the 24 volt AC fuse on the AutoSampler/External Events PCB (see paragraph 9). If the fuse is OK and the solenoids connected to TB1 function normally, then the fault is with the diagnostic circuit. The instrument can be run temporarily with this fault. If the fuse is OK, but the solenoids connected to TB1 do not function properly, then probably a bad connection exists between the A/S PCB and the Mother PCB, or a loose connection at J24 on the Mother PCB or the transformer is bad, or a shorted winding. Call Varian Customer Support. If the 24 VAC fuse is bad, disconnect all the solenoids from TB1. Install a new fuse. Put the high voltage cover back on. Turn on the instrument. Rerun the Automatic Tests. If Fault 411 is still present, the board has a short and should be replaced. If Fault 411 is not present, perform the following procedure to isolate the faulty part:

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Step 1: Turn the instrument off and remove the high voltage cover. Step 2: Reconnect one of the solenoids to TB1. Step 3: Install the high voltage cover, turn the instrument on. Step 4: Enter method parameters to turn the event on for 30 seconds for the solenoid just connected. Press [START] and allow the instrument to run long enough to turn on the solenoid. Press [RESET]. Rerun the Automatic Tests. Step 5: If Fault 411 is present, the solenoid just connected is faulty. The solenoid should be replaced. Replace the fuse. Step 6: If Fault 411 is not present, repeat the procedure reconnecting an additional solenoid each time through the procedure until the faulty solenoid is found. If all of the solenoids are reconnected without finding a faulty solenoid, check the solenoid wires for nicks in the insulation that might short to chassis. Also check that the total load does not exceed 60 watts.
412-414	Pressure ADC Faults	These faults indicate that the pressure ADC, multiplexer, or channel select latch is faulty. Pressure readings will be inaccurate.	Replace the AutoSampler/External Events PCB.

NOTE: FAULTS 413-416 If any of the transducers are reading negative voltages, these faults (413-416) will be present. Recalibrate the transducer(s) per the **Installation** section.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
415-416	Pressure Transducer Faults	These faults indicate that the Pressure Transducer PCB is not operating correctly. Pressure readings will be inaccurate.	The pressure transducer PCB is located in the pneumatics compartment. First check that the cable between the A/S External Events PCB and the Pressure Transducer PCB is connected to both ends. If the cable is properly connected, then replace the Pressure Transducer PCB.
417-421	Communication to Printer/Plotter Failure	The display indicates PRINTER BUSY when a printer function is executed.	The flat ribbon cable (P/N 03-917817-00) or printer/plotter is defective. If a replacement PCL/ADC PCB is available, replace the board. If not, replace the printer assembly. If replacing the pcb or the printer assembly doesn’t fix the problem, replace the cable. If the problem still exists, call Varian Customer Support.
422	Memory Error On PCL/ADC PCB	The display indicates PRINTER BUSY when a printer function is executed. The STATUS LED on the PCL/ADC PCB is off.	Either the 8155 RAM memory or the 8051 code memory is defective. If a replacement PCL/ADC PCB is available, replace the board. If not, replace the printer assembly.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
423	ROM Version Mismatch	The display indicates PRINTER BUSY when a printer function is executed.	The 8051 is the wrong version for the instrument. Call Varian Customer Support to resolve the version conflict.
424	Printer/Plotter Power Supply Failure	The display indicates PRINTER BUSY when a printer function is executed. The STATUS LED on the PCL/ADC PCB is off.	The printer/plotter power supply is not within its voltage tolerance. Verify that the power cable is plugged into J69 on the Printer/Plotter Power Supply PCB. Check if the green LED FUSE OK indicator is lighted. If it is, the power supply has failed. Replace the printer assembly. If the green LED FUSE OK indicator is not lighted, the fuse on the Printer/Plotter Power Supply (F1) is blown. Replace fuse F1 (2 A, 250 V slow blow). If the fuse blows again, replace the printer assembly.

Refer to paragraph 9 for electronic hardware locations.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
425	Left Edge Sensor Failure	The display indicates PRINTER BUSY when a printer function is executed. The STATUS LED on the PCL/ADC PCB is off.	The left edge sensor was found to be non-functional when the thermal print head tried to find the home position. Verify that the left edge sensor switch is plugged into J67 on the Printer/Plotter Power Supply PCB. Verify that the thermal print head moves when the instrument is turned ON or RESET is pressed. If the thermal print head is at its end of travel, a groaning sound will be heard, indicating the belt is slipping. Verify that the thermal print head is not to the left of the left edge sensor arm. If the above actions do not correct the problem, replace the printer assembly. If the thermal print head does not move, check if the head position motor is plugged into J68 on the Printer/Plotter Power Supply PCB. Verify that belt is intact and connected to thermal print head. If the above actions do not correct the problem, replace the printer assembly.
426	ADC Failed to Calibrate	The display indicates PRINTER BUSY when a printer function is executed. The STATUS LED on the PCL/ADC PCB is off.	The offset or reference errors in the printer/plotter ADC fell outside the range for self calibration. Verify that the analog signal cable is installed in J62 on the PCL/ADC PCB and in J15 on the Mother PCB. If the cable is installed correctly, then the ADC has failed. If a replacement PCL/ADC PCB is available, replace the board. If not, replace the printer assembly.
427	Serial Internal Loopback Failure	Either the outputs or inputs of the UART are faulty.	Replace the Serial Interface PC Board to correct this failure.
428	Serial External Loopback Failure	Either the test switches (S1 or S2) is in the TEST position when the Instrument Test is run , or the Serial I/O cable is faulty, or 3) the Serial Interface PC Board is faulty.	To determine which problem is present, test switches (S1 and S2) on the Serial Interface PC Board **must** be in the TEST position.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
			Step 1: Remove the instrument top covers. Step 2: First check to see if **either switch** is in the TEST position. If this is the case, place **both** switches in the TEST position, replace covers, return the instrument to operation, and rerun the Instrument Test. If Fault 428 reappears, there may be a faulty Serial I/O cable or a serial external loopback failure. Step 3a: If the Serial I/O cable **is NOT** connected from the 402 to the Serial Interface PCB, replace the Serial Interface PC Board. Set both switches to the NORMAL position. If the switches are left in the TEST position, Fault 64 will be displayed. Step 3b: If the Serial I/O cable **is** connected from the 402 to the Serial Interface PCB, disconnect the cable at the GC end and rerun the Instrument Test. **If Fault 428 is NOT displayed,** the cable is bad. Replace the Serial I/O cable. Reset both switches to the NORMAL position. If the switches are left in the TEST position, Fault 64 will be displayed. If Fault 428 reappears, there is a faulty Serial Interface PC Board. Replace the Serial Interface PC Board. Set both switches to the NORMAL position. If the switches are left in the TEST position, Fault 64 will be displayed.
429	Control Station A Failure	This fault appears when 1) there is a faulty control station connected to Channel A, or 2) there is a faulty Serial Interface PCB.	If Control Station A **is NOT** connected to the instrument, there is a fault on the Serial Interface PCB. Replace the Serial Interface PCB. If Control Station A **is connected** to the instrument, disconnect Control Station A and rerun the Instrument Test. If Fault 429 is no longer displayed, there is a possible control station short. Replace the control station. If Fault 429 is displayed, there is a fault on the Serial Interface PC Board. Replace the Serial Interface PCB.
430	Control Station B Failure		See Fault 429.
491	An AC Power Control for a Heater or Coolant Valve is Stuck “On” (**Star 3600 CX only**)	Because of the hazard involved, all devices operated directly from line voltage are disabled when this fault is detected. Operation can be restored by pressing RESET, but the temperature-controlled zone may go beyond its normal range. Do not run the instrument in this condition unless you do not have an injector connected to J79 on the Temp. Control PCB.	Replace the Temperature Control PCB. note that this problem may be intermittent. In this case, it will be worse when the instrument is hot. Avoid false conclusions by allowing the instrument to remain at its normal operating conditions for some time and then running the diagnostic tests before reaching any final conclusions.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
492	AC Power Control for Injector B Heater is Stuck “Off”	The Injector B Heater will not function at all.	Replace the Temperature Control PCB.
493	AC Power Control for Injector B Heater is intermittent	May result in slow heating, poor temperature stability, or intermittent operation.	Replace the Temperature Control PCB.
494	An AC Power Control for a Heater or Coolant Valve is Stuck “On” (**Star 3600 CX only**)		See text for Fault 491.
495	AC Power Control for Detector B Heater Stuck “Off” (Star 3600 CX only)		
496	AC Power Control for Detector B Heater is Intermittent (Star 3600 CX only)		See text for Faults 492-493.
497	An AC Power Control for a Heater or Coolant Valve is Stuck “On” (**Star 3600 CX only**)		See text for Fault 491.
498	AC Power Control for Injector B Coolant Valve Off in Star 3600 CX		See text for Faults 492-493.
499	Injector B Coolant Valve Intermittent in Star 3600 CX		See text for Faults 492-493.
500	Injector B or Auxiliary Inject Switch Closed (**Star 3600 CX only**)	The inject switch is being held down for some reason. The GC will go back into run immediately at the end of a run or if RESET is pushed.	This condition is usually caused by overtightening the injector nut. Loosen it and see if anything else is holding the mechanism down. If the fault remains when the switch actuator is completely free, there is a problem in the switch, the injector harness, or the Temp. Control PCB, or the cable. Disconnect the switch from the harness. If the fault goes away, replace the switch. Otherwise, disconnect the injector harness from the Temp. Control PCB and install a spare Probe Simulator plug. All four connectors along the top of the board must have harnesses or Probe Simulators on them. If this corrects the problem, replace the injector harness. Otherwise, replace the Temp. Control PCB.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
501-502	Temperature Control Analog-to-Digital Converter Failure (**Star 3600 CX only**)	Temperatures cannot be measured or controlled accurately. Because of the hazard involved, all devices operated directly from line voltage are disabled when these faults are detected.	Operation can be restored by pressing RESET to clear the fault display, but the instrument will shut down again if the faults are detected in the Background tests during normal operation. Replace the Temperature Control PCB.
503-506	Carriage Motor Phase Bad.	One of the Carriage motor phases is faulty, or the electronics that drive it is faulty. The Carriage motor cable is unplugged.	Check cable connection.
		Carriage motor is defective.	Call Customer Support for motor replacement.
		8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
507-510	Plunger Motor Phase Bad.	One of the Plunger motor phases is faulty or the electronics that drive it is faulty. Plunger motor cable is unplugged.	Check and correct cable connection at J9 on the Controller PC Board.
	Carriage flex cable unplugged.	Check and correct cable connector at J9 on the Controller PC Board. The Plunger drive motor is defective.	Call Customer Support for motor replacement.
	8200 CX Controller PC Board is defective.		Call Customer Support for board replacement.
511	Short circuited stepper motor driver.	A shorted stepper motor driver has been detected on either the plunger motor or carriage motor drive circuit. The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
512	Rotate motor drive bad.	A fault has been detected related to the rotate motor driver. Position Sensor PC Board is defective.	Call Customer Support for board replacement.
513	Rotate motor is defective.	A fault has been detected related to the rotate motor driver. Position Sensor PC Board is defective.	Call Customer Support for board replacement.
514-515	Translate motor is defective.	A fault has been detected related to the translate motor drive. Position sensor PC Board is defective.	Call Customer Support for board replacement.
516	Motor triac shorted.	A shorted triac that controls the translate or rotate motor has been detected.	Call Customer Support for board replacement.
517-518	Translate motor is defective.	A fault has been detected related to the translate motor driver.	Call Customer Support for board replacement.
		Position sensor PC Board is defective.	Call Customer Support for board replacement.
519	ROM checksum bad; 8200 CX ROM is bad.	8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
520	The 8200 CX RAM is bad.	8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
521	Carrousel not latched. The storage module latch sensor is indicating that the storage module is unlatched.	The Storage Module is not securely closed.	Check to be sure the Storage Module is locked in place; relatch if required.
		The latch microswitch is defective.	Call Customer Support for latch replacement or repair.
		The latch sensor cable is not plugged into the Controller PC Board.	Check to be sure that the sensor cable is plugged into J6 of the 8200 CX Controller PC Board.
522	Air pressure low. The air pressure sensor located on the Controller PC Board has detected that the incoming air pressure is below 40 psig. This may have been a momentary condition.	AutoSampler air pressure is low or unstable.	Check the air supply cylinder to be sure a stable flow regulated at 40-60 psig is provided.
	If the AutoSampler is sharing a common air line with other instruments. Check for stable air pressure at the back of the AutoSampler.	The air pressure sensor tube/fittings are restricted.	Check lines for unrestricted flow.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
523	Solvent/Air B valve bad. The Solvent/Air B valve or its driver is faulty.	The Solvent Air B is unplugged from the Controller PC Board.	Check to be sure that the electrical lead from valve L1 is connected to position #1 of J8.
		The Solvent/Air B valve is defective.	Call Customer Support for valve replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
524	Solvent/Air A valve bad. The Solvent/Air A valve or its driver is faulty.	The Solvent/Air A valve is unplugged from the Controller PC Board.	Check to be sure the electrical lead from valve L2 is connected to position #2 of J8.
		The Solvent/Air A valve is defective.	Call Customer Support for valve replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
525	Air B valve or its driver is defective.	The Air B valve is unplugged from the Controller PC Board.	Check to be sure the electrical lead from valve L5 is connected to position #5 of J8.
		Air B valve is defective.	Call Customer Support for valve replacement.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
526	Air A valve bad. Air A valve or its driver is faulty.	The Air A valve is unplugged from the Controller PC Board.	Check to be sure the electrical lead from valve L3 is connected to position #3 of J8.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
527	Disposal IN valve bad. The Disposal IN valve or its driver is faulty.	The Disposal IN valve is unplugged from the Controller PC Board.	Check to be sure the electrical lead from valve L6 is connected to position #6 of J8.
		The Disposal IN valve is defective.	Call Customer Support for valve replacement.
		8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
528	Disposal OUT valve bad. The Disposal OUT valve or its driver is faulty.	The Disposal OUT valve is unplugged from the Controller PC Board.	Check to be sure the electrical lead from valve L7 is connected to position #7 of J8.
		The Disposal OUT valve is defective.	Call Customer Support for valve replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
529	Stop Solenoid bad. The Stop Solenoid or its driver is faulty.	The Stop Solenoid is unplugged from the Controller PC Board.	Check to be sure the electrical lead from the Stop Solenoid is connected to position #4 of J8.
		Stop Solenoid is defective.	Call Customer Support for Solenoid replacement.
		8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
530	Valve driver short circuit.	Controller PC Board is defective.	Call Customer Support for board replacement.
531	Carriage Home Sensor bad. An attempt was made to move the syringe carriage to its upper position sensor (Home) and the sensor was not detected.	Carriage Home Sensor cable unplugged.	Check to be sure the cable is connected to J4.
		Carriage Home Sensor defective.	Call Customer Support for Sensor replacement.
		Carriage jammed.	Check for physical causes of jammed carriage.
		Carriage motor bad.	Call Customer Support for motor replacement.
		Controller PC Board defective.	Call Customer Support for board replacement.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
532	Plunger Home Sensor bad. An attempt was made to move the syringe plunger to its lower position sensor (Home), and the sensor was not detected.	Carriage flex cable unplugged.	Check to be sure the flex cable is connected to J9.
		Plunger mechanism jammed.	Check for any physical reasons for jammed mechanism.
		Plunger Home Sensor bad.	Call Customer Support for sensor replacement.
		Plunger motor bad.	Call Customer Support for plunger motor replacement.
		Controller PC Board defective.	Call Customer Support for board replacement.
533	Vial Tray Present Sensor bad. An attempt was made to rotate the vial tray a full revolution, and detect the vial tray home position slot with the vial tray sensor. The slot was not detected.	Vial/Home Sensor PC Board defective.	Call Customer Support for board replacement.
		Position Sensor PC Board defective.	Call Customer Support for board replacement.
		Position Sensor ribbon cable not plugged in correctly or cable defective.	Check cable connection; reconnect ribbon cable.
		The Position PC Board to Controller PC Board ribbon cable is defective.	Check cable connection. Call Customer Support to replace ribbon cable.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
534	Index Sensor bad. An attempt was made to rotate the vial tray one or more vial positions, and the Index Sensor flag was not detected.	Index Sensor/Rotate motor cable not plugged in correctly.	Check cable connection.
		Index Sensor/Rotate motor cable assembly is defective.	Call Customer Support for motor cable assembly replacement.
		Rotate motor jammed.	Call Customer Support for motor replacement.
		The Position Sensor PC Board to Controller PC Board ribbon cable is defective.	Check cable connection. Call Customer Support to replace ribbon cable.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
535-537	Translate Position Sensor bad. An attempt was made to move the vial tray in or out from the tower, and the expected position sensor was not detected.	Translate Position flag is improperly adjusted.	Reposition the flag.
		Position Sensor PC Board is defective.	Call Customer Support for board replacement.
		Position Sensor ribbon cable is unplugged or defective.	Check ribbon cable connection. Call Customer Support for replacement ribbon cable.
		Translate mechanism is jammed.	Check for any apparent causes of the jam. Call Customer Support for repair or replacement of the Translate mechanism.
		Translate motor is bad.	Call Customer Support for motor replacement.
		The Position Sensor PC Board to Controller PC Board ribbon cable is defective.	Check cable connection. Call Customer Support to replace ribbon cable.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
538-539	Vial Sensor bad. An attempt was made to verify the operation of the vial detector sensors (inner and outer rows), and a fault was detected.	The vial tray is full of vials. There must be one empty vial position in each row for this test.	Remove at least one vial from each row of the carrousel and repeat the Instrument Test.
		The carriage flex cable is not plugged in.	Check to be sure cable is connected.
		The IR.LED is not plugged in or is incorrectly adjusted.	Call Customer Support to correct adjustment and check connection.
		The IR.LED PC Board is defective.	Call Customer Support for board replacement.
		The IR.LED is defective.	Call Customer Support to replace LED.
		The Vial/Home PC Board is defective.	Call Customer Support for board replacement.
		The Position Sensor PC Board is defective.	Call Customer Support for board replacement.
		The Position Sensor to Controller PC Board ribbon cable is defective.	Check cable connection. Call Customer Support for ribbon cable replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
540	Vial Tray Home Sensor bad. An attempt was made to rotate the vial tray to Rack 1, Vial 1 and detect the vial tray Home slot at the location. The Home slot was not detected.	Vial tray mechanism not correctly aligned.	Call Customer Support for realignment.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
		Vial/Home Sensor PC Board defective.	Call Customer Support for board replacement.
		Position Sensor ribbon cable unplugged or defective.	Check cable connection or call Customer Support for ribbon cable replacement.
		The Position Sensor to Controller PC Board ribbon cable is defective.	Check cable connection. Call Customer Support for ribbon cable replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
541	Vial tray removed. The Vial Tray Sensor has detected that there is no vial tray present or that the tray was momentarily lifted.	The vial tray is removed or not correctly mounted.	Install vial tray in correct orientation.
		The Vial/Home Sensor PC Board is defective.	Call Customer Support for board replacement.
		Position Sensor ribbon cable is unplugged or defective.	Check cable connection or call Customer Support for ribbon cable replacement.
542	24 VAC bad. The diagnostics circuitry has detected that 24 volt power is no longer available to drive the vial tray rotate and translate motors.	Position Sensor Ribbon cable is unplugged or defective.	Check cable connection or replace.
		Position Sensor PC Board defective.	Call Customer Support for board replacement.
		Transformer is defective.	Call Customer Support for transformer replacement.
		Controller PC Board is defective.	Call Customer Support for board replacement.
543	8200 CX power off. The GC electronics has detected that there is no power in the 8200 CX AutoSampler.	8200 CX is not turned on or has no power available to it.	Check power cord connection. Check power source.
		The 8200 CX fuse is blown.	Replace 8200 CX fuse.
		The 8200 CX Serial Interface cable is defective or not plugged in correctly.	Check the interface cable for proper connection at the AutoSampler and GC. Replace if found defective.
544	No response from 8200 CX. The GC electronics has attempted to communicate with the 8200 CX and has failed to detect a response.	8200 CX power failure has occurred.	Check 8200 CX power fuse, power cable connection.
		The 8200 CX Serial Interface cable is defective or not plugged in correctly.	Check connections or replace cable.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
		The GC CPU PC Board is defective.	Call Customer Support for board replacement.
545	8200 CX Serial Communication Checksum error. Some data that was sent between the 8200 CX AutoSampler and the GC was detected as bad. This may have been a one time occurrence	The 8200 CX Serial Interface cable shield is not connected to ground correctly.	Check that the bared shield is firmly clamped in the grounded clamp.
		The 8200 CX Serial Interface Cable is defective or not properly installed.	Check cable installation and replace if defective. Call Customer Support for cable replacement.
		The 8200 CX Controller PC Board is defective.	Call Customer Support for board replacement.
		The GC CPU PC Board is defective.	Call Customer Support for board replacement.
546	The 8200 CX has been reset.	Power glitch to the 8200 CX.	Check for possible power failure. Check all power cable connections.
		Power has been interrupted to the 8200 CX.	Check for cause.
		The GC has reset the 8200 CX.	Check for possible causes of the reset by the GC.
701	Plunger calibration failure. An attempt was made to set the “Zero” position of the syringe plunger at a location that was too high up the syringe barrel.	The 8200 CX is in the incorrect position for calibration.	Check syringe plunger calibration procedures.
		The IR.LED PC Board is defective.	Call Customer Support for board replacement.
		The carriage flex cable is unplugged or defective.	Check cable connections or call Customer Support for replacement if defective.
702	Fault during plunger calibration.	Unspecified.	If this fault occurs, the instrument test should be performed to provide specific information.

5 Extended Tests

Extended Tests are not included with Automatic Tests because they either disturb the instrument’s operating conditions or require operator interaction. To avoid actuating valves or destroying methods inadvertently, read the description of each test before initiating it. Four tests are provided to check the column oven cooling vents, External Event AC relays, front panel keyboard, and the instrument memory.

5.1 Initiating Extended Tests

Extended tests can be run only after the Automatic Tests have been completed. To enter into Extended Tests, press [SHIFT][INSTR TEST] and wait for the Automatic Tests to conclude.

a. If the display shows TESTS OK, press [ENTER].

b. If a fault number appears, press [ENTER] until the display shows RETURN TO TEST MENU? NO. Press [YES][ENTER]. (Pressing [NO][ENTER] returns you to the beginning of the Automatic faults.)

   A similar procedure is used to advance through the Extended Tests by pressing [ENTER] until the desired test is offered or the display shows RETURN TO TEST MENU? NO.

5.2 Vent Tests

After you have entered into Extended Tests, the initial display will be VENT TEST? NO. Press [ENTER] to advance to the next test. Press [YES][ENTER] to test the column oven vent system. Note that the column oven temperature will drop briefly during this test; a few minutes may be required for stabilization after the test. If the system is good, the display will read TESTS OK. If a problem exists, the display will show one of the following fault codes:

Error Code	Fault or Error	Possible Cause	Suggested Remedy
901	AC test timer bad.	The remaining vent tests will not be valid, but normal chromatographic operation is not affected.	Replace the CPU PCB to restore the diagnostic functions.
902	Vent motor control won't turn off.	The motor will try to continue to rotate after it reaches the fully open or closed position.	Replace the Temperature Control PC Board.
903	Vent motor bad.	Neither limit switch can be activated by running the motor. If the motor turns during this test, either the Temperature Control PCB has failed or both limit switches are bad.	
904-905	Vent open control defective.	Proper AC voltage is not being applied to the motor to open the vents.	Replace the Temperature Control PCB.
906	Vent open control won't turn off.	The motor will try to continue to rotate after it reaches the fully open position.	Replace the Temperature Control PCB.
907	Vent open limit switch bad.	Check the mechanism to see if the switch is actually being depressed.	Replace the switch or correct the mechanical problem. If the switch is good, replace the Temperature Control PCB.
908	Intermittent vent open limit switch or control.		Rerun the test to determine where the problem lies.
909-910	Vent close control defective.	Proper AC voltage is not being applied to the motor to close the vents.	Replace the Temperature Control PCB.
911	Vent close control won't turn off.	The motor will try to continue to rotate after it reaches the fully closed position.	Replace the Temperature Control PCB.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
912	Vent close limit switch bad.	Check the mechanism to see if the switch is actually being depressed.	Replace the switch or correct the mechanical problem. If the switch is good, replace the Temperature Control PCB.
913	Intermittent vent close limit switch or control.		Rerun the test to determine where the problem lies.

5.3 Relay Tests

The next Extended Test to choose from is RELAY TEST? NO. Press [ENTER] to advance to the next test or [YES][ENTER] to test the External Event AC relays. If a problem exists, the display will show one of the following codes. All of the failures except Fault 801 are corrected by replacing the External Events PCB.

Error Code	Fault or Error	Possible Cause	Suggested Remedy
801	AC test timer bad.	The remaining relay tests will not be valid, but normal chromatographic operation is not affected.	Replace the CPU PCB to restore the diagnostic functions.
802	One (or more) of the AC relays won't turn off.		If none of the relays which are in use appear to be affected, operation may continue until the External Events PCB is replaced to correct the problem.
803	Event relay #1 won't turn off.	See Fault 802.	
804	Event relay #1 intermittent.	The AC control for relay #1 is not turning on continuously. The device which it is operating may not function at all or may be only partially activated.	Replace the External Events PCB, or temporarily switch to an unused relay.
805	Event relay #1 won't turn on.	The device operated by relay will not be activated when Event #1 is turned on.	Replace the External Events PCB, or temporarily switch to an unused relay.
806	Event relay #2 won't turn off.	See Fault 802.	
807	Event relay #2 intermittent.	See Fault 804.	
808	Event relay #2 won't turn on.	See Fault 805.	
809	Event relay #3 won't turn off.	See Fault 802.	
810	Event relay #3 intermittent.	See Fault 804.	
811	Event relay #3 won't turn on.	See Fault 805.	
812	Event relay #4 won't turn off.	See Fault 802.	
813	Event relay #4 intermittent.	See Fault 804.	
814	Event relay #4 won't turn on.	See Fault 805.	

5.4 Key Echo Tests

The third Extended Test to choose from is KEY ECHO? NO. Press [ENTER] to advance to the next test or [YES][ENTER] to activate keyboard tests. If some of the keys on the keyboard seem to be responding improperly or not at all, this test can help to isolate the problem. The following are the correct codes which should appear on the display when each key is pressed. If any other code is displayed or there is no response at all, there is a fault with the keyboard touch panel or the Keyboard Display PCB, assuming all other Core Tests were good.

All keys marked with an asterisk (*) require that the related optional hardware be installed before responding to this test.

To terminate the Key Echo Test and return to the Test Menu, press [RESET].

If a single key fails to respond, the fault is in the keyboard touch panel. If 16 or more keys have failed, or if any keys respond with the wrong codes, the fault is probably in the Keyboard Display PCB. Failure of an intermediate number of keys could be caused by a fault in either the PCB or the touch panel. Contact Varian Customer Support for assistance in repairing the problems.

GC CONTROL KEYS

- START 1B
- GC CONFIGURE 0B
- INSTR TEST 8B
- IGNITE A F2 Only while being depressed
- IGNITE B 72 Only while being depressed
- COL OVEN ON 08
- COL OVEN OFF 88
- *(PLOTTER) START F1
- *FEED PAPER 71 Only while being depressed
- *(PLOTTER) STOP 07
- *ZERO PEN 87
- ATTENUATION DET A(UP) 10
- ATTENUATION DET A(DOWN) 00
- ATTENUATION DET B(UP) 40
- ATTENUATION DET B(DOWN) 20

OPERATIONS Keys

- BUILD/MODIFY 0D
- ACTIVE LINE 8D
- STATUS 0C
- ACTIVATE 1D
- *PRINT 1C
- *REPORT 9C
- COPY 2D
- LOCK/UNLOCK AD
- TUNE 2C
- DELETE PROGRAM 4D
- DELETE SECTION/TABLE 4C

AUTOMATION CONTROL Keys

•	*RACK TABLE	2E
•	*(RACK TABLE) SUSPEND	AE
•	*SEQUENCE TABLE	E
•	*(SEQUENCE TABLE) SUSPEND	9E

METHODS Keys

•	METHOD 1	0A
•	METHOD 2	1A
•	METHOD 3	2A
•	METHOD 4	4A
•	COLUMN	18
•	INJECTOR	28
•	DETECTOR	48
•	*PLOTTER	17
•	*AUTOSAMPLER	27
•	*RELAY	47

DATA HANDLING Keys (In-Board Data Handling Only)

•	INTEGRATION	05
•	TIME EVENTS	25
•	PEAK TABLE	45

DISPLAY CONTROL Keys

•		41
•		11
•		21
•		04

ENTRY Keys

•	ENTER	01	
•	[-]	12	
•	[·]	22	
•	0/OFF	42	
•	1/SINGLE	43	
•	2/MULTI	23	
•	3	13	
•	4/YES	46	
•	5/NO	26	
•	6	16	
•	7/A	49	
•	8/B	29	
•	9	19	
•	CE	09	
•	ALPHA ENTRY	06	(In-Board Data Handling Only)
•	A—Z	03	(In-Board Data Handling Only)
•	Z—A	02	(In-Board Data Handling Only)

SHIFT, PROMPT, and HELP Keys

• SHIFT	No response, except in connection with other keys, as listed
• PROMPT	F4 Only while being depressed
• HELP	74 Only while being depressed

5.5 Destructive RAM Tests

The Destructive RAM test is the last of the Extended Tests. Press [ENTER] to conclude these tests or press [YES][ENTER] to test the main RAM memory.

> CAUTION: Doing the Destructive RAM test will destroy all stored methods and tables.

This test is used to find “soft” errors in the instrument memory which cause improper operation but are not caught in the Core tests. The test can also be initiated by cold starting the instrument with TP6 on the CPU PCB connected to ground (TP2) if the test cannot be started in the normal way.

The fault display is divided into 18 characters. Only the first two fields of 4 digits are of concern during the Destructive RAM tests. However, the last two digits (at the far right) are the test clock, which advances time every 1.6 seconds.

If no fault is found, only the first 4 digits and last 2 digits will be displayed. This test will run continuously until the main power is switched off and back on to do a cold start. Since some “soft” or random faults may happen occasionally, this test could be run for hours until an error is found. Room temperature and other environmental changes may make a marginal device fail occasionally.

As soon as an error is detected, its address will be displayed in the second 4-digit field and held until the second error is found, which could be as soon as the next test, or less than half a second. **Any error address and the remaining four groups of 2-digit codes should be recorded and returned with the faulty CPU PC Board.**

An example of a RAM fault could be:

0010	D001	E8	00	E1	B0	07
CYCLES	ADDRESS	TEST INFORMATION				CLOCK

Nine cycles went by before this error was found. The chip, and thus the CPU PC Board, still should be considered faulty.

6 Starting and Exiting Tests, Displaying and Printing Results

Initiating Automatic Tests

Tests may be run any time the instrument is not in RUN. Press [SHIFT] [INSTR TEST] to start the Automatic tests. Within a minute, the message TESTS OK will be displayed, or the first fault message will appear. Any remaining fault messages can be seen by using the display control keys or ENTER.

> NOTE: At cold start, the Automatic tests are performed without operator interaction.

Exiting Tests

It is possible to exit from a test only after it has run to completion. This can be done either by proceeding to the next test (see **Initiating Extended Tests**) or by returning to normal GC functions. Any OPERATIONS key can be pressed to go back to normal operation whenever the TESTS OK message or a fault message is being displayed, or when the instrument is prompting the user for the next test selection. The fault messages generated by a particular test can no longer be displayed after exiting from the that test, but they can still be printed if a printer/plotter is installed. (See **Printing the Results of Tests.**)

Initiating Extended Tests

> NOTE: Because the Extended tests can operate valves, change the column oven temperature, and even destroy methods and tables, be sure to read paragraph 5 before initiating any of these tests.

Extended tests can be run only after the Automatic tests have been run by pressing [SHIFT] [INSTR TEST]. A prompt offering the first extended test (vents) is displayed by pressing [ENTER] whenever the TESTS OK message is displayed, or by pressing [YES] [ENTER] whenever the message RETURN TO TEST MENU? is displayed. The test is started by pressing [YES] [ENTER] in response to the prompt. Pressing only [ENTER] moves the display on to the next test.

After a particular test selection has been bypassed or run, the only way to return to that test is to start over from the Automatic tests by pressing [SHIFT] [INSTR TEST].

Printing and Clearing the Results of Tests

The results of the Automatic or Extended tests are cleared prior to running the tests each time, so the fault messages reflect only the latest pass through the test. Pressing [RESET] clears all of the fault messages, including those detected by the Background tests. (See Appendix C for information on the Background tests.)

After any test has been run, the results can be printed on the printer/plotter by pressing [SHIFT] [REPORT]. The latest results of all of the Automatic, Extended, and Background tests will be printed.

Using the Blinking STATUS Light to Display Background Fault Messages

A blinking STATUS light indicates that the instrument has detected a fault condition during normal operation. Press [STATUS] to display the initial fault message, and then press [ENTER] to display additional fault messages. Note that these messages are completely separate from the automatic tests described in paragraph 4.2. Refer to paragraph 4.1 for a complete listing of the background fault messages and information on the Background tests.

7 Troubleshooting Procedures

There are only two reasons that you should be reading this section:

1. You are observing a functional problem (temperature zone, AutoSampler, etc.) that is out of control or not functioning but no fault messages have appeared on the display.
2. Everything seems to be operating normally but chromatographic performance is not meeting expectations.

If neither of the above statements are true, please return to paragraph 1.2, Automatic Test Description, and perform those tests. If, however, either of the statements are true, take the time to be sure that the system is set up properly, i.e., methods correct, hardware properly installed, cables connected, etc. Many chromatographic malfunctions that are observed are often found to be “cockpit” errors. That is, either the method wasn’t built correctly or the hardware was not configured to do the expected analysis. Therefore, reassess the setup and the method. Only then should you proceed with troubleshooting. Also, it has to be assumed that regular preventative maintenance has been performed on the sensitive components such as septa or filters. The user must be the best judge of servicing based on the environment that the instrument is in, the frequency of use, and applicable regulatory standards.

Another assumption is that all components are standard and unmodified. All configurations must be standard, as ordered from the factory.

If you are convinced that the method is built correctly, and all the hardware is proper for the specific analysis intended, proceed with this Troubleshooting section. Refer to paragraph 8, Functional Problems, for symptom 1, and refer to paragraph 8.10, Chromatographic Interpretations, for symptom 2. Each section is intended as a quick guide for the most likely problem. If the repair is not self explanatory there will be references to other paragraphs or other manuals. If you experience difficulties or are unsure of safety precautions (there are lethal voltages under covers attached with screws), please call your nearest Varian Customer Support Representative.

This Troubleshooting Procedure is intended to be a guide to the most obvious problems and cannot be considered as a complete coverage of every possible combination of faults.

The following list of drawings will assist you in identifying and locating components called out in the following troubleshooting sections.

Manual Section/Figure(s)	**View/Description**
Introduction, Figures 1, 2	Basic Instrument
Introduction, Figure 2	Column Oven
530µ Manual, 03-914243-00	Injector, 1041
Septum-Equipped Programmable Injector (SPI) Manual, 03-914218-00, Figures 1-2, 2-2	Injector, 1093/1094
Printer/Plotter	Printer/Plotter
Installation, Figure 5	Chart Recorder
Automation Control	AutoSampler
4400 Integrator (Data Systems tabbed section)	4400 Integrator

8 Functional Problems

The following is a list of functional problems that can be observed without any special test equipment. Most corrective actions are self explanatory from the list of possible causes. However, if more explanation is needed, there will frequently be more direct instructions listed in the adjacent column to assist in the troubleshooting or repair procedure.

Functional Problem	Paragraph
General Thermal Zone	8.1
Specific Thermal Zones	8.2
Column Oven	
Universal Injector Oven/Auxiliary Oven	
Detector Oven	
8200 CX AutoSampler	8.3
External Events/Valve Control	8.4
Printer/Plotter	8.5
Data System/Control Station	8.6
Miscellaneous Troubleshooting	8.7
Inject Switch	
Remote Control	
Ignitor (FID, FPD)	
Pressure Transducer	8.8
Split Ratio Transducer	8.9
Chromatographic Interpretations	8.10

8.1 General Thermal Zone (Including Subambient)

Refer to Table 2 for General Thermal Zone Troubleshooting.

8.2 Specific Thermal Zones

Always read paragraph 8.1 before continuing with any specific thermal troubleshooting.

Refer to Table 3 for Column Oven Troubleshooting, Table 4 for Universal Injector Oven/Auxiliary Oven Troubleshooting, and Table 5 for Detector Oven Troubleshooting.

Table 2
General Thermal Zone Troubleshooting

Symptom	Possible Causes	Solution
1. Zone will not heat; NOT READY LED on.	Zone turned OFF in GC Configure table.	Reactivate required zone.
For typical ballistic heat-up and cool- down curves for various zones, see Figure 7 through Figure 10.	Open heater, broken terminals or unplugged connector.	Turn unit off, unplug from wall outlet and disconnect the indicated connector. If the resistance for the following zones are at room temperature and cannot be measured, replace the heaters or writing. The plug numbers and resistance values are:
	Column oven (1): P20, P21 pins 1 & 2, 24 ohms; 17 ohms for Star 3600 CX Column oven (2): P20, P21 pins 1 & 3, 24 ohms; 17 ohms for Star 3600 CX Universal Inj.: P70, P72, or P79 pins 1 & 2;, 112 ohms SPI (120 VAC): P70, P72, or P79 pins 1 & 2, 70 ohms SPI (240 VAC): P70, P72, or P79 pins 1 & 2, 280 ohms 33/Star 3400 CX Ion detector base (120 VAC): P71, pins 1 & 2, 65 ohms	33/Star 3400 CX Ion detector base (240 VAC): P71, pins 1 & 4, 260 ohms 3500 Ion detector base (120 VAC): P71, pins 1 & 2, 114 ohms 3500 Ion detector base (240 VAC): P71, pins 1 & 4, 455 ohms Star 3600 CX Ion detector base (1): P71 or P78, pins 1 2, 120 ohms Star 3600 CX Ion detector base (2): P71 or P78, pins 2 & 4, 120 ohms TCD block (1): P71, P78, pins 1 & 2, 287 ohms TCD block (2): P71, P78, pins 3 & 4, 287 ohms

NOTE: Replacement column oven heater is 03-917096-00 (3300/Star 3400 CX/3500 GCs) or 03-918117-00 (Star 3600 CX GCs).

Symptom	Possible Causes	Solution
2. Erratic control, cycling display.	Bad ADC on Temperature Control PCB or bad temperature sensing probe.	Replace temp. sensor probe plug with probe simulator. Displayed temp. for zone should be 0±15°. If not, replace Temp. Control PCB. If reading = zero, probe may be faulty.
	Temperature sensing probe not correctly positioned.	Check the probe positions per figures in the appropriate detector/injector section. Column oven probe body must be exposed at least 3/4" inside column oven.
	Heater and sensor leads, lugs, or connectors deteriorated, loose, or dirty.	Unplugging and replugging connector may be sufficient to wipe contacts clean. Any heater terminal that is discolored is an indication of a poor connection and needs prompt repair.
	Thermal leak with neighboring zone or ambient.	During reconfiguration or repair, insulating material may have been left out or overly compressed.
3. Coolant time-out occurred in GC Configure table. First, check possible causes from Symptoms 1 and 2, above.	Subambient setpoint not obtainable (column oven and on-column capillary injector oven only).	Reactivate zone.
	Setpoint is below limit for coolant: Max. limit for LCO_2 is - 65°C, LN_2 is - 99°C.	Recheck method for setpoint and coolant to be used.

	LN_2 feed tube poorly installed.	Keep line as short as possible and well insulated. LN_2 has to cool the feed tube before it can cool the oven.
	Gas source depleted or tank shut off.	Check all valves and replace tank, if empty.
	Feed line or nozzle restricted.	Clean line and nozzle if fog is absent. Check only when oven is near ambient temperature. A heavy fog is an indication of normal operation.
	Control valve faulty. Notice if valve has an audible click when setpoint changed to a value above and below actual temperature.	Replace valve if no audible click is heard.
	Vent not fully closed.	See Table 3, symptom number 2.
	Insulation iced up around nozzle.	This is usually caused by opening the column oven door when the oven is at subambient temperatures, which causes condensation to occur and ice to form.
	Wrong coolant selection in configuration table.	Select either injector or column oven for control, as required.

Table 3
Column Oven Troubleshooting

Symptom	Possible Causes	Solution
1. Column oven won't program per spec. in Figure 8.	Mixing fan faulty.	Check for blade rotation. a. If blade not rotating, move blade manually. If rotation is obstructed, remove object. b. If blade can't be moved manually, bearings have seized. Replace motor. c. If blade can be rotated manually, the motor or its leads are open. Replace motor.
	Fan blade loose.	Observe blade for wobble or shaft rotating and blade remaining stationary. Tighten blade setscrews.
	One of the two heaters or its lead is open.	Disconnect P21 & P21 and measure about 24 ohms (17 ohms for Star 3600 CX) between pins 1 and 2, and pins 1 and 3. If value is not measured, replace the heaters or wiring.
	Vent motor or switches faulty.	Do the Vent Tests, paragraph 5.2
	Vent flap is malfunctioning.	Broken/bent vent flaps need to be replaced if they are not flush with the oven.
	Triac Q1 is faulty.	If Triac Q1 is bad, it will require replacing the Mother PCB. Recheck the Temperature Control PCB, wiring, heaters, etc., as replacement of the Mother PCB is an extensive task and should be left as a last resort.

Table 2 (Continued)
General Thermal Zone Troubleshooting

Symptom	Possible Causes	Solution
2. Erratic operation.	Mixing fan faulty.	Check for blade rotation. a. If blade not rotating, move blade manually. If rotation is obstructed, remove object. b. If blade can't be moved manually, bearings have seized. Replace motor. c. If blade can be rotated manually, the motor or its leads are open. Replace motor.
	Fan blade loose.	Observe blade for wobble or shaft rotating and blade remaining stationary. Tighten blade setscrews.
	Vent motor cycling or erratic.	Do Vent Tests, paragraph 5.2
	Cooling fan faulty.	Replace fan if not rotating.

Table 4
Universal Injector/Auxiliary Oven Troubleshooting

Symptom	Possible Causes	Solution
1. Injector will not heat up to set point per spec. in Figure 7.	Review paragraph 8.1.	Two halves of injector clam-shell must be tightly clamped with mounting hardware.
2. Auxiliary oven does not control properly.	Variable, due to this being a user-designed heat zone. Refer to paragraph 8.1 for typical symptoms and solutions.	This user-designed heat zone requires a close thermal coupling between heater and probe and correct heater size to load. Also, make certain that a 100 ohm @ 0°C, 0.00392 ohm/ohm/°C type of platinum probe is used.

Table 5
Detector Oven

Symptom	Possible Causes	Solution
1. Ion or TCD oven will not heat to upper temperatures and heats slowly per spec. in Figure 7 (ion) or Figure 9 (TCD).	Review paragraph 8.1.	Make certain that both heaters and the probe are installed correctly. See appropriate figures in Sections 8, 9, 11 or 12 for ionization heaters and probe.
	One of the two heaters or its lead is open.	On a Star 3600 CX Ion, disconnect P71 or P78 and measure about 120 ohms between pins 1 & 2 or 2 & 4. If this value is not measured, replace the heaters or wiring. For TCD measure P71 resistance of 287 ohms between pins 1 and 2 and pins 3 and 4. If this value is not measured, replace the heaters or wiring.

TYPICAL BALLISTIC HEATUP AND COOL DOWN CURVES
(Figures 7, 8, 9, & 10)

CONDITIONS:
- 20°C AMBIENT
- NO COLUMNS INSTALLED
- LINE VOLTAGE: 115 VAC, 60 Hz
- ALL COVERS INSTALLED
- ADJACENT THERMAL ZONES TURNED OFF
- COLUMN MIXING FAN ON

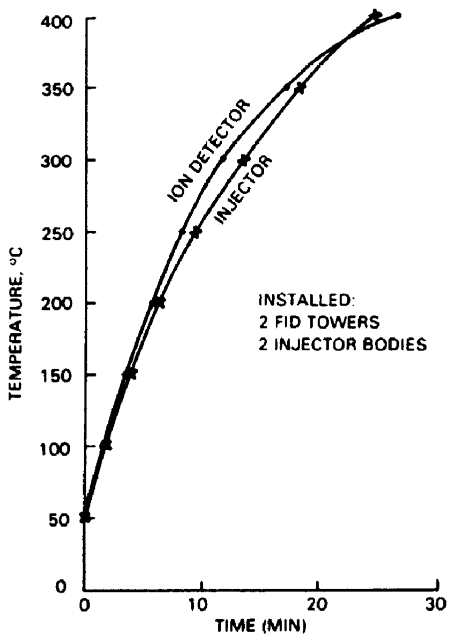


Figure 7a Ionization Detector and Injector Ballistic Heat-Up Rates (Except 3600 GCs)

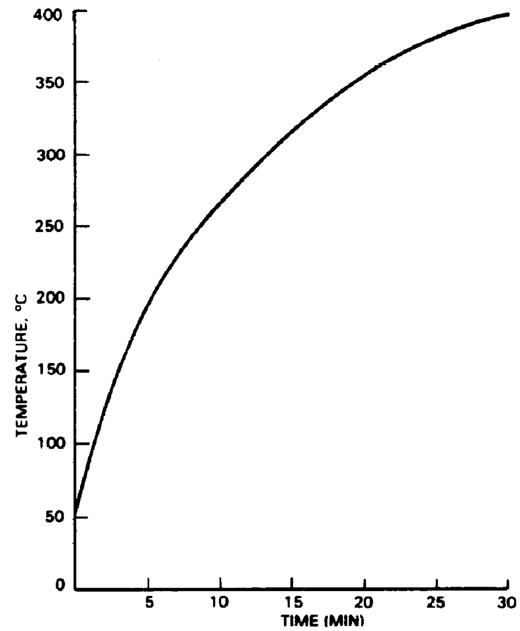


Figure 7b Ionization Detector Ballistic Heat-Up Rates (3600 GCs Only)

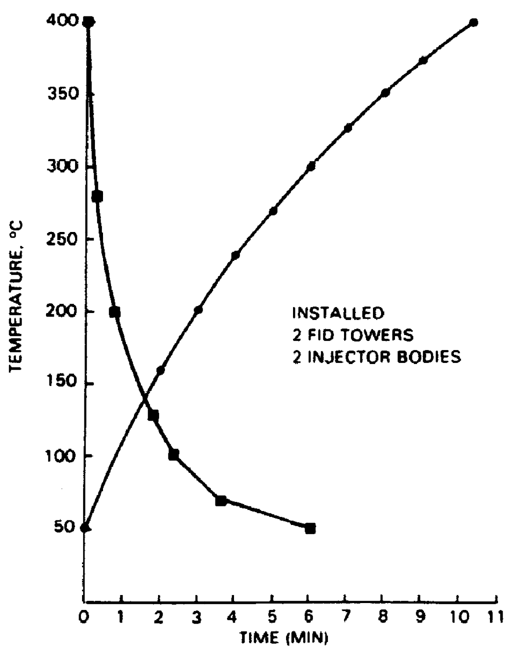


Figure 8a Column Oven Ballistic Heat-Up and Cooldown Rates (Except 3600 GCs)

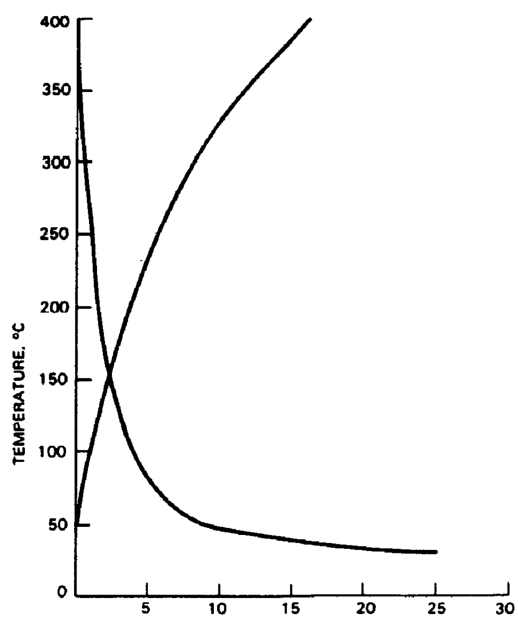


Figure 8b Column Oven Ballistic Heat-Up and Cooldown Rates (3600 GCs Only)

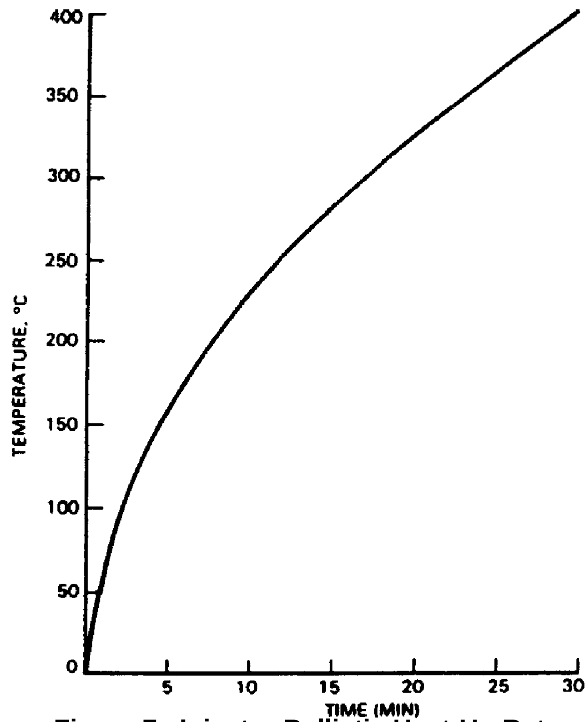


Figure 7c Injector Ballistic Heat-Up Rates (3600 GCs Only)

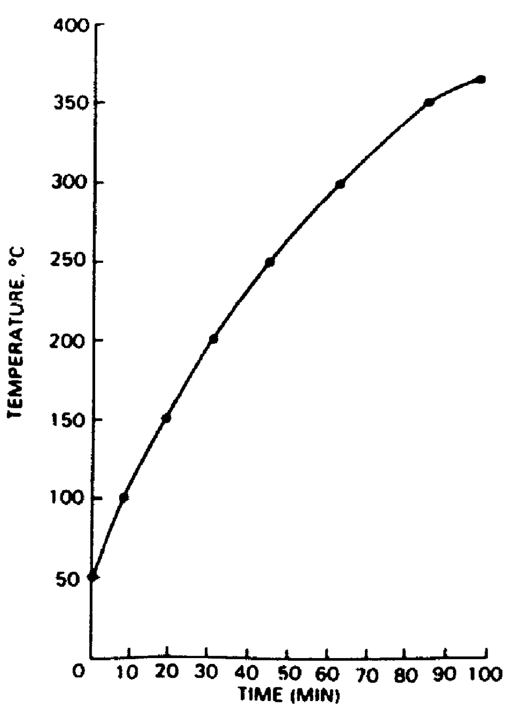


Figure 9 TCD Ballistic Heat-Up Rates (3300/Star 3400 CX/3600 GCs)

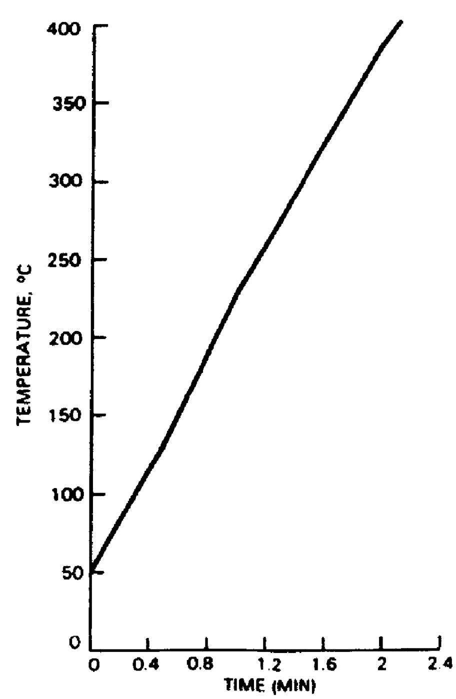


Figure 10 1093 SPI Injector Heat-Up Rates (3000 Series GCs)

8.3 8200 CX AutoSampler

If you are not comfortable using certain electronic test equipment (e.g., ohmmeter) and performing minor repairs, or if you do not have access to an electronics technician, you can call a Customer Support Representative to arrange a visit.

Table 6 describes techniques to diagnose problems with the 8200 CX AutoSampler that are not detected by the electronic diagnostics of the 3000 Series GCs. These troubleshooting procedures assume that you have run the diagnostic tests and no fault has been reported.

Table 6
8200 CX AutoSampler Troubleshooting and Diagnostics

Symptom	Possible Causes	Solution
Split peaks	Injection speed too slow for split injection	Use a fast injection speed (5 to 10 µL/sec) for split injection to obtain best peak shape, especially for early eluting peaks.
	Injection speed too fast for solvent/ column combination	Narrow-bore capillary columns easily produce split peaks due to solvent flooding. Reduce injection speed and raise initial column temperature to vaporize solvent gradually during cold on-column or splitless injection.
	Polar sample solvent beads up on non-polar or semi-polar liquid phase	Use a non-polar solvent plug with polar sample solvents to act as co-solvent.
	Sample size too large	Can also cause solvent flooding with narrow-bore columns. Reduce sample size if possible; reduce injection speed. Reducing solvent plug size may also help, but may lead to increased solute discrimination.
	Component concentration too high	Exceeding the capacity of the column liquid phase (overloading the column) may cause split or deformed peaks. Reduce the sample concentration by diluting the sample.
Poor peak area reproducibility (High area RSDs)	Syringe leaking at needle seal (solvent appears around syringe nut)	Ensure syringe nut is tight; if leaks continue, replace needle and Kalrez seal. When replacing needle, check syringe barrel surface for cracks or chips. Cracks or large chips necessitate replacing the syringe.
	Syringe leaking at plunger seal (solvent appears on upper body of syringe)	Leaks at plunger seal will lead to solvent flowing over outside of syringe barrel during wash cycle. Tighten plunger guide to restore seal. Do not overtighten; increased friction can cause stepper motor to stall.
	Syringe plunger tip Teflonℜ seal worn	Replace syringe. A worn Teflon plunger tip seal will allow air or solvent to flow past the plunger tip, causing varying amounts of sample to be withdrawn from vial.
	Viscous sample injected with wrong mode	Use Viscous Sample Mode, instead of Standard Mode.
	Volatile sample injected with wrong mode	Use Volatile Sample Mode instead of Standard Sample Mode when injecting solvents such as methylene chloride, carbon disulfide, or pentane.
	Partially plugged needle	Replace needle if plug cannot be cleared manually.

	Inlet problems	Check for leaks, flow controller failures, pressure fluctuations, etc. See Trouble-shooting Section of your GC manual.
	Waste arm plugged	Check for free flow of wash solvent through syringe and out waste arm.
	Solvent reservoir empty	Refill reservoir.
	Too many injections per vial	With long run times and volatile sample solvents, concentration of components in sample can increase after sample vial septum is punctured. When using Neat Mode, a slight vacuum can form within vial as sample is removed.
	Insufficient solvent plug volume when using solvent flush injection	Solvent plug volume should be greater than needle volume; i.e., 1.0 µL or more.
Bent needle	Tray misaligned	If syringe is installed correctly in syringe holder (vertical, with no binding), and needle hits edge of vial, call Varian Customer Support. *DO NOT* forcibly rotate the carrousel to achieve proper alignment!
	Wrong needle insertion depth	With certain disposable vials and some microvials, needle depth default of 90% will allow needle to hit bottom of vial. Change needle depth parameter to lower value (e.g., 80%).
	Wrong vial used	Use only 1.5 mL vials and microvials certified acceptable by Varian. *(See listing of approved vials in Appendix C of this manual.)* In particular, some microvial inserts have very small openings, allowing the autosampler needle to hit the glass edge.
	Syringe misaligned	Adjust the syringe mount, following procedure in Section 2 of the 8200 CX AutoSampler Operator's Manual (P/N 03-914405-00).
	Needle hits edge of septum nut when injecting	If syringe is mounted correctly in syringe holder (vertical, with no binding, aligned with sample vials), then loosen autosampler mounting plate screw and align entire autosampler to injector, as described in Section 2 of the 8200 CX AutoSampler Operator's Manual (P/N 03-914405-00).
	Waste arm jammed or misaligned	Ensure that waste arm is tightly mounted (no loose nuts) and aligned. If jammed, check for air pressure problems. If waste arm sticks using proper gas pressure, call Varian Customer Support.
	Too much resistance from new septum	After a new septum is installed, lower autosampler carriage manually until the needle pierces the new septum. This procedure also checks the alignment of the needle with the injection port. Do not overtighten the injector nut, as this will increase the force required for the needle to penetrate the septum.

Symptom	Possible Causes	Solution
	Obstruction within injector	Check for obstructions or incorrectly installed column within injector. In particular, be certain that small diameter columns are not being used with large diameter insert in the SPI. The wrong insert will allow columns to be inserted too far into the injector.
Sample component carryover (“ghost peaks”)	Wash time too short	Use longer wash time than default of 20 seconds.
	Wrong wash solvent	Use a wash solvent that is miscible with sample solvent. If a wide range of polarities are present in the sample, especially in high concentrations (e.g., perfumes), use two wash solvents of different polarities.
	Defective syringe and/or needle	Voids or gaps in syringe seals or dead volume in tip of defective needle can lead to carryover; replace syringe and/or needle.
	Inlet problem	Inlet may be too cold, contain poorly swept areas because of poor seals, or otherwise contribute to carryover.
	Plugged wash bottle frit	Replace frit. Verify that wash solvent flows freely through syringe during wash cycle.
	Valves plugged due to swollen Viton seals caused by using ketones as wash solvent	If necessary to use ketones as wash solvents, replace standard valves with optional valves built with Kalrez seals (P/N 03-918533-90).
	Waste arm plugged	Clear waste arm; ensure free flow of solvent through syringe during wash cycle.
	Wash solvent reservoir empty	Refill reservoir.
	Contaminated gas supply to autosampler	Not actually sample component carryover, but extra peaks due to contaminants dissolved in wash and backup solvent. Ensure that gas supply to autosampler is chromatographically pure. At minimum, gas supply should pass through a good hydrocarbon/organics filter.
	Contaminated wash solvent	Use only chromatographic grade wash and backup solvents.
	Septum contamination	Condition injector septa in GC oven prior to use. For ultratrace analysis, condition waste arm septa also.
Wash solvent carryover	Wrong sampling mode chosen	If wash solvent carryover is not desired, use the Neat Sampling Mode.
	Wash solvent too viscous to be removed by Neat Sampling Mode	Use a less viscous wash solvent; or use the original wash solvent followed by a less viscous solvent; or use air dry in User Defined Mode to remove most solvent before sampling. (Note that use of air dry may lead to increased syringe wear.)
	Wash bottle frit and lines not purged properly when changing to new solvent.	When changing solvent in a wash bottle, use a new, dry filter frit. The porous frits absorb a large quantity of solvent, which is difficult to remove completely by purging. After changing solvents, set wash time to 180 sec and repeat several wash cycles.
No peaks, or small peaks	Plugged syringe needle	If syringe needle cannot be cleared manually, replace needle.

Table 6 (Cont.)
8200 CX AutoSampler Troubleshooting and Diagnostics

Symptom	Possible Causes	Solution
	Bad syringe needle seal	A poor needle seal will allow air to be sucked into syringe instead of sample. Replace needle and seal; ensure syringe nut is tight.
	Syringe needle not inserted into sample	Increase value of A/S Vial Needle Depth so that syringe needle dips into the sample. This parameter must be carefully adjusted to sample 20 µL or less in non-standard microvials.
	Teflon plunger seal worn out or defective	Sample may be withdrawn into syringe, but leak past defective Teflon seal when needle is inserted into pressurized injector. Replace syringe.
	GC problems	Wrong splitter setting, leaks, wrong detector settings, broken column, etc. Consult Troubleshooting Section of your GC manual.
Short Syringe Lifetime	High friction due to use of air dry parameter	Use air dry only if absolutely necessary.
	Overuse of Neat Sampling Mode	Neat Sampling Mode should be used only when minimal wash solvent carryover is required. Syringe wear is increased when using this mode.
Vial pulled out of tray by syringe needle	Vial retainer arm misaligned	Realign retainer arm or call Varian Customer Support.
	Unapproved vial used	Use only vials approved for use in the 8200 CX GC AutoSampler.
Vial not found or skipped	Cap of vial removed or missing	Infrared sensor beam must be blocked to detect vial. If vial must be sampled without cap, place opaque tape over the bottom of the vial.
	Defective infrared sensor	Call Varian Customer Support.
Solvent or sample peak tailing	Injection speed too fast for splitless or large bore (0.53 mm) vaporizing injection	Use slow injection speed (1-2 µL/sec), especially with large sample volumes.
	Inlet or other GC problems	Poor internal seals, plugged septum purge, too low a vent flow, etc., will contribute to tailing. Consult Troubleshooting Section of your GC Manual.
Poor retention time reproducibility	Rarely due to autosampler malfunction	Often an inlet system problem. Change injector septum first. If problem persists, consult Troubleshooting Section of your GC Manual and check entire system for leaks. If autosampler timing problem is suspected, call Varian Customer Support.
Sample discrimination (early or late eluting peaks reduced in size relative to other components)	Autosampler not set to Solvent Flush Mode	Standard Mode, which uses solvent flush injection, should be used to minimize sample discrimination. All defaults should be maintained.
	Injection speed too high	Too high an injection speed into a hot injector can cause loss of low-boiling components due to flashback. Reduce autosampler injection speed.

Symptom	Possible Causes	Solution
	Wrong choice of backup solvent	Low-boiling solvents can vaporize too rapidly from the syringe needle, leaving higher boiling components behind, especially with slow injection speeds.
	Wrong injector temperature	Too high an injector temperature can cause loss of low-boiling solutes. Too low an injector temperature can cause loss of high-boiling components in a vaporizing injector. Ideal results will be obtained with non-vaporizing injection (SPI), followed by temperature programming the injector.

8.4 External Events/Valve Control

Use the following information to find faults in External Events/Valve Control that built-in diagnostics do not cover. This information assumes that you have run the Automatic Tests and the Extended Tests for External Events, no faults have been reported, but you know that you have a problem.

If you do not feel comfortable using an ohmmeter and doing minor repairs or have access to a person that is, there are two courses of action. The first is to replace the External Events PCB; the second is to call Varian Customer Support.

8.5 Printer/Plotter

Refer to Table 7 for Printer/Plotter Troubleshooting.

Table 7
Printer/Plotter Troubleshooting

Symptom	Possible Cause	Solution
1. PLOTTER section cannot be built into the method.	The GC has a fault.	Do the Automatic Tests per paragraph 1.2.
	Printer/plotter unplugged.	Remove the screw and slide the printer/plotter out and check that the flat ribbon cable is connected to J61 and that the power plug is connected to J69. Check for loose connector.
	Printer/plotter fuse blown.	While under power, observe if both green LEDs are lit. If not, replace fuse F1.
	Flat cable faulty or bad connector.	If both LEDs are lit, the flat cable needs replacing.
	Printer/plotter faulty.	If the Status LED is off, the printer/plotter is faulty and needs replacing.
2. Paper-out false indication.	Torn paper.	Observe that the web of paper from the roller is untorn and feeding straight.
	Paper out sensor faulty or unplugged.	If the sensor is connected to J66, disconnect and inspect connector. (Unplugging and reconnecting may sufficiently clean the contacts.) If no fault is found, replace the printer/plotter unit.
3. Paper feeds erratically, wrinkles, and/or jams.	Torn paper from the supplier.	Take out the paper and re-feed it again.

Table 7 (Cont.)
8200 CX AutoSampler Troubleshooting and Diagnostics

Symptom	Possible Causes	Solution
	Use of non-standard paper.	Use only Varian thermal paper, P/N 03-917650-00.
	Paper stored improperly.	If the newly installed paper has been stored in an excessively cool and humid location, it may take several days for it to feed correctly in the lab environment.
	GC front panel door not shut.	Shut GC door.
	GC faulty or erratic.	Do the Automatic Tests, paragraph 1.2.
	Printer/plotter erratic or faulty.	Replace printer/plotter.
4. Distorted printing or plotting.	GC faulty.	Do the Automatic Tests, paragraph 1.2.
	Paper feed erratic.	Check distance between time ticks. If not correct, check for jammed paper. See Symptom #3. Press SHIFT FEED PAPER. If paper doesn't feed smoothly, replace printer/plotter.
	Loose belt on paper feed motor or thermal printhead motor.	Tighten the belts.
	Head control erratic.	If the head can move freely, and no pieces of paper are obstructing its travel, replace the printer/plotter.
5. Print or plot is light.	Use of non-standard paper.	Use only Varian thermal paper, P/N 030-917650-00.
	Switch S1 on Printer/Plotter Power Supply PCB in wrong position.	Each printhead is selected (A, B, or C) and stamped accordingly on the head cable. Set S1 on the Printer/Plotter Power Supply PCB accordingly.
	Residue build up on printhead.	Remove the paper. Clean the head with alcohol soaked non-abrasive pad.
	Printer, power supply, or printhead faulty.	Replace printer/plotter.
6. Missing dots.	Printhead or PCL/ADC PC Board faulty.	Replace printer/plotter.

8.6 Data System Troubleshooting

Refer to the Diagnostics section of your GC Star Workstation Operator's Manual.

8.7 Miscellaneous Troubleshooting

Refer to Table 8 for Miscellaneous Troubleshooting, which includes inject switch, remote control, and ignitor.

Table 8
Miscellaneous Troubleshooting

Symptom	Possible Cause	Solution
1. Instrument won't go to RUN after injection, either with AutoSampler or manual injection.	Controller faulty.	Run Automatic Tests, paragraph 1.2.
	Inject switch, wiring, or connector faulty.	Inject switch may be stuck open or closed. a) Inject stuck down or shorted wiring will allow one run and stop all others. Check for error message. b) Inject switch stuck up or broke wiring will prevent any run from starting.
	Inject switch bent or mechanically obstructed.	Check inject switch's actuator for free travel, not obstructed by the AutoSampler, top cover, or injector cover. If multiple septa are used, the injector nut may be too high and the switch will remain on when an AutoSampler is installed.
2. Flame won't ignite on FID or FPD.	Keyboard Display, Temperature Control, or Power Supply PCB faulty.	Run Automatic Tests, paragraph 1.2. Key should "beep" when depressed. Check to see if "beep" has been disabled in Configuration Section.
	Faulty ignition coil, cable, or connector at the tower on the PC board.	With H_2 flow turned off, press and hold IGNITE and observe ignitor coil inside the appropriate detector tower. The coil should glow red. Check that the connectors are both secure and are connected to the correct PC board. Check continuity of the cable or coil with an ohmmeter or use replacements to localize fault.
	Ignitor probe assembly not installed properly.	Align the flat on the ignitor probe with the pin on the tower arm (3500 GCs only). Align probe key with tower arm slot (3300, Star 3400 CX GCs).
	No fuel gas at tower.	Ferrule may be over tightened. Gas supply may be depleted or shut off.
	Improperly adjusted flow rates.	Adjust flow rates per the **Installation** section.
3. Remote start or Ready inputs control signals faulty.	Faulty cable or its connector.	Check quality of cable and connectors, preferably with an ohmmeter. Since these control signals are basic, it is easy to simulate the remote station; short pins 1 and 12 on J16 to give a READY condition; short pins 3 and 4 to give a START condition.
	Faulty Temperature Control PC Board.	Exchange the PC board.

Symptom	Possible Causes	Solution
4. Remote start or Ready output signal faulty.	Faulty cable or its connector.	Check quality of cable and connectors, preferably with an ohmmeter. These control signals can be measured with an ohmmeter. Measure a short on pins 1 and 3 on J23 for a READY instrument, open for NOT READY. Measure a 1 second short at the start of a run on pins 4 and 5 on J23.
	Faulty Keyboard Display PC Board.	Exchange the Keyboard Display PCB. DO NOT forget to replace the metal cover after the exchange.
5. TCD has background Fault 43/53, even under normal conditions with no leaks.	Badly oxidized cell.	Switch to 490 position on Switch S1 on the TCD PCB. Replace the cell if that does not work.

8.8 Pressure Transducer

If you do not have an External Events PCB or an AutoSampler/External Events PCB as a spare or you have replaced the PCB and the problem remains, proceed with Table 9, Pressure Transducer Troubleshooting.

- Solution Procedures

8.8.1 (Ref. Symptom 1, Table 9)

Turn the instrument off, unplug from main power, and remove the high voltage cover. Remove the External Events PCB. Remove the Pressure Transducer cable (03-917829-00 for Star 3400 CX/3500 GCs; 03-917829-01 for Star 3600 CX GCs) from J103 on the External Events PCB. Connect an ohmmeter between pins 9 and 2 on P103.

If the ohmmeter reads zero ohms, then the External Events PCB is faulty and should be replaced. If the ohmmeter reads infinity, then either the Pressure Transducer cable or the Pressure Transducer PCB is faulty. The most likely source of a problem is the cable.

8.8.2 (Ref. Symptom 2, Table 9)

Turn the instrument off, unplug from main power, and remove the high voltage cover. Remove the External Events PCB. Remove the Pressure Transducer cable (03-917829-00 for Star 3400 CX/3500 GCs; 03-917829-01 for Star 3600 CX GCs) from J103 on the External Events PCB. Connect an ohmmeter between pins 2 and 10 on P103. If the ohmmeter reads infinity, then the Pressure Transducer cable and Pressure Transducer PCB are okay. Replace the External Events PCB.

If the ohmmeter reads zero, then either the cable or the Pressure Transducer PC Board is faulty. The most likely source is the Pressure Transducer PC Board.

8.8.3 (Ref. Symptom 2, Table 9)

If the change in pressure reading is real (not electronic), then there should also be a change in the chromatogram. If no chromatogram is available, inject a known sample under known instrument conditions. If the chromatogram has changed, go to the chromatography troubleshooting section (Table 11) of this troubleshooting manual. If there has been no change in the chromatogram, then there is an electronic problem. Go to paragraph 8.8.4.

8.8.4 (Ref. Symptom 2, Table 9)

To locate the fault down to the level of a replaceable assembly will require a higher degree of troubleshooting by the operator than has been previously assumed. The most likely assembly to have failed is the Pressure Transducer PCB. The operator may choose to replace the Pressure Transducer PCB and see if the new assembly fixes the problem. The operator may choose to call Customer Support at this point.

The procedure that follows requires the use of a digital multimeter and a pressure gauge of known accuracy “T’d” into the pneumatic line going to the Pressure Transducer. If these are not available, then do not proceed further.

1. Perform the calibration described in the **Installation** section of this manual. If the Pressure Transducer voltages are within the accuracy of the pressure gauge you are using, the Pressure Transducer PCB is okay. Go to step 2. If the Pressure Transducer does not pass the calibration, replace the Pressure Transducer PCB.
2. Disconnect the Pressure Transducer cable from the Pressure Transducer PCB and the External Events PCB. Measure the resistance from pin 5 at one end of the cable to pin 5 at one end of the cable to pin 5 at the other end of the cable. Also measure the resistance from pin 6 at one end of the cable to pin 6 at the other end of the cable. **Both wires should measure zero ohms**. If they do not, the cable is defective and should be replaced. If both wires do measure zero ohms, the External Events PCB is probably defective and should be replaced.

Table 9
Pressure Transducer Troubleshooting

Symptom	Possible Cause	Solution
1. Both A and B pressures not reported in instrument Status or Run log.	Option not present.	Option requires the presence of a Pressure Transducer PCB, cable and External Event option.
	GC Configure table states column(s) not installed (COLUMN A/B INSTALLED? = NO).	In GC Configure table, enter YES for COLUMN A/B INSTALLED.
	External Event PCB board lock not closed.	Close board lock.
	Option not connected properly.	See Installation section of this manual for pressure transducer installation.
	Faulty External Event PCB, Pressure Transducer cable, or Pressure Transducer PCB.	See paragraph 8.9.1.

Symptom	Possible Causes	Solution
2. Pressures for either A or B not reported in Status or Run log.	Faulty E/E PCB, Pressure Transducer cable, or Pressure Transducer PCB.	See paragraph 8.9.2.
	GC Configure table states column(s) not installed (COLUMN A/B INSTALLED? = NO).	In GC Configure table, enter YES for COLUMN A/B INSTALLED.
3. Channel A or channel B pressure readings are wrong.	Carrier gas depleted or shut off.	See paragraph 8.9.3.
	Faulty E/E PCB, Pressure Transducer cable, or Pressure Transducer PCB.	See paragraph 8.9.4.
	Pressure Transducer outputs are out of allowed range.	Measure voltages between the following test points on the Pressure Transducer PCB with the instrument power on. (If the electronic flow meter or split ratio transducer, 3500 and Star 3600 CX GCs only, are present in the instrument, then disconnect the cable to these options before making the voltage measurements.) TP1 and TP3 – allowed range=0 to +5 volts TP2 and TP3 – allowed range=0 to +5 volts If both measurements are good, then check the pressure display on the instrument. If the display is okay now, then the problem is associated with the flowmeter option or the split ratio transducer (3500/Star 3600 CX GCs only) option For Star 3400 CX GCs, call Varian Customer Support. For 3500 or Star 3600 CX GCs, refer to **Split Ratio Transducer** troubleshooting, paragraph 8.10.
	Pressure Transducer needs calibration.	See the **Installation** section of this manual.

8.9 Split Ratio Transducer

This information is provided to help find faults in the Spit Ratio Transducer option that built-in diagnostics do not cover. This information assumes that you have run the Automatic Tests, no faults have been reported, but you know that a problem exists.

The Split Ratio Transducer option consists of a Split Ratio Transducer PC Board mounted in the pneumatics compartment, interface circuitry always present on the External Events or AutoSampler/External Events PCB, and a cable passing between the two pc boards.

If you do not feel comfortable using an ohmmeter and doing minor repairs or have access to a person that is, there are two courses of action. The first is to replace the External Events or AutoSampler/External Events PCB from a spares kit; the second is to call Varian Customer Support.

If you do not have a External Events or AutoSampler/External Events PCB as a spare, or you have replaced the PCB and the problem remains, then proceed with Table 10, Split Ratio Transducer Troubleshooting.

- Solution Procedures

8.9.1 (Ref. Symptom 1, Table 10)

Turn the instrument off, unplug from main power, and remove the high voltage cover. Remove the External Events PCB. Remove the Flow Transducer cable (03-917868-00 for 3500 GCs; 03-917868-01 for Star 3600 CX GCs) from J102 on the External Events PCB. Connect an ohmmeter between pins 7 and 2 on P102.

If the ohmmeter reads zero ohms, then the External Events PCB is faulty and should be replaced. If the ohmmeter reads infinity, then either the Flow Transducer cable or the Split Ratio Transducer PCB is faulty. The most likely source of a problem is the cable.

8.9.2 (Ref. Symptom 2, Table 10)

Turn the instrument off, unplug from main power, and remove the high voltage cover. Remove the External Events PCB. Remove the Flow Transducer cable (03-917868-00 for 3500 GCs; 03-917868-01 for Star 3600 CX GCs) from J102 on the External Events PCB. Connect an ohmmeter between pins 2 and 8 on P102. If the ohmmeter reads infinity, then the Flow Transducer cable and Pressure Transducer PCB are okay. Replace the External Events PCB.

If the ohmmeter reads zero, then either the cable or the Flow Transducer PC Board is faulty. The most likely source is the Split Ratio Transducer PC Board.

8.9.3 (Ref. Symptom 3, Table 10)

If the change in split ratio is real (not electronic), then there should also be a change in the chromatogram. If no chromatogram is available, inject a known sample under known instrument conditions. If the chromatogram has changed, go to the chromatography troubleshooting section (Table 11) of this troubleshooting manual. If there has been no change in the chromatogram, then there is an electronic problem. Go to paragraph 8.9.4.

8.9.4 (Ref. Symptom 3, Table 11)

To locate the fault down to the level of a replaceable assembly will require a higher degree of troubleshooting by the operator than has been previously assumed. The most likely assembly to have failed is the Split Ratio Transducer PCB. The operator may choose to replace the Split Ratio Transducer PCB and see if the new assembly fixes the problem. The operator may choose to call Customer Support at this point.

The procedure that follows requires the use of a digital multimeter and a bubble flowmeter attached to the splitter exit on the left side of the GC. If these are not available, then do not proceed further.

1. Perform the calibration described in the Installation section of this manual. If the Split Ratio Transducer voltages are within the accuracy of the flowmeter gauge you are using, the Split Ratio Transducer PCB is okay. Go to step 2. If the Split Ratio Transducer does not pass the calibration, replace the Split Ratio Transducer PCB.
2. Disconnect the Flow Transducer cable from the Split Ratio Transducer PCB and the External Events PCB. Measure the resistance from pin 5 at one end (P111) of the cable to pin 5 at the other end (P102) of the cable. Also measure the resistance from pin 6 at one end (P111) of the cable to pin 6 (P102) at the other end of the cable. Both wires should measure zero ohms. If they do not, the cable is defective and should be replaced. If both wires do measure zero ohms, the External Events PCB is probably defective and should be replaced.

Table 10
Split Ratio Transducer Troubleshooting

Symptom	Possible Cause	Solution
1. Both A and B split ratios not reported in instrument status or Run log.	Option not present.	Option requires the presence of a Split Ratio Transducer PCB, cable and External Event option.
	GC Configure table states column(s) not installed (COLUMN A/B NOT INSTALLED? = NO).	Enter YES in the GC Configure table for COLUMN A/B INSTALLED.
	External Event PCB board lock not closed.	Close board lock.
	Option not connected properly.	See the Installation section of this manual for split ratio transducer installation.
	Faulty External Event PCB, Flow Transducer cable, or Split Ratio Transducer PCB.	See paragraph 8.10.1.
2. Split ratios for either A or B not reported in Status or Run log.	Faulty E/E PCB, Flow Transducer cable, or Split Ratio Transducer PCB.	See paragraph 8.10.2.
	GC Configure table states column(s) not installed (COLUMN A/B NOT INSTALLED? = NO).	Enter YES in the GC Configure table for COLUMN A/B INSTALLED.
3. Channel A or channel B split ratio readings are wrong.	Carrier gas depleted or shut off.	See paragraph 8.10.3.
	Faulty E/E PCB, Split Ratio Transducer cable, or Split Ratio Transducer PCB.	See paragraph 8.10.4.
	Outputs of channel A or B on the Split Ratio Transducer are out of allowed range.	With instrument turned on, check with a voltmeter the voltage between the following test points: Split Ratio Transducer PCB: TP1 or TP5 and TP3 or TP6 (grounds). TP2 or TP4 and TP3 or TP6 (grounds). If any of the voltage measurements are not within 0 to +5 volts, then the channel, side with this bad measurement should be re-calibrated or it may be defective. **First**, see split ratio transducer calibration in the **Installation** section.
	Outputs of the Pressure Transducer may be out of the allowed range.	See Table 9, Pressure Transducer Troubleshooting. The Pressure Transducer must be calibrated before the Split Ratio Transducer can be accurately calibrated. Refer to the Installation section for either pressure or split ratio transducer calibration.

8.10 Chromatographic Troubleshooting

The troubleshooting procedures in this section are organized based on observable chromatographic deviations from known responses of a standard sample. This may be any combination of peak shapes, area, elution times or baseline characteristics. Because these observations may be the only indication of a potential problem, the fault can be very elusive and may be anywhere in the system and yet appear to be very obviously the fault of something else. Because of the complexity of localizing a chromatographic problem, always recheck your method, the hardware, and perform the Automatic Tests per paragraph 1.2. All discussions assume a basic GC and recorder configuration.

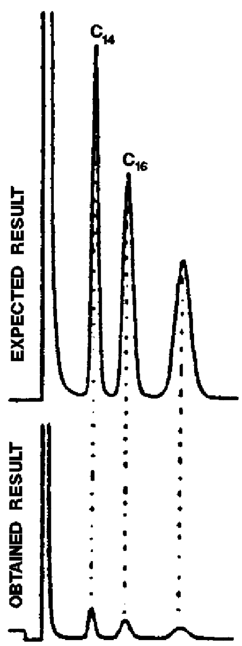
The following sections deal with observations. Study your data, determine what it should be, and review the following list for the best match. The solutions in these sections assume that the operator has some knowledge of chromatographic operation and maintenance. Refresh yourself with the paragraphs dealing with split ratio and pressure transducer calibration in the **Installation** section.

Refer to Table 11 for Chromatographic Troubleshooting.

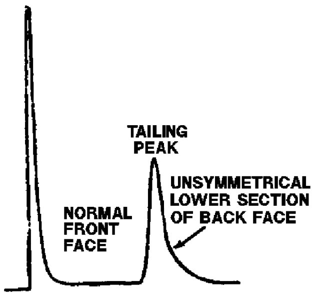
Symptom Number	Symptom Name
1	Changes in sensitivity; peak missing or very small.
2	Tailing peaks.
3	Changes in retention time.
4	Increased noise level (with negligible drift).
5	Constant baseline drift in one direction.
6	Cycling baseline.
7	Spikes at irregular intervals.
8	Short spikes or peaks at regular intervals.
9	Rising baseline when temperature programming.
10	Baseline stepping. Baseline does not return to zero, attenuation is incorrect, peaks are flat-topped.
11	Baseline cannot be zeroed.
12	Unexpected peaks.
13	Unresolved peaks.
14	Square-topped peaks.
15	Round-topped peaks.
16	Negative peaks.
17	Extra peaks.
18	FID only — Sudden drop-off of otherwise normal peak. Pen returns to level below previous baseline. FID flames become extinguished.
19	Negative dips after peaks.
20	Flash injection only — Loss of resolution.
21	Poor resolution (between peaks 1 and 2).
22	Leading peaks.
23	Reverse leading peaks.

Table 11
Chromatographic Troubleshooting

Symptom	Possible Cause	Solution
1. Change in Sensitivity (No or lower peak height) With No Other Deviations.	Chart recorder or printer/plotter inoperative or faulty.	a. Check that the recorder power cord is plugged into wall outlet of proper voltage and into the rear of the recorder. Exchange with a known good chart recorder. b. For the built-in printer/plotter, perform Automatic Tests per paragraph 1.2.
"Sensitivity" refers to peak size (height or area) for a certain amount of sample injected.	Recorder or plotter attenuation set incorrectly.	Check method or attenuation knob setting and recorder.
	Recorder cables faulty or mis-connected.	Check signal cables. a. Check plug position at GC and recorder. b. Make sure recorder terminals don't have a shorting strip or plug installed.
	Chart recorder zero button faulty.	Check recorder zero button to make sure that it is not stuck or held down or faulty.
	Detector cables, connectors & related internal parts faulty or mis-assembled.	Visually inspect the detector. a. See paragraph 7 for lists of diagrams of detector assemblies. b. Internal tower parts can be contaminated, depending on analysis. Clean and reassemble collectors, tips, cells, etc. c. Cables at tower (ion only) and at PCB connector detents to be fully seated. d. If a dual detector is installed, exchange cables to assist in isolating the fault.
	AutoSampler faulty.	See AutoSampler Troubleshooting, Table 6 (8200 CX A/S)
	Column switching valves leaking.	Check for leaks and proper switching operation. See the **Installation** section for pneumatic leak checking.
	Make-up, carrier, or fuel gas flows wrong.	Check flows (see Table 2, **Pre-Installation Instructions**): a. Check for clogged flame jet and clean if required. b. Check fuel gas ratios, make-up gas, and carrier gas flows.
	Flame not lit (FID, FPD).	Test for flame lit: Section 8 (FID) or Section 12 (FPD).
	TCD out of balance or faulty filament.	See the TCD detector section for TCD balancing.
	Septum leaking.	Tighten septum nut or replace septum.
	Syringe (manual and A/S) faulty.	Check for clogged lines or needle, and for leaks around plunger for loss of sample.
	TCD filament protection fuse F2 open.	Replace fuse. Remove ECD PCB or clean short to ground that caused fuse to blow.
	ECD electrometer or pulser bad.	Set ECD switch S3 to TEST; Range 10, A/Z ON, S1 to N_2HIGH. Disconnect cable from electrometer input. Check baseline mV reading; should read 80 mV +60% to -20%. If not, replace the PCB.



2. Tailing peaks or unsymmetrical peak slopes.	Sample reaction with system components.	Eliminate metal that contacts sample, deactivate or change columns, or derivatize sample. This peak has a normal leading slope and a partial normal back slope, but before reaching baseline, begins to lag.
	Column contaminated.	Presence of water in carrier gas or excessive injector temperature stripping of partition liquid. Use a pure gas source and correct temperature settings.
	Injector contaminated.	Clean or replace insert. May have to replace column or break off front portion.
	Thermally labile samples.	Reduce injector and column temperatures.
	TCD overloaded.	Reduce sample size if the filament protection became activated.
	Injector temperature too low.	Raise temperature to volatilize all of the components within the sample.
	Leaking gas sample valve.	See the **Installation** section for checking pneumatic leaks.
	Improper injections.	Inject smaller amounts and do so quickly, fully penetrating the septum and into the injector body.
	Column installed incorrectly.	Column should penetrate injector body to appropriate depth. See Section 14 or appropriate capillary injector manual.



3. Changes in retention time.	Carrier flow changes.	Carrier flow changes: a. Pressure regulator, split ratio valve, or flow controller changed or malfunctioning. b. Depleted gas supply. Replace cylinder when pressure drops below 100 psig. c. Leak between regulator and column inlet.
	Injector leak.	Septum may leak only at time of injection or all the time. Replace if it does.
	Unexpected changes in column oven temperature.	Column oven temperature can vary because of: a. Verify that the method hasn't been changed. b. Perform Automatic Tests, paragraph 1.2, to test temperature controller. c. Insufficient equilibration time after cool down if ambient temperature has increased. d. Column temperature too near ambient temperature. e. Exhausted coolant supply or clogged nozzle or feedline.
	Column contamination.	Clean or replace column.
	Column overload.	Overloaded packed column, will yield longer retention times: Overloaded adsorption columns yield shorter retention times.
	Loss of liquid phase or phase degradation.	Excessive temperatures for extended periods degrade column. Replace column.
	Poor injection technique.	Excessively slow injection causes peak distortion.
	Main power faulty.	Erratic or excessively noisy main power can disrupt normal operation. See the **Installation** section.

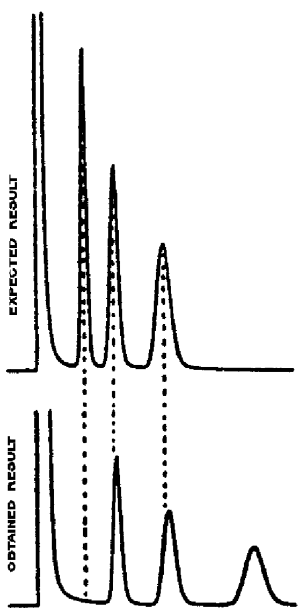


Table 11 (Cont.)
Chromatographic Troubleshooting

Symptom	Possible Causes	Solution
	Inject switch faulty.	Faulty inject switch would keep a temperature program at isothermal. Check switch and connector. See paragraph 8.8 and Table II (Misc. Troubleshooting Section).
	Chart recorder or plotter faulty.	Erratic paper feed. Check paper feed against a fixed time.
4. Increased noise level (with negligible drift) a. Expected result ($1x10^{-12}$) b. Observed result	Chart recorder or plotter erratic.	Exchange with a known good unit, if possible. See paragraph 8.6, **Printer/Plotter. Troubleshooting.**
	Recorder cables faulty.	Check cables and connectors, including shields. Exchange with good ones.
	AC main power faulty.	Check line for new sources of interference, such as welders, ultrasonic cleaners, large motors, etc.
	Power ground inadequate.	Check for faulty grounds, especially on strip type bench outlets.
	Detector assembly and related hardware faulty.	Examine and repair faulty parts: (see appropriate detector section). a. Tighten detector tower to base bolts. Seal must be in good condition. b. Signal cables and polarization BNC cables detented and fully seated at both ends. c. Replace ferrule at base of flame tip. d. Clean deposits from flame tip. e. Operate detector above 120°C to eliminate formation of water condensation. f. Excessive air drafts over detectors. . Excessive ambient air pollution or high dust levels.
	TSD bead faulty.	Relocate or replace TSD bead. Also, re-access bead current and bias values.
	FPD photomultiplier faulty.	Replace faulty FPD photomultiplier tube. Light leaks can also be a noise source.
	ECD source starting to be inactive.	ECD foil depleted or contaminated and needs replacing.
	ECD O_2 contamination.	Eliminate leaks and/or scrub gases.
	Column conditions inferior.	Check and correct column faults: . Loose or missing plug at detector end of column will allow packing material into the detector. b. Excessive bleed or contaminated column. Recondition column or replace.

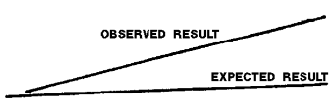
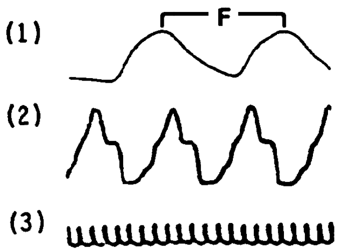
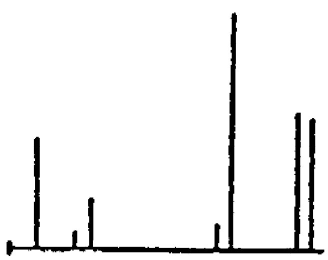
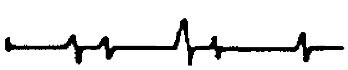
Symptom	Possible Causes	Solution
	Gas supplies faulty (fuel gas, make-up, or carrier gas).	Troubleshoot pneumatic system and repair faults: a. Check for leaks or interrupted service. b. Check tank or supply pressure regulator. Do not locate in thermally instable air, such as in the direct path of an air conditioner. c. Replace any contaminated supply with clean, dry gas. d. Replace clogged or spent filters. e. Leak in gas line. Refer to **Installation** section for leak testing procedures.
	Bad signal cable.	Replace cable.
	Excessive vibration.	Isolate instrument from excessive vibration.
	Detector electronics faulty.	Evaluate the electrometer and controllers: a. Cap input of FID, TSD, FPD: no noise means electrometer okay. FID: Then turn off flame with cables connected. Quiet baseline means polarizer okay. If still noisy, disconnect ignite cable; if noise goes away, polarizer is noisy. Replace PCB to fix polarizer. b. Perform Automatic Tests, paragraph 1.2. Intermittent problems may be difficult to locate. These are best isolated by an exchange of known good components.
	Detector electronics faulty.	Evaluate the electrometer and controllers: c. Check time constant switch. Use the longest possible setting. d. Dirty or contaminated cable or PCB connectors. Carefully clean with a pencil eraser or similar abrasive. Cycling the connector open and closed several times may be sufficient cleaning.
5. Constant baseline drift in one direction.	TCD baseline shifts after each injection.	Faulty filament temperature limit circuit. Unplug bridge from TCD PCB; if (a.) background Fault 43/53 is not displayed, replace PCB, or (b.) switch set to 490 with oxidizing sample; use 390, if possible.
	Continuous oxidation of TCD filaments.	Perform pressure leak check; TCD cell may need to be replaced (0_2 back diffusion at any fitting could be responsible).
	System contamination after start up, particularly with new or under-conditioned column.	Overnight bakeout procedure at the recommended upper conditioning temperatures for the column.
	Detector contamination, particularly ECD.	Check purity of carrier gas. Try open tube from injector to detector. Condition overnight at elevated temperature.
	TCD flow not balanced.	Check flow rates of both channels.
	Detector temperature unstable.	Allow sufficient time for detector stabilization after changing detector temperature.
	Ionization detector leaking at seal.	Replace aluminum washer. See appropriate detector section for procedure.
	FID flame tip ferrule cracked.	Replace flame tip ferrule. See appropriate detector section for procedure.

Table 11 (Cont.)
Chromatographic Troubleshooting

Symptom	Possible Causes	Solution
6. Cycling baseline.	Thermal problem, example 1.	Check temperature stability of injector, column, and detector, and/or systematically change the setpoint by 10°C of each or the zones in sequence. The pattern will change within one F period after the associated controller is changed.
	Pneumatic problem in pressure regulator, example 2.	a. Change the setpoint pressure of the pressure regulator to a high pressure (+5 psig); if cycling is interrupted, then resumes after approximately 30 seconds, the regulator is not controlling at this pressure. Try increasing pressure, replacing regulator. Eliminate air currents across pneumatic compartment and tank regulator. b. Low gas pressure from source.
	Pneumatic problem in flow controller, example 3.	Replace flow controller.
7. Spikes at irregular intervals.	Detector contamination.	Check decontamination procedures for FID flame tip. Some spiking is common when the flame has been off for over a day. Air borne particulates are most frequently the cause; therefore, protecting the exit orifice from atmospheric particles falling into the detector is important.
	Electrical interference from external sources.	Check for heavy current drains on the same power circuit as the chromatograph. An isolation transformer may be needed.
	Quick atmospheric pressure changes from opening and closing doors, blowers, etc.	Relocate instrument to minimize problem. Do not locate under heater or air conditioner blowers.
	FID only—. Dust particles or other foreign material burned in flame.	Keep detector chamber free of dust particles. Blow out or vacuum detector to remove dust.
Sharp spiking at regular Intervals	Column fittings loose.	Tighten column connections.
	Electronic circuitry defective.	Perform Automatic Tests per paragraph 1.1. Cap input of FID, TSD, FPD: no electronic fault if spikes go away.
	Connection between detector and electronics poor.	Check for faulty detector cables.
	TSD, FID, or ECD only — Dirty detector probe insulators.	Clean detector probe insulators with clean solvent. Do not touch clean insulators with fingers.
8. Short spikes or peaks at regular intervals.	Condensation in flow lines causing carrier gas to bubble through.	Heat lines to remove condensation while purging with dry gas.
	FID only — Water condensation in hydrogen line coming from hydrogen generator.	Remove water from line and replace or regenerate filter.
	TCD only — Bubble flowmeter with high liquid level attached to detector exit line.	Remove flowmeter tube from exit line.
	TCD only — Carrier gas moisture filters exhauster.	Replace or regenerate carrier gas filters.

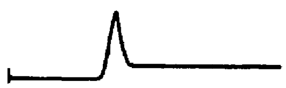
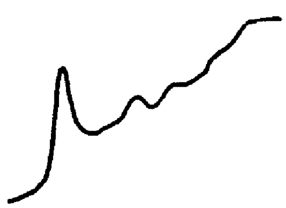
Symptom	Possible Causes	Solution
9. Rising baseline when temperature programming. 	Increase in column or septum bleed when temperature rises.	Recondition column and septum; use high-temperature septum. Use column with different phase, cross-linked phase, or smaller film thickness.
	Column flow rates not balanced.	Adjust reference column flow rate at maximum temperature to zero baseline.
10. Baseline stepping. Baseline does not return to zero, attenuation is incorrect, peaks are flat-topped. 	Instrument not properly grounded.	Make sure instrument connected to good earth ground.
	Excessive recorder deadband.	Recalibrate according to chart recorder manual.
11. Baseline cannot be zeroed.	Detector control circuitry defective.	Perform Automatic Tests per paragraph 1.2.
	Autozero not enabled.	Be sure Autozero enabled in method. Autozero functions only when GC is READY.
	Excessive background from column bleed.	Condition column; use different column.
	FID or ECD only — Detector contaminated.	Clean detector base and detector (see appropriate detector section).
	ECD only — O_2 contamination.	Eliminate leaks or scrub gas.
	TCD only — Detector filaments out of balance.	Check filament resistances. Replace detector if necessary.
	FID, TSD only — FID/TSD selector switch on electrometer set to wrong position.	Set FID/TSD selector switch to appropriate position.
12. Unexpected peaks. 	High boiling sample components eluting from previous injection.	Perform rapid temperature program after each analysis to purge high boiling impurities out of column.

Table 11 (Cont.)
Chromatographic Troubleshooting

Symptom	Possible Causes	Solution
	Ghost peaks from septum, unconditioned column, contaminated carrier gas, or previous sample components.	To confirm ghost peaks from septum or contamination upstream from column, do the following: 1. Measure cooldown and re-equilibration time. 2. Run temperature program and measure the magnitude of ghost peak. 3. Allow twice the cool down and equilibration time. 4. Repeat program and peak measurement If peaks are doubled, this confirms upstream contamination. To isolate contamination from other upstream causes, install the Teflon® injector blank-offplug and repeat above procedure. If ghost peaks disappear, the septum is at fault and can be minimized by: a. Better quality septum b. Lower injector temperature c. Preconditioning septum d. Very short initial hold before programming If ghost peaks persist, upstream contamination is indicated and can be minimized by installing a 1/8" x 6" long molecular sieve trap between the flow controller and the injector.
13. Unresolved peaks.	Column oven temperature too high.	Reduce column oven temperature.
	Column too short.	Use longer column.
	Mobile phase has baked off of column support material.	Replace or repack column.
	Incorrect column for application.	Consult your nearest Varian Customer Support representative for column advice.
	Carrier gas flow rate too high.	Reduce carrier gas flow rate.
	Poor injection technique.	Review sample injection techniques.
14. Square-topped peaks.	Printer/plotter or recorder attenuation too low.	An off scale solvent peak will result in this shape — not a defect. Data system not involved unless "overrange" message.
	Electronic or detector saturation due to sample overload.	Select less sensitive range setting. The best range setting is the most sensitive position that will hold all peaks of interest on scale at an attenuation of 1024 with a 1 mV chart recorder. Reduce sample volume or concentration.
15. Round-topped peaks. 	Detector overload.	Reduce sample volume or concentration.

Table 11 (Cont.)
Chromatographic Troubleshooting

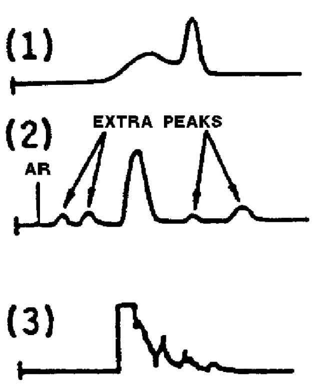
Symptom	Possible Causes	Solution
16. Negative peaks.	TCD only: Sample injected into wrong column.	Inject sample into correct column.
	Contamination in carrier gas (some peaks reversed in direction of response).	Reverse output signal. Vacancy chromatography. Particularly in trace analysis, concentration of a certain component is greater in the carrier gas (impurity) than it is in the sample. Condition is common with TCD when leak into carrier gas. Contaminated septa, depleted gas filters, etc., can contribute to this condition. Successful trace analysis demands that the system be at optimum performance: a.Be sure all gas inlet filters are functional so that highest purity is assured. b. Use cylinder gases of proven purity. c. System may need to be leak checked.
	Recorder leads reversed.	Check recorder connections.
	Contamination in detector.	Decontaminate or replace insulators in FID or TSD. Decontaminate ECD foil and insulators.
	Partial negative response	“W” shaped peaks: When using a TCD to analyze for H_2; with H_2 concentration above 3%, negative H_2 peak results; with H_2 concentration below 3%, positive H_2 peak results. Phenomenon can be minimized by changing the sample loop size or by using 8% H_2, 92% He carrier gas, which always yields negative H_2 peaks.
17. Extra peaks.	Heavy residual material eluting from previous sample injection (1).	Allow sufficient time for previous sample compounds to elute.
	Condensed moisture and other impurities from carrier gas eluting during temperature-programmed run (1).	Install, replace, or regenerate carrier gas filter.
	Air peak (2) (TCD only).	Normal when making syringe injections.
	Desorption from column packing when solvent is injected (2).	Make several solvent injections and recondition column.
	Sample decomposition (2, 3).	Reduce injector temperature. Use different column if packing material is causing or catalyzing decomposition.
	Contaminated sample (3).	Test sample contaminated. Use fresh test sample.
	Sample interaction with mobile phase or solid support of column packing (1, 2, 3).	Use different column. Consult nearest Varian Customer Support representative for column advice.
	Contamination from glassware, syringes, etc., (1, 2, 3).	Make sure glassware, syringes, etc., are clean.

Table 11 (Cont.)
Chromatographic Troubleshooting

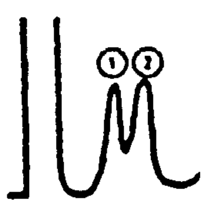
Symptom	Possible Causes	Solution
18. FID only — Sudden drop off of otherwise normal peak. Pen returns to level below previous baseline. FID flame becomes extinguished.	Sample size too large.	Reduce sample size. Reignite flame.
	Carrier gas flow rate too high.	Adjust carrier gas flow rate.
	Flame tip orifice too small.	Replace flame tip.
	Flame tip plugged.	Clean or replace flame tip.
	Loss of hydrogen or air.	Check hydrogen and air supplies. Re-establish proper flow rates.
	Sample contains more oxygen than combustion air, causing flashback.	Dilute sample with inert gas, or use oxygen rather than air to support combustion.
19. Negative dips after peaks.	Contaminated detector, ECD.	Clean detector as described in the **ECD** detector section.
	High column bleed.	Condition column.
20. Flash injection only — Loss of resolution.	Flash injector not seating in injector body.	Clean inside of injector body and reinstall glass insert. If using a 1/8" column with 1/4" injector, be sure column does not extend too far into injector body.
	Glass wool in injector insert is missing or positioned too high in insert.	Place glass wool loosely in lower third of insert.
	Sample injected too rapidly.	Decrease rate of injection to 10 µL or less per second.
21. Insufficient resolution (between peaks 1 and 2).	Temperature of the column too high.	Repeat the analysis with a lower temperature by about 25°C. Depending on the relationship to the other peaks, a temperature program might be advantageous.
	Non-optimum column flows.	The column flow rate usually will cause only small differences in resolution unless a very low flow is used. Suggested flows for best resolution are shown below: *Column Internal Diameter* 2 mm — 4 mm N_2 12-15 mL/min — 25-30 mL/min He 24-30 mL/min — 50-60 mL/min

Table 11 (Cont.)
Chromatographic Troubleshooting

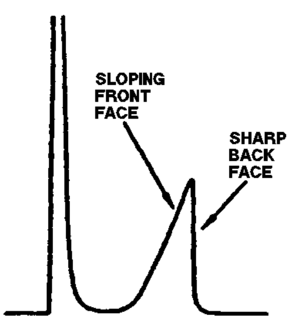
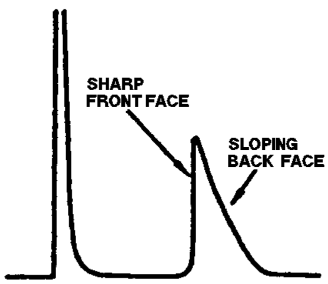
Symptom	Possible Causes	Solution
	Column too short.	Although the number of plates increases linearly with an increase in column length (providing the packing efficiency can be maintained), the resolution only increases by the square root of the increase in column length, i.e., a 4 times longer column will only increase resolution by 2 fold. Another consideration to increasing column length is the resulting increase in column inlet pressure. Above 40 psig, leak problems start to be a limiting factor. Usually a 1-3 meter, 2 mm ID packed column is recommended for maximum column length.
	Poor choice of column liquid phase.	Selecting a liquid phase of different polarity may help if there is a difference in polarity of the components. If 1 is more polar than 2: a. A lower polarity liquid phase will improve the separation. b. A slightly higher polarity liquid phase will reduce separation or cause co-elution. c. A much higher polarity liquid phase may provide separation, with 2 eluting before 1. If 1 is less polar than 2: a. A lower polarity liquid phase will reduce separation or might yield a separation with 2 eluting before 1. b. A more polar liquid phase will yield more separation.
	Detector time constant too long.	Use FAST switch position for very narrow capillary peaks.
	Column degradation.	Replace or repack column.
22. Leading peaks. Those peaks exhibiting a slow rise to apex with a sharp drop to baseline.	Column overload due to an excessive amount of sample.	Inject a smaller volume of sample or dilute the sample mixture.
	Column overload due to too low column temperature.	Increase the column temperature.
	Column overload due to insufficient liquid phase on the solid support, e.g., possibly from extended operation at excessive temperature, or H_2 in carrier gas, H_2O in carrier gas.	a. Replace the column with a new one. b. Change column composition to a higher % liquid phase coating (about 20% is maximum possible loading for Chrom W, 10% for Chrom G, and 40% for Chrom P).
	Carrier velocity too low.	Increase column flow rate.

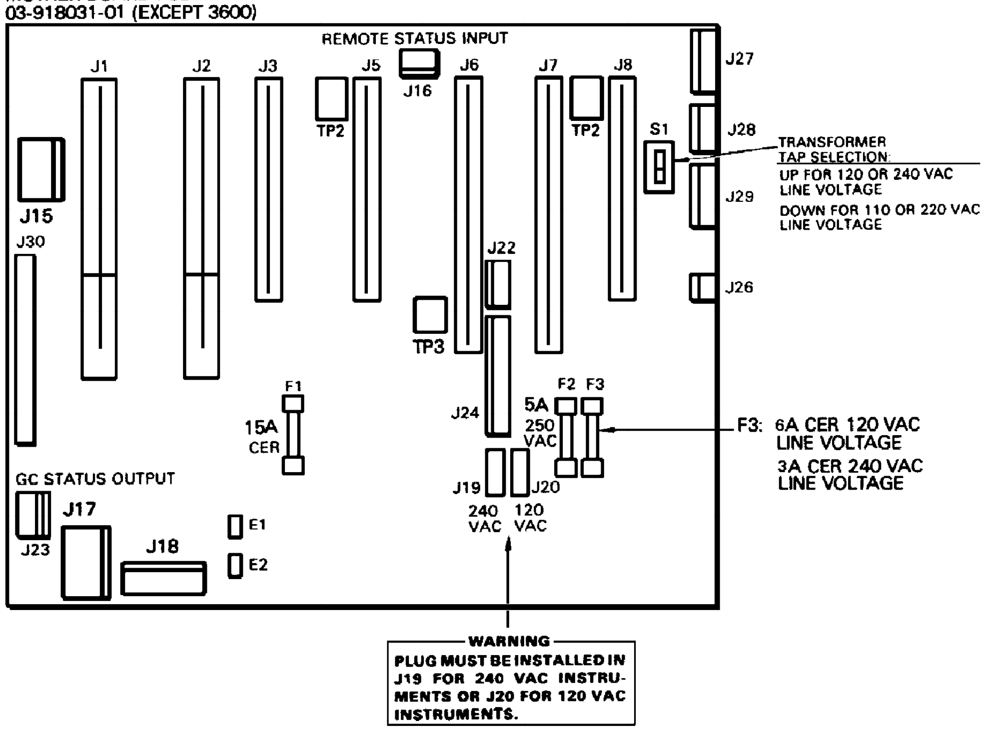
Table 11 (Cont.)
Chromatographic Troubleshooting

Symptom	Possible Causes	Solution
23. Reverse leading peaks. Those peaks exhibiting a sharp rise to apex followed by a slow constant return to baseline.		CONDITIONS: Adsorption column operating at a temperature above the boiling point of the compound (the usual case) **or** partition column operating at a temperature above the boiling point at the compound, such as a solvent (the usual case).
	Column overload due to an excessive amount of sample.	Reduce the volume of sample injected.
	Column temperature too high.	Reduce column temperature.
	Column velocity too low.	Increase column flow rate.

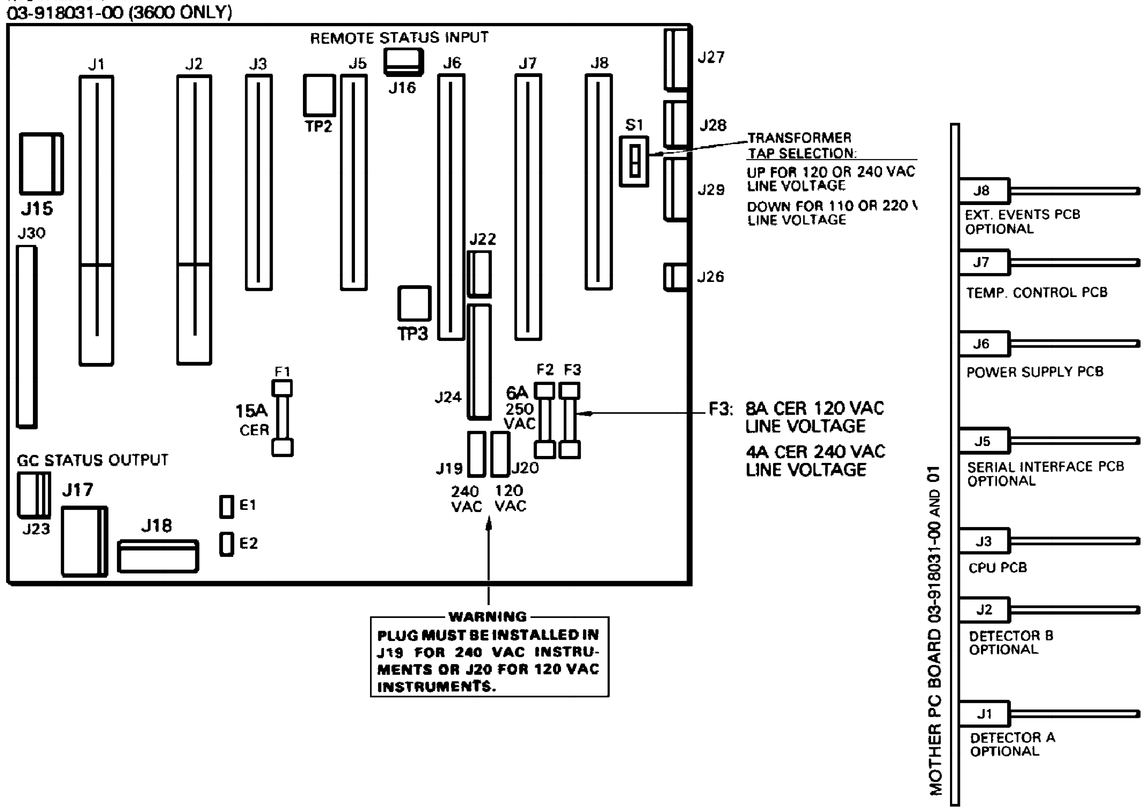
9 Electronic Hardware Locations

Refer to the following figures for electronic hardware locations.

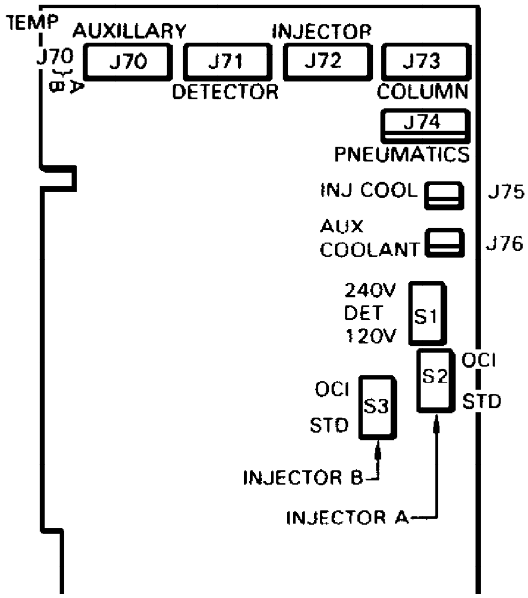
MOTHER BOARD PCB
03-918031-01 (EXCEPT 3600)



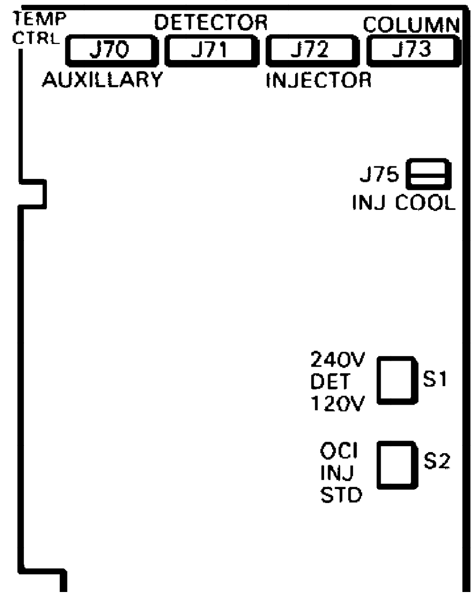
MOTHER BOARD PCB
03-918031-00 (3600 ONLY)



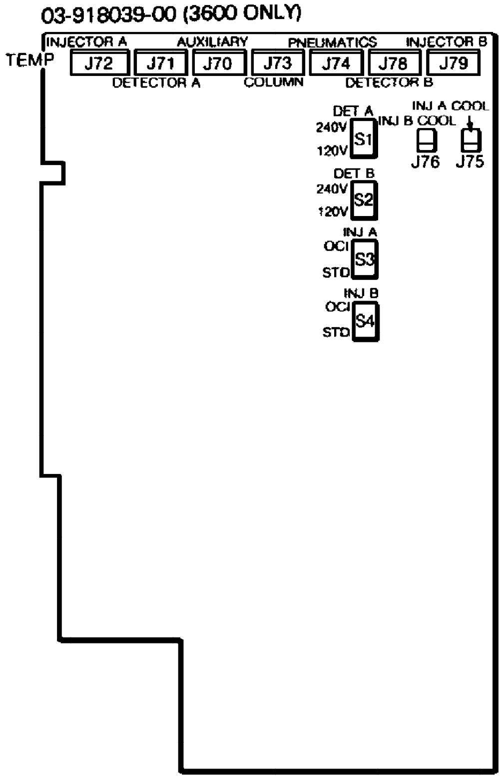
J7 TEMP. CONTROL PCB
03-917712-02 (3500)



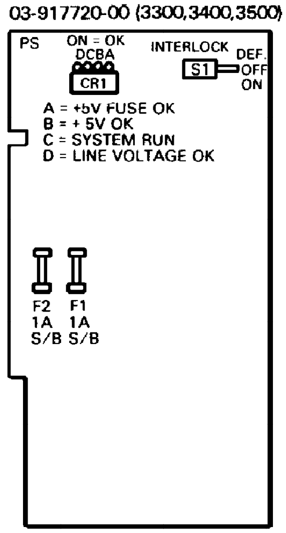
J7 TEMP. CONTROL PCB
03-917712-00 (3300, 3400)



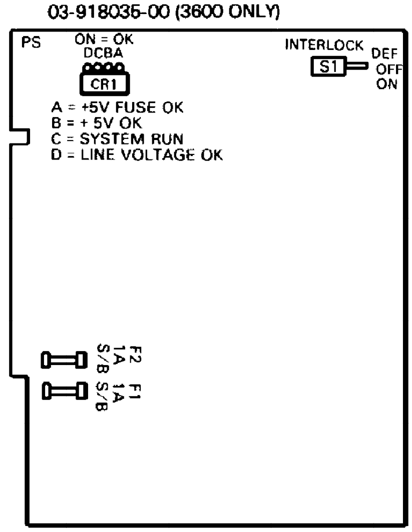
J7 TEMP. CONTROL PCB
03-918039-00 (3600 ONLY)



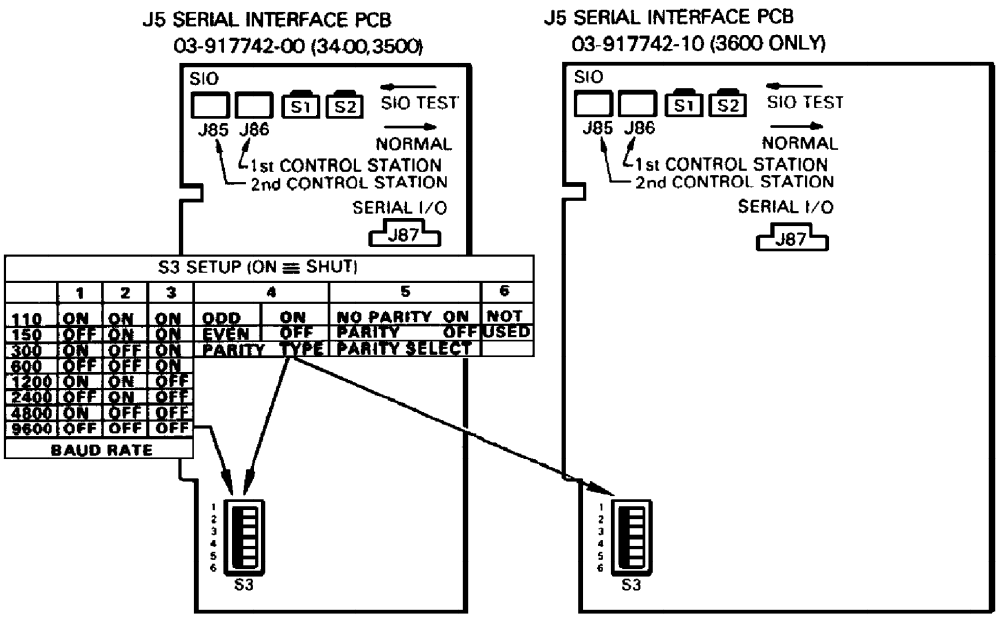
J6 POWER SUPPLY PCB
03-917720-00 (3300,3400,3500)



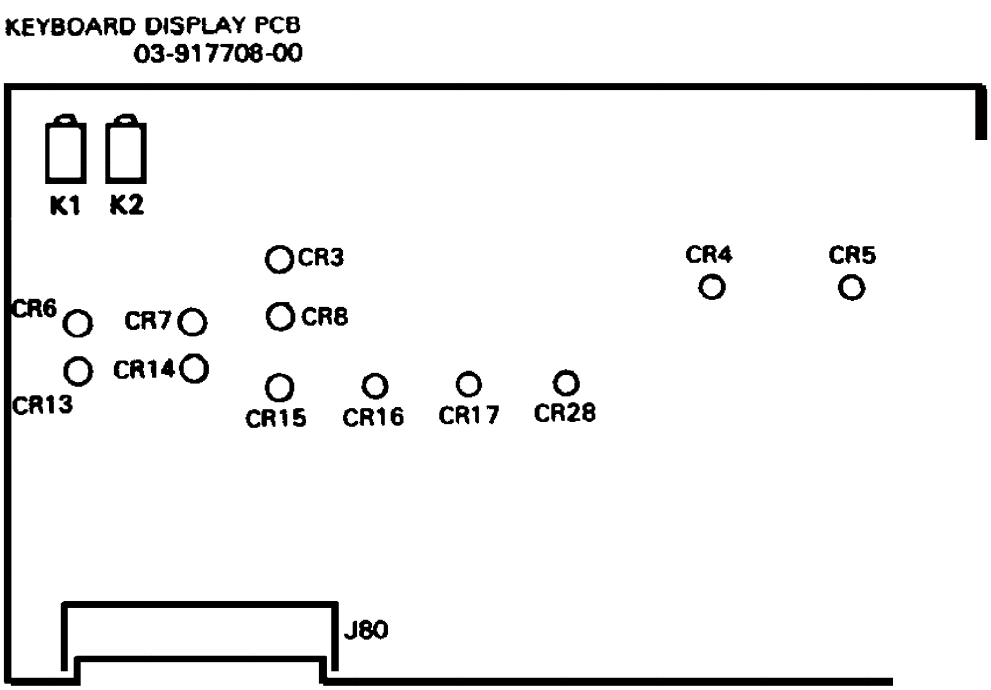
J6 POWER SUPPLY PCB
03-918035-00 (3600 ONLY)

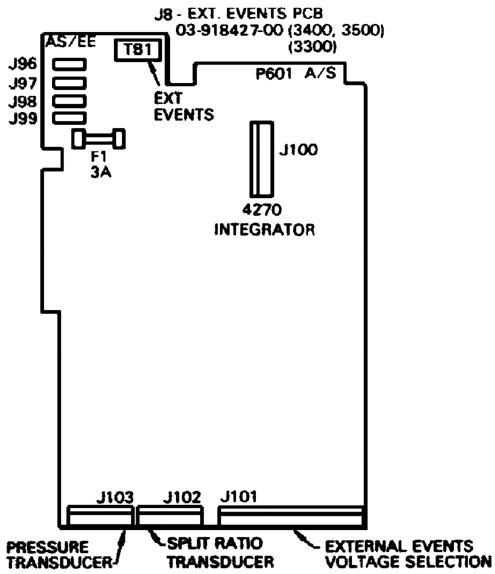


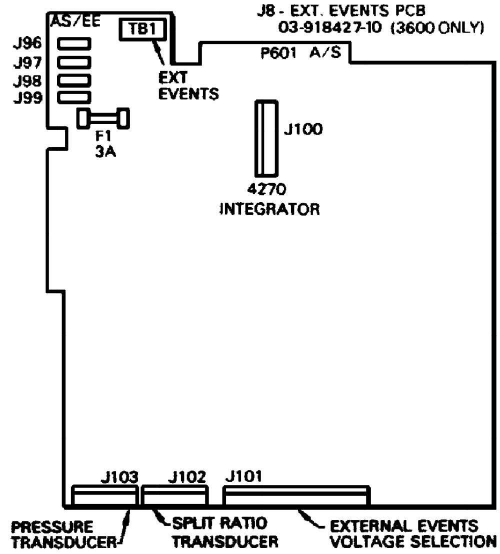
Electronic Hardware Locations (Continued)

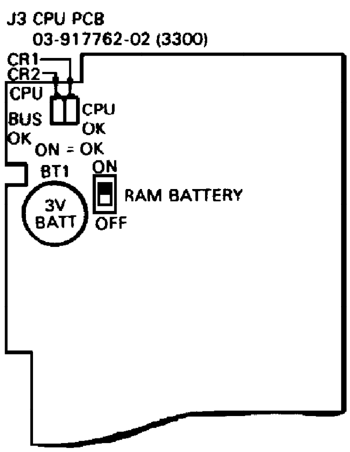


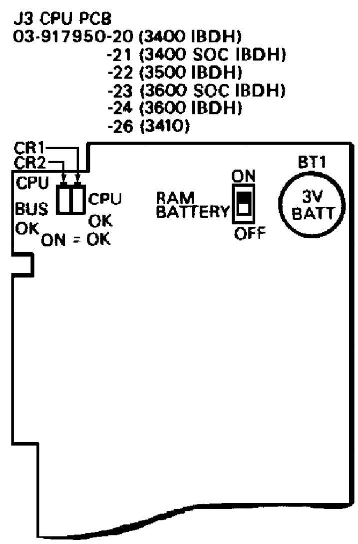
S3 SETUP (ON ≡ SHUT)								
	1	2	3	4		5		6
110	ON	ON	ON	ODD	ON	NO PARITY	ON	NOT
150	OFF	ON	ON	EVEN	OFF	PARITY	OFF	USED
300	ON	OFF	ON	PARITY	TYPE	PARITY SELECT		
600	OFF	OFF	ON					
1200	ON	ON	OFF					
2400	OFF	ON	OFF					
4800	ON	OFF	OFF					
9600	OFF	OFF	OFF					
BAUD RATE								

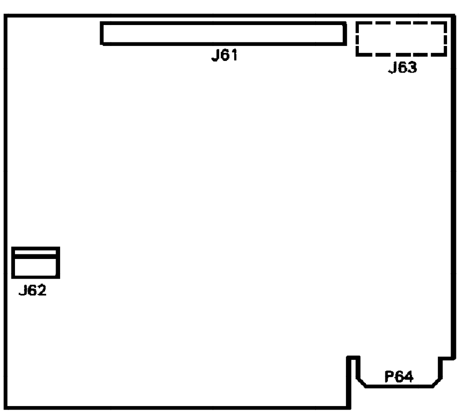




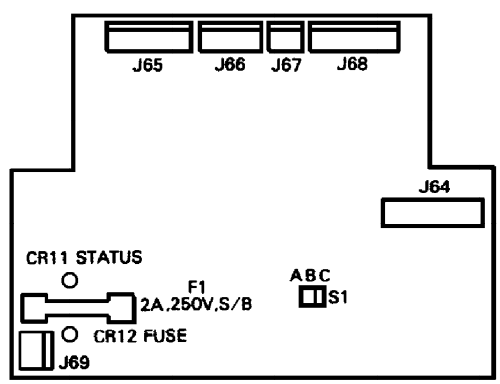




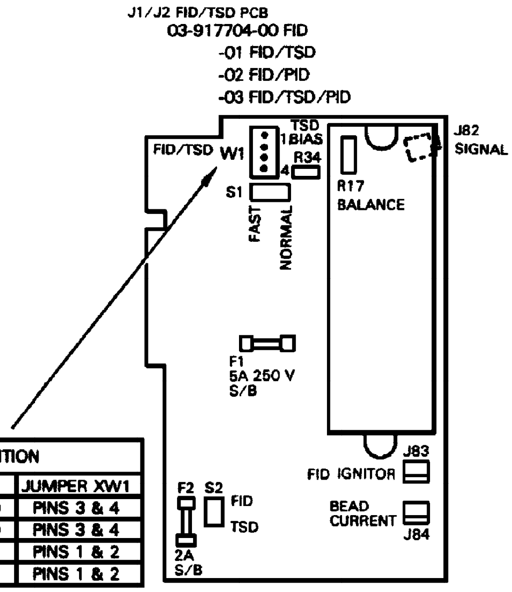




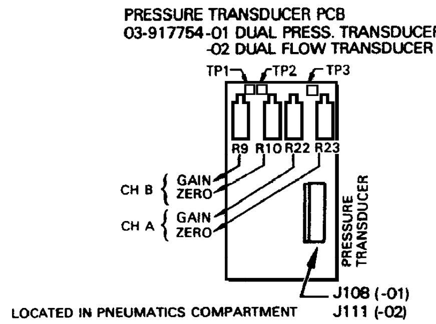
PCL/ADC PCB 03-917602-00



PRINTER/PLOTTER POWER SUPPLY PCB 03-917606-00



JUMPER POSITION		
DASH NO	W1	JUMPER XW1
-00	NON-PID	PINS 3 & 4
-01	NON-PID	PINS 3 & 4
-02	PID	PINS 1 & 2
-03	PID	PINS 1 & 2



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