Hardware Reference Manual
2-3-9000-757
JULY 2011

1500XA Gas Chromatograph

ROSEMOUNT® Analytical

EMERSON™ Process Management

NOTICE

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IMPORTANT INSTRUCTIONS

- Read all instructions prior to installing, operating, and servicing this product.
- Follow all warnings, cautions, and instructions marked on and supplied with this product.
- Inspect the equipment packing case and if damage exists, notify your local carrier for liability.
- Open the packing list and carefully remove equipment and spare or replacement parts from the case. Inspect all equipment for damage and missing parts.
- If items are damaged or missing, contact the manufacturer at 1 (713) 827-6314 for instructions about receiving replacement parts.
- Install equipment as specified per the installation instructions and per applicable local and national codes. All connections shall be made to proper electrical and pressure sources.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent personal injury.
- Use of this product for any purpose other than its intended purpose may result in property damage and/or serious injury or death.
- Before opening the flameproof enclosure in a flammable atmosphere, the electrical circuits must be interrupted.
- Repairs must be performed using only authorized replacement parts as specified by the manufacturer. Use of unauthorized parts can affect the product's performance and place the safe operation of the product at risk.
- When installing or servicing ATEX-certified units, the ATEX approval applies only to equipment without cable glands. When mounting the flameproof enclosures in a hazardous area, only flameproof cable glands certified to IEC 60079-1 must be used.
- Technical assistance is available 24 hours a day, 7 days a week by calling 1 (713) 827-6314.

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Section 1: Description

1.1 Purpose of this manual

The *1500XA Gas Chromatograph Hardware Reference Manual* (P/N 3-9000-757) is intended as a user's guide to accompany the 1500XA gas chromatograph system.

Note
For software operation instructions, see the *MON20/20 Software for Gas Chromatographs User Manual* (P/N 3-9000-745).

This manual provides the following information:

- Section 1 gives a general description of the 1500XA gas chromatograph (GC) system and its components, their configurations and functions. It also provides a brief introduction to GC operation theory and terminology.
- Section 2 gives guidelines for sampling system and gas connections, descriptions of the analyzer subsystems and components, and descriptions of the controller subsystems and components.
- Section 3 provides instructions for installing the GC hardware.
- Section 4 provides instructions for regular maintenance and care of the GC hardware as well as instructions for troubleshooting, repairing, and servicing the GC.
- Section 5 provides a list of boards, valves, and other components suggested as spare parts.

1.2 Introduction

The 1500XA is a high-speed GC that is factory engineered to meet specific field application requirements based on stream composition and the anticipated concentration of the components of interest. The GC typically consists of two major components, the analyzer assembly and the sample conditioning system:

- **Analyzer Assembly (XA Series)**

  Located near the sample tap in an environment-dependant shelter. The assembly includes columns, detectors, preamplifier, valves, solenoids, and the analyzer, which includes electronics and ports for signal processing, instrument control, data storage, personal computer (PC) interface, and telecommunications.

- **Sample Conditioning System (SCS)**

  Located between the process stream and the analyzer sample inlet, usually mounted on the lower portion of the analyzer stand. The standard configuration SCS includes a mounting plate, block (or shutoff) valves, and filters. Optionally, the SCS can be configured with Genie® bypass filters, liquid shut-off valves, and optional solenoids for stream switching; all of which can be enclosed in an electric (heat tape design) oven.

In its standard configuration, the 1500XA can handle multiple streams.

Although the 1500XA can be operated from the local operator interface (LOI), it is designed to be run primarily from a personal computer (PC) running MON 2020. The PC provides the user with the greatest capability, ease-of-use, and flexibility. One PC running MON 2020 can connect with multiple gas chromatographs over a local area network. The GC's Ethernet capability makes it possible to interact with the GC even if it is located in a hazardous area. The PC can be used to display chromatograms and reports, which can then be stored as files on the PC's hard drive.

1.3 Functional description

A sample of the gas to be analyzed is taken from the process stream by a sample probe installed in the process line. The sample passes through a sample line to the SCS where it is filtered or otherwise conditioned. After conditioning, the sample flows to the Analyzer Assembly for separation and detection of the gas components.

The chromatographic separation of the sample gas into its components is accomplished in the following manner. A precise volume of sample gas is injected into one of the analytical columns. The column contains a stationary phase (packing) that is either an active solid or an inert solid support that is coated with a liquid phase (absorption partitioning). The sample gas is moved through the column by means of a mobile phase (carrier gas). The selective retardation of the components takes place in the column, causing each component to move through the column at a different rate. This separates the sample into its constituent gases and vapors.

A detector located at the outlet of the analytical column senses the elution of components from the column and produces electrical outputs proportional to the concentration of each component.

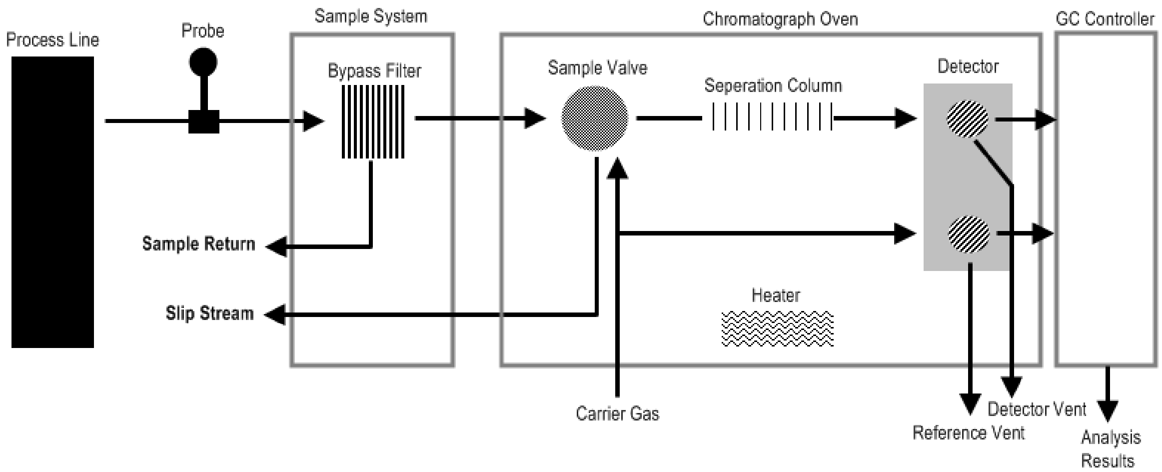
Note
For additional information, see "Software description" on page 1-4.

Output from the electronic assembly is normally displayed on a remotely located PC or a printer. Connection between the GC and the PC can be accomplished via a direct serial line, an optional ethernet cable, or via a Modbus-compatible communication interface.

Several chromatograms may be displayed via MON2020, with separate color schemes, allowing the user to compare present and past data.

In most cases it is essential to use MON2020 to configure and troubleshoot the GC. The PC may be remotely connected via ethernet, telephone, radio or satellite communications. Once installed and configured, the GC can operate independently for long periods of time.

Figure 1-1. Gas chromatography process model



1.4 Software description

The GC uses three distinct types of software. This enables total flexibility in defining the calculation sequence, printed report content, format, type and amount of data for viewing, control and/or transmission to another computer or controller assembly. The three types are:

- Embedded GC firmware
- Maintenance and operations software (MON2020)

The firmware is installed before the GC is shipped. Note that the hardware and the firmware are tested together as a unit before the equipment leaves the factory. MON2020 communicates with the GC and can be used to initiate site system setup (i.e., operational parameters, application modifications, and maintenance).

1.4.1 Embedded GC firmware

The GC's embedded firmware supervises operation of the GC through its internal microprocessor-based controller; all direct hardware interface is via this control software, which consists of a multi-tasking program that controls separate tasks in system operation, as well as hardware self-testing, user application downloading, start-up, and communications. Once configured, the GC can operate as a stand alone unit.

1.4.2 MON2020

MON2020 is a Windows-based program that allows the user to maintain, operate, and troubleshoot a gas chromatograph. Individual GC functions that can be initiated or controlled by MON2020 include, but are not limited to, the following:

- Valve activations
- Timing adjustments
- Stream sequences
- Calibrations
- Validations
- Baseline runs
- Analyses
- Halt operation
- Stream/detector/heater assignments
- Stream/component table assignments
- Stream/calculation assignments
- Diagnostics
- Alarm and event processing
- Event sequence changes
- Component table adjustments
- Calculation adjustments

- Alarm parameters adjustments
- Analog scale adjustments
- LOI variable assignments (optional)
- Foundation fieldbus variable assignments (optional)

Reports and logs that can be produced, depending upon the GC application in use, include, but are not limited to, the following:

- Configuration report
- Parameter list
- Analysis chromatogram
- Chromatogram comparison
- Alarm log (unacknowledged and active alarms)
- Event log
- Various analysis reports

For a complete list of the GC functions, reports, and logs available through MON2020, consult the software manual (P/N 2-3-9000-745).

MON2020 provides operator control of the GC, monitors analysis results, and inspects and edits various parameters that affect GC operation. It also controls display and printout of the chromatograms and reports, and it stops and starts automatic analysis cycling or calibration runs.

After the equipment/software has been installed and the operation stabilized, automatic operation can be initiated via an ethernet network.

1.5 Theory of operation

The following sections discuss the theory of operation for the GC, the engineering principles and the concepts used.

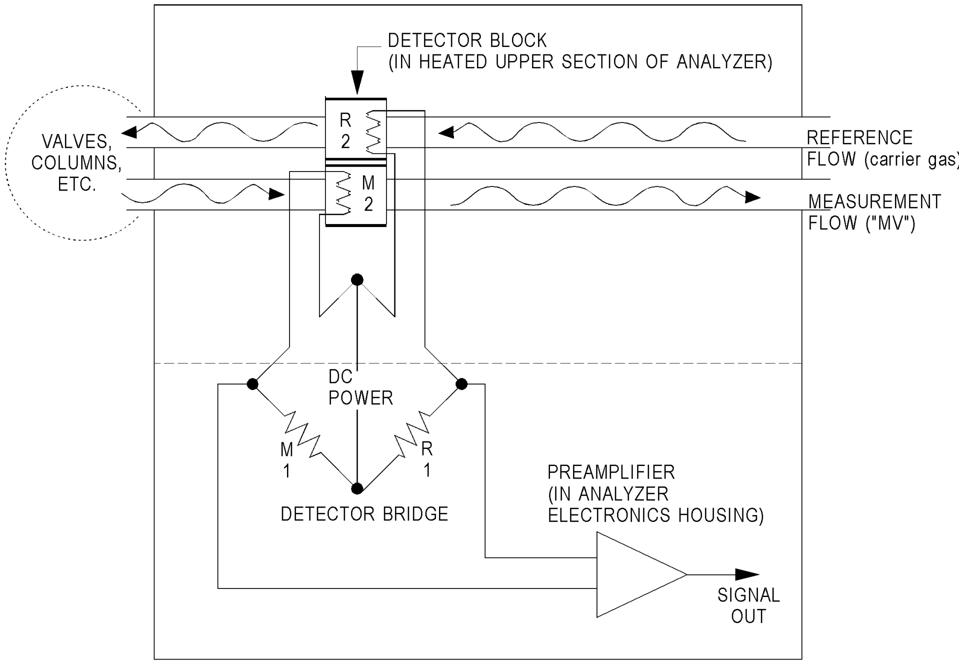
Note
See "Section 1.7: Glossary" for definitions of the terminology used in the following explanations.

1.5.1 Thermal conductivity detector

One of the detectors available on the GC is a thermal conductivity detector (TCD) that consists of a balanced bridge network with heat sensitive thermistors in each leg of the bridge. Each thermistor is enclosed in a separate chamber of the detector block.

One thermistor is designated the reference element and the other thermistor is designated the measurement element. See Figure 1-2 for a schematic diagram of the thermal conductivity detector.

Figure 1-2. Analyzer assembly with TCD bridge



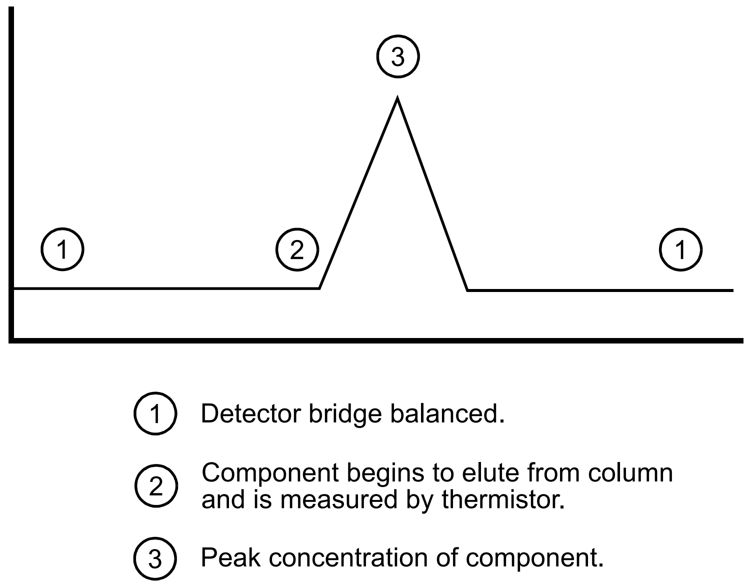
In the quiescent condition, prior to injecting a sample, both legs of the bridge are exposed to pure carrier gas. In this condition, the bridge is balanced and the bridge output is electrically nulled.

The analysis begins when the sample valve injects a fixed volume of sample into the column. The continuous flow of carrier gas moves the sample through the column. As successive components elute from the column, the temperature of the measurement element changes.

The temperature change unbalances the bridge and produces an electrical output proportional to the component concentration.

The differential signal developed between the two thermistors is amplified by the preamplifier. Figure 1-3 illustrates the change in detector electrical output during elution of a component.

Figure 1-3. Detector output during component elution



In addition to amplifying the differential signal developed between the two thermistors, the preamplifier supplies drive current to the detector bridge.

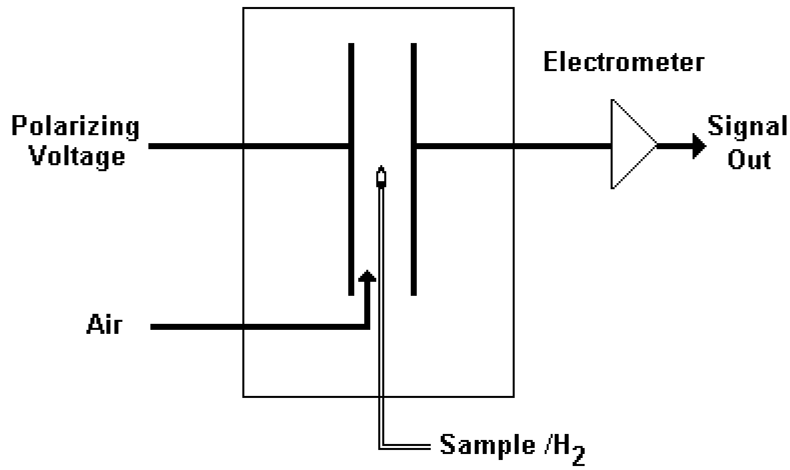
The signal is proportional to the concentration of a component detected in the gas sample. The preamplifier provides four different gain channels as well as compensation for baseline drift.

The signals from the preamplifier are sent to the electronic assembly for computation, recording on a printer, or viewing on a PC monitor with MON2020.

1.5.2 Flame ionization detector

The other detector available for the GC is the flame ionization detector (FID). The FID requires a polarization voltage and its output is connected to the input to a high impedance amplifier that is called an electrometer. The burner uses a mixture of hydrogen and air to maintain the flame. The sample of gas to be measured is also injected into the burner. See Figure 1-4 for a schematic diagram of the FID.

Figure 1-4. Analyzer assembly with FID detector bridge



1.5.3 Data acquisition

Every second, exactly 50 equally spaced data samples are taken (i.e., one data sample every 20 milliseconds) for analysis by the GC.

As a part of the data acquisition process, groups of incoming data samples are averaged together before the result is stored for processing. Non-overlapping groups of N samples are averaged and stored, and thus reduce the effective incoming data rate to $40/N$ samples per second. For example, if $N = 5$, then a total of 40/5 or 8 (averaged) data samples are stored every second.

The value for the variable N is determined by the selection of a Peak Width parameter (PW). The relationship is

$$N = PW$$

where PW is given in seconds. Allowable values of N are 1 to 63; this range corresponds to PW values of 2 to 63 seconds.

The variable N is known as the integration factor. This term is used because N determines how many points are averaged, or integrated, to form a single value. The integration of data upon input, before storing, serves two purposes:

- The statistical noise on the input signal is reduced by the square root of N. In the case of $N = 4$, a noise reduction of two would be realized.
- The integration factor controls the bandwidth of the chromatograph signal. It is necessary to match the bandwidth of the input signal to that of the analysis algorithms in the controller assembly. This prevents small, short-duration perturbations from being recognized as true peaks by the program. It is therefore important to choose a Peak Width that corresponds to the narrowest peak in the group under consideration.

1.5.4 Peak detection

For normal area or peak height concentration evaluation, the determination of a peak's start point and end point is automatic. The manual determination of start and end points is used only for area calculations in the Forced Integration mode. Automatic determination of peak onset or start is initiated whenever Integrate Inhibit is turned off. Analysis is started in a region of signal quiescence and stability, such that the signal level and activity can be considered as baseline values.

Note
The controller assembly software assumes that a region of signal quiescence and stability will exist.

Having initiated a peak search by turning Integrate Inhibit off, the controller assembly performs a point by point examination of the signal slope. This is achieved by using a digital slope detection filter, a combination low pass filter and differentiator. The output is continually compared to a user-defined system constant called Slope Sensitivity. A default value of 8 is assumed if no entry is made. Lower values make peak onset detection more sensitive, and higher values make detection less sensitive. Higher values (20 to 100) would be appropriate for noisy signals, e.g. high amplifier gain.

Onset is defined where the detector output exceeds the baseline constant, but peak termination is defined where the detector output is less than the same constant.

Sequences of fused peaks are also automatically handled. This is done by testing each termination point to see if the region immediately following it satisfies the criteria of a baseline. A baseline region must have a slope detector value less than the magnitude of the baseline constant for a number of sequential points. When a baseline region is found, this terminates a sequence of peaks.

A zero reference line for peak height and area determination is established by extending a line from the point of the onset of the peak sequence to the point of the termination. The values of these two points are found by averaging the four integrated points just prior to the onset point and just after the termination points, respectively.

The zero reference line will, in general, be non-horizontal, and thus compensates for any linear drift in the system from the time the peak sequence starts until it ends.

In a single peak situation, peak area is the area of the component peak between the curve and the zero reference line. The peak height is the distance from the zero reference line to the maximum point on the component curve. The value and location of the maximum point is determined from quadratic interpolation through the three highest points at the peak of the discrete valued curve stored in the controller assembly.

For fused peak sequences, this interpolation technique is used both for peaks, as well as, valleys (minimum points). In the latter case, lines are dropped from the interpolated valley points to the zero reference line to partition the fused peak areas into individual peaks.

The use of quadratic interpolation improves both area and height calculation accuracy and eliminates the effects of variations in the integration factor on these calculations.

For calibration, the controller assembly may average several analyses of the calibration stream.

1.6 Basic analysis computations

Two basic analysis algorithms are included in the controller assembly:

- Area Analysis – calculates area under component peak
- Peak Height Analysis – measures height of component peak

Note
For additional information about other calculations performed, see the MON2020 user manual.

1.6.1 Concentration analysis - response factor

Concentration calculations require a unique response factor for each component in an analysis. These response factors may be manually entered by an operator or determined automatically by the system through calibration procedures (with a calibration gas mixture that has known concentrations).

The response factor calculation, using the external standard, is:

$$ARF_n = \frac{Area_n}{Cal_n} \quad \text{or} \quad HRF_n = \frac{Ht_n}{Cal_n}$$

where

ARF_n	area response factor for component "n" in area per mole percent
$Area_n$	area associated with component "n" in calibration gas
Cal_n	amount of component "n" in mole percent in calibration gas
Ht_n	peak height associated with component "n" mole percent in calibration gas
HRF_n	peak height response factor for component "n"

Calculated response factors are stored by the controller assembly for use in the concentration calculations, and are printed out in the configuration and calibration reports.

Average response factor is calculated as follows:

$$RFAVG_n = \frac{\sum_{i=1}^{k} RF_i}{k}$$

where

$RFAVG_n$	area or height average response factor for component “n”
RF_i	area or height average response factor for component “n” from the calibration run
k	number of calibration runs used to calculate the response factors

The percent deviation of new *RF* averages from old *RF* average is calculated in the following manner:

$$deviation = \left[\frac{RF_{new} - RF_{old}}{RF_{old}} \times 100\right]$$

where the absolute value of percent deviation has been previously entered by the operator.

1.6.2 Concentration calculation - mole percentage (without normalization)

Once response factors have been determined by the controller assembly or entered by the operator, component concentrations are determined for each analysis by using the following equations:

$$CONC_n = \frac{Area_n}{ARF_n} \quad \text{or} \quad CONC_n = \frac{Ht_n}{HRF_n}$$

where

ARF_n	Area response factor for component "n" in area per mole percent.
$Area_n$	Area associated with component "n" in unknown sample.
$CONC_n$	Concentration of component "n" in mole percent.
Ht_n	Peak height associated with component "n" mole percent in unknown sample.
HRF_n	Peak height response factor for component "n".

Component concentrations may be input through analog inputs 1 to 4 or may be fixed. If a fixed value is used, the calibration for that component is the mole percent that will be used for all analyses.

1.6.3 Concentration calculation in mole percentage (with normalization)

The normalized concentration calculation is:

$$CONCN_n = \frac{CONC_n}{\sum_{i=1}^{k} CONC_i} \times 100$$

where

$CONCN_n$	Normalized concentration of component “n” in percent of total gas concentration.
$CONC_i$	Non-normalized concentration of component “n” in mole percent for each “k” component.
$CONC_n$	Non-normalized concentration of component “n” in mole percent.
k	Number of components to be included in the normalization.

Note
The average concentration of each component will also be calculated when data averaging is requested.

1.7 Glossary

Auto zero

Automatic zeroing of the TCD preamplifier can be configured to take place at any time during the analysis if the component is not eluting or the baseline is steady.

The FID will auto zero at each new analysis run and can be configured to auto zero anytime during the analysis if the component is not eluting or the baseline is steady. The TCD is only auto zeroed at the start of a new analysis.

Baseline

Signal output when there is only carrier gas going across the detectors. In a chromatogram you should only see Baseline when running an analysis without injecting a sample.

Carrier gas

The gas used to push the sample through the system during an analysis. In C6+ analysis we use Ultra Pure (zero grade) Carrier Gas for the carrier. This gas is 99.995 percent pure.

Chromatogram

A permanent record of the detector output. A chromatograpm is obtained from a PC interfaced with the detector output through the controller assembly. A typical chromatogram displays all component peaks, and gain changes. It may be viewed in color as it is processed on a PC VGA display. Tick marks recorded on the chromatogram by the controller assembly indicate where timed events take place.

Component

Any one of several different gases that may appear in a sample mixture. For example, natural gas usually contains the following components: nitrogen, carbon dioxide, methane, ethane, propane, isobutane, normal butane, isopentane, normal pentane, and hexanes plus.

Condulet

A box with a removable cover providing access to wiring in conduit (conduit outlet) that is part of an optional cable entry package.

CTS

Clear to send.

DCD

Data carrier detect.

DSR

Data set ready.

DTR

Data terminal ready.

FID

Flame ionization detector. The optional FID may be used in place of a TCD for the detection of trace compounds. The FID requires a polarization voltage and its output is connected to the input to a high impedance amplifier, an electrometer. The sample of gas to be measured is injected into the burner with a mixture of hydrogen and air to maintain the flame.

Foundation Fieldbus

A digital, two-way, multi-drop communcation link among automation systems and intelligent field devices from different manufacturers that allows the devices to be connected to a network and to interact with each other and with the hosts.

LSIV

Liquid sample injection valve. The optional LSIV is used to convert a liquid sample to a gas sample by vaporizing the liquid in a heated chamber, then analyzing the flashed sample.

Methanator

The optional methanator, also known as a catalytic converter, transforms otherwise undetectable carbon dioxide and/or carbon monoxide into methane by adding hydrogen and heat to the sample.

Response factor

Correction factor for each component as determined by the following calibration:

$$RF = \frac{RawArea}{CalibrationConcentration}$$

Retention time

Time, in seconds, that elapses between the start of analysis and the sensing of the maximum concentration of each component by the detector.

RI

Ring indicator.

RLSD

Received line signal detect. A digital simulation of a carrier detect.

RTS

Request to send.

RxD, RD, or S_{in}

Receive data, or signal in.

TCD

Thermal conductivity detector. A detector that uses the thermal conductivity of the different gas components to produce an unbalanced signal across the bridge of the preamplifier. The higher the temperature, the lower the resistance on the detectors.

TxD, TD, or S_{out}

Transmit data, or signal out.

Section 2: Equipment description and specifications

The 1500XA gas chromatograph combines the proven analytical components of the 700XA gas chromatograph with the larger oven capacity and flexibility of a traditional air-bath oven design.

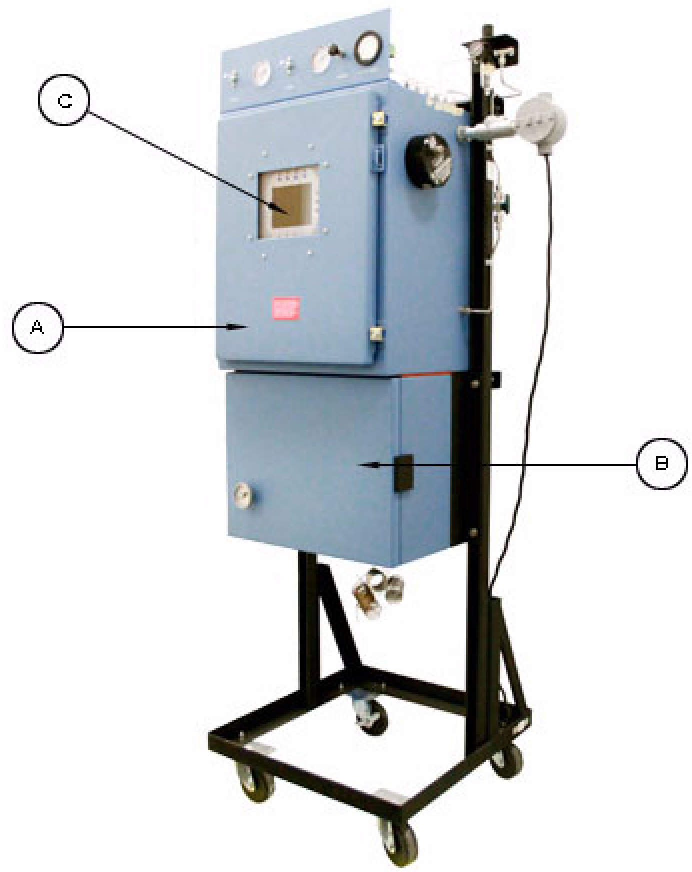
This section describes the various subsystems and components that make up the GC gas chromatograph. It also details the GC's equipment specifications.

2.1 Equipment description

The 1500XA consists of an electronics enclosure mounted above an air bath oven. The electronics enclosure houses the GC's electrical and electronic components such as the CPU board and the power supply. The oven houses the analyzer components such as the valves and the columns.

This GC is designed for hazardous locations.

Figure 2-1. The 1500XA



A. Electronics enclosure
B. Air bath oven
C. LOI

2.1.1 The electronics enclosure

The electronics enclosure contains the card cage assembly and the local operator interface. The enclosure may also contain an optional AC/DC power supply.

The local operator interface

The local operator interface (LOI) is mounted on the door of the electronics enclosure. The LOI has a state of the art, high resolution color display that is touch key activated and that allows you to operate the 1500XA without a laptop or a PC.

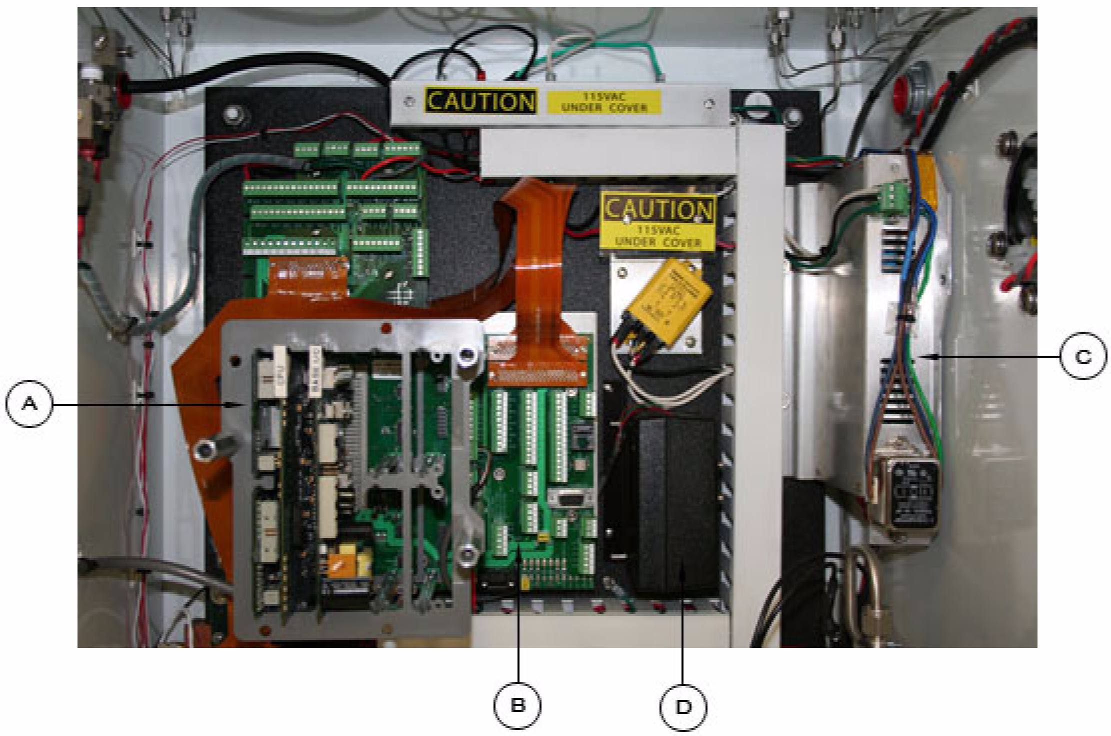
The LOI includes the following features:

- Color LCD with VGA (640 x 480 pixels) resolution.
- ASCII text and graphics modes.
- Adjustable auto-backlighting.
- 8 infrared-activated touch screen keys that eliminate the requirement for a magnetic pen.
- Complete GC status, control and diagnostics, including full chromatogram display.

See Appendix A for more information about operating an LOI.

The electronics assembly

Figure 2-2. The electronics assembly components



The electronics assembly contains the following components:

A. Card cage, which contains the following boards and slots
   - CPU board
   - Base I/O board
   - Heater/solenoid driver board
   - Detector preamp board
   - ROC slots
   - Two expansion slots—one for an additional heater/solenoid board, and one for an additional detector preamp board.

B. Backplane/field termination board

C. AC/DC power supply converter

D. Optional Foundation Fieldbus module

Pressure switch

The pressure switch activates when the carrier pressure falls below a predetermined setpoint. When activated, the switch triggers a general alarm that displays on the LOI and in MON 2020.

Mechanical pressure regulators

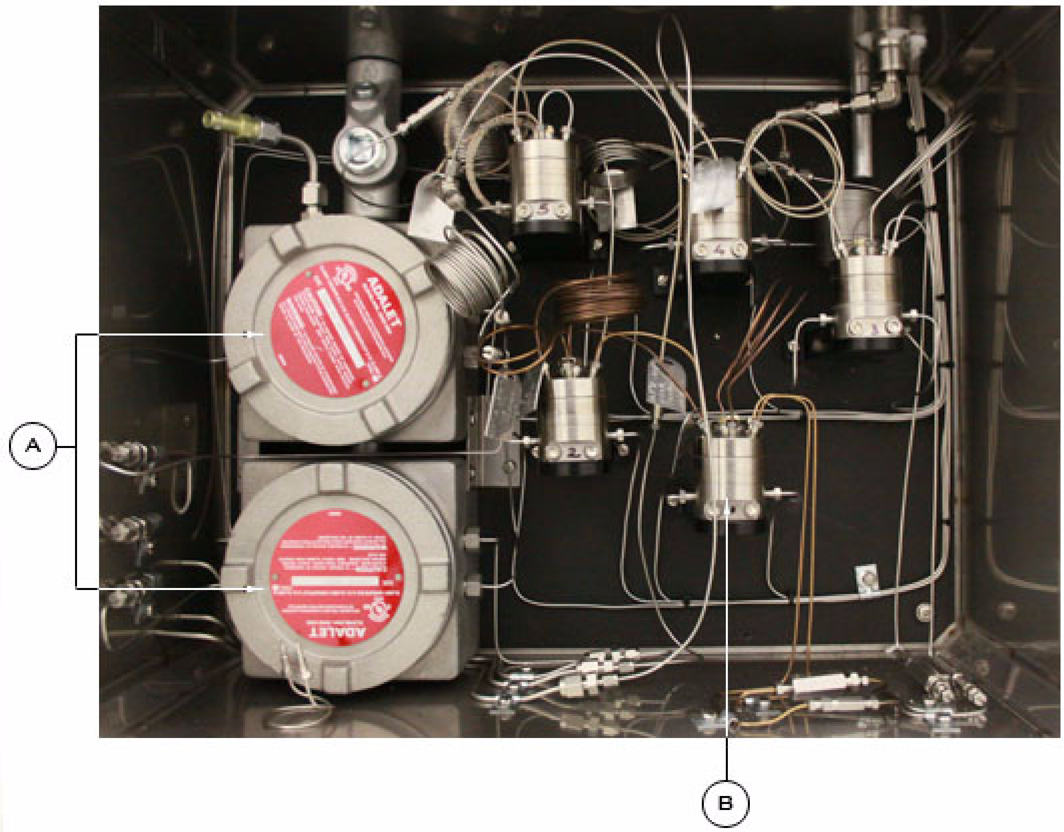
The mechanical pressure regulators and gauges are used to set and monitor the pressure of the carrier gas flow through the GC's columns, as well as the pressure of the FID air and fuel (H_2), if installed.

The regulators and gauges are typically located on the top or side of the electronics enclosure.

2.1.2 The air bath oven

The air bath oven uses a conventional instrument air heater design for maximum analytical flexibility. The oven has capacity for up to eight chromatograph valves. There is also the capacity to install liquid sample valves for heavier samples. The oven can operate at temperatures up to 150° C (300° F) as the application dictates.

Figure 2-3. Components that are housed in the air bath oven



A. Explosion-proof detector housings
B. Valves

The air bath oven contains the valves, the stream switching system, and the solenoid assemblies.

A more detailed component list for the upper compartment includes the following:

- **Valves**. There are two types of XA valves: 6-port and 10-port. A 700XA can have a maximum of four XA valves consisting of any combination of the two types.
- **Column module**. Either capillary or micro-packed.

- **Thermal conductivity detector (TCD)**. The 700XA has a minimum of one TCD and a maximum of two TCDs.
- **Two column heaters**.
- **One temperature switch for each heating element**. The switch turns off its heating element if the heating element reaches 257° F (160° C).
- **Pressure switch**. The pressure switch activates when the carrier pressure falls below a predetermined setpoint. When activated, the switch triggers a general alarm that displays on the front panel or LOI and in MON20/20.
- **Flame ionization detector (FID)**. The optional flame ionization detector can be used in place of a TCD for the detection of trace levels of compounds.
- **Flame photometric detector (FPD)**. The optional flame photometric detector can be used in place of a TCD for the detection of trace levels of sulphur compounds. For more information, see the Flame Photometric Detector Module for Model 500 and 700 Gas Chromatographs Hardware Reference manual, which is available at the Daniel Web site.
- **Methanator**. The optional methanator, which is also known as the catalytic converter, converts otherwise undetectable carbon dioxide and/or carbon monoxide into methane by adding hydrogen and heat to the sample.
- **Liquid sample injection valve (LSIV)**. The optional liquid sample injection valve is used to convert a liquid sample to a gas sample, expanding the GC's capability by allowing it to measure liquids. A measured sample is placed in a heated chamber above the vaporization point of the liquid and then it is flashed to a gas. Once vaporized, the sample is pushed by the carrier gas through the heated tubing into the column train.

2.1.3 Sampling system

A well designed, properly adjusted sampling system is essential to optimum performance of any gas chromatograph. If a good sample is *not* obtained for analysis, the whole purpose of the system is compromised.

The purpose of the sample handling system is to transfer a conditioned fluid sample that is compatible with gas chromatography requirements.

The sample conditioning system (SCS) is located between the process stream and the analyzer, and is usually mounted beneath the air bath oven. It serves these purposes:

- Extracts final sample from the fast loop.
- Performs final filtration.
- Performs stream switching for a multi-stream analyzer.
- Adjusts the final pressure, temperature, and flow control on the selected sample flowing to the sample valve.

The following points should be considered in selecting and installing a sampling system:

- Sample point
- Sample volume and flow rate
- Sample conditioning
- Contamination precautions
- Valving
- Calibration gas

Sampling point location

Gas samples must be representative of the process stream and must be taken from a location where stratification or separation of components does not occur. The sampling point should be as close as feasible to the analyzer.

Sample volume and flow rate

An adequate response time for sample analysis requires that sample volumes should generally be as small as possible, and the flow rate between the sampling point and the analyzer should be as high as possible, consistent with accuracy. To minimize time lag and to prevent back diffusion, dryers and filters in the sampling line should be as small as possible. When long sampling lines cannot be avoided, flow velocity in the line can be increased by decreasing the downstream pressure.

Typically, pressure is reduced at the sample point with a pressure regulating sample probe. The input pressure to the analyzer can be adjusted between 15 and 30 pounds per square inch, gauge (psig). Reducing the pressure at the sample point avoids the problem of heavy liquid dropout in the sample line during cold weather. The flow rate in the sample line is set at 15 cubic centimeters (cc) per minute with a flow restrictor valve in the analyzer.

The GC is capable of accepting liquid phase samples also. In this case, the pressure is regulated by means of a back pressure regulator located on the SCS mounting plate.

If the stream is at ambient pressure or under slight vacuum, an eductor or pump may be used to force sample through the sample loop. In this situation, sample shut-off technique with equalizing coil is employed to ensure consistency of the sample volume.

Use this general rule to approximate sample lag time caused by the length of sample line:

$$\text{lag time} = \frac{(\text{length of sample tubing})(\text{volume of sample per foot})}{\text{flow rate of sample}}$$

For example, a sample line constructed of 1/8-inch tubing contains approximately one cubic centimeter of volume per foot. Therefore, with a flow rate of 15 cubic centimeters per minute, the lag time of the sample between the sample point and the analyzer is calculated by dividing the length of the line, in feet, by 15.

$$\text{lag time} = \frac{(100\ \text{ft})(1\ \text{cc of sample / foot})}{15\ \text{cc / minute}} = 6.67\ \text{minutes}$$

Therefore, the sample in a 100-foot sample line would take almost seven minutes to travel the length of the line.

Sample conditioning

Sample systems should contain at least one filter to remove solid particles from the sample stream. All applications require **5-micron** fine-element filters upstream of the analyzer.

Contamination precautions

Several precautions are recommended to minimize the possibility of contaminating samples. Except in special applications, filters should be of either the ceramic or the porous metallic type to avoid the absorption losses characteristic of fiber or paper filters. Pressure regulators and flow controllers containing cork or felt filters or absorbent diaphragms should not be used. Sampling lines for noncorrosive streams should be stainless steel tubing and must be clean and free of grease. Lines must be pressure tight to prevent diffusion of moisture or atmospheric gases into the sample. Pipe threads should be dressed only with Teflon tape on pipe threads and never with pipe thread compounds (dope).

Valving

A block valve should be installed immediately downstream of the sample takeoff point to permit shutdown of the system for maintenance. Block valves should be rated for the process line pressure. Tight seating of all connections is essential.

Calibration gas

A calibration gas used for process analysis should be blended to Primary Standards, which are blended using weights that are traceable to a recognized standards body. If the calibration standard is a gas, the standard should not have any component that could drop out at the coldest temperature to which the gas will be subjected.

If a liquid calibration standard is being used, the head pressure must be sufficient to prevent bubble-out of components.

2.2 Equipment specifications

Use the following table to determine the utility specifications.

Table 2-1. 1500XA unit specifications

Type	Specification
Dimensions (without sampling system)	198cm H x 61cm W x 61cm D (78" H x 24" W x 24" D)(mounted on stand)
Weight (without sampling system)	Approximately 68 kg. (150 lbs.)
Mounting	• Wall mount (Standard) • Free-standing (Optional)
Power	115 VAC ±15%, 220 VAC ±15%, 50/60 Hz 400 watts running, 1100 watts start-up
Instrument air	• 4 SCFM at 40 psig of oil-free instrument air for purge and oven heat
Valve actuation	• 90 psig for valve actuation
Environment	0° to 55°C (32° to 130°F) for TCD and FID; 20°C ± 5°C (70°F ± 10°F) for FPD
Area Classification Options (Hardware dependent)	Designed to meet Class I, Div. 1, Groups B, C, D with X-Purge; Class I Div. 2, Groups B, C, D with Z-Purge

2.2.1 Electronic hardware

Use the following table to determine the electronic hardware specifications:

Table 2-2. Electronic hardware specification

Type	Specification
Communication ports	2 Ethernet ports
Analog inputs	2, isolated on the backplane
Standard analog outputs	6, isolated on the backplane
Optional analog outputs	8, with optional expansion slots, isolated
Discrete digital inputs	5, on the backplane
Discrete digital outputs	5 relay "Form C" contacts on the backplane; relay contact rating of 24 VDC nominal @ 1 Amp
Transient protection	Over-voltage category II

2.2.2 Oven components

The following table lists the specifications for the components that are housed in the air bath oven.

Table 2-3. Oven assembly specifications

Type	Specification
Valves	6-port and 10-port valves; piston-operated diaphragms with pneumatic actuation
Columns	Supports packed, micro-packed and capillary columns.
Solenoid actuation	• 24 VDC • 80 - 120 PSI
Wetted parts	316 stainless steel and Kapton® diaphragm
Temperature	Maximum oven operating temperature of 150 °C (302 °F).

2.2.3 Software

The following table lists the specifications for the GC's software.

Table 2-4. Software specifications

Type	Specification
Software	PC-based MON2000.
Firmware	Embedded firmware.
Methods	4 Timed Event tables and 4 Component Data tables assignable to each stream.
Peak Integration	• Fixed time or auto slope and peak identification. • Update retention time upon calibration or during analysis.

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Section 3: Installation and setup

This section provides instructions for installing and setting up the 1500XA.

Note
Because the 1500XA is available in different configurations, it is possible that not all of the instructions in this section apply to your particular GC. In most cases, however, to install and set up a 1500XA, it is recommended that you follow the instructions in the same order as presented in this manual.

3.1 Precautions and warnings

Note
The analyzer electronics and oven assembly, when housed inside a purged enclosure, meet the certifications and classifications identified in Table 2-1, "1500XA unit specifications," on page 11. Emerson Process Management does not, however, accept any responsibility for installations of these, or any attached equipment, in which the installation or operation thereof has been performed in a manner that is negligent and/or non-compliant with applicable safety requirements.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Install and operate all equipment as designed and comply with all safety requirements. The "Seller" does not accept any responsibility for installations of the 700XA, or any attached equipment, in which the installation or operation thereof has been performed in a manner that is negligent and/or non-compliant with applicable safety requirements.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

If the unit is not operated in a manner recommended by the manufacturer, the overall safety could be impaired.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

The unit is intended to be connected to supply mains by qualified personnel in accordance with local and national codes.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

A suitable APPROVED switch and fuse or a circuit breaker shall be provided to facilitate the disconnection of mains power.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

The unit is required to be used in a well ventilated area.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

All gas connections must be properly leak tested at installation.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

No user replaceable part inside except a few parts that are only allowed to be accessed by trained service personnel.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Exit ports may discharge dangerous levels of toxic vapors; use proper protection and a suitable exhaust device.

CAUTION

Waste electrical and electronic products must not be disposed of with household waste. Please recycle where facilities exist. Check with your local authority or retailer for recycling advice.

Note

The 1500XA is field-certified. See the certification tag on the GC for specific details about these agency approvals.

3.1.1 Hazardous environments

Follow these precautions if installing or operating the GC in a hazardous area:

- Install and operate only the purged version of the GC in a hazardous area.
- Do not operate a personal computer in a hazardous area. To interface with a GC in a hazardous area, use a PC that is remotely connected to the GC and that is located in a nonhazardous area.
- Ensure that field connections to the analyzer and the GC are made through purged conduit or flameproof glands.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Observe all applicable regulations when installing purged GC units. Failure to observe all regulations when installing purged GC units may result in noncompliance, equipment damage or personal injury.

The purged analyzer housing is designed for use in locations where fire and explosion hazards may exist, specifically, areas that are classified by the National Electronics Code (NEC) as Class I, Division 2, Group B, C, and D. However, other regulations do apply. For example, all interconnecting runs of cable through conduit must be sealed at least 18 inches beyond the conduit's point of entry into certified purged housing. Consult your company's policies and procedures and other applicable requirements documents to determine appropriate wiring and installation practices.

3.2 Gas chromatograph wiring

3.2.1 Power source wiring

Follow these precautions when installing AC power source wiring to GC:

- All wiring must conform to the NEC, local state or other jurisdiction, and company standards and practices.
- Provide single-phase, three-wire power at 120 or 240 VAC, 50-60 Hertz.

Note
You cannot use a three-phase AC power source with the 1500XA; the transformer cannot support the current load.

Note
If you do not have a single phase, three-wire AC power source, you must purchase an isolation transformer. Refer to Drawing #CE19492E1 at the back of the manual for more information.

- Include a switch or circuit breaker that is marked as the power disconnect device in the building installation in a safe area.
- Provide appropriate circuit breaker protection so that the major components of the GC are protected by one circuit breaker.
- Use multi-stranded copper conductor wire according to your local codes and requirements.

3.2.2 Signal wiring

Follow these general precautions for field wiring digital and analog input/ output (I/O) lines:

- Metal conduit must be used for all process signal wiring.
- Metal conduit used for process signal wiring must be grounded at conduit support points (grounding the conduit at multiple points helps prevent induction of magnetic loops between the conduit and cable shielding).
- Use suitable lubrication for wire pulls in conduit to prevent wire stress.
- All process signal wiring should be a single, continuous length between field devices and the GC. If, however, length or conduit runs require that multiple wiring pulls be made, the individual conductors must be interconnected with suitable terminal blocks.
- Use separate conduits for AC voltage and DC voltage circuits.
- Do not place digital or analog I/O lines in same conduit as AC power circuits.
- Use only shielded cable for digital I/O line connections.
- Ground the shield at only one end.
- Shield-drain wires must not be more than two AWG sizes smaller than the conductors for the cable.
- When inductive loads (relay coils) are driven by digital output lines, the inductive transients must be diode clamped directly at the coil.
- Any auxiliary equipment wired to the GC must have its signal common isolated from earth/chassis ground.

Note
Any loop of extra cable left for service purposes inside the GC purged housing must not be placed near the conduit entry for AC power. This applies to all digital and analog I/O lines connecting to the GC. If the above precaution is not followed, the data and control signals to and from the GC can be adversely affected.

3.2.3 Electrical and signal ground

Follow these general precautions for grounding electrical and signal lines:

- For shielded signal conducting cables, shield-drain wires must not be more than two AWG sizes smaller than the conductors for the cable. Shielding is grounded at only one end.
- Metal conduit used for process signal wiring must be grounded at conduit support points (intermittent grounding of conduit helps prevent induction of magnetic loops between the conduit and cable shielding).
- A dedicated ground lug is located inside the GC's electronics enclosure on the back wall. Chassis ground conductors (color code green) inside the electronics enclosure should be stranded, insulated copper wire. These device chassis ground conductors should all be connected to the dedicated ground lug.
- A dedicated ground lug is located on the outside of the GC's case. This ground point should be connected to a copper ground rod as described in the next bulleted item.
- A single-point ground (the outside case ground lug) must be connected to a copper-clad, 10-foot long, 0.75-inch diameter steel rod that is buried, full-length, vertically into the soil as close to the equipment as is practical. (Grounding rod furnished by others.)
- Resistance between the copper-clad steel ground rod and the earth ground must not exceed 25 ohms.
- The equipment-grounding conductors used between the GC and the copper-clad steel ground rod must be sized according to the following specifications:
    - Length, 15 feet or less- AWG 8, stranded, insulated copper wire (4.6 meters)
    - Length, 15 to 30 feet-AWG 6, stranded, insulated copper wire (4.6 to 9.1 meters)
    - Length, 30 to 100 feet-AWG 4, stranded, insulated copper wire (9.1 to 30.5 meters)

- All inter-enclosure equipment-grounding conductors must be protected by metal conduit.
- External equipment, such as data printers, that are connected to the GC should be powered via isolation transformers to minimize the ground loops caused by the internally shared safety and chassis grounds.

3.2.4 Electrical conduit

Follow these general precautions for conduit installation:

- Conduit cutoffs must be square. Cutoffs must be made by a cold cutting tool, hacksaw, or by some other approved means that does not deform the conduit ends or leave sharp edges.
- All conduit fitting threads, including factory-cut threads, must be coated with a metal-bearing conducting grease, such as Crouse-Hinds STL or equivalent, prior to assembly.
- Temporarily cap the ends of all conduit run runs immediately after installation to prevent accumulation of water, dirt, or other contaminants. If necessary, swab out conduits prior to installing the conductors.
- Install drain fittings at the lowest point in the conduit run; install seals at the point of entry to the GC's purged housing to prevent vapor passage and accumulation of moisture.
- Use liquid-tight conduit fittings for conduit which is exposed to moisture.

When conduit is installed in hazardous areas, follow these general precautions for conduit installation:

- All conduit runs must have an explosion-proof sealing (potting) fitting located within 18 inches (45.5 centimeters) distance from the conduit entrance to explosion-proof housings.
- The conduit installation must be vapor tight, with threaded hub fittings, sealed conduit joints and gaskets on covers, or other approved vapor-tight conduit fittings.

CAUTION

Consult your company's policies and procedures and other applicable requirements documents to determine wiring and installation practices that are appropriate for hazardous areas. Failure to do so may cause personal injury or damage to equipment.

3.2.5 Sample systems requirements

Table 3-1. Sample system guidelines

Line Length	If possible, avoid long sample lines. In case of a long sample line, flow velocity can be increased by decreasing downstream pressure and using by-pass flow via a speed loop. **CAUTION**: Stream switching requires a sample pressure of 20 psig.
Sample Line Tubing Material	• Use Silco tubing for H_2S streams; for all other applications use stainless steel tubing. • Ensure tubing is clean and free of grease.
Dryers and Filters	Use small sizes to minimize lag time and prevent back diffusion. • Install a minimum of one filter to remove solid particles. Most applications require fine-element filters upstream of the GC. The 1500XA hardware includes a 2-micron filter. • Do use ceramic or porous metallic type filters. Do not use cork or felt filters.
Pressure Regulators and Flow Controllers	• Use stainless steel wetted materials. • Should be rated for sample pressure and temperature.
Pipe Threads and Dressings	*Do* use Teflon tape. Do not use pipe thread compounds (dope).
Valving	• Install a block valve downstream of sample takeoff point for maintenance and shutdown. • Block valve should be needle valve or cock valve type, of proper material and packing, and rated for process line pressure.

3.3 Preparation

Your GC was started and inspected before it left the factory. Program parameters were installed in the system and documented in the GC Config Report furnished with your GC.

3.3.1 Site selection

Follow these guidelines for site selection:

- Provide adequate access space for performing maintenance and adjustments.
  - Allow a minimum of 3 feet (.9 m) in front for operator access.
  - If possible, mount the Analyzer components in a vertical stack configuration; it provides the greatest operator convenience.
- Install the Analyzer as close as possible to the sample stream.
- Ensure that exposure to radio frequency (RF) interference is minimal.

3.3.2 Unpacking the unit

Observe the following checklist for unpacking the unit and inspecting for damage:

1. Unpack the equipment:
   - 1500XA
   - CD-ROM containing software and manuals
2. Ensure that all documentation and software are included on the CD-ROM:
   - PDF version of the *1500XA Gas Chromatograph System Reference Manual* (P/N 3-9000-757) (This manual.)
   - PDF version of the *MON2020 Software for Gas Chromatographs Users Manual* (P/N 3-9000-745)
   - *MON2020 Software for Gas Chromatographs* application, *Modbus Test* application, and other GC applications (P/N 2-3-2350-745)

Installation and startup of the GC should proceed only if all required materials are on hand and free from obvious defects.

If any parts or assemblies appear to have been damaged in shipment, first file a claim with the carrier. Next, complete a full report describing the nature and extent of the damage and forward this report immediately to Customer Service for further instructions. See the Customer Repair Report at the back of this manual. Include complete model number information. Disposition instructions will be returned immediately. If you have any questions regarding the claim process, call 1-(713)-827-6314 for assistance.

3.3.3 Necessary tools and components

Observe the following checklist of tools and components that you will need for installing the analyzer:

- Chromatographic grade carrier gas: zero grade helium, nitrogen (99.995% pure, with less than 5 ppm water, and less than 0.5 ppm hydrocarbons), argon, or hydrogen.
- High pressure dual-stage regulator for the carrier gas cylinder, high side up to 3000 pounds per square inch, gauge (psig), low side capable of controlling pressure up to 150 psig.
- Calibration standard gas with correct number of components and concentrations. See "Calibration gas" on page 2-11.
- Dual-stage regulator for the calibration gas cylinder, low pressure side capable of controlling pressure up to 30 psig.
- Sample probe (fixture for procuring the stream, or sample gas for chromatographic analysis).
- 1/8-inch stainless steel tubing for connecting calibration standard to analyzer, 1/4-inch SS tubing for connecting carrier to the analyzer, 1/8-inch SS tubing for connecting stream gas to the analyzer.
- Miscellaneous Swagelok tube fittings, tubing benders and tubing cutter.
- 14 American Wire Gauge (18 Metric Wire Gauge) or larger electrical wiring and conduit to provide 115 or 230 volts AC, single phase, 50 to 60 Hertz (Hz), from an appropriate circuit breaker and power

disconnect switch. See guidelines in "Power source wiring" on page 3-4.

- Digital volt-ohm meter with probe-type leads.
- A flow measuring device.

3.3.4 Optional tools and components

Observe the following checklist of tools and components you may need for installing and using the GC:

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Do not use a PC or a printer in a hazardous area. Serial port and Modbus communications links are provided to connect the unit to the PC and to connect to other computers and printers in a safe area. Failure to follow this warning may result in injury or death to personnel or cause damage to the equipment.

Supporting tools and components include:

- Use a Windows-based PC and either a direct or remote communications connection to interface with the 1500XA. See the MON2020 user manual for more information on specific PC requirements.
- The 1500XA comes with an Ethernet port on the back plane that is factory-wired with an RJ-45 connector. Refer to "Connecting directly to a PC using the GC's Ethernet port" on page 3-20 for more information.

3.4 Installing the analyzer

3.4.1 Analyzer AC power wiring

To connect power to the GC, follow these steps:

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Do not connect AC power leads without first ensuring that AC power source is switched off. Failure to observe all safety precautions could result in serious injury or death.

1. Locate the three leads for connecting power to the GC. The leads are colored as follows:

Hot	Black
Neutral	White
Ground	Green

2. Connect the leads to the 115-volt AC power source (i.e., with circuit breaker and power disconnect switch).

   Make power line splices and conduit seals that comply with applicable wiring requirements (for hazardous environments).

CAUTION

Do not apply power to the GC until all power, interconnection, and external signal connections have been verified, and proper grounds have been made. Failure to properly connect the GC unit may result in serious equipment damage or personal injury.

3. If necessary, connect the analyzer's chassis ground to an external copper ground rod (at remote locations). See “Electrical and signal ground” on page 3-6 for more information.

3.4.2 Sample and gas lines

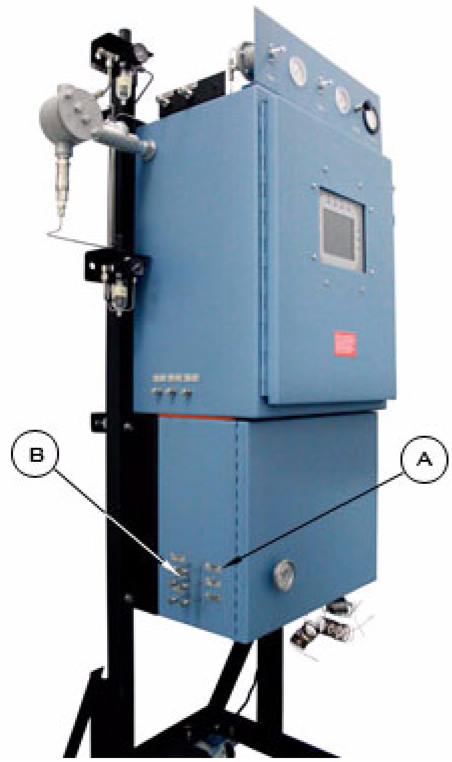
To install GC sample and gas lines:

Note
Unless the sample stream is known to react with stainless steel, use tubing of stainless steel construction. Keep tubing internally clean and dry to avoid contamination. Before connection the sample and gas lines, blow clean air or gas through them. Blow out internal moisture, dust, etc.

---

1. Remove the plug from the sample vent (SV) line.
   - If desired, connect the SV line to an external (ambient pressure) vent. If the vent line is terminated in an area exposed to wind, protect the exposed vent with a metal shield.
   - Use 1/4-inch or 3/8-inch tubing for vent lines longer than 10 feet.

Figure 3-1. GC sample and measure vent lines



A. Measure vent lines (2)
B. Sample vent lines (2)

Note that, at this stage in the installation, the GC measure vent (MV) line remains plugged until leak checks are completed. For regular operation, however, the MV line must be unplugged, or open.

Do not discard the vent line plugs. They are useful when leak-checking the GC and its sample and gas line connections.

2. Connect carrier gas to the GC. The carrier gas inlet is labelled "Carrier In" and is a 1/8-inch T-fitting.

CAUTION

Do not turn on gas until you have completed leak checking the carrier and sample lines. Failure to follow this precaution may cause injury to personnel or damage equipment.

- Use 1/8-inch or 1/4-inch stainless steel tubing to conduct carrier gas.
- Use a dual-stage regulator with high-side capacity of 3000 psig and low-side capacity of 150 psig.
- See Appendix C for a description of a dual-cylinder carrier gas manifold (P/N 3-5000-050) with these features:.
  - Carrier gas is fed from two bottles.
  - When one bottle is nearly empty (100 psig), the other bottle becomes the primary supply.
  - Each bottle can be disconnected for refilling without interrupting GC operation.

3. Connect sample gas stream(s) to the GC inlets located at the bottom of the lower enclosure.

   - Use 1/8-inch or 1/4-inch stainless steel tubing to connect sample gasses.
   - Ensure that pressure of sample line is regulated to maintain 15 to 30 psig (±10%).

   After all lines have been installed, proceed with leak checking the carrier and sample lines. See “Checking for leaks” on page 3-49; note that it requires the AC power to be turned on at the GC.

3.4.3 RS-485 serial port terminals

To ensure correct communication with all hosts, place a 120-ohm terminating resistor across the GC serial port terminals on the RS-485 link. On a multi-dropped link, install the terminating resistor on the last controller link only.

3.4.4 Installing and connecting to an analog modem card

The XA series gas chromatographs have two slots—I/O Slot A and I/O Slot B—available in the card cage in the electronics enclosure for installing an analog modem.

Note
MON 2020 only recognizes Microsoft Windows-compatible modems that have all relevant drivers installed correctly.

Note
Analog modems will only work with PSTN phone lines. Analog modems will not work with VOIP networks.

The following four LEDs are provided on the modem for troubleshooting:

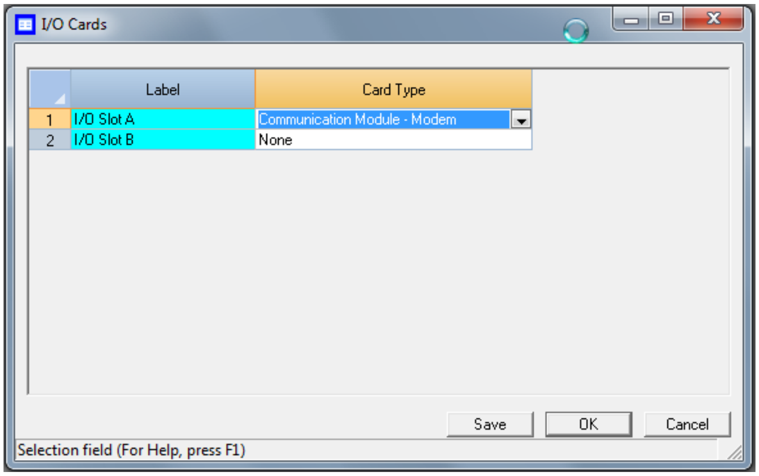
- **RI** (Ring Indicator) - This LED flashes when it senses a "ring". This LED should only flash once per connection because the modem automatically answers on the first ring.
- **CD** (Carrier Detect) - This LED glows green while connected to MON 2020.
- **RX** (Receive) - This LED flashes while the GC receives data from MON 2020.
- **TX** (Transmit) - This LED flashes while the GC sends data to MON 2020.

Installing the analog modem

To install an analog modem, do the following:

1. Start MON 2020 and connect to the GC.
2. Select **I/O Cards...** from the **Tools** menu. The *I/O Cards* window displays.
3. Change the **Card Type** for the appropriate I/O slot to **Communication Module - Modem**.

Figure 3-2. The I/O Cards window

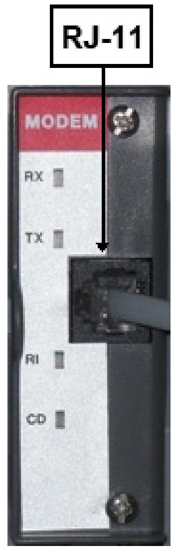


4. Click **Save**. MON 20/20 displays the following message:

   `The GC must be rebooted for the ROC Card changes to take effect`

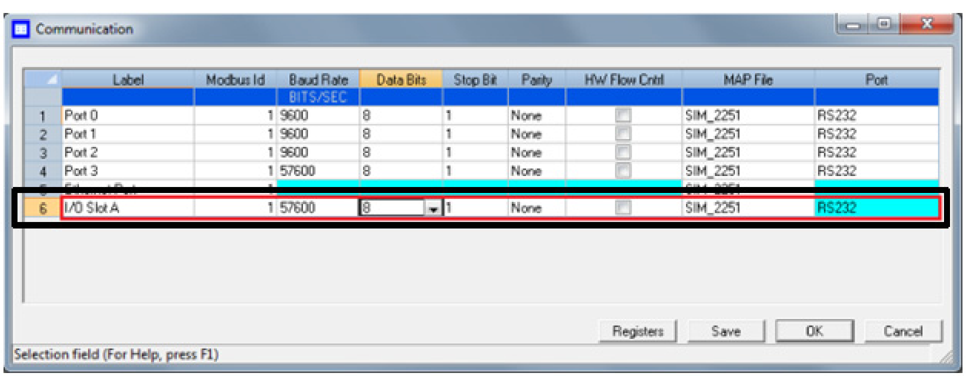
5. Click **OK** to dismiss the message.
6. Click **OK** to close the *I/O Cards* window.
7. Disconnect from the GC.
8. Turn off the GC.
9. Insert the analog modem card into the appropriate I/O slot in the GC's card cage. Make certain that the I/O slot matches that from Step 3.
10. Tighten the card's screws to secure the modem in the slot.
11. Insert a telephone cable into the modem card's RJ-11 socket.

Figure 3-3. Location of RJ-11



12. Start the GC.
13. Return to MON 2020 and connect to the GC via its Ethernet connection.
14. Select **Communication...** from the **Application** menu. The *Communication* window displays. The appropriate I/O slot should be listed in the first column (*Label*).

Figure 3-4. The *Communication* window



Note
The fields in the *Label* column are editable so it is possible to give your modem card a more appropriate name, if necessary.

15. Set the **Baud Rate** for the analog modem card to **57600**.
16. Make note of the I/O slot's Modbus Id.
17. Click **Save**.
18. Click **OK** to close the *Communication* window.
19. Disconnect from the GC.

3.4.5 Connecting to the GC via the analog modem

To connect to a GC via its analog modem, do the following:

1. Start MON 2020 and select **GC Directory...** from the **File** menu. The *GC Directory* window displays.
2. Select **Add** from the *GC Directory* window's **File** menu. A row is added to the bottom of the directory table.
3. Replace "GC Name" with a more appropriate identifier for the GC to which you will be connecting.

Note
You can also enter more information about the GC in the Short Desc field.

4. Select the **Modem** check box.
5. Click the **Modem...** button. The *Modem Connection Properties for DialUp* window displays.
6. Make sure that the Comm Address matches the Modbus Id from the *Communication* window.
7. Select the appropriate modem from the **Modem** drop-down list. The *Edit Telephone Number* dialog box displays.
8. Enter the modem's telephone number and click **OK**. The *Modem Properties* window displays.

9. Click **OK** to close the *Modem Properties* window.
10. Click the *GC Directory* window's **Save** button.
11. Click the *GC Directory* window's **OK** button to close the window.
12. Select **Connect...** from the **Chromatograph** menu. The *Connect to GC* window displays.
13. Click the **Modem** button for the appropriate GC. The *Login* dialog box displays.
14. Enter the appropriate user name and password and click **OK**. MON 2020 will connect to the GC via the modem connection.

3.4.6 Connecting directly to a PC using the GC's Ethernet port

The GC's DHCP server feature and its Ethernet port on the back plane at J22 allow you to connect directly to the GC. This is a useful feature for GCs that are not connected to a local area network; all that is needed is a PC—typically a notebook computer—and a CAT 5 Ethernet cable.

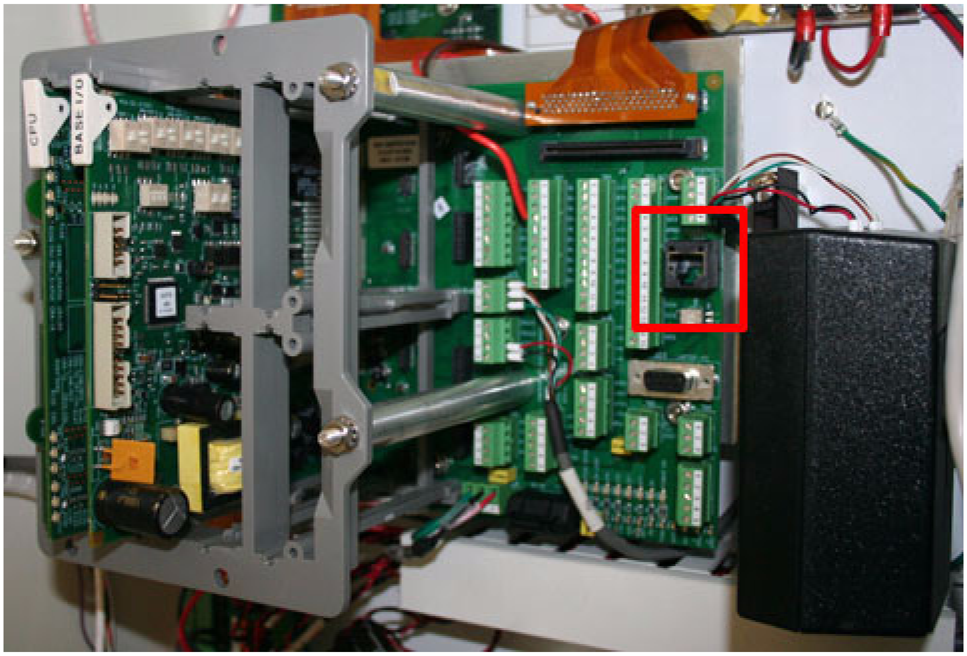
Note
The PC must have an Ethernet network interface card (NIC) that supports the automatic medium-dependent interface crossover (Auto-MDIX) technology and either an Ethernet cable or an Ethernet crossover cable of atleast CAT 5.

Note
The GC can be connected (or remain connected) to the local network on TB11 on the back plane while the DHCP feature is being used.

To set up the PC for the direct connection, do the following:

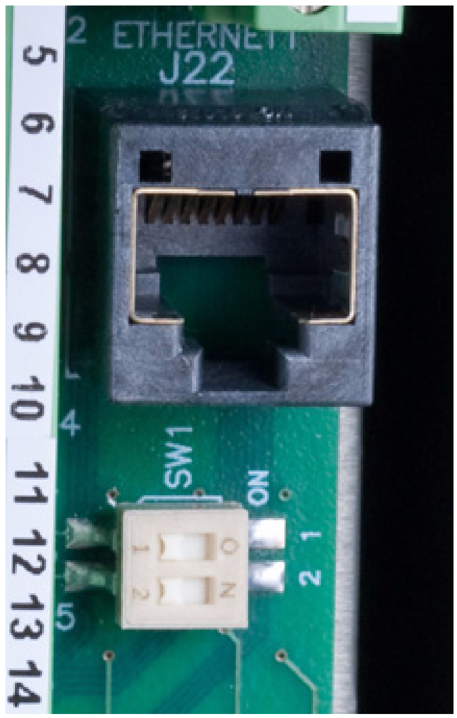
1. Plug one end of the Ethernet cable into the PC's Ethernet port and the other end into the GC's RJ45 socket on J22 on the backplane.

Figure 3-5. RJ45 socket (Ethernet port) on the GC's back plane



2. Locate the set of switches at SW1, directly beneath the Ethernet port on the back plane. Flip the switch that is labelled “1” to ON. This starts the GC’s DHCP server feature. The server typically takes approximately 20 seconds to initialize and startup.

Figure 3-6. SW1 switches on the back plane



Note

Although it is possible to use the Ethernet cable to connect the GC—by way of the RJ45 socket—to the local network, do not do so if the SW1 switch has been turned on. Setting the SW1 switch to ON puts the GC in server mode, and doing so while the GC is plugged into the LAN will disrupt the local network's functioning.

3. Wait for 20 seconds and then do the following to ensure that the server has provided an IP address to the PC:

   (a.) From the PC, go to **Start** → **Control Panel** → **Network Connections**.

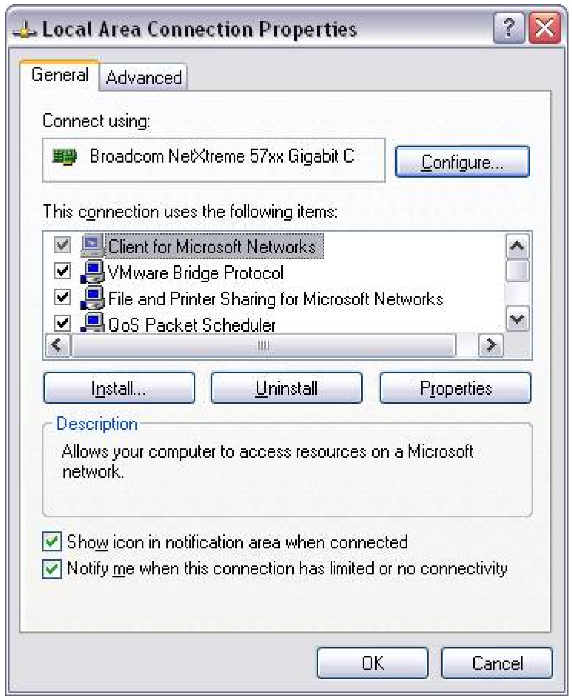
(b.) The *Network Connections* window lists all Dial-up and LAN / High-Speed Internet connections installed on the PC. In the list of LAN / High Speed Internet connections, find the icon that corresponds to the PC-to-GC connection and check the status that displays beneath the "Local Area Connection". It should show the status as "Connected". The PC is now capable of connecting to the GC. See "Using MON 20/20 to connect to the GC" on page 3-26.

Figure 3-7. Local Area Connection

If the status is "Disconnected", it may be that the PC is not configured to accept IP addresses; therefore, do the following:

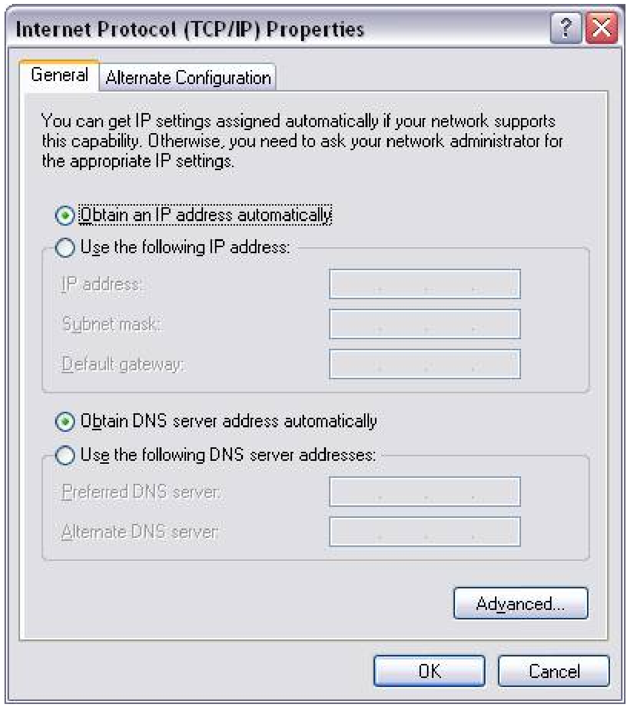
1. Right-click on the icon and select **Properties**. The *Local Area Connection Properties* window displays.

Figure 3-8. The Local Area Connection Properties screen



2. Scroll to the bottom of the *Connection* list box and select **Internet Protocol (TCP/IP)**.
3. Click **Properties**. The *Internat Protocol (TCP/IP) Properties* window displays.

Figure 3-9. The Internat Protocol (TCP/IP) Properties window



4. To configure the PC to accept IP addresses issued from the GC, select the *Obtain an IP address automatically* and *Obtain DNS server address automatically* check boxes.
5. Click **OK** to save the changes and to close the *Internat Protocol (TCP/IP) Properties* window.
6. Click **OK** to close the *Local Area Connection Properties* window.
7. Return to the *Network Connections* window and confirm that the appropriate icon's status reads "Connected". If the icon still reads "Disconnected" refer to "Troubleshooting DHCP connectivity issues" on page 3-27.

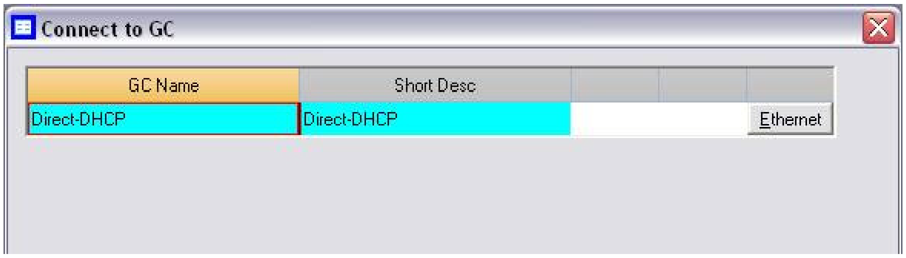
Note
If you power cycle the GC, then you will lose connectivity. After the GC initializes completely, refer to "Troubleshooting DHCP connectivity issues" on page 3-27 to learn how to "repair" the connection.

Using MON 20/20 to connect to the GC

To connect to the GC, do the following:

1. Start MON 2020. After starting, the *Connect to GC* window displays.

Figure 3-10. The Connect to GC window



2. Locate **Direct-DHCP** under the *GC Name* column. This GC directory is created automatically when MON 2020 is installed. It can be renamed but the IP address that it references—192.168.135.100—should not be changed.
3. Click the associated **Ethernet** button. MON 2020 prompts you to enter a username and password, after which you will be connected to the GC.

3.4.7 Troubleshooting DHCP connectivity issues

Use the following tips to troubleshoot server connectivity issues:

- Ensure that the GC is up and running. If the GC has a switch panel, check the "CPU" LED on the front panel; a green light means that the GC is operational. If the GC has an LOI, ensure that the LOI is communicating with the GC.
- Check the following connections:
  - If you are using a Ethernet straight cable, ensure that the PC has an Ethernet network interface card with auto-MDIX.
  - If your Ethernet network interface card does not support auto-MDIX, ensure that you are using an Ethernet crossover patch cable.
  - Check to see if the CPU board's link lights are on. The three lights are located on the front bottom edge of the card. If link lights are off, then check your connections.

Figure 3-11. CPU board link lights

- Do the following to ensure that your network adapter is enabled:

  (a.) Go to **Start** → **Control Panel** → **Network Connections**.

  (b.) Check the status of the *Local Area Connection* icon. If the status appears as **Disabled**, right-click on the icon and select **Enable** from the context menu.

- Do the following to try to repair the network connection:

  (a.) Go to **Start** → **Control Panel** → **Network Connections**.

  (b.) Right-click on the *Local Area Connection* icon and select **Repair** from the context menu.

3.4.8 Connecting directly to a PC using the GC's serial port

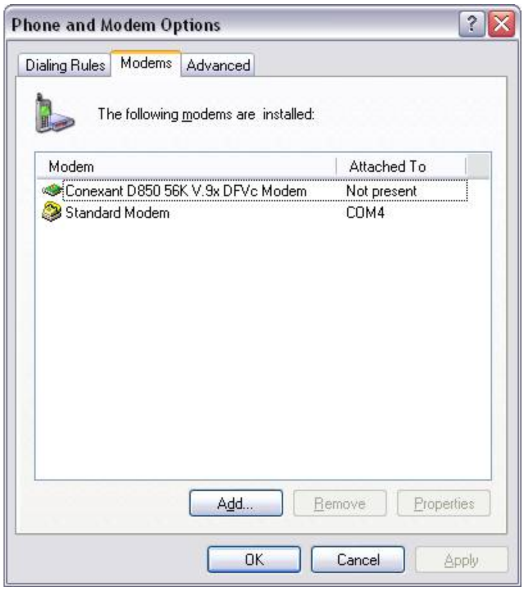
The GC's serial port at J23 on the back plane allows a PC with the same type of port to connect directly to the GC. This is a useful feature for a GC that is located in an area without internet access; all that is needed is a PC running Windows XP Service Pack 3—typically a notebook computer—and a direct connect cable.

To set up the PC for the direct connection, do the following:

1. Do the following to install the **Daniel Direct Connect** modem driver onto the PC:

   (a.) Navigate to **Start** → **Control Panel** and double-click the **Phones and Modem Options** icon. The *Phones and Modem Options* dialog displays.

Figure 3-12. Phones and Modem Options dialog



   (b.) Select the *Modem* tab and click **Add...**. The *Add Hardware Wizard* displays.

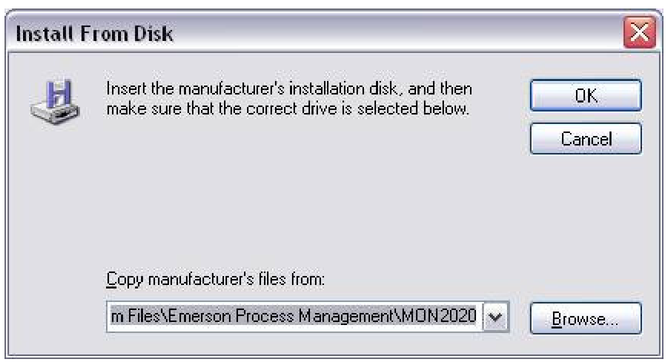
Figure 3-13. The Add Hardware Wizard

(c.) Select the **Don't detect my modem; I will select it from a list** check box and then click **Next**.

Figure 3-14. Install New Modem

(d.) Click **Have Disk**. The *Install from Disk* dialog appears.

Figure 3-15. Install from Disk dialog



(e.) Click **Browse** and the *Browse* dialog displays.

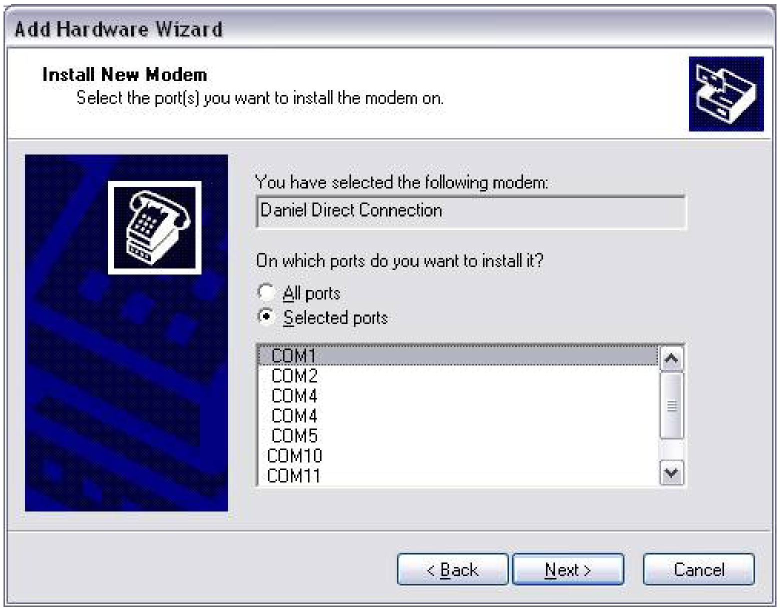
(f.) Navigate to the MON 2020 install directory (typically C:\Program Files\Emerson Process Management\MON2020) and select **Daniel Direct Connection.inf**.

(g.) Click **Open**. You will be returned to the *Install from Disk* dialog.

(h.) Click **OK**. You will be returned to the *Add Hardware Wizard*.

(i.) Click **Next**.

Figure 3-16. The Add Hardware Wizard



(j.) Select an available serial port and click **Next**. The *Hardware Installation* dialog displays.

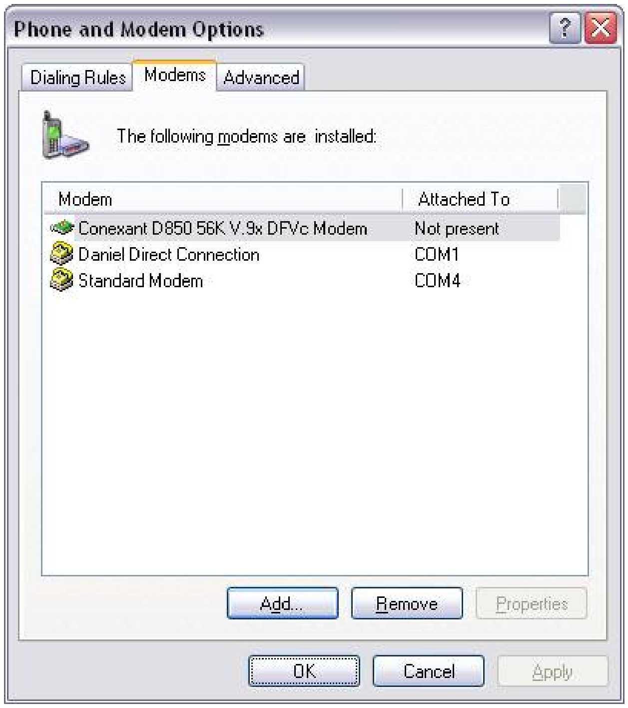
Figure 3-17. The Hardware Installation dialog

(k.) Click **Continue Anyway**. After the modem driver is installed, you will be returned to the *Add Hardware Wizard*.

Figure 3-18. The Add Hardware Wizard - Installation was successful

(l.) Click **Finish**. You will be returned to the *Phones and Modems* dialog. The **Daniel Direct Connect** modem should be listed in the *Modem* column.

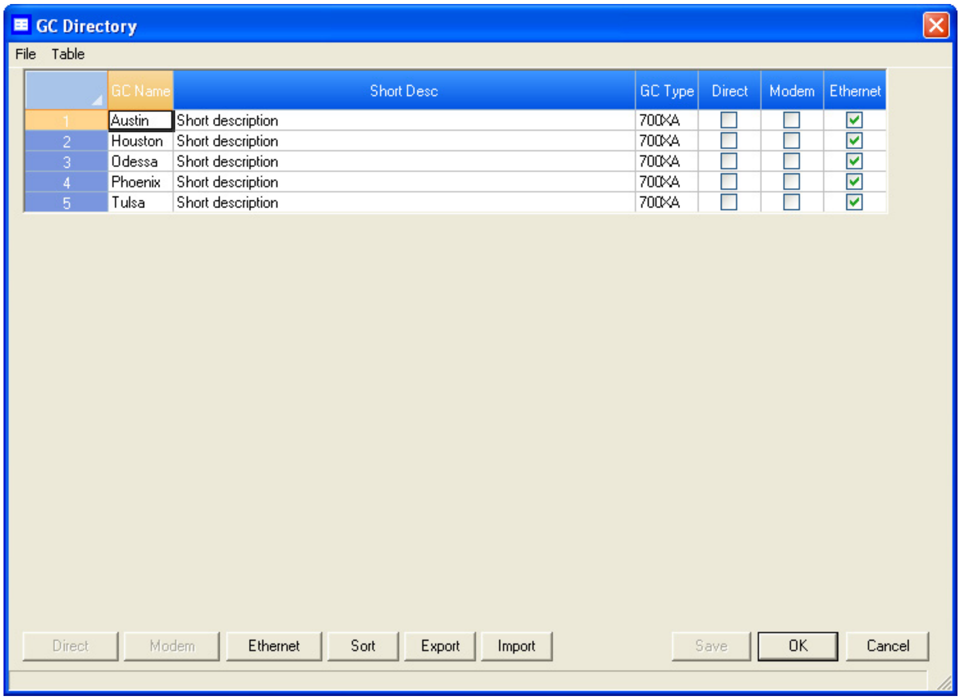
Figure 3-19. The Phones and Modems dialog



2. Start MON 2020 and do the following to create a GC connection for the **Daniel Direct Connection** modem:

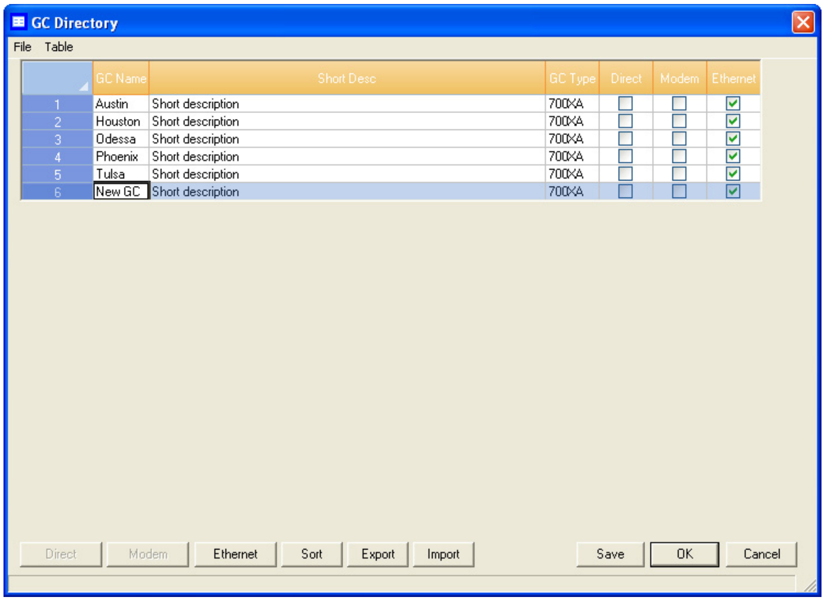
   (a.) Select **GC Directory** from the **File** menu. The *GC Directory* window displays.

Figure 3-20. The GC Directory window



(b.) Select **Add** from the GC Directory window's **File** menu. A **New GC** row will be added to the bottom of the table.

Figure 3-21. The GC Directory window with new GC row



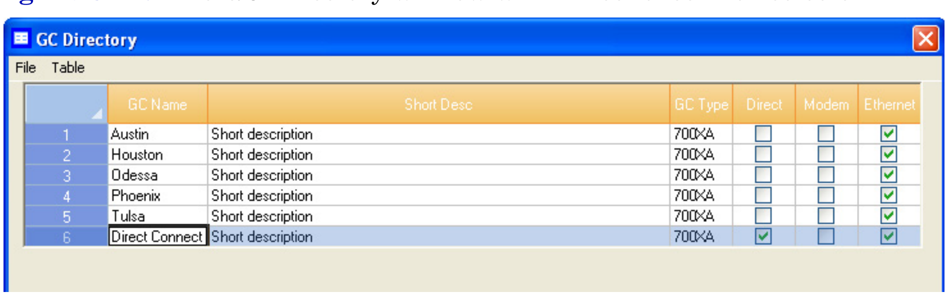
(c.) Select the **New GC** text and type in a new name for the GC connection.

Note

You can enter optional but helpful information about the connection in the *Short Desc* column.

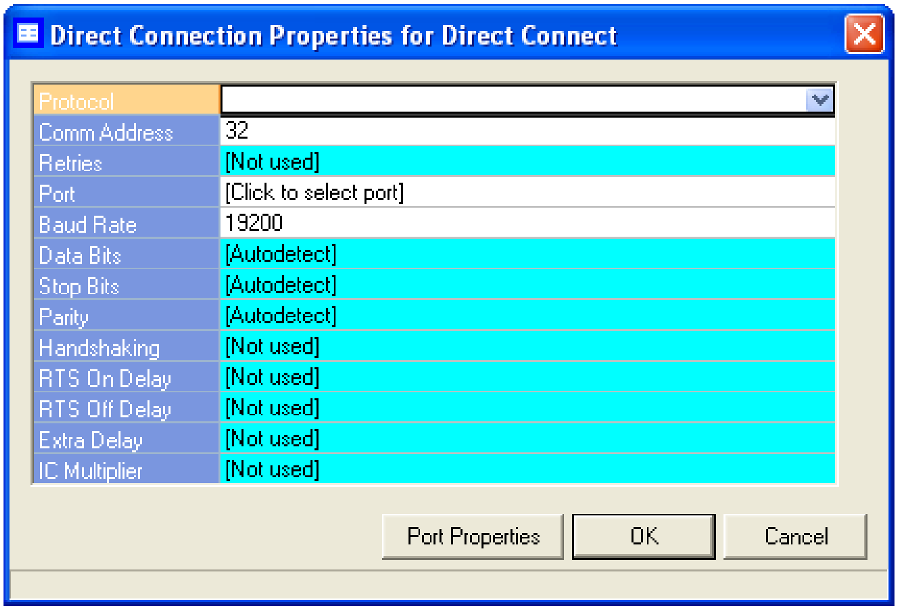
(d.) Select the new GC's *Direct* check box.

Figure 3-22. The GC Directory window with Direct check box selected



(e.) Click the Direct button located at the bottom of the GC Directory window. The Direct Connection Properties window displays.

Figure 3-23. The Direct Connection Properties window



(f.) Select **Daniel Direct Connection (COM*n*)** from the *Port* drop-down window.

Note

The letter *n* stands for the COM number.

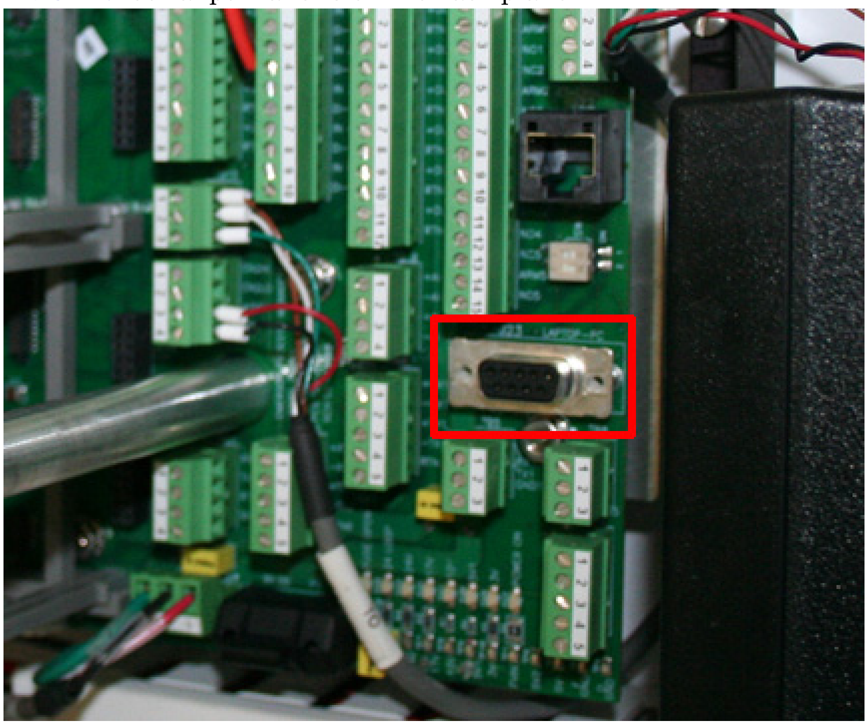
(g.) Select **57600** from the *Baud Rate* drop-down window.

(h.) Click **OK** to save the settings. You will be returned to the *GC Directory* window.

(i.) Click **OK** to save the new GC connection and to close the *GC Directory* window.

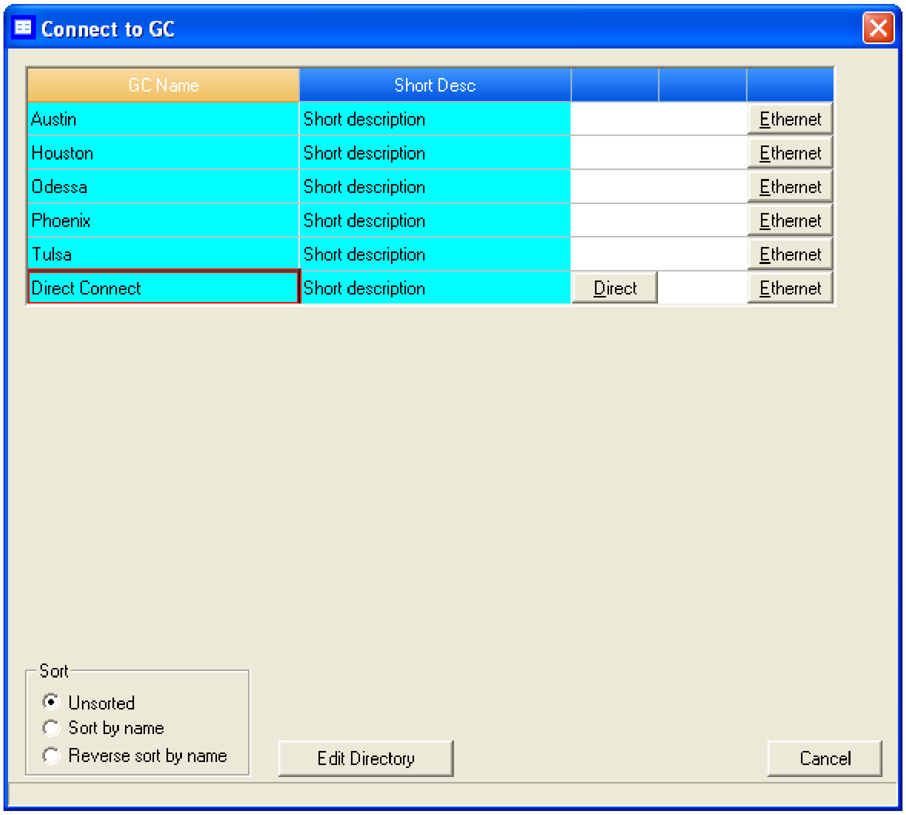
3. Connect one end of the direct connect cable to the GC's serial port at J23 on the back plane.

Figure 3-24. Serial port at J23 on the back plane



4. Connect the other end of the direct connect cable to the PC's corresponding serial port.
5. Select **Connect...** from the **Chromatograph** menu. The *Connect to GC* window displays.

Figure 3-25. The Connect to GC window



6. Click **Direct** to connect to the GC using the serial cable connection.

3.4.9 Assigning a static IP address to the GC

To configure the GC with a static IP address, do the following:

1. Start MON 2020 and log on to GC using a direct Ethernet connection. For more information, refer to "Connecting directly to a PC using the GC's Ethernet port" on page 3-13.
2. Select **Ethernet ports...** from the **Applications** menu. The *Ethernet Ports* window displays.
3. Depending upon the Ethernet port to which you want to assign a static IP address, do the following:

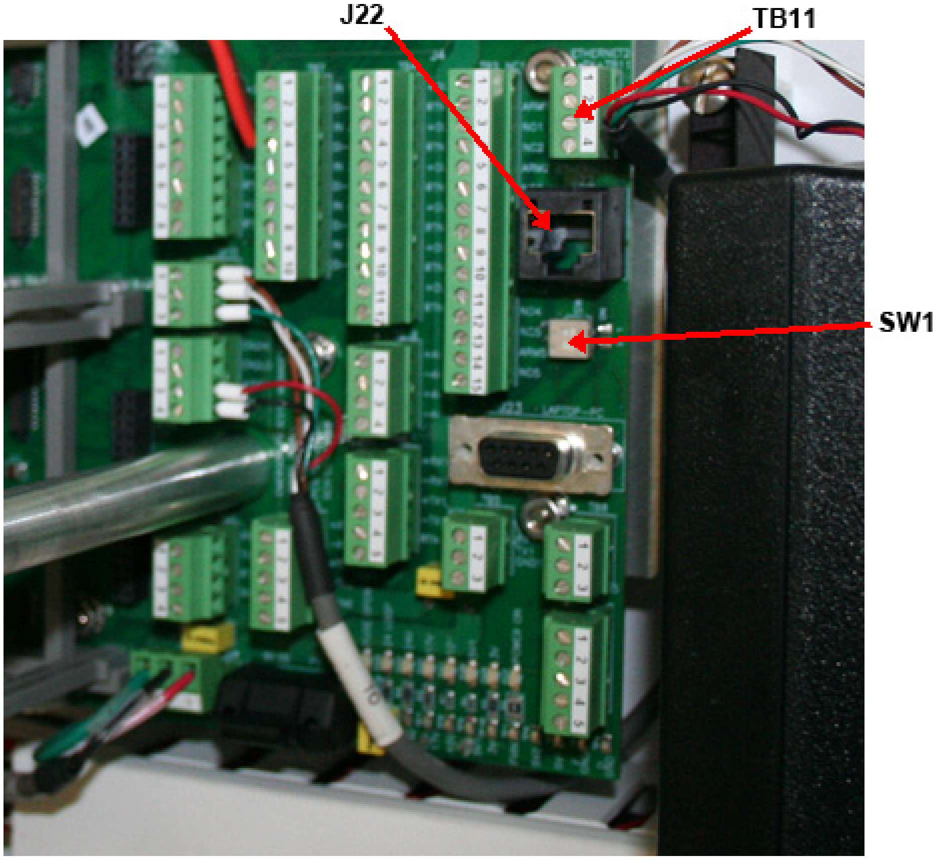
- The Ethernet port at TB11: Enter the appropriate values in the **Ethernet 2 IP Address**, the **Ethernet 2 Subnet**, and the **Default Gateway** fields.
- The RJ-45 Ethernet port at J22: Enter the appropriate values in the **Ethernet 1 IP Address**, the **Ethernet 1 Subnet**, and the **Default Gateway** fields.

Note
IP, Subnet, and Gateway addresses can usually be obtained from a member of your IT staff.

---

4. Click **OK**.
5. Log off the GC.
6. Access the backplane, which is located in the GC's lower enclosure.

Figure 3-26. Port locations on the backplane



7. If you are setting up a static IP address for the Ethernet port at J22, and you also intend to connect to your company's local area network, do the following:

   (a.) Locate the set of dip switches, labeled 1 and 2, at SW1 on the backplane. SW1 is located directly beneath the Ethernet port at J22.

   (b.) Move dip switch **2** to its left position. This disables the DHCP server.

8. Use the following schematics as a guide to wiring the GC via its Phoenix connector at TB11. Figure 3-33 shows the traditional wiring scheme; Figure 3-34 shows how to wire a CAT5e cable if you cut off its RJ-45 plug.

Figure 3-27. Field wiring to TB11

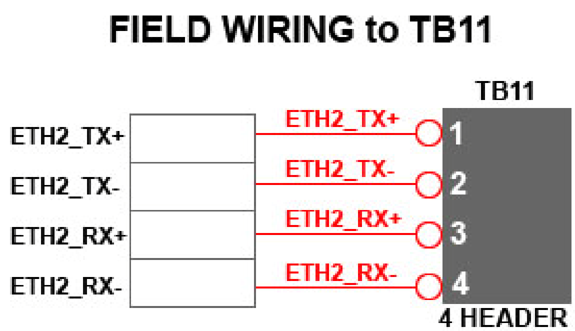
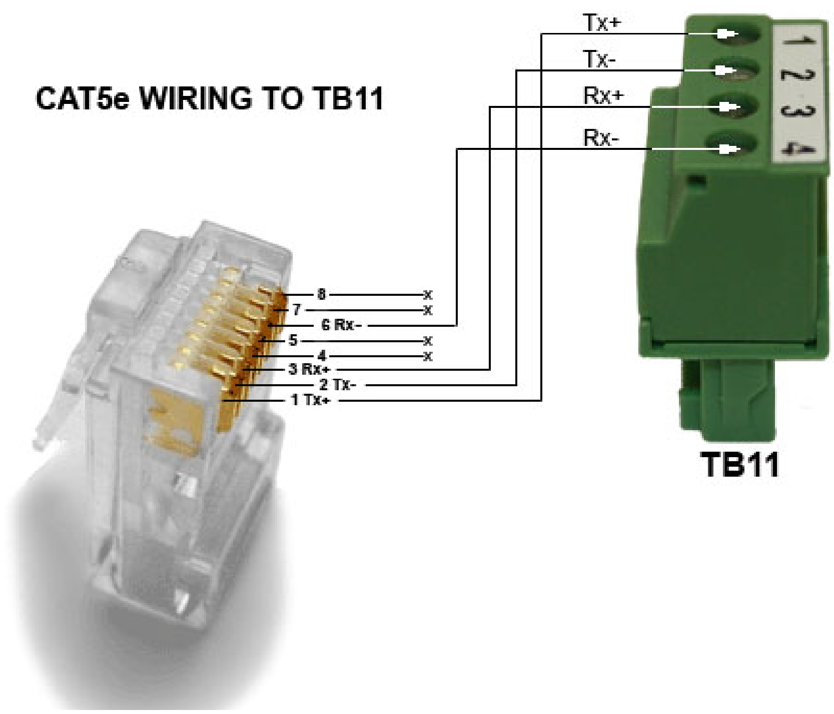


Figure 3-28. CAT5e wiring to TB11

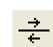


To connect to the GC, do the following:

1. Start MON 2020 and select **GC Directory...** from the **File** menu. The *GC Directory* window displays.
2. Select **Add** from the *GC Directory* window's **File** menu. A **New GC** profile will be added to the end of table.

Note
You can also rename the GC's profile as well as add a short description.

---

3. Select the new profile and click **Ethernet...**. The *Ethernet Connection Properties for New GC* window displays.
4. Enter the GC's static IP address in the **IP address** field.
5. Click **OK**. The *Ethernet Connection Properties for New GC* window closes.
6. Click **Save** on the *GC Directory* window.
7. Click **OK** to close the *GC Directory* window.
8. Select **Connect...** from the **Chromatograph** menu or click the  icon. The *Connect to GC* window displays.
9. The newly created GC profile should be listed in the table. Locate it and click the **Ethernet** button that is associated with it. The *Login* window displays.
10. Enter a **User Name** and **User Pin** and click **OK**.

3.4.10 Discrete digital I/O wiring

The GC's back plane has five discrete outputs and five discrete inputs. Refer to the MON2020 user manual to learn how to configure the digital outputs.

Discrete digital inputs

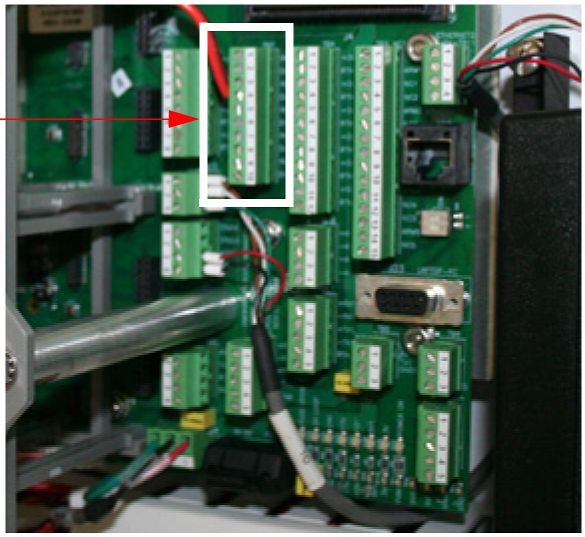
To connect digital signal input lines to the GC, do the following:

1. Access the back plane.

   The discrete inputs are located on the backplane at TB7.

Figure 3-29. TB7 on the backplane

TB7



2. Route digital I/O lines appropriately, especially in the case of the explosion-proof enclosure.

There are connections for five digital inputs and five digital output lines, as indicated in the following table:

Table 3-2. Discrete digital inputs

TB7	Function
Pin 1	F_DIG_IN1
Pin 2	DIG_GND
Pin 3	F_DIG_IN2
Pin 4	DIG_GND
Pin 5	F_DIG_IN3
Pin 6	DIG_GND
Pin 7	F_DIG_IN4
Pin 8	DIG_GND
Pin 9	F_DIG_IN5
Pin 10	DIG_GND

Discrete digital outputs

The discrete outputs are located on TB3, which is a 15-pin Phoenix connector, and have five Form-C relays on the back plane. All contact outputs have a rating of 1A @30 VDC.

Figure 3-30. TB3 on the backplane

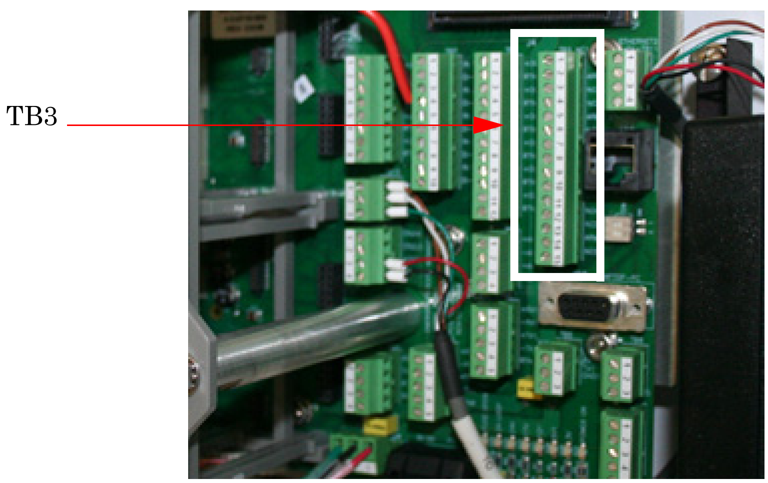


Table 3-3 lists the discrete digital output function for each pin on the TB3 connector.

Table 3-3. Discrete Digital Outputs

TB3	Function
Pin 1	DIG_OUT NC1
Pin 2	DIG_OUT ARM1
Pin 3	DIG_OUT NO1
Pin 4	DIG_OUT NC2
Pin 5	DIG_OUT ARM2
Pin 6	DIG_OUT NO2
Pin 7	DIG_OUT NC3
Pin 8	DIG_OUT ARM3
Pin 9	DIG_OUT NO3
Pin 10	DIG_OUT NC4
Pin 11	DIG_OUT ARM4
Pin 12	DIG_OUT NO4
Pin 13	DIG_OUT NC5
Pin 14	DIG_OUT ARM5
Pin 15	DIG_OUT NO5

Note
Form-C relays are single-pole double-throw (SPDT) relays that have three positions: normally closed (**NC**); an intermediate position, also called the "make-before-break" position (**ARM**); and normally open (**NO**).

3.4.11 Analog input wiring

There are two analog inputs on the backplane located at TB10.

Figure 3-31. TB10 on the backplane

TB10

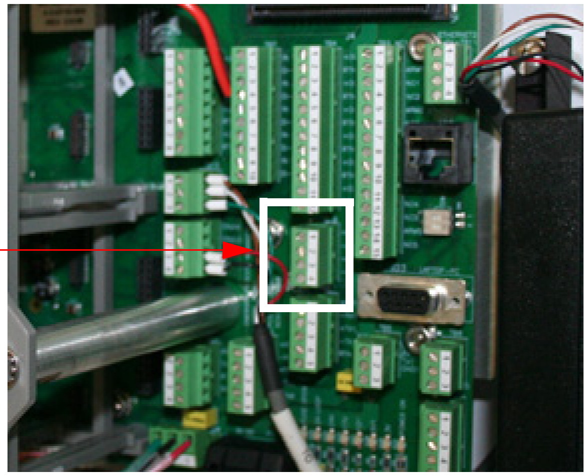


Table 3-4. Analog Inputs

TB10	Function
Pin 1	+AI_1
Pin 2	-AI_1
Pin 3	+AI_2
Pin 4	-AI_2

3.4.12 Analog output wiring

There are six standard analog outputs on the standard backplane, which is a 12-pin Phoenix connector located at TB4.

Figure 3-32. TB4 on the backplane

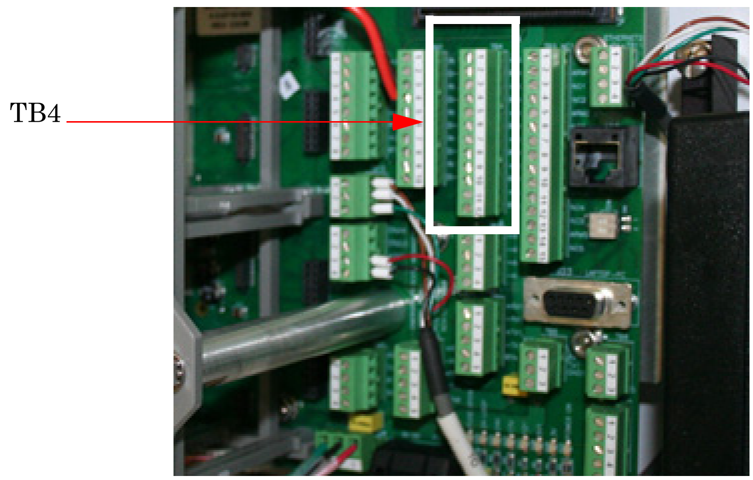


Table 3-5. Analog Outputs

TB4	Function
Pin 1	+ Loop1
Pin 2	Loop_RTN1
Pin 3	+ Loop 2
Pin 4	Loop_RTN2
Pin 5	+ Loop 3
Pin 6	Loop_RTN3
Pin 7	+ Loop 4
Pin 8	Loop_RTN4
Pin 9	+ Loop 5
Pin 10	Loop_RTN5
Pin 11	+ Loop 6
Pin 12	Loop_RTN6

3.5 Leak checking and purging for first calibration

Verify that all electrical connections are correct and safe, and then turn the unit on.

3.5.1 Checking for leaks

To perform a leak check, follow these steps:

1. Plug all vents.
2. Make sure the setting of the carrier gas cylinder regulator is 115 pounds per square inch, gauge (psig).
3. Check all fittings at the pressure regulator flow panel and at the carrier gas cylinder regulator with a leak detector. Correct any leaks detected.
4. Turn the carrier gas cylinder shut-off valve clockwise to close. Observe the carrier gas pressure for ten minutes to check for a drop in carrier pressure. The drop should be less than 200 psig on the high side of the regulator/gauge. If the carrier gas pressure remains constant, no leaks are present.
5. Use the LOI to actuate the valves on and off and observe the pressure with the valves in different positions than in step 4. When the valves are switched, some pressure change is normal because of carrier loss. Momentarily open cylinder valve to restore pressure if necessary.
6. If the pressure does not hold constant, check all valve fittings for tightness.
7. Repeat step 5 again. If leaks persist, check the valve ports with a commercial Helium leak detector. Do not use a liquid leak detector on the valves or other components in the oven.

3.5.2 Purging carrier gas lines

Purging carrier and calibration gas lines requires AC power and a PC connected to the GC.

Note
Tubing should be clean and dry internally. During installation, the tubing should have been blown free of internal moisture, dust, or other contaminants.

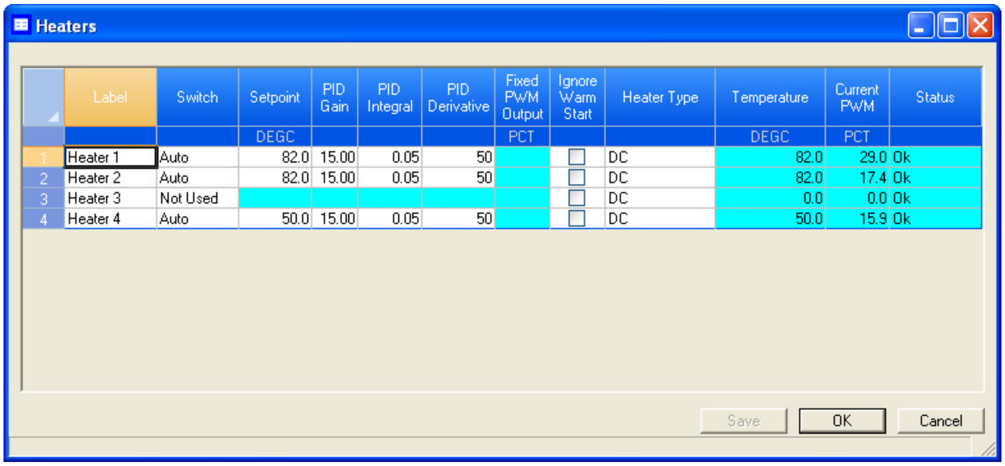
To purge the carrier gas lines, do the following:

1. Ensure that the measure vent line plugs have been removed, and the vent lines are open.
2. Ensure that the carrier gas bottle valve is open.
3. Set the GC side of the carrier gas to 120 psig.
4. Turn on the GC and the PC.
5. Start MON 2020 and connect to the GC.

Note
Consult the *MON 20/20 Software for Gas Chromatograph* manual for information about connecting to a GC.

6. Select **Hardware** → **Heaters**. The *Heaters* window displays. The temperature values for the heaters should indicate that the unit is warming up.

Figure 3-33. The Heaters window



7. Allow the GC system temperature to stabilize and the carrier gas lines to become fully purged with carrier gas, which usually takes about an hour.
8. Select **Control** → **Auto Sequence**.

   For more information about this function, refer to the *MON 20/20 Software for Gas Chromatographs* manual.

Note
A purging period of 4 to 8 hours (or overnight) is recommended, during which no changes should be made to the settings described in Steps 1 through 7.

3.5.3 Purging calibration gas lines

To purge the calibration gas lines, do the following:

1. Ensure that the carrier gas lines have been fully purged and that the sample vent plugs have been removed.
2. Close the calibration gas bottle valve.
3. Fully open the block valve associated with the calibration gas feed. The block valve is located on the lower right-hand corner of the front panel.

Refer to the *MON 20/20 Software for Gas Chromatographs* manual for instructions on selecting streams.

4. Open the calibration gas bottle valve.
5. Increase the outlet pressure to 40 psig, plus or minus five percent, at the calibration gas bottle regulator.
6. Close the calibration gas bottle valve.
7. Let both gauges on the calibration gas bottle valve bleed down to 0 psig.
8. Repeat Steps 4 through 7, five times.
9. Open the calibration gas bottle valve.

3.6 System start-up

To perform system start-up, follow these steps:

1. For system startup, run an analysis of the calibration gas. Use MON2020 to run a single stream analysis on the calibration stream. Once proper operation of the GC is verified, halt the analysis by selecting **Control** → **Halt**. See the MON2020 *Software for Gas Chromatographs User Manual (*P/N 3-9000-745*)* for more information.

Note
You can also use the LOI to halt the analysis. See Appendix A for more information.

2. Start auto sequence of the line gas stream(s) by selecting **Control** → **Auto Sequence...** from MON 20/20. See the MON2020 manual for more information. The GC will begin the auto sequence analysis mode.

Note
You can also use the LOI to initiate auto sequencing. See Appendix A for more information.

Section 4: Maintenance and troubleshooting

4.1 Hazardous environments

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Observe all precautionary signs posted on the 1500XA. Failure to do so can result in injury or death to personnel or cause damage to the equipment.

The GC enclosure is rated for a general purpose area and is certified by CSA for Class I Division 2 Groups B, C, and D locations, Temperature Code T3 with an optional Type Z purge.

Special conditions for safe use must be met. The maximum constructional gap (i_c) is less than that required by Table 1 of IEC 60079-1:2004 as detailed in the Table 4-1 below.

Table 4-1 Flamepath Fitting Tube Gap Safety

FLAMEPATH	MAXIMUM GAP (MM)	COMMENT
Fitting tube adaptor/fitting tube taper	0.000	Taper fit
Fitting tube/taper/tubes	0.132	

Before opening the GC assembly, reduce the risk of igniting hazardous atmospheres by disconnecting the equipment from all power sources. Keep the assembly closed tightly when in operation to reduce the risk of igniting hazardous atmospheres.

Incoming inlet wiring must meet local standards (i.e. in conduit with seal fitting within 18” or via cable glands certified to IEC 60079-1). Seal all unused entries with blanks certified to IEC 60079-1.

Please direct all health, safety and certification related questions to: Emerson Process Management, Gas Chromatographs, Applications Engineering Group, 713-827-6314 or 1-866-GC Center (1-866-422-3683).

4.2 Troubleshooting and repair concept

The most efficient method for maintaining and repairing the GC is a component-replacement concept that allows you to return the system to operation as quickly as possible. Sources of trouble, such as printed-circuit assemblies, valves, etc., are identified during troubleshooting test procedures and are replaced at the lowest level practical with units in known working order. The defective components are then either repaired in the field or returned to Measurement Services for repair or replacement.

4.3 Routine maintenance

The GC will perform accurately for long periods with very little attention (except for maintaining the carrier gas cylinders). A consistent record of certain parameters will assist greatly in assuring that your GC is operating to specifications. The maintenance checklist should be filled out periodically, dated, and kept on file for access by maintenance technicians as necessary. This gives you a historical record of the operation of your GC, enables a maintenance technician to schedule replacement of gas cylinders at a convenient time, and allows quick troubleshooting and repair when it becomes necessary.

A chromatogram, a Configuration Report, and a Raw Data Report should also be made and filed with the checklist, furnishing a positive dated record of the GC. The chromatogram and reports can also be compared to the chromatograms and reports run during the troubleshooting process.

4.3.1 Maintenance checklist

Print the sample maintenance checklist on the following page as necessary for your files. If you have a problem, please complete the checklist first and have the results available, as well as the sales order number, when calling for technical assistance at 1-713-827-6314. The sales order number can be found on the nameplate located on the right side wall of the GC. The chromatograms and reports archived when your GC left the factory are filed by this number.

Note

To find the default measurements for the parameters on the checklist, use MON 20/20 to view the GC's Parameter List.

MAINTENANCE CHECKLIST

Date Performed: _______________ Sales Order Number: _______________

System Parameters	As Found	As Left
Carrier Gas Cylinder		
Cylinder Pressure Reading (High)	_____ psig	_____ psig
Cylinder Pressure Outlet Reading	_____ psig	_____ psig
Cylinder Pressure Panel Regulator	_____ psig	_____ psig
Sample System		
Sample Line Pressure(s)	(1)_____ psig	_____ psig
	(2)_____ psig	_____ psig
	(3)_____ psig	_____ psig
	(4)_____ psig	_____ psig
	(5)_____ psig	_____ psig
Sample Flows	(1)___ cc/min	___ cc/min
Sample Vent 1 (SV1)	(2)___ cc/min	___ cc/min
Sample Vent 2 (SV2)	(3)___ cc/min	___ cc/min
	(4)___ cc/min	___ cc/min
	(5)___ cc/min	___ cc/min
Calibration Gas		
High Pressure Reading	_____ psig	_____ psig
Outlet Pressure Reading	_____ psig	_____ psig
Flow	___ cc/min	___ cc/min

4.3.2 Routine maintenance procedures

- To give yourself a basis for comparison in the future, complete the maintenance checklist at least two times each month. Place the sales order number, date, and time on the form and file it.
- Save a chromatogram of the operating GC on the PC with MON2020. Print configuration, calibration, and raw data reports and file them with MON2020.
- Check carrier and calibration gas supplies.

4.3.3 Service programs

Measurement Services offers maintenance service programs that are tailored to fit specific requirements. Contracts for service and repair can be arranged by contacting Measurement Services at the address or telephone number on the Customer Repair Report at the back of this manual.

4.4 Access to GC components

Review "Equipment description and specifications" on page 2-1 to familiarize yourself with the locations and placement of the GC's core components.

4.5 Precautions for handling printed circuit assemblies

Printed circuit assemblies contain CMOS integrated circuits that can be damaged if the assemblies are not properly handled. The following precautions must be observed when working with the assemblies:

- Do not install or remove the printed circuit assemblies while power is applied to the units.
- Keep electrical components and assemblies in their protective carriers or wrapping until ready for use.
- Use the protective carrier as a glove when installing or removing printed circuit assemblies.

- Maintain contact with a grounded surface to prevent static discharge when installing or removing printed circuit assemblies.

4.6 General troubleshooting

This section contains general troubleshooting information for the GC. The information is arranged as appropriate either by major subsystems or by major functions of the instrument.

Note
Correct ALL alarms before re-calibration.

4.6.1 Hardware alarms

Use the following table to identify the alarm and possible cause and solution for the problem.

Alarm Name	Possible Causes/Solution
LTLOI Failure	No switch panel detected or connected. Recommended actions: 1. Power the GC down completely. 2. Check that the board is seated in the correct slot of the backplane board. 3. Power up the GC. 4. If message appears again, replace Switch Panel Board.
Maintenance Mode	A technician has put the GC into maintenance mode for servicing. To disable maintenance mode, unclick the **Maintenance Mode** checkbox in the *System* dialog.

Alarm Name	Possible Causes/Solution
Power Failure	The GC has experienced a re-start since alarms were last cleared, caused by power failure. The GC automatically starts in warm start mode. During warm start mode, the GC does the following: 1. Waits for the heaters to stabilize. 2. Purges the sample loop. 3. Actuates the valves for two cycles. After completing these actions, the GC switches to auto-sequence mode.
User Calculation Failure	One or more errors were detected while parsing a user-defined calculations. This usually happens when a user-defined calculation attempts to use a system variable that does not exist. Recommended action: Fix the calculation that is referring to the undefined system variable.
FF Board Comm Failure	Foundation Fieldbus board not detected. Recommended actions: 1. Power the GC down completely. 2. Check that the Foundation Fieldbus module cable is properly seated in the correct slot on the backplane board. 3. Check that the board is securely plugged into the Foundation Fieldbus module. 4. Check that the Foundation Fieldbus module is receiving power. 5. Power up the GC. 6. If the alarm appears again, replace the Foundation Fieldbus board.

Alarm Name	Possible Causes/Solution
Low Battery Voltage	A low battery voltage has been detected on the CPU board. Replace the CPU board immediately to avoid losing GC configuration data. Recommended actions: 1. Save the GC Configuration to a PC. 2. Save any Chromatograms and/or Results to a PC. 3. Power down the GC. 4. Replace the CPU Board. 5. Restore Configuration back to the GC.
Preamp Board 1 Comm Failure	Preamp board not detected. Recommended actions: 1. Power the GC down completely. 2. Check that the board is properly seated in the correct slot (SLOT 1) on the backplane. 3. Power up the GC. 4. If message appears again, replace the preamp board.
Preamp Board 2 Comm Failure	Preamp board not detected. Recommended actions: 1. Power the GC down completely. 2. Check that the board is properly seated in the correct slot (SLOT 3) on the backplane. 3. Power up the GC. 4. If message appears again, replace the preamp board.
Heater Solenoid Board 1 Comm Failure	Heater/Solenoid board not detected. Recommended actions: 1. Power the GC down completely. 2. Check that the board is properly seated in the correct slot (SLOT 2) on the backplane. 3. Power up the GC. 4. If message appears again, replace the heater/ solenoid board.

Alarm Name	Possible Causes/Solution
Heater Solenoid Board 2 Comm Failure	Heater/Solenoid board not detected. Recommended actions: 1. Power the GC down completely. 2. Check that the board is properly seated in the correct slot (SLOT 4) on the backplane. 3. Power up the GC. 4. If message appears again, replace the heater/ solenoid board.
BaseIO Board Comm Failure	Base I/O (Multifunction I/O) board not detected. Recommended actions: 1. Power the GC down completely. 2. Check that the board is properly seated in the correct slot (SLOT 5) on the backplane. 3. Power up the GC. 4. If message appears again, replace the Base IO board.
Stream Skipped	One or more streams in the stream sequence cannot be analyzed because their "Usage" option is set to "Unused". Recommended actions: Use MON 20/20 to do one of the following: Remove the unused stream(s) from the stream sequence. Change the Usage option of the stream(s) in the Streams dialog to something other than “Unused”.
GC Idle	The GC has been placed in Idle mode and is not running an analysis.

Alarm Name	Possible Causes/Solution
Warm Start Failed	The GC failed to achieve desired operating condition after power up. Unable to regulate heater zone temperature(s). Recommended actions: 1. Check heater settings in MON 20/20 or the LOI. 2. Check that the carrier gas cylinder pressure is 10 psi (or greater) above the mechanical regulator set point. 3. Confirm that carrier cylinder has flow to the GC. 4. Check for leaks in the carrier gas sample path. 5. Confirm that RTDs are not open. 6. If necessary, replace RTD(s), heater(s) and/or regulator(s).
Heater 1 Out Of Range Heater 2 Out Of Range Heater 3 Out Of Range Heater 4 Out Of Range Heater 5 Out Of Range Heater 6 Out Of Range Heater 7 Out Of Range Heater 8 Out Of Range	The GC failed to regulate heater zone temperatures for the indicated heater to within preset limits. Recommended actions: 1. Check temperatures within the GC, using MON 20/20 or the LOI. Be aware that the GC may generate this alarm during start up or if the setpoint has been changed. 2. Check wiring, looking for splits or loose connections at the termination board (for both the heaters and the RTDs). 3. If necessary, replace the defective heater and/or RTD.

Alarm Name	Possible Causes/Solution
Flame Out	The FID flame will not light or has extinguished. Recommended actions: 1. Use the front switch panel or the Local Operator Interface or MON 2020 to ignite the FID. 2. If unable to sustain the flame, confirm that both fuel and air cylinders are connected and contain sufficient pressure. 3. Confirm that fuel and air set points are set to achieve factory-desired mixture. 4. Confirm that there is no blockage at the FID outlet - such as a cap or ice. 5. Check that the wiring connections are secure for the FID, both on the FID cap and at the termination board. 6. If necessary, replace the FID module.
Flame Over Temperature	The FID flame temperature is above safe limits set at the factory and the FID flame has been extinguished, the fuel supply valve closed, and automatic analyses halted. Recommended actions: 1. Confirm that both fuel and air cylinders are connected and contain sufficient volume. 2. Confirm that fuel and air set points are set to achieve desired mixture. 3. Use the front switch panel or the Local Operator Interface or MON 2020 to ignite the FID.
Detector 1 Scaling Factor Failure	The GC detected an excess scaling factor deviation for Detector #1. Recommended action: Replace the preamp board located in SLOT 1 on the backplane.
Detector 2 Scaling Factor Failure	The GC detected an excess scaling factor deviation for Detector #2. Recommended action: Replace the preamp board located in SLOT 1 on the backplane.

Alarm Name	Possible Causes/Solution
Detector 3 Scaling Factor Failure	The GC detected an excess scaling factor deviation for Detector #3. Recommended action: Replace the preamp board located in SLOT 3 on the backplane.
Detector 4 Scaling Factor Failure	The GC detected an excess scaling factor deviation for Detector #4. Recommended action: Replace the preamp board located in SLOT 3 on the backplane.
No sample flow 1 (Applies to the optional sample flow switch.)	There is no sample flow in the GC. Recommended actions: Check sample gas rotometer in the sample conditioning system for flow and do one of the following: If no gas flow or no rotometer is present, do the following: 1. Confirm that there is gas flow at the sample point location. 2. Check that the sample valves in the sample conditioning system are open. 3. Check that the bypass return vent path is free of obstruction. 4. Confirm that the sample line is connected from the sample point to the GC's sample conditioning system and is free of obstructions. 5. Close the valve at the sample tap, remove pressure from the line and check the filters at the probe or the sample conditioning system or both. If they are filled with liquids or particulates, replace the filtering elements. If automatic stream selection valves are present, confirm that they are operating properly. If a slight sample gas flow is present at the rotometer in the sample conditioning system, drain or replace all filters. If flow is observed in the rotometer, replace the sample flow switch because it might have failed.
No sample flow 2	Refer to "No sample flow 1".

<table>
<tr><th>Alarm Name</th><th>Possible Causes/Solution</th></tr>
<tr><td>Loss of Purge

(Applies to the 1500XA only)</td><td>There is a failure in the purge operation.

<u>Recommended actions</u>:

1. Check that there is inert purge gas flowing into the electronic enclosure of the gas chromatograph. If not, replace the purge gas bottle or repair the source of purge gas.

2. Confirm that the door to the electronic enclosure is shut and that there is positive pressure (above setpoint) present in the enclosure. If there is no positive pressure, and purge gas is flowing into the enclosure, look for damage to the door gasket and/or bulkheads and sealing materials. Repair as needed.

3. Look for loose or disconnected terminations on the purge controller assembly. Note that the purge controller assembly is mounted on the exterior of the GC but its terminations can be accessed from the interior of the electronics enclosure. Repair as required.

4. Replace purge controller assembly.</td></tr>
<tr><td>Low Carrier Pressure 1</td><td>Input carrier pressure for detector 1 is below the preset limit.

<u>Recommended action</u>: Check that the carrier cylinder pressure is 10 psi (or greater) above the mechanical regulator set point. If input carrier pressure is low, check the carrier cylinder pressure. Replace carrier gas cylinder if required.</td></tr>
<tr><td>Low Carrier Pressure 2</td><td>Input carrier pressure for detector 2 is below the preset limit.

<u>Recommended action</u>: Check that the carrier cylinder pressure is 10 psi (or greater) above the mechanical regulator set point. If input carrier pressure is low, check the carrier cylinder pressure. Replace carrier gas cylinder if required.</td></tr>
</table>

Alarm Name	Possible Causes/Solution
Low Carrier Pressure 3	Input carrier pressure for detector 3 is below the preset limit. Recommended action: Check that the carrier cylinder pressure is 10 psi (or greater) above the mechanical regulator set point. If input carrier pressure is low, check the carrier cylinder pressure. Replace carrier gas cylinder if required.
Low Carrier Pressure 4	Input carrier pressure for detector 4 is below the preset limit. Recommended action: Check that the carrier cylinder pressure is 10 psi (or greater) above the mechanical regulator set point. If input carrier pressure is low, check the carrier cylinder pressure. Replace carrier gas cylinder if required.
Analog Input 1 High Signal Analog Input 2 High Signal Analog Input 3 High Signal Analog Input 4 High Signal Analog Input 5 High Signal Analog Input 6 High Signal Analog Input 7 High Signal Analog Input 8 High Signal Analog Input 9 High Signal Analog Input 10 High Signal	Measured value for the indicated analog input is greater than the user-defined full scale range.
Analog Input 1 Low Signal Analog Input 2 Low Signal Analog Input 3 Low Signal Analog Input 4 Low Signal Analog Input 5 Low Signal Analog Input 6 Low Signal Analog Input 7 Low Signal Analog Input 8 Low Signal Analog Input 9 Low Signal Analog Input 10 Low Signal	Measured value for the indicated analog input is lower than the user-defined full scale range.

Alarm Name	Possible Causes/Solution
Analog Output 1 High Signal Analog Output 2 High Signal Analog Output 3 High Signal Analog Output 4 High Signal Analog Output 5 High Signal Analog Output 6 High Signal Analog Output 7 High Signal Analog Output 8 High Signal Analog Output 9 High Signal Analog Output 10 High Signal Analog Output 11 High Signal Analog Output 12 High Signal Analog Output 13 High Signal Analog Output 14 High Signal	Measured value for the indicated analog output is greater than the user-defined full scale range.
Analog Output 1 Low Signal Analog Output 2 Low Signal Analog Output 3 Low Signal Analog Output 4 Low Signal Analog Output 5 Low Signal Analog Output 6 Low Signal Analog Output 7 Low Signal Analog Output 8 Low Signal Analog Output 9 Low Signal Analog Output 10 Low Signal Analog Output 11 Low Signal Analog Output 12 Low Signal Analog Output 13 Low Signal Analog Output 14 Low Signal	Measured value for the indicated analog output is lower than the user-defined zero range.

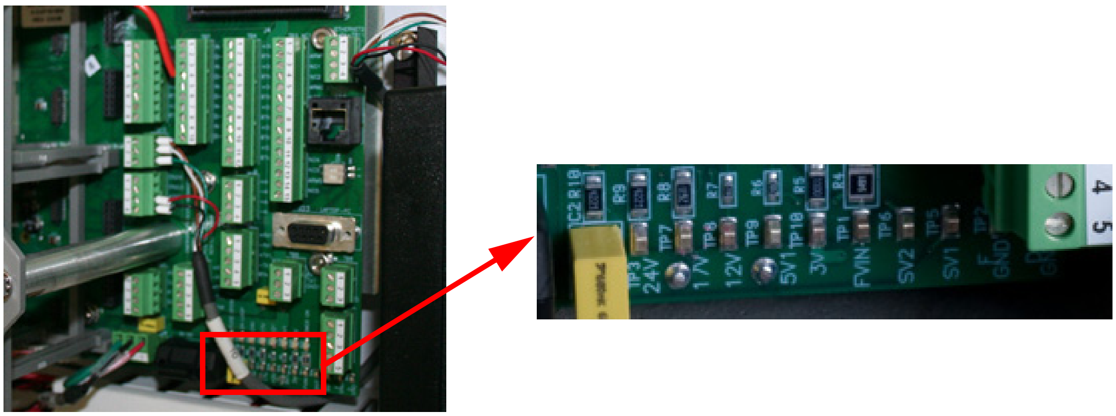
Alarm Name	Possible Causes/Solution
Stream 1 Validation Failure Stream 2 Validation Failure Stream 3 Validation Failure Stream 4 Validation Failure Stream 5 Validation Failure Stream 6 Validation Failure Stream 7 Validation Failure Stream 8 Validation Failure Stream 9 Validation Failure Stream 10 Validation Failure Stream 11 Validation Failure Stream 12 Validation Failure Stream 13 Validation Failure Stream 14 Validation Failure Stream 15 Validation Failure Stream 16 Validation Failure Stream 17 Validation Failure Stream 18 Validation Failure Stream 19 Validation Failure Stream 20 Validation Failure	The most recent validation sequence for the indicated stream failed. Recommended actions: 1. Check that the validation gas cylinder isolation valves are open. 2. Check that the validation gas regulators are set properly and that the cylinder is not empty. 3. If the cylinder is empty, replace with a full cylinder. 4. If the gas used for validation is the same as the gas that is used for calibration, ensure that the cylinder gas composition value listed on the cylinder's tag or on the certificate of analysis received from the supplier matches the value displayed in MON 2020's Component Data table. 5. If there is a mismatch, edit the Component Data table to reflect the correct value. 6. Re-run the validation sequence. 7. If still unsuccessful contact Analyzer Technician.

Alarm Name	Possible Causes/Solution
Stream 1 RF Deviation Stream 2 RF Deviation Stream 3 RF Deviation Stream 4 RF Deviation Stream 5 RF Deviation Stream 6 RF Deviation Stream 7 RF Deviation Stream 8 RF Deviation Stream 9 RF Deviation Stream 10 RF Deviation Stream 11 RF Deviation Stream 12 RF Deviation Stream 13 RF Deviation Stream 14 RF Deviation Stream 15 RF Deviation Stream 16 RF Deviation Stream 17 RF Deviation Stream 18 RF Deviation Stream 19 RF Deviation Stream 20 RF Deviation	The most recent calibration sequence failed. Recommended actions: 1. Check that the calibration gas cylinder isolation valves are open. 2. Check that the calibration gas regulators are set properly and that the cylinder is not empty. If the cylinder is empty replace it with a full cylinder. 3. Verify that the calibration cylinder gas composition value listed on the cylinder tag or on the certificate of analysis received from supplier matches the calibration cylinder gas composition value displayed in MON 2020's Component Data table. If there is a mismatch, edit the Component Data table to reflect the correct value. Re-run the calibration sequence. 4. If still unsuccessful contact Analyzer Technician, as adjustment of valve timing, valve maintenance and/or column repair may be required.

4.6.2 Test points

This section applies to GCs with two TCDs. If your GC is equipped with an FID or LSIV this section does not apply.

Figure 4-1. Test points on the back plane



The backplane has a set of test points that allow you to measure the voltage output of the Base I/O card. Each test point is labeled with a voltage value that, when measured with a voltmeter, should give a measurement equal to what is displayed on the label. A reading that does not match this label may indicate a faulty Base I/O card. Try swapping out the suspect card with a different one, and take another measurement. To get a measurement for a test point, touch the voltmeter's negative probe to the D GND test point, and touch the voltmeter's positive probe to the desired test point.

The following test points are associated with the following GC components:

Test Point	GC Component	Tolerances
24V (Regulated)	GC power	±2.4V
18V	Preamp (Input for the bridge circuit)	±0.5V
12V	Optional I/O cards	±0.6V
5V1	System chips	±0.25V

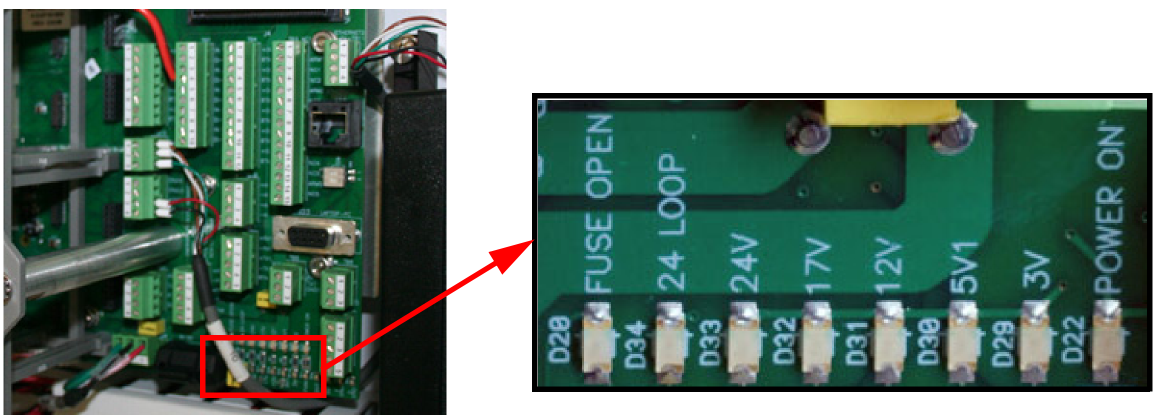
Test Point	GC Component	Tolerances
3.3V	System chips	±0.15V
FVIN, F GND	Field voltage input and ground	±0V - 3V (21v - 30v)
SV1, SV2	Solenoid voltages that drive the heater/solenoid card	±2.4V

The input voltage range for DC/DC power supply is between 21 and 30 volts. The input range for AC/DC power supply is 90 - 264 volts (auto-ranging).

Voltage LEDs

A set of LEDs can be found above the test points. These LEDs are a quick way to visually inspect the voltage status of some of the GC's electrical components.

Figure 4-2. Voltage LEDs



The following LEDs are associated with the following GC components:

LED	GC Component
FUSE OPEN	Glows red when the fuse has blown or been removed; otherwise, it is not lit.
24 LOOP (Power)	Glows green when the current loop for the analog outputs is functioning properly; otherwise, it is not lit.
24V (Regulated)	Glows green when the GC power is functioning properly; otherwise, it is not lit.
17V (Input for the preamp)	Glows green when the Preamp is functioning properly; otherwise, it is not lit.
12V (Input for the I/O cards)	Glows green when the optional ROC expansion card is functioning properly; otherwise, it is not lit.
5V1	Glows green when the System chips are functioning properly; otherwise, it is not lit.
3V	Glows green when the System chips are functioning properly; otherwise, it is not lit.
POWER ON	Glows green when the GC is on; otherwise, it is not lit.

4.6.3 Sample flow balance check

Ensure that the flow panel gauge is properly set. Flow should be as specified on the Parameter List for the 1500XA. To access the list, start MON 2020, connect to the GC and select **Parameter List** from the **Logs/ Reports** menu.

4.6.4 Carrier flow balance check

Check the flow at the measure vent and sample vent using a portable electronic flow meter or a mechanical flow meter.

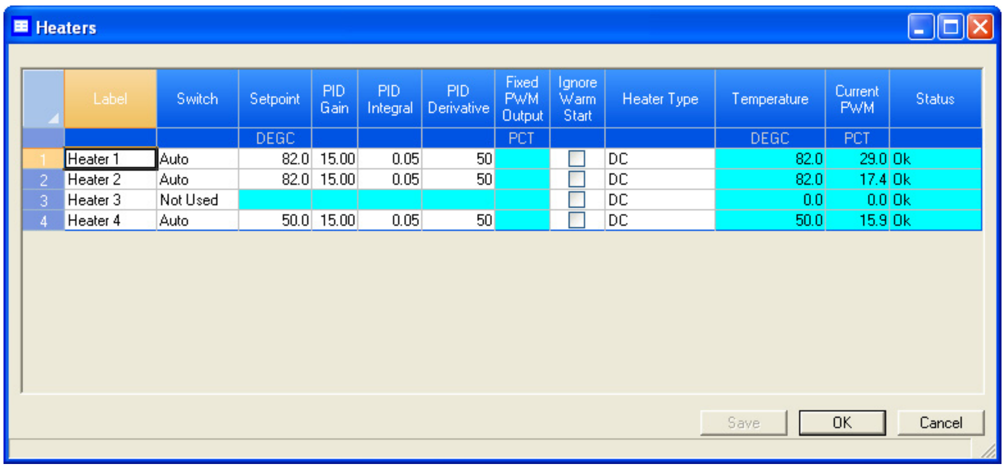
If your reading is abnormal, do not adjust the gauge; instead, consult with the Customer Service department.

4.6.5 Temperature

Use MON2020 to monitor the temperature of the detector(s) and heaters to determine if the GC is thermally stable.

When connected to the GC via MON2020, select **Heaters...** from the **Hardware** menu to access this function. The *Heaters* window displays.

Figure 4-3. The Heater window



	Label	Switch	Setpoint (DEGC)	PID Gain	PID Integral	PID Derivative	Fixed PWM Output (PCT)	Ignore Warm Start	Heater Type	Temperature (DEGC)	Current PWM (PCT)	Status
1	Heater 1	Auto	82.0	15.00	0.05	50			DC	82.0	29.0	Ok
2	Heater 2	Auto	82.0	15.00	0.05	50			DC	82.0	17.4	Ok
3	Heater 3	Not Used							DC	0.0	0.0	Ok
4	Heater 4	Auto	50.0	15.00	0.05	50			DC	50.0	15.9	Ok

When viewing the *Heater* window, the typical heater configuration is as follows:

- **Heater 1** refers to the air bath oven.
- **Heater 2** and **Heater 3** are application-defined or not used.
- **Heater 4** refers to the methanator, if one is installed; otherwise, it is not used.

The *Temperature* column on the *Heaters* window displays the current temperature; the *Current PWM* column displays the percentage of power being used to run the heater.

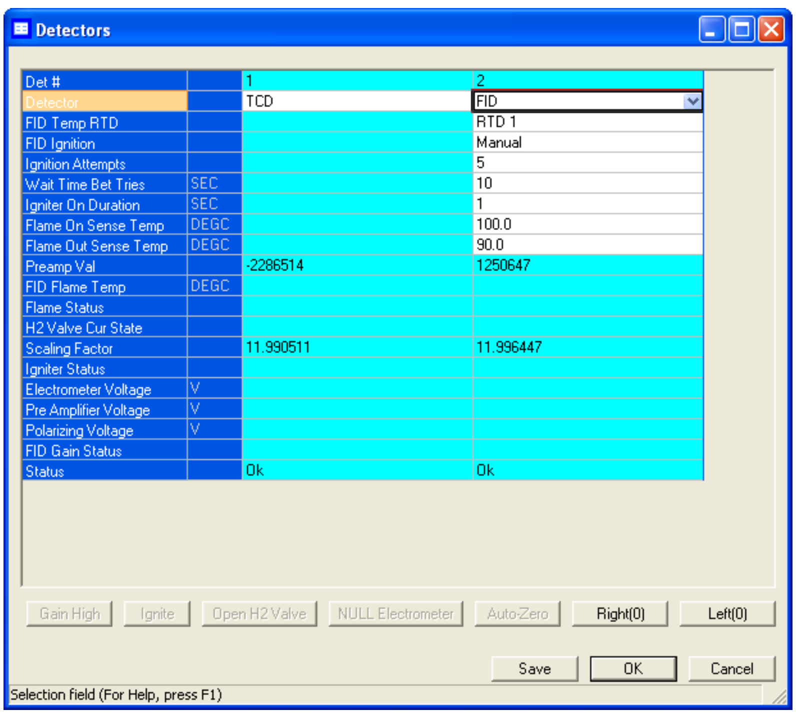
Note
The GC will wait for its temperature to stabilize—based on its setpoint—before it begins an analysis.

The settings and values shown in the *Heaters* window or the GC's Parameter List are based on the specific customer application. These values should not be changed unless recommended by Application Engineering, customer service personnel, or as part of a factory application requirement.

4.6.6 FID Configuration

When connected to the GC via MON2020, select **Detectors** from the **Hardware** menu to access the *Detectors* dialog. Refer to the MON2020 user manual for additional configuration details.

Figure 4-4. The Detectors window



Configure the following fields from the *Detectors* dialog:

- FID Ignition - manual or automatic
- Ignition Attempts
- Wait Time Bet Tries - wait time between tries
- Igniter **ON** duration
- Flame **ON** Sense Temperature
- Flame **OUT** Sense Temperature
- Electrometer Voltage

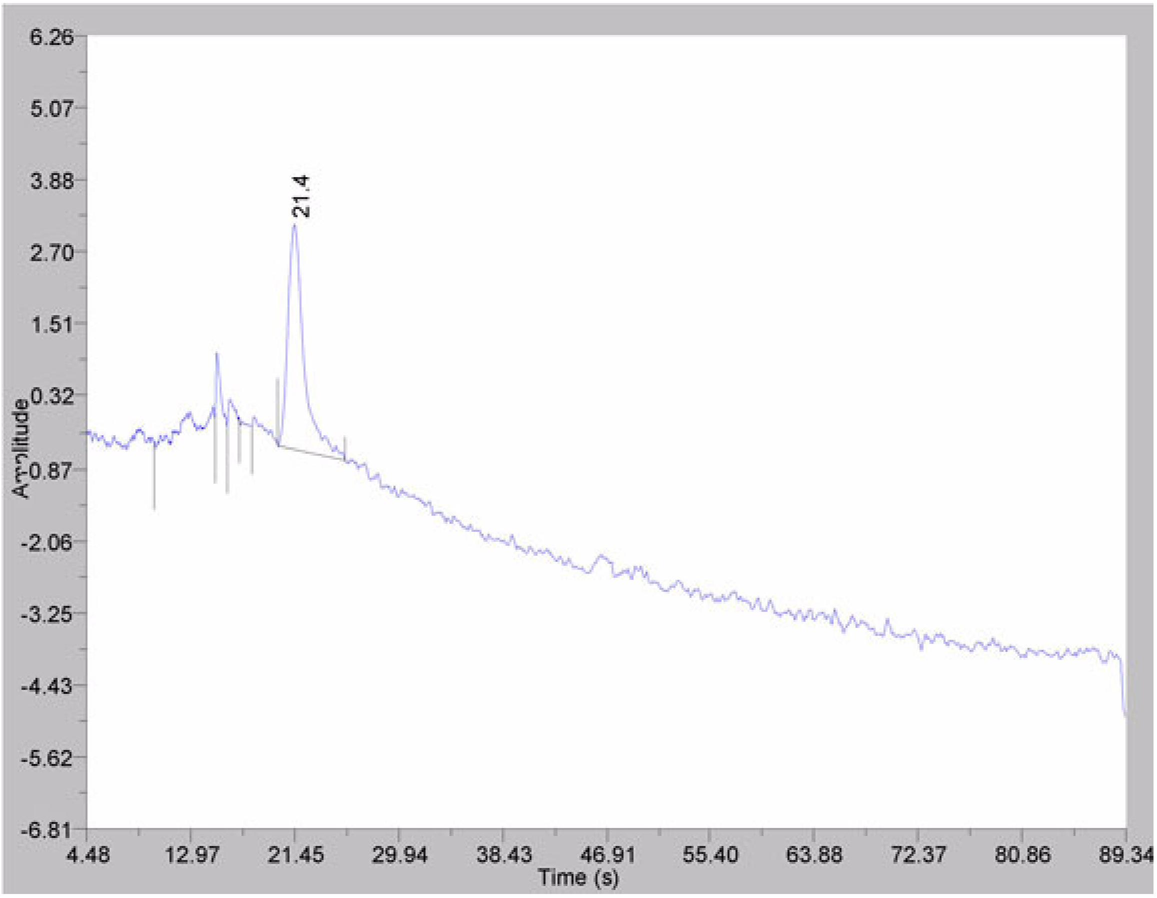
4.6.7 Baseline noise

Baseline noise is any perturbation on the detector output that is not related to an eluted solute. It is a fundamental property of the detecting system and determines its maximum sensitivity. Baseline noise can be divided into the following three types:

- Short term noise
- Long term noise
- Drift

Short term noise results from baseline upsets that have frequencies significantly higher than those of an eluted peak. Short term noise is not a serious problem as it is easily removed by appropriate noise filters without significantly affecting the profiles of the peaks. Its source usually originates from either the detector sensor system or the preamplifier.

Figure 4-5. An example of baseline noise

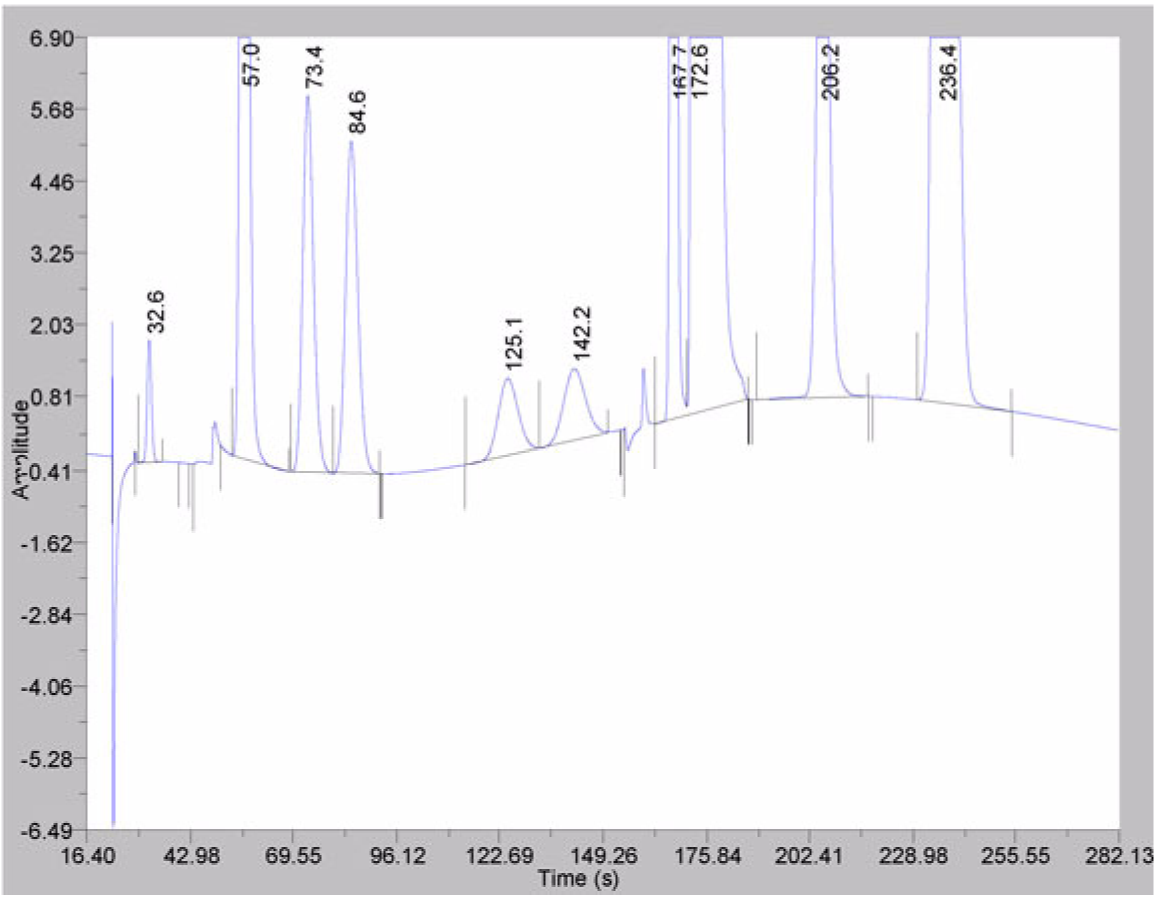


Long term noise results from baseline upsets that have frequencies similar to those of an eluted peak. This type of noise is the most damaging because it can not be differentiated from very small peaks. Long term noise cannot be removed by electronic filtering without affecting the profiles of the eluted peaks. Long term noise usually arises from temperature, pressure or flow rate changes in the sensing cell and is largely controlled by detector design. It is this noise that ultimately limits the sensitivity of the detector.

A noisy baseline can be caused by carrier leaks, an electronic failure in the preamplifier, a faulty power supply, inbalance of carrier flow or defective thermistors in the detector.

Baseline drift results from baseline upsets that have frequencies that are significantly larger than those of the eluted peak. Drift is almost always due to either changes in ambient temperature, changes in mobile flow rate, detector cell pressure or column bleed in the GC. Drift is easily controlled by choosing operating parameters that are within detector and column specifications.

Figure 4-6. An example of baseline drift



To ensure that the baseline is not drifting, compare the baseline upsets caused by valve actuations with those of the spectrum chromatogram provided with the Operational Parameters Sheet.

Ensure that no evidence of component elutions is present when sample is not being injected.

If differences exist between the two spectrum chromatograms, the problem may be due to one or more of the following:

- Programming of events
- Leaks in the carrier system
- Column deterioration due to liquid contamination from a sample

4.7 Checking the GC for leaks

There are two procedures for leak-checking a GC: a field-level check and a factory-level check.

4.7.1 Field-checking the GC for leaks

To perform a field-service leak check of the GC, do the following:

1. Plug all vents.
2. Make sure the setting of the carrier gas cylinder regulator is 115 pounds per square inch, gauge (psig).
3. Check all fittings at the pressure regulator flow panel and at the carrier gas cylinder regulator with an electronic leak detector. Correct any leaks detected.
4. Turn the carrier gas cylinder shut-off valve clockwise to close. Observe the carrier gas pressure for ten minutes to check for a drop in carrier pressure. The drop should be less than 200 psig on the high side of the regulator/gauge. If the carrier gas pressure remains constant, no leaks are present.
5. Use the LOI or MON2020 to actuate the valves on and off and observe the pressure with the valves in different positions than in step 4. When the valves are switched, some pressure change is normal

because of carrier loss. Momentarily open cylinder valve to restore pressure if necessary.

6. If the pressure does not hold constant, check all valve fittings for tightness.
7. Repeat step 5 again. If leaks persist, check the valve ports with a commercial Helium leak detector. Do not use a liquid leak detector such as Snoop® on the valves or components in the oven.

4.7.2 Factory-checking the GC for leaks

To perform a factory-level leak check of the GC, do the following:

Note
The following are steps performed to leak-check the gas chromatograph at the factory when it is quality-checked prior to release. This procedure is more thorough and is designed to isolate specific zones of the GC where a leak may occur.

Before beginning the procedure, be sure to plug the measure vent, which is labeled "MV". Leave the sample vent, labeled "SV" unplugged.

Leak check the carrier gas line first, according to the following steps:

1. Purge the analyzer valves with carrier gas, as follows:
   (a) Open the carrier gas bottle valve and slowly increase the carrier gas feed line pressure to 115 psig, ±2%, with the dual-stage regulator at the carrier gas bottle.
   (b.) If appropriate, make sure the valve actuation pressure is between 110 and 120 psig.
   (c) Use the LOI or switch panel to turn each analyzer valve OFF and ON five times.
2. Pressurize and check the carrier gas feed line, as follows:
   (a) Set all analyzer valve switches to the ON position.
   (b) Open the carrier gas bottle valve, and ensure that the carrier gas feed line pressure is 110 pounds per square inch gauge (psig), ±2%.
   (c) Shut the carrier gas bottle valve.

   (d) Observe the pressure on the high-side regulator gauge of the carrier gas bottle. Because the measure vent line is plugged, the pressure should not decrease during a period of 2-3 minutes.
   (e) Set all analyzer valves to the OFF position.
   (f) Repeat steps 4-b through 4-d.
   (g) Set all analyzer valves to AUTO for regular operation.

3. This completes the carrier gas line leak check. Next, leak check the calibration gas feed line, according to the steps that follow.
4. Plug the sample vent, which is labeled "SV".
5. Pressurize the calibration gas line to 50 psig.

Note
Calibration gas line pressure of 50 psig is for leak check and test purposes only. For normal operation, the calibration gas line pressure is maintained at 20-30 psig.

   (a) Shut the calibration gas bottle valve.
   (b) Observe the pressure on the high-side regulator gauge of the calibration gas bottle. Because the sample vent line is plugged, the pressure should not decrease during a period of 2-3 minutes.

6. This completes the calibration gas line leak check. Next, leak-check the sample gas lines, according to the steps that follow.
7. Pressurize the sample gas line to 50 psig.

Note
Calibration gas line pressure of 50 psig is for leak check and test purposes only. For normal operation, the calibration gas line pressure is maintained at 20-30 psig.

   (a) Shut off the sample gas.
   (b) Observe the pressure on any gauge that indicates pressure between the closed sample gas block valve and the plugged sample vent line. Because the line is plugged, the pressure should not decrease during a period of 30 minutes.

8. Leak test all other sample stream lines by connecting gas to each of the sample streams and repeating steps 9 through 10-b.

9. Finish the test and set up the analyzer for normal operation, as follows:
   (a) Ensure that all analyzer valves are set to AUTO.
   (b) UNPLUG THE MEASURE AND SAMPLE VENT LINES.
   (c) If the calibration gas bottle was used to leak-check the sample stream lines, reconnect the calibration gas bottle to the calibration gas line on the SCS mounting plate, and reconnect the sample stream lines.

4.7.3 Plugged lines, columns, or valves

To ensure that lines, columns, and valves are not plugged, check the gas flow at valve ports. For a reference, use the flow diagram in the drawing package, and remember these points about flow diagrams:

- Port-to-port flow paths are indicated by solid or dashed lines.
- A dashed line indicates flow direction when the valve is ON, that is, energized.
- A solid line indicates flow direction when the valve is OFF, i.e., not energized.
- A combination of solid and dashed lines indicates a constant flow path regardless of the ON/OFF state of the valve.

4.8 Valves

Only minimal repair and maintenance is required by the customer (e.g., replacing the diaphragms).

4.8.1 Required tools for valve maintenance

The tools required for performing repair and general maintenance on the valve assemblies are:

- Torque wrench, scaled in foot-pounds
- 1/2” socket for 10-port valves
- 7/16” socket for 6-port valves
- 1/4” open-ended wrench
- 5/16” open-ended wrench
- 5/32” allen wrench

4.8.2 Valve replacement parts

Replacement parts required for each valve consists of one of the following:

- Diaphragm Kit 6-port XA Valve (P/N 2-4-0710-248)
- Diaphragm Kit 10-port XA Valve (P/N 2-4-0710-171)

Figure 4-7. XA valves

4.8.3 Valve overhaul

The XA valves are designed to withstand millions of actuation cycles without leakage or failure. If service is required, the valve can be overhauled using replacement parts available from Customer Service. If you need assistance, call 1-713-827-6314.

Note
Replacement factory-built valves are available. We recommend returning and replacing the 6-port valve for extensive repairs or complete replacement.

Use the following procedure for overhauling a valve:

1. Shut off carrier and sample gas streams entering the unit.
2. Open the door to the lower enclosure to access the valves.

3. Disconnect tubing and fittings that attach to the valve from other locations.
4. Loosen the attaching bolt on the valve to be replaced or serviced.
5. Loosen the valve's torque bolt.

Figure 4-8. The torque bolt

6. Holding the lower piston plate, pull the valve straight off the block. The alignment pins may stick slightly.

Note
Ensure that the primary seal diaphragm is correctly installed on the primary plate.

7. Remove and discard the old valve diaphragms and gaskets.
8. Clean the sealing surface as required using a lint-free cloth and isopropyl alcohol. Blow the sealing surface with clean, dry instrument air or carrier gas. Dirt including dust and lint can cause troublesome leakage.

Note
Do not use an oil-based cleaner on the valve.

9. Replace the old diaphragms, in the same order, with the new ones supplied.

10. Reinstall the valve using the following steps:
    (a.) Align the pins with holes in the block and push the valve assembly into place.
    (b.) Tighten the valve's torque bolt. The 6-port valve requires 20 ft/lb of torque; the 10-port valve requires 30 ft/lb of torque.
    (c.) Reconnect all fittings and tubing.

4.8.4 Valve cleaning

Use isopropyl alcohol (P/N 9-9960-111) to clean a valve.

Note
Do not use an oil-based cleaner on valves.

4.9 Detector maintenance

When a TCD fails to perform normally it should be replaced. Signs that a TCD may be faulty include, but are not limited to, the following:

- A chromatogram with a wandering or drifting baseline;
- A chromatogram with a noisy baseline;
- A chromatogram with a no peaks;
- No chromatogram.

The definitive test for a faulty TCD involves measuring the resistance of each filament using a voltmeter. A set of thermistors should give the same voltmeter reading; therefore, if a thermistor reading is significantly different from the reading of its mate, the pair should be replaced, otherwise the TCD bridge will be unbalanced, noisy and drifty.

4.9.1 Required tools for TCD maintenance

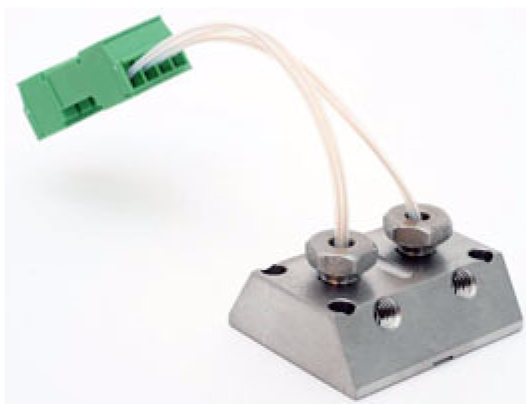
A flat-head screwdriver is required for removing and replacing TCDs.

4.9.2 TCD replacement parts

The following parts are required to replacing one TCD:

- Thermistor seal (P/N 6-5000-084)
- Thermistor set (P/N 6-1611-083)

Figure 4-9. TCD with block



4.9.3 Replacing a TCD

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

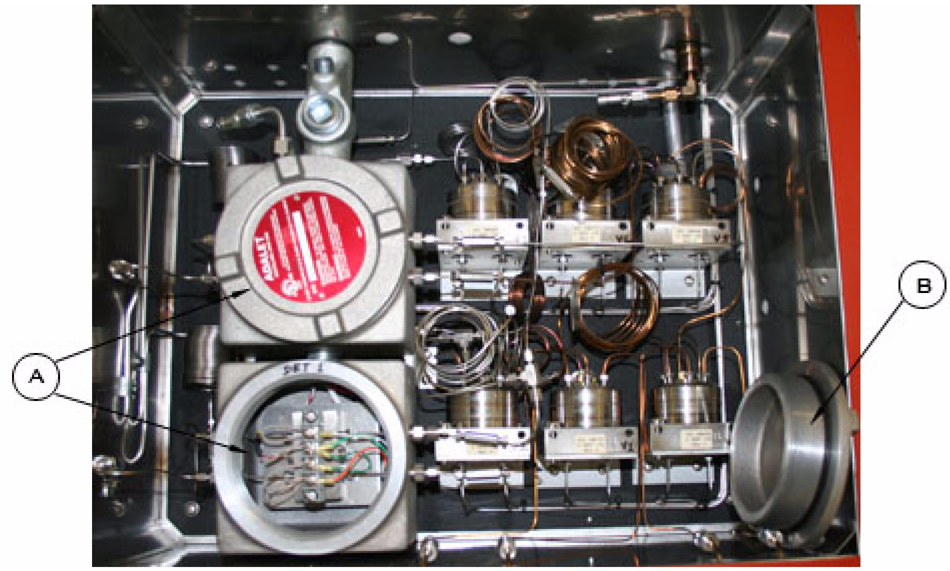
Disconnect all electrical power to the unit and ensure the area is free of explosive gases. Failure to follow this warning may result in injury or death to personnel or cause damage to the equipment.

Use the following procedure to replace a detector:

1. Disconnect all power to the unit.

2. Open the door of the lower enclosure to gain access to the TCD housing(s).

Figure 4-10. The lower enclosure

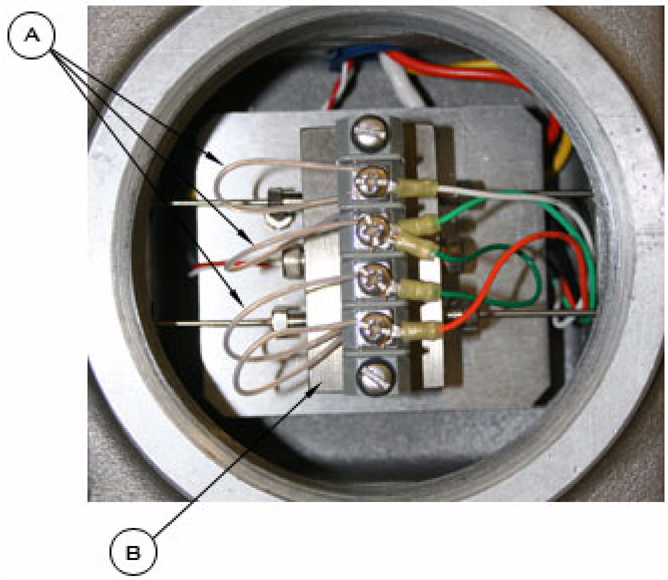


A. TCD housings
B. Housing cover

3. Unscrew and remove the cover to the housing whose detector you want to replace.

4. Unscrew and release all wire leads from the termination block.

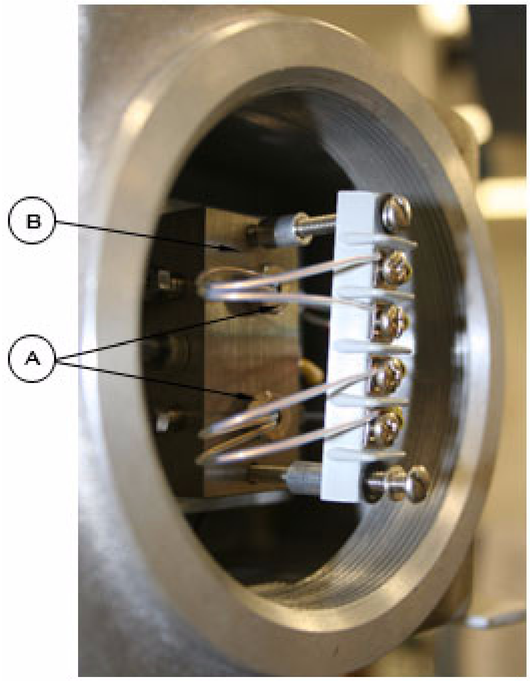
Figure 4-11. TCD leads



A. TCD leads
B. Termination block

5. Unscrew and remove the two termination block screws located at the top and bottom of the termination block to gain access to the TCD block and retainer nuts.

Figure 4-12. The TCD block



A. TCD retainer bolts
B. TCD block

6. The TCD element is held within the TCD retainer bolt. To replace the element, do the following:

   (a.) Unscrew the retainer bolt from the TCD block.

   (b.) Remove the old teflon seals, element, and its wires from the retainer nut and insert the new teflon seals and element.

   (c.) Screw the retainer bolt back into the TCD block.

7. Reconnect all wire leads to the termination block.

8. Use the two termination block screws to return the termination block to its original position over the TCD block.

4.9.4 Removing the FID

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

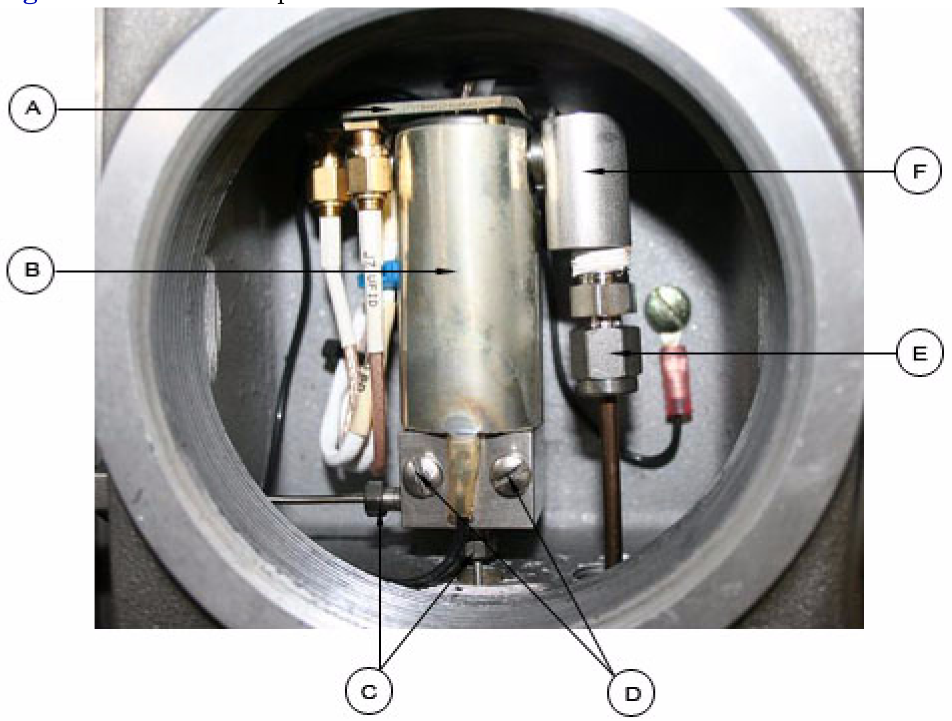
Disconnect all electrical power to the unit and ensure the area is free of explosive gases. Failure to follow this warning may result in injury or death to personnel or cause damage to the equipment.

Use the following procedure to remove the FID from the GC:

1. Disconnect all power to the unit.
2. Open the door of the lower enclosure to gain access to the FID housing and allow components to cool down so that they can be handled.
3. Unscrew and remove the housing cover to gain access to the FID.

4. Unscrew the tubing connecters located at the bottom of the FID.

Figure 4-13. FID components



A. FID board
B. Shield
C. Tube connectors
D. FID block screws
E. Exhaust tube
F. Vent cover

5. Unscrew the two FID block screws.
6. Unscrew the FID exhaust tube.
7. Grasp the edges of the FID board on top of the unit and pull and wiggle to remove the six socket tubes that extend onto the pins in the cap.
8. Unscrew the vent cover
9. Grasp the shielded section and lift it over the burner. Pull the cap out of the shield. Remove the body from the shield, if necessary.

4.9.5 FID maintenance

The FID cap has no replaceable parts. Damage like a broken RTD or broken igniter coil requires a replacement cap.

The burner tip can be removed for cleaning.

1. Loosen the isolating nut one turn.
2. Gently lift out the burner tip tube. Use short needle nose pliers if it is stubborn, taking care not to bend the tube. The alternative is to unscrew the assembly and clean as an assembly.

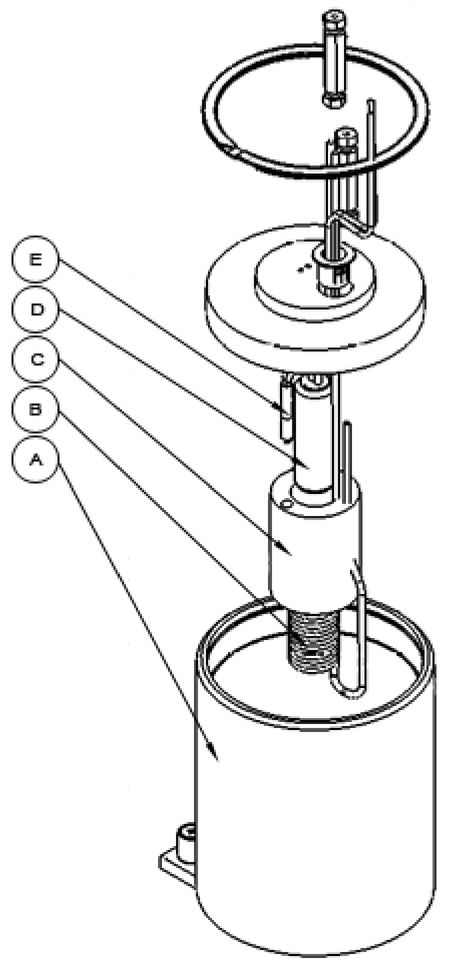
4.9.6 FID re-assembly

1. Insert burner tip tube into the isolating nut. Be certain it is fully seated. There should be about .350" of tube visible.
2. Tighten the isolating nut in small increments until the tube ceases to pull free. Slight additional tightening will ensure proper sealing.
3. Place the cap onto the end of the body with the deep cavity. Once the alignment pin is in its mating hole, gently press the two parts together and ensure the o-ring is seated properly.
4. Slide the FID shield onto the body from the bottom. Align the notch with the exhaust fitting and insert the two screws.
5. Lower the FID body assembly onto the base, placing the alignment pin in its hole. Press the body into place, seating the o-ring. Tighten the screws slightly more than 'finger tight.'
6. Re-connect the ground lead.
7. Press the FID exhaust tube onto the fitting and anchor with the ‘U’ shaped clip. (1/16" tubing makes an adequate clip.)
8. Plug the FID board onto the cap.

4.10 Methanator maintenance

The optional methanator, which is a catalytic converter, converts otherwise undetectable CO_2 and/or CO into methane by adding hydrogen and heat to the sample. The methanator requires little maintenance.

Figure 4-14. Optional Methanator Assembly



A. Case
B. Catalytic Column
C. Tube
D. Heater
E. RTD (temperature detector)

The RTD is replaceable. When replacing it, take care to anchor the RTD cable to the tubing to prevent loosening over time.

To replace the RTD, consult drawing #CE-22210, which is available at the back of this manual.

4.11 Measure vent flow

You will need an accurate flow meter for this measurement.

To measure the measure vent flow, proceed as follows:

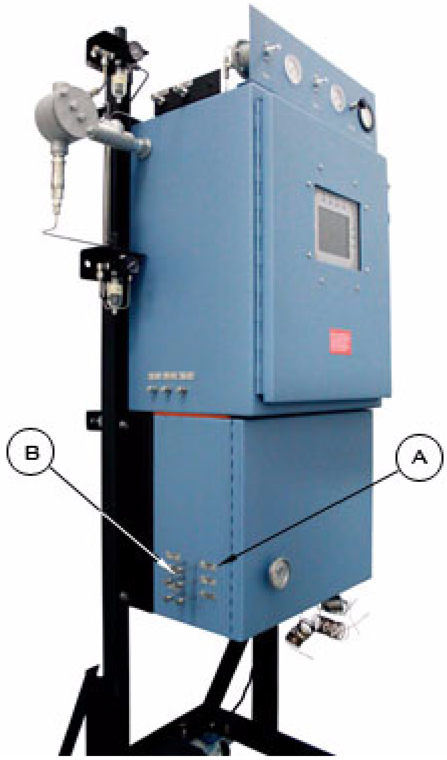
1. Attach a flow meter to the vent output labeled "Measure Vent 1" on the left side of the 1500XA's lower enclosure.

   The flow should measure 12-18 cc/min.

2. Attach a flow meter to the "Measure Vent 2" output.

   The flow should measure 12-18 cc/min.

Figure 4-15. Measure flow vents



A. Measure vents (2)
B. Sample vents (2)

4.12 Electrical components

The GC is designed to operate for long periods of time without need for preventive or regularly scheduled maintenance. The GC can also be constructed using purged enclosures.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Disconnect all electrical power to the unit and ensure the area is free of explosive gases. Failure to follow this warning may result in injury or death to personnel or cause damage to the equipment.

Should there be a need to open the purged enclosure, first disconnect all electrical power to the unit, and ensure the area is free of explosive gases. Prior to opening the GC, check the operating parameters of the application with a PC using MON2020 and attempt to isolate or fix any incorrect parameters.

To access the electrical components,

1. Ensure electrical power is disconnected from the unit and the environment is safe.
2. Open the electronics enclosure front panel and access the card cage assembly holding the circuit boards.

Figure 4-16. Card cage assembly

A. Card cage

3. Note the location and direction of any board removed. Remove only one end of any cable necessary to obtain access to the desired board. Remember or make note of the cable installation so that the cables can be replaced in the same order. Release the catch(es) and remove/replace the circuit board(s) as necessary.

Note
After removing the cable(s), any board may be replaced without removing the card cage assembly.

4.13 Communications

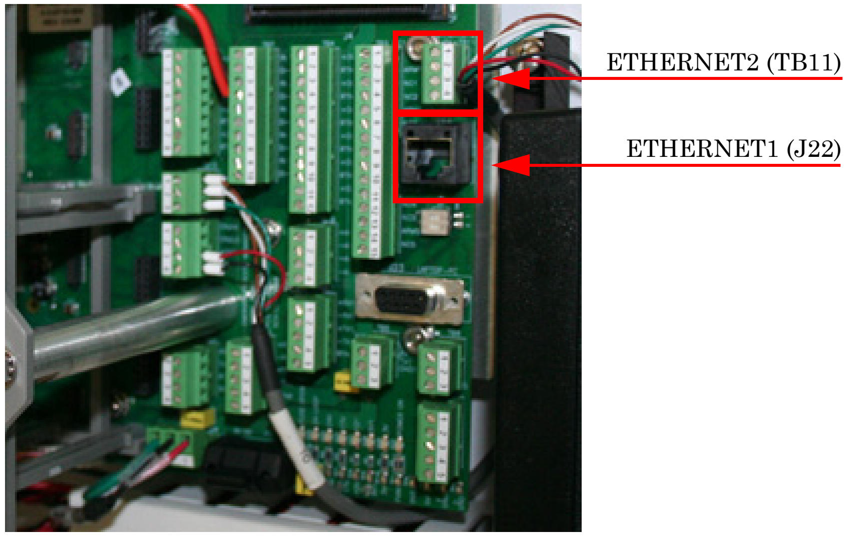
The 1500XA has four serial communications ports: COM0, COM1, COM2, and COM3, which is a dedicated PC-to-GC port. The mode for each of the first three ports can be set to RS232, RS422, or RS485. These port configurations are normally specified by the customer at the time of order and then set at the factory, but they can be changed at any time with MON2020.

Note
The backplane has two switches located at SW1. The first switch is is used for starting the DHCP server. See "Connecting directly to a PC using the GC's Ethernet port" on page 3-20 for more information. The second second is reserved for future use.

The backplane has two ethernet ports. The following table lists relevant data:

Name	Location	Connector Type
ETHERNET1	J22	RJ45 (DHCP-enabled)
ETHERNET2	TB11	Phoenix

Figure 4-17. Ethernet ports on the backplane



4.13.1 Changing the line drivers

The following table lists the relevant traits of the GC's serial ports.

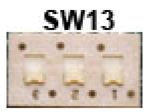
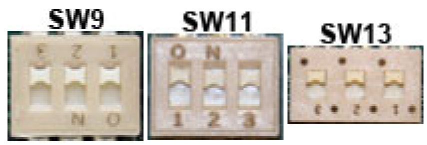
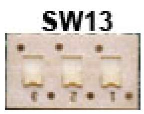
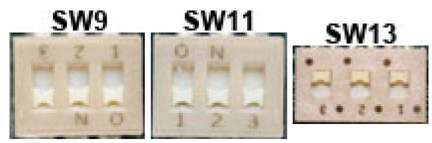
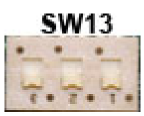
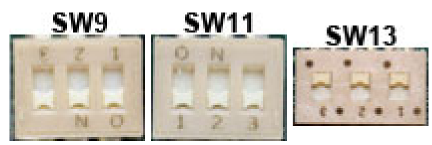
Port Name	Port Mode	Port Location on the back plane	Communication Modes Supported
Port 0	RS232	TB1	Modbus ASCII/RTU
	RS422, RS485	TB2	
Port 1	RS232	TB5	Modbus ASCII/RTU
	RS422, RS485	TB6	
Port 2	RS232	TB8	Modbus ASCII/RTU
	RS422, RS485	TB9	
Port 3 (DB9 connector)	RS232	J23 (LAPTOP-PC)	Modbus ASCII/RTU Direct connection through MON 2020

Note
Port 3 can be used to set up a direct-to-PC connection. See "Connecting directly to a PC using the GC's Ethernet port" on page 3-20 for more information.

The factory setting for each port is RS-232. To change the setting of a serial port, do the following:

1. Start MON 2020 and connect to the GC.
2. Select **Communication...** from the **Applications** menu. The *Communication* window displays.
3. Select the appropriate mode from the *Port* drop-down list for the appropriate serial port. The options are **RS232** or **RS485 or RS422**.
4. Click **OK**.
5. Close MON2020.
6. Turn off the GC.
7. Locate and remove the Base I/O board, which is located in the card cage in the GC's lower enclosure.
8. Consult the following table, which shows the correct switch settings for each mode. The first column lists the port number; the first row lists the communications mode. The table cell at which the desired port and the desired mode intersect contains the appropriate switch settings for that configuration.

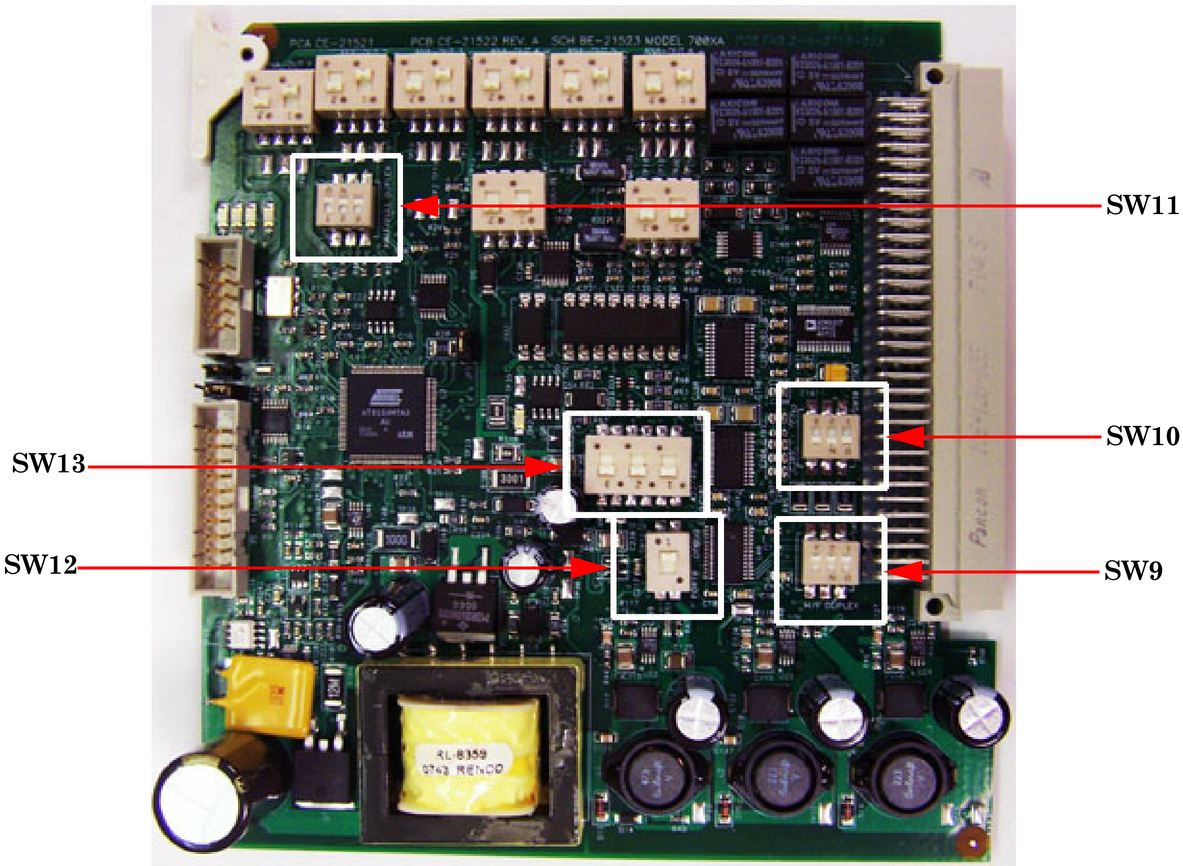
Port 0 corresponds with channel “1” on each switch; Port 1 corresponds with channel “2” on each switch; Port 2 corresponds with channel “3” on each switch.

	RS-232	RS-422 (Full Duplex/4-Wire)	RS-485 (Half Duplex/2-Wire)
Port 0			
Port 1			
Port 2			

Therefore, if you want to set Port 1 to RS-232 mode, you would set channel “2” on SW13 to the down position.

9. To learn the location of a switch on the Base I/O board, consult Figure 4-2:

Figure 4-18. Serial port switches on the Base I/O board

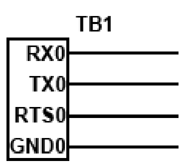
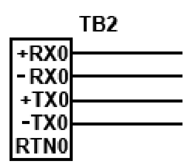
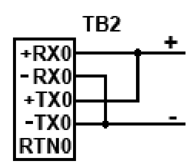
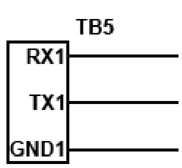
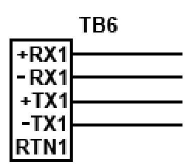
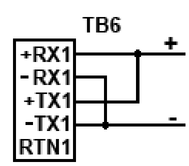
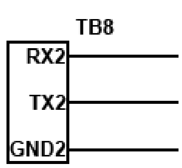
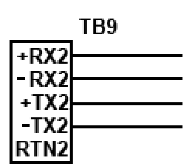
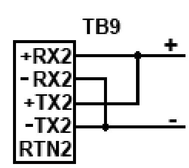


Note
The Base I/O board should be oriented with the ejector edge at the top, facing left.

10. Make sure that SW12 is set to the down position; otherwise, Port 0 will not function.

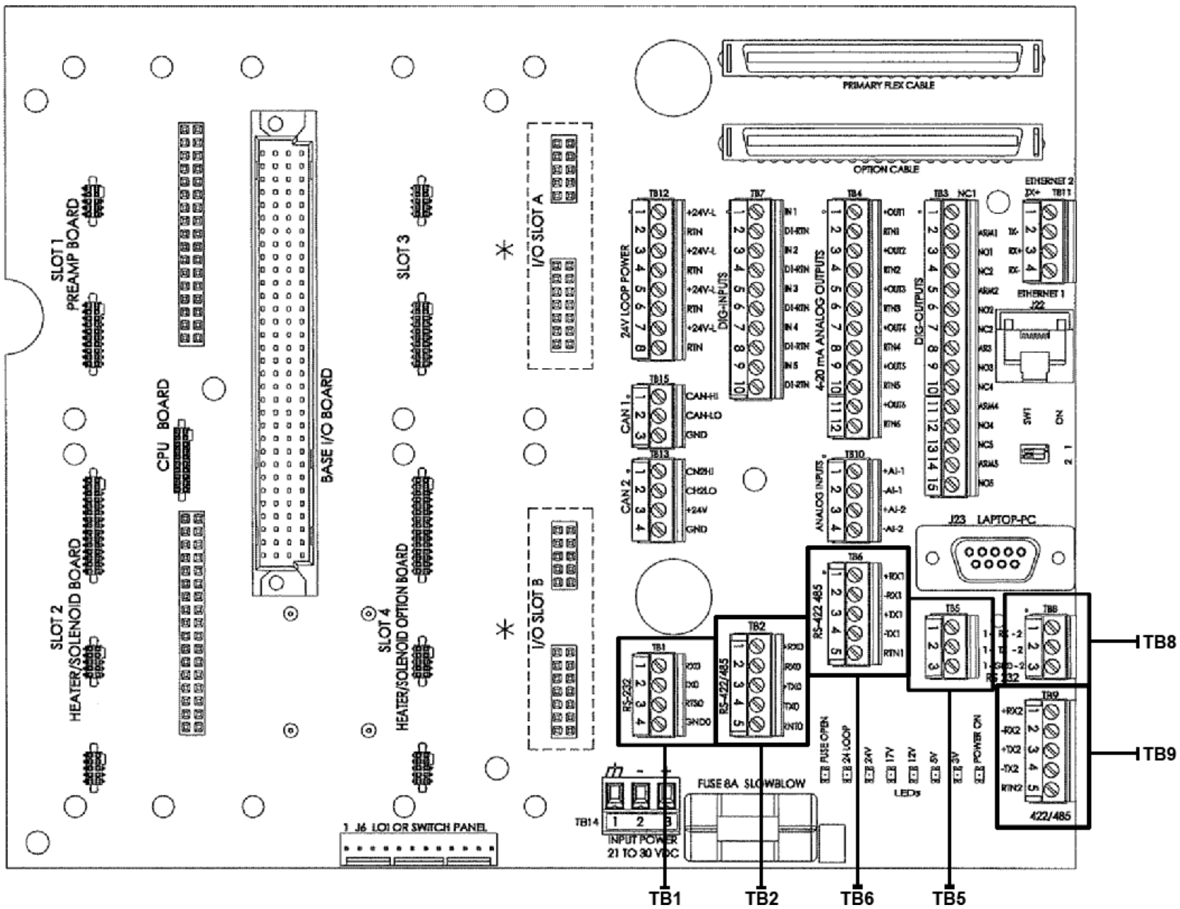
Note
Ordinarily SW12 should never be adjusted. It is used by the factory for testing purposes. If it was somehow set to the top, be sure to return it to its factory-set position, which is the bottom position.

11. To enable line termination for a serial port, set the appropriate port switch on SW10 to the bottom position.
12. Replace the Base I/O board in the card cage.
13. Consult the following table, which shows the correct termination block wiring for each mode and port. The first column lists the port number; the first row lists the communications mode. The table cell at which the desired port and the desired mode intersect contains the appropriate wiring for that configuration.

	RS-232	RS-422 (Full Duplex/4-Wire)	RS-485 (Half Duplex/2-Wire)
Port 0			
Port 1			
Port 2			

14. Access the backplane and consult the following graphic to locate the appropriate terminal blocks:

Figure 4-19. Terminal block locations on the backplane



15. Once the appropriate termination blocks are wired correctly, you can start up the GC.

4.13.2 Optional RS-232 serial ports

It is possible to install an optional RS-232 board in one or both of the expansion I/O slots provided on the GC's card cage in the electronics enclosure.

This extra port can be used for Modbus ASCII/RTU communications or to connect directly to a computer installed with MON 2020.

To install an optional RS-232 board, do the following:

1. Start MON 2020 and connect to the GC.
2. Select **I/O Cards...** from the **Tools** menu. The *I/O Cards* window displays.
3. Identify the appropriate card slot under the *Label* column and then select **Communications module - RS232** from the appropriate *Card Type* drop-down list.
4. Click **OK**.
5. Turn off the GC.
6. Install the RS-232 board into the appropriate I/O card slot in the GC's card cage.
7. Start the GC.

4.13.3 Optional RS-485/RS-422 serial ports

It is possible to install an optional RS-485 board in one or both of the expansion I/O slots provided on the GC's card cage in the electronics enclosure. This card can be configured in RS-422 (4-wire) or RS-485 (2-wire) mode. RS-485 mode is the standard setting; to configure the card for RS-422 mode, see "Configuring the optional RS-485 serial port to function as an RS-422 serial port" on page 4-54.

This extra port can be used for Modbus ASCII/RTU communications or to connect directly to a computer installed with MON 20/20. When used to connect to MON 20/20, the following limitations apply:

- Limited bandwidth.
- Supported on Windows XP® only—port won't work with Windows Vista® or Windows 7®.
- Must uncheck the **Use PPP protocol for serial connection (use SLIP if uchecked)** check box on the *Program Settings* window in MON 20/20.

4.13.4 Installing an optional RS-485/RS-422 serial port card

To install an optional RS-485/RS-422 serial port card, do the following:

1. Start MON 20/20 and connect to the GC.
2. Select **I/O Cards...** from the **Tools** menu. The *I/O Cards* window displays.
3. Identify the appropriate card slot under the *Label* column and then select **Communications module - RS422/485** from the appropriate *Card Type* drop-down list.
4. Click **OK**.
5. Turn off the GC.
6. Install the RS-485/RS-422 serial port card into the appropriate expansion slot in the GC's card cage.
7. Start the GC.

4.13.5 Configuring the optional RS-485 serial port to function as an RS-422 serial port

Use the following table to learn the correct jumper settings for configuring the optional RS-485 serial port to function as an RS-422 serial port:

Jumpers	RS-485 (Half Duplex/2-Wire)	RS-422 (Full Duplex/4-Wire)
J3	Half	Full
J5	Half	Full
	Termination IN	Termination OUT
J4	In	Out
J6	In	Out
	TB1 Wire Terminals	
	RS-485 (Half Duplex/2-Wire)	RS-422 (Full Duplex/4-Wire)
A	RxTx+	Rx+
B	RxTx-	Rx-
Y	NC	Tx+
Z	NC	Tx-

4.14 Installing or replacing a Foundation Fieldbus module

The Foundation Fieldbus module should be mounted adjoining the card cage. It is held in place by the LOI post tips that attach to the LOI posts.

Mounting the Foundation Fieldbus module requires the following items:

- A Foundation Fieldbus module
- A Foundation Fieldbus assembly bracket
- Two thumb screws
- Two flat washers
- A Foundation Fieldbus cable assembly

4.14.1 Removing a Foundation Fieldbus module

To remove the module, do the following:

1. Unscrew the two LOI post tips. The Foundation Fieldbus module can now be detached from the card cage.
2. Unscrew the two thumb screws that attach the Foundation Fieldbus assembly bracket to the Foundation Fieldbus module.

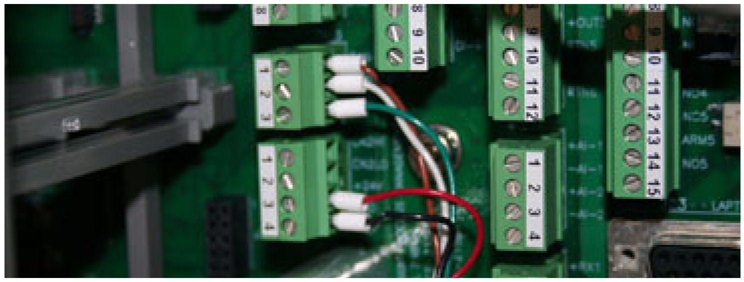
4.14.2 Installing a Foundation Fieldbus module

To install a Foundation Fieldbus module, do the following:

1. Attach the Foundation Fieldbus assembly bracket to the Foundation Fieldbus module by aligning the two holes in the Foundation Fieldbus assembly bracket with the two holes at the bottom of the Foundation Fieldbus module and screwing in the two thumb screws.
2. Attach the Foundation Fieldbus assembly bracket to the card cage by aligning the Foundation Fieldbus assembly bracket's second set of holes with the LOI post tip holes in the card cage.
3. Screw in the LOI post tips.
4. Use the following wiring chart to connect the Foundation Fieldbus cable assembly to the backplane:

Backplane connector	Post Number	Wire
TB15	1	Brown
	2	White
	3	Green
TB13	3	Red
	4	Black

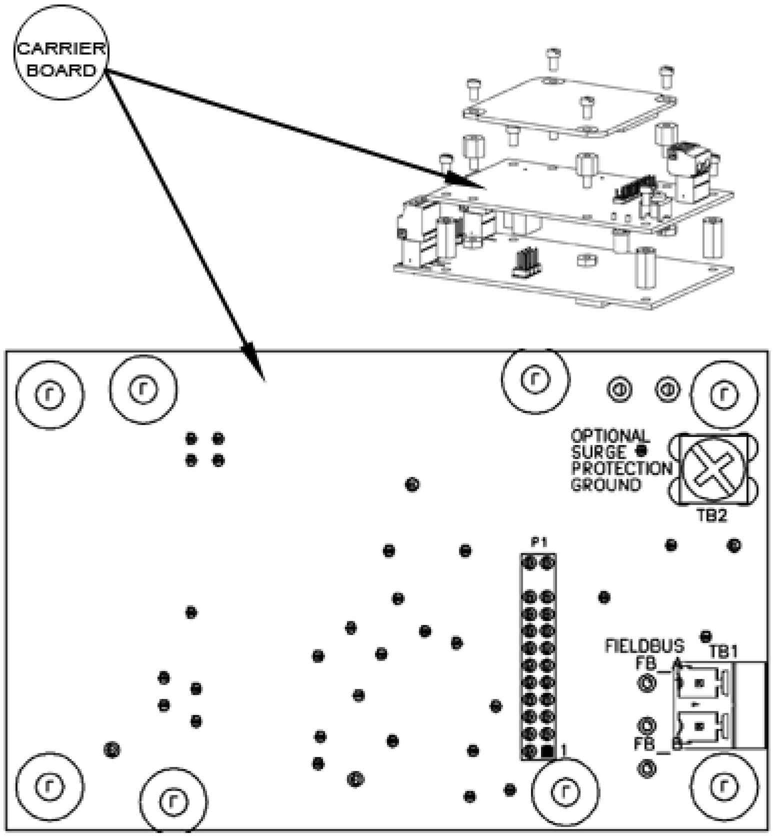
Figure 4-20. Foundation Fieldbus wiring on the backplane



4.14.3 Connecting the GC's Foundation Fieldbus module to a Fieldbus segment

The Foundation Fieldbus module has a terminal at TB1 on the carrier board, which is the middle card in the stack. This terminal can be used to connect to a Fieldbus segment.

Figure 4-21. Carrier board showing connector at TB1



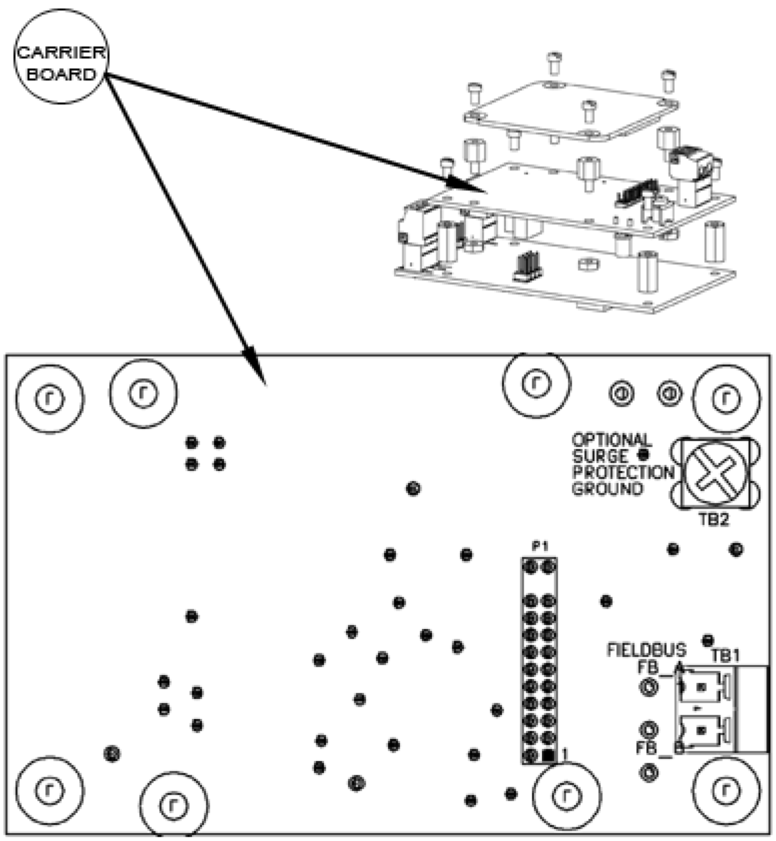
To connect to a Fieldbus segment, do the following:

1. Attach one end of a wire to **FB_A** on the carrier board and to the positive (+) terminal on the fieldbus segment.
2. Attach one end of a wire to **FB_B** on the carrier board and to the negative (-) terminal on the fieldbus segment.

4.14.4 Connecting the optional ground wire

If you wish to provide the Foundation Fieldbus module with surge protection, there is a ground lug at TB2 on the module's carrier board, which is the middle card in the stack. One end of the ground wire should be attached to this lug nut, and the other end should be attached to the frame of the GC.

Figure 4-22. Carrier board showing ground lug at TB2



CAUTION

```
The Foundation Fieldbus module is designed to be intrinsically safe; however,
attaching a ground wire will nullify this feature.
```

4.15 Analog inputs and outputs

The analog outputs can be calibrated or adjusted via MON2020. However, these outputs should be measured with a good digital meter upon initial installation at zero scale and full scale. Then the span can be set with MON2020 so that it represents values from zero to 100 percent of the user-defined units in use.

Nominally, calibration is made within a range of 4-20 milliamperes (mA) output from each analog channel. However, zero scale calibrations can be set with 0 mA output, and full scale calibration can be set with up to 22.5 mA output. If there is reason to suspect that the span on any particular channel might be off after a period of time and heavy use, then the analog output for that channel should be recalibrated.

4.15.1 Analog inputs

There are two isolated analog inputs available at TB10 on the backplane. See “Analog input wiring” on page 3-47 for more information.

4.15.2 Factory settings for analog input switches

Figure 4-23 shows the factory settings for the analog input switches that are located on the Base I/O board. These analog inputs are set to accept a current (4-20 mA) source.

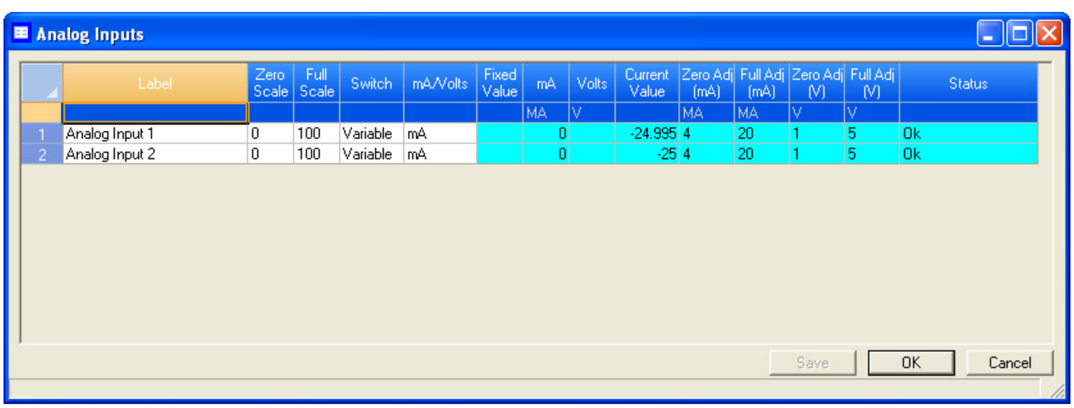
Figure 4-23. Factory settings for analog input switches

Note
To set an analog input to accept a voltage (0-10 VDC) source, flip the appropriate switch in the opposite direction from that shown in Figure 4-23.

4.15.3 Selecting the input type for an analog input

An analog input can be set to either voltage (0-10V) or current (4-20 mA) by flipping the appropriate switches on the Base I/O board.

1. Turn off the GC.
2. Locate and remove the Base I/O board, which is in the card cage in the GC's lower enclosure.
3. To set analog input #1 to current, locate **SW1** on the Base I/O board and push the switches up, toward the card ejector; to set the analog input to voltage, push the switches down, away from the card ejector.
4. To set analog input #2 to current, locate **SW2** on the Base I/O board and push the switches up, toward the card ejector; to set the analog input to voltage, push the switches down, away from the card ejector.
5. Replace the Base I/O board in the card cage.
6. Start up the GC.
7. Start MON2020 and connect to the GC.
8. Select **Analog Inputs** from the **Hardware** menu. The *Analog Inputs* screen displays.

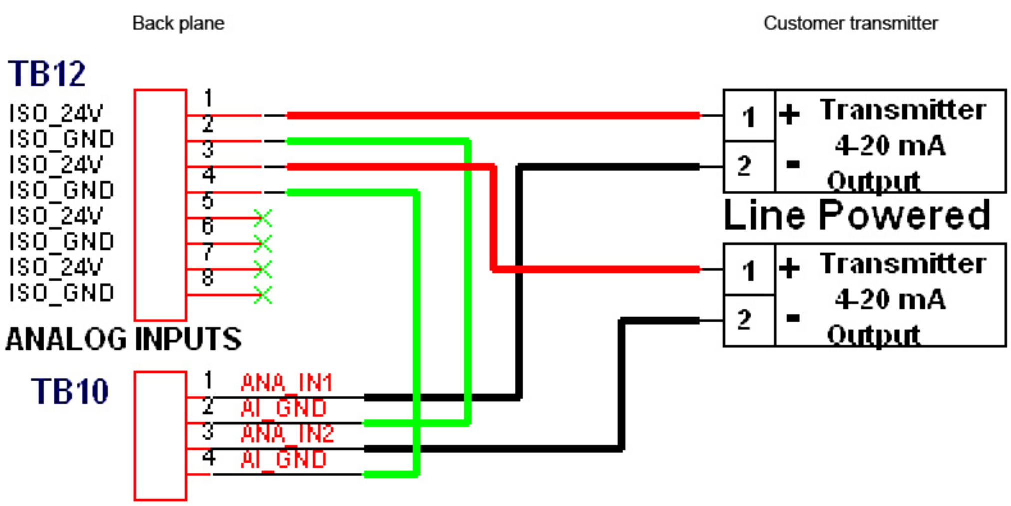


9. To set the analog input to current, select **mA** from the *mA/Volts* drop-down list for the appropriate analog input; to set the analog input to voltage, select **Volts** from the *mA/Volts* drop-down list for the appropriate analog input.
10. Click **Save** to save the changes and keep the window open, or click **OK** to save the changes and close the window.

4.15.4 Typical wiring for line-powered transmitters

The following drawing shows the most common wiring plan for supplying power to two 4-20 mA transmitters, such as pressure sensor transmitters.

Figure 4-24. Typical wiring for line-powered transmitters



4.15.5 Analog outputs

The 1500XA has six standard analog outputs on the backplane at TB4. See "Analog output wiring" on page 3-48 for more information.

4.15.6 Factory settings for analog output switches

This drawing shows how to wire up to six devices to the analog outputs that are located on the back plane. It also shows how to wire up to two analog inputs.

Figure 4-25. Wiring for six analog outputs

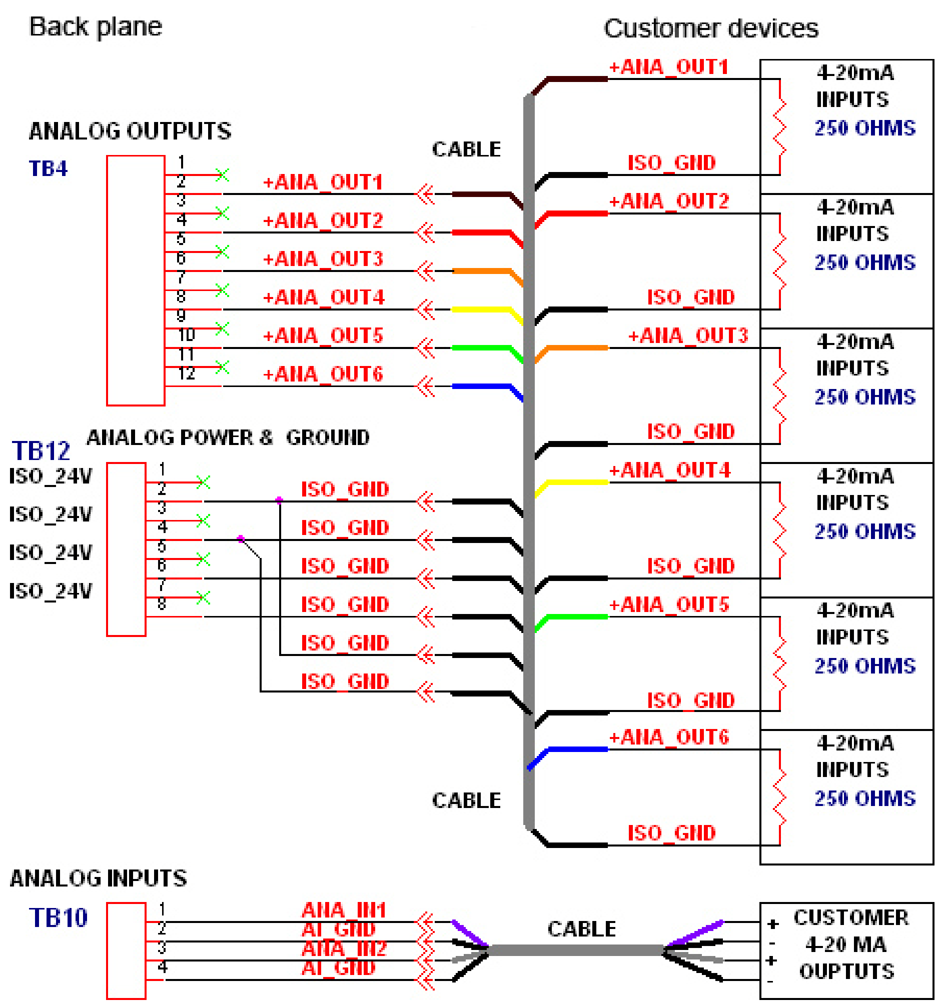
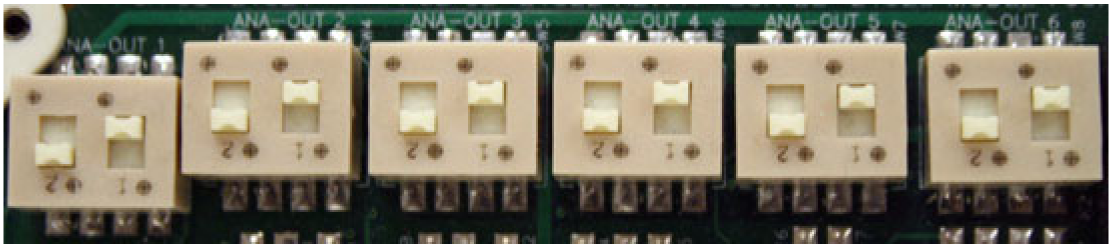


Figure 4-26 shows the factory settings for the analog output switches that are located on the Base I/O board.

Figure 4-26. Factory settings for analog output switches



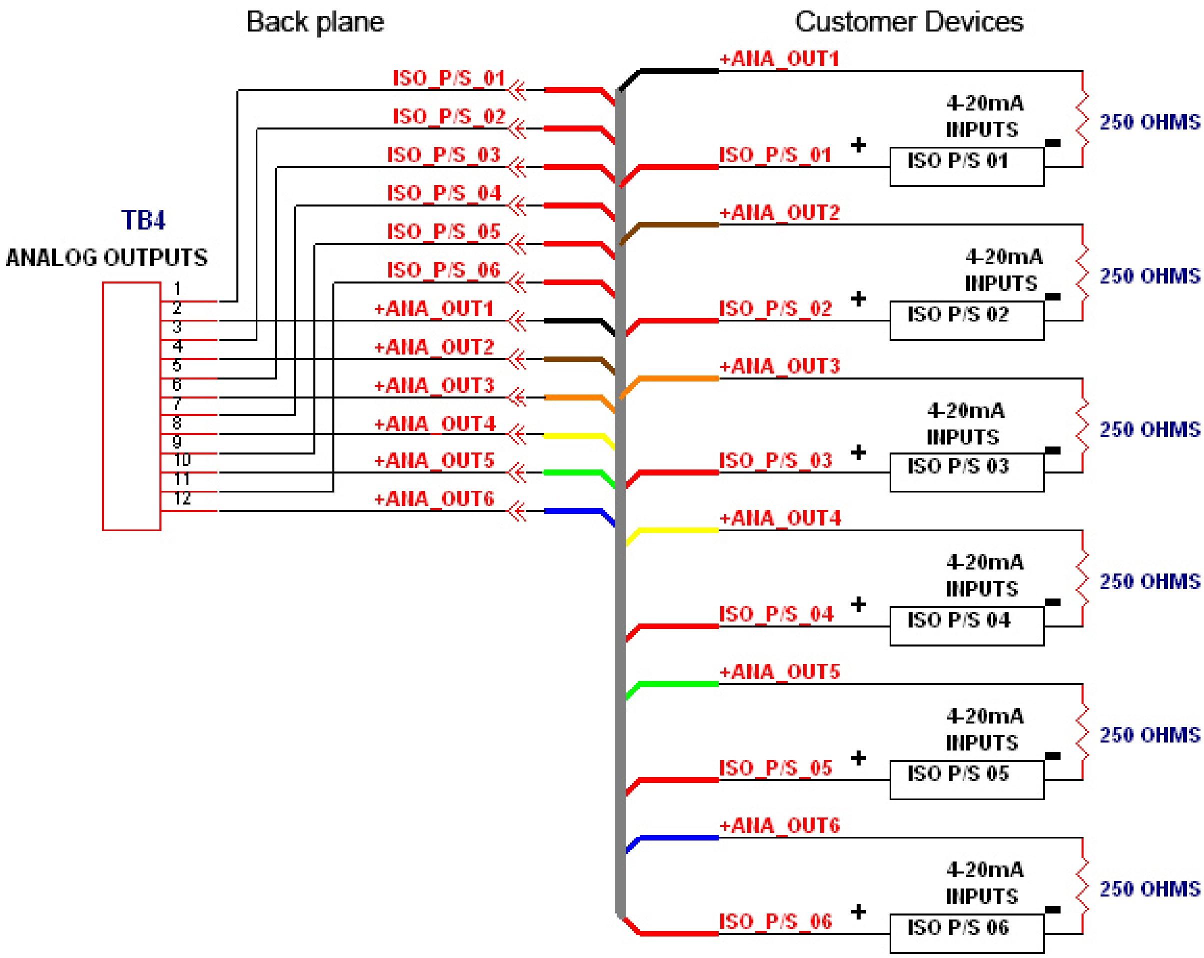
4.15.7 Wiring and switch settings for customer-powered analog outputs

It is possible to furnish power to each analog output while maintaining isolation between channels.

Consult the following diagrams before wiring a customer-powered device:

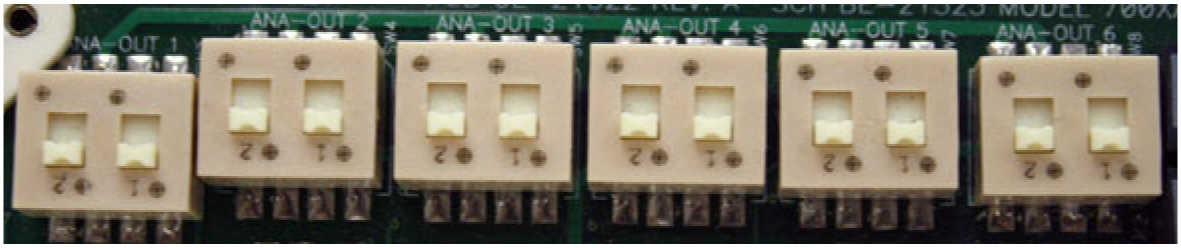
1. This drawing shows the wiring that is necessary to provide power to each analog output while maintaining isolation between channels.

Figure 4-27. Wiring for customer-powered analog outputs



2. This drawing shows the settings for the analog output switches, located on the Base I/O board, that are necessary to provide power to each analog output while maintaining isolation between channels.

Figure 4-28. Settings for analog output switches



4.15.8 Analog output adjustment

The initial analog output adjustments are set at the factory, before shipment, at standard values (4-20 mA). It may be necessary to check and/or adjust these values depending on output cabling/impedance. The adjustment may require two persons if the units are some distance apart. It requires a good digital meter to check the zero and full scale values at the receiving end. The scale or span value can then be adjusted with MON2020.

It is possible to calibrate the analog outputs using different engineering units, volts and percentages.

4.16 Discrete digital inputs and outputs

For instructions on connecting digital inputs and outputs to the backplane, see “Discrete digital I/O wiring” on page 3-44 for more details.

An external loopback test circuit can be built for troubleshooting the digital input/output operation.

4.17 Recommended spare parts

See Appendix D for the lists of recommended spare parts for approximately one year of maintenance. The quantities listed in the tables represent the number of spares to cover most contingencies for one 1500XA.

Service and repair service contracts, however, are offered that make maintaining an inventory of spare parts for the GC unnecessary. Details regarding service contracts may be obtained by contacting Customer Service at 1-713-827-6314.

4.18 Upgrading the embedded software

The Base Operating System performs functions similar to operating systems such as DOS or Windows® or Linux®. BOS provides the basic resources and interfaces to run the user's tasks. Unlike DOS or Windows® or Linux®, BOS is an embedded, real-time, multi-tasking, and preemptive operating system. There is no direct user-level interface to it. If a BOS upgrade is required for your system, refer to the MON2020 users manual for additional information.

The GC's applications use the tools provided by BOS to perform the desired gas chromatograph functions for the user. There are different applications to facilitate different gas chromatographic needs. To load a new application or to upgrade an existing application, refer to the MON2020 user's manual for details.

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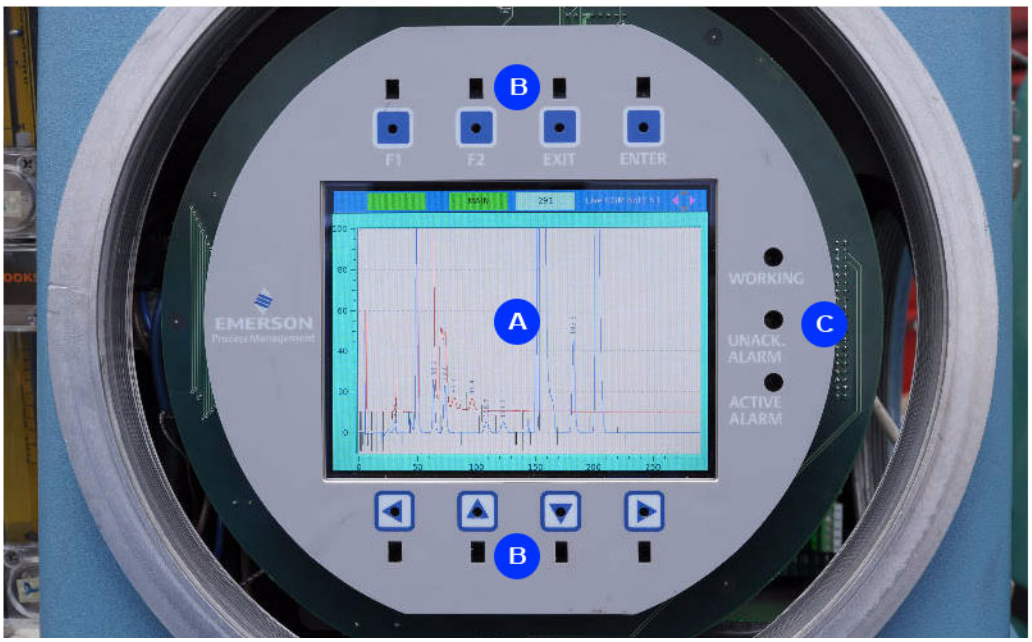
Appendix A, Local operator interface

A.1 Interface components for displaying and entering data

The local operator interface (LOI) has multiple components that you can use to interact with the unit.

Figure A-1. The LOI



A. LCD screen
B. Keypads
C. LED indicators

A.1.1 Light emitting diode indicators

There are three light emitting diode (LED) status indicators on the LOI that show the overall status of the gas chromatograph. These LEDs are positioned to the right of the display screen. Each LED, when lit, indicates a specific condition.

Table A-1. GC conditions indicated by the LEDs

The GC is currently running an analysis.

The GC has atleast one unacknowledged alarm.

The GC has an out-of-tolerance or alarm condition that requires an operator action.

A.1.2 LCD screen

The LCD screen measures 111.4mm by 83.5 mm and is capable of 640 by 4800 VGA pixel resolution, supporting both text and full graphics. The backlighting, boost, and brightness are all under software control. The boost and brightness levels are user-adjustable.

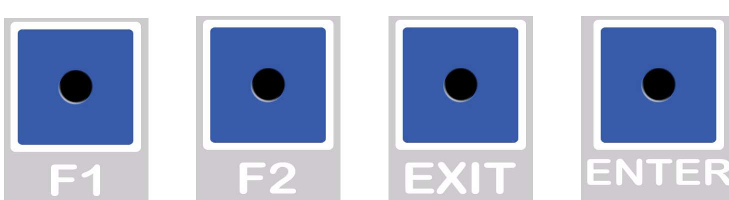
A.1.3 Keypad

The keypad consists of eight infrared keys. See "Navigating the screen" on page A-6 for more information.

A.1.3.1 The command keys

The four keys located above the LCD screen are "command" keys.

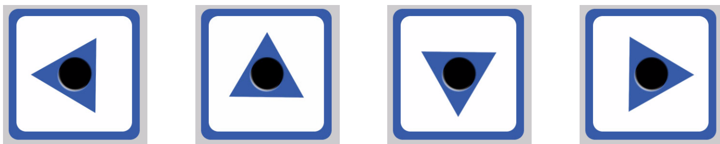
Table A-2. The command keys



A.1.3.2 The arrow keys

The four keys below the LCD screen are arrow keys that allow you to navigate within the screen by scrolling or moving the cursor from field to field. These keys function in the same way as a computer keyboard's arrow keys.

Table A-3. The arrow keys



A.1.3.3 Pressing a key

A key is "pressed" by placing a finger on the glass over the associated key hole and then removing the finger. Holding a finger over the key hole will cause that key to repeat until the finger is removed.

A.2 Using the local operator interface

A.2.1 Start up

Upon starting the GC, the LOI automatically runs in *Status Display* mode, in which it scrolls through a predefined series of screens, displaying each screen for approximately 30 seconds.

Table A-4. Status Display Mode Screens in Order of Appearance

Status	Displays information about the operational state of the analyzer, including a scrolling list of up to 25 user-selectable parameters that can be defined or modified using the MON 2000 application. **NOTE**: There may be more than one *Status* screen, depending upon the GC's mode of operation.
Live Chromatogram	Displays the chromatogram for the current analysis in real time. **NOTE**: There may be more than one *Live Chromatogram* screen, depending upon the GC's mode of operation. **NOTE**: This screen does not display if the GC is not currently analyzing a sample.
Active Alarms	Lists active alarms, if any.
Heater	Displays information about the PID temperature control loops.
Valves	Displays the settings and states of the stream and analyzer valves.

In *Status Display* mode, you can manually scroll to the next screen using the RIGHT arrow key, or to the previous screen using the LEFT arrow key. You can pause automatic scrolling at any time by pressing the EXIT key, and you can resume automatic scrolling by pressing either the LEFT or the RIGHT arrow key. Automatic scrolling resumes after ten minutes of keypad inactivity.

Pressing F1 when "MOVE" is displayed in the green box below it takes the focus inside the screen so that you can navigate through the controls of the screen using the LEFT, RIGHT, UP and DOWN keys. Pressing EXIT returns the focus to the top level—that is, outside of the screen. Pressing

LEFT or RIGHT at the top level resumes automatic scrolling in addition to moving to the previous or next screen.

At any time while in *Status Display* mode, you can press ENTER or F2 to enter the *Main Menu*. Use the EXIT key to leave the *Main Menu* and return the LOI to *Status Display* mode. If you log onto the GC from the *Main Menu* to perform operations or edit data, when you exit the menu you will automatically be logged off the LOI.

A.2.2 Navigating menus

At any time while in *Status Display* mode, you can press ENTER or F2 to enter the *Main Menu*.

Use the UP and DOWN arrow keys to navigate between fields or controls within each drop down menu. Pressing the DOWN arrow key while focus is on the last field of a drop down menu moves the focus to the first field on a screen. Alternatively, pressing the UP arrow key while focus is on the first field of the drop down menu causes the focus to move to the last field.

Use the ENTER key from the *Main Menu* to activate submenus and individual menu items.

Press EXIT to leave the *Main Menu* and return the LOI to *Status Display* mode, if no menu is dropped down. If a menu is dropped down then pressing EXIT closes that menu.

If you log onto the GC from the *Main Menu* to perform operations or edit data, when you exit the menu you will automatically be logged off the LOI.

The *Main Menu* allows you access to all of the available LOI screens.; however, you must be logged on to make changes. If you are not logged on and you attempt to edit a field, the *Login* screen will appear first.

After a period of fifteen minutes of inactivity, you will be automatically logged off.

A.2.3 Navigating the screen

LOI screens have several functions. They can display data for review; they can display data for editing; and they can be used to initiate activities.

Within any given screen, the function of the ENTER key depends upon the context. It can be used to validate and save changes or to initiate an action.

If a validation error is found after pressing ENTER, an “Invalid Entry” message displays. Press ENTER again to close the message and then re-enter your data.

Pressing EXIT closes the currently open screen. If you have made changes to the screen, the LOI will display a confirmation message asking if you want to save your changes. Use the arrow keys to select the appropriate button and press ENTER. If you select **No**, your changes will be discarded and the *Main Menu* will display; if you select **Cancel**, the message window will close and you will be returned to the current screen; if you select **Yes**, your changes will be validated and saved and then you will be returned to the *Main Menu*.

The F1 and F2 keys are context dependent. A one-word desrciption of the function of each of these keys displays in a green prompt box directly under the key in the title bar of the top-level full-sized screen.

In some cases, F1 acts as a toggle between scrolling either a line or a page at a time. When this is true, the currently selected option (LN or PG) displays with a green background and black text, while the non-selected option displays with a black background and green text. Table A-5 lists the possible functions of the F1 key:

Table A-5. Functions of the F1 key

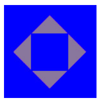
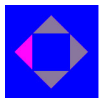
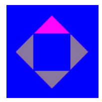
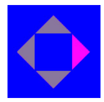
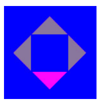
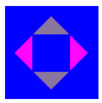
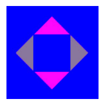
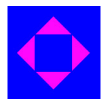
MOVE	Press F1 to move the cursor around within the boundary of the screen.
EDIT	Press F1 to open the edit dialog for the field that contains the cursor. The type of dialog that displays depends upon the type of field to be edited. See “Editing numeric fields” on page A-8 and “Editing non-numeric fields” on page A-9 for more information.
SELECT	Press F1 to select the field to be edited.
BACKSP	Press F1 to delete the character to the left of the cursor.
LN PG	Press F1 to scroll line by line within a screen.
LN PG	Press F1 to scroll page by page within a screen.

Note
Throughout this appendix, when referring to the F1 key, the key’s current valid function will be indicated in parenthesis—for instance, F1 (MOVE) or F1 (SELECT).

The F2 key, when “MAIN” is displayed in the prompt box, closes all screens and goes back to the *Main Menu*.

There is a navigation icon in the upper right corner of the screen that indicates which navigation keys are active for the currently displayed screen.

Table A-6. Navigation icons

			
None	Left	Up	Right
			
Down	Left/Right	Up/Down	All

When you press a key, a green square will flash in the upper left corner if the key is valid; if the key is not valid, a red box will flash in the upper left corder.

A.2.4 Editing numeric fields

When the focus is on an editable field, pressing F1 (EDIT) will display the *Edit Dialog* containing the field's original text.

Use the LEFT and RIGHT arrow keys to move through the individual characters within the field and to select the character to be changed. Use the UP and DOWN arrows keys to select the value of each digit. The possible values are 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, **–** (minus), . (period), and E.

The **–** (minus) value is available for signed numbers.

The . (period) and E values are available for floating-point numbers, except for retention times and timed event values.

The following rules apply when entering a floating-point value:

- More than one E is not allowed.
- More than one . is not allowed.

- If the previous position is an E then a . and a 0 is not allowed.
- A – is allowed only after an E or at the first position only.
- If the previous position is . then an E is not allowed.
- If the first character is a – and the current index is 1 then a . is not allowed.
- If the previous position is a – then a 0 is not allowed.
- If the next character is an E then a . is not allowed at the previous location.

The DOWN arrow key moves backward in the list from the current value of the selected digit.

The UP arrow key moves forward in the list from the current value of the selected digit.

The F1 (BACKSP) key acts as a backspace and deletes the digit immediately to the left of the current position.

The ENTER key validates and saves the entry, then closes the *Edit Dialog*. The new entry will display in the field.

The EXIT key cancels any changes that were entered and closes the *Edit Dialog*, restoring the previous value to the field.

A.2.5 Editing non-numeric fields

The function of the keys when editing non-numeric data is context-dependant.

A.2.5.1 Editing alphanumeric fields

Alphanumeric fields take numbers (0 - 9) and letters (a - z, A - Z).

A.2.5.2 Selecting check boxes

Press F1 (SELECT) to select or clear a check box.

Figure A-2. Selecting a check box

A.2.5.3 Clicking buttons

Press F1 (EXECUTE) to click the button and execute the command.

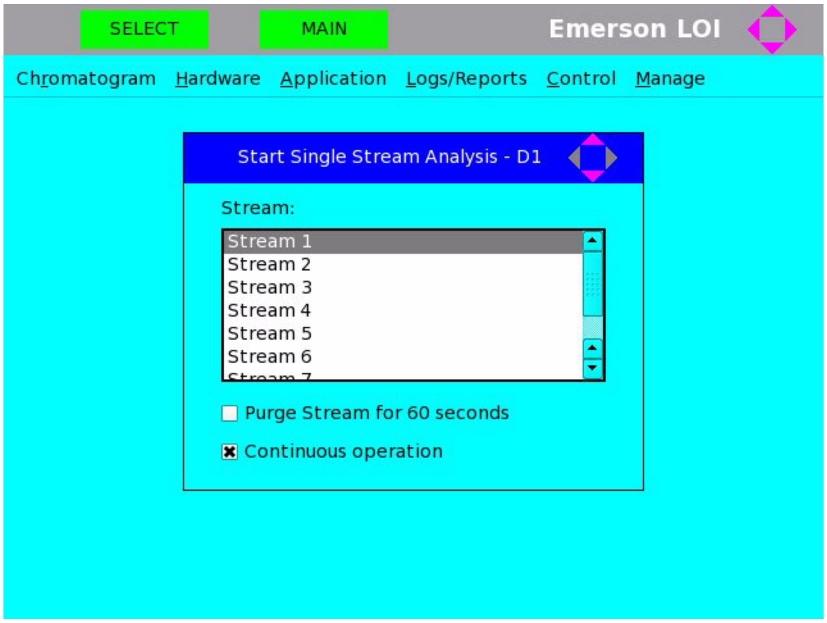
A.2.5.4 Selecting radio buttons

1. Press F1 (SELECT) to select a group of radio buttons.
2. Use the UP and DOWN arrow keys to move through the various radio buttons within the group.
3. Press ENTER to accept the current selection or press EXIT to abort any changes and to restore the previous selection.

A.2.5.5 Selecting an item from a list box

1. Press F1 (SELECT) while focused on the list box to switch it to edit mode.

Figure A-3. Selecting a list box



2. Use the UP and DOWN arrows keys to move between the values within the list box.
3. Press ENTER to accept the current selection or press EXIT to abort the new selection and the list box will revert to the previous selection.

A.2.5.6 Selecting an item from a combo box

1. Press F1 (SELECT) while focused on the combo field and a *Combo Dialog* opens and displays a list of available selections.

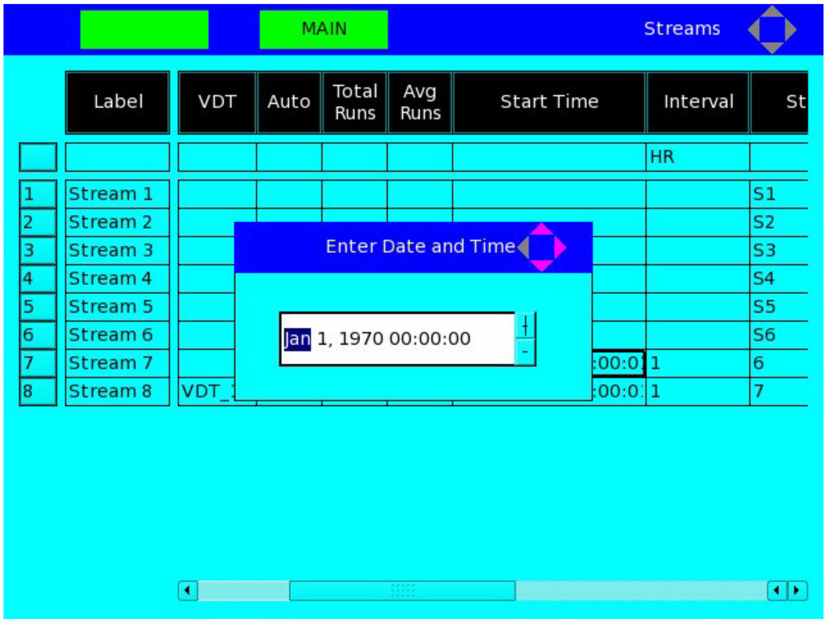
Figure A-4. Selecting a combo box

2. Use the UP and DOWN arrow keys to move between the selections.
3. Press ENTER to select the desired value or press EXIT to restore the combo box's initial value.

A.2.5.7 Entering a date and time

1. Press F1 (SELECT) while focused on the the *Date and Time* field and the *Enter the Date and Time* dialog displays. By default, the focus is set on the "Month" unit.

Figure A-5. Entering a date and time



2. Use the UP and DOWN arrow keys to change the value of the unit—that is, to go from January to February, or from 1 to 2.
3. Use the LEFT and RIGHT arrow keys to change units—that is, to go from months to years or hours to minutes.

Note
If the focus is on the left most section, the LEFT arrow key will be inactive and similarly if the focus is on the right most section, the RIGHT arrow key will be inactive.

4. Press ENTER to save the change or press EXIT to discard the change and restore the original value.

A.2.5.8 Setting the time

1. Press F1 (SELECT) while focused on the the *Time* field and the *Enter the Time* dialog displays. By default, the focus is set on the "Hour" unit.
2. Use the UP and DOWN arrow keys to change the value of the unit.

3. Use the LEFT and RIGHT arrow keys to change units—to go from hours to minutes, for example.

Note
If the focus is on the left most section, the LEFT arrow key will be inactive and similarly if the focus is on the right most section, the RIGHT arrow key will be inactive.

---

4. Press ENTER to save the change or press EXIT to discard the change and restore the original value.

A.3 Screen navigation and interaction tutorial

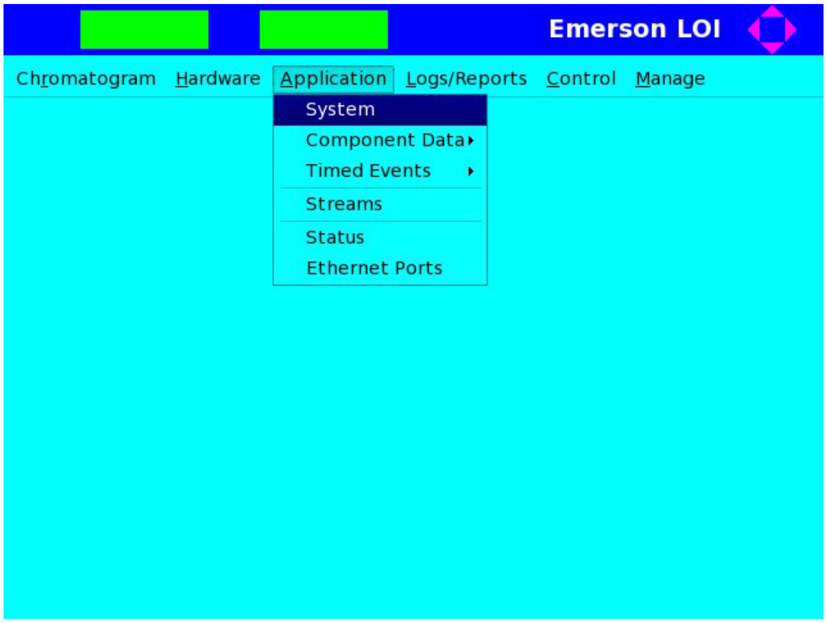
This tutorial, which guides you through the procedure for editing data on a screen, will incorporate all of the preceding information to demonstrate the typical method of navigating and interacting with the LOI. You will learn how to perform the following actions:

- Opening and closing screens
- Navigating through tables
- Selecting fields for editing
- Saving data

1. From the *Main Menu*, click the RIGHT arrow key enough times to navigate to the *Application* menu. The *System* submenu, since it is thefirst item in the list, is already selected.

Note
In this instance, the term “click” means to tap the glass on the spot directly above the arrow’s keyhole.

Figure A-6. Navigate to the Application menu

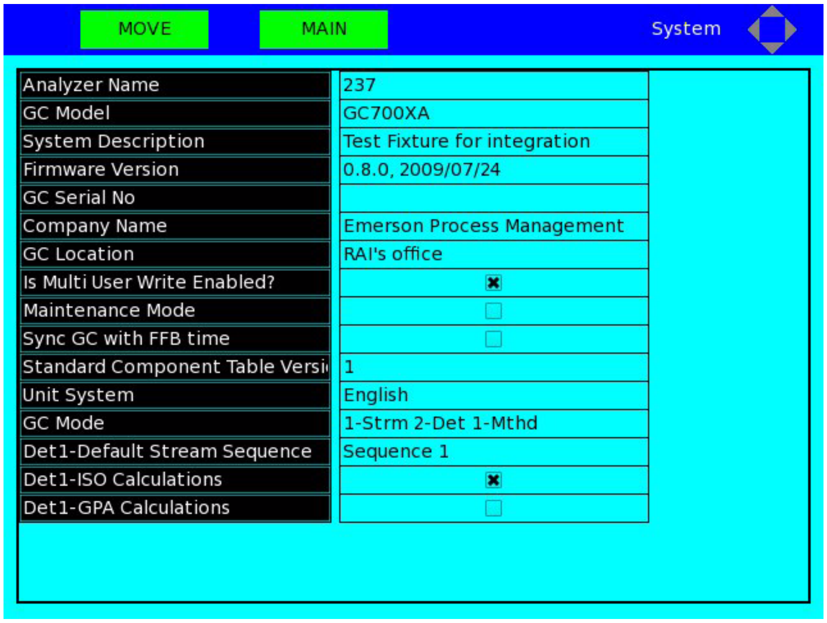


Note
Notice the navigation icon in the upper right corner, which indicates that all four arrow keys are active. This allows you to navigate to all of the menu items and sub menu items.

Note
Notice that the greem prompt boxes are empty. This means that the F1 and F2 keys are inactive from the *Main Menu*.

2. Click ENTER. The *System* screen displays.

Figure A-7. The System screen

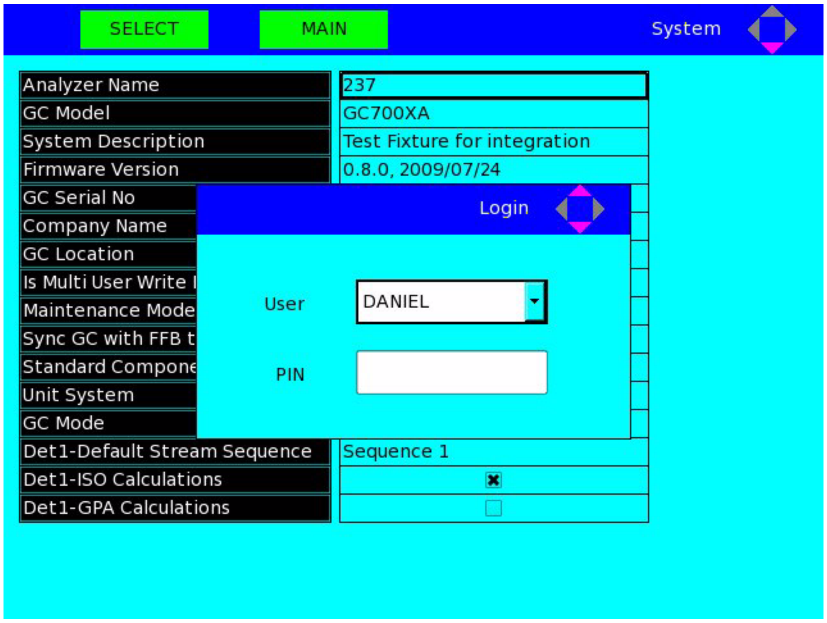


Note
Notice the navigation icon in the upper right corner, which indicates that no arrow keys are active.

3. Notice that the green prompt boxes now display function keywords. “MAIN” means that if you click the F2 key, the LOI will close the current screen and return you to the *Main Menu*. “MOVE” means that if you click the F1 key, you will be allow to use the arrow keys to navigate within the *System* screen. Click F1. The LOI switches to Edit mode.
4. Notice that the navigation icon in the upper right corner of the screen indicates that the down arrow is active. Click the down arrow once. Now the navigation icon indicates that both the up and down arrows are active. click the up arrow once to return to the previous cell. The navigation icon again indicates that only the down arrow is active.
5. Notice that the green F1 prompt box reads “EDIT”. Click F1.

6. You must be logged in to the GC to make a change to any screen. If you try to edit a field before logging in—as you just did—the LOI displays the *Login* dialog to prompt you to log in.

Figure A-8. You must log in to the GC before editing a screen



Note
Notice that there is also a navigation icon on the *Login* dialog.

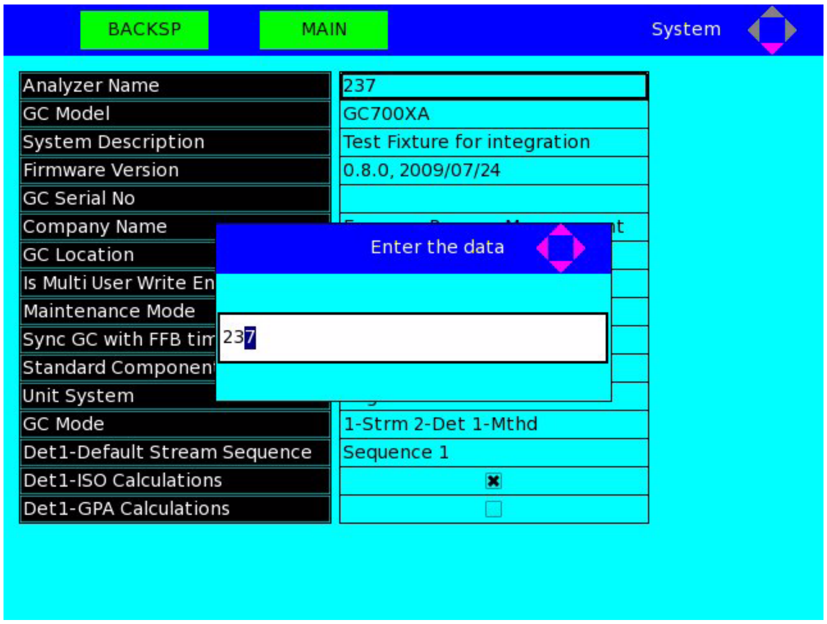
7. Click F1 (SELECT) and navigate up or down the list to highlight your username.

Note
For the remainder of this tutorial, when referring to the F1 key, the key's current valid function will be indicated in parenthesis—for instance, F1 (MOVE) or F1 (SELECT).

8. Click ENTER.
9. Navigate to the *Pin* field, press F1 (EDIT), and enter your password.
10. Click ENTER twice.

11. Now that your are logged in, you can edit the fields on the screen. Click F1 (EDIT). The *Enter the data* dialog displays.

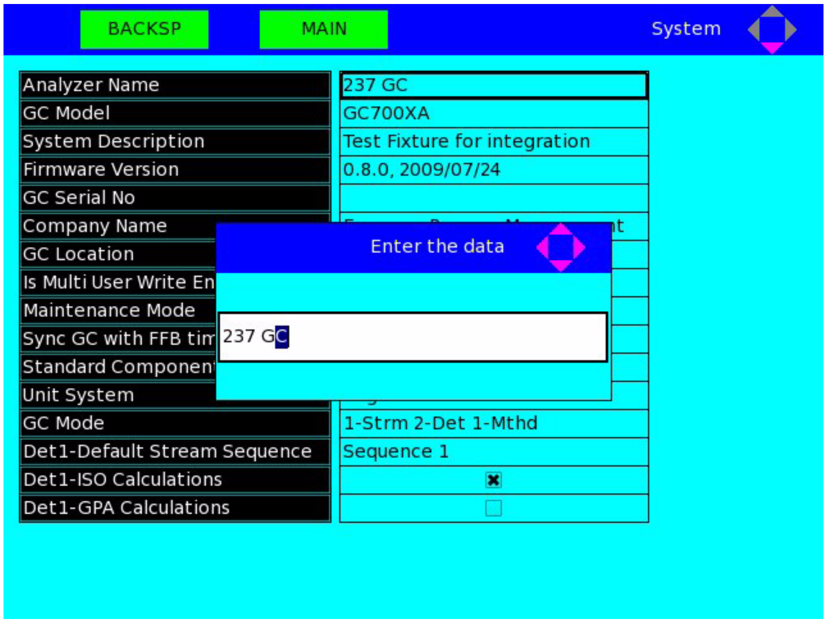
Figure A-9. The Enter the data dialog allows you to edit the selected field



12. To delete a character, press F1 (BACKSP). To enter new data, use the UP and DOWN arrows to cycle through the available characters, and use the RIGHT arrow key to add a new character to the field.

13. When you are finished entering data, press ENTER to validate and save the new information. To discard the information, press EXIT.

Figure A-10. The field now holds new data

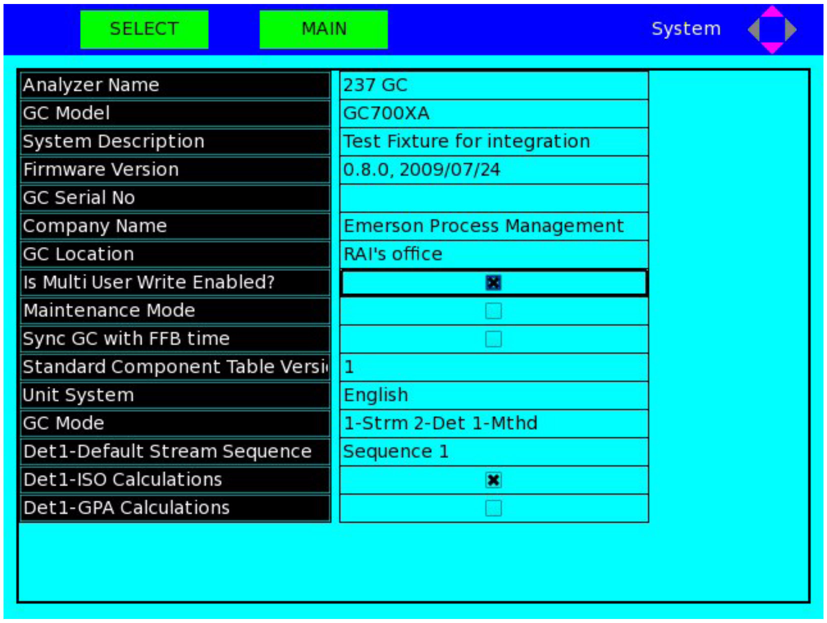


Note

If a validation error is found after pressing ENTER, an "Invalid Entry" message displays. Press ENTER to close the message and then re-enter your data.

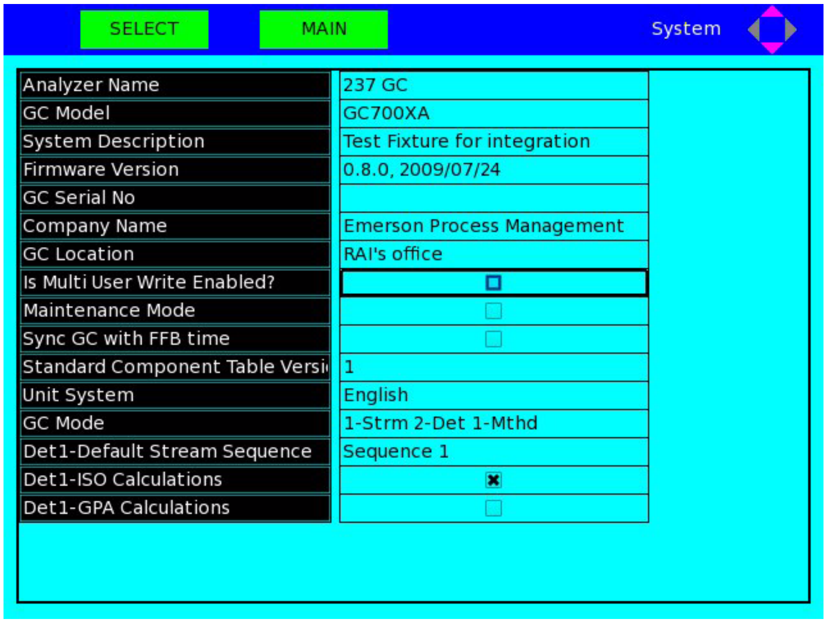
14. Use the down arrow to move to the *Is Multi User Write Enabled?* check box.

Figure A-11. The Is Multi User Write Enabled? check box



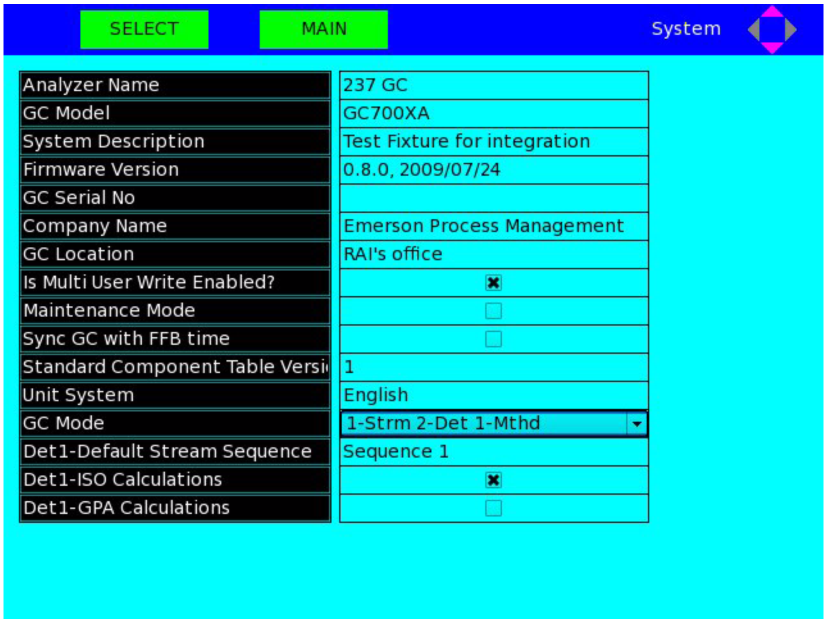
15. Press F1 (SELECT). This clears the checkbox.

Figure A-12. The Is Multi User Write Enabled? check box, no longer checked



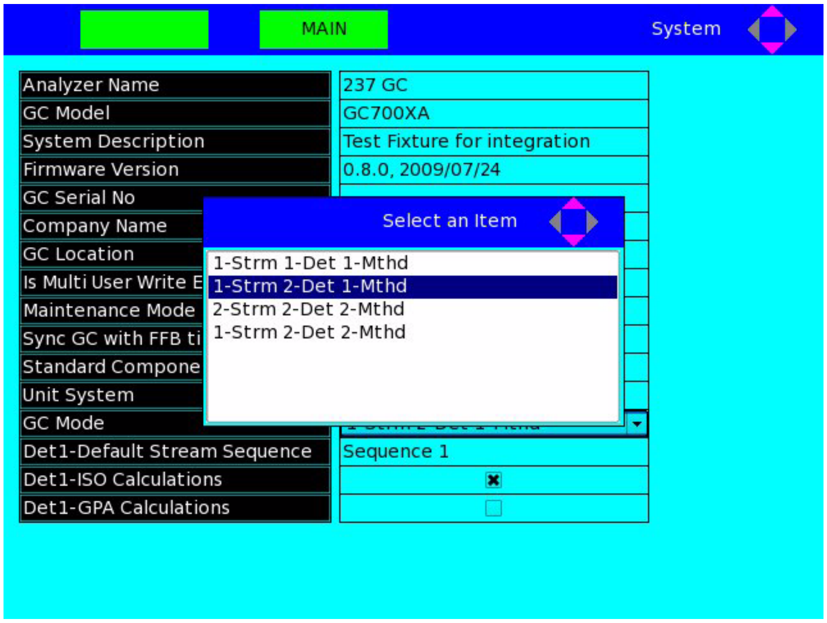
16. Click F1 (SELECT) again to re-select the checkbox.
17. Navigate to the *GC Mode* field.

Figure A-13. The GC Mode field



18. Press F1 (SELECT). The *Select an Item* combo box displays.

Figure A-14. The Select an Item combo box



19. Use the DOWN arrow to scroll down to the last item in the combo box. Press ENTER.

20. Press ENTER a second time to save all the changes that were made to the table.

Note
If you neglect to press ENTER at this point, all of your changes will be lost.

21. Press F2 (MAIN) to return to the *Main Menu*.

This concludes the tutorial.

A.4 The LOI screens

The *Main Menu* has six top-level submenus: *Chromatogram*, *Hardware*, *Applications*, *Control*, *Logs/Reports*, and *Manage*.

Table A-7 lists the submenus and commands that are available from the *Main Menu*.

Table A-7. Submenus and their commands

Submenu	Command	Subcommands	Reference
Chromatogram			
	View		
		Chromatogram Settings	page 27
		Live Chromatogram View Screen (Status Mode)	page 28
		Live Chromatogram Screen (Advanced Mode)	page 29
		Archived Chromatogram Screen (Advanced Mode)	page 30
		Live & Archived Chromatogram Viewer Options Menu	page 30
		CGM Scaling Screen	page 31
		Chromatogram CDT Table	page 32
		Chromatogram TEV Table	page 32
		Chromatogram Raw Data Table	page 33
Hardware			
	Heaters		page 34
	Valves		page 35
	Electronic Pressure Ctrl		page 36
	Detectors		page 36
	Discrete Inputs		page 37

Table A-7. Submenus and their commands

Submenu	Command	Subcommands	Reference
	Discrete Outputs		page 37
	Analog Inputs		page 38
	Analog Outputs		page 38
	Installed Hardware		page 39
Application			
	System		page 40
	Component Data		page 41
		CDT 1	
		CDT 2	
		CDT 3	
		CDT 4	
	Timed Events		page 41
		TEV 1	
		TEV 2	
		TEV 3	
		TEV 4	
	Streams		page 43
	Status		page 44
		DET1	
		DET2	
	Ethernet Ports		page 44
Logs/Reports			
	Maintenance Log		page 46
	Event Log		page 47
	Alarm Log		page 47
	Unack Alarms		page 48

Table A-7. Submenus and their commands

Submenu	Command	Subcommands	Reference
	Active Alarms		page 48
	Report Display		page 49
Control			
	Auto Sequence		page 51
	Single Stream		page 51
	Halt		page 52
	Calibration		page 53
	Validation		page 53
	Stop Now		page 54
Manage			
	LOI Settings		page 56
	Change PIN		page 57
	Diagnostics		page 57
	Log out		no screen

Refer to the *MON20/20 Software for Gas Chromatographs User Manual* for detailed information regarding the commands listed in Table A-7.

A.4.1 The Chromatogram menu

The *Chromatogram* menu enables you to view live and archived chromatograms and their associated CDT and TEV tables, as well as to edit the display properties if the chromatogram screens.

Refer to the “Using the chromatograph functions” section of the *MON20/20 Software for Gas Chromatographs User Manual* for detailed information regarding the *Chromatogram* menu screens.

Figure A-15. The Chromatogram menu

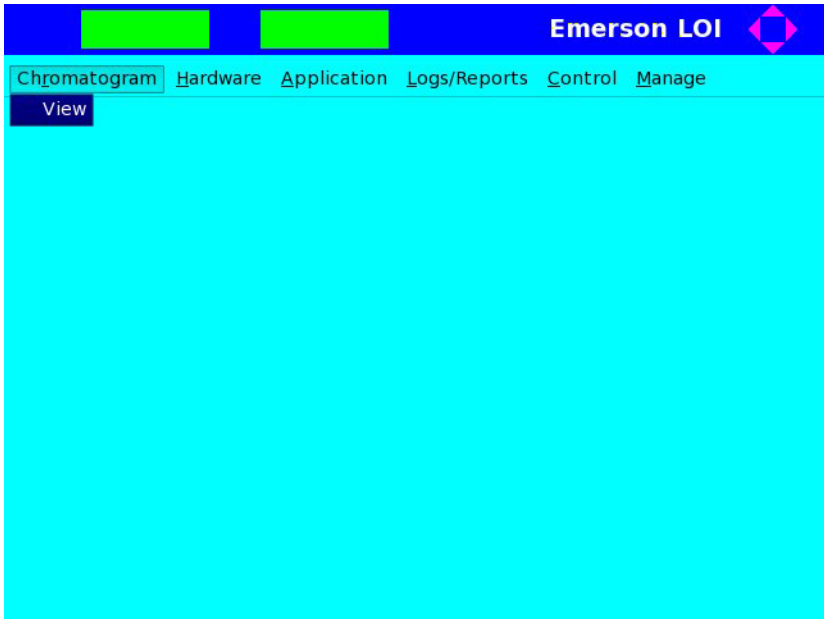


Figure A-16. The Chromatogram Settings screen

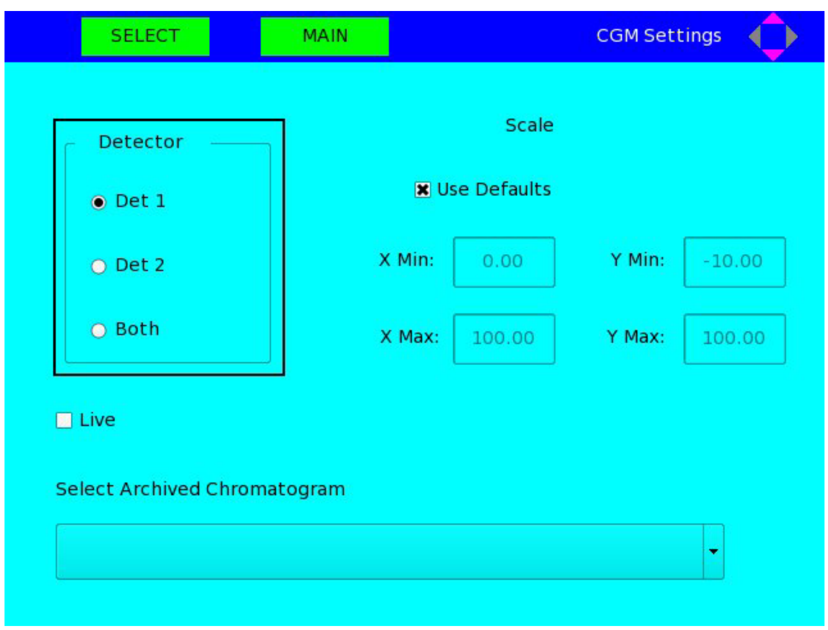
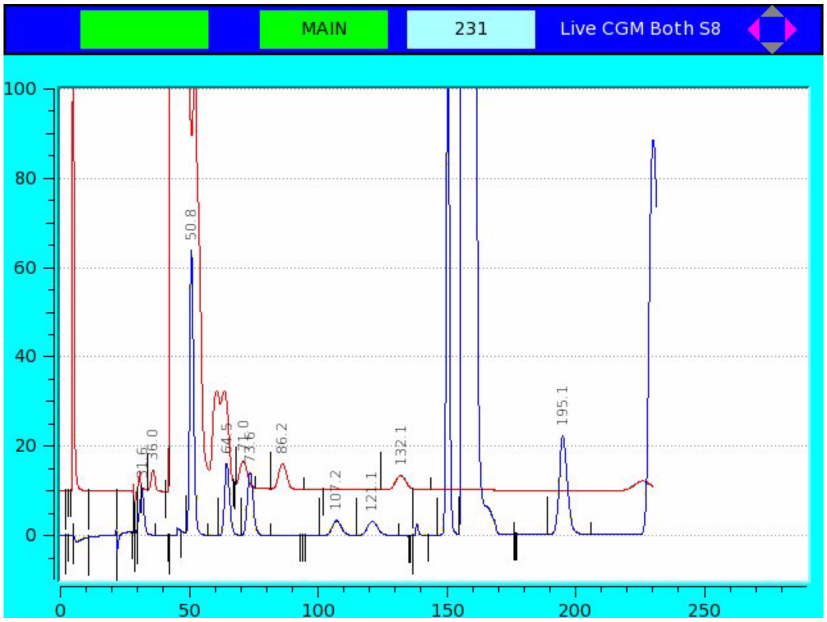
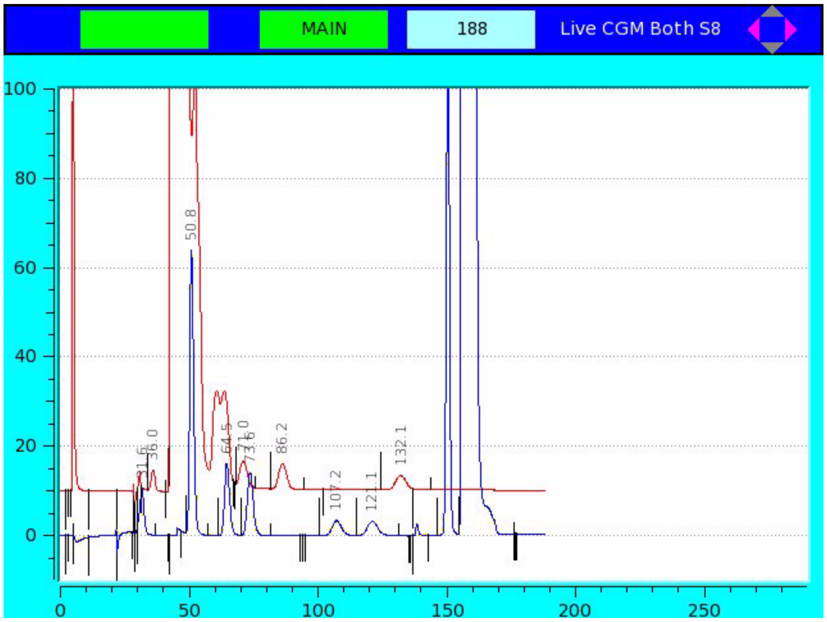


Figure A-17. The Live Chromatogram View (Status Mode) screen



Note
The blue box displays the current analysis time.

Figure A-18. The Live Chromatogram View (Advanced Mode) screen



Note
The blue box displays the current analysis time.

Figure A-19. The Archived Chromatogram (Advanced Mode) screen

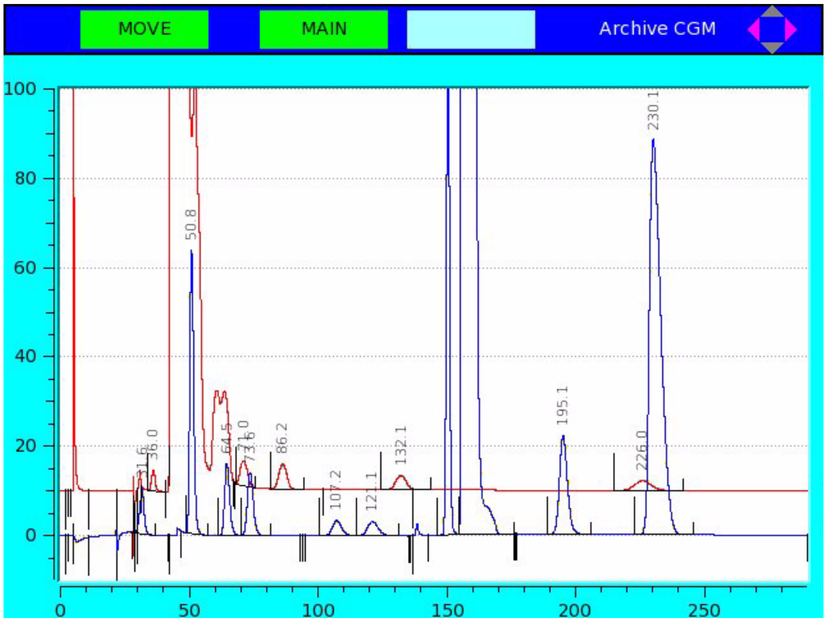
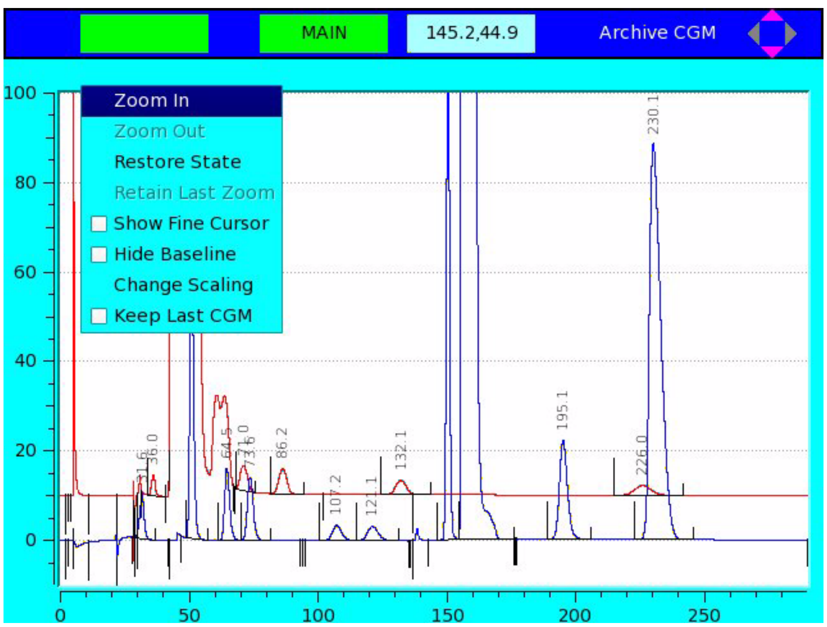


Figure A-20. The Live & Archived Chromatogram Viewer Options screen



Note
The blue box displays the cursor's x- (analysis time) and y- (amplitude) coordiantes.

Figure A-21. The CGM Scaling screen

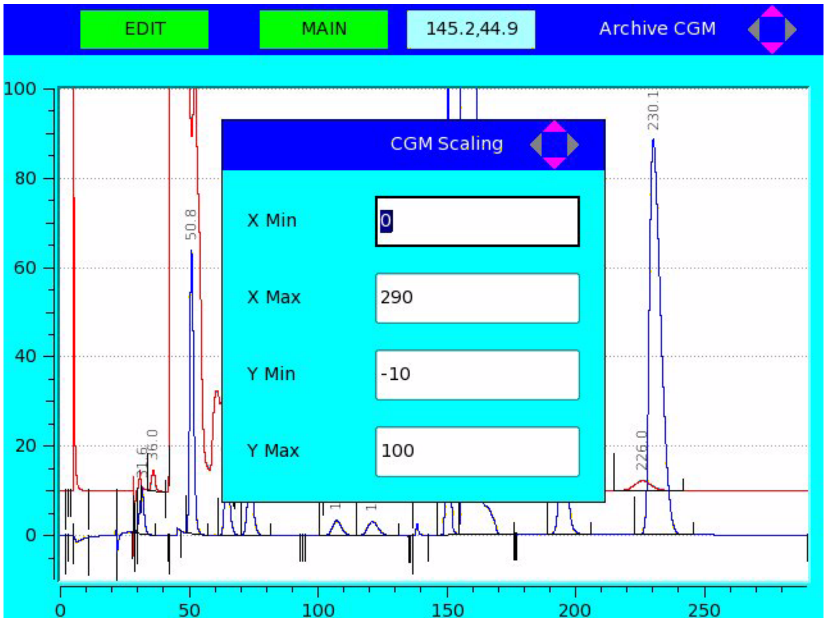
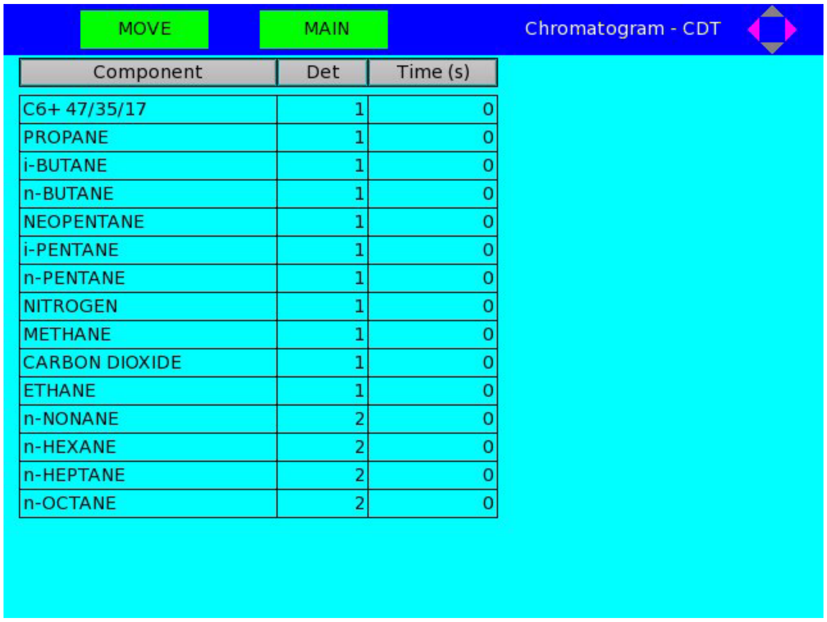
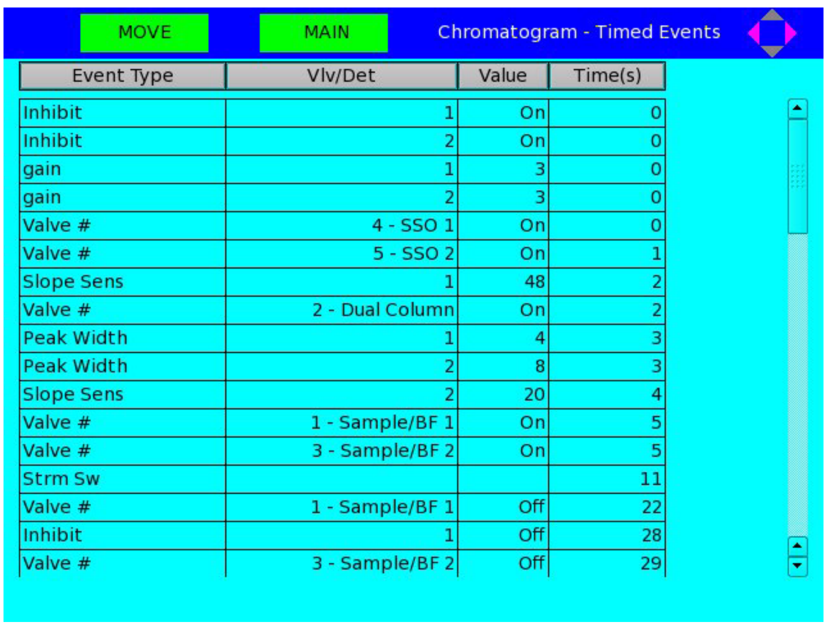


Figure A-22. The Chromatogram CDT Table screen



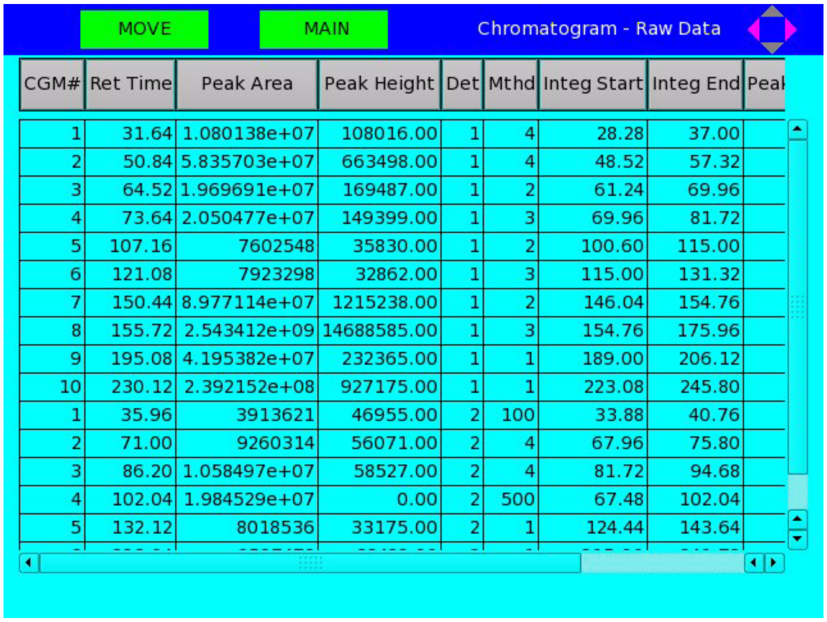
Component	Det	Time (s)
C6+ 47/35/17	1	0
PROPANE	1	0
i-BUTANE	1	0
n-BUTANE	1	0
NEOPENTANE	1	0
i-PENTANE	1	0
n-PENTANE	1	0
NITROGEN	1	0
METHANE	1	0
CARBON DIOXIDE	1	0
ETHANE	1	0
n-NONANE	2	0
n-HEXANE	2	0
n-HEPTANE	2	0
n-OCTANE	2	0

Figure A-23. The Chromatogram TEV Table screen



Event Type	Vlv/Det	Value	Time(s)
Inhibit	1	On	0
Inhibit	2	On	0
gain	1	3	0
gain	2	3	0
Valve #	4 - SSO 1	On	0
Valve #	5 - SSO 2	On	1
Slope Sens	1	48	2
Valve #	2 - Dual Column	On	2
Peak Width	1	4	3
Peak Width	2	8	3
Slope Sens	2	20	4
Valve #	1 - Sample/BF 1	On	5
Valve #	3 - Sample/BF 2	On	5
Strm Sw			11
Valve #	1 - Sample/BF 1	Off	22
Inhibit	1	Off	28
Valve #	3 - Sample/BF 2	Off	29

Figure A-24. The Chromatogram Raw Data Table screen



CGM#	Ret Time	Peak Area	Peak Height	Det	Mthd	Integ Start	Integ End	Peak
1	31.64	1.080138e+07	108016.00	1	4	28.28	37.00	
2	50.84	5.835703e+07	663498.00	1	4	48.52	57.32	
3	64.52	1.969691e+07	169487.00	1	2	61.24	69.96	
4	73.64	2.050477e+07	149399.00	1	3	69.96	81.72	
5	107.16	7602548	35830.00	1	2	100.60	115.00	
6	121.08	7923298	32862.00	1	3	115.00	131.32	
7	150.44	8.977114e+07	1215238.00	1	2	146.04	154.76	
8	155.72	2.543412e+09	14688585.00	1	3	154.76	175.96	
9	195.08	4.195382e+07	232365.00	1	1	189.00	206.12	
10	230.12	2.392152e+08	927175.00	1	1	223.08	245.80	
1	35.96	3913621	46955.00	2	100	33.88	40.76	
2	71.00	9260314	56071.00	2	4	67.96	75.80	
3	86.20	1.058497e+07	58527.00	2	4	81.72	94.68	
4	102.04	1.984529e+07	0.00	2	500	67.48	102.04	
5	132.12	8018536	33175.00	2	1	124.44	143.64	

A.4.2 The Hardware menu

The *Hardware* menu enables you to view and manage the GC's hardware components.

Refer to the "Using the hardware functions" section of the *MON20/20 Software for Gas Chromatographs User Manual* for detailed information regarding the *Hardware* menu screens.

Figure A-25. The Hardware menu

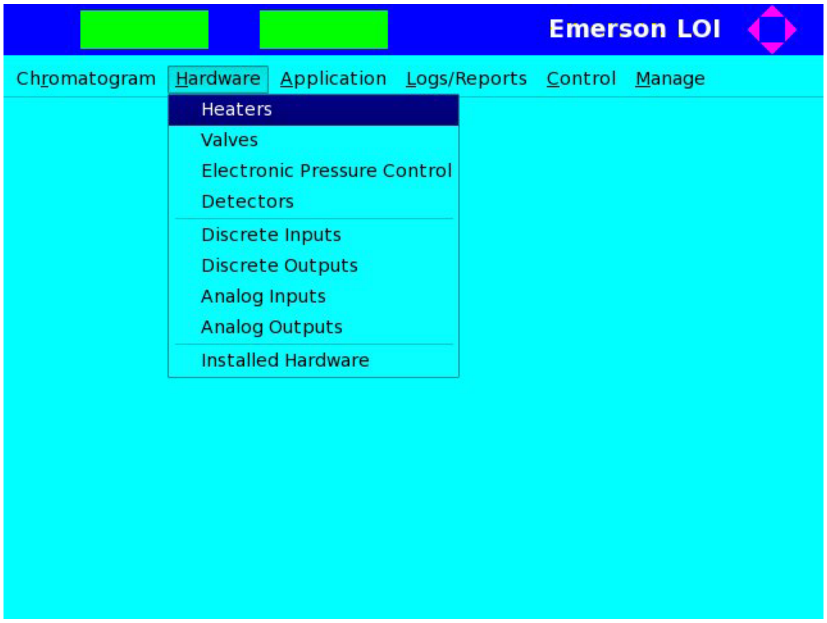


Figure A-26. The Heaters screen

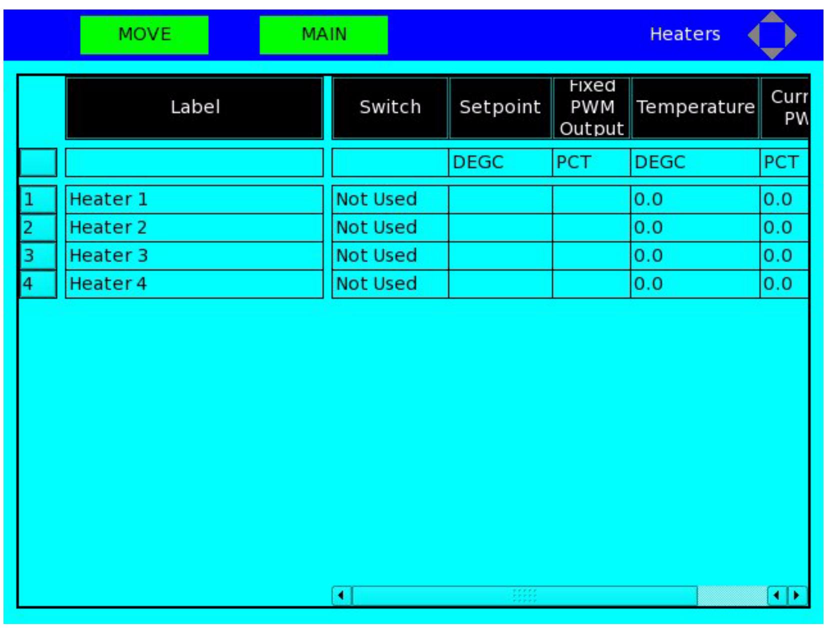


Figure A-27. The Valves screen

Note

The usage (Sample/BF1, Dual Column), mode (Auto, Off), and state (green = on, black = off, red = error) of each valve is displayed. See the "Configuring the valves" section of the *MON20/20 Software for Gas Chromatographs User Manual* for more information.

Figure A-28. The EPC screen

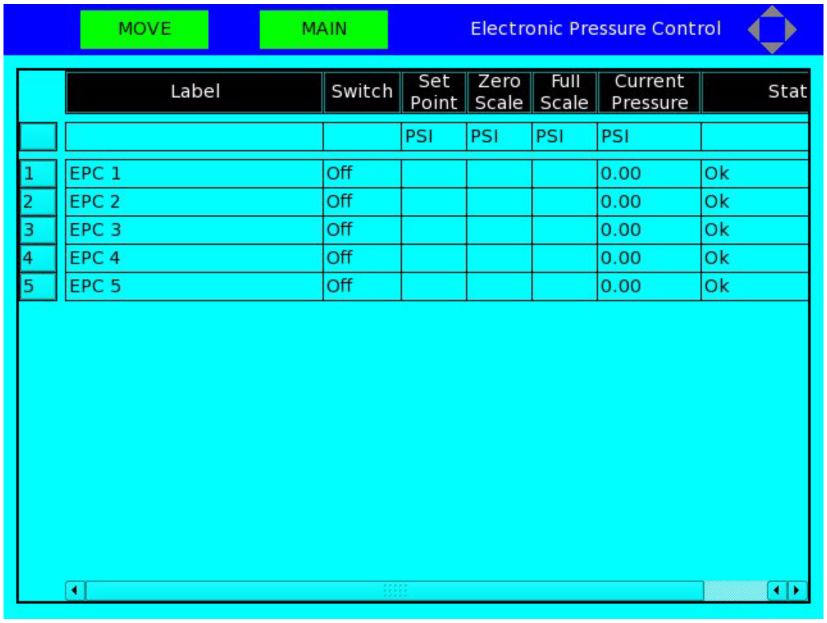
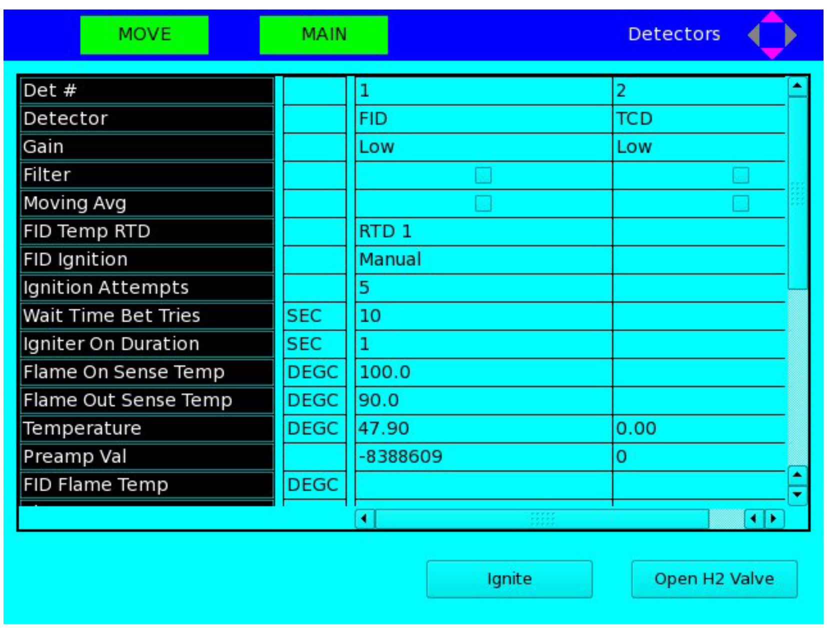
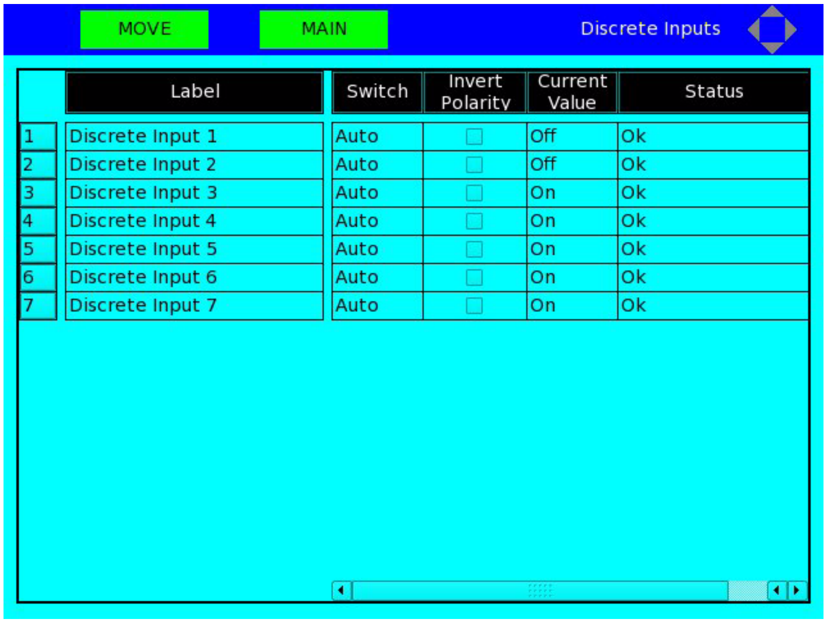


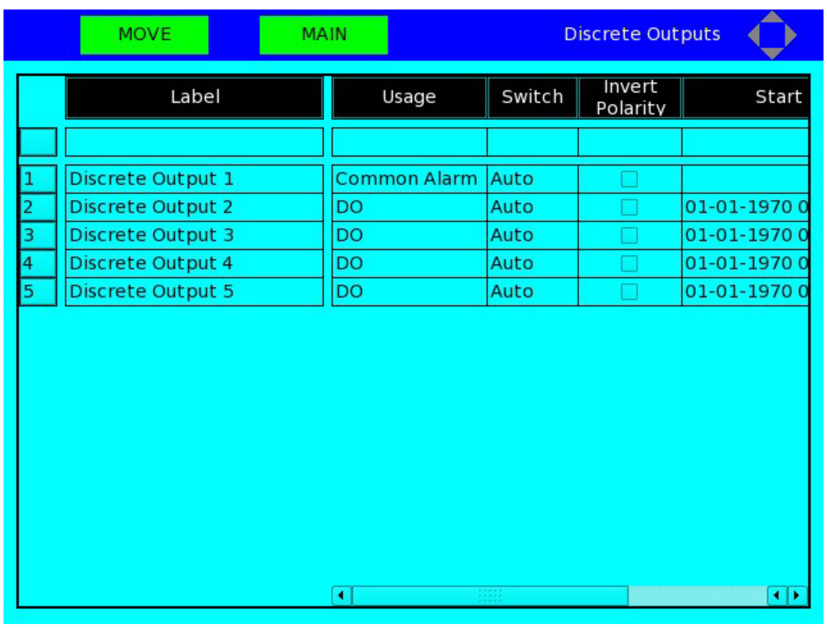
Figure A-29. The Detectors screen





	Label	Switch	Invert Polarity	Current Value	Status
1	Discrete Input 1	Auto	☐	Off	Ok
2	Discrete Input 2	Auto	☐	Off	Ok
3	Discrete Input 3	Auto	☐	On	Ok
4	Discrete Input 4	Auto	☐	On	Ok
5	Discrete Input 5	Auto	☐	On	Ok
6	Discrete Input 6	Auto	☐	On	Ok
7	Discrete Input 7	Auto	☐	On	Ok

Figure A-30. The Discrete Inputs screen



	Label	Usage	Switch	Invert Polarity	Start
1	Discrete Output 1	Common Alarm	Auto	☐	
2	Discrete Output 2	DO	Auto	☐	01-01-1970 0
3	Discrete Output 3	DO	Auto	☐	01-01-1970 0
4	Discrete Output 4	DO	Auto	☐	01-01-1970 0
5	Discrete Output 5	DO	Auto	☐	01-01-1970 0

Figure A-31. The Discrete Outputs screen

Figure A-32. The Analog Inputs screen

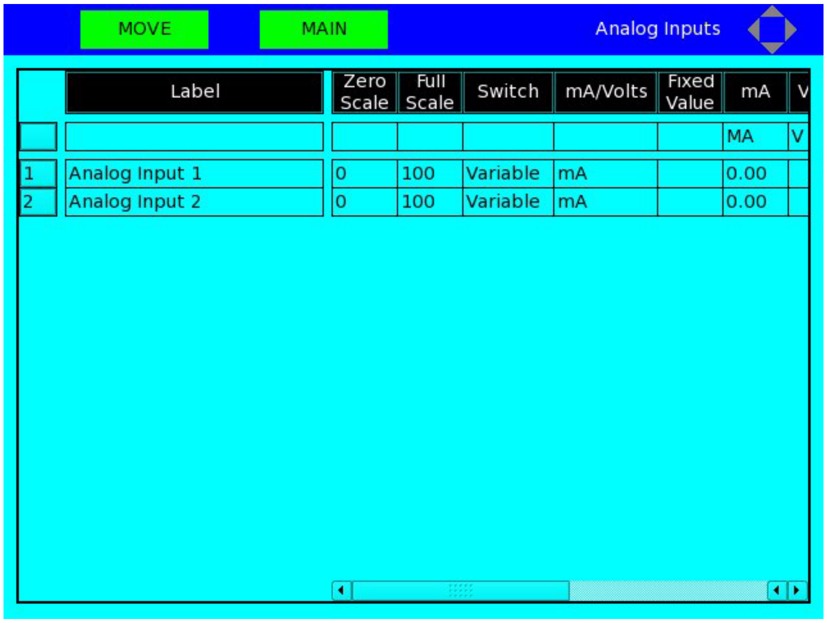


Figure A-33. The Analog Outputs screen

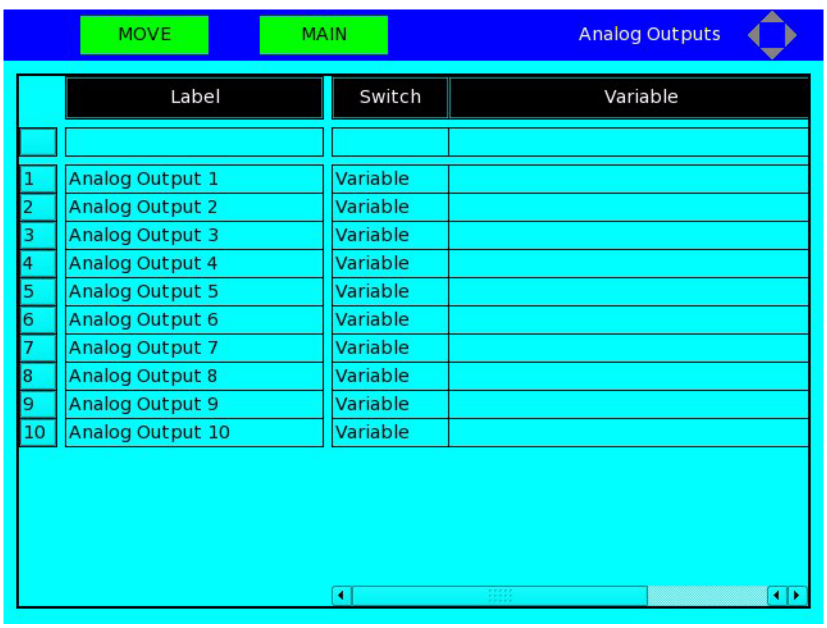
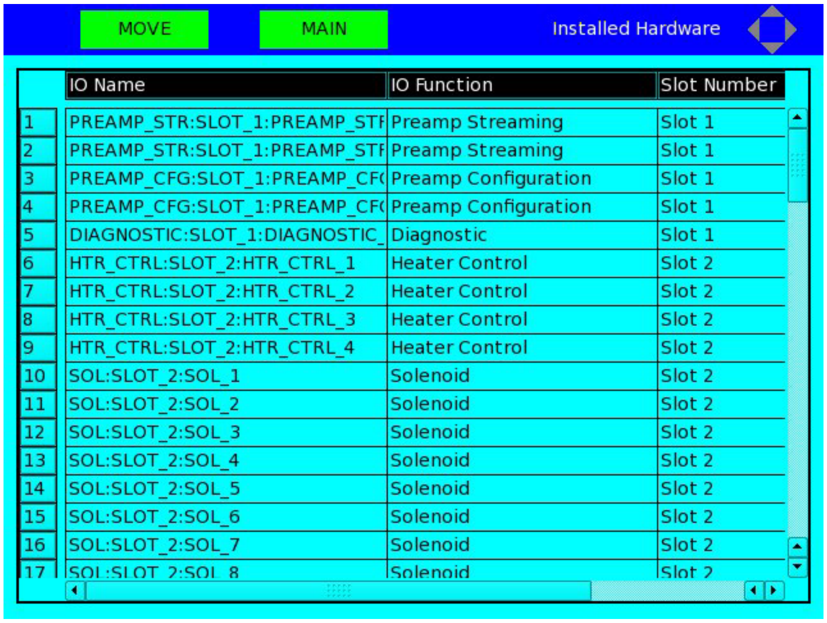


Figure A-34. The Installed Hardware screen



A.4.3 The Application menu

The *Application* menu allows you to view the CDT, TEV and streams tables for the GC. The *System*, *Status*, and *Ethernet Ports* screens are also accessible from this menu.

Refer to the “Using the application functions” section of the *MON20/20 Software for Gas Chromatographs User Manual* for detailed information regarding the *Application* menu screens.

Figure A-35. The Application menu

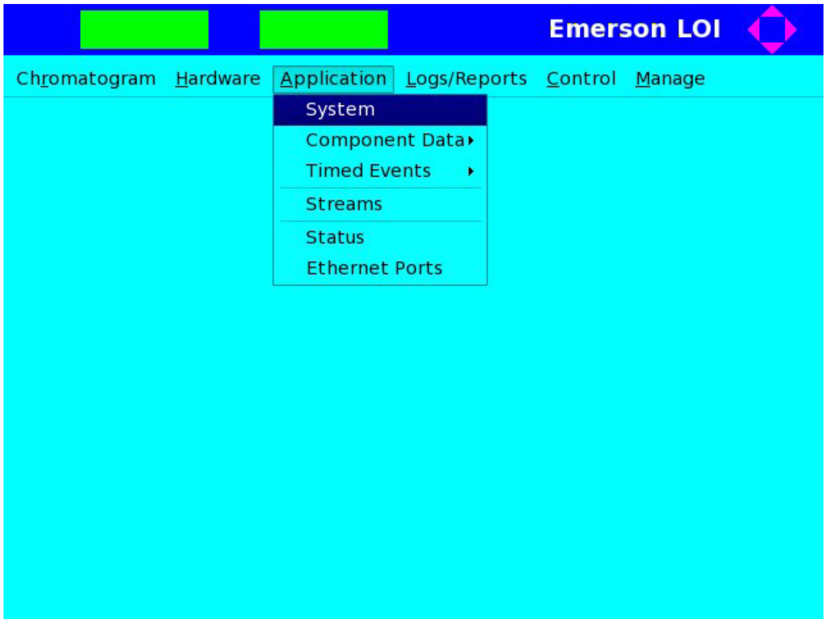


Figure A-36. The System screen

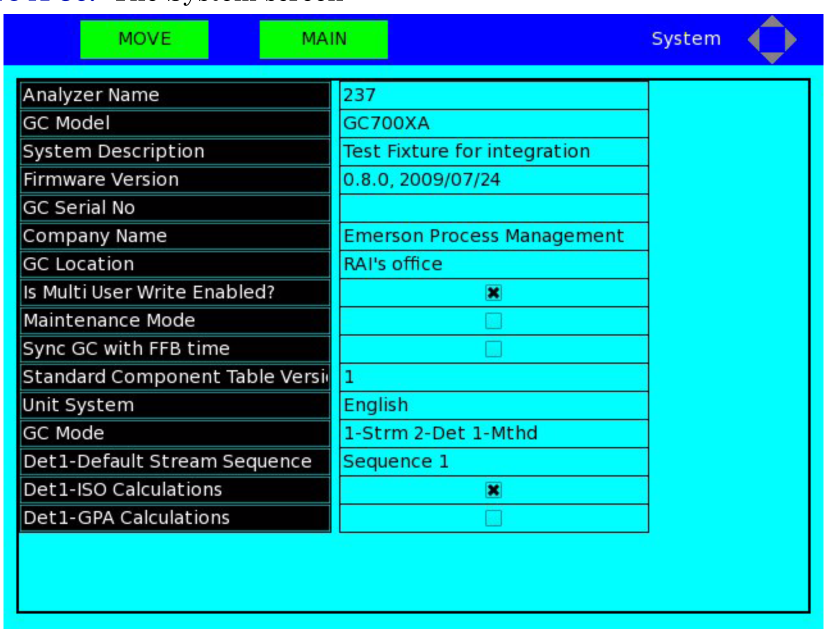
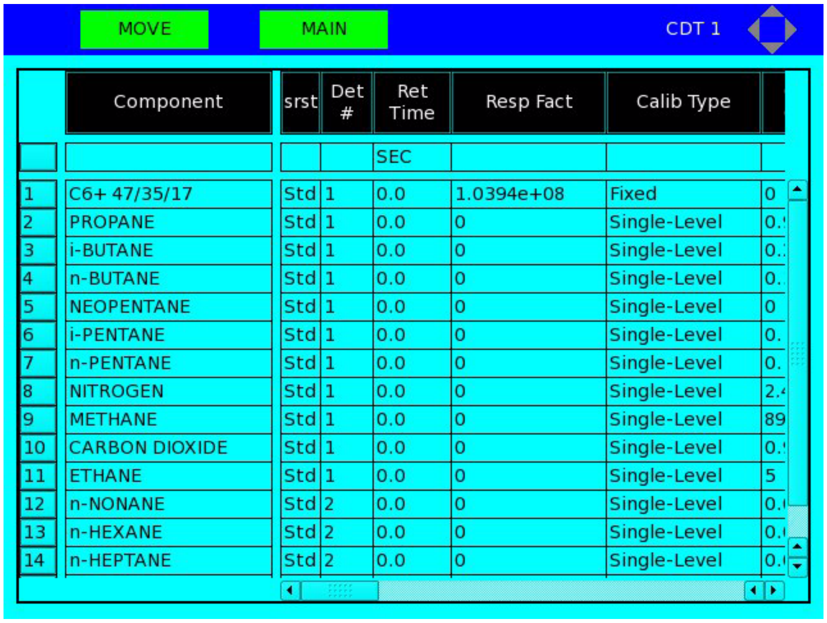
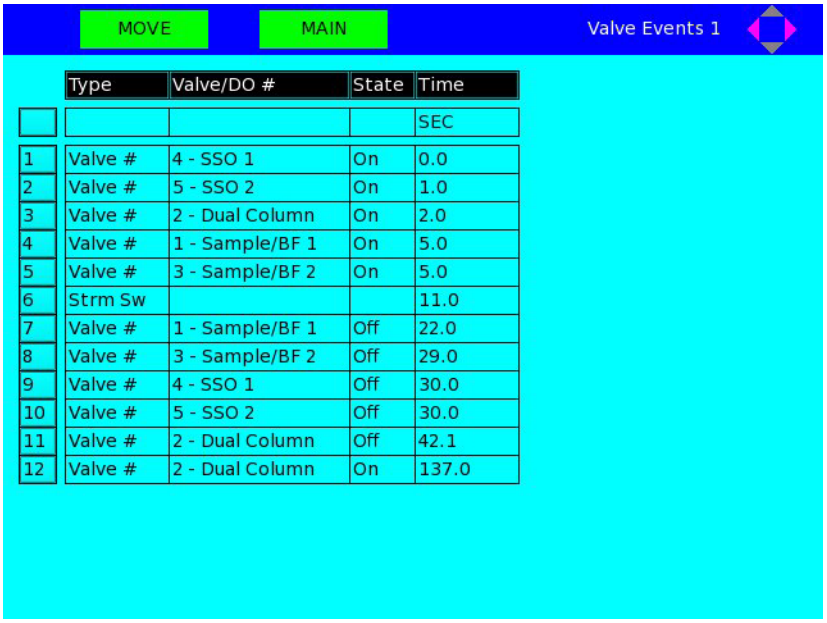


Figure A-37. The CDT screen



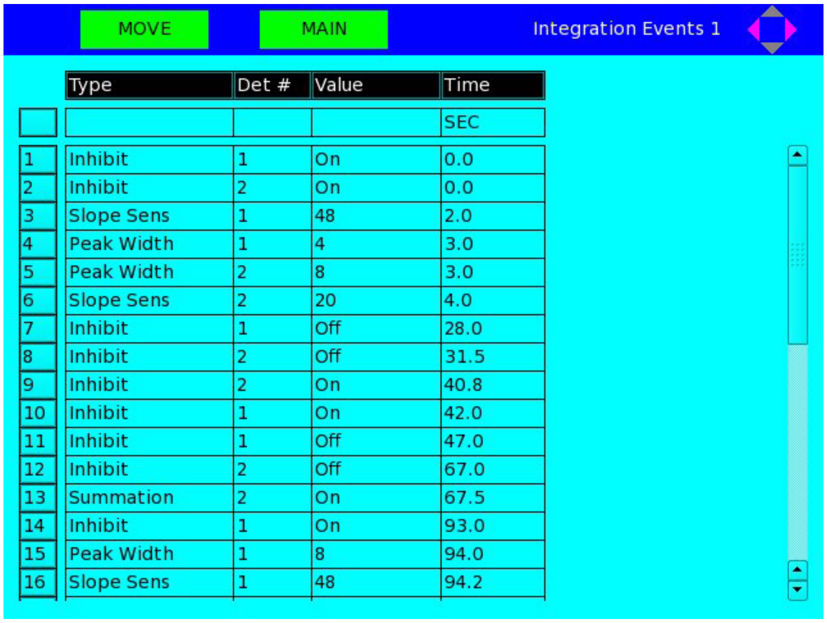
	Component	srst	Det #	Ret Time	Resp Fact	Calib Type	
				SEC			
1	C6+ 47/35/17	Std	1	0.0	1.0394e+08	Fixed	0
2	PROPANE	Std	1	0.0	0	Single-Level	0.
3	i-BUTANE	Std	1	0.0	0	Single-Level	0.
4	n-BUTANE	Std	1	0.0	0	Single-Level	0.
5	NEOPENTANE	Std	1	0.0	0	Single-Level	0
6	i-PENTANE	Std	1	0.0	0	Single-Level	0.
7	n-PENTANE	Std	1	0.0	0	Single-Level	0.
8	NITROGEN	Std	1	0.0	0	Single-Level	2.
9	METHANE	Std	1	0.0	0	Single-Level	89
10	CARBON DIOXIDE	Std	1	0.0	0	Single-Level	0.
11	ETHANE	Std	1	0.0	0	Single-Level	5
12	n-NONANE	Std	2	0.0	0	Single-Level	0.
13	n-HEXANE	Std	2	0.0	0	Single-Level	0.
14	n-HEPTANE	Std	2	0.0	0	Single-Level	0.

Figure A-38. The TEV - Valve Events screen



	Type	Valve/DO #	State	Time
				SEC
1	Valve #	4 - SSO 1	On	0.0
2	Valve #	5 - SSO 2	On	1.0
3	Valve #	2 - Dual Column	On	2.0
4	Valve #	1 - Sample/BF 1	On	5.0
5	Valve #	3 - Sample/BF 2	On	5.0
6	Strm Sw			11.0
7	Valve #	1 - Sample/BF 1	Off	22.0
8	Valve #	3 - Sample/BF 2	Off	29.0
9	Valve #	4 - SSO 1	Off	30.0
10	Valve #	5 - SSO 2	Off	30.0
11	Valve #	2 - Dual Column	Off	42.1
12	Valve #	2 - Dual Column	On	137.0

Figure A-39. The TEV - Integration Events screen

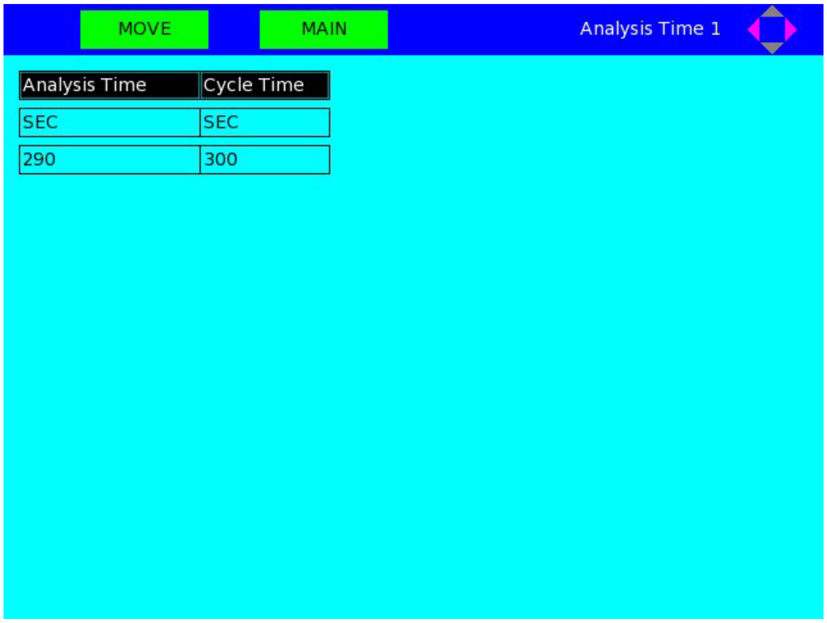


	Type	Det #	Value	Time
				SEC
1	Inhibit	1	On	0.0
2	Inhibit	2	On	0.0
3	Slope Sens	1	48	2.0
4	Peak Width	1	4	3.0
5	Peak Width	2	8	3.0
6	Slope Sens	2	20	4.0
7	Inhibit	1	Off	28.0
8	Inhibit	2	Off	31.5
9	Inhibit	2	On	40.8
10	Inhibit	1	On	42.0
11	Inhibit	1	Off	47.0
12	Inhibit	2	Off	67.0
13	Summation	2	On	67.5
14	Inhibit	1	On	93.0
15	Peak Width	1	8	94.0
16	Slope Sens	1	48	94.2

Figure A-40. The TEV - Spectrum Gain Events screen

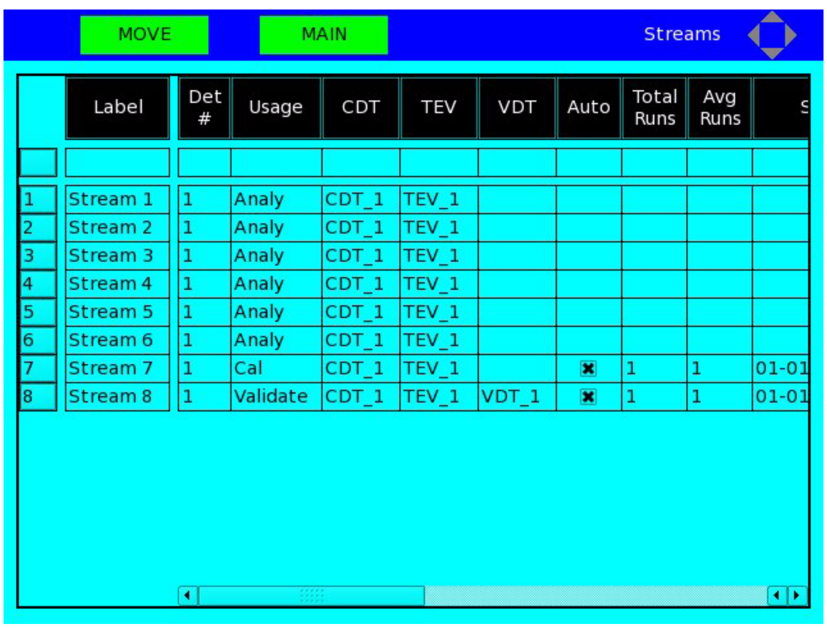
	Det #	Gain	Time
			SEC
1	1	3	0.0
2	2	3	0.0

Figure A-41. The TEV - Analysis Time screen



Analysis Time	Cycle Time
SEC	SEC
290	300

Figure A-42. The Streams screen



	Label	Det #	Usage	CDT	TEV	VDT	Auto	Total Runs	Avg Runs	S
1	Stream 1	1	Analy	CDT_1	TEV_1					
2	Stream 2	1	Analy	CDT_1	TEV_1					
3	Stream 3	1	Analy	CDT_1	TEV_1					
4	Stream 4	1	Analy	CDT_1	TEV_1					
5	Stream 5	1	Analy	CDT_1	TEV_1					
6	Stream 6	1	Analy	CDT_1	TEV_1					
7	Stream 7	1	Cal	CDT_1	TEV_1		x	1	1	01-01
8	Stream 8	1	Validate	CDT_1	TEV_1	VDT_1	x	1	1	01-01

Figure A-43. The Status screen

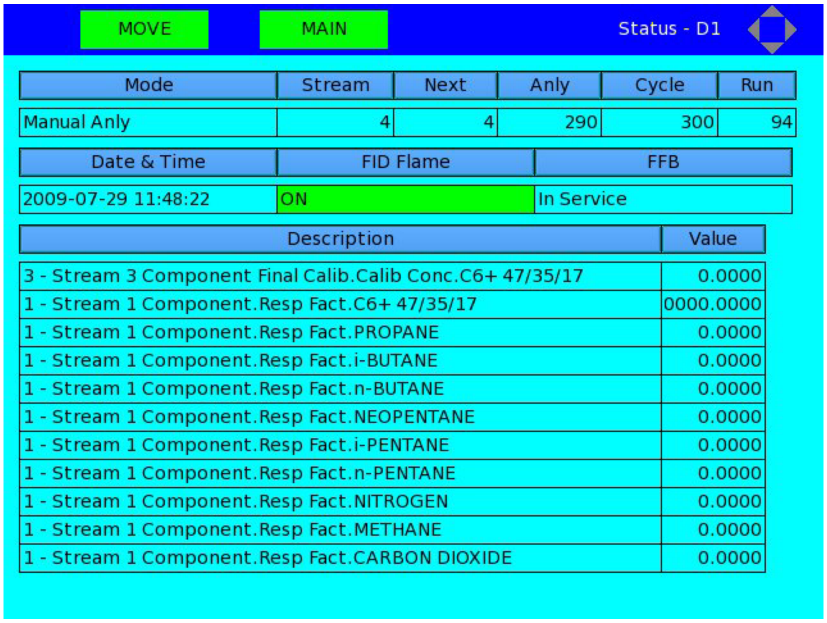
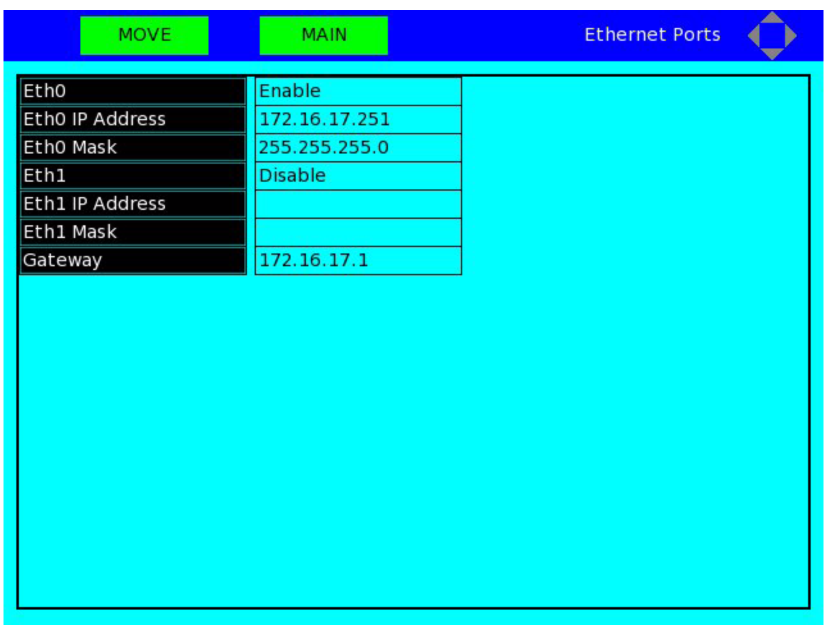


Figure A-44. The Ethernet Ports screen



A.4.4 The Logs/Reports menu

The *Logs/Reports* menu enables you to view the various reports that are avilable from the GC.

Refer to the “Logs/Reports” section of the *MON20/20 Software for Gas Chromatographs User Manual* for detailed information regarding the *Logs/Reports* menu screens.

Figure A-45. The Logs/Reports menu

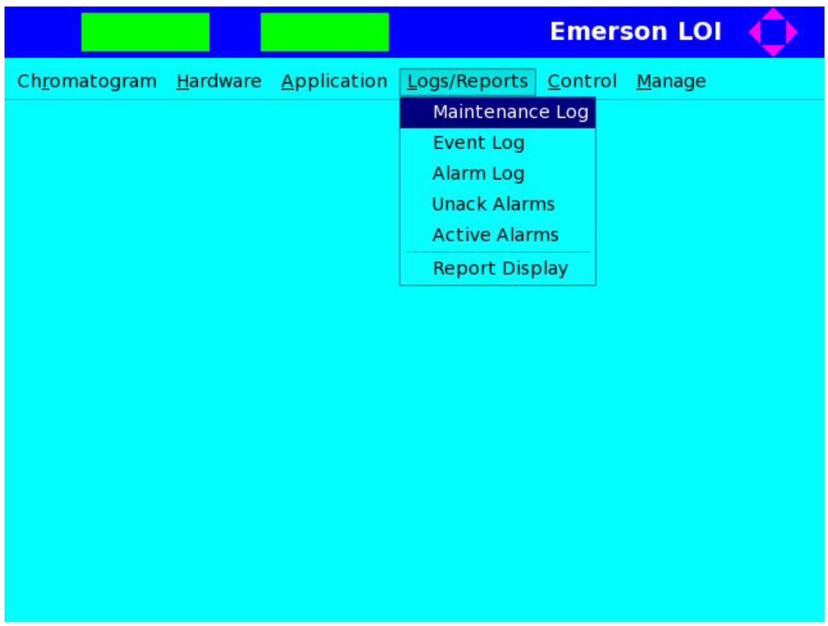


Figure A-46. The Maintenance Log screen

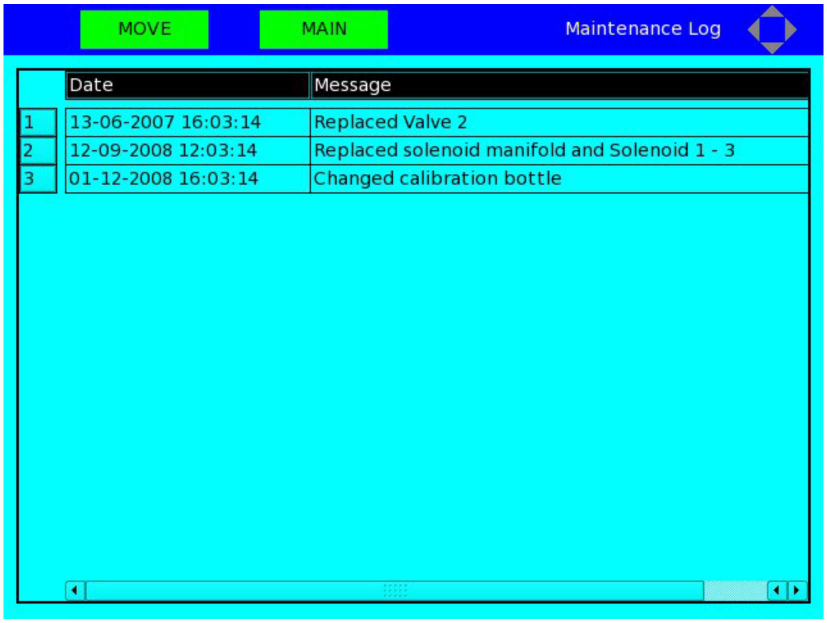


Figure A-47. The Event Log screen

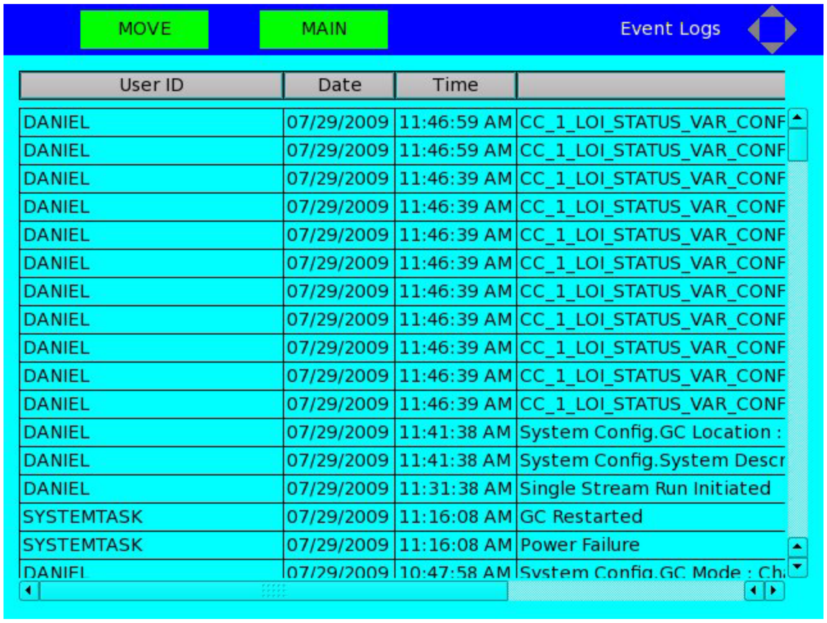


Figure A-48. The Alarm Log screen

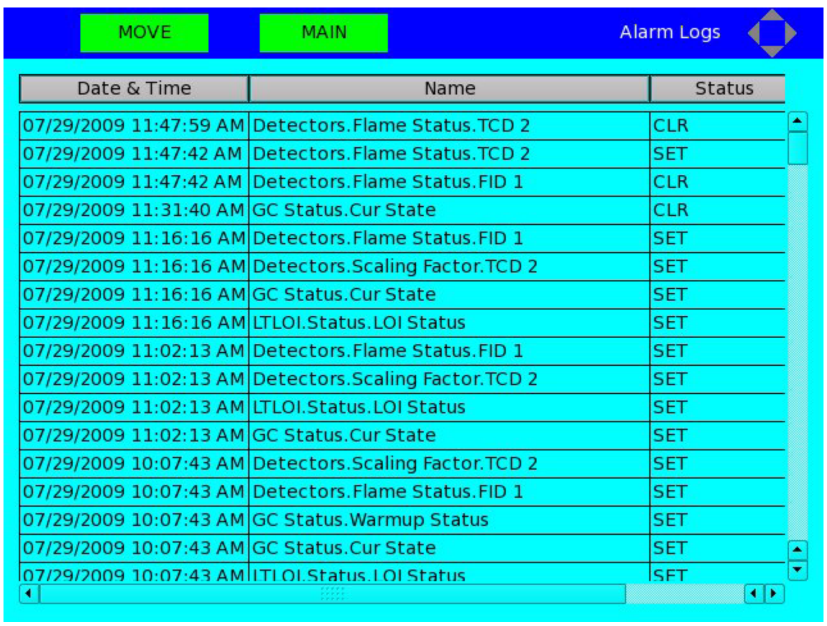


Figure A-49. The Unack Alarms screen

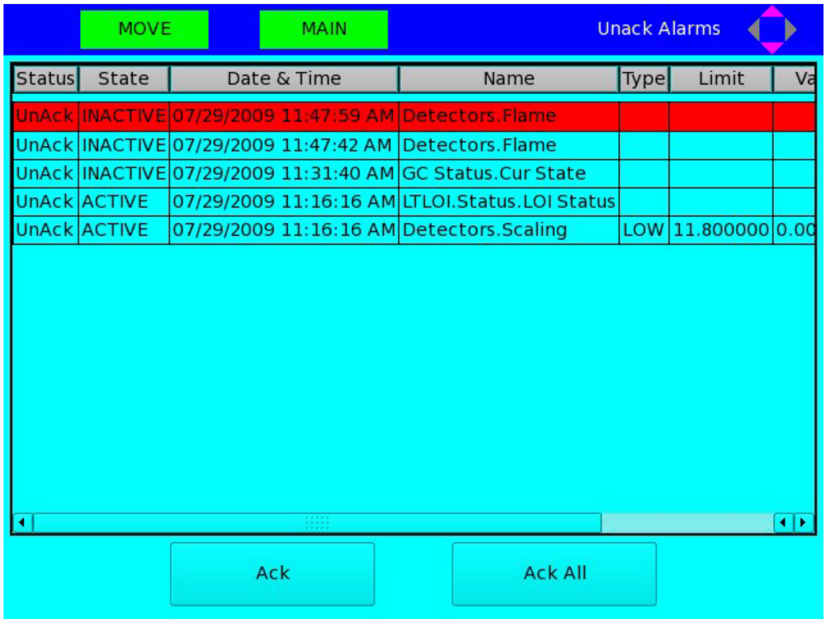


Figure A-50. The Active Alarms screen

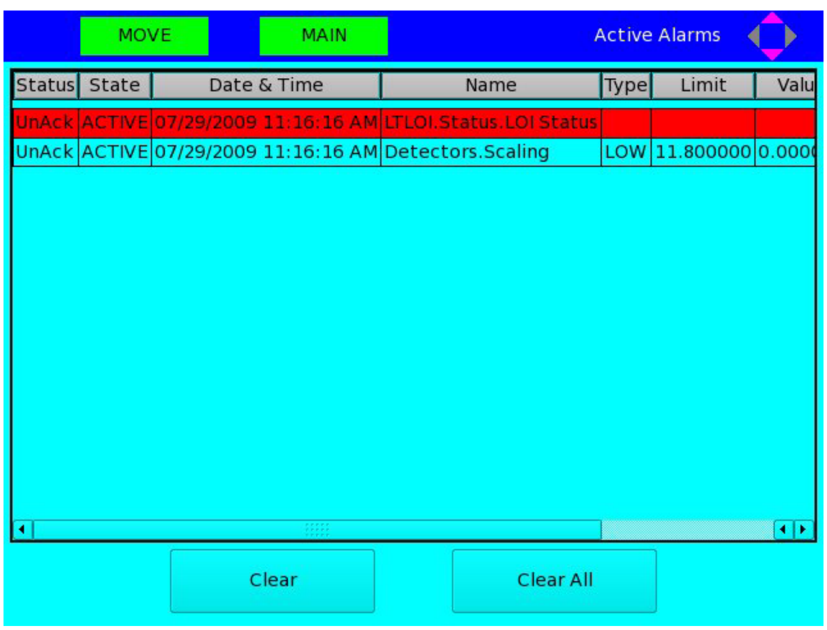
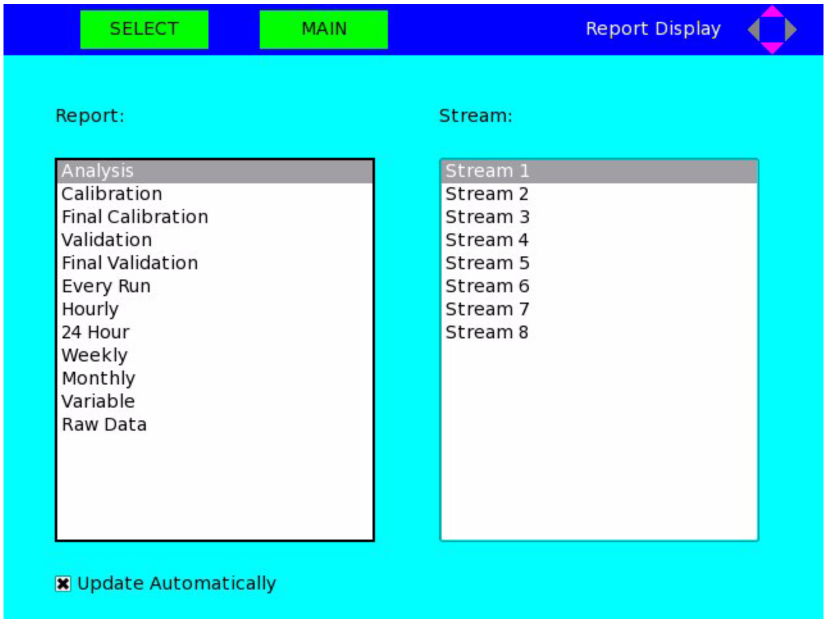


Figure A-51. The Report Display screen



A.4.5 The Control menu

The *Control* menu enables you to stop, calibrate, or place on automatic control a sample stream from the analyzer.

Refer to the “Control menu” section of the *MON20/20 Software for Gas Chromatographs User Manual* for detailed information regarding the *Control* menu screens.

Figure A-52. The Control menu

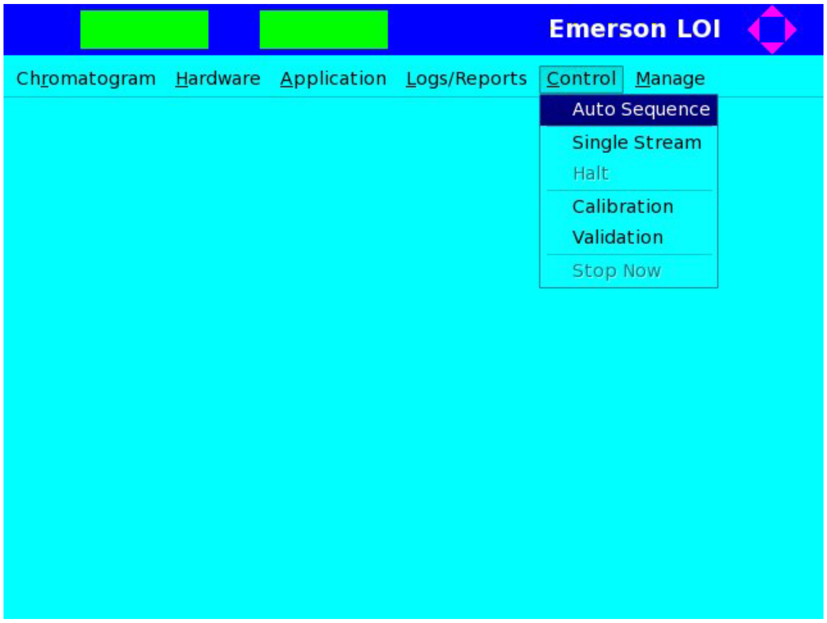


Figure A-53. The Auto Sequence screen

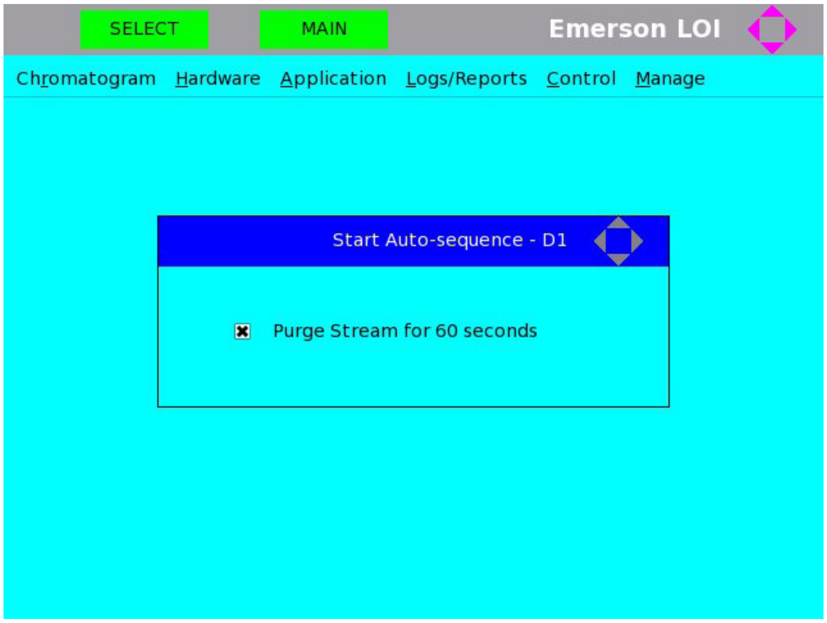


Figure A-54. The Single Stream screen

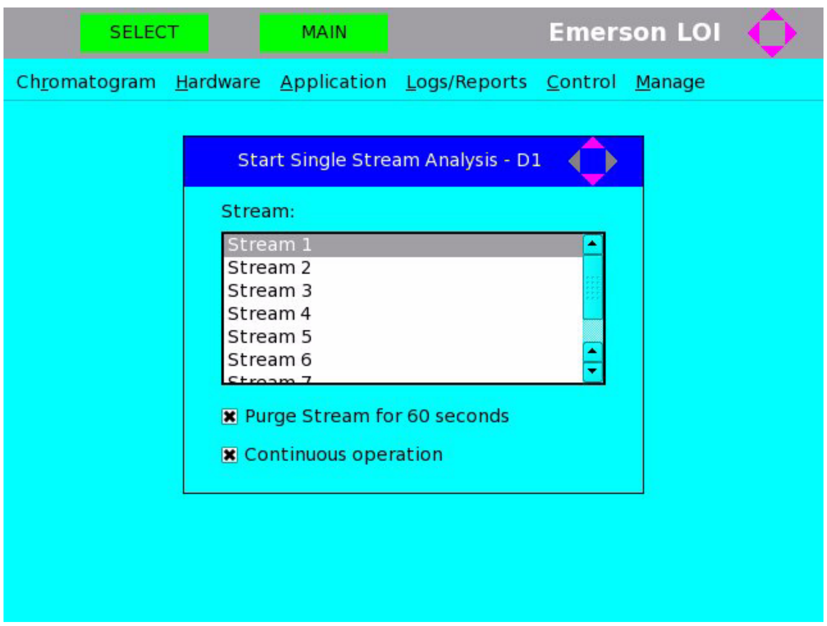


Figure A-55. The Halt screen

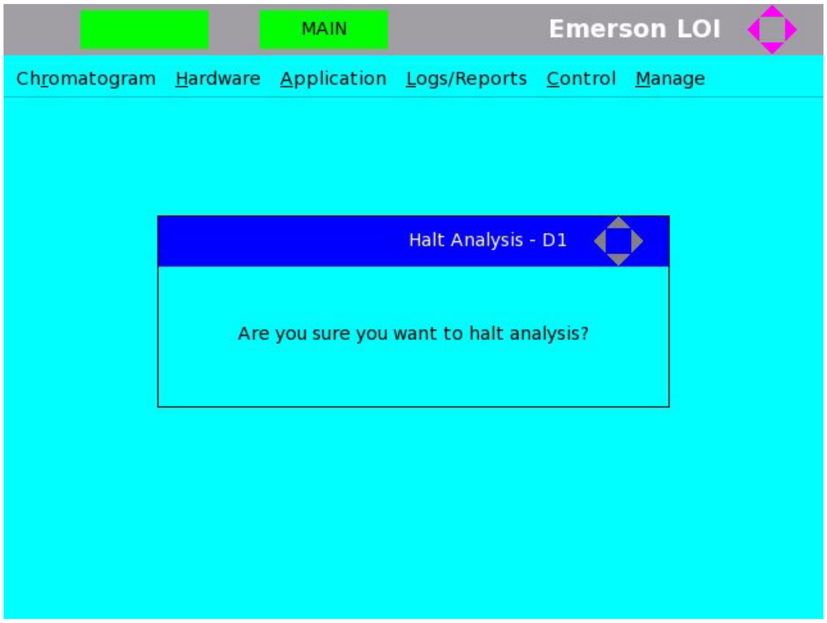


Figure A-56. The Calibration screen

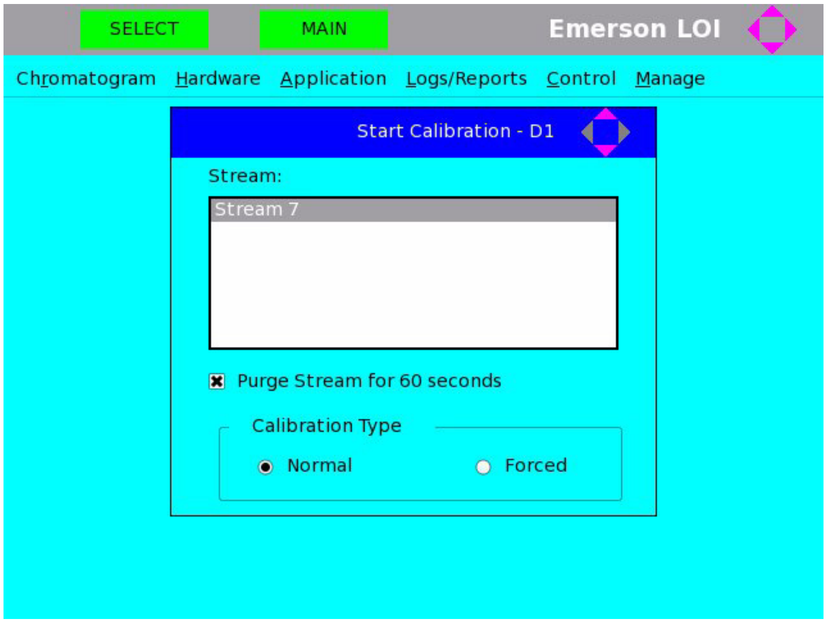


Figure A-57. The Validation screen

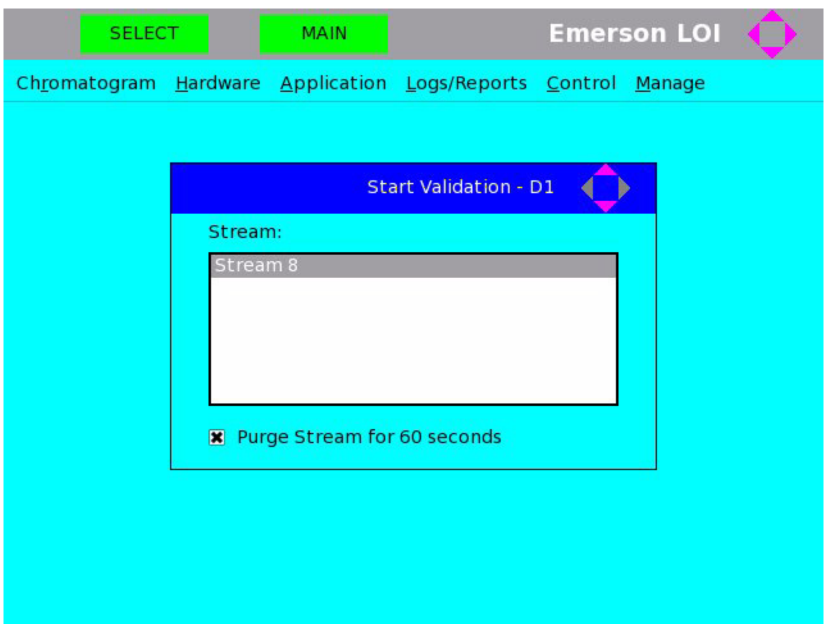
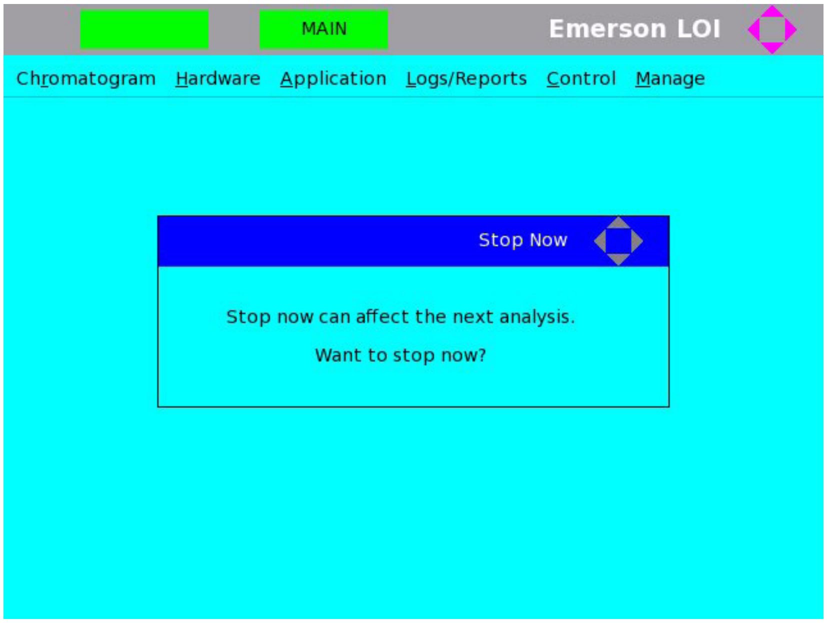


Figure A-58. The Stop Now screen



A.4.6 The Manage menu

The *Manage* menu enables you to chane the LOI's settings, change a user's password, and log off of the GC to which you are connected.

Refer to the "Manage menu" section of the *MON20/20 Software for Gas Chromatographs User Manual* for detailed information regarding the *Manage* menu screens.

Figure A-59. The Manage menu

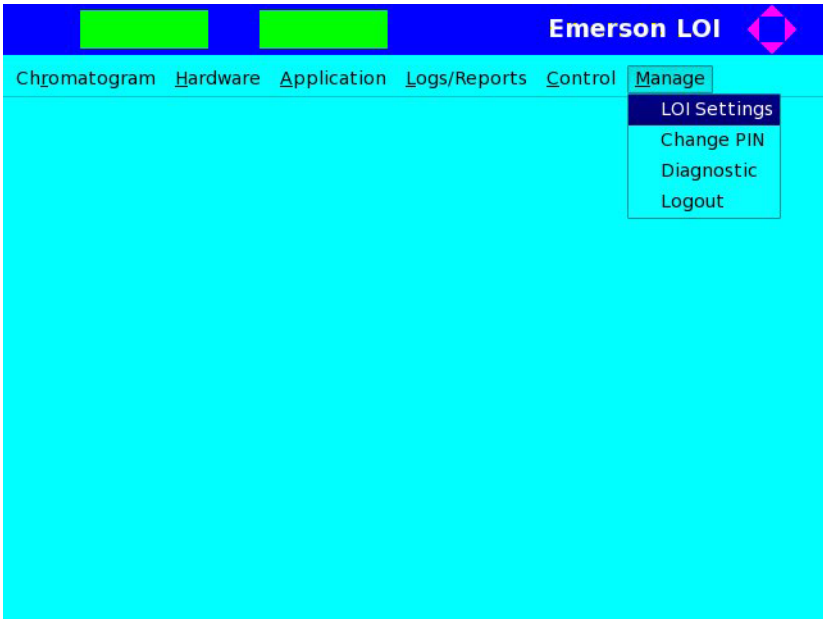


Figure A-60. The LOI Settings screen

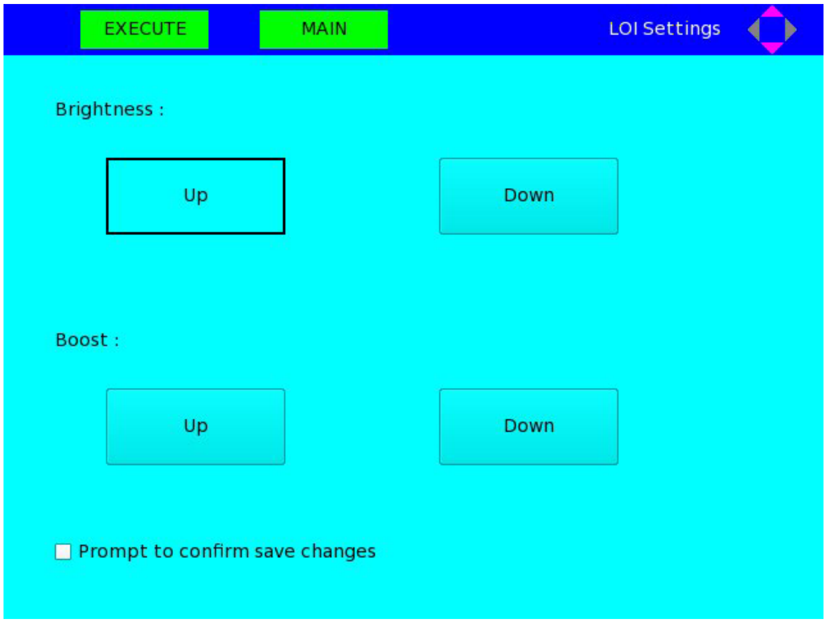


Figure A-61. The Create PIN screen

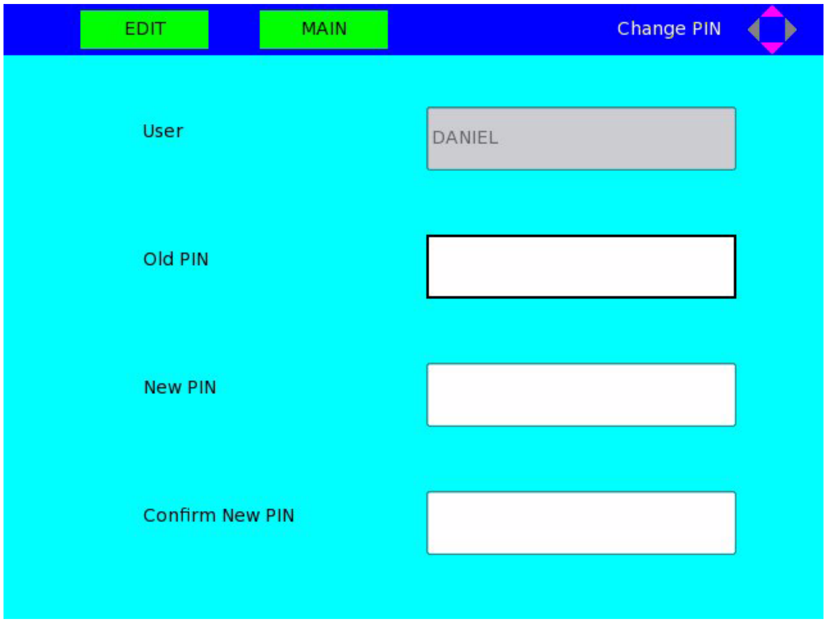
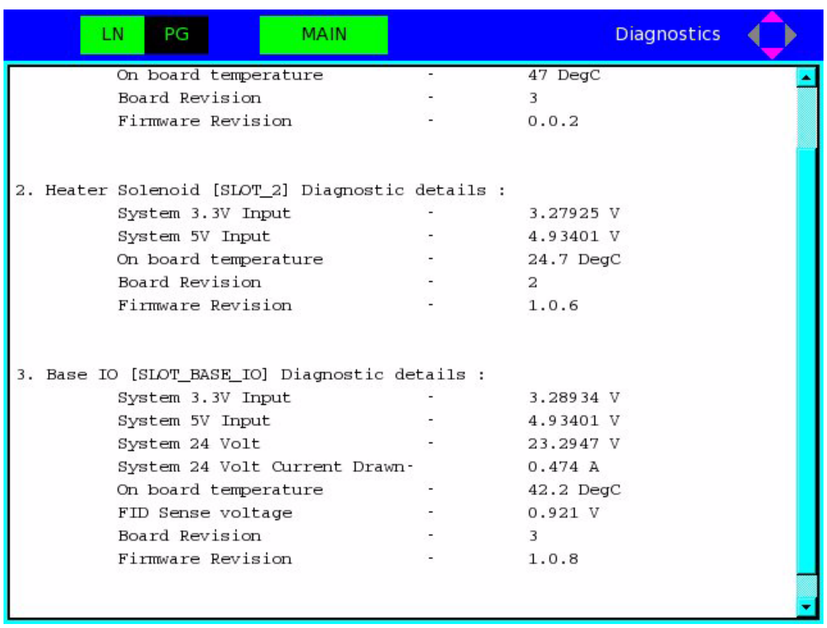


Figure A-62. The Diagnostic screen

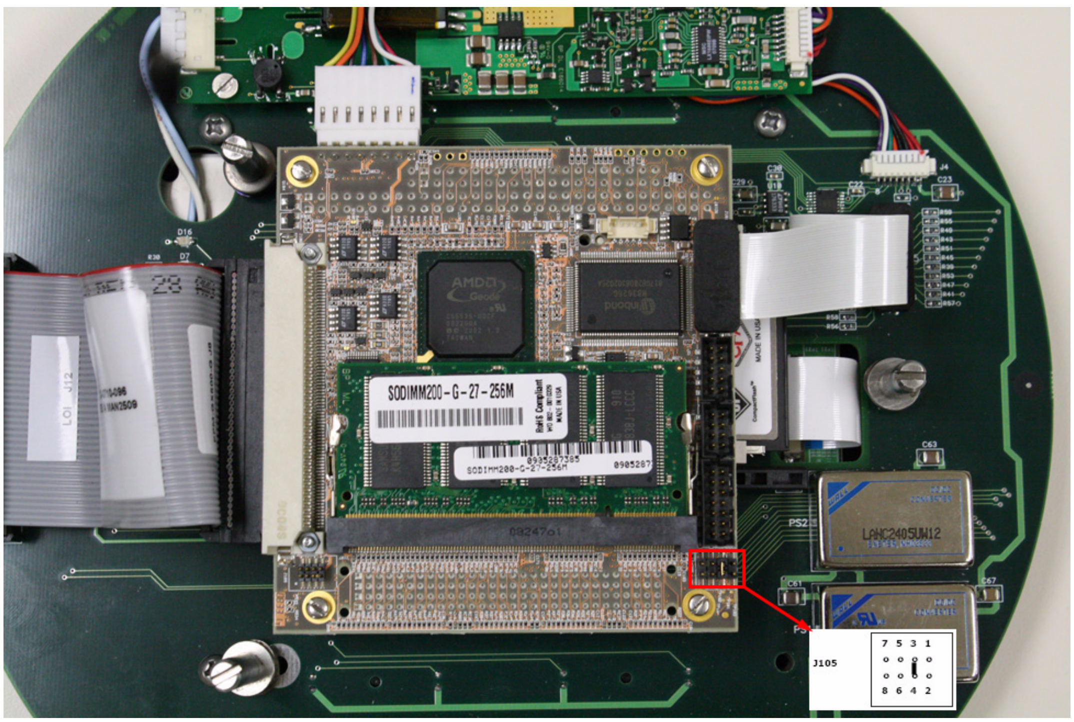


A.5 Troubleshooting a blank LOI screen

If the LOI is powered up but the LCD screen is blank, do the following:

1. Unscrew and remove the LOI from the GC.
2. Flip the LOI over to expose its motherboard and associated electronics.

Figure A-63. Jumpers at J105 on LOI motherboard



3. Check the jumpers located at J105 on the motherboard. These jumpers control the screen's power. To function properly, jumper pins 3 and 4 must be set; if they are not, set them.

If the screen is still blank, contact Customer Service at 1-713-827-6380 for assistance.

Appendix B, Carrier gas installation and maintenance

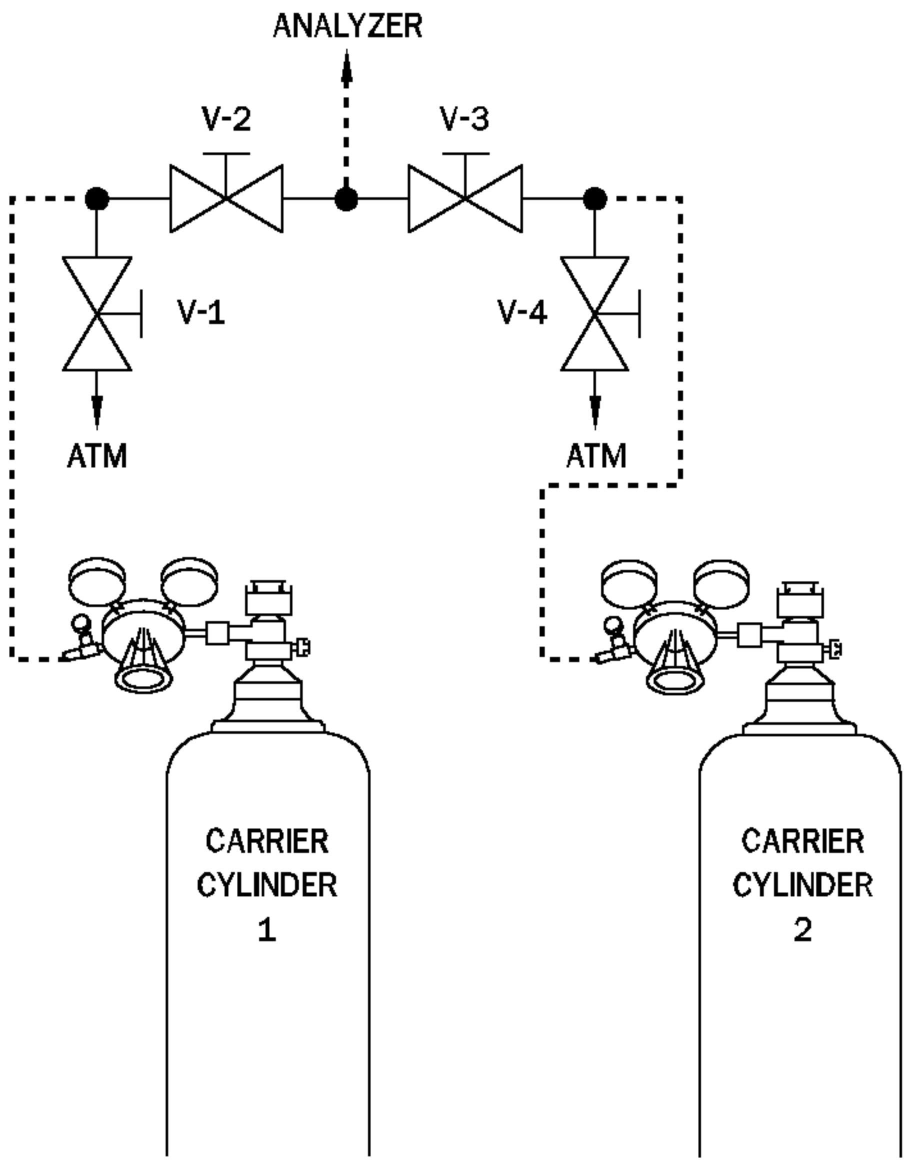
B.1 Carrier gas

This appendix provides a description of the optional carrier manifold (P/N 3-5000-050) that permits the connection of two carrier gas bottles, or cylinders, to a gas chromatograph (GC) system. The benefits of this manifold are as follows:

Note
The illustration and information in this appendix are adapted from drawing AE-10098.

- When one bottle is nearly empty (i.e., 100 psig remaining), the other bottle becomes the primary supply.
- Each bottle can be disconnected for refilling without interrupting GC operation.

Figure B-1. Manifold for two carrier gas bottles to GC system



V-1	Carrier cylinder 1	Bleed valve
V-2	Carrier cylinder 1	Block valve
V-3	Carrier cylinder 2	Block valve
V-4	Carrier cylinder 2	Bleed valve

B.2 Installation and line purging

To install and purge the dual-bottle carrier gas manifold, proceed as follows:

1. Install manifold as shown in Figure A-1. Close all valves and tighten all fittings. Run tubing to the Analyzer, but do not connect.
2. Back off pressure regulator (counter clockwise) fully.
3. Open cylinder valve for Carrier Cylinder 1. The pressure indicator will read the cylinder pressure.
4. Open the shut-off valve attached to the carrier regulator.
5. Regulate pressure out of the cylinder to 20 psig, then close the cylinder valve.
6. Open V-1 (bleed valve) and let the carrier gas bleed to atmosphere until both gauges read 0 psig, then close V-1.
7. Repeat Steps 4 and 5 two more times to purge the line to V-2.
8. Purge the line to V-3 by repeating Steps 2 through 6; but this time, use bleed valve V-4 and Carrier Cylinder 2.
9. With valves 1-4 closed, open both cylinder valves and regulate both carriers to approximately 10 psig.
10. Open V-2 and V-3 simultaneously, then turn both cylinder valves off and let the carrier gasses bleed through the line to the Analyzer until all gauges read 0 psig.
11. Repeat steps (8) and (9) two more times to purge line to Analyzer.
12. Close V-3, leave V-2 open.
13. Open cylinder valve of Carrier Cylinder 1 and, with carrier gas flowing at 10 psig or below, connect carrier line to Analyzer.
14. Slowly regulate Carrier Cylinder 1 to 110 psig.
15. Open V-3 and slowly regulate Carrier Cylinder 2 to 100 psig. (By doing this, all but 100 pounds of Carrier Cylinder 1 will be used before any of Carrier Cylinder 2 is used. When Carrier Cylinder 1 gets to 100 pounds, replace the cylinder). Leak-check all of the fittings carefully.
16. Let the Analyzer run overnight before calibrating.

B.3 Replacing carrier cylinder

To replace one carrier cylinder without interrupting GC operation, proceed as follows:

1. Turn cylinder valve off.
2. Back off on cylinder pressure regulator until handle turns freely. Remove cylinder.
3. Attach new cylinder to regulator and repeat Steps 3 through 7 of Installation Instructions, "Section A.2: Installation and line purging", using appropriate bleed valve to purge line. Leak-check the fitting.
4. Open the appropriate block valve to the analyzer (V-2 or V-3) and regulate outlet pressure to appropriate level. (See Steps 14 and 15 of Installation Instructions, "Section A.2: Installation and line purging".)

Appendix C, Calibration gas installation and maintenance

The calibration gas used for BTU analysis should be blended of gases specified as Primary Standards. Primary Standard gases are blended using weights that are traceable to the National Institute of Standards and Technology (N.I.S.T). For other applications, the calibration gas should be blended to the specifications detailed in the analyzer's Application Data Sheets.

The calibration gas should not have any component that could drop out at the coldest temperature to which the gas will be subjected. A typical blend for a temperature of zero degrees Fahrenheit is listed in the following table (Table A-1). No dropout will occur in this calibration gas if it is blended at a pressure below 250 psig.

Table C-1. Contents of Example Calibration Gas

Gas	Mole Percent
Nitrogen	2.5
Carbon Dioxide	0.5
Methane	Balance
Propane	1.0
Isobutane	0.3
N-butane	0.3
Neopentane	0.1
Isopentane	0.1
N-pentane	0.1
N-hexane	0.03

The sampling system should be carefully planned for the best chromatographic analyses.

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Appendix D, Recommended spare parts

The following list of recommended spare parts will allow you to maintain a single 1500XA for approximately two years.

For a more detailed list of recommended spare parts, please see the documentation package that was provided with the 1500XA.

Description	Part Number	Quantity
Preamplifier board	2-3-0710-001	1
Base I/O board	2-3-0710-003	1
Solenoid/Heater board	2-3-0710-002	1
CPU Board	2-3-0710-007	1
Battery, Lithium (for XA series CPU boards only)	2-5-3750-041	1
Assembly, Carrier Dryer	2-3-0710-066	1
Pressure switch, carrier, for 1500XA	2-4-0710-209	1
Solenoid, 4-Way, MAC	2-4-0710-224	4
Power supply	2-3-0710-053	1
Assembly, Over-Temperature switch, 150 °C	2-3-1000-136	1
Assembly, RTD GC Oven	2-3-1700-092	1
Fuse Kit	2-5-4203-138	1
LOI	2-3-0710-028	1
Heater Assembly	2-3-1510-106 (115 VAC) 2-3-1510-107 (230 VAC)	1
Solid State Relay	2-5-2710-055	1
Timer Relay	2-5-2710-040 (115 VAC) 2-5-2710-054 (230 VAC)	1

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Appendix E, Shipping and long-term storage recommendations

The following recommendations should be followed:

- For shipping purposes the gas chromatograph should be secured to a wooden pallet, maintained in a vertical position and enclosed in a wood framework with a cardboard skin.
- Auxiliary equipment such as sample probes may be stored in the packaging in which it was shipped. If this packaging material is no longer available, secure the equipment to prevent excessive shaking and protect the accessories in a water proof enclosure.
- The gas chromatograph should be stored in a sheltered environment that is temperature controlled between -30^{o}C (-22^{o}F) and 70^{o}C (158^{o}F) to keep the gas chromatograph's protective coatings from deteriorating from exposure to rain or caustic or corrosive environments. Humidity in the sheltered environment should be non-condensing.
- The program stored in the remote or integral controller memory may be retained through battery back-up for at least two years. If lost for some reason, a custom program for downloading the appropriate GC application is included on the CD shipped with the system documentation.
- If the gas chromatograph has been in operation, the system should be purged with carrier gas before powering the gas chromatograph down. Allowing the gas chromatograph to perform a couple of analysis cycles without sample gas is an acceptable method of purging the system. Monitor the results and remove power after component values fall to "0" or after peaks are significantly reduced in size.
- After removing power from the GC, remove the purge gas and immediately cap all inlets and vents, including the carrier drier. These vents and inlets should be capped with the fittings that were in place when the GC shipped from the factory or with Swagelok caps (not provided). This will protect the columns and filters and should result in a trouble-free start up when the unit is returned to service.

- The sample conditioning system vents and inlets should also be capped with the fittings that were in place when the system shipped from the factory. Additionally, all vents should be closed.
- Any remaining openings—such as conduit entries—should also have appropriate plugs installed to prevent foreign material such as dust or water from entering the system.

Appendix F, Engineering drawings

F.1 List of engineering drawings

This addendum contains the following engineering drawings:

BE-22175	Label Set Field Wiring Card 1 (Sheets 1, 2, and 3)
CE-19492E1	Transformer Assembly
DE-31007	Outline and Dimensional, 1500XA

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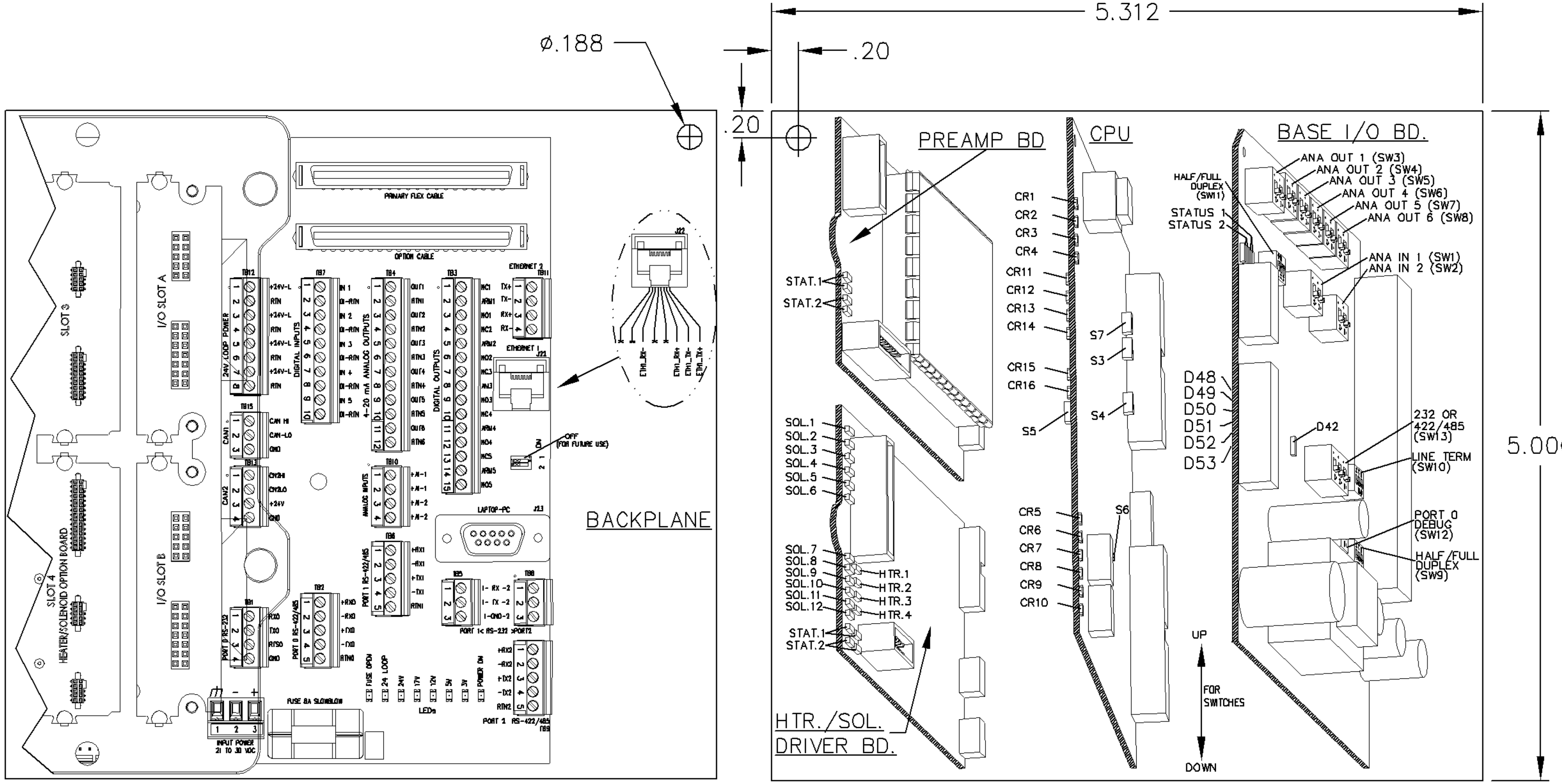


FRONT VIEW

BACK VIEW

NOTES:

1. ELEC. DATA CARDS, 3 CARDS PER SET, LAMINATED WITH 10 MIL LAMINATE, CUSTOM HOLE, TIED MARINE QUALITY CORD 18" WITH A #10 RING TERMINAL TO ATTACH TO MACHINERY. PRINTED ON PHOTO WHITE 29# COLOR PAPER HAMMERMILL, COPIED 2 UP ON 2 SIDES. LAMINATE TO OVERLAP PAPER BY 1/8" (FINAL SIZE 5 9/16" x 5 1/4").

2. USE FULL SIZE PDF FORMAT PRINT OUT AS SOURCE. DO NOT USE TIFF.

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
C	7-28-08	HM	ECO-XX-5003987	EM	BLB
B	6-04-08	HM	ECO-XX-5003858	EM	BLB
A	04-22-08	HM	ECO-XX-5003346	EM	BLB

SI METRIC
THIRD ANGLE PROJECTION

MATERIAL
SEE NOTE 1.

FINISH
SEE NOTE 1.

PROJ. FILE NO. - NONE

FILENAME: BE22175C1.dwg, DATE: 07-28-08, TIME: 1:00 P.M.

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
X.XX ±.015
X.XXX ±.005
ANGULAR ±0° 30'
FINISH 200 RA MAX

BREAK ALL SHARP CORNERS TO .003-.015 RADIUS AND REMOVE ALL BURRS

EMERSON Process Management

TITLE
LABEL SET
FIELD WIRING
CARD 1
MODEL 700XA

DRN BLB/HM	DATE 04/03/08	DWG NO. BE-22175	REV C
CHKD EM	DATE 04/22/08		
ENG BLB	DATE 04/22/08	SCALE 1:1	P/N 2-4-0710-155	SHT 1 OF 3

ϕ.188 5.312 0.20 0.20 5.00

BASE I/O BD.

ANALOG INPUTS

SW1, SW2	CHANNEL 1	CHANNEL 2
0 TO 20 mA	SW1-1 = UP	SW2-1 = UP
	SW1-2 = UP	SW2-2 = UP
0 TO 10 V	SW1-1 = DOWN	SW2-1 = DOWN
	SW1-2 = DOWN	SW2-2 = DOWN

(TOWARD EJECTOR EDGE = UP)

ANALOG OUTPUTS

SW3, 4, 5, 6, 7, 8	POSITION IN LOOP TOP	MIDDLE	BOTTOM
CHANNEL 1, SW3-1	DOWN	UP	UP
SW3-2	UP	UP	DOWN
CHANNEL 2, SW4-1	DOWN	UP	UP
SW4-2	UP	UP	DOWN
CHANNEL 3, SW5-1	DOWN	UP	UP
SW5-2	UP	UP	DOWN
CHANNEL 4, SW6-1	DOWN	UP	UP
SW6-2	UP	UP	DOWN
CHANNEL 5, SW7-1	DOWN	UP	UP
SW7-2	UP	UP	DOWN
CHANNEL 6, SW8-1	DOWN	UP	UP
SW8-2	UP	UP	DOWN

(TOWARD EJECTOR EDGE = UP)

LED	FUNCTION	ON	OFF
D42	24V LOOP POWER	OVER CURRENT	OK

LED	FUNCTION		ACTIVITY
D48	SERIAL DATA	RXD0	
D49	" "	TXD0	FLASHING: NORMAL
D50	" "	RXD1	OFF: QUIET
D51	" "	TXD1	ON: LOCKED
D52	" "	RXD2	
D53	" "	2XD2	

HALF/FULL DUPLEX

SW9	PORT0	PORT1	PORT2	
HALF	DOWN	DOWN	DOWN	(2 WIRE)
FULL	UP	UP	UP	(4 WIRE)

RS-232 OR RS 422/485 STATUS

SW11	PORT0	PORT1	PORT2
HALF	UP	UP	UP
FULL	DOWN	DOWN	DOWN

LINE TERMINATOR RS-485

SW10	PORT0	PORT1	PORT2
IN	DOWN	DOWN	DOWN
?	UP	UP	UP

(AWAY FROM BOARD CENTERLINE = ON)

PORT 0 DEBUG

SW12	
NORMAL	#1 & #2 UP
DEBUG	#1 & #2 DOWN

RS-232 OR RS-422/485

SW13	PORT0	PORT1	PORT2
RS-232	UP	UP	UP
RS-433/485	DOWN	DOWN	DOWN

LED	STARTUP	CAN FAIL	NORMAL
STAT.1 GREEN	ON	—	FLASH
STAT.1 RED	ON	FLASH	—
STAT.2 GREEN	ON	—	—
STAT.2 RED	ON	FLASH	—

HTR./SOL. DRIVER BD.

	LED LIT	DARK
SOL.1	ON	OFF
SOL.2	ON	OFF
SOL.3	ON	OFF
SOL.4	ON	OFF
SOL.5	ON	OFF
SOL.6	ON	OFF
SOL.7	ON	OFF
SOL.8	ON	OFF
SOL.9	ON	OFF
SOL.10	ON	OFF
SOL.11	ON	OFF
SOL.12	ON	OFF
HTR.1	ON	OFF
HTR.2	ON	OFF
HTR.3	ON	OFF
HTR.4	ON	OFF

LED	STARTUP	REBOOT	NORMAL
STAT.1 GREEN	ON	—	FLASH
STAT.1 RED	—	FLASH	—
STAT.2 GREEN	ON	—	—
STAT.2 RED	—	FLASH	—

LED	SOL ERROR	TEMP ERROR	
STAT.1 GREEN	—	—	
STAT.1 RED	ON	ON	
STAT.2 GREEN	—	—	
STAT.2 RED	—	—	

PREAMP BD

LED	FUNCTION	ON	OFF	FLASH
STAT.1 GREEN	BOARD ACTIVE			
STAT.1 RED				
STAT.2 GREEN				
STAT.2 RED				

LED	STARTUP	CAN FAIL	NORMAL
STAT.1 GREEN	ON	—	FLASH
STAT.1 RED	ON	FLASH	—
STAT.2 GREEN	ON	—	—
STAT.2 RED	ON	FLASH	—

LED	PREAMP
STAT.1 GREEN FLASH 5 HZ	#1 BROADCAST ON
STAT.1 GREEN FLASH 1 HZ	#1 BROADCAST OFF
STAT.2 GREEN FLASH 5 HZ	#2 BROADCAST ON
STAT.2 GREEN FLASH 1 HZ	#2 BROADCAST OFF

CPU – SWITCHES & LEDs

LED	
CR1	BOARD STATUS – GREEN
CR2	BOARD STATUS – RED
CR3	LOI RX
CR4	LOI TX
CR5	ETH1 CONFIG1
CR6	ETH1 CONFIG2
CR7	ETH1 CONFIG3
CR8	ETH2 CONFIG1
CR9	ETH2 CONFIG2
CR10	ETH2 CONFIG3
CR11	COM 1 RX
CR12	COM 1 TX
CR13	COM 1 RTS
CR14	COM 1 CTS
CR15	COM 2 RX
CR16	COM 2 TX

SWITCH
S3 FACTORY SET
S4 FACTORY SET
S5 FACTORY SET
S6 FACTORY SET
S7 FACTORY SET

NOTES:

1. ELEC. DATA CARDS, 3 CARDS PER SET, LAMINATED WITH 10 MIL LAMINATE, CUSTOM HOLE, TIED MARINE QUALITY CORD 18" WITH A #10 RING TERMINAL TO ATTACH TO MACHINERY. PRINTED ON PHOTO WHITE 29# COLOR PAPER HAMMERMILL, COPIED 2 UP ON 2 SIDES. LAMINATE TO OVERLAP PAPER BY 1/8" (FINAL SIZE 5 9/16" x 5 1/4").
2. USE FULL SIZE PDF FORMAT PRINT OUT AS SOURCE. DO NOT US TIFF.

SI METRIC

THIRD ANGLE PROJECTION

MATERIAL: SEE NOTE 1.

FINISH: SEE NOTE 1.

PROJ. FILE NO.

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
C	7-28-08	HM	ECO-XX-5003987	EM	BLB
B	06-04-08	HM	ECO-XX-5003858	EM	BLB
A	04-22-08	HM	ECO-XX-5003346	EM	BLB

FILENAME: BE22175C2.dwg, DATE: 07-28-08, TIME: 1:14 P.M.

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES

X.XX ±.015
X.XXX ±.005
ANGULAR ±0° 30'
FINISH 200 RA MAX

BREAK ALL SHARP CORNERS TO .003-.015 RADIUS AND REMOVE ALL BURRS

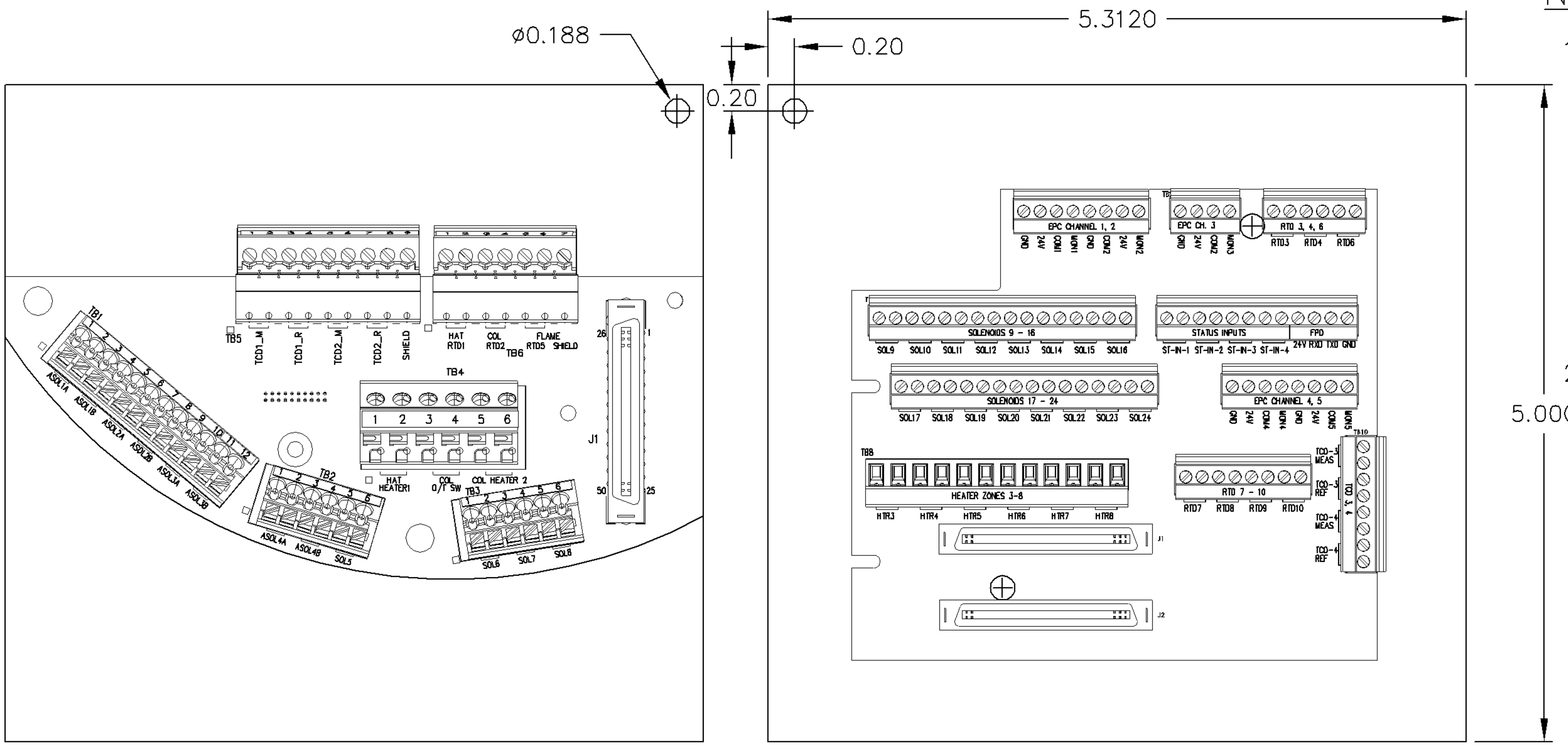
EMERSON Process Management

TITLE: LABEL SET FIELD WIRING CARD 2 MODEL 700XA

DRN	BLB/HM	DATE	04/03/08
CHKD	EM	DATE	04/22/08
ENG.	BLB	DATE	04/22/08

DWG NO. BE-22175 REV C

SCALE 1:1 P/N 2-4-0710-155 SHT 2 OF 3



NOTES:

1. ELEC. DATA CARDS, 3 CARDS PER SET, LAMINATED WITH 10 MIL LAMINATE, CUSTOM HOLE, TIED MARINE QUALITY CORD 18" WITH A #10 RING TERMINAL TO ATTACH TO MACHINERY. PRINTED ON PHOTO WHITE 29# COLOR PAPER HAMMERMILL, COPIED 2 UP ON 2 SIDES. LAMINATE TO OVERLAP PAPER BY 1/8" (FINAL SIZE 5 9/16 x 5 1/4").
2. USE FULL SIZE PDF FORMAT PRINT OUT AS SOURCE. DO NOT USE TIFF.

SI METRIC

THIRD ANGLE PROJECTION

MATERIAL: SEE NOTE 1.

FINISH: SEE NOTE 1.

PROJ. FILE NO.

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
C	7-28-08	HM	ECO-XX-5003987	EM	BLB
B	06-04-08	HM	ECO-XX-5003858	EM	BLB
A	04-22-08	HM	ECO-XX-5003346	EM	BLB

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GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
X.XX ±.015
X.XXX ±.005
ANGULAR ±0° 30'
FINISH 200 RA MAX

BREAK ALL SHARP CORNERS TO .003-.015 RADIUS AND REMOVE ALL BURRS

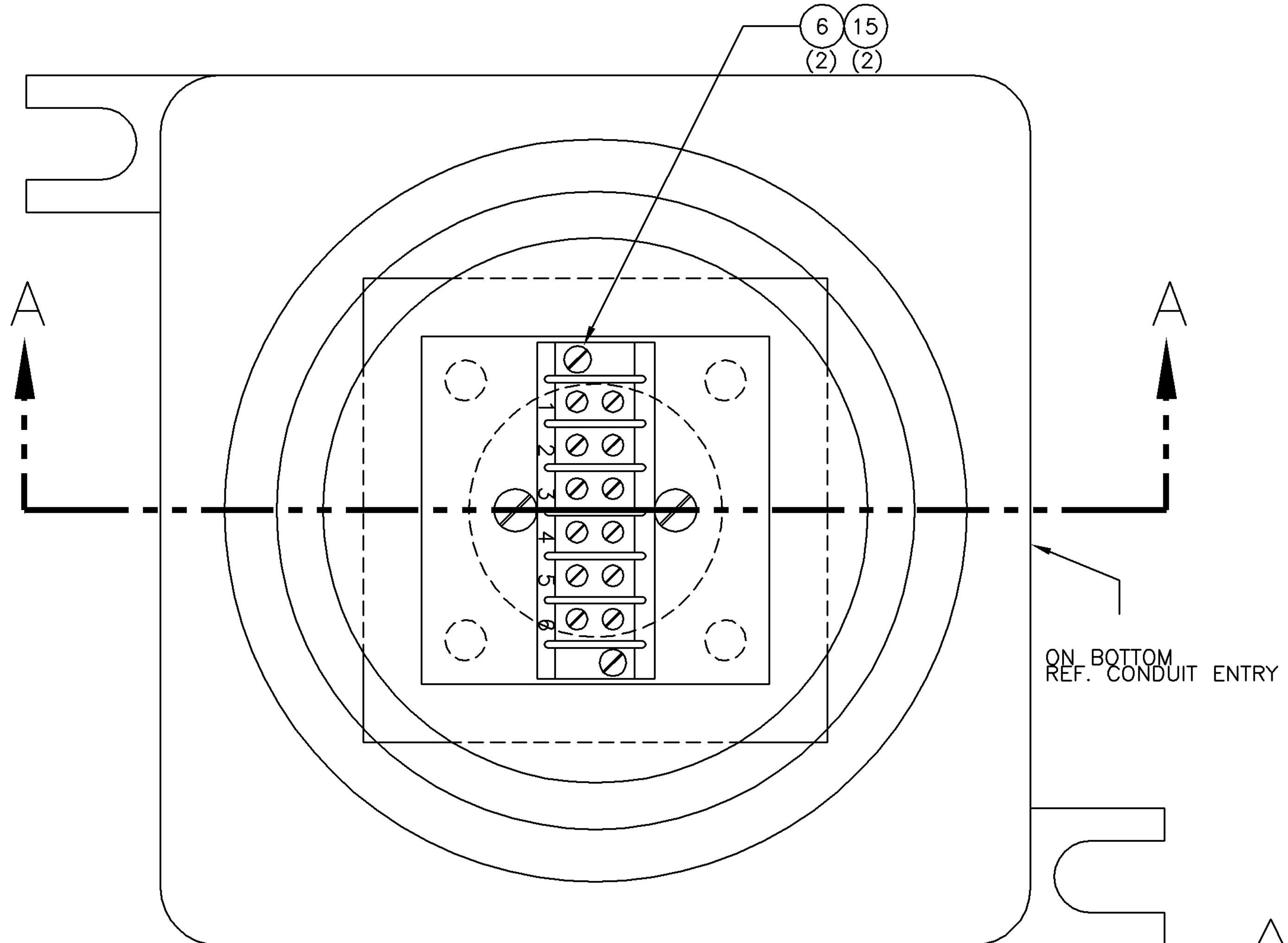
EMERSON Process Management

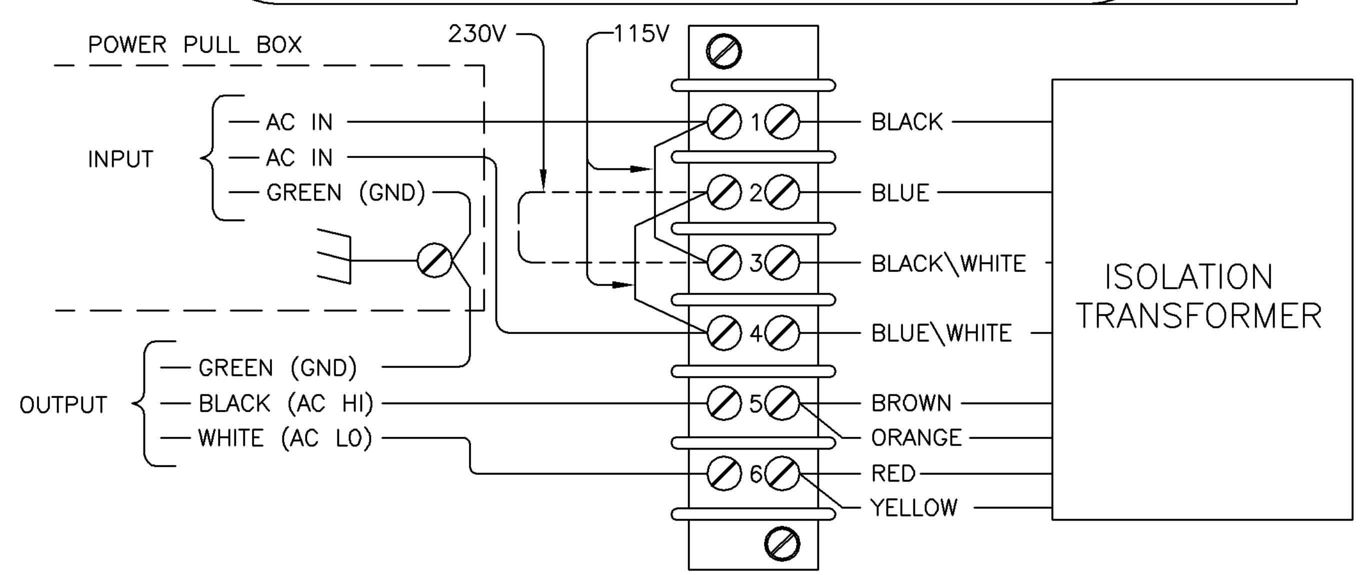
TITLE: LABEL SET FIELD WIRING CARD 3 MODEL 700XA

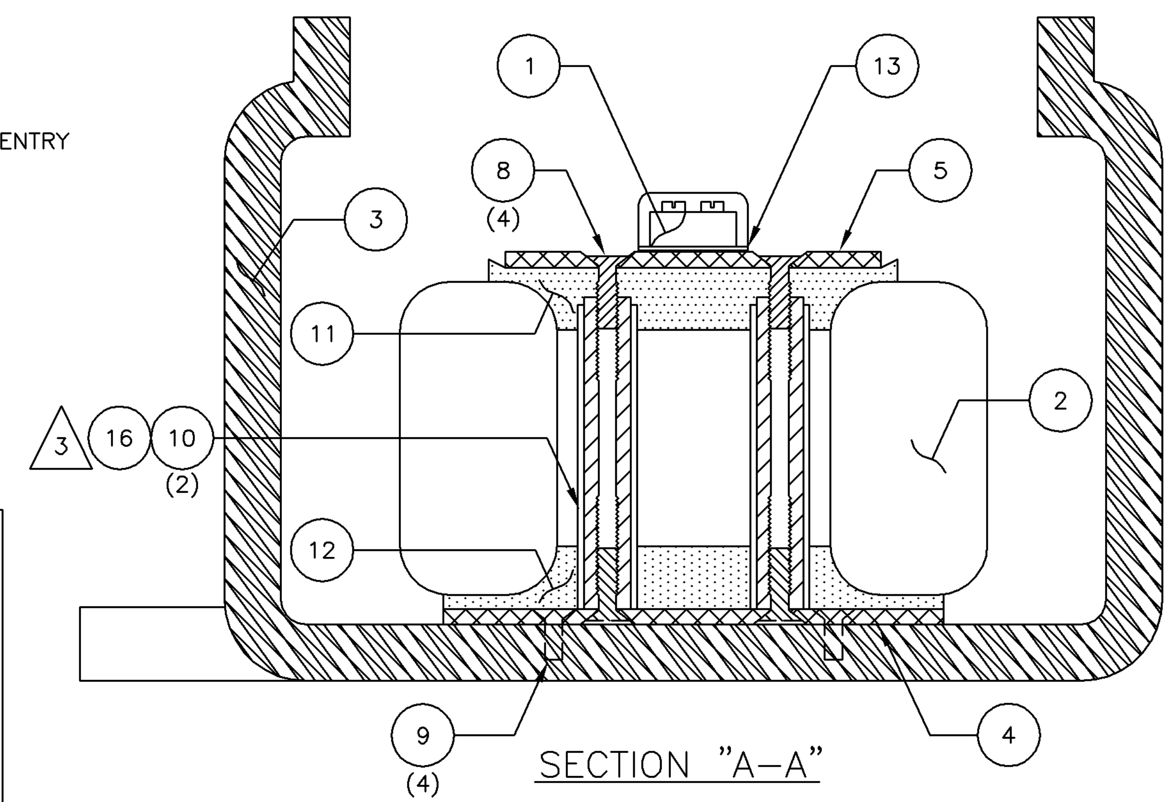
DRN BLB/HM	DATE 04/15/08	DWG NO. BE-22175	REV C
CHKD EM	DATE 04/22/08		
ENG BLB	DATE 04/22/08	SCALE 1:1	P/N 2-4-0710-155	SHT 3 OF 3

NOTES:

1. THE FIRST STEP IN THE ASSEMBLY REQUIRES THAT THE STANDOFFS (ITEM 10) BE MOUNTED ON LOWER PLATE (ITEM 4) AND THEN THE PLATE IS TO BE MOUNTED IN THE ENCLOSURE BEFORE THE REMAINING ITEMS ARE TO BE ASSEMBLED.
2. WIRE TRANSFORMER TO TERMINAL STRIP PER WIRING DIAGRAM USING TERMINAL LUGS (ITEM 14). JUMPER FOR 230 VAC PER TABLE. USE TERMINAL LUGS (ITEM 18) FOR JUMPERS AND INPUT/OUTPUT WIRING. PUT EXTRA (6) TERMINAL LUGS (ITEM 18) IN BAG AND TAPE TO INSIDE OF ENCLOSURE LID.
3. (△3) INSTALL SHRINK TUBING (ITEM 16) ON THE ENTIRE LENGTH OF (2) STANDOFFS (ITEM 10).







SECTION "A–A"

CONNECT JUMPERS PER CHART

INPUT	OUTPUT	JUMPER #1	JUMPER #2
230V	115V	2–3	NONE
115V	115V	1–3	2–4

SI METRIC

THIRD ANGLE PROJECTION

MATERIAL: SEE ORDER

FINISH: SEE ORDER

PROJ. FILE NO. – NONE

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
E	11-09-07	CC	ECO-XX-5003273	EM	HS
D	3-05-03	HM	ECO-XX-166401	EM	DLT
C	4/3/98	RD	ECO-9433	EM	DLT
B	6/97	RD	ECO-9194	EM	DLT
A	3/20/97	RD	ECO-9092	EM	DLT

FILENAME: CE19492E1.dwg, DATE: 11-09-07, TIME: 2:05 P.M.

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
X.XX ±.015
X.XXX ±.005
ANGULAR ±0° 30'
FINISH 200 RA MAX

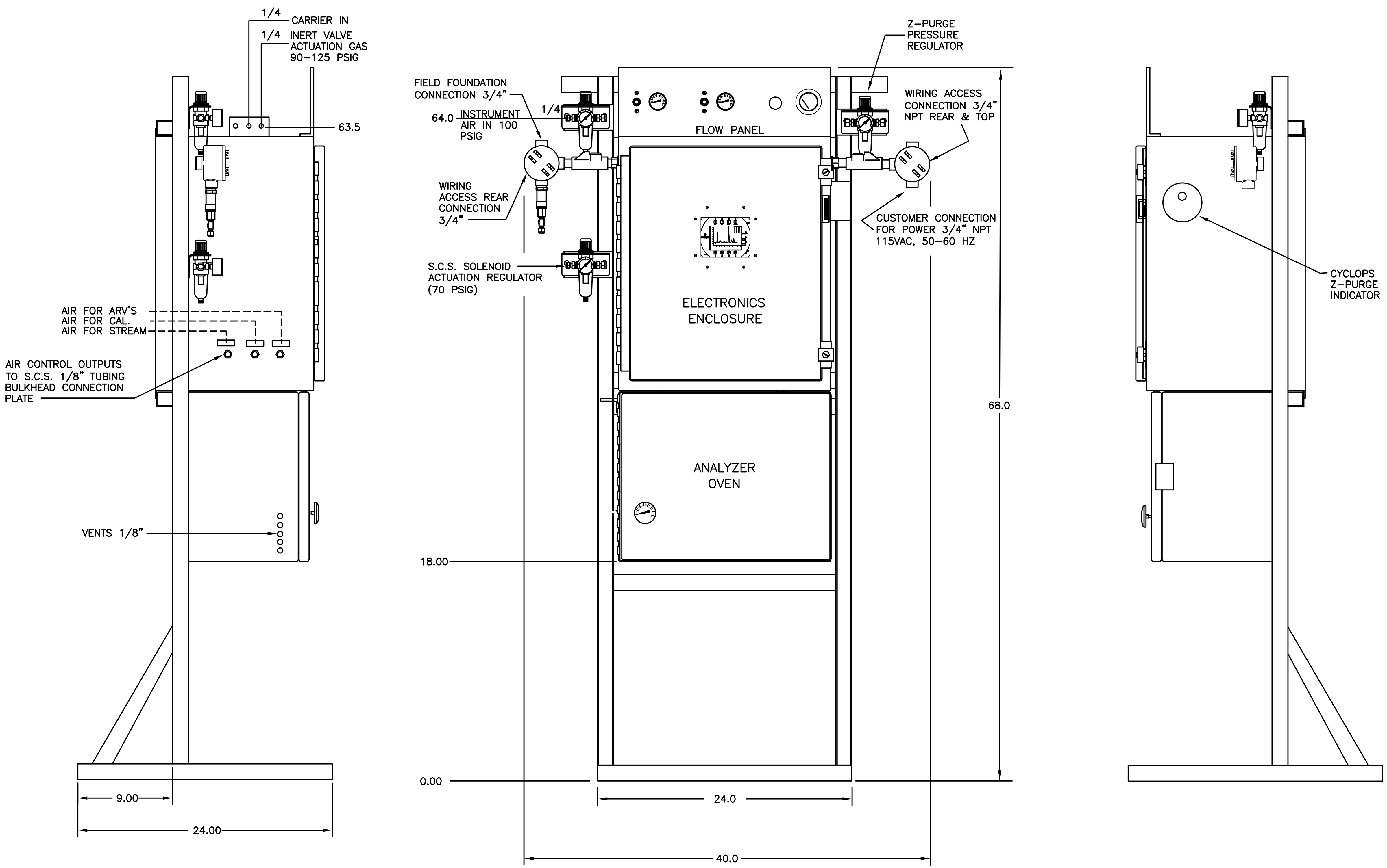
BREAK ALL SHARP CORNERS TO .003–.015 RADIUS AND REMOVE ALL BURRS

EMERSON. Process Management

TITLE: TRANSFORMER ASSEMBLY

DRN RD	DATE 1/7/92	DWG NO. CE–19492	REV E
CHKD EM	DATE 2/11/97		
ENG. DLT	DATE 3/20/97	SCALE NTS	P/N SEE ORDER

SHT 1 OF 1



SI METRIC						
THIRD ANGLE PROJECTION						
MATERIAL N/A						
	A	5-7-10	HM	RELEASED	EM	NP
FINISH N/A	REV	DATE	DRN	DESCRIPTION	CHKD	APPD
PROJ. FILE NO. – NONE	FILENAME: DE31007A1.dwg, DATE: 05-07-10, TIME: 10:39 A.M.					

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
X.XX ±.015
X.XXX ±.005
ANGULAR ±0° 30'
FINISH 200 RA MAX

BREAK ALL SHARP CORNERS TO .003–.015 RADIUS AND REMOVE ALL BURRS

EMERSON. Process Management

TITLE
OUTLINE AND DIMENSIONAL
MODEL 1500 XA
CYCLOPS Z–PURGE
(GENERIC)

DRN MANCHA	DATE 05/07/10	DWG NO. DE–31007	REV A
CHKD EM	DATE 5/7/10		
APPD NP	DATE 5/7/10	SCALE NTS · P/N SEE ORDER	SHT 1 OF 1

WARRANTY CLAIM PROCEDURES

To make a warranty claim, you, the Purchaser, must:

1. Provide Daniel Measurement and Control, Inc. or Rosemount Analytical, Inc. with proof of the Date of Purchase and proof of the Date of Shipment of the product in question.
2. Return the product to Daniel Measurement Services (DMS) within 12 months of the date of original shipment of the product, or within 18 months of the date of original shipment of the product to destinations outside of the United States. The Purchaser must prepay any shipping charges. In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss of the product during shipment.
3. To obtain warranty service or to locate the nearest DMS office, sales office, or service center, call (713) 827-6314, fax a request to (713) 827-6312, or write to:

   Daniel Measurement Services
   11100 Brittmore Park Drive
   Houston, Texas 77041

   You can also contact DMS via **www.emersonprocess.com/daniel**.

4. When contacting DMS for product service, the Purchaser is asked to provide information as indicated on the following page entitled "Customer Repair Report".
5. For product returns from locations outside the United States, it will be necessary for you to obtain the import consignment address so that DMS's customs broker can handle the importation with the U.S. Customs Service.
6. DMS offers both on call and contract maintenance service designed to afford single source responsibility for all its products.
7. DMS reserves the right to make changes at any time to any product to improve its design and to insure the best available product.

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CUSTOMER REPAIR REPORT

FOR SERVICE, COMPLETE THIS FORM, AND RETURN IT ALONG WITH THE AFFECTED EQUIPMENT TO CUSTOMER SERVICE AT THE ADDRESS INDICATED BELOW.

COMPANY NAME: ____

TECHNICAL CONTACT: ______________________ PHONE: ______________

REPAIR P. O. #: ______________ IF WARRANTY, UNIT S/N: ______________

INVOICE ADDRESS: ____

____

____

SHIPPING ADDRESS: ____

____

____

RETURN SHIPPING METHOD: ____

EQUIPMENT MODEL #: ____________ S/N: ____________ FAILURE DATE: ____________

DESCRIPTION OF PROBLEM: ____

____

____

WHAT WAS HAPPENING AT TIME OF FAILURE? ______________________________

____

ADDITIONAL COMMENTS: ____

____

____

REPORT PREPARED BY: ______________________ TITLE: ______________

IF YOU REQUIRE TECHNICAL ASSISTANCE, PLEASE FAX OR WRITE THE CUSTOMER SERVICE DEPARTMENT AT:

DANIEL MEASUREMENT SERVICES
DIVISION OF EMERSON PROCESS MANAGEMENT
ATTN: CUSTOMER SERVICE
11100 BRITTMOORE PARK DRIVE
HOUSTON, TEXAS 77041

PHONE: (713) 827-6314
FAX: (713) 827-6312

FOR FASTEST SERVICE CONTACT DANIEL MEASUREMENT SERVICES VIA OUR WEBSITE:
www.emersonprocess.com/daniel

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