Operating Manual

Series 210SA
Sulfur Gas Analyzer
with Mass Flow Control and Auto-Zero

Series 210-06000001: 115 V, 50/60 Hz

Series 212-06000001: 230 V, 50/60 Hz

Series 210-06000002: 115 V, 50/60 Hz

Series 212-06000002: 230 V, 50/60 Hz

Series 210-06000003: 115 V, 50/60 Hz

Series 212-06000003: 230 V, 50/60 Hz

February 2021

Rev. 3

READ INSTRUCTIONS BEFORE OPERATING

GOW-MAC®
INSTRUMENT CO.

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All information referred to and/or included in this report is current as of the original issue date of this manual. GOW-MAC® Instrument Co. makes no warranty or representation with respect to the accuracy of the information or with respect to the suitability of the use of such information outside GOW-MAC® Instrument Co., nor does GOW-MAC® Instrument Co. assume responsibility for any injury or damage which may result, directly or indirectly, from the use of such information.

The warranties made by GOW-MAC® Instrument Co. with respect to the product are voided if the product is not used and serviced in accordance with the instructions in this manual.

Please protect yourself and your employees by following these operating instructions. We encourage our customers to write or call for any additional information relative to the use or repair of this instrument.

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LIABILITY Buyer assumes all responsibility for warning and protecting its employees and independent contractors with respect to all hazards to persons and property in any way connected with the Equipment and the use thereof. Seller's liability for any claim of any kind hereunder, whether or not based on contract, tort (including negligence), strict liability, warranty, or any other grounds, shall not exceed the purchase price of the Equipment or the portion of the purchase price attributable to any part or parts of the Equipment in respect to which such claim is made. Seller shall not be liable for any special, indirect, incidental, or consequential damages. Without limiting the generality of the foregoing, Seller shall have no liability with respect to the results obtained by use of the Equipment, whether in terms of product condition, operating cost, general effectiveness, success or failure, or regardless of any statement made in any written proposal submitted by Seller. It is expressly understood that any technical advice furnished by Seller with reference to the Equipment is given gratis and Seller assumes no obligation or liability for the advice given or results obtained, all such advice being given and accepted at Buyer's risk. Each party hereby agrees to indemnify and hold the other party harmless from any actions, lawsuits, demands, claims, losses, expenses, costs, including but not limited to legal fees, and damages arising from the injury, illness or death of the indemnifying party's employees in any way related to the Equipment, whether or not such injury, illness, or death is claimed to have been caused by, resulted from, or was in any way connected with the negligence of the party to be indemnified.

PROPRIETARY INFORMATION Buyer agrees to maintain all proprietary information disclosed by Seller, including such proprietary information obtainable upon examination of the Equipment, in confidence and to refrain from any disclosure thereof to any third party (including any affiliate of Buyer), for any purpose, without the prior written consent of Seller. Buyer agrees to use said proprietary information solely for purposes of maintaining and operating the Equipment, and to refrain from any use thereof to design, construct, have constructed and/or operate any duplication or modification of the Equipment, or from any other use thereof, without the prior written consent of Seller.

IMPORTANT INFORMATION

These instructions are written for personnel operating the GOW-MAC® Series 210SA Sulfur Analyzer. Read and understand the safety precautions in this manual to become familiar with the safe practices for operating this equipment.

Dangers, Warnings, Cautions, and Notes
Dangers, Warnings, Cautions, and Notes appear throughout this manual. A sample of each statement appears below. Within each sample, a definition of the statement type and its purpose is given.

DANGERS alert you to an immediate hazard that causes serious injury or death and requires special precautions to be taken.

WARNINGS alert you to a potential hazard that causes serious injury or death *under certain conditions.*

CAUTIONS alert you to a non-immediate or potential hazard or an unsafe practice that presents a minor threat of personal injury or damage to equipment, data, or processes.

NOTES emphasize or remind you of an important piece of information.

Contents

Quality Control Final Instrument Inspection Report

Instrument Model No. ..... _____
Instrument Serial Number ..... _____

Oven Temperature..... _____
Detector Temperature..... _____
mV Output ..... _____
Transport Flowrate ..... _____
Vent 2 Flowrate (backflush)..... _____
FPD Total H_2 Fuel Flowrate (Main & Aux)..... _____
FPD Total Air Flowrate..... _____
NIST Traceable Standard Reference Number ..... _____

0.5 to 1.5 ppm Carbonyl Sulfide (COS) in CO_2
Instrument Display Reading ..... _____

Current Limitations (Series 210- or 212-06000001)
20 mA (100 ppb) Actual ..... _____ mA
4 mA (0 ppb) Actual ..... _____ mA

Current Limitations (Series 210- or 212-06000002)
20 mA (2 ppm) Actual ..... _____ mA
4 mA (0 ppm) Actual ..... _____ mA

Current Limitations (Series 210- or 212-06000003)
20 mA (0.5 ppm) Actual ..... _____ mA
4 mA (0 ppm) Actual ..... _____ mA

Trigger ..... _____
Ready ..... _____
Date ..... _____
Technician ..... _____

GOW-MAC INSTRUMENT CO.

IMPORTANT WARNING

THIS MANUAL MUST BE CAREFULLY READ BY ALL INDIVIDUALS WHO HAVE OR WILL HAVE THE RESPONSIBILITY FOR INSTALLING, USING, OR SERVICING THE PRODUCT.

Like any piece of complex equipment, the Series 210SA SULFUR ANALYZER will perform as designed only if it is installed, used and serviced in accordance with the manufacturer's instructions. OTHERWISE IT COULD FAIL TO PERFORM AS DESIGNED AND PERSONS WHO RELY ON THIS PRODUCT FOR THEIR SAFETY COULD SUSTAIN SEVERE BODILY INJURY OR DEATH.

The warranties made by GOW-MAC Instrument Co. with respect to the product are voided if the product is not installed, used and serviced in accordance with the instructions in this manual.

Please protect yourself and your employees by following these operating instructions. We encourage our customers to write or call for any additional information relative to the use or repair of this instrument.

Technical Support

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E-mail: sales@gow-mac.com

GENERAL WARNINGS AND SAFETY

1. The Series 210SA Sulfur Analyzer should be installed, operated and maintained in strict accordance with its labels, cautions, warnings, instructions, and within the limitations stated.

2. The Sulfur Analyzer housing must be located in a non-hazardous area.

3. **Allow instrument to reach room temperature before beginning installation.**

4. Use genuine GOW-MAC replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair instrument performance. Repair or alteration of the Sulfur Analyzer, beyond the scope of these instructions or by anyone other than GOW-MAC or a GOW-MAC Representative could cause the product to fail to perform as designed, and persons who rely on this product for their safety could sustain severe bodily injury or death.

5. DISCONNECT the instrument from **ALL** power sources **BEFORE** removing instrument housing and exposing potentially dangerous voltages.

6. **DO NOT** overload the AC outlet with other electrical equipment.

7. Adhere to the color coding descriptions when hooking up electrical connections.

8. Repair or replace faulty or frayed wiring.

9. Make sure that the actual line voltage is the value for which the instrument was designed. Make sure that the power cord is plugged into the correct voltage source.

10. Perform periodic leak checks on all gas connections.

11. **DO NOT** allow flammable and/or toxic wastes to accumulate.

12. Keep combustibles away from gas cylinders and eliminate ignition sources.

13. Maintain adequate ventilation around Sulfur Analyzer, especially above and behind the analyzer.

14. Dispose of wastes properly.

GENERAL PRECAUTIONS FOR HANDLING AND STORING HIGH PRESSURE GAS CYLINDERS

Compressed gases have properties that can cause serious accidents, injuries, and even death if proper precautions and safety practices are not followed. Therefore, during handling and use of these gases, be certain to use applicable safety precautions described by your local compressed gas supplier, the Compressed Gas Association, and/or O.S.H.A. regulations.

1. Read the label on all cylinders **BEFORE** using to identify the cylinder contents. If the label is illegible, return the cylinder to the supplier. **DO NOT ASSUME THE CONTENTS.**

2. Secure cylinders in storage and in use to an immovable structure to prevent accidental falling or movement. Read the relevant safety codes.

3. Store or move cylinders ONLY in the vertical position and with cylinder caps installed. **DO NOT** move or transport cylinders with regulators attached.

4. Store cylinders in a well ventilated area away from heat or ignition sources.

5. When installing tubing, provide ONLY approved, adequate pressure reducing regulators and pressure relief devices to prevent over-pressurizing of tubing and equipment.

6. Never drop cylinders or permit them to strike each other violently.

7. Cylinders may be stored in the open but, in such cases, should be protected against extremes of weather and from damp ground (to prevent rusting). In areas where extreme temperatures are prevalent, store cylinders in the shade.

8. The valve protection cap should be left on each cylinder until cylinder has been secured against a wall or bench, or placed in a cylinder stand and is ready for use.

9. Avoid dragging, rolling or sliding cylinders even for a short distance. Move cylinders by using a suitable hand truck.

10. Never tamper with safety devices in valves or cylinders.

11. Do not store full and empty cylinders together. Serious suck-back can occur when an empty cylinder is attached to a pressurized system.

12. No part of a cylinder should be subjected to a temperature higher than 52 °C (125 °F). Do not permit flame to come in contact with any part of a compressed gas cylinder.

1
PRINCIPLE OF OPERATION

The GOW-MAC Series 210SA Sulfur Analyzer meets ISBT (International Society of Beverage Technologists) Method 14 General Requirements and Guidelines for selective measurement of Total Sulfur Content (TSC) in beverage-grade, vaporized liquid CO_2.

Sulfur-containing compounds are isolated from the sample using proprietary technology, and quantified by a Flame Photometric Detector (FPD) without interference from other potential impurities in beverage-grade CO_2. The detector exhibits linearity over three orders of magnitude, with a detection limit of < 5 ppb COS.

Total sulfur content of the sample is analyzed and quantified by the software system, with the results displayed digitally on the instrument's front panel as TSC (Total Sulfur Content) in ppm (v/v) as Sulfur, as defined by IBST Method 14.0.

The main principle of instrument operation is operator-free, continuous analysis. Design considerations have incorporated simplicity with reliability in order to allow the automatic sampling, introduction, speciation, detection and quantitation of impurities.

Calibration, calibration validation, data acquisition and data analysis are performed automatically by the on-board software system, described in Chapter 6.

By following the recommended calibration and operation procedures, the 200SA provides proven, consistently accurate, low-cost analysis results that meet or exceed ISBT general requirements and guidelines for beverage-grade CO_2 sulfur analyzers.

1.1 Detector

The Series 210SA uses a Flame Photometric Detector (FPD). The FPD is a mass sensitive detector that exploits the chemiluminescence reaction of sulfur compounds in a hydrogen/air flame. The resulting emitted light is filtered, for sulfur specificity, and collected in a photomultiplier tube (PMT, see Chapter 1, Section 1.3.1)

1.2 Flow System

The flow system combines transport, calibration and sample gas flows with discreet injection and total sulfur detection capability.

1.2.1 Transport gas, calibration gas and sample enter through clearly labeled compression fittings on the rear of the instrument. *See Chapter 3 - Operating Controls.* Transport, calibration and sample gases are externally regulated by the user with house controls or by using the GOW-MAC calibration/sample gas flow control accessory. The sample/calibration gas flow during sample loop purge may be monitored by the flow meter on the front panel of the instrument while the instrument is purging.

1.2.2 The sample introduction system is comprised of two pneumatically actuated valves. *See Flow Diagram located in back of manual.* The first valve is for the selection of the calibration **or** the sample gas. The second is the gas-sampling/backflush valve that is connected to the sample loop and the speciation oven. A shut-off valve provides discreet, constant volume injections. Timed switching of the backflush valve ensures that the species of interest are sent to the detector while interfering species are cleared out of the speciation oven to vent. Both valves can be controlled manually (for diagnostics only) by the on-board software system.

1.2.3 The speciation system is a proprietary module for the precise identification of total sulfur, packaged in a constant-temperature oven. The temperature of the oven is preset at the factory for operational use. The software system incorporates a conditioning step for routine elevated temperature conditioning of the speciation system. This “bake-out” procedure is described in detail in Chapter 7, Section 7.2.

1.2.4 Support Gas Flow Control

Air and hydrogen for the FPD flame, and nitrogen Transport gas are each controlled by an internal mass flow controller.


NOTE

The flow rates for the Air, Fuel, and Transport gases are preset and controlled byt he instrument. The operator interface controls to set and read gas flows are described in Section 3. The flow set procedure for the mass flow controllers is described in Section 5.

1.2.5 Products of combustion of the detector flame and all other gases that pass through the detector are vented from the detector through its chimney. Water vapor is the visible indication of flame inside the detector. A silicone tube (1/4-in ID) is connected to the chimney adapter and allows condensing water vapor to drain via gravity through the back panel and away from the analyzer.


NOTE

The tube must be connected during operation to prevent water accumulation on the chassis below the detector.

1.3 Electronics

1.3.1 *Photomultiplier Tube (PMT):* Produces photoelectrons in response to the emitted light from the sulfur chemiluminescence reaction. The photoelectrons are focused onto an electron multiplier where the signal is amplified and then collected.

1.3.2 *Flame-Out Detection Circuit:* Consists of two components: 1) flame-out electrometer: detects the presence of the flame by monitoring the detector temperature; and 2) the solenoid/relay driver board: deactivates the solenoid valve on the fuel gas line upon receipt of signal from the flame-out detection circuit.

2
SPECIFICATIONS

Gas Connections:	1/8-in Swagelok®
Mounting:	EIA Standard 19-in rack (7U height) or bench top
Transport Gas Flow Rate:	Approximately 30 cc/min. (refer to the *Quality Control Final instrument Inspection Report* for test flow)
Transport Gas:	• Nitrogen (N_2), 99.999% Zero-grade minimum • Pressure: 20-60 psig • Flow: 30 ccpm; preset by instrument.
Sample Gas:	5 psig (20 psig max); approximately 100 cc/inject
Calibration Gas:	5 psig (20 psig max); approximately 100 cc/inject
Fuel Gas:	• Hydrogen (H_2), 99.999% UHP/Zero-grade or better • Pressure: 20-60 psig • Flow: ≅ 70 ccpm; preset by instrument.
Air Gas:	• Air, 99.999% UHP/Zero-grade or better • Pressure: 20-60 psig • Flow: ≅ 110 ccpm; preset by instrument.
Detector Temperature:	Factory preset
Oven Temperature Regulation:	Factory preset with software controlled conditioning
Sensitivity:	< 5 ppb COS
Safety:	• Flame-out indicator • Fuel automatic shut-off in case of flame out
User Interface:	***Keypad*** Numerical, non-tactile ***Display*** Vacuum fluorescent 256 x 128 dot graphic 115 x 57 mm viewing area
Power Required:	400 VA (clean, stable power)
Dimensions:	16.9-in W x 12.25-in H x 23-in D (42.9 x 31.1 x 58.4 cm)
Weight:	Net: 50 lbs. (23 kg) Shipping: 60 lbs. (28 kg)

3
OPERATING CONTROLS

The operator should become thoroughly familiar with Figures 3-1, 3-2 and the following descriptions of the controls BEFORE continuing.

3.1 Front Panel, Series 210SA

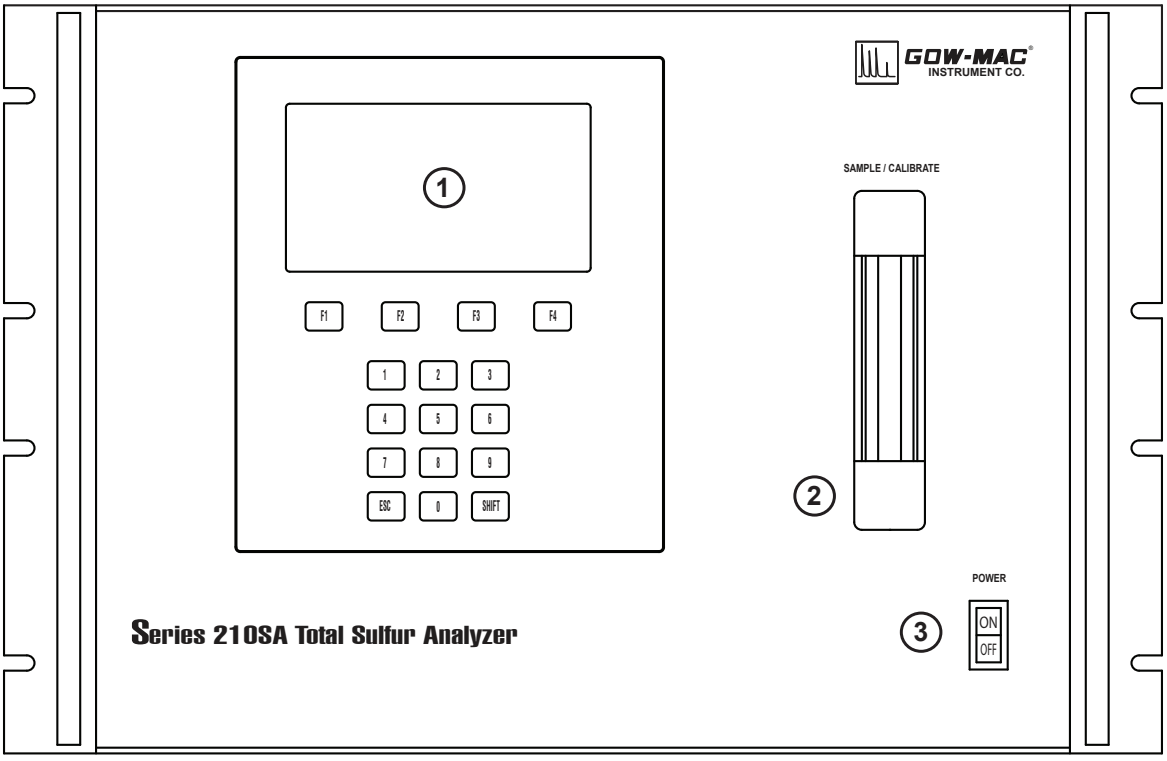


Figure 3-1
Series 210SA Front Panel

1. **VFD Display**: Displays sample concentrations in ppb and process messages.
2. **Sample Flow Meter:** Indicates the calibration gas or sample flow rate in cc/min. during sample loop purge only.
3. **Power "ON/OFF" Switch**: Activates or deactivates AC power to the instrument. The back panel Power Switch must also be "ON".

3.2 Back Panel Series 210SA

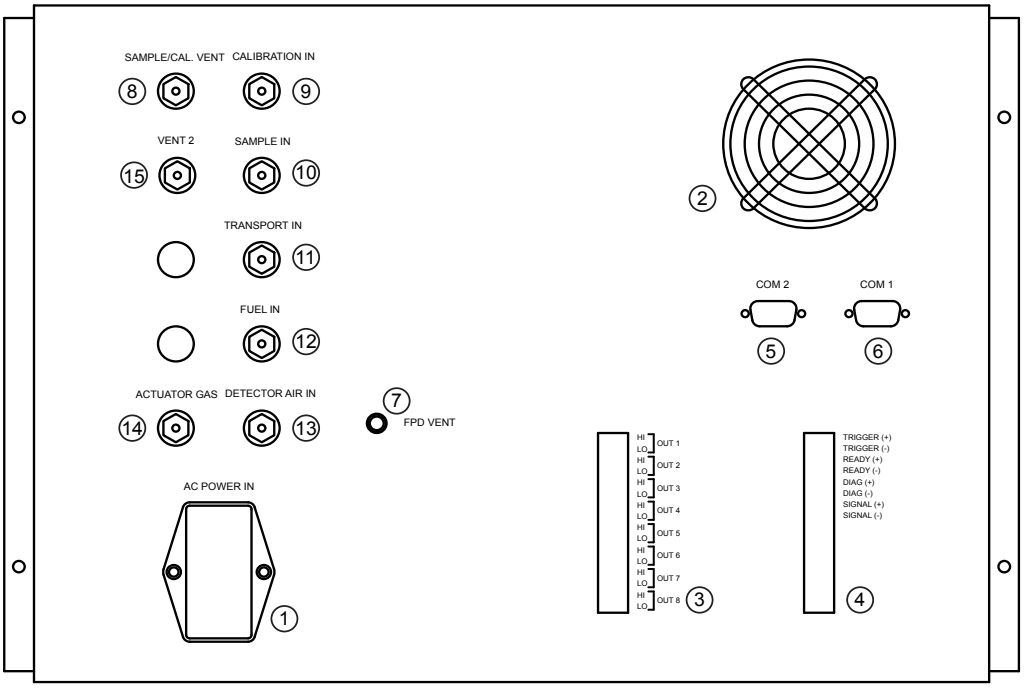


Figure 3-2 Series 210SA Back Panel

1. **AC Power IN**: Power cord connection with power switch and fuse holder. Front panel Power Switch must also be “ON”.
2. **Exhaust Fan:** instrument cabinet cooling and vent
3. **Terminal Strip:** Dedicated 4-20 mA outputs.

   a. 4 mA = 0 ppb, 20 mA = 100 ppb for Series 200- or 202-06000001
   b. 4 mA = 0 ppm, 20 mA = 2 ppm for Series 200- or 202-06000002
   c. 4 mA = 0 ppm, 20 mA = 0.5 ppm for Sereis 200- or 202-06000003
4. **Terminal Strip:** Interface connections for Signal, Ready and Trigger function
5. **COM 1:** DB9 connector used for serial output - peak name, concentration (ASCII comma delimited)
6. **COM 2: Not used**
7. **FPD Exhaust:** Detector effluent. 1/4-in ID silicone tubing connected to FPD chimney.
8. **Fuel In:** 1/8-in Swagelok® fitting
9. **Calibration In:** Passivated 1/8-in Swagelok® fitting. Refer to flow diagram for supply pressure.
10. **Sample In:** Passivated 1/8-in Swagelok® fitting. Refer to flow diagram for supply pressure.
11. **Transport In:** 1/8-in Swagelok® fitting. Refer to flow diagram for supply pressure.
12. **Fuel Gas In:** 1/8-in Swagelok® fitting. Refer to flow diagram for supply pressure.
13. **Detector Air In:** 1/8-in Swagelok® fitting. Refer to flow diagram for supply pressure.
14. **Actuator Gas:** 1/8-in Swagelok® fitting. Refer to flow diagram for supply pressure.
15. **Vent 2:** Transport 1 vent during Sampling/Backflush valve INJECT and Transport 2 vent during Sampling/Backflush valve PURGE/BACKFLUSH; 1/8-in Swagelok® fitting.

4
INSTALLATION

IMPORTANT

All supply gases should not contain sulfur compounds. Any sulfur content will reduce the expected range of interest.

4.1 Equipment Required

4.1.1 *Nitrogen Transport Gas*: The transport gas may be supplied via high-pressure cylinder, or by a nitrogen generator. Transport nitrogen must be certified to a minimum purity of 99.999%, and contain < 0.1 ppm hydrocarbon impurity (zero grade).

4.1.2 *Hydrogen*: minimum 99.999% zero grade

4.1.3 *Air*: 99.999% zero grade

4.1.4 *Calibration Standard*: A gravimetrically prepared cylinder or permeation device may be used for calibration of the analyzer. The cylinder standard may contain any inert balance gas, including carbon dioxide. The standard, or permeation device, must be certified to a concentration of 0.5 to 1.5 ppm carbonyl sulfide (COS) in N_2, He, or CO_2. ***Traceability to NIST is highly recommended.***

NOTE

All support gases supplied to the GOW-MAC 210SA analyzer should be accompanied by certificates of analysis from the vendor.

4.1.5 *Sample*: Carbon dioxide samples may be provided to the instrument in a manner most convenient to the user's application, i.e., from cylinders, bulk storage facilities, rail cars and/or delivery trucks. Sample filtration to 2 microns or less is required to protect gas sampling valves' sliding surfaces.

4.1.6 *Pressure Regulation*: Transport, calibration and sample gas regulation is carried out external to the instrument. Dual-stage regulators are recommended in order to ensure consistency of input flows to the sampling system. "Inerting" of wetted surfaces is also recommended to prevent loss of analyte molecules during transport to the instrument. ***GOW-MAC Instrument Company can provide stream selection and regulation as an accessory package to the instrument. Call our Sales Department for details.***

Table 4-1
Inlet Gas Pressures, psig

GAS	RECOMMENDED	MAXIMUM
TRANSPORT	60	60
SAMPLE	5	20
CALIBRATION	5	20
FUEL	60	60
AIR	60	60

4.1.7 AC power source:

AC NEEDS TO BE CLEAN AND STABLE.

Series 210-06000001: 115 V, 50 Hz
Series 212-06000001: 230 V, 60 Hz
Series 210-06000002: 115 V, 50 Hz
Series 212-06000002: 230V, 60 Hz
Series 210-06000003: 115 V, 50 Hz
Series 212-06000003: 230 V, 60 Hz

OPERATING INSTRUCTIONS FOR ALL MODELS ARE THE SAME, EXCEPT FOR LINE VOLTAGE REQUIREMENTS. TO PREVENT DAMAGE TO THE INSTRUMENT, MAKE SURE THAT THE AC ELECTRICAL OUTLET IS THE CORRECT VOLTAGE FOR YOUR INSTRUMENT BEFORE PLUGGING IT INTO THE OUTLET.

4.1.8 Several pieces of INERT tubing cleaned as described later in this section. Inert tubing is essential for the Calibration/Sample lines due to the inherent reactivity of sulfur compounds to reactive, untreated sites on tubing walls.

4.2 Unpacking and Inspection

4.2.1 When unpacking the instrument, check it carefully for evidence of shipping damage or rough handling. Check to ensure that all components ordered have either been supplied or back-ordered. ***Report any damage or discrepancies immediately to GOW-MAC Instrument Company.***

4.2.2 Remove all plastic and/or paper shipping caps and restraints before operating.

4.2.3 **Allow instrument to reach room temperature before beginning installation.**

4.2.4 Fill out and return the yellow ***Warranty-Registration Card*** included in this manual to ensure that the warranty will be validated and that you will be kept informed of any improvements or other items of interest.

4.3 Location

4.3.1 The Sulfur Analyzer should be placed in a location that is secure, vibration free, and protected from abrupt temperature changes and drafts (ambient operating air temperature range should be between 20-30 °C (68-86 °F) for optimum results. Irregular changes in the instruments' surroundings may upset the temperature stability in the course of an analysis or preparation.

4.3.2 There must be full access and easy viewing of the front panel of the analyzer. In addition, provisions should be made for access to the rear panel (gas, electrical and software interfaces), and for removal of the top panel for maintenance activities described in Section 7.

4.3.3 Allow adequate space for the safe and compliant installation of necessary gas cylinders. **Cylinders should be secured to the wall or a table at all times.**

CAUTION

FOLLOW THE "GENERAL WARNINGS AND CAUTIONS" AND "GENERAL PRECAUTIONS FOR HANDLING AND STORING HIGH PRESSURE GAS CYLINDERS" LOCATED AT THE FRONT OF THIS MANUAL; CONTACT YOUR LOCAL GAS SUPPLIER TO ENSURE PROPER HANDLING OF CYLINDERS.

4.3.4 An electrical outlet (AC) should be near the location where the analyzer is to be installed. If the outlet is not a 3-pin type, make sure that a good ground connection is available, since a good ground is necessary for proper operation. The AC outlet should be connected to a circuit that is not heavily loaded with other electrical equipment. Input voltage to the instrument should be steady for optimum operating stability. If the AC line voltage varies, consideration should be given to the installation of a stabilizing transformer and/or an uninterruptable power supply at the AC outlet.

4.4 Electrical Connections

CAUTION

ALL SWITCHES SHOULD BE IN THE "OFF" POSITION BEFORE ANY ELECTRICAL CONNECTIONS ARE MADE

4.4.1 *Power Cable Connection*: The power cord (provided) is connected from the *AC Power IN,* located on the back of the analyzer, to an AC outlet.

4.4.2 *4 - 20 mA Terminal Strip:* The signal is proportional to the concentration of the impurity of interest.

Series 210- or 212-06000001

4 mA = 0 ppb
20 mA = 100 ppb

Series 210- or 212-06000002

4 mA = 0 ppm
20 mA = 2 ppm

Series 210- or 212-06000003

4 mA = 0 ppm
20 mA = 0.5 ppm

NOTE

Terminal pair labeled "OUT 1" is used for the sulfur analyzer. Refer to Figure 4.1.

NOTE

A minimum loop resistance of 100-200 Ω is required.

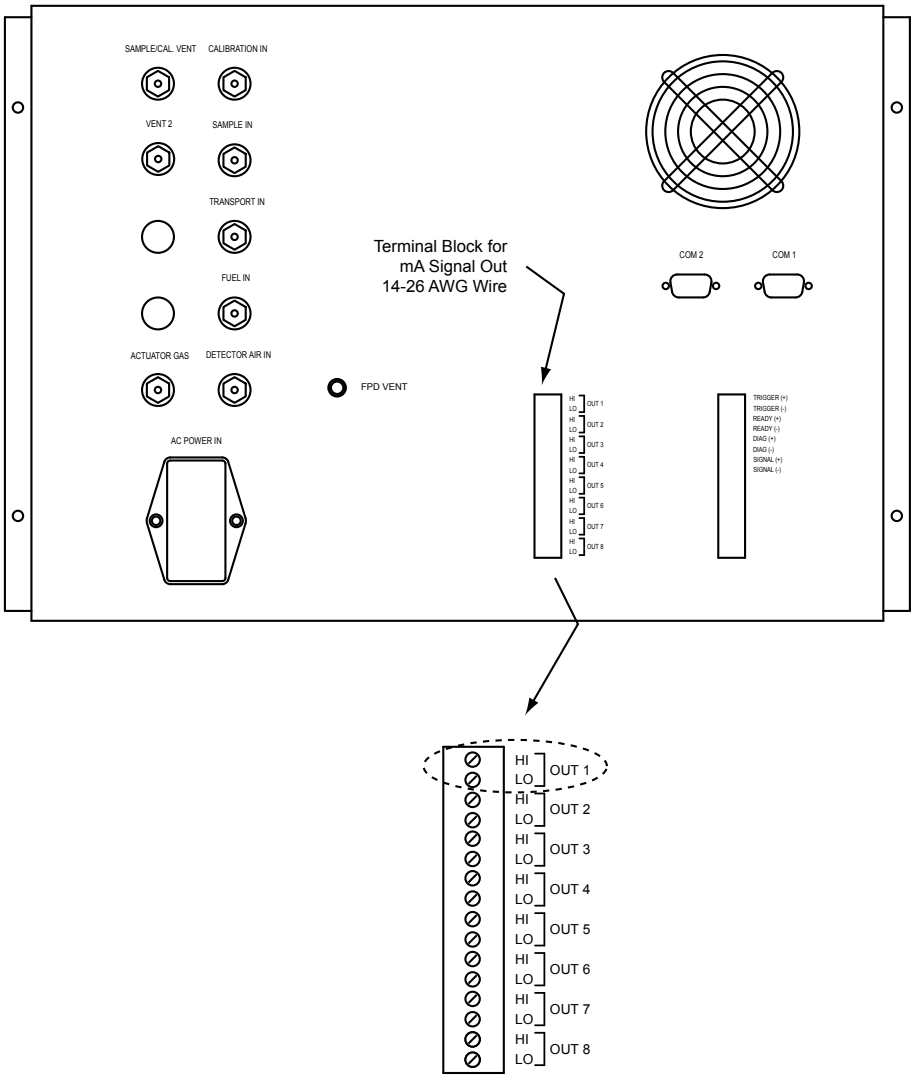


Figure 4-1
4-20 mA Terminal Strip

Refer to Figure 4-2 and Table 4-2. Wire size to fit the terminal blocks is 14-26 AWG.

TRIGGER (+ and -): requires an open contact or TTL voltage to the analyzer in order to start an analysis sequence.

Input High = ON: 5.0 V DC or Open Contact
Input Low = OFF: 0.8 VDC or Closed Contact

READY (+ and -): contact closure (Closed = Ready, Open = Not Ready) from the analyzer to an external device.

DIAG (+ and -): Diagnostic Out - used in diagnosing problems with the instrument and/or assists in set-up.

SIGNAL (+ and -): millivolt output used for reference and checking/setting the zero level.

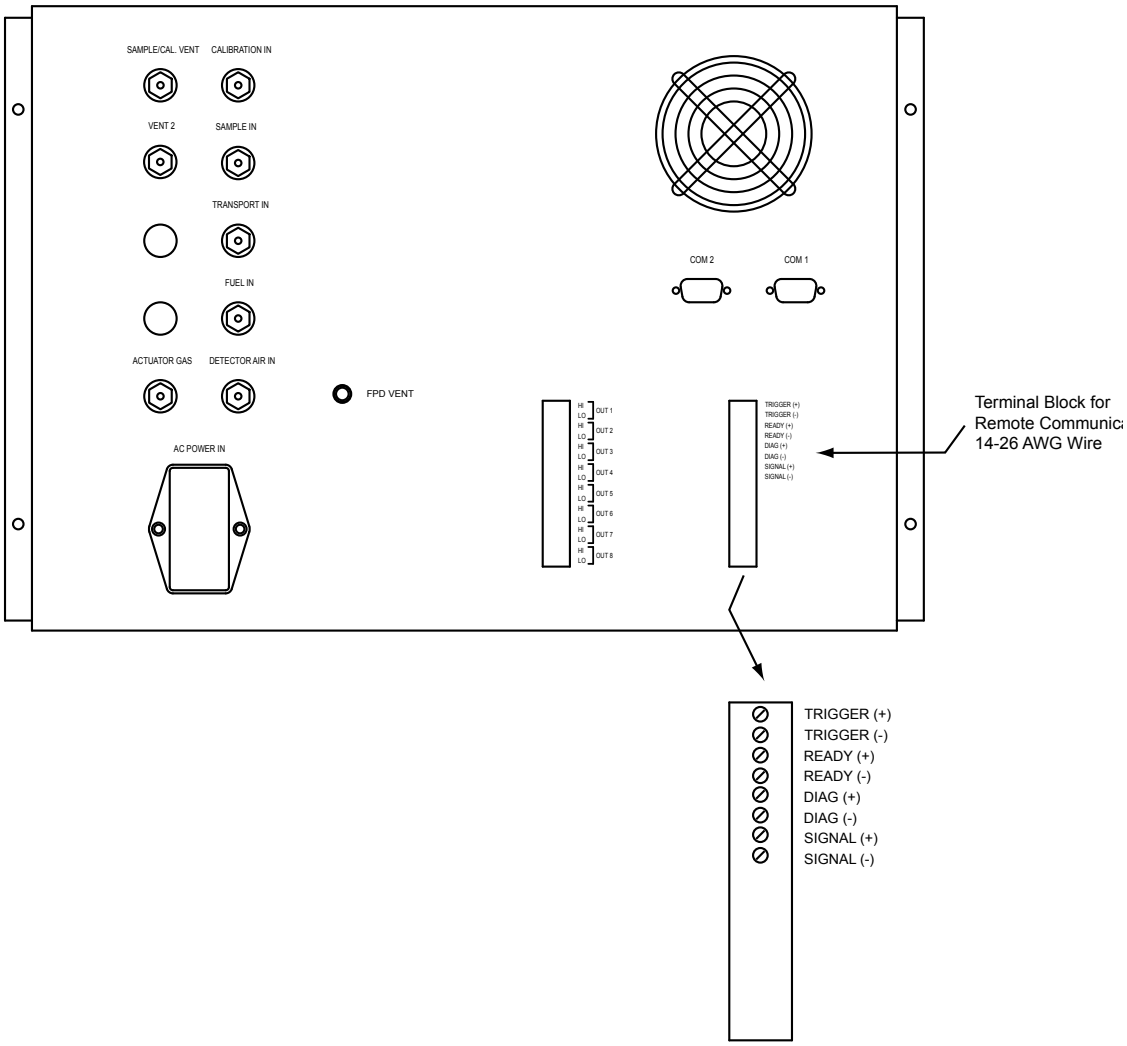


Figure 4-2
Trigger, Ready, Diagnostic and Signal Functions Terminal Block

Table 4-2

Control Signals & Diagnostic Signal Outputs

TRIGGER	Input High (+)	2.0 VDC Minimum 5.0 VDC Nominal or Open Contact 5.5 VDC Maximum	
	Input Low (-)	0.8 VDC Maxmium or Closed Contact	
READY	Ready (+)	Closed Contact	*Contact Rating* D/C Volts Only Maximum 24 V @ 500 mA
	Not Ready (-)	Open Contact	
DIAG	(+) Output High	Diagnostic Output	
	(-) Output Low		
SIGNAL	(+) Output High	From ± 2.5 V (depends on sample and instrument settings)	
	(-) Output Low		

4.5 Gas Connections

4.5.1 The use of 1/8-in diameter passivated tubing is **absolutely necessary** for all external gas lines and all components in contact with sulfur-bearing gases. GOW-MAC recommends that all wetted surfaces in contact with the sample and calibration gases be passivated for sulfur. The following tubing may be used:

- 1/16-in OD x 0.040-in ID, passivated stainless steel, GOW-MAC part no. 163-276
- 1/8-in OD x 0.085-in ID, passivated stainless steel, GOW-MAC part no. 163-277

4.5.2 Transport, Fuel and Air Tubing

For transport, fuel, and air line connections, stainless steel or copper tubing may be used if it is hydrocarbon-free. Cleaning for oxygen service is suitable to assure hydrocarbon-free

NOTE

Plastic tubing is NOT recommended, since all plastics are permeable to air.

All gas connections to the cylinder regulators and inlet ports should be made as follows:

4.5.2.1 Remove all protective packaging plugs and/or caps from gas INLET and OUTLET PORTS if not already done.

4.5.2.2 To prevent contamination of the analyzer by grease, oil, or chemical residue, the following cleaning procedure should be followed for purging tubing prior to connecting it to the analyzer:

i. Clean tubing pieces by flushing with acceptable solvent, such as acetone, to remove any oil residue that may be present.

WARNING

CLEANING SOLVENTS ARE EXTREMELY FLAMMABLE. USE CARE WHEN USING THESE MATERIALS. DO NOT EXPOSE THEM TO OPEN FLAMES OR OTHER POTENTIAL IGNITION SOURCES OTHERWISE, AN EXPLOSION OR FIRE MAY OCCUR.

ii. After washing, let tubing drain and dry. Apply a flow of **dry** zero grade nitrogen for a few minutes to aid drying and flush out residual contaminants.

iii. All external tubing should be clean and free of moisture before connecting to gas cylinders and the sulfur analyzer.

4.5.2.3 Connect one end of the pre-cleaned tubing to the source gas, which may be a gas cylinder, hydrogen generator or permeation tube outlet system. Refer to Figure 4-3.

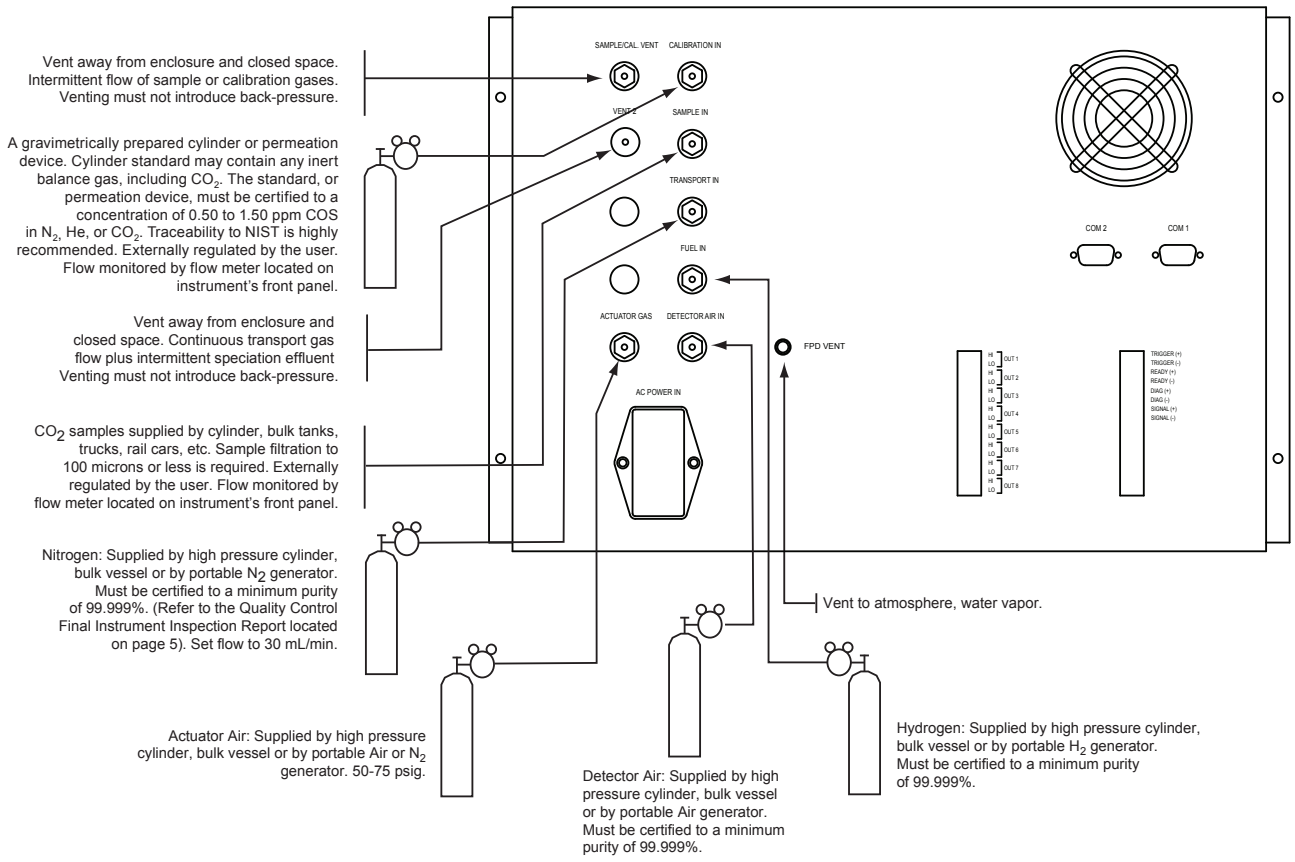


Figure 4-3
Gas Connections

4.5.3 Purge tubing with a flow of gas from the source for 3 to 4 minutes.

CAUTION

HYDROGEN MUST BE PROPERLY VENTED. ELIMINATE *ALL*

IGNITION SOURCES BEFORE PURGING WITH HYDROGEN.

4.5.4 Connect the free end to the appropriate inlet of the analyzer (Transport, Calibration Gas or Sample Gas). Check that there is a sample filter installed. A filter ***must*** be installed that filters out particles larger than 2 microns and ***must*** be passivated metal or otherwise inert (plastic) to prevent reaction with sulfur.

4.5.5 After all connections have been made, it is important to check for leaks. **Refer to Section 4.6 below**.

4.6 Leak Testing

After all connections have been made, it is **IMPORTANT** that they be tight and free from leaks. Leaks in the system will cause baseline drift, noise, and may reduce sensitivity.

LEAKS IN THE HYDROGEN LINE ARE HAZARDOUS. HYDROGEN IS AN EXTREMELY EXPLOSIVE GAS.

The lower explosive limit (LEL) of hydrogen in air is 4% and the upper explosive limit (UEL) in air is 75%. **CARE MUST BE EXERCISED** in handling this gas and the system must be free of leaks.

HYDROGEN SHOULD BE TURNED OFF AT THE SOURCE WHEN NOT IN USE.

This instrument has been completely leak-tested and checked out prior to shipping. It is possible that leaks have developed during shipment. The most likely source of leaks will be subsequent connections or reconnections made by the user.


NOTE

All connections should be leak-tested with the gases flowing before the instrument is operated.

Each gas must be flowing to check for leaks. Use Table 4-1 to set pressures on the cylinders or external pump (if so equipped). The use of soap or other organic substances to check for leaks IS NOT recommended. They will contaminate the system. The easiest way to locate leaks in the system is with the GOW-MAC Model 21-070 Mini Gas Leak Detector. Contact GOW-MAC Instrument Co. for information and pricing regarding these products.


NOTE

Leak checks should be run periodically and are a *MUST* when new tubing and fittings are installed.

5
INITIAL START-UP PROCEDURE: Gas Flows

The correct way to setup a Series 210SA for initial installation, or after an extended shutdown is as follows:

NOTE

Necessary items for installation include:
- Multimeter
- Flowmeter
- Strip Chart Recorder or other recording device

5.1 Set Gas Flows

Make the necessary hydrogen, sample, and calibration gas connections to the respective bulkhead fittings on the rear of the analyzer. Refer to Section 4.5, “Gas Connections”.

5.1.1 Transport Gas

5.1.1.1 Initiate the flow of hydrogen transport gas to the system. Set the outlet pressure of the hydrogen source as prescribed in Table 4-1.

5.1.1.2 Can be viewed by pressing “***SHIFT”*** and then “***1”*** from the Home screen or Setup Home screen.

5.1.1.3 The system will power up and preset the transport gas to 30 mL/min. (cc/min). Adjustment to the transport gas flow rate is made by following Section 6.2.2.3 *Setting Flows*.

5.1.2 Sample Gas

5.1.2.1 Initiate flow of sample gas to the analyzer. Set SAMPLE pressure as prescribed in Table 4-1 using *cylinder regulator*.

5.1.2.2 The required pressure flow can only be measured if Valve 5 is opened (Sample Cut Valve).

5.1.3 Calibration Gas

5.1.3.1 Initiate flow of calibration gas to the analyzer. Set CALIBRATION pressure as prescribed in Table 4-1 using *cylinder regulator*. The required pressure flow can only be measured if Valve 5 is opened (Sample Cut Valve).

6
GENERAL OPERATION

6.1 Power-up

See the Appendix A: "Quick Start Reference Flow Chart" for assistance.

6.1.1 Go to the back panel of the GC. Find the power receptacle and confirm the fuse holder arrows are in alignment >< for your power supply (120 V or 240 V).

6.1.2 Put the power switch in the "OFF" position (O).

6.1.3 Connect the female ends of the power cable into the receptacle.

6.1.4 Connect the male end to AC power source.

CAUTION

It is very important that the Transport Gas has been connected and turned on <u>BEFORE</u> applying any power to the instrument.

6.1.5 Turn "ON" (I) both power switches. (One above power cord on rear; one on front panel.)

6.1.6 The instrument is now ready to operate.

6.1.7 Upon power up, instrument displays

LOAD LAST PROGRAM
ENTER TO LOAD
ESC THEN ENTER TO SKIP

6.1.7.1 Push "***ENTER***" (F4) to restore last program settings and proceed to "Ignitor Procedure" (Sec. 6.2.2.4), then on to "Run Calibration Gas" in the Calibration section (6.3.6).

<u>OR</u>

Press "***ESC***", then "***ENTER***" (F4) to begin manually setting up and reprogramming the instrument.

6.2 Programming

Wait for "SYSTEM IS READY" to appear on screen.

From Main Page: manually ZERO instrument (Set Baseline) by pressing "*SHIFT***", then "***ESC***"**.

NOTE

Be sure “SHIFT” is displayed on the screen anytime you press the Shift Button. If it is not, press “***SHIFT***” again.

The instrument will automatically zero itself before a calibration.

IMPORTANT

Allow for purge and temperature stability; then re-zero the instrument. Flow and temperature settings will be set to factory default values. Refer to the Application Sheet provided with each particular instrument.

6.2.1 Set-up (Discovery Mode)

[Be sure to **thoroughly** purge instrument before Set-up.]

Enter SET UP / DISCOVERY MODE by pressing ***F2*** (SET UP).

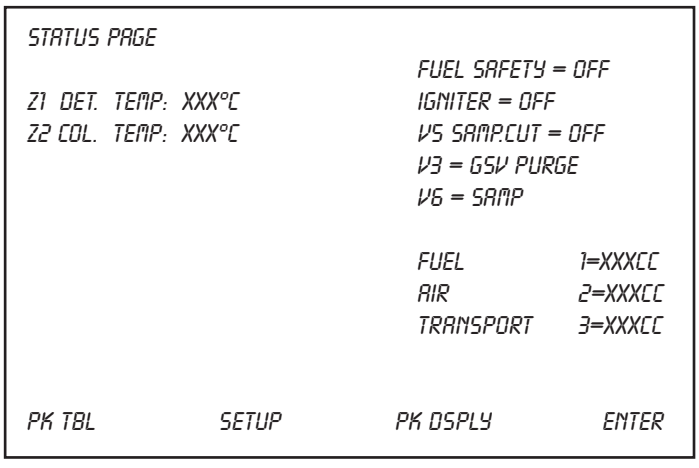
NOTE

Status Page

In “HOME” or “SET-UP” MODES, view STATUS PAGE by pressing “***SHIFT”***, then “***1***”.

Press “***ESC***” to exit Status Page.

Display on Screen:



6.2.1.1 Status Screen

i. *Fuel Safety* - When “off”, the flame detection circuitry is monitoring the detector’s flame.

ii. *Ignitor* - Indicates if the ignitor has been turned ON or OFF.

iii. *V5 Sample Cut* - Indicates whether the sample is flowing (OFF= CCW) or blocked (ON = CW). This valve can be set manually. When an injection is initiated, this valve sets a “Dropball” injection sequence in motion.

iv. *V3 (Valve 3)* - displays the status of the injection valve.

v. *V6 (Valve 6)* - displays the status of the Sample/Calibration Gas Selection Valve.

vi. Other SET-UP MODE options:

Table 6-1

Setup Mode Options Summary	Press to Select
Set Temperatures	“0”
Set Valves	“1”
Set Flows	“2”
Prog. Valve Switching	“***SHIFT***”, then “***7***”
Clear all programming parameters	“***ENTER***” (F4), then “***7***”
See below for detailed instructions	

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings.

6.2.2 Setting Parameters

Clear all previous parameters by pushing “***ENTER***” (F4), then “***7***”. “Clearing Settings” appears briefly on the screen.

6.2.2.1 Temperatures

IMPORTANT

Set temperatures according to specific instrument configuration and/or instructions. Damage may result to a heated component of the instrument if it’s temperature limitation has been exceeded. Refer to Application Sheet provided for specific parameters and settings.

i. Press "***0***" to enter *Set Temperature* mode.

Display reads: SET TEMPERATURE
PLEASE WAIT...

SELECT Z1 = DET TEMP
SELECT Z2 = OVEN TEMP

ii. Select desired Zone to program.

Press 1 or 2 on keypad:

Zone1 = Detector
Zone2 = Column 1

iii. Press ***"Enter" (F4)*** to set the temperature of the selected zone. (or "***ESC"*** then "***Enter"*** (F4) to end.)

Enter temperature in format XXX; i.e. 070 for 70˚C

Display reads: TEMPERATURE SET

iv. Press "***0***" again to set another zone temperature, or ***"ESC"*** to return to SETUP MODE. Pressing "***ESC***" will not be acknowledged on the screen.

6.2.2.2 Valves

In SETUP Mode, press "***1***" to manually set valves 1 thru 6 to desired positions.

NOTE

CW = On
CCW = Off

Valves default to CCW / Off position if not set.

---

i. To set valve positions or switches (refer to Table 6-2):

a. Press "***SHIFT***", then the ***valve #*** on keypad to set that valve to the "CCW / OFF" position (Default Position).

Or

Press the ***valve #*** on the keypad to set that valve to the "**CW / ON**" position.

If the valve or switch is not currently in the position you to which you wish to set it, you will hear it switch after your keypad entry.

NOTE

Not all instruments may be equipped with all valves.

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings.

Table 6-2

Valve/Switch Position Key (CCW is the default position)		
Valve 1	On (CW)	Bypass On (refer to Sect. 6.2.2.4 Ignitor Procedure)
	Off (CCW)	Bypass Off
Switch 2	On (CW)	Ignitor On (refer to Sect 6.2.2.4 Ignitor Procedure)
	Off (CCW)	Ignitor Off
Valve 3 (Sample Valve)	On (CW)	BEGIN INJECTION SEQUENCE
	Off (CCW)	Purging Sample Loop
Switch 4	On (CW)	Flame Status ON or OFF
Valve 5	On (CW)	Shutoff (Cut) Valve ON (No Valve 6 flow to Valve 3)
	Off (CCW)	Shutoff (Cut) Valve OFF (Valve 6 flow to Valve 3)
Valve 6	On (CW)	Sample Gas to Valve 3
	Off (CCW)	Calibration Gas to Valve 3

ii. Valve/Switch Position Details

a. VALVE 1: BYPASS FUNCTION= Pressing "***1***" will turn ON the Bypass Function.

CAUTION

Once activated (ON), the Bypass Function allows Hydrogen Fuel to flow for approximately 30 seconds to assist in purging-out the fuel line.

WARNING

NEVER leave the instrument unattended while Hydrogen Fuel is flowing and the detector flame is un-lit.

Pressing "***SHIFT***" then "***1***" will turn OFF the Bypass Function.

b. SWITCH 2: IGNITOR= Pressing "***2***" will start the detector ignition sequence. The sequence takes approximately 30 seconds. If the flame does not light, "0 = 002" will appear on-screen above the F2 Key. See IGNITOR PROCEDURE (Sec.6.2.2.4)

iii. VALVE 3: SAMPLE VALVE= Pressing "***3***" initiates a manual injection sequence which sets the valve in position to purge and inject calibration or sample gas.

iv. SWITCH 4: FLAME DETECTION= Pressing "***4***" will determine if the detector's flame is lit. "*READ FLAME*" will appear briefly on-screen. If no flame is detected, "*FLAME OUT*" will appear in the upper right corner of the screen, and "0 = 002" will be displayed above the F2 Key.

v. VALVE 5: SAMPLE CUT VALVE= Pressing "***5***" will allow SAMPLE or CALIBRATION GAS (determined by Valve 6 position) to flow to the Sample Valve (3). Pressing "***SHIFT"*** then "***5***" will "CUT" the gas flow to Valve 3.

vi. VALVE 6: Pressing "***6***" (CW) will enable Sample Gas to flow Valve 3 for analysis. Pressing "***SHIFT***" then "***6***" (CCW) will flow Calibration gas to Valve 3. Positioning this valve will allow for setting the proper flow rates for the Sample and Calibration gases, as well as selecting the desired gas to be analyzed.

vii. SWITCH 9: Pressing "***9***" will turn Peak Detection OFF. Pressing "***SHIFT***" then "***9***" will turn Peak Detection ON and activate the threshold and zero function for use in the Peak Discovery Mode.

IMPORTANT

These functions, which allow the user to set up and program the instrument, are also accessible in Peak Discovery Mode.

IMPORTANT: Because this system contains multiple computers, ***always be very careful*** not to initiate more than one sequence command at a time. Be patient and wait for one sequence to end before beginning another so as not to initiate conflicting sequences.

If this practice is not followed, the instrument may need to be reset by powering off, waiting 30 seconds, and then on again.

Press "***ESC***" to exit Valve Setting and return to SET UP MODE

Display reads: *SET VALVES END*

6.2.2.3 Setting Flows

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings. The valves may have to be switched in order to read/set flow rates.

---

i. Use Flow Diagram to set manually-adjusted flows. (Suggested transport gas flows = 30 mL/min.)

ii. To Set MFC Flows, press "***2***"

Display reads:
```
SET FLOW
PLEASE WAIT...
SELECT MFC 1, 2, OR 3=

1= FUEL
2= AIR
3= TRANSPORT
```

iii. Select desired Mass Flow Controller (1, 2, or 3)

Display reads:
```
SET MFC X FLOW RATE

ENTER TO SET MFC FLOW

ESC THEN ENTER TO END
```

iv. Set flow rate in format XXX; i.e. 030 = 30 mL/min.

Table 6-3		
Suggested Gas Flow Rates		
Sample	30 mL/min.	Flow is set with customer supplied external controller
Transport	30 mL/min.	Set during the power up sequence
Air	≅ 80 mL/min.	Set automatically within the ignitor procedure
Fuel	≅ 50 mL/min.	Set automatically within the ignitor procedure

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings.

Display reads: `FLOW RATE SET` when entered.

v. Press "***2***" again to enter another flow rate, or Press "***ESC***" to return to SETUP MODE (Pushing "***ESC***" will not be acknowledged on the screen)

WARNING

NEVER leave the instrument unattended while Hydrogen Fuel is flowing and the detector flame is un-lit.

Proceed to Ignitor Procedure

6.2.2.4 Ignitor Procedure

NOTE The instrument oven and detector should be allowed to heat up and stabilize before trying to ignite the Detector.

i. When the procedure described below is initiated, the instrument will purge the detector with 500 cc/min. air and then introduce 60 cc/min. of hydrogen (H_2) before igniting the flame detector. This condition will exist for approximately 30 seconds.

   Once the detector's flame has been ignited, the bypass safety is removed and safety is maintained by the flame detection circuit. If the flame should be extinguished, the *Flame Detection Circuit* will interrupt the flow of fuel gas and produce an indicator that the flame has been extinguished; i.e., above the F2 key there will be a message 0 = 002.

   a. While still in **SETUP Mode**, press "***1***" to enter the MANUAL VALVE SWITCH MODE.

   b. Press "***2***" to start the igniting sequence.

      Display reads: PLEASE WAIT...

      The sequence takes about 30 seconds. If the flame DID NOT light, "0 = 002" will appear on-screen above the F2 Key.

      The fuel flow will be disabled until the sequence has been re-initiated.

   c. After the flame has lit press the "***ESC***" key to exit the manual valve mode.

      Using the QC sheet supplied with the instrument press "***2***" and then set the Fuel, Air and Transport gases as dictated on the QC sheet These were the settings used to Qualify the instrument.

      Adjustments may need to be made based on the instruments current environment. Keep in mind that these adjustments will effect the sensitivity of the instrument and the instruments ability to maintain a flame during the operation of the instrument.

IMPORTANT ***Repeat Ignitor Procedure until the flame lights.***

ii. Press "***ESC***" to exit Manual Valve/Switch Mode. (Pushing "***ESC***" will not be acknowledged on the screen)

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings.

6.2.2.5 Valve Switching Times

i. While still in SETUP MODE, press "***SHIFT***", then "***7***" to set Valve Switching Times.

NOTE

Be sure "SHIFT" is displayed on the screen anytime you press the Shift Button. If it is not, press "***SHIFT***" again.

Display reads PLEASE WAIT...

SAMPLE VALVE SETTING
ENTER TO SET SAMPLE VALVE
ESC THEN ENTER TO SKIP

ii. Press "***ENTER***" (F4) to set Sample Valve CW-1 (Valve 3 injection time).

Enter times in format: XX:XX; e.g. 00:01

iii. Set Sample Valve CCW-1 (Valve 3 switch to purge time)

Enter times in format: XX:XX; e.g. 20:13

iv. Screen displays: SAMPLE SETTING 2
ENTER TO SET SAMPLE VALVE
ESC THEN ENTER TO SKIP

This function is not used in this application. Press "***ESC***" then "***ENTER***" (F4) to skip.

Programmed times are displayed on the screen.

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings.

Press "***ENTER***" (F4) to continue.

v. Press "***ESC***" to exit and return to SET UP MODE. (Pushing "***ESC***" will not be acknowledged on the screen)

6.2.2.6 Peak Discovery Mode

This mode is used to accurately determine the elution time and peak-width of all components of interest in the analyzed sample.

To enter Peak Discovery Mode, press "***F1***" (PEAK DM).

Display reads: *PLEASE WAIT...*

ENTER DISCOVERY MODE
PRESS ENTER TO CONTINUE

i. Press "***ENTER***" (F4) to start CAPTURE.

On Screen:

S = BASELINE VOLTAGE READING (REPRESENTED BY SOLID LINE)
PRESS "ZERO" (F4) TO RESET BASELINE TO ZERO.

ANALYSIS RUN TIMER: RESET BY EACH INJECTION. RUNS ON 24 HOUR CLOCK.

T = THRESHOLD VOLTAGE SETTING (REPRESENTED BY DOTTED LINE)
THE THRESHOLD SETTING MUST BE HIGHER THAN BASELINE VOLTAGE (S).
PRESS THRESHOLD (F3) IF DOTTED LINE FALLS BELOW BASELINE VOLTAGE LEVEL.

ii. Delete previous peak data and clear screen by pressing "***SHIFT***", then "***F4"*** (Zero).

NOTE: After pressing the SHIFT key you MUST see the word SHIFT on the display. If you do not see SHIFT, press the "***SHIFT***" key again.

iii. Wait for a stable baseline (solid line).

a. The first 10 points establish the zero baseline.

b. Before first expected peak start time, turn Detection ON by pressing "***SHIFT***", then "***9***". If unsure of peak start times, several peak setup runs may be required until approximate peak start times are known.

iv. Procedure for analyzing sulfur compound(s):

a. Press "3" to begin the injection sequence.

b. The objective is to allow the CO_2 and other impurities to exit the speciation oven to vent while keeping the sulfur compound(s) close to the front of the column.

c. Press "***SHIFT***" and then "***3***" to display SHIFT message. Press "***3***" to return the valve to the backflush position. This will send the sulfur compound(s) to the detector. If the displayed peak is too large, try again and wait 20 seconds longer before switching to backflush.

d. Repeat steps a-c above until the captured peak is acceptable. Begin with the setting used to qualify the instrument at the factory. This setting will, in most cases, work. This saves on setup time.

v. Use ZERO, THRESHOLD, Detection ON and Detection OFF to accurately capture peak retention times and peak widths.

NOTE

Turn Detection ON by pressing "***SHIFT***", then "***9***". Turn Detection OFF by pressing "***9***".

---

a. ZERO - will return current "S" value to zero voltage level.

NOTE

DETECTION must be ON to utilize this function ("***SHIFT***", then "***9***").

---

b. THRESHOLD (T) — Dotted-line which appears initially 0.0060 V above baseline voltage reading (S). The purpose of the THRESHOLD line is to accurately determine Peak START, END, and WIDTH data to be entered in the PEAK TABLE in "Peak Table", under Calibration, page 41, of these instructions.

c. Peak START time is established when voltage reading (S) initially crosses above THRESHOLD line.

d. Peak END time is established when voltage reading (S) crosses below THRESHOLD line, after a Peak Start time has been initiated.

e. Peak Width (PW) is calculated as the difference in seconds between Peak START and END times.

f. Pressing ***THRESHOLD*** (F3) will move dotted line 0.0010 V above the baseline voltage reading (S). For accurate peak integrations, the Threshold Value should be as close to the baseline voltage level as possible, but still above noise and baseline fluctuations. Up to 14 recorded peaks, whether baseline fluctuations or actual peaks will be documented and displayed on the screen. Through practice in the use of ZERO, THRESHOLD, Detection ON and Detection OFF, the skilled operator will record the most accurate peak data possible to precisely locate and quantify peaks of interest for integration in the "Peak Table", under Calibration (Sect. 6.3.1) of these instructions.

vi. When all peaks of interest have been captured, hit "ESC" to exit CAPTURE MODE (Peak Discovery Mode).

Display reads: CAPTURE ENDING
PLEASE WAIT...

a. Wait for SYSTEM IS READY message.

vii. Press "***END***" (F2) to exit SET UP MODE.

viii. Review peaks captured (up to 14 peaks):

a. Press PK DSPLY (F3) to enter "Peak Display Mode".

b. Use corresponding keypad numbers to review peaks captured in the table on the screen (Table 6-4).

Table 6-4: Peak Display

Press	To View	Peak #
"1" thru ***"8"***		1 thru 8
"SHIFT", then "***1***"		9
"SHIFT", then "***2***"		10
"SHIFT", then "***3***"		11
"SHIFT", then "***4***"		12
"SHIFT", then "***5***"		13
"SHIFT", then "***6***"		14

c. Make sure all components of interest have been accurately recorded with regard to peak start time, width, shape and resolution. Note peak shapes, start, and end times with respect to the threshold line.

d. Record PEAK START Times and PEAK WIDTHs to be entered in "Peak Table", under Calibration (Sect 6.3.1) of these instructions.

e. To precisely capture an entire peak for accurate integration, it may be necessary to increase the size of the "window" that will locate the peak. To do this, subtract a few seconds from the PEAK START Time recorded on screen, AND increase the PEAK WINDOW size by adding a corresponding number of seconds on both the front and back of the window.

Example:

Peak 1 data recorded on screen:

START TIME= 02:46; PEAK WIDTH=007

After reviewing this peak in Peak Display Mode, we determined that to accurately integrate this peak, we would like the integration to begin 3 seconds earlier, and end 3 seconds later than displayed. Therefore, we will record the Peak Start Time as 02:43 (02:46 – 3 sec.).

To increase the size of the window to capture our new peak size, we must add 3 seconds to both the beginning and the end of the peak window, making our new Peak Width = 013 (007+3+3). So, for Peak 1, we would enter into the Calibration Table in Sec. II: Start Time = 02:43; Peak Width = 013

IMPORTANT

Care must be taken not to increase the peak window more than necessary, as baseline noise could be added to the peak size; or another peak could overlap into the peak window. A minimum of 3 seconds must be allotted between peak windows for integration. The distance between peaks can be adjusted if necessary by altering flow rates and oven temperatures.

ix. When done reviewing peaks and recording Peak Start Times and Peak Widths of components of interest, Press "***0***" on keypad to exit "Peak Display Mode".

x. Press "***SHIFT***", then "***ENTER***" (F4) to clear data from screen. Peaks can still be viewed in Peak Display Mode if desired.

However —

While in SET UP MODE, pressing "***SHIFT***", then "***ENTER***" (F4) will **PERMANENTLY DELETE** all peak data.

xi. Go back to SET UP MODE (Sect. 6.2.1) to repeat capture run if the precision of any of the peaks of interest is not acceptable, or you wish to verify the precision of your first capture analysis.

Before repeating capture run, return to SET-UP Mode and permanently delete previous peak data by pressing "***SHIFT***", then "***ENTER***" (F4).

6.3 Calibration

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings

6.3.1 Peak Table

Press "***F1"*** (PK TBL) to enter Peak Table.

6.3.1.1 Press "***ENTER***" (F4) to continue as instructed on screen.

6.3.1.2 Snapshot of Current Time Position (from injection) is displayed.

i. Press "***ENTER***" (F4) to continue.

6.3.1.3 Current "Valve Switching Times" are displayed.

i. Press "***ENTER***" (F4) to continue.

6.3.2 Event Timer Reset

Press "***ENTER***" (F4) to initialize Event Timer, or press "***ESC***" then "***ENTER***" (F4) to skip, as instructed on screen.

6.3.3 Sample Valve Settings

At this point, you have an opportunity to program or change Valve 3 inject/purge times, if desired.

6.3.3.1 Press "***ENTER***" (F4) to program / change valve switching times. (XX:XX format max= 59:59)

OR

6.3.3.2 Press "***ESC***" then "***ENTER***" to skip, as instructed on screen, if no changes need to be made.

Screen displays:
SAMPLE SETTING 2.
ENTER TO SET SAMPLE VALVE
ESC THEN ENTER TO SKIP

This function is not used in this application.

Press "***ESC***" then "***ENTER***" (F4) to skip.

Programmed times are displayed on the screen.

6.3.3.3 Press "***ENTER***" (F4) to continue.

6.3.4 Set Peak Table

Here the information on the components of interest obtained in "Peak Display Mode" is programmed into the instrument in the "Peak Table".

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings

Screen displays:
ENTER PEAK TABLE

ENTER TO SET PEAK INFO
ESC THEN ENTER TO SKIP.

6.3.4.1 Press "***ENTER***" (F4) to continue to peak table programming.

Screen Displays:
OF PEAKS
(1 OR 2)

NOTE

A “Marker Peak” may be added to set a Backflush time, and indicate to the instrument the end of the analysis run. If the Marker Peak is used, enter 2 peaks for the # of peaks.

6.3.4.2 Enter # of Peaks on keypad.

6.3.4.3 Press “***ENTER***” (F4) to accept entry, or “***ESC***” then “***ENTER***” (F4) to re-enter number of peaks, as instructed on screen.

6.3.4.4 Enter Peak #1 Start Time (XX:XX format; max = 59:59)

Press “***ENTER***” (F4) to accept entry, or “***ESC***” then “***ENTER***” (F4) to re-enter.

6.3.4.5 Enter Peak #1 Width (XXX format)

Press “**ENTER**” (F4) to accept entry, or “***ESC***” then “***ENTER***” (F4) to re-enter.

6.3.4.6 Enter Polarity of Peak #1 (Press “***1***” on keypad)

Press “***ENTER***” (F4) to accept entry, or “***ESC***” then “***ENTER***” (F4) to re-enter.

6.3.4.7 Repeat steps “c” through “e” for any additional peaks (as appropriate for your application).

NOTE

As a guideline for a Marker Peak, use **two times the end time** of Peak 1 as the Start Time for the Marker; and a Peak Width of 005. For example, if Peak 1 Start Time is 01:00, and the Peak Width is 060 (seconds), the Peak 1 end time would be 02:00. The Marker Peak Start Time would then be 06:00 (02:00 X 2= 4:00. 4 minutes after Peak 1 end= 06:00.); and the Peak Width would be 005.

This is only a guideline, and can be adjusted as necessary.

6.3.4.8 After information for the last peak is entered into the Peak Table and accepted,

Screen displays: *PEAK EVENT TABLE*

ESC THEN ENTER TO ABORT
ENTER TO ACCEPT

6.3.4.9 Press “***ENTER***” (F4) to accept Peak Table information just entered, or “***ESC***” then “ENTER” (F4) to re-enter.

Screen displays: *PROCESSING PLEASE WAIT...*

Wait until message clears. (~5 min.)

AND

Screen displays: SYSTEM IS READY
PEAK EVENT TABLE COMPLETE

PUSH SHIFT THEN 6
TO PROGRAM CONCENTRATIONS

6.3.5 Input Standard Concentrations, Peak Labels, Run Control, and Trigger

6.3.5.1 Press "***SHIFT***", then "***6***" on keypad

i. Enter Standard Concentration of each peak in XXX.XX format.

See Application Sheet and Flow Diagram provided with each particular instrument for specific parameters and settings

---

ii. Enter "000.00" for Marker Peak concentration, if applicable.

After last peak concentration is entered,

Screen displays: ENTER TO LABEL PEAKS
ESC THEN ENTER TO END

6.3.5.2 Press "***ENTER***" (F4) to Label Peaks

or

"***ESC***", then "***ENTER***" (F4) to skip naming peaks.

6.3.5.3 Enter Peak Labels in format XXXXX.

Select five (5) alpha/numeric, or blank characters to identify each peak. Use "***4***" and "***6***" on keypad to cycle through characters. Holding in "4" and "6" keys will cycle through characters faster.

Press "***ENTER***" (F4) to select each character, one at a time. FIVE characters must be selected for each component.

6.3.5.4 After the last character of the last component is entered,

Screen displays: RUN CONTROL:
1-AUTO 0-MANUAL

"AUTO" will allow sampling to run continuously without operator input. "MANUAL" will stop and wait for operator input after one sample run.

Use keypad to enter "***1***" for "AUTO"; enter "***0***" for "MANUAL".

NOTE

To exit “AUTO” run control mode, press “***ENTER***” (F4), then “***SHIFT***”. Instrument will operate in “MANUAL” mode after current run.

6.3.5.5 Set Trigger:

TRIGGER ON, if selected, will delay run start until input is received (terminals unshorted).

Press “1” to turn TRIGGER ON; Press “0” to turn TRIGGER OFF.

Screen will display: *PLEASE WAIT*

Wait until message clears. (~5 min.)

6.3.5.6 As instructed on screen, press “***ENTER***” (F4) to END.

Display reads: *PROG. COMPLETE*

Wait until screen displays: *SYSTEM IS READY*

6.3.6 Run Calibration Gas

Press “***SHIFT***”, then “***4***” to enter “Calibration Mode”.

6.3.6.1 Calibration gas will be automatically analyzed twice and evaluated. The calibration is the average of the two runs.

6.3.6.2 If the precision of the calibration runs are within 10%, “CAL VALIDATED” is displayed on-screen.

If the Calibration is not validated, display will indicate “VAL Failed”. Rerun Calibration Gas if Cal is not validated by pressing “***SHIFT***”, then “***4***”. Repeat until “CAL VALIDATED” is displayed on-screen.

Calibration Check: Press “***ENTER***” (F4), then “***SHIFT***”, then “***5***” to check the calibration. The Calibration Gas will be analyzed as a Sample, and the results will be displayed on screen for evaluation.

If satisfactory results are achieved on Calibration Check, proceed to “RUN SAMPLE”.

6.4 Run Sample

To make a **Sample Run**, press "***SHIFT***", then "***5***".

Screen Displays: ZEROING PLEASE WAIT

6.4.1 Analysis results will be displayed on screen when completed. Sampling will run continuously if "AUTO" Run Control was selected (Sect. 6.3.5.4).

6.4.2 To **EXIT "AUTO" run control mode**, press "***ENTER***" (F4), then "***SHIFT***". Instrument will stop after one analysis run.

7
MAINTENANCE & SERVICE

WARNING — HIGH VOLTAGE

NOTE

It is <u>HIGHLY</u> recommended that GOW-MAC Instrument Co. be consulted prior to any maintenance activity being undertaken. GOW-MAC service professionals will ensure the necessity of the maintenance and will protect the user against any possible warranty violations and/or unnecessary instrument downtime.

7.1 Changing the Oven Assembly

7.1.1 The oven assembly contains the speciation device, which allows identification of the sulfur species amidst the many other impurities in the carbon dioxide (CO_2) matrix.

Figure 7-1 illustrates the oven assembly.

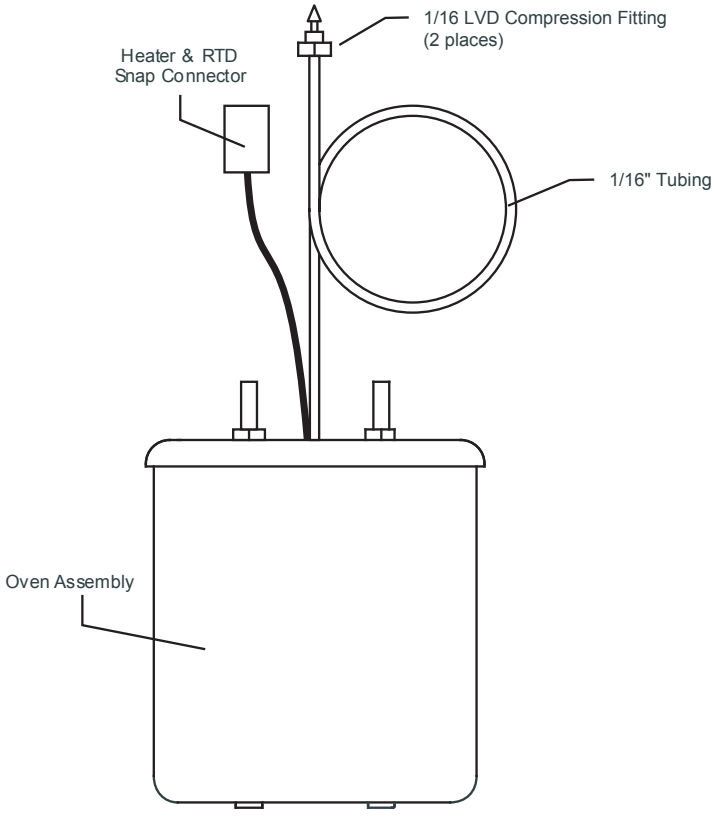


Figure 7-1
Sulfur Analyzer Oven Assembly

7.1.2 Turn instrument power OFF by flipping power switches located on both the back and front panels of the analyzer.

7.1.3 Remove the top cover of the instrument. Four (4) Phillips-head screws at each corner secure the top cover. The screws must be removed completely.

7.1.4 Disconnect the 1/16-in fittings at Ports 5 and 9 on the 10-port sample/backflush valve. (Figure 7-2).

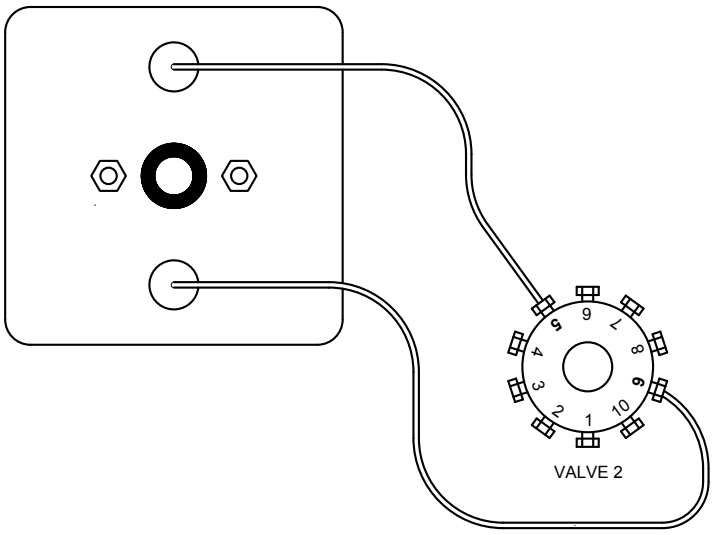


Figure 7-2

7.1.5 Disconnect the oven temperature control cable via the white plastic “snap” connector (Figure 7-3).

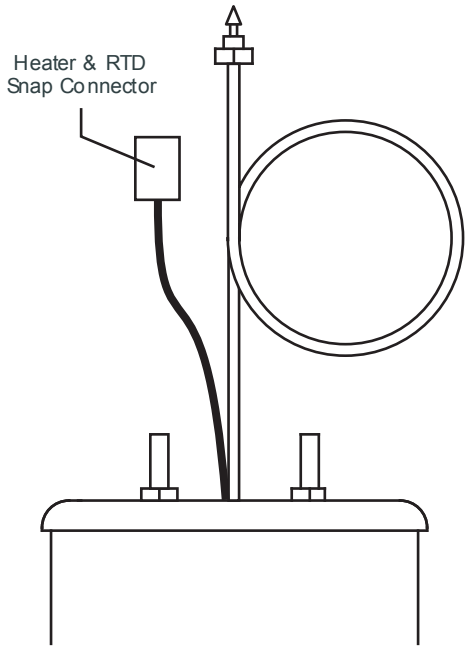


Figure 7-3

7.1.6 Loosen the four thumbscrews adjacent to the corners of the oven module, and slide the front and rear securing brackets away from the oven module (See Figure 7-4).

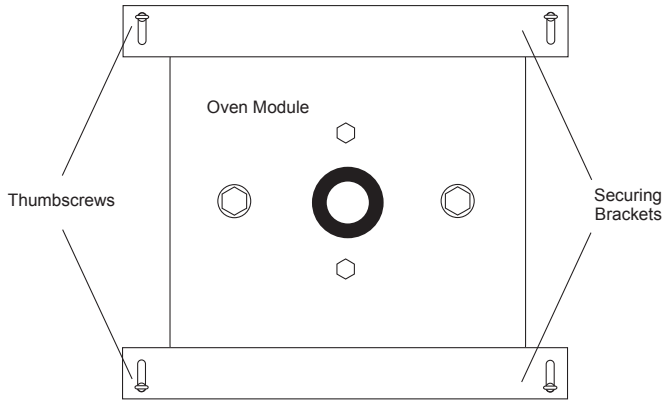


Figure 7-4

7.1.7 Remove the oven module.

7.1.8 Insert new oven module.

7.1.9 Slide front and rear securing brackets over top of oven module and hand-tighten the four thumbscrews.

7.1.10 Reconnect the oven control wires via the white plastic “snap” connectors.

7.1.11 Reconnect both 1/16-in LDV compression fittings to Valve 2, ports 5 and 9 (refer to Figure 7-2)

i. Hand-tighten each fitting.

ii. Tighten slightly further with a 1/4-in wrench.

7.1.12 Replace the top cover to the instrument.

7.2 Speciation Bake-out

WARNING

CONSULT FACTORY *PRIOR* TO PERFORMING THIS OPERATION!!!
(610) 954-9000

“Baking-Out” is a method of ridding the *speciation oven* of contamination. It is the next option aside from allowing time for the system to clear out by itself. The amount and actual substance of contamination usually will determine which method is used. If a Bake-Out is necessary, follow these steps:

7.2.1 *Transport Gas* must be flowing.

7.2.2 During the bake out cycle, the sample/backflush valve automatically goes to the CW (INJECT) position, allowing any speciation oven contamination to be swept out through the VENT 2 fitting (on the back panel) to vent.

7.2.3 To bake out the speciation oven(s) follow the following procedure:

7.2.3.1 Press "***SETUP"*** (F2) to enter the setup mode from the home screen.

7.2.3.2 Press "***1***" to enter the Manual Valve mode.

7.2.3.3 Press "***3***" to switch the Gas Sampling Valve to the inject position.

7.2.3.4 Press "***ESC***" to exit the valve mode.

7.2.3.5 Press "***0***" to enter the temperature mode.

7.2.3.6 Change the speciation oven temperature to the bake-out temperature of 80 °C.

7.2.3.7 Press "***SHIFT***" than "***1***" to monitor the oven temperature.

7.2.4 Six (6) hours is usually adequate, but overnight may be needed for more severe cases.

7.2.5 Press "***ESC***" to exit the Status page.

7.2.5.1 Press "***0***" to enter the temperature mode and change the temperature of the oven back to operating temperature. Refer to the supplied QC sheet.

7.2.5.2 Monitor the temperature and wait for stability be for operation the instrument.

7.2.6 Allow several hours for the output to stabilize with reestablished flow before calibrating.

7.3 FPD Replacement

Figure 7-5 shows detector electrical connection location.

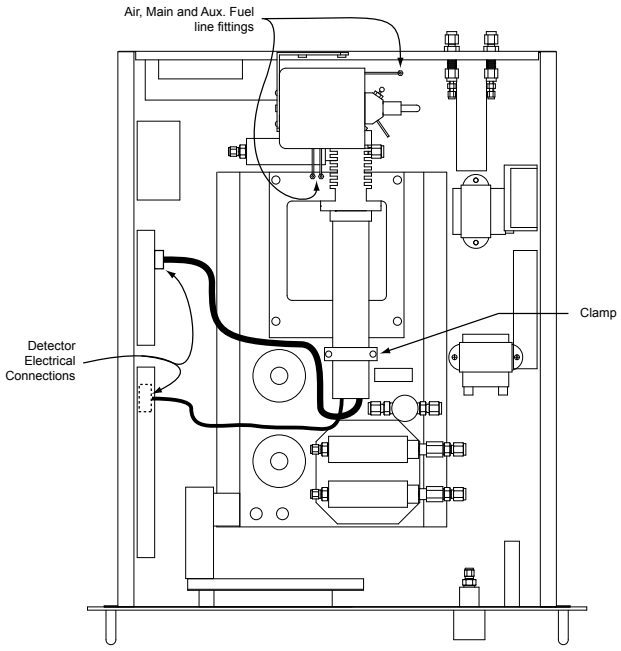


Figure 7.5

UNPLUG THE INSTRUMENT FROM THE AC POWER SOURCE.

7.3.1 Disconnect external gas lines from the instrument.

7.3.2 Remove four (4) screws from top panel of the instrument. Remove panel.

7.3.3 Referring to Figure 7-5, carefully disconnect the COAXIAL SIGNAL CONNECTOR from the box by twisting the coaxial connector 1/4 turn CCW. Disconnect the molex connector leading to the other wires on the end of the photo multiplier tube (PMT).

7.3.4 Disconnect the AIR line to the FPD by using two (2) 5/16-in open-end wrenches.

7.3.5 Disconnect the FUEL line to the FPD by using two (2) 5/16-in open-end wrenches.

7.3.6 Disconnect the SAMPLE line at FPD base by using a 1/4-in open-end wrench.

Be very careful when removing the SAMPLE line from the FPD. It is inserted about 2-in into the flame jet and must be kept straight to enable reinsertion.

7.3.7 Disconnect the glow plug lead at the plastic connector.

7.3.8 Disconnect the detector heater cable assembly at the Molex connector.

7.3.9 Disconnect the condensate drain tube from the detector chimney adapter.

7.3.10 Unlatch the pipe clamp that secures the PMT to the chassis.

7.3.11 Using a 7/64-in hex key, remove the one (1) socket head screw holding the detector assembly to the bracket.

7.3.12 Lift the detector assembly out of the instrument. Replace with new detector and reverse steps above.

7.4 Service

ONLY trained GOW-MAC personnel should undertake service and maintenance of the Series 210SA Sulfur Analyzer beyond the activities described in this manual. Optional service arrangements with GOW-MAC Instrument Company include:

7.4.1 *Service Agreement*: provides uninterrupted service, repair or replacement of the analyzer as an extension to the warranty.

7.4.2 *Loaner Agreement*: a working instrument is provided while the user's primary unit is under repair at the GOW-MAC facility.

7.4.3 *On-site service calls*: Available for a daily rate plus parts and expenses portal-to portal.

Contact GOW-MAC Instrument Company for a complete description of service and maintenance options.

GOW-MAC Instrument Co.
277 Brodhead Road
Bethlehem, PA 18017 USA
Tel: (610) 954-9000
Fax: (610) 954-0599
E-mail: sales@gow-mac.com

8
TROUBLESHOOTING

PROBLEM	CAUSE	REMEDY
Excessive noise	Contaminants bleeding from speciation system	Initiate BAKE-OUT procedure (see Sect. 7.2)
	Contaminated transport gas	Replace transport gas. Ensure > 99.999% pure
No output	Flame not lit	Check flame.
Poor sensitivity	Insufficient sample	Increase sample flow rate.
Signal drift	Contaminants bleeding from speciation system	Initiate BAKE-OUT procedure (see Sect. 7.2)
Poor calibration validation/Erroneous results	Speciation system malfunction	Initiate BAKE-OUT procedure (see Sect. 7.2). If persists, replace oven assembly per Sect. 7.1.
	Transport flow setting incorrect	Check flow from DET OUT and adjust to the rate located on the *Quality Control Final Inspection Report* (page 7).
Gas flows insufficient.	Supply pressures too low or too high	Adjust supply pressures (see Section 5 - Installation)
Gas flows nonexistent.	Internal valving in wrong position.	Refer to Section 6.2.2.2.

9
REPLACEMENT PARTS

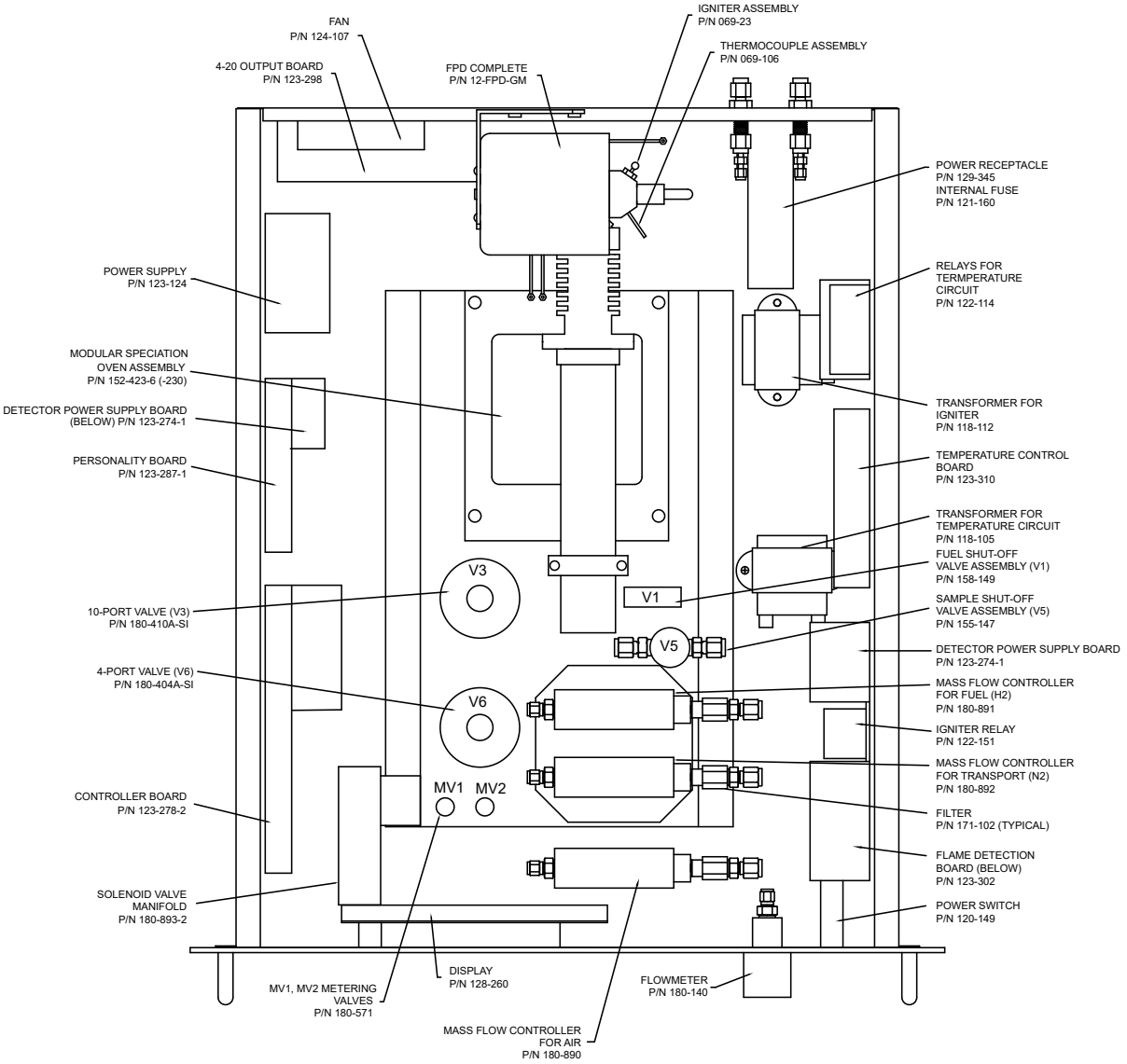


Figure 9-1

Description	**Part Number**
Flame Photometric Detector (FPD), complete	12-FPD-GM
Detector Igniter Assembly	069-23
Thermocouple Assembly	069-106
Transformer, Temperature Control PCB	118-105
Transformer, Igniter	118-112
Switch, Power; lighted rocker (front panel)	120-149

Description	Part Number
Fuse, 3.15 A, 250 V	121-160
Relay, Temperature Circuit, solid state, 25 A	122-114
Relay, Ignitor	122-151
PCB, Power Supply, 160 VDC	123-121
Power Supply, DC	123-124
PCB, Detector Power Supply	123-274-1
PCB, 4-20 mA Output	123-298
PCB, Flameout Detection	123-302
PCB, Controller for 200- or 202-06000001	123-278-2
PCB, Controller for 200- or 202-06000002	123-278-7
PCB, Controller for 200- or 202-06000003	123-278-8
PCB, Personality for FPD	123-287-7
PCB, Temperature Controller	123-310
Fan, 24 V	124-107
Cord, AC input power	127-378
Display, vacuum fluorescent	128-260
Receptacle with power switch and fuse holder (back panel)	129-345
Modular Speciation Oven Assembly (115 V)	152-423-6
Modular Speciation Oven Assembly (230 V)	152-423-6-230
Cable, detector heater & probe, 120 V	155-144
Cable, detector heater & probe, 240 V	155-144-230
Cable, column oven heater & probe, 120 V	155-146
Cable, column oven heater & probe, 240 V	155-146-230
Valve, sample shut-off, with cable (V5)	155-147
Valve, Fuel shut-off with cable (V1)	155-149
Filter, 20 micron (mass flow controller inlets)	171-102
Filter, 7 micron (actuator air inlet)	171-171
Restrictor, Flow, passivated	171-357-SP
Flowmeter, CO_2, 10 - 120 sccm @ STP (Sample/Calibration)	180-140
Valve, 4-port, low temperature with pneumatic actuator (V6)	180-404A-SI
Valve, 10-port, low temperature with pneumatic actuator (V3)	180-410A-SI
Sample Loop, 1.0 mL, passivated	180-453SI
Valve, Metering (MV1, MV2)	180-571
Mass Flow Controller, Air	180-890
Mass Flow Controller, Hydrogen (H_2)	180-891
Mass Flow Controller, Nitrogen (N_2)	180-892
Valve, solenoid, 24 V, on manifold	180-893-2

10
DRAWINGS

Drawing	B-20028	Flow Diagram
Drawing	D-20008	Wiring Schematic (115 V and 230 V)

Appendix A
Series 210SA Commands

ZERO INSTRUMENT ..... SHIFT, ESC

RUN CALIBRATION GAS ..... SHIFT, 4
CALIBRATION CHECK ..... ENTER, SHIFT, 5
RUN SAMPLE ..... SHIFT, 5

SET UP MODE F2

0 TEMPERATURE

1 VALVES — MUST ESC TO EXIT
- Bypass Function = 1
- Ignitor Sequence = 2
- INJECT STANDARD/SAMPLE = 3
- Flame Detection = 4

2 FLOWS

SHIFT, 7 ..... PROGRAM VALVE SWITCHING

ENTER, 7 ..... CLEAR PROGRAMMING DATA

EXIT SET UP MODE ..... END

STATUS PAGE ..... SHIFT, 1
EXIT STATUS PAGE ..... ESC

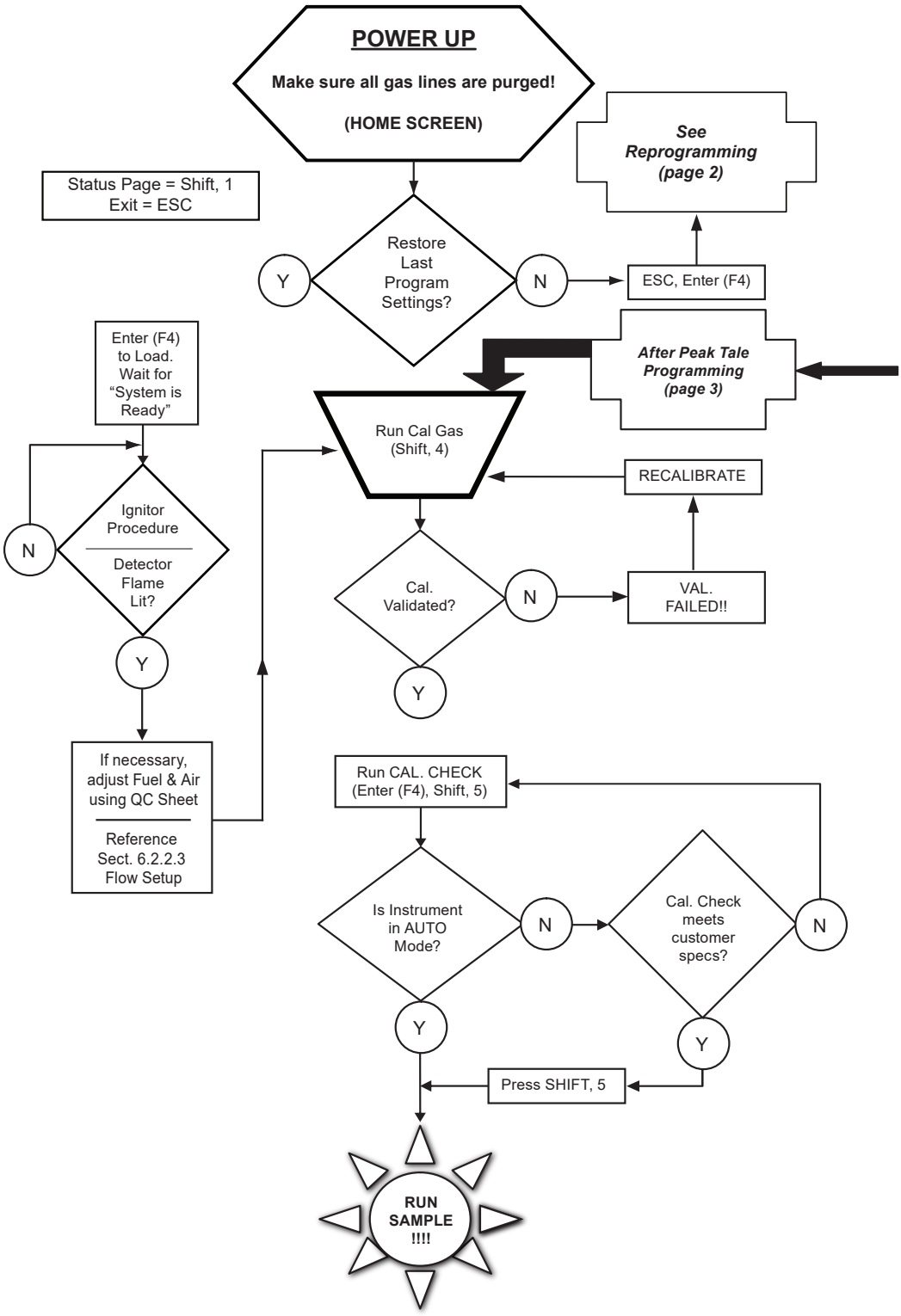
PEAK DISCOVERY MODE ..... PEAK DM (F1)
CLEAR DATA AND SCREEN ..... SHIFT, ENTER (F4)
DETECTION ON ..... SHIFT, 9
DETECTION OFF 9
PEAK DISPLAY MODE ..... PK DISPLY (F3)
EXIT PEAK DISPLY 0

ENTER STANDARD CONCENTRATIONS,
PEAK LABELS, AUTO/MAN AND TRIGGER ..... SHIFT, 6

EXIT AUTO RUN ..... ENTER (F4), SHIFT

Appendix B
Series 210SA Quick Start Reference Flow Chart

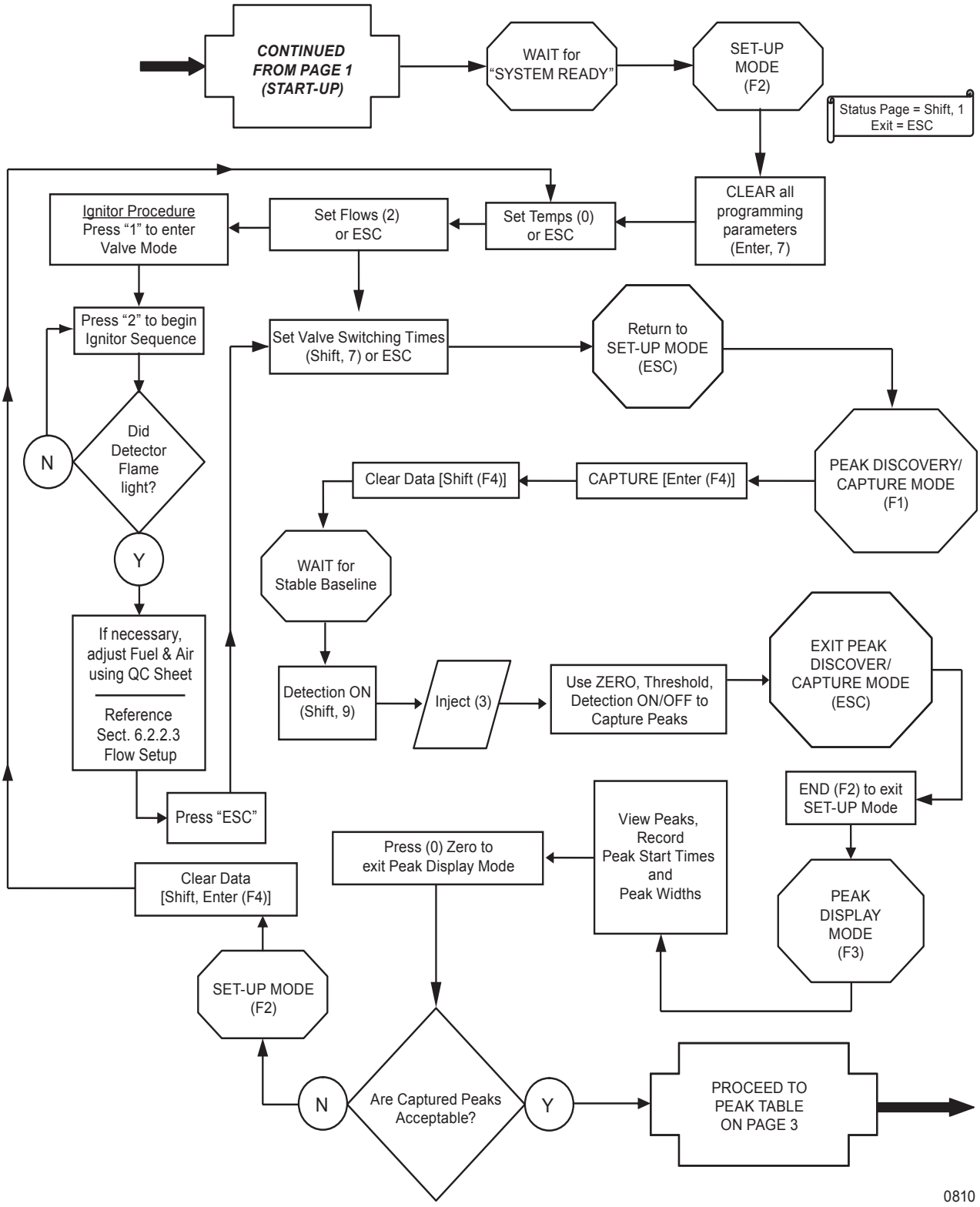
Series 210SA Quick Start Reference Flow Chart
START-UP (page 1)
(Refer to Operating Manual for Detailed Instructions)



Series 210SA Quick Start Reference Flow Chart
Reprogramming

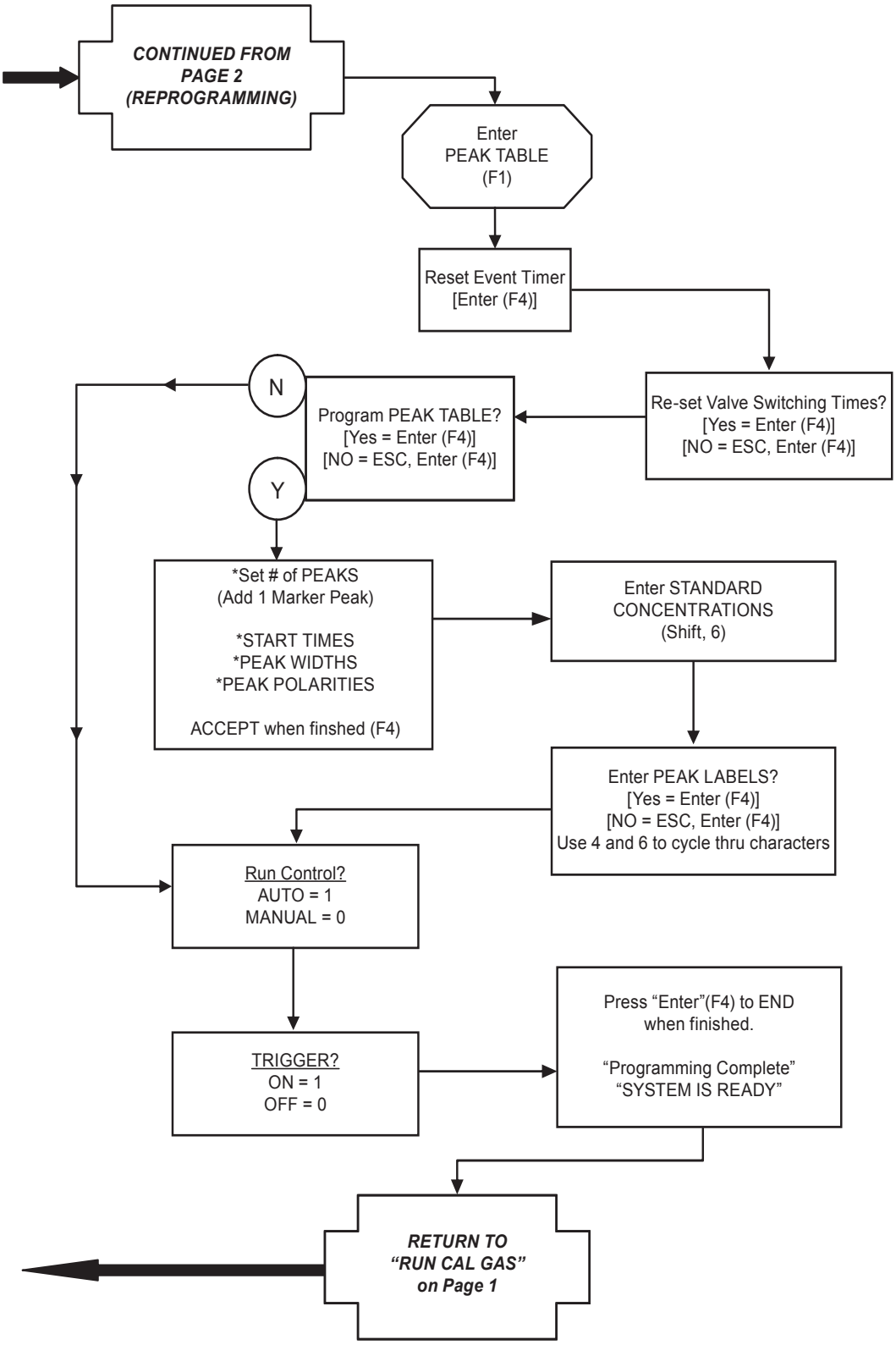
(page 2)

(refer to operating manual for detailed instructions)



Series 210SA Quick Start Reference Flow Chart
Peak T

(page 3)
(refer to operating manual for detailed instructions)



Warranty

THE Series 210SA ANALYZER SOLD BY GOW-MAC® INSTRUMENT CO. IS WARRANTED FOR A PERIOD OF ONE (1) YEAR AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP. THE TERMS OF THIS WARRANTY ARE AS FOLLOWS:

1. The warranty period begins with the shipping date of the equipment to the original purchaser.

2. Certain parts such as batteries, fuses, glass accessories, lamps, columns, etc., are expendable in normal use, and their service life is unpredictable. Such items are not covered by this warranty.

3. All requests for service or repair under this warranty must be received within the warranty period by GOW-MAC® or its authorized representative. All repairs are made at GOW-MAC plants or at the office of authorized representatives.

4. All repairs, adjustments, and other service under this warranty shall be performed free of charge to the purchaser. However, warranty service and repairs shall be limited to equipment malfunctions which, in the opinion of GOW-MAC®, are due or traceable to defects in original materials or workmanship. Instrument malfunctions caused by abuse or neglect of the equipment are expressly not covered by this warranty.

5. Instrument parts which have been repaired or replaced during the warranty period are themselves warranted only for the remaining unexpired portion of the original six month warranty.

6. Repairs, adjustments, and service performed after expiration of the six month warranty period shall be charged to the purchaser at the then current prices for parts, labor, and transportation.

7. This warranty attaches to the equipment itself and is not limited to the original purchaser. Unexpired portions of the warranty are thus transferable to subsequent owners.

8. GOW-MAC® expressly disclaims any liability to users of its products for consequential damages of any kind arising out of or connected with the use of its products.

9. Except as stated in Sections 1 through 8 above, GOW-MAC® makes no warranty, expressed or implied (either in fact or by operation of law), statutory or otherwise; and, except as stated in Sections 1 through 8 above, GOW-MAC® shall have no liability under any warranty, expressed or implied (either in fact or by operation of law), statutory or otherwise.

10. Statements made by any person, including representatives of GOW-MAC® which are inconsistent or in conflict with the terms of this warranty shall not be binding upon GOW-MAC® unless reduced to writing and approved by an officer of the Company.

11. This warranty shall be governed by the laws of the Commonwealth of Pennsylvania.

Health and Safety Declaration for the Return of GOW-MAC Instrument Co. Equipment

In order to protect our employees from exposure to various hazards, the following statements and/or questions **MUST** be answered by you. Fill out this document in its entirety and either fax or e-mail it to GOW-MAC Instrument Co., Attn: Repair Dept, **BEFORE** returning the product.

The instrument/device/part being returned **will not** be accepted into GOW-MAC's facility until we receive this completed document. Once the product has been approved for return by our Chemical Safety Officer, an acknowledgement will be promptly issued to you with notification of your **Return Materials Authorization (RMA) number** and the procedure to follow for returning the product. *All applicable regulations should be followed when returning instrumentation, devices, and or parts.*

Customer to Record the Following:

Model # / Part #: _____

Serial #: _____

Service Technician spoken to: _____

Today's Date: _____

If this form is not approved by our chemical safety officer, the instrument/device/part WILL NOT be permitted into our facility for servicing!

A] Briefly list the application(s) for which the instrument/device/part was used, as well as any and all chemicals, gases, and/or materials analyzed and their concentrations. (**MUST be filled in**): _____

_____

B] Is there the possibility of internal or external contamination on or in this instrument/device/part?

❑ Yes – see below ❑ No – proceed to C.

Please check the appropriate box.

- ❑ Chemicals or Substances That Are Hazardous to Health
- ❑ Blood, Body Fluids, (e.g. Urine, Secretions), Pathological Specimens
- ❑ Regulated Medical Wastes
- ❑ Infectious Substances or other Bio-Agents (e.g. Protein, Enzymes, Antibodies)
- ❑ Radioactive Isotopes used in the area. Detail type (ECD, Isotopic Labels, etc) and Activity in Micro Curies
- ❑ Biodegradable Material That Could Become Hazardous
- ❑ Other Hazards _____

If any of the above boxes are checked the following statements and/or questions must be answered.

1. Specifically describe where (on or in) the instrument/device/part there could be any residual contamination (for example: blood spill on the surface).____

   _____
2. Provide details of these hazards. Include names, Material Safety Data Sheets (MSDS), and concentration of contaminants, where possible. _____

   _____
3. Describe the method of decontamination used. Attach Procedure._____

   _____

C] I declare that the above information is true and complete to the best of my knowledge. I acknowledge that any inconsistencies between the condition of the instrument and the statements made on this form will delay the repair process.

Authorized signature _____ Date: _____

Name (Printed) _____ Phone number: _____

Company name: _____ Fax number: _____

Shipping address: _____

City: _____ State/Country: _____ Zip :_____

E-mail address: _____

BEFORE item can be shipped, fax completed form to: (610) 954-0599 or e-mail it to: repairs@gow-mac.com

For GOW-MAC Use Only:

❑ **Passed** Safety Inspection. **OK** to proceed to Repair Dept.

❑ **Failed Safety Inspection. DO NOT** proceed to Repair Dept.

Signed: _____

Chem. Safety Off.

RMA No: _____

Date ____/____/____

Comments: ( ) None

( ) On Back >>>>

277 Brodhead Road, Bethlehem, PA 18017 U.S.A. Tel: (610) 954-9000 Fax: (610) 954-0599 E-mail: sales@gow-mac.com URL: www.gow-mac.com