TRAINING MANUAL

MODEL 465L
OZONE MONITOR

TELEDYNE
INSTRUMENTS
Advanced Pollution Instrumentation
A Teledyne Technologies Company

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1. PRINCIPLE OF OPERATION

1.1. THEORY OF OPERATION

The detection of ozone molecules is based on absorption of 254 nm UV light due to an internal electronic resonance of the O_3 molecule. The Model 465 uses a mercury lamp constructed so that a large majority of the light emitted is at the 254nm wavelength. Light from the lamp shines down a hollow quartz tube that is alternately filled with sample gas, and then filled with gas scrubbed to remove ozone. The ratio of the intensity of light passing through the scrubbed gas to that of the sample forms a ratio I/I_O. This ratio forms the basis for the calculation of the ozone concentration.

The Beer-Lambert equation, shown below, calculates the concentration of ozone from the ratio of light intensities.

$$C_{O_3} = -\frac{10^9}{\alpha \times \ell} \times \frac{\mathrm{T}}{273^o\mathrm{K}} \times \frac{29.92 inHg}{\mathrm{P}} \times \ln \frac{\mathrm{I}}{\mathrm{I}_o}$$

Where:

- I = Intensity of light passed through the sample
- I_o = Intensity of light through sample free of ozone
- α = absorption coefficient
- ℓ = path length
- C_{O_3} = concentration of ozone in ppb
- T = sample temperature in degrees Kelvin
- P = pressure in inches of mercury

As can be seen the concentration of ozone depends on more than the intensity ratio. Temperature and pressure influence the density of the sample. The density changes the number of ozone molecules in the absorption tube which impacts the amount of light removed from the light beam. These effects are addressed by directly measuring temperature and pressure and including their actual values in the calculation. The absorption coefficient is a number that reflects the inherent ability of ozone to absorb 254 nm light. Most current measurements place this value at 308 cm^{-1} atm^{-1} at STP. The value of this number reflects the fact that ozone is a very efficient absorber of UV radiation which is why stratospheric ozone protects the life forms lower in the atmosphere from the harmful effects from solar UV radiation. Lastly, the absorption path length determines how many molecules are present in the column of gas in the absorption tube.

The intensity of light is converted into a voltage by a high resolution A/D (analog-to-digital) converter. The digitized signal and other variables are used by the CPU to compute the concentration using the above formula.

About every 2.5 seconds the M465 completes a measurement cycle consisting of a 1 second wait period for the sample tube to flush, followed by a 150 ms measurement of the UV light intensity to obtain (I). The sample valve is switched to admit scrubbed sample gas for 1 second, followed by a 150 ms measurement of the UV light intensity to obtain (I_O). Measurement of the (I_O) every 2.5 seconds eliminates instrument drift due to changing intensity of the lamp caused by aging and dirt.

2. PNEUMATIC AND ASSEMBLIES

2.1. PNEUMATIC DIAGRAM

Figure 2-1 below is a pneumatic diagram that can be referenced when performing troubleshooting on the monitor. Note that certain items, such as the Stream Selector and Electronic Flow meter are optional and will not be present in all M465L monitors.

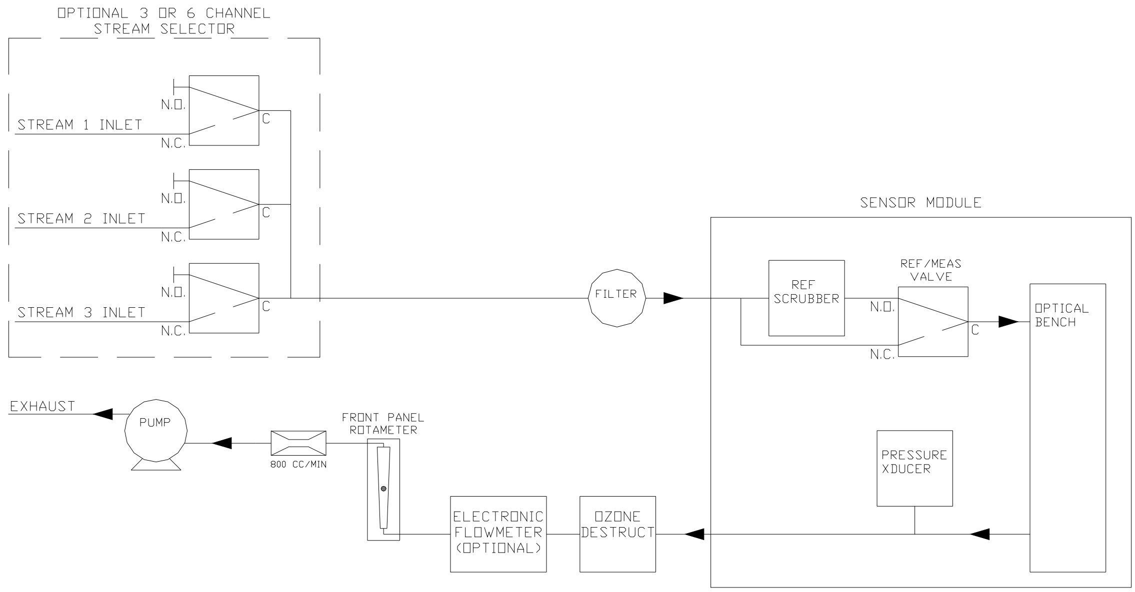

Figure 2-1: Pneumatic Diagram, 3 Stream Configuration

2.2. PNEUMATIC CONNECTIONS

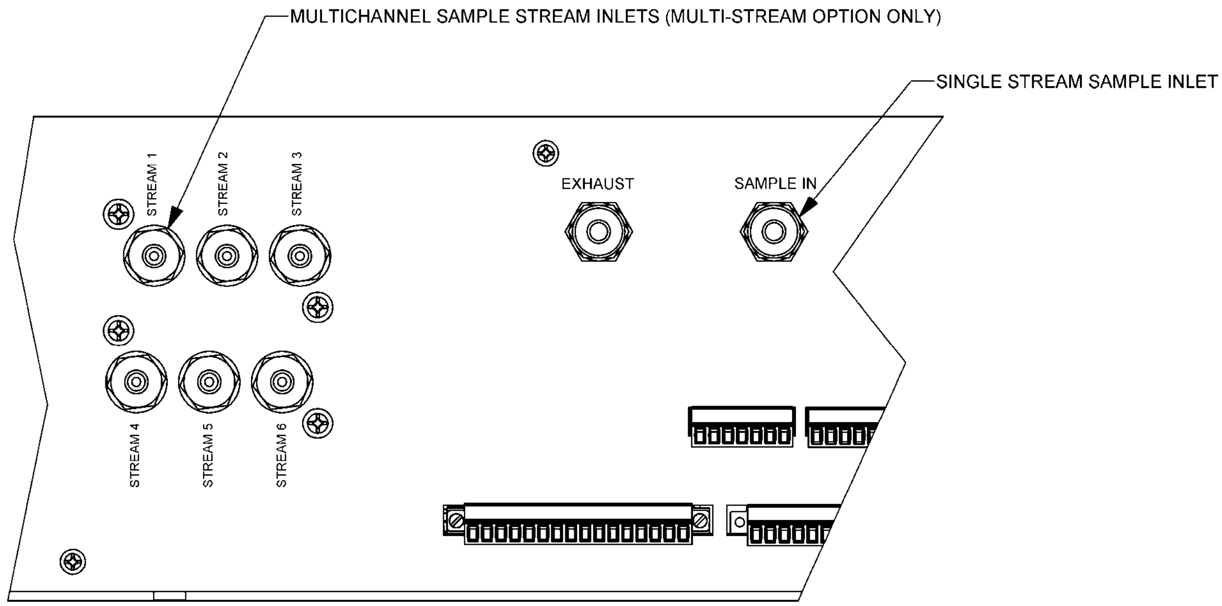

Figure 2-2: Pneumatic Connections, Rack Mount Configuration

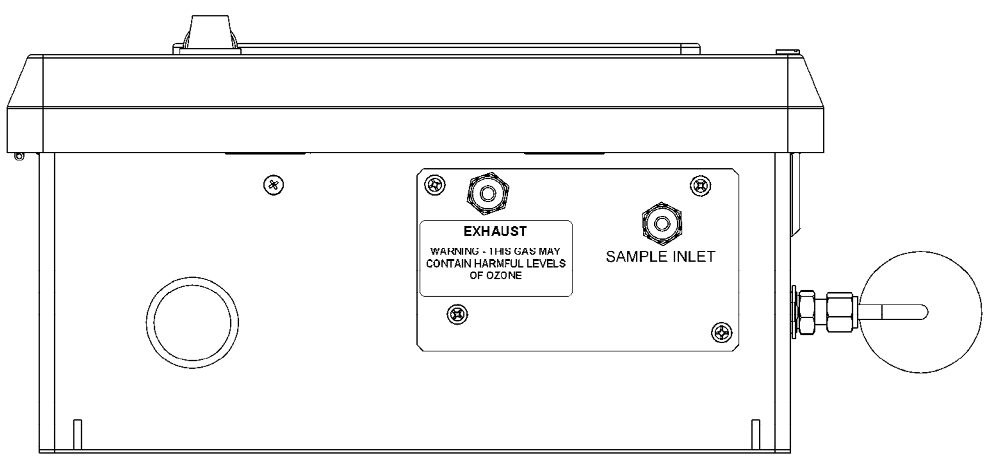

Figure 2-3: Pneumatic Connections, NEMA Configuration, Single Stream

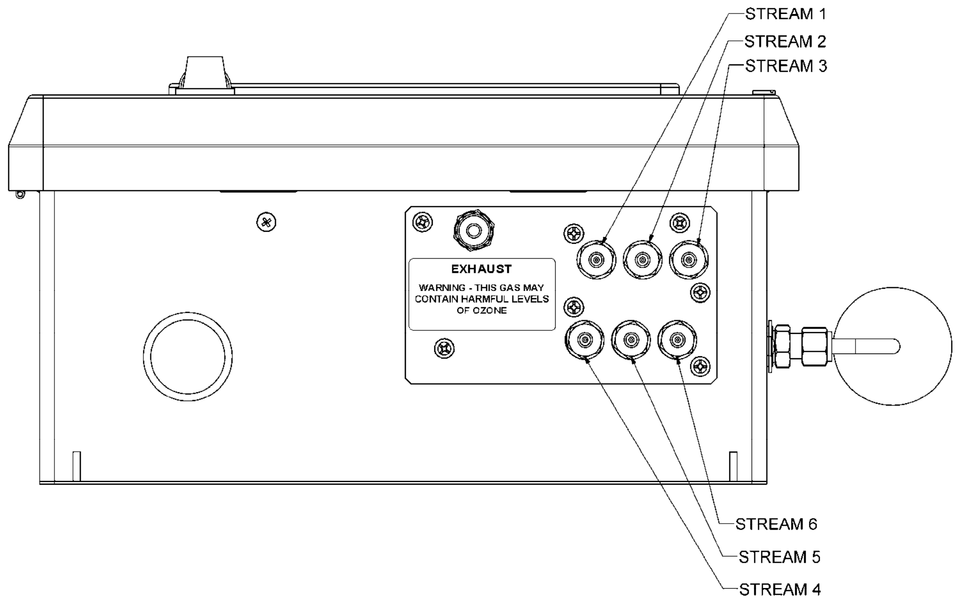

Figure 2-4: Pneumatic Connections, NEMA Configuration, Multi-Stream

3. INSTRUMENT LAYOUT

3.1. INSTRUMENT LAYOUT

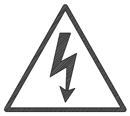

Figure 3-1 and Figure 3-2 below shows the internal layout of the M465L. These figures will be referenced in the procedures that follow.
Note the caution areas where high voltage (line voltage) may be present when power is connected to the instrument.

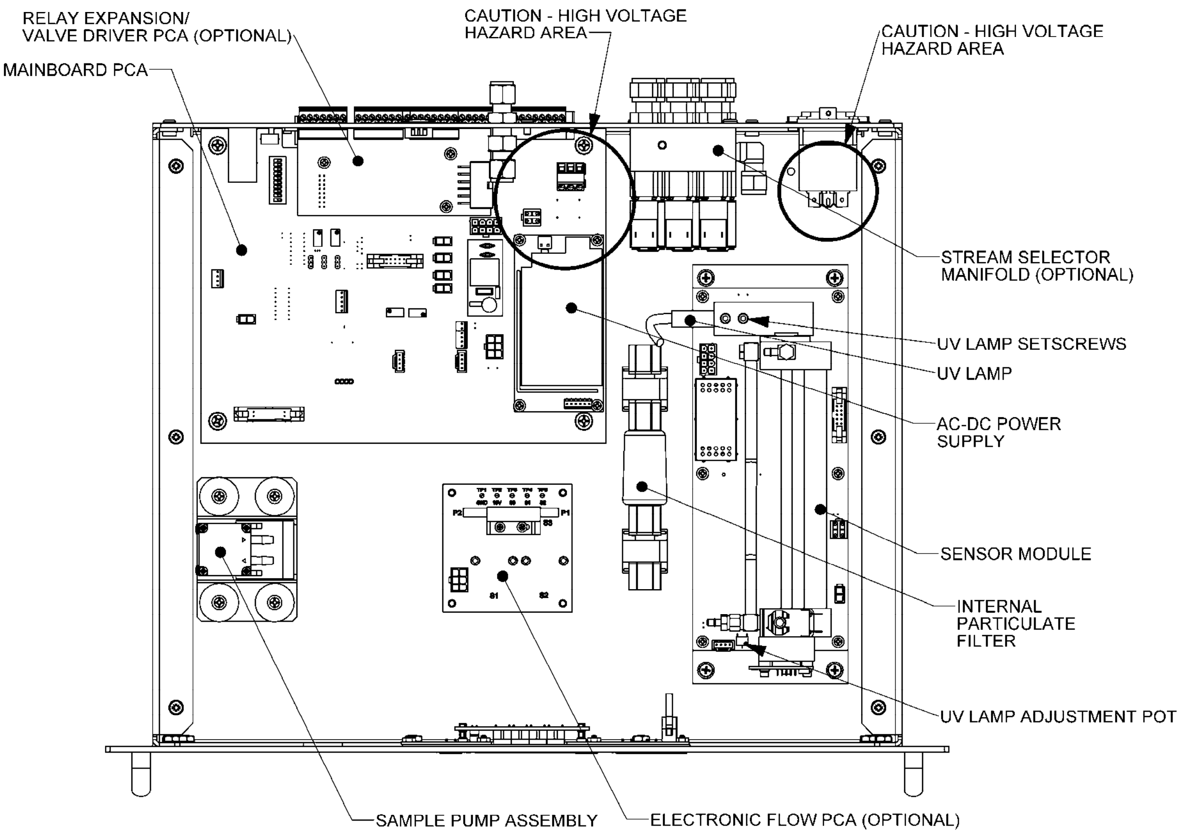

Figure 3-1: Instrument Layout, Rack Mount Configuration

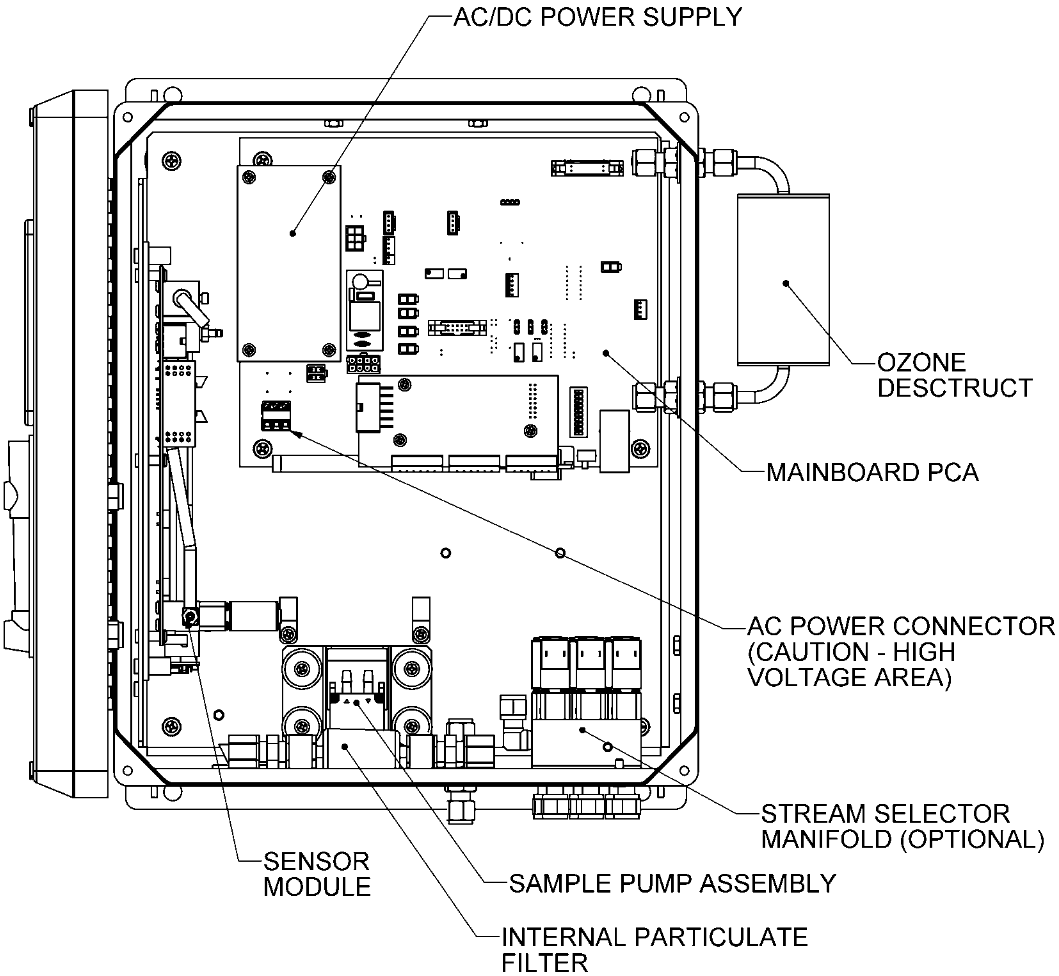

Figure 3-2: Instrument Layout, NEMA Configuration

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4. MENU STRUCTURE

4.1. FRONT PANEL MENU STRUCTURE

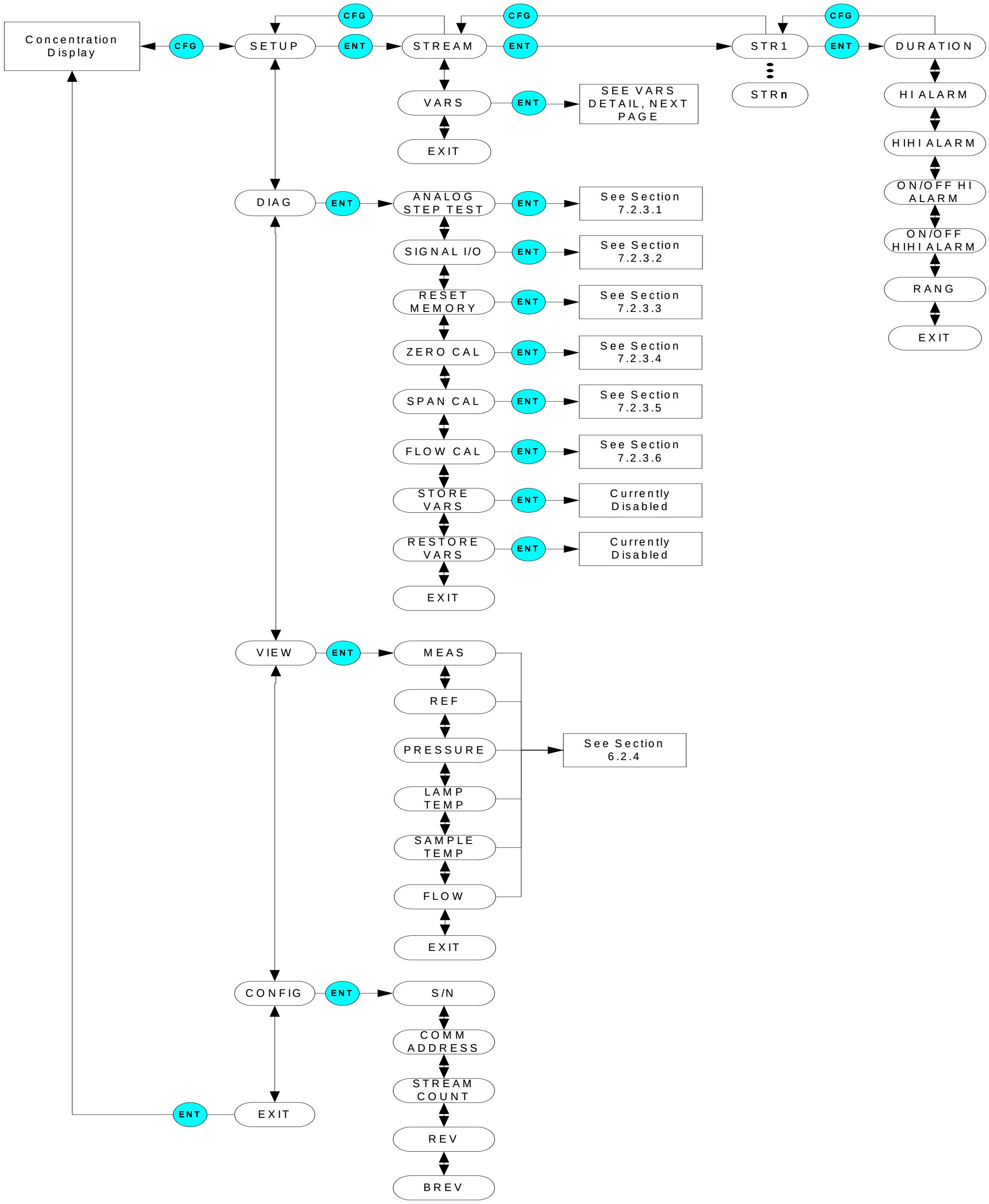


Figure 3-1: Front Panel Menu Diagram (Page 1)

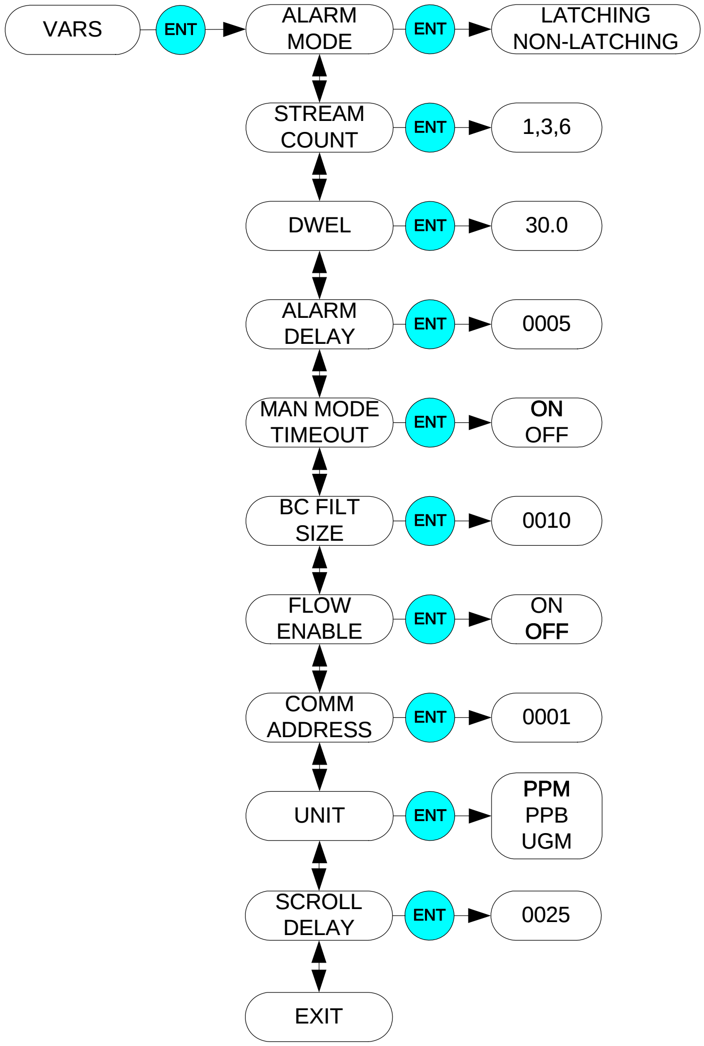


Figure 3-2: Front Panel Menu Diagram (Page 2)

5. CALIBRATION PROCEDURES

5.1. ZERO CALIBRATION

The zero calibration allows the instrument to calibrate its internal ozone offset factor. This should only be done with a source of zero air connected to the “Sample In” port of the M465L. Allow the instrument to stabilize on the zero air source before attempting to zero. This normally takes 10-15 minutes.

When entering the Zero Calibration menu, the prompt “ENT TO CAL” appears on the display. Simply confirm the calibration by pressing the **ENT** button to perform the calibration (to abort the calibration, press and hold the **CFG** button to return to the previous menu level.) After pressing **ENT**, the instrument will automatically exit the menu mode and return to Concentration mode. The concentration reading should quickly go to zero. Please note that while measuring zero air, a certain amount of noise or “dithering” of the concentration about the zero point will occur and is normal. This noise is typically 1-3 ppb (0.001 - 0.003 ppm) in magnitude.

5.2. SPAN CALIBRATION

The span calibration allows the instrument to calibrate its internal slope factor based on a known ozone concentration. This should be done with a source of ozone span gas connected to the “Sample In” port of the M465L. Allow the instrument to stabilize on the span gas source for a minimum of 1 hour before performing the span calibration.

NOTE

A Span Calibration should only be performed with a precision source of ozone calibration gas, such as a Teledyne API Model 700 or Model 703 calibrator. Simple ozone generators without a measurement feedback system should never be used for performing span calibrations.

If you are unsure regarding the suitability of a particular source of calibration gas, contact Customer Service at Teledyne API for assistance.

Figure 5- below shows the Span Cal menu. After the instrument has stabilized on the source of span gas, navigate to the Span Cal menu. Next enter the Span Target concentration (the actual concentration of ozone being supplied to the monitor) and press **ENT**. The display will next show a confirmation menu, **ENT TO SPAN**. Press **ENT** to perform the Span Calibration, or **CFG** to abort back to the start. If the calibration is successful, the display will return to the concentration menu and the monitor reading should change adjust to read very close to the target value. If the calibration cannot be performed, an **OUT OF RANGE** error will be displayed. Press **ENT** to confirm and the display will return to the start of the Span Cal menu.

If the **OUT OF RANGE** error occurs, it means the Span Cal cannot be performed because it would result in an out of range slope value for the monitor. This means that either the sensor in the monitor is malfunctioning, causing improper readings, or the actual ozone concentration being supplied to the monitor is different than the target value being entered.

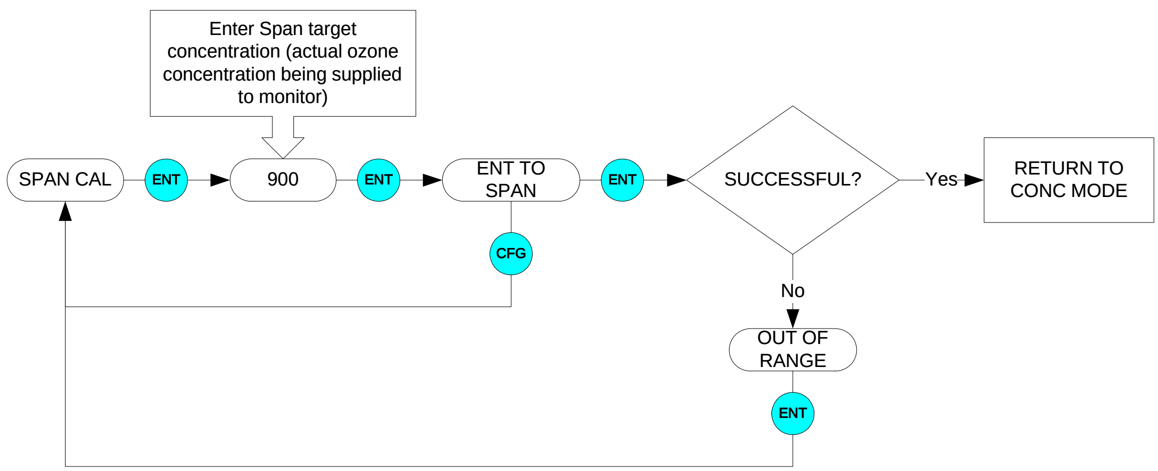


Figure 5-1: Span Cal Menu

5.3. FLOW CALIBRATION

The flow calibration allows the instrument to calibrate its internal flow meter reading. This should be done with a calibrated flow meter connected to the “Sample In” port of the M465L.

Figure 5- below shows the Flow Cal menu. After the instrument has stabilized on the source of span gas, navigate to the Flow Cal menu and Press **ENT**. Next enter the Flow Cal target (the actual flow as measured at the sample inlet) and press **ENT**. The display will next show a confirmation menu, **ENT TO CAL**. Press **ENT** to perform the Flow Calibration, or **CFG** to abort back to the start. If the calibration is successful, the display will return to the concentration. If the calibration cannot be performed, an **OUT OF RANGE** error will be displayed. Press **ENT** to confirm and the display will return to the start of the Flow Cal menu.

If the **OUT OF RANGE** error occurs, it means the Flow Cal cannot be performed because it would result in an out of range flow slope value for the monitor. This means that either the flow sensor in the monitor is malfunctioning, causing improper readings, or the actual flow is different than the target value being entered.

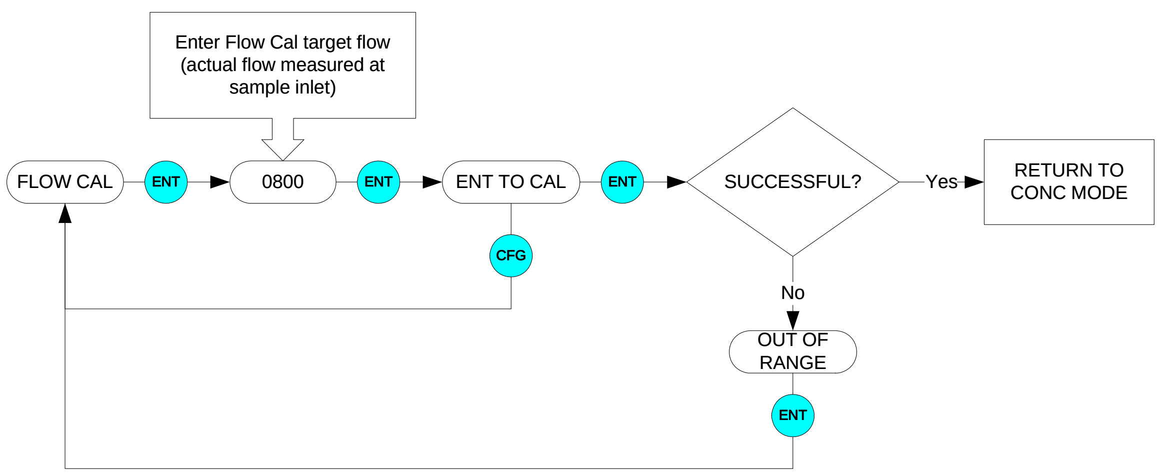


Figure 5-2: Flow Cal Menu

5.4. analog output calibration

5.4.1 Configuring the Analog Output

The analog output can be configured for either 0-5V DC or 4-20mA operation. To change or verify the configuration of the analog output:

1. Disconnect power from the M465L.
2. Remove the six screws and the top cover (Rack Mount Configuration) or open front panel (NEMA Configuration.)
3. Locate the Main board PCA (see Figure 3-1 or Figure 3-2.)
4. Set the desired operation as shown in Figure 5-5-3.
5. Re-Install the top cover or re-secure the front panel (NEMA Configuration.)

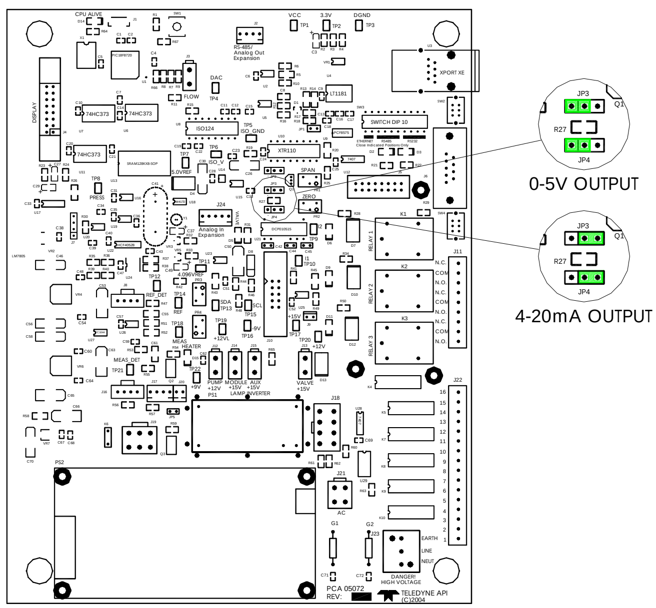


Figure 5-3: Main board – Analog Output Configuration

5.4.2 CURRENT CALIBRATION

1. Ensure that the jumpers on the board are set to current. Refer to FIGURE 5-3
2. Disconnect the GENERAL I/O connector located on the rear panel of the instrument. Refer to 5-4.

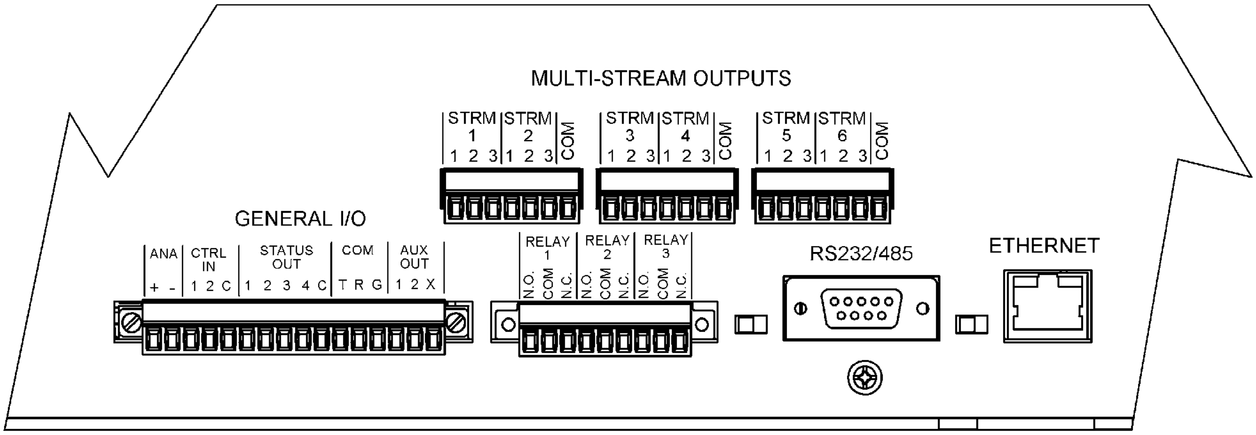


Figure 5-4: REAR PANEL ELECTRICAL I/O CONNECTIONS

3. Insert meter probes into ANA +/-. Set the Meter for DC current. Ensure that the meter leads are setup on the meter for DC current.
4. On the front panel display press CFG-▼-ENT. You are now in the ANALOG STEP TEST. (This will step from 0% to 100% of your output range) Press ENT.
5. Press ▼to stop the step test at 0%.
6. Turn the ZERO potentiometer on the board Counter Clockwise (CCW) until the meter reads 4ma.
7. Press ▼again once to step down to 100%.
8. Turn the SPAN potentiometer on the board (CCW) until the meter reads 20ma.
9. You will need to do this a few times as the both ZERO/SPAN potentiometers will affect one another.

6. MAINTENANCE AND ADJUSTMENTS

6.1. MAINTENANCE TABLE

Table 6-6-1 below outlines the suggested maintenance procedures and intervals for ensuring the M465L continues to operate accurately and reliably. These intervals are based on continuous (24 hours a day – 7 days a week) operation. These intervals may be lengthened for intermittent operation.

Table 6-1: Maintenance Schedule

Maintenance Item	Recommended Interval	Section
Replace internal particulate filter	6 months[*1]	6.2
Adjust UV lamp	As Indicated by 'Check Lamp' LED or status output	6.4
Replace lamp	As required; when adjustment can no longer be performed.	6.5
Replace sample pump	2 years	6.6
Replace Sensor Module Valve	2 years	6.7
Clean the Optics	As required; when a new, or known good lamp and sensor cannot achieve optimal outputs.	6.7
[*1] When external sample line pre-filters are used. If pre-filters are not used, internal sample filter should be replaced every month.		

6.2.

6.3. Replacing Internal Particulate Filter

1. Disconnect power from the M465L.
2. Remove the six screws and the top cover (Rack Mount Configuration) or open front panel (NEMA Configuration.)
3. Locate the filter (see Figure 3-1 or Figure 3-2) Un-strap the filter from the two plastic hold-down clamps. Note the arrow on the filter showing flow direction.
4. Loosen the two nuts holding the filter into the two union fittings.
5. Install the nuts on the new filter. Hand-tighten until snug do not use tools.
6. Perform steps 1 through 3 in reverse order to complete installation.

6.4. UV Lamp Adjustment

1. Instrument should be running and warmed up for at least 20 minutes.
2. With instrument running, remove the six screws and the top cover.
3. Navigate the front panel menu to VIEW menu and scroll to REF display and press **ENT**. At this point there should be a scrolling display similar to "REF = XXXX MV." See Section 4.1 for details on menu navigation.
4. Locate the UV Detector adjustment pot on the forward end of the sensor module (see Figure 3-1 or Figure 3-2.)
5. While observing the REF value on the display, slowly turn the pot to adjust the value. The target adjustment range is as high as possible within the range of **800 – 1150 mV. IMPORTANT Do not exceed 1150 mV.**
6. If the required adjustment cannot be achieved by adjusting the UV Detector pot alone, then additional adjustment can be made by loosening the two UV lamp setscrews on the UV lamp housing (see Figure 3-1 or Figure 3-2) and rotating the lamp. Rotate the lamp very slowly while observing the REF value on the display. Make sure the lamp does not pull out and remains seated in the housing while it is being rotated. Re-tighten the two setscrews when a desired point has been reached.
7. If necessary, additional "fine tuning" can now be done with the UV Detector adjustment pot per step 5.
8. Re-Install instrument cover and observe REF value on display for a couple minutes to verify it does not drift out of the adjustment range.

6.5. UV Lamp Replacement

1. Disconnect power from the M465L.
2. Remove the six screws and the top cover (Rack Mount Configuration) or open front panel (NEMA Configuration.)
3. Loosen the two UV lamp setscrews on the UV lamp housing (see Figure 3-1 or Figure 3-2.)
4. Unplug the lamp power cord from the connector labeled P1 on the sensor module.
5. Loosen the four slotted captive screws attaching the sensor module to the chassis.
6. Carefully slide the lamp out of housing. The sensor module may need to be raised slightly to completely remove the lamp.
7. Install the new lamp, seating it in the lamp housing until it stops.
8. Re-attach the sensor module captive screws to the chassis.
9. Re-tighten the two UV lamp setscrews.
10. Plug the lamp power cord into P1 on the sensor module.
11. Reconnect power to the instrument and turn on power switch. Let instrument warm up for at least 20 minutes.
12. Perform UV lamp adjustment procedure per Section 6.4.

6.6. Sample Pump Replacement

1. Disconnect power from the M465L.
2. Remove the six screws and the top cover (Rack Mount Configuration) or open front panel (NEMA Configuration.)
3. Locate sample pump assembly (See Figure 3-1 or 3-2.)
4. Cut off the clamps holding the tubing to the pump nipples and remove tubing. Note which tubing is connected to inlet and outlet.
5. Unplug the pump power connector from the main board PCA at connector J12.
6. Remove the four screws attaching the sample pump assembly to the chassis.
7. Turn over pump assembly and remove the two screws holding the sheet-metal base to the pump.
8. Install the base on the new pump.
9. Install new pump assembly in chassis.
10. Reconnect tubing; note that outlet fitting of pump should be connected to tubing routed to the ‘Exhaust’ fitting on rear panel.
11. Re-install new tubing clamps or cable-ties to secure tubing connections.

6.7. Sensor Valve Replacement

1. Disconnect power from the M465L.
2. Remove the six screws and the top cover (Rack Mount Configuration) or open front panel (NEMA Configuration.)
3. Locate sensor module assembly (See Figure 3-1 or 3-2.)
4. Unplug the two-pin valve connector from the sensor PCA.
5. Remove the silver retainer clip from the top of the sensor valve. A pair of pliers may be used to slide off the retainer clip.
6. The valve coil can now be removed by sliding upwards.
7. Remove the two (2) mounting screws using a #2 Phillips screwdriver. See Figure 6-1. Note that there are four screw heads visible on the top of the valve body, only two (2) of these should be removed.
8. Remove valve body from sensor manifold.
9. Clean any residue or dirt off the surface of the manifold using a lint-free cloth and distilled or DI water.
10. Install the new valve by reversing steps 1-7. Note the proper orientation of the new valve as shown in Figure 6-.

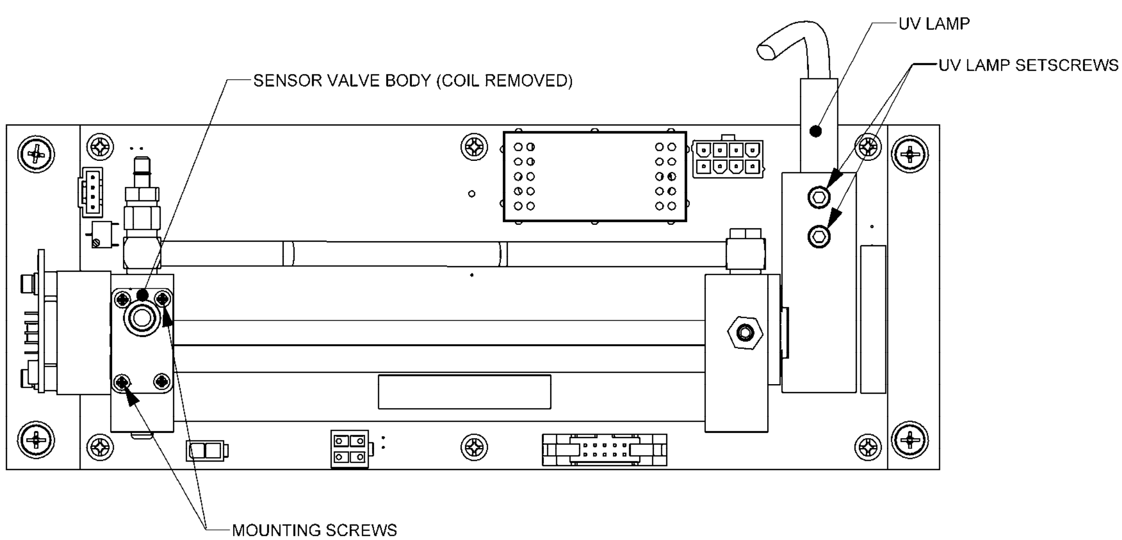


Figure 6-1: Sensor Detail

6.8. Cleaning the Optics

If 1000mV of output from the lamp and ref detector cannot be attained, then the optics will need to be cleaned. The windows in the sensor are quartz and must be handled delicately. Use only water and soft fiber wipes when cleaning the windows. Remove the sensor from the instrument. Unplug the valve, and the ref detector from the bench assembly. Two hex screws hold the ref detector in place. Remove the screws careful not to loose the plastic washers on the end or the screw, or the spacers between the ref detector board, and the detector manifold. Between the detector manifold and the valve manifold is the reference window and o-ring. See Figure 7-4 assembly drawing 3 in section 7.2.5 for more details on part order. Re-assemble the reference detector as in Figure 7-4 but leave the sensor and valve connections unplugged. Remove the 4 screws shown on Figure 7-6 careful not to damage the pressure sensor under the exhaust manifold. The reference scrubber and absorption tube shown in assembly step 4 of Figure 7-4 are held in place by 4 o-rings. Carefully pull apart the two manifolds so that you do not stress the Teflon tube. The scrubber and AB tube should both be removable without removing the Teflon tube. Inspect the o-rings for damage, and replace if necessary.

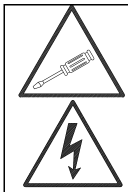
****Do not attempt to clean the reference scrubber****

Take the absorption tube and rinse with filtered water, blow out any excess moisture with nitrogen, canned air, or any other source of clean dry air. Once the absorption tube is clean and dry, the AB tube and the reference scrubber go back into place by pressing them between the two manifolds. The last optic is the exhaust manifold window. The window holding plate is between the exhaust manifold and the lamp manifold, and is held in place by two screws. See Figure 7-1 assembly drawing 1 for part order. Clean the rear optic the same as the reference optic, and reassemble.

6.9. Cleaning Exterior Surfaces of the M465L

If necessary, the front panel mask and keyboard of the M465L can be cleaned with a damp cloth. Do not attempt to clean any of the other surfaces of the instrument. Do not submerge any part of the instrument in water or cleaning solution.

7. TROUBLESHOOTING



CAUTION
RISK OF ELECTRICAL SHOCK. THE OPERATIONS OUTLINED IN THIS CHAPTER ARE TO BE PERFORMED BY QUALIFIED MAINTENANCE PERSONNEL ONLY!

7.1. Reference Drawings

The drawings contained in this section are for general reference and may be useful when performing certain troubleshooting activities.

7.1.1. Pneumatic Diagram

Figure 2-1 below is a pneumatic diagram that can be referenced when performing troubleshooting on the monitor. Note that certain items, such as the Stream Selector and Electronic Flow meter are optional and will not be present in all M465L monitors.

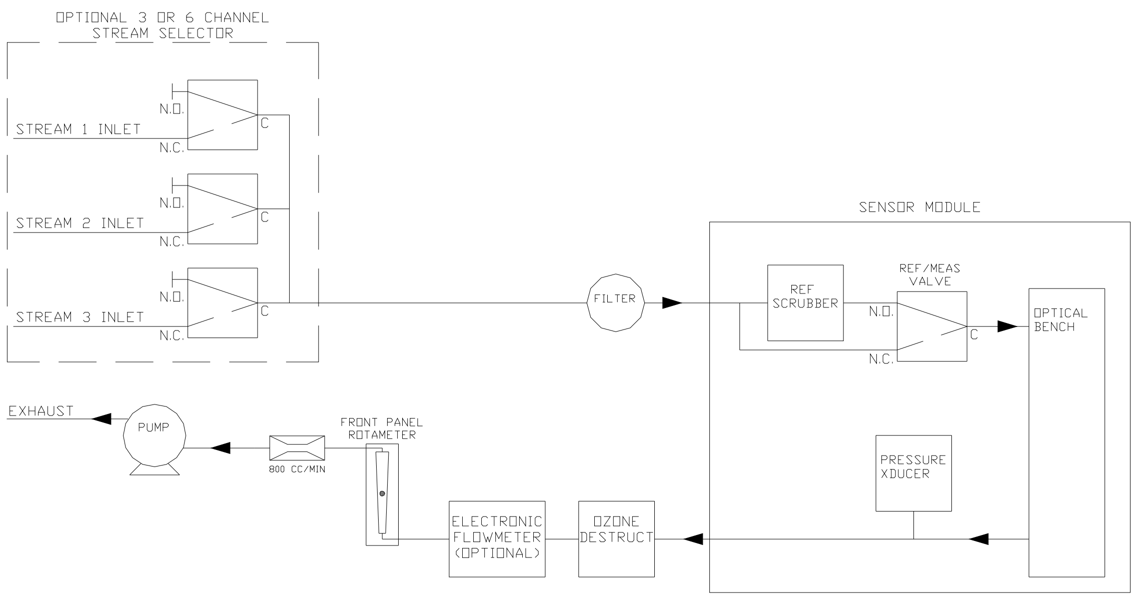


Figure 7-1: Pneumatic Diagram, 3 Stream Configuration

7.1.2. Interconnect Diagram

Figure 7-2 below details the electrical connections between the various electronic modules in the M465L.

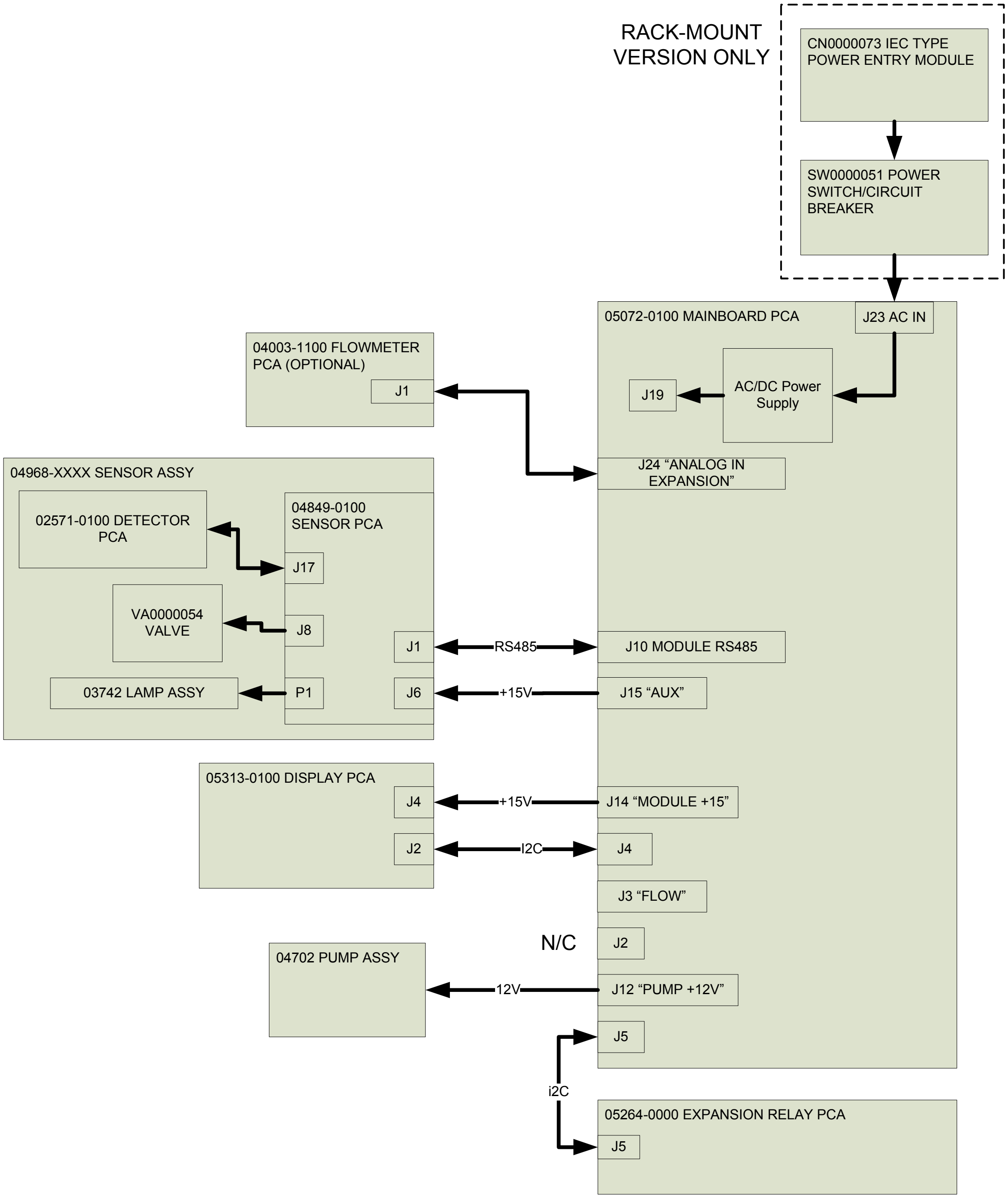


Figure 7-2: Interconnect Diagram

The M465L has 4 front-panel status LED's that reflect the current operating status of the monitor, and indicate fault conditions. There are also four relay Status Outputs on the rear panel (or internally in the NEMA configuration) that also reflect the state of these status LED's. See Section 4.2.3 of the operator's manual for more information on the Status Outputs.

The Status LED's are categorized into Critical and Non-Critical warnings. Critical warnings are those that would normally require immediately removing the monitor from service and repairing it. Non-critical warnings are those that indicate some maintenance would be useful, but not immediately required.

Table 7-1: Status LED / Output Definitions

Status Output #	Status LED Label	Normal Operating State	Triggers	Critical Warning?
1	Sensor OK	On	• No bench communications • Reference < 125.0 mV • Reference > 1230.0 mV	Yes
2	Invalid Reading	Off	• O3 Concentration < -10.0 PPB • O3 Concentration > F.S. Range	No
3	Check Lamp	Off	• Reference < 250.0 mV	No
4	Pneumatic Error	Off	• Pressure < 9.0 psia • Pressure > 14.9 psia • Flow < 640 cc/min • Flow > 960 cc/min	No

7.1.3. Sensor OK

The Sensor OK LED indicates the status of the O3 sensor module in the monitor. The normal state of this LED (or Status Output) is On. If this LED remains off after the normal 20 minute warm-up period, then a failure has occurred and the monitor should be removed from service and repaired.

The most common cause of this warning is a failure of the UV Lamp. A UV Lamp Adjustment (See Section 6.4) should be attempted. If the UV Lamp cannot be adjusted to meet the specified values, then a UV Lamp Replacement should be performed (See Section 6.5.)

This warning can also be caused by a communications error with the sensor module. Inspect the two cables between the Main board PCA and Sensor Module for loose or intermittent connections (See Section 3-1 for monitor layout.) If no cable problem can be found, then the Sensor Module should be replaced.

7.1.4. Invalid Reading

The Invalid Reading LED indicates that the instrument is reading a value that cannot be represented properly on the analog output. Since the analog output is limited to 0-5V (or 4-20mA,) it cannot properly represent negative values, or values in excess of the full-scale range.

If the monitor is consistently reading negative values, then a zero calibration should be performed.

If the monitor is consistently reading values in excess of the full-scale range, then the range value should be adjusted higher.

7.1.5. Check Lamp

The Check Lamp LED indicates that the UV Lamp intensity has dropped below 250mV, a level where UV Lamp Adjustment (See Section 6.4) should be made at the next convenient opportunity. Note that this is a non-critical warning and immediate service is not required. However if the UV Lamp intensity drops below 125mV, then the Sensor OK LED will also turn off, indicating that the monitor must be immediately serviced or taken off-line.

7.1.6. Pneumatic Error

The Pneumatic Error LED indicates that one of the pneumatic parameters, flow or pressure, has gone outside of normal ranges. Note that this is a non-critical warning and immediate service is not required. However if the Sensor

OK LED turns off then the monitor must be immediately serviced or taken off line.

The first step in troubleshooting a Pneumatic Error is determining which parameter has caused the warning. At the monitor front panel, navigate to the VIEW menu. Examine the Flow and Pressure values and compare them to the limits described in Table 7-1 and take appropriate action as described below.

7.1.6.1. Pressure Too High

The monitor inlet is being pressurized. The monitor inlet should be allowed to sample gas at ambient pressure. Disconnect all sample lines from the monitor and read the pressure again. If the value then drops to within the acceptable range, then one of the sample lines is at elevated pressure.

If the inlet is being pressurized, then the design of the sample system should be reviewed and corrected. Contact Teledyne API customer service for assistance.

7.1.6.2. Pressure Too Low

Something may be restricting the flow through the monitor, causing the sample pump to pull a vacuum on the sensor module. First, unplug the sample pump power plug on the Main board PCA and observe the pressure reading. If the pressure reading is still too low, then likely there is a problem with the pressure sensor on the Sensor Module and the Sensor Module should be replaced. Next reconnect the pump and disconnect all sample lines from the monitor and see if the pressure increases to normal levels. If it does, then the problem is somewhere in the sampling system external to the monitor. If the pressure is still below the limit with the sample lines removed, then there is a restriction in the pneumatics of the monitor upstream of the sensor assembly. The most likely cause is a plugged particulate filter. Disconnect the outlet fitting on the sample filter and observe the pressure. If it returns to normal levels then the restriction is in the particulate filter or inlet manifold assembly (multi-stream configurations only.) Replace particulate filter per Section 6.2.

7.1.7. Absorption Bench Assembly Breakdown

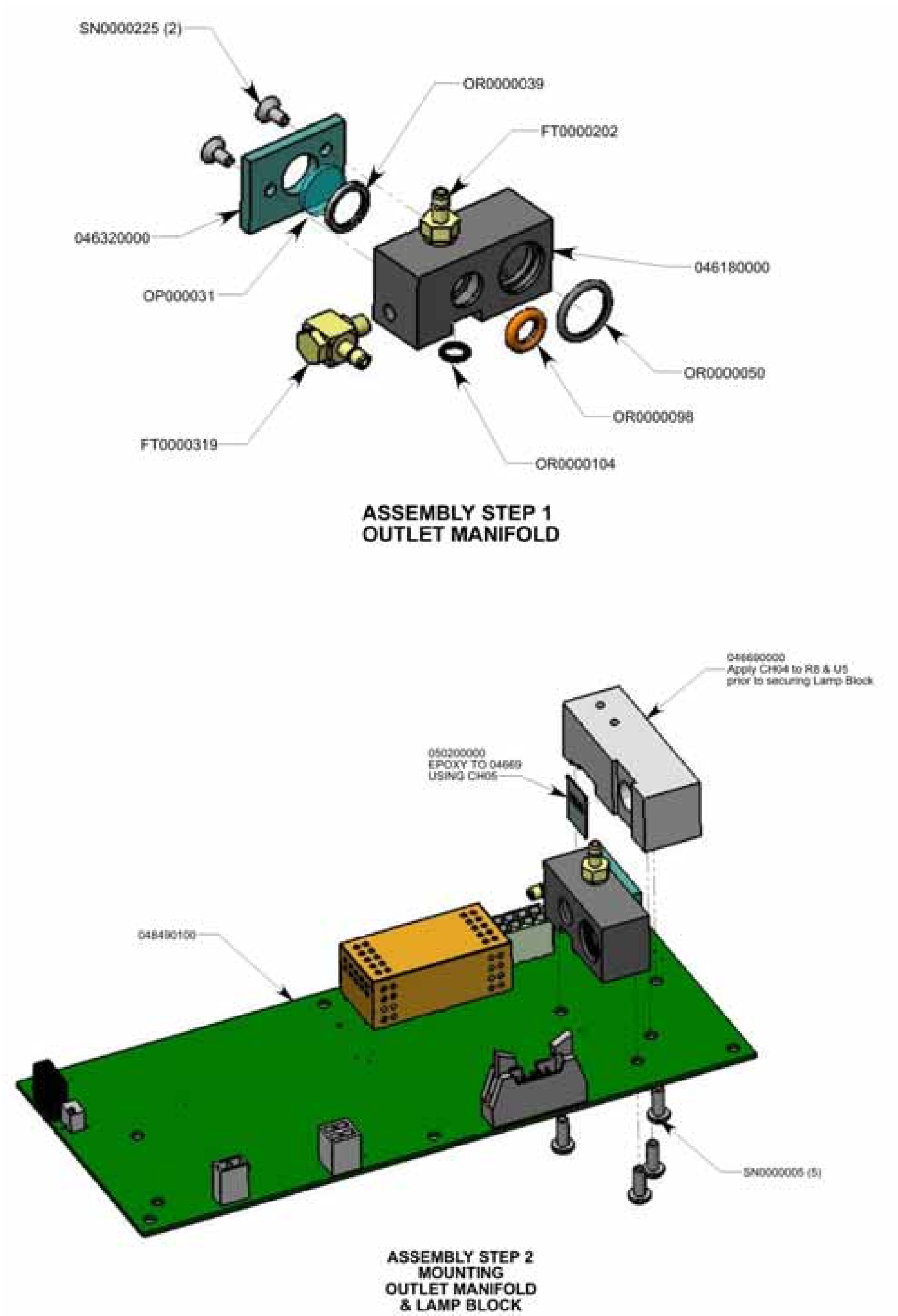
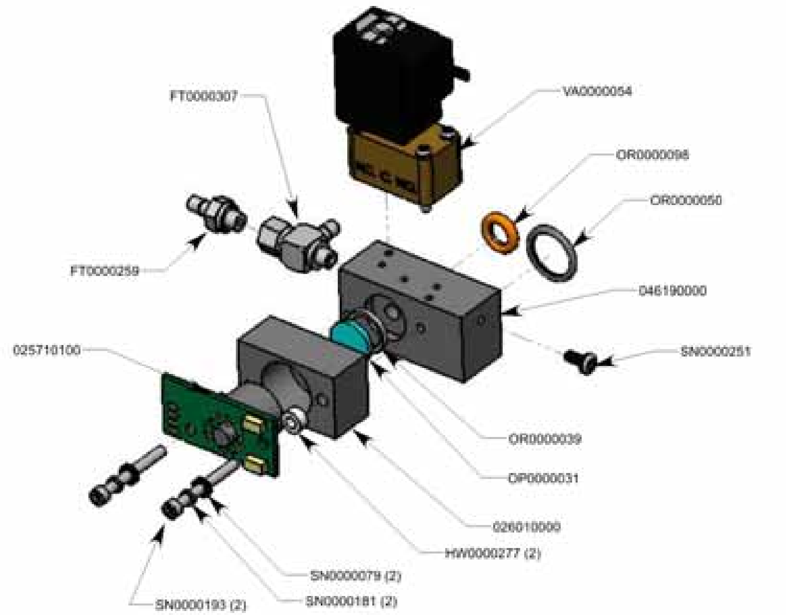
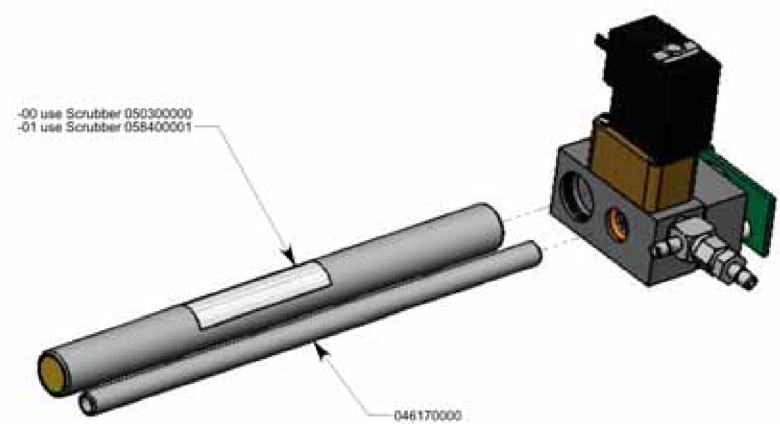


Figure 7-3

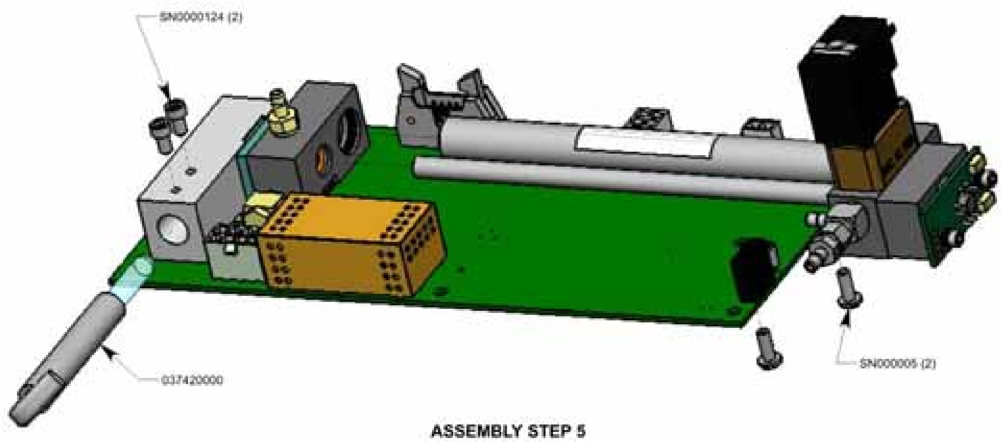


ASSEMBLY STEP 3
INLET MANIFOLD



ASSEMBLY STEP 4

Figure 7-4


SN0000124 (2)
037420000
SN000005 (2)
ASSEMBLY STEP 5

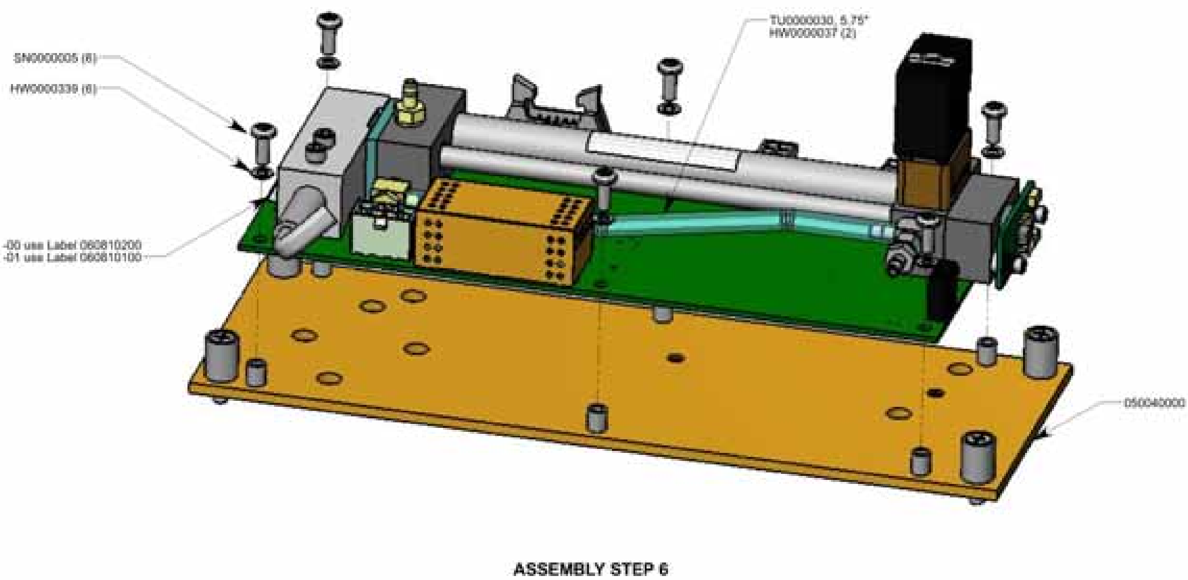

SN0000005 (6)
HW0000339 (6)
TU0000030, 5.75"
HW0000037 (2)
-00 use Label 060810200
-01 use Label 060810100
050040000
ASSEMBLY STEP 6

Figure 7-5

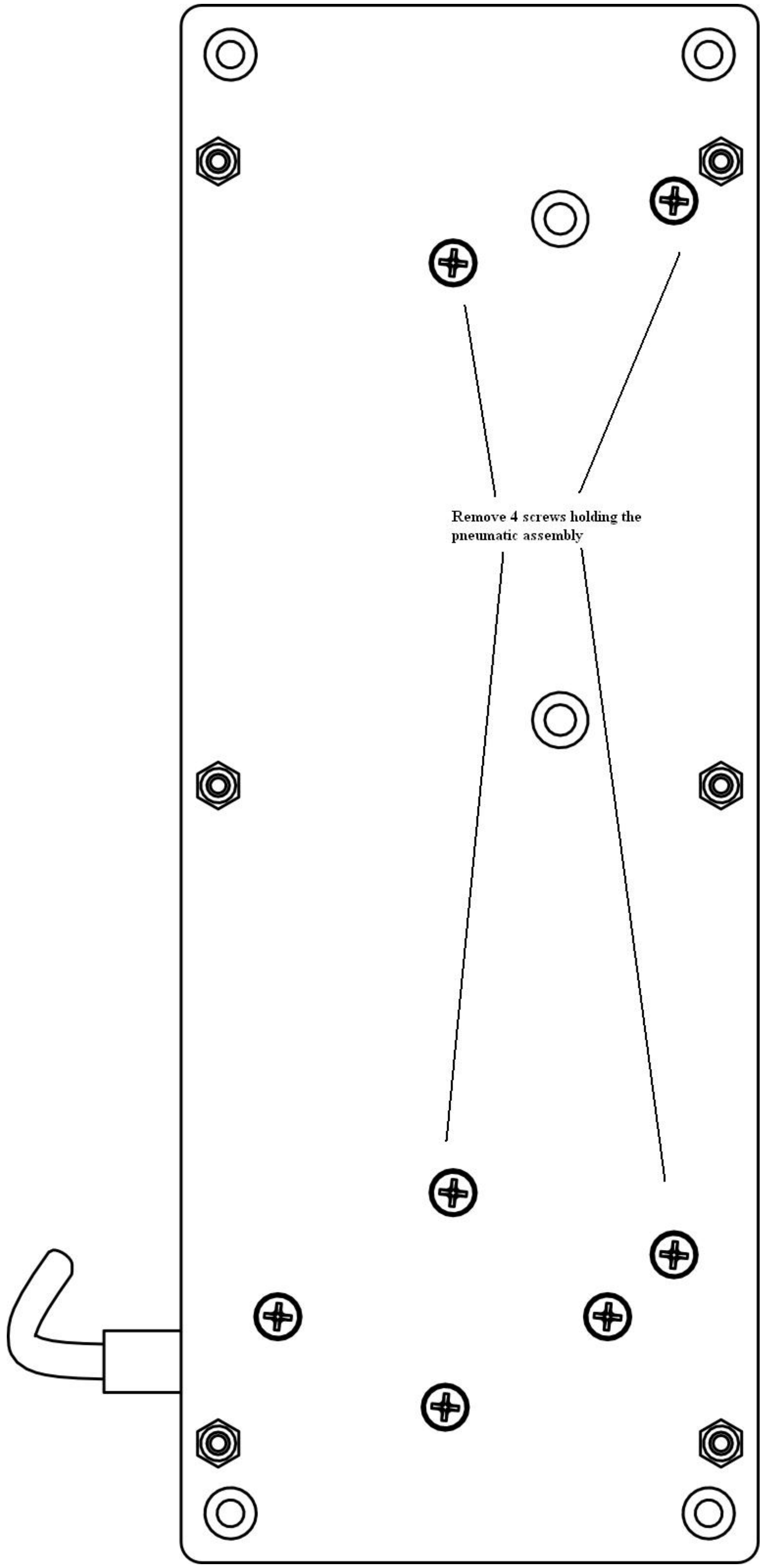


Figure 7-6
Bench base plate rear view

8. SPECIFICATIONS

Specifications

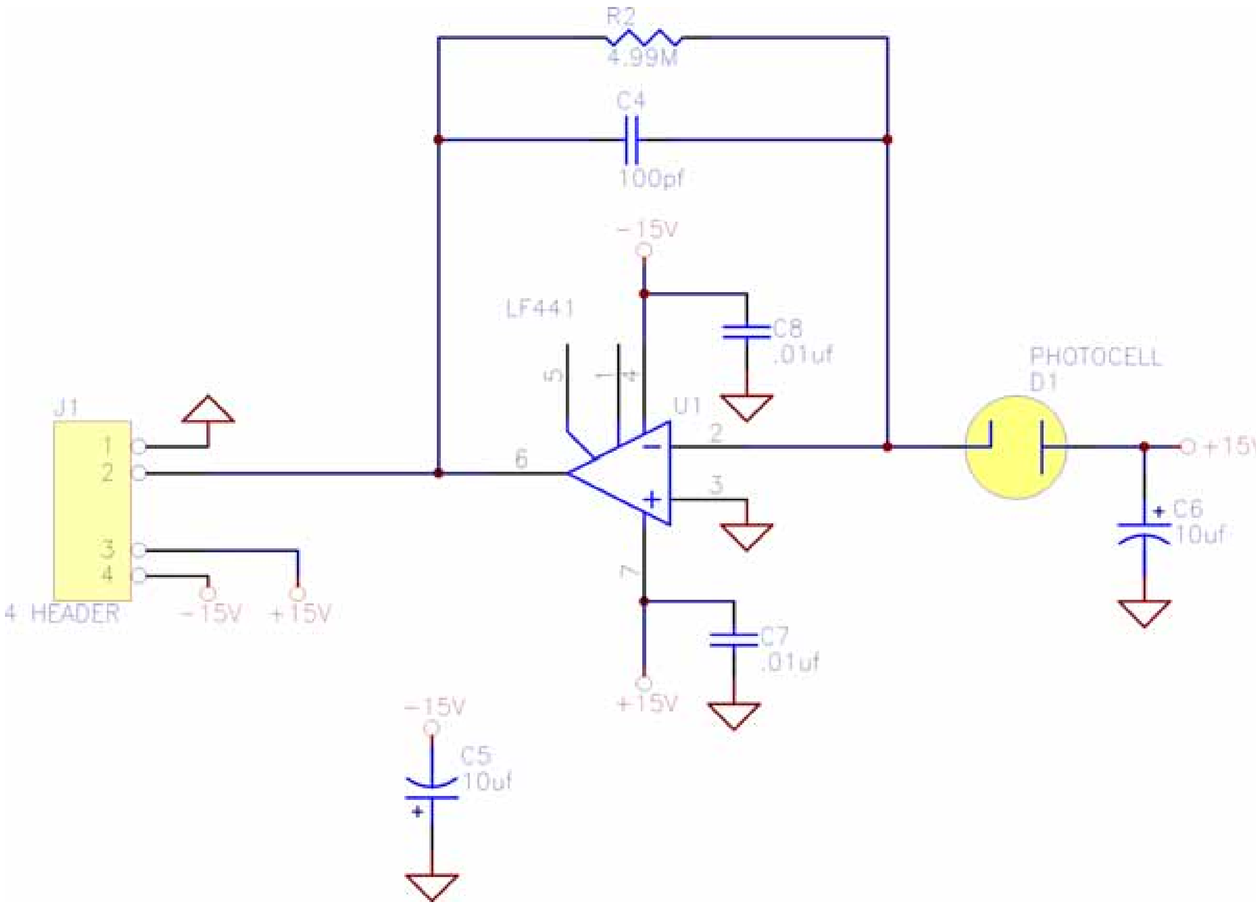
Analog Output Ranges	User selectable to any full scale range from: 1 PPM to 500 PPM 1000 PPB to 10,000 PPB 2000 µg/m^3 to 10,000 µg/m^3 100 PPHM to 10,000 PPHM (optional configuration)
Display Range Limits (limited to the 4 digit display)	1 PPM to 500 PPM 1000 PPB to 9999 PPB 2000 ug/m^3 to 9999 ug/m^3 100 PPHM to 999 PPHM (optional configuration)
Measurement Units	PPM, PPB, µg/m^3, PPHM (optional configuration)
Zero Noise	< .0015 PPM (rms)
Span Noise	< .5% of reading (rms) (above 0.1 PPM)
Lower Detectable Limit	< .003 PPM (rms)
Accuracy	+/- 1% of full scale range
Response Time (95%)	<30 sec
Sample Flow Rate	0.8 L/min
Temperature Range	5-45^{o} C
Humidity Range	10-90% RH, Non-Condensing
Dimensions (H x W x D)	5.22” x 19.0" x 15.3" (133 mm x 483 mm x 388 mm) – Rack Mount Version 16.01” x 15.6” x 6.90” (407mm x 396mm x 175mm) – NEMA 4X Version
Weight	12.6 lb. (5.73 kg) - Rack Mount Version 15.2 lb. (6.91 kg) – NEMA 4X Version
Power	100-240 V~, 50/60 Hz, 74W max
Environmental Conditions	Installation Category (Overvoltage Category) II Pollution Degree 2
Maximum Operating Altitude	2000 meters
Analog Output, Voltage Mode	0 - 5V

Isolated Analog Output, 4-20mA Mode	Maximum voltage between outputs and ground 60V peak
System OK Status Relay	SPDT (Form C) Dry Contact, 250 VAC, 5A
Global Alarm Relays	SPDT (Form C) Dry Contact, 250 VAC, 5A (x2, HI and HI-HI)
Instrument Status Outputs	6 - SPST Dry Contact, 50VDC, 250mA Resistive Load

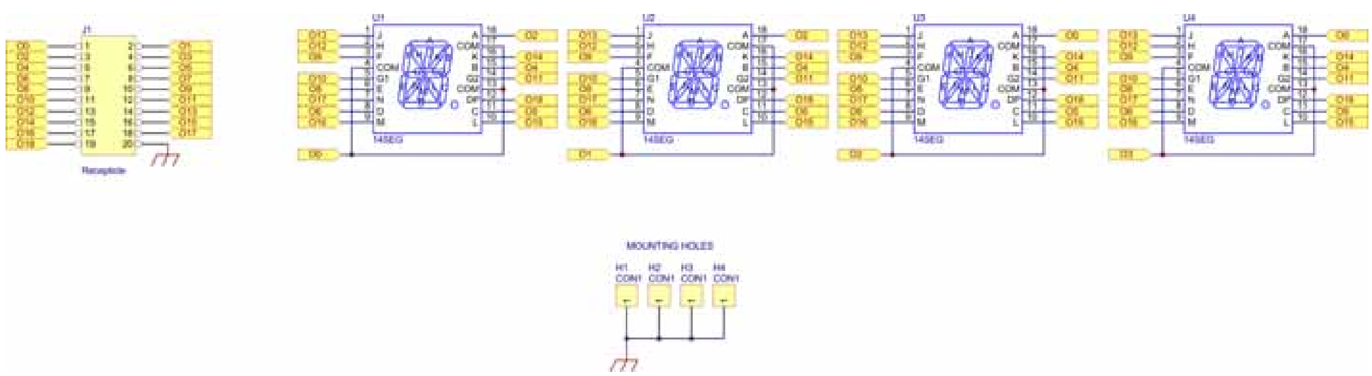
Multi-Stream Specifications:

Minimum Stream Duration (Cycle Time)	1.0 min
Stream Alarm Relays (HI and HI-HI)	SPST Dry Contact, 50VDC, 250mA Resistive Load (2 per stream)
Stream ID Relays	SPST Dry Contact, 50VDC, 250mA Resistive Load (1 per stream)

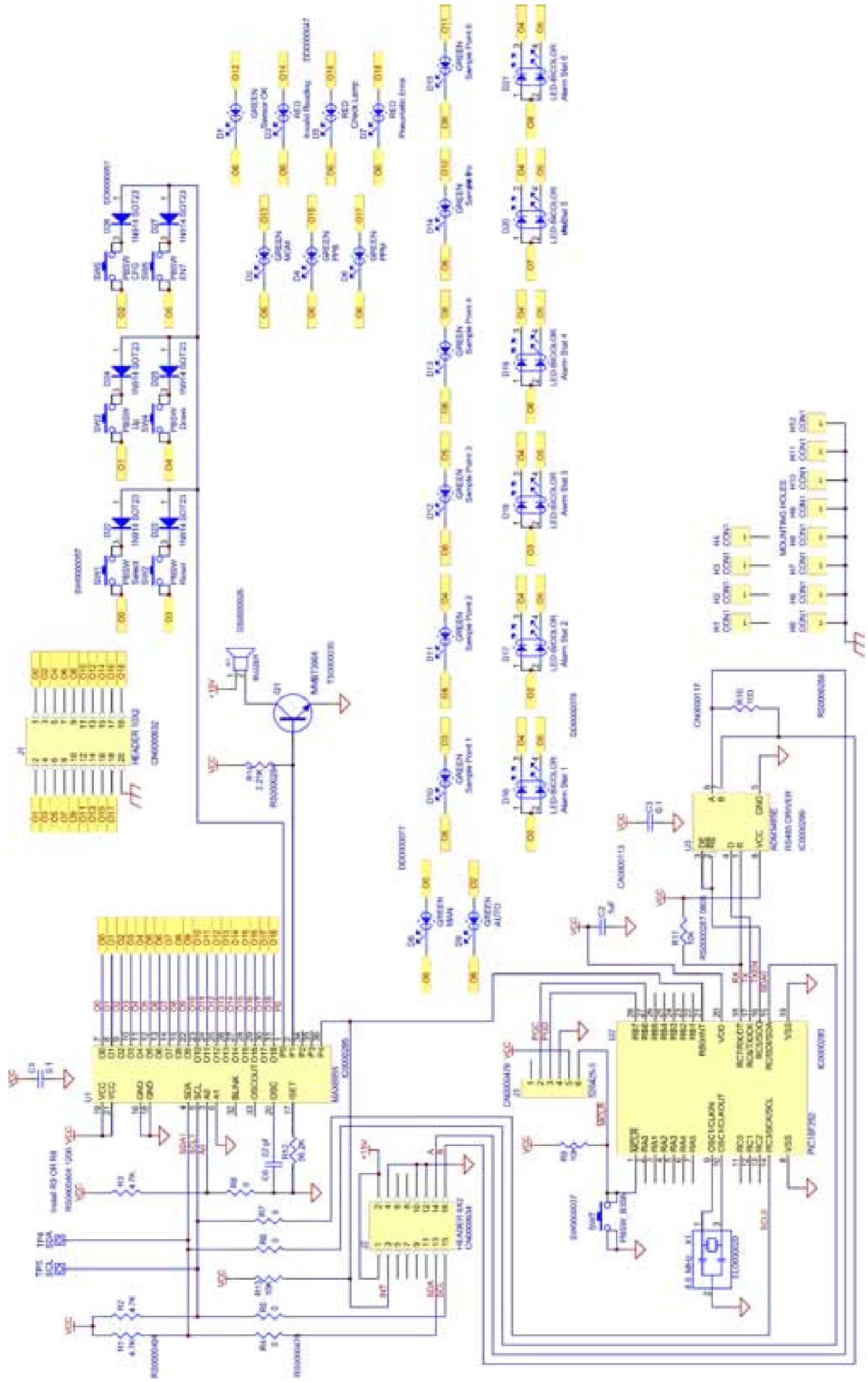
9. SCHEMATICS



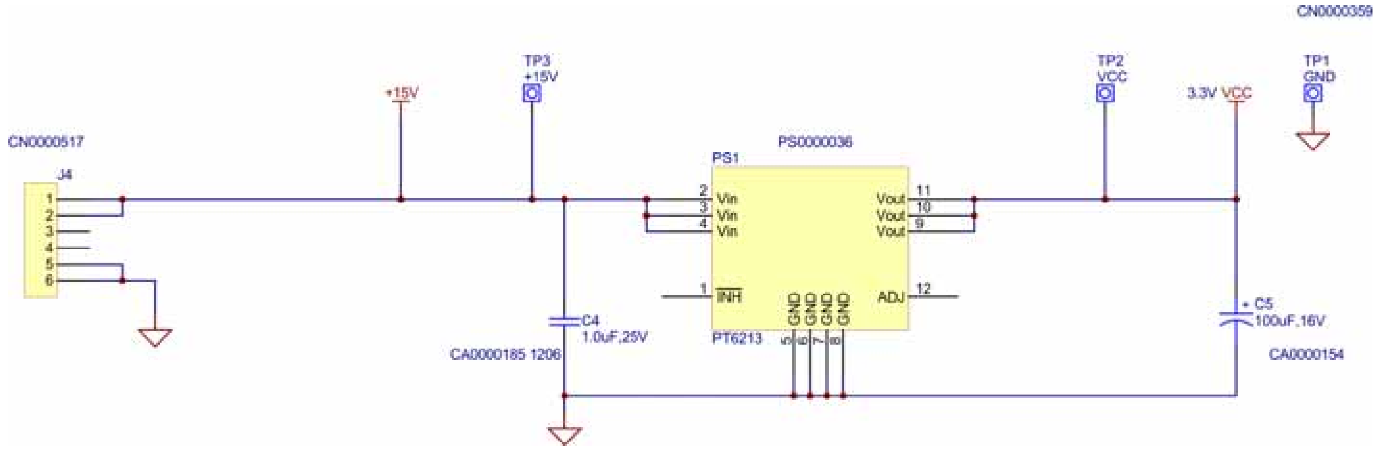
UV Preamp Schematic



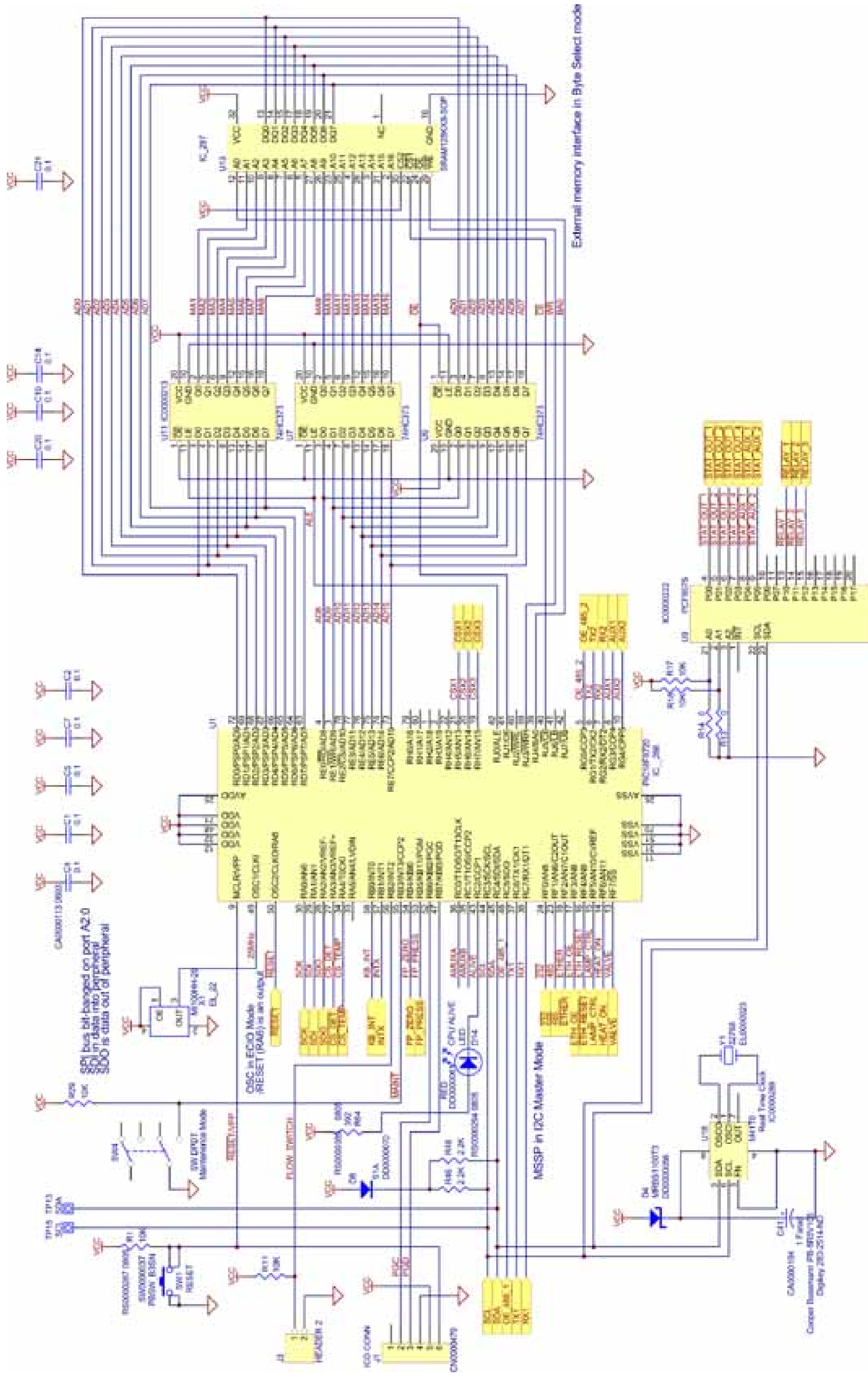
Display Schematic



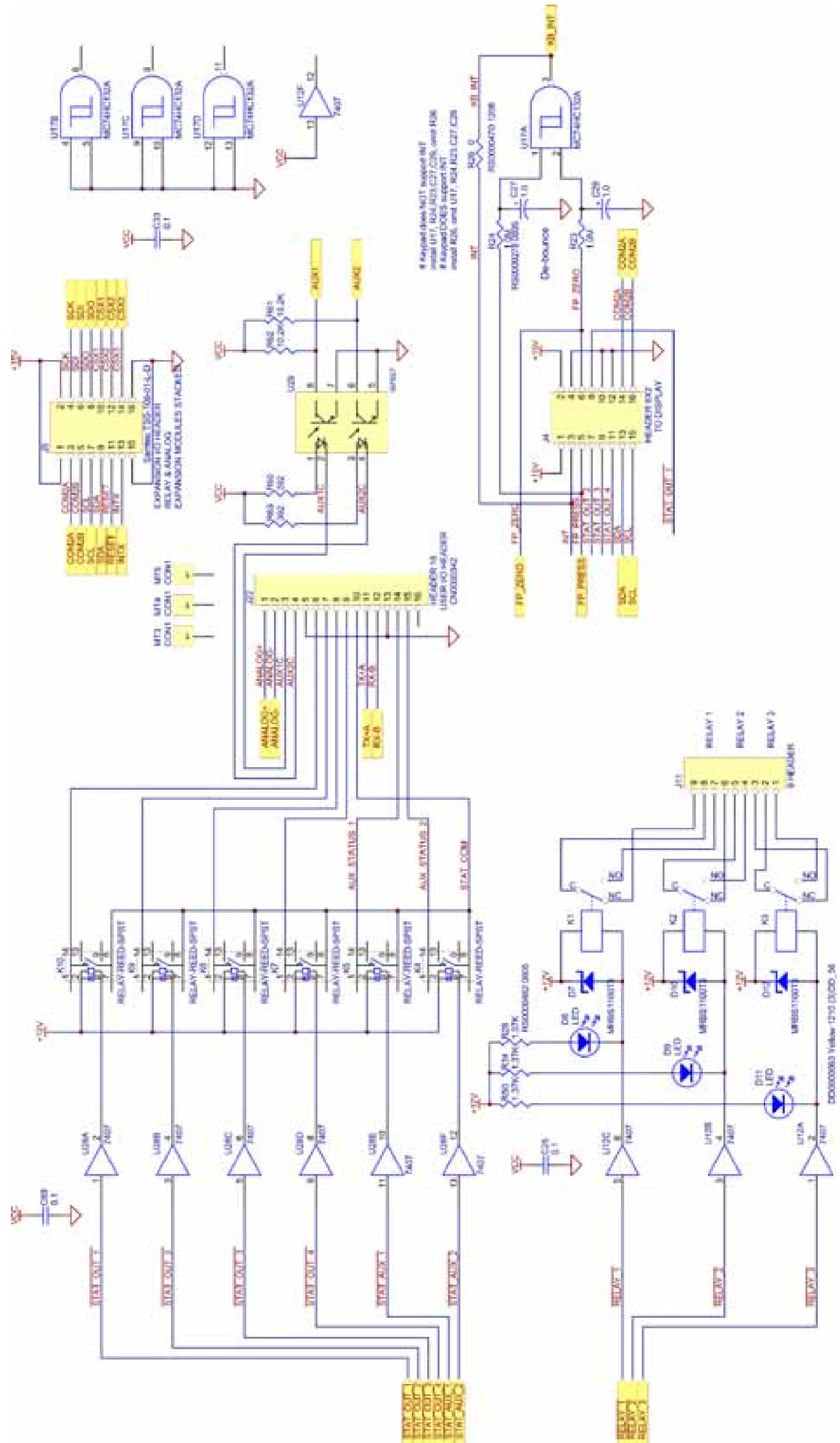
Front Panel 1 of 2



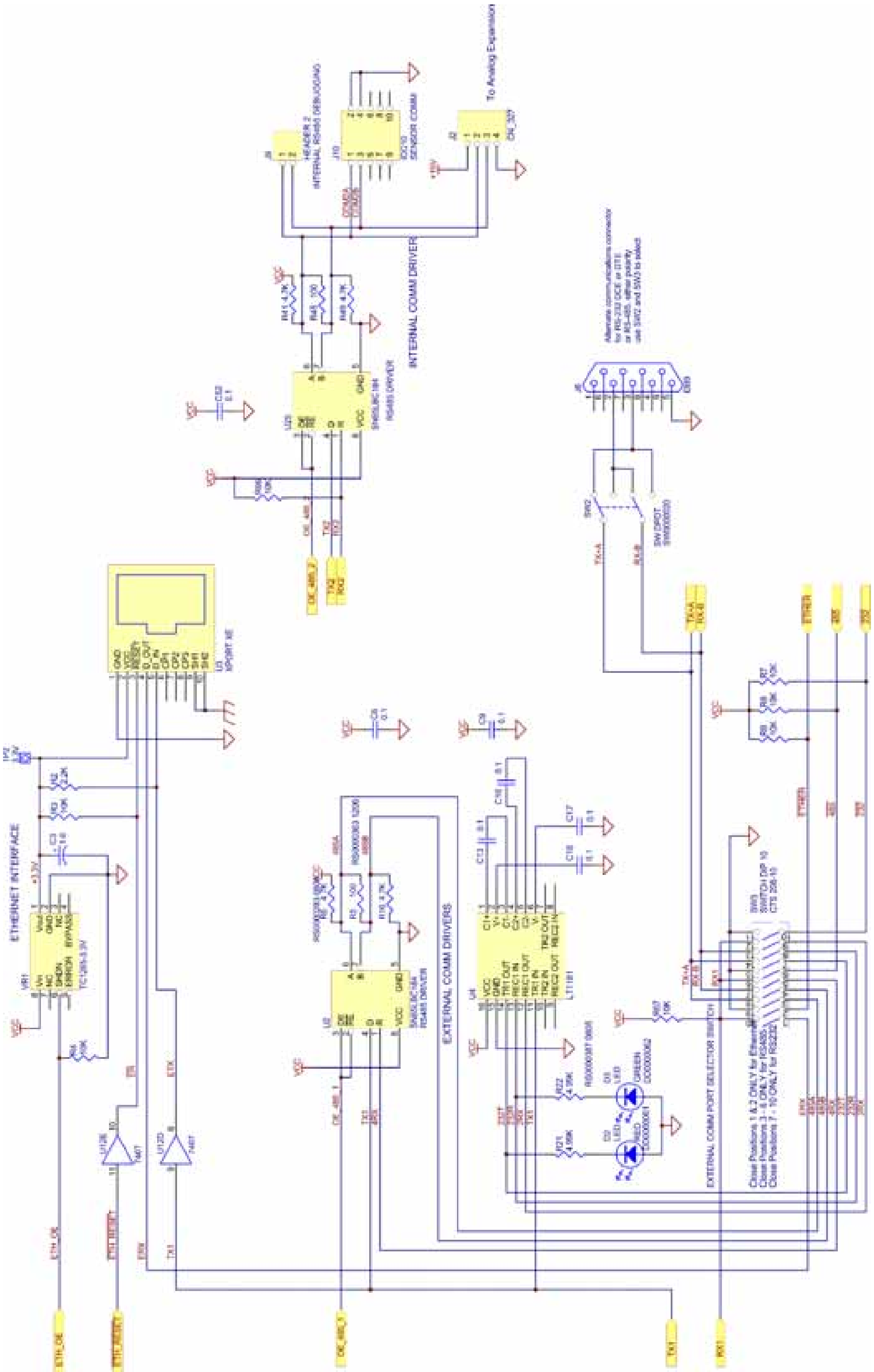
Front Panel 2 of 2



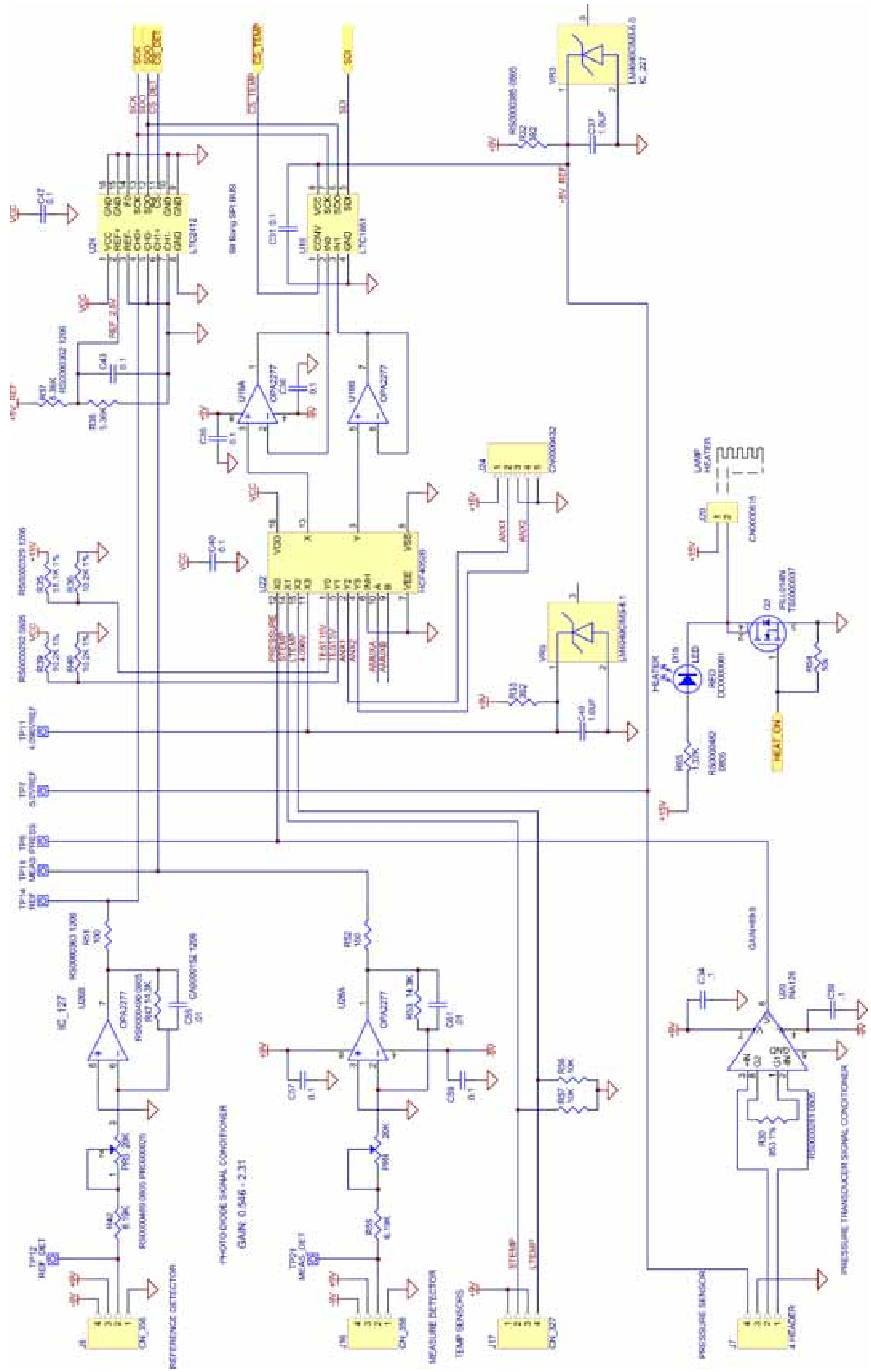
Main Board 1 of 6



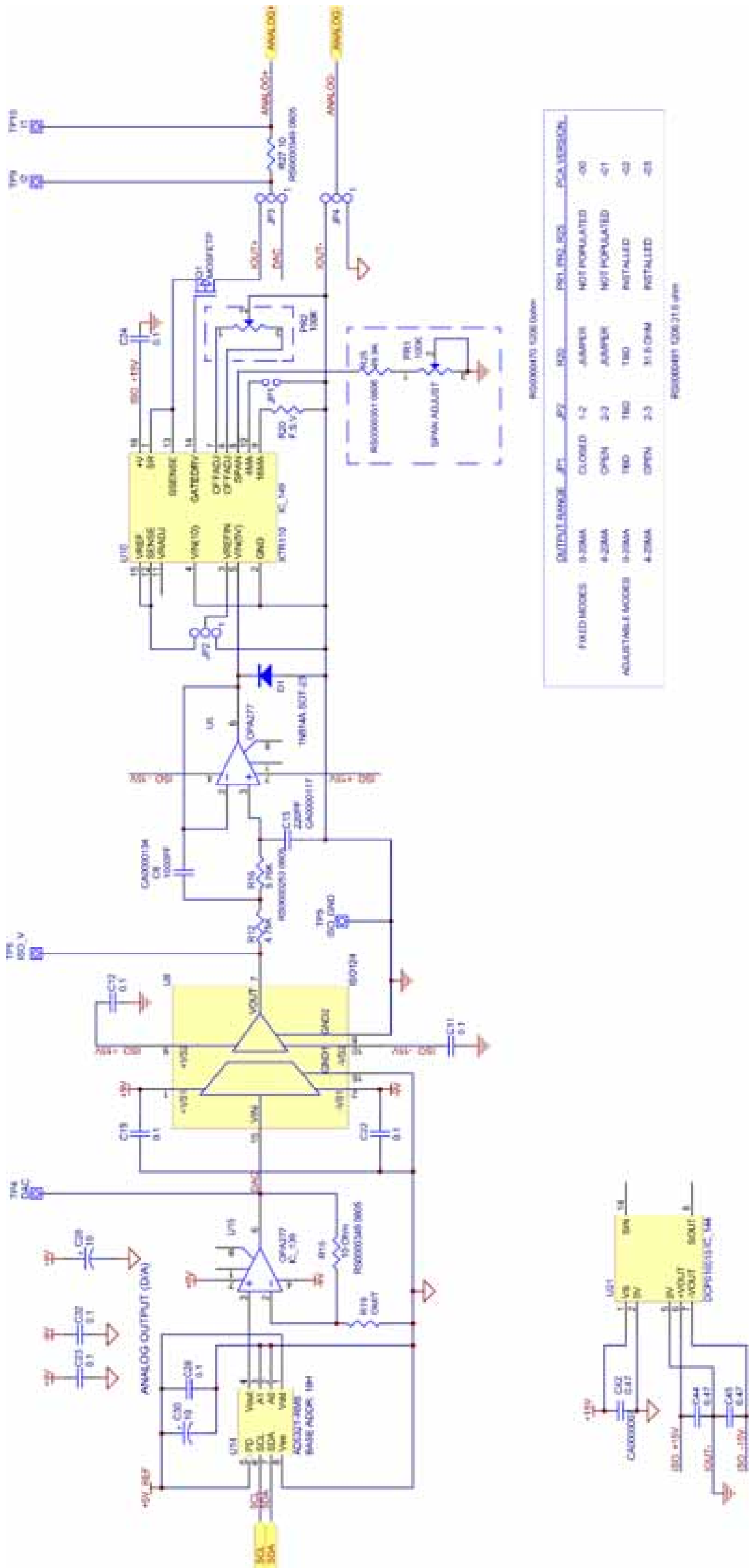
Main Board 2 of 6



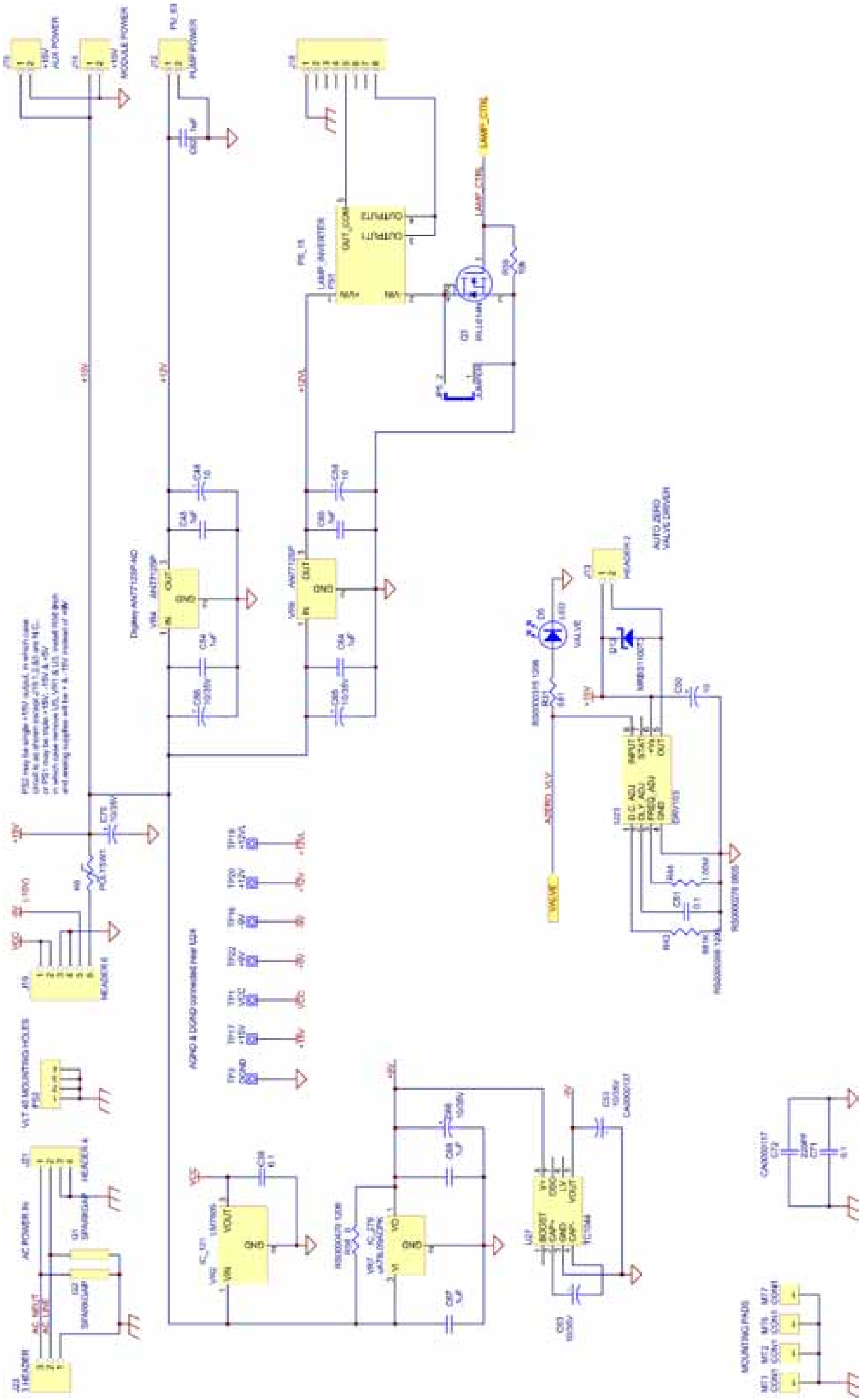
Main Board 3 of 6



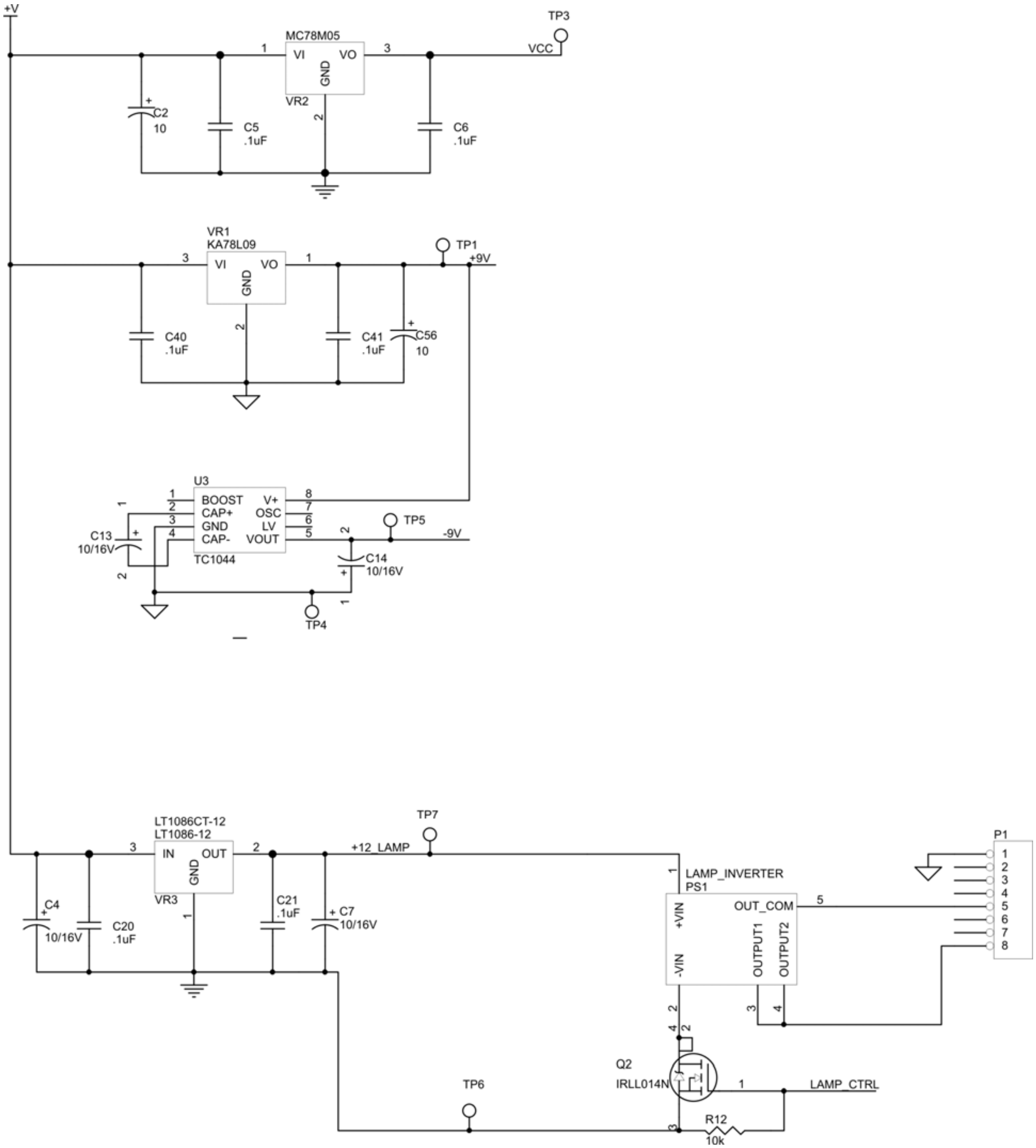
Main Board 4 of 6



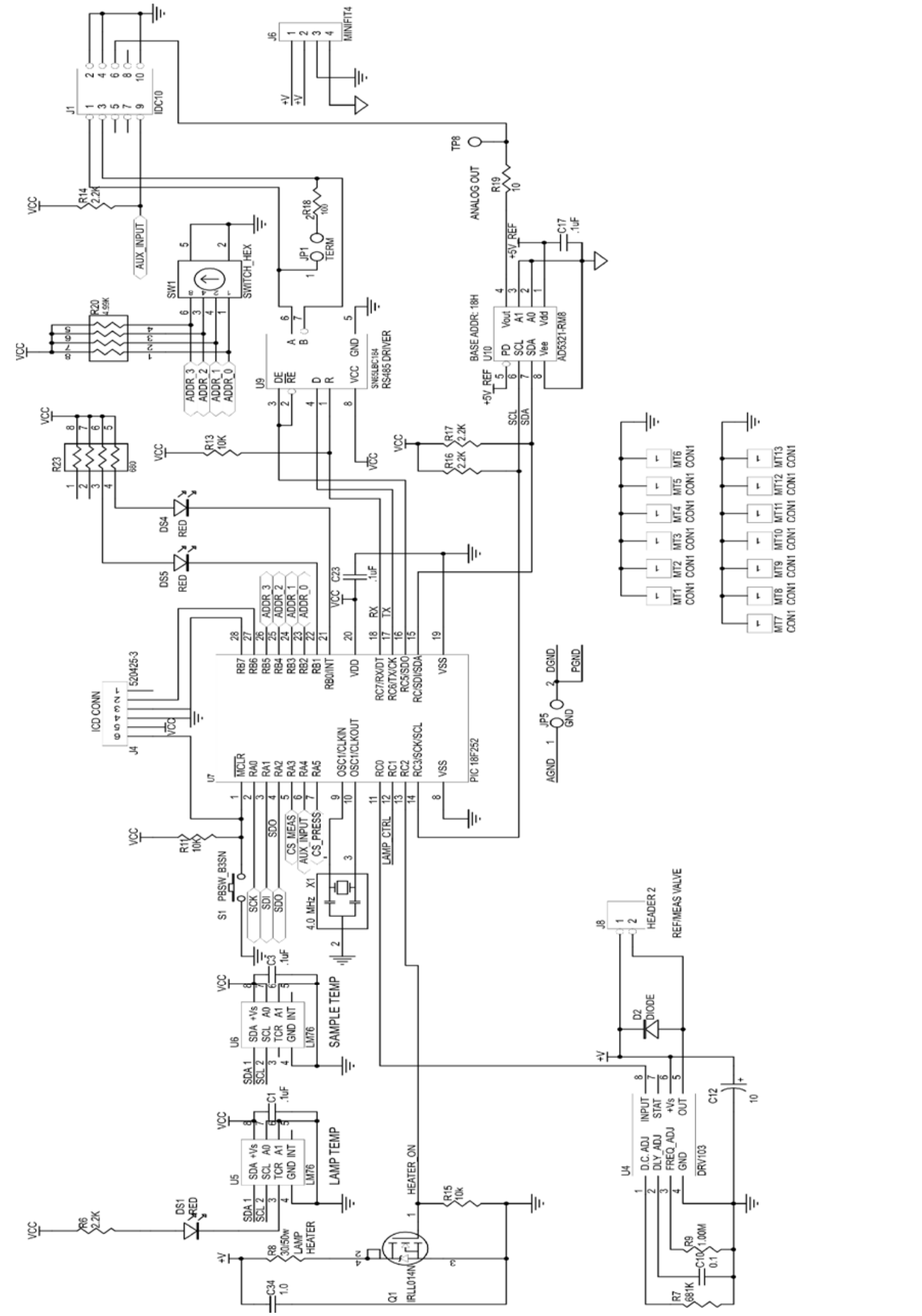
Main Board 5 of 6



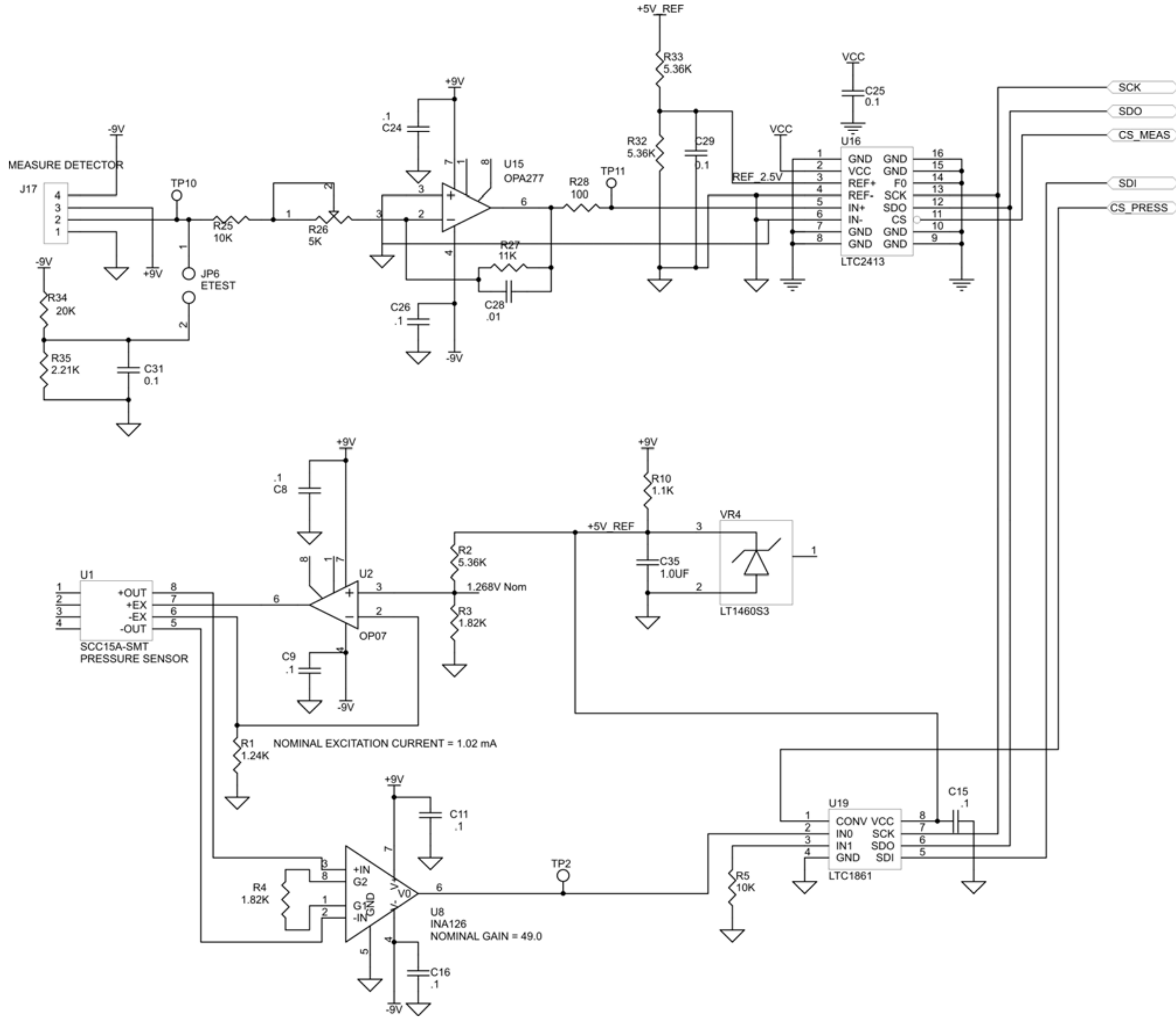
Main Board 6 of 6



Absorption Bench 1 of 3



Absorption Bench 2 of 3



Absorption Bench 3 of 3

10. SERVICE NOTES

M465L Modbus Communication Setup

I. **PURPOSE:**
This document will go through how to setup your computer with "ModBus Reader" and use it to communicate to the M465L. It will also go through how to use it for data logging purposes.

II. **TOOLS:**
ModBus Reader with M465L Configuration files (Available on the Website under "software")
RS232 serial Cable

III. **PARTS:**
None

The electronics used in T-API analyzers are sensitive to Electrostatic Discharge (ESD). When working on any T-API device, please ensure that you are properly grounded prior to handling or touching any electronic circuitry in the analyzers! For more information on how to protect sensitive components from ESD during handling, please contact T-API customer service and ask for the ESD Service note number 03-022A.

IV. **PROCEDURE:**

1. "ModBus Reader" is a FREEWARE product of KurySoft. The FREEWARE is available at http://www.kurysoft.com/download.shtml or our website at, http://www.teledyne-api.com/software/. Please download "ModBus Reader" form one of these websites.
2. Please go to our website and download the **M465L configuration files**. If you choose to download ModBus Reader from our website, you should visit the Kurysoft website to review the "END-USER LICENSE AGREEMENT"
3. Connect a 9 pin serial cable from the RS232/485 port on the back of the analyzer to your computers serial port. Remove the cover of the analyzer and on the circuit board close to the location of the RS232 port you should see two LEDs. They are labeled D2 (red) and D3 (green). Both of these LEDs should be on. If they are not, switch the DCE/DTE switch on the back of the analyzer to the other position. Both lights should now be on, if they are not, check your cable connections again.
4. Unzip the "ModBus Reader" file and copy the .EXE file to your desktop. Double-click on the icon to begin the installation process. When you get to the Associated Extensions screen, you will want to check both the .mbc and .mbs boxes.
5. Unzip the M465L Configuration files and place both files in the same directory that ModBus Reader was installed into. The default for this is C:\Program Files\ModbusConstructor.
6. After the installation has been completed, launch ModBus Reader.
7. Go to FILE, OPEN, and open the file "M465L.mbs".

8. Go to Connection and then COM Parameters and make sure that all of the settings are as follows

Port:	COM1	(The serial port on your computer, most use COM1)
Baud rate:	57600	
Parity:	None	
Stop Bits:	1 stop bit	

9. Once these settings are correct, click OK. Go to Mode and select Master Settings. Make sure the "Slave Address" is the same as the address on your M465L. The default for this value is "1". To confirm the address on your analyzer follow the directions below.
   a. At the instrument: Press Config
   b. Press the Down Arrow 3 times
   c. CONFIG will show on the display, Press Enter
   d. Press the Down Arrow 1 time
   e. ADDRESS will show on the display, Press Enter
   f. The display will show COMM ADDRESS = (number)
   g. Record the number, this is your analyzers Slave address
   h. Press Config 3 times to return to the concentration display
10. Once the address has been entered into the Slave address, press OK. Go to Connection and make sure that COM1, or which ever com port you selected, has a check mark next to it. If it doesn't, select COM1.
11. Go to Connection and then to Connect. The boxes in interface screen should now be updating with numbers.

DATA LOGGING

12. In the ModBus Reader program go to Tools and then Data Logging Setup. Make sure that the following settings are correct.
    - **Write to common file (by session)** is selected
    - **Write on every response** is checked
    - **Open new file on connection** is selected
    - **Save file every, minutes** is checked
    - **Absolute time** is selected
13. Once these values are selected press OK. Go to Tools and then select Start Data Log. The ModBus Reader will now start to save all of the values that are seen on the screen. This file is saved in the same directory as the one that the ModBus Reader was installed into. You can open this file in Excel or other program. The file is "TAB" delimited.

NOTE: If you wish to create your own user interface screen to communicate to the analyzer you can go to the website http://www.kurysoft.com. This has the ModBus Constructor program which has a free trial period but must be purchased after a trial period. This program can be used to create interfaces similar to the M465L interface.