# Model CM2 *Plus* MicroLyzer™

# Instrument Manual


QT02260 Rev A

# USER ASSISTANCE

If your Model CM2 Plus does not perform as stated in this manual, please contact our Customer Service Department. Please reference this device as the **Model CM2 Plus MicroLyzer** and have the Serial Number from the Serial Number/Rating Plate located on the rear panel of the instrument ready for faster service.

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**Operators of the MicroLyzer CM2 Plus should be familiar with the procedures outlined in the operating and maintenance sections of this instrument manual.**

**The servicing sections of this instrument manual are intended to aid the qualified technician with electrical repairs.**

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## INTRODUCTION

The QuinTron Model CM2 *Plus* MicroLyzer™ is a special gas chromatograph that has been designed to measure trace concentrations (0-100 parts per million) of hydrogen in expired (alveolar) air samples in the presence of trace amounts of other biologically-produced reducing gases. “Reducing gases” are those which can be burned, or oxidized, like alcohols, acetone, ketone, carbon monoxide, etc. The chromatographic system detects $H_2$ in the presence of other gases which might interfere with its measurement.

## DESCRIPTION OF CONTROLS


*Figure 1. Front Panel of the Model CM2 Plus MicroLyzer*

## FRONT PANEL COMPONENTS

① The **SAMPLE VALVE** is on the operator’s right side of the instrument. When it is pulled OUT, the sample can be loaded through the sample flush port immediately below it. When pressed IN, the sample is introduced into the carrier-gas stream and sent to the sensor for analysis.

② Samples may be injected into the **SAMPLE FLUSH PORT** only when the **SAMPLE VALVE** is out. Patient samples sholud always be dried using the SivRite-10 Cartridge.

③ The **ZERO CONTROL** is used to adjust the meter reading to 000. It should only be adjusted when the valve stem is pulled out (Led is GREEN).

④ The **OFFSET ADJUST SCREW** and the ⑤ **OFFSET CHECK** button are used together to set the proper signal strength going to the sensor. The **OFFSET** needs to be checked and adjusted daily when the instrument is put into operation to be sure the system is adequately warmed up so the sensor is stable in its response sensitivity.

⑥ The **CALIBRATE (CAL) CONTROL** is used to set the sensitivity of the system when a calibrating gas is analyzed. It should only be adjusted when the valve stem is IN (LED is RED).

⑦ The **POWER/PUMP SWITCH** is on the operator's left side of the instrument. It is a two position switch:

**ON** (Up) Normal operation with the pump ON and circulating air through the system.
**OFF \ STANDBY** (Down) The pump is off with sensor and other electronics kept stable.

⑧ The **LIGHT-EMITTING DIODE** (LED) is located below the panel meter. When the valve stem is out the LED is GREEN indicating "GO FOR SAMPLE". When the valve stem is pushed in, the LED changes to RED indicating "STOP THIS IS AN ANALYZED SAMPLE".

⑨ The **PANEL METER** is located in the upper left portion of the panel. It is used to read the $H_2$ concentration in ppm. It is also displays the OFFSET when the OFFSET CHECK button is pushed.


*Figure 2. Rear Panel of the CM2 Plus MicroLyzer*

## REAR PANEL COMPONENTS

① The **NO-PRESSURE DRYING TUBE** is a large tube attached to the back of the instrument. It is filled with SivRite-3™ , a conditioning material which filters and helps to purify the room air used to carry the gas sample through the instrument. SivRite-3™ has an indicating desiccant added to it that is blue when active and must be changed with new material when 2/3 of the material has changed color to pink. Both ends of the ColumPak™ fiber should be replaced with every refill. The ColumPak™ fiber helps filter dust particles from entering the pump and valve components.

② The **POWER SWITCH**, **POWER RECEPTACLE,** and ③ **FUSE PANEL** are located on the right as you face the back of the instrument. The proper power supply cable and only fuses of the proper amperage should be used with the instrument, as indicated on the ④ **SERIAL NUMBER PLATE** in the center of the back panel.

⑤ The **AIR IN** port is attached to the No-Pressure Drying Tube.

⑥ The **LINEARIZING SWITCH**, a thumb-wheel switch used to adjust the linearity of the output of the sensor if necessary. It was set at the factory, and will not require readjustment unless the operating conditions or component characteristics have changed enough to require “re-linearization”.

## INSTALLATION AND SETUP

Follow the instructions for installing the MicroLyzer CAREFULLY AND PRECISELY. This is necessary to insure proper and satisfactory operation of the instrument. Any instrument with the sensitivity required to measure parts per million in a sample of alveolar air will be equally sensitive to other conditions that can affect the measuring device. It cannot be overemphasized that this system is a delicate and sensitive instrument, and that it must be handled as such.

1. Carefully unpack the MicroLyzer and determine by observation if any damage has occurred as a result of shipment. If damage is found, an immediate report should be made to the shipping agency and to QuinTron or its distributor. The accessory package provided with the instrument includes syringes, stopcocks, ColumPak fiber, SivRite-10 Starter Kit that includes the SivRite-10 Cartridge, SivRite-3, instrument documentation, and a screwdriver.

2. Following inspection attach the power cord to the instrument and plug the system into a grounded power outlet of the appropriate AC voltage. The Serial Number Plate lists the Voltage (VAC) and Line Frequency (Hz). Pull the VALVE stem to its OUT position. Turn the rear panel power switch ON. The Status LED and Meter will indicate power is present. If the equipment fails to operate, be sure there is power at the outlet, then check all connections, cables and fuses.

4. Flip the front panel PUMP/POWER switch up to ON and allow the unit to WARM-UP OVERNIGHT.

5. After warm up, press and hold the CHECK button in and use the supplied screwdriver to turn the ADJUST screw until the meter reads 035 (±2).

6. Verify the LED is GREEN by pulling the Sample Valve out. Adjust the ZERO control until the panel meter indicates "000". If the meter does not change when the zero control is turned make sure that the calibrate control is NOT turned fully one way or the other (i.e. not "pinned").

## CALIBRATION

The instrument must be calibrated before unknown samples can be analyzed accurately. Do not calibrate the instrument unless the OFFSET reading is stable at a constant value of 035 (±2). The reference gas must be of a known concentration of $H_2$ in AIR. Some calibrating gases, made for use with other gas chromatographs, are mixture of $H_2$ and nitrogen, but a $H_2/N_2$ mixture is NOT suitable for calibrating MicroLyzers. The solid-state $H_2$ sensor requires that $O_2$ be present for the sensor to respond properly. For this reason, we recommend QuinGas-1™, which is prepared with $H_2$ in air. Each tank of QuinGas-1 is individually calibrated using a primary Standard which is traceable to the National Bureau of Standards.

**Calibrate the MicroLyzer as follows:**

1. Be sure the VALVE stem is pulled out (LED is GREEN). Verify that the OFFSET is set to 035 (±2). Use the ZERO control to readjust the meter to 000.

2. Attach the brass needle valve regulator to the top of the QuinGas-1 cylinder. Fit a 35 ml syringe with a one-way stopcock to the Luer fitting on the top of the gas regulator and VERY slowly turn the valve counter-clockwise. The plunger will begin to rise. When there is at least 20 ml of gas in the syringe, gently turn the clockwise to stop the flow of gas and close the stopcock. Do not over-tighten the valve or the soft brass needle valve will be damaged and it will leak. It is recommended that a small plastic syringe be stored in the Luer fitting on the cylinder to detect incomplete valve closure if it occurs. Remove the valve from the gas tank when not in use.

3. Attach the loaded syringe to the FLUSH port of the instrument, open the stopcock and carefully inject the gas. Push the VALVE stem in. Remove the syringe from the instrument. The LED will change to red, indicating that an analysis is in progress. After about 30 seconds the meter reading will begin to climb and hold a value. After the meter value has stopped climbing use the CAL knob to adjust the meter value to match the QuinGas-1 value.

4. When the VALVE stem is pulled out, the LED reverts back to green. Wait for the meter to return to "000" before injecting another sample. If "000" has not returned after about 2 minutes, verify that the offset has returned to 035 (±2). If the offset is readjusted reset the "000", inject another 20 ml sample of QuinGas-1 and check the calibration. Repeat the calibration process to insure reproducibility to within ± 2 - 3 ppm. Check the calibration periodically during the day. Experience with the instrument will teach you how often this is necessary.

## ANALYZING PATIENT SAMPLES

After the calibration is complete, alveolar air samples collected from the patient can now be analyzed. Patient samples are saturated with water vapor and must be dried to prevent damage to the chromatographic separating column. To dry the sample as it is flushed into the instrument, insert the male end of the SIVRITE-10 CARTRIDGE into the SAMPLE port and connect the sample-syringe to the other end. Flush at least 20ml of the patient's sample through the drying tube. Failure to use the SivRite-10 Cartridge can result in damage to the chromatographic separating column.

Push the VALVE stem in. The LED will turn from green to red. As with the calibration gas, the meter will begin to respond within about 30 seconds. When it has reached its peak and remains stable, record the value displayed on the meter. After recording the $H_2$ concentration, pull the VALVE stem out. The LED will change to green and erase the previous sample value. When the meter reading returns to "000", the instrument is ready for another sample or a calibration check.

If the red LED flashes when the peak value is reached the internal amplifiers can not reliably display the high $H_2$ concentration. You can dilute the sample with room air (fill the syringe halfway with the patient sample and the rest of the way with room air).

## SYSTEM SHUTDOWN AND STANDBY

After an analysis session is completed and no more samples are to be analyzed for the day, the instrument can be put into the STANDBY by flipping the switch on the front panel of the instrument down. This turns off the pump but leaves the electrical circuit on, thereby reducing the warm-up time required the next time the instrument is to be used. Do not consider the STANDBY position as a "waiting" position between samples.

## RECOMMENDED DAILY PROCEDURE

When the instrument is to be used on a daily basis, the following procedures should be followed:

1. The No-Pressure Drying Tube and the SivRite-10 Cartridge should be inspected each day, and desiccants should be changed if required.

2. Check and adjust the offset voltage to 035 (±2).

3. Zero and calibrate the instrument using QuinGas-1 reference gas before each analytical session and as often during the analytical session as experience demonstrates is necessary. Run patient samples.

4. When testing is completed, and no more samples are to be analyzed for the day, the instrument can be put into the STANDBY position. Leave it on STANDBY even if the MicroLyzer will not be used for several days, this helps to keep the sensor conditioned.

## OPERATORS MAINTENANCE SECTION

The maintenance requirements for the Model CM2 *Plus* MicroLyzer are minimal, but is very important that they be followed carefully. Three drying tubes require inspection and/or maintenance each time the instrument is turned on.

### SivRite-3 No-Pressure Drying Tube

**Please reference Figure3.** The SivRite-3 in the conditioning column should be replaced when 2-3 inches of blue material remains at the right end (outlet) of the column. To change the SivRite-3, remove the column from the clips on the back panel. Twist and pull the outlet end piece (1) from the tube (2). Remove the ColumPak fiber (3) and empty the discharged SivRite-3 (4). Fill the column with fresh material. Make sure it is tamped tightly. This insures that settling will not occur resulting in air streaming along the top instead of being pulled through SivRite-3 in the column. Replace the ColumPak fiber wad and the acrylic end. Twist, pull, and remove the other end piece. Replace the ColumPak wad and the acrylic end.The column is now ready for use.

Note: Replacing the ColumPak fiber material prevents SivRite-3 dust from entering into the instrument and damaging the internal pump and sample valve.

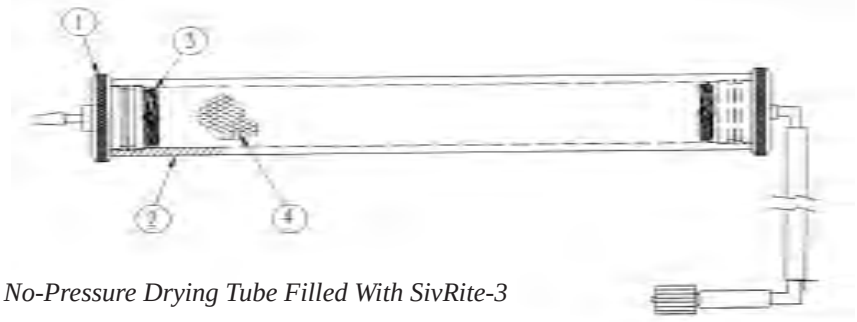


*Figure 3. No-Pressure Drying Tube Filled With SivRite-3*

### SivRite-10 Cartridge

**Please reference Figure 4 & top**. Replace the desiccant when there is ½ to ¾ inches of blue material remaining in the SivRite-10 Sample Drying Tube. It should be refilled with SivRite-10 ONLY. The blue indicator granules will change to pink as the material becomes exhausted.

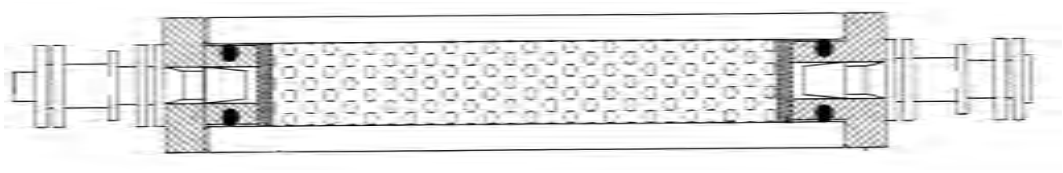

*Figure 4. SivRite-10 Cartidge Assembly*

To replace the SivRite-10 desiccant first remove the top (1) from the SivRite-10 bottle (2) and install the filler cap (3). Remove one end piece (4) of the SivRite-10 Cartridge (5). Remove the Columnpak fiber (6) from the end of the SviRite-10 Cartridge and empty the used SivRite-10 desiccant from the cartridge. Replace the ColumPak fiber in the bottom of the cartridge by removing the cartridge end, rolling a small piece of fiber into a ball, and inserting it into the end. Insert the end piece making sure that all of the fiber is contained. Insert the filler cap into the end of the cartridge and fill. Insert another new piece of Columnpak fiber and reinstall end piece. Remove the filler cap from the SivRite-10 bottle and replace bottle top.

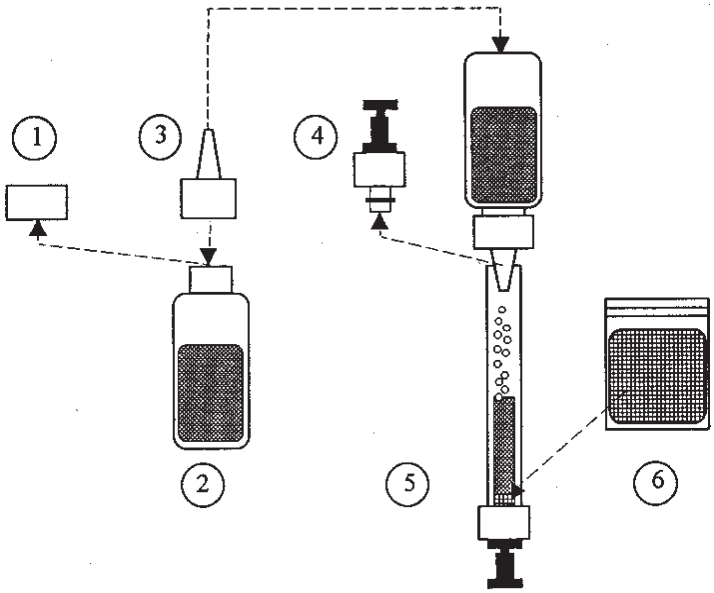


*Figure 5. Refilling the SivRite-10 Cartridge*

## OFFSET CHECK

The OFFSET CHECK push-button on the front panel allows the offset voltage (in millivolts) to be displayed on the panel meter. It is displayed only as long as the CHECK button is pressed in.

> NOTE: The nominal offset voltage should be 035 (±2). It will require re-adjusting if there is a large change in operating temperature or if there is an inadvertent contamination of the column with water vapor. The offset value goes up and down when samples are being analyzed. It should be readjusted only after the instrument has been on for at least 1 hour and the offset value stable, and at least 3 minutes after a sample of any kind has been analyzed.

Following the warm-up period, be sure the VALVE stem is pulled OUT (LED is GREEN). Press the OFFSET CHECK push-button. The reading should be between 035 (±2) on the panel meter. It will fluctuate slightly during the day because ambient temperature changes and other factors affect the offset voltage. The offset voltage should not be readjusted capriciously. Submit to the urge only when necessary.

## OFFSET ADJUSTMENT

Depress and hold the OFFSET CHECK button and use the screwdriver provided to rotate the OFFSET ADJUST control until the desired offset voltage is achieved. If the Offset Adjust control is changed, it will be necessary to re-zero and recalibrate the instrument.

It should be re-adjusted if a meter reading of "000" can not be obtained with the ZERO control when the VALVE stem is pulled out or if the proper value for a calibrating gas cannot be displayed on the meter even though the CAL adjustment is rotated fully clockwise with the VALVE stem pushed in.

## HALF-CAL CHECK

A Half-Cal check should be preformed periodically, for instance, once a month. Samples of MAX, HIGH and MID reference gases are available from QuinTron, containing about 150, 100 and 50ppm, H2, respectively. Linearity should be checked in the range of interest, e.g., up to 100 ppm unless research studies are involved since higher values for clinical studies are usually not quantitatively important. At least one calibrating gas should be used regularly, and 100 ppm H2 is recommended. This can be diluted precisely to check linearity at lower concentrations by using the procedure described below.

1. Analyze a sample of QuinGas-1 HIGH containing 100 ppm $H_2$ in the usual way. Then fill a 35 ml syringe (equipped with a stopcock) with QuinGas-1 and eject the excess gas so the syringe contains precisely 15 ml of calibrating gas.

2. VERY CAREFULLY draw in EXACTLY 15 ml or room air (fill to the 30 ml mark).

3. Inject this mixture into the FLUSH port. Push the VALVE stem in and observe the reading. It should equal about 50% of the reading for the reference gas. For instance, if the calibrating gas is 104 ppm, the meter should display 52 ppm. It cannot be stressed enough that dilutions must be made very accurately.

4. If the test results differ from the expected value (half of the reference gas concentration) by more than 3-4 ppm, refer to the Linearization Techniques section of this manual.

# PREVENTATIVE MAINTENANCE

Very simple maintenance will keep your Model CM2 *Plus* MicroLyzer running at peak efficiency. This preventative maintenance section focuses in detail on the three areas of primary importance.

## The No-Pressure Drying Tube

The No-Pressure Drying Tube is filled with SivRite-3 (QT01153-C). How often the SivRite-3 material is changed based on the the length of time the pump is running and the humidity level of the room air. SivRite-3 is a combination of molecular sieve, which is a very good desiccant and holds a lot of moisture, Indicating Drierite, which indicate when it is time to change the material, and activated carbon, which adsorbs contaminents from the air. You will notice that on each end of the tube are two balls of white material called ColumPak fiber (QT00517-T). This fiber helps to keep the SivRite-3 compressed in the tube and filters out dust particles that may enter into the inner plumbing system of the unit which can damage the internal pump. If this material is not replaced regularly they become plugged with dust affecting the flow rate and possibly allowing SivRite-3 dust to enter into the system causing mild to severe blockage of the internal pump and valve assembly.

Each of the ends of the SivRite-3 has end caps that are removed when you replace the expired SivRite-3. These ends have two large o-rings on them. Please inspect these o-rings for flexibility and light lubrication. These o-rings ensure a proper seal for the end caps. If these o-rings show signs of wear, splitting or flat spotting please replace with new o-rings. Be sure that they are lightly lubricated with QuinTron o-ring lube (QT900568-M).

As instructed in the operator's section of this manual, it is very important that the No-Pressure Drying Tube is maintained. QuinTron has placed a sticker on the drying tube as an reminder of when the SivRite-3 material should be replaced. Please follow this procedure, if the tube is allowed to turn completely pink, moisture entering the system will damage the internal chromatographic separating column and possibly cause sensor damage.

Your final inspection of this tube should include the visual inspection of all the tubing that is part of the SivRite-3. Check for areas for any possible leakage. If any tubing shows signs of wear, please replace with fresh tubing. Also be sure that the elbow is screwed tightly on the end-piece and that the AIR IN connection on the back of the instrument is tight.

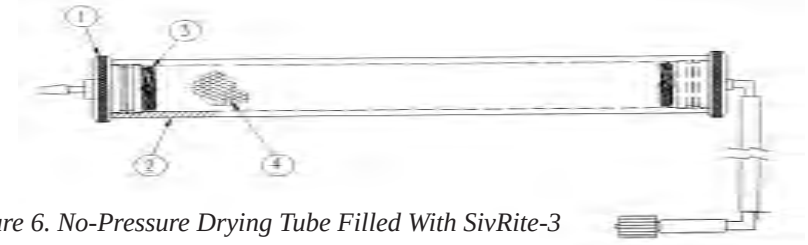


*Figure 6. No-Pressure Drying Tube Filled With SivRite-3*

## Sample Valve Assembly

The last area is the Sample Valve Assembly. The sample valve assembly is the combination of Valve and Valve Stem. The condition of the Sample Valve Assembly depends on the maintenance of the first two areas described above; With proper maintenance of the No-Pressure Drying Tube, SivRite-10 Cartridge this area will require minor attention. The recommended cleaning interval is every 6 months to one year. To maintenance the Sample Valve assembly you need to remove the cover to gain access to the valve stem e-clip that holds the stem in place. Please refer to Figure 7 (Model CM2 Plus) Pneumatic System) and Figure 8 (Sample Valve) for valve configuration.

Removing the e-clip will allow you to slide the valve stem out the front panel of the unit. Once the stem is removed, inspect the valve stem for dirt and grime. Wipe off any excess buildup and inspect the o-rings. If the o-rings need replacement do so at this time. Use the QuinTron O-Ring Tool Set (QT900566-J). If the build up is severe you may need to remove all tubing to the valve assembly and clean all valve ports due to possible blockages. If the buildup is minor, proceed with the cleaning and inspection of the o-rings. Then using a pipe cleaner, clean out the inner portion of the valve. Once all parts have been inspected and cleaned, lightly lubricate the o-rings and reassemble. Note: When lubricating the o-rings, make sure that no large clumps of lubricant are visible. Large clumps can block ports if present.Only a slight amount of lube is required.

Performing these maintenance steps will ensure that your unit operates trouble free. If you have any questions regarding these procedures, please feel free to contact QuinTron Instrument Company's Technical Support Department.

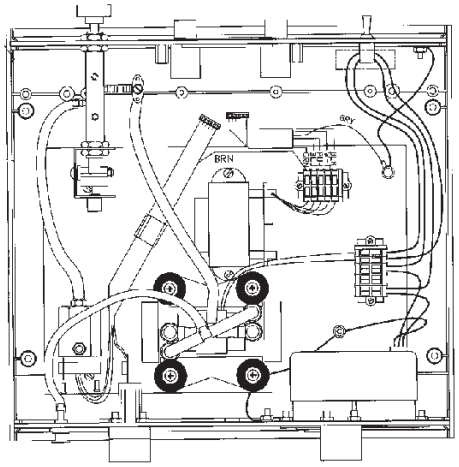


*Figure 7. Pneumatic System*

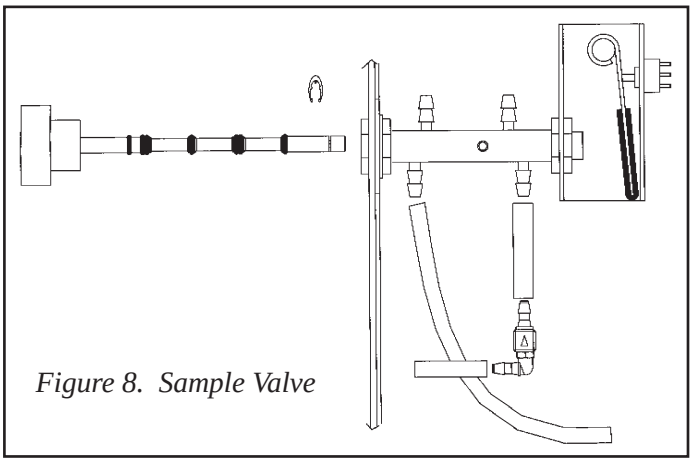

*Figure 8. Sample Valve*

## SERVICING THE INSTRUMENT

This section describes the system in technical terms and gives assistance in recognizing and correcting problems if they occur. You should be familiar with the descriptions of the system and its operation that are presented in the other sections of this manual before attempting to repair the instrument. Repairs and service should be done only by qualified service personnel. The technicians of the repair/service department of QuinTron are available for assistance; please do not hesitate to contact us.

## COVER REMOVAL

Unplug the power cord from the rear of the Model CM2 *Plus*. (Refer to Figure 9) Remove the drying tube (1) from the back and set it on the table next to the unit. Turn the unit upside down. Remove the four screws (4) that are holding the cover. Turn the unit right-side up. Slide the cover (3) straight up and then off.

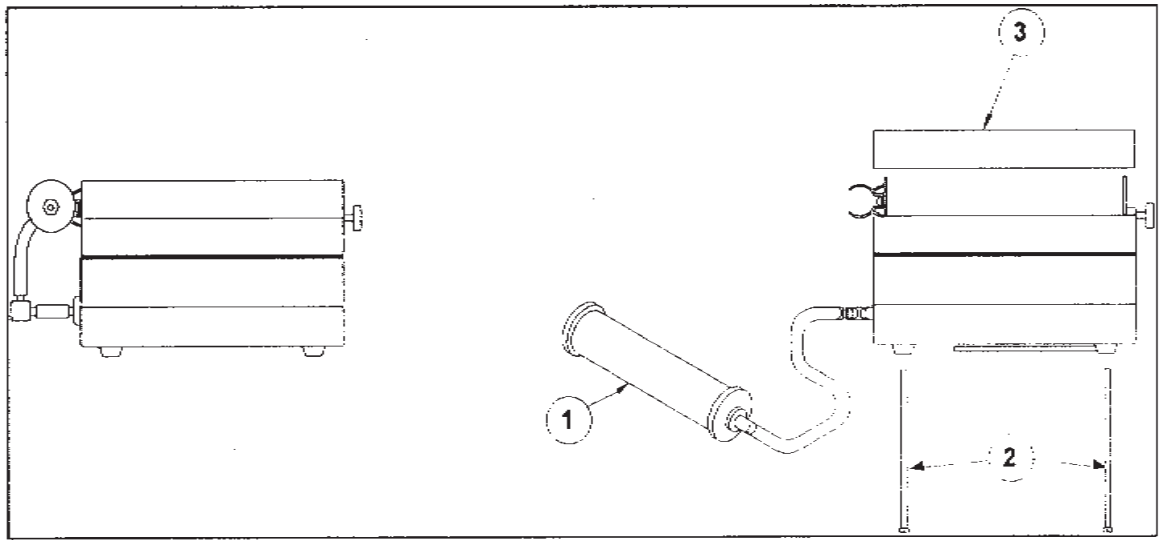


*Figure 9. Cover Removal*

## PNEUMATIC SYSTEM

A small pump inside the instrument (Refer to Figure 10) pulls the carrier gas through the SivRite-3 in the conditioning column on the back of the unit and into the room-air inlet port on the back panel. The pump then pushes the carrier gas through sampling valve, the chromatographic column, and in to the sensor block.

The Model CM2 *Plus* MicroLyzer uses atmospheric (room) air as a carrier gas. To prevent moisture damage and to reduce the effect of other possible contaminants of room air which would affect the sensor (such as alcohol, carbon, monoxide, acetone, hydrocarbons and other organic reducing gases) the carrier gas is pulled through the SivRite-3 conditioning column clipped on the back of the MicroLyzer.

The pump flow is determined by the line frequency and voltage. Using improper voltage and/or frequency per the rating plate will cause inaccurate results and may damage the pump.

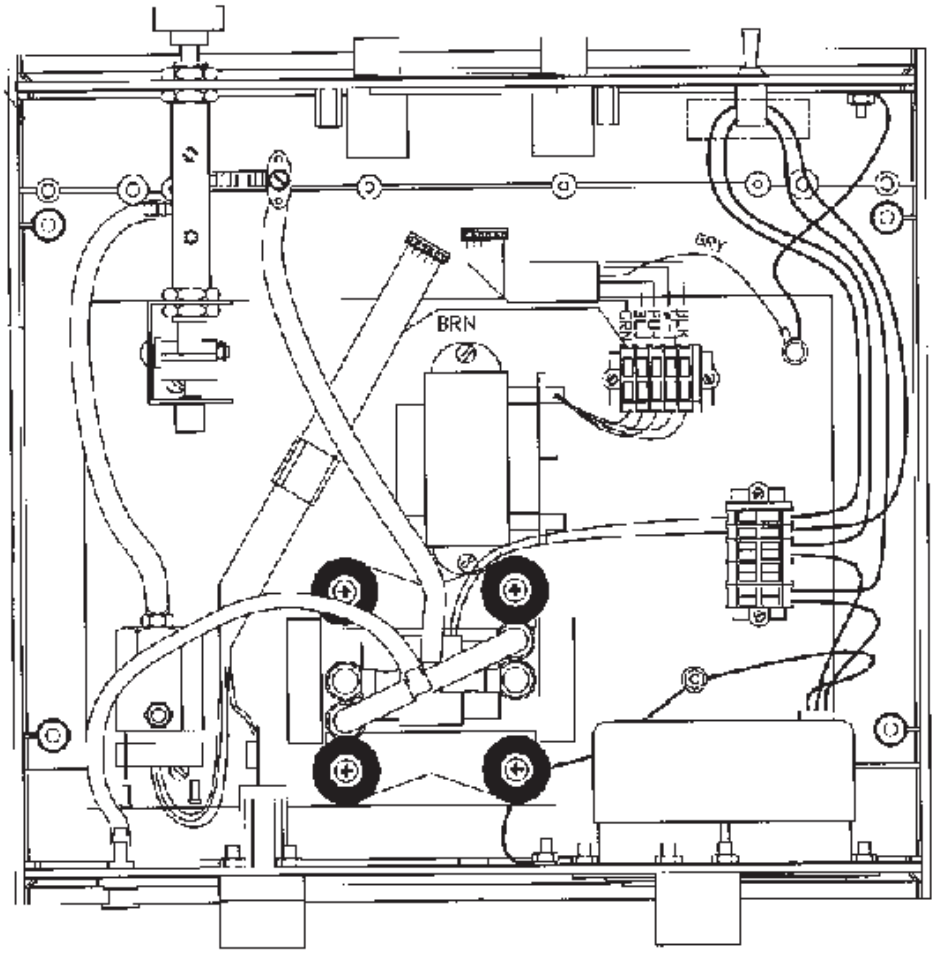


*Figure 10. Model CM2 Plus Pneumatic System*

The SAMPLE VALVE, (Refer to Figure 11) when pulled out, permits a sample loop to be filled from the sample inlet port on the front panel, and at the same time allows the carrier gas to bypass the sample loop and flow to the sensor. When the valve is pushed in, the sample is introduced into the carrier gas stream.

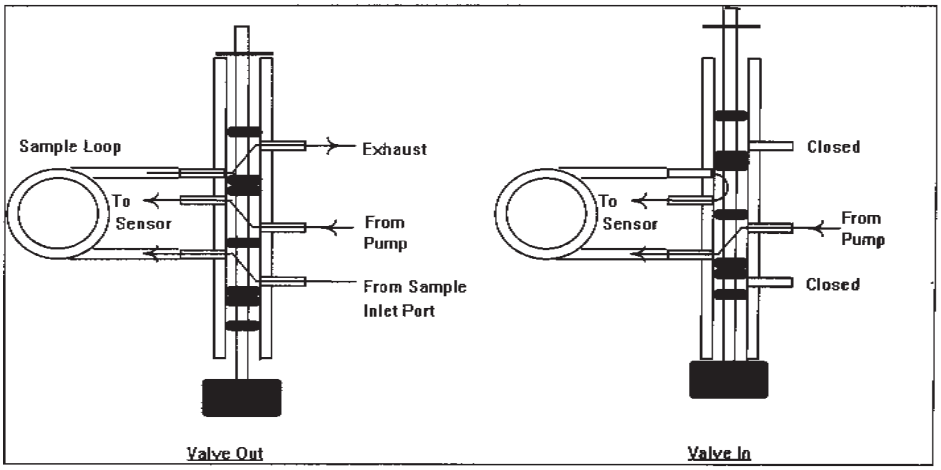


*Figure 11. Sample Valve*

The sample can be injected into the sample loop ONLY when the VALVE is pulled out. Samples should be dried by filtering them through the SAMPLE DRYING TUBE. A sample size of 20 ml should be used to fill the sample loop.

## ELECTRICAL SYSTEM

A block diagram of the electrical circuit for the Model CM2 *Plus* MicroLyzer is shown in Figure 12. This is an overall presentation, to provide an understanding of the principal functions of the electrical system.

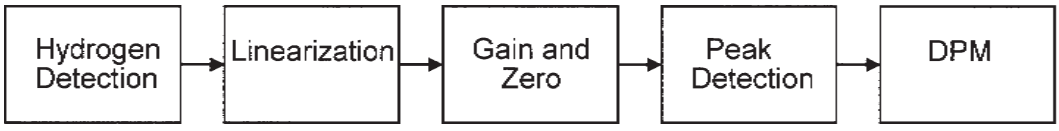


*Figure 12. Electrical Block Diagram*

On the left side of the diagram is a block label “Hydrogen Detection”. The sensor’s conductivity increases in the presence of hydrogen.

Adsorption of a gas molecule on the surface of the semiconductor results in the transfer of electrons due to different energy levels of the gas molecule at the semiconductor surface. O2, which can accept electrons, is adsorbed onto the surface of N-type semiconductors. When electrons are transferred from the donor level of the semiconductor to the layer of adsorbed gas it results in a lowering of the conductivity of the material. When the sensor which has already adsorbed O2 comes in contact with hydrogen (a reducing, combustible gas), the molecules of hydrogen are adsorbed so the transfer of electrons is

in the opposite direction to that of the O2 reaction, resulting in an increased density of electrons in the semiconductor space charge-layer and decreased potential barriers at the grain boundaries (increasing conductivity). This occurs when hydrogen comes in contact with the sensor during the analysis.

Because the signal produced by the sensor is nonlinear, a curve plotted for varying concentrations of H2 versus the sensor output would not be a straight line; it must be linearized. The block labeled "LINEARIZATION" accomplishes this task. A linearization switch on the back of the instrument controls the degree to which the nonlinear curve is "straightened" and must be readjusted if the operating conditions change.

When only carrier gas flows past the sensor, a baseline, or "offset" voltage is generated. It is nulled by the ZERO adjust on the front panel so the meter shows "000" when no H2 is present. The actual baseline voltage can be observed on the meter by pressing the "OFFSET" button on the front panel. When a bolus (concentrated mass) of H2 is carried past the sensor during the analysis of a sample, the voltage generated at the sensor is increased and presented to the linearizing circuit.

After the signal is linearized, it must be amplified so the signal voltage properly represents the correct H2 concentration. The process of setting the meter to "000" (zero adjust) when no H2 is present and setting the calibration adjustment, which changes the gain of the signal so it represents parts per million (ppm H2), is accomplished in the block labeled "GAIN & ZERO".

The peak of the response curve (maximum voltage change from the baseline) represents the H2 concentration. To assist in recording the highest value, a peak-detector circuit preserves the peak value in a short term memory circuit and displays it on the meter. This is accomplished in the block labeled "PEAK DETECTION".

The digital panel meter (label DPM) has the ability to convert the analog voltage signal into a digital (numeric) form, which is displayed as parts per million H2, corresponding to the units used to calibrate the instruments.

The printed circuit board layout with test points labeled is shown in Figure 13. The electrical schematic diagram for the Model CM2 *Plus* MicroLyzer is presented in Figures 14a, 14b, and 14c. All test point voltages listed are referenced to the system ground (TPI).

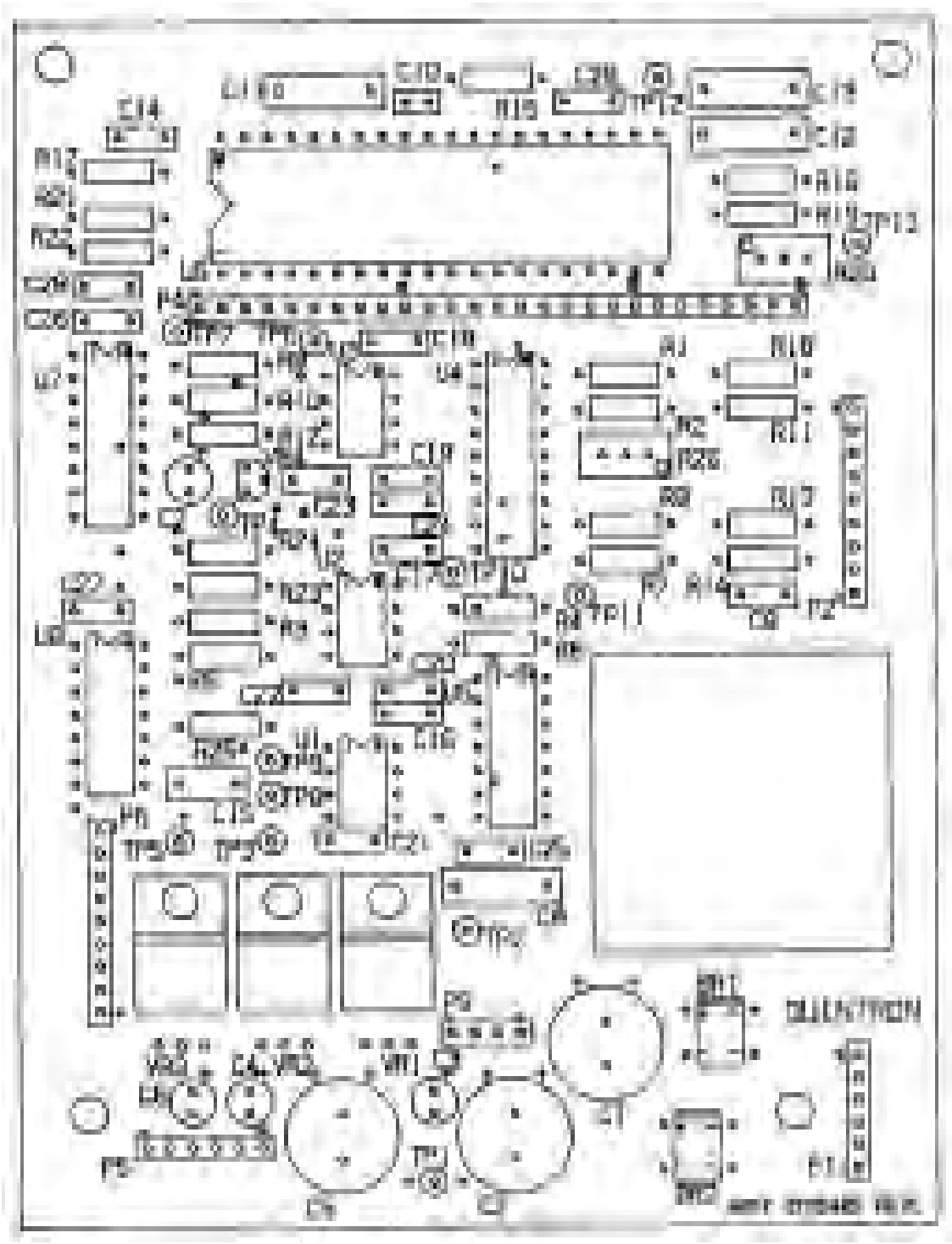

*Figure 13. Printed Circuit Board Layout*

## ELECTRICAL TEST POINTS

Refer to Figure 13, the board layout for the location of the test points to be checked.

| | | |
|---|---|---|
| TP1 | GROUND | Reference |
| TP2 | 7812 voltage regulator output | +12V DC |
| TP3 | 7912 voltage regulator output | -12V DC |
| TP4 | 79L05 voltage regulator output | -5V DC |
| TP5 | 7805 voltage regulator output | +5V DC |
| TP6 | Positive voltage reference output | +2.0 V DC |
| TP7 | Negative voltage reference output | -2.0V DC |
| TP8 | Sensor offset voltage | +35 mV DC (during operation) |

## DESCRIPTION OF THE ELECTRICAL CIRCUIT

The schematic has been separated into three sections labeled figure 14a, 14b, and 14c. The first section, 14a, has the linearizing, gain and peak detect circuits. P5, on the left side, is the connection for the sensor, the recorder outputs and the linearization switch. The sensor has an internal heater powered by the 5 volt supply. The same 5 volt supply is used as the reference voltage for the sensor. A voltage divider circuit is formed between the sensor element and the offset adjustment on the front panel.

U1A is the buffer amplifier for the sensor. U4 is the linearization circuit. R26 is factory set so that the sensor is linear when the rear panel linearization switch is set to 5. Usually, linearization adjustments by the operator are made with the switch. U4 also contains a 2-volt reference that is buffered by U3B and is used in several places in the circuit. U3A inverts the 2-volt reference for a –2 volt reference which is used for the zero adjustment.

U2A is the buffer amplifier for the zero adjustment. U2B is the difference amplifier that subtracts the zero signal from the linearized sensor signal. It also provides a gain of 10 to the signal. This is more gain than is needed by the meter outputs, but is needed for minimizing the known offset shifts of U6, the peak detect circuit.

The peak detect circuit output on pin 5 follows the input when the valve is out (pins 1 and 14 high). When the valve is pushed in, the output of U6 holds the peak value. The internal comparitor in U6 is used to detect sensor signals greater than 8 volts (great than 2 volts at pin 11). If the signal is greater than 8 volts, pin 12 goes low to trigger the over-range alert circuit in the next section.

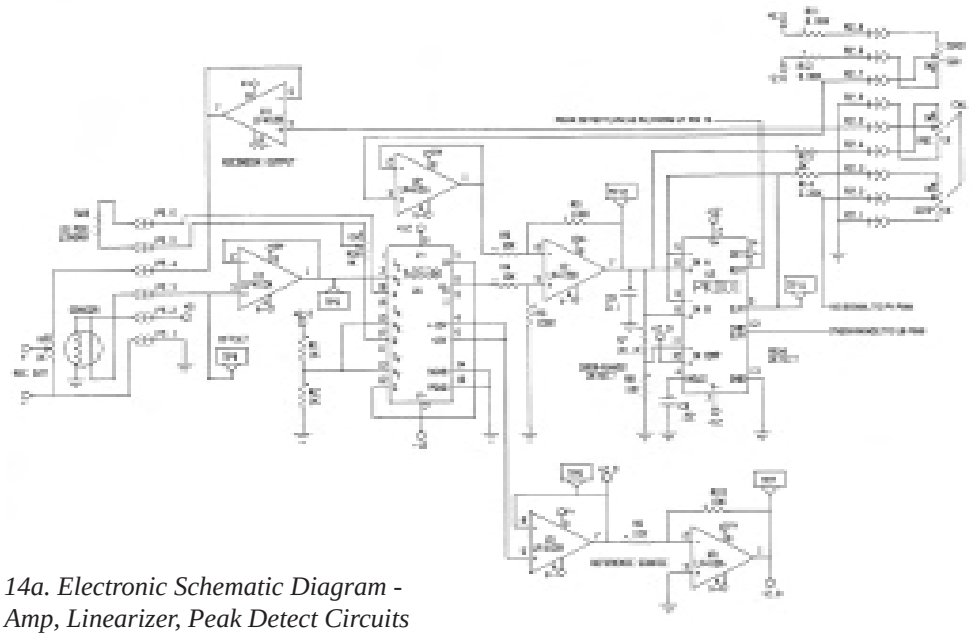

*Figure 14a. Electronic Schematic Diagram - Sensor Amp, Linearizer, Peak Detect Circuits*

The second section, Fig. 14b, has P6 on the left side. This connector is wired to the valve switch. P6 is a 9 position connector which is compatible with older units even though only two wires are used. The signal is inverted by U7C for the over-range circuit and the LED drivers. The signal is inverted back by U7D for the peak detector. When the valve is out, the latch formed by U8A and U8B is reset, and the GREEN LED is driven by U7A. When the valve is in, the RED LED is driven by U7F. If an over-range is detected, the latch circuit is set, which allows the oscillator circuit, U8C, to run. This causes the RED LED to flash. The analytical results from that analysis should be voided. The flashing stops when the valve is pulled out.

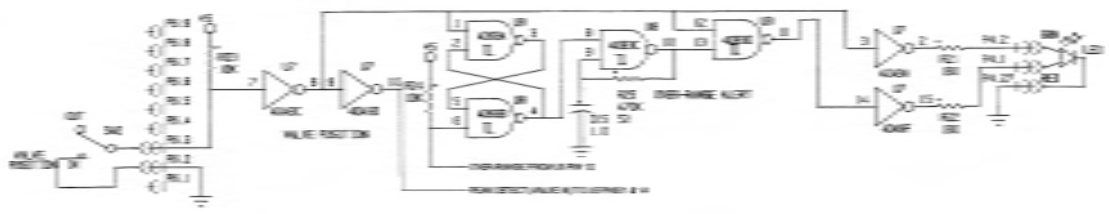

*Figure 14b. Electronic Schematic Diagram, Valve Switch, Overrange Flasher*

The last section, Fig. 14c, is the power supply and digital panel meter part of the schematic. The power supplies are driven by two different transformer windings. The first is a center tapped 25.2 volt winding providing ± 12 volt power supplies. The −12 volt power supply is reduced by VR4 for the −5 volt power supply. The other winding powers the +5 volt power supply.

The digital panel meter (DPM) circuit is based around U6, the digital voltmeter chip. The reference voltage at TP13 should be adjusted for 1.00 volts DC with respect to TP1. The input signal to the DPM circuit at TP 12 must be between ± 1.999 volts and should match the DPM reading. The typical operating range is 0 to 200 mV. P4 goes to the display board which is not shown.

P3 attaches to the offset (CHECK) switch and the offset adjust potentiometer. When the switch is depressed, the offset value from the sensor is displayed on the DPM. Otherwise, the zeroed or linearized sensor value is displayed.

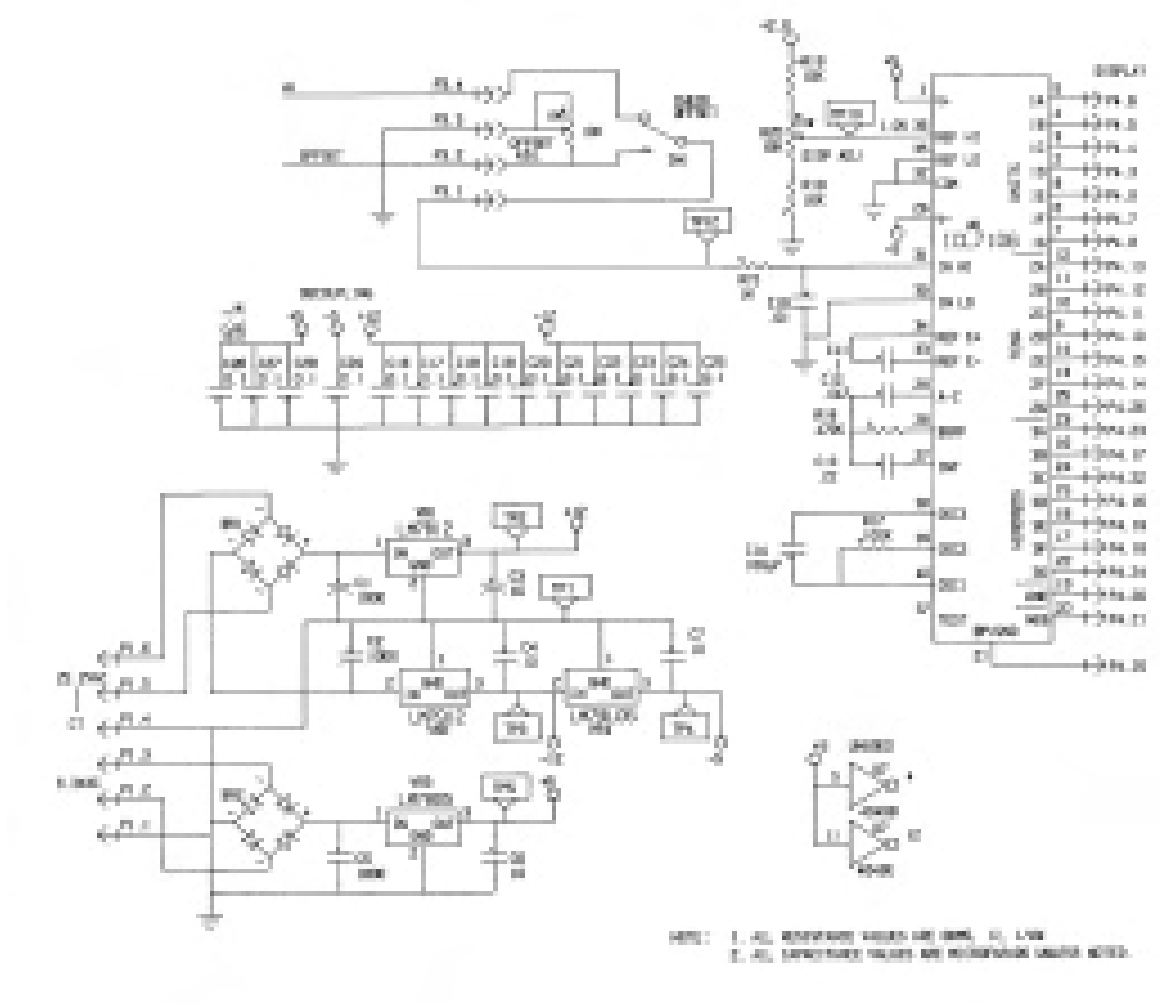

*Figure 14c. Electronic Shematic diagram, Power Supply, Digital Meter, Offset Check Switch*

## CALIBRATION OF THE DIGITAL PANEL METER

Do not change this setting unless the ICL7601 IC has been replaced or you are sure the reading at TP8 is not in agreement with the calibrated digital volt meter. Adjust R20 for a reading of 1.000 volts at TP13 with respect to TP1 (Ground). The meter must be accurate to at least one millivolt. This a rough calibration of the reference voltage. The next step will account for variations in components.

With the power switch on STANDBY, connect a calibrated volt meter to TP12 with ground on TP1. Adjust the offset voltage setting to a value greater than 200mv. Turn the CAL control and the ZERO control clockwise until the reading on the calibrated volt meter reads 1.000 volts. Adjust R20 until the front panel meter agrees with the volt meter. Now reduce the setting to see that the two meters change at the same rate. Check the range from 0 mV to 1000mV. The meters should agree through this range within ± 2 mV.

# LINEARIZATION TECHNIQUE FOR THE MICROLYZER

A LINEARITY CHECK should be performed periodically. For normal clinical use, normal and low calibrating gases (containing about 100 and 50 ppm $H_2$ respectively) should be used. For some research studies, the MAX reference QuinGas-1 (containing about 150 ppm $H_2$) is available from QuinTron. Linearity should be checked in the range of interest, e.g., up to 100 ppm for clinical studies which higher values are usually not quantitatively important. Research studies often involve higher values which need to be quantified accurately.

If more than one reference gas is available for linearity checking, 100 ppm $H_2$ is recommended. This can be diluted precisely to check linearity at lower concentrations by using the procedure described below. Note: Room air may be contaminated and may not provide accurate dilutions but in most cases will work.

1. Calibrate using a sample of reference gas containing 100% of 100 ppm H2 in the usual way. Then fill a 35 ml syringe (equipped with a stopcock) with reference gas. Aspirate the excess gas so the syringe contains precisely 15 cc of reference gas.

2. Draw in EXACTLY 15 cc of room air (fill to the 30 cc mark) through the sample drying tube to remove humidity from the room air.

3. Inject this 50% mixture (1/2 QuinGas & 1/2 room air) into the FLUSH port. Push the VALVE stem in and observe the reading. It should equal approximatly 50% of the reading for the 100% reference gas. For instance, if the calibrating gas is 104 ppm, the meter should display around 52 ppm. Dilutions must be made very accurately. You are hand diluting parts per million some error is to be expected.

4. If the test results consistently differ from the expected value (half of the reference gas concentration) by more than 2-3 ppm, refer to the section on Linearization Technique in the Service Manual.

If the low calibration (or half cal) reading is not within 2 PPM or 5% of the value labeled on the QuinGas-1 tank, the linearity switch should be adjusted to improve the linearity. Increase the switch setting if the low calibration (or half cal) values are higher than expected, and decrease the setting if they are lower, to make it linear. Changing the position by one step for each percent the reading is in error (for instance one step for each percentage-point error if the test gas represents 100 ppm) is a good first approximation.

For non-linearity that can not be corrected within the range of the linearity switch, refer to the troubleshooting guide which follows.

## TROUBLE SHOOTING GUIDE

The following is a list of possible problems that may occur and possible solutions that should be tried:

**Problem: No response to the H2 QuinGas-1.**

**Solution 1:** Check all pneumatic connections for leaks, using SNOOP LEAK DETECTOR (Catalog # QT00573-T).

**Solution 2:** Check the flow rate at the detector block with a flow meter by removing the column from the block and attaching a small flow meter. The flow rate should be 75-100 ml/min. If there is no flow to the detector make sure the pump is functioning properly and there are no leaks in the system.

**Solution 3:** Check to see if the offset changes at the following points when a calibration sample is injected:

**TP8-** If there is no offset reading at this point, the detector may need to be replaced or there may not be power to it. Check to see that there is +5V on the blue wire at the detector.
**TP9-** If there is no offset voltage at this point, replace op-amp U1.
**TP10-** If there is no change in the output of the AD538 when a sample is injected, this chip may need to be replaced.
**TP11-** If there is no output from the PKD01, replace this chip.

**Problem: The Linearization Switch is on position 9 and the Half-Cal check values are still to high.**

Solution1: Adjust R26 on the main board clockwise 3 turns.

**Problem: The linearization Switch is on position 1 and the Half-Cal check values are still too low.**

Solution: Adjust R26 on the main board counterclockwise 3 turns.

**Problem: The flow rate is improper.**

Solution 1: Check to see if the flow rate is within the range of 30-40 ml/min. at the detector block. If the flow rate is too low, the pump speed can be adjusted by adjusting the internal flow control.

Solution 2: The flow rate must be readjusted after replacing the separating column in the instrument.

**Problem: The RED LED flashes when the valve is pressed in when running calibration gases.**

Solution 1: Reduce the OFFSET voltage (even if it is in the correct range) and see if this improves the linearity at higher concentrations. Continue

to reduce it unless the CAL setting can not be increased enough to provide an accurate meter reading.

Solution 2: Check to see if the flow rate is still within the range of 75-100 ml/min. at the detector block. If the flow rate is too low it can be increased by adjusting the internal flow control or changing the column in the instrument.

**Problem: The RED LED flashes when the valve is pressed in when running a patient samples.**

Solution: Dilute the sample with equal volume of room-air and rerun the analysis. Then multiply the results on the front panel meter by two.

**Problem: Meter readings are very unstable, the meter is blank or the meter reads 1__ or −1__.**

Solution: Make sure that there is a valid input voltage (+1.99V at TP12) to the meter circuit before changing the chip. Turn the Cal control fully counterclockwise. This should reduce the signal to 0. A valid input can also be achieved by pressing the offset button and checking the voltage level at TP8 and TP12; they should be the same.

Solution 2: The ICL7601 chip may need to be replaced. Make sure that the power supply voltages (+12 and -12 Volts). If the ICL7601 is replaced, the meter will need to be re-calibrated.

# CUSTOMER SERVICE

**Contact Information**

The staff at QuinTron is committed to service. If you have any problems, questions, comments, or suggestions, please call our CUSTOMER SERVICE HOT-LINE 1-800-542-4448 or FAX 1-414-645-3484 or e-mail support@quintron-usa.com.

**Procedure for Returning an Instrument for Service**

Follow the procedures below when it is necessary to return a unit to QuinTron for service:

1. Write to or call QuinTron Customer Service for a return materials pack list, which must appear on all cartons and on all paperwork.

2. Carefully pack the unit in its original container or equivalent. Damage during shipment to QuinTron is the responsibility of the shipper.

3. When returning the unit to QuinTron for service, always include a note with the following information:

   YOUR NAME
   INSTITUTION
   ADDRESS
   CITY, STATE, ZIP CODE
   TELEPHONE NUMBER
   RETURN PACK IST
   MODEL, SERIAL NUMBER
   BRIEF DESCRIPTION OF PROBLEM
   REPAIR P.O. (if required)

4. All units returned to QuinTron for repair should be shipped FedEx prepaid if possible. It is recommended that the unit be insured when shipped. QuinTron WILL NOT ACCEPT UNITS THAT HAVE BEEN SENT C.O.D. without prior authorization.

5. Ship item to:
   QuinTron Instrument Company.
   3712 West Pierce Street
   Milwaukee, WI 53215
   ATTN.: REPAIR

   Instruments under normal warranty or covered with an Extended Warranty Service Agreement will be returned after service or replacement, via Federal Express ground service to any U.S. destination. If another conveyance is required (e.g., Next Day, UPS, etc.), the customer must pay the additional shipping charges. International shipments will be handled on an individual basis. Service on instruments out of warranty will be billed on a time and materials basis. Estimates are available. The authority, or purchase order, should precede or accompany the instrument returned for repair. It should also include specific return shipping instructions, if required. Goods will be shipped Federal Express ground, unless otherwise specified, with shipping charges prepaid and added to the invoice.

# MODEL CM2 *PLUS* MICROLYZER SPECIFICATIONS

Input Power (factory set)
Refer to Serial Number Plate

Fuse Rating
½ amp normal blow-2 each

Linear Response Range H2
0-100 ppm

Accuracy H2
± 2pm or 5% of meter reading

Sensitivity H2
2ppm

Sample Size
15 cc minimum
20 cc recommended

Flow rate (at detector)
75 to 100 cc/min.

Offset Voltage
25-45 mV (see factory setting) 35mV

Desiccant
SivRite-10 (QT00435-J)
SivRite-3 Room Air Conditioner (QT01153-C)

Calibration Gas
50 to 150 ppm – H2 \ Balance Simulated Alveolar Air

Carrier Gas
Atmospheric (room) Air
Conditioned with SivRite-3

Case Size
Width 12 1/2" (32 cm)
Height 7" (18cm)
Depth 13 1/3" (34 cm)
Weight 8.5 lb. (3.9 kg)

# STANDARD WARRANTY QUINTRON PRODUCTS

QuinTron Instrument Company warrants that the instruments and all components thereof will be free from defects in materials and/or workmanship for TWO years from the date of shipment. Any warranty hereunder is extended only to the original consumer purchaser/user and is not assignable without written acknowledgment from QuinTron.

In the event of malfunction or other indication of failure that is attributable directly to faulty workmanship or materials within the period of the warranty, QuinTron will assume the responsibility of repairing or replacing the defective component and restoring the instrument to proper operating condition. QuinTron may replace the defective component or item with a new or repaired functionally equivalent component.

Before returning a product for repair, the customer or agent must contact QuinTron Customer Service by mail, or at either (414) 645-4222 or toll-free (within the Continental U.S. and Canada) at 1-800-542-4448 for a Returned Materials Packlist. Ordinarily, the customer pays the cost of returning the instrument to the factory and QuinTron pays for the return shipment to the customer.

International shipments will be handled on an individual basis. Our phone is (414) 645-4222 and our fax is (414) 645-3484. Please contact our office for further instructions.

The Internal Chromatographic column is specifically exempted from this warranty because its maintenance depends solely on the care with which the instrument is handled. Such replacement will not ordinarily be required for years with proper care and operation of instrument. If the column performs poorly or is nonfunctional, it will be replaced at the current market price.

There shall be no warranty for either parts or labor after the expiration of two years from the shipment date unless an Extended Service Policy is in force.

While QuinTron has made every effort to provide clear and accurate technical information about the application of its products, QuinTron assumes no liability for any events arising out of their use or because of the application of technical information provided.

This warranty is in lieu of all other expressed warranties with respect to QuinTron products.

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