TELEDYNE
ADVANCED POLLUTION INSTRUMENTATION
A Teledyne Technologies Company

ADDENDUM TO MODEL 100E OPERATORS MANUAL
(P/N 04515)

FOR

MODEL 100EU TRACE LEVEL SULFUR DIOXIDE ANALYZER

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1. PREFACE

NOTE

The information contained in this addendum is pertinent to M100EU analyzers running software revision F.0. Some or all of the information may not be applicable to later revisions of software.

The software revision your analyzer is running is displayed in the upper left-hand corner of the display any time the instrument is in SETUP mode.

This addendum is based on the Model 100E Operators Manual (P/N 04145). In most ways the M100EU is identical to the M100E in design and operation, therefore most of the basic set up information, operating instructions as well as calibration, maintenance, troubleshooting and repair methods are found in that manual. This addendum documents only those areas where the M100EU is different in design or operating method from the M100E.

Therefore this addendum includes instructions and information regarding:

- Additional Test Functions
- Adjusting the PMT HV for “Factory Calibrations”
- Differences in theory of operation

1.1 REFERENCE NUMBERING CONVENTION

Unless otherwise specified, chapter, section, figure and table reference numbers referred to within this text are relative to this document.

EXAMPLE: “Figure 2-1” refers to the figure, within this document, labeled as 2-1.

References to chapters, sections, figures and tables in the original document will be labeled as such.

EXAMPLE: “Figure 6.1 of the M101E Operators Manual (P/N 04145, REV. A)”.

USER NOTES

USER NOTES:

2. SPECIFICATIONS, APPROVALS AND WARRANTY

2.1 SPECIFICATIONS

Table 2-1: Model 100EU Basic Unit Specifications

Min/Max Range (Physical Analog Output)	In 1ppb increments from 50ppb to 20 000ppb, dual ranges or auto ranging
Measurement Units	ppb, ppm, µg/m3, mg/m3 (user selectable)
Zero Noise[2]	25 ppt RMS (50 ppt RMS with 360 nM filter installed)
Span Noise[2]	0.5% of reading RMS, above 5 ppb
Lower Detectable Limit[3]	50 ppt RMS
Zero Drift (24 hours)	<200 ppt (<400 ppt with 360 nM filter installed)
Zero Drift (7 days)	<200 ppt (<400 ppt with 360 nM filter installed)
Span Drift (7 Days)	<0.5% FS
Linearity	1% of full scale
Precision	0.5% of reading
Temperature Coefficient	< 0.1% per ^{o}C
Lag Time[1]	30 sec
Rise/Fall Time[1]	95% in <140 sec
Sample Flow Rate	650cc/min. ±10%
Temperature Range	5-40oC
Humidity Range	0 - 95% RH, non-condensing
Dimensions H x W x D	7" x 17" x 23.5" (178 mm x 432 mm x 597 mm)
Weight, Analyzer (Basic Configuration)	45 lbs (20.5 kg) w/internal pump
AC Power Rating	100 V, 50/60 Hz (3.25A); 115 V, 60 Hz (3.0 A); 220 – 240 V, 50/60 Hz (2.5 A)
Environmental	Installation category (over-voltage category) II; Pollution degree 2
Analog Outputs	Three (3) Outputs
Analog Output Ranges	100 mV, 1 V, 5 V, 10 V, 2-20 or 4-20 mA isolated current loop. All Ranges with 5% Under/Over Range
Analog Output Resolution	1 part in 4096 of selected full-scale voltage
Status Outputs	8 Status outputs from opto-isolators
Control Inputs	6 Control Inputs, 3 defined, 3 spare
Serial I/O	One (1) RS-232; One (1) RS-485 (2 connecters in parallel) Baud Rate : 300 – 115200: Optional Ethernet Interface
Certifications	EN61326 (1997 w/A1: 98) Class A, FCC Part 15 Subpart B Section 15.107 Class A, ICES-003 Class A (ANSI C63.4 1992) & AS/NZS 3548 (w/A1 & A2; 97) Class A. IEC 61010-1:90 + A1:92 + A2:95,
1-As defined by the USEPA; **2** – 25 samples taken, 10 sec. interval; **3** – Twice zero noise	

2.2 EPA EQUIVALENCY DESIGNATION

At this time the M100EU has not been certified by the EPA as an equivalent method at the time of this writing however it is anticipated that the M100EU will qualify as Reference Method Number EQSA-0495-100 per 40 CFR Part 53 in the near future. Please see section 2.2 of the M100E manual, P/N 04515 for details.

2.3 CE MARK COMPLIANCE

See Section 2.3 of the M100E Manual - P/N 04515

2.4 WARRANTY

See Section 2.4 of the M100E Manual - P/N 04515

User Notes:

3. GETTING STARTED

3.1 UNPACKING THE M100EU

Unpack the M100EU as per the directions in Section 3.1 of the M100E Manual - P/N 04515, with the following change. There are two redheaded shipping screws that hold down the PMT/Sensor assembly and must be removed prior to operation. They are located along the base of the PMT housing adjacent to the chassis.

3.2 INTERNAL LAYOUTS

Figures 3-1 replaces Figure 3-9 in the M100E manual. The primary difference between the M100EU and M100E layouts is the differences in the PMT Housing, the location of the PMT preamp PCA and the addition of a Sync Demodulator PCA.

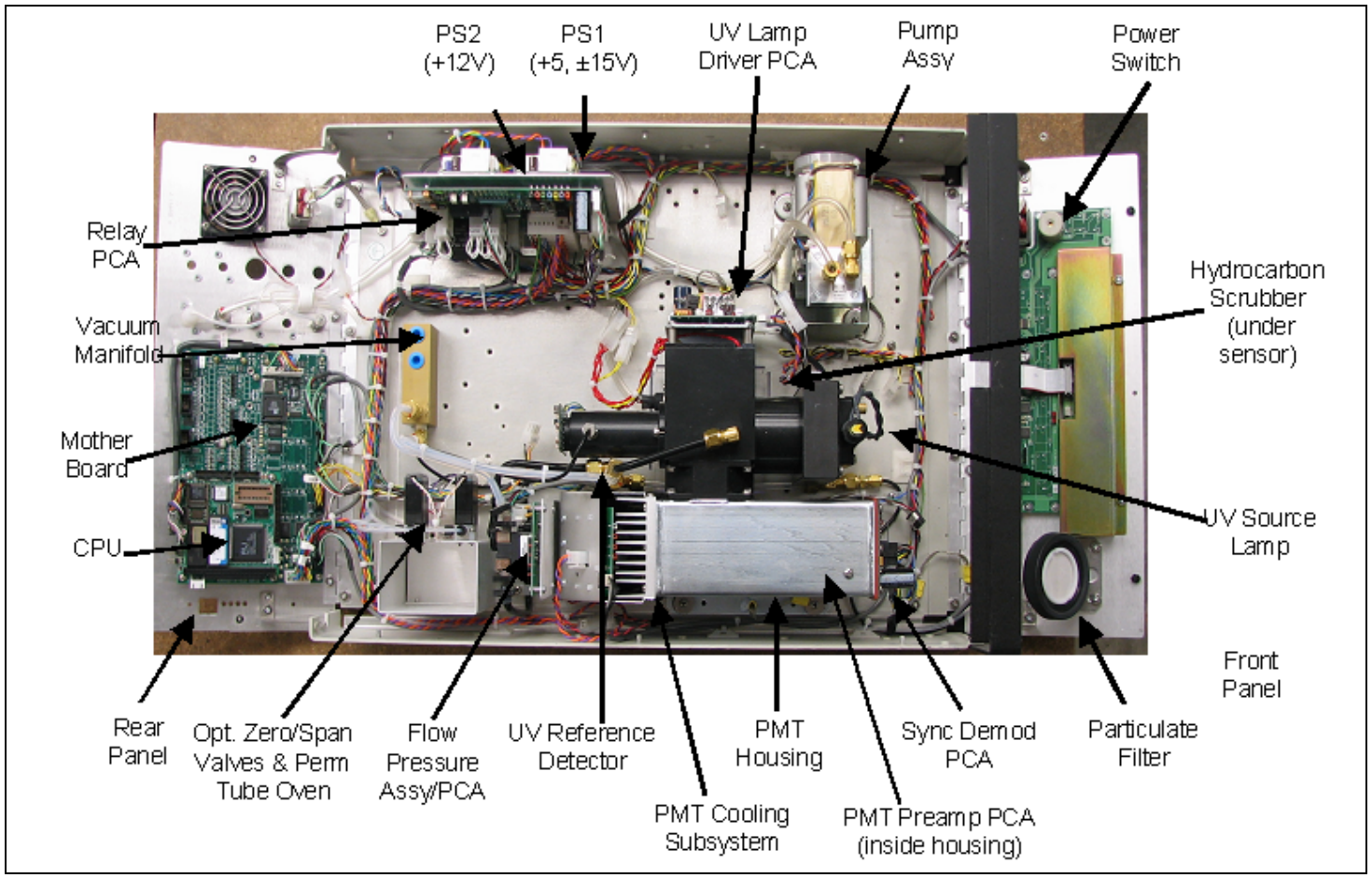


Figure 3-1: M100EU Internal Layout

3.3 FUNCTIONAL CHECK OF THE M100EU

To perform an initial functional check of the M100EU follow the steps contained in Section 3.2.4 of the M100E Manual - P/N 04145, but use the Test functions described in below.

3.3.1 TEST FUNCTIONS

Table 3-1 supersedes the figure in Step 2 of Section 3.2.4 and Figure 6-2 of the M100E Manual - P/N 04145. Table 11-1 supersedes Table 6-2. The only differences between the M100E and M100EU's test functions are the addition of STABIL2 and UV STAB.

Table 3-1: Test Functions Defined

DISPLAY	PARAMETER	UNITS	DESCRIPTION
RANGE	RANGE - - RANGE1 RANGE2	PPB, PPM, UGM & MGM	The Full Scale limit at which the reporting range of the analyzer's ANALOG OUTPUTS is currently set. THIS IS NOT the Physical Range of the instrument. See Section 6.7 of M100E manual for more information. If DUAL or AUTO Range modes have been selected, two RANGE functions will appear, one for each range.
STABIL	STABILITY	ppb	Standard deviation of SO_2 Concentration readings. Data points are recorded every ten seconds. The calculation uses the last 25 data points.
STABIL2	STABILITY	ppb	Standard deviation of SO_2 Concentration readings, per EPA. Data points are recorded every 120 seconds. The calculation uses the last 25 data points.
PRES	SAMPLE PRESSURE	in-Hg-A	The current pressure of the sample gas as it enters the sample chamber, measured between the SO_2 and Auto-Zero valves.
SAMP FL	SAMPLE FLOW	cm^3/min (cc/m)	The flow rate of the sample gas through the sample chamber. This value is not measured but calculated from the sample pressure.
PMT	PMT Signal	mV	The raw output voltage of the PMT.
NORM PMT	NORMALIZED PMT Signal	mV	The output voltage of the PMT after normalization for offset and temperature/pressure compensation (if activated).
UV LAMP	Source UV Lamp Intensity	mV	The output voltage of the UV reference detector.
UV STAB	Stability of UV Lamp Intensity	mV	Standard deviation of UV reference detector output. Data points are recorded every ten seconds. The calculation uses the last 25 data points.
LAMP RATIO	UV Source lamp ratio	%	The current output of the UV reference detector divided by the reading stored in the CPU's memory from the last time a UV Lamp calibration was performed.
STR. LGT	Stray Light	ppb	The offset due to stray light recorded by the CPU during the last zero-point calibration performed.
DRK PMT	Dark PMT	mV	The PMT output reading recorded the last time the UV source lamp shutter was closed.
DRK LMP	Dark UV Source Lamp	mV	The UV reference detector output reading recorded the last time the UV source lamp shutter was closed.
SLOPE	SO_2 measurement Slope	-	The sensitivity of the instrument as calculated during the last calibration activity. The slope parameter is used to set the span calibration point of the analyzer.

(table continued)

Table 3-1: Test Functions Defined

DISPLAY	PARAMETER	UNITS	DESCRIPTION
OFFSET	SO_2 measurement Offset	-	The overall offset of the instrument as calculated during the last calibration activity. The offset parameter is used to set the zero point of the analyzer response.
HVPS	HVPS	V	The PMT high voltage power supply.
RCELL TEMP	SAMPLE CHAMBER TEMP	°C	The current temperature of the sample chamber.
BOX TEMP	BOX TEMPERATURE	°C	The ambient temperature of the inside of the analyzer case.
PMT TEMP	PMT TEMPERATURE	°C	The current temperature of the PMT.
IZS TEMP[1]	IZS TEMPERATURE[1]	°C	The current temperature of the internal zero/span option. Only appears when IZS option is enabled
TEST[2]	TEST SIGNAL[2]	mV	Signal of a user-defined test function on output channel A4.
TIME	CLOCK TIME	hh:mm:ss	The current day time for iDAS records and calibration events.

To view the TEST Functions press the following Key sequence:

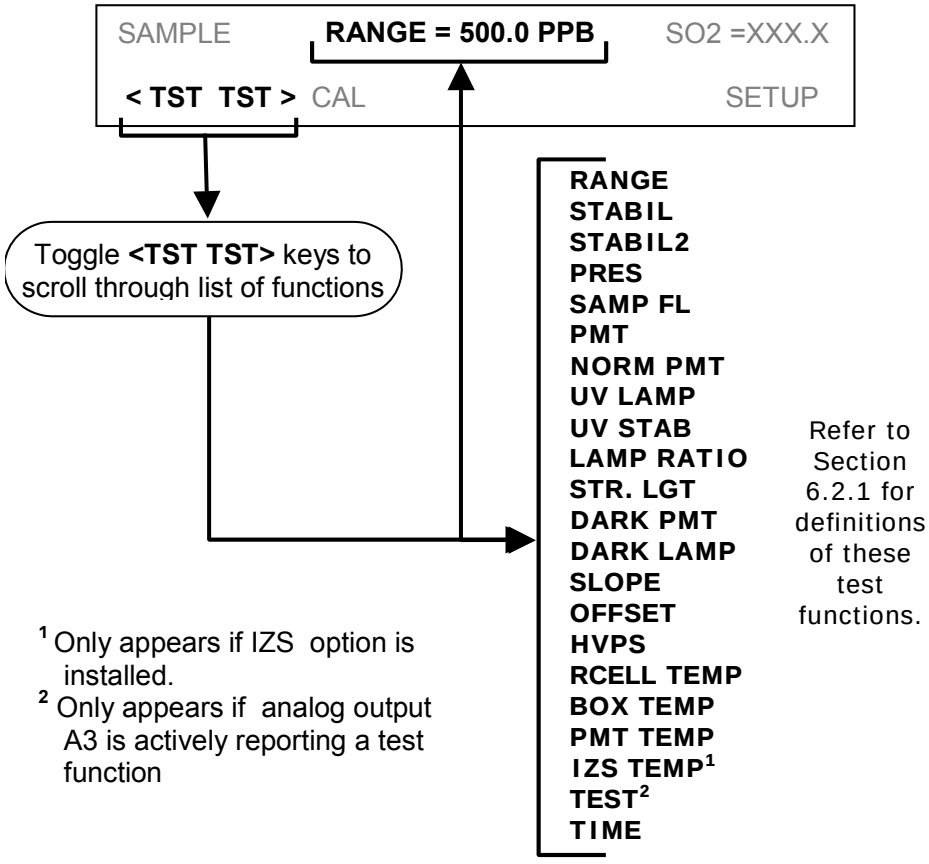


Figure 3-2: M100EU Test Functions

USER NOTES:

4. FREQENTLY ASKED QUESTIONS & GLOSSARY

Please refer to Section 4 of the M100E manual, PN 04515 for information.

USER NOTES:

5. OPTIONAL HARDWARE AND SOFTWARE

Please refer to Section 5 of the M100E manual, PN 04515 for information.

USER NOTES:

6. M100EU OPERATING INSTRUCTIONS

NOTE

For the most part the operation instruction for the M100EU are the same as those described in Chapter 6 of the M100E Manual - P/N 04515 with the exception that there are additional test parameters and setup procedures.

6.1 ADDITIONAL TEST PARAMETERS

Please see Section 3.3 above for details on the additional test parameters.

6.2 STBL MENU: SETUP FOR THE THREE STABILITY FUNCTIONS

There is an additional submenu on the Secondary Setup Menu in the M100EU's software. The STBL menu, see Figure 6-1 allows the user to modify the settings for the three stability calculations that are displayed as Test Functions on the front panel and are available via the serial data port and that can be logged with the iDAS. Test Function STABIL, CONC1 in the menus below, is equivalent to the standard M100E STABIL function and is useful when conducting calibrations and other operations in which the operator has limited time to view the display. CONC2, which is the same as the STABIL2 test function has been configured so that it calculates stability in the same way as required by the EPA. STABIL2 is useful when comparing instruments against the EPA standard but is very slow and difficult to use for calibration or other activities where the operator must wait for analyzer to settle to the desired value. UVLAMP is the same as UV STAB on the front panel is a diagnostic that can be used to understand the stability of the UV lamp.

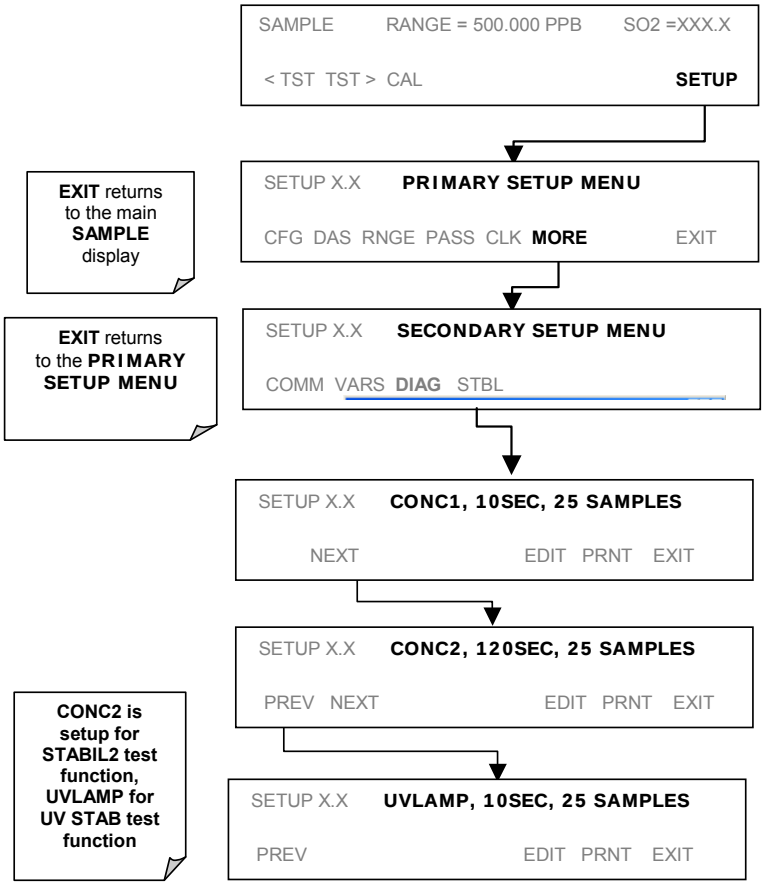


Figure 6-1: Accessing the STBL Menu

User Notes:

7. CALIBRATION PROCEDURES

Calibration of the M100EU should be performed according to the procedures described in Chapters 7 & 8 of the M100E Manual - P/N 04145. However, delivering span and zero gases for the lower ranges that the M100EU is designed for can be difficult. For best results when calibrating the M100EU, wait **one hour** for the instrument to stabilize when delivering zero and span gases before pressing the zero and span buttons. Attention must be paid to the quality of the gasses, the level of contaminants in the gases as well as the history and conditioning of the gas delivery components. Only Teflon or glass should be used for any "wetted" surfaces that the calibration gasses contact. All delivery system components should be conditioned by running span gas for a minimum of four hours before conducting actual span calibrations.

USER NOTES:

8. EPA PROTOCOL CALIBRATION

The M100EU is designated as an equivalent method for measuring SO2 under certification EQSA-0495-100. Calibration of the M100EU is done so in a manner that is consistent with EPA requirements. For calibration in this manner please refer to section 8 of the M100E manual.

USER NOTES:

9. INSTRUMENT MAINTENANCE

Instrument maintenance is almost identical to that in the M100E. The M100EU uses a 1 micron sample filter, instead of the 5 micron sample filter used in the M100E. Replacement part numbers are shown below.

Part Number	Description
009690200	AKIT, TFE FLTR ELEMENT, 47MM, 1UM (100)
05920	UV Zinc LAMP, M100EU

For all other maintenance questions, please refer to section 9 in the M100E manual.

USER NOTES:

10. THEORY OF OPERATION

The M100EU is a modified M100E. The primary differences are the way in which the PMT and UV reference signals are acquired and processed. The M100EU has no shutter but rather employs synchronous demodulation to capture the dark and light PMT and UV reference signals several times per second. A printed circuit board, the Sync Demodulator, attached to the end of the PMT housing, on the sensor assembly, includes circuitry that digitizes the PMT and UV reference signals and synchronizes the operation of the UV source with these measurements. This method of signal processing minimizes the error that changing offsets could make in an instrument that is designed to operate near its detection limit.

10.1 ELECTRONIC OPERATION

The following information is in addition to that contained in Section 10.2 of the M100E Manual - P/N 04145.

10.1.1 SENSOR MODULE

At the heart of the M100EU's signal processing, illustrated in Figure 10-1 below, is the Synchronous Demodulator PCA. The PCA is attached to the end of the PMT housing and serves to seal the end of the PMT housing. The sync demodulator controls the operation of the UV Lamp driver, digitizes the analog output signals from the PMT UV reference detector and PMT temperature sensor, controls the PMT cooler (TEC), controls the PMT HV via a local I2C bus, and communicates with the analyzer's CPU over the master I2C bus. Digitized and processed data from the UV reference and PMT are passed to the analyzer's CPU over the master I2C bus and data for control of the PMT HV control DAC is passed from the CPU to the DAC on the PMT preamp via the microcontroller on the Sync Demod board.

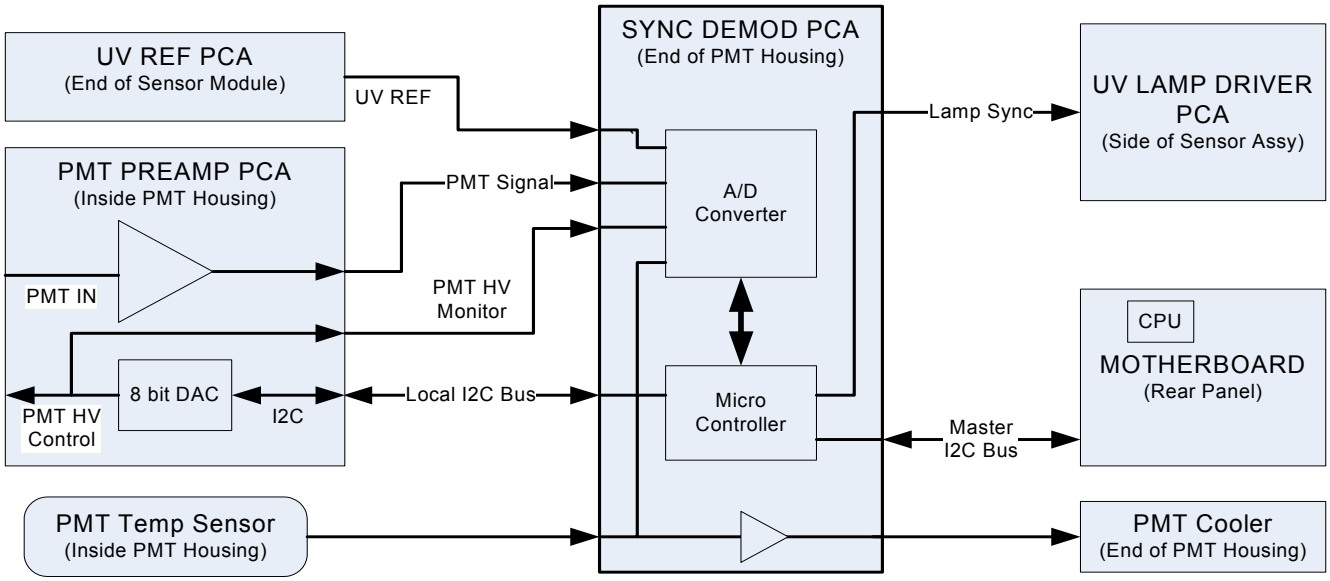


Figure 10-1: Sensor Block Diagram

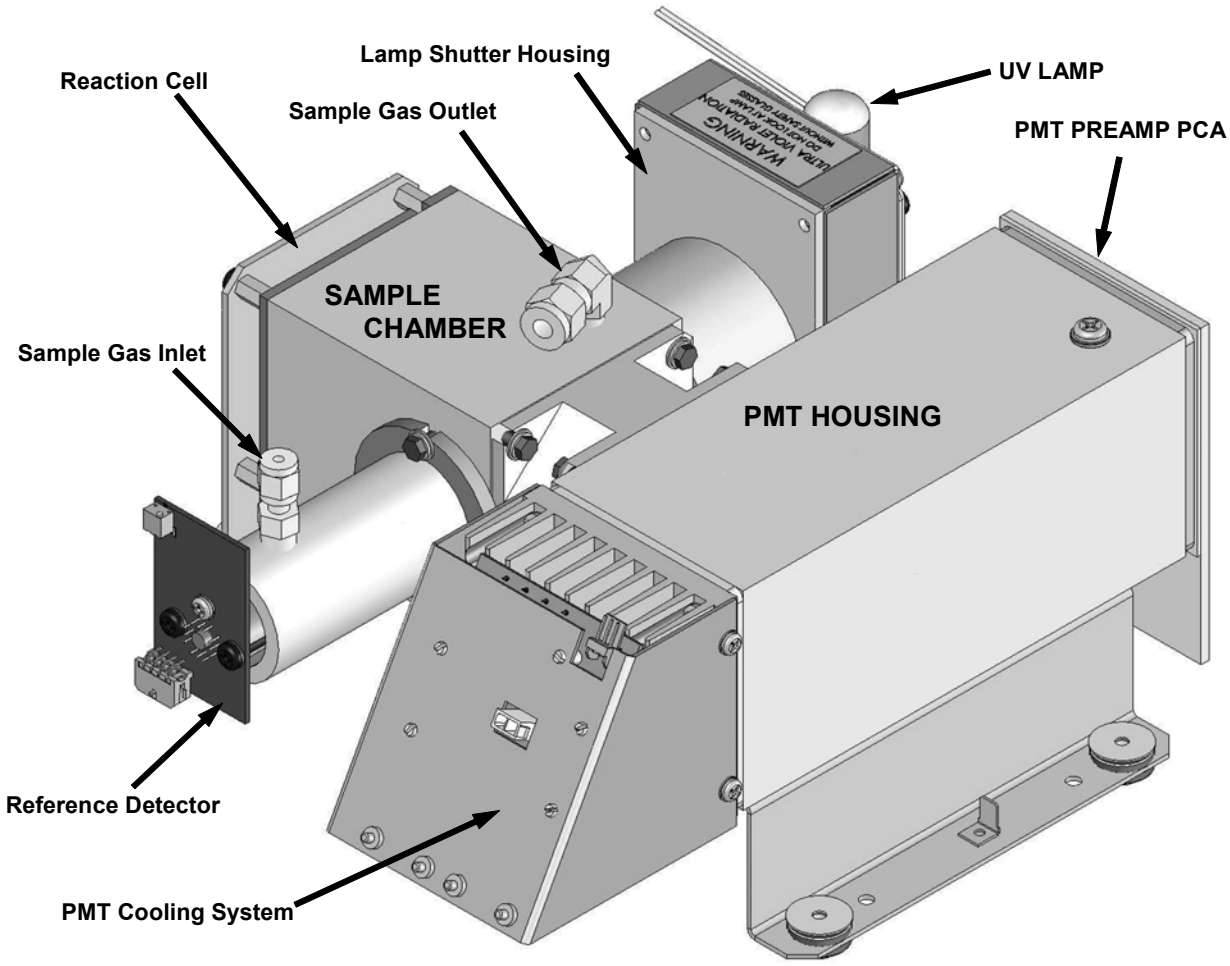


Figure 10-2: M100EU Sensor Module Assembly

These components are divided into two significant subassemblies. The sample chamber and the PMT assembly.

Figure 10-3 shows an exploded view of the sample chamber assembly

Figure 11-3 shows an exploded view of the PMT Assembly

10.1.1.1 Sample Chamber

The main electronic components of the sample chamber are the reference detector(see Section 10.2.2 of the M100E Manual - P/N 04145); the UV Lamp (see Section 10.2.1 of the M100E Manual - P/N 04145) and its electronically operated shutter (see Section 9.2.1 of this addendum); and the sample chamber heating circuit,

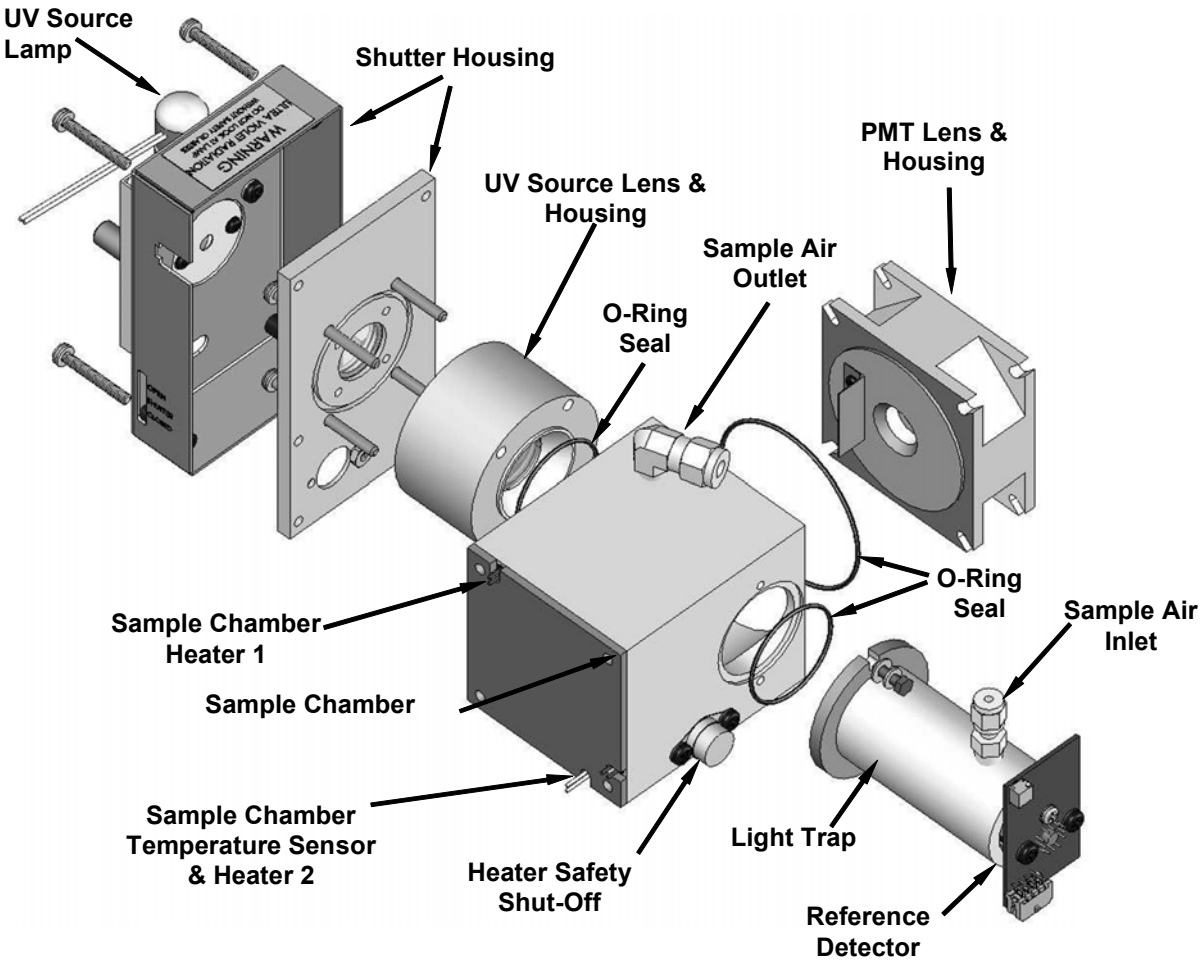


Figure 10-3: M100EU Sample Chamber Exploded View

User Notes:

11. TROUBLESHOOTING& REPAIR

This section includes various troubleshooting and repair information that is either in addition to that included in Chapter 11 of the M100E Manual (P/N 04145)

CAUTION

THE OPERATIONS OUTLINED IN THIS CHAPTER MUST BE PERFORMED BY QUALIFIED MAINTENANCE PERSONNEL ONLY.

PLEASE READ CHAPTER 11 OF THE M100E MANUAL (P/N 04145) BEFORE ATTEMPTING THE FOLLOWING TROUBLE SHOOTING OR REPAIR PROCEDURES

CAUTION

RISK OF ELECTRICAL SHOCK. SOME OPERATIONS NEED TO BE CARRIED OUT WITH THE ANALYZER OPEN AND RUNNING.

EXERCISE CAUTION TO AVOID ELECTRICAL SHOCKS AND ELECTROSTATIC OR MECHANICAL DAMAGE TO THE ANALYZER.

DO NOT DROP TOOLS INTO THE ANALYZER OR LEAVE THOSE AFTER YOUR PROCEDURES.

DO NOT SHORTEN OR TOUCH ELECTRIC CONNECTIONS WITH METALLIC TOOLS WHILE OPERATING INSIDE THE ANALYZER.

USE COMMON SENSE WHEN OPERATING INSIDE A RUNNING ANALYZER.

11.1.1 FAULT DIAGNOSIS WITH WARNING MESSAGES

The warning messages for the M100EU are identical to those included in Section 11.1.1 of the M100E Manual (P/N 04145)

11.1.2 FAULT DIAGNOSIS WITH TEST FUNCTIONS

The following table supersedes Table 11.2 of the M100E Manual - P/N 04145.

Table 11-1: Test Functions - Possible Causes for Out-Of-Range Values

TEST FUNCTION	NOMINAL VALUE(S)	POSSIBLE CAUSE(S)
STABIL (STANDARD)	≤0.075 ppb with zero air	Faults that cause high stability values are: pneumatic leak; low or very unstable UV lamp output; light leak; faulty HVPS; defective preamp board; aging PMT; PMT recently exposed to room light; dirty/contaminated reaction cell.
STABIL2 (EPA DEF)	≤0.075 ppb with zero air	Same as STABIL
SAMPLE FL	650 cm^3/min ± 10%	Faults can be caused by: clogged critical flow orifice; pneumatic leak; faulty flow sensor; sample line flow restriction.
PMT	-20 TO 150 mV with zero air	High or noisy readings could be due to: calibration error; pneumatic leak; light leak (improper assembly); aging UV filter; low UV reference output; PMT recently exposed to room light; light leak in reaction cell; reaction cell contaminated; HVPS problem. *It takes 24-48 hours for a PMT exposed to ambient light levels to return to normal functioning.*

(table continued)

Table 11-1: Test Functions - Possible Causes for Out-Of-Range Values

TEST FUNCTION	NOMINAL VALUE(S)	POSSIBLE CAUSE(S)
NORM PMT	- -	Noisy Norm PMT value (assuming unchanging SO_2 concentration of sample gas): Calibration error; HVPS problem; PMT problem; UV reference problem; UV lamp problem.
UV LAMP	2000 - 4000 mV	This is the instantaneous reading of the UV lamp intensity. Low UV lamp intensity could be due to: aging UV lamp; UV lamp position out of alignment; faulty lamp transformer; aging or faulty UV detector; dirty optical components. Intensity lower than 600 mV will cause **UV LAMP WARNING.**
UV STAB	0 to 100 mV	Unstable lamp or failed UV lamp driver.
LAMP RATIO	30 TO 120%	The current output of the UV reference detector divided by the reading stored in the CPU's memory from the last time a UV Lamp calibration was performed. Out of range lamp ratio could be due to: malfunctioning UV lamp; UV lamp position out of alignment; faulty lamp transformer; aging or faulty UV detector; dirty optical components; pin holes or scratches in the UV optical filters; light leaks.
STR LGT	<100 ppb	High stray light could be caused by: aging UV filter; contaminated reaction cell; light leak; pneumatic leak.
DRK PMT	200 - 325 mV	High dark PMT reading could be due to: light leak; high pmt temperature; high electronic offset.
DRK LMP	-50 - +200 mV	High dark UV detector could be caused by: light leak; high electronic offset.
HVPS	≈ 400 V to 900 V	Incorrect HVPS reading could be caused by; HVPS broken; preamp board circuit problems.
RCELL TEMP	50ºC ± 1ºC	Incorrect temperature reading could be caused by: malfunctioning heater; relay board communication (I^1C bus); relay burnt out
BOX TEMP	ambient + ~ 5ºC	Incorrect temperature reading could be caused by: Environment out of temperature operating range; broken thermistor; runaway heater
PMT TEMP	7ºC ± 2ºC constant	Incorrect temperature reading could be caused by: TEC cooling circuit broken; High chassis temperature; 12V power supply
IZS TEMP (OPTION)	50ºC ± 1ºC	Malfunctioning heater; relay board communication (I^1C bus); relay burnt out
PRESS	ambient ± 2 IN-HG-A	Incorrect SAMPLE pressure could be due to: pneumatic leak; malfunctioning valve; malfunctioning pump; clogged flow orifices; sample inlet overpressure; faulty pressure sensor
SLOPE	1.0 ± 0.3	Slope out of range could be due to: poor calibration quality ; span gas concentration incorrect; leaks; UV Lamp output decay.
OFFSET	< 250 mV	High offset could be due to: incorrect span gas concentration/contaminated zero air/leak; low-level calibration off; light leak; aging UV filter; contaminated reaction cell; pneumatic leak.
TIME OF DAY	Current time	Incorrect Time could be caused by: Internal clock drifting; move across time zones; daylight savings time?

11.1.3 FAULT DIAGNOSIS WITH SYNC DEMOD PCA LEDS

There are four green Light Emitting Diodes (LEDs) on the bottom left side of the Sync Demodulator PCA. They indicate various statuses and can be used to troubleshoot problems associated with the board.

Table 11-2: Relay PCA Status LED Failure Indications

Indicator	Function	Description	Action
DS4	Watchdog	Toggles on or off every second	Steady on or off controller on PCA has crashed, PMT temp. control still operates but PMT, REF and PMT Temp voltages as shown in test functions will be XXXX. Press reset button on sync demod to restart, if problem continues check power supply voltages on PCA or PCA is failing and must be replaced
DS3	I2C Activity	Flashes each time sync demod is polled by instrument CPU once every 1 to 1.5 seconds	Steady on or off indicates I2C bus failure check wiring harness taking I2C to motherboard, another I2C device is hanging bus, I2C transceiver on motherboard has failed, or CPU has problem
DS2	A/D Status 1	Short frequent flashes tracks timing of A/D converter	Lack of flash indicates internal failure of A/D or firmware. Press reset button on sync demod to restart, if problem continues check power supply voltages on PCA or PCA is failing and must be replaced
DS1	A/D Status 2		

11.2 OTHER PERFORMANCE PROBLEMS

Please refer to Section 11.4 of the M100E manual, P/N 04515 for information.

11.3 ADDITIONAL REPAIR PROCEDURES

The following repair procedures are in addition to those listed in Section 11.6 of the M100E Manual - P/N 04145,

11.3.1 UV LAMP ADJUSTMENT AND/OR REPLACEMENT

There are two ways in which ambient conditions can affect the UV Lamp output and therefore the accuracy of the SO2 concentration measurement. These are:

LAMP AGING

Over a period of months, the UV energy will show a downward trend, usually 30% - 50% in the first 90 days, and then a slower rate, until the end of useful life of the lamp. Periodically running the UV lamp calibration routine (see Section 6.9.7 of the M100E Manual - P/N 04145) will compensate for this until the lamp output becomes too low to function at all, 2-3 years nominally.

LAMP POSITIONING

The UV output level of the lamp is not even across the entire length of the lamp. Some portions of the lamp shine slightly more brightly than others. At the factory the position of the UV lamp is adjusted to optimize the amount of UV light shining through the UV filter/lens and into the reaction cell. Changes to the physical alignment of the lamp can affect the analyzer's ability to accurately measure SO_2. See Section 11.6.3.2 of the M100E Manual (P/N 04145) for instructions on adjusting the lamp position.

11.3.1.1 Adjusting the UV Lamp (*Peaking the Lamp*

CAUTION:

ALWAYS WEAR UV-PROTECTIVE, SAFETY GLASSES WHEN WORKING WITH THE UV LAMP ASSEMBLY

1. Set the analyzer display to show the signal I/O function, **UVLAMP_SIGNAL** (see Section 11.1.3 of the M100E Manual - P/N 04145). **UVLAMP_SIGNAL** is function 35.
2. Slightly loosen the large brass thumbscrew located on the shutter housing (see Figure 10-1) so that the lamp can be moved.
3. While watching the **UVLAMP_SIGNAL** reading, slowly rotate the lamp or move it back and forth vertically until the **UVLAMP_SIGNAL** reading is at its maximum.
    - Best peak intensity will occur when the dot (or arrow) on top of the lamp is pointing in the direction of the reaction cell.
    - Ideally, the reading should be 4000mV±200mV.
    - If **UVLAMP_SIGNAL** is lower than 600mV, replace the lamp.
    - If **UVLAMP_SIGNAL** is greater than 4400 mV, adjust the pot on the UV reference board down until the output reads 4400 mV, and then continue to peak the lamp.

NOTE:

DO NOT grasp the UV lamp by its cap when changing its position (see Figure 11-2).

Always grasp the main body of the lamp.

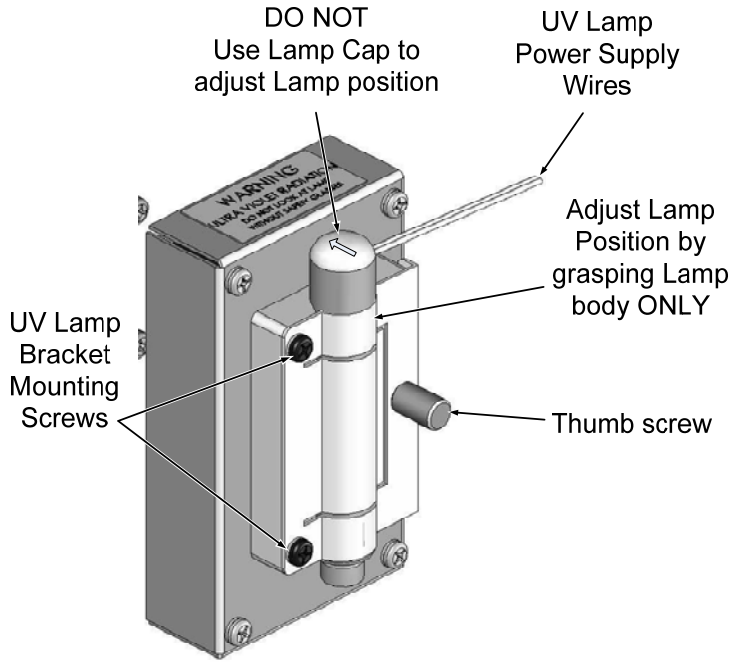


Figure 11-1: UV Lamp Adjustment

4. Finger tighten the thumbscrew

NOTE
DO NOT over tighten the thumbscrew

11.3.1.2 Replacing the UV Lamp

1. Turn off the analyzer.
2. Disconnect the UV lamp from its power supply.
   - You can find the power supply connector by following the two, white UV Lamp power supply wires from the lamp to the power supply.
3. Loosen, but do not remove the two UV lamp bracket screws, and the large brass thumbscrew located on the shutter housing (see Figure 11-2) so that the lamp can be moved.

NOTE:

DO NOT grasp the UV lamp by its cap when changing its position (see Figure 11-2).

Always grasp the main body of the lamp.

4. Remove the UV Lamp by pulling it straight up.
5. Insert the new UV lamp into the bracket.
6. Tighten the two UV lamp bracket screws, but leave the brass thumb screw un-tightened.
7. Connect the new UV lamp to the power supply.
8. Turn the instrument on and perform the UV adjustment procedure as defined in section 10.5.1.1 of this addendum
9. Finger tighten the thumbscrew.

NOTE:

DO NOT over-tighten the thumbscrew.

10. Perform a lamp calibration procedure (see Section 6.9.7 of the M100E Manual - P/N 04145) and a zero point and span point calibration (see Chapter 7 of the M100E Manual - P/N 04145).

11.3.2 REPLACING THE UV FILTER/LENS

Note:

Be careful not to leave thumbprints on the interior of the sample chamber. The various oils that make up fingerprints fluoresce brightly under UV light and will significantly affect the accuracy of the analyzer's SO_2 measurement)

1. Turn off the instrument's power and remove the power cord from the instrument.
2. Unplug the J4 connector from the motherboard to allow tool access.
3. Remove 4 screws from the lamp housing cover (see Figure 11-2) and remove the cover .
4. Remove 4 screws from the UV filter retainer.

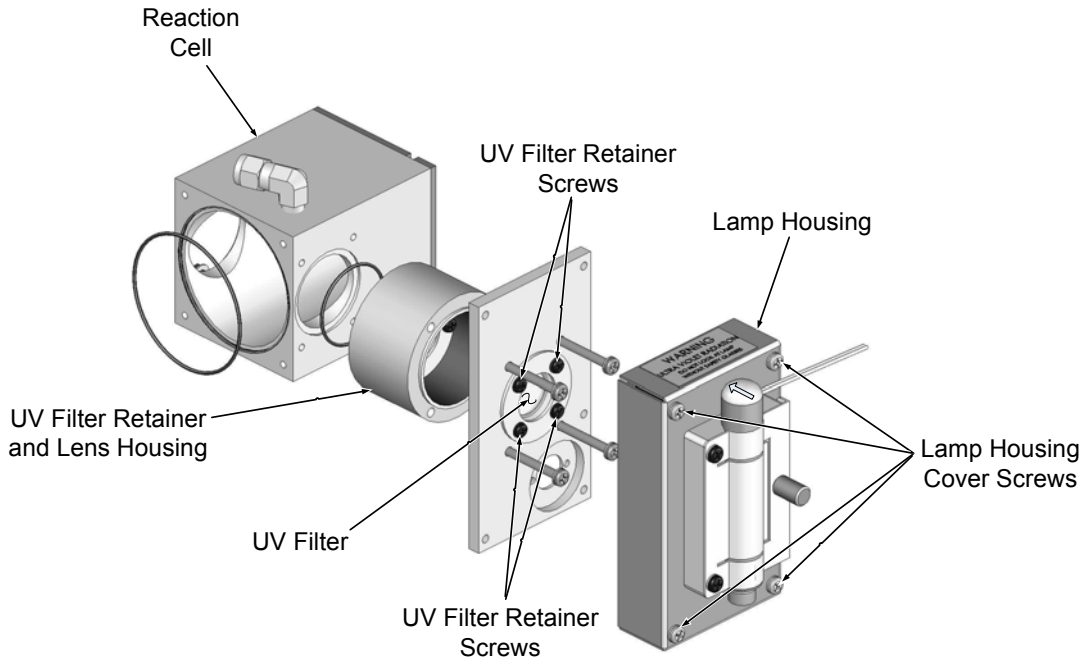


Figure 11-2: Disassembling the Shutter Assembly

5. Carefully remove the UV filter.
6. Install the UV filter with arrow pointing towards reaction cell. Handle carefully and never touch the filter's surface. The UV filter's wider (ring) side should be facing out. Install the UV filter retainer and tighten screws.
7. Install the lamp housing cover and mini-fit connector. Tighten 4 screws.
8. Re-plug J4 connector into the motherboard.

11.3.3 REPLACING THE PMT, HVPS OR TEC

The PMT should last for the lifetime of the analyzer. However, in some cases, the high voltage power supply (HVPS) or the thermo-electric cooler (TEC) may fail. To replace the PMT, the HVPS or the TEC:

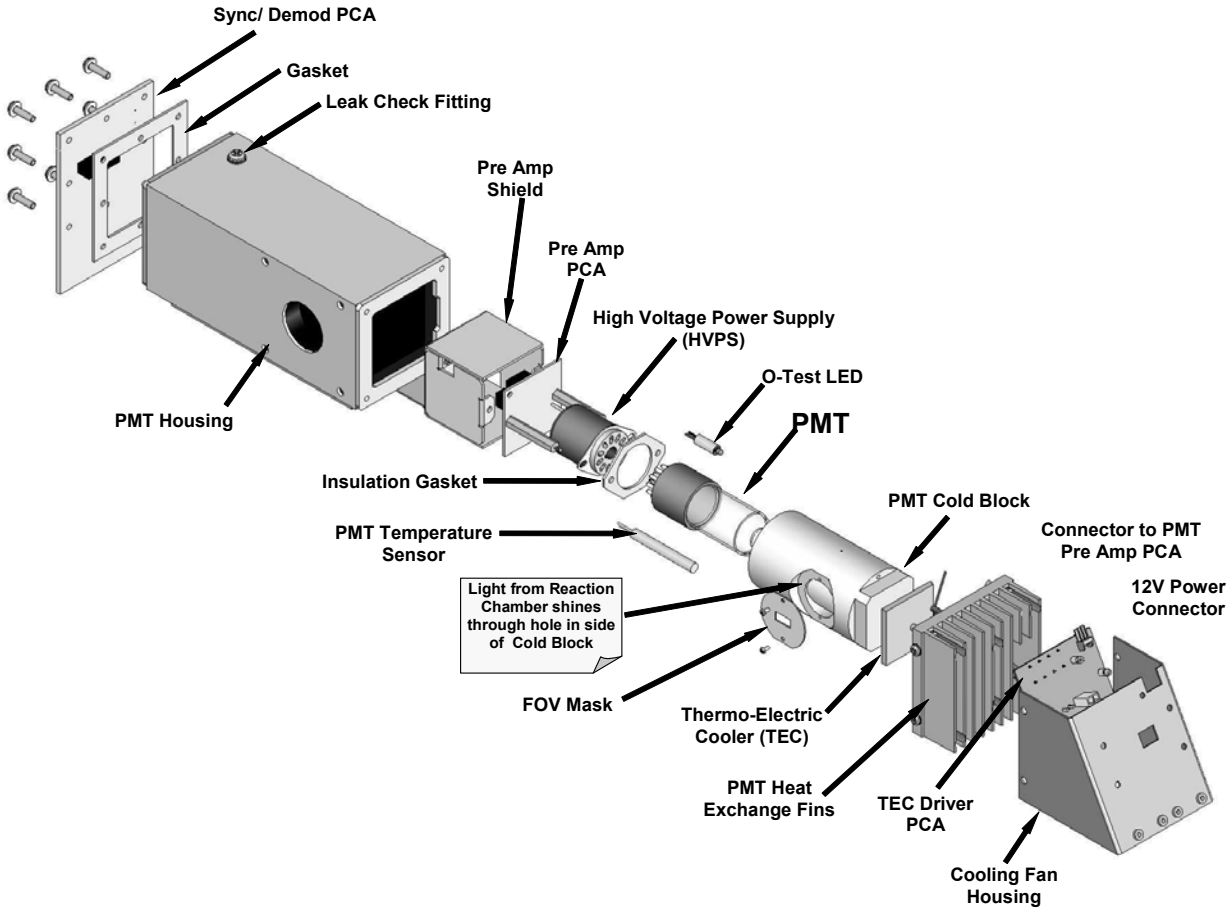


Figure 11-3: PMT Assembly - Exploded View

1. Power down the analyzer, disconnect the power cord, remove the cover and disconnect all pneumatic and electrical connections from the sensor assembly.
2. Remove the entire sensor module assembly from the analyzer.
3. Remove the fluorescence cell assembly.
4. Remove the two connectors on the Sync Demod board
5. Remove the Sync Demod Board (6 screws with plastic washers). Disconnect the electrical connector that leads to the preamp board further inside the housing.
6. Remove all of the desiccant bags inside the PMT housing.
7. Along with the plate, slide out the OPTIC TEST LED and the thermistor that measures the PMT temperature.
   - The thermistor will be coated with a white, thermal conducting paste. Do not contaminate the inside of the housing or the PMT tube with this grease.
8. Unscrew the PMT assembly. It is held to the cold block by two plastic screws.

- Because the threads of the plastic screws are easily damaged it is highly recommended to use new screws when reassembling the unit.

9. Carefully take out the assembly consisting of the HVPS, the gasket, preamp assembly and the PMT.
10. Change the PMT or the HVPS or both, clean the PMT glass tube with a clean, anti-static wipe and do not touch it after cleaning.
11. If the cold block or TEC is to be changed disconnect the TEC driver board from the preamplifier board.
    a) Remove the cooler fan duct (4 screws on its side) including the driver board.
    b) Disconnect the driver board from the TEC and set the sub-assembly aside.
    c) Remove the end plate with the cooling fins (4 screws) and slide out the PMT cold block assembly, which contains the TEC.
    d) Unscrew the TEC from the cooling fins and the cold block and replace it with a new unit.
12. Re-assemble the TEC subassembly in reverse order.

NOTE

The thermo-electric cooler needs to be mounted flat to the heat sink.

If there is any significant gap, the TEC might burn out.

Make sure to apply heat sink paste before mounting it and tighten the screws evenly and cross-wise.

    a) Make sure to use thermal grease between the TEC and the cooling fins as well as between the TEC and the cold block.
    b) Align the side opening in the cold block with the hole in the PMT housing where the sample Chamber attaches.
    c) Evenly tighten the long mounting screws for good thermal conductivity.
13. Re-insert the TEC subassembly.
    - Make sure that the O-ring is placed properly and the assembly is tightened evenly.
14. Insert the LED and thermistor into the cold bloc.
15. Re-insert the PMT/HVPS subassembly.
    - Don’t forget the gasket between HVPS and PMT.
    - Use new plastic screws to mount the PMT assembly on the PMT cold block.
16. Insert the new desiccant bags.
17. Reconnect the cable from the preamp board to the back of the Sync Demod board then carefully reattach the Sync Demod board to the housing
    - Make sure that the gasket is between the back of the board and the front of the PMT housing.
    - Be sure to tighten these screws evenly,
18. Reconnect the cables and the reaction cell
19. Replace the sensor assembly into the chassis and fasten with four screws and washers.
20. Reconnect all electrical and pneumatic connections, leak check the system and power up the analyzer.
    - Verify the basic operation of the analyzer using the ETEST and OTEST features (see Section 6.9.5 & 6.9.6 of the M100E Manual - P/N 04145) or by measuring calibrated zero and span gases.
21. Perform a PMT Hardware calibration (see Section 11.6.6 of the M100E Manual - P/N 04145)
22. Perform a zero point and span calibration (See Chapter 7 of the M100E Manual - P/N 04145)

11.3.4 M100EU PMT HARDWARE CALIBRATION (*FACTORY CAL*)

THIS PROCEDURE SUPERSEDES THE ONE CONTAINED IN SECTION 11.6.3 OF THE M100E MANUAL - P/N 04145.

The sensor module hardware calibration adjusts the slope of the PMT output when the Instruments slope and offset values are outside of the acceptable range and all other more obvious causes for this problem have been eliminated. Because the PMT HV is remotely controlled and there is no PMT preamp gain adjust, this procedure is done automatically through the analyzer software.

1. Set the instrument reporting range to **SNGL** & 500 ppb (see Section 6.7.4 of the M100E Manual - P/N 04145)
2. Perform a full zero–point calibration using zero air (see Chapter 7 of the M100E Manual - P/N 04145).
3. Let the instrument stabilize by allowing it to run for one hour.
4. Adjust the UV Lamp. (See Section 10.5.1.1 of this addendum)
5. Perform a **LAMP CALIBRATION** procedure (see Section 6.9.7 of the M100E Manual - P/N 04145).
6. Feed 400 ppb span gas into the analyzer.
7. Wait approximately 30-60 minutes (or until the stability reads ≤ 0.1 ppb), then under the DIAG menu select PMT CALIBRATION.
8. Either press **ENTR** if you are using 400 ppb or change the concentration value to what is appropriate and then press **ENTR**.
9. Select the range that you wish to setup (low or high).
10. Wait two to three minutes until you get a message that indicates the HV has been adjusted successfully.

NOTE

If a reporting range other than 500 ppb is used in this procedure:

Use a span gas equal to 80% of the reporting range and adjust the PMT to a target NORM PMT value of twice the ppb value of the span gas.

EXAMPLE
If the reporting range is 800 ppb then set the target concentration to 640 ppb for this procedure.

11. Wait until the **STABIL** value is ≤ 0.1 ppb.
12. Scroll to the NORM PMT value and verify that it is approximately twice the ppb value of the span gas.
13. Perform a zero / span calibration.
14. Check the slope and offset values and compare them to the values in Table 7-5 of the M100E Manual - P/N 04145.
15. Steps 7 - 14 may have to be performed more than once in order to compensate for any over/undershooting of the PMT reading based on the adjusted HVPS drive voltage. Best results occur after performing the PMT calibration (steps 7 - 14) at least two consecutive times

11.4 TECHNICAL ASSISTANCE

If this addendum and its trouble-shooting / repair sections do not solve your problems, technical assistance may be obtained from:

Teledyne Instruments
Advanced Pollution Instrumentation Division
(TAPI)
Customer Service
9480 Carroll Park Drive
San Diego, California 92121-5201USA

Toll-free Phone: 800-324-5190
Phone: 858-657-9800
Fax: 858-657-9816
Email: API-CustomerService@Teledyne.com
Website: http://www.Teledyne-API.com

Before you contact Teledyne Instruments' Customer service, fill out the problem report form in Appendix C, which is also available online for electronic submission at http://www.Teledyne-API.com/forms/p-fmapicom.asp.

USER NOTES:

APPENDIX A - Version Specific Software Documentation

APPENDIX A-1: MODEL 100EU SOFTWARE MENU TREES

APPENDIX A-2: MODEL 100EU SETUP VARIABLES AVAILABLE VIA SERIAL I/O

APPENDIX A-3: MODEL 100EU WARNINGS AND TEST MEASUREMENTS VIA SERIAL I/O

APPENDIX A-4: MODEL 100EU SIGNAL I/O DEFINITIONS

APPENDIX A-5: MODEL 100EU IDAS FUNCTIONS

APPENDIX A-6: MODEL 100EU TERMINAL COMMAND DESIGNATORS

APPENDIX A-1: M100E Software Menu Trees, Revision F.0B

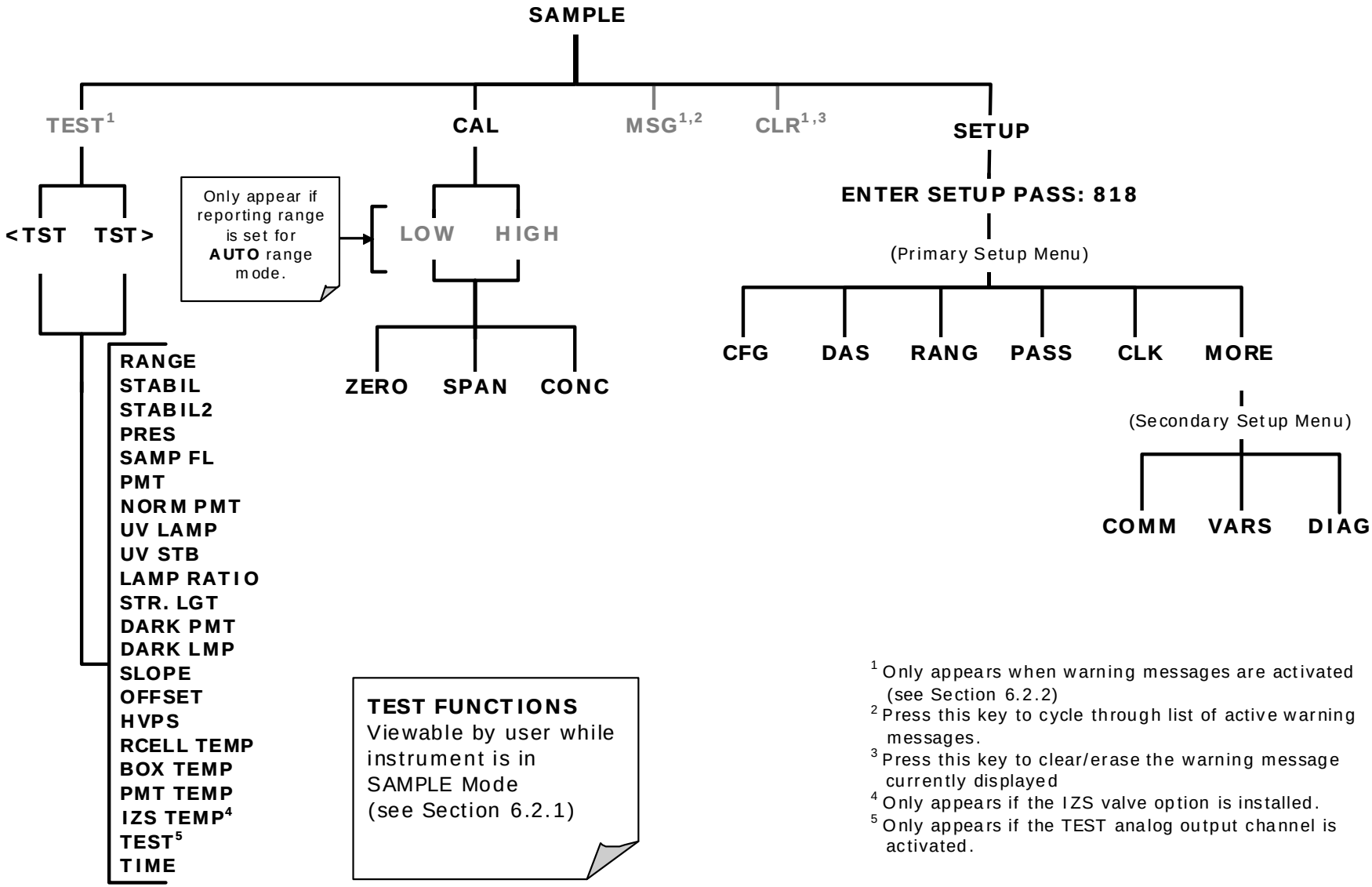


Figure A-1: Basic Sample Display Menu

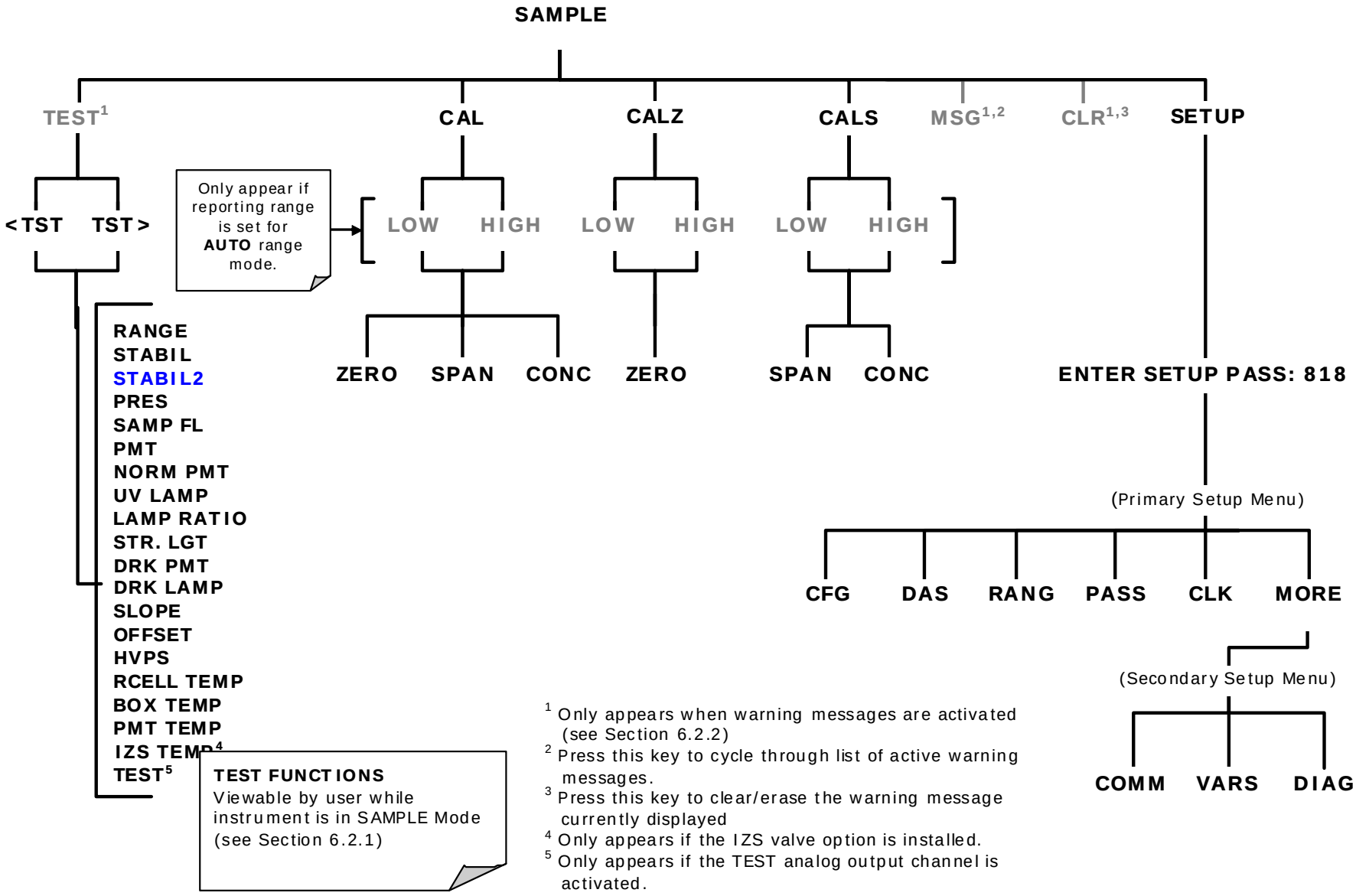


Figure A-2: Sample Display Menu - Units with Z/S Valve or IZS Option installed

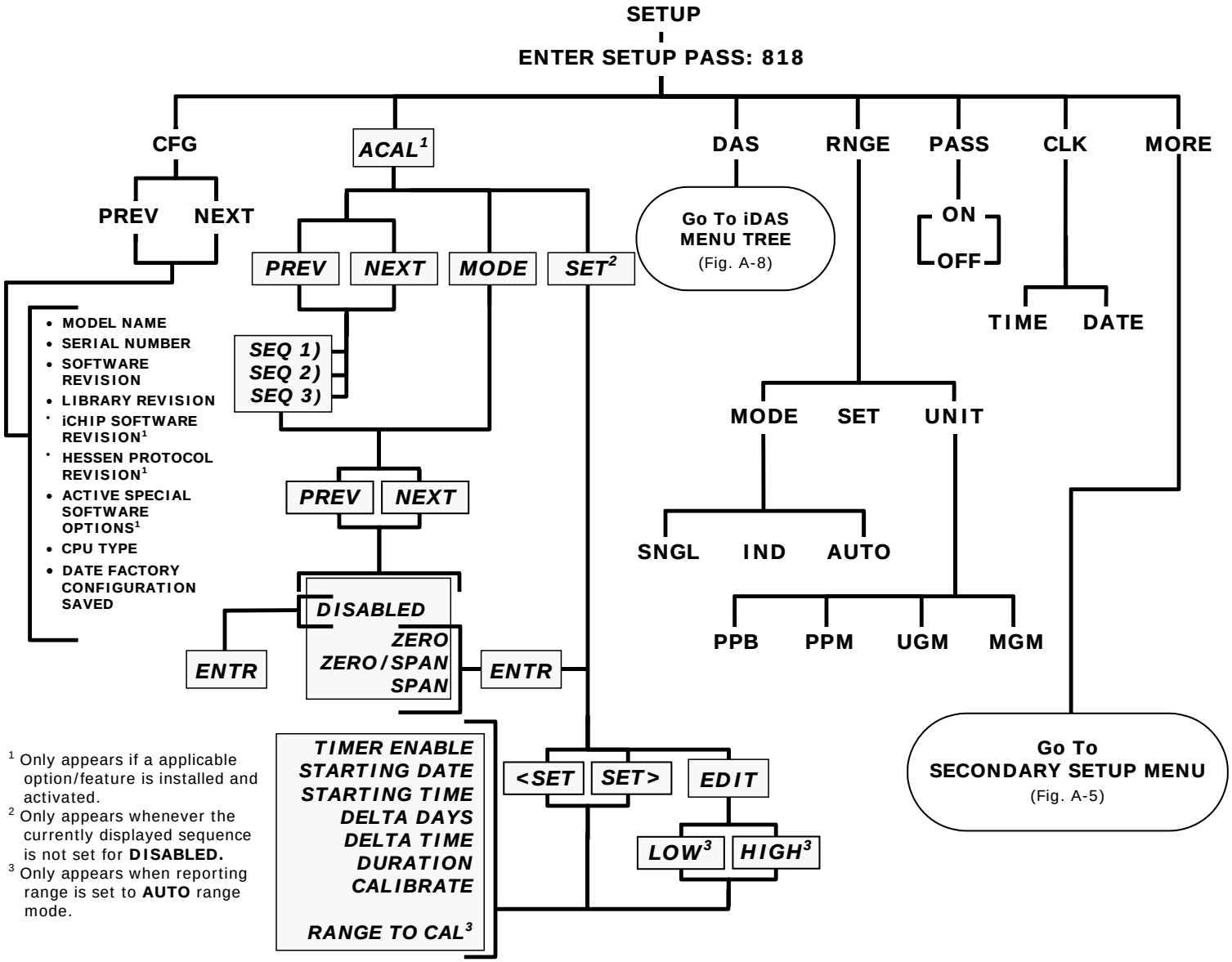


Figure A-3: Primary Setup Menu (Except iDAS)

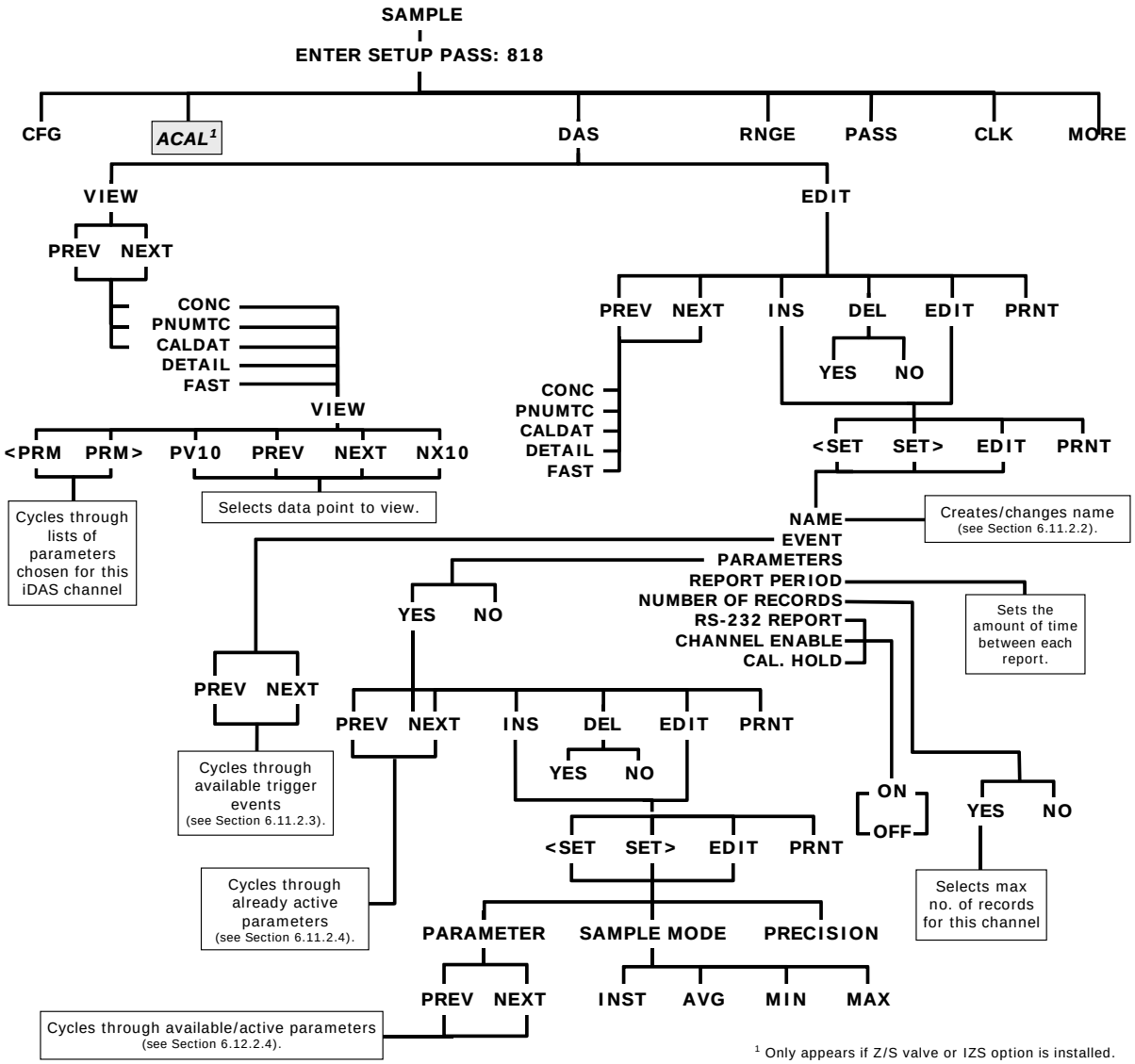


Figure A-4: Primary Setup Menu (iDAS)

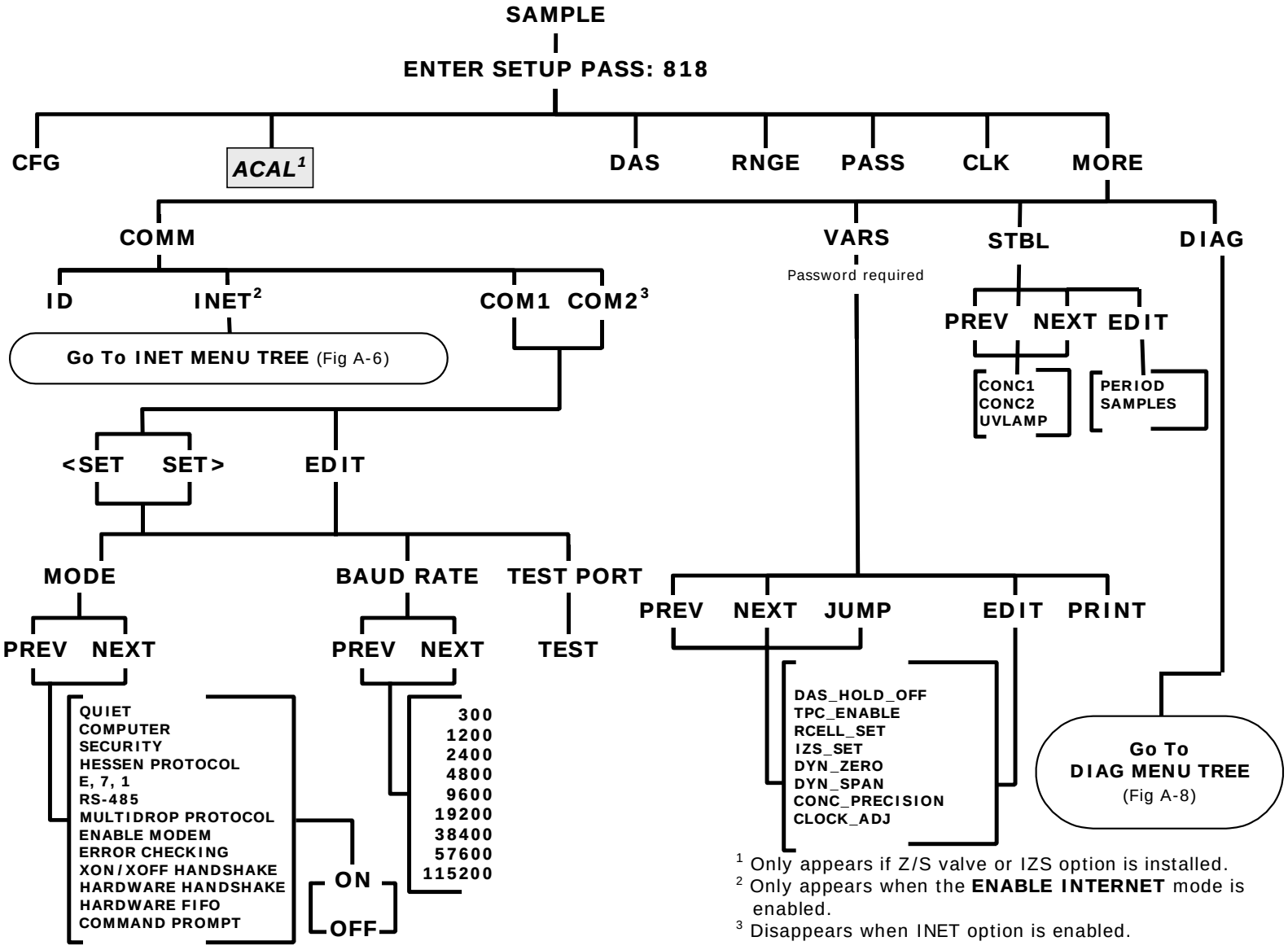
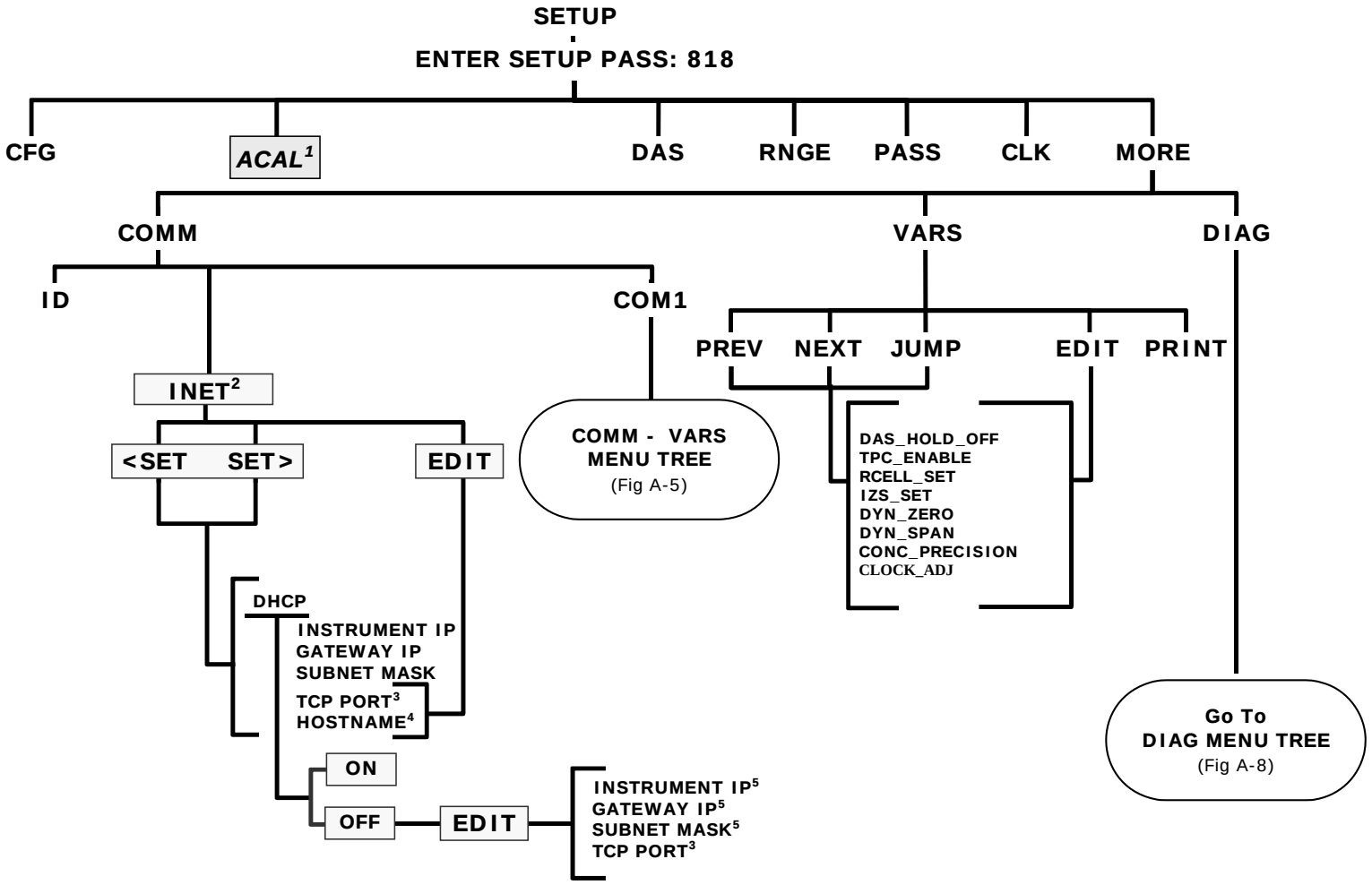


Figure A-5: Secondary Setup Menu (COMM & VARS)



[1] Only appears if a valve option is installed.
[2] Only appears when the Ethernet card (option 63) is installed.
[3] Although **TCP PORT** is editable regardless of the **DHCP** state, do not change the setting for this property unless instructed to by Teledyne Instruments Customer Service personnel.
[4] **HOST NAME** is only editable when DHCP is **ON**.
[5] **INSTRUMENT IP**, **GATEWAY IP** & **SUBNET MASK** are only editable when DHCP is **OFF**.

Figure A-6: Secondary Setup Menu (COMM Menu with Ethernet Card)

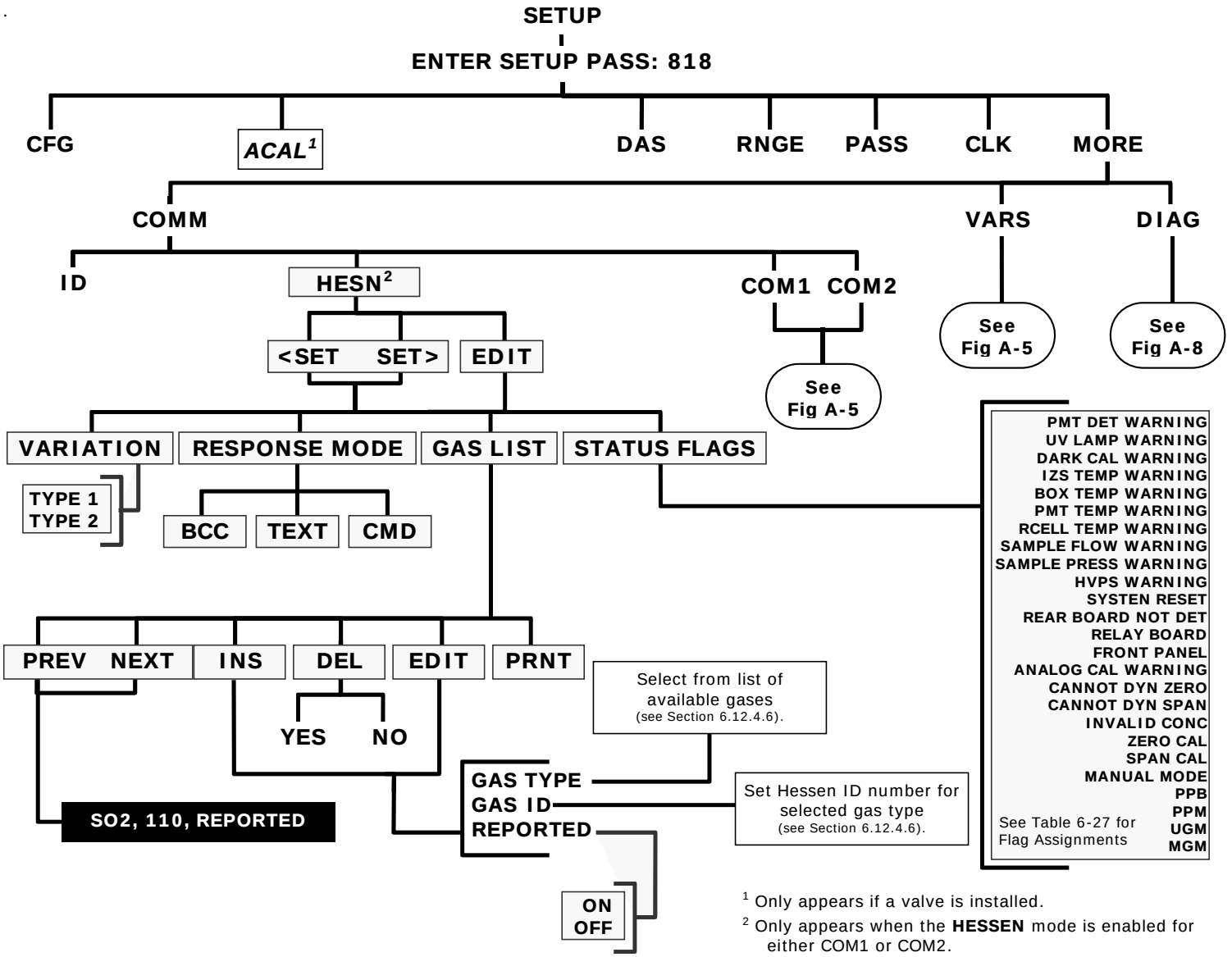


Figure A-7: Secondary Setup Menu - HESSEN Submenu

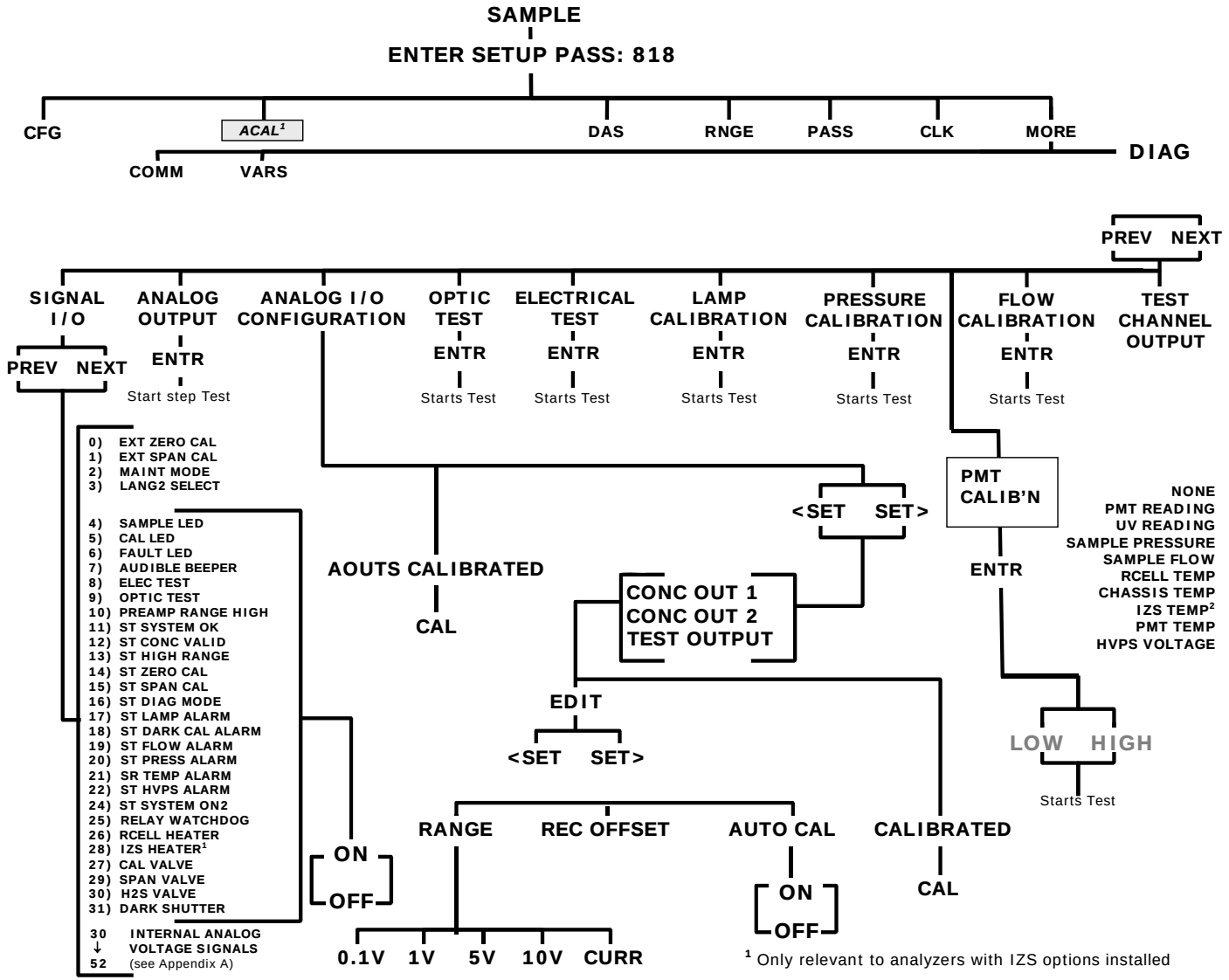


Figure A-8: Secondary Setup Menu (DIAG)

APPENDIX A-2: Setup Variables For Serial I/O, Revision F.0B

Table A-1: M100EU Setup Variables, Revision F.0B

M100EU Setup Variables for Latest Revision				
Setup Variable	**Numeric Units**	**Default Value**	**Value Range**	**Description**
DAS_HOLD_OFF	Minutes	15	0.5–20	Duration of DAS hold off period.
TPC_ENABLE	— ON,	OFF [4]	OFF, ON	ON enables temperature and pressure compensation; OFF disables it.
RCELL_SET	ºC	50 Warnings: 45–55	30–70	Reaction cell temperature set point and warning limits.
IZS_SET [1]	ºC	50 Warnings: 45–55	30–70	IZS temperature set point and warning limits.
DYN_ZERO	— OFF		OFF, ON	ON enables contact closure dynamic zero; OFF disables it.
DYN_SPAN	— OFF		OFF, ON	ON enables contact closure dynamic span; OFF disables it.
CONC_PRECISION	— 1		AUTO, 0, 1, 2, 3, 4	Number of digits to display to the right of the decimal point for concentrations on the display. Enclose value in double quotes (“) when setting from the RS-232 interface.
STABIL_GAS [99]	— SO2		SO2, O2 [10], CO2 [11]	Selects gas for stability test measurement.
CLOCK_ADJ	Sec./Day 0		-60–60	Time-of-day clock speed adjustment.
LANGUAGE_SELECT	— ENGL		ENGL, SECD, EXTN	Selects the language to use for the user interface. Enclose value in double quotes (“) when setting from the RS-232 interface.
MAINT_TIMEOUT	Hours 2		0.1–100	Time until automatically switching out of software-controlled maintenance mode.
CONV_TIME	—	33 MS	33 MS, 66 MS, 133 MS, 266 MS, 533 MS, 1 SEC, 2 SEC	Conversion time for PMT and UV detector channels. Enclose value in double quotes (“) when setting from the RS-232 interface.
DWELL_TIME	Seconds 1,		0.1–10	Dwell time before taking each

		0.2 [4]		sample.
FILT_SIZE	Samples 240,	30 [3], 5 [4]	1–480	Moving average filter size.
FILT_ASIZE	Samples 20,	6 [3]	1–100	Moving average filter size in adaptive mode.
FILT_DELTA	PPM 0.02,	10 [3]	0.001–0.1, 1–100[3]	Absolute change to trigger adaptive filter.
FILT_PCT	% 5,	10 [2]	1–100	Percent change to trigger adaptive filter.
FILT_DELAY	Seconds 180		0–300	Delay before leaving adaptive filter mode.
FILT_ADAPT	— ON,	OFF [4]	OFF, ON	ON enables adaptive filter; OFF disables it.
NEG_CONC_SUPPRESS	— OFF		OFF, ON	ON pegs negative concentrations at zero; OFF permits negative concentrations
DIL_FACTOR	— 1		0.1–1000	Dilution factor if dilution enabled with *FACTORY_OPT* variable.
CO2_DWELL [11]	Seconds 1		0.1–30	Dwell time before taking each sample.
CO2_FILT_ADAPT [11]	— ON		ON, OFF	ON enables CO_2 adaptive filter; OFF disables it.
CO2_FILT_SIZE [11]	Samples 48		1–300	CO_2 moving average filter size in normal mode.
CO2_FILT_ASIZE [11]	Samples 12		1–300	CO_2 moving average filter size in adaptive mode.
CO2_FILT_DELTA [11]	% 2		0.1–10	Absolute change in CO_2 concentration to shorten filter.
CO2_FILT_PCT [11]	% 10		0.1–100	Relative change in CO_2 concentration to shorten filter.
CO2_FILT_DELAY [11]	Seconds 90		0–300	Delay before leaving CO_2 adaptive filter mode.
CO2_DIL_FACTOR [11]	— 1		0.1–1000	Dilution factor for CO_2. Used only if is dilution enabled with *FACTORY_OPT* variable.
CO2_STD_CELL_TEMP [11]	ºK 323		1–500	Standard CO_2 cell temperature for temperature compensation.
CO2_STD_CELL_PRESS [11]	"Hg 28.50		1.00–50.00	Standard CO_2 cell pressure for pressure compensation.
O2_DWELL [10]	Seconds 1		0.1–30	Dwell time before taking each sample.
O2_FILT_ADAPT [10]	— ON		ON, OFF	ON enables O_2 adaptive filter; OFF disables it.
O2_FILT_SIZE [10]	Samples 60		1–500	O_2 moving average filter size in normal mode.
O2_FILT_ASIZE [10]	Samples 10		1–500	O_2 moving average filter size in adaptive mode.

O2_FILT_DELTA [10]	% 2		0.1–100	Absolute change in O_2 concentration to shorten filter.
O2_FILT_PCT [10]	% 2		0.1–100	Relative change in O_2 concentration to shorten filter.
O2_FILT_DELAY [10]	Seconds 20		0–300	Delay before leaving O_2 adaptive filter mode.
O2_DIL_FACTOR [10]	— 1		0.1–1000	Dilution factor for O_2. Used only if is dilution enabled with *FACTORY_OPT* variable.
O2_CELL_SET [10]	ºC	50 Warnings: 45–55	30–70	O_2 sensor cell temperature set point and warning limits.
O2_STD_CELL_TEMP [10]	ºK 323		1–500	Standard O_2 cell temperature for temperature compensation.
O2_STD_CELL_PRESS [10]	"Hg 28.50		1.00–50.00	Standard O_2 cell pressure for pressure compensation.
USER_UNITS	— PPB,	PPM [3]	PPB, PPM, UGM, MGM PPM, MGM [3]	Concentration units for user interface. Enclose value in double quotes (“) when setting from the RS-232 interface.
LAMP_DRIVE [6]	mV	5000	0–5000	Lamp power setting.
LAMP_CAL	mV	3500	1000–5000	Last calibrated UV lamp reading.
LAMP_GAIN	— 0.9		0.5–1.5	UV lamp compensation attenuation factor.
BXTEMP_TPC_GAIN	— 1,	0 [12]	0–10	Box temperature compensation attenuation factor.
SPRESS_TPC_GAIN	— 1		0–10	Sample pressure compensation attenuation factor.
PMT_TARG_CONC [12]	Conc 400		0.01–9999.99	Target SO_2 concentration during PMT calibration.
PMT_UPDATE_PERIOD [12]	Seconds 10		1–100	Period between HVPS gain updates during PMT calibration.
PMT_CAL_TIMEOUT [12]	Minutes 5		1–100	Maximum time for PMT calibration to succeed.
HVPS_ADJUST [12]	—	0	0–200	HVPS gain adjustment.
HVPS_INTEG [12]	Gain 5		0–500	Integral coefficient for adjusting HVPS gain during PMT calibration.
HVPS_STABIL [12]	— 1		0.1–10	HVPS gain must stabilize to within this limit for PMT calibration to succeed.
PMT_ADJUST [12]	—	0	0–65535	PMT gain adjustment.
SLOPE_CONST	— 8,	6.25 [3]	0.1–10	Constant to make visible slope close to 1.

DARK_MODE [5]	— AUT	O	OFF, AUTO, CMND	Dark calibration mode. OFF disables it; AUTO does it periodically; CMND does it only when commanded. Enclose value in double quotes (“) when setting from the RS-232 interface.
DARK_ENABLE [1, 3, 4]	— ON,	OFF [4]	OFF, ON	ON enables PMT/UV dark calibration; OFF disables it.
DARK_FREQ	Minutes 30,	720 [3]	0.1–1440	Dark calibration period.
DARK_PRE_DWELL	Seconds 10		1–60	Dwell time after closing dark shutter or turning off lamp or selecting preamp range.
DARK_POST_DWELL	Seconds 10,	30 [3]	1–180	Dwell time after opening dark shutter or turning on lamp.
DARK_SAMPLES	Samples 5		1–10	Number of dark samples to average.
DARK_FSIZE	Samples 2		1–100	Dark offset moving average filter size.
DARK_LIMIT	mV 200,	400 [3]	0–1000	Maximum dark offset allowed.
SO2_TARG_ZERO1	Conc 0		-100–999.99	Target SO_2 concentration during zero calibration of range 1.
SO2_SPAN1	Conc 400,	4000 [3]	0.01–9999.99	Target SO_2 concentration during span calibration of range 1.
SO2_SLOPE1	PPB/mV, PPM/mV [3]	1 0.25–	4	SO_2 slope for range 1.
SO2_OFFSET1	mV 0		-1500–1500	SO_2 offset for range 1.
SO2_TARG_ZERO2	Conc 0		-100–999.99	Target SO_2 concentration during zero calibration of range 2.
SO2_SPAN2	Conc 400,	4000 [3]	0.01–9999.99	Target SO_2 concentration during span calibration of range 2.
SO2_SLOPE2	PPB/mV, PPM/mV [3]	1 0.25–	4	SO_2 slope for range 2.
SO2_OFFSET2	mV 0		-1500–1500	SO_2 offset for range 2.
CO2_TARG_SPAN_CONC [11]	% 12		0.1–1000	Target CO_2 concentration during span calibration.
CO2_SLOPE [11]	— 1		0.5–5	CO_2 slope.
CO2_OFFSET [11]	% 0		-10–10	CO_2 offset.
O2_TARG_SPAN_CONC [10]	% 20.95		0.1–100	Target O_2 concentration during span calibration.
O2_SLOPE [10]	— 1		0.5–2	O_2 slope.
O2_OFFSET [10]	% 0		-10–10	O_2 offset.
RANGE_MODE	— SNGL		SNGL, DUAL, AUTO,	Range control mode. Enclose value in double quotes (“) when setting from the RS-232 interface.

			AUTO2	
PHYS_RANGE1	PPM 2,	500 [3]	0.1–2500, 5–10000 [3]	Low pre-amp range.
PHYS_RANGE2	PPM 22,	5500 [3]	0.1–2500, 5–10000 [3]	High pre-amp range.
CONC_RANGE1	Conc 500,	5000 [3]	0.1–50000	D/A concentration range 1.
CONC_RANGE2	Conc 500,	5000 [3]	0.1–50000	D/A concentration range 2.
CO2_RANGE [11]	% 15		0.1–500	CO_2 concentration range.
O2_RANGE [10]	% 100		0.1–500	O_2 concentration range.
SAMP_FLOW_SET	cc/m	700, 250 [1+9] Warnings: 350–1200, 175–325 [1+9]	0–6000	Sample flow set point for flow calculation and warning limits.
SAMP_FLOW_SLOPE	— 1		0.5–1.5	Sample flow slope correction factor (adjusted flow = measured flow x slope).
VAC_SAMP_RATIO [3]	— 0.53		0.1–2	Maximum vacuum pressure / sample pressure ratio for valid sample flow calculation.
SAMP_PRESS_SET	"Hg	29.92 Warnings: 15–35	0–100	Sample pressure set point for pressure compensation and warning limits.
VAC_PRESS_SET [3]	"Hg	6 Warnings: 3–10	0–100	Vacuum pressure set point for pressure compensation and warning limits.
BOX_SET	ºC	30 Warnings: 8–50	5–60	Box temperature warning limits. Set point is not used.
PMT_SET	ºC	7, 15 [12] Warnings: 2–12, 2–20 [12]	0–40	PMT temperature set point and warning limits.

RS232_MODE	BitFlag 0,	3 [5]	0–65535	RS-232 COM1 mode flags. Add values to combine flags. 1 = quiet mode 2 = computer mode 4 = enable security 8 = enable hardware handshaking 16 = enable Hessen protocol [8] 32 = enable multi-drop 64 = enable modem 128 = ignore RS-232 line errors 256 = disable XON / XOFF support 512 = disable hardware FIFOs 1024 = enable RS-485 mode 2048 = even parity, 7 data bits, 1 stop bit 4096 = enable command prompt 8192 = even parity, 8 data bits, 1 stop bit 16384 = enable dedicated MODBUS ASCII protocol 32678 = enable dedicated MODBUS RTU or TCP protocol
BAUD_RATE	— 192	00	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	RS-232 COM1 baud rate. Enclose value in double quotes (“) when setting from the RS-232 interface.
MODEM_INIT	—	“AT Y0 &D0 &H0 &I0 S0=2 &B0 &N6 &M0 E0 Q1 &W0”	Any character in the allowed character set. Up to 100 characters long.	RS-232 COM1 modem initialization string. Sent verbatim plus carriage return to modem on power up or manually. Enclose value in double quotes (“) when setting from the RS-232 interface.
RS232_MODE2	BitFlag	0	0–65535	RS-232 COM2 mode flags. *(Same settings as RS232_MODE.)*
BAUD_RATE2	— 192	00	300, 1200, 2400, 4800, 9600,	RS-232 COM2 baud rate. Enclose value in double quotes (“) when setting from the RS-232 interface.

			19200, 38400, 57600, 115200	
MODEM_INIT2	—	"AT Y0 &D0 &H0 &I0 S0=2 &B0 &N6 &M0 E0 Q1 &W0"	Any character in the allowed character set. Up to 100 characters long.	RS-232 COM2 modem initialization string. Sent verbatim plus carriage return to modem on power up or manually. Enclose value in double quotes (") when setting from the RS-232 interface.
RS232_PASS	Password	940331	0–999999	RS-232 log on password.
MACHINE_ID	ID	100	0–9999	Unique ID number for instrument.
COMMAND_PROMPT	— "Cmd>	"	Any character in the allowed character set. Up to 100 characters long.	RS-232 interface command prompt. Displayed only if enabled with *RS232_MODE* variable. Enclose value in double quotes (") when setting from the RS-232 interface.
TEST_CHAN_ID	— NONE		NONE, PMT READING, UV READING, VACUUM PRESSURE[3], SAMPLE PRESSURE, SAMPLE FLOW, RCELL TEMP, O2 CELL TEMP [10], CHASSIS TEMP, IZS TEMP [1], PMT TEMP, HVPS VOLTAGE	Diagnostic analog output ID. Enclose value in double quotes (") when setting from the RS-232 interface.
REMOTE_CAL_MODE	— LOW		LOW, HIGH, CO2 [11], O2 [10]	Range to calibrate during contact-closure and Hessen calibration. Enclose value in double quotes (") when setting from the RS-232 interface.
PASS_ENABLE	— OFF		OFF, ON	ON enables passwords; OFF disables them.
STABIL_FREQ [99]	Seconds 10		1–300	Stability measurement sampling period.
STABIL_SAMPLES [99]	Samples 25		2–40	Number of samples in concentration stability reading.
RCELL_CYCLE	Seconds 2		0.5–30	Reaction cell temperature control cycle period.

RCELL_PROP	1/ºC	0.3 (prop. band = 3.3 ºC)	0–10	Reaction cell temperature PID proportional coefficient.
RCELL_INTEG	— 0.005		0–10	Reaction cell temperature PID integral coefficient.
RCELL_DERIV	— 0.5		0–10	Reaction cell temperature PID derivative coefficient.
O2_CELL_CYCLE [10]	Seconds 10		0.5–30	O_2 cell temperature control cycle period.
O2_CELL_PROP [10]	— 1		0–10	O_2 cell PID temperature control proportional coefficient.
O2_CELL_INTEG [10]	— 0.1		0–10	O_2 cell PID temperature control integral coefficient.
O2_CELL_DERIV [10]	— 0	(disabled)	0–10	O_2 cell PID temperature control derivative coefficient.
IZS_CYCLE [1]	Seconds 2		0.5–30	IZS temperature control cycle period.
IZS_PROP [1]	1/ºC	1 (prop. band = 1 ºC)	0–10	IZS temperature PID proportional coefficient.
IZS_INTEG [1]	— 0.03		0–10	IZS temperature PID integral coefficient.
IZS_DERIV [1]	— 0		0–10	IZS temperature PID derivative coefficient.
HVPS_SET	Volts	650, 550 [3] Warnings: 400–900, 400–700 [3]	0–2000	High voltage power supply warning limits. Set point is not used.
MAX_PMT_DETECTOR	mV 499	5	0–5000	PMT detector maximum warning limit.
PHOTO_ABS_LIMITS [1]	mV	450 Warnings: 125–625	0–5000	Pre-amplified UV lamp minimum/maximum warning limits. Set point is not used.
UV_LAMP_LIMITS	mV	3500 Warnings: 1000–4995	0–5000	UV lamp minimum/maximum warning limits. Set point is not used.
ELEC_TEST_LEVEL [12]	—	0	0–65535	Electrical test level setting.
OPTIC_TEST_LEVEL [12]	—	0	0–65535	Optical test level setting.
CONC_LIN_ENABLE [3]	— ON		OFF, ON	*ON* enables concentration linearization; *OFF* disables it.
SERIAL_NUMBER	— “000	00000 ”	Any character in the allowed character set. Up to 100 characters long.	Unique serial number for instrument. Enclose value in double quotes (“) when setting from the RS-232 interface.
DISP_INTENSITY	— HIGH		HIGH, MED, LOW,	Front panel display intensity. Enclose value in double quotes (“) when setting from the RS-232 interface.

			DIM	
I2C_RESET_ENABLE	— ON		OFF, ON	I^2C bus automatic reset enable.
CLOCK_FORMAT	—	"TIME=%H:%M:%S"	Any character in the allowed character set. Up to 100 characters long.	Time-of-day clock format flags. Enclose value in double quotes (") when setting from the RS-232 interface. "%a" = Abbreviated weekday name. "%b" = Abbreviated month name. "%d" = Day of month as decimal number (01 – 31). "%H" = Hour in 24-hour format (00 – 23). "%I" = Hour in 12-hour format (01 – 12). "%j" = Day of year as decimal number (001 – 366). "%m" = Month as decimal number (01 – 12). "%M" = Minute as decimal number (00 – 59). "%p" = A.M./P.M. indicator for 12-hour clock. "%S" = Second as decimal number (00 – 59). "%w" = Weekday as decimal number (0 – 6; Sunday is 0). "%y" = Year without century, as decimal number (00 – 99). "%Y" = Year with century, as decimal number. "%%" = Percent sign.
FACTORY_OPT	BitFlag 0		0–65535	Factory option flags. Add values to combine flags. 1 = enable dilution factor 2 = zero/span valves installed 4 = IZS installed (implies zero/span valves installed) 8 = low span valve installed 16 = display units in concentration field 32 = enable software-controlled maintenance mode 64 = enable lamp power analog output 128 = enable switch-controlled maintenance mode 256 = compute only offset during zero calibration 1024 = enable high flow rate sensor

				2048 = enable Internet option 4096 = enable pre-amplified UV lamp monitoring

[1] M100E.
[2] M100ES.
[3] M100E H.
[4] M100EF .
[5] RP84 00S.
[6] Engineering firmware only.
[7] iChi p option.
[8] Must power-cycle instrument for these options to fully take effect.
[9] Low span option.
[10] O_2 option.
[11] CO $_2$ option.
[12] M100E U.
[99] Obsolete.

APPENDIX A-3: Warnings and Test Functions, Revision F.0B

Table A-2: M100EU Warning Messages, Revision F.0B

Name [1]	Message Text	Description
WSYSRES SYST	EM RESET	Instrument was power-cycled or the CPU was reset.
WDATAINIT	DATA INITIALIZED	Data storage was erased.
WCONFIGINIT CONFIG	INITIALIZED	Configuration storage was reset to factory configuration or erased.
WPMT	PMT DET WARNING	PMT detector outside of warning limits specified by *DETECTOR_LIMIT* variable.
WUVLAMP	UV LAMP WARNING	UV lamp reading outside of warning limits specified by *DETECTOR_LIMIT* variable.
WSAMPFLOW	SAMPLE FLOW WARN	Sample flow outside of warning limits specified by *SAMP_FLOW_SET* variable.
WSAMPPRESS	SAMPLE PRESS WARN	Sample pressure outside of warning limits specified by *SAMP_PRESS_SET* variable.
WVACPRESS [5]	VACUUM PRESS WARN	Vacuum pressure outside of warning limits specified by *VAC_PRESS_SET* variable.
WBOXTEMP BOX	TEMP WARNING	Chassis temperature outside of warning limits specified by *BOX_SET* variable.
WRCELLTEMP RCEL	L TEMP WARNING	Reaction cell temperature outside of warning limits specified by *RCELL_SET* variable.
WO2CELLTEMP [10]	O2 CELL TEMP WARN	O_2 sensor cell temperature outside of warning limits specified by *O2_CELL_SET* variable.
WIZSTEMP IZS	TEMP WARNING	IZS temperature outside of warning limits specified by *IZS_SET* variable.
WPMTTEMP	PMT TEMP WARNING	PMT temperature outside of warning limits specified by *PMT_SET* variable.
WDARKCAL [5]	DARK CAL WARNING	Dark offset above limit specified by *DARK_LIMIT* variable.
WHVPS HVPS	WARNING	High voltage power supply output outside of warning limits specified by *HVPS_SET* variable.
WDYNZERO	CANNOT DYN ZERO	Contact closure zero calibration failed while *DYN_ZERO* was set to *ON*.
WDYNSPAN	CANNOT DYN SPAN	Contact closure span calibration failed while *DYN_SPAN* was set to *ON*.
WREARBOARD	REAR BOARD NOT DET	Rear board was not detected during power up.
WRELAYBOARD	RELAY BOARD WARN	Firmware is unable to communicate with the relay board.
WFRONTPANEL	FRONT PANEL WARN	Firmware is unable to communicate with the front panel.
WANALOGCAL	ANALOG CAL WARNING	The A/D or at least one D/A channel has not been calibrated.

Table A-3: M100EU Test Functions, Revision F.0B

Name [1]	Message Text	Description
RANGE RANGE=	500.0 PPB [3] SO2 RNG=500.0 PPB [3, 10, 11]	D/A range in single or auto-range modes.
RANGE1 RANGE1=50	0.0 PPB [3] SO2 RN1=500.0 PPB [3, 10, 11]	D/A #1 range in independent range mode.
RANGE2 RANGE2=50	0.0 PPB [3] SO2 RN2=500.0 PPB [3, 10, 11]	D/A #2 range in independent range mode.
CO2RANGE	CO2 RNG=100 PCT [11] CO	$_2$ range.
O2RANGE O2	RNG=100 WT% [10]	O_2 range.
STABILITY ST	ABIL=0.0 PPB [3] SO2 STB=0.0 PPB [3, 10] O2 STB=0.0 WT% [10] CO2 STB=0.0 PCT [11]	Concentration stability #1. Configure with **SETUP-MORE-STBL**.
STABILITY2 [6] ST	ABIL2=0.0 PPB [3] SO2 STB2=0.0 PPB [3, 10] O2 STB2=0.0 WT% [10] CO2 STB2=0.0 PCT [11]	Concentration stability #2. Configure with **SETUP-MORE-STBL**.
RESPONSE [2] RSP=	1.11(0.00) SEC	Instrument response. Length of each signal processing loop. Time in parenthesis is standard deviation.
VACUUM [5] VAC=9.1	IN-HG-A	Vacuum pressure.
SAMPPRESS	PRES=29.9 IN-HG-A	Sample pressure.
SAMPFLOW	SAMP FL=700 CC/M	Sample flow rate.
PMTDET	PMT=762.5 MV	Raw PMT reading.
NORMPMTDET	NORM PMT=742.9 MV	PMT reading normalized for temperature, pressure, auto-zero offset, but not range.
UVDET	UV LAMP=3457.6 MV	UV lamp reading.
STABILITYUV [6]	UV STB=5.607 MV	UV lamp stability reading.
LAMPRATIO	LAMP RATIO=100.0 %	UV lamp ratio of current reading divided by calibrated reading.
STRAYLIGHT	STR. LGT=0.1 PPB	Stray light offset.
DARKPMT	DRK PMT=19.6 MV	PMT dark offset.
DARKLAMP	DRK LMP=42.4 MV	UV lamp dark offset.
SLOPE SLOPE=1.061		Slope for current range, computed during zero/span calibration.
OFFSET OF	FSET=250.0 MV	Offset for current range, computed during zero/span calibration.
CO2SLOPE [11] CO2	SLOPE=1.0000	CO_2 slope, computed during zero/span calibration.
CO2OFFSET [11]	CO2 OFFSET=0.00 %	CO_2 offset, computed during zero/span calibration.
O2SLOPE [10] O2	SLOPE=0.980	O_2 slope, computed during zero/span calibration.
O2OFFSET [10]	O2 OFFSET=1.79 %	O_2 offset, computed during zero/span

		calibration.
HVPS	HVPS=650 VOLTS	High voltage power supply output.
RCELLDUTY	RCELL ON=0.00 SEC	Reaction cell temperature control duty cycle.
RCELLTEMP	RCELL TEMP=52.1 C	Reaction cell temperature.
O2CELLTEMP [10]	O2 CELL TEMP=50.2 C	O_2 sensor cell temperature.
BOXTEMP	BOX TEMP=35.5 C	Internal chassis temperature.
PMTTEMP	PMT TEMP=7.0 C	PMT temperature.
IZSDUTY	IZS ON=0.00 SEC	IZS temperature control duty cycle.
IZSTEMP	IZS TEMP=52.2 C	IZS temperature.
SO2 SO2=	261.4 PPB	SO_2 concentration for current range.
CO2 [11] CO2=	0.00 PCT	CO_2 concentration.
O2 [10] O2=0.00	WT%	O_2 concentration.
TESTCHAN T	EST=3721.1 MV	Value output to *TEST_OUTPUT* analog output, selected with *TEST_CHAN_ID* variable.
CLOCKTIME T	IME=10:38:27	Current instrument time of day clock.

[1] The name is used to request a message via the RS-232 interface, as in “T BOXTEMP”.

[2] Engi neering software.

[3] Current instrument units.

[4] M100E.

[5] M100E H.

[6] M100E U.

[10] O_2 option.

[11] CO $_2$ option.

APPENDIX A-4: M100Eu Signal I/O Definitions, Revision F.0B

Table A-4: M100EU Signal I/O Definitions, Revision F.0B

Signal Name	Bit or Channel Number	Description
Internal inputs, U7, J108, pins 9–16 = bits 0–7, default I/O address 322 hex		
0–7		Spare
AUX board digital outputs, default I^2C address 30 hex		
ELEC_TEST [3]	0	1 = electrical test on 0 = off
OPTIC_TEST [3]	1	1 = optic test on 0 = off
DARK_TEST [3]	2	1 = dark test on 0 = off
PREAMP_RANGE_HI [3]	3	1 = select high preamp range 0 = select low range
Internal outputs, U8, J108, pins 1–8 = bits 0–7, default I/O address 322 hex		
ELEC_TEST	0	1 = electrical test on 0 = off
OPTIC_TEST	1	1 = optic test on 0 = off
PREAMP_RANGE_HI	2	1 = select high preamp range 0 = select low range
3–5		Spare
I2C_RESET	6	1 = reset I^2C peripherals 0 = normal
I2C_DRV_RST	7	0 = hardware reset 8584 chip 1 = normal
Control inputs, U11, J1004, pins 1–6 = bits 0–5, default I/O address 321 hex		
EXT_ZERO_CAL	0	0 = go into zero calibration 1 = exit zero calibration
EXT_SPAN_CAL	1	0 = go into span calibration 1 = exit span calibration
EXT_LOW_SPAN [2, 6]	2	0 = go into low span calibration 1 = exit low span calibration
3–5		Spare
6–7		Always 1
Control inputs, U14, J1006, pins 1–6 = bits 0–5, default I/O address 325 hex		
0–5		Spare
6–7		Always 1
Control outputs, U17, J1008, pins 1–8 = bits 0–7, default I/O address 321 hex		
0–7		Spare

Control outputs, U21, J1008, pins 9–12 = bits 0–3, default I/O address 325 hex		
0–3		Spare
Alarm outputs, U21, J1009, pins 1–12 = bits 4–7, default I/O address 325 hex		
ST_SYSTEM_OK2, MB_RELAY_36 [9]	4	1 = system OK 0 = any alarm condition or in diagnostics mode
		Controlled by MODBUS coil register
MB_RELAY_37 [9]	5	Controlled by MODBUS coil register
MB_RELAY_38 [9]	6	Controlled by MODBUS coil register
MB_RELAY_39 [9]	7	Controlled by MODBUS coil register
A status outputs, U24, J1017, pins 1–8 = bits 0–7, default I/O address 323 hex		
ST_SYSTEM_OK	0	0 = system OK 1 = any alarm condition
ST_CONC_VALID	1	0 = conc. valid 1 = warnings or other conditions that affect validity of concentration
ST_HIGH_RANGE	2	0 = high auto-range in use 1 = low auto-range
ST_ZERO_CAL	3	0 = in zero calibration 1 = not in zero
ST_SPAN_CAL	4	0 = in span calibration 1 = not in span
ST_DIAG_MODE 5		0 = in diagnostic mode 1 = not in diagnostic mode
ST_LOW_SPAN_CAL [2, 6]	6	0 = in low span calibration 1 = not in low span
7		Spare
B status outputs, U27, J1018, pins 1–8 = bits 0–7, default I/O address 324 hex		
ST_LAMP_ALARM	0	0 = lamp intensity low 1 = lamp intensity OK
ST_DARK_CAL_ALARM	1	0 = dark cal. warning 1 = dark cal. OK
ST_FLOW_ALARM	2	0 = any flow alarm 1 = all flows OK
ST_PRESS_ALARM	3	0 = any pressure alarm 1 = all pressures OK
ST_TEMP_ALARM	4	0 = any temperature alarm 1 = all temperatures OK
ST_HVPS_ALARM	5	0 = HVPS alarm 1 = HVPS OK
ST_CO2_CAL [11]	6	0 = in CO_2 calibration 1 = not in CO_2 calibration
ST_O2_CAL [10]	7	0 = in O_2 calibration 1 = not in O_2 calibration
Front panel I^2C keyboard, default I^2C address 4E hex		

MAINT_MODE	5 (input)	0 = maintenance mode 1 = normal mode
LANG2_SELECT	6 (input)	0 = select second language 1 = select first language (English)
SAMPLE_LED	8 (output)	0 = sample LED on 1 = off
CAL_LED	9 (output)	0 = cal. LED on 1 = off
FAULT_LED	10 (output)	0 = fault LED on 1 = off
AUDIBLE_BEEPER	14 (output)	0 = beeper on (for diagnostic testing only) 1 = off
Relay board digital output (PCF8575), default I^2C address 44 hex		
RELAY_WATCHDOG 0		Alternate between 0 and 1 at least every 5 seconds to keep relay board active
RCELL_HEATER	1	0 = reaction cell heater on 1 = off
2–3		Spare
IZS_HEATER	4	0 = IZS heater on 1 = off
O2_CELL_HEATER [10]	5	0 = O_2 sensor cell heater on 1 = off
CAL_VALVE	6	0 = let cal. gas in 1 = let sample gas in
SPAN_VALVE	7	0 = let span gas in 1 = let zero gas in
LOW_SPAN_VALVE [2, 6]	8	0 = let low span gas in 1 = let sample gas in
CYLINDER_VALVE [7]	8	0 = open pressurized span inlet valve 1 = close valve
ZERO_VALVE [2]	9	0 = let zero gas in 1 = let sample gas in
DARK_SHUTTER	10	0 = close dark shutter 1 = open
11–	15	Spare
AUX board analog inputs, default I^2C address 30 hex		
PMT_SIGNAL [3]	0 (register number)	PMT detector
UVLAMP_SIGNAL [3]	1	UV lamp intensity
NORM_PMT_SIGNAL [3]	2	Normalized PMT detector
PMT_TEMP [3] 3		PMT temperature
HVPS_VOLTAGE [3]	4	HV power supply output
PMT_DARK [3]	5	PMT reading during dark cycles
LAMP_DARK [3]	6	Lamp reading during dark cycles

AGND_DARK [3]	7	AGND reading during dark cycles
AGND_LIGHT [3]	8	AGND reading during light cycles
VREF_DARK [3]	9	VREF4096 reading during dark cycles
VREF_LIGHT [3]	10	VREF4096 reading during light cycles
Rear board primary MUX analog inputs		
	PMT detector	
HVPS_VOLTAGE	1	HV power supply output
PMT_TEMP 2		PMT temperature
UVLAMP_SIGNAL	3	UV lamp intensity
4		Temperature MUX
PHOTO_ABS [8]	5	Pre-amplified UV lamp intensity
O2_SENSOR [10] 6		O_2 concentration sensor
SAMPLE_PRESSURE 7		Sample pressure
TEST_INPUT_8	8	Diagnostic test input
REF_4096_MV	9	4.096V reference from MAX6241
SAMPLE_FLOW	10	Sample flow rate
VACUUM_PRESSURE [2] 10		Vacuum pressure
CO2_SENSOR [11] 11		CO_2 concentration sensor
	12–13	Spare (thermocouple input?)
14		DAC MUX
REF_GND 15		Ground reference
Rear board temperature MUX analog inputs		
BOX_TEMP	0	Internal box temperature
RCELL_TEMP	1	Reaction cell temperature
IZS_TEMP 2		IZS temperature
3		Spare
O2_CELL_TEMP [10] 4		O_2 sensor cell temperature
TEMP_INPUT_5	5	Diagnostic temperature input
TEMP_INPUT_6	6	Diagnostic temperature input
7		Spare
Rear board DAC MUX analog inputs		
DAC_CHAN_1	0	DAC channel 0 loopback
DAC_CHAN_2	1	DAC channel 1 loopback
DAC_CHAN_3	2	DAC channel 2 loopback
DAC_CHAN_4	3	DAC channel 3 loopback
Rear board analog outputs		
CONC_OUT_1, DATA_OUT_1	0	Concentration output #1 (SO_2, range #1), Data output #1
CONC_OUT_2, DATA_OUT_2	1	Concentration output #2 (SO_2, range #2), Data output #2
CONC_OUT_3 [10,] DATA_OUT_3	2	Concentration output #3 (CO_2 or O_2), Data output #3

TEST_OUTPUT, DATA_OUT_4	3	Test measurement output, Data output #4
I^2C analog output (AD5321), default I^2C address 18 hex		
LAMP_POWER [5]	0	Lamp power (0–5V)

[1] Optional.
[2] M100E H.
[3] M100E U.
[4] M100EF .
[5] Engineering firmware only.
[6] Low span option.
[7] Pressurized span option.
[8] M100E.
[9] MODBUS option.
[10] O_2 option.
[11] CO_2 option.

M100E MODBUS Register Map		
MODBUS Register Address (dec., 0-based)	**Description**	**Units**
MODBUS Floating Point Input Registers (32-bit IEEE 754 format; read in high-word, low-word order; read-only)		
0	PMT detector reading	mV
2 [1]	Pre-amplified UV lamp intensity reading	mV
4	UV lamp intensity reading	mV
6	UV lamp ratio of calibrated intensity	%
8 PMT	electrical offset	mV
10	UV lamp electrical offset	mV
12 SO	$_2$ slope for range #1	—
14 SO	$_2$ slope for range #2	—
16 SO	$_2$ offset for range #1	mV
18 SO	$_2$ offset for range #2	mV
20	SO_2 concentration for range #1 during zero/span calibration, just before computing new slope and offset	PPB, PPM [2]
22	SO_2 concentration for range #2 during zero/span calibration, just before computing new slope and offset	PPB
24 SO	$_2$ concentration for range #1	PPB
26 SO	$_2$ concentration for range #2	PPB
28 [12] SO	$_2$ concentration for range #1, with O_2 correction	PPB
30 [12] SO	$_2$ concentration for range #2, with O_2 correction	PPB
32 Conc	entration stability	PPB
34	Stray light reading	PPB
36	Reaction cell temperature	°C
38 [1] IZ	S temperature	°C
40 PMT	temperature	°C
42 [1, 2] Sample	flow	cc/m
44 Sampl	e pressure	“Hg
46 [2] Vacuum	pressure	“Hg
48	Internal box temperature	°C
50	High voltage power supply output	Volts
52	Diagnostic test input (TEST_INPUT_8)	mV
54	Diagnostic temperature input (TEMP_INPUT_5)	°C
56	Diagnostic temperature input (TEMP_INPUT_6)	°C
58	Ground reference (REF_GND)	mV
60	4096 mV reference (REF_4096_MV)	mV
100 [10]	O_2 concentration	%

102 [10]	O_2 concentration during zero/span calibration, just before computing new slope and offset	%
104 [10]	O_2 slope	—
106 [10]	O_2 offset	%
108 [10]	O_2 sensor cell temperature	°C
200 [11] CO	$_2$ concentration	%
202 [11]	CO_2 concentration during zero/span calibration, just before computing new slope and offset	%
204 [11] CO	$_2$ slope	—
206 [11] CO	$_2$ offset	%
MODBUS Floating Point Holding Registers (32-bit IEEE 754 format; read/write in high-word, low-word order; read/write)		
0 Maps	to *SO2_SPAN1* variable; target conc. for range #1	Conc. units
2 Maps	to *SO2_SPAN2* variable; target conc. for range #2	Conc. units
100 [10] Maps	to *O2_TARG_SPAN_CONC* variable	%
200 [11] Maps	to *CO2_TARG_SPAN_CONC* variable	%
MODBUS Discrete Input Registers (single-bit; read-only)		
0	PMT detector warning	
1 UV	detector warning	
2 Dark	calibration warning	
3 [1] IZ	S temperature warning	
4 Box	temperature warning	
5 PMT	temperature warning	
6	Reaction cell temperature warning	
7 Sampl	e flow warning	
8 Sampl	e pressure warning	
9 [2] Vacuum	pressure warning	
10 HVPS	warning	
11	System reset warning	
12	Rear board communication warning	
13 Rela	y board communication warning	
14	Front panel communication warning	
15 Anal	og calibration warning	
16 D	ynamic zero warning	
17 D	ynamic span warning	
18 Invali	d concentration	
19	In zero calibration mode	
20 [2]	In low span calibration mode	
21	In span calibration mode	
22	In multi-point calibration mode	
23	In Hessen manual mode	
24	System is OK (same meaning as *SYSTEM_OK* I/O signal)	

100 [10] In	O_2 calibration mode
101 [10]	O_2 cell temperature warning
200 [11] In	CO_2 calibration mode
MODBUS Coil Registers (single-bit; read/write)	
0	Maps to relay output signal 36 (*MB_RELAY_36* in signal I/O list)
1	Maps to relay output signal 37 (*MB_RELAY_37* in signal I/O list)
2	Maps to relay output signal 38 (*MB_RELAY_38* in signal I/O list)
3	Maps to relay output signal 39 (*MB_RELAY_39* in signal I/O list)
20 [13]	Triggers zero calibration of range #1 (on enters cal.; off exits cal.)
21 [13]	Triggers span calibration of range #1 (on enters cal.; off exits cal.)
22 [13]	Triggers zero calibration of range #2 (on enters cal.; off exits cal.)
23 [13]	Triggers span calibration of range #2 (on enters cal.; off exits cal.)

[1] M100E.

[2] M100E H.

[10] O_2 option.

[11] CO_2 option.

[12] SO_2 with O_2 correction option.

[13] Set *DYN_ZERO* or *DYN_SPAN* variables to *ON* to enable calculating new slope or offset. Otherwise a calibration check is performed.

APPENDIX A-5: M100EU iDAS Functions, Revision F.0B

Table A-5: M100EU DAS Trigger Events, Revision F.0B

Name	Description
ATIMER	Automatic timer expired
EXITZR	Exit zero calibration mode
EXITLS [2, 3]	Exit low span calibration mode
EXITHS	Exit high span calibration mode
EXITMP	Exit multi-point calibration mode
EXITO2 [10]	Exit O_2 calibration mode
SLPCHG	Slope and offset recalculated
CO2SLC [11]	CO_2 slope and offset recalculated
O2SLPC [10]	O_2 slope and offset recalculated
EXITDG	Exit diagnostic mode
PMTDTW	PMT detector warning
UVLMPW	UV lamp warning
DRKCLW [1]	Dark calibration warning
RCTMPW	Reaction cell temperature warning
O2TMPW [10]	O_2 sensor cell temperature warning
IZTMPW [1]	IZS temperature warning
PTEMPW	PMT temperature warning
SFLOWW	Sample flow warning
SPRESW	Sample pressure warning
VPRESW [2]	Vacuum pressure warning
BTEMPW	Box temperature warning
HVPSW	High voltage power supply warning

[1] M100E.
[2] M100E H.
[3] Low span option.
[10] O_2 option.
[11] CO 2 option.

Table A-6: M100EU iDAS Functions, Revision F.0B

Name	Description	Units
PMTDET	PMT detector reading	mV
PHABS [1]	Pre-amplified UV lamp intensity reading	mV
UVDET	UV lamp intensity reading	mV
LAMPR	UV lamp ratio of calibrated intensity	%
DRKPMT	PMT electrical offset	mV
DARKUV	UV lamp electrical offset	mV
SLOPE1	SO_2 slope for range #1	—

SLOPE2	SO_2 slope for range #2	—
OFSET1	SO_2 offset for range #1	mV
OFSET2	SO_2 offset for range #2	mV
CO2SLP [11]	CO_2 slope	—
CO2OFS [11]	CO_2 offset	%
O2SLPE [10]	O_2 slope	—
O2OFST [10]	O_2 offset	%
ZSCNC1	SO_2 concentration for range #1 during zero/span calibration, just before computing new slope and offset	PPB, PPM [2]
ZSCNC2	SO_2 concentration for range #2 during zero/span calibration, just before computing new slope and offset	PPB
CO2ZSC [11]	CO_2 concentration during zero/span calibration, just before computing new slope and offset	%
O2ZSCN [10]	O_2 concentration during zero/span calibration, just before computing new slope and offset	%
CONC1	SO_2 concentration for range #1	PPB
CONC2	SO_2 concentration for range #2	PPB
SO2CR1 [12]	SO_2 concentration for range #1, with O_2 correction	PPB
SO2CR2 [12]	SO_2 concentration for range #2, with O_2 correction	PPB
CO2CNC [11]	CO_2 concentration	%
O2CONC [10]	O_2 concentration	%
STABIL	Concentration stability #1	PPB
STABL2 [3]	Concentration stability #2	PPB
STABUV [3]	UV lamp stability	mV
STRLGT	Stray light reading	PPB
RCTEMP	Reaction cell temperature	°C
O2TEMP [10]	O_2 sensor cell temperature	°C
IZSTMP [1]	IZS temperature	°C
PMTTMP	PMT temperature	°C
SMPFLW [1, 2]	Sample flow	cc/m
SMPPRS	Sample pressure	“Hg
VACUUM [2]	Vacuum pressure	“Hg
BOXTMP	Internal box temperature	°C
HVPS	High voltage power supply output	Volts
TEST8	Diagnostic test input (TEST_INPUT_8)	mV
TEMP5	Diagnostic temperature input (TEMP_INPUT_5)	°C
TEMP6	Diagnostic temperature input (TEMP_INPUT_6)	°C
REFGND	Ground reference (REF_GND)	mV
RF4096	4096 mV reference (REF_4096_MV)	mV
AGNDDK [3]	AGND reading during dark cycles	mV
AGNDLT [3]	AGND reading during light cycles	mV
RF4VDK [3]	VREF4096 reading during dark cycles	mV
RF4VLT [3]	VREF4096 reading during light cycles	mV

[1] M100E.
[2] M100E H.
[3] M100E U.
[10] O_2 option.
[11] CO_2 option.
[12] SO_2 with O_2 correction option.

APPENDIX A-6: Terminal Command Designators, Revision F.0B

Table A-7: Terminal Command Designators, Revision F.0B

COMMAND A	DDITIONAL COMMAND SYNTAX	DESCRIPTION
? [ID]		Display help screen and this list of commands
LOGON [ID]	Password	Establish connection to instrument
LOGOFF [ID]		Terminate connection to instrument
T [ID]	SET ALL|name|hexmask	Display test(s)
	LIST [ALL|name|hexmask] [NAMES|HEX]	Print test(s) to screen
	Name	Print single test
	CLEAR ALL|name|hexmask	Disable test(s)
W [ID]	SET ALL|name|hexmask	Display warning(s)
	LIST [ALL|name|hexmask] [NAMES|HEX]	Print warning(s)
	name	Clear single warning
	CLEAR ALL|name|hexmask	Clear warning(s)
C [ID]	ZERO|LOWSPAN|SPAN [1|2]	Enter calibration mode
	ASEQ number	Execute automatic sequence
	COMPUTE ZERO|SPAN	Compute new slope/offset
	EXIT	Exit calibration mode
	ABORT	Abort calibration sequence
D [ID]	LIST	Print all I/O signals
	name[=value]	Examine or set I/O signal
	LIST NAMES	Print names of all diagnostic tests
	ENTER name	Execute diagnostic test
	EXIT	Exit diagnostic test
	RESET [DATA] [CONFIG] [exitcode] Reset	instrument
	PRINT ["name"] [SCRIPT]	Print iDAS configuration
	RECORDS ["name"]	Print number of iDAS records
	REPORT ["name"] [RECORDS=number] [FROM=<start date>][TO=<end date>][VERBOSE|COMPACT|HEX] (Print DAS records)(date format: MM/DD/YYYY(or YY) [HH:MM:SS]	Print iDAS records
	CANCEL	Halt printing iDAS records
V [ID]	LIST	Print setup variables
	name[=value [warn_low [warn_high]]]	Modify variable
	name="value"	Modify enumerated variable
	CONFIG	Print instrument configuration
	MAINT ON|OFF	Enter/exit maintenance mode
	MODE	Print current instrument mode
	DASBEGIN [<data channel definitions>] DASEND	Upload iDAS configuration
	CHANNELBEGIN propertylist CHANNELEND	Upload single iDAS channel
	CHANNELDELETE ["name"]	Delete iDAS channels

The command syntax follows the command type, separated by a space character. Strings in [brackets] are optional designators. The following key assignments also apply.

TERMINAL KEY ASSIGNMENTS	
ESC Abort	line
CR (ENTER)	Execute command
Ctrl-C	Switch to computer mode
COMPUTER MODE KEY ASSIGNMENTS	
LF (line feed)	Execute command
Ctrl-T	Switch to terminal mode

USER NOTES:

APPENDIX B - SPARE PARTS LISTS

- 053600100 – M100EU Spare Parts List
- 059460000 – M100EU Recommended Spares Stocking Levels

M100EU Spare Parts List

Part Number	Description
000940100	ORIFICE, 3 MIL, IZS
000940800	ORIFICE, 012 MIL, RXCELL
002690000	LENS, UV
002700000	LENS, PMT
002720000	FILTER, PMT OPTICAL, 330 NM
003290000	ASSY, THERMISTOR
005960000	AKIT, EXPEND, 6LBS ACT CHARCOAL
009690200	AKIT, TFE FLTR (FL19) ELEM, 47MM, (100)
009690300	AKIT, TFE FLTR ELEMENT, 47MM, 1UM (30)
013140000	ASSY, COOLER FAN (NOX/SOX)
013210000	ASSY, VACUUM MANIFOLD, M100A/E
013390000	ASSY, KICKER, M100A/E
013400000	PMT, SO2, M100A/E
013420000	ASSY, ROTARY SOLENOID, M100A/E/U/H
013570000	ASSY, THERMISTOR (COOLER)
014400100	OPTION, ZERO AIR SCRUBBER, M100E
014750000	AKIT, EXP KIT, M100A/M100E, IZS
016290000	WINDOW, SAMPLE FILTER, 47MM (KB)
016300700	ASSY, SAMPLE FILTER, 47MM, ANG BKT (KB)
037860000	ORING, TFE RETAINER, SAMPLE FILTER
040010000	ASSY, FAN REAR PANEL, E SERIES
040030100	PCA, FLOW/PRESSURE
041710000	ASSY, CPU, CONFIGURATION, "E" SERIES *
042410200	ASSY, PUMP, INT, E SERIES
042580000	PCA, KEYBOARD, E-SERIES, W/V-DETECT
042900100	PROGRAMMED FLASH, E SERIES
043570000	AKIT, EXPENDABLES, M100E/M101E/M108E
043940000	PCA, INTERFACE, ETHERNET, E-SERIES
044670000	PCA, ANALOG OUTPUT ISOLATOR, E SERIES
045150100	MANUAL, OPERATION, M100E
045230200	PCA, RELAY CARD W/RELAYS, E SERIES, S/N'S >455
046250000	ASSY, RXCELL HEATER/FUSE, M100E
046260000	ASSY, THERMISTOR, RXCELL, M100E (KB)
048620200	PCA, SERIAL INTERFACE, w/ MD, E SERIES
048830000	AKIT, EXP KIT, EXHAUST CLNSR, SILCA GEL
049310100	PCA, TEC CONTROL, E SERIES
050610100	CONFIGURATION PLUGS, 115V/60Hz
050610200	CONFIGURATION PLUGS, 115V/50Hz
050610300	CONFIGURATION PLUGS, 220-240V/50Hz
050610400	CONFIGURATION PLUGS, 220-240V/60Hz
050630200	PCA, REF DET w/OP20, DUAL OUT, M100EU
051990000	ASSY, SCRUBBER, INLINE EXHAUST, DISPOS
052660000	ASSY, HEATER/THERMISTOR (IZS)
054340000	PCA, PRECISION INT. PMT PREAMP, M100EU
054650000	PCA, SYNC/DEMOD, M100EU
055100200	OPTION, PUMP ASSY, 240V *

M100EU Spare Parts List

Part Number	Description
055560000	ASSY, VALVE, VA59 W/DIODE, 5" LEADS
055920000	ASSY, SO2 SENSOR, M100EU (KB)
055930100	DOC, W/SOFTWARE, M100EU
056080000	ASSY, HVPS, M100EU PMT
058020100	PCA, E-SERIES MOTHERBOARD, GEN 5
059200000	ASSY, UV LAMP, M100EU
061930200	PCA, 100EU, UV LAMP DRIVER, GEN-2
CN0000458	CONNECTOR, REAR PANEL, 12 PIN
CN0000520	CONNECTOR, REAR PANEL, 10 PIN
DS0000025	DISPLAY, E SERIES (KB)
FL0000001	FILTER, SS
FL0000003	FILTER, DFU
FM0000004	FLOWMETER (KB)
HW0000005	FOOT, CHASSIS
HW0000020	SPRING
HW0000036	TFE TAPE, 1/4" (48 FT/ROLL)
KIT000093	REPLACEMENT KIT, 214NM FLTR (03187)
KIT000095	AKIT, REPLACEMENT COOLER, A/E SERIES
KIT000219	KIT, 4-20MA CURRENT OUTPUT (E SERIES)
KIT000253	KIT, SPARE PS37, E SERIES
KIT000254	KIT, SPARE PS38, E SERIES
OP0000031	WINDOW, QUARTZ, REF DETECTOR
OR0000001	ORING, FLOW CONTROL/IZS
OR0000004	ORING, OPTIC/CELL, CELL/TRAP
OR0000006	ORING, CELL/PMT
OR0000007	ORING, PMT/BARREL/CELL
OR0000015	ORING, PMT FILTER
OR0000016	ORING, UV LENS
OR0000025	ORING, ZERO AIR SCRUBBER
OR0000027	ORING, COLD BLOCK/PMT HOUSING & HEATSINK
OR0000039	ORING, QUARTZ WINDOW/REF DETECTOR
OR0000046	ORING, PERMEATION OVEN
OR0000083	ORING, PMT SIGNAL & OPTIC LED
OR0000084	ORING, UV FILTER
OR0000094	ORING, SAMPLE FILTER
PU0000022	KIT, PUMP REBUILD
RL0000015	RELAY, DPDT, (KB)
SW0000051	SWITCH, POWER, CIRC BR
SW0000059	PRESSURE SENSOR, 0-15 PSIA, ALL SEN
WR0000008	POWER CORD, 10A

Teledyne Advanced Pollution Instrumentation

RECOMMENDED SPARE PARTS STOCKING LEVELS
Model 100EU

		UNITS				
PART NO	**DESCRIPTION**	**1**	**2-5**	**6-10**	**11-20**	**21-30**
000940800	Orifice, 12 Mil		1	2	4	4
002720000	Filter, 330 NM			1	2	3
013140000	Cooler Fan	1	1	2	4	4
013400000	PMT, SO2				1	1
014080100	Assy, HVPS, NOX/SOX					1
014610000	Kit, Replacement Cooler					1
040010000	Assy, Fan, Rear Panel, E Series	1	1	2	4	4
040030100	PCA, Press Sensors (1X), Flow, E Series		1	2	4	4
041710000	CPU, Configuration E Series				1	1
042410400	Assy, Pump, Internal, E Series, 115/240V					1
042580000	PCA, Keyboard				1	1
045230200	PCA, Relay Board w/Diode Protection			1	1	2
050630200	PCA, M100EU UV Ref Det, Dual Out				1	2
054340000	PCA, Prescision INT, PMT Preamp				1	1
054650000	PCA, Sync/Demod				1	1
054710000	Assy, UV Lamp, M100E		1	2	4	4
055120200	PCA, Bursting UV Driver, M100EU		1	1	2	2
057020100	PCA, Motherboard, E Series, GEN 4				1	2
DS0000025	Display				1	1

	IZS/ZS Option					
055560000	ASSY, VALVE, VA59 W/DIODE, E-SERIES		1	2	2	4

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Appendix C – Warranty Repair Questionnaire

CUSTOMER: _____ PHONE: _____

CONTACT NAME: _____ FAX NO. _____

SITE ADDRESS: _____

MODEL 100EU SERIAL NO.: _____ FIRMWARE REVISION: _____

1. ARE THERE ANY FAILURE MESSAGES? _____

_____

_____

2. PLEASE COMPLETE THE FOLLOWING TABLE: **(NOTE: *DEPENDING ON OPTIONS INSTALLED, NOT ALL TEST PARAMETERS BELOW WILL BE AVAILABLE IN YOUR INSTRUMENT)***

Parameter ***IF OPTION IS INSTALLED**	**Recorded Value**	**Acceptable Value**
RANGE	PPB/PPM	
STABIL	PPB	≤0.3 PPB WITH ZERO AIR
STABIL2	PPB	<= 1 PPB WITH ZERO AIR
PRESS	IN-HG-A	AMBIENT (- 2) IN-HG-A
SAMPLE FLOW	cm^3/MIN	650 ± 10%
PMT SIGNAL WITH ZERO AIR	mV	-20 TO 150 mV
PMT SIGNAL AT SPAN GAS CONC	mV PPB/PPM	0-5000 mV 0-20000 PPB
NORM PMT AT SPAN GAS CONC	mV PPB/PPM	0-5000 mV 0-20000 PPB
UV LAMP	mV	2000 TO 4000 mV
UV STAB	mV	< 15mV
LAMP RATIO	mV	30 TO 120%
STR. LGT	PPB	≤ 100 PPB/ ZERO AIR
DARK PMT	mV	200-325
DARK LAMP	mV	-50 TO 200 mV
SLOPE		1.0 ± 0.5
OFFSET	mV	< 250 mV
HVPS	V	≈ 400 – 800
RCELL TEMP	ºC	50ºC ± 1
BOX TEMP	ºC	AMBIENT ± 5
PMT TEMP	ºC	9.5ºC ± 2º CONSTANT
IZS TEMP*	ºC	50ºC ± 1
ETEST	mV	2000 mV ± 500
OTEST	mV	2000 mV ± 1000
Values are in the Signal I/O		
REF_4096_MV	mV	4096mv±2mv and Must be Stable
REF_GND	mV	0± 0.5 and Must be Stable

3. WHAT IS THE SAMPLE FLOW & SAMPLE PRESSURE W/SAMPLE INLET ON REAR OF MACHINE CAPPED?

   SAMPLE FLOW -_____CC **SAMPLE PRESS** - _____IN-HG-A

4. WHAT ARE THE FAILURE SYMPTOMS? _____

   _____

5. IF POSSIBLE, PLEASE INCLUDE A PORTION OF A STRIP CHART PERTAINING TO THE PROBLEM. CIRCLE PERTINENT DATA.
6. THANK YOU FOR PROVIDING THIS INFORMATION. YOUR ASSISTANCE ENABLES TELEDYNE API TO RESPOND FASTER TO THE PROBLEM THAT YOU ARE ENCOUNTERING.

Appendix D – Schematic List

Table D-1: List of Included Electronic Schematics

DOCUMENT #	DOCUMENT TITLE
0506402	M100EU UV Ref PCA
05435	M100EU Internal PMT Preamp PCA
05466	M100EU Sync/Demod PCA
0591602	M100EU Bursting UV Lamp Driver

Other schematics can be found in the M100E Operators Manual (04145).