



**TELEDYNE**

**ADVANCED POLLUTION INSTRUMENTATION**

A Teledyne Technologies Company

***MODEL T100H***  
***UV FLUORESCENCE SO<sub>2</sub> ANALYZER***  
**Addendum to T100 Operation Manual, PN 06807**

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# SAFETY MESSAGES

Important safety messages are provided throughout this manual for the purpose of avoiding personal injury or instrument damage. Please read these messages carefully. Each safety message is associated with a safety alert symbol, and are placed throughout this manual; the safety symbols are also located inside the instrument. It is imperative that you pay close attention to these messages, the descriptions of which are as follows:



**WARNING:** Electrical Shock Hazard



**HAZARD:** Strong oxidizer



**GENERAL WARNING/CAUTION:** Read the accompanying message for specific information.



**CAUTION:** Hot Surface Warning



**Do Not Touch:** Touching some parts of the instrument without protection or proper tools could result in damage to the part(s) and/or the instrument.



**Technician Symbol:** All operations marked with this symbol are to be performed by qualified maintenance personnel only.



**Electrical Ground:** This symbol inside the instrument marks the central safety grounding point for the instrument.

## CAUTION



**This instrument should only be used for the purpose and in the manner described in this manual. If you use this instrument in a manner other than that for which it was intended, unpredictable behavior could ensue with possible hazardous consequences.**

**NEVER use any gas analyzer to sample combustible gas(es)!**

## Note

For Technical Assistance regarding the use and maintenance of this instrument or any other Teledyne API product, contact Teledyne API's Customer Service Department:

Telephone: 800-324-5190

Email: [api-customerservice@teledyne.com](mailto:api-customerservice@teledyne.com)

or access any of the service options on our website at <http://www.teledyne-api.com/>

## CONSIGNES DE SÉCURITÉ

Des consignes de sécurité importantes sont fournies tout au long du présent manuel dans le but d'éviter des blessures corporelles ou d'endommager les instruments. Veuillez lire attentivement ces consignes. Chaque consigne de sécurité est représentée par un pictogramme d'alerte de sécurité; ces pictogrammes se retrouvent dans ce manuel et à l'intérieur des instruments. Les symboles correspondent aux consignes suivantes :



**AVERTISSEMENT** : Risque de choc électrique



**DANGER** : Oxydant puissant



**AVERTISSEMENT GÉNÉRAL / MISE EN GARDE** : Lire la consigne complémentaire pour des renseignements spécifiques



**MISE EN GARDE** : Surface chaude



**Ne pas toucher** : Toucher à certaines parties de l'instrument sans protection ou sans les outils appropriés pourrait entraîner des dommages aux pièces ou à l'instrument.



**Pictogramme « technicien »** : Toutes les opérations portant ce symbole doivent être effectuées uniquement par du personnel de maintenance qualifié.



**Mise à la terre** : Ce symbole à l'intérieur de l'instrument détermine le point central de la mise à la terre sécuritaire de l'instrument.

### MISE EN GARDE



**Cet instrument doit être utilisé aux fins décrites et de la manière décrite dans ce manuel. Si vous utilisez cet instrument d'une autre manière que celle pour laquelle il a été prévu, l'instrument pourrait se comporter de façon imprévisible et entraîner des conséquences dangereuses.**

**NE JAMAIS** utiliser un analyseur de gaz pour échantillonner des gaz combustibles!

# WARRANTY

## WARRANTY POLICY (02024D)

Prior to shipment, T-API equipment is thoroughly inspected and tested. Should equipment failure occur, T-API assures its customers that prompt service and support will be available.

## COVERAGE

After the warranty period and throughout the equipment lifetime, T-API stands ready to provide on-site or in-plant service at reasonable rates similar to those of other manufacturers in the industry. All maintenance and the first level of field troubleshooting are to be performed by the customer.

## NON-API MANUFACTURED EQUIPMENT

Equipment provided but not manufactured by T-API is warranted and will be repaired to the extent and according to the current terms and conditions of the respective equipment manufacturer's warranty.

## GENERAL

During the warranty period, T-API warrants each Product manufactured by T-API to be free from defects in material and workmanship under normal use and service. Expendable parts are excluded.

If a Product fails to conform to its specifications within the warranty period, API shall correct such defect by, in API's discretion, repairing or replacing such defective Product or refunding the purchase price of such Product.

The warranties set forth in this section shall be of no force or effect with respect to any Product: (i) that has been altered or subjected to misuse, negligence or accident, or (ii) that has been used in any manner other than in accordance with the instruction provided by T-API, or (iii) not properly maintained.

**THE WARRANTIES SET FORTH IN THIS SECTION AND THE REMEDIES THEREFORE ARE EXCLUSIVE AND IN LIEU OF ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESSED OR IMPLIED. THE REMEDIES SET FORTH IN THIS SECTION ARE THE EXCLUSIVE REMEDIES FOR BREACH OF ANY WARRANTY CONTAINED HEREIN. API SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR RELATED TO THIS AGREEMENT OF T-API'S PERFORMANCE HEREUNDER, WHETHER FOR BREACH OF WARRANTY OR OTHERWISE.**

## TERMS AND CONDITIONS

All units or components returned to Teledyne API should be properly packed for handling and returned freight prepaid to the nearest designated Service Center. After the repair, the equipment will be returned, freight prepaid.

### CAUTION – Avoid Warranty Invalidation



Failure to comply with proper anti-Electro-Static Discharge (ESD) handling and packing instructions and Return Merchandise Authorization (RMA) procedures when returning parts for repair or calibration may void your warranty. For anti-ESD handling and packing instructions please refer to "Packing Components for Return to Teledyne API's Customer Service" in the *Primer on Electro-Static Discharge* section of this manual, and for RMA procedures please refer to our Website at <http://www.teledyne-api.com> under Customer Support > Return Authorization.

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# ABOUT THIS ADDENDUM

This T100H addendum, PN 07265, is to be used in conjunction with the T100 manual, PN 06807; it is comprised of multiple documents, in PDF format, as listed below.

<b>Part No.</b>	<b>Rev</b>	<b>Name/Description</b>
07265	A	T100H Addendum to T100 Manual
05244	B	Appendix A Menu Trees (Refer to Appendix A of the T100 manual for related software documentation).
06928	2011Mar24	Spare parts List (in Appendix B, this Addendum)
04527	2011Mar24	Recommended Spares Stocking Levels (in Appendix B, this Addendum)
04357	A	Expendables (in Appendix B, this Addendum)
05029	D	Appendix C Repair Questionnaire
Note: for schematics, please see Appendix D of the T100 manual, PN 06807)		

## NOTE

Please read in its entirety before making any attempt made to operate the instrument.

# REVISION HISTORY

2011 March 25, T100H Addendum, PN07265 Rev A, DCN6038 Initial Release

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# 1. INTRODUCTION

This addendum is based on the Model T100 Operators Manual (P/N 06807). In most ways the T100H analyzer is identical to the T100 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 T100H is different in design or operating method from the T100.

## 1.1. T100H Documentation

**NOTE**

Throughout this addendum, words printed in capital, bold letters, such as **SETUP** or **ENTR** represent messages as they appear on the analyzer's front panel display

**NOTE**

The menu flowcharts in this addendum contain typical representations of the analyzer's display during the various operations being described. These representations are not intended to be exact and may differ slightly from the actual display of your instrument.

## 1.2. Using This Manual Addendum

This manual addendum has the same overall structure as that of the T100 operator's manual, to simplify referring between the two. The manual has the following sections:

**Table of Contents:**

Outlines the contents of the addendum in the order the information is presented. This is a good overview of the topics covered in the manual. There is also a list of tables, a list of figures and a list of appendices.

**Specifications and Warranty**

This section contains a list of the analyzer's performance specifications, a description of the conditions and configuration under which EPA equivalency was approved and Teledyne Instrument's warranty statement.

**Getting Started:**

A concise set of instructions for setting up, installing and running your analyzer for the first time.

**FAQ:**

Answers to the most frequently asked questions about operating the analyzer.

**Optional Hardware & Software**

A description of optional equipment to add functionality to your analyzer.

**Operation Instructions**

This section includes step by step instructions for operating the analyzer and using its various features and functions.

**Calibration Procedures**

General information and step by step instructions for calibrating your analyzer.

**Instrument Maintenance**

Description of preventative maintenance procedures that should be regularly performed on you instrument to assure good operating condition.

**Theory of Operation**

This section describes the aspects of T100H operation that differ from the T100 manual.

**Maintenance & Troubleshooting Section:**

This section includes pointers and instructions for diagnosing problems that are specific to the T100H. The T100 manual has a more complete troubleshooting section, most of which also applies to the T100H.

**Appendices:**

For easier access and better updating, some information has been separated out of the manual and placed in a series of appendices at the end of this addendum. These include: software menu trees, warning messages, definitions of DAS & serial I/O variables (Appendix A), spare parts and other lists (Appendix B), repair questionnaire (Appendix C).

## 2. SPECIFICATIONS, APPROVALS & WARRANTY

### 2.1. Specifications

**Table 2-1: Model T100H Basic Unit Specifications**

Min/Max Range (Physical Analog Output)	Min: 0-10 ppm Full scale Max: 0-5,000 ppm Full scale (selectable, dual ranges and auto ranging supported)
Measurement Units	ppm, mg/m <sup>3</sup> (user selectable)
Zero Noise <sup>1</sup>	0.1 ppm (RMS)
Span Noise <sup>1</sup>	< 1% of reading (RMS) above 10 ppm
Lower Detectable Limit <sup>2</sup>	0.2 ppm
Zero Drift (24 hours)	< 1 ppm
Span Drift (24 hours)	< 0.5% fo full scale
Linearity	1% of full scale
Precision	0.5% of reading above 10 ppm
Voltage Coefficient	< 0.05% per V
Lag Time <sup>1</sup>	5 seconds
Rise/Fall Time <sup>1</sup>	< 30 sec to 95%
Sample Flow Rate	700 cm <sup>3</sup> /min ±10%
AC Power Rating	100V-120V, 220V-240V, 50/60 Hz
Recorder Offset	±10%
Analog Output Ranges	mV, 1 V, 5 V, 10V, 5V, 1V, 0.1V (selectable)
Analog Output Resolution	1 part in 4096 of selected full-scale voltage
Included I/O	1 Ethernet: 10/100Base-T 2 RS232 (300-115,200 baud) 2 USB device ports 8 opto-isolated digital status outputs 6 opto-isolated digital control inputs 4 analog outputs
Optional I/O	1 USB com port 1 RS485 8 analog inputs (0-10V, 12-bit) 4 digital alarm outputs Multidrop RS232 3 4-20mA current outputs
Temperature Range	5-40°C
Temperature Coefficient	< 0.1% per °C
Humidity Range	0 - 95% RH, non-condensing
Environmental	Installation category (over-voltage category) II; Pollution degree 2
Dimensions H x W x D	7" x 17" x 23.5" (178 mm x 432 mm x 597 mm)
Weight	Analyzer: 31 lbs (16 kg); External pump: 15 lbs (7kg)
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,
<sup>1</sup> As defined by the USEPA.	
<sup>2</sup> Defined as twice the zero noise level by the USEPA.	

## 2.2. CE Mark Compliance

### Emissions Compliance

The Teledyne Advanced Pollution Instrumentation UV Fluorescence SO<sub>2</sub> Analyzer was tested and found to be fully compliant with:

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.

### Safety Compliance

The Teledyne-Advanced Pollution Instrumentation UV Fluorescence SO<sub>2</sub> Analyzer was tested and found to be fully compliant with:

IEC 61010-1:90 + A1:92 + A2:95,

## 3. GETTING STARTED

### 3.1. Unpacking and Initial Setup



#### CAUTION

To avoid personal injury, always use two persons to lift and carry the Model T100H.



#### WARNING

Ensure that the power source voltage and frequency match those of the instrument specs on the rear panel model label. Never disconnect electronic circuit boards, wiring harnesses or electronic subassemblies while the unit is under power.



#### CAUTION – Avoid Warranty Invalidation

Printed circuit assemblies (PCAs) are sensitive to electro-static discharges too small to be felt by the human nervous system. Damage resulting from failure to use ESD protection when working with electronic assemblies will void the instrument warranty.

See *A Primer on Electro-Static Discharge* in the main manual for more information on preventing ESD damage.

1. Inspect the received packages for external shipping damage. If damaged, please advise the shipper first, then TAPI.
2. Included with your analyzer is a printed record (Form number 04989) of the final performance characterization performed on your instrument at the factory. This record is an important quality assurance and calibration record for this instrument. It should be placed in the quality records file for this instrument.
3. Carefully remove the top cover of the analyzer and check for internal shipping damage.
  - Remove the set screw located in the top, center of the rear panel
  - Remove the screws fastening the top cover to the unit (four per side).
  - Lift the cover straight up.
4. Inspect the interior of the instrument to make sure all circuit boards and other components are in good shape and properly seated.
5. Check the connectors of the various internal wiring harnesses and pneumatic hoses to make sure they are firmly and properly seated.
6. Verify that all of the optional hardware ordered with the unit has been installed. These are checked on the paperwork (Form 04989) accompanying the analyzer.

### 3.1.1. Electrical Connections:

For full details on the electrical connections of the T100H, please refer to the T100 user's manual (#06807), Electrical Connections section.

#### 3.1.1.1. External Pump

The T100H is equipped with an external pneumatic pump. This pump is powered separately from the instrument via its own power cord. The pump has no ON/OFF switch and should begin operating as soon as it is plugged into a live power supply.



#### WARNING

- **Check the voltage / frequency label on the rear panel of the instrument and on the external pump for compatibility with the local power. Do not plug in either the analyzer or the pump unless the voltages or frequencies are correct.**
- **Power connection must have a functioning ground connection. Do not defeat the ground wire on power plug.**
- **Turn off analyzer power before disconnecting or connecting electrical subassemblies.**
- **Do not operate with cover off.**

## 3.2. Pneumatic Connections

### NOTE

To prevent dust from getting into the analyzer, it was shipped with small plugs inserted into each of the pneumatic fittings on the rear panel. Make sure that all dust plugs are removed before attaching exhaust and supply gas lines. Store for future use.

Table 3-1: Inlet / Outlet Connector Descriptions

REAR PANEL LABEL	FUNCTION
Sample	Connects the sample gas to the analyzer. When operating the analyzer without zero span option, this is also the inlet for any calibration gases.
Exhaust	Connect an exhaust gas line to this port to the inlet of the external pump.
Zero Air	On Units with zero/span valve option installed, this port connects the zero air gas or the zero air cartridge to the analyzer.

Figure 3-5 of the T100 Manual (P/N 06807) shows the internal pneumatic flow of the T100 in its standard configuration. For a diagram of the internal pneumatic flow of the T100H, see Figure 3-2 of this addendum.

### 3.2.1.1. Pneumatic Connections to T100H Basic Configuration:

The pneumatic connections for the T100H analyzer in its basic configuration are nearly identical to those described in the T100 Manual (P/N 06807) Section 3.5 except that the T100H has an external pump. Therefore:

- A pneumatic line of 1/4" PTFE must be attached between the analyzer's exhaust port and the inlet port of the pump.
- The exhaust from the pump must be vented outside the shelter or immediate area surrounding the instrument using a maximum of 10 meters of 1/4" PTFE tubing.

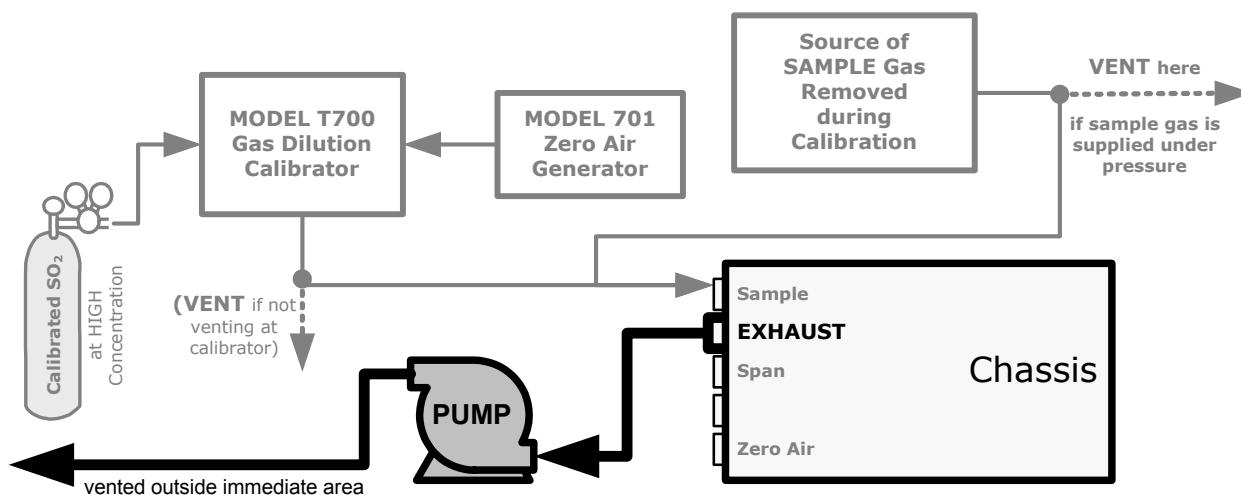


Figure 3-1: Example of Pneumatic Connections to T100H External Pump

This change is true for all configurations and variations of the T100H.

### 3.2.1.2. Connections with Internal Valve Options Installed

- There is no IZS option available for the T100H .
- An additional valve option (Option 50C - Zero & Two Span Points) is available on the T100H. The pneumatic set up for this option is:

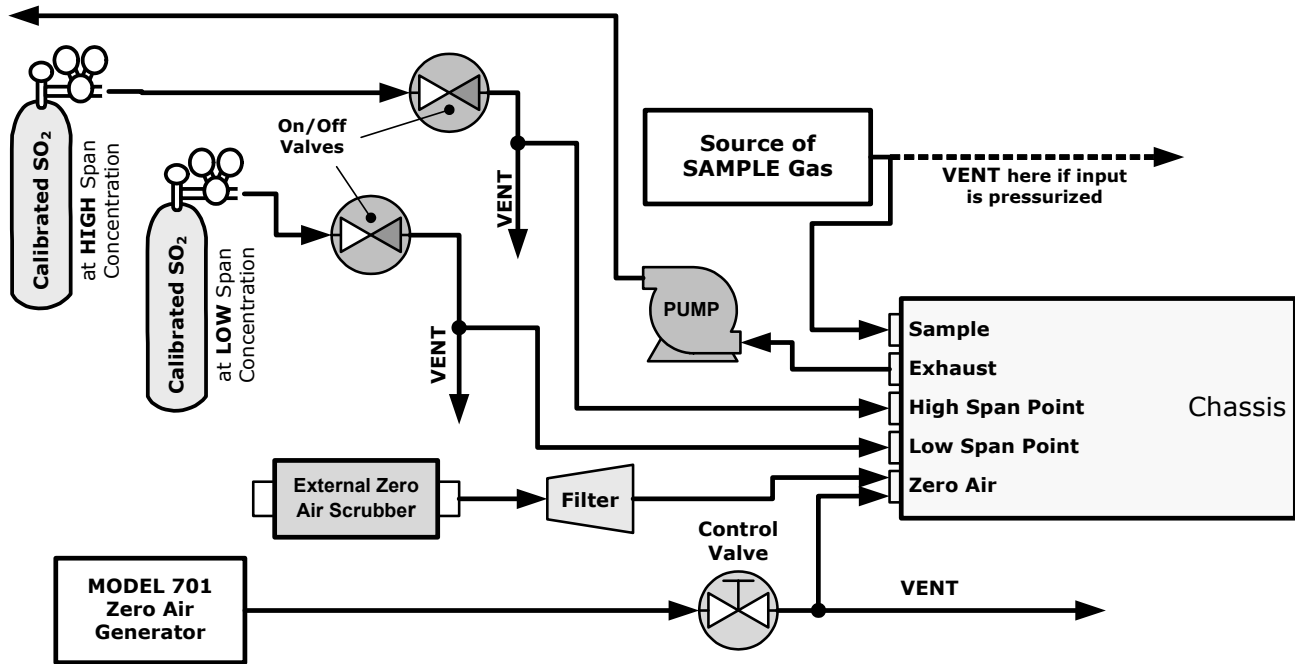


Figure 3-2: Pneumatic Connections to T100H with Zero and Two Span Point Valve Option

### 3.2.2. T100H Layout

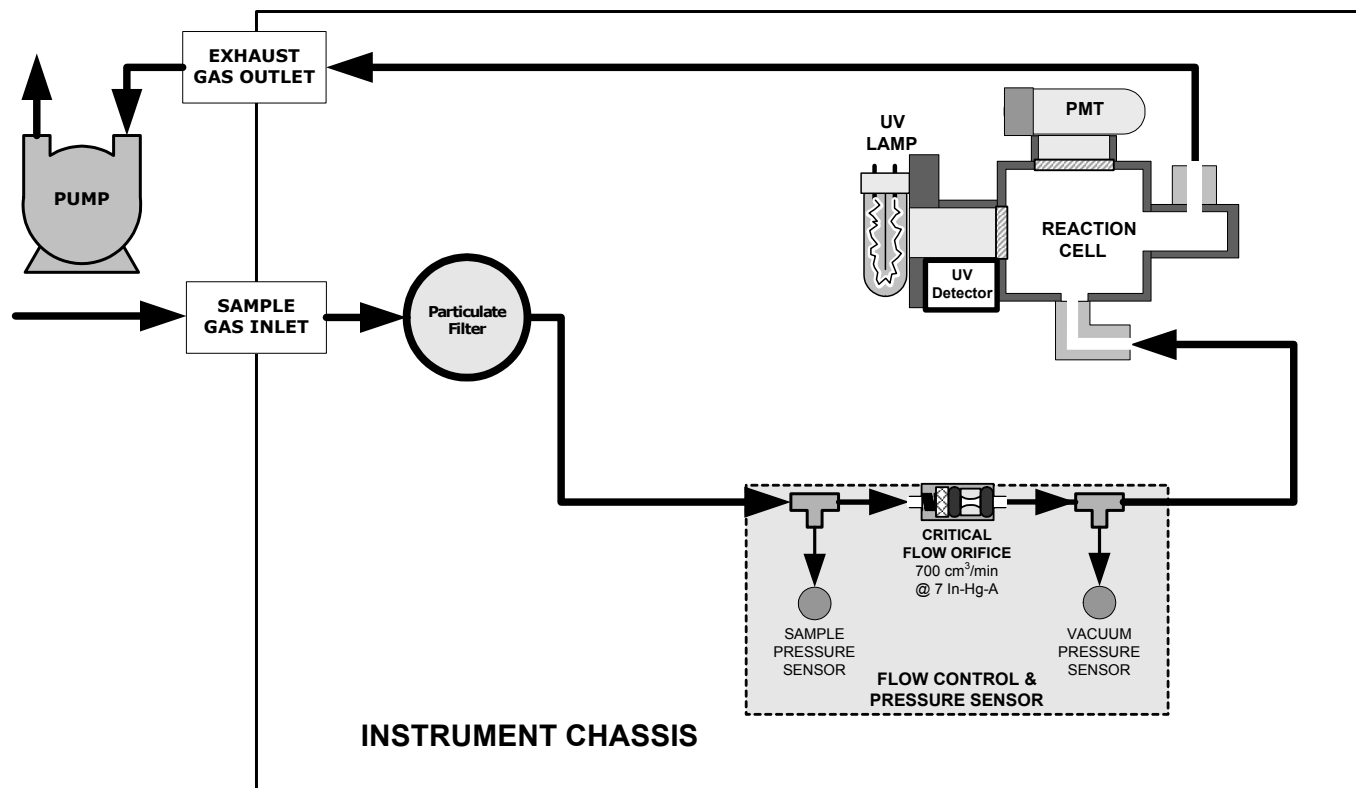


Figure 3-3: Internal Pneumatic flow for T100H in Basic Configuration

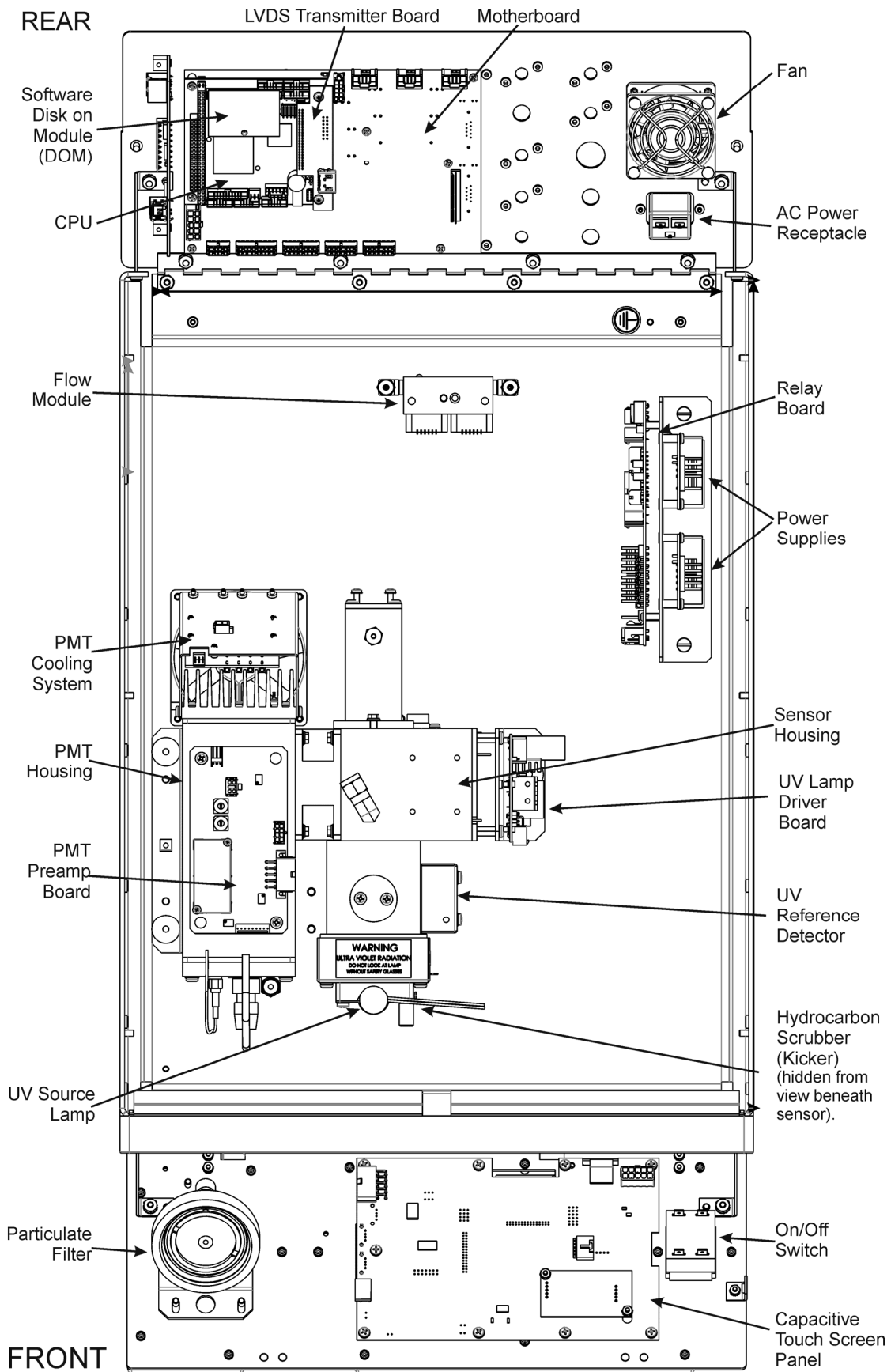


Figure 3-4: T100H Layout (Basic Unit – No Valve Options)

### 3.3. Initial Operation

With the following exceptions, the operation of the T100H is nearly identical to that of the T100. Please refer to the T100 User's Manual, Section 3, for details on initial operation, including common warning messages, functional check, and initial calibration and common interferences for the T100H.

#### 3.3.1. Warning Messages

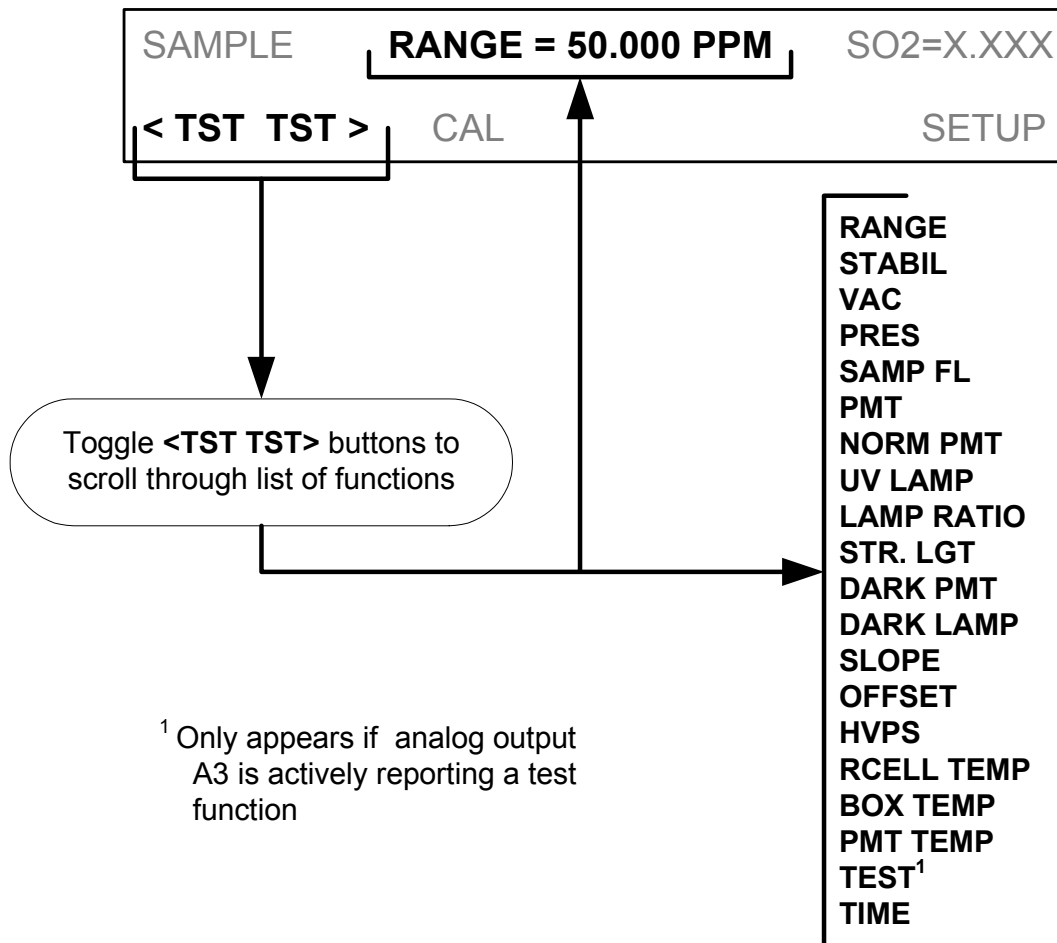
Please refer to the T100 User's Manual (06807), Section 3, for a complete listing of warnings for the T100H. The following table lists warnings that differ in the T100H from those described in the T100 manual.

**Table 2-1: Possible Warning Messages at Start-Up**

MESSAGE	MEANING
<b>Vacuum Pressure Warning</b>	The vacuum pressure reading is out of its allowed range. The pump may have failed, or the instrument may have a leak or obstruction in the flow path.

#### 3.3.2. Test Functions

Check to make sure that the analyzer is functioning within allowable operating parameters as described in the T100 Manual (P/N 06807). The available test functions for the T100H are:



### 3.3.3. Interferents for SO<sub>2</sub> Measurements

Hydrocarbons are a significant interferent for UV fluorescent SO<sub>2</sub> measurements, however, the typical T100H application does not have hydrocarbons in the sample stream. Therefore, in order to reduce cost to the customer, the T100H in its standard configuration does not include a hydrocarbon kicker/scrubber.

If your application includes hydrocarbons in the sample gas stream, it is very important that they be removed from the sample gas prior to it entering the analyzer's sample chamber. A hydrocarbon Kicker Option (OPT 65) package (see Section 5 of this manual) is available for this purpose.

## 4. FREQUENTLY ASKED QUESTIONS (FAQs)

More FAQs are included in the T100 manual, which also includes a glossary of terms.

**Q:** How long does the sample pump last?

**A:** The sample pump should last about one year and the pump diaphragms should to be replaced annually or when necessary.

To determine if the diaphragm on a T100H needs replacing check the **VAC** test function (instead of the **PRES** function as described in the T100 Manual - P/N 06807). If the **VAC** value is > 10 in-Hg-A, the diaphragm should be replaced.

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## 5. OPTIONAL HARDWARE AND SOFTWARE

With the following additions, changes and exceptions, the options listed in Table 1-1 of the T100 Manual (P/N 06807) are also available for the T100H.

### 5.1. Ambient Zero/Ambient Span Valves (Option 50A)

The T100H zero/span valve option is identical to that of the T100 in respect to operation and valve states (see Table 3-10 of the T100 Manual). The internal pneumatic connections are slightly different.

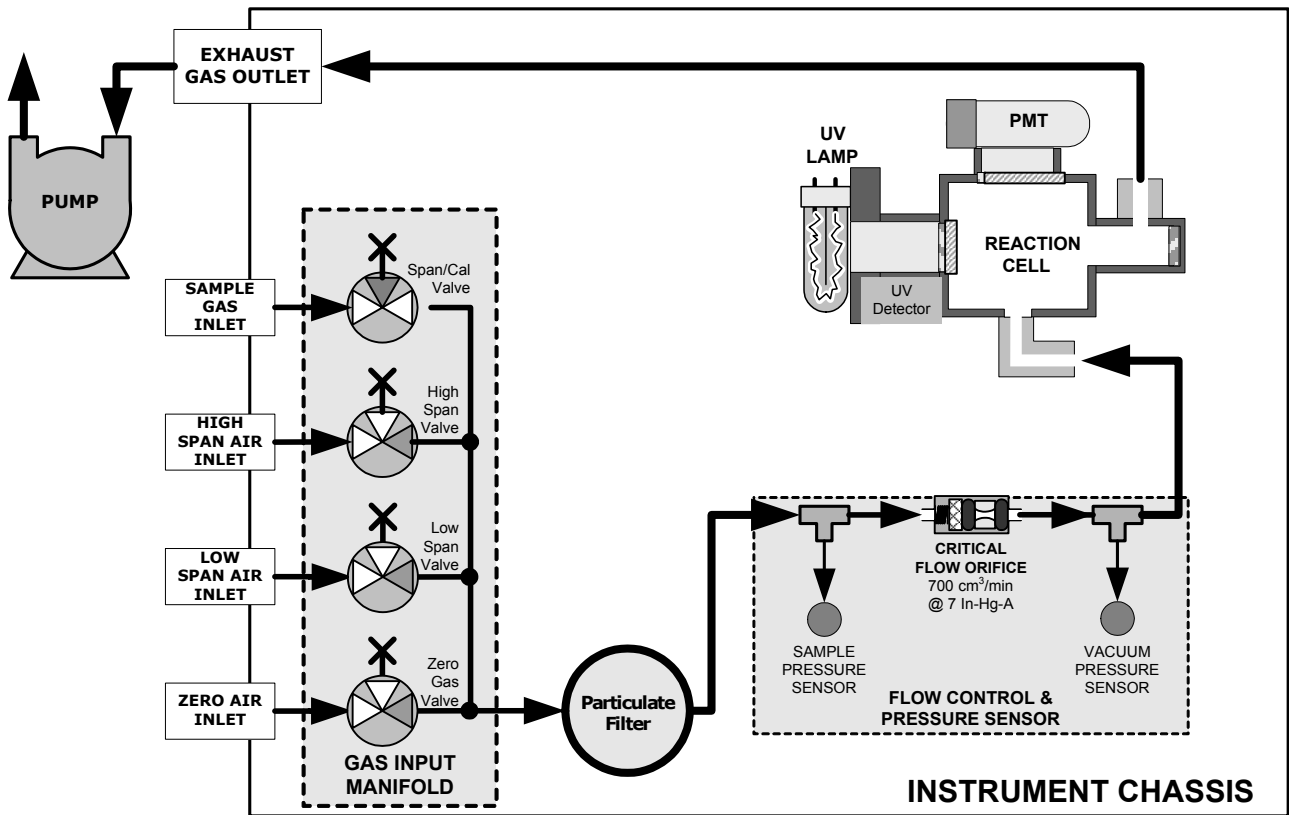


Figure 5-1: Pneumatic Diagram of the T100H With Z/S Option Installed.

## 5.2. Ambient Zero / Two Ambient Span Valve Option (OPT 50C)

This option includes a special set of valves that allows two separate SO<sub>2</sub> mixtures to enter the analyzer from two independent sources. Typically these two gas mixtures will come from two, separate, pressurized bottles of certified calibration gas: one mixed to produce a SO<sub>2</sub> concentration equal to the expected span calibration value for the application and the other mixed to produce a concentration at or near the midpoint of the intended measurement range. Individual gas inlets, labeled HIGH SPAN and LOW SPAN are provided at the back on the analyzer.

The valves allow the user to switch between the two sources via keys on the front panel or from a remote location by way of either the analyzer's digital control inputs or by sending commands over it's serial I/O port(s).

### NOTE

The analyzer's software only allows the **SLOPE** and **OFFSET** to be calculated when sample is being routed through the **HIGH SPAN** inlet.

The **LOW SPAN** gas is for midpoint reference checks only.

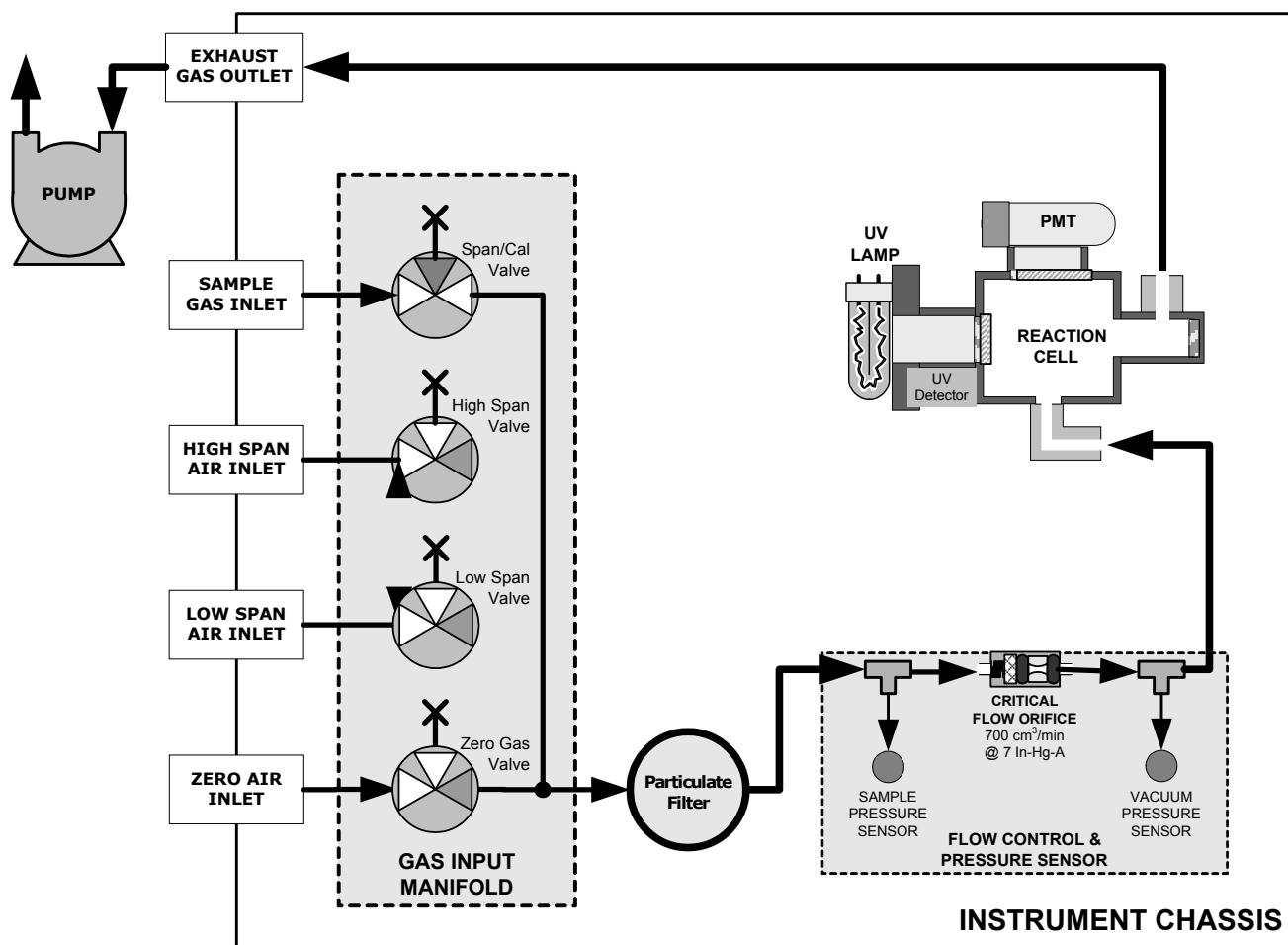


Figure 5-2: Pneumatic Diagram of the T100H with Option 50C Installed

Table 5-1 describes the state of each valve during the analyzer's various operational modes.

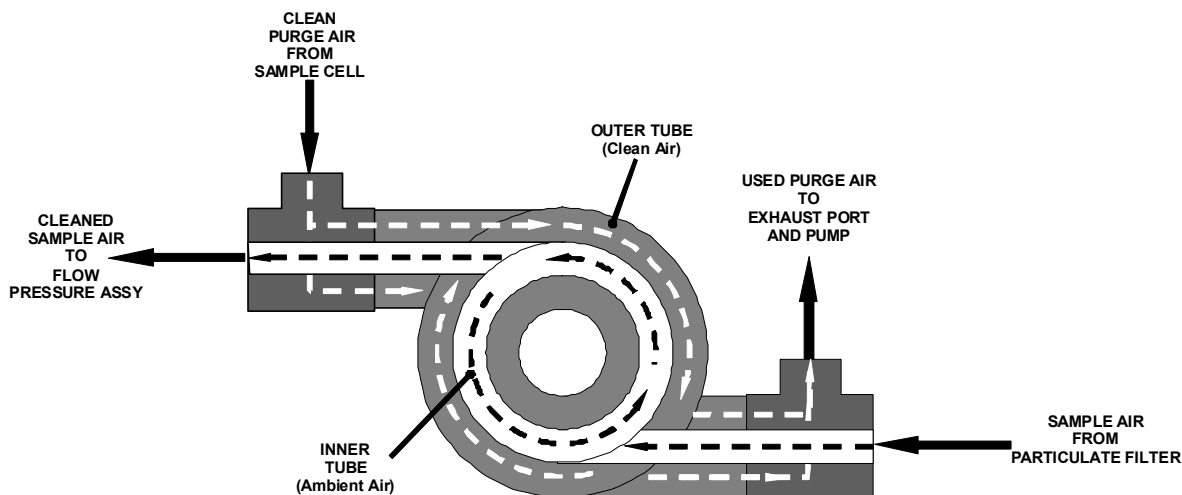
**Table 5-1: Two-Point Span Valve Operating States**

MODE	VALVE	CONDITION
SAMPLE	Sample/Cal	Open to SAMPLE inlet
	Zero Gas Valve	Closed to ZERO AIR inlet
	High Span Valve	Closed to HIGH SPAN inlet
	Low Span Valve	Closed to LOW SPAN inlet
ZERO CAL	Sample/Cal	Closed to SAMPLE inlet
	Zero Gas Valve	Open to ZERO AIR inlet
	High Span Valve	Closed to HIGH SPAN inlet
	Low Span Valve	Closed to LOW SPAN inlet
HIGH SPAN CAL	Sample/Cal	Closed to SAMPLE inlet
	Zero Gas Valve	Closed to ZERO AIR inlet
	High Span Valve	Open to HIGH SPAN inlet
	Low Span Valve	Closed to LOW SPAN inlet
Low Span Check	Sample/Cal	Closed to SAMPLE inlet
	Zero Gas Valve	Closed to ZERO AIR inlet
	High Span Valve	Closed to HIGH SPAN inlet
	Low Span Valve	Open to LOW SPAN inlet

### 5.3. Hydrocarbon Kicker Option (OPT 86D)

This option is specifically designed for those applications where hydrocarbons are present in the sample gas stream. It includes an internal, scrubber consisting of a tube of a specialized plastic that absorbs hydrocarbons very well located within an outer flexible plastic tube shell.

As gas flows through the inner tube, hydrocarbons are absorbed into the membrane walls, and transported through the membrane wall and into the hydrocarbon free, purge gas flowing through the outer tube (see Figure 5-3). This process is driven by the hydrocarbon concentration gradient between the inner and outer of the tubes.



**Figure 5-3: Hydrocarbon Scrubber (Kicker) – OPT 86D**

The scrubbed air from the inner tube is returned to be used as the purge gas in the outer tube after it passes through the analyzer's reaction cell. This means that when the analyzer is first started, the concentration gradient

between the inner and outer tubes is small and the scrubber's efficiency is relatively low. When the instrument is turned on after having been off for more than 30 minutes, it takes a certain amount of time for the gradient to become large enough for the scrubber to adequately remove hydrocarbons from the sample air.

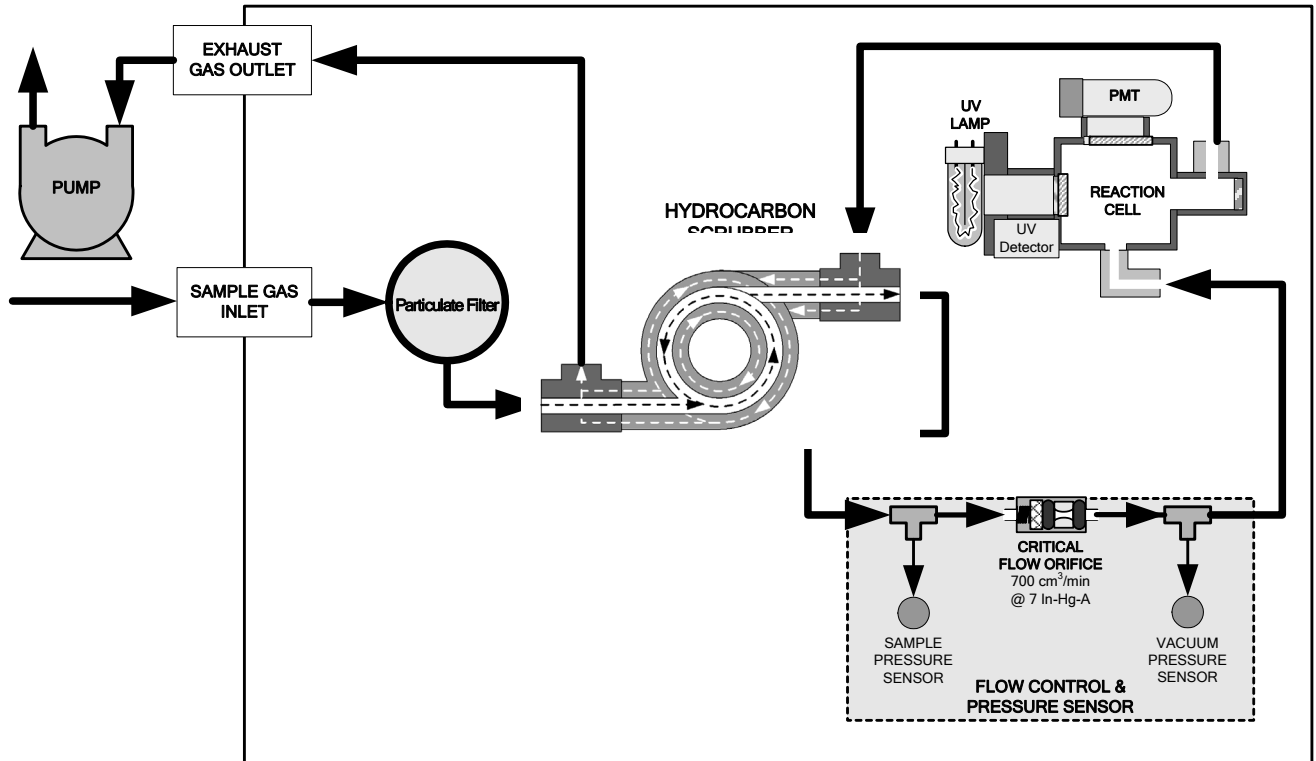


Figure 5-4: T100H Internal Pneumatic Diagram with Hydrocarbon Scrubber Installed

## 6. OPERATING INSTRUCTIONS

### 6.1. Warning Messages

Please refer to the T100 User's Manual (06807), Section 4.2.2, for a list of warnings for the T100H. The following table list describes an additional warning in the T100H.

**Table 6-1: Additional T100H Warning Messages**

MESSAGE	MEANING
Vacuum Pressure Warning	The vacuum pressure reading is out of its allowed range. The pump may have failed, or the instrument may have a leak or obstruction in the flow path.

### 6.2. Test Functions

Please refer to the T100 Manual (06807), Section 4.2.1, for a list of test functions for the T100H. The following table lists test functions that are in addition to or differ from those listed there.

**Table 6-2: Additional T100H Test Functions**

DISPLAY	PARAMETER	UNITS	DESCRIPTION
VAC	Vacuum Pressure	In-Hg-A	The actual pressure measured on the vacuum side of the T100H's critical flow orifice. This is the pressure of the gas in the instrument's sample chamber.
PRES	Sample GAS Pressure	in-Hg-A	The current pressure of the sample gas as it enters the sample inlet at the back of the analyzer, but upstream of the critical flow orifice and before the gas enters the reaction cell.

#### 6.2.1. Test Channel Output

When activated, output channel **A3** can be used to report one of the test functions viewable from the SAMPLE mode display. To activate the A3 channel and select a test function, follow instructions in Section 6.9.10 of the T100 Manual (P/N 06807).

The following table lists test functions that are in addition to or differ from those listed in Table 6-14 of the T100 Manual.

**Table 6-3: Additional T100H Test Parameters Available for Analog Output A3**

TEST CHANNEL	TEST PARAMETER RANGE
VACUUM PRESSURE	0-40 in-Hg-A

### 6.2.2. Range Units

The T100H only displays concentrations in parts per million ( $10^6$  mols per mol, **PPM**) or milligrams per cubic meter ( $\text{mg}/\text{m}^3$ , **MGM**).

- NOT AVAILABLE: Parts per billion ( $10^9$  mols per mol, **PPB**) and micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ , **UGM**).

To change the concentration units of the T100H follow the instructions found in Section 6.7.7 of the T100 Manual.

### 6.2.3. Using the T100H with a Hessen Protocol Network

The set up and use of the T100H in Hessen protocol networks is the same as described in Section 6.12.4 of the T100 Manual (P/N 06807) except that there are minor differences in the status flags. The following table supercedes Table 6-27 of the T100 Manual.

**Table 6-4: T100H Default Hessen Status Bit Assignments**

STATUS FLAG NAME	DEFAULT BIT ASSIGNMENT
<b>WARNING FLAGS</b>	
SAMPLE FLOW WARNING	0001
PMT DET WARNING	0002
UV LAMP WARNING	0002
HVPS WARNING	0004
DARK CAL WARNING	0008
RCELL TEMP WARNING	0010
PMT TEMP WARNING	0040
INVALID CONC	0080
<b>OPERATIONAL FLAGS</b>	
In Manual Calibration Mode	0200
In Zero Calibration Mode	0400
In Low Span Calibration Mode	0800
In Span Calibration Mode	0800
<b>UNITS OF MEASURE FLAGS</b>	
UGM <sup>1</sup>	0000
MGM	2000
PPB <sup>1</sup>	4000
PPM	6000
<b>SPARE/UNUSED BITS</b>	0020, 0100, 8000
<b>UNASSIGNED FLAGS</b>	
Box Temp Warning	System Reset
Sample Press Warning	Front Panel Warning
Vacuum Press Warning	Analog Cal Warning
Rear Board Not Detected	Cannot Dyn Zero
Relay Board Warning	Cannot Dyn Span
<sup>1</sup> Although assigned flags, these units are not available on the T100H	

## 6.2.4. Default DAS Channels


The default Data Channels included in the T100H analyzer's software include the **CONC**, **PNUMT** & **CALDAT** channels. The **FAST** & **DETAIL** preset channels are not included.

## 6.2.5. Remote Operation Using the External Digital I/O

### 6.2.5.1. Status Outputs

The function and pin assignment5s for the T100H digital status outputs are:.

**Table 6-5: Status Output Signals**

SATUS CONNECTOR PIN NUMBER <sup>1</sup>	STATUS DEFINITION	CONDITION
1	<b>SYSTEM OK</b>	ON if no faults are present.
2	<b>CONC VALID</b>	OFF any time the HOLD OFF feature is active, such as during calibration or when other faults exist possibly invalidating the current concentration measurement (example: sample flow rate is outside of acceptable limits). ON if concentration measurement is valid.
3	<b>HIGH RANGE</b>	ON if unit is in high range of the AUTO Range Mode
4	<b>ZERO CAL</b>	ON whenever the instrument's ZERO point is being calibrated.
5	<b>HIGH SPAN CAL</b>	ON whenever the instrument is set for <b>DUAL</b> or <b>AUTO</b> reporting range mode an it's high range span point is being calibrated .
6	<b>DIAG MODE</b>	ON whenever the instrument is in DIAGNOSTIC mode
7	<b>LOW SPAN CAL</b>	ON whenever the instrument is set for <b>DUAL</b> or <b>AUTO</b> reporting range mode an it's lows range span point is being calibrated .
8	<b>SPARE</b>	
D	<b>EMITTER BUS</b>	The emitters of the transistors on pins 1-8 are bussed together.
	<b>SPARE</b>	
+	<b>DC POWER</b>	+ 5 VDC, 300 mA source (combined rating with Control Output, if used).
	<b>Digital Ground</b>	The ground level from the analyzer's internal DC power supplies

<sup>1</sup> Located on Rear Panel

### 6.2.5.2. Control Inputs

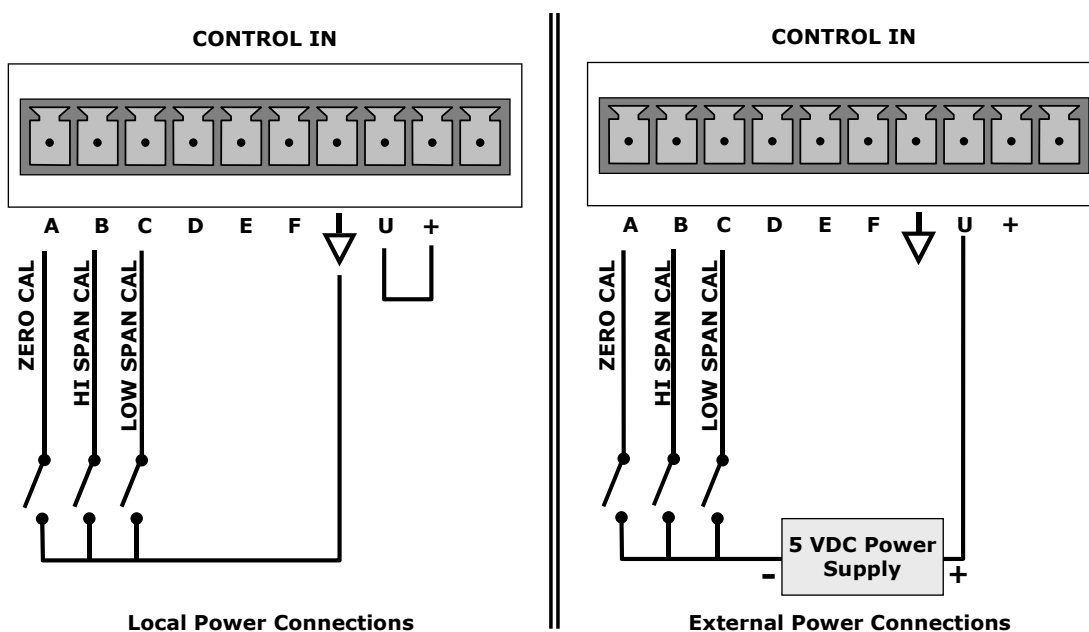


Figure 6-1: Control Input Connector

Table 6-6: Control Input Signals

INPUT #	STATUS DEFINITION	ON CONDITION
A	<b>REMOTE ZERO CAL</b>	The analyzer is placed in Zero Calibration mode. The mode field of the display will read ZERO CAL R.
B	<b>REMOTE HIGH SPAN CAL</b>	If the instrument is set for <b>DUAL</b> or <b>AUTO</b> reporting rang mode, activating this input causes the analyzer to enter high range span calibration mode. The mode field of the display will read SPAN CAL R.
C	<b>REMOTE LO SPAN CAL</b>	The analyzer is placed in low span calibration mode as part of performing a low span (midpoint) calibration. The mode field of the display will read LO CAL R.
D, E & F	<b>SPARE</b>	
	<b>Digital Ground</b>	The ground level from the analyzer's internal DC power supplies (same as chassis ground)
U	<b>External Power input</b>	Input pin for +5 VDC required to activate pins A – F.
+	<b>5 VDC output</b>	Internally generated 5V DC power. To activate inputs A – F, place a jumper between this pin and the “U” pin. The maximum amperage through this port is 300 mA (combined with the analog output supply, if used).

# 7. CALIBRATION AND CALIBRATION CHECK PROCEDURES

Calibration procedures for the T100H are the same as those for the T100. One exception to this statement is that the T100H has a special valve option, Zero and Two Span Point Valve Option - OPT 52 (See Section 5.1), that allows a mid-span point be checked.

## 7.1. Manual Calibration with Zero and Two Span Valve (OPT 52)

**NOTE**

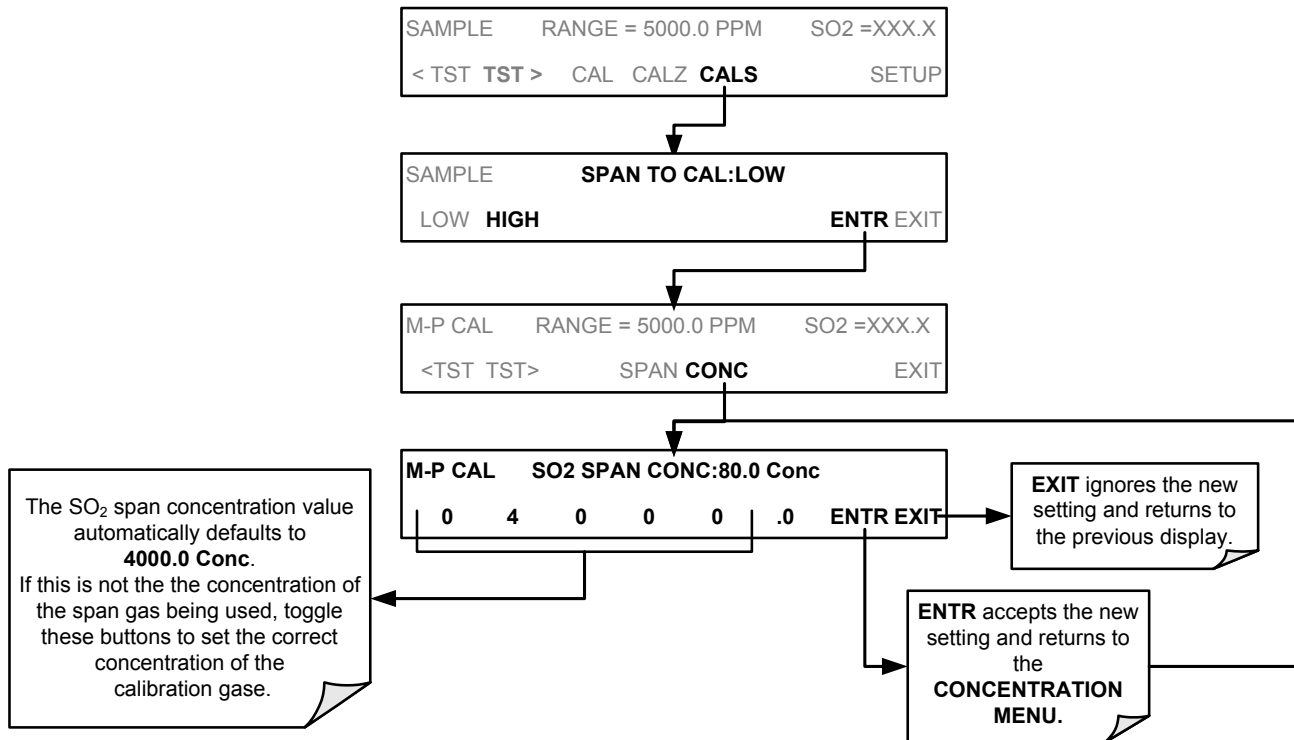
**It is only possible to calibrate to the high span gas. The low span gas is only used for calibration checks.**

Zero and Span calibrations using the Zero and two Span Valve option are similar to that described in Section 7.2, except that:

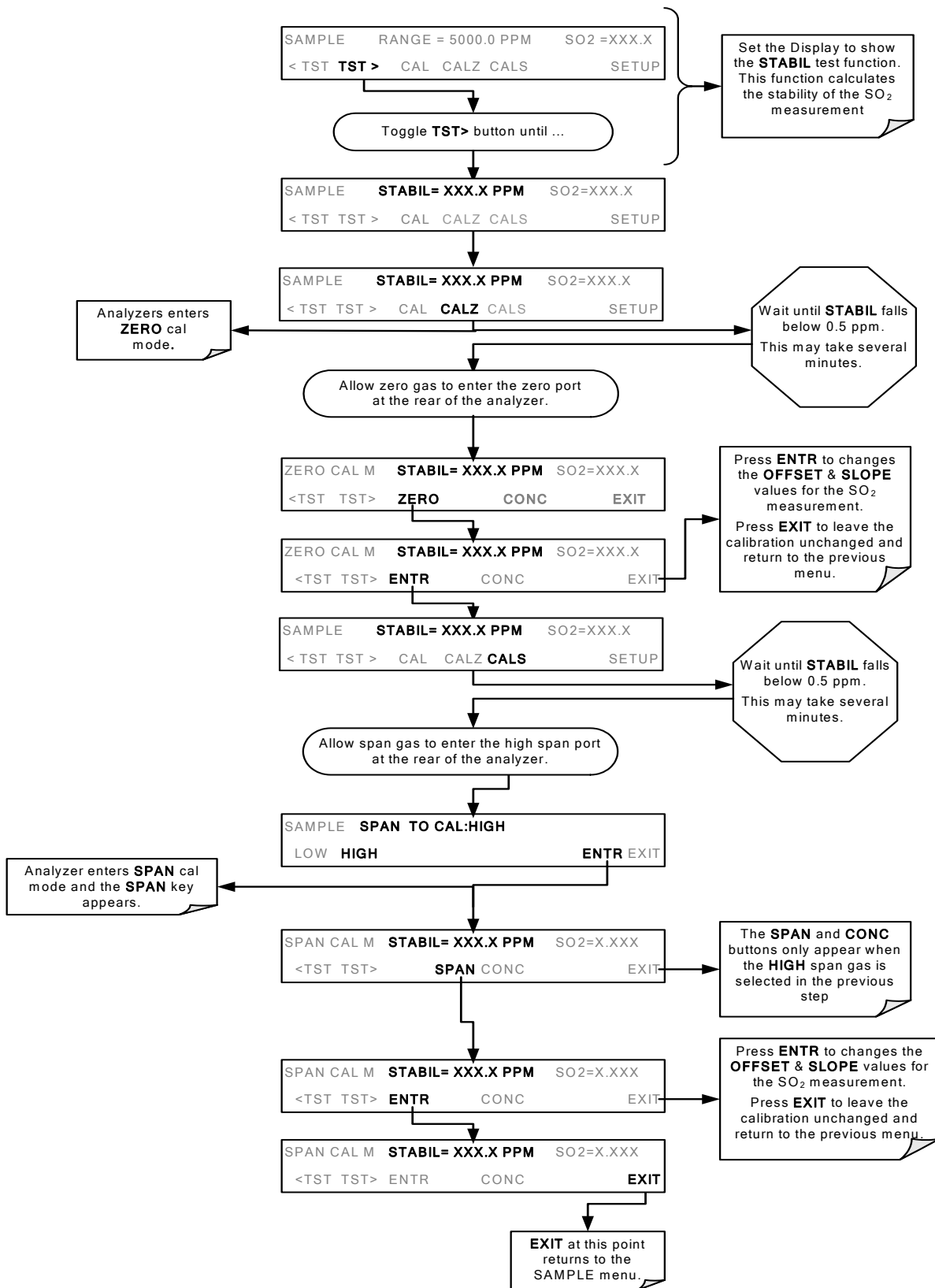
- Zero air and both span gas is supplied to the analyzer through the zero gas and span gas inlets rather than through the sample inlet.
- The zero and cal operations are initiated directly and independently with dedicated keys (**CALZ** & **CALS**)

**STEP ONE:** Connect the sources of zero air and span gas to the respective ports on the rear panel (see Figure 3-2 of this addendum).

**STEP TWO:** Set the expected SO<sub>2</sub> high span gas value:

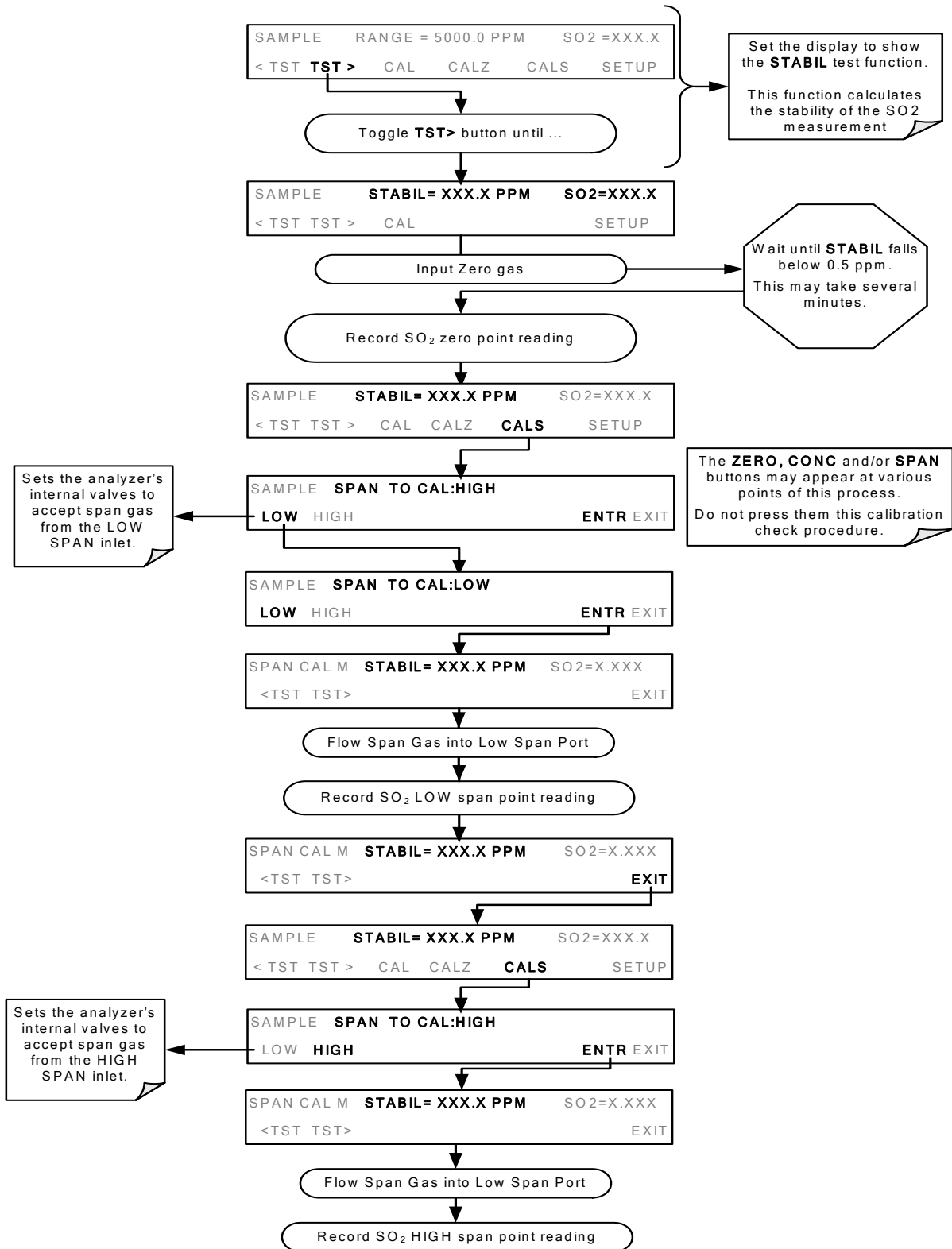


**STEP THREE:** Perform the calibration according to the following flow chart:



## 7.2. Manual Calibration Check with Ambient Zero and Two Ambient Span Valve Option (OPT 50C) Installed

Set up is identical to that shown in **STEP ONE** of the preceding section. To perform the zero/span check:



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## 8. INSTRUMENT MAINTENANCE

### 8.1. Maintenance Schedule

There is no Internal IZS offered for the T100H.

### 8.2. Predictive Diagnostics

Because the T100H's internal pneumatics are monitored in a different manner than those of the T100 there are some differences in how the instrument's test functions are used as predictive diagnostics. Table 8-1 of this addendum supersedes Table 9-2 of the T100 Manual

**Table 8-1: Predictive Uses for Test Functions**

TEST FUNCTION	DAS FUNCTION	CONDITION	BEHAVIOR		INTERPRETATION
			EXPECTED	ACTUAL	
PRES	SMPPRS	Sample gas pressure upstream of the critical flow orifice.	Constant within atmospheric changes	Slowly increasing	<ul style="list-style-type: none"> <li>Flow path is clogging up.                             <ul style="list-style-type: none"> <li>- Check critical flow orifice &amp; sintered filter.</li> <li>- Replace particulate filter</li> </ul> </li> </ul>
				Slowly decreasing	<ul style="list-style-type: none"> <li>Developing leak in pneumatic system to vacuum (developing valve failure)</li> </ul>
VAC	VACUUM	Gas pressure downstream of the critical flow orifice (e.g. inside reaction cell).	Constant within atmospheric changes	Fluctuating	<ul style="list-style-type: none"> <li>Developing leak in pneumatic system</li> </ul>
SAMP FL	SMPFLW	Standard Operation	Stable	Slowly Decreasing	<ul style="list-style-type: none"> <li>Flow path is clogging up.                             <ul style="list-style-type: none"> <li>- Check critical flow orifice &amp; sintered filter.</li> <li>- Replace particulate filter</li> </ul> </li> </ul>
DRK PMT	DRKPMT	PMT output when UV Lamp pulses off	Constant within $\pm 20$ of check-out value	Significantly increasing	<ul style="list-style-type: none"> <li>PMT cooler failure</li> </ul>
<i>SO<sub>2</sub></i> Concentration	CONC1	Standard configuration at span	stable for constant concentration	Decreasing over time	<ul style="list-style-type: none"> <li>Drift of instrument response; UV Lamp output is excessively low.</li> </ul>
				Fluctuating	<ul style="list-style-type: none"> <li>Leak in gas flow path.</li> </ul>
LAMP RATIO	LAMPR	Standard Operation	Stable and near 100%	Fluctuating or Slowly increasing	<ul style="list-style-type: none"> <li>UV detector wearing out</li> <li>UV source Filter developing pin holes</li> </ul>
				Slowly decreasing	<ul style="list-style-type: none"> <li>UV detector wearing out</li> <li>Opaque oxides building up on UV source Filter</li> <li>UV lamp aging</li> </ul>

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# 9. THEORY OF OPERATION

## 9.1. The UV Light Path

The UV light path of the T100H is similar to that of the T100 (see Section 10.2 of the T100 Manual). The main differences between the T100H and the T100 are:

- The location of the reference detector (See Section 9.1.1 of this addendum).
- The methods used to reject for certain measurement interferences is different (see Section 9.1.2 of this addendum).

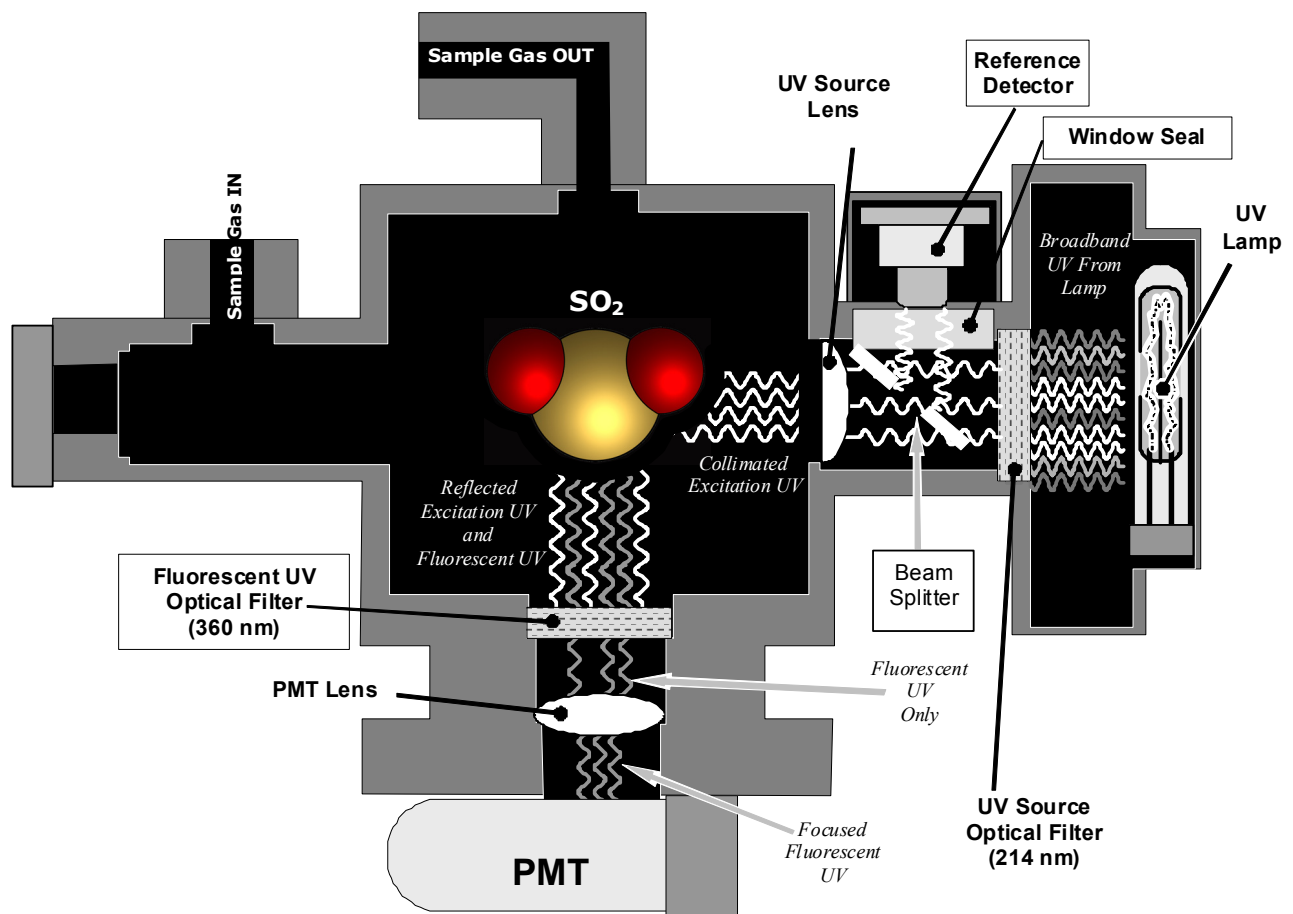


Figure 9-1: UV Light Path

### 9.1.1. The Reference Detector

A vacuum diode UV detector that converts UV light to a DC current is used to measure the intensity of the excitation UV source lamp. The location of the T100H reference detector differs from that of the T100.

- On the T100 this detector is located directly across the reaction cell from the lamp where it can measure the output of the lamp directly. Because the T100 is designed to measure relatively low concentrations of SO<sub>2</sub>, enough of the lamp's 214 nm source light makes it through the reaction cell to get a reliable reading.
- On the T100H the detector is located between the UV lamp and the reaction cell and to the side. A beam splitter reflects a portion of the lamp output 90 degrees, through a window and onto the detector. This arrangement is required because nearly all of 214 nm UV source light entering the reaction cell is absorbed by the higher concentrations of SO<sub>2</sub> typically measured by the T100H.

A window transparent to UV light provides an air-proof seal that prevents ambient gas from contaminating the sample chamber.

### 9.1.2. Direct Measurement Interferents

The most common source of interference when measuring SO<sub>2</sub> is from other gases that fluoresce in a similar fashion to SO<sub>2</sub> when exposed to UV Light. The most significant of these are:

- A class of hydrocarbons called poly-nuclear aromatics (PNA) of which xylene and naphthalene are two prominent examples.
- Nitric oxide (NO), which fluoresces in the a spectral range near to SO<sub>2</sub>. For critical applications where high levels of NO are expected an optional 360 nm optical filter is available that improves the rejection of NO (contact customer service for more information).

The methods by which the Model T100H rejects interference for these substances differs from the T100 as follows.

- Since the typical application for which the T100H rarely includes the presences of hydrocarbons or PNA's, no hydrocarbon scrubber (kicker) is included in the T100H's base configuration. An optional scrubber (see Section 5.3of this addendum) is available.
- On the other hand the typical T100H application often includes much higher concentrations of Nitric Oxide (NO), which fluoresces in a spectral range near that of SO<sub>2</sub>. Therefore a 360 nm filter replaces the 330nm UV filter located between the PMT and the reaction cell in order to more efficiently reject for interference due to the higher concentrations of NO.

## 9.2. Pneumatic Operation

### 9.2.1. Sample Gas Flow

The flow of gas through the T100H UV Fluorescence SO<sub>2</sub> Analyzer is created by a small external pump that pulls air through the instrument. The T100H has no kicker to scrub hydrocarbons from the sample stream. Typical applications for the T100H do not have hydrocarbons in the sample stream.

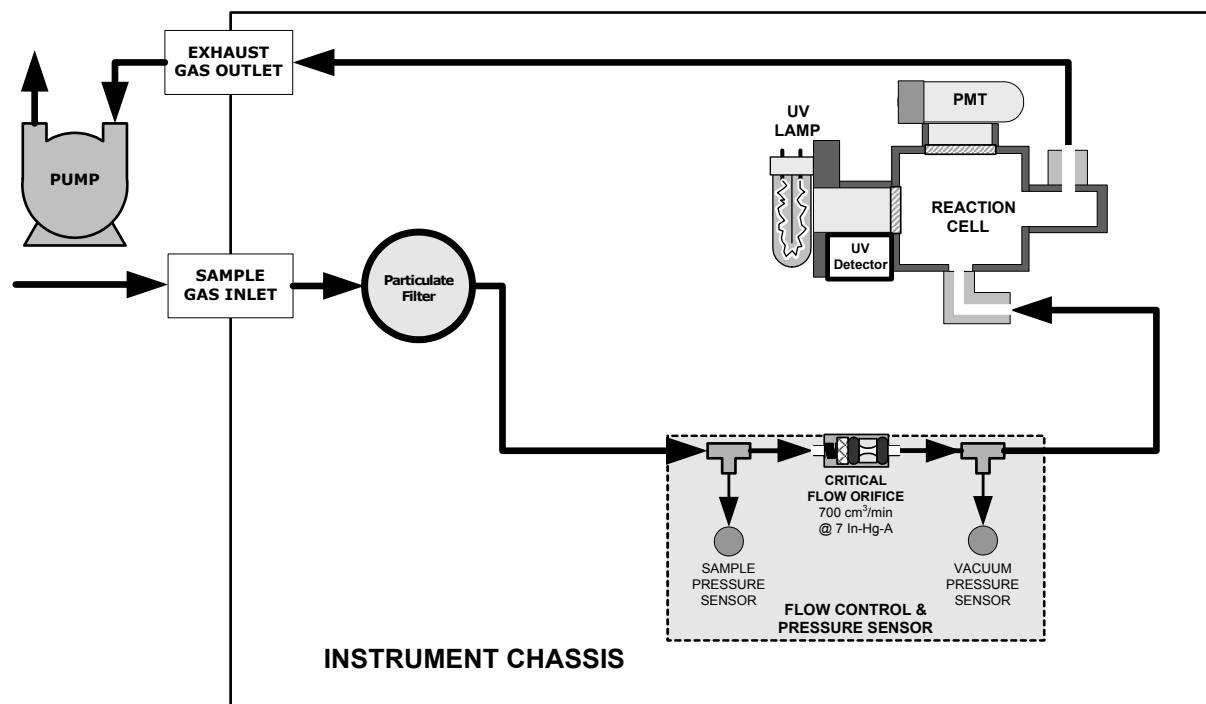


Figure 9-2: Pneumatic Diagram of the T100H – Base Configuration

## 9.2.2. Pneumatic Sensors

The T100H uses two pneumatic sensors to verify gas flow. These sensors are located on a printed circuit assembly, called the pneumatic pressure/flow sensor board. This PCA is attached to a manifold containing the critical flow orifice that sets the instrument flow rate.

### 9.2.2.1. Sample Pressure Sensor

An absolute pressure transducer plumbed to the input of the analyzer's sample chamber is used to measure the pressure of the sample gas before it passes through the critical flow orifice. This is used to validate the critical flow condition (2:1 pressure ratio) through the instrument's critical flow orifice.

The actual sample gas pressure measurement is viewable through the analyzer's front panel display as the test function **PRES**

### 9.2.2.2. Vacuum Pressure Sensor

An absolute pressure transducer measures the pressure on the vacuum side of the critical flow orifice and is used to measure the sample gas pressure in the reaction cell. If the vacuum pressure is not in the correct range, a warning will be displayed by the software. Also, if the temperature/pressure compensation (TPC) feature is turned on, the output of this sensor is also used to supply pressure data for that calculation.

The actual pressure of the gas downstream from the critical flow orifice (including the gas inside the reaction cell) viewable through the analyzer's front panel display as the test function **VAC**

### 9.2.2.3. Sample Flow Calculation

Unlike the T100, which uses a thermal-mass flow sensor to directly measure the gas flow through the instrument, the T100H calculates the gas as follows.

- The ratio of the two pressures is measured and used to validate critical flow. If the ratio is not correct ( $< 2:1$ ) the **SAMPLE FLOW WARN** message is activated. Also, the value of the **SAMP FL** test function is set to **XXXX**.

If the pressure ratio between the two sensors is valid ( $\geq 2:1$ ), the instrument calculates the flow based on sample gas pressure level (**PRES**) and is viewable via the front panel as the **SAMP FL** test function.

### 9.3. Electronic Operation

The following figures replace Figures 10-10 & 10-19 of the T100 Manual (P/N 06807). There is no IZS option, a vacuum pressure sensor replaces the T100's thermal-mass flow sensor and provision is made for the two ambient span valve option.

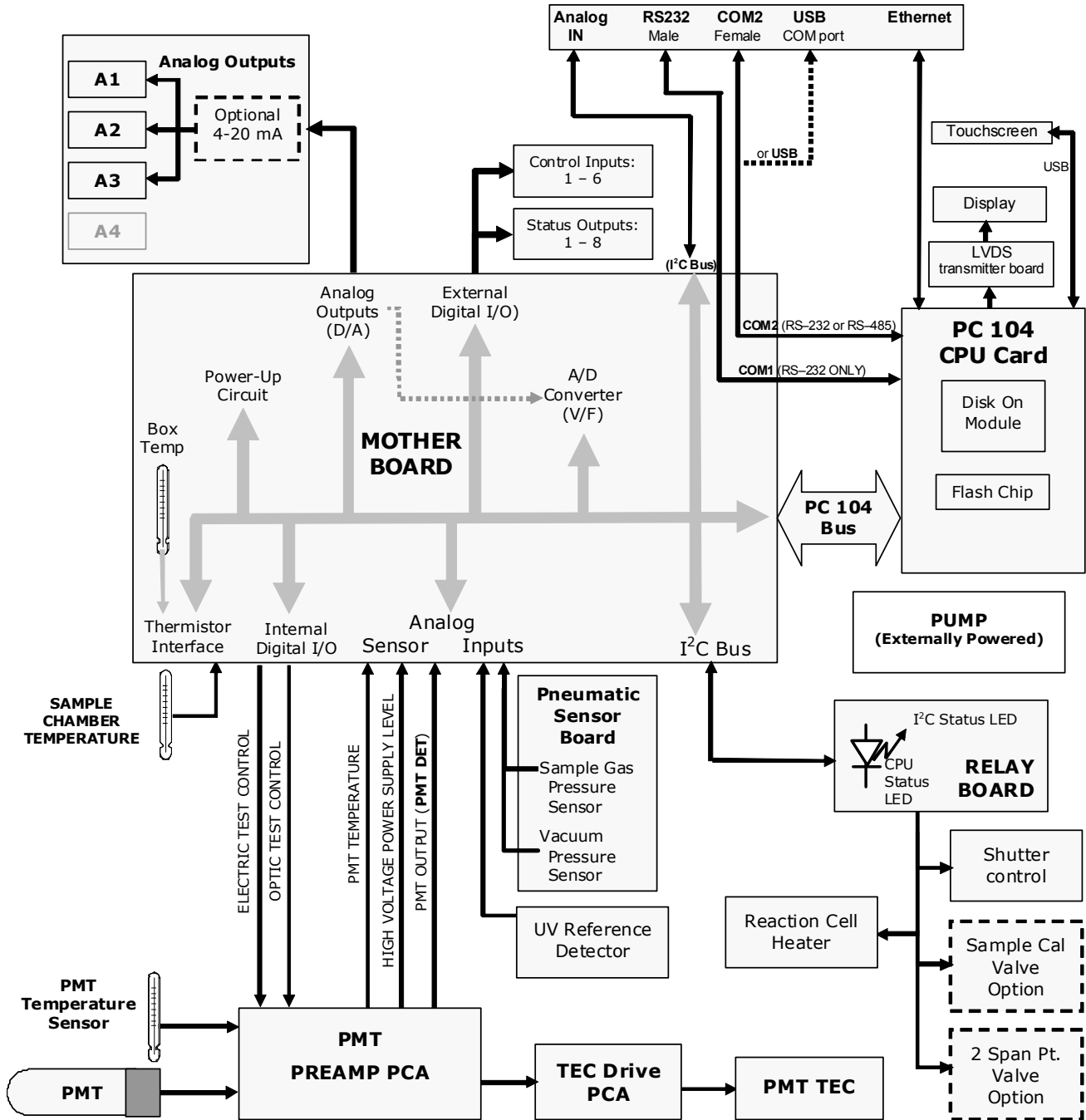


Figure 9-3: T100H Electronic Block Diagram

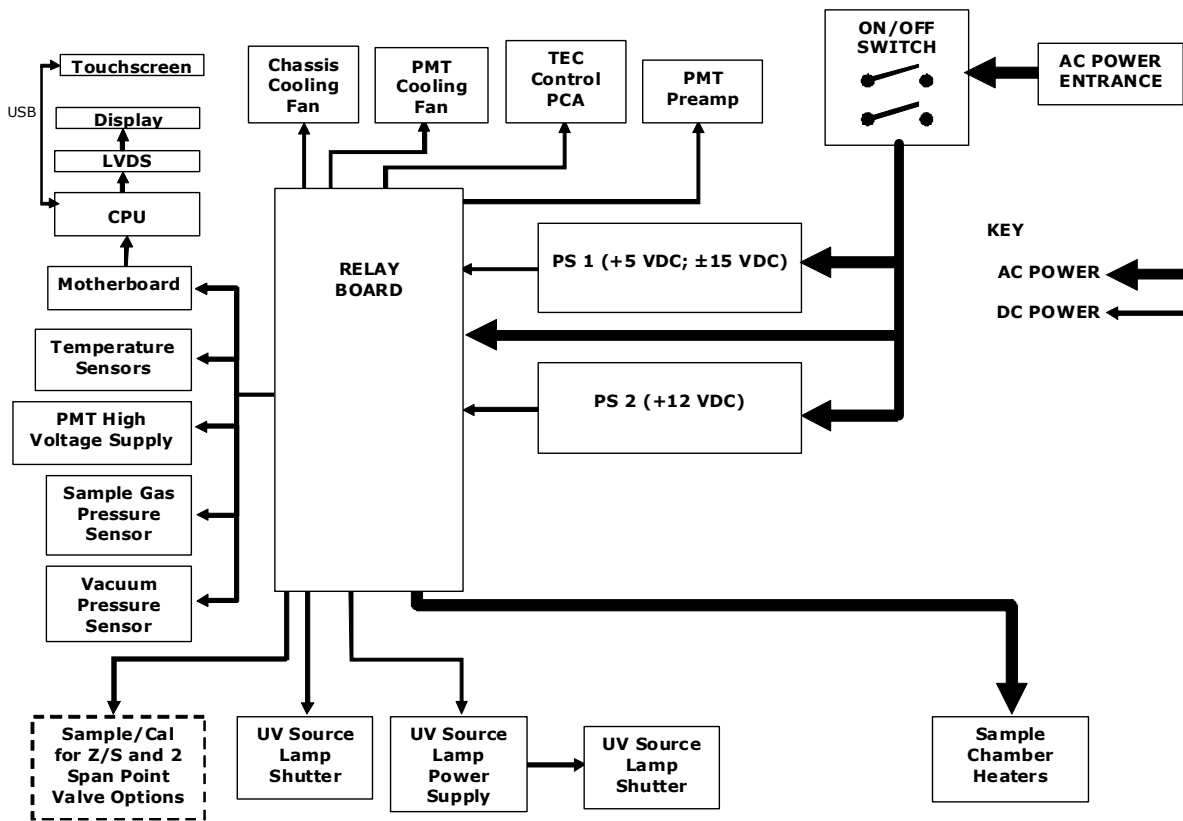


Figure 9-4: T100H Power Distribution Block Diagram

## 10. TROUBLESHOOTING & REPAIR

For the most part the information contained in Section 11 of the T100 Manual (P/N 06807) is also applicable to the T100H. There are a few exceptions however.

### 10.1.1. Fault Diagnosis with Warning Messages

Table 10-1: Warning Messages - Indicated Failures

WARNING MESSAGE	FAULT CONDITION	POSSIBLE CAUSES
VACUUM PRESS WARN	Gas pressure inside the reaction cell outside of warning limits.	If sample pressure is > 10 in-Hg: <ul style="list-style-type: none"><li>○ Pneumatic Leak</li><li>○ Bad Pump → Rebuild Pump</li><li>○ Failed pressure sensor/circuitry</li></ul>

### 10.1.2. Fault Diagnosis with Test Functions

Table 10-2: Test Functions - Possible Causes for Out-Of-Range Values

TEST FUNCTION	NOMINAL VALUE(S)	POSSIBLE CAUSE(S)
VAC	<9.1 IN-HG-A	Incorrect sample gas pressure could be due to: pneumatic leak; malfunctioning valve; malfunctioning pump; clogged flow orifices; sample inlet overpressure; faulty pressure sensor

## 10.2. Subsystem Checkout

### 10.2.1. Pneumatic Sensor Assembly

The pneumatic sensor assembly of the T100H differs from that of the T100 in that there is no flow sensor. Instead the assembly includes two pressure sensors located on either side of a critical flow orifice. The T100H software infers the gas flow rate by mathematically comparing the two pressure readings.

If you suspect that one of the two pressure sensors is failing:

1. Cap the sample inlet.
2. After a few seconds, check the **VAC** and **PRES** test functions and verify that:
  - The **VAC** value matches the **PRES** value to within 1 In-Hg-A, and;
  - Both are less than 10 in-Hg-A (i.e. under vacuum).
3. Uncap the sample inlet and unplug the pump.
4. After a few minutes, the value **VAC** and **PRES** should match within 1 In-Hg-A, and read atmospheric pressure.
  - If the two sensors do not match or are significantly different from ambient atmospheric pressure, call Teledyne Instruments customer service.

## 10.3. Repair Procedures

### 10.3.1. Repairing the Sample Gas Flow Control Assembly

The Critical Flow Orifice is part of the pressure sensor and flow control assembly. The jewel orifice is protected by a sintered filter, so it is unusual for the orifice to need replacing, but it is possible for the sintered filter and o-rings to need replacing. See the Spare Parts list in Appendix B for part numbers and kits.

To replace the filter and/or orifice

1. Turn off Power to the analyzer.
2. Locate the pressure sensor / flow control assembly.
3. Disconnect the signal cable and pneumatic fittings.
4. Remove the assembly from the optical bench by removing the 2 screws at each end of the assembly.
5. The inlet end of the assembly is located at the end with the straight pneumatic fitting. Remove the fitting and the components as shown in the exploded view.
6. Replace the o-rings (p/n:OR01) and the sintered filter (p/n:FL01).
7. if you are replacing the Critical Flow Orifice itself (p/n:00094100), make sure that the side with the colored window (usually RED) is facing upstream to the flow gas flow.
8. Re-assemble in reverse order. See the Spares List in Appendix B for part numbers.
9. After re-connecting the power and pneumatic lines, flow check the instrument as described in the Section 1.5.2 of the T100 Operator's Manual.

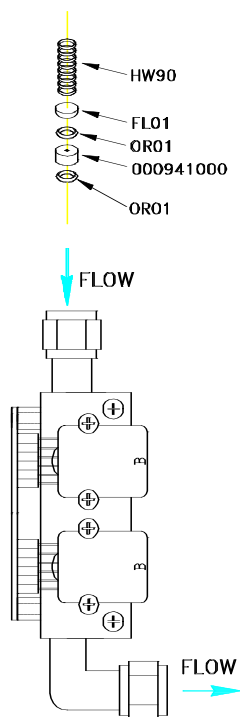


Figure 10-1: Flow Control Assembly

## 10.3.2. Sensor Module Repair & Cleaning

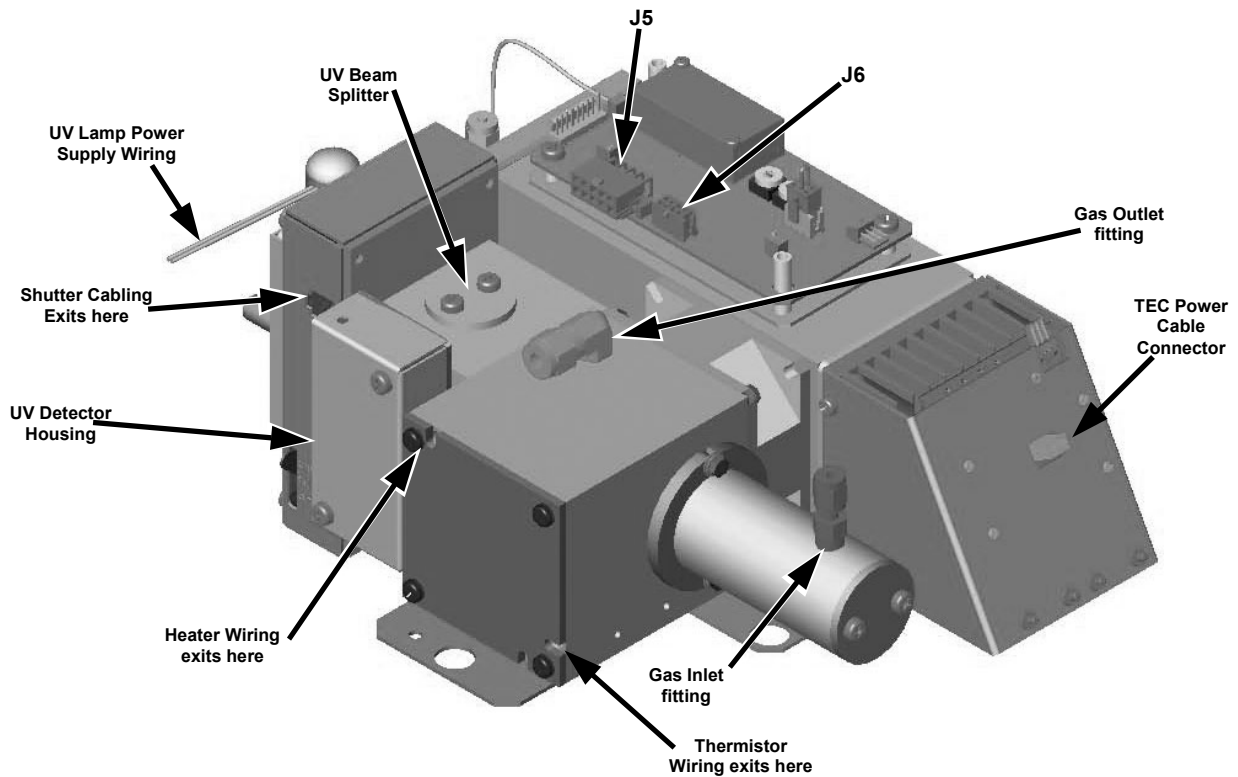
**NOTE:**

After any repair or service has been performed on the sensor module, the T100H should be allowed to warm up for 60 minutes.

Always perform a leak check (See Section 11.5.1) and calibrate the analyzer (see Section 7) before placing it back in service.

The most significant difference between the T100 sensor module and the T100H sensor module is the location of the reference detector. Therefore most of the procedures described in Section 11.6.3 apply to the T100H as well.

Exceptions are noted below:



**Figure 10-2: Sensor Module Wiring and Pneumatic Fittings**

### 10.3.2.1. Adjusting the UV Lamp (*Peaking the Lamp*)

There are two ways in which ambient conditions can effect the UV Lamp output and therefore the accuracy of the SO<sub>2</sub> concentration measurement: Lamp Aging and Lamp Positioning.

**Lamp Aging** - Over a period of months, the UV energy will show a downward trend, usually 30% 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) will compensate for this until the lamp output becomes too low to function at all.

**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 analyzers ability to accurately measure SO<sub>2</sub>.

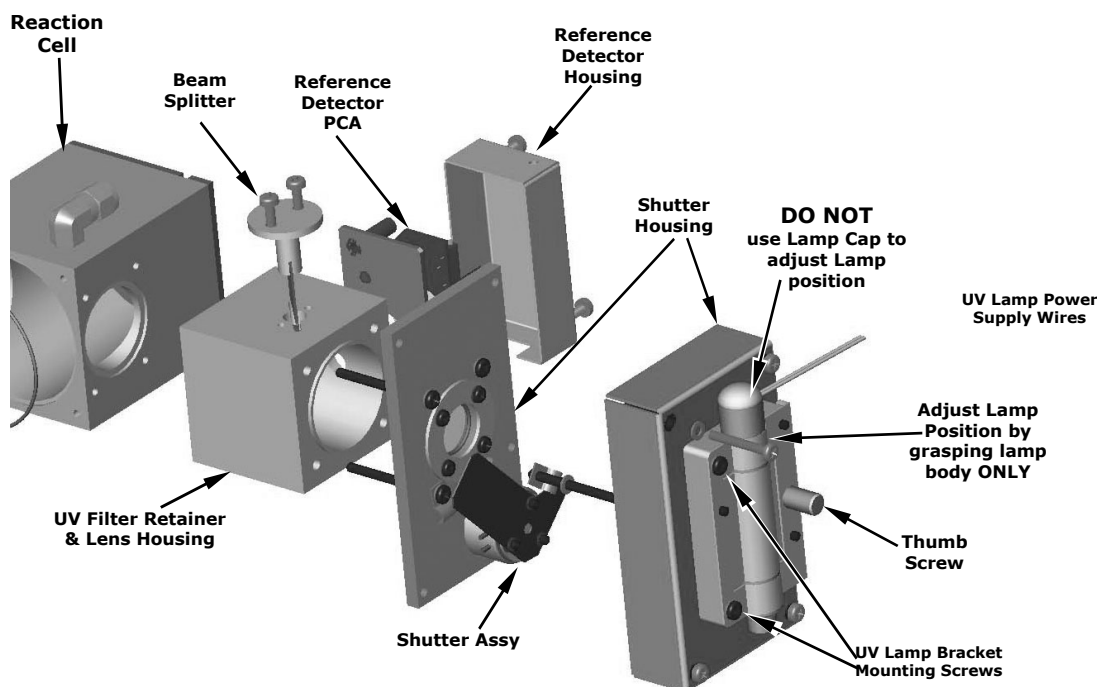


Figure 10-3: Shutter Assembly - Exploded View



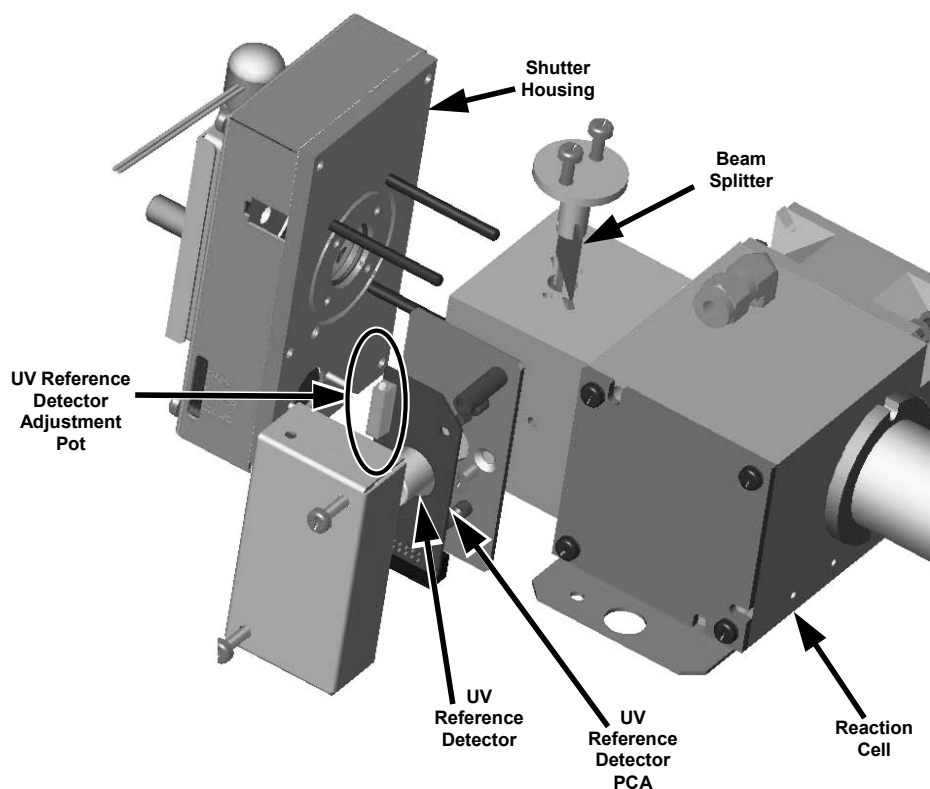
**CAUTION:**

**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). **UVLAMP\_SIGNAL** is function 33.
2. Slightly loosen the large brass thumbscrew located on the shutter housing (see Figure 10-3) 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.
  - **DO NOT** grasp the UV lamp by its cap when changing its position (see Figure 10-3). Always grasp the main body of the lamp.
4. Compare the **UVLAMP\_SIGNAL** reading to the information in Table 10-3 and follow the instructions there.

**Table 10-3: Example of HVPS Power Supply Outputs**

UVLAMP_SIGNAL	ACTION TO BE TAKEN
3500mV±200mV.	No Action Required
> 4900mV at any time.	Adjust the UV reference detector potentiometer (see Figure 10-4) until <b>UVLAMP_SIGNAL</b> reads approximately 3600mV before continuing to adjust the lamp position.
>4500mV or < 1000mV	Adjust the UV reference detector potentiometer (see Figure 10-4) until <b>UVLAMP_SIGNAL</b> reads as close to 3500mV as possible.
< 600mV	Replace the lamp.

**Figure 10-4: Location of UV Reference Detector Potentiometer**

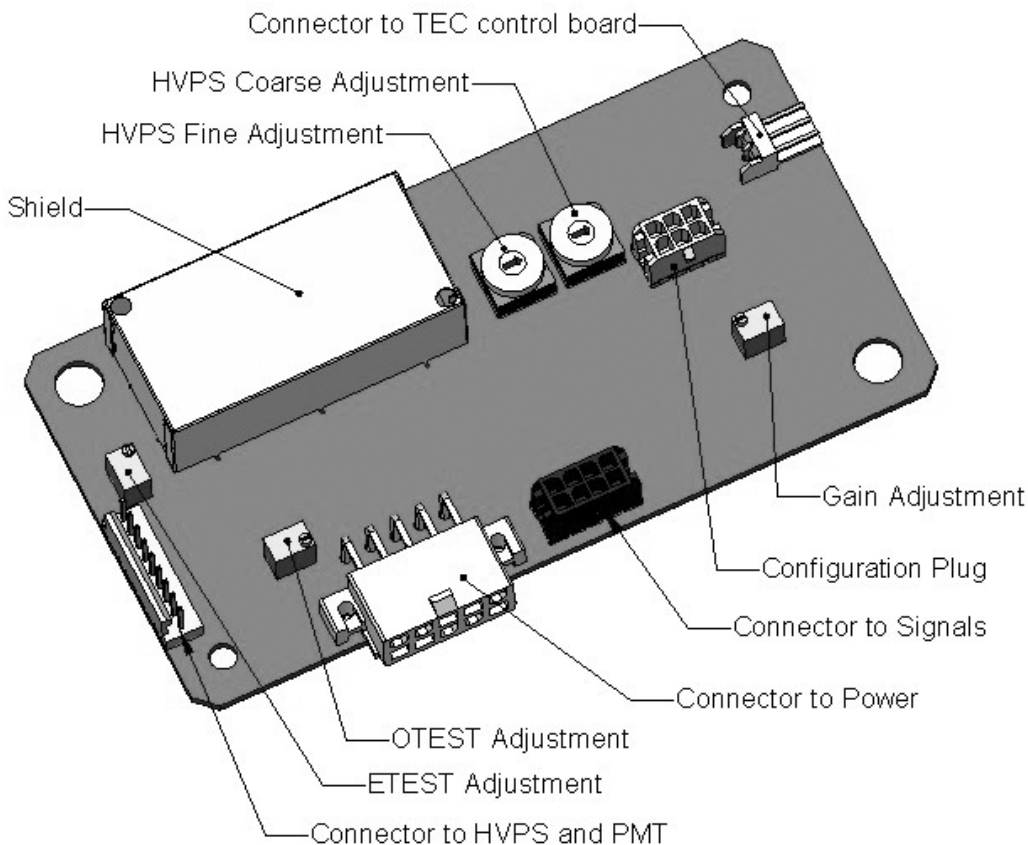
- Finger tighten the thumbscrew.

**NOTE:**

**DO NOT** over-tighten the thumbscrew.

### 10.3.2.2. PMT Hardware Calibration (**FACTORY CAL**)

The sensor module hardware calibration adjusts the slope of the PMT output when the instrument's slope and offset values are outside of the acceptable range and all other more obvious causes for this problem have been eliminated.



**Figure 10-5: Pre-Amplifier Board Layout**

1. Set the instrument reporting range type to **SNGL** (see Section 6.7.4 of the T100 Manual)
2. Perform a zero-point calibration using zero air (see Section 7 of the T100 Manual).
3. Let the instrument stabilize by allowing it to run for one hour.
4. Adjust the UV Lamp. (See Section 10.3.2.1 of this addendum)
5. Perform a **LAMP CALIBRATION** procedure (see Section 6.9.7 of the T100 Manual).
6. Locate the Preamp board (see Figure 3-4 of this addendum).
7. Locate the Following Components On the Preamp board (see Figure 10-5 of this addendum):
  - HVPS coarse adjustment switch (Range 0-9, then A-F)
  - HVPS fine adjustment switch (Range 0-9, then A-F)
  - Gain adjustment potentiometer (Full scale is 10 to 12 turns).

8. Set the HVPS coarse adjustment to its minimum setting (0).
9. Set the HVPS fine adjustment switch to its maximum setting (F).
10. Turn the gain adjustment potentiometer clockwise to its maximum setting.
11. Set the front panel display to show **STABIL** (see Section 6.2.1 of the T100 Manual)
12. Feed span gas into the analyzer.
13. Wait until the **STABIL** value is below 0.5 ppm,

**NOTE**

Use a span gas equal to 80% of the reporting range.

Example: for a reporting range of 200 ppm, use a span gas of 160 ppm.

14. Scroll to the **OFFSET** function and record the value.
15. Scroll to the **NORM PMT** value.

**NOTE**

Do not overload the PMT by accidentally setting both adjustment switches to their maximum setting. This can cause permanent damage to the PMT.

16. Determine the target **NORM PMT** value according to the following formulas.
  - If the reporting range is set for  $\leq 500$  ppm (the instrument will be using the 500 ppm physical range):
 
$$\text{Target NORM PMT} = (8 \times \text{span gas concentration}) + \text{OFFSET}$$
  - If the reporting range is set for  $\geq 5,001$  PPB (the instrument will be using the 5,500 ppm physical range):
 
$$\text{Target NORM PMT} = (0.8 \times \text{span gas concentration}) + \text{OFFSET}$$

**EXAMPLE:** If the **OFFSET** is 33 mV, the Reporting Range is 1000 ppm, the span gas should be 800 ppm SO<sub>2</sub> and the calculation would be:

$$\begin{aligned} \text{Target NORM PMT} &= (0.8 \times 800) + 33 \text{ mV} \\ \text{Target NORM PMT} &= 640 + 33 \text{ mV} \\ \text{Target NORM PMT} &= 673 \text{ mV} \end{aligned}$$

17. Set the HVPS coarse adjustment switch to the lowest setting that will give you more than the target NORM PMT signal from Step 16.
  - The coarse adjustment typically increments the **NORM PMT** signal in 100-300 mV steps.
18. Adjust the HVPS fine adjustment such that the **NORM PMT** value is at or just above the target NORM PMT signal from Step 16.
19. Continue adjusting the both the coarse and fine switches until **NORM PMT** is as close to (but not below) the target NORM PMT value from Step 16.

20. Adjust gain adjustment potentiometer until the **NORM PMT** value is  $\pm 10$  mV of the target level from Step 16.
21. Perform span calibration (see Section 7 of the T100 Manual)
22. Scroll to the **SLOPE** function and record the value.
23. If the value of the **SLOPE** is between 0.900 and 1.100 the PMT Hardware calibration is complete.
24. If the value of the **SLOPE** is less than 0.900 or greater than 1.100:
  1. Multiply the slope value from step 22 by the norm PMT value from step 19.
  2. Repeat steps 17 through 24 using this new value for **NORM PMT**.

## 10.4. Technical Assistance

If this manual and its trouble-shooting / repair sections do not solve your problems, technical assistance may be obtained from Teledyne Instruments, Customer Service, 9480 Carroll Park Drive, San Diego, CA 92121. Phone: +1 858 657 9800 or 1-800 324 5190. Fax: +1 858 657 9816. Email: [api-customerservice@teledyne.com](mailto:api-customerservice@teledyne.com).

Before you contact 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/index.asp>.

## **APPENDIX A - Version Specific Software Documentation**

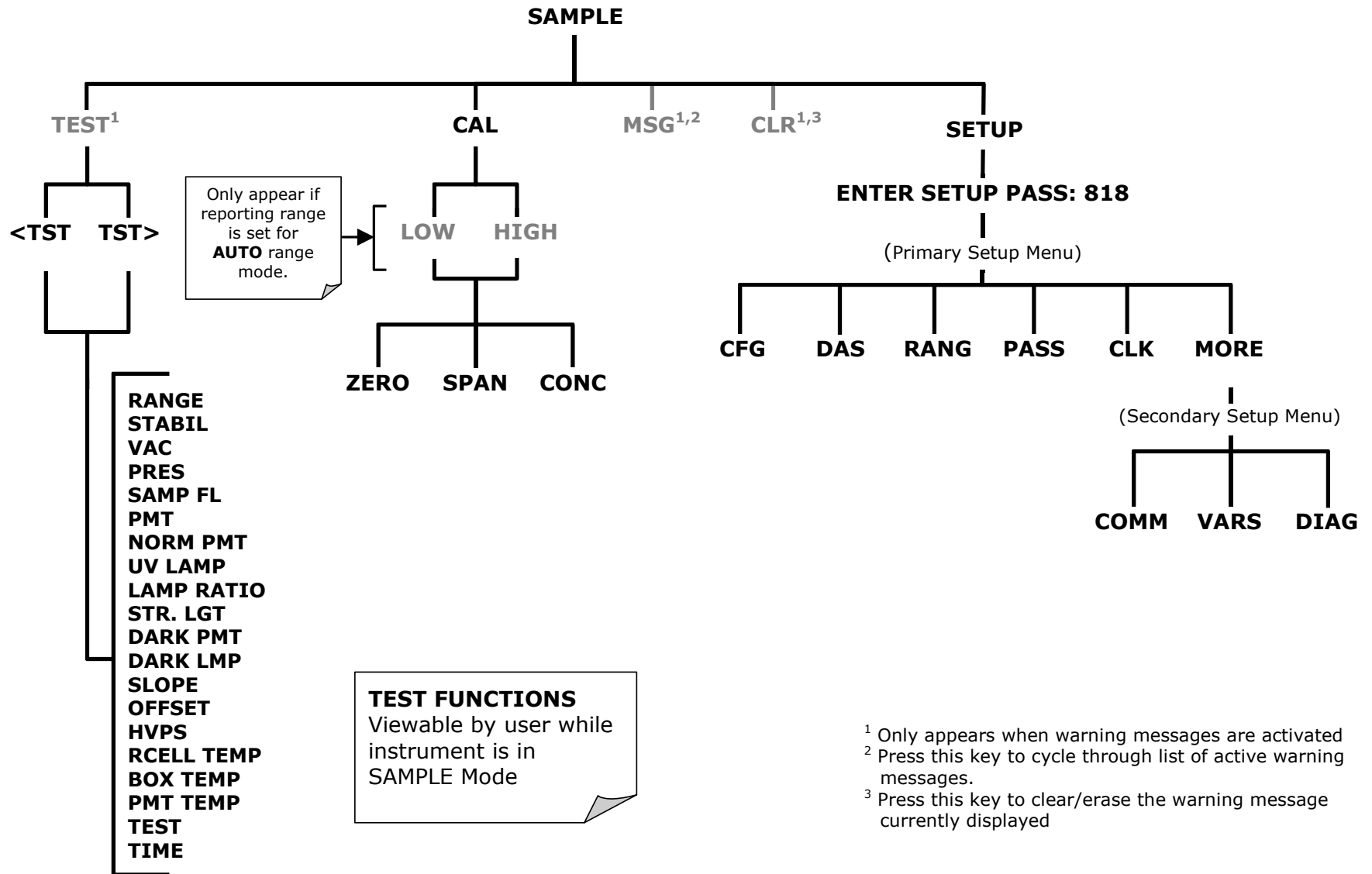
### **APPENDIX A-1: Models T100H, 100EH Software Menu Trees**

**NOTE**

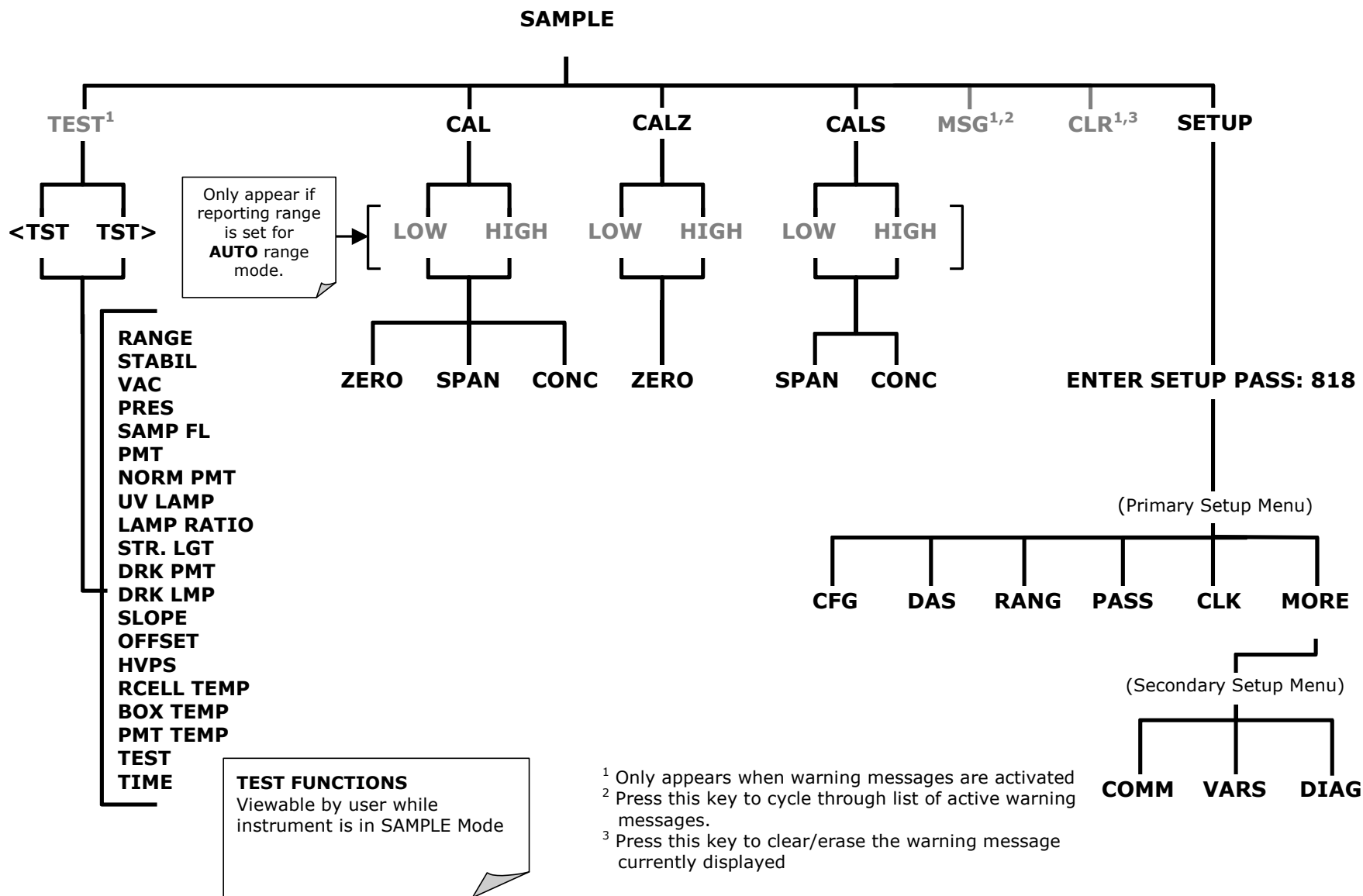
**As the menu tree structure for the T100H and 100EH menu tree structure varies from that of the T100 and M100E, they are included in this appendix. Please refer to Appendix A of the "parent" manual (either the T100 or the 100EH) for all other software documentation.**



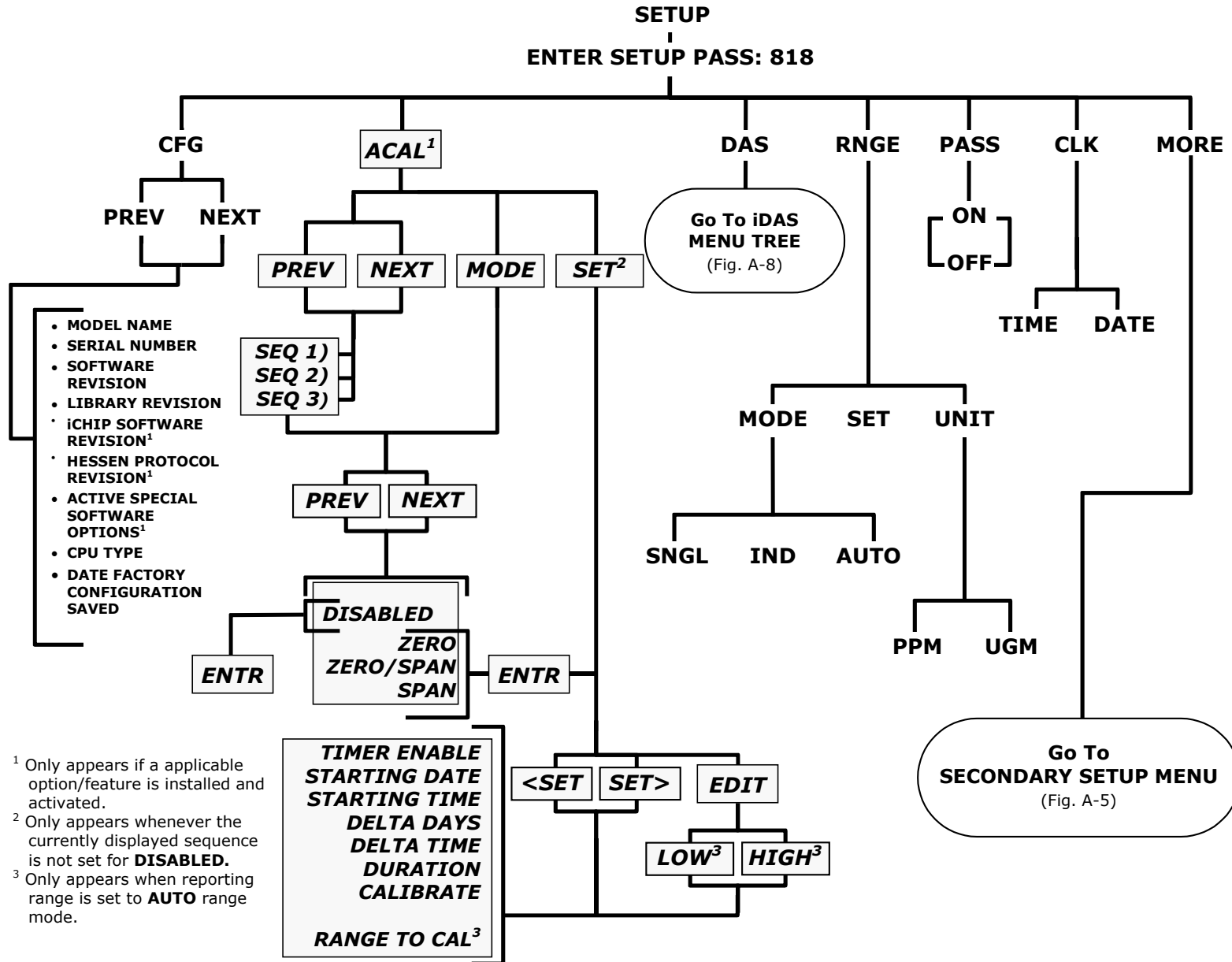
**APPENDIX A-1: Software Menu Trees, Rev C.0**



**Figure A-1: Basic Sample Display Menu**



**Figure A-2: Sample Display Menu - Z/S Valve Option installed**



<sup>1</sup> Only appears if a applicable option/feature is installed and activated.  
<sup>2</sup> Only appears whenever the currently displayed sequence is not set for **DISABLED**.  
<sup>3</sup> Only appears when reporting range is set to **AUTO** range mode.

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

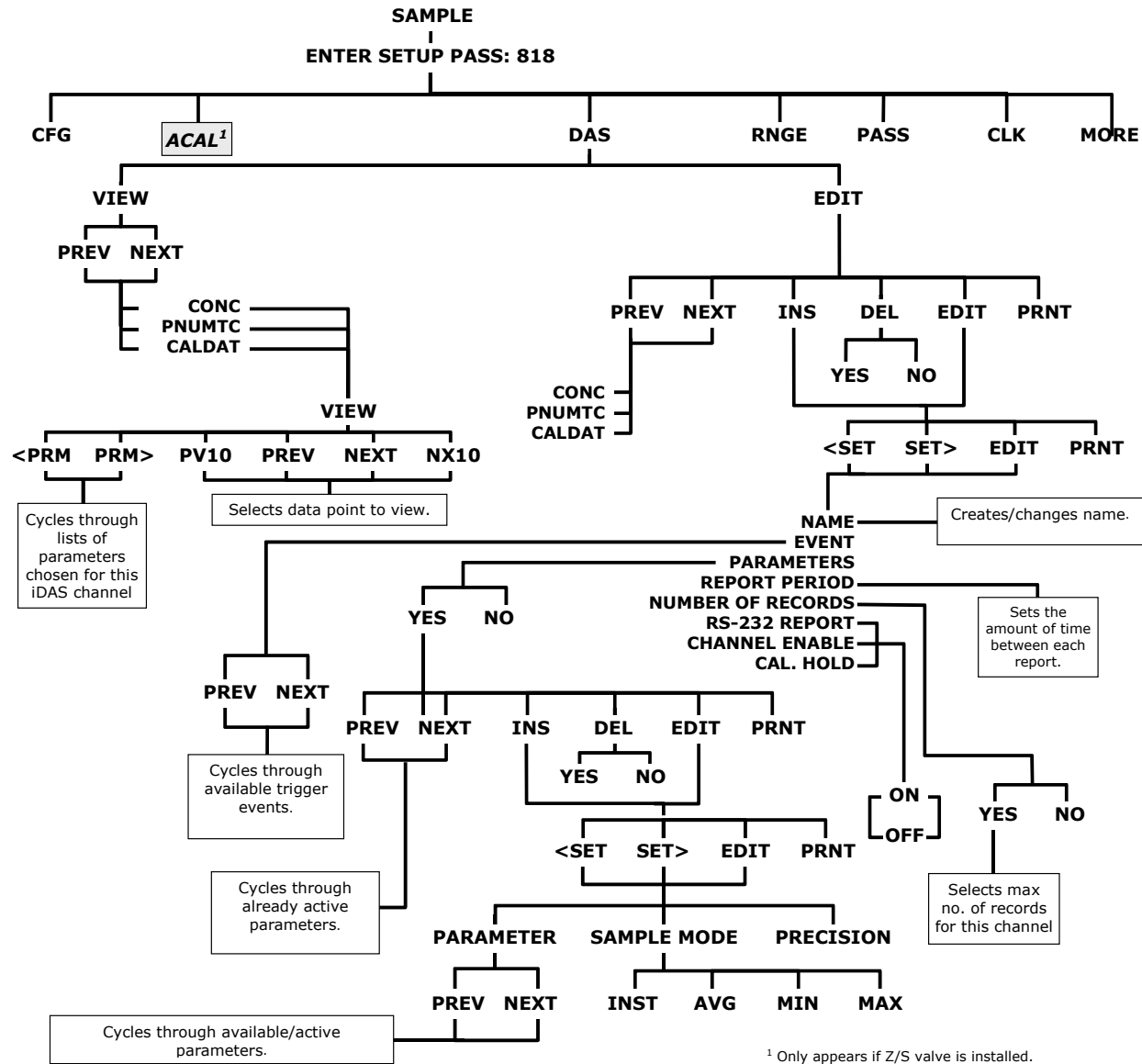


Figure A-4: Primary Setup Menu (iDAS)

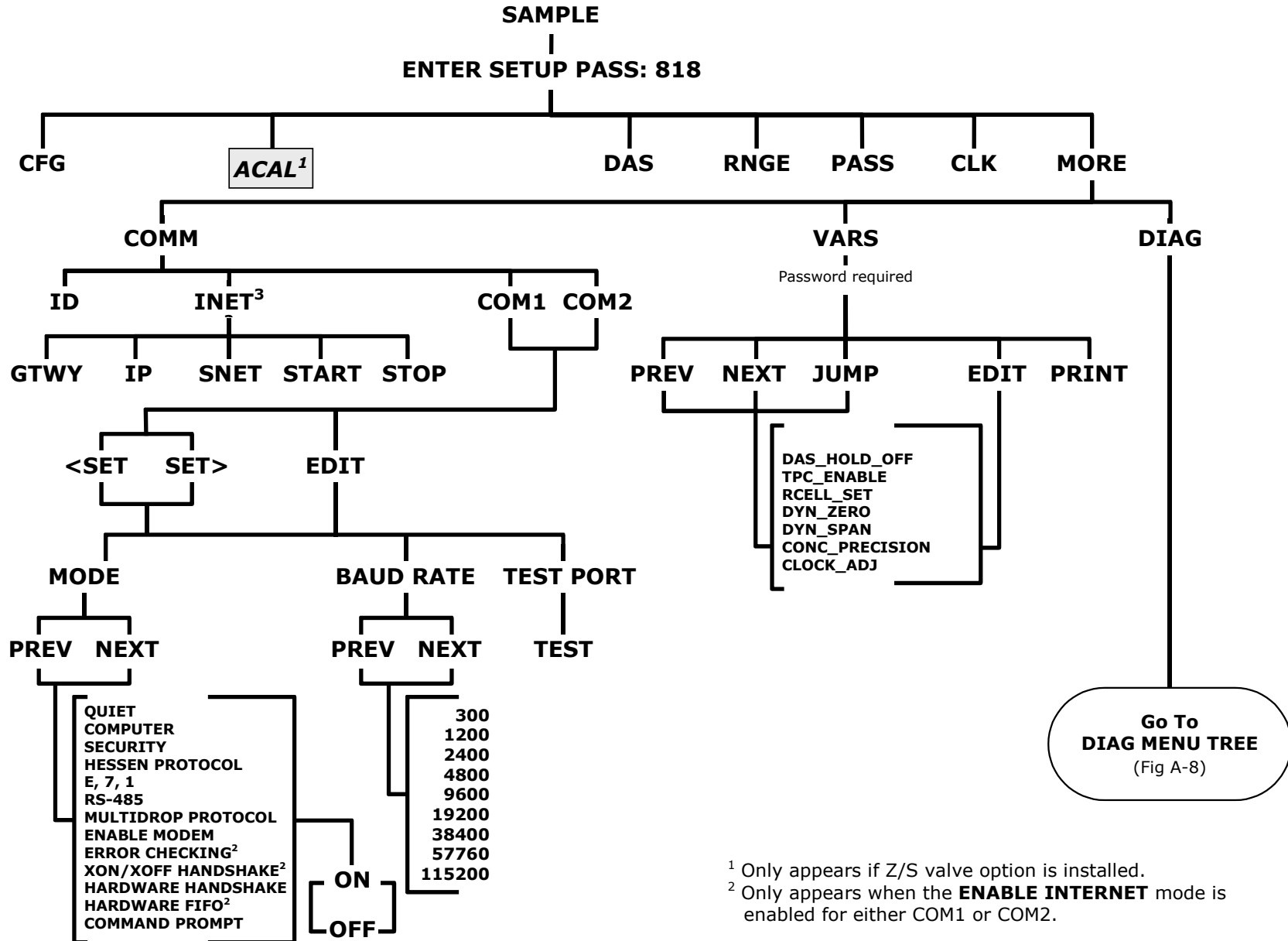
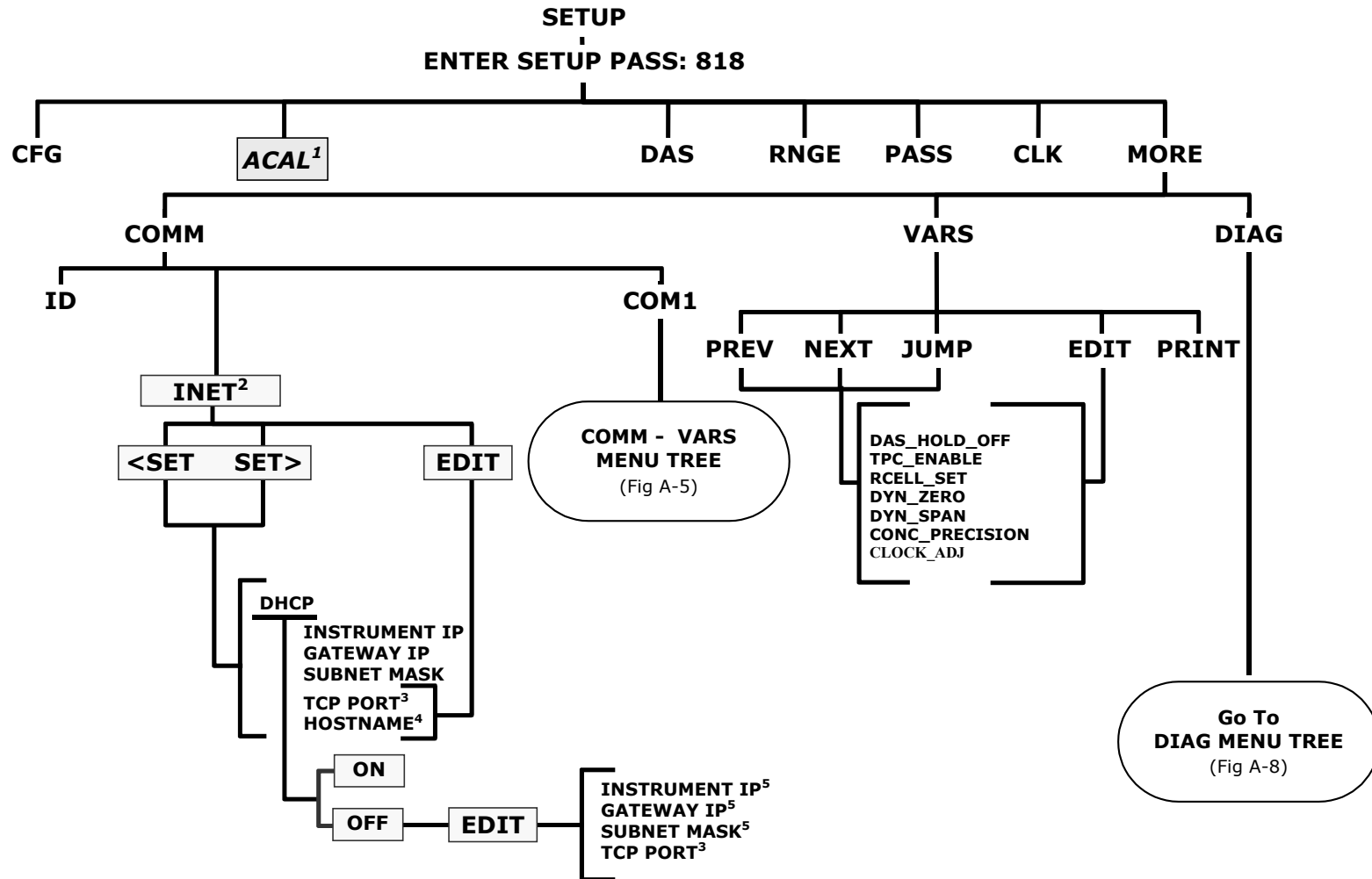


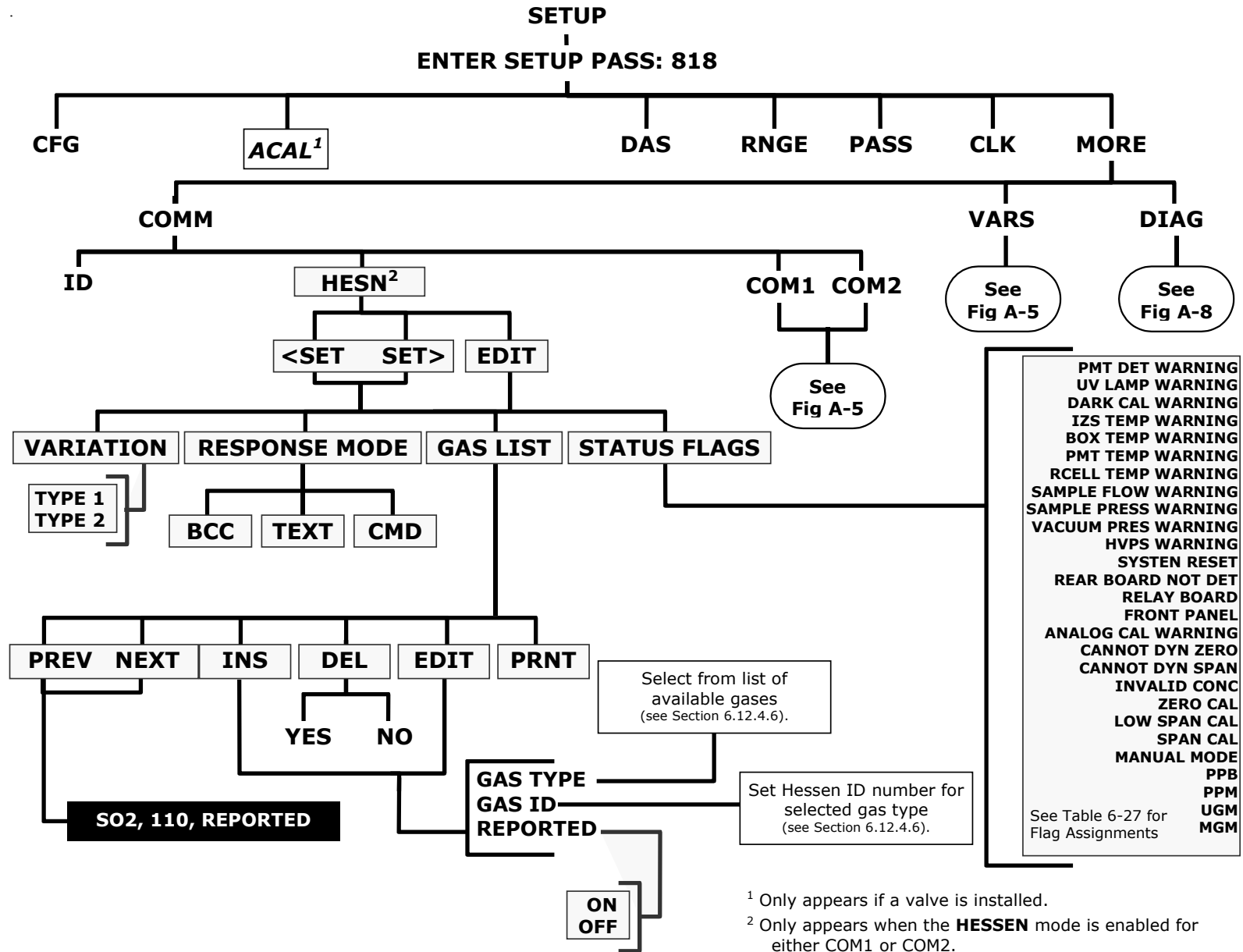
Figure A-5: Secondary Setup Menu (COMM & VARS)

<sup>1</sup> Only appears if Z/S valve option is installed.  
<sup>2</sup> Only appears when the **ENABLE INTERNET** mode is enabled for either COM1 or COM2.



- <sup>1</sup> Only appears if a valve option is installed.
- <sup>2</sup> Only appears when the Ethernet card (option 63) is installed.
- <sup>3</sup> 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.
- <sup>4</sup> **HOST NAME** is only editable when **DHCP** is **ON**.
- <sup>5</sup> **INSTRUMENT IP**, **GATEWAY IP** & **SUBNET MASK** are only editable when **DHCP** is **OFF**.

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



<sup>1</sup> Only appears if a valve is installed.

<sup>2</sup> Only appears when the **HESSEN** mode is enabled for either COM1 or COM2.

Figure A-7: Secondary Setup Menu - HESSEN Submenu

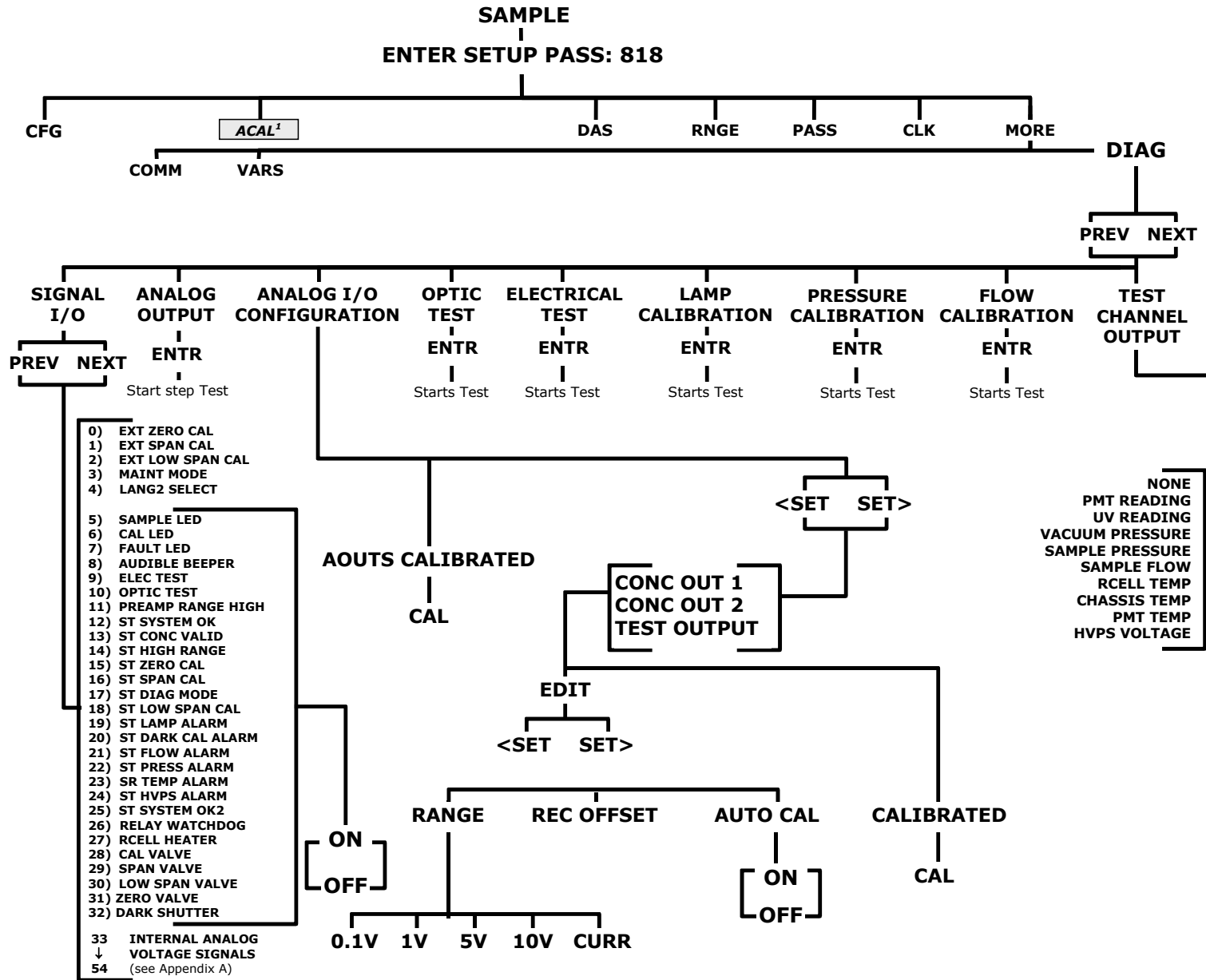


Figure A-8: Secondary Setup Menu (DIA)

## APPENDIX B - Spare Parts

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**Note** Use of replacement parts other than those supplied by Teledyne Advanced Pollution Instrumentation (TAPI) may result in non-compliance with European standard EN 61010-1.

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**Note** Due to the dynamic nature of part numbers, please refer to the TAPI Website at <http://www.teledyne-api.com> or call Customer Service at 800-324-5190 for more recent updates to part numbers.

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069280000 LIST, SPARE PARTS, T100H 3/24/2011 11:04:39 AM

PARTNUMBER	DESCRIPTION
000940400	CD, ORIFICE, .004 BLUE
000940800	CD, ORIFICE, .012 (NO PAINT)
002690000	CD, LENS, PL-CON (KB)
002700000	CD, LENS, BI-CON (KB)
002740000	CD FILTER, PMT 360NM(KB)
005960000	AKIT, EXP, 6LBS ACT CHARCOAL (2 BT=1)
006900000	RETAINER PAD CHARCOAL, SMALL, 1-3/4"
009690000	AKIT, TFE FLTR ELEM (FL6 100=1) 47mm
009690100	AKIT, TFE FLTR ELEM (FL6, 30=1) 47mm
013140000	ASSY, COOLER FAN (NOX/SOX)
013400000	CD, PMT, SO2, (KB)
013420000	ASSY, ROTARY SOLENOID
013570000	THERMISTOR HOUSING ASSY SOX/NOX(KB)
014080100	ASSY, HVPS, SOX/NOX
014750000	AKIT, EXP KIT, IZS
016290000	WINDOW, SAMPLE FILTER, 47MM (KB)
016300700	ASSY, SAMPLE FILTER, 47MM, ANG BKT
018080000	AKIT, DESSICANT BAGGIES, (12)
023410000	ASSY, FLOW MODULE, M100AH/EH
036850000	PLUG, SEALING, M700 INLET MAN
037860000	ORING, TEFLON, RETAINING RING, 47MM (KB)
040010000	ASSY, FAN REAR PANEL
041620200	ASSY, SO2 SENSOR, M100EH (B/F)
041800400	PCA, PMT PREAMP, VR
043570100	AKIT, EXPENDABLES, M100EH
045230200	PCA, RELAY CARD
045870100	PCA, REF DETECTOR PREAMP, W/ADJ, M100EH
046250000	ASSY, RXCELL HEATER/FUSE
046260000	ASSY, THERMISTOR, RXCELL (KB)
048190100	ASSY, RELAY/PS, M100E/M200E/M400E
049310100	PCA,TEC DRIVER,PMT,(KB)
050610100	OPTION, 100-120V/60Hz (KB)
050610200	OPTION, 100-120V/50Hz (KB)
050610300	OPTION, 220-240V/50Hz, (KB)
050610400	OPTION, 220-240V/60Hz (KB)
050610500	OPTION, 100V/50Hz, (OBS)
050610600	OPTION, 100V/60Hz (OBS)
051990000	ASSY, SCRUBBER, INLINE EXHAUST, DISPOS
053020100	ASSY, INLET MANIFOLD VALVE, VA23
053020200	ASSY, INLET MANIFOLD VALVE, VA24
058021100	PCA, MOTHERBD, GEN 5-ICOP
061930000	PCA, UV LAMP DRIVER, GEN-2 43mA *
066970000	PCA, INTRF. LCD TOUCH SCRNM, F/P
067240000	CPU, PC-104, VSX-6154E, ICOP *(KB)
067300000	PCA, AUX-I/O BD, ETHERNET, ANALOG & USB
067300100	PCA, AUX-I/O BOARD, ETHERNET
067300200	PCA, AUX-I/O BOARD, ETHERNET & USB
067900000	LCD MODULE, W/TOUCHSCREEN(KB)

068810000	PCA, LVDS TRANSMITTER BOARD
069340100	DOM, w/SOFTWARE, STD, T100H *
069500000	PCA, SERIAL & VIDEO INTERFACE BOARD
072150000	ASSY. TOUCHSCREEN CONTROL MODULE
072780000	KIT, T100H MANUAL
CN0000073	POWER ENTRY, 120/60 (KB)
CN0000458	PLUG, 12, MC 1.5/12-ST-3.81 (KB)
CN0000520	PLUG, 10, MC 1.5/10-ST-3.81 (KB)
FL0000001	FILTER, SS (KB)
FL0000003	FILTER, DFU (KB)
HW0000005	FOOT
HW0000036	TFE TAPE, 1/4" (48 FT/ROLL)
HW0000090	SPRING, SS, LONG
HW0000093	SPRING
HW0000101	ISOLATOR
HW0000149	SEALING WASHER, #10
HW0000453	SUPPORT, CIRCUIT BD, 3/16" ICOP
HW0000685	LATCH, MAGNETIC, FRONT PANEL
KIT000093	AKIT, REPLCMNT(3187)214NM FLTR (BF)
KIT000095	AKIT, REPLACEMENT COOLER
KIT000207	KIT, RELAY RETROFIT
KIT000219	AKIT, 4-20MA CURRENT OUTPUT
KIT000236	KIT, UV LAMP, w/ADAPTER (BIR)
KIT000253	ASSY & TEST, SPARE PS37
KIT000254	ASSY & TEST, SPARE PS38
OR0000001	ORING, 2-006VT *(KB)
OR0000004	ORING, 2-029V
OR0000006	ORING, 2-038V
OR0000007	ORING, 2-039V
OR0000015	ORING, 2-117V
OR0000016	ORING, 2-120V
OR0000025	ORING, 2-133V
OR0000027	ORING, 2-042V
OR0000048	ORING, 2-112S
OR0000050	ORING, 2-014V
OR0000051	ORING, 2-008V
OR0000060	ORING, 2-005S
OR0000083	ORING, 105M, 1MM W X 5 MM ID, VITON
OR0000084	ORING, 2-020V
OR0000094	ORING, 2-228V, 50 DURO VITON(KB)
PU0000005	PUMP, THOMAS 607, 115V/60HZ (KB)
PU0000006	PUMP, THOMAS 607, 220V/50HZ (KB)
PU0000011	REBUILD KIT, THOMAS 607(KB)
PU0000054	PUMP, THOMAS 688, 100V, 50/60HZ
PU0000064	REBUILD KIT, 688 SERIES, SINGLE HEAD *
RL0000015	RELAY, DPDT, (KB)
SW0000025	SWITCH, POWER, CIRC BREAK, VDE/CE *(KB)
SW0000059	PRESSURE SENSOR, 0-15 PSIA, ALL SEN
WR0000008	POWER CORD, 10A(KB)

## Recommended Spare Parts Stocking Levels

(Reference 04527 24Mar2011)

Part Number	Description	1	2-5	6-10	11-20	21-30	UNITS
000940800	CD, ORIFICE, .012 (NO PAINT)		1	2	4	4	
002740000	CD FILTER, PMT 360NM(KB)				1	2	
013400000	CD, PMT, SO2, (KB)				1	1	
014080100	ASSY, HVPS, SOX/NOX					1	
014610000	KIT, REPLACEMENT COOLER ASSY					1	
023400000	BEAM SPLITTER, M100AH/EH				1	2	
023410000	ASSY, FLOW MODULE, M100AH/EH			1	2	3	
040010000	ASSY, FAN REAR PANEL	1	1	2	4	4	
041800400	PCA, PMT PREAMP, VR		1	2	4	4	
042410200	42410200: For 240V operation, use 055100200				1	1	
042580000	PCA, KEYBOARD, W/V-DETECT(KB) (E-Series)					1	
045230200	PCA, RELAY CARD				1	1	
045870100	PCA, REF DETECTOR PREAMP, W/ADJ, M100EH			1	1	2	
055100200	ASSY, OPTION, PUMP, 240V *				1	2	
055560000	ASSY, VALVE, VA59 W/DIODE, 5" LEADS		1	2	4	4	
058021100	PCA, MOTHERBD, GEN 5-ICOP				1	1	With IZS, ZS Option
061930000	PCA, UV LAMP DRIVER, GEN-2 43mA *		1	1	2	2	
062870000	CPU, PC-104, VSX-6150E, ICOP (KB)*		1	2	2	4	
DS0000025	DISPLAY(KB) (E-Series)				1	1	
FM0000004	FLOWMETER (KB)				1	2	
KIT000236	KIT, UV LAMP, w/ADAPTER (BIR)				1	1	
OP0000030	OXYGEN TRANSDUCER, PARAMAGNETIC				1	1	
SW0000059	PRESSURE SENSOR, 0-15 PSIA, ALL SEN					1	
						1	

<b>Part Number</b>	<b>Description</b>	<b>Quantity</b>
009690100	KIT, TFE FILTER ELEMENTS, 47MM, 5UM (30)	1
018080000	AKIT, DESSICANT BAGGIES (12)	1
FL0000001	FILTER, SS	2
HW0000020	SPRING	2
NOTE01-23	SERVICE NOTE, HOW TO REBUILD THE KNF PUMP	1
OR0000001	ORING, SAMPLE FLOW	4
PU0000022	REBUILD KIT, FOR PU20 & 04084	1

**Appendix C**  
**Warranty/Repair Questionnaire**  
**Models T100H, 100EH**  
(05029D DCN 6038)



CUSTOMER: \_\_\_\_\_ PHONE: \_\_\_\_\_

CONTACT NAME: \_\_\_\_\_ FAX NO. \_\_\_\_\_

SITE ADDRESS: \_\_\_\_\_

MODEL 100EH SERIAL NO.: \_\_\_\_\_ FIRMWARE REVISION: \_\_\_\_\_

1. ARE THERE ANY FAILURE MESSAGES? \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_

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

Parameter	Displayed As	Observed Value	Units	Nominal Range
Range	<b>RANGE</b>		PPM UG/M <sup>3</sup>	1-5000 PPM Standard
Stability	<b>STABIL</b>		PPM UG/M <sup>3</sup>	<.1 PPM with Zero Air
Vacuum	<b>VAC</b>		In-Hg-A	4 – 10 “Hg
Sample Pressure	<b>PRES</b>		In-Hg-A	24 – 29
Sample Flow	<b>SAMP FL</b>		CC/MIN	700 ±10%
PMT Signal	<b>PMT</b>		MV	0 ± 100 with Zero Air
Normalized PMT Signal	<b>NORM PMT</b>		MV	0 ± 100 with Zero Air
UV Lamp	<b>UV LAMP</b>		MV	1000 – 4800
UV Lamp Ratio	<b>LAMP RATIO</b>		%	35 – 120%
Stray Light	<b>STR. LGT</b>		PPM	-50 to +100
Dark PMT	<b>DRK PMT</b>		MV	<200
Dark Lamp	<b>DRK LMP</b>		MV	-30 to 50
Slope	<b>SLOPE</b>		-	1.0 ± 0.3
Offset	<b>OFFSET</b>		MV	<200
High Voltage Power Supply	<b>HVPS</b>		V	400 – 750*
Reaction Cell Temperature	<b>RCELL TEMP</b>		°C	50 ± 1
Box Temperature	<b>BOX TEMP</b>		°C	Ambient + (3-7)
PMT Temperature	<b>PMT TEMP</b>		°C	7 ± 2
Time of Day	<b>TIME</b>		HH:MM:SS	

TELEDYNE API CUSTOMER SERVICE  
 EMAIL: [api-customerservice@teledyne.com](mailto:api-customerservice@teledyne.com)  
 PHONE: (858) 657-9800 TOLL FREE: (800) 324-5190 FAX: (858) 657-9816

**Appendix C**  
**Warranty/Repair Questionnaire**  
**Models T100H, 100EH**  
 (05029D DCN 6038)



<b>Test Settings</b>		
<b>Test Value</b>	<b>Observed Value</b>	<b>Acceptable Value</b>
E TEST PMT Reading		2000 ± 1000MV
O TEST PMT Reading		2000 ± 20 MV

2. HAVE YOU PERFORMED A LEAK CHECK AND FLOW CHECK? \_\_\_\_\_
3. WHAT ARE THE FAILURE SYMPTOMS? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
4. WHAT TEST HAVE YOU DONE TRYING TO SOLVE THE PROBLEM? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
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.

**TELEDYNE API CUSTOMER SERVICE**  
**EMAIL: [api-customerservice@teledyne.com](mailto:api-customerservice@teledyne.com)**  
**PHONE: (858) 657-9800 TOLL FREE: (800) 324-5190 FAX: (858) 657-9816**