INSTRUCTION MANUAL

TML50H
UV FLUORESCENCE SO_2 ANALYZER

Addendum to the TML50 Instruction Manual (P/N 045150102)

35 INVERNESS DRIVE EAST
ENGLEWOOD, CO 80112
USA

TOLL-FREE SUPPORT: 800-846-6062
FAX: 303-799-4853
TEL: 303-792-3300
E-MAIL: tml_support@teledyne.com
WEBSITE: http://www.teledyne-ml.com

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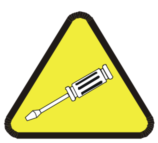
SAFETY MESSAGES

Your safety and the safety of others is very important. We have provided many important safety messages in this addendum. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

	**GENERAL SAFETY HAZARD: Refer to the instructions for details on the specific hazard.**
	**CAUTION: Hot Surface Warning**
	**CAUTION: Electrical Shock Hazard**
	**TECHNICIAN SYMBOL: All operations marked with this symbol are to be performed by qualified maintenance personnel only.**

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

USER NOTES:

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

USER NOTES:

USER NOTES:

1. TML50H 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 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.

Thank you for purchasing the TML50H UV Fluorescence SO_2 Analyzer!

The documentation for this instrument is available in either printed format or in electronic format on a CD-ROM.

The electronic manual is in Adobe® Systems Inc. "Portable Document Format". The Adobe® Acrobat Reader® software, which is necessary to view these files, can be downloaded for free from the internet at http://www.adobe.com/.

The electronic version of the manual has many advantages:

- Keyword and phrase search feature
- Figures, tables and internet addresses are linked so that clicking on the item will display the associated feature or open the website.
- A list of chapters and sections as well as thumbnails of each page are displayed to the left of the text.
- Entries in the table of contents are linked to the corresponding locations in the manual.
- Ability to print sections (or all) of the manual

Additional documentation for the TML50H UV Fluorescence SO_2 Analyzer is available from Teledyne Instruments' website at http://www.teledyne-ml.com

- Sensor-e.com software manual, part number 039450000
- Multi-drop manual, part number 01842
- iDAS Manual, part number 028370000.

1.1. Using This Manual Addendum

This manual addendum has the same overall structure as that of the TML50 instruction 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

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

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 TML50H operation that differ from the TML50 manual.

Maintenance & Troubleshooting Section:

This section includes pointers and instructions for diagnosing problems that are specific to the TML50H. The TML50 manual has a more complete troubleshooting section, most of which also applies to the TML50H.

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 iDAS & serial I/O variables, spare parts list, repair questionnaire, interconnect listing and drawings, and electronic schematics.

2. SPECIFICATIONS & APPROVALS

2.1. Specifications

Table 2-1: TML50H Basic Unit Specifications

Min/Max Range (Physical Analog Output)	In 1ppb increments from 10ppm to 5,000 ppm, dual ranges or auto ranging
Measurement Units	ppm, mg/m3 (user selectable)
Zero Noise[1]	0.05 ppm rms
Span Noise[1]	< 0.5% of reading (above 50 ppm)
Lower Detectable Limit[2]	0.1 ppm rms
Zero Drift (24 hours)	< 1 ppm
Zero Drift (7 days)	< 2 ppm
Span Drift (7 Days)	< 0.5% FS
Linearity	1% of full scale
Precision	0.5% of reading[1]
Temperature Coefficient	< 0.1% per ^{o}C
Voltage Coefficient	< 0.05% per V
Lag Time[1]	5 sec
Rise/Fall Time[1]	95% in < 30 sec
Sample Flow Rate	700 cm^3/min. ±10%
Temperature Range	5-40^{o}C
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
Weight, Pump Pack	16 lbs (7 kg)
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 Defined as twice the zero noise level by the USEPA.

2.2. CE Mark Compliance

Emissions Compliance

The Teledyne Instruments UV Fluorescence SO_2 Analyzer TML50H 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.

Tested on 21 February 2003 - 08 March 2003 at CKC Laboratories, Inc., Report Number CE03-021A.

Safety Compliance

The Teledyne Instruments UV Fluorescence SO_2 Analyzer TML50H was tested and found to be fully compliant with:

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

Issued by CKC Laboratories on 4 April 2003, Report Number WO-80146.

3. GETTING STARTED

3.1. Unpacking and Initial Setup

CAUTION

To avoid personal injury, always use two persons to lift and carry the TML50H.

1. Inspect the received packages for external shipping damage. If damaged, please advise the shipper first, then T-ML.

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.

NOTE

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

See Chapter 12 of the TML50 Manual (P/N 045150102) for more information on preventing ESD damage.

CAUTION

Never disconnect electronic circuit boards, wiring harnesses or electronic subassemblies while the unit is under power.

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 TML50H, please refer to the TML50 user's manual (#045150102), Chapter 3.

3.1.1.1. External Pump

The TML50H 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.

CAUTION

- **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 eletrical 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.

Table 3-1: Inlet / Outlet Connector Nomenclature

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 TML50 Manual (P/N 045150102) shows the internal pneumatic flow of the TML50 in its standard configuration. For a diagram of the internal pneumatic flow of the TML50H, see Figure 3-3 of this addendum.

3.2.1.1. Pneumatic Connections to TML50H Basic Configuration:

The pneumatic connections for the TML50H analyzer in its basic configuration are nearly identical to those described the TML50 Manual (P/N 045150102) Section 3.1.2.2 except that the TML50H has an external pump. Therefore:

- A pneumatic line of ¼" PTEF must be attached between the analyzer's exhaust port and the inlet port of the pump.
- The exhaust from must be vented outside the shelter or immediate area surrounding the instrument using a maximum of 10 meters of 1/4" PTFE tubing.

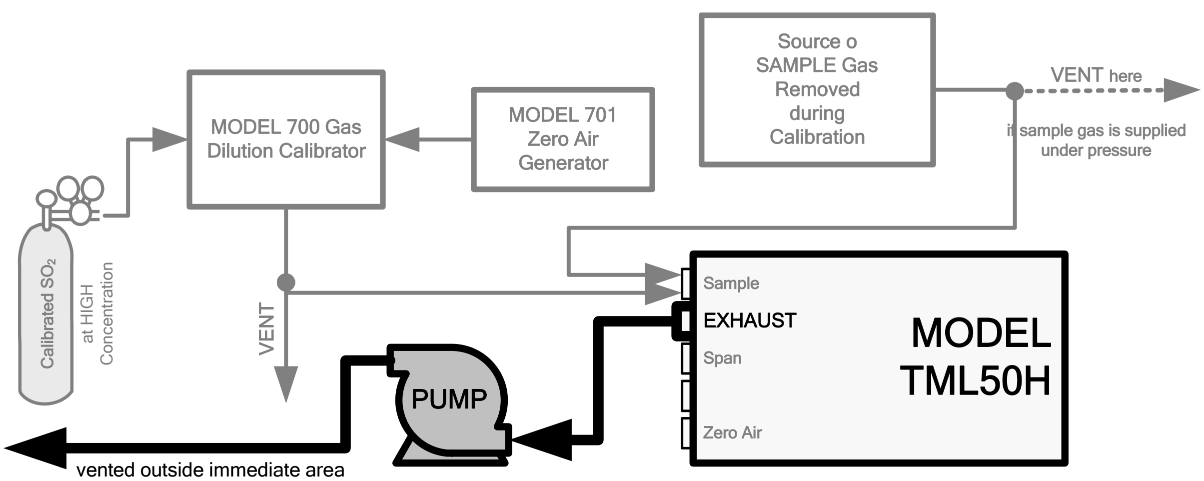


Figure 3-1: Example of Pneumatic Connections to TML50H External Pump

This change is true for all configurations and variations of the TML50H.

3.2.1.2. Connections with Internal Valve Options Installed

- There is no IZS option available for the TML50H.
- An additional valve option (Option 52 - Zero & Two Span Points) is available on the TML50H. The pneumatic set up for this option is:

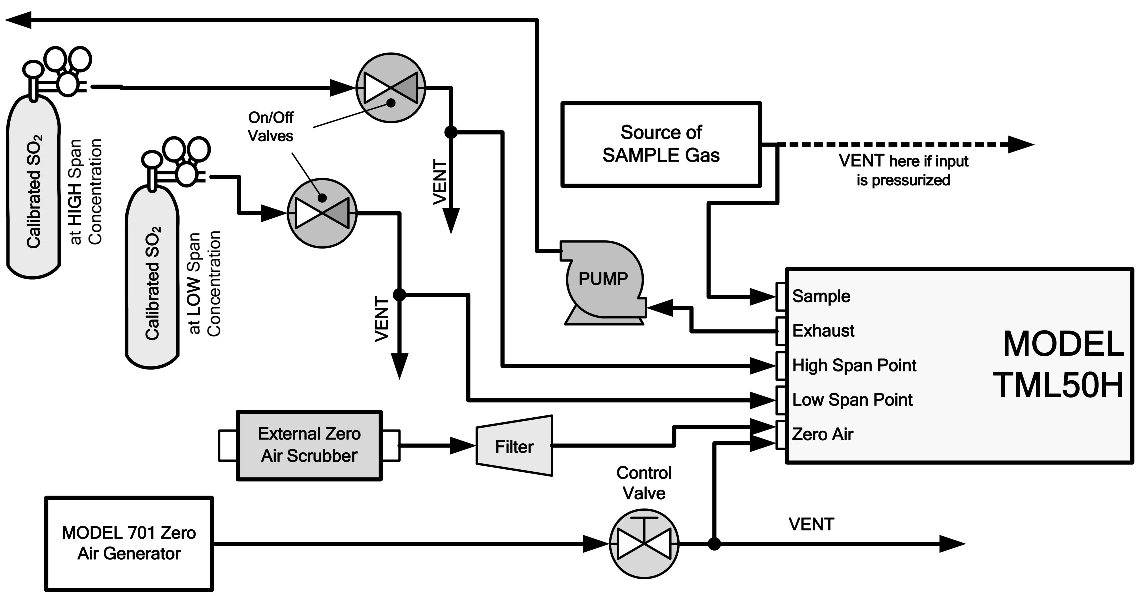


Figure 3-2: Pneumatic Connections to TML50H with Zero and Two Span Point Valve Option

3.2.2. TML50H Layout

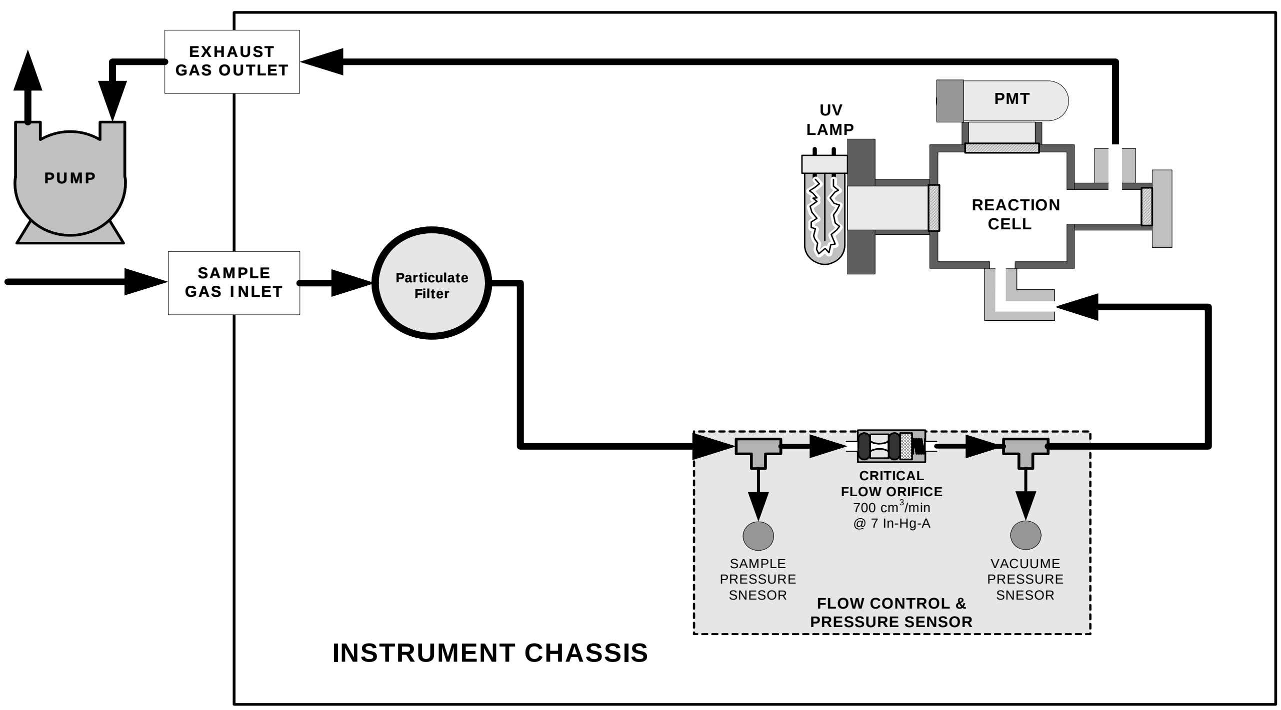


Figure 3-3: Internal Pneumatic flow for TML50H in Basic Configuration

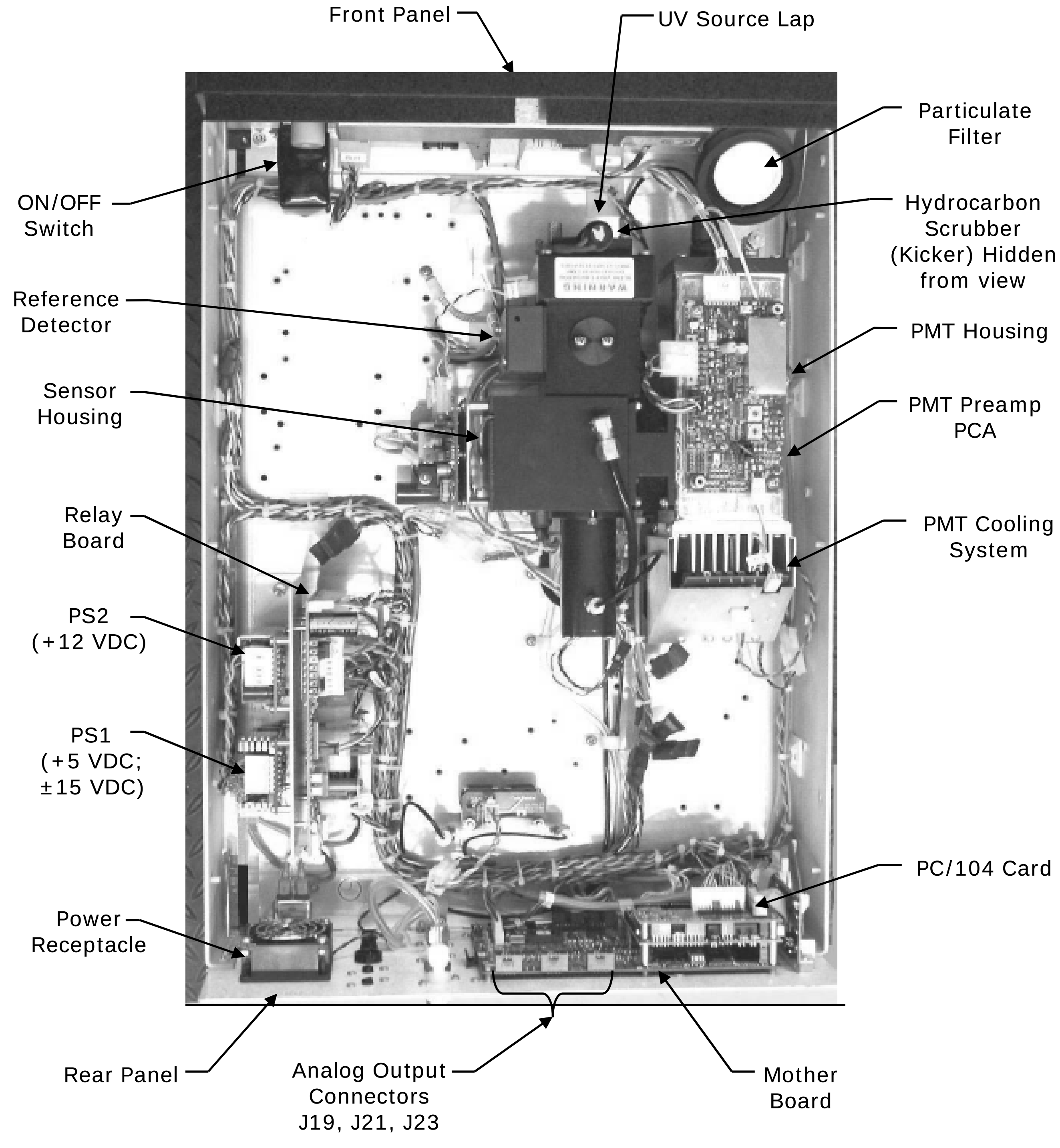


Figure 3-4: TML50H Layout (Basic Unit – No Valve Options)

3.3. Initial Operation

With the following exceptions, the operation of the TML50H is nearly identical to that of the TML50. Please refer to the TML50 User's Manual, Chapter 3, for details on initial operation, including common warning messages, functional checkout of the instrument, initial calibration, and common interferents for the TML50H.

3.3.1. Warning Messages

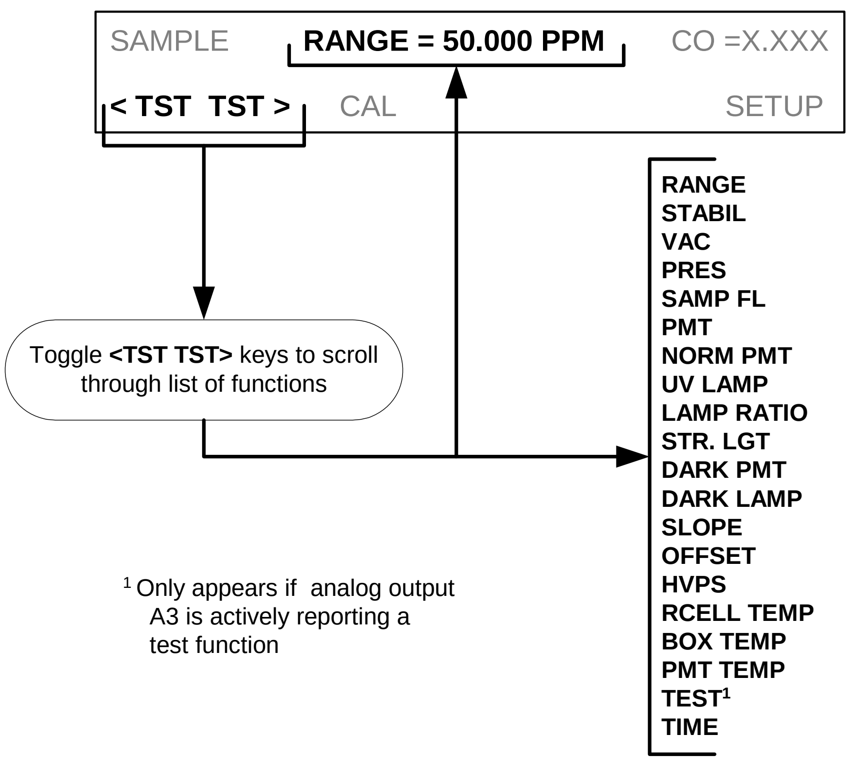
Please refer to the TML50 User's Manual (P/N 045150102), Chapter 3, for a complete listing of warnings for the TML50H. The following table lists warnings that differ in the TML50H from those described in the TML50 manual.

Table 3-2: Possible Warning Messages at Start-Up

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.

3.3.2. Test Functions

Check to make sure that the analyzer is functioning within allowable operating parameters as described in Section 3.2.4 of the TML50 Manual (P/N 045150102). The available test functions for the TML50H is:



3.3.3. Interferents for SO_2 Measurements

Hydrocarbons are a significant interferent for UV fluorescent SO_2 measurements; however, the typical TML50H application does not have hydrocarbons in the sample stream. Therefore, in order to reduce cost to the customer, the TML50H 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 below) is available for this purpose.

USER NOTES:

4. FREQUENTLY ASKED QUESTIONS

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 TML50H needs replacing check the **VAC** test function (instead of the **PRES** function as described in the TML50 Manual - P/N 045150102). If the **VAC** value is > 10 in-Hg-A, the diaphragm should be replaced.

USER NOTES:

5. OPTIONAL HARDWARE AND SOFTWARE

With the following additions, changes and exceptions, the options listed in Chapter 5 of the TML50 Manual (P/N 045150102) are also available for the TML50H.

5.1. Zero/Span Valves (Option 50)

The TML50H zero/span valve option is identical to that of the TML50 in respect to operation and valve states (see Table 5-1 of the TML50 Manual). The internal pneumatic connections are slightly different.

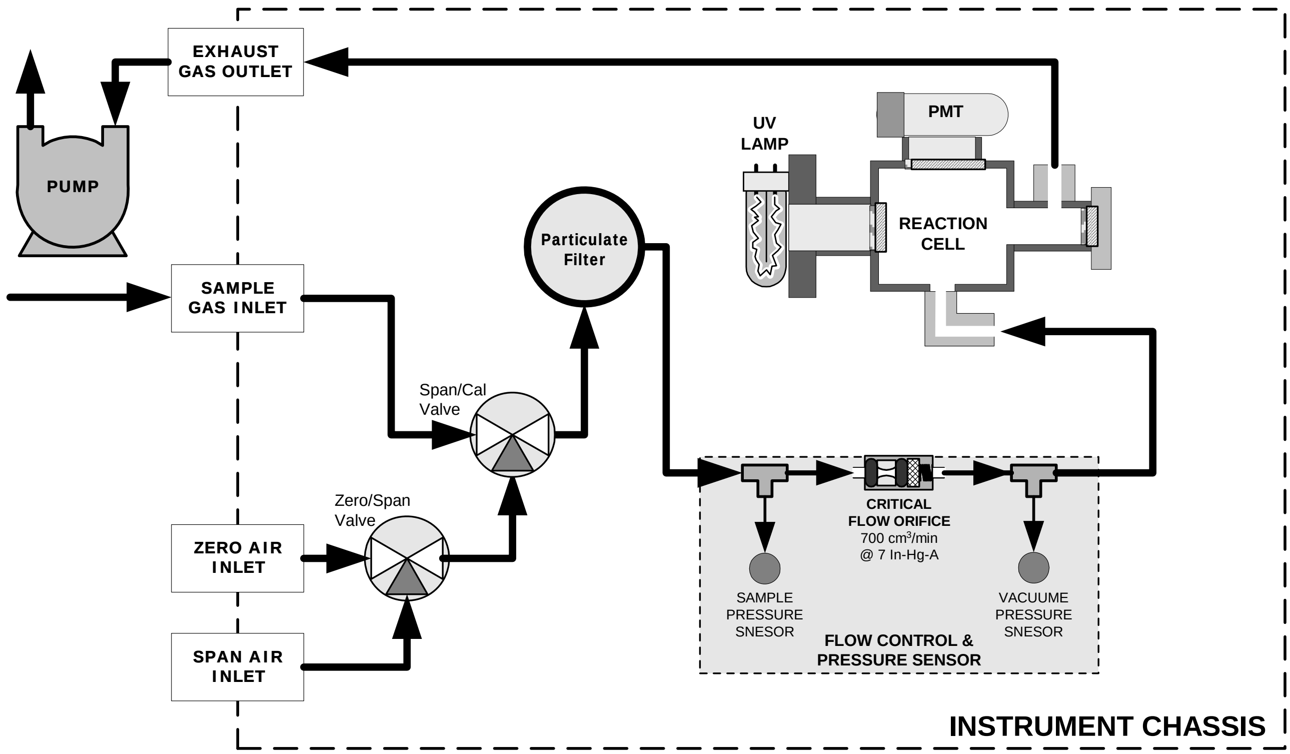


Figure 5-1: Pneumatic Diagram of the TML50H With Z/S Option Installed.

5.2. Internal Zero/Span Gas Generator (Option 51)

The IZS valve option (OPT 51) is not available for the TML50H.

5.3. Zero and Two Span Point Valve Option (OPT 52)

This option includes a special set of valves that allows two separate SO_2 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_2 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 its 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.

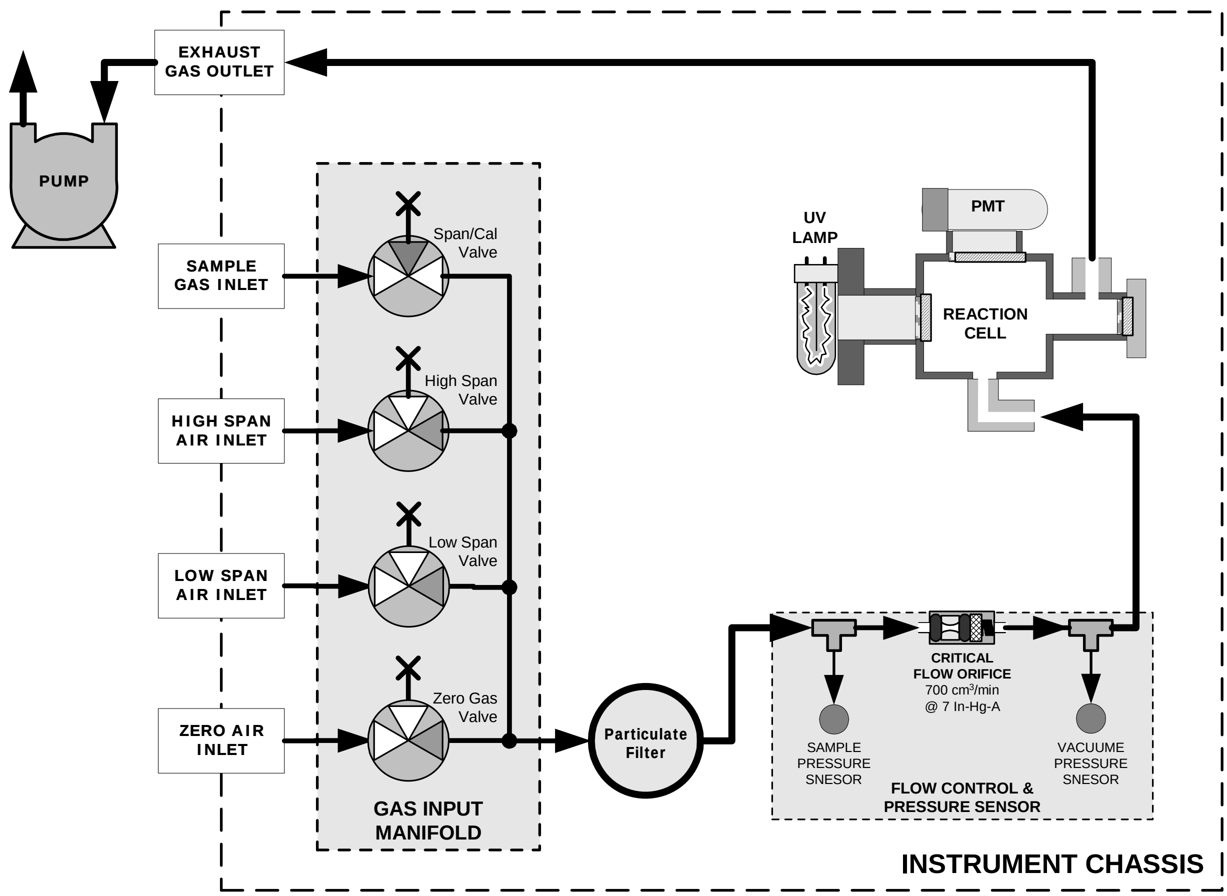


Figure 5-2: Pneumatic Diagram of the TML50H With 2-Span Point Option Installed.

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**

5.4. Hydrocarbon Kicker Option (OPT 65)

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 and is located within an outer flexible plastic tube shell.

As gas flows through the inner tube, hydrocarbons are absorbed into the membrane walls and are 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.

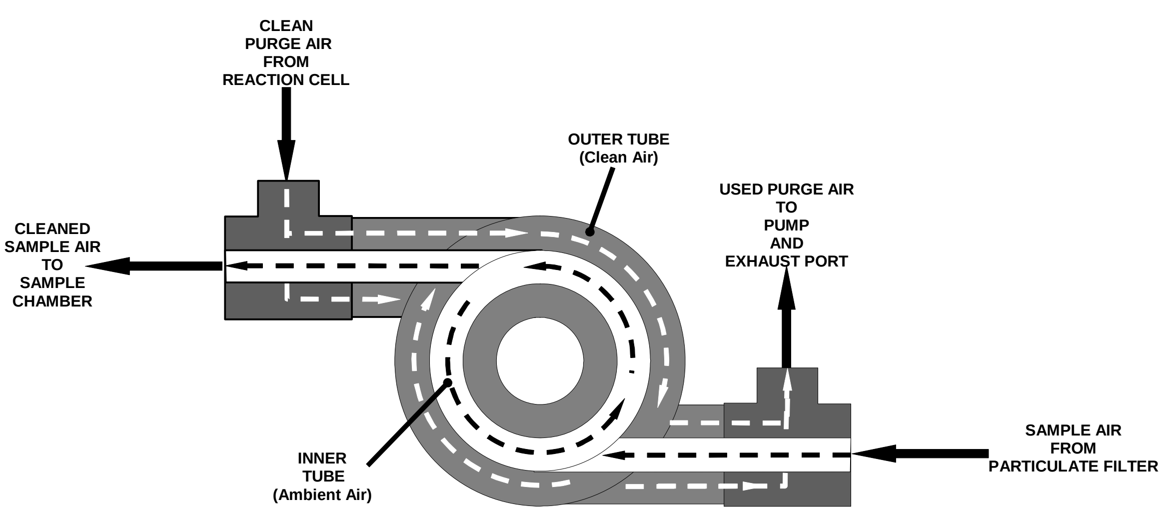


Figure 5-3: Hydrocarbon Scrubber (Kicker) – OPT 65

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.

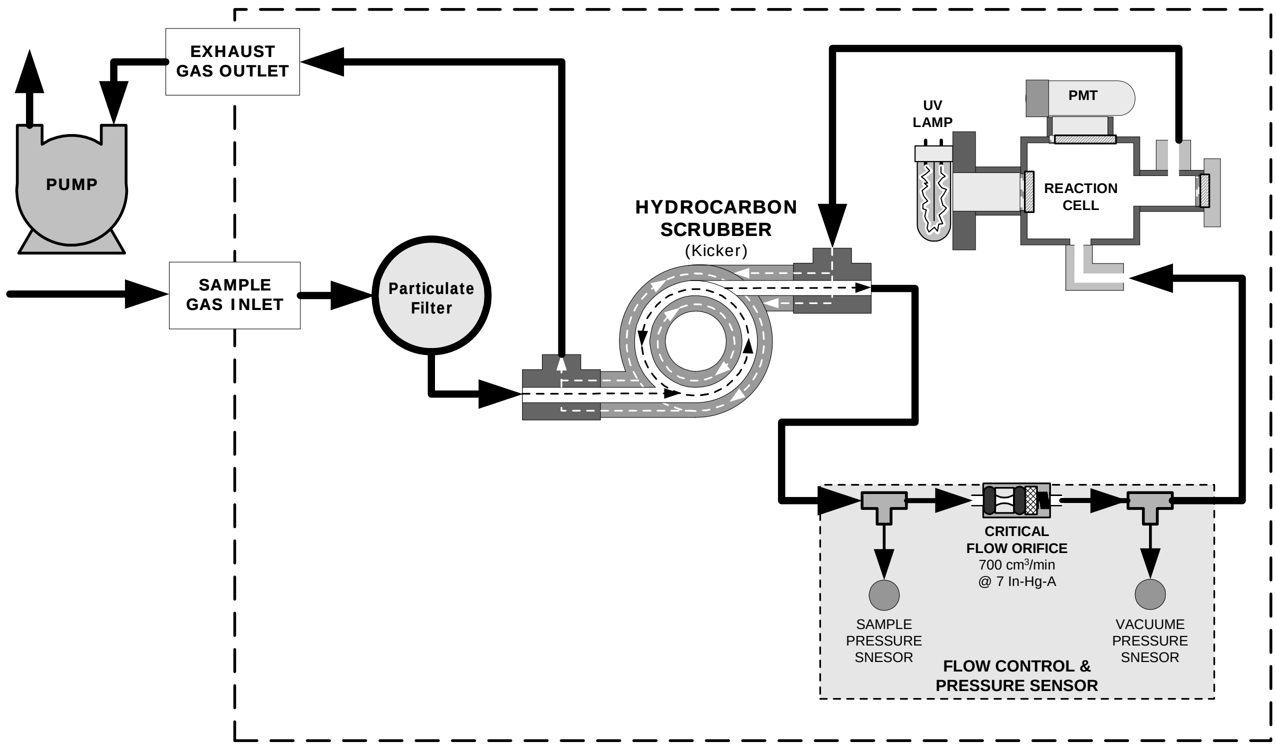


Figure 5-4: TML50H Internal Pneumatic Diagram with Hydrocarbon Scrubber Installed.

6. OPERATING INSTRUCTIONS

6.1. Warning Messages

Please refer to the TML50 User's Manual (P/N 045150102), Chapter 3, for a complete listing of warnings for the TML50H. The following table lists warnings that differ in the TML50H from those described in the TML50 manual.

Table 6-1: Additional TML50H 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 TML50 Manual (P/N 045150102), Chapter 6, for a complete list of test functions for the TML50H. The following table lists test functions that are in addition to or differ from those listed there.

Table 6-2: Additional TML50H Test Functions

DISPLAY	PARAMETER	UNITS	DESCRIPTION
VAC	Vacuum Pressure	In-Hg-A	The actual pressure measured on the vacuum side of the TML50H'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 TML50 Manual (P/N 045150102).

The following table lists test functions that are in addition to or differ from those listed in Table 6-14 of the TML50 Manual.

Table 6-3: Additional TML50H 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 TML50H only displays concentrations in parts per million (10^6 mols per mol, **PPM**) or milligrams per cubic meter (mg/m^3, **MGM**).

- NOT AVAILABLE: Parts per billion (10^9 mols per mol, **PPB**) and micrograms per cubic meter (µg/m^3, **UGM**).

To change the concentration units of the TML50H follow the instructions found in Section 6.7.7 of the TML50 Manual.

6.2.3. Using the TML50H with a Hessen Protocol Network

The set up and use of the TML50H in Hessen protocol networks is the same as described in Section 6.12.4 of the TML50 Manual (P/N 045150102) except that there are minor differences in the status flags. The following table supersedes Table 6-27 of the TML50 Manual.

Table 6-4: TML50H Default Hessen Status Bit Assignments

STATUS FLAG NAME	DEFAULT BIT ASSIGNMENT
WARNING FLAGS	
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
OPERATIONAL FLAGS	
In Manual Calibration Mode	0200
In Zero Calibration Mode	0400
In Low Span Calibration Mode	0800
In Span Calibration Mode	0800
UNITS OF MEASURE FLAGS	
UGM[1]	0000
MGM	2000
PPB[1]	4000
PPM	6000
SPARE/UNUSED BITS	0020, 0100, 8000
UNASSIGNED FLAGS	
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
[1] Although assigned flags, these units are not available on the TML50H	

6.2.4. Default iDAS Channels

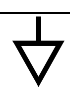
The default Data Channels included in the TML50H analyzer's software include the **CONC, PNUMT** & **CALDAT** channels. The **FAST & DETAIL** preset channels are not included.

6.2.5. Remote Operation Using the External Digital I/O

6.2.5.1. Status Outputs

The function and pin assignments for the TML50H digital status outputs are:

Table 6-5: Status Output Signals

SATUS CONNECTOR PIN NUMBER[1]	STATUS DEFINITION	CONDITION
1	**SYSTEM OK**	ON if no faults are present.
2	**CONC VALID**	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	**HIGH RANGE**	ON if unit is in high range of the AUTO Range Mode
4	**ZERO CAL**	ON whenever the instrument's ZERO point is being calibrated.
5	**HIGH SPAN CAL**	ON whenever the instrument is set for **DUAL OR AUTO** reporting range mode and its high range span point is being calibrated.
6	**DIAG MODE**	ON whenever the instrument is in DIAGNOSTIC mode
7	**LOW SPAN CAL**	ON whenever the instrument is set for **DUAL OR AUTO** reporting range mode and its lows range span point is being calibrated.
8	**SPARE**	
D	**EMITTER BUS**	The emitters of the transistors on pins 1-8 are bussed together.
	SPARE	
+	**DC POWER**	+ 5 VDC, 300 mA source (combined rating with Control Output, if used).
	**Digital Ground**	The ground level from the analyzer's internal DC power supplies
[1] Located on Rear Panel		

6.2.5.2. Control Inputs

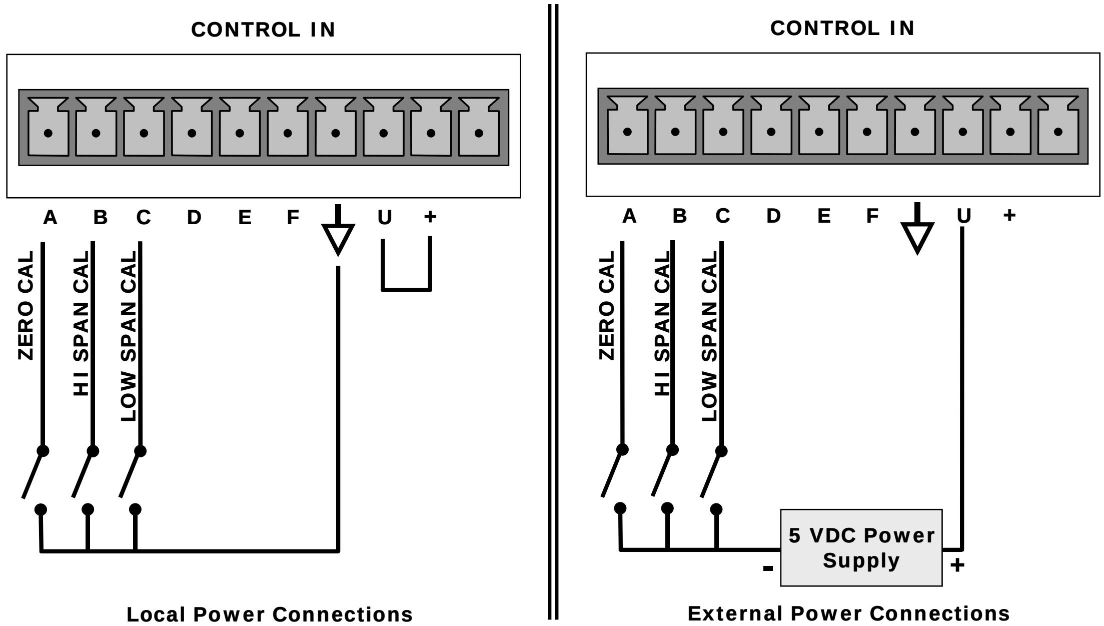
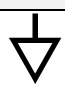


Figure 6-1: Control Input Connector

Table 6-6: Control Input Signals

INPUT #	STATUS DEFINITION	ON CONDITION
A	**REMOTE ZERO CAL**	The analyzer is placed in Zero Calibration mode. The mode field of the display will read ZERO CAL R.
B	**REMOTE HIGH SPAN CAL**	If the instrument is set for **DUAL OR AUTO** reporting range 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	**REMOTE LO SPAN CAL**	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	**SPARE**	
	**Digital Ground**	The ground level from the analyzer's internal DC power supplies (same as chassis ground)
U	**External Power input**	Input pin for +5 VDC required to activate pins A – F.
+	**5 VDC output**	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 TML50H are the same as those for the TML50. One exception to this statement is that the TML50H 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 the Zero and Two Span Point Valve Option (OPT 52)installed.

NOTE

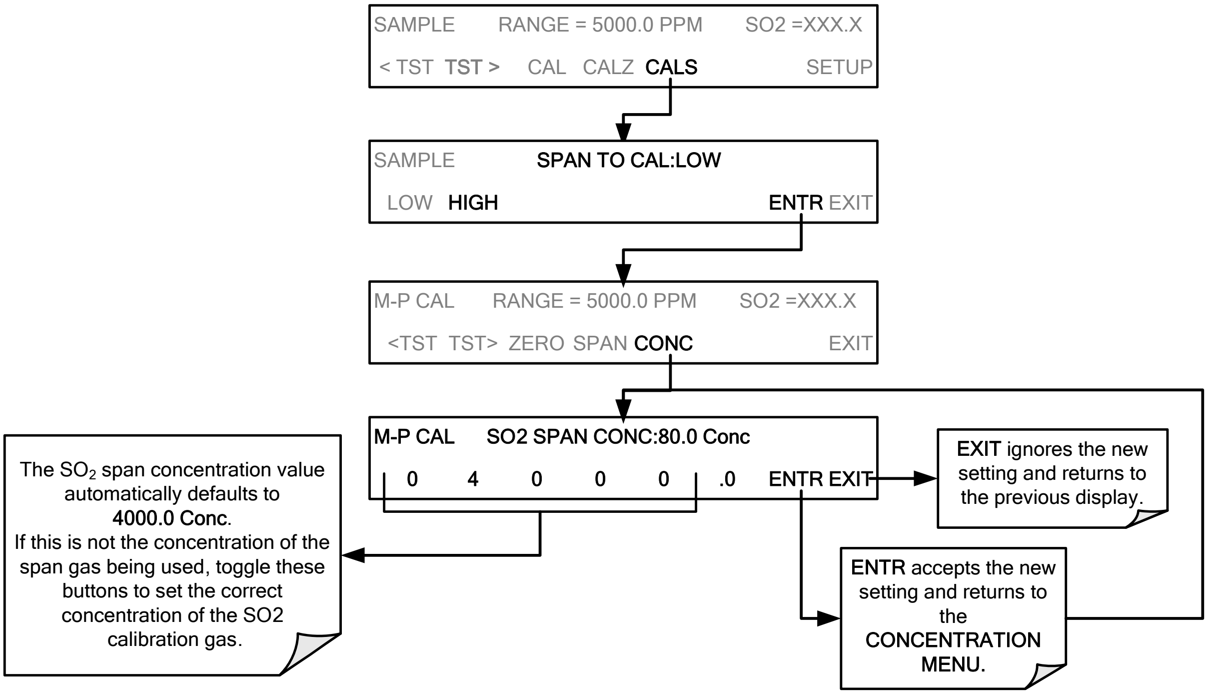
It is only possible to calibrate to the high span **gas. The low span gas is only used for calibration checks.**

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

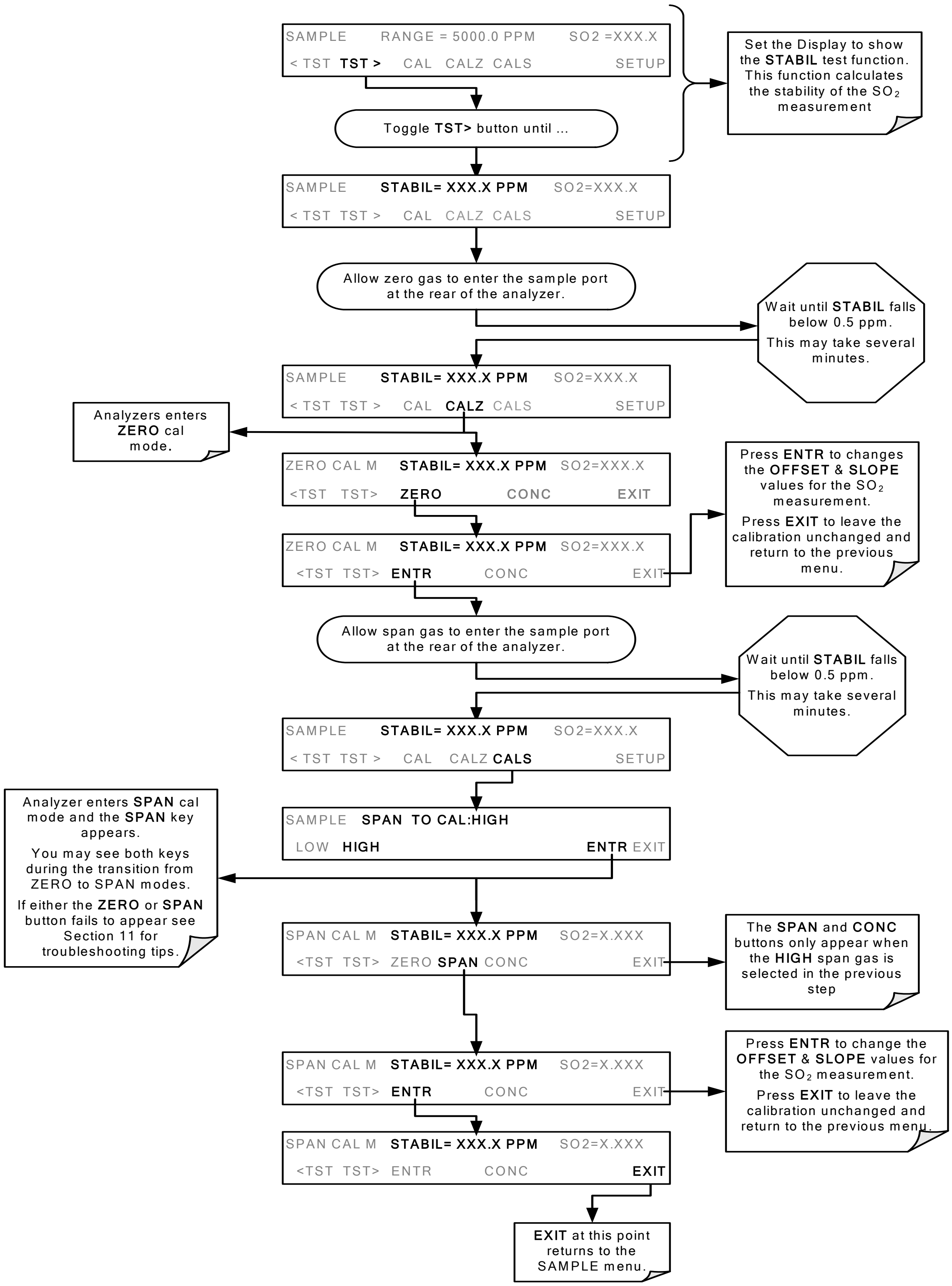
- Zero air and both span gases are supplied to the analyzer through the zero gas and span gas inlets rather than through the sample inlet.
- The zero and cal operations are initiated directly and independently with dedicated keys (**CALZ** & **CALS**)

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_2 high span gas value:

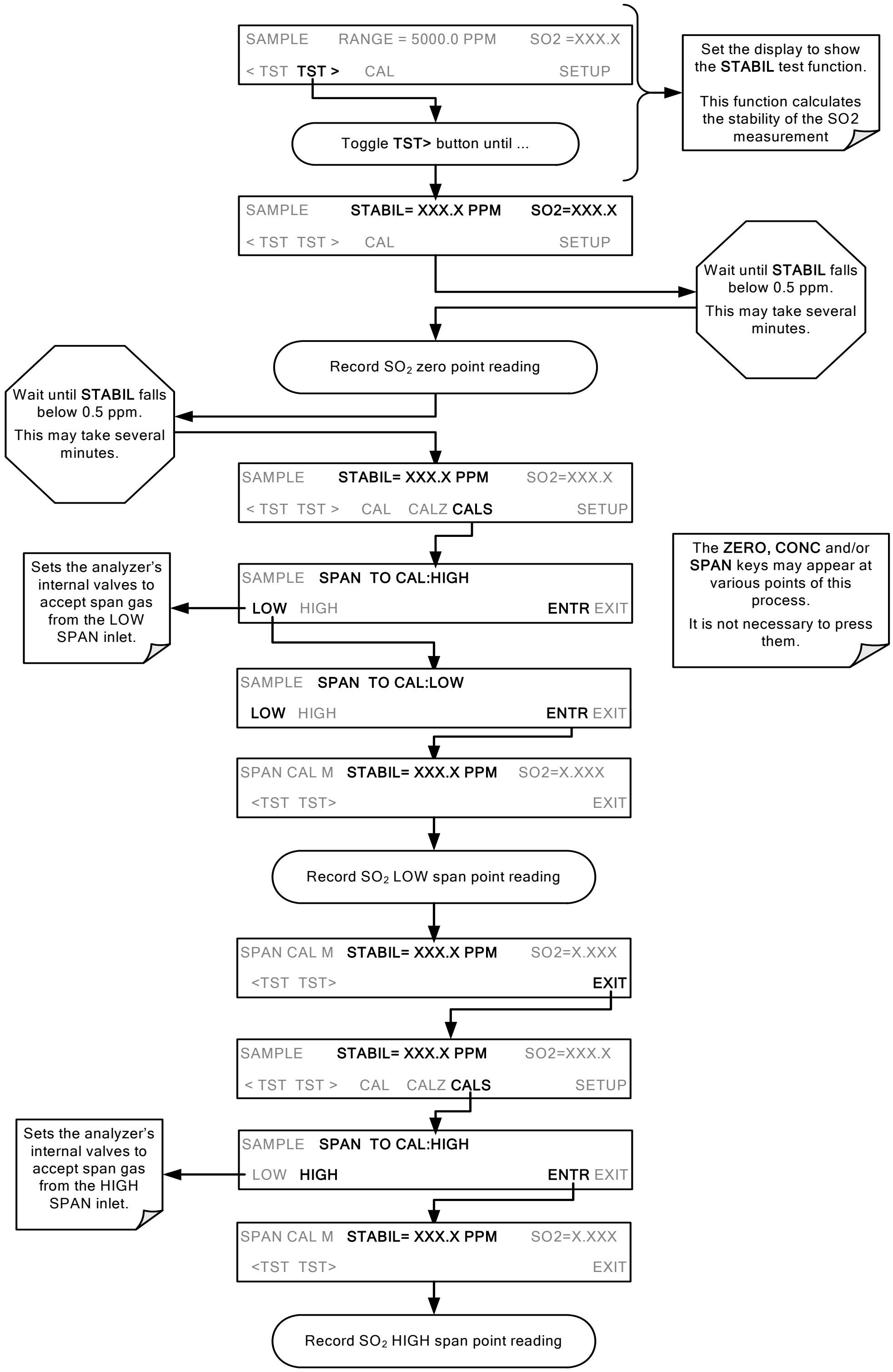


STEP THREE: Perform the calibration according to the following flow chart:



7.2. Manual Calibration Check with the Zero and Two Span Point Valve Option (OPT 52)installed.

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



USER NOTES:

8. INSTRUMENT MAINTENANCE

8.1. Maintenance Schedule

There is no Internal IZS offered for the TML50H.

8.2. Predictive Diagnostics

Because the TML50H's internal pneumatics are monitored in a different manner than those of the TML50 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 TML50 Manual

Table 8-1: Predictive Uses For Test Functions

TEST FUNCTION	iDAS FUNCTION	CONDITION	BEHAVIOR EXPECTED	BEHAVIOR ACTUAL	INTERPRETATION
PRES	**SMPPRS**	Sample gas pressure upstream of the critical flow orifice.	Constant within atmospheric changes	Slowly increasing	• Flow path is clogging up. - Check critical flow orifice & sintered filter. - Replace particulate filter
				Slowly decreasing	• Developing leak in pneumatic system to vacuum (developing valve failure)
VAC	**VACUUM**	Gas pressure downstream of the critical flow orifice (e.g. inside reaction cell.	Constant within atmospheric changes	Fluctuating	• Developing leak in pneumatic system
SAMP FL	**SMPFLW**	Standard Operation	Stable	Slowly Decreasing	• Flow path is clogging up. - Check critical flow orifice & sintered filter. - Replace particulate filter
DRK PMT	**DRKPMT**	PMT output when UV Lamp shutter closed	Constant within ±20 of check-out value	Significantly increasing	• PMT cooler failure • Shutter Failure
SO_2 CONCENTRATION	**CONC1**	Standard configuration at span	stable for constant concentration	Decreasing over time	• Drift of instrument response; UV Lamp output is excessively low.
				Fluctuating	• Leak in gas flow path.
LAMP RATIO	**LAMPR**	Standard Operation	Stable and near 100%	Fluctuating or Slowly increasing	• UV detector wearing out • UV source Filter developing pin holes
				Slowly deceasing	• UV detector wearing out • Opaque oxides building up on UV source Filter • UV lamp aging

USER NOTES:

9. THEORY OF OPERATION

9.1. The UV Light Path

The UV light path of the TML50H is similar to that of the TML50 (see Section 10.2 of the TML50 Manual). The main differences between the TML50H and the TML50 are:

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

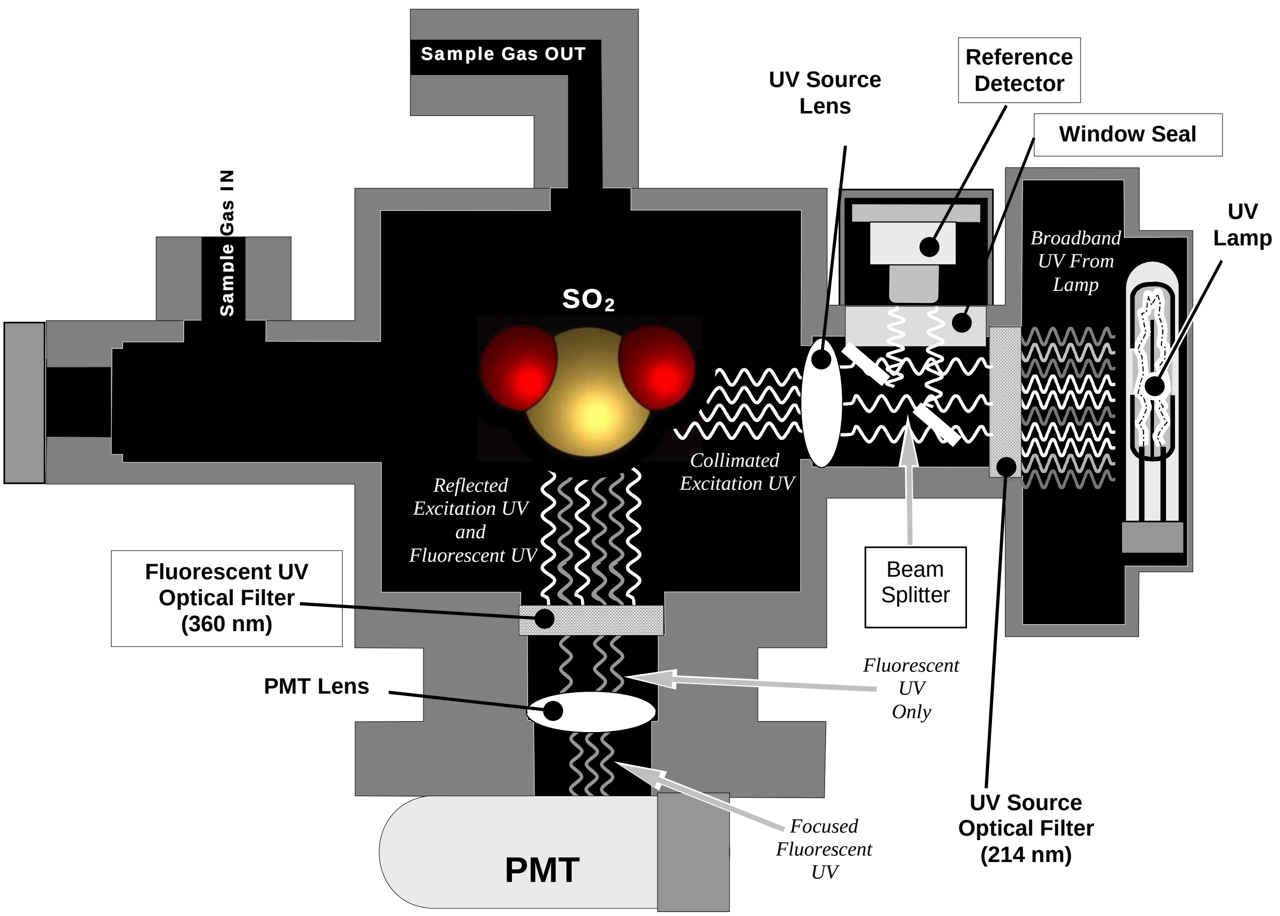


Figure 9-1: UV Light Path

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 TML50H reference detector differs from that of the TML50.

- On the TML50 this detector is located directly across the reaction cell from the lamp where it can measure the output of the lamp directly. Because the TML50 is designed to measure relatively low concentrations of SO_2, enough of the lamp's 214 nm source light makes it through the reaction cell to get a reliable reading.

- On the TML50H 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_2 typically measured by the TML50H.

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 Interferences

The most common source of interference when measuring SO_2 is from other gases that fluoresce in a similar fashion to SO_2 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 spectral range near to SO_2. 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 TML50H rejects interference for these substances differs from the TML50 as follows.

- Since the typical application for which the TML50H rarely includes the presences of hydrocarbons or PNA's, no hydrocarbon scrubber (kicker) is included in the TML50H's base configuration. An optional scrubber (see Section 5.4 of this addendum is available).

- On the other hand the typical TML50H application often includes much higher concentrations of Nitric Oxide (NO), which fluoresces in a spectral range near that of SO_2. Therefore an optional 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 TML50H UV Fluorescence SO2 Analyzer is created by a small external pump that pulls air through the instrument. The TML50H has no kicker to scrub hydrocarbons from the sample stream. Typical applications for the TML50H do not have hydrocarbons in the sample stream.

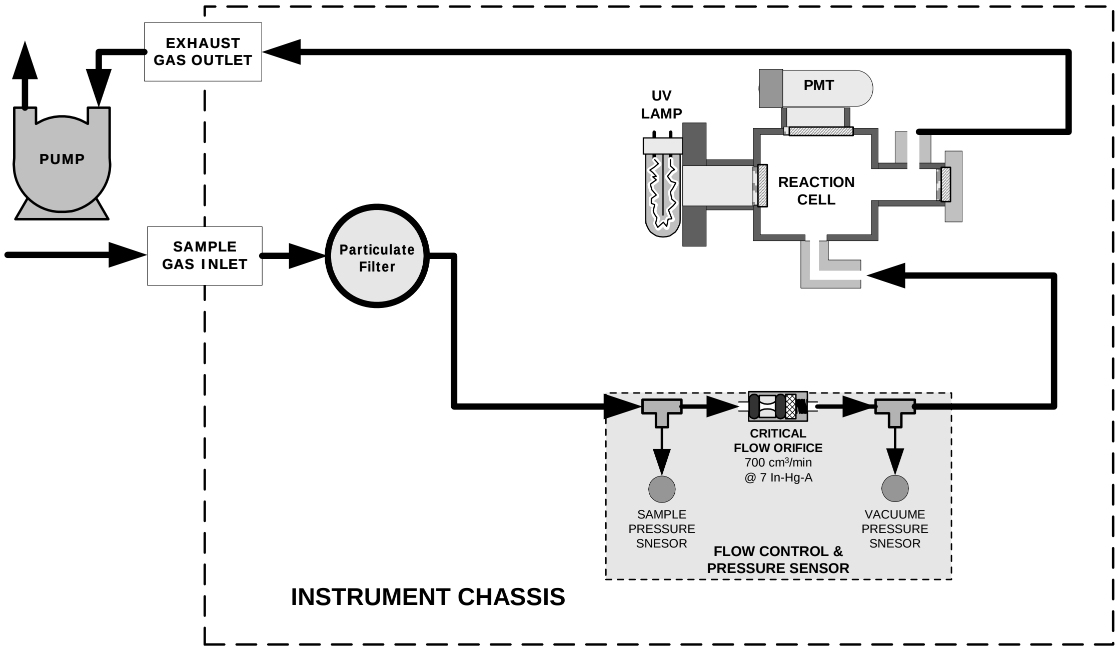


Figure 9-2: Pneumatic Diagram of the TML50H – Base Configuration

9.2.2. Pneumatic Sensors

The TML50H 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 TML50, which uses a thermal-mass flow sensor to directly measure the gas flow though the instrument, the TML50H 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 (≥ 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 TML50 Manual (P/N 045150102). There is no IZS option, a vacuum pressure sensor replaces the TML50's thermal-mass flow sensor and provision is made for the two span point valve option.

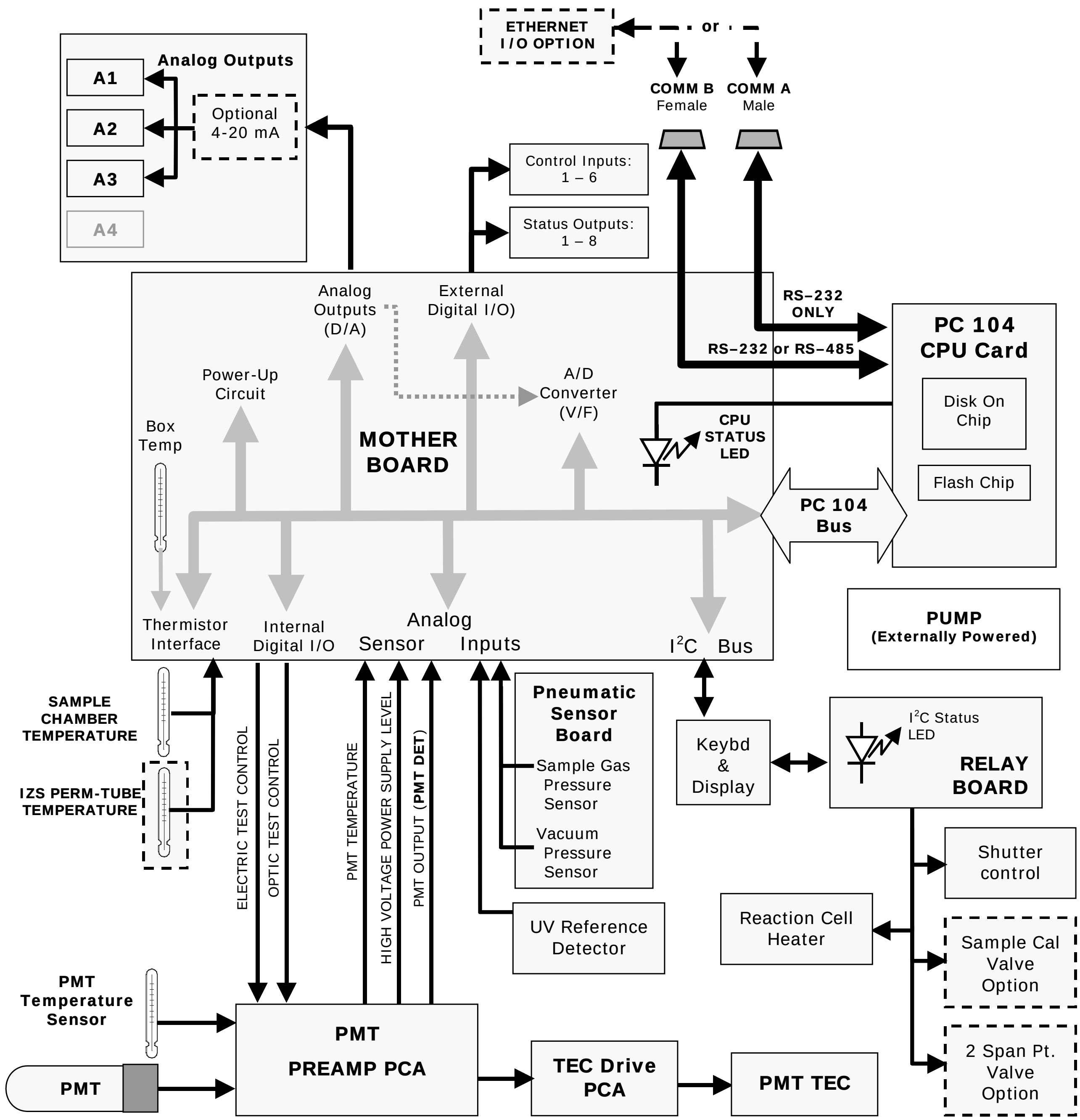


Figure 9-3: TML50H Electronic Block Diagram

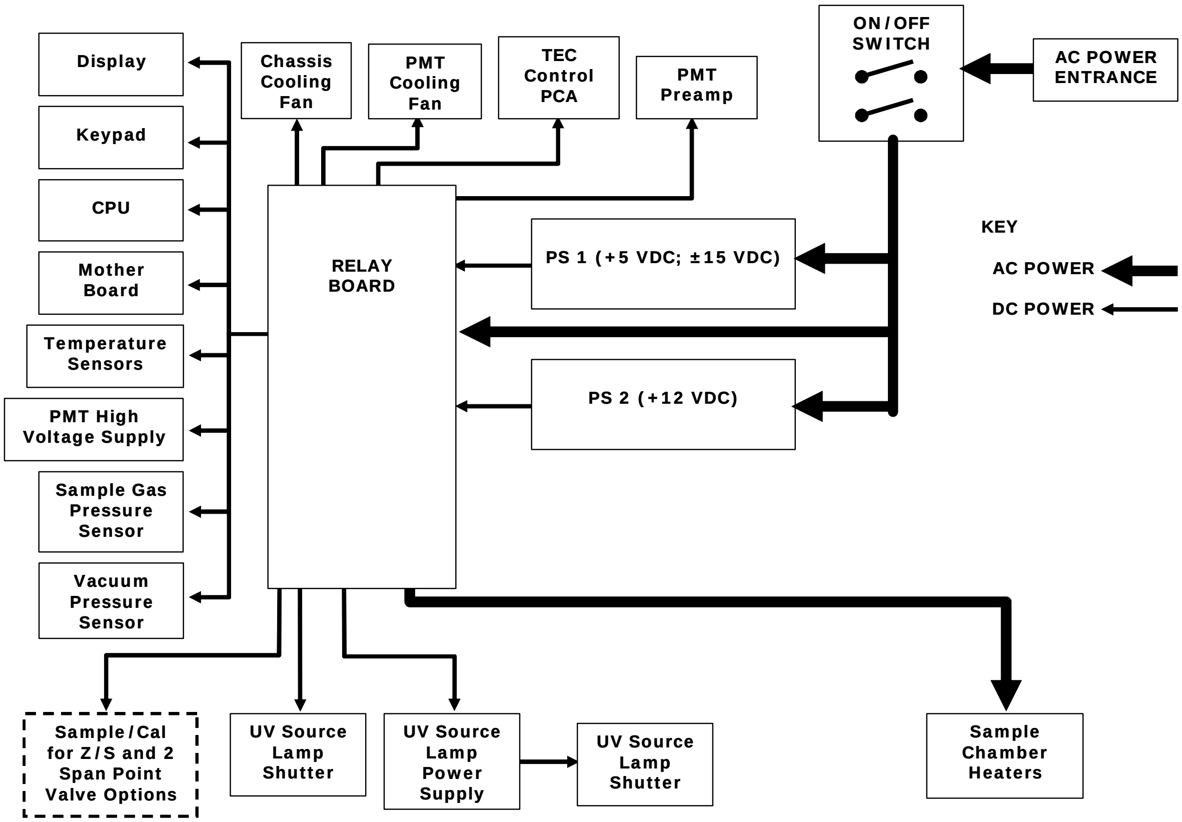


Figure 9-4: TML50H Power Distribution Block Diagram

USER NOTES:

10. TROUBLESHOOTING & REPAIR

For the most part the information contained in Chapter 11 of the TML50 Manual (P/N 045150102) is also applicable to the TML50H. 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: o Pneumatic Leak o Bad Pump → Rebuild Pump o Failed pressure sensor/circuitry

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 TML50H differs from that of the TML50 in that there is no flow sensor. Instead the assembly includes two pressure sensors located on either side of a critical flow orifice. The TML50H 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 11.5.2 of the TML50 Instruction Manual.

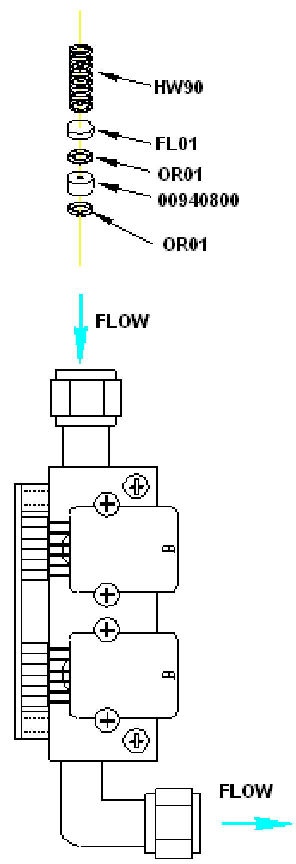


Figure 10-1: Flow Control Assembly

10.3.2. Sensor Module Repair & Cleaning

NOTE:

After any repair or service has been performed on the sensor module, the TML50H should be allowed to warm up for 60 minutes.

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

The most significant difference between the TML50 sensor module and the TML50H sensor module is the location of the reference detector. Therefore most of the procedures described in Section 11.6.3 apply to the TML50H as well.

Exceptions are noted below:

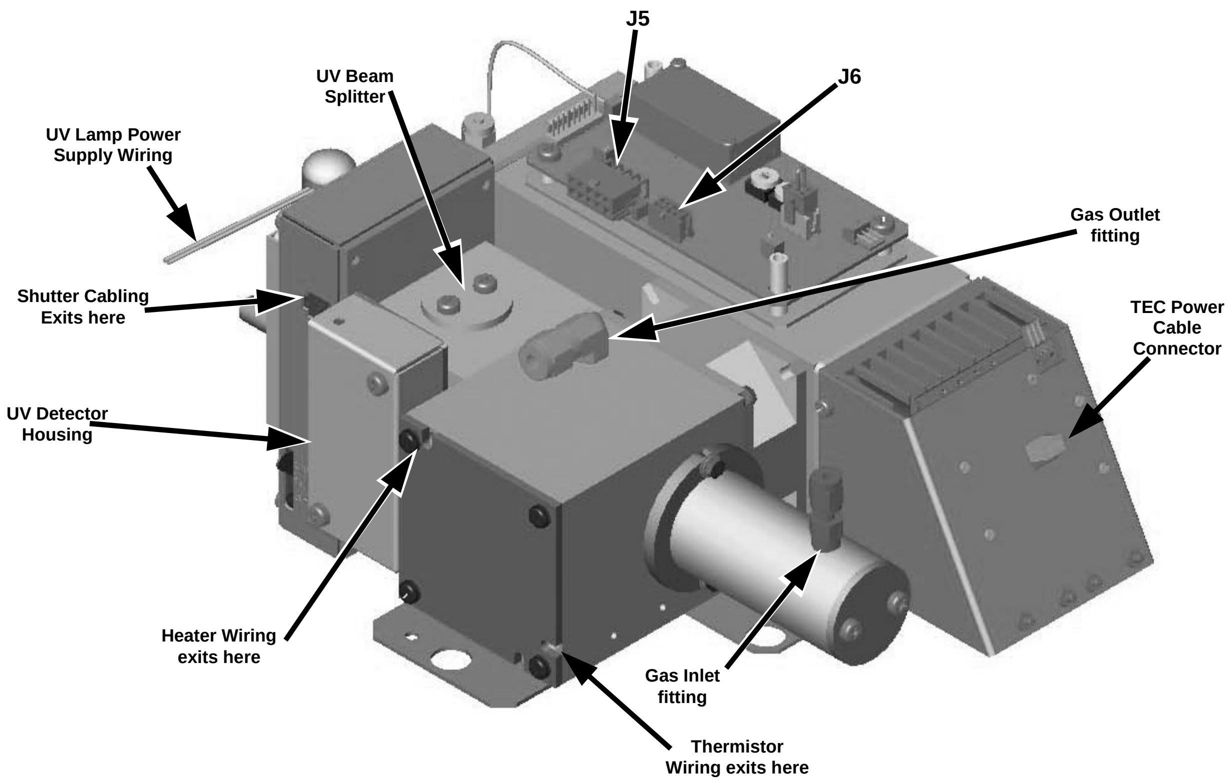


Figure 10-2: Sensor Module Wiring and Pneumatic Fittings

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

There are three ways in which ambient conditions can effect the UV Lamp output and therefore the accuracy of the SO_2 concentration measurement. These are:

Line Voltage Change: UV lamp energy is directly proportional to the line voltage. This can be avoided by installing adequate AC Line conditioning equipment such as a UPS/surge suppressor.

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_2.

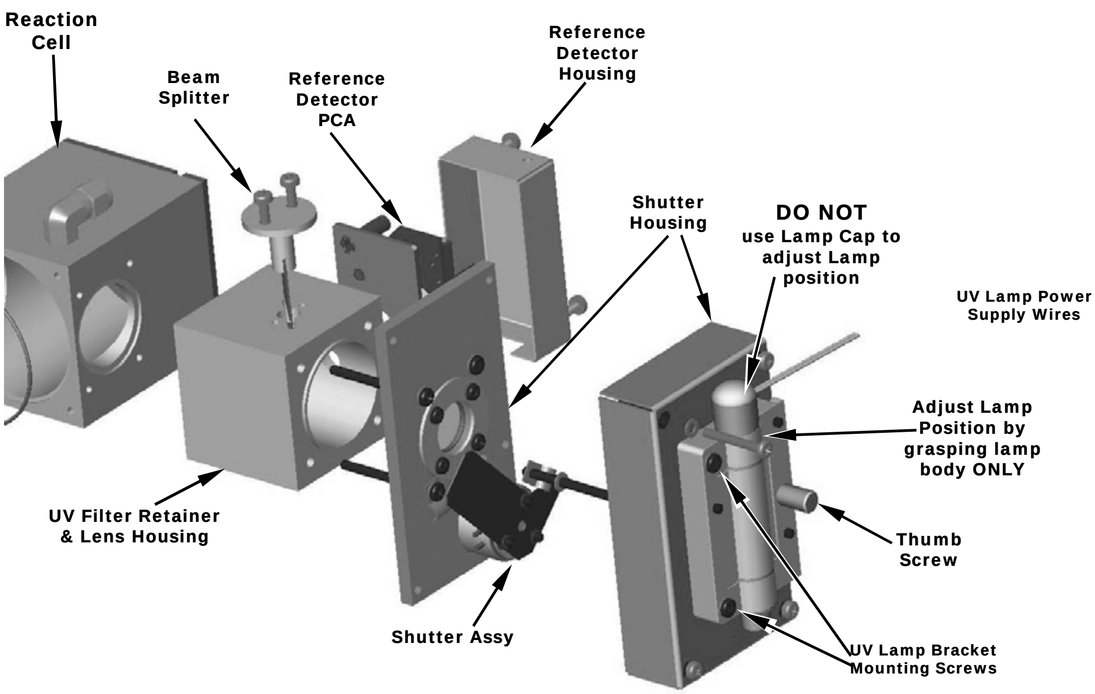


Figure 10-3: Shutter Assembly - Exploded View

	**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 **UVLAMP_SIGNAL** reads approximately 3600mV before continuing to adjust the lamp position.
>4500mV or < 1000mV	Adjust the UV reference detector potentiometer (see Figure 10-4) until **UVLAMP_SIGNAL** reads as close to 3500mV as possible.
.< 600mV	Replace the lamp.

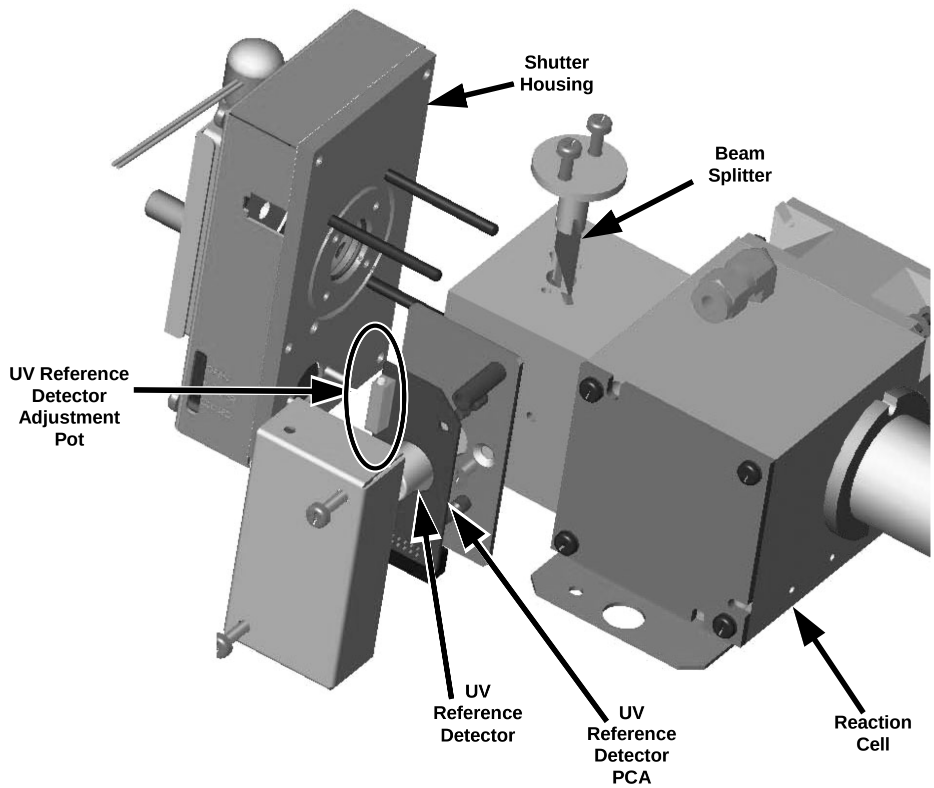


Figure 10-4: Location of UV Reference Detector Potentiometer

5. 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.

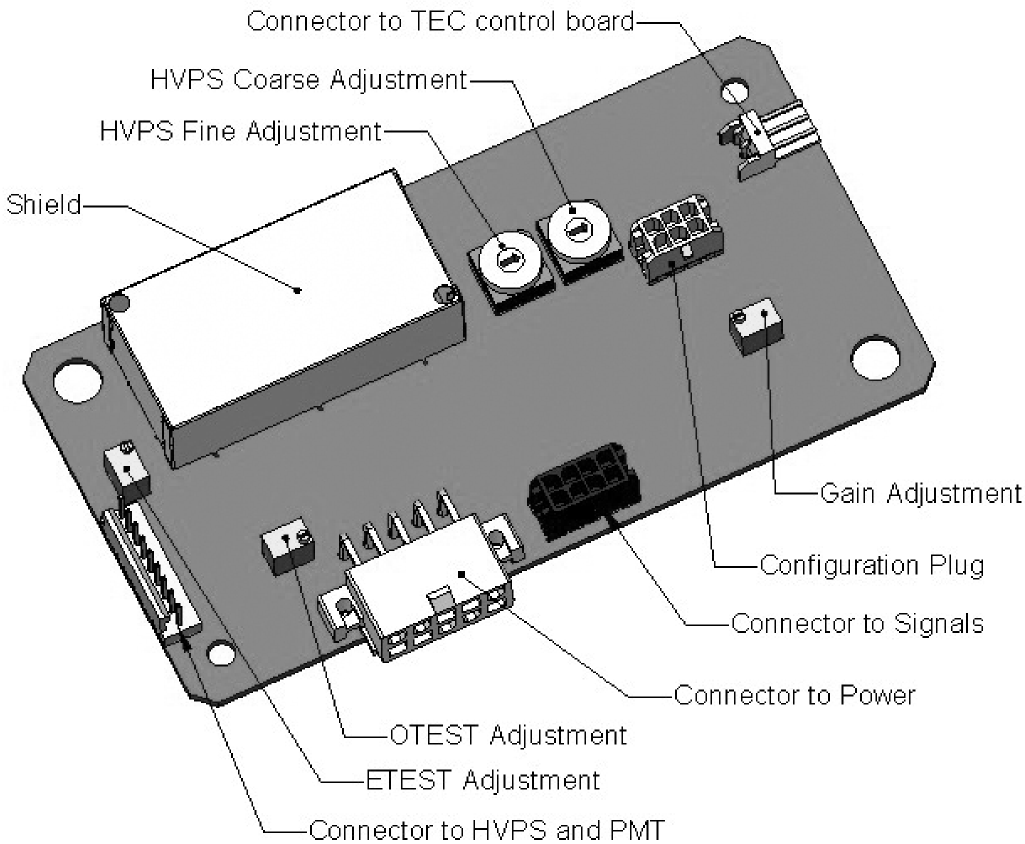


Figure 10-5: Pre-Amplifier Board Layout

1. Set the instrument reporting range type to **SNGL** (see Section 6.7.4 of the TML50 Manual)
2. Perform a zero–point calibration using zero air (see Chapter 7 of the TML50 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 TML50 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 TML50 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 ≤ 500 ppm (the instrument will be using the 500 ppm physical range):

  Target **NORM PMT** = (8 x span gas concentration) + **OFFSET**

- If the reporting range is set for ≥ 2,001 ppb(the instrument will be using the 5,000 ppm physical range):

  Target **NORM PMT** = (0.8 x span gas concentration) + **OFFSET**

EXAMPLE: If the **OFFSET** is 33 mV, the Reporting Range is 1000 ppm, the span gas should be 800 ppm SO_2 and the calculation would be:

Target **NORM PMT** = (0.8 x 800) + 33 mV
Target **NORM PMT** = 640 + 33 mV
Target **NORM PMT** = 673 mV

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 ±10 mV of the target level from Step 16.

21. Perform span calibration (see Chapter 7 of the TML50 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**.

10.3.2.3. PMT Hardware Calibration (*FIELD CAL*)

1. Make sure to perform a lamp calibration before proceeding.
2. Perform a full zero calibration using nitrogen or zero air.
3. Flow span gas to the analyzer and wait until the **STABIL** value is 0.5 or less.
4. In the **SETUP-VARS** menu scroll to, and manually set the **SO_2** or **NOx SLOPE** value to 1.000.
5. Turn the gain adjustment pot on the PMT preamp board, R29, fully clockwise.
6. Set the HVPS fine adjustment switch S1 to its highest setting.
7. While observing the gas concentration on the analyzer's display, set the HVPS coarse adjustment switch S1 to the lowest setting that is just above the span gas value.
8. Set the HVPS fine adjustment switch S1 to the lowest setting that is just above the span gas value.
9. Using the gain adjustment pot, R29, set the analyzer to read the exact span gas value. This value may fluctuate a bit.
10. Perform a software span calibration so that the analyzer may set its slope and offset values.
11. Review the slope and offset values. The slopes should be 1.000 ±0.3, and the offset values should be 0.0 ±20mV (-20 to +150mV is allowed).
12. Flow zero gas to the analyzer gas and wait until the **STABIL** value is 0.5 or less. Initiate an optic test (**OTEST**) from the **SETUP** – **DIAG** menu. Scroll to the **NORM_PMT** value on the analyzer's main display.

13. Set the **OTEST** adjustment pot, R28, to obtain a **NORM_PMT** value of approximately 2000mV.
14. Initiate an electric test (**ETEST**) from the **SETUP** – **DIAG** menu. Scroll to the **NORM_PMT** value on the analyzer's main display.
15. Set the **ETEST** adjustment pot, R19, to obtain a **NORM_PMT** value of approximately 2000mV.

10.4. Technical Assistance

If this addendum and its trouble-shooting / repair sections do not solve your problems, technical assistance may be obtained from Teledyne Instruments, Customer Service, 35 Inverness Drive East, Englewood, CO 80112. Phone: 1-800-846-6062. Fax: 1-303-799-4853. Email: tml_support@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-ml.com

USER NOTES:

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APPENDIX A: Version Specific Software Documentation

APPENDIX A-1: TML50H Software Menu Trees, Revision C.1

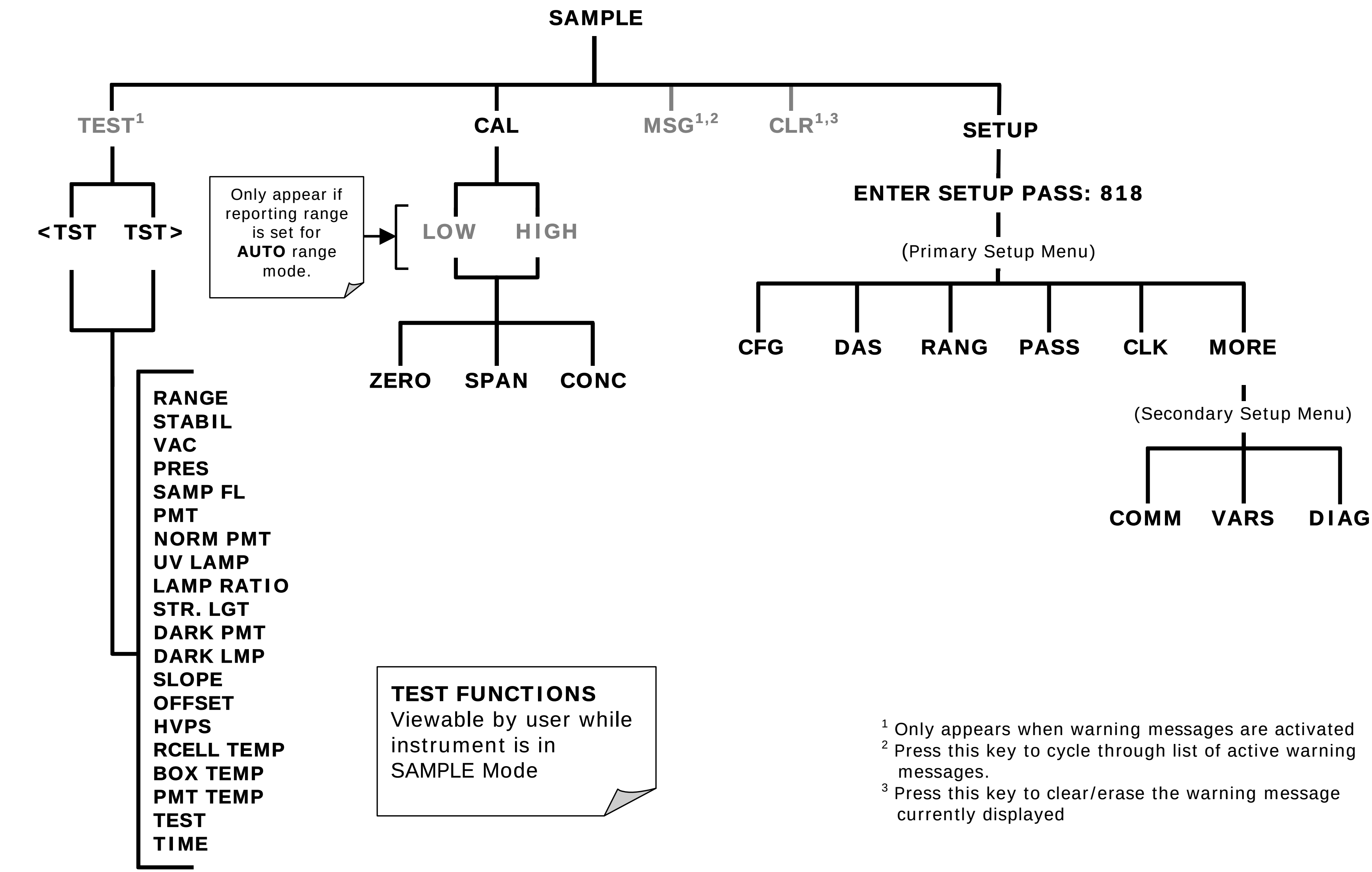
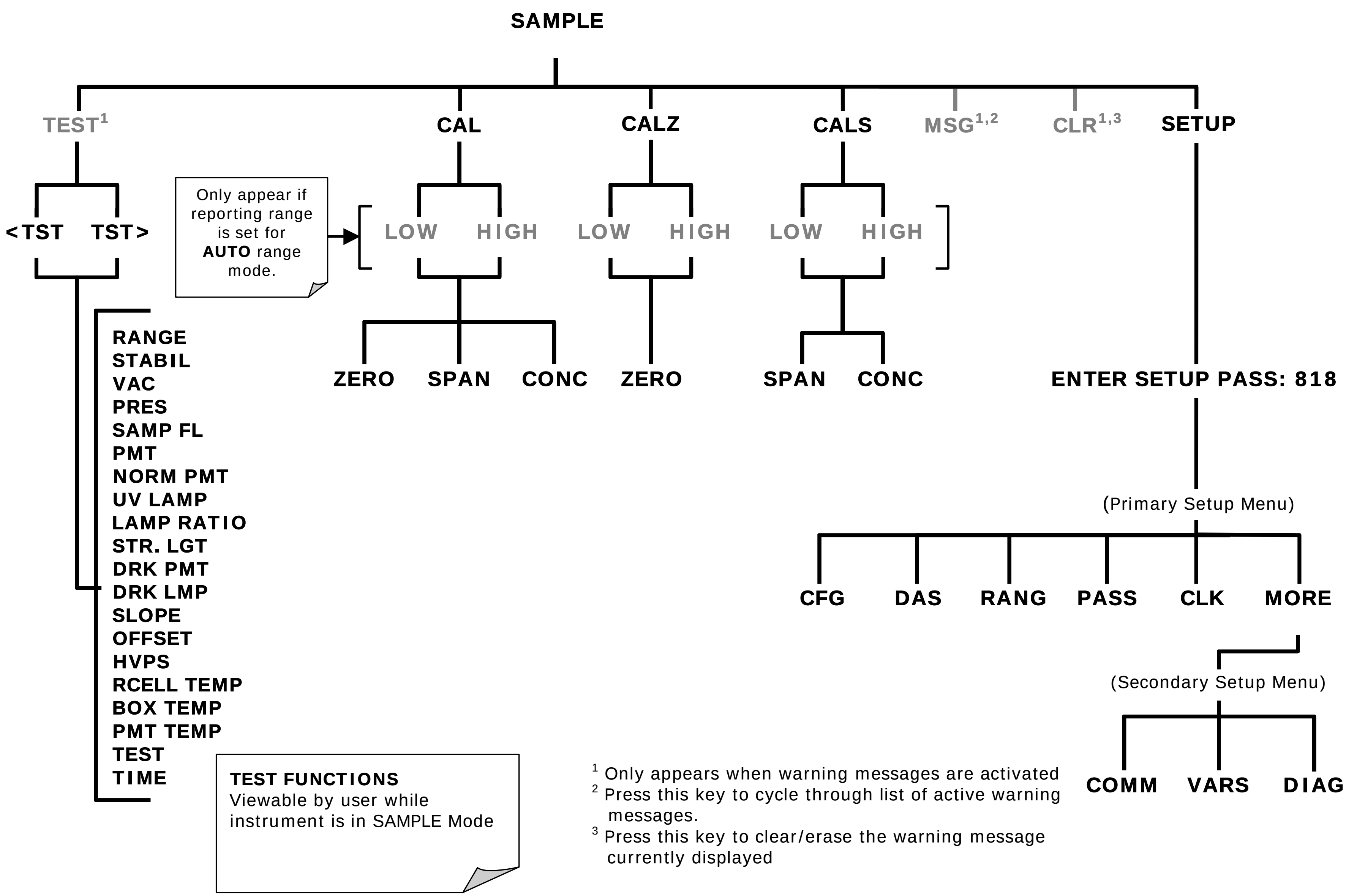


Figure A-1: Basic Sample Display Menu



[1] Only appears when warning messages are activated
[2] Press this key to cycle through list of active warning messages.
[3] Press this key to clear/erase the warning message currently displayed

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

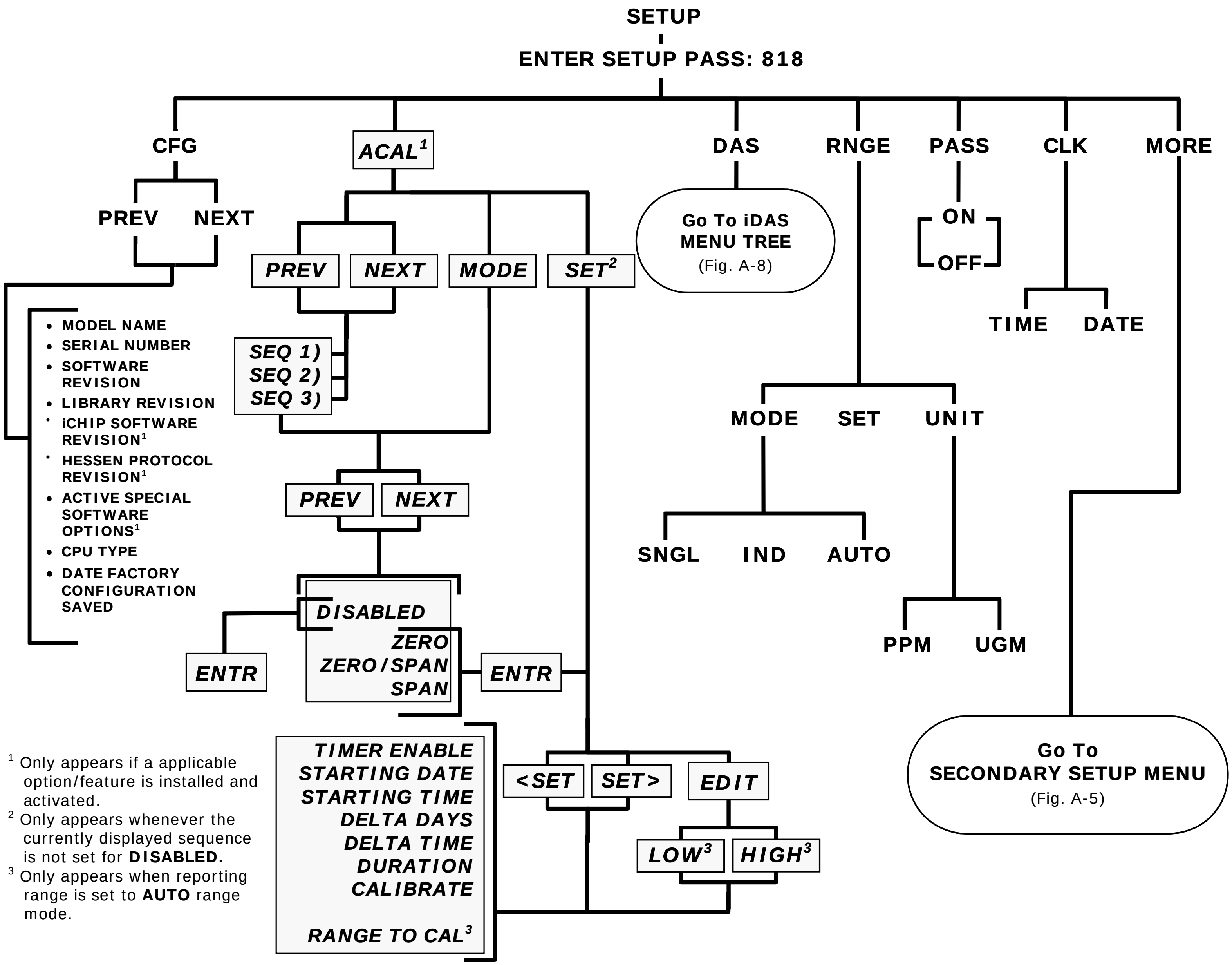


Figure A-3: Primary Setup Menu (Except iDAS)

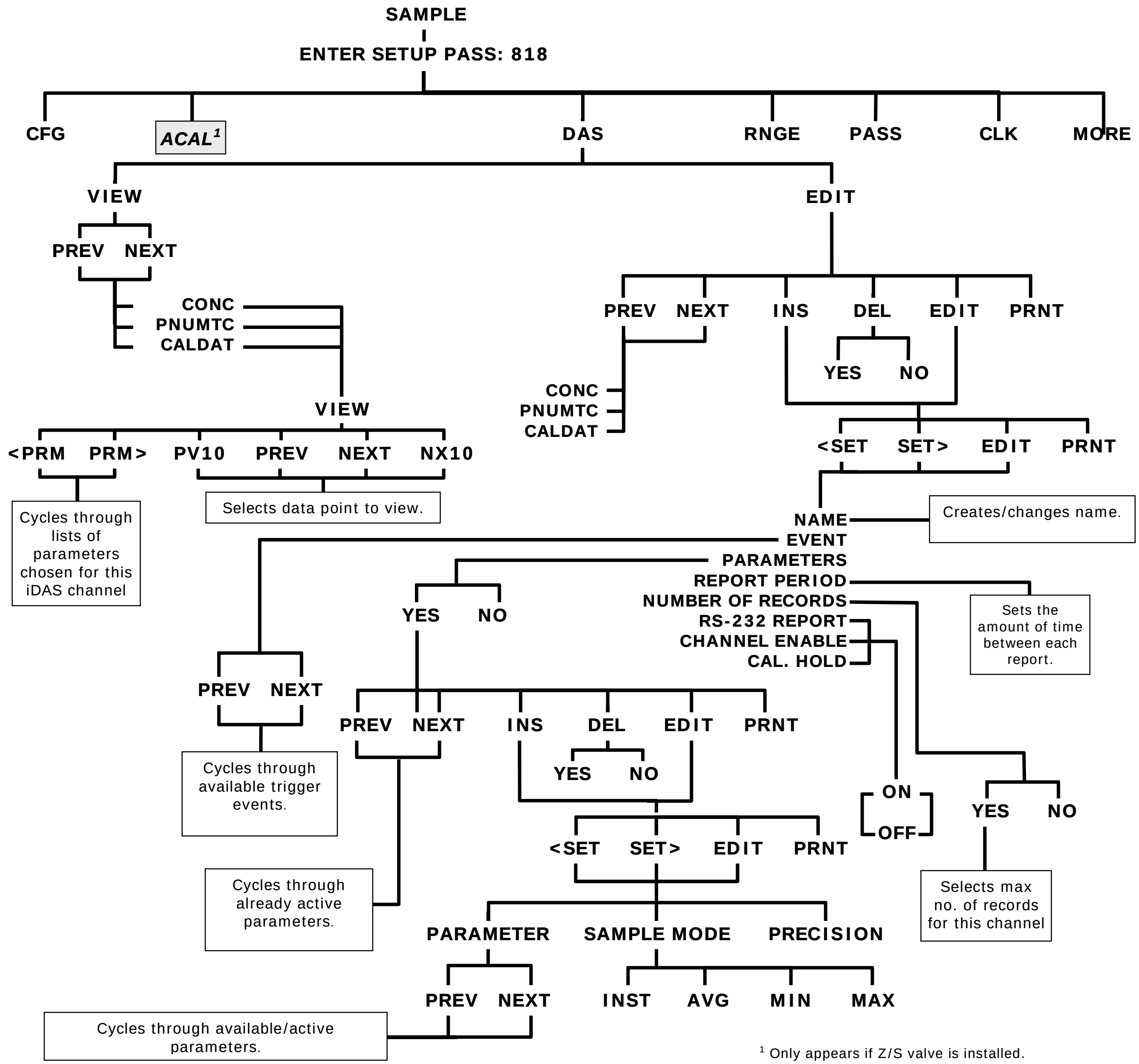
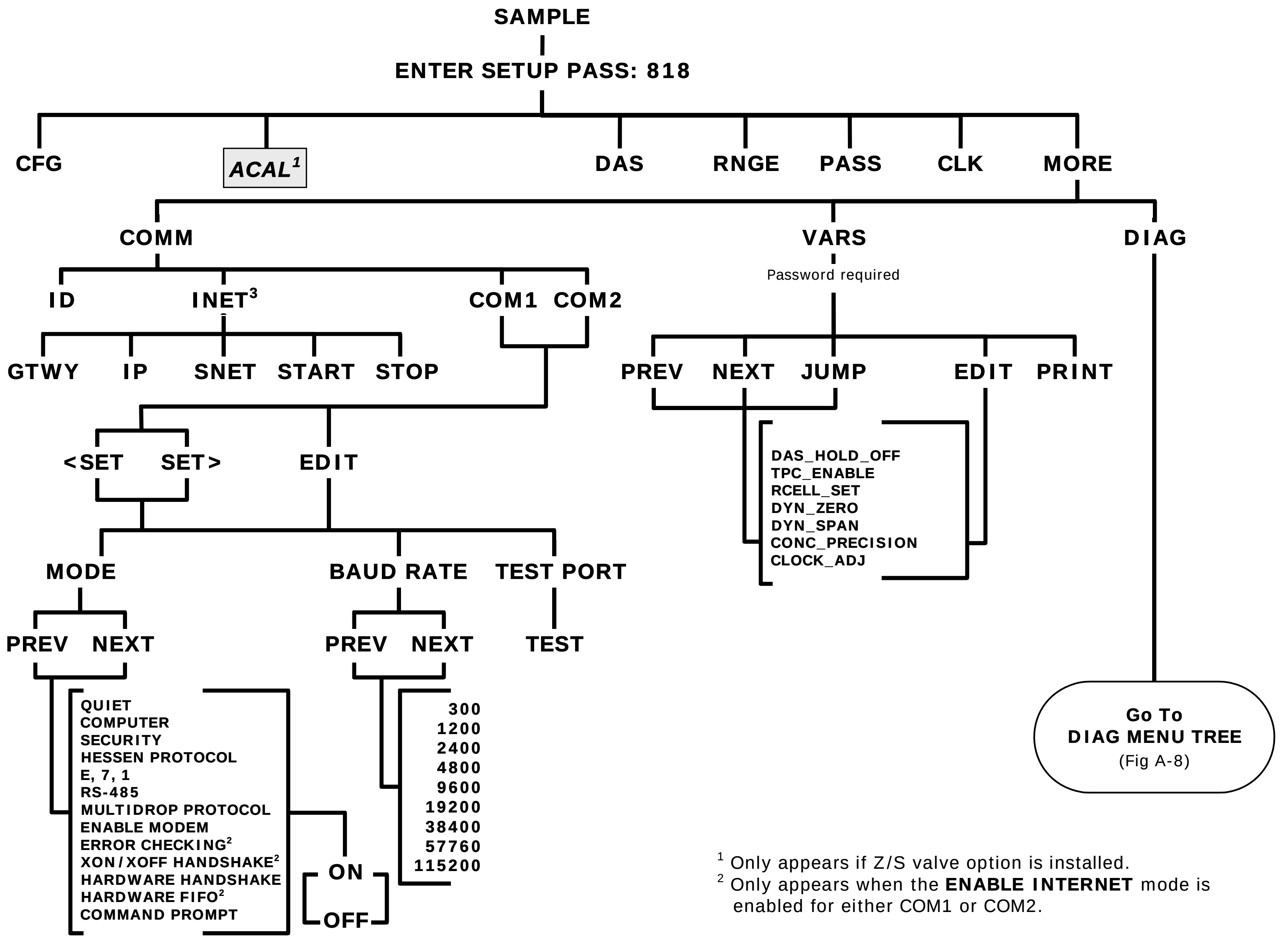
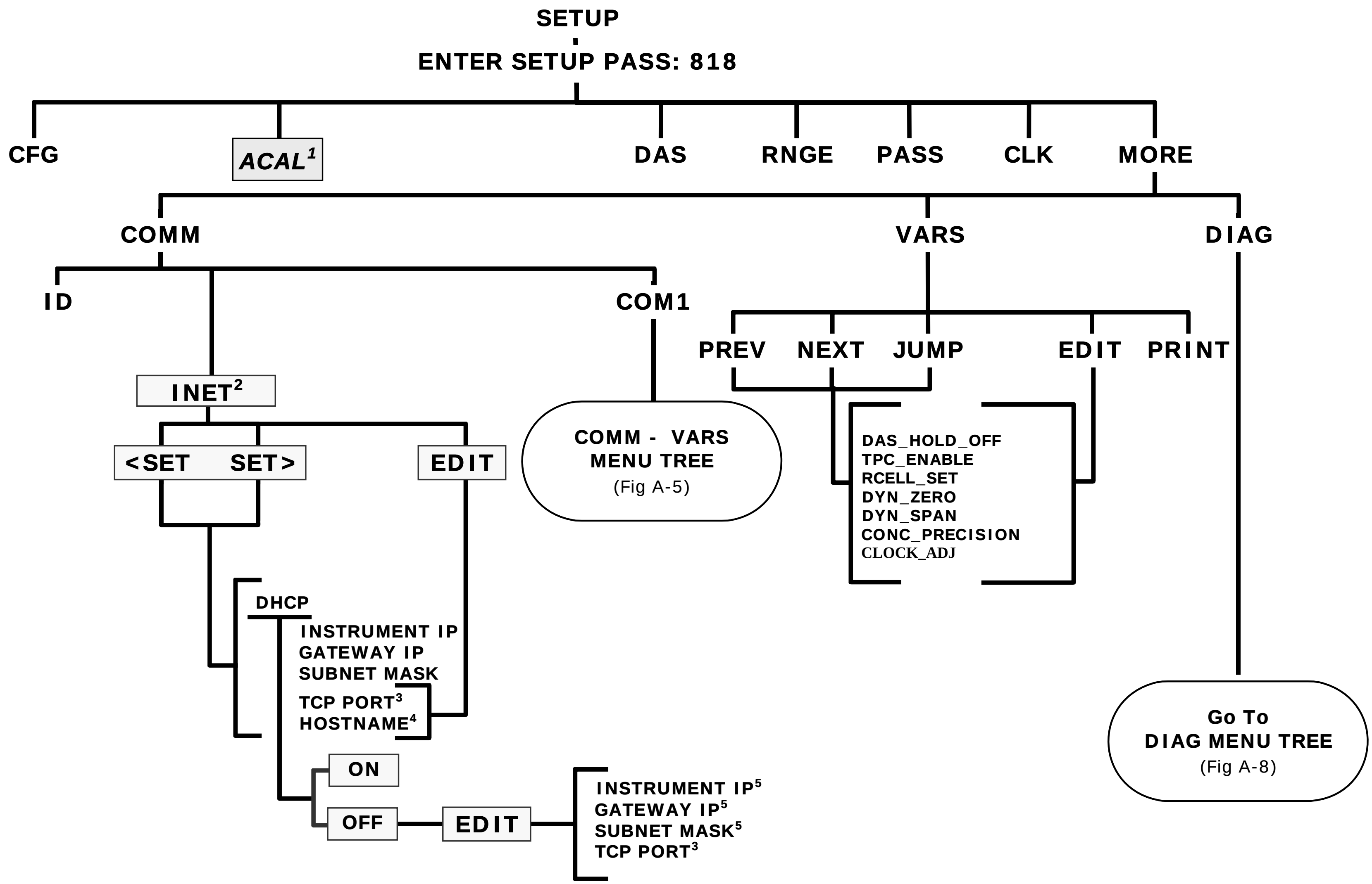


Figure A-4: Primary Setup Menu (iDAS)



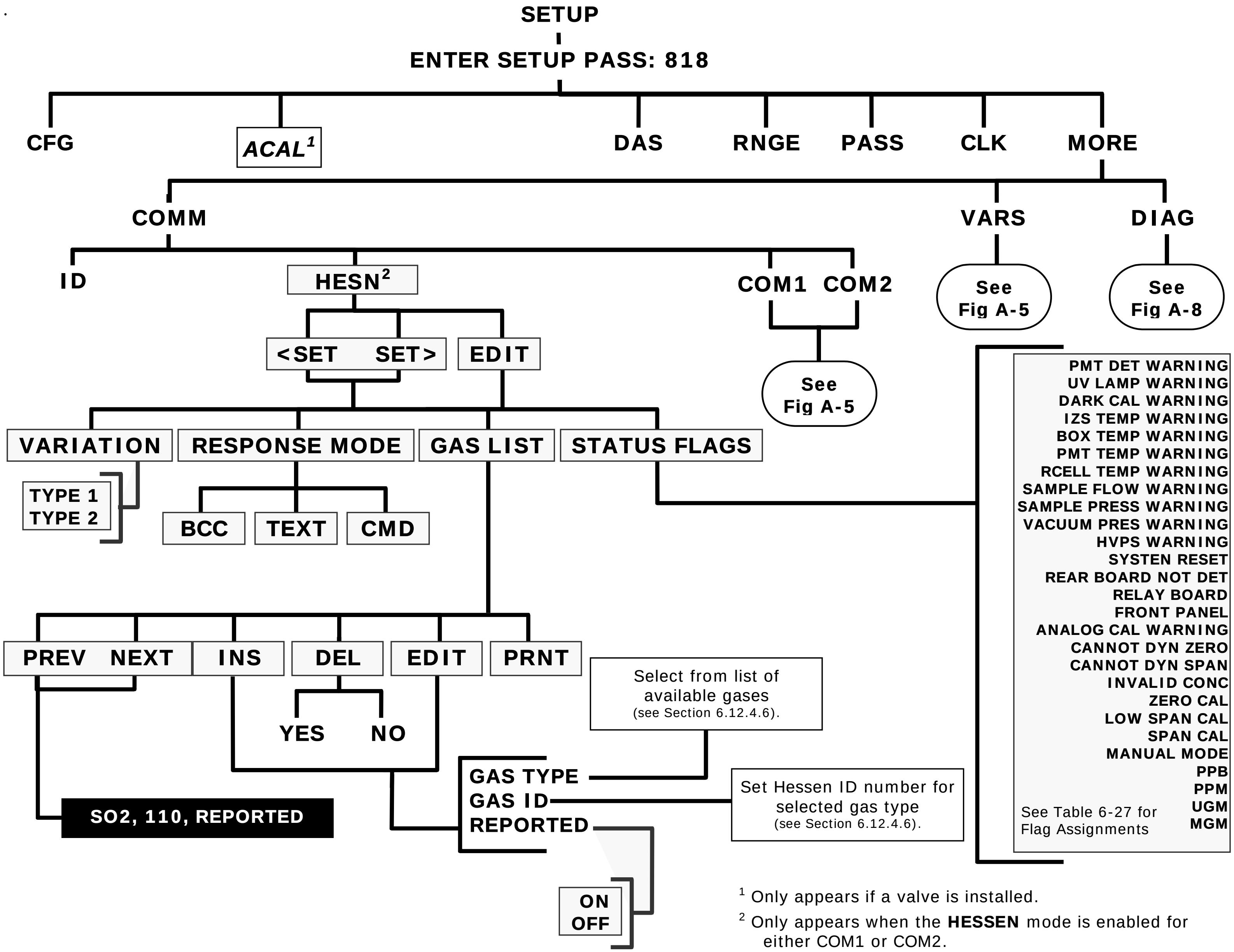
[1] Only appears if Z/S valve option is installed.
[2] Only appears when the **ENABLE INTERNET** mode is enabled for either COM1 or COM2.

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)



[1] Only appears if a valve is installed.

[2] Only appears when the **HESSEN** mode is enabled for either COM1 or COM2.

Figure A-7: Secondary Setup Menu - HESSEN Submenu

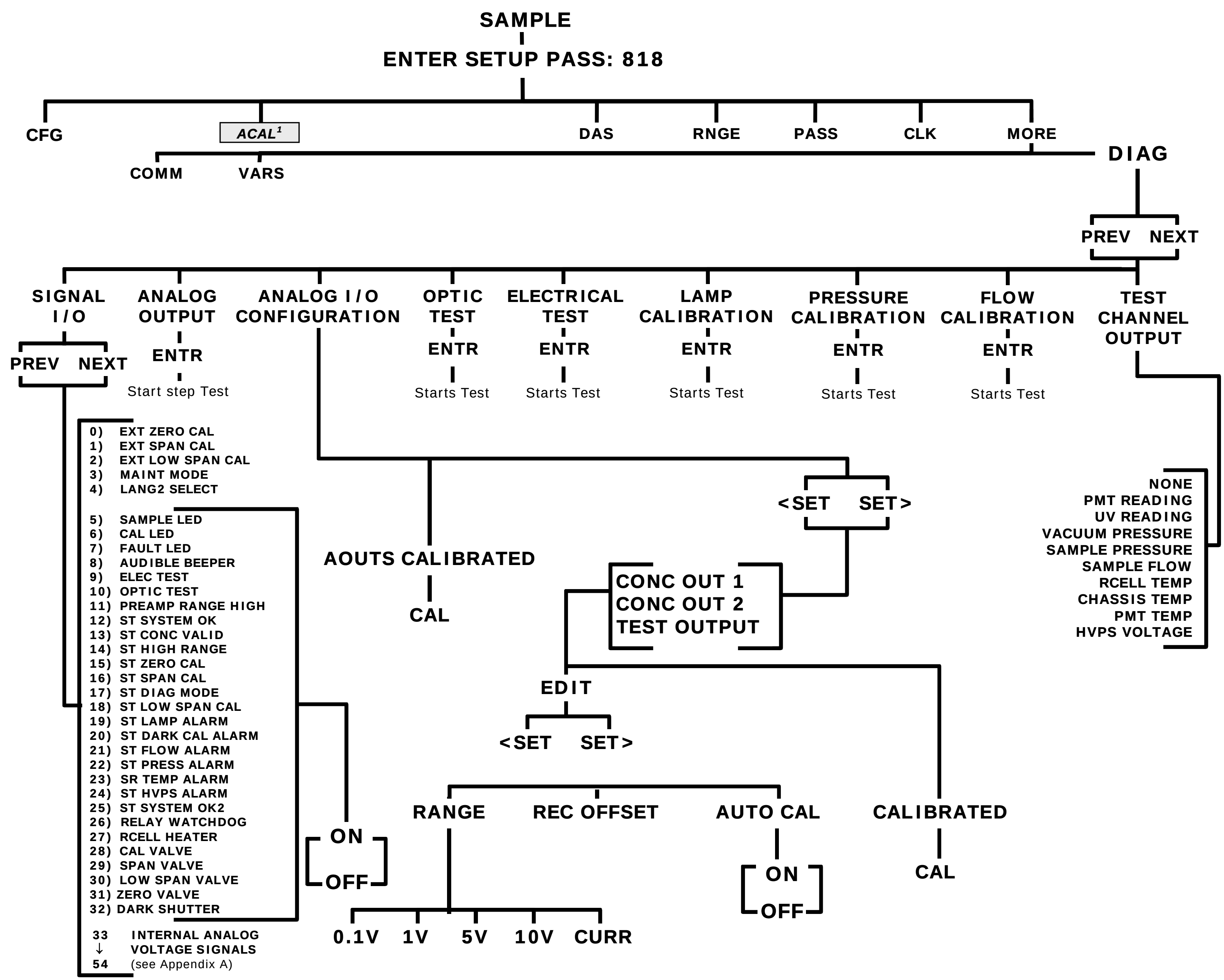


Figure A-8: Secondary Setup Menu (DIAG)

APPENDIX A-2: Setup Variables For Serial I/O, Revision C.1

Table A-1: TML50H Setup Variables, Revision C.1

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, 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.
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.
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 sample.
FILT_SIZE	Samples	30	1–480	Moving average filter size.
FILT_ASIZE	Samples	6	1–100	Moving average filter size in adaptive mode.
FILT_DELTA	PPM	10	1–100	Absolute change to trigger adaptive filter.
FILT_PCT	%	5	1–100	Percent change to trigger adaptive filter.
FILT_DELAY	Seconds	180	0–300	Delay before leaving adaptive filter mode.
FILT_ADAPT	—	ON	OFF, ON	ON enables adaptive filter; OFF disables it.
DIL_FACTOR	—	1	0.1–1000	Dilution factor if dilution

SETUP VARIABLE	NUMERIC UNITS	DEFAULT VALUE	VALUE RANGE	DESCRIPTION
				enabled with *FACTORY_OPT* variable.
USER_UNITS	—	PPM	PPM, UGM	Concentration units for user interface. Enclose value in double quotes (“) when setting from the RS-232 interface.
LAMP_CAL	mV	3500	1000–5000	Last calibrated UV lamp reading.
LAMP_GAIN	—	0.9	0.5–1.5	UV lamp compensation attenuation factor.
TEMPCO_GAIN	—	0	0–2	Temperature coefficient attenuation factor for pressure readings.
SLOPE_CONST	—	6.25	0.1–10	Constant to make visible slope close to 1.
DARK_ENABLE	—	ON	OFF, ON	ON enables PMT/UV dark calibration; OFF disables it.
DARK_FREQ	Minutes	30,	0.1–1440	Dark calibration period.
DARK_LAMP_OFF	Seconds	1	0.01–10	Dark calibration lamp off 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	30	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	400	0–1000	Maximum dark offset allowed.
SO2_SPAN1	Conc	4000	0.1–50000	Target SO_2 concentration during span calibration of range 1.
SO2_SLOPE1	PPM/mV	1	0.25–4	SO_2 slope for range 1.
SO2_OFFSET1	mV	0	-1500–1500	SO_2 offset for range 1.
SO2_SPAN2	Conc	4000	0.1–50000	Target SO_2 concentration during span calibration of range 2.
SO2_SLOPE2	PPM/mV	1	0.25–4	SO_2 slope for range 2.
SO2_OFFSET2	mV	0	-1500–1500	SO_2 offset for range 2.
RANGE_MODE	—	SNGL	SNGL, DUAL, AUTO, AUTO2	Range control mode. Enclose value in double quotes (“) when setting from the RS-232 interface.
PHYS_RANGE1	PPM	500	5–10000	Low pre-amp range.
PHYS_RANGE2	PPM	5500	5–10000	High pre-amp range.
CONC_RANGE1	Conc	5000	0.1–50000	D/A concentration range 1.
CONC_RANGE2	Conc	5000	0.1–50000	D/A concentration range 2.
SAMP_FLOW_SET	cc/m	700	0–1200	Sample flow set point for flow

SETUP VARIABLE	NUMERIC UNITS	DEFAULT VALUE	VALUE RANGE	DESCRIPTION
				calculation and warning limits.
SAMP_FLOW_SLOPE	—	1 Warnings: 350–1200	0.5–1.5	Sample flow slope correction factor (adjusted flow = measured flow x slope).
VAC_SAMP_RATIO	—	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.
SAMP_PRESS_SLOPE	—	1	0.5–1.5	Sample pressure slope correction factor (adjusted pressure = measured pressure x slope).
VAC_PRESS_SET	“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 Warnings: 2–12	0–40	PMT temperature set point and warning limits.
RS232_MODE	BitFlag	0	0–65535	RS-232 COM1 mode flags. Add values to combine flags. 1 = quiet mode 2 = computer mode 4 = enable security 16 = enable Hessen protocol *Must power-cycle instrument for these options to fully take effect.* 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
BAUD_RATE	—	19200	300, 1200, 2400,	RS-232 COM1 baud rate. Enclose value in double quotes (“) when setting from the RS-

SETUP VARIABLE	NUMERIC UNITS	DEFAULT VALUE	VALUE RANGE	DESCRIPTION
			4800, 9600, 19200, 38400, 57600, 115200	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	—	19200	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	RS-232 COM2 baud rate. Enclose value in double quotes (") when setting from the RS-232 interface.
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, SAMPLE PRESSURE, SAMPLE FLOW, RCELL TEMP, CHASSIS TEMP, 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	Range to calibrate during contact-closure and Hessen calibration. Enclose value in double quotes (") when setting

SETUP VARIABLE	NUMERIC UNITS	DEFAULT VALUE	VALUE RANGE	DESCRIPTION
				from the RS-232 interface.
PASS_ENABLE	—	OFF	OFF, ON	ON enables passwords; OFF disables them.
STABIL_FREQ	Seconds	10	1–300	Stability measurement sampling period.
STABIL_SAMPLES	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.
HVPS_SET	Volts	550 Warnings: 400–700	0–2000	High voltage power supply warning limits. Set point is not used.
DETECTOR_LIMIT	mV	1000 Warnings: 600–4995	0–5000	UV lamp and PMT detector warning limits. Set point is not used.
SERIAL_NUMBER	—	"00000000"	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, DIM	Front panel display intensity. Enclose value in double quotes (") when setting from the RS-232 interface.
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).

SETUP VARIABLE	NUMERIC UNITS	DEFAULT VALUE	VALUE RANGE	DESCRIPTION
				"%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 2048 = enable Internet option

APPENDIX A-3: Warnings and Test Functions, Revision C.1

Table A-2: TML50H Warning Messages, Revision C.1

NAME	MESSAGE TEXT	DESCRIPTION
WSYSRES	**SYSTEM 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.

NAME	MESSAGE TEXT	DESCRIPTION
WSAMPPRESS	**SAMPLE PRESS WARN**	Sample pressure outside of warning limits specified by *SAMP_PRESS_SET* variable.
WVACPRESS	**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	**RCELL TEMP WARNING**	Reaction cell temperature outside of warning limits specified by *RCELL_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	**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: TML50H Test Functions, Revision C.1

TEST FUNCTION	MESSAGE TEXT	DESCRIPTION
RANGE	RANGE=500.0 PPB	D/A range in single or auto-range modes.
RANGE1	RANGE1=500.0 PPB	D/A #1 range in independent range mode.
RANGE2	RANGE2=500.0 PPB	D/A #2 range in independent range mode.
STABILITY	STABIL=0.0 PPB	Concentration stability (standard deviation based on setting of *STABIL_FREQ* and *STABIL_SAMPLES*).
VACUUM	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.
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	OFFSET=250.0 MV	Offset for current range, 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.
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.
TESTCHAN	TEST=3721.1 MV	Value output to *TEST_OUTPUT* analog output, selected with *TEST_CHAN_ID* variable.
CLOCKTIME	TIME=10:38:27	Current instrument time of day clock.

APPENDIX A-4: TML50H Signal I/O Definitions, Revision C.1

Table A-4: TML50H Signal I/O Definitions, Revision C.1

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
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	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	4	1 = system OK 0 = any alarm condition or in diagnostics mode
	5–7	Spare
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

SIGNAL NAME	BIT OR CHANNEL NUMBER	DESCRIPTION
		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	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
	6–7	Spare
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

SIGNAL NAME	BIT OR CHANNEL NUMBER	DESCRIPTION
		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
	5	Spare
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	8	0 = let low span gas in 1 = let sample gas in
ZERO_VALVE	9	0 = let zero gas in 1 = let sample gas in
DARK_SHUTTER	10	0 = close dark shutter 1 = open
	11–15	Spare
Rear board primary MUX analog inputs		
PMT_SIGNAL	0	PMT detector
HVPS_VOLTAGE	1	HV power supply output
PMT_TEMP	2	PMT temperature
UVLAMP_SIGNAL	3	UV lamp intensity
	4	Temperature MUX
	5–6	Spare
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	10	Vacuum pressure
TEST_INPUT_11	11	Diagnostic test input
	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
TEMP_INPUT_4	4	Diagnostic temperature input
TEMP_INPUT_5	5	Diagnostic temperature input

SIGNAL NAME	BIT OR CHANNEL NUMBER	DESCRIPTION
TEMP_INPUT_6	6	Diagnostic temperature input
	7	Spare
Rear board DAC MUX analog inputs		
DAC_CHAN_0	0	DAC channel 0 loopback
DAC_CHAN_1	1	DAC channel 1 loopback
DAC_CHAN_2	2	DAC channel 2 loopback
DAC_CHAN_3	3	DAC channel 3 loopback
Rear board analog outputs		
CONC_OUT_1	0	Concentration output #1
CONC_OUT_2	1	Concentration output #2
TEST_OUTPUT	2	Test measurement output
	3	Spare

APPENDIX A-5: TML50H iDAS Functions, Revision C.1

Table A-5: TML50H DAS Trigger Events, Revision C.1

NAME	DESCRIPTION
ATIMER	Automatic timer expired
EXITZR	Exit zero calibration mode
EXITLS	Exit low span calibration mode
EXITHS	Exit high span calibration mode
EXITMP	Exit multi-point calibration mode
SLPCHG	Slope and offset recalculated
EXITDG	Exit diagnostic mode
PMTDTW	PMT detector warning
UVLMPW	UV lamp warning
RCTMPW	Reaction cell temperature warning
PTEMPW	PMT temperature warning
SFLOWW	Sample flow warning
SPRESW	Sample pressure warning
VPRESW	Vacuum pressure warning
BTEMPW	Box temperature warning
HVPSW	High voltage power supply warning

Table A-6: TML50H iDAS Functions, Revision C.1

NAME	DESCRIPTION	UNITS
PMTDET	PMT detector 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
ZSCNC1	SO_2 concentration for range #1 during zero/span calibration, just before computing new slope and offset	PPB
ZSCNC2	SO_2 concentration for range #2 during zero/span calibration, just before computing new slope and offset	PPB
CONC1	SO_2 concentration for range #1	PPB
CONC2	SO_2 concentration for range #2	PPB
STABIL	SO_2 concentration stability	PPB
STRLGT	Stray light reading	PPB
RCTEMP	Reaction cell temperature	°C
PMTTMP	PMT temperature	°C
SMPFLW	Sample flow	cc/m
SMPPRS	Sample pressure	“Hg
VACUUM	Vacuum pressure	“Hg
BOXTMP	Internal box temperature	°C
HVPS	High voltage power supply output	Volts
TEST8	Diagnostic test input (TEST_INPUT_8)	mV
TEST11	Diagnostic test input (TEST_INPUT_11)	mV
TEMP4	Diagnostic temperature input (TEMP_INPUT_4)	°C
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

APPENDIX A-6: Terminal Command Designators, Revision C.1

Table A-7: Terminal Command Designators, Revision C.1

<table>
<tr><th>COMMAND</th><th>ADDITIONAL COMMAND SYNTAX</th><th>DESCRIPTION</th></tr>
<tr><td>? [ID]</td><td></td><td>Display help screen and this list of commands</td></tr>
<tr><td>LOGON [ID]</td><td>password</td><td>Establish connection to instrument</td></tr>
<tr><td>LOGOFF [ID]</td><td></td><td>Terminate connection to instrument</td></tr>
<tr><td rowspan="4">T [ID]</td><td>SET ALL|name|hexmask</td><td>Display test(s)</td></tr>
<tr><td>LIST [ALL|name|hexmask] [NAMES|HEX]</td><td>Print test(s) to screen</td></tr>
<tr><td>name</td><td>Print single test</td></tr>
<tr><td>CLEAR ALL|name|hexmask</td><td>Disable test(s)</td></tr>
<tr><td rowspan="4">W [ID]</td><td>SET ALL|name|hexmask</td><td>Display warning(s)</td></tr>
<tr><td>LIST [ALL|name|hexmask] [NAMES|HEX]</td><td>Print warning(s)</td></tr>
<tr><td>name</td><td>Clear single warning</td></tr>
<tr><td>CLEAR ALL|name|hexmask</td><td>Clear warning(s)</td></tr>
<tr><td rowspan="5">C [ID]</td><td>ZERO|LOWSPAN|SPAN [1|2]</td><td>Enter calibration mode</td></tr>
<tr><td>ASEQ number</td><td>Execute automatic sequence</td></tr>
<tr><td>COMPUTE ZERO|SPAN</td><td>Compute new slope/offset</td></tr>
<tr><td>EXIT</td><td>Exit calibration mode</td></tr>
<tr><td>ABORT</td><td>Abort calibration sequence</td></tr>
<tr><td rowspan="10">D [ID]</td><td>LIST</td><td>Print all I/O signals</td></tr>
<tr><td>name[=value]</td><td>Examine or set I/O signal</td></tr>
<tr><td>LIST NAMES</td><td>Print names of all diagnostic tests</td></tr>
<tr><td>ENTER name</td><td>Execute diagnostic test</td></tr>
<tr><td>EXIT</td><td>Exit diagnostic test</td></tr>
<tr><td>RESET [DATA] [CONFIG] [exitcode]</td><td>Reset instrument</td></tr>
<tr><td>PRINT ["name"] [SCRIPT]</td><td>Print iDAS configuration</td></tr>
<tr><td>RECORDS ["name"]</td><td>Print number of iDAS records</td></tr>
<tr><td>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]</td><td>Print iDAS records</td></tr>
<tr><td>CANCEL</td><td>Halt printing iDAS records</td></tr>
<tr><td rowspan="6">V [ID]</td><td>LIST</td><td>Print setup variables</td></tr>
<tr><td>name[=value [warn_low [warn_high]]]</td><td>Modify variable</td></tr>
<tr><td>name="value"</td><td>Modify enumerated variable</td></tr>
<tr><td>CONFIG</td><td>Print instrument configuration</td></tr>
<tr><td>MAINT ON|OFF</td><td>Enter/exit maintenance mode</td></tr>
<tr><td>MODE</td><td>Print current instrument mode</td></tr>
<tr><td></td><td>DASBEGIN [<data channel definitions>] DASEND</td><td>Upload iDAS configuration</td></tr>
<tr><td></td><td>CHANNELBEGIN propertylist CHANNELEND</td><td>Upload single iDAS channel</td></tr>
<tr><td></td><td>CHANNELDELETE ["name"]</td><td>Delete iDAS channels</td></tr>
</table>

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:

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APPENDIX B - TML50H Spare Parts List

NOTE

Use of replacement parts other than those supplied by TML may result in non-compliance with European standard EN 61010-1.

- TML50HSP – TML50H Spare Parts List

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MONITOR LABS
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TML50H ANALYZER SPARE PARTS LIST

REVISION HISTORY

LTR	DESCRIPTION	DATE	INCORP	APPR
A	Release per ECO 6605	7/10/2006	CAD	JN
B	Skipped to match vendor's REV level	N/A	N/A	N/A
C	Skipped to match vendor's REV level	N/A	N/A	N/A
D	Skipped to match vendor's REV level	N/A	N/A	N/A
E	Skipped to match vendor's REV level	N/A	N/A	N/A
F	Skipped to match vendor's REV level	N/A	N/A	N/A
G	Skipped to match vendor's REV level	N/A	N/A	N/A
H	Updated Per DCN TML50HSPH/ECO 6648	2/23/2007	CAD	JN
J	Skipped to match vendor's REV level	N/A	N/A	N/A
K	Updated Per DCN TML50HSPK/ECO 6679	10/1/2007	JN	JN
L	Updated Per DCN TML50HSPL/ECO 6723	5/19/2008	CAD	JN
M	Updated Per DCN TML50HSPM/ECO 6750	8/6/2008	CAD	JN
N	Updated Per DCN TML50HSPN/ECO 6842	6/25/2009	CAD	JN

TML50H INDIVIDUAL SPARE PARTS LIST

Part Number	Description	Level
000940400	ORIFICE, 4 MIL, BLUE	2
000940800	ORIFICE, 012 MIL, RXCELL	2
002690000	LENS, UV	2
002700000	LENS, PMT	2
002740000	FILTER, PMT OPTICAL, 360 NM	2
003290000	ASSY, THERMISTOR	3
009690000	AKIT, TFE FLTR ELEMENT, 47MM, (FL6) (100)	2
009690100	AKIT, TFE FLTR, 47MM, (FL6) (30)	1
013140000	ASSY, COOLER FAN (NOX/SOX)	2
013390000	ASSY, KICKER, TML50H	3
013400000	CD, PMT, SO2, TML50/E	3
013420000	ASSY, ROTARY SOLENOID, TML50	2
013570000	ASSY, THERMISTOR (COOLER)	3
014080100	ASSY, HVPS, SOX/NOX	3
016290000	WINDOW, SAMPLE FILTER, 47MM	2
016300700	ASSY, SAMPLE FILTER, 47MM, ANG BKT, TFE	3
018080000	KIT, DESSICANT BAGGIES (12)	1
023410000	PCA, FLOW/PRESSURE TML50H	3
037860000	ORING, TFE RETAINER, SAMPLE FILTER	1
040010000	ASSY, FAN REAR PANEL, E SERIES	2
040300100	ASSY.,CONFIG PLUG FOR 045230200, AC MAIN 100-115V 50/60HZ	3
040300200	ASSY.,CONFIG PLUG FOR 045230200, AC MAIN 220-240V 50/60HZ	3
040300300	ASSY.,CONFIG PLUG FOR 045230200, SINGLE HEATER	3
041710000	ASSY, CPU, CONFIGURATION, "E" SERIES	3
042580000	PCA, KEYBOARD, E-SERIES, W/V-DETECT	3
042900100	PROGRAMMED FLASH, E SERIES	3
043940000	PCA, INTERFACE, ETHERNET, E-SERIES	3
045150102	MANUAL, OPERATION, TML50	3
045870100	PCA, TML50H UV REF DETECTOR	3
046210000	ADDENDUM, MANUAL, TML50H	3
046250000	ASSY, RXCELL HEATER/FUSE, TML50	2
046260000	ASSY, THERMISTOR, RXCELL, TML50	3
048620200	PCA, SERIAL INTERFACE, w/ MD, E SERIES	3
049310100	PCA, TEC CONTROL, E SERIES	3
050830100	DISK-ON-CHIP, w/SOFTWARE, TML50H	3
058021100	PCA, MOTHERBOARD, E SERIES, GEN 5-I	3
884-017300	PUMP ASSY, EXTERNAL, 115V/60 HZ, THOMAS	2
98415105-1	EXTERNAL SCRUBBER ASSY., CHARCOAL	2
CN0000458	CONNECTOR, REAR PANEL, 12 PIN	3
CN0000520	CONNECTOR, REAR PANEL, 10 PIN	3
DS0000025	DISPLAY, E SERIES	3
FL0000001	FILTER, SS	1
HW0000005	FOOT, CHASSIS	3
HW0000036	TFE TAPE, 1/4" (48 FT/ROLL)	1
HW0000090	SPRING, SS, FLOW CONTROL	1
KIT000095	REPLACEMENT, COOLER KIT, TML50/41	3
KIT000207	KIT, TML50H RELAY RETROFIT	3

TML50H INDIVIDUAL SPARE PARTS LIST

Part Number	Description	Level
KIT000253	KIT, SPARE PS37, E SERIES	3
KIT000254	POWER SUPPLY, SWITCHING, 12V/60W	3
OR0000001	ORING, FLOW CONTROL/IZS	1
OR0000084	ORING, UV FILTER	1
PU0000071	PUMP, EXTERNAL, ULTRAQUIET, KNF, 115V/60HZ	2
PU0000073	REBUILD KIT FOR PU71	1
RL0000015	RELAY, DPDT, GORDOS PREFERRED	2
SW0000051	SWITCH, POWER, CIRC BR	3
SW0000059	PRESSURE XDUCER, 0-15 PSIA	2
041800400	PCA, PMT PREAMP, TML50	R2
043570000	AKIT, EXPENDABLES, TML50/87	R1
045230200	PCA, RELAY CARD W/RELAYS, E SERIES, S/N'S >455	R2
47280000	KIT, SPARE PARTS, TML50	R2
061930000	PCA, UV LAMP DRIVER, GEN-2	R2
98000242	KIT, PUMP SERVICE, THOMAS PUMP	R2
850-056500	REFILL KIT, ACTIVATED CHARCOAL, 1 LB.	R1
KIT000093	REPLACEMENT KIT, 214NM FILTER (03187)	R2
KIT000236	KIT, UV LAMP REPLCMNT w/E-A ADPTR.	R2
OR0000004	ORING, OPTIC/CELL, CELL/TRAP	R1
OR0000006	ORING, CELL/PMT	R1
OR0000007	ORING, PMT/BARREL/CELL	R1
OR0000015	ORING, PMT FILTER	R1
OR0000016	ORING, UV LENS	R1
OR0000027	ORING, COLD BLOCK/PMT HOUSING & HEATSINK	R1
OR0000048	ORING, REF DETECTOR	R1
OR0000060	ORING, PRESSURE TRANSDUCER	R1
OR0000083	ORING, PMT SIGNAL & OPTIC LED	R1
OR0000094	ORING, SAMPLE FILTER	R1

SPARE PARTS FOR ANALYZER OPTIONS ARE ON FOLLOWING PAGE(S)

INDEX OF OPTIONS FOR TML 50H

Option	Description
41	Current Loop Analog Output
50	Zero/Span Valves
52	Zero and Two Span Point Valve
O2	Oxygen Sensor
ZA	Zero Air Scrubber

TML 50H INDIVIDUAL OPTIONS SPARE PARTS LIST

Option	Part Number	Description	Level
41	KIT000219	PCA, 4-20MA OUTPUT, (E-OPTION)	3
50	055560000	ASSY, VALVE, VA59 W/DIODE	2
50	HW0000149	OPTION, SEALING WASHER, INLET VALVE	R1
52	016350100	ASSY, SEALING PLUG, INLET	R2
52	053020100	OPTION, ASSY., INLET MANIFOLD VALVE, ZERO/SPAN	2
52	053020200	OPTION, ASSY., INLET MANIFOLD VALVE, SAMPLE	2
52	OR0000050	OPTION, ORING, SEALING PLUG, INLET MANIFOLD	R1
52	OR0000051	OPTION, ORING, SEALING PLUG, INLET MANIFOLD	R1
O2	000940400	ORIFICE, 4 MIL, O2 OPTION	R2
O2	043420000	ASSY, HEATER/THERMISTOR O2 OPTION	3
O2	OP0000030	OXYGEN TRANSDUCER	3
ZA	005960000	OPTION, KIT, EXPENDABLES, ACTIVATED CHARCOAL	R1
ZA	006900000	OPTION, RETAINER PAD, CHARCOAL SCRUBBER	2
ZA	014400100	OPTION, ZERO AIR SCRUBBER, TML50	3
ZA	FL0000003	OPTION, FILTER, DFU	1
ZA	HW0000093	OPTION, SPRING, CHARCOAL SCRUBBER	2
ZA	OR0000025	OPTION, ORING, ZERO AIR SCRUBBER	1

Levels marked with an "R" are TML recommended parts to have on hand for typical repairs and maintenance.

Level 1: General maintenance supplies and expedables such as filters, O-rings, lamps, etc.

Level 2: Critical items that are known from experience to have a higher failure rate, such as pumps, heaters, converters, valves, and circuit boards.

Level 3: Other miscellaneous items not included in Level 1 or 2. This level includes other spare parts that are not expected to fail over a given time frame.

Warranty/Repair Questionnaire TML50H

CUSTOMER: ______________________________ PHONE: ____________________________________

CONTACT NAME: __________________________ FAX NO. ____________________________________

SITE ADDRESS: ____

TML50H 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	**RANGE**		PPM UG/M^3	1-5000 PPM Standard
Stability	**STABIL**		PPM UG/M^3	<.1 PPM with Zero Air
Vacuum	**VACUUM**		"Hg	4 – 10 "Hg
Sample Pressure	**PRES**		In-Hg-A	24 – 29
Sample Flow	**SAMP FL**		CC/MIN	700 ±10%
PMT Signal	**PMT**		MV	0 ± 100 with Zero Air
Normalized PMT Signal	**NORM PMT**		MV	0 ± 100 with Zero Air
UV Lamp	**UV LAMP**		MV	1000 – 4800
UV Lamp Ratio	**LAMP RATIO**		%	35 – 120%
Stray Light	**STR. LGT**		PPM	-50 to +100
Dark PMT	**DRK PMT**		MV	<200
Dark Lamp	**DRK LMP**		MV	-30 to 50
Slope	**SLOPE**		-	1.0 ± 0.3
Offset	**OFFSET**		MV	<200
High Voltage Power Supply	**HVPS**		V	400 – 750*
Reaction Cell Temperature	**RCELL TEMP**		°C	50 ± 1
Box Temperature	**BOX TEMP**		°C	Ambient + (3-7)
PMT Temperature	**PMT TEMP**		°C	7 ± 2
Time of Day	**TIME**		HH:MM:SS	

TELEDYNE ML CUSTOMER SERVICE
EMAIL: tml_support@teledyne.com
PHONE: (303) 792-3300 TOLL FREE: (800) 846-6062 FAX: (303) 799-4853

Warranty/Repair Questionnaire TML50H

TELEDYNE MONITOR LABS
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Test Settings		
Test Value	**Observed Value**	**Acceptable Value**
ETEST PMT Reading		2000 ± 1000MV
OTEST 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 ML TO RESPOND FASTER TO THE PROBLEM THAT YOU ARE ENCOUNTERING.

TELEDYNE ML CUSTOMER SERVICE
EMAIL: tml_support@teledyne.com
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APPENDIX D - ELECTRONIC SCHEMATICS

Table D-1: List of Included Electronic Schematics

DOCUMENT #	DOCUMENT TITLE
03956	PCA, 03955, Relay Driver
02173	PCA, 02172, Pressure Flow Sensor Board
05703	PCA, 05702, Motherboard, Gen4
04181	PCA, 04180, PMT Preamp
04259	PCA, 04258, Keyboard Display Interface
01312	PCA, 04120, UV Detector Preamp
04693	PCA, UV Lamp Driver, TML50H
04932	PCA, Thermo-Electric Cooler Board
04468	PCA, Analog Output Series Res

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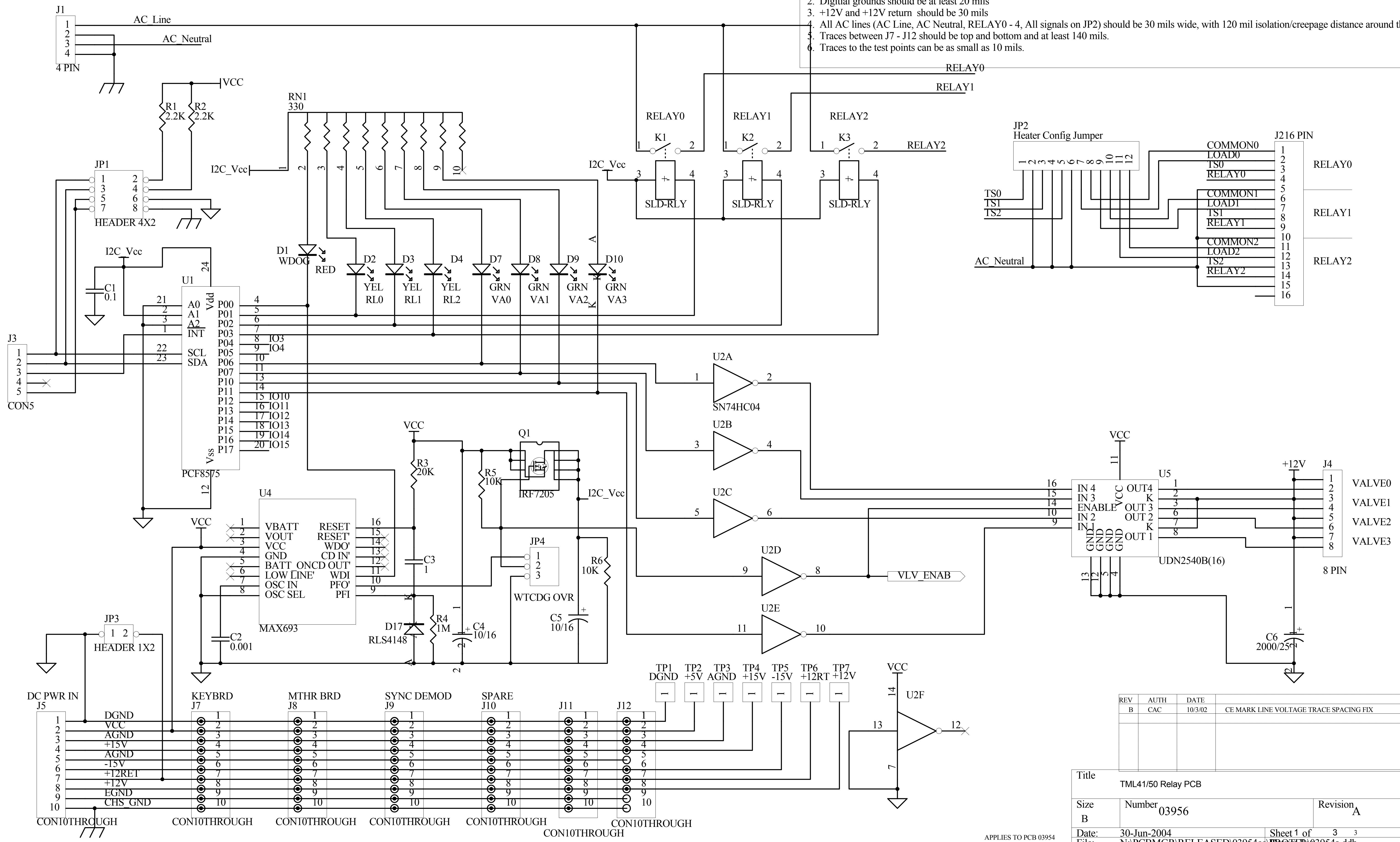
General Trace Width Requirements

1. Vcc (+5V) and I2C VCC should be 15 mil
2. Digitial grounds should be at least 20 mils
3. +12V and +12V return should be 30 mils
4. All AC lines (AC Line, AC Neutral, RELAY0 - 4, All signals on JP2) should be 30 mils wide, with 120 mil isolation/creepage distance around them
5. Traces between J7 - J12 should be top and bottom and at least 140 mils.
6. Traces to the test points can be as small as 10 mils.



REV	AUTH	DATE	
B	CAC	10/3/02	CE MARK LINE VOLTAGE TRACE SPACING FIX

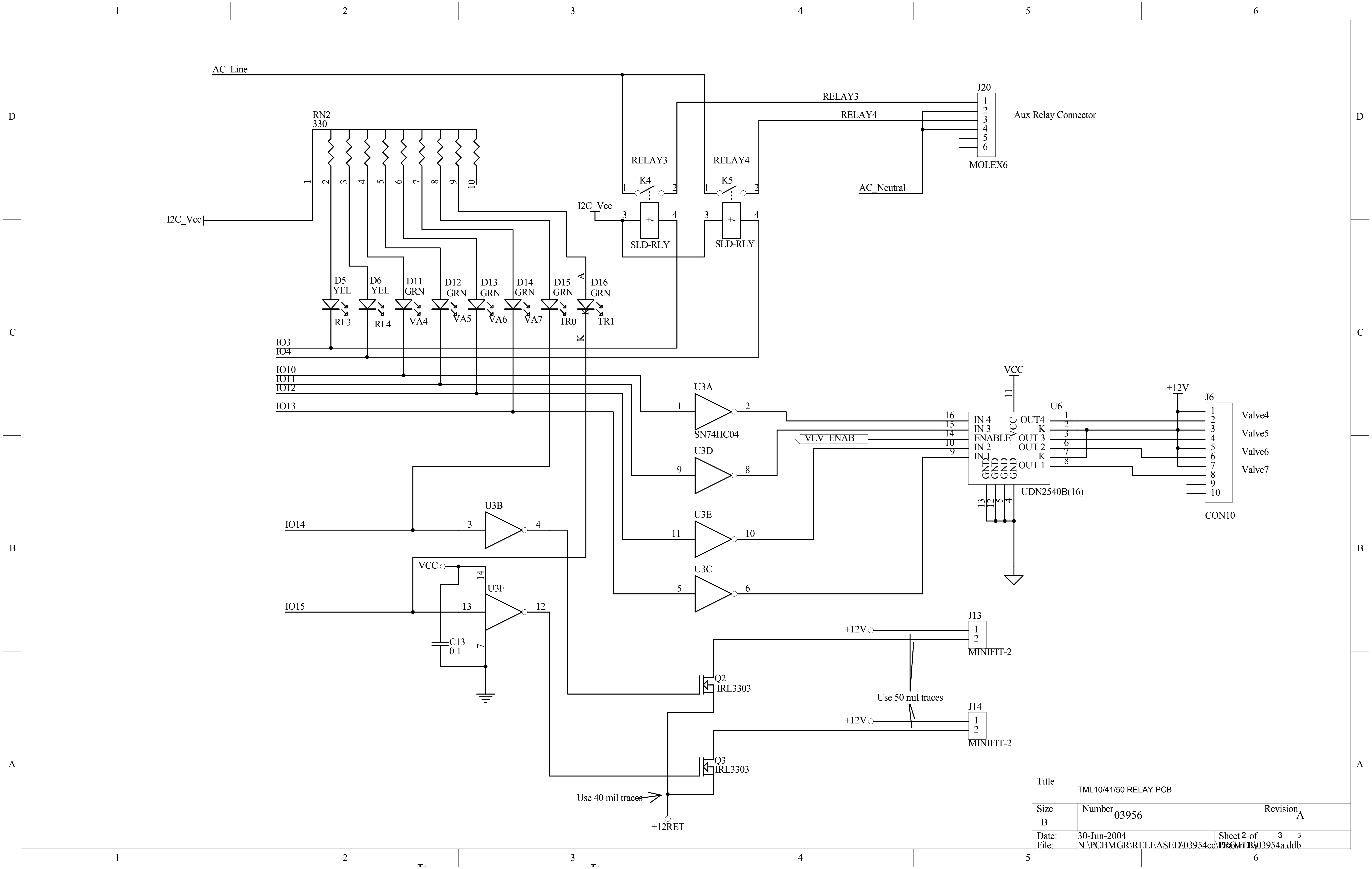
Title: TML41/50 Relay PCB

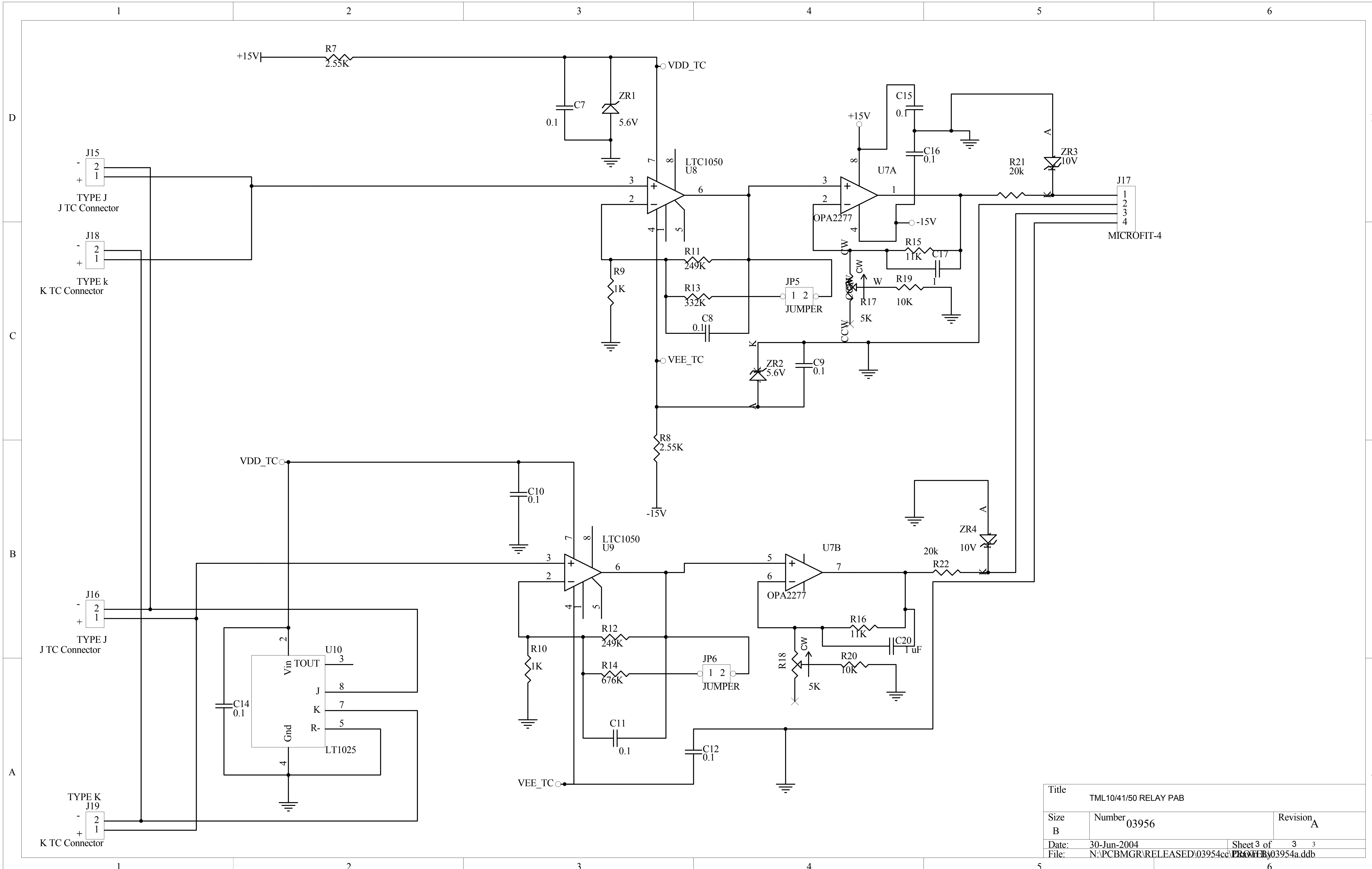
Size: B | Number: 03956 | Revision: A

Date: 30-Jun-2004 | Sheet 1 of 3

File: N:\PCBMGR\RELEASED\03954cc\PROTEL\03954a.ddb | Drawn By:

APPLIES TO PCB 03954


AC_Line
RN2
330
I2C_Vcc
RELAY3
RELAY4
J20
Aux Relay Connector
MOLEX6
AC_Neutral
K4
K5
SLD-RLY
D5 YEL
D6 YEL
D11 GRN
D12 GRN
D13 GRN
D14 GRN
D15 GRN
D16 GRN
RL3
RL4
VA4
VA5
VA6
VA7
TR0
TR1
IO3
IO4
IO10
IO11
IO12
IO13
IO14
IO15
U3A
SN74HC04
U3B
U3C
U3D
U3E
U3F
VCC
VLV_ENAB
U6
UDN2540B(16)
IN 4
IN 3
ENABLE
IN 2
IN 1
OUT4
OUT 3
OUT 2
OUT 1
GND
+12V
J6
Valve4
Valve5
Valve6
Valve7
CON10
C13
0.1
J13
MINIFIT-2
J14
Q2
IRL3303
Q3
IRL3303
Use 50 mil traces
Use 40 mil traces
+12RET
Title
TML10/41/50 RELAY PCB
Size
B
Number
03956
Revision
A
Date:
30-Jun-2004
Sheet 2 of 3
File:
N:\PCBMGR\RELEASED\03954cc\PROTEL\03954a.ddb
Drawn By:


+15V
R7
2.55K
VDD_TC
C7
0.1
ZR1
5.6V
LTC1050
U8
R11
249K
R13
332K
C8
0.1
R9
1K
VEE_TC
R8
2.55K
-15V
J15
TYPE J
J TC Connector
J18
TYPE k
K TC Connector
C15
0.1
+15V
C16
0.1
U7A
OPA2277
-15V
R15
11K
C17
1
R19
10K
R17
5K
CW
CCW
W
JP5
JUMPER
ZR2
5.6V
C9
0.1
R21
20k
ZR3
10V
J17
MICROFIT-4
VDD_TC
C10
0.1
LTC1050
U9
R12
249K
R14
676K
JP6
JUMPER
C11
0.1
R10
1K
C12
0.1
VEE_TC
U7B
OPA2277
R16
11K
C20
1 uF
R18
5K
R20
10K
ZR4
10V
20k
R22
J16
TYPE J
J TC Connector
U10
Vin
TOUT
J
K
R-
Gnd
LT1025
C14
0.1
TYPE K
J19
K TC Connector
Title
TML10/41/50 RELAY PAB
Size
B
Number
03956
Revision
A
Date:
30-Jun-2004
Sheet 3 of 3
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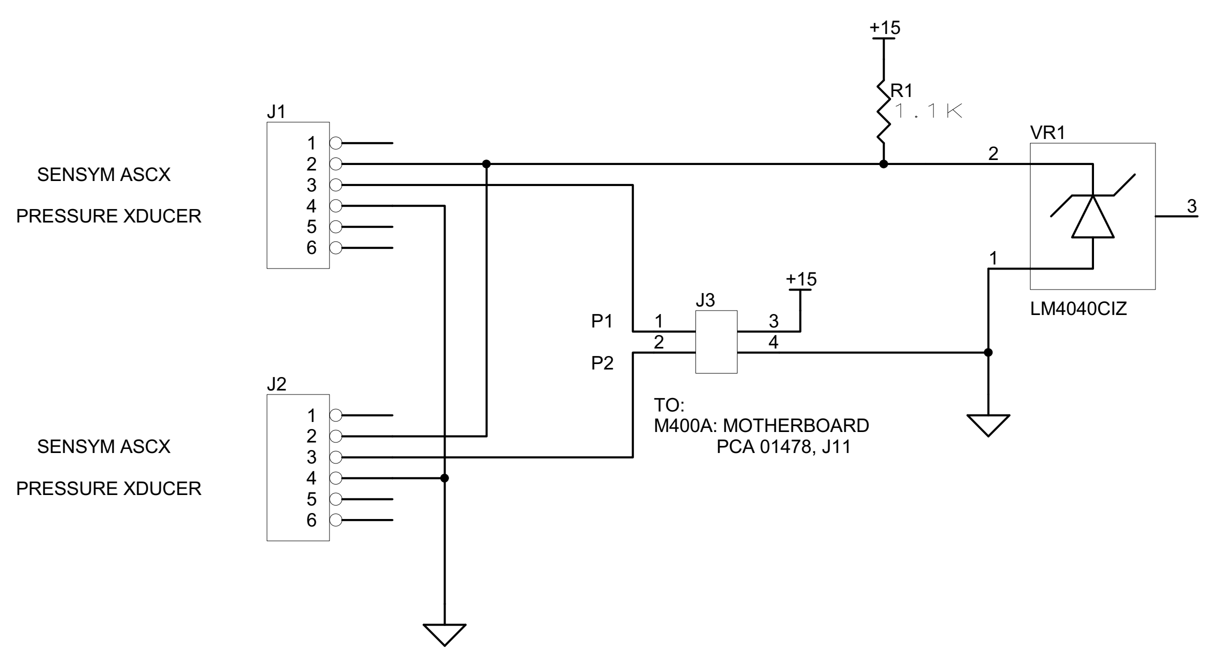
Drawn By:



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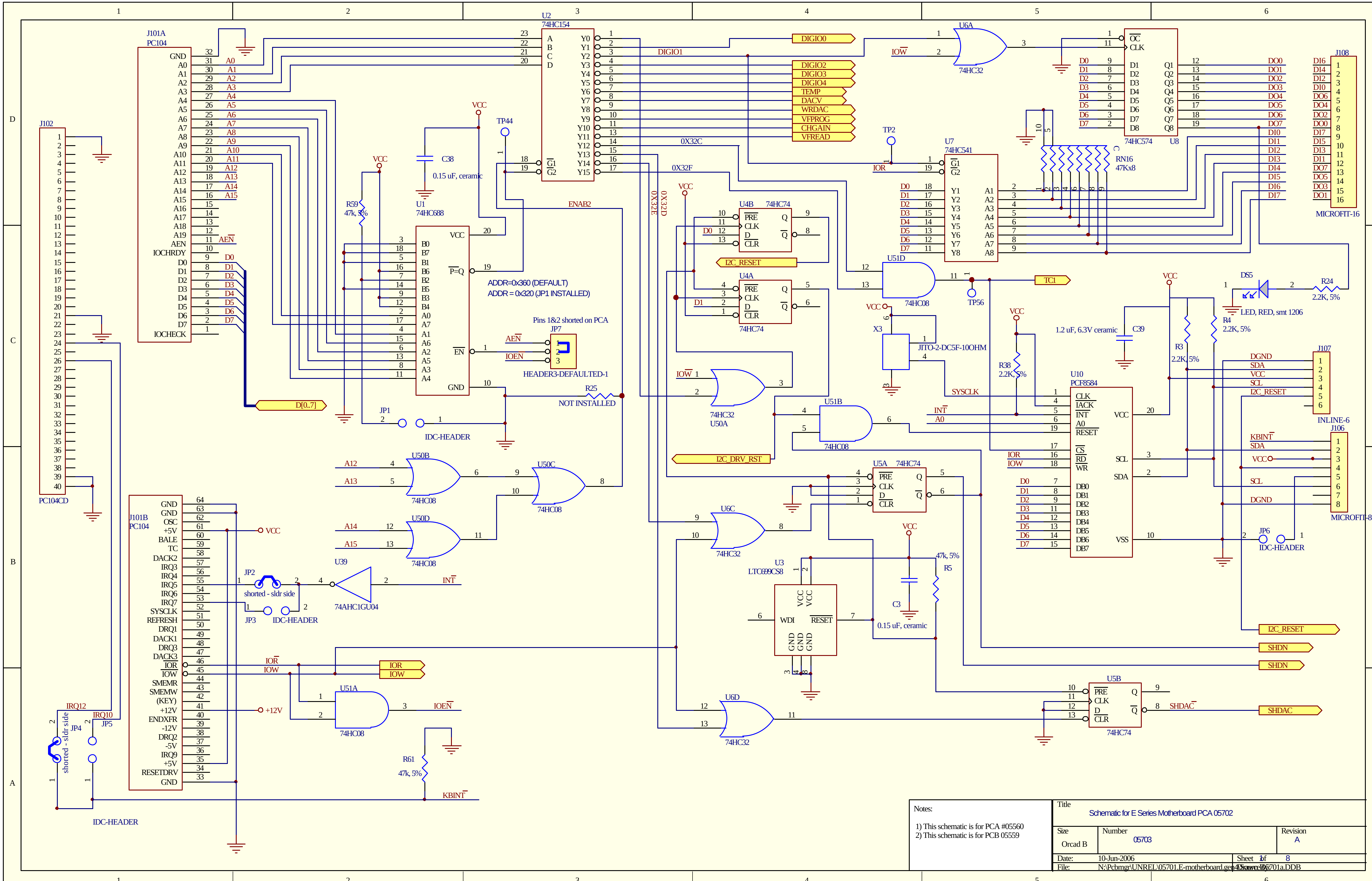
APPROVALS	DATE
DRAWN	
CHECKED	
APPROVED	

PRESSURE/FLOW PCB

SIZE	DRAWING NO.	REVISION
B	02173	B

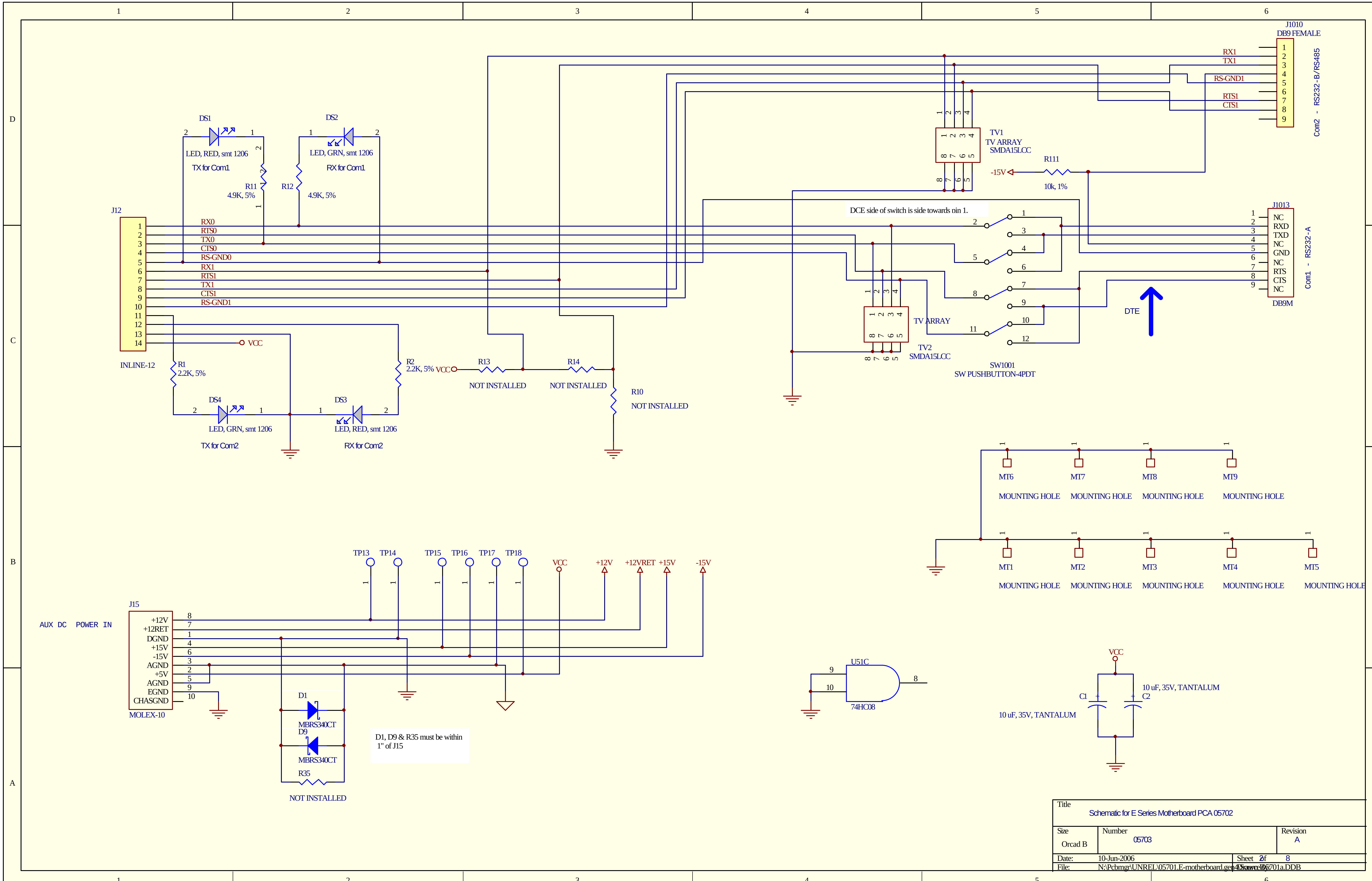
LAST MOD. 11-Nov-2002 | SHEET 1 of 1



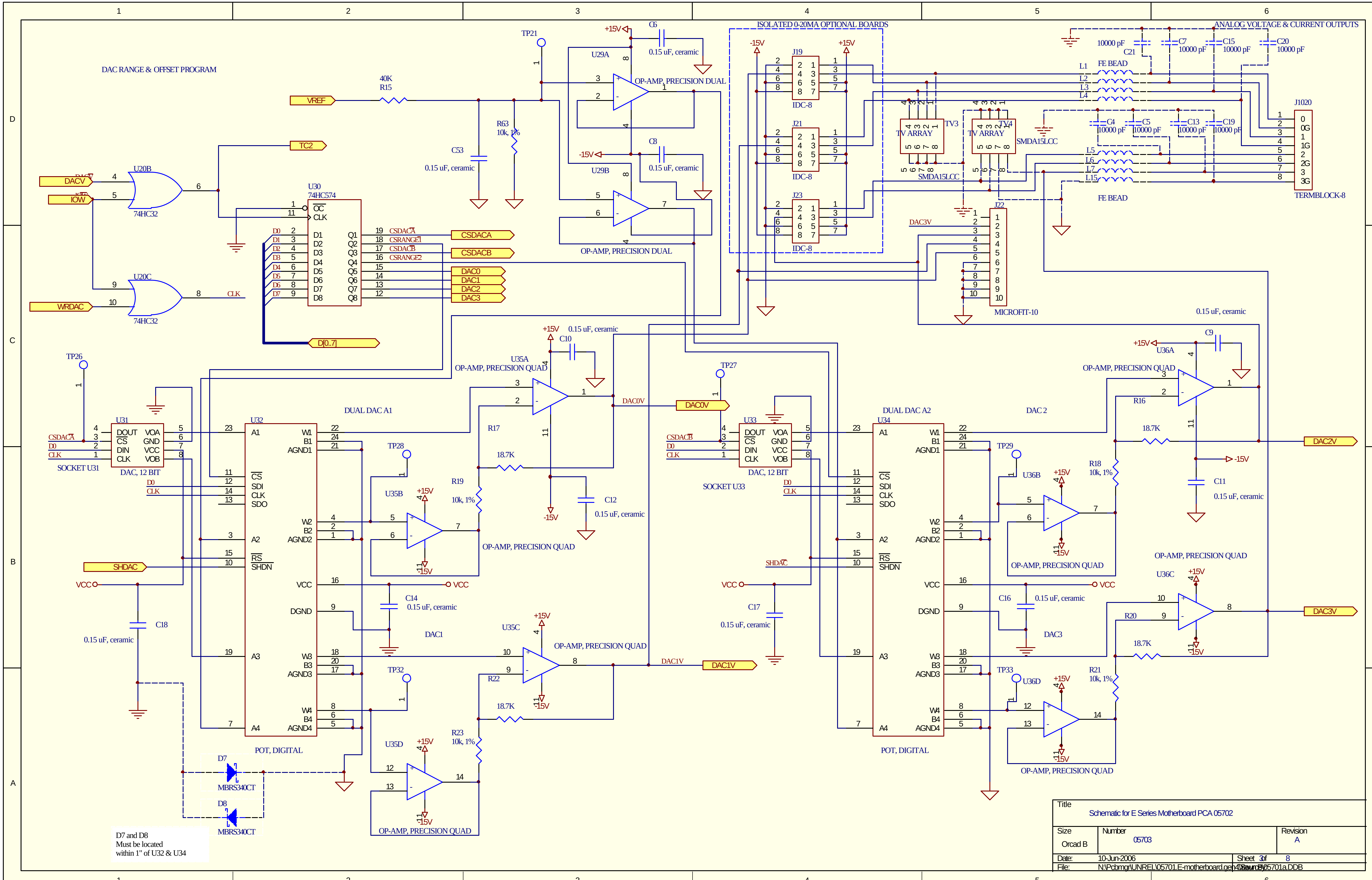
Notes:

1) This schematic is for PCA #05560
2) This schematic is for PCB 05559

Title	Schematic for E Series Motherboard PCA 05702	
Size: Orcad B	Number: 05703	Revision: A
Date: 10-Jun-2006	Sheet 1 of 8	
File: N:\Pcbmgr\UNREL\05701.E-motherboard.ge	Drawn: 05701a.DDB	



Title	Schematic for E Series Motherboard PCA 05702
Size	Orcad B
Number	05703
Revision	A
Date:	10-Jun-2006
Sheet	2 of 8
File:	N:\Pcbmgr\UNREL\05701.E-motherboard.gen4\Drawn\05701a.DDB



DAC RANGE & OFFSET PROGRAM
VREF
40K
R15
TC2
DACV
IOW
WRDAC
U20B
74HC32
U20C
74HC32
CLK
U30
74HC574
CSDACA
CSRANGE1
CSDACB
CSRANGE2
DAC0
DAC1
DAC2
DAC3
D[0..7]
TP21
U29A
U29B
OP-AMP, PRECISION DUAL
C6
C8
0.15 uF, ceramic
C53
R63
10k, 1%
+15V
-15V
ISOLATED 0-20MA OPTIONAL BOARDS
J19
J21
J23
IDC-8
TV3
TV4
TV ARRAY
SMDA15LCC
J22
MICROFIT-10
DAC3V
ANALOG VOLTAGE & CURRENT OUTPUTS
10000 pF
C21
C7
C15
C20
C4
C5
C13
C19
L1
L2
L3
L4
L5
L6
L7
L15
FE BEAD
J1020
TERMBLOCK-8
TP26
U31
SOCKET U31
DAC, 12 BIT
U32
DUAL DAC A1
POT, DIGITAL
U35A
U35B
U35C
U35D
OP-AMP, PRECISION QUAD
C10
C12
C14
C17
C18
R17
R19
R22
R23
18.7K
TP27
TP28
TP32
DAC0V
DAC1V
SHDAC
VCC
DAC1
U33
SOCKET U33
U34
DUAL DAC A2
DAC 2
TP29
TP33
U36A
U36B
U36C
U36D
C9
C11
C16
R16
R18
R20
R21
DAC2V
DAC3
D7
D8
MBRS340CT
D7 and D8
Must be located
within 1" of U32 & U34
Title
Schematic for E Series Motherboard PCA 05702
Size
Orcad B
Number
05703
Revision
A
Date: 10-Jun-2006
Sheet 3 of 8
File: N:\Pcbmgr\UNREL\05701.E-motherboard.gen4\Source\05701a.DDB
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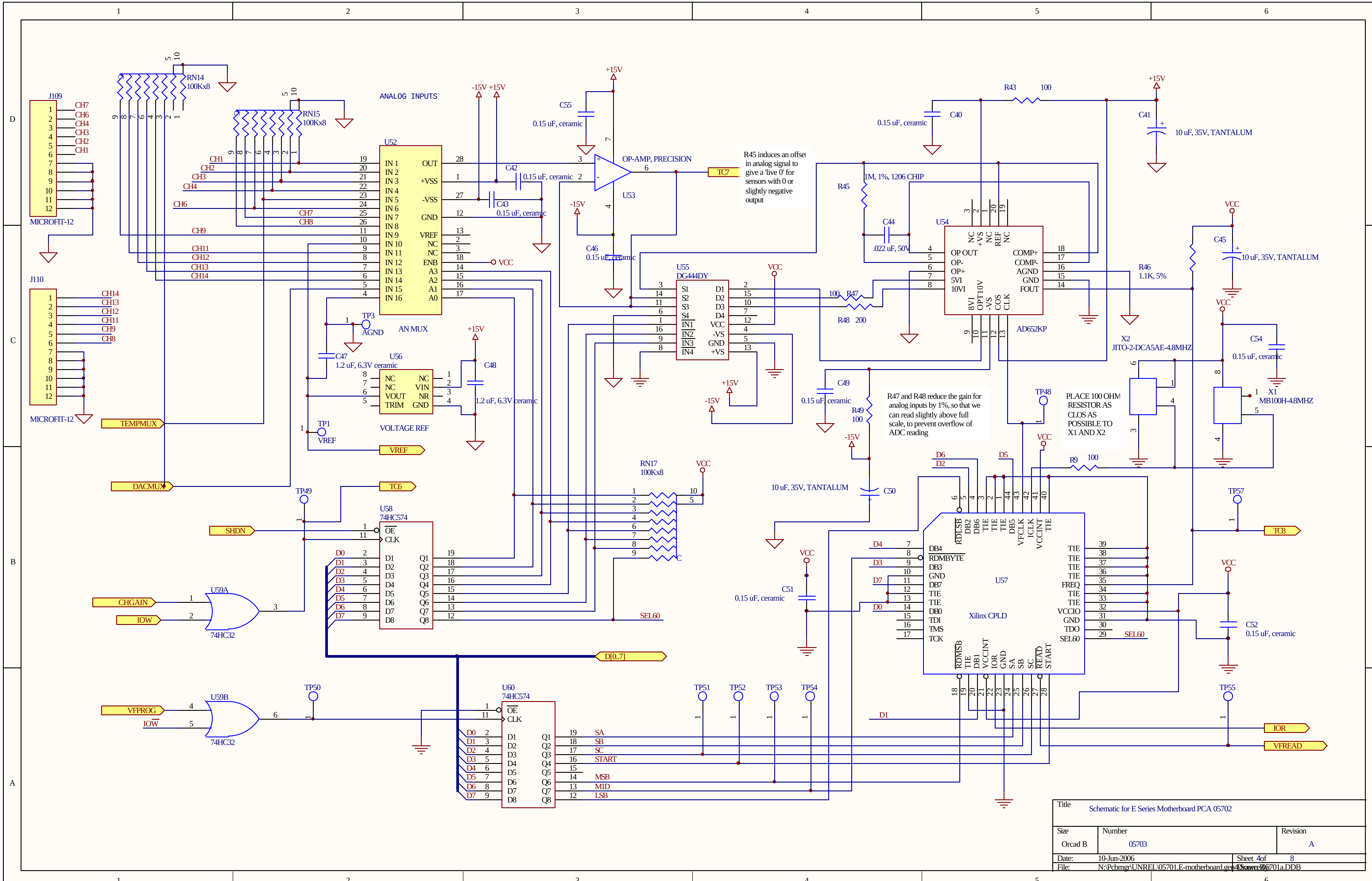
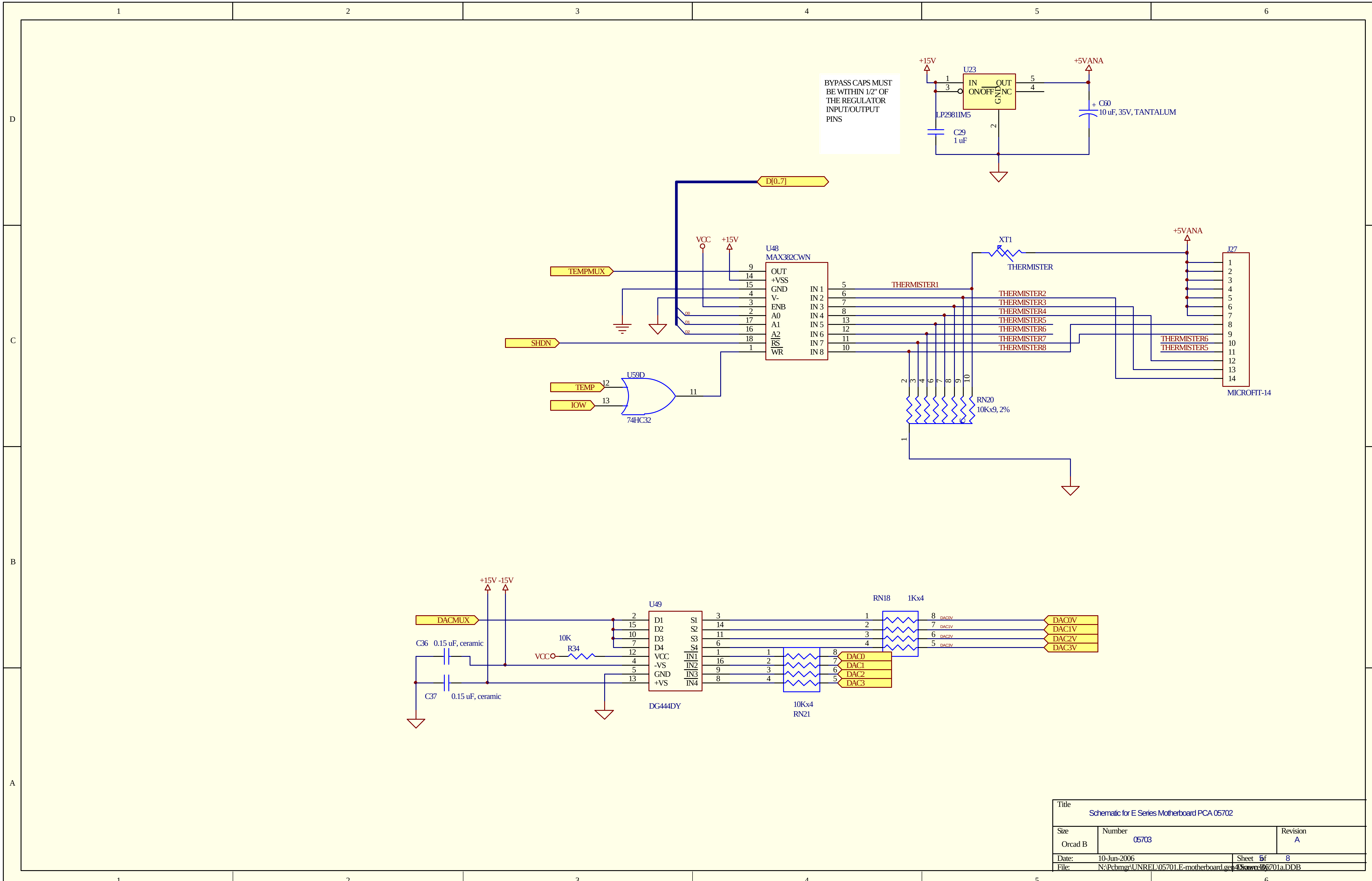
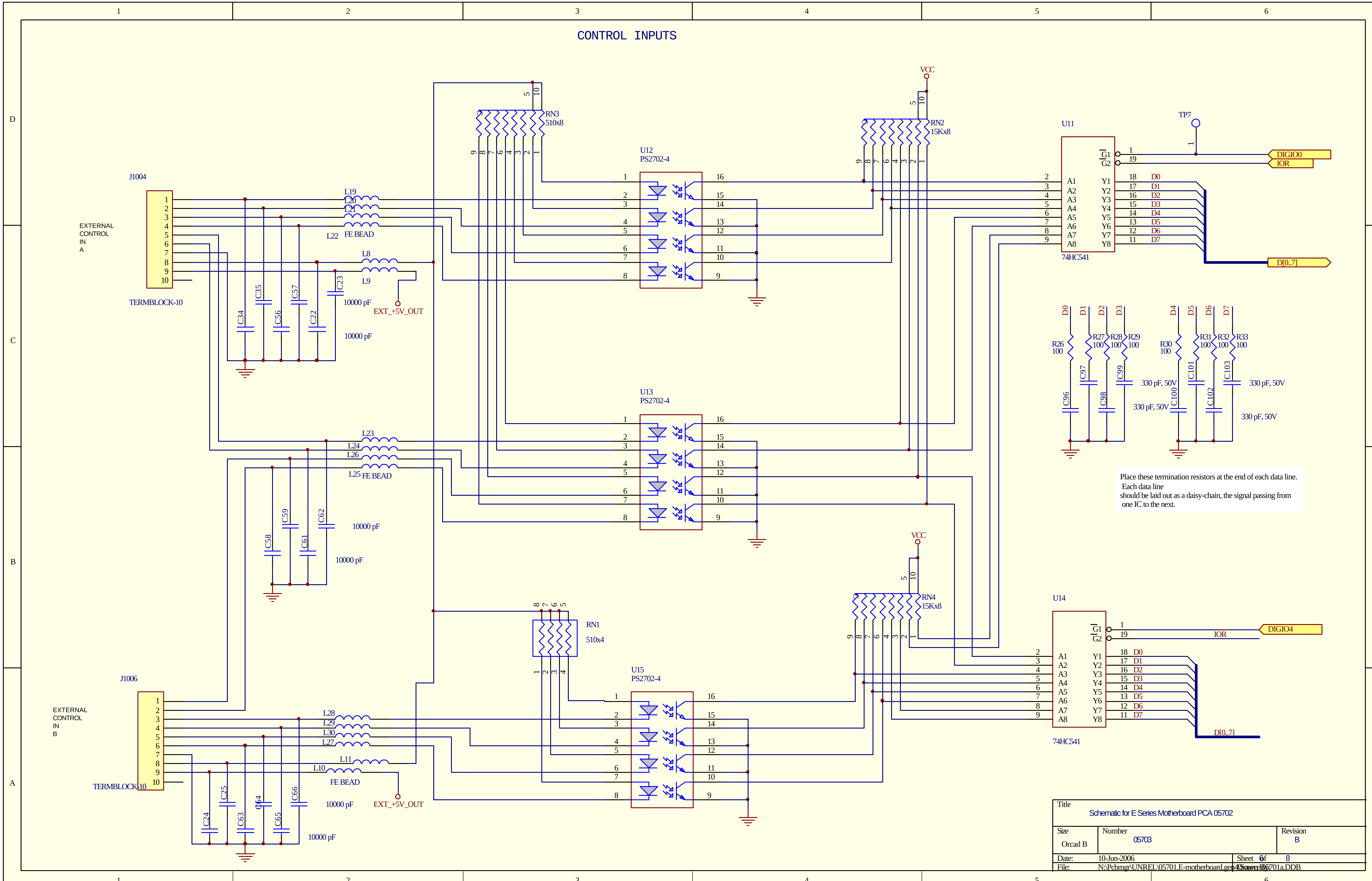
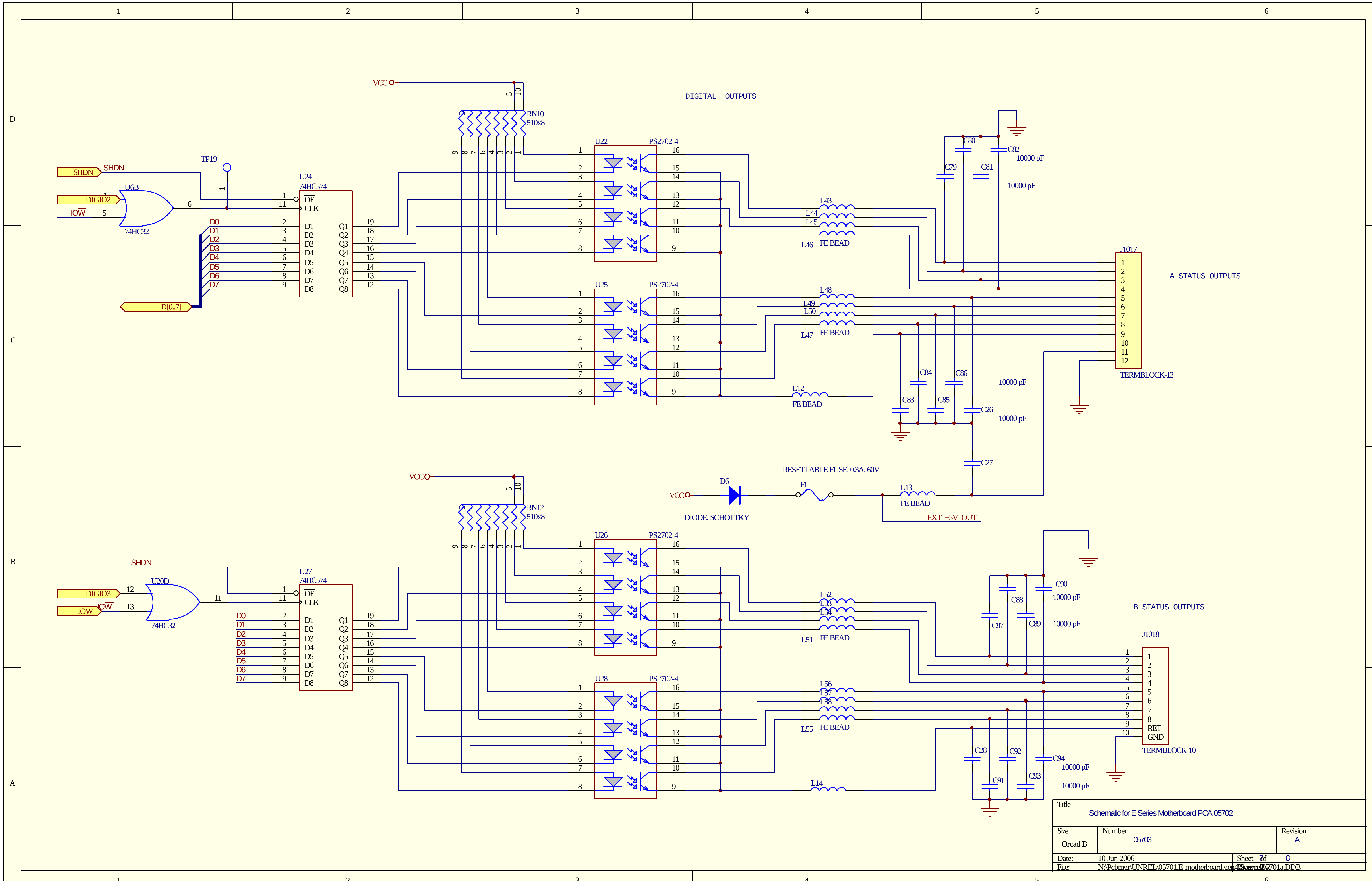

ANALOG INPUTS
J109
MICROFIT-12
J110
MICROFIT-12
RN14
100Kx8
RN15
100Kx8
U52
AN MUX
U53
OP-AMP, PRECISION
U54
AD652KP
U55
DG444DY
U56
VOLTAGE REF
U57
Xilinx CPLD
U58
74HC574
U60
74HC574
U59A
74HC32
U59B
74HC32
RN17
100Kx8
X1
MB100H-4.8MHZ
X2
JITO-2-DCA5AE-4.8MHZ
R45 induces an offset in analog signal to give a 'live 0' for sensors with 0 or slightly negative output
R47 and R48 reduce the gain for analog inputs by 1%, so that we can read slightly above full scale, to prevent overflow of ADC reading
PLACE 100 OHM RESISTOR AS CLOS AS POSSIBLE TO X1 AND X2
TEMPMUX
DACMUX
SHDN
CHGAIN
IOW
VFPROG
VREF
TC6
TC7
TC8
IOR
VFREAD
D[0..7]
SEL60
Title
Schematic for E Series Motherboard PCA 05702
Size
Orcad B
Number
05703
Revision
A
Date: 10-Jun-2006
Sheet 4 of 8
File: N:\Pcbmgr\UNREL\05701.E-motherboard.gen4\Drawn By: 05701a.DDB

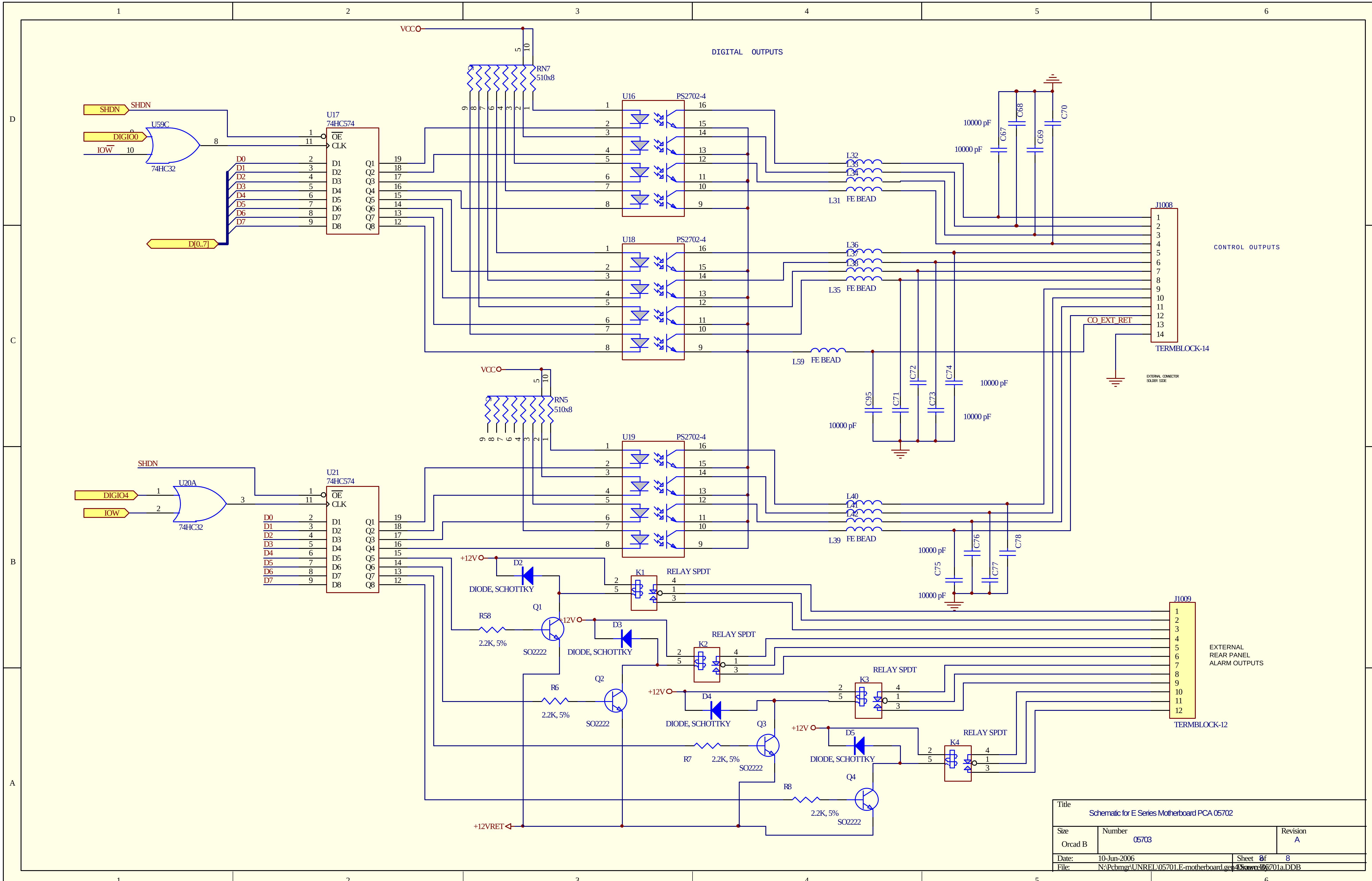

BYPASS CAPS MUST BE WITHIN 1/2" OF THE REGULATOR INPUT/OUTPUT PINS
+15V
U23
IN
OUT
ON/OFF
NC
GND
LP2981IM5
+5VANA
C60
10 uF, 35V, TANTALUM
C29
1 uF
D[0..7]
VCC
+15V
U48
MAX382CWN
OUT
+VSS
GND
V-
ENB
A0
A1
A2
RS
WR
IN 1
IN 2
IN 3
IN 4
IN 5
IN 6
IN 7
IN 8
TEMPMUX
SHDN
XT1
THERMISTER
+5VANA
J27
MICROFIT-14
THERMISTER1
THERMISTER2
THERMISTER3
THERMISTER4
THERMISTER5
THERMISTER6
THERMISTER7
THERMISTER8
THERMISTER6
THERMISTER5
U59D
TEMP
IOW
74HC32
RN20
10Kx9, 2%
+15V -15V
DACMUX
U49
D1
D2
D3
D4
VCC
-VS
GND
+VS
S1
S2
S3
S4
IN1
IN2
IN3
IN4
DG444DY
C36 0.15 uF, ceramic
C37 0.15 uF, ceramic
10K
R34
VCC
RN18
1Kx4
DAC0V
DAC1V
DAC2V
DAC3V
DAC0
DAC1
DAC2
DAC3
10Kx4
RN21
Title
Schematic for E Series Motherboard PCA 05702
Size
Orcad B
Number
05703
Revision
A
Date: 10-Jun-2006
Sheet 5 of 8
File: N:\Pcbmgr\UNREL\05701.E-motherboard.gen4\Drawn by: 05701a.DDB



CONTROL INPUTS
J1004
EXTERNAL
CONTROL
IN
A
TERMBLOCK-10
J1006
EXTERNAL
CONTROL
IN
B
TERMBLOCK-10
L19
L20
L21
L22
FE BEAD
L8
L9
L23
L24
L26
L25
FE BEAD
L28
L29
L30
L27
L11
L10
FE BEAD
C34
C35
C56
C57
C22
C23
10000 pF
C58
C59
C61
C62
C24
C25
C63
C64
C65
C66
EXT_+5V_OUT
RN3
510x8
RN2
15Kx8
RN4
15Kx8
RN1
510x4
U12
PS2702-4
U13
PS2702-4
U15
PS2702-4
U11
74HC541
U14
74HC541
VCC
TP7
DIGIO0
IOR
DIGIO4
D[0..7]
D0
D1
D2
D3
D4
D5
D6
D7
R26
R27
R28
R29
R30
R31
R32
R33
100
C96
C97
C98
C99
C100
C101
C102
C103
330 pF, 50V
Place these termination resistors at the end of each data line.
Each data line
should be laid out as a daisy-chain, the signal passing from
one IC to the next.
Title
Schematic for E Series Motherboard PCA 05702
Size
Orcad B
Number
05703
Revision
B
Date: 10-Jun-2006
Sheet 6 of 8
File: N:\Pcbmgr\UNREL\05701.E-motherboard.gen4\Drawn By: 05701a.DDB



Title	Schematic for E Series Motherboard PCA 05702	
Size: Orcad B	Number: 05703	Revision: A
Date: 10-Jun-2006	Sheet 7 of 8	
File: N:\Pcbmgr\UNREL\05701.E-motherboard.gen4\Source\05701a.DDB		



Title: Schematic for E Series Motherboard PCA 05702

Size: Orcad B

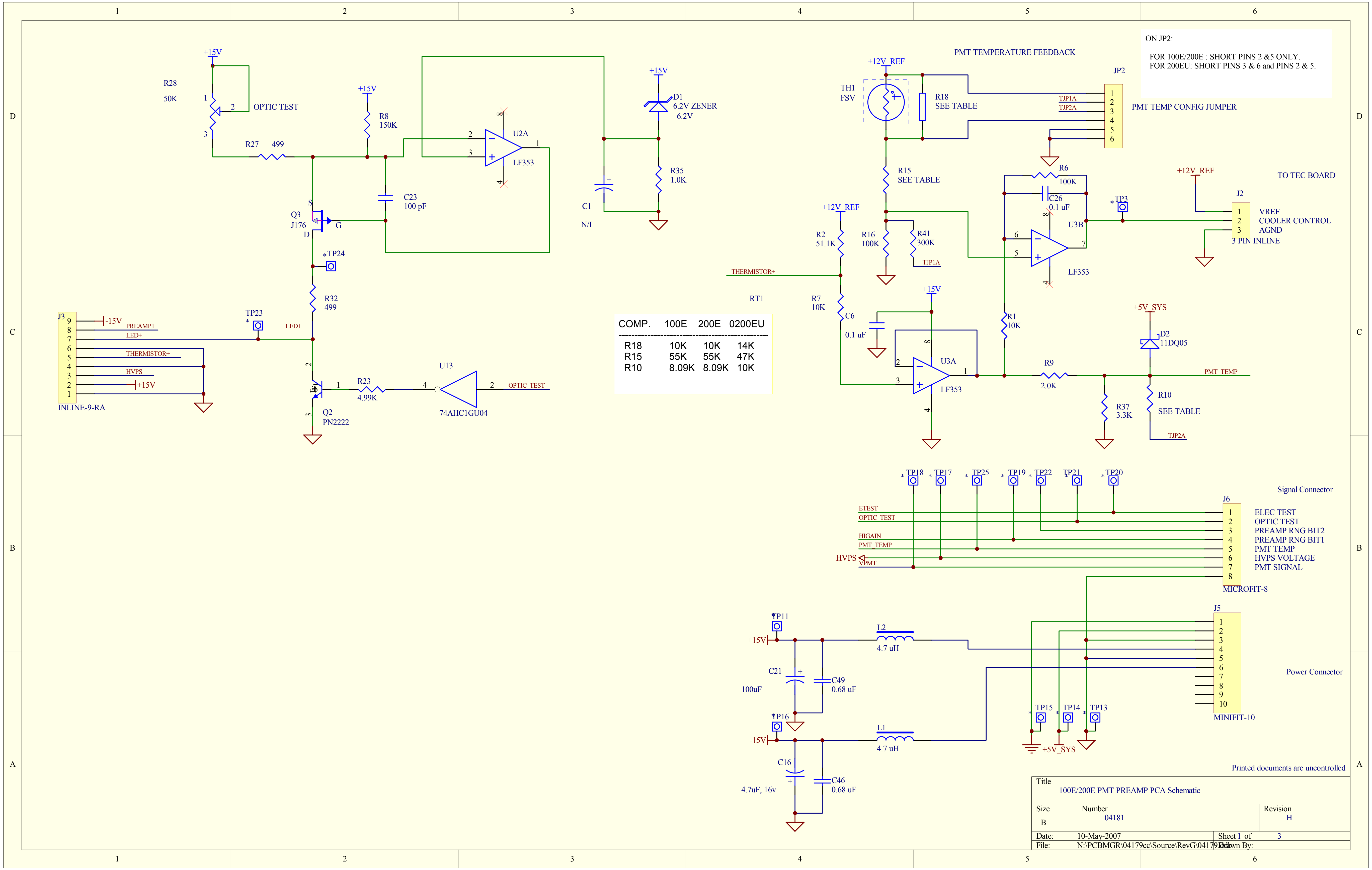
Number: 05703

Revision: A

Date: 10-Jun-2006

Sheet 8 of 8

File: N:\Pcbmgr\UNREL\05701.E-motherboard.gen4\Schematic\05701a.DDB



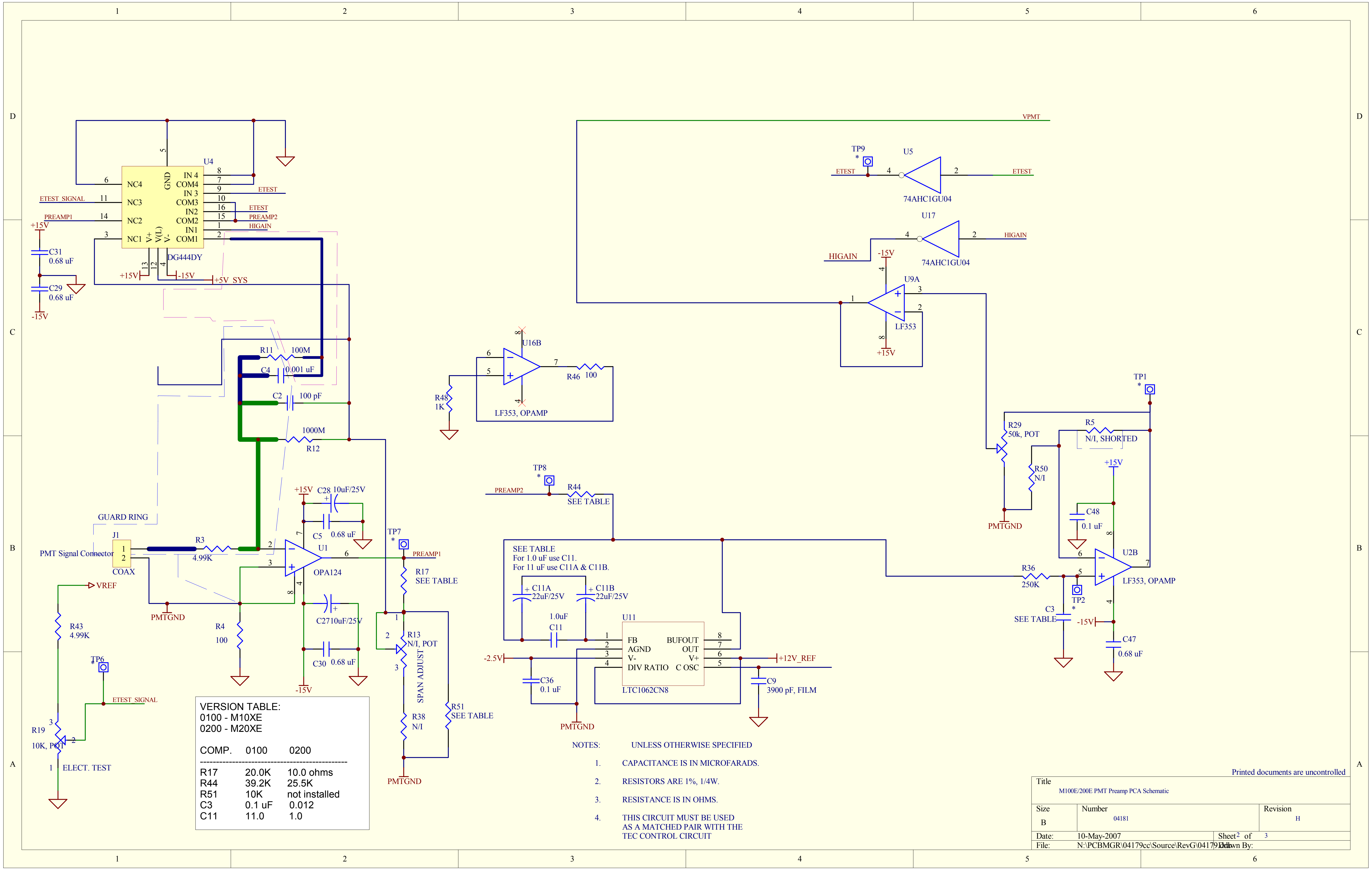
COMP.	100E	200E	0200EU
R18	10K	10K	14K
R15	55K	55K	47K
R10	8.09K	8.09K	10K

Title: 100E/200E PMT PREAMP PCA Schematic

Size: B | Number: 04181 | Revision: H

Date: 10-May-2007 | Sheet 1 of 3

File: N:\PCBMGR\04179cc\Source\RevG\04179.ddb | Drawn By:



VERSION TABLE:
0100 - M10XE
0200 - M20XE

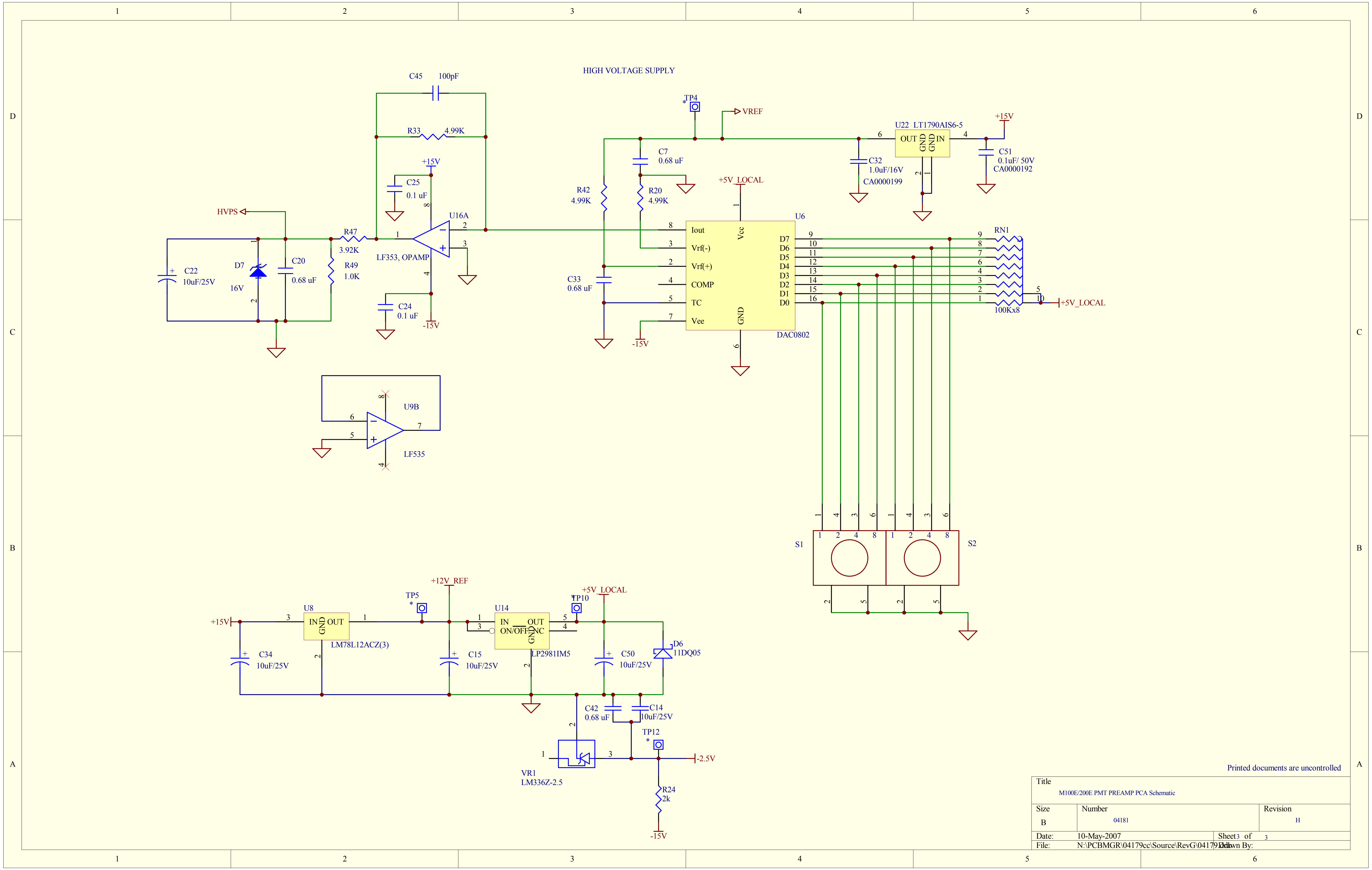
COMP.	0100	0200
R17	20.0K	10.0 ohms
R44	39.2K	25.5K
R51	10K	not installed
C3	0.1 uF	0.012
C11	11.0	1.0

NOTES: UNLESS OTHERWISE SPECIFIED

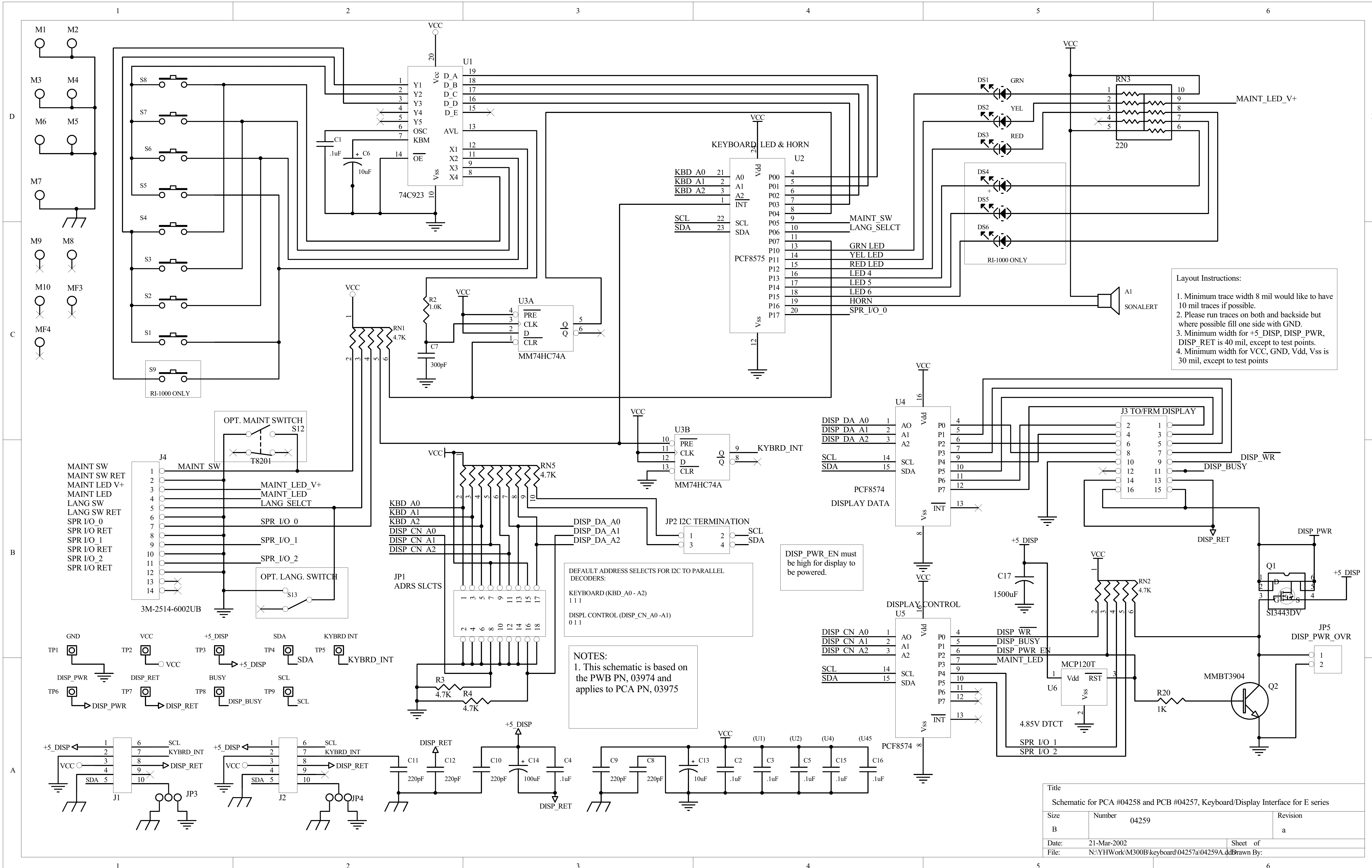
1. CAPACITANCE IS IN MICROFARADS.
2. RESISTORS ARE 1%, 1/4W.
3. RESISTANCE IS IN OHMS.
4. THIS CIRCUIT MUST BE USED AS A MATCHED PAIR WITH THE TEC CONTROL CIRCUIT

Printed documents are uncontrolled

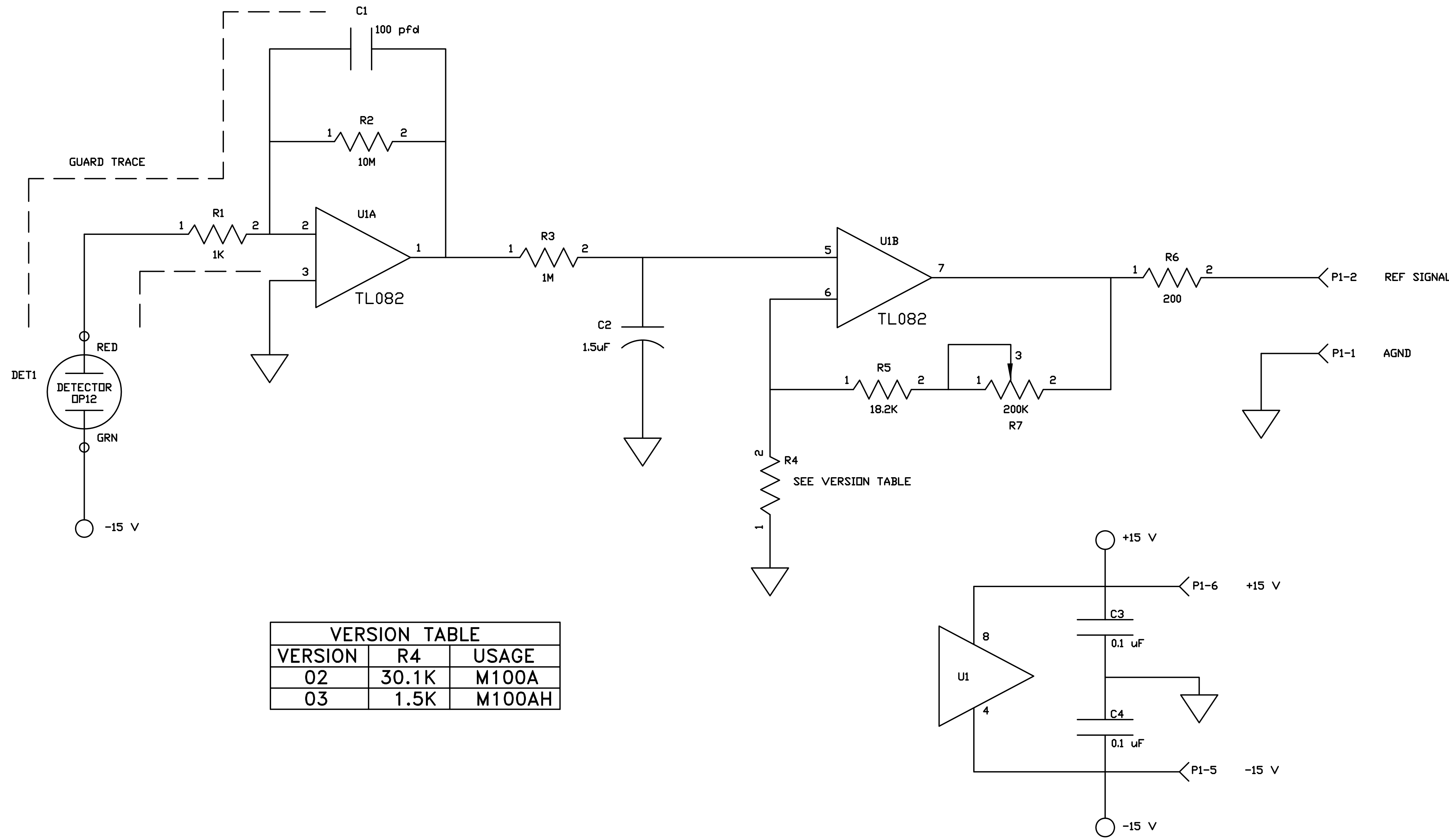
Title	M100E/200E PMT Preamp PCA Schematic	
Size B	Number 04181	Revision H
Date: 10-May-2007	Sheet 2 of 3	
File: N:\PCBMGR\04179cc\Source\RevG\04179.ddb	Drawn By:	



Title		
M100E/200E PMT PREAMP PCA Schematic		
Size: B	Number: 04181	Revision: H
Date: 10-May-2007		Sheet 3 of 3
File: N:\PCBMGR\04179cc\Source\RevG\04179.ddb		Drawn By:


KEYBOARD, LED & HORN
74C923
PCF8575
MM74HC74A
PCF8574
DISPLAY DATA
DISPLAY CONTROL
J3 TO/FRM DISPLAY
JP2 I2C TERMINATION
JP1
ADRS SLCTS
OPT. MAINT SWITCH
OPT. LANG. SWITCH
3M-2514-6002UB
RI-1000 ONLY
SONALERT
SI3443DV
MMBT3904
MCP120T
4.85V DTCT
JP5
DISP_PWR_OVR
MAINT SW
MAINT SW RET
MAINT LED V+
MAINT LED
LANG SW
LANG SW RET
SPR I/O_0
SPR I/O RET
SPR I/O_1
SPR I/O RET
SPR I/O_2
SPR I/O RET
Layout Instructions:
1. Minimum trace width 8 mil would like to have 10 mil traces if possible.
2. Please run traces on both and backside but where possible fill one side with GND.
3. Minimum width for +5_DISP, DISP_PWR, DISP_RET is 40 mil, except to test points.
4. Minimum width for VCC, GND, Vdd, Vss is 30 mil, except to test points
DISP_PWR_EN must be high for display to be powered.
DEFAULT ADDRESS SELECTS FOR I2C TO PARALLEL DECODERS:
KEYBOARD (KBD_A0 - A2)
1 1 1
DISPL CONTROL (DISP_CN_A0 -A1)
0 1 1
NOTES:
1. This schematic is based on the PWB PN, 03974 and applies to PCA PN, 03975
Title
Schematic for PCA #04258 and PCB #04257, Keyboard/Display Interface for E series
Size B
Number 04259
Revision a
Date: 21-Mar-2002
Sheet of
File: N:\YHWork\M300B\keyboard\04257a\04259A.ddb
Drawn By:

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	C	U1,R5 CHANGED	8/15/95	HC
	D	ADD C4, R7	10/5/98	HC
	F	INCORPORATED ALL VERSIONS	12/11/02	CB
	G	RESISTOR R5 IS 18.2K	4/17/03	CB



VERSION TABLE		
VERSION	R4	USAGE
02	30.1K	M100A
03	1.5K	M100AH

NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTENCE IS IN OHMS.
2. RESISTORS ARE 1%, 1/4W.
3. CAPACITORS ARE IN MICROFARADS.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

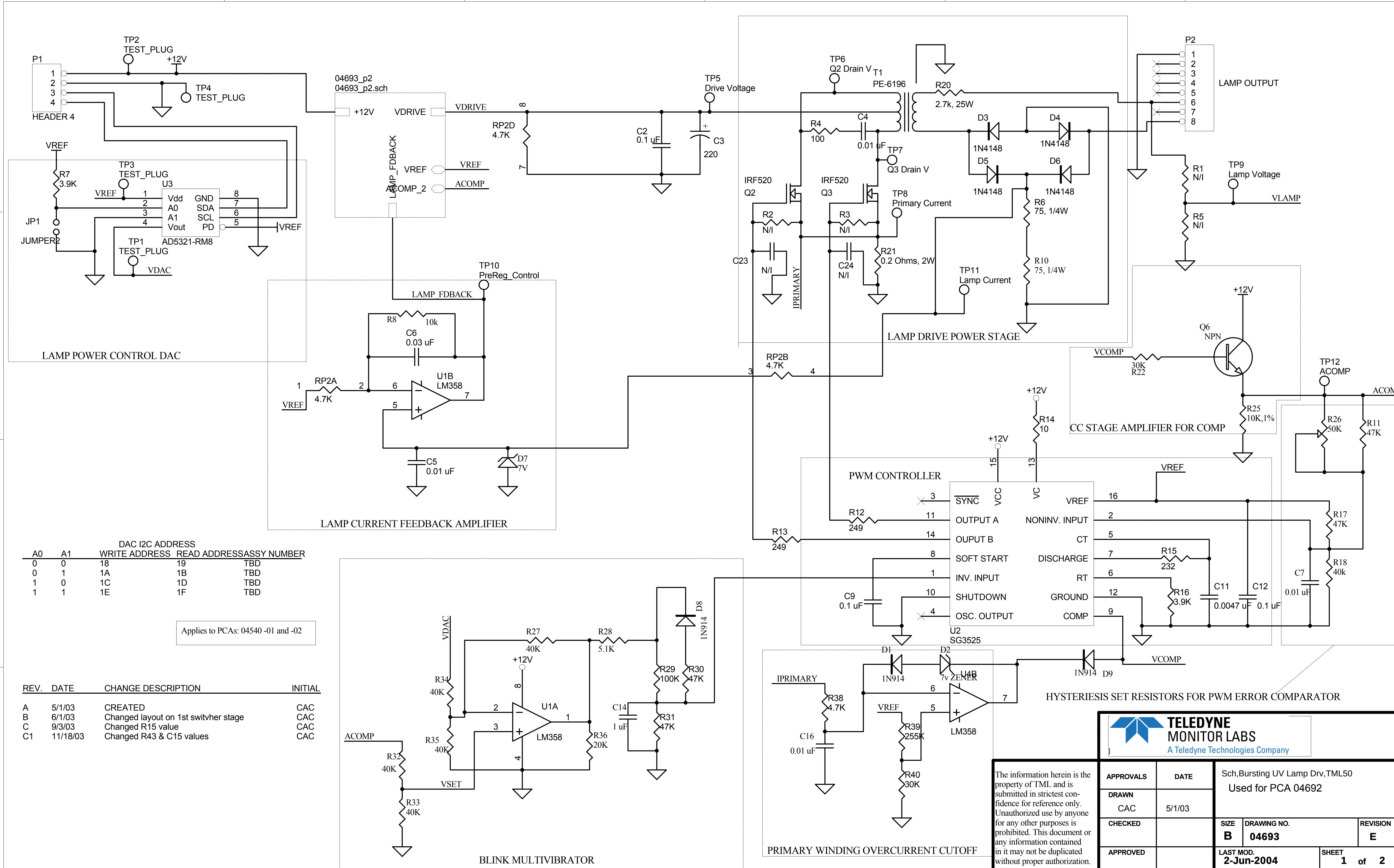
CONTRACT NO.

APPROVALS	DATE
DRAWN	
CHECKED	

REFERENCE DETECTOR PREAMP

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B		01312	G

SCALE SHEET 1 OF 1



DAC I2C ADDRESS

A0	A1	WRITE ADDRESS	READ ADDRESS	ASSY NUMBER
0	0	18	19	TBD
0	1	1A	1B	TBD
1	0	1C	1D	TBD
1	1	1E	1F	TBD

Applies to PCAs: 04540 -01 and -02

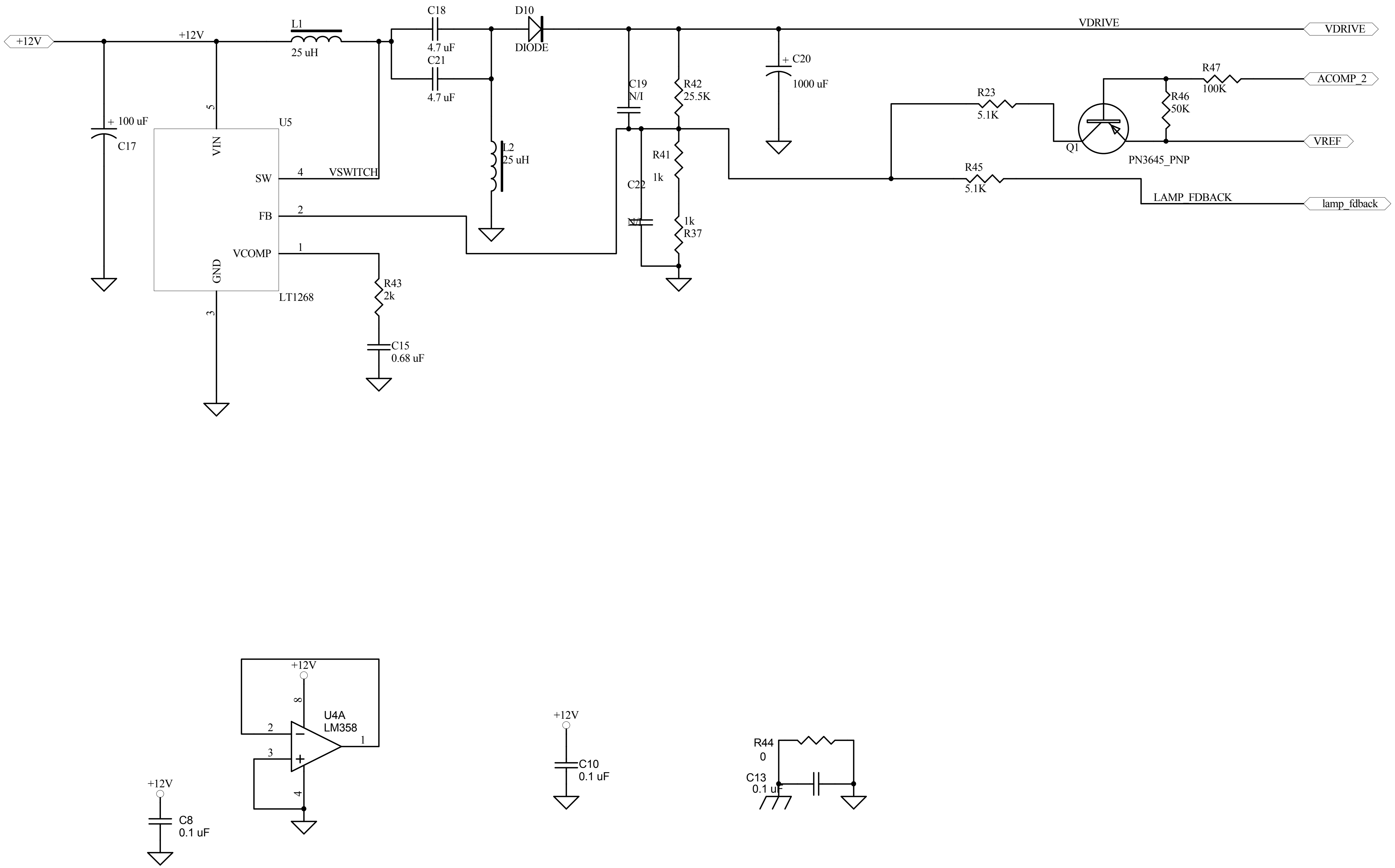
REV.	DATE	CHANGE DESCRIPTION	INITIAL
A	5/1/03	CREATED	CAC
B	6/1/03	Changed layout on 1st switvher stage	CAC
C	9/3/03	Changed R15 value	CAC
C1	11/18/03	Changed R43 & C15 values	CAC

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

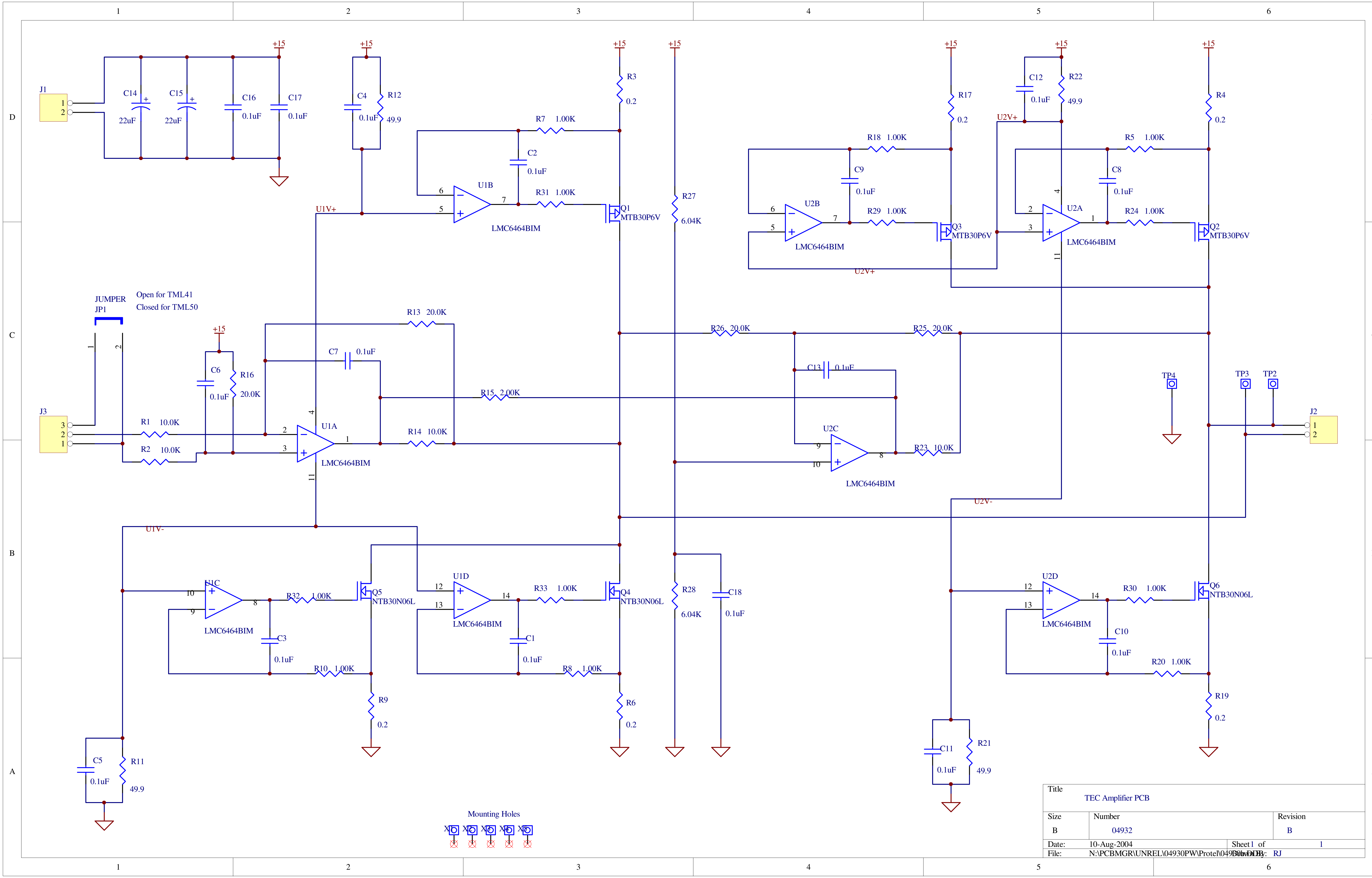
APPROVALS	DATE
DRAWN CAC	5/1/03
CHECKED	
APPROVED	

Sch,Bursting UV Lamp Drv,TML50
Used for PCA 04692

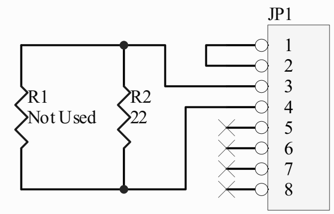
SIZE: B — DRAWING NO.: 04693 — REVISION: E
LAST MOD.: 2-Jun-2004 — SHEET 1 of 2



Title	Sch, Bursting UV Lamp Drv, TML50	
Size B	Number 04693	Revision E
Date: 2-Jun-2004	Sheet 2 of 2	
File: N:\PCBMGR\RELEASED\04691CC\source\04693.Ddb	Drawn By:	



J1
C14 22uF
C15 22uF
C16 0.1uF
C17 0.1uF
+15
C4 0.1uF
R12 49.9
R3 0.2
R7 1.00K
C2 0.1uF
U1B
R31 1.00K
Q1 MTB30P6V
LMC6464BIM
U1V+
R27 6.04K
R17 0.2
C12 0.1uF
R22 49.9
U2V+
R4 0.2
R18 1.00K
C9 0.1uF
U2B
R29 1.00K
Q3 MTB30P6V
R5 1.00K
C8 0.1uF
U2A
R24 1.00K
Q2 MTB30P6V
JUMPER
JP1
Open for TML41
Closed for TML50
R13 20.0K
C7 0.1uF
C6 0.1uF
R16 20.0K
R26 20.0K
R25 20.0K
C13 0.1uF
R15 2.00K
TP4
TP3
TP2
J3
R1 10.0K
R2 10.0K
U1A
R14 10.0K
U2C
R23 10.0K
J2
U2V-
U1V-
U1C
R32 1.00K
Q5 NTB30N06L
U1D
R33 1.00K
Q4 NTB30N06L
R28 6.04K
C18 0.1uF
U2D
R30 1.00K
Q6 NTB30N06L
C3 0.1uF
R10 1.00K
C1 0.1uF
R8 1.00K
C10 0.1uF
R20 1.00K
R9 0.2
R6 0.2
R19 0.2
C11 0.1uF
R21 49.9
C5 0.1uF
R11 49.9
Mounting Holes
Title
TEC Amplifier PCB
Size B
Number 04932
Revision B
Date: 10-Aug-2004
Sheet 1 of 1
File: N:\PCBMGR\UNREL\04930PW\Protel\04930.DDB
Drawn By: RJ



Title: SCH, E-Series Analog Output Isolator, PCA 04467		
Size: A	Number: 04468	Revision: B
Date: 6/28/2004		Sheet of
File: N:\PCBMGR\..\04468B.sch		Drawn By: