

**RELAY PCA
PN 04523
INSTRUCTION MANUAL**

***Addendum to TML41/41M/41H,
TML50/50M, TML60, & TML87
Instruction Manuals***



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SAFETY MESSAGES

For general safety information, please refer to your TML41/M/H, TML50/H, TML60, TML87 instruction manual.



CAUTION

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



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 your TML41/M/H, TML50/H, TML60, TML87 instruction manual for more information on preventing ESD damage.

NOTE

Technical Assistance regarding the use and maintenance of any Teledyne Instruments products can be obtained by:

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1. INTRODUCTION

This addendum documents a recent upgrade to the relay card installed in some of the TML50 and TML41 series analyzers. A new relay PCA design, P/N 04523 replaces P/N 03955 and all of its versions in the following instruments.

It also corrects several errors related to the function of the relay PCA.

Table 1-1: List of Analyzers Using New Relay PCA P/N 04523

PRODUCT FAMILY	MODEL	RELAY PCA VERSION ¹
		045230200
UV Fluorescence	TML50	✓
	TML50H	✓
	TML87	✓
	TML60	✓
Chemiluminescence	TML41	✓
	TML41H	✓
	TML41M	✓
¹ See Sections 1.3.1 and 1.3.2		

For those instruments, the information included in this addendum supersedes the information related to the relay PCA that appears in the chapters on Theory of Operation and Troubleshooting & Repair of your TML41/M/H, TML50/H, TML60, TML87 instruction manuals.

Because the instruction manual for each model family is slightly different there is no direct correspondence between the sections and chapters of this addendum and those of the manual.

1.1. What's the Same

In most respects the electronic operation of the **Relay PCA 04523** is the same as Relay PCA 03955.

- Both are used by the CPU to operate various AC and DC heaters that control the temperature of key components of the analyzers to such as sensor modules, reaction cells and converters as well as certain optional components such as IZS permeation tubes.

In both cases a set of configuration jumpers located on the relay card is used to configure the heaters for 110 VAC, 60 Hz vs. 230 VAC, 50 Hz operation.

- Both Relay cards, based on commands from the CPU received over the I²C bus, energize/de-energize the various solenoid valves used to control the sample gas path of the analyzers (e.g. reference/measure valves; zero-span-cal valve options; IZS options; etc.)
- Both distribute the AC and DC power to the various electrically powered components and assemblies for the instrument.
- Both include a special watchdog circuit that automatically shut off all valves as well as turn off the UV Source(s) and all heaters should either the CPU cease issuing commands or the I²C bus fail. In both cases the sample pump will continue to run.

1.2. What's Different

The major differences between the **Relay PCA 04523** and Relay PCA 03955 are:

- On instruments with internal pumps, the pump is now configured for use with 110 VAC, 60 Hz vs. 220 VAC, 50 Hz operation by a set of configuration jumpers on the Relay PCA. Previously a set of inline connectors and wiring harnesses performed this function.
- The configurability of the two thermocouple inputs has been expanded to allow for both grounded and ungrounded thermocouples
- A retainer plate has been added to the 045230200 version to keep the solid state AC power relays securely inserted in their sockets.
- Because the board has been physically changed, locations of components such as jumper blocks, connectors and status LED's have changed.

1.3. Relay PCA Location and Layout

Generally the relay PCA is located in the right-rear quadrant of the analyzer and is mounted vertically on the back side of the same bracket as the instrument's DC power supplies, however the exact location of the relay PCA may differ from model to model. Please check the Getting Started chapter of your TML41/M/H, TML50/H, TML60, TML87 instruction manual.

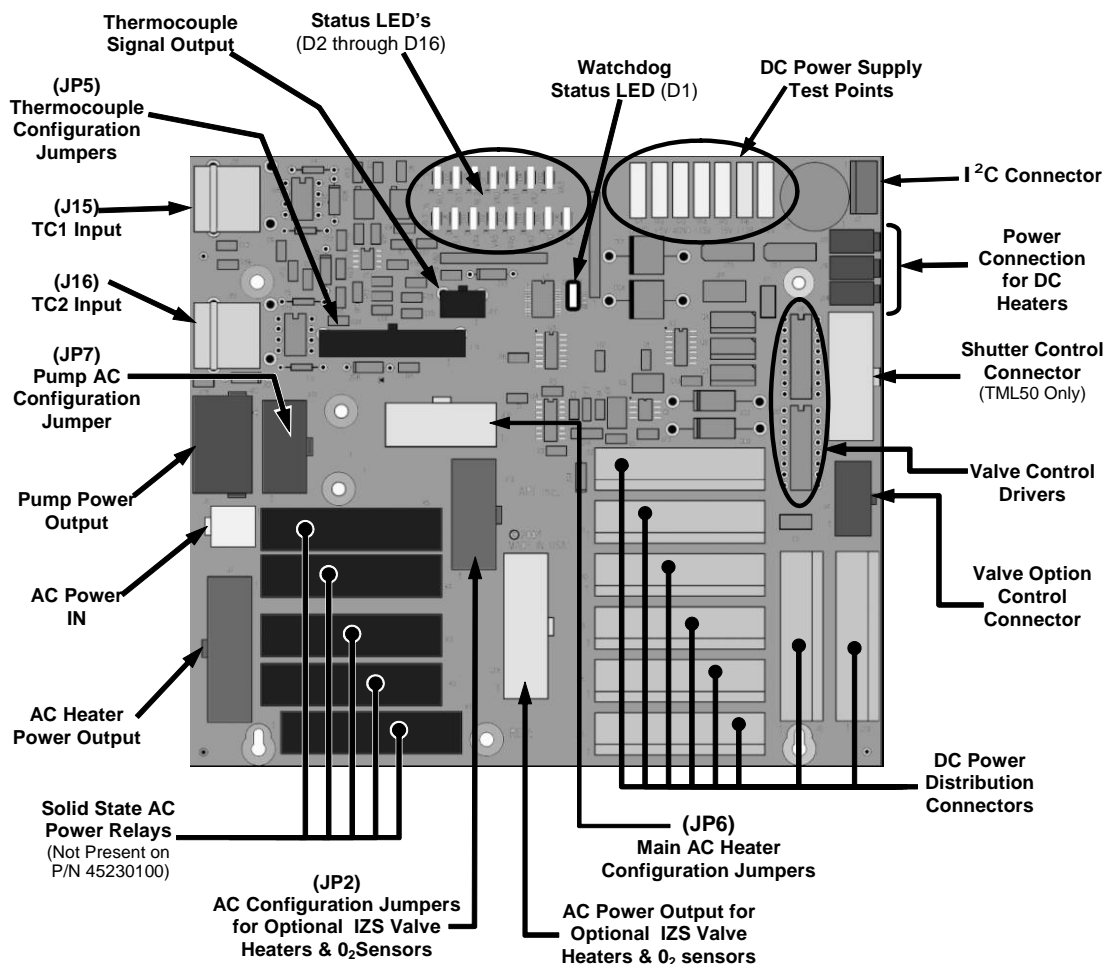


Figure 1-1: Relay PCA Layout (P/N 04523)

There are two versions of the new relay card. Table 1-1 above cross references the PCA version with the various analyzer models.

1.3.1. Version 045230200

This is the most commonly used version of the Relay PCA. It includes a bank of solid state AC relays. This version is installed in analyzers where components such as AC powered heaters must be turned ON & OFF. A retainer plate is installed over the relay to keep them securely seated in their sockets.

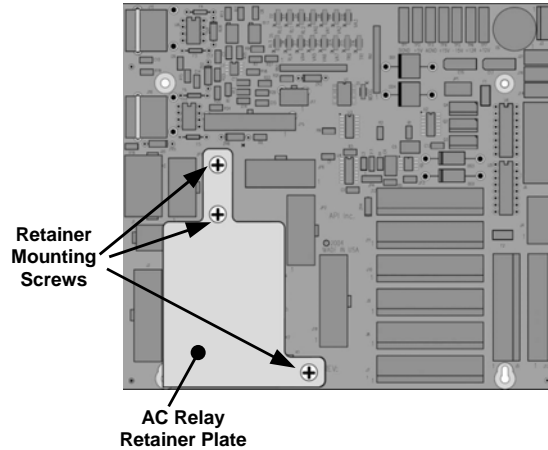


Figure 1-2: Relay PCA P/N 045230200 with AC Relay Retainer In Place

1.3.2. Version 045230100

This is the base version of the Relay PCA. It does not include the AC relays and is used in instruments where there are no AC powered components requiring control. A plastic insulating safety shield covers the empty AC Relay sockets (See Figure 1-3)

	<p style="text-align: center;">CAUTION</p> <p>Never remove this safety shield while the instrument is plugged in and turned on. The contacts of the AC relay sockets beneath the shield carry high AC voltages even when no relays are present.</p>
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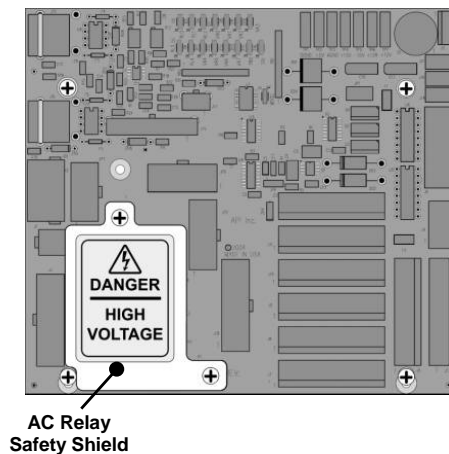


Figure 1-3: Relay PCA P/N 045230100 with Safety Shield In Place

USER NOTES:

2. OPERATION AND CONFIGURATION

2.1. Power Distribution

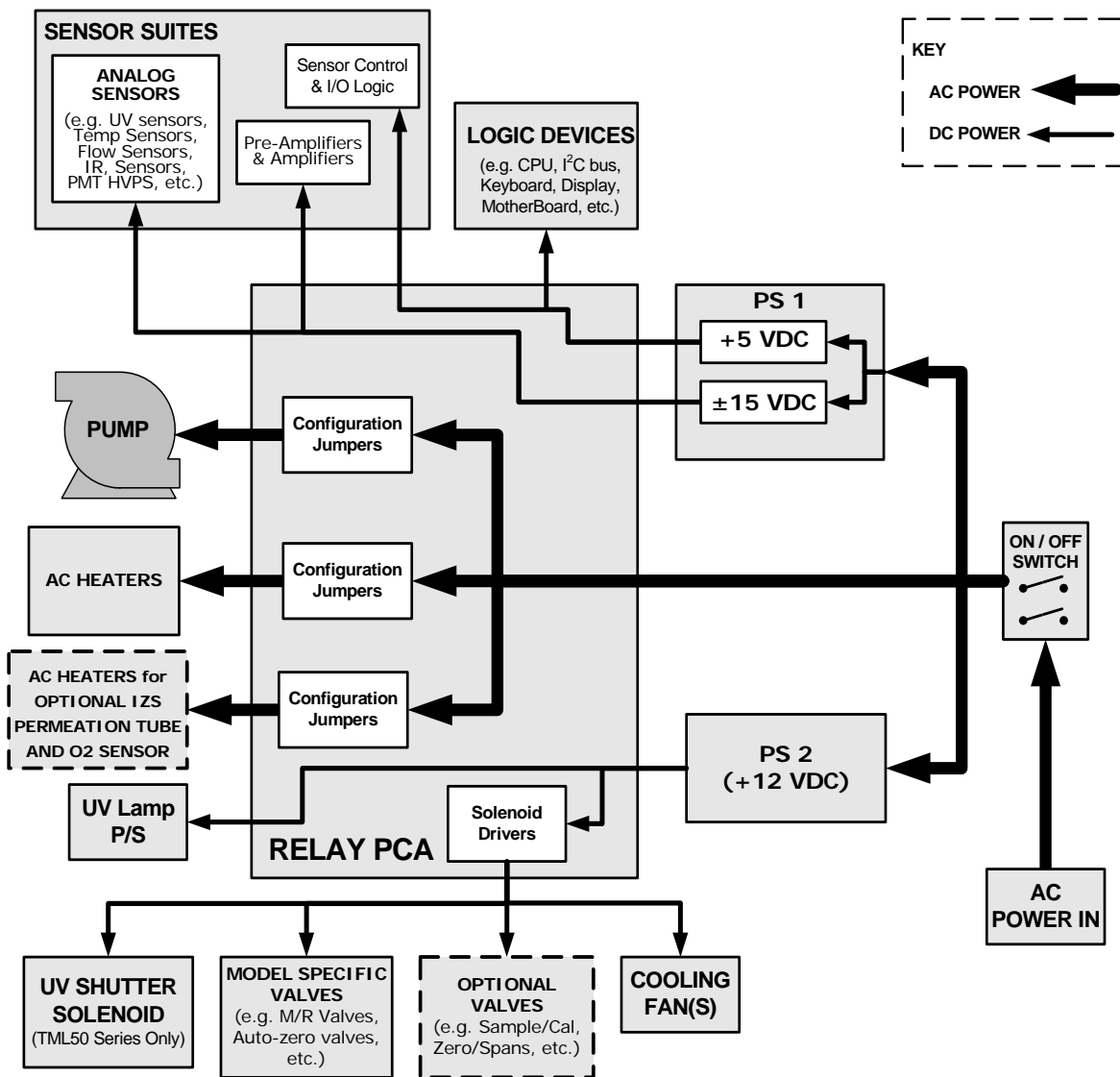


Figure 2-1: Power Distribution Block Diagram

2.1.1. AC Power Configuration

The digital electronic systems will operate with any of the specified power regimes. As long as instrument is connected to 100-120 VAC or 220-240 VAC at either 50 or 60 Hz it will turn on and after about 30 seconds show a front panel display. Internally, the status LEDs located on the Relay PCA, Motherboard and CPU should turn on as soon as the power is supplied.

On the other hand, some of the analyzer's non-digital components, such as the pump and the various AC powered heaters must be properly configured for the type of power being supplied to the instrument. Figure 2-3 shows the location of the various sets of AC Configuration jumpers.

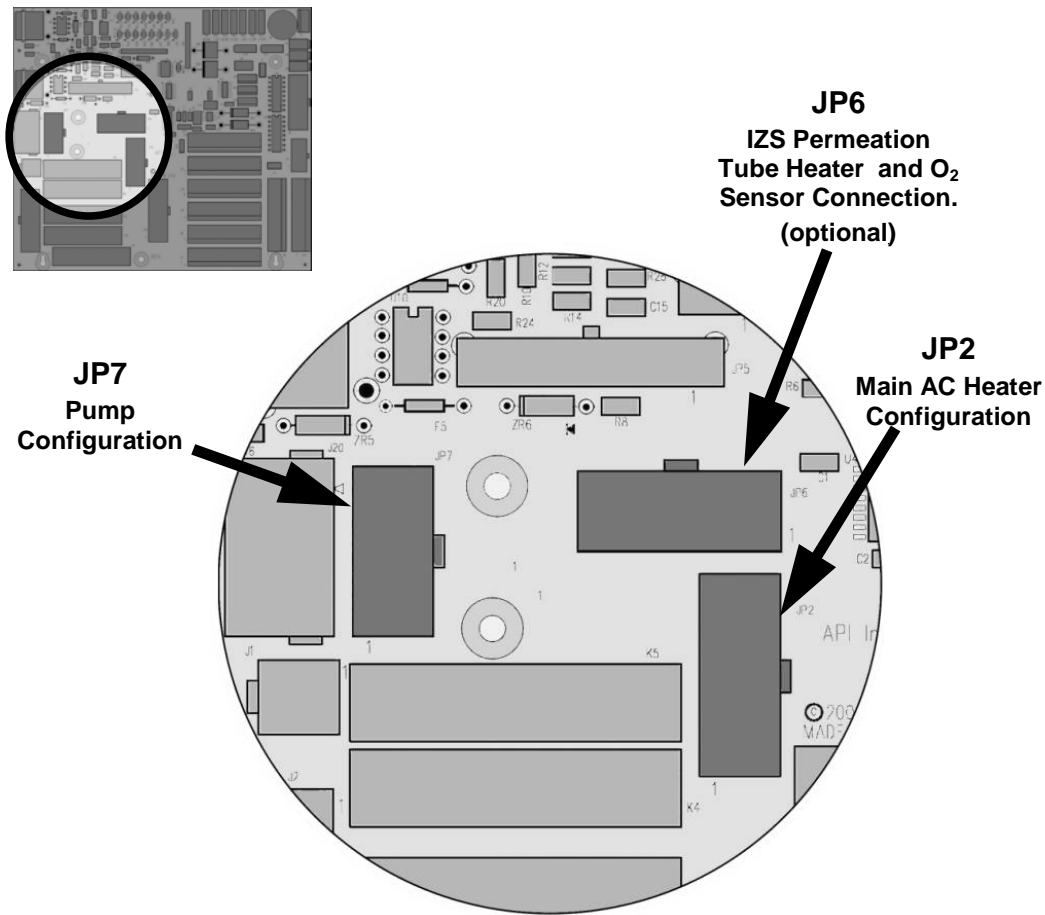


Figure 2-2: Location of AC power Configuration Jumpers

There are several changes between the **Relay PCA 04523** and previous version regarding AC power configuration and distribution.

- Previously, in analyzer models with internal pumps, the AC power for the pump came directly from the instrument back panel. The 04523 version handles all AC and DC power distribution including power to the pump.
- Prior to this change, configuring the pump for compatibility with various line voltages and frequencies was done with a set of hard-wired, in-line connections. The **Relay PCA 04523** now includes a set of jumpers that perform this function. This change increases reliability and simplifies troubleshooting and repair operations.
- The **Relay PCA 04523** includes a set of jumpers that connect AC power to heaters included in several optional items, such as the IZS valve option and the O₂ sensor option available on the TML41 and TML50 series instruments. In earlier versions of the relay PCA this was also handled by in-line connections.

2.1.1.1. AC configuration – Internal Pump (JP7)

AC power configuration for internal pumps is set using Jumper set JP7 (see Figure 1-1 for the location of JP7).

Table 2-1: AC Power Configuration for Internal Pumps (JP7)

LINE POWER	LINE FREQUENCY	JUMPER COLOR	FUNCTION	JUMPER BETWEEN PINS
110VAC 115 VAC	60 HZ	WHITE	Connects pump pin 3 to 110 / 115 VAC power line	2 to 7
			Connects pump pin 3 to 110 / 115 VAC power line	3 to 8
			Connects pump pins 2 & 4 to Neutral	4 to 9
	50 HZ ¹	BLACK	Connects pump pin 3 to 110 / 115 VAC power line	2 to 7
			Connects pump pin 3 to 110 / 115 VAC power line	3 to 8
			Connects pump pins 2 & 4 to Neutral	4 to 9
220VAC 240 VAC	60 HZ	BROWN	Connects pump pins 3 and 4 together	1 to 6
			Connects pump pin 1 to 220 / 240VAC power line	3 to 8
	50 HZ ¹	BLUE	Connects pump pins 3 and 4 together	1 to 6
			Connects pump pin 1 to 220 / 240VAC power line	3 to 8

¹ A jumper between pins 5 and 10 may be present on the jumper plug assembly, but is only functional on the TML30 and has no function on the Models TML41 or TML50.

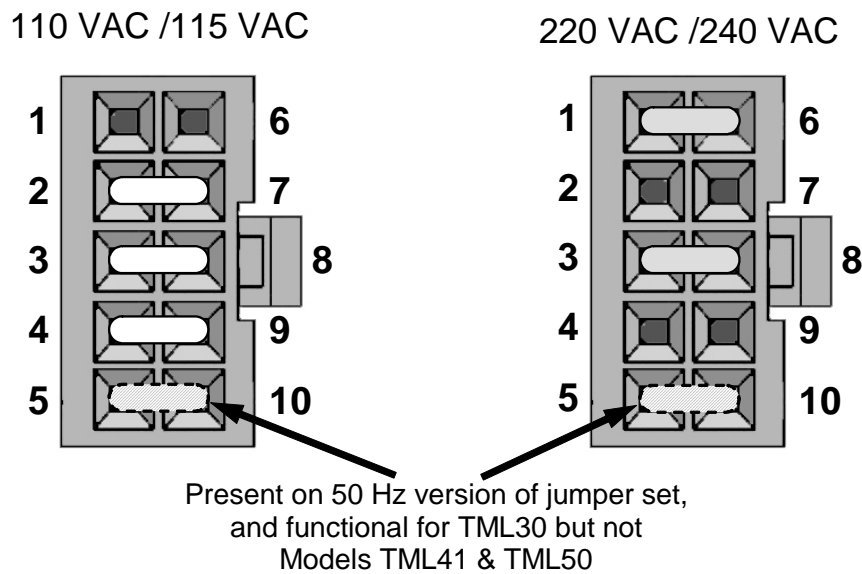


Figure 2-3: Pump AC Power Jumpers (JP7)

2.1.1.2. AC Configuration – Standard Heaters (JP2)

Power configuration for the AC standard heaters is set using Jumper set JP2 (see Figure 1-1 for the location of JP2).

Table 2-2: Power Configuration for Standard AC Heaters (JP2)

LINE VOLTAGE	JUMPER COLOR	HEATER(S)	MODEL'S USED ON	JUMPER BETWEEN PINS	FUNCTION
110 VAC / 115 VAC 50Hz & 60 Hz	WHITE	Reaction Cell / Sample Chamber Heaters	TML41 & TML50	1 to 8	Common
				2 to 7	Neutral to Load
		Mini Hi-Con Converter	TML41H	3 to 10	Common
				4 to 9	Neutral to Load
		Moly Converter	TML41 and TML87	3 to 10	Common
				4 to 9	Neutral to Load
Bypass Manifold	TML41M & TML41H	5 to 12	Common		
		6 to 11	Neutral to Load		
220 VAC / 240 VAC 50Hz & 60 Hz	BLUE	Reaction Cell / Sample Chamber Heaters	TML41 & TML50	1 to 7	Load
		Hi Concentration Converter	TML50H	3 to 9	Load
		Moly Converter	TML87 and TML41	3 to 9	Load
		Bypass Manifold	TML41M & TML41H	5 to 11	Load

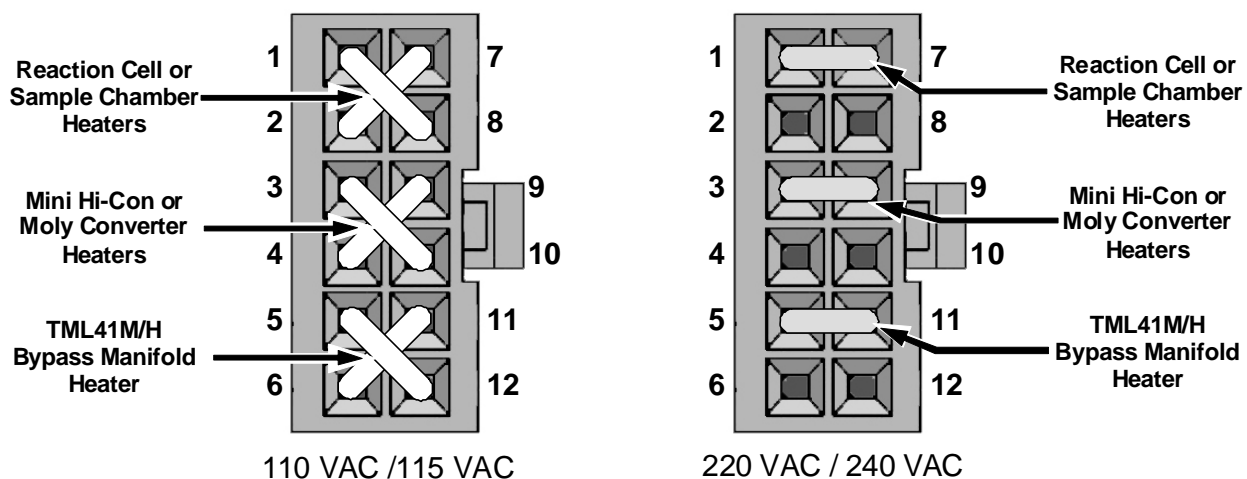


Figure 2-4: Typical Set Up of AC Heater Jumper Set (JP2)

2.1.1.3. AC Configuration –Heaters for Option Packages (JP6)

Both the IZS valve option and the O₂ sensor options include AC heaters that maintain an optimum operating temperature for key components of those options. Jumper set JP6 is used to connect the heaters associated with those options to AC power. Since these heaters work with either 110/155 VAC or 220/240 VAC, there is only one jumper configuration.

Table 2-3: Power Configuration for Optional AC Heaters (JP6)

JUMPER COLOR	HEATER(S)	MODEL'S USED ON	JUMPER BETWEEN PINS	FUNCTION
RED	IZS Permeation Tube Heater	TML41 & TML50	1 to 8	Common
			2 to 7	Neutral to Load
	O2 Sensor Heater	TML41 & TML50	3 to 10	Common
			4 to 9	Neutral to Load

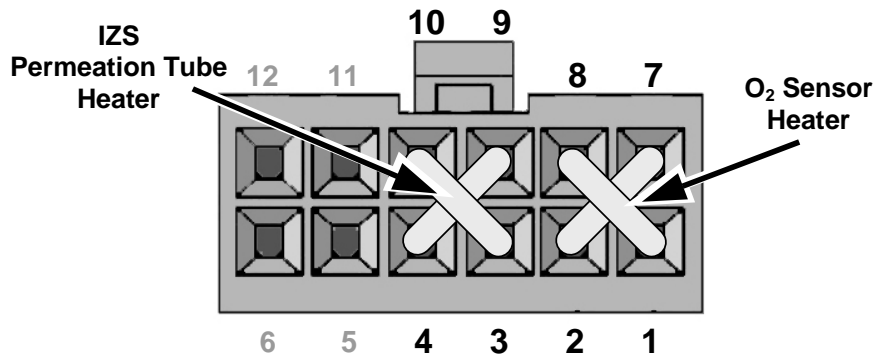


Figure 2-5: Typical Set Up of AC Heater Jumper Set (JP6)

2.2. Valve Control

Other than the location of the connectors and control chips on the PCA (see Figure 1-1 above), there have been no significant changes to the method by which the instruments' various valves and valve options are controlled.

2.3. Status LEDs & Watch Dog Circuitry

Like the previous version, the status LED's on the **Relay PCA 04523** includes thirteen LEDs that indicate the status of the analyzer's heaters, valves and other general operating conditions. Since the functions represented by these LED differ from model to model, check your TML41/M/H, TML50/H, TML60, TML87 instruction manual for their exact assignments (this can normally be found in the section on Electronic Theory of Operation).

While the functional assignments for the LED's of each model have remained unchanged their location on the PCA is different. See Figure 2-3 of this addendum for the new locations.

2.3.1. Watchdog Indicator (D1)

The most important of the status LED's on the relay board is the red I²C Bus watch-dog LED. It is controlled directly analyzer's CPU over the I²C bus. Special circuitry on the relay PCA watches the status of D1. Should this LED ever stay ON or OFF for 30 seconds, indicating that the CPU or I²C bus has stopped functioning, this Watchdog Circuit automatically shuts all valves and turns off all heaters and lamps.

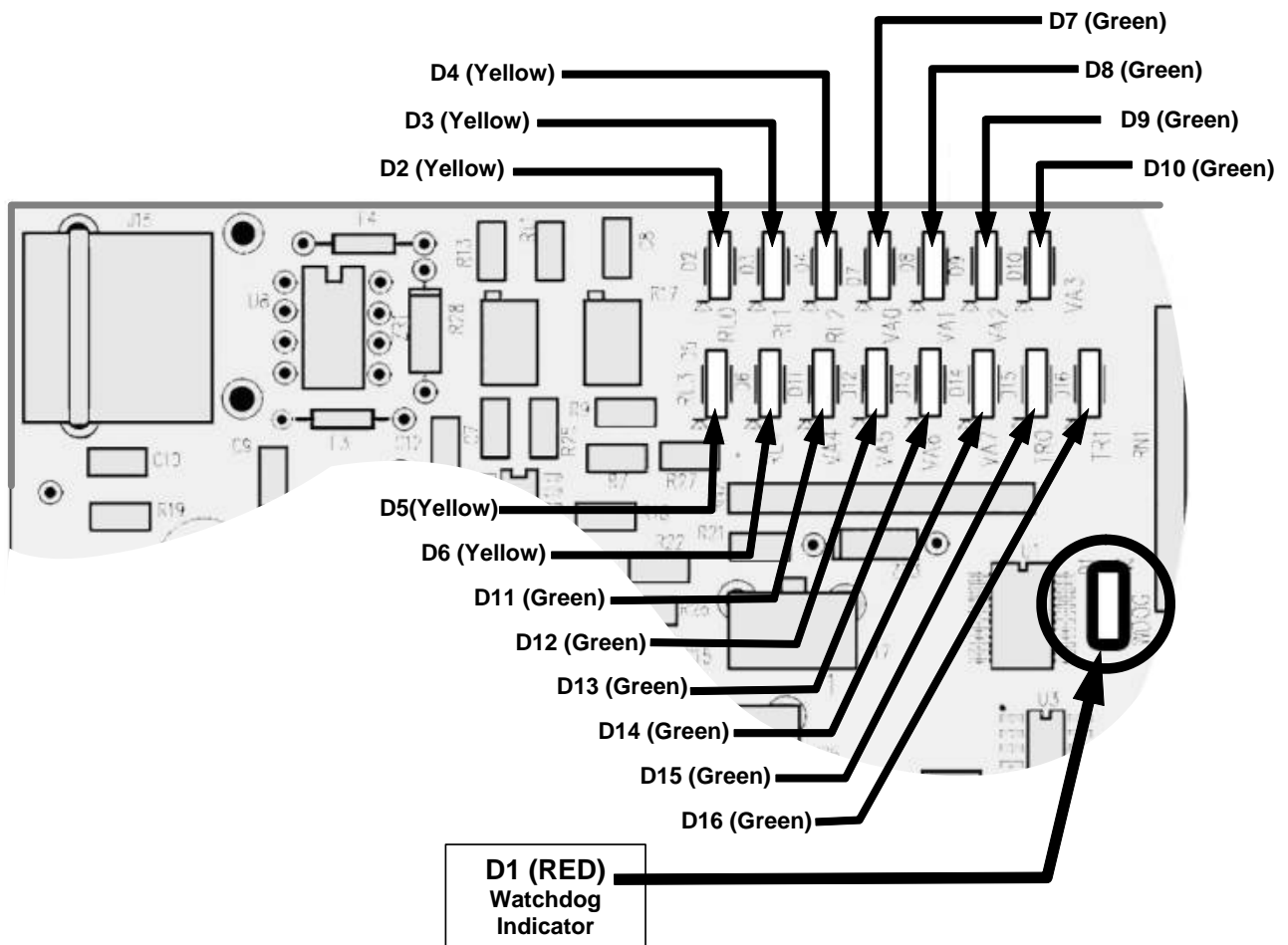


Figure 2-6: Status LED Locations – Relay PCA 04523

2.4. Heater Control Loop

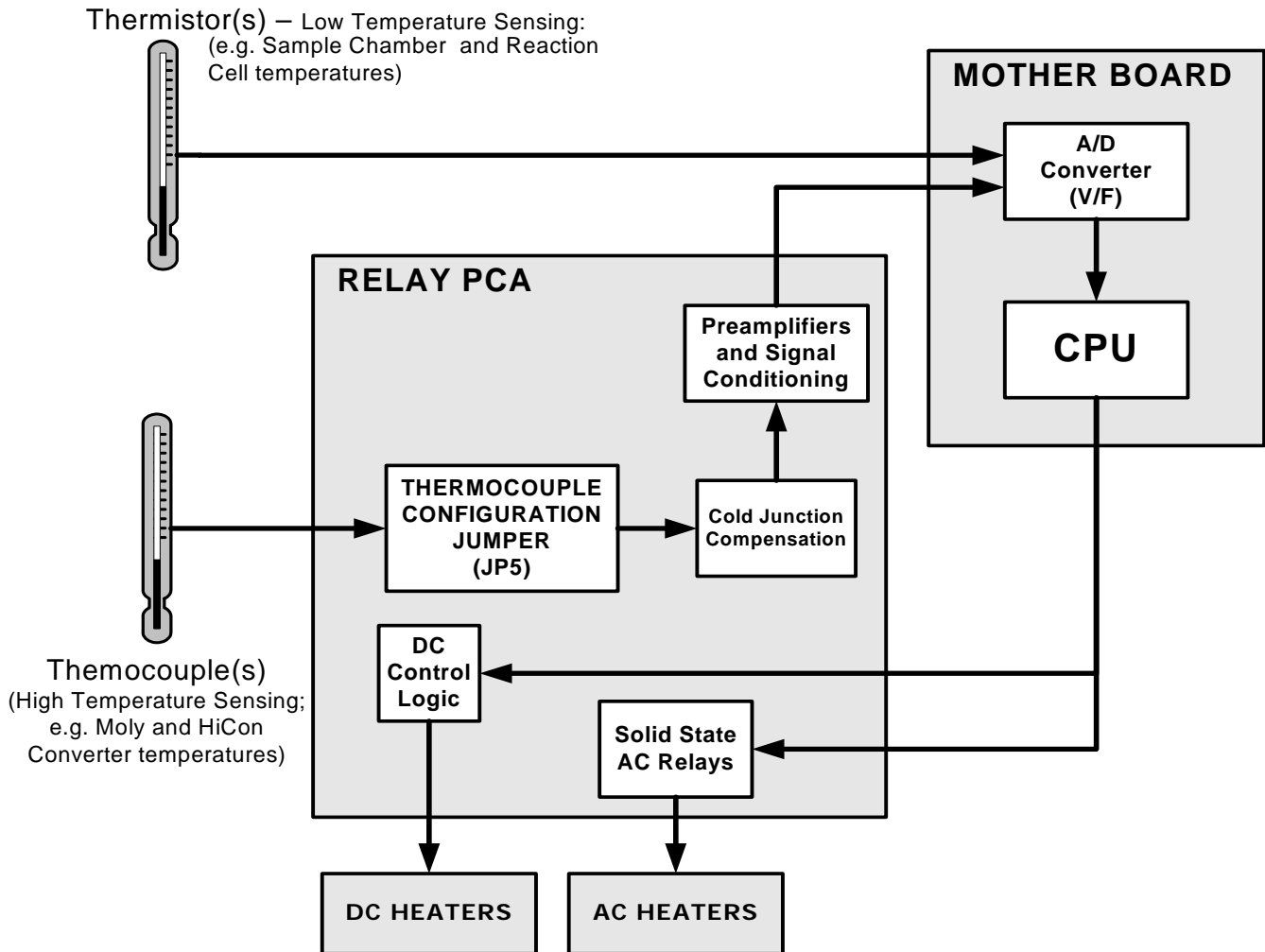


Figure 2-7: Heater Control Loop Block Diagram.

While the role of the heater control loop for the analyzers is basically unchanged from the previous version (see Figure 2-4), the configurability of the Thermocouple inputs has been enhanced. Previously, the two T/C inputs could be configured for either type-T or type-K thermocouples. The 04523 relay PCA adds the following.

- Both T/Cs can now be configured as either grounded or ungrounded thermocouples.
- Standard configuration for both types of thermocouples is 10 mV/°C. In order to accommodate the TML41H's Mini High-Con converter option, a type-K; 5mV/°C output configuration has been added.

2.4.1. Thermocouple Inputs and Configuration Jumper (JP5)

Although the 04523 relay PCA supports two thermocouple inputs, the current TML50/TML41 series analyzers only utilize one. By default, this single thermocouple input is plugged into the TC1 input (J15). TC2 (J16) is currently not used. See Figure 1-1 for location of J15 and J16

Table 2-4: Thermocouple Configuration Jumper (JP5) Pin-Outs

TC INPUT	JUMPER PAIR	DESCRIPTION	FUNCTION
TC1	1 – 11	Gain Selector	Selects preamp gain factor for J or K TC - IN = J TC gain factor - OUT = K TC gain factor
	2 – 12	Output Scale Selector	Selects preamp gain factor for J or K TC - IN = 5 mV / °C - OUT = 10 mV / °C
	3 – 13	Type J Compensation	When present, sets Cold Junction Compensation for J type Thermocouple
	4 – 14	Type K Compensation	When present, sets Cold Junction Compensation for K type Thermocouple
	5 – 15	Termination Selector	Selects between Isolated and grounded TC - IN = Isolate TC - OUT = Grounded TC
TC2	6 – 16	Gain Selector	Same as Pins 1 – 11 above.
	7 – 17	Output Scale Selector	Same as Pins 2 – 12 above.
	8 – 18	Type J Compensation	Same as Pins 3 – 13 above.
	9 – 19	Type K Compensation	Same as Pins 4 – 14 above.
	10 – 20	Termination Selector	Same as Pins 5 – 15 above.

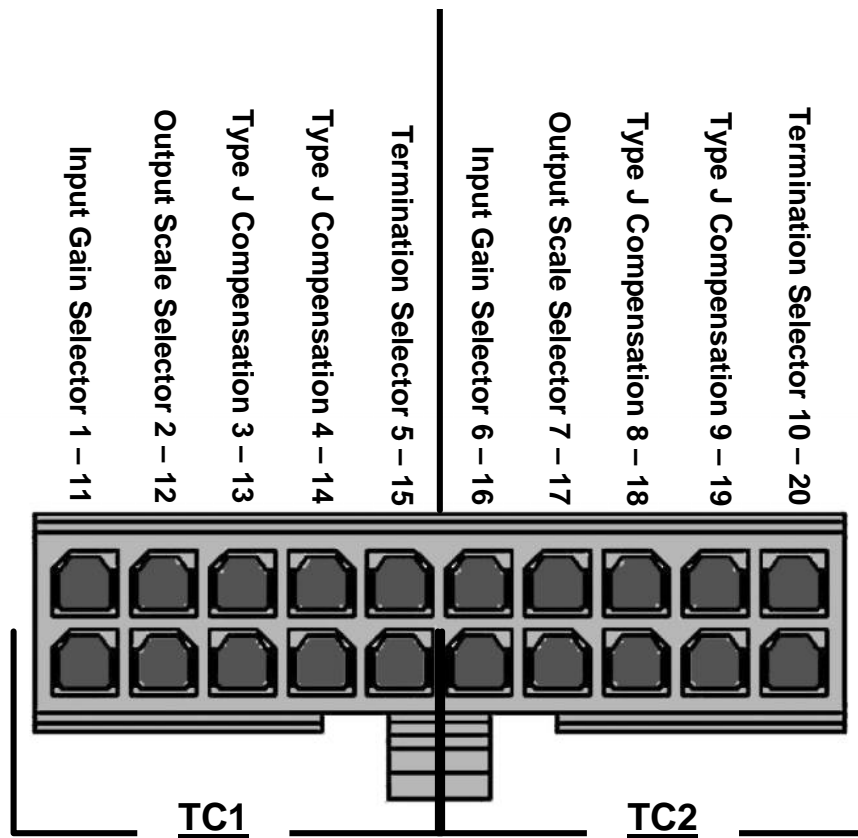


Figure 2-8: Thermocouple Configuration Jumper (JP5) Pin-Outs

Table 2-5: Typical Thermocouple Settings for TML41/TML50 series analyzers

TC TYPE	TERMINATION TYPE	OUTPUT SCALE TYPE	JUMPER BETWEEN PINS	USED ON	JUMPER COLOR
INPUT TC1 (J15)					
K	GROUND	5mV / °C	2 – 12 4 – 14	TML50H with Mini HiCon Converter	BROWN
K	ISOLATED	5mV / °C	2 – 12 4 – 14 5 – 15	TML50H with Mini HiCon Converter	GREY
K	ISOLATED	10mV / °C	4 – 14 5 – 15	TML41/TML50 with Moly Converter	PURPLE
J	ISOLATED	10mV / °C	1 – 11 3 – 13 5 – 15	TML41/TML50 with Moly Converter	RED
J	GROUND	10mV / °C	1 – 11 3 – 13	TML41/TML50 with Moly Converter	GREEN

2.5. DC Power Supply Test Points

The tables defining the names and functions of the DC power test point that appear in Chapter 11 of some revisions of the TML41/M/H, TML50/H, TML60, TML87 instruction manual are incorrect. The following tables show the correct information.

Table 2-6: DC Power Test Point and Wiring Color Code

NAME	TEST POINT#	COLOR	DEFINITION
DGND	1	Black	Digital ground
+5V	2	Red	
AGND	3	Green	Analog ground
+15V	4	Blue	
-15V	5	Yellow	
+12R	6	Purple	12 V return (ground) line
+12V	7	Orange	

Table 2-7: DC Power Supply Acceptable Levels

POWER SUPPLY	VOLTAGE	CHECK <u>RELAY</u> BOARD TEST POINTS				MIN V	MAX V
		FROM Test Point		TO Test Point			
		NAME	#	NAME	#		
PS1	+5	DGND	1	+5	2	+4.80	+5.25
PS1	+15	AGND	3	+15	4	+13.5	+16.0
PS1	-15	AGND	3	-15V	5	-14.0	-16.0
PS1	AGND	AGND	3	DGND	1	-0.05	+0.05
PS1	Chassis	DGND	1	Chassis	N/A	-0.05	+0.05
PS2	+12	+12V Ret	6	+12V	7	+11.8	+12.5
PS2	DGND	+12V Ret	6	DGND	1	-0.05	+0.05

As on the previous version of the relay card, the test points are located at the top, right-hand corner of the PCA (see Figure 1-1)

USER NOTES:

3. TROUBLESHOOTING AND REPAIR

General Trouble shooting hints for the relay PCA are the same as described for the previous versions for the PCA. See Chapter 11 of your TML41/M/H, TML50/H, TML60, TML87 instruction manual for more information.

3.1. Removing / Replacing the Relay PCA from the Instrument

The Relay retainer plate installed on the 045230200 PCA (version with AC relays) covers the lower right mounting screw of the relay PCA. Therefore, when removing the relay PCA, the retainer plate must be removed first.

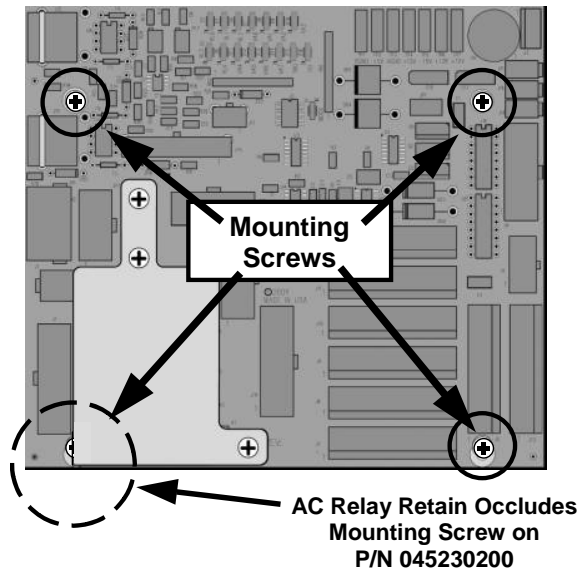


Figure 3-1: Relay PCA 04523 Mounting Screw Locations

USER NOTES:

4. SCHEMATICS AND SPARE PARTS FOR RELAY PCA P/N 04523

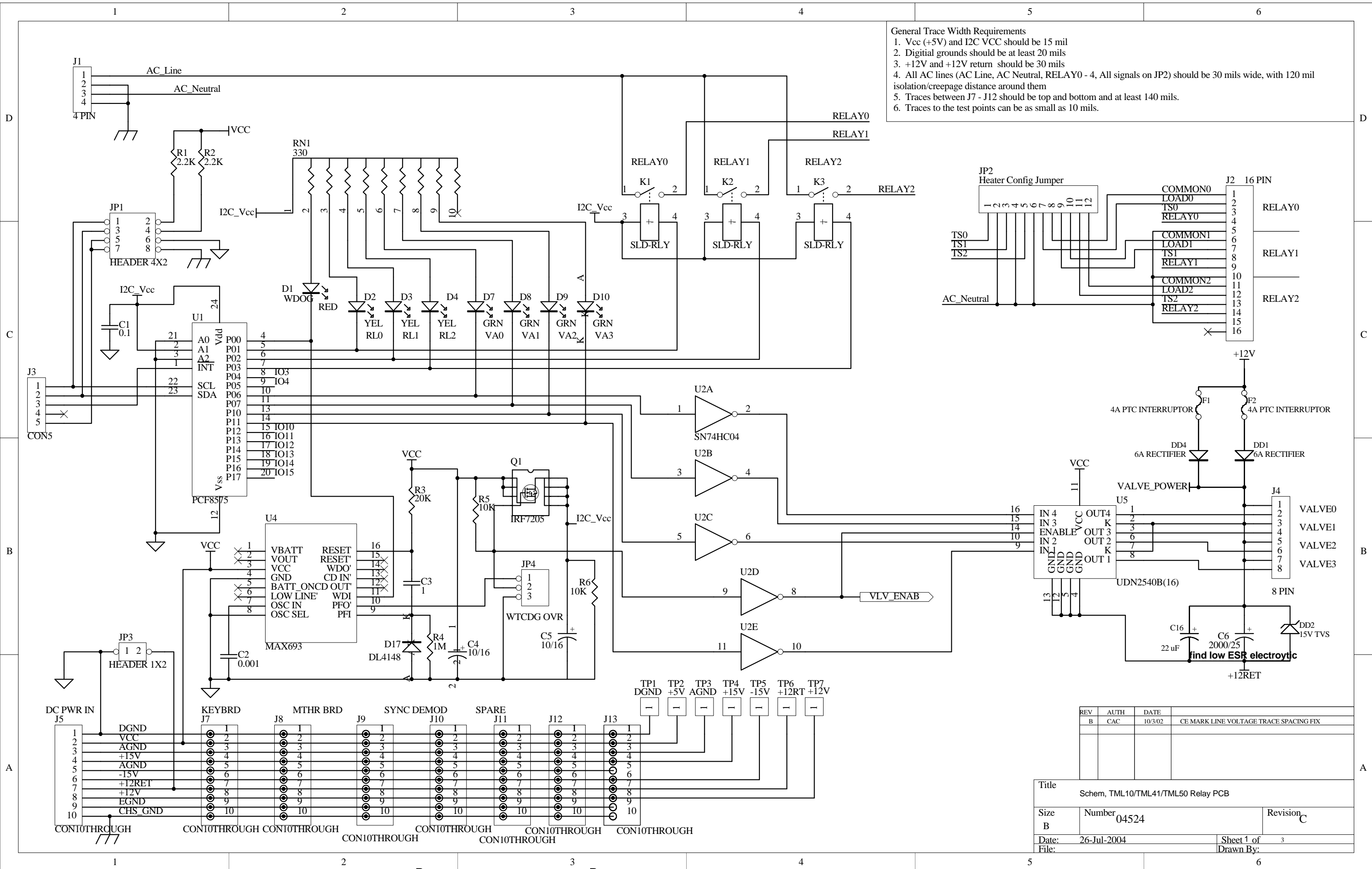
Table 4-1: List of Spare Parts

DOCUMENT #	DOCUMENT TITLE
RL0000015	Relay, DPDT, AC, Solid State, E-Series
041520500	Module, Relay PCA & Power Supply

Table 4-2: List of Included Electronic Schematics

DOCUMENT #	DOCUMENT TITLE
04524	PCA, 04523, TML50, TML41, M400E Relay PCB

USER NOTES:

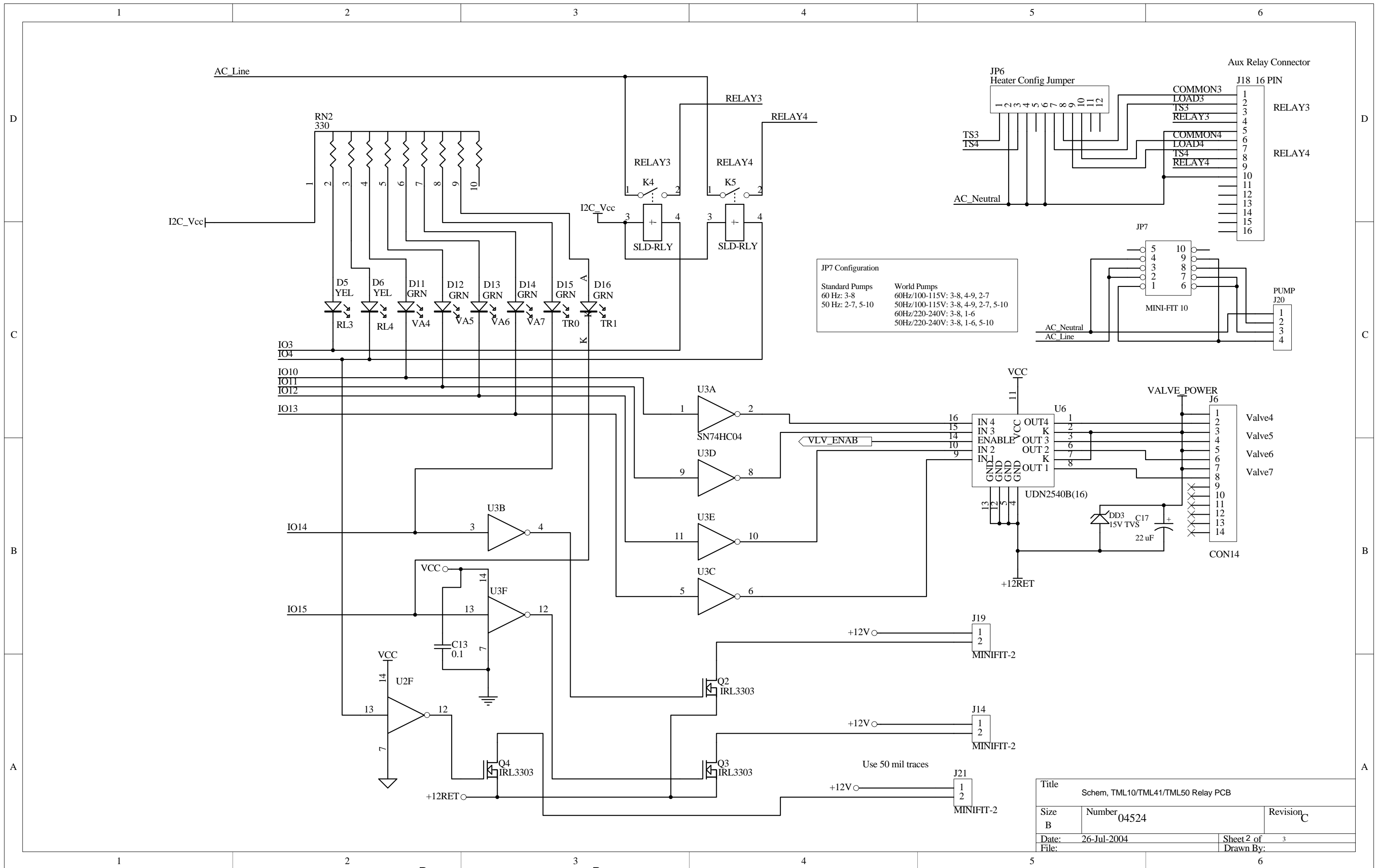


General Trace Width Requirements

1. Vcc (+5V) and I2C VCC should be 15 mil
2. Digital 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.

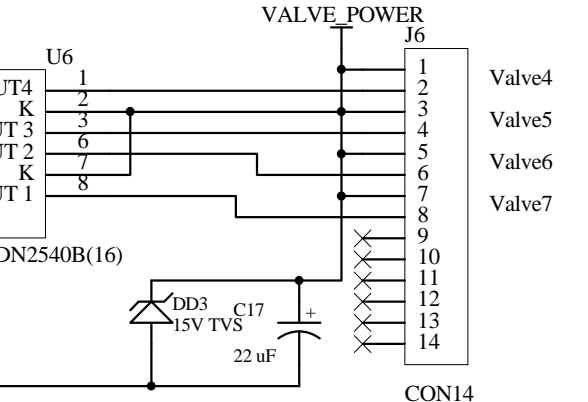
REV	AUTH	DATE	DESCRIPTION
B	CAC	10/3/02	CE MARK LINE VOLTAGE TRACE SPACING FIX

Title: Schem, TML10/TML41/TML50 Relay PCB		
Size: B	Number: 04524	Revision: C
Date: 26-Jul-2004	Sheet 1 of 3	
File:	Drawn By:	

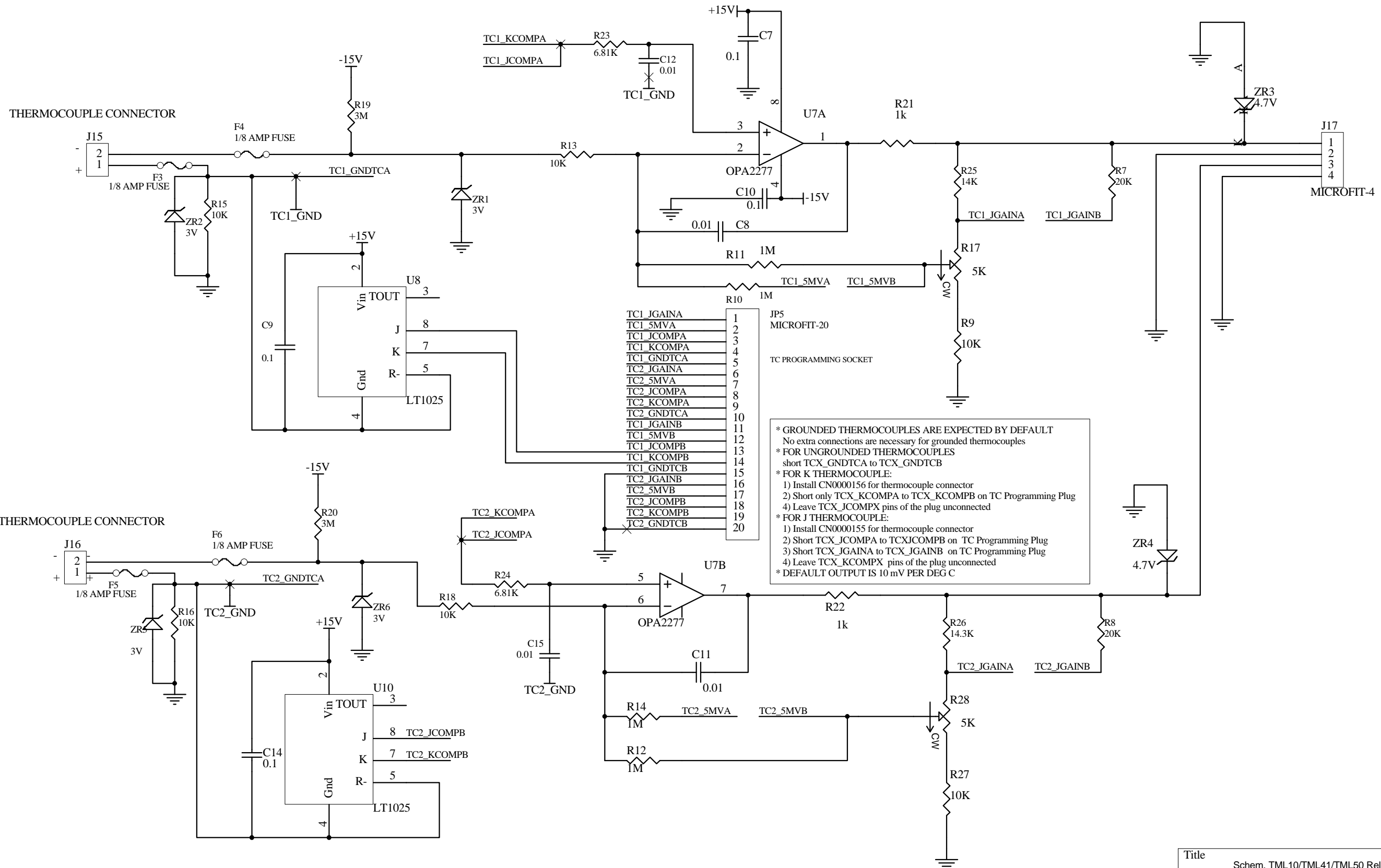


JP7 Configuration

Standard Pumps	World Pumps
60 Hz: 3-8	60Hz/100-115V: 3-8, 4-9, 2-7
50 Hz: 2-7, 5-10	50Hz/100-115V: 3-8, 4-9, 2-7, 5-10
	60Hz/220-240V: 3-8, 1-6
	50Hz/220-240V: 3-8, 1-6, 5-10



Title			Schem, TML10/TML41/TML50 Relay PCB		
Size	Number			Revision	
B	04524			C	
Date:	26-Jul-2004	Sheet 2 of 3		Drawn By:	
File:					



- 1 TC1_JGAINA
- 2 TC1_5MVA
- 3 TC1_JCOMPA
- 4 TC1_KCOMPA
- 5 TC1_GNDTCA
- 6 TC2_JGAINA
- 7 TC2_5MVA
- 8 TC2_JCOMPA
- 9 TC2_KCOMPA
- 10 TC2_GNDTCA
- 11 TC1_JGAINB
- 12 TC1_5MVB
- 13 TC1_JCOMPB
- 14 TC1_KCOMPB
- 15 TC1_GNDTCB
- 16 TC2_JGAINB
- 17 TC2_5MVB
- 18 TC2_JCOMPB
- 19 TC2_KCOMPB
- 20 TC2_GNDTCB

JP5
MICROFIT-20
TC PROGRAMMING SOCKET

* GROUNDED THERMOCOUPLES ARE EXPECTED BY DEFAULT
No extra connections are necessary for grounded thermocouples
* FOR UNGROUNDED THERMOCOUPLES
short TCX_GNDTCA to TCX_GNDTCB
* FOR K THERMOCOUPLE:
1) Install CN0000156 for thermocouple connector
2) Short only TCX_KCOMPA to TCX_KCOMPB on TC Programming Plug
3) Short TCX_JGAINA to TCX_JGAINB on TC Programming Plug
4) Leave TCX_KCOMPX pins of the plug unconnected
* FOR J THERMOCOUPLE:
1) Install CN0000155 for thermocouple connector
2) Short TCX_JCOMPA to TCX_JCOMPB on TC Programming Plug
3) Short TCX_JGAINA to TCX_JGAINB on TC Programming Plug
4) Leave TCX_KCOMPX pins of the plug unconnected
* DEFAULT OUTPUT IS 10 mV PER DEG C

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