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Introduction

The Quad-channel Thermo-Electric Cooler Control (Quad-TEC) Platform is a demonstration vehicle designed to demonstrate temperature control of four independent EDFA pump lasers with a single TMS320F28x DSP. It consists of a circuit board assembly and DSP software designed to control the temperature of four pump lasers. The electronics board contains a Digital Signal Processor (DSP), precision analog electronics to monitor the laser temperature, and efficient driver electronics to control the current through a thermo-electric cooler to maintain the laser temperature. It also has provisions to connect an external computer to monitor the control loop operation.

On this platform, the pump lasers are replaced with laser emulation units with thermal characteristics that match an actual pump laser. A resistor inside the butterfly package generates the heat that must be dissipated by the thermo-electric cooler.

The platform can be run either connected to a PC or as a stand-alone unit. When run as a stand-alone unit, the platform controls the laser temperatures to setpoints selected by jumpers. LED's indicate that the temperature is being controlled within 10 mK.

When attached to a PC, the setpoints can be individually varied and performance data measured and displayed. This document describes the steps to attach the demonstration platform to a personal computer and verify it has been connected properly by exercising the unit.

Contents of Evaluation Kit

Included in the Quad-TEC demonstration platform are:

- An electronics board
- An RS232 cable
- Board stand-offs
- A compact disc including documentation and software

Note that the power supply for the demonstration platform is not included in the kit. An Astrodyne SPU50-1 (5V, 10A, with 5-pin DIN connector) power supply is recommended.

Quad-TEC Platform Overview

A high-level diagram of the demonstration platform is shown in Figure 1. The host PC, running a command program supplied by TI, is attached to the electronics board via an RS232 (serial) cable. Commands from the PC are received by the DSP and the temperatures of the pump lasers are controlled by the DSP.

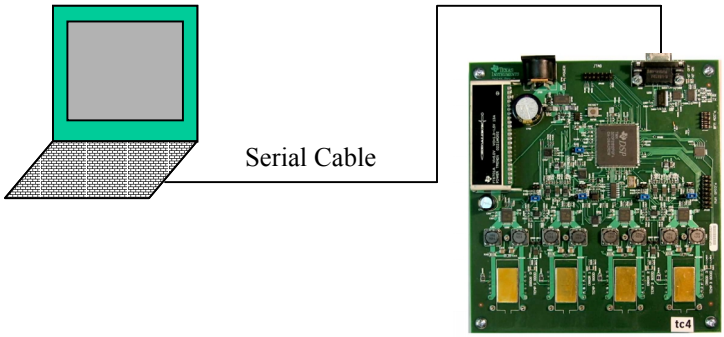

Figure 1. Typical connection of platform

Installing the Control Software

This section describes how to install the control software that communicates commands to the platform via the RS232 (serial) cable. The control software allows commands to be sent to the platform to monitor and control the temperature setpoint through an intuitive GUI interface. More details on the installation can be found in the "TEC Platform Software Installation Guide."

In this description, the CD is assumed to be the D: drive and your hard drive is assumed to be the C: drive. Substitute the drive letters for your CD and hard drives if they are not the D: and C: drives, respectively. The setup program is found in the CD's D:\GUI directory. The control software has been archived in a self-extracting ZIP format. To install the software, double-click the V1R2.EXE file in the D:\GUI directory. Unzip the files to this directory: **C:\TEC4X**. Several files will be copied into the specified directory.

If you do not have Matlab® Version 6.0 or later, you will also need to install the Matlab® libraries by double-clicking on the mgInstaller.exe file found in the CD's C:\TEC4X directory after unzipping. When asked, supply the same path as was used to install the GUI (C:\TEC4X). The mgInstaller program will install two subdirectory trees called BIN and TOOLBOX and place the necessary Matlab® library files (DLL's) in them.

Removing the Quad-TEC Platform from its Protective Packaging

The platform should be used in an ESD-safe environment. Remove the board from its static-safe bag while using an ESD wrist strap or equivalent protection. Attach the four stand-offs to the board at the four corners. Place the board on a static-safe work surface.

Connecting the Platform

The demonstration platform is connected to the PC using the serial cable provided. The serial cable is gray and has a 9-pin D-shell connector (one end male, the other female) on either end. Attach the male end of the cable to the D-shell connector on the platform board. The other female end is connected to the male connector on the PC. Note that you may have to remove the nuts on the end of the cable connected to the PC. Figure 2 shows the location of the RS-232 connector on the platform board.

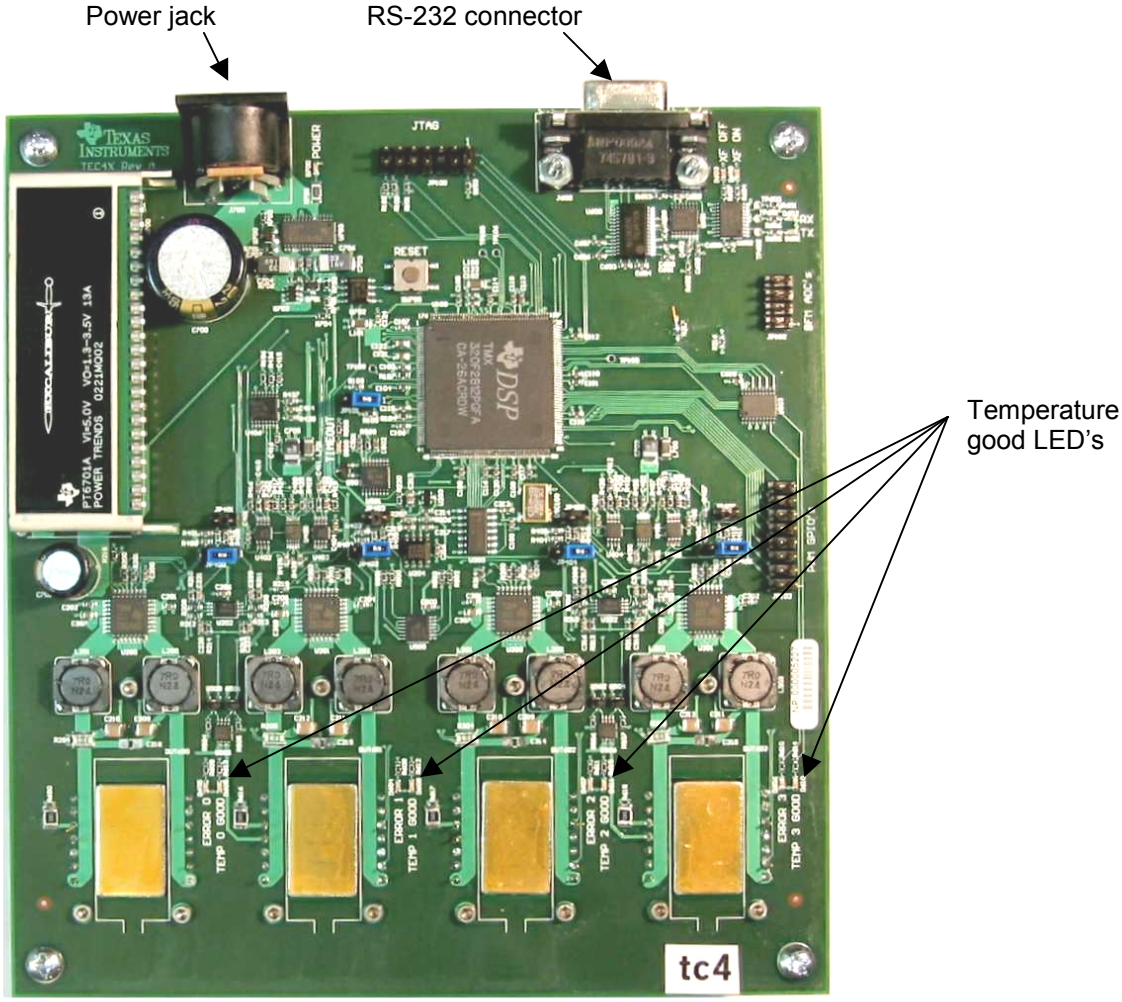

Figure 2. Location of RS232 and power connectors

Next, connect the 5V power supply (not included in the kit; use an Astrodyne SPU50-1 or equivalent) to the board and plug the power supply into a wall outlet. The location of the power supply jack is shown in Figure 2. If the power has been connected properly, the four "temperature in control" green LED's should light in sequence.

Establishing Connection between the PC and Demonstration Platform

The next step is to verify that commands can be sent between the PC and the board. After making certain that the evaluation board is powered on, double-click on the TEC_Control.bat file in the C:\TEC4X directory to start.

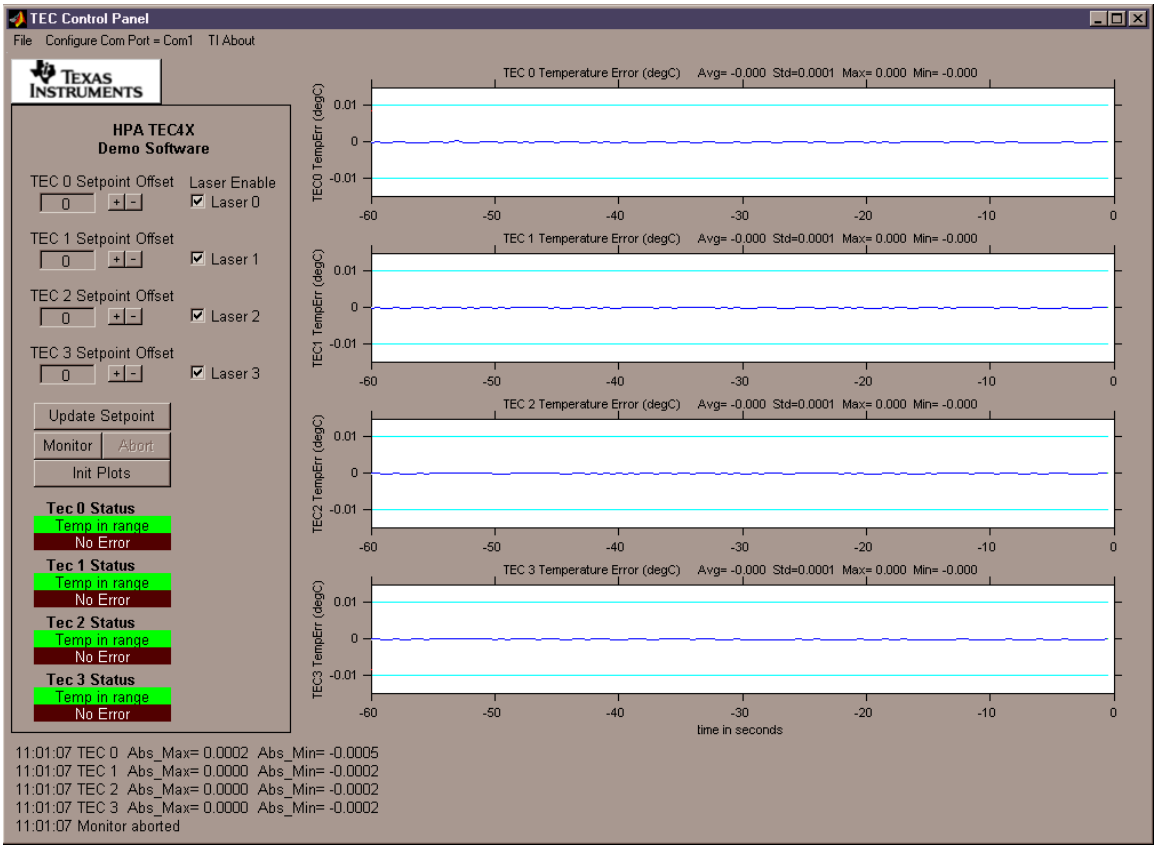

Figure 4. Quad TEC Control Program GUI Interface

The first time the TEC_CONTROL program is run, a window will pop-up and request a choice of COM PORT. By pressing the button for the COM PORT where the serial cable is attached, the initial COM PORT is selected. The active COM port can be changed at any time by using the “Configure Com Port” Menu Item at the top of the TEC_CONTROL program window. Once the serial port cable is connected and the platform hardware is running, you can push the MONITOR button to start monitoring the temperature. You can stop the strip chart by pushing the ABORT button. You should observe the four plots showing the temperature error of the four TEC channels scrolling across the screen. The status icons at the left should all be green.

If pressing the MONITOR button gives an error message, check that the RS232 cable is connected and that the power is connected to the platform board. Try to change the COM port to find the correct one for your computer. Please note that COM ports may be used by other applications on your PC (e.g., Palm Pilot synchronization programs) or may be disabled in your BIOS.

If the program indicates that certain files cannot be found, ensure that the program was installed in the proper directory. The batch file expects the program to be installed in the C:\TEC4X directory. If the program was installed to a different directory, the batch file must be modified to point to the new directory name. More information on installing the GUI program can be found in the “Quad-Channel TEC

Controller Software Installation Guide." More information on using the GUI program can be found in the "Quad-Channel TEC Software User's Guide."

Status LEDs

Figure 5 shows the status LED's of the demonstration platform.

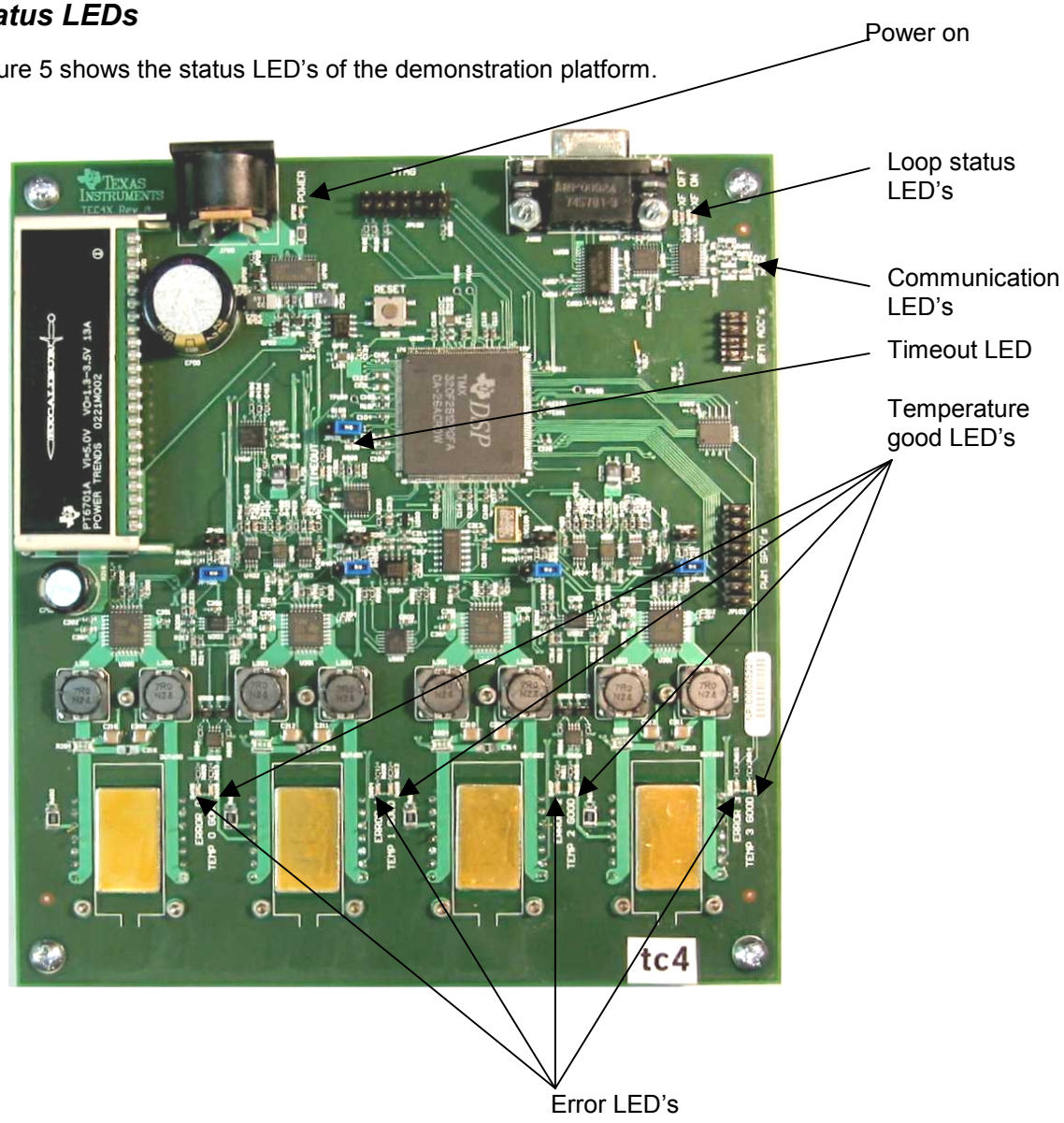

Figure 5. Status LED's

Each of the four TEC channels has a pair of LED's (one green and one red) to indicate the status of the channels. When lit, the four green LED's (D610, D611, D608, and D609) indicate that each of the channels is being held within 10 mK of the temperature set-point. The red LED's (D605, D604, D607, and D606) indicate error conditions for each channel, which include open-circuit thermistor, short-circuit thermistor, and errors detected by the PWM drivers. The error is indicated by flashing the red LED in a specific pattern. The error is latched and isn't cleared until either the board is reset with the reset switch or a new setpoint is entered for the channel using the GUI interface. If multiple errors occur, then the LED will indicate all the latched errors in sequence. Error codes are summarized in Table 1.

LED Blink Error Code Number	LED Blink Error Code Meaning
1	Reserved
2	Maximum TEC control voltage exceeded
3	Maximum TEC current exceeded
4	Thermistor open-circuit
5	Thermistor short-circuit
6	DRV592 fault 0 – Current > 4A
7	DRV592 fault 1 – Voltage < 2.8V
8	DRV592 fault 2 – Driver junction temperature > 130C
9	Available
10	Available
11	Available
12	Available
13	Available
14	Available
15	Available

Table 1. Error Codes Displayed on Error LED's

There is a timer included on the board that senses if the processor gets lost. If the processor fails to reset the timer properly, then the red "TIMEOUT" LED (D500) will light. The timeout also disables power to the resistors used to generate heat inside the butterfly packages and disables the TEC drivers.

The two communication LED's (D601 and D602) indicate data communication along the RS232 cable to/from the attached PC. The green "TX" LED indicates data being transmitted to the PC, while the red "RX" LED indicates data being received from the PC.

The "loop status" LED's (D603 and C600) light when the servo control loop is active.

Configuration Jumpers

There are several jumpers on the platform that allow configuration of the four TEC channels, as well as allowing for injection of errors into the system.

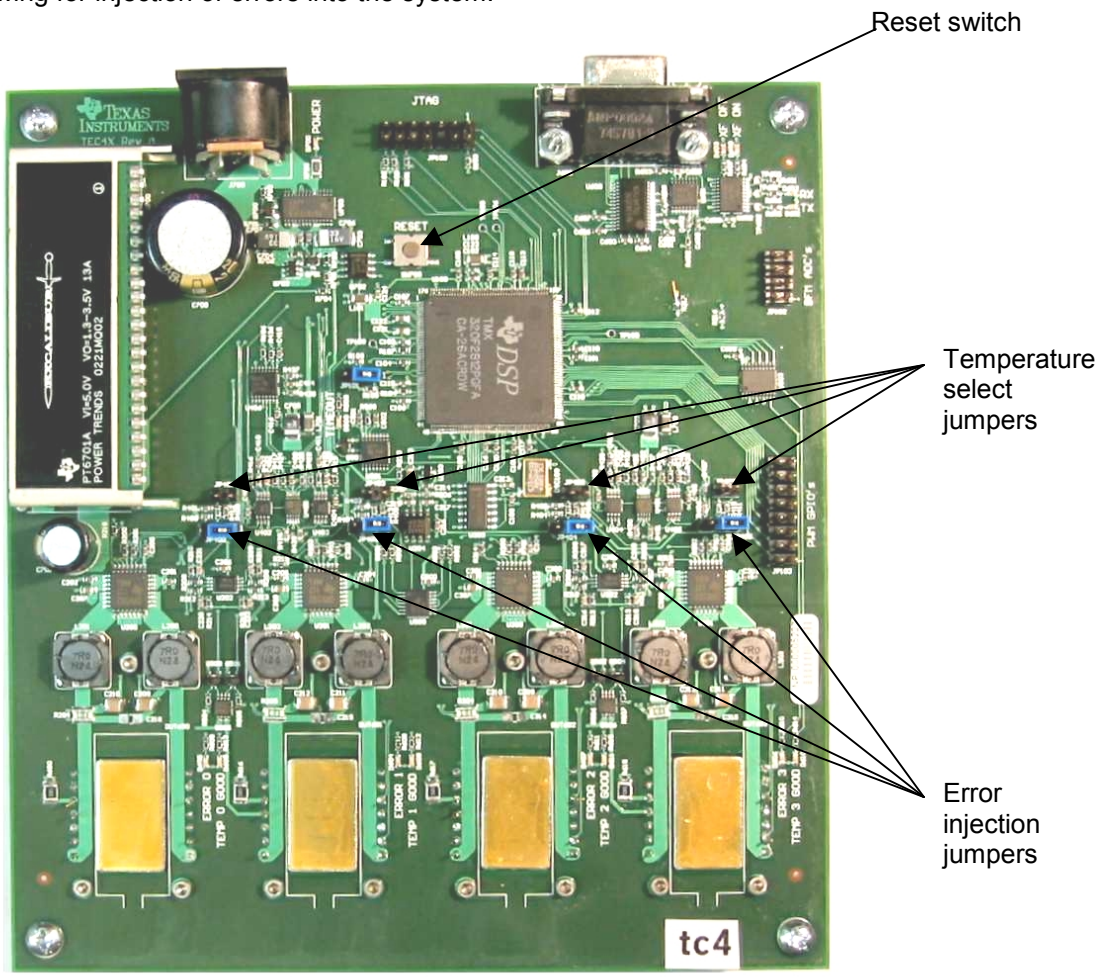

Figure 6. Configuration Jumper Locations

Four jumpers select the nominal temperature setpoint of the four TEC channels (JP401, JP403, JP405, and JP407). When the jumper for any particular channel is removed, its setpoint is 25C. When the jumper is populated, the setpoint is 35C. When the board is connected to the PC, then the setpoint can be moved around the nominal settings given by the jumper.

There are four three-pin headers that can be used inject thermistor errors into the system. It is important for the platform to detect open- and short-circuited thermistors to prevent the servo loop from acting on bad information about the actual temperature of the lasers.

There are three positions that these three-pin headers can be set. When the middle pin of the three-pin connector is connected to the right pin (“right” as the board is oriented as shown in Figure 6) of the connector with the jumper, then the channel operates in its normal fashion. When the jumper is removed, this causes the thermistor to be open-circuited, and the error LED for that channel (as well as the error indicator in the GUI) will indicate a “thermistor open” error. This error is latched and the LED will remain

flashing until the platform is reset with the reset switch or a new temperature set-point for that channel is sent from the GUI.

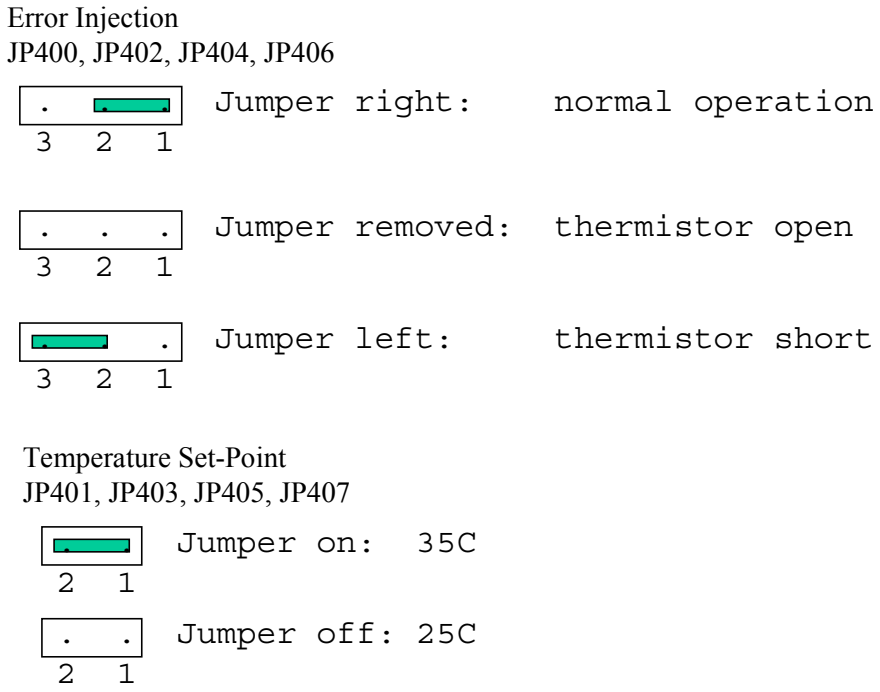

Figure 7. Configuration Jumpers. “Right” and “left” assume the board is oriented as in Figure 6.

When the middle pin is connected to the left pin with the jumper, then the thermistor is short-circuited. Usually both an open-circuit and short-circuit error are shown with the LED’s, since the jumper had to be removed before being moved to the left, and removing the jumper forces an open-circuit error.

Board Connectors

There are several connectors on the board that can be used to monitor the operation of the board or add function to the base design. The connectors are illustrated in Figure 8.

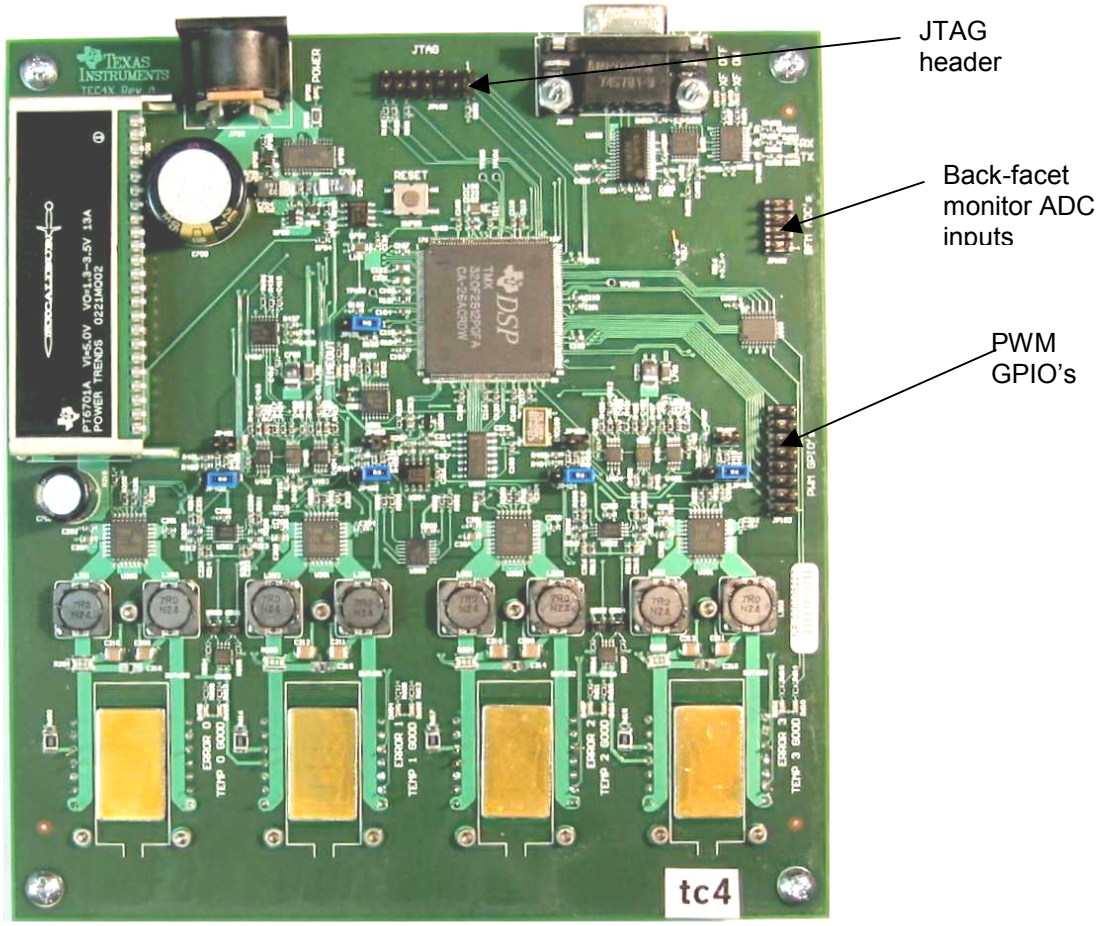

Figure 8. Board Connector Locations

The "JTAG header" (JP100) is the standard 14-pin connector that is used to control the DSP through an emulator.

The back-facet monitor ADC inputs (JP102) are provided to allow for expansion of the platform function. Pins 1, 3, 5, and 7 (the right side of the connector if the board is oriented as shown in Figure 8) are attached to four spare ADC channels of the DSP. It would be possible to attach a voltage proportional to the current sensed by the back-facet monitor diode in an actual pump laser and implement the power control as an additional control loop in the processor.

The "PWM GPIO's" connector (JP103) is connected to the spare pulse-width modulation pins from the processor. As described in the white paper, it is possible to expand the design to eight TECs, and the additional PWM lines needed for the design could be accessed here.

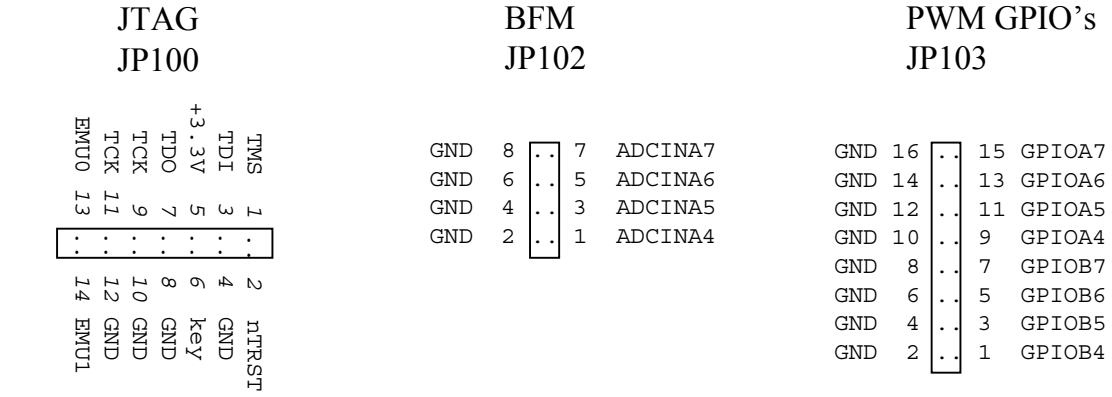

Figure 9. Connectors

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