

RELAY BOARD TESTING PROCEDURE

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Pin notation: BPxx means pin xx of backplane connector (or holes on PCB)
TCxx means pin xx of top connector (or holes on PCB)

Before proceeding, jumper backplane pins BP35 and BP36 (tie analog and power grounds together), and leave this throughout testing.

Current sensing of Solar Array Strings and PPU

This is to insure that current sensors generate appropriate voltages on DS2450S chips. The response for array-string currents is 5 Volts/Amp, and for PPU is 1 Volt/Amp.

Apply +5V to BP40 through a 1 kOhm resistor (to prevent excessive current if a mistake), and COMMON (GND) to BP35. [This powers DS2450S chips, which must be done since array sense voltages will be present on A-D inputs.]

Connect a 100 Ohm, high-wattage (> 5W) load resistor between TC50 (combined array output) and GND (BP35). Current from any string will pass through this resistor, so application of 24V (nominal UW string voltage) to any string input (on TOP connector) will result in a current of ~ 0.24 A in that string, and a sense voltage of ~ 1.2V generated by the associated current sensor will be sent to an A-D input of a DS2450S A-D chip.

Monitor the voltage across the 1 kOhm resistor - It should be no higher than a few 10's of millivolts (corresponding to a current of a few 10's of microamps), indicating there is no fault in the 5-V line on board or any DS2450S chip. Also, make sure that +5V appears on pins 1 of each DS2450S chip, and that 0V appears on each pin 4. Make sure there is continuity between BP11 (1-wire bus) and pin 3 of each DS2450S.

Successively connect a +24V source (the voltage is not critical; use a voltage comparable to the nominal voltage of VT's solar strings) to each string input of the TOP connector (TC13-20 and TC43-49) with the 24V COMMON lead connected to GND (BP35).

In each case, check that ~ 24V (or whatever you apply) appears on your 100 Ohm load resistor (a bit less due to diode drop), and that the correct voltage (~ 1.2V) appears at the appropriate input pin of the appropriate DS2450S (see relay board documentation for association between the string monitored and the chip/pin where the sense voltage is sent). While doing this, check that ~ 0 V appears on other DS2450S inputs (i.e., no crosstalk).

PPU current sense. Connect a ~ 10 Ohm, high-wattage (> 10 W) resistor between TC12 and GND (BP35). Apply +10V to BP35 and COMMON to GND (BP35). Make sure the ~10 V appears across your 10 Ohm resistor [1-Amp current], and that ~ 1.0 V appears on pin 5 of IC20 (one of the DS2450S chips). [You could use a different resistance than 10 Ohm, and different applied voltage than 10V, as long as the current $V/R \sim 1$ A.]

Test Lightband Switches.

Connect a 10 Ohm, high-wattage resistor between +20 V and TC7 (LSS2-) and COMMON to GND (BP35). [This will draw ~ 2.0A when Lightband is activated, approximately the nominal Lightband current.] Also connect a line between GND (BP35) and TC36 (bypasses relays).

Apply a logic square wave (LO: 0 to 0.8 V; HI: 2.4 to 3.3V) to BP28 (LSS2 control), with digital COMMON at GND (BP35). The frequency can be low (say 10 Hz). When logic signal is HI, the 20V should appear across your 10 Ohm resistor, and when LO, the voltage on this resistor should be 0V. Repeat for LSS1: Now your 10 Ohm resistor should be between +20V and TC8 (LSS1-), and the logic signal should be connected to BP27 (LSS1 Control). Same test as for LSS2.

Note that what's important is that the voltage drop in the MOSFET switches is small in the ON state. You should check that the voltage between GND and TC7 is < 0.2 V when ON (LSS2), and that the voltage between GND and TC8 is < 0.2 V when ON (LSS1). Also, the MOSFET's (IC21 and IC22) should not get hot when ON.

For the following Relay tests, disconnect all resistors and voltages used in the above tests.

Test Relays 1-4 (Before rework)

Apply a 24 Volt pulse to MSDS1: positive to TC30, negative to TC60. The pulse length should be > 0.2 sec. This should latch relays 1-4 in the OFF position. To check this, make sure there is infinite resistance between the following pins:

| <u>Relay</u> | <u>Pins</u> | <u>Check lines</u> |
|---------------------|--------------------|---------------------------|
| 1 | TC50 - TC51 | CK21-CK24 |
| | TC21-TC53 | CK22-CK23 |
| 2 | TC51-TC19 | CK21-CK19 |
| | TC21-TC52 | CK22-CK20 |
| 3 | TC22-TC55 | CK19-CK18 |
| | TC52-TC54 | CK20-CK17 |
| 4 | TC59-TC58 | CK16-CK14 |
| | TC56-TC57 | CK15-CK13 |
| Pos Arr | TC50-TC25 | |
| Neg Arr | TC29-TC28 | |
| Pos Bat | TC24-TC23 | |
| Neg Bat | TC27-TC26 | |

Now apply a 24 V pulse with polarity switched: positive to TC60, negative to TC30. This should latch relays 1-4 in the ON position. Check that there is zero resistance between each of the above pairs of pins.

Test Relays 5-8 (Before rework)

Apply a 24 Volt pulse to MSDS2: positive to TC31, negative to TC1. The pulse length should be > 0.2 sec. This should latch relays 5-8 in the OFF position. To check this, make sure there is infinite resistance between the following pins:

| <u>Relay</u> | <u>Pins</u> | <u>Check lines</u> |
|---------------------|--------------------|---------------------------|
| 5 | TC33-TC32 | CK2-CK4 |
| | TC36-TC2 | CK1-CK3 |
| 6 | TC34-TC39 | CK5-CK7 |
| | TC35-TC10 | CK6-CK8 |
| 7 | TC10-TC40 | CK8-CK10 |
| | TC39-TC11 | CK7-CK9 |
| 8 | TC11-TC42 | CK9-CK11 |
| | TC40-TC12 | CK9-CK12 |
| Pos PPU | BP34-TC5 and TC6 | |
| Neg PPU | BP35-TC3 and TC9 | |
| Pos LSS | BP34-TC4 | |
| Neg LSS | BP35-TC36 | |

Now apply a 24 V pulse with polarity switched: positive to TC1, negative to TC31. This should latch relays 5-8 in the ON position. Check that there is zero resistance between each of the above pairs of pins.