DKW 10/14/2016

Rhine Automatic Batter Watering Board Functional Test Procedure

Revision 5

Changes from previous rev are highlighted.

**Setup**:

A clamshell fixture has test probes that make connections with all necessary points when the board is placed in the fixture and the latch is closed over the board. Test commands are sent to the board using the CAN interface. The board executes the commands and returns status over the same interface.

All CAN communication is with CAN node ID #**13**.

**Test Sequence**:

1. Install board in machine.
2. Turn power on. Power supply is set to 24.0V and should be capable of driving a 5A load. Power is applied as indicated: COM goes to J3-1. +24V goes to J3-7.

**Firmware Rev Check:**

1. Read the firmware revision by sending the following command: **read CAN index 0x100A subindex 0x00**. Check the returned value against latest revision.
2. Read the hardware revision by sending the following command: **read CAN index 0x1009 subindex 0x00**. Check the returned value against latest revision.

**Initial Power/Switch Input Tests:**

1. Apply 24V to J3-7.
2. J3-3 should be floating.
3. Read water tank low switch by sending the following command: **read CAN index 0x3928 subindex 0x03.** Bit 5 must be **1.**
4. Short J3-3 to ground.
5. Read water tank low switch by sending the following command: **read CAN index 0x3928 subindex 0x03.** Bit 5 must be **0**.
6. J3-4 should be floating.
7. Read CONFIGURE\_BIT\_0 input by sending the following command: **read CAN index 0x3928 subindex 0x01.** Bit 0 must be 1.
8. Short J3-4 to ground.
9. Read CONFIGURE\_BIT\_0 input by sending the following command: **read CAN index 0x3928 subindex 0x01.** Bit 0 must be 0.
10. J3-5 should be floating.
11. Read CONFIGURE\_BIT\_1 input by sending the following command: **read CAN index 0x3928 subindex 0x01.** Bit 2 must be 1.
12. Short J3-5 to ground.
13. Read CONFIGURE\_BIT\_1 input by sending the following command: **read CAN index 0x3928 subindex 0x01.** Bit 2 must be 0.
14. Wait 10 seconds.
15. Read BATTERY\_VOLTAGE by sending the following command: **read CAN index 0x3922 subindex 0x07 bytes 0 and 1.** Reading is measured voltage x 100. Reading must come back within ±1% of 24.0V. (2376 < reading < 2424)

**Low Side Driver 0 and 1 Tests:**

This is now unpopulated circuitry. Test is unnecessary.

**Spare input Test:**

This is unpopulated circuitry. Test is unnecessary.

**LED Driver Test:**

1. Test fixture has a 332 Ohm ¼ Watt resistor between J3-10 and Common GND.
2. Test the LED driver output by sending the following command: **Write 0 to CAN index 0x3929 subindex 0x01.**
3. Measure pin J3-10 WRT common. Must read 0V.
4. Turn on the LED output by sending the following command: **Write 1 to CAN index 0x3929 subindex 0x01.**
5. Measure pin J3-10 WRT common. Must read 2.4V±10%.

**Flow Sensor Test:**

1. Apply open circuit to J5-2.
2. Verify voltage from J5-2 with respect to J5-1. Voltage must measure 5V±10%.
3. Verify +3.3V on FLOW\_SWITCH (J5-3) in reference of GND (J5-1).
4. Apply a 50 Ohm 1 Watt resistor between J5-1 to J5-2.
5. Verify voltage from J5-2 to J5-1. Voltage must measure 2.5V±0.75V.
6. Apply a 495Hz 5V square wave to J5-3 WRT ground.
7. Wait 10 seconds.
8. Read the flow sensor input by sending the following command: **Read 1 byte from CAN index 0x3928 subindex 0x02.**
9. Reading must be 485Hz-500Hz, take hexadecimal value and convert to decimal for mL/min. Divide that value by 22.4 for Hz.

**Water Pump LSD Test:**

1. Apply open load to the water pump low side driver.
2. Turn on the water pump driver by sending the following command: **Write 1200 to CAN index 0x3920 subindex 0x01 bytes 0 and 1.** This runs the water pump driver at ~50% duty cycle with a current limit of 5.0A into an open load.
3. Read water pump driver status by sending the following command: **read CAN index 0x3921 subindex 0x01.** Bit 6 must be 0 (bit 6 is shorted load). Bit 5 must be 0. (bit 5 is FET fault) Bit 2 must be 1 (bit 2 is open load). Bit 1 must be 0 (bit 1 is overcurrent).
4. Power cycle the UUT to clear the fault.
5. Apply a 15Ω 50W load to the water pump driver.
6. Turn on the water pump driver by sending the following command: **Write 1200 to CAN index 0x3920 subindex 0x01 bytes 0 and 1.** This runs the water pump driver at 50% duty cycle with a current limit of 5.0A into a load that wants to draw 1.6A.
7. Read water pump status by sending the following command: **read CAN index 0x3921 subindex 0x01.** Bit 6 must be 0 (bit 6 is shorted load). Bit 5 must be 0. (bit 5 is FET fault) Bit 2 must be 0 (bit 2 is open load). Bit 1 must be 0 (bit 1 is overcurrent).
8. Read water pump current by sending the following command**: read CAN index 0x3921 subindex 0x03 bytes 0 and 1.** Water pump current must be 1.6A±0.2A. Reading is current x 100 so (140 < reading < 180)
9. Read water pump output voltage with a meter at the output connector. J4-2 must be 12V ±1V WRT J3-1. (8.5V±1V if not measured with a true RMS meter)
10. Turn off water pump driver by sending the following command: **Write 02 to CAN index 0x3920 subindex 0x01.**
11. Read water pump current by sending the following command**: read CAN index 0x3921 subindex 0x03 bytes 0 and 1.** Water pump current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
12. Apply a 4Ω 100W load to the water pump driver.
13. Turn on the water pump driver by sending the following command **Write 1200 to CAN index 0x3920 subindex 0x01 bytes 0 and 1.** This runs the water pump driver at 50% duty cycle with a current limit of 5.0A into a load that wants to take 6.0A.
14. Read water pump status by sending the following command: **read CAN index 0x3921 subindex 0x01.** Bit 1 must be 1 (bit 1 is overcurrent). Bit 5 must be 0. (bit 5 is FET fault) Bit 2 must be 0 (bit 2 is open load).
15. Read water pump current by sending the following command**: read CAN index 0x3921 subindex 0x03 bytes 0 and 1.** Water pump current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
16. Power cycle the UUT to clear the fault.

End of test. Power off.