Hercules Industrial User Interface
PCA 1256673
Revision F

Revision Table

Revision	Changes	Engineer	Date
A	Initial Version	BAP	2023-06-26
B	• Update the Setup Section • Update Write Serial Number section • Update Hour meter section to remove resistor from test • Update Potentiometer check • Add 2nd option to backup camera • Update CAN bus section	BAP	2023-07-12
C	• Low side driver resistor changed from 12.1k to 1.12k • Updated every section with new commands • Consolidated Switch membrane test into the switch test	BAP	2023-07-26
D	• Fix typos in Analog Inputs section • Update RS232 and UART4 sections to enable a simple loopback test • Fix typo in step 4 of LSD Output Test • Correct Digital Input pin mapping • Correct CAN message ID for reading back data	BAP	2023-12-14
E	• Move CAN to beginning of test • Update Initialize FCT mode section to wait for CANdump	BAP	2023-12-18
F	• Change LCD backlight resistor to 30ohms • Update CAN bus test	BAP	2024-02-21

Table of Contents

Setup:

A fixture has connections with pogo pins for all necessary points. All Test commands are sent to the board using the UART debug port (J16). The board executes the commands and returns status over the same interface. The UART terminal should be configured for 115200 baud, 1 stop bits and 8 data bits. Operator input is required to verify LCD and touch panel function if the LCD is installed in the test fixture. The LCD may be omitted from the test fixture with prior approval from Tennant.

1. Install user interface assembly in machine.
2. Turn power on. Power supply is set to 24.0V and should be capable of driving a 2A load. Power is applied as indicated: COM goes to J3-1. +24V goes to J3-2 and J4-2. The board will not operate if J4-2 is below 8V.

CAN Bus Test:

The baud rate for CAN 0 is 500kbps. CAN 1 is 125kbps. Node ID is 0x01.

1. Verify that the DUT is sending messages on the CAN bus.
    a. One example is the heartbeat message, 0x701. The data field is typically non-zero.
2. This is sufficient to test both the TX and RX capability of the transceiver.
3. Do the test twice. Once for CAN Bus 0 and once for CAN Bus 1.

Initialize FCT Mode:

1. Before logging into the terminal wait until the messages "`Starting candump CAN0`" and "`Starting candump CAN1`" appear.
2. Login to the UART debug port. Username is "**`root`**" and password is "**`am4`**". Note: the password characters will not echo back to the terminal for security reasons.
3. Initialize FCT mode by typing "fct" and pressing return.

Revision Verification:

1. Read the software and hardware versions with the command "**`version`**".
2. The SW revision shall match the revision number listed in the released drawing of 1266673.
3. The HW revision shall match the revision number listed in the released drawing of 1266673.

Write Serial Number:

1. Write Tennant board serial number (where [SN] is the serial number on the board) to EEPROM by sending the following command over THE DEBUG INTERFACE: **`config w 499 [SN]`**

   Response must include:
   Writing of parameter: **499**

2. Wait 5 seconds and cycle power to board.
3. Read the board serial number from memory by sending the following command over the debug interface: **"`config r 499`"**
4. Response must include the serial number written to the board.

Serial Flash:

1. Programming the serial flash with the bootloader file will serve as the test. Successfully booting and logging into the terminal application is considered a pass.

Trusted Platform Module (TPM):

1. Run command "**`tpm ?`**"
2. Confirm that the board ID is a non-zero number

RTC:

1. All times shall be set to local manufacturing time
2. Set the seconds with the command "**`time s=XX`**"
3. Set the minutes with the command "**`time m=XX`**"
4. Set the hours with the command "**`time h=XX`**"
5. Save the time to the RTC with the command "**`time w`**"
6. Power cycle board for at least 10 seconds
7. Read back the time with the command "**`time ?`**", and verify it has incremented for approximately the amount of time since it was set.

Power Input:

1. Read status of battery power with command "**`power ?`**"
2. Battery voltage will be returned. `hw_Power_Batt_Plus_Voltage()` shall be 24V ± 2.2%
3. Read status of key switch power with command "**`power ?`**"
4. key switch voltage will be returned. `hw_Power_Battery_Voltage()` shall be 24V ± 2.2%
5. Apply 24V to J4-3
6. Read status of charger power with command "**`power ?`**"
7. Charger voltage will be returned. `hw_Power_Voltage_Charge_Interlock()` shall be 24V ± 2.2%
8. Run command "**`power ?`**"

9. BATT+ LOW() shall be false
10. KEYSWITCH+ LOW() shall be false
11. CHARGER+ LOW() shall be false
12. Lower voltage at J3-2, J4-2, and J4-3 to 6.5V
13. Run command TBD suggestion "**`power ?`**"
14. Batt low input shall be True
15. Key switch input shall be True
16. Charger input shall be True

USB Power:

1. Connect a 5W, 10Ω load to the +5V and GND connections of the USB A connector (J5-1 and J5-4)
2. J5-1 shall measure 5V ± 0.5V
3. The USB switch has temperature based current limit feature. It will limit the current at approximately 1.5A
4. Connect a 25W, 1.5Ω load to the +5V and GND connections of the USB A connector (J5-1 and J5-4)
5. This will draw 3.33A through a circuit with a 1.5A current limit
6. Send command **"`usb ?`"**
7. `hw_USB_Over_Current()` shall be True

5V Sensor Power:

1. Measure J18-13 WRT J18-14 with a DMM. Must measure 5.0V±1V.
2. Apply a 50Ω 1W load between J18-13 and J18-14
3. Measure J18-13 WRT J18-14 with a DMM. Must measure 3.27±0.5V.
4. Remove load from connector J15

Digital Input:

1. Read inputs with command "**`inputs ?`**"
2. All inputs shall be false except for inputs 20, 21, 22, and 23, which shall be True
3. Refer table below for pin mapping of each input. Each input shall change state to True when bias is applied. Inputs 20, 21, 22, and 23 shall change state to False when bias is applied.

Input Name	Bias and Pin	FCT mapping
Membrane 0	Connect J8-2 to J8-3	Switch 0
Membrane 5	Connect J8-5 to J8-4	Switch 5
Membrane 10	Connect J8-7 to J8-6	Switch 10
Membrane 15	Connect J8-9 to J8-8	Switch 15
Mem_digin_1	Apply GND to J10-1	Switch 16
Mem_digin_2	Apply GND to J10-2	Switch 17
Digin_1	Apply 24V to J4-6	Switch 20

Digin_2	Apply 24V to J18-4	Switch 21
Digin_3	Apply 24V to 18-5	Switch 22
Digin_4	Apply 24V to J18-6	Switch 23
Digin_5	Apply GND to J18-7	Switch 24
Digin_6	Apply GND to J18-8	Switch 25
Digin_7	Apply GND to J18-9	Switch 26
Digin_8	Apply GND to J18-10	Switch 27

Analog Input:

1. Read analog inputs with the command "**`ainputs ?`**"
2. Under IIO 1, `ainputs_State( in_voltage2_raw )` and `ainputs_State( in_voltage3_raw )` shall be 0V
3. Apply 3V to J18-11
4. Read analog inputs with the command "**`ainputs ?`**"
5. `ainputs_State( in_voltage2_raw )` reading shall be 3V ± 5%
6. Apply 4V to J18-12
7. Read analog inputs with the command "**`ainputs ?`**"
8. `ainputs_State( in_voltage3_raw )` reading shall be 4V ± 5%

Low Side Driver Output:

1. Connect a 1.21k 1W resistor to each of the following pins
    a. J19-1 to J3-2.
    b. J19-2 to J3-2
    c. J19-3 to J3-2
    d. J19-4 to J3-2
    e. J19-5 to J3-2
    f. J19-6 to J3-2
    g. J19-7 to J3-2
    h. J19-8 to J3-2
2. Enable all low side drivers by sending the following command: "**`lsd e=0`**"
3. Turn on low side driver 1 output by sending the following command: "**`lsd e=1`**"
4. Confirm the driver turned on by measuring J19-1. J19-1 must measure less than 1V WRT GND.
5. Turn off low side driver 1 output by sending the following command: "**`lsd d=1`**"
6. Repeat steps 2 through 4 for all 8 low side drivers
7. Low side driver chart with commands for reference
8. Disable all LSDs by sending the following command: "**`lsd e=0`**"

LSD Name	Pin Number	Turn ON Command	Turn OFF Command
LSD_1	J19-1	`lsd e=1`	`lsd d=1`
LSD_2	J19-2	`lsd e=2`	`lsd d=2`
LSD_3	J19-3	`lsd e=3`	`lsd d=3`
LSD_4	J19-4	`lsd e=4`	`lsd d=4`
LSD_5	J19-5	`lsd e=5`	`lsd d=5`
LSD_6	J19-6	`lsd e=6`	`lsd d=6`
LSD_7	J19-7	`lsd e=7`	`lsd d=7`
LSD_8	J19-8	`lsd e=8`	`lsd d=8`

Hour Meter Output:

1. Enable hour meter with command "**`hour e`**"
2. Measure J3-6 with a DMM. Measurement shall be 5V ± 0.5V
3. Turn of hour meter with command "**`hour d`**"

Membrane LED:

1. The test setup should have a 1.5kohm load resistor from each LED output LED1 through LED32 to 3.3V.
2. Confirm that all membrane panel LEDs are turned off by sending the following command over THE DEBUG INTERFACE: "**`led o=0`**".
3. Confirm that J8-10 through J8-24 and J8-28 through J8-44 are all turned off.
4. Turn on LED 1 by sending the "**`led e=1`**" command over THE DEBUG INTERFACE. The response must include:

   led_Set(1, 1:LED_MODE_ON, False)

5. Confirm that J8-10 is turned on.
6. Turn off LED 1 by sending the "**`led d=1`**" command over THE DEBUG INTERFACE. The response must include:

   led_Set(1, 1:LED_MODE_ON, False)

7. Confirm that J8-10 is turned off
8. Repeat steps 5 through 8 for all 32 LEDs.
9. LED chart with commands for reference:

LED Name	Pin Number	Turn ON Command	Turn OFF Command
LED_1	J8-10	`led e=1`	`led d=1`
LED_2	J8-11	`led e=2`	`led d=2`
LED_3	J8-12	`led e=3`	`led d=3`
LED_4	J8-13	`led e=4`	`led d=4`
LED_5	J8-14	`led e=5`	`led d=5`
LED_6	J8-15	`led e=6`	`led d=6`

LED_7	J8-16	led e=7	led d=7
LED_8	J8-17	led e=8	led d=8
LED_9	J8-18	led e=9	led d=9
LED_10	J8-19	led e=10	led d=10
LED_11	J8-20	led e=11	led d=11
LED_12	J8-21	led e=12	led d=12
LED_13	J8-22	led e=13	led d=13
LED_14	J8-23	led e=14	led d=14
LED_15	J8-24	led e=15	led d=15
LED_16	J8-28	led e=16	led d=16
LED_17	J8-29	led e=17	led d=17
LED_18	J8-30	led e=18	led d=18
LED_19	J8-31	led e=19	led d=19
LED_20	J8-32	led e=20	led d=20
LED_21	J8-33	led e=21	led d=21
LED_22	J8-34	led e=22	led d=22
LED_23	J8-35	led e=23	led d=23
LED_24	J8-36	led e=24	led d=24
LED_25	J8-37	led e=25	led d=25
LED_26	J8-38	led e=26	led d=26
LED_27	J8-39	led e=27	led d=27
LED_28	J8-40	led e=28	led d=28
LED_29	J8-41	led e=29	led d=29
LED_30	J8-42	led e=30	led d=30
LED_31	J8-43	led e=31	led d=31
LED_32	J8-44	led e=32	led d=32

Display Supply Test:

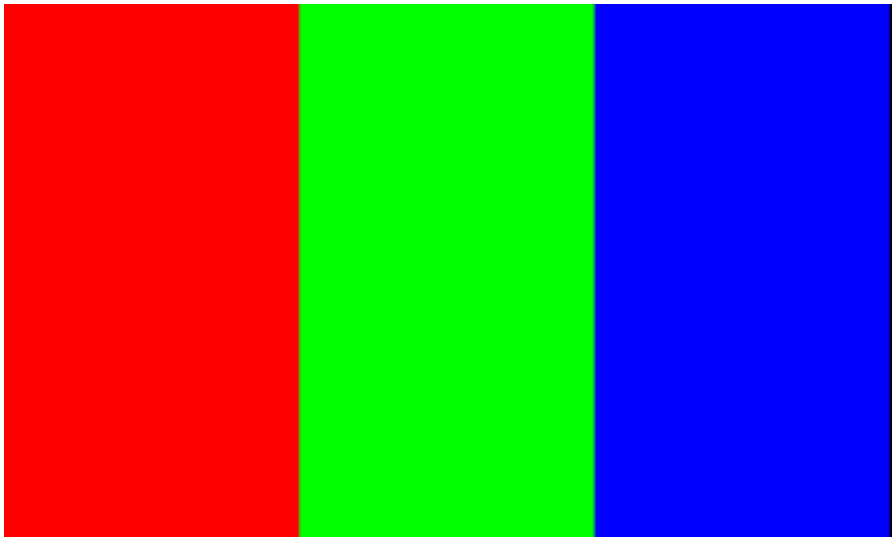
1. Measure J15 pin 1 WRT common with a DMM. Must measure 5.0V±1V.
2. Apply a 50Ω 1W load between pins 1 and 2 of connector J15
3. Measure pin 1 WRT common with a DMM. Must measure 3.27±0.5V.
4. Remove load from connector J15

Potentiometer Check:

1. Apply 3.3V to pin 5 of connector J14
2. The voltage at pin 1 of U1301 shall be 0.52V +/- 0.1V

LCD Color:

1. Send the command "**`screen t`**"
2. Confirm that the following pattern appears on the LCD:



Touchscreen:

1. Send the command "**`screen c`**"
2. Follow the prompt on the LCD to calibrate the touchscreen:

3. After calibration the screen will go blank

Backlight Driver:

If no LCD is included in the fixture, the previous two sections can be ignored. If it is included this section can be skipped.

1. Connect a 30Ω 3W resistor between nets LCD_BL_P and LCD_BL_N
2. The voltage at LCD_BL_P with respect to GND shall be 4V +/- 10%
3. For reference, the max current of the backlight circuit is 269mA

Backup Camera:

There are two options for this test.

Option 1:

1. Plug in backup camera to J6
2. Run command "**`screen m`**"
3. Visually verify LCD shows the camera image without aberration

Option 2:

1. Emulate the camera data using a DAC and apply to J6-4
2. Run command "**`screen m`**"
3. Verify the decoder is working by reading the digital output of the decoder and compare to the DAC input

RS-232:

1. Connections: J18-1 is RS232 RXD, J18-2 is RS232 TXD
2. Connect J18-1 to J18-2
3. Send the command "**`rs232 t`**"
4. The UI will a character string over the TX pin and read it on the RX pin
5. Verify that the response is PASS

UART (5V):

1. Connections: J4-4 is 5V UART RXD, J4-5 is 5V UART TXD
2. Connect J4-4 to J4-5
3. Send the command "**`uart4 t`**"
4. The UI will send data over the TX pin and read it on the RX pin
5. The UI will a character string over the TX pin and read it on the RX pin
6. Verify that the response is PASS

USB Host:

1. Connect a flash drive or generic storage device to J5
2. The storage device shall have the file X.txt on it
3. Run command "**`usb h`**"
4. The response must include "**`USB checking for file "X.txt": OK`**"

USB device:

1. Connect J7 to a computer
2. Verify the PID and VID of the device