

WATERS CORPORATION
ENGINEERING TEST SPECIFICATION AND PROCEDURE
COMPANY CONFIDENTIAL

SYSTEM/ASSEMBLY NAME: **ACQUITY QSM PUMP PERSONALITY BOARD**

PART NUMBER AFFECTED: **210000345**

TEST EQUIPMENT NAME: **GTS FUNCTIONAL BOARD TEST**

TEST EQUIPMENT NUMBER: **TE83001**

TEST EQUIPMENT LOCATION: **WATERS, MILFORD MA ; FLEXTRONIC, SINGAPORE**

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TABLE OF CONTENTS

I.	Introduction to the QSM Functional Board Test.....	5
II.	Functional Test System Features.....	5
III.	Test Fixture Setup (Initial).....	5
IV.	Test Setup/Connections and Test Program.....	5
1.	Connections	5
2.	Test Program	5
V.	Figures.....	6
VI.	Test Description and Specifications.....	6
3.	Test 24 VDC Input Voltage (J26)	6
4.	Test 24 VDC Input Current (J26)	6
5.	Test Communications on CPU2K RS232 Port.....	6
6.	Test Fuses F1-F8.....	7
7.	Test +5V Vcc Voltage Monitor Readback	7
8.	Test +15V Voltage Monitor Readback	7
9.	Test -15V Voltage Monitor Readback	7
10.	Test +24V Voltage Monitor Readback	7
11.	Test 5V GND Voltage Monitor Readback.....	7
12.	Test Fan1 Output (J32_1 J32_3)	7
13.	Test Fan2 Output (J33_1 J33_3)	7
14.	Test Event In 1 Closed Input (J18_1 to J18_2 Shorted)	7
15.	Test Event In 1 Open Input (J18_1 to J18_2 Opened)	7
16.	Test Event In 2 Closed Input (J18_5 to J18_6 Shorted)	7
17.	Test Event In 2 Open Input (J18_5 to J18_6 Opened)	7
18.	Test Leak Detect - Not Connected State (J30_2 to J30_3 1Kohm)	7
19.	Test Leak Detect - Connected State (J30_2 to J30_3 1Kohm, J30_1 Input High State)	8
20.	Test Leak Detect - Leak State (J30_2 to J30_3 1Kohm, J30_2 Input Low State).....	8
21.	Test Status LEDs Vcc J8_1	8
22.	Test Status LEDs J8_2 High	8
23.	Test Status LEDs J8_2 Low.....	8
24.	Test Status LEDs J8_3 High	8
25.	Test Status LEDs J8_3 Low	8
26.	Test GPV A Output ON (J21_5 to J21_1)	8
27.	Test GPV A Output OFF (J21_5 to J21_1)	8
28.	Test GPV B Output ON (J21_6 to J21_2)	8
29.	Test GPV B Output OFF (J21_6 to J21_2)	8

30. Test GPV C Output ON (J21_7 to J21_3).....	9
31. Test GPV C Output OFF (J21_7 to J21_3)	9
32. Test GPV D Output ON (J21_8 to J21_4).....	9
33. Test GPV D Output OFF (J21_8 to J21_4)	9
34. Test Seal Wash Output ON (J27_1 to J27_2).....	9
35. Test Seal Wash Output OFF (J27_1 to J27_2).....	9
36. Test i2V Connected Input OPEN State (J28_5 to J28_6 Open)	9
37. Test i2V Connected Input SHORT State (J28_5 to J28_6 Short)	9
38. Test i2V Output ON, Curent 0 Amps ((TP388) J28_1(+) to (TP386) J28_3(-)).....	9
39. Test i2V Output ON, Curent 0.2 Amps ((TP388) J28_1(+) to (TP386) J28_3(-)).....	10
40. Test i2V Output ON, Curent 0.45 Amps ((TP388) J28_1(+) to (TP386) J28_3(-)).....	10
41. Test i2V Output ON, Curent 0.3 Amps ((TP388) J28_1(+) to (TP386) J28_3(-)).....	10
42. Test i2V Output ON, Watchdog Timed-Out ((TP388) J28_1(+) to (TP386) J28_3(-)).....	10
43. Test Degasser Motor Drive (J29 pins 1-6)	10
44. Test Degasser Status Atmospheric PSI Readback (J22 pins 1-6 (TP288, 214, 1104, 405, 399, 1104)).....	11
45. Test Degasser Status Vacuum PSI Readback (J22 pins 1-6 (TP288, 214, 1104, 405, 399, 1104))	11
46. Test Right Transducer (Accumulator) Low PSI Readback (J31_7, J31_1, J31_6)	11
47. Test Right Transducer (Accumulator) High PSI Readback (J31_7, J31_1, J31_6)	11
48. Test Left Transducer (Primary) Low PSI Readback (J31_9, J31_5, J31_10)	11
49. Test Left Transducer (Primary) High PSI Readback (J31_9, J31_5, J31_10)	11
50. Test Primary Motor Step Error Check (J10_5-8, J12_1-10).....	11
51. Test Primary Motor Step Check (J10_5-8, J12_1-10).....	12
52. Test Accumulator Motor Step Error Check (J10_1-4, J13_1-10)	12
53. Test Accumulator Motor Step Check (J10_1-4, J13_1-10)	12
54. Test Vent Valve Home Position Error Check (J19 and J20)	12
55. Test Vent Valve Positive Step Check (J19 and J20).....	12
56. Test SSValve Home Position Error Check (J24 and J25)	12
57. Test SSValve Positive Step Check (J24 and J25)	12

EQUIPMENT REQUIRED

Quantity	Part Number	Description
1	TE 83001	QSM Personality Board Functional Test Fixture

DISPOSABLES REQUIRED

Quantity	Part Number	Description
NA		

REFERENCE DOCUMENTATION

Document Number	Description
810000345	Board Functional Specification
210000345	Board Assembly Drawing
710000345	Board Schematic
NA	TE83001 Fixture Schematic

I. Introduction to the QSM Functional Board Test

The QSM Personality Board Functional Test Fixture mounted to the GTS (Global Test System) is designed to functionally test the Water's Corporation 210000345 board.

The UUT should have had an in-circuit test performed prior to testing on this station. This will screen out most catastrophic board problems.

The system uses a vacuum fixture to pull the board down into a bed of nails for test access. Most, but not all, test points are accessed at the UUT's connectors.

II. Functional Test System Features

The fixture used on the GTS has an ID system to identify the correct fixture in the test code. The fixture incorporates a CPU 2000 board with the latest QSM firmware. For motor loads, all actual motor assemblies are installed in the fixture for the vent, ssvalve, degasser, primary and accumulator.

The Test is controlled through an Operator Interface Test Program written in LabVIEW.

The Test Software is designed to run either Production Test or Diagnostic Test. Production Test will run all testing in a top down "fail at first failure" mode. All data collected is sent to the SigmaQuest server.

In Diagnostic Test, the board will be first checked for power supply compliance, and then for communications capability. If acceptable, then the test software will enter the Diagnostic Test Menu page. Any test thereafter can be selected and repeated to help troubleshoot and verify a board failure.

III. Test Fixture Setup (Initial)

Place the TE83001 QSM Personality Board fixture onto the GTS (TE82988) Test System.

Align the interface to the GTS and gently close the receiver locking handle.

Launch the GTS Board Test User Interface Icon on the PC monitor.

IV. Test Setup/Connections and Test Program

1. CONNECTIONS

1.1. Place the UUT (210000345 board) on the test fixture.

1.2. Connect the 180 pin CPU2000 cable to the UUT.

2. TEST PROGRAM

2.1. Ensure the GTS Operator Interface Test Program is open.

2.2. Select the QSM Personality board 210000345 UUT.

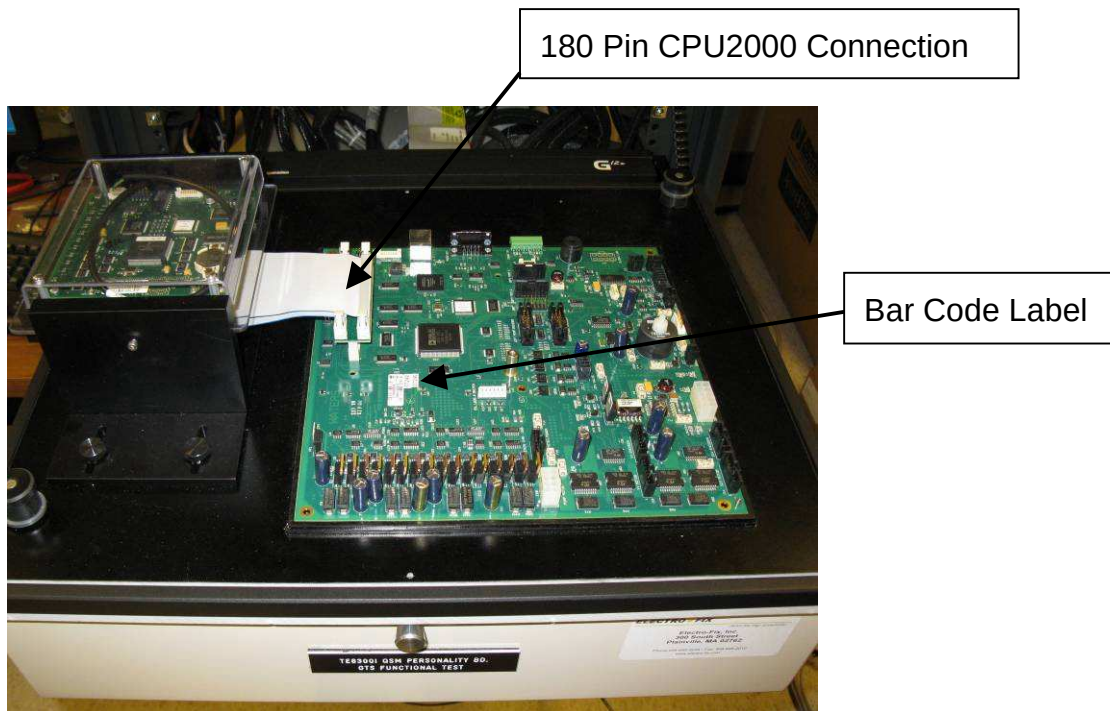
2.3. Press the **Test UUT** button on the screen.

2.4. A popup window will appear and prompt the operator to select **Production Test** or **Diagnostic Test**. Select **Production Test**. Note: **Diagnostic Test** is for troubleshooting board failures only.

2.5. To start the test, use the bar code scanner and scan the UUT serial number. The testing will then begin automatically.

2.6. A Pass or Fail result will be presented at the end of testing.

V. Figures



TE83001 with QSM Personality Board

VI. Test Description and Specifications

3. **TEST 24 VDC INPUT VOLTAGE (J26)**

The UUT is powered up with a 24 VDC power supply. The Input Voltage is measured to verify the proper input voltage.

The limits are: Low: 23.0 VDC High: 25.0 VDC

4. **TEST 24 VDC INPUT CURRENT (J26)**

The Input Current is measured.

The limits are: Low: 0.2 Amp High: 1.5 Amp

5. **TEST COMMUNICATIONS ON CPU2K RS232 PORT**

A carriage return is sent to the UUT via the RS232 console port J1 on the CPU2000 board (embedded in the fixture, J1_1=Tx, J1_2=Rx, J1_3=Gnd). The port is set default for 38400 baud, 1 stop, 8 bit, no parity, no flow control. A prompt from the CPU2000 is expected to verify the

CPU2000's microprocessor is up alive and talking when interfaced with the UUT. The prompt expected is "CONSOLE:>".

6. TEST FUSES F1-F8

Fuses F1 through F8 are all verified together with one peek command. The serial command *peek 0x500002* is sent. The expected response is FF.

7. TEST +5V VCC VOLTAGE MONITOR READBACK

The serial command *dump vtagemonitor* is sent. A list of board voltages is returned. The limits are: Low: 4.5 VDC High: 5.5 VDC

8. TEST +15V VOLTAGE MONITOR READBACK

The serial command *dump vtagemonitor* is sent. A list of board voltages is returned. The limits are: Low: 14.0 VDC High: 16.0 VDC

9. TEST -15V VOLTAGE MONITOR READBACK

The serial command *dump vtagemonitor* is sent. A list of board voltages is returned. The limits are: Low: -16.0 VDC High: -14.0 VDC

10. TEST +24V VOLTAGE MONITOR READBACK

The serial command *dump vtagemonitor* is sent. A list of board voltages is returned. The limits are: Low: 23.5 VDC High: 24.5 VDC

11. TEST 5V GND VOLTAGE MONITOR READBACK

The serial command *dump vtagemonitor* is sent. A list of board voltages is returned. The limits are: Low: -0.5 VDC High: 0.5 VDC

12. TEST FAN1 OUTPUT (J32_1 J32_3)

The Fan1 output voltage is measured at pins J32_1 and J32_3. The limits are: Low: 23.0 VDC High: 25.0 VDC

13. TEST FAN2 OUTPUT (J33_1 J33_3)

The Fan2 output voltage is measured at pins J33_1 and J33_3. The limits are: Low: 23.0 VDC High: 25.0 VDC

14. TEST EVENT IN 1 CLOSED INPUT (J18_1 TO J18_2 SHORTED)

A relay shorts pins J18_1 to J18_2. The serial command *peek 0x500038* is sent. The expected response is 01.

15. TEST EVENT IN 1 OPEN INPUT (J18_1 TO J18_2 OPENED)

A relay opens pins J18_1 to J18_2. The serial command *peek 0x500038* is sent. The expected response is 00.

16. TEST EVENT IN 2 CLOSED INPUT (J18_5 TO J18_6 SHORTED)

A relay shorts pins J18_5 to J18_6. The serial command *peek 0x500038* is sent. The expected response is 02.

17. TEST EVENT IN 2 OPEN INPUT (J18_5 TO J18_6 OPENED)

A relay opens pins J18_5 to J18_6. The serial command *peek 0x500038* is sent. The expected response is 00.

18. TEST LEAK DETECT - NOT CONNECTED STATE (J30_2 TO J30_3 1KOHM)

There is a 1K ohm resistor from pins J30_2 to J30_3. The serial command *peek 0x50003b* is sent. The expected response is 00.

19. TEST LEAK DETECT - CONNECTED STATE (J30_2 TO J30_3 1KOHM, J30_1 INPUT HIGH STATE)

Input pins J30_1 and J30_2 are connected together with an 82 ohm resistor using a relay. This provides a 3.2 vdc input to J30_1 of the Personality board. There is also a 1K ohm resistor from pins J30_2 to J30_3. The serial command *peek 0x50003b* is sent. The expected response is 02.

20. TEST LEAK DETECT - LEAK STATE (J30_2 TO J30_3 1KOHM, J30_2 INPUT LOW STATE)

The Input pin J30_3 is shorted to GND via a relay. The serial command *peek 0x50003b* is sent. The expected response is 01.

21. TEST STATUS LEDS VCC J8_1

The status LEDs voltage output is measured at pins J8_1 to J8_4.
The limits are: Low: 4.5 VDC High: 5.5 VDC

22. TEST STATUS LEDS J8_2 HIGH

The serial command *poke 0x500006 0x00* is sent. The status LEDs digital logic output is measured at pin J8_2. The output state is expected to be high.

23. TEST STATUS LEDS J8_2 LOW

The serial command *poke 0x500006 0x01* is sent. The status LEDs digital logic output is measured at pin J8_2. The output state is expected to be low.

24. TEST STATUS LEDS J8_3 HIGH

The serial command *poke 0x500006 0x00* is sent. The status LEDs digital logic output is measured at pin J8_3. The output state is expected to be high.

25. TEST STATUS LEDS J8_3 LOW

The serial command *poke 0x500006 0x02* is sent. The status LEDs digital logic output is measured at pin J8_3. The output state is expected to be low.

26. TEST GPV A OUTPUT ON (J21_5 TO J21_1)

A 75 ohm resistor is connected across J21_1 to J21_5. The serial command *gpvsetvalve A* is sent. The output voltage is measured across the resistor.
The limits are: Low: 3.5 VDC High: 5.5 VDC

27. TEST GPV A OUTPUT OFF (J21_5 TO J21_1)

A 75 ohm resistor is connected across J21_1 to J21_5. The serial command *gpvsetvalve B* is sent. The output voltage is measured across the resistor.
The limits are: Low: -1.0 VDC High: 1.0 VDC

28. TEST GPV B OUTPUT ON (J21_6 TO J21_2)

A 75 ohm resistor is connected across J21_2 to J21_6. The serial command *gpvsetvalve B* is sent. The output voltage is measured across the resistor.
The limits are: Low: 3.5 VDC High: 5.5 VDC

29. TEST GPV B OUTPUT OFF (J21_6 TO J21_2)

A 75 ohm resistor is connected across J21_2 to J21_6. The serial command *gpvsetvalve C* is sent. The output voltage is measured across the resistor.

The limits are: Low: -1.0 VDC High: 1.0 VDC

30. TEST GPV C OUTPUT ON (J21_7 TO J21_3)

A 75 ohm resistor is connected across J21_3 to J21_7. The serial command *gpvsetvalve C* is sent. The output voltage is measured across the resistor.

The limits are: Low: 3.5 VDC High: 5.5 VDC

31. TEST GPV C OUTPUT OFF (J21_7 TO J21_3)

A 75 ohm resistor is connected across J21_3 to J21_7. The serial command *gpvsetvalve D* is sent. The output voltage is measured across the resistor.

The limits are: Low: -1.0 VDC High: 1.0 VDC

32. TEST GPV D OUTPUT ON (J21_8 TO J21_4)

A 75 ohm resistor is connected across J21_4 to J21_8. The serial command *gpvsetvalve D* is sent. The output voltage is measured across the resistor.

The limits are: Low: 3.5 VDC High: 5.5 VDC

33. TEST GPV D OUTPUT OFF (J21_8 TO J21_4)

A 75 ohm resistor is connected across J21_4 to J21_8. The serial command *gpvsetvalve A* is sent. The output voltage is measured across the resistor.

The limits are: Low: -1.0 VDC High: 1.0 VDC

34. TEST SEAL WASH OUTPUT ON (J27_1 TO J27_2)

A 150 ohm resistor is connected across J27_1 to J27_2. The serial command *poke 0x500011 0x01* is sent. The output voltage is measured across the resistor.

The limits are: Low: 23.0 VDC High: 25.0 VDC

35. TEST SEAL WASH OUTPUT OFF (J27_1 TO J27_2)

A 150 ohm resistor is connected across J27_1 to J27_2. The serial command *poke 0x500011 0x00* is sent. The output voltage is measured across the resistor.

The limits are: Low: -1.0 VDC High: 1.0 VDC

36. TEST I2V CONNECTED INPUT OPEN STATE (J28_5 TO J28_6 OPEN)

A 10 ohm load resistor is connected across J28_1 to J28_3. Input pin J28_5 is open to J28_6. The serial command *peek 0x500019* is sent. The expected response is 00.

Note: J28 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP1388 J28_1, TP1386 J28_3, TP1387 J28_5, TP1104 J28_6.

37. TEST I2V CONNECTED INPUT SHORT STATE (J28_5 TO J28_6 SHORT)

A 10 ohm load resistor is connected across J28_1 to J28_3. Input pin J28_5 is shorted to J28_6 by a relay to simulate the connected state. The serial command *peek 0x500019* is sent. The expected response is 01.

Note: J28 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP1388 J28_1, TP1386 J28_3, TP1387 J28_5, TP1104 J28_6.

38. TEST I2V OUTPUT ON, CURENT 0 AMPS ((TP388) J28_1(+)) TO ((TP386) J28_3(-))

A 10 ohm load resistor is connected across J28_1 to J28_3. Input pin J28_5 is shorted to J28_6 by a relay to simulate the connected state.

The serial command *poke 0x50001A 0xFF* is sent. (To turn off watchdog).

The serial command *poke 0x50001D 0xFF* is sent. (To set for fast decay).

The serial command *poke 0x500009 0x00* is sent. (To set for minimum current).

The serial command *poke 0x500018 0x03* is sent. (To turn current on pos. direction).

The DC Voltage is measured across the 10 ohm load resistor.

The limits are: Low: -0.1 VDC High: 0.1 VDC

Note: J28 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP1388 J28_1, TP1386 J28_3, TP1387 J28_5, TP1104 J28_6.

39. TEST I2V OUTPUT ON, CURENT 0.2 AMPS ((TP388) J28_1(+) TO (TP386) J28_3(-))

A 10 ohm load resistor is connected across J28_1 to J28_3. Input pin J28_5 is shorted to J28_6 by a relay to simulate the connected state.

The serial command *poke 0x500009 0x34* is sent. (To set current for ~.2 amp).

The DC Voltage is measured across the 10 ohm load resistor.

The limits are: Low: 0.8 VDC High: 1.5 VDC

Note: J28 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP1388 J28_1, TP1386 J28_3, TP1387 J28_5, TP1104 J28_6.

40. TEST I2V OUTPUT ON, CURENT 0.45 AMPS ((TP388) J28_1(+) TO (TP386) J28_3(-))

A 10 ohm load resistor is connected across J28_1 to J28_3. Input pin J28_5 is shorted to J28_6 by a relay to simulate the connected state.

The serial command *poke 0x500009 0x77* is sent. (To set current for ~.45 amp).

The DC Voltage is measured across the 10 ohm load resistor.

The limits are: Low: 3.3 VDC High: 4.1 VDC

Note: J28 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP1388 J28_1, TP1386 J28_3, TP1387 J28_5, TP1104 J28_6.

41. TEST I2V OUTPUT ON, CURENT 0.3 AMPS ((TP388) J28_1(+) TO (TP386) J28_3(-))

A 10 ohm load resistor is connected across J28_1 to J28_3. Input pin J28_5 is shorted to J28_6 by a relay to simulate the connected state.

The serial command *poke 0x500009 0x51* is sent. (To set current for ~.3 amp).

The DC Voltage is measured across the 10 ohm load resistor.

The limits are: Low: 1.8 VDC High: 2.6 VDC

Note: J28 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP1388 J28_1, TP1386 J28_3, TP1387 J28_5, TP1104 J28_6.

42. TEST I2V OUTPUT ON, WATCHDOG TIMED-OUT ((TP388) J28_1(+) TO (TP386) J28_3(-))

A 10 ohm load resistor is connected across J28_1 to J28_3. Input pin J28_5 is shorted to J28_6 by a relay to simulate the connected state.

The serial command *poke 0x50001A 0x50* is sent. (To set the watchdog timeout to 2 seconds).

The test program then waits 3 seconds, to allow timeout.

The DC Voltage is measured across the 10 ohm load resistor.

The limits are: Low: -0.1 VDC High: 0.1 VDC

Note: J28 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP1388 J28_1, TP1386 J28_3, TP1387 J28_5, TP1104 J28_6.

43. TEST DEGASSER MOTOR DRIVE (J29 PINS 1-6)

A degasser motor is connected to the degasser motor output drive at J29 pins 1 through 6. The test fixture degasser motor is coupled to an encoder wheel. An optical sensor reads the encoder wheel and feeds the output to a digital counter.

The serial command *rundmotor* is sent.

The limits are: Low: 1550 counts High: 1650 counts

44. TEST DEGASSER STATUS ATMOSPHERIC PSI READBACK (J22 PINS 1-6 (TP288, 214, 1104, 405, 399, 1104))

A Degasser Transducer board is connected to J22 pins 1 through 6. The vacuum sensor on the Transducer board is left at atmospheric. The serial command *wdegasserstatus* is sent. The response is expected to be at atmospheric.

The limits are: Low: 14.0 PSIA High: 15.0 PSIA

Note: J22 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP288 J29_1, TP214 J29_2, TP1104 J29_3, TP405 J29_4, TP399 J29_5, TP1104 J29_6.

45. TEST DEGASSER STATUS VACUUM PSI READBACK (J22 PINS 1-6 (TP288, 214, 1104, 405, 399, 1104))

A Degasser Transducer board is connected to J22 pins 1 through 6. The vacuum sensor on the transducer board is set to vacuum state by a relay. The serial command *wdegasserstatus* is sent. The response is expected to be at vacuum.

The limits are: Low: -0.1 PSIA High: 0.9 PSIA

Note: J22 is a surface mount connector, therefore equivalent connector pin nets are probed via the following under board Test Points. TP288 J29_1, TP214 J29_2, TP1104 J29_3, TP405 J29_4, TP399 J29_5, TP1104 J29_6.

46. TEST RIGHT TRANSDUCER (ACCUMULATOR) LOW PSI READBACK (J31_7, J31_1, J31_6)

A resistor divider is used across J31 pins 7, 1, and 6 to provide a 0.5 VDC input at pin 1. This simulates approximately zero PSI from a transducer. The serial command *zerotransducers* is sent to zero the transducer reading. The serial *xread accum* is sent to get the reading.

The limits are: Low: -100. PSI High: 100. PSI

47. TEST RIGHT TRANSDUCER (ACCUMULATOR) HIGH PSI READBACK (J31_7, J31_1, J31_6)

A resistor divider is used across J31 pins 7, 1, and 6 to provide a 2.0 VDC input at pin 1. This simulates approximately 9300 PSI from a transducer. The serial *xread accum* is sent to get the reading.

The limits are: Low: 9100. PSI High: 9500. PSI

48. TEST LEFT TRANSDUCER (PRIMARY) LOW PSI READBACK (J31_9, J31_5, J31_10)

A resistor divider is used across J31 pins 9, 5, and 10 to provide a 0.5 VDC input at pin 5. This simulates approximately zero PSI from a transducer. The serial command *zerotransducers* is sent to zero the transducer reading. The serial *xread primary* is sent to get the reading.

The limits are: Low: -100. PSI High: 100. PSI

49. TEST LEFT TRANSDUCER (PRIMARY) HIGH PSI READBACK (J31_9, J31_5, J31_10)

A resistor divider is used across J31 pins 9, 5, and 10 to provide a 2.0 VDC input at pin 5. This simulates approximately 9300 PSI from a transducer. The serial *xread primary* is sent to get the reading.

The limits are: Low: 9100. PSI High: 9500. PSI

50. TEST PRIMARY MOTOR STEP ERROR CHECK (J10_5-8, J12_1-10)

A Primary Motor assembly with Encoder is connected to J10 pins 5 through 8 and J12 pins 1 through 10.

The serial command *mo* is sent. (This turns on the motors).

The serial command *dh* is sent. (This defines home for the motors).

The serial command *pr -x1 -v9000 -a9000 -b 15000* is sent. (This runs the motor).

The motor run response string is checked for any returned errors.
No errors are expected.

51. TEST PRIMARY MOTOR STEP CHECK (J10_5-8, J12_1-10)

A Primary Motor assembly with Encoder is connected to J10 pins 5 through 8 and J12 pins 1 through 10.

The serial command *gp* is sent. (This returns the motor position as read by the encoder).

The limits are: Low: 14980. steps High: 15020. steps

52. TEST ACCUMULATOR MOTOR STEP ERROR CHECK (J10_1-4, J13_1-10)

An Accumulator Motor assembly with Encoder is connected to J10 pins 1 through 4 and J13 pins 1 through 10.

The serial command *mo* is sent. (This turns on the motors).

The serial command *dh* is sent. (This defines home for the motors).

The serial command *pr -x2 -v9000 -a9000 -b 15000* is sent. (This runs the motor).

The motor run response string is checked for any returned errors.

No errors are expected.

53. TEST ACCUMULATOR MOTOR STEP CHECK (J10_1-4, J13_1-10)

An Accumulator Motor assembly with Encoder is connected to J10 pins 1 through 4 and J13 pins 1 through 10.

The serial command *gp* is sent. (This returns the motor position as read by the encoder).

The limits are: Low: 14980. steps High: 15020. steps

54. TEST VENT VALVE HOME POSITION ERROR CHECK (J19 AND J20)

A Vent Valve Motor assembly with Encoder is connected to J19 pins 1 through 8 and J20 pins 1 through 7.

The serial command *poke 0x500008 0x182* is sent. (This sets the current).

The serial command *sphome ventvalve* is sent. (This runs the motor to home position).

The motor run response string is checked for any returned errors.

No errors are expected.

55. TEST VENT VALVE POSITIVE STEP CHECK (J19 AND J20)

A Vent Valve Motor assembly with Encoder is connected to J19 pins 1 through 8 and J12 pins 1 through 7.

The serial command *mmovr ventvalve 15000* is sent. (This moves the motor).

The serial command *spshow ventvalve* is sent. (This returns the motor position).

The limits are: Low: 24. steps High: 25. steps

56. TEST SSVALVE HOME POSITION ERROR CHECK (J24 AND J25)

A Six Port SSValve Motor assembly with Encoder is connected to J24 pins 1 through 8 and J25 pins 1 through 7.

The serial command *poke 0x50000A 0x182* is sent. (This sets the current).

The serial command *sphome ssvalve* is sent. (This runs the motor to home position).

The motor run response string is checked for any returned errors.

No errors are expected.

57. TEST SSVALVE POSITIVE STEP CHECK (J24 AND J25)

A Six Port SSValve Motor assembly with Encoder is connected to J24 pins 1 through 8 and J25 pins 1 through 7.

The serial command *mmovr ssvalve 15000* is sent. (This moves the motor).
The serial command *spshow ssvalve* is sent. (This returns the motor position).
The limits are: Low: 24. steps High: 25. steps