T300/T350 Scrub Board Functional Test Procedure

Part Number: 1225593

Revision Table

Revision	Changes	Name	Date
1		DKW	3/27/2015
1.5	Zander	TWB	10/13/15
2	Updated Chempump Speed Set Test	TWB	3/29/16
3	Updated chempump test current limit.	DKW	8/24/2016
4	Updated for Monaco	CAH	3/17/2017
5	Scrub motor current test revision	CAH	1/02/2019
6	Added Alternate 1 test methods Update Chem pump (alternate 1) and H20 pump tests (alternate 1)	BAP	8/5/2022
7	Updated alternate 1 resistance values to 33 ohms for the valve output and 22 ohms for all the other outputs Update I-Drive load resistance to 1k ohm	BAP	8/23/2022
8	Update step 35 in Initial Power/Switch Input Tests with new acceptance criteria for a 1kohm load	BAP	10/28/2022
9	• Update step 35 in Initial Power/Switch Input Tests with new acceptance criteria for a 1kohm load (new value is 8.6V) • Section Scrub Motor Driver: Fix typo in step 14 so that the output turns off • Section Scrub Motor Driver (Alternate 1): Fix typo in step 14 so that the output turns off • "Section Actuator Bridge Driver Test: All of the current reading bounds have been updated to be the correct order of magnitude (steps 13, 25, 31, and 38) • Section Actuator Bridge Driver Test (Alternate 1): All of the current reading bounds have been updated to be the correct order of magnitude (steps 13, 26, 32, and 39) • Section Actuator Bridge Driver Test: Remove steps 21 through 40 as software does not support current limits over 5A • Section Actuator Bridge Driver Test (alternate 1): Remove steps 22 through 41 as software does not support current limits over 5A	BAP	11/30/2022

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.

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 75A load. Power is applied as indicated: COM goes to large screw stud J7 and J4-8, J8-8, J8-10, J9-10. +24V goes to small screw stud J6, J8-1, J8-7.

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.

Initial Power/Switch Input Tests:

1. Apply 24V to J4-1.
2. Read EC-water Pump Motor Circuit Breaker by sending the following command: **read CAN index 0x3085 subindex 0x01.** Bit 7 must be 0.
3. Remove 24V from J4-1.
4. Read EC-water Pump Motor Circuit Breaker by sending the following command: **read CAN index 0x3085 subindex 0x01.** Bit 7 must be 1.
5. Apply 24V to J4-2.
6. Read EC-water Circuit Breaker by sending the following command: **read CAN index 0x3085 subindex 0x01.** Bit 5 must be 0.
7. Remove 24V from J4-2.
8. Read EC-water Circuit Breaker by sending the following command: **read CAN index 0x3085 subindex 0x01.** Bit 5 must be 1.
9. J4-4 should be floating.
10. Read chemical tank switch by sending the following command: **read CAN index 0x3083 subindex 0x01.** Bit 5 must be 1.
11. Short J4-4 to ground.
12. Read chemical tank switch by sending the following command: **read CAN index 0x3083 subindex 0x01.** Bit 5 must be 0.
13. J4-5 should be floating.
14. Read scrub head down switch by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 4 must be 0.
15. Short J4-5 to ground.
16. Read scrub head down switch by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 4 must be 1.
17. J4-6 should be floating.
18. Read parking brake switch by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 6 must be 0.
19. Short J4-6 to ground.

20. Read parking brake switch by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 6 must be 1.
21. J4-7 should be floating.
22. Read squeegee down switch by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 2 must be 0.
23. Short J4-7 to ground.
24. Read squeegee down switch by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 2 must be 1.
25. Wait 10 seconds.
26. Read VBAT_POWER_MONITOR_ANALOG by sending the following command: **read CAN index 0x3042 subindex 0x07 bytes 0 and 1.** Reading is measured voltage x 100. Reading must come back within ±4% of 24.0V. (2304 < reading < 2496)
27. Apply 24V to J9-2.
28. Read E-stop switch out by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 0 must be 0.
29. Turn off I-Drive enable by sending the following command: **write 0 to CAN index 0x30A0 subindex 0x01.** Measure pin J9-1 WRT common with a DMM. Must measure 0V±.5V.
30. Turn on I-Drive enable by sending the following command: **write 1 to CAN index 0x30A0 subindex 0x01.** Measure pin J9-1 WRT common with a DMM. Must measure 24V±2V.
31. Pull the net RESET_DRIVERS/ low with an open drain output.
32. Measure pin J9-1 WRT common with a DMM. Must measure 0V±.5V.
33. Remove the external bias from net RESET_DRIVERS/
34. Test current limiting on I-Drive enable output by applying a 100Ω 5W load between J9-1 and common.
    a. **Alternate 1**: It is acceptable to use a 1kΩ 0.5W load
35. Measure pin J9-1 WRT common with a DMM. Must measure 1.0V±0.4V.
    a. **Alternate 1:** Measure pin J9-1 WRT common with a DMM. Must measure 8.64V±0.4V**.**
36. Remove load from J9-1.
37. Remove 24V from J9-2.
38. Read E-stop switch out by sending the following command: **read CAN index 0x3080 subindex 0x01.** Bit 0 must be 1.
39. Apply 24V to J9-7.
40. Read I-Drive Circuit Breaker by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 7 must be 0.
41. Remove 24V from J9-7.
42. Read I-Drive Circuit Breaker Circuit Breaker by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 7 must be 1.
43. J9-3 should be floating.
44. Read I-drive Aux2 by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 0 must be 0.
45. Short J9-3 to ground.

46. Read I-drive Aux2 by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 0 must be 1.
47. J9-4 should be floating.
48. Read I-drive Aux3 by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 5 must be 0.
49. Short J9-4 to ground.
50. Read I-drive Aux3 by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 5 must be 1.
51. J9-5 should be floating.
52. Read I-drive status by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 6 must be 0.
53. Short J9-5 to ground.
54. Read I-drive status by sending the following command: **read CAN index 0x30A1 subindex 0x01.** Bit 6 must be 1.
55. Power Cycle board to remove any faults

<u>Serial Flash Test:</u>

1. Write the board serial number to the serial EEPROM by sending the following command: Write the serial number into parameter 1999. (ASCII is fine for the characters) as below:
    a. **Write object 0x2000 sub-index 0x02 with data { 00, 01, CF, 07, 1E, 00, 00, 00, __, __, __, …}**
    b. **Example serial number 123456 = {00, 01, CF, 07, 1E, 00, 00, 00, 31, 32, 33, 34, 35, 36 }**
    c. **Read object 0x2000 sub-index 0x01 and verify array = { 00, 01, CF, 07, 00, 00, 00, 00}}**
2. Read back the board serial number from the serial EEPROM by sending the following command: Read the serial number from parameter 1999 as below:
    a. **Write object 0x2000 sub-index 0x02 with data {00, 00, CF, 07, 1E, 00, 00, 00}**
    b. **Read object 0x2000 sub-index 0x01 and verify array = { 00, 00, CF, 07, 1E, 00, 00, 00, __, __, __, …}**

<u>Hour meter Test:</u>

1. Test the hour meter output by reading pin J8-9 WRT common with a DMM. Must read 0V.
2. The rest of the hour meter test is in the scrub motor test section.

<u>Chempump Speed Set Test:</u>

1. Connect J8-11 to ground.
2. Read the chempump pot by sending the following command: **read CAN index 0x3083 subindex 0x02 bytes 0 and 1.** Reading is a percentage of full scale, where full scale = 2.7V. Reading from the UUT must be 0 to 50.
3. Connect J8-11 to a source of 1.024V.
4. Read the chempump pot by sending the following command: **read CAN index 0x3083 subindex 0x02 bytes 0 and 1.** Reading from the UUT must be 355±5%.

5. Connect J8-11 to a source of 2.048V.
6. Read the chempump pot by sending the following command: **read CAN index 0x3083 subindex 0x02 bytes 0 and 1.** Reading from the UUT must be 709±5%.

<u>Valve LSD Test:</u>

1. Apply open load to the valve low side driver.
2. Turn on the valve driver by sending the following command: **Write 1 to CAN index 0x3050 subindex 0x01.**
3. This runs the valve driver at 100% duty cycle with a current limit of 1.0A into an open load.
4. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** 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).
5. Power cycle the UUT to clear the fault.
6. Apply a 50Ω 50W load to the valve driver.
7. Turn on the valve driver by sending the following command: **Write 1 to CAN index 0x3050 subindex 0x01.** This runs the valve driver at 100% duty cycle with a current limit of 1.0A.
8. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** 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).
9. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve current must be 0.48A±0.1A. Reading is current x 100 so (38 < reading < 58)
10. Turn off valve driver by sending the following command: **Write 2 to CAN index 0x3050 subindex 0x01.**
11. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
12. Apply a 15Ω 50W load to the valve driver.
13. Turn on the valve driver by sending the following command: **Write 1 to CAN index 0x3050 subindex 0x01.** This runs the valve driver at 100% duty cycle with a current limit of 1.0A into a load that wants to take 1.6A.
14. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** Bit 1 must be 1. (bit 1 is overcurrent) Bit 2 must be 0 (bit 2 is open load).
15. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve 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.

<u>Valve LSD Test (Alternate 1):</u>

1. Apply open load to the valve low side driver.

2. Turn on the valve driver by sending the following command: **Write 1 to CAN index 0x3050 subindex 0x01.**
3. This runs the valve driver at 100% duty cycle with a current limit of 1.0A into an open load.
4. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** 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).
5. Power cycle the UUT to clear the fault.
6. Apply a 33Ω 50W load to the valve driver.
7. Turn on the valve driver by sending the following command: **Write 1 to CAN index 0x3050 subindex 0x01.** This runs the valve driver at 100% duty cycle with a current limit of 1.0A.
8. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** 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).
9. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve current must be 0.73A±0.1A. Reading is current x 100 so (76 < reading < 96)
10. Turn off valve driver by sending the following command: **Write 2 to CAN index 0x3050 subindex 0x01.**
11. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
12. Inject a voltage of 20mV into pin 1 of U54
13. Turn on the valve driver by sending the following command: **Write 1 to CAN index 0x3050 subindex 0x01.** This runs the valve driver at 100% duty cycle with the injected voltage representing a steady state current of 0.9A.
14. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** Bit 1 must be 0. (bit 1 is overcurrent) Bit 2 must be 0 (bit 2 is open load).
15. Increase the voltage at pin 1 of U54 to 25.8mV, which represents a steady state current of 1.2A
16. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve current must be 1.2A±0.1A. Reading is current x 100 so (110 < reading < 130)
17. Remove the injected voltage from pin 1 of U54
18. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** Bit 1 must be 1. (bit 1 is overcurrent) Bit 2 must be 0 (bit 2 is open load).
19. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
20. Power cycle the UUT to clear the fault.

<u>Digital Power Monitor Circuit Test:</u>

1. This tests the circuit's ability to shut down the drivers if the system power is low voltage. It uses the valve driver circuit to test this.
2. Lower the 24V supply to 10V.
    a. Alternate 1:Verify 10V is applied by measuring the net 'B+_GOOD'
    b. Alternate 1: Measure voltage at the net RESET_DRIVERS/. The voltage shall be less than 0.5V
3. Apply a 15Ω 50W load to the valve driver.
4. Turn on the valve driver by sending the following command: **Write 1 to CAN index 0x3050 subindex 0x01.** This runs the valve driver at 100% duty cycle with a current limit of 1.0A, however the power monitor circuit should inhibit operation.
5. Read valve driver status by sending the following command: **read CAN index 0x3051 subindex 0x01.** 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).
6. Read valve current by sending the following command: **read CAN index 0x3051 subindex 0x03 bytes 0 and 1.** Valve current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
7. Power cycle the UUT to clear the fault.
8. Restore power to 24.0V.

<u>Global Reset (Alternate 1):</u>

1. This tests the circuit's ability to shut down the drivers if the micro resets.
2. Pull the net RESET/ low with an open drain output.
3. Measure voltage at the net RESET_DRIVERS/. The voltage shall be less than 0.5V
4. Power cycle board to reset any faults

<u>Chem Pump LSD Test:</u>

1. Apply open load to the chem pump low side driver.
2. Turn on the chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the chem pump driver at 50% duty cycle with a current limit of 1.0A into an open load.
3. Read chem pump driver status by sending the following command: **read CAN index 0x3091 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 30Ω 50W load to the chem pump driver.
6. Turn on the chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the chem pump driver at 50% duty cycle with a current limit of 1.0A into a load that wants to draw 0.8A.

7. Read chem pump status by sending the following command: **read CAN index 0x3091 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 chem pump current by sending the following command**: read CAN index 0x3091 subindex 0x03 bytes 0 and 1.** Chem pump current must be 0.66A±0.1A. Reading is current x 100 so (56 < reading < 76)
9. Read chem pump output voltage with a meter at the output connector. J8-6 must be 12V ±1V WRT J8-10. (8.5V±1V if not measured with a true RMS meter)
10. Turn off chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
11. Read chem pump current by sending the following command**: read CAN index 0x3091 subindex 0x03 bytes 0 and 1.** Chem pump current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
12. Apply an 8Ω 50W load to the chem pump driver.
13. Turn on the chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the chem pump driver at 50% duty cycle with a current limit of 2.0A into a load that wants to take 3.0A.
14. Read chem pump status by sending the following command: **read CAN index 0x3091 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 chem pump current by sending the following command**: read CAN index 0x3091 subindex 0x03 bytes 0 and 1.** Chem 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.

<u>Chem Pump LSD Test (Alternate 1):</u>

1. Apply open load to the chem pump low side driver.
2. Turn on the chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the chem pump driver at 50% duty cycle with a current limit of 1.0A into an open load.
3. Read chem pump driver status by sending the following command: **read CAN index 0x3091 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 22Ω 50W load to the valve driver.
6. Turn on the chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the chem pump driver at 50% duty cycle with a current limit of 2.0A.
7. Read chem pump status by sending the following command: **read CAN index 0x3091 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 chem pump current by sending the following command**: read CAN index 0x3091 subindex 0x03 bytes 0 and 1.** Chem pump current must be 1.09A±0.1A. Reading is current x 100 so (119 < reading < 139)
9. Read chem pump output voltage with a meter at the output connector. J8-6 must be 12V ±1V WRT J8-10. (8.5V±1V if not measured with a true RMS meter)
10. Turn off chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
11. Read chem pump current by sending the following command**: read CAN index 0x3091 subindex 0x03 bytes 0 and 1.** Chem pump current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
12. Inject a voltage of 200mV at pin 1 of U42
13. Turn on the chem pump driver by sending the following command: **Write to CAN index 0x3090 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
14. This runs the chem pump driver at 50% duty cycle with a current limit of 2.0A with the injected voltage representing a steady state current of 1.8A.
15. Increase the voltage at pin 1 of U42 to 230mV, which represents 2.1A of load current
16. Read chem pump status by sending the following command: **read CAN index 0x3091 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).
17. Read chem pump current by sending the following command**: read CAN index 0x3091 subindex 0x03 bytes 0 and 1.** Chem pump current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
18. Power cycle the UUT to clear the fault.

<u>H2O Pump/IDRIVE Forward LSD Test: (MONACO ONLY)</u>

1. Apply open load to the H2O Pump/IDRIVE Forward low side driver.
2. Turn on the Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the Pump/IDRIVE driver at 50% duty cycle with a current limit of 1.0A into an open load.
3. Read Pump/IDRIVE driver status by sending the following command: **read CAN index 0x30B1 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 30Ω 50W load to the Pump/IDRIVE driver.
6. Turn on the Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the Pump/IDRIVE driver at 50% duty cycle with a current limit of 1.0A into a load that wants to draw 0.8A.
7. Read Pump/IDRIVE status by sending the following command: **read CAN index 0x30B1 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 Pump/IDRIVE current by sending the following command**: read CAN index 0x30B1 subindex 0x03 bytes 0 and 1.** Pump/IDRIVE current must be 0.66A±0.1A. Reading is current x 100 so (56 < reading < 76)
9. Read Pump/IDRIVE output voltage with a meter at the output connector. J8-5 must be 12V ±1V WRT J8-8. (8.5V±1V if not measured with a true RMS meter)
10. Turn off Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
11. Read Pump/IDRIVE current by sending the following command**: read CAN index 0x30B1 subindex 0x03 bytes 0 and 1.** Pump/IDRIVE current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
12. Apply an 8Ω 50W load to the Pump/IDRIVE driver.
13. Turn on the Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the Pump/IDRIVE driver at 50% duty cycle with a current limit of 2.0A into a load that wants to take 3.0A.
14. Read Pump/IDRIVE status by sending the following command: **read CAN index 0x30B1 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 Pump/IDRIVE current by sending the following command**: read CAN index 0x30B1 subindex 0x03 bytes 0 and 1.** Pump/IDRIVE 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.

<u>H2O Pump/IDRIVE Forward LSD Test (Alternate 1)</u>

1. Apply open load to the H2O Pump/IDRIVE Forward low side driver.
2. Turn on the Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.** This runs the Pump/IDRIVE driver at 50% duty cycle with a current limit of 1.0A into an open load.
3. Read Pump/IDRIVE driver status by sending the following command: **read CAN index 0x30B1 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 22Ω 50W load to the H20 pump driver.
6. Turn on the Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
7. This runs the Pump/IDRIVE driver at 50% duty cycle with a current limit of 2.0A.
8. Read Pump/IDRIVE status by sending the following command: **read CAN index 0x30B1 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).

19. Read Pump/IDRIVE current by sending the following command**: read CAN index 0x30B1 subindex 0x03 bytes 0 and 1.** Pump/IDRIVE current must be 1.09A±0.1A. Reading is current x 100 so (119 < reading < 139)
9. Read Pump/IDRIVE output voltage with a meter at the output connector. J8-5 must be 12V ±1V WRT J8-8. (8.5V±1V if not measured with a true RMS meter)
10. Turn off Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
11. Read Pump/IDRIVE current by sending the following command**: read CAN index 0x30B1 subindex 0x03 bytes 0 and 1.** Pump/IDRIVE current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
12. Inject a voltage of 200mV at pin 1 of U46
13. Turn on the Pump/IDRIVE driver by sending the following command: **Write to CAN index 0x30B0 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
14. This runs the chem pump driver at 50% duty cycle with a current limit of 2.0A with the injected voltage representing a steady state current of 1.8A.
15. Increase the voltage at pin 1 of U46 to 230mV, which represents 2.1A of load current
16. Read Pump/IDRIVE status by sending the following command: **read CAN index 0x30B1 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).
17. Read Pump/IDRIVE current by sending the following command**: read CAN index 0x30B1 subindex 0x03 bytes 0 and 1.** Pump/IDRIVE current must be 0.0A±0.1A. Reading is current x 100 so (0 < reading < 10)
18. Power cycle the UUT to clear the fault.

<u>Vac Fan Driver Test:</u>

1. Commands will be sent to control the vac fan driver on the UUT, which has resistive loads applied to its outputs (across J10-5 to J10-6).
2. Apply open load to the vac fan driver.
3. Turn on the vac fan driver by sending the following commands:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
4. This runs the vac fan driver at 50% duty cycle with a current limit of 5.0A into an open load.
5. Read vac fan driver status by sending the following command: **read CAN index 0x3041 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).
6. Read the vac fan current by sending the following commands**: read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 0.0A±0.5A. Reading is current x 100 so (0 < reading < 50)
7. Power cycle the UUT to clear the fault.
8. Apply a 1.25Ω 500W load to the vac fan driver.

9. Turn on the vac fan driver by sending the following commands:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 2500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
10. This runs the vac fan driver at 50% duty cycle with a current limit of 25.0A into a load that wants to draw 19.2A.
11. Read vac fan driver status by sending the following command: **read CAN index 0x3041 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).
12. Read the vac fan current by sending the following commands**: read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 18±1A. Reading is current x 100 so (1700 < reading < 1900).
13. Stop the vac fan motor driver by sending the following command: **Write to CAN index 0x3040 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
14. Read the vac fan current by sending the following commands**: read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 0.0A±0.5A. Reading is current x 100 so (0 < reading < 50)
15. Apply a 0.75Ω 1000W load to the vac fan driver.
16. Turn on the vac fan driver by sending the following command:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 2500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
17. This runs the vac fan driver at 50% duty cycle with a current limit of 25.0A into a load that wants to draw 32A.
18. Read vac fan driver status by sending the following command: **read CAN index 0x3041 subindex 0x01.** Bit 6 must be 1 (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).
19. Read the vac fan current by sending the following commands**: read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 0.0A±0.5A. Reading is current x 100 so (0 < reading < 50)
20. Power cycle the UUT to clear the fault.
21. Apply a 1.25Ω 500W load to the vac fan driver. Turn on the vac fan driver by sending the following command:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 2500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 2300, byte 3 = 0.**
22. This runs the vac fan driver at 95% duty cycle with a current limit of 25A.
23. Read vac fan driver status by sending the following command: **read CAN index 0x3041 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).
24. Read vac fan output voltage with a meter at the output connector. J10-5 must be 22V ±2V WRT J10-6.
25. Stop the vac fan motor driver by sending the following command: **Write to CAN index 0x3040 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**

Vac Fan Driver Test (Alternate 1):

1. Commands will be sent to control the vac fan driver on the UUT, which has resistive loads applied to its outputs (across J10-5 to J10-6).
2. Apply open load to the vac fan driver.
3. Turn on the vac fan driver by sending the following commands:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
4. This runs the vac fan driver at 50% duty cycle with a current limit of 5.0A into an open load.
5. Read vac fan driver status by sending the following command: **read CAN index 0x3041 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).
6. Read the vac fan current by sending the following commands**: read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 0.0A±0.5A. Reading is current x 100 so (0 < reading < 50)
7. Power cycle the UUT to clear the fault.
8. Apply a voltage divider of one 22Ω 50W resistor and one 330Ω 50W resistor to the vac fan output. R1 shall be connected between J10-5 and J10-6. R2 shall be connected between J10-6 and J7 (GND)
9. Measure the voltage at J10-6. It shall be 22.5V ±0.5V
10. Turn on the vac fan driver by sending the following commands:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
11. This runs the vac fan driver at 50% duty cycle with a current limit of 5.0A.
12. Measure the voltage at J10-6 with an ADC with a minimum sampling rate of 10kHz.
    a. When the high side FET is on, the voltage shall be 24V ±0.5V
    b. When the low side FET is on, the voltage shall be 0V ±0.5V
13. Stop the vac fan motor driver by sending the following command: **Write to CAN index 0x3040 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
14. Inject a voltage of 25.8mV at pin 3 of U24
15. Turn on the vac fan driver by sending the following commands:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 2500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
16. This runs the vac fan driver at 50% duty cycle with a current limit of 25.0A with the injected voltage representing a steady state current of 19A.
17. Read vac fan driver status by sending the following command: **read CAN index 0x3041 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).

18. Read the vac fan current by sending the following commands: **read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 19±1A. Reading is current x 100 so (1700 < reading < 1900).
19. Stop the vac fan motor driver by sending the following command: **Write to CAN index 0x3040 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
20. Read the vac fan current by sending the following commands: **read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 0.0A±0.5A. Reading is current x 100 so (0 < reading < 50)
21. Inject a voltage of 26.8mV at pin 3 of U24
22. Turn on the vac fan driver by sending the following command:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 2500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
23. This runs the vac fan driver at 50% duty cycle with a current limit of 25.0A with the injected voltage representing a steady state current of 20A.
24. Increase the voltage at pin 3 of U24 to 32.8mV. 32.8mV represents 26A of load current
25. Read vac fan driver status by sending the following command: **read CAN index 0x3041 subindex 0x01.** Bit 6 must be 1 (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).
26. Remove the injected voltage from pin3 of U24
27. Read the vac fan current by sending the following commands: **read CAN index 0x3041 subindex 0x03 bytes 0 and 1.** Vac fan current must be 0.0A±0.5A. Reading is current x 100 so (0 < reading < 50)
28. Power cycle the UUT to clear the fault.
29. Apply a 22Ω 50W resistor to the output
30. Turn on the vac fan driver by sending the following command:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 2500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 2300, byte 3 = 0.**
31. This runs the vac fan driver at 95% duty cycle with a current limit of 25A.
32. Read vac fan driver status by sending the following command: **read CAN index 0x3041 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).
33. Read vac fan output voltage with a meter at the output connector. J10-5 must be 22V ±2V WRT J10-6.
34. Stop the vac fan motor driver by sending the following command: **Write to CAN index 0x3040 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**

Scrub Motor Driver Test:

1. Commands will be sent to control the scrub motor driver on the UUT, which has resistive loads applied to its outputs (across J10-1 to J10-3).
2. Apply open load to the scrub motor driver.
3. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 50.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 1200.**
4. This runs the scrub motor driver at 50% duty cycle with a current limit of 5.0A into an open load.
5. Read scrub motor driver status by sending the following command: **read CAN index 0x3001 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).
6. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 0.0A±0.5A. Reading is current x 10 so (0 < reading < 5)
7. Power cycle the UUT to clear the fault.
8. Apply a 0.625Ω 1000W load to the scrub motor driver.
9. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 1200.**
10. This runs the scrub motor driver at 50% duty cycle with a current limit of 50.0A into a load that wants to draw 38.4A.
11. Read scrub motor driver status by sending the following command: **read CAN index 0x3001 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).
12. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 35.2A+2,-4A. Reading is current x 10 so (312 < reading <372).
13. Test the hour meter output by reading pin J8-9 WRT common with a DMM. Must read over 4.0V. (hour meter runs only when the scrub motor does)
14. Stop the scrub motor driver by sending the following command: **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 00.**
15. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 0A±2A. Reading is current x 10 so (0 < reading < 20)
16. Apply a 0.375Ω 1500W load to the scrub motor driver.
17. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 1200.**
18. This runs the scrub motor driver at 50% duty cycle with a current limit of 50.0A into a load that wants to draw 64A.
19. Read scrub motor driver status by sending the following command: **read CAN index 0x3001 subindex 0x01.** Bit 6 must be 1 (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).

20. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 0A±2A. Reading is current x 10 so (0 < reading < 20)
21. Power cycle the UUT to clear the fault.
22. Apply a 0.625Ω 1000W load to the scrub motor driver.
23. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 2300.**
24. This runs the scrub motor driver at 95% duty cycle with a current limit of 50A into a load that wants to draw 38.4A.
25. Read scrub motor output voltage with a meter at the output connector. J10-1 must be 22V ±2V WRT J10-3.
26. Stop the scrub motor driver by sending the following command: **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 00.**

<u>Scrub Motor Driver Test (Alternate 1):</u>

1. Commands will be sent to control the scrub motor driver on the UUT, which has resistive loads applied to its outputs (across J10-1 to J10-3).
2. Apply open load to the scrub motor driver.
3. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 50.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 1200.**
4. This runs the scrub motor driver at 50% duty cycle with a current limit of 5.0A into an open load.
5. Read scrub motor driver status by sending the following command: **read CAN index 0x3001 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).
6. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 0.0A±0.5A. Reading is current x 10 so (0 < reading < 5)
7. Power cycle the UUT to clear the fault.
8. Apply a voltage divider of one 22Ω 50W resistor and one 330Ω 50W resistor to the vac fan output. R1 shall be connected between J10-1 and J10-3. R2 shall be connected between J10-6 and J7 (GND)
9. Measure the voltage at J10-3. It shall be 22.5V ±0.5V
10. Turn on the vac fan driver by sending the following commands:
    a. **Write to CAN index 0x3042 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3040 subindex 0x01 byte0=1, bytes 1 and 2 = 1200, byte 3 = 0.**
11. This runs the vac fan driver at 50% duty cycle with a current limit of 5.0A.
12. Measure the voltage at J10-3 with an ADC with a minimum sampling rate of 10kHz.
    a. When the high side FET is on, the voltage shall be 24V ±0.5V

    b. When the low side FET is on, the voltage shall be 0V ±0.5V

13. Stop the vac fan motor driver by sending the following command: **Write to CAN index 0x3040 subindex 0x01 byte0=2, bytes 1 and 2 = 00, byte 3 = 0.**
14. Inject a voltage of 44.8mV at pin 3 of U27
15. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 1200.**
16. This runs the scrub motor driver at 50% duty cycle with the injected voltage representing a steady state current of 38A.
17. Read scrub motor driver status by sending the following command: **read CAN index 0x3001 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).
18. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 38A+2,-4A. Reading is current x 10 so (312 < reading <372).
19. Test the hour meter output by reading pin J8-9 WRT common with a DMM. Must read over 4.0V. (hour meter runs only when the scrub motor does)
20. Stop the scrub motor driver by sending the following command: **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 00.**
21. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 0A±2A. Reading is current x 10 so (0 < reading < 20)
22. Inject a voltage of 54.8mV at pin 3 of U27
23. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 1200.**
24. This runs the vac fan driver at 50% duty cycle with a current limit of 25.0A with the injected voltage representing a steady state current of 48A.
25. Increase the voltage at pin 3 of U27 to 58.7mV, which represents 52A of load current
26. Read scrub motor driver status by sending the following command: **read CAN index 0x3001 subindex 0x01.** Bit 6 must be 1 (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).
27. Read the scrub motor current by sending the following commands**: read CAN index 0x3001 subindex 0x03 bytes 0 and 1.** Scrub motor current must be 0A±2A. Reading is current x 10 so (0 < reading < 20)
28. Power cycle the UUT to clear the fault.
29. Apply a 22Ω 50W resistor to the output
30. Turn on the scrub motor driver by sending the following command:
    a. **Write to CAN index 0x3002 subindex 0x01 bytes 0 and 1 = 500.**
    b. **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 2300.**
31. This runs the scrub motor driver at 95% duty cycle with a current limit of 50A.

32. Read scrub motor output voltage with a meter at the output connector. J10-1 must be 22V ±2V WRT J10-3.
33. Stop the scrub motor driver by sending the following command: **Write to CAN index 0x3000 subindex 0x01 bytes 0 and 1 = 00.**
34. End of test. Power off.

<u>Actuator Bridge Driver Test:</u>

1. Commands will be sent to control the actuator driver on the UUT, which has resistive loads applied to its outputs (across J8-3 to J8-4).
2. Apply open load to the actuator driver.
3. Turn on the actuator driver by sending the following commands:
    a. **Write 500 to CAN index 0x3022 subindex 0x01 bytes 0 and 1. (sets current limit to 5.0A)**
    b. **Write to CAN index 0x3020 subindex 0x01, bytes 1 and 2 = 500, and byte 0 = 4. (sets PWM to 50%, sets extend direction)**
4. This "extends" the actuator at 50% duty cycle with a current limit of 5.0A, driving an open load.
5. Read actuator driver status by sending the following command: **read CAN index 0x3021 subindex 0x01 byte 0.** Bit 5 must be 0. (bit 5 = short) Bit 4 must be 0. (bit 4 = overcurrent)
6. **Read CAN index 0x3021 subindex 0x04 byte 0.** Byte 0 must read 3 (at extend limit = open circuit while extending)
7. Read actuator current by sending the following command: **read CAN index 0x3021 subindex 0x05 bytes 0 and 1.** Actuator current must be 0A±0.2A. Reading is current x 100 so (0 < reading < 20)
8. Power cycle the UUT to clear the fault.
9. Apply an 8Ω 100W load to the actuator driver.
10. Turn on the actuator driver by sending the following commands:
    a. **Write 500 to CAN index 0x3022 subindex 0x01 bytes 0 and 1. (sets current limit to 5.0A)**
    b. **Write 500 to CAN index 0x3020 subindex 0x01 bytes 1 and 2, and 4 to byte 0. (sets PWM to 50%, sets extend direction)**
11. This "extends" the actuator at 50% duty cycle with a current limit of 5.0A into a load that wants to draw 3.0A.
12. Read actuator driver status by sending the following command: **read CAN index 0x3021 subindex 0x01 byte 0.** Bit 5 must be 0. (bit 5 = short) Bit 4 must be 0. (bit 4 = overcurrent)
13. Read actuator current by sending the following command: **read CAN index 0x3021 subindex 0x05 bytes 0 and 1.** Actuator current must be 3.0A±0.3A. Reading is current x 100 so (270 < reading < 330)
14. Stop the actuator motor driver by sending the following command: **Write 0 to CAN index 0x3022 subindex 0x01 bytes 1 and 2, and 4 to byte 0. (sets PWM to 0%, sets extend direction)**
15. Apply a 4Ω 200W load to the actuator driver.
16. Turn on the actuator driver by sending the following commands:

   a. **Write 500 to CAN index 0x3022 subindex 0x01 bytes 0 and 1. (sets current limit to 5.0A)**
   b. **Write 500 to CAN index 0x3020 subindex 0x01 bytes 1 and 2, and 4 to byte 0. (sets PWM to 50%, sets extend direction)**
17. This "extends" the actuator at 50% duty cycle with a current limit of 5.0A, with a load that wants to draw 6.0A.
18. Read actuator driver status by sending the following command: **read CAN index 0x3021 subindex 0x01 byte 0.** Bit 5 must be 1. (bit 5 = short)
19. Read actuator current by sending the following command: **read CAN index 0x3021 subindex 0x05 bytes 0 and 1.** Actuator current must be 0A±0.2A. Reading is current x 100 so (0 < reading < 20)
20. Power cycle the UUT to clear the fault.

<u>Actuator Bridge Driver Test (Alternate 1):</u>

1. Commands will be sent to control the actuator driver on the UUT, which has resistive loads applied to its outputs (across J8-3 to J8-4).
2. Apply open load to the actuator driver.
3. Turn on the actuator driver by sending the following commands:
   a. **Write 500 to CAN index 0x3022 subindex 0x01 bytes 0 and 1. (sets current limit to 5.0A)**
   b. **Write to CAN index 0x3020 subindex 0x01, bytes 1 and 2 = 500, and byte 0 = 4. (sets PWM to 50%, sets extend direction)**
4. This "extends" the actuator at 50% duty cycle with a current limit of 5.0A, driving an open load.
5. Read actuator driver status by sending the following command: **read CAN index 0x3021 subindex 0x01 byte 0.** Bit 5 must be 0. (bit 5 = short) Bit 4 must be 0. (bit 4 = overcurrent)
6. **Read CAN index 0x3021 subindex 0x04 byte 0.** Byte 0 must read 3 (at extend limit = open circuit while extending)
7. Read actuator current by sending the following command: **read CAN index 0x3021 subindex 0x05 bytes 0 and 1.** Actuator current must be 0A±0.2A. Reading is current x 100 so (0 < reading < 20)
8. Power cycle the UUT to clear the fault.
9. Inject a voltage of 21.8mV at pin 3 of U26
10. Turn on the actuator driver by sending the following commands:
    a. **Write 500 to CAN index 0x3022 subindex 0x01 bytes 0 and 1. (sets current limit to 5.0A)**
    b. **Write 500 to CAN index 0x3020 subindex 0x01 bytes 1 and 2, and 4 to byte 0. (sets PWM to 50%, sets extend direction)**
11. This "extends" the actuator at 50% duty cycle with a current limit of 5.0A with the injected voltage representing a steady state current of 3.0A.

12. Read actuator driver status by sending the following command: **read CAN index 0x3021 subindex 0x01 byte 0.** Bit 5 must be 0. (bit 5 = short) Bit 4 must be 0. (bit 4 = overcurrent)
13. Read actuator current by sending the following command: **read CAN index 0x3021 subindex 0x05 bytes 0 and 1.** Actuator current must be 3.0A±0.3A. Reading is current x 100 so (270 < reading < 330)
14. Stop the actuator motor driver by sending the following command: **Write 0 to CAN index 0x3022 subindex 0x01 bytes 1 and 2, and 4 to byte 0. (sets PWM to 0%, sets extend direction)**
15. Inject a voltage of 36.8mV at pin 3 of U26
16. Turn on the actuator driver by sending the following commands:
    a. **Write 750 to CAN index 0x3022 subindex 0x01 bytes 0 and 1. (sets current limit to 5.0A)**
    b. **Write 500 to CAN index 0x3020 subindex 0x01 bytes 1 and 2, and 4 to byte 0. (sets PWM to 50%, sets extend direction)**
17. This “extends” the actuator at 50% duty cycle with a current limit of 7.5A, with an injected voltage that represents a steady state current of 6A.
18. Increase the voltage at pin 3 of U26 to 51.8mV, which represents 9A of load current
19. Read actuator driver status by sending the following command: **read CAN index 0x3021 subindex 0x01 byte 0.** Bit 5 must be 1. (bit 5 = short)
20. Read actuator current by sending the following command: **read CAN index 0x3021 subindex 0x05 bytes 0 and 1.** Actuator current must be 0A±0.2A. Reading is current x 100 so (0 < reading < 20)
21. Power cycle the UUT to clear the fault.