TROTTER CONTROLS FORT WORTH, TEXAS	TEST SPECIFICATION REPORT X ORDER	NUMBER TS-0003	REVISION
TITLE Test Procedure ~ Digital Servo Card 209G500-1	BY CHK'D Carey Gray VT DATE 03/29/06	MODEL 209G500-1 SERIAL ALL PAGE OF 1 8	

References

Item	Document	Comments
1.	ER – 0001 CCS & Microchip 16F876A Integration Issues	
2.	ER – 0002 Servo Card (209G500-1) Integration Issues	

Summary
This procedure outlines the methods used to test part number 209G500-1 before shipment. This procedure must be followed to insure that the unit will work properly when installed.

Basic System Specifications

The unit takes input from a hall-effect style absolute SSI serial encoder, a 1~5 volt analog reference voltage input, and outputs a + 40ma signal to control a servo valve. This allows the unit to control a hydraulic servo valve so that the angle of a rotary actuator "tracks" the 1~5 volt reference signal.

Power Requirements

Input Voltage1: +24Vdc @ 100 ma max
Input Voltage2: 4.5Vdc ~ 5.1Vdc @ 125 ma max

PWM Analog Output Characteristics

- PWM output current is proportional to the input voltage to the unit minus the position of the actuator reported by the SSI encoder.
- Minimum Possible Output Current: 0ma
- Minimum Output Current under program control: 0ma
- Maximum Output Current: ± (@ supply voltage=5.000V)
  - When current potentiometer is properly adjusted
- D/A resolution under program control: 10 bit
- Output Voltage Resolution from uP PWM command: 0.0039mV

With an ammeter connected to DR(**+**) (positive ammeter lead) and DR(**–**) (negative ammeter lead), the following applies:

- Output Current < 0 ma → Opens gatebox doors on FRDS units
- Output Current > 0 ma → Closes gatebox doors on FRDS units

- LED7 = current direction indication
- LED8 = phase enable control (on = enabled)

Connections

Power and Encoder Connections

- Plug the 21 position connector included on test fixture p/n 1091-0001 into the digital servo card (J1). The assembly also includes a 10 position connector to be plugged to an Air Tractor low current power supply (60437). Other power sources may be used but it must include a +24V & 5V source.
  If a variable 5VDC is used then the silver potentiometer can be removed. This potentiometer is used to vary the input voltage for one part of the test.
- Connect an encoder assembly 60429-6 to the 5825-0001 cable that is part of the 1091-0001 test fixture.

See fig below for more detailed information

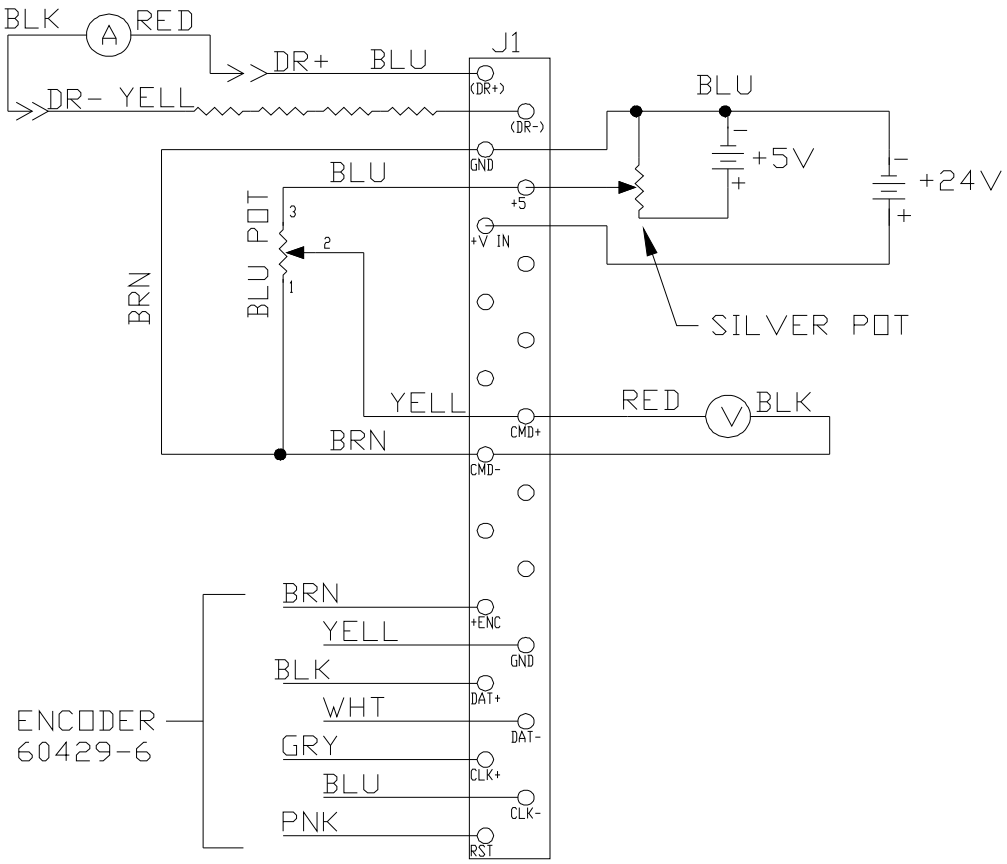

Figure 1~ 1091-0001 schematic

Current Meter Connections

- Connect the positive lead (Red lead) of a current meter to the DR(+) yellow lead of the 1091-0001 test fixture.
- Connect the negative lead (Black lead) of a current meter to the DR(−) blue lead of the 1091-0001 test fixture.
- This meter is used to monitor the current sent to the hydraulic servo valve by the servo card. A load resistor is included on the test fixture to simulate a servo valve.

Voltmeter Connections

- Connect the positive lead (Red lead) of a voltmeter to the CMD + (lead or pin 10) of the 1091-0001 test fixture.
- Connect the negative lead (Black lead) of a voltmeter to the CMD − (lead or pin 11) of the 1091-0001 test fixture.
- This voltmeter is used to monitor the 1 ~ 5 volt input command voltage to the digital servo card.

Programming Instructions

Configuration Bits (Watchdog/Brownout)

We had extensive problems getting the configuration bits set programmatically. We suspect that this is being caused by the ICD2 software's use of the configuration bits.

Configuration Bits Workaround

The following procedure was used to "work around" the configuration bit issue.

The procedure for setting configuration bits is as follows:

With the MPLAB software opened, the MPLAB ICD2 connected to the USB port of the PC and the MPLAB ICD2 connected to the servo card, follow the instructions below:

1. PROGRAMMER - SELECT PROGRAMMER - ICD2 (wait for the "MPLAB ICD2 ready")
2. PROJECT - OPEN - SERVO V5 (or latest rev)
3. PROJECT - COMPILE (select the compile icon or F10)
4. Set the configuration bits as follows:

```
Osscillator  = HS
WDT = ON
Power Up Timer = ON
Brownout = ON
Low Voltage Program = Disabled
Flash Program Write = Write Protection Off
Data EE Protect = Off
Code Protect = Off
```

3. Leave the configuration bit window above open
4. Save the workspace
5. Now write the program to the microcontroller.
   a. PROGRAMMER – PROGRAM – OK (to disable debug mode) (wait for" MPLAB ICD2 READY")
6. Pull programming cable off the servo card, LED lights on servo card will begin to flash.

Test Sequence

The home position of the encoder now needs to be set. Three buttons and three LED's inside the electronics enclosure are used to set the home position for the system. The following steps must be completed within 30 seconds or the system will reset.

Set up / Set "Home" Position

1. Make sure the unit is connected as described on figure 1 above.
2. Turn the +24Vdc and +5Vdc power supplies ON, verify voltages at J1-5 (+24V) & J1-4 (+5V) on servo card with reference to GND (J1-3), if +5v is not present adjust silver pot.
3. Adjust voltage between CMD+ & CMD- (using the blue pot) to read 1.0V
4. Adjust current to anything grater than +15 ma by turning the encoder shaft.
5. Press and hold switch B1 and switch B3 simultaneously. (for 1st time home setup, cycle power OFF & ON while pressing B1 & B3 or press and release BR while holding B1 this will reset power the servo card).
6. LED's #3, #4 and #5 will flash independently then begin to flash in unison. When this occurs release switch B3 while continuing to hold switch B1.
7. Release switch B1.
8. LED #3 located beside switch B1 should turn on. Press switch B1 and hold for approximately 1 second then release. *LED #3 should go out when switch B1 is pressed*.
9. LED #4 located beside switch B2 should now turn be on. Press switch B2 and hold for approximately 1 second then release. *LED #4 should go out when switch B2 is pressed*.
10. LED #5 located beside switch B3 should now be on. Press switch B3 and hold for approximately 1 second then release. *LED #5 should go out when switch B3 is pressed*.
11. LED #4 should begin to blink at about 1 Hz indicating you are in Set Up mode. Home position is the only option you can modify during Set Up.
12. Press and hold switch B1 for approximately 1 – 2 seconds then release. *LED #4 should remain in the state it was when the switch was pressed then continue to blink after releasing the switch*.
13. Home position is now set. LED #4 should continue to blink at about a 1 Hz rate indicating you are still in Set Up mode.
14. Verify that the current is different from the current setting above (+15 ma) should be around 6~7 ma
15. Turn the +24Vdc and +5Vdc power supplies off for 10 seconds.
16. Turn the +24Vdc and +5Vdc power supplies on.

17. The servo card should flash LED's #3, #4 and #5 individually then all three simultaneously then LED #3 will begin to flash at about a 1 Hz rate to indicate the program is running and no errors are present.

Adjust Maximum Output Current

1. Turn the +24Vdc and +5Vdc power supplies ON, verify voltages at J1 on servo card using GND (J1-3) as reference, if +5v is not present adjust silver pot.
2. The servo card should flash LED's #3, #4 and #5 individually then all three simultaneously then LED #3 will begin to flash at about a 1 Hz rate to indicate the program is running and no errors are present.
3. Adjust the blue potentiometer attached to the 1091-0001 test fixture so that the voltmeter reads approximately 2.5 volts. LED #7 should turn ON as soon as voltage is increased.
4. Adjust the potentiometer on the digital servo card until the measured current is **-** 28 ma ±1ma.
5. Rotate the encoder clockwise (as viewed from the end of the shaft) until the current is approximately ±0 milliamps.
6. Adjust the blue potentiometer attached to the 1091-0001 test fixture so that the voltmeter reads approximately 1 volt.
7. The measured current should be approximately + 28 ma ± 2 ma

Test the A/D input range

1. Adjust the blue potentiometer attached to the 1091-0001 test fixture so that the voltmeter reads approximately 1 volt.
2. Adjust the encoder until the measured current is approximately + 28 ma ± 5 ma . Do not move the encoder after this step.
3. Slowly adjust the blue potentiometer (CCW) on the 1091-0001 test fixture until the voltmeter reads 0.6 volts.
4. A low input command voltage fault will be detected and the unit should go into an error condition as follows:
   a. LED# B2 will flash 12 times and then pause. This indicates that a low command voltage fault has been detected. This pattern will repeat continuously.
   b. The current meter should read approximately -8 ma +2 ma.
5. Slowly adjust the potentiometer on the 1091-0001 test fixture until the voltmeter reads 1.0 volts.
6. The current should read approximately +28 ma (if the encoder has not been moved since step 2 above).

Brownout Reset Test

The success of the brownout configuration should be checked by varying the main power voltage to the unit. It should automatically reset at a voltage between 3.6 & 4 volts.

- Apply +5.0Vdc and +24Vdc power to the unit.
- Wait for the unit to power up.
- Verify that the unit has servo control. Led#3 should be flashing at about 1 flash per second to indicate operation with no errors present.
- Slowly reduce the voltage on the 5.0 Vdc power supply (by using the silver pot if a non-variable power supply is used) to the system until the unit resets.
- The unit should reset at a voltage between 3.6V and 3.9V.
- Increase the voltage to approximately 5.0 volts (by using the silver pot if a non-variable power supply is used).
- Verify that the unit restarts and runs the startup LED sequence.
- Wait for a few seconds and verify that the unit has servo control. Led#3 should be flashing at about 1 flash per second to indicate proper operation with no errors present.

Watchdog Timer Test:

The success of the watchdog should be checked as follows:

- Apply power to the unit.
- Wait for the unit to power up.
- Verify that the unit has servo control. Led#3 should be flashing at about 1 flash per second to indicate operation with no errors present.
- Press and hold buttons 1 & 3 (do not release until instructed to do so in the step below). This will force the unit to lock up. LED's #3, #4 and #5 should remain in the state they were when the switches were pressed and then lock up.
  - The unit should lock up when both buttons are held in and then should automatically reset from the start (since the watchdog doesn't get reloaded during lockup condition).
- Verify that the unit restarts and runs the startup LED sequence.
- Release buttons 1 & 3, LED's 3 & 4 should go off and the unit will seem like is ready for setting home position (LED 2 ON solid).
- After about 7 seconds, verify that the unit restarts & has servo control. Led#3 should be flashing at about 1 flash per second to indicate operation with no errors present.

Temperature Test

This testing is optional and not required for production units.

Problems with oscillator startup were experienced on some production units. This was attributed to leakage on the oscillator capacitors. After replacement, units were tested by heating and cooling the capacitors to extreme temperatures with no startup failures.

Low Temperature:

1. Set the incoming voltage to 4.4 volts.
2. Cool the oscillator crystal and timing capacitors (near crystal) to approximately 32°F.
3. Cycle power several times and verify that the unit starts up normally.

High Temperature:

1. Set the incoming voltage to 4.4 volts.
2. Heat the oscillator crystal and timing capacitors (near crystal) to approximately 140°F.
3. Cycle power several times and verify that the unit starts up normally.

Supplemental Information

System will recover from the following errors:

1. Encoder disconnected then connected.
2. Encoder connected, disconnected then connected.
3. Brownout voltage (if volts falls below 3.9 volts, the processor will reset).
4. Watchdog timer error due to incorrect branch in software or memory problem.
5. Analog voltage out of range.
6. Can recover from all limp modes except EPROM invalid.

Heartbeat:

An approximately 1 Hz heart beat is output on the OUT1 & OUT2 fault outputs and on one of the LED's. The LED stops and the fault output slows down a lot when a fault is detected.

Defines the number of LED flashes to display when a specific fault is detected.

Fault Detected	# Flashes	Comment/Description
#define UI_FAULT_ENCODER_RANGE	2	; Goes into analog "limp" mode
#define UI_FAULT_ENCODER_BUSY	4	; Goes into analog "limp" mode
#define UI_FAULT_ENCODER_MISSING	6	; Goes into analog "limp" mode
#define UI_FAULT_ENCODER_NOTLOW	8	; Goes into analog "limp" mode
#define UI_FAULT_EEPROM_INVALID	10	; Goes into analog "limp" mode
#define UI_FAULT_VOLTAGE_RANGE	12	; Sets output current to open the doors
Default: No error detected	16	; This is a no fault display during recovery

Limp Mode ~ Servo Card:

The doors can be opened and closed by the servo system even with the encoder disconnected. Unplug the encoder on both the servo card and encoder upgrade and verify that the doors open & close OK. The doors will move at about ¼ speed when the servo card is in LIMP mode due to a fault.

Note: Limp mode can be caused by any of the faults listed. The operation of the system when in limp mode is discussed below:

- If analog command <= 0.7 volts ; always try to open the doors (-10mA constant current)
- If 0.7V<analog command<=1.5 volts ; try to close the doors (+10mA current)
- If 1.5V<= analog command <=5 volts ; try to open the doors (-10mA current)
- The success of the brownout configuration can be checked by varying the main power voltage to the unit. It should automatically reset at a voltage between 3.6 & 4 volts.