

<b>TROTTER CONTROLS</b> FORT WORTH, TEXAS	<b>PROCESS SPECIFICATION</b>		NUMBER	REVISION
	<b>REPORT ORDER</b>		PS-0025	
TITLE ANALOG INPUT CALIBRATION – FRDS GENII CORE MODULE	BY	CHK'D	MODEL	
	LA	VT	5950-0009	
	DATE		SERIAL	
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**Overview**

This report establishes the procedures for analog input-voltage calibration tests to be performed on the 5950-0009 Core Module used on the FRDS GEN II control system.

**References**

Item	Document	Company
1	Document# MMA1250D, Low G Micro-machined Accelerometer Datasheet	Freescale Semiconductor
2	Schematic Diagram, 5990-0006.SCH	Trotter Controls, Inc
3	Assy BOM, 5950-0009, PEDYNE Database	Trotter Controls, Inc
4	PS0035 - FRDS GEN II Memory Management	Trotter Controls, Inc
5	PS0032 - FRDS GEN II - Dump Pit Calibration	Trotter Controls, Inc

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## Objectives

Provide a production procedure for calibration of the analog inputs of the FRDS GEN II system.

## Calibration Voltages

The calibration conditions for the various sensors are shown in the table below:

**Table 1 ~ Analog input calibration maximum and minimum reference voltages.**

ID	Signal Name	uP Channel	5990-0006 PWB Pin Number	Min Cal Volts	Max Cal Volts	Comments
1	PhotoEye	AN2	J14B-3	Photo Eye Blocked	LED light source directly over photo eye & touching panel	0 – 4.5V on test fixture for 5950-0009 and verify count change before installation into pilot interface. Verify light changes output volts on photo eye board before installation into pilot interface.
2	AcceL1 {1}	AN6	J14B-5 (monitor volts FROM accel) <b>Do not apply external voltage to this pin. {2}</b>	Unit rotate 180 degrees (-1 G) – accel output 1570 – 1680 Counts	Unit flat (1 G) – accel output 2230 – 2270 Counts	Accel output is 2.5V + 0.4 V/G, offset varies by 0.25V from part to part
3	AcceL2 {1}	AN7	J14B-6 (monitor volts FROM accel) <b>Do not apply external voltage to this pin. {2}</b>	Unit rotate 180 degrees (-1 G) – accel output 1570 – 1680 Counts	Unit flat (1 G) – accel output 2230 – 2270 Counts	Accel output is 2.5V + 0.4 V/G, offset varies by 0.25V from part to part
4	Gatebox Angle	AN8	J7B-1	0	4.50	See Table 2 for Min and Max counts
5	Foam	AN9	J7B-2	0	4.50	See Table 2 for Min and Max counts
6	Hyd Press	AN10	J7B-3	0	4.50	See Table 2 for Min and Max counts
7	Hopper	AN11	J7B-4	0	4.50	See Table 2 for Min and Max counts
8	Battery	AN12	J7B-5	15.00	24.00	See Table 2 for Min and Max counts

Notes: {x}

- The accelerometer must be calibrated inertially by rotating the assembly 90 degrees as specified. Note that the zero G voltages may be different for the two accelerometers.

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2. Pins J14B-5 and J14B-6 can be used to externally monitor the accelerometers output voltages. These pins are connected to the accelerometers outputs through a 1K series resistor.

## Calibration Procedures

### On Aircraft Procedure

This procedure should only be used when no other options remain. The following should be done prior to manual calibration.

- Reinstall calibration from back up memory. See PS0035 – FRDS GEN II Memory Management
- Reenter calibration values from “Calibration Data Sheet”. See Table 7 of PS-0032, sheet located in relay box.

If the above can't be accomplished, then follow the following the procedure “Factory Primary Procedure” below. This procedure calls out locations to apply the properly calibrated voltages.

### Factory primary Procedure

Below lays out the process used to calibrate all analog sensors. The step by step instructions detail those calibrations that are accomplished by applying a giving voltage. Other sensors require different procedures and will be detailed later in this procedure.

The following require special procedures outlined at the end of this procedure.

- Photo
- Accelerometer 1 (AccelOne)
- Accelerometer 2 (AccelTwo)
- +24V

The following use procedures detailed below

- Gate Angle (GateAngle)
- Hopper
- Hyd. Pressure (HydPres)
- Foam

<b>TROTTER CONTROLS</b> <b>FORT WORTH, TEXAS</b>	<b>PROCESS SPECIFICATION</b>		NUMBER PS-0025	REVISION
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### Calibration of voltage points

This procedure includes the Save Memory command during and/or at the end of the calibration process, the system should not indicate any errors prior to calibration to avoid saving any errors into memory.

The A/D converters should be calibrated as follows:

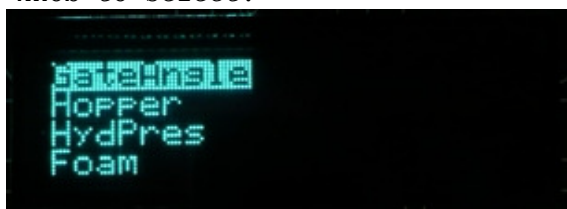
1. From the FRDS menu, select MAINT → Analog Calibrate



2. The Analog calibrate menu will appear.



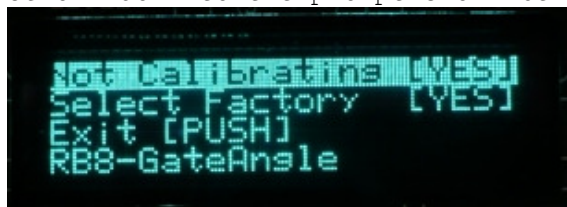
3. Select the Analog Input you want to calibrate per the ID column in the calibration voltages table. Here we are using Gate Angle. Use the Scroll knob to select.



4. Push scroll knob to make a selection.



5. Scroll down to the prompt shown below.



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6. Select using the "Yes / Foam" switch. The screen will change to indicate that calibration mode has been entered like shown below.



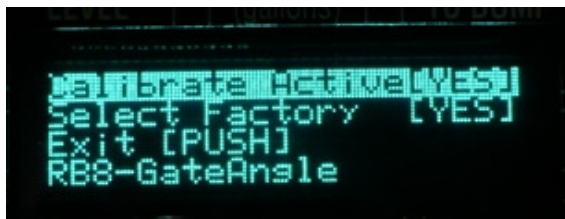
7. Scroll up to the 0V input calibration value prompt.



8. Connect calibration supply to specified / selected calibration input.  
 9. Apply the minimum input voltage for the given input. In this case 0VDC  
 10. WAIT for the counts value to stabilize then press the "Yes / Foam" switch to accept the voltage present at the input as the minimum reference voltage.  
 11. Scroll Down to the 4.5V input calibration value prompt.



12. Apply the maximum input voltage for the given input. In this case 4.5VDC  
 13. WAIT for the counts value to stabilize then press the "Yes / Foam" switch to accept the voltage present at the input as the maximum reference voltage.  
 14. Scroll Down to the "Calibrate Active" prompt.



15. Select "Yes / Foam" switch to exit calibration for this point. Below should be displayed.

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16. Scroll Down to the "Exit [PUSH]" prompt to exit back to the analog menu.



17. To calibrate the rest of the calibration points, repeat steps 3 ~ 16 until all analog voltage input channels are calibrated.
18. Save the analog calibration values to EEPROM both to memory and to backup memory by following the steps below:
- o Press the No/Menu switch select Maint - Save Memory - Both
  - o Save to backup Memory - Press the No/Menu switch select - Maint - Save Memory - press and hold Lamp Test & Yes/Foam at the same time then press the selector wheel and release Lamp Test & Yes/Foam.

See PS0035 - FRDS GEN II Memory Management for more information on "Save" command.

### Calibration point figures

These points are used when calibrating voltage-based inputs.



**Figure 1 - Gate Angle Calibration Point**



**Figure 2 - Hopper Gallons Calibration Point**

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**Figure 3 - Hydraulic Pressure Calibration Point**



**Figure 4 - Foam Gallons Calibration Point**

**Calibration of special points.**

**Photo Eye**

Calibration of the Photo eye is somewhat subjective when it comes to the bright light simulation.

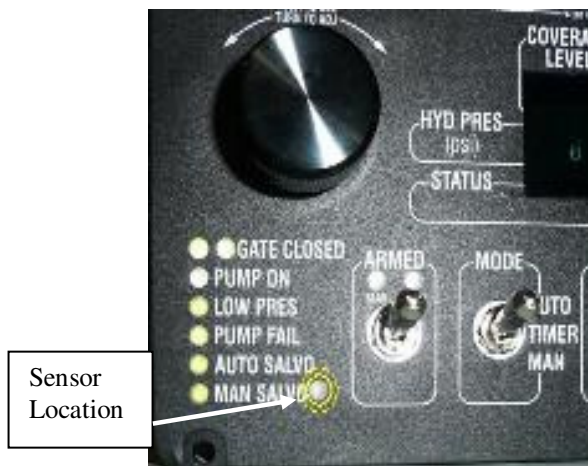
If the calibration light ends up being dimmer than another source of light, like sunlight, an error will be displayed on the Pilot interface during operation. This error is "118\_Photo range Err"

Calibration of the Photo eye in the field is not critical and will not effect functionality of the FRDS system.

Calibration of the photo eye is done using the same process steps 1 thru 8 of "Calibration of voltage points", even though they are shown for Gate Angle. At step 9 begin the process below.

1. Cover the sensor with your finger or other item that blocks the light from reaching the sensor.

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2. Press the "Yes / Foam" switch to accept the voltage present at the input as the minimum.
3. Place a bright light source to the sensor. This should be as bright or brighter than sunlight shining on the sensor.
4. Press the "Yes / Foam" switch to accept the voltage present at the input as the maximum.
5. Follow steps 14 thru 16 above from "Calibration of voltage points".
6. Save the analog calibration values to EEPROM. See PS0035 - FRDS GEN II Memory Management.

### AcceL1 and AcceL2

Calibration of the Accelerometers is done with the pilot interface placed on a level surface.

Calibration consists of giving the unit a +1G and -1G range. Since there is always 1G present, this makes calibration simple.

Calibration of the accelerometers is done using the same process steps 1 thru 6 of "Calibration of voltage points", even though they are shown for Gate Angle. At step 7 begin the process below.

1. Scroll up to the -1.00 input calibration value prompt.



2. Flip PI upside down on level surface
3. Press the "Yes / Foam" switch to accept the input as -1G.
4. Flip PI back to normal on level surface
5. Scroll Down to the 1.00 input calibration value prompt.

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6. Press the "Yes / Foam" switch to accept the input as 1G.
7. Follow steps 14 thru 16 above from "Calibration of voltage points".
8. Save the analog calibration values to EEPROM. See PS0035 – FRDS GEN II Memory Management.

#### **+24V**

Calibration of the battery volt meter is done by varying the voltage supplied to the FRDS.

The voltages are 15V lowest and 24V highest. This is just for calibration of the voltage sensor. The FRDS will stay powered up at 15VDC but operation will be compromised. The lowest operating voltage is normally 22VDC.

Calibration of the +24V on the aircraft is difficult and not recommended.

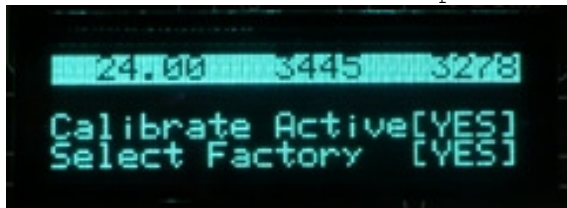
Calibration of the volt meter requires having the FRDS connected to a variable power supply capable of 0-36VDC at 10Amps. Use of a known good volt meter to verify the voltage is recommended.

Calibration of the volt meter is done using the same process steps 1 thru 6 of "Calibration of voltage points", even though they are shown for Gate Angle. At step 7 begin the process below.

1. Scroll up to the 15.00 input calibration value prompt.



2. Adjust the voltage supply to 15VDC, use a precision meter to verify voltage
3. Press the "Yes / Foam" switch to accept the input as +15VDC.
4. Scroll down to the 24.00 input calibration value prompt.



5. Adjust the voltage supply to 24VDC, use a precision meter to verify voltage

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6. Press the "Yes / Foam" switch to accept the input as +24VDC.
7. Follow steps 14 thru 16 above from "Calibration of voltage points".
8. Save the analog calibration values to EEPROM both to memory and to backup memory by following the steps below:
  - o Press the No/Menu switch select Maint - Save Memory - Both
  - o Save to backup Memory press the No/Menu switch select - Maint - Save Memory - press and hold Lamp Test & Yes/Foam at the same time then press the selector wheel and release Lamp Test & Yes/Foam.

See PS0035 - FRDS GEN II Memory Management for more information on "Save" command.

### Factory Test bench Procedure

The test bench procedure is only used at the factory and requires a special test jig custom built for this process.

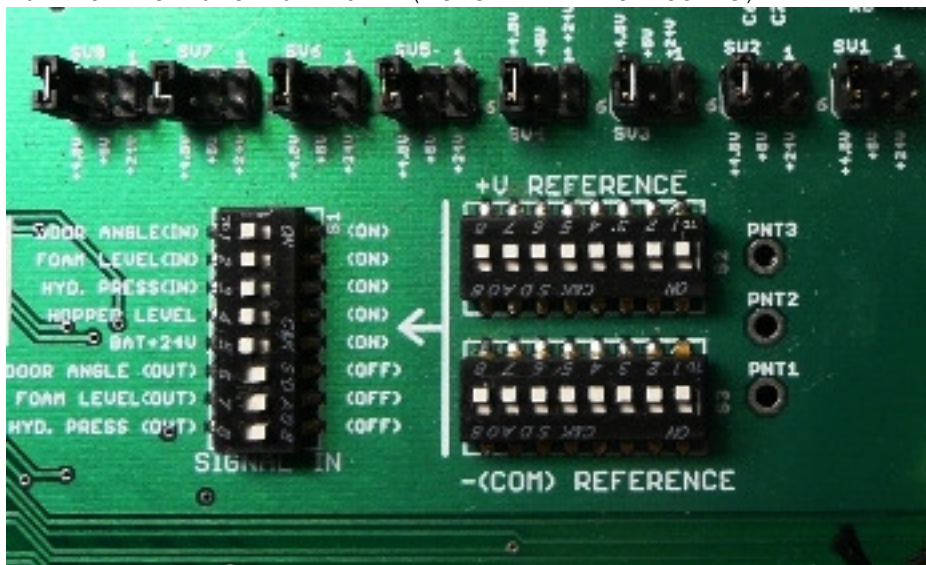
#### References

Item	Document	Company
1	5950-0029 Test fixture board	Trotter Controls Inc.

The purpose of this procedure isn't to calibrate the analog values but to verify proper operation of the analog to digital conversion circuitry, prior to assembly in a complete Pilot Interface unit.

The A/D converters should be tested / calibrated as follows:

1. Turn S1-6, S1-7 and S1-8 "OFF" ("SIGNAL IN" Switch's)
2. Turn S1-1thru S1-5 "ON" ("SIGNAL IN" Switch's)

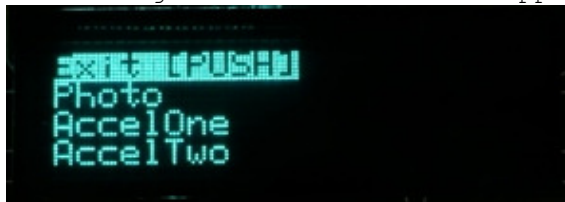


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3. From the FRDS menu, select MAINTENANCE → Analog Calibrate



4. The Analog calibrate menu will appear.



5. Select the Analog Input you want to calibrate per the ID column in the calibration voltages table. Gate Angle is shown in the example. Use the Scroll knob to select.



6. Push the scroll knob to make a selection.

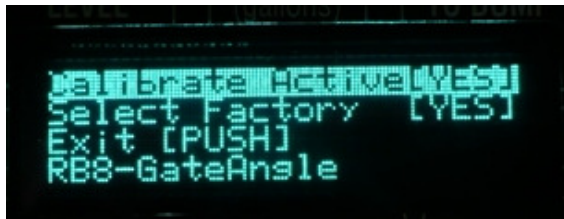


7. Scroll down to the prompt shown below.



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- Select using the "Yes / Foam" switch. The screen will change to indicate that calibration mode has been entered like shown below.



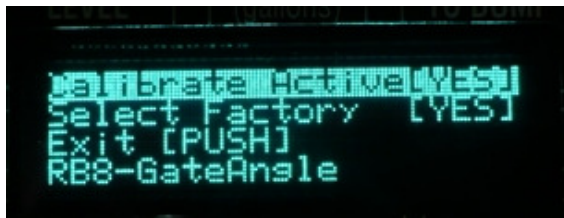
- Scroll up to the 0V input calibration value prompt.



- Refer to Table 2 for switch settings for selected point to calibrate.
- Apply the 0V input voltage for the given input.
- Check that the counts in the "Real" column are within range as shown in Table 2.
- Press the "Yes / Foam" switch to accept the voltage present at the input as the minimum reference voltage.
- Scroll Down to the 4.5V input calibration value prompt.



- Refer to Table 2 for switch settings for selected point to calibrate
- Apply the 4.5V input voltage for the given input.
- Check that the counts in the "Real" column are within range as shown in Table 2.
- Press the "Yes / Foam" switch to accept the voltage present at the input as the maximum reference voltage.
- Scroll Down to the "Calibrate Active" prompt.



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20. Toggle the "Yes / Foam" switch to exit calibration for this point. Below should be displayed.



21. Scroll Down to the "Exit [PUSH]" prompt to exit back to the analog menu.



- 22. Repeat steps 4 through 21 until all analog voltage input channels are calibrated / tested.
- 23. Save the analog calibration values to EEPROM. See PS0035 – FRDS GEN II Memory Management.

**Table 2 ~ Switch configuration**

Switch (+ Reference)	Switch (0V Reference)	Supplies	Description
S2-1 (OFF)	S3-1 (ON)	0V	Gate Angle (GateAngle)
S2-1 (ON)	S3-1 (OFF)	4.5V	Gate Angle (GateAngle)
S2-1 (ON)	S3-1 (ON)	SHORTS	Do not do
S2-2 (OFF)	S3-2 (ON)	0V	Foam
S2-2 (ON)	S3-2 (OFF)	4.5V	Foam
S2-2 (ON)	S3-2 (ON)	SHORTS	Do not do
S2-3 (OFF)	S3-3 (ON)	0V	Hydraulic Pressure (HydPres)
S2-3 (ON)	S3-3 (OFF)	4.5V	Hydraulic Pressure (HydPres)
S2-3 (ON)	S3-3 (ON)	SHORTS	Do not do
S2-4 (OFF)	S3-4 (ON)	0V	Hopper Gallons
S2-4 (ON)	S3-4 (OFF)	4.5V	Hopper Gallons
S2-4 (ON)	S3-4 (ON)	SHORTS	Do not do
S2-5 (OFF)	S3-5 (ON)	0V	+24V
S2-5 (ON)	S3-5 (OFF)	24V	+24V
S2-5 (ON)	S3-5 (ON)	SHORTS	Do not do

Table 2 shows the configuration and switch settings required to apply calibration voltages to the given analog input to be calibrated.

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**Table 3 ~ Analog count acceptable range**

Description	Min Reading	Max Reading	Tweak Number
Photo 0	<b>0</b>	<b>5</b>	100
Photo 4.5V	<b>2150*</b>	<b>2300*</b>	102
Accel (lor 2) -1G	<b>1570</b>	<b>1680</b>	112/124
Accel (lor 2) 1G	<b>2230</b>	<b>2270</b>	114/126
Gate Angle (GateAngle) 0V	<b>2010</b>	<b>2060</b>	136
Gate Angle (GateAngle) 4.5V	<b>3500</b>	<b>3560</b>	138
Hopper Gallons 0V	<b>2010</b>	<b>2060</b>	148
Hopper Gallons 4.5V	<b>3500</b>	<b>3560</b>	150
Hydraulic Pressure (HydPres) 0V	<b>2010</b>	<b>2060</b>	160
Hydraulic Pressure (HydPres) 4.5V	<b>3500</b>	<b>3560</b>	162
Foam 0V	<b>2010</b>	<b>2060</b>	172
Foam 4.5V	<b>3500</b>	<b>3560</b>	174
+24V @ 15V	<b>2800</b>	<b>2820</b>	184
+24V @ 24V	<b>3260</b>	<b>3290</b>	186
* can vary from this			

Table 3 shows Min and Max analog count values that should be seen during the calibration / testing sequence.