RESET - ARCS GNDRAD and SKYRAD Datalogger Calibration (CALF)

I. Purpose:

The purpose of this procedure is to describe the steps performed by the RESET team to field calibrate the GRNRAD and SKYRAD dataloggers using precision resistors and a voltage standard.

II. Cautions and Hazards:

- The voltage standard runs on 110 Volt AC power. These procedures should only be conducted by RESET team member trained in electrical safety.
- These procedures can be conducted at the dataloggers if there is no reasonable chance of rain. In most cases the voltage source is more stable when the dataloggers are disconnected from the data system and brought inside and powered with a well grounded 12 V power supply. The interference with the data stream must be logged.

III. Requirements:

- Reference Standard Voltage Source.
- Calibrated Digital multimeter.
- Precision Resistors.
- Six and Eight Pin Break-Out Boxes.
- Computer with Terminal Emulation Software.

IV. Procedure:

Note: A high quality ground *must* be connected to the datalogger case before continuing with the rest of the procedure. If the datalogger does not have a good ground reference, a significant offset on the A/D measurements will occur. We have also found that when calibrating each channel separately, the input for the channels not under test need to be shorted. Failure to do so can produce a 10 to 70 microvolt variable offset. While conducting this procedure , log serial numbers, standard voltages and resistances versus measured values on Excel formatted calibration form FM(DAQR)-001 (example attached).

A. To Simulate a PIR Sensor:

(See Attachment 10—A. To Simulate a PIR Sensor Work Process Flow Diagram.)

1. Ensure you have a high quality ground connected to datalogger.

2. Log serial numbers, standard voltages and resistances versus measured value while conducting this procedure.
3. Ensure you have an 8-pin breakout or sensor substitution box.
4. Put precision resistors (4.125, 8.25, 17.5 K Ohm) across pins 2 and 3, and 7 and 8 (the 4.125K Ohm resistance can be made with two 8.25K Ohm resistors in parallel).

   Note: To measure resistances with Fluke, the PIR connection to the datalogger needs to be disconnected.

5. Attach standard voltage source across pin 4 (negative) and pin 5 (positive).

   Note: The lights on the Valhalla voltage source are confusing. The “operate/standby” light needs to be OFF in standby; the light is ON and no voltage is supplied. For PIR simulation all top row lights are OFF and 200mV full scale light is illuminated on the second row.

6. Connect breakout or sensor substitution box to connector 2 (or 6) on SKYRAD or connector 6 on GNDRAD datalogger.
7. Disconnect connector Term (to ADaM) and connect RS422 converter box.
8. Connect 9-pin connector on the converter box to computer with terminal emulator software (communications at 9600 baud, com1, 8 bits, 1 stop bit, No Parity, Xon/Xoff).
9. Press “U” (no carriage RETURN) to establish communications with the ZENO.
10. Check the time on the Logger by going to the system function menu (F) and pressing S. Change time and date if need be and note in form FM(DAQR)-001.
11. Select the Test Menu (T).
12. Press “R” for raw data in volts.
13. Examine PIRG (or PIRD) data channels with 0, 0.5, and 1 mV selected from the voltage source.
14. Log differences between input and output, time and date in calibration data sheets.
15. If offset greater than 15 microvolts is observed, check voltage source with calibrated Digital Multimeter. (If difference between voltage source and digital Multimeter is greater than 4 uV, document variance, contact instrument mentor, and follow mentor’s directions.)

16. If offset confirmed to lead to greater than 4 W/m2 (about 16 uV), document variance, contact mentor, and if mentor agrees, change ZENO voltage calibration offset (continue to section B. below).
17. If offset confirmed not greater than 4 W/m2 (about 16 uV), change to user menu (press “U”).
18. Type “F” for system function menu.
19. Type “C4/1” to make real-time output format.
20. Type “Q” to quit and start display.
21. Examine Case and Dome resistances for PIRG (or PIRD).
22. Log differences between input and measured resistances, time and date on calibration data sheet.
23. If differences greater than 0.2%, record variance, check resistances with calibrated Digital Multimeter and repeat.
24. If differences not greater than 0.2%, quit to terminate connection.
25. If differences greater than 0.2% persist, record variance, contact mentor, and, if mentor directs, change fixed resistor calibration (see section C. below). Disable real-time output by selecting System Function Menu and typing “C4/0.” **(This step and the following are very IMPORTANT, ADaM data could be corrupted).**
26. Continue to Section C.

B. To Change Voltage Calibration:

(See Attachment 11—B. To Change Voltage Calibration Work Process Flow Diagram.)

1. Calculate offset voltage and gain that produce the best value in W/m2 (#uV* calibration coefficient [example: 279330] at a voltage level that corresponds to a median daytime value (0.6 mV). A voltage offset of 7 uV corresponds to about 2 W/m2).
2. Find the ratio of expected versus measured values in the same units.
3. Change to Sensor Menu in ZENO Program Menu.
4. Change the calibration factors (usually only the offset conversion coefficient C) in the Sensor menu (see Attachments 1 and 2, Sensor Configuration Tables).
5. Repeat the instrument test steps in section A. above to ensure that corrected calibration leads to acceptable differences between expected and measured values (less than 4 W/m2).

6. Go to Data Output Menu and change the version number (use Capital "V").
7. Return to ZENO Program Menu.
8. Type "E" to save settings to EPROM.
9. Save the configuration using XT and the Windows transfer menu (format is skyymmdd.cfg or gndymmdd.cfg).
10. Type "Q" to quit and terminate connection.
11. Reconnect datalogger with original connections.
12. Ensure that the new configuration file is loaded to ADaM.

C. To Change PIR Fixed-Resistor Calibration for Resistance and Voltage Offset Differences:

(See Attachment 12—To Change PIR Fixed-Resistor Calibration for Resistance and Voltage Offset Differences Work Process Flow Diagram.)

1. Determine ratio of input resistance and output that best balances both calibration resistance values for 4125 and 8250 Ohms for each channel (Case and Dome).
2. Multiply this ratio by currently used value (close to 10000) in the respective process (see attachments 4 and 6, SKYRAD or GNDRAD Sensor Configuration Tables for process number).
3. Press "Z" to go to ZENO Program Menu.
4. Jump to the processes for the PIRG or PIRD channels scheduled for change.
5. Change the resistance values to the one calculated in step 2 above. (The resistance values must be changed at three locations for each resistance value change. In processes 4, 7, 26, and 29 enter the resistance value for the slope and minus the resistance value as the offset [the last two items].)
6. Press "Q" to quit.
7. Wait several minutes to ensure that the changes take effect, e.g., view the raw data from the Test Menu until non-zeros appear.
8. From the system function menu, re-enable real-time output (enter "C4/1").
9. Press "Q" to quit and view the computed thermistor resistances.
10. Redo the instrument test steps above (section A., step 14. and following) to make sure corrected calibration leads to acceptable

differences between expected and measured values (less than 15 Ohms).

11. Go to user menu (U).
12. Press “Z” to return to ZENO program menu.
13. Press “D” to change to Data Output and change the version number (use capital “V”).
14. Type “E” to save settings to EPROM.
15. Save the configuration using “XT” and the Windows transfer menu (format is skyymmdd.cfg or gndymmdd.cfg)..
16. Change “C4/0” to disable real-time data format (IMPORTANT!).
17. Press “Q” to quit to terminate the connection.
18. After disconnecting instrument simulating equipment, reconnect datalogger with original connections.
19. Ensure that the new configuration file is loaded to ADaM.

D. To Simulate PSP, IRT (both SKYRAD and GRNRAD), NIP (only on SKYRAD), and NET (GRNRAD and Comparison SKYRAD):

(See Attachment 13—D. To simulate PSP, IRT (both SKYRAD and GRNRAD), NIP (only on SKYRAD), and NET (GRNRAD and Comparison SKYRAD) Work Process Flow Diagram.)

1. Ensure that these sensors have the required 6-pin breakout box.
2. Connect voltage standard between pins 2 (negative) and 3 (positive) on breakout box.
3. Plug breakout box into connectors 1 for PSPG, 5 for PSPD, 3 for IRT, 7 for NIP, and 9 for NET.
4. Insert the following voltages:
   - PSP 0, 6, and 12 mV
   - IRT 0, 0.5, and 1 V
   - NIP 0, 6, and 12 mV
   - NET -9.5, 45, and 95 mV
5. Compare input and output voltages from the raw data.
6. If values differ by more than “insignificant values” listed in Attachment 2— Insignificant Voltage Offsets Chart, document variance, contact mentor, and follow mentor’s directions, e.g., change the offset and gain following the same procedures in section C. above for voltage

calibration changes for the PIR (also see attachments at the end of this document).

7. Retest, repeating 6. Above.
8. If values do not differ by more than "Insignificant Values" listed in Attachment 2— Insignificant Voltage Offsets Chart, continue to step E. below.

Note: The need to retest is especially important on PSP as the occasional automatic offset by the logger after connection can lead to a temporary offset of about 50mV.

E. To compensate for an IRT channel offset

1. If an offset is observed in the IRT channel (e.g. the logger reads 95 mV when 100 mV is entered), this can be compensated for by using the relationship 5 mV corresponds to a 0.125 degree temperature offset. Therefore, changing the negative temperature offset for the IRT from –60 to –59.875 on the SKYRAD or –50 to –49.875 on the GNDRAD.

F. To Simulate UBV (only on SKYRAD):

(See Attachment 14—To Simulate UBV (only on SKYRAD) Work Process Flow Diagram.)

1. Connect voltage standard between pins 2 (negative) and 3 (positive) and pins 2 and 6 for UBV_UV and UBV_T, respectively on the 8-pin Breakout Box. (Disconnect the resistors if necessary.)
2. Connect the Breakout Box to connector 4 on the SKYRAD datalogger.
3. Insert 0, 1.25, and 4 Volts on UBV_UV (pins 2 and 3).
4. Insert 0, 1, and 2 Volts on UBV_T (pins 2 and 6).
5. Compare input and output voltages from the raw data.
6. If values differ by more than the "Insignificant Values" (see Attachment 2— Insignificant Voltage Offsets Chart), document variance, contact mentor, and follow directions, e.g., change the offset and gain following the same procedures in section C. above for voltage calibration changes for the PIR.

G. To Change the calibration coefficient for a UVB:

1. The uvb's come from Solar Light with a calibration coefficient (if they are new this value is usually 0.250 V/(MED/Hr).
2. The coeffiecient in V/(MED/Hr) needs to be changed to W/m^2.

3. The calibration factor is determined by dividing the conversion from (MED)/Hour to W/m^2 by the calibration in V/(MED)/Hour, ie. 0.05829/cal, where cal is in V/(MED)/Hour. Example: for calibration factors from the factory of 0.25 and 0.27 V/(MED)/Hour the coefficients going into the zeno logger are 0.05829/0.25 = 0.233 and 0.05829/0.27 = 0.2159 ,respectively.
4. For the later case the logger sensor menu will become: SENSOR 1 "UvbV" 13 0 0 0 0 0 0 1 0 2 0 0.2159 0 0 0 0 0 0 0 0 0 0

H. To Calibrate Datalogger Voltage Divider for Power-Level Sensing:

(See Attachment 15—To Calibrate Datalogger Voltage Divider for Power-Level Sensing Work Process Flow Diagram.)

1. Measure the input power voltage with a Digital Multimeter.
2. Adjust the calibration factor in the Sensor Menu (Sensor 13) to obtain the proper external battery voltage reading. (View by selecting the Scaled Sensor Data option from the ZENO Test Menu.)
3. Enter the calibration coefficients for the sensors into the ZENO configuration. (A ZENO Sensor Configuration Table is included in the SKYRAD Datalogger Installation Procedures.)
4. If the values differ more than the “Insignificant Values” (see Attachment 2— Insignificant Voltage Offsets Chart), document the variance, contact the mentor, follow mentor’s directions, and retest.
5. If the values do not differ more than the “Insignificant Values” (see Attachment 2— Insignificant Voltage Offsets Chart), end this procedure.

V. References:

1. Coastal Environmental Systems, "Acceptance Procedures," 1995.
2. ZENO Corp., "Zeno-3200 Users Manual," May, 1995.
3. Hart, R. "SKYRAD Datalogger Installation Procedures: Including SKYRAD GRNRAD and SMET Sensor Configuration Tables", ANL ARCS Procedures, 1995.

VI. Attachments:

1. Thermistor/Process Menu # Chart
2. Insignificant Voltage Offsets Chart
3. SKYRAD Sensor Configuration Table
4. Processes for SKYRAD Fixed Resistors Chart
5. GNDRAD Sensor Configuration Table
6. Processes for GNDRAD Fixed Resistors Chart
7. SKYRAD and GNDRAD Logger Data Output Table
8. Example of SKYRAD Logger Configuration
9. FM(DAQR)-001, ARCS SKYRAD and GNDRAD Datalogger Field Calibration Form
10. Example of Completed Form
11. A. To Simulate a PIR Sensor Work Process Flow Diagram
12. B. To Change Voltage Calibration Work Process Flow Diagram
13. C. To Change PIR Fixed-Resistor Calibration for Resistance and Voltage Offset Differences Work Process Flow Diagram
14. D. To Simulate PSP, IRT (both SKYRAD and GRNRAD), NIP (only on SKYRAD), and NET (GRNRAD and Comparison SKYRAD) Work Process Flow Diagram
15. E. To Simulate UBV (Only SKYRAD) Work Process Flow Diagram
16. F. To Calibrate Datalogger Voltage Divider for Power-Level Sensing Work Process Flow Diagram
17. Enter and Exit GNDRAD and SMET ZENO CONFIG Process

Attachment 1

Thermistor/Process Menu

Thermistor	Process Menu #
PIRG Case	4&5
PIRG Dome	7&8
PIRD Case	26&27
PIRD Dome	29&30
PIRDN Case	4&5
PIRDN Dome	7&8

Attachment 2

Insignificant Voltage Offsets

PIR	PIR R	PSP	IRT	NIP	NET	UVB_UV	UVB_T	Vin
16uV	20W	20uV	1mV	20uV	20uV	20mV	20mV	
	0.2V							

Attachment 3

SKYRAD Sensor Configuration Table

When installing or changing the following sensors or instruments, the calibration coefficients need to be written into the appropriate ZENO Sensor Menu. The offsets in the Sensor Menu and the values of the fixed resistors in the Process Menu for the PIR thermistors should only be changed as a result of a datalogger calibration using 0.1% precision resistors.

Sensor or Instrument	Designation	Sensor Menu No.	Connector No.
Global Pyrgeometer	PIRG	4	2
Diffuse Pyrgeometer	PIRD	5	6
Global Pyranometer	PSPG	1	1
Diffuse Pyranometer	PSPD	2	5
Pyroheliometer	NIP	3	7
Infra-Red Thermometer	IRT-UP	6	3
UVB Temperature	UVB-T	7	4
UVB Signal	UVB-UV	8	4

Attachment 4

Processes for SKYRAD Fixed Resistors

Thermistor	Process Menu No's
PIRG Case Thermistor	4 & 5
PIRG Dome Thermistor	7 & 8
PIRD Case Thermistor	26 & 27
PIRD Dome Thermistor	29 & 30

In processes 4, 7, 26, and 29 enter the resistance value for the slope and minus the resistance value as the offset (the last two items).

Attachment 5

GNDRAD Sensor Configuration Table

When installing or changing the following sensors or instruments, the calibration coefficients need to be written into the appropriate ZENO Sensor Menu. The offsets in the Sensor Menu and the values of the fixed resistors in the Process Menu for the PIR thermistors should only be changed as a result of a datalogger calibration using 0.1% precision resistors.

Sensor or Instrument	Designation	Sensor Menu No.	Connector No.
Upwelling Pyrgeometer	PIRDN	1	6
Upwelling Pyranometer	PSPDN	2	5
Upwelling IRT	IRT-DN	3	3
Daytime Net Radiation	NET+	6	9
Nighttime Net Radiation	NET-	7	9

Attachment 6

Processes for GNDRAD Fixed Resistors

Thermistor	Process Menu No's
PIRDN Case Thermistor	4 & 5
PIRDN Dome Thermistor	7 & 8

In processes 4 and 7, enter the resistance value for the slope and minus the resistance value as the offset (the last two items).

Attachment 7

SKYRAD and GNDRAD Logger Data Output Table

SKYRAD Logger

Site ID	Version #	Date

Time	Bit #	PSPg ave	PSPg sd	PSPg max	PSPg min	PIRg _E1	PIRg _E2	PIRg _E3	RGc _1	RGc _2	RGc _3

RGd_1	RGd_2	RGd_3	PIRG ave	PIRG sd	PIRG max	PIRG min	IRT ave	IRT sd	IRT max	IRT min

UVB T1	UVB T2	UVB T3	UVB 1	UVB 2	UVB 3	UVB ave	UVB sd	UVB max	UVB min

PSPD ave	PSP D sd	PSPD max	PSPD min	PIRd_e1	PIRd_e2	PIRd_e3	RDc_1	RDc_2	RDc_3

RDd_1	RDd_2	RDd_3	PIRD ave	PIRD sd	PIRD max	PIRD min	NIP ave	NIP sd	NIP max

NIP min	T int	V int	T ext

GNDRAD Logger

Site ID	Version #	Date

Time	Bit#	PSPD n ave	PSPD n sd	PSPDn max	PSPDn min	PIRDn e1	PIRDn e2	PIRDn e3	RC1

RC2	RC3	RD1	RD2	RD3	PIRDn ave	PIRDn sd	PIRDn max	PIRDn min	irt Dn ave	irt Dn sd

irt Dn max	irt Dn min	Net ave	Net sd	Net max	Net min	Int temp	Batt_Int	Batt Ext

Attachment 8

Example of SKYRAD Logger Configuration

```
* Zeno 3200 System Setup File
* Program Version And Date: ZENO-3200 using ZENOSOFT V1.85H-1403B2-1.1 Feb 22 1999 15:21:33 CS B300
* (C)opyright 1995-1999, Coastal Environmental Systems, Seattle, WA, USA.
* Setup File Date And Time: 00/07/06 21:28:34
PARAM1 60 0 60 2 110 4 102 0 9600 9600
PARAM2 9600 0 0 0 0 3 0 0 0 0
PARAM3 16777 1 60 18 600 20 0 0 2 2
PARAM4 2 2 0 0 1 3276800 0 -1 5 0
PARAM5 3 0 0 0 100 0 0 0 0 0
PARAM6 0 0 0 916923600 50336144 151 196608 0 1 0
PARAM7 151 0 1280 0 10000 -1 -1 0 10 1
PARAM8 42 0 0 0 0 0 0 0 0 0
PARAM9 0 0 0 0
PARAM10 "NONE" "NONE" "NONE" "NONE" "NONE" "NONE" "" "ZENO" "" ""
REPEAT1 -1 -1 -1 -1 -1 -1 -1 -1
CONSTANT1 0 0 0 0 0 0 0 0 0 0
CONSTANT2 0 0 0 0 0 0 0 0 0 0
GSI 1 NO_COMMAND
SENSOR 3 "PspG" 3 2 2 0 0 0 0 1 0 2 0 128156 0 0 0 0 0 0 0 0 0 0
SENSOR 3 "PspD" 4 2 2 0 0 0 0 1 0 2 0 127551 0 0 0 0 0 0 0 0 0 0
SENSOR 3 "Nip" 5 2 2 0 0 0 0 1 0 2 0 121051 0 0 0 0 0 0 0 0 0 0
SENSOR 3 "PirG" 1 2 0 0 0 0 0 1 0 2 0 299401 0 0 0 0 0 0 0 0 0 0
SENSOR 3 "PirD" 2 2 0 0 0 0 0 1 0 2 0 225733 0 0 0 0 0 0 0 0 0 0
SENSOR 1 "Irt" 12 0 0 2 0 0 3 1 0 2 0 25 -60 0 0 0 0 0 0 0 0 0
SENSOR 1 "UvbT" 14 0 0 0 0 0 0 1 0 2 0 50 -25 0 0 0 0 0 0 0 0 0
SENSOR 1 "UvbV" 13 0 0 0 0 0 0 1 0 2 0 0.2332 0 0 0 0 0 0 0 0 0 0
SENSOR 1 "Rgc" 8 0 0 0 2 1 0 1 0 2 0 -0.4 1 0 0 0 0 0 0 0 0 0
SENSOR 1 "Rgd" 9 0 0 0 2 1 0 1 0 2 0 -0.4 1 0 0 0 0 0 0 0 0 0
SENSOR 1 "Rdc" 10 0 0 0 2 1 0 1 0 2 0 -0.4 1 0 0 0 0 0 0 0 0 0
SENSOR 1 "Rdd" 11 0 0 0 2 1 0 1 0 2 0 -0.4 1 0 0 0 0 0 0 0 0 0
SENSOR 1 "Vext" 1 0 0 0 0 0 0 2 1 3 0 10.0678 0 0 0 0 0 0 0 0 0 0
```

SENSOR 1 "Vint" 2 0 0 0 0 0 0 2 1 3 0 1.0024 0 0 0 0 0 0 0 0 0 0

SENSOR 1 "Tint" 3 0 0 0 0 0 0 1 0 3 0 1 0 0 0 0 0 0 0 0 0 0

PROCESS 1 2 "PspG-AVE" S1.1

PROCESS 3 2 "PspG-ALM" S1.1 1400 -20 12

PROCESS 5 9 "Rgc-INV" S9.1

PROCESS 5 12 "Rgc-6POL" P3.1 0 0 0 0 0 9984 -9984

PROCESS 4 1 "NTC-Rgc" S9.1 0.00103085 0.000238918 1.57464e-07 9984

PROCESS 5 9 "Rdg-INV" S10.1

PROCESS 5 12 "Rgd-6POL" P6.1 0 0 0 0 0 9980 -9980

PROCESS 4 1 "NTC-Rgd" S10.1 0.00103085 0.000238918 1.57464e-07 9980

PROCESS 4 6 "PirG-c" P8.2 P5.2 S4.1 1 4

PROCESS 1 9 "PirG-COL" S4.1

PROCESS 1 9 "Rgc-COL" P4.1

PROCESS 1 9 "Rgd-COL" P7.1

PROCESS 1 2 "PirG-cAV" P9.2

PROCESS 3 2 "PirG-cAL" P9.2 475 375 13

PROCESS 1 2 "Irt-AVE" S6.1

PROCESS 3 2 "Irt-ALRM" S6.1 40 -60 14

PROCESS 4 5 "UvbT-BIO" S7.1 S8.1

PROCESS 1 9 "UvbT-COL" S7.1

PROCESS 1 9 "UvbV-COL" S8.1

PROCESS 1 2 "UvbT-AVE" P17.2

PROCESS 3 2 "UvbT-ALM" S7.1 26 24 16

PROCESS 3 2 "UvbT-ALM" P17.2 1.2 0 17

PROCESS 1 2 "PspD-AVE" S2.1

PROCESS 3 2 "PspD-ALM" S2.1 700 -20 18

PROCESS 5 9 "Rdc-INV" S11.1

PROCESS 5 12 "Rdc-6POL" P25.1 0 0 0 0 0 9984 -9984

PROCESS 4 1 "NTC-Rdc" S11.1 0.00103085 0.000238918 1.57464e-07 9984

PROCESS 5 9 "Rdd-INV" S12.1

PROCESS 5 12 "Rdd-6POL" P28.1 0 0 0 0 0 9980 -9980

PROCESS 4 1 "NTC-Rdd" S12.1 0.00103085 0.000238918 1.57464e-07 9980

PROCESS 4 6 "PirD-c" P30.2 P27.2 S5.1 1 4

PROCESS 1 9 "PirD-COL" S5.1

PROCESS 1 9 "Rdc-6PCL" P26.1

PROCESS 1 9 "Rdd-6PCL" P29.1

PROCESS 1 2 "PirD-cAV" P31.2

PROCESS 3 2 "PirD-cAL" P31.2 475 375 19

PROCESS 1 2 "Nip-AVE" S3.1

PROCESS 3 2 "Nip-ALRM" S3.1 950 -20 20

PROCESS 3 1 "BIT"

PROCESS 1 1 "Temp-Int" S15.1

PROCESS 1 1 "Volt-ext" S13.1

PROCESS 1 1 "Volt-int" S14.1

DATA 6 1,2 "TWP-" P1.1 0 0 1

DATA 6 1,2 "Nauru." P1.1 0 0 1

DATA 6 1,2 "skyrad<20>" P1.1 0 0 1

DATA 6 1 "V000706.00" P1.1 0 0 1

DATA 6 1 "<20>" P1.1 0 0 1

DATA 3 1,2 "" P1.1 0 0 1

DATA 8 1 "BIT" P39.L1 0 0 6

DATA 8 1 "PspGav" P1.1 2 0 8

DATA 8 1 "PspGsd" P1.3 2 0 8

DATA 8 1 "PspGmx" P1.4 2 0 8

DATA 8 1 "PspGmn" P1.5 2 0 8

DATA 8 1 "PirG_E1" P10.10 2 0 8

DATA 8 1 "PirG_E2" P10.30 2 0 8

DATA 8 1 "PirG_E3" P10.50 2 0 8

DATA 8 1 "RGc_1" P11.10 2 0 8

DATA 8 1 "RGc_2" P11.30 2 0 8

DATA 8 1 "RGc_3" P11.50 2 0 8

DATA 8 1 "RGd_1" P12.10 2 0 8

DATA 8 1 "RGd_2" P12.30 2 0 8

DATA 8 1 "RGd_3" P12.50 2 0 8

DATA 8 1 "PirGav" P13.1 2 0 8

DATA 8 1 "PirGsd" P13.3 2 0 8

DATA 8 1 "PirGmx" P13.4 2 0 8

DATA 8 1 "PirGmn" P13.5 2 0 8

DATA 8 1 "IrtAv" P15.1 2 0 8

DATA 8 1 "IrtSd" P15.3 2 0 8

DATA 8 1 "IrtMx" P15.4 2 0 8

DATA 8 1 "IrtMn" P15.5 2 0 8

DATA 8 1 "UvbT1" P18.10 2 0 8

DATA 8 1 "UvbT2" P18.30 2 0 8

DATA 8 1 "UvbT3" P18.50 2 0 8

DATA 8 1 "Uvb1" P19.10 4 0 8

DATA 8 1 "Uvb2" P19.30 4 0 8

DATA 8 1 "Uvb3" P19.50 4 0 8

DATA 8 1 "UvbAv" P20.1 4 0 8

DATA 8 1 "UvbSd" P20.3 4 0 8

DATA 8 1 "UvbMx" P20.4 4 0 8

DATA 8 1 "UvbMn" P20.5 4 0 8

DATA 8 1 "PspDAv" P23.1 2 0 8

DATA 8 1 "PspDSd" P23.3 2 0 8

DATA 8 1 "PspDMx" P23.4 2 0 8

DATA 8 1 "PspDMn" P23.5 2 0 8

DATA 8 1 "PirD_E1" P32.10 2 0 8

DATA 8 1 "PirD_E2" P32.30 2 0 8

DATA 8 1 "PirD_E3" P32.50 2 0 8

DATA 8 1 "RDc_1" P33.10 2 0 8

DATA 8 1 "RDc_2" P33.30 2 0 8

DATA 8 1 "RDc_3" P33.50 2 0 8

DATA 8 1 "RDd_1" P34.10 2 0 8

DATA 8 1 "RDd_2" P34.30 2 0 8

DATA 8 1 "RDd_3" P34.50 2 0 8

DATA 8 1 "PirDAv" P35.1 2 0 8

DATA 8 1 "PirDSd" P35.3 2 0 8

DATA 8 1 "PirDMx" P35.4 2 0 8

DATA 8 1 "PirDMn" P35.5 2 0 8

DATA 8 1 "NipAv" P37.1 2 0 8

DATA 8 1 "NipSd" P37.3 2 0 8

DATA 8 1 "NipMx" P37.4 2 0 8

DATA 8 1 "NipMn" P37.5 2 0 8

DATA 8 1 "Tint" P40.1 2 0 8

DATA 8 1 "Vint" P42.1 2 0 8

DATA 8 1 "Vext" P41.1 2 0 8

DATA 6 2 "<20>PIRG_Rc:" P1.1 0 0 1

DATA 7 2 "RGc" P4.1 2 0 1

DATA 6 2 "<20>PIRG_Rd:" P1.1 0 0 1

DATA 7 2 "RGd" P7.1 2 0 1

DATA 6 2 "<20>PIRG_Tc:" P1.1 0 0 1

DATA 7 2 "TGc<20>K" P5.2 2 0 1

DATA 6 2 "<20>PIRG_Td:" P1.1 0 0 1

DATA 7 2 "TGd<20>K" P8.2 2 0 1

DATA 6 2 "<20>PIRG_cor:" P1.1 0 0 1

DATA 7 2 "PIRG" P9.2 2 0 1

DATA 6 2 "<20>UVB_cor:" P1.1 0 0 1

DATA 7 2 "UVB" P17.2 4 8 1

DATA 6 2 "<20>PIRD_Rc:" P1.1 0 0 1

DATA 7 2 "RDc" P26.1 2 0 1

DATA 6 2 "<20>PIRD_Rd:" P1.1 0 0 1

DATA 7 2 "RDd" P29.1 2 0 1

DATA 6 2 "<20>PIRD_Tc:" P1.1 0 0 1

DATA 7 2 "TDc<20>K" P27.2 2 0 1

DATA 6 2 "<20>PIRD_Td:" P1.1 0 0 1

DATA 7 2 "TDd<20>K" P30.2 2 0 1

DATA 6 2 "<20>PIRD_cor:" P1.1 0 0 1

DATA 7 2 "PIRD" P31.2 2 0 1

DATA 6 1,2 "<0D><0A>" P1.1 0 0 1

Attachment 9

ARCS SKYRAD and GNDRAD Data logger Field Calibration Form FM(DAQR)-001

ARCS SKYRAD and GNDRAD Data Logger Field Calibration Form

I. Calibration information

This is a (check which):	Calibration	Calibration Check	Field Calibration
			X

Date:	GMT Begin Time:	GMT End Time:	ARCS #

Instrument / System:	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
SKYRAD1 ZENO Datalogger	ZENO-3200(RAD)	
GNDRAD1 ZENO Datalogger	ZENO-3200(RAD)	

Current Configuration Version:	New Configuration Version

Location (eg. PNNL, Manus):	Participant(s):	Issued by:	Signature(s):

Reference Instrument(s):	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
Voltage source (Val)	2701C	
Voltmeter Fluke (Flk)	8842A	

Precision Resistors 4018, 8240, and 17790 Ohms

Verify that serial numbers of reference instruments are correct (yes / no)

Verify calibration coefficients and configuration file changed accordingly for PIRs, PSPs, and NIPs. (yes / no)

NOTES:

II. Initial Values

Sensor / Element Connection Location	Reference Target (Val) Actual (Flk)	Reading Actual or Range	Reference Target (Val) Actual (Flk)	Reading Actual or Range	Reference Target (Val) Actual (Flk)	Reading Actual or Range
PIRG Signal	0.0µV	(µV)	500.0µV		1000.0µV	
Connector 2	Short		500		1000	
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3						
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	Short		500		1000	
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3						
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PSPG	0.0µV		6000.0µV		12000.0µV	
Connector 1	Short		6000		12000	
PSPD	0.0µV		6000.0µV		12000.0µV	
Connector 5	Short		6000		12000	
NIP	0.0µV		6000.0µV		12000.0µV	
Connector 7	Short		6000		12000	
IRT	0.0mV		500.0mV		1000.0mV	
Connector 3	Short		500		1000	
UVB_UV pins 2&3	0.0mV		1250.0mV		4000.0mV	
Connector 4	Short		1250		4000	
UVB_T pis 2&6	0.0mV		1000.0mV		2000.0mV	
Connector 4	Short		1000		2000	
GNDRAD						
PIR Dn Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	Short		500		1000	
PIR Dn Rc	4000 Ω		8000 Ω		16000 Ω	
	4017		8245		17785	
PIR Dn Rd	4000 Ω		8000 Ω		16000 Ω	
	4024		8257		17789	
PSP Dn	0.0µV		6000.0µV		12000.0µV	
Connector 5	Short		6000		12000	
NET (+ values)	10.0mV		50.0mV		100.0mV	
Connector 9	10		50		100	
NET (- values)	- 10.0mV		- 50.0mV		- 100.0mV	
Connector 9 pins 3&2	-10		-50		-100	
IRT	0.0mV		500.0mV		1000.0mV	
Connector 3	Short		500		1000	
Voltage Divider						

Were there calibration changes?(yes/no) **No?**

II. Final Values

Sensor / Element Serial Number:	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual
PIRG Signal	0.0µV		500.0µV		1000.0µV	
Connector 2						
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3						
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6						
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3						
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PSPG	0.0µV		6000.0µV		12000.0µV	
Connector 1						
PSPD	0.0µV		6000.0µV		12000.0µV	
Connector 5						
NIP	0.0µV		6000.0µV		12000.0µV	
Connector 7						
IRT	0.0 mV		500.0 mV		1000.0 mV	
Connector 3						
UVB_UV	0.0 mV		1250.0 mV		4000.0 mV	
Connector 4						
UVB_T	0.0 mV		1000.0 mV		2000.0 mV	
Connector 4						
PIR Dn Signal	0.0µV		500.0µV		1000.0µV	
PIR Dn Rc	4000 Ω		8000 Ω		16000 Ω	
PIR Dn Rd	4000 Ω		8000 Ω		16000 Ω	
PSP Dn	0.0µV		6000.0µV		12000.0µV	
NET (+ values)	9.5 mV		45.0 mV		95.0 mV	
NET (- values)	- 9.5 mV		- 45.0 mV		- 95.0 mV	
IRT	0.0 mV		500.0 mV		1000.0 mV	
Voltage Divider						

IV Statistics(if applicable)

No. of Samples:	Std. Dev.	CF Range %	Uncertanty %

V. Calilbration Change (if applicable)

Sensor or Parameter	Sensor Serial No. Old/New	Internal Resistance (Ohms) Old/New	Original Sensitivity (Volts/Unit) Old/New	Offset Old/New	Quadratic Old/New

Document(s) Referenced:
PRO(DAQR)-001.001

Document(s) Updated:

PROBLEMS:

Attachment 10
Example of Completed Form

ARCS SKYRAD and GNDRAD Data Logger Field Calibration Form

I. Calibration information

This is a (check which):	Calibration	Calibration Check	Field Calibration
			X

Date:	GMT Begin Time:	GMT End Time:	ARCS #
6/28/00	21:10	22:30	2

Instrument / System:	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
SKYRAD1 ZENO Datalogger	ZENO-3200(RAD)	30
GNDRAD1 ZENO Datalogger	ZENO-3200(RAD)	

Current Configuration Version:	New Configuration Version
V991017.00	

Location (eg. PNNL, Manus):	Participant(s):	Issued by:	Signature(s):
Nauru	Kornke/Porch		

Reference Instrument(s):	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
Voltage source (Val)	2707A	26-1348
Voltmeter Fluke (Flk)	8842A	670251

Precision Resistors 4020, 8250, and 16210 Ohms

Verify that serial numbers of reference instruments are correct (yes / no) **yes**

Verify calibration coefficients and configuration file changed accordingly for PIRs, PSPs, and NIPs. (yes / no) **yes**

NOTES:
Ran out of DAQR forms and used DAQC form for original.

II. Initial Values

Sensor / Element Connection Location	Reference Target (Val) Actual (Flk)	Reading Actual or Range	Reference Target (Val) Actual (Flk)	Reading Actual or Range	Reference Target (Val) Actual (Flk)	Reading Actual or Range
PIRG Signal	0.0µV	(µV)	500.0µV		1000.0µV	
Connector 2	Short	-2 to -4	500	496 to 500	1000	999 to 1001
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3	4023	4021	8252	8245 to 58	16202	16197
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8	4023	4020	8248	8255	16203	16218
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	Short	0.2 to 0.5	500	502to 503	1000	1005 to 1006
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3	4023	4021	8252	8258	16202	16196 to 224
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8	4022	4020	8248	8241 to 55	16203	16190 to 217
PSPG	0.0µV		6000.0µV		12000.0µV	
Connector 1	Short	-2 to -4	6000	5996 to 97	12000	11993 to 12000
PSPD	0.0µV		6000.0µV		12000.0µV	
Connector 5	Short	-2 to -4	6000	5995 to 98	12000	11993 to 11995
NIP	0.0µV		6000.0µV		12000.0µV	
Connector 7	Short	-0 to -2	6000	5996 to 8	12000	11993 to 5
IRT	0.0mV		500.0mV		1000.0mV	
Connector 3	Short	0	500	498	1000	998
UVB_UV pins 2&3	0.0mV		1250.0mV		4000.0mV	
Connector 4	Short	0	1250	1249.7	4000	3999
UVB_T pis 2&6	0.0mV		1000.0mV		2000.0mV	
Connector 4	Short	0	1000	999.8	2000	1999.5
GNDRAD						
PIR Dn Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	Short	-1 to -2	500	501 to 502	1000	1000 to 1002
PIR Dn Rc	4000 Ω		8000 Ω		16000 Ω	
	4023	4017	8252	8248	16202	16177 to 205
PIR Dn Rd	4000 Ω		8000 Ω		16000 Ω	
	4022	4017	8248	8234-48	16203	16205
PSP Dn	0.0µV		6000.0µV		12000.0µV	
Connector 5	Short	0 to 1	6000	5990 to 2	12000	1000 to 1002
NET (+ values)	10.0mV		50.0mV		100.0mV	
Connector 9	10	10	50	50	100	100
NET (- values)	- 10.0mV		- 50.0mV		- 100.0mV	
Connector 9 pins 3&2	-10	-10	-50	-50	-100	-100
IRT	0.0mV		500.0mV		1000.0mV	
Connector 3	Short	4.088 V	500	491-492	1000	991 to 992
Voltage Divider						

Were there calibration changes?(yes/no) **No?**

II. **Final Values**

Sensor / Element Serial Number:	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual
PIRG Signal	0.0µV		500.0µV		1000.0µV	
Connector 2						
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3						
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6						
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3						
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PSPG	0.0µV		6000.0µV		12000.0µV	
Connector 1						
PSPD	0.0µV		6000.0µV		12000.0µV	
Connector 5						
NIP	0.0µV		6000.0µV		12000.0µV	
Connector 7						
IRT	0.0 mV		500.0 mV		1000.0 mV	
Connector 3						
UVB_UV	0.0 mV		1250.0 mV		4000.0 mV	
Connector 4						
UVB_T	0.0 mV		1000.0 mV		2000.0 mV	
Connector 4						
PIR Dn Signal	0.0µV		500.0µV		1000.0µV	
PIR Dn Rc	4000 Ω		8000 Ω		16000 Ω	
PIR Dn Rd	4000 Ω		8000 Ω		16000 Ω	
PSP Dn	0.0µV		6000.0µV		12000.0µV	
NET (+ values)	9.5 mV		45.0 mV		95.0 mV	
NET (- values)	- 9.5 mV		- 45.0 mV		- 95.0 mV	
IRT	0.0 mV		500.0 mV		1000.0 mV	
Voltage Divider						

IV **Statistics**(if applicable)

No. of Samples:	Std. Dev.	CF Range %	Uncertanty %

V. **Calilbration Change**(if applicable)

Sensor or Parameter	Sensor Serial No. Old/New	Internal Resistance (Ohms) Old/New	Original Sensitivity (Volts/Unit) Old/New	Offset Old/New	Quadratic Old/New

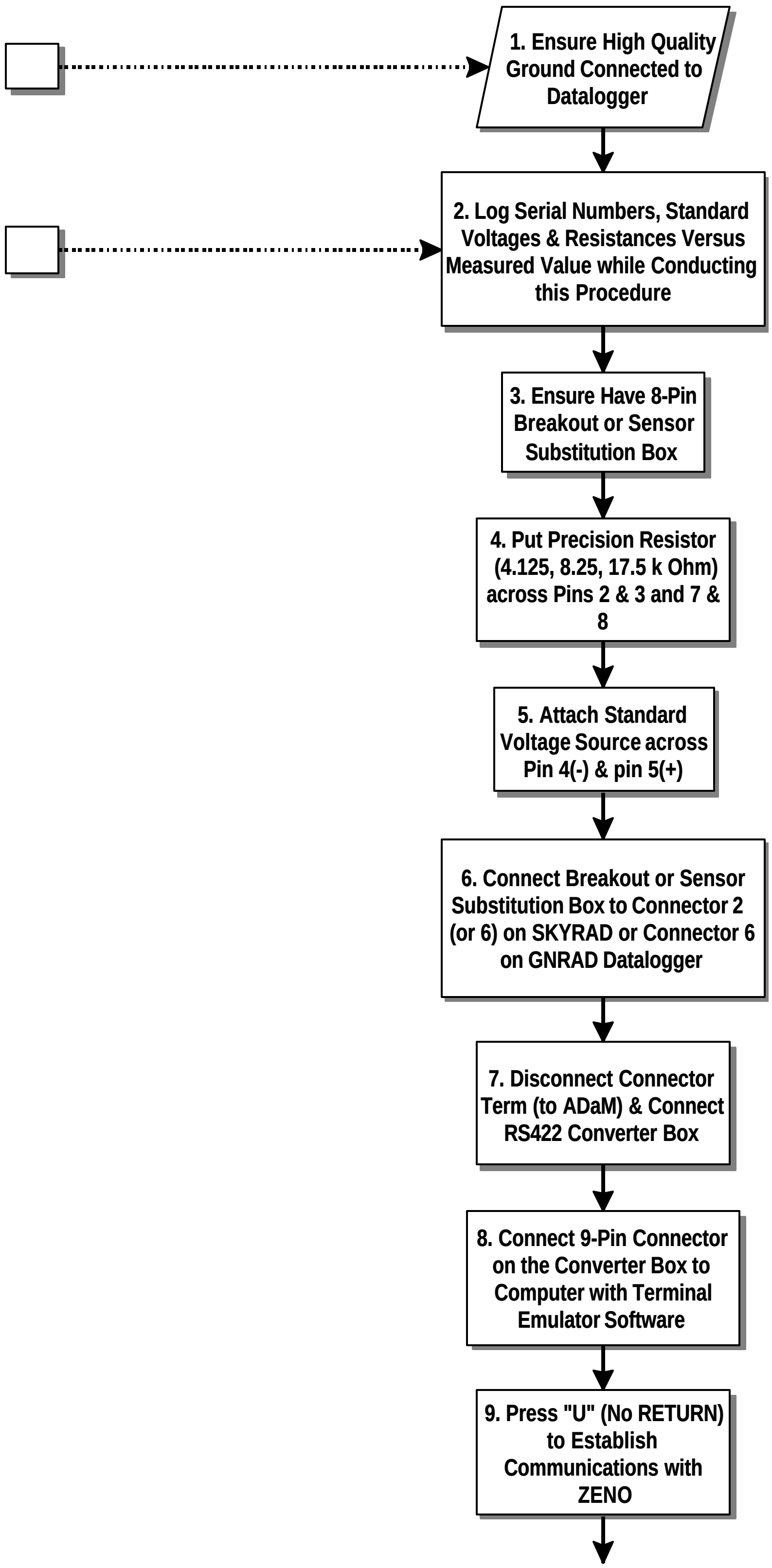
Document(s) Referenced:	Document(s) Updated:
PRO(DAQR)-001.001	

PROBLEMS:

IRT channel shows 4 V on dead short, but when signal applied is off by about 10 mV. Called Dick Hart. Seems to be channel problem.

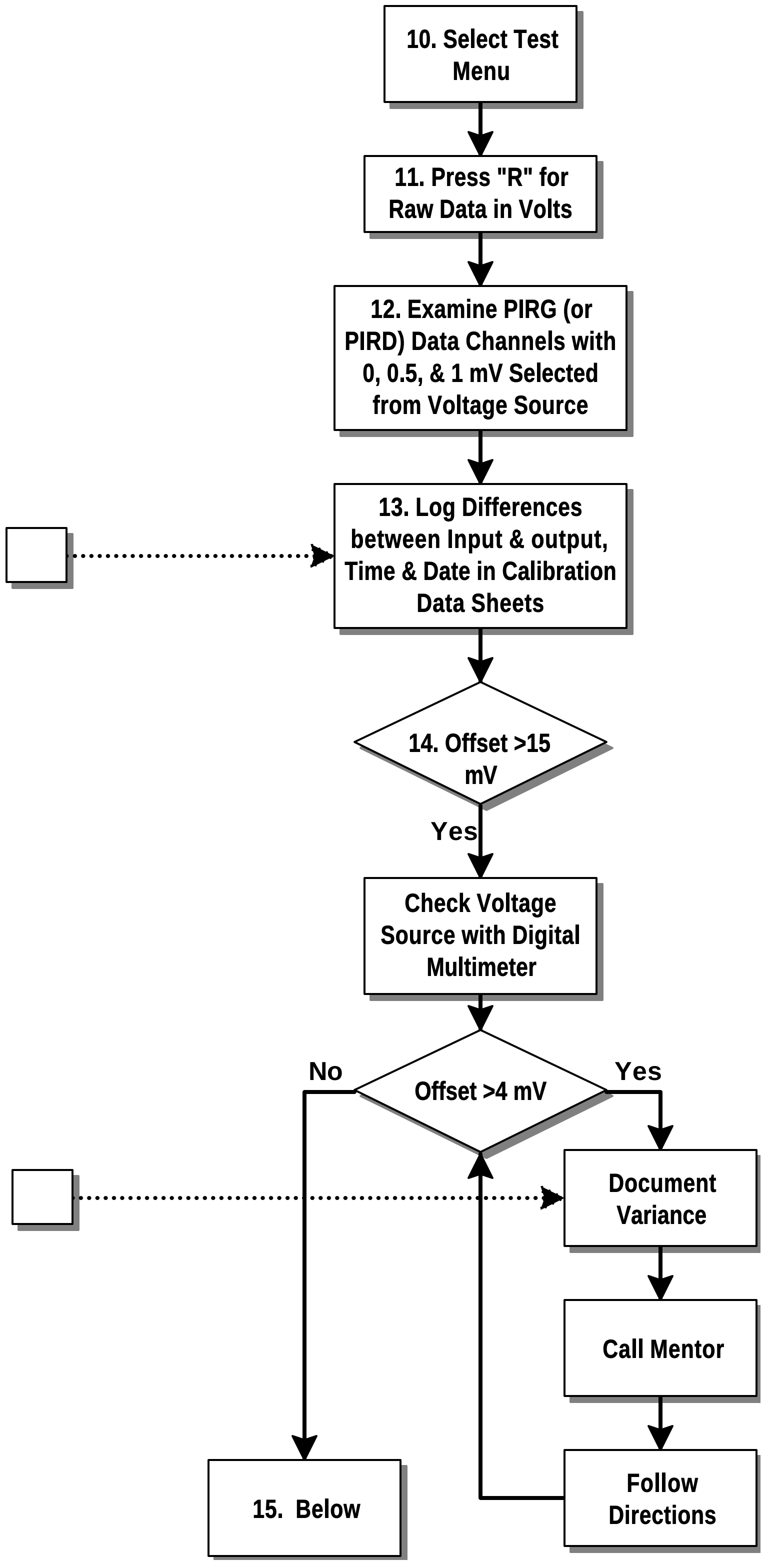
Attachment 11

A. To Simulate a PIR Sensor



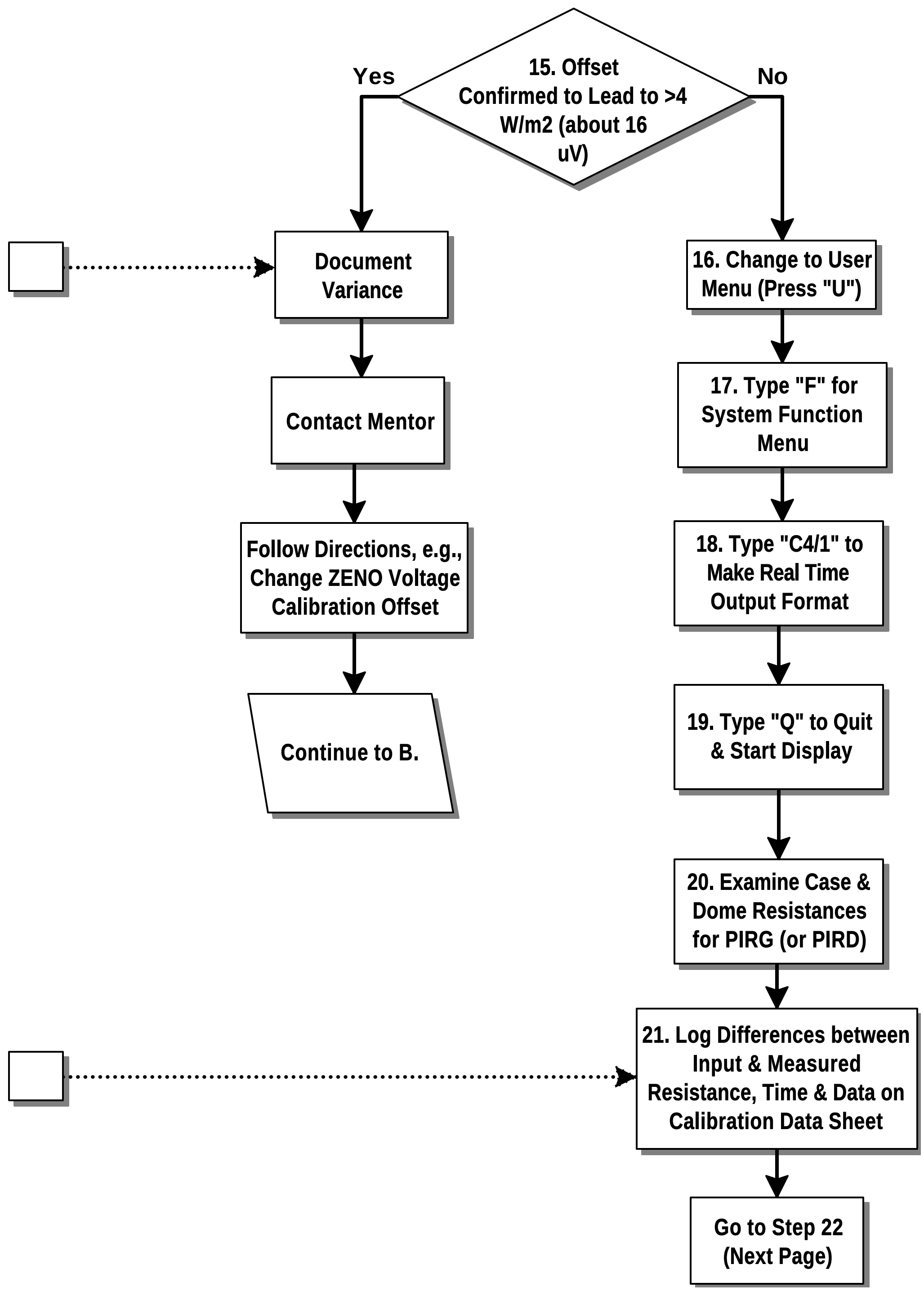
(Page 2)

A. To Simulate a PIR Sensor

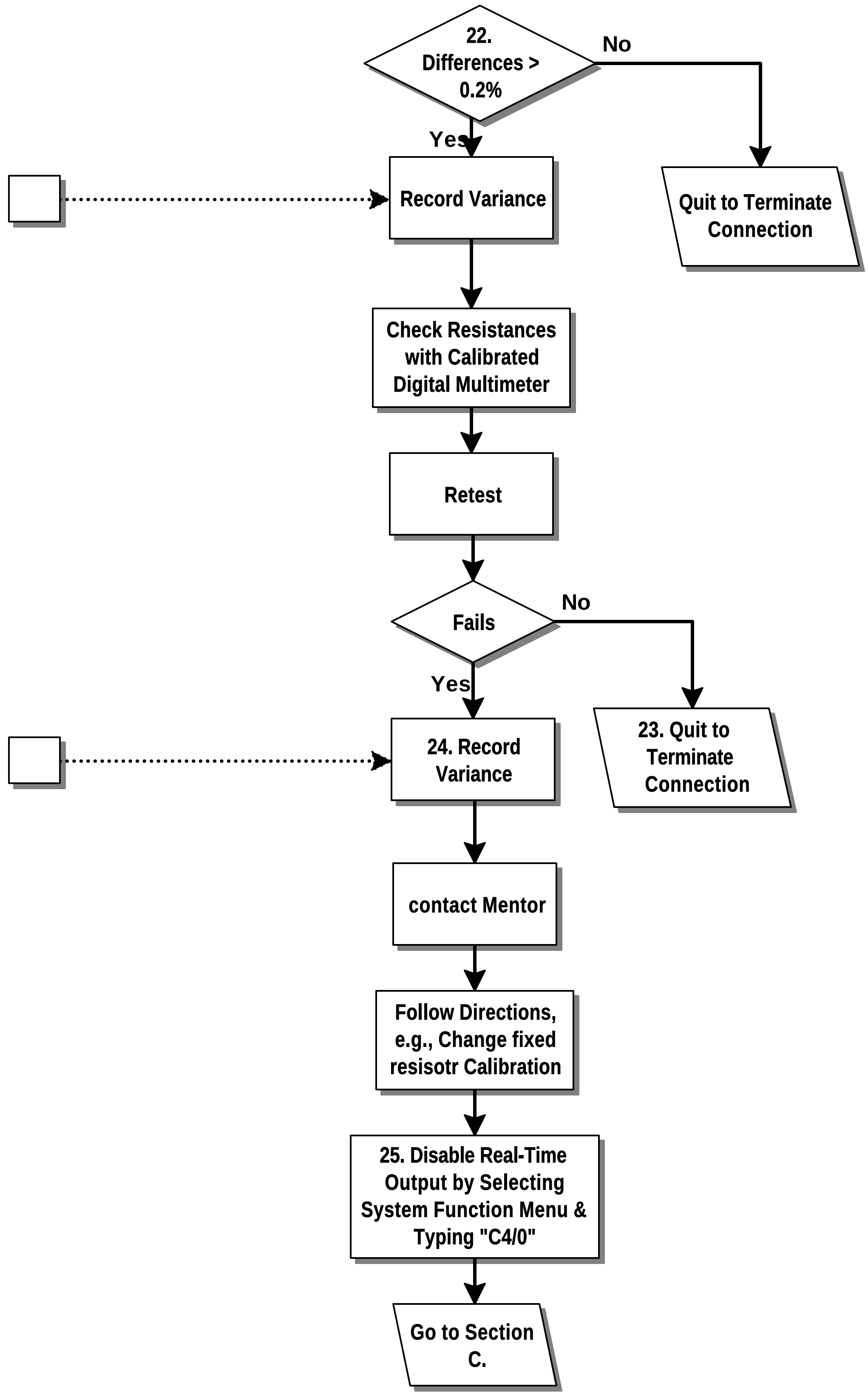


(Page 3)

A. To Simulate a PIR Sensor

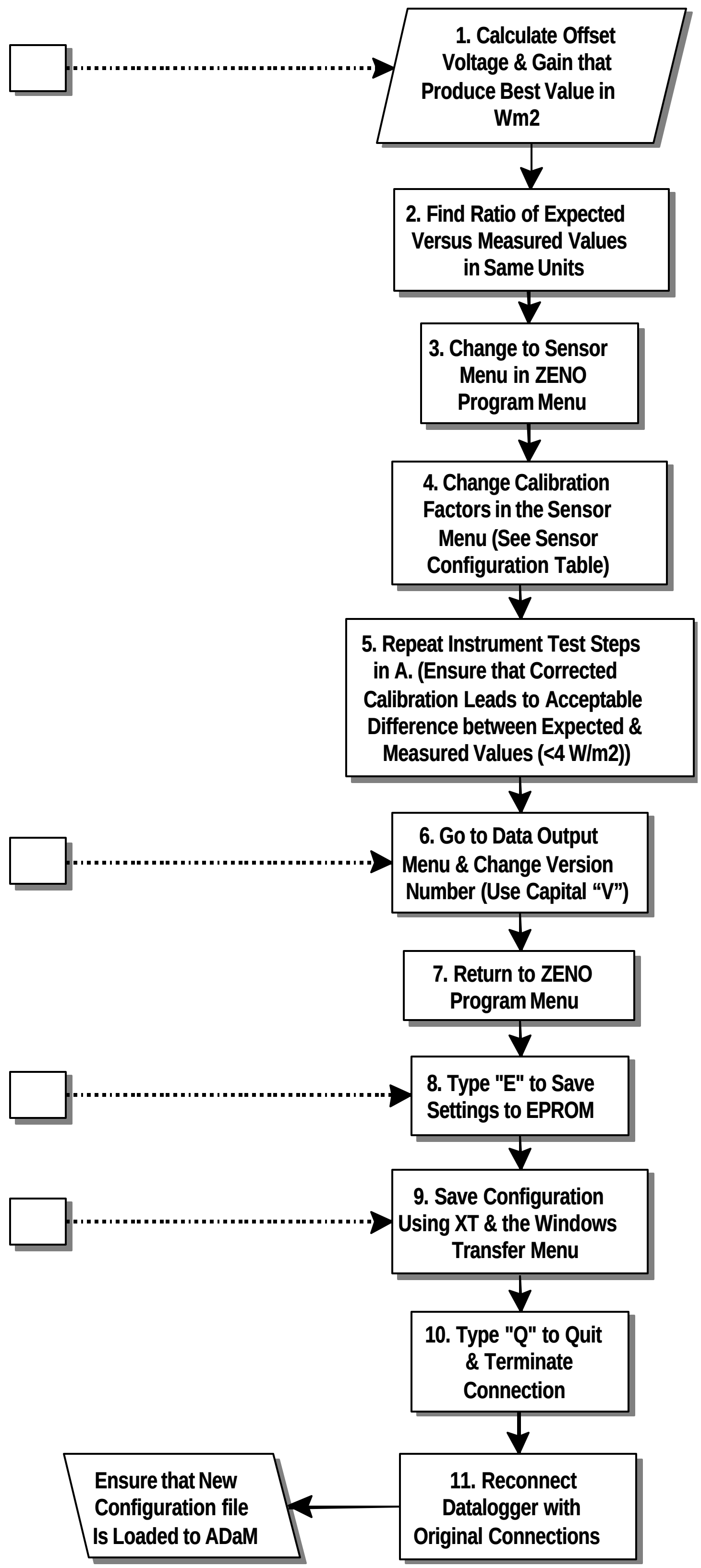


A. To Simulate a PIR Sensor (Page 4)



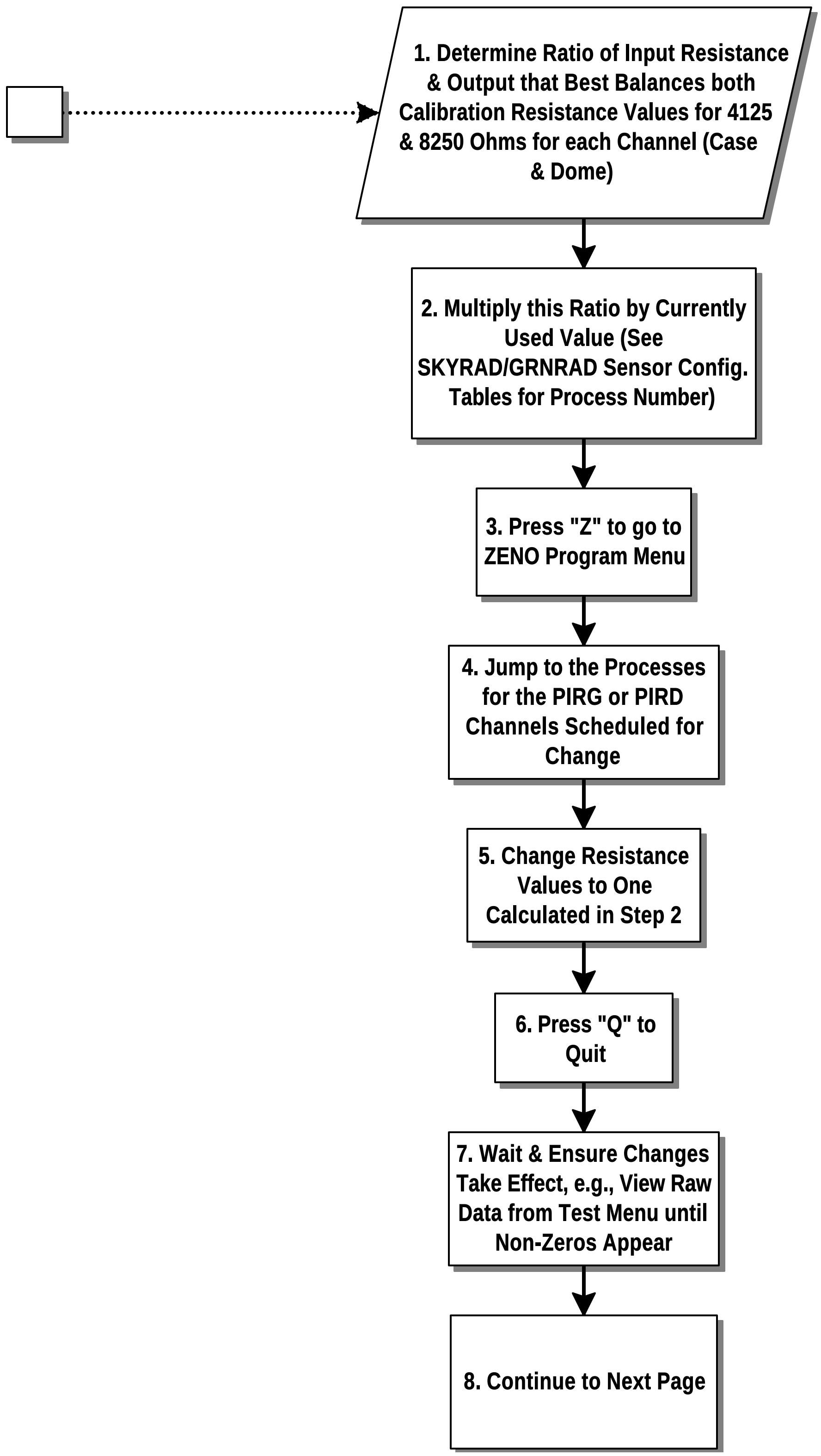
Attachment 12

B. To Change Voltage Calibration

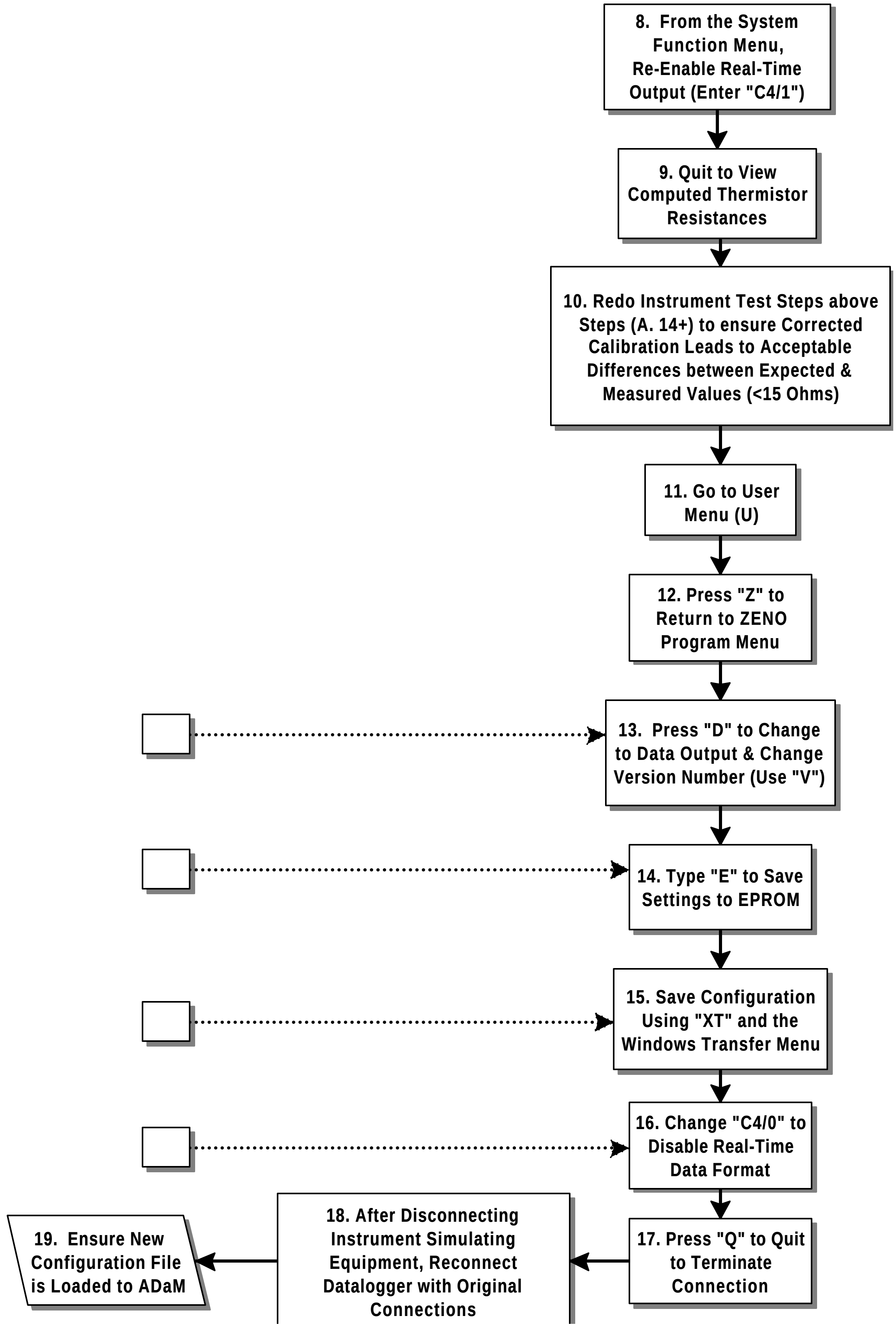


Attachment 13

C. To Change PIR Fixed-Resistor Calibration for Resistance and Voltage Offset Differences

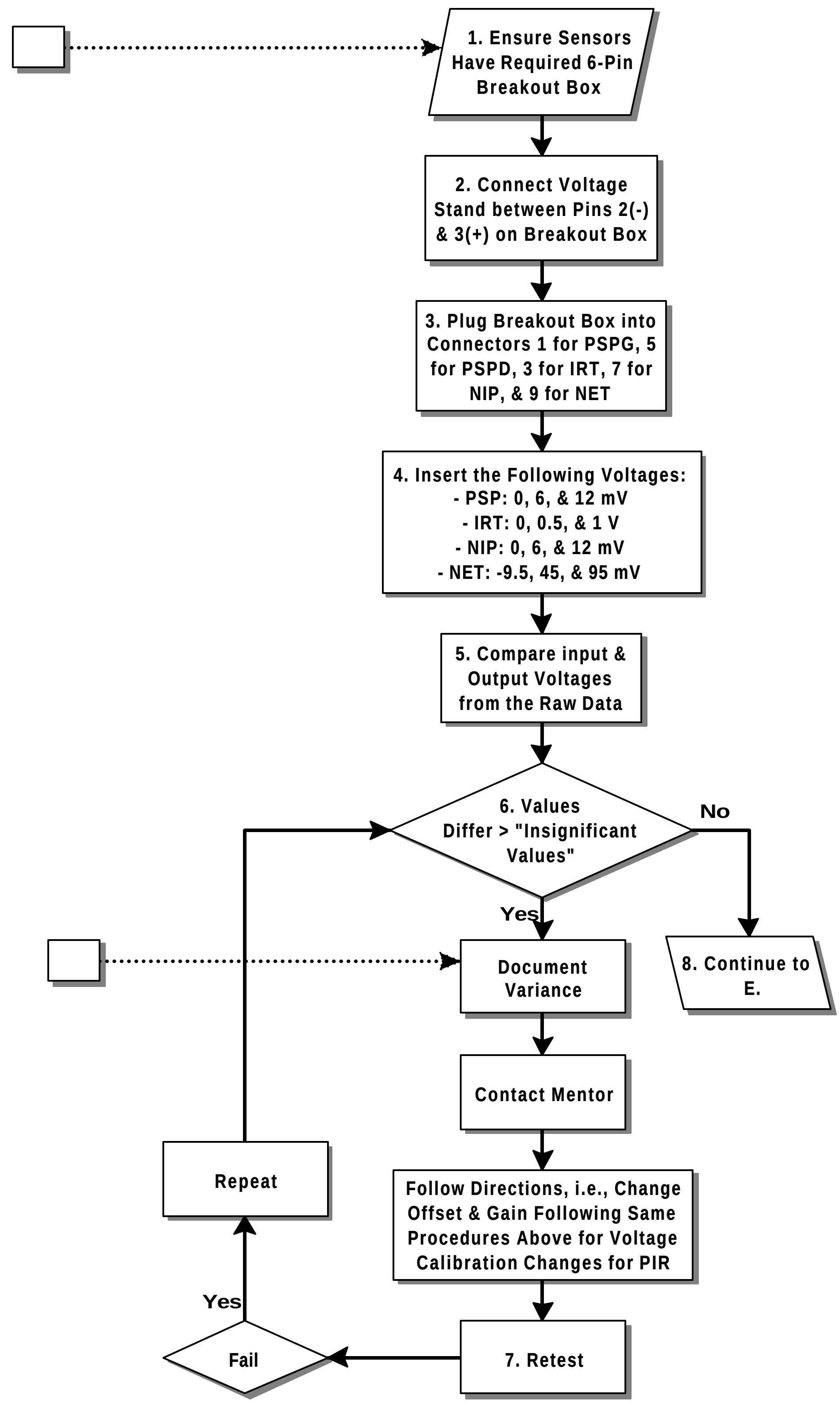


C. To Change PIR Fixed-Resistor Calibration for Resistance and Voltage Offset Differences (Page 2)



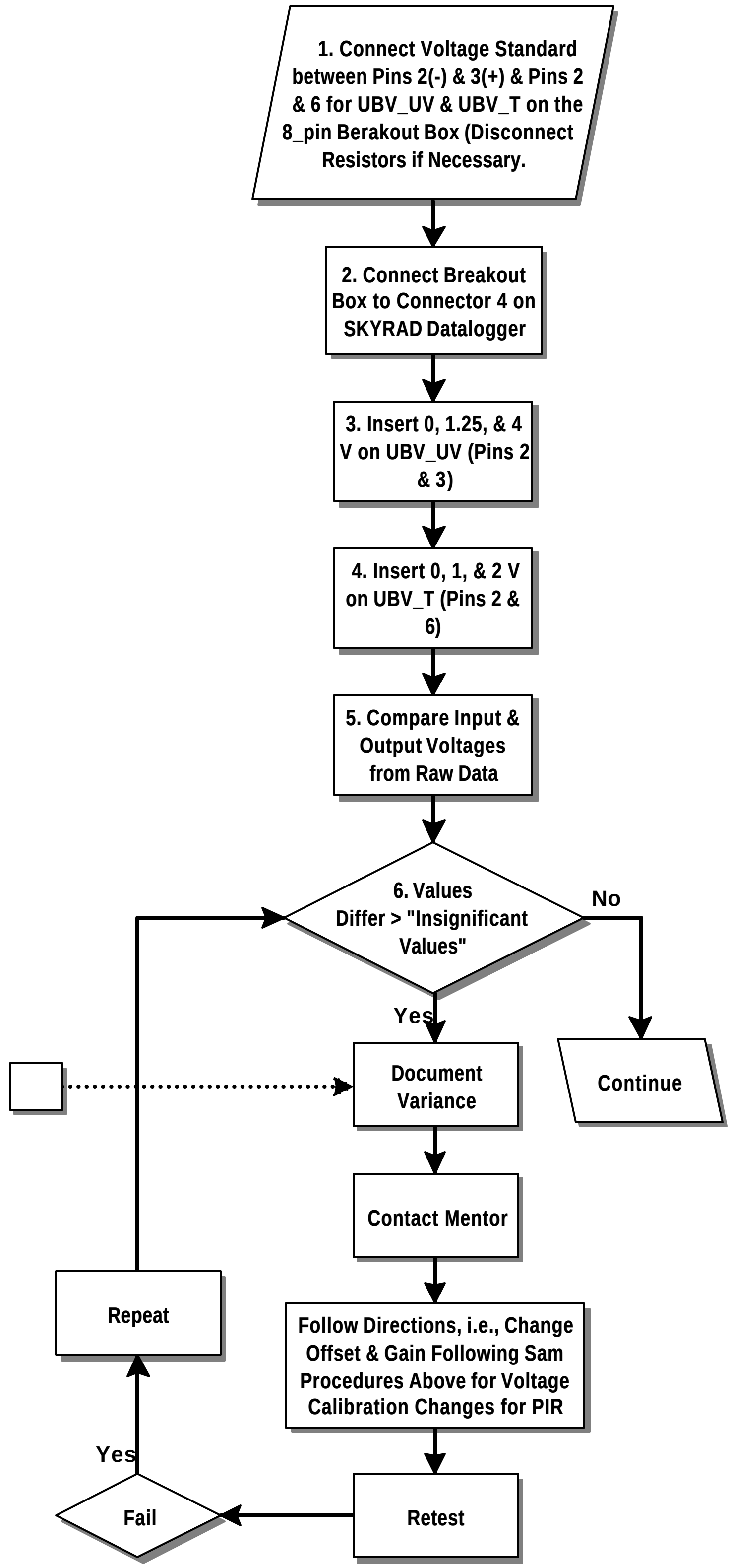
Attachment 14

D. To Simulate PSP, IRT (both SKYRAD and GRNRAD) and NIP (only on SKYRAD), and NET (GRNRAD and Comparison SKYRAD)



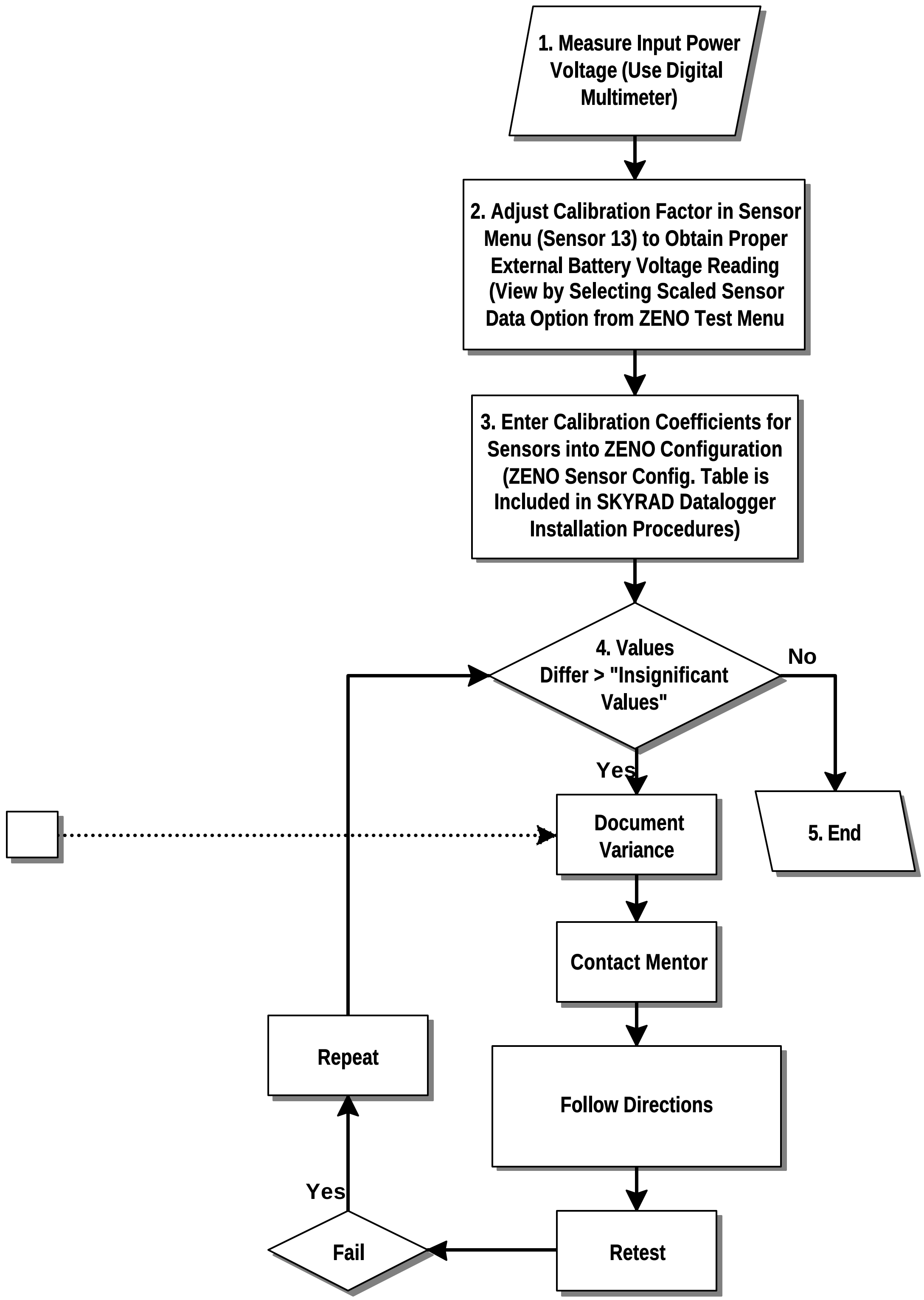
Attachment 15

E. To Simulate UBV (Only SKYRAD)



Attachment 16

F. To Calibrate Datalogger Voltage Divider for Power Level Sensing



Attachment 17– Enter and Exit GNDRAD and SMET ZENO CONFIG Process
(Temporary Addenda to DAQ Calibration Procedures until Coastal Fixes Software Problem)

1. Connect to SKYRAD using telnet, terminal, hyperterminal, . . .
2. Enter **u<cr>** to bring up Zeno User Menu.
3. Enter **z<cr>** and the password **zeno<cr>** to go into Zeno Program Menu.

(Within Zeno Program make changes that are needed [example below].)

4. Enter **p<cr>** to go to the Process Menu.
5. Enter **j7<cr>** to go to process step 7.
6. Enter **c10/9972<cr>** to change the erroneous coefficient.

(End of example.)

7. Enter **z<cr>** to return to the Zeno Program Menu.
8. Enter **d<cr>** to enter the Data Output Menu.
9. Enter **j4<cr>** to go to data output line 4.
10. Enter **c3/Vyymmdd.00<cr>** where **yy** is the year (00), **mm** is the month, and **dd** is the day of the month.
11. Enter **z<cr>** to return to the Zeno Program Menu.
12. Enter **e<cr>** to save the change to **eeprom**.

Perform the following between steps 12 and 13 if the change is done <u>locally</u> instead of <u>remotely</u>:

12.a. Enter **l<cr>** to go to the System Load Menu.
12.b. Enter **xt<cr>** to transmit the config file to the local pc.
12.c. After the config file is received, enter **z<cr>** to return to the Zeno Program Menu.

13. Enter **r<cr>** and then **y<cr>** to reset the system.
14. Wait for the following response from the Zeno:

The system will now reset. Please wait.
Searching for flash logging memory . . .
Found Chip #1.
Found Chip #2.
Found Chip #3.
Found Chip #4.
Found Chip #5.
Found Chip #6.
Found Chip #7.
Found Chip #8.
Watchdog Reset
Please wait . . ./
ZENO-3200 using ZENOSOFT V1.85H-1403B2-1.1 Feb 22 1999 15:21:33 CS B300 ©opyright 1995-1999, Coastal Environment Systems, Seattle, WA, USA.
System Tim = 00/01/05 18:56:16
Initializaing Zeno 3200 . . ./

Zeno 3200 is Data Sampling. Type ‘U’<enter> to access the User Interface.
Note! The System Time will be the current Zeno date and time.

15. Disconnect from the Zeno.