



DataNet Calibration Procedure

This document outlines the calibration procedure for Fourier's full range of DataNet data loggers: DNL808, DNL810, DNL910 and DNL920. Use the calibration sheet at the end of the document to record the calibrated values, and also as a reference for the acceptable tolerance for each input. Please refer to the *Calibration* section in the *DataNet User Guide* for general overview regarding DataNet calibrations before proceeding with the specific Calibration procedure below.

A: Required Equipment.....	1
B: Pre-Calibration Overview	1
B-1: Resetting Calibration Settings	2
B-2: Saving Calibration Settings	3
B-3: Loading Calibration Settings.....	3
C: DataNet Calibration Procedure	4
C-1: Voltage 0-1 V Input.....	4
C-2: Voltage 0-50 mV Input.....	5
C-3: Current 4-20 mA Input.....	5
C-4: PT-100 Input.....	6
C-5: Thermocouple J, K and T Inputs	7
C-6: Internal Temperature Sensor	8
C-7: Internal Humidity Sensor	9
C-8: External NTC Temperature Sensor.....	10
Appendix A: DataNet Calibration Sheet	12

A: Required Equipment

- DataNet data logger connected to DataNet network (monitored by DNR900)
- Power supply for DataNet DNL910 and DNL920 (or sufficiently charged battery pack)
- **Martel MC-1000** calibrator (or suitable alternative calibration device), with black and red banana cable each connected to a green terminal blocks (+ is the red cable and - is the black cable)
- **Calibration chamber** for calibrating internal temperature and humidity sensors
- **DataNet v1.1 software** or higher installed on PC

B: Pre-Calibration Overview

All DataNet data loggers are shipped from Fourier Systems fully calibrated, with certified calibration certificates. The default factory calibration settings for all inputs are saved on to each logger and cannot be erased. The user may restore these settings at any time by right-clicking on the logger icon in DataNet Map View and selecting **Calibration > Restore Factory Calibration Default**, once the logger is in **Stop** mode.

Note: To access the Calibration dialog the default password is 1234. The password can be changed in the password dialog box.

Each logger sensor can be calibrated using the Two-point calibration method, and then tweaked using offset calibration, except for the Thermocouples. These sensors require offset calibration only. The following table lists all inputs that may be calibrated on DataNet loggers.



Sensor	Type	Calibration Method
Current	4 – 20 mA	Two-point calibration and offset
Humidity (Internal)	Digital	Two-point calibration and offset
Temperature (Internal)	Digital	Offset
Temperature (Internal)	PT-100	Two-point calibration and offset
Temperature	PT-100 2-wire	Two-point calibration and offset
Temperature	Thermocouple J	Offset calibration
Temperature	Thermocouple K	Offset calibration
Temperature	Thermocouple T	Offset calibration
Voltage	0 to 1 V	Two-point calibration and offset
Voltage	0 to 50 mV	Two-point calibration and offset

Two-point Calibration

The two-point calibration sets the gain (slope) and offset (intercept) of the sensor's conversion function. Use the two-point calibration to calibrate all DataNet sensors except for the Thermocouples. In some cases you may need to refine your calibration using the fine offset tuning tool.

Offset Calibration

To calibrate the Thermocouple temperature sensors: TC-J, TC-K and TC-T, first calibrate the 50 mV sensor type. That will set the slope for all Thermocouple temperature sensors. Then proceed to adjust the offset using the Offset calibration technique.

B-1: Resetting Calibration Settings

The default factory calibration settings are saved on to each logger and cannot be erased. However, before beginning DataNet calibration the user must reset the logger's calibration settings so the calibration is performed on raw values rather than already calibrated values.

- When performing full calibration of all the logger inputs, reset calibration settings for the whole logger. Right-click the logger icon in DataNet Map View and select **Calibration > Reset Calibration**, once the logger is in **Stop** mode. Note that the factory calibration default has not been affected.
- When calibrating only specific inputs of the logger e.g. Voltage, reset the calibration settings from within the sensor input calibration window. Select **Calibration > Calibrate**, select the sensor type from the **Sensor** drop-down menu, click **Setup** and then click **Reset Calibration**. Proceed with the calibration.

Note: To access the Calibration dialog the default password is 1234. The password can be changed in the password dialog box.



B-2: Saving Calibration Settings

Once the calibration procedure has been completed and the logger calibration settings updated, you should also manually save the logger's calibration settings locally to your PC.

1. Open the logger context menu, select **Calibration > Save Calibration** and enter the password to access this feature.
2. The **Save As** dialog will open. Name the calibration file (with extension .dcf) and save it either in the default Calibration folder in the DataNet directory or in a folder of your choice.

B-3: Loading Calibration Settings

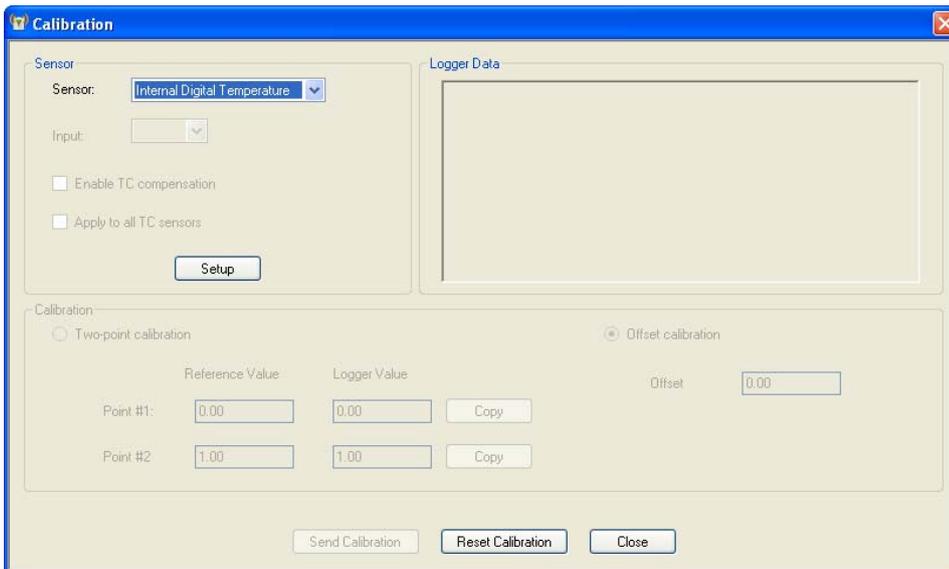
You can load a previously saved DataNet .dcf calibration file at any time to restore a logger's specific calibration settings. This is not the factory default settings, but a specific calibration performed by the DataNet user.

1. Open the logger context menu, select **Calibration > Load Calibration** and enter the password to access this feature.
2. In the **Open** dialog, browse to the calibration file you need and click **Open**. The logger will be updated with the new calibration settings.

C: DataNet Calibration Procedure

This chapter contains specific calibration procedures for each input available on the DataNet family of data loggers. To begin the procedure:

1. Right-click the logger icon in DataNet Map View and select **Stop** (if logger is running).
2. If performing full logger calibration, reset the logger calibration settings. Otherwise, press the **Reset Calibration** button from within the Calibration window. Refer to section B-1 above.
3. From the logger context menu select **Calibration > Calibrate**. The following window will open.

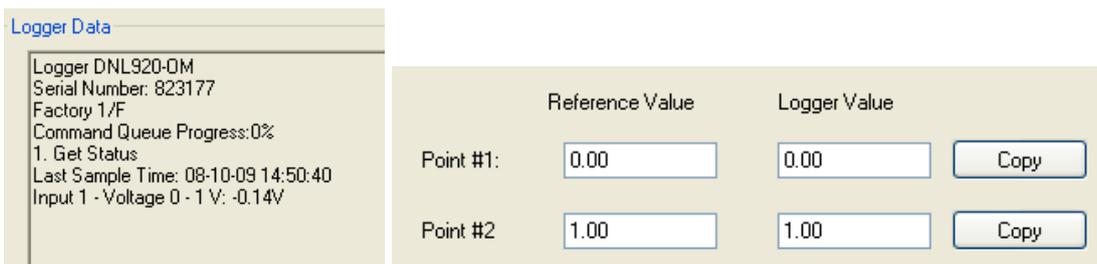


You are now ready to begin calibration. Refer to the sections below for specific instructions depending on the input type.

C-1: Voltage 0-1 V Input

Supported loggers: DNL910 and DNL920

1. From the **Calibration** dialog select **Voltage 0-1 V** in the **Sensor** drop-down menu.
2. From the **Inputs** drop-down menu select **All**. This will calibrate all logger inputs using 2-point calibration. Selecting individual inputs enables offset calibration only.
3. Click **Setup** to enable the 2-point calibration pane.
4. Connect the calibrator to DataNet In-1 and input a 0 V signal for the first reference value. When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #1.



5. Input a 1.0 V signal for the second reference value. When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #2.



6. Press **Send Calibration** to send these values to the logger memory.
7. Compare the real value in the Logger Data pane to the reference value. If the values are within an acceptable margin of error you may close the Calibration window, or move on to the next sensor or input.
8. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value.
9. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value. Enter the offset value and click **Send Calibration**.

C-2: Voltage 0-50 mV Input

Supported loggers: DNL910 and DNL920

1. From the **Calibration** dialog select **Voltage 0-50 mV** in the **Sensor** drop-down menu.
2. From the **Inputs** drop-down menu select **All**. This will calibrate all logger inputs using 2-point calibration. Selecting individual inputs enables offset calibration only.
3. Click **Setup** to enable the 2-point calibration pane.
4. Connect the calibrator to DataNet In-1 and input a 0 mV signal for the first reference value.
When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #1.

Logger Data	
Logger DNL920-0M Serial Number: 823177 Factory 1/F Last Sample Time: 08-10-09 15:15:56 Input 1 - Voltage 0 - 50 mV: -12.56mV	

	Reference Value	Logger Value	
Point #1:	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="button" value="Copy"/>
Point #2:	<input type="text" value="50.00"/>	<input type="text" value="50.00"/>	<input type="button" value="Copy"/>

5. Input a 50 mV signal for the second reference value. When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #2.
6. Press **Send Calibration** to send these values to the logger memory.
7. Compare the real value in the Logger Data pane to the reference value. If the values are within an acceptable margin of error you may close the Calibration window, or move on to the next sensor or input.
8. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value.
9. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value. Enter the offset value and click **Send Calibration**.

C-3: Current 4-20 mA Input

Supported loggers: DNL910 and DNL920

1. From the **Calibration** dialog select **Current 4-20 mA** in the **Sensor** drop-down menu.
2. From the **Inputs** drop-down menu select **All**. This will calibrate all logger inputs using 2-point calibration. Selecting individual inputs enables offset calibration only.
3. Click **Setup** to enable the 2-point calibration pane.
4. Connect the calibrator to DataNet In-1 and input a 5.13 mA signal for the first reference value.
When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #1.



Logger Data	Reference Value	Logger Value	
Logger DNL920-DM Serial Number: 823177 Factory 1/F Last Sample Time: 08-10-09 15:19:21 Input 1 - Current 4 - 20 mA: 0.00mA	Point #1: <input type="text" value="5.13"/>	<input type="text" value="5.13"/>	<input type="button" value="Copy"/>
	Point #2: <input type="text" value="15.38"/>	<input type="text" value="15.38"/>	<input type="button" value="Copy"/>

5. Input a 15.38 mV signal for the second reference value. When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #2.
6. Press **Send Calibration** to send these values to the logger memory.
7. Compare the real value in the Logger Data pane to the reference value. If the values are within an acceptable margin of error you may close the Calibration window, or move on to the next sensor or input.
8. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value.
9. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value. Enter the offset value and click **Send Calibration**.

C-4: PT-100 Input

Supported loggers: DNL910 and DNL920

Note: Calibrating the PT-100 input simultaneously calibrates the internal temperature sensor on the DNL-910.

1. From the **Calibration** dialog select **PT-100** in the **Sensor** drop-down menu.
2. From the **Inputs** drop-down menu select **All**. This will calibrate all logger inputs using 2-point calibration. Selecting individual inputs enables offset calibration only.
3. Click **Setup** to enable the 2-point calibration pane.
4. Click **Reset Calibration**. This is mandatory prior to *every* PT-100 calibration.
5. Connect the calibrator to DataNet In-1 and input a 0 °C PT-100 signal for the first reference value. When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #1.

Logger Data	Reference Value	Logger Value	
Logger DNL920-DM Serial Number: 823177 Factory 1/F Last Sample Time: 08-10-09 15:23:23 Input 1 - PT-100: 400.00°C	Point #1: <input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="button" value="Copy"/>
	Point #2: <input type="text" value="350.00"/>	<input type="text" value="350.00"/>	<input type="button" value="Copy"/>

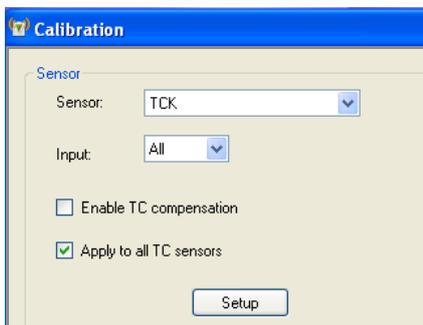
6. Input a 350 °C PT-100 signal for the second reference value. When the logger registers a value in the **Logger Data** pane, click **Copy** to enter the value for Point #2.
7. Press **Send Calibration** to send these values to the logger memory.
8. Compare the real value in the Logger Data pane to the reference value. If the values are within an acceptable margin of error you may close the Calibration window, or move on to the next sensor or input.
9. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value. Enter the offset value and click **Send Calibration**.

C-5: Thermocouple J, K and T Inputs

Supported loggers: DNL910 and DNL920

Note: Ensure the mV input is calibrated before calibrating the Thermocouple inputs. The mV input is used to calibrate the Thermocouple readings.

1. From the **Calibration** dialog select **TCJ, K or T** in the **Sensor** drop-down menu.
2. Ensure the **Enable TC Compensation** checkbox is *not* selected.
3. If you wish the calibration to apply to all thermocouple types, select the **Apply to all TC sensors** checkbox. Otherwise, the calibration will apply only to the sensor type selected in step 1.



4. Click **Setup** to enable the Offset calibration pane.
5. Connect the calibrator to DataNet In-1 and configure it to the mV setting.
6. Use the table below for entering the mV value, depending on the TC being calibrated. The mV value corresponds to a specific temperature value. You may enter a reference value for the lower (0 °C) or upper (1000 °C) range depending on the range the logger will be used. The offset will be the same at both points.

	Point 1			Point 1		
	Temp	Tolerance	Voltage	Temp	Tolerance	Voltage
TCK	0°C (32°F)	±0.5°C (±32.9°F)	0 mV	1000°C (212°F)	±5°C (±41°F)	41.269 mV
TCJ	0°C (32°F)	±0.5°C (±32.9°F)	0 mV	1000°C (212°F)	±5°C (±41°F)	57.953 mV
TCT	0°C (32°F)	±0.5°C (±32.9°F)	0 mV	350°C (662°F)	±2°C (±35.6°F)	17.819 mV

7. Click **Send Calibration** and verify the readings are correct at both lower and upper limits.





C-6: Internal Temperature Sensor

For DNL910

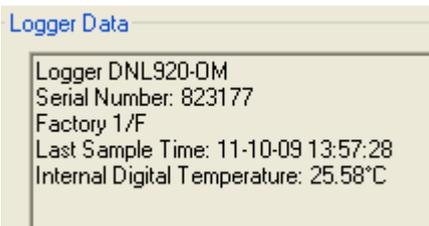
The DNL910's internal temperature sensor is a PT-100 sensor. Calibration of this sensor is performed by calibrating the external PT-100 input i.e. two-point calibration followed by offset calibration. Refer to section C4 above.

For DNL810 and DNL920

The DNL810 and DNL920 internal temperature sensor is a digital sensor and doesn't require calibration prior to shipping. If you wish to calibrate this sensor follow the instructions below.

Note: When calibrating this sensor do not connect the AC charger to the logger, as charging the logger will affect the temperature readings.

1. Setup the logger by selecting the internal temperature sensor with a sampling rate of one sample every minute and transmission rate of every minute.
2. Place the logger in a temperature calibration chamber or other environmentally controlled room with an accurate temperature sensor as a reference.
3. The calibration method used is Offset calibration meaning only one temperature point is required. Fourier recommends using the mid-range point of 23 °C but other values may be used at your discretion. Set the calibration chamber to the declared reference point. After two hours (or once the logger readings have stabilized) remove the logger.
4. Ensure all logger data is downloaded to the DataNet software.
5. Stop the logger and enter the main **Calibration** dialog.
6. From the **Calibration** dialog select **Internal Digital Temperature** in the **Sensor** drop-down menu.
7. Click **Setup** to enable the Offset calibration pane.
8. Using the DataNet data graph, calculate the average DataNet logger reading at the reference point used. You need to locate the graph cursors over the stabilized (flat) area of the plot at each reference point.
9. Enter the stabilized value in the **Offset** field and press **Send Calibration** to send these values to the logger memory.



10. In order to verify the calibration was successful, return the logger to the calibration chamber and leave it running at the same reference point for another two hour. Once the readings have stabilized, compare the real value in the Logger Data pane to the reference value. If the values are within an acceptable margin of error you may close the Calibration window.
11. If the calibration is not accurate enough use the **Offset calibration** feature to further tweak the real value. Enter the offset value and click **Send Calibration**.



C-7: Internal Humidity Sensor

Supported loggers: DNL810, DNL920

The DNL810 and DNL920 internal humidity sensor is a digital sensor and doesn't require calibration prior to shipping. If you wish to calibrate this sensor follow the instructions below.

Note: When calibrating this sensor do not connect the AC charger to the logger, as charging the logger will affect the humidity readings.

1. Setup the logger by selecting the internal humidity sensor with a sampling rate of one sample every minute and transmission rate of every minute.
2. Place the logger in a humidity calibration chamber.
3. The calibration is performed using two humidity reference points. Fourier recommends using the points 33 and 76 % but you may use other values as you see fit. The chamber should also be set to 23 °C throughout the calibration process. Set the chamber to the first rH point (the lower limit) and after two hours, set the chamber to the second rH point. Four hours after placing the logger in the chamber, remove the logger.
4. Ensure all logger data is downloaded to the DataNet software.
5. Stop the logger and enter the main **Calibration** dialog.
6. From the **Calibration** dialog select **Internal RH** in the **Sensor** drop-down menu.
7. Click **Setup** to enable the 2-point calibration pane.
8. In the Point #1 and Point #2 fields enter the first and second Reference values respectively e.g. 33 and 76 %.
9. Using the data graph, calculate the average DataNet logger reading at the two reference points you used. You need to locate the graph cursors over the stabilized (flat) area of the plot at each reference point.
10. Enter the stabilized values in the Point #1 and Point #2 Logger value fields respectively. Press **Send Calibration** to send these values to the logger memory.

The screenshot shows two windows from the DataNet software. The 'Calibration' window is on the left, titled 'Calibration', with a radio button selected for 'Two-point calibration'. It contains a table with two columns: 'Reference Value' and 'Logger Value'. There are two rows for 'Point #1' and 'Point #2'. Each row has input fields for both values and a 'Copy' button. The values entered are: Point #1 (33.00, 36.00) and Point #2 (76.00, 80.00). The 'Logger Data' window is on the right, titled 'Logger Data', and displays the following information: Logger DNL920-0M, Serial Number: 823177, Factory 1/F, Last Sample Time: 11-10-09 14:11:25, Internal Digital Temperature: 25.48°C, and Internal RH: 48.09%.

	Reference Value	Logger Value	
Point #1:	33.00	36.00	Copy
Point #2:	76.00	80.00	Copy

Logger Data

Logger DNL920-0M
Serial Number: 823177
Factory 1/F
Last Sample Time: 11-10-09 14:11:25
Internal Digital Temperature: 25.48°C
Internal RH: 48.09%

11. In order to verify the calibration was successful, return the logger to the calibration chamber and leave it running at the two reference points for two hours at each point. Once the readings have stabilized, compare the real value in the Logger Data pane to the reference value. If the values are within an acceptable margin of error you may close the Calibration window.
12. If the calibration is not accurate enough use the **Offset calibration** feature to tweak the real value. Enter the offset value and click **Send Calibration**.

C-8: External NTC Temperature Sensor

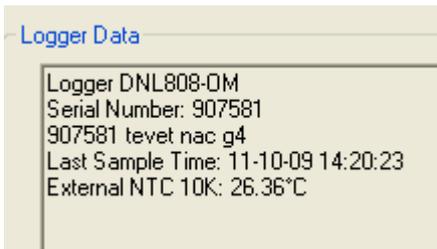
Supported logger: DNL808

There are two ways to calibrate the NTC input:

- **Option 1:** Using a calibrator, connected to the external sensor input
- **Option 2:** Using a calibration chamber or other temperature controlled environment, by connecting the NTC sensor to the logger input

Option 1: Using a Calibrator

1. Entering the **Calibration** dialog will automatically enable the 2-point calibration pane as there is only one input to calibrate on the DNL808. Select the **Offset calibration** pane.
2. Connect the calibrator to DataNet In-1 and input a 680 Ω signal to the logger. 680 Ω is equivalent to a reading of 100 °C.
3. If the logger value in the **Logger Data** pane is not within a tolerance of ± 0.5 °C from 100 °C then enter the offset value in the **Offset** field and click **Send Calibration**.



4. If the calibration is still not accurate enough use the **Offset calibration** feature to tweak the real value. Enter the offset value again and click **Send Calibration**.

Option 2: Using a Calibration Chamber

1. Setup the logger with a sampling rate of one sample every minute and transmission rate of every minute.
2. Place the logger in a temperature calibration chamber or other environmentally controlled room with an accurate temperature sensor as a reference.
3. The calibration is performed using two temperature reference points. Fourier recommends using the points 0 and 50 °C but you may use other values as you see fit. Set the chamber to the first temperature point (the lower limit) and after two hours, set the chamber to the second temperature point. Four hours after placing the logger in the chamber, remove the logger.
4. Ensure all logger data is downloaded to the DataNet software.
5. Stop the logger and enter the main **Calibration** dialog. The 2-point calibration pane will be automatically enabled as there is only one input to calibrate on the DNL808.
6. In the Point #1 and Point #2 fields enter the first and second Reference values respectively e.g. 0 and 50 °C.
7. Using the data graph, calculate the average DataNet logger reading at the two reference points you used. You need to locate the graph cursors over the stabilized (flat) area of the plot at each reference point.



8. Enter the stabilized values in the Point #1 and Point #2 Logger value fields respectively. Press **Send Calibration** to send these values to the logger memory.

The image shows two overlapping software windows. The 'Calibration' window on the left has a title bar and a radio button for 'Two-point calibration'. It contains a table with two rows: 'Point #1' and 'Point #2'. Each row has a 'Reference Value' column and a 'Logger Value' column. For Point #1, the Reference Value is 0.00 and the Logger Value is 2.00. For Point #2, the Reference Value is 50.00 and the Logger Value is 51.8. Each Logger Value field has a 'Copy' button to its right. The 'Logger Data' window on the right has a title bar and displays the following text: 'Logger DNL808-DM', 'Serial Number: 907581', '907581 tevet nac g4', 'Last Sample Time: 11-10-09 15:07:55', and 'External NTC 10K: 51.23°C'.

	Reference Value	Logger Value	
Point #1:	0.00	2.00	Copy
Point #2:	50.00	51.8	Copy

Logger Data
Logger DNL808-DM
Serial Number: 907581
907581 tevet nac g4
Last Sample Time: 11-10-09 15:07:55
External NTC 10K: 51.23°C

9. In order to verify the calibration was successful, return the logger to the calibration chamber and leave it running at the two reference points for two hours at each point. Once the readings have stabilized, compare the real value in the Logger Data pane to the reference value. If the values are within an acceptable margin of error you may close the **Calibration** window.
10. If the calibration is not accurate enough use the Offset calibration feature to tweak the real value. Enter the offset value and click **Send Calibration**.



Appendix A: DataNet Calibration Sheet

S/N: _____

Voltage 0-1 V

Calibrator	DataNet	After calibration	Pass/Fail
0 V			±50 mV
0-1 V			±50 mV

0-50 mV

Calibrator	DataNet	After calibration	Pass/Fail
0 mV			±250 μ V
50 mV			±250 μ V

PT100 2-wire

Calibrator	DataNet	After calibration	Pass/Fail
0 °C			±0.5 °C
350 °C			±1.5 °C

TCJ

Calibrator	DataNet	After calibration	Pass/Fail
0 °C			±0.5 °C
50 °C			±0.5 °C
1000 °C			±5 °C

TCK

Calibrator	DataNet	After calibration	Pass/Fail
0 °C			±0.5 °C
50 °C			±0.5 °C
1000 °C			±5 °C

TCT

Calibrator	DataNet	After calibration	Pass/Fail
0 °C			±0.5 °C
50 °C			±0.5 °C
350 °C			±2 °C

Current 4-20 mA

Calibrator	DataNet	After calibration	Pass/Fail
5.13 mA			±100 μ A
15.38 mA			±100 μ A

NTC-10K (DNL808)

Calibrator	DataNet	After calibration	Pass/Fail
100 °C (680 Ω)			±0.5 °C

Tester Name:

Date: