Hanwell
Ultimate peace of mind
Part of the Ellab Group

TS6066
Calibrating Linear Sensors

Technical Support Note

hanwell.com

Intentionally Left Blank

Document History

Document Number: TS6066

Issue No.	Issue Date	Changes	By
1	31 October 2018	First Issue.	IR
2	2 January 2019	Addition of further information on using the sensor, calibration and specified voltages.	IR
3	12 June 2020	Addition of link to new Offset-Gain Calculator. Addition of Ellab Logo	IR

Contents

1 Overview

In general, Hanwell Linear Sensors Units accept a current or voltage input from a sensor. This current or voltage corresponds to some physical parameter and EMS/Synergy/Radiolog needs to be told how to display the data it receives in the correct Engineering units.

In practice this means entering a **Gain**, an **Offset**, a **Title** and **Units** for each channel.

By default, the device will show mV / mA directly. If you wish to display Engineering units other than mV / mA, then the **Offset**, **Gain**, **Channel Title**, **Display Units** and **Precision** can be changed as required.

- The **Offset** is the raw value which will correspond to 0 in the units you are using.
- The **Gain** is the change in actual value per raw count.

Both Offset and Gain can be calculated from the manufacturer's specifications for the sensor you wish to use;

To help you with this, visit the **Gain and Offset Calculator** on the **Hanwell Pro Sensor-Transmitters/Data Loggers** page of the Online Help:

http://www.help.emsprocloud.com/index.html?hanwell-pro-sensor-transmitter.html#gainandoffsetcalculation

Use the calculator to calculate your required **Gain** and **Offset** values. Enter these calculated values by editing the sensor properties in the software user interface and then sending any changes to the device using the **Calibrate** function.

- The principles behind the above are explained at in Sections 3 and 4 of this manual.

2 Using the Sensor

You will need a **Y055** USB lead to synchronise this device with either Synergy or EMS.

Please consult Document **IM5990** the **4000 Series Sensors User Guide** for details on adding and configuring sensors:

http://www.pd.hanwell.com/4000SensorsUserGuide.pdf

2.1 Additional Information

- Do not apply more than the specified maximum voltages, or you risk damaging the unit.
- For a 4 - 20mA unit, the 4 - 20mA input must be 3.5 volts compliant i.e. the current source must be capable of generating a minimum of 3.5 volts at 20mA.

3 Principles

The Linear Sensor Unit measures current or voltage as a raw number in the range 0 to 4095 (**R**) and the PC software converts this to Engineering Units (**E**) via the following relationship:

$$E = (R - O) * g$$

Where:

g = Gain

O = Offset for that Channel

To calibrate the Linear Sensor Unit, you will need two values of R (**R_1** and **R_2**) and the two corresponding E values (**E_1** and **E_2**)

The Gain is then given by:

$$g = (E_2 - E_1) / (R_2 - R_1)$$

And the Offset by:

$$O = R_1 - (E_1 / g)$$

As a check on your arithmetic it should also be true that:

$$O = R_2 - (E_2 / g)$$

- **O can only be an integer value so round the calculation to the nearest whole number.**
- **The offset does not have to be in the range 0 to 4095 but this is the range of raw numbers that can be transmitted.**
- **The Gain can be positive or negative and should be entered to the precision allowed by the software.**

4 Worked Example

As an example, consider a 4 to 20mA Temperature Sensor with the following characteristics:

Temperature (°C)	Current (mA)
35	7.64
70	11.47
105	15.29
121	17.07
140	19.12

We will choose the most widely separated values for **E,** so:

$$\mathbf{E_1 = 35^{o}C}$$

$$\mathbf{E_2 = 140^{o}C}$$

You will next need to calculate (or measure) what raw values will correspond to the two associated currents (7.64 and 19.12mA in this case). This is done via the calibration values for the Hanwell device you are using- as an example take the following:

RL5000	Raw
4mA	674
20mA	3375

So, 7.64mA will give:

(7.64-4) / (20-4) * (3375 - 674) + 674 = 1288.48 counts

And similarly, 19.12mA will give:

(19.12-4) / (20-4) * (3375 - 674) + 674 = 3226.45 counts.

So, using the terminology above:

$$E_1 = 35°C$$

$$E_2 = 140°C$$

$$R_1 = 1288.48$$

$$R_2 = 3226.45$$

Therefore:

$$g = (E_2 - E_1) / (R_2 - R_1)$$

That is:

$$(140 - 35) / (3226.45 - 1288.48) = 0.05418$$

And:

$$O = R_1 - (E_1 / g)$$

That is:

$$1288.48 – (35 / 0.05418) = 642.49$$ (Round this to give O=642)

As a check, it also should be true that:

$$O = R_2 – (E_2 / g)$$

Or:

$$3226.45 – (140 / 0.05418) = 642.47$$

Which is correct to the precision used here.

So:

G = 0.05418 and **O = 642** are the values to enter into the PC software.

5 Contact Hanwell Solutions

UK Customers:

Hanwell Solutions Limited

Pendle House

Jubilee Road

Letchworth

Hertfordshire

SG6 1SP

Tel: 01462 688070

Email: sales@hanwell.com

Web: www.hanwell.com

For Technical Support:

Tel: 01462 688 078

Email: support@hanwell.com

EU & Overseas Customers:

Please contact your local Hanwell Distributor.

A list of distributors is available at: www.hanwell.com/global-distributors

Intentionally Blank

Hanwell

Ultimate peace of mind