06 - MICIN Calculating Scale and Offset

When reading data from a vehicle using sensor equipment such as the Micro-Input Module it is often necessary to convert the data into a more meaningful format, for example converting a voltage from a throttle or brake pedal into something more useful like percentage pedal press.

Online scale and offset calculator

There is an **online scale and offset calculator** on our VBOX Motorsport website which can be used to quickly calculate the required scale and offset for analogue inputs. This can be found here:

http://www.vboxmotorsport.co.uk/inde...68-calculators

Typical RPM scales

Typically an RPM signal from an ignition coil will need to be scaled to get an RPM in the form:

RPM = f *60* 2/cylinders.

This is because Input Modules gives pulses per second which we need to convert into revolutions per minute.

E.G. 1 pulse per second = 60 pulses per minute x 2 (2 revolutions of crankshaft per combustion of spark plug) = 120 divided by the number of cylinders (4) = revs per minute (30).

So, for a four cylinder engine it would be 120 divided by 4 = 30.

Try these values as starting points.

Cylinders	Scale
3	40
4	30
5	24
6	20
8	15
10	12
12	10

Calculating scale and offset manually

This application note will explain step-by-step how to calculate the scale and offset values required to convert the throttle position voltage from the input of a Micro-Input Module to percentage throttle applied.

It should be noted that this calculation only works for linear data where the plot of the data produces a straight line.

1. Obtain full scale voltage values

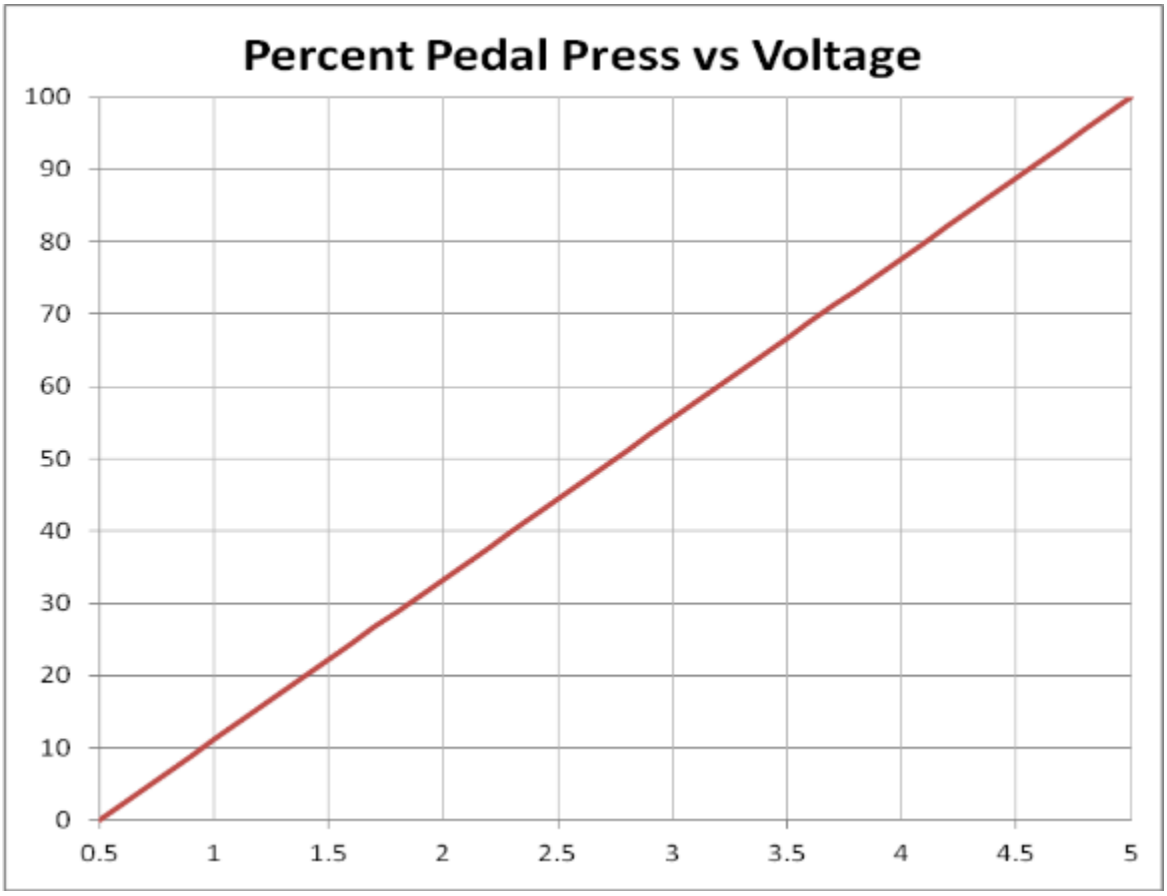
Assume that the voltage read by the MCIN is 0.5 V when the pedal is not being pressed and 5 V when the pedal is fully pressed. You have two values which correspond to 0 % and 100 % throttle pedal position. So how do we determine what scale and offset values to apply to a voltage value to obtain throttle position as a percent?

2. Visualising the Data

If you were to plot voltage (x) against percent (y), you have two sets of points that you can plot.

The line between these two points is a straight line.

Voltage (x)	Pedal Press (y)
0.5	0 %
5	100 %



3. The equation of a straight line

The equation describing a straight line is as follows:

Y = Mx + c

Where;

Y = The Y values (pedal press)

X = The X values (sensor voltage)

m = scale (gradient of the line)

c = offset (intercept with the Y-axis)

4. Calculating the gradient of the line

The gradient of a line is the change in Y divided by the change in X which gives:

m = dY/dX

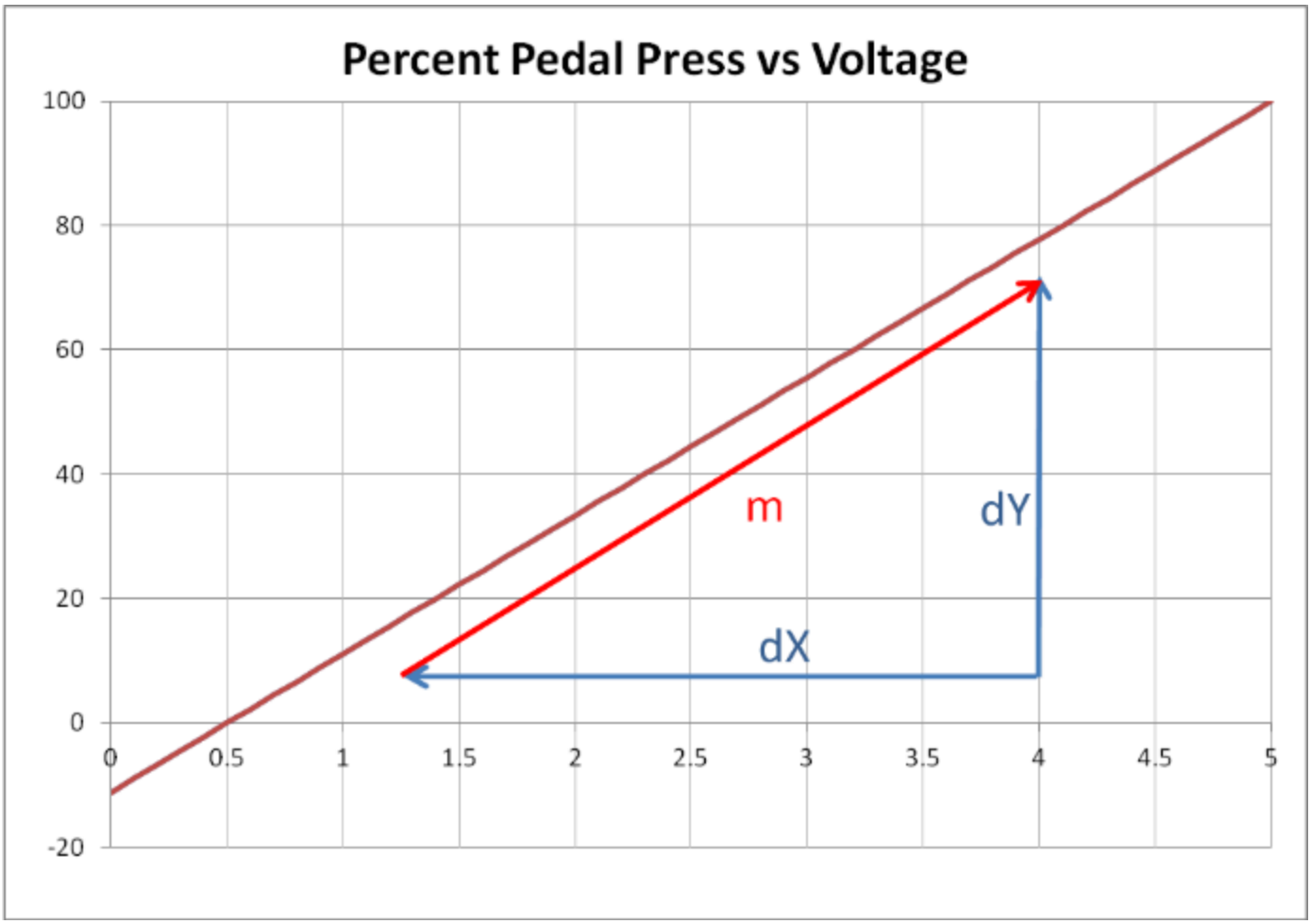
dY = 100 – 0 = 100

dX = 5 – 0.5 = 4.5

Therefore the gradient of the line is:

dY/dX = (100 - 0)/(5 – 0.5)

= 22.22



5. Substituting values to find the offset

To find the offset value we simply substitute the known values back into our equation as follows:

Taking the values when the pedal is not pressed.

Voltage = 0.5 V, percent = 0.

Y = mX + c therefore 0 = (22.22 * 0.5) + c

0 = 11.11 + c

Taking 11.11 from both sides of the equation gives us:

C = -11.11

6. The full equation for the line

Substituting these values back into the equation again gives us the full equation of the line which passes through our two points.

Y = 22.22X – 11.11

7. Checking the equation

We can double check our equation is correct by calculating a percentage value for a known voltage output.

We know that:

Voltage (x)	**Percent Pedal Press (y)**
0.5	0
5	100

Using the equation we have just derived produces the following results:

Y = 22.22X – 11.11

Y = (22.22 * **0.5**) – 11.11 = **0 %**

This is correct, as 0.5 V is equal to a 0 % pedal press.

Y = (22.22 * **5.0**) – 11.11 = **99.99 %**

This is also correct as we know that 5 V = 100 % pedal press.

8. Plotting the full line

The graph below illustrates the calculated scale and offset values.