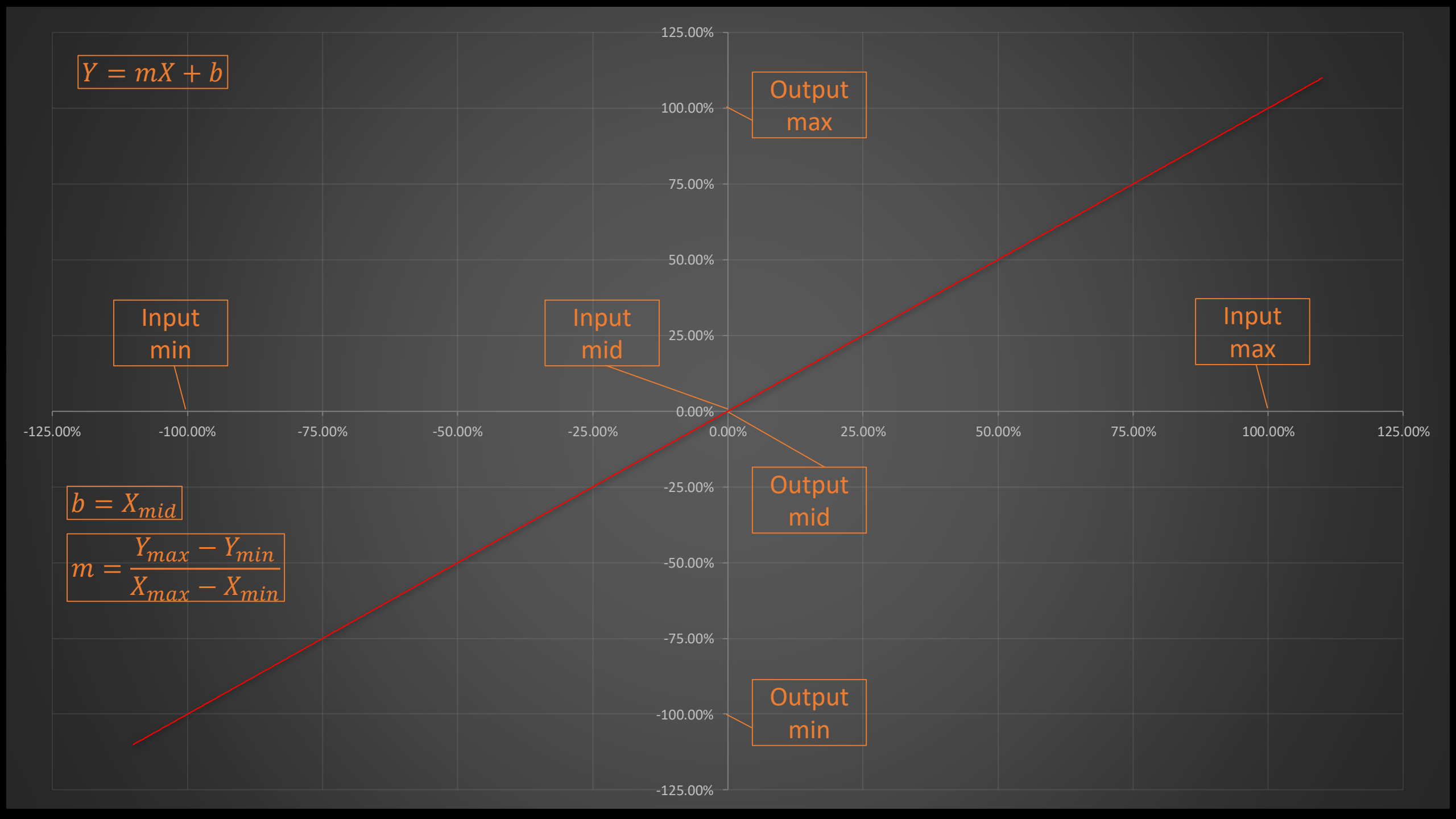
$$Y = mX + b$$

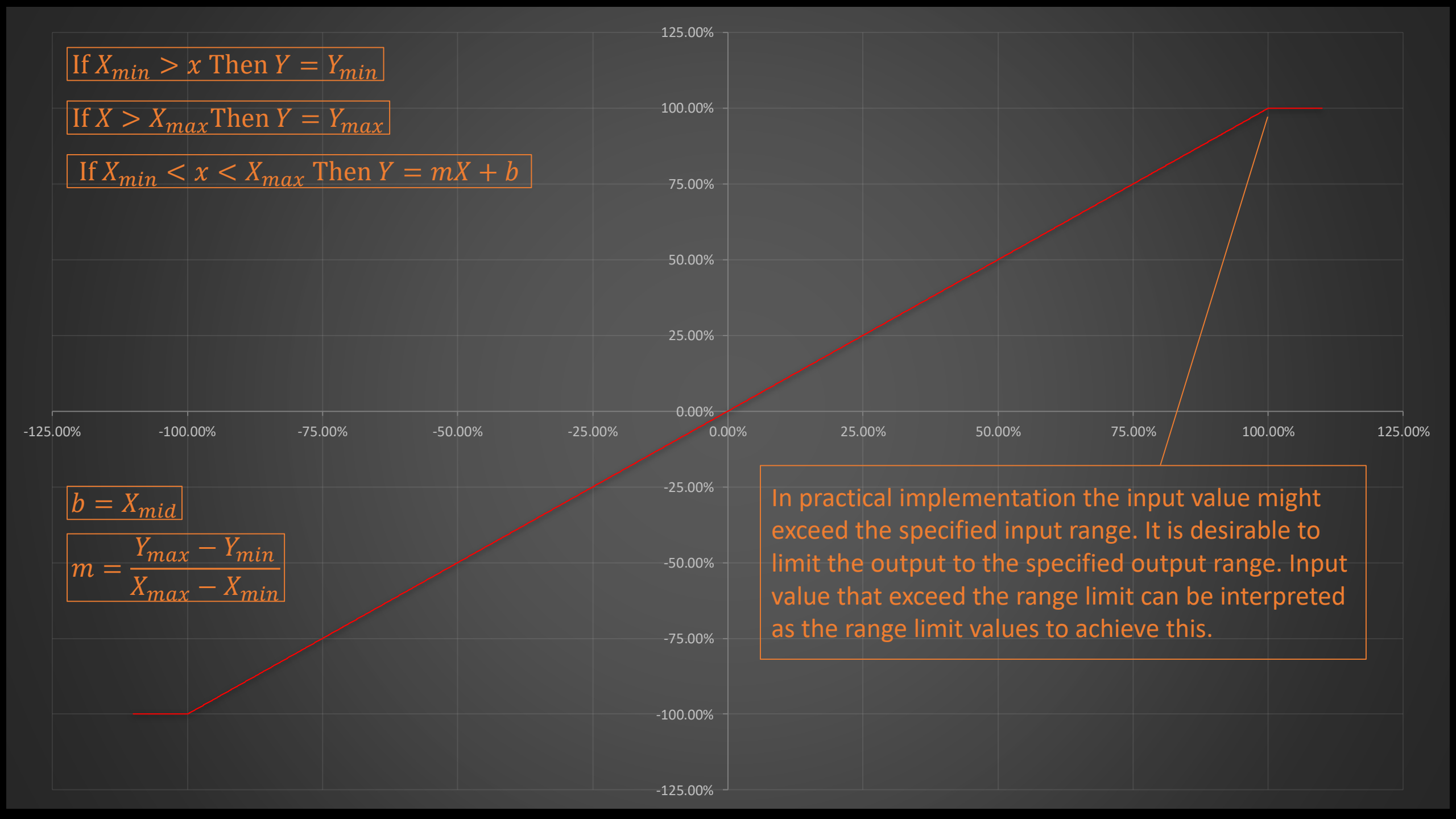
$$b = X_{mid}$$

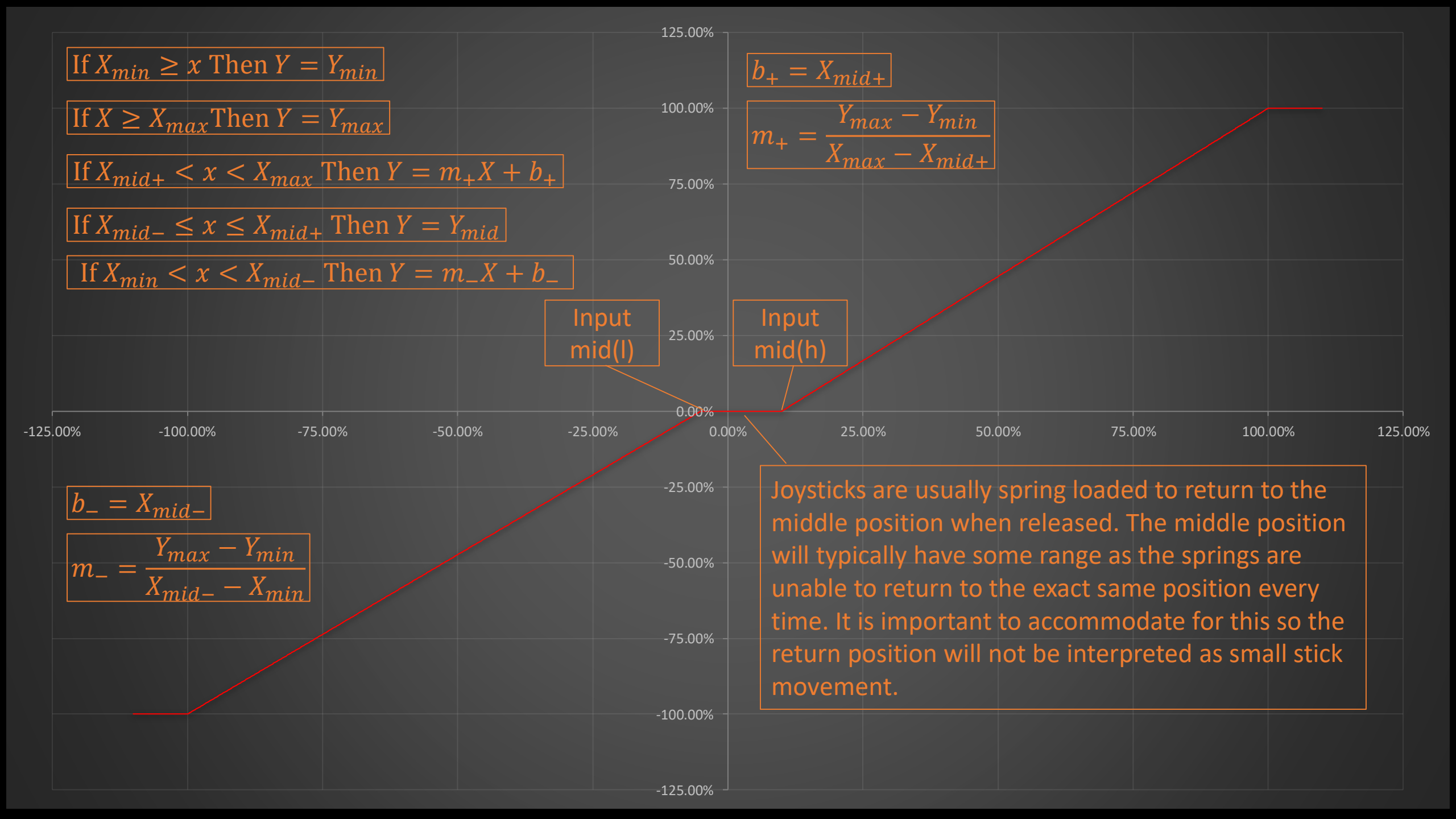
$$m = \frac{Y_{max} - Y_{min}}{X_{max} - X_{min}} = \frac{rise}{run} = slope$$

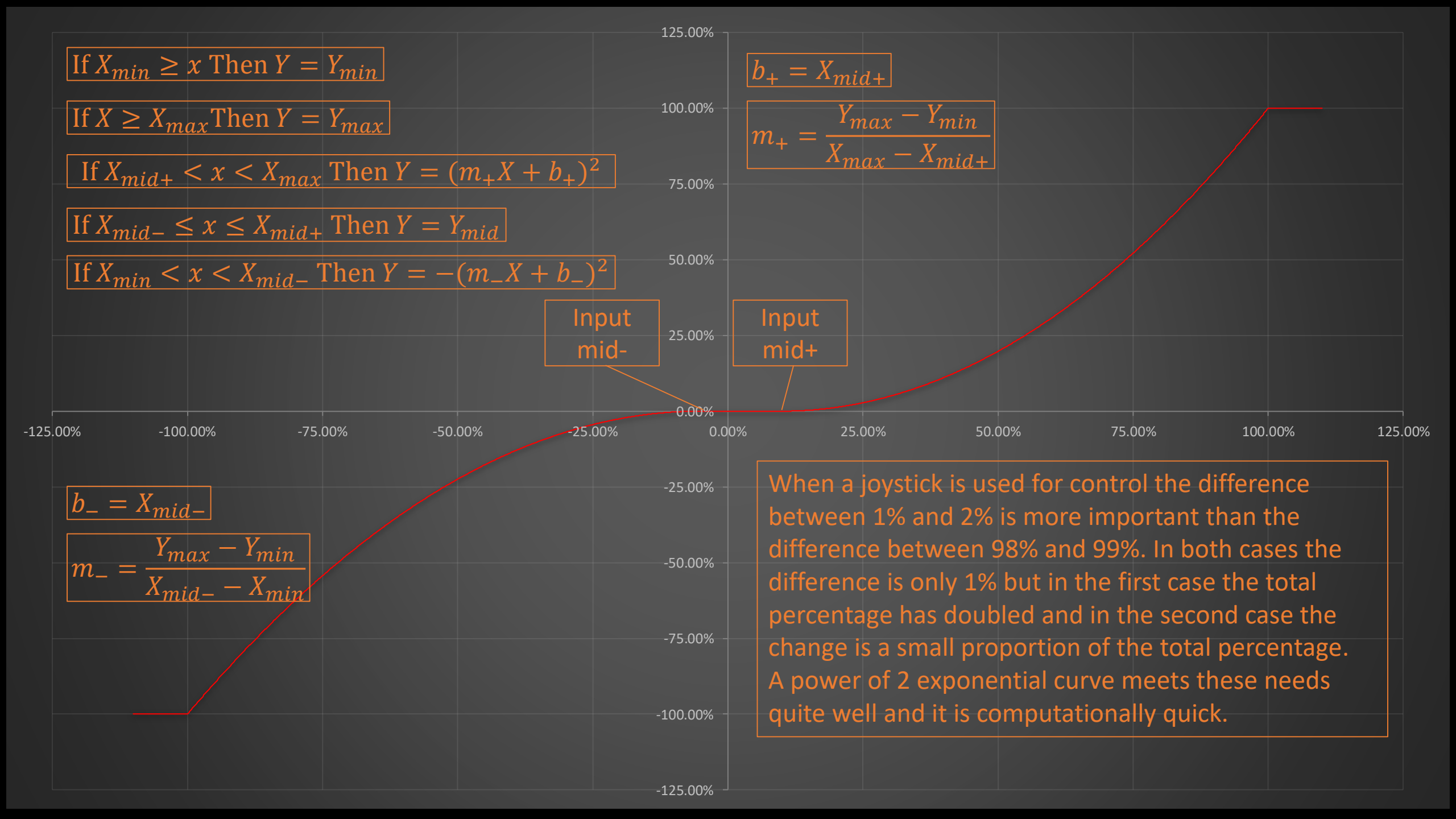
$$-1 = -100\%$$ $$0 = 0\%$$ $$1 = 100\%$$

Input min	Input mid	Input max	m	b	Output min	Output max
-10V	0V	+10V	0.1	0	-1	1
+10V	0V	-10V	-0.1	0	-1	1
4mA	16mA	20mA	0.125	16	-1	1
20mA	16mA	4mA	-0.125	16	-1	1
-5V	0V	+5V	0.2	0	-1	1
+5V	0V	-5V	-0.2	0	-1	1
0V	2.5V	+5V	0.4	2.5	-1	1
+5V	2.5V	0V	-0.4	2.5	-1	1
-1	0	1	1	0	-1	1
1	0	-1	-1	0	-1	1


$Y = mX + b$
125.00%
100.00%
75.00%
50.00%
25.00%
0.00%
-25.00%
-50.00%
-75.00%
-100.00%
-125.00%
-125.00%
-100.00%
-75.00%
-50.00%
-25.00%
0.00%
25.00%
50.00%
75.00%
100.00%
125.00%
Output max
Input min
Input mid
Input max
Output mid
Output min
$b = X_{mid}$
$m = \frac{Y_{max} - Y_{min}}{X_{max} - X_{min}}$


If $X_{min} > x$ Then $Y = Y_{min}$
If $X > X_{max}$ Then $Y = Y_{max}$
If $X_{min} < x < X_{max}$ Then $Y = mX + b$
$b = X_{mid}$
$m = \frac{Y_{max} - Y_{min}}{X_{max} - X_{min}}$
In practical implementation the input value might exceed the specified input range. It is desirable to limit the output to the specified output range. Input value that exceed the range limit can be interpreted as the range limit values to achieve this.
125.00%
100.00%
75.00%
50.00%
25.00%
0.00%
-25.00%
-50.00%
-75.00%
-100.00%
-125.00%
-125.00%
-100.00%
-75.00%
-50.00%
-25.00%
0.00%
25.00%
50.00%
75.00%
100.00%
125.00%


If $X_{min} \geq x$ Then $Y = Y_{min}$
If $X \geq X_{max}$ Then $Y = Y_{max}$
If $X_{mid+} < x < X_{max}$ Then $Y = m_+X + b_+$
If $X_{mid-} \leq x \leq X_{mid+}$ Then $Y = Y_{mid}$
If $X_{min} < x < X_{mid-}$ Then $Y = m_-X + b_-$
$b_+ = X_{mid+}$
$m_+ = \frac{Y_{max} - Y_{min}}{X_{max} - X_{mid+}}$
$b_- = X_{mid-}$
$m_- = \frac{Y_{max} - Y_{min}}{X_{mid-} - X_{min}}$
Input mid(l)
Input mid(h)
125.00%
100.00%
75.00%
50.00%
25.00%
0.00%
-25.00%
-50.00%
-75.00%
-100.00%
-125.00%
-125.00%
-100.00%
-75.00%
-50.00%
-25.00%
0.00%
25.00%
50.00%
75.00%
100.00%
125.00%
Joysticks are usually spring loaded to return to the middle position when released. The middle position will typically have some range as the springs are unable to return to the exact same position every time. It is important to accommodate for this so the return position will not be interpreted as small stick movement.


If $X_{min} \geq x$ Then $Y = Y_{min}$
If $X \geq X_{max}$ Then $Y = Y_{max}$
If $X_{mid+} < x < X_{max}$ Then $Y = (m_+X + b_+)^2$
If $X_{mid-} \leq x \leq X_{mid+}$ Then $Y = Y_{mid}$
If $X_{min} < x < X_{mid-}$ Then $Y = -(m_-X + b_-)^2$
$b_+ = X_{mid+}$
$m_+ = \frac{Y_{max} - Y_{min}}{X_{max} - X_{mid+}}$
$b_- = X_{mid-}$
$m_- = \frac{Y_{max} - Y_{min}}{X_{mid-} - X_{min}}$
Input mid-
Input mid+
125.00%
100.00%
75.00%
50.00%
25.00%
0.00%
-25.00%
-50.00%
-75.00%
-100.00%
-125.00%
-125.00%
-100.00%
-75.00%
-50.00%
-25.00%
0.00%
25.00%
50.00%
75.00%
100.00%
125.00%
When a joystick is used for control the difference between 1% and 2% is more important than the difference between 98% and 99%. In both cases the difference is only 1% but in the first case the total percentage has doubled and in the second case the change is a small proportion of the total percentage. A power of 2 exponential curve meets these needs quite well and it is computationally quick.