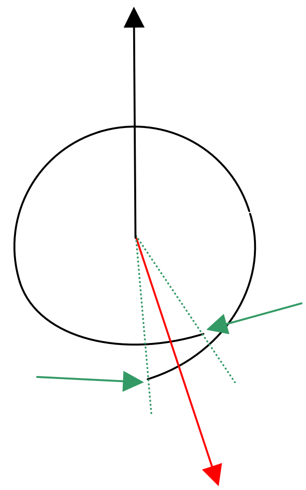
Calculation of bearing from rotator feedback resistor

Definition of variable names:



Name	Symbol	Range	Description
Bearing	B	0 to 3599	Normal meaning, West = 270º, North = 0º etc. Defined in units of $^{1}/_{10}$ º for integer values
Zero Offset	Z	0 to 3599	Bearing of the zero point, where the feedback resistor track overlaps itself. Units of $^{1}/_{10}$ º
Theta	Th	< 0 to > 3600 Negative values are possible	Angle around feedback potentiometer track. Defined as Th = 0º when Bearing = Z. Units of $^{1}/_{10}$ º The value can range from below 0º to above 360º depending on track overlap.
Resistance	Rpot	Rmin - Rmax	Resistance of track for this Th
A/D Reading	N	(0) to < Nmax	Output of A/D converter, reading the voltage delivered by the potentiometer formed by Rtop and Rpot when fed from Vin = K * Vref
Position	P	(> 0) to (< 4095)	Calculated and normalised value of feedback potentiometer position.
Gradient	M	Signed Integer	Gradient of the line relating Th to P
y Intercept	C	0 – 3599	Intercept of the line relating Th to P

Define values of K' and Rtop to maximise the dynamic range of the A/D as Rpot varies over its range. K' is the multiplication of Vref to give Vin, feeding the top of the potential divider.

For example, if Rtop = Rmax, maximum output voltage from the potential divider is Vin / 2, so the dynamic range is at maximum for Vin = 2 * Vref. This is then scaled by the full scale output value of the A/D, so for a 10 bit converter, K = 1024 * K' = 2048.

N (A/D reading) = Rpot / (Rpot + Rtop) * K   K = Vin / Vref * $N_{\text{full scale}}$
K = 2048 for Vtop/Vref = 2 and $N_{FSD} = 1024$

P (Position) = N / (K - N) * 4096   Position around track
Scaled by 4096 for arithmetic accuracy.
P may change in either direction with Th depending on potentiomenter connections

Th (Theta) = (M * P) / 16384 + C   M = gradient, C = intercept
Based on units of $^{1}/_{10}$ º and with M suitably scaled to minimise arithmetic error. M may be positive or negative, and Th may be negative for low values of P

B (Bearing) = (Th + Z) MOD 3600   Units of $^{1}/_{10}$ º

Reverse calculations to derive M and C from two pairs of Bearing / P measurements.

Determine Z (the bearing of the zero position) from measurement.

Rotate to two known bearings B_1 and B_2, measure the resulting values of P_1 and P_2

$Th_1 = (B_1 - Z) \text{ MOD } 3600$

$Th_2 = (B_2 - Z) \text{ MOD } 3600$

With all angles defined in integer units of $^1/_{10}{}^{o}$

Calculate Gradient, M, and y-intercept, C :

$M = 16384 * (Th_1 - Th_2) / (P_1 - P_2)$

$C = Th_1 - P_1 * M / 16384$ *or* $Th_2 - P_2 * M / 16384$