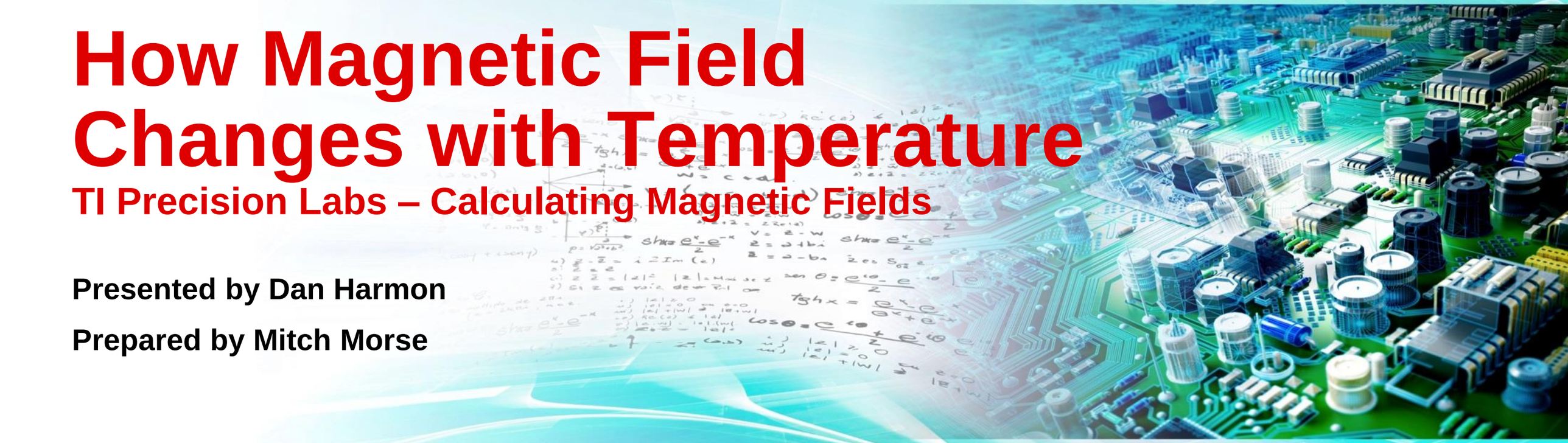
How Magnetic Field Changes with Temperature

TI Precision Labs – Calculating Magnetic Fields



Presented by Dan Harmon

Prepared by Mitch Morse

How Br changes with temp for permanent magnets

	ALNICO						CERAMIC			NEODYMIUM							SAMARIUM COBALT		
	SINTERED		CAST																
GRADE	2	8H	2	5	8B	8HE	1	5	8	30	35SH	35	38	40	45	50	18	22	26
MAGNETIC CHARACTERISTICS																			
Max. Energy Product (Bd Hd) Max. (Mgo)	1.5	5.25	5.4	5.5	5.5	6	1	3.4	3.5	30	35	35	38	40	45	50	18	22	26
Residual Induction Br. gauss	7100	7250	7500	12700	8300	9000	2200	3800	3850	11400	11900	12150	12500	12900	13800	14300	8900	9500	10400
Coercive Force Hc-oErstEds	550	1975	580	640	1650	1600	1825	2400	2950	10400	11000	11050	11800	12300	10500	11500	8600	9200	9500
Intrinsic Coercive Force Hci-oersteds	575	2125	600	645	1860	1620	3250	2420	3250	13500	>17000	13500	>12000	>14000	>11000	>11000	>20000	>20000	20000
Saturation Magnetizing Force Hs-oersteds	2000	6000	2000	3000	6000	6000	10000	10000	10000	30000	30000	30000	30000	30000	30000	30000	40000	40000	55000
Recoil Permeability	6.4	3.2	2.6	2.1	2.0	3	1.15	1.05	1.07	1.05	1.05	1.05	1.08	1.08	1.05	1.05	1.05	1.05	1.05
Magnetic Orientation (anisotropic)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
MATERIAL CHARACTERISTICS																			
Density - IB./in.3	.243	.254	.263	.265	.262	.265	.175	.177	.177	.268	.275	.268	.268	.269	.268	.268	.304	.304	.297
Curie Temp.-F°	1544	1562	1472	1544	1580	1580	842	842	842	625	648	625	635	635	600	600	1380	1380	1515
Max. Practical Operating Temperature-F°	1000	1000	932	1000	1000	1000	480	480	480	180	300	180	180	180	180	180	575	575	575
Reversible temp. coef of Br %/F°	.011	.006	.020	.011	.006	.006	.105	.105	.105	.066	.052	.066	.066	.061	.061	.061	.022	.022	.019

https://buymagnets.com/content/upload/files/Magnet%20Characteristics.pdf

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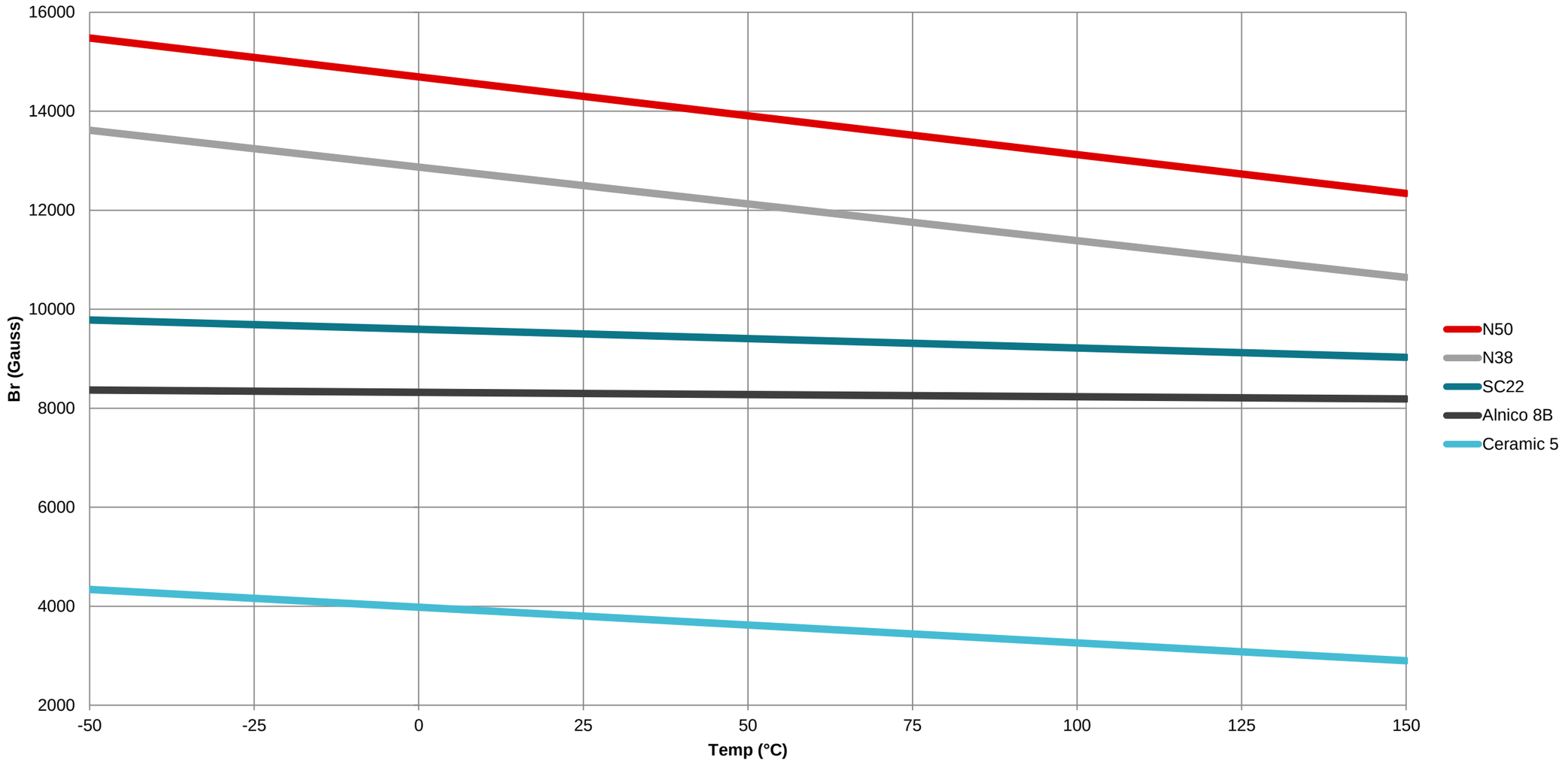
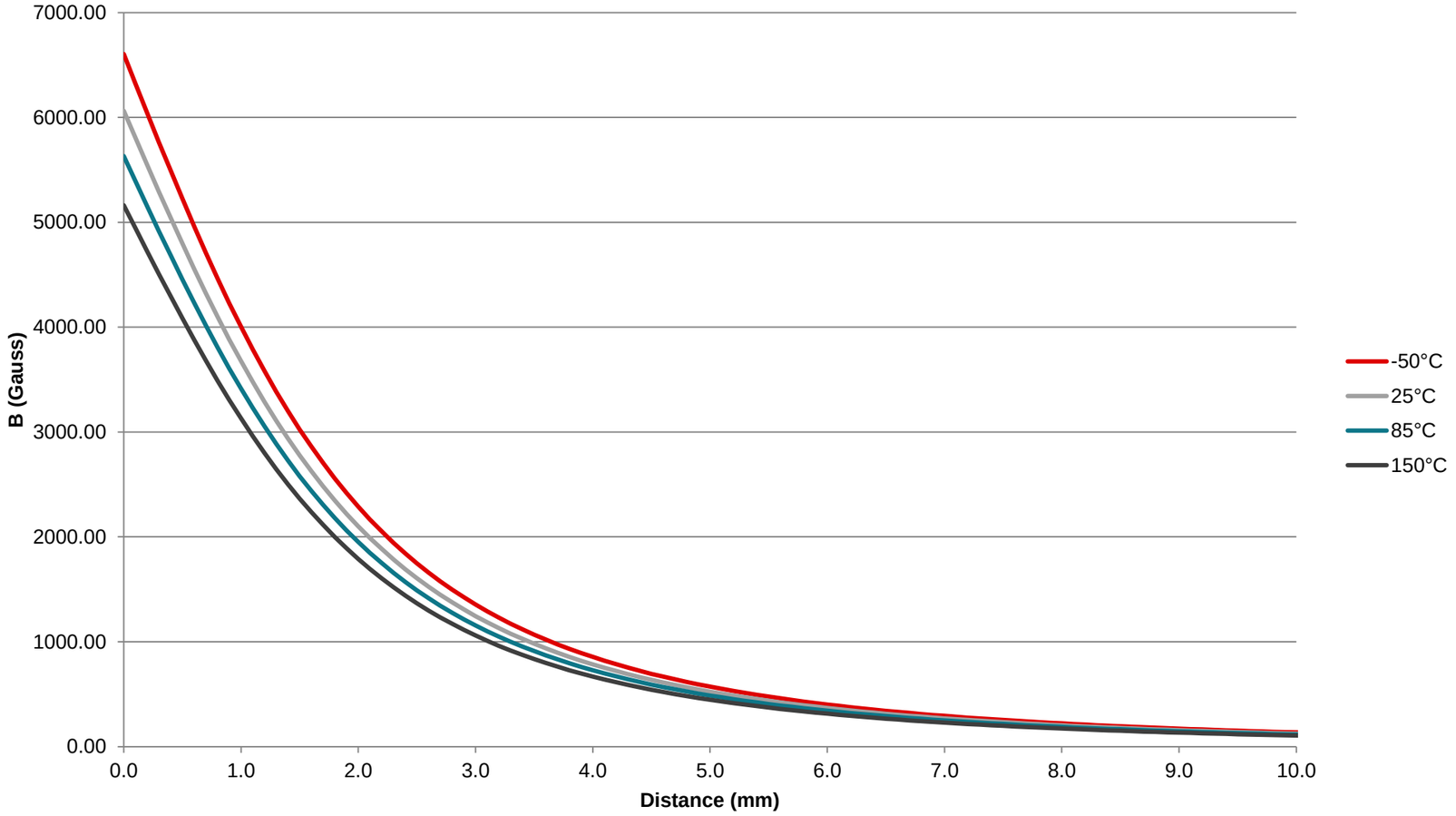


How magnetic field is affected by temperature

Example Magnet

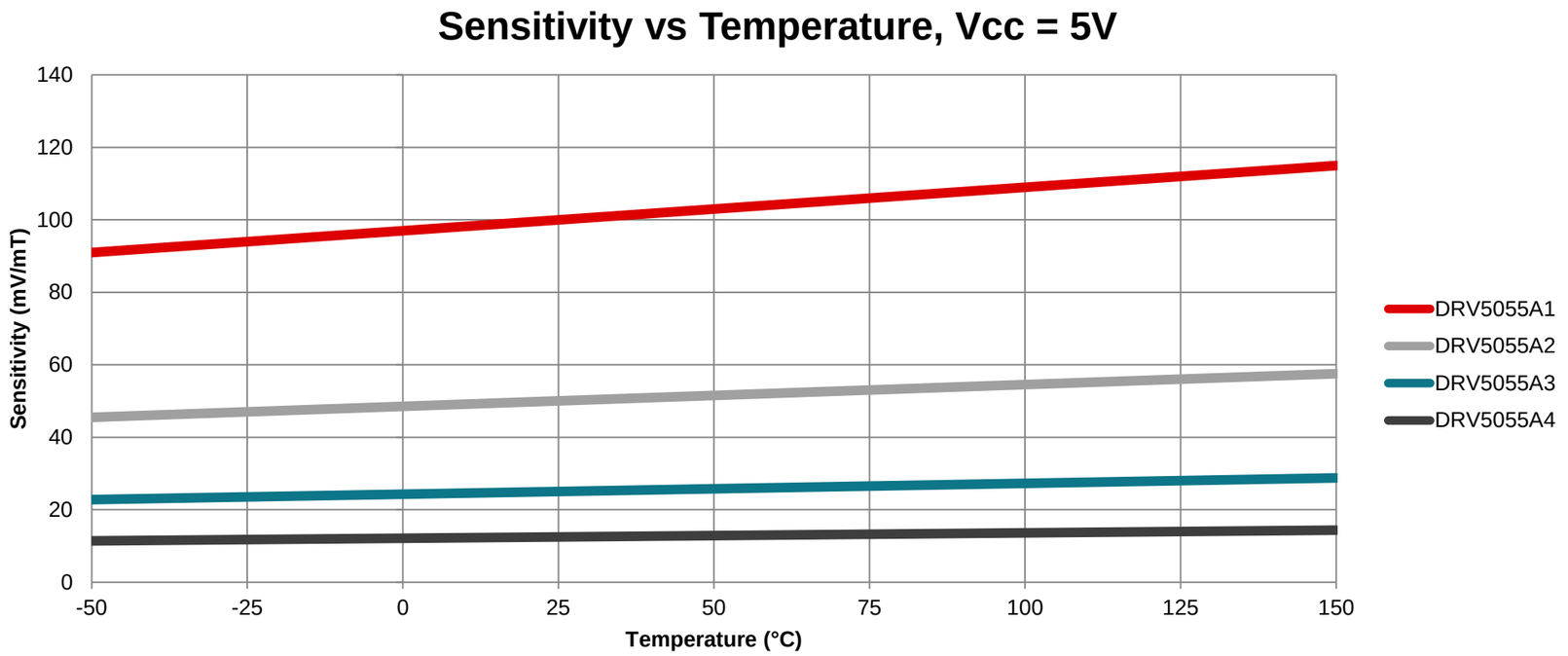
- Cylindrical Magnet (N38)
- Height: 9.525 mm
- Diameter: 4.7625 mm



TI’s Hall temperature sensitivity compensation

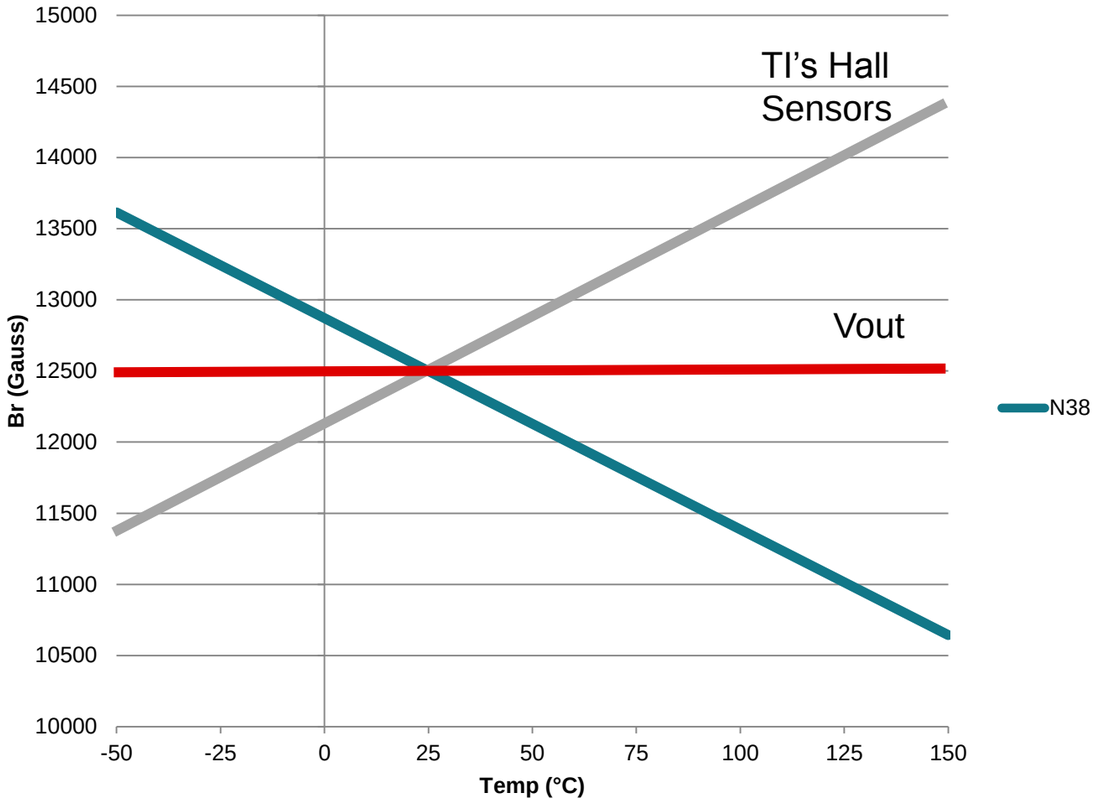
DRV5055 datasheet section: 6.6 Magnetic Characteristics

V_L	Linear range of output voltage(4)		0.2	V_{CC} – 0.2	V
S_{TC}	Sensitivity temperature compensation for magnets(5)			0.12	%/°C
S_{LE}	Sensitivity linearity error(4)	V_{OUT} is within V_L		±1%	
S_{SE}	Sensitivity symmetry error(4)	V_{OUT} is within V_L		±1%	

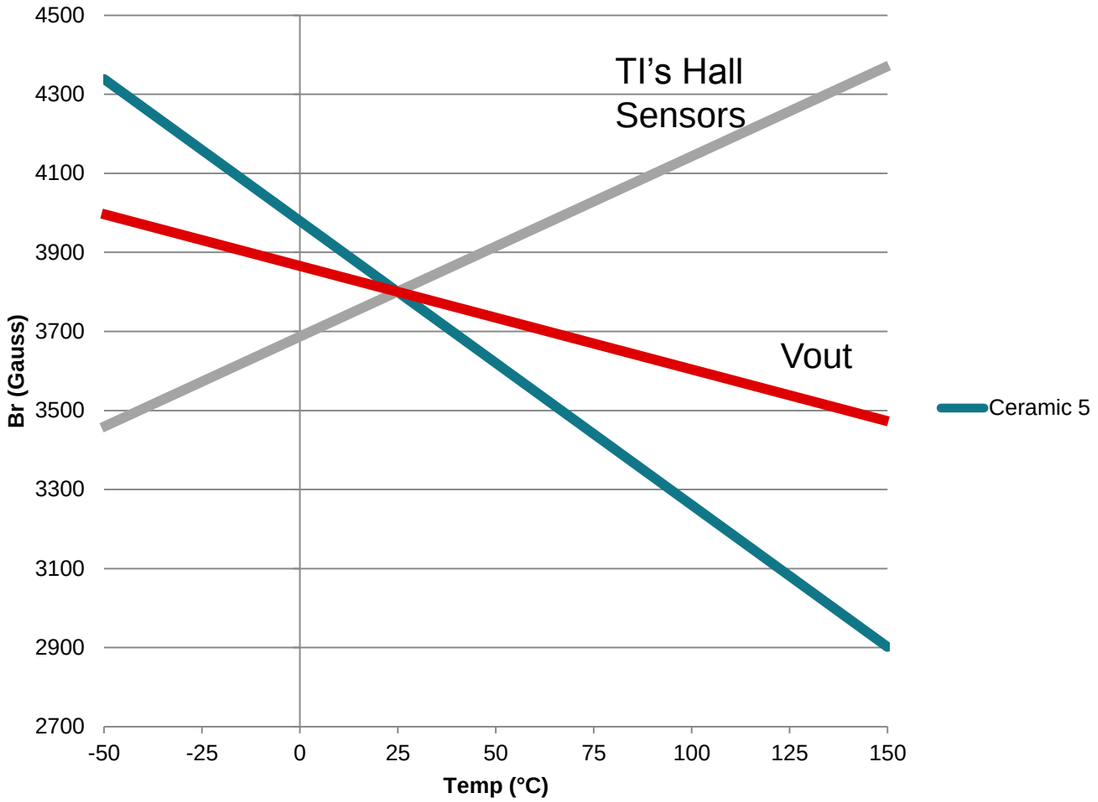


How TI Hall sensors adjust for changes in Br

Neodymium 38 compensation



Ceramic 5 compensation



To find more magnetic position sensing technical resources and search products, visit ti.com/halleffect