Steps to Calculate Noise Generator ENR on Noise Figure Analyser

1. Calibrate Noise Figure Analyser (NFA) using calibrated noise source from Agilent 346A.
2. Remove the Noise Source & connect Noise Generator (NSGEN) from our existing system. This includes Noise source NC501/ NC 502 / NC 503.
3. Now go to measurent : select "Phot".
4. Go to scale, & select linear instead of dB.

   All measurements are done in linear mode.
5. Make sure NSGEN is ON & EH Cal is selected.

   Note down the reading at Marker points, or can save as a trace & image.
6. Repeat 5th step for High Cal, Med Cal, Low Cal & Noise OFF.
7. Remove the source & connect a well calibrated 50 ohm Load, save the measurement as a Pcold.

   ENR= 10*log ((Phot-Pcold)/Pcold) .

   Where ENR : Excess Noise Ratio in dB.

   Phot : Power measured in linear for diff cal levels.

   Pcold: Power measured in linear for Load.

   Above formula corresponds to

   ENR = 10* log((Thot-Tcold)/Tcold)

   Where Thot : Temp. in deg K for diff cal levels.

   Tcold: Temp. in deg K for Noise Off.

   & we know

   P = KTΔFG

   Where P : Power in linear

   T : Temp. in deg K

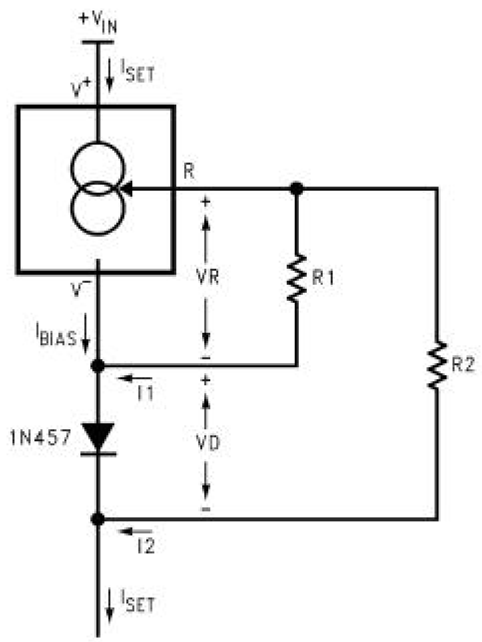
   ΔF : BW

   G : Gain in linear

Noise Source Current Sensitivity for ENR Variation

In existing L-band Noise Generator (NSGEN) only current regulator is there, voltage regulator for 15 V is residing outside NSGEN unit.

Current regulator LM334 is a constant current output source, whose current can be controlled by resistors R1, R2. The circuit shown below is selected as it provides temperature compensation also.



A forward biased diode is added to cancel +ve temperature coefficient of LM334 with –ve temp. coefficient of diode 1N457.

For temperature compensation

R2/R1 = 10.0132 should be there.

Calculating R1 , R2 for getting current Iset

$$Iset = \frac{VR}{R1} + \frac{VR + VD}{R2}$$

VD = Forward voltage across diode = 0.6V

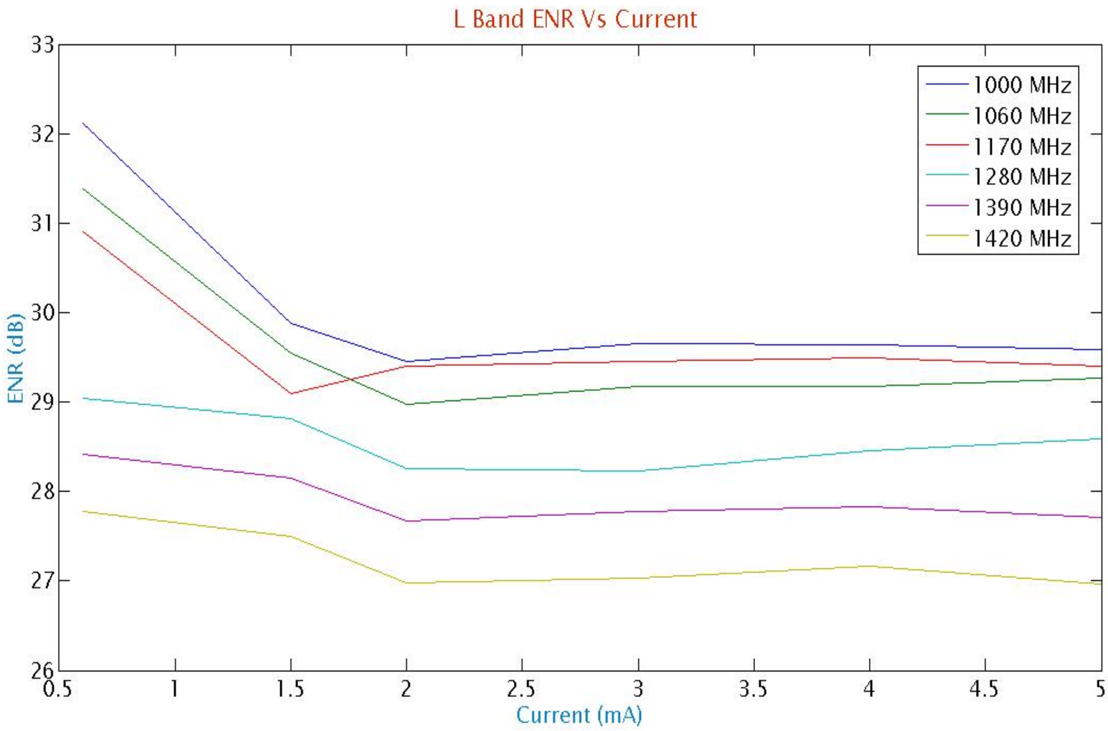
VR = Voltage across R1 @ T0 (298K) = 0.677V

After making the calculations from above, set the current for 0.6 mA, 1.5 mA, 2 mA, 3 mA, 4 mA, 5 mA.

Measured the Phot value on Noise Figure Analyzer (NFA) as per the instructions stated above. Then calculated the ENR value for the same.

As well as directional coupler loss, calculated the probable temperature to be injected at LNA.

In L-band NSGEN, power divider is also incorporated in it, so when we are doing measurements for CH1, terminated CH2 & vice versa.



Plot above shows ENR Vs Current, for various frequencies.

Below 1 mA current, ENR changes drastically, as well as it drops more voltage across current source, i.e. doesn't keep constant voltage at the input of Noise Source. For all other values of current voltage is maintained.

So we can't conclude as a one equation for ENR Vs Current.

Rather ENR is approx. constant for current above 2 mA.

Current Sensitivity for ENR Variation

Freq	0.6 mA	1.5 mA		2 mA		3 mA		4 mA		5 mA	
MHz	ENR	ENR	ENR change per %ΔI).6 mA - 1.5 m	ENR	ENR change per %ΔI 1.5mA -2 mA	ENR	ENR change per %ΔI 2 mA-3 mA	ENR	ENR change per %ΔI 3 mA-4 mA	ENR	ENR change per %ΔI 4mA -5 mA
1000.00	32.11	29.88	0.0148	29.45	0.0131	29.65	-0.0040	29.64	0.0003	29.59	0.0023
1010.00	31.91	29.74	0.0144	29.34	0.0121	29.52	-0.0036	29.49	0.0008	29.45	0.0023
1020.00	31.66	29.47	0.0146	29.02	0.0135	29.22	-0.0041	29.22	0.0002	29.20	0.0008
1030.00	31.44	29.21	0.0149	28.76	0.0134	28.93	-0.0035	28.94	-0.0001	28.94	-0.0003
1040.00	31.35	29.11	0.0149	28.61	0.0151	28.83	-0.0044	28.83	0.0001	28.83	-0.0003
1050.00	31.35	29.26	0.0140	28.70	0.0167	28.95	-0.0049	28.94	0.0003	28.95	-0.0010
1060.00	31.38	29.55	0.0122	28.97	0.0177	29.17	-0.0042	29.18	0.0000	29.27	-0.0049
1070.00	31.34	29.75	0.0106	29.13	0.0187	29.33	-0.0041	29.34	-0.0002	29.49	-0.0073
1080.00	31.18	29.74	0.0096	29.08	0.0196	29.29	-0.0041	29.29	-0.0001	29.43	-0.0072
1090.00	31.03	29.56	0.0098	28.95	0.0184	29.12	-0.0034	29.12	0.0001	29.29	-0.0087
1100.00	30.90	29.37	0.0102	28.79	0.0174	28.95	-0.0033	28.97	-0.0003	29.14	-0.0086
1110.00	30.91	29.31	0.0107	28.78	0.0159	29.01	-0.0045	28.97	0.0009	29.13	-0.0080
1120.00	30.99	29.37	0.0108	28.91	0.0137	29.12	-0.0043	29.11	0.0003	29.22	-0.0054
1130.00	30.98	29.50	0.0099	29.15	0.0104	29.33	-0.0035	29.30	0.0006	29.38	-0.0038
1140.00	30.93	29.53	0.0093	29.28	0.0077	29.43	-0.0030	29.44	-0.0003	29.45	-0.0008
1150.00	30.92	29.53	0.0092	29.43	0.0031	29.53	-0.0020	29.54	-0.0005	29.52	0.0010
1160.00	30.97	29.37	0.0107	29.45	-0.0024	29.53	-0.0017	29.57	-0.0010	29.48	0.0045
1170.00	30.91	29.10	0.0121	29.40	-0.0091	29.46	-0.0011	29.50	-0.0012	29.40	0.0050
1180.00	30.76	28.89	0.0125	29.34	-0.0135	29.37	-0.0007	29.44	-0.0020	29.28	0.0081
1190.00	30.59	28.97	0.0108	29.32	-0.0106	29.33	-0.0002	29.42	-0.0026	29.21	0.0102
1200.00	30.44	29.19	0.0083	29.34	-0.0045	29.31	0.0005	29.42	-0.0034	29.23	0.0099
1210.00	30.30	29.29	0.0067	29.32	-0.0009	29.25	0.0015	29.39	-0.0043	29.12	0.0136
1220.00	30.26	29.37	0.0060	29.30	0.0021	29.20	0.0019	29.38	-0.0054	29.06	0.0158
1230.00	30.21	29.36	0.0057	29.21	0.0044	29.07	0.0028	29.32	-0.0074	28.89	0.0214
1240.00	30.09	29.26	0.0055	29.08	0.0053	28.87	0.0043	29.17	-0.0091	28.68	0.0244
1250.00	29.76	29.07	0.0046	28.81	0.0079	28.59	0.0044	28.92	-0.0098	28.32	0.0299

Current Sensitivity for ENR Variation

Freq	0.6 mA	1.5 mA		2 mA		3 mA		4 mA		5 mA	
MHz	ENR	ENR	ENR change per %ΔI).6 mA - 1.5 m.	ENR	ENR change per %ΔI 1.5mA -2 mA	ENR	ENR change per %ΔI 2 mA-3 mA	ENR	ENR change per %ΔI 3 mA-4 mA	ENR	ENR change per %ΔI 4mA -5 mA
1260.00	29.38	28.90	0.0032	28.54	0.0106	28.23	0.0062	28.68	-0.0135	28.13	0.0277
1270.00	29.08	28.78	0.0020	28.34	0.0131	27.99	0.0070	28.49	-0.0149	28.26	0.0113
1280.00	29.04	28.82	0.0014	28.25	0.0172	28.23	0.0003	28.45	-0.0065	28.59	-0.0070
1290.00	29.15	28.91	0.0016	28.20	0.0213	28.61	-0.0082	28.43	0.0054	28.77	-0.0169
1300.00	29.36	29.05	0.0021	28.23	0.0243	28.89	-0.0131	28.48	0.0125	28.88	-0.0203
1310.00	29.38	29.04	0.0023	28.34	0.0208	28.94	-0.0119	28.42	0.0156	28.89	-0.0237
1320.00	29.00	28.79	0.0014	28.43	0.0106	28.75	-0.0062	28.14	0.0181	28.67	-0.0263
1330.00	28.60	28.47	0.0008	28.40	0.0021	28.48	-0.0015	27.98	0.0150	28.40	-0.0208
1340.00	28.32	28.11	0.0014	28.17	-0.0016	28.17	0.0000	28.01	0.0046	28.10	-0.0043
1350.00	28.15	27.77	0.0026	27.89	-0.0035	27.86	0.0005	27.95	-0.0025	27.78	0.0084
1360.00	28.30	27.65	0.0043	27.83	-0.0055	27.77	0.0012	27.98	-0.0063	27.70	0.0139
1370.00	28.48	27.76	0.0048	27.81	-0.0015	27.69	0.0024	27.99	-0.0089	27.61	0.0189
1380.00	28.64	28.09	0.0037	27.87	0.0066	27.77	0.0020	28.04	-0.0081	27.67	0.0181
1390.00	28.41	28.15	0.0017	27.67	0.0146	27.78	-0.0023	27.83	-0.0013	27.71	0.0057
1400.00	28.22	28.07	0.0010	27.54	0.0157	27.66	-0.0023	27.70	-0.0013	27.59	0.0054
1410.00	27.94	27.76	0.0012	27.24	0.0156	27.30	-0.0012	27.41	-0.0033	27.23	0.0090
1420.00	27.78	27.50	0.0019	26.98	0.0156	27.03	-0.0009	27.17	-0.0042	26.96	0.0104
1430.00	27.84	27.37	0.0032	26.86	0.0152	26.92	-0.0011	27.04	-0.0037	26.84	0.0101
1440.00	28.28	27.61	0.0045	27.10	0.0153	27.16	-0.0013	27.28	-0.0036	27.10	0.0090
1450.00	28.66	27.88	0.0052	27.38	0.0149	27.46	-0.0015	27.56	-0.0031	27.38	0.0090
1460.00	28.96	28.12	0.0056	27.70	0.0124	27.76	-0.0012	27.89	-0.0040	27.72	0.0087
1470.00	28.73	27.89	0.0056	27.56	0.0100	27.64	-0.0016	27.79	-0.0043	27.59	0.0098
1480.00	28.24	27.42	0.0055	27.04	0.0115	27.18	-0.0028	27.32	-0.0042	27.09	0.0116
1490.00	27.85	27.06	0.0052	26.55	0.0154	26.68	-0.0026	26.82	-0.0043	26.64	0.0091
1500.00	27.80	27.02	0.0052	26.31	0.0214	26.47	-0.0032	26.61	-0.0039	26.38	0.0111

Current Sensitivity for ENR Variation

ENR

Freq (MHz)	1000.00	1060.00	1170.00	1280.00	1390.00	1420.00
Current (mA)						
0.60	32.11	31.38	30.91	29.04	28.41	27.78
1.50	29.88	29.55	29.10	28.82	28.15	27.50
2.00	29.45	28.97	29.40	28.25	27.67	26.98
3.00	29.65	29.17	29.46	28.23	27.78	27.03
4.00	29.64	29.18	29.50	28.45	27.83	27.17
5.00	29.59	29.27	29.40	28.59	27.71	26.96

Voltages

	V1	V2	V3	V4	V5	ENR Change due to vtg
Current (mA)						
0.60	15.29	15.01	9.93	9.86	9.35	2.85
1.50						
2.00	15.40	14.62	13.83	13.78	13.08	0.04
3.00	15.17	14.43	13.70	13.65	13.13	0.05
4.00	15.30	14.46	13.71	13.70	13.20	-0.02
5.00	15.40	14.43	13.70	13.60	13.18	

Current Sensitivity Vs Noise temp injected at LNA

Freq	0.6 mA	1.5 mA	2 mA	3 mA	4 mA	5 mA
MHz	Temperature at LNA i/p					
1000.00	1224.95	734.33	664.11	695.69	694.16	686.93
1010.00	1185.84	720.73	656.94	684.58	680.43	673.41
1020.00	1135.10	685.80	618.57	648.59	647.66	645.38
1030.00	1095.60	654.91	591.13	615.16	615.45	616.42
1040.00	1087.54	649.90	579.03	609.25	608.58	609.55
1050.00	1102.88	681.27	599.35	634.18	632.72	635.53
1060.00	1125.82	739.61	645.94	677.66	677.89	693.32
1070.00	1129.67	784.68	679.85	713.05	714.13	738.41
1080.00	1106.30	793.17	682.39	714.96	715.51	739.51
1090.00	1083.82	772.71	671.22	697.76	697.12	725.42
1100.00	1064.82	748.74	655.20	680.92	682.65	710.22
1110.00	1083.84	749.20	663.37	698.68	693.62	719.60
1120.00	1118.11	770.08	693.11	727.95	726.09	744.42
1130.00	1130.99	803.99	742.60	772.95	769.24	782.89
1140.00	1132.52	822.10	774.81	802.16	804.08	807.10
1150.00	1145.72	832.85	813.16	832.07	835.11	831.21
1160.00	1175.57	813.61	828.92	845.38	851.61	834.29
1170.00	1175.99	775.62	831.40	841.98	849.91	830.75
1180.00	1151.43	748.63	830.33	837.38	850.18	818.99
1190.00	1123.65	773.27	838.66	840.46	857.65	818.34
1200.00	1099.46	824.61	853.64	848.64	871.12	832.45
1210.00	1079.56	857.22	863.02	848.28	876.55	823.52
1220.00	1085.23	883.78	869.35	850.18	886.21	824.24
1230.00	1086.79	894.03	864.56	837.07	885.69	802.62
1240.00	1071.73	886.26	850.65	809.97	868.25	776.13
1250.00	1008.97	860.65	810.18	770.48	830.88	724.02

Current Sensitivity Vs Noise temp injected at LNA

Freq	0.6 mA	1.5 mA	2 mA	3 mA	4 mA	5 mA
MHz	Temperature at LNA i/p					
1260.00	936.55	838.16	772.81	719.64	797.88	702.48
1270.00	885.50	826.95	747.97	690.29	773.95	734.84
1280.00	890.41	847.34	742.53	739.86	777.60	803.06
1290.00	926.40	876.19	744.31	817.92	784.59	848.01
1300.00	986.50	916.83	760.77	884.66	804.01	882.53
1310.00	1003.61	927.47	790.62	906.38	804.31	896.84
1320.00	933.45	888.33	818.81	879.57	765.69	864.29
1330.00	862.05	837.86	824.37	838.62	747.72	822.75
1340.00	819.07	781.79	791.24	791.45	764.15	779.40
1350.00	799.77	732.34	752.23	748.09	762.72	733.78
1360.00	838.63	721.86	752.69	742.26	778.79	730.49
1370.00	887.58	751.22	760.08	739.74	791.97	725.96
1380.00	932.54	821.08	780.71	762.90	811.88	747.00
1390.00	897.22	845.61	756.24	776.35	784.33	763.94
1400.00	869.82	840.25	744.99	765.20	772.58	753.76
1410.00	828.52	793.82	704.53	714.33	732.54	702.92
1420.00	808.76	758.73	673.22	680.41	702.66	669.83
1430.00	831.76	746.14	664.20	672.87	692.05	660.67
1440.00	932.36	799.12	710.84	721.58	741.81	711.83
1450.00	1032.80	862.46	769.59	783.28	802.01	769.42
1460.00	1121.84	923.25	839.28	850.97	877.58	843.17
1470.00	1079.15	889.62	824.27	839.95	868.19	829.84
1480.00	977.39	808.56	740.65	765.14	790.25	749.22
1490.00	904.46	755.57	671.33	691.45	714.52	685.39
1500.00	908.32	759.19	644.67	669.14	689.68	655.30

Voltage Sensitivity

As voltage regulator is outside the unit, we directly varied the voltage from supply, rather than giving standard 15 V, tried for 13 V, 14 V, and 15 V.
Data is not properly analyzed, but in general when we goes below 15 V, ENR changes more than we go upside of 15 V.
More data has to be measured with precise steps.

Temperature Sensitivity

Measurements for T_{LNA} Vs temperature variation in environmental chamber was done. As environmental chamber doesn't lock for intermediate temperature, we can't measure stabilized thing. It gives us two cases

1. It stables for higher temp. approx 55 deg C & then goes lower temp. 10 deg C
   (T_{LNA} varies from 60 deg K to 55 deg K)
2. It stables for lower temp. approx 10 deg C & then goes up to 55 deg C.
   (T_{LNA} varies from 60 deg K to 55 deg K)

So it is better to make whole NSGEN unit ENR variation for different temperature after coming new environmental chamber.
(Note : Keep Calibrated Noise Source outside Environmental Chamber)

Low Temperature coefficients Resistor

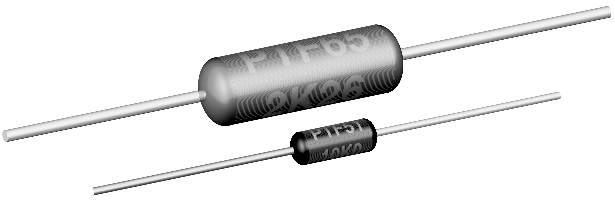
We can use Metal film resistors, high precision, high stability for lower temperature coefficients, only 5 ppm / deg C from Vishay electronics.
Datasheet is attached herewith for the reference.

Some points yet to be understood:

- Noise Source is said to be work for 15 V, as per datasheet, but we give 15 V at current source i/p & it gives 13 V at noise source input.
- NC503 ENR flatness is +/- 1.5 dB , so it is obvious that ENR changes with frequency. But we have to ensure that it is not more than that.
  This can be calibrated out in software, i.e. for so n so freq. noise deflection will be so n so.
- Noise Source states to give 31 dB ENR, but it states "min. 31 dB ENR" but at NSGEN unit output (1.5 mA we use normally) we get 29.5 dB (1060 MHz) which includes power divider (6 dB) + switches (2 dB) losses, which means Noise Source NC503 is giving 29.5 + 6 + 2 = 37.5 dB at it's immediate output.

(IMP Note : This data resembles to the data at the time of installation.)

Metal Film Resistors, High Precision, High Stability



FEATURES

- Extremely low temperature coefficient of resistance
- Very low noise and voltage coefficient
- Very good high frequency characteristics
- Can replace wirewound bobbins
- Proprietary epoxy coating provides superior moisture protection
- For surface mount product, see Vishay Dale's PSF datasheet
- Compliant to RoHS Directive 2002/95/EC

Pb-free Available

e3

RoHS* COMPLIANT

STANDARD ELECTRICAL SPECIFICATIONS

GLOBAL MODEL	HISTORICAL MODEL	POWER RATING (3) $P_{85\,°C}$ W	LIMITING ELEMENT VOLTAGE MAX. (1) V	TEMPERATURE COEFFICIENT ± ppm/°C	TOLERANCE ± %	RESISTANCE RANGE Ω
PTF51	PTF-51	0.05	200	5, 10, 15	0.02, 0.05, 0.1, 0.25, 0.5, 1	15 to 100K
PTF56	PTF-56	0.125	300	5, 10, 15	0.01, 0.02, 0.05, 0.1, 0.25, 0.5, 1	15 to 500K
PTF65	PTF-65	0.25	500	5, 10, 15	0.05, 0.1, 0.25, 0.5, 1	15 to 1M

Notes

- Marking: Print-marked-model, value, tolerance, TC, date code
- DSCC has created a drawing to support the need for a precision axial-leaded product. Vishay Dale is listed as a resource on this drawing as follows:

DSCC DRAWING NUMBER	VISHAY DALE MODEL	POWER RATING $P_{85\,°C}$ W	RESISTANCE RANGE Ω	TOLERANCE ± %	TEMPERATURE COEFFICIENT ± ppm/°C	MAXIMUM WORKING VOLTAGE (1) V
89088	PTF56..31, PTF56..32 (2)	0.100	15 to 100K	0.01, 0.05, 0.1, 0.5, 1	5, 10	200
90038	PTF65..16, PTF65..14 (2)	0.250	15 to 100K	0.05, 0.1, 0.5, 1	5, 10	200

This drawing can be viewed at: www.dscc.dla.mil/Programs/MilSpec/ListDwgs.asp?DocType=DSCCdwg

(1) Continuous working voltage shall be $\sqrt{P \times R}$ or maximum working voltage, whichever is less.
(2) Hot solder dipped leads
(3) For operation of the PTF resistors at higher power ratings, see the Load Life Shift Due to Power and Derating table. This table gives a summary of the effects of using the PTF product at the more common combinations of power rating and case size, as well as quantifies the load life stability under those conditions.

TEMPERATURE COEFFICIENT CODES

GLOBAL TC CODE	HISTORICAL TC CODE	TEMPERATURE COEFFICIENT
Z	T-16	5 ppm/°C
Y	T-13	10 ppm/°C
X	T-10	15 ppm/°C

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: PTF5620K500BYRE (preferred part numbering format)

P	T	F	5	6	2	0	K	5	0	0	B	Y	R	E			

GLOBAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING	SPECIAL
PTF51 **PTF56** **PTF65**	**R** = Ω **K** = kΩ **M** = MΩ **15R000** = 15 Ω **500K00**= 500 kΩ **1M0000**= 1.0 MΩ	**T** = ± 0.01 % (4) **Q** = ± 0.02 % (4) **A** = ± 0.05 % **B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 % **F** = ± 1 %	**Z** = 5 ppm **Y** = 10 ppm **X** = 15 ppm **0** = Special	**EK** = Lead (Pb)-free, bulk **EA** = Lead (Pb)-free, T/R (full) **EB** = Lead (Pb)-free, T/R (1000 pieces) **BF** = Tin/lead, bulk **RE** = Tin/lead, T/R (full) **R6** = Tin/lead, T/R (1000 pieces)	Blank = Standard (Dash number) (Up to 3 digits) From **1 to 999** as applicable

Historical Part Number example: PTF-5620K5BT-13R36 (will continue to be accepted)

PTF-56	20K5	B	T-13	R36
HISTORICAL MODEL	RESISTANCE VALUE	TOLERANCE CODE	TEMP. COEFFICIENT	PACKAGING

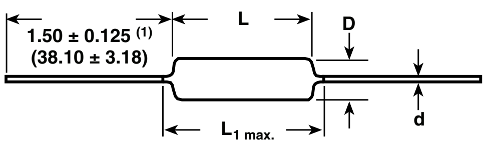
Note

(4) Historical tolerance codes were BB for 0.01 % and BC for 0.02 %

* Pb containing terminations are not RoHS compliant, exemptions may apply

TECHNICAL SPECIFICATIONS				
PARAMETER	**UNIT**	**PTF51**	**PTF56**	**PTF65**
Rated Dissipation at 85 °C	W	0.05	0.125	0.25
Limiting Element Voltage	V≅	200	300	500
Insulation Voltage (1 Min)	V_{eff}	> 500	> 500	> 500
Thermal Resistance	K/W	< 1300	< 520	260
Terminal Strength, Axial	N	> 150	> 50	> 50
Insulation Resistance	Ω	≥ 10^{11}	≥ 10^{11}	≥ 10^{11}
Category Temperature Range	°C	- 55 to + 150	- 55 to + 150	- 55 to + 150
Failure Rate	10^{-9}/h	< 1	< 1	< 1
Weight (Max.)	g	0.11	0.35	0.75

DIMENSIONS



Note

(1) 1.08 ± 0.125 (27.43 ± 3.18) if tape and reel

GLOBAL MODEL	**DIMENSIONS** in inches (millimeters)			
	L	**D**	**L_1 max.**	**d**
PTF51	0.150 ± 0.020 (3.81 ± 0.51)	0.070 ± 0.010 (1.78 ± 0.25)	0.200 (5.08)	0.016 (0.41)
PTF56	0.250 ± 0.031 (6.35 ± 0.79)	0.091 ± 0.009 (2.31 ± 0.23)	0.300 (7.62)	0.025 (0.64)
PTF65	0.375 ± 0.062 (9.53 ± 1.57)	0.145 ± 0.016 (3.68 ± 0.41)	0.475 (12.07)	0.025 (0.64)

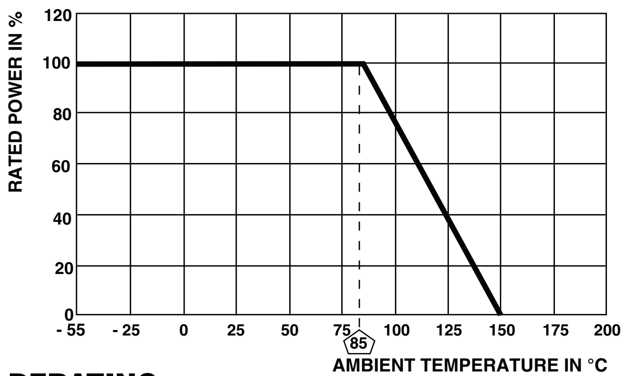
PERFORMANCE		
TEST	**CONDITIONS OF TEST**	**TEST RESULTS (TYPICAL TEST LOTS)**
Life (at Standard Power Ratings)	MIL-PRF-55182 Paragraph 4.8.18 1000 h rated power at + 85 °C	≤ ± 0.04 %
Thermal Shock	MIL-STD-202, Method 107 - 55 °C to + 85 °C	≤ ± 0.02 %
Short Time Overload	MIL-R-10509, Paragraph 4.7.6	≤ ± 0.01 %
Low Temperature Operation	MIL-PRF-55182, Methods 4.8.10	≤ ± 0.02 %
Moisture	MIL-PRF-55182, Paragraph 4.8.15	≤ ± 0.08 %
Resistance to Soldering Heat	MIL-STD-202, Methods 210	≤ ± 0.02 %
Damp Heat IEC 60068-2-3	56 days at 40 °C and 92 % RH	≤ ± 0.08 %
Dielectric Withstanding Voltage	MIL-STD-202, Methods 301 and 105	≤ ± 0.01 %

MATERIAL SPECIFICATIONS	
Element	Precision deposited nickel chrome alloy with controlled annealing
Encapsulation	Specially formulated epoxy compounds. Coated construction
Core	Fire-cleanded high purity ceramic
Termination	Standard lead material is solder-coated copper. Solderable and weldable per MIL-STD-1276, Type C.

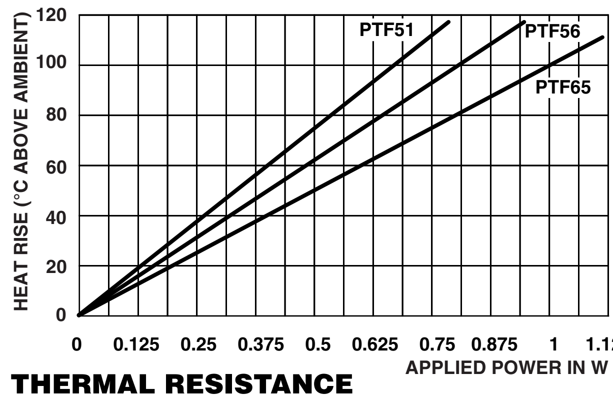
LOAD LIFE SHIFT DUE TO POWER AND DERATING (AT 85 °C)

The power rating for the PTF parts is tied to the derating temperature, the heat rise of the parts, and the ΔR for the load life performance. When the tables/graphs below are used together they show that when the parts are run at higher power ratings, the parts will run hotter, which has the potential of causing the resistance of the parts to shift more over the life of the part.

LOAD LIFE SHIFT VS. POWER RATING					
LOAD LIFE	**CONDITIONS OF TEST**	**MAXIMUM ΔR (TYPICAL TEST LOTS)**			
	MIL-PRF-55182 Paragraph 4.8.18 1000 h rated power at + 85 °C	≤ ± 0.04 %	≤ ± 0.15 %	≤ ± 0.5 %	≤ ± 1.0 %
MODEL		**POWER RATING AT + 85 °C**			
PTF51		1/20 W	1/10 W	1/8 W	1/4 W
PTF56		1/8 W	-	1/4 W	1/2 W
PTF65		1/4 W	-	1/2 W	3/4 W



DERATING



THERMAL RESISTANCE

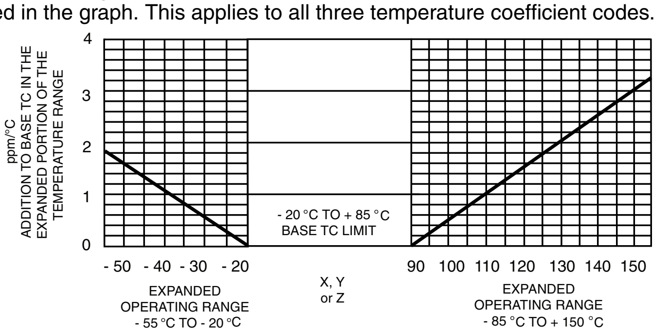
Example: When a PTF56 part is run at 1/8 W in a 70 °C ambient environment, the resistor will generate enough heat that the surface temperature of the part will reach about 17 °C over the ambient temperature, and over the life of the part this could cause the resistance value to shift up to ± 0.04 %.
If the same resistor was instead run at 1/4 W in a 70 °C environment, the element will heat up to about 30 °C over ambient, and over the life of the part the resistance value could shift roughly ± 0.5 %.
And if the resistor was run at its maximum power rating of 1/2 W in a 70 °C environment, it will heat up to about 61°C over ambient, and you could see the resistance value shift roughly ± 1 % over the life of the part.

TEMPERATURE COEFFICIENT OF RESISTANCE

Temperature coefficient (TC) of resistance is normally stated as the maximum amount of resistance change from the original + 25 °C value as the ambient temperature increases or decreases. This is most commonly expressed in parts per million per degree centigrade (ppm/°C).

The resistance curve over the operating temperature range is usually a non-linear curve within predictable maximum limits. PTF resistors have a very unifom resistance temperature characteristic when measured over the operating range of - 20 °C to + 85 °C. The standard temperature coefficients available are
X = ± 15 ppm/°C, Y = ± 10 ppm/°C and Z = ± 5 ppm/°C.

Some applications of the PTF require operation beyond the specifications of - 20 °C to + 85 °C. The change in temperature coefficient of resistance is very small (less than ± 0.05 ppm/°C) over the expanded temperature range of - 55 °C to + 150 °C. Therefore, when operating outside the range - 20 °C to + 85 °C, the designer can plan for a worst case addition of ± 0.05 ppm/°C for each degree centigrade beyond either - 20 °C or + 85 °C as indicated in the graph. This applies to all three temperature coefficient codes.



Example: Assume the operating characteristics demand a temperature range from - 55 °C to + 125 °C. This requires a ± 35 °C Δ below - 20 °C and a ± 40 °C Δ above + 85 °C. The extreme Δ being ± 40 °C means that the worst case addition to the specified TC limit of ± 0.05 ppm/°C times ± 40 °C or ± 2 ppm/°C. Therefore, a Z which is characterized by a base TC limit of ± 5 ppm/°C over the temperature range of - 20 °C to + 85 °C will exhibit a maximum temperature coefficient of ± 7 ppm/°C over the expanded portion of the temperature range of - 55 °C to + 125 °C.

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