Handy Resistor Simulates RTD Temperature Outputs, such as PT-100 and PT-1000

FEATURES AND BENEFITS

- **Temperature coefficient of resistance (TCR): —55°C to +125°C, 25°C ref.**
  - RTD simulator (C): ±2 ppm/°C typical (see Table 1)
  - RTD simulator (K): ±1 ppm/°C typical (see Table 1)
- Resistance tolerance: to ±0.005% (50 ppm)
- Load life stability: ±0.005% after 2,000 hrs at rated power at 70°C
- Power rating: to 0.6 W at +70°C
- Resistance range: 10 Ω to 5k Ω (for higher or lower values, please contact us)
- Vishay Foil resistors are not restricted to standard values; specific “as required” values can be supplied at no extra cost or delivery (e.g., 1K01234 vs. 1k)
- **Electrostatic discharge (ESD): at least to 25 kV**
- Non inductive, non capacitive design
- Rise time: 1 ns effectively no ringing
- Current noise: 0.010 μV_{RMS}/V of applied voltage (<–40 dB)
- Thermal EMF: 0.05 µV/°C
- Voltage coefficient: <0.1 ppm/V
- Low inductance: <0.08 µH
- Terminal finishes available: lead (Pb)-free, tin/lead alloy
- **Each RTD Simulator based on the Bulk Metal® foil technology comes with built-in climate control (CC) feature.**

The only resistor with internal climate isolation.

Pb-free Available

RoHS* COMPLIANT

INTRODUCTION

Calibrate all your RTD inputs

The new Foil RTD Simulators can simulate RTD's in all types of instruments, such as transmitters, controllers, and data acquisition, process control, lab equipment, etc. Each resistance unit comes with NIST certification and printed temperature on the resistor itself. Connect an RTD and instantly read the temperature indicated on the resistor itself.

Better than a decade box—faster, easier, and much less expensive

This new RTD Simulator is a complete compact simulator for checkout and calibration of all RTD instruments in the field, shop or control room.

The long-term stability conditions of the RTD Simulator are regulated with respect to temperature and humidity.

CLIMATE CONTROL (CC)

Two predictable and opposing physical phenomena within the composite structure of the resistive alloy and its substrate are the key to the low absolute TCR capability of a Bulk Metal® Foil resistor:

- Resistivity of the resistive alloy changes directly with temperature in free air (resistance of the foil increases when temperature increases.)
- The Coefficient of Thermal Expansion (CTE) of the alloy and the substrate to which the foil alloy is cemented are different resulting in a compressive stress on the resistive alloy when temperature increases (resistance of the foil decreases due to compression caused by the temperature increases).

The TCR of the Foil resistor is achieved by matching two opposing effects—the inherent increase in resistance due to temperature increase vs. the compression—related decrease in resistance due to that same temperature increase. The two effects occur simultaneously resulting in an unusually low predictable, repeatable, and controllable TCR.

Due to VPG’s Bulk Metal Foil resistor design, this TCR characteristic is accomplished automatically, without selection, and regardless of the resistance value or the date of manufacture—even if years apart!

Note

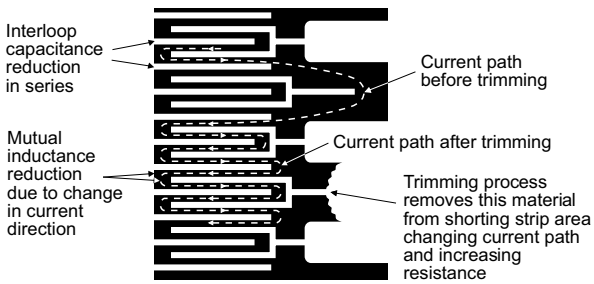
∗ Pb containing terminations are not RoHS compliant; exemptions may apply.

Table 1—Resistance vs. TCR
(–55°C to +125°C, +25°C Ref.)

RTD SIMULATOR	RESISTANCE VALUE (Ω)	TYPICAL TCR AND MAX. SPREAD (ppm/°C)
RTD-K	80 to <5k	±1 ±2.5
RTD-C	80 to <5k	±2 ±2.5
RTD-K	50 to <80	±1 ±3.5
RTD-C		±2 ±3.5
RTD-K	10 to <50	±1 ±4.5
RTD-C		±2 ±4.5

(1) C refers to C Foil Alloy; K refers to the K Foil Alloy.

Figure 1—Trimming to Values
(conceptual illustration)

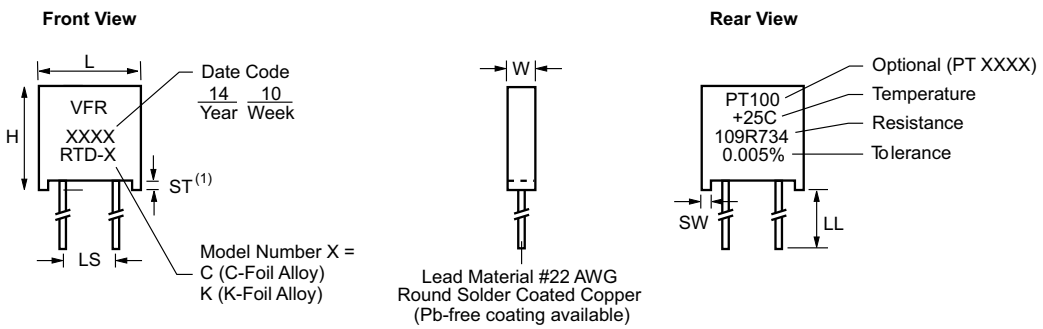


Foil shown in black, etched spaces in white

Note

To acquire a precision resistance value, the Bulk Metal® Foil chip is trimmed by selectively removing built-in "shorting bars." To increase the resistance in known increments, marked areas are cut, producing progressively smaller increases in resistance. This method reduces the effect of "hot spots" and improves the long-term stability of the Vishay Foil resistors.

Figure 2—Standard Imprinting and Dimensions



Notes

(1) Standoffs provided to allow proper flushing of flux, debris, and contaminates from under resistor after all solder operations.

(2) The standoffs shall be so located as to give a lead clearance of 0.010" minimum between the resistor body and the printed circuit board when the standoffs are seated on the printed circuit board.

Table 2—Model Selection

MODEL NUMBER	MAXIMUM WORKING VOLTAGE	AVERAGE WEIGHT IN GRAMS	DIMENSIONS		TIGHTEST TOLERANCE VS. LOWEST RESISTANCE VALUE
			INCHES	mm	
RTD-C (RTD-J) (1)	300	0.6	W: 0.105 ±0.010 L: 0.300 ±0.010 H: 0.326 ±0.010 ST: 0.010 min. SW: 0.040 ±0.005 LL: 1.000 ±0.125 LS: 0.150 ±0.005	2.67 ±0.25 7.62 ±0.25 8.28 ±0.25 0.254 min. 1.02 ±0.13 25.4 ±3.18 3.81 ±0.13	0.005% / 50 Ω 0.01% / 25 Ω 0.02% / 12 Ω 0.05% / 10 Ω
RTD-K (RTD-L) (1)					

(1) 0.200" (5.08 mm) lead spacing available—specify RTD-J for RTD-C and RTD-L for RTD-K.

Table 3—Environmental Performance Comparison

GROUP/PARAMETER		MIL-PRF-55182 CHAR J	RTD SIMULATOR	
			MAXIMUM ΔR	TYPICAL ΔR
Test Group I				
Thermal shock, 5 x (–65°C to +150°C)		±0.2%	±0.01% (100 ppm)	± 0.002 % (20 ppm)
Short time overload, 6.25 x rated power		±0.2%	±0.01% (100 ppm)	± 0.003 % (30 ppm)
Test Group II				
Low temperature storage (24 h at –65°C)		±0.15%	±0.01% (100 ppm)	±0.002% (20 ppm)
Low temperature operation (45 min, rated power at –65°C)		±0.15%	±0.01% (100 ppm)	±0.002% (20 ppm)
Terminal strength		±0.2%	±0.01% (100 ppm)	±0.002% (20 ppm)
Test Group III				
Dielectric Withstanding Voltage (DWV)		±0.15%	±0.01% (100 ppm)	±0.002% (20 ppm)
Resistance to solder heat		±0.1%	±0.01% (100 ppm)	±0.005% (50 ppm)
Moisture resistance		±0.4%	±0.05% (500 ppm)	±0.01% (100 ppm)
Test Group IV				
Shock		±0.2%	±0.01% (100 ppm)	±0.002% (20 ppm)
Vibration		±0.2%	±0.01% (100 ppm)	±0.002% (20 ppm)
Test Group V				
Life test at 0.3 W/+125°C	2000 h	±0.5%	±0.015% (150 ppm)	±0.01% (100 ppm)
	10 000 h	±2.0%	±0.05% (500 ppm)	±0.03% (300 ppm)
Test Group Va				
Life test at 0.6 W (2 x rated power)/+70°C, 2000 h		±0.5%	±0.015% (150 ppm)	±0.01% (100 ppm)
Test Group VI				
High temperature exposure (2000 h at +175°C)		±2.0%	±0.1% (1000 ppm)	±0.05% (500 ppm)
Test Group VII				
Voltage coefficient		5 ppm/V	<0.1 ppm/V	<0.1 ppm/V

About Table 4, PT100 Temperature/Resistance, on pages 4–6

The resistance value for PT1000 is ten times the resistance value for PT100 at any temperature. For example the resistance value for PT100 at 25ºC is 109.7338 ohms (Table 4), while the resistance value of the PT1000 at 25ºC is 1097.338 ohms.

For values greater than 100R, round to 6 digits; for example: +25ºC = 109.7338 or 109.734

Table 4—PT100 Temperature/Resistance Table (contd)

°C	–0	–1	–2	–3	–4	–5	–6	–7	–8	–9
–200	18.4932									
–190	22.8031	22.3737	21.9439	21.5139	21.0834	20.6526	20.2215	19.7899	19.3580	18.9258
–180	27.0779	26.6520	26.2257	25.7990	25.3720	24.9447	24.5171	24.0891	23.6608	23.2321
–170	31.3200	30.8972	30.4741	30.0507	29.6270	29.2029	28.7786	28.3539	27.9289	27.5036
–160	35.5313	35.1115	34.6914	34.2710	33.8503	33.4294	33.0081	32.5865	32.1646	31.7425
–150	39.7137	39.2967	38.8794	38.4619	38.0440	37.6260	37.2076	36.7889	36.3700	35.9508
–140	43.8691	43.4547	43.0401	42.6252	42.2101	41.7946	41.3790	40.9631	40.5469	40.1304
–130	47.9993	47.5873	47.1752	46.7628	46.3501	45.9372	45.5241	45.1107	44.6971	44.2832
–120	52.1058	51.6962	51.2863	50.8762	50.4659	50.0554	49.6446	49.2336	48.8224	48.4109
–110	56.1903	55.7828	55.3751	54.9672	54.5591	54.1507	53.7422	53.3334	52.9244	52.5152
–100	60.2541	59.8486	59.4429	59.0371	58.6310	58.2247	57.8182	57.4115	57.0047	56.5976
–90	64.2987	63.8950	63.4912	63.0873	62.6831	62.2787	61.8742	61.4695	61.0645	60.6594
–80	68.3251	67.9233	67.5212	67.1190	66.7166	66.3141	65.9114	65.5084	65.1054	64.7021
–70	72.3346	71.9344	71.5340	71.1335	70.7328	70.3319	69.9309	69.5297	69.1284	68.7268
–60	76.3282	75.9296	75.5307	75.1318	74.7326	74.3334	73.9339	73.5343	73.1346	72.7347
–50	80.3068	79.9096	79.5123	79.1148	78.7171	78.3194	77.9214	77.5234	77.1251	76.7268
–40	84.2713	83.8754	83.4795	83.0834	82.6871	82.2908	81.8943	81.4976	81.1008	80.7039
–30	88.2222	87.8277	87.4331	87.0383	86.6434	86.2484	85.8532	85.4579	85.0625	84.6669
–20	92.1603	91.7671	91.3737	90.9802	90.5866	90.1929	89.7990	89.4050	89.0109	88.6166
–10	96.0861	95.6941	95.3019	94.9097	94.5173	94.1247	93.7321	93.3394	92.9465	92.5535
0	100.0000	99.6091	99.2182	98.8271	98.4359	98.0445	97.6531	97.2615	96.8698	96.4780
°C	**+0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+6**	**+7**	**+8**	**+9**
0	100.0000	100.3907	100.7814	101.1719	101.5623	101.9526	102.3427	102.7328	103.1227	103.5125
10	103.9022	104.2918	104.6813	105.0706	105.4599	105.8490	106.2380	106.6269	107.0156	107.4043
20	107.7928	108.1813	108.5696	108.9578	109.3458	109.7338	110.1216	110.5094	110.8970	111.2845
30	111.6718	112.0591	112.4463	112.8333	113.2202	113.6070	113.9937	114.3802	114.7667	115.1530
40	115.5392	115.9254	116.3113	116.6972	117.0830	117.4686	117.8541	118.2395	118.6248	119.0100
50	119.3951	119.7800	120.1648	120.5495	120.9341	121.3186	121.7030	122.0872	122.4713	122.8554
60	123.2392	123.6230	124.0067	124.3902	124.7737	125.1570	125.5402	125.9233	126.3063	126.6891
70	127.0718	127.4545	127.8370	128.2194	128.6016	128.9838	129.3658	129.7478	130.1296	130.5113
80	130.8928	131.2743	131.6556	132.0369	132.4180	132.7990	133.1799	133.5606	133.9413	134.3218
90	134.7022	135.0825	135.4627	135.8428	136.2227	136.6026	136.9823	137.3619	137.7414	138.1207
100	138.5000	138.8791	139.2582	139.6371	140.0159	140.3945	140.7731	141.1515	141.5299	141.9081
110	142.2862	142.6642	143.0420	143.4198	143.7974	144.1749	144.5523	144.9296	145.3068	145.6838
120	146.0608	146.4376	146.8143	147.1909	147.5673	147.9437	148.3199	148.6960	149.0721	149.4479
130	149.8237	150.1994	150.5749	150.9504	151.3257	151.7009	152.0759	152.4509	152.8257	153.2005
140	153.5751	153.9496	154.3240	154.6982	155.0724	155.4464	155.8203	156.1941	156.5678	156.9414
150	157.3149	157.6882	158.0614	158.4345	158.8075	159.1804	159.5531	159.9258	160.2983	160.6707
160	161.0430	161.4152	161.7872	162.1592	162.5310	162.9027	163.2743	163.6458	164.0172	164.3884
170	164.7596	165.1306	165.5015	165.8723	166.2429	166.6135	166.9839	167.3542	167.7245	168.0945
180	168.4645	168.8344	169.2041	169.5737	169.9432	170.3126	170.6819	171.0511	171.4201	171.7890
190	172.1579	172.5266	172.8951	173.2636	173.6319	174.0002	174.3683	174.7363	175.1042	175.4719
200	175.8396	176.2071	176.5746	176.9419	177.3090	177.6761	178.0431	178.4099	178.7766	179.1432
210	179.5097	179.8761	180.2424	180.6085	180.9745	181.3405	181.7063	182.0719	182.4375	182.8029
220	183.1683	183.5335	183.8986	184.2636	184.6284	184.9932	185.3578	185.7223	186.0867	186.4510
230	186.8152	187.1793	187.5432	187.9070	188.2707	188.6343	188.9978	189.3611	189.7244	190.0875
240	190.4505	190.8134	191.1762	191.5389	191.9014	192.2638	192.6262	192.9884	193.3504	193.7124
250	194.0743	194.4360	194.7976	195.1591	195.5205	195.8818	196.2429	196.6040	196.9649	197.3257
260	197.6864	198.0469	198.4074	198.7677	199.1280	199.4881	199.8481	200.2079	200.5677	200.9274

Table 4—PT100 Temperature/Resistance Table (contd)

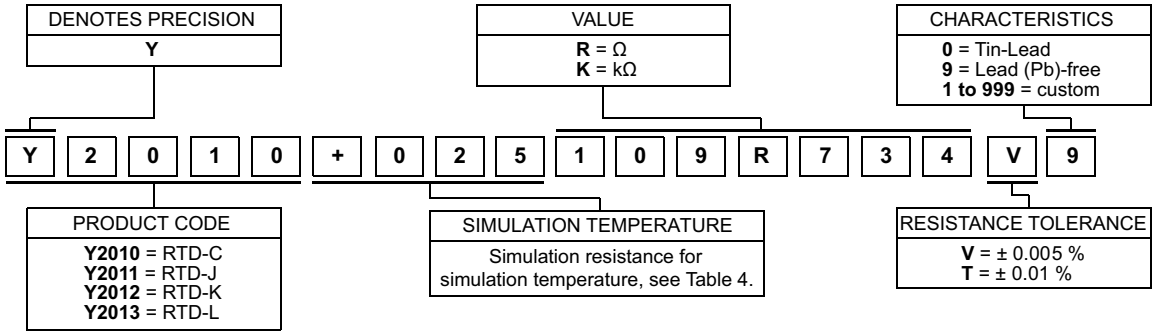
°C	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
270	201.2869	201.6463	202.0056	202.3648	202.7238	203.0828	203.4416	203.8003	204.1589	204.5174
280	204.8758	205.2340	205.5922	205.9502	206.3081	206.6659	207.0236	207.3811	207.7386	208.0959
290	208.4531	208.8102	209.1672	209.5240	209.8808	210.2374	210.5939	210.9503	211.3066	211.6628
300	212.0188	212.3747	212.7305	213.0862	213.4418	213.7973	214.1527	214.5079	214.8630	215.2180
310	215.5729	215.9277	216.2823	216.6369	216.9913	217.3456	217.6998	218.0539	218.4078	218.7617
320	219.1154	219.4690	219.8225	220.1759	220.5291	220.8823	221.2353	221.5882	221.9410	222.2937
330	222.6463	222.9987	223.3511	223.7033	224.0554	224.4074	224.7592	225.1110	225.4626	225.8142
340	226.1656	226.5169	226.8680	227.2191	227.5700	227.9209	228.2716	228.6222	228.9726	229.3230
350	229.6733	230.0234	230.3734	230.7233	231.0731	231.4227	231.7723	232.1217	232.4710	232.8202
360	233.1693	233.5183	233.8672	234.2159	234.5645	234.9130	235.2614	235.6097	235.9578	236.3059
370	236.6538	237.0016	237.3493	237.6969	238.0443	238.3917	238.7389	239.0860	239.4330	239.7799
380	240.1267	240.4733	240.8199	241.1663	241.5126	241.8588	242.2048	242.5508	242.8966	243.2423
390	243.5879	243.9334	244.2788	244.6241	244.9692	245.3142	245.6591	246.0039	246.3486	246.6932
400	247.0376	247.3819	247.7261	248.0702	248.4142	248.7581	249.1018	249.4455	249.7890	250.1324
410	250.4757	250.8188	251.1619	251.5048	251.8476	252.1903	252.5329	252.8754	253.2177	253.5600
420	253.9021	254.2441	254.5860	254.9278	255.2694	255.6110	255.9524	256.2937	256.6349	256.9760
430	257.3170	257.6578	257.9985	258.3392	258.6797	259.0200	259.3603	259.7005	260.0405	260.3804
440	260.7202	261.0599	261.3995	261.7389	262.0783	262.4175	262.7566	263.0956	263.4344	263.7732
450	264.1119	264.4504	264.7888	265.1271	265.4653	265.8033	266.1413	266.4791	266.8168	267.1544
460	267.4919	267.8293	268.1665	268.5036	268.8407	269.1776	269.5143	269.8510	270.1876	270.5240
470	270.8603	271.1965	271.5326	271.8686	272.2044	272.5402	272.8758	273.2113	273.5467	273.8820
480	274.2172	274.5522	274.8871	275.2219	275.5566	275.8912	276.2257	276.5600	276.8943	277.2284
490	277.5624	277.8963	278.2300	278.5637	278.8972	279.2306	279.5639	279.8971	280.2302	280.5632
500	280.8960	281.2287	281.5613	281.8938	282.2262	282.5585	282.8906	283.2226	283.5545	283.8863
510	284.2180	284.5496	284.8810	285.2124	285.5436	285.8747	286.2057	286.5365	286.8673	287.1979
520	287.5284	287.8588	288.1891	288.5193	288.8493	289.1793	289.5091	289.8388	290.1684	290.4979
530	290.8272	291.1565	291.4856	291.8146	292.1435	292.4723	292.8010	293.1295	293.4579	293.7862
540	294.1144	294.4425	294.7705	295.0983	295.4261	295.7537	296.0812	296.4086	296.7359	297.0630
550	297.3901	297.7170	298.0438	298.3705	298.6970	299.0235	299.3498	299.6761	300.0022	300.3282
560	300.6540	300.9798	301.3055	301.6310	301.9564	302.2817	302.6069	302.9319	303.2569	303.5817
570	303.9064	304.2310	304.5555	304.8799	305.2042	305.5283	305.8523	306.1762	306.5000	306.8237
580	307.1472	307.4707	307.7940	308.1172	308.4403	308.7633	309.0861	309.4089	309.7315	310.0540
590	310.3764	310.6987	311.0209	311.3429	311.6648	311.9867	312.3084	312.6299	312.9514	313.2728
600	313.5940	313.9151	314.2361	314.5570	314.8778	315.1984	315.5190	315.8394	316.1597	316.4799
610	316.8000	317.1199	317.4398	317.7595	318.0791	318.3986	318.7180	319.0373	319.3564	319.6754
620	319.9944	320.3132	320.6318	320.9504	321.2689	321.5872	321.9054	322.2235	322.5415	322.8594
630	323.1771	323.4948	323.8123	324.1297	324.4470	324.7642	325.0812	325.3982	325.7150	326.0317
640	326.3483	326.6648	326.9811	327.2974	327.6135	327.9295	328.2454	328.5612	328.8769	329.1924
650	329.5079	329.8232	330.1384	330.4535	330.7684	331.0833	331.3980	331.7126	332.0271	332.3415
660	332.6558	332.9700	333.2840	333.5979	333.9117	334.2254	334.5390	334.8525	335.1658	335.4790
670	335.7922	336.1052	336.4180	336.7308	337.0435	337.3560	337.6684	337.9807	338.2929	338.6050
680	338.9169	339.2287	339.5405	339.8521	340.1636	340.4749	340.7862	341.0973	341.4084	341.7193
690	342.0301	342.3407	342.6513	342.9617	343.2721	343.5823	343.8924	344.2024	344.5122	344.8220
700	345.1316	345.4411	345.7505	346.0598	346.3690	346.6780	346.9870	347.2958	347.6045	347.9131
710	348.2215	348.5299	348.8381	349.1463	349.4543	349.7622	350.0699	350.3776	350.6851	350.9926
720	351.2999	351.6071	351.9141	352.2211	352.5280	352.8347	353.1413	353.4478	353.7542	354.0605
730	354.3666	354.6726	354.9786	355.2844	355.5900	355.8956	356.2011	356.5064	356.8116	357.1167
740	357.4217	357.7266	358.0314	358.3360	358.6405	358.9449	359.2492	359.5534	359.8575	360.1614
750	360.4653	360.7690	361.0726	361.3760	361.6794	361.9827	362.2858	362.5888	362.8917	363.1945

Table 4—PT100 Temperature/Resistance Table

°C	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
760	3634972	3637997	3641022	3644045	3647067	3650088	3653107	3656126	3659143	3662160
770	3665175	3668189	3671202	3674213	3677224	3680233	3683241	3686248	3689254	3692258
780	3695262	3698264	3701265	3704265	3707264	3710262	3713258	3716254	3719248	3722241
790	3725233	3728224	3731213	3734202	3737189	3740175	3743160	3746144	3749126	3752108
800	3755088	3758067	3761045	3764022	3766998	3769972	3772945	3775917	3778888	3781858
810	3784827	3787794	3790761	3793726	3796690	3799653	3802615	3805575	3808535	3811493
820	3814450	3817406	3820361	3823314	3826267	3829218	3832168	3835117	3838065	3841011
830	3843957	3846901	3849844	3852786	3855727	3858667	3861605	3864543	3867479	3870414
840	3873348	3876280	3879212	3882142	3885072	3888000	3890926	3893852	3896777	3899700
850	3902623									

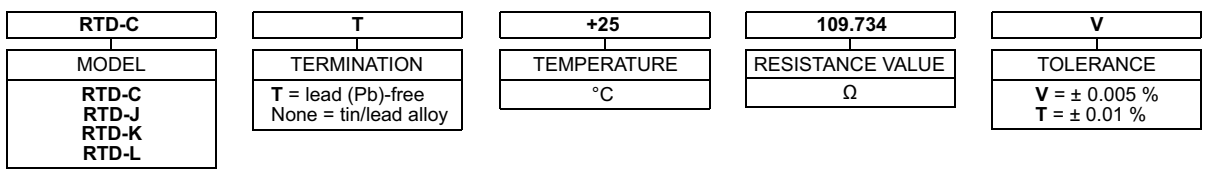
Table 5—Global Part Number Information [1]

GLOBAL PART NUMBER: Y2010+025109R734V9



TYPE: RTD-C
TEMPERATURE: +25ºC
VALUE: 109.734 Ω
ABSOLUTE TOLERANCE: ± 0.005 %
TERMINATION: lead (Pb)-free
PACKAGING: bulk pack (standard)

PART NUMBER: RTD-C T +25ºC 109.734 V



Note

(1) Resistors will be supplied per value specified on the order. Temperature listed is for reference only; customer's Resistance vs Temperature correlation not verified by VFR.

(2) For non-standard requests, please contact application engineering.

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