KOA SPEER ELECTRONICS, INC.

RoHS COMPLIANT

spec sheet

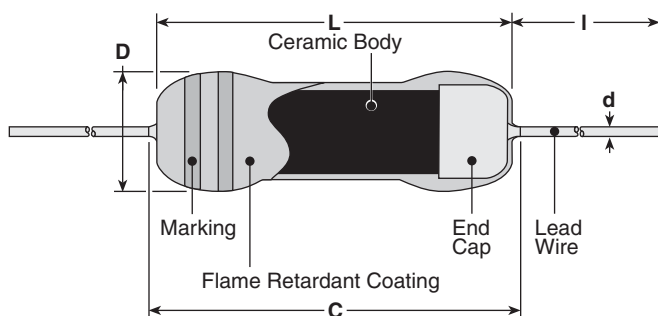SS-02 R6
AHA 6/20/07

ISO 9001:2000 CERTIFIED
TS-16949 CERTIFIED

Fixed Ceramic Composition Resistors
# Type PCF

1. Scope of Application

This specification relates to non-flammable coated, insulated type, fixed ceramic resistors (type PCF) manufactured by KOA T&T Corporation.

2. Dimension and Construction

Dimensions inches *(mm)*					
Type	**L**	**C (max.)**	**D**	**d (nom.)**	**I**
PCF1/2	.354±.039 *(9.0±1.0)*	.437 *(11.1)*	.138±.02 *(3.5±0.5)*	.028 *(0.7)*	1.18±.118 *(30.0±3.0)*
PCF1	0.65±.039 *(16.5±1.0)*	.748 *(19.0)*	.217±.039 *(5.5±1.0)*	.031 *(0.8)*	1.50±.118 *(38.0±3.0)*
PCF2	.748±.039 *(19.0±1.0)*	.886 *(22.5)*	.276±.039 *(7.0±1.0)*		
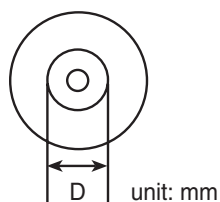
Type Designation	1/2	1	2
Allowable uncoated area of resistor end surface	1.5	2.2	2.9

3. Type Designation

The type designation shall be in the following form:

PCF	1/2	C	T631	R	102	K
Type	Power Rating	Termination Material	Taping	Packaging	Nominal Resistance	Tolerance
	1/2 1 2	C: SnCu (Other termination styles available, contact factory for options)	T631 T52	A: Ammo R: Reel	2 significant figures + 1 multiplier	K: ±10% M: ±20%

4. Applications and Ratings

Part Designation	Power Rating @ 70°C	Minimum Dielectric Withstanding Voltage	Resistance Range E-12	Resistance Tolerance	Absolute Maximum Working Voltage	Absolute Maximum Overload Voltage	Absolute Maximum Pulse Voltage*	Operating Temperature Range
PCF1/2	0.5W	500V	4.7Ω - 100KΩ	K: ±10% M: ±20%	200V	400V	10kV	-40°C to +200°C
PCF1	1.0W				300V	600V	14kV	
PCF2	2.0W	700V	3.3Ω - 390KΩ		400V	800V	20kV	

* Resistance to pulse: change shall be ±5% of the pre-test values. 1 sec. ON, 1 second OFF, 20,000 cycles.
  The voltage is applied with maximum pulse voltage.

5. Characteristics

No.	Requirement (MIL-STD 202)	Characteristics	Test Method
1	Resistance (Method 303)	Resistance to the nominal resistance should be in each resistance tolerance shown below. |	Resistance Tolerance
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K	± 10%
M	± 20%		In the event of a difference in resistance readings attributable to the test voltage used, the specified test voltage listed below shall be used. | Nominal Resistance Range	Recommended Test Voltages (DC Volts)
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3.3 to 9.1 ohms	0.3
10 to 91 ohms	1.0
100 to 910 ohms	3.0
1k to 9.1k ohms	3.0
10k to 91k ohms	3.0
100k to 1M ohms	3.0	
2	Temperature Coefficient (Method 304)	-1300 ± 300ppm/°C	Resistors shall be maintained within ± 1°C at the ambient temperatures listed below. The use of forced circulating air is recommended to assure temperature stability and uniformity. Resistance measurements shall be made at each temperature 15 minutes after air temperature has stabilized at the specified temperature. The percent difference in resistance referred to the resistance at +25°C shall be computed with the following formula: $$\text{Percent Resistance Difference} = \frac{(R-r)}{r} \times 100$$ Where: R is the resistance at test temperature r is the resistance at +25°C | Sequence	Ambient Temperature
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1	+25°C
2	-40°C
3	+25°C
4	+75°C
5	+125°C	
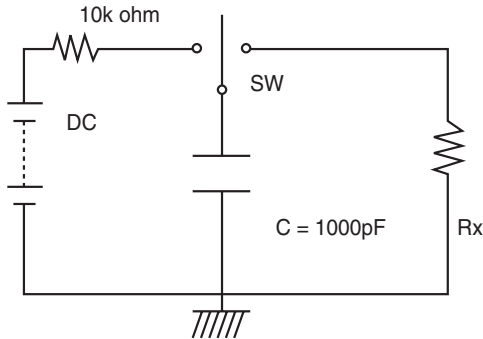
5. Characteristics (Continued)

No.	Requirement (MIL-STD 202)	Characteristics	Test Method
3	Voltage Coefficient from 1k ohms ~ (Method 309)	0 ~ -0.2%/V	The resistance shall be measured at one-tenth the RCWV and at full RCWV. Application of voltages shall be momentary to minimize heating effects. The resistance - voltage coefficient shall be calculated with the following formula: $$\text{Voltage Coefficient} = \frac{(R-r) \times 100}{r \times 0.9 \,(RCWV)}$$ Percent Per Volt Where: R is the resistance at full RCWV r is the resistance at one-tenth RCWV
4	Short Time Overload	Within ± (2% + 0.05 ohm)	A well regulated DC or sine wave RMS voltage 2.5 times the RCWV, but not exceeding the limit values listed in Table 1, shall be applied for 5 seconds. Resistance shall be measured before and approximately 30 minutes after the application of the test voltage.
5	Terminal Strength (Method 211)	Resistance change shall be ± (1% + 0.05 ohm) of the Pre-test value, with no terminal loosening, and lead-wire break-down developing.	(see table below)
6	Vibration (Method 201)	Resistance change shall be ± (2% + 0.05 ohm) of the Pre-test value, with no terminal loosening and lead-wire break-down developing.	Initial resistance shall be measured. The frequency shall be varied approximately logarithmically between the nominal limits of 10 to 55 Hertz with a return sweep to 10 Hertz shall be traversed in approximately 1 minute. This sweep cycle shall be performed repeatedly for 2 hours in each three directions to perpendicular. Final measurements and examination for mechanical failures shall be made after the test.
7	Resistance to soldering heat (Method 210)	Resistance change shall be ± (2% + 0.05 ohm) of the Pre-test value with no mechanical damage in appearance and marking.	Initial resistance shall be measured. Resistor leads shall then be immersed, one at a time for 3.5 ± 0.5 sec. each, in molten solder at +350°C ± 10°C to a distance of 2 - 2.5mm from the resistor body. Final resistance shall be measured 2 ± 1 hr. after the immersions.

Test Method table for No. 5:

Test Item	Lead wire (D) (mm)		Test Method
	Ø 0.6, 0.7	Ø 0.8	
Tensile Strength	10N (1.02kgf)	20N (2.04kgf)	30 ± 5 sec
Bending Strength	0.51kgf	———	5N (0.5kgf)
	———	1.02kgf	10N (1.02kgf)

5. Characteristics (Continued)

| 8	Solderability (Method 208)	Over 3/4th of the lead-wire surface area shall be covered with solder, when judged visually.	The lead-wire is immersed for 2 - 3 seconds in methanol solution containing rosin body is immersed in melted solder at temperature of 235 ±5°C for a period of 3 ± 0.5 sec. as far as the point 2 - 2.5mm from the resistor body.
9	Resistance to solvents	No evidence of mechanical damage in appearance and marking.	1. Sample shall be immersed in ultrasonic solvents of 28kHz frequency, 150w ($0.3w/cm^2$) power at 35 ± 5°C for 2 minutes. 2. After samples shall be immersed in specified solvents (following table) for 3 minutes, the resistor shall be immediately wiped with a dry cloth (velvet or gauze) 　　(Solvents) 1. Iso-proryle alcohol 2. 1-1-1 trichloroethane
10	Dielectric withstanding voltage (Method 301)	The resistor develops no dielectric breakdown. Resistance change shall be ± (1% + 0.05 ohm) of the Pre-test value.	The resistors shall be clamped in the trough of a 90°C metallic V-block of such size that the resistor body does not extend beyond the ends of the trough. The resistor leads shall be positioned such that they are no closer to the V-block than if they were parallel to the sides of the V-block. This prevents unnecessary proximity of the leads to the block, while permitting complete seating of the resistor body in the block. 　　Sine wave RMS voltages from an alternating current supply at commercial line frequency not more than 100 Hertz as specified in Table 1 shall be applied at the rate of approximately 100 volts per second between resistor terminals connected together and the V-block, and held for 5 seconds.
11	Flame-proof (UL-492-2)		The coating cab withstand the overload test, with no possibilities of ignition. 1. Overload Test as per UL-492, Item 13: A piece of cotton cloth (A piece of gauze untreated corresponding to Nos 32-28 that measures 36 inches in width and 14 - 15 yards per pound) is wound around a resistor. Then, the resistor is applied with voltage which is increased by two times, three times, . . . ten times the rated voltage at intervals of one minute till the resistor is broken down. If the cotton cloth is found igniting, the resistor shall be considered unacceptable. 　　The coating is completely proof against any kind of heat sources. Even if exposed to gas burner flames or heated red with nichrome wire wounded, the coating will not flame, nor soften and melt to drop. 2. Hot-wire Ignition Test as per UL-492-2, Item 9: A nichrome wire (Mixture of Cr 20% and Ni 80% which measures 0.0201 inches in diameter and 865 feet per pound, and having 1.61 ohm per foot) is wound a resistor at intervals of 1/4 inch so as to result in power consumption of 65W or more. Then, the resistor is heated red with electricity supplied to the nichrome wire.

5. Characteristics (Continued)

12	Resistance to pulse	Resistance change shall be ± 5% of the Pre-test value.	Test circuit is shown below. 1 sec. on and 1 sec. off 20,000 cycles. The voltage is applied with maximum pulse voltage shown in Table 1. 10k ohm SW DC C = 1000pF Rx
13	Low Temperature Operation	Resistance change shall be ± 5% of the Pre-test value.	Initial resistance shall be measured. The resistors shall then be exposed to the air stream at -40°C ± 3°C for 24 hours with no voltage applied, after which the resistors shall be placed at room temperature, final resistance shall be measured.
14	Thermal Shock (Method 107)	Resistance change shall be ± (2% ± 0.05 ohm) of the Pre-test value.	Initial resistance shall be measured. The resistors shall be subjected to the temperature cycle specified below for a total of five cycles, performed continuously. Temperatures in Steps 1 and 3 shall be maintained by forced air circulation. The hot and cold chambers shall be of such capacity that air temperature will reach the temperatures specified in Table 4 within 2 minutes after the resistors have been placed in the appropriate chamber. Final resistance shall be measured approximately one hour after completion of the fifth cycle.
15	Moisture Resistance	Resistance change shall be ± 5% of the Pre-test value.	Initial resistance shall be measured before the test. Resistors shall be exposed to a temperature of 40 ± 2°C and a relative humidity of 90 - 95%, for 1,000 hours. After removal from the chamber, the resistors shall be allowed to dry at room ambient for approximately one hour. Final resistance shall be measured.

Thermal Shock Test Sequence

Step	Temperature (°C)	Time (min.)
1	-40 ± 3	30
2	+25 ± 5	10 ~ 15
3	+85 ± 2	30
4	+25 ± 5	10 ~ 15

PAGE 5 OF 6

5. Characteristics (Continued)

16	Moisture Life (Method 103)	Resistance change shall be ± 5% of the Pre-test value.	Initial resistance shall be measured. Resistors shall be placed in a chamber at relative humidity of 90 - 95% at ambient temperature of 40 ± 2°C. Then DC RCWV shall be applied intermittently 1-1/2 hr. (on), 1/2 hr. (off) for a total of 1,000 hrs. After removal from the chamber, the resistors shall be allowed to dry at room ambient for approximately 1 hr. Final resistance shall be measured.
17	Operating Life (Method 108)	Resistance change shall be ± 5% of the Pre-test value.	Initial resistance shall be measured. Resistors shall be placed at ambient temperature of 70 ± 3°C. Then DC RCWV shall be applied intermittently 1-1/2 hr. (on), 1/2 hr. (off) for a total of 1,000 hrs. After return to room temperature, final resistance shall be measured.

5.1 Derating Curve

Under ambient temperature in excess of 70°C, the load shall be derated as shown in the figure below.
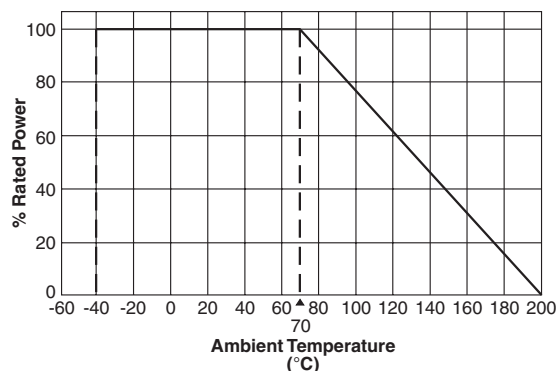
5.2 Rated Voltage

Resistors shall have a rated direct current (DC) continuous working voltage or an approximate sine wave rootmean square (rms) alternation-current (AC) continuous working voltage at commercial line frequency and wave form corresponding to the power rating, as determined from the following formula:

In no case shall the rated DC or rms AC continuous working voltage be greater than the applicable maximum value.

Where, $E = \sqrt{P \times R}$
E = Rated DC or rms AC
    continuous working voltage (V)
P = Power rating (W)
R = Nominal resistance (OHM)

6. Marking

The resistors shall be marked with color codes as per EIA-172.