This specification is intended to be utilized in conjunction with Series PCN data sheet.

RESISTOR SPECIFICATION

RCD Series PCN
Power Composition Resistors

RESISTORS • CAPACITORS • COILS • DELAY LINES

RCD Components Inc. 520 E.Industrial Pk Dr, Manchester, NH, USA 03109
Tel:603-669-0054 Fax:603-669-5455

Disclaimers:

1. It is recommended to evaluate product in actual use conditions to ensure that the proper component is selected for use.
2. Specifications are subject to change without notice. Information is offered solely for user consideration and verification, and is not, in part or total, to be construed as constituting a warranty or representation for which RCD Components Inc., or its officers and employees, assume legal responsibility.
3. All orders are subject to RCD's Terms and Conditions per form GF061.

RCD Series PCN Power Composition Resistors

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Note: Performance ratings apply to standard Series PCN resistors, unless indicated otherwise. Consult factory for performance ratings of parts with options or are custom-designed to meet specialty requirements.

For additional information not presented in this report, request following Application Guides…

Forced Air Convection Across Power Resistors (Engineering Report #R-33)
Power Derating Factors for Grouping Resistors (Engineering Report #R-36)

1.0 SERIES PCN PRODUCT HISTORY

RCD's composition resistors were developed in the late 1970's primarily to achieve high surge and overload capability in sizes significantly smaller than conventional wirewound power resistors. The PCN Series have been constantly improved and expanded over the years to achieve greater performance levels, as well as a wider range of resistance values and design options.

2.0 PRODUCT DESCRIPTION

Designed for low through high-power applications (1/4W – 400W), the units are available with a wide range of custom options including special coating for oil immersion, non-standard values, military screening, etc. Refer to data sheet for list of options, dimensions, etc.

3.0 DESIGN FEATURES

- Bulk composition resistance element withstands surge energy levels and voltages unmatched by wirewound and film technologies
- Design objectives are achieved via use of high density- conductive ceramic and carbon powder and special binder
- Wide choice of packaging options (axial-lead, molded rectangular surface mount, various lead forming options (including ZZ surface mount style), ferrule clip mount, etc.)
- Excellent high-frequency performance due to non-inductive construction
- Flameproof construction available

4.0 CONSTRUCTION AND MANUFACTURING PROCESS

The design and construction of the PCN Series results in excellent performance and reliability. Resistance elements are manufactured from a custom-tailored blend of materials (typically clays, alumina, carbon, metal oxide, binder) depending on the resistance value, surge capability, operating environment, etc. The elements are extruded or molded to size. Terminations are typically sprayed over the ends of rods and tubes, or pinned/capped with axial leads or surface mount terminals. Parts are available with insulation overcoat. Parts are marked with resistance value and tolerance as a minimum (custom marking is available).

5.0 QUALITY CONTROL

As part of RCD's ABZED program (Absolute Zero Defects), key stages of production are monitored to ensure optimum performance and workmanship, and the Final outgoing inspection ensures compliance to dimensional and electrical requirements. A wide range of military screening tests are available as an option for higher reliability applications.

6.0 TEMPERATURE RISE

Power resistors are designed to run hot when subjected to full rated power levels. The estimated temperature rise in air is roughly 2°C per percent of rated power (utilizing the parts at 50% of rated power equates to a temperature rise of approximately 100°C). The temperature rise of low power PCN resistors, particularly smaller models (PCN1/4M through PCN2S), depends largely on heat conduction through the leads or end terminations, which can vary significantly depending on PCB material and layout (i.e. pad size, trace area, copper thickness, air flow, etc.). The estimated temperature rise on these small sizes is roughly 1°C per percent of rated power. The resistors will generally exhibit lower temperature rise when utilized in oil medium, typically 25-50% lower depending on volume and flow rate. It is recommended to evaluate product in actual use conditions to ensure that the optimum component is selected.

7.0 ELECTRICAL, ENVIRONMENTAL, AND MECHANICAL PERFORMANCE

7.1 Terminal Strength (PCN1S – PCN5: terminations shall not break when tested per MIL-STD-202 Method 211, pull test. Direct load shall be 5 lbs.

7.2 Solderability (PCN1/4M – PCN5): When resistors are tested per ANSI-J-STD-002 Cat.1, the dipped surface of the lead shall be at least 95% covered with new solder coating. On resistors with standoffs, the portion of the lead below the standoff shall meet 95% solderability requirements.

7.3 Solvent Resistance:
The parts are resistant to alcohol and aqueous based cleaners. Care should be taken to quickly and thoroughly dry parts after washing.

Do not brush with hard bristles or use jet spray immediately after soaking. The specialty option HC coating is recommended for most oil and harsh solvent applications.

7.4 DC Resistance Measurement:

7.4.1 The temperature at which the dc resistance measurement is made will affect the final value of resistance. In addition, resistance values may vary with the measuring voltage.

7.4.2 DC resistance shall be measured with a resistance bridge or other suitable test equipment. The limit of error in the bridge or other test equipment shall not exceed one-hundredth of the specified tolerance on the measured resistance (for example, the limit of error in the bridge or other test equipment shall not exceed ± 0.05 percent, unless otherwise specified. The test current through the specimen shall be as small as practical considering the sensitivity of the indicating instruments. High resistance values (>100Kohm should be tested at suitably high voltage levels (100V DC). When it is important that the temperature of the specimen shall not rise appreciably during the measurement, the test voltage shall be applied uninterruptedly for as short a time as practicable, but in no case for more than 5 seconds, unless otherwise specified.

7.4.3 Unless otherwise specified, the measurement shall be made at a temperature of 20-25°C. In the case of measurement dispute, dc resistance measurements shall be made at 25°C and the parts pre-conditioned in dry air at 100°C for 120 hours to eliminate any inaccuracy due to moisture absorption.

7.4.4 Examples of suitable test equipment for resistors in use by RCD is ESI 242D Resistance Measurement System or ESI 263 Precision DC Resistance Bridge, utilizing 4-terminal gold plated test clips. Equipment calibration to be traceable to NIST standards.

7.5 Temperature Coefficient: Typical TCR for Series PCN is 300 to 1500ppm/°C (generally NTC). TC is typically measured at 25°C and 100°C but can be measured at customer-specified temperatures with prior arrangement.

7.6 Overload & Pulse Capability

a) Short Time Overload: PCN resistors are capable of overloads up to 10 times rated power for 5 seconds (not to exceed 2.5 x maximum voltage rating). Small sizes (PCN1/4M – PCN2S) are rated 3 times rated power for 5 seconds (not to exceed 2.5 x maximum voltage rating). Increased overloads are available on custom basis (consult factory).

b) Pulse Capability: Pulse capability is dependent on a variety of factors including size, construction (hollow vs solid), resistance value, waveform, repetition rate, environmental conditions, etc. RCD's PCN Series offer excellent pulse capability, and it is recommended that all pulse-applications be reviewed with RCD's engineering department to ensure optimum selection. Peak pulse and joule energy levels are given on data sheet as a general comparison guideline and starting point. Increase voltage and energy levels are available on a customized basis.

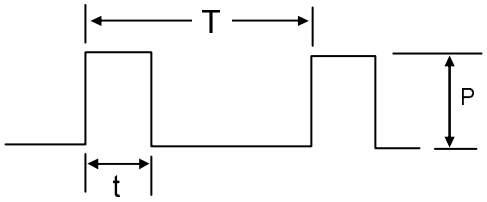
a) Pulse must not exceed peak rated voltage and energy levels

b) If ambient temperature exceeds 40ºC (or 20ºC on PCN1/4M through PCN2S), derate peak wattage/voltage/energy levels by .526%/ºC (.952%/ºC on PCN1/4M through PCN2S), and

c) Derate Pulse Capability for High Altitudes and Humidity: power capability is affected by altitude. Operation at high altitudes can also result in corona and arcing, especially in high humidity environments. Peak pulse voltage, power and energy ratings are to be derated 10% per 10,000 feet. RCD has not established a derating factor for high humidity, however offers specialty designs for products utilized in harsh environments such as tropical or naval.

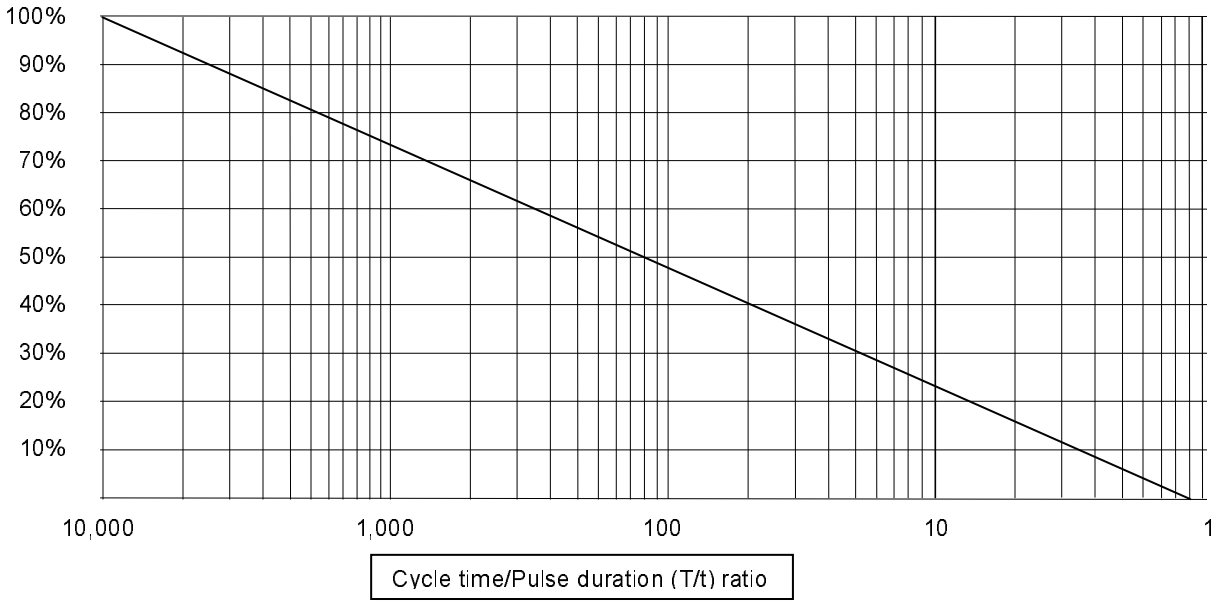
d) Resistors subjected to multiple pulses or repetitive pulse streams must meet the criteria for a single pulse, and the average power must not exceed the published wattage rating.

Average Power = Pt/T
P= Peak Power (Watts)
t= Pulse duration (Seconds)
T= Cycle Time



Example: Peak Power (P)= 1000W, pulse duration (t) = 10uS, cycle time = 60Hz (.01667S)... 1000W x .00001S / .01667S = .6 Watts average power.

e) The single pulse rating is based on Cycle time/Pulse duration (T/t) ratio of 10,000 or greater. For smaller T/t ratios, derate pulse capability according to following chart. Complete RCD's "Surge Questionnaire Form" if standard or Opt.P (Pulse Tolerant) construction won't suffice so that we can recommend the optimum resistor for your application. Always verify selection by evaluating prototypes under worst-case conditions.



For improved performance and reliability, a 30% pulse derating factor is recommended (50% if parts are subjected to multiple pulses).. Always verify selection by evaluating prototypes under worst-case conditions.

7.7 Voltage Rating and Voltage Coefficient:

a. Maximum Voltage Rating: PCN Series resistors have a DC or AC_{PEAK} voltage rating equivalent to $(PxR)^{1/2}$, not to exceed maximum voltage levels listed on data sheet. Increased voltage levels are available.

b. Voltage Coefficient: The voltage coefficient (amount that the resistance value temporarily changes with applied voltage) varies inversely to body size, i.e. larger parts generally have lower VC. VC is measured at 10% rated voltage and 100% rated voltage. Typical VC is .0025% to .03%/V. .

7.8 Oil Immersion and Forced Air Characteristics: Series PCN with option HC are capable of operation in both air and oil environments (all commonly-used oils). These parts are typically given a proprietary insulation to ensure protection. Series PCN30S, 50S, 75S, 100S, 150S, and 400S Option HC solid rods are prepared for oil immersion via specialty oil impregnation. These parts are designed solely for use in oil mediums, not both air and oil like other PCN models. If utilized in air, these parts (PCN30SHC – PCN400SHC) will smoke and emit a residue. The voltage rating in oil is same as in air but the power rating , especially in a large volume of well stirred oil can often be increased 50% to 100% or more. Ditto forced air convection.

7.9 Moisture Resistance: When tested at 90%-100% relative humidity for 240 hours, the resistance shift shall not exceed 10% + .005 ohm. Low values exhibit less change due to humidity (typically 5% or less). The effect of moisture absorption may be eliminated via preconditioning (see 7.4.3)

7.10 Load Life: Series PCN resistors have an indefinite life expectancy, i.e. there is no expected "burn-out" period when used within published guidelines. Stability level is typically within 5% to 10% when subjected to full rated power at room ambient (cycled 1½ hours on, ½ hour off) for 1000 hours. Tightened stability levels are available via extra preconditioning.

7.11 Vibration: Under harsh conditions of shock or vibration, all leaded resistors should be mounted so that the body is restrained from movement, as specified by Mil-PRF-39007 par.6.5. If clamps are utilized to hold the resistor body in place, the performance of the resistor could be enhanced or retarded depending on the thermal conductivity of the material. Under normal vibration conditions, all sizes may be supported by their leads only. For improved vibration resistance, keep lead lengths as short as practical. When subjected to Vibration per MIL-STD-202 Method 201 (6 hours), the resistance value shall not shift more than 2% +.005Ω (resistors shall be mounted per Mil-R-26 par 4.6.15 (A). Specialty design is available for high vibration applications.

7.12 Dielectric Withstanding Voltage (PCN1/4M through PCN2S): When tested per MIL-STD-202 M.311 using V-block mounting, there shall be no evidence of flashover, mechanical damage, arcing, or insulation breakdown. Dielectric rating is 500VAC for 60 seconds (increased voltage levels available). Standard PCN2 through 400S are not insulated (conformal coated design available).

7.13 Insulation Resistance: Insulation resistance shall be 10 MegΩ Minimum when tested per method 302 of MIL-STD-202 test condition A, and prepared per MIL-R-26 Par.4.6.8.1(A) and 4.6.8.1(G)

7.14 Noise: Noise levels have not been characterized but can be tested on an item by item basis. Noise levels in composition resistors are inherently higher than wirewound and most film resistors and therefore should not be utilized in noise-sensitive applications. For those applications, RCD offers high energy non-inductive specialty wirewound resistors.

7.15 Operating Temperature Range: **PCN1/4M through PCN2S** -55°C to +125°C **PCN2 through PCN400S** -55°C to +230°C, (ratings up to 350°C available)

7.16 Power/ Voltage/ Energy Derating:
PCN1/4M through PCN2S: Derate 0.952%/°C when ambient temperature exceeds 20°C (to zero at 125°C).
PCN2 through PCN400S: Derate 0.526%/°C when ambient temperature exceeds 40°C (to zero at 230°C).

7.17 Flame Retardancy: Series PCN2 through PCN400S are flame retardant in accordance with UL94-V0 (not applicable to Option HC). Other models meet UL-94V1.

7.18 Shelf Life: Typical shelf life stability is 0.2% $\triangle R$/year

7.19 Inductance: The inductance of RCD's PCN Series is extremely low (generally in nH range) due to "bulk" nature of the composition without windings or spiral turns. The resistors are considered "non-inductive" and are typically useable up into the MHz range (values <10Kohm).

8.0 General Notes:

1. Smoke may be emitted from resistors on initial use in powered circuits, especially when utilized at or near the full power level
2. Organic solvents are not recommend for cleaning the resistors.
3. Series PCN will crack or chip if not handled carefully. Be careful to avoid nicking the resistor with screw driver or other pointed objects.
4. Standard products are not recommended for use in oil (specify option 'HC').
5. Series PCN are non-inductive and may be used at high frequencies. The maximum operating frequencies haven't been fully characterized (contact factory for assistance). .
6. Evaluate prototypes under worst case conditions to ensure proper performance
7. Do not exceed the recommended usable load. Resistors must used within the rated voltage range to prevent the shortening of service life and/or failure of the resistance elements
8. Avoid touching resistors in operation; the surface temperature ranges from approximately 125°C to 230°C when utilized at the full rated value. Maintaining a surface temperature to 50% of rated maximum will extend resistor service life.
9. Keep temperature from rising by choosing a resistor with a higher rated capacity; do not use a component having the exact load value required. For considerations of safety in extended period applications, the resistor rating should be at least two, and preferably more than four times higher than the actual wattage involved.
10. Avoid utilization in damp dusty areas because the accumulation can cause shorts under high voltage conditions.

9. TYPICAL APPLICATIONS

Dummy Loads
X-Ray Equipment
Impulse Generators
Overvoltage protection
Induction Heaters
High voltage/High In-Rush Current Circuits
System Earthing/Grounding
Dynamic Braking
Radar
Snubber Circuits
RF amplifiers

10. RoHS Compliance
Specify "W" at end of P/N for RoHS compliant construction