



Components and Distribution

Passive Components for Critical-Use Applications

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It is often taken for granted that Military Specification “Mil-Spec” passive components are the best choice for critical-use applications due to the special testing that each piece is subjected to. But are all Mil-spec components the same? Do all military specifications ensure highest reliability levels, or at least “high” reliability? And what if there isn’t a Mil-specification that covers the particular component characteristics that are needed?

By specifying Mil-spec part numbers, some design engineers mistakenly assume that they will be assured of the highest degree of uniformity and reliability. In practice, however, there is a great deal more involved than simply specifying a military part. In some cases, improved performance and reliability levels can actually be achieved by not specifying a military p/n.

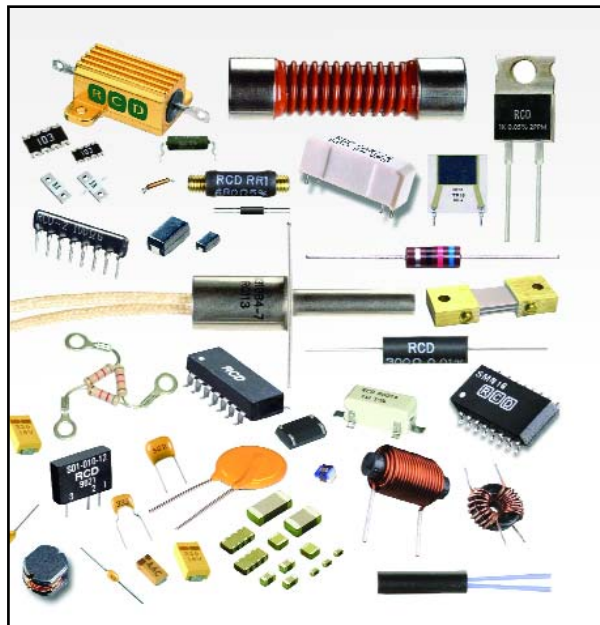
What exactly is a “Mil-spec” component? One would think this to be a rather straightforward definition, but because of the variety of Military standards, some component users have a different understanding than others. When combined with a rather loose interpretation by some, there can be quite a bit of confusion. One of the sources of confusion relates to a

product being a “true” Mil-spec item vs. a Mil-grade or Mil-equivalent item. Unfortunately, the terms “Mil-grade” and “Mil-equivalent” are used rather carelessly and can mean vastly different things to different people. In some cases, these terms are used to indicate items that are identical to the true Mil-spec version in every

way (often even built on the same production lines) except without the requisite Mil-spec testing and/or marking and/or traceability. Others tend to use the terms rather loosely indicating a commercial part that “generally” meets the key criteria of the Mil-spec item.

For instance many commercial buyers make reference to military p/n RN55 when in need of 1/4W 100PPM 1 percent metal film resistors — a common and highly standardized component. But in actuality, very few actually need a true RN55, or even a true equivalent, opting instead for the garden variety — and much lower priced — commercial counterpart.

Some of the differences involve color band marking instead of alphanumeric printing, shorter lead wires, RoHS



RCD's standard and custom passive components are now available with up-screening for critical-use applications.

tin plating instead of tin-lead plating, and limited inspection/screening.

True Mil-Spec Products

By comparison, a “true Mil-spec” product has been thoroughly tested and approved, such as those items formally listed on the Defense Department QPL (Qualified Product Listing). In order to maintain approval, these products generally require extensive monthly/quarterly/annual screening and life testing, a rather costly proposition and one of the main reasons that the number of manufacturers of Mil-approved items has greatly dwindled over the past two decades. The Mil specs governing passive components fall into three categories:

- Military standards (MIL-STD) detail the processes and materials to be used to make or test the product.
- Military handbooks (MIL-HDBK) are primarily sources of compiled information and guidance related to the operation of the product.
- Military specifications describe the physical and operational characteristics of a product, and are comprised of a wide range of Performance specifications (MIL-PRF), Detail specifications (MIL-DTL), and Defense drawings (DSCC). All of the terms are often used interchangeably, and frequently referred to simply as “Mil-specs”.

Military Performance specifications are further characterized according to reliability level:

- “C”: non-established reliability.
- “M”: established reliability at 1 percent/1000hr failure rate.
- “P”: established reliability at 0.1 percent/1000hr failure rate.
- “R”: established reliability at 0.01 percent/1000hr failure rate.
- “S”: established reliability at 0.001 percent/1000hr failure rate.
- “T”: space-level reliability.

In addition to conventional Military standards, the U.S. Government’s Defense Supply Center has also published a range of CIDs (Commercial Item Description). A CID describes a commercial product that will satisfy the form/fit/function requirements of various — generally less demanding — applications. Agencies are being pressed to avoid government-unique requirements by the DoD and as a result contractors are being encouraged to use commercially available products that have a CID instead of traditional Mil-spec items whenever feasible. Another approach is to use COTS (Commercial Off-The-Shelf) components. Initially, the push was to use standard, low cost commercial components, but over a period of time, COTS has come to represent a component that bridges the commercial vs. Mil-spec gap, i.e. commercial parts with ruggedized designs and/or special testing to achieve enhanced reliability.

RCD has been producing commercial and military passive components for nearly 40 years, offering the entire gamut of passive components, from commercial CIDs and COTS, right up to ultra-high reliability Space-level components. The company specializes in passive components that often go a step or two beyond the established Mil-spec requirements for

critical use applications. Critical-use applications are typically those that dictate the highest level of reliability, as is the case in many military, aerospace, nuclear, and medical applications. Depending on the product, RCD not only manufactures and tests in accordance with the applicable Mil-specs, but often provides a much wider range of values, tolerances, and options.

For example, if the Mil-spec of a particular resistor only covers the range of 0.1 ohm to 1000 ohm, or a tolerance of 1 percent to 5 percent, then users are unable to source formally qualified parts below 0.1 ohm, above 1Kohm, and tolerances tighter than 1 percent. The solution in such cases is to buy RCD’s Mil-spec equivalent, a far better choice than settling for less reliable or unproven components. Likewise, if an application needs specialty performance characteristics, such as high vibration, high surge energy,

cryogenic temperature, microwave frequency, etc., RCD can supply customized components with the full gamut of Mil-spec screening.

Tin-Whisker Problem

Tin whiskers are electrically conductive filaments that sometimes grow from surfaces where tin — especially bright electroplated tin — is used as a final finish. Tin whiskers have been observed to grow to lengths of several millimeters or longer. Electronic system failures have been attributed to short circuits caused by tin whiskers that bridge closely-spaced circuitry. For example, tin whiskers have been suspected as the cause of the failure of the Galaxy IV satellite in 1998, as well as failed relays in nuclear power facilities, intermittent pacemaker operation, etc. As electronic components get smaller, whiskers become an even larger concern. The primary solution has been to use tin-lead solder, but now that lead has been widely eliminated as part of the RoHS initiative, there is a major problem sourcing lead-bearing components.

Some manufacturers continue to offer a tin-lead option, but most have discontinued it on some or all products. RCD continues to support its customers with tin-lead products. In fact, all of the company’s critical-use products are available in whisker-free Tin-Lead (Sn-Pb) termination finish.

RCD’s broad offering of COTS and critical-use products are an extension of its knowledge and experience with high reliability products. The program has been expanded recently and is now available on nearly the company’s full line of resistors, capacitors, inductors and delay lines. Products are targeted to a wide range of critical-use applications including avionics systems, industrial embedded systems, test and ground support equipment, satellite systems, medical instrumentation, etc. In addition, RCD supplies a full range of “up-screened” components. These are typically commercial products that are “up-screened” in conjunction with customer or military requirements. RCD reviews the needs of the customer to determine the type and degree of testing that will ensure a reduced reliability risk, generally without involving the long term testing required by the military specifications. Since RCD tailors the test/screening program to the application, it can enable reduced costs to the user by eliminating

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excessive testing and also by eliminating the need for customer SCD's (Source Control Drawings).

RCD offers a variety of screening and pre-conditioning options designed to improve reliability and stabilize components for critical-use applications. In many cases, the performance and reliability exceeds that of Mil-spec items by employing a far more stringent level of stress screening. The company's test programs include: burn-in; humidity/moisture resistance; life testing; noise/distortion; temperature coefficient; pulse/ overload capability; shock and vibration dielectric strength; insulation resistance; solvent resistance; solderability; temp. cycling/ thermal shock; and X-ray analysis.

Passive Component Availability

RCD's unique position and four decades of experience can often achieve the most challenging design requirements while offering significant cost savings. The products supplied by RCD critical applications include the following, most of which are available on the exclusive SWIFT™ program — manufactured within one week:

Resistors

- Ultra-precision film/foil/WW resistors to 0.001 percent.
- Wirewound/film/composition resistors to 1300W.
- Power resistors to 30kilojoules, 300kV, 10kW.
- Thick and thin film chip resistors, networks, hybrids, IPCs.
- Shunts and current sensors to 15kA.
- Non-magnetic devices for MRI and other medical applications.
- Specialty models — fusible, surgeproof, microwave, temperature-sensitive, cryogenic, waterproof, high vibration.

Capacitors

- MLCC chips from 0201 to 3035, 0.47pF to 100μF.
- Axial and radial-lead Ceragold™ ceramic construction.
- COG (NPO), X5R, X7R, Z5U and Y5V.
- Tantalum chip Tangold™caps, 0.1μF to 470μF
- Radial-lead tantalum, 0.047μF to 680μF.
- Specialty models — low ESR, high-frequency, high-voltage (30kV).
- Precision tolerances to ±1%, matching to 0.1%.
- Arrays, networks, hybrids, IPCs.
- Non-magnetic devices for MRI and other medical applications.

Magnetics & Delay Lines

- Shielded & non-shielded inductors/coils.
- Active/passive/programmable delay lines.
- Air coils.
- Toroids.
- Spark coil transformers.
- Wide band chokes.
- Variable coils.
- Pot core assemblies.
- Pulse and miniature transformers.
- Trigger and telecom transformers.
- Mutually coupled inductors.
- Specialty models — (high voltage, high frequency, high temperature, fusible, surgeproof, cryogenic, waterproof, high vibration)

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