

High-Reliability Power Transistors

Power transistors classified as high-reliability types have come to be primarily associated with military and aerospace applications. In many ways, this association is misleading because the commercial equipment market is probably the largest user of high-reliability products, but not necessarily by that label. Military and aerospace agencies, however, have been largely responsible for establishment of comprehensive published reliability specifications and standards which have been accepted by the solid-state industry. MIL standards dominate the procedures used to specify high-reliability solid-state devices and represent a common reference point frequently used by commercial users to define their requirements.

Military and aerospace requirements for high-reliability solid-state devices are extremely large and diverse, not only in terms of performance, operating conditions, and reliability, but also in terms of logistics and procurement. As a result of these requirements, the military services have jointly developed specifications and standards under which most military end-use solid-state devices are procured. To simplify procurement, logistics, and the development of reliability data, MIL specs are not issued for the full spectrum of devices manufactured; rather, they are restricted to those devices for which significant need is demonstrated and are specified so that the device can have as wide applicability as possible. Although the limits for operating conditions may exceed those required for some applications, they simplify procurement and assure a supply of devices for the majority of military equipment.

SPECIFICATIONS AND STANDARDS

There are two major military specifications used for the procurement of standard solid-state devices by the military. These specifications are MIL-S-19500, which covers

devices such as discrete transistors, thyristors, and diodes, and MIL-M-38510, which covers microcircuits, both hybrid and monolithic.

MIL-S-19500 is the specification for the familiar "JAN" devices. Detailed electrical specifications are prepared as needed by the three military services and coordinated by the Defense Electronic Supply Center. At present, approximately six hundred detailed electrical specifications are included in the MIL-S-19500 system.

JAN AND JANTX POWER TRANSISTORS

Table XXX shows the wide product line of JAN and JANTX military-specification solid-state power transistors available from RCA for high-reliability applications in military, aerospace, and critical industrial usage. These power transistors are processed in accordance with the MIL-S-19500 general specifications. MIL-STD-750 test methods are used as required by the individual military detail specification. This table lists the individual MIL-S-19500 specification number for each family of devices.

Four levels of product assurance requirements, JAN, JANTX, JANTXV, and JANS are defined in Military Specification MIL-S-19500. Devices designated as JAN types receive electrical testing only. JANTX devices receive 100 percent screening such as bake, temperature cycling, acceleration, hermetic seal, high-temperature reverse bias, and power burn-in. JANTXV types receive JANTX testing but with critical visual inspection prior to sealing the package. JANS level types receive JANTXV testing plus manufacturing certification, process controls and wafer lot acceptance with electrical testing using larger sample sizes with tighter acceptance criteria.

The Defense Electronics Supply Center (DESC) maintains a Qualified Products List

(QPL-19500) of all device types and the manufacturers qualified to supply these devices in accordance with MIL-S-19500. This list is updated periodically and is available to designers and manufacturers of military equipment.

DESC military standard MIL-STD-701 of standard semiconductor devices lists the preferred JANTXV, JANTX, and JAN types for military equipment designers and manufacturers.

NASA military standard MIL-STD-975 of standard semiconductor devices lists the preferred JANS and JANTXV types for flight and mission-essential ground-support equipment.

MIL-STD-750 is the military standard specification of test methods for discrete solid state devices.

RCA NON-JAN TYPE POWER TRANSISTORS

Many power transistors are not covered by military specifications, either because they are too new or are not used in sufficient quantities. Many of these devices offer the most recent technological advances or have special performance characteristics which offer advantages to the designer of high-reliability equipment. RCA cooperates with the users of such devices in establishment of high-reliability specifications patterned after MIL standards, which allow these designs to be approved for use in military and aerospace systems, as well as commercial equipment. If the use warrants, these specifications may be submitted by RCA, or the user, to the cognizant military specification agency as candidates for MIL approval as a standard type.

Table XXX - RCA JAN and JANTX Solid-State Power Devices

Parent Type	Military Specification Type	MIL-S-19500/* Specification
POWER TRANSISTORS		
Hometaxial-Base Types		
2N1479	JAN2N1479	207
2N1480	JAN2N1480	207
2N1481	JAN2N1481	207
2N1482	JAN2N1482	207
2N1487	JAN2N1487	208
2N1488	JAN2N1488	208
2N1489	JAN2N1489	208
2N1490	JAN2N1490	208
2N3055	JAN2N3055, JANTX2N3055	407
2N3441	JAN2N3441, JANTX2N3441	369
2N3442	JAN2N3442, JANTX2N3442	370
2N3771	JAN2N3771, JANTX2N3771	413
2N3772	JAN2N3772, JANTX2N3772	413
Epitaxial-Base Types		
2N5302	JAN2N5302, JANTX2N5302	456
2N5303	JAN2N5303, JANTX2N5303	456
High-Current Darlington Types		
2N6283	JAN2N6283, JANTX2N6283	504
2N6284	JAN2N6284, JANTX2N6284	504
2N6383	JAN2N6383, JANTX2N6383	523
2N6384	JAN2N6384, JANTX2N6384	523
2N6385	JAN2N6385, JANTX2N6385	523
2N6648	JAN2N6648, JANTX2N6648	527
2N6649	JAN2N6649, JANTX2N6649	527
2N6650	JAN2N6650, JANTX2N6650	527

Table XXX (Cont'd)

Parent Type	Military Specification Type	MIL-S-19500/* Specification
POWER TRANSISTORS		
High-Voltage Types		
2N3439	JAN2N3439, JANTX2N3439	368
2N3440	JAN2N3440, JANTX2N3440	368
2N3584	JAN2N3584, JANTX2N3584	384
2N3585	JAN2N3585, JANTX2N3585	384
2N5415S	JAN2N5415S, JANTX2N5415S	485
2N5416S	JAN2N5416S, JANTX2N5416S	485
2N6211	JAN2N6211, JANTX2N6211	461
2N6212	JAN2N6212, JANTX2N6212	461
2N6213	JAN2N6213, JANTX2N6213	461
2N6306	JAN2N6306, JANTX2N6306	498
2N6308	JAN2N6308, JANTX2N6308	498
2N6546	JAN2N6546, JANTX2N6546	525
2N6671	JAN2N6671, JANTX2N6671	536
2N6673	JAN2N6673, JANTX2N6673	536
2N6674	JAN2N6674, JANTX2N6674	537
2N6675	JAN2N6675, JANTX2N6675	537
2N6676	JAN2N6676, JANTX2N6676	538
2N6678	JAN2N6678, JANTX2N6678	538
High-Speed Types		
2N3879	JAN2N3879, JANTX2N3879	526
2N5038	JAN2N5038, JANTX2N5038	439
2N5039	JAN2N5039, JANTX2N5039	439
2N5671	JAN2N5671, JANTX2N5671	488
2N5672	JAN2N5672, JANTX2N5672	488
2N6032	JAN2N6032, JANTX2N6032	528
2N6033	JAN2N6033, JANTX2N6033	528

*MIL-S-19500 specifications can be obtained from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pa. 19120.

Most procurements of solid-state devices for military systems are made by the equipment contractor from the MIL-STD parts list as awards are received for electronic equipment. Some military and aerospace programs, because of their size, duration, or special requirements (Minuteman and Apollo are two examples), require that special specifications and process methods, or even special production lines, be established and tailored to the particular functional, reliability, and

economic needs of the program. RCA Solid State Division has frequently used the resources of its laboratories, production facilities, and expert technical staff to contribute to the success of such programs.

All RCA high-reliability solid-state power devices are processed in accordance with the provisions of MIL-S-19500. These provisions include the following items:

1. A clearly defined procedure for the conversion of a customer specification

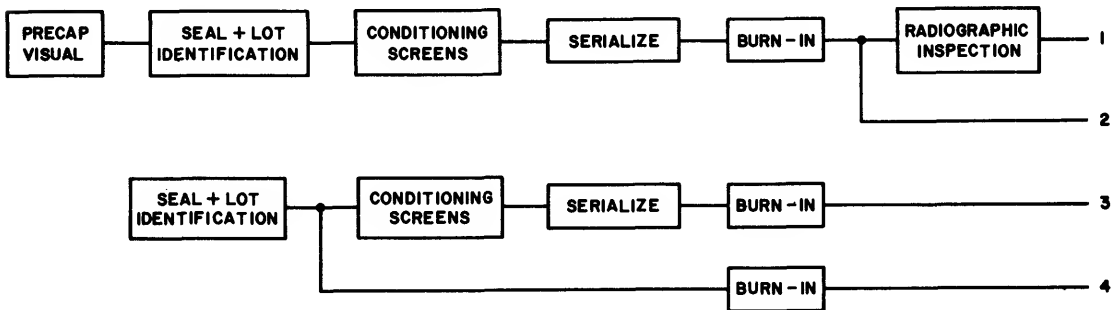
into an RCA internal specification with built-in safeguards to assure the customer that the delivered parts meet or exceed his specification requirements.

2. A formalized personnel training and testing program which assures that each operation is performed correctly.
3. A complete inspection of incoming materials, utilities, and work in process using on-site facilities such as scanning-electron-microscope and X-ray equipment.
4. Maintenance of cleanliness in work areas.
5. Rigorous control over changes in design materials, and processes with documentation kept in active files for a minimum of three years.
6. Tool and test equipment maintenance and calibration in strict accordance with MIL-C-45662, "Calibration System Requirements."
7. A quality-assurance program in accordance with MIL-Q-9858, "Quality Program

Requirements."

For detailed information on the Lot Sampling plans used for RCA high-reliability solid-state power devices, as defined by MIL-S-19500 and MIL-STD-105D, refer to **RCA Power Devices DATABOOK, SSD-220 Series.**

In addition to JAN and JANTX types, high-reliability selections of all RCA power transistors can be obtained on a custom basis. Such power transistors are subjected to high-reliability preconditioning and screening in accordance with the Group A, B, and C Sampling Tests as specified in MIL-STD-750 or special customer requirements. These power transistors can be supplied to four basic reliability levels shown in Fig. 370. Level 3 devices are equivalent to JANTX devices. For RCA Level 4 devices, the preconditioning consists of burn-in only. Fig. 371 shows the processing requirements specified by MIL-S-19500 for JAN and JANTX solid-state power devices.



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Fig. 370 - Process-flow chart for four reliability levels of RCA high-reliability power transistors.

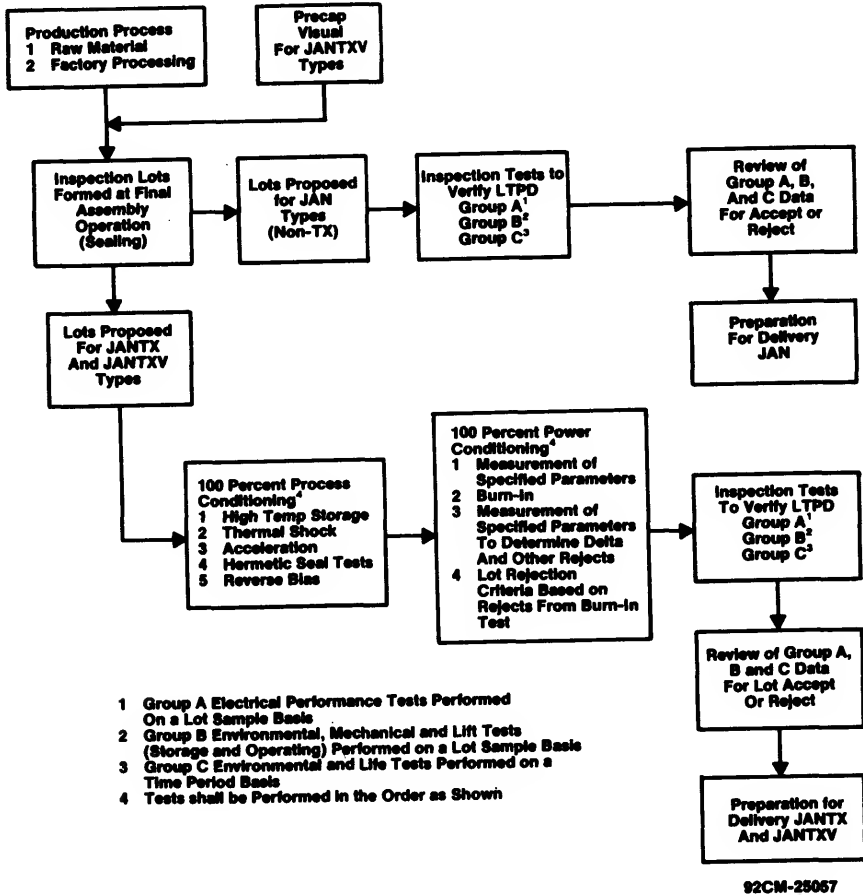


Fig. 371 - Order of procedure diagram for JAN and JANTX solid-state power devices.