

ENGINEERING PRACTICES STUDY 1150

TITLE: CHANGE PROPOSAL FOR THE CONFORMANCE INSPECTION OF
SCHOTTKY RECTIFIERS IN MIL-PRF-19500 SLASH SHEETS

29 August 2016

PROJECT NUMBER: 5961-2016-075

FINAL REPORT

Study Conducted by DLA LAND AND MARITIME

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I. OBJECTIVES: The objective of this EP study was to solicit user input to determine the clarifications needed to a previously submitted proposal for the standardization of the conformance inspection flow of Schottky rectifier MIL-PRF-19500 specification sheets.

II. BACKGROUND: A JEDEC task group submitted a proposed update to DLA for the Schottky rectifier conformance inspections of MIL-PRF-19500 (see **attachment 1**). The purpose of the original proposal was to establish specific testing flows for multiple types of Schottky devices. During the implementation of the proposed format update we received comments indicating that the original proposal from JEDEC should be reviewed again before additional specification proposals are made. The JEDEC proposal was distributed to MIL-PRF-19500 users and manufacturers requesting a review of the proposal. The comments that were received are included in **attachment 2**.

The original JEDEC task group reviewed and recommended the new format for leaded and case mounted Schottky slash sheets. The report contains two groups:

- The "Signal Schottky diodes (lead mounted devices)"
- The "Power Schottky diodes (case mounted device)"

Based on the initial comments that were received before the study was distributed, the boilerplate needs updated to include all applicable Schottky flows, at a minimum adding a flow for standard Schottky devices. The previous effort grouped too many device types into the two proposed categories possibly making some of the proposal unusable or miscategorized. Based on those comments we have received the signal Schottky boilerplate is more applicable to standard Schottky devices.

Before DLA implements additional slash sheet proposals, further input is needed on the attached final JEDEC report (initial requests have only generated 3 responses). DLA has updated an excel file received from the first survey to include all of the Schottky slash sheet conformance inspection requirements and included it in this EP study so a more extensive comparison can be made (comparing Tj, Test methods, and conditions). Please review the original JEDEC proposal, the initial comments received, and the the existing Schottky slash sheet flows in the attached table.

III. RESULTS: No comments were received that provided guidance for clarifying the initial industry proposal to update the Schottky rectifier conformance inspection.

IV. CONCLUSIONS: The results of this EP study provided no further input for clarification of the proposals to the Schottky conformance inspection. The industry proposal will be retained for use in future proposals when additional clarification is obtained.

V. RECOMMENDATIONS: DLA Land and Maritime recommends that military and industry representatives review the attached proposed conformance inspection flow for the MIL-PRF-19500 Schottky slash sheets to create a more detailed proposal.

Attachment 1 - (Original final report with additional added guidance in color)

G06-03 Schottky Diode (SKY) Signal (SIG) and Case Mounted (CM) (Burn-in) Boilerplate

Schottky diodes are divided into two main categories; lead mounted (signal) and case mounted (power) devices. Schottky diodes are further differentiated by barrier height metal, low Vf with high Ir and low Ir with high Vf. Standard testing flows for each category and type is required. A generic testing flow with variation to address power and material differences has result in the following:

A. For lead mounted devices (signal) Schottky diodes, modify to comply as follows:

JANS

1. Screening:
 - a. DC HTRB ⁵ (48 hrs) with T_J to be defined in the slash sheet. Screen 10, TM 1038, condition A, t = 48 hrs.
 - b. Power (forward bias) ⁶ DC burn-in (240hrs). Screen 12, TM 1038, condition B, t = 240 hrs.
2. Group B: Intermittent operation life (IOL) test ⁵. 2000 cycles. Subgroup 4, TM 1037, 2000 cycles.
3. Forward bias DC life tests with T_J ⁵: to be defined in slash sheet:
 - a. Group B: Forward bias DC life test (1000 hrs). Group B, subgroup 5, TM 1038, condition B, t = 1000 hrs.
 - b. Group C: Forward bias ⁶ DC life test (1000 hrs). Group C, subgroup 6, TM 1038, condition B, t = 1000 hrs.
4. Group E: 1000 hour test (DC HTRB ⁵). Subgroup 2, TM 1038, condition A, t = 1000 hrs.

JANTX and JANTXV

1. Screening:
 - a. DC HTRB ⁵ (48 hrs) with T_J to be defined in the slash sheet. Screen 10, TM 1038, condition A, t = 48 hrs.
 - b. Power (forward bias) ⁶ DC burn-in (96hrs). Screen 12, TM 1038, condition B, t = 96 hrs.
2. Life tests with T_J ⁵ to be defined in the slash sheet:
 - a. Group B: 340 hrs forward bias power burn-in. Subgroup 3, TM 1038, condition B, t = 340 hrs.
 - b. Group C: 1000 hrs forward bias power burn-in. Subgroup 6, TM 1038, condition B, t = 1000 hrs.
3. Group E: 1000 hour test (DC HTRB ⁵). Subgroup 2, TM 1038, condition A, t = 1000 hrs.

B. For power (case mounted device) Schottky modify to comply as follows:

JANS

1. Screening:
 - a. DC HTRB ⁵ (240 hrs) with T_J to be defined in slash sheet. Screen 10, TM 1038, condition A, t = 240 hrs.
 - b. No power (forward bias) burn-in (1038, con B). Power requirement prohibitive. Screens 11 and 12 are to be NA.
2. Intermittent operation life (IOL) test with T_J ⁵ to be defined in slash sheet:
 - a. Group B: IOL test of 2000 cycles. Subgroup 4, TM 1037, 2000 cycles.
 - b. Group C: IOL test of 6000 cycles; can be a continuation from group B IOL devices. Subgroup 6, TM 1037, 6K cycles.
3. DC HTRB ⁵ tests with T_J ⁵ to be defined in the slash sheet:
 - a. Group B: DC HTRB at 340 hrs or IAW slash sheet. Subgroup 5, TM 1038, condition A, t = 340 hrs.
 - b. Group C: DC HTRB at 1000 hrs IAW 19500. Subgroup 6, TM 1038, condition A, t = 1000 hrs.
4. Group E: DC HTRB ⁵ at 1000 hrs (IAW 19500). Subgroup 2, TM 1038, condition A, t = 1000 hrs.

JANTX and JANTXV

1. Screening:
 - a. DC HTRB ⁵ (48 hrs) with T_J to be defined in the slash sheet. Screen 10, TM 1038, condition A.
 - b. No power (forward bias) burn-in (1038, con B). Power requirement prohibitive. Screens 11 and 12 are to be NA.
2. Intermittent operation life tests with T_J ⁵ to be define in the slash sheet:
 - a. Group B: IOL test of 2000 cycles. Subgroup 3, TM 1037, 2000 cycles.
 - b. Group C: IOL test of 6000 cycles; can be a continuation from group B IOL devices. SG 6, TM 1037, 6K cycles.
3. Group E: DC HTRB ⁵ at 1000 hrs (IAW 19500). Subgroup 2, TM 1038, condition A.

G06-03 Schottky Diode (SKY) Signal (SIG) and Case Mounted (CM) (Burn-in) Boilerplate - Continued

Notes:

- 1) The screening and group B life test was previously performed using a half sine wave bias, this has changed to a DC bias. The DC bias is a more effect screening method to remove latent defects on Schottky devices. This test is considered to be the best stress the devices.
- 2) I_{OL} is the optimal test for all power (case mounted solder die attached) devices not just schottky diodes.
- 3) I_{OL} is a package test as well as a die test.
- 4) DC HTRB is a die only test which stresses the termination for any ionic contamination as well as any defect in the anode Schottky area.
- 5) DC HTRB Junction Temperature (T_J) will be depend on the design and construction and set for a T_J that ensures the device will not go into a thermal runaway regime while still stressing the junctions.
- 6) Power (forward Bias) Burn-in Junction Temperature (T_J) (to be define in the slash sheet) will depend on the design and construction and is set for a T_J that ensures that failure mechanisms such as silicon imperfections, bulk defects, lattice defects, barrier defects, electro migration, etc... are detected.

Attachment 2 Comments: (Only 3 individuals commented back out of 61 contacted. One user and 2 device manufacturers)

Commenter 1:

- 1) Burn-in Junction temperature - The junction temperature to be determined in slash sheet is somewhat concerning. I have done a research for both the low power and high power Schottky diodes, see attach excel file.
 - a. There were slash sheets that had the Burn-in T_J matching the device rated T_J while others were way below.
 - b. It is fine to have the Burn-in T_J below the device rating, however, we need to understand how the device max operational junction temperature was determined and validated.
 - c. If the rated T_J can be argued as validated during Life test, then some of the slash sheets are deficient. Some of the Life test conditions were still way below the device rated junction temperature.
 - d. I believe the main argument here and should be addressed by this exercise (Boiler plates) is the validation of the device junction temperature. We users look at the T_J as our guideline for derating devices in our applications and if the T_J values were not tested or not validated at least in Life test or Burn-in, where and what data set can we rely on?
- 2) Power Burn-in (SSOP) - In general what I noticed was that the requirement for SSOP B/I has stopped at 3 Amp rating, then suddenly a 15 Amp Schottky came up with a SSOP requirement. This is inconsistent with the above proposal. The 15 Amp Schottky is using case mounted packaging so the expectation was no SSOP Burn-in.

Notes 5 and 6 above – If junction temperature depends on the design and construction then the junction temperature rating of the device shall be in such a way that it can be validated by Life test at least. If the Burn-in or Life test T_J needs to be lowered then the device max T_J rating should follow suite. It is misleading to show the device was rated at max T_J of +150°C while both Burn-in and Life test were tested to T_J of +100°C. I would also recommend that a power vs temperature derating curve to be included in each slash sheet or similar to the derating curves of ss620 or ss586.

Commenter 2:

Hi Jason, We review the attached Boilerplate summary and have the following comments.

The Group C for JANTX level diodes has the 1000k life test, we should move the JANS 1K life test in group C to the JANTX 1K life test in group C. The JANS has the 1K in the group B already. See attached mark up. Or we can state per the applicable slash sheet as I'm not sure if this is the case with all diode technology (small signal) group C6 gives the manufacture the option to do steady state or IOL. Also, MIL-PRF-19500 E-IV, Screening table for Burn-in (12) indicates case mounted rectifiers condition A for JANTX or JANTXV and cond B for JANS? Not sure why we are calling out different cond for quality levels, Should the condition be the same? I marked this table up in order to correct. See attached page 2.

B. Our task group has agreed to test Power schottky diodes (case mounted device) [including rectifier junction diodes] as follows:

JANTX, TXV

1. Screening DC HTRB ⁵. (48 hrs) junction temperature (Tj) (to be define in the slash sheet).
2. No Power (forward bias) burn-in (power requirement prohibitive)
3. Life tests with junction temperature (Tj) ⁵. (to be define in the slash sheet):
 - a. Group B I_{OL} life test 2000 cycles
 - b. Group C I_{OL} life test 6000 cycles and can be a continuation from Group B I_{OL} devices.
4. Group E 1000 hour test (DC HTRB ⁵) will be performed in group E testing

JANS

1. Screening DC HTRB ⁵. (240 hrs) junction temperature (Tj) (to be define is slash sheet).
2. No Power (forward bias) burn-in (power requirement prohibitive)
3. Life test with junction temperature (Tj) ⁵. (to be define in slash sheet):
 - a. Group B I_{OL} life test 2000 cycles
 - b. Group C I_{OL} life test 6000 cycles and can be a continuation from Group B I_{OL} devices.
4. Group B DC HTRB ⁵. with junction temperature (Tj) (to be define in the slash sheet) 1000 hrs (IAW Slash Sheet)
5. Group C DC HTRB ⁵. with junction temperature (Tj) (to be define in the slash sheet) 1000 hrs (IAW 19500) ~~X~~
6. Group E 1000 hour test (DC HTRB ⁵) will be performed in group E testing

X move to JANTX, 1000 hrs is in the group B for JANS

Table E-IV Screening (attached page 2)

			IV.)	IV.)	
12. Burn-in					
a. For bipolar transistors	1039	As specified. Test condition B.	100-percent 240 hours (minimum)	100-percent 160 hours (minimum)	100-percent 160 hours (minimum)
b. For power FETs	1042	Test condition A.	240 hours (minimum)	160 hours (minimum) 10/	160 hours (minimum) 10/
c. For diodes, zeners, and rectifiers	1038	Test condition B.	240 hours (minimum)	96 hours (minimum)	96 hours (minimum)
For case mount rectifiers		Condition A (HTRB), JANTX and JANTXV only.	Not applicable 240 hrs	48 hours (minimum)	48 hours (minimum)
		Condition A, for JANS	240 hours (minimum)	Not applicable	Not applicable
d. For thyristors 11/	1040		240 hours (minimum)	96 hours (minimum)	96 hours (minimum)
e. For bipolar small die transistors	1039	Condition B	240 hours (minimum)	160 hours (minimum)	160 hours (minimum)
f. For bipolar power transistors	1039	Condition B	240 hours (minimum)	160 hours (minimum)	160 hours (minimum)

See footnotes at end of table.

Commenter 3:

Jason,

Right off the bat I disagree with the way this document begins:

- 1) What is with the lumping of Rectifier with Schottky? I thought this was supposed to be just for Schottky product.
- 2) The "lead mounted (signal) and case mounted (power) are totally incorrect categories. What is everyone thinking? Signal devices are micro-junction Schottkys that can be either leaded, MELF or case mounted in SMD packages. Power devices can be either leaded, MELF or case mounted too. So much for using the package to differentiate.

Schottky and Rectifier Junction (case mounted) diodes are divided into two main categories; lead mounted (signal) and case mounted (power) devices. Schottky diodes are further differentiated by barrier height metal, low V_f with high I_r and low I_r with high V_f . Standard testing flows for each category and type is required. A generic testing flow with variation to address power and material differences has result in the following:

- 3) Then, of course, you can have leaded and case-mount packages both on the same slash sheet.

Then...

- 4) With very leaky devices such as low barrier height Schottkys (and heavily gold-doped rectifiers) where DC HTRB means very limited T_j operation, one option is to use $\frac{1}{2}$ -sine HTRB which permits higher junction temperatures in exchange for the reverse voltage duty cycle. This was the old, and often criticized, $I_o=0A$ burn-in but it did get T_j up higher. This should be discussed to see if it is more desirable. The ThermalRating model knows exactly how to deal with this scenario.
- 5) For the forward biased burn-in, the DC could also be full-wave 50Hz or 60Hz rectified IO burn-in (100 to 120 half-sine pulses per second with no dwell between pulses). This addresses a cost saving option for the Vendor and there should be agreement as to whether this can be permitted (or not).
- 6) Last, but not least, remember that the Schottky maximum T_j only applies to reverse biased operation. For forward biased-only operation, we might want to discuss if a T_j that is greater than the boiler plate T_j on the slash sheet might be permissible. I know that Aerospace Users have long complained about the low burn-in and Group B temperatures used for some Schottkys. Definitely something to be discussed.

My feeling is that the "Final Report" is not yet ready for Prime Time. I would rather see a list of every slash sheet that comes under this "gun" and find out which ones some people think are broken and first try to fit those into some standardization category based on what is alledged to be "broken" and try to "fix" the category. Remember, everytime a broad-stroke "standardization" quest is started, a lot of headaches occur as a result of the infamous "copy-and-paste" errors, the "it can't be done" surprise revelations not to mention the "we don't have the equipment for that" road blocks.

Specification	Surf Mount	Io	Case	Dual	Part	Bv	Vf	Tj	HTRB (Screen 10)	Power B/I (Screen 12)	Life test, JANS (B5)
MIL-PRF-19500/553		22.5	DO-4		1N6391	45	0.68/0.5	-55 to +175°C	1038A, 48 hrs, JTX/V NOT APPLICABLE	JANS, 1038 A, TJ = +150°C min, VR = 36 V dc, t = 48 hrs	1027 IF = 20 A average at TC = +130°C, for 340 hours, f = 60 Hz, VR = VRWM.
MIL-PRF-19500/554		54	DO-5		1N6392	45	0.82/1	-55 to +175°C	Not applicable	1038 A, TJ = +150°C min, VR = 36 V dc, IO = 0, t = 48 hrs	Not applicable
MIL-PRF-19500/567		3.6	TO-39		1N6492	45	0.68/4	-65 to +175°C	TC = +130°C	1038 B, TA = +50°C max, adjust IO and TA to achieve TJ = +135°C min, VR = 45 V (pk), IO = 0.75 A min, f = 60 Hz, heat sinking may be used.	1027, IF = 3.2 A dc min adjust TA or IF as required IF or TA to achieve a lot TJ = +275°C.
MIL-PRF-19500/586	Optional	1	DO-41/UR		1N5819-1 1N5817UR-1	45	0.49	-65 to +125°C	TA = +110°C; VRWM = 45 V(pk)	1038 B, IF = 1.0 A dc (min), adjust IF or TA to achieve TJ = 100°C min.	1026 IF = 1 A dc (min), adjust IF or TA to achieve TJ = 125°C (min).
MIL-PRF-19500/608		15	TO-254	YES	1N6660	45	0.55/5	-65 to +150°C	Not applicable	1038 A. VR = 36 V dc; TJ = +125°C.	1038 A, VR = 36 V dc, TJ = +125°C, t = 340 hrs min; heat sinking allowed. Shall be extended to 1000 on each JANS wafer lot.
MIL-PRF-19500/610	Optional	0.2	DO-35/UR		1N6677-1 1N6677UR-1	40	0.37	-65 to +125°C	TA = +110°C; VRWM = 40 V(pk); IO = 0, half sine wave, f = 60 Hz	1038 B, IF = 200 mA dc.	1027 IF = 200 mA dc min, adjust IF or TA to achieve TJ = + 125°C min.
MIL-PRF-19500/620	Optional	3	DO-41/US		1N5822 1N5822US	40	0.5	-65 to +125°C	TA = +90°C; VRWM = 40 V(pk), TJ is not to exceed 115°C at VRWM.	IF = 3.0 A dc (min), TJ?	1026 IF = 3 A dc min, adjust IF or TA to achieve TJ = +125°C.
MIL-PRF-19500/649		15	TO-257		1N6781	60	.88/15	-65 to +150°C	Not applicable	1038 A; TC = +125°C min; VR = 48 V dc.	1038 A, TJ = TC = +150°C, VR = 48V dc.
MIL-PRF-19500/656		15	TO-257	YES	1N6785	45	0.75	-65 to +150°C	Not applicable	1038 A. TC = +125°C; VR = 36 V dc.	1038 A, TJ = TC = +150°C, VR = 36 V dc
MIL-PRF-19500/670	Optional	3	DO-41/US		1N6831 1N6831US	200	.91/3	-65 to +200°C	1N6826: TA = +150°C; VR = 80 V(dc); TJ is not to exceed +200°C with VRWM.	TA=room ambient, burned-in at TJ = +150°C minimum.	1038 IF = 3.0 (min) with IF adjusted as required to achieve an average lot TJ = +200°C +0, -15°C.
MIL-PRF-19500/671	Optional	15	TO-254/U3	YES	1N6828/U3	100	1.1/15	-65 to +150°C	TJ = +150°C; VR = 80 % of rated VR	1038 A, TJ = +150°C, Io = adjusted to achieve specified TJ. Forward burn-in conditions may be AC, DC, or half cycle Sinusoidal Io.	1038 A, TJ = +150 °C, VR at 80 % of rated VR.
MIL-PRF-19500/678	YES	10	U3		1N6840U3	35	0.75	-65 to +150°C	Not applicable	1038 A. TC = + 125°C; VR = 80 percent of rated VRWM dc.	1038 B, TJMAX = +150°C, TA = 100°C, 240 hrs
MIL-PRF-19500/679	YES	15	U3		1N6844U3	100	0.9	-65 to +150°C	Not applicable	1038 A, TJ = +125°C; VR = 80 V dc.	1038 A, VR = 80 V dc, TJ = +125°C min, t = 240 hours min; (heat sinking allowed).

MIL-PRF-19500/680	YES	10	U3	YES	1N6842U3	60	0.78	-65 to +150°C	Not applicable	1038 A, TJ = +125°C; VR = 80 percent of rated VRWM dc.	1038 B, TJ = +150°C, TA +100°C, 240 hrs.
MIL-PRF-19500/681	YES	15	U3	YES	1N6843U3	100	1.03	-65 to +150°C	Not applicable	1038 A, TJ = +125°C; VR = 80 V dc.	1038 A, VR =80 V dc, TJ =+125C, t =240 hrs min; (heat sinking allowed).
MIL-PRF-19500/682	YES	30	U3		1N6845U3	45	0.72	-65 to +150°C	Not applicable	1038 A, TJ = +125°C, VR = 36 V dc.	1038 Condition A, VR = 36 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1000 hours on each JANS wafer lot.
MIL-PRF-19500/719	YES	25	SURF		1N6872UTK2	45	0.77	-65 to +175°C	Not applicable	1038 A, TC =150°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 B IF = 1 A dc min, adjust TA and IF to achieve TJ = +175°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).
MIL-PRF-19500/720	YES	75	SURF		1N6882UTK4	45	0.79	-65 to +175°C	Not applicable	1038 A, TC =150°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 B, IF = 1 A dc min, adjust TA and IF to achieve TJ = +175°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).
MIL-PRF-19500/721	YES	100	SURF		1N6892UTK1	45	0.8	-65 to +175°C	Not applicable	1038 A, TC =150°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 B, IF = 1 A dc min, adjust TA and IF to achieve TJ = +175°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).
MIL-PRF-19500/722	YES	150	SURF		1N6902UTK3	45	0.78	-65 to +175°C	Not applicable	1038 A, TC =150°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 B, IF = 1 A dc min, adjust TA and IF to achieve TJ = +175°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).
MIL-PRF-19500/723	YES	25	SURF		1N6910UTK2	15	0.52	-65 to +150°C	Not applicable	1038 A, TC =125°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 Condition B, IF = 1 A dc minimum, adjust TA and IF to achieve TJ = +150°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).
MIL-PRF-19500/724	YES	75	SURF		1N6920UTK4	15	0.5	-65 to +150°C	Not applicable	1038 A, TC =125°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 Condition B, IF = 1 A dc minimum, adjust TA and IF to achieve TJ = +150°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).
MIL-PRF-19500/725	YES	100	SURF		1N6930UTK1	15	0.5	-65 to +150°C	Not applicable	1038 A, TC =125°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 Condition B, IF = 1 A dc minimum, adjust TA and IF to achieve TJ = +150°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).
MIL-PRF-19500/726	YES	150	SURF		1N6940UTK3	15	0.5	-65 to +150°C	Not applicable	1038 A, TC =125°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 Condition B, IF = 1 A dc minimum, adjust TA and IF to achieve TJ = +150°C, +0°C, -35°C, t = 240 hours min; (heat sinking allowed).

MIL-PRF-19500/730	Optional	35	TO-254/CCU1	YES	1N7043/1N7037CCU1	100	1.3	-65 to +150°C	Not applicable	1038 A, TJ =125°C, t = 240 hours, (t = 48 hours for TX/V), VRM= 80 % of rated VRWM	1038 Condition A, VR = 80 V dc, TJ = +125°C, t = 1,000 hours min; heat sinking allowed. As an alternative method a five (5) dice sample from each individual wafer from the wafer lot shall be qualified for 1,000 hours min then each conformance inspection lot requires 340 hours min when selected from qualified wafers. This option must be approved by the qualifying activity based on data from at least 3 wafer lots. Any change to the die design, or a conformance inspection failure of the alternate method, requires the 3 wafer lot qualification prior to using this alternative method.
MIL-PRF-19500/731	YES	30	U3	YES	1N7038U3	150	1.18	-65 to +150°C	Not applicable	1038 A, VR = 120 V dc; TJ = +125°C	1038 A, VR = 120 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1000 on each JANS wafer lot.
MIL-PRF-19500/735	Optional	10	TO-257AA/U1		1N7045T3/1N7041CCU1	45	0.73	-65 to +150°C	Not applicable	1038 A. VR = 36 V dc; TJ = +125°C.	1038 A, VR = 36 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1000 on each JANS wafer lot.
MIL-PRF-19500/737	Optional	35	TO-254/257/U1	YES	1N7039CCT1/T3/U1	150	1.13	-65 to +150°C	Not applicable	1038 A, VR = 120 V dc; TJ = +125°C.	1038 Condition A, VR = 120 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1,000 hours on each JANS wafer lot.
MIL-PRF-19500/754	YES	30	U3	YES	1N7064CCU3	45	0.68	-65 to +150°C	Not applicable	1038 A, VR = 36 V dc; TJ = +125°C.	1038 A, VR = 36 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1,000 hours for each wafer lot.
MIL-PRF-19500/761		35	TO-254AA		1N7069T1	100	1.05	-65 to +150°C	Not applicable	1038 A, VR = 80 V dc; TJ = +125°C.	1038 A, VR = 80 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1,000 on each JANS wafer lot.
MIL-PRF-19500/762		35	TO-254AA	YES	1N7062CCT1	100	1.11	-65 to +150°C	Not applicable	1038 A, VR = 80 V dc; TJ = +125°C.	1038 A, VR = 80 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1,000 on each JANS wafer lot.

MIL-PRF-19500/763		16	TO-257	YES	1N7070T3	100	0.75	-65 to +150°C	Not applicable	1038 A, VR = 80 V dc; TJ = +125°C.	1038 A, VR = 80 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1,000 on each JANS wafer lot.
MIL-PRF-19500/764		45	TO-258AA	YES	1N7071CCT8	45	0.71	-65 to +150°C	Not applicable	1038 A, VR = 36 V dc; TJ = +125°C	1038 A, VR = 36 V dc, TJ = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1,000 hours for each wafer lot.
MIL-PRF-19500/765	Optional	16	TO-257/U3	YES	1N7072CCT3 1N7078U3	30	0.48	-65 to +150°C	Not applicable	1038 A, VR = 24V dc; TJ = +100°C	1038 A, VR = 24 V dc, TJ = +100°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1,000 hours for each wafer. As an alternative method a ten dice sample (or 1 die per wafer whichever is greater) from each individual wafer shall be qualified for 1,000 hours minimum, then each screened inspection lot requires 340 hours minimum when selected from qualified wafers.
MIL-PRF-19500/771	Optional	16	TO-257/U3	YES	1N7059CCT3/1 N7060U3	60	0.58	-65 to +150°C	Not applicable	1038 A condition A. TJ = +100°C; VR = 48 V dc.	1038 A, VR = 48 V dc, TJ = +100°C, t = 340 hours min; heat sinking allowed. As an alternative method a five (5) dice sample from each individual wafer from the wafer lot shall be qualified for 1,000 hours min then each conformance inspection lot requires 340 hours min when selected from qualified wafers. This option must be approved by the qualifying activity based on data from at least 3 wafer lots. Any change to the die design, or a conformance inspection failure of the alternate method, requires the 3 wafer lot qualification prior to using this alternative method.

Specification	Life test, JTX/V (B3)	Life test, GRP C6
MIL-PRF-19500/553	1048 TJ = 150°C min, VR = 36 V dc, IO = 0, t = 48 hours	1048 TJ = 150°C min, VR = 36 V dc, IO = 0.
MIL-PRF-19500/554	1048 TJ = 150°C min, VR = 36 V dc. IO = 0, t = 48 hours.	1048 TJ = 150°C min, VR = 36 V dc. IO = 0.
MIL-PRF-19500/567	1027, TA = +25°C, IO = 0.75 A, VRM = 45 V (pk).	1026, IO = 0.75 A, VRWN = 45 V(pk), TA = +25°C.
MIL-PRF-19500/586	1027 IF = 1 A dc (min), adjust IF or TA to achieve TJ = 125°C (min).	1027 IF = 1 A dc (min), adjust IF or TA to achieve TJ = 125°C (min).
MIL-PRF-19500/608	1037 ΔTC = +85°C min, IF = 2 A min for 2,000 cycles.	C6 1037 ΔTC = +85°C, IF = 2 A min for 6,000 cycles. C6 1038 Condition A, VR = 36V dc, TJ = 125°C, t = 1000 hours min (for TX, TXV only); (heat sinking allowed).
MIL-PRF-19500/610	1027 IF = 200 mA dc min, adjust IF or TA to achieve TJ = + 125°C min.	1027 IF = 200 mA dc min, adjust IF or TA to achieve TJ = + 125°C min.
MIL-PRF-19500/620	1027 IF = 3 A dc min, adjust IF or TA to achieve TJ = +125°C.	1027 IF = 3 A dc min, adjust IF or TA to achieve TJ = +125°C.
MIL-PRF-19500/649	1037 IF or IO = 2A (min); ΔTJ = +85°C, min.	C6 1037 IF or IO = 2A (min); ΔTJ = +85°C, min. C6 1038 A JANS only; 1000 hours, TJ = TC = +150°C, VR = 48V dc.
MIL-PRF-19500/656	1037 IF or IO = 2 A (min); ΔTJ ≥ 85°C, +15°C, -5°C.	1037 IF or IO = 2 A (min); ΔTJ ≥ 85°C, +15°C, -5°C
MIL-PRF-19500/670	1027 IO = 3.0 A; TA = room ambient; f = 50-60 Hz, at VRWM (see 1.3); TL ≤ +55°C, lead length = .375 inch.	C6 1026 IO = 3.0 A; TA = room ambient; f = 50-60 Hz, at VRWM (see 1.3). TL ≤ +55°C, lead length = .375 inch (9.52 mm). C6 1038 A JANS only, 1000hrs, TJ = TC = +150°C
MIL-PRF-19500/671	1027 IF or IO = 2 A (min); ΔTJ ≥ +85°C, + 15°C, - 5°C for 2,000 cycles min.	1026 IF or IO = 2 A (min); ΔTJ ≥ +85 °C, + 15 °C, - 5 °C for 6,000 cycles min.
MIL-PRF-19500/678	1037 Each diode: IF or IO = 2 A (min) ΔTJ = 85°C, +15°C, - 5°C.	1037 Each diode: IF or IO = 2 A (min) ΔTJ = 85°C, +15°C, - 5°C.
MIL-PRF-19500/679	1037 ΔTC = +85°C min, IF = 2 A min for 2,000 cycles.	1037 ΔTC = +85°C, min, IF = 2 A min for 6,000 cycles.

MIL-PRF-19500/680	1037 for each diode: IF or IO = 1 A (min); $\Delta T_J = 85^\circ\text{C}$, $+15^\circ\text{C}$, -5°C .	1037 IF or IO = 1A (min).
MIL-PRF-19500/681	1037 $\Delta T_C = +85^\circ\text{C}$ min, IF = 2 A.	1037 $\Delta T_C = +85^\circ\text{C}$, min, IF = 2 A.
MIL-PRF-19500/682	1037 $\Delta T_J = +85^\circ\text{C}$, IF = 2 A min for 2,000 cycles.	C6 1037 $\Delta T_J = +85^\circ\text{C}$, IF = 2 A min for 6,000 cycles. C6 1038 A, VR = 36 V dc, $T_J = +125^\circ\text{C}$, t = 1,000 hours min (required for TX, TXV only) (heat sinking allowed) .
MIL-PRF-19500/719	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 6,000 cycles.
MIL-PRF-19500/720	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum , IF = 2 A minimum for 6,000 cycles.
MIL-PRF-19500/721	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 6,000 cycles.
MIL-PRF-19500/722	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 6,000 cycles.
MIL-PRF-19500/723	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 6,000 cycles.
MIL-PRF-19500/724	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 6,000 cycles.
MIL-PRF-19500/725	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 6,000 cycles.
MIL-PRF-19500/726	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 2,000 cycles.	1037 $\Delta T_J = +85^\circ\text{C}$ minimum, IF = 2 A minimum for 6,000 cycles.

MIL-PRF-19500/730	1037 $\Delta TC = +85^{\circ}C$, IF = 2 A minimum for 2,000 cycles.	1038 Condition A, VR = 80 V dc, TJ = $+125^{\circ}C$, t = 1,000 hours min; heat sinking allowed. As an alternative method a five (5) dice sample from each individual wafer from the wafer lot shall be qualified for 1,000 hours min then each conformance inspection lot requires 340 hours min when selected from qualified wafers. This option must be approved by the qualifying activity based on data from at least 3 wafer lots. Any change to the die design, or a conformance inspection failure of the alternate method, requires the 3 wafer lot qualification prior to using this alternative method.
MIL-PRF-19500/731	1037 $\Delta TC = +85^{\circ}C$ minimum, IF = 2 A minimum for 2,000 cycles.	C6, 1037 $\Delta TC = +85^{\circ}C$ minimum, IF = 2 A minimum for 6,000 cycles. C6, 1038 A, VR = 120Vdc, TJ = $+125^{\circ}C$, t = 1000 hours min; (heat sinking allowed), for TX, TXV only.
MIL-PRF-19500/735	1037 $\Delta TC = +85^{\circ}C$, IF = 2 A minimum.	C6 1037 $\Delta TC = +85^{\circ}C$, IF = 2 A min. C6, 1038 Condition A, VR = 36 V dc, TJ = $+125^{\circ}C$, t = 1,000 hours min; (heat sinking allowed). (required for TX and TXV levels only)
MIL-PRF-19500/737	1037 $\Delta TC = +85^{\circ}C$ min, IF = 2 A min for 2,000 cycles.	C6 1037 $\Delta TC = +85^{\circ}C$ min, IF = 2 A min for 6,000 cycles. C6, 1038 A, VR = 120Vdc, TJ = $+125^{\circ}C$, t = 1000 hours min; (heat sinking allowed), for TX, TXV only separate samples may be used.
MIL-PRF-19500/754	1037 $\Delta TC = +85^{\circ}C$, IF = 2 A min.	C6 1037 $\Delta TC = +85^{\circ}C$, IF = 2 A min. C6 1038 A, VR = 36 V dc, TJ = $+125^{\circ}C$, t = 1,000 hours min; heat sinking allowed. (for TX and TXV only).
MIL-PRF-19500/761	1037 $\Delta TC = +85^{\circ}C$, IF = 2 A min.	C6 1037 $\Delta TC = +85^{\circ}C$, IF = 2 A min. C6 1038 A, VR = 80 V dc, TJ = $+125^{\circ}C$, t = 1,000 hours min; heat sinking allowed. (for TX and TXV only).
MIL-PRF-19500/762	1037 $\Delta TC = +85^{\circ}C$, IF = 2 A min.	C6 1037 $\Delta TC = +85^{\circ}C$, IF = 2 A min. C6 1038 A, VR = 80 V dc, TJ = $+125^{\circ}C$, t = 1,000 hours min; heat sinking allowed. (for TX and TXV only).

MIL-PRF-19500/763	1037 Δ TC = +85°C, IF = 2 A min.	C6 1037 Δ TC = +85°C, IF = 2 A min. C6 1038 A, VR = 80 V dc, TJ = +125°C, t = 1,000 hours min; heat sinking allowed. (for TX and TXV only).
MIL-PRF-19500/764	1037 Δ TC = +85°C, IF = 2 A min.	C6 1037 Δ TC = +85°C, IF = 2 A minimum. C6 1038 A, VR = 36 V dc, TJ = +125°C, t = 1,000 hours min; heat sinking allowed. (for TX and TXV only).
MIL-PRF-19500/765	1037 Δ TC = +85°C, IF = 2 A minimum.	C6 1037 Δ TC = +85°C, IF = 2 A minimum. C6 1038 A, VR = 24 V dc, TJ = +100°C, t = 340 hours min (for TX, TXV only); heat sinking allowed. This test shall be extended to 1,000 hours for each wafer. Separate samples may be used. As an alternative method a ten dice sample (or 1 die per wafer whichever is greater) from each individual wafer shall be qualified for 1,000 hours minimum, then each screened inspection lot requires 340 hours minimum when selected from qualified wafers.
MIL-PRF-19500/771	1037 Δ TC = +85°C, IF = 2 A minimum for 2,000 cycles.	C6 1037 Δ TC = +85°C, IF = 2 A minimum for 2,000 cycles. C6 1038 Condition A, VR = 48 V dc, TJ = +100°C, t = 1,000 hours min (for TX, TXV only); heat sinking allowed. As an alternative method a five (5) dice sample from each individual wafer from the wafer lot shall be qualified for 1,000 hours min then each conformance inspection lot requires 340 hours min when selected from qualified wafers. This option must be approved by the qualifying activity based on data from at least 3 wafer lots. Any change to the die design, or a conformance inspection failure of the alternate method, requires the 3 wafer lot qualification prior to using this alternative method.