The documentation and process conversion measures necessary to comply with this revision shall be completed by 8 June 2010.

INCH-POUND
MIL-PRF-19500/608D
w/AMENDMENT 1
8 March 2010
SUPERSEDING
MIL-PRF-19500/608D
24 August 2009

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, SCHOTTKY, POWER RECTIFIER, COMMON CATHODE, COMMON ANODE CENTER TAP, DOUBLER, TYPES 1N6660, 1N6660CCT1, 1N6660R, 1N6660CAT1, AND 1N6660DT1, JAN, JANTX, JANTXV, AND JANS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for a silicon, schottky, power rectifier diodes. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (TO-254AA isolated).

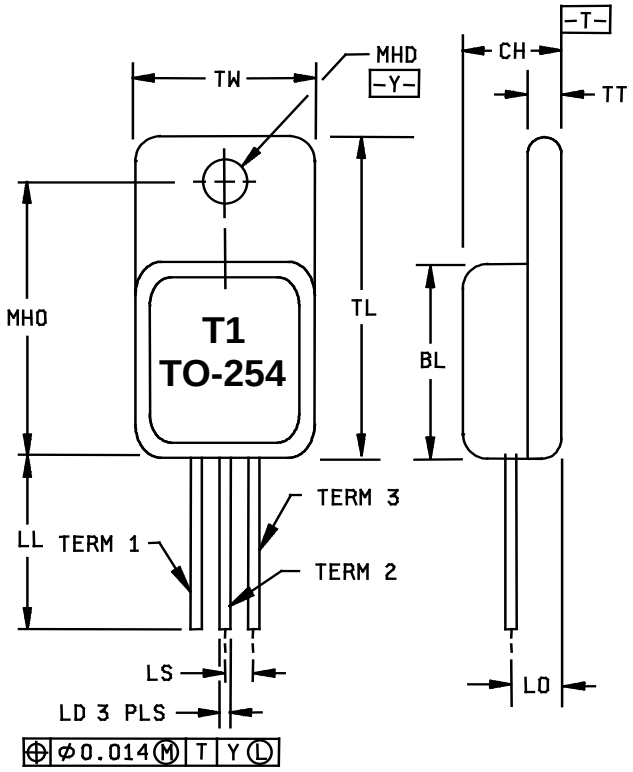
1.3 Maximum ratings. T_A = +25°C, unless otherwise indicated.

Type	V_R (1)	V_{RWM} (1)	I_O (1) (2) (3) T_C = 100°C	I_{FSM} (1) t_p = 8.3 ms T_C = +25°C	$R_{\Theta JC}$ (1) (4) Die 1	$R_{\Theta JC}$ (1) (4) Die 2	T_{STG} & T_J
	V	V	A dc	A(pk)	°C/W	°C/W	°C
1N6660 1N6660CCT1	45	45	15	300	1.65	1.65	-65 to +150
1N6660R 1N6660CAT1	45	45	15	300	2.8	2.8	
1N6660DT1	45	45	15	300	2.8	1.65	

(1) Each individual diode.
(2) For derating see figures 2 and 3.
(3) Total package current is limited to 30 A dc.
(4) For thermal impedance graphs see figures 4 and 5.

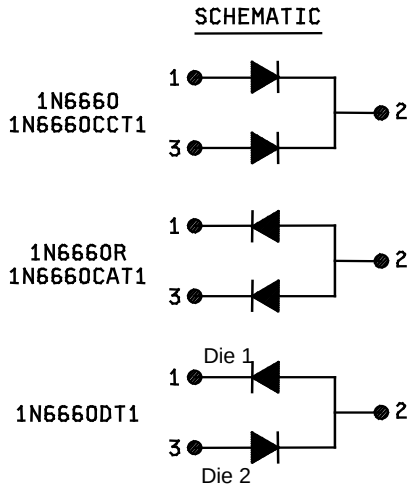
1.4 Primary electrical characteristics. $R_{\Theta JC}$ (entire package) = 0.85°C/W maximum for 1N6660CCT1. $R_{\Theta JC}$ (entire package) = 1.5°C/W maximum for 1N6660CAT1 and 1N6660DT1. $R_{\Theta JA}$ = 50°C/W maximum, each individual diode.

* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to semiconductor@dscc.dla.mil . Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil .



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.535	.545	13.59	13.84
CH	.249	.260	6.32	6.60
LD	.035	.045	0.89	1.14
LL	.510	.570	12.95	14.48
LO	.150 BSC		3.81 BSC	
LS	.150 BSC		3.81 BSC	
MHD	.139	.149	3.53	3.78
MHO	.665	.685	16.89	17.40
TL	.790	.800	20.07	20.32
TT	.040	.050	1.02	1.27
TW	.535	.545	13.59	13.84

NOTES:
1. Dimensions are in inches
2. Millimeters are given for general information only.
3. All terminals are isolated from case.
4. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.



Types 1N6660, 1N6660CCT1, 1N6660R, 1N6660CAT1, and 1N6660DT1

FIGURE 1. Physical dimensions and configuration (TO-254AA).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 - Test Methods for Semiconductor Devices.

* (Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or https://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturers list before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (TO-254AA) herein. Methods used for electrical isolation of the terminal feedthroughs shall employ materials that contain a minimum of 90 percent Al_2O_3 (ceramic).

3.4.1 Polarity. Polarity and terminal configuration shall be in accordance with figure 1 herein.

3.4.2 Lead material, finish, and formation. Lead material shall be Kovar or Alloy 52; a copper core or plated core is permitted. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead formation, material, or finish is desired, it shall be specified in the acquisition document (see 6.2). When lead formation is performed, as a minimum, the vendor shall perform 100 percent hermetic seal in accordance with screen 14 of table E-IV of MIL-PRF-19500 and 100 percent dc testing in accordance with table I, subgroup 2 herein.

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I.

3.6 Electrical test requirements. The electrical test requirements shall be as specified in tables I and II.

3.7 Marking. Marking shall be in accordance with MIL-PRF-19500. The 1N6660CCT1 and 1N6660CAT1 are directly substitutable for the 1N6660 and 1N6660R, respectively, and are preferred.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4 and tables I and II herein).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not require the performance of table III tests, the tests specified in table III herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

* 4.3 Screening (JANS, JANTXV, and JANTX levels). Screening shall be in accordance with table E-IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table E-IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
(1) (2) 3b	Method 4066 of MIL-STD-750, condition A, one pulse, tp = 8.3ms, I_O = 0, V_{RWM} = 0, I_{FSM} = see 1.3 herein.	Method 4066 of MIL-STD-750, condition A, one pulse, tp = 8.3ms, I_O = 0, V_{RWM} = 0, I_{FSM} = see 1.3 herein.
3c	Thermal impedance (see 4.3.2)	Thermal impedance (see 4.3.2)
3d	Avalanche energy test (see 4.3.3)	Avalanche energy test (see 4.3.3)
4	Required	Not applicable
5, 8	Required	Not applicable
9, 10	Not applicable	Not applicable
11	V_{F1} and I_{R1}	V_{F1} and I_{R1}
12	See 4.3.1	See 4.3.1, t = 48 hours.
* 13	Subgroups 2 and 3 of table I herein, V_{F1} and I_{R1}, excluding thermal impedance; ΔV_{F1} = ±50 mV (pk); ΔI_{R1} = ±25 μA dc or ±100 percent from the initial value, whichever is greater.	Subgroup 2 of table I herein, V_{F1} and I_{R1}; excluding thermal impedance; ΔV_{F1} = ±50 mV (pk); ΔI_{R1} = ± 25 μA dc or ±100 percent from the initial value, whichever is greater.
15	Required	Not applicable

(1) Surge shall precede thermal impedance.
(2) Surge and thermal impedance shall be performed any time after screen 3a and before screen 13.

4.3.1 High temperature reverse bias. Reverse bias conditions are as follows: Method 1038 of MIL-STD-750, test condition A. V_R = 36 V dc; T_J = +125°C.

* 4.3.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3101 or 4081 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, and t_{MD}. Measurement delay time (t_{MD}) = 70 μs max. See table III, subgroup 4 herein.

* 4.3.3 Avalanche energy test. The avalanche energy test is to be performed using the circuit as shown on figure 6 or equivalent. The Schottky rectifier under test shall be capable of absorbing the reverse energy, as follows: I_{AS} = 2 A minimum, L = 260 μH.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table E-V of MIL-PRF-19500, and table I herein. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in tables E-VIa (JANS) and E-VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2, forward voltage test (V_{F1}) and reverse leakage test (I_{R1}) herein. Delta measurements shall be in accordance with table II herein.

4.4.2.1 Group B inspection, table E-VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
B4	1037	ΔT_C = +85°C, I_F = 2 A minimum for 2,000 cycles.
B5	1038	Condition A, VR = 36 V dc, T_J = +125°C, t = 340 hours min; heat sinking allowed. This test shall be extended to 1000 on each JANS wafer lot.
B6	4081	1N6660CAT1, 1N6660DT1 (die 1), $R_{\Theta JC}$ = 2.8°C/W maximum for each leg. 1N6660CCT1, 1N6660DT1 (die 2), $R_{\Theta JC}$ = 1.65°C/W maximum for each leg.

4.4.2.2 Group B inspection, table E-VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1037	ΔT_C = +85°C minimum, I_F = 2 A minimum for 2,000 cycles.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2, forward voltage test (V_{F1}) and reverse leakage test (I_{R1}) herein. Delta measurements shall be in accordance with table II herein.

Subgroup	Method	Condition
C2	2036	Condition A, weight = 10 lbs, t = 15 seconds.
C6	1037	ΔT_C = +85°C, I_F = 2 A minimum for 6,000 cycles.
C6	1038	Condition A, V_R =36V dc, T_J =125°C, t = 1000 hours minimum (for TX, TXV only); (heat sinking allowed).

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-IX of MIL-PRF-19500, and table III herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurements shall be as specified in section 4 of MIL-STD-750.

***** TABLE I. Group A inspection. 1/ 2/

Inspection	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
* Thermal impedance 3/	3101	See 4.3.2	$Z_{\Theta JC}$			
1N6660CAT1, 1N6660DT1 (die 1) 1N6660CCT1, 1N6660DT1 (die 2)						°C/W
Forward voltage	4011	I_F = 5 A (pk) pulsed (see 4.5.1) I_F = 15 A (pk) pulsed (see 4.5.1) I_F = 30 A (pk) pulsed (see 4.5.1)	V_{F1} V_{F2} V_{F3}		0.55 0.75 1.0	V dc V dc V dc
Reverse current	4016	DC method, V_R = 45 V dc, pulsed (see 4.5.1)	I_{R1}		1.0	mA dc
Subgroup 3						
High temperature operation:		T_A = +125°C				
Reverse current leakage	4016	DC method, V_R = 45 V dc, pulsed (see 4.5.1)	I_{R2}		40	mA dc
Low temperature operation:		T_A = -55°C				
Forward voltage	4011	I_F = 15 A (pk) pulsed (see 4.5.1)	V_{F4}		0.8	V dc
Subgroup 4						
Junction capacitance	4001	V_R = 5 V dc; f = 1 MHz; V_{SIG} = 50 mV (p-p) (max)	C_J		2,000	pF
Subgroup 6						
Surge	4066	I_{FSM} = 300 A (pk), 8.3 ms; pulsed (see 4.5.1)				
Electrical measurements		See table I, subgroup 2 herein				
Subgroup 7						
Dielectric withstanding voltage	1016	V_R = 500 V dc; all leads shorted; V as measured from leads to case	DWV		10	µA
Scope display evaluation	4023	Stable only				
Electrical measurements		See table I, subgroup 2 herein				

1/ For sampling plan, see MIL-PRF-19500.
2/ Each individual diode.
3/ This test required for the following end-point measurements only:
Group B, subgroups 3 and 4 (JANS).
Group B, subgroups 2 and 3 (JAN, JANTX, JANTXV).
Group C, subgroups 2, and 6.
Group E, subgroup 1.

* TABLE II. Groups A, B, C, and E electrical end-point and delta measurements. 1/ 2/ 3/ 4/ 5/ 6/

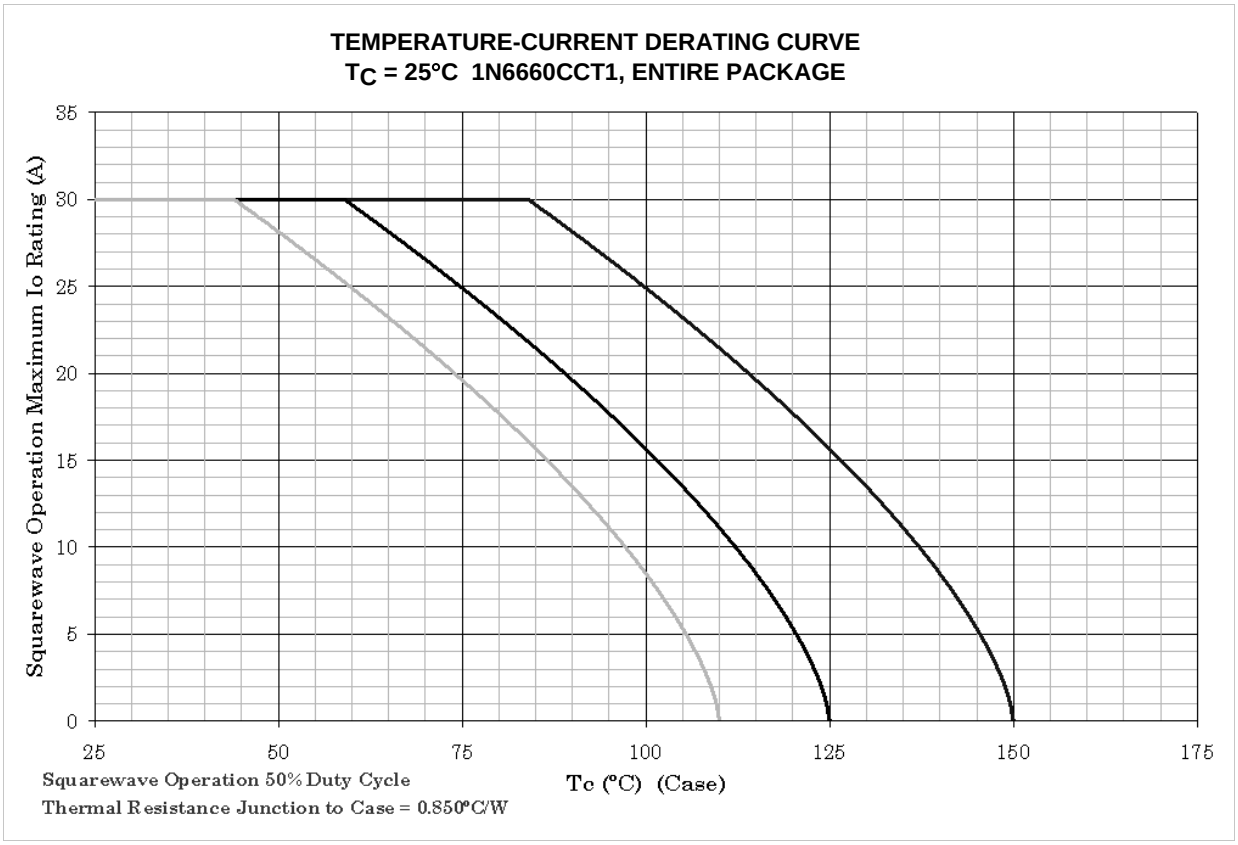
Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	I_F = 5 A (pk), pulsed (see 4.5.1)	ΔV_{F1}	±50 mV dc from initial reading.		
2.	Reverse current	4016	V_R = 45 V dc, pulsed (see 4.5.1), dc method	ΔI_{R1}	±25 μA dc or ±100 percent from initial reading, whichever is greater.		
3.	Thermal impedance 1N6660CAT1, 1N6660DT1 (die 1) 1N6660CCT1, 1N6660DT1 (die 2)	3101	See 4.3.2	$Z_{\Theta JC}$			°C/W

1/ Each individual diode.
2/ The electrical measurements for table E-VIa (JANS) of MIL-PRF-19500 are as follows:
   a. Subgroup 3, see table II herein, steps 1 and 2.
   b. Subgroup 4, see table II herein, steps 1 and 2.
   c. Subgroup 5, see table II herein, steps 1 and 2.
3/ The electrical measurements for table E-VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:
   a. Subgroup 2, see table II herein, steps 1 and 2.
   b. Subgroup 3, see table II herein, steps 1 and 2.
   c. Subgroup 6, see table II herein, steps 1 and 2.
4/ The electrical measurements for table E-VII of MIL-PRF-19500 are as follows:
   a. Subgroups 2 and 3, see table II herein, steps 1 and 2.
   b. Subgroup 6, see table II herein, steps 1 and 2.
5/ The electrical measurements for table E-IX of MIL-PRF-19500 are as follows:
   a. Subgroup 1, see table II herein, steps 1 and 2.
   b. Subgroup 2, see table II herein, steps 1 and 2.
6/ Devices which exceed the table I, limits for this test shall not be accepted.

TABLE III. Group E inspection (all quality levels) for qualification and requalification only.

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			
Temperature cycling	1051	500 cycles	n = 45, c = 0
Hermetic seal	1071		
Electrical measurements		See group A, subgroup 2, and table II	
Subgroup 2			
Steady-state blocking life	1048	t = 1,000 hours, T_J = +125°C; V_R = 36 V dc	n = 45, c = 0
Electrical measurements		See group A, subgroup 2, and table II	
Subgroup 3			
Not applicable			
Subgroup 4			
Thermal impedance curves	3101	See MIL-PRF-19500	
Subgroup 6			
ESD	1020		n = 3, c = 0
Subgroup 10 1/			
Surge	4066	Condition A; T_A = +25°C; I_{FSM} = 300 A, 100 surges	n = 22, c = 0
Electrical measurements		See group A, subgroup 2	

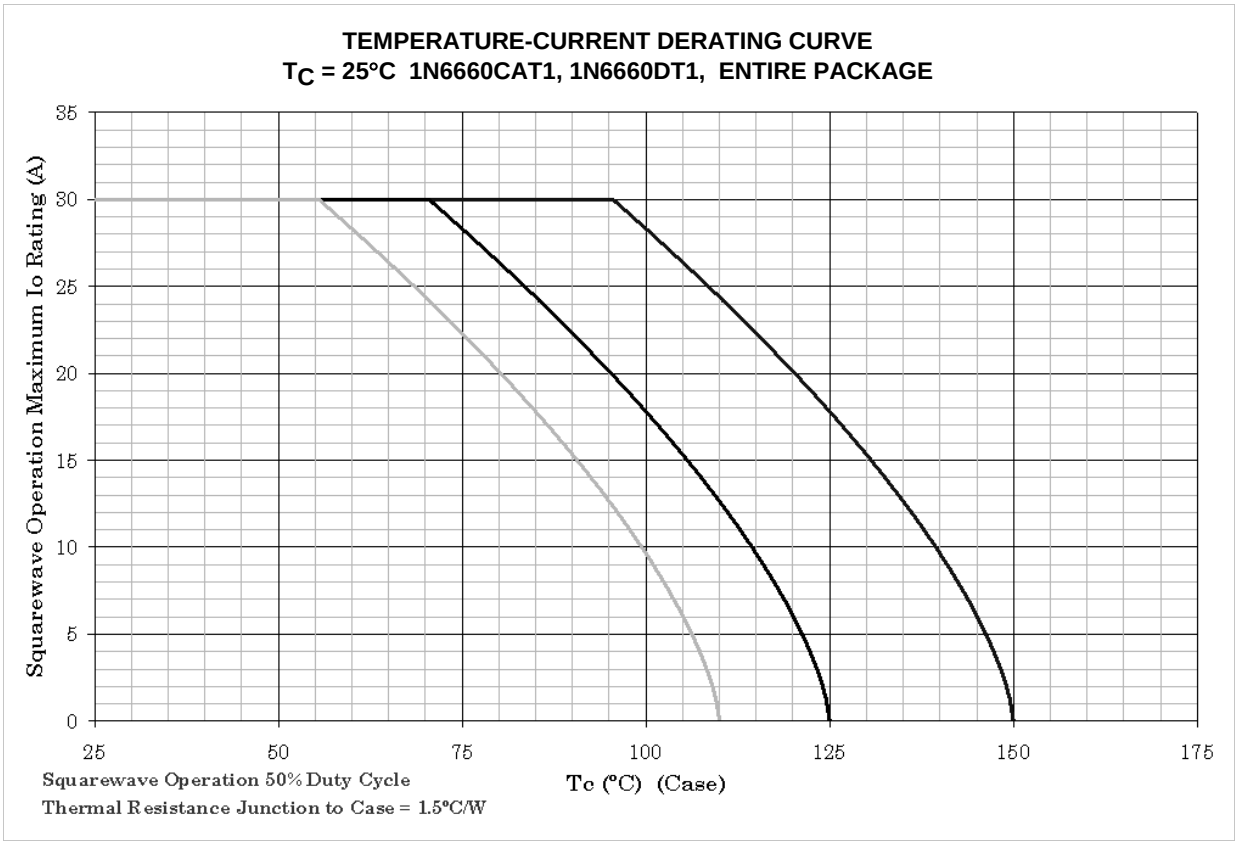
1/ For each diode.



NOTES:

1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at ≤ T_J specified on this curve. Any parallel line to this curve will intersect the appropriate current for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperature (T_J ≤ 150°C) and power rating specified. (See 1.3 herein.)
3. Derate design curves chosen at T_J ≤ 125°C, and 110°C to show current rating where most users want to limit T_J in their application.

FIGURE 2. Temperature-current derating graph.



NOTES:

1. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate current for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperature ($T_J \leq 150°C$) and power rating specified. (See 1.3 herein.)
3. Derate design curves chosen at $T_J \leq 125°C$, and 110°C to show current rating where most users want to limit T_J in their application.

FIGURE 3. Temperature-current derating graph 1N6660CAT1, 1N6660DT1, die 1.

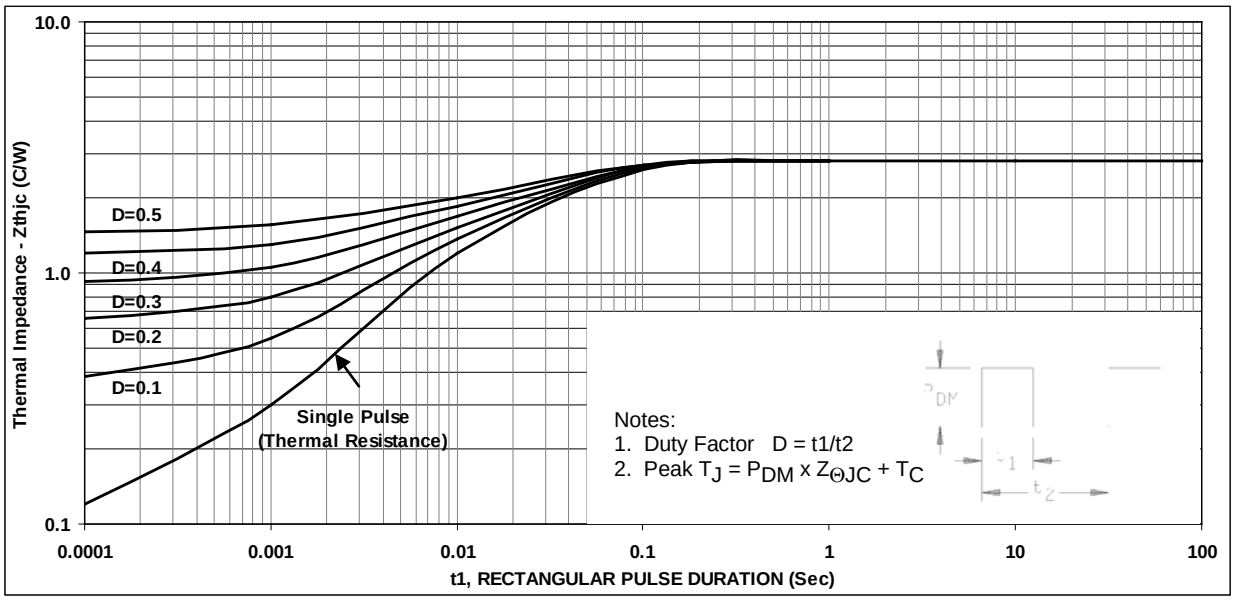


FIGURE 4. Thermal impedance for each leg 1N6660CAT1, 1N6660DT1, die 1, and 1N6660R.

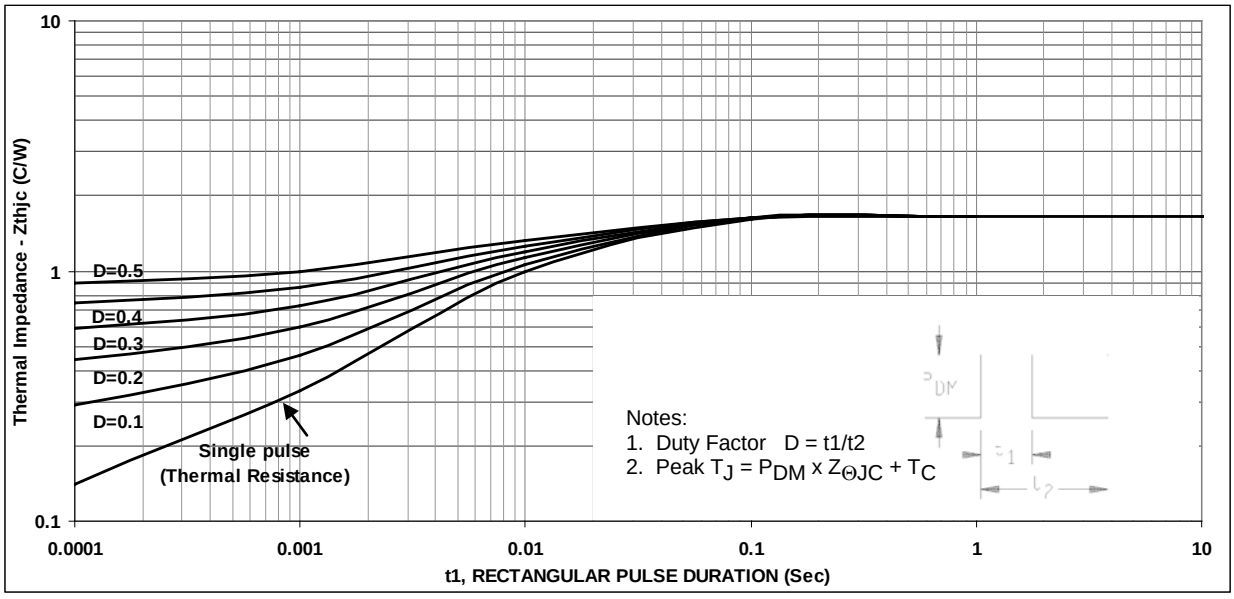
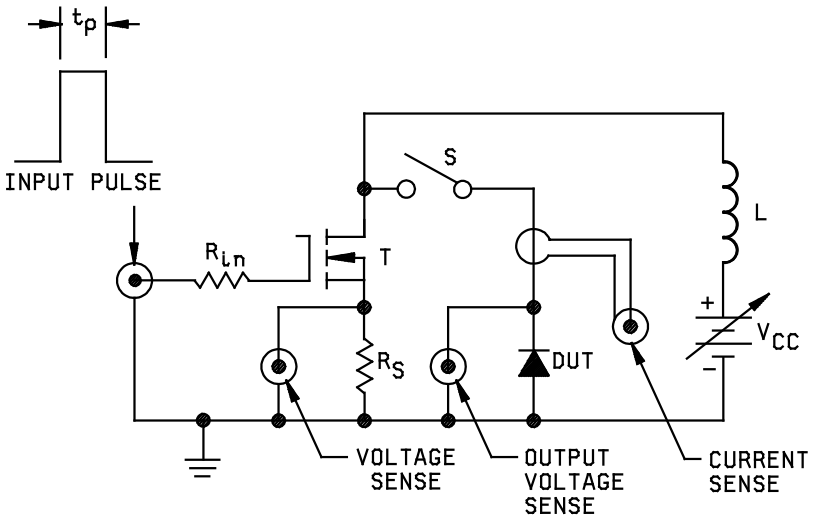


FIGURE 5. Thermal impedance for each leg 1N6660CCT1, 1N6660DT1, die 2, and 1N6660.



Input pulse: R_{in} = 50 ohms
V_G = 10 volts, R_S = 0.1 ohms
Z_G = 50 ohms, $V_{CC} \approx$ 10 volts
L = 260 μH
Duty cycle ≤ 1 percent, T = IRF130/2N6756 or equivalent

PROCEDURES:

1. With S open, adjust pulse width to test current of 2 amps through R_S.
2. Close S, verify test current with current sense.
3. Read peak output voltage (see 4.3.3).

* FIGURE 6. Avalanche energy test circuit.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Packaging requirements (see 5.1).

c. Lead material, finish, and formation (see 3.4.1).

d. Product assurance level and type designator.

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML-19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil . An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.daps.dla.mil .

6.4 Cross reference substitution list. The 1N6660CCT1 and 1N6660CAT1 are the preferred part numbers, and are directly substitutable for the 1N6660 and 1N6660R respectively.

* 6.5 Amendment notations. The margins of this specification are marked with asterisks to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

Custodians:
Army - CR
Navy - EC
Air Force - 85
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2009-106)

Review activities:
Army - AR, MI, SM
Navy - AS, MC, OS
Air Force - 19, 99

* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.daps.dla.mil .