

The documentation and process conversion measures necessary to comply with this document shall be completed by 3 February 2023.

INCH-POUND

MIL-PRF-19500/441L
w/AMENDMENT 2
3 November 2022
SUPERSEDING
MIL-PRF-19500/441L
w/AMENDMENT 1
3 April 2017

PERFORMANCE SPECIFICATION SHEET

TRANSISTOR, PNP, SILICON, POWER,
ENCAPSULATED (THROUGH HOLE AND SURFACE MOUNT), AND UNENCAPSULATED,
RADIATION HARDNESS ASSURANCE, DEVICE TYPES 2N3740 AND 2N3741
QUALITY LEVELS JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC.

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 power PNP silicon 2N3740 and 2N3741 transistors. Four levels of product assurance (JAN, JANTX, JANTXV, and JANS) are provided for each encapsulated device type and two levels of product assurance (JANHC and JANKC) are provided for each unencapsulated device type as specified in [MIL-PRF-19500](#). Provisions for radiation hardness assurance (RHA) to eight radiation levels is provided for quality levels JANTXV, JANS, JANHC, and JANKC. RHA level designators "M", "D", "P", "L", "R", "F", "G", and "H" are appended to the device prefix to identify devices, which have passed RHA requirements.

1.2 Package and die outlines. The device package for the encapsulated device type are as follows: TO-66 in accordance with [figure 1](#) and surface mount in accordance with [figure 2](#). The dimensions and topography for JANHC and JANKC unencapsulated die are in accordance with [figure 3](#).

1.3 Maximum ratings. Unless otherwise specified, $T_A = +25^\circ\text{C}$.

Types	P_T (1)	P_T (1)	P_T (1)	$R_{\theta JC}$	$R_{\theta JC}$	V_{CBO}	V_{CEO}	V_{EBO}	I_B	I_C	T_{STG} and T_J
	$T_C = +25^\circ\text{C}$	$T_A = +25^\circ\text{C}$	$T_C = +100^\circ\text{C}$	(2) TO-66 only	(2) U4 only						
	<u>W</u>	<u>W</u>	<u>W</u>	<u>$^\circ\text{C/W}$</u>	<u>$^\circ\text{C/W}$</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>$^\circ\text{C}$</u>
2N3740	25	3	14	7	6	-60	-60	-7	-2	-4	-65 to +200
2N3741	25	3	14	7	6	-80	-80	-7	-2	-4	-65 to +200

(1) See [figures 4](#) and [5](#) for temperature-power derating curves.

(2) See [figures 6](#) and [7](#), transient thermal impedance graphs.

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1.4 Primary electrical characteristics. Unless otherwise specified, $T_C = +25^\circ\text{C}$.

Limits	h_{FE2} (1) $V_{CE} = -1\text{ V dc}$ $I_C = -250\text{ mA dc}$	h_{FE4} (1) $V_{CE} = -1\text{ V dc}$ $I_C = -1\text{ A dc}$	$ h_{fe} $ $V_{CE} = -10\text{ V dc}$ $I_C = -100\text{ mA dc}$ $f = 5\text{ MHz}$	$V_{CE(sat)}^2$ (1) $I_C = -1.0\text{ A dc}$ $I_B = -125\text{ mA dc}$	C_{obo} $V_{CB} = -10\text{ V dc}$ $I_E = 0$ $100\text{ kHz} \leq f \leq 1\text{ MHz}$	Pulse response t_{on}	Pulse response t_{off}
Min Max	30 120	10	1 12	<u>V dc</u> -0.6	<u>pF</u> 100	<u>ns</u> 400	<u>μs</u> 1

(1) Pulsed (see 4.5.1).

1.5 Part or Identifying Number (PIN). The PIN is in accordance with MIL-PRF-19500, and as specified herein. See 6.5 for PIN construction example and 6.6 for a list of available PINs.

1.5.1 JAN brand and quality level designators.

1.5.1.1 Encapsulated devices. The quality level designators for encapsulated devices that are applicable for this specification sheet from the lowest to the highest level are as follows: the base quality level "JAN" that uses no modifiers, "JANTX", "JANTXV", and "JANS".

1.5.1.2 Unencapsulated devices (die). The quality level designators for unencapsulated devices (die) that are applicable for this specification sheet from the lowest to the highest level are as follows: "JANHC" and "JANKC".

1.5.2 Radiation hardness assurance (RHA) designator. The RHA levels that are applicable for this specification sheet from lowest to highest are as follows: "M", "D", "P", "L", "R", "F", "G", and "H".

1.5.3 Device type. The designation system for the device types of transistors covered by this specification sheet are as follows.

1.5.3.1 First number and first letter symbols. The transistors of this specification sheet use the first number and letter symbols "2N".

1.5.3.2 Second number symbols. The second number symbols for the transistors covered by this specification sheet are as follows: "3740" and "3741".

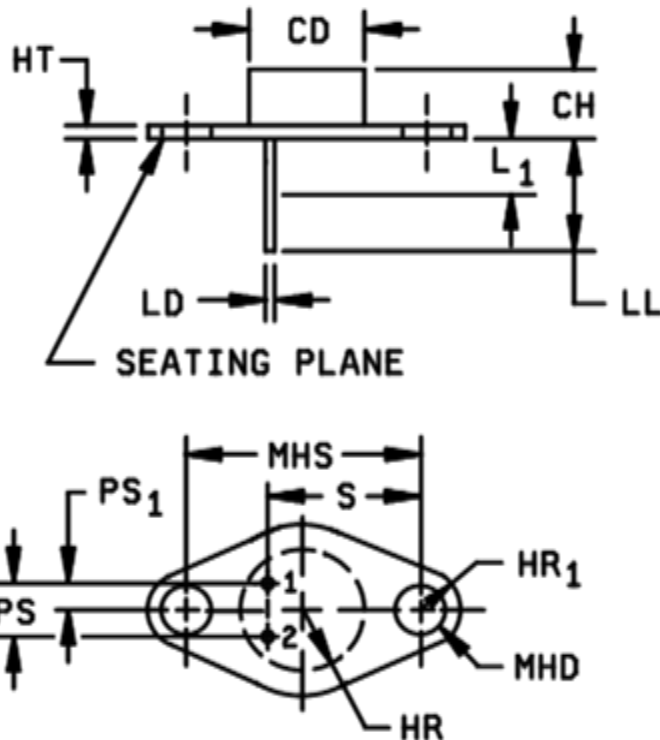
1.5.4 Suffix symbols. The following suffix symbols are incorporated in the PIN as applicable.

1.5.4.1 Following suffix symbols. The following suffix symbols are incorporated in the PIN for this specification sheet:

No Suffix	Indicates a through-hole mount package similar to a TO-66 metal can (see figure 1).
U4	Indicates a 3 pad surface mount package (see figure 2).

1.5.5 Lead finish. The lead finishes applicable to this specification sheet are listed on QML-19500.

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Symbol	Dimensions				Notes	Symbol	Dimensions				Notes
	in	in	mm	mm			in	in	mm	mm	
	Min	Max	Min	Max			Min	Max	Min	Max	
CD		.620		15.75	9	LL	.360	.500	9.14	12.70	4, 8
CH	.250	.340	6.35	8.64		L ₁		.050		1.27	4, 8
HT	.050	.075	1.27	1.91		MHD	.142	.152	3.61	3.86	6
HR		.350		8.89		MHS	.958	.962	24.33	24.43	
HR ₁	.115	.145	2.92	3.68	5	PS	.190	.210	4.83	5.33	3
LD	.028	.034	0.71	0.86	4, 8	PS ₁	.093	.107	2.36	2.72	3
						S	.570	.590	14.48	14.99	3

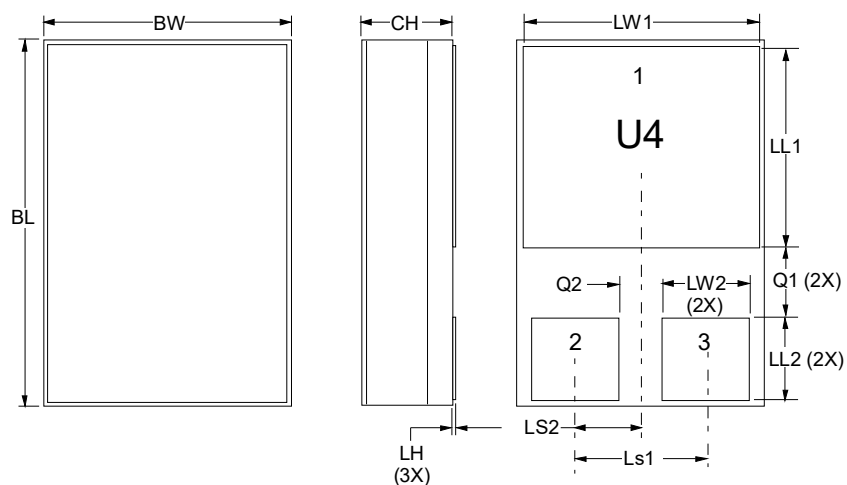
NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. These dimensions should be measured at points .050 to .055 inch (1.27 to 1.40 mm) below seating plane. When gauge is not used, measurement will be made at seating plane.
4. Both terminals.
5. At both ends.
6. Two holes.
7. The collector shall be electrically connected to the case.
8. LD applies between L₁ and LL. Lead diameter shall not exceed twice LD within L₁.
9. Lead 1 is the emitter, lead 2 is the base, collector is the case.

*

FIGURE 1. Physical dimensions, TO-66 (2N3740, 2N3741).

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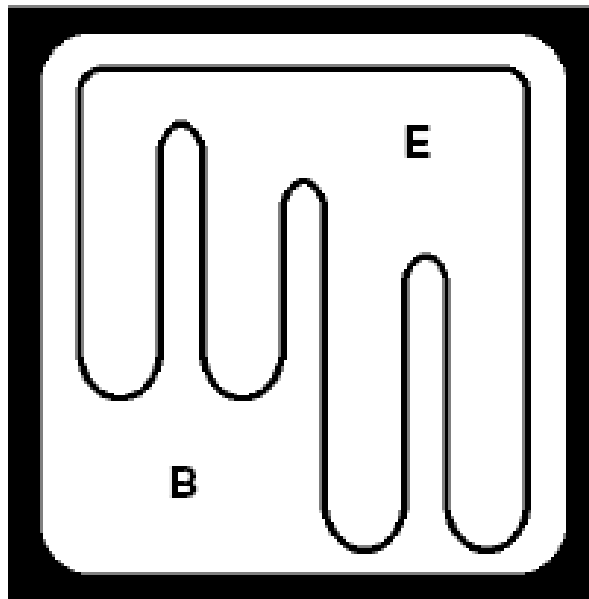


Symbol	Dimensions			
	in	in	mm	mm
	Min	Max	Min	Max
BL	.215	.225	5.46	5.72
BW	.145	.155	3.68	3.94
CH	0.049	0.075	1.24	1.91
LH		.020		0.51
LW1	.135	.145	3.43	3.68
LW2	.047	.057	1.19	1.45
LL1	.085	.125	2.16	3.17
LL2	.045	.075	1.14	1.9
LS1	0.07	.095	1.78	2.41
LS2	0.035	.048	0.890	1.21
Q1	0.03	.070	0.76	1.78
Q2	0.02	0.035	0.51	0.89
TERM 1	Collector			
TERM 2	Base			
TERM 3	Emitter			

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.

FIGURE 2. Physical dimensions and configuration (SMD.22) (2N3740U4, 2N3741U4).



C - version

NOTES:

1. Chip size: .070 x .070 inch \pm .002 inch (1.78 x 1.78 mm \pm .0508 mm).
2. Chip thickness: .014 \pm .0015 inch (.356 \pm .0381 mm) nominal.
3. Top metal: Aluminum 54,000 Å minimum, 66,000Å nominal.
4. Back metal: Al/Ti/Ni/Au 10,000Å minimum, 12,000Å nominal.
5. Backside: Collector.
6. Bonding pad: B = .028 x .016 inch (.711 x .406 mm), E = .028 x .016 inch (.711 x .406 mm).
7. Previous A and B versions of JANC die are obsolete.

FIGURE 3. Physical dimensions, JANHCC and JANKCC die.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 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 and 4 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://quicksearch.dla.mil>.)

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 ([QML-19500](#)) 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 and physical dimensions. The Interface and physical dimensions shall be as specified in [MIL-PRF-19500](#), and herein. The device package styles shall be as follows: TO-66, in accordance with [figure 1](#), three pad surface mount case outline in accordance with [figure 2](#), and unencapsulated die in accordance with [figure 3](#) for device types JANHC and JANKC.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with [MIL-PRF-19500](#), [MIL-STD-750](#), and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see [6.2](#)).

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

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3.6 Radiation hardness assurance (RHA). Radiation hardness assurance requirements and test levels shall be as defined in [MIL-PRF-19500](#).

3.7 Marking.

3.7.1 Through hole mount packages. Marking shall be in accordance with [MIL-PRF-19500](#).

3.7.2 Surface mount packages. Marking shall be in accordance with [MIL-PRF-19500](#). The marking of the U4 package shall consist of an abbreviated part number, the date code, and the manufacturer's symbol or logo. The prefixes JAN, JANTX, JANTXV and JANS can be abbreviated as J, JX, JV and JS respectively. The "2N" prefix and the "U4" suffix can also be omitted. The radiation hardness designator shall immediately precede (or replace) the device "2N" identifier (depending upon degree of abbreviation required).

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 [table I, II, and III](#)).

4.2 Qualification inspection. Qualification inspection shall be in accordance with [MIL-PRF-19500](#) and as specified herein.

4.2.1 JANHC and JANKC devices. JANHC and JANKC devices are qualified in accordance with [MIL-PRF-19500](#).

4.2.2 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 request the performance of [table IV](#) tests, the tests specified in [table IV](#) herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

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4.3 Screening.

4.3.1 Screening of encapsulated devices (quality levels JANTX, JANTXV and JANS only). Screening of encapsulated devices 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	Measurements for JANS level	Measurements for JANTX and JANTXV levels
(1) 3c	Thermal impedance, method 3131 of MIL-STD-750 , see 4.3.1.2.	Thermal impedance, method 3131 of MIL-STD-750 , see 4.3.1.2.
9	I_{CEX1} and h_{FE2}	Not applicable.
10	48 hours minimum.	48 hours minimum.
11	I_{CEX1} and h_{FE2} ; ΔI_{CEX1} = 100 percent of initial value or 50 nA dc, whichever is greater, Δh_{FE2} = \pm 25 percent of initial value.	I_{CEX1} and h_{FE2}
12	See 4.3.1.1	See 4.3.1.1
13	Subgroups 2 and 3 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 50 nA dc; whichever is greater; Δh_{FE2} = \pm 25 percent of initial value.	Subgroup 2 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 50 nA dc, whichever is greater; Δh_{FE2} = \pm 25 percent of initial value.

(1) Thermal impedance shall be performed anytime after temperature cycling, JANTX and JANTXV levels do not need to be repeated in screening requirements.

4.3.1.1 Power burn-in conditions. Power burn-in conditions are as follows: V_{CB} = -10 to -30 V dc. Power shall be applied to the device to achieve a junction temperature, T_J = +175 °C minimum and a minimum P_D = 75 percent of P_T maximum rated as defined in [1.3](#).

4.3.1.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3131 of [MIL-STD-750](#) using the guidelines in that method for determining I_M , I_H , t_H , t_{SW} , (and V_H where appropriate). See table IV, group E, subgroup 4 herein.

4.3.2 Screening of unencapsulated die (JANHNC and JANKC). Screening of JANHC and JANKC unencapsulated die shall be in accordance with appendix G of [MIL-PRF-19500](#). The Burn-in duration for the JANKC level shall follow the JANS requirements; the JANHC level shall follow the JANTX requirements of [MIL-PRF-19500](#).

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4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing of MIL-PRF-19500, and 4.4.2.1 (JANS), and 4.4.2.2 (JAN, JANTX, and JANTXV). Delta requirements shall be in accordance with table II herein.

4.4.2.1 Quality level JANS, table E-VIA of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B4	1037	$V_{CB} = -10$ V dc, 2,000 cycles, $t_{ON} = t_{OFF} = 3$ minutes, $P_{D(ON)} = P_D$ max rated in accordance with 1.3; $P_{D(OFF)} = 0$.
B5	1027	(NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.) $V_{CB} = -10$ V dc, $P_D \geq 100$ percent of maximum rated P_T (see 1.3). Option 1: 96 hours minimum sample size in accordance with table VIa of MIL-PRF-19500, adjust T_A or P_D to achieve $T_J = +275^\circ\text{C}$ minimum. Option 2: 216 hours minimum, sample size = 45, $c = 0$; adjust T_A or P_D to achieve $T_J = +225^\circ\text{C}$ minimum.

4.4.2.2 Quality level JAN, JANTX and JANTXV, table E-VIB of MIL-PRF-19500. Separate samples may be used for each step. Delta requirements for JAN, JANTX, and JANTXV shall be after each step and shall be in accordance with table II herein.

<u>Step</u>	<u>Method</u>	<u>Condition</u>
1	1037	6,000 cycles, $t_{ON} = t_{OFF} = 3$ minutes, $P_{D(ON)} = P_D$ max rated per 1.3; $P_{D(OFF)} = 0$. $n = 45$, $c = 0$.
2	1048	Blocking life: $T_A = +150^\circ\text{C}$, $V_{CB} = 80$ percent of rated voltage, 48 hours min. $n = 45$, $c = 0$.
3	1032	High-temperature life (non-operating), $t = 340$ hours, $T_A = +200^\circ\text{C}$. $n = 22$, $c = 0$.

4.4.2.3 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements:

- For JAN, JANTX, and JANTXV, samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.
- Shall be chosen from an inspection lot that has been submitted to and passed table I, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

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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](#), and 4.4.3.1 (JANS), and 4.4.3.2 (JAN, JANTX, and JANTXV) herein for group C testing. Delta requirements shall be in accordance with [table II](#) herein.

4.4.3.1 Quality level JANS, table E-VII of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	2036	Test condition A, weight = 3 lbs, t = 15 s, not applicable to 2N3740U4 and 2N3741U4.
C5	3131	Thermal resistance; see 4.3.1.2, $R_{\theta JC} = 7^{\circ}\text{C/W}$ for 2N3740, 2N3741; $R_{\theta JC} = 6^{\circ}\text{C/W}$ for 2N3740U4, 2N3741U4.
C6	1037	6,000 cycles, $t_{ON} = t_{OFF} = 3$ minutes, $P_{D(ON)} = P_D$ max rated in accordance with 1.3 ; $P_{D(OFF)} = 0$.

4.4.3.2 Quality levels JAN, JANTX, and JANTXV, table E-VII of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	2036	Test condition A, weight = 3 lbs, t = 15 s, not applicable to 2N3740U4 and 2N3741U4.
C5	3131	Thermal resistance; see 4.3.1.2 , $R_{\theta JC} = 7^{\circ}\text{C/W}$ for 2N3740, 2N3741; $R_{\theta JC} = 6^{\circ}\text{C/W}$ for 2N3740U4, 2N3741U4.
C6		Not applicable.

4.4.3.3 Group C inspection sample selection. Samples for subgroups in group C shall be chosen at random from any lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes [table I](#) tests for conformance inspection. Testing of a group using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

4.4.4 Group D inspection. Conformance inspection for hardness assured JANS and JANKC types shall include the group D tests specified in [table III](#) herein. These tests shall be performed as required in accordance with [MIL-PRF-19500](#) and method 1019 of [MIL-STD-750](#), for total ionizing dose or method 1017 of [MIL-STD-750](#) for neutron fluence as applicable (see [6.2](#) herein), except group D, subgroup 2 may be performed separate from other subgroups. Group D inspection may also be performed ahead of the screening lot using die selected in accordance with [MIL-PRF-19500](#) and related documents. Alternate package options may also be substituted for the testing provided there is no adverse effect to the fluence profile.

4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of [MIL-PRF-19500](#) and as specified herein. Delta requirements shall be in accordance with [table II](#) herein.

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

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of [MIL-STD-750](#).

4.5.2 Inspection conditions. Unless otherwise specified, all inspections shall be conducted at a case temperature of $+25^{\circ}\text{C} \pm 3^{\circ}\text{C}$.

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TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1 2/</u>						
Visual and mechanical <u>3/</u> examination	2071					
Solderability <u>3/ 4/</u>	2026	n = 15 leads, c = 0				
Resistance to <u>3/ 4/ 5/</u> solvent	1022	n = 15 devices, c = 0				
Salt atmosphere (corrosion) <u>4/</u>	1041	n = 6 devices, c = 0, (For laser marked devices only)				
Temp cycling <u>3/ 4/</u>	1051	Test condition C, 25 cycles, n = 22 devices, c = 0				
Hermetic seal <u>4/</u> Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements <u>4/</u>		Table I, subgroup 2 herein				
Bond strength <u>3/ 4/</u>	2037	Pre-condition T _A = +250°C at t = 24 hrs or T _A = +300°C at t = 2 hrs, n = 11 wires, c = 0				
Decap Internal visual <u>4/</u>	2075	n = 4 devices, c = 0				
<u>Subgroup 2</u>						
Thermal impedance <u>6/</u>	3131	See 4.3.1.2	Z _{θJX}			°C/W
Breakdown voltage, collector to emitter 2N3740 2N3741	3011	Bias condition D; I _C = -100 mA dc; pulsed (see 4.5.1)	V _{(BR)CEO}	-60 -80		V dc V dc
Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition D V _{CE} = -40 V dc V _{CE} = -60 V dc	I _{CEO}		-10	μA dc
Emitter to base cutoff current	3061	Bias condition D; V _{EB} = -7 V dc	I _{EBO}		-100	nA dc
Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition A; V _{BE} = +1.5 V dc V _{CE} = -60 V dc V _{CE} = -80 V dc	I _{CEX1}		-300	nA dc

See footnotes at end of table.

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TABLE I. Group A inspection - Continued.

Inspection 1/ 	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> -Continued.						
Collector to base cutoff current 2N3740 2N374	3036	Bias condition D V _{CE} = -60 V dc V _{CE} = -80 V dc	I _{CBO}		-100	nA dc
Base emitter voltage (non-saturated)	3066	Test condition B; V _{CE} = -1 V dc; I _C = -250 mA dc pulsed (see 4.5.1)	V _{BE}		-1	V dc
Saturation voltage and resistance	3071	I _C = -250 mA dc; I _B = -25 mA dc pulsed (see 4.5.1)	V _{CE(sat)1}		-0.4	V dc
Saturation voltage and resistance	3071	I _C = -1 A dc; I _B = -125 mA dc pulsed (see 4.5.1)	V _{CE(sat)2}		-0.6	V dc
Forward-current transfer ratio	3076	V _{CE} = -1 V dc; pulsed (see 4.5.1) I _C = -100 mA dc I _C = -250 mA dc I _C = -500 mA dc I _C = -1 A dc	h _{FE1} h _{FE2} h _{FE3} h _{FE4}	40 30 20 10	120	
Forward-current transfer ratio	3076	V _{CE} = -5 V dc; I _C = -4 A dc pulsed (see 4.5.1)	h _{FE5}	3		
<u>Subgroup 3</u>						
High temperature operation:		T _A = +150°C				
Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition A, V _{BE} = +1.5 V dc V _{CE} = -60 V dc V _{CE} = -80 V dc	I _{CEX2}		-25	μA dc
Low temperature operation:		T _A = -55°C				
Forward-current transfer ratio	3076	V _{CE} = -1 V dc; I _C = -250 mA dc pulsed (see 4.5.1)	h _{FE6}	10		
<u>Subgroup 4</u>						
Small-signal short-circuit forward-current transfer ratio	3206	V _{CE} = -10 V dc; I _C = -50 mA dc; f = 1 kHz	h _{fe}	25	250	
Small-signal short-circuit forward-current transfer ratio	3306	V _{CE} = -10 V dc; I _C = -100 mA dc; f = 5 MHz	h _{fe}	1	12	

See footnotes at end of table.

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TABLE I. Group A inspection - Continued.

Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued.						
Open circuit output capacitance	3236	$V_{CB} = -10 \text{ V dc}; I_E = 0;$ $100 \text{ KHz} \leq f \leq 1 \text{ MHz}$	C_{obo}		100	pF
Pulse response						
Turn-on time			$I_C = -1 \text{ A dc}; I_{B1} = -0.1 \text{ A dc}$ (see figure 8)	t_{on}	400	ns
Turn-off time			$I_C = -1 \text{ A dc}; I_{B1} = I_{B2} = -0.1 \text{ A dc}$ (see figure 8)	t_{off}	1	μs
<u>Subgroup 5</u>						
SOA (continuous dc)	3051	$T_C = +25^\circ\text{C};$ power application time = 1 s; 1 cycle (see figure 9) $V_{CE} = -6.25 \text{ V dc}; I_C = -4 \text{ A dc}$				
Test 1						
Test 2			$V_{CE} = -20 \text{ V dc}; I_C = -1.25 \text{ A dc}$			
Test 3			$I_C = -150 \text{ mA dc}$			
2N3740 2N3741			$V_{CE} = -50 \text{ V dc}$ $V_{CE} = -65 \text{ V dc}$			
SOA (clamped switching)	3053	$T_A = +25^\circ\text{C}; V_{CC} = -15 \text{ V dc};$ duty cycle ≤ 5 percent, $t_p = 1.5 \text{ ms}$ (vary to obtain I_C), $I_C = -4 \text{ A dc}$ (see figures 10 and 11)				
2N3740 2N3741			Clamp voltage = -60 V dc Clamp voltage = -80 V dc			
End-point electrical measurements			See table I, subgroup 2 herein			
SOA (switching)			Load condition C (unclamped inductive) (see figure 12); $T_A = +25^\circ\text{C};$ duty cycle ≤ 5 percent, $R_S = 0.1 \Omega;$ $t_r = t_f \leq 500 \text{ ns}; R_{BB1} = 50 \Omega;$ $V_{BB1} = -10 \text{ V dc}; R_{BB2} = \infty;$ $V_{BB2} = 0; V_{CC} \geq -20 \text{ V dc}$			
Test 1			$t_p = 375 \mu\text{s}$ (vary to obtain I_C); $I_C = -1 \text{ A dc}; L = 5 \text{ mH}$ (min) at 1 A with maximum dc resistance of 0.5 Ω . For reference only: 2 ESSEX Stancor C-2688 (in parallel), or equivalent			

See footnotes at end of table.

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TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 5</u> - Continued.						
Test 2		$t_p = 1.5$ ms (vary to obtain I_C); $I_C = -.25$ A dc; $L = 80$ mH (min) at .25 A with a maximum dc resistance of 1Ω . For reference only. ESSEX Stancor C-2691 or Triad C = 48				
SOA (clamped switching) (destructive)	3053	Condition B, $T_A = +25^\circ\text{C}$; $V_{CC} = -55$ V dc (see figures 10 and 11); duty cycle ≤ 5 percent, $t_p = 1.5$ ms (vary to obtain I_C); $I_C = -4$ A dc				
2N3740 2N3741		Clamp voltage = -60 V dc Clamp voltage = -80 V dc				
End-point electrical measurements		See table I, subgroup 2 herein				
<u>Subgroups 6 and 7</u>						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.

2/ For resubmission of failed subgroup 1, double the sample size of the failed test or sequence of tests.

3/ Separate samples may be used.

4/ Not required for JANS.

5/ Not required for laser marked devices.

6/ This test required for the following end-point measurements only:

Group B, subgroups 3, 4, and 5 (JANS).

Group B, see 4.4.2.2 herein, after each step (JAN, JANTX, and JANTXV).

Group C, subgroup 2 and 6 for JANS and subgroup 2 only for JAN, JANTX, and JANTXV.

Group E, subgroup 1.

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TABLE II. Group B, C, and E delta measurements. 1/ 2/ 3/ 4/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition A; $V_{BE} = +1.5$ V dc $V_{CE} = -60$ V dc $V_{CE} = -80$ V dc	ΔI_{CEX1}			100 percent of initial value or -50 nA dc, whichever is greater.
2.	Forward-current transfer ratio	3076	$V_{CE} = -1$ V dc; $I_C = -250$ mA dc; pulsed (see 4.5.1)	Δh_{FE2}			± 25 percent change from initial reading.
3.	Saturation voltage and resistance	3071	$I_C = -250$ mA dc; $I_B = -25$ mA dc; pulsed (see 4.5.1)	$\Delta V_{CE(sat)1}$			-50 mV dc change from initial value.

- 1/ The delta measurements for table E-VIA (JANS) of MIL-PRF-19500 are as follows:
- Subgroup 4, see table II, step 3.
 - Subgroup 5, see table II, steps 1, 2, and 3.
- 2/ The delta measurements for 4.4.2.2, group B (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are after each step in 4.4.2.2, see table II, steps 1, 2, and 3.
- 3/ The delta measurements for table E-VII of MIL-PRF-19500 are as follows: Subgroup 6, see table II, steps 1 and 2 (JANS only).
- 4/ The delta measurements for table E-IX (all quality levels) of MIL-PRF-19500 are as follows: Subgroup 1, see table II, step 2; subgroup 2, see table II, steps 1 and 2.

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* TABLE III. Group D inspection.

Inspection <u>1/</u> <u>2/</u> <u>3/</u>	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u> <u>4/</u>						
Neutron irradiation	1017	Neutron exposure $V_{ces} = 0$ V				
Breakdown voltage, collector to emitter 2N3740 2N3741	3011	Bias condition D; $I_C = -100$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	-60 -80		V dc V dc
Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition D $V_{CE} = -40$ V dc $V_{CE} = -60$ V dc	I_{CEO}		-20	μ A dc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = -7$ V dc	I_{EBO}		-200	nA dc
Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition A; $V_{BE} = +1.5$ V dc $V_{CE} = -60$ V dc $V_{CE} = -80$ V dc	I_{CEX1}		-600	nA dc
Collector to base cutoff current 2N3740 2N3741	3036	Bias condition D, $V_{CE} = -60$ V dc $V_{CE} = -80$ V dc	I_{CBO}		-200	nA dc
.Base emitter voltage (nonsaturated)	3066	Test condition B; $V_{CE} = -1$ V dc; $I_C = -250$ mA dc pulsed (see 4.5.1)	V_{BE}		-2	V dc
Saturation voltage and resistance	3071	$I_C = -250$ mA dc; $I_B = -25$ mA dc pulsed (see 4.5.1)	$V_{CE(sat)1}$		-0.46	V dc
Saturation voltage and resistance	3071	$I_C = -1$ A dc; $I_B = -125$ mA dc pulsed (see 4.5.1)	$V_{CE(sat)2}$		-0.69	V dc
Forward-current transfer ratio	3076	$V_{CE} = -1$ V dc; pulsed (see 4.5.1) $I_C = -100$ mA dc $I_C = -250$ mA dc $I_C = -500$ mA dc $I_C = -1$ A dc	$[h_{FE1}]$ <u>5/</u> $[h_{FE2}]$ <u>5/</u> $[h_{FE3}]$ <u>5/</u> $[h_{FE4}]$ <u>5/</u>	[20] [15] [10] [5]	120	
Forward-current transfer ratio	3076	$V_{CE} = -5$ V dc; $I_C = -4$ A dc pulsed (see 4.5.1)	$[h_{FE5}]$ <u>5/</u>	[1.5]		

See footnotes at end of table.

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* TABLE III. Group D inspection - Continued.

Inspection <u>1/</u> <u>2/</u> <u>3/</u>	MIL-STD-750		Symbol	Limits	Limits	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u>						
Total dose irradiation 2N3740 2N3741	1019	Gamma exposure, Condition A Vces = -48V Vces = -64V	V _{(BR)CEO}	-60 -80		V dc V dc μA dc
Breakdown voltage, collector to emitter 2N3740 2N3741	3011	Bias condition D; I _C = -100 mA dc; pulsed (see 4.5.1)				
Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition D V _{CE} = -40 V dc V _{CE} = -60 V dc	I _{CEO}		-20	
Emitter to base cutoff current	3061	Bias condition D; V _{EB} = -7 V dc	I _{EBO}		-200	nA dc
Collector to emitter cutoff current 2N3740 2N3741	3041	Bias condition A; V _{BE} = -1.5 V dc V _{CE} = -60 V dc V _{CE} = -80 V dc	I _{CEx1}		-600	nA dc
Collector to base cutoff current 2N3740 2N3741	3036	Bias condition D V _{CE} = -60 V dc V _{CE} = -80 V dc	I _{CBO}		-200	nA dc
Base emitter voltage (nonsaturated)	3066	Test condition B; V _{CE} = -1 V dc; I _C = -250 mA dc pulsed (see 4.5.1)	V _{BE}		-2	V dc
Saturation voltage and resistance	3071	I _C = -250 mA dc; I _B = -25 mA dc pulsed (see 4.5.1)	V _{CE(sat)1}		-0.46	V dc
Saturation voltage and resistance	3071	I _C = -1 A dc; I _B = -125 mA dc pulsed (see 4.5.1)	V _{CE(sat)2}		-0.69	V dc
Forward-current transfer ratio	3076	V _{CE} = -1 V dc; pulsed (see 4.5.1) I _C = -100 mA dc I _C = -250 mA dc I _C = -500 mA dc I _C = -1 A dc	[h _{FE1}] <u>5/</u> [h _{FE2}] <u>5/</u> [h _{FE3}] <u>5/</u> [h _{FE4}] <u>5/</u>	[20] [15] [10] [5]	120	
Forward-current transfer ratio	3076	V _{CE} = -5 V dc; I _C = -4 A dc pulsed (see 4.5.1)	[h _{FE5}] <u>5/</u>	[1.5]		

1/ Tests to be performed on all devices receiving radiation exposure.

2/ For sampling plan, see MIL-PRF-19500.

3/ Electrical characteristics apply to all device types unless otherwise noted.

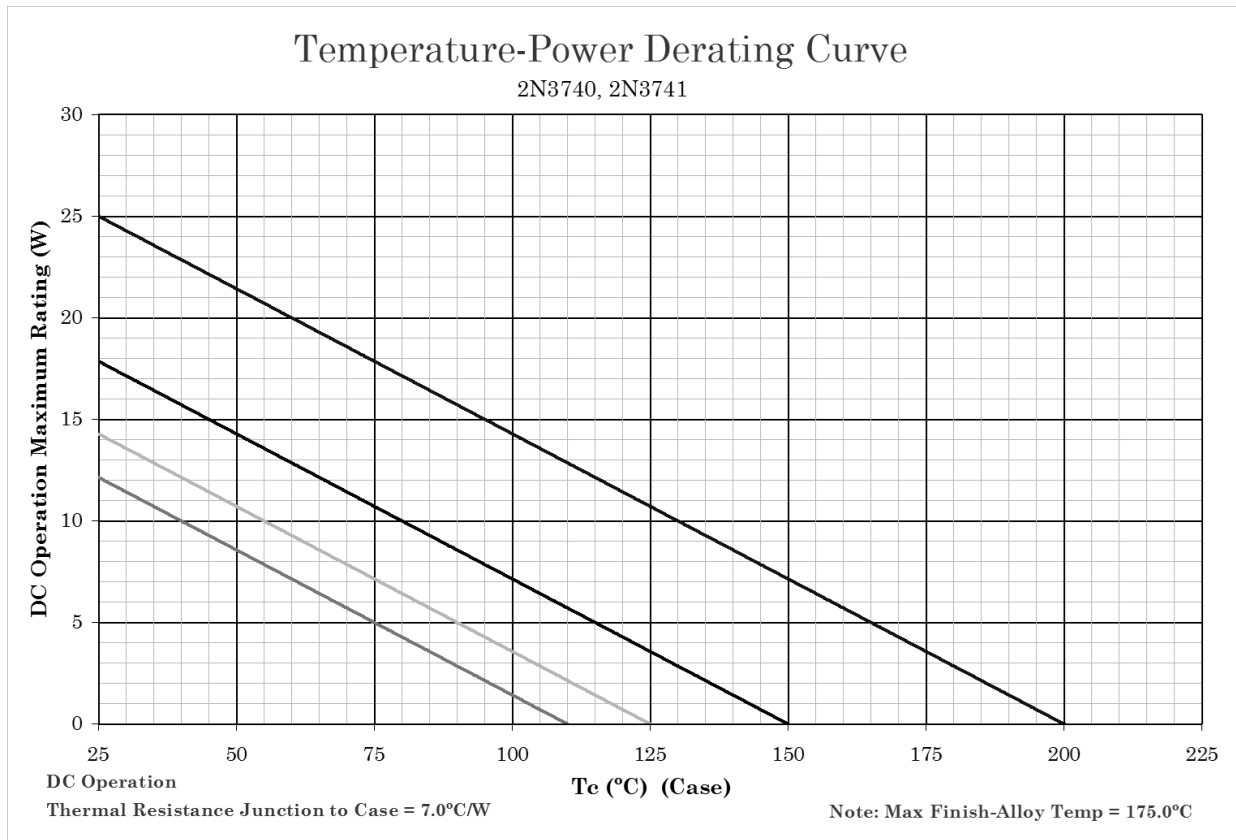
4/ See 6.2.e herein.

5/ See method 1019, of MIL-STD-750, for how to determine [h_{FE}] by first calculating the delta(1/h_{FE}) from the pre and post-radiation h_{FE}. Notice that [h_{FE}] is not the same as h_{FE} and cannot be measured directly. The [h_{FE}] value can never exceed the pre-radiation minimum h_{FE} that it is based upon.

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TABLE IV. Group E inspection (all quality levels) - for qualification or re-qualification only.

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
<u>Subgroup 1</u>			
Temperature cycling (air to air)	1051	Test condition C, 500 cycles.	45 devices c = 0
Hermetic seal Fine leak Gross leak	1071		
Electrical measurements		See table I, subgroup 2 and table II herein.	
<u>Subgroup 2</u>			
Blocking life	1048	$T_A = +150^{\circ}\text{C}$, $V_{CB} = 80$ percent of rated voltage, $t = 1,000$ hours.	45 devices c = 0
Electrical measurements		See table I, subgroup 2 and table II herein.	
<u>Subgroup 4</u>			
Thermal impedance curves		See MIL-PRF-19500.	Sample size N/A
<u>Subgroup 8</u>			
Reverse stability	1033	Condition B.	45 devices c = 0

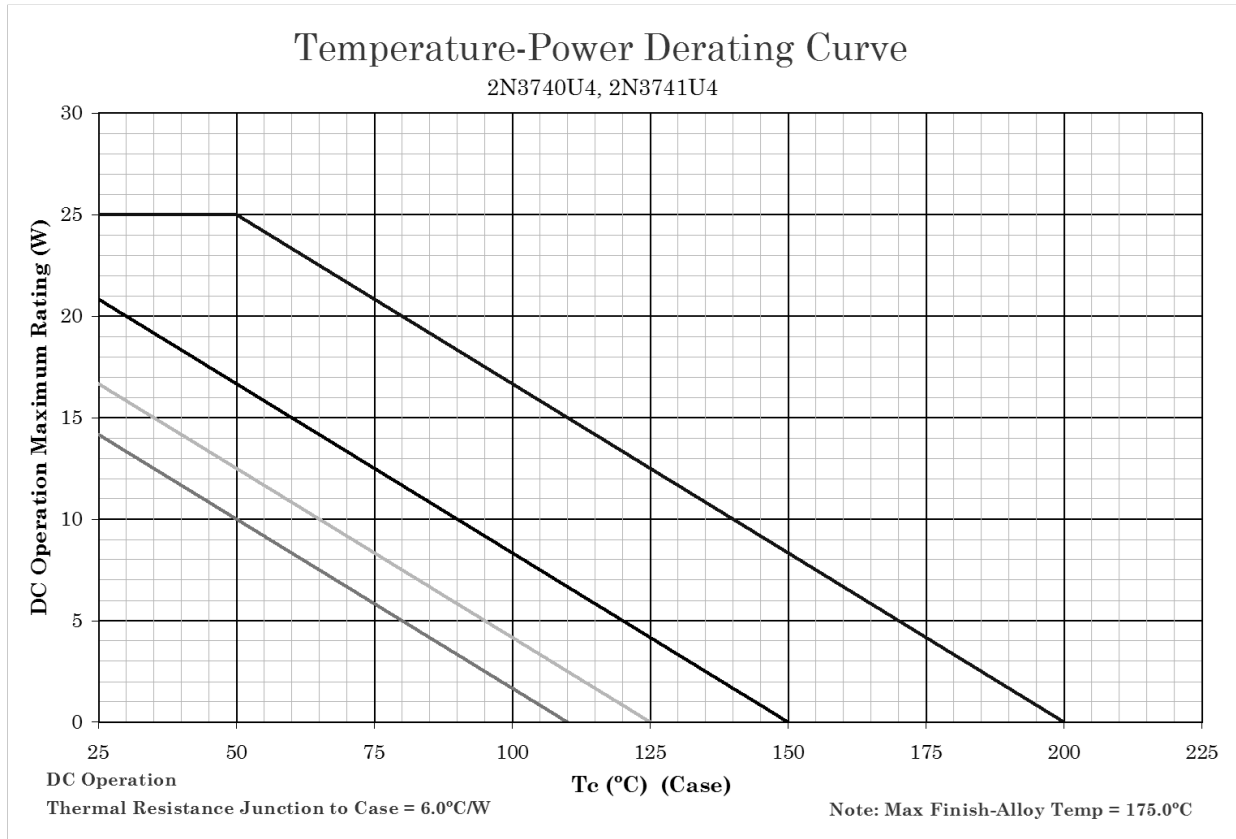


$$R_{\theta JC} = 7^{\circ}\text{C/W}$$

NOTES:

1. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperature ($T_J \leq +200^{\circ}\text{C}$) and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^{\circ}\text{C}$ where the maximum temperature of electrical test is performed.
4. Derate design curves chosen at $T_J \leq +125^{\circ}\text{C}$ and $+110^{\circ}\text{C}$ to show power rating where most users want to limit T_J in their application.

FIGURE 4. Temperature-power derating graph (2N3740, 2N3741, TO-66).



$$R_{\theta JC} = 6^{\circ}\text{C/W}$$

NOTES:

1. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperature ($T_J \leq +200^{\circ}\text{C}$) and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq +150^{\circ}\text{C}$ where the maximum temperature of electrical test is performed.
4. Derate design curves chosen at $T_J \leq +125^{\circ}\text{C}$ and $+110^{\circ}\text{C}$ to show power rating where most users want to limit T_J in their application.

FIGURE 5. Temperature-power derating graph (2N3740U4, 2N3741U4).

Maximum Thermal Impedance

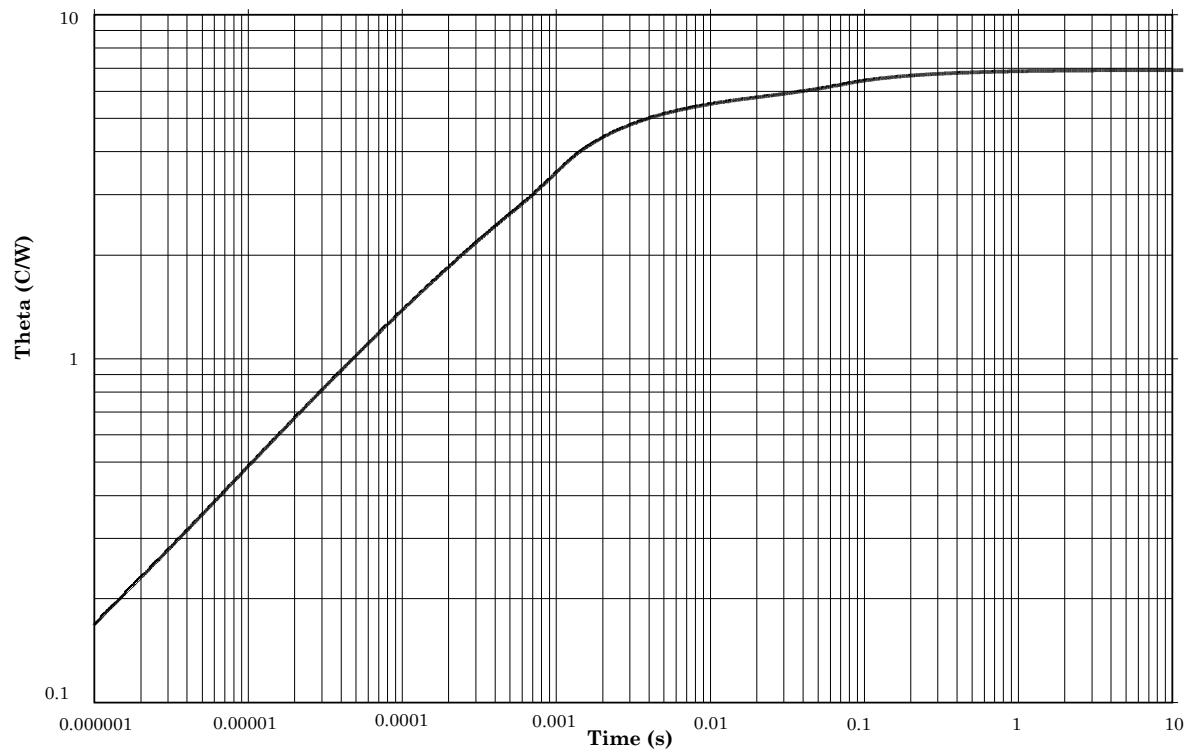


FIGURE 6. Transient thermal impedance graph (2N3740 and 2N3741).

Maximum Thermal Impedance

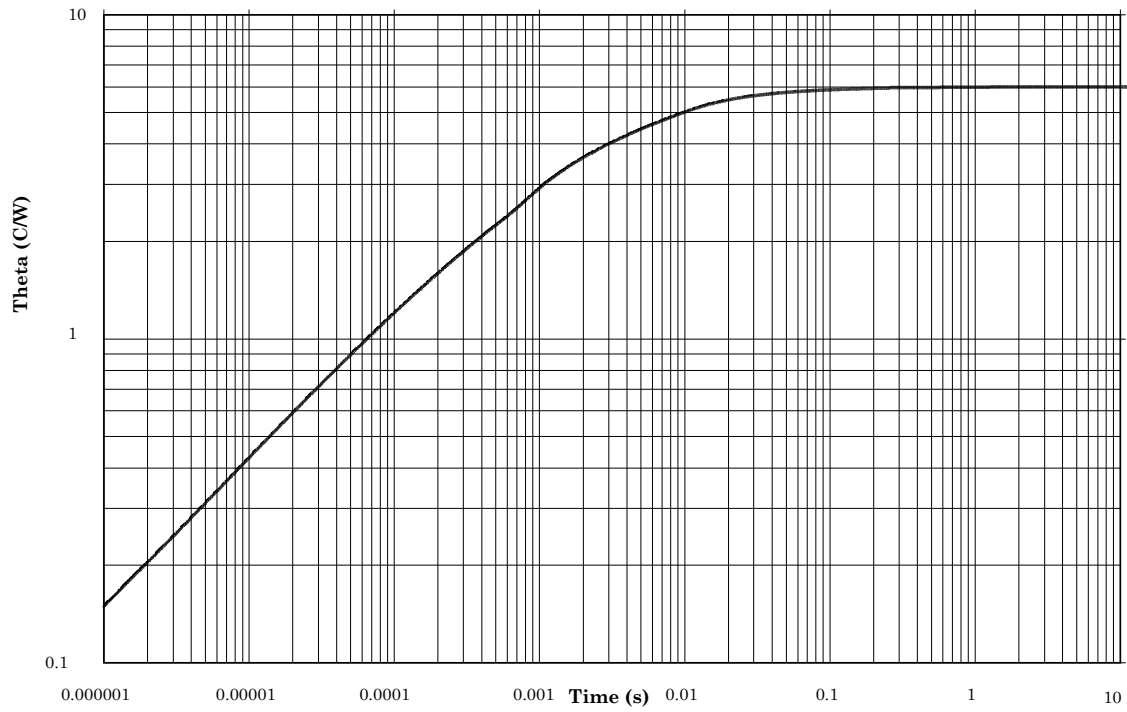
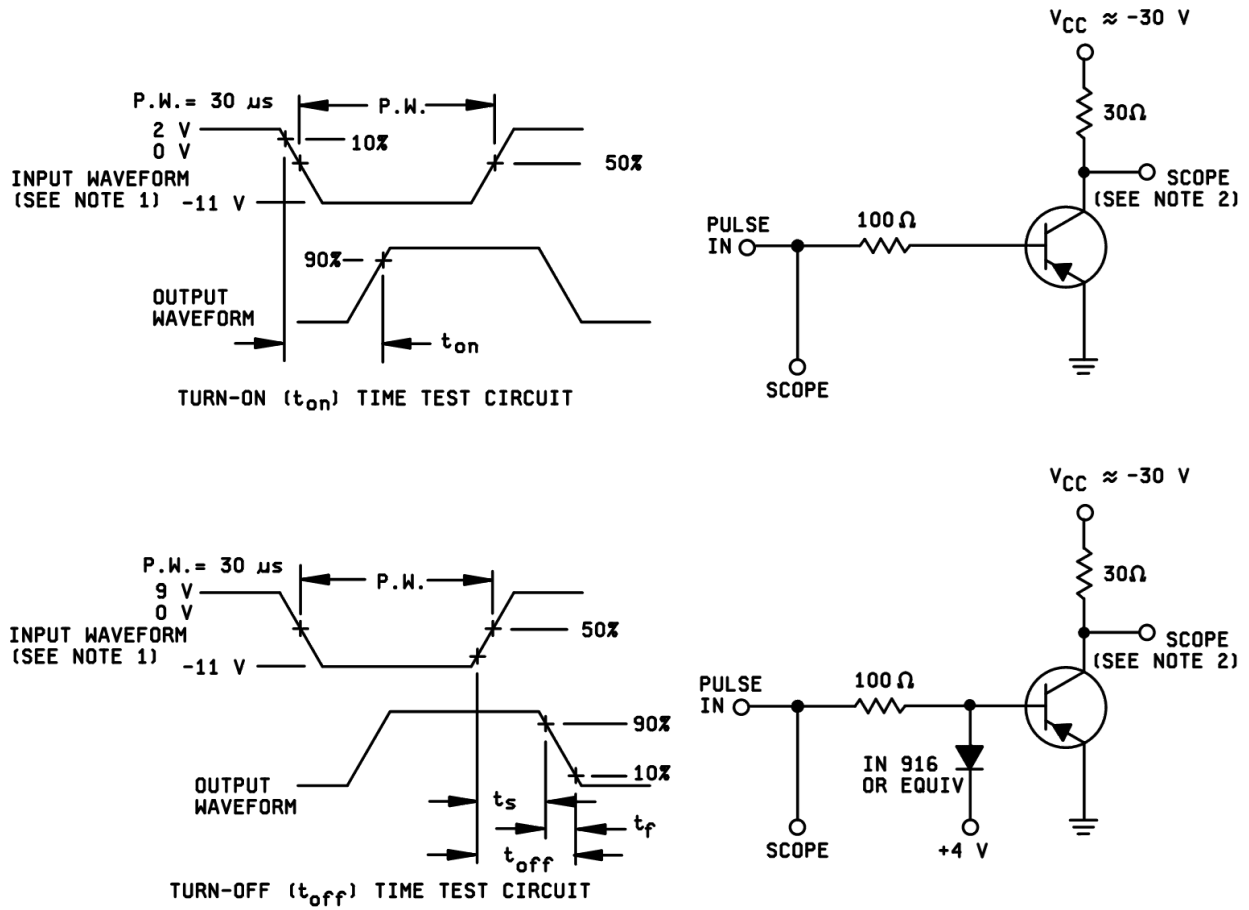


FIGURE 7. Transient thermal impedance graph (2N3740U4 and 2N3741U4).



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 20 ns; duty cycle ≤ 2 percent; generator source impedance shall be 50 Ω .
2. Output sampling oscilloscope: $Z_{in} \geq 100$ k Ω ; $C_{in} \leq 12$ pF; rise time ≤ 2 ns.

FIGURE 8. Pulse response test circuits.

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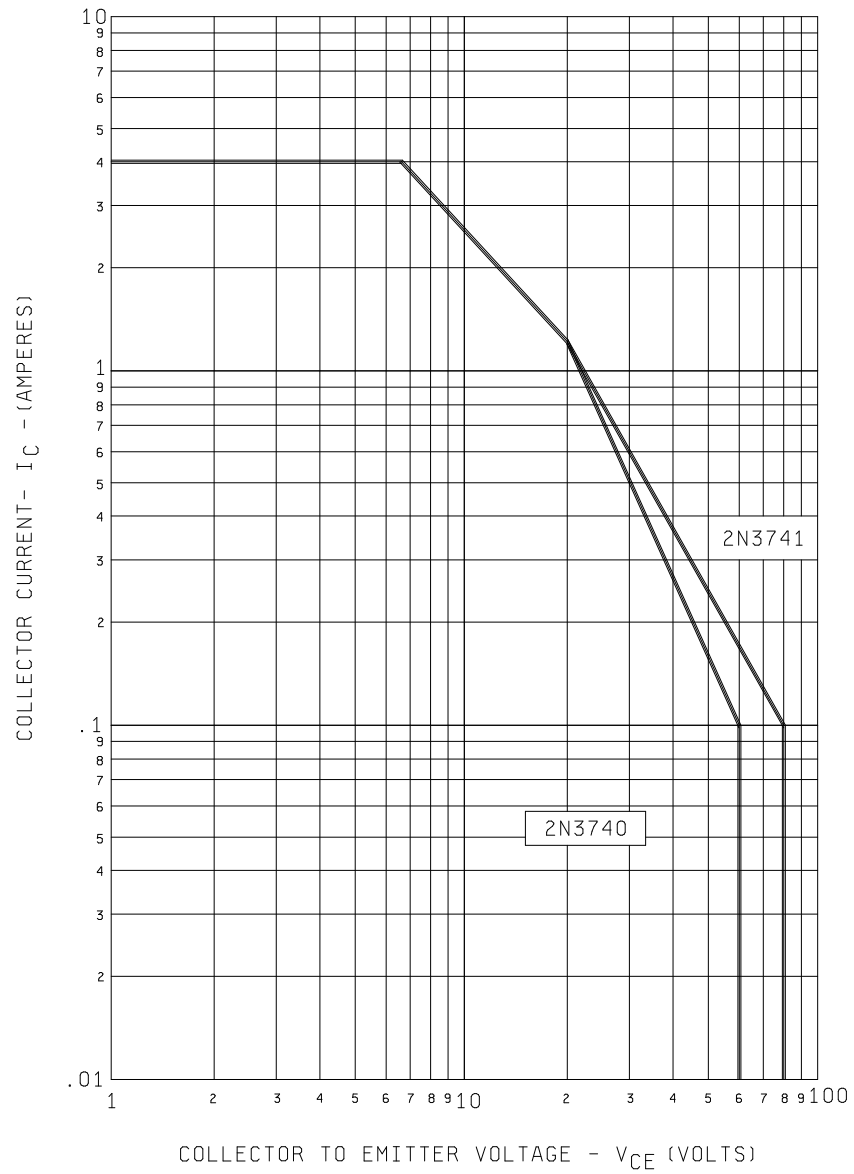
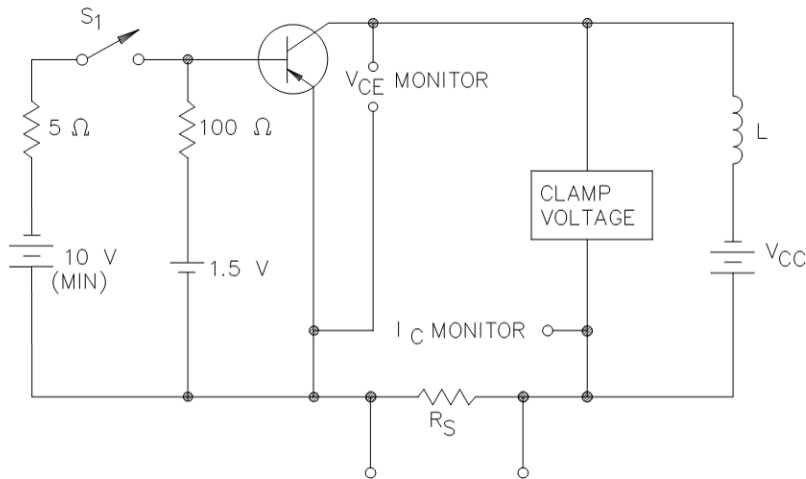


FIGURE 9. Maximum SOA graph (continuous dc, all devices).

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$R_S \leq .1\Omega$ 12W; 1 percent tolerance maximum (noninductive).

$L = 5$ mH at 4 A with a maximum dc resistance of 0.5Ω .
Reference only: 2 ESSEX Stancor C-2688 (in parallel),
or equivalent.

Procedure

1. With switch S_1 closed, set the specified test conditions.
2. Open S_1 . Device fails if the clamp voltage is not reached.
3. Perform specified end-point tests.

FIGURE 10. Clamped inductive sweep test circuit.

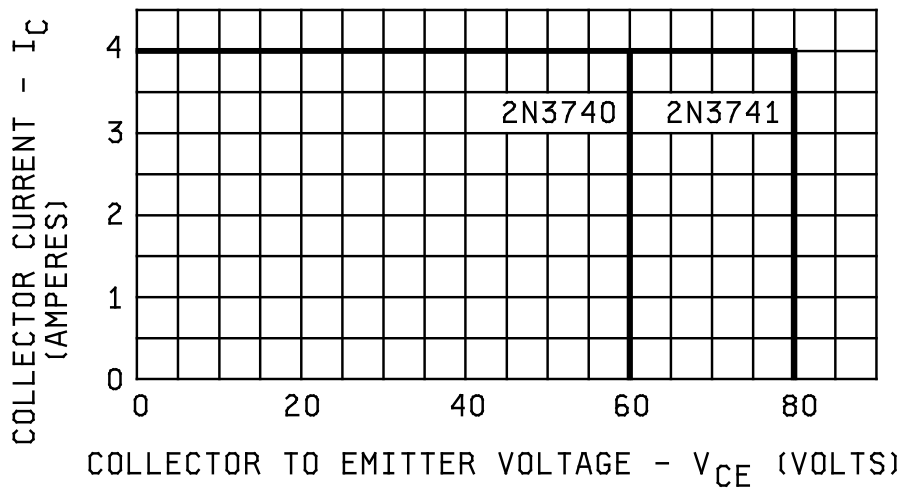


FIGURE 11. SOA for switching between saturation and cutoff (clamped inductive load, all devices).

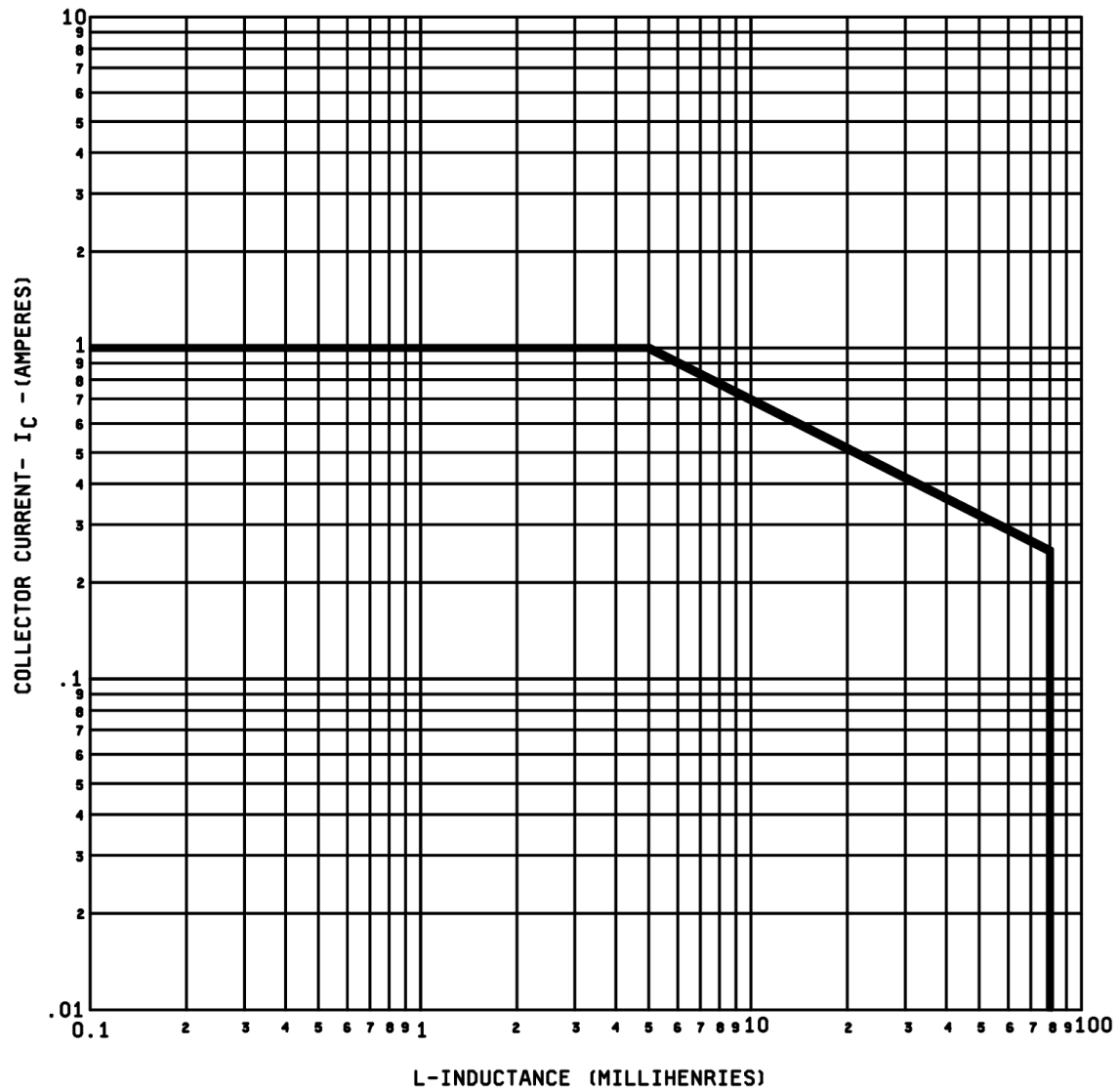


FIGURE 12. Safe operating area for switching between saturation and cutoff (unclamped inductive load).

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 finish (see 3.4.1).
- d. The complete PIN (see [1.5](#) and [6.5](#)).
- e. For acquisition of RHA designated devices, table III, subgroup 1 testing of group D herein is optional. If subgroup 1 is desired, it must be specified in the contract.

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 DLA Land and Maritime, ATTN: 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.dla.mil>.

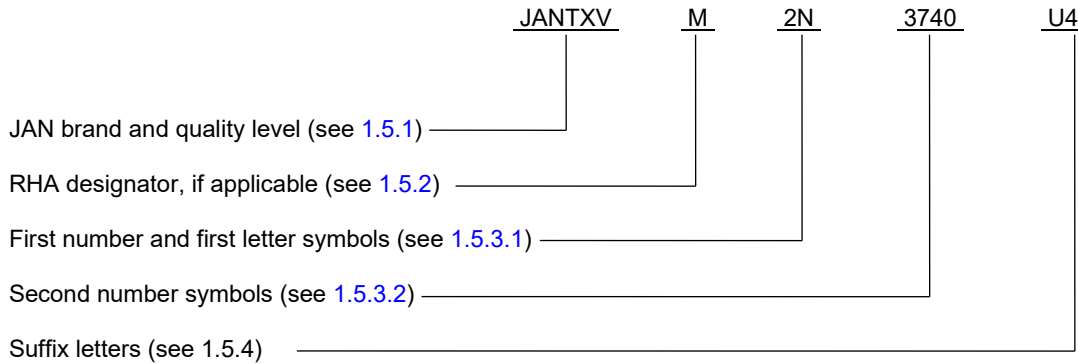
6.4 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example, JANHCC3740) will be identified on the QPDSIS. The previous die versions A and B are no longer available.

JANC ordering information	
PIN	Manufacturer
	43611
2N3740	JANHCC2N3740
2N3740	JANKCC2N3740
2N3741	JANHCC2N3741
2N3741	JANKCC2N3741

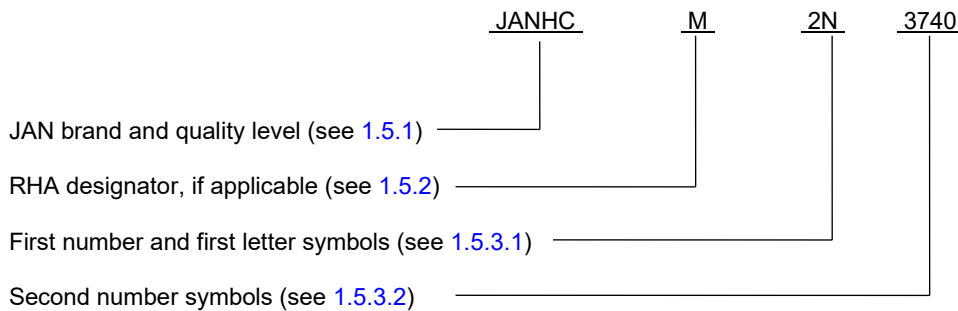
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6.5 PIN construction examples.

6.5.1 Encapsulated devices. The PIN for encapsulated devices are constructed using the following form:



6.5.2 Un-encapsulated devices. The PINs for unencapsulated devices are constructed using the following form.



6.6 List of PINs.

6.6.1 Encapsulated devices. The following is a list of possible PINs available for encapsulated devices covered by this specification sheet.

PINs for devices of the base quality level	PINs for devices of the "TX" quality level	PINs for devices of the "TXV" quality level	PINs for devices of the "TXV" quality level with RHA (1)
JAN2N3740	JANTX2N3740	JANTXV2N3740	JANTXV#2N3740
JAN2N3740U4	JANTX2N3740U4	JANTXV2N3740U4	JANTXV#2N3740U4
JAN2N3741	JANTX2N3741	JANTXV2N3741	JANTXV#2N3741
JAN2N3741U4	JANTX2N3741U4	JANTXV2N3741U4	JANTXV#2N3741U4

PINs for devices of the "S" quality level	PINs for devices of the "S" quality level with RHA (1)
JANS2N3740	JANS#2N3740
JANS2N3740U4	JANS#2N3740U4
JANS2N3741	JANS#2N3741
JANS2N3741U4	JANS#2N3741U4

* (1) The number sign (#) represents one of eight RHA designators available ("M", "D", "P", "L", "R", "F", "G", or "H").

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6.6.2 Unencapsulated devices. The following is a list of possible PINs available for unencapsulated devices covered by this specification sheet.

JANHCC#2N3740	JANHCC#2N3741
JANKCC#2N3740	JANKCC#2N3741

- (1) The number sign (#) represents one of eight RHA designators available ("M", "D", "P", "L", "R", "F", "G", or "H").

6.7 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 and relationship to the last previous issue.

Custodians:

Army - CR
* Navy - SH
Air Force - 85
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2022-068)

Review activities:

Army - AR, AV, MI, SM
Navy - AS, MC
* Air Force - 19, 71

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.dla.mil/>.