

The documentation and process conversion measures necessary to comply with this document shall be completed by 19 August 2012.

MIL-PRF-19500/370H
19 February 2013
SUPERSEDING
MIL-PRF-19500/370G
14 August 2008

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-POWER,
TYPE 2N3442, JAN, JANTX, AND JANTXV

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 NPN silicon, high-power transistor. Three levels of product assurance are provided for each device type as specified in [MIL-PRF-19500](#).

1.2 Physical dimensions. The device package style is TO-204AA (formerly TO-3) in accordance with [figure 1](#).

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

Type	P_T (1) $T_A = +25^\circ\text{C}$	P_T (2) $T_C = +25^\circ\text{C}$	$R_{\theta JC}$ (3)	V_{CBO}	V_{CEO}	V_{EBO}	V_{CER}	I_B	I_C	T_J and T_{STG}
	<u>W</u>	<u>W</u>	<u>$^\circ\text{C}/\text{W}$</u>	<u>V dc</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>
2N3442	6.0	117	1.5	160	140	7	150	7	10	-65 to +200

- (1) Derate linearly 34.2 mW/ $^\circ\text{C}$ above $T_A = +25^\circ\text{C}$.
(2) See [figure 2](#) for temperature-power derating curves.
(3) See [figure 3](#) for transient thermal impedance graph.

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

	h_{FE1} (1)	$V_{CE(sat)}$ (1)	h_{fe}
Limits	$V_{CE} = 4 \text{ V dc}$ $I_C = 3 \text{ A dc}$	$I_C = 3 \text{ A dc}$ $I_B = 300 \text{ mA dc}$	$V_{CE} = 4 \text{ V dc}$ $I_C = 3 \text{ A dc}$, $f = 100 \text{ kHz}$
Min	20	<u>V dc</u>	1.0
Max	70	1.0	

- (1) Pulsed (see [4.5.1](#)).

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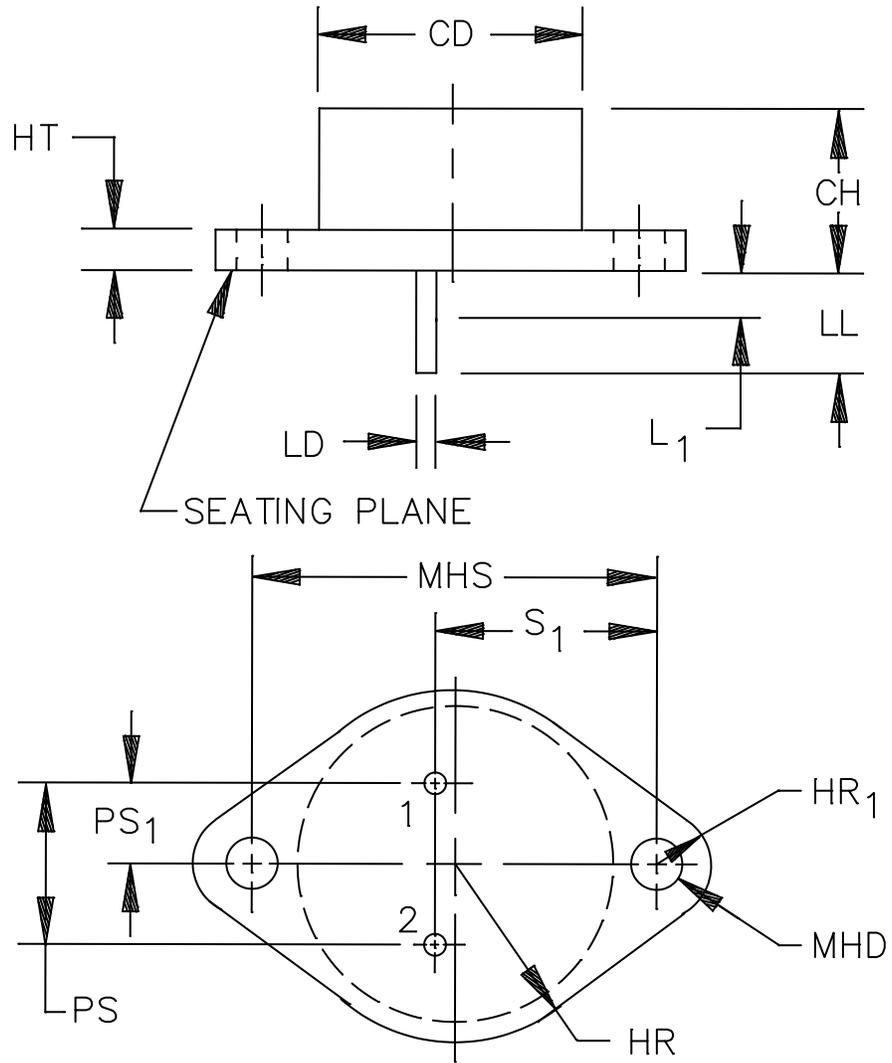


FIGURE 1. Physical dimensions (TO-204AA, formerly TO-3).

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.23	3
CH	.250	.450	6.35	11.43	
HR	.495	.525	12.57	13.34	
HR ₁	.131	.188	3.33	4.78	4
HT	.060	.135	1.52	3.43	
L ₁		.050		1.27	5, 6
LD	.038	.043	0.97	1.09	5, 6
LL	.312	.500	7.92	12.70	5
MHD	.151	.161	3.84	4.09	4
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	7
PS ₁	.205	.225	5.21	5.72	7
S ₁	.655	.675	16.64	17.15	7

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Terminal 1 is the emitter; terminal 2 is the base; and the collector shall be electrically connected to the case.
3. Body contour is optional within zone defined by dimension CD.
4. Applies to both ends.
5. Applies to both terminals.
6. Dimension LD applies between L₁ and LL. Lead diameter shall not exceed twice dimension LD within dimension L₁. Diameter is uncontrolled in dimension L₁.
7. These dimensions shall be measured at points .050 inch (1.27 mm) to .055 inch (1.4 mm) below the seating plane. When gauge is not used, measurement will be made at the seating plane.
8. The seating plane of the header shall be flat within .001 inch (0.03 mm) concave to .004 inch (0.10 mm) convex inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .001 inch (0.03 mm) concave to .006 inch (0.15 mm) convex overall.
9. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

FIGURE 1. Physical dimensions ((TO-204AA, formerly TO-3) – Continued.

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.dla.mil/quicksearch> or <https://assist.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 manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein shall be as specified in [MIL-PRF-19500](#).

3.4 Interface and physical dimensions. The interface requirements and physical dimensions shall be as specified in [MIL-PRF-19500](#) and on [figure 1](#) (TO-204AA, formerly TO-3) herein.

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

3.4.2 Polarity. The identification of terminals of the device package shall be as shown on [figure 1](#). Terminal 1 shall be connected to the emitter, terminal 2 shall be connected to the base, and the collector shall be electrically connected to the case.

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 [table I](#).

3.7 Marking. Marking shall be in accordance with [MIL-PRF-19500](#).

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](#)).

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 request the performance of [table II](#) tests, the tests specified in [table II](#) 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 (quality levels JANTX and JANTXV only). 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
	JANTX and JANTXV levels only
3c (1)	Thermal impedance (transient), see 4.3.1.
11	h_{FE1} , I_{CEX}
12	See 4.3.2.
13	See table I , subgroup 2 herein. ΔI_{CEX} = 100 percent or 2 μ A dc whichever is greater; Δh_{FE1} = 25 percent of initial value.

- (1) Thermal impedance shall be performed anytime after temperature cycling (screen 3a) and does not need to be repeated in screening requirements.

4.3.1 Thermal impedance. The thermal impedance measurements shall be performed in accordance with test method 3131 of [MIL-STD-750](#) using the guidelines in that test method for determining I_H , I_M , t_H , t_{SW} (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μ s maximum. The thermal impedance limit used in screen 3c and [table I](#), subgroup 2 herein shall be set statistically by the supplier. See [table II](#), subgroup 4 (group E) herein.

4.3.2 Power burn-in conditions. The power burn-in conditions shall be as follows: $T_J = +187.5^\circ\text{C} \pm 12.5^\circ\text{C}$; $V_{CB} = 10$ to 30 V dc; $T_A \leq +35^\circ\text{C}$. With approval of the qualifying activity and preparing activity, alternate burn-in criteria (hours, bias conditions, T_J , and mounting conditions) may be used. A justification demonstrating equivalence is required. In addition, the manufacturing site's burn-in data and performance history will be essential criteria for burn-in modification approval.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of table I, subgroup 1 and 2. Table E-VIB, subgroup 1 of MIL-PRF-19500 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2.

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) shall be in accordance with the applicable inspections of table I, subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the test methods and conditions specified for subgroup testing in table E-VIB of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with the applicable inspections of table I, subgroup 2 herein. Delta measurements shall be in accordance with the applicable step of 4.6 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B3	1037	For solder die attach: 2,000 cycles; $V_{CB} = 10 - 30$ V dc, $T_A \leq +35^\circ\text{C}$.
	or	
	1026	For eutectic die attach: $V_{CB} = 10$ to 30 V dc, $T_A \leq +35^\circ\text{C}$, adjust P_T to achieve $T_J = +175^\circ\text{C}$ minimum.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-VII of MIL-PRF-19500 and as follows herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirements shall be in accordance with the applicable step of 4.6 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	2036	Test condition A, weight = 10 pounds \pm 10 ounce (4.5Kg \pm 0.28Kg), t = 15 s.
C5	3131	See 3.4.1, $R_{\theta JC} = 1.5^\circ\text{C/W}$.
C6	1037	For solder die attach: 6,000 cycles; $V_{CB} = 10$ to 30 V dc, $T_A \leq +35^\circ\text{C}$.
	or	
	1026	For eutectic die attach: $V_{CB} = 10$ to 30 V dc, $T_A \leq +35^\circ\text{C}$, adjust P_T to achieve $T_J = +175^\circ\text{C}$ minimum.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in appendix E, table E-IX of MIL-PRF-19500 and as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirements shall be in accordance with the applicable step of 4.6 herein.

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

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

4.6 Delta requirements. The requirements for delta measurements for groups B, C, and E shall be as specified below. (1) (2) (3)

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1	Collector to base cutoff current	3041	Bias condition A; $V_{CE} = 125 \text{ V dc}$ $V_{EB} = 1.5 \text{ V dc}$	ΔI_{CEX} (4)	100 percent of initial reading or 2 $\mu\text{A dc}$, whichever is greater.		

- (1) The delta measurements for group B, product assurance levels JAN, JANTX and JANTXV as follows:
 - a. In addition to the measurements specified for subgroup 3 of table E-VIB of [MIL-PRF-19500](#), the measurements of step 1 shall also be taken.
 - b. In addition to the measurements specified for subgroup 6 of table E-VIB of [MIL-PRF-19500](#), the measurements of step 1 also be taken.
- (2) The delta measurements for group C, all product assurance levels, shall be as follows: In addition to the measurements specified for subgroup 6 of table E-VII of [MIL-PRF-19500](#), the measurements of step 1 shall also be taken.
- (3) The delta measurements for group E, all product assurance levels, shall be as follows: In addition to the measurements specified for subgroups 1 and 2 of table E-IX of [MIL-PRF-19500](#), the measurements of step 1 shall also be taken.
- (4) Devices which exceed the [table I](#) (group A) limits for this test shall not be accepted.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Max	Min	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Thermal impedance	3131	See 4.3.1	$Z_{\theta JC}$			$^{\circ}C/W$
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 3 \text{ A dc}$, pulsed (see 4.5.1), see figure 4	$V_{(BR)CEO}$	140		V dc
Breakdown voltage, collector to emitter	3011	Bias condition B; $I_C = 1.5 \text{ A dc}$, $R_{BE} = 100 \Omega$, see figure 4	$V_{(BR)CER}$	150		V dc
Breakdown voltage, collector to emitter	3011	Bias condition A; $I_C = 1.5 \text{ A dc}$, $V_{EB} = 1.5 \text{ V dc}$, see figure 4	$V_{(BR)CEX}$	160		V dc
Collector to emitter cutoff current	3041	Bias condition A; $V_{CE} = 125 \text{ V dc}$, $V_{EB} = 1.5 \text{ V dc}$	I_{CEX}		0.01	mA dc
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 140 \text{ V dc}$	I_{CBO1}		0.1	mA dc
Emitter to base cutoff current	3061	Condition D; $V_{EB} = 7 \text{ V dc}$	I_{EBO}		1	mA dc
Base emitter voltage (nonsaturated)	3066	Test condition B; pulsed (see 4.5.1), $I_C = 3 \text{ A dc}$, $V_{CE} = 4.0 \text{ V dc}$	V_{BE}		1.7	V dc
Saturation voltage and resistance	3071	Pulsed (see 4.5.1), $I_C = 3 \text{ A dc}$, $I_B = 300 \text{ mA dc}$	$V_{CE(sat)}$		1.0	V dc
Forward-current transfer ratio	3076	$V_{CE} = 4 \text{ V dc}$, $I_C = 3 \text{ A dc}$, pulsed (see 4.5.1)	h_{FE1}	20	70	

See footnote at end of table.

TABLE I. Group A inspection – Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Max	Min	
<u>Subgroup 3</u>						
High temperature operation: Collector to base cutoff current	3036	$T_A = +150^\circ\text{C}$ Bias condition D; $V_{CB} = 140\text{ V dc}$	I_{CBO2}		1.0	mA dc
Low temperature operation		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 4\text{ V dc}$, $I_C = 3\text{ A dc}$, pulsed (see 4.5.1)	h_{FE2}	15		
<u>Subgroup 4</u>						
Small-signal, short circuit forward-current transfer ratio	3306	$V_{CE} = 4\text{ V dc}$, $I_C = 3\text{ A dc}$, $f = 100\text{ kHz}$	h_{fe}	1		
<u>Subgroup 5</u>						
Safe operating area (continuous dc)	3051	$T_C = +25^\circ\text{C}$; $t = 1\text{ s}$, see figure 5				
<u>Test 1</u>		$V_{CE} = 11.7\text{ V dc}$, $I_C = 10\text{ A dc}$				
<u>Test 2</u>		$V_{CE} = 78\text{ V dc}$, $I_C = 1.5\text{ A dc}$				
<u>Test 3</u>		$V_{CE} = 125\text{ V dc}$, $I_C = 0.5\text{ A dc}$				
Electrical measurements		See subgroup 2 of this table				
<u>Subgroups 6 and 7</u>						
Not applicable						

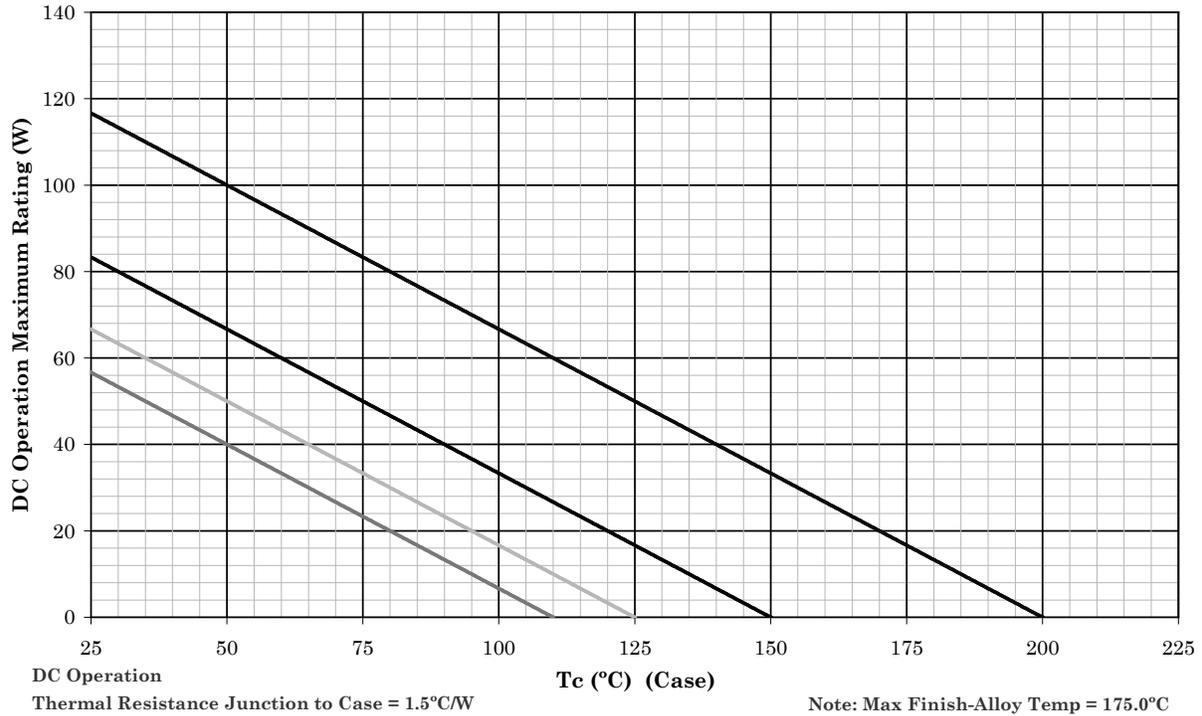
1/ For sampling plan, see MIL-PRF-19500.

TABLE II. Group E inspection (all quality levels) – for qualification and re-qualification only.

Inspection	MIL-STD-750		Qualification sample plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition G, 500 cycles.	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I , subgroup 2 and 4.6 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Blocking life	1048	Test temperature = +125°C; V_{CB} = 80 percent of rated voltage; t = 1,000 hours.	
Electrical measurements		See table I , subgroup 2 and 4.6 herein.	
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		See MIL-PRF-19500 .	
<u>Subgroup 8</u>			45 devices c = 0
Reverse voltage leakage stability	1033	Condition B for devices < 400 V.	

Temperature-Power Derating Curve

TC=25°C 2N3442

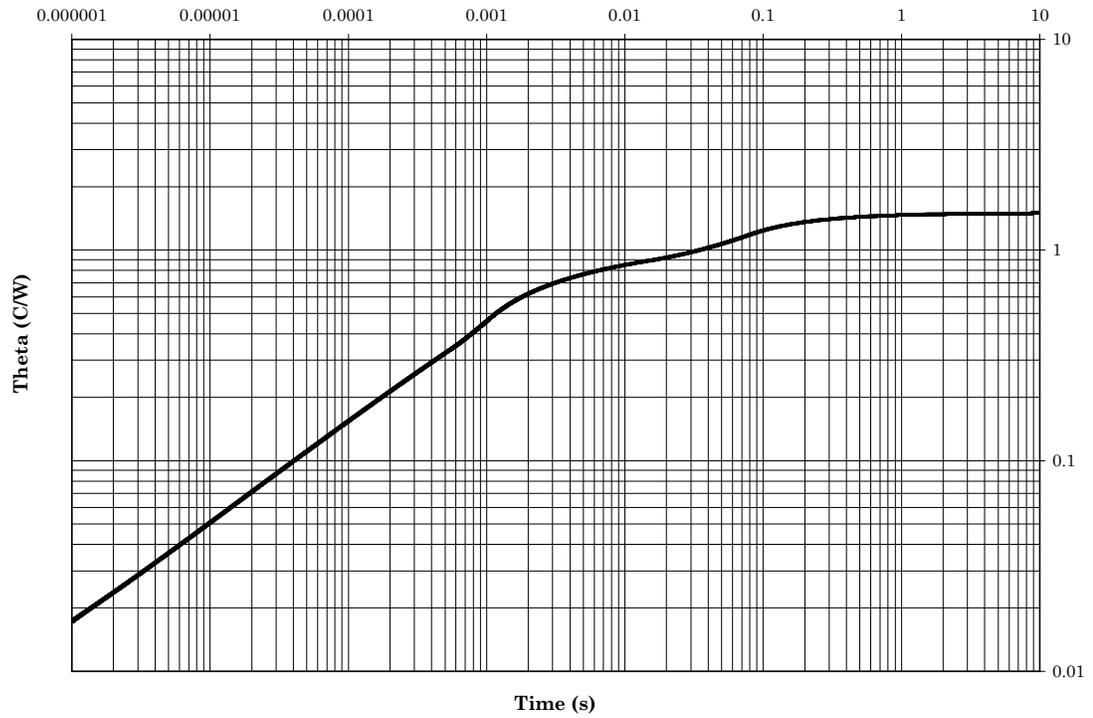


NOTES:

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 2. Temperature-power derating graph for device type 2N3442 (TO-204AA, formerly TO-3).

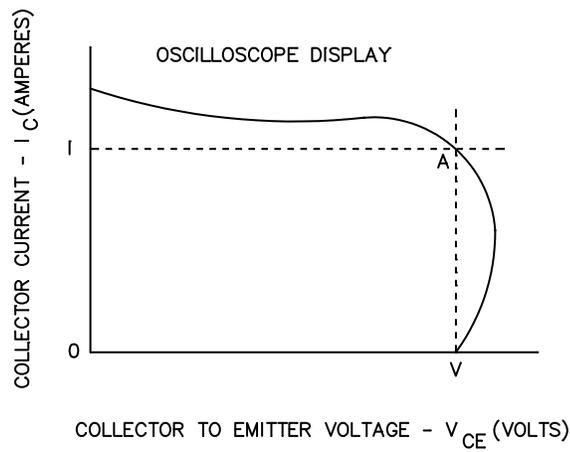
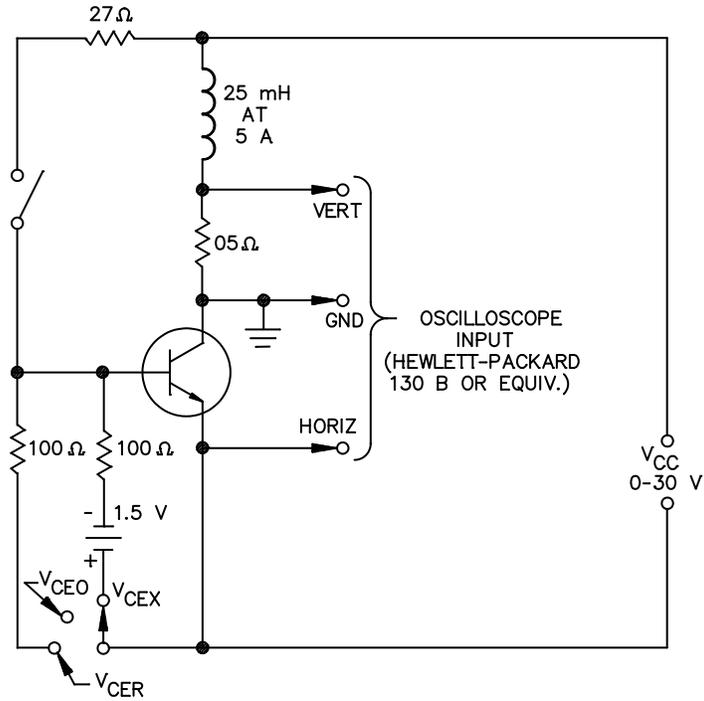
Maximum Thermal Impedance
TO-204AA Package (formerly TO-3)
T_C = +25°C



T_C = +25°C. Thermal resistance = 1.5°C/W.

|

FIGURE 3. Transient thermal impedance graph for device type 2N3442.



NOTE: The voltages, V_{CE0} , V_{CER} , or V_{CEX} are acceptable when the trace falls to the right and above point "A".

FIGURE 4. Test circuit for V_{CE0} , V_{CER} , and V_{CEX} .

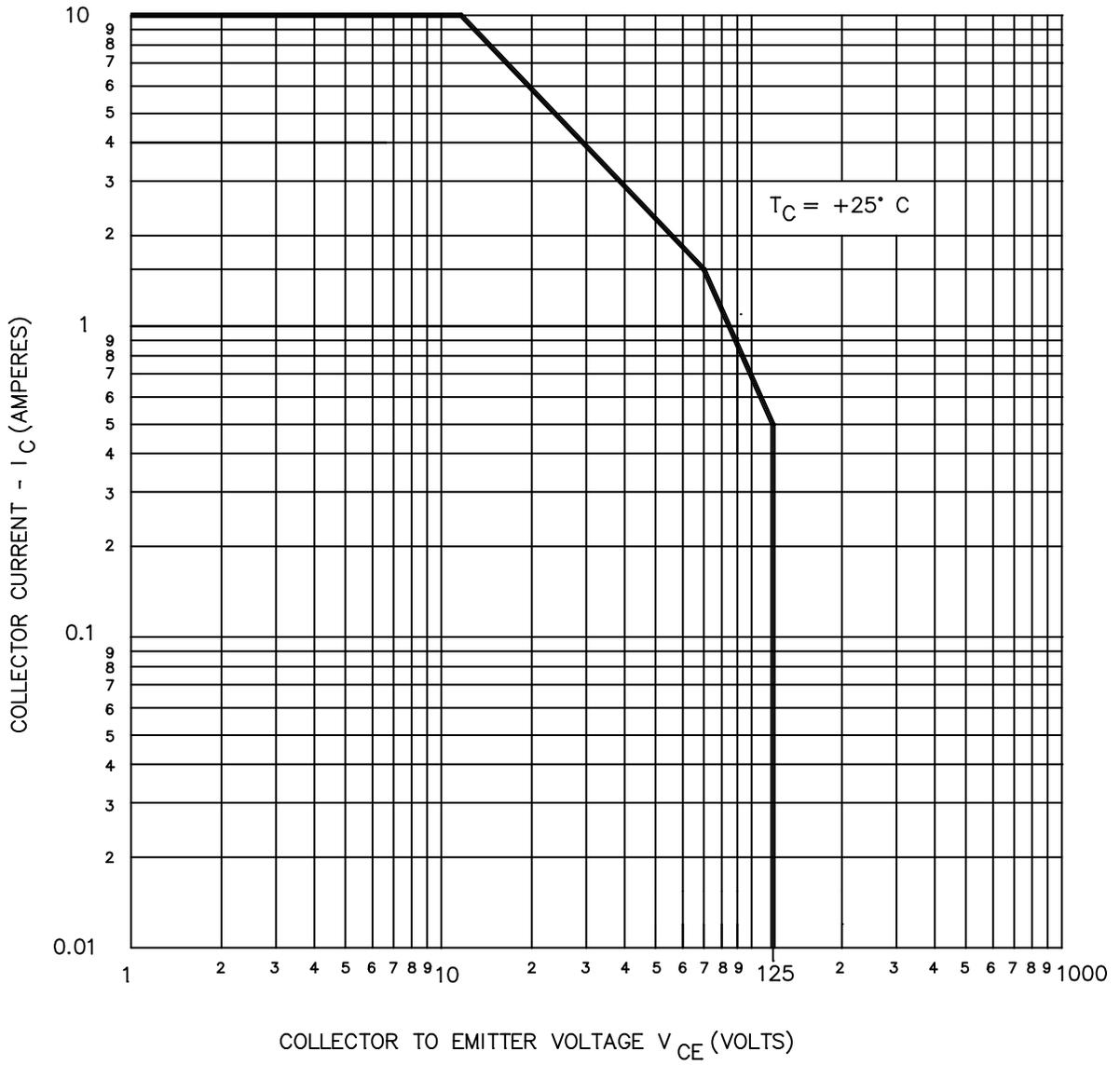


FIGURE 5. Maximum safe operating graph (dc).

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 Part or Identifying Number (PIN), see title and section [1](#).

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 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. 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 – EC
Air Force – 85
DLA – CC

Preparing activity:
DLA – CC

(Project 5961-2013-015)

Review activities:
Army – AR, MI
Navy – AS, MC
Air Force – 19, 99

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