The documentation and process conversion measures necessary to comply with this revision shall be completed by 4 November 1999

INCH-POUND

MIL-PRF-19500/505B
4 August 1999
SUPERSEDING
MIL-S-19500/505A(USAF)
6 October 1993

PERFORMANCE SPECIFICATION SHEET
SEMICONDUCTOR DEVICE, DARLINGTON TRANSISTOR, PNP, SILICON, POWER
TYPE 2N6286, 2N6287 JAN, JANTX, AND JANTXV

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

1. SCOPE

1.1 Scope. This specification covers the performance requirements for PNP, Darlington, power transistors. Three levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to T0-3).

1.3 Maximum ratings.

Type	P_T 1/		V_{CBO}	V_{CEO}	V_{EBO}	I_C	I_B	T_{op} and T_{STG}
	T_C = +25°C	T_C = +100°C						
	W	W	V dc	V dc	V dc	A dc	A dc	°C
2N6286	175	87.5	-80	-80	-7	-20	-0.5	-65 to +175
2N6287	175	87.5	-100	-100	-7	-20	-0.5	-65 to +175

1/ Derate linearly at 1.17 W/°C above T_C > +25°C.

1.4 Primary electrical characteristics.

	h_{FE2} 1/ V_{CE} = -3 V dc I_C = -10 A dc	h_{FE3} 1/ V_{CE} = -3 V dc I_C = -20 A dc	$V_{CE(sat)1}$ I_C = -20 A dc I_B = -200 mA dc	$V_{CE(sat)2}$ I_C = -10 A dc I_B = -40 mA dc	$V_{BE(sat)}$ I_C = -20 A dc I_B = -200 mA dc	Switching	
						t_{on}	t_{off}
			V dc	V dc	V dc	µs	µs
Min	1,250	300					
Max	18,000		-3.0	-2.0	-4.0	2	10

	C_{obo} V_{CB} = -10 V dc I_E = 0 100 kHz ≤ f ≤ 1 MHz	$R_{\theta JC}$	h_{fe} V_{CE} = -3 V dc I_C = -10 A dc f = 1 MHz	$\lvert h_{fe} \rvert$ V_{CE} = -3 V dc I_C = -10 A dc f = 1 MHz
	pF	°C/W		
Min			700	8
Max	400	0.857		80

1/ Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad St., Columbus, OH 43216-5000, by using the addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5961

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 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

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

STANDARD

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), 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 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

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 (similar to T0-3) herein.

3.4.1 Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with MIL-STD-750, MIL-PRF-19500, and herein.

3.5 Marking. Devices shall be marked in accordance with MIL-PRF-19500.

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

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I.

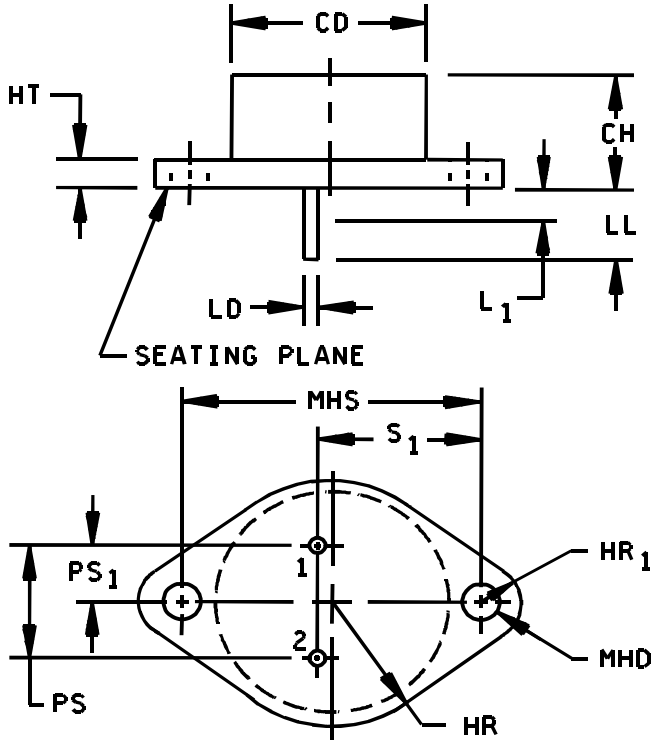
4. VERIFICATION

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).



NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Body contour is optional within zone defined by CD
4. These dimensions shall be measured at points .050 (1.27 mm) to 0.055 (1.40 mm) below seating plane.
5. Both terminals.
6. At both ends.
7. Two holes.
8. Terminal 1 is the emitter, terminal 2 is base. The collector shall be electrically connected to the case.
9. LD applies between L1 and LL. Diameter is uncontrolled in L1.
10. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions. (Similar to TO-3)

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max			
CD		0.875		22.23	3
CH	0.250	0.360	6.35	9.14	
HR	0.495	0.525	12.57	13.34	
HR_1	0.131	0.188	3.33	4.78	
HT	0.060	0.135	1.52	3.43	
LD	0.038	0.043	0.97	1.09	5, 9
LL	0.312	0.500	7.92	12.7	5
L_1		0.050		1.27	5, 9
MHD	0.151	0.165	3.84	4.19	7
MHS	1.177	1.197	29.90	30.40	
PS	0.420	0.440	10.67	11.18	4
PS_1	0.205	0.225	5.21	5.72	
S_1	0.655	0.675	16.64	17.15	

FIGURE 1. Physical dimensions (Similar to TO-3) - Continued.

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

4.3 Screening. Screening shall be in accordance with table 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 IV of MIL-PRF-19500)	Measurements
	JANTX and JANTXV levels
11	I_{CEX1} and h_{FE1}
12	See 4.3.1
13	Subgroup 2 of table I herein; I_{CEX1} = 100 percent of initial value or 100 µA dc, whichever is greater. Δh_{FE1} = ±40 percent of initial value.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

T_J = +162.5°C ±12.5°C, $V_{CE} \geq$ -10 V dc.

NOTE: No heat sink or forced air cooling on the devices shall be permitted.

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 MIL-PRF-19500, and table I herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

Subgroup	Method	Condition
B3	1037	For solder die attach: $V_{CB} \geq$ -10 V dc; $T_A \leq$ 35°C, 2,000 cycles.
B3	1037	For eutectic die attach: $T_A \leq$ 35°C adjust P_T to achieve T_J = 150°C minimum, $V_{CB} \geq$ -10 V dc.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

Subgroup	Method	Condition
C2	2036	Tension: test condition A; weight = 10 lbs; time = 15 s.
C6	1037	For solder die attach: $V_{CB} \geq$ -10 V dc; $T_A \leq$ 35°C, 6,000 cycles.
C6	1037	For eutectic die attach: $T_A \leq$ 35°C adjust P_T to achieve T_J = 150°C minimum, $V_{CB} \geq$ -10 V dc.

4.5 Method 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.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Breakdown voltage, collector - emitter	3011	Bias condition D; I_C = -100 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N6286				-80		V dc
2N6287				-100		V dc
Collector - emitter cutoff current	3041	Bias condition A; V_{BE} = +1.5 V dc	I_{CEX1}		-0.5	mA dc
2N6286		V_{CE} = -80 V dc				
2N6287		V_{CE} = -100 V dc				
Collector - emitter cutoff current	3041	Bias condition D	I_{CEO}		-1.0	mA dc
2N6286		V_{CE} = -40 V dc				
2N6287		V_{CE} = -50 V dc				
Emitter - base cutoff current	3061	Bias condition D; V_{EB} = -7 V dc	I_{EBO}		-2.5	mA dc
Base – emitter (nonsaturated)	3066	Test condition B; V_{CE} = -3 V dc; I_C = -10 A dc	V_{BE}		-2.8	V dc
Base - emitter voltage (saturated)	3066	Test condition A; I_C = -20 A dc; I_B = -200 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)}$		-4.0	V dc
Collector - emitter saturated voltage	3071	I_C = -20 A dc; I_B = -200 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		-3.0	V dc
Collector - emitter saturated voltage	3071	I_C = -10 A dc; I_B = -40 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		-2.0	V dc
Forward-current transfer ratio	3076	V_{CE} = -3 V dc; I_C = -1 A dc; pulsed (see 4.5.1)	h_{FE1}	1,500		
Forward-current transfer ratio	3076	V_{CE} = -3 V dc; I_C = -10 A dc; pulsed (see 4.5.1)	h_{FE2}	1,250	18,000	

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Forward-current transfer ratio	3076	V_{CE} = -3 V dc; I_C = -20 A dc; pulsed (see 4.5.1)	h_{FE3}	300		
Subgroup 3						
High-temperature operation:		T_A = +150°C				
Collector - emitter cutoff current	3041	Bias condition A; V_{BE} = +1.5 V dc;	I_{CEX2}		-5.0	mA dc
2N6286		V_{CE} = -80 V dc				
2N6287		V_{CE} = -100 V dc				
Collector - emitter saturated voltage	3071	I_C = -10 A dc; I_B = -40 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)3}$		-2.0	V dc
Low-temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = -3 V dc; I_C = -10 A dc; pulsed (see 4.5.1)	h_{FE4}	150		
Subgroup 4						
Pulse response:						
Turn-on time		V_{CC} = -30 V dc; I_C = -10 A dc; I_B = -40 mA dc; (see figure 2)	t_{on}		2.0	µs
Turn-off time		V_{CC} = -30 V dc; I_C = -10 A dc; I_{B1} = I_{B2} = -40 mA dc (see figure 2)	t_{off}		10	µs
Magnitude of common- emitter small-signal short-circuit forward- current transfer ratio	3306	V_{CE} = -3 V dc; I_C = -10 A dc; f = 1.0 MHz	$\lvert h_{fe} \rvert$	8	80	
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = -3 V dc; I_C = -10 A dc	h_{fe}	300		
Open circuit output capacitance	3236	V_{CB} = -10 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		400	pF

See footnote at end of table.

TABLE I. Group A inspection - Continued.

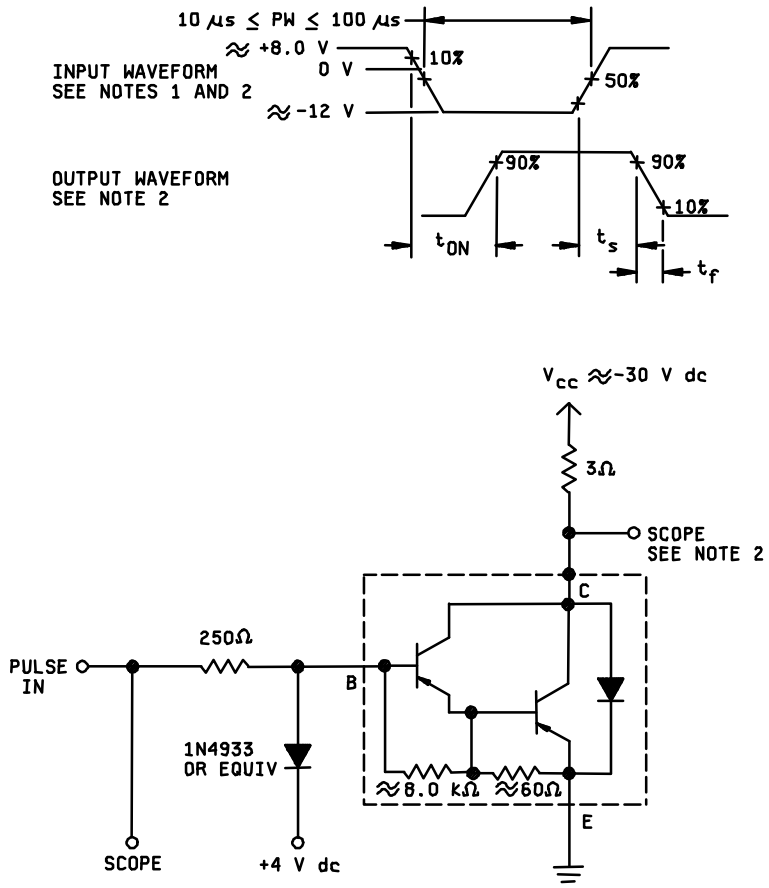
Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5						
Safe operating area continuous (dc)	3051	T_C = +25°C; t = 1 s; 1 cycle; (see figure 3)				
Test 1		V_{CE} = -8.75 V dc; I_C = -20 A dc				
Test 2		V_{CE} = -30 V dc; I_C = -5.8 A dc				
Test 3						
2N6286		V_{CE} = -80 V dc; I_C = -100 mA dc				
2N6287		V_{CE} = -100 V dc; I_C = -100 mA dc				
Electrical measurements		See table I, subgroup 2				
Safe operating area (switching)	3053	Load condition C; (unclamped inductive load); (see figure 4) T_A = +25°C; $R_S \leq 0.1\ \Omega$; $t_r + t_f \leq 15$ ns; duty cycle ≤2 percent				
Test 1		t_p = 80 µs; (vary to obtain I_C); $R_{BB1} \geq 50\ \Omega$; $V_{BB1} \geq$ -10 V dc; $R_{BB2} = \infty$; V_{BB2} = 0; I_C = -20 A dc; $V_{CC} \geq$ -50 V dc; The coil used shall provide a minimum inductance of 1 mH at 20 A. (For reference only; two coils in parallel (Super Electric Corporation type S16884 or equivalent).)				
Test 2		t_p = 1 ms; (vary to obtain I_C); $R_{BB1} \geq 50\ \Omega$; $V_{BB1} \geq$ -10 V dc; $R_{BB2} = \infty$; V_{BB2} = 0; I_C = -500 mA dc; $V_{CC} \geq$ -50 V dc; The coil used shall provide a minimum inductance of 100 mH at 500 mA. (For reference only; two coils in series, 80 mH and 20 mH windings (Triad C-48u or equivalent).)				

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5 - Continued						
Electrical measurements		See table I, subgroup 2				
Safe operating area (switching)	3053	Load condition B; (clamped inductive load); T_A = +25°C; R_S = 0.1 Ω; $t_r + t_f \leq 1.0$ µs; duty cycle ≤ 2 percent; t_p = 1 ms (vary to obtain I_C); R_{BB1} = 50 Ω; V_{BB1} = -10 V dc; R_{BB2} = 100 Ω; V_{BB2} = +1.5 V dc; V_{CC} = -25 V dc; I_C = -20 A dc; $R_L \leq 2$ Ω; L = 5 mH; (Four coils in parallel, 20 mH windings (Triad C-48u or equivalent)).				
2N6286		Clamp voltage = 80 +0, -5 V dc				
2N6287		Clamp voltage = 100 +0, -5 V dc Device fails if clamp voltage is not reached				
Electrical measurements		See table I, subgroup 2				
Subgroups 6 and 7						
Not applicable						

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



NOTES:

1. The input waveform is supplied by a pulse generator with the following characteristics: $t_r \leq 20$ ns, $t_f \leq 20$ ns, $Z_{out} = 50\ \Omega$, PW = 23 µs, duty cycle ≤ 2 percent.
2. The output waveform is monitored on a sampling oscilloscope with $Z_{in} \geq 20\ M\Omega$, $C_{in} \leq 11.5$ pF, $t_r \leq 2$ ns.
3. Resistors shall be noninductive types.
4. The dc power supplies may require additional by-passing in order to minimize ringing.

FIGURE 2. Pulse response test circuit.

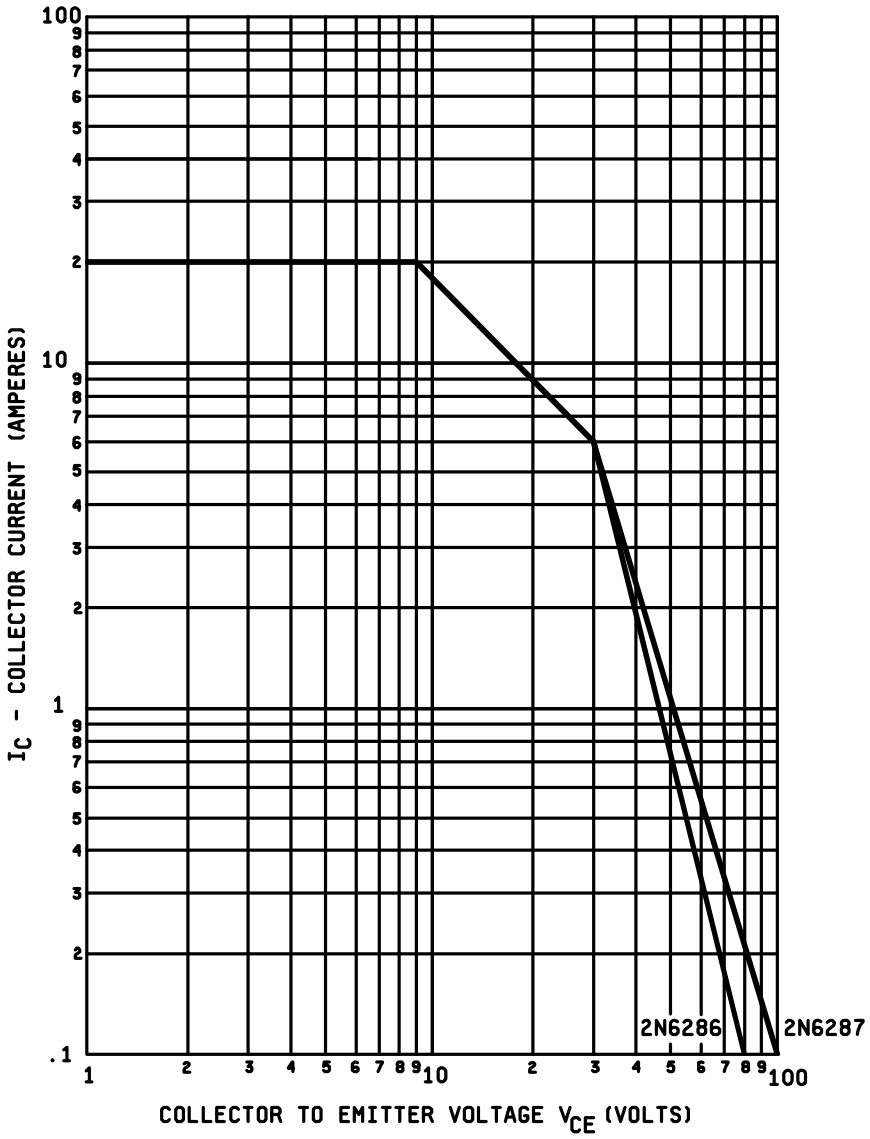


FIGURE 3. Maximum safe operating area (continuous dc).

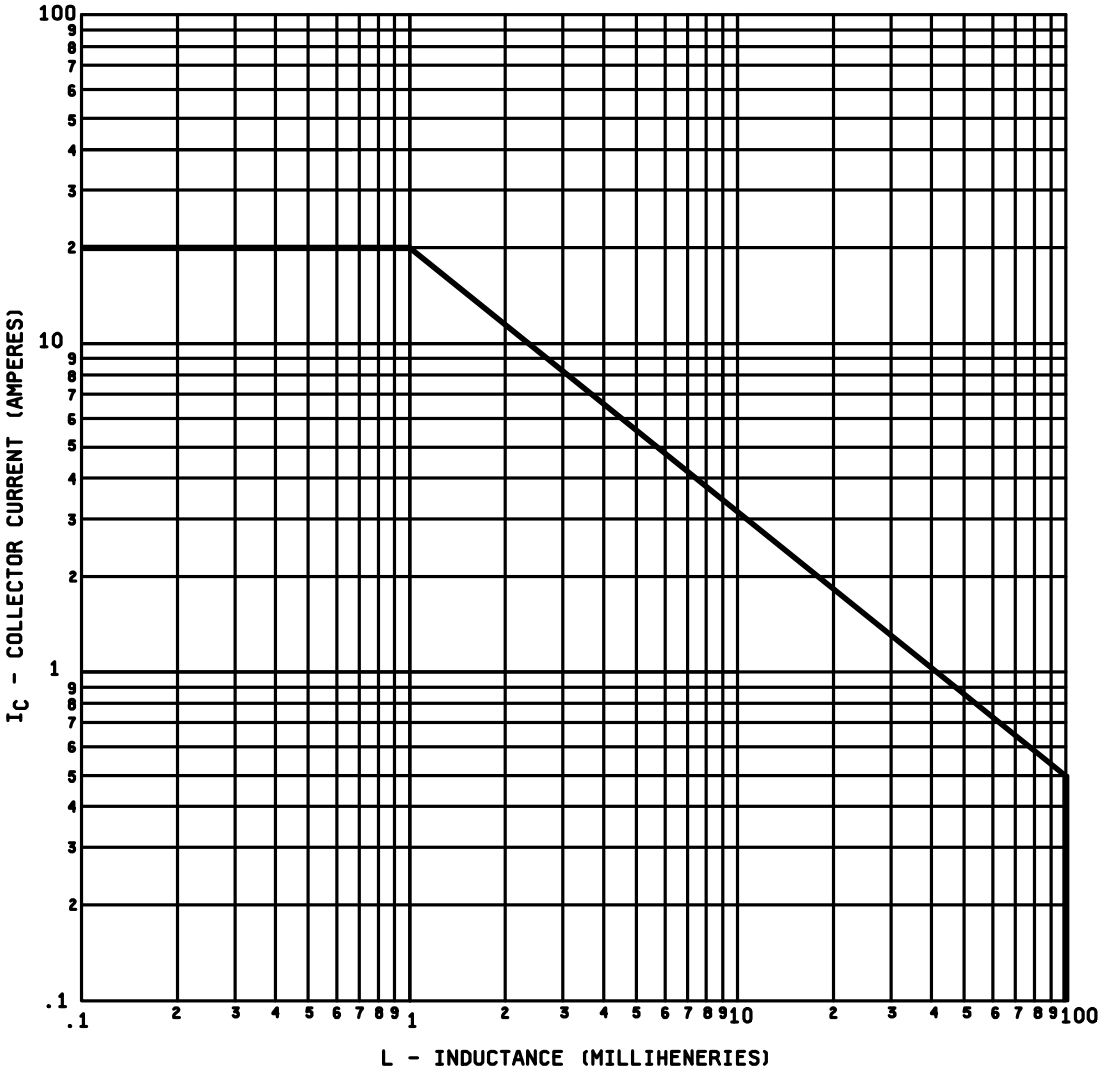


FIGURE 4. Safe operating area for switching between saturation and cutoff (unclamped inductive load).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements should be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' 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.)

6.1 Notes. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Issue of DODISS to be cited in the solicitation (see 2.2.1).

b. The lead finish as specified (see 3.4.1).

c. Type designation and quality assurance level.

d. Packaging requirements (see 5.1).

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 Manufacturer's 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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Air Force - 11
DLA – CC

Preparing activity:
DLA - CC

Review activities:
Air Force - 19, 99

(Project 5961-2067)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-19500/505B	**2. DOCUMENT DATE (YYMMDD)** 990804

3. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, DARLINGTON TRANSISTOR, PNP, SILICON, POWER TYPES 2N6286, 2N6287 JAN, JANTX AND JANTXV

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) Commercial DSN FAX EMAIL	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. Point of contact: Alan Barone,	b. TELEPHONE Commercial 614-692-0510 DSN 850-0510 FAX 614-692-6939 EMAIL alan_barone@dscc.dla.mil
c. ADDRESS : Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad Street, Columbus, OH 43216-5000	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-68880