INCH-POUND

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 October 2001.

MIL-PRF-19500/544D
27 July 2001
SUPERSEDING
MIL-PRF-19500/544C
21 July 2000

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER
TYPES 2N5152, 2N5154, 2N5152L, 2N5154L, 2N5152U3, 2N5154U3
JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN, silicon, power transistors for use in high-speed power-switching applications. Four levels of product assurance are provided for each encapsulated device type and two levels of product assurance are provided for each unencapsulated device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. Figure 1 (similar to T0-5 and T0-39), figures 2, 3, and 4 (die dimensions), and figure 5 (U3).

1.3 Maximum ratings.

Type	P_T T_A = +25°C	P_T T_C = +25°C	V_{CBO}	V_{CEO}	V_{EBO}	I_C	I_C (1)	Reverse pulse (2) energy	Safe operating area	T_{stg} and T_J
	W	W	V dc	V dc	V dc	A dc	A dc	mJ		°C
2N5152, L	1 (3)	11.8 (4)	100	80	5.5	2	10	15	See figure 6	-65 to +200
2N5154, L	1 (3)	11.8 (4)	100	80	5.5	2	10	15		-65 to +200
2N5152U3	1.16 (5)	100 (6)	100	80	5.5	2	10	15	See figure 6	-65 to +200
2N5154U3	1.16 (5)	100 (6)	100	80	5.5	2	10	15		-65 to +200

(1) This value applies for Pw ≤ 8.3 ms, duty cycle ≤ 1%
(2) This rating is based on the capability of the transistors to operate safely in the unclamped inductive load energy test circuit of figure 7.
(3) Derate linearly 5.7 mW/°C for T_A > +25°C
(4) Derate linearly 66.7 mW/°C for T_C > +25°C
(5) Derate linearly 6.67 mW/°C for T_A > +25°C
(6) Derate linearly 571 mW/°C for T_C > +25°C

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, Post Office Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics at T_C = +25°C.

Limits	h_{FE2} (1) V_{CE} = 5 V I_C = 2.5 A		$\|h_{fe}\|$ V_{CE} = 5 V I_C = 500 mA dc		$V_{BE(sat)2}$ (1) I_C = 5 A dc I_B = 500 mA dc	$V_{CE(sat)2}$ (1) I_C = 5 A dc I_B = 500 mA dc	C_{obo} V_{CB} = 10 V dc I_E = 0 f = 1` Mhz	$R_{\theta JA}$	$R_{\theta JC}$
	2N5152 (2)	2N5154 (2)	2N5152 (2)	2N5154 (2)					
					Vdc	Vdc	pF	°C/W	°C/W
Min	30	70	6	7					
Max (TO-5, TO-39)	90	200			2.2	1.5	250	175	15
Max (U3)	90	200			2.2	1.5	250	150	1.75

(1) Pulsed (see 4.5.1).
(2) The limits specified apply to all package outlines unless otherwise stated.

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 section 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

DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), 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 specification and the references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

Symbol 11	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	0.305	0.335	7.75	8.51	6
CH	0.240	0.260	6.10	6.60	
HD	0.335	0.370	8.51	9.40	
LC	0.200 TP		5.08 TP		7
LD	0.016	0.021	0.41	0.53	8, 9
LL	.500	.750	12.70	19.05	8, 9, 13
LU	0.016	0.019	0.041	0.48	8, 9
L_1		0.050		1.27	8, 9
L_2	0.250		6.35		8, 9
Q		0.050		1.27	6
TL	0.029	0.045	0.74	1.14	4, 5
TW	0.028	0.034	0.71	0.86	3
r		0.010		0.25	11
α	45° TP		45° TP		7
P	0.100		2.54		
Notes	1, 2, 10, 12, 14				

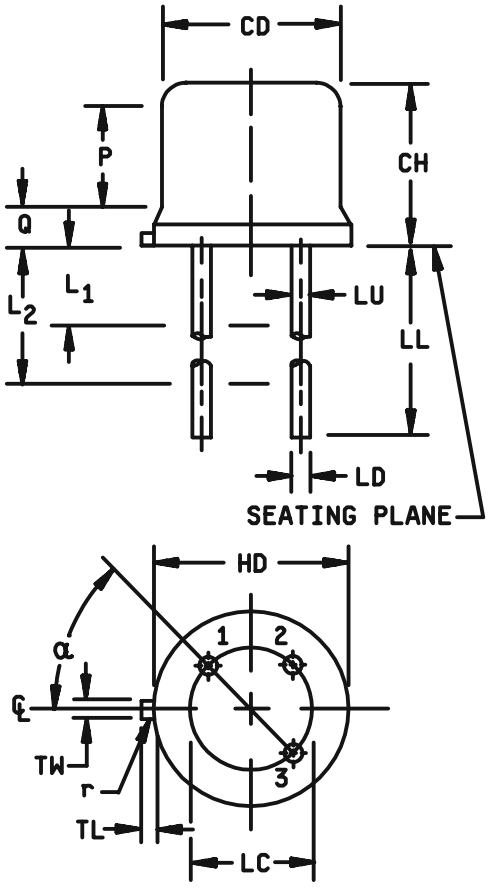


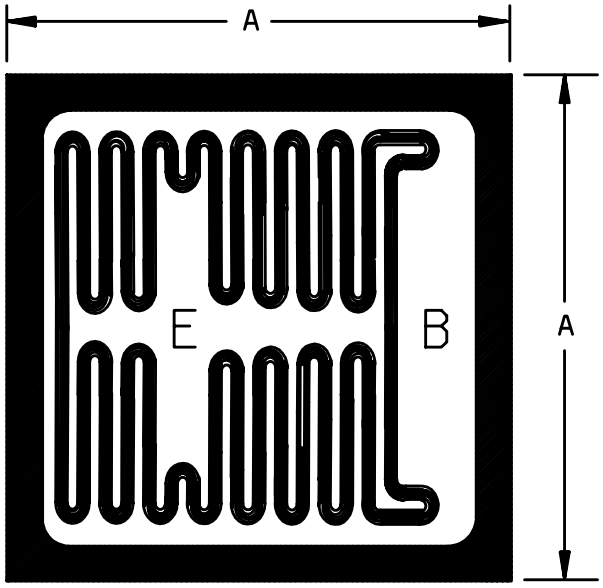
FIGURE 1. Physical dimensions (similar to TO – 5 and TO-39).

NOTES:

1. Dimension are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of 0.011 (0.28 mm).
4. TL measured from maximum HD.
5. Outline in this zone is not controlled.
6. CD shall not vary more than 0.010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
7. Leads at gauge plane 0.054 +0.001 -0.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within 0.007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by gauge.
8. LU applies between L_1 and L_2. Dimension LD applies between L_2 and L minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
9. All three leads.
10. The collector shall be internally connected to the case.
11. r (radius) applies to both inside corners of tab.
12. In accordance with ANSI Y14.5M, diameters are equivalent to ∅x symbology.
13. For "L" suffix devices, dimension LL is 1.50 (38.10 mm) minimum, 1.75 (19.05 mm) maximum.
14. Lead designation, depending on device type, shall be as follows:

Lead number	TO-39	TO-5
1	Emitter	Emitter
2	Base	Base
3	Collector	Collector

FIGURE 1. Physical dimensions (similar to TO – 5 and TO-39) continued.

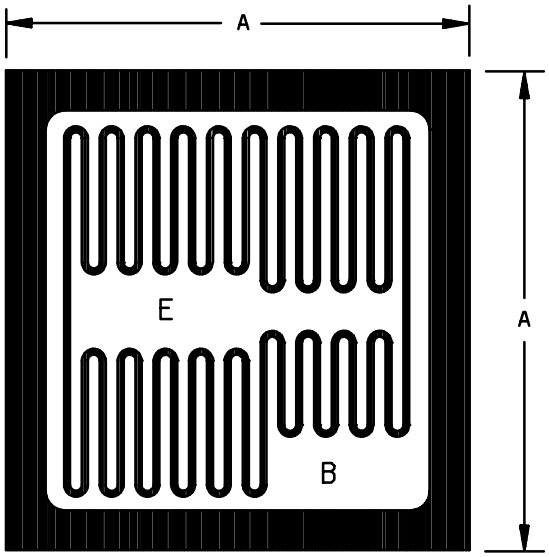


Dimensions				
LTR	Inches		Millimeters	
	Min	Max	Min	Max
A	0.117	0.127	2.97	3.23

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ± 0.005 (0.13 mm).
4. The physical characteristics of the die are;
   Thickness: 0.008 (0.20 mm) to 0.012 (0.30 mm), tolerance is ± 0.005 (0.13 mm).
   Top metal: Aluminum, 40,000 Å minimum, 50,000 Å nominal.
   Back metal: Gold 2,500 Å minimum, 3,000 Å nominal.
   Back side: Collector.
   Bonding pad: B = 0.015 (0.38 mm) x 0.0072 (0.183).
   E = 0.015 (0.38 mm) x 0.0060 (0.152).

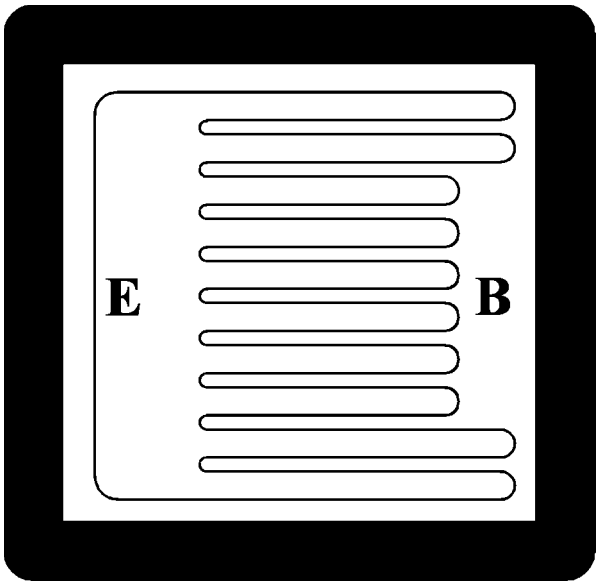
FIGURE 2. JANHCA and JANKCA die dimensions.



Dimensions				
LTR	Inches		Millimeters	
	Min	Max	Min	Max
A	0.095	0.105	2.41	2.66

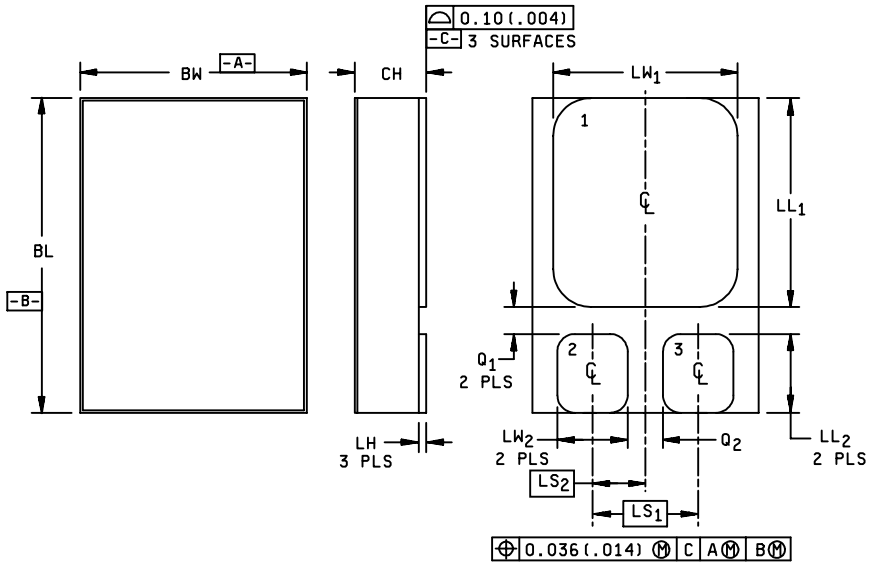
NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ±0.005 (0.13 mm).
4. The physical characteristics of the die are;
5. Thickness: 0.0078 (0.198 mm) nominal, tolerance is ±0.005 (0.13 mm).
   Top metal: Aluminum, 25,000 Å minimum, 33,000 Å nominal.
   Back metal: Gold 1,500 Å minimum, 2,500 Å nominal.
   Back side: Collector.
   Bonding pad: 0.012 (0.305 mm) min. x .030 (0.761 mm) minimum.

FIGURE 3. JANHCB and JANKCB die dimensions.



1. Die size.	0.120 x 0.120 inches ±0.002 inches
2. Die thickness	0.010 ±0.0015 inches nominal
3. Top metal	Aluminum, 30,000Å minimum, 35,000Å nominal
4. Back metal	A. Al/Ti/Ni/Ag 12kÅ/3kÅ/7kÅ/7kÅ minimal, 15kÅ/5kÅ/10kÅ/10kÅ nominal B. Gold 2500Å minimum, 3000Å nominal
5. Backside	Collector
6. Bonding pad	B = 0.052 x 0.012 inches, E = 0.084 x 0.012 inches

FIGURE 4. JANHCC and JANKCC die dimensions.



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	0.395	0.405	10.04	10.28
BW	0.291	0.301	7.40	7.64
CH	0.1085	0.1205	2.76	3.06
LH	0.010	0.020	0.25	0.51
LW1	0.281	0.291	7.14	7.41
LW2	0.090	0.100	2.29	2.54
LL1	0.220	0.230	5.59	5.84
LL2	0.115	0.125	2.93	3.17
LS1	0.150 BSC		3.81 BSC	
LS2	0.075 BSC		1.91 BSC	
Q1	0.030	---	0.762	---
Q2	0.030	---	0.762	---
TERM 1	Drain			
TERM 2	Gate			
TERM 3	Source			

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimensions and tolerances shall be in accordance with ANSI Y14.5M-1982.
4. Terminal 1 - collector, terminal 2 - base, terminal 3 – emitter.

SCHEMATIC

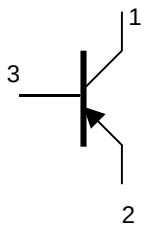


FIGURE 5. Physical dimensions and configuration for surface mount (U3).

3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

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 (QML 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 and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 (Similar to T0-5 and T0-39), and figures 2, 3, 4 (die dimensions) for JANHC and JANKC, and figure 5 (U3)

3.4.1 Current density. Current density of internal conductors shall be as specified in MIL-PRF-19500.

3.4.2 Lead finish. Lead finish shall be solderable as defined in 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.

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

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).

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

4.2.1 JANHC and JANKC qualification. JANHC and JANKC qualification inspection shall be in accordance with MIL-PRF-19500.

4.3. Screening (JANS, JANTX, and JANTXV levels only). 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)	Measurement	
	JANS levels	JANTX and JANTXV levels
1a 1b	Not required Required	Not required Required for JANTXV only
2	Optional	Optional
3a 3b 3c	Required Not applicable Thermal response (see 4.5.3)	Required Not applicable Thermal response (see 4.5.3)
4	Required	Optional
5	Required	Not applicable
7a and 7b	Required	Required
8	Required	Not required
9	I_{CES1} and h_{FE2}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CES1} and h_{FE2}; ΔI_{CES1} = 100 percent of initial value or100 nA dc, whichever is greater. $\Delta h_{FE2} = \pm$ 20 percent.	I_{CES1} and h_{FE2}
12	See 4.3.2	See 4.3.2
13	Subgroup 2 and 3 of table I herein; ΔI_{CES1} = 100 percent of initial value or 100 nA dc, whichever is greater. $\Delta h_{FE2} = \pm$ 20 percent.	Subgroup 2 of table I herein; ΔI_{CES1} = 100 percent of initial value or 100 nA dc, whichever is greater. $\Delta h_{FE2} = \pm$ 20 percent.
14a and 14b	Optional	Optional
15	Required	Not required
16	Required	Not required

4.3.1. Screening (JANHC and JANKC). Screening of JANC die shall be in accordance with MIL-PRF-19500 Burn-in duration for the JANKC level follows JANS requirements; the JANHC follows JANTX requirements.

4.3.2. Power burn-in conditions. Power burn-in conditions are as follows: V_{CB} = 10 - 30 Vdc, T_A = room ambient as defined in the general requirements of paragraph 4.5 of MIL-STD-750. Power shall be applied to the device to achieve a Junction temperature, T_J=135 °C minimum and a minimum P_D = 75 percent of P_T maximum rated as defined in 1.3 herein.

4.4. Conformance inspection. Conformance inspection shall be 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. 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 test and conditions specified for subgroup testing in table VIa (JANS) and table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and 4.4.2.1 and 4.4.2.2 herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

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

Subgroup	Method	Conditions
B4	1037	V_{CB} = 10 - 30 Vdc.
B5	1027	V_{CB} = 10 V dc; T_A < +125°C ±25°C for 96 hours with P_T adjusted according to the chosen T_A to give T_J = +275°C minimum. Optionally the test may be performed for a minimum of 216 hours with P_T adjusted to achieve a T_J = +225°C minimum; sample size = 45, c = 0. In this case the ambient temperature shall be adjusted such that a minimum 75 percent of maximum rated P_T (see1.3) is applied to the device under test. (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.)
B6	3131	See 4.5.2.

4.4.2.2. Group B inspection, (JAN, JANTX, and JANTXV). Separate samples may be used for each step. In the event of a group B failure, the manufacturer may pull a new sample at double size from either the failed assembly lot or from another assembly lot from the same wafer lot. If the new “assembly lot” option is exercised, the failed assembly lot shall be scrapped.

Step	Method	Conditions
1	1039	Steady-state life: Test condition B, 340 hours min., V_{CB} = 10 - 30 V dc, power shall be applied to achieve T_J = +175°C minimum using a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3. n = 45 devices, c = 0.
2	1039	The steady-state life test of step 1 shall be extended to 1,000 Hrs for each die design. Samples shall be selected from a wafer lot every twelve months of wafer production. Group B, step 2 shall not be required more than once for any single wafer lot. n = 45, c = 0.
3	1032	High-temperature life (non-operating), t = 340 hours, T_A = +200°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:

a. 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. See MIL-PRF-19500.

b. Must be chosen from an inspection lot that has been submitted to and passed group A, 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 (group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

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 VII of MIL-PRF- and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

Subgroup	Method	Conditions
C2	2036	Test condition E, (not applicable for U3 packages).
C6	1037	V_{CB} = 10 - 30 V dc, 6,000 cycles.

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

Subgroup	Method	Condition	Sampling plan
E1	1051	500 cycles	45 devices, c = 0
E2	1039	Condition A, 500 hours	45 devices, c = 0
E3		Not applicable	
E4	3131	$R_{\theta JC}$ = 15°C/W maximum (TO-5,and TO-39) $R_{\theta JC}$ = 1.75°C/W maximum (U3) See 4.5.2	22 devices, c = 0
E5		Not applicable	

4.5. Methods of inspection and test. Methods of inspection and test shall be as specified in the 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.

4.5.2. Thermal resistance. Thermal resistance measurements shall be conducted in accordance with method 3131 of MIL-STD-750. The following details shall apply:

a. Collector current magnitude during power application shall be 500 mA dc minimum.

b. Collector to emitter voltage magnitude shall be 10 V dc.

c. Reference temperature measuring point shall be the case.

d. Reference temperature measuring point shall be within the range +25°C ≤ T_R ≤ +35°C. The chosen reference temperature shall be recorded before the test is started.

e. Mounting arrangement shall be with heat sink to case.

f. Maximum limit of $R_{\theta JC}$ shall be 15.0°C/W for (TO-5, andTO-39) and 1.75°C/W for U3.

4.5.3. Thermal response (ΔV_{BE} measurements). The ΔV_{BE} measurements shall be performed in accordance with method 3131 of MIL-STD-750. The ΔV_{BE} conditions (I_H and V_H) and maximum limit shall be derived by each vendor. The chosen ΔV_{BE} measurement and conditions for each device in the qualification lot shall be submitted in the qualification report and a thermal response curve shall be plotted. The chosen ΔV_{BE} shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. One-hundred percent safe operating area (SOA) testing may be performed in lieu of thermal response testing herein provided that the appropriate conditions of temperature, time, current, and voltage to achieve die attach integrity are approved by the qualifying activity. The following parameter measurements shall apply:

a. I_M measurement ..... 10 mA.

b. V_{CE} measurement voltage ..... 16 V (same as V_H).

c. I_H collector heating current ..... 1 A minimum.

d. V_H collector-emitter heating voltage ..... 16 V minimum.

e. t_H heating time ..... 10 ms.

f. t_{MD} measurement delay time ..... 50 µs maximum.

g. t_{SW} sample window time ..... 10 µs maximum.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical examination 3/	2071	n = 45 devices, c = 0				
Solderability 3/, 4/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/, 4/, 5/	1022	n = 15 devices, c = 0				
Temp Cycling 3/, 4/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Heremetic Seal 4/ Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements 4/		Group A, subgroup 2				
Bond strength 3/, 4/	2037	Precondition T_A = +250°C at t = 24 hrs or T_A = +300°C at t = 2 hrs n = 11 wires, c = 0				
Subgroup 2						
Breakdown voltage, collector to emitter	3011	Bias condition D, I_C = 100 mA dc; I_B = 0, Pulsed (see 4.5.1)	$V_{(BR)CEO}$	80		V dc
Collector to emitter cutoff current	3041	Bias condition C, V_{CE} = 60 V dc; V_{BE} = 0	I_{CES1}		1.0	µA dc
Collector to emitter cutoff current	3041	Bias condition C, V_{CE} = 100 V dc; V_{BE} = 0	I_{CES2}		1.0	mA dc
Collector to emitter cutoff current	3041	Bias condition D, V_{CE} = 40 V dc, I_B = 0	I_{CEO}		50	µA dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 4 V dc, I_C = 0	I_{EBO1}		1.0	µA dc
Emitter to base cutoff current	3061	Bias condition D, V_{EB} = 5.5 V dc, I_C = 0	I_{EBO2}		1.0	mA dc
Forward current transfer ratio	3076	V_{CE} = 5 V dc, I_C = 50 mA dc	h_{FE1}			
2N5152 2/				20		
2N5154				50		

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} = 5 V dc, I_C = 2.5 A dc, pulsed (see 4.5.1)	h_{FE2}			
2N5152 2/				30	90	
2N5154				70	200	
Forward current transfer ratio	3076	V_{CE} = 5 V dc, I_C = 5 A dc, pulsed (see 4.5.1)	h_{FE3}			
2N5152 2/				20		
2N5154				40		
Base-emitter voltage (nonsaturated)	3066	Test condition B, V_{CE} = 5 V dc, I_C = 2.5 A dc, pulsed (see 4.5.1)	V_{BE}		1.45	V dc
Base-emitter saturation voltage	3066	Test condition A, I_C = 2.5 A dc, I_B = 250 mA dc, pulsed (see 4.5.1)	$V_{BE(sat)1}$		1.45	V dc
Base-emitter saturation voltage	3066	Test condition A, I_C = 5 A dc, I_B = 500 mA dc, pulsed (see 4.5.1)	$V_{BE(sat)2}$		2.2	V dc
Collector-emitter saturation voltage	3071	I_C = 2.5 A dc, I_B = 250 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.75	V dc
Collector-emitter saturation voltage	3071	I_C = 5 A dc, I_B = 500 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)2}$		1.5	V dc
Subgroup 3						
High temperature operation:		T_C = +150°C				
Collector to emitter cutoff current	3041	Bias condition A, V_{CE} = 60 V dc, V_{BE} = -2 V dc	I_{CEX}		500	µA dc
Low temperature operation		T_C = -55°C				
Forward - current transfer ratio	3076	V_{CE} = 5 V dc, I_C = 2.5 A dc, pulsed (see 4.5.1)	h_{FE4}			
2N5152 2/				15		
2N5154				25		

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 4						
Common-emitter, small-signal, short-circuit, forward-current transfer ratio	3206	V_{CE} = 5 V dc I_C = 100 mA dc, f = 1 kHz	h_{fe}			
2N5152 2/				20		
2N5154				50		
Magnitude of common-emitter, small-signal short-circuit, forward-current, transfer ratio	3306	V_{CE} = 5 V dc, I_C = 500 mA dc, f = 10 MHz	$\lvert h_{fe} \rvert$			
2N5152 2/				6		
2N5154				7		
Open-circuit output capacitance	3236	V_{CB} = 10 V dc, I_E = 0, f = 1 MHz	C_{obo}		250	pf
Switching time		I_C = 5 A dc, I_{B1} = 500 mA dc	t_{on}		0.5	µs
		I_{B2} = -500 mA dc	t_s		1.4	µs
		$V_{BE(off)}$ = 3.7 V dc	t_f		0.5	µs
		R_L = 6Ω; (See figure 8)	t_{off}		1.5	µs
Subgroup 5						
Safe operating area (d.c.)	3051	Pre-pulse condition for each test: V_{CE} = 0, I_C = 0, T_C = +25°C				
		Pulse condition for each test t_p = 1 sec. 1 cycle, T_C = +25°C, (see figure 6)				
Test # 1		V_{CE} = 5.0 V dc, I_C = 2 A dc for TO39/5 V_{CE} = 5.8 V dc, I_C = 2 A dc for U3, unheatsunk (see note 3) or TBD				
Test # 2		V_{CE} = 32 V dc, I_C = 310 mA dc for TO39/5 V_{CE} = 32 V dc, I_C = 360 mA dc for U3, unheatsunk (see note 3) or TBD				

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						
Test # 3		V_{CE} = 80 V dc, I_C = 12.5 mA dc for TO39/5 V_{CE} = 80 V dc, I_C = 14.5 mA dc for U3, unheatsunk (see note 3) or TBD				
Safe operating area (unclamped inductive)		T_C = +25°C, R_{BB1} = 10Ω R_{BB2} = 100Ω, L = 0.3 mH, RL = 0.1Ω, V_{CC} = 10 V dc, V_{BB1} = 10 V dc, V_{BB2} = 4 V dc, I_{CM} = 10 A dc, (see figure 7)				
End-point electrical measurements		See table I, subgroup 2				
Subgroups 6 and 7						
Not applicable						

1/ For sampling plan see MIL-PRF-19500.
2/ For resubmission of failed subgroup A1, double the sample size of the failed test or sequence of tests. A failure in group A, subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.
3/ Separate samples may be used.
4/ Not required for JANS devices.
5/ Not required for laser marked devices.

TABLE II. Groups B, C and E delta electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward - current transfer ratio	3076	I_C = 2.5 A dc, V_{CE} = 5 V dc, Pulsed (see 4.5.1)	Δh_{FE2}	± 20percent change from initial reading.		

1/ The delta measurements for table VIa (JANS) of MIL-PRF-19500 are as follows: Subgroups 4 and 5, see table II herein, step 1.

2/ The delta measurements for table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500 are as follows: All subgroups, see table II herein, step 1.

3/ The delta measurements for table VII of MIL-PRF-19500 are as follows: Subgroup 6, see table II herein, step 1.

4/ The delta measurements for 4.4.4 are as follows: Subgroups 1 and 2, see table II herein, step 1.

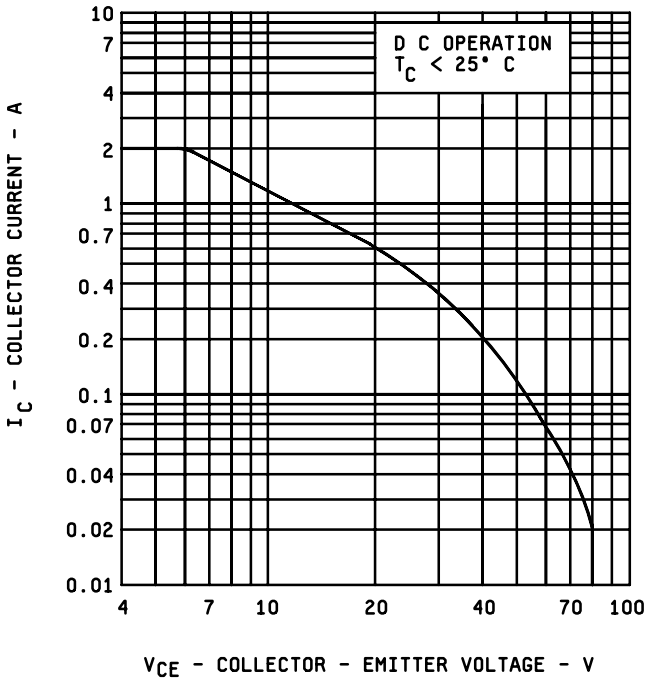


FIGURE 6. Maximum safe operating area.

R_{BB1} = 10Ω
R_{BB2} = 100Ω
L = 0.3 mH
R_L = 0.1Ω
V_{CC} = 10 V dc
I_{CM} = 10 A
V_{BB1} = 10 V dc
V_{BB2} = 4 V dc

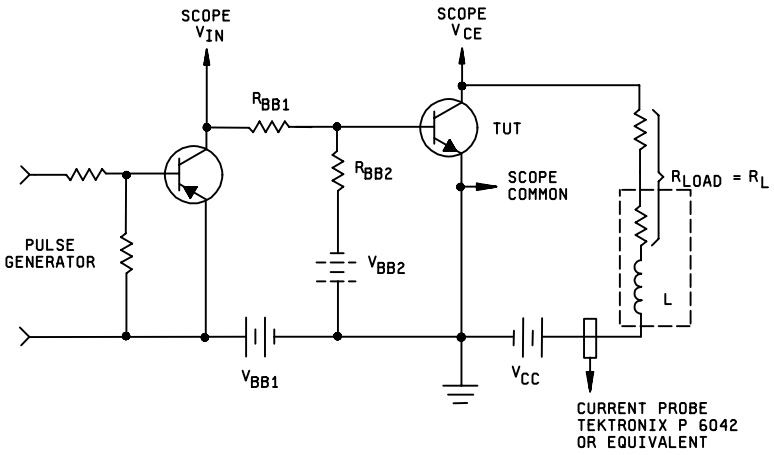
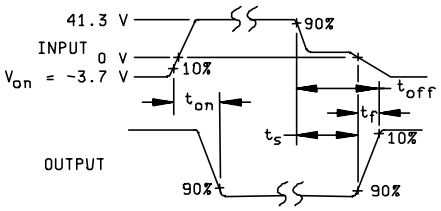
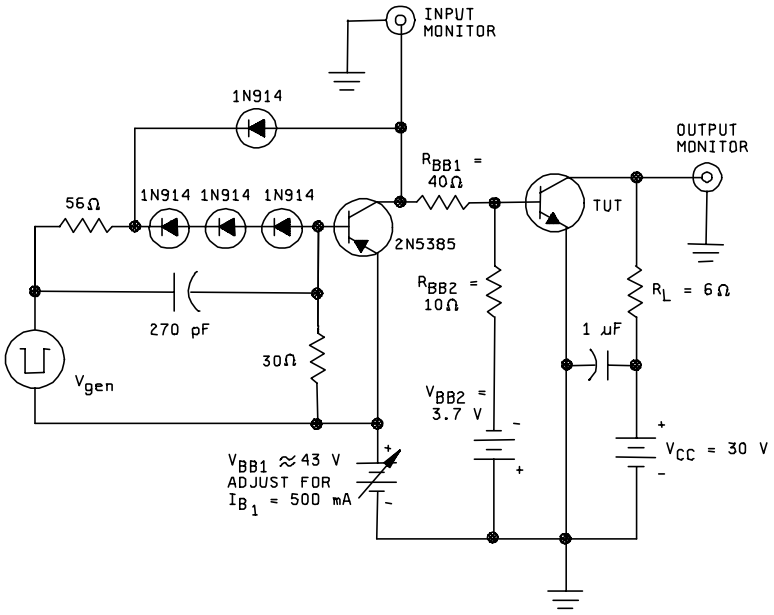


FIGURE 7. Unclamped inductive load energy test circuit.





NOTES:

1. V_{gen} is a -30 pulse (from 0 V) into a 50 ohm termination.
2. The V_{gen} waveform is supplied by a generator with the following characteristics: $t_r \leq 15$ ns, $t_f \leq 15$ ns, Z_{out} = 50 ohm, duty cycle ≤ 2%, t_w = 20 µs.
3. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 1$ ns, $R_{in} \geq 10$ Mohm, $C_{in} \leq 11.5$ pF.
4. Resistors must be noninductive types.
5. The dc power supplies may require additional bypassing in order to minimize ringing.
6. An equivalant drive circuit may be used

FIGURE 8. Switching time 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 actual packaging of materiel 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 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).

c. The lead finish as specified (see 3.4.2).

d. Type designation and quality assurance level.

e. 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 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 43216-5000.

6.4. Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N5152) will be identified on the QML.

JANHC and JANKC ordering information			
PIN	Manufacturer		
	33178	34156	43611
2N5152 2N5154	JANHCA2N5152 JANHCA2N5154	JANHCB2N5152 JANHCB2N5154	JANHCC2N5152 JANHCC2N5154
2N5152 2N5154	JANKCA2N5152 JANKCA2N5154	JANKCB2N5152 JANKCB2N5154	JANKCC2N5152 JANKCC2N5154

6.5. 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.

Custodians:
Air Force - 11
Navy NW
NASA - NA
DLA – CC

Review activity:
Air Force - 19

Preparing activity:
DLA – CC

(Project 5961-2398)

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-19500/544D	2. DOCUMENT DATE 010727

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER TYPES 2N5152, 2N5154, 2N5152L, 2N5154L, 2N5152U3 2N5154U3 JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan.barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC, P. O. Box 3990, 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 427-6888