MIL-S-19500/341B
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SUPERSEDING
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2 November 1966
(See 6.3.)

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-FREQUENCY, POWER TYPES 2N3375, TX2N3375, 2N3553, TX2N3553, 2N4440 AND TX2N4440

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

1. SCOPE

1.1 Scope. This specification covers the detail requirements for NPN, silicon, high-frequency, power-amplifier transistors. The prefix "TX" is used on devices submitted to and passing the special process-conditioning, testing, and screening as specified in 4.5 through 4.5.8.1.

1.2 Physical dimensions. Type 2N3375 and 2N4440, see figure 1.
Type 2N3553, see figure 2 (TO-39).

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	T_{stg}	T_J
	W	W	Vdc	Vdc	Vdc	Adc	°C	°C
2N3375, 2N4440	2.6 1/	11.6 3/	65	40	4	1.5	-65 to +200	+200
2N3553	1.0 2/	7.0 4/	65	40	4	1.0	-65 to +200	+200

1/ Derate linearly 14.86 mW/°C for $T_A > 25°C$.
2/ Derate linearly 5.71 mW/°C for $T_A > 25°C$.
3/ Derate linearly 0.066 W/°C for $T_C > 25°C$.
4/ Derate linearly 0.04 W/°C for $T_C > 25°C$.

1.4 Primary electrical characteristics.

Limits	$V_{CE(sat)}$ 1/ I_C = 500 mAdc, I_B = 100 mAdc (2N3375, 2N4440)	$V_{CE(sat)}$ 1/ I_C = 250 mAdc, I_B = 50 mAdc (2N3553)	C_{obo} I_E = 0, V_{CB} = 30 Vdc, 100kHz ≤ f ≤ 1 MHz	$\lvert h_{fe} \rvert$ V_{CE} = 28 Vdc, I_C = 125 mAdc, f = 100 MHz	h_{FE} V_{CE} = 5 Vdc 1/, I_C = 150 mAdc
	Vdc	Vdc	pf		
Min	---	---	---	3.5	15
Max	0.7	0.6	10	---	150

Limits	P_{out} 2/ P_{in} = 1.0 W, f = 100 MHz (2N3375)	P_{out} 2/ P_{in} = 1.0 W, f = 400 MHz (2N3375)	P_{out} 2/ P_{in} = 0.25 W, f = 175 MHz (2N3553)	P_{out} 2/ P_{in} = 1.0 W, f = 100 MHz (2N4440)	P_{out} 2/ P_{in} = 1.0 W, f = 400 MHz (2N4440)
	W	W	W	W	W
Min	7.5	3.0	2.5	10	4.0
Max	14	6.0	5.0	16	8.0

1/ Pulsed test (see 4.4.1).
2/ See 6.4 for typical power output vs. frequency.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

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

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

* 3.2 Abbreviations, symbols, definitions, and equations. The abbreviations, symbols, definitions, and equations used herein are as defined in MIL-S-19500, and as follows:

P_{in} - - - - - - - - - - - - - Input power
P_{out} - - - - - - - - - - - - Output power
η - - - - - - - - - - - - - - Collector efficiency ($\eta = \frac{\text{rf power out}}{\text{dc power in}} \times 100$)

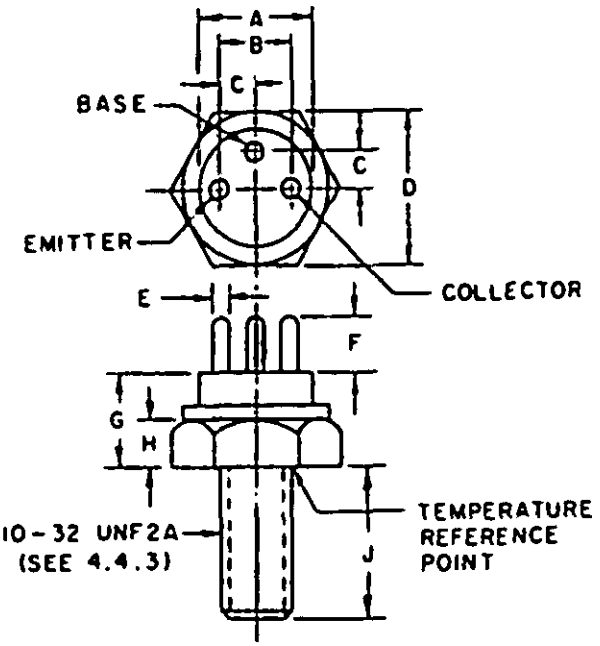
3.3 Design, construction and physical dimensions. Transistors shall be of the design, construction, and physical dimensions shown on figures 1 and 2.

* 3.3.1 Lead material and finish. Lead material, for type 2N3553 only, shall be Kovar or alloy 52 and final finish shall be gold-plated. (Leads may be tin-coated if specified in the contract or order, and this requirement shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking (see 6.2).

* 3.3.1.1 Lead material. If lead material need be specified, it shall be specified in the contract or order (see 6.2).

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III, and as follows:

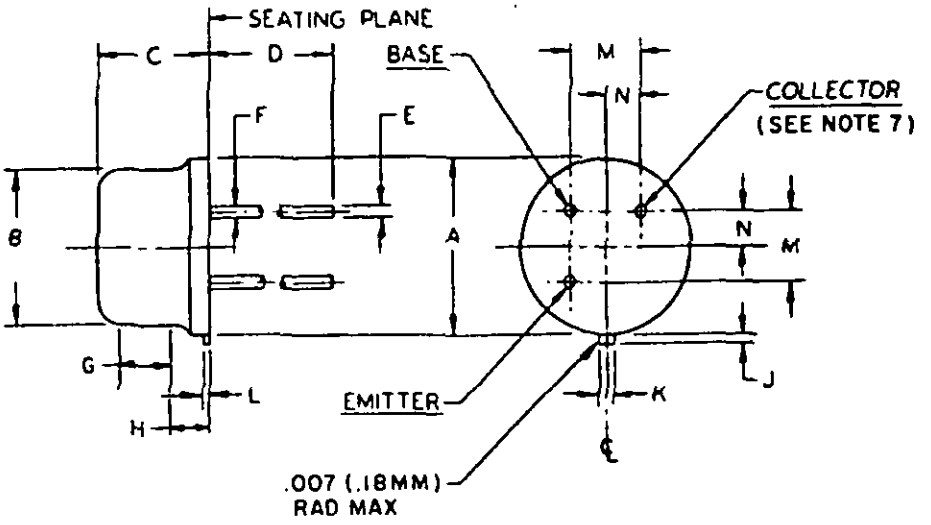
* 3.4.1 Process-conditioning, testing, and screening for "TX" type. Process-conditioning, testing, and screening for the "TX" type shall be as specified in 4.5.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.320	.340	8.13	8.64	
B	.195	.205	4.96	5.21	
C	.095	.105	2.41	2.67	
D	.420	.440	10.67	11.18	
E	.035	.045	.89	1.14	5
F	.140	.160	3.56	4.06	5
G	.245	.295	6.22	7.49	
H	.115	.135	2.92	3.43	
J	.422	.453	10.72	11.51	

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. The pin spacing permits insertion in any socket having a pin-circle diameter of .200 (50.8 mm) and contacts which will accommodate pins having a diameter of .035 (.89 mm) minimum, .045 (1.14 mm) maximum.
3. The torque applied to a 10-32 hex nut assembled on the thread during installation should not exceed 12 inch-pounds.
4. All terminals electrically isolated from case.
5. All three terminals.

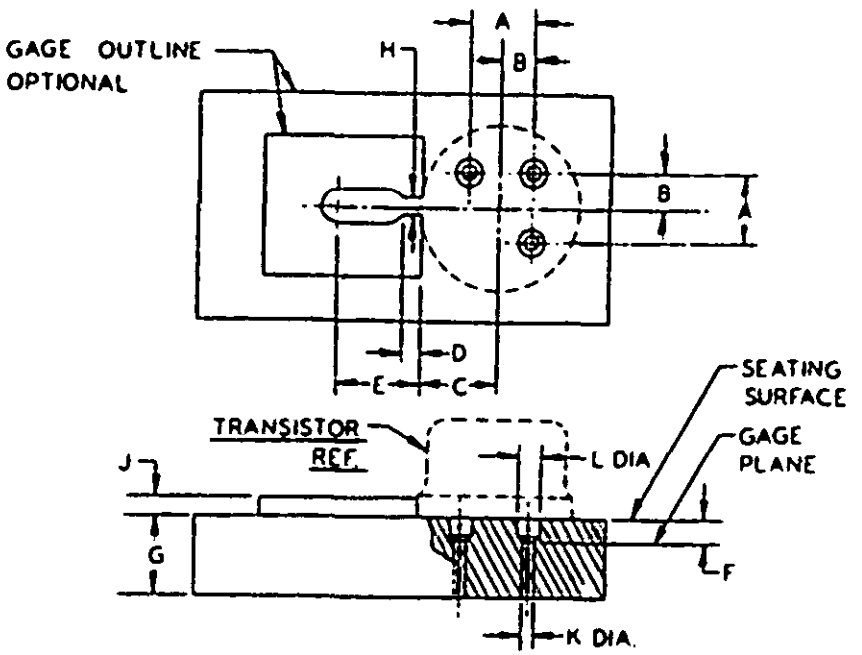
FIGURE 1. Physical dimensions of transistor types 2N3375, TX2N3375, 2N4440 and TX2N4440.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.335	.370	8.51	9.40	
B	.305	.335	7.75	8.51	
C	.240	.260	6.10	6.60	
D	.500	.750	12.70	19.05	9
E	.016	.021	.41	.53	2,9
F	.016	.019	.41	.48	3,9
G	.100	---	2.54	---	4
H	---	---	---	---	5
J	.029	.045	.74	1.14	8
K	.028	.054	.71	.86	
L	.009	.125	.23	3.18	
M	.1414 Nom		3.59 Nom		6
N	.0707 Nom		1.80 Nom		6

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. Measured in the zone beyond .250 (6.35 mm) from the seating plane.
3. Measured in the zone .050 (1.27 mm) and .250 (6.35 mm) from the seating plane.
4. Variations on dimension B in this zone shall not exceed .010 (.25 mm).
5. Outline in this zone is not controlled.
6. When measured in a gaging plane .054+.001, -.000 (1.37+.03,-.00 mm) below the seating plane of the transistor maximum diameter leads shall be within .007 (.18 mm) of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance. Figure 3 shows the preferred measured method.
7. The collector shall be internally connected to the case.
8. Measured from the maximum diameter of the actual device.
9. All 3 leads. (see 3.5.1 and 3.5.2).

FIGURE 2. Physical dimensions of transistor types 2N3553 and TX2N3553 (TO-39).



NOTES:

1. The following gaging procedure shall be used: The use of a pin straightener prior to insertion in the gage is permissible. The device being measured shall be inserted until its seating plane is .125±.010 (3.18±.25 mm) from the seating surface of the gage. A spacer may be used to obtain the .125 (3.18 mm) distance from the gage seat prior to force application. A force of 8 oz ±.5 oz shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage.
2. The location of the tab locator, within the limits of dimension C, will be determined by the tab and flange dimension of the device being checked.
3. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.

LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.1409	.1419	3.58	3.60	
B	.0709	.0712	1.78	1.81	
C	.182	.199	4.62	5.05	
D	.009	.011	.23	.28	
E	.125 Nom		3.18 Nom		
F	.054	.055	1.37	1.40	
G	.372	.378	9.45	9.60	
H	.0360	.0365	.89	.90	
J	.150 Nom		3.81 Nom		
K	.0325	.0335	.83	.85	
L	.0595	.0605	1.51	1.54	

FIGURE 3. Gage for lead and tab location for transistor types 2N3553 and TX2N3553.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

(a) Country of origin.
(b) Manufacturer's identification.

* 3.5.1 "TX" marking. Devices in accordance with the "TX" requirements shall include the additional marking "TX" preceding the type designation.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

* 4.2.1 Qualification testing. The non-TX type shall be used for qualification testing. Upon request to the qualifying activity, qualification will be extended to include the "TX" type of the device.

* 4.3 Quality conformance inspection. Quality conformance inspection shall consist of groups A, B, and C inspections. When specified in the contract or order, one copy of the quality conformance inspection data, pertinent to the device inspection lot, shall be supplied with each shipment by the device manufacturer.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

4.3.3 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

* 4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hour life-test, may be continued on test for 1,000-hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C, 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours, shall be computed for 1,000-hour acceptance criteria.

* 4.3.5 Group C testing. The contractor shall, throughout the course of a contract or order, permit the Government representative to scrutinize all test data and findings covering manufacturer's test program on group C characteristics and parameters for the product concerned. Upon determination by the Government inspector (in advance of group C, 6-month, test results) that group C parameters are not being adequately met, the Government inspector may require lot-by-lot inspection. normally for a minimum of 3 consecutive lots, to be performed for required group C tests.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, and as follows:

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

* 4.4.2 Time limit for end-point test measurements. End-point tests for qualification and quality conformance inspection shall be completed within 96 hours after completion of the last test in the subgroup.

4.4.3 Terminal strength (stud torque). Acceptance criteria after the stud torque test shall be 10-32 UNF-2A for external threaded parts in accordance with Handbook H28.

* 4.4.4 Power output and collector efficiency measurement. The device shall be tested in the circuit of figure 5, 6, or 7, as appropriate. The specified conditions shall be applied and the variable capacitors adjusted to obtain maximum power output. When the maximum power output is obtained, the collector current shall be measured and recorded and the collector efficiency shall be computed as follows:

$$\eta \text{ in } \% = \frac{P_O \text{ (watts)}}{28 \times I_C \text{ (amperes)}} \times 100$$

* 4.4.5 Burnout by pulsing. The devices shall be tested in the circuit of figure 8. The voltage source shall be increased from zero until the specified current is reached. The current shall be maintained for the specified time.

TABLE I. Group A inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 1			10	5				
Visual and mechanical examination	2071				---	---	---	---
* Subgroup 2			5	3				
Breakdown voltage, collector to base	3001	Bias cond. D; I_C = 100 µAdc			BV_{CBO}	65	---	Vdc
Breakdown voltage, collector to emitter (unclamped inductive)	---	I_C = 0 to 200 mAdc (see fig. 4)			BV_{CEO}	40	---	Vdc
Breakdown voltage, collector to emitter (unclamped inductive)	---	V_{BE} = -1.5 Vdc; I_C = 0 to 200 mAdc (see fig. 4)			BV_{CEX}	65	---	Vdc
Collector to emitter cutoff current	3041	Bias cond. D; V_{CE} = 30 Vdc			I_{CEO}	---	.05	mAdc
Breakdown voltage, emitter to base	3026	Bias cond. D; I_E = 100 µAdc			BV_{EBO}	4.0	---	Vdc
Collector to emitter voltage (saturated)	3071							
2N3375, 2N4440		I_C = 500 mAdc; I_B = 100 mAdc; pulsed (see 4.4.1)			$V_{CE(sat)}$	---	0.7	Vdc
2N3553		I_C = 250 mAdc; I_B = 50 mAdc; pulsed (see 4.4.1)			$V_{CE(sat)}$	---	0.6	Vdc
Forward-current transfer ratio	3076	V_{CE} = 5 Vdc; I_C = 150 mAdc; pulsed (see 4.4.1)			h_{FE}	15	150	---

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
* Subgroup 3			5	3				
Open circuit output capacitance	3236	V_{CB} = 30 Vdc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz			C_{obo}	---	10	pf
Real part of small-signal short circuit input impedance	3266	V_{CE} = 28 Vdc; I_C = 100 mAdc; f = 200 MHz			RE_{hie}	---	20	ohms
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 28 Vdc; I_C = 125 mAdc; f = 100 MHz			$\lvert h_{fe} \rvert$	3.5	---	---
Power output	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz; (see 4.4.4 and fig. 5)						
2N3375					P_{out}	7.5	14	watts
2N4440					P_{out}	10	16	watts
Collector efficiency 2N3375, 2N4440	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz (see 4.4.4)			η	65%	---	---
Power output	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 400 MHz; (see 4.4.4 and fig. 6)						
2N3375					P_{out}	3.0	6.0	watts
2N4440					P_{out}	4.0	8.0	watts
Collector efficiency 2N3375, 2N4440	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 400 MHz (see 4.4.4)			η	40%	---	---
Power output 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz; (see 4.4.4 and fig. 7)			P_{out}	2.5	5.0	watts
Collector efficiency 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz; (see 4.4.4)			η	50%	---	---
* Subgroup 4			15	10				
High-temperature operation	---	T_A = +150° C			---	---	---	---
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 30 Vdc			I_{CBO}	---	200	µAdc
Low-temperature operation	---	T_A = -55° C			---	---	---	---
Forward-current transfer ratio	3076	V_{CE} = 5 Vdc; I_C = 150 mAdc; pulsed (see 4.4.1)			h_{FE}	10	---	---

TABLE II. Group B inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
* Subgroup 1			20	20				
Physical dimensions	2066	(See figures 1 and 2.)			---	---	---	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
• Subgroup 2			15	15				
Solderability	2026	Dwell time = 10 ±1 sec for type 2N3375 and 2N4440 only			---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. C			---	---	---	---
Thermal shock (glass strain)	1056	Test cond. B			---	---	---	---
Terminal strength (tension) 2N3375 and 2N4440 only	2036	Test cond. A; weight = 5 lb; time = 15 sec each terminal			---	---	---	---
Terminal strength (stud torque) 2N3375 and 2N4440 only	2036	Test cond. D2; torque = 12 in.-lb; time = 15 sec (see 4.4.3)			---	---	---	---
Seal (leak-rate)	---	MIL-STD-202, method 112, test cond. C, procedure III; test cond. A or B for gross leaks			---	---	1×10^{-7}	atm cc/sec
Moisture resistance	1021	Omit initial conditioning for 2N3375 and 2N4440 only			---	---	---	---
End points: (See 4.4.2.)								
Collector to emitter cutoff current	3041	Bias cond. D; V_{CE} = 30 Vdc			I_{CEO}	---	.05	mAdc
Power output	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz; (see 4.4.4 and fig. 5)						
2N3375					P_{out}	7.5	---	watts
2N4440					P_{out}	10	---	watts
Collector efficiency 2N3375, 2N4440	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz; (see 4.4.4)			η	65%	---	---
Power output 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz; (see 4.4.4 and fig. 7)			P_{out}	2.5	---	watts
Collector efficiency 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz; (see 4.4.4)			η	50%	---	---
• Subgroup 3			15	15				
Shock	2016	500 G, 1.0 msec for types 2N3375 and 2N4440; 1,500 G, 0.5 msec for type 2N3553; 5 blows each orientation: X_1, Y_1, Y_2, and Z_1			---	---	---	---
Vibration fatigue	2046	Nonoperating			---	---	---	---
Vibration, variable frequency	2056				---	---	---	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 3 - Continued								
Constant acceleration	2006	20,000 G for type 2N3553; 10,000 G for types 2N3375 and 2N4440; each orientation X_1, Y_1, Y_2, and Z_1			---	---	---	---
End points: (Same as subgroup 2)								
Subgroup 4			20	20				
Terminal strength (lead fatigue) 2N3553 only	2036	Test cond. E			---	---	---	---
Subgroup 5			20	20				
Salt atmosphere (corrosion)	1041				---	---	---	---
End points: (Same as subgroup 2)								
* Subgroup 6			7	A=5				
High-temperature life (nonop. rating) (TX types only)	1031	T_{stg} = +200° C			---	---	---	---
High-temperature life (nonoperating) (Non-TX types only)	1031	T_{stg} = +200° C; time = 340 hours (see 4.3.4)			---	---	---	---
End points: (See 4.4.2)								
Collector to emitter cutoff current	3041	Bias cond. D; V_{CE} = 30 Vdc			I_{CEO}	---	0.1	mAdc
Power output	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz; (see 4.4.4 and fig. 5)						
2N3375					P_{out}	7.2	---	watts
2N4440					P_{out}	9.7	---	watts
Collector efficiency 2N3375, 2N4440	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz; (see 4.4.4)			η	65%	---	---
Power output 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz; (see 4.4.4 and fig. 7)			P_{out}	2.3	---	watts
Collector efficiency 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz; (see 4.4.4)			η	50%	---	---
* Subgroup 7			7	A=5				
Steady state operation life (TX types only)	1026							
2N3375, 2N4440		T_C = +140°C; P_C = 4.0 W; V_{CB} = 28 Vdc			---	---	---	---
2N3553		T_A = +25°C; P_C = 1.0 W; V_{CB} = 28 Vdc			---	---	---	---

TABLE II. Group B inspection - Continued

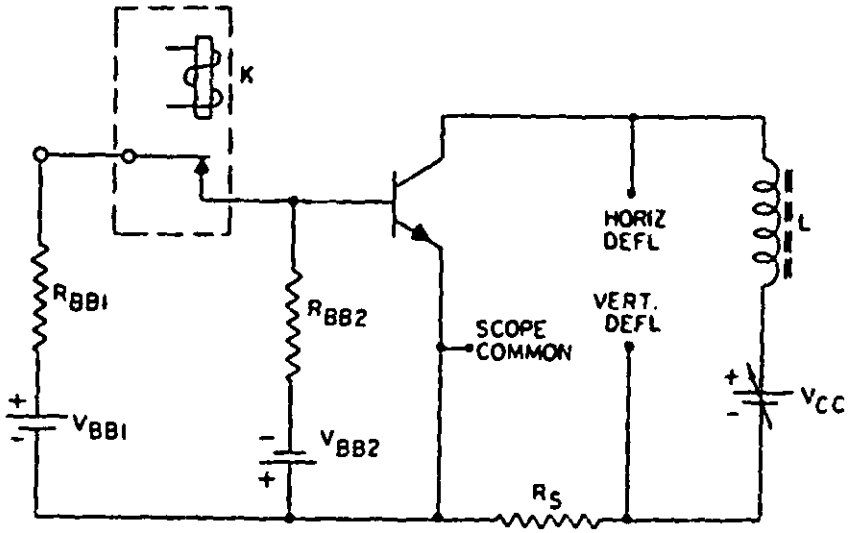
Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
* Subgroup 7 - Continued								
Steady state operation life (non-TX types only)	1026							
2N3375, 2N4440		T_C = +140°C; P_C = 4.0 W; V_{CB} = 28 Vdc; time = 340 hours (see 4.3.4)			---	---	---	---
2N3553		T_A = +25°C; P_C = 1.0 W; V_{CB} = 28 Vdc, time = 340 hours (see 4.3.4)			---	---	---	---
End points: (Same as subgroup 6)								

TABLE III. Group C inspection

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
* Subgroup 1			20	20				
Barometric pressure, reduced (altitude operation)	1001	Normal mounting; pressure = 8 mm Hg for 60 sec min			---	---	---	---
Measurement during above test:								
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 65 Vdc			I_{CBO}	---	0.1	mAdc
Thermal resistance	3151							
2N3375, 2N4440					θ_{J-C}	---	15	°C/W
2N3553					θ_{J-C}	---	25	°C/W
* Subgroup 2			20	20				
Burnout by pulsing	3005	Prepulse cond: V_{CB} = 0, I_C = 0						
2N3375, 2N4440		Pulse cond: I_C = 1.5 Adc; t_p = 60 sec for 1 cycle; $t_r \leq 6$ sec; $t_f \leq 6$ sec (see 4.4.5 and fig. 8)			---	---	---	---
2N3553		I_C = 1.0 Adc; t_p = 60 sec for 1 cycle; $t_r \leq 6$ sec; $t_f \leq 6$ sec (see 4.4.5 and fig. 8)			---	---	---	---
End points: (See 4.4.2.) (Same as for subgroup 2 of group B.)								

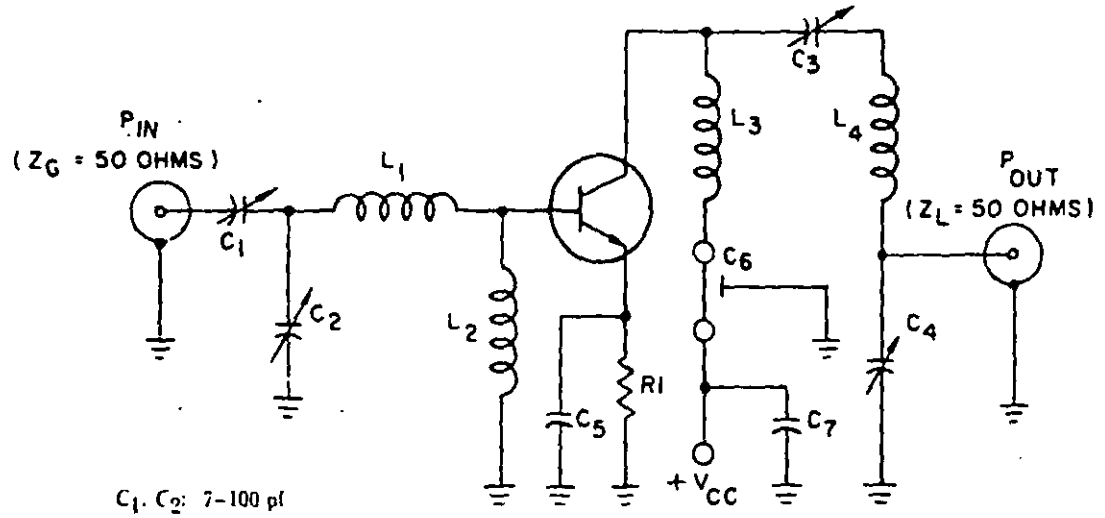
TABLE III. Group C inspection - Continued

Examination or test	MIL-STD-750		LTPD		Symbol	Limits		
	Method	Details	Non TX	TX		Min	Max	Unit
Subgroup 3			λ=10	--				
High-temperature life (nonoperating)	1031	T_{stg} = +200°C (see 4.3.4)			---	---	---	---
End points: (See 4.4.2.)								
Collector to emitter cutoff current	3041	Bias cond. D; V_{CE} = 30 Vdc			I_{CEO}	---	0.1	mAdc
Power output	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz (see 4.4.4 and fig. 5)						
2N3375					P_{out}	7.2	---	watts
2N4440					P_{out}	9.7	---	watts
Collector efficiency 2N3375, 2N4440	---	V_{CC} = 28 Vdc; P_{in} = 1.0 W; f = 100 MHz; (see 4.4.4)			η	65%	---	---
Power output 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz (see 4.4.4 and fig. 7)			P_{out}	2.3	---	watts
Collector efficiency 2N3553	---	V_{CC} = 28 Vdc; P_{in} = 0.25 W; f = 175 MHz; (see 4.4.4)			η	50%	---	---
Subgroup 4			λ=10	--				
Steady state operation life 2N3375, 2N4440	1026	(See 4.3.4) T_C = +140°C; P_C = 4.0 W; V_{CB} = 28 Vdc			---	---	---	---
2N3553		T_A = +25°C; P_C = 1.0 W; V_{CB} = 28 Vdc						
End points: (Same as subgroup 3)								



R_{BB1} = 150 ohms
V_{BB1} = 20 Vdc
K = 5 p.s.t. relay, 6 v.a.c coil, Clare Mercury Relay, Model No. HGP-1001 (or equivalent).
R_{BB2} = 33 ohms, V_{BB2} = 1.5 Vdc } for BV_{CEX}
R_{BB2} = Infinity, V_{BB2} = 0 } for BV_{CEO}
R_S = 1 ohm ± 1%, 5 watt non-inductive
V_{CC} = Regulated, variable voltage DC power supply capable of up to 30 volts and .5A. The output voltage should be pre-adjusted for 200 mA collector current (about 17 volts).
L = 25 mH, 100 mA, 83 ohms DC resistance (Miller No.957, or equivalent).

FIGURE 4. BV_{CEO}, BV_{CEX} (Unclamped inductive) test circuit.



C_1, C_2: 7–100 pf
C_3, C_4: 4–40 pf
C_5: 330 pf, disc ceramic
C_6: 1500 pf (feed through)
C_7: 0.005 µf, disc ceramic
L_1: 3 turns No. 16 wire, 1/4 inch ID, 5/16 inch long
L_2: Ferrite choke, Z = 750 (±20%) ohms
L_3: 2.4 µh choke
L_4: 5 turns No. 16 wire, 5/16 inch ID, 7/16 inch long
R_1: 1.35 ohms, non-inductive

FIGURE 5. RF amplifier circuit for 2N3375 and 2N4440 power-output test (100 MHz operation).

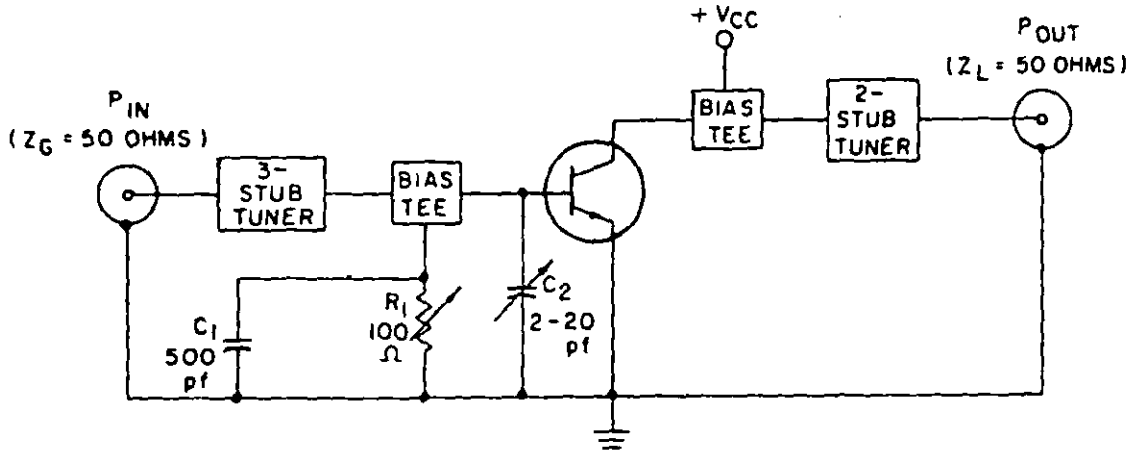
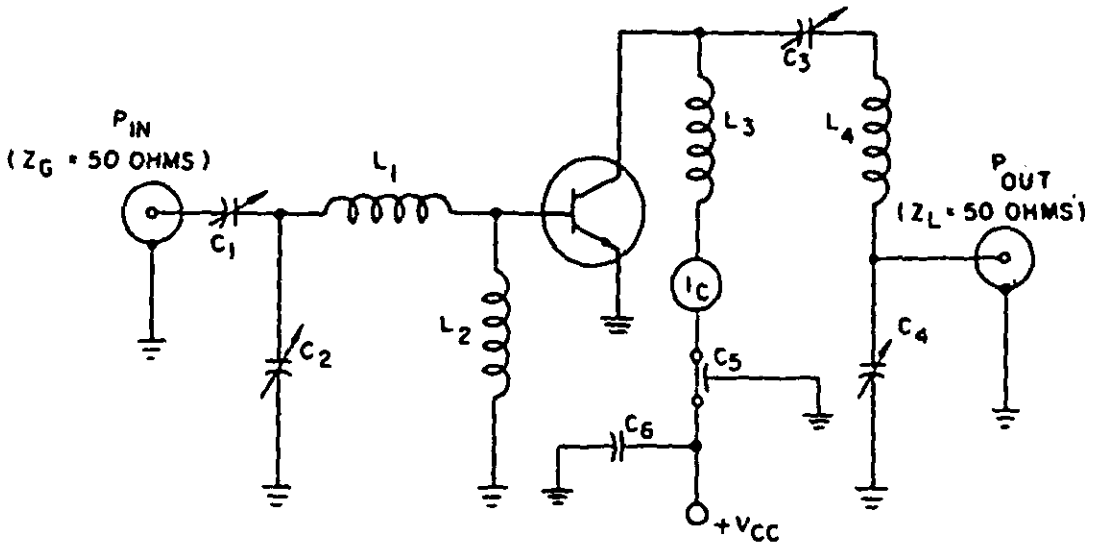


FIGURE 6. RF amplifier circuit for 2N3375 and 2N4440 power-output test (400 MHz operation).



C_1, C_2, C_3, C_4 3-35 pf
C_5: 1,000 pf (feed through)
C_6: 0.006 µf, disc ceramic
L_1: 2 turns No. 16 wire, 3/16 inch ID, 1/4 inch long
L_2: Ferrite choke, Z = 450 ohms
L_3: 2 turns No. 16 wire, 1/4 inch ID, 1/4 inch long
L_4: 4 turns No. 16 wire, 3/8 inch ID, 3/8 inch long

FIGURE 7. RF amplifier circuit for 2N3553 power-output test (175 MHz operation).

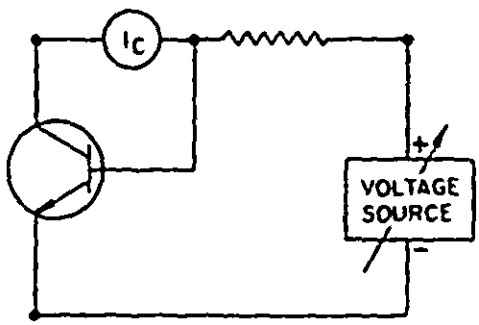


FIGURE 8. Burnout by pulsing test circuit.

* 4.5 Process-conditioning, testing, and screening for "TX" type. The procedure for process-conditioning, testing, and screening for the "TX" type shall be in accordance with 4.5.1 through 4.5.8.1 and figure 9. Process-conditioning shall be conducted on 100 percent of the lot, prior to submission of the lot to the tests specified in tables I, II, and III. (At the option of the manufacturer, the non-TX type may be subjected to process-conditioning and testing.)

* 4.5.1 Quality assurance (lot verification). Quality assurance shall keep lot records for 3 years, minimum, monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these devices. The records shall be available for review by the customer at all times. The quality assurance monitoring shall include, but not be limited to: Process-conditioning, testing, and screening. (The conditioning and screening tests performed as standard-production tests need not be repeated when these are predesignated and acceptable to the Government as being equal to or more severe than specified herein and the relative process-conditioning sequence is maintained.)

* 4.5.2 High-temperature storage. All devices shall be stored for at least 24 hours at a minimum temperature (T_A) of 200° C.

* 4.5.3 Thermal shock (temperature cycling). All devices shall be subjected to thermal shock (temperature cycling) in accordance with MIL-STD-750, method 1051, test condition C, except that 10 cycles shall be continuously performed and the time at the temperature extremes shall be 15 minutes, minimum.

* 4.5.4 Acceleration. All devices shall be subjected to acceleration test in accordance with MIL-STD-750, method 2006, with the following exceptions: The test shall be performed one time in the Y_1 orientation only, at a peak level of 20,000 G minimum for type 2N3553 and 10,000 G minimum for types 2N3375 and 2N4440. The one minute hold-time requirement shall not apply.

* 4.5.5 Hermetic seal (fine-leak) test. All devices shall be fine-leak tested in accordance with MIL-STD-202, method 112, test condition C, procedure IIIa or IIIb (using the applicable conditions of 4.5.5.1 or 4.5.5.2), except that the gross-leak test shall be as specified in 4.5.5.3.

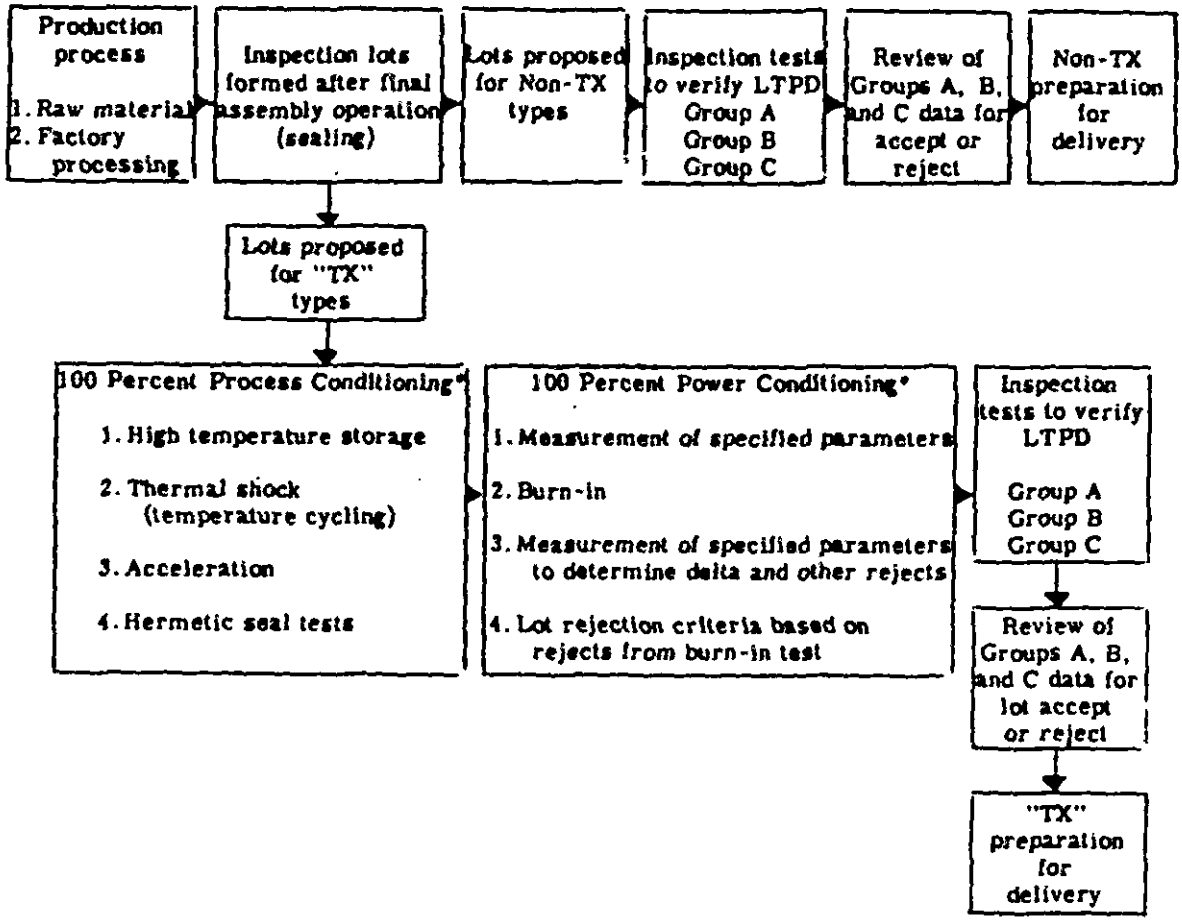
* 4.5.5.1 Conditions for procedure IIIa. The devices shall be placed in a sealed chamber and pressurized to 50 psig minimum with helium gas for a minimum of 4 hours. The devices shall then be removed from the chamber and within 30 minutes be subjected to a helium leak detection test. Devices shall be rejected that exhibit a leak rate of 1×10^{-7} cubic centimeter (cc) of helium per second when measured at a differential pressure of one atmosphere. All devices exhibiting this leakage rate or greater shall be removed from the lot.

* 4.5.5.2 Conditions for procedure IIIb. The devices shall be placed in an activation tank, pressurized with Krypton 85 tracer gas in a nitrogen solution, for sufficient time to detect a leak rate of 1×10^{-8} atmospheric cubic centimeters per second (atm cc/sec). Within four hours after subjection to this pressurization, the leak rate of the devices shall be determined on an attribute basis using the general equation shown below. Any device exhibiting a leak rate equal to or greater than 1×10^{-8} atm cc/sec shall be removed from the lot. The general equation for use with radioactive-gas leak test equipment is:

$$Q = \frac{R}{SKT(P_e^2 - P_i^2)}$$

where:

Q = leak rate in atm cc/sec.
R = net counting rate of tested part above background in cts/min.
S = specific activity of the test gas mixture in μCi/atm cc.
K = counting efficiency of the system for the given part in cts/min μCi.
P_e = pressure of test gas in activation tank during pressurization in atm abs.
P_i = pressure inside part under test in atm abs.
T = duration of pressurization in test gas mixture in seconds.



*ORDER OF THE TESTS IN THE BLOCKS SHALL BE PERFORMED AS SHOWN

FIGURE 9. Order of procedure diagram for Non-TX and "TX" types.

* 4.5.5.3 Hermetic seal (gross-leak) test. All devices shall be tested for gross-leaks by immersing in non-corrosive ethylene glycol at approximately 100°C for a minimum of 15 seconds and observed for bubbles. All devices that bubble shall be removed from the lot.

* 4.5.6 Preburn-in tests. The parameters I_{CEO} and h_{FE} of table IV shall be measured and the data recorded for all devices in the lot. All devices shall be handled or identified such that the delta end points can be determined after the burn-in test. All devices which fail to meet these requirements shall be removed from the lot and the quantity removed shall be noted on the lot history.

* TABLE IV. Burn-in test measurements

Test	MIL-STD-750		Symbol	Limits		Unit
	Method	Details		Min	Max	
Collector to emitter cutoff current	3041	Bias cond. D; V_{CE} = 30 Vdc	I_{CEO}	---	.05	mAdc
Forward-current transfer ratio	3076	V_{CE} = 5 Vdc; I_C = 150 mAdc; pulsed (see 4.4.1)	h_{FE}	15	150	---

* 4.5.7 Burn-in test. All devices shall be operated for 168 hours minimum under the following conditions:

$T_A = 25 \pm 3°C$ $V_{CB} = 30$ Vdc $P_T = 2.6$ W (2N3375, 2N4440)
$P_T = 1.0$ W (2N3553)

* 4.5.6 Post burn-in tests. The parameters I_{CEO} and h_{FE} of table IV shall be retested after burn-in and the data recorded for all devices in the lot. The parameters measured shall not have changed during the burn-in test from the initial value by more than the specified amount as follows:

ΔI_{CEO} = 100 percent or 5 microamperes, whichever is greater

Δh_{FE} = ±20 percent

* 4.5.8.1 Burn-in test failures (screening). All devices that exceed the delta (Δ) limits of 4.5.8 or the limits of table IV after burn-in, shall be removed from the inspection lot and the quantity removed shall be noted on the lot history. If the quantity removed after burn-in should exceed 10 percent of the number of devices subjected to the burn-in test, then the entire inspection lot shall be unacceptable for the "TX" type.

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

6. NOTES

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

6.2 Ordering data.

(a) Lead finish if other than gold-plated (see 3.3.1).

(b) Lead material (see 3.3.1.1).

(c) Inspection data (see 4.3).

6.3 Interchangeability criteria. Types 2N3375 and 2N3553 covered herein are interchangeable with the devices covered by the superseded MIL-S-19500/341A.

6.4 Typical power output vs frequency curves. The typical power output vs frequency for types 2N3375, 2N3553 and 2N4440 are shown on figures 10, 11, and 12, respectively.

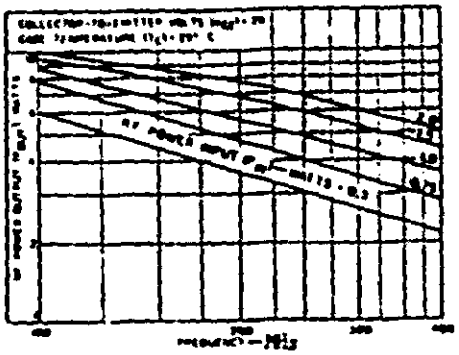


FIGURE 10. Typical power output vs frequency for type 2N3375.

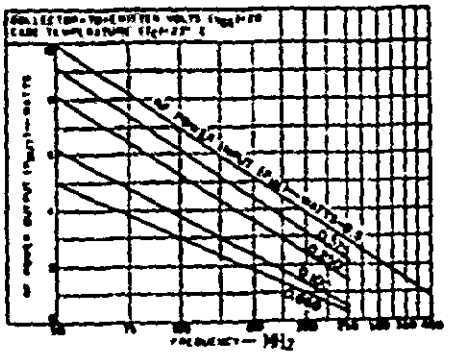


FIGURE 11. Typical power output vs frequency for type 2N3553.

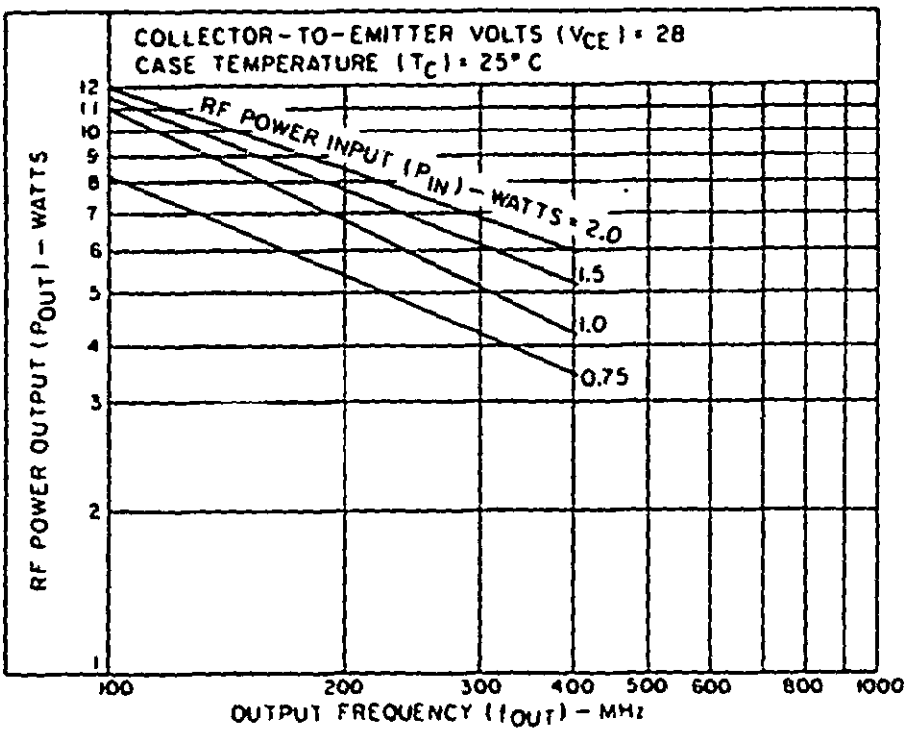


FIGURE 12. Typical power output vs frequency for type 2N4440.

6.5 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) 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.

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Navy - EC
Air Force - 11

Review activities:
Army - EL, MU, MI
Navy - EC, SH
Air Force - 11, 17, 85
DSA - ES

User activities:
Army - SM, MI
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