MIL-S-19500/112C(EL)
4 May 1967
SUPERSEDING
MIL-S-19500/112B(SigC)
23 November 1966

MILITARY SPECIFICATION

TRANSISTOR, PNP, GERMANIUM
TYPES 2N502A AND 2N502B

1. SCOPE

1.1 Scope.- This specification covers the detail requirements for germanium, PNP, transistors for particular use as 200-MHz amplifier devices having a minimum power gain of 10 db, in compatible equipment circuits. (See 3.4 and 6.2 herein.)

1.2 Outline and dimensions.- See Figures 1A and 1B, and 3.3 herein.

1.3 Maximum ratings.-

P_T 1/	V_{CBO}	V_{CES}	V_{EBO}	T_{stg}
mW	Vdc	Vdc	Vdc	°C
75	-30	-30	-0.5	-65 to + 100

1/ This power dissipation is for 1,000 hours expected life at T_A = +25°C For power dissipation at T_A > +25°C, derate at 1.0 mW/°C.

1.4 Particular electrical characteristics.- (At T_A=+25°C):

	h_{fe} at: f = 1 KHz V_{CE}=-10 Vdc I_E=2 mAdc		P.G. at: f=200 MHz V_{CB}=-10Vdc I_E =2 mAdc	NF at: f=200 MHz V_{CB}=-10 Vdc I_E = 2 mAdc	$r_b'C_c$ at: f=46 MHz V_{CB}=-10Vdc I_E= 2 mAdc	C_{obo} at: f = 1 MHz V_{CB}=-10 Vdc I_E = 0
	2N502A	2N502B				
Min	---	---	db	db	psec	pf
	15	25	10	---	5	---
Max	200	80	---	7	25	1.6

FSC-5961

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 this specification to the extent specified herein:

SPECIFICATIONS

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 contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer. Both the title and number or symbol should be stipulated when requesting copies.)

3. REQUIREMENTS

3.1 Requirements.- Requirements for the transistors shall be in accordance with Specification MIL-S-19500 and as otherwise specified herein.

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

$r_b'C_c$ . . . . . extrinsic base-resistance collector-capacitance product

3.3 Design and construction.- The transistor shall be of the design, construction, and physical dimensions specified in either Fig.1A or Fig.1B herein. (See 3.3.2 herein.)

3.3.1 Terminal arrangement.- The terminal arrangement on the transistor shall be as indicated in Figures 1A or 1B.

3.3.2 Terminal-lead length.- Terminal-lead length(s) other than that specified in Figures 1A or 1B may be furnished under contract or order (see 6.3 herein) where the devices covered herein are required directly for particular equipment-circuit installation. Where such other lead-lengths are required and provided, it shall not be construed as affecting adversely the Qualified-product status of the device, or applicable JAN marking.

3.3.3 Operating position.- The transistor shall be capable of proper operation in any position.

3.4 Performance characteristics.- The transistor performance characteristics shall be as specified in Tables I, II and III herein. Except where specifically differentiated for each transistor type (see 1.3, 1.4 and Tables I, II, and III herein), the performance requirements, including characteristics, ratings, and test conditions apply equally to both transistor types covered herein.

3.5 Marking.- Except as otherwise specified herein, marking shall be in accordance with Specification MIL-S-19500. If any specification-requirements waiver has been granted, the product-identification marking shall consist of the classification type designation only. The "manufacturer's identification" and "country of origin" may, at option of the manufacturer, be omitted from being marked directly on the semiconductor device covered herein.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- Except as otherwise specified herein, the responsibility for inspection, general procedures for acceptance, classification of inspection, and inspection conditions and methods of test shall be in accordance with Specification MIL-S-19500, Quality Assurance Provisions.

4.2 Qualification and acceptance inspection.- Qualification and Quality Conformance inspection shall be in accordance with Specification MIL-S-19500, Quality Assurance Provisions, and as otherwise specified herein (see 4.2.2 herein). Groups A, B, and C inspection shall consist of the examinations and tests specified in Table I, II, and III, respectively, herein. Quality Conformance inspection shall include inspection of Preparation for Delivery (see 5.1 herein).

4.2.1 Specified LTPD for subgroups.- The LTPD specified for a subgroup in Tables I, II, and III herein shall apply for all of the tests, combined, in the subgroup.

4.2.2 Group B-Group C life test samples.- Samples that have been subjected to Group B, 340-hour life test may be continued on test for 1000 hours in order to satisfy Group C life test requirements. These samples shall be predesignated, and shall remain subject to the Group C, 1000-hour acceptance evaluation after they have passed the Group B, 340-hour acceptance criteria; hereto, the cumulative total of failures found during 340-hour test and during the subsequent interval up to 1000 hours on these samples shall be computed for 1000-hour acceptance criteria.

4.2.3 Group C testing.- Unless otherwise specified, Group C tests shall be performed on the initial lot and thereafter on a lot every 6 months. (See Table III herein). 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.

4.2.4 Disposition of sample units.- Sample units that have been subjected to Group B, Subgroup 2, 4, and 5 tests shall not be delivered on the contract or order. Sample units that have been subjected to and have passed Group B, Subgroups 1, 3, 6, 7 and 8 and Group C tests (these tests to be considered non-destructive), may be delivered on the contract or order provided that, after Group B and C inspection is terminated, those sample units are subjected to and pass Group A inspection. Defective units from any sample group that may have passed group inspection shall not be delivered on the contract or order until the defect(s) has been remedied to the satisfaction of the Government.

4.3 Particular examination and test requirements.-

4.3.1 Interval for End-Point test measurements.- All applicable End-Point Test measurements shall be performed, after sample units have been subjected to required physical-mechanical or environmental test(s), in accordance with the following time-delay limitations:

(a) For Qualification inspection: within 24 hours.

(b) For Quality Conformance inspection: within 96 hours

4.3.2 Mechanical damage resulting from test. Except for intentionally deforming, mutilating, or dismembering mechanical-stress tests to which samples are subjected, there shall be no evidence of mechanical damage to any sample unit as a result of any of the Groups A, B, or C tests.

Table I. Group A inspection.

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 1		10				
2071	Visual and mechanical examination	---		---	---	---	---
	Subgroup 2		5				
3036	Collector-base cutoff current	Bias Cond. D V_{CB}= -10 Vdc		I_{CBO}	---	-4	uAdc
3036	Collector-base cutoff current	Bias Cond. D V_{CB}= -30 Vdc		I_{CBO}	---	-10	uAdc
3041	Collector-emitter cutoff current	Bias Cond. C V_{CE}= -30 Vdc		I_{CES}	---	-10	uAdc
3061	Emitter-base cutoff current	Bias Cond. D V_{EB}= -0.5 Vdc		I_{EBO}	---	-100	uAdc
3011	Collector-emitter breakdown voltage	Bias Cond. D I_C= 1 mAdc		BV_{CEO}	15	---	Vdc
	Subgroup 3		10				
3206	Small-signal short-circuit forward-current transfer ratio:	V_{CE}= -10 Vdc I_E = 2 mAdc f = 1 kHz					
	2N502A			h_{fe}	15	200	---
	2N502B			h_{fe}	25	80	---
3306	Magnitude of common emitter small-signal short-circuit transfer ratio	V_{CE}= -10 Vdc I_E = 2 mAdc f = 100 MHz		$\|h_{fe}\|$	1.5	6	---

Table I. Group A inspection - (Cont'd).

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 3-(Cont'd)						
3236	Output capacitance	V_{CB}= -10 Vdc I_E = 0 f = 1 MHz		C_{obo}	---	1.6	pf
3246	Noise figure	V_{CB}= -10 Vdc I_E= 2 mAdc f = 200 MHz		NF	---	7	db
---	Extrinsic base-resistance collector-capacitance product	V_{CB}= -10 Vdc I_E = 2 mAdc f = 46 MHz Test circuit per Fig. 2 herein		$r_{b'}C_c$	5	25	psec
3256	Small-signal power gain	V_{CB}= -10 Vdc I_E= 2 mAdc f = 200 MHz Test circuit per Fig. 3 herein		P.G.	10	20	db

1/ See 3.4 herein.

Table II. Group B inspection.

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 1		20				
2066	Physical dimensions	---		---	---	---	---
	Subgroup 2		15				
2026	Solderability	Omit aging		---	---	---	---
1051	Temperature cycling	Test Cond. B except $T_{(high)}$= +100°C		---	---	---	---
1056	Thermal shock (glass strain)	Test Cond. A		---	---	---	---
2/	Seal (leak rate)	Test Cond. C, procedure 111; Test Cond. A or B for gross leaks		---	---	10^{-7}	atm cc/sec
1021	Moisture resistance	---		---	---	---	---
	End-Point tests:						
3036	Collector-base cut-off current	Bias Cond. D V_{CB}= -10 Vdc		I_{CBO}	---	-4	uAdc
3206	Small-signal short-circuit forward-current transfer ratio:	V_{CE}= -10 Vdc I_E = 2 mAdc f = 1 kHz					
	2N502A			h_{fe}	15	200	---
	2N502B			h_{fe}	25	80	---
	Subgroup 3		15				
2016	Shock	3/ Non-operating 500G 5 blows of 1.0 msec ea. in orientations X1, Y1, Y2, Z1 (total = 20 blows)		---	---	---	---

Table II. Group B inspection - (Cont'd).

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 3-(Cont'd)						
2046	Vibration fatigue	Non-oper., 10G		---	---	---	---
2056	Vibration, variable frequency	10G		---	---	---	---
2006	Constant acceleration	10,000G Orientations X1, Y1, Y2, Z1		---	---	---	---
	End-Point tests: Same as for subgroup 2, above						
	Subgroup 4		20				
2036	Terminal strength (lead fatigue)	Test Cond. E		---	---	---	---
	Subgroup 5		20				
1041	Salt atmosphere (corrosion)	---		---	---	---	---
	End-Point tests: Same as for Subgroup 2, above						
	Subgroup 6 4/		15				
5/	High-temperature operation:	T_A = +55°C					
3036	Collector-base cutoff current	Bias Cond. D V_{CB}= -10 Vdc		I_{CBO}	---	40	uAdc
5/	Low-temperature operation:	T_A = -55°C					
3206	Small-signal short-circuit forward-current transfer ratio:	V_{CE}= -10 Vdc I_E= 2 mAdc f = 1 kHz					
	2N502A			h_{fe}	7	200	---
	2N502B			h_{fe}	12	80	---

Table II. Group B inspection - (Cont'd).

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 7		7				
1031	High-temperature life (non-operating)	T_{stg} = +100°C t = 340 hours 6/		---	---	---	---
	End-Point tests:						
3036	Collector-base cut-off current	Bias Cond. D V_{CB} = -30 Vdc		I_{CBO}	---	-20	uAdc
3206	Small-signal short-circuit forward-current transfer ratio:	V_{CE} = -10 Vdc I_E = 2 mAdc f = 1 kHz					
	2N502A			h_{fe}	10	250	---
	2N502B			h_{fe}	20	95	---
	Subgroup 8		7				
1026	Steady state operation life:	T_A = +25°C V_{CB} = -10 Vdc I_C = 7.5 mAdc t = 340 hours 6/		---	---	---	---
	End-point tests: Same as for Subgroup 7, above						

1/ See 3.4 and 4.3.1 herein.

2/ Per Method 112 in Standard MIL-STD-202.

3/ Per 4.3.4 herein.

4/ For this Subgroup, the sample units subjected to the High-Temperature Operation test shall be permitted to return to and be stabilized at room ambient temperature prior to their being subjected to the Low-Temperature Operation test.

5/ Measurement(s) shall be made after thermal equilibrium has been reached at the temperature specified.

6/ See 4.2.2 herein.

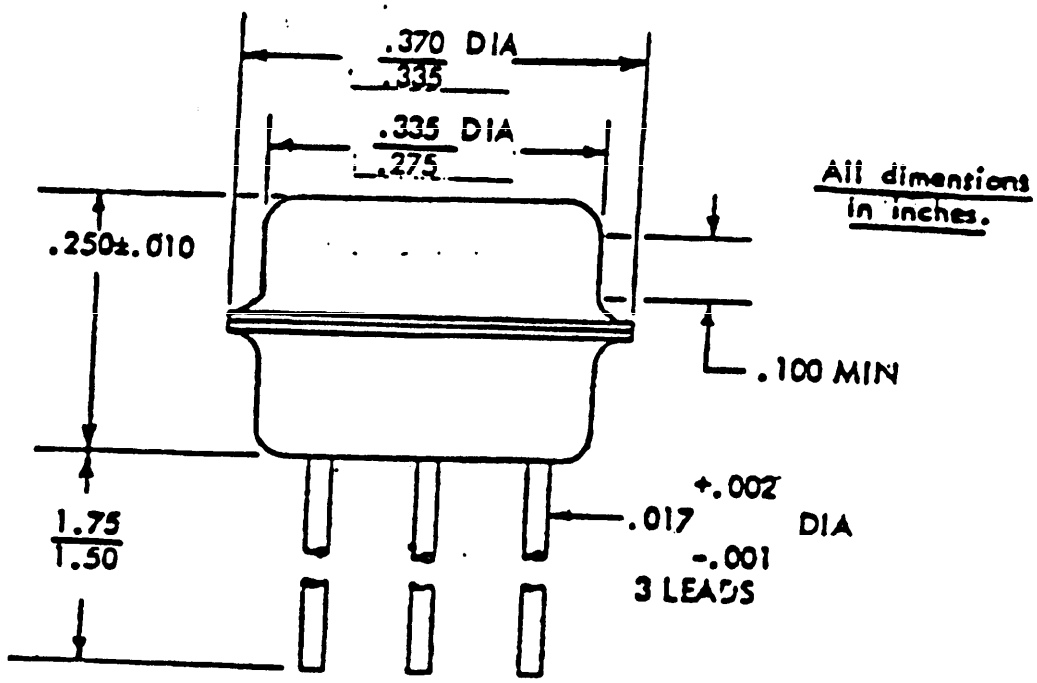
Table III. Group C inspection. 1/

Test Method per MIL-STD-750	Examination or test 2/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 1		λ=10				
1031	High-temperature life (non-operating)	T_{stg} = +100°C t = 1000 hrs 3/		---	---	---	---
	End-Point tests:						
3036	Collector-base cut-off current:	Bias Cond. D V_{CB} = -30 Vdc		I_{CBO}	---	-20	uAdc
3206	Small-signal short-circuit forward-current transfer ratio:	V_{CE} = -10 Vdc I_C = 2 mAdc f = 1kHz					
	2N502A			h_{fe}	10	250	---
	2N502B			h_{fe}	20	95	---
	Subgroup 2		λ=10				
1026	Steady state operation life:	T_A = +25°C V_{CE} = -10 Vdc I_C = 7.5 mAdc t = 1000 hrs 3/		---	---	---	---
	End-Point tests: Same as for Subgroup 1, above						

1/ Periodicity: See 4.2.3 herein.

2/ See 3.4 and 4.3.1 herein.

3/ See 4.2.2 herein.



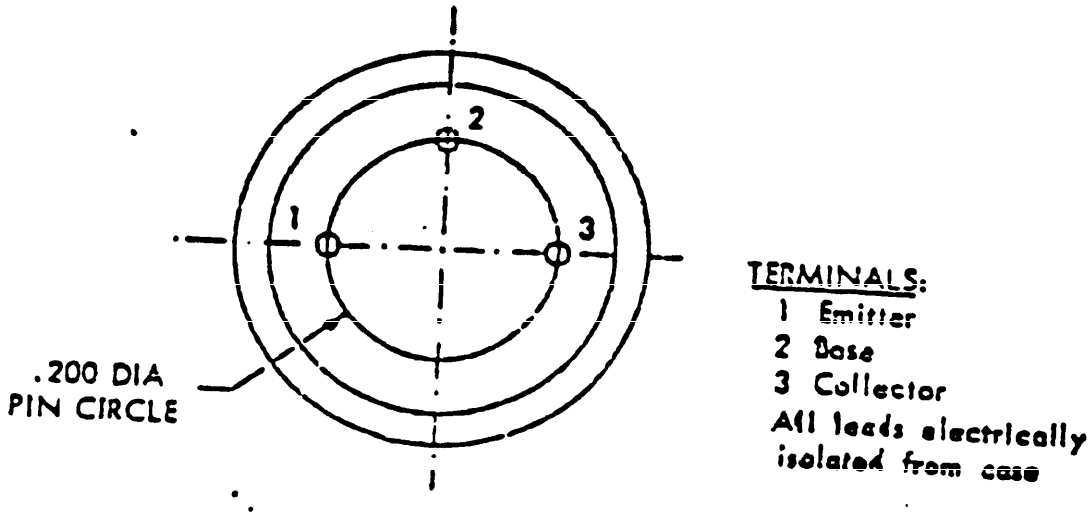
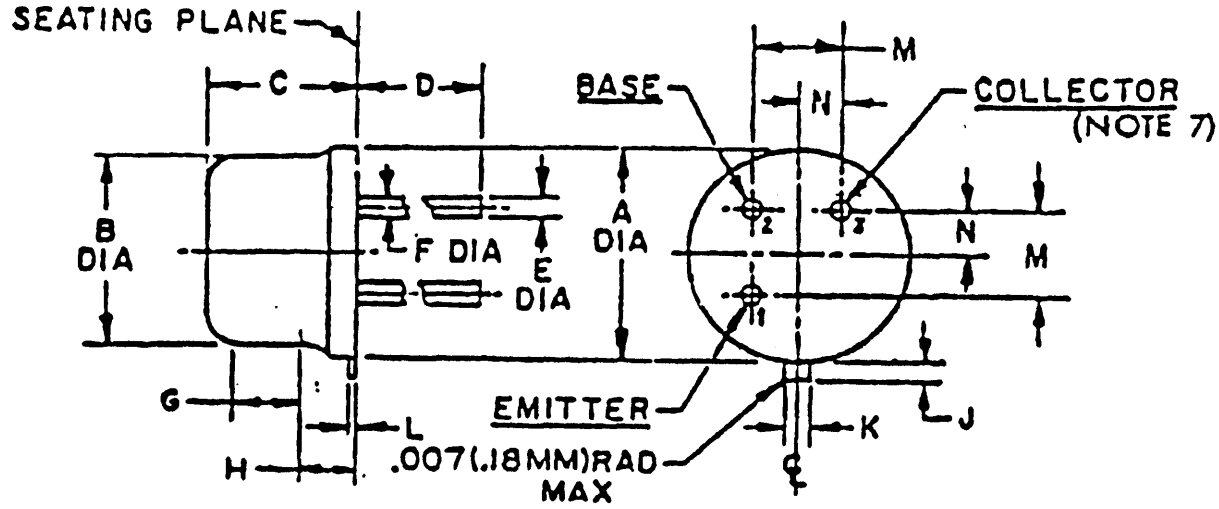


Figure 1A. Outline and dimensions.

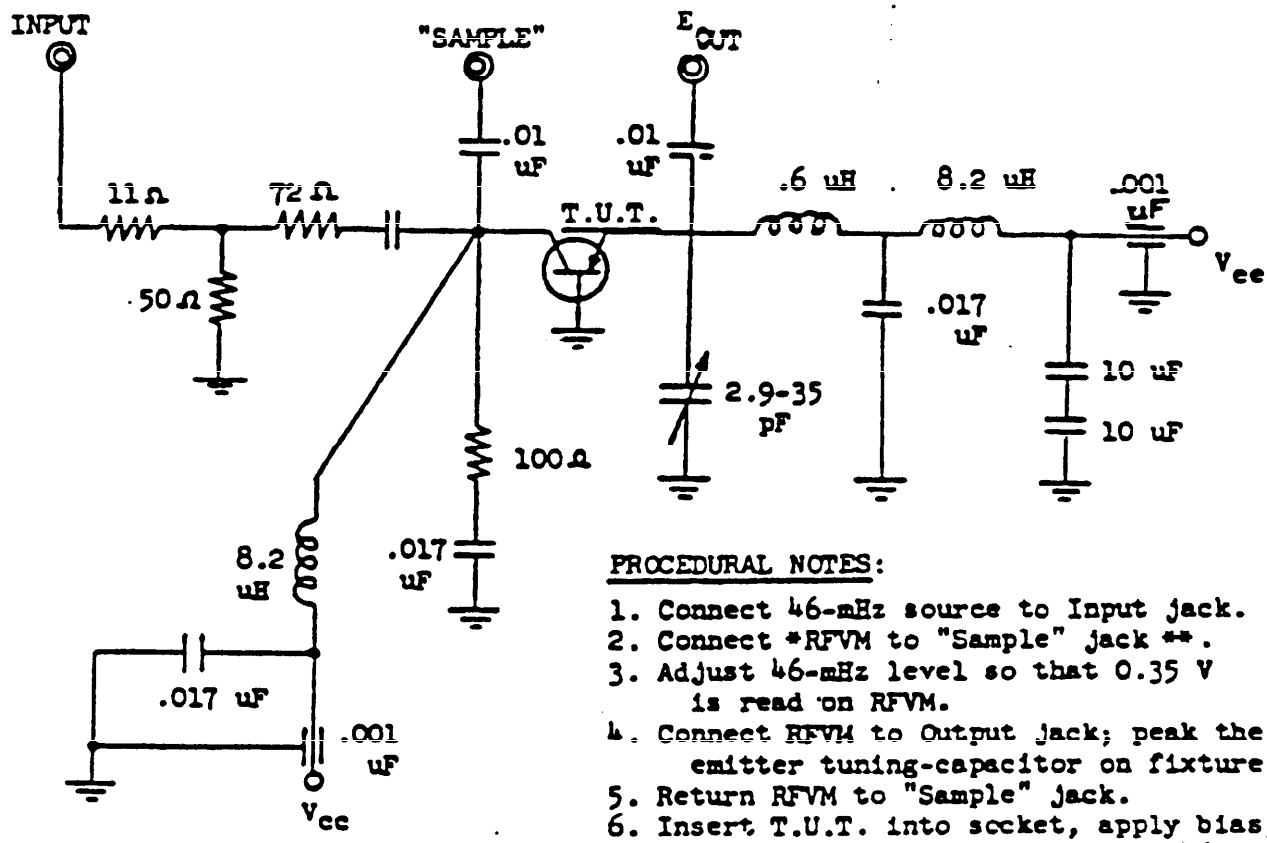


DIMENSIONS					NOTES
LTR	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.335	.370	8.51	9.40	
B	.305	.335	7.75	8.51	
C	.240	.260	6.10	6.60	
D	1.500	1.750	3.81	4.45	9
E	.016	.021	.41	.53	2,9
F	.016	.019	.41	.48	3,9
G	.100	---	2.54	---	4
H	---	---	---	---	5
J	.029	.045	.74	1.14	8
K	.028	.034	.71	.86	
L	.009	.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 Dim 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 (1.37 mm +.03 mm) below the seating plane of the transistor max dia leads shall be within .007 (.18 mm) of their true location relative to a maximum width tab. Smaller dia leads shall fall within the outline of the max dia lead tolerance.
7. All leads electrically isolated from case.
8. Measured from the maximum diameter of the actual device.
9. All 3 leads.

Figure 18. Outline and dimensions.



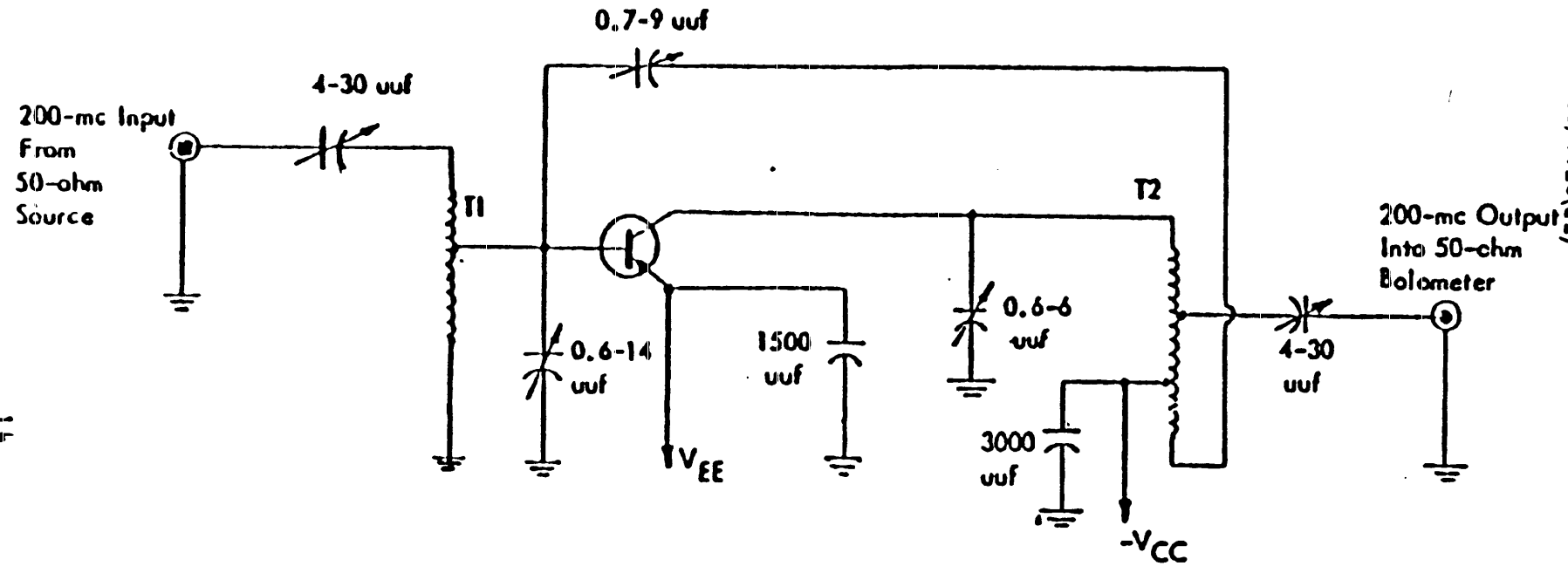
PROCEDURAL NOTES:

1. Connect 46-mHz source to Input jack.
2. Connect *RFVM to "Sample" jack **.
3. Adjust 46-mHz level so that 0.35 V is read on RFVM.
4. Connect RFVM to Output jack; peak the emitter tuning-capacitor on fixture.
5. Return RFVM to "Sample" jack.
6. Insert T.U.T. into socket, apply bias, and set 46-mHz level for a 0.346-volt reading on RFVM.
7. Connect RFVM to "Output" jack. $r_b C_c$ is read with 1 mV= 10 psec, 3 mV= 30 psec, etc.; (the 0.346 V_{in} should be checked regularly during successive test measurements).

*RFVM = Boonton Type 91CA or equiv.; (high impedance); unterminated probe, Boonton type 91-6C adapter or equiv, to be used.

**Adapter BNC UG-491A/U, or equiv., to be used for connections to Input, "Sample", and Output jacks.

Figure 2. $r_b C_c$ Test circuit.



Notes:

T1: 5-1/2 turns #16 silver-plated copper wire tapped at 2-1/4 turns.
Coil = 3/8 I.D., and approximately 3/4 long.

T2: 6-1/2 turns #16 silver-plated copper wire tapped at 2-1/2 and 3-1/2 turns.
Coil = 3/8 I.D., and approximately 7/8 long.

Figure 3. 200-mc Power Amplifier test circuit.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery.- Preparation for delivery shall be in accordance with Specification MIL-S-19500.

6. NOTES

6.1 Notes.- The notes included in Specification MIL-S-19500, with the following additions or exceptions, are applicable to this specification.

6.2 Application guidance.- The transistors conforming to requirements of this document issue are recommended as ready replacements (having superior-controlled characteristics) for the transistors covered by previous issue(s) of this document.

6.3 Ordering data.-

a. Terminal-lead length.- (If other than as shown in Fig. 1A or 1B herein): See 3.3.2 herein.

6.4 Qualification.- With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in Qualified Products List (QPL)-19500, whether or not such products have actually been so listed by that date. Information pertaining to qualification of products covered by this specification should be requested from the Commanding General, U. S. Army Electronics Command, Fort Monmouth, New Jersey 07703, Attention: AMSEL-PP-EM-2.

6.5 Changes from previous issue.- Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodian:
Army-EL

Preparing activity:
Army-EL

Project No. 5961-A099