

MILITARY SPECIFICATION  
TRANSISTOR, PNP, SILICON  
TYPE 2N2378

1. SCOPE

1.1 Scope. - This specification covers the detail requirements for silicon, PNP, transistors for use, particularly, in switching, amplifier circuitry.

1.2 Outline and dimensions. - (See Figure 1.)

1.3 Particular electrical characteristics. - At:  $T_A = +25^\circ \pm 3^\circ\text{C}$ . (See 3.2 herein.):

|         | $C_{ob}$<br>(at: $f = 4\text{ mc}$<br>$V_{CB} = -6\text{ Vdc}$<br>$I_C = -1\text{ mAdc}$ ) | $f_t$<br>(at: $f = 4\text{ mc}$<br>$V_{CE} = -6\text{ Vdc}$<br>$I_E = 1\text{ mAdc}$ ) | $r_{b'} C_c$<br>(at: $f = 10\text{ mc}$<br>$V_{CB} = -6\text{ Vdc}$<br>$I_E = 1\text{ mAdc}$ ) | $h_{FE}$<br>(at:<br>$V_{CE} = -0.5\text{ Vdc}$<br>$I_C = -15\text{ mAdc}$ ) | $V_{CE(sat)}$<br>(at:<br>$I_C = -5\text{ mAdc}$<br>$I_B = -0.8\text{ mAdc}$ ) |
|---------|--|--|--|---|---|
|         | <u>pf</u>  | <u>mc</u>  | <u>psec</u>  | <u>---</u>  | <u>Vdc</u>  |
| Minimum | ---  | 7.2  | ---  | 15  | ---   |
| Maximum | 12   | ---  | 5,000  | ---   | -0.15   |

1.4 Absolute maximum ratings. - At  $T_A = 25^\circ \pm 3^\circ\text{C}$ , unless otherwise specified.  
(See 3.2 herein):

| $P_T$ <sup>1/</sup> | $V_{CB}$          | $V_{CE}$          | $V_{EB}$          | $T_{stg}$                | Altitude <sup>2/</sup> |
|---------------------|-------------------|-------------------|-------------------|--------------------------|------------------------|
| <u>mW</u><br>150    | <u>Vdc</u><br>-10 | <u>Vdc</u><br>-10 | <u>Vdc</u><br>-10 | <u>°C</u><br>-65 to +140 | <u>ft</u><br>85,000    |

<sup>1/</sup> For power dissipation at  $T_A > +25^\circ\text{C}$ , derate at 1.33 mW/°C.

<sup>2/</sup> Without voltage derating.

## 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-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 activity 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 transistor 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:

$k'$ s .....hole storage  
 $P_T$  .....Total power dissipation of the device: sum of  
 collector and emitter power dissipations =  
 $(V_{CB}I_C) + (V_{EB}I_E)$   
 $r_b' C_c$  .....extrinsic base-resistance collector-capacitance  
 product

3.3 Design and construction.- The transistor shall be of the design, construction, and physical dimensions specified on Figure 1.

3.3.1 Lead arrangement.- The lead arrangement on the transistor shall be as indicated in Figure 1 herein.

3.3.2 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.

3.5 Marking.- The transistor shall be marked in accordance with Specification MIL-S-19500 and as follows: When the diminutive size or lack of suitable surface area prevents routine marking on the device of all items required by Specification MIL-S-19500, the following items may be omitted in the following preferred order: color-band type identification (if specified for the device), country of origin, manufacturer's identification. Where only a minimum of items can suitably be marked on the device, first consideration shall be given to marking the complete type designation (see 3.5.1), and then to inclusion of the acceptance date and inspection lot identification. However, all required marking shall be placed on the unit package.

3.5.1 Complete type-designation marking.- Complete type-designation marking of transistors procured on Department of Army contracts, and which have passed Government inspection and comply with all requirements of this specification, shall consist of: "USA-manufacturer's qualification code letters-transistor designation (including any assigned reliability indicator)". The letters "JAN" or any abbreviation thereof shall not be used. If any specification waiver has been granted, the combination "USA-manufacturer's qualification code letters" shall not be used to complete the type-designation marking.

#### 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.

4.1.1 Responsibility for inspection.- Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Qualification and acceptance inspection.- Qualification and Acceptance Inspection shall be in accordance with Specification MIL-S-19500, Quality Assurance Provisions, and as otherwise specified herein. Groups A, B and C inspection shall consist of the examinations and tests specified in Table I, II, and III respectively. Group C inspection shall be conducted on the initial lot and thereafter on a lot approximately every 90 days or every fifth lot, whichever occurs first. Acceptance inspection shall include inspection of Preparation for Delivery (see 5.1.).

4.2.1 Specified LTPD for subgroups.- The LTPD specified for a subgroup in Tables I, II, and III shall apply for all of the tests, combined, in the subgroup. (See 6.3)

4.2.2 Disposition of sample units.- Sample units subjected to Group B, Subgroup 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, 2, 3, 6, and 7 tests, and Group C, subgroup 1 tests, 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 Test temperature.- All electrical test measurements shall be made at room ambient temperature of  $+25^{\circ} \pm 3^{\circ}\text{C}$  unless otherwise specified herein.

4.3.2 Interval for end-point test measurements.- All applicable end-point test measurements shall be made within four (4) hours after the particular sample units have been subjected to the required physical-mechanical or environmental test(s). This "interval" requirement shall not be applicable to measurements specified to be made during (subjecting of sample units to) a physical-mechanical or environmental test, and shall not be applicable where otherwise specified for life test(s).

4.3.3 Mechanical damage resulting from tests.- 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 after any of the Group A, B, or C tests.

Table I. Group A inspection.

| Test Method per<br>MIL-STD-750 | Examination or test                                     | Conditions   | LTPD | Symbol          | Limits |       | Unit            |
|--------------------------------|---|--|------|-----------------|--------|-------|-----------------|
|                                |   |  |      |                 | Min.   | Max.  |                 |
|                                | <u>Subgroup 1</u>                                       |  | 10   |                 |        |       |                 |
| 2071                           | Visual and mechanical examination                       | ---  |      | ---             | ---    | ---   | ---             |
|                                | <u>Subgroup 2</u>                                       |  | 5    |                 |        |       |                 |
| 3061                           | Emitter-to-base cutoff current                          | Bias Cond. D<br>$V_{EB} = -10 \text{ Vdc}$<br>$I_C = 0$  |      | $I_{EBO}$       | ---    | -0.1  | $\mu\text{Adc}$ |
| 3036                           | Collector-to-base cutoff current                        | Bias Cond. D<br>$V_{CB} = -10 \text{ Vdc}$<br>$I_E = 0$  |      | $I_{CBO}$       | ---    | -0.1  | $\mu\text{Adc}$ |
| 3066                           | Base-to-emitter voltage                                 | Test Cond. B<br>$I_C = -5 \text{ mAdc}$<br>$I_B = -0.8 \text{ mAdc}$   |      | $V_{BE}$        | -0.75  | -1.0  | Vdc             |
| 3071                           | Saturation voltage                                      | $I_C = -5 \text{ mAdc}$<br>$I_B = -0.8 \text{ mAdc}$   |      | $V_{CE(sat)}$   | ---    | -0.15 | Vdc             |
| 3076                           | Static forward-current transfer ratio                   | $V_{CE} = -0.5 \text{ Vdc}$<br>$I_C = -15 \text{ mAdc}$  |      | $h_{FE}$        | 15     | ---   | ---             |
|                                | <u>Subgroup 3</u>                                       |  | 5    |                 |        |       |                 |
| 2011                           | Breakdown voltage, collector-to-emitter                 | Bias Cond. D<br>$I_C = -25 \mu\text{Adc}$<br>$I_E = 0$   |      | $BV_{CEO}$      | 10     | ---   | Vdc             |
| ---                            | Extrinsic base-resistance collector-capacitance product | $V_{CB} = -6 \text{ Vdc}$<br>$I_E = 1 \text{ mAdc}$<br>$f = 10 \text{ mc}$<br>Test circuit per Fig. 2 herein |      | $r_b \cdot C_c$ | ---    | 5,000 | psec            |
| 3261                           | Extrapolated unity-gain frequency                       | $V_{CE} = -6 \text{ Vdc}$<br>$I_E = 1 \text{ mAdc}$<br>$f = 4 \text{ mc}$                                    |      | $f_t$           | 7.2    | ---   | mc              |
| 3041                           | Collector-to-emitter cutoff current, reverse bias       | Bias Cond. A<br>$V_{CE} = -4.5 \text{ Vdc}$<br>$V_{BE} = -0.45 \text{ Vdc}$                                  |      | $I_{CEX}$       | ---    | -25   | $\mu\text{Adc}$ |

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

| Test Method per<br>MIL-STD-750 | Examination or test                      | Conditions  | LTPD | Symbol    | Limits |      | Unit             |
|--------------------------------|--|---|------|-----------|--------|------|------------------|
|                                |  |   |      |           | Min.   | Max. |                  |
|                                | <u>Subgroup 4</u>                        |   | 5    |           |        |      |                  |
| ---                            | Hole storage                             | $I_B = -1 \text{ mA dc}$<br>$f = 10 \text{ mc}$<br>Test circuit and<br>procedure per<br>Fig. 3 herein |      | $k'_3$    | ---    | 1/5  | nsec             |
| 3236                           | Output capacitance                       | $V_{CB} = -6 \text{ V dc}$<br>$I_C = -1 \text{ mA dc}$<br>$f = 4 \text{ mc}$                          |      | $C_{ob}$  | ---    | 12   | pf               |
|                                | <u>Subgroup 5</u> <sup>1/</sup>          |   | 15   |           |        |      |                  |
| <u>2/</u>                      | High-temperature operation:              | $T_A = +125^\circ\text{C, min}$   |      |           |        |      |                  |
| 3036                           | Collector-to-base<br>cutoff current      | Bias Cond. D<br>$V_{CB} = -10 \text{ V dc}$<br>$I_E = 0$  |      | $I_{CBO}$ | ---    | 15   | $\mu\text{A dc}$ |
| <u>2/</u>                      | Low-temperature operation:               | $T_A = -55^\circ \begin{matrix} +0^\circ \\ -3^\circ \end{matrix} \text{C}$                           |      |           |        |      |                  |
| 3076                           | Static forward-current<br>transfer ratio | $V_{CE} = -0.5 \text{ V dc}$<br>$I_C = -15 \text{ mA dc}$   |      | $h_{FE}$  | 10     | ---  | ---              |

<sup>1/</sup> For this Subgroup, the sample units subjected to the High-Temperature Operation test shall be allowed to return to and be stabilized at room ambient temperature prior to their being subjected to the Low-Temperature Operation test.

<sup>2/</sup> Test measurement shall be made at the temperature specified after the sample units have reached thermal equilibrium at that temperature.

Table II. Group B inspection.

| Test Method per<br>MIL-STD-750 | Examination or test<br>1/                | Conditions  | LTPD | Symbol | Limits |      | Unit |
|--------------------------------|--|---|------|--------|--------|------|------|
|                                |  |   |      |        | Min.   | Max. |      |
|                                | <u>Subgroup 1</u>                        |   | 20   |        |        |      |      |
| 2066                           | Physical dimensions                      | ---   |      | ---    | ---    | ---  | ---  |
|                                | <u>Subgroup 2</u>                        |   | 15   |        |        |      |      |
| 2026                           | Solderability                            | ---   |      | ---    | ---    | ---  | ---  |
| 1051                           | Temperature cycling                      | Test Cond. C except<br>$T(\text{high}) = +140^{\circ} + 3^{\circ}\text{C}$<br>$- 0^{\circ}\text{C}$                       |      |        |        |      |      |
| 1056                           | Thermal shock<br>(glass strain)          | Test Cond. B  |      | ---    | ---    | ---  | ---  |
| 1021                           | Moisture resistance                      | No initial conditioning   |      | ---    | ---    | ---  | ---  |
|                                | <u>End-point tests:</u>                  |   |      |        |        |      |      |
| 3036                           | Collector-to-base<br>cutoff current      | Bias Cond. D<br>$V_{CB} = -10\text{ Vdc}$<br>$I_E = 0$  |      | ICBO   | ---    | -0.3 | uAdc |
| 3076                           | Static forward-current<br>transfer ratio | $V_{CE} = -0.5\text{ Vdc}$<br>$I_C = -15\text{ mAdc}$   |      | hFE    | 12     | ---- | ---  |
|                                | <u>Subgroup 3</u>                        |   | 15   |        |        |      |      |
| 2016                           | Shock                                    | Non-operating<br>Acceleration = 500 G<br>5 blows of 1 msec<br>ea. in orientations<br>X1, Y1, Y2, Z1<br>(total = 20 blows) |      | ---    | ---    | ---  | ---  |
| 2056                           | Vibration, variable                      | Acceleration = 10G, min   |      | ---    | ---    | ---  | ---  |
| 2046                           | Vibration fatigue                        | Non-operating<br>Acceleration = 10G, min  |      | ---    | ---    | ---  | ---  |
| 2006                           | Constant acceleration<br>(centrifuge)    | $G = 10,000$<br>Orientations X1, Y1, Y2, Z1   |      | ---    | ---    | ---  | ---  |
|                                | <u>End-point tests:</u>                  |   |      |        |        |      |      |
|                                | Same as for Subgroup 2<br>above          |   |      |        |        |      |      |

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

| Test Method per MIL-STD-750 | Examination or test<br>1/             | Conditions  | LTPD         | Symbol    | Limits |      | Unit            |
|-----------------------------|---------------------------------------|---|--------------|-----------|--------|------|-----------------|
|                             |                                       |   |              |           | Min.   | Max. |                 |
|                             | <u>Subgroup 4</u>                     |   | 15           |           |        |      |                 |
| 2036                        | Lead fatigue                          | Test Cond. E  |              | ---       | ---    | ---  | ---             |
|                             | <u>End-point tests:</u>               |   |              |           |        |      |                 |
|                             | Same as for Subgroup 2 above          |   |              |           |        |      |                 |
|                             | <u>Subgroup 5</u>                     |   |              |           |        |      |                 |
| 1041                        | Salt atmosphere (corrosion)           | ---   |              | ---       | ---    | ---  | ---             |
|                             | <u>End-point tests:</u>               |   |              |           |        |      |                 |
|                             | Same as for Subgroup 2 above          |   |              |           |        |      |                 |
|                             | <u>Subgroup 6</u>                     |   | $\lambda=10$ |           |        |      |                 |
| 1031                        | High-temperature life (non-operating) | $T_{stg} = +140^{\circ}\text{C, min}$   |              | ---       | ---    | ---  | ---             |
|                             | <u>End-point tests:</u>               |   |              |           |        |      |                 |
| 3036                        | Collector-to-base cutoff current      | Bias Cond. D<br>$V_{CB} = -10 \text{ Vdc}$<br>$I_E = 0$   |              | $I_{CBO}$ | ---    | -2.0 | $\mu\text{Adc}$ |
| 3076                        | Static forward-current transfer ratio | $V_{CE} = -0.5 \text{ Vdc}$<br>$I_C = -15 \text{ mAdc}$   |              | $h_{FE}$  | 12     | ---  | ---             |
|                             | <u>Subgroup 7</u>                     |   | $\lambda=10$ |           |        |      |                 |
| 1026                        | Steady-state operation life           | $V_{CB} = -10 \text{ Vdc}$<br>$P_T = 150 \text{ mW}$<br>$T_A = +25^{\circ} \pm 3^{\circ}\text{C}$ |              | ---       | ---    | ---  | ---             |
|                             | <u>End-point tests:</u>               |   |              |           |        |      |                 |
|                             | Same as for Subgroup 6 above          |   |              |           |        |      |                 |

1/ See 4.3.2 herein.

Table III. Group C inspection.<sup>1/</sup>

| Test Method per<br>MIL-STD-750 | Examination or test                                   | Conditions   | LYPD | Symbol | Limits |      | Unit      |
|--------------------------------|---|--|------|--------|--------|------|-----------|
|                                |   |  |      |        | Min.   | Max. |           |
|                                | <u>Subgroup 1</u>                                     |  | 20   |        |        |      |           |
| 1001                           | Barometric pressure, reduced<br>(altitude operation): | Pressure = $15 \pm 2$ mmHg<br>$t = 60$ sec, min<br>Normal mounting |      |        |        |      |           |
| 3036                           | Collector-to-base<br>cutoff current                   | <sup>2/</sup><br>Bias Cond. D<br>VCB = -10 Vdc<br>IE = 0           |      | ICBO   | ---    | 0.1  | $\mu$ Adc |

<sup>1/</sup> Periodicity: see 4.2 herein.

<sup>2/</sup> This test to be performed and measurement made during subjection of the sample units to the reduced pressure specified.

## 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 exceptions, are applicable to this specification.

6.2 Intended use.- Transmitter Type 2N2378 covered herein is designed intentionally to serve current maintenance needs as a direct replacement for Transistor Type 2N496 in existing military equipments. Transistor 2N496, previously available under requirements of Military Specification MIL-S-19500/85(SigC), is no longer being manufactured. It should be noted that Transistor 2N2378 covered herein is more diminutive, dimensionally, than former Transistor 2N496. It should be noted further, that, for maintenance-replacement purposes in existing military equipments, Transistor 2N2378 is more readily adaptable to use in limited-space circuitry than the available equivalent but larger-dimensioned Transistor Type JAN-2N1119 that is covered by Military Specification MIL-S-19500/139.

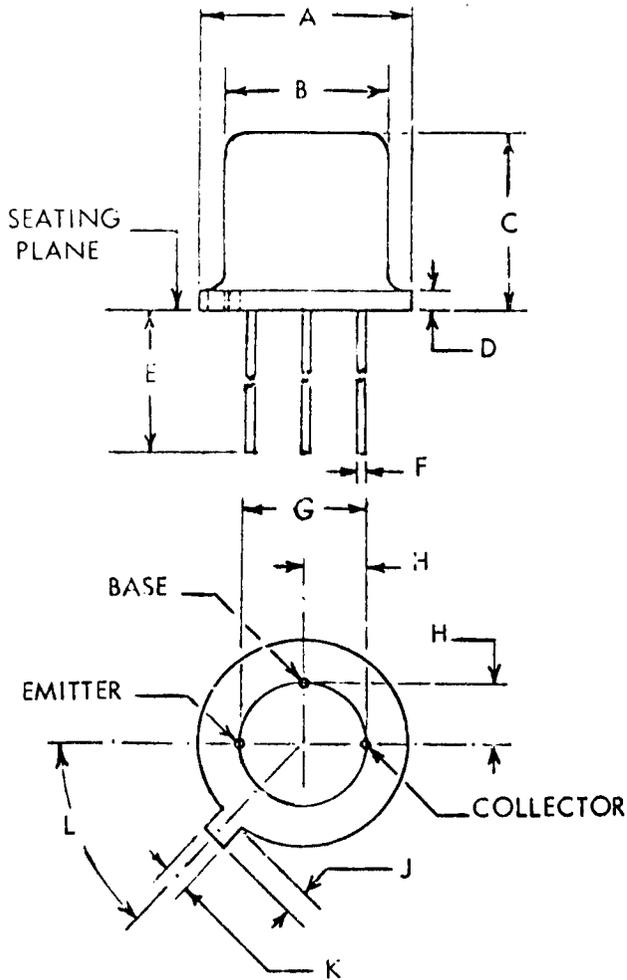
6.3 Re-evaluation or verification inspection.- The LTPD method is exceptionally well suited for inspection at source, since it provides a high degree of assurance (90% confidence) that the lot represented has a proportion defective less than the specified LTPD value. However, the LTPD method is not suitable for inspection performed subsequent to source inspection since it provides, at most, a 10% confidence that the lot represented by a failed sample actually contains a proportion defective in excess of the specified LTPD value. As a result, whenever the quality of a lot is re-evaluated or verified by sampling inspection subsequent to the supplier's satisfactory demonstrations of compliance with the quality requirements, lot disposition should be based on a sampling plan which provides reasonable assurance that any lot rejected contains a proportion defective greater than the specified LTPD or  $\lambda$  value for any individual subgroup. When deemed necessary the purchase order should specify the detailed criteria for lot disposition.

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, supplement (Army), 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 Chief, Specification Engineering Division, U.S. Army Electronics Materiel Support Agency, Fort Monmouth, New Jersey, attention: SELMS-PPA-3.

Custodian:  
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Project No. 5960- A471



| REF. | DIMENSIONS |      |            |      | NOTES |
|------|------------|------|------------|------|-------|
|      | INCHES     |      | MILLIMETER |      |       |
|      | MIN.       | MAX. | MIN.       | MAX. |       |
| A    | .209       | .230 | 5.31       | 5.84 |       |
| B    | .178       | .195 | 4.52       | 4.95 |       |
| C    | .170       | .210 | 4.32       | 5.33 |       |
| D    |            | .030 |            | 0.76 |       |
| E    | .500       |      | 12.70      |      |       |
| F    | .016       | .019 | 0.41       | 0.48 | 1     |
| G    | .100       |      | 2.54       |      |       |
| H    | .050       |      | 1.27       |      | 2     |
| J    | .028       | .048 | 0.71       | 1.22 |       |
| K    | .036       | .046 | 0.91       | 1.17 |       |
| L    | 45°        |      | 45°        |      | 2     |

NOTES:

1. The specified lead diameter (3 leads) applies to the zone between .050 and .250 below seating plane. Between .250 from seating plane, and end of lead, a maximum of .021 shall be held.
2. As measured with a suitable gage at a gaging plane  $.054 \pm .001$  below seating plane, the lead orientation shall be within .007 of specified locations relative to true orientation of tab (centerline). When gage is not used, measurement shall be made at seating plane.
3. All terminals insulated from case.

Figure 1. Outline and dimensions.

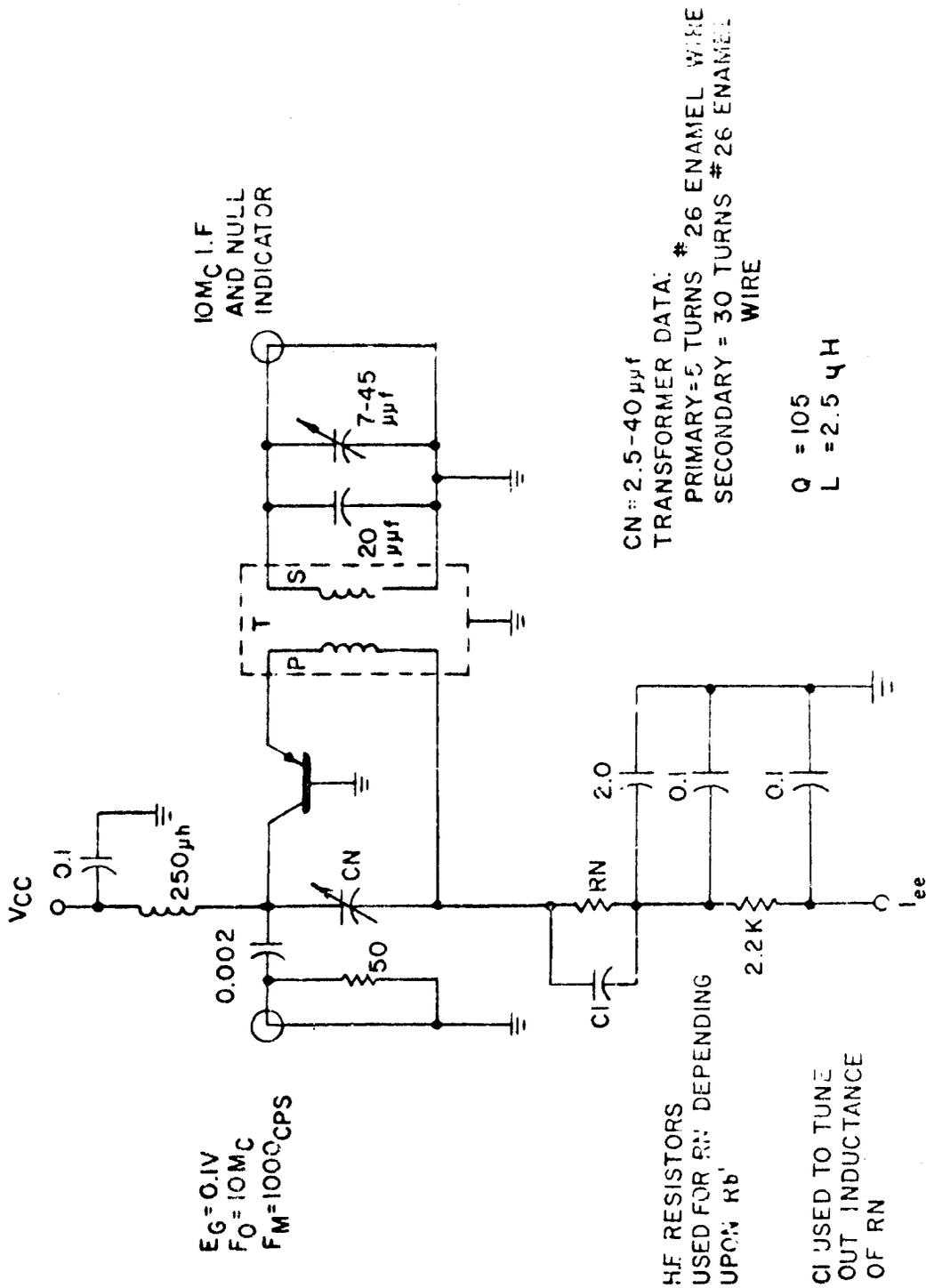
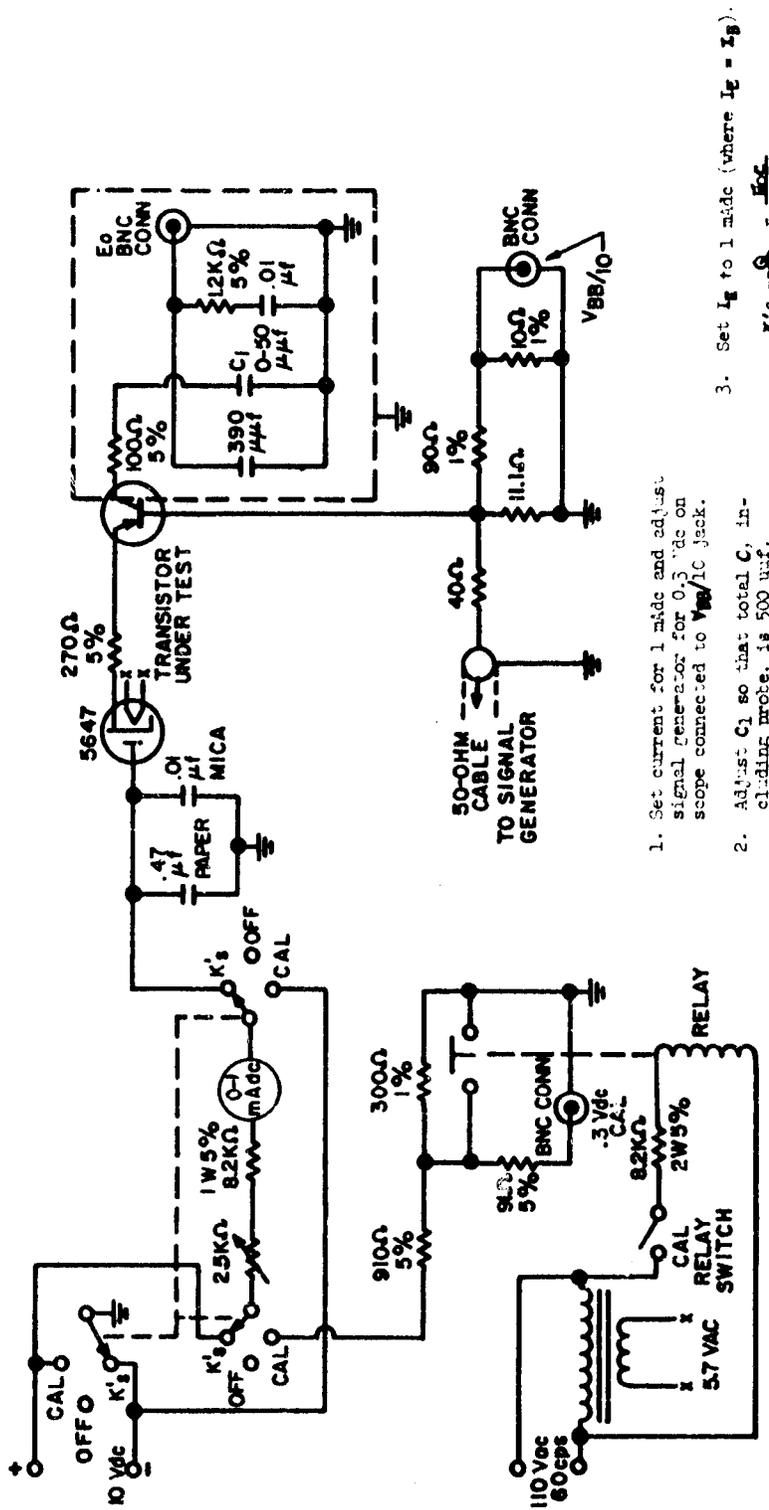


Figure 2. A<sub>2</sub>/C<sub>2</sub> test circuit.



1. Set current for 1 mAdc and adjust signal generator for 0.3 Vdc on scope connected to V<sub>BB</sub>/10 jack.
2. Adjust C<sub>1</sub> so that total C<sub>1</sub> including probe, is 500 uuf.
3. Set I<sub>E</sub> to 1 mAdc (where I<sub>E</sub> = I<sub>B</sub>).

$$K's = \frac{C_1}{I_B} = \frac{500}{1} = 500$$

where:  
 C = 500 uuf.  
 I<sub>B</sub> = 1 mAdc.

FIGURE 3. Hole-storage test circuit.

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval  
No. 22-R255

**INSTRUCTIONS:** The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. 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. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.

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B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?

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