

# MILITARY SPECIFICATION

## SEMICONDUCTOR DEVICE, DIODE, SILICON, SWITCHING, TYPES 1N643, 1N662 AND 1N663

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 silicon, semiconductor diodes for use, particularly, in computer-equipment circuits, and having the following particular characteristics.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings.

| Type  | $V_F$                     | $V_{RM}(wkg)$             | $I_o \frac{1}{2}$        | $I_f(surge)$<br>(at: 1/120 sec) |
|-------|---------------------------|---------------------------|--------------------------|---------------------------------|
|       | <u><math>V(pk)</math></u> | <u><math>V(pk)</math></u> | <u><math>mAdc</math></u> | <u><math>mA</math></u>          |
| 1N643 | 200                       | 175                       | 40                       | 500                             |
| 1N662 | 100                       | 80                        | 40                       | 500                             |
| 1N663 | 100                       | 80                        | 100                      | 500                             |

1/ Derate 1N643 and 1N662 at 0.32 mAdc/°C above  $T_A = 25^\circ C$ .  
Derate 1N663 at 0.48 mAdc/°C above  $T_A = 25^\circ C$ .

OPERATING AMBIENT TEMPERATURE:  $-65^\circ$  to  $+150^\circ C$

STORAGE TEMPERATURE:  $-65^\circ$  to  $+175^\circ C$

BAROMETRIC PRESSURE, REDUCED: 15 torr

1.4 Electrical characteristics.

| $V_F$                        | $I_R$<br>$V_R = 10 Vdc$       | C                           | $t_{rr}$                    |
|------------------------------|-------------------------------|-----------------------------|-----------------------------|
| <u><math>Vdc(max)</math></u> | <u><math>nAdc(max)</math></u> | <u><math>pF(max)</math></u> | <u><math>ns(max)</math></u> |
| 1.0                          | 25                            | 3                           | 1N643 300                   |
| 1.0                          | 25                            | 3                           | 1N662 500                   |
| 1.0                          | 25                            | 3                           | 1N663 500                   |

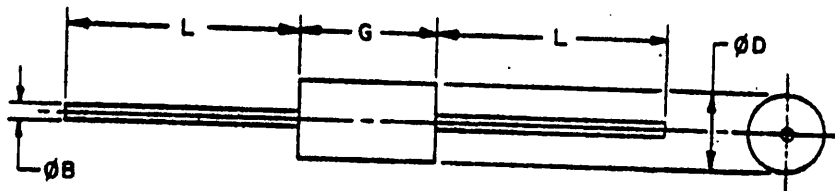
### 2. APPLICABLE DOCUMENTS

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.



| DIMENSIONS |        |       |             |       | NOTES |
|------------|--------|-------|-------------|-------|-------|
| LTR        | INCHES |       | MILLIMETERS |       |       |
|            | MIN    | MAX   | MIN         | MAX   |       |
|            |        |       |             |       |       |
| ØB         | .019   | .021  | .48         | .53   | 3     |
| ØD         | .077   | .130  | 1.98        | 3.30  |       |
| G          | .195   | .300  | 4.95        | 7.62  |       |
| L          | 1.000  | 1.500 | 25.40       | 38.10 |       |

## 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. See 3.5.
3. Both leads shall be within the specified limit.

FIGURE 1. Semiconductor device diode, types 1N643, 1N662, and 1N663.

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 Steady state operation life. This test shall be conducted with a half-sine wave of the specified peak voltage impressed across the diode in the reverse direction followed by a half-sine wave form of the specified average rectified current. The forward conduction angle of the rectified current shall not be greater than  $180^\circ$  nor less than  $150^\circ$ , and the power shall be equal to or greater than that of a half-sine wave.

4.4.2 Thermal shock (temperature cycling). Temperature cycling shall be in accordance with MIL-STD-750, method 1051, test condition C, except that the high temperature shall be  $175^\circ\text{C}$ . Ten cycles shall be continuously performed and the time at the temperature extremes shall be 15 minutes (minimum).

TABLE I. Group A inspection.

| Examination or test                     | MIL-STD-750 |                                                                                                                                      | L<br>T<br>P<br>D | Symbol   | Limits |     | Unit              |
|-----------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|--------|-----|-------------------|
|                                         | Method      | Details                                                                                                                              |                  |          | Min    | Max |                   |
| <u>Subgroup 1</u>                       |             |                                                                                                                                      | 10               |          |        |     |                   |
| Visual and mechanical examination       | 2071        |                                                                                                                                      |                  | ---      | ---    | --- | ---               |
| <u>Subgroup 2</u>                       |             |                                                                                                                                      | 5                |          |        |     |                   |
| Forward voltage                         | 4011        |                                                                                                                                      |                  | $V_F$    |        |     |                   |
| 1N643                                   |             | $I_F = 10 \text{ mAdc}$                                                                                                              |                  |          | ---    | 1.0 | Vdc               |
| 1N662                                   |             | $I_F = 10 \text{ mAdc}$                                                                                                              |                  |          | ---    | 1.0 | Vdc               |
| 1N663                                   |             | $I_F = 100 \text{ mAdc}$                                                                                                             |                  |          | ---    | 1.0 | Vdc               |
| Reverse current                         | 4016        | $V_R = 10 \text{ Vdc}$                                                                                                               |                  | $I_R$    |        |     |                   |
| 1N643                                   |             |                                                                                                                                      |                  |          | ---    | 25  | nAdc              |
| 1N662                                   |             |                                                                                                                                      |                  |          | ---    | 25  | nAdc              |
| 1N663                                   |             |                                                                                                                                      |                  |          | ---    | 25  | nAdc              |
| Reverse current                         | 4016        |                                                                                                                                      |                  | $I_R$    |        |     |                   |
| 1N643                                   |             | $V_R = 100 \text{ Vdc}$                                                                                                              |                  |          | ---    | 1.0 | $\mu\text{Adc}$   |
| 1N662                                   |             | $V_R = 50 \text{ Vdc}$                                                                                                               |                  |          | ---    | 5.0 | $\mu\text{Adc}$   |
| 1N663                                   |             | $V_R = 75 \text{ Vdc}$                                                                                                               |                  |          | ---    | 5.0 | $\mu\text{Adc}$   |
| Reverse current at peak reverse voltage | 4016        |                                                                                                                                      |                  | $I_R$    |        |     |                   |
| 1N643                                   |             | $v_r = 200 \text{ V(pk)}$                                                                                                            |                  |          | ---    | 100 | $\mu\text{A(pk)}$ |
| 1N662                                   |             | $v_r = 100 \text{ V(pk)}$                                                                                                            |                  |          | ---    | 100 | $\mu\text{A(pk)}$ |
| 1N663                                   |             | $v_r = 100 \text{ V(pk)}$                                                                                                            |                  |          | ---    | 100 | $\mu\text{A(pk)}$ |
| Reverse recovery time                   | 4031        | Test condition B; $I_F = 5 \text{ mAdc}$ ; $I_R = 17.5 \text{ mAdc}$ ; $R_L = 2300 \text{ ohms} \pm 10\%$ ; $C = 40 \text{ pF, max}$ |                  | $t_{rr}$ |        |     |                   |
|                                         |             | Recover to:                                                                                                                          |                  |          |        |     |                   |
| 1N643                                   |             | $I_R = 200 \mu\text{Adc}$                                                                                                            |                  |          | ---    | 300 | ns                |
| 1N662                                   |             | $I_R = 400 \mu\text{Adc}$                                                                                                            |                  |          | ---    | 500 | ns                |
| 1N663                                   |             | $I_R = 200 \mu\text{Adc}$                                                                                                            |                  |          | ---    | 500 | ns                |

## 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.)

## 3. REQUIREMENTS

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

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500.

3.3 Design, construction, and physical dimensions. The semiconductor diode shall be of the design, construction, and physical dimensions shown on figure 1.

3.3.1 Lead finish. Lead finish shall be tinned or gold plated. Lead finish may be specified in the contract or order (see 6.2), without affecting the qualified product status of the device or applicable JAN marking.

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

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

- (a) First letter "C" from qualification designation code.
- (b) Manufacturer's identification.
- (c) Country of origin.

It is permissible to have the type number on two adjacent lines; however, if this is done, the break in the type number shall be as follows: 1N-XXX.

## 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.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections.

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.

TABLE I. Group A inspection. - Continued

| Examination or test    | MIL-STD-750 |                                                 | L<br>T<br>P<br>D | Symbol               | Limits     |            | Unit            |
|------------------------|-------------|-------------------------------------------------|------------------|----------------------|------------|------------|-----------------|
|                        | Method      | Details                                         |                  |                      | Min        | Max        |                 |
| Subgroup 2 - Continued |             |                                                 |                  |                      |            |            |                 |
| Forward recovery time  | 4026        | $I_F = 50 \text{ mAdc}$                         |                  | $v_{fr}$<br>$t_{fr}$ | ---<br>--- | 3.5<br>100 | Vdc<br>ns       |
| Reverse current        | 4016        | $V_R = 10 \text{ Vdc}; T_A = 100^\circ\text{C}$ |                  | $I_R$                |            |            |                 |
| 1N643                  |             |                                                 |                  |                      | ---        | 5          | $\mu\text{Adc}$ |
| 1N662                  |             |                                                 |                  |                      | ---        | 5          | $\mu\text{Adc}$ |
| 1N663                  |             |                                                 |                  |                      | ---        | 5          | $\mu\text{Adc}$ |
| Reverse current        | 4016        | $T_A = 100^\circ\text{C}$                       |                  | $I_R$                |            |            |                 |
| 1N643                  |             | $V_R = 100 \text{ Vdc}$                         |                  |                      | ---        | 15         | $\mu\text{Adc}$ |
| 1N662                  |             | $V_R = 50 \text{ Vdc}$                          |                  |                      | ---        | 100        | $\mu\text{Adc}$ |
| 1N663                  |             | $V_R = 75 \text{ Vdc}$                          |                  |                      | ---        | 50         | $\mu\text{Adc}$ |
| Capacitance            | 4001        |                                                 |                  | C                    |            |            |                 |
| 1N643                  |             | $V = 175 \text{ V}$                             |                  |                      | ---        | 3          | pF              |
| 1N662                  |             | $V = 80 \text{ V}$                              |                  |                      | ---        | 3          | pF              |
| 1N663                  |             | $V = 80 \text{ V}$                              |                  |                      | ---        | 3          | pF              |

TABLE II. Group B inspection.

| Examination or test                    | MIL-STD-750 |                                                                    | L<br>T<br>P<br>D | Symbol         | Limits |     | Unit |
|----------------------------------------|-------------|--------------------------------------------------------------------|------------------|----------------|--------|-----|------|
|                                        | Method      | Details                                                            |                  |                | Min    | Max |      |
| <u>Subgroup 1</u>                      |             |                                                                    | 10               |                |        |     |      |
| Physical dimensions                    | 2066        | (See figure 1)                                                     |                  | ---            | ---    | --- | ---  |
| <u>Subgroup 2</u>                      |             |                                                                    | 15               |                |        |     |      |
| Solderability                          | 2026        |                                                                    |                  |                |        |     |      |
| Thermal shock<br>(temperature cycling) | 1051        | Test condition C                                                   |                  | ---            | ---    | --- | ---  |
| Thermal shock (glass strain)           | 1056        | Test condition A                                                   |                  | ---            | ---    | --- | ---  |
| Vibration, variable frequency          | 2056        | Nonoperating                                                       |                  | ---            | ---    | --- | ---  |
| Terminal strength:<br>Tension          | 2036        | Test condition A; 2 lbs;<br>t = 3 sec                              |                  | ---            | ---    | --- | ---  |
| Hermetic seal                          | 1071        | Test condition G or H for<br>fine leaks; C or E for<br>gross leaks |                  | ---            | ---    | --- | ---  |
| Moisture resistance                    | 1021        | (Omit initial conditioning)                                        |                  | ---            | ---    | --- | ---  |
| End points:<br>Forward voltage         | 4011        |                                                                    |                  | V <sub>F</sub> |        |     |      |
| 1N643                                  |             | I <sub>F</sub> = 10 mAdc                                           |                  |                | ---    | 1.0 | Vdc  |
| 1N662                                  |             | I <sub>F</sub> = 10 mAdc                                           |                  |                | ---    | 1.0 | Vdc  |
| 1N663                                  |             | I <sub>F</sub> = 100 mAdc                                          |                  |                | ---    | 1.0 | Vdc  |

TABLE II. Group B inspection - Continued

| Examination or test                          | MIL-STD-750 |                                                                                                                                                    | L<br>T<br>P<br>D | Symbol | Limits |                 | Unit |
|----------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------|--------|-----------------|------|
|                                              | Method      | Details                                                                                                                                            |                  |        | Min    | Max             |      |
| <u>Subgroup 2 - Continued</u>                |             |                                                                                                                                                    |                  |        |        |                 |      |
| End points: -Continued                       |             |                                                                                                                                                    |                  |        |        |                 |      |
| Reverse current                              | 4016        | $T_A = 100^{\circ}\text{C}$                                                                                                                        | 15               | $I_R$  |        |                 |      |
| 1N643                                        |             | $V_R = 100\text{ Vdc}$                                                                                                                             |                  | ---    | 15     | $\mu\text{Adc}$ |      |
| 1N662                                        |             | $V_R = 50\text{ Vdc}$                                                                                                                              |                  | ---    | 100    | $\mu\text{Adc}$ |      |
| 1N663                                        |             | $V_R = 75\text{ Vdc}$                                                                                                                              |                  | ---    | 50     | $\mu\text{Adc}$ |      |
| <u>Subgroup 3</u>                            |             |                                                                                                                                                    |                  |        |        |                 |      |
| Shock                                        | 2016        | 500 G; $t \approx 1\text{ ms}$ ; 5 blows each orientation: $X_1$ , $Y_1$ , and $Y_2$                                                               | 15               | ---    | ---    | ---             | ---  |
| Vibration, variable frequency (nonoperating) | 2056        | 10 G                                                                                                                                               |                  | ---    | ---    | ---             | ---  |
| Constant acceleration                        | 2006        | 20,000 G; $X_1$ , $Y_1$ , and $Y_2$ orientations                                                                                                   |                  | ---    | ---    | ---             | ---  |
| End points:<br>(Same as subgroup 2)          |             |                                                                                                                                                    |                  |        |        |                 |      |
| <u>Subgroup 4</u>                            |             |                                                                                                                                                    |                  |        |        |                 |      |
| Terminal strength:<br>Lead fatigue           | 2036        | Test condition E; 1 lb                                                                                                                             | 15               | ---    | ---    | ---             | ---  |
| End points:<br>(Same as for subgroup 2)      |             |                                                                                                                                                    |                  |        |        |                 |      |
| <u>Subgroup 5</u>                            |             |                                                                                                                                                    |                  |        |        |                 |      |
| Surge current                                | 4066        | $T_A = 100^{\circ}\text{C}$ ; $I_0 = 10\text{ mAdc}$ ;<br>$I_1(\text{surge}) = 500\text{ mA}$ ;<br>$t_p = 1/120\text{ s}$<br>10 surges at 1/minute | 15               |        |        |                 |      |
| 1N643                                        |             | $V_R = 175\text{ V(pk)}$                                                                                                                           |                  | ---    | ---    | ---             | ---  |
| 1N662                                        |             | $V_R = 80\text{ V(pk)}$                                                                                                                            |                  | ---    | ---    | ---             | ---  |
| 1N663                                        |             | $V_R = 80\text{ V(pk)}$                                                                                                                            |                  | ---    | ---    | ---             | ---  |
| End points:<br>(Same as subgroup 2)          |             |                                                                                                                                                    |                  |        |        |                 |      |
| <u>Subgroup 6</u>                            |             |                                                                                                                                                    |                  |        |        |                 |      |
| Salt atmosphere (corrosion)                  | 1041        |                                                                                                                                                    | 15               | ---    | ---    | ---             | ---  |
| <u>Subgroup 7</u>                            |             |                                                                                                                                                    |                  |        |        |                 |      |
| High-temperature life (nonoperating)         | 1031        | $T_A = 175^{\circ}\text{C}$                                                                                                                        | $\lambda = 10$   | ---    | ---    | ---             | ---  |
| End points:<br>(Same as subgroup 2)          |             |                                                                                                                                                    |                  |        |        |                 |      |

TABLE II. Group B inspection. - Continued

| Examination or test                 | MIL-STD-750 |                                                                | L<br>T<br>P<br>D | Symbol | Limits |     | Unit            |
|-------------------------------------|-------------|----------------------------------------------------------------|------------------|--------|--------|-----|-----------------|
|                                     | Method      | Details                                                        |                  |        | Min    | Max |                 |
| <u>Subgroup 8</u>                   |             |                                                                | $\lambda = 10$   |        |        |     |                 |
| Steady state operation life         | 1026        | $f = 60 \text{ Hz}$ (see 4.4.1)                                |                  |        |        |     |                 |
| 1N643                               |             | $I_O = 40 \text{ mAdc}$ ;<br>$V_{RM(wkg)} = 175 \text{ V(pk)}$ |                  | ---    | ---    | --- | ---             |
| 1N662                               |             | $I_O = 40 \text{ mAdc}$ ;<br>$V_{RM(wkg)} = 80 \text{ V(pk)}$  |                  | ---    | ---    | --- | ---             |
| 1N663                               |             | $I_O = 60 \text{ mAdc}$ ;<br>$V_{RM(wkg)} = 80 \text{ V(pk)}$  |                  | ---    | ---    | --- | ---             |
| End points:<br>(Same as subgroup 2) |             |                                                                |                  |        |        |     |                 |
| <u>Subgroup 9</u>                   |             |                                                                | 15               |        |        |     |                 |
| Low temperature operation:          |             | $T_A = -65^\circ\text{C}$                                      |                  |        |        |     |                 |
| Forward voltage                     | 4011        |                                                                |                  | $V_F$  |        |     |                 |
| 1N643                               |             | $I_F = 10 \text{ mAdc}$                                        |                  |        | ---    | 1.2 | Vdc             |
| 1N662                               |             | $I_F = 10 \text{ mAdc}$                                        |                  |        | ---    | 1.2 | Vdc             |
| 1N663                               |             | $I_F = 100 \text{ mAdc}$                                       |                  |        | ---    | 1.2 | Vdc             |
| Reverse current                     | 4016        |                                                                |                  | $I_R$  |        |     |                 |
| 1N643                               |             | $V_R = 100 \text{ Vdc}$                                        |                  |        | ---    | 1   | $\mu\text{Adc}$ |
| 1N662                               |             | $V_R = 50 \text{ Vdc}$                                         |                  |        | ---    | 5   | $\mu\text{Adc}$ |
| 1N663                               |             | $V_R = 75 \text{ Vdc}$                                         |                  |        | ---    | 5   | $\mu\text{Adc}$ |

TABLE III. Group C inspection.

| Examination or test                                  | MIL-STD-750 |                               | L<br>T<br>P<br>D | Symbol | Limits |     | Unit              |
|------------------------------------------------------|-------------|-------------------------------|------------------|--------|--------|-----|-------------------|
|                                                      | Method      | Details                       |                  |        | Min    | Max |                   |
| <u>Subgroup 1</u>                                    |             |                               | 15               |        |        |     |                   |
| Barometric pressure,<br>reduced (altitude operation) | 1001        | 15 torr; $t = 60 \text{ sec}$ |                  | ---    | ---    | --- | ---               |
| Measurement during test:                             |             |                               |                  |        |        |     |                   |
| Reverse current at peak<br>reverse voltage           | 4016        |                               |                  | $i_R$  |        |     |                   |
| 1N643                                                |             | $v_R = 200 \text{ V(pk)}$     |                  |        | ---    | 100 | $\mu\text{A(pk)}$ |
| 1N662                                                |             | $v_R = 100 \text{ V(pk)}$     |                  |        | ---    | 100 | $\mu\text{A(pk)}$ |
| 1N663                                                |             | $v_R = 100 \text{ V(pk)}$     |                  |        | ---    | 100 | $\mu\text{A(pk)}$ |

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

6. NOTES

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

Custodians:

Army - EL  
Navy - EC  
Air Force - 17

Review activities:

Army - MU, MI  
Navy -  
Air Force - 11, 80  
DSA - ES

User activities:

Army - SM  
Navy - AS, CG, MC, OS, SH  
Air Force - 13, 15, 19

Preparing activity:

Army - EL

Agent: DSA - ES

(Project 5961-0244)

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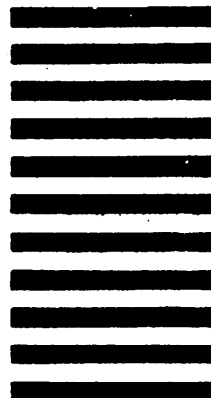


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# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

☐ VENDOR

☐ USER

☐ MANUFACTURER

☐ OTHER (Specify): \_\_\_\_\_

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Code) - Optional

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