

Dual NPN Bias Resistor Transistors R1 = 2.2 k Ω , R2 = 47 k Ω

NPN Transistors with Monolithic Bias Resistor Network

MUN5235DW1, NSBC123JDXV6, NSBC123JDP6

This series of digital transistors is designed to replace a single device and its external resistor bias network. The Bias Resistor Transistor (BRT) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT eliminates these individual components by integrating them into a single device. The use of a BRT can reduce both system cost and board space.

Features

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- S and NSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

MAXIMUM RATINGS

(T_A = 25°C, common for Q₁ and Q₂, unless otherwise noted)

| Rating | Symbol | Max | Unit |
|--------------------------------|----------------------|-----|------|
| Collector-Base Voltage | V_{CBO} | 50 | Vdc |
| Collector-Emitter Voltage | V_{CEO} | 50 | Vdc |
| Collector Current - Continuous | Ic | 100 | mAdc |
| Input Forward Voltage | V _{IN(fwd)} | 12 | Vdc |
| Input Reverse Voltage | V _{IN(rev)} | 5 | Vdc |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

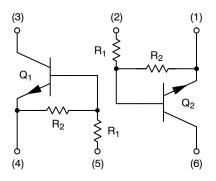
ORDERING INFORMATION

| Device | Package | Shipping [†] |
|--------------------------------------|---------|-----------------------|
| MUN5235DW1T1G, SMUN5235DW1T1G | SOT-363 | 3,000 / Tape & Reel |
| SMUN5235DW1T3G | SOT-363 | 10,000 / Tape & Reel |
| NSBC123JDXV6T1G | SOT-563 | 4,000 / Tape & Reel |
| NSBC123JDXV6T5G NSVBC123JDXV6T5G* | SOT-563 | 8,000 / Tape & Reel |
| NSBC123JDP6T5G | SOT-963 | 8,000 / Tape & Reel |
| NSVBC123JDXV6T1G | SOT-563 | 4,000 / Tape & Reel |

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

1

PIN CONNECTIONS



MARKING DIAGRAMS



SOT-363 **CASE 419B**





SOT-563 CASE 463A





SOT-963 CASE 527AD



= Specific Device Code 7M/D

Μ Date Code* = Pb-Free Package

(Note: Microdot may be in either location)

^{*}Date Code orientation may vary depending upon manufacturing location.

THERMAL CHARACTERISTICS

| | Characteristic | Symbol | Max | Unit |
|---|-------------------------------|-----------------------------------|--------------------------|-------------|
| MUN5235DW1 (SOT-363) ON | IE JUNCTION HEATED | | | |
| Total Device Dissipation $T_A = 25^{\circ}C \qquad \text{(Note 1)}$ (Note 2) Derate above 25°C (Note 2) | (Note 1) | P _D | 187 256 1.5 2.0 | mW mW/°C |
| Thermal Resistance, Junction to Ambient | (Note 1) (Note 2) | $R_{	heta JA}$ | 670 490 | °C/W |
| MUN5235DW1 (SOT-363) BC | OTH JUNCTION HEATED (Note 3) | <u>.</u> | | |
| Total Device Dissipation TA = 25°C (Note 1) (Note 2) Derate above 25°C (Note 2) | (Note 1) | P _D | 250 385 2.0 3.0 | mW mW/°C |
| Thermal Resistance, Junction to Ambient (Note 2) | (Note 1) | $R_{	hetaJA}$ | 493 325 | °C/W |
| Thermal Resistance, Junction to Lead (Note 1) (Note 2) | | $R_{	hetaJL}$ | 188 208 | °C/W |
| Junction and Storage Temper | ature Range | T _J , T _{stg} | -55 to +150 | °C |
| NSBC123JDXV6 (SOT-563) | ONE JUNCTION HEATED | · | | |
| Total Device Dissipation T _A = 25°C (Note 1) Derate above 25°C | (Note 1) | P _D | 357 2.9 | mW mW/°C |
| Thermal Resistance, Junction to Ambient | (Note 1) | $R_{	hetaJA}$ | 350 | °C/W |
| NSBC123JDXV6 (SOT-563) I | BOTH JUNCTION HEATED (Note 3) | | | |
| Total Device Dissipation $T_A = 25^{\circ}C$ (Note 1) Derate above 25°C | (Note 1) | P _D | 500 4.0 | mW mW/°C |
| Thermal Resistance, Junction to Ambient | (Note 1) | $R_{	hetaJA}$ | 250 | °C/W |
| Junction and Storage Temper | ature Range | T _J , T _{stg} | -55 to +150 | °C |
| NSBC123JDP6 (SOT-963) O | NE JUNCTION HEATED | | | |
| Total Device Dissipation $T_A = 25^{\circ}C \qquad \text{(Note 4)}$ (Note 5) Derate above 25°C (Note 5) | (Note 4) | P _D | 231 269 1.9 2.2 | MW mW/°C |
| Thermal Resistance, Junction to Ambient (Note 5) | (Note 4) | $R_{	hetaJA}$ | 540 464 | °C/W |
| NSBC123JDP6 (SOT-963) B | OTH JUNCTION HEATED (Note 3) | • | | |
| Total Device Dissipation T _A = 25°C (Note 4) (Note 5) Derate above 25°C (Note 5) | (Note 4) | P _D | 339 408 2.7 3.3 | MW mW/°C |
| Thermal Resistance, Junction to Ambient (Note 5) | (Note 4) | $R_{	heta JA}$ | 369 306 | °C/W |
| Junction and Storage Temper | ature Range | T _J , T _{stg} | -55 to +150 | °C |

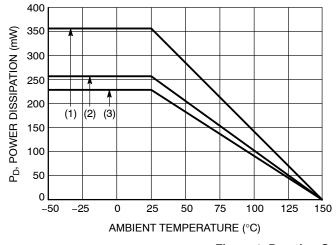
- FR-4 @ Minimum Pad.
 FR-4 @ 1.0 × 1.0 Inch Pad.
 Both junction heated values assume total power is sum of two equally powered channels.
 FR-4 @ 100 mm², 1 oz. copper traces, still air.
 FR-4 @ 500 mm², 1 oz. copper traces, still air.

ELECTRICAL CHARACTERISTICS (T_A = 25°C, common for Q₁ and Q₂, unless otherwise noted)

| Characteristic | Symbol | Min | Тур | Max | Unit |
|--|--------------------------------|-------|-------|-------|------|
| OFF CHARACTERISTICS | • | | • | | • |
| Collector-Base Cutoff Current $(V_{CB} = 50 \text{ V}, I_E = 0)$ | I _{CBO} | - | - | 100 | nAdc |
| Collector-Emitter Cutoff Current $(V_{CE} = 50 \text{ V}, I_B = 0)$ | I _{CEO} | - | - | 500 | nAdc |
| Emitter-Base Cutoff Current $(V_{EB} = 6.0 \text{ V}, I_C = 0)$ | I _{EBO} | - | - | 0.2 | mAdc |
| Collector-Base Breakdown Voltage ($I_C = 10 \mu A$, $I_E = 0$) | V _{(BR)CBO} | 50 | - | - | Vdc |
| Collector-Emitter Breakdown Voltage (Note 6) $(I_C = 2.0 \text{ mA}, I_B = 0)$ | V _{(BR)CEO} | 50 | - | - | Vdc |
| ON CHARACTERISTICS | | | | | |
| DC Current Gain (Note 6) (I _C = 5.0 mA, V _{CE} = 10 V) | h _{FE} | 80 | 140 | - | |
| Collector-Emitter Saturation Voltage (Note 6) (I _C = 10 mA, I _B = 1.0 mA) | V _{CE(sat)} | - | - | 0.25 | V |
| Input Voltage (Off) (V _{CE} = 5.0 V, I _C = 100 μ A) | V _{i(off)} | - | 0.6 | - | Vdc |
| Input Voltage (On) ($V_{CE} = 0.2 \text{ V}, I_C = 5.0 \text{ mA}$) | V _{i(on)} | - | 0.8 | - | Vdc |
| Output Voltage (On) (V _{CC} = 5.0 V, V _B = 2.5 V, R _L = 1.0 k Ω) | V _{OL} | - | - | 0.2 | Vdc |
| Output Voltage (Off) (V _{CC} = 5.0 V, V _B = 0.5 V, R _L = 1.0 k Ω) | V _{OH} | 4.9 | - | - | Vdc |
| Input Resistor | R1 | 1.5 | 2.2 | 2.9 | kΩ |
| Resistor Ratio | R ₁ /R ₂ | 0.038 | 0.047 | 0.056 | |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

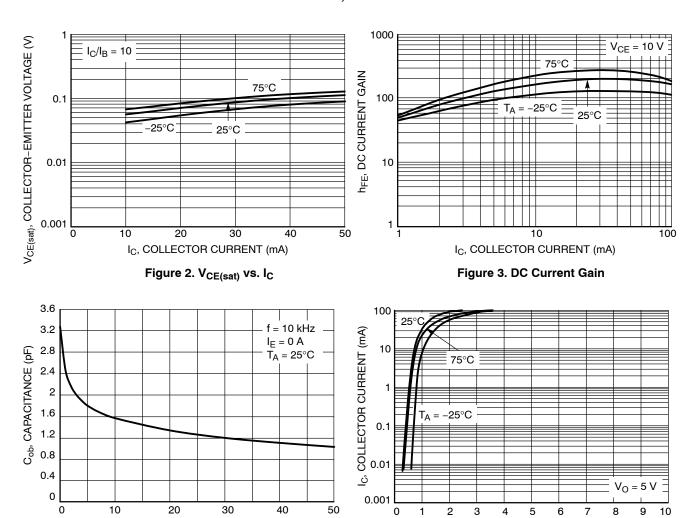
6. Pulsed Condition: Pulse Width = 300 ms, Duty Cycle ≤ 2%.



- (1) SOT-363; 1.0×1.0 Inch Pad
- (2) SOT-563; Minimum Pad
- (3) SOT-963; 100 mm², 1 oz. Copper Trace

Figure 1. Derating Curve

TYPICAL CHARACTERISTICS MUN5235DW1, NSBC123JDXV6



V_R, REVERSE BIAS VOLTAGE (VOLTS)

Figure 4. Output Capacitance

 $\label{eq:Vin} V_{in}, \mbox{ INPUT VOLTAGE (V)}$ Figure 5. Output Current vs. Input Voltage

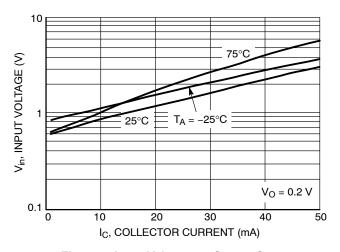


Figure 6. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS NSBC123JDP6

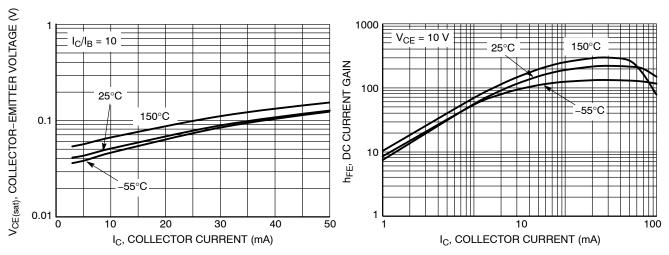


Figure 7. V_{CE(sat)} vs. I_C

Figure 8. DC Current Gain

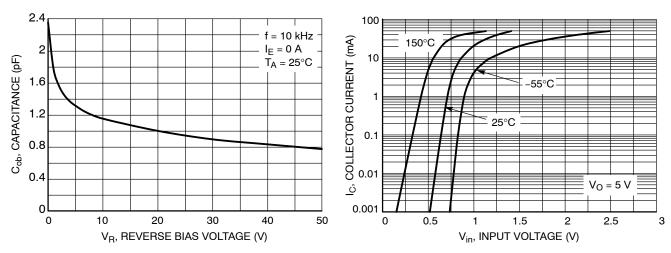


Figure 9. Output Capacitance

Figure 10. Output Current vs. Input Voltage

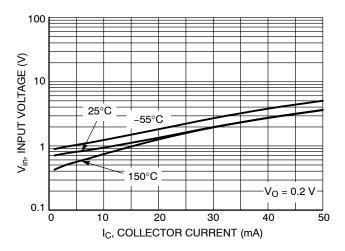
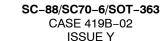
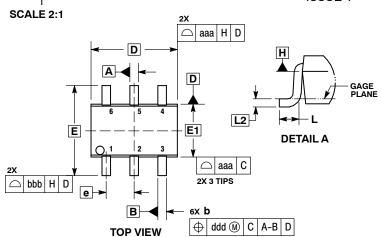


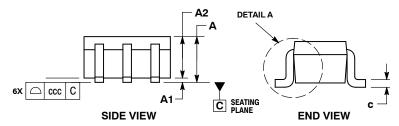
Figure 11. Input Voltage vs. Output Current





DATE 11 DEC 2012





NOTES:

- 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M. 1994.
- CONTROLLING DIMENSION: MILLIMETERS.
 DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH,
- DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H. DIMENSIONS b AND B ARE DETERMINED AT DATUM H. DIMENSIONS b AND C APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.

- DIMENSION 6 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION 6 AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

| | MIL | LIMETE | ERS | | INCHES | 3 |
|-----|----------|---------|------|-----------|--------|-------|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| Α | | | 1.10 | | | 0.043 |
| A1 | 0.00 | | 0.10 | 0.000 | | 0.004 |
| A2 | 0.70 | 0.90 | 1.00 | 0.027 | 0.035 | 0.039 |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| С | 0.08 | 0.15 | 0.22 | 0.003 | 0.006 | 0.009 |
| D | 1.80 | 2.00 | 2.20 | 0.070 | 0.078 | 0.086 |
| E | 2.00 | 2.10 | 2.20 | 0.078 | 0.082 | 0.086 |
| E1 | 1.15 | 1.25 | 1.35 | 0.045 | 0.049 | 0.053 |
| е | | 0.65 BS | С | 0.026 BSC | | |
| L | 0.26 | 0.36 | 0.46 | 0.010 | 0.014 | 0.018 |
| L2 | 0.15 BSC | | (| 0.006 BS | SC | |
| aaa | | 0.15 | | | 0.006 | |
| bbb | 0.30 | | | 0.012 | | |
| ccc | 0.10 | | | 0.004 | | |
| ddd | | 0.10 | | | 0.004 | |

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code

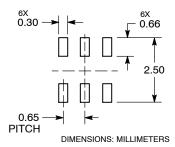
= Date Code*

= Pb-Free Package

(Note: Microdot may be in either location)

- *Date Code orientation and/or position may vary depending upon manufacturing location.
- *This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "=", may or may not be present. Some products may not follow the Generic Marking.

RECOMMENDED SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

STYLES ON PAGE 2

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SC-88/SC70-6/SOT-363 CASE 419B-02 ISSUE Y

DATE 11 DEC 2012

| STYLE 1: PIN 1. EMITTER 2 2. BASE 2 3. COLLECTOR 1 4. EMITTER 1 5. BASE 1 6. COLLECTOR 2 | STYLE 2: CANCELLED | STYLE 3: CANCELLED | STYLE 4: PIN 1. CATHODE 2. CATHODE 3. COLLECTOR 4. EMITTER 5. BASE 6. ANODE | STYLE 5: PIN 1. ANODE 2. ANODE 3. COLLECTOR 4. EMITTER 5. BASE 6. CATHODE | STYLE 6: PIN 1. ANODE 2 2. N/C 3. CATHODE 1 4. ANODE 1 5. N/C 6. CATHODE 2 |
|--|--|---|---|---|--|
| STYLE 7: PIN 1. SOURCE 2 2. DRAIN 2 3. GATE 1 4. SOURCE 1 5. DRAIN 1 6. GATE 2 | STYLE 8: CANCELLED | STYLE 9: PIN 1. EMITTER 2 2. EMITTER 1 3. COLLECTOR 1 4. BASE 1 5. BASE 2 6. COLLECTOR 2 | STYLE 10: PIN 1. SOURCE 2 2. SOURCE 1 3. GATE 1 4. DRAIN 1 5. DRAIN 2 6. GATE 2 | STYLE 11: PIN 1. CATHODE 2 2. CATHODE 2 3. ANODE 1 4. CATHODE 1 5. CATHODE 1 6. ANODE 2 | STYLE 12: PIN 1. ANODE 2 2. ANODE 2 3. CATHODE 1 4. ANODE 1 5. ANODE 1 6. CATHODE 2 |
| STYLE 13: PIN 1. ANODE 2. N/C 3. COLLECTOR 4. EMITTER 5. BASE 6. CATHODE | STYLE 14: PIN 1. VREF 2. GND 3. GND 4. IOUT 5. VEN 6. VCC | STYLE 15: PIN 1. ANODE 1 2. ANODE 2 3. ANODE 3 4. CATHODE 3 5. CATHODE 2 6. CATHODE 1 | STYLE 16: PIN 1. BASE 1 2. EMITTER 2 3. COLLECTOR 2 4. BASE 2 5. EMITTER 1 6. COLLECTOR 1 | STYLE 17: PIN 1. BASE 1 2. EMITTER 1 3. COLLECTOR 2 4. BASE 2 5. EMITTER 2 6. COLLECTOR 1 | STYLE 18: PIN 1. VIN1 2. VCC 3. VOUT2 4. VIN2 5. GND 6. VOUT1 |
| STYLE 19: PIN 1. I OUT 2. GND 3. GND 4. V CC 5. V EN 6. V REF | STYLE 20: PIN 1. COLLECTOR 2. COLLECTOR 3. BASE 4. EMITTER 5. COLLECTOR 6. COLLECTOR | STYLE 21: PIN 1. ANODE 1 2. N/C 3. ANODE 2 4. CATHODE 2 5. N/C 6. CATHODE 1 | STYLE 22: PIN 1. D1 (i) 2. GND 3. D2 (i) 4. D2 (c) 5. VBUS 6. D1 (c) | STYLE 23: PIN 1. Vn 2. CH1 3. Vp 4. N/C 5. CH2 6. N/C | STYLE 24: PIN 1. CATHODE 2. ANODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE |
| STYLE 25: PIN 1. BASE 1 2. CATHODE 3. COLLECTOR 2 4. BASE 2 5. EMITTER 6. COLLECTOR 1 | STYLE 26: PIN 1. SOURCE 1 2. GATE 1 3. DRAIN 2 4. SOURCE 2 5. GATE 2 6. DRAIN 1 | STYLE 27: PIN 1. BASE 2 2. BASE 1 3. COLLECTOR 1 4. EMITTER 1 5. EMITTER 2 6. COLLECTOR 2 | STYLE 28: PIN 1. DRAIN 2. DRAIN 3. GATE 4. SOURCE 5. DRAIN 6. DRAIN | STYLE 29: PIN 1. ANODE 2. ANODE 3. COLLECTOR 4. EMITTER 5. BASE/ANODE 6. CATHODE | STYLE 30: PIN 1. SOURCE 1 2. DRAIN 2 3. DRAIN 2 4. SOURCE 2 5. GATE 1 6. DRAIN 1 |

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

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MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS



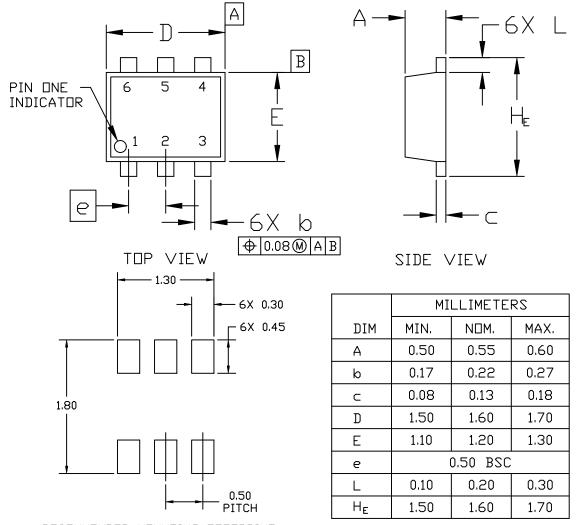


SOT-563, 6 LEAD CASE 463A ISSUE H

DATE 26 JAN 2021

NOTES:

- I. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
- 2. CONTROLLING DIMENSION: MILLIMETERS
- 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.



RECOMMENDED MOUNTING FOOTPRINT*

For additional information on our Pb-Free strategy and soldering details, please download the DN Semiconductor Soldering and Mounting Techniques Reference Manual, SDLDERRM/D.

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SOT-563, 6 LEAD

CASE 463A ISSUE H

DATE 26 JAN 2021

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|--|--|--|
| STYLE 4: PIN 1. COLLECTOR 2. COLLECTOR 3. BASE 4. EMITTER 5. COLLECTOR 6. COLLECTOR | STYLE 5: PIN 1. CATHODE 2. CATHODE 3. ANODE 4. ANODE 5. CATHODE 6. CATHODE | STYLE 6: PIN 1. CATHODE 2. ANODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE |
| STYLE 7: PIN 1. CATHODE 2. ANODE 3. CATHODE 4. CATHODE 5. ANODE 6. CATHODE | STYLE 8: PIN 1. DRAIN 2. DRAIN 3. GATE 4. SDURCE 5. DRAIN 6. DRAIN | STYLE 9: PIN 1. SDURCE 1 2. GATE 1 3. DRAIN 2 4. SDURCE 2 5. GATE 2 6. DRAIN 1 |
| 2, N/C 3 CATHONE 2 | STYLE 11: PIN 1. EMITTER 2 2. BASE 2 3. COLLECTOR 1 4. EMITTER 1 5. BASE 1 6. COLLECTOR 2 | |

GENERIC MARKING DIAGRAM*



XX = Specific Device CodeM = Month Code= Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

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MECHANICAL CASE OUTLINE

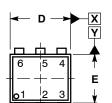




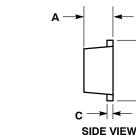
SOT-963 CASE 527AD-01 **ISSUE E**

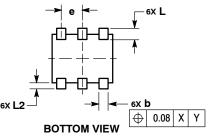
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DATE 09 FEB 2010



TOP VIEW





| 6x L2 - 6x b |
|---|
| BOTTOM VIEW $iggl(iggl(iggl) iggl(0.08 iggl(X iggr) Y iggr) iggl(iggl) iggl(0.08 iggl(X iggr) Y iggr) iggl(iggl(0.08 iggl) iggl(X iggr) Y iggl) iggl(iggl(0.08 iggl) iggl(X iggl) iggl($ |

STYLE 2:

STYLE 5:

STYLE 8:

PIN 1. DRAIN 2. DRAIN

PIN 1. EMITTER 1

3. BASE 2

PIN 1. CATHODE

2. CATHODE

3. ANODE 4. ANODE 5. CATHODE

6. CATHODE

3. GATE 4. SOURCE

5. DRAIN

6. DRAIN

2. EMITTER2

4. COLLECTOR 2 5. BASE 1

6. COLLECTOR 1

STYLE 1: PIN 1. EMITTER 1 2. BASE 1

COLLECTOR 2 EMITTER 2 BASE 2

6. COLLECTOR 1

STYLE 4: PIN 1. COLLECTOR 2. COLLECTOR 3. BASE

4. EMITTER 5. COLLECTOR 6. COLLECTOR

STYLE 7: PIN 1. CATHODE 2. ANODE 3. CATHODE 4. CATHODE ANODE 6. CATHODE

STYLE 10: PIN 1. CATHODE 1 2. N/C 3. CATHODE 2

 4. ANODE 2
 5. N/C 6. ANODE 1

STYLE 3:

PIN 1. CATHODE 1 2. CATHODE 1 3. ANODE/ANODE 2

4. CATHODE 2 5. CATHODE 2 6. ANODE/ANODE 1

STYLE 6:

PIN 1. CATHODE 2. ANODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE

STYLE 9: PIN 1. SOURCE 1 2. GATE 1 3. DRAIN 2 4. SOURCE 2

5. GATE 2 6. DRAIN 1

NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: MILLIMETERS 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD

THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL 4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| | MILLIMETERS | | | |
|-----|-------------|------|------|--|
| DIM | MIN | NOM | MAX | |
| Α | 0.34 | 0.37 | 0.40 | |
| b | 0.10 | 0.15 | 0.20 | |
| С | 0.07 | 0.12 | 0.17 | |
| D | 0.95 | 1.00 | 1.05 | |
| Е | 0.75 | 0.80 | 0.85 | |
| е | 0.35 BSC | | | |
| HE | 0.95 | 1.00 | 1.05 | |
| L | 0.19 REF | | | |
| L2 | 0.05 | 0.10 | 0.15 | |

GENERIC MARKING DIAGRAM*



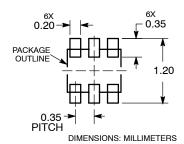
= Specific Device Code

= Month Code М

*This information is generic. Please refer to device data sheet for actual part marking.

Pb-Free indicator, "G" or microdot " ■", may or may not be present.

RECOMMENDED MOUNTING FOOTPRINT



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|------------------|---------------------|---|-------------|
| DESCRIPTION: | SOT-963, 1X1, 0.35P | | PAGE 1 OF 1 |

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