## NST65011 MW6

## Dual Matched General Purpose Transistor

NPN Matched Pair
These transistors are housed in an ultra-small SOT-363 package ideally suited for portable products. They are assembled to create a pair of devices highly matched in all parameters, eliminating the need for costly trimming. Applications are Current Mirrors; Differential, Sense and Balanced Amplifiers; Mixers; Detectors and Limiters. Complementary PNP equivalent NST65010MW6T1G is available.

## Features

- Current Gain Matching to $10 \%$
- Base-Emitter Voltage Matched to 2 mV
- Drop-In Replacement for Standard Device
- NSV Prefix for Automotive and Other Applications Requiring

Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable

- These Devices are $\mathrm{Pb}-$ Free, Halogen Free/BFR Free and are RoHS Compliant

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
| :--- | :---: | :---: | :---: |
| Collector-Emitter Voltage | $\mathrm{V}_{\mathrm{CEO}}$ | 65 | V |
| Collector-Base Voltage | $\mathrm{V}_{\mathrm{CBO}}$ | 80 | V |
| Emitter-Base Voltage | $\mathrm{V}_{\text {EBO }}$ | 6.0 | V |
| Collector Current - Continuous | $\mathrm{I}_{\mathrm{C}}$ | 100 | mAdc |

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.

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
| :---: | :---: | :---: | :---: |
| Total Device Dissipation <br> Per Device <br> FR-5 Board (Note 1) <br> $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ <br> Derate Above $25^{\circ} \mathrm{C}$ | $\mathrm{P}_{\mathrm{D}}$ | 380 | mW |
| Thermal Resistance, <br> Junction to Ambient | $\mathrm{R}_{\theta \mathrm{JJA}}$ | 350 | $\mathrm{~mW} /{ }^{\circ} \mathrm{C}$ |
| Junction and Storage <br> Temperature Range | $\mathrm{T}_{\mathrm{J}}, \mathrm{T}_{\text {stg }}$ | -55 to +150 | ${ }^{\circ} \mathrm{C}$ |

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MARKING DIAGRAMS


2G = Device Code
M = Date Code

- = Pb-Free Package
(Note: Microdot may be in either location)


## ORDERING INFORMATION

| Device | Package | Shipping $^{\dagger}$ |
| :---: | :---: | :---: |
| NST65011MW6T1G | SOT-363 <br> (Pb-Free) | $3,000 /$ <br> Tape \& Reel |
| NSVT65011MW6T1G | SOT-363 <br> (Pb-Free) | $3,000 /$ <br> Tape \& Reel |

$\dagger$ 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.

ELECTRICAL CHARACTERISTICS $\left(T_{A}=25^{\circ} \mathrm{C}\right.$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
| OFF CHARACTERISTICS |  |  |  |  |  |
| Collector-Emitter Breakdown Voltage, ( $\mathrm{IC}_{\mathrm{C}}=10 \mathrm{~mA}$ ) | $\mathrm{V}_{\text {(BR)CEO }}$ | 65 | - | - | V |
| Collector-Emitter Breakdown Voltage, ( $\mathrm{IC}_{\mathrm{C}}=10 \mu \mathrm{~A}, \mathrm{~V}_{\mathrm{EB}}=0$ ) | $\mathrm{V}_{(\mathrm{BR}) \mathrm{CES}}$ | 80 | - | - | V |
| Collector-Base Breakdown Voltage, ( $\mathrm{I}_{\mathrm{C}}=10 \mu \mathrm{~A}$ ) | $\mathrm{V}_{\text {(BR)CBO }}$ | 80 | - | - | V |
| Emitter-Base Breakdown Voltage, ( $\mathrm{I}_{\mathrm{E}}=1.0 \mu \mathrm{~A}$ ) | $\mathrm{V}_{(\mathrm{BR}) \text { EBO }}$ | 6.0 | - | - | V |
| $\begin{aligned} & \text { Collector Cutoff Current } \\ & \left(\mathrm{V}_{C B}=30 \mathrm{~V}\right) \\ & \left(\mathrm{V}_{\mathrm{CB}}=30 \mathrm{~V}, T_{A}=150^{\circ} \mathrm{C}\right) \end{aligned}$ | $\mathrm{I}_{\text {CBO }}$ | - | - | $\begin{aligned} & 15 \\ & 5.0 \end{aligned}$ | $\begin{aligned} & \mathrm{nA} \\ & \mu \mathrm{~A} \end{aligned}$ |

## ON CHARACTERISTICS

| $\begin{aligned} & \text { DC Current Gain } \\ & \left(\mathrm{I}_{\mathrm{C}}=10 \mu \mathrm{~A}, \mathrm{~V}_{\mathrm{CE}}=5.0 \mathrm{~V}\right) \\ & \left(\mathrm{I}_{\mathrm{C}}=2.0 \mathrm{~mA}, \mathrm{~V}_{\mathrm{CE}}=5.0 \mathrm{~V}\right) \\ & \left(\mathrm{I}_{\mathrm{C}}=2.0 \mathrm{~mA}, \mathrm{~V}_{\mathrm{CE}}=5.0 \mathrm{~V}\right)(\text { Note } 2) \end{aligned}$ | $\begin{gathered} h_{F E} \\ h_{\text {FE(1) }} h_{\text {FE }(2)} \end{gathered}$ | $\begin{aligned} & 150 \\ & 200 \\ & 0.9 \end{aligned}$ | $\begin{aligned} & -\overline{-} \\ & 300 \\ & 1.0 \end{aligned}$ | $\begin{gathered} - \\ 500 \\ 1.1 \end{gathered}$ | - |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Collector-Emitter Saturation Voltage } \\ & \left(I_{C}=10 \mathrm{~mA}, I_{\mathrm{B}}=0.5 \mathrm{~mA}\right) \\ & \left(I_{C}=100 \mathrm{~mA}, \mathrm{I}_{\mathrm{B}}=5.0 \mathrm{~mA}\right) \end{aligned}$ | $\mathrm{V}_{\text {CE(sat) }}$ |  | - | $\begin{aligned} & 250 \\ & 600 \end{aligned}$ | mV |
| $\begin{aligned} & \text { Base-Emitter Saturation Voltage } \\ & \left(I_{C}=10 \mathrm{~mA}, I_{\mathrm{B}}=0.5 \mathrm{~mA}\right) \\ & \left(I_{\mathrm{C}}=100 \mathrm{~mA}, I_{\mathrm{B}}=5.0 \mathrm{~mA}\right) \end{aligned}$ | $\mathrm{V}_{\mathrm{BE} \text { (sat) }}$ | $\begin{aligned} & 700 \\ & 850 \end{aligned}$ | $\begin{aligned} & 750 \\ & 890 \end{aligned}$ | $\begin{aligned} & 800 \\ & 950 \end{aligned}$ | mV |
| $\begin{aligned} & \text { Base-Emitter On Voltage } \\ & \left(I_{C}=2.0 \mathrm{~mA}, \mathrm{~V}_{\mathrm{CE}}=5.0 \mathrm{~V}\right) \\ & \left(I_{\mathrm{C}}=10 \mathrm{~mA}, \mathrm{~V}_{\mathrm{CE}}=5.0 \mathrm{~V}\right) \\ & \left(\mathrm{I}_{\mathrm{C}}=2.0 \mathrm{~mA}, \mathrm{~V}_{\mathrm{CE}}=5.0 \mathrm{~V}\right)(\text { Note } 3) \\ & \hline \end{aligned}$ | $\begin{gathered} \mathrm{V}_{\mathrm{BE}(\mathrm{on})} \\ \mathrm{V}_{\mathrm{BE}(1)-} \mathrm{V}_{\mathrm{BE}(2)} \\ \hline \end{gathered}$ | 580 | 660 - 1.0 | 700 770 2.0 | mV |

SMALL-SIGNAL CHARACTERISTICS

| Current-Gain - Bandwidth Product, $\left(\mathrm{I}_{\mathrm{C}}=10 \mathrm{~mA}, \mathrm{~V}_{\mathrm{CE}}=5 \mathrm{Vdc}, \mathrm{f}=100 \mathrm{MHz}\right)$ | $\mathrm{f}_{\mathrm{T}}$ | 100 | - | - | MHz |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Output Capacitance, $\left(\mathrm{V}_{\mathrm{CB}}=10 \mathrm{~V}, \mathrm{f}=1.0 \mathrm{MHz}\right)$ | $\mathrm{C}_{\mathrm{ob}}$ | - | - | 4.5 | pF |
| Noise Figure, $\left(\mathrm{I}_{\mathrm{C}}=0.2 \mathrm{~mA}, \mathrm{~V}_{\mathrm{CE}}=5 \mathrm{Vdc}, \mathrm{R}_{\mathrm{S}}=2 \mathrm{k} \Omega, \mathrm{f}=1 \mathrm{kHz}, \mathrm{BW}=200 \mathrm{~Hz}\right)$ | NF | - | - | 10 | dB |

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.
2. $h_{\mathrm{FE}(1)} / h_{\mathrm{FE}(2)}$ is the ratio of one transistor compared to the other transistor within the same package. The smaller $\mathrm{h}_{\mathrm{FE}}$ is used as numerator.
3. $\mathrm{V}_{\mathrm{BE}(1)}-\mathrm{V}_{\mathrm{BE}(2)}$ is the absolute difference of one transistor compared to the other transistor within the same package.

TYPICAL CHARACTERISTICS


Figure 1. Normalized DC Current Gain


Figure 3. Collector Saturation Region


Figure 5. Capacitances


Figure 2. "Saturation" and "On" Voltages


Figure 4. Base-Emitter Temperature Coefficient


Figure 6. Current-Gain - Bandwidth Product

TYPICAL CHARACTERISTICS


Figure 7. Active Region Safe Operating Area

The safe operating area curves indicate $\mathrm{I}_{\mathrm{C}}-\mathrm{V}_{\mathrm{CE}}$ limits of the transistor that must be observed for reliable operation. Collector load lines for specific circuits must fall below the limits indicated by the applicable curve.

The data of Figure 7 is based upon $\mathrm{T}_{\mathrm{J}(\mathrm{pk})}=150^{\circ} \mathrm{C} ; \mathrm{T}_{\mathrm{C}}$ or $\mathrm{T}_{\mathrm{A}}$ is variable depending upon conditions.



## 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.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994. 2. CONTROLLING DIMENSION: MILLIMETERS
2. 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.
3. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF DIMENSIONS D AND E1 AT THE OUT
THE PLASTIC BODY AND DATUM H.
DATUMS A AND B ARE DETERMINED AT DATUM H
4. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE O.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

|  | MILLIMETERS |  |  | INCHES |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | --- | --- | 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 |
| C | 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 |
| e | 0.65 BSC |  |  | 0.026 BSC |  |  |
| L | 0.26 | 0.36 |  | 0.46 | 0.010 | 0.014 |
| L2 | 0.15 BSC |  |  | 0.006 BSC |  |  |
| aaa | 0.15 |  |  | 0.006 |  |  |
| bbb | 0.30 |  |  | 0.012 |  |  |
| ccc | 0.10 |  |  | 0.004 |  |  |
| ddd | 0.10 |  |  | 0 |  |  |

GENERIC MARKING DIAGRAM*

XXX = Specific Device Code

M = 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. $\mathrm{Pb}-F r e e ~ i n d i c a t o r, ~ " G " ~ o r ~ m i c r o d o t ~ " " ", ~ m a y ~$ or may not be present. Some products may not follow the Generic Marking.


## STYLES ON PAGE 2

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| DESCRIPTION: | SC-88/SC70-6/SOT-363 | PAGE 1 OF 2 |

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## SC-88/SC70-6/SOT-363

CASE 419B-02
ISSUE Y
STYLE 1:
PIN 1. EMITTER 2
2. BASE 2
3. COLLECTOR 1
4. EMITTER 1
5. BASE 1
6. COLLECTOR 2

STYLE 7:
PIN 1. SOURCE 2
2. DRAIN 2
3. GATE 1
4. SOURCE 1
5. DRAIN 1
6. GATE 2

STYLE 13:
PIN 1. ANODE
2. N/C
3. COLLECTOR
4. EMITTER
5. BASE
6. CATHODE

STYLE 19:
PIN 1. IOUT
2. GND
3. GND
4. V CC
5. V EN
6. V REF
STYLE 25:
PIN 1. BASE 1
2. CATHODE
3. COLECTOR 2
4. BASE 2
5. EMITTER
6. COLLECTOR 1
STYLE 2:
CANCELLED

STYLE 8:
CANCELLED

STYLE 14:
PIN 1. VREF
2. GND
3. GND
4. IOUT
5. VEN
6. VCC

STYLE 20:
PIN 1. COLLECTOR
2. COLLECTOR
3. BASE
4. EMITTER
5. COLLECTOR
6. COLLECTOR
STYLE 26:
PIN 1. SOURCE 1
2. GATE 1
3. DRAIN 2
4. SOURCE 2
5. GATE 2
6. DRAIN 1

| STYLE 3 : <br> CANCELLED | STYLE 4: <br> PIN 1. CATHODE <br> 2. CATHODE <br> 3. COLLECTOR <br> 4. EMITTER <br> 5. BASE <br> 6. ANODE | STYLE 5: <br> PIN 1. ANODE <br> 2. ANODE <br> 3. COLLECTOR <br> 4. EMITTER <br> 5. BASE <br> 6. CATHODE | STYLE 6: <br> PIN 1. ANODE 2 <br> 2. $\mathrm{N} / \mathrm{C}$ <br> 3. CATHODE 1 <br> 4. ANODE 1 <br> 5. $\mathrm{N} / \mathrm{C}$ <br> 6. CATHODE 2 |
| :---: | :---: | :---: | :---: |
| STYLE 9: | STYLE 10: | STYLE 11: | STYLE 12: |
| PIN 1. EMITTER 2 | PIN 1. SOURCE 2 | PIN 1. CATHODE 2 | PIN 1. ANODE 2 |
| 2. EMITTER 1 | 2. SOURCE 1 | 2. CATHODE 2 | 2. ANODE 2 |
| 3. COLLECTOR 1 | 3. GATE 1 | 3. ANODE 1 | 3. CATHODE 1 |
| 4. BASE 1 | 4. DRAIN 1 | 4. CATHODE 1 | 4. ANODE 1 |
| 5. BASE 2 | 5. DRAIN 2 | 5. CATHODE 1 | 5. ANODE 1 |
| 6. COLLECTOR 2 | 6. GATE 2 | 6. ANODE 2 | 6. CATHODE 2 |
| STYLE 15: | STYLE 16: | STYLE 17: | STYLE 18: |
| PIN 1. ANODE 1 | PIN 1. BASE 1 | PIN 1. BASE 1 | PIN 1. VIN1 |
| 2. ANODE 2 | 2. EMITTER 2 | 2. EMITTER 1 | 2. VCC |
| 3. ANODE 3 | 3. COLLECTOR 2 | 3. COLLECTOR 2 | 3. VOUT2 |
| 4. CATHODE 3 | 4. BASE 2 | 4. BASE 2 | 4. VIN2 |
| 5. CATHODE 2 | 5. EMITTER 1 | 5. EMITTER 2 | 5. GND |
| 6. CATHODE 1 | 6. COLLECTOR 1 | 6. COLLECTOR 1 | 6. VOUT1 |
| STYLE 21: | STYLE 22: | STYLE 23: | STYLE 24: |
| PIN 1. ANODE 1 | PIN 1. D1 (i) | PIN 1. Vn | PIN 1. CATHODE |
| 2. $\mathrm{N} / \mathrm{C}$ | 2. GND | 2. CH 1 | 2. ANODE |
| 3. ANODE 2 | 3. D2 (i) | 3. Vp | 3. CATHODE |
| 4. CATHODE 2 | 4. D2 (c) | 4. N/C | 4. CATHODE |
| 5. N/C | 5. VBUS | 5. CH 2 | 5. CATHODE |
| 6. CATHODE 1 | 6. D1 (c) | 6. N/C | 6. CATHODE |
| STYLE 27: | STYLE 28: | STYLE 29: | STYLE 30: |
| PIN 1. BASE 2 | PIN 1. DRAIN | PIN 1. ANODE | PIN 1. SOURCE 1 |
| 2. BASE 1 | 2. DRAIN | 2. ANODE | 2. DRAIN 2 |
| 3. COLLECTOR 1 | 3. GATE | 3. COLLECTOR | 3. DRAIN 2 |
| 4. EMITTER 1 | 4. SOURCE | 4. EMITTER | 4. SOURCE 2 |
| 5. EMITTER 2 | 5. DRAIN | 5. BASE/ANODE | 5. GATE 1 |
| 6. COLLECTOR 2 | 6. DRAIN | 6. CATHODE | 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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