# Integrated Relay, Inductive Load Driver

# NUD3112


**SC−74**
**CASE 318F**
**STYLE 7**

This device is used to switch inductive loads such as relays, solenoids incandescent lamps, and small DC motors without the need of a free−wheeling diode. The device integrates all necessary items such as the MOSFET switch, ESD protection, and Zener clamps. It accepts logic level inputs thus allowing it to be driven by a large variety of devices including logic gates, inverters, and microcontrollers.

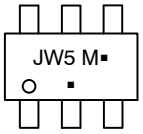
### Features

- Provides a Robust Driver Interface Between D.C. Relay Coil and Sensitive Logic Circuits
- Optimized to Switch Relays of 12 V Rail
- Capable of Driving Relay Coils Rated up to 6.0 W at 12 V
- Internal Zener Eliminates the Need of Free−Wheeling Diode
- Internal Zener Clamp Routes Induced Current to Ground for Quieter Systems Operation
- Low $V_{DS(ON)}$ Reduces System Current Drain
- These Devices is Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Telecom: Line Cards, Modems, Answering Machines, FAX
- Computers and Office: Photocopiers, Printers, Desktop Computers
- Consumer: TVs and VCRs, Stereo Receivers, CD Players, Cassette Recorders
- Industrial: Small Appliances, Security Systems, Automated Test Equipment, Garage Door Openers

### MARKING DIAGRAM



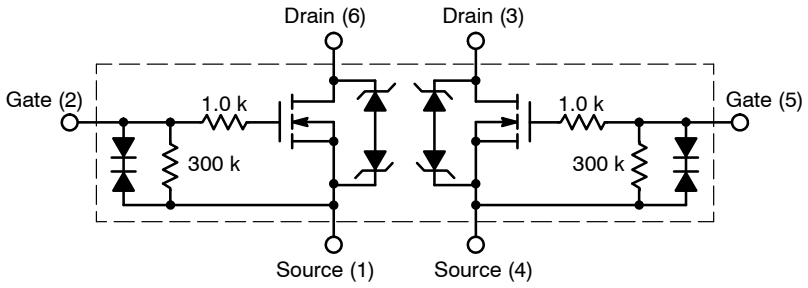

JW5 = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NUD3112DMT1G | SC−74 (Pb−Free) | 3000 / 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.

### INTERNAL CIRCUIT DIAGRAMS



**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise specified)

| Symbol | Rating | Value | Unit |
|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage – Continuous | 14 | $V_{dc}$ |
| $V_{GS}$ | Gate to Source Voltage – Continuous | 6 | $V_{dc}$ |
| $I_D$ | Drain Current – Continuous | 500 | mA |
| $E_z$ | Single Pulse Drain–to–Source Avalanche Energy ($T_{Jinitial}$ = 25°C) | 50 | mJ |
| $T_J$ | Junction Temperature | 150 | °C |
| $T_A$ | Operating Ambient Temperature | –40 to 85 | °C |
| $T_{stg}$ | Storage Temperature Range | –65 to +150 | °C |
| $P_D$ | Total Power Dissipation (Note 1) Derating Above 25°C | 1.8 | mW/°C |
| $P_D$ | Total Power Dissipation (Note 1) Derating Above 25°C | 3.0 | mW/°C |
| $R_{\theta JA}$ | Thermal Resistance Junction–to–Ambient (Note 1) | 329 | °C/W |
| ESD | Human Body Model (HBM) According to EIA/JESD22/A114 | 2000 | V |

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.

1. Mounted onto minimum pad board.

**TYPICAL ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted)

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| $V_{BRDSS}$ | Drain to Source Sustaining Voltage (Internally Clamped)<br>($I_D$ = 10 mA) | 14 | 16 | 17 | V |
| $B_{VGSO}$ | $I_g$ = 1.0 mA | – | – | 8 | V |
| $I_{DSS}$ | Drain to Source Leakage Current<br>($V_{DS}$ = 12 V , $V_{GS}$ = 0 V, $T_A$ = 25°C)<br>($V_{DS}$ = 12 V, $V_{GS}$ = 0 V, $T_A$ = 85°C) | –<br>– | –<br>– | 20<br>40 | μA |
| $I_{GSS}$ | Gate Body Leakage Current<br>($V_{GS}$ = 3.0 V, $V_{DS}$ = 0 V)<br>($V_{GS}$ = 5.0 V, $V_{DS}$ = 0 V) | –<br>– | –<br>– | 35<br>65 | μA |
| **ON CHARACTERISTICS** | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage<br>($V_{GS}$ = $V_{DS}$, $I_D$ = 1.0 mA)<br>($V_{GS}$ = $V_{DS}$, $I_D$ = 1.0 mA, $T_A$ = 85°C) | 0.8<br>0.8 | 1.2<br>– | 1.4<br>1.4 | V |
| $R_{DS(on)}$ | Drain to Source On–Resistance<br>($I_D$ = 250 mA, $V_{GS}$ = 3.0 V)<br>($I_D$ = 500 mA, $V_{GS}$ = 3.0 V)<br>($I_D$ = 500 mA, $V_{GS}$ = 5.0 V)<br>($I_D$ = 500 mA, $V_{GS}$ = 3.0 V, $T_A$ = 85°C)<br>($I_D$ = 500 mA, $V_{GS}$ = 5.0 V, $T_A$ = 85°C) | –<br>–<br>–<br>–<br>– | –<br>–<br>–<br>–<br>– | 1.2<br>1.3<br>0.9<br>1.3<br>0.9 | Ω |
| $I_{DS(on)}$ | Output Continuous Current<br>($V_{DS}$ = 0.25 V, $V_{GS}$ = 3.0 V)<br>($V_{DS}$ = 0.25 V, $V_{GS}$ = 3.0 V, $T_A$ = 85°C) | 300<br>200 | 400<br>– | –<br>– | mA |
| $g_{FS}$ | Forward Transconductance<br>($V_{OUT}$ = 12.0 V, $I_{OUT}$ = 0.25 A) | 350 | 490 | – | mmhos |

**TYPICAL ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted) (continued)

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | |
| $C_{iss}$ | Input Capacitance ($V_{DS}$ = 12 V, $V_{GS}$ = 0 V, f = 10 kHz) | – | 23 | – | pF |
| $C_{oss}$ | Output Capacitance ($V_{DS}$ = 12 V, $V_{GS}$ = 0 V, f = 10 kHz) | – | 30 | – | pF |
| $C_{rss}$ | Transfer Capacitance ($V_{DS}$ = 12.0 V, $V_{GS}$ = 0 V, f = 10 kHz) | – | 7 | – | pF |
| **SWITCHING CHARACTERISTICS** | | | | | |
| **Symbol** | **Characteristic** | **Min** | **Typ** | **Max** | **Unit** |
| | Propagation Delay Times: | | | | nS |
| $t_{PHL}$ | High to Low Propagation Delay; Figure 1 ($V_{DS}$ = 12 V, $V_{GS}$ = 5.0 V) | – | 21 | – | |
| $t_{PLH}$ | Low to High Propagation Delay; Figure 1 ($V_{DS}$ = 12 V, $V_{GS}$ = 5.0 V) | – | 91 | – | |
| | Transition Times: | | | | nS |
| $t_f$ | Fall Time; Figure 1 ($V_{DS}$ = 12 V, $V_{GS}$ = 5.0 V) | – | 36 | – | |
| $t_r$ | Rise Time; Figure 1 ($V_{DS}$ = 12 V, $V_{GS}$ = 5.0 V) | – | 61 | – | |

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.

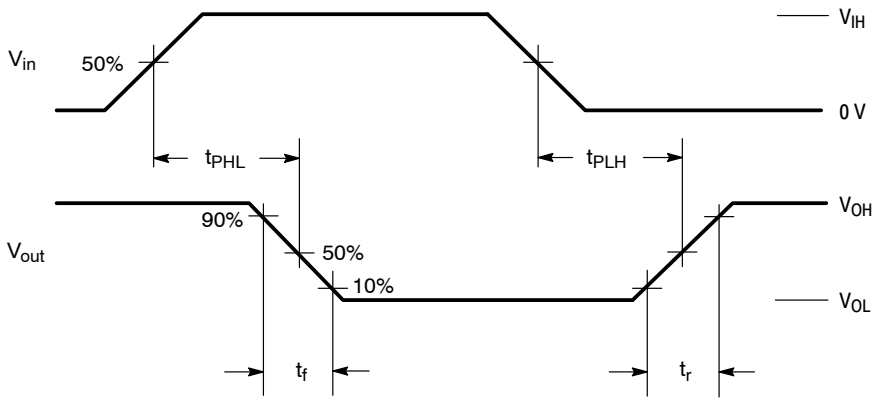



**Figure 1. Switching Waveforms**

## TYPICAL PERFORMANCE CURVES ($T_J$ = 25°C UNLESS OTHERWISE SPECIFIED)

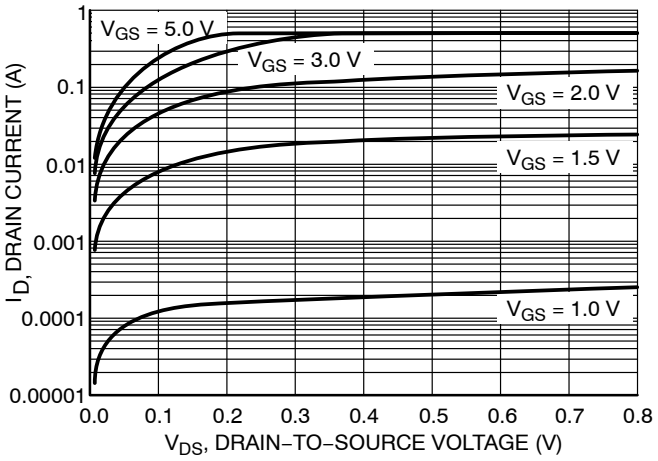



**Figure 2. Output Characteristics**

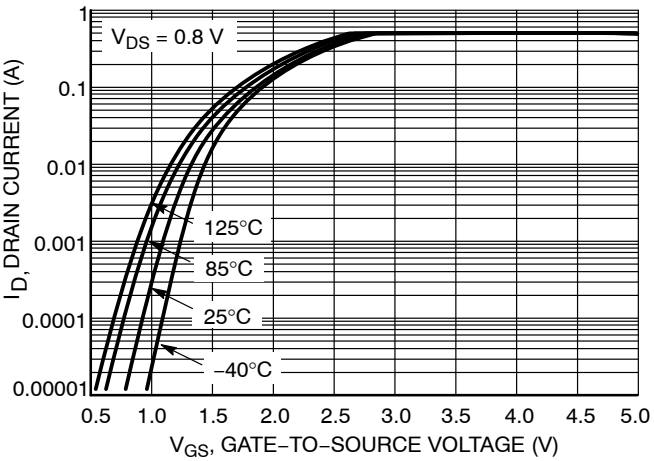



**Figure 3. Transfer Function**

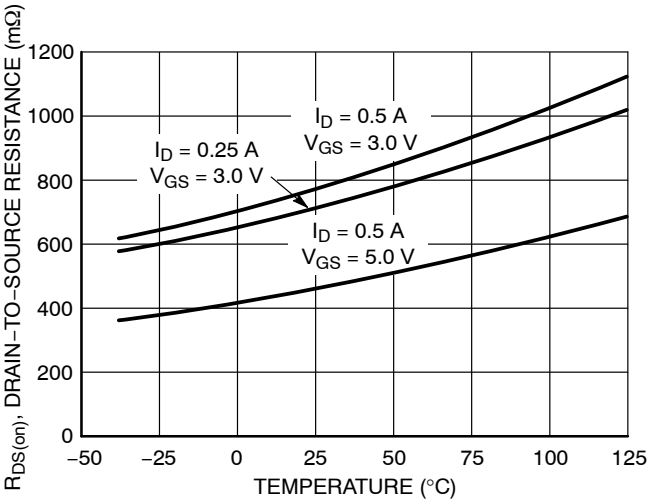



**Figure 4. On−Resistance Variation vs. Temperature**

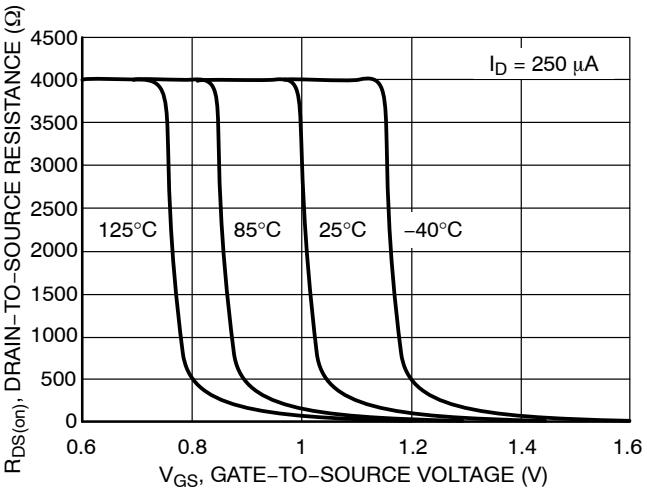



**Figure 5. $R_{DS(ON)}$ Variation vs. Gate−to−Source Voltage**

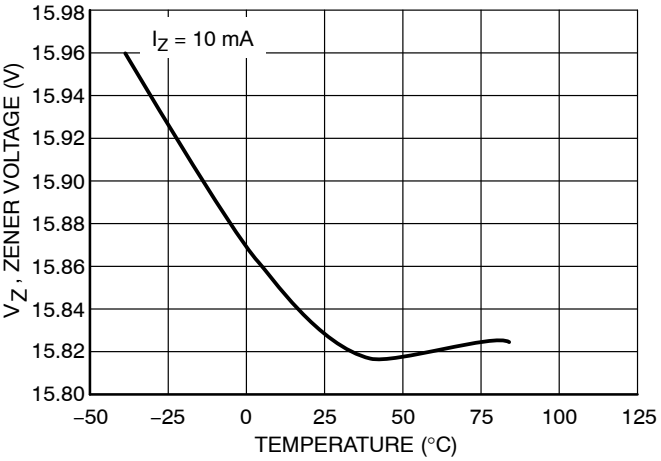



**Figure 6. Zener Voltage vs. Temperature**

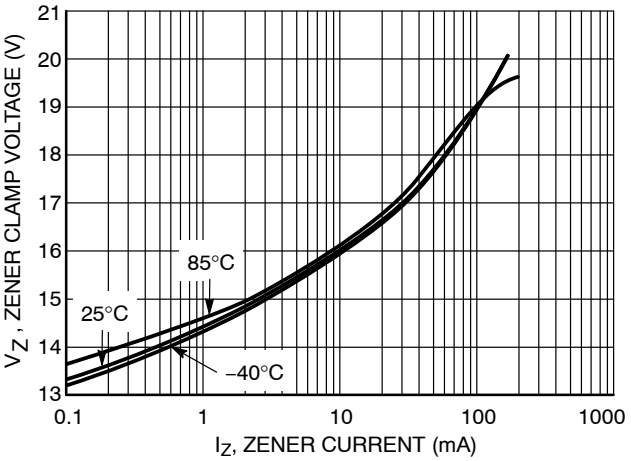



**Figure 7. Zener Clamp Voltage vs. Zener Current**

## TYPICAL PERFORMANCE CURVES ($T_J$ = 25°C UNLESS OTHERWISE SPECIFIED) (continued)

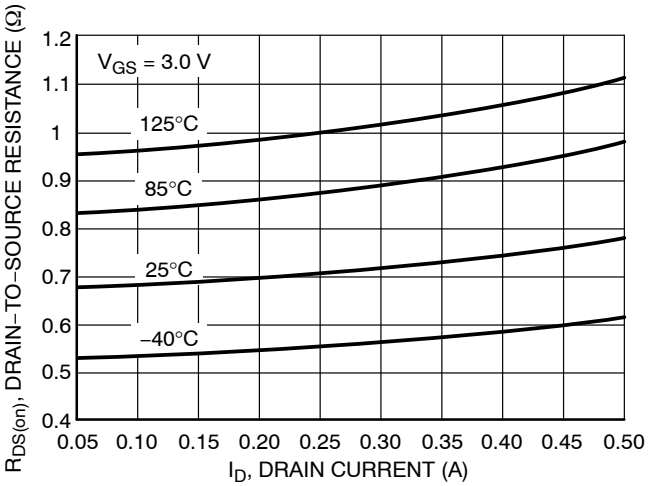



**Figure 8. On−Resistance vs. Drain Current and Temperature**

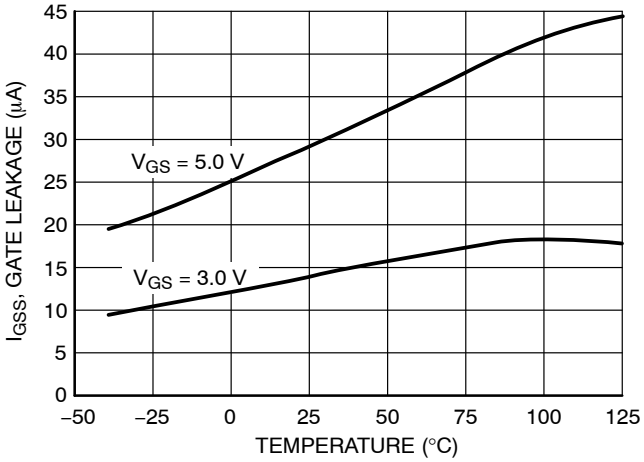



**Figure 9. Gate Leakage vs. Temperature**

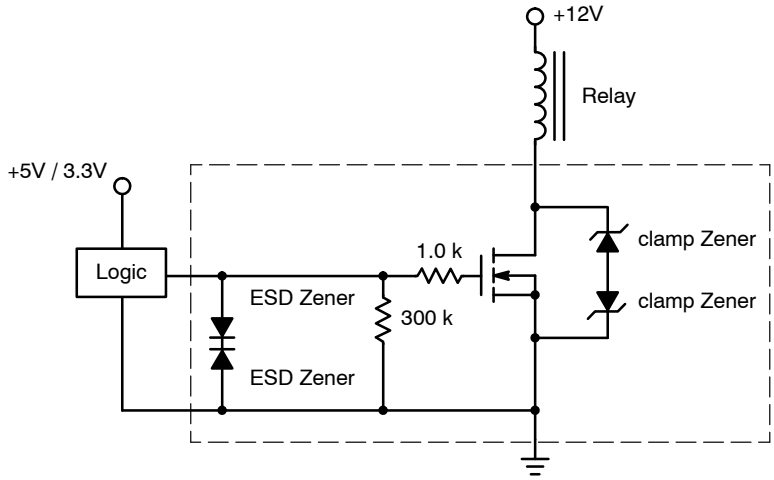


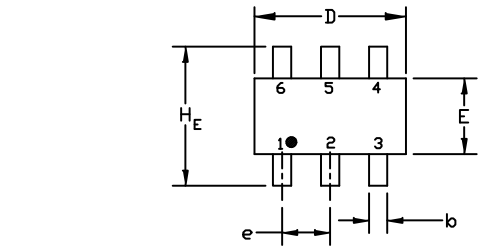

**Figure 10. Typical Application Circuit**

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

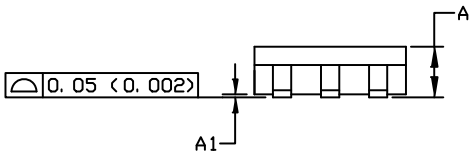
**SCALE 2:1**

**SC−74**
CASE 318F
ISSUE P

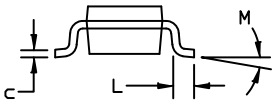
DATE 07 OCT 2021




TOP VIEW




SIDE VIEW

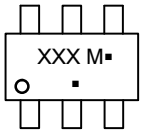



END VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994
2. CONTROLLING DIMENSION: INCHES
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.90 | 1.00 | 1.10 | 0.035 | 0.039 | 0.043 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.25 | 0.37 | 0.50 | 0.010 | 0.015 | 0.020 |
| c | 0.10 | 0.18 | 0.26 | 0.004 | 0.007 | 0.010 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 1.30 | 1.50 | 1.70 | 0.051 | 0.059 | 0.067 |
| e | 0.85 | 0.95 | 1.05 | 0.034 | 0.037 | 0.041 |
| $H_E$ | 2.50 | 2.75 | 3.00 | 0.099 | 0.108 | 0.118 |
| L | 0.20 | 0.40 | 0.60 | 0.008 | 0.016 | 0.024 |
| M | 0° | --- | 10° | 0° | --- | 10° |

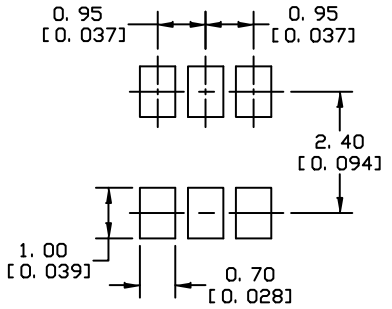
### GENERIC MARKING DIAGRAM*




XXX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

(Note: Microdot may be in either 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.




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

SOLDERING FOOTPRINT

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

STYLE 2:
PIN 1. NO CONNECTION
2. COLLECTOR
3. EMITTER
4. NO CONNECTION
5. COLLECTOR
6. BASE

STYLE 3:
PIN 1. EMITTER 1
2. BASE 1
3. COLLECTOR 2
4. EMITTER 2
5. BASE 2
6. COLLECTOR 1

STYLE 4:
PIN 1. COLLECTOR 2
2. EMITTER 1/EMITTER 2
3. COLLECTOR 1
4. EMITTER 3
5. BASE 1/BASE 2/COLLECTOR 3
6. BASE 3

STYLE 5:
PIN 1. CHANNEL 1
2. ANODE
3. CHANNEL 2
4. CHANNEL 3
5. CATHODE
6. CHANNEL 4

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

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

STYLE 8:
PIN 1. EMITTER 1
2. BASE 2
3. COLLECTOR 2
4. EMITTER 2
5. BASE 1
6. COLLECTOR 1

STYLE 9:
PIN 1. EMITTER 2
2. BASE 2
3. COLLECTOR 1
4. EMITTER 1
5. BASE 1
6. COLLECTOR 2

STYLE 10:
PIN 1. ANODE/CATHODE
2. BASE
3. EMITTER
4. COLLECTOR
5. ANODE
6. CATHODE

STYLE 11:
PIN 1. EMITTER
2. BASE
3. ANODE/CATHODE
4. ANODE
5. CATHODE
6. COLLECTOR

| | | |
|---|---|---|
| **DOCUMENT NUMBER:** | **98ASB42973B** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red. |
| **DESCRIPTION:** | **SC−74** | **PAGE 1 OF 1** |

## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
**Email Requests to:** orderlit@onsemi.com

**onsemi Website:** www.onsemi.com

**TECHNICAL SUPPORT**
**North American Technical Support:**
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

**Europe, Middle East and Africa Technical Support:**
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

◊