# NCR169D

# General Purpose Sensitive Gate Silicon Controlled Rectifier

## Reverse Blocking Thyristor

PNPN device designed for line-powered general purpose applications such as relay and lamp drivers, small motor controls, gate drivers for larger thyristors, and sensing and detection circuits. Supplied in a cost effective plastic TO-226AA package.

### Features

- Sensitive Gate Allows Direct Triggering by Microcontrollers and Other Logic Circuits
- On−State Current Rating of 0.8 Amperes RMS at 80°C
- Surge Current Capability − 10 Amperes
- Immunity to dV/dt − 20 V/μsec Minimum at 110°C
- Glass-Passivated Surface for Reliability and Uniformity
- Device Marking: NCR169D, Date Code
- Pb−Free Packages are Available

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

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Peak Repetitive Off−State Voltage (Note 1.) ($T_J$ = −40 to 110°C, Sine Wave, 50 to 60 Hz; Gate Open) | $V_{DRM}$, $V_{RRM}$ | 400 | Volts |
| On-State RMS Current ($T_C$ = 80°C) 180° Conduction Angles | $I_{T(RMS)}$ | 0.8 | Amp |
| Peak Non-Repetitive Surge Current (1/2 Cycle, Sine Wave, 60 Hz, $T_J$ = 25°C) | $I_{TSM}$ | 10 | Amps |
| Circuit Fusing Consideration (t = 10 ms) | $I^2t$ | 0.415 | $A^2s$ |
| Forward Peak Gate Power ($T_A$ = 25°C, Pulse Width ≤ 1.0 μs) | $P_{GM}$ | 0.1 | Watt |
| Forward Average Gate Power ($T_A$ = 25°C, t = 20 ms) | $P_{G(AV)}$ | 0.10 | Watt |
| Forward Peak Gate Current ($T_A$ = 25°C, Pulse Width ≤ 1.0 μs) | $I_{GM}$ | 1.0 | Amp |
| Reverse Peak Gate Voltage ($T_A$ = 25°C, Pulse Width ≤ 1.0 μs) | $V_{GRM}$ | 5.0 | Volts |
| Operating Junction Temperature Range @ Rate $V_{RRM}$ and $V_{DRM}$ | $T_J$ | −40 to 110 | °C |
| Storage Temperature Range | $T_{stg}$ | −40 to 150 | °C |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. $V_{DRM}$ and $V_{RRM}$ for all types can be applied on a continuous basis. Ratings apply for zero or negative gate voltage; however, positive gate voltage shall not be applied concurrent with negative potential on the anode. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

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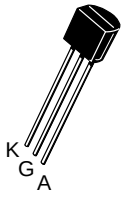
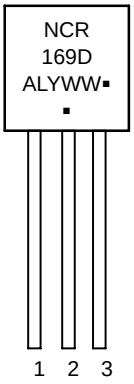
**SCR**
**0.8 AMPERES RMS**
**400 VOLTS**


**TO−92**
**(TO−226AA)**
**CASE 029**
**STYLE 10**

**MARKING DIAGRAM**




A = Assembly Location
L = Wafer Lot
Y = Year
WW = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

| PIN ASSIGNMENT | |
|---|---|
| 1 | Cathode |
| 2 | Gate |
| 3 | Anode |

**ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

## THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance − Junction to Case<br>− Junction to Ambient | $R_{\theta JC}$<br>$R_{\theta JA}$ | 75<br>200 | °C/W |
| Lead Solder Temperature<br>(< 1/16″ from case, 10 secs max) | $T_L$ | 260 | °C |

## ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C unless otherwise noted)

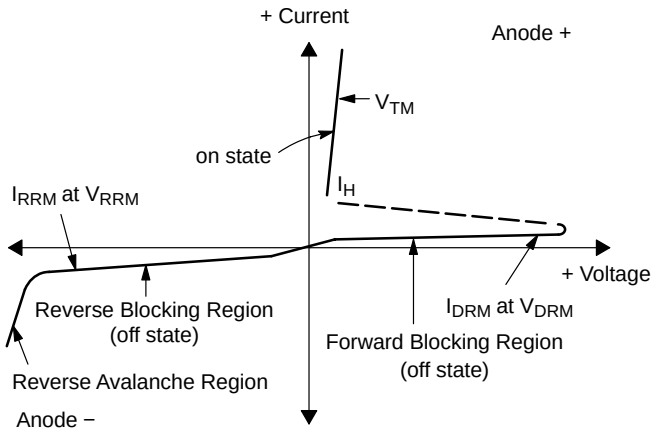
| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Peak Repetitive Forward or<br>Reverse Blocking Current (Note 1.)<br>($V_D$ = Rated $V_{DRM}$ and $V_{RRM}$; $R_{GK}$ = 1.0 kΩ) | <br>$T_C$ = 25°C<br>$T_C$ = 110°C | $I_{DRM}$, $I_{RRM}$ | <br>−<br>− | <br>−<br>− | <br>10<br>0.1 | <br>μA<br>mA |
| **ON CHARACTERISTICS** | | | | | | |
| Peak Forward On−State Voltage(*)<br>($I_{TM}$ = 1.0 Amp Peak @ $T_A$ = 25°C) | | $V_{TM}$ | − | − | 1.7 | Volts |
| Gate Trigger Current (Continuous dc) (Note 2.)<br>($V_{AK}$ = 12 V, $R_L$ = 100 Ohms) | $T_C$ = 25°C | $I_{GT}$ | − | 40 | 200 | μA |
| Holding Current (Note 2.)<br>($V_{AK}$ = 12 V, $I_{GT}$ = 0.5 mA) | $T_C$ = 25°C<br>$T_C$ = −40°C | $I_H$ | −<br>− | 0.5<br>− | 5.0<br>10 | mA |
| Latch Current<br>($V_{AK}$ = 12 V, $I_{GT}$ = 0.5 mA, $R_{GK}$ = 1.0 k) | $T_C$ = 25°C<br>$T_C$ = −40°C | $I_L$ | −<br>− | 0.6<br>− | 10<br>15 | mA |
| Gate Trigger Voltage (Continuous dc) (Note 2.)<br>($V_{AK}$ = 12 V, $R_L$ = 100 Ohms, $I_{GT}$ = 10 mA) | $T_C$ = 25°C<br>$T_C$ = −40°C | $V_{GT}$ | −<br>− | 0.62<br>− | 0.8<br>1.2 | Volts |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Critical Rate of Rise of Off−State Voltage<br>($V_D$ = Rated $V_{DRM}$, Exponential Waveform, $R_{GK}$ = 1000 Ohms, $T_J$ = 110°C) | | dV/dt | 20 | 35 | − | V/μs |
| Critical Rate of Rise of On−State Current<br>($I_{PK}$ = 20 A; Pw = 10 μsec; diG/dt = 1.0 A/μsec, Igt = 20 mA) | | di/dt | − | − | 50 | A/μs |

*Indicates Pulse Test: Pulse Width ≤ 1.0 ms, Duty Cycle ≤ 1%.

1. $R_{GK}$ = 1000 Ohms included in measurement.
2. Does not include $R_{GK}$ in measurement.

## Voltage Current Characteristic of SCR

| Symbol | Parameter |
|---|---|
| $V_{DRM}$ | Peak Repetitive Off State Forward Voltage |
| $I_{DRM}$ | Peak Forward Blocking Current |
| $V_{RRM}$ | Peak Repetitive Off State Reverse Voltage |
| $I_{RRM}$ | Peak Reverse Blocking Current |
| $V_{TM}$ | Peak on State Voltage |
| $I_H$ | Holding Current |



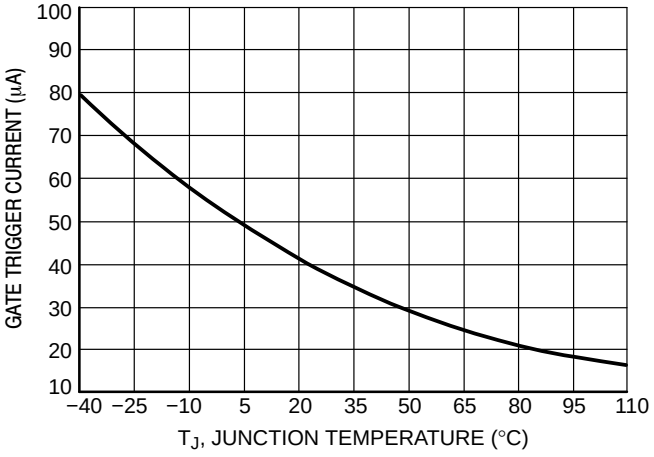




**Figure 1. Typical Gate Trigger Current versus Junction Temperature**

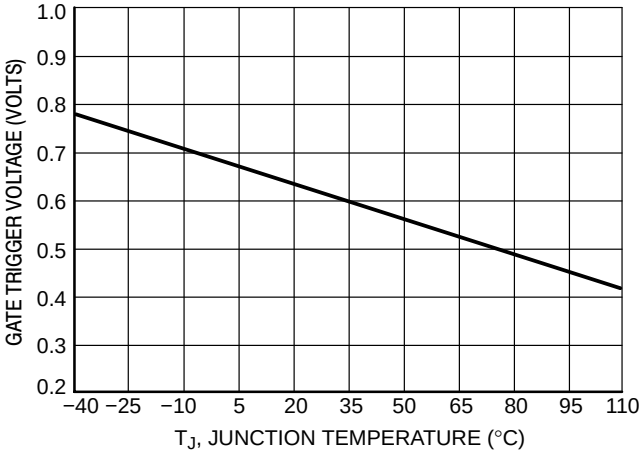



**Figure 2. Typical Gate Trigger Voltage versus Junction Temperature**

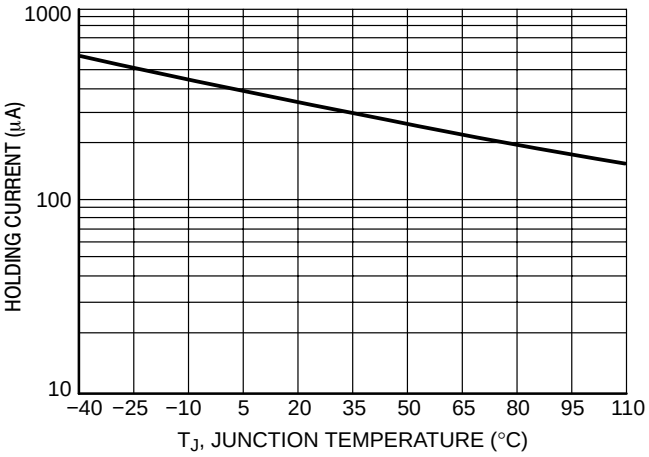



**Figure 3. Typical Holding Current versus Junction Temperature**

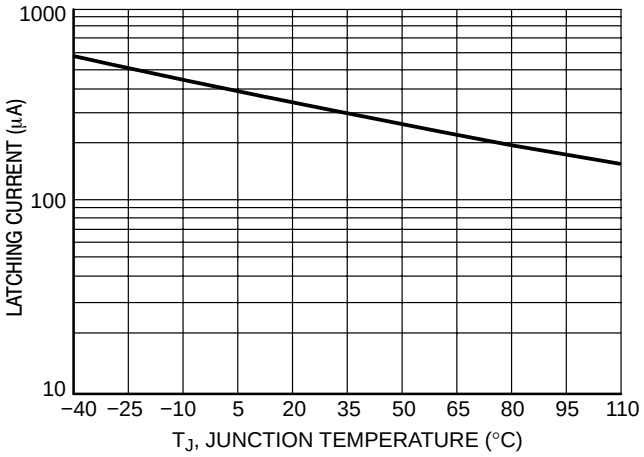



**Figure 4. Typical Latching Current versus Junction Temperature**

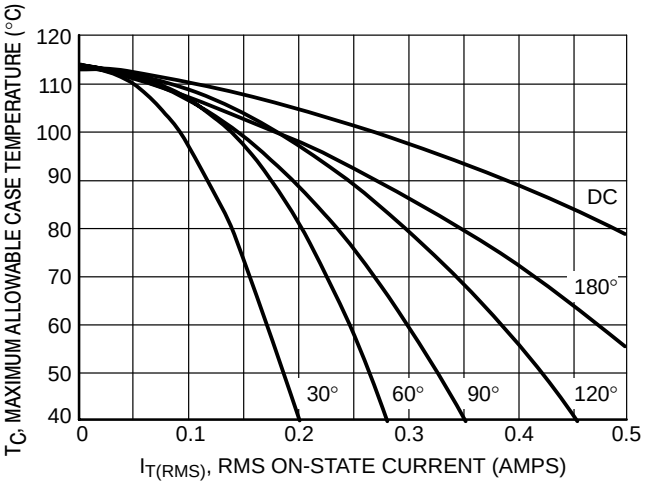



**Figure 5. Typical RMS Current Derating**

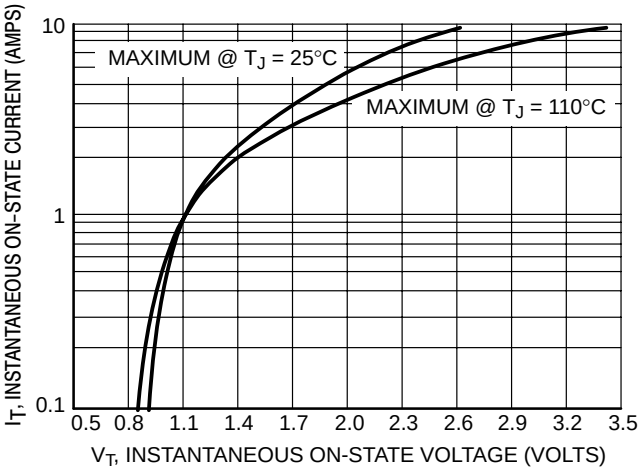



**Figure 6. Typical On−State Characteristics**

# TO−92 EIA RADIAL TAPE IN FAN FOLD BOX OR ON REEL

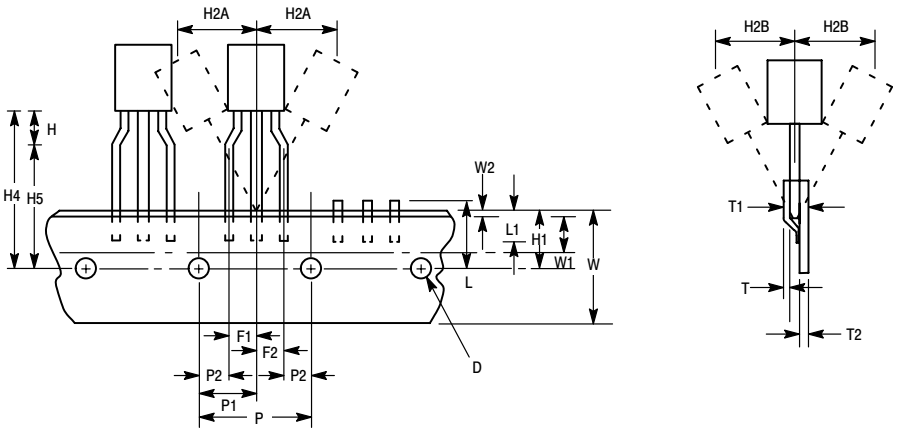



**Figure 7. Device Positioning on Tape**

| Symbol | Item | Specification | | | |
|---|---|---|---|---|---|
| | | Inches | | Millimeter | |
| | | Min | Max | Min | Max |
| D | Tape Feedhole Diameter | 0.1496 | 0.1653 | 3.8 | 4.2 |
| D2 | Component Lead Thickness Dimension | 0.015 | 0.020 | 0.38 | 0.51 |
| F1, F2 | Component Lead Pitch | 0.0945 | 0.110 | 2.4 | 2.8 |
| H | Bottom of Component to Seating Plane | .059 | .156 | 1.5 | 4.0 |
| H1 | Feedhole Location | 0.3346 | 0.3741 | 8.5 | 9.5 |
| H2A | Deflection Left or Right | 0 | 0.039 | 0 | 1.0 |
| H2B | Deflection Front or Rear | 0 | 0.051 | 0 | 1.0 |
| H4 | Feedhole to Bottom of Component | 0.7086 | 0.768 | 18 | 19.5 |
| H5 | Feedhole to Seating Plane | 0.610 | 0.649 | 15.5 | 16.5 |
| L | Defective Unit Clipped Dimension | 0.3346 | 0.433 | 8.5 | 11 |
| L1 | Lead Wire Enclosure | 0.09842 | − | 2.5 | − |
| P | Feedhole Pitch | 0.4921 | 0.5079 | 12.5 | 12.9 |
| P1 | Feedhole Center to Center Lead | 0.2342 | 0.2658 | 5.95 | 6.75 |
| P2 | First Lead Spacing Dimension | 0.1397 | 0.1556 | 3.55 | 3.95 |
| T | Adhesive Tape Thickness | 0.06 | 0.08 | 0.15 | 0.20 |
| T1 | Overall Taped Package Thickness | − | 0.0567 | − | 1.44 |
| T2 | Carrier Strip Thickness | 0.014 | 0.027 | 0.35 | 0.65 |
| W | Carrier Strip Width | 0.6889 | 0.7481 | 17.5 | 19 |
| W1 | Adhesive Tape Width | 0.2165 | 0.2841 | 5.5 | 6.3 |
| W2 | Adhesive Tape Position | .0059 | 0.01968 | .15 | 0.5 |

NOTES:

1. Maximum alignment deviation between leads not to be greater than 0.2 mm.
2. Defective components shall be clipped from the carrier tape such that the remaining protrusion (L) does not exceed a maximum of 11 mm.
3. Component lead to tape adhesion must meet the pull test requirements.
4. Maximum non−cumulative variation between tape feed holes shall not exceed 1 mm in 20 pitches.
5. Holddown tape not to extend beyond the edge(s) of carrier tape and there shall be no exposure of adhesive.
6. No more than 1 consecutive missing component is permitted.
7. A tape trailer and leader, having at least three feed holes is required before the first and after the last component.
8. Splices will not interfere with the sprocket feed holes.

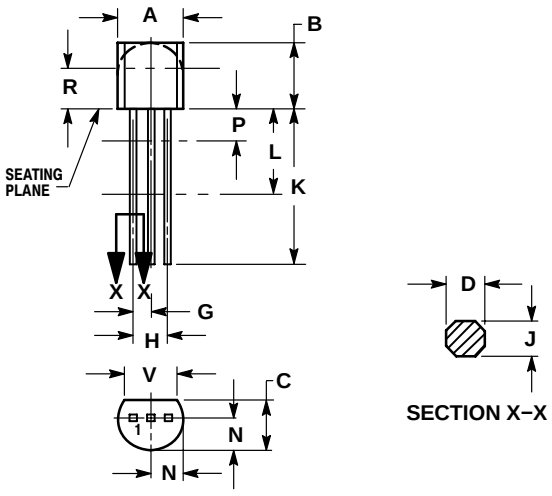
**ORDERING & SHIPPING INFORMATION: MCR100 Series packaging options, Device Suffix**

| Device | Description of TO92 Tape Orientation | Shipping |
|---|---|---|
| NCR169D | N/A, Bulk | Bulk in Box (5K/Box) |
| NCR169DG | N/A, Bulk | Bulk in Box (5K/Box) (Pb−Free) |
| NCR169DRLRA | Round side of TO92 and adhesive tape visible | Radial Tape and Reel (2K/Reel) |
| NCR169DRLRAG | Round side of TO92 and adhesive tape visible | Radial Tape and Reel (2K/Reel) (Pb−Free) |
| NCR169DRLRM | Flat side of TO92 and adhesive tape visible | Radial Tape and Fan Fold Box (2K/Box) |
| NCR169DRLRMG | Flat side of TO92 and adhesive tape visible | Radial Tape and Fan Fold Box (2K/Box) (Pb−Free) |
| NCR169DRLRP | Flat side of TO92 and adhesive tape visible | Radial Tape and Fan Fold Box (2K/Box) |
| NCR169DRLRPG | Flat side of TO92 and adhesive tape visible | Radial Tape and Fan Fold Box (2K/Box) (Pb−Free) |

†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.

## PACKAGE DIMENSIONS

**TO−92 (TO−226AA)**
CASE 029−11
ISSUE AL




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.175 | 0.205 | 4.45 | 5.20 |
| B | 0.170 | 0.210 | 4.32 | 5.33 |
| C | 0.125 | 0.165 | 3.18 | 4.19 |
| D | 0.016 | 0.021 | 0.407 | 0.533 |
| G | 0.045 | 0.055 | 1.15 | 1.39 |
| H | 0.095 | 0.105 | 2.42 | 2.66 |
| J | 0.015 | 0.020 | 0.39 | 0.50 |
| K | 0.500 | --- | 12.70 | --- |
| L | 0.250 | --- | 6.35 | --- |
| N | 0.080 | 0.105 | 2.04 | 2.66 |
| P | --- | 0.100 | --- | 2.54 |
| R | 0.115 | --- | 2.93 | --- |
| V | 0.135 | --- | 3.43 | --- |

STYLE 10:
PIN 1. CATHODE
2. GATE
3. ANODE

## PUBLICATION ORDERING INFORMATION

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