

# NUP4304MR6, SZNUP4304MR6

## Low Capacitance Diode Array for ESD Protection in Four Data Lines

NUP4304MR6 is a micro-integrated device designed to provide protection for sensitive components from possible harmful electrical transients; for example, ESD (electrostatic discharge).

### Features

- Low Capacitance (1.5 pF Maximum Between I/O Lines)
- Single Package Integration Design
- Provides ESD Protection for JEDEC Standards JESD22  
Machine Model = Class C  
Human Body Model = Class 3B
- Protection for IEC61000-4-2 (Level 4)  
8.0 kV (Contact)  
15 kV (Air)
- Ensures Data Line Speed and Integrity
- Fewer Components and Less Board Space
- Direct the Transient to Either Positive Side or to the Ground

### Applications

- USB 1.1 and 2.0 Data Line Protection
- T1/E1 Secondary IC Protection
- T3/E3 Secondary IC Protection
- HDSL, IDSL Secondary IC Protection
- Video Line Protection
- Microcontroller Input Protection
- Base Stations
- I<sup>2</sup>C Bus Protection
- AEC-Q101 Qualified and PPAP Capable
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements
- This is a Pb-Free Device\*



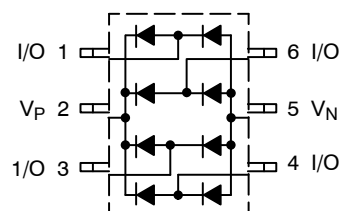
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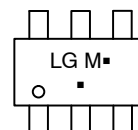


TSOP-6  
CASE 318F

### PIN CONFIGURATION AND SCHEMATIC



### MARKING DIAGRAM



LG = Specific Device Code  
M = Date Code  
■ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device          | Package             | Shipping†              |
|-----------------|---------------------|------------------------|
| NUP4304MR6T1G   | TSOP-6<br>(Pb-Free) | 3,000 /<br>Tape & Reel |
| SZNUP4304MR6T1G | TSOP-6<br>(Pb-Free) | 3,000 /<br>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.

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

# NUP4304MR6, SZNUP4304MR6

## MAXIMUM RATINGS (Each Diode) ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating                                                                                  | Symbol          | Value             | Unit |
|-----------------------------------------------------------------------------------------|-----------------|-------------------|------|
| Reverse Voltage                                                                         | $V_R$           | 70                | Vdc  |
| Forward Current                                                                         | $I_F$           | 200               | mAdc |
| Peak Forward Surge Current                                                              | $I_{FM(surge)}$ | 500               | mAdc |
| Repetitive Peak Reverse Voltage                                                         | $V_{RRM}$       | 70                | V    |
| Average Rectified Forward Current (Note 1) (averaged over any 20 ms period)             | $I_{F(AV)}$     | 715               | mA   |
| Repetitive Peak Forward Current                                                         | $I_{FRM}$       | 450               | mA   |
| Non-Repetitive Peak Forward Current<br>t = 1.0 $\mu\text{s}$<br>t = 1.0 ms<br>t = 1.0 S | $I_{FSM}$       | 2.0<br>1.0<br>0.5 | A    |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. FR-5 =  $1.0 \times 0.75 \times 0.062$  in.

## THERMAL CHARACTERISTICS

| Characteristic                                         | Symbol          | Max         | Unit               |
|--------------------------------------------------------|-----------------|-------------|--------------------|
| Thermal Resistance Junction-to-Ambient                 | $R_{\theta JA}$ | 556         | $^\circ\text{C/W}$ |
| Lead Solder Temperature<br>Maximum 10 Seconds Duration | $T_L$           | 260         | $^\circ\text{C}$   |
| Junction Temperature                                   | $T_J$           | -40 to +150 | $^\circ\text{C}$   |
| Storage Temperature                                    | $T_{stg}$       | -55 to +150 | $^\circ\text{C}$   |

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (Each Diode)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                                                                                                   |            |                  |                  |                            |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------|------------------|----------------------------|------------------|
| Reverse Breakdown Voltage<br>( $I_{(BR)} = 100 \mu\text{A}$ )                                                                                                                     | $V_{(BR)}$ | 70               | –                | –                          | Vdc              |
| Reverse Voltage Leakage Current<br>( $V_R = 70 \text{ Vdc}$ )<br>( $V_R = 25 \text{ Vdc}$ , $T_J = 150^\circ\text{C}$ )<br>( $V_R = 70 \text{ Vdc}$ , $T_J = 150^\circ\text{C}$ ) | $I_R$      | –<br>–<br>–      | –<br>–<br>–      | 2.5<br>30<br>50            | $\mu\text{Adc}$  |
| Capacitance (between I/O pins)<br>( $V_R = 0 \text{ V}$ , $f = 1.0 \text{ MHz}$ )                                                                                                 | $C_D$      | –                | 0.8              | 1.5                        | pF               |
| Capacitance (between I/O pin and ground)<br>( $V_R = 0 \text{ V}$ , $f = 1.0 \text{ MHz}$ )                                                                                       | $C_D$      | –                | 1.6              | 3                          | pF               |
| Forward Voltage<br>( $I_F = 1.0 \text{ mAdc}$ )<br>( $I_F = 10 \text{ mAdc}$ )<br>( $I_F = 50 \text{ mAdc}$ )<br>( $I_F = 150 \text{ mAdc}$ )                                     | $V_F$      | –<br>–<br>–<br>– | –<br>–<br>–<br>– | 715<br>855<br>1000<br>1250 | mV <sub>dc</sub> |

1. FR-5 =  $1.0 \times 0.75 \times 0.062$  in.

2. Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.

# NUP4304MR6, SZNUP4304MR6

## Curves Applicable to Each Cathode

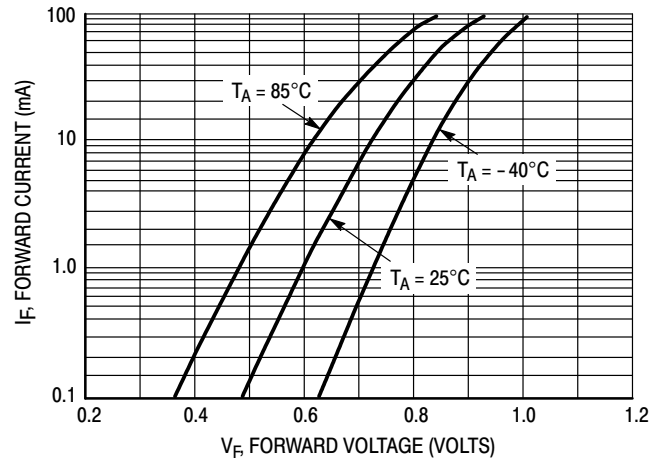


Figure 1. Forward Voltage

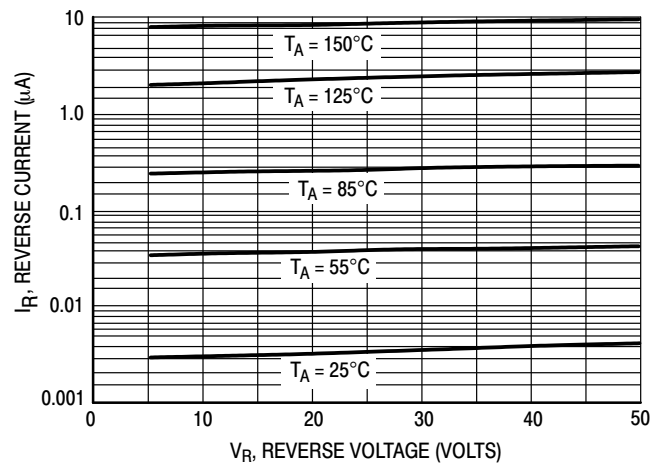


Figure 2. Leakage Current

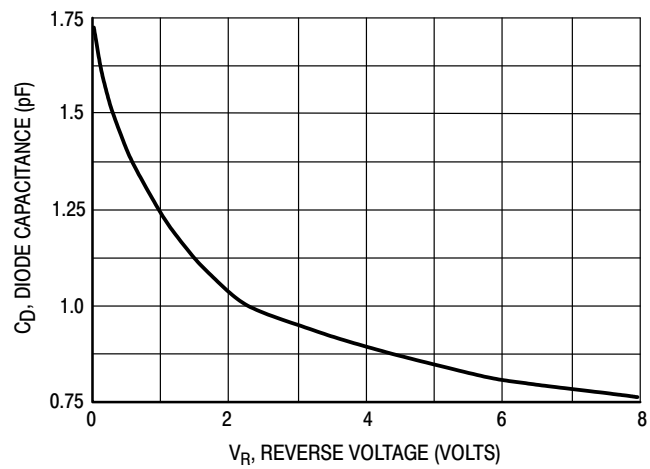


Figure 3. Capacitance

## APPLICATIONS INFORMATION

The NUP4304MR6 is a low capacitance diode array designed to protect sensitive electronics such as communications systems, computers, and computer peripherals against damage due to ESD events or transient overvoltage conditions. Because of its low capacitance, it can be used on high speed I/O data lines. The integrated design of the NUP4304MR6 offers surge rated, low capacitance steering diodes integrated in a single package (TSOP-6). If a transient condition occurs, the steering diodes will drive the transient to the positive rail of the power supply or to ground.

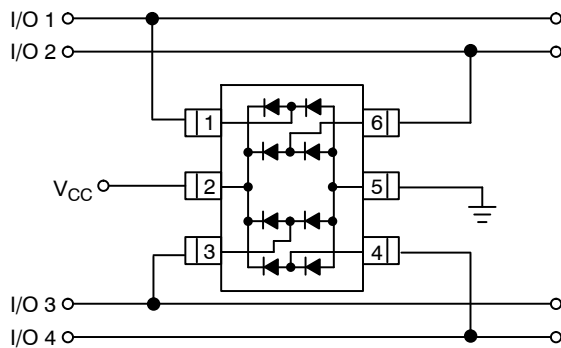
### NUP4304MR6 Configuration Options

The NUP4304MR6 is able to protect up to four data lines against transient overvoltage conditions by driving them to a fixed reference point for clamping purposes. The steering diodes will be forward biased whenever the voltage on the protected line exceeds the reference voltage ( $V_f$  or  $V_{CC} + V_f$ ). The diodes will force the transient current to bypass the sensitive circuit.

Data lines are connected at pins 1, 3, 4 and 6. The negative reference is connected at pin 5. This pin must be connected directly to ground by using a ground plane to minimize the PCB's ground inductance. It is very important to reduce the PCB trace lengths as much as possible to minimize parasitic inductance.

#### Option 1

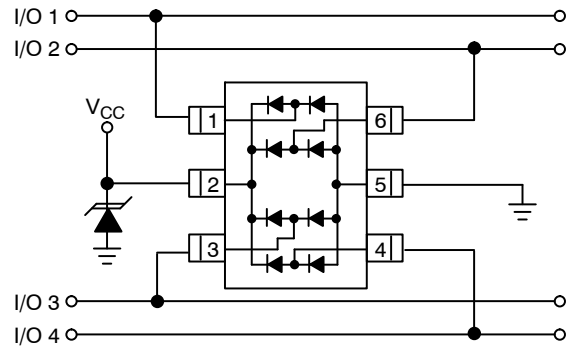
Protection of four data lines using  $V_{CC}$  as reference.



For this configuration, connect pin 2 directly to the positive supply rail ( $V_{CC}$ ), the data lines are referenced to the supply voltage. Biasing of the steering diodes reduces their capacitance.

#### Option 2

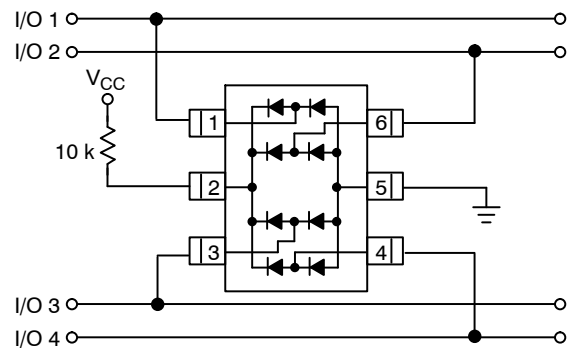
Protection of four data lines and the supply rail using  $V_{CC}$  as a reference and an external TVS diode.



If additional protection of the supply rail is desired, an external TVS diode may be added across  $V_{CC}$  and ground. This will prevent overvoltage conditions on the supply rail protecting the supply and other circuits connected to it.

#### Option 3

Protection of four data lines with bias and power supply isolation resistor.

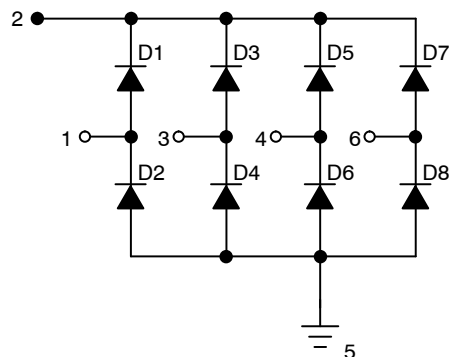
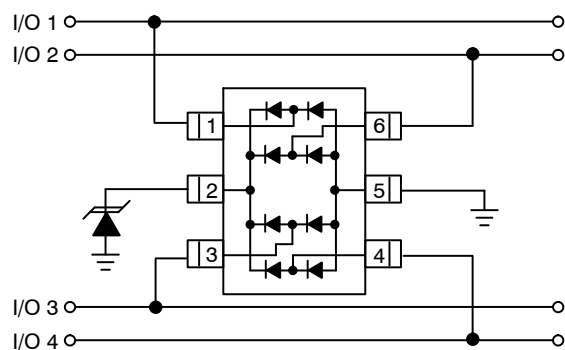


The NUP4304MR6 can be isolated from the power supply by connecting a series resistor between pin 2 and  $V_{CC}$ . A 10 kΩ resistor is recommended for this application. This will maintain bias on the internal steering diodes, reducing their capacitance.

## NUP4304MR6, SZNUP4304MR6

### Option 4

Protection of four data lines without biasing of the internal steering diodes.



NUP4304MR6 Equivalent Circuit

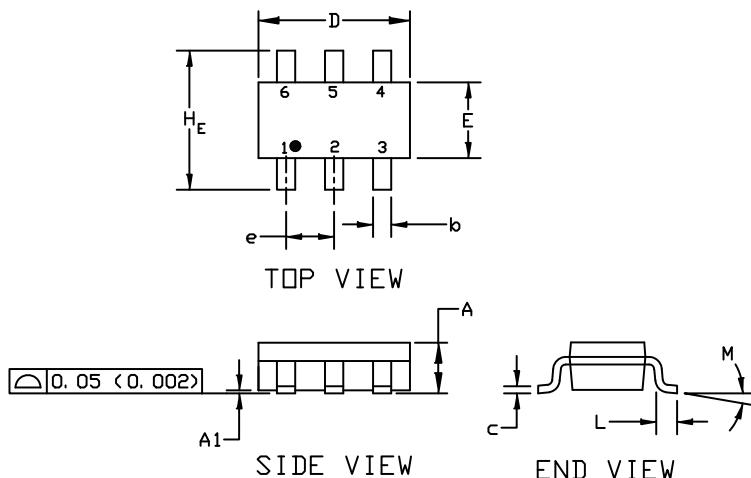
In applications lacking a positive supply reference an external TVS diode may be used as a reference. For these applications, the TVS is connected between pin 2 and the ground plane. The steering diodes will conduct whenever the voltage on the protected line exceeds their forward voltage plus the working voltage of the TVS diode ( $V_c = V_f + V_{TVS}$ ). In this case, the effective capacitance of the steering diodes will be higher than if a bias was applied.



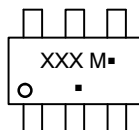
SCALE 2:1

SC-74  
CASE 318F  
ISSUE P

DATE 07 OCT 2021



GENERIC  
MARKING DIAGRAM\*



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

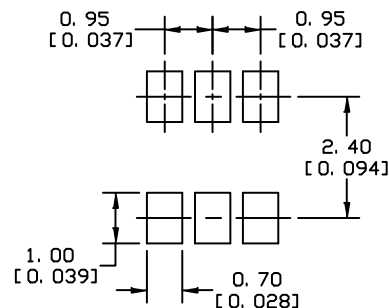
(Note: Microdot may be in either location)

\*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.

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.

| DIM            | MILLIMETERS |      |      | INCHES |       |       |
|----------------|-------------|------|------|--------|-------|-------|
|                | 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 <sub>E</sub> | 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*   |



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

SOLDERING FOOTPRINT

|                                                                                                         |                                                                                                                      |                                                                                                                   |                                                                                                                                                |                                                                                                               |                                                                                                       |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>STYLE 1:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE<br>4. CATHODE<br>5. ANODE<br>6. CATHODE     | <b>STYLE 2:</b><br>PIN 1. NO CONNECTION<br>2. COLLECTOR<br>3. EMITTER<br>4. NO CONNECTION<br>5. COLLECTOR<br>6. BASE | <b>STYLE 3:</b><br>PIN 1. EMITTER 1<br>2. BASE 1<br>3. COLLECTOR 2<br>4. EMITTER 2<br>5. BASE 2<br>6. COLLECTOR 1 | <b>STYLE 4:</b><br>PIN 1. COLLECTOR 2<br>2. EMITTER 1/EMITTER 2<br>3. COLLECTOR 1<br>4. EMITTER 3<br>5. BASE 1/BASE 2/COLLECTOR 3<br>6. BASE 3 | <b>STYLE 5:</b><br>PIN 1. CHANNEL 1<br>2. ANODE<br>3. CHANNEL 2<br>4. CHANNEL 3<br>5. CATHODE<br>6. CHANNEL 4 | <b>STYLE 6:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE<br>4. CATHODE<br>5. CATHODE<br>6. CATHODE |
| <b>STYLE 7:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. DRAIN 2<br>4. SOURCE 2<br>5. GATE 2<br>6. DRAIN 1 | <b>STYLE 8:</b><br>PIN 1. EMITTER 1<br>2. BASE 2<br>3. COLLECTOR 2<br>4. EMITTER 2<br>5. BASE 1<br>6. COLLECTOR 1    | <b>STYLE 9:</b><br>PIN 1. EMITTER 2<br>2. BASE 2<br>3. COLLECTOR 1<br>4. EMITTER 1<br>5. BASE 1<br>6. COLLECTOR 2 | <b>STYLE 10:</b><br>PIN 1. ANODE/CATHODE<br>2. BASE<br>3. EMITTER<br>4. COLLECTOR<br>5. ANODE<br>6. CATHODE                                    | <b>STYLE 11:</b><br>PIN 1. EMITTER<br>2. BASE<br>3. ANODE/CATHODE<br>4. ANODE<br>5. CATHODE<br>6. COLLECTOR   |                                                                                                       |

|                         |                    |                                                                                                                                                                                     |
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