

# Digital FET, N-Channel

## FDV301N, FDV301N-F169

### General Description

This N-Channel logic level enhancement mode field effect transistor is produced using onsemi's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance. This device has been designed especially for low voltage applications as a replacement for digital transistors. Since bias resistors are not required, this one N-channel FET can replace several different digital transistors, with different bias resistor values.

### Features

- 25 V, 0.22 A Continuous, 0.5 A Peak
  - $R_{DS(on)} = 5 \Omega @ V_{GS} = 2.7 V$
  - $R_{DS(on)} = 4 \Omega @ V_{GS} = 4.5 V$
- Very Low Level Gate Drive Requirements Allowing Direct Operation in 3 V Circuits.  $V_{GS(th)} < 1.06 V$
- Gate-Source Zener for ESD Ruggedness. > 6 kV Human Body Model
- Replace Multiple NPN Digital Transistors with One DMOS FET
- This Device is Pb-Free and Halide Free

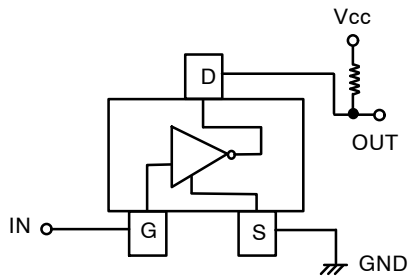
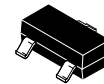
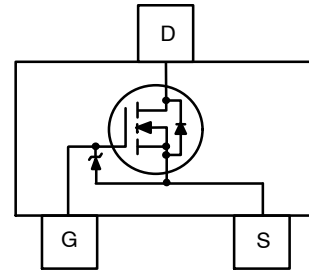
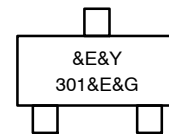


Figure 1. Inverter Application



SOT-23  
CASE 318-08

### MARKING DIAGRAM



|     |                        |
|-----|------------------------|
| &E  | = Designates Space     |
| &Y  | = Binary Calendar Year |
|     | Coding Scheme          |
| 301 | = Specific Device Code |
| &G  | = Date Code            |

### ORDERING INFORMATION

| Device                   | Package                               | Shipping†             |
|--------------------------|---------------------------------------|-----------------------|
| FDV301N,<br>FDV301N-F169 | SOT-23-3<br>(Pb-Free,<br>Halide-Free) | 3000 /<br>Tape & Reel |

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

# FDV301N, FDV301N-F169

## ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$ unless otherwise noted.

| Symbol           | Parameter                                                                            | FDV301N    | Unit             |
|------------------|--------------------------------------------------------------------------------------|------------|------------------|
| $V_{DS}, V_{CC}$ | Drain–Source Voltage, Power Supply Voltage                                           | 25         | V                |
| $V_{GS}, V_I$    | Gate–Source Voltage, $V_{IN}$                                                        | 8          | V                |
| $I_D, I_O$       | Drain/Output Current – Continuous                                                    | 0.22       | A                |
|                  |                                                                                      | 0.5        |                  |
| $P_D$            | Maximum Power Dissipation                                                            | 0.35       | W                |
| $T_J, T_{STG}$   | Operating and Storage Temperature Range                                              | –55 to 150 | $^\circ\text{C}$ |
| ESD              | Electrostatic Discharge Rating MIL–STD–883D Human Body Model (100 pF/1500 $\Omega$ ) | 6.0        | kV               |

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 $T_A = 25^\circ\text{C}$ unless otherwise noted.

| Symbol          | Parameter                               | Value | Unit                      |
|-----------------|-----------------------------------------|-------|---------------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction–to–Ambient | 357   | $^\circ\text{C}/\text{W}$ |

## INVERTER ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ unless otherwise noted.

| Symbol       | Parameter                         | Test Conditions                                    | Min | Typ | Max | Unit          |
|--------------|-----------------------------------|----------------------------------------------------|-----|-----|-----|---------------|
| $I_{O(off)}$ | Zero Input Voltage Output Current | $V_{CC} = 20\text{ V}, V_I = 0\text{ V}$           | –   | –   | 1   | $\mu\text{A}$ |
| $V_{I(off)}$ | Input Voltage                     | $V_{CC} = 5\text{ V}, I_O = 10\text{ }\mu\text{A}$ | –   | –   | 0.5 | V             |
| $V_{I(on)}$  |                                   | $V_O = 0.3\text{ V}, I_O = 0.005\text{ A}$         | 1   | –   | –   |               |
| $R_{O(on)}$  | Output to Ground Resistance       | $V_I = 2.7\text{ V}, I_O = 0.2\text{ A}$           | –   | 4   | 5   | $\Omega$      |

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.

## ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ unless otherwise noted.

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                              |                                     |                                                                     |    |    |     |                            |
|------------------------------|-------------------------------------|---------------------------------------------------------------------|----|----|-----|----------------------------|
| $BV_{DSS}$                   | Drain–Source Breakdown Voltage      | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$                 | 25 | –  | –   | V                          |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | $I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$   | –  | 25 | –   | $\text{mV}/^\circ\text{C}$ |
| $I_{DSS}$                    | Zero Gate Voltage Drain Current     | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$                         | –  | –  | 1   | $\mu\text{A}$              |
|                              |                                     | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55^\circ\text{C}$ | –  | –  | 10  |                            |
| $I_{GSS}$                    | Gate – Body Leakage Current         | $V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$                          | –  | –  | 100 | nA                         |

### ON CHARACTERISTICS

|                                |                                          |                                                                      |      |      |      |                            |
|--------------------------------|------------------------------------------|----------------------------------------------------------------------|------|------|------|----------------------------|
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Temp. Coefficient | $I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$    | –    | –2.1 | –    | $\text{mV}/^\circ\text{C}$ |
| $V_{GS(th)}$                   | Gate Threshold Voltage                   | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$                      | 0.70 | 0.85 | 1.06 | V                          |
| $R_{DS(on)}$                   | Static Drain–Source On–Resistance        | $V_{GS} = 2.7\text{ V}, I_D = 0.2\text{ A}$                          | –    | 3.8  | 5    | $\Omega$                   |
|                                |                                          | $V_{GS} = 2.7\text{ V}, I_D = 0.2\text{ A}, T_J = 125^\circ\text{C}$ | –    | 6.3  | 9    |                            |
|                                |                                          | $V_{GS} = 4.5\text{ V}, I_D = 0.4\text{ A}$                          | –    | 3.1  | 4    |                            |
| $I_{D(on)}$                    | On–State Drain Current                   | $V_{GS} = 2.7\text{ V}, V_{DS} = 5\text{ V}$                         | 0.2  | –    | –    | A                          |
| $g_{FS}$                       | Forward Transconductance                 | $V_{DS} = 5\text{ V}, I_D = 0.4\text{ A}$                            | –    | 0.2  | –    | S                          |

# FDV301N, FDV301N-F169

## ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ unless otherwise noted. (continued)

| Symbol                         | Parameter                    | Test Conditions                                                 | Min | Typ | Max | Unit |
|--------------------------------|------------------------------|-----------------------------------------------------------------|-----|-----|-----|------|
| <b>DYNAMIC CHARACTERISTICS</b> |                              |                                                                 |     |     |     |      |
| $C_{iss}$                      | Input Capacitance            | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | –   | 9.5 | –   | pF   |
| $C_{oss}$                      | Output Capacitance           |                                                                 | –   | 6   | –   |      |
| $C_{rss}$                      | Reverse Transfer Capacitance |                                                                 | –   | 1.3 | –   |      |

## SWITCHING CHARACTERISTICS (Note 1)

|              |                       |                                                                                        |   |      |     |    |
|--------------|-----------------------|----------------------------------------------------------------------------------------|---|------|-----|----|
| $t_{D(on)}$  | Turn – On Delay Time  | $V_{DD} = 6\text{ V}, I_D = 0.5\text{ A}, V_{GS} = 4.5\text{ V}, R_{GEN} = 50\ \Omega$ | – | 3.2  | 8   | ns |
| $t_r$        | Turn – On Rise Time   |                                                                                        | – | 6    | 15  |    |
| $t_{D(off)}$ | Turn – Off Delay Time |                                                                                        | – | 3.5  | 8   |    |
| $t_f$        | Turn – Off Fall Time  |                                                                                        | – | 3.5  | 8   |    |
| $Q_g$        | Total Gate Charge     | $V_{DS} = 5\text{ V}, I_D = 0.2\text{ A}, V_{GS} = 4.5\text{ V}$                       | – | 0.49 | 0.7 | nC |
| $Q_{gs}$     | Gate–Source Charge    |                                                                                        | – | 0.22 | –   |    |
| $Q_{gd}$     | Gate–Drain Charge     |                                                                                        | – | 0.07 | –   |    |

## DRAIN–SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

|                 |                                                       |                                                         |   |     |      |   |
|-----------------|-------------------------------------------------------|---------------------------------------------------------|---|-----|------|---|
| I <sub>S</sub>  | Maximum Continuous Drain–Source Diode Forward Current |                                                         | – | –   | 0.29 | A |
| V <sub>SD</sub> | Drain–Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 0.29 A (Note 1) | – | 0.8 | 1.2  | V |

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.

1. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## TYPICAL CHARACTERISTICS

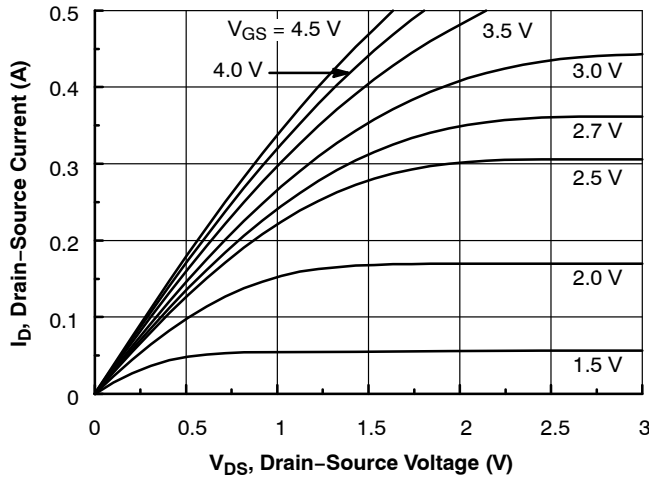


Figure 2. On-Region Characteristics

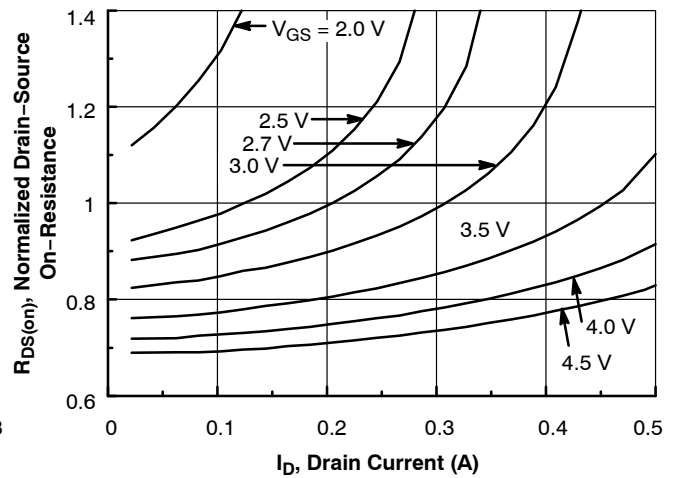


Figure 3. On-Resistance Variation with Drain Current and Gate Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

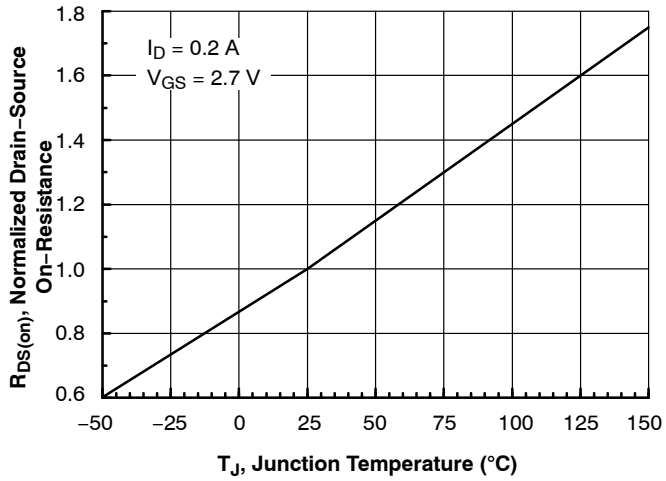


Figure 4. On-Resistance Variation with Temperature

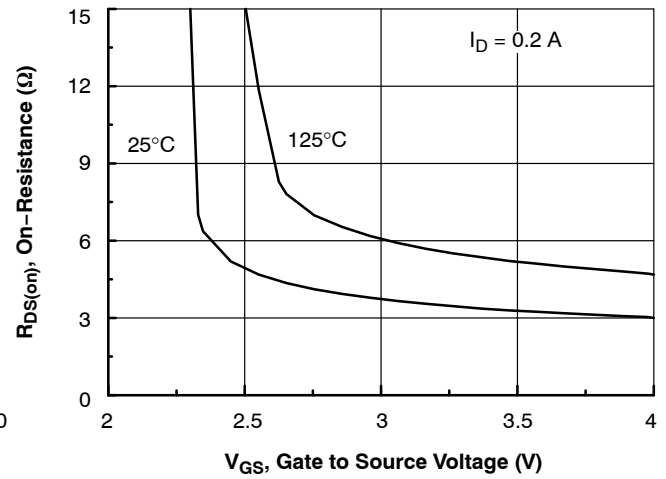


Figure 5. On Resistance Variation with Gate-To-Source Voltage

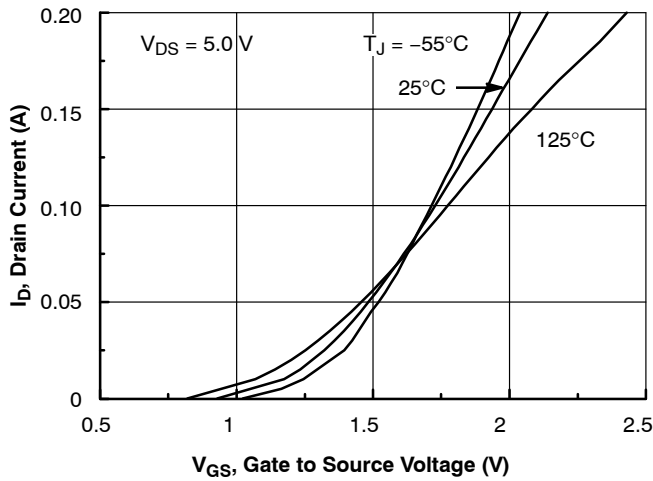


Figure 6. Transfer Characteristics

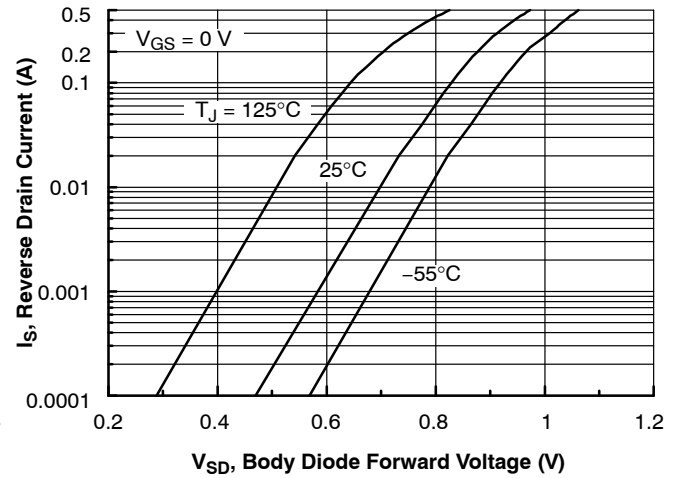


Figure 7. Body Diode Forward Voltage Variation with Source Current and Temperature

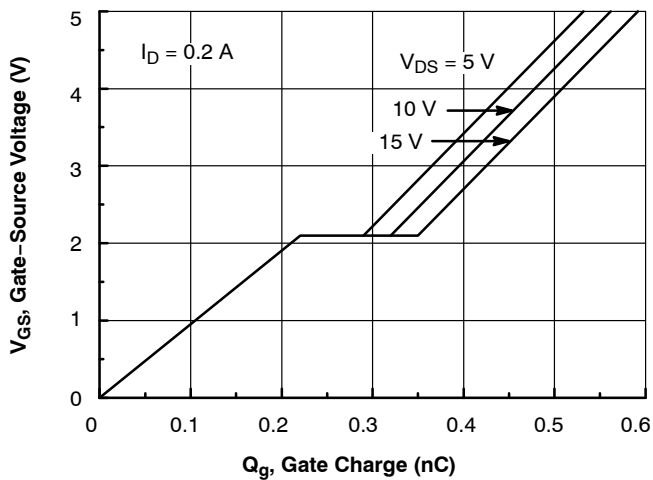


Figure 8. Gate Charge Characteristics

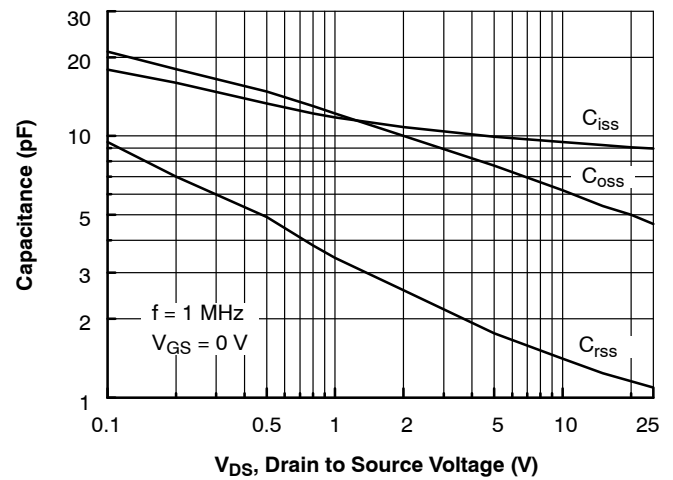


Figure 9. Capacitance Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

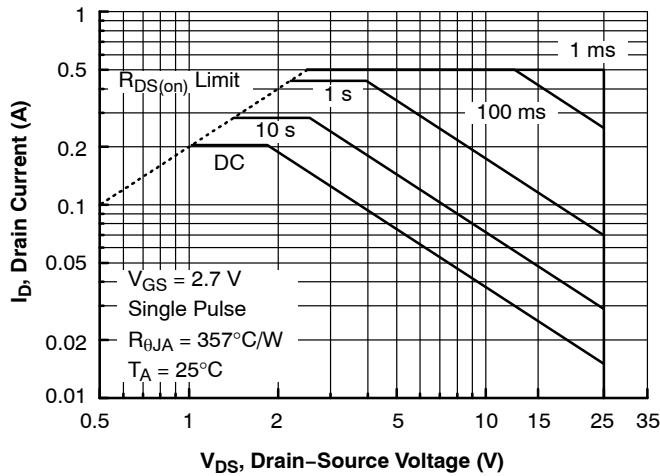


Figure 10. Maximum Safe Operating Area

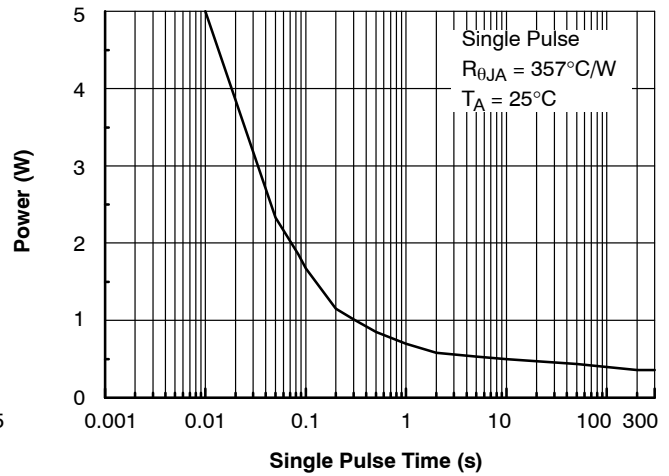


Figure 11. Single Pulse Maximum Power Dissipation

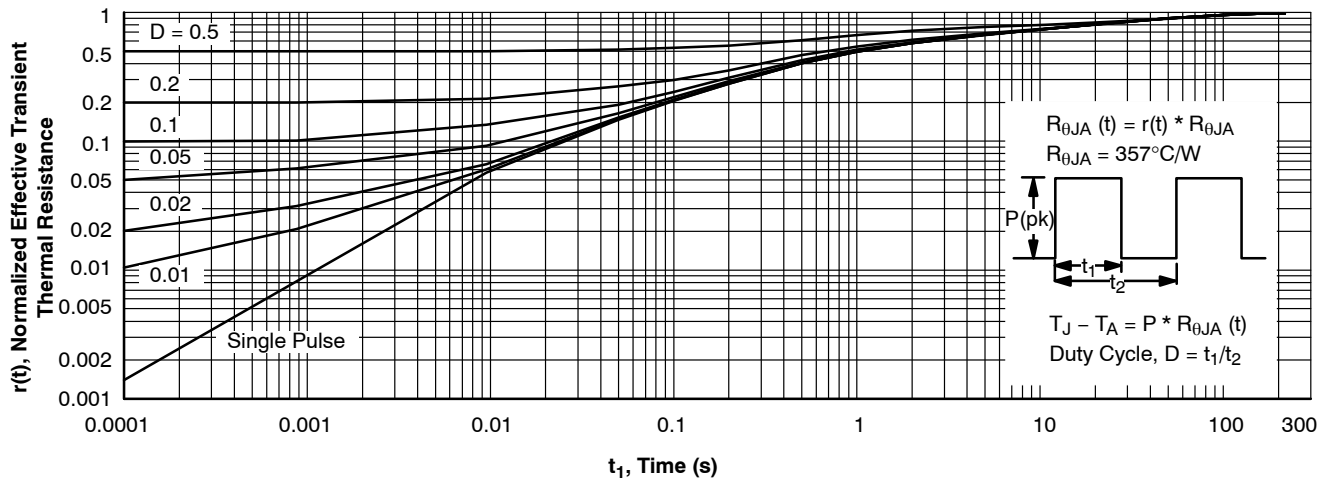
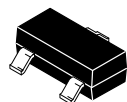


Figure 12. Transient Thermal Response Curve

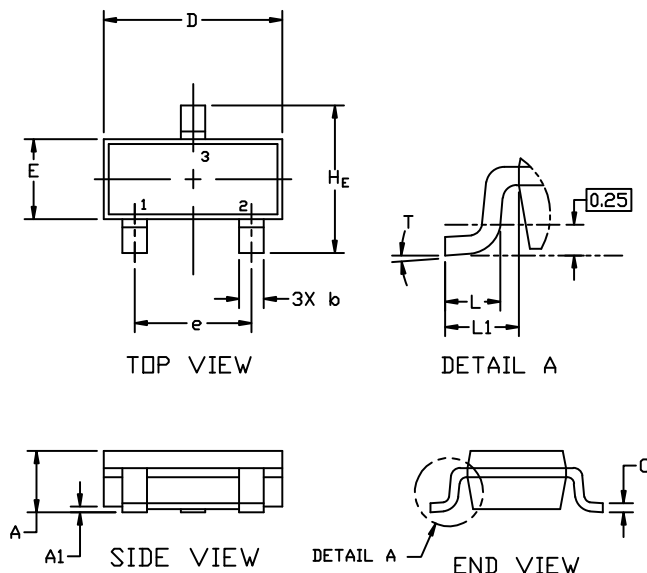
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 4:1

**SOT-23 (TO-236)**  
**CASE 318**  
**ISSUE AT**

DATE 01 MAR 2023

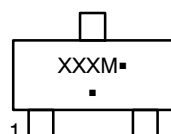


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M,1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

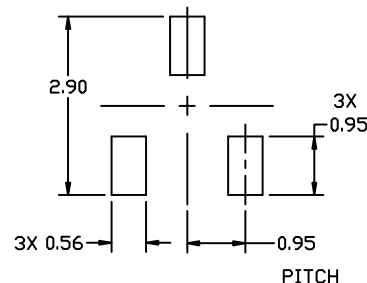
| DIM            | MILLIMETERS |      |      | INCHES |       |       |
|----------------|-------------|------|------|--------|-------|-------|
|                | MIN.        | NOM. | MAX. | MIN.   | NOM.  | MAX.  |
| A              | 0.89        | 1.00 | 1.11 | 0.035  | 0.039 | 0.044 |
| A1             | 0.01        | 0.06 | 0.10 | 0.000  | 0.002 | 0.004 |
| b              | 0.37        | 0.44 | 0.50 | 0.015  | 0.017 | 0.020 |
| c              | 0.08        | 0.14 | 0.20 | 0.003  | 0.006 | 0.008 |
| D              | 2.80        | 2.90 | 3.04 | 0.110  | 0.114 | 0.120 |
| E              | 1.20        | 1.30 | 1.40 | 0.047  | 0.051 | 0.055 |
| e              | 1.78        | 1.90 | 2.04 | 0.070  | 0.075 | 0.080 |
| L              | 0.30        | 0.43 | 0.55 | 0.012  | 0.017 | 0.022 |
| L1             | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.027 |
| H <sub>E</sub> | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| T              | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

## GENERIC MARKING DIAGRAM\*



XXX = Specific Device Code  
M = Date 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.



## RECOMMENDED MOUNTING 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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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



### SOT-23 (TO-236) CASE 318 ISSUE AT

DATE 01 MAR 2023

|                                                         |                                                       |                                                             |                                                             |                                                             |                                                             |
|---------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| STYLE 1 THRU 5:<br>CANCELLED                            | STYLE 6:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 7:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR       | STYLE 8:<br>PIN 1. ANODE<br>2. NO CONNECTION<br>3. CATHODE  |                                                             |                                                             |
| STYLE 9:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE      | STYLE 10:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE     | STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE-ANODE | STYLE 12:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE       | STYLE 13:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE           | STYLE 14:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          |
| STYLE 15:<br>PIN 1. GATE<br>2. CATHODE<br>3. ANODE      | STYLE 16:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE | STYLE 17:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. CATHODE | STYLE 18:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. ANODE | STYLE 19:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE-ANODE | STYLE 20:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE          |
| STYLE 21:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN       | STYLE 22:<br>PIN 1. RETURN<br>2. OUTPUT<br>3. INPUT   | STYLE 23:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE         | STYLE 24:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE           | STYLE 25:<br>PIN 1. ANODE<br>2. CATHODE<br>3. GATE          | STYLE 26:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION |
| STYLE 27:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE | STYLE 28:<br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE     |                                                             |                                                             |                                                             |                                                             |

|                  |                 |                                                                                                                                                                                     |
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