

# 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

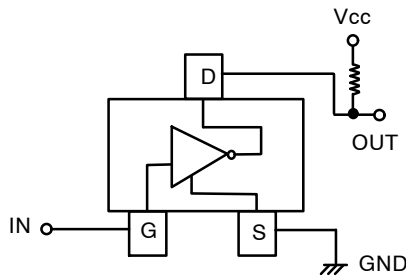
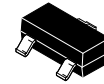
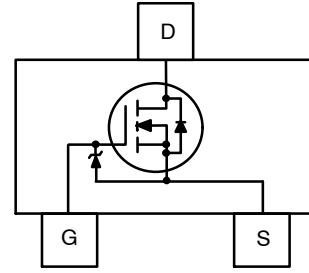
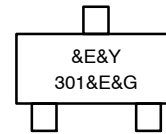


Figure 1. Inverter Application



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, FDV301N-F169	SOT-23-3 (Pb-Free, Halide-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 Specification Brochure, BRD8011/D.

# FDV301N, FDV301N-F169

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

Symbol	Parameter	FDV301N	Unit
$V_{DSS}, V_{CC}$	Drain-Source Voltage, Power Supply Voltage	25	V
$V_{GSS}, V_I$	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	$V_{CC} = 5\text{ V}, I_O = 10\ \mu\text{A}$	-	-	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
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### OFF CHARACTERISTICS

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	25	-	-	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	$I_D = 250\ \mu\text{A}$ , 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	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	-2.1	-	$\text{mV}/^\circ\text{C}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	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	-	

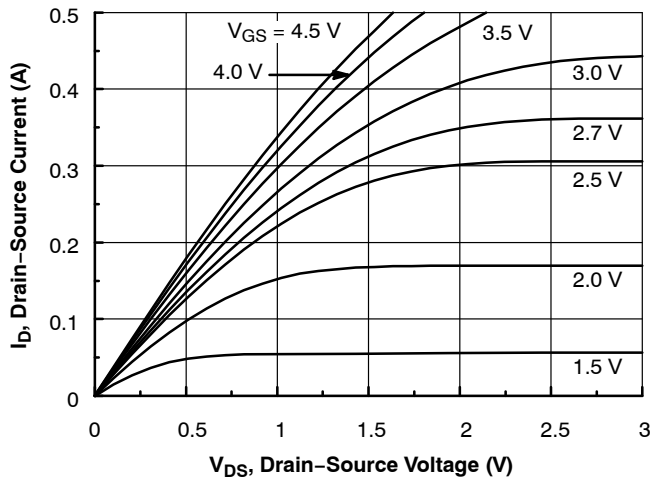
**DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS**

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	-	-	0.29	A		
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 0.29\text{ A}$ (Note 1)		-	0.8	1.2	V

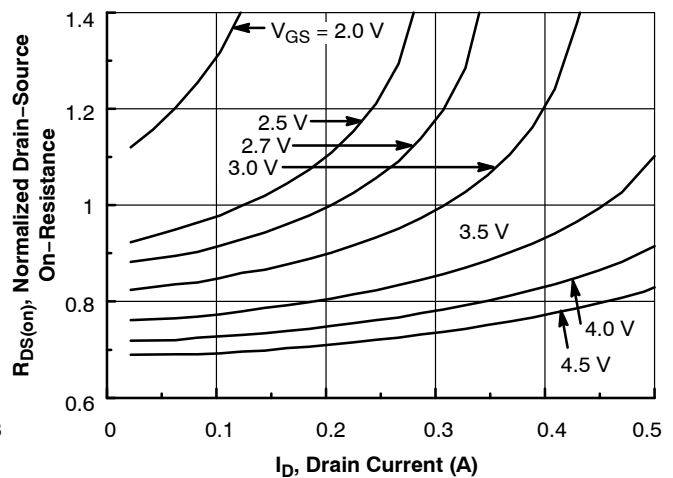
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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**

# FDV301N, FDV301N-F169

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

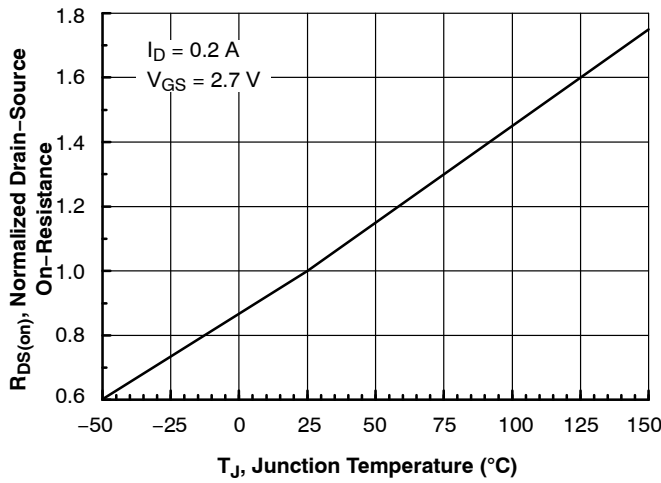


Figure 4. On-Resistance Variation with Temperature

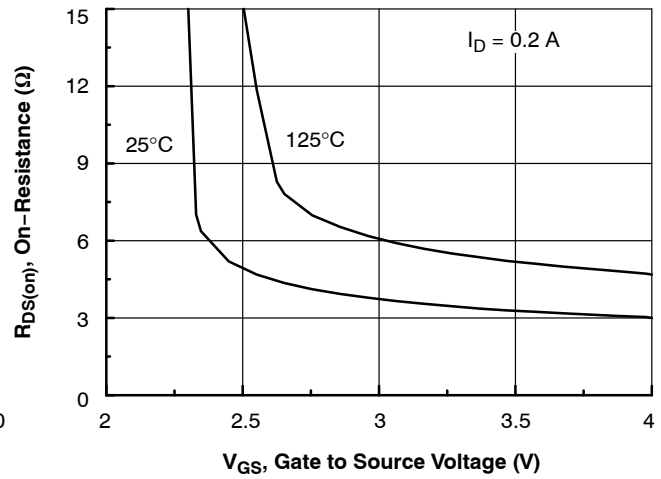


Figure 5. On Resistance Variation with Gate-To-Source Voltage

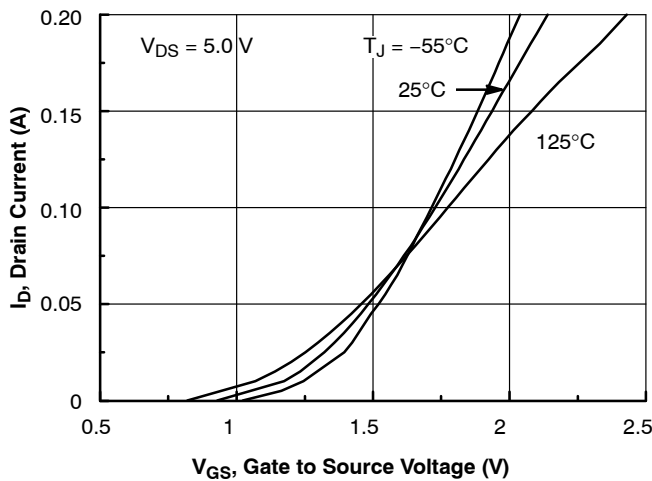


Figure 6. Transfer Characteristics

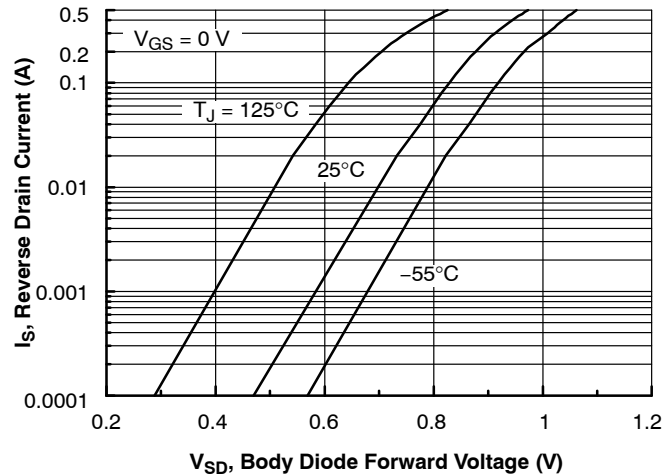


Figure 7. Body Diode Forward Voltage Variation with Source Current and Temperature

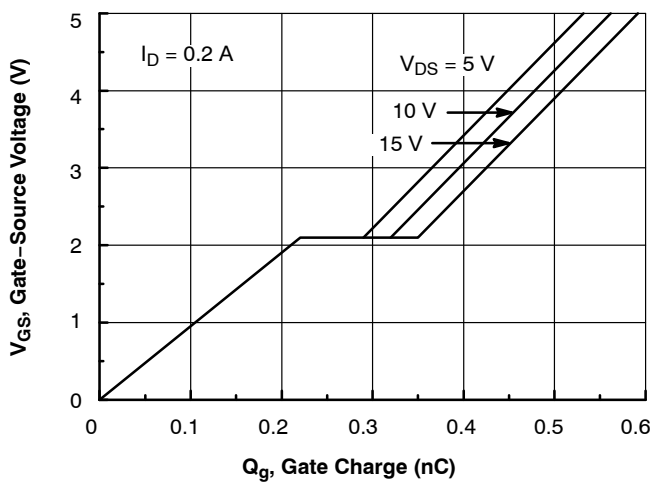


Figure 8. Gate Charge Characteristics

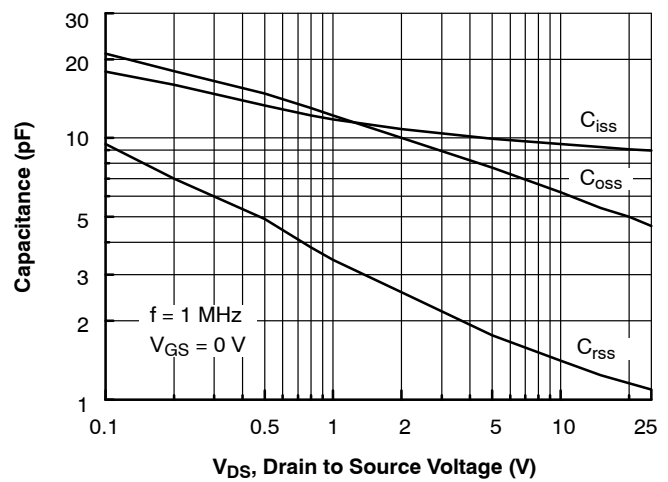


Figure 9. Capacitance Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

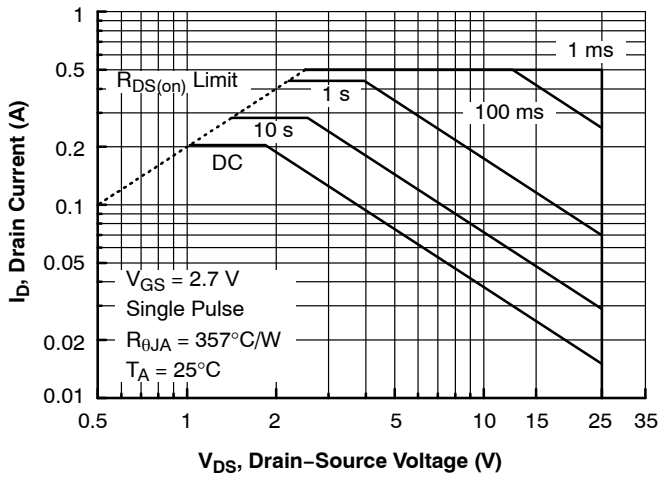


Figure 10. Maximum Safe Operating Area

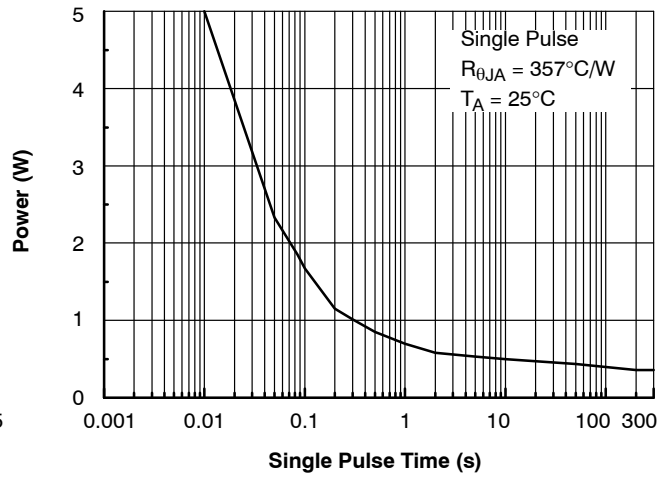


Figure 11. Single Pulse Maximum Power Dissipation

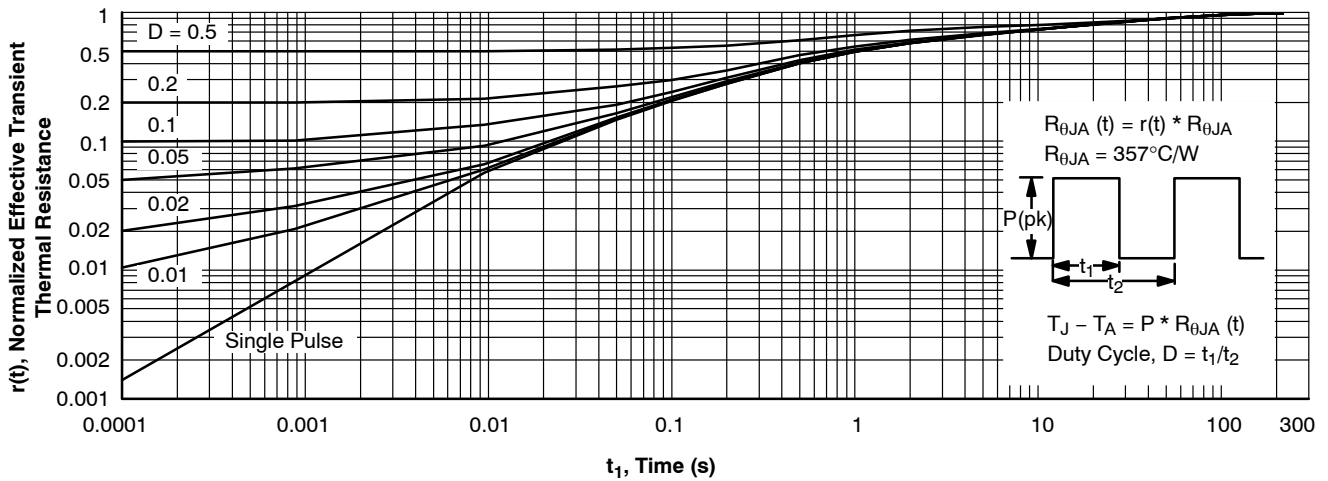


Figure 12. Transient Thermal Response Curve

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



**SOT-23 (TO-236)**  
CASE 318-08  
ISSUE AS

DATE 30 JAN 2018

SCALE 4:1

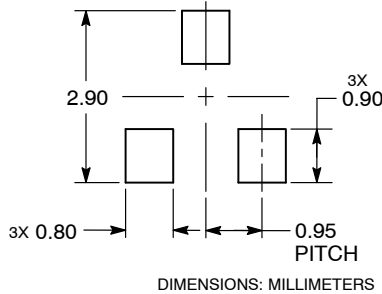


**NOTES:**

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
HE	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

**RECOMMENDED SOLDERING FOOTPRINT**



**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.

STYLE 1 THRU 5:  
CANCELLED

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

STYLE 7:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

STYLE 8:  
PIN 1. ANODE  
2. NO CONNECTION  
3. CATHODE

STYLE 9:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 10:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE

STYLE 11:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE-ANODE

STYLE 12:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE

STYLE 13:  
PIN 1. SOURCE  
2. DRAIN  
3. GATE

STYLE 14:  
PIN 1. CATHODE  
2. GATE  
3. ANODE

STYLE 15:  
PIN 1. GATE  
2. CATHODE  
3. ANODE

STYLE 16:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE

STYLE 17:  
PIN 1. NO CONNECTION  
2. ANODE  
3. CATHODE

STYLE 18:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. ANODE

STYLE 19:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE-ANODE

STYLE 20:  
PIN 1. CATHODE  
2. ANODE  
3. GATE

STYLE 21:  
PIN 1. GATE  
2. SOURCE  
3. DRAIN

STYLE 22:  
PIN 1. RETURN  
2. OUTPUT  
3. INPUT

STYLE 23:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 24:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE

STYLE 25:  
PIN 1. ANODE  
2. CATHODE  
3. GATE

STYLE 26:  
PIN 1. CATHODE  
2. ANODE  
3. NO CONNECTION

STYLE 27:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE

STYLE 28:  
PIN 1. ANODE  
2. ANODE  
3. ANODE

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