

MOSFET– Specified, P-Channel, POWERTRENCH® 2.5 V



ON Semiconductor®

www.onsemi.com

FDG328P

General Description

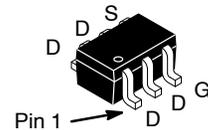
This P-Channel 2.5 V specified MOSFET is produced in a rugged gate version of ON Semiconductor's advanced POWERTRENCH process. It has been optimized for power management applications for a wide range of gate drive voltages (2.5 V – 12 V).

Features

- –1.5 A, –20 V
 - ◆ $R_{DS(ON)} = 0.145 \Omega @ V_{GS} = -4.5 V$
 - ◆ $R_{DS(ON)} = 0.210 \Omega @ V_{GS} = -2.5 V$
- Low Gate Charge
- High Performance Trench Technology for Extremely Low $R_{DS(ON)}$
- Compact Industry Standard SC70–6 Surface Mount Package
- These Devices are Pb–Free and are RoHS Compliant

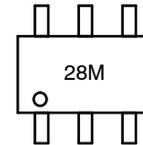
Applications

- Load Switch
- Power Management
- DC/DC Converter



SC–88/SC70–6/SOT–363
CASE 419B–02

MARKING DIAGRAM



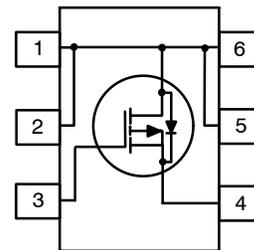
28 = Specific Device Code
M = Assembly Operation Month

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

| Symbol | Parameter | Ratings | Units |
|----------------|--|----------------------|------------------|
| V_{DSS} | Drain–Source Voltage | –20 | V |
| V_{GSS} | Gate–Source Voltage | ± 12 | V |
| I_D | Drain Current | Continuous (Note 1a) | –1.5 |
| | | Pulsed | –6 |
| P_D | Power Dissipation for Single Operation | (Note 1a) | 0.75 |
| | | (Note 1b) | 0.48 |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | –55 to +150 | $^\circ\text{C}$ |

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.

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

THERMAL CHARACTERISTICS

| Symbol | Parameter | Ratings | Unit |
|-----------------|---|---------|---------------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction–to–Ambient (Note 1b) | 260 | $^\circ\text{C}/\text{W}$ |

- $R_{\theta JA}$ is the sum of the junction–to–case and case–to–ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.
 - 170 $^\circ\text{C}/\text{W}$ when mounted on a 1 in² pad of 2 oz copper.
 - 260 $^\circ\text{C}/\text{W}$ when mounted on a minimum pad.

FDG328P

PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device | Reel Size | Tape Width | Shipping [†] |
|----------------|---------|-----------|------------|-----------------------|
| 28 | FDG328P | 7" | 8 mm | 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.

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

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

OFF CHARACTERISTICS

| | | | | | | |
|--------------------------------------|---|---|-----|----|------|-------|
| BV _{DSS} | Drain-Source Breakdown Voltage | V _{GS} = 0 V, I _D = -250 μA | -20 | - | - | V |
| ΔBV _{DSS} / ΔT _J | Breakdown Voltage Temperature Coefficient | I _D = -250 μA, Referenced to 25°C | - | -9 | - | mV/°C |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} = -16 V, V _{GS} = 0 V | - | - | -1 | μA |
| I _{GSSF} | Gate-Body Leakage, Forward | V _{GS} = 12 V, V _{DS} = 0 V | - | - | 100 | nA |
| I _{GSSR} | Gate-Body Leakage, Reverse | V _{GS} = -12 V, V _{DS} = 0 V | - | - | -100 | nA |

ON CHARACTERISTICS (Note 2)

| | | | | | | |
|--|--|---|------|-------------------|-------------------|-------|
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = -250 μA | -0.6 | - | -1.5 | V |
| ΔV _{GS(th)} / ΔT _J | Gate Threshold Voltage Temperature Coefficient | I _D = -250 μA, Referenced to 25°C | - | 3 | - | mV/°C |
| R _{DS(on)} | Static Drain-Source On-Resistance | V _{GS} = -4.5 V, I _D = -1.5 A V _{GS} = -2.5 V, I _D = -1.2 A V _{GS} = -4.5 V, I _D = -1.5 A, T _J = 125°C | - | 120 169 156 | 145 210 203 | mΩ |
| I _{D(on)} | On-State Drain Current | V _{GS} = -4.5 V, V _{DS} = -5 V | -3 | - | - | A |
| g _{FS} | Forward Transconductance | V _{DS} = -5 V, I _D = -1.5 A | - | 3 | - | S |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|------------------|------------------------------|---|---|-----|---|----|
| C _{iss} | Input Capacitance | V _{DS} = -10 V, V _{GS} = 0 V, f = 1.0 MHz | - | 337 | - | pF |
| C _{oss} | Output Capacitance | | - | 88 | - | pF |
| C _{rss} | Reverse Transfer Capacitance | | - | 51 | - | pF |

SWITCHING CHARACTERISTICS (Note 2)

| | | | | | | |
|---------------------|---------------------|--|---|-----|----|----|
| t _{d(on)} | Turn-On Delay Time | V _{DD} = -10 V, I _D = 1 A, V _{GS} = -4.5 V, R _{GEN} = 6 Ω | - | 9 | 18 | ns |
| t _r | Turn-On Rise Time | | - | 12 | 22 | ns |
| t _{d(off)} | Turn-Off Delay Time | | - | 10 | 20 | ns |
| t _f | Turn-Off Fall Time | | - | 5 | 10 | ns |
| Q _g | Total Gate Charge | V _{DS} = -10 V, I _D = -1.5 A, V _{GS} = -4.5 V | - | 3.7 | 6 | nC |
| Q _{gs} | Gate-Source Charge | | - | 0.7 | - | nC |
| Q _{gd} | Gate-Drain Charge | | - | 1.3 | - | nC |

DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

| | | | | | | |
|-----------------|---|--|---|-------|------|---|
| I _S | Maximum Continuous Drain-Source Diode Forward Current | - | - | -0.62 | A | |
| V _{SD} | Drain-Source Diode Forward Voltage | V _{GS} = 0 V, I _S = -0.62 A (Note 2) | - | -0.7 | -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.

2. Pulse Test: Pulse Width < 300 μs, Duty Cycle < 2.0%

TYPICAL PERFORMANCE CHARACTERISTICS

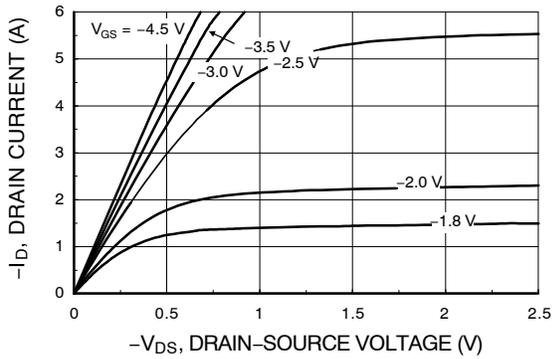


Figure 1. On-Region Characteristics

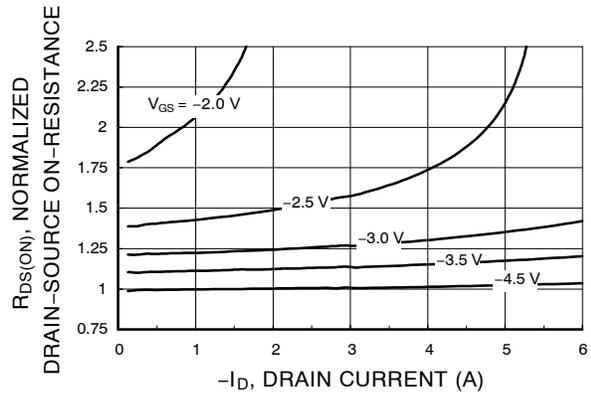


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

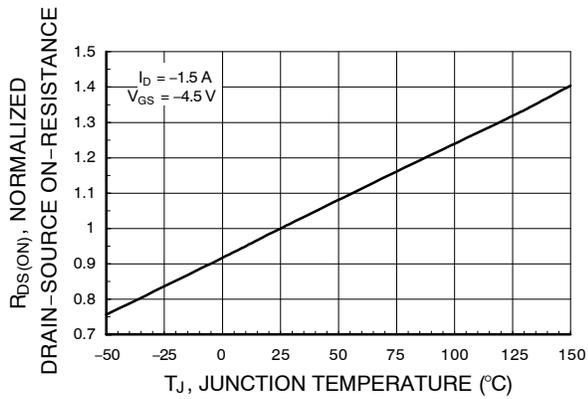


Figure 3. On-Resistance Variation with Temperature

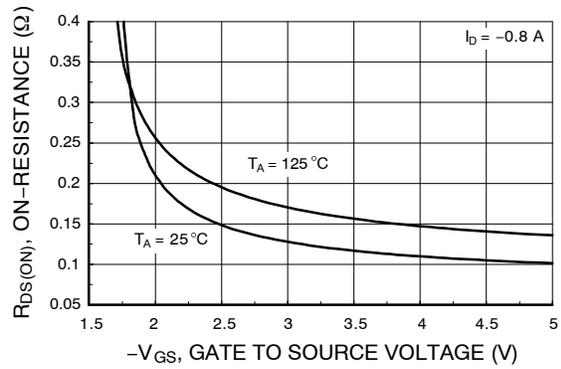


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

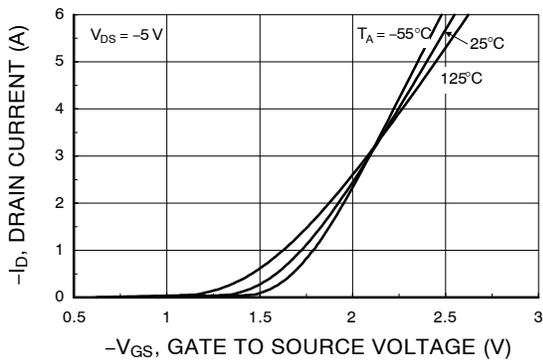


Figure 5. Transfer Characteristics

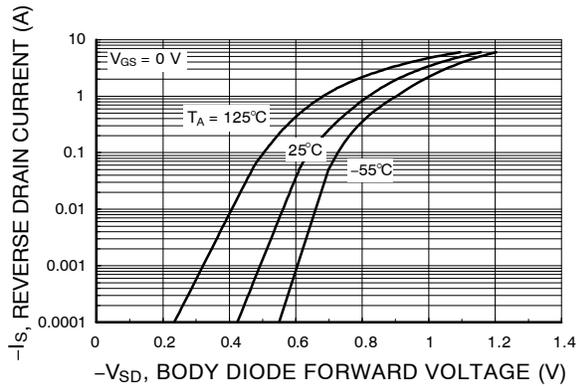


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

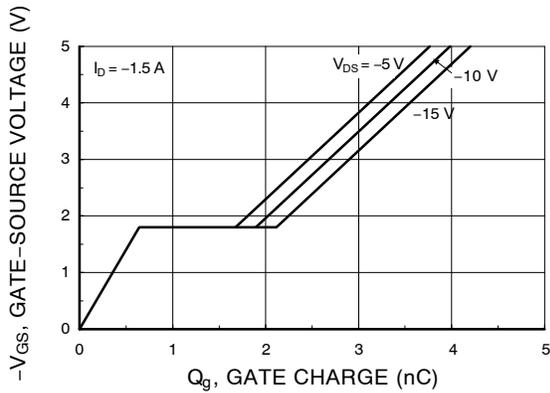


Figure 7. Gate Charge Characteristics

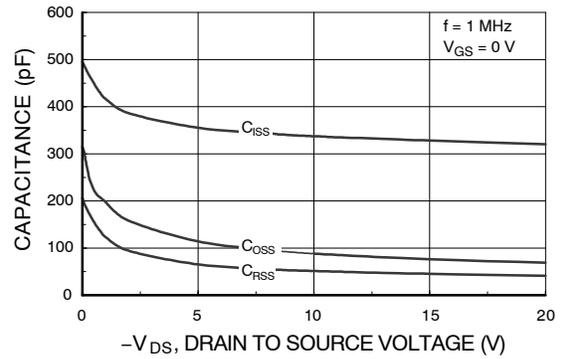


Figure 8. Capacitance Characteristics

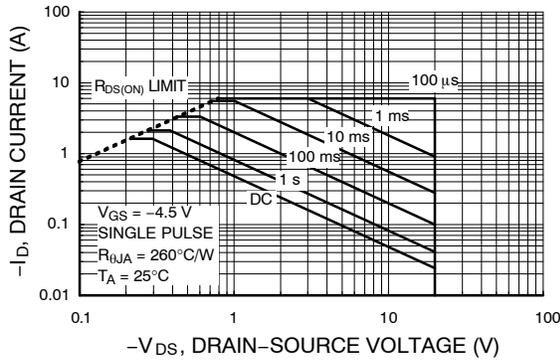


Figure 9. Maximum Safe Operating Area

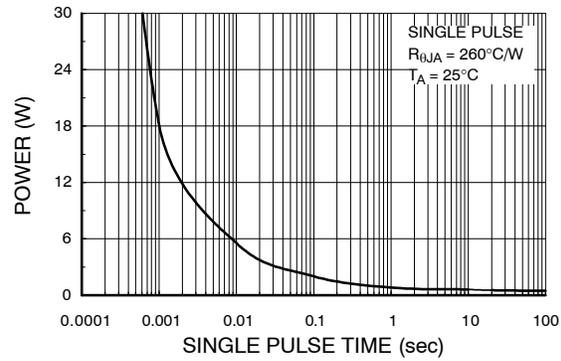
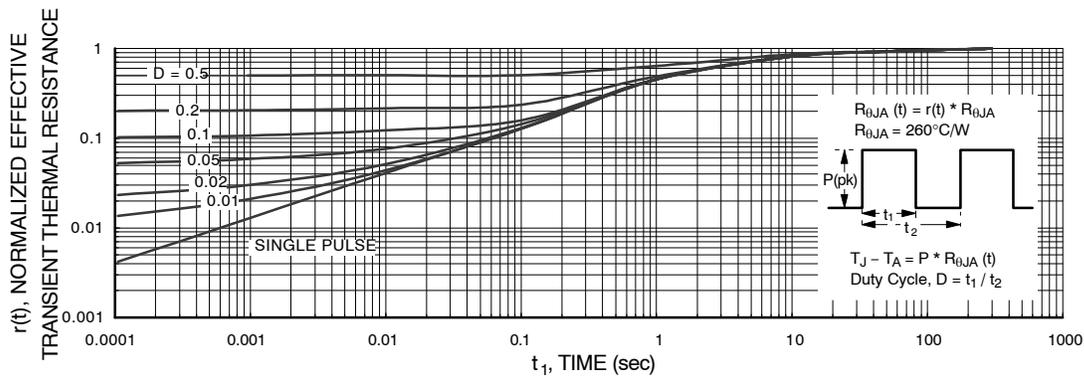


Figure 10. Single Pulse Maximum Power Dissipation



Thermal characterization performed using the conditions described in Note 1b.
Transient thermal response will change depending on the circuit board design.

Figure 11. Transient Thermal Response Curve

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

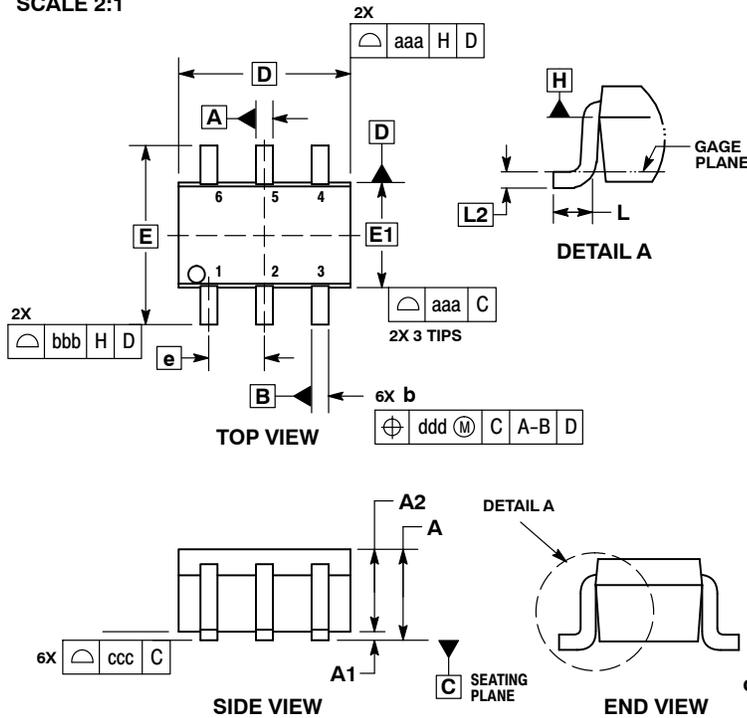
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1
SCALE 2:1

SC-88/SC70-6/SOT-363
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ISSUE Y

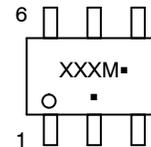
DATE 11 DEC 2012



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
 4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
 5. DATUMS A AND B ARE DETERMINED AT DATUM H.
 6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
 7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | --- | --- | 1.10 | --- | --- | 0.043 |
| A1 | 0.00 | --- | 0.10 | 0.000 | --- | 0.004 |
| A2 | 0.70 | 0.90 | 1.00 | 0.027 | 0.035 | 0.039 |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| C | 0.08 | 0.15 | 0.22 | 0.003 | 0.006 | 0.009 |
| D | 1.80 | 2.00 | 2.20 | 0.070 | 0.078 | 0.086 |
| E | 2.00 | 2.10 | 2.20 | 0.078 | 0.082 | 0.086 |
| E1 | 1.15 | 1.25 | 1.35 | 0.045 | 0.049 | 0.053 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.26 | 0.36 | 0.46 | 0.010 | 0.014 | 0.018 |
| L2 | 0.15 BSC | | | 0.006 BSC | | |
| aaa | 0.15 | | | 0.006 | | |
| bbb | 0.30 | | | 0.012 | | |
| ccc | 0.10 | | | 0.004 | | |
| ddd | 0.10 | | | 0.004 | | |

GENERIC MARKING DIAGRAM*



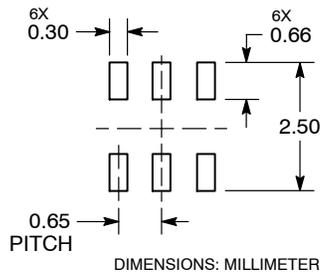
- XXX = Specific Device Code
- M = Date Code*
- = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing 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.

RECOMMENDED SOLDERING 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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CASE 419B-02
ISSUE Y

DATE 11 DEC 2012

| | | | | | |
|---|---|--|--|--|--|
| STYLE 1: PIN 1. EMITTER 2 2. BASE 2 3. COLLECTOR 1 4. EMITTER 1 5. BASE 1 6. COLLECTOR 2 | STYLE 2: CANCELLED | STYLE 3: CANCELLED | STYLE 4: PIN 1. CATHODE 2. CATHODE 3. COLLECTOR 4. EMITTER 5. BASE 6. ANODE | STYLE 5: PIN 1. ANODE 2. ANODE 3. COLLECTOR 4. EMITTER 5. BASE 6. CATHODE | STYLE 6: PIN 1. ANODE 2 2. N/C 3. CATHODE 1 4. ANODE 1 5. N/C 6. CATHODE 2 |
| STYLE 7: PIN 1. SOURCE 2 2. DRAIN 2 3. GATE 1 4. SOURCE 1 5. DRAIN 1 6. GATE 2 | STYLE 8: CANCELLED | STYLE 9: PIN 1. EMITTER 2 2. EMITTER 1 3. COLLECTOR 1 4. BASE 1 5. BASE 2 6. COLLECTOR 2 | STYLE 10: PIN 1. SOURCE 2 2. SOURCE 1 3. GATE 1 4. DRAIN 1 5. DRAIN 2 6. GATE 2 | STYLE 11: PIN 1. CATHODE 2 2. CATHODE 2 3. ANODE 1 4. CATHODE 1 5. CATHODE 1 6. ANODE 2 | STYLE 12: PIN 1. ANODE 2 2. ANODE 2 3. CATHODE 1 4. ANODE 1 5. ANODE 1 6. CATHODE 2 |
| STYLE 13: PIN 1. ANODE 2. N/C 3. COLLECTOR 4. EMITTER 5. BASE 6. CATHODE | STYLE 14: PIN 1. VREF 2. GND 3. GND 4. IOUT 5. VEN 6. VCC | STYLE 15: PIN 1. ANODE 1 2. ANODE 2 3. ANODE 3 4. CATHODE 3 5. CATHODE 2 6. CATHODE 1 | STYLE 16: PIN 1. BASE 1 2. EMITTER 2 3. COLLECTOR 2 4. BASE 2 5. EMITTER 1 6. COLLECTOR 1 | STYLE 17: PIN 1. BASE 1 2. EMITTER 1 3. COLLECTOR 2 4. BASE 2 5. EMITTER 2 6. COLLECTOR 1 | STYLE 18: PIN 1. VIN1 2. VCC 3. VOUT2 4. VIN2 5. GND 6. VOUT1 |
| STYLE 19: PIN 1. IOUT 2. GND 3. GND 4. V CC 5. V EN 6. V REF | STYLE 20: PIN 1. COLLECTOR 2. COLLECTOR 3. BASE 4. EMITTER 5. COLLECTOR 6. COLLECTOR | STYLE 21: PIN 1. ANODE 1 2. N/C 3. ANODE 2 4. CATHODE 2 5. N/C 6. CATHODE 1 | STYLE 22: PIN 1. D1 (i) 2. GND 3. D2 (j) 4. D2 (c) 5. VBUS 6. D1 (c) | STYLE 23: PIN 1. Vn 2. CH1 3. Vp 4. N/C 5. CH2 6. N/C | STYLE 24: PIN 1. CATHODE 2. ANODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE |
| STYLE 25: PIN 1. BASE 1 2. CATHODE 3. COLLECTOR 2 4. BASE 2 5. EMITTER 6. COLLECTOR 1 | STYLE 26: PIN 1. SOURCE 1 2. GATE 1 3. DRAIN 2 4. SOURCE 2 5. GATE 2 6. DRAIN 1 | STYLE 27: PIN 1. BASE 2 2. BASE 1 3. COLLECTOR 1 4. EMITTER 1 5. EMITTER 2 6. COLLECTOR 2 | STYLE 28: PIN 1. DRAIN 2. DRAIN 3. GATE 4. SOURCE 5. DRAIN 6. DRAIN | STYLE 29: PIN 1. ANODE 2. ANODE 3. COLLECTOR 4. EMITTER 5. BASE/ANODE 6. CATHODE | STYLE 30: PIN 1. SOURCE 1 2. DRAIN 2 3. DRAIN 2 4. SOURCE 2 5. GATE 1 6. DRAIN 1 |

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