

# MTD6N15

## Power Field Effect Transistor DPAK for Surface Mount N-Channel Enhancement-Mode Silicon Gate

This Power FET is designed for high speed, low loss power switching applications such as switching regulators, converters, solenoid and relay drivers.

### Features

- Silicon Gate for Fast Switching Speeds
- Low  $R_{DS(on)}$  — 0.3  $\Omega$  Max
- Rugged — SOA is Power Dissipation Limited
- Source-to-Drain Diode Characterized for Use With Inductive Loads
- Low Drive Requirement —  $V_{GS(th)} = 4.0$  V Max
- Surface Mount Package on 16 mm Tape
- Pb-Free Package is Available

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	150	Vdc
Drain-Gate Voltage ( $R_{GS} = 1.0$ M $\Omega$ )	$V_{DGR}$	150	Vdc
Gate-Source Voltage	$V_{GS}$	$\pm 20$	Vdc
– Continuous	$V_{GSM}$	$\pm 40$	Vpk
– Non-Repetitive ( $t_p \leq 50$ $\mu$ s)			
Drain Current – Continuous	$I_D$	6.0	Adc
– Pulsed	$I_{DM}$	20	
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	20 0.16	W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$ (Note 1)	$P_D$	1.25 0.01	W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ (Note 1) Derate above $25^\circ\text{C}$ (Note 2)	$P_D$	1.75 0.014	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +150	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance			$^\circ\text{C}/\text{W}$
– Junction-to-Case	$R_{\theta JC}$	6.25	
– Junction-to-Ambient (Note 1)	$R_{\theta JA}$	100	
– Junction-to-Ambient (Note 2)	$R_{\theta JA}$	71.4	

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.

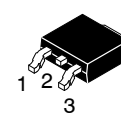
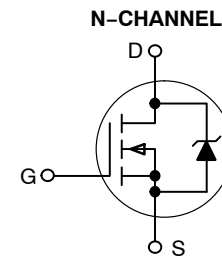
1. When surface mounted to an FR4 board using the minimum recommended pad size.
2. When surface mounted to an FR4 board using 0.5 sq. in. drain pad size.



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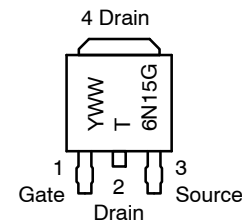
<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
150 V	0.3 $\Omega$	6.0 A



CASE 369C  
DPAK  
(Surface Mount)  
STYLE 2

### MARKING DIAGRAM & PIN ASSIGNMENTS



Y = Year  
WW = Work Week  
6N15 = Device Code  
G = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping†
MTD6N15T4	DPAK	2500/Tape & Reel
MTD6N15T4G	DPAK (Pb-Free)	2500/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.

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## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Drain-Source Breakdown Voltage (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 0.25 mAdc)	V <sub>(BR)DSS</sub>	150	-	Vdc
Zero Gate Voltage Drain Current (V <sub>DS</sub> = Rated V <sub>DSS</sub> , V <sub>GS</sub> = 0 Vdc) T <sub>J</sub> = 125°C	I <sub>DSS</sub>	-	10 100	μAdc
Gate-Body Leakage Current, Forward (V <sub>GSF</sub> = 20 Vdc, V <sub>DS</sub> = 0)	I <sub>GSSF</sub>	-	100	nAdc
Gate-Body Leakage Current, Reverse (V <sub>GSR</sub> = 20 Vdc, V <sub>DS</sub> = 0)	I <sub>GSSR</sub>	-	100	nAdc

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.0 mAdc) T <sub>J</sub> = 100°C	V <sub>GS(th)</sub>	2.0 1.5	4.5 4.0	Vdc
Static Drain-Source On-Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 3.0 Adc)	R <sub>DS(on)</sub>	-	0.3	Ω
Drain-Source On-Voltage (V <sub>GS</sub> = 10 Vdc) (I <sub>D</sub> = 6.0 Adc) (I <sub>D</sub> = 3.0 Adc, T <sub>J</sub> = 100°C)	V <sub>DS(on)</sub>	-	1.8 1.5	Vdc
Forward Transconductance (V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 3.0 Adc)	g <sub>FS</sub>	2.5	-	mhos

## DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 25 Vdc, V <sub>GS</sub> = 0 Vdc, f = 1.0 MHz) (See Figure 11)	C <sub>iss</sub>	-	1200	pF
Output Capacitance		C <sub>oss</sub>	-	500	
Reverse Transfer Capacitance		C <sub>rss</sub>	-	120	

## SWITCHING CHARACTERISTICS\* (T<sub>J</sub> = 100°C)

Turn-On Delay Time	(V <sub>DD</sub> = 25 Vdc, I <sub>D</sub> = 3.0 Adc, R <sub>G</sub> = 50 Ω) (See Figures 13 and 14)	t <sub>d(on)</sub>	-	50	ns
Rise Time		t <sub>r</sub>	-	180	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	200	
Fall Time		t <sub>f</sub>	-	100	
Total Gate Charge	(V <sub>DS</sub> = 0.8 Rated V <sub>DSS</sub> , I <sub>D</sub> = Rated I <sub>D</sub> , V <sub>GS</sub> = 10 Vdc) (See Figure 12)	Q <sub>g</sub>	15 (Typ)	30	nC
Gate-Source Charge		Q <sub>gs</sub>	8.0 (Typ)	-	
Gate-Drain Charge		Q <sub>gd</sub>	7.0 (Typ)	-	

## SOURCE-DRAIN DIODE CHARACTERISTICS\*

Forward On-Voltage	(I <sub>S</sub> = 6.0 Adc, di/dt = 25 A/μs, V <sub>GS</sub> = 0 Vdc)	V <sub>SD</sub>	1.3 (Typ)	2.0	Vdc
Forward Turn-On Time		t <sub>on</sub>	Limited by stray inductance		
Reverse Recovery Time		t <sub>rr</sub>	325 (Typ)	-	ns

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

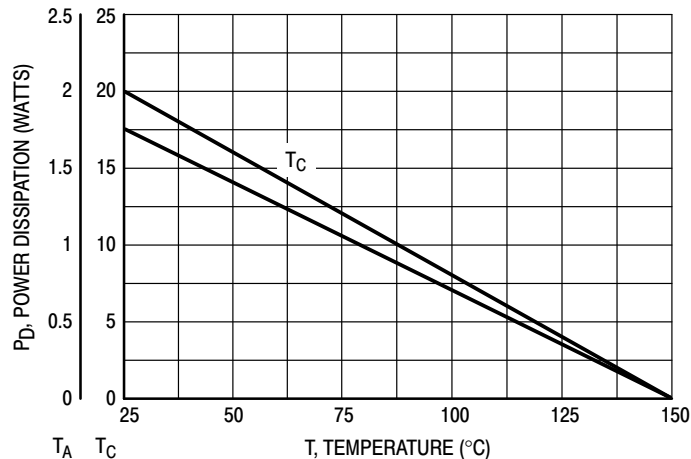


Figure 1. Power Derating

TYPICAL ELECTRICAL CHARACTERISTICS

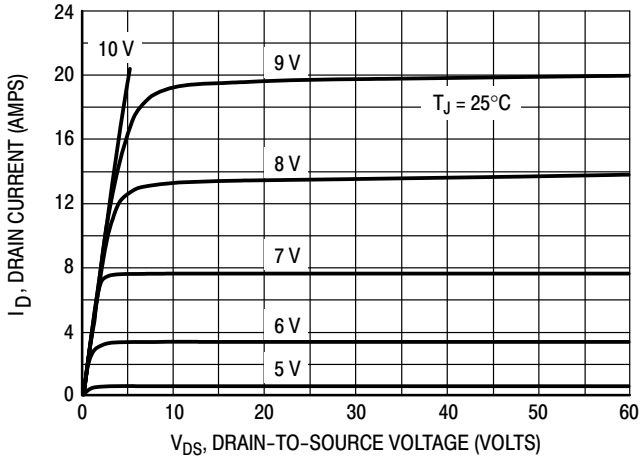


Figure 2. On-Region Characteristics

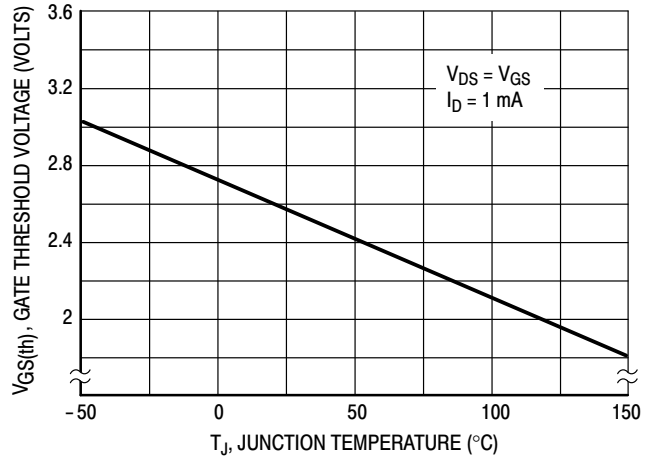


Figure 3. Gate-Threshold Voltage Variation With Temperature

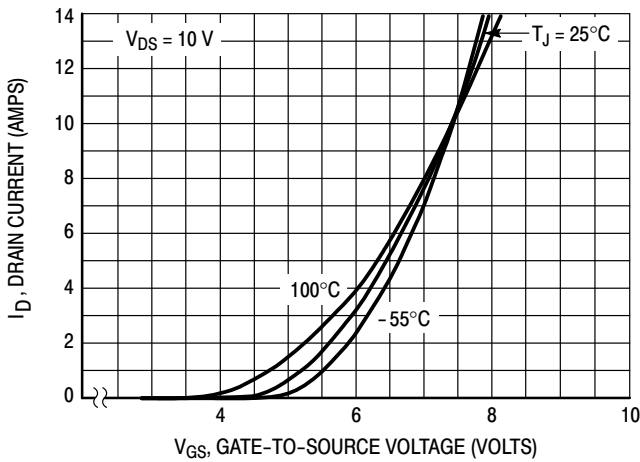


Figure 4. Transfer Characteristics

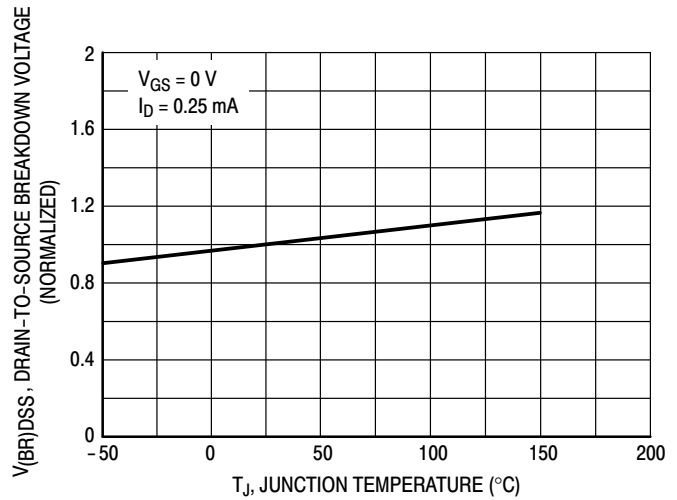


Figure 5. Breakdown Voltage Variation With Temperature

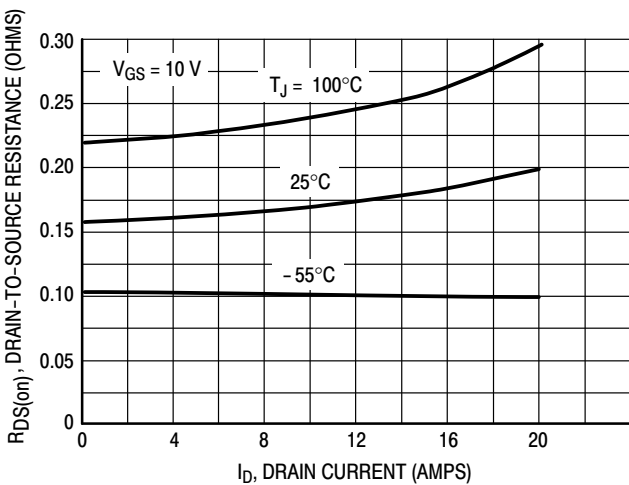


Figure 6. On-Resistance versus Drain Current

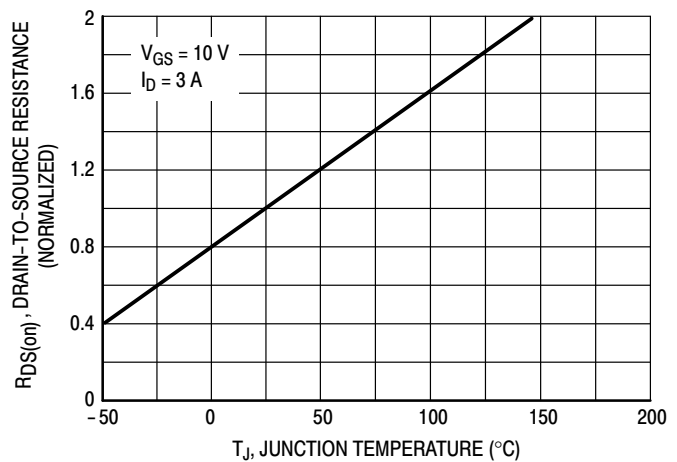


Figure 7. On-Resistance Variation With Temperature

SAFE OPERATING AREA

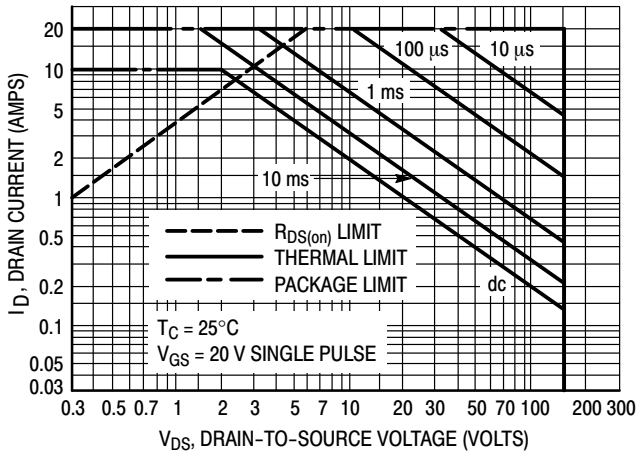


Figure 8. Maximum Rated Forward Biased Safe Operating Area

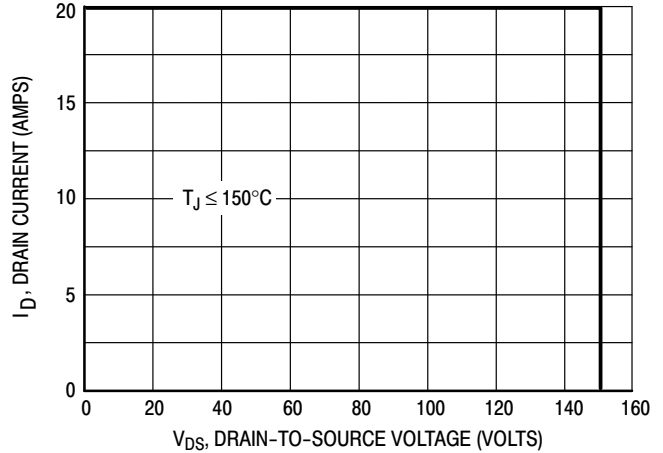


Figure 9. Maximum Rated Switching Safe Operating Area

FORWARD BIASED SAFE OPERATING AREA

The FBSOA curves define the maximum drain-to-source voltage and drain current that a device can safely handle when it is forward biased, or when it is on, or being turned on. Because these curves include the limitations of simultaneous high voltage and high current, up to the rating of the device, they are especially useful to designers of linear systems. The curves are based on a case temperature of 25°C and a maximum junction temperature of 150°C. Limitations for repetitive pulses at various case temperatures can be determined by using the thermal response curves. Motorola Application Note, AN569, "Transient Thermal Resistance-General Data and Its Use" provides detailed instructions.

SWITCHING SAFE OPERATING AREA

The switching safe operating area (SOA) of Figure 9 is the boundary that the load line may traverse without incurring damage to the MOSFET. The fundamental limits are the peak current,  $I_{DM}$  and the breakdown voltage,  $V_{(BR)DSS}$ . The switching SOA shown in Figure 8 is applicable for both turn-on and turn-off of the devices for switching times less than one microsecond.

The power averaged over a complete switching cycle must be less than:

$$\frac{T_{J(max)} - T_C}{R_{\theta JC}}$$

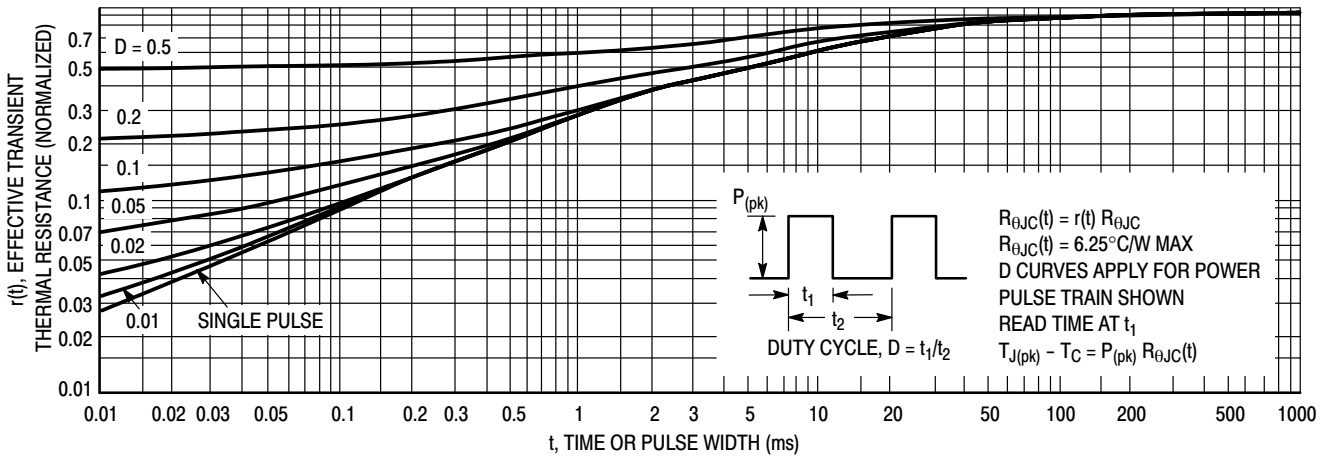


Figure 10. Thermal Response

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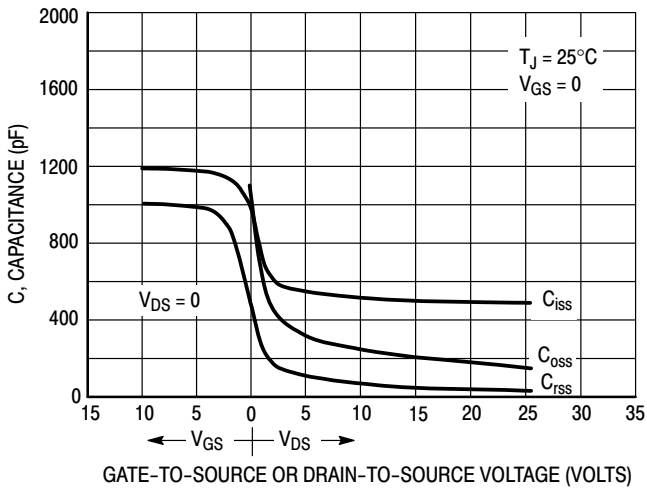


Figure 11. Capacitance Variation

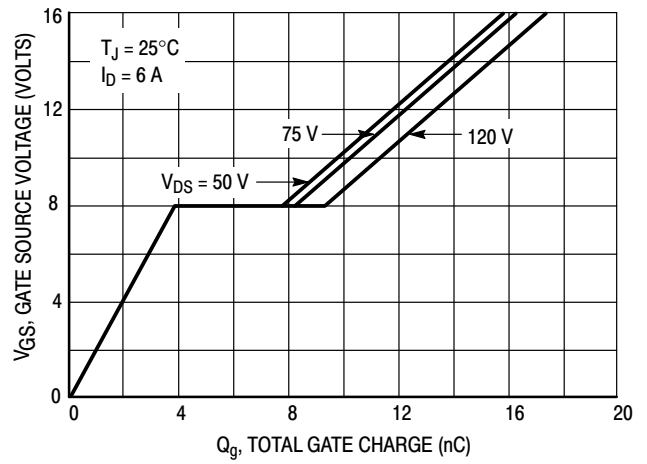


Figure 12. Gate Charge versus Gate-To-Source Voltage

## RESISTIVE SWITCHING

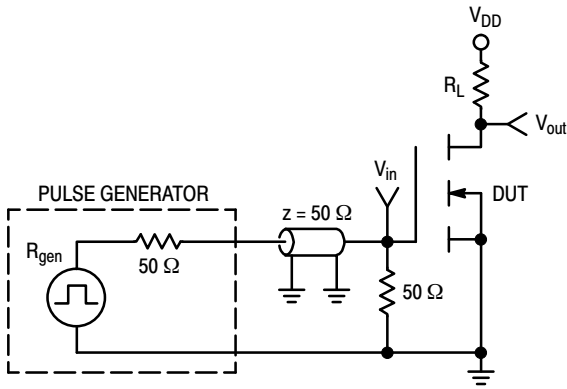


Figure 13. Switching Test Circuit

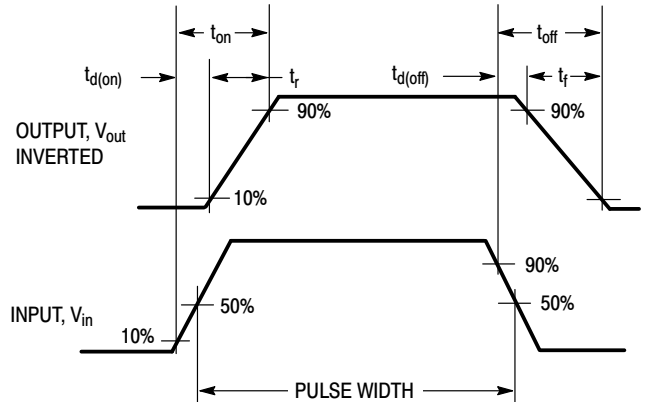
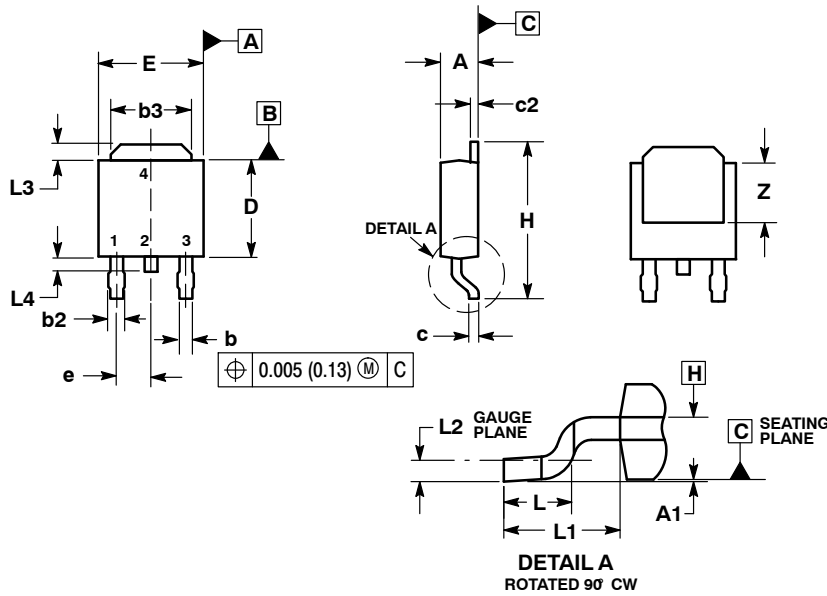


Figure 14. Switching Waveforms

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## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369C ISSUE D



#### NOTES:

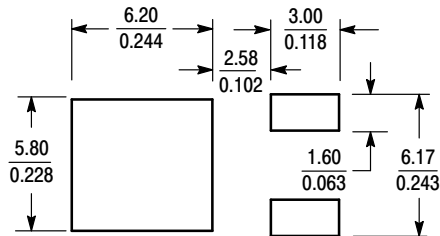
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.030	0.045	0.76	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090 BSC		2.29 BSC	
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.108 REF		2.74 REF	
L2	0.020 BSC		0.51 BSC	
L3	0.035	0.050	0.89	1.27
L4	---	0.040	---	1.01
Z	0.155	---	3.93	---

#### STYLE 2:

- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN

#### SOLDERING FOOTPRINT\*



SCALE 3:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

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