

## N-Channel 60 V (D-S) MOSFET

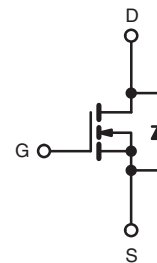
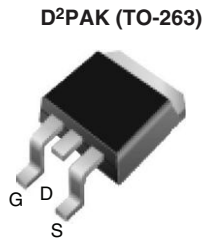
PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a, e</sup>	Q <sub>g</sub> (Max)
60	0.023 at V <sub>GS</sub> = 10 V	50	66 nC
	0.027 at V <sub>GS</sub> = 4.5 V	40	

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Surface Mount
- Available in Tape and Reel
- Dynamic dV/dt Rating
- Logic-Level Gate Drive
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**  
Available



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V <sub>DS</sub>	60	V
Gate-Source Voltage	V <sub>GS</sub>	± 10	
Continuous Drain Current <sup>f</sup>	V <sub>GS</sub> at 10 V	T <sub>C</sub> = 25 °C	A
Continuous Drain Current		T <sub>C</sub> = 100 °C	
Pulsed Drain Current <sup>a</sup>	I <sub>DM</sub>	200	
Linear Derating Factor		1.0	W/°C
Linear Derating Factor (PCB Mount) <sup>e</sup>		0.025	
Single Pulse Avalanche Energy <sup>b</sup>	E <sub>AS</sub>	400	mJ
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	W
Maximum Power Dissipation (PCB Mount) <sup>e</sup>		T <sub>A</sub> = 25 °C	
Peak Diode Recovery dV/dt <sup>c</sup>	dV/dt	4.5	V/ns
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature) <sup>d</sup>	for 10 s	300 <sup>d</sup>	

### Notes

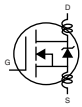
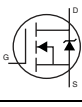
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- V<sub>DD</sub> = 25 V, starting T<sub>J</sub> = 25 °C, L = 179 μH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = 51 A (see fig. 12).
- I<sub>SD</sub> ≤ 51 A, di/dt ≤ 250 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 175 °C.
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material).
- Current limited by the package, (die current = 51 A).

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup>	$R_{thJA}$	-	40	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.0	

**Note**

a. When mounted on 1" square PCB (FR-4 or G-10 material).

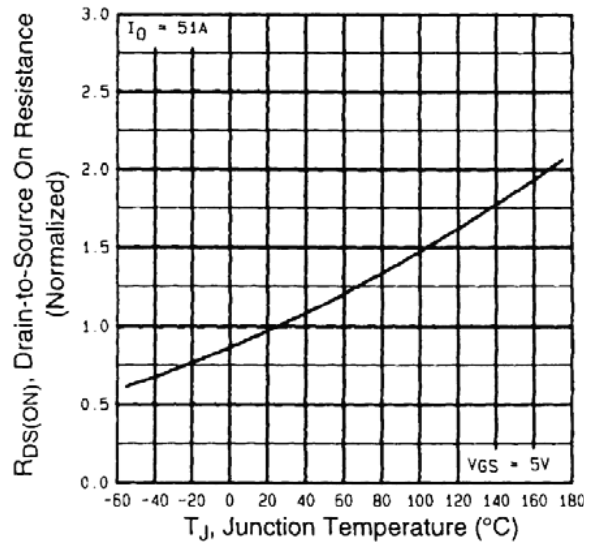
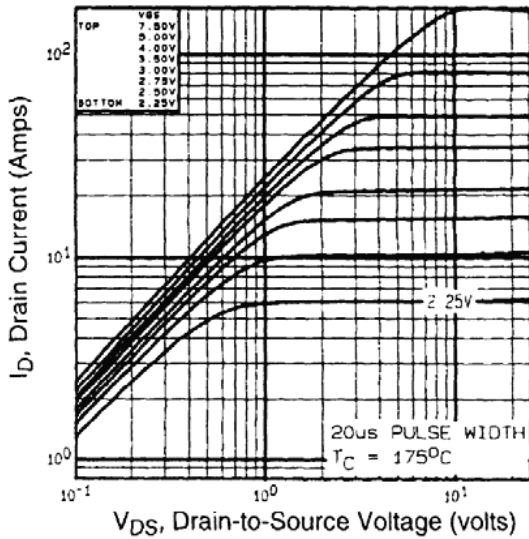
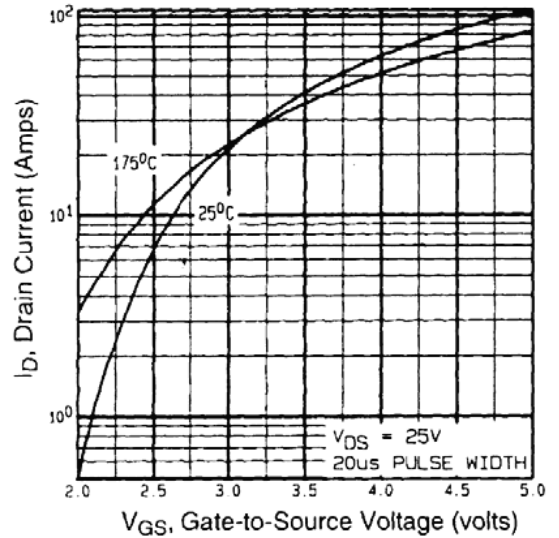
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0, I_D = 250\ \mu A$	60	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, $I_D = 1\text{ mA}$	-	0.070	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\ \mu A$	1.0	-	3.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 10\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$	-	-	25	$\mu A$
		$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ °C}$	-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 21\text{ A}^b$	-	23	-	$\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 15\text{ A}^b$	-	27	-	
Forward Transconductance	$g_{fs}$	$V_{DS} = 25\text{ V}, I_D = 21\text{ A}^b$	23	-	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$	-	3000	-	pF
Output Capacitance	$C_{oss}$		-	1000	-	
Reverse Transfer Capacitance	$C_{rss}$		-	200	-	
Total Gate Charge	$Q_g$	$V_{GS} = 5.0\text{ V}, I_D = 51\text{ A}, V_{DS} = 48\text{ V}, \text{ see fig. 6 and 13}^b$	-	60	-	nC
Gate-Source Charge	$Q_{gs}$		-	10	-	
Gate-Drain Charge	$Q_{gd}$		-	40	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 30\text{ V}, I_D = 51\text{ A}, R_g = 4.6\ \Omega, R_D = 0.56\ \Omega, \text{ see fig. 10}^b$	-	17	-	ns
Rise Time	$t_r$		-	230	-	
Turn-Off Delay Time	$t_{d(off)}$		-	42	-	
Fall Time	$t_f$		-	110	-	
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact 	-	4.5	-	nH
Internal Source Inductance	$L_S$		-	7.5	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	50 <sup>c</sup>	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	200	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ °C}, I_S = 51\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	2.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ °C}, I_F = 51\text{ A}, di/dt = 100\text{ A}/\mu s^b$	-	130	180	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	0.84	1.3	$\mu C$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\ \mu s$ ; duty cycle  $\leq 2\%$ .
- c. Current limited by the package, (Die Current = 51 A).

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



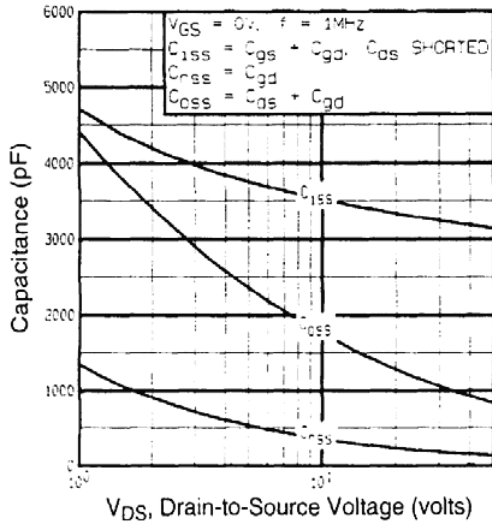


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

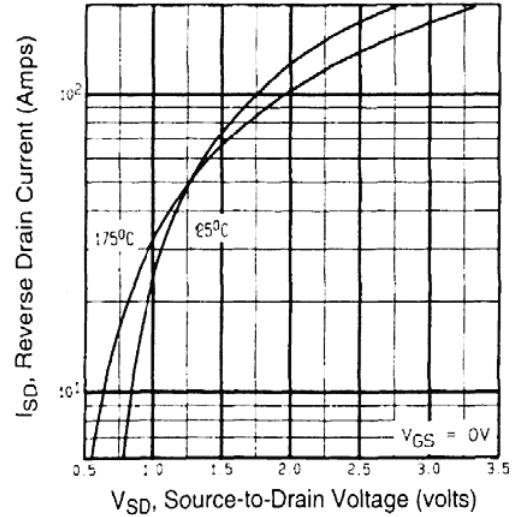


Fig. 7 - Typical Source-Drain Diode Forward Voltage

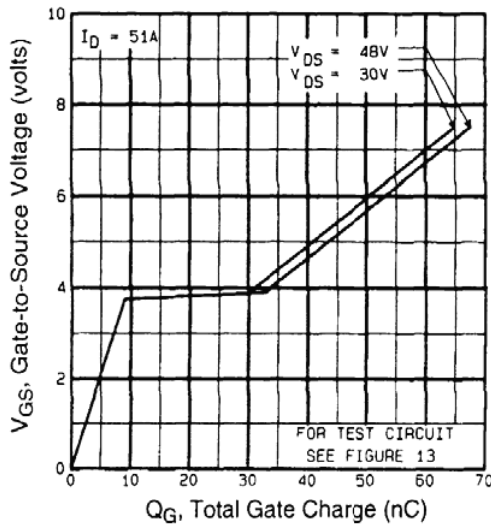


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

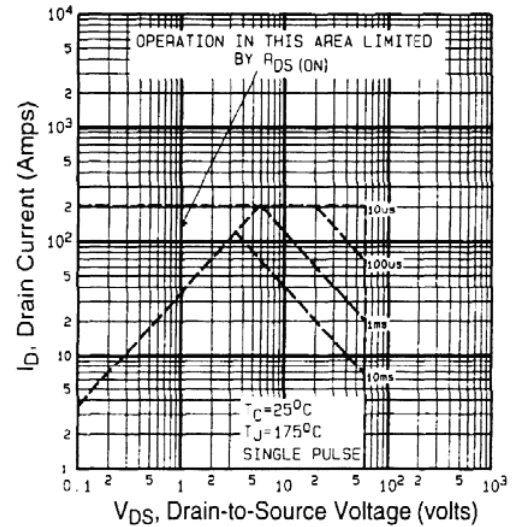


Fig. 8 - Maximum Safe Operating Area

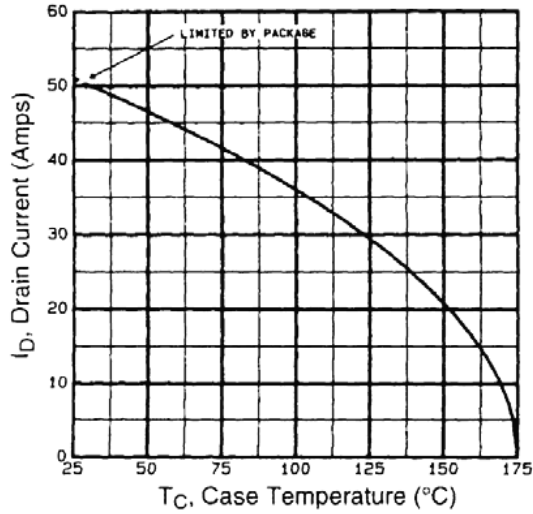


Fig. 9 - Maximum Drain Current vs. Case Temperature

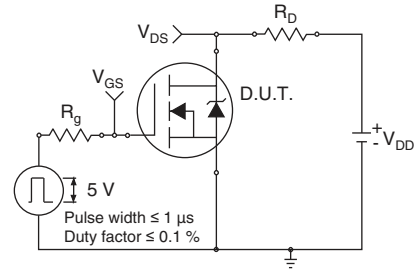


Fig. 10a - Switching Time Test Circuit

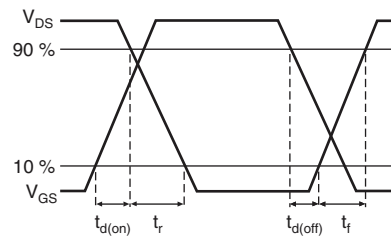


Fig. 10b - Switching Time Waveforms

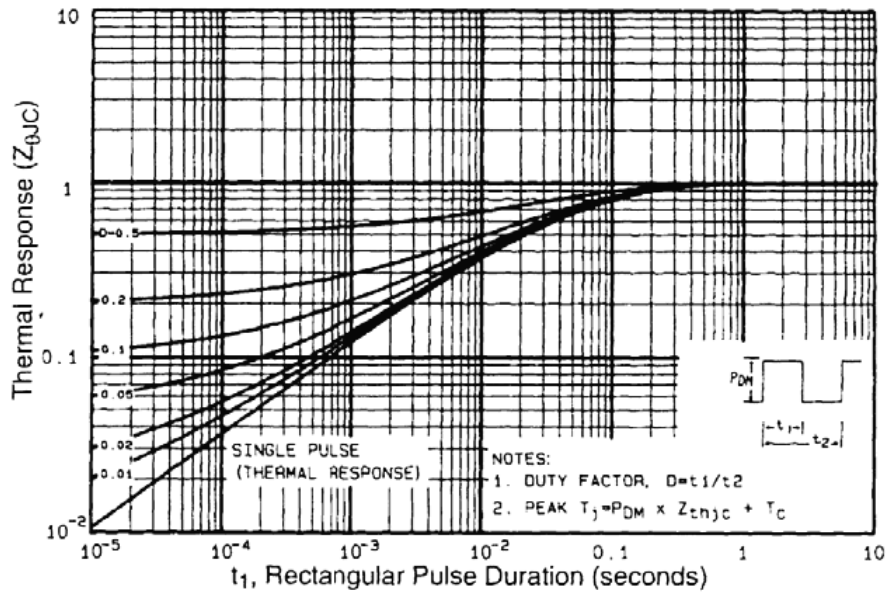


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

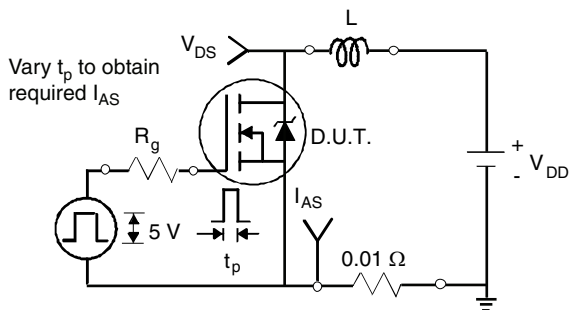


Fig. 12a - Unclamped Inductive Test Circuit

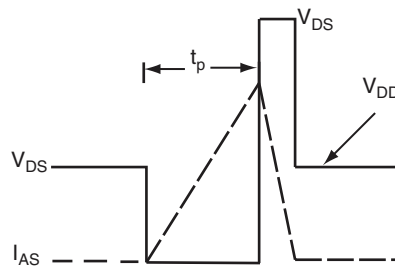


Fig. 12b - Unclamped Inductive Waveforms

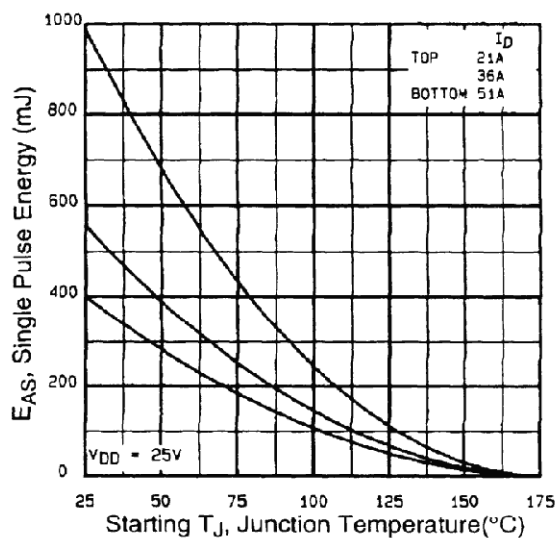


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

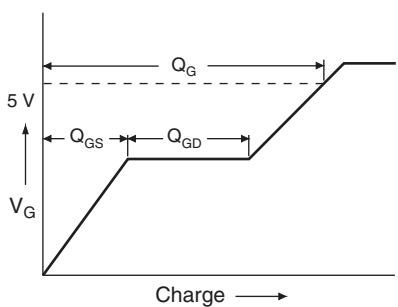


Fig. 13a - Basic Gate Charge Waveform

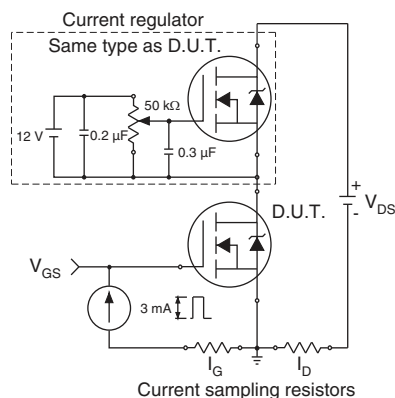
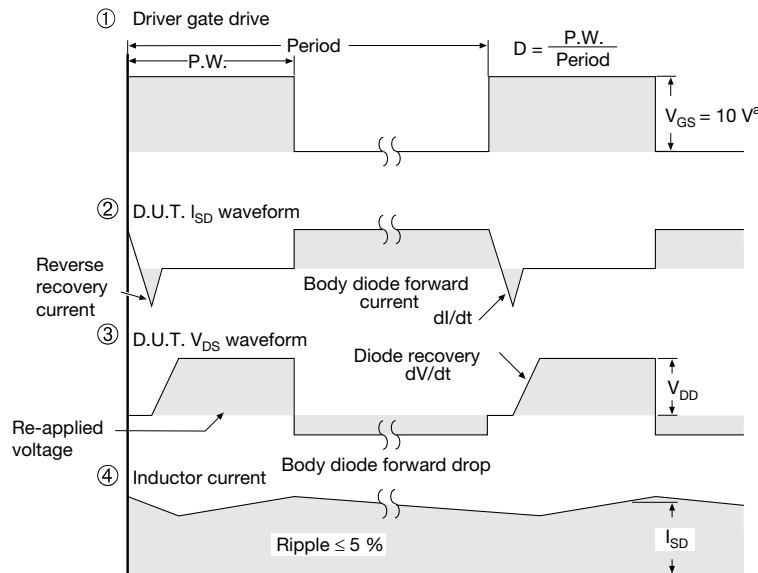
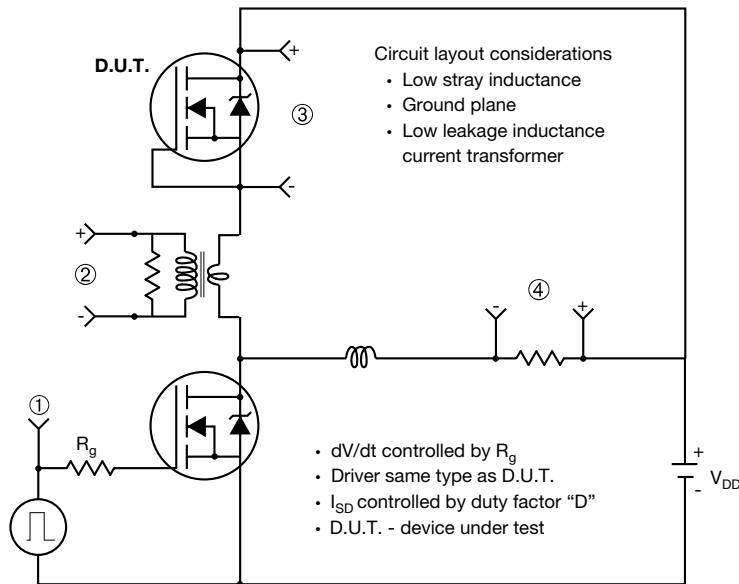


Fig. 13b - Gate Charge Test Circuit

**Peak Diode Recovery dV/dt Test Circuit**

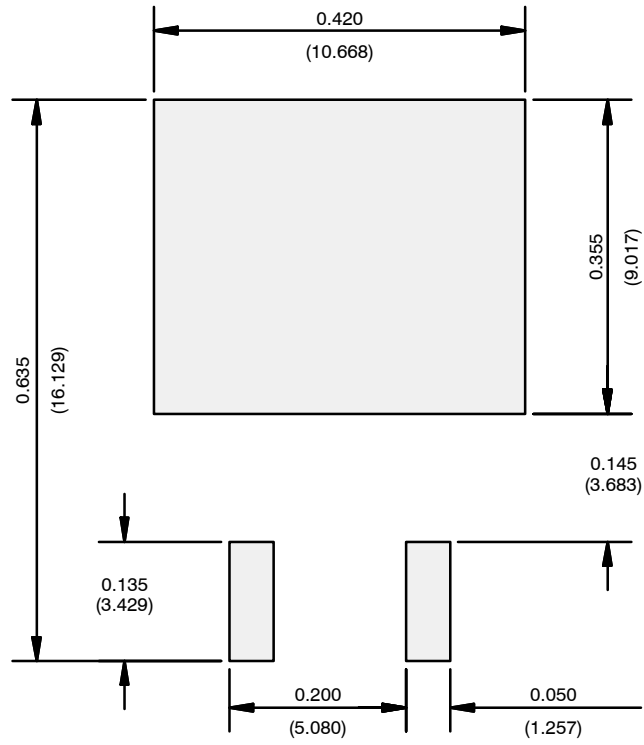


**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)



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