

N-Channel 650 V (D-S) Super Junction MOSFET

PRODUCT SUMMARY		
V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ max. (Ω) at 25 °C	$V_{GS} = 10$ V	0.19
Q_g max. (nC)	106	
Q_{gs} (nC)	14	
Q_{gd} (nC)	33	
Configuration	Single	

FEATURES

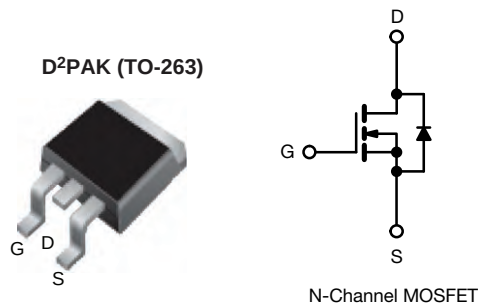
- Reduced t_{rr} , Q_{rr} , and I_{RRM}
- Low figure-of-merit (FOM) $R_{on} \times Q_g$
- Low input capacitance (C_{iss})
- Low switching losses due to reduced Q_{rr}
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Telecommunications
 - Server and telecom power supplies
- Lighting
 - High-intensity discharge (HID)
 - Fluorescent ballast lighting
- Consumer and computing
 - ATX power supplies
- Industrial
 - Welding
 - Battery chargers
- Renewable energy
 - Solar (PV inverters)
- Switch mode power supplies (SMPS)



ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)					
PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V _{DS}	650	V
Gate-Source Voltage			V _{GS}	± 30	
Continuous Drain Current (T _J = 150 °C)	V _{GS} at 10 V	T _C = 25 °C	I _D	20	A
		T _C = 100 °C		13	
Pulsed Drain Current ^a			I _{DM}	60	
Linear Derating Factor				1.7	W/°C
Single Pulse Avalanche Energy ^b			E _{AS}	367	mJ
Maximum Power Dissipation			P _D	208	W
Operating Junction and Storage Temperature Range			T _J , T _{stg}	-55 to +150	°C
Drain-Source Voltage Slope	T _J = 125 °C		dV/dt	37	V/ns
Reverse Diode dV/dt ^d		31			
Soldering Recommendations (Peak Temperature) ^c	for 10 s			300	°C

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature.
 b. $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 5.1$ A.
 c. 1.6 mm from case.
 d. $I_{SD} \leq I_D$, $dI/dt = 100$ A/ μ s, starting $T_J = 25$ °C.

THERMAL RESISTANCE RATINGS

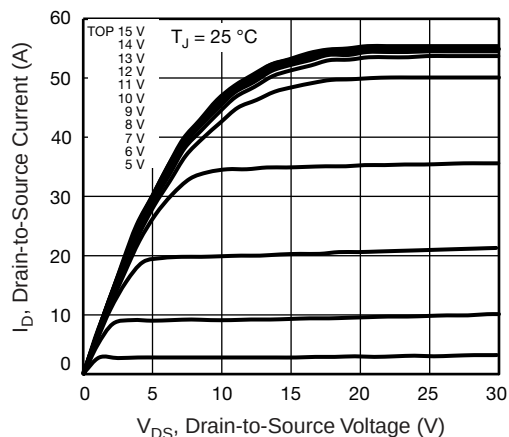
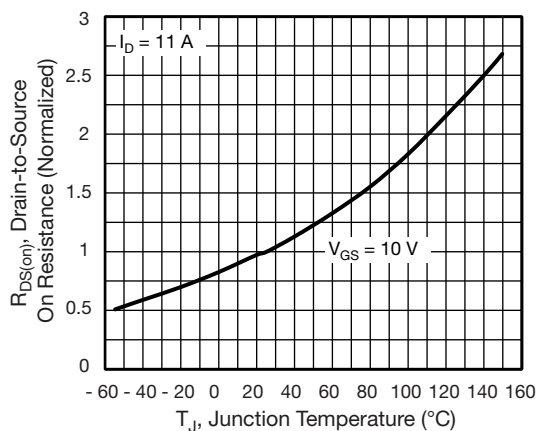
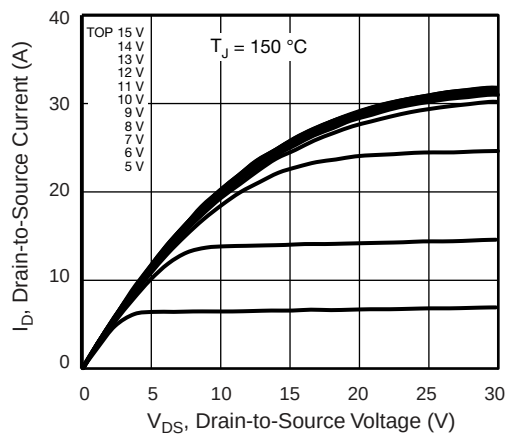
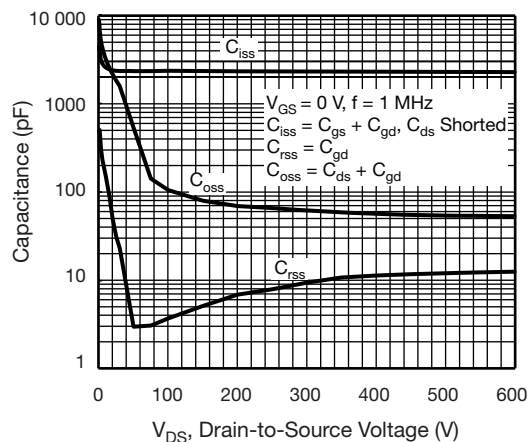
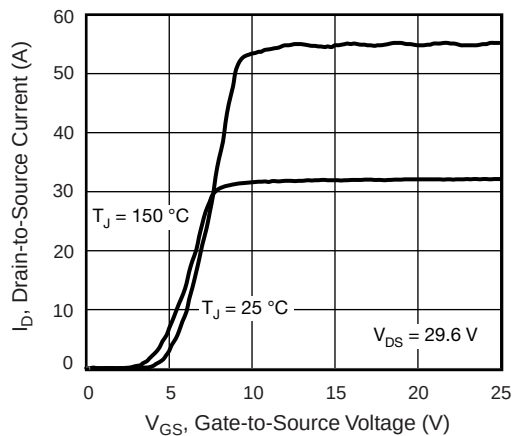
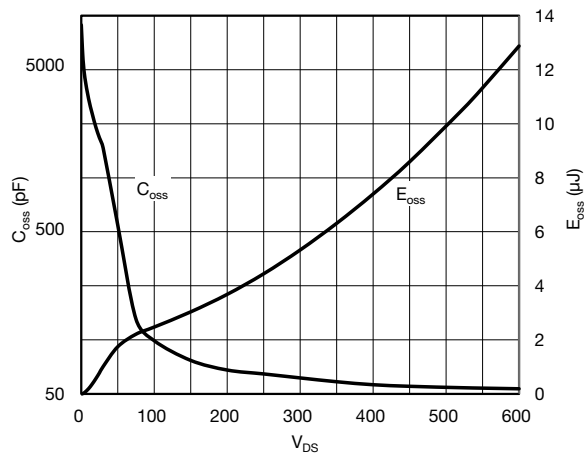
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	62	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.5	

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

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA		650	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA		-	0.67	-	V/°C
Gate-Source Threshold Voltage (N)	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		2	-	4	V
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 20 V		-	-	± 100	nA
		V _{GS} = ± 30 V		-	-	± 1	μA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 520 V, V _{GS} = 0 V		-	-	1	μA
		V _{DS} = 520 V, V _{GS} = 0 V, T _J = 125 °C		-	-	500	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = 10 V	I _D = 11 A	-	0.19	-	Ω
Forward Transconductance	g _{fs}	V _{DS} = 30 V, I _D = 11 A		-	7.0	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz		-	2322	-	pF
Output Capacitance	C _{oss}			-	105	-	
Reverse Transfer Capacitance	C _{rss}			-	4	-	
Effective Output Capacitance, Energy Related ^a	C _{o(er)}	V _{DS} = 0 V to 520 V, V _{GS} = 0 V		-	84	-	pF
Effective Output Capacitance, Time Related ^b	C _{o(tr)}			-	293	-	
Total Gate Charge	Q _g	V _{GS} = 10 V	I _D = 11 A, V _{DS} = 520 V	-	71	106	nC
Gate-Source Charge	Q _{gs}			-	14	-	
Gate-Drain Charge	Q _{gd}			-	33	-	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 520 V, I _D = 11 A, V _{GS} = 10 V, R _g = 9.1 Ω		-	22	44	ns
Rise Time	t _r			-	34	68	
Turn-Off Delay Time	t _{d(off)}			-	68	102	
Fall Time	t _f			-	42	84	
Gate Input Resistance	R _g	f = 1 MHz, open drain		-	0.78	-	Ω
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	21	A
Pulsed Diode Forward Current	I _{SM}			-	-	53	
Diode Forward Voltage	V _{SD}	T _J = 25 °C, I _S = 11 A, V _{GS} = 0 V		-	0.9	1.2	V
Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = I _S = 11 A, dI/dt = 100 A/μs, V _R = 25 V		-	160	-	ns
Reverse Recovery Charge	Q _{rr}			-	1.2	-	μC
Reverse Recovery Current	I _{RRM}			-	14	-	A

Notes

- a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .
 b. $C_{oss(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Fig. 1 - Typical Output Characteristics

Fig. 4 - Normalized On-Resistance vs. Temperature

Fig. 2 - Typical Output Characteristics

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

Fig. 3 - Typical Transfer Characteristics

Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

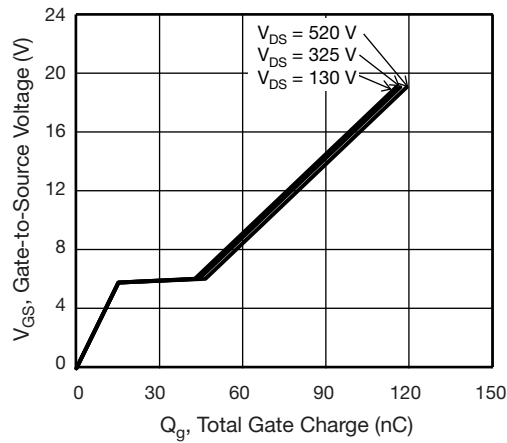


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

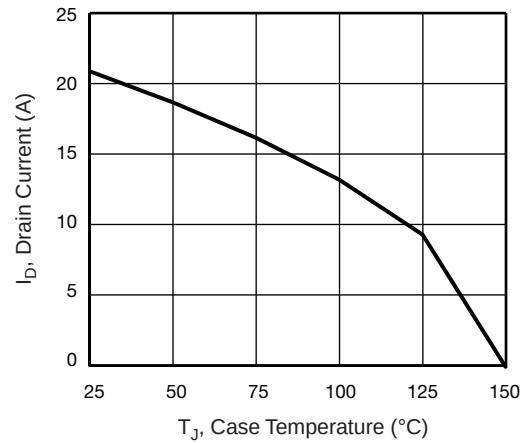


Fig. 10 - Maximum Drain Current vs. Case Temperature

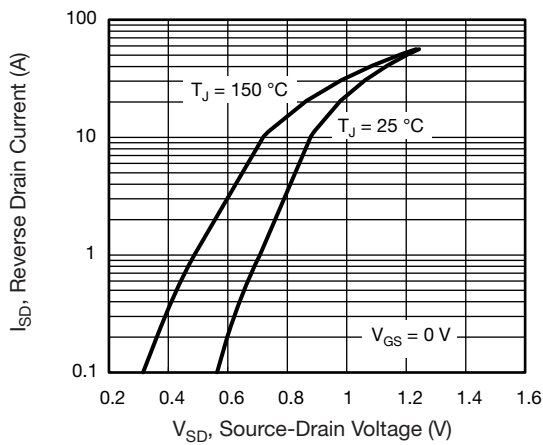


Fig. 8 - Typical Source-Drain Diode Forward Voltage

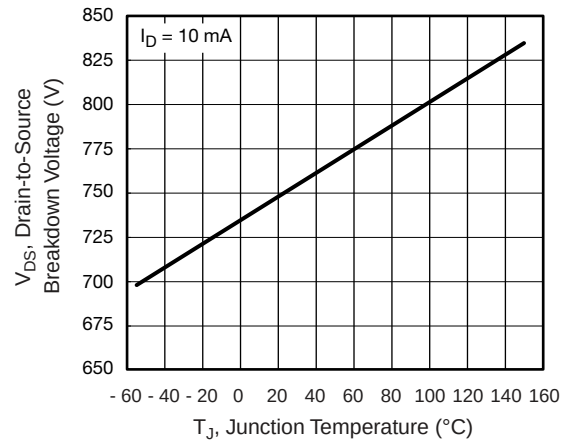


Fig. 11 - Temperature vs. Drain-to-Source Voltage

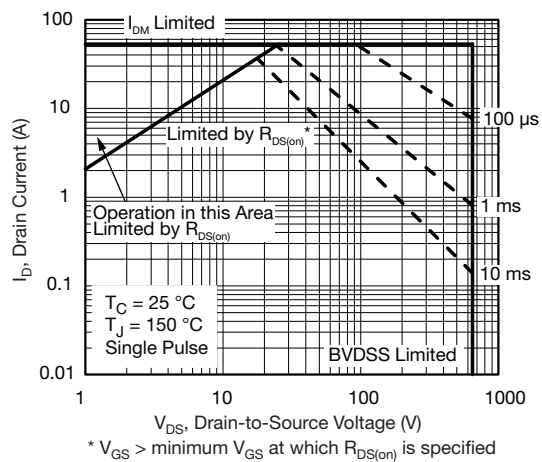


Fig. 9 - Maximum Safe Operating Area

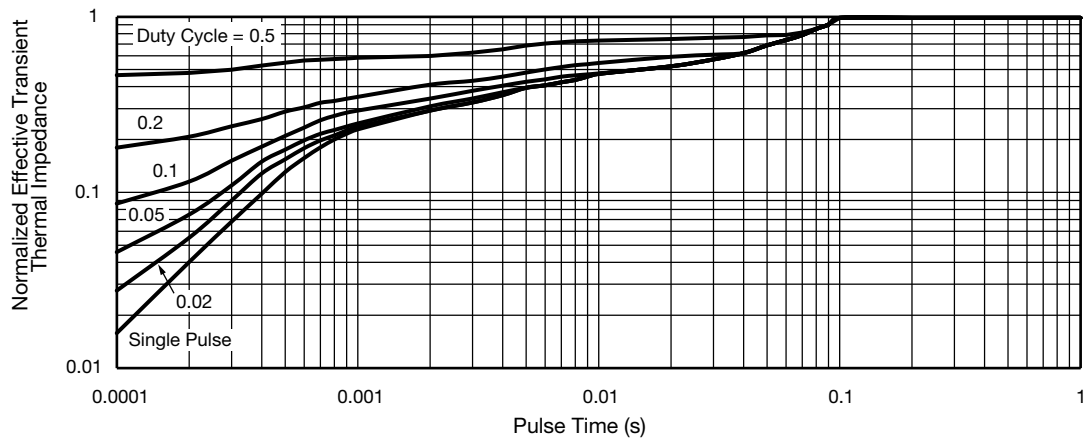


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

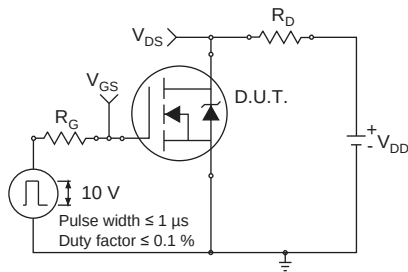


Fig. 13 - Switching Time Test Circuit

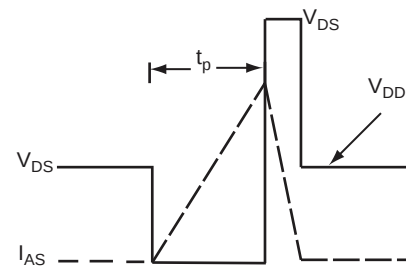


Fig. 16 - Unclamped Inductive Waveforms

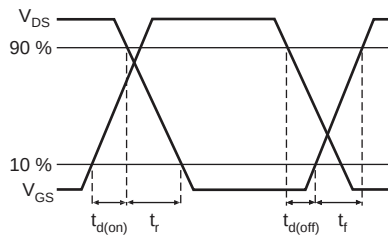


Fig. 14 - Switching Time Waveforms

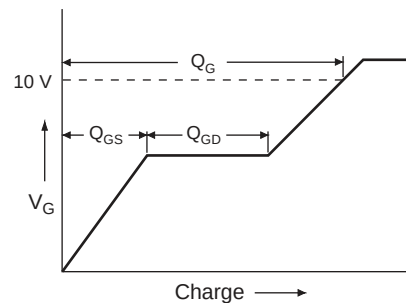


Fig. 17 - Basic Gate Charge Waveform

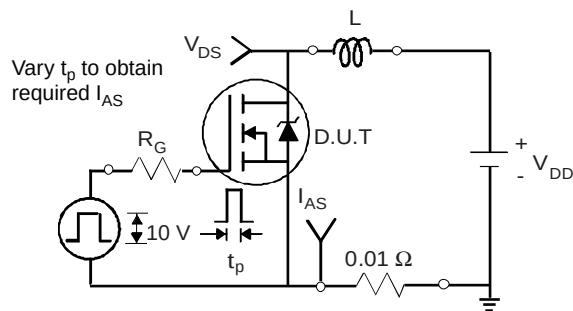


Fig. 15 - Unclamped Inductive Test Circuit

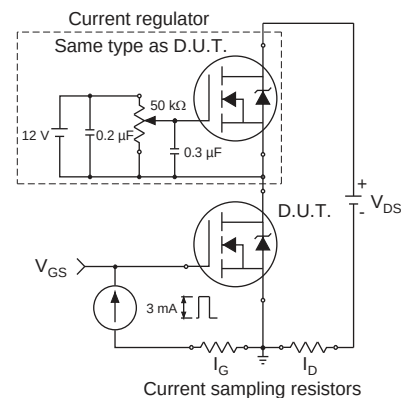
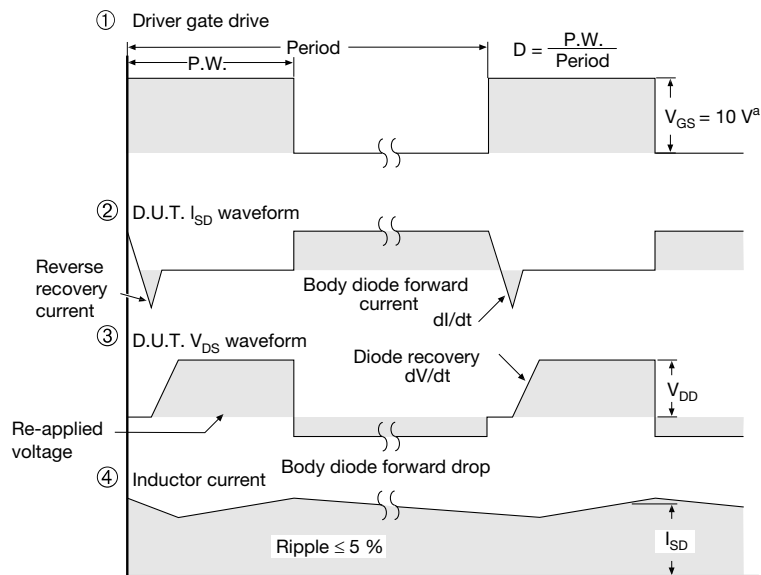
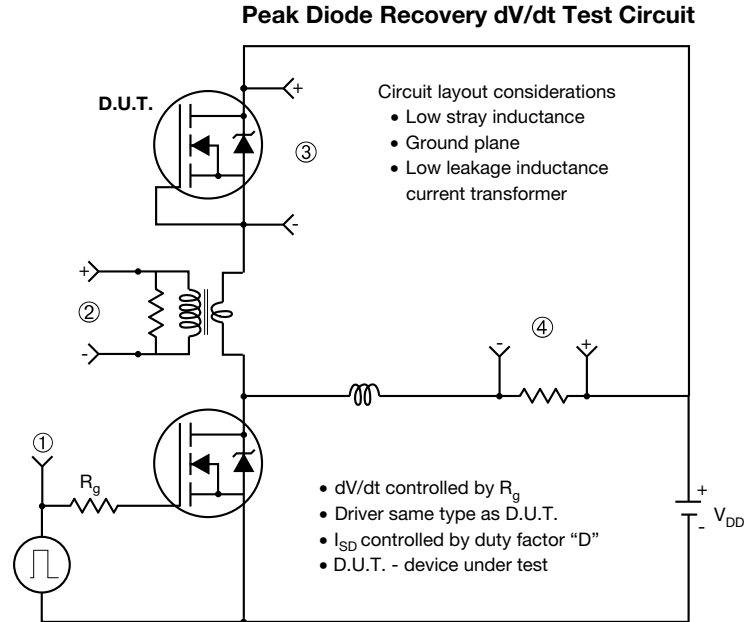
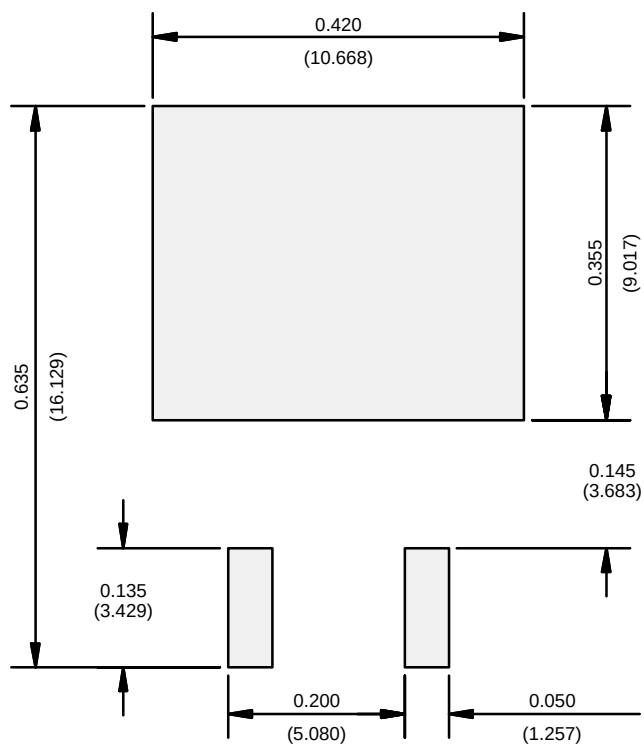


Fig. 18 - Gate Charge Test Circuit

**Note**a. $V_{GS} = 5\text{ V}$ for logic level devices**Fig. 19 - For N-Channel**

RECOMMENDED MINIMUM PADS FOR D²PAK: 3-Lead

Recommended Minimum Pads
Dimensions in Inches/(mm)

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