

EF Series Power MOSFET with Fast Body Diode

PRODUCT SUMMARY		
V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ max. at 25 °C (Ω)	$V_{GS} = 10$ V	0.065
Q_g max. (nC)	228	
Q_{gs} (nC)	32	
Q_{gd} (nC)	62	
Configuration	Single	

FEATURES

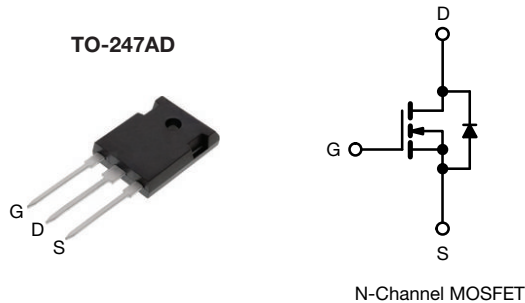
- Fast body diode MOSFET using E series technology
- Reduced t_{rr} , Q_{rr} , and I_{RRM}
- Low figure-of-merit (FOM) $R_{on} \times Q_g$
- Low input capacitance (C_{iss})
- Increased robustness due to low Q_{rr}
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Telecommunications
 - Server and telecom power supplies
- Lighting
 - High-intensity lighting (HID)
 - Light emitting diodes (LEDs)
- Consumer and computing
 - ATX power supplies
- Industrial
 - Welding
 - Battery chargers
- Renewable energy
 - Solar (PV inverters)
- Switching mode power supplies (SMPS)
 - Applications using the following topologies
 - LLC
 - Phase shifted bridge (ZVS)
 - 3-level inverter
 - AC/DC bridge



ORDERING INFORMATION	
Package	TO-247AD
Lead (Pb)-free and Halogen-free	SiHW47N60EF-GE3


ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)				
PARAMETER	SYMBOL		LIMIT	UNIT
Drain-Source Voltage	V_{DS}		600	V
Gate-Source Voltage	V_{GS}		± 30	
Continuous Drain Current ($T_J = 150$ °C)	V_{GS} at 10 V	$T_C = 25$ °C	47	A
		$T_C = 100$ °C	29	
Pulsed Drain Current ^a	I_{DM}		138	
Linear Derating Factor			3	W/°C
Single Pulse Avalanche Energy ^b	E_{AS}		1500	mJ
Maximum Power Dissipation	P_D		379	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}		-55 to +150	°C
Drain-Source Voltage Slope	$T_J = 125$ °C		70	V/ns
Reverse Diode dV/dt ^d	dV/dt		50	
Soldering Recommendations (Peak Temperature) ^c	for 10 s		300	°C

Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 73.5$ mH, $R_g = 25$ Ω , $I_{AS} = 6.4$ A
- 1.6 mm from case
- $I_{SD} \leq I_D$, $dI/dt = 500$ A/ μ s, starting $T_J = 25$ °C



THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.33	

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}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		600	-	-	V		
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$		-	-	-	V/°C		
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		2.0	-	4.0	V		
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA		
		$V_{GS} = \pm 30\text{ V}$		-	-	± 1	μA		
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$		-	-	1	μA		
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	500			
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 24\text{ A}$	-	0.056	0.065	Ω		
Forward Transconductance	g_{fs}	$V_{DS} = 30\text{ V}, I_D = 24\text{ A}$		-	17	-	S		
Dynamic									
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$		-	5000	-	pF		
Output Capacitance	C_{oss}			-	220	-			
Reverse Transfer Capacitance	C_{rss}			-	7	-			
Effective Output Capacitance, Energy Related ^a	$C_{o(er)}$			$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$		-		172	-
Effective Output Capacitance, Time Related ^b	$C_{o(tr)}$					-		634	-
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 24\text{ A}, V_{DS} = 480\text{ V}$	-	152	228	nC		
Gate-Source Charge	Q_{gs}			-	32	-			
Gate-Drain Charge	Q_{gd}			-	62	-			
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 480\text{ V}, I_D = 24\text{ A}, V_{GS} = 10\text{ V}, R_g = 4.4\text{ }\Omega$		-	30	60	ns		
Rise Time	t_r			-	56	84			
Turn-Off Delay Time	$t_{d(off)}$			-	91	137			
Fall Time	t_f			-	56	84			
Gate Input Resistance	R_g			$f = 1\text{ MHz}, \text{open drain}$		0.2		0.46	1.0
Drain-Source Body Diode Characteristics									
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	47	A		
Pulsed Diode Forward Current	I_{SM}			-	-	138			
Diode Forward Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 24\text{ A}, V_{GS} = 0\text{ V}$		-	0.9	1.2	V		
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 24\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	199	398	ns		
Body Diode Reverse Recovery Charge	Q_{rr}			-	1.4	2.8	μC		
Reverse Recovery Current	I_{RRM}			-	13.2	-	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)

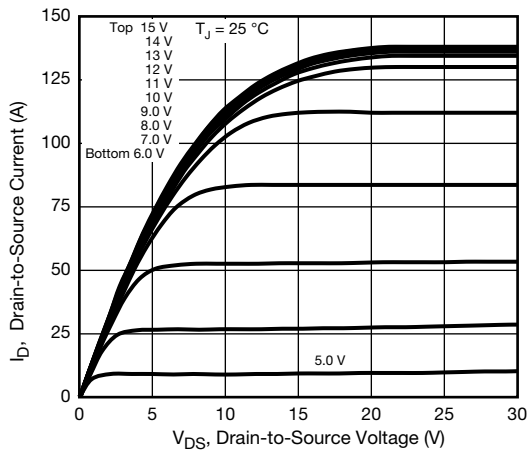


Fig. 1 - Typical Output Characteristics

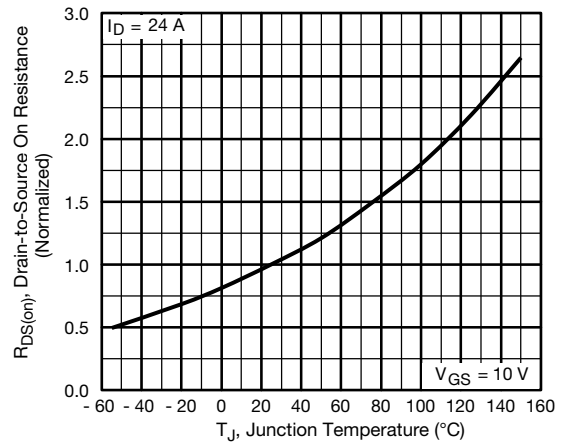


Fig. 4 - Normalized On-Resistance vs. Temperature

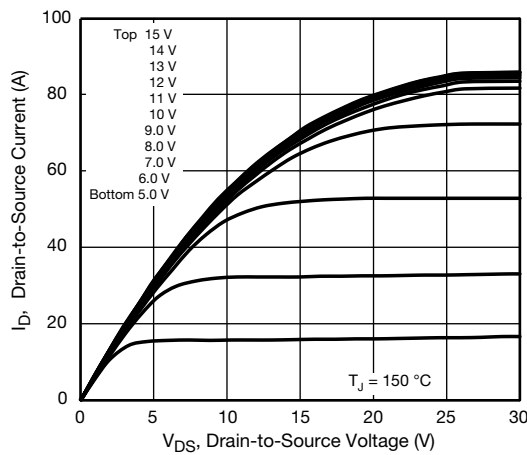


Fig. 2 - Typical Output Characteristics

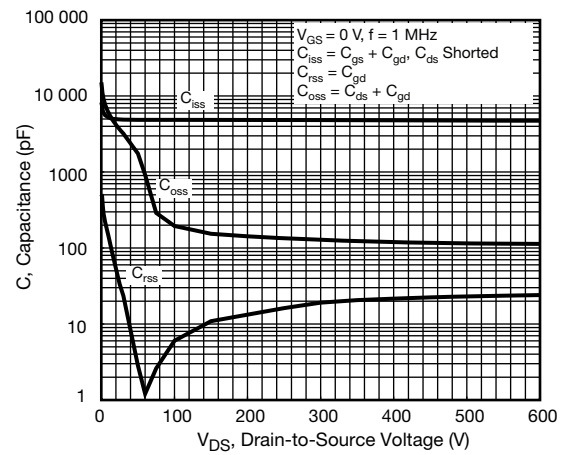


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

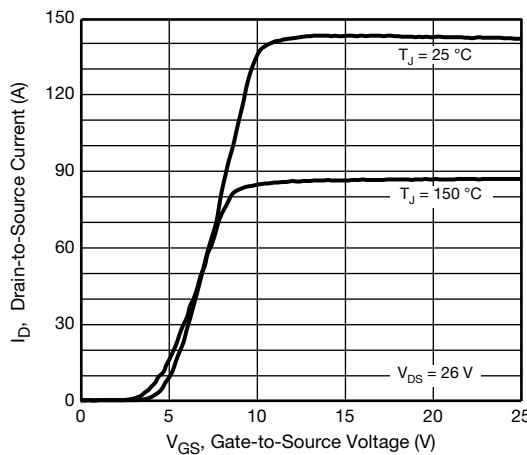


Fig. 3 - Typical Transfer Characteristics

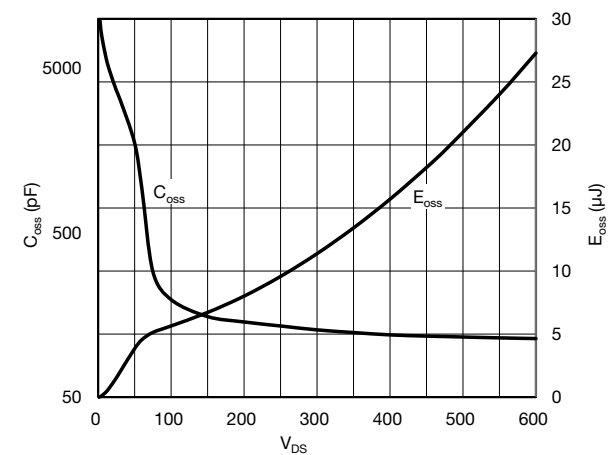


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

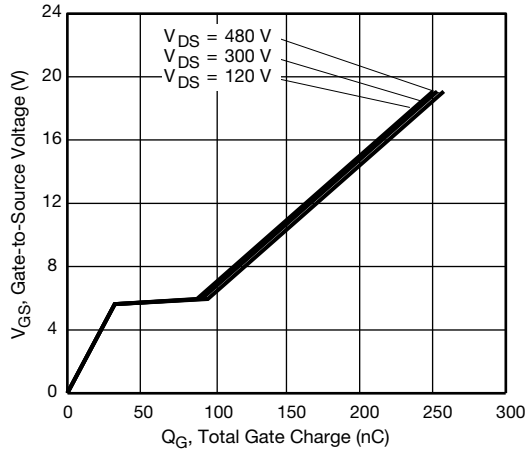


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

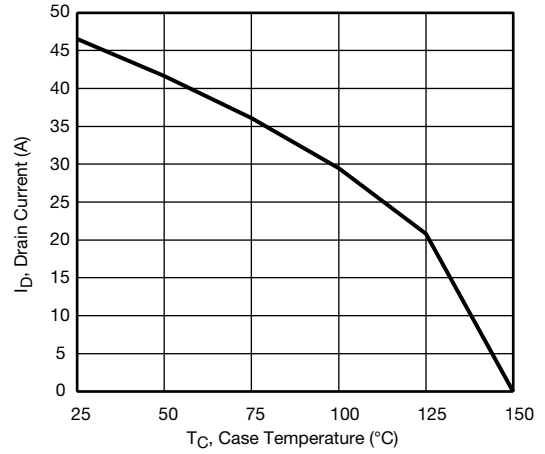


Fig. 10 - Maximum Drain Current vs. Case Temperature

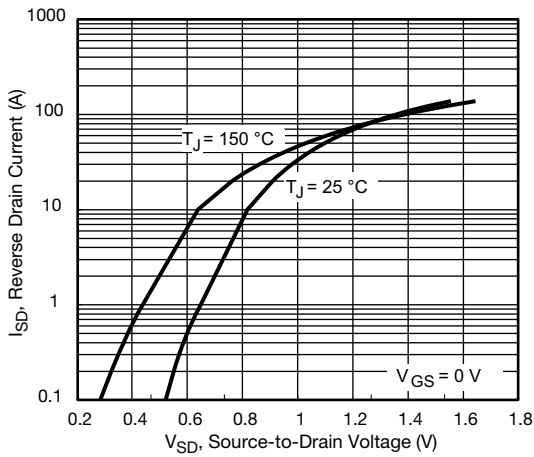


Fig. 8 - Typical Source-Drain Diode Forward Voltage

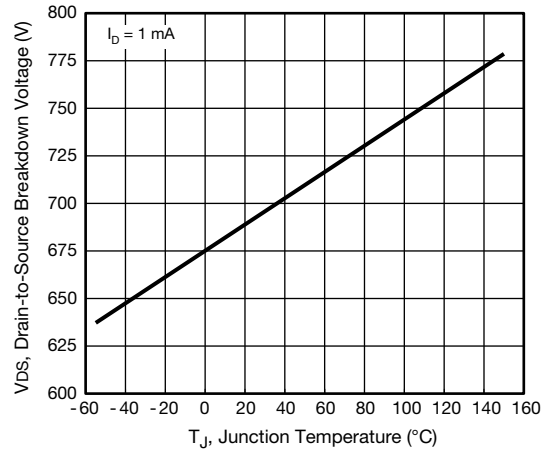


Fig. 11 - Temperature vs. Drain-to-Source Voltage

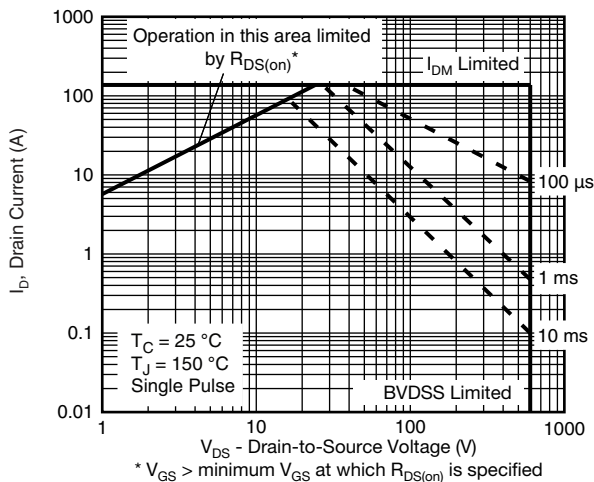


Fig. 9 - Maximum Safe Operating Area

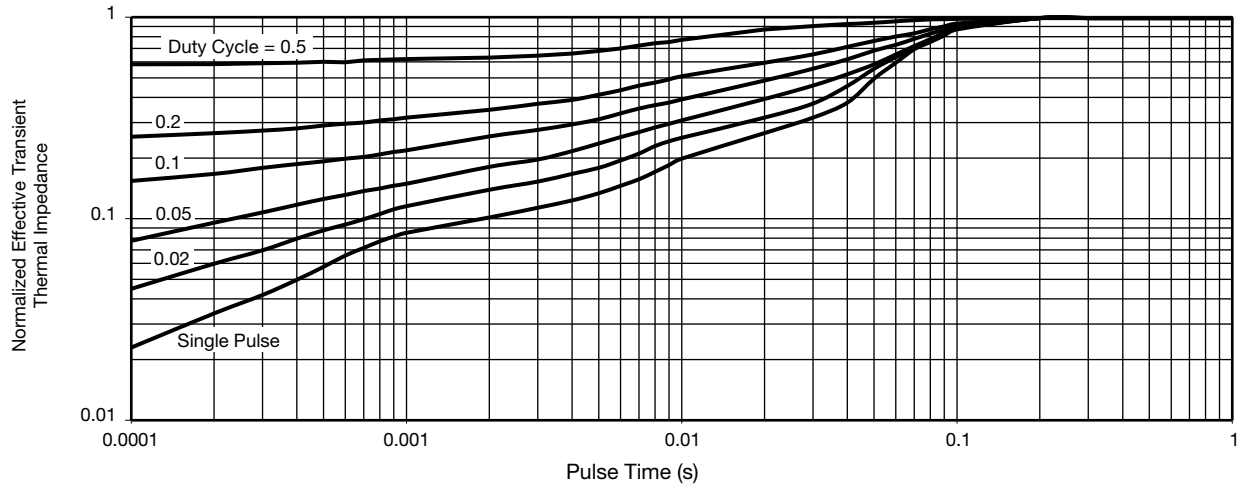


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

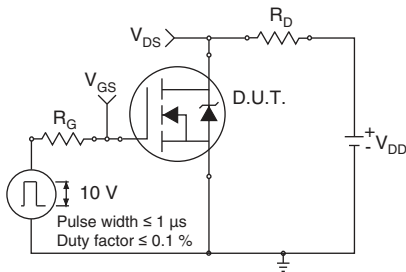


Fig. 13 - Switching Time Test Circuit

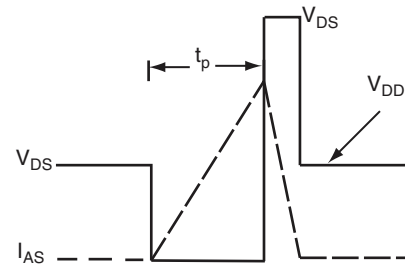


Fig. 16 - Unclamped Inductive Waveforms

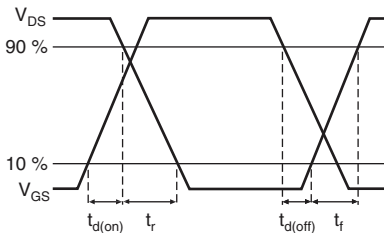


Fig. 14 - Switching Time Waveforms

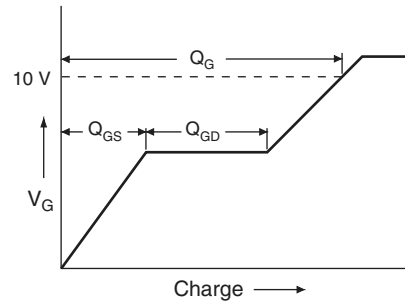


Fig. 17 - Basic Gate Charge Waveform

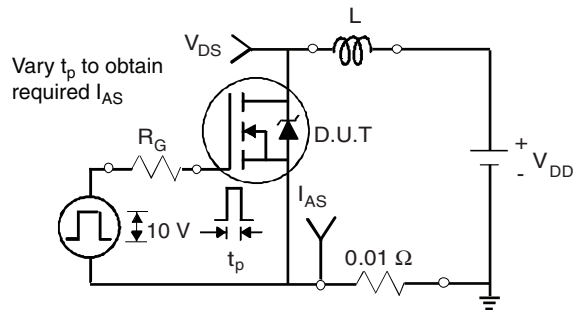


Fig. 15 - Unclamped Inductive Test Circuit

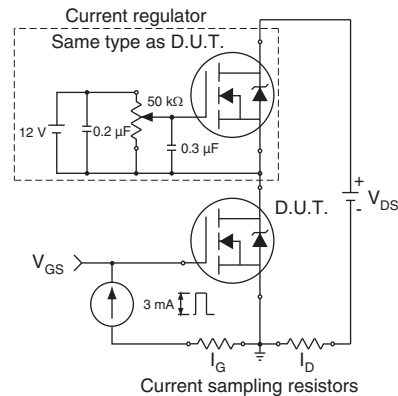
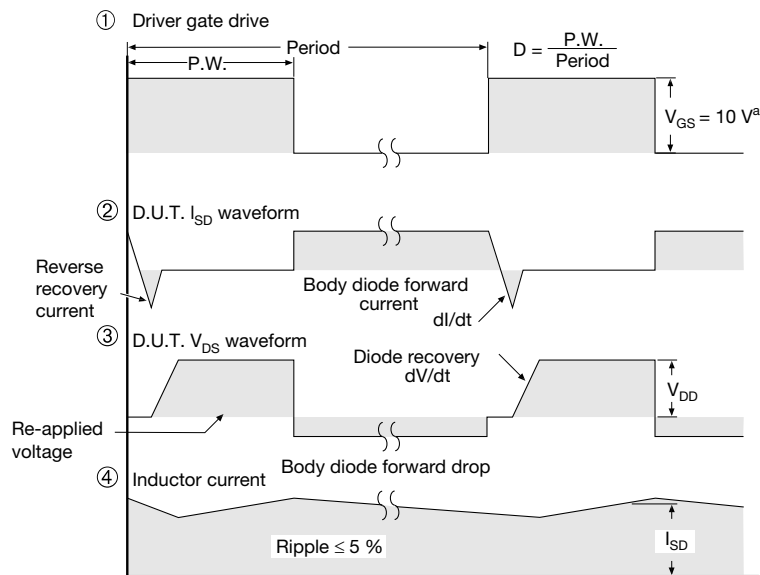
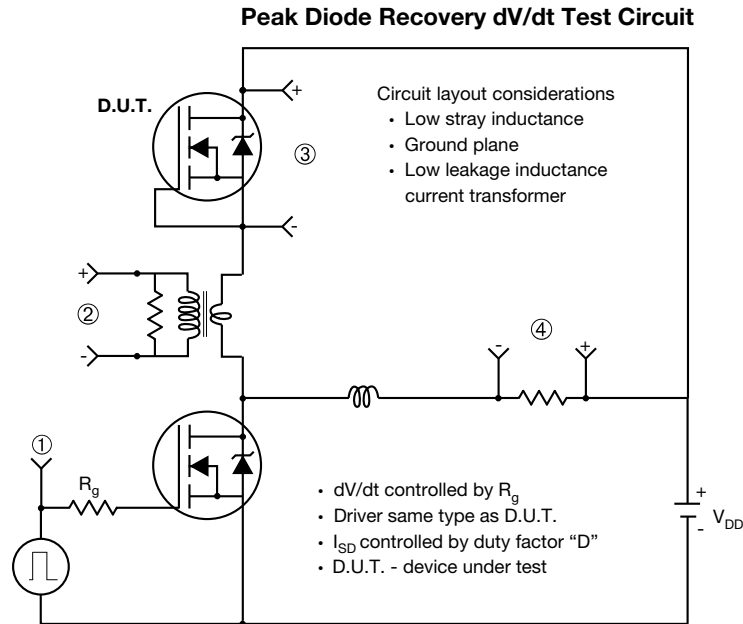


Fig. 18 - Gate Charge Test Circuit



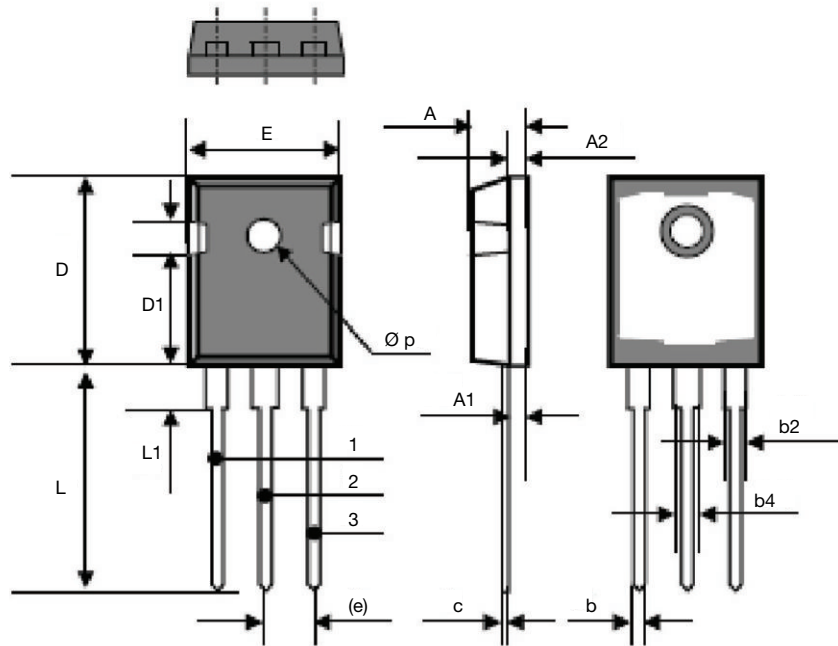
Note

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

Fig. 18 - For N-Channel

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TO-247AD (High Voltage)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.70	5.31	0.185	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b2	1.65	2.41	0.065	0.095
b4	2.59	3.43	0.102	0.135
c	0.61 BSC		0.024 BSC	
D	20.80	21.46	0.819	0.845
D1	3.68	5.49	0.145	0.216
(e)	5.46 BSC		0.215 BSC	
E	15.49	16.26	0.610	0.640
L	19.81	20.32	0.780	0.800
L1	4.06	4.50	0.160	0.177
Ø p	3.51	3.66	0.138	0.144
ECN: S17-0178-Rev. B, 06-Feb-17				
DWG: 6010				



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