

# HMW60N043F7

## N-Channel eMOS F7 Power MOSFET

600 V, 64 A, 43 mΩ

### Description

The 600V eMOS F7 is a fast recovery type MOSFET using E7 technology. eMOS F7 is an advanced Power Master Semiconductor's Super Junction MOSFET family by utilizing charge balance technology for excellent low on-resistance and gate charge. It combines the benefits of a fast switching performance with ease of usage and robustness. Additionally, we offer low reverse recovery time( $t_{rr}$ ) and reverse recovery charge( $Q_{rr}$ ). Thus, 600V eMOS F7 is very suitable for the bridge structure topology, especially for resonant converters (LLC, PSFB, etc.).

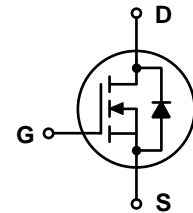
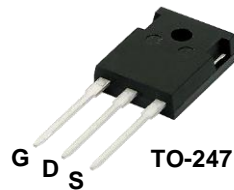
### Applications

- Soft Switching Topologies
- Telecom and Server Power Supplies
- EV Charger and Industrial Power Supplies

### Features

$BV_{DSS} @ T_{J,max}$	$I_D$	$R_{DS(on),max}$	$Q_{g,typ}$
650 V	64 A	43 mΩ	144 nC

- Reduced Switching & Conduction Losses
- Fast Recovery Body-Diode
- Lower Gate Resistance
- 100% Avalanche Tested
- Pb-free and RoHS Compliant



### Absolute Maximum Ratings ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain to Source Voltage	600	V
$V_{GSS}$	Gate to Source Voltage	±30	V
$I_D$	Drain Current	Continuous ( $T_C = 25^\circ\text{C}$ )	64
		Continuous ( $T_C = 100^\circ\text{C}$ )	40.5
$I_{DM}$	Drain Current	Pulsed (Note1)	192
$E_{AS}$	Single Pulsed Avalanche Energy	(Note2)	457
$I_{AS}$	Avalanche Current	(Note2)	8.4
$E_{AR}$	Repetitive Avalanche Energy	(Note1)	4.46
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt	(Note3)	
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	446
		Derate Above $25^\circ\text{C}$	3.57
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds	260	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.28	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

## Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
HMW60N043F7	HMW60N043F7	TO-247	Tube	30 units

Electrical Characteristics ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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## Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	600			V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$	650			
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$			10	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}$		78		
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA

## On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 4.3\text{ mA}$	3.0		5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 32\text{ A}$		36	43	m $\Omega$

## Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V},$ $f = 250\text{ kHz}$		5496		pF
$C_{oss}$	Output Capacitance			135		pF
$C_{o(tr)}$	Time Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		1474		pF
$C_{o(er)}$	Energy Related Output Capacitance			215		pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}, I_D = 32\text{ A},$ $V_{GS} = 10\text{ V}$		144		nC
$Q_{gs}$	Gate to Source Charge			36		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			71		nC
$R_G$	Gate Resistance	$f = 1\text{ MHz}$		1		$\Omega$

## Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 400\text{ V}, I_D = 32\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 3.3\text{ }\Omega$ See Figure 13		30		ns
$t_r$	Turn-On Rise Time			13		ns
$t_{d(off)}$	Turn-Off Delay Time			96		ns
$t_f$	Turn-Off Fall Time			8		ns

## Source-Drain Diode Characteristics

$I_S$	Maximum Continuous Diode Forward Current			64		A
$I_{SM}$	Maximum Pulsed Diode Forward Current			192		A
$V_{SD}$	Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 32\text{ A}$			1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{DD} = 400\text{ V}, I_{SD} = 32\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$		193		ns
$Q_{rr}$	Reverse Recovery Charge			1.86		$\mu\text{C}$

## ※Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 8.4\text{ A}, R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 32\text{ A}, di/dt \leq 100\text{ A}/\mu\text{s}, V_{DD} \leq 400\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .

Typical Performance Characteristics

Figure 1. On-Region Characteristics

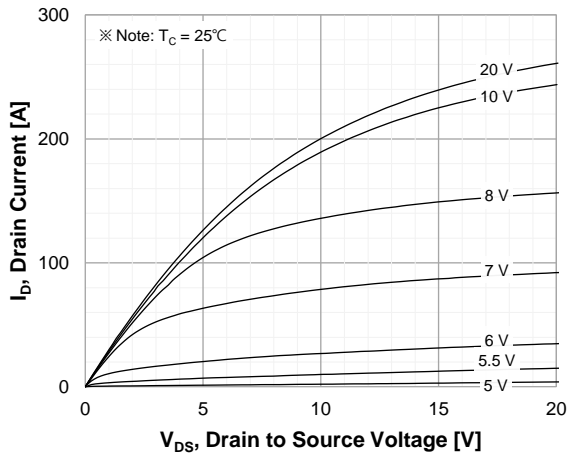


Figure 2. Transfer Characteristics

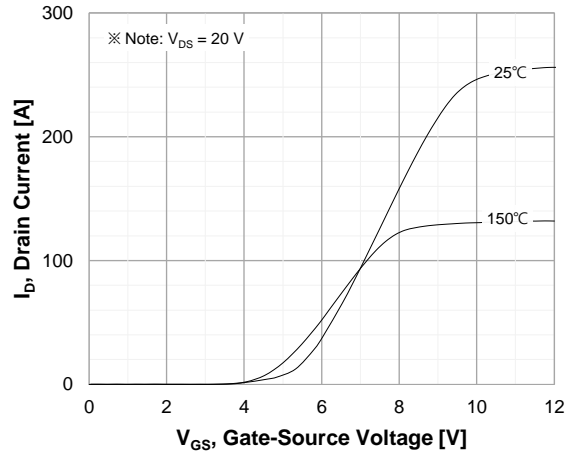


Figure 3. On-Resistance Characteristics vs. Drain Current and Gate Voltage

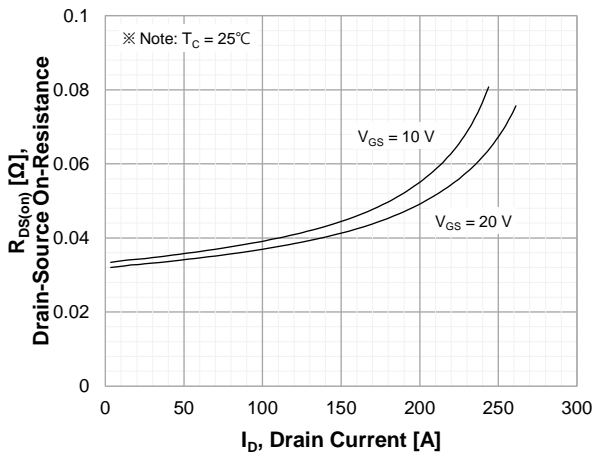


Figure 4. Diode Forward Voltage Characteristics vs. Source-Drain Current and Temperature

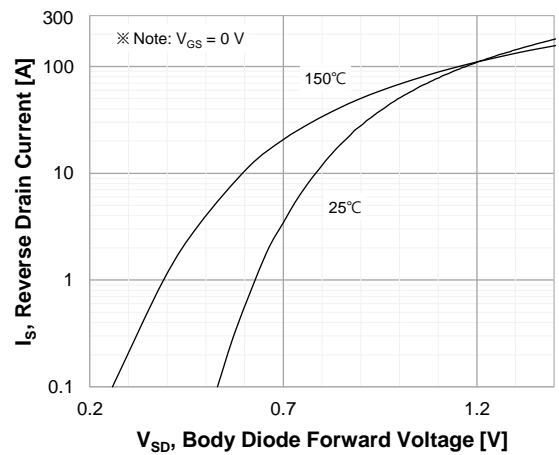


Figure 5. Capacitance Characteristics

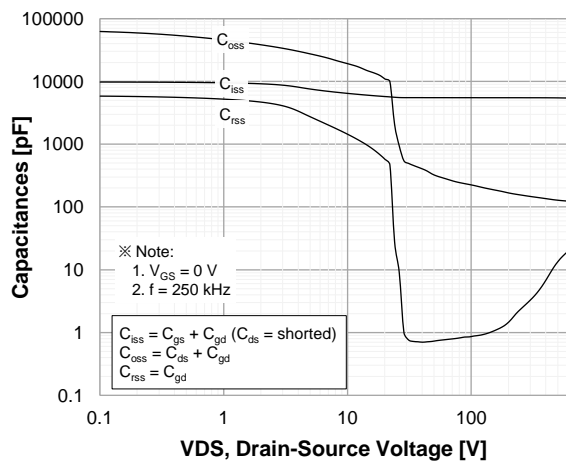
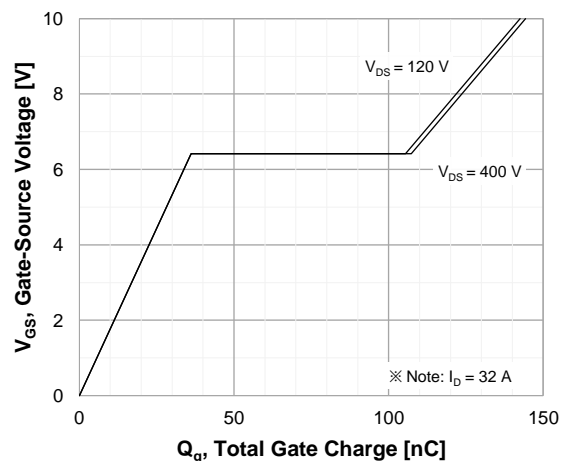


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics

Figure 7. Breakdown Voltage Characteristics vs. Temperature

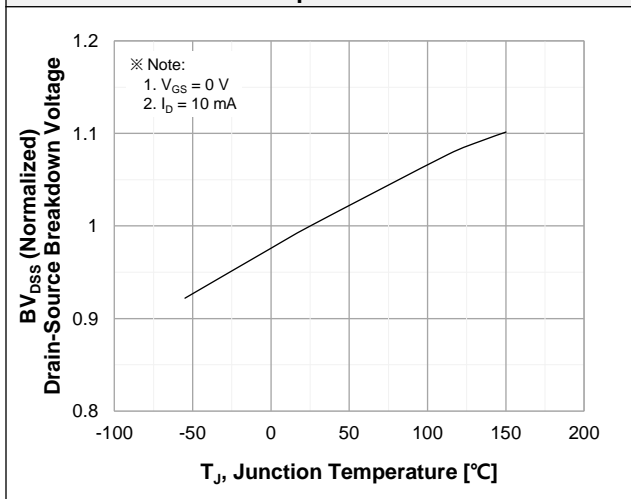


Figure 8. On-Resistance Characteristics vs. Temperature

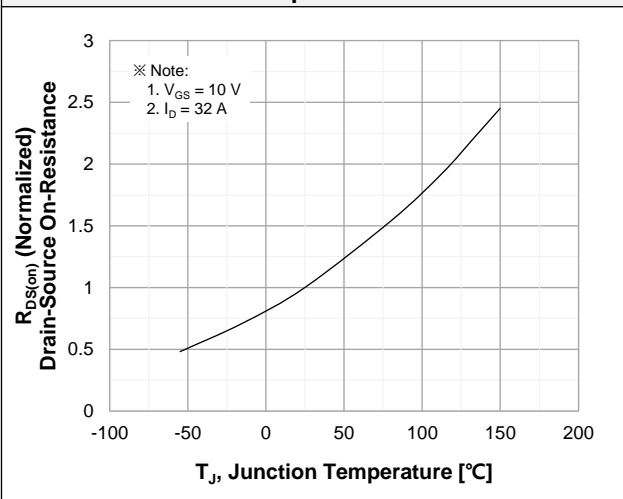


Figure 9. Maximum Safe Operating Area

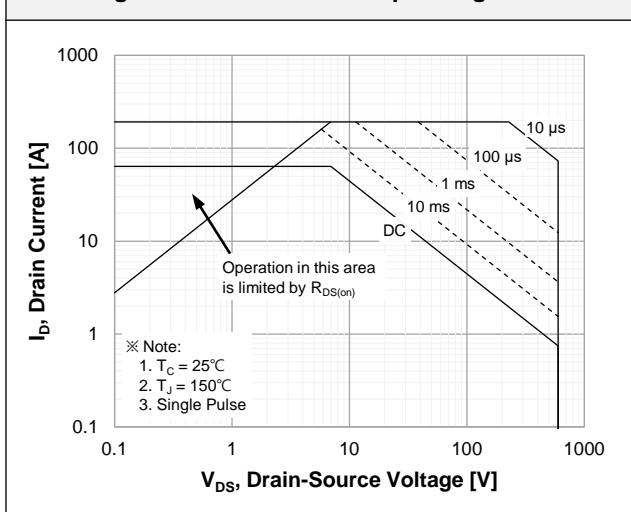


Figure 10. Maximum Drain Current vs. Case Temperature

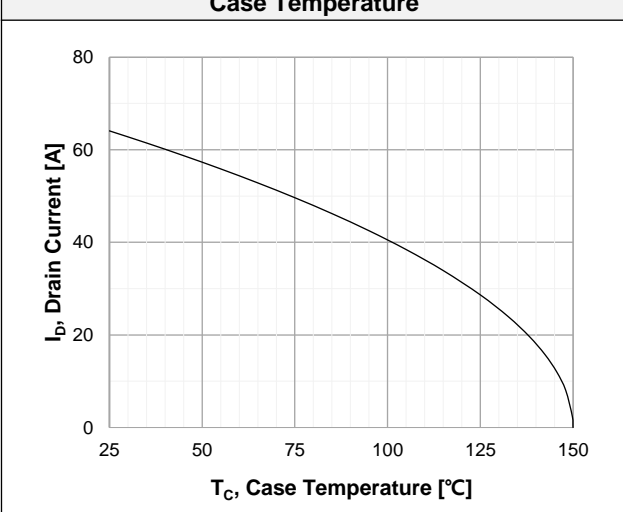


Figure 11. E\_oss vs. Drain to Source Voltage

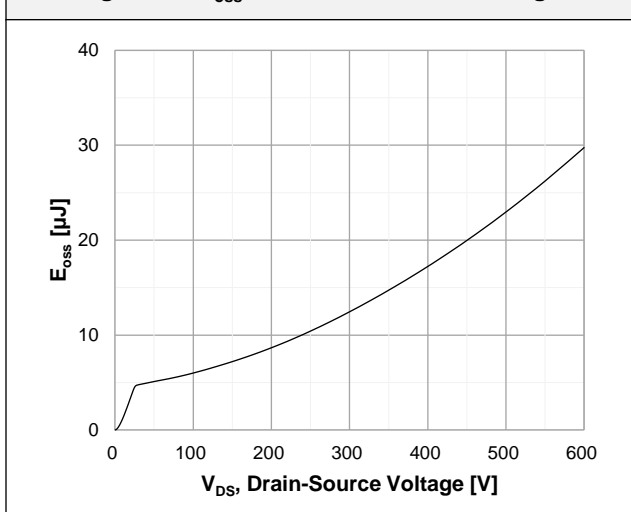
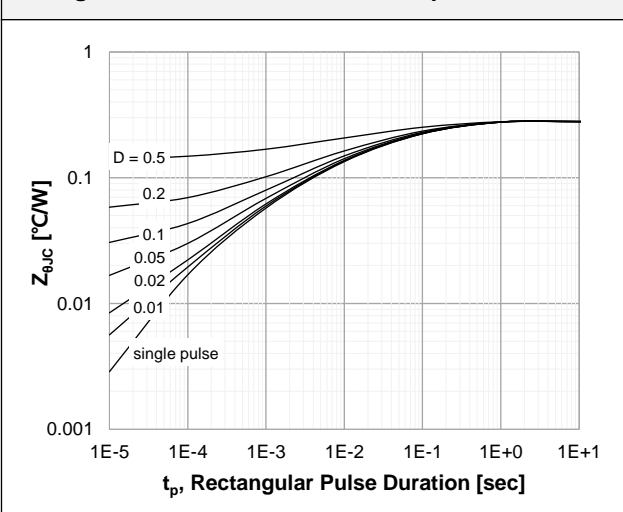


Figure 12. Transient Thermal Response Curve



Test Circuits

Figure 13. Inductive Load Switching Test Circuit and Waveforms

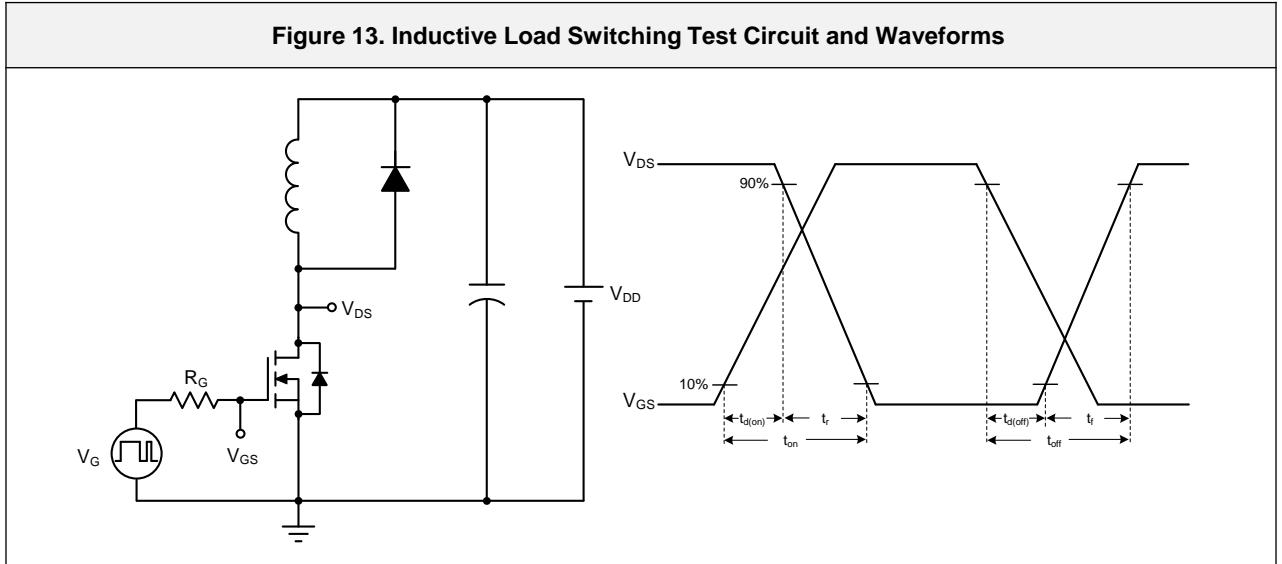


Figure 14. Unclamped Inductive Switching Test Circuit and Waveforms

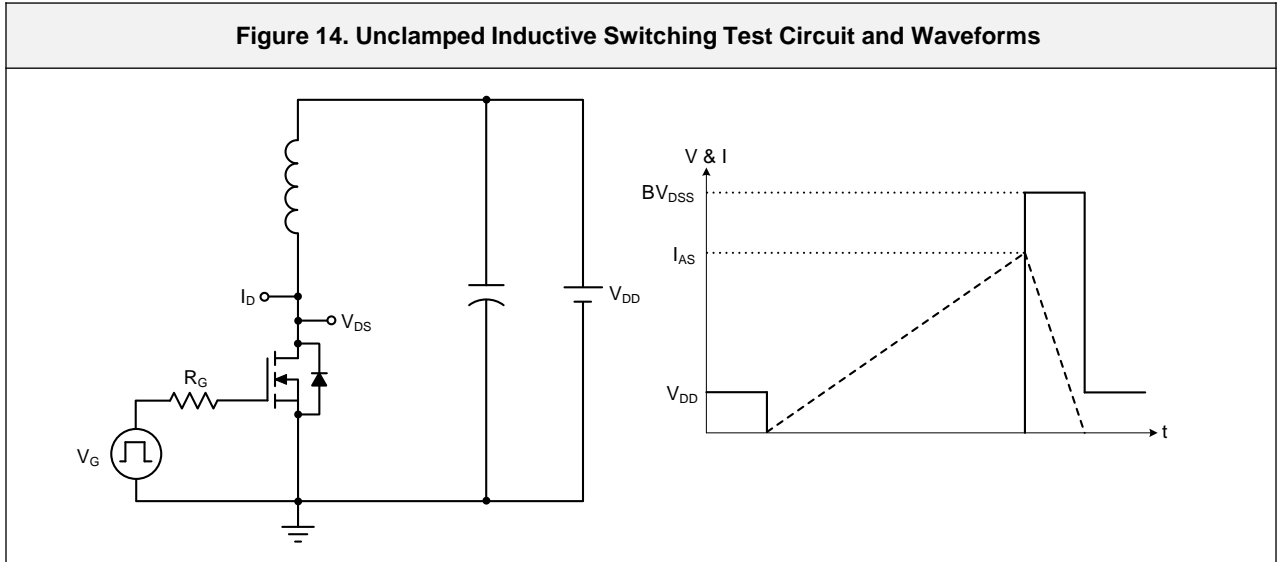
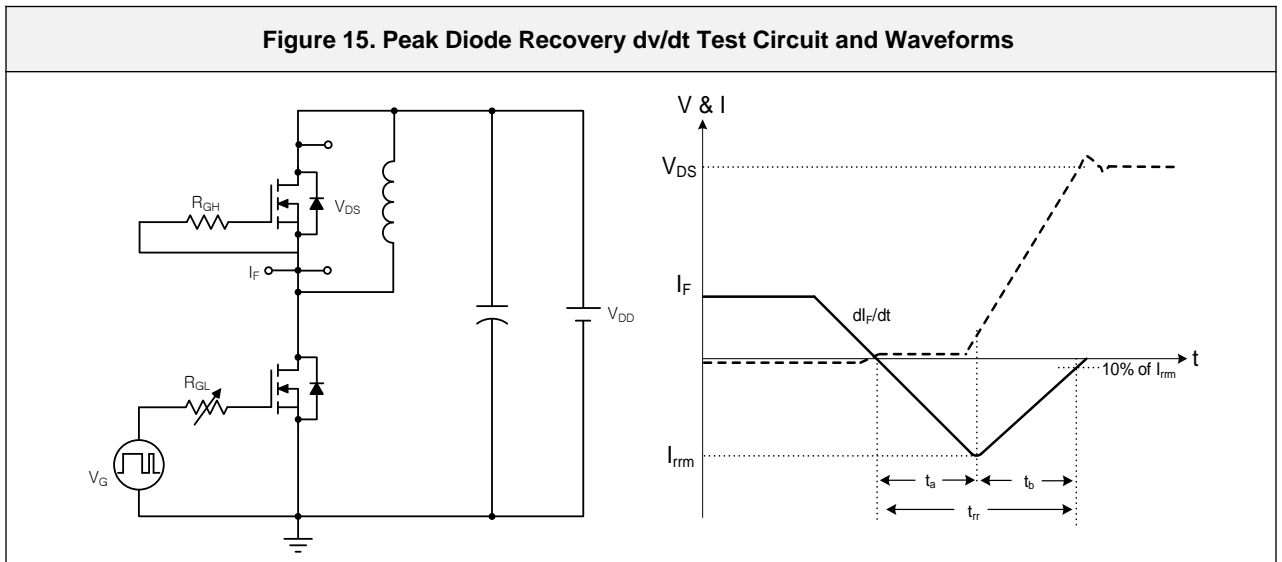
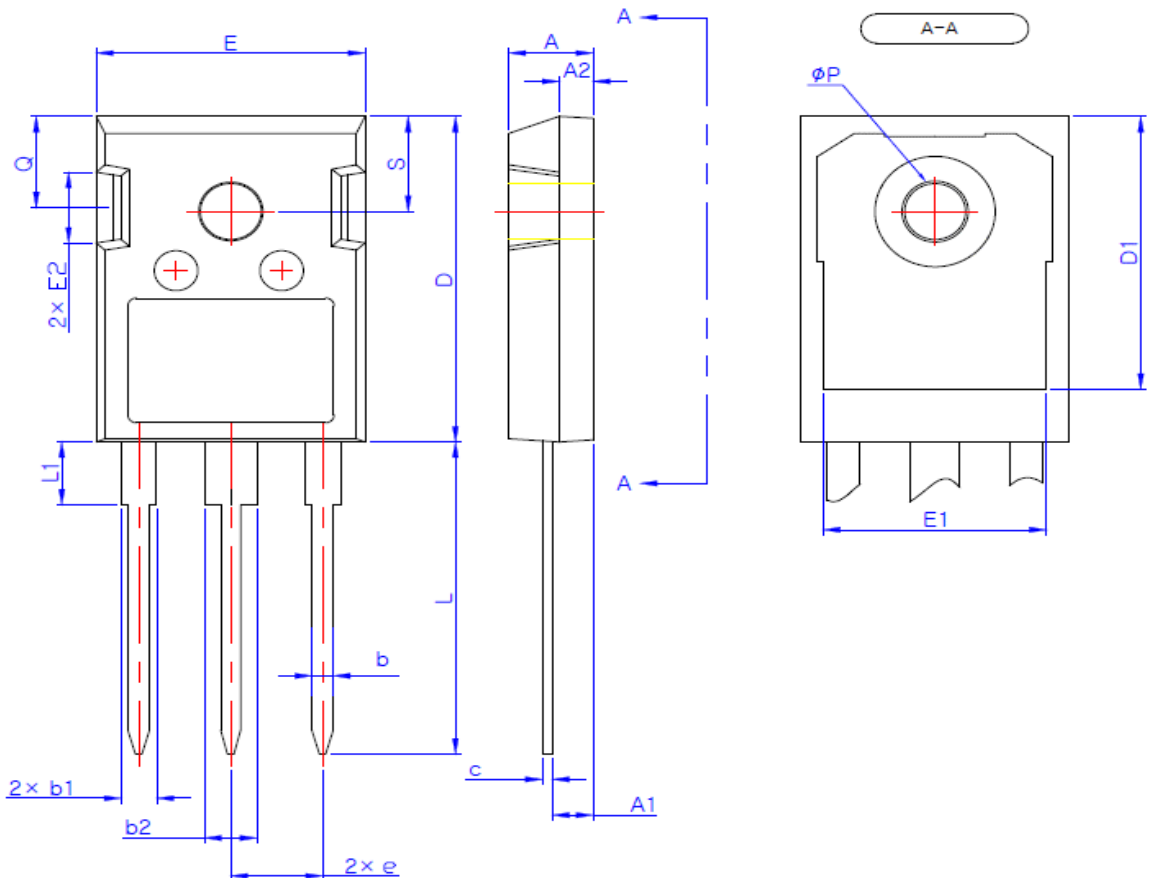


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit and Waveforms



Package Outlines

TO-247



SYMBOL	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.29	2.42	2.54
A2	1.90	2.00	2.10
b	1.10	1.20	1.30
b1	1.91	2.06	2.20
b2	2.92	3.06	3.20
c	0.50	0.60	0.70
D	20.80	21.07	21.34
D1	17.43	17.63	17.83
E	15.75	15.94	16.13
E1	13.06	13.26	13.46
E2	4.32	4.58	4.83
e	5.45 BSC		
L	19.85	20.05	20.25
L1	4.05	4.27	4.49
φP	3.55	3.60	3.65
Q	5.59	5.89	6.19
S	6.15 BSC		

\* Dimensions in millimeters