

FMF60N193F7

N-Channel ϵ MOS F7 Power MOSFET

600 V, 18.2 A, 193 m Ω



Description

The 600V ϵ MOS F7 is a fast recovery type MOSFET using E7 technology. ϵ MOS F7 is an advanced Faster 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 ϵ MOS F7 is very suitable for the bridge structure topology, especially for resonant converters (LLC, PSFB, etc.).

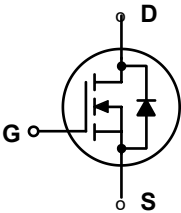
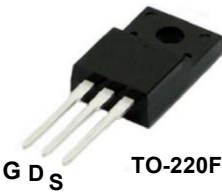
Applications

- Soft Switching Topologies
- Telecom and Sever 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	18.2 A	193 m Ω	33.5 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 ($T_C = 25^{\circ}\text{C}$)	18.2*
		Continuous ($T_C = 100^{\circ}\text{C}$)	11.5*
I_{DM}	Drain Current	Pulsed (Note1)	54.6*
E_{AS}	Single Pulsed Avalanche Energy (Note2)	102	mJ
I_{AS}	Avalanche Current (Note2)	4	A
E_{AR}	Repetitive Avalanche Energy (Note1)	1.6	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note3)	50	
P_D	Power Dissipation	($T_C = 25^{\circ}\text{C}$)	36
		Derate Above 25°C	0.29
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	$^{\circ}\text{C}$

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	3.5	$^{\circ}\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
FMF60N193F7	FMF60N193F7	TO-220F	Tube	50 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	μA
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}$		60		
I_{GSS}	Gate-Source Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$			± 100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1.7\text{ mA}$	3.0		5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 8.5\text{ A}$		160	193	m Ω

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V},$ $f = 250\text{ kHz}$		1218		pF
C_{oss}	Output Capacitance			34		pF
$C_{o(tr)}$	Time Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		358		pF
$C_{o(er)}$	Energy Related Output Capacitance			54.5		pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}, I_D = 8.5\text{ A},$ $V_{GS} = 10\text{ V}$		33.5		nC
Q_{gs}	Gate to Source Charge			8.2		nC
Q_{gd}	Gate to Drain "Miller" Charge			17.2		nC
R_G	Gate Resistance	$f = 1\text{ MHz}$		1.3		Ω

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 400\text{ V}, I_D = 8.5\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 10\text{ }\Omega$ See Figure 13		15		ns
t_r	Turn-On Rise Time			9		ns
$t_{d(off)}$	Turn-Off Delay Time			50		ns
t_f	Turn-Off Fall Time			7		ns

Source-Drain Diode Characteristics

I_S	Maximum Continuous Diode Forward Current			18.2	A
I_{SM}	Maximum Pulsed Diode Forward Current			54.6	A
V_{SD}	Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 8.5\text{ A}$		1.2	V
t_{rr}	Reverse Recovery Time	$V_{DD} = 400\text{ V}, I_{SD} = 8.5\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$		119	ns
Q_{rr}	Reverse Recovery Charge			0.7	μC

※Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $I_{AS} = 4\text{ A}, R_G = 25\text{ }\Omega$, starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 8.5\text{ A}, di/dt \leq 100\text{ A}/\mu\text{s}, V_{DD} \leq 400\text{ V}$, starting $T_J = 25^\circ\text{C}$.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

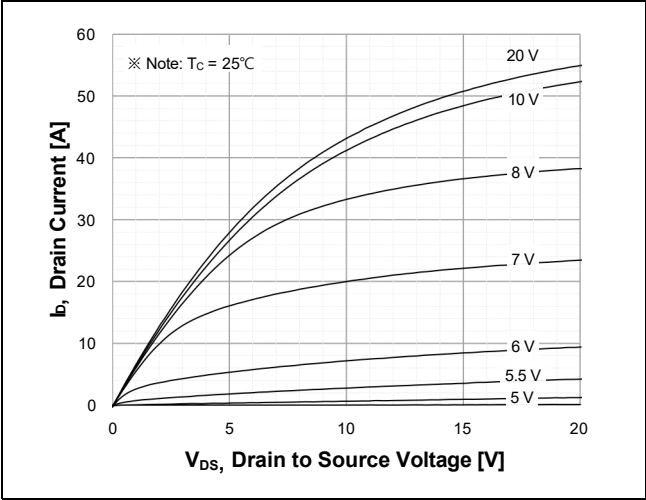


Figure 2. Transfer Characteristics

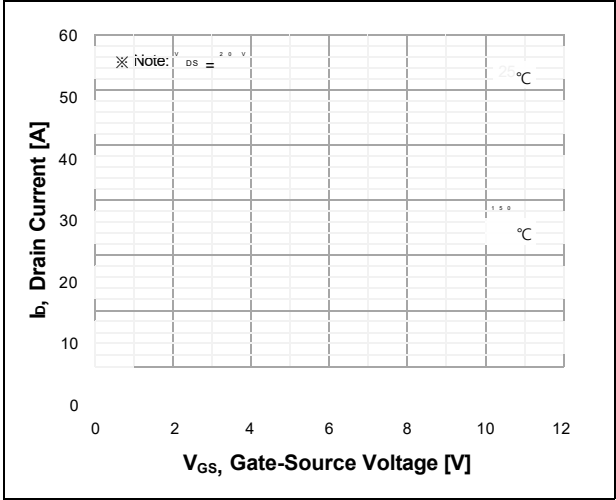


Figure 3. On-Resistance Characteristics vs. Drain Current and Gate Voltage

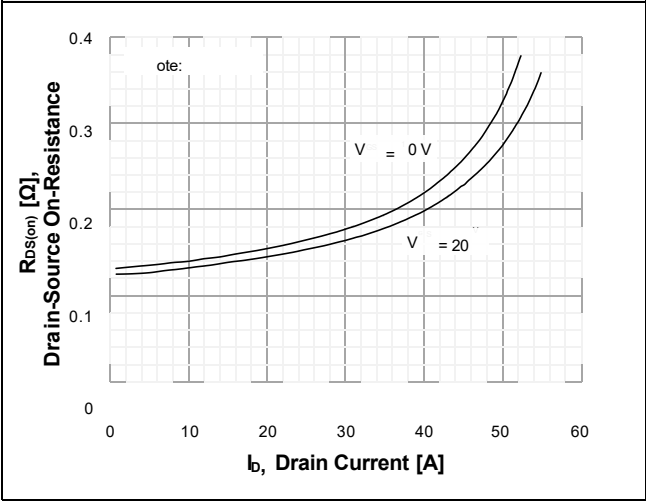


Figure 4. Diode Forward Voltage Characteristics vs. Source-Drain Current and Temperature

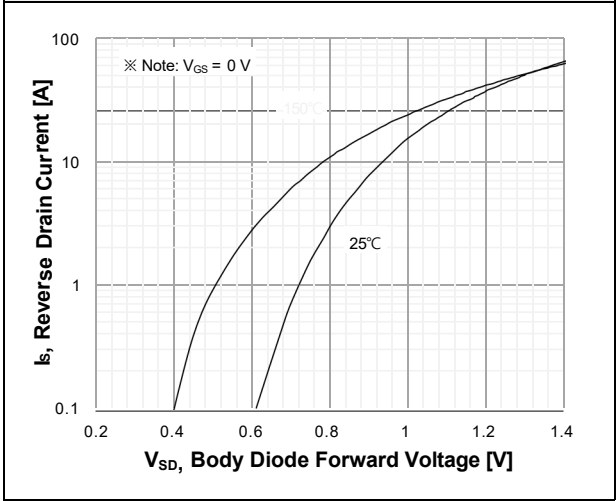


Figure 5. Capacitance Characteristics

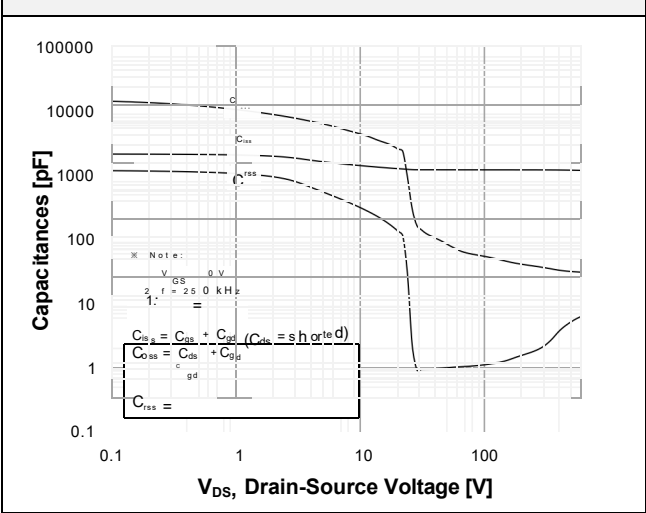
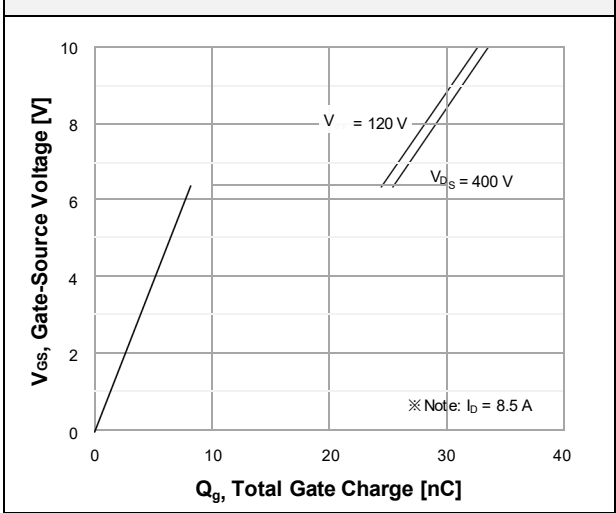


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics

Figure 7. Breakdown Voltage Characteristics vs. Temperature

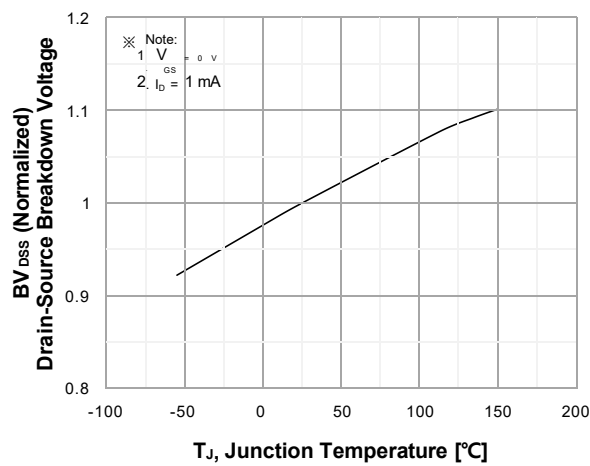


Figure 8. On-Resistance Characteristics vs. Temperature

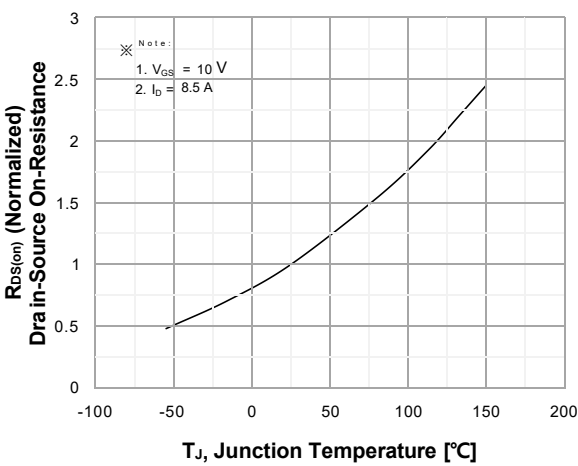


Figure 9. Maximum Safe Operating Area

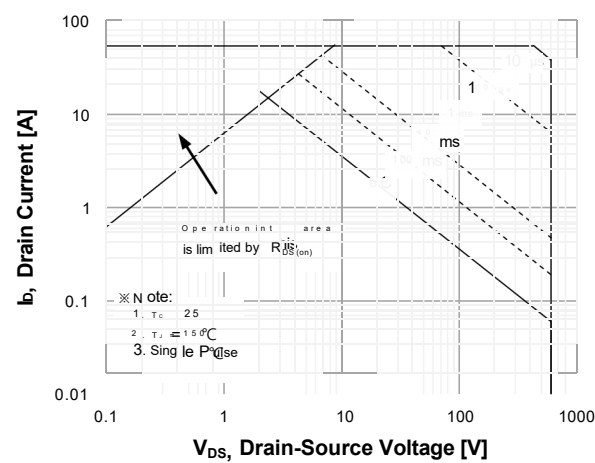


Figure 10. Maximum Drain Current vs. Case Temperature

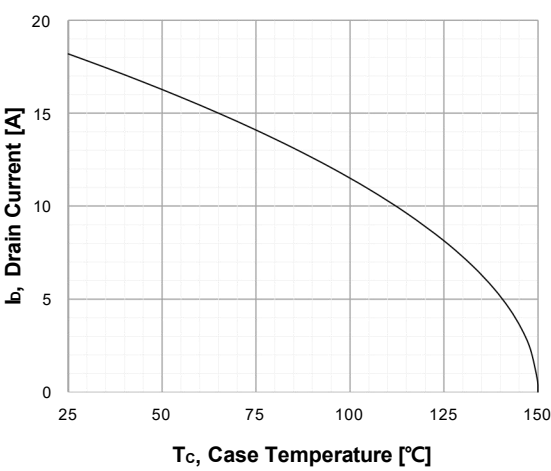


Figure 11. E_{OSS} vs. Drain to Source Voltage

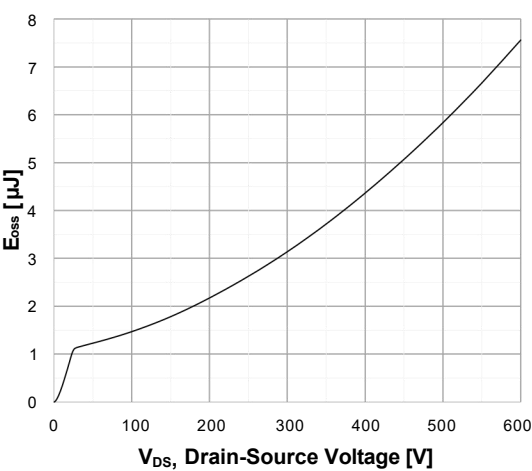
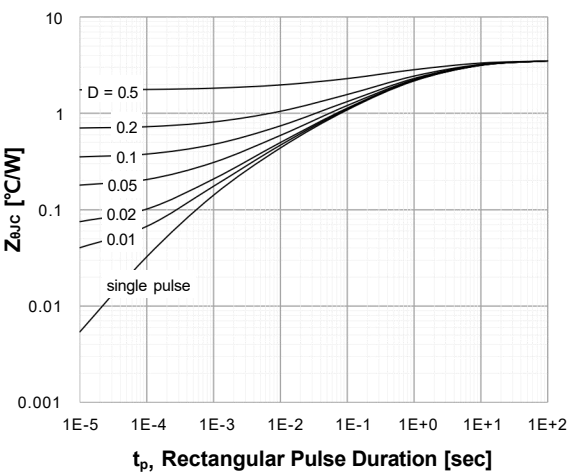


Figure 12. Transient Thermal Response Curve



Test Circuits

Figure 13. Inductive Load Switching Test Circuit and Waveforms

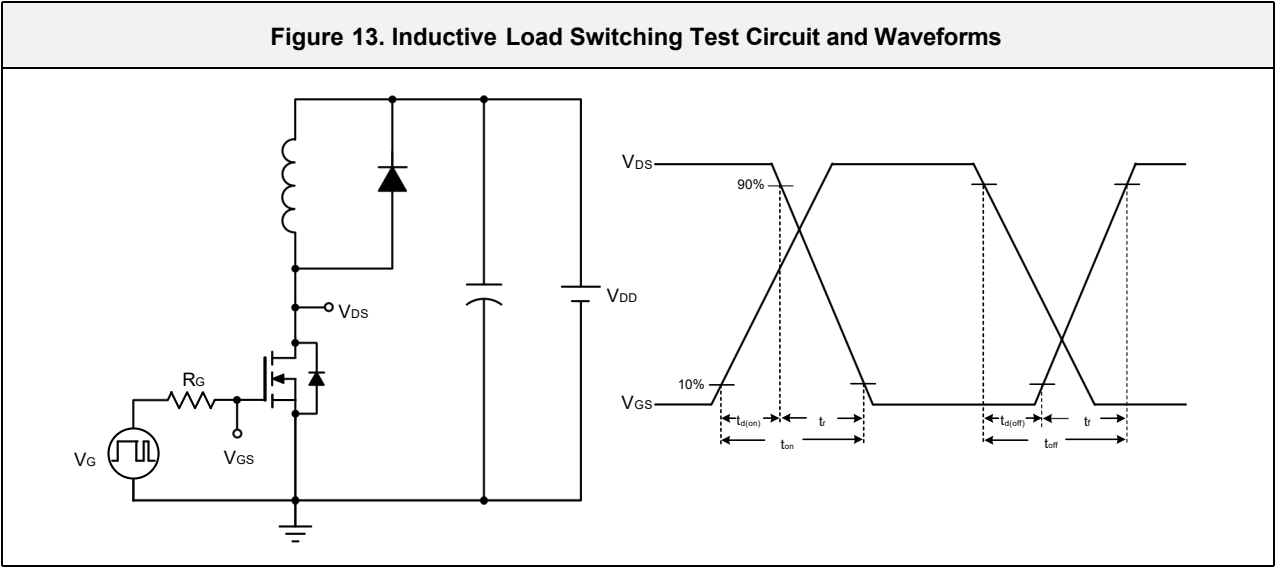


Figure 14. Unclamped Inductive Switching Test Circuit and Waveforms

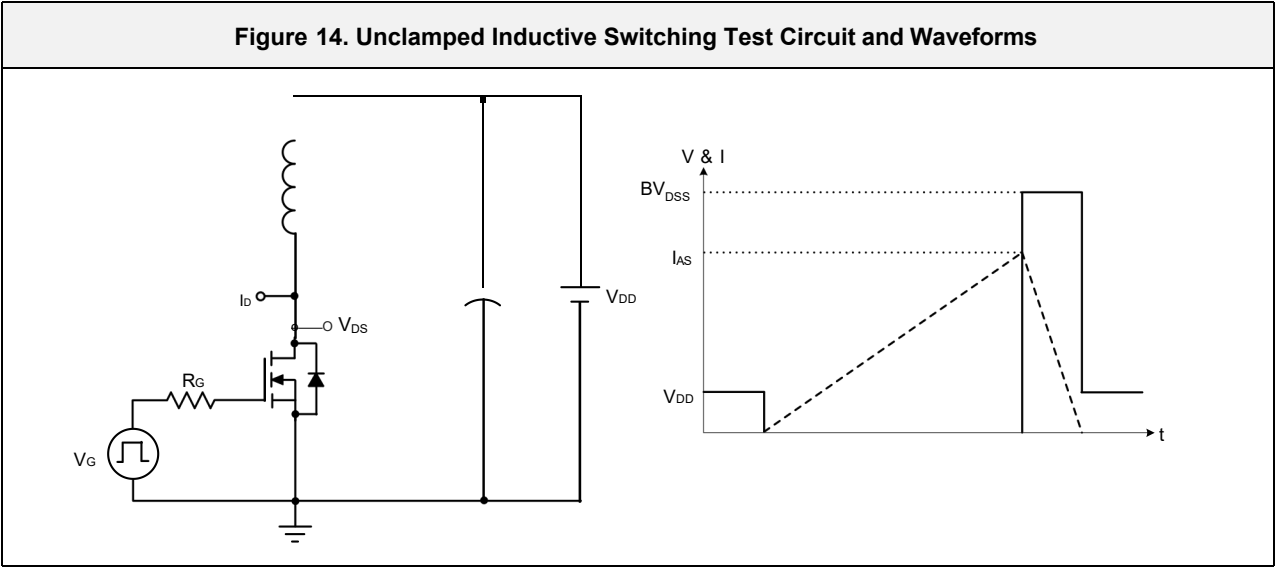
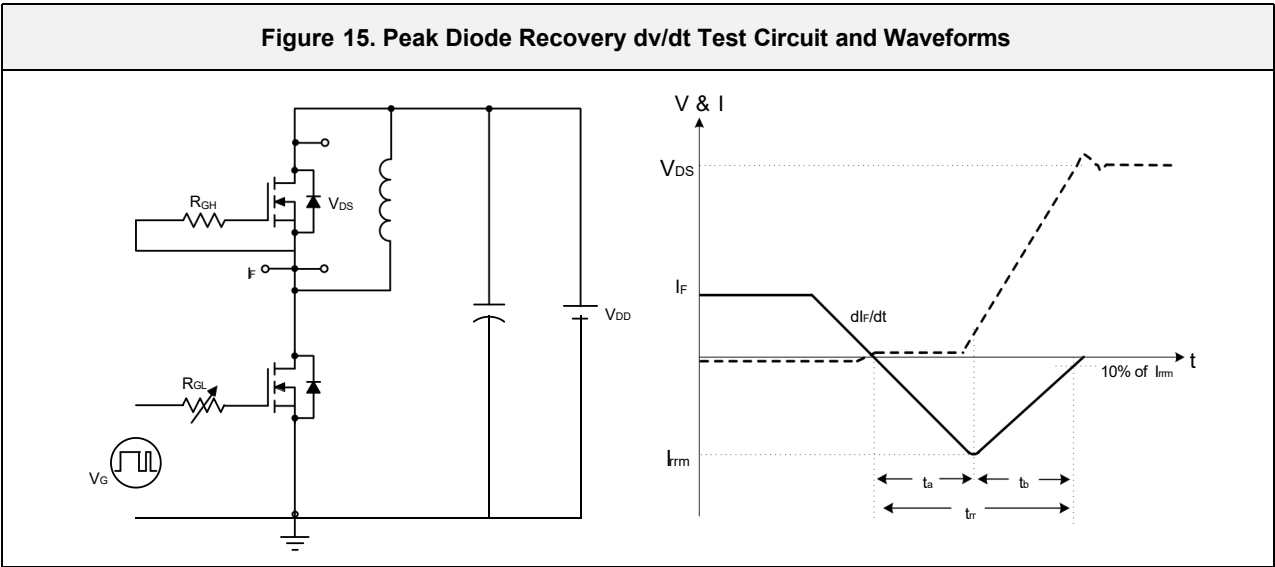
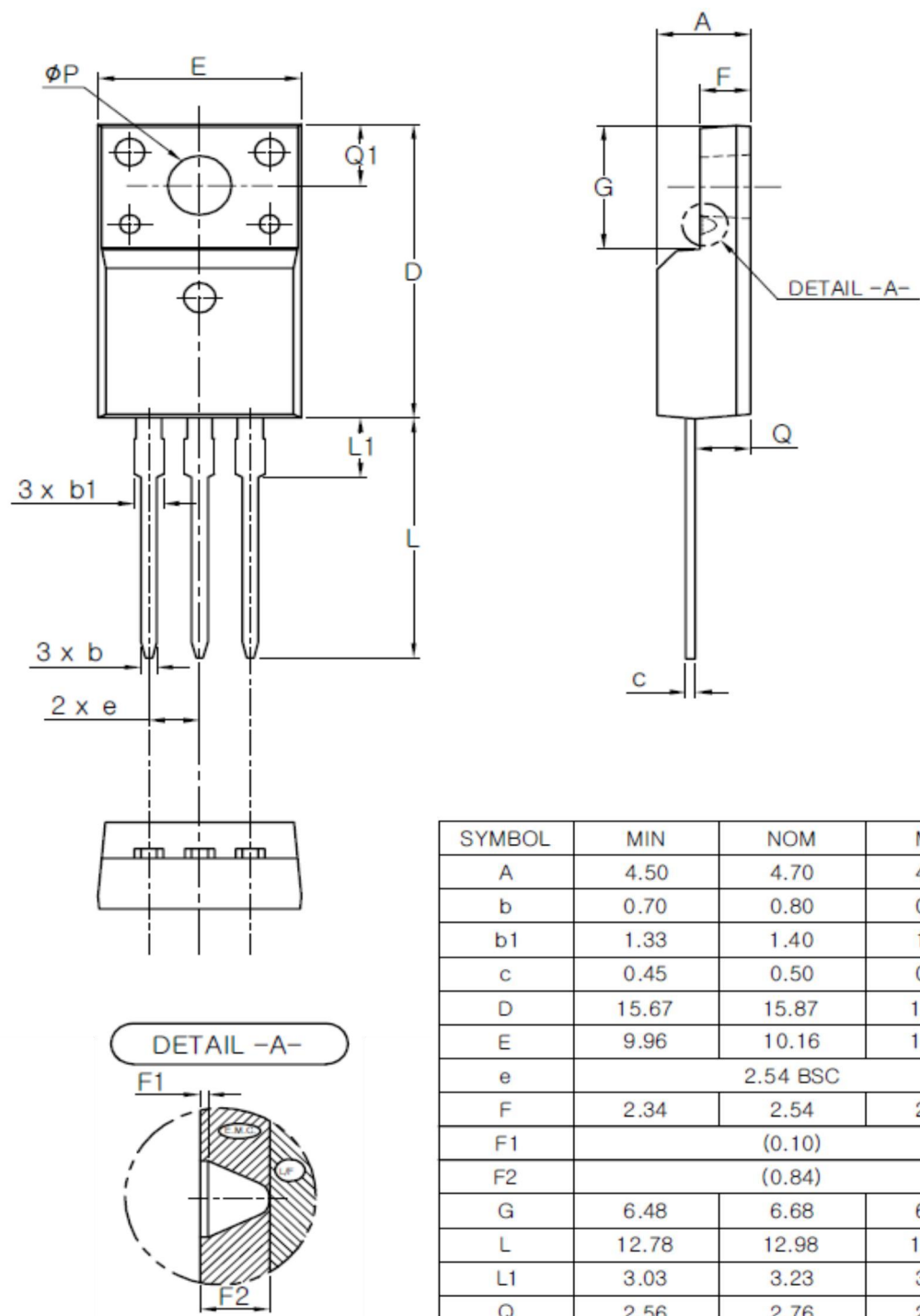


Figure 15. Peak Diode Recovery dv/dt Test Circuit and Waveforms



Package Outlines

TO-220F



SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.90
b	0.70	0.80	0.90
b1	1.33	1.40	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
E	9.96	10.16	10.36
e	2.54 BSC		
F	2.34	2.54	2.74
F1	(0.10)		
F2	(0.84)		
G	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
Q	2.56	2.76	2.96
Q1	3.10	3.30	3.50
ϕP	3.08	3.18	3.28

* Dimensions in millimeters