

FMF60N099E7
N-Channel ϵ MOS E7 Power MOSFET
600 V, 32 A, 99 m Ω



Description

The 600V ϵ MOS E7 is an advanced Faster Semiconductor's Super Junction MOSFET family by utilizing charge balance technology for excellent low on-resistance and gate charge.

This technology combines the benefits of a fast switching performance with ease of usage and robustness.

Consequently, the ϵ MOS E7 family is suitable for application requiring high power density and superior efficiency.

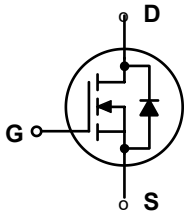
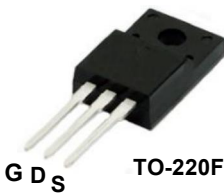
Applications

- PFC, Hard & Soft Switching Topologies
- Industrial & Consumer Power Supplies

Features

$BV_{DSS} @ T_{J,max}$	I_D	$R_{DS(on),max}$	$Q_{g,typ}$
650 V	32 A	99 m Ω	52 nC

- Reduced Switching & Conduction Losses
- Lower Gate Resistance
- 100% Avalanche Tested
- Pb-free, Halogen Free, and RoHS Compliant



Absolute Maximum Ratings ($T_C = 25^{\circ}C$ 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 ($T_C = 25^{\circ}C$)	32*	A
		Continuous ($T_C = 100^{\circ}C$)	20.2*	
I_{DM}	Drain Current	Pulsed (Note1)	96*	A
E_{AS}	Single Pulsed Avalanche Energy (Note2)		199	mJ
I_{AS}	Avalanche Current (Note2)		5.6	A
E_{AR}	Repetitive Avalanche Energy (Note1)		2.6	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note3)		20	
P_D	Power Dissipation	($T_C = 25^{\circ}C$)	43	W
		Derate Above $25^{\circ}C$	0.34	W/ $^{\circ}C$
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to 150	$^{\circ}C$
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds		260	$^{\circ}C$

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	2.9	$^{\circ}C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
FMF60N099E7	FMF60N099E7	TO-220F	Tube	50 units

Electrical Characteristics (T_C = 25°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 V, I _D = 1 mA	600			V
		V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C	650			
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 600 V, V _{GS} = 0 V			1	μA
		V _{DS} = 480 V, V _{GS} = 0 V, T _J = 125°C		2.1		
I _{GSS}	Gate-Source Leakage Current	V _{GS} = ±30 V, V _{DS} = 0 V			±100	nA

On Characteristics

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 2.1 mA	2.5		4.5	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 15.3 A		85	99	mΩ

Dynamic Characteristics

C _{iss}	Input Capacitance	V _{DS} = 400 V, V _{GS} = 0 V, f = 250 kHz		2270		pF
C _{oss}	Output Capacitance			58		pF
C _{o(tr)}	Time Related Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		670		pF
C _{o(er)}	Energy Related Output Capacitance			92		pF
Q _{g(tot)}	Total Gate Charge at 10 V	V _{DS} = 400 V, I _D = 15.3 A, V _{GS} = 10 V		52		nC
Q _{gs}	Gate to Source Charge			12.7		nC
Q _{gd}	Gate to Drain "Miller" Charge			22.4		nC
R _G	Gate Resistance	f = 1 MHz		0.9		Ω

Switching Characteristics

t _{d(on)}	Turn-On Delay Time	V _{DS} = 400 V, I _D = 15.3 A, V _{GS} = 10 V, R _G = 10 Ω See Figure 13		17		ns
t _r	Turn-On Rise Time			10		ns
t _{d(off)}	Turn-Off Delay Time			86		ns
t _f	Turn-Off Fall Time			11		ns

Source-Drain Diode Characteristics

I _S	Maximum Continuous Diode Forward Current			32	A
I _{SM}	Maximum Pulsed Diode Forward Current			96	A
V _{SD}	Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 15.3 A		1.2	V
t _{rr}	Reverse Recovery Time	V _{DD} = 400 V, I _{SD} = 15.3 A, di _F /dt = 100 A/μs		346	ns
Q _{rr}	Reverse Recovery Charge			5.1	μC

※Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. I_{AS} = 5.6 A, R_G = 25 Ω, starting T_J = 25°C.
3. I_{SD} ≤ 15.3 A, di/dt ≤ 100 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

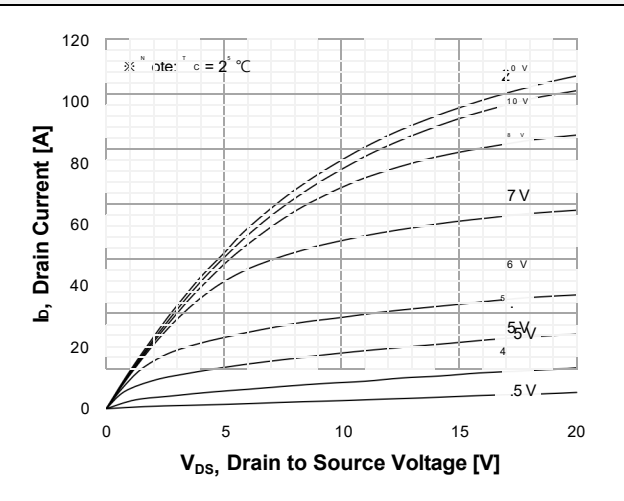


Figure 2. Transfer Characteristics

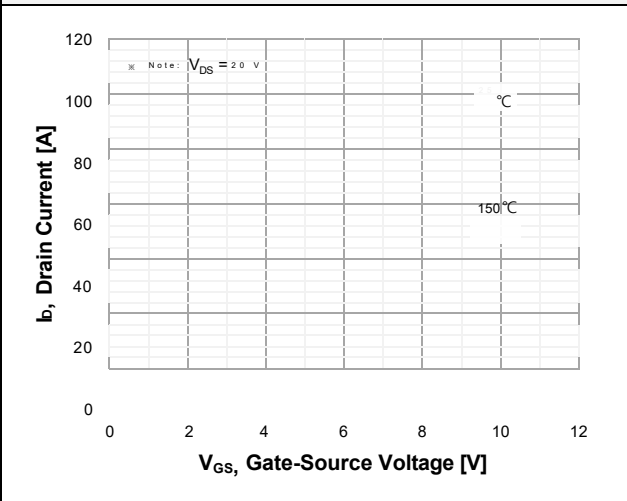


Figure 3. On-Resistance Characteristics vs. Drain Current and Gate Voltage

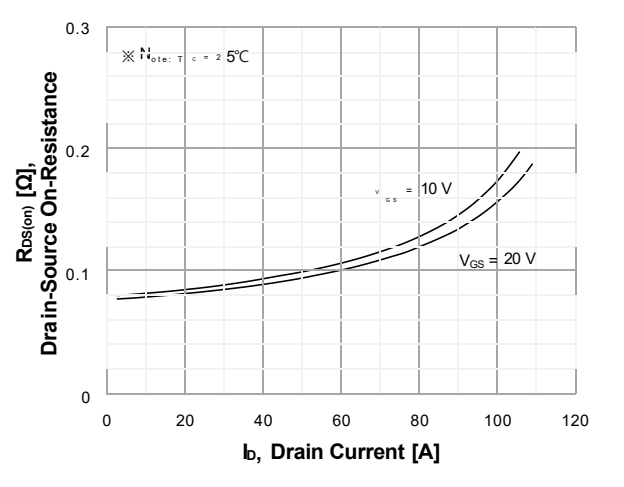


Figure 4. Diode Forward Voltage Characteristics vs. Source-Drain Current and Temperature

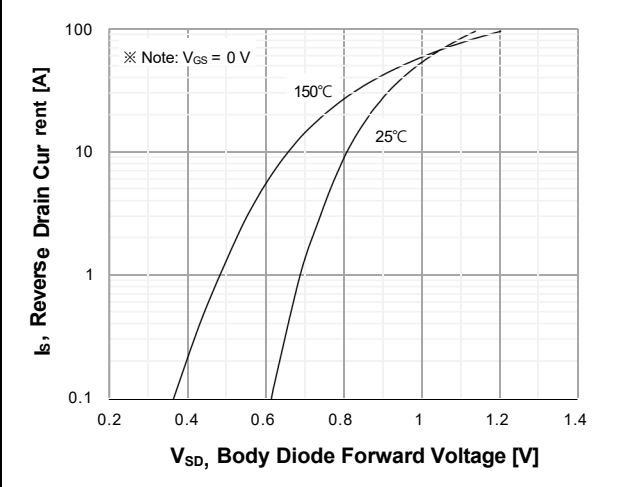


Figure 5. Capacitance Characteristics

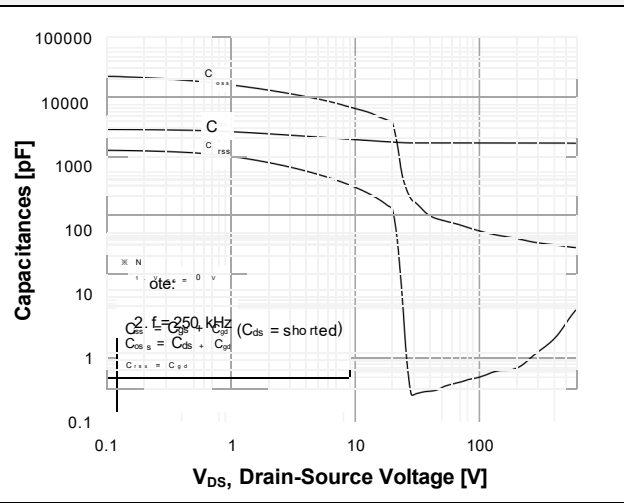
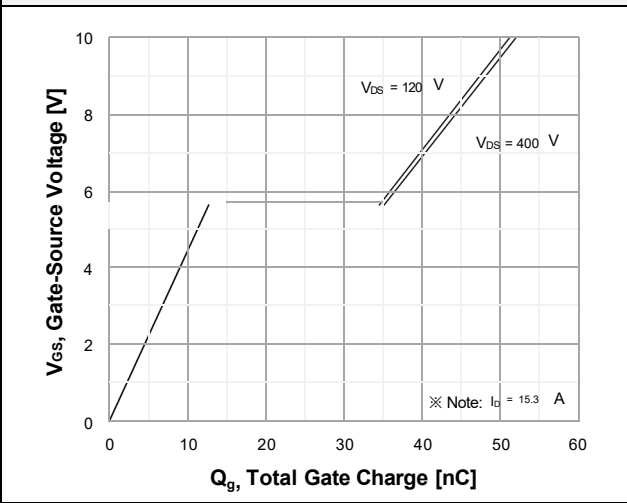


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics

Figure 7. Breakdown Voltage Characteristics vs. Temperature

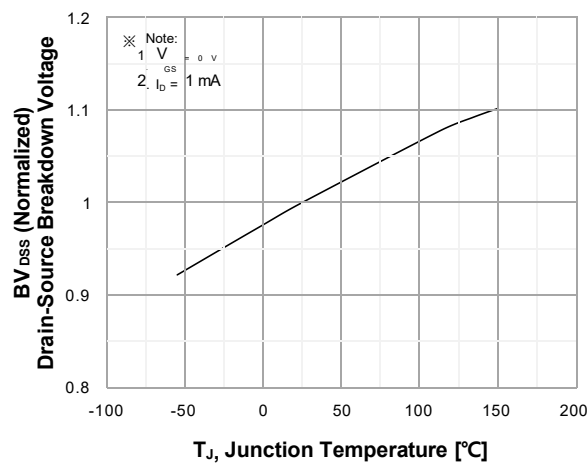


Figure 8. On-Resistance Characteristics vs. Temperature

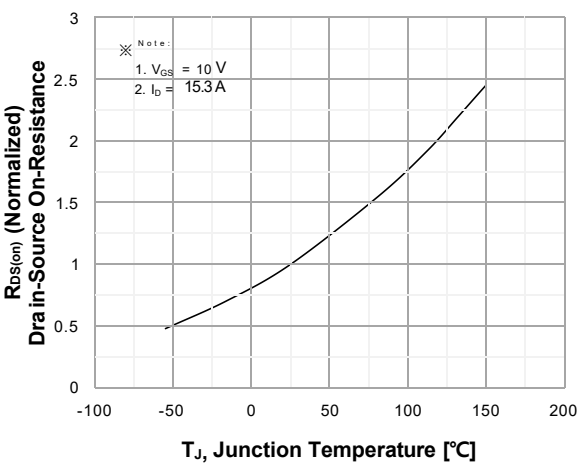


Figure 9. Maximum Safe Operating Area

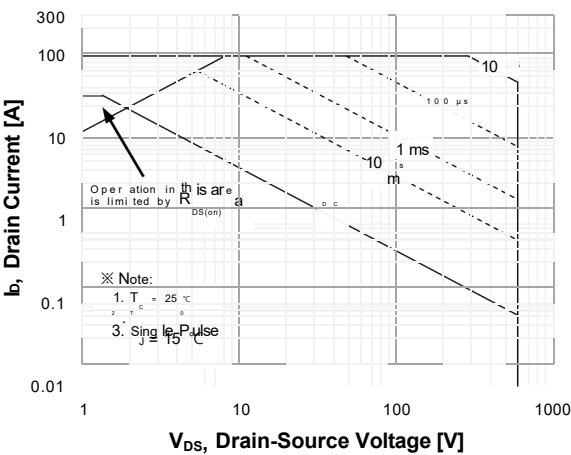


Figure 10. Maximum Drain Current vs. Case Temperature

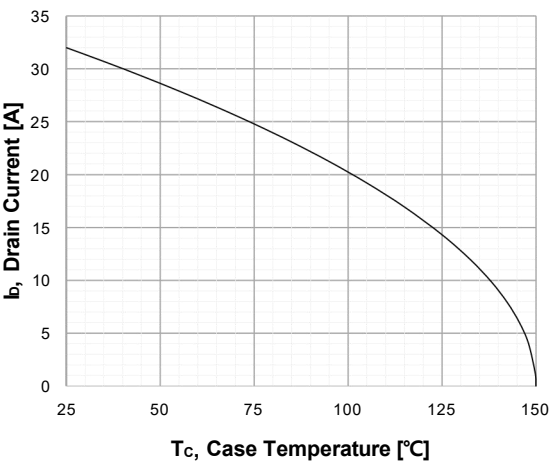


Figure 11. E_{oss} vs. Drain to Source Voltage

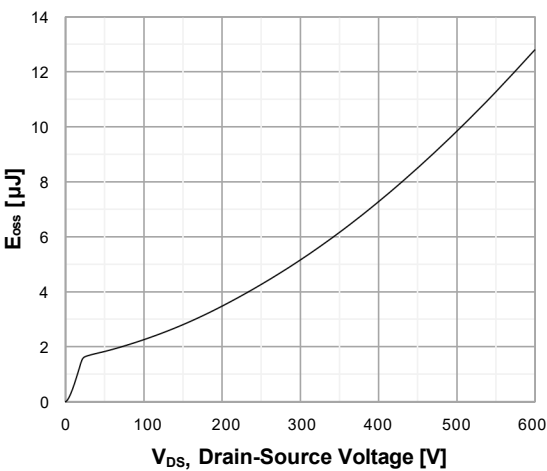
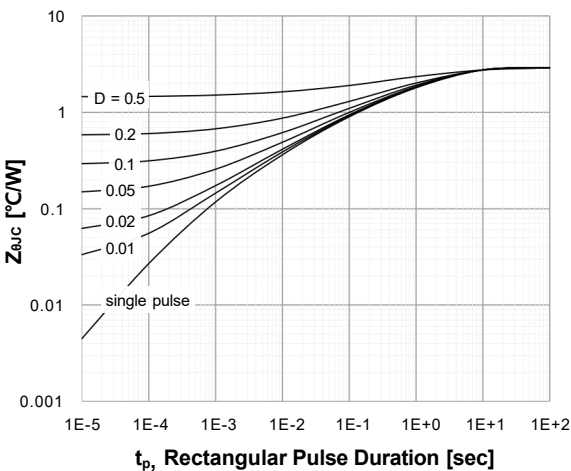


Figure 12. Transient Thermal Response Curve



Test Circuits

Figure 13. Inductive Load Switching Test Circuit and Waveforms

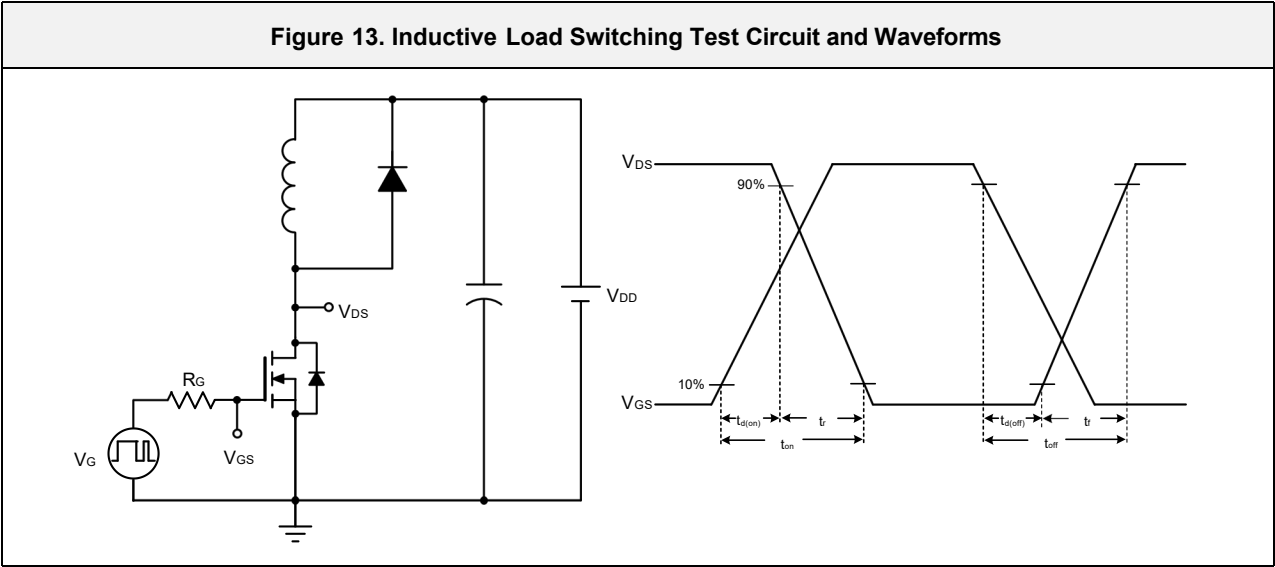


Figure 14. Unclamped Inductive Switching Test Circuit and Waveforms

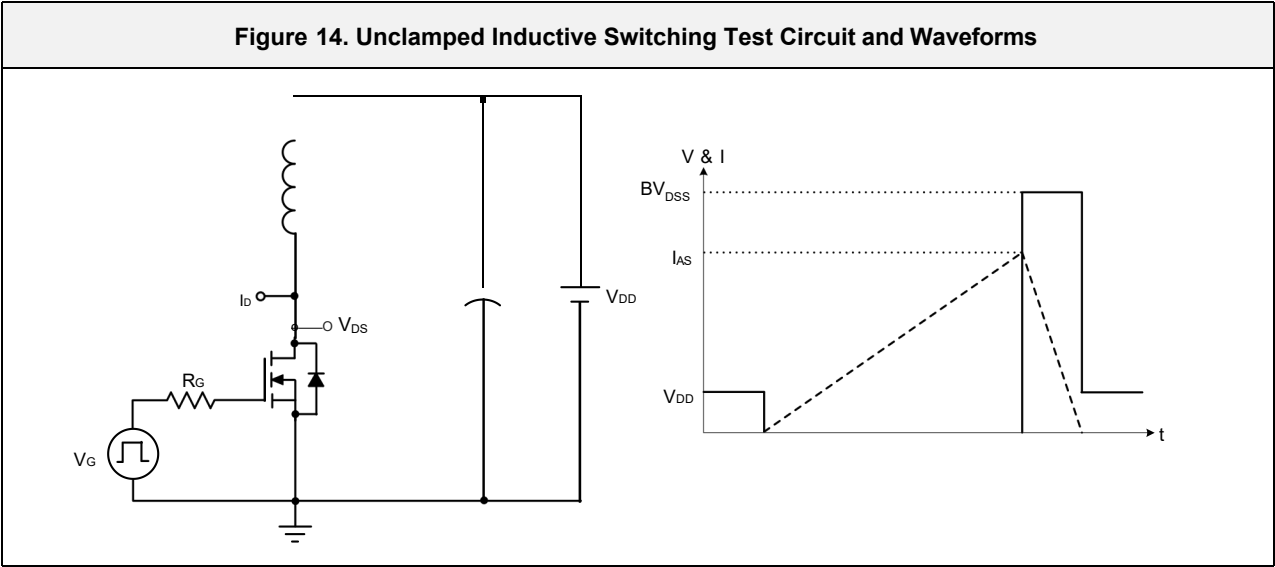
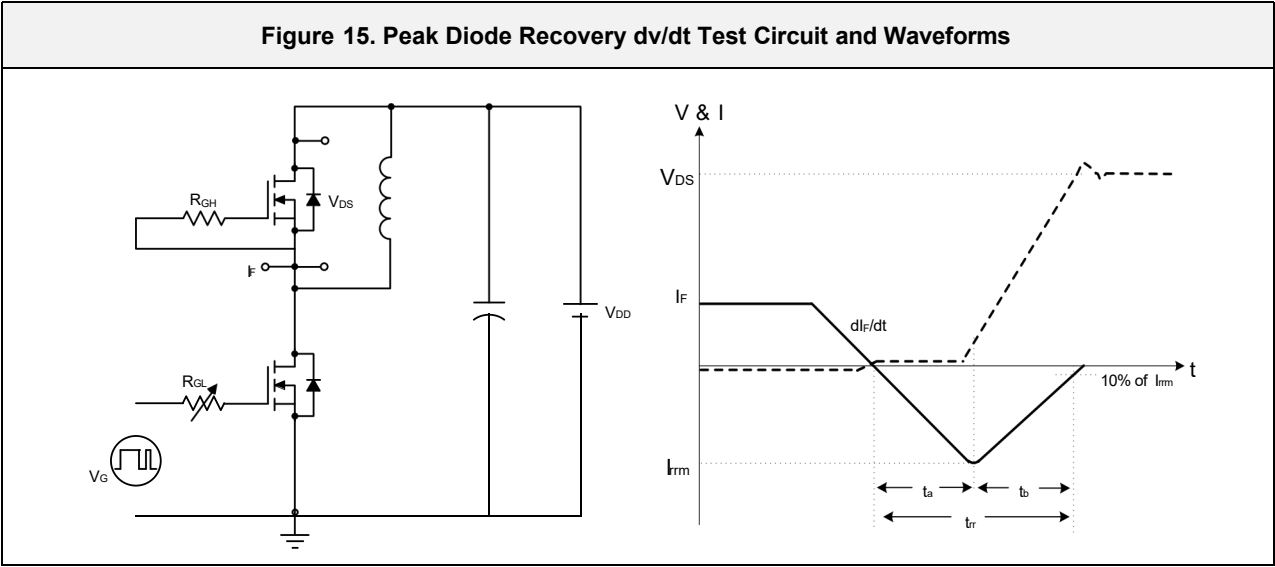
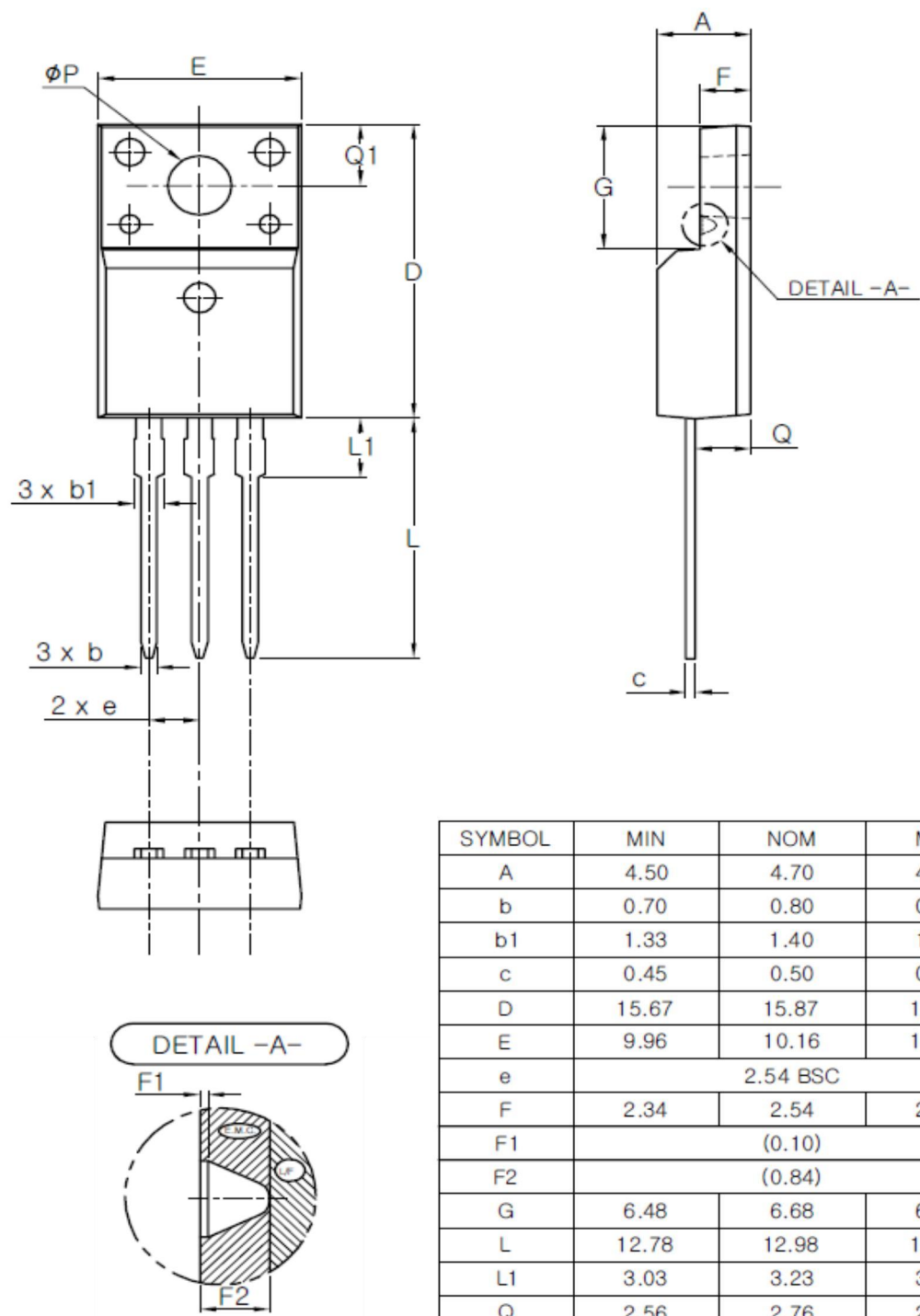


Figure 15. Peak Diode Recovery dv/dt Test Circuit and Waveforms



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