

650 V, 12.5 A, 280 mΩ

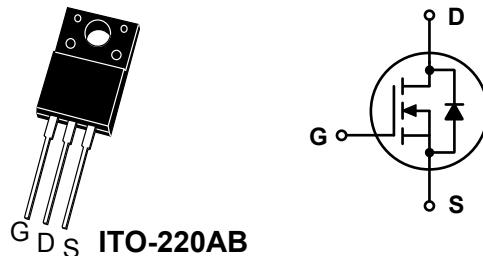
Description

The 650V E series has excellent low on-resistance and gate charge by utilizing charge balance technology. This technology combines the benefits of an excellent switching performance with ease of usage and robustness. Consequently, the 650V E series is suitable for application requiring superior efficiency and extra safety margin for design with higher voltage.

Features

BV_{DSS} @ $T_{J,max}$	I_D	$R_{DS(on),max}$	$Q_{g,typ}$
700 V	12.5 A	280 mΩ	21 nC

- Reduced Switching & Conduction Losses
- Lower Switching Noise
- 100% Avalanche Tested
- Pb-free and RoHS Compliant
- Compliance with EU REACH



Applications

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

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

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		650	V
V_{GSS}	Gate to Source Voltage		± 30	V
I_D	Drain Current	Continuous ($T_C = 25^\circ\text{C}$)	12.5*	A
		Continuous ($T_C = 100^\circ\text{C}$)	8.0*	
I_{DM}	Drain Current	Pulsed (Note1)	37.5*	A
E_{AS}	Single Pulsed Avalanche Energy		54	mJ
I_{AS}	Avalanche Current		3	A
E_{AR}	Repetitive Avalanche Energy		1.11	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt		20	
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	30	W
		Derate Above 25°C	0.24	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to 150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds		260	°C

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	4.1	°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
HXMH65M280EF	H65M280EF	ITO-220AB	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	650			V
		V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C	700			
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V			1	μA
		V _{DS} = 520 V, V _{GS} = 0 V, T _J = 125°C		2		
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 = 1.1 mA	2.5		4.5	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 5.3 A		238	280	mΩ

Dynamic Characteristics

C _{iss}	Input Capacitance	V _{DS} = 400 V, V _{GS} = 0 V, f = 250 kHz		789		pF
C _{oss}	Output Capacitance		22			pF
C _{o(tr)}	Time Related Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		286		pF
C _{o(er)}	Energy Related Output Capacitance		36			pF
Q _{g(tot)}	Total Gate Charge at 10 V	V _{DS} = 400 V, I _D = 5.3 A, V _{GS} = 10 V		21.0		nC
Q _{gs}	Gate to Source Charge		4.0			nC
Q _{gd}	Gate to Drain "Miller" Charge		10.9			nC
R _G	Gate Resistance	f = 1 MHz		6.9		Ω

Switching Characteristics

t _{d(on)}	Turn-On Delay Time	V _{DS} = 400 V, I _D = 5.3 A, V _{GS} = 10 V, R _G = 10 Ω See Figure 13		11		ns
t _r	Turn-On Rise Time		10			ns
t _{d(off)}	Turn-Off Delay Time		49			ns
t _f	Turn-Off Fall Time		10			ns

Source-Drain Diode Characteristics

I _S	Maximum Continuous Diode Forward Current			12.5	A	
I _{SM}	Maximum Pulsed Diode Forward Current			37.5	A	
V _{SD}	Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 5.3 A		1.2	V	
t _{rr}	Reverse Recovery Time	V _{DD} = 400 V, I _{SD} = 5.3 A, dI _F /dt = 100 A/μs		240		ns
Q _{rr}	Reverse Recovery Charge		2.36			μC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. I_{AS} = 3 A, R_G = 25 Ω, starting T_J = 25°C.
3. I_{SD} ≤ 5.3 A, di/dt ≤ 100 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C.



Typical Performance Characteristics

Figure 1. On-Region Characteristics

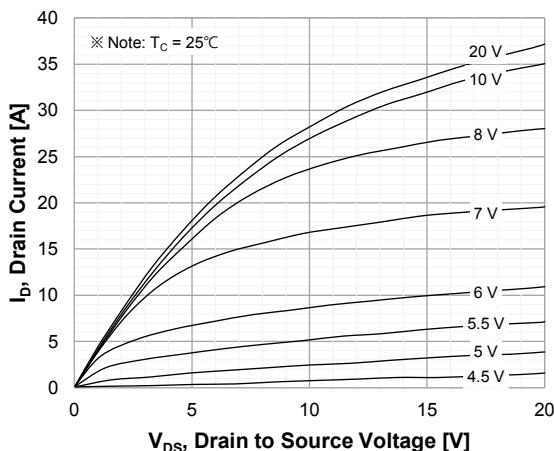


Figure 2. Transfer Characteristics

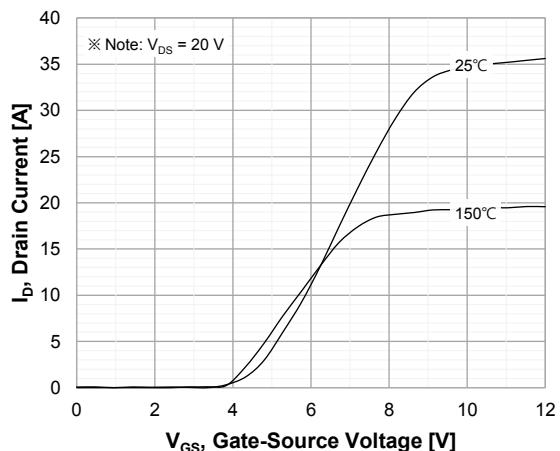


Figure 3. On-Resistance Characteristics vs. Drain Current and Gate Voltage

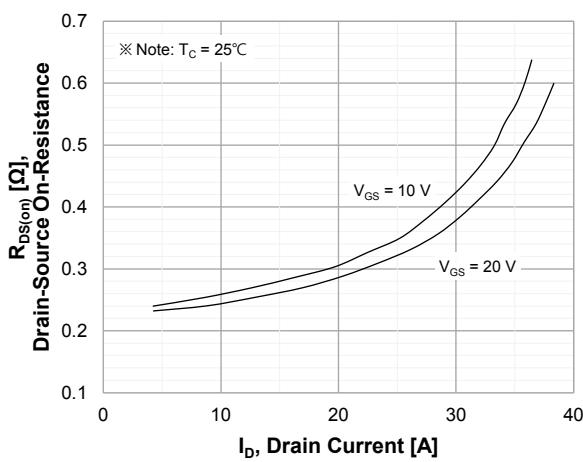


Figure 4. Diode Forward Voltage Characteristics vs. Source-Drain Current and Temperature

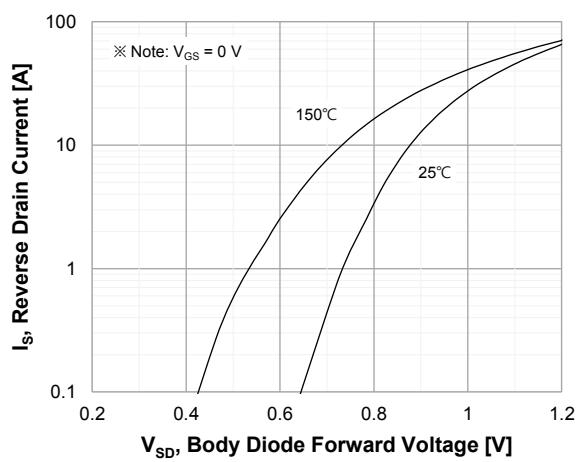


Figure 5. Capacitance Characteristics

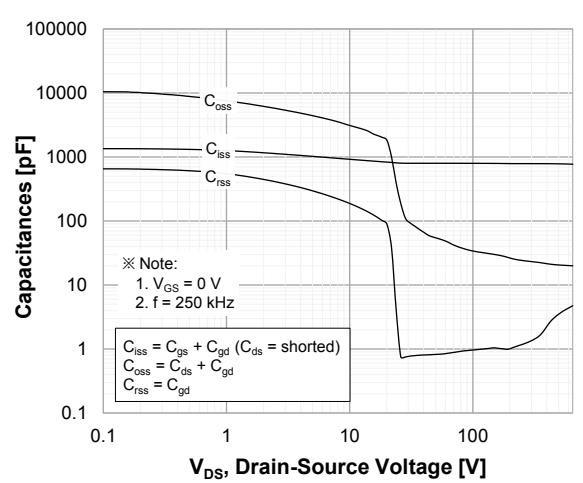
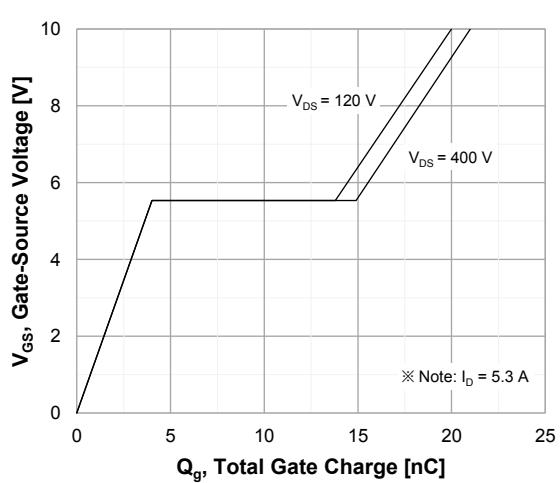


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics

Figure 7. Breakdown Voltage Characteristics vs. Temperature

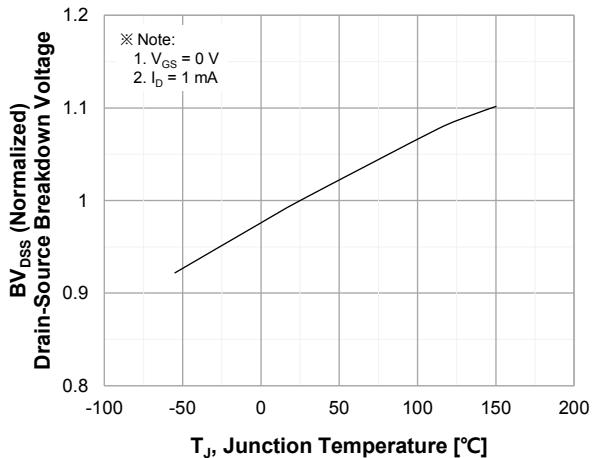


Figure 8. On-Resistance Characteristics vs. Temperature

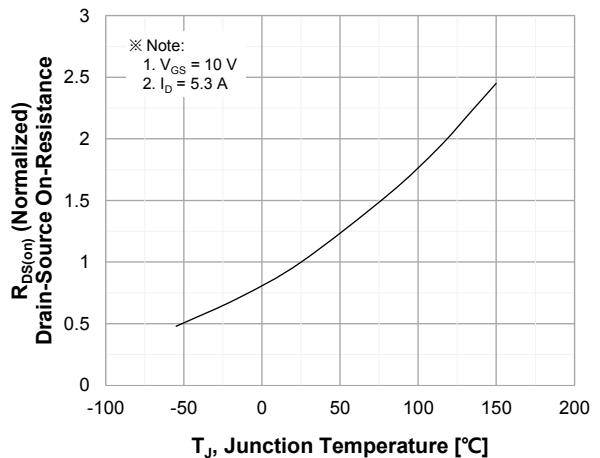


Figure 9. Maximum Safe Operating Area

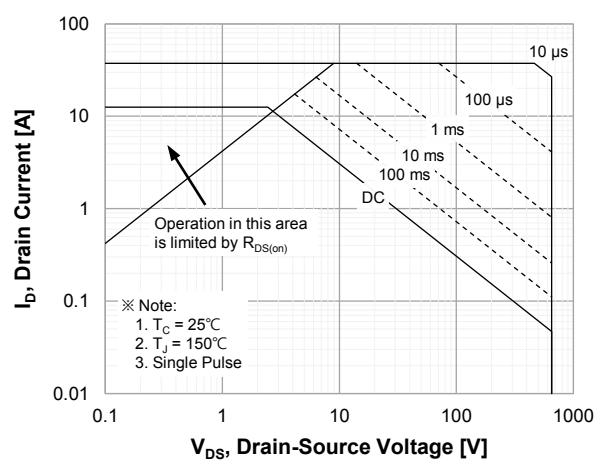


Figure 10. Maximum Drain Current vs. Case Temperature

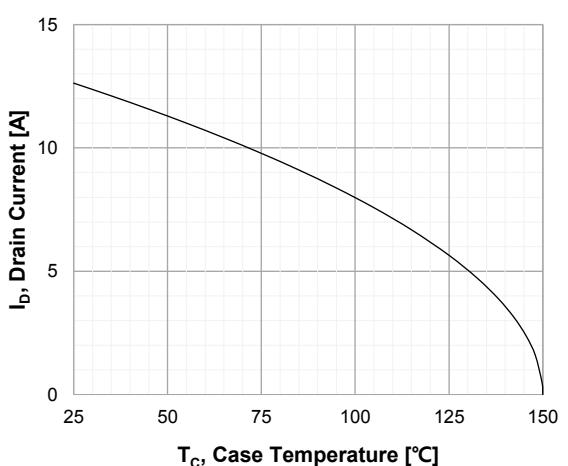


Figure 11. E_{oss} vs. Drain to Source Voltage

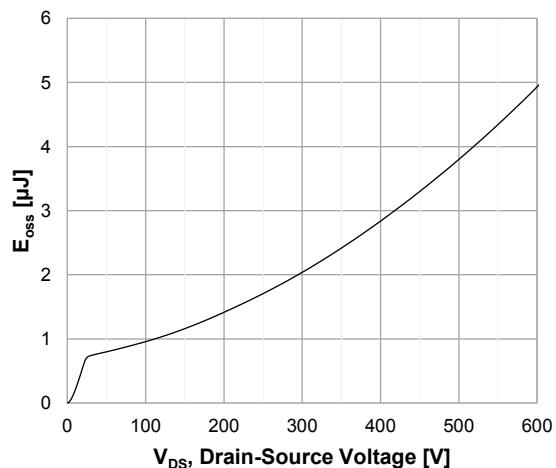
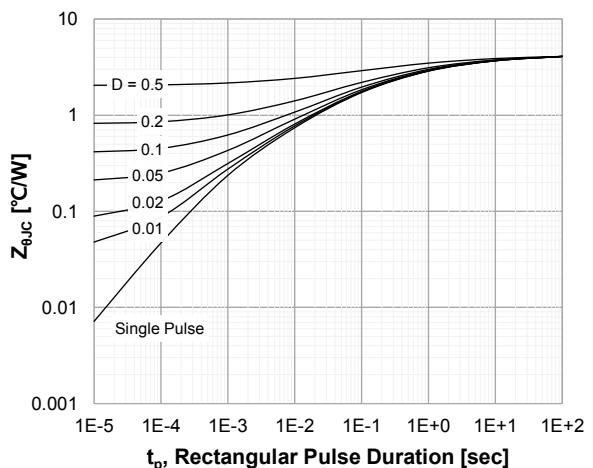


Figure 12. Transient Thermal Response Curve



Test Circuits

Figure 13. Inductive Load Switching Test Circuit and Waveforms

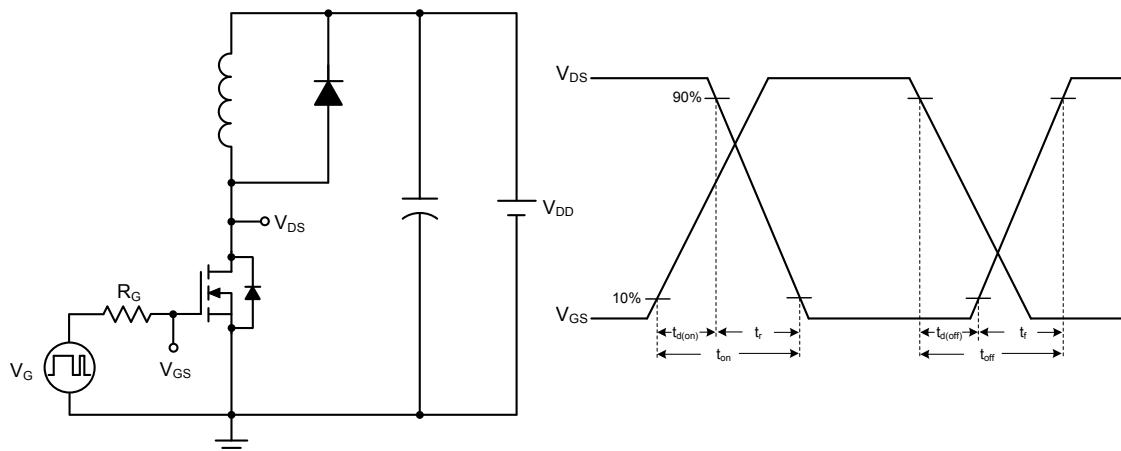


Figure 14. Unclamped Inductive Switching Test Circuit and Waveforms

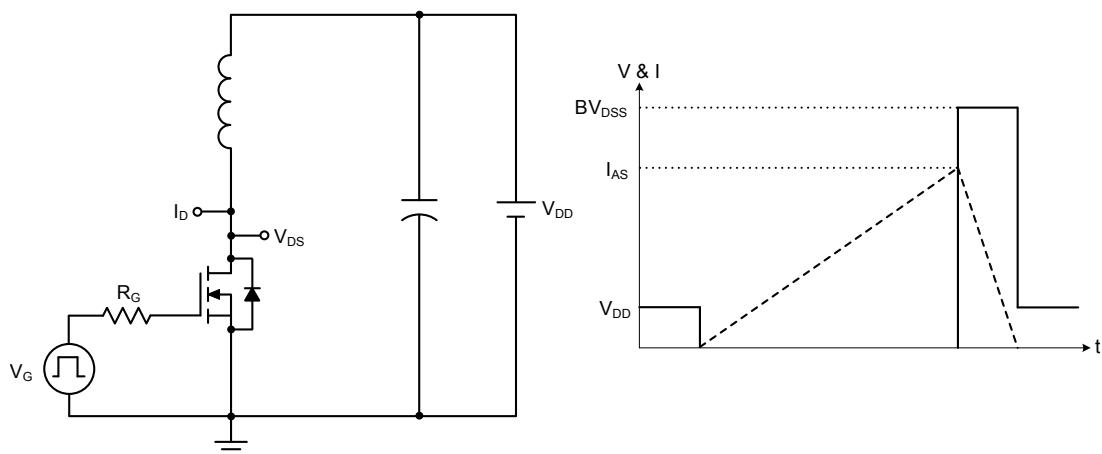
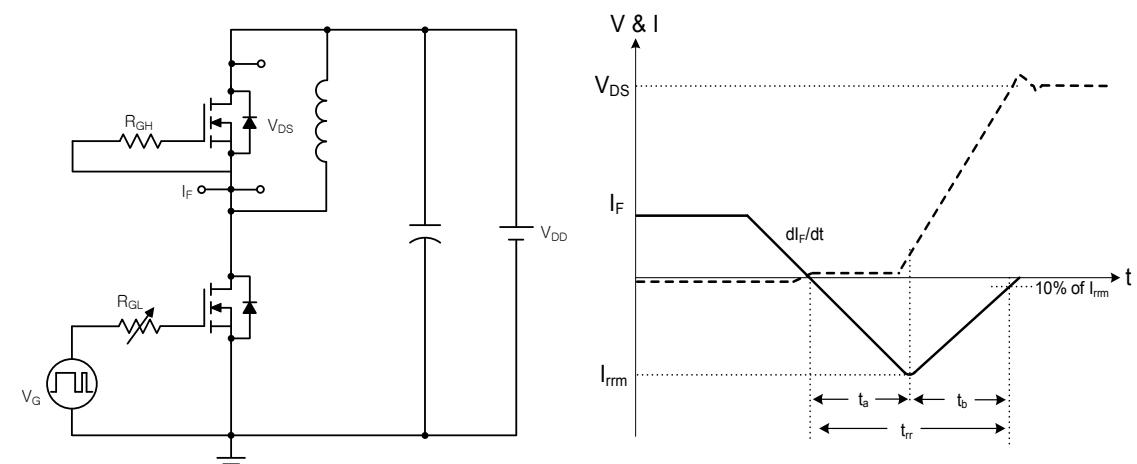
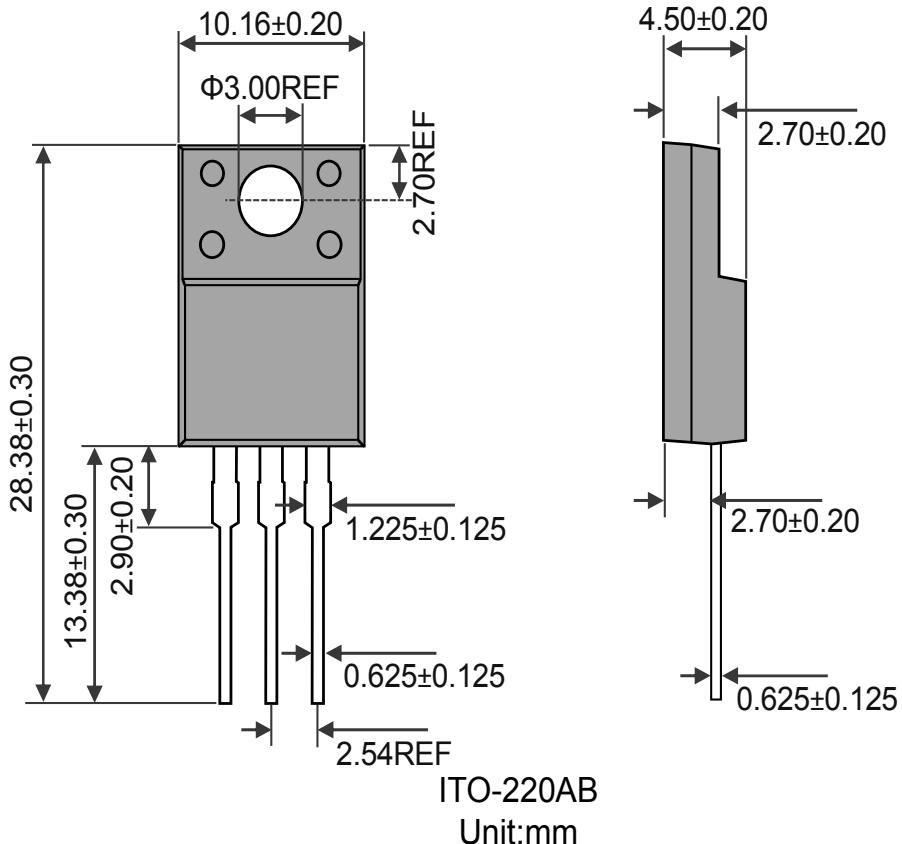


Figure 15. Peak Diode Recovery dv/dt Test Circuit and Waveforms



Package Outlines

ITO-220AB



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