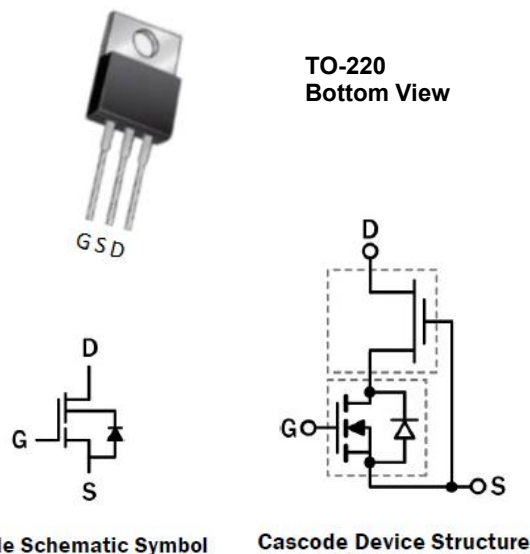


Features

- 650V, 13A, $R_{DS(on)}$ (Typ.) = 150mΩ@VGS = 10V.
- Very low Q_{RR}
- Reduced Crossover Loss
- RoHS Compliant and Halogen-free Packaging

Application

- Datacom
- SMPS, PV Inverter, UPS
- Servo motor



Absolute Maximum Ratings (T_c = 25° C unless otherwise noted)

Symbol	Parameter		Limit	Unit
			TO-220	
V _{DS}	Drain-Source Voltage		650	V
V _{(TR)DSS}	Transient Drain to Source Voltage ^a		800	V
V _{GSS}	Gate-Source Voltage		± 20	V
P _D	Maximum power Dissipation @T _C = 25°C		65	W
I _D	Drain Current-Continuous	T _C = 25°C ^b	13	A
	Drain Current-Continuous	T _C = 100°C ^b	9	A
I _{DM}	Drain Current-Pulsed	Pulse Width = 10μs	60	A
T _C	Operating Temperature Case		-55 to +150	°C
T _J	Operating Temperature Junction		-55 to +150	°C
T _S	Storage Temperature		-55 to +150	°C
T _{SOLD}	Soldering Peak Temperature ^e		260	°C

Thermal Characteristics

Symbol	Parameter	Typical	Unit
R _{θJC}	Thermal Resistance Junction-Case	1.9	°C/W
R _{θJA}	Thermal Resistance Junction-Ambient	50	°C/W

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

■ Off Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{(BL)DSS}$	Reverse Breakdown Voltage	$V_{GS} = 0V$	650	-	-	V
I_{DSS}	Reverse Leakage Current	$V_{GS} = 0V, V_{DS} = 650V$	-	-	20	μA
		$V_{GS} = 0V, V_{DS} = 650V$ $T_J = 150^\circ \text{C}$	-	50	-	μA
I_{GSS}	Gate-to-source Leakage Current	$V_{DS} = 0V, V_{GS} = \pm 20V$	-	-	± 100	nA

■ On Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 500\mu A$	3	4	5	V
$R_{DS(on)eff}$	On Resistance	$V_{GS} = 10V, I_D = 8A$	-	150	180	m Ω
		$V_{GS} = 10V, I_D = 8A$ $T_J = 150^\circ \text{C}$	-	298	-	

■ Dynamic Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
C_{iss}	Input Capacitance	$V_{GS} = 0V,$ $V_{DS} = 400V$ $f = 1MHz$	-	506	-	pF
C_{oss}	Output Capacitance		-	30	-	
C_{rss}	Transfer Capacitance		-	0.8	-	
$C_{o(er)}$	Output Capacitance, energy related	$V_{GS} = 0V,$ $V_{DS} = 0 \sim 400V$	-	48	-	pF
$C_{o(tr)}$	Output Capacitance, time related		-	106	-	

■ On Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-On Delay Time	$V_{GS} = 0 \sim 12V,$ $V_{DS} = 400V,$ $I_D = 10A,$ $R_g = 40\Omega$	-	44	-	ns
t_r	Turn-On Rise Time		-	16	-	
$t_{d(off)}$	Turn-Off Delay Time		-	40	-	
t_f	Turn-Off Fall Time		-	12	-	
Q_G	Total Gate Charge	$V_{GS} = 0 \sim 10V,$ $V_{DS} = 400V,$ $I_D = 9A$	-	16	-	nC
Q_{GS}	Gate-Source Charge		-	4.8	-	
Q_{GD}	Gate-Drain Charge		-	4.4	-	
Q_{oss}	Output Charge	$V_{GS} = 0V, V_{DS} = 0 \sim 400V$	-	34	-	nC



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650V GaN Power Transistor (FET)

■ Drain-Source Diode Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
I_S	Reverse Current	$V_{GS} = 0\text{ V}$, $T_C = 100^\circ\text{C}$, $\leq 25\%$ duty cycle	-	-	13	A
V_{SD}	Reverse Voltage	$V_{GS} = 0\text{ V}$, $I_S = 10\text{ A}$	-	2.0	-	V
		$V_{GS} = 0\text{ V}$, $I_S = 5\text{ A}$	-	1.4	-	V
t_{RR}	Reverse Recovery Time	$I_S = 10\text{ A}$, $V_{DS} = 400\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$	-	21	-	ns
Q_{RR}	Reverse Recovery Charge		-	45	-	nC

Notes:

- In off-state, spike duty cycle $D < 0.01$, spike duration $< 1\text{ }\mu\text{s}$
- For increased stability at high current operation
- Continuous switching operation
- ≤ 300 pulses per second for a total duration ≤ 20 minutes
- For 10 sec., 1.6mm from the case

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

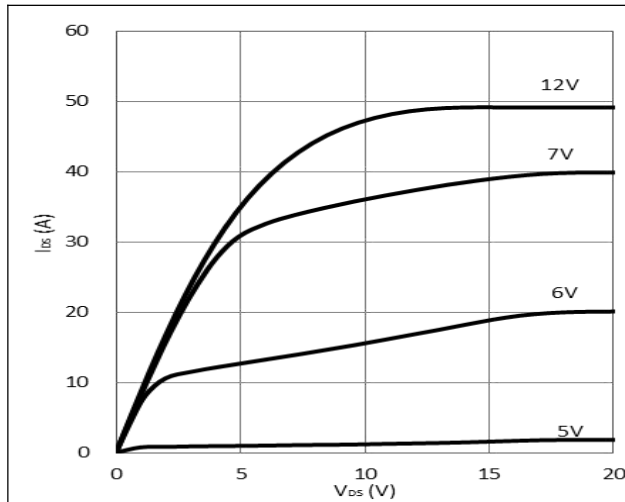


Figure 1. Typical Output Characteristics $T_j=25^\circ\text{C}$
Parameter: V_{GS}

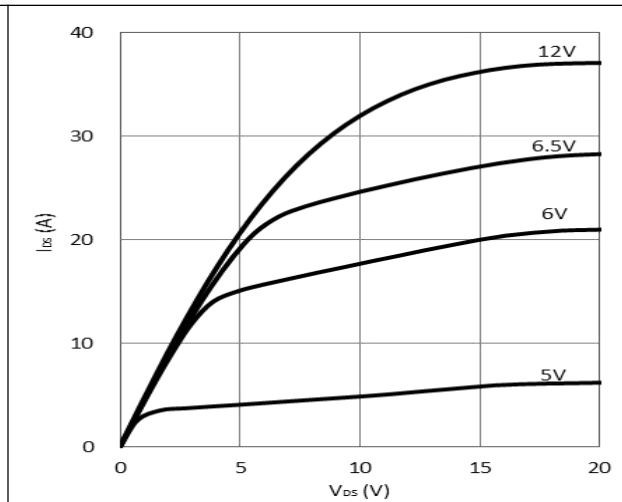


Figure 2. Typical Output Characteristics $T_j = 150^\circ\text{C}$
Parameter: V_{GS}

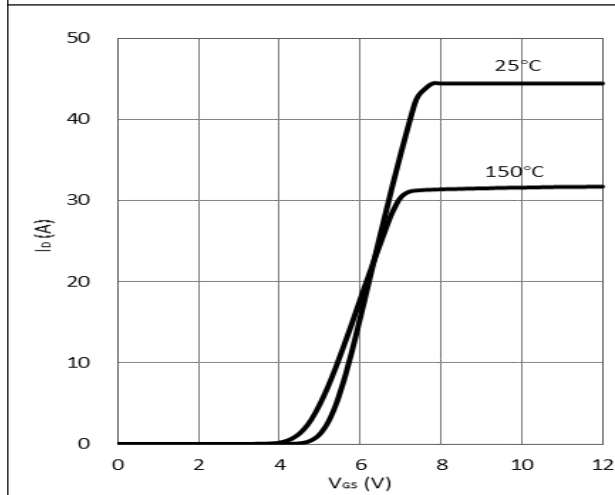


Figure 3. Typical Transfer Characteristics $V_{DS}=10\text{V}$
Parameter: T_j

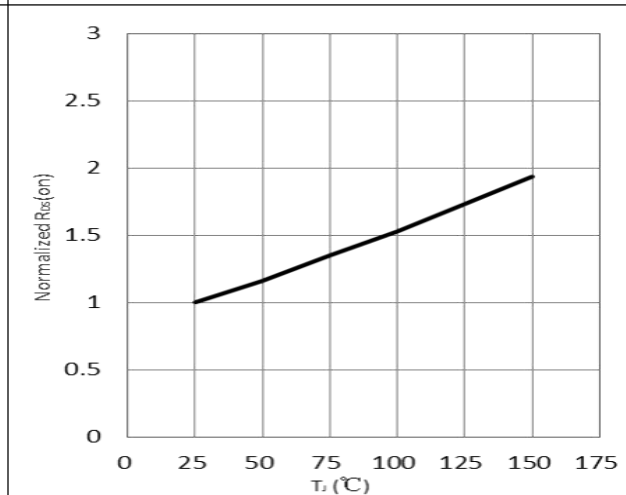


Figure 4. Normalized On-resistance
 $I_D = 4\text{ A}, V_{GS} = 12\text{ V}$

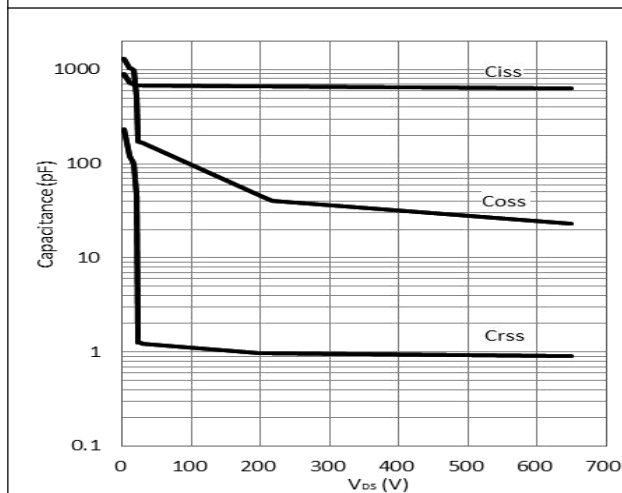


Figure 5. Typical Capacitance
 $V_{GS} = 0\text{V}, f = 1\text{MHz}$

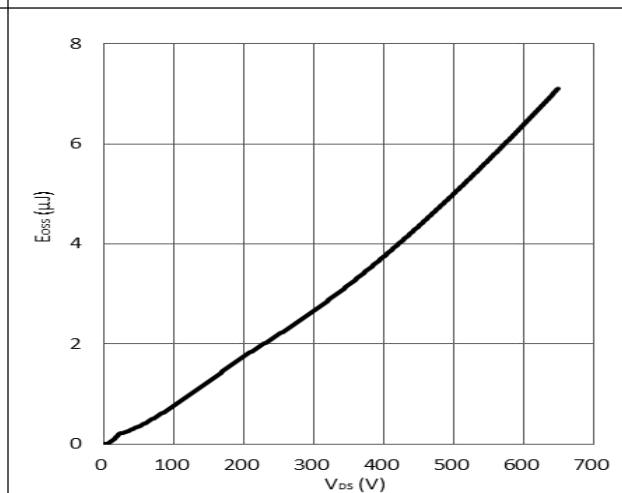
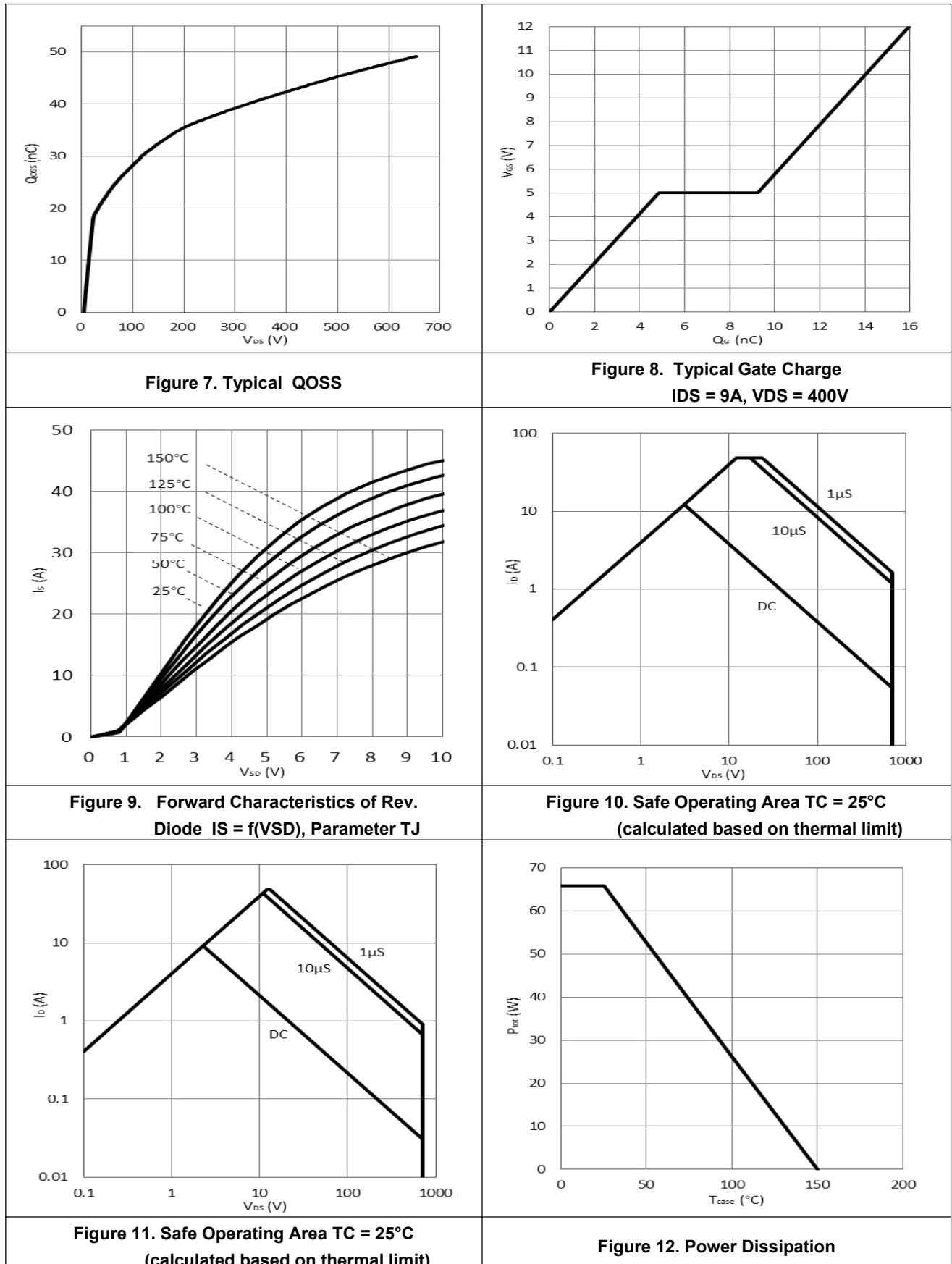


Figure 6. Typical C_{OSS} Stored Energy

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



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

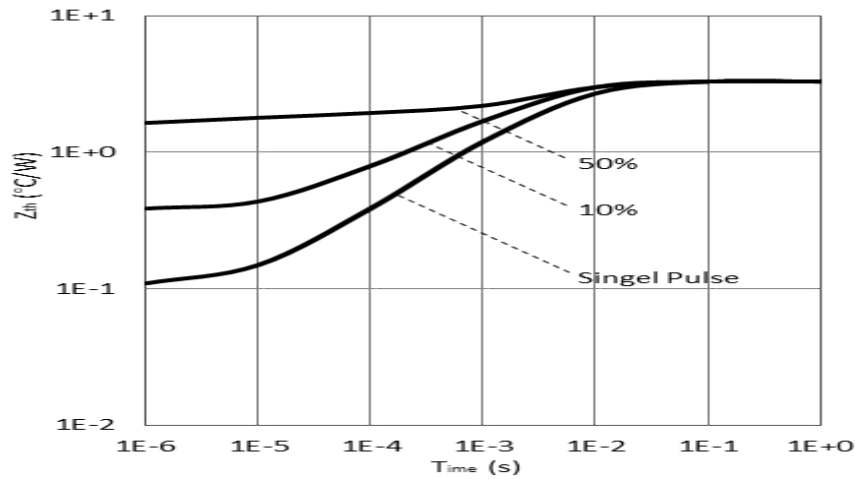


Figure 13. Transient Thermal Resistance

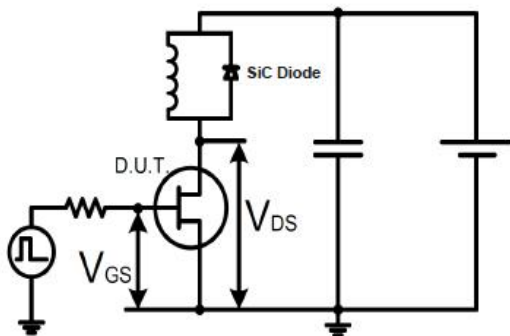


Figure 14. Switching Time Test Circuit

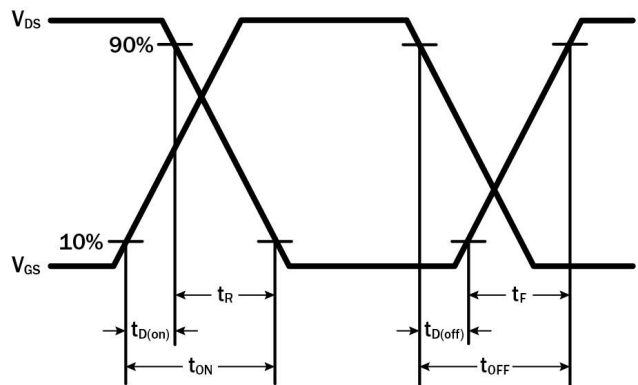


Figure 15. Switching Time Waveform

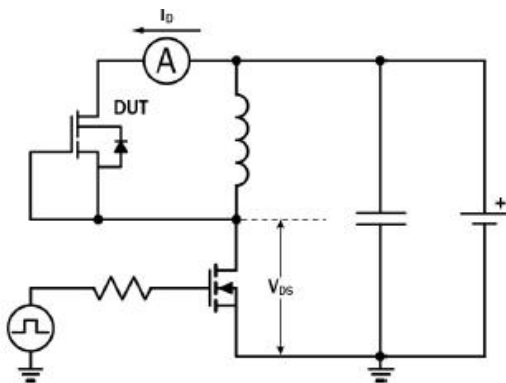


Figure 16. Diode Characteristics Test Circuit

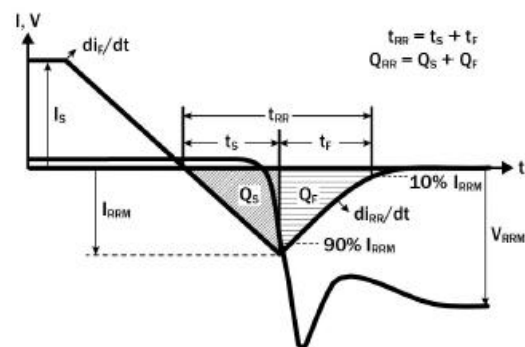
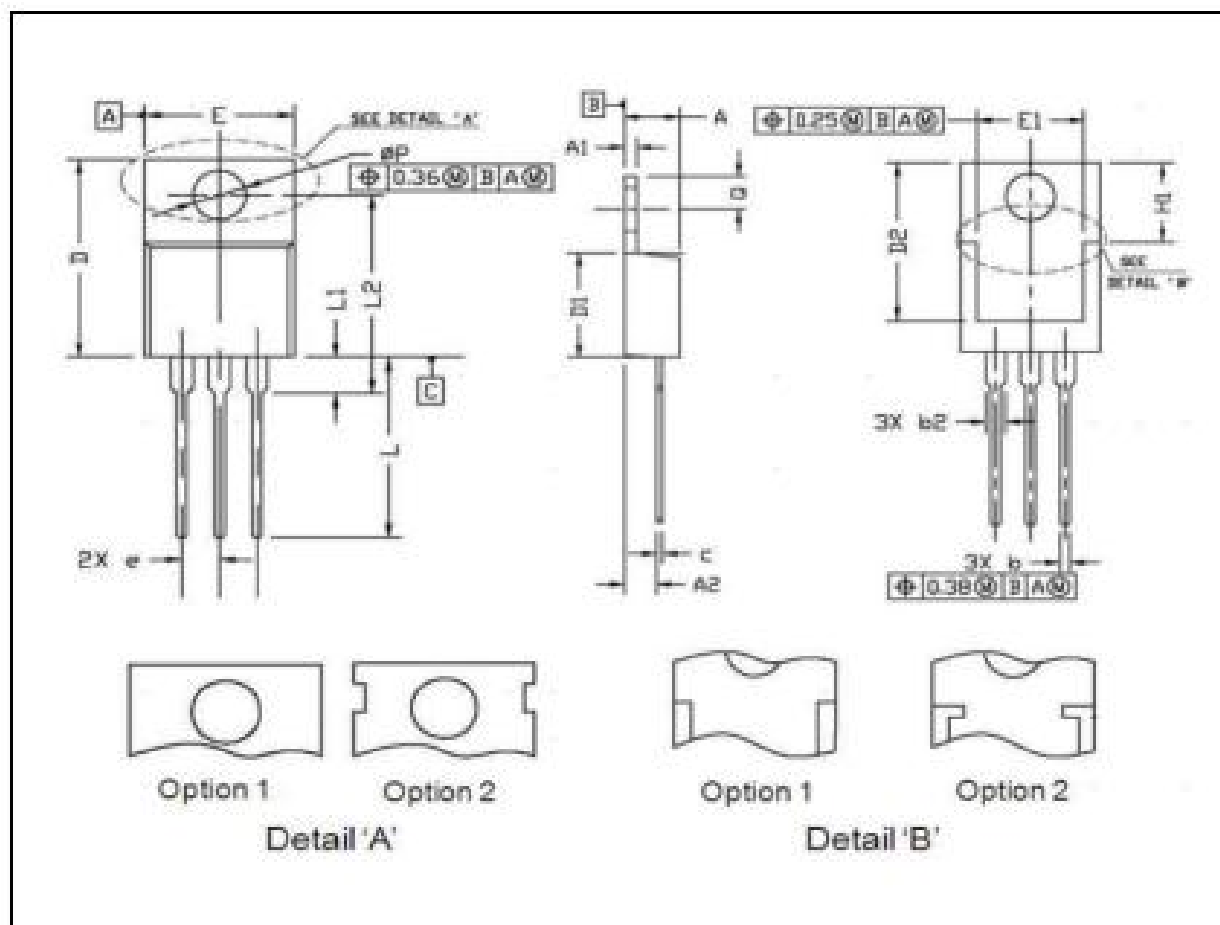


Figure 17. Diode Recovery Waveform

■ TO-220 Package Information



SYMBOL	Millimeter		
	Min	Nom	Max
A	4.30	4.50	4.80
A1	1.20	1.30	1.45
A2	2.20	2.50	2.90
b	0.69	0.85	0.95
b2	1.00	1.30	1.60
c	0.33	0.45	0.65
D	14.70	15.50	16.20
D1	8.59	9.00	9.65
D2	11.75	12.70	13.60
e	2.54BSC		
E	9.60	10.00	10.60
E1	7.00	7.50	8.46
H1	6.20	6.60	7.00
L	12.60	13.70	14.80
L1	2.70	3.40	3.80
L2	12.13	14.20	16.50
Q	2.40	2.80	3.10
P	3.50	3.70	3.90



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650V GaN Power Transistor (FET)

■ Revision History

Version	Date	Subjects (major changes since last revision)
0.1	2022-03-20	Preliminary version
1.0	2024-10-10	Datasheet Complete