

1.Description

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts.

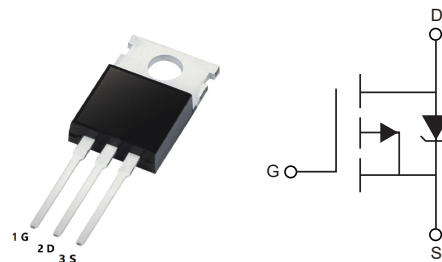
2.Features

- $V_{DS(V)} = -55V$
- $I_D = -12A$
- $R_{DS(ON)} < 175m\Omega (V_{GS} = -10V)$

3.Pinning information

Pin	Symbol	Description
1	G	GATE
2	D	DRAIN
3	S	SOURCE

TO-220



4.Absolute Maximum Ratings

Parameter		Symbol	Rating	Units
Continuous Drain Current, $V_{GS} = -10V$	$T_C = 25^\circ C$	I_D	-12	A
Continuous Drain Current, $V_{GS} = -10V$	$T_C = 100^\circ C$		-8.5	A
Pulsed Drain Current ①		I_{DM}	-48	A
Power Dissipation	$T_C = 25^\circ C$	P_D	45	W
Linear Derating Factor			0.3	W/ $^\circ C$
Gate-to-Source Voltage		V_{GS}	± 20	V
Single Pulse Avalanche Energy ②		E_{AS}	96	mJ
Avalanche Current ①		I_{AR}	-7.2	A
Repetitive Avalanche Energy ①		E_{AR}	4.5	mJ
Peak Diode Recovery dv/dt ③		dv/dt	-5	V/ns
Storage Temperature Range		T_J, T_{STG}	-55 to 175	$^\circ C$
Soldering Temperature, for 10 seconds			300 (1.6mm from case)	$^\circ C$
Mounting torque, 6-32 or M3 screw			10 lbf•in (1.1N•m)	



5.Thermal resistance rating

Parameter	Symbol	Typ	Max	Units
Junction-to-Case	$R_{\theta JC}$		3.3	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{\theta CS}$	0.5		°C/W
Junction-to-Ambient	$R_{\theta JA}$		62	°C/W



6. Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$I_D = -250\mu\text{A}$, $V_{GS} = 0\text{V}$	-55			V
Breakdown Voltage Temp. Coefficient	$\Delta V_{(BR)DSS}/T_J$	$I_D = -1\text{mA}$, Reference to 25°C		-0.05		V/ $^\circ\text{C}$
Static Drain-to-Source On-Resistance	$R_{DS(ON)}$	$V_{GS} = -10\text{V}$, $I_D = -7.2\text{A}$ ④			175	m Ω
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = -250\mu\text{A}$	-2		-4	V
Forward Transconductance	g_{FS}	$V_{DS} = -25\text{V}$, $I_D = -7.2\text{A}$	2.5			S
Drain-to-Source Leakage Current	I_{DSS}	$V_{DS} = -55\text{V}$, $V_{GS} = 0\text{V}$			-25	μA
		$V_{DS} = -44\text{V}$, $V_{GS} = 0\text{V}$, $T_J = 150^\circ\text{C}$			-250	μA
Gate-to-Source Forward Leakage	I_{GSS}	$V_{GS} = 20\text{V}$			100	nA
Gate-to-Source Reverse Leakage		$V_{GS} = -20\text{V}$			-100	nA
Total Gate Charge	Q_g	$I_D = -7.2\text{A}$			19	nC
Gate-to-Source Charge	Q_{gs}	$V_{DS} = -44\text{V}$, $V_{GS} = -10\text{V}$			5.1	nC
Gate-to-Drain ("Miller") Charge	Q_{gd}	See Fig. 6 and 13 ④			10	nC
Turn-On Delay Time	$t_{D(on)}$	$V_{DD} = -28\text{V}$, $I_D = -7.2\text{A}$ $R_G = 24\Omega$, $R_D = 3.7\Omega$ See Fig. 10 ④		13		ns
Rise Time	t_r			55		ns
Turn-Off Delay Time	$t_{D(off)}$			23		ns
Fall Time	t_f			37		ns
Internal Drain inductance	L_D	Between lead, 6mm (0.25in.) from package and center of die contact		4.5		nH
Internal Source inductance	L_S			7.5		nH
Input Capacitance	C_{iss}	$V_{GS} = 0\text{V}$, $V_{DS} = -25\text{V}$ $f = 1.0\text{MHz}$, See Fig. 5		350		pF
Output Capacitance	C_{oss}			170		pF
Reverse Transfer Capacitance	C_{rss}			92		pF



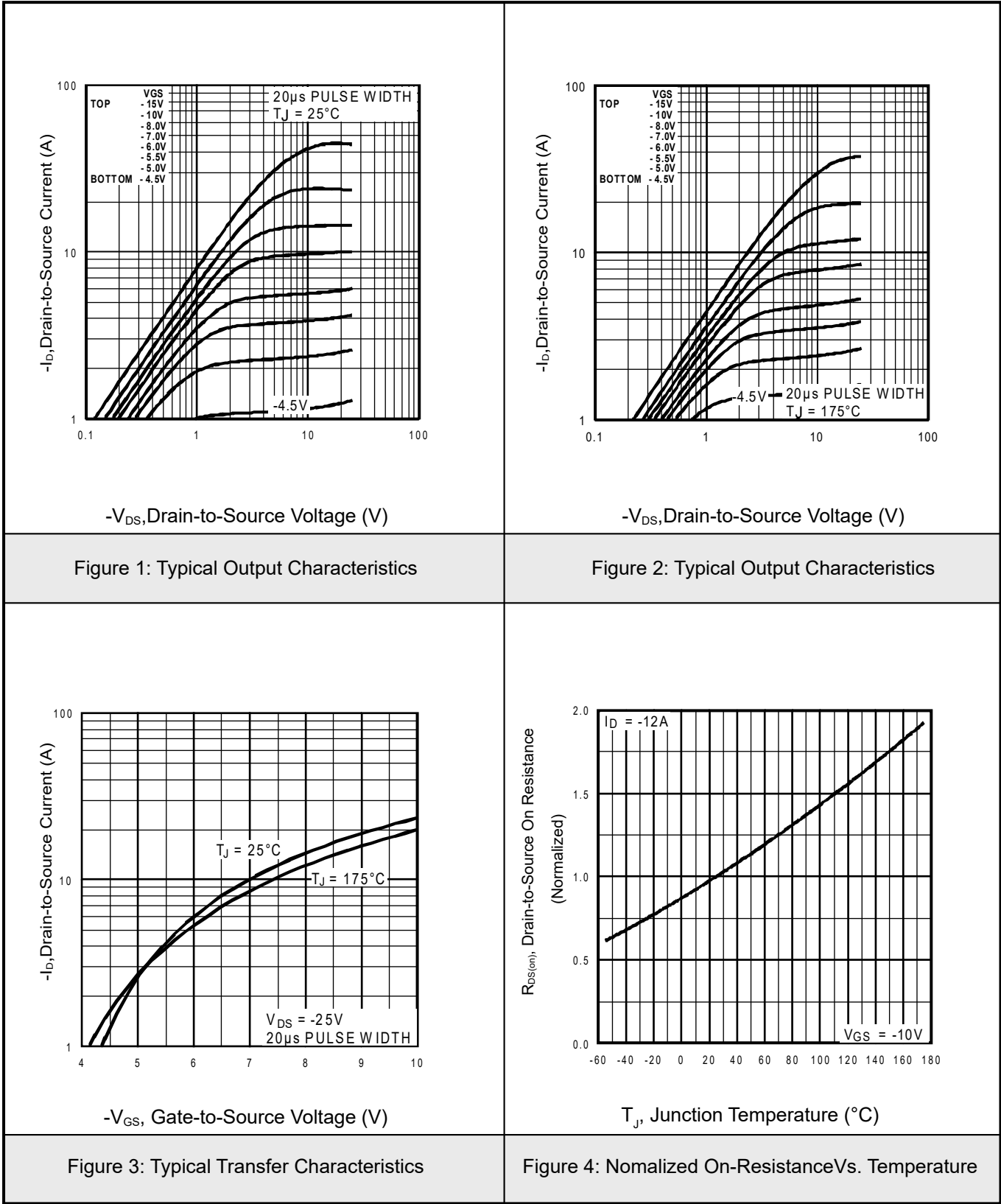
Source-Drain Ratings and Characteristics						
Continuous Source Current (Body Diode)	I_S	MOSFET symbol showing the integral reverse p-n junction diode.			-12	A
Pulsed Source Current (Body Diode) ①	I_{SM}				-48	
Diode Forward Voltage	V_{SD}	$T_J=25^{\circ}\text{C}$, $I_S=-7.2\text{A}$, $V_{GS}=0\text{V}$ ④			-1.6	V
Reverse Recovery Time	t_{rr}	$T_J=25^{\circ}\text{C}$, $I_F=-7.2\text{A}$ $di/dt=-100\text{A}/\mu\text{s}$ ④		47	71	ns
Reverse Recovery Charge	Q_{rr}			84	130	μC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Starting $T_J=25^{\circ}\text{C}$, $L=3.7\text{mH}$, $R_G=25\Omega$, $I_{AS}=-7.2\text{A}$. (See Figure 12)
- ③ $I_{SD} \leq 7.2\text{A}$, $di/dt \leq -280\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^{\circ}\text{C}$
- ④ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$

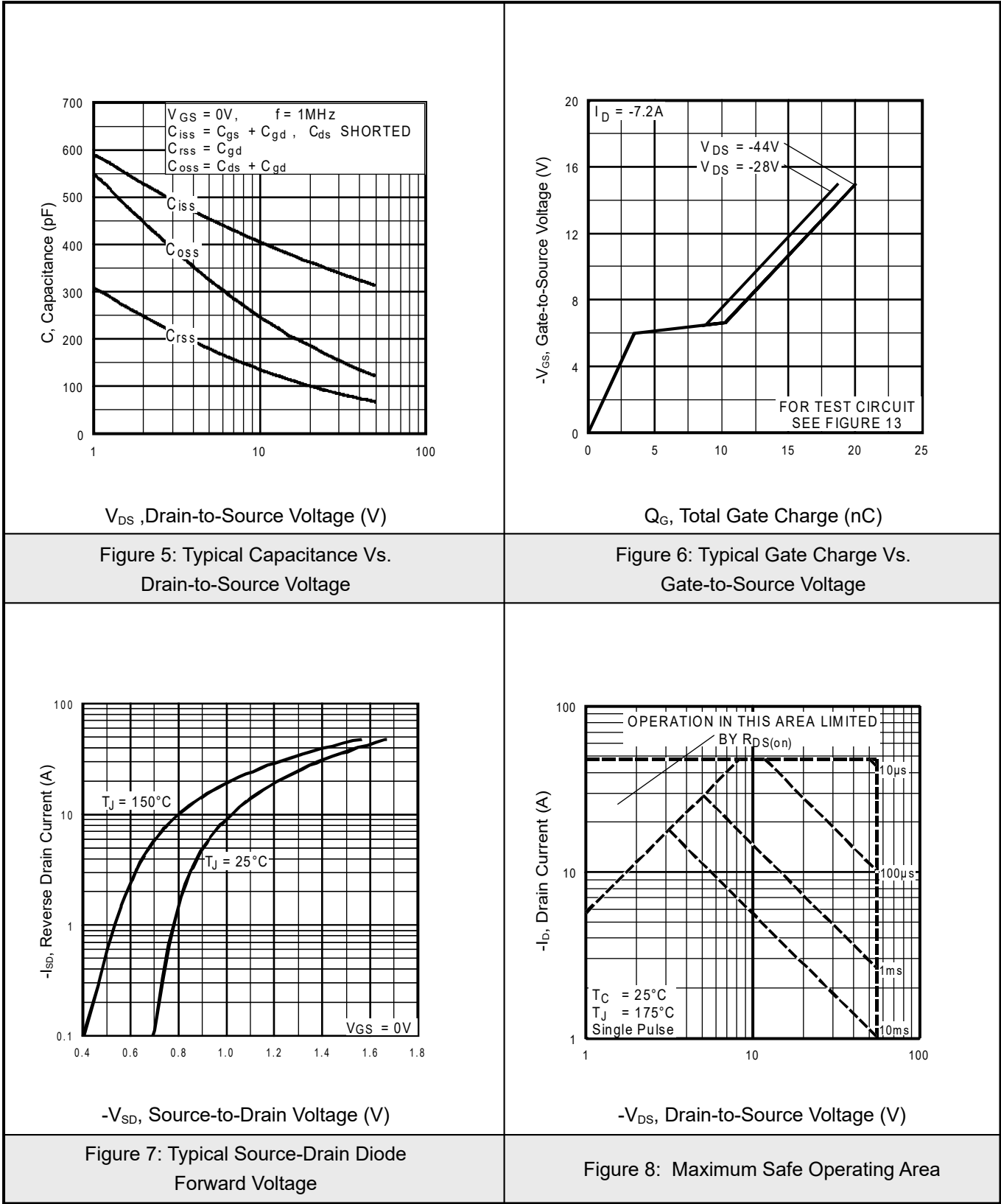


7.1 Typical Characteristics



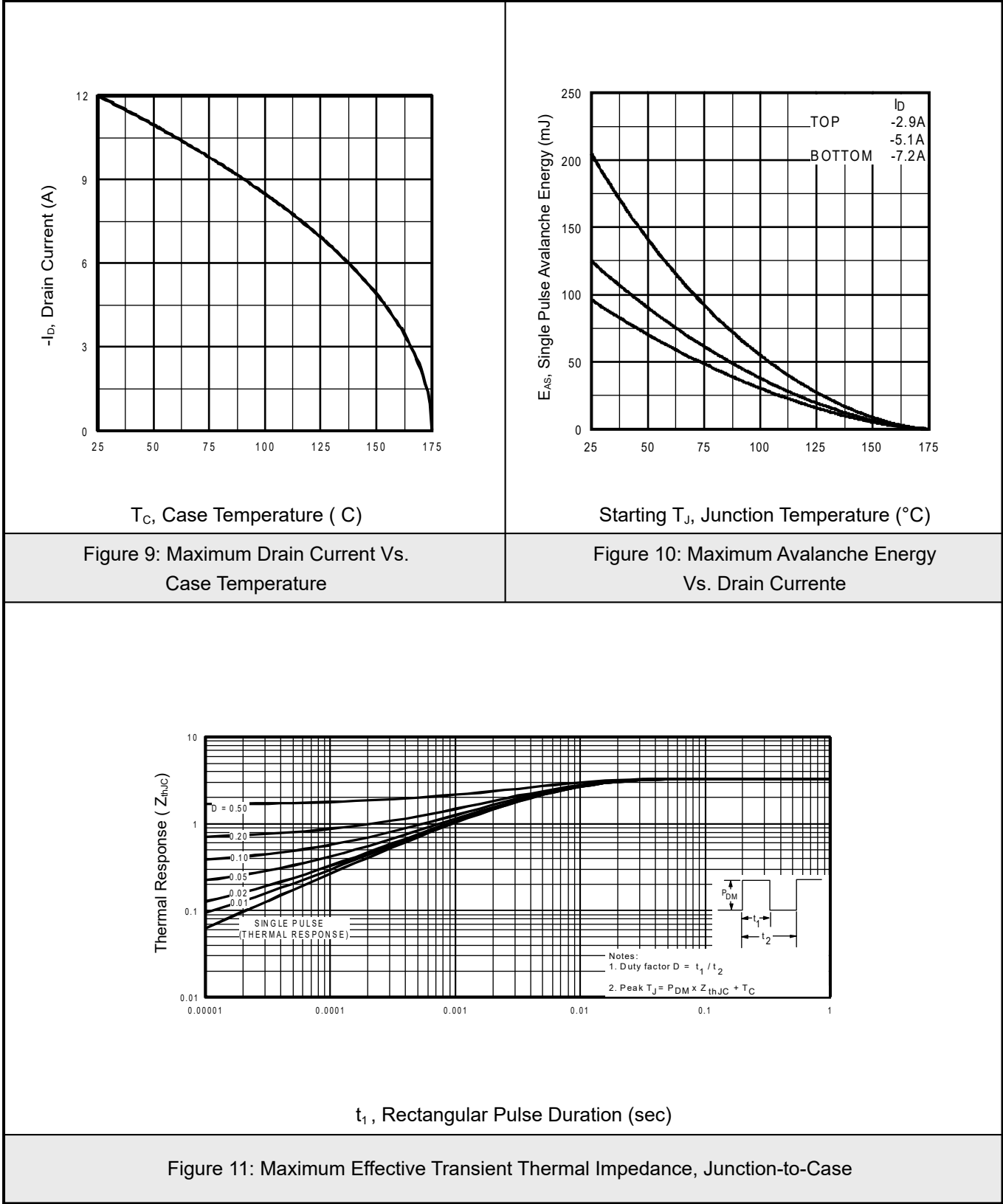


7.2Typical Characteristics





7.3Typical Characterisitics



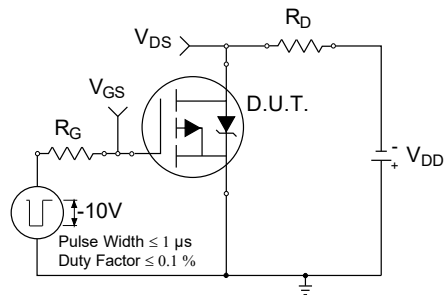


Figure 12a: Switching Time Test Circuit

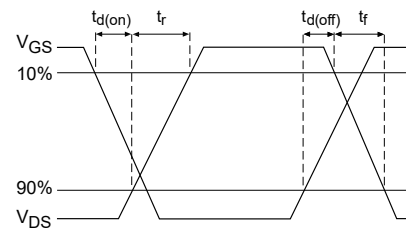


Figure 12b: Switching Time Waveforms

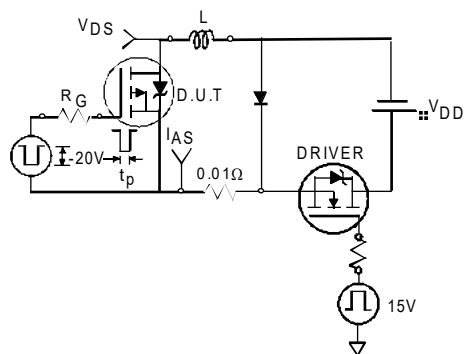


Figure 13a: Unclamped Inductive Test Circuit

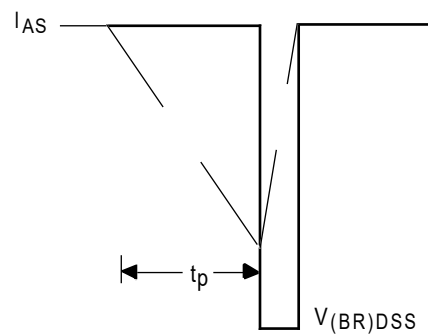


Figure 13b: Unclamped Inductive Waveforms

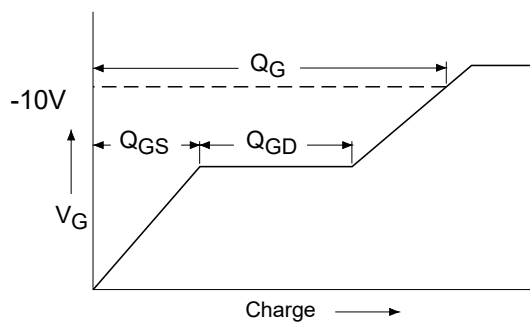


Figure 14a: Basic Gate Charge Waveform

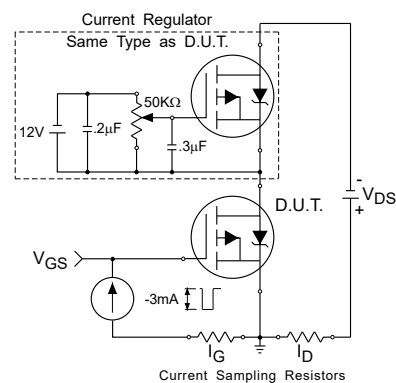
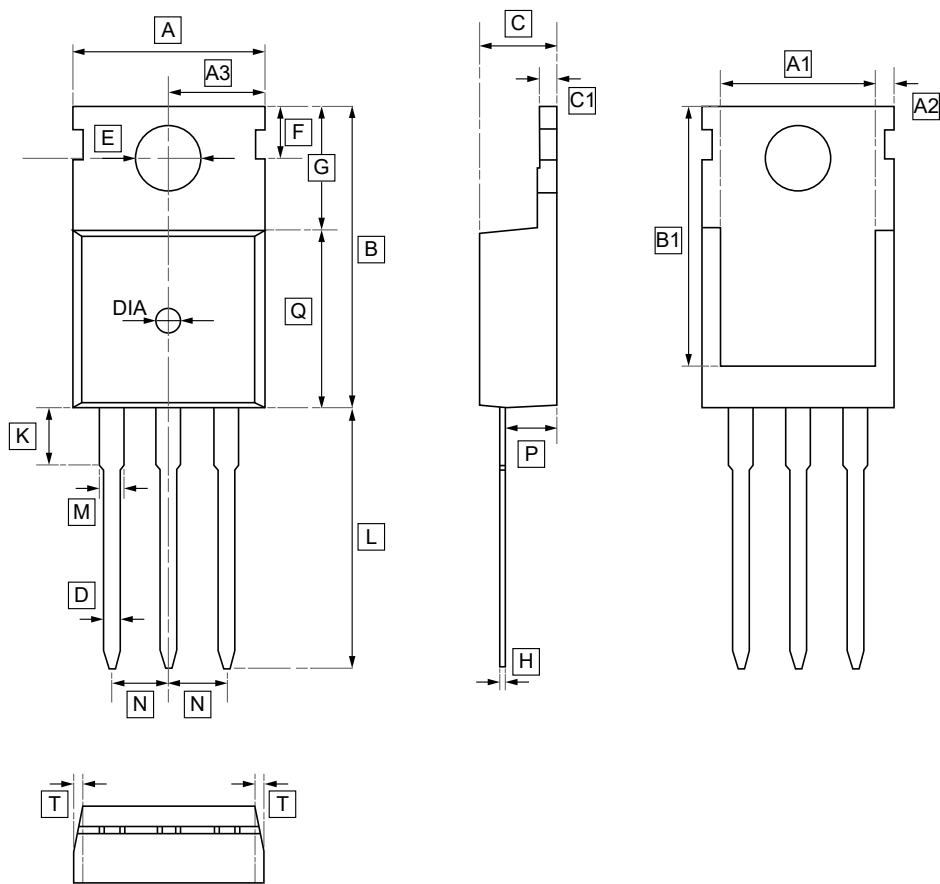


Figure 14b: Gate Charge Test Circuit



8.TO-220 Package Outline Dimensions



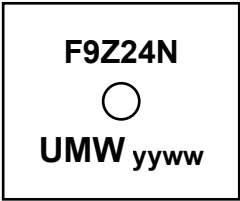
DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	A3	B	B1	C	C1	D	E	F	G
Min	9.7	8.44	1.05	4.8	15.4	12.9	4.28	1.1	0.6	3.4	2.65	5.2
Max	10.3	8.84	1.25	5.2	16.2	13.5	4.68	1.5	1.0	3.8	3.25	5.8

Symbol	H	K	L	L1	M	N	P	Q	T	DIA
Min	0.4	2.9	12.8	2.7	1.15	2.49	2.1	8.7	W:0.35	⌀1.5
Max	0.6	3.3	13.6	3.3	1.35	2.59	2.7	9.3		(deep 0.2)



9.Ordering information



yy: Year Code
ww: Week Code

Order Code	Package	Base QTY	Delivery Mode
UMW IRF9Z24N	TO-220	1000	Tube and box



10.Disclaimer

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