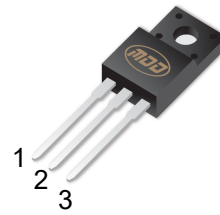


V_{DS}	600V
$I_D(T_C=25^{\circ}C)$	4A
$R_{DS(on),max}$	2.4Ω@ $V_{GS}=10V$
$Q_{g,typ}$	12.8nC

TO-220F-3L



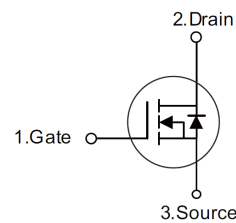
General Features

- ◆ Low $R_{DS(on)}$
- ◆ Low gate charge
- ◆ 100% UIS tested
- ◆ RoHS compliant

Application

- ◆ Power faction correction.
- ◆ Switched mode power supplies.
- ◆ LED driver.

Equivalent Circuit



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

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	600	V
Gate-Source Voltage	V_{GS}	±30	V
Continuous Drain Current	I_D	4	A
Pulsed Drain Current(Note 1)	I_{DM}	16	A
Avalanche Energy Single Pulsed (Note 2)	E_{AS}	245	mJ
Peak Diode Recovery dv/dt (Note 3)	dv/dt	5	V/ns
Power Dissipation TO-220F	P_D	32	W
Junction Temperature	T_J	150	°C
Storage Temperature	T_{stg}	-55 ~150	°C

Thermal Characteristics

Parameter	Symbol	Value	Unit
		TO-220F	
Thermal resistance, Junction-to-case	$R_{\theta JC}$	3.8	°C/W
Thermal resistance, Junction-to-ambient	$R_{\theta JA}$	62.5	°C/W

- Notes:**
1. Pulse width limited by maximum junction temperature.
 2. L=10mH, $I_{AS} = 7A$, Starting $T_J = 25^{\circ}C$.
 3. $I_{SD} = 4A$, $di/dt \leq 100A/\mu s$, $V_{DD} \leq BV_{DS}$, Starting $T_J = 25^{\circ}C$.

Ta = 25°C unless otherwise specified

Symbol	Parameter		Condition	Min	Typ	Max	Unit
V_{(BR)DSS}	Drain-Source Breakdown Voltage		V_{GS}=0V, I_D=250μA	600	--	--	V
I_{gss}	Gate-Source Leakage Current	Forward	V_{GS}=30V, V_{DS}=0V	--	--	100	nA
		Reverse	V_{GS}=-30V, V_{DS}=0V	--	--	-100	nA
I_{DSS}	Drain-Source Leakage Current		V_{DS}=600V, V_{GS}=0V	--	--	1	uA
V_{GS(TH)}	Gate Threshold Voltage		V_{DS}=V_{GS}, I_D=250μA	2.0	--	4.0	V
R_{DS(ON)}	Drain-Source On-State Resistance		V_{GS}=10V, I_D=2A	--	2.0	2.4	Ω

Dynamic Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{DS}=25V V_{GS}=0V f=1MHz	--	580	--	pF
C_{oss}	Output Capacitance		--	50	--	pF
C_{rss}	Reverse Transfer Capacitance		--	3	--	pF
Q_g	Total Gate Charge	V_{DS}=480V, V_{GS}=10V, I_D=4A (Note1,2)	--	12.8	--	nC
Q_{gs}	Gate Source Charge		--	3.1	--	nC
Q_{gd}	Gate Drain Charge		--	5.5	--	nC

Switching Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
t_{d(on)}	Turn on Delay Time	V_{DS}=300V, I_D=4A, R_G=10Ω (Note1,2)	--	13	--	ns
t_r	Turn on Rise Time		--	31	--	ns
t_{d(off)}	Turn Off Delay Time		--	38	--	ns
t_f	Turn Off Fall Time		--	17	--	ns

Source Drain Diode Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{SD}	Drain-Source Diode Forward Voltage	I_S=4A, V_{GS}=0V	--	--	1.5	V
t_{rr}	Body Diode Reverse Recovery Time	V_R=400V I_F=4A, -diF/dt =100A/μs	--	275	--	ns
Q_{rr}	Body Diode Reverse Recovery Charge		--	1.43	--	uC

Notes:

- 1.Pulse test ; Pulse width≤300us, duty cycles≤2%.
- 2.Essentially independent of operating temperature.

Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

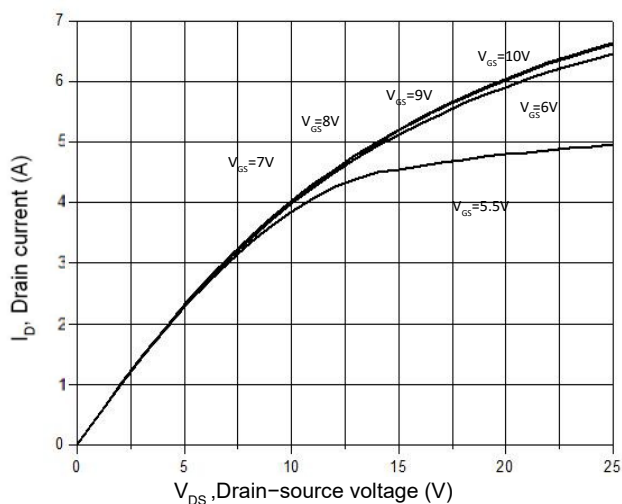


Figure 2. Transfer Characteristics

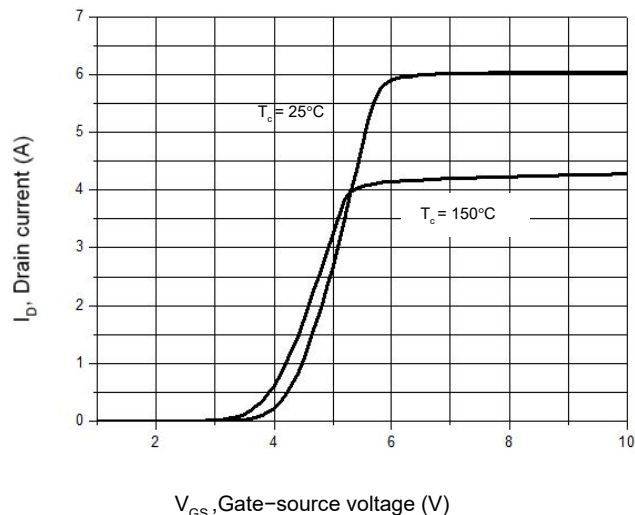


Figure 3. On-Resistance Variation vs. Drain Current

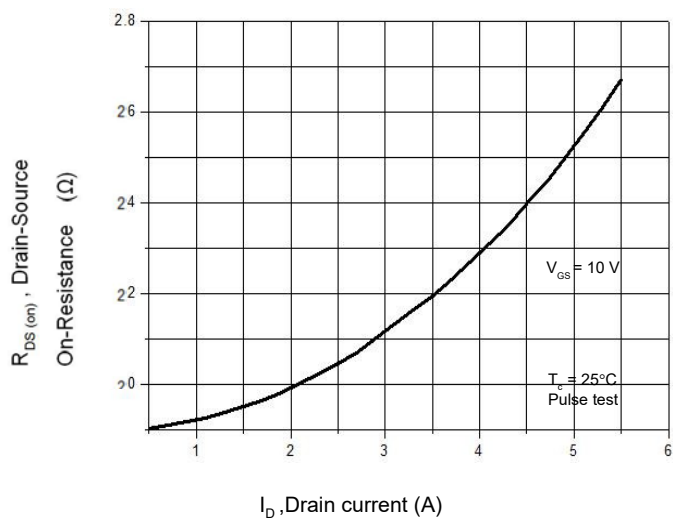


Figure 4. Threshold Voltage vs. Temperature

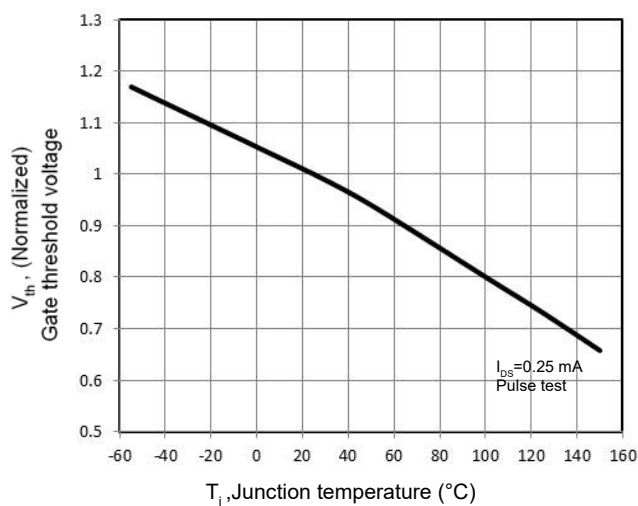


Figure 5. Breakdown Voltage vs. Temperature

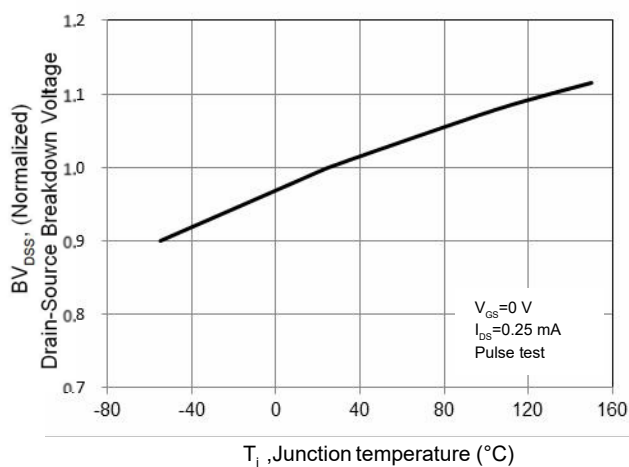


Figure 6. On-Resistance vs. Temperature

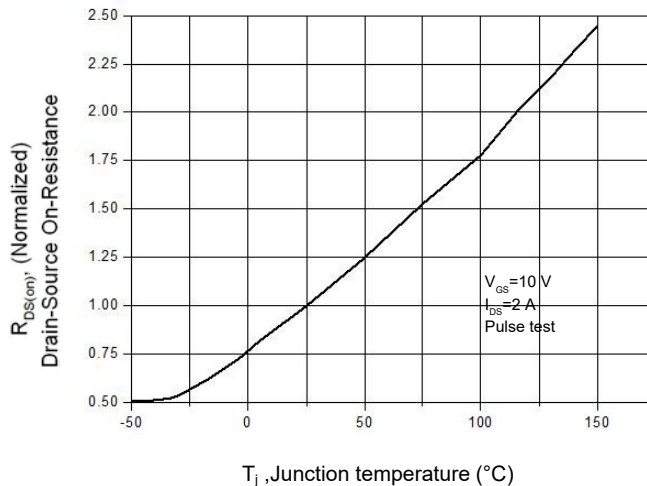


Figure 7. Capacitance Characteristics

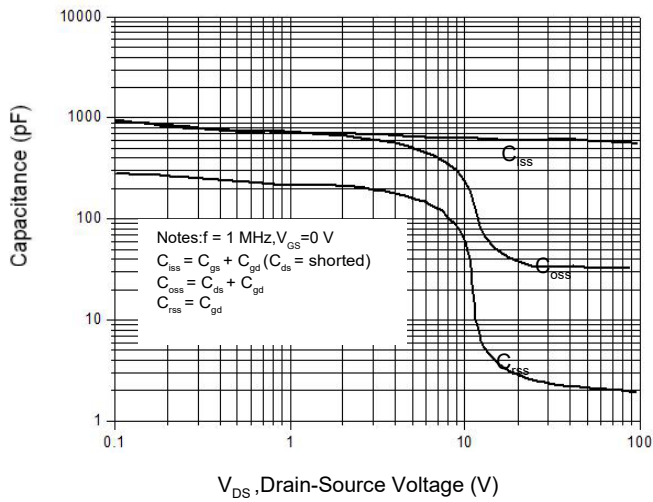


Figure 8. Gate Charge Characterist

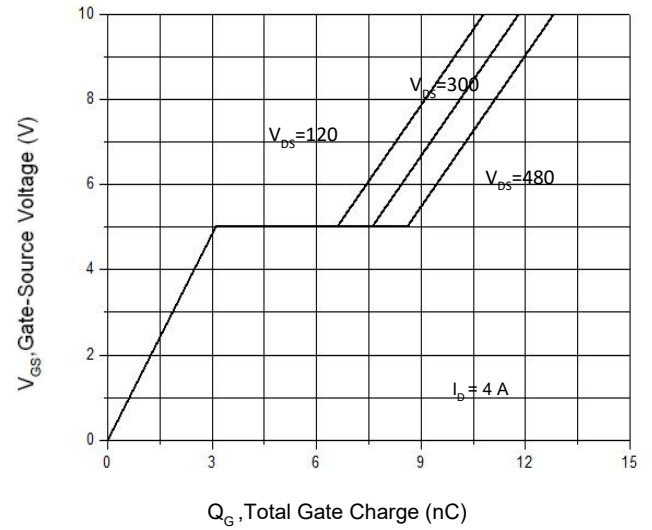


Figure 9. Maximum Safe Operating Area
TO-220F

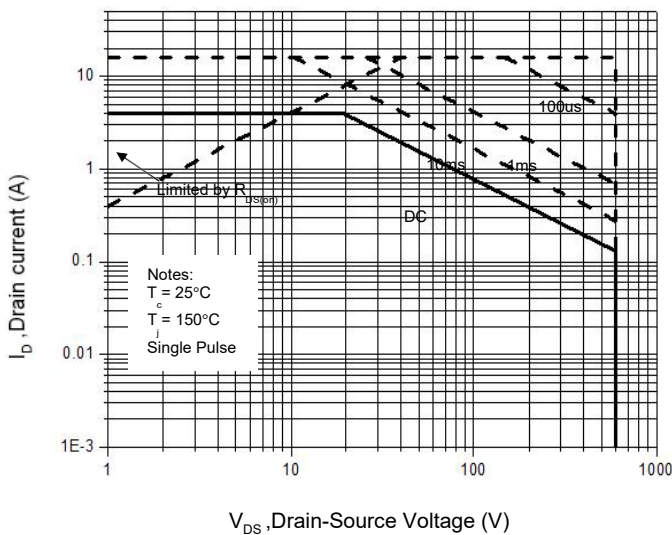


Figure 10. Maximum Safe Operating Area
TO-220/TO-252

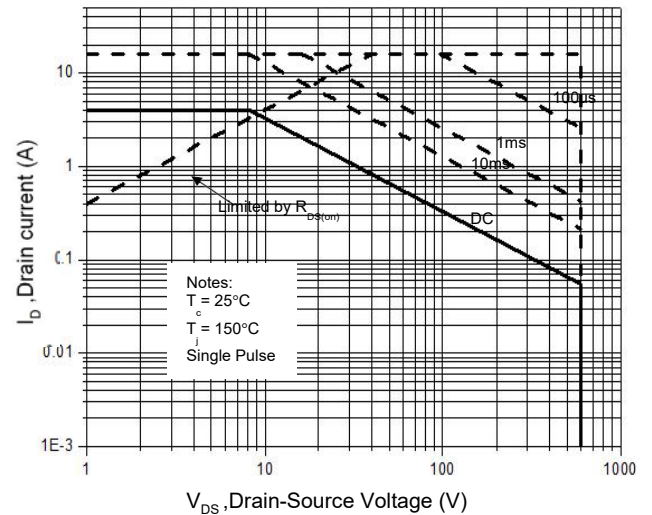


Figure 11. Power Dissipation vs. Temperature
TO-220F

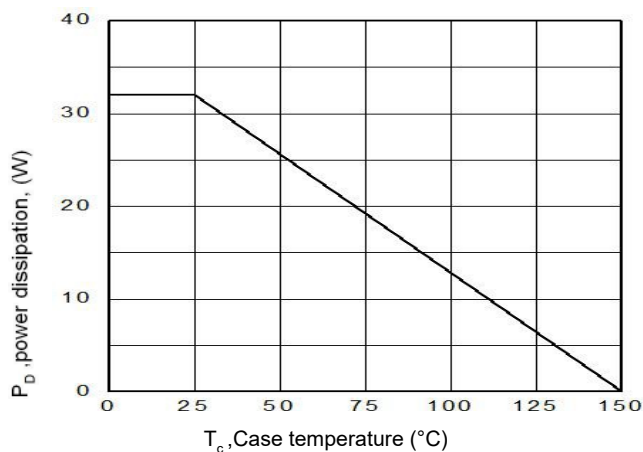


Figure 12. Power Dissipation vs.
Temperature TO-220/TO-252

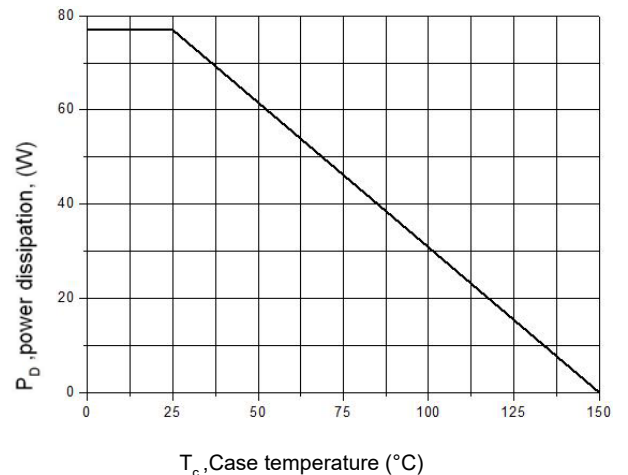


Figure 13. Continuous Drain Current vs. Temperature

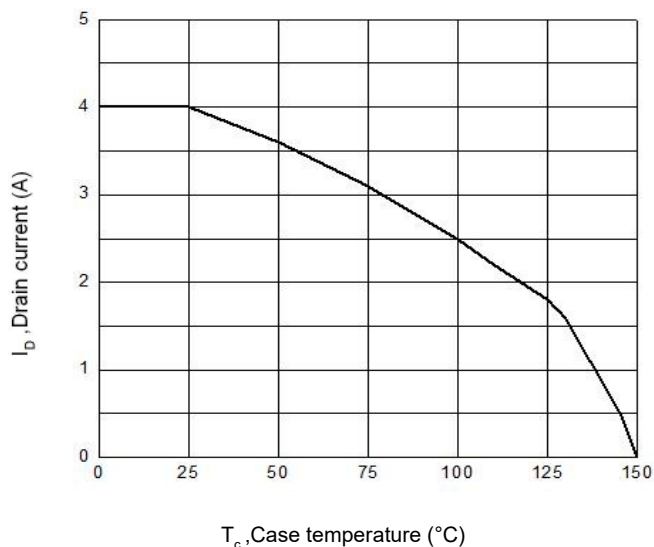


Figure 14. Body Diode Transfer Characteristics

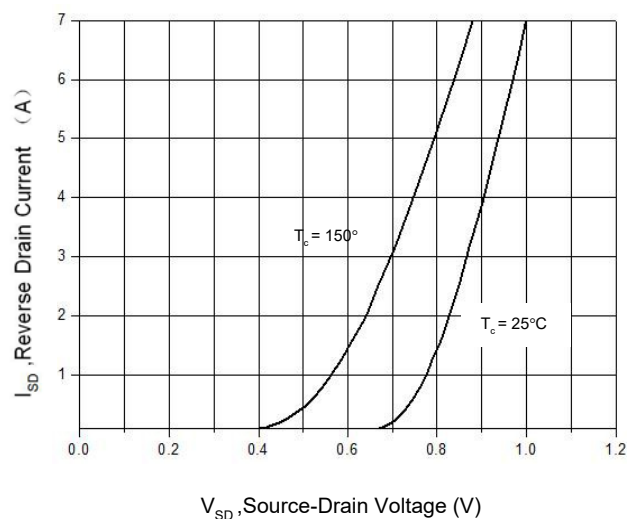


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

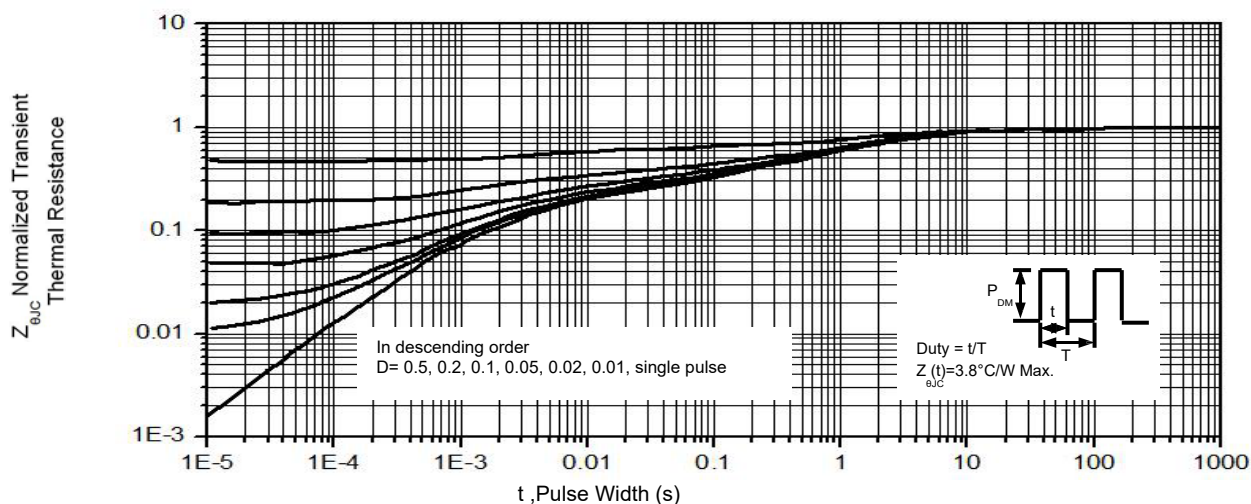
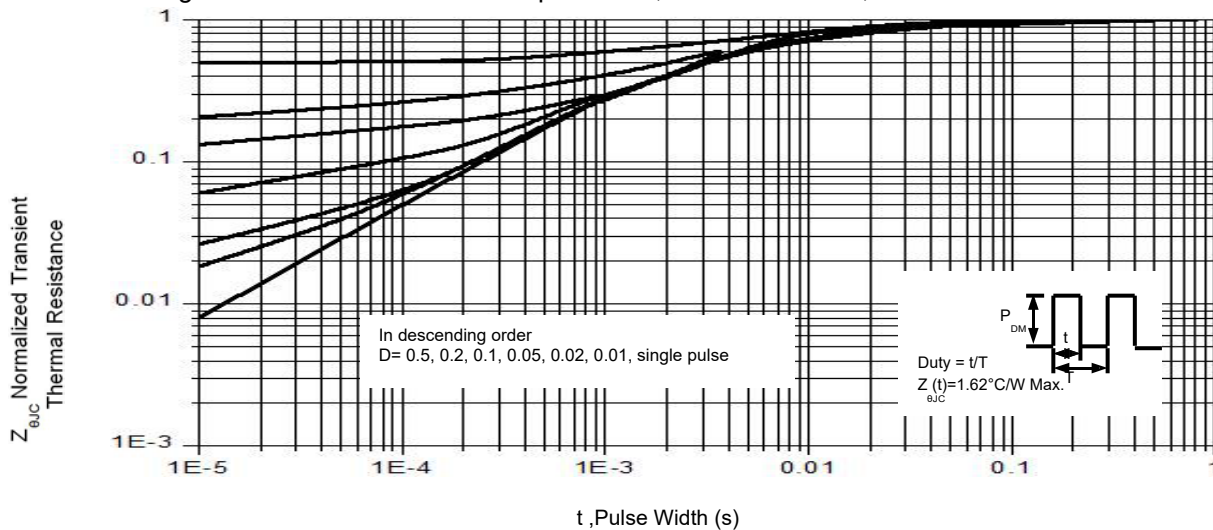
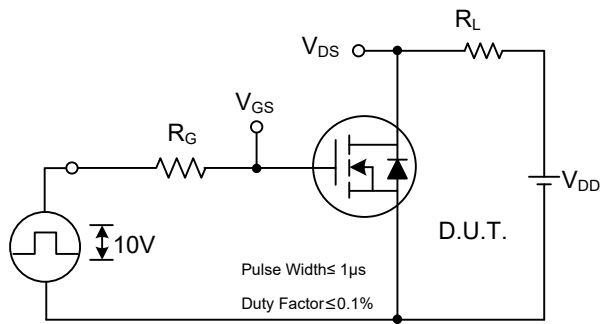
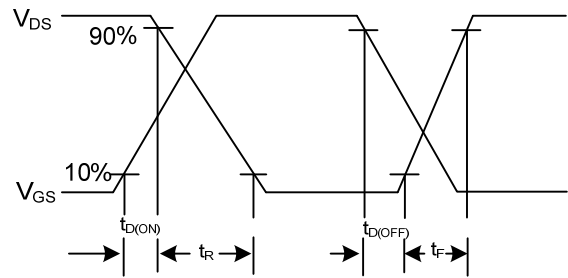


Figure 16. Transient Thermal Impedance, Junction to Case, TO-220/TO-252

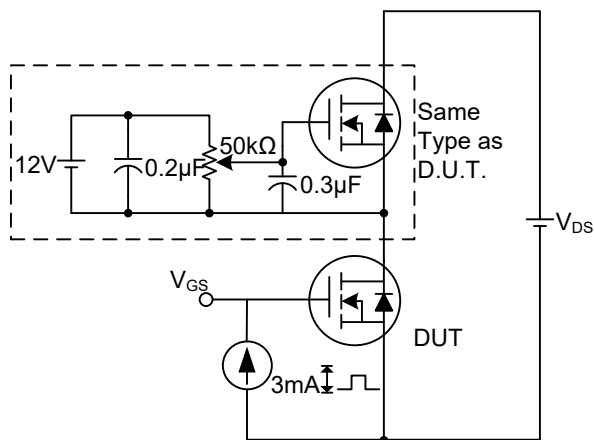




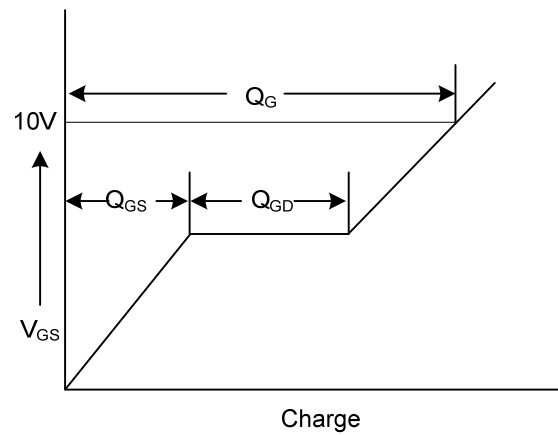
Switching Test Circuit



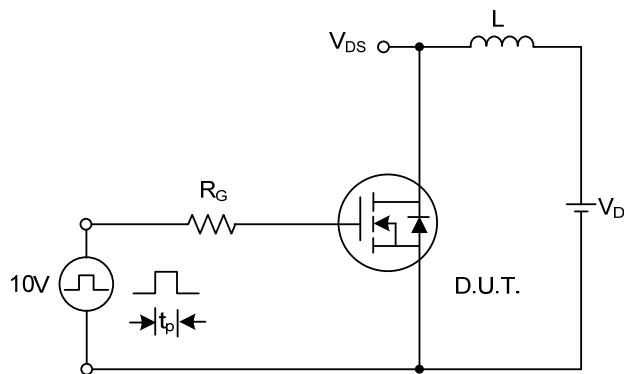
Switching Waveforms



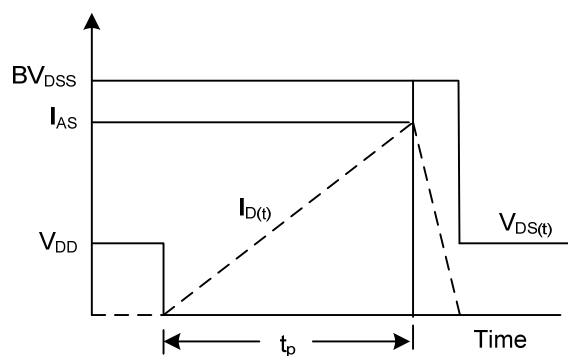
Gate Charge Test Circuit



Gate Charge Waveform



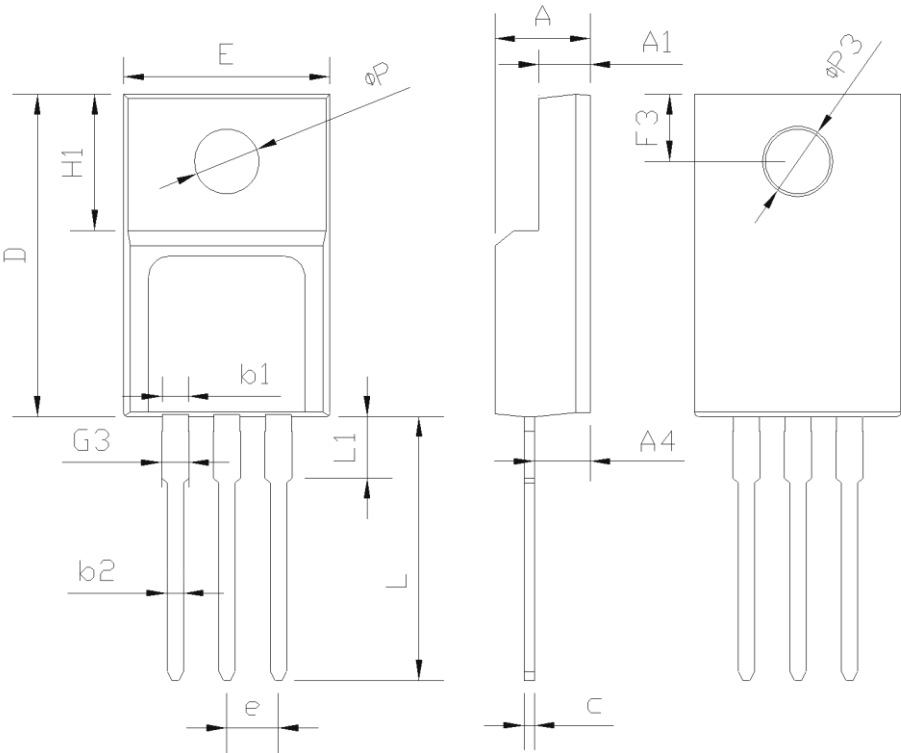
Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

The curve above is for reference only.

Mechanical Dimensions for TO-220F-3L



SYMBOL	mm		
	MIN	NOM	MAX
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
D	15.57	15.87	16.17
H1	6.70REF		
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.88	3.03	3.18
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80	0.95

Package Marking and Ordering Information

Part Number	Marking	Package	Units/Tube	Units/Reel
MDD4N60F	4N60F	TO-220F	50	