



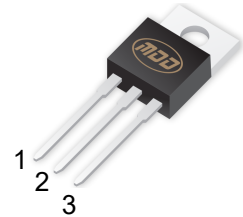
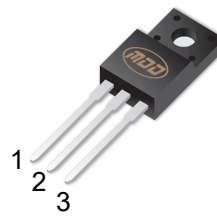
MDD20N65F/MDD20N65P

650V N-Channel Enhancement Mode MOSFET

V_{DS}	650 V
$I_D(T_c=25^\circ\text{C})$	20A
$R_{DS(on),max}$	0.5 Ω @ $V_{GS}=10V$
$Q_{g,typ}$	58.3nC

TO-220F-3L

TO-220-3L



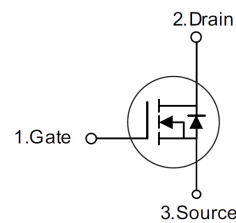
General Features

- Ultra low gate charge
- Low reverse transfer Capacitance
- Fast switching capability
- Avalanche energy tested
- Improved dv/dt capability, high ruggedness

Application

- High efficiency switch mode power supplies
- Electronic lamp ballasts based on half bridge
- LED power supplies

Equivalent Circuit



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

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	650	V
Gate-Source Voltage	V_{GS}	± 30	V
Continuous Drain Current	I_D	20	A
Pulsed Drain Current(Note 1)	I_{DM}	80	A
Avalanche Energy Single Pulsed (Note 2)	E_{AS}	720	mJ
Continuous diode forward current	I_S	20	A
Diode pulse current	$I_{S,pulse}$	80	A
Peak Diode Recovery dv/dt (Note 3)	dv/dt	5	V/ns
Power Dissipation TO-220F	P_D	45	W
Power Dissipation TO-220		250	W
Junction Temperature	T_J	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 ~ 150	$^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO-220F	TO-220	
Thermal resistance, Junction-to-case	$R_{\theta JC}$	2.78	0.5	$^\circ\text{C/W}$
Thermal resistance, Junction-to-ambient	$R_{\theta JA}$	62.5	40	$^\circ\text{C/W}$

- Notes:**
1. Pulse width limited by maximum junction temperature.
 2. L=10mH, $I_{AS} = 12A$, Starting $T_J = 25^\circ\text{C}$.
 3. $I_{SD} = 20A$, $di/dt \leq 100A/\mu s$, $V_{DD} \leq BV_{DS}$, Starting $T_J = 25^\circ\text{C}$.



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Ta = 25°C unless otherwise specified

Symbol	Parameter	Condition	Min	Typ	Max	Unit	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	650	--	--	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	$V_{DS}=650V, V_{GS}=0V$	--	--	1	μA	
$V_{GS(TH)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0	--	4.0	V	
$R_{DS(ON)}$	Drain-Source On-State Resistance	$V_{GS}=10V, I_D=10A$	--	0.42	0.5	Ω	

Dynamic Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{DS}=25V$ $V_{GS}=0V$ $f=1MHz$	--	2962	--	pF
C_{oss}	Output Capacitance		--	266	--	pF
C_{rss}	Reverse Transfer Capacitance		--	18	--	pF
Q_g	Total Gate Charge	$V_{DS}=520V,$ $V_{GS}=10V,$ $I_D=20A$ (Note1,2)	--	58.3	--	nC
Q_{gs}	Gate Source Charge		--	16.7	--	nC
Q_{gd}	Gate Drain Charge		--	19.3	--	nC

Switching Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$t_{d(on)}$	Turn on Delay Time	$V_{DS}=325V,$ $I_D=20A,$ $R_G=10\Omega$ (Note1,2)	--	--	18.8	ns
t_r	Turn on Rise Time		--	--	43.4	ns
$t_{d(off)}$	Turn Off Delay Time		--	--	98.2	ns
t_f	Turn Off Fall Time		--	--	16.9	ns

Source Drain Diode Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I_{SD}	Source drain current(Body Diode)		--	--	20	A
I_{SM}	Pulsed Current		--	--	80	A
V_{SD}	Drain-Source Diode Forward Voltage	$I_S=20A, V_{GS}=0V$	--	--	1.5	V
t_{rr}	Body Diode Reverse Recovery Time	$V_R=325$ $I_F=20A,$ $-dI_F/dt=100A/\mu s$	--	492.8	--	ns
Q_{rr}	Body Diode Reverse Recovery Charge		--	7.46	--	μC

Notes:

- 1.Pulse test ; Pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.
- 2.Essentially independent of operating temperature.



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Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

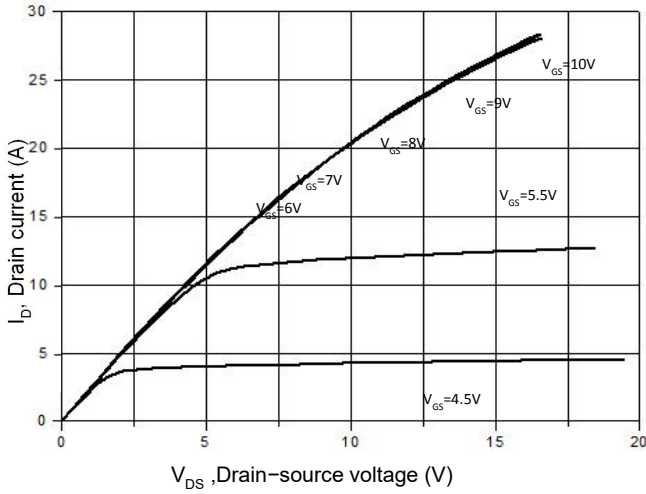


Figure 2. Transfer Characteristics

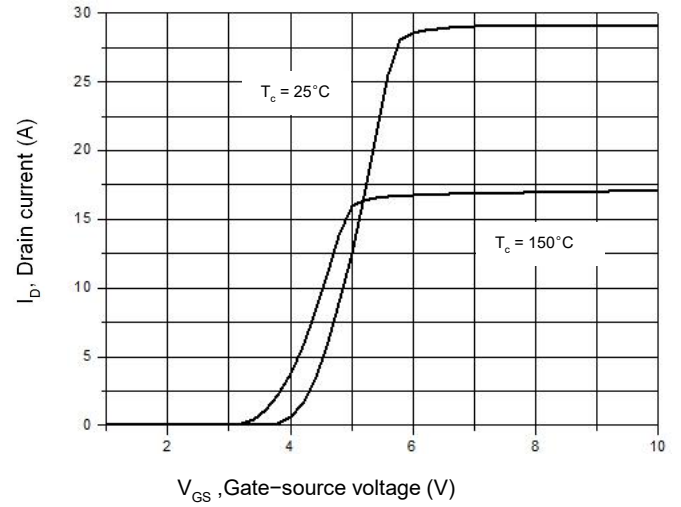


Figure 3. On-Resistance Variation vs. Drain Current

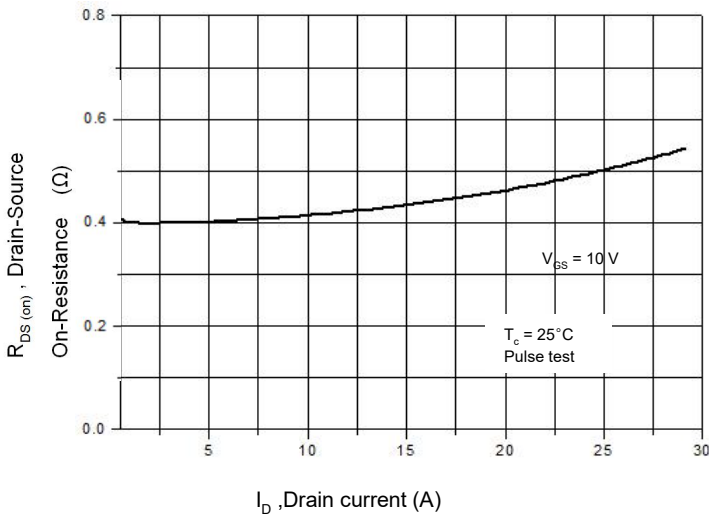


Figure 4. Threshold Voltage vs. Temperature

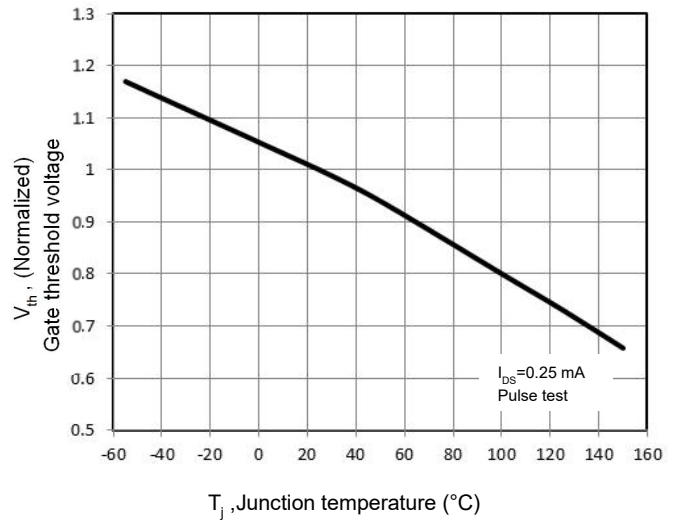


Figure 5. Breakdown Voltage vs. Temperature

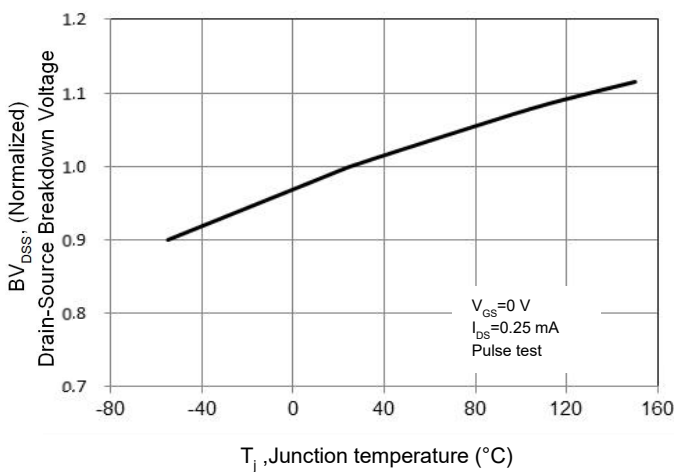
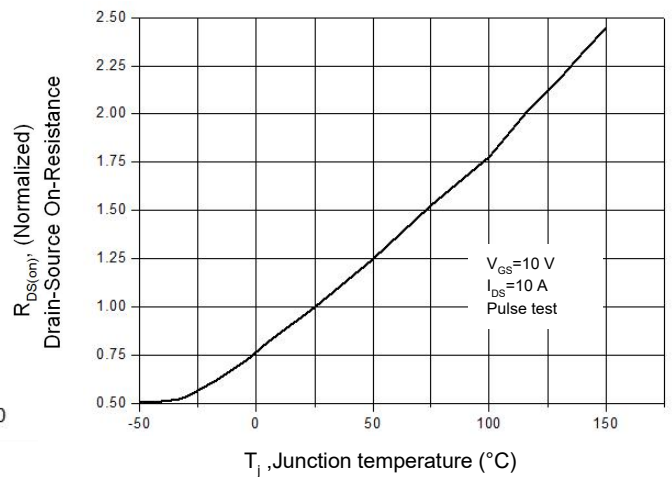


Figure 6. On-Resistance vs. Temperature





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Figure 7. Capacitance Characteristics

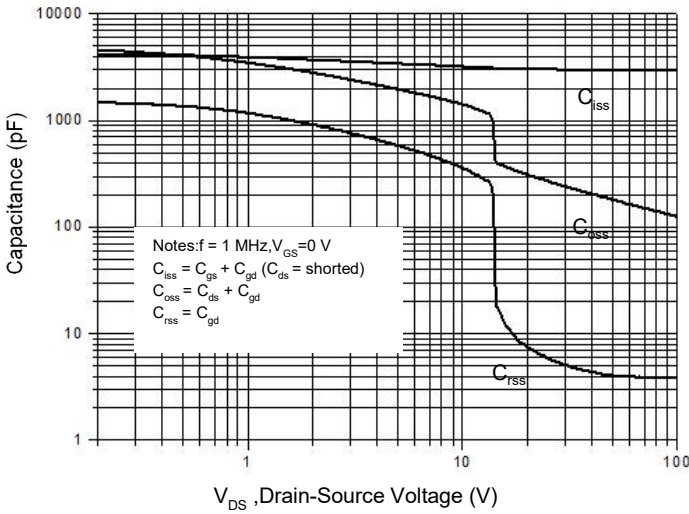


Figure 8. Gate Charge Characteristics

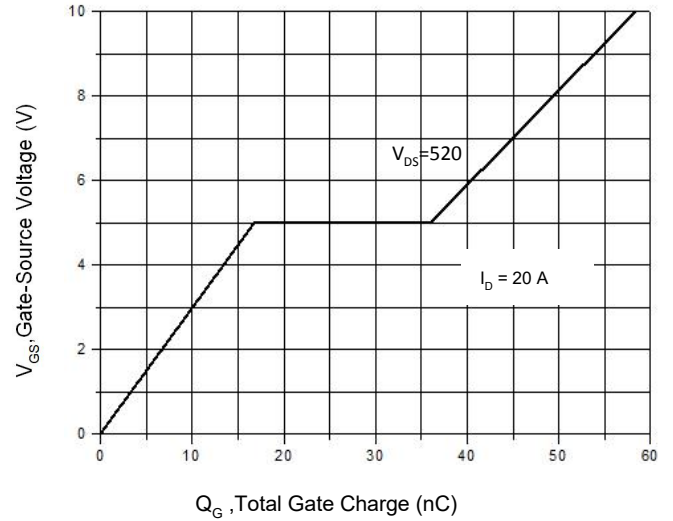


Figure 9. Maximum Safe Operating Area
TO-220F

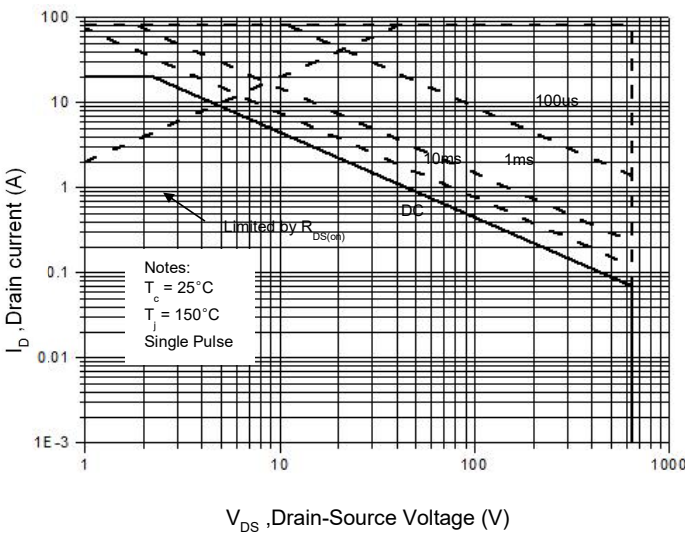


Figure 10. Maximum Safe Operating Area
TO-220

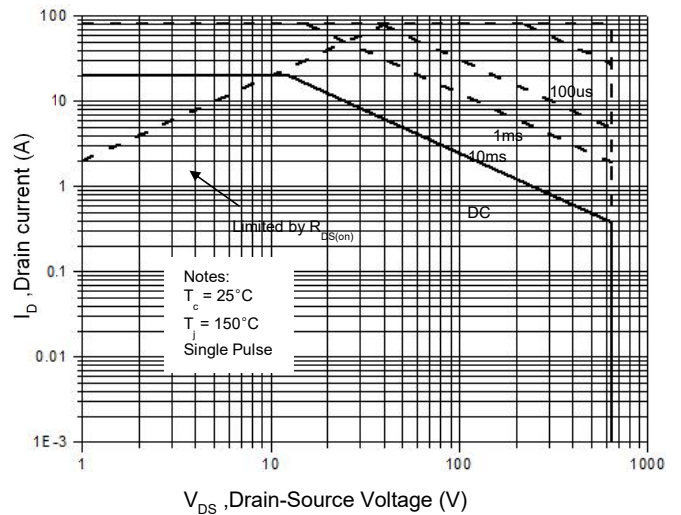


Figure 11. Power Dissipation vs. Temperature
TO-220F

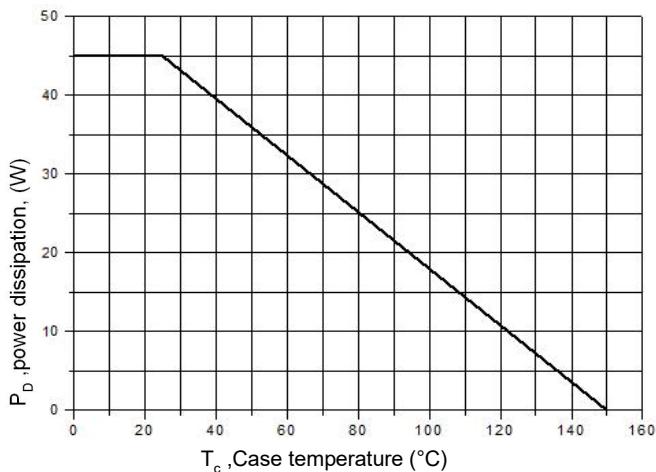
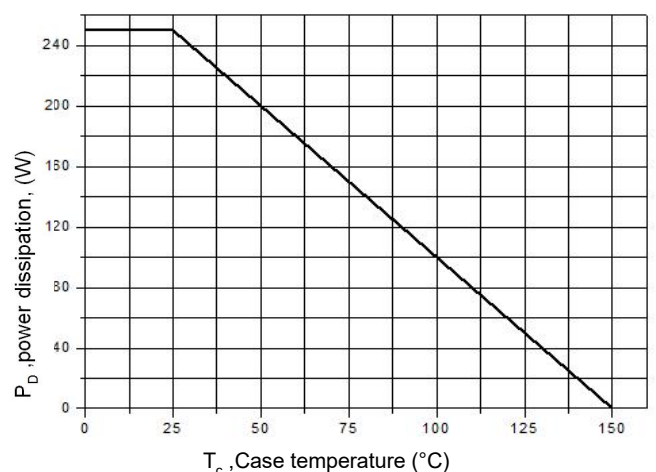


Figure 12. Power Dissipation vs. Temperature
TO-220





MDD20N65F/MDD20N65P

650V N-Channel Enhancement Mode MOSFET

Figure 13. Continuous Drain Current vs. Temperature

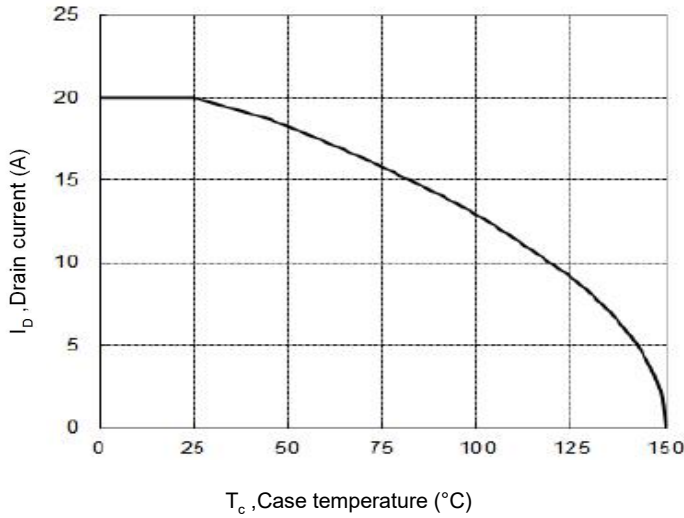


Figure 14. Body Diode Transfer Characteristics

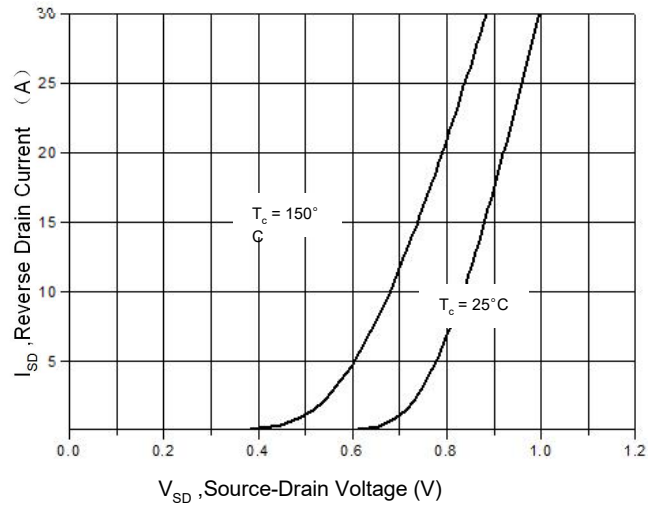


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

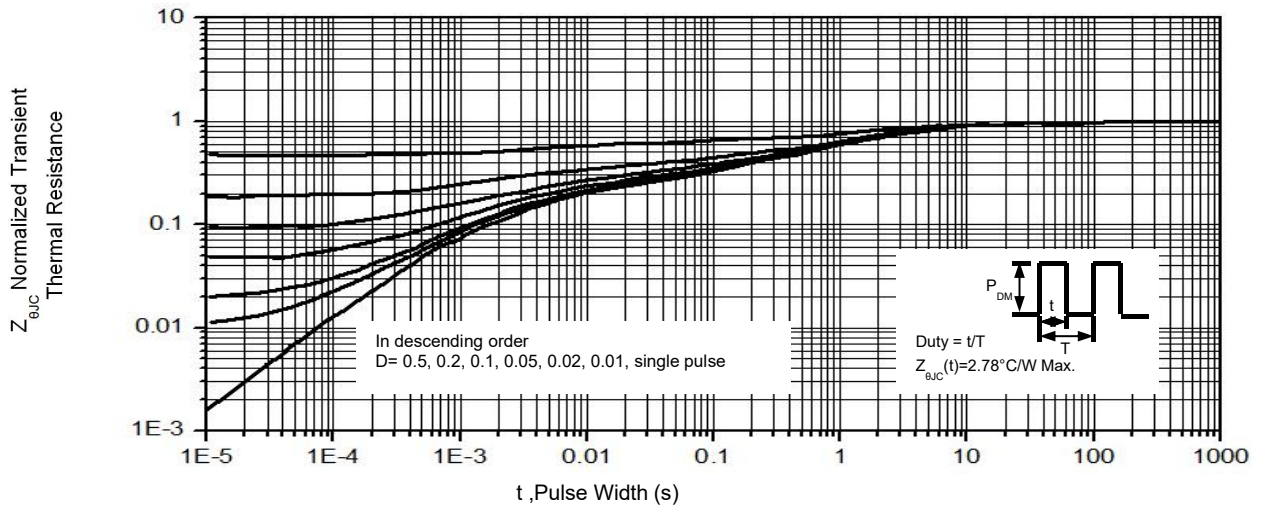
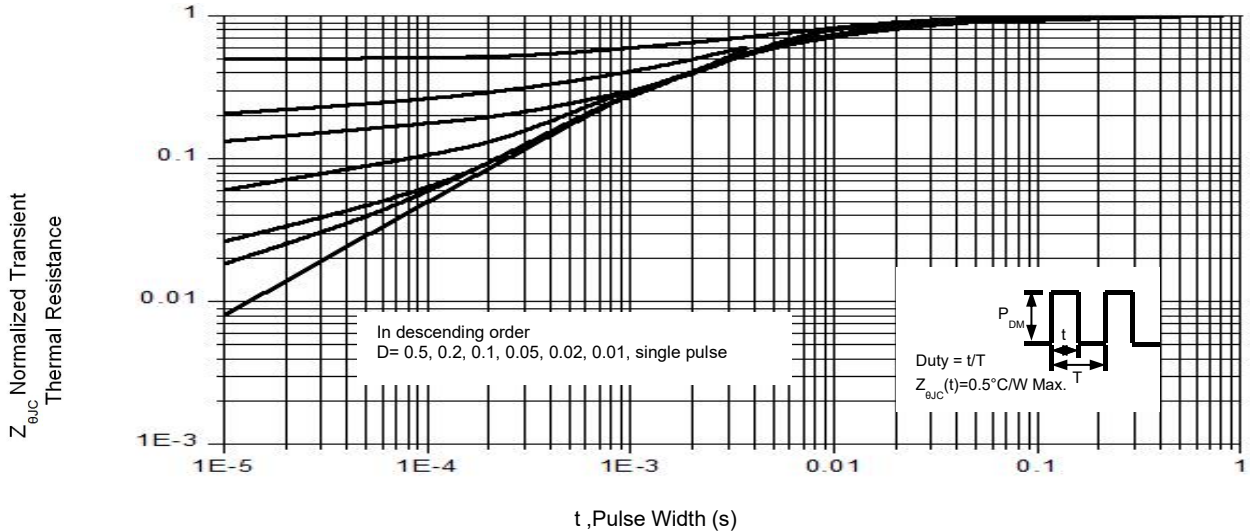
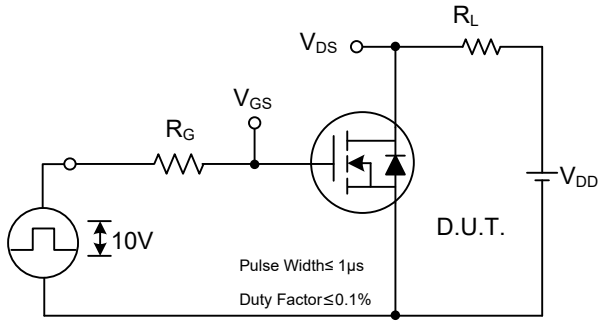
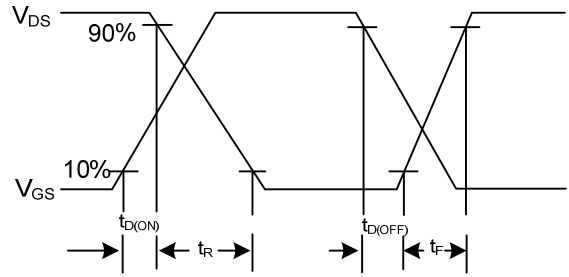


Figure 16. Transient Thermal Impedance, Junction to Case, TO-220

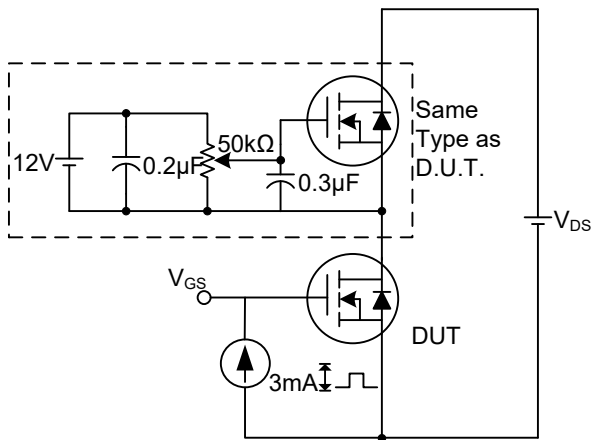




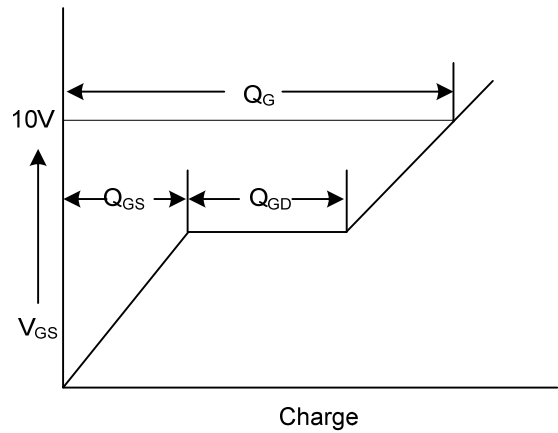
Switching Test Circuit



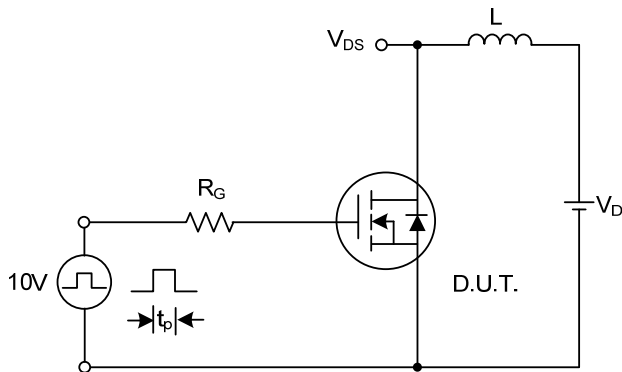
Switching Waveforms



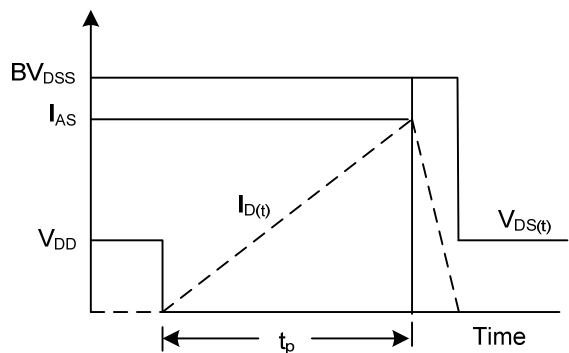
Gate Charge Test Circuit



Gate Charge Waveform



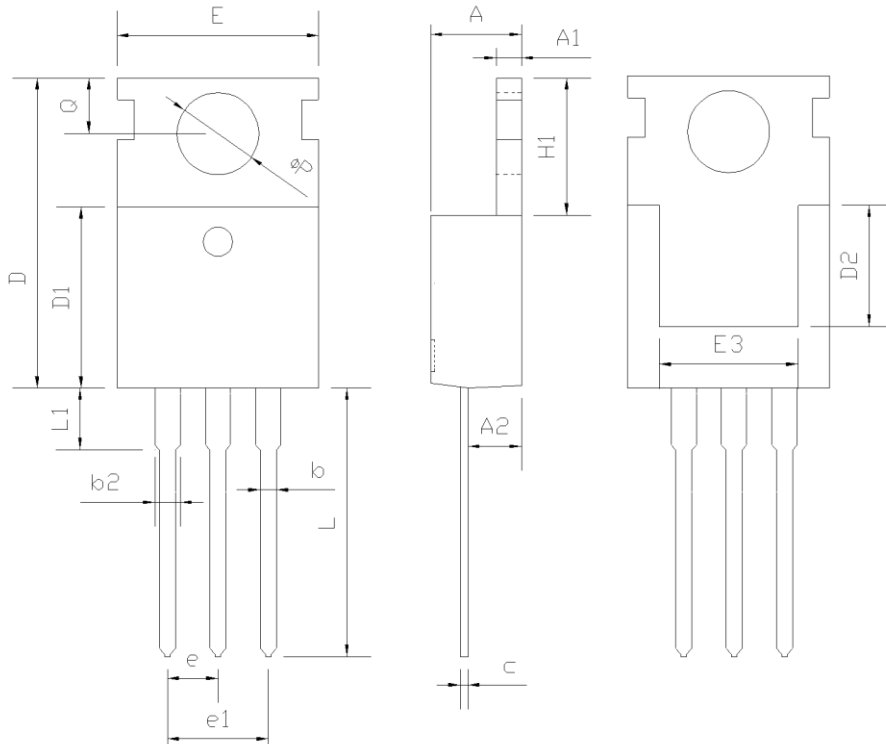
Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

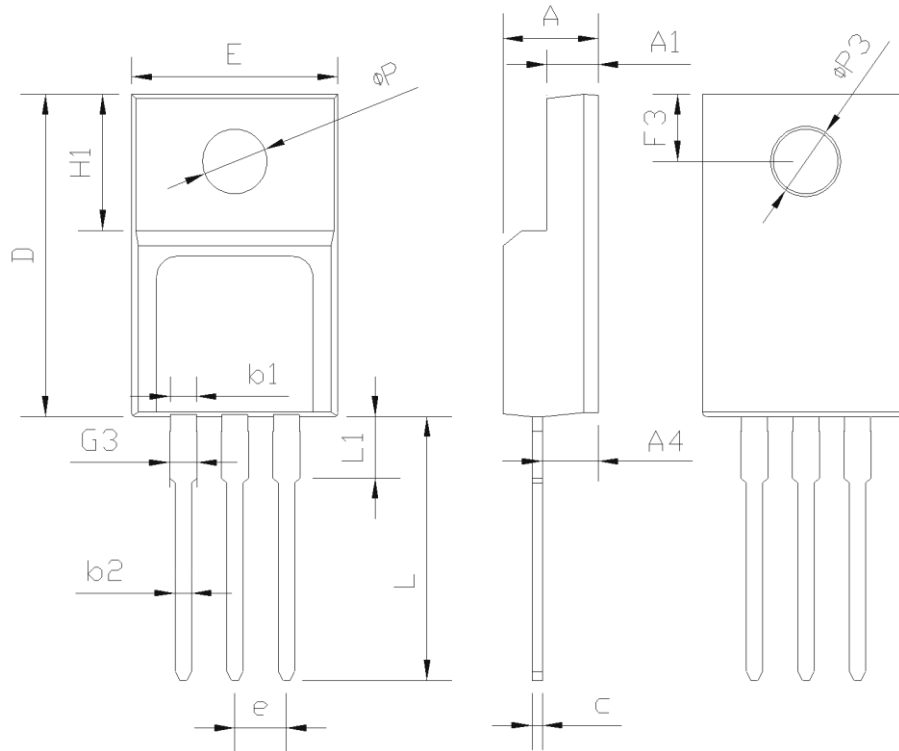
The curve above is for reference only.

Mechanical Dimensions for TO-220-3L



SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.70
A1	1.25	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30
E3	7.00	-	-
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ΦP	3.40	3.60	3.80
Q	2.60	2.80	3.00

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
MDD20N65F	20N65F	TO-220F	50	
MDD20N65P	20N65P	TO-220-3L	50	