



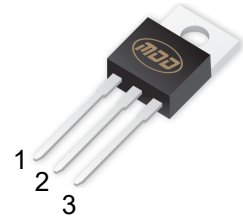
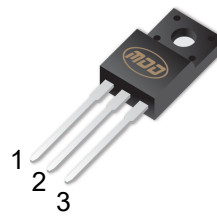
MDD20N65F/MDD20N65P

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



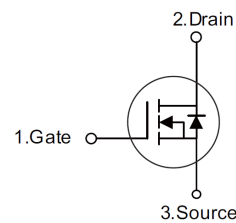
General Features

- 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, IAS = 12A, Starting $T_J=25^\circ\text{C}$.
 3. ISD = 20A, di/dt $\leq 100\text{A/us}$, VDD \leq BVDS, 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=250μA	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	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=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=10Ω (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/μs	--	492.8	--	ns
Q_{rr}	Body Diode Reverse Recovery Charge		--	7.46	--	uC

Notes:

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



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Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

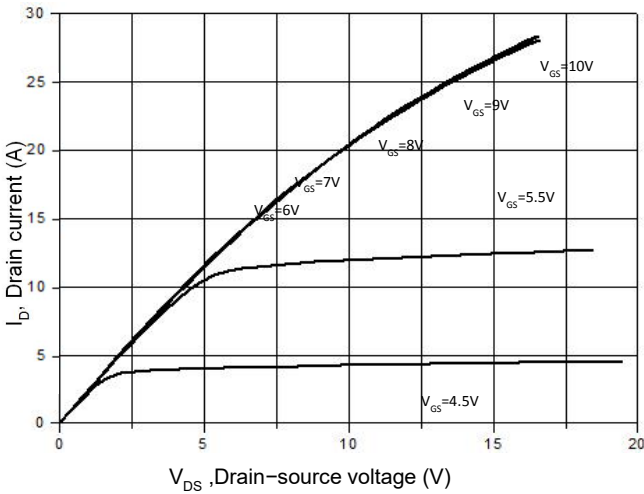


Figure 2. Transfer Characteristics

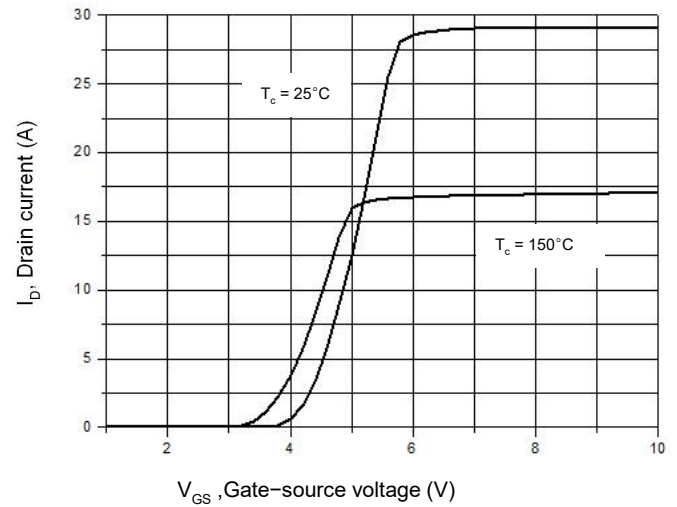


Figure 3. On-Resistance Variation vs. Drain Current

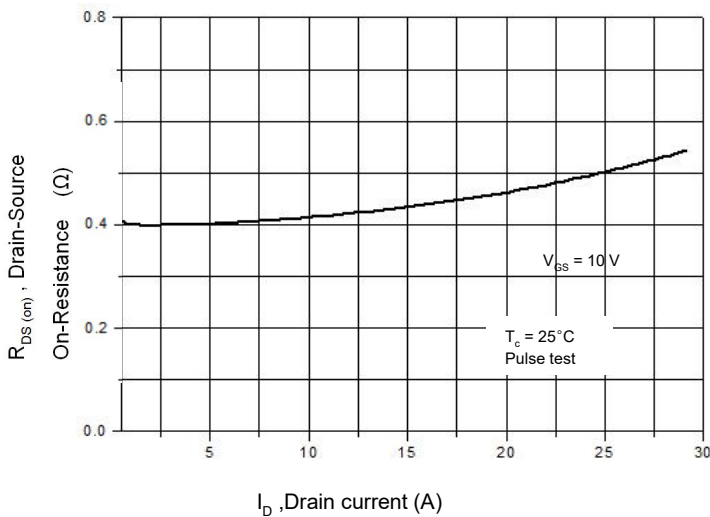


Figure 4. Threshold Voltage vs. Temperature

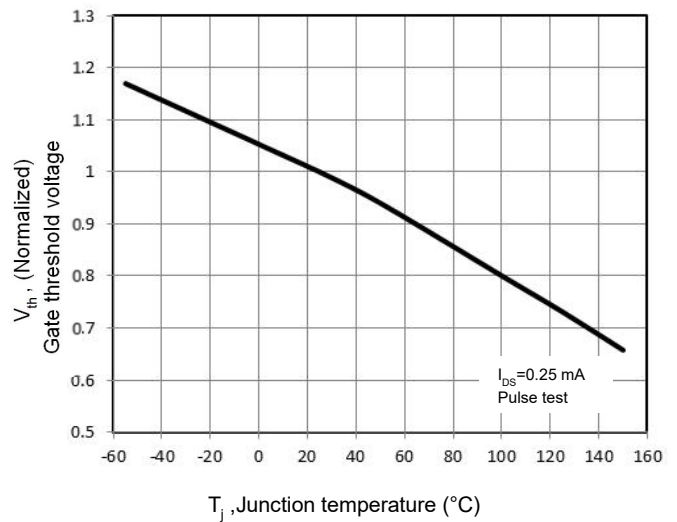


Figure 5. Breakdown Voltage vs. Temperature

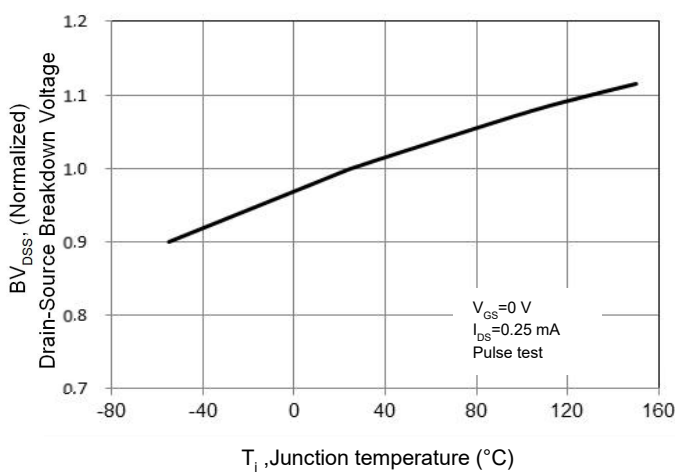
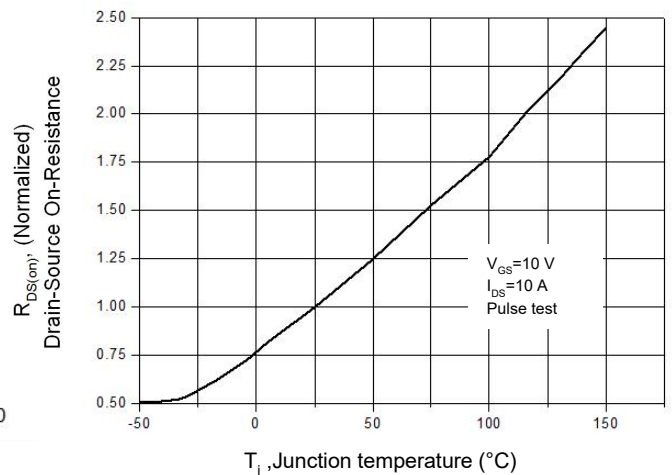


Figure 6. On-Resistance vs. Temperature





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Figure 7. Capacitance Characteristics

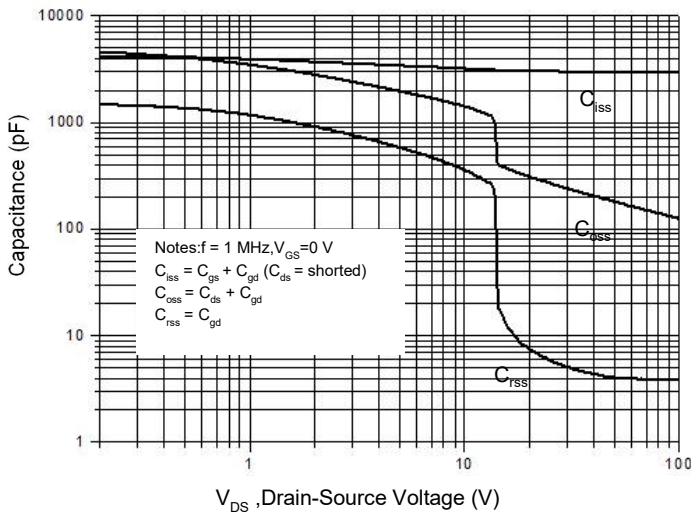


Figure 8. Gate Charge Characteristics

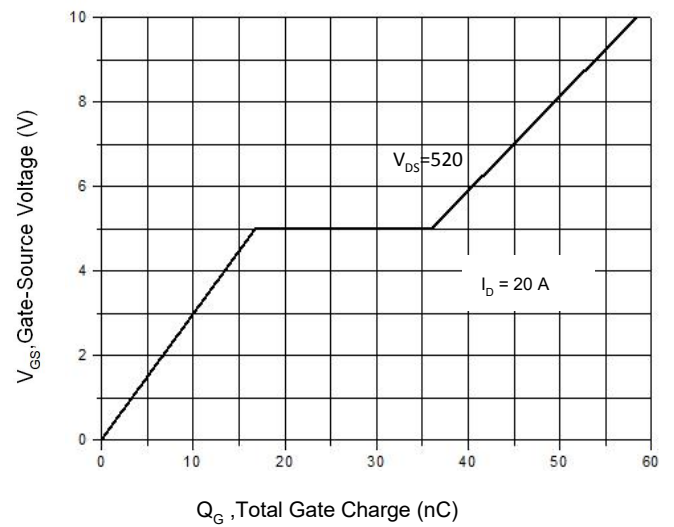


Figure 9. Maximum Safe Operating Area
TO-220F

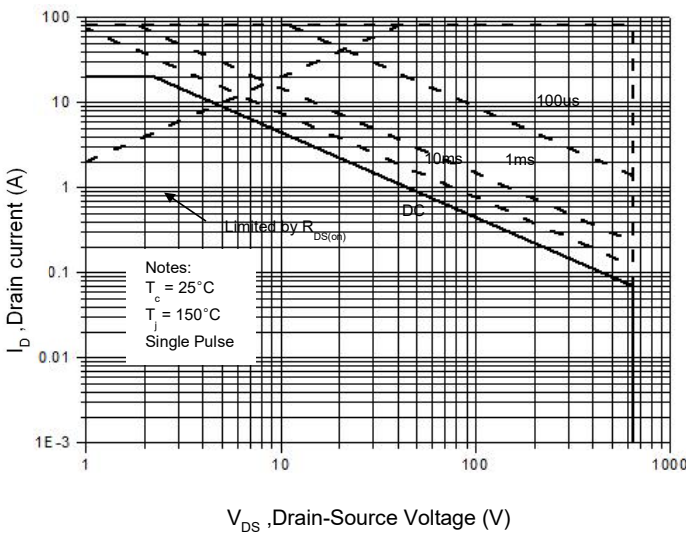


Figure 10. Maximum Safe Operating Area
TO-220

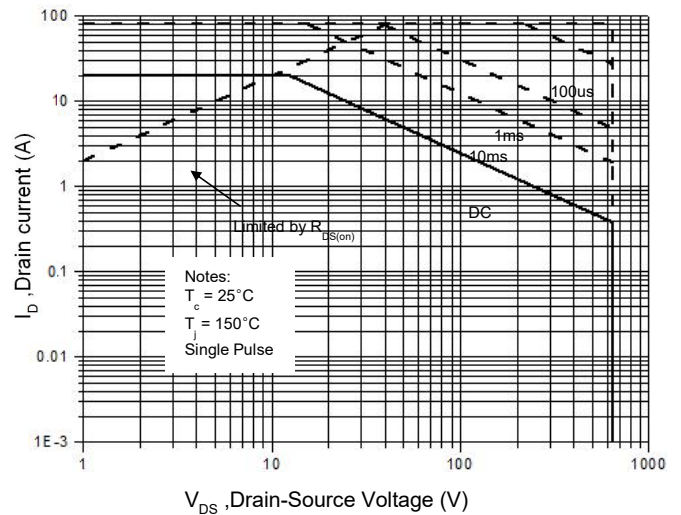


Figure 11. Power Dissipation vs. Temperature
TO-220F

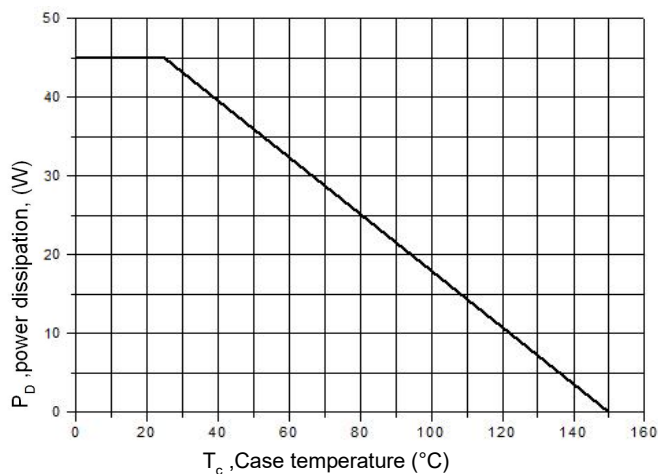
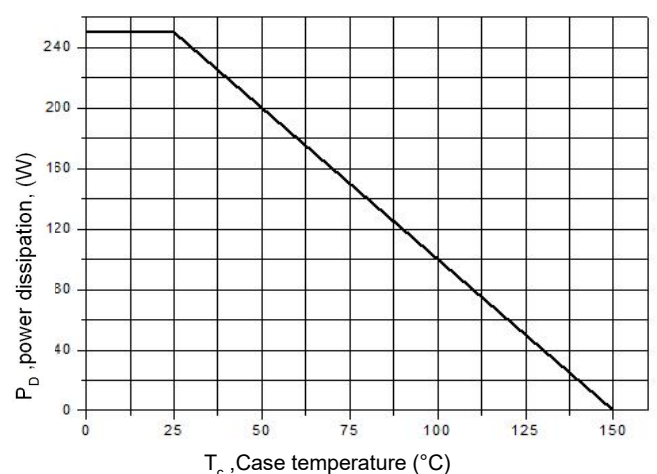


Figure 12. Power Dissipation vs. Temperature
TO-220





MDD20N65F/MDD20N65P

650V N-Channel Enhancement Mode MOSFET

Figure 13. Continuous Drain Current vs. Temperature

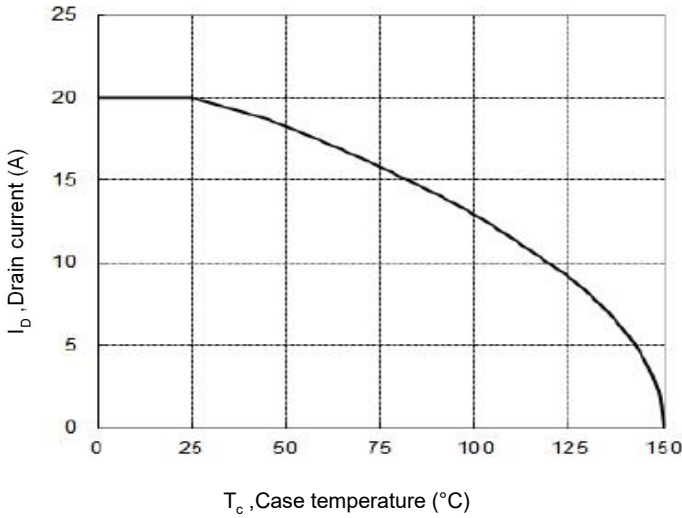


Figure 14. Body Diode Transfer Characteristics

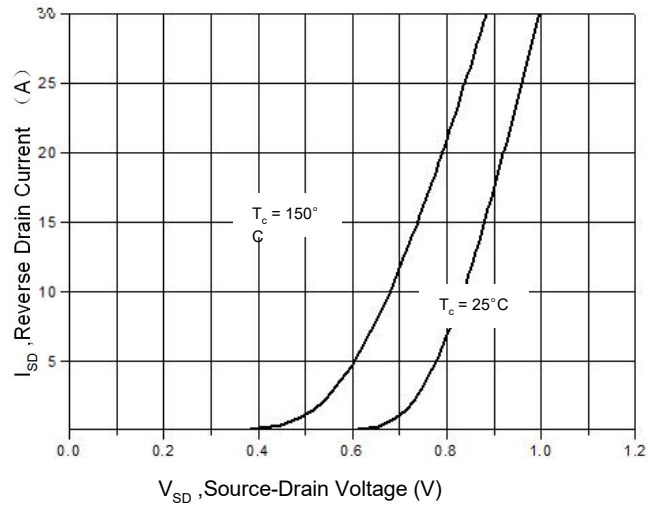


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

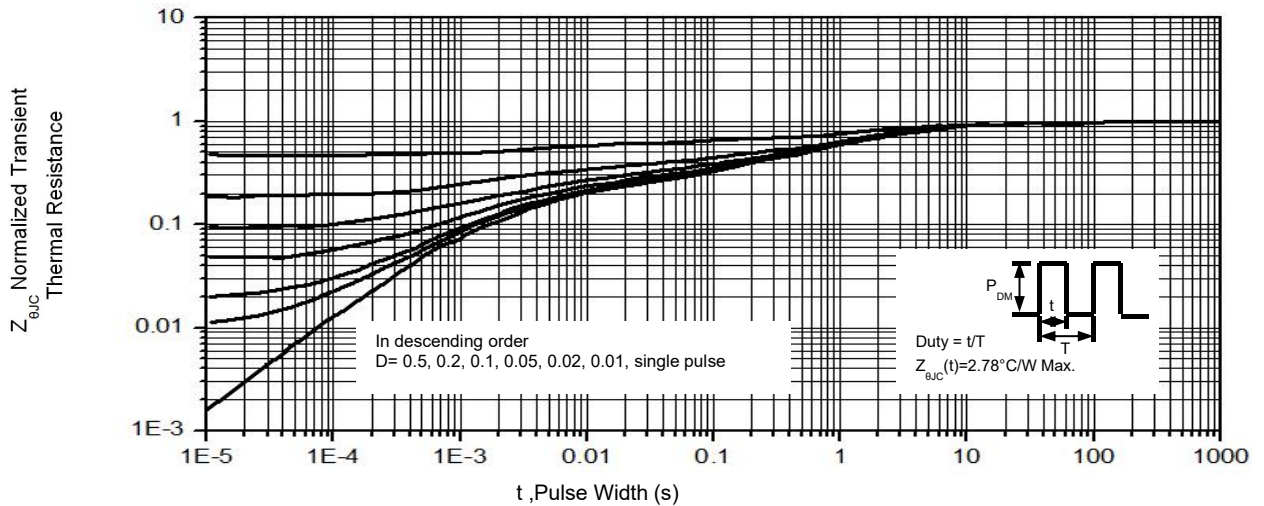
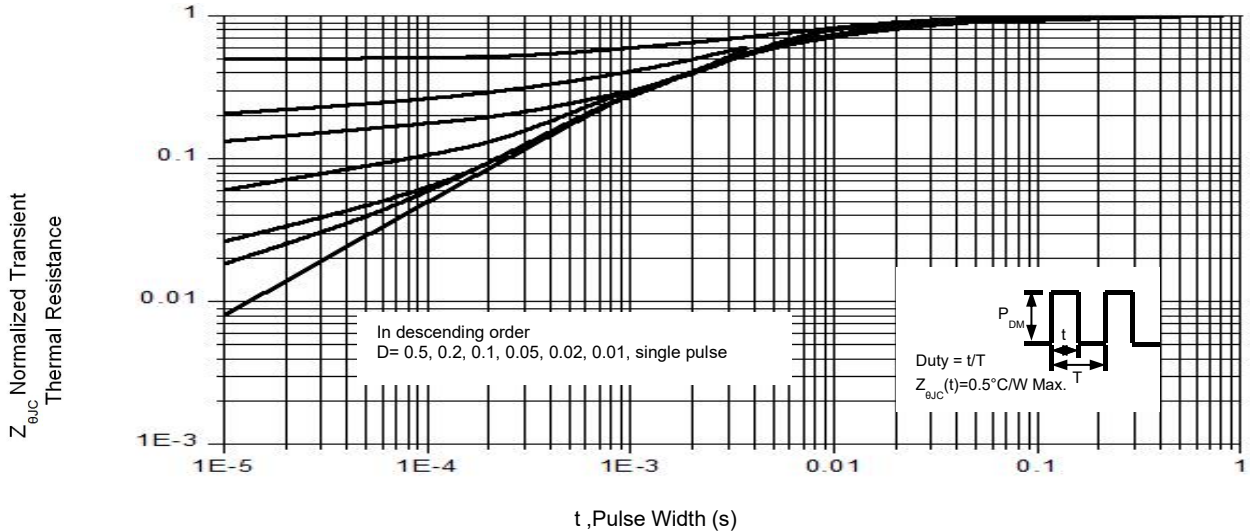
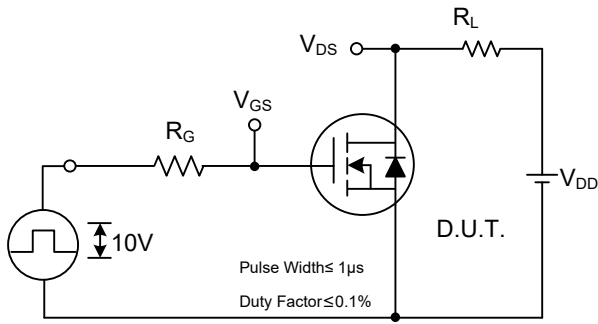
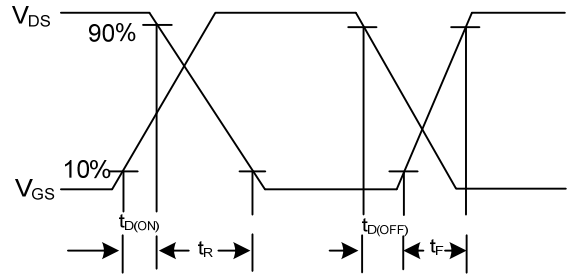


Figure 16. Transient Thermal Impedance, Junction to Case, TO-220

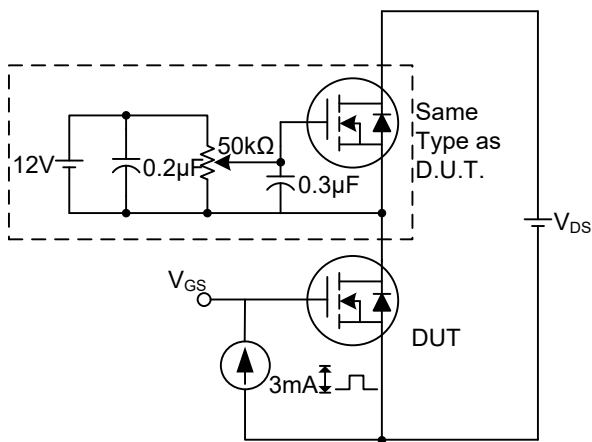




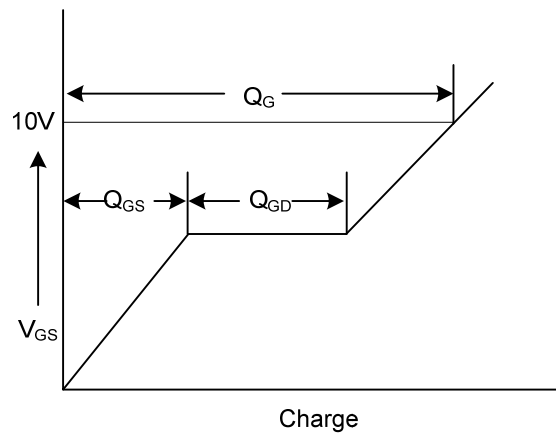
Switching Test Circuit



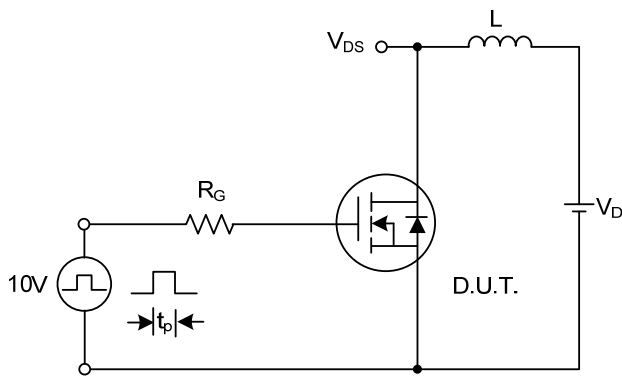
Switching Waveforms



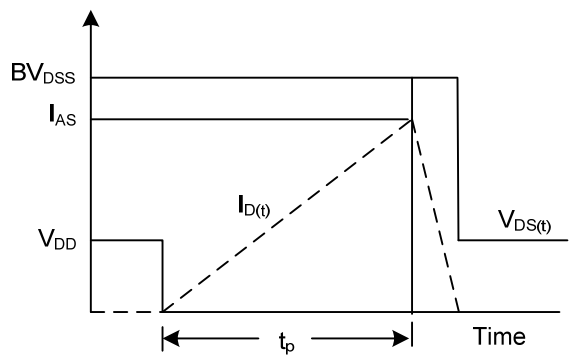
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

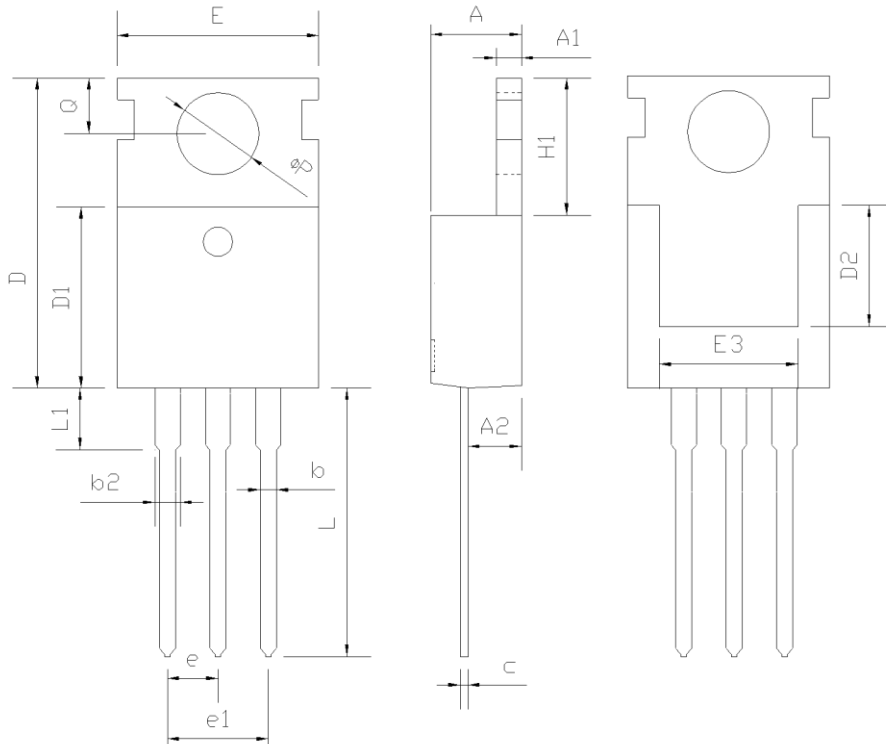
The curve above is for reference only.



MDD20N65F/MDD20N65P

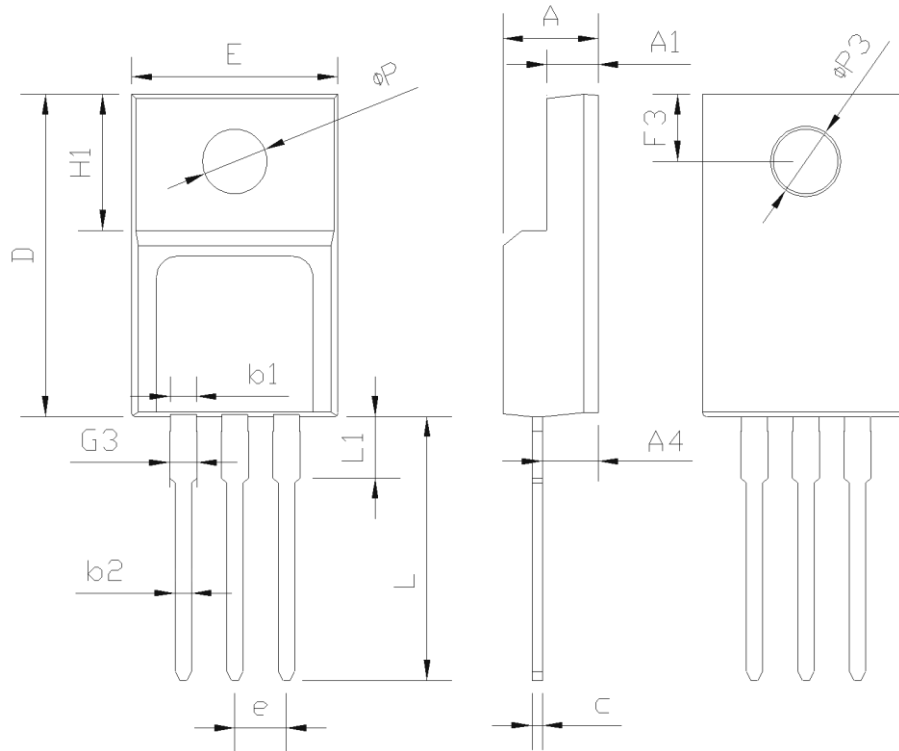
650V N-Channel Enhancement Mode MOSFET

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	

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