



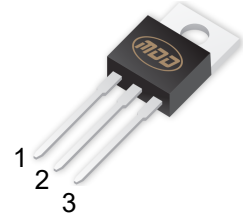
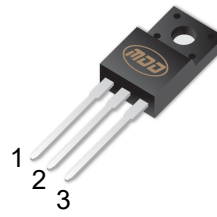
MDD16N65F/MDD16N65P

650V N-Channel Enhancement Mode MOSFET

V_{DS}	650 V
$I_D(T_c=25^\circ\text{C})$	16A
$R_{DS(on),max}$	0.6 Ω @ $V_{GS}=10V$
$Q_{g,typ}$	53.9nC

TO-220F-3L

TO-220-3L



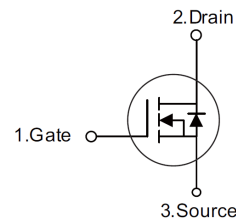
General Features

- 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	16	A
Pulsed Drain Current(Note 1)	I_{DM}	64	A
Avalanche Energy Single Pulsed (Note 2)	E_{AS}	605	mJ
Continuous diode forward current	I_S	16	A
Diode pulse current	$I_{S,pulse}$	64	A
Peak Diode Recovery dv/dt (Note 3)	dv/dt	5	V/ns
Power Dissipation TO-220F	P_D	44	W
Power Dissipation TO-220		180	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	$R_{\theta JC}$	2.85	0.69	$^\circ\text{C/W}$
Thermal resistance, Junction-to-ambient	$R_{\theta JA}$	110	62.5	$^\circ\text{C/W}$

- Notes:**
1. Pulse width limited by maximum junction temperature.
 2. L=10mH, IAS = 11A, Starting $T_J=25^\circ\text{C}$.
 3. ISD = 16A, di/dt $\leq 100A/\mu\text{s}$, $V_{DD} \leq BV_{DS}$, 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 =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 =8A	--	0.48	0.6	Ω	

Dynamic Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
C _{iss}	Input Capacitance	V _{DS} =25V V _{GS} =0V f=1MHz	--	2640	--	pF
C _{oss}	Output Capacitance		--	235	--	pF
C _{riss}	Reverse Transfer Capacitance		--	15	--	pF
Q _g	Total Gate Charge	V _{DS} =520V, V _{GS} =10V, I _D =16A (Note1,2)	--	53.9	--	nC
Q _{gs}	Gate Source Charge		--	13.4	--	nC
Q _{gd}	Gate Drain Charge		--	20.1	--	nC

Switching Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
t _{d(on)}	Turn on Delay Time	V _{DS} =325V, I _D =16A, R _G =10Ω (Note1,2)	--	--	15.4	ns
t _r	Turn on Rise Time		--	--	41.0	ns
t _{d(off)}	Turn Off Delay Time		--	--	88.7	ns
t _f	Turn Off Fall Time		--	--	17.8	ns

Source Drain Diode Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I _{SD}	Source drain current(Body Diode)		--	--	16	A
I _{SM}	Pulsed Current		--	--	64	A
V _{SD}	Drain-Source Diode Forward Voltage	I _S =16A, V _{GS} =0V	--	--	1.5	V
t _{rr}	Body Diode Reverse Recovery Time	V _R =325 I _F =16A, -dI _F /dt =100A/μs	--	448.4	--	ns
Q _{rr}	Body Diode Reverse Recovery Charge		--	5.38	--	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

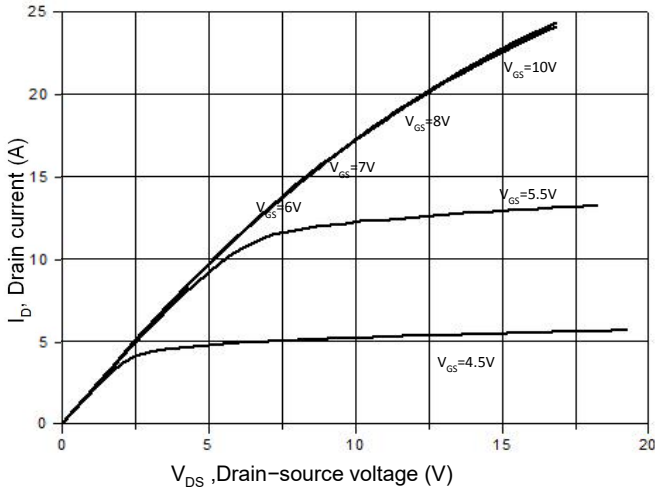


Figure 2. Transfer Characteristics

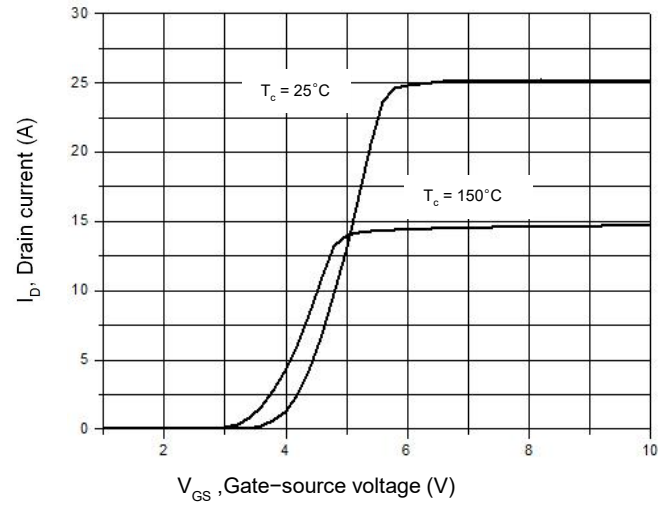


Figure 3. On-Resistance Variation vs. Drain Current

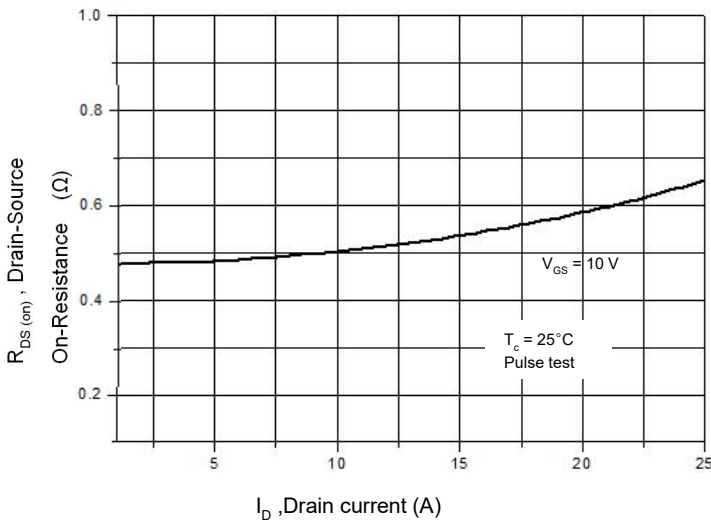


Figure 4. Threshold Voltage vs. Temperature

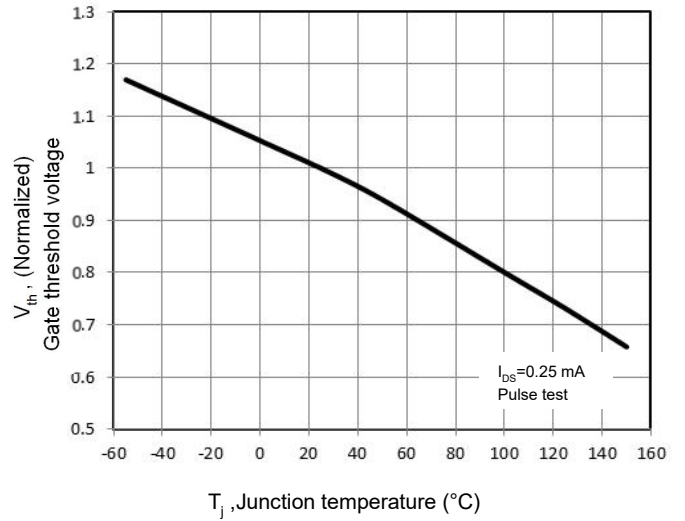


Figure 5. Breakdown Voltage vs. Temperature

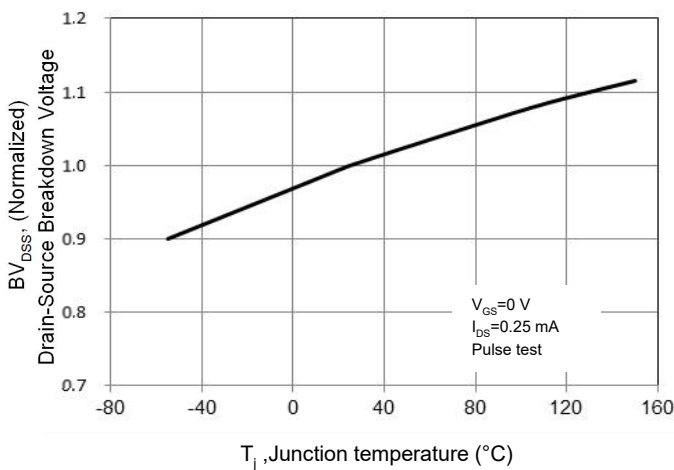
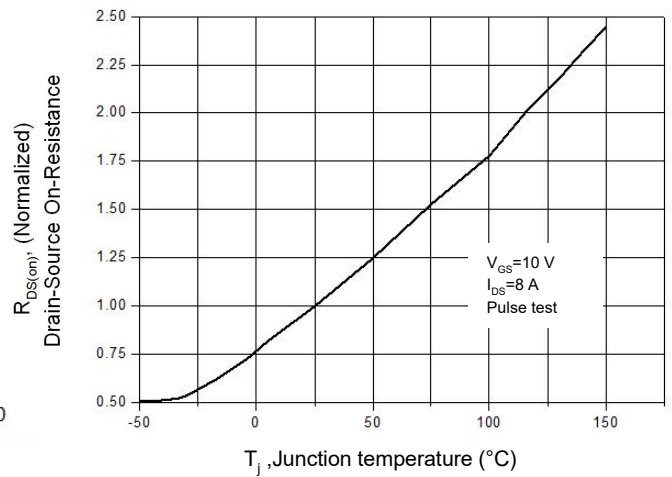


Figure 6. On-Resistance vs. Temperature





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Figure 7. Capacitance Characteristics

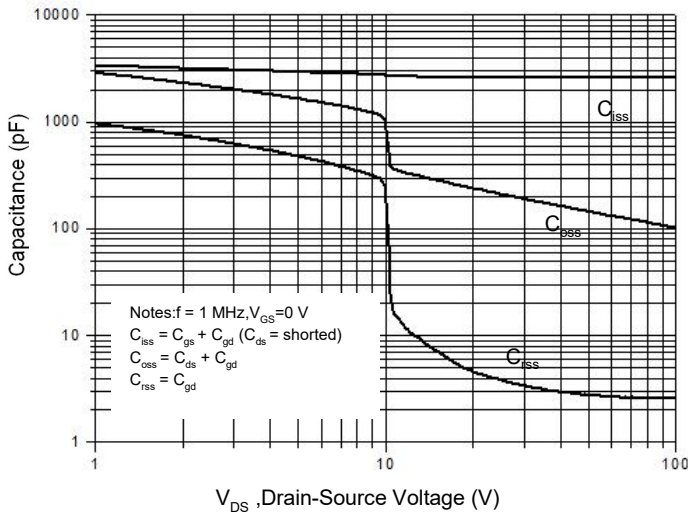


Figure 8. Gate Charge Characteristics

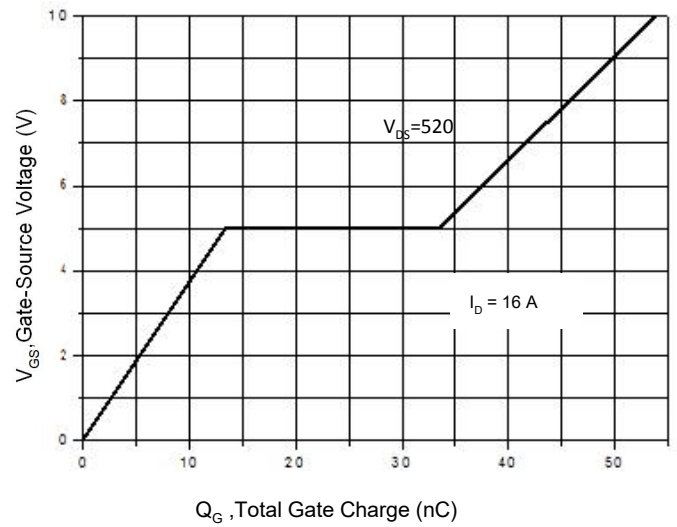


Figure 9. Maximum Safe Operating Area
TO-220F

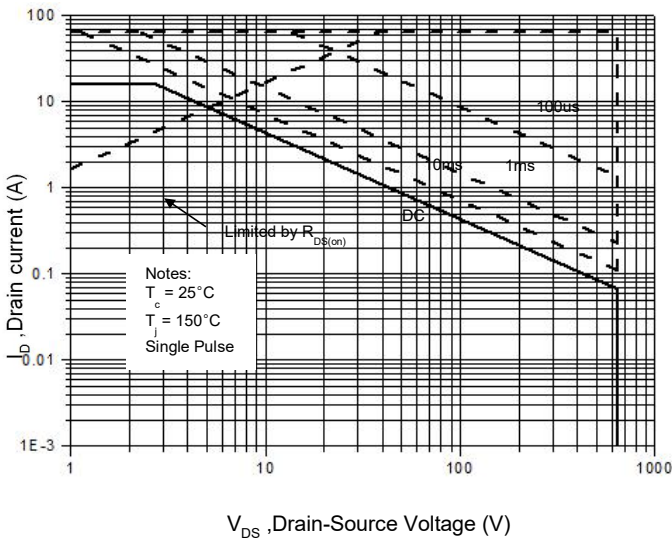


Figure 10. Maximum Safe Operating Area
TO-220

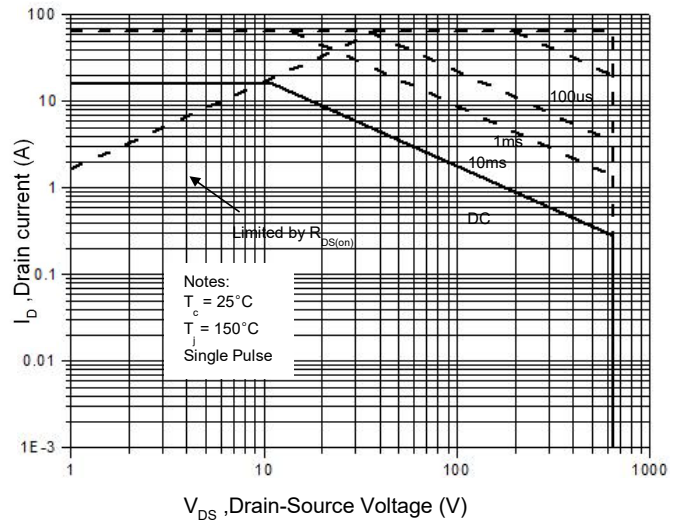


Figure 11. Power Dissipation vs. Temperature
TO-220F

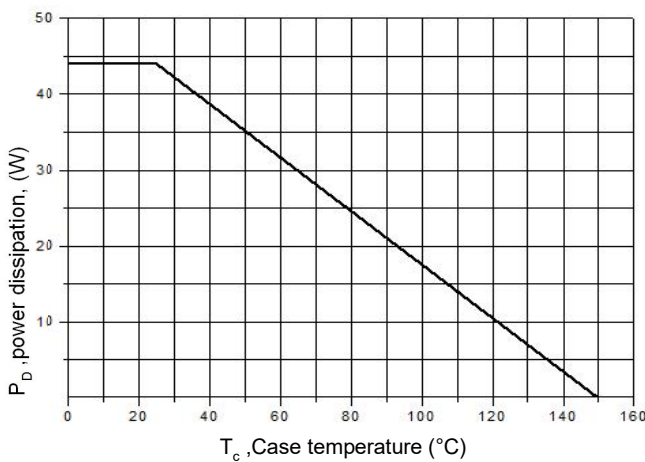
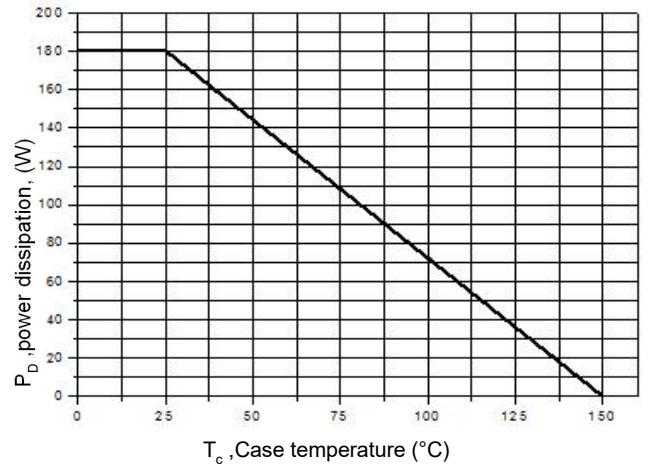


Figure 12. Power Dissipation vs. Temperature
TO-220





MDD16N65F/MDD16N65P

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Figure 13. Continuous Drain Current vs. Temperature

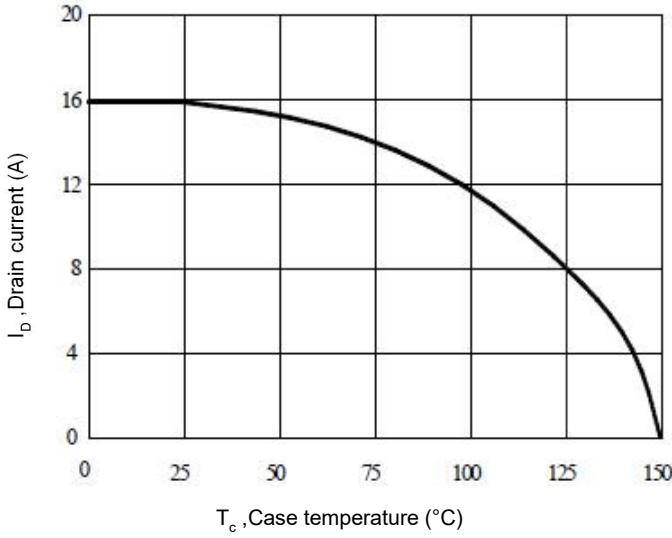


Figure 14. Body Diode Transfer Characteristics

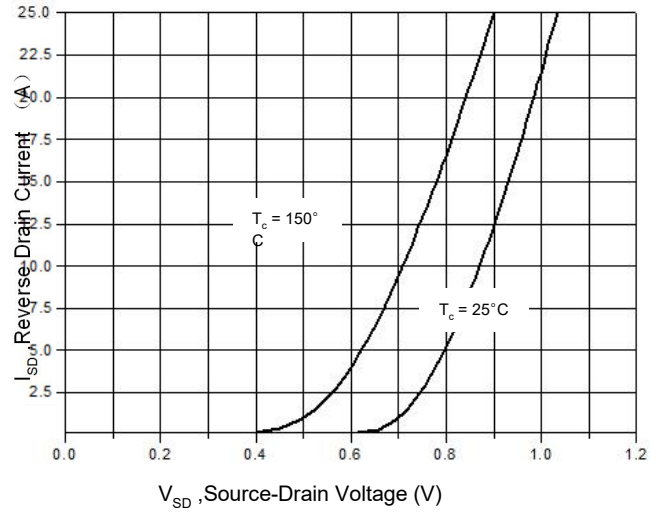


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

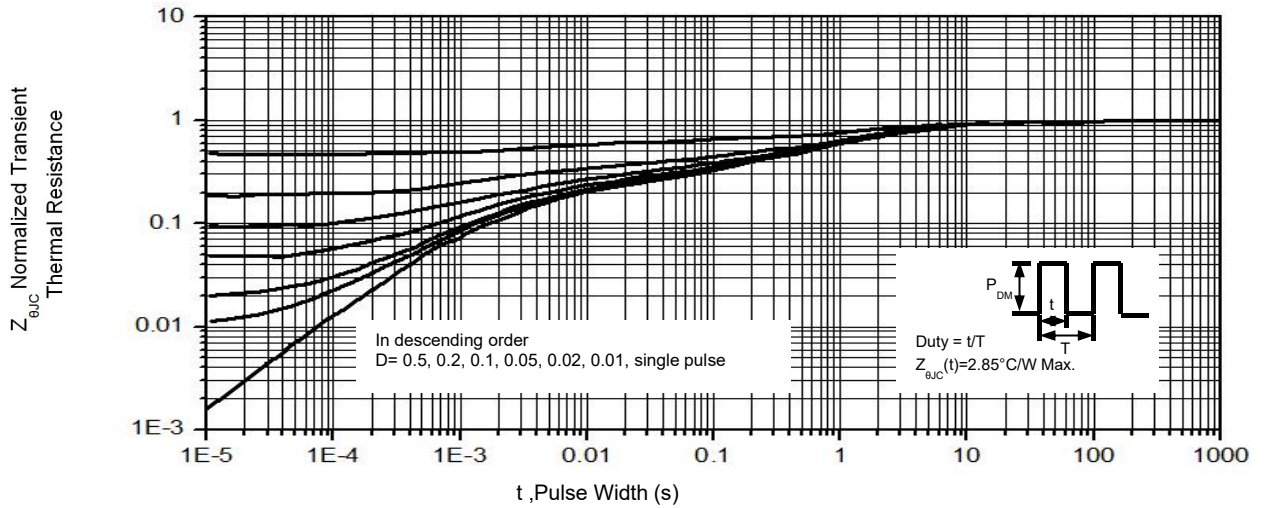
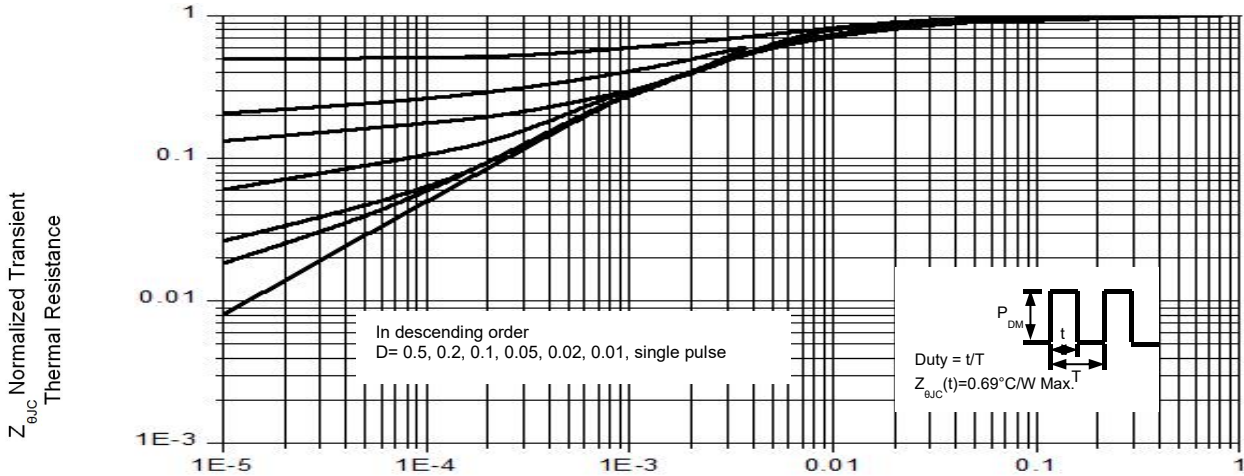
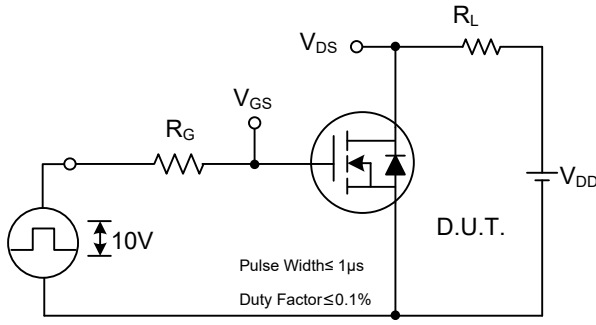
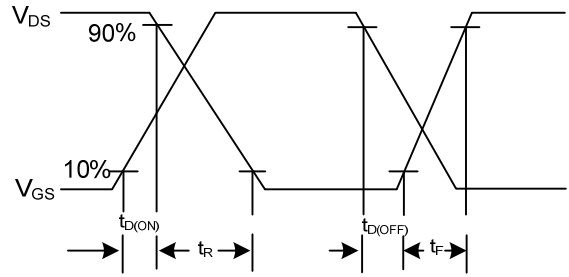


Figure 16. Transient Thermal Impedance, Junction to Case, TO-220

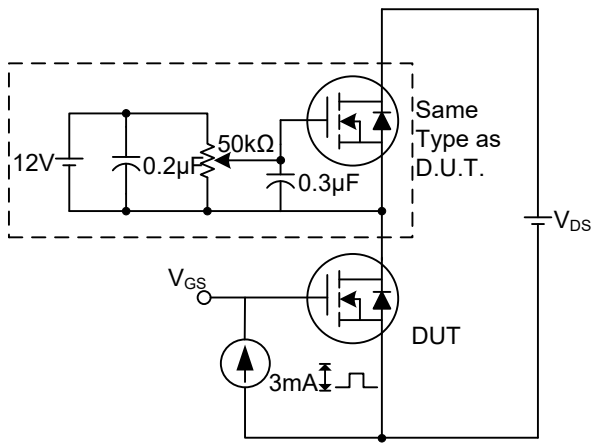




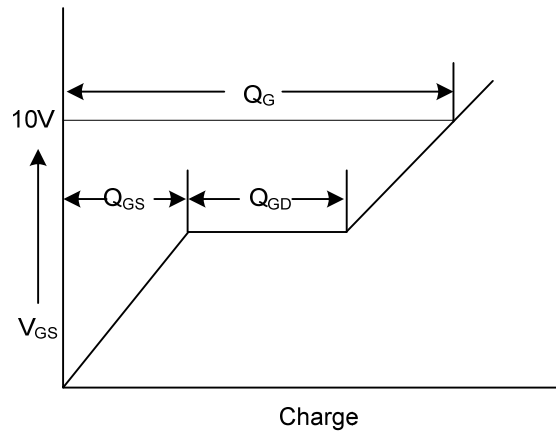
Switching Test Circuit



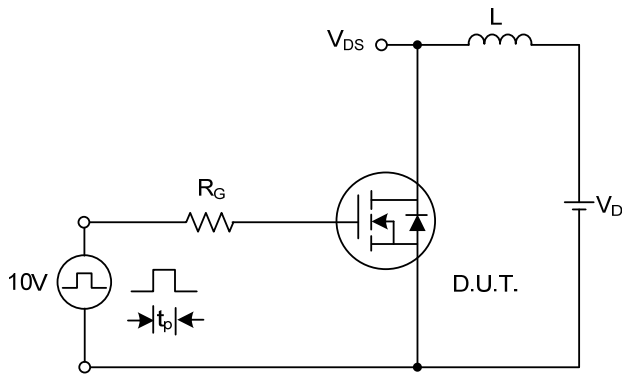
Switching Waveforms



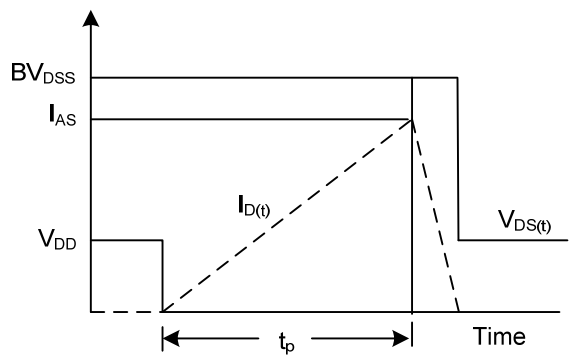
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

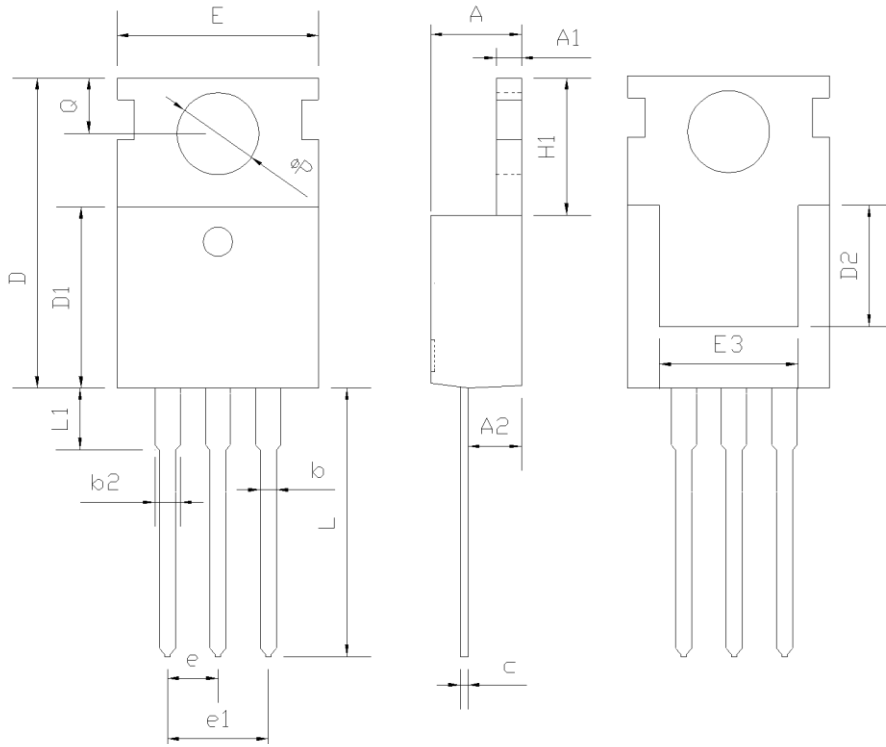
The curve above is for reference only.



MDD16N65F/MDD16N65P

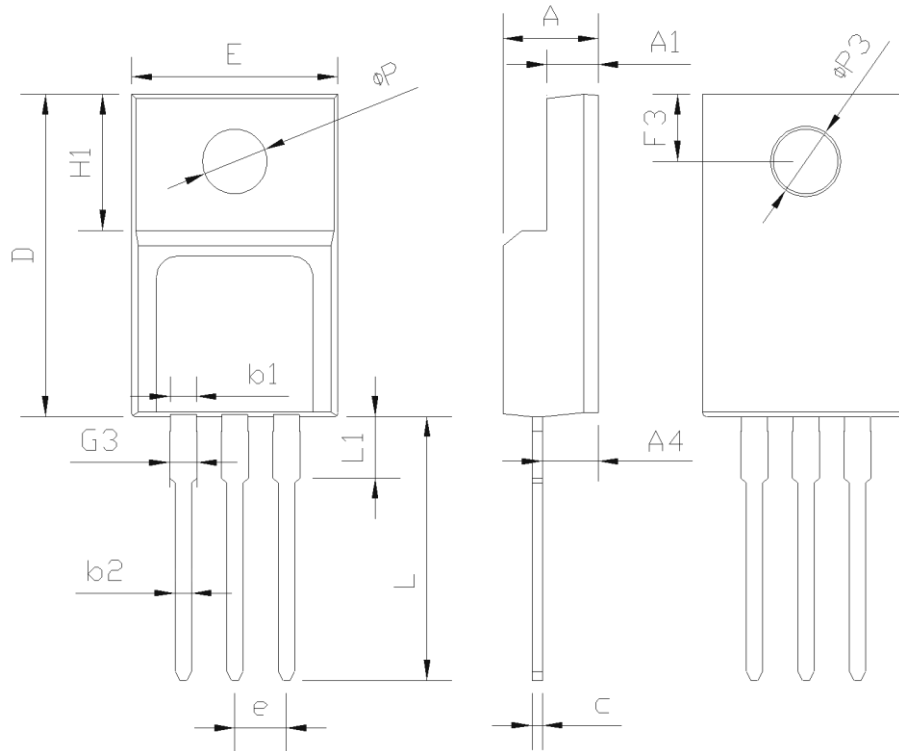
650V N-Channel Enhancement Mode MOSFET

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
MDD16N65F	16N65F	TO-220F	50	
MDD16N65P	16N65P	TO-220-3L	50	

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