

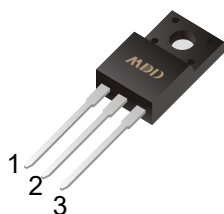


# MDD7N65F/MDD7N65P/MDD7N65D

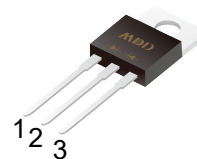
650V N-Channel Enhancement Mode MOSFET

$V_{DS}$	650 V
$I_D(T_C=25^\circ\text{C})$	7A
$R_{DS(on),max}$	1.4 $\Omega$ @ $V_{GS}=10V$
$Q_{g,typ}$	20.7nC

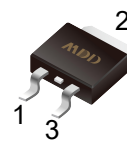
TO-220F-3L



TO-220-3L



TO-252



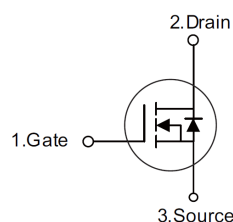
## General Features

- 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	$V_{GS}$	$\pm 30$	V
Continuous Drain Current	$I_D$	7	A
Pulsed Drain Current (Note 1)	$I_{DM}$	28	A
Avalanche Energy Single Pulsed (Note 2)	$E_{AS}$	352	mJ
Continuous diode forward current	$I_S$	7	A
Diode pulse current	$I_{S,pulse}$	28	A
Peak Diode Recovery dv/dt (Note 3)	dv/dt	5	V/ns
Power Dissipation TO-220F	$P_D$	39	W
Power Dissipation TO-220/TO-252		100	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/TO-252	
Thermal resistance, Junction-to-case	$R_{\theta JC}$	3.2	1.25	$^\circ\text{C/W}$
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.  $L=10\text{mH}$ ,  $I_{AS} = 8.4\text{A}$ , Starting  $T_J = 25^\circ\text{C}$ .
  3.  $I_{SD} = 7\text{A}$ ,  $di/dt \leq 100\text{A/us}$ ,  $V_{DD} \leq BV_{DS}$ , Starting  $T_J = 25^\circ\text{C}$ .



# MDD7N65F/MDD7N65P/MDD7N65D

650V N-Channel Enhancement Mode MOSFET

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	$\mu A$	
$V_{GS(TH)}$	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	$V_{GS}=10V, I_D=3.5A$	--	1.2	1.4	$\Omega$	

## Dynamic Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$C_{iss}$	Input Capacitance	$V_{DS}=25V$ $V_{GS}=0V$ $f=1MHz$	--	1090		pF
$C_{oss}$	Output Capacitance		--	111		pF
$C_{rss}$	Reverse Transfer Capacitance		--	6.1		pF
$Q_g$	Total Gate Charge	$V_{DS}=520V,$ $V_{GS}=10V,$ $I_D=7A$ (Note1,2)	--	20.7	--	nC
$Q_{gs}$	Gate Source Charge		--	5.7	--	nC
$Q_{gd}$	Gate Drain Charge		--	7.2	--	nC

## Switching Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$t_{d(on)}$	Turn on Delay Time	$V_{DS}=325V,$ $I_D=7A,$ $R_G=10\Omega$ (Note1,2)	--	--	12.2	ns
$t_r$	Turn on Rise Time		--	--	33.4	ns
$t_{d(off)}$	Turn Off Delay Time		--	--	53.6	ns
$t_f$	Turn Off Fall Time		--	--	15	ns

## Source Drain Diode Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$I_{SD}$	Source drain current(Body Diode)		--	--	7	A
$I_{SM}$	Pulsed Current		--	--	28	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$I_S=7A, V_{GS}=0V$	--	0.85	1.5	V
$t_{rr}$	Body Diode Reverse Recovery Time	$V_R=325V$ $I_F=7A,$ $-dI_F/dt=100A/\mu s$	--	373.2	--	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge		--	2.1	--	$\mu C$

### Notes:

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



### Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

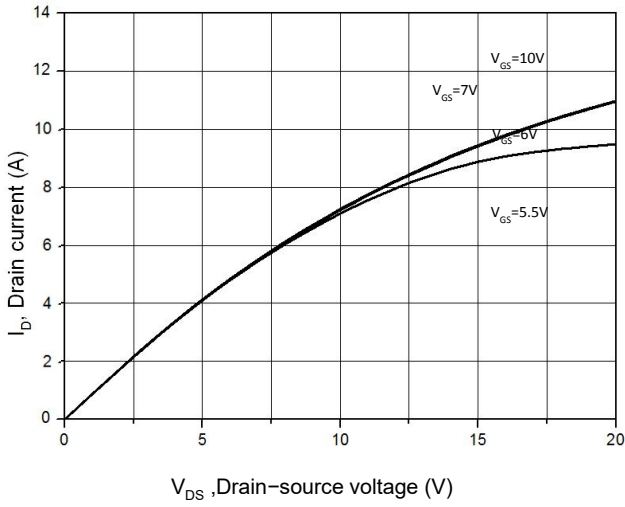


Figure 2. Transfer Characteristics

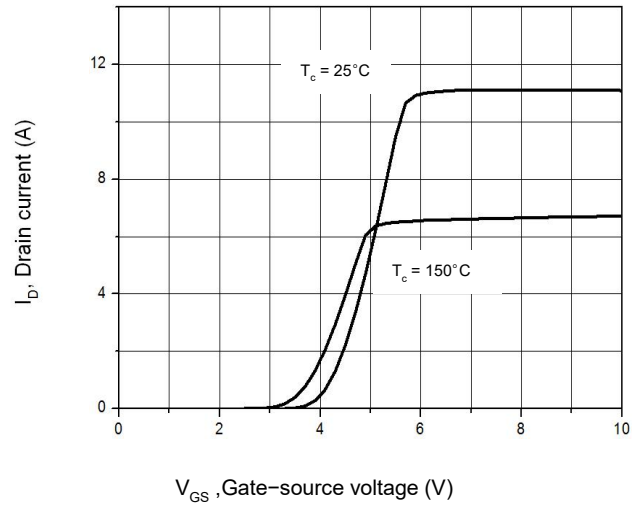


Figure 3. On-Resistance Variation vs. Drain Current

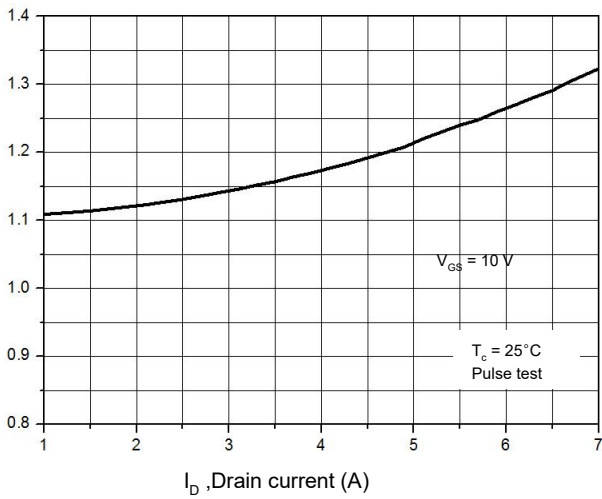


Figure 4. Threshold Voltage vs. Temperature

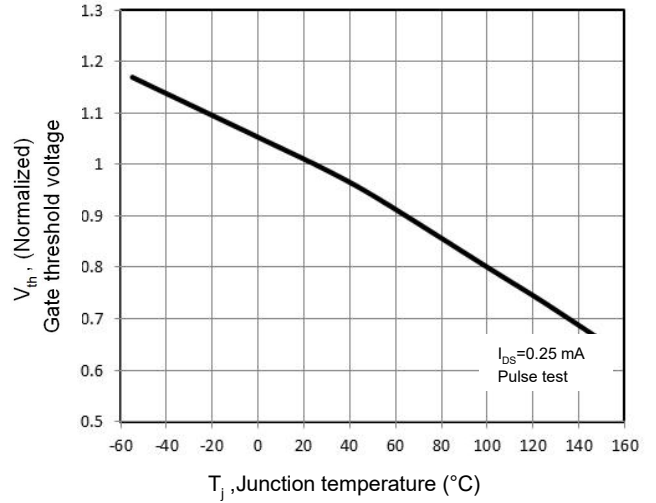


Figure 5. Breakdown Voltage vs. Temperature

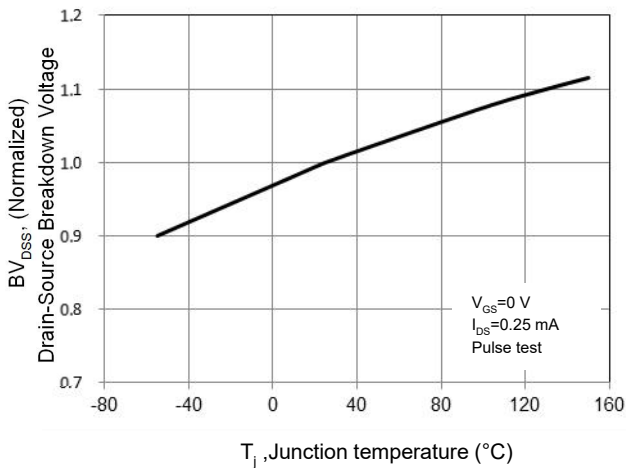
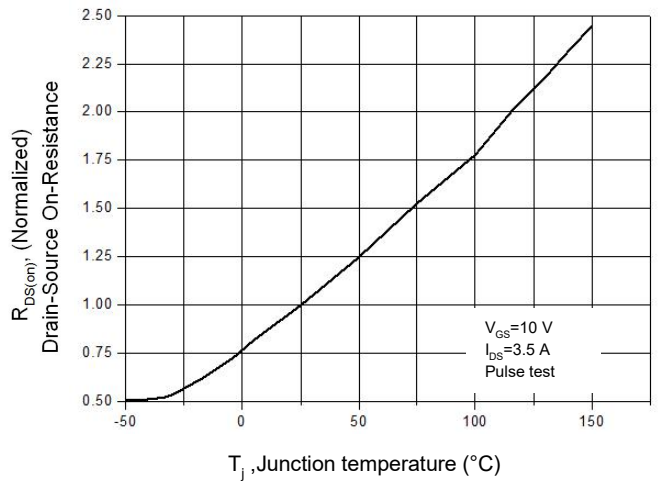


Figure 6. On-Resistance vs. Temperature





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650V N-Channel Enhancement Mode MOSFET

Figure 7. Capacitance Characteristics

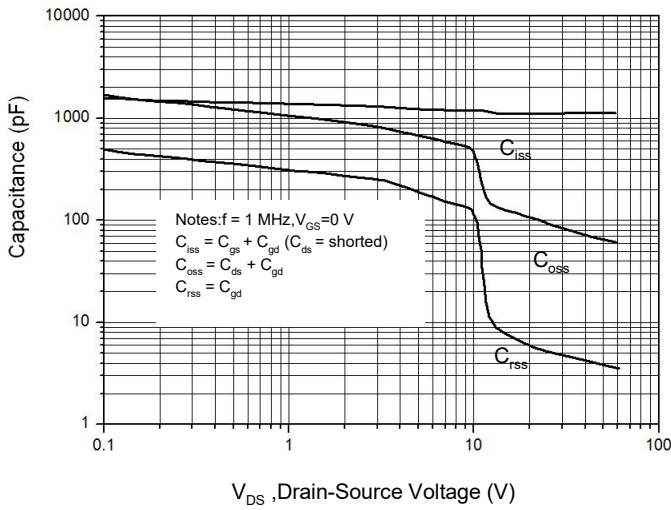


Figure 8. Gate Charge Characteristic

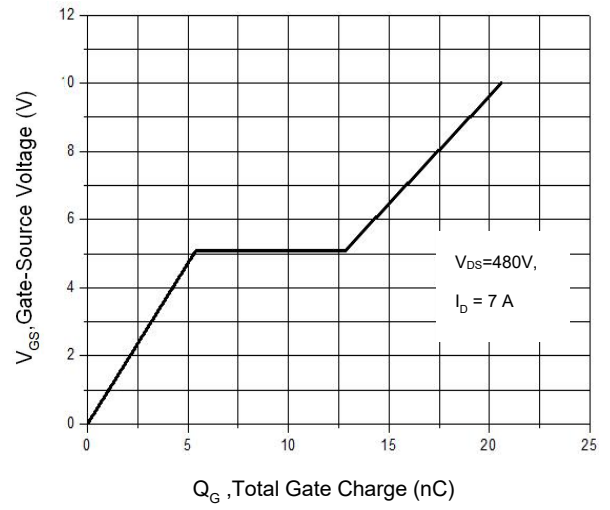


Figure 9. Maximum Safe Operating Area TO-220F

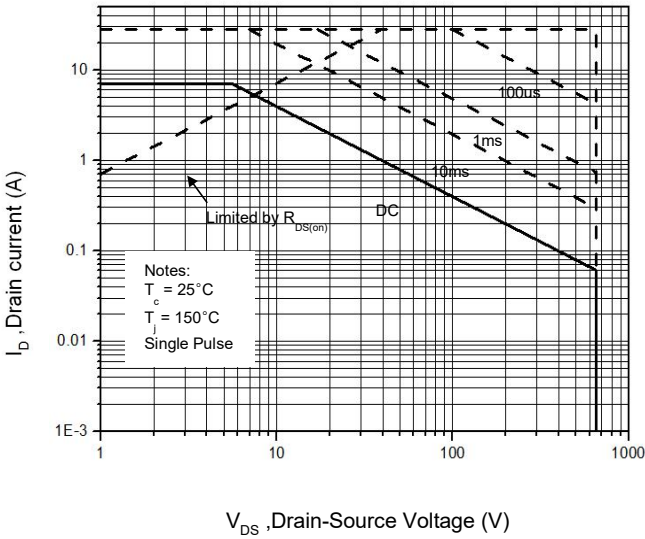


Figure 10. Maximum Safe Operating Area TO-220/ TO-252

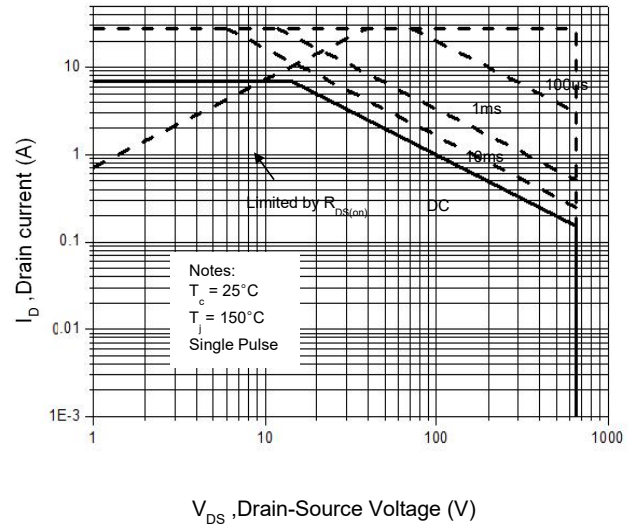


Figure 11. Power Dissipation vs. Temperature TO-220F

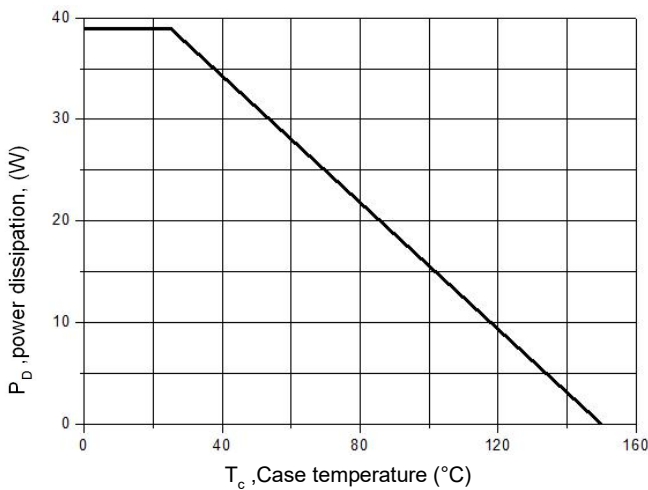
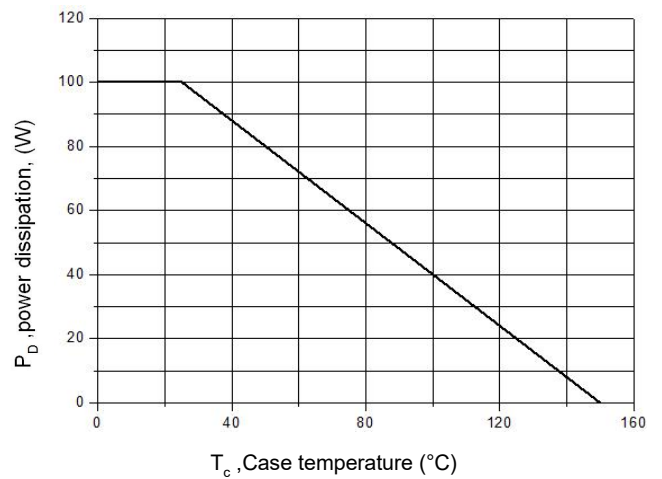


Figure 12. Power Dissipation vs. Temperature TO-220 / TO-252





# MDD7N65F/MDD7N65P/MDD7N65D

650V N-Channel Enhancement Mode MOSFET

Figure 13. Continuous Drain Current vs. Temperature

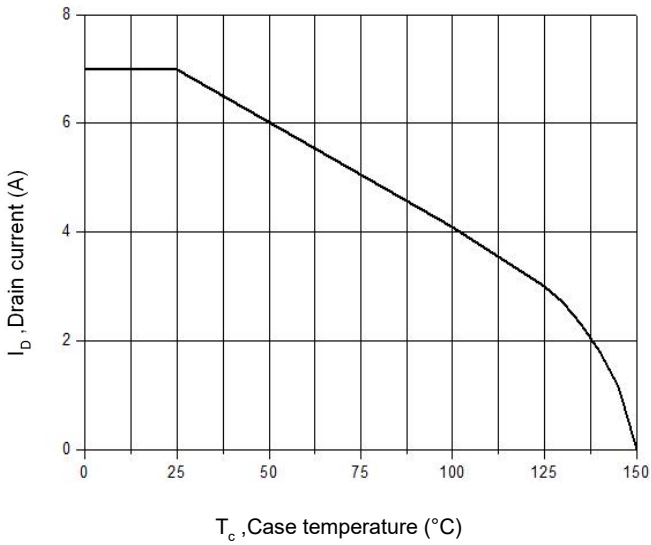


Figure 14. Body Diode Transfer Characteristics

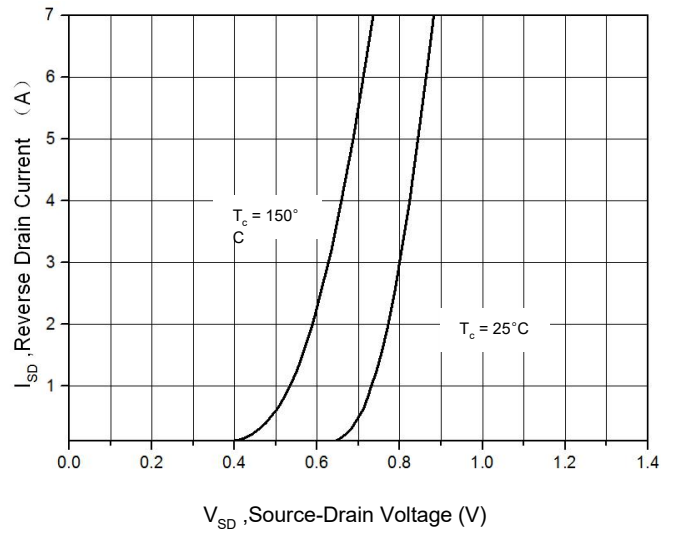


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

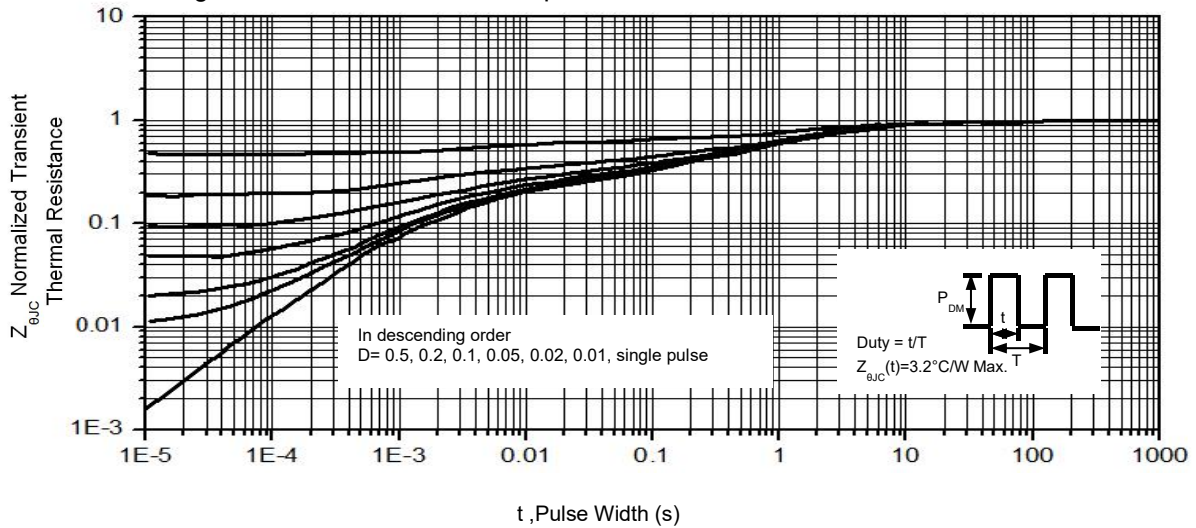
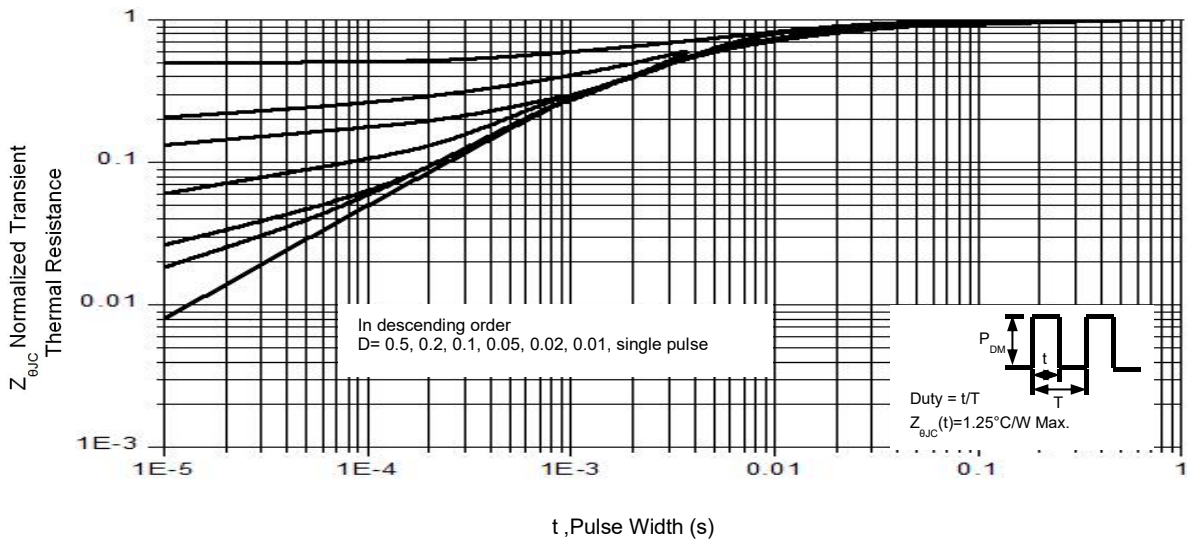


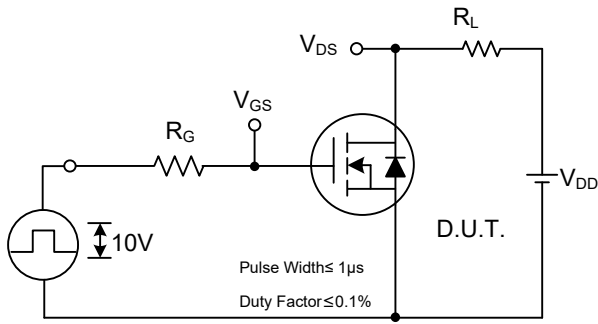
Figure 16. Transient Thermal Impedance, Junction to Case, TO-220/ TO-252



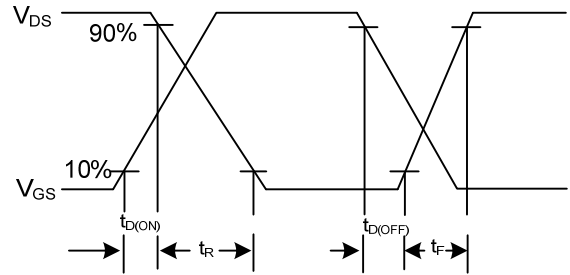


# MDD7N65F/MDD7N65P/MDD7N65D

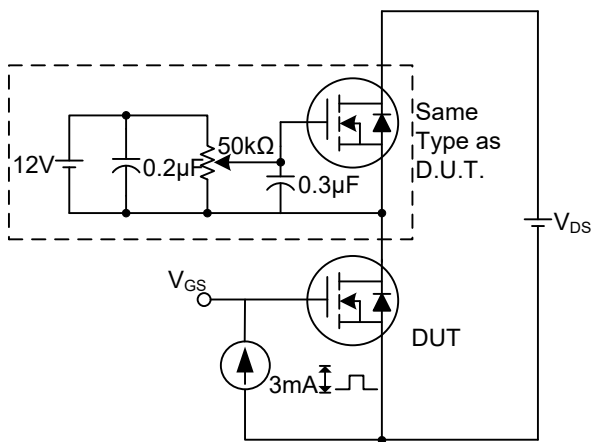
650V N-Channel Enhancement Mode MOSFET



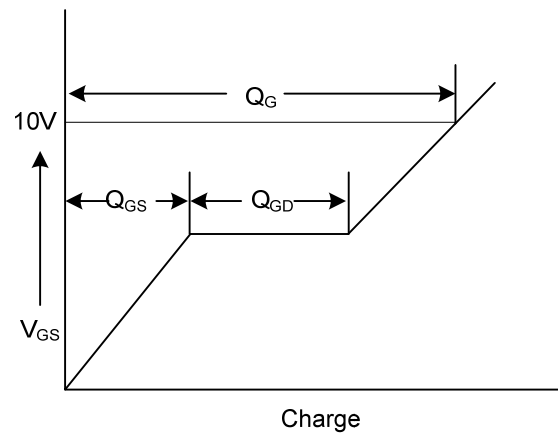
Switching Test Circuit



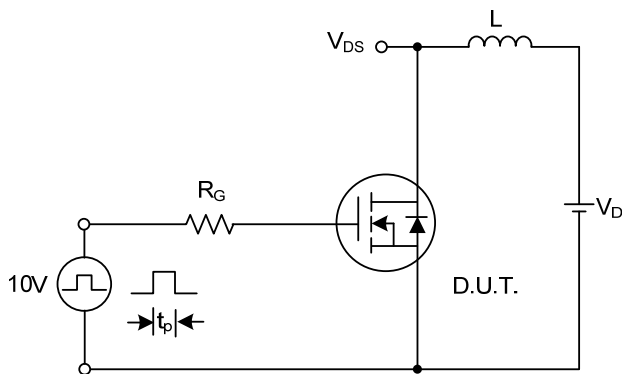
Switching Waveforms



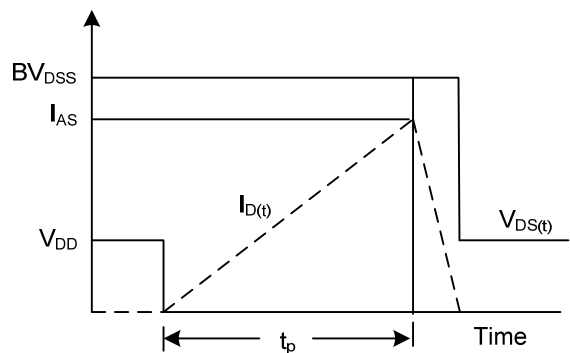
Gate Charge Test Circuit



Gate Charge Waveform



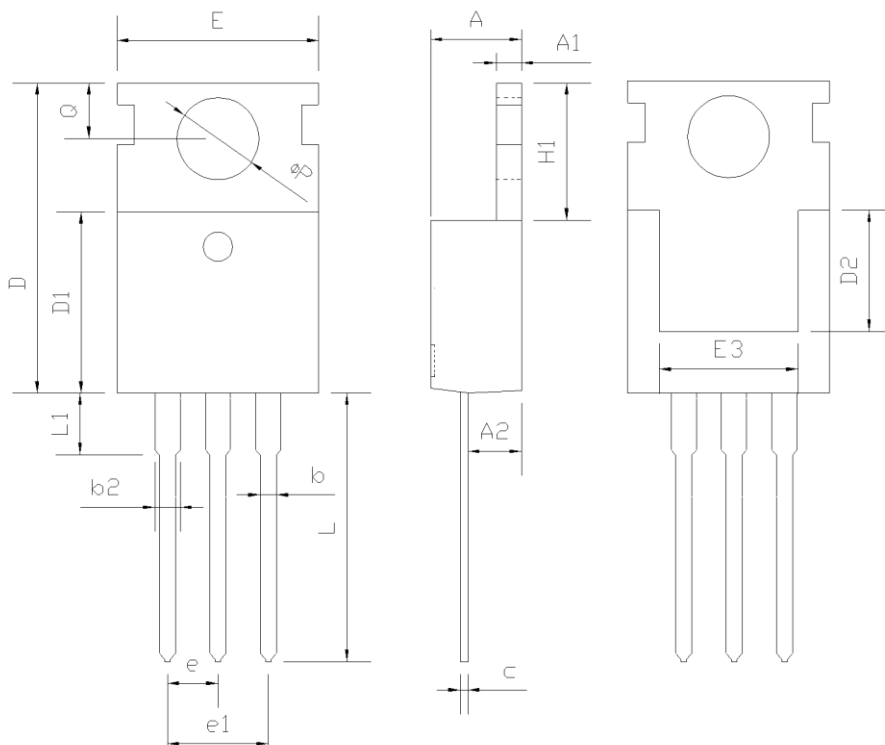
Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

The curve above is for reference only.

### Mechanical Dimensions for TO-220



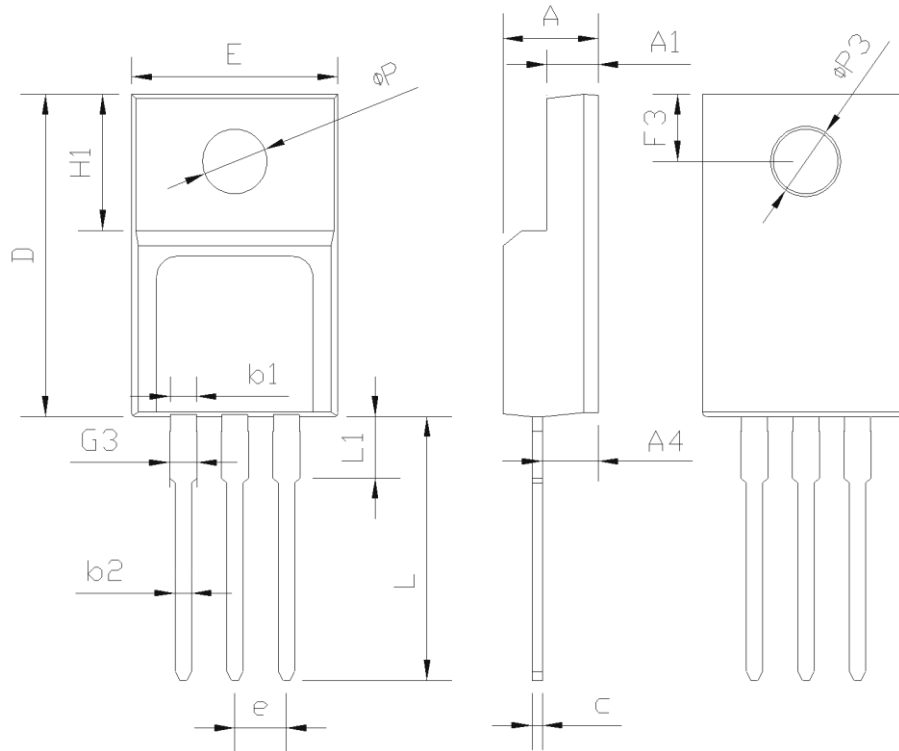
SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.70
A1	1.25	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30
E3	7.00	-	-
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
$\Phi P$	3.40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



# MDD7N65F/MDD7N65P/MDD7N65D

650V N-Channel Enhancement Mode MOSFET

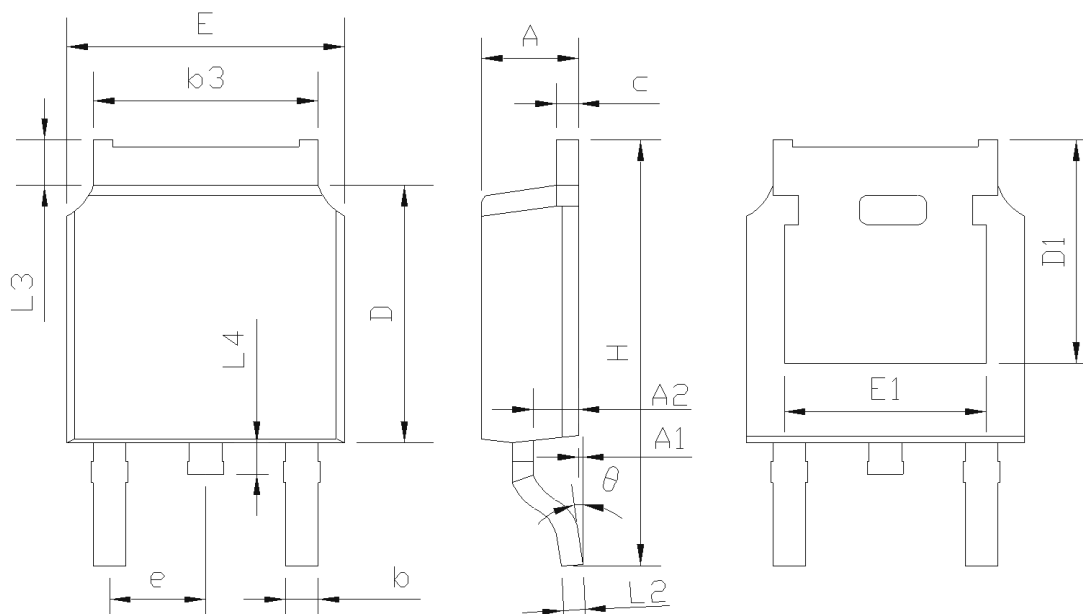
## Mechanical Dimensions for TO-220F



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



### Mechanical Dimensions for TO-252



SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0.00	-	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.73
E1	4.63	-	-
e	2.286BSC		
H	9.40	10.10	10.50
L2	0.51BSC		
L3	0.88	-	1.28
L4	0.50	-	1.00
$\theta$	0°	-	8°

### Package Marking and Ordering Information

Part Number	Marking	Package	Units/Tube	Units/Reel
MDD7N65F	7N65F	TO-220F	50	
MDD7N65P	7N65P	TO-220-3L	50	
MDD7N65D	7N65D	TO-252		2500