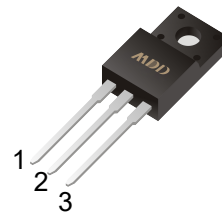


TO-220F-3L



V_{DS}	500V
$I_D(T_C=25^{\circ}\text{C})$	13A
$R_{DS(on),max}$	$0.52\Omega @ V_{GS}=10V$
$Q_{g,typ}$	37nC

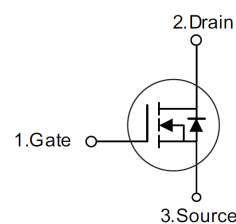
General Features

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

Application

- ◆ Electronic ballast
- ◆ Switched mode power supplies.
- ◆ UPS.

Equivalent Circuit



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

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	500	V
Gate-Source Voltage	V_{GS}	± 30	V
Continuous Drain Current	I_D	13	A
Pulsed Drain Current(Note 1)	I_{DM}	52	A
Avalanche Energy Single Pulsed (Note 2)	E_{AS}	845	mJ
Peak Diode Recovery dv/dt (Note 3)	dv/dt	4.5	V/ns
Power Dissipation TO-220F	P_D	50	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	
Thermal resistance, Junction-to-case	$R_{\theta JC}$	2.58	$^{\circ}\text{C/W}$
Thermal resistance, Junction-to-ambient	$R_{\theta JA}$	62.5	$^{\circ}\text{C/W}$

- Notes:**
1. Pulse width limited by maximum junction temperature.
 2. $L=5\text{mH}$, $I_{AS} = 13\text{A}$, Starting $T_J= 25^{\circ}\text{C}$.
 3. $I_{SD} = 13\text{A}$, $di/dt \leq 100\text{A/us}$, $V_{DD} \leq BV_{DS}$, Starting $T_J= 25^{\circ}\text{C}$.

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	500	--	--	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}=500V, 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=6.5A	--	0.35	0.52	Ω

Dynamic Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{DS}=25V V_{GS}=0V f=1MHz	--	2000	--	pF
C_{oss}	Output Capacitance		--	190	--	pF
C_{rss}	Reverse Transfer Capacitance		--	10	--	pF
Q_g	Total Gate Charge	V_{DS}=400V, V_{GS}=10V, I_D=13A (Note1,2)	--	37	--	nC
Q_{gs}	Gate Source Charge		--	10.9	--	nC
Q_{gd}	Gate Drain Charge		--	17.2	--	nC

Switching Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit
t_{d(on)}	Turn on Delay Time	V_{DS}=250V, I_D=13A, R_G=25Ω (Note1,2)	--	90	--	ns
t_r	Turn on Rise Time		--	160	--	ns
t_{d(off)}	Turn Off Delay Time		--	150	--	ns
t_f	Turn Off Fall Time		--	60	--	ns

Source Drain Diode Characteristics

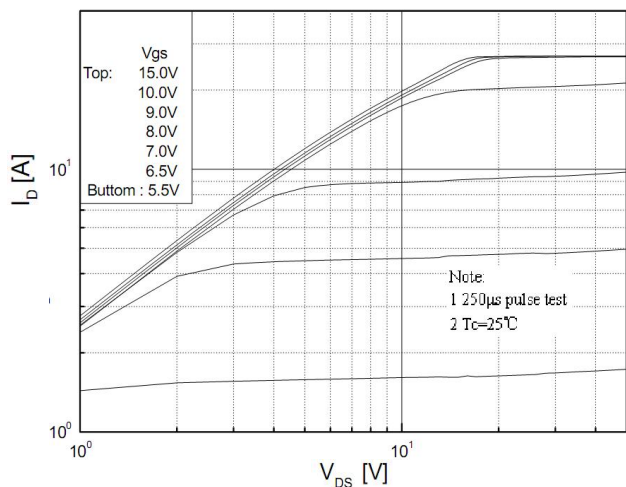
Symbol	Parameter	Condition	Min	Typ	Max	Unit
I_{SD}	Source drain current(Body Diode)		--	--	13	A
I_{SM}	Pulsed Current		--	--	52	A
V_{SD}	Drain-Source Diode Forward Voltage	I_S=13A, V_{GS}=0V	--	--	1.4	V
t_{rr}	Body Diode Reverse Recovery Time	V_{GD}=0V I_F=13A, -diF/dt =100A/μs	--	410	--	ns
Q_{rr}	Body Diode Reverse Recovery Charge		--	4.5	--	uC

Notes:

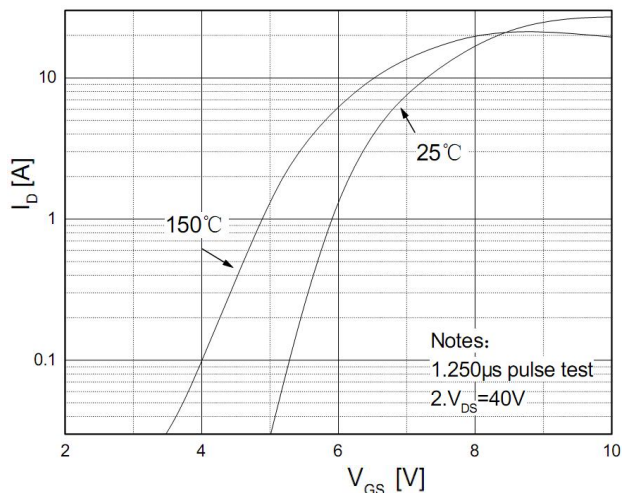
- 1.Pulse test ; Pulse width≤300us, duty cycles≤2%.
- 2.Essentially independent of operating temperature.

Electrical Characteristics Diagrams

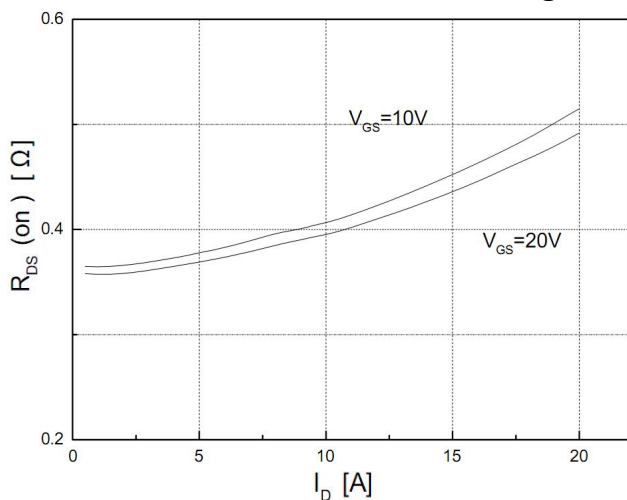
On-Regin Characteristics



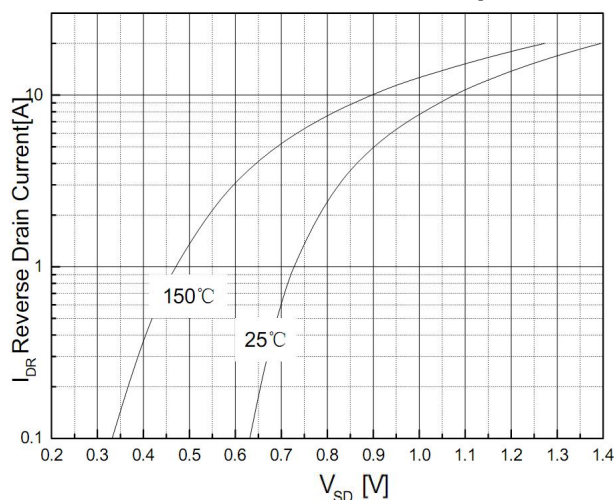
Transfer Characteristics



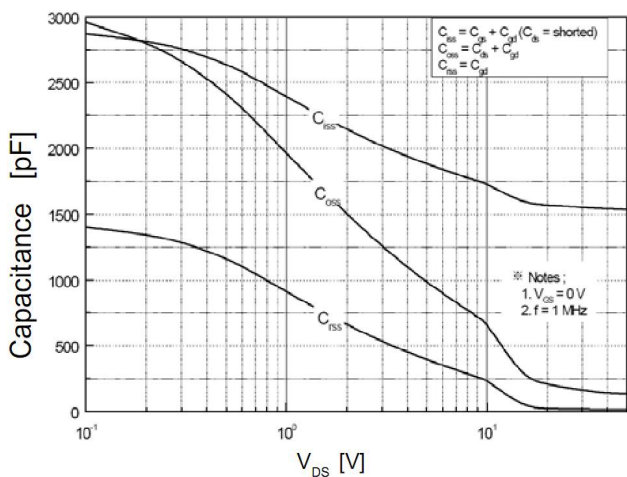
On-Resistance Variation vs. Drain Current and Gate Voltage



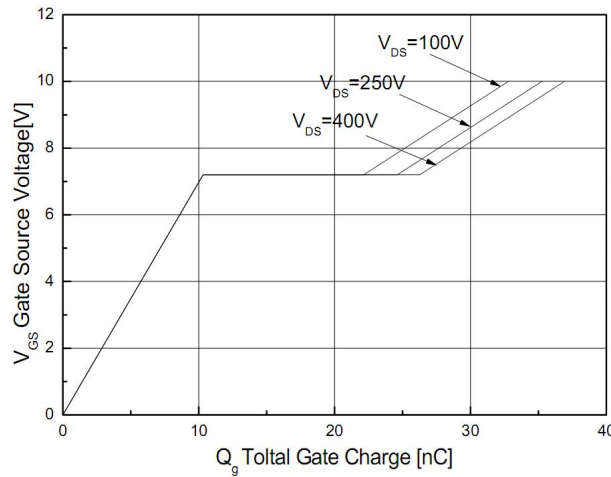
Body Diode Forward Voltage Variation vs. Source Current and Temperature



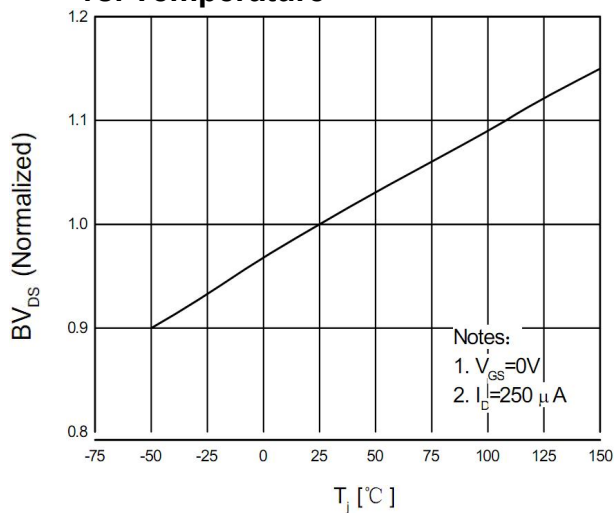
Capacitance Characteristics



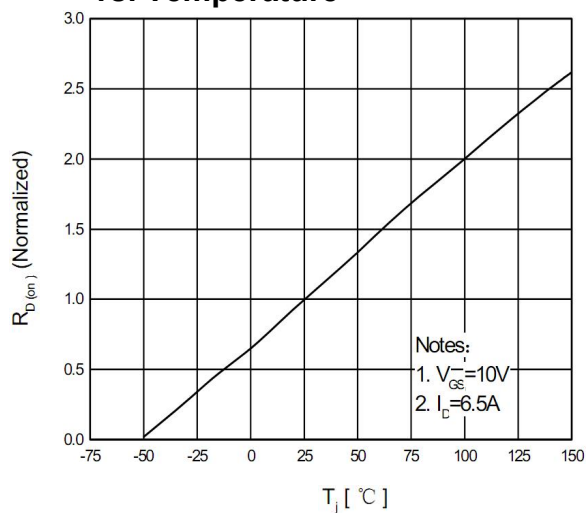
Gate Charge Characteristics



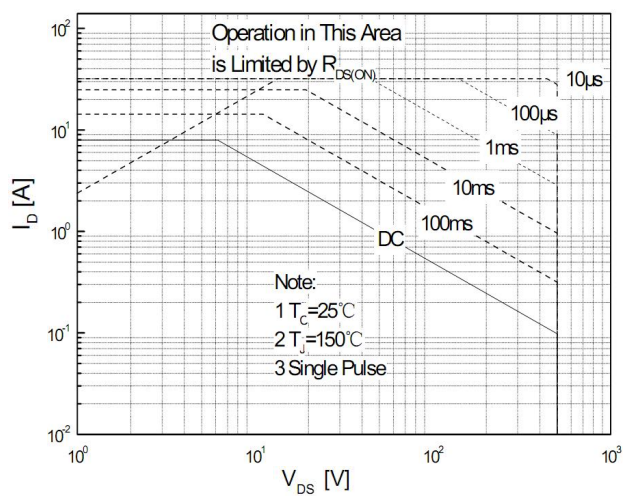
Breakdown Voltage Variation vs. Temperature



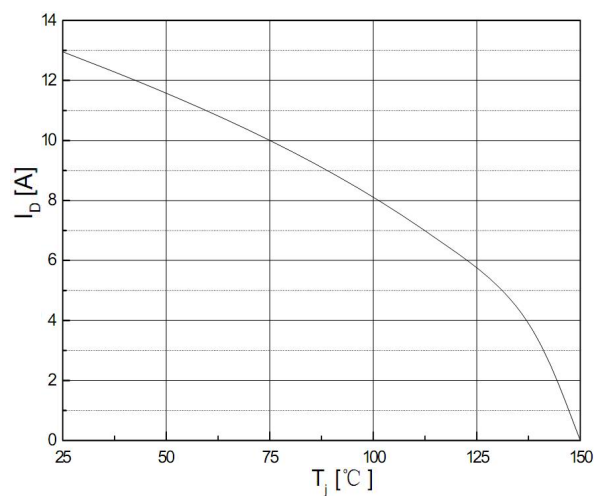
On-Resistance Variation vs. Temperature

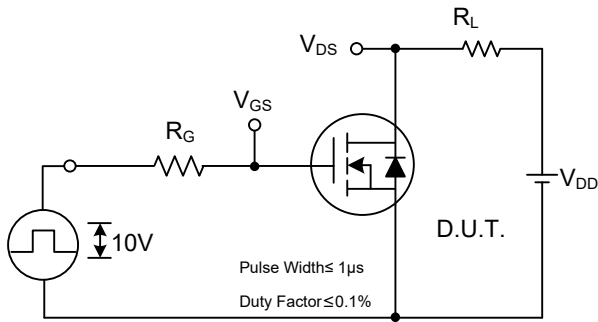


Maximum Safe Operating Area

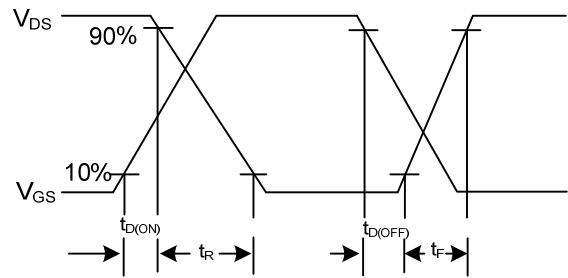


Maximum Drain Current Vs. Case Temperature

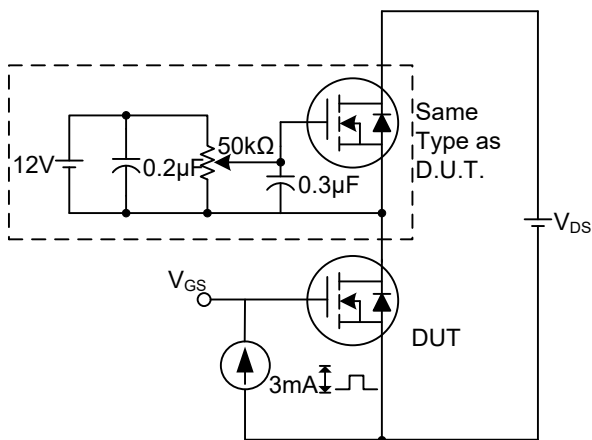




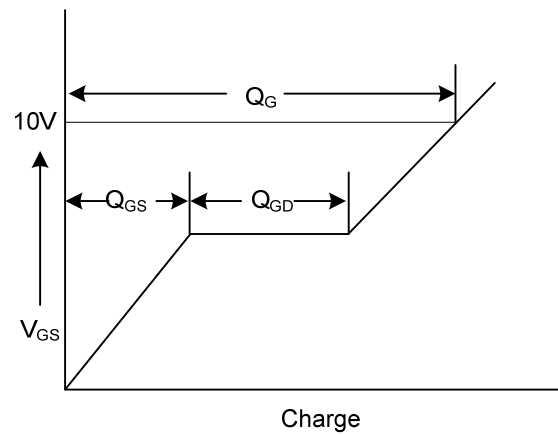
Switching Test Circuit



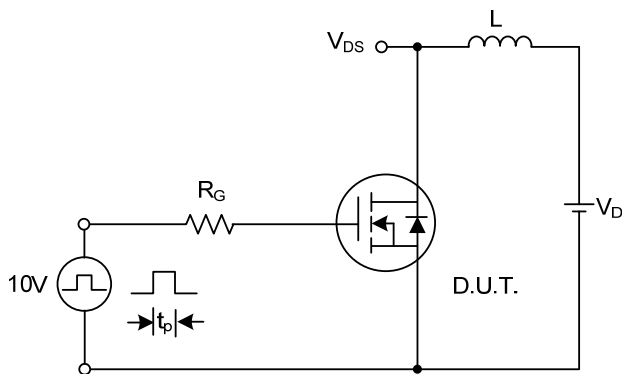
Switching Waveforms



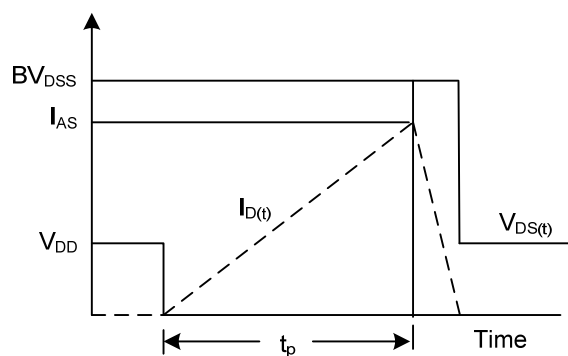
Gate Charge Test Circuit



Gate Charge Waveform



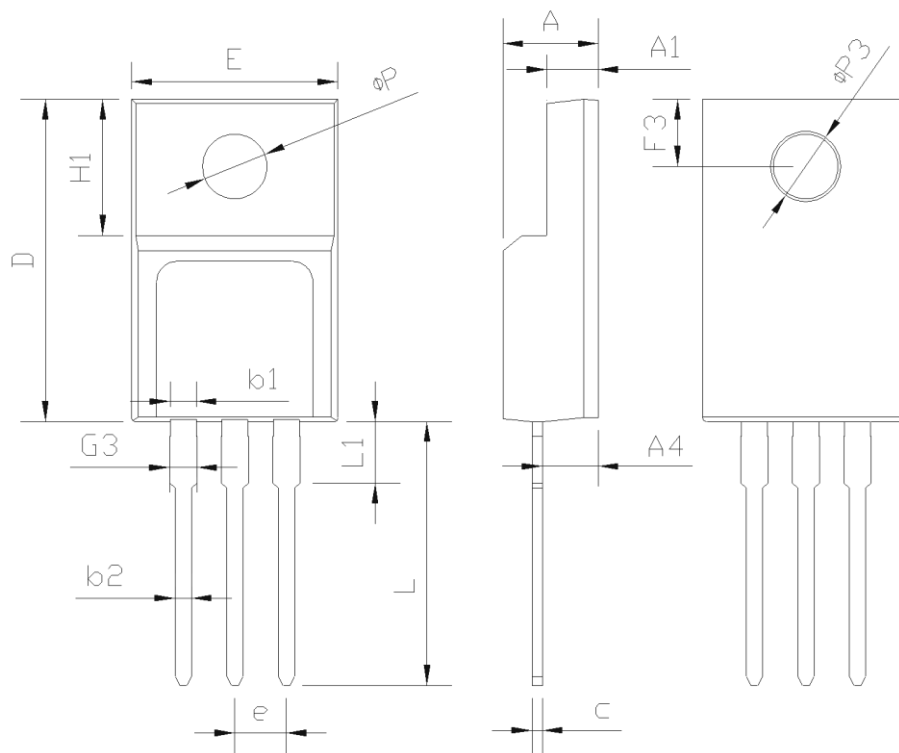
Unclamped Inductive Switching Test Circuit



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
MDD13N50F	13N50F	TO-220F	50	