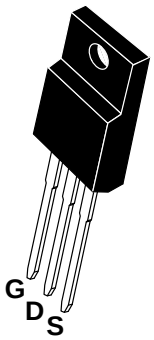
Advanced N-Ch Power MOSFET

PIN Connection TO-220F

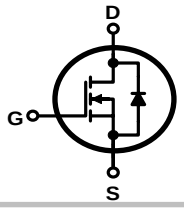


Switchng Regulator Application

Features

- High Voltage: BV_{DSS}=600V(Min.)
- Low C_{rss} : C_{rss}=8.5F(Typ.)
- Low gate charge : Qg=14.5nC(Typ.)
- Low $R_{DS(on)}$:$R_{DS(on)}$=1.8Ω

Schematic diagram



Marking Diagram

Y = Year
A = Assembly Location
WW = Work Week
FIR5N60F = Specific Device Code

Absolute maximum ratings (T_C=25°C unless otherwise noted)

Characteristic	Symbol		Rating	Unit
Drain-source voltage	V_{DSS}		600	V
Gate-source voltage	V_{GSS}		±30	V
Drain current (DC) *	I_D	(Tc=25℃)	4.5	A
		(Tc=100℃)	3.2	A
Drain current (Pulsed) *	I_{DM}		16	A
Power dissipation	P_D		30	W
Avalanche current (Single)	I_{AS}		4.5	A
Single pulsed avalanche energy	E_{AS}		200	mJ
Avalanche current (Repetitive)	I_{AR}		4.5	A
Repetitive avalanche energy	E_{AR}		30	mJ
Junction temperature	T_J		150	°C
Storage temperature range	T_{stg}		-55~150	

* Limited by maximum junction temperature

Characteristic		Symbol	Typ.	Max.	Unit
Thermal resistance	Junction-case	$R_{th(J-C)}$	-	4.16	°C/W
	Junction-ambient	$R_{th(J-A)}$	-	120	

Electrical Characteristics (T_C=25°C unless otherwise noted)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Drain-source breakdown voltage	BV_{DSS}	I_D=250uA, V_{GS}=0	600	-	-	V
Gate threshold voltage	$V_{GS(th)}$	I_D=250uA, V_{DS}=V_{GS}	2.0	-	4.0	V
Drain-source cut-off current	I_{DSS}	V_{DS}=600V, V_{GS}=0V	-	-	1	uA
Gate leakage current	I_{GSS}	V_{DS}=0V, V_{GS}=±30V	-	-	±100	nA
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=2.0A	-	1.8	2.3	Ω
Forward transfer conductance	g_{fs}	V_{DS}=10V, I_D=2.0A	-	3.5	-	S
Input capacitance	Ciss	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	535	--	pF
Output capacitance	Coss		-	55	--	
Reverse transfer capacitance	Crss		-	6.8	--	
Turn-on delay time	$t_{d(on)}$	V_{DD}=300V, I_D=4.5A R_G=25Ω	-	8.5	-	ns
Rise time	t_r		-	6.5	-	
Turn-off delay time	$t_{d(off)}$		-	31	-	
Fall time	t_f		-	8.5	-	
Total gate charge	Q_g	V_{DS}=480V, V_{GS}=10V I_D=4.5A	-	13	15	nC
Gate-source charge	Q_{gs}		-	3	-	
Gate-drain charge	Q_{gd}		-	6	-	

Source-Drain Diode Ratings and Characteristics (T_C=25°C unless otherwise noted)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Source current (DC)	I_S	Integral reverse diode in the MOSFET	-	-	4.5	A
Source current (Pulsed)	I_{SM}		-	-	16	
Forward voltage	V_{SD}	V_{GS}=0V, I_S=4.5A	-	-	1.5	V
Reverse recovery time	t_{rr}	I_S=4.5A, V_{GS}=0V dI_F/dt=100A/us	-	430	-	ns
Reverse recovery charge	Q_{rr}		-	1.27	-	uC

[a1]: Repetitive rating; pulse width limited by maximum junction temperature
[a2]: L=10mH, I_D=6.3A, Start T_J=25
[a3]: I_{SD} =4.5 A,di/dt ≤100A/us,V_{DD}≤$BV_{DS,}$ Start T_J=25

Characteristics Curve:

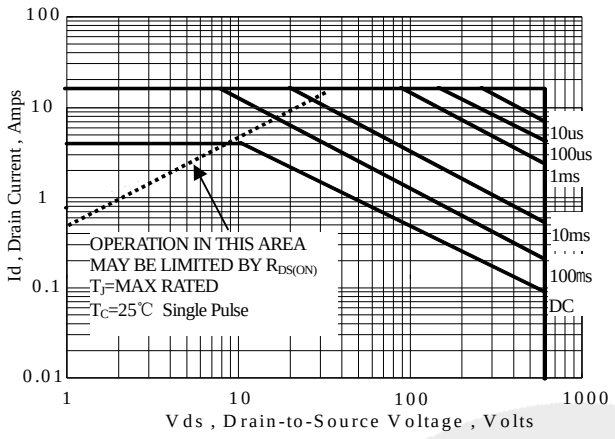


Figure 1 Maximum Forward Bias Safe Operating Area

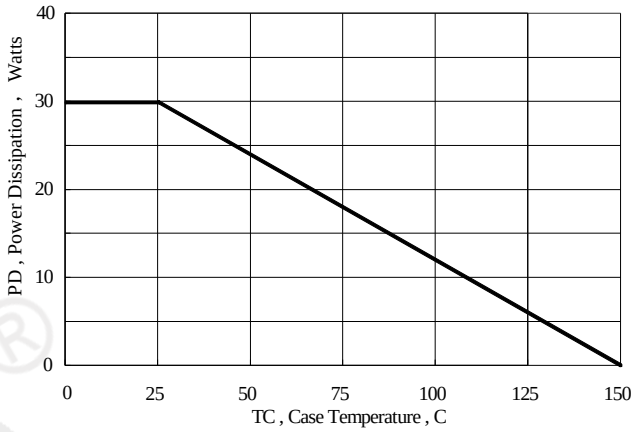


Figure 2 Maximum Power Dissipation vs Case Temperature

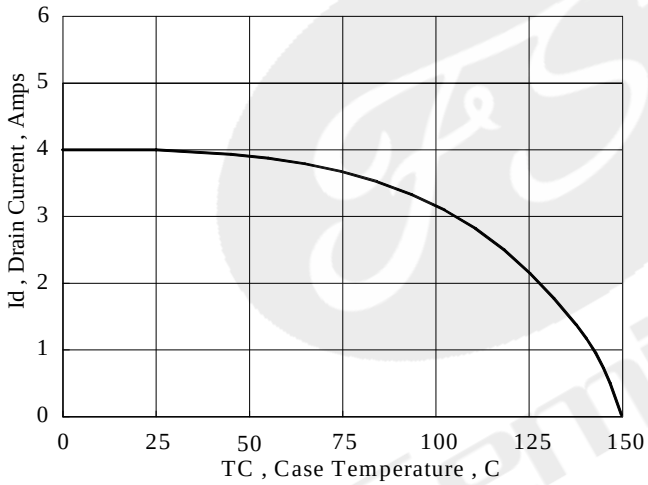


Figure 3 Maximum Continuous Drain Current vs Case Temperature

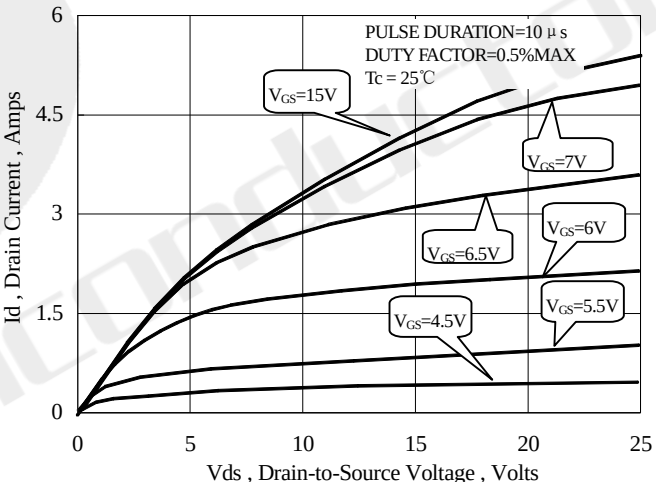


Figure 4 Typical Output Characteristics

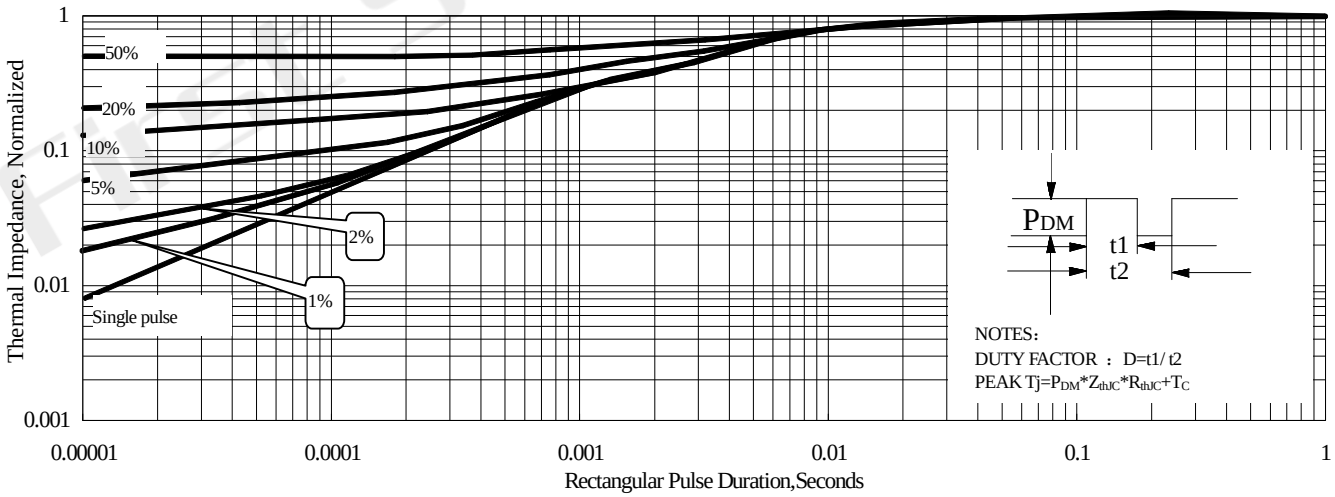


Figure 5 Maximum Effective Thermal Impendance , Junction to Case

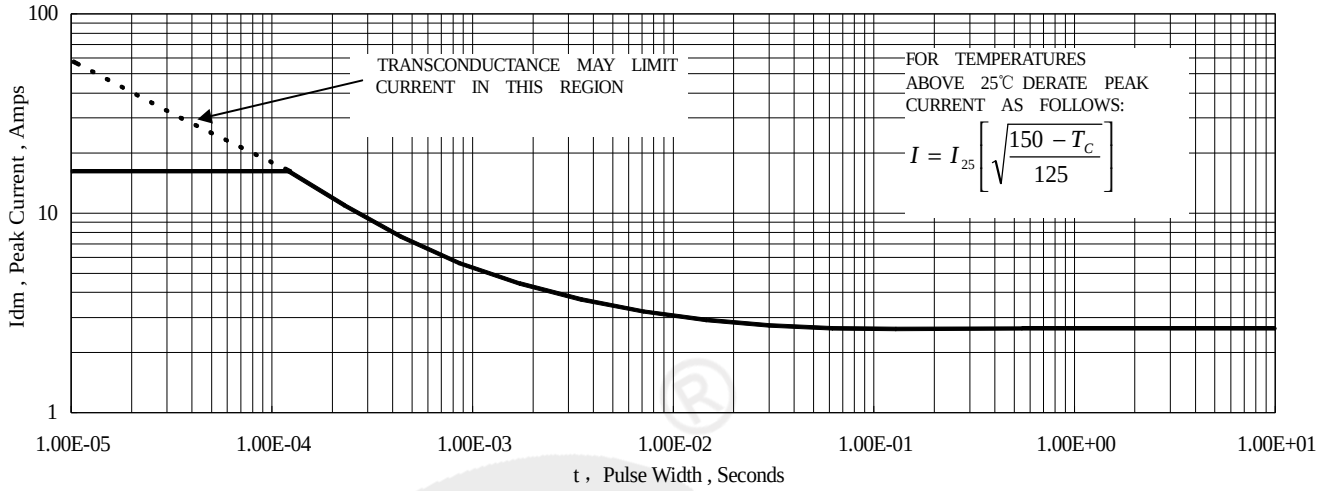


Figure 6 Maximum Peak Current Capability

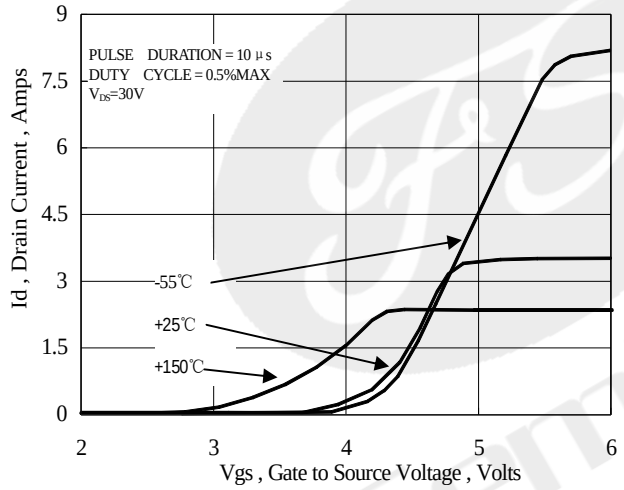


Figure 7 Typical Transfer Characteristics

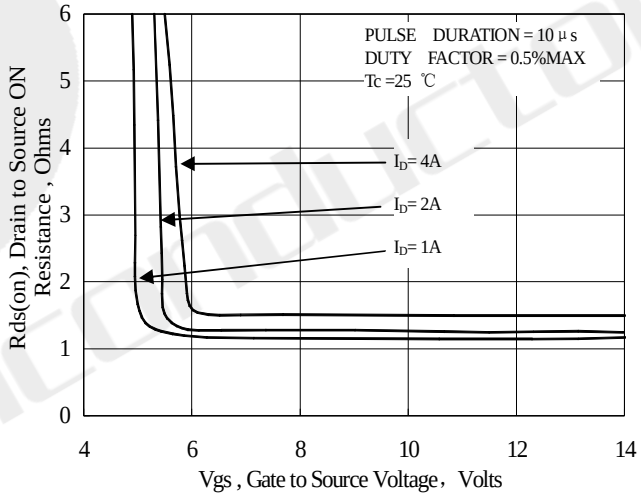


Figure 8 Typical Drain to Source ON Resistance vs Gate Voltage and Drain Current

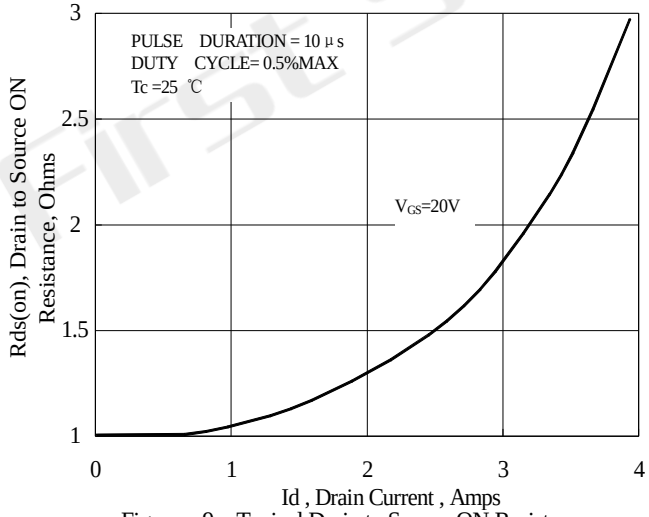


Figure 9 Typical Drain to Source ON Resistance vs Drain Current

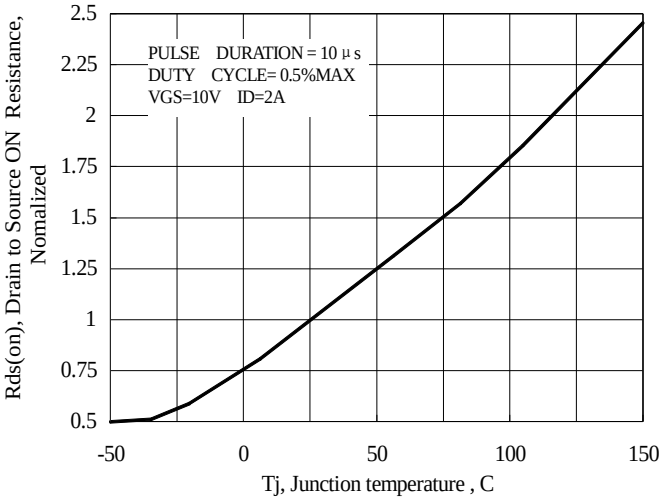


Figure 10 Typical Drian to Source on Resistance vs Junction Temperature

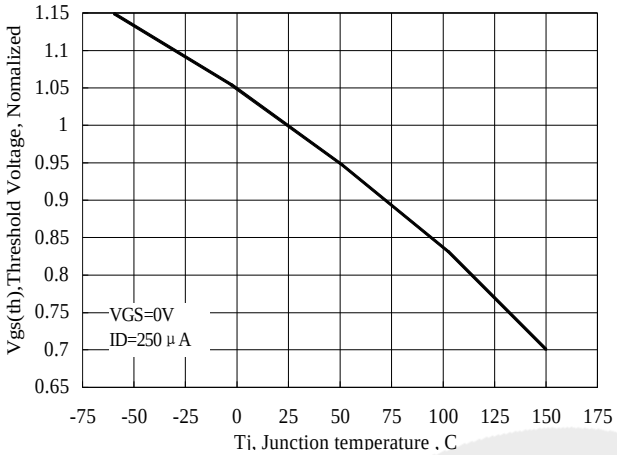


Figure 11 Typical Theshold Voltage vs Junction Temperature

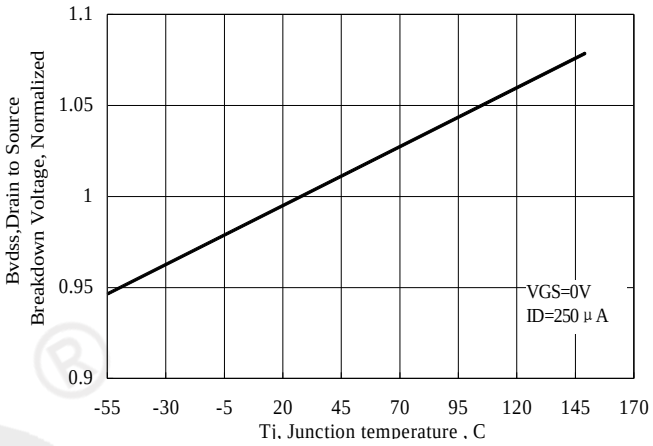


Figure 12 Typical Breakdown Voltage vs Junction Temperature

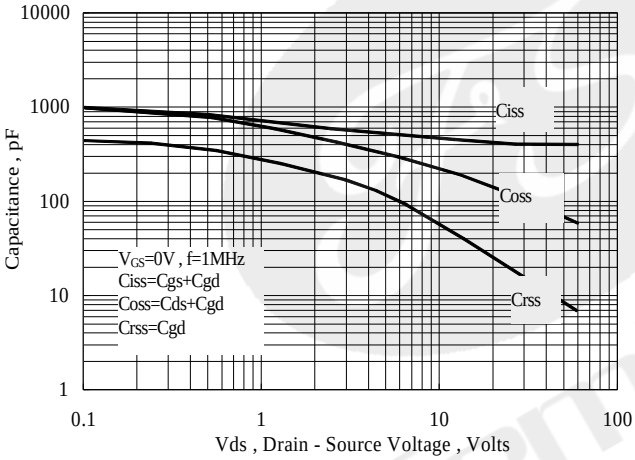


Figure 13 Typical Capacitance vs Drain to Source Voltage

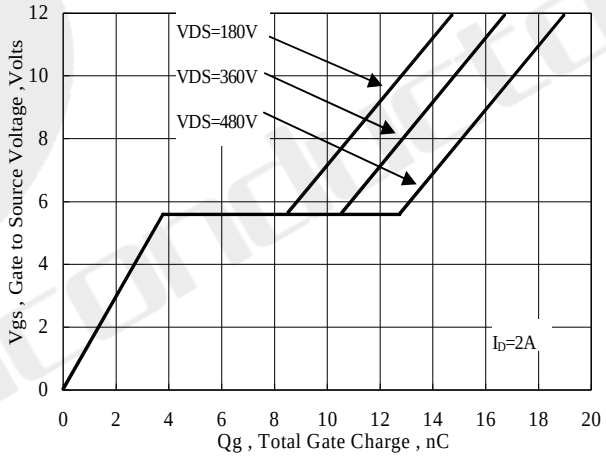


Figure 14 Typical Gate Charge vs Gate to Source Voltage

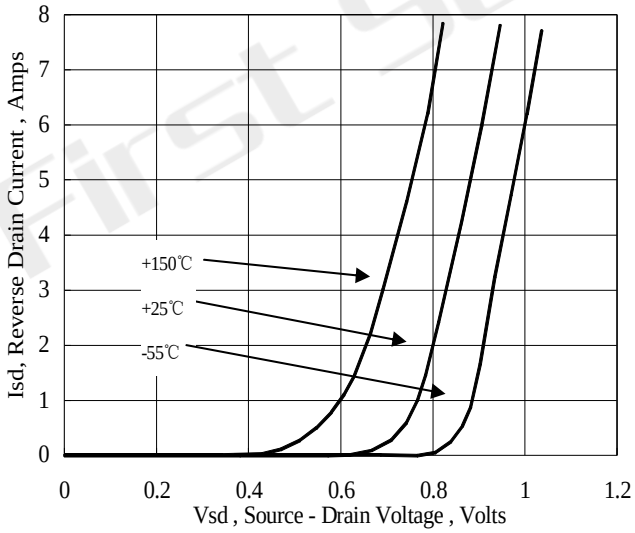


Figure 15 Typical Body Diode Transfer Characteristics

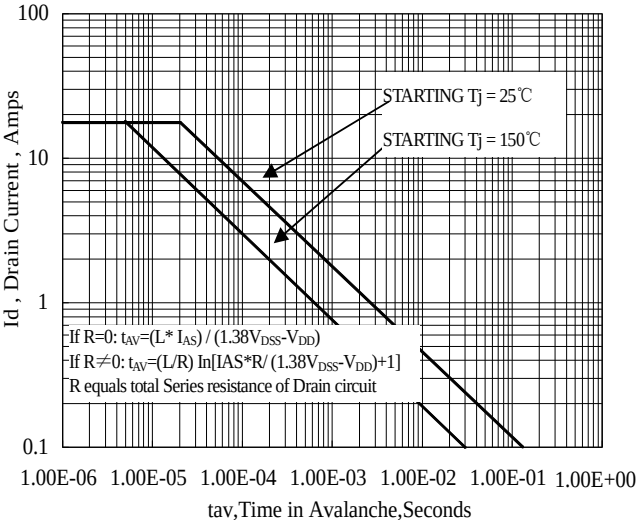


Figure 16 Unclamped Inductive Switching Capability

Test Circuit and Waveform

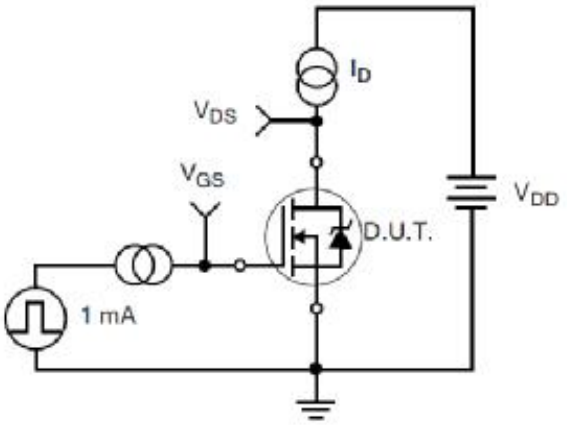


Figure 17. Gate Charge Test Circuit

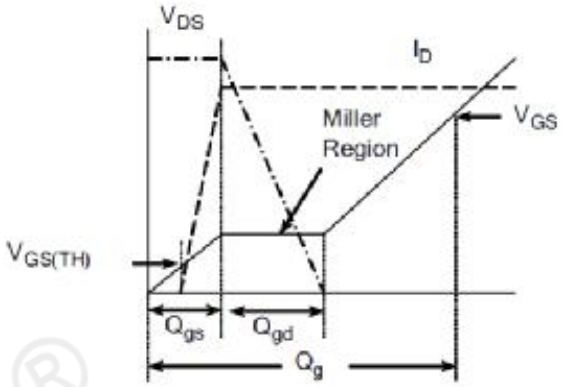


Figure 18. Gate Charge Waveform

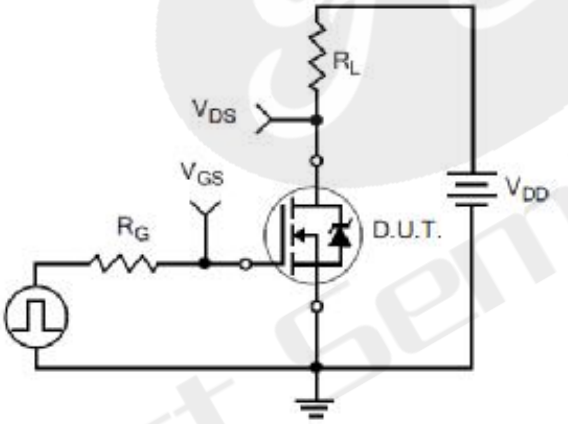


Figure 19. Resistive Switching Test Circuit

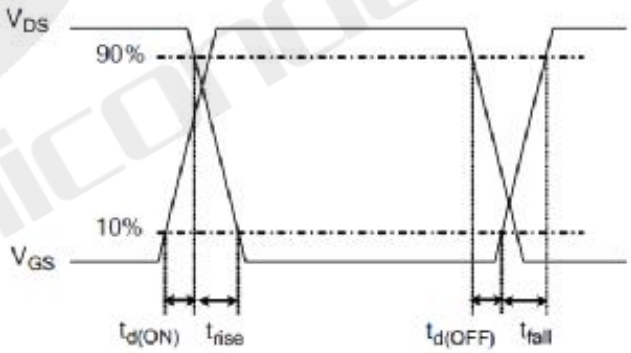


Figure 20. Resistive Switching Waveforms

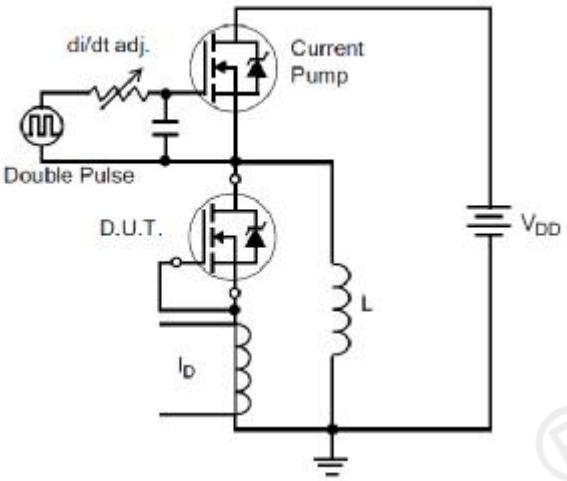


Figure 21. Diode Reverse Recovery Test Circuit

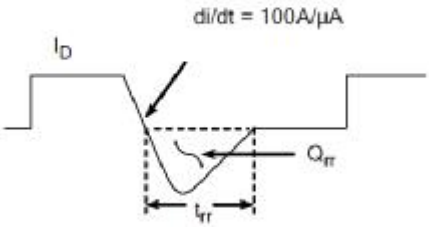


Figure 22. Diode Reverse Recovery Waveform

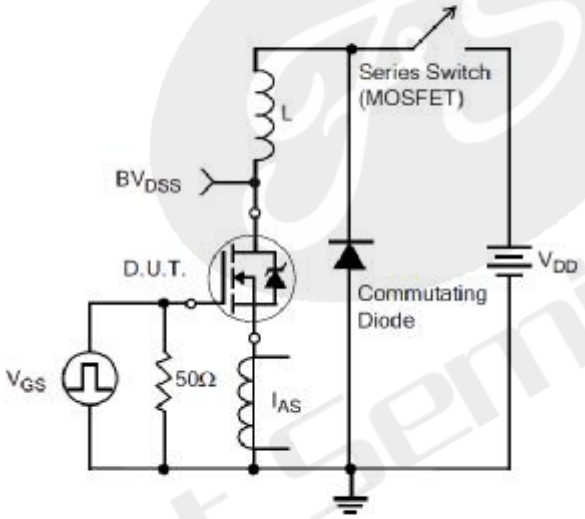
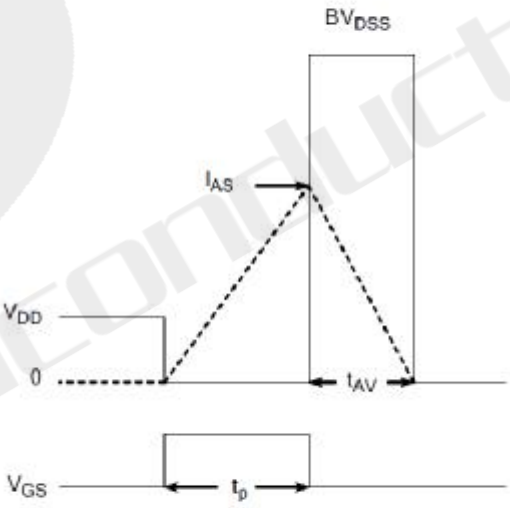


Figure 23. Unclamped Inductive Switching Test Circuit

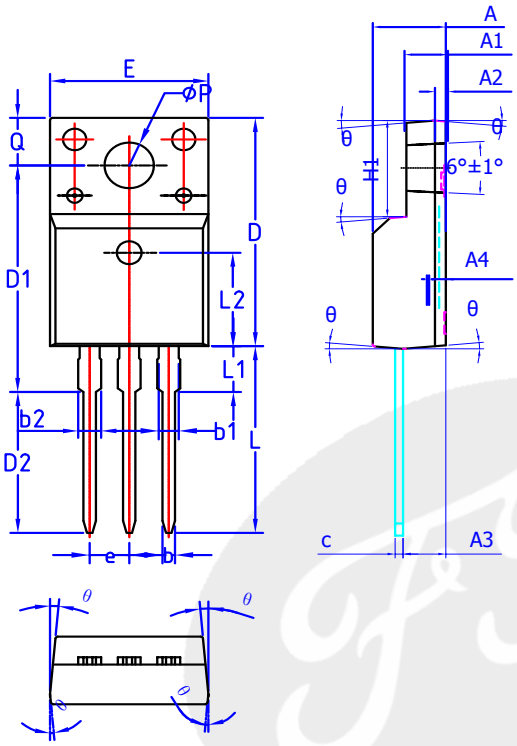


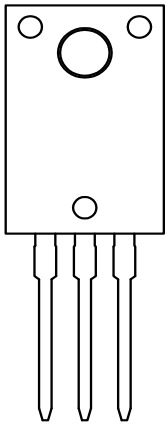
$$E_{AS} = \frac{I_{AS}^2 L}{2}$$

Figure 24. Unclamped Inductive Switching Waveforms

Package Dimensions

TO-220F





Units: mm

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2		0.70 REF	
A3	2.56	2.76	2.96
b	0.70	0.80	0.90
b1	1.17	1.2	1.25
b2	1.17	1.2	1.25
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	10.0	10.2	10.4
E	9.96	10.16	10.36
e		2.54BSC	
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	-	-	3.50
L2		6.50REF	
ØP	3.08	3.18	3.28
Q	3.20	3.30	3.40
θ1	1°	3°	5°
A4	0.53	0.56	0.59

Declaration

- FIRST reserves the right to change the specifications, the same specifications of products due to different packaging line mold, the size of the appearance will be slightly different, shipped in kind, without notice! Customers should obtain the latest version information before ordering, and verify whether the relevant information is complete and up-to-date.
- Any semiconductor product under certain conditions has the possibility of failure or failure,The buyer has the responsibility to comply with safety standards and take safety measures when using FIRST products for system design and manufacturing,To avoid To avoid potential failure risks, which may cause personal injury or property damage!
- Product promotion endless, our company will wholeheartedly provide customers with better products!

ATTACHMENT

Revision History

Date	REV	Description	Page
2018.01.01	1.0	Initial release	