



General Description

The series of devices use advanced super junction technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

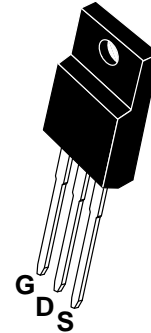
Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

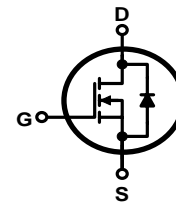
Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)

PIN Connection TO-220F



Schematic diagram



Marking Diagram



Y	= Year
A	= Assembly Location
WW	= Work Week
VT	= Version & Thickness
FIR4N60F	= Specific Device Code

Table 1. Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

Parameter	Symbol	Value	Unit
Drain-Source Voltage ($V_{GS}=0V$)	V_{DS}	600	V
Gate-Source Voltage ($V_{DS}=0V$)	V_{GS}	± 30	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	4	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	2.5	A
Pulsed drain current (Note 1)	I_{DM} (pulse)	12	A
Maximum Power Dissipation ($T_c=25^\circ\text{C}$)	P_D	77	W
Derate above 25°C		0.62	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	E_{AS}	130	mJ
Avalanche current (Note 1)	I_{AR}	2	A
Repetitive Avalanche energy, t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	0.2	mJ



Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55...+150	°C
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Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	1.62	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	120	°C /W

Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current($T_c=25^\circ C$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			1	μA
Zero Gate Voltage Drain Current($T_c=125^\circ C$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			50	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 30V, V_{DS}=0V$			± 100	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.5	3	4.5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=2.5A$		2.2	2.4	Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		300		PF
Output Capacitance	C_{oss}			28		PF
Reverse Transfer Capacitance	C_{rss}			2.3		PF
Total Gate Charge	Q_g	$V_{DS}=480V, I_D=4A,$ $V_{GS}=10V$		6.5	10	nC
Gate-Source Charge	Q_{gs}			1.3		nC
Gate-Drain Charge	Q_{gd}			2.5		nC

Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=2.5A,$ $R_G=20\Omega, V_{GS}=10V$		6		nS
Turn-on Rise Time	t_r			3		nS
Turn-Off Delay Time	$t_{d(off)}$			48	60	nS
Turn-Off Fall Time	t_f			8	15	nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_c=25^\circ C$		4		A
Pulsed Source-drain current(Body Diode)	I_{SDM}			12		A
Forward On Voltage	V_{SD}	$T_j=25^\circ C, I_{SD}=4A, V_{GS}=0V$		1.4		V
Reverse Recovery Time	t_{rr}	$T_j=25^\circ C, I_F=4A, di/dt=100A/\mu s$		150		nS
Reverse Recovery Charge	Q_{rr}			0.85		μC
Peak reverse recovery current	I_{rrm}			11		A

Notes: 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2. $T_j=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$



TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

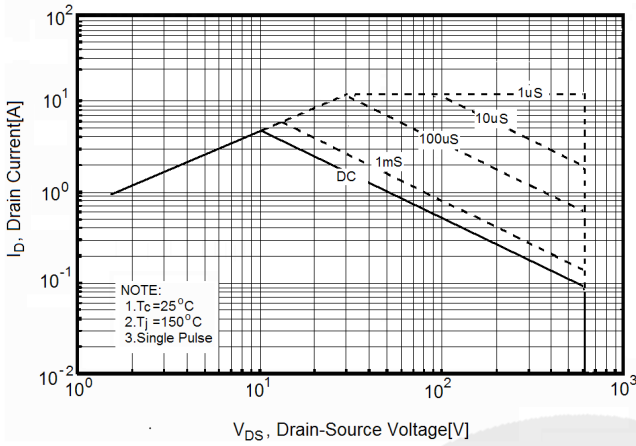


Figure2. Source-Drain Diode Forward Voltage

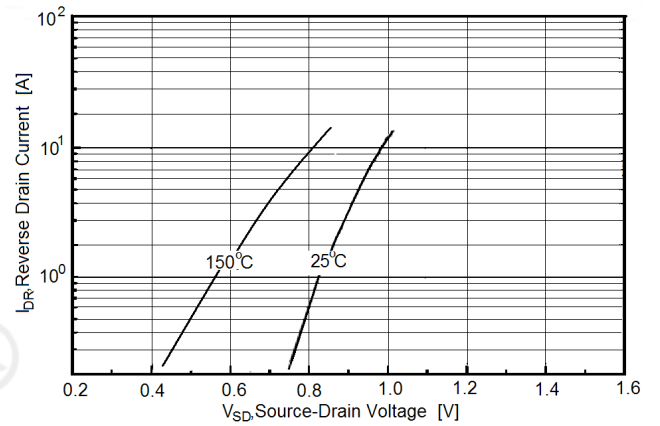


Figure3. Output characteristics

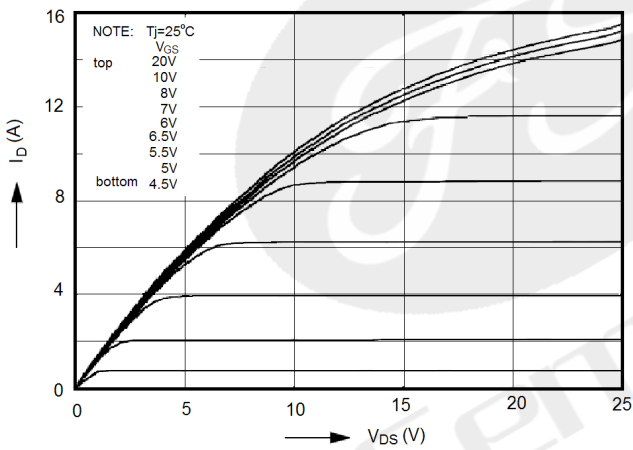


Figure4. Transfer characteristics

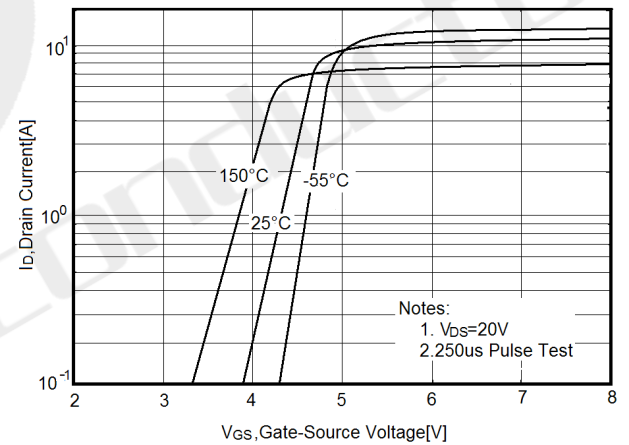


Figure5. Static drain-source on resistance

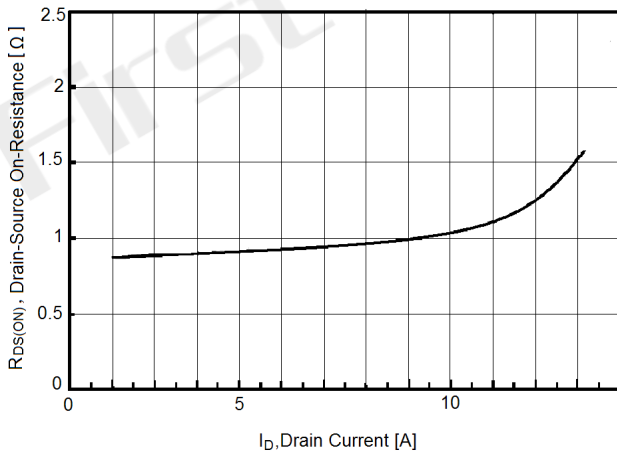


Figure6. $R_{DS(ON)}$ vs Junction Temperature

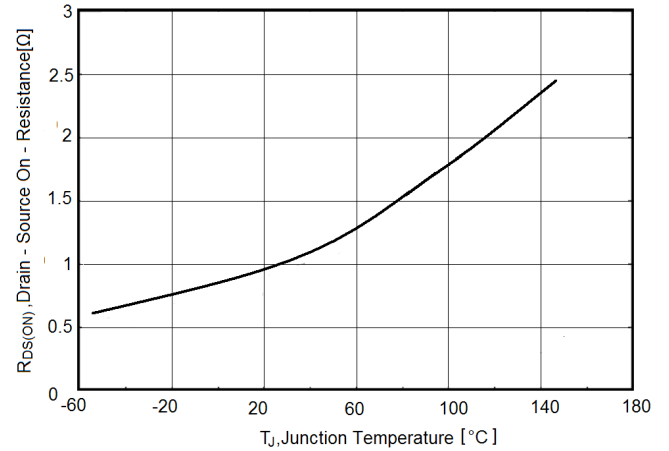




Figure7. BV_{DSS} vs Junction Temperature

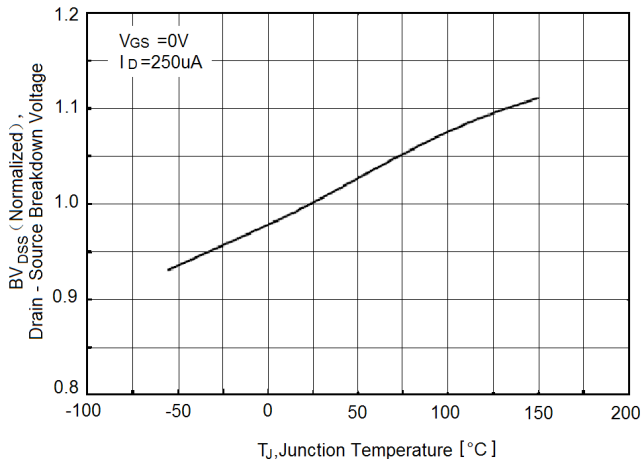


Figure8. Maximum I_D vs Junction Temperature

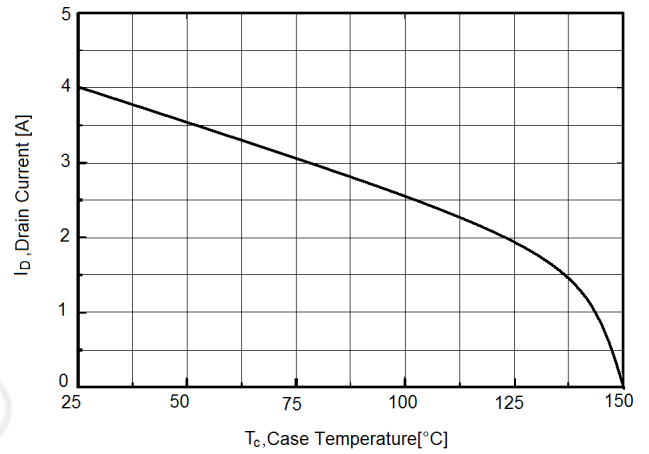


Figure9. Gate charge waveforms

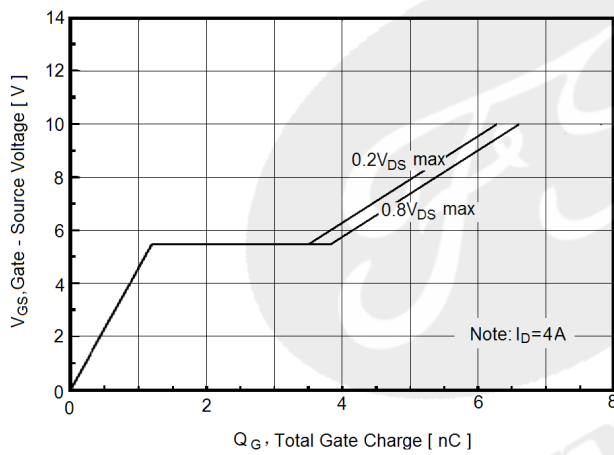


Figure10. Capacitance

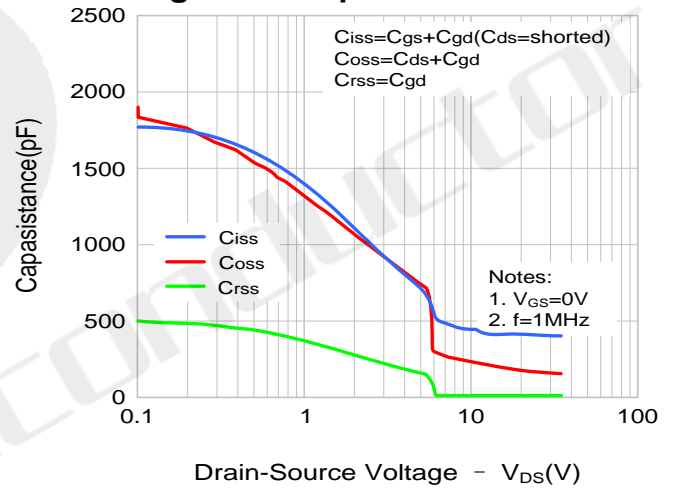
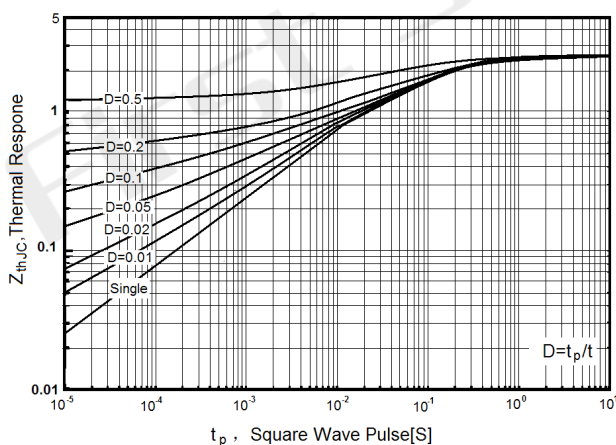
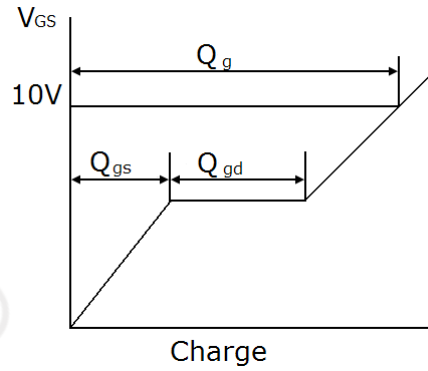
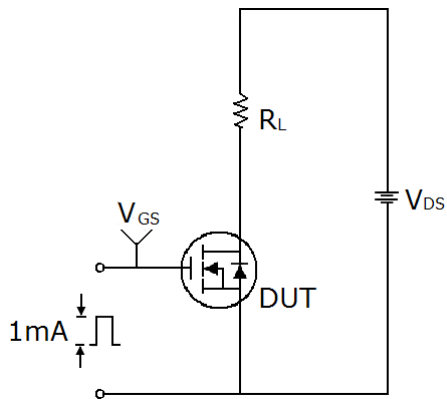


Figure11. Transient Thermal Impedance

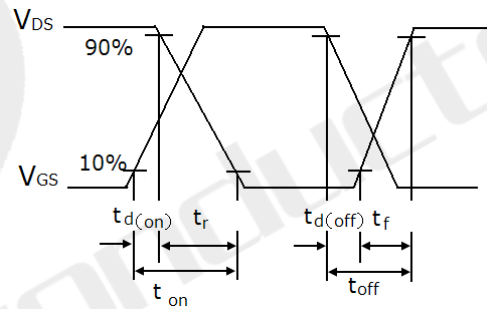
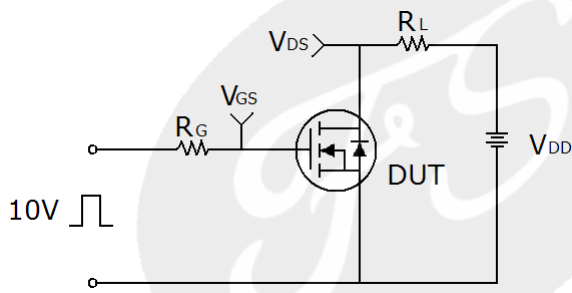


Test circuit

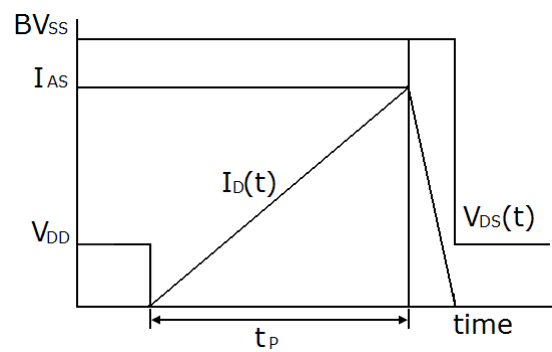
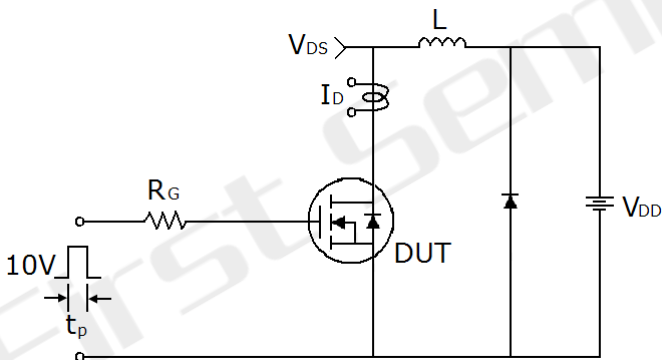
1) Gate charge test circuit & Waveform



2) Switch Time Test Circuit:



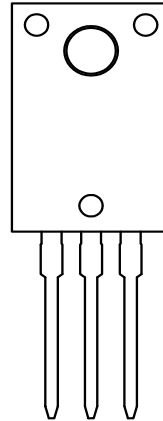
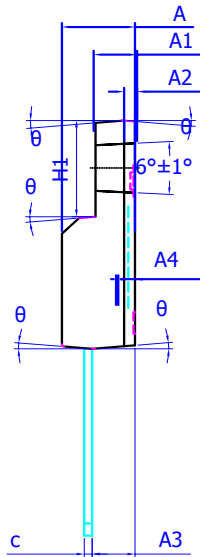
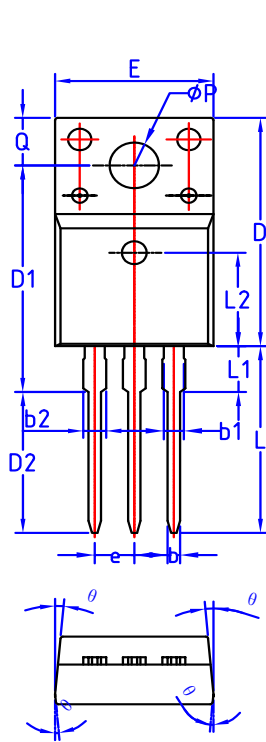
3) Unclamped Inductive Switching Test Circuit & Waveforms





Package Information

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		
phi P	3.08	3.18	3.28
Q	3.20	3.30	3.40
phi 1	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	