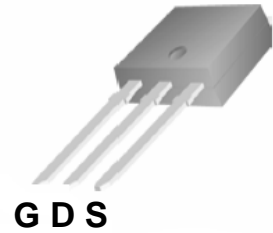




PIN Connection TO-251

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.



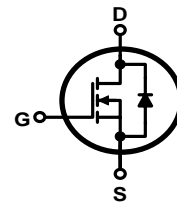
Features

- 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

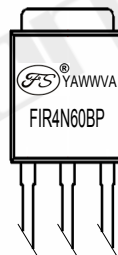
Application

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

Schematic diagram



Marking Diagram



- Y = Year
- A = Assembly Location
- WW = Work Week
- VA = Version & Assembly plant
- FIR4N60BP = Specific Device Code

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	600	V
Gate-Source Voltage ( $V_{DS}=0V$ )	$V_{GS}$	$\pm 30$	V
Continuous Drain Current at $T_c=25^{\circ}C$	$I_{D(DC)}$	4	A
Continuous Drain Current at $T_c=100^{\circ}C$	$I_{D(DC)}$	2.5	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	12	A
Maximum Power Dissipation( $T_c=25^{\circ}C$ )	$P_D$	77	W
Derate above $25^{\circ}C$		0.62	W/ $^{\circ}C$
Single pulse avalanche energy (Note2)	$E_{AS}$	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
--	----------------	------------	----

**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)	$R_{thJA}$	110	°C /W

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current(Tc=25°C)	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			1	μA
Zero Gate Voltage Drain Current(Tc=125°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
<b>Dynamic Characteristics</b>						
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

<b>Switching times</b>						
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
<b>Source- Drain Diode Characteristics</b>						
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		uC
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

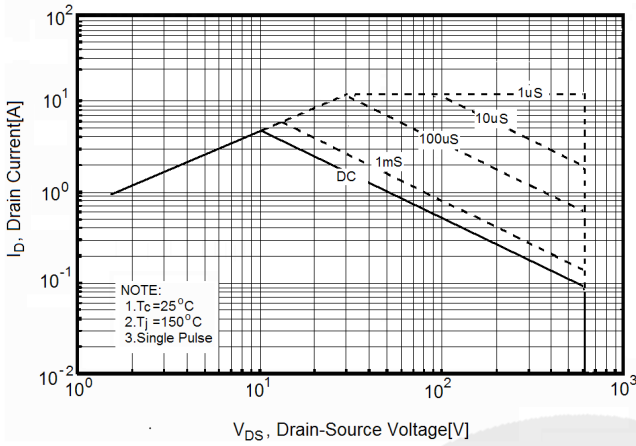


Figure2. Source-Drain Diode Forward Voltage

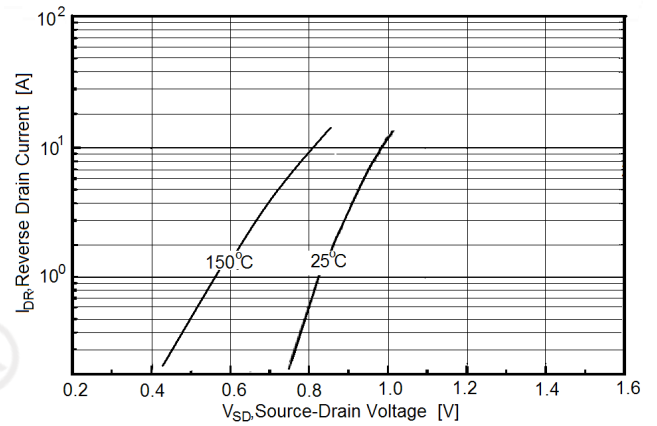


Figure3. Output characteristics

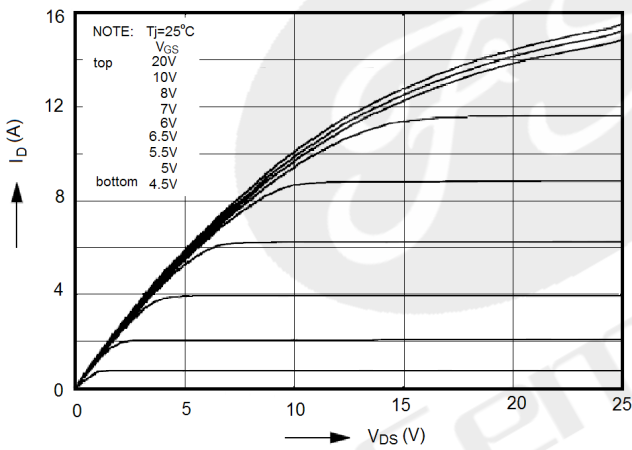


Figure4. Transfer characteristics

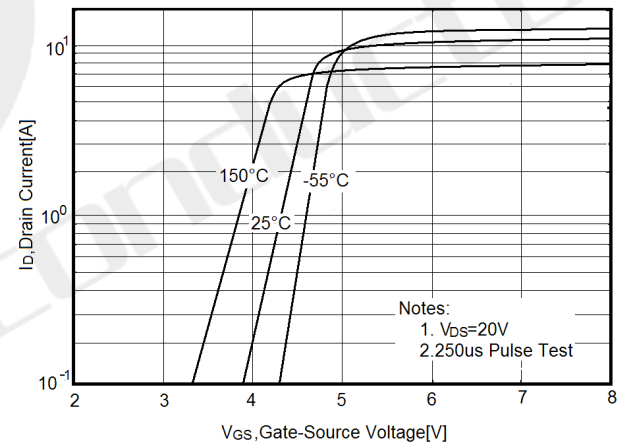


Figure5. Static drain-source on resistance

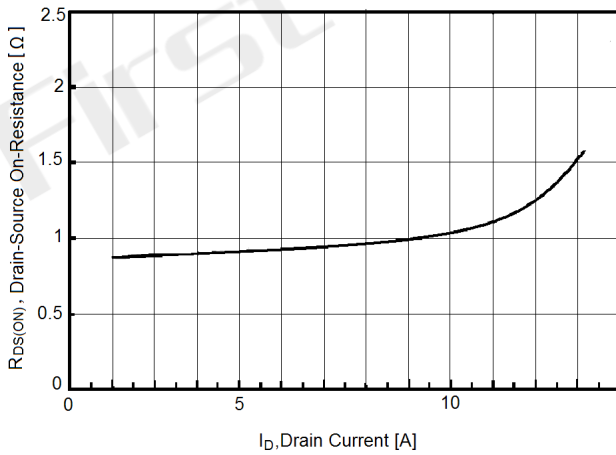


Figure6.  $R_{DS(ON)}$  vs Junction Temperature

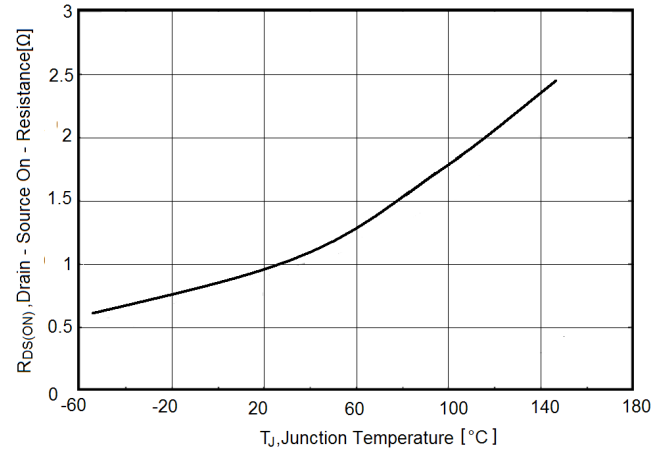




Figure7.  $BV_{DSS}$  vs Junction Temperature

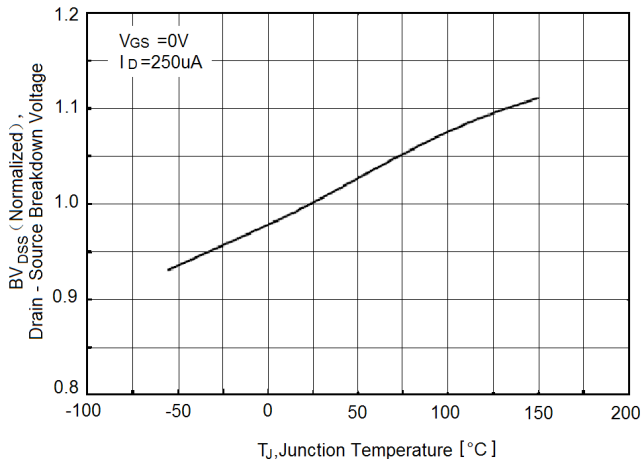


Figure8. Maximum  $I_D$  vs Junction Temperature

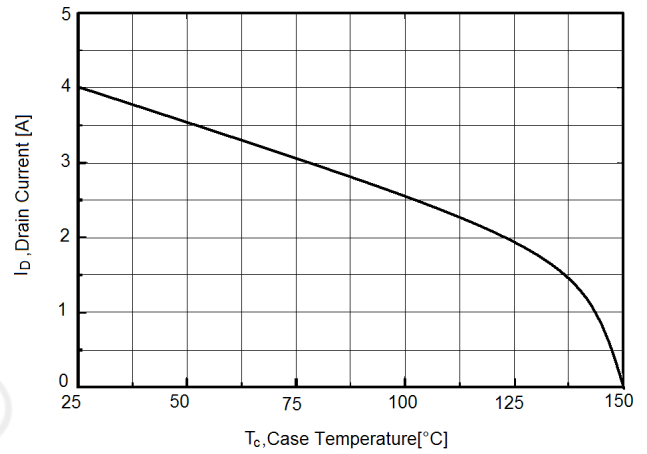


Figure9. Gate charge waveforms

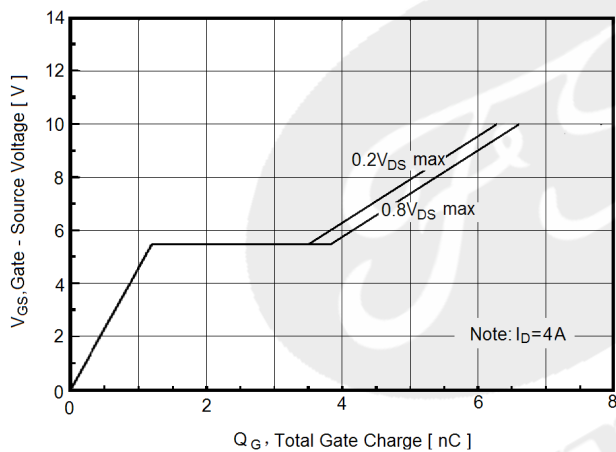


Figure10. Capacitance

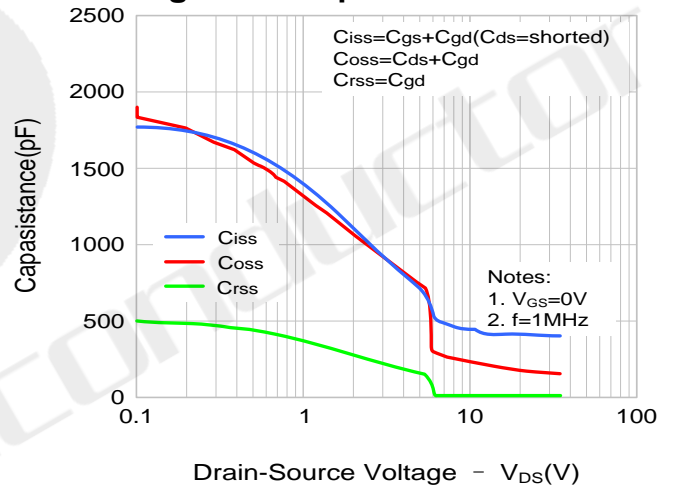
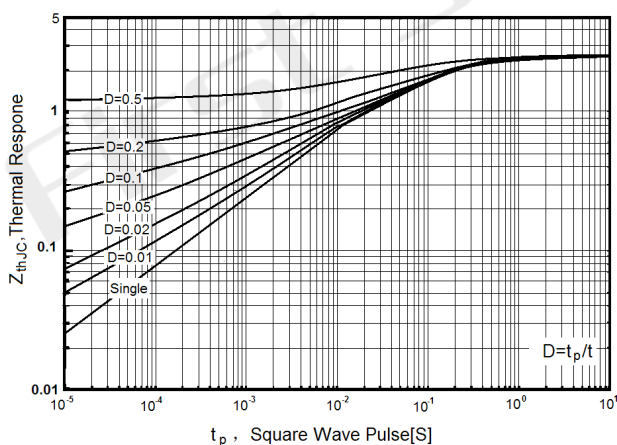
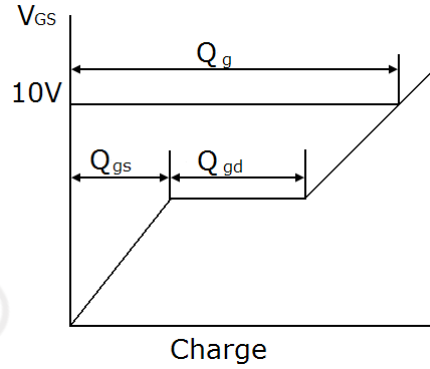
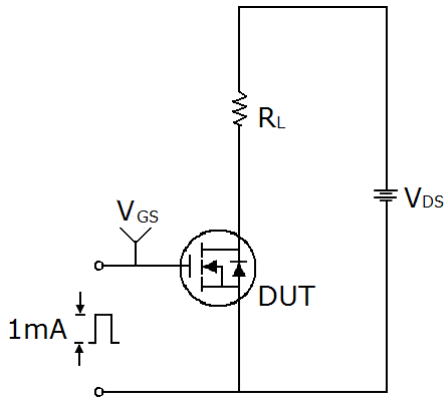


Figure11. Transient Thermal Impedance

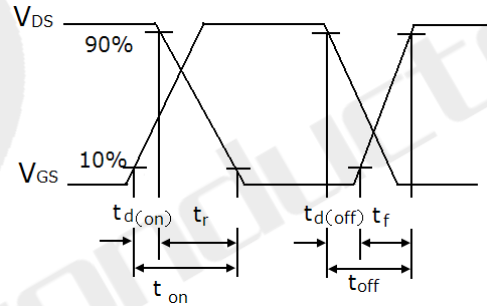
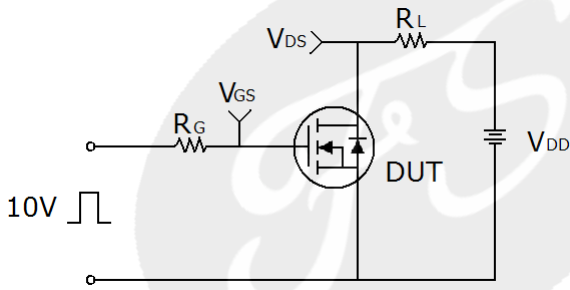


## Test circuit

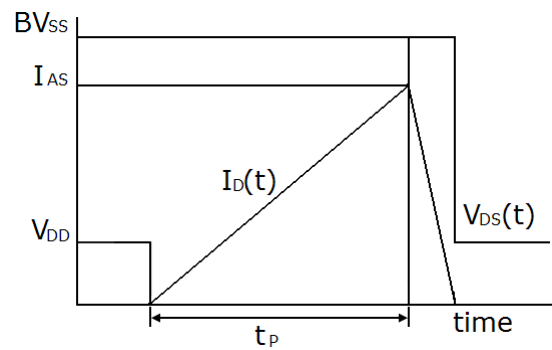
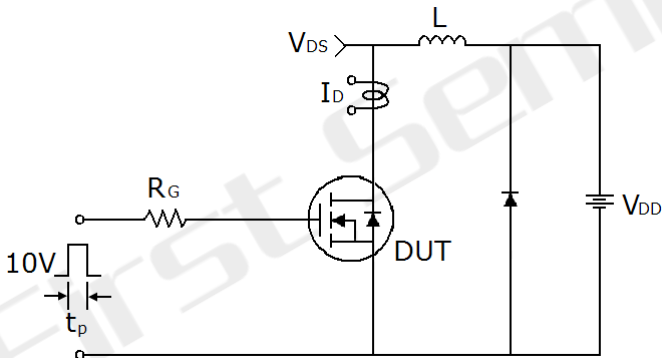
### 1) Gate charge test circuit & Waveform



### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms

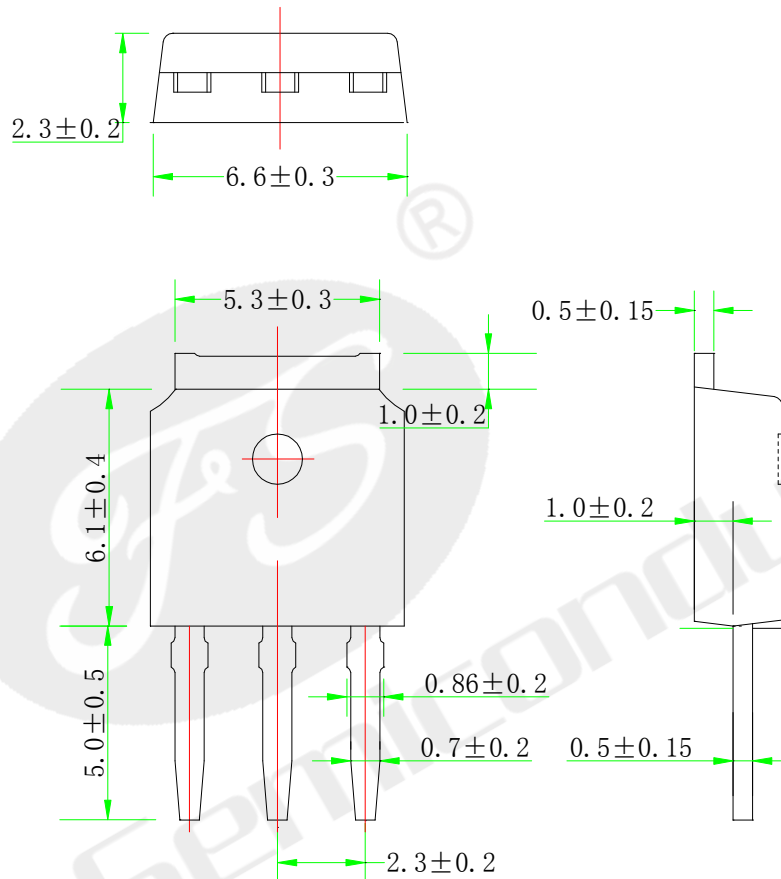




Package Information

TO-251

Units: mm





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	