

# N-Channel Super Junction Power MOSFET III

## 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



Schematic diagram



TO-252

## Application

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

$V_{DS}$	700	V
$R_{DS(ON)TYP}$	680	mΩ
$I_D$	7	A

## Package Marking And Ordering Information

Device	Device Package	Marking
MJ70T680K	TO-252	MJ70T680K

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	700	V
Gate-Source Voltage ( $V_{DS}=0V$ ) ,AC ( $f>1\text{ Hz}$ )	$V_{GS}$	$\pm 30$	V
Continuous Drain Current at $T_c=25^{\circ}C$	$I_D$ (DC)	7	A
Continuous Drain Current at $T_c=100^{\circ}C$	$I_D$ (DC)	4.5	A
Pulsed drain current <sup>(Note 1)</sup>	$I_{DM}$ (pluse)	28	A
Maximum Power Dissipation ( $T_c=25^{\circ}C$ )	$P_D$	60	W
Derate above $25^{\circ}C$	$P_D$	0.48	W/ $^{\circ}C$
Single pulse avalanche energy <sup>(Note 2)</sup>	$E_{AS}$	101	mJ
Avalanche current <sup>(Note 1)</sup>	$I_{AR}$	1.5	A
Repetitive Avalanche energy, $t_{AR}$ limited by $T_{jmax}$ <sup>(Note 1)</sup>	$E_{AR}$	0.28	mJ

Parameter	Symbol	Value	Unit
Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$	$dv/dt$	50	V/ns
Reverse diode $dv/dt$ , $V_{DS} \leq 480\text{ V}$ , $I_{SD} < I_D$	$dv/dt$	15	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	$-55...+150$	$^{\circ}C$

\* limited by maximum junction temperature

Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R <sub>thJC</sub>	2.08	°C/W
Thermal Resistance, Junction-to-Ambient (Maximum)	R <sub>thJA</sub>	62	°C/W

Table 3. Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	700	-	-	V
Zero Gate Voltage Drain Current (Tc=25°C)	I <sub>DSS</sub>	V <sub>DS</sub> =700V,V <sub>GS</sub> =0V	-	-	1	μA
Zero Gate Voltage Drain Current (Tc=125°C)	I <sub>DSS</sub>	V <sub>DS</sub> =700V,V <sub>GS</sub> =0V	-	-	100	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V,V <sub>DS</sub> =0V	-	-	±100	nA
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250μA	3	-	4	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V,I <sub>D</sub> =3.5A	-	680	760	mΩ
Dynamic Characteristics						
Input Capacitance	C <sub>ies</sub>	V <sub>DS</sub> =50V,V <sub>GS</sub> =0V F=1.0MHz	-	435	-	pF
Output Capacitance	C <sub>OSS</sub>		-	28	-	pF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	3.3	-	pF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V,I <sub>D</sub> =7A V <sub>GS</sub> =10V	-	11	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	3.5	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	5	-	nC
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =420V,I <sub>D</sub> =3.5A R <sub>G</sub> =4.7Ω,V <sub>GS</sub> =10V	-	8.5	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	7	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	59	77	nS
Turn-Off Fall Time	t <sub>f</sub>		-	9.5	16	nS
Source- Drain Diode Characteristics						
Source-drain current (Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25°C	-	-	7	A
Pulsed Source-drain current (Body Diode)	I <sub>SDM</sub>		-	-	28	A
Forward On Voltage	V <sub>SD</sub>	T <sub>J</sub> =25°C,I <sub>SD</sub> =7A,V <sub>GS</sub> =0V	-	0.9	1.2	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> =25°C,I <sub>F</sub> =3.5A di/dt=100A/μs	-	210	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>		-	0.85	-	uC
Peak reverse recovery Current	I <sub>rrm</sub>		-	8	-	A

## Notes

- 1.Repetitive Rating: Pulse width limited by maximum junction temperature
2. $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=50\text{V}$ ,  $V_G=10\text{V}$ ,  $R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

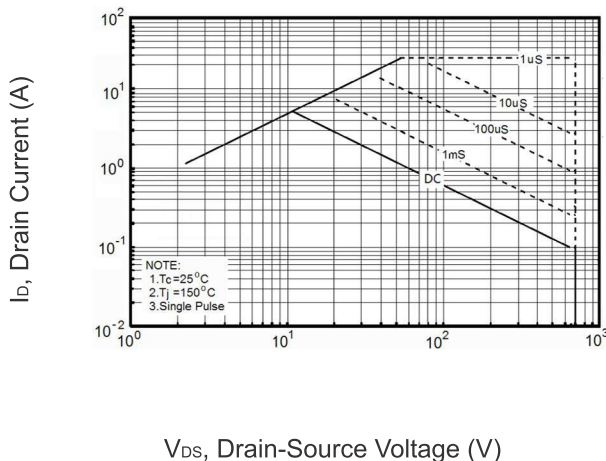


Figure 1 Safe operating area

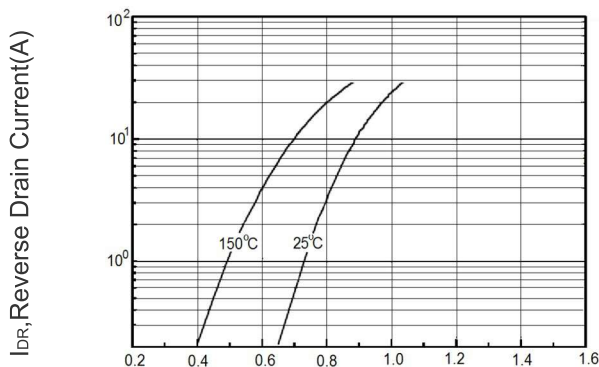


Figure 2 Source-Drain Diode Forward Voltage

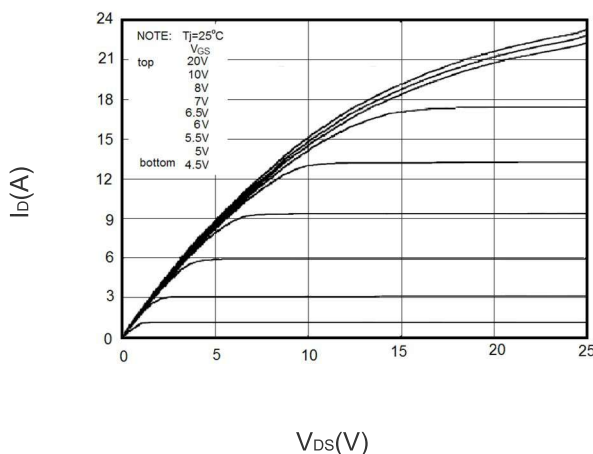


Figure 3 Output characteristics

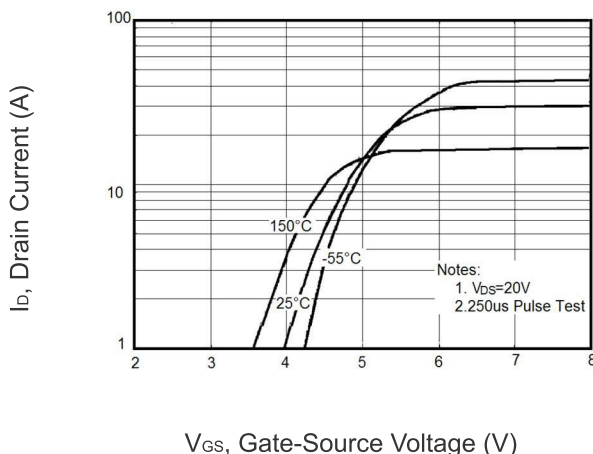


Figure 4 Transfer characteristics

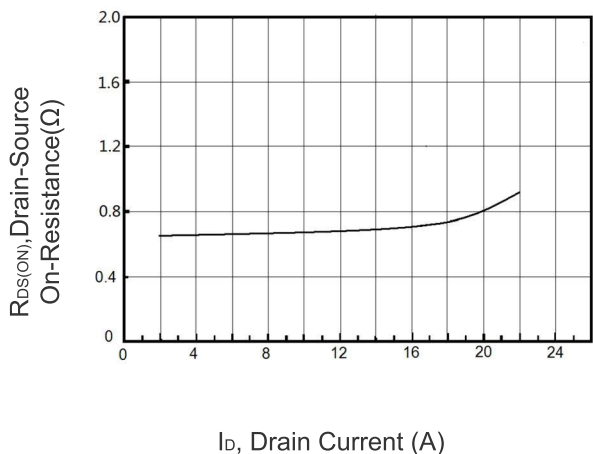


Figure 5 Static drain-source on resistance

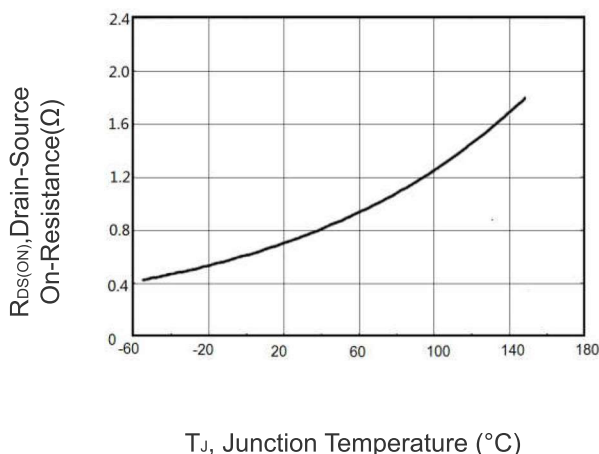


Figure 6  $R_{DS(ON)}$  vs Junction Temperature

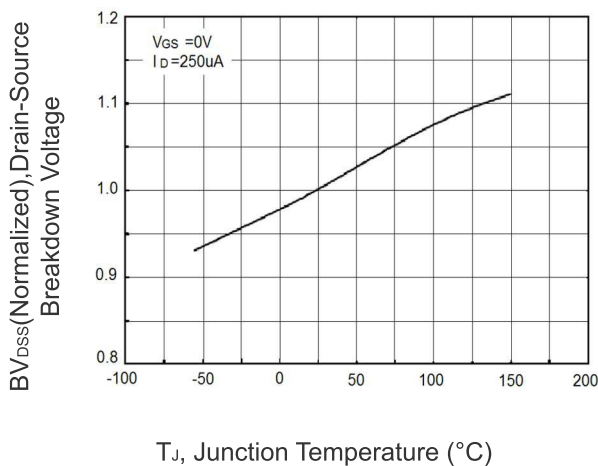


Figure 7  $BV_{DSS}$  vs Junction Temperature

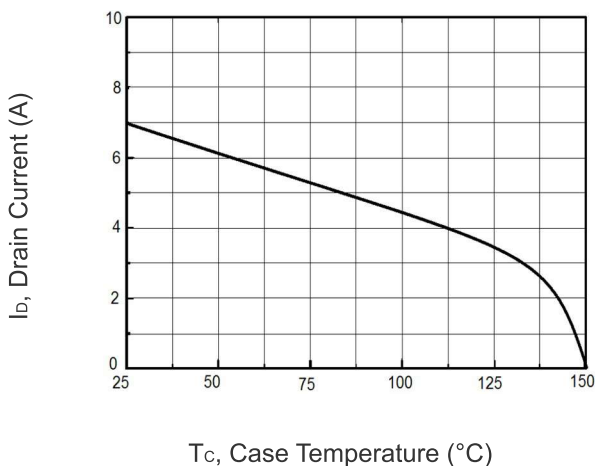


Figure 8 Maximum  $I_D$  vs Junction Temperature

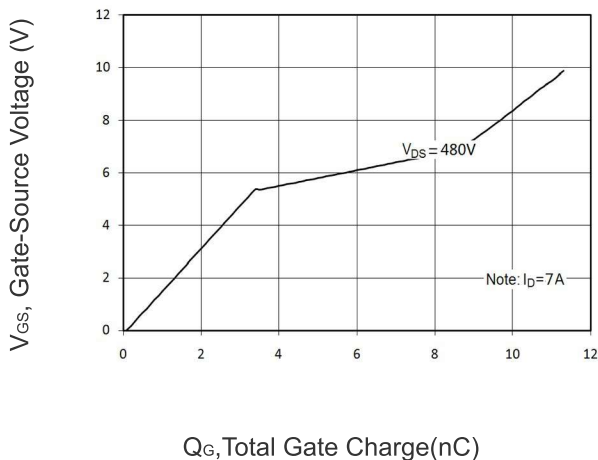


Figure 9 Gate charge waveforms

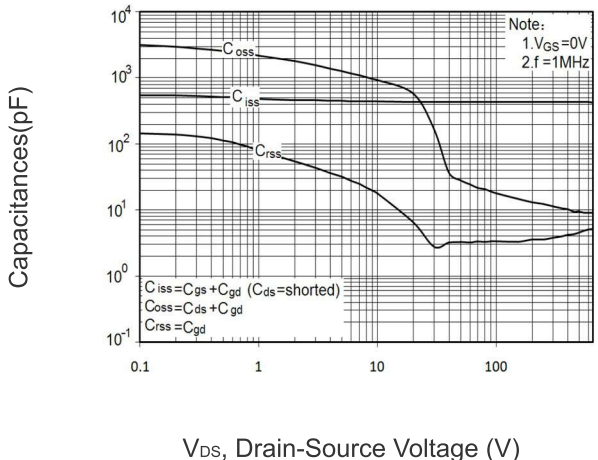


Figure 10 Capacitance

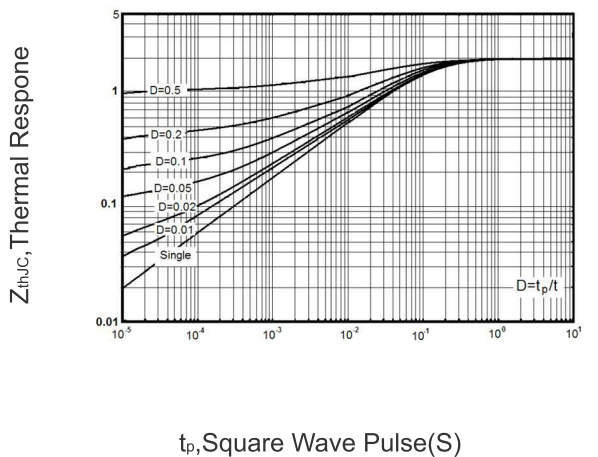
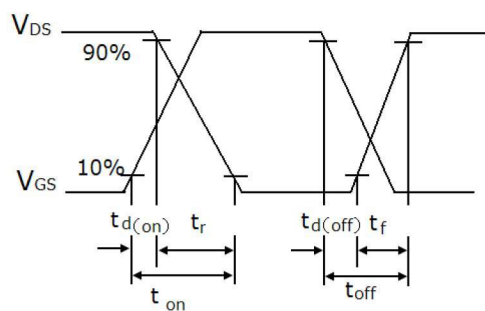


Figure 11 Transient Thermal Impedance

## Test circuit



Gate charge test circuit & Waveform

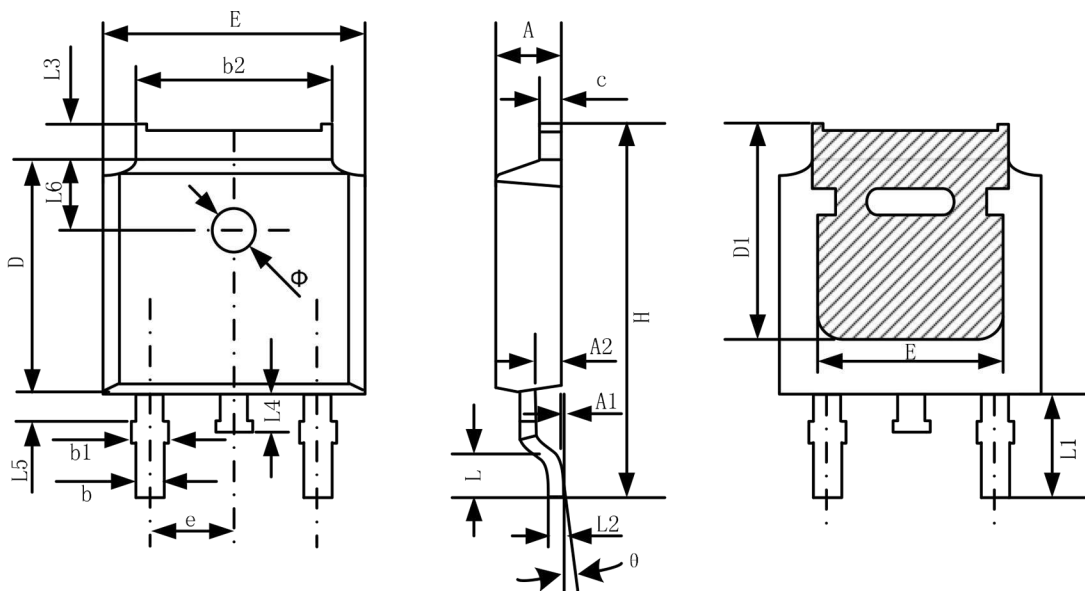


Switch Time Test Circuit



Unclamped Inductive Switching Test Circuit & Waveforms

TO-252-2 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.38	0.087	0.094
A1	0.00	0.10	0.000	0.004
A2	0.90	1.10	0.035	0.043
b	0.72	0.85	0.028	0.033
b1	0.72	0.90	0.028	0.035
b2	5.13	5.46	0.202	0.215
c	0.47	0.60	0.019	0.024
D	6.00	6.20	0.236	0.244
D1	5.25	--	0.207	--
E	6.50	6.70	0.256	0.264
E1	4.70	--	0.185	--
e	2.19	2.39	0.086	0.094
H	9.80	10.40	0.386	0.409
L	1.40	1.70	0.055	0.067
L1	2.90 REF		0.114 REF	
L2	0.508 BSC		0.020 BSC	
L3	0.90	1.25	0.035	0.049
L4	0.60	1.00	0.024	0.039
L5	0.15	0.75	0.006	0.030
L6	1.80 REF		0.071 REF	
$\Phi$	1.20	1.40	0.047	0.055
$\theta$	0°	8°	0°	8°

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