

# N-Channel Super Junction Power MOSFET II

## General Description

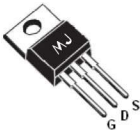
The series of devices use advanced super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

## 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-220

## Application

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

$V_{DS}$	650	V
$R_{DS(ON) MAX}$	180	mΩ
$I_D$	21	A

## Package Marking And Ordering Information

Device	Device Package	Marking
MJ65R180	TO-220	MJ65R180

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

Parameter	Symbol	MJ65R180	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	650	V
Gate-Source Voltage ( $V_{DS}=0V$ )	$V_{GS}$	±30	V
Continuous Drain Current at $T_c=25^{\circ}C$	$I_D$ (DC)	21	A
Continuous Drain Current at $T_c=100^{\circ}C$	$I_D$ (DC)	13.2	A
Pulsed drain current <sup>(Note 1)</sup>	$I_{DM}$ (pluse)	63	A
Maximum Power Dissipation( $T_c=25^{\circ}C$ )	$P_D$	200	W
Derate above 25°C	$P_D$	1.6	W/°C
Single pulse avalanche energy <sup>(Note 2)</sup>	$E_{AS}$	690	mJ
Avalanche current <sup>(Note 1)</sup>	$I_{AR}$	7	A
Repetitive Avalanche energy, $t_{AR}$ limited by $T_{jmax}$ <sup>(Note 1)</sup>	$E_{AR}$	1	mJ

Parameter	Symbol	MJ65R180	Unit
Drain Source voltage slope, $V_{DS} \leq 480 V$	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS} \leq 480 V, I_{SD} < I_D$	dv/dt	15	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+150	°C

\* limited by maximum junction temperature

Table 2. Thermal Characteristic

Parameter	Symbol	MJ65R180	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R <sub>thJC</sub>	0.62	°C/W
Thermal Resistance, Junction-to-Ambient (Maximum)	R <sub>thJA</sub>	62.5	°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	650	-	-	V
Zero Gate Voltage Drain Current (Tc=25°C)	I <sub>DSS</sub>	V <sub>DS</sub> =650V,V <sub>GS</sub> =0V	-	0.05	1	μA
Zero Gate Voltage Drain Current (Tc=125°C)	I <sub>DSS</sub>	V <sub>DS</sub> =650V,V <sub>GS</sub> =0V	-	-	100	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±30V,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	2.5	3	3.5	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V,I <sub>D</sub> =10.5A	-	150	180	mΩ
Dynamic Characteristics						
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =20V,I <sub>D</sub> =10.5A	-	17.5	-	S
Input Capacitance	C <sub>ies</sub>	V <sub>DS</sub> =50V,V <sub>GS</sub> =0V F=1.0MHz	-	1950	-	PF
Output Capacitance	C <sub>oss</sub>		-	150	-	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	5	-	PF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V,I <sub>D</sub> =21A V <sub>GS</sub> =10V	-	45	70	nC
Gate-Source Charge	Q <sub>gs</sub>		-	9	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	18	-	nC
Intrinsic gate resistance	R <sub>G</sub>	f=1 MHz open drain	-	1	-	Ω
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V,I <sub>D</sub> =11A R <sub>G</sub> =4Ω,V <sub>GS</sub> =10V	-	11	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	6	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	61	100	nS
Turn-Off Fall Time	t <sub>f</sub>		-	4.5	12	nS
Source- Drain Diode Characteristics						
Source-drain current (Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25°C	-	-	21	A
Pulsed Source-drain current (Body Diode)	I <sub>SDM</sub>		-	-	63	A
Forward on voltage	V <sub>SD</sub>	T <sub>J</sub> =25°C,I <sub>SD</sub> =21A,V <sub>GS</sub> =0V	-	0.9	1.3	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> =25°C,I <sub>F</sub> =21A di/dt=100A/μs	-	310	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>		-	5	-	uC
Peak Reverse Recovery Current	I <sub>rrm</sub>		-	28	-	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)

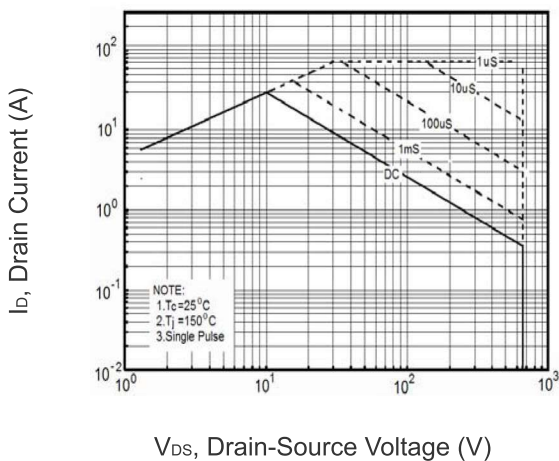


Figure 1 Safe operating area

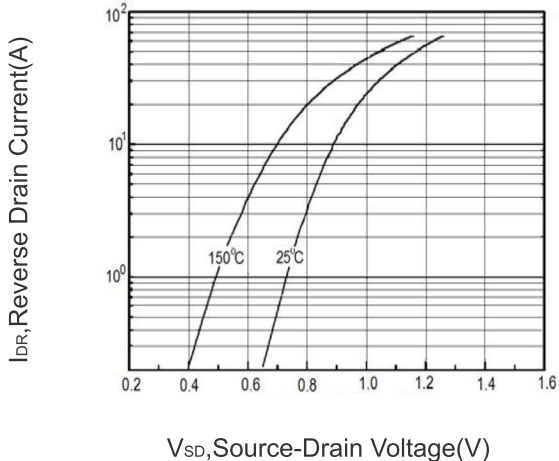


Figure 3 Source-Drain Diode Forward Voltage

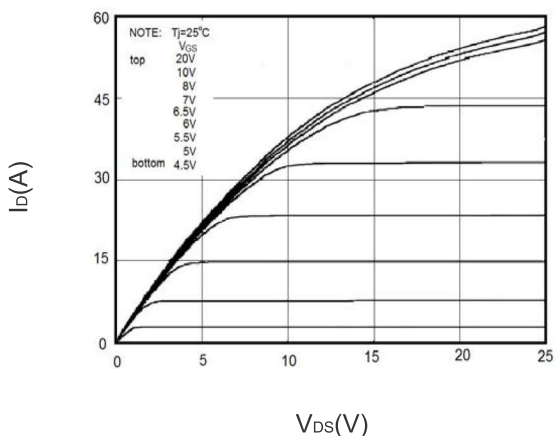


Figure 4 Output characteristics

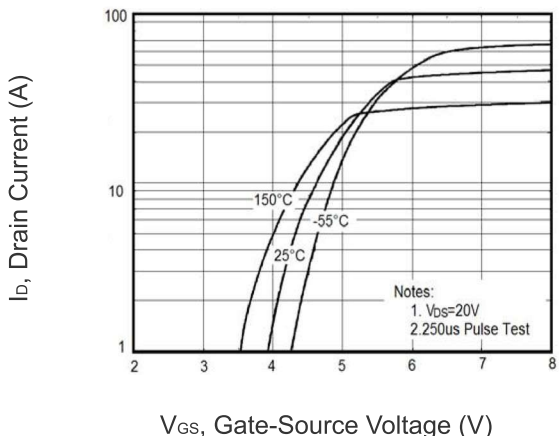


Figure 5 Transfer characteristics

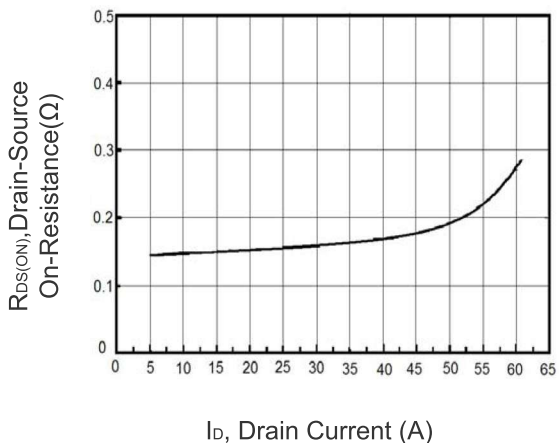


Figure 6 Static drain-source on resistance

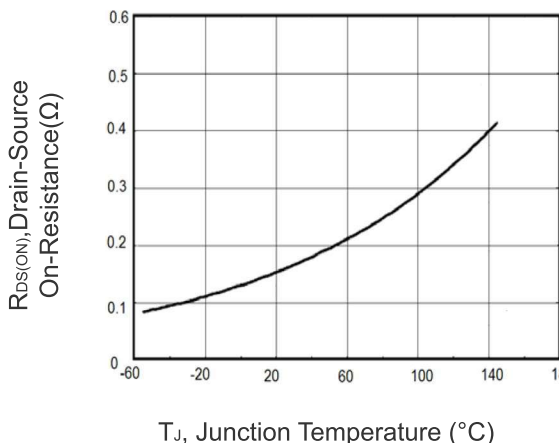


Figure 7  $R_{DS(ON)}$  vs Junction Temperature

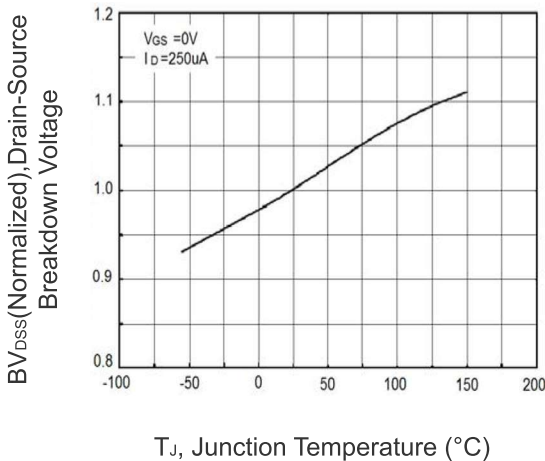


Figure 8  $BV_{DSS}$  vs Junction Temperature

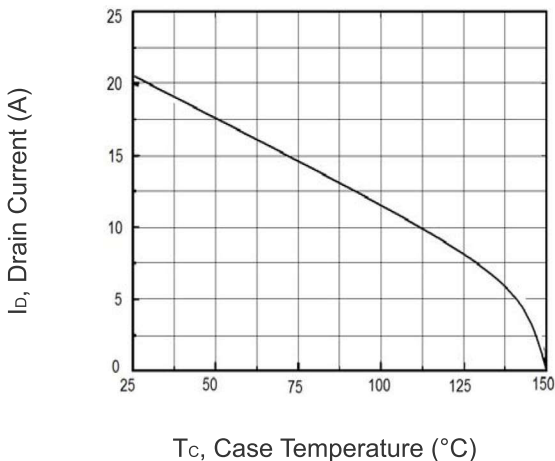


Figure 9 Maximum  $I_D$  vs Junction Temperature

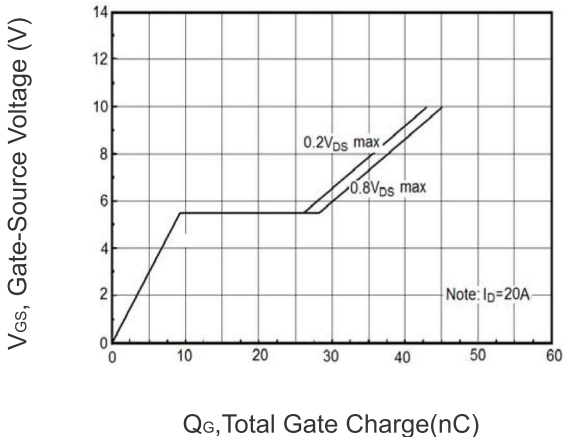


Figure 10 Gate charge waveforms

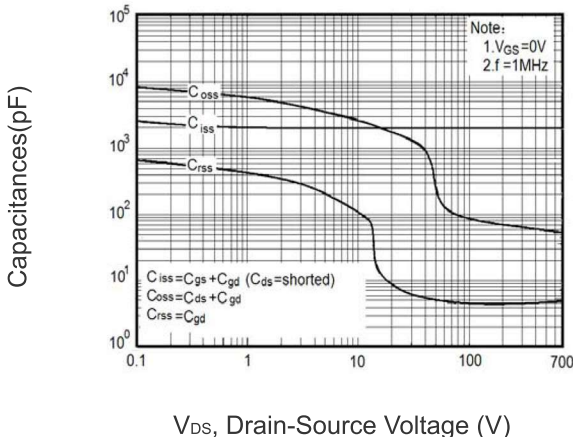


Figure 11 Capacitance

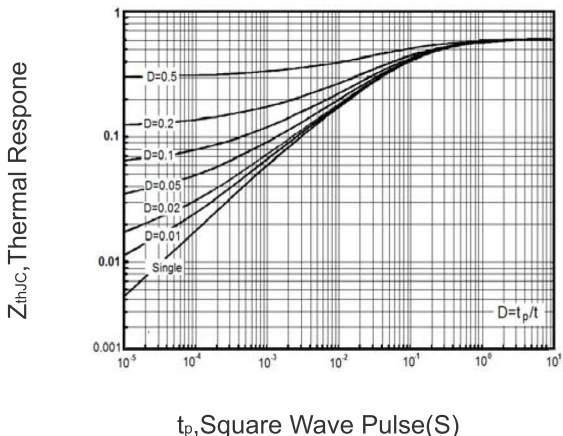
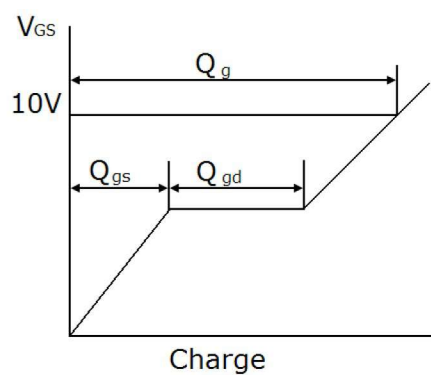
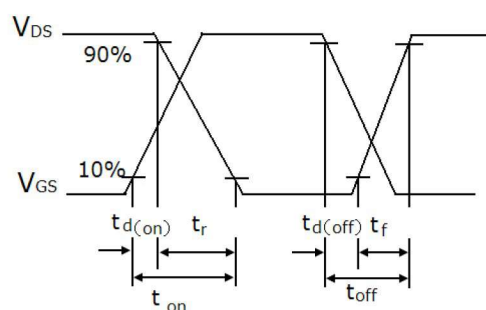
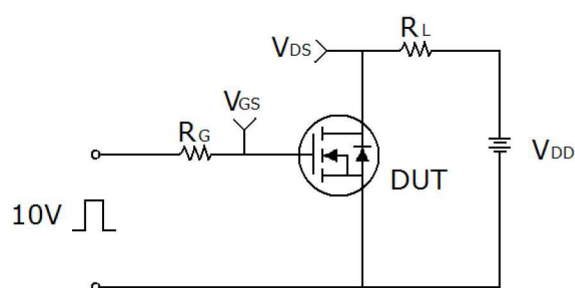


Figure 12 Transient Thermal Impedance

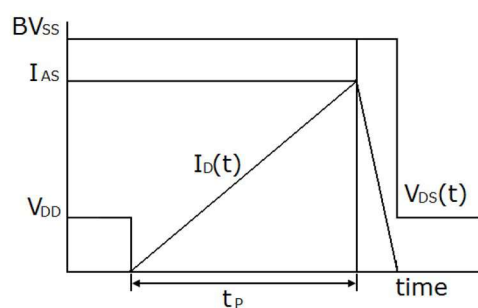
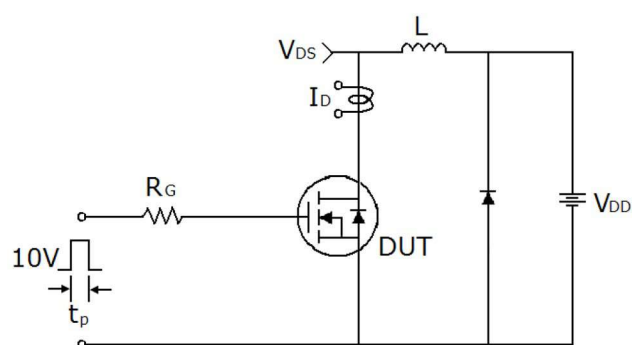
## Test circuit



Gate charge test circuit & Waveform

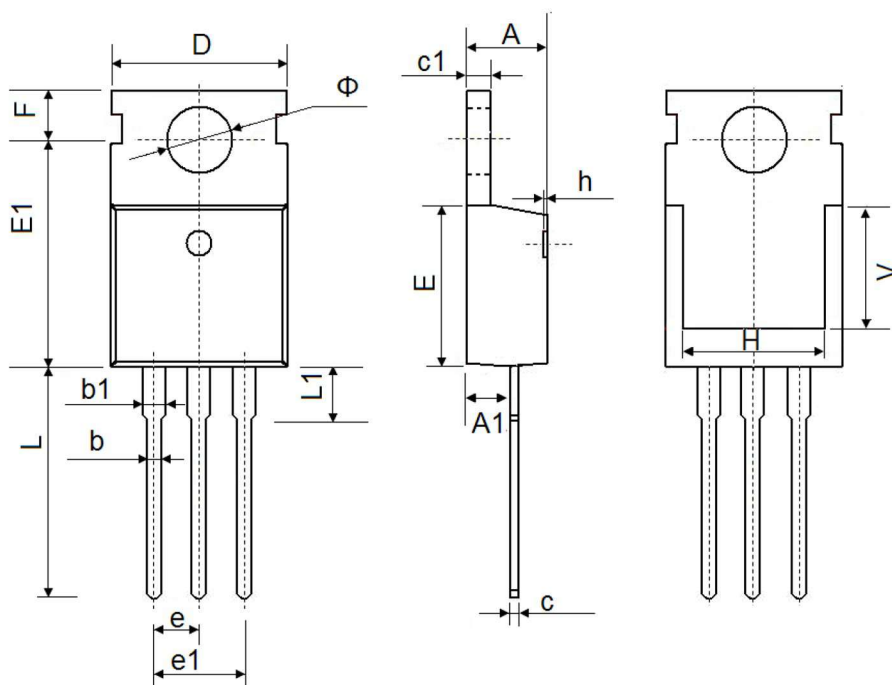


Switch Time Test Circuit



Unclamped Inductive Switching Test Circuit & Waveforms

## TO-220-3L-C Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	7.500 REF.		0.295 REF.	
Φ	3.400	3.800	0.134	0.150

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