

# N-Channel Super Junction Power MOSFET

## General Description

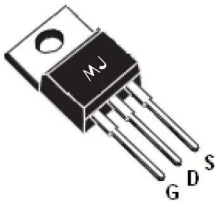
The series of devices use advanced super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

## 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
$R_{DS(ON)MAX}$	1200	m $\Omega$
$I_D$	4	A

## Package Marking And Ordering Information

Device	Device Package	Marking
MJ65R1K2	TO-220	MJ65R1K2

Table 1. Absolute Maximum Ratings (Tc=25℃)

Parameter	Symbol	MJ65R1K2	Unit
Drain-Source Voltage (V <sub>GS</sub> =0V)	V <sub>DS</sub>	650	V
Gate-Source Voltage (V <sub>DS</sub> =0V)	V <sub>GS</sub>	±30	V
Continuous Drain Current at Tc=25℃	I <sub>D</sub> (DC)	4	A
Continuous Drain Current at Tc=100℃	I <sub>D</sub> (DC)	2.5	A
Pulsed drain current <sup>(Note 1)</sup>	I <sub>DM</sub> (pluse)	12	A
Maximum Power Dissipation (Tc=25℃)	P <sub>D</sub>	46	W
Derate above 25℃	P <sub>D</sub>	0.37	W/℃
Single pulse avalanche energy <sup>(Note 2)</sup>	E <sub>AS</sub>	130	mJ
Avalanche current <sup>(Note 1)</sup>	I <sub>AR</sub>	2	A
Repetitive Avalanche energy , t <sub>AR</sub> limited by T <sub>Jmax</sub> <sup>(Note 1)</sup>	E <sub>AR</sub>	0.2	mJ

Parameter	Symbol	MJ65R1K2	Unit
Drain Source voltage slope, V <sub>DS</sub> ≤480 V	dv/dt	50	V/ns
Reverse diode dv/dt, V <sub>DS</sub> ≤480 V, I <sub>SD</sub> <I <sub>D</sub>	dv/dt	15	V/ns
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55...+150	℃

\* limited by maximum junction temperature

Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R <sub>thJC</sub>	2.7	°C/W
Thermal Resistance, Junction-to-Ambient (Maximum)	R <sub>thJA</sub>	62	°C/W

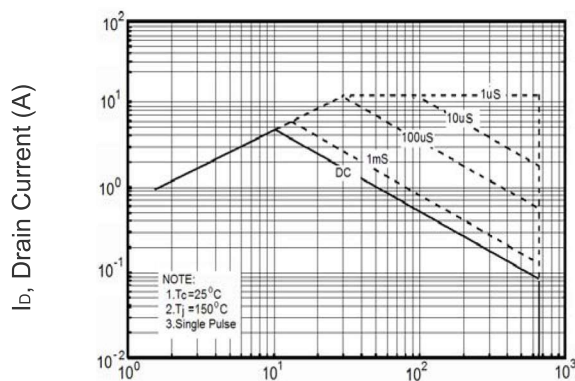
Table 3. Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

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	650	-	-	V
Zero Gate Voltage Drain Current (Tc=25°C)	I <sub>DSS</sub>	V <sub>DS</sub> =650V,V <sub>GS</sub> =0V	-	-	1	μA
Zero Gate Voltage Drain Current (Tc=125°C)	I <sub>DSS</sub>	V <sub>DS</sub> =650V,V <sub>GS</sub> =0V	-	-	50	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> =2.5A	-	1000	1200	mΩ
Dynamic Characteristics						
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =20V,I <sub>D</sub> =2.5A	-	4	-	S
Input Capacitance	C <sub>ies</sub>	V <sub>DS</sub> =50V,V <sub>GS</sub> =0V F=1.0MHz	-	280	-	PF
Output Capacitance	C <sub>oss</sub>		-	26	-	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	2.3	-	PF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V,I <sub>D</sub> =4A V <sub>GS</sub> =10V	-	6.5	10	nC
Gate-Source Charge	Q <sub>gs</sub>		-	1.3	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	2.5	-	nC
Intrinsic gate resistance	R <sub>G</sub>	f=1 MHz open drain	-	2.5	-	Ω
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V,I <sub>D</sub> =2.5A R <sub>G</sub> =20Ω,V <sub>GS</sub> =10V	-	6	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	3	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	48	60	nS
Turn-Off Fall Time	t <sub>f</sub>		-	8	15	nS
Source- Drain Diode Characteristics						
Source-drain current (Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25°C	-	-	4	A
Pulsed Source-drain current (Body Diode)	I <sub>SDM</sub>		-	-	12	A
Forward On Voltage	V <sub>SD</sub>	T <sub>J</sub> =25°C,I <sub>SD</sub> =4A,V <sub>GS</sub> =0V	-	1	1.3	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> =25°C,I <sub>F</sub> =4A di/dt=100A/μs	-	150	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>		-	0.85	-	uC
Peak reverse recovery current	I <sub>rrm</sub>		-	11	-	A

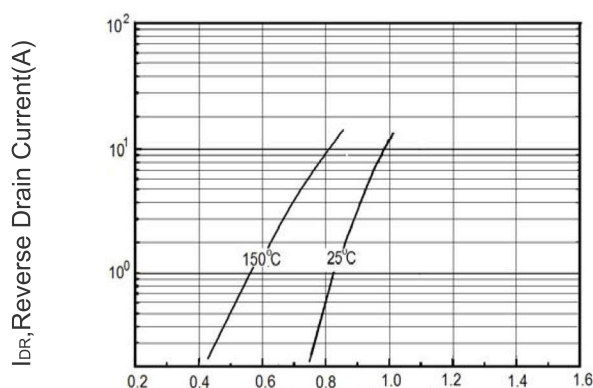
## Notes

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

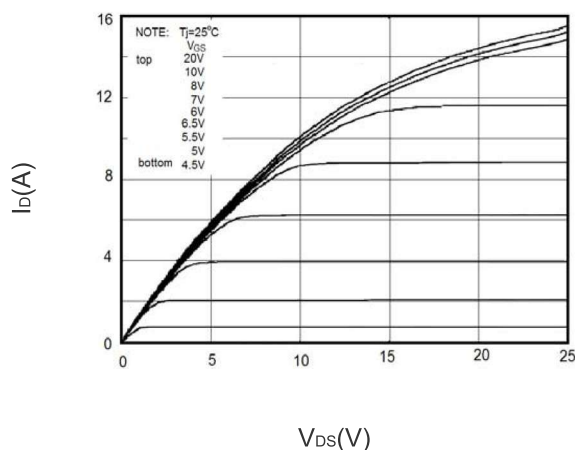
## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)



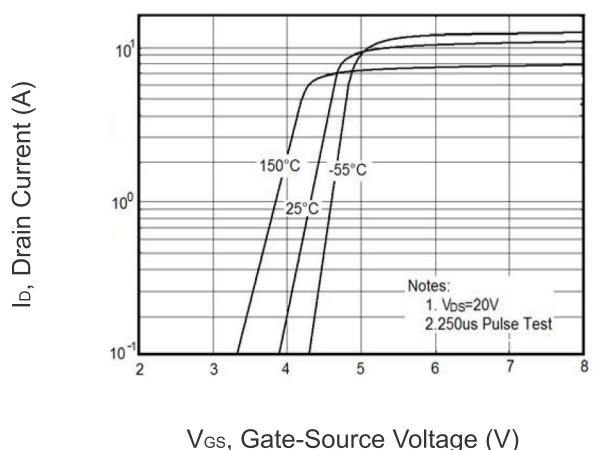
$V_{DS}$ , Drain-Source Voltage (V)  
Figure 1 Safe operating area



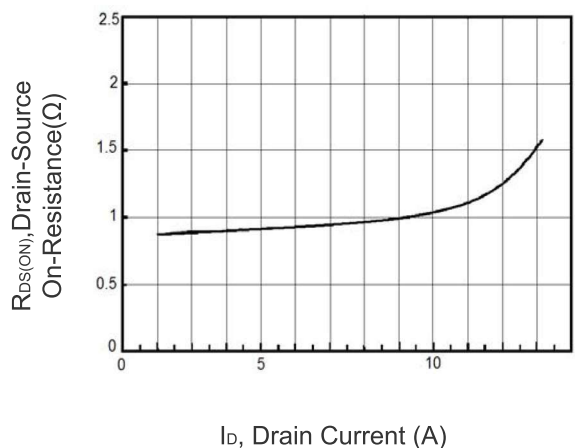
$V_{SD}$ , Source-Drain Voltage(V)  
Figure 2 Source-Drain Diode Forward Voltage



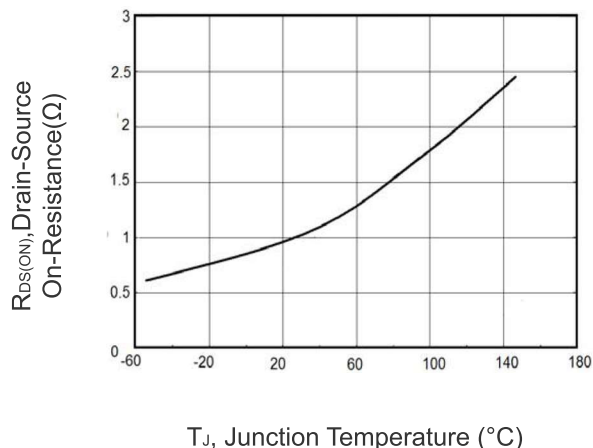
$V_{DS}(V)$   
Figure 3 Output characteristics



$V_{GS}$ , Gate-Source Voltage (V)  
Figure 4 Transfer characteristics



$I_D$ , Drain Current (A)  
Figure 5 Static drain-source on resistance



$T_J$ , Junction Temperature ( $^{\circ}\text{C}$ )  
Figure 6  $R_{DS(ON)}$  vs Junction Temperature

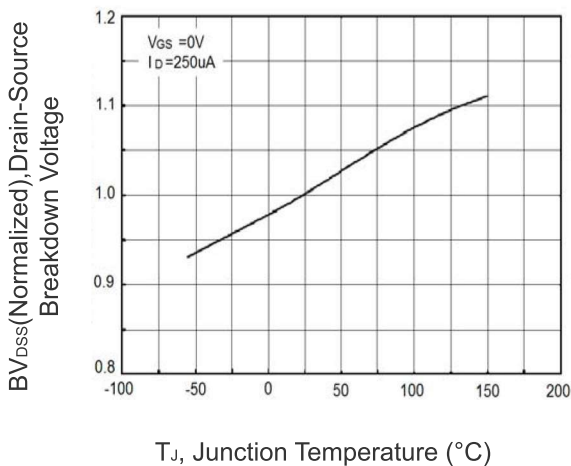


Figure 7  $BV_{DSS}$  vs Junction Temperature

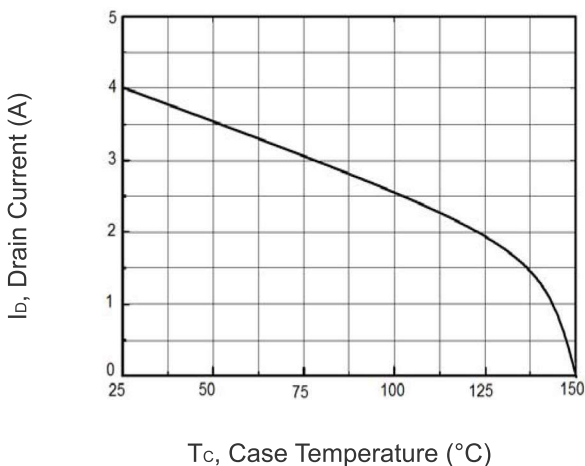


Figure 8 Maximum  $I_D$  vs Junction Temperature

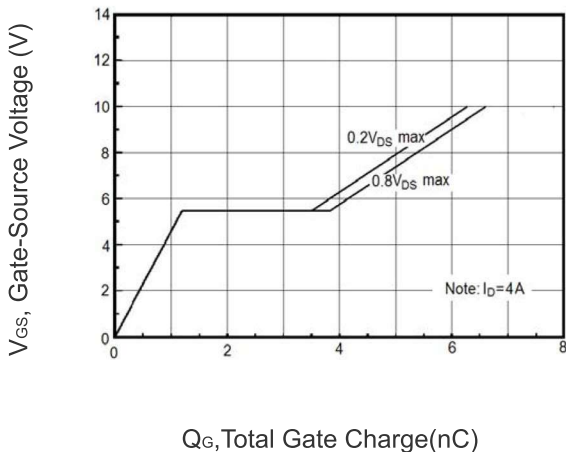


Figure 9 Gate charge waveforms

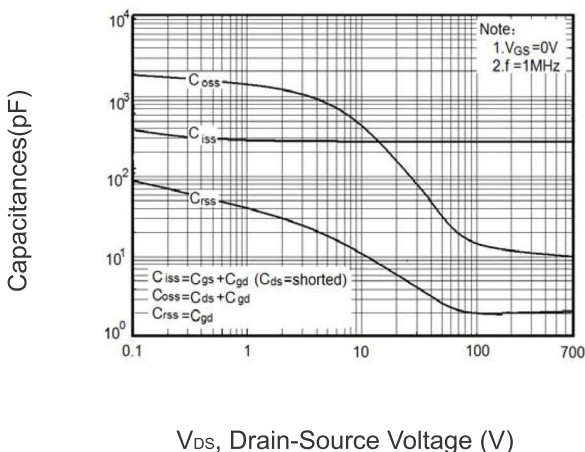


Figure 10 Capacitance

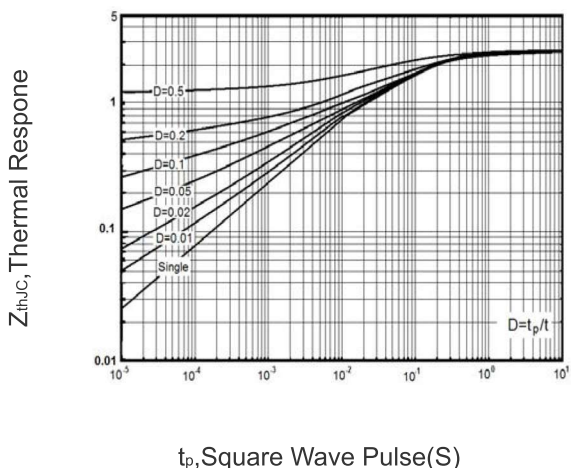
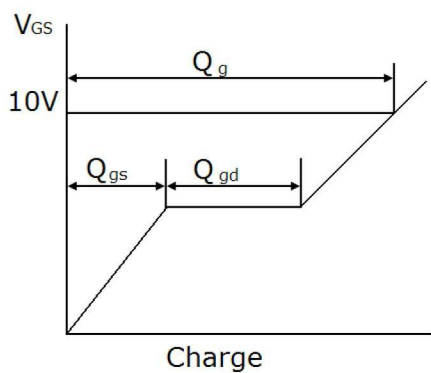
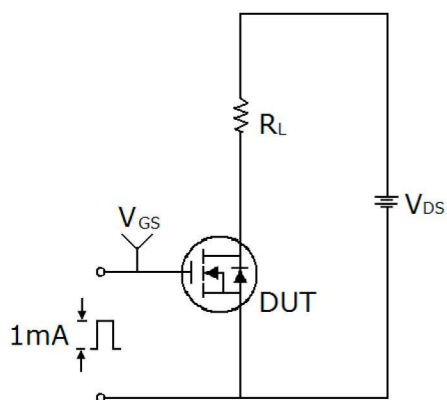
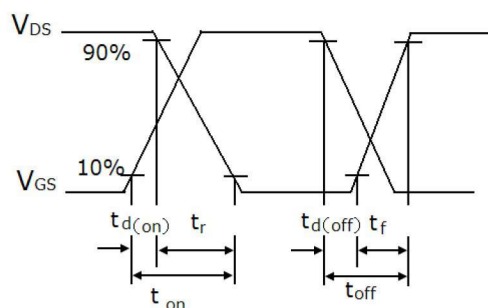


Figure 11 Transient Thermal Impedance

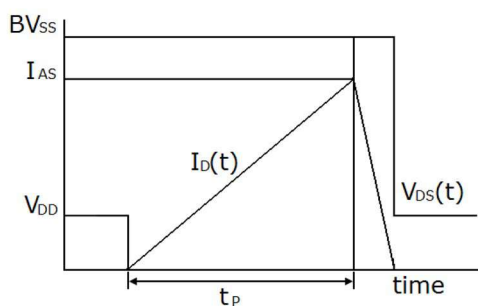
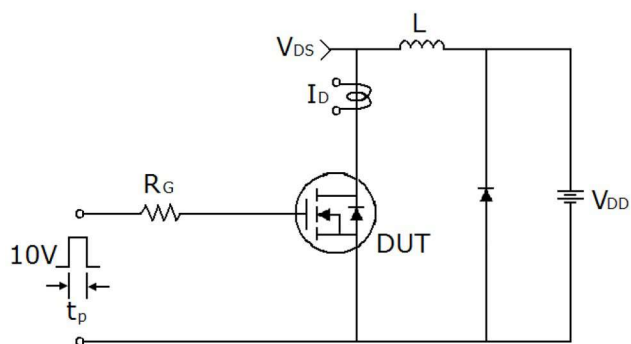
## Test circuit



Gate charge test circuit & Waveform

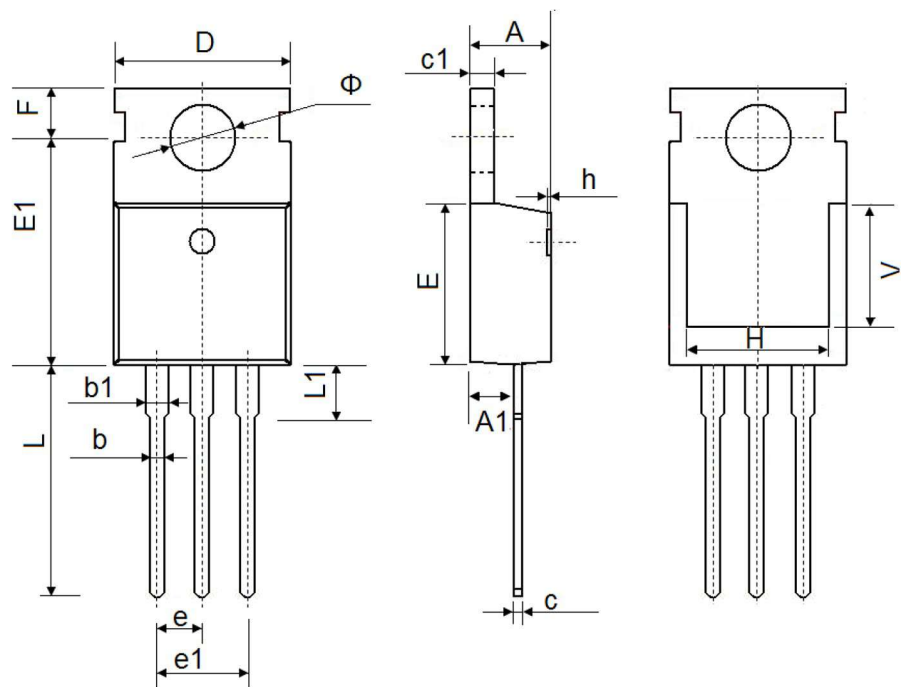


Switch Time Test Circuit



Unclamped Inductive Switching Test Circuit & Waveforms

# TO-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

## Attention:

Any and all MJ power products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your MJ power representative nearest you before using any MJ power products described or contained herein in such applications.

MJ power assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all MJ power products described or contained herein.

Specifications of any and all MJ power products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

MJ power Semiconductor CO.,LTD. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.

In the event that any or all MJ power products(including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of MJ power Semiconductor CO.,LTD.

Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. MJ power believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the MJ power product that you intend to use.

This catalog provides information as of Sep.2010. Specifications and information herein are subject to change without notice.