JJMICROELECTRONICS (China)

Qidong
No. 3000, Qiantang River Road,
Economic Development Zone,
Qidong, Jiangsu

Nantong
No. 6, Jinggangshan Road,
Sutong Science and Technology Industrial Park,
Nantong, Jiangsu

No.1, Jinggangshan Road,
Suxitong Park, Nantong, Jiangsu

Shenzhen
Room 4108, Block B1, Building 12,
Shenzhen Bay Science and
Technology Ecological Park, Shenzhen

Room 1403, Block B, Building 3,
Tianyungu Phase I, Bantian Street,
Longgang District, Shenzhen

Wuxi
H1-7, China Internet of Things
International Innovation Park,
No.6, Jingxian Road, Xinwu District, Wuxi

Shanghai
11 / F, Block A, No. 333, Haiyang 1st Road,
Lingang Special Area Shanghai Pilot Free Trade Zone

Room 1501 & 1502,
AFC Great Hongqiao International,
No.999, Li'an Road, Xinzhuang Town,
Minhang District, Shanghai

Chengdu
No. 2 Heshun Road, Chengdu High-tech Zone,
block 3 unit 2 #09-03, Chengdu

JJMICROELECTRONICS (International)

Singapore
1 One-north Crescent,
Level 7 Singapore 138538

India
Delhi, India

Germany
Stuttgart, Germany

Hungary
Budapest, Hungary

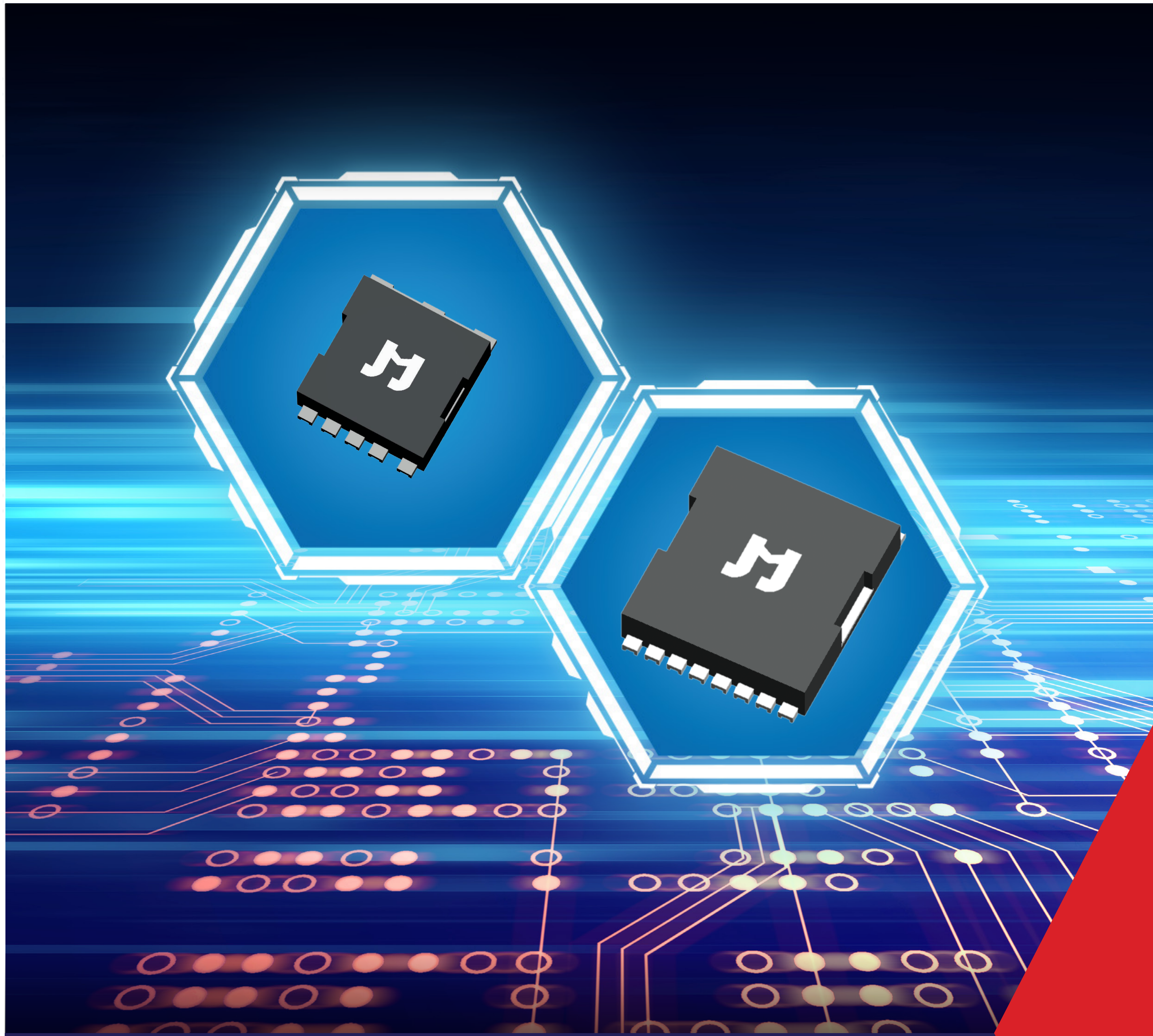
www.jjm.com Aug 2025

Integrity · Pragmatism · Innovation · Win-Win

Product Guide 2025

JJMICROELECTRONICS

MOSFET
Selection Guide



www.jjm.com

Aug 2025 I Stock Code 300623

Company Profile

JJMICROELECTRONICS

is a **leading global IDM for quality power semiconductor devices** with
30 years of manufacturing excellence.

Key Facts

JJM was established in 1995 and became public listed in 2017. Since then, there has been phenomenal growth, with a **CAGR of 31% (2017-2024)**

Founded
In 1995, Current Registered Capital
USD 105 million* (CNY 736 million)

Revenue
USD 406 million* (CNY 2.9 billion)
revenue in 2024

Headquartered
In China,
International HQ in Singapore

Facilities
9 Subsidiaries, 4 Wafer Fabs,
4 A&T sites, 7 R&D teams in 5 R&D centers

Sales Network
Sales representatives & distributors
across the globe

Employees
Over 3,000 employees
of which 15% are in R&D

*7 CNY/USD for 2024

Our Vision is to be an internationally competitive and trusted manufacturer of power semiconductor devices

Our History

1995 - 2000

The Beginning of Pragmatic Innovation

- JJM established in 1995
- Develop, A/T and sales of Thyristors

2001 - 2013

Reform & Innovate for Better Product Performance

- Develop, A/T and sale of power components, protective components, diodes, and power modules

2014 - 2016

Capital Innovation for a Promising Future

- Subsidiary “JieJie Semicon” established for protective components and diodes
- “Power Electronics Eng. Tech Research Center” established

2017

A Promising Future

- JJM listed on Shenzhen Stock Exchange (Stock code 300623)
- MOSFET R&D center established
- Develop, A/T and sales of MOSFETs

2018 - 2019

Expansion Of Innovation

- New A/T @QD
- Subsidiary “JJM Shenzhen” & “JJM Shanghai” established

2020

Technology & Quality

- Lab is CNAS accredited
- Subsidiaries “Jiangsu JieJie Semicon”, “JJM Wuxi”, “JJM Nantong”, and “Jiangsu JieJie Semicon Tech Research” established

2021 - 2022

Global Strategic Framework

- Subsidiary “Jiangsu Yixi Tech” established
- Automotive grade A/T kicked off
- GSM International HQ established in SG
- MP started in our Nantong new 8” fab

2023

Expansion of Global Network & Innovation

- GSM International sales established in India and Germany
- Mass production of 6 inch wafer fab @Nantong
- Develop, A/T & Sales of IGBTs

2024

Strengthening Innovation

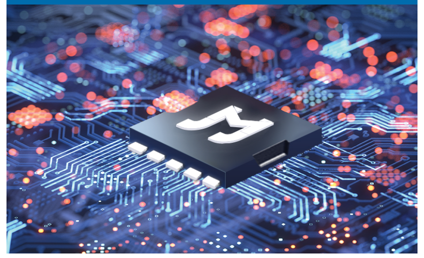
- Subsidiary “JieJie Microelectronics (Chengdu)” established for opto-coupler R&D

3 Main Pillars for Success

In creating **values for you**, we stand by our pillars of technological innovation, superior quality and competitive agility as keys to customer success and our continued growth to create value for our customers, shareholders, employees and community.

Technological Innovation

Superior Quality



Competitive Agility

Global Network & Manufacturing Facilities

JJM Sales Offices (10) **JJM Manufacturing Sites (4)** **Distribution Partners** AMERICAS, EUROPE, ASIA PACIFIC

Solutions for Industry

JJM products are designed and developed to fulfil a **diverse array of application requirements across various industries.**

Our innovative technologies and commitment to excellence enable faster market entry and improved cost efficiency for our customers.

Automotive

- Clean Energy
- Electrification
- Autonomous Driving

Industrial

- Sustainable Energy
- Industry 4.0
- Automation

Consumer

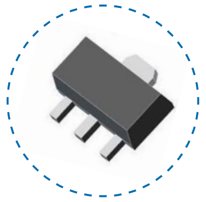
- Energy Efficiency
- Digitalization
- Connectivity IoT

Communication

- Mobility
- Cloud Computing
- Artificial Intelligence

Contents

Through-hole Packages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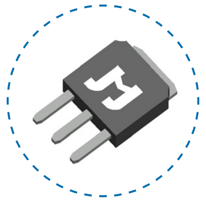
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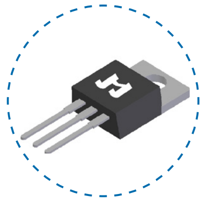
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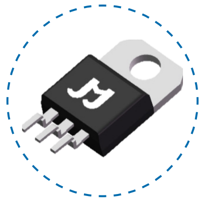
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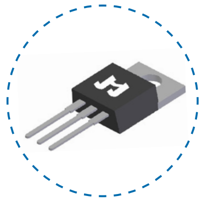
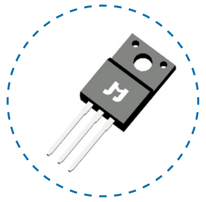

TO-220C-3L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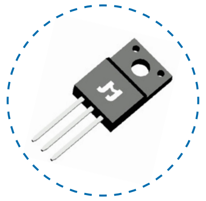
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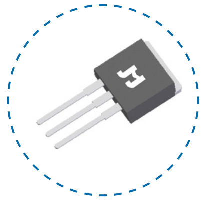
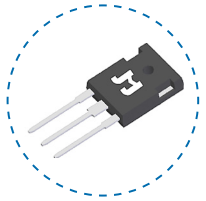

TO-262-3L


TO-247-3L

Surface-Mount Packages


DFN1006-3L


DFN2020-6L


DFN3333-8L


DFN3030-8L


DFN5060-8L

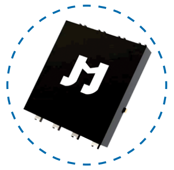

DFN8080-4L


PDFN3x3-8L

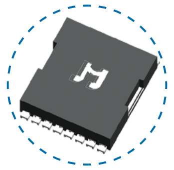

PDFN3x3-8L-D


PDFN5x6-8L

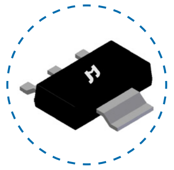

PDFN5x6-8L-D


PDFN5x6-8L-HW


PowerJE® 7x8
sTOLL-comp.


PowerJE® 10x12
TOLL-comp.


SOT-23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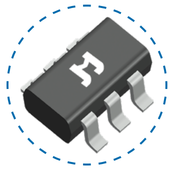
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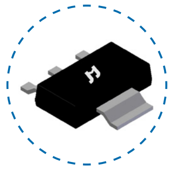
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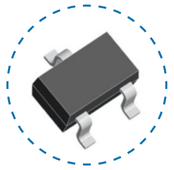
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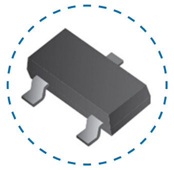
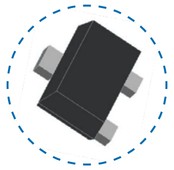
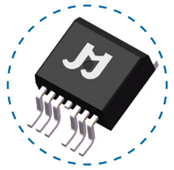
SOT-363-3L


SOT-523-3L


SOT-723-3L


TO-252-3L


TO-263-3L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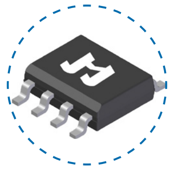
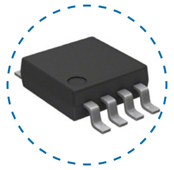

SOP-8L


TSSOP-8

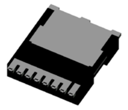
Packaging Advantages

Advanced Packaging

TO-263-3L

Packaging Area	Height	Max Current
150mm²	4.4mm	195A

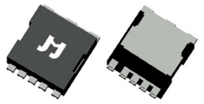
20% reduction in area
45% reduction in height



PowerJE® 10x12

Packaging Area	Height	Max Current
120mm²	2.3mm	**360A**

63% reduction in area
45% reduction in height



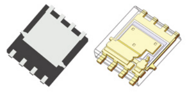
PowerJE® 7x8

Packaging Area	Height	Max Current
56mm²	2.3mm	**260A**

TO-252-3L

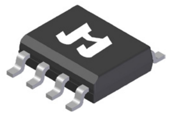
Packaging Area	Height	Max Current
60mm²	2.3mm	100A

48% reduction in area
55% reduction in height



PDFN5x6-8L

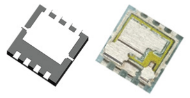
Packaging Area	Height	Max Current
32mm²	1.0mm	**100A**



SOP-8L

Packaging Area	Height	Max Current
30mm²	1.75mm	25A

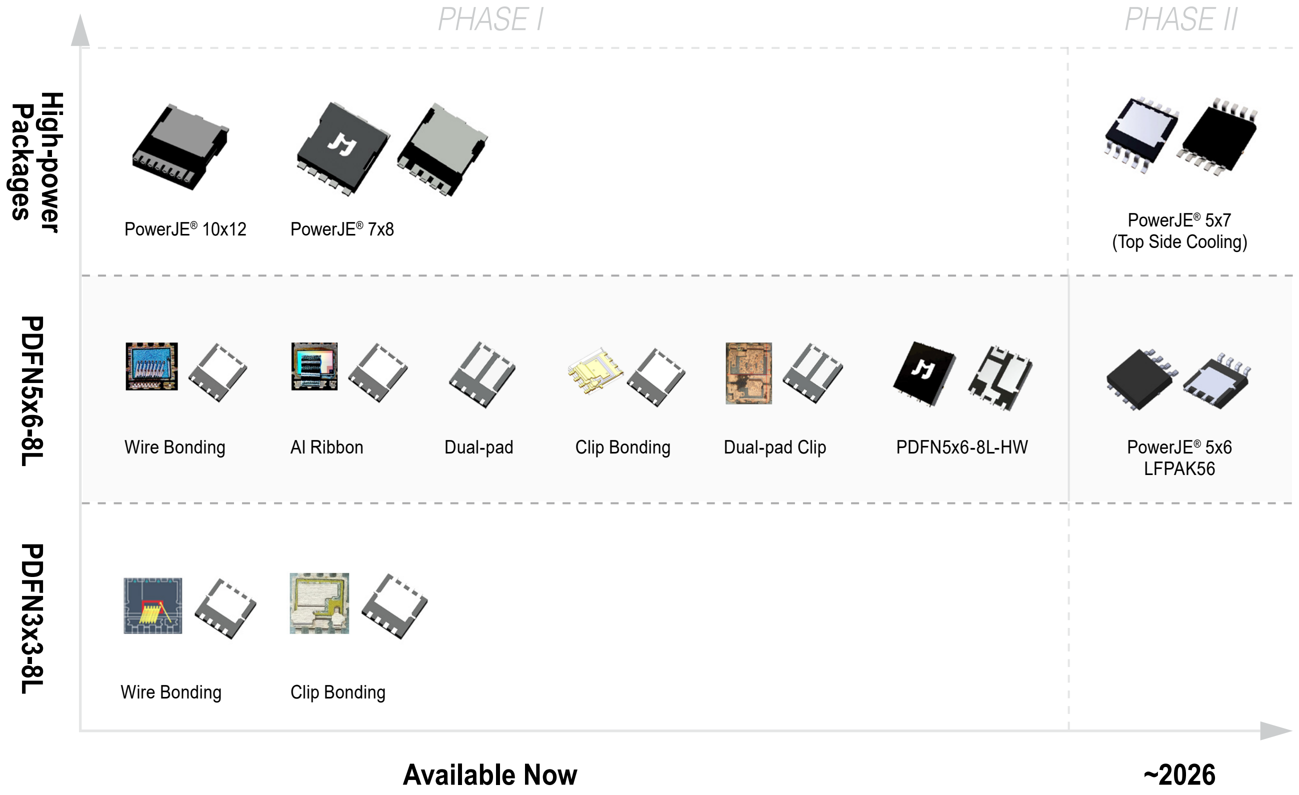
64% reduction in area
55% reduction in height



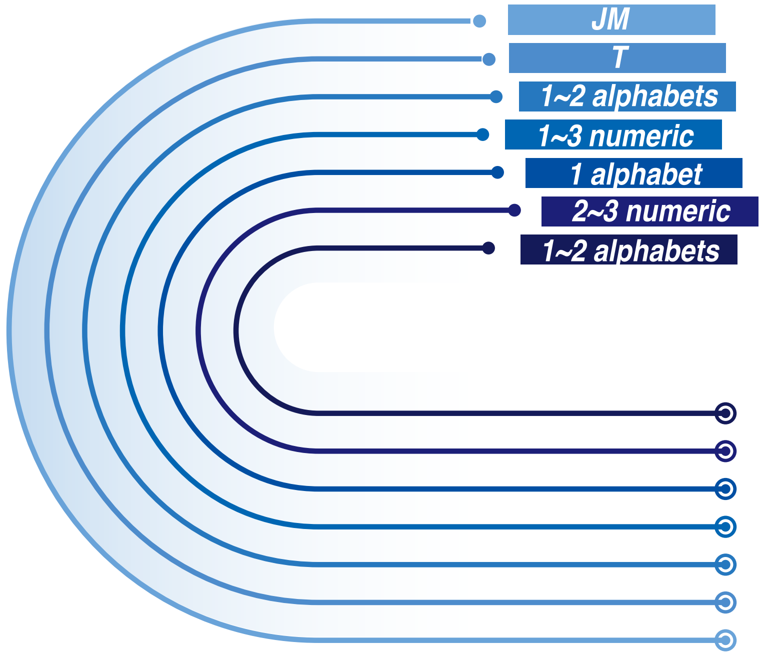
PDFN3x3-8L

Packaging Area	Height	Max Current
10.8mm²	1.0mm	195A

Roadmap for Industrial and Automotive Packages



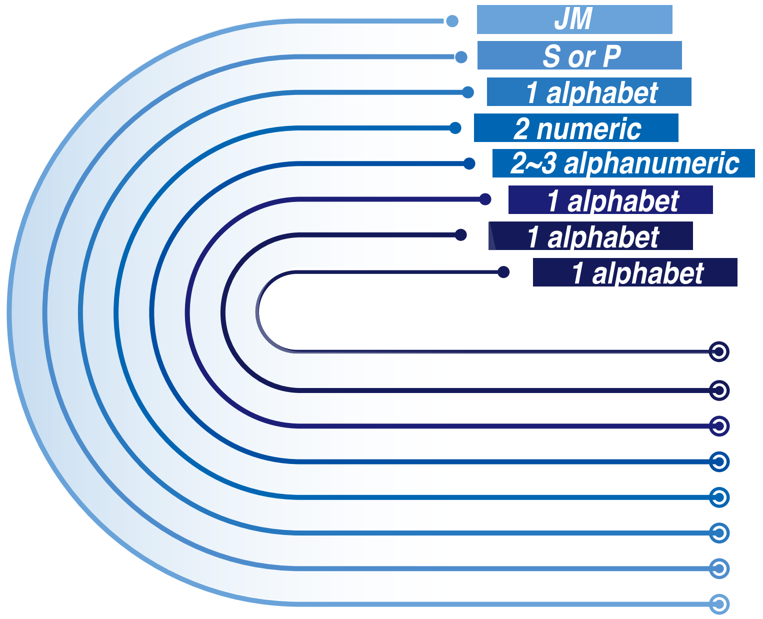
Nomenclature of JMT-series N-ch and P-ch Trench LV/MV MOSFETs



6mΩ: 6*10 → 060
60mΩ: 60*10 → 600
600mΩ: 600*10 → 60*100 → 60D
600mΩ: 6,000*10 → 60*1,000 → 60EV

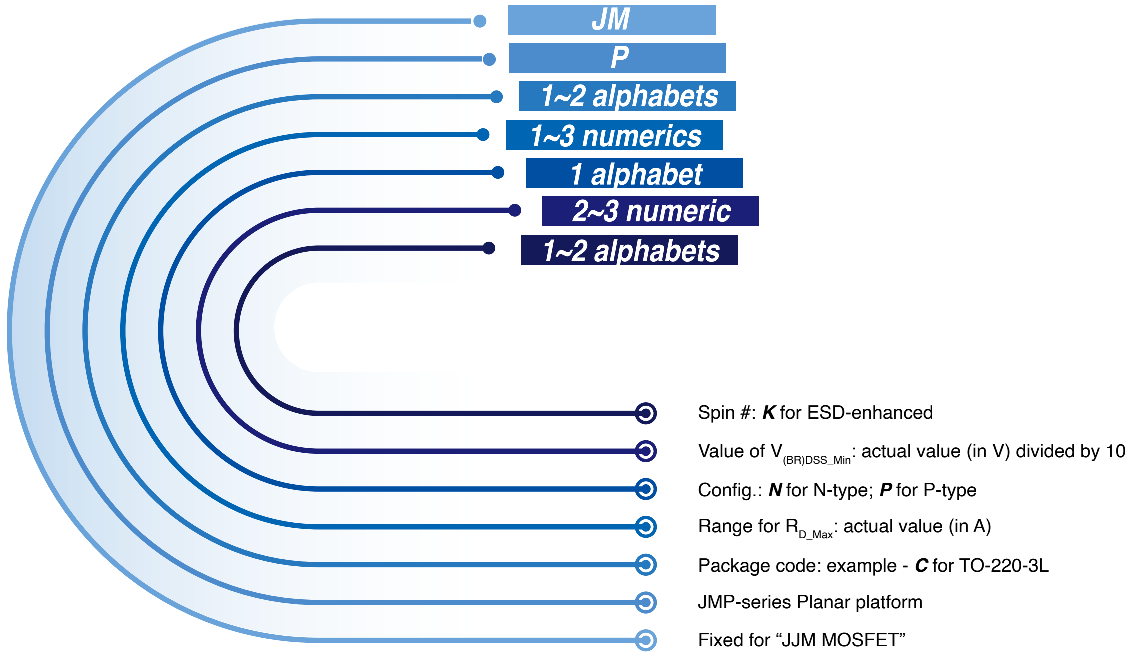
Spin #: K for ESD - enhanced
Value of $V_{(BR)DSS\_Min}$: actual value (in V) divided by 10
Config.: ***N*** for N - type; ***P*** for P - type; ***C*** for N - type + P - type
Range for $R_{DS(ON)\_Max}$: actual value (in mΩ) multiplied by 10
Package code: example - ***Q*** for PDFN3x3 - 8L
JMT - series Trench platform
Fixed for “JJM MOSFET”

Nomenclature of JSFET® N-ch & JPFET® P-ch SGT LV/MV MOSFETs



Special Code: default blanked; ***Q*** for auto-grade
Package Code: ***U*** for PDFN3x3-8L; ***G*** for PDFN5x6-8L; …
Spin #
Range for $R_{DS(ON)\_Typ}$
Value of $V_{(BR)DSS\_Min}$ divided by 10
$V_{GS(th)}$: ***H*** for high range; ***L*** for low range
Polarity: ***S*** for N-type JSFET®-series; ***P*** for P-type JPFET®-series
Fixed for “JJM MOSFET”

Nomenclature of JMP-series N-ch Planar HV MOSFET



Spin #: ***K*** for ESD-enhanced

Value of $V_{(BR)DSS\_Min}$: actual value (in V) divided by 10

Config.: ***N*** for N-type; ***P*** for P-type

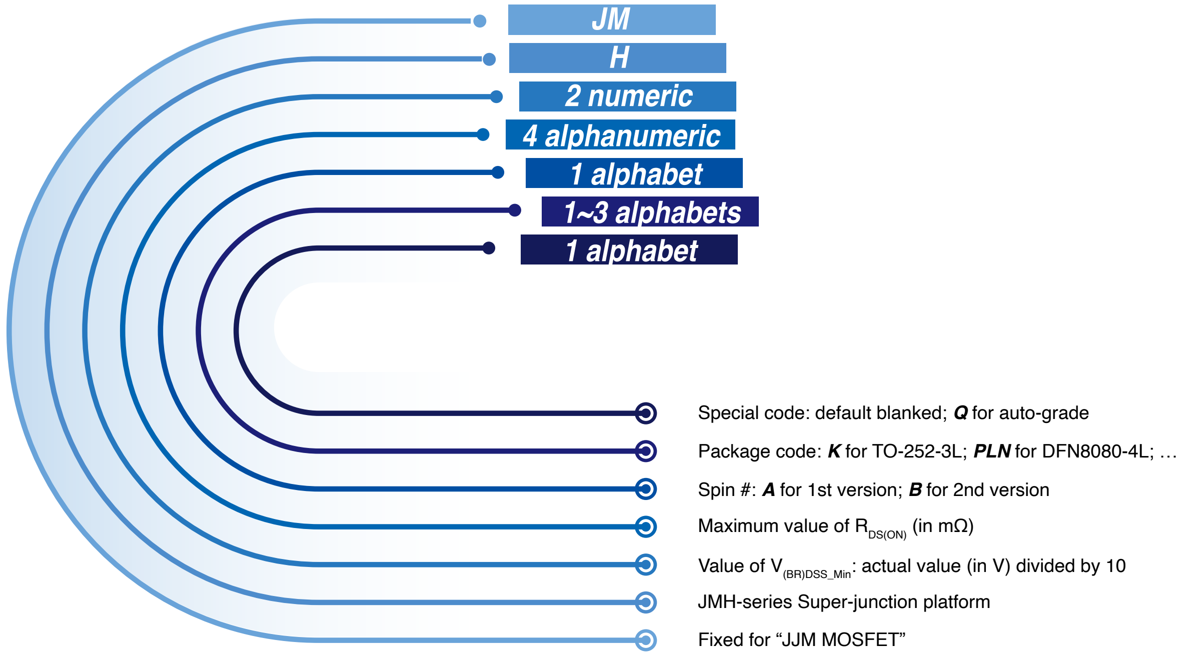
Range for R_{D_Max}: actual value (in A)

Package code: example - ***C*** for TO-220-3L

JMP-series Planar platform

Fixed for "JJM MOSFET"

Nomenclature of JHFET® Super-junction HV MOSFETs



Special code: default blanked; ***Q*** for auto-grade

Package code: ***K*** for TO-252-3L; ***PLN*** for DFN8080-4L; …

Spin #: ***A*** for 1st version; ***B*** for 2nd version

Maximum value of $R_{DS(ON)}$ (in mΩ)

Value of $V_{(BR)DSS\_Min}$: actual value (in V) divided by 10

JMH-series Super-junction platform

Fixed for "JJM MOSFET"

Automotive-grade MOSFETs with V_{DS_MIN} = -100 ~ 650V

Automotive-grade MOSFETs from JJMicroelectronics (JJM) offer breakdown voltage V_{DS_MIN} from -100V to 650V. The gate-source threshold voltage $V_{GS(th)}$ is at either high-level (2.7 ~ 3.5V) or low-level (1.5 ~ 1.9V, -1.0 ~ -3.0V). Source-Drain turn-ON resistance RDS(ON) is as low as 0.56mΩ (@ V_{GS} = 10V). FOM is low as 55.

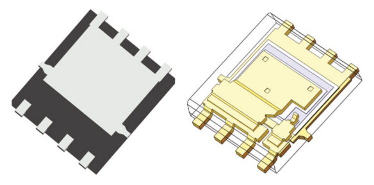
These MOSFETs were typically assembled in the highly efficient power packages of either the low-profile surface-mounted type or the legacy through-hole type. These include while not limited to the following packages with excellent thermal characteristics: PDFN3x3-8L, PDFN5x6-8L/-D, PowerJE®10x12 (TOLL-compatible), PowerJE®7x8 (sTOLL-compatible), TO-247-3, etc. All devices were tested for long-term reliability and quality in accordance to the relevant standards defined by AEC Council and JEDEC.

These automotive-grade MOSFETs are widely applied in various pre-installed & after-market sub-systems in automobiles shipped worldwide. These systems and related applications include, but not exclusively, ADAS, infotainment systems, secondary-side (i.e. synchronous DC-DC rectification) of OBC (on-board charger), motor driving in BCM (body control module) and EPS (electronic power steering), electronic relay, load switch, power switch, wireless charging etc.

Single N-channel automotive-grade MOSFETs

PDFN 5x6 SMD Package

PDFN5x6-8L



R_{DSON_MAX}@V_{GS}=10V / V_{DS}	40V (I_D: 106~355A)	60V (I_D: 108~318A)	100V (I_D: 150A)
0.8 mΩ	JMSL0401PGQ		
0.9 mΩ	JMSH040SPGQ		
1 mΩ	JMSH0401PGQ		
1.1 mΩ		JMSH060STGQ	
1.3 mΩ		JMSL060SPGQ	
1.4 mΩ		JMSH060SPGWQ	
1.7 mΩ	JMSH0401MGQ		
1.9 mΩ		JMSH0602MGQ	
2.1 mΩ		JMSH0602PGQ	
2.4 mΩ	JMSH0402MGQ JMSL0402MGQ JMSL0402MGWQ		
2.6 mΩ	JMSH0403RGQ	JMSH0603PGQ	
2.9 mΩ	JMSL0403PGQ	JMSH0603MGQ	
3.3 mΩ	JMSH0403PGQ		
4 mΩ	JMSL04055GQ		JMSH1003NGQ
5.1 mΩ		JMSH0606PGQ	
5.4 mΩ	JMSH0406PGQ		
5.5 mΩ		JMSL0606PGQ	

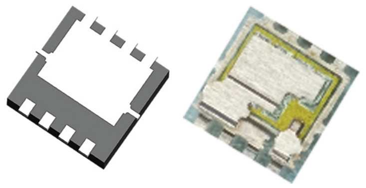
(continued)

(continued)

R_{DSON_MAX}@V_{GS}=10V / V_{DS}	60V (I_D: 39~91A)	100V (I_D: 35~120A)	150V (I_D: 27~77A)
5.8 mΩ		JMSL1006PGQ	
8.8 mΩ	JMSL0609PGQ	JMSL1008PGQ	
9.6 mΩ		JMSH1008PGQ	
9.7 mΩ	JMSL0612PGQ JMSL0612PGWQ		
12.1 mΩ		JMSL1010PGQ JMSL1010PGWQ	
13.4 mΩ			JMSH1509PGQ
17.1 mΩ		JMSL1018PGQ	
21.2 mΩ		JMSH1018PGQ	
24 mΩ	JMSL0620PGEQ		
31 mΩ		JMSL1040PGQ	
64 mΩ			JMSH1552PGWQ

PDFN 3x3 SMD Package

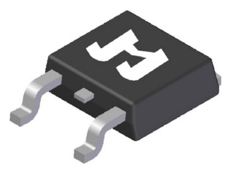
PDFN3x3-8L



R_{DSON_MAX}@V_{GS}=10V / V_{DS}	40V (I_D: 57~62A)	60V (I_D: 42~57A)	100V (I_D: 21~55A)
4.5 mΩ	JMSL04055UQ		
5.4 mΩ	JMSH0406PUQ		
5.5 mΩ		JMSL0606PUQ	
7.2 mΩ		JMSL0609PUQ	
8.4 mΩ		JMSL06063UQ	
9.5 mΩ		JMSL06120UQ	
10.8 mΩ			JMSL1010PUQ
16.6 mΩ			JMSL1018PUQ
32 mΩ			JMSL1040PUQ

DPAK SMD Package

TO-252-3L

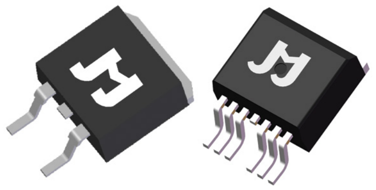


R_{DSON_MAX}@V_{GS}=10V / V_{DS}	40V (I_D: 66~125A)	60V (I_D: 42~106A)	100V (I_D: 39~92A)	150V (I_D: 26A)
3.1 mΩ		JMSH0602PKQ		
3.5 mΩ	JMSL0402MKQ			
3.8 mΩ	JMSH0402PKQ			
5.2 mΩ		JMSL0606PKQ		
5.8 mΩ	JMSL04055KQ	JMSH06060KQ		
6.2 mΩ	JMSH0406PKQ			
7.2 mΩ		JMSL0609PKQ		
8.5 mΩ			JMSL1008MKQ	
10.1 mΩ			JMSH1008PKQ	
10.2 mΩ			JMSL1010MKQ	
11 mΩ			JMSH1010MKQ	
13.5 mΩ		JMSL0612PKQ		
17 mΩ			JMSL1018PKQ	
65 mΩ				JMSH1565PKQ

D2PAK SMD Package

TO-263-3L

TO-263-7L



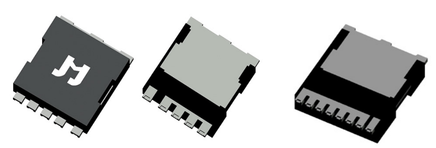
R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	40V (I_D: 223A)	60V (I_D: 229A)	100V (I_D: 164~264A)	150V (I_D: 134~178A)
2.3 mΩ			JMSH1001NE7Q$^{\#}$	
2.5 mΩ		JMSH0602PEQ		
2.7 mΩ	JMSH0402PEQ		JMSH1001NEQ	
4 mΩ			JMSH1003PEQ	
4.5 mΩ			JMSH1003PE7Q$^{\#}$	
4.8 mΩ				JMSH1504PEQ
6.7 mΩ				JMSH1507PEQ

 # - D2PAK-7L

PowerJE® SMD package (TO-Leadless compatible)

PowerJE®
7x8

PowerJE®
10x12



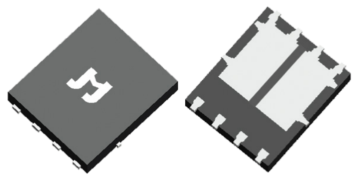
R_{DSON_MAX}@V_{GS}=10V / V_{DS}	40V (I_D: 295~476A)	80V (I_D: 400A)	100V (I_D: 212~435A)	120V (I_D: 360A)	150V (I_D: 210A)
0.85 mΩ	JMSH040SMTLQ				
1 mΩ	JMSH040SPTLQ				
1.1 mΩ	JMSH040SPTSQ[#] JMSH0401PTSQ[#]				
1.4 mΩ		JMSH0801PTLQ			
1.6 mΩ			JMSH1001PTLQ		
2.1 mΩ	JMSH0401PTLQ				
2.2 mΩ			JMSH1001NTLQ		
2.4 mΩ				JMSH1202PTLQ	
3.9 mΩ			JMSH1003PTLQ		
4.8 mΩ					JMSH1504NTLQ

 # - PowerJE® 7x8 (sTOLL compatible)

Dual N-channel Automotive-grade MOSFETs

PDFN 5x6 SMD Package

PDFN5x6-8L-D



R_{DSON_MAX}@V_{GS}=10V / V_{DS}	40V (I_D: 51~140A)	60V (I_D: 23~78A)	100V (I_D: 18~30A)
3.6 mΩ	JMSH0403PGHWQ[#]		
5.4 mΩ		JMSH0606PGDQ	
6.3 mΩ	JMSL04060GDQ		
6.7 mΩ	JMSH0406PGDQ		
10.8 mΩ		JMSL0615PGDQ	
18 mΩ			JMSL1020PGDQ
24 mΩ		JMSL0620PGDEQ	JMSL1040PGDQ
37 mΩ		JMSH0602PGQ	

 # - Half-bridge configuration

Industrial-grade MOSFETs with V_{DS_MIN} = -100 ~ 400V

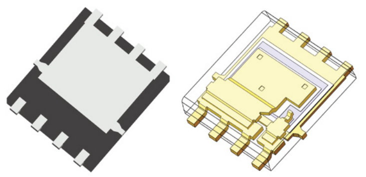
These LV (-30V ≤ V_{DS_MIN} ≤ 30V) and MV (-100V ≤ V_{DS_MIN} ≤ 40V, 40V ≤ V_{DS_MIN} < 400V) MOSFETs of N-ch or P-ch are designed on either trench or SGT technology platform. While the trench-type MOSFETs generally have higher stamina (i.e. E_{AS}) than the SGT-type MOSFETs at the same die size, the latter would offer lower RDS(ON), Qg and Ciss hence lower conduction and switching losses.

For consumer electronics (fast chargers, FPTVs, personal audio, home appliances, gaming & toys, personal computing, power tools, automobiles, etc.), networking equipment (router, multi-port switches, web / storage / security servers, etc.), communication equipment (4G/5G base stations, BBU, RRUs, AAUs, etc.), industrial equipment (robotics, factory, industrial PCs, energy storage system, solar/wind/hydro power generation, farming, public transportation, etc.), JJM offers the following low/mid-voltage MOSFETs to meet the diverse needs of system designers.

Single N-channel industrial-grade MOSFETs

PDFN 5x6 SMD Package

PDFN 5x6-8L



R_{DSON_MAX}@V_{GS}=10V / V_{DS}	30V (I_D: 80~358A)	40V (I_D: 100~330A)	60V (I_D: 106~294A)	80V (I_D: 137~162A)	100V (I_D: 152~159A)
0.7 mΩ	JMSL030STG				
0.8 mΩ	JMSL030SPG				
0.9 mΩ		JMSL040SPG JMSH040SPG			
1 mΩ		JMSH0401PG			
1.1 mΩ	JMSL0301TG	JMSL0401PG	JMSL0601TG		
1.3 mΩ			JMSL0602MG		
1.8 mΩ	JMSL0302PG JMTG018N03A	JMSL0402PG JMSH0402PG			
1.9 mΩ			JMSH0602PG		
2.1 mΩ		JMTG021N04A			
2.2 mΩ	JMTG3002B JMSL0302MG		JMSL0602PG		
2.3 mΩ	JMSL0303TG				
2.4 mΩ		JMTG027N04A			
2.5 mΩ		JMSL0402TG			
2.9 mΩ		JMTG035N04L	JMSL0603PG		
3.1 mΩ	JMTG3003A				
3.3 mΩ		JMSH0403PG			
3.4 mΩ	JMTG040N03A		JMSH0603PG	JMSL0803MG	
3.5 mΩ		JMTG4004A JMTG035N04A		JMSH0803MG	
3.6 mΩ					JMSL1003XG
3.7 mΩ					JMSH1003NG
3.9 mΩ		JMSL0403PG		JMSH0804NG JMSH0803NGS	

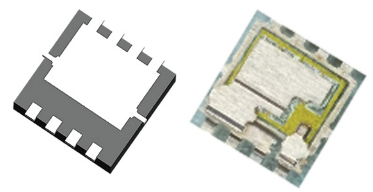
(continued)

(continued)

R_{DSON_MAX}@ V_{GS}=10V / V_{DS}	30V (I_D: 30~103A)	40V (I_D: 40~103A)	60V (I_D: 40~114A)	80V (I_D: 129A)	100V (I_D: 19~128A)	150V (I_D: 25~88A)
4.1 mΩ				JMSH0805PG		
4.2 mΩ	JMTG3005C		JMSL0606PG			
4.7 mΩ	JMTG3005A					
4.8 mΩ					JMSH1004NG	
4.9 mΩ		JMSL0406PG JMTG055N04A	JMTG060N06A			
5.1 mΩ	JMTG3005B	JMSH0406PG	JMSL0605PG			
5.4 mΩ					JMSL1004RG	
5.5 mΩ					JMSL1006PG	
5.7 mΩ					JMSL1005PG JMSL1006PGS	
5.8 mΩ			JMSH0606PG JMTG070N06A			
5.9 mΩ					JMSH1004RG	
6.2 mΩ	JMSL0307PG				JMSH1005PG	
6.4 mΩ					JMSH1006PG JMSL1009PG	
7.2 mΩ					JMSH1006PGS	
7.7 mΩ					JMSL1010PG	
7.9 mΩ		JMTG60N04B				
8 mΩ			JMSL0608PG		JMSH1008PG	
8.6 mΩ	JMTG3008A					
9.5 mΩ					JMSH1010PG	
9.7 mΩ			JMSL0612PG			
9.8 mΩ	JMTG100N03A					
9.9 mΩ						JMSH1509PG
10 mΩ			JMTG100N06A		JMSL1010PGS	
10.9 mΩ		JMTG100N04A				
11.8 mΩ			JMSL0611PG			
13.3 mΩ						JMSL1509PG
15 mΩ			JMTG170N06A			
16.7 mΩ					JMSL1018PG	
19 mΩ					JMSH1018PG	
20 mΩ						JMSH1516PG
30 mΩ					JMTG320N10A	
31 mΩ					JMSL10380G	
64 mΩ						JMSH1552PG
82 mΩ					JMSL10A13G	

PDFN 3x3 SMD Package

PDFN3x3-8L

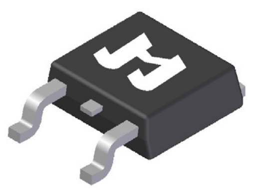


R_{DSON_MAX}@ V_{GS}=10V / V_{DS}	20V (I_D: 50~80A)	30V (I_D: 12~100A)	40V (I_D: 30~85A)	60V (I_D: 34~69 A)	100V (I_D: 10~45A)	150V (I_D: 14A)
2.3 mΩ		JMSL0302PU				
2.4 mΩ		JMSL0303TU				
2.5 mΩ			JMSL0403PU			
2.7* mΩ	JMTQ025N02A					
3 mΩ		JMTR3002A				
3.1 mΩ			JMSH0403PU			
3.4 mΩ		JMTQ3003A				
3.9* mΩ	JMTQ90N02A					
4 mΩ		JMTQ040N03A				
4.4 mΩ		JMTQ3005C				
4.5 mΩ			JMSL0406PU			
4.7 mΩ				JMSL0606PU		
4.8 mΩ		JMTQ3005A				
4.9* mΩ	JMTQ050N02A					
5.4 mΩ			JMSH0406PU			
5.6 mΩ		JMTQ3006C	JMTQ055N04A			
5.9 mΩ		JMSL0310PU		JMSH0606PU		
6.1 mΩ		JMTQ3006B				
6.6 mΩ			JMTQ062N04A			
7.9 mΩ					JMSL1009PUN	
8.1 mΩ				JMSL0608PU		
8.6 mΩ		JMTQ3008A	JMTQ60N04B			
9 mΩ					JMSL1010PU	
9.6 mΩ				JMSL0612PU		
10 mΩ					JMSH1010PU	
11.1 mΩ			JMTQ100N04A			
11.2 mΩ		JMTQ100N03A				
11.7 mΩ				JMSL0611PU		
11.8 mΩ		JMTQ120N03A				
13.8 mΩ		JMTQ3400D				
15 mΩ				JMTQ35N06A		
17.2 mΩ		JMTQ190N03A				
19.4 mΩ		JMTQ240N03A				
32 mΩ					JMSL10380U JMTQ320N10A	
67 mΩ						JMSH1552PU
120 mΩ					JMTQ11DN10A	

** - R_{DSON_MAX} based on V_{GS}=4.5V*

DPAK SMD Package

TO-252-3L



R_{DSON_MAX}@ V_{GS}=10V / V_{DS}	20V (I_D: 30~90A)	30V (I_D: 40~190A)	40V (I_D: 57~150A)	60V (I_D: 51~120A)	80V (I_D: 112~130A)	100V (I_D: 49~80A)
2.6 mΩ		JMTK3002B JMTK018N03A				
2.7 mΩ				JMSH0602PK		
3.4 mΩ		JMTK3003A				
3.6 mΩ	JMTK90N02A	JMTK3004A				
3.7 mΩ				JMSH0603PK		
3.8 mΩ			JMTK035N04L			
3.9 mΩ		JMTK3005D				
4 mΩ		JMTK3005C JMTK3005L				
4.1 mΩ					JMSH0804NK	
4.3 mΩ			JMTK4004A			
4.4 mΩ		JMTK3005A JMTK3005B	JMTK1404A		JMSH0805PK	
4.8 mΩ			JMSL0403PK			
4.9 mΩ	JMTK75N02A		JMTK4005A			
5 mΩ		JMTK3006D				
5.2 mΩ				JMSL0606PK		
5.4 mΩ			JMSL0406PK			
5.5 mΩ						JMSL1005PK
5.6 mΩ		JMTK3006C JMTK3006E				
5.8 mΩ				JMSH0606PK		
5.9 mΩ			JMTK4006A	JMTK060N06A		
6 mΩ		JMTK3006B				
6.2 mΩ	JMTK2006A					
6.6 mΩ				JMTK80N06A		
7 mΩ			JMTK60N04B			
7.4 mΩ			JMSH0406PK			
7.6 mΩ						JMSH1006PK
7.9 mΩ						
8.1 mΩ	JMTK2007A					
8.2 mΩ						JMSH1008PK
8.4 mΩ						JMSL1010PK
8.6 mΩ		JMTK50N03A				
8.8 mΩ				JMSL0608PK JMSL0612PK		
9.8 mΩ						JMSH1010PK
10 mΩ		JMTK100N03A		JMTK58N06B JMTK110N06A		
10.4 mΩ	JMTK100N02A					

(continued)

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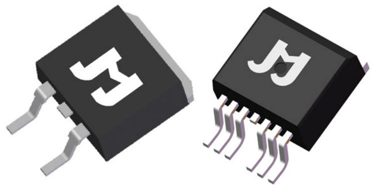
R_{DSON_MAX}@V_{GS}=10V	30V (I_D: 20A)	60V (I_D: 15~50A)	100V (I_D: 10~59A)	150V (I_D: 17~32A)	200V (I_D: 8.1A)
11 mΩ			JMSL1010PKS		
12.2 mΩ	JMTK120N03A				
15 mΩ		JMTK50N06B			
17.4 mΩ			JMSL1018PK		
19 mΩ			JMSH1018PK		
20 mΩ			JMTK170N10A		
22 mΩ				JMSH1516PK	
27.8 mΩ			JMTK320N10A		
29 mΩ		JMTK290N06A			
33 mΩ		JMTK330N06A			
48 mΩ			JMTK500N10A		
56.9 mΩ		JMTK480N06A			
63 mΩ				JMSH1552PK	
108 mΩ			JMTK10N10A		
109 mΩ			JMSL10A13K		
300 mΩ					JMPK630BJ

D2PAK SMD Package

TO-263-3L

TO-263-7L



R_{DSON_MAX}@ V_{GS}=10V / V_{DS}	30V (I_D: 150~190A)	40V (I_D: 190~224A)	60V (I_D: 184~218A)	80V (I_D: 199~313A)	100V (I_D: 175~353A)	110V (I_D: 199~303A)
1.6 mΩ						JMSH1101PE7$^{\#}$
1.8 mΩ					JBE101N JMSH1001NE7$^{\#}$	
1.9 mΩ				JMSH0801PE	JVE101N JMSH1001NE	
2.1 mΩ				JMSH0802PE		
2.1 mΩ		JMTE025N04D				
2.4 mΩ	JMTE018N03A					
2.5 mΩ			JMSH0602PE	JMSH0802ME		
2.6 mΩ	JMTE3002B				JBE102T	JBE111P JMSH1101PE
2.8 mΩ		JMSH0401PE			JVE102T JMSH1002NE	
2.9 mΩ	JMTE3003A				JBE102G	
3.1 mΩ					JVE102G	JBE112Q JMSH1102QE
3.3 mΩ			JMSH0603PE			JBE112T JMSH1102TE
3.5 mΩ				JMSH0803ME		
3.6 mΩ					JVE103T JMSH1003NE	
3.7 mΩ				JBE083M	JBE102Y JMSH1002YE	

 # - Represent D2PAK-7L

(continued)

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R_{DSON_MAX}@ V_{GS}=10V /	40V (I_D: 150A)	60V (I_D: 117~218A)	80V (I_D: 133~164A)	100V (I_D: 54~223A)	110V (I_D: 173~181A)	150V (I_D: 65~200A)	200V (I_D: 23~109A)
3.8 mΩ		JMTE035N06D					
3.9 mΩ				JBE103T			
4 mΩ	JMTE035N04A		JMSH0804NE	JMSH1003NE7#	JMSH1102YE		
4.1 mΩ				JBE113P			
4.2 mΩ				JMSH1003TE			
4.5 mΩ					JMSH1103TE	JMSH1504NE JMSH1504NE7#	
4.8 mΩ			JMSH0805PE	JMSH1004NE			
4.9 mΩ			JBE084M				
5 mΩ				JMSH1005PE			
5.9 mΩ		JMSL0606PE					
6 mΩ		JMTE060N06A					
7.4 mΩ				JMSH1006PE		JMSH1507PE	
7.5 mΩ			JBE083NS				
7.6 mΩ				JMSL1010PE			
8 mΩ				JMSH1008PE			
10.5 mΩ							
10.7 mΩ						JMSH1509PE	JMSH2010PE
19 mΩ				JMSH1018PE			
86 mΩ						JMSH1516PE	JMPE34N20BJ
157 mΩ							JMPE18N20BJ

 # - Represent D2PAK-7L

DFN-2020 SMD package

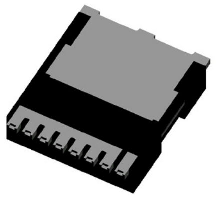
DFN2020-6L

R_{DSON_MAX}@V_{GS}= 4.5V / V_{DS}	20V (I_D: 10~25A)	30V (I_D: 8~22A)
6.6 mΩ	JMTV070N02A	
9 mΩ	JMTV080N02A	
9.8 mΩ	JMTV100N02A	
11.8 mΩ		JMTV075N03A
17.6 mΩ		JMTV3010A
19.5 mΩ		JMTV120N03A
25.1 mΩ		JMTV3400A
28.3 mΩ		JMTV240N03A

** - R_{DSON_MAX} based on V_{GS}=4.5V*

PowerJE® SMD package

PowerJE®
10x12

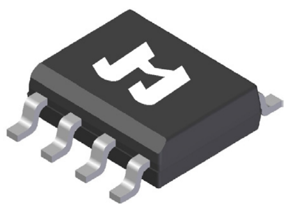


R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	40V (I_D: 284~486A)	60V (I_D: 332A)	80V (I_D: 242~406A)	100V (I_D: 184~467A)
0.8 mΩ	JMSL040SMTL			
1.1 mΩ	JMSH0401PTS#			
1.3 mΩ	JMSL0402MTL JMSL0402PTL		JMSH0801MTL	JMSH1001MTL
1.35 mΩ	JMSH0401PTL			
1.5 mΩ			JMSH0801PTL	
1.6 mΩ		JMSH0601PTL		JMSH1001PTL JMSH1001NTL
1.8 mΩ			JMSH0802PTL	
2 mΩ			JMSH0802MTL	
2.1 mΩ				JMSH1002TTL
2.4 mΩ				JMSH1002NTL
2.7 mΩ			JMSH0803MTL	
2.9 mΩ			JBL083M	
3 mΩ				JMSH1002YTL
5 mΩ				JMSH1003TTL

 # - sTOLL 7x8

R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	110V (I_D: 196~256A)	120V (I_D: 189~300A)	150V (I_D: 176~263A)	200V (I_D: 119A)
2.2 mΩ	JBL111P			
2.7 mΩ	JBL112T			
2.8 mΩ		JMSH1202PTL		
3.9 mΩ		JMSH1204PTL	JMSH1504NTL	
4.2 mΩ	JBL113P			
5.1 mΩ			JMSH1506MTL	
8.6 mΩ				JMSH2010PTL

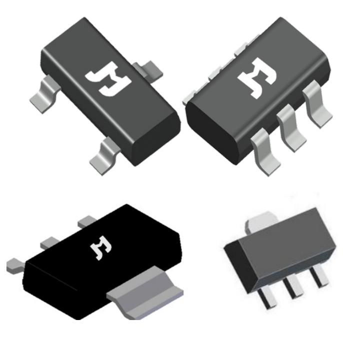
SOP-8 SMD package



SOP-8L

R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	30V (I_D: 4.5~20A)	40V (I_D: 6~15A)	60V (I_D: 10~17A)	100V (I_D: 3~12A)	150V (I_D: 4.1A)
6 mΩ	JMTP045N03A				
8.5 mΩ		JMTP080N04A			
8.7 mΩ	JMTP3008A				
9 mΩ			JMTP075N06A		
9.6 mΩ	JMTP4406A				
10 mΩ				JMSL1009PP	
10.3 mΩ			JMSL0608PP		
10.4 mΩ			JMSL0612PP		
11.2 mΩ				JMSL1010PP	
11.8 mΩ			JMSL0611PP		
12 mΩ			JMTP110N06A		
15.9 mΩ			JMTP170N06A		
16.5 mΩ		JMTP130N04A			
21 mΩ				JMSH1018PP	
33 mΩ				JMSL10380P	
36 mΩ	JMTP380N03D				
39 mΩ		JMTP400N04A			
66 mΩ					JMSH1552PP
85 mΩ				JMSL10A13P	
115 mΩ				JMTP11DN10A	

Small Signal N-Channel



SOT-89-3L

SOT-23-3L

SOT-23-6L

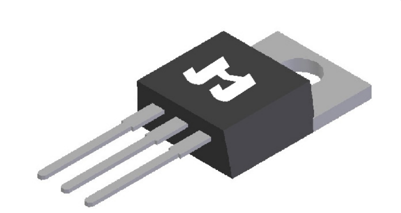
SOT-223-3L

Package / V_{DS}	20V R_{DSON_MAX}: 10.7~240 mΩ (I_D: 0.75~8A)	30V R_{DSON_MAX}: 28.6~65 mΩ (I_D: 4~5.8A)	40V R_{DSON_MAX}: 27~52 mΩ (I_D: 4~8A)	60V R_{DSON_MAX}: 42~2870 mΩ (I_D: 0.2~5.4A)	100V R_{DSON_MAX}: 43~312 mΩ (I_D: 2.2~7A)
SOT-23-3L	JMTJ100N02A	JMTJ3400A	JMTL400N04A	JMTL2310A	JMSL10A13L
	JMTL2312A	JMTJ3404A		JMTL2N7002KS	JMTJ11DN10A
	JMTL2312L	JMTL3400A		JMTL2N7002KSQ#	JMTL3N10A
	JMTL3416KS	JMTL3404A			
	JMTJ2302C	JMTL3400L			
	JMTL2302C	JMTL3404B			
	JMTL2302B	JMTL3402A			
	JMTL3134K	JMTL3406A			
	JMTL3134KQ#				
SOT-23-6L			JMTM170N04A	JMTM330N06A	
				JMTM2310A	
SOT-323-3L	JMTLA3134K			JMTLA2N7002KS	
SOT-523-3L	JMTL3134KT5				
SOT-723-3L	JMTL3134KT7				
SOT-89-3L				JMTN330N06A	JMTN11DN10A
				JMTN2310A	
SOT-223-3L				JMTY2310A	JMSL10380Y
					JMSL1070PY
					JMTY11DN10A
					JMSL10130AY

 # - Automotive grade

TO-220 Through-hole Package

TO-220-3L



R_{DSON_MAX}@ V_{GS}=10V / V_{DS}	30V (I_D: 90~190A)	40V (I_D: 60~190A)	60V (I_D: 80~180A)	80V (I_D: 126~249A)	100V (I_D: 103~353A)	110V (I_D: 126~176A)	150V (I_D: 133~200A)
2.2 mΩ					JMSH1001NC		
2.6 mΩ		JMTC025N04D		JMSH0802MC	JMSH1002TC		
2.7 mΩ	JMTC018N03A						
2.9 mΩ					JMSH1002NC		
3.1 mΩ	JMTC3002B			JMSH0803PC			
3.3 mΩ	JMTC3003A						
3.4 mΩ			JMSH0602PC				
3.5 mΩ						JMSH1102QC	
3.7 mΩ				JMSH0803MC		JMSH1102TC	
3.8 mΩ					JVC103K JVC103T JMSH1003NC		
4 mΩ		JMTC035N04A			JMSH1002YC		
4.1 mΩ							
4.2 mΩ				JMSH0804NC	JMSH1003TC	JMSH1102YC	
4.3 mΩ			JMTC035N06D				
4.5 mΩ		JMTC4004A					
4.6 mΩ							
4.7 mΩ						JMSH1101PC	
4.8 mΩ							JMSH1504NC
4.9 mΩ					JMSH1004NC		
5 mΩ	JMTC3005A				JVC113T	JMSH1103TC	
5.2 mΩ				JMSH0805PC			
5.3 mΩ					JVC105E JMSH1005PC		
5.6 mΩ					JVC502E		
5.7 mΩ				JVC085T	JMSL1005PC JMSH1003TF#		
5.8 mΩ					JMSH1004MC		
6 mΩ			JMTC060N06A				
6.2 mΩ			JMSH0606PC		JMSL1009PC		JMSH1507PC
7 mΩ			JMTC80N06A				
7.3 mΩ					JMSH1007PC		
7.5 mΩ					JMSL1009PF#		
7.7 mΩ		JMTC60N04B					
7.8 mΩ					JMSH1006PC		
8 mΩ					JMSH1008PC		

(# - TO-220 FullPAK)

(continued)

(continued)

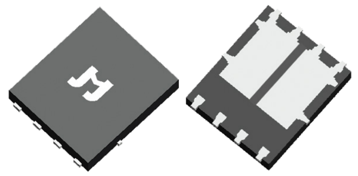
R_{DSON_MAX}@V_{GS}=10V / V_{DS}	60V (I_D: 55~58A)	100V (I_D: 30~79A)	150V (I_D: 53~84A)	200V (I_D: 8.3~96A)
9.6 mΩ		JMSL1010PC		
10.3 mΩ		JMSH1010PC		
10.6 mΩ			JMSH1509PC	
10.8 mΩ	JMTC58N06B			
11.7 mΩ				JMSH2010PC
14.5 mΩ	JMTC110N06A			
19 mΩ		JMSH1018PC		
20 mΩ		JMTC170N10A		
23 mΩ			JMSH1516PC	
32 mΩ		JMTC320N10A		
64 mΩ				JMPC52N20BJ
85 mΩ				JMPC34N20BJ
106 mΩ				JMPC28N20BJ
150 mΩ				JMPC18N20BJ
280 mΩ				JMPF630BJ#
296 mΩ				JMPC630BJ

(# - TO-220 FullPAK)

Dual N-channel industrial-grade MOSFETs

PDFN 5x6 SMD Package

PDFN5x6-8L-D

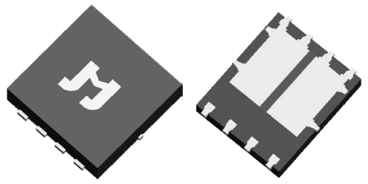


R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	30V (I_D: 41A)	40V (I_D: 45~131A)	60V (I_D: 31~88A)	100V (I_D: 4.5~69A)
3.6 mΩ		JMSH0403PGHW#		
5.4 mΩ			JMSH0606PGD	
6.3 mΩ		JMSL0406PGD JMSH0406PGD		
7.1 mΩ			JMSL0606PGD	
7.9 mΩ	JMTG3008D			
8.2 mΩ		JMTG062N04D		
9.6 mΩ		JMTG080N04D		
11 mΩ			JMSL0608PGD	
11.7 mΩ				JMSL1010PGD
12.9 mΩ			JMTG100N06D	
14 mΩ			JMSL0611PGD	
19 mΩ				JMSL1018PGD
22 mΩ				JMSH1018PGD
85 mΩ				JMSL10A13GD
124 mΩ				JMSL10130PGD
295 mΩ				JMTG28DN10D

 # - Half-bridge configuration

PDFN 3x3 SMD Package

PDFN3x3-8L-D



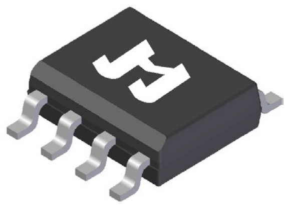
R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	30V (I_D: 12~34A)	40V (I_D: 12~29A)	60V (I_D: 34A)	100V (I_D: 6.7A)
9.9 mΩ	JMSL0315PUD			
11.8 mΩ	JMTQ075N03D			
12.9 mΩ	JMTQ100N03D			
13.5 mΩ	JMTQ3010D			
14.3 mΩ	JMTQ120N03D			
14.7 mΩ			JMSL0611PUD	
18 mΩ		JMTQ120N04D		
19.2 mΩ	JMTQ240N03D	JMTQ130N04D		
21.6 mΩ				
26 mΩ		JMTQ220N04D JMTQ230N04D		
128 mΩ				JMSL10130PUD

(continued)

(continued)

SOP-8 SMD Package

SOP-8L



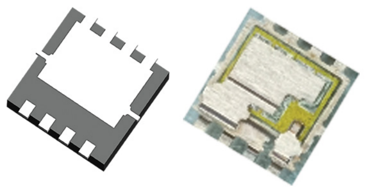
R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	20V (I_D: 6~6.5A)	30V (I_D: 8~12A)	40V (I_D: 13A)	60V (I_D: 5~11A)
10.3 mΩ			JMTP080N04D	
11.6 mΩ		JMTP3010D		
12.3 mΩ				JMSL0609PPD
13.4 mΩ				JMSL0612PPD
14 mΩ				JMTP110N06D
17* mΩ	JMTP9926A			
20.2 mΩ		JMTP240N03D		
20.4 mΩ				JMTP170N06D
23 mΩ		JMTP260N03D		
27* mΩ	JMTP9926B			
38 mΩ				JMTP330N06D

** - R_{DSON_MAX} based on V_{GS}=-4.5V*

Single P-channel industrial-grade MOSFETs

PDFN 3x3 SMD Package

PDFN3x3-8L



R_{DSON_MAX}@V_{GS}= -10V / V_{DS}	-20V (I_D: -55A)	-30V (I_D: -40~-50A)
7.4 mΩ		JMTQ080P03A
8.3* mΩ	JMTQ55P02A	
9.4 mΩ		JMTQ100P03A

** - R_{DSON_MAX} based on V_{GS}=-4.5V*

(continued)

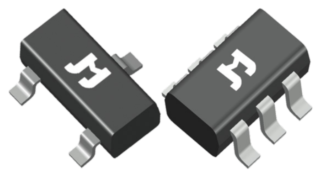
(continued)

R_{DSON_MAX}@V_{GS}= -10V / V_{DS}	-30V (I_D: -12~-35A)	-40V (I_D: -8~-30A)	-100V (I_D:-17A)
10 mΩ	JMTQ4407A		
13 mΩ		JMTQ130P04A	
14 mΩ	JMTQ160P03A		
17.4 mΩ	JMTQ200P03A		
36 mΩ		JMTQ440P04A	
51 mΩ			JMPL1050PU
80 mΩ	JMTQ11DP03A		

SOT-23 SMD Package

SOT-23-3L

SOT-23-6L



R_{DSON_MAX}@V_{GS}= -4.5V / V_{DS}	-12V (I_D: -4.1~-7A)	-20V (I_D: -2~-7A)	-30V (I_D: -4~-4.2A)	-40V (I_D: -2.8~-5A)
18.7 mΩ		JMTJ210P02A		
21 mΩ	JMTJ2333A			
26 mΩ		JMTJ250P02A		
31 mΩ	JMTL2305B			
35 mΩ		JMTL2305A		
38 mΩ		JMTJ3415KL		
39 mΩ		JMTM3415KL$^{\#}$		
40 mΩ		JMTL3415KL		
46* mΩ			JMTL3407A JMTJ3407A	
47* mΩ			JMTL3401A JMTJ3401A	
52 mΩ		JMTL2301C		
62* mΩ			JMTL3401B	
64* mΩ			JMTJ3401B	
85* mΩ				JMTM850P04A$^{\#}$
88* mΩ				JMTL850P04A
104 mΩ		JMTL2301B		
125 mΩ		JMTL2301E		

** - R_{DSON_MAX} based on V_{GS}=-4.5V*

 # - SOT-23-6L

DPAK SMD Package

TO-252-3L

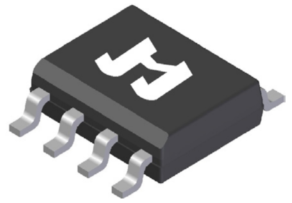
R_{DSON_MAX}@V_{GS}= -10V / V_{DS}	-20V (I_D: -60A)	-30V (I_D: -20~-100A)	-40V (I_D: -10~-70A)	-60V (I_D: -22A)	-100V (I_D: -22A)
5.3 mΩ		JMTK050P03A			
6.4 mΩ		JMTK060P03A			
6.5 mΩ		JMTK080P03A			
8.5* mΩ	JMTK50P02A				
9.2 mΩ			JMTK085P04A		
9.2 mΩ		JMTK50P03A			
10 mΩ		JMTK100P03A			
13 mΩ			JMTK130P04A		
14 mΩ		JMTK160P03A			
26.8 mΩ		JMTK340P03A			
39 mΩ			JMTK440P04A		
46 mΩ				JMPL0648PKQ$^{\#}$	
62 mΩ					JMPL1050PK

** - R_{DSON_MAX} based on V_{GS}=-4.5V*

 # - Automotive grade

SOP-8 SMD package

SOP-8L



R_{DSON_MAX}@V_{GS}= 10V / V_{DS}	-20V (I_D: -15A)	-30V (I_D: -5.1~-15A)	-40V (I_D: -12~-15A)
9* mΩ	JMTP085P02A	JMTP080P03A	
14 mΩ		JMTP4407A	
14.3 mΩ			JMTP130P04A
16.5 mΩ		JMTP4407B	
16.6 mΩ		JMTP4435A	
25 mΩ		JMTP250P03A	
25.6 mΩ		JMTP340P03A	
38 mΩ			JMTP440P04A
40 mΩ		JMTP9435A	
51 mΩ			JMTP520P04A
75 mΩ			JMTP850P04A

** - R_{DSON_MAX} based on V_{GS}=-4.5V*

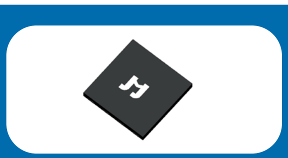
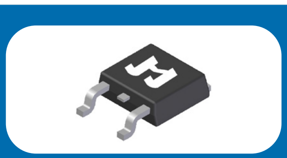
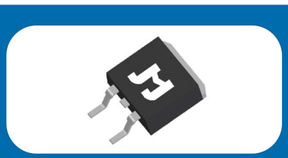
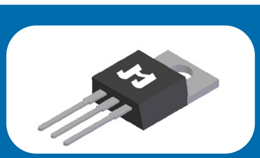
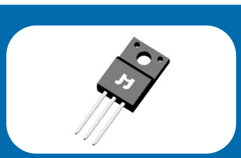
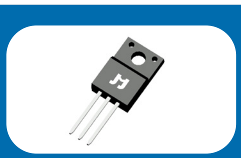
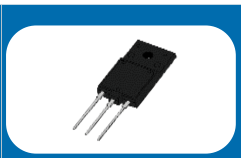
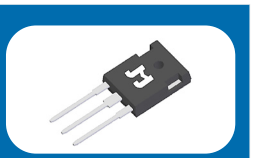
High-voltage MOSFETs (≥ 400V)

Industrial-grade MOSFETs with 400V ≤ V_{DS_MIN} ≤ 1kV

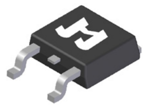
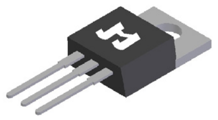
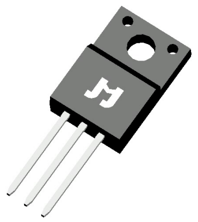
There exist two technology platforms in the design of high-voltage MOSFETs: planar, SJ (super-junction). The latter is further divided into two device structures: multi-layer epitaxy, deep trench.

For battery charging, DC-DC voltage switching including power inverting, AC or DC motor driving, and other high-voltage applications, JJM offers the following high-voltage MOSFETs to meet the diverse needs of system designers. These MOSFETs are designed in either planar or SJ technology platform.

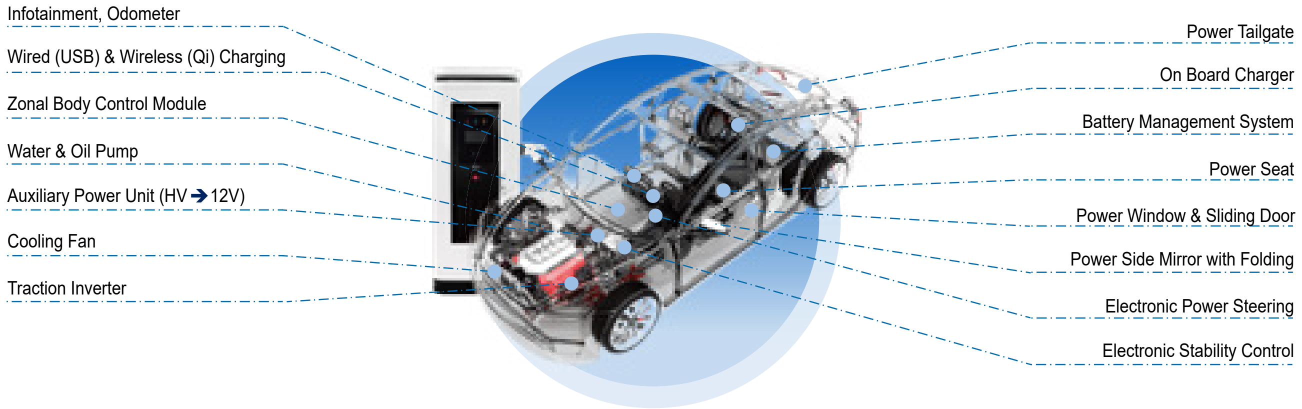
Superjunction 650V MOSFETs

Package									
	DFN8080-4L (8x8 mm)	**DPAK (TO-252-3L)**	**D2PAK (TO-263-3L)**		**TO-220**	**TO-220FP**	**TO-220FP NL**	**TO-3PF**	**TO-247**
30mΩ (I_D=65A)									JMH65R030PSFD
40mΩ (I_D=53A)									JMH65R040PSFD
70mΩ (I_D=22~38A)					JMH65R070PCFD	JMH65R070PFFD			JMH65R070PSFD
90~94mΩ (I_D=18~29A)					JMH65R090PCFD	JMH65R090PFFD		JMH65R090PZFFD	JMH65R090PSFD
110mΩ (I_D=9.3~35A)	JMH65R110PPLNFD		JMH65R110PEFD		JMH65R110PCFD	JMH65R110PFFD			JMH65R110ASFD
190mΩ (I_D=12~21A)	JMH65R190APLN JMH65R190APLNFD		JMH65R190PEFD		JMH65R190PCFD	JMH65R190PFFD	JMH65R190ACFP		JMH65R190PSFD
290mΩ (I_D=10~12A)	JMH65R290APLN		JMH65R290AE			JMH65R290AF	JMH65R290ACFP		
348~368mΩ (I_D=6.8~8.2A)		JMH65R360PK				JMH65R360PF JMH65R360MF			
430mΩ (I_D=10.4~11.2A)	JMH65R430APLN	JMH65R430AK	JMH65R430AE			JMH65R430AF	JMH65R430ACFP		
600mΩ (I_D=7~7.4A)		JMH65R600PK				JMH65R600PF			
950~980mΩ (I_D=4~5.3A)	JMH65R980APLN	JMH65R980AK				JMH65R950MF	JMH65R980ACFP		

Planar 500~650V MOSFETs

Package		I_D / V_{DS}	500V (R_{DSON_MAX}: 300~1810 mΩ)		600V (R_{DSON_MAX}: 366~2520 mΩ)	650V (R_{DSON_MAX}: 470~2640mΩ)
	**DPAK (TO-252-3L)**	7				JMPK7N65BJ
		5	JMPK5N50BJ			
		4			JMPK4N60BJ	JMPK4N65BJ
		25	JMPF25N50BJ			
	**TO-220**	20			JMPF20N60BJ	JMPF20N65BJ
		18	JMPF18N50BJ			
		16			JMPF16N60BJ	JMPF16N65BJ
		15	JMPF15N50BJ			
		13	JMPF13N50BJ			
		12			JMPF12N60BJ	JMPF12N65BJ
		10			JMPF10N60BJ	JMPF10N65BJ
		9	JMPF840BJ			
		8			JMPF8N60BJ	
		7				JMPF7N65BJ
		5	JMPF5N50BJ			
		4			JMPF4N60BJ	JMPF4N65BJ
	**TO-220FP**	25	JMPC25N50BJ		JMPC25N60BJ	
		20			JMPC20N60BJ	JMPC20N65BJ
		18	JMPC18N50BJ			
		16			JMPC16N60BJ	JMPC16N65BJ
		15	JMPC15N50BJ			
		13	JMPC13N50BJ			
		12			JMPC12N60BJ	JMPC12N65BJ
		10			JMPC10N60BJ	JMPC10N65BJ
		9	JMPC840BJ			
		8			JMPC8N60BJ	
		7				JMPC7N65BJ

APPLICATIONS OF AUTO-GRADE POWER SEMICONDUCTORS IN AUTOMOBILES



The shift from brushed to brushless motors, the proliferation of LEDs to replace the filament-type light bulbs in lightings, the increasing use of DC motors to improve fuel efficiency, the adoption of more IA (artificial intelligence) technology in driver assistance (e.g. blind-spot warning, lane departure warning, lane keeping assist, adaptive cruise control, etc.) result in the use of more and more power semiconductor components in vehicles. In alignment to the mega trend of electrification of transportation & mobility, JJMICROELECTRONICS (a.k.a. JJM®) has been offering more and more automotive-grade components to E-mobility (battery storage, renewable energy source, electric propulsion) accent & exterior lightings, ADAS (advanced driver assistant systems), vehicle-to-vehicle communications & cybersecurity, telematics and infotainment, etc.

In the auto-grade MOSFETs which bear 'Q' as the last letter in the product name, the die is designed with key performance matrices {ONresistance RDS(ON), input capacitance CISS, total gate charge Qg} minimized and SOA (safe operating area) further optimized. Assembled in the thermally efficient low-profile packages like the TOLL-compatible PowerJE®10x12 and PDFN5x6-8L with long protruded lead pins, these autograde MOSFETs offer world-class power efficiency, lower operating temperature, exceptional long-term reliability despite of the hostile working environment typical inside and outside of automobiles.

At JJM, the auto-grade diodes (TVS, ESD, rectifier, zener, etc.) are constructed with the patented clip assembly process. Compared to the traditional A+B structure, the risk of cold joint is minimized, thermal and physical stress on the die surface are minimized. All these result in outstanding long-term component reliability. Long-standing and reliable protection to prevent the semiconductor devices (application processor, mixed-signal interface IC, etc.) used in key sub-systems like power and traction inverter from damage by spurious electrical surges and other hazard are achieved. These auto-grade diodes offer world-class electrical performance like clamping voltage tailored to specific application requirement, low leakage current, and fast response as well as compliance to AEC-Q101-Rev-E stress test standards.

Roadmap for Industrial and Automotive Packages

01 Auto-grade power semiconductor components (MOSFET, TVS) from JJM are being extensively applied to motor driving in the many sub-systems in automobiles: EPS (electronic power steering), oil pumps, water pumps, power windows, rear trunk / hatch, power seats, power sunroofs, etc.

02 Auto-grade MOSFETs offer outstanding performance matrices {ON-resistance RDS(ON), input capacitance CISS, total gate charge Qg} with the SOA (safe operating area) further optimized. Assembled in the thermally efficient low-profile packages like the TOLL-compatible PowerJE®10x12, and the PDFN5x6-8L with long protruded lead pins, these power-efficient auto-grade MOSFETs are widely applied in various applications inside automobiles. The long-term reliability are ensured by their compliance to the AEC-Q101- Rev-E stress test standards.

03 Assembled in the patented DO-218 package of JJM, the auto-grade TVS (transient voltage suppressor) can be applied to both 12VDC and 24VDC systems. They were tested to pass ISO 16750-2 P5a/5b compliant load-dump test and off PPP_Max performance of 4.6 ~ 8kW. Besides the ability to perform consistently across all key electrical matrices, these TVS also offer high surge immunity and exceptional long-term operating reliability. Hence, these auto-grade TVS are field-proven to be indispensable for the protection of valuable electronic sub-systems inside automobiles.

Components Recommended: Auto-grade MOSFETs

Product Name	JJM Package	Config-uration	V_{DS}— Max (V)	I_D_Max (A)	$V_{GS(th)\_Typ}$ (V)	$R_{DS(ON)\_Typ}$ @ V_{GS} = 10V (mΩ)	$R_{DS(ON)\_Max}$ @ V_{GS} = 10V (mΩ)	V_{GS_Max} (V)	E_{AS_Max} (mJ)	C_{iss_Typ} (pF)	Q_{g_Typ} (nC)
JMSH0401PGQ	PDFN5x6-8L	N	40	276	2.8	0.9	1.1	±20	441	5280	68
JMSH0401PTLQ	PowerJE®10x12	N	40	337	2.8	1	1.25	±20	317	5280	68
JMSL0402MGQ	PDFN5x6-8L	N	40	198	1.6	1.3	1.7	±20	194	3125	47
JMSL0402MGQ	PDFN5x6-8L	N	40	183	1.6	1.6	2	±20	163	3133	46
JMSH0403PGQ	PDFN5x6-8L	N	40	121	2.8	2.7	3.4	±20	216	1542	22
JMSL0406PGQ	PDFN5x6-8L	N	40	90	1.6	4.2	5.2	±20	36	1204	17.9
JMSL04060GDQ	PDFN5x6-8L-D	N+N	40	49	1.6	5.5	6.9	±20	36	1227	17.9
JMSH060SPGQ	PDFN5x6-8L	N	60	314	2.8	1	1.3	±20	1014	7219	102
JMSH0602MGQ	PDFN5x6-8L	N	60	225	2.8	1.3	1.7	±20	375	5874	81
JMSH0603PGQ	PDFN5x6-8L	N	60	168	2.8	1.9	2.4	±20	240	3562	50
JMSH0606PGDQ	PDFN5x6-8L-D	N+N	60	56	2.8	4.7	5.8	±20	216	1492	34

Components Recommended: Auto-grade TVS

Product Name		Package	ISO16750-2 P5A	V_{R_Max}	@ I_R	V_{BR}		@ I_T	V_{C_Max}	@ I_{PP}
Uni-Polar	Bi-Polar		Test Pulse: 10 times	(V)	(mA)	Min (V)	Max (V)	(mA)	(V)	A
SM8S22A-AL	SM8S22CA-AL	DO-218AB	US: 101V/1Ω/400ms	22	5	24.4	26.9	5	35.5	186
SM8S24A-AL	SM8S24CA-AL	DO-218AB	US: 101V/1Ω/400ms	24	5	26.7	29.5	5	38.9	170
SM8S30A-AL	SM8S30CA-AL	DO-218AB	US: 202V/4Ω/350ms	30	5	33.3	36.8	5	48.4	136
SM8S33A-AL	SM8S33CA-AL	DO-218AB	US: 202V/4Ω/350ms	33	5	36.7	40.6	5	53.3	124
SM8S36A-AL	SM8S36CA-AL	DO-218AB	US: 202V/4Ω/350ms	36	5	40.0	44.2	5	58.1	114
SM6P22A	SM6P22C	SMC	US: 87V/2Ω/150ms	22	5	24.4	26.9	5	35.5	141
SM6P24A	SM6P24C	SMC	US: 87V/2Ω/150ms	24	5	26.7	29.5	5	38.9	129
SM6P30A	SM6P30C	SMC	US: 151V/8Ω/150ms	30	5	33.3	36.8	5	48.4	103
SM6P33A	SM6P33C	SMC	US: 151V/8Ω/150ms	33	5	36.7	40.6	5	53.3	94
SM6P36A	SM6P36C	SMC	US: 151V/8Ω/150ms	36	5	40	44.2	5	58.1	86

Power Sourcing (Lightings incl.) in Automobiles

- Auto-grade power semiconductor components (MOSFET, TVS) from JJM are being extensively applied to power sourcing applications (accent lights, head lamp, incl.) in automobiles.

- Partly attributed by the advanced wafer process, the auto-grade MOSFETs offer excellent electrical characteristics such as RDS(ON) and Qg. The resultant low switching and conduction loss significantly reduce operating temperature hence they are good fit for the power conversion circuits running at high frequency to minimize BOM (bill of materials) space. The portfolio of auto-grade MOSFETs currently cover V_{DS_MIN} from 40 ~ 150V (medium-voltage category). Future releases shall be extended all the way to 650V and higher.

- The auto-grade TVS are assembled with the patented clip assembly process. Compared to the traditional A+B structure, the risk of cold joint is minimized, thermal and physical stress on the die surface are minimized, high degree of long-term operating reliability are resulted. On top, the excellent voltage clamping ability, low leakage current and fast response are typical of these auto-grade TVS. Compliance to the AEC-Q101-Rev-E stress test standards provide another further warranty to trustable operation.

Components Recommended: Auto-grade MOSFETs

Product Name	**JJM Package**	**Config-uration**	**V_{DS}– Max (V)**	**I_{D_Max} (A)**	**$V_{GS(th)\_Typ}$ (V)**	**$R_{DS(ON)\_Typ}$ @ V_{GS} = 10V (mΩ)**	**$R_{DS(ON)\_Max}$ @ V_{GS} = 10V (mΩ)**	**V_{GS_Max} (V)**	**E_{AS_Max} (mJ)**	**C_{iss_Typ} (pF)**	**Q_{g_Typ} (nC)**
JMSL06063UQ	PDFN3x3-8L	N	60	44	1.6	7.5	9.4	±20	34	1087	16.6
JMSL0610PGDQ	PDFN5x6-8L-D	N+N	60	38	1.6	8.5	10.6	±20	34	1087	16.6
JMSL0612PGQ	PDFN5x6-8L	N	60	52	1.6	9.5	12	±20	20	731	13.9
JMSL0612PKQ	TO-252-3L	N	60	57	1.7	9.9	12	±20	58	734	13.1
JMSL0620PGQ	PDFN5x6-8L	N	60	32	1.8	16	20	±20	26	409	7.5
JMSL0620PGDQ	PDFN5x6-8L-D	N+N	60	23	1.8	18	23	±20	26	409	7.5
JMSL1006PGQ	PDFN5x6-8L	N	100	110	1.8	4.7	5.9	±20	110	2604	42
JMSL1008PGQ	PDFN5x6-8L	N	100	88	1.8	6	7.6	±20	102	2200	34
JMSL1010PKQ	TO-252-3L	N	100	86	1.9	8.3	10	±20	94	1535	26
JMSL1010PUQ	PDFN3x3-8L	N	100	46	1.9	8.5	10.6	±20	45	1535	26
JMSL1018PGQ	PDFN5x6-8L	N	100	47	1.8	15	18.7	±20	29	769	12.7
JMSH1504PTLQ	PowerJE®10x12	N	150	227	3.2	3.3	4.2	±20	800	6540	88
JMSH1507PEQ	TO-263-3L	N	150	161	3.2	5.2	6.5	±20	540	4320	68
JMSH1509PGQ	PDFN5x6-8L	N	150	87	3.2	8.5	9.9	±20	331	2181	30
JMSH1535PGQ	PDFN5x6-8L	N	150	29	3.3	27	35	±20	48	760	12.3

Components Recommended: Auto-grade TVS

Product Name		**Package**	**P_{PP}**	**V_{R_Max}**	**@ I_R**	**V_{BR} (V)**		**@ I_T**	**V_{C_Max}**	**@ I_{PP}**
Uni-Polar	**Bi-Polar**		**(W)**	**(V)**	**(μA)**	**Min**	**Max**	**(mA)**	**(V)**	**A**
SMBJ22A-AU	SMBJ22CA-AU	SMB	600	22	1	24.4	26.9	1	35.5	16.9
SMBJ24A-AU	SMBJ24CA-AU	SMB	600	24	1	26.7	29.5	1	38.9	15.4
SMBJ26A-AU	SMBJ26CA-AU	SMB	600	26	1	28.9	31.9	1	42.1	14.3
SMBJ30A-AU	SMBJ30CA-AU	SMB	600	30	1	33.3	36.8	1	48.4	12.4
SMBJ33A-AU	SMBJ33CA-AU	SMB	600	33	1	36.7	40.6	1	53.3	11.3
10BJ22A-AU	10BJ22CA-AU	SMB	1,000	22	1	24.4	26.9	1	35.5	28.2
10BJ24A-AU	10BJ24CA-AU	SMB	1,000	24	1	26.7	29.5	1	38.9	25.7
10BJ26A-AU	10BJ26CA-AU	SMB	1,000	26	1	28.9	31.9	1	42.1	23.8
10BJ30A-AU	10BJ30CA-AU	SMB	1,000	30	1	33.3	36.8	1	48.4	20.7
10BJ33A-AU	10BJ33CA-AU	SMB	1,000	33	1	36.7	40.6	1	53.3	18.8
15BJ22A-AU	15BJ22CA-AU	SMB	1,500	22	1	24.4	26.9	1	35.5	42.3
15BJ24A-AU	15BJ24CA-AU	SMB	1,500	24	1	26.7	29.5	1	38.9	38.6
15BJ26A-AU	15BJ26CA-AU	SMB	1,500	26	1	28.9	31.9	1	42.1	35.6
15BJ30A-AU	15BJ30CA-AU	SMB	1,500	30	1	33.3	36.8	1	48.4	31.0
15BJ33A-AU	15BJ33CA-AU	SMB	1,500	33	1	36.7	40.6	1	53.3	28.2

Battery Management (BMS) in Automobiles

- Auto-grade power semiconductor components (MOSFET, TVS) from JJM manifest unique benefits to battery management system whose behavior is critical to NEVs (new energy vehicles).

- JJM offers auto-grade MOSFETs with ON-resistance as low as 0.56 mΩ which contribute to lower operating temperature. Assembled in state-of-the-art packaging process, the resulted power discrete component perfectly customer demands for the often conflicting requirement of high power and low heat dissipation. To name a few, auto-grade MOSFETs housed in the PDFN5x6-8L, PowerJE®7x8 (compatible with sTOLL), PowerJE®10 x12 (compatible with TOLL) offer some of the best class-leading performance in the industry. In addition, these components undergo the rigorous AEC-Q101-REV-E compliant stress tests, hence they are field proven to meet the challenge of harsh operating conditions typical of automobiles.

- The auto-grade TVS are manufactured with the patented clip assembly process. As opposed to the traditional A+B assembly, cold joint is minimized, die stress is much reduced, outstanding long-term reliability is achieved. These components achieve excellent peak pulse power P_{PP_Max} at 1kW and more in the minuscule SMB package size. Both uni-directional-bi-directional type of protection capabilities are available. Overall, the excellent electrical performance, the outstanding voltage clamping ability, the low leakage current , the fast response to incoming spurious voltage surges, and the compliance to AEC-Q101-Rev-E stress test standards make these auto-grade TVS from JJM a perfect answer to the ever demanding safety and reliability requirement upon the tens of millions of vehicles purchased by consumers nowadays.

Components Recommended: Auto-grade MOSFETs

Product Name	JJM Package	Config-uration	V_{DS}_Max (V)	I_{D_Max} (A)	$V_{GS(th)\_Typ}$ (V)	$R_{DS(ON)\_Typ}$ @ V_{GS} = 10V (mΩ)	$R_{DS(ON)\_Max}$ @ V_{GS} = 10V (mΩ)	V_{GS_Max} (V)	E_{AS_Max} (mJ)	C_{iss_Typ} (pF)	Q_{g_Typ} (nC)
JMSH0401PTLQ	PowerJE®10x12	N	40	337	2.8	1	1.25	±20	317	5280	68
JMSH0401PTSQ	PowerJE®7x8	N	40	352	2.8	0.9	1.1	±20	441	5214	66
JMSL0402MGQ	PDFN5x6-8L	N	40	198	1.6	1.3	1.7	±20	194	3125	47
JMSH0402PKQ	TO-252-3L	N	40	170	2.8	2	2.5	±20	194	3020	41
JMSL0402MGQ	PDFN5x6-8L	N	40	183	1.6	1.6	2	±20	163	3133	46
JMSH0403PGQ	PDFN5x6-8L	N	40	121	2.8	2.7	3.4	±20	216	1542	22
JMSH0403PGHWQ	PDF-N5x6-8L-HW	N+N	40	111	2.8	2.7	3.3	±20	182	1715	25
JMSL0403PGQ	PDFN5x6-8L	N	40	128	1.5	2.5	3.1	±20	79	1424	22
JMSH0406PGDQ	PDFN5x6-8L-D	N+N	40	68	2.8	5.2	6.5	±20	96	1027	14.9
JMSL0406PUQ	PDFN3x3-8L	N	40	57	1.6	4.5	5.6	±20	36	1204	17.9
JMSH0406PUQ	PDFN3x3-8L	N	40	59	2.8	4.8	6	±20	96	1032	15.4
JMSL0406PKQ	TO-252-3L	N	40	78	1.6	4.7	5.6	±20	36	1204	17.9
JMSH0406PKQ	TO-252-3L	N	40	73	2.8	5	6.2	±20	96	1027	15.2
JMSH0406PGQ	PDFN5x6-8L	N	40	90	2.8	4.1	5.1	±20	96	1027	14.9
JMSL0406PGQ	PDFN5x6-8L	N	40	90	1.6	4.2	5.2	±20	36	1204	17.9

Components Recommended: Auto-grade TVS

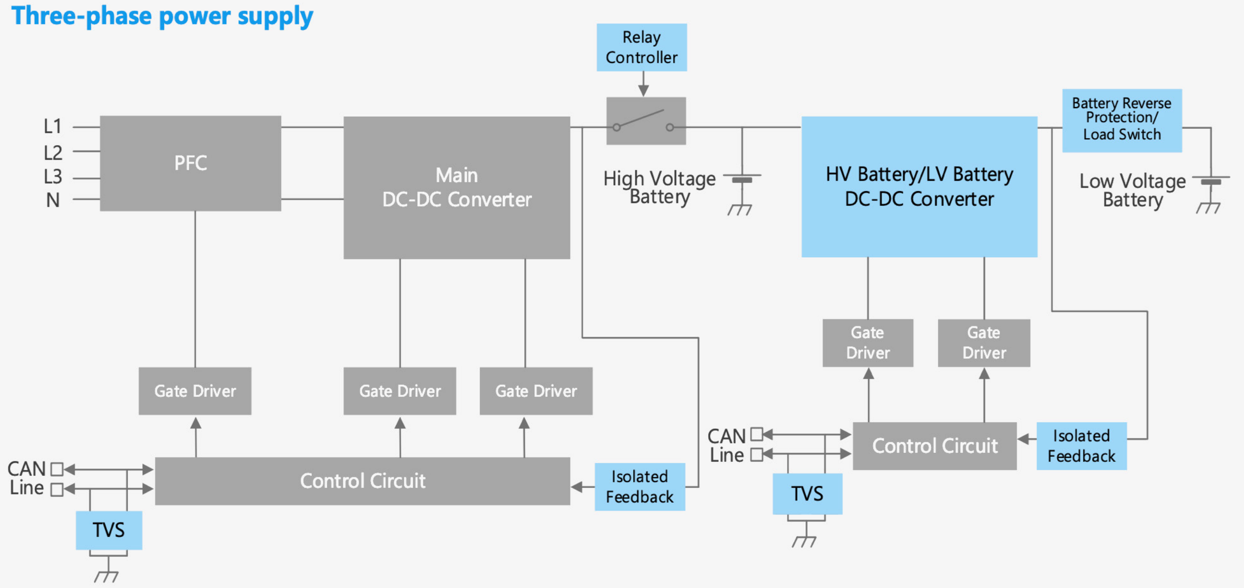
Product Name		Package	P_{PP}	V_{R_Max}	@ I_R	V_{BR} (V)		@ I_T	V_{C_Max}	@ I_{PP}
Uni-Polar	Bi-Polar		(W)	(V)	(mA)	Min	Max	(mA)	(V)	A
SMBJ22A-AU	SMBJ22CA-AU	SMB	600	22	1	24.4	26.9	1	35.5	16.9
SMBJ24A-AU	SMBJ24CA-AU	SMB	600	24	1	26.7	29.5	1	38.9	15.4
SMBJ26A-AU	SMBJ26CA-AU	SMB	600	26	1	28.9	31.9	1	42.1	14.3
SMBJ30A-AU	SMBJ30CA-AU	SMB	600	30	1	33.3	36.8	1	48.4	12.4
SMBJ33A-AU	SMBJ33CA-AU	SMB	600	33	1	36.7	40.6	1	53.3	11.3

CHARGING STATION

NEV (new energy vehicle) Charging Station operate in similar fashion as the fuel dispensers in typical gas station. They are either secured to the ground or wall-mounted. Nowadays, charging station are commonly installed in public establishments (government & commercial buildings, shopping malls, restaurants, banks, hotels, underground & ground-level parking lots, etc.) and private properties (1/2-car attached garages, parking lots, etc.) in residential area to refill the battery energy depleted at standard / fast speed depending on the capability of the charging and the receiving ends. The input of charging station is directly connected to the provincial / national electric power grid while the output end is equipped with a bulky charging plug with AC / DC output voltage level.

Today, many NEV charging station provide more than one charging plug with VAC output to facilitate standard (7 ~ 22kW) to rapid (CCS type for 50 ~ 350kW). In comparison, the CHAdeMO type charging plug provides VDC output at 25 ~ 100kW. The typical 'slow' charging station is designed to output VAC in either single-phase or three-phase to provide charging rate at 7 / 22 / 40 kW. This is converted into DC voltage by the OBC (on-board charger) inside the NEV to recharge the on-board battery storage. Such 'slow' charger is generally installed in residential & commercial parking lots. Charging station with VDC output (also known as 'off-board charger') directly re-charge the on-board battery storage without the OBC. Such charging station are typically designed to support high charging rate at 60 / 120 / 200 kW or more

Three-phase power supply



The AC power from the grid are fed into the OBC of an NEV through the charging station. The OBC converts VAC to VDC in order to re-charge the on-board battery storage, typically through some kind of distribution box. On the other hand, charging station with VDC output embeds inside a number of AC-to-DC power modules connected in series & parallel configuration. In view of the commercial offerings in the market, there exist 3 major trends: 1) multiple output levels with each at a constant power rating; 2) multiple output voltages with each at a constant charging current; 3) multiple high-power modules connected in series & parallel configuration.

In charging station with VDC output, there are two key power stages. The PFC (power factor correction) stage maintains the phase relationship between input current and voltage. As a result, the total harmonic distortion (THD) cast upon the current in the AC power grid are significantly reduced. The reactive power dissipated are minimized and the overall energy efficiency are improved.

In charging station with VDC output, the second key power stage is the DC-DC up-inverter. This takes the DC-level output from the PFC stage and converts it to the voltage level required for battery charging. The output voltage and current of the up-inverter vary over time depending on the overall health and charge level of the on-board battery storage.

JJM offers a wide range of automotive-grade power discrete semiconductor components to suit the PFC and DC-DC up-inverter (primary-side and secondary-side rectification) power stages. These include, rectifier bridges, FRED (fast recovery epitaxy diode), TVS (transient voltage suppressor), ESD protection for the CAN communication port, low-VF schottky rectifiers, and power MOSFETs.

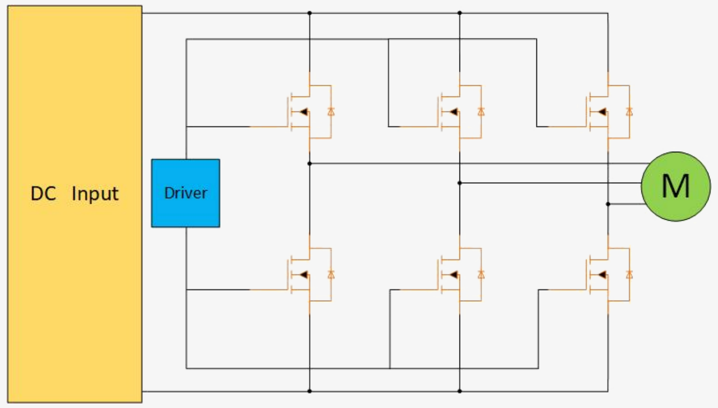
Components Recommended: Auto-grade Epitaxial Fast Recovery Rectifiers

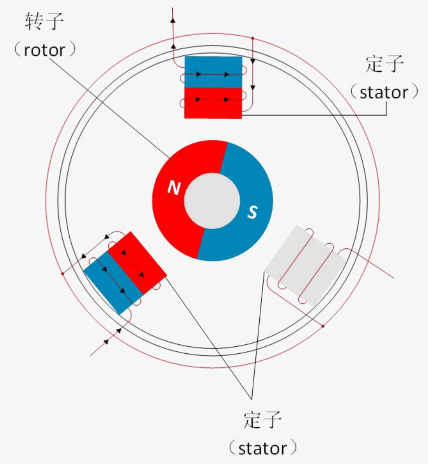
Product Name	$I_{F(AV)\_Max}$ (A)	V_{RRM_Max} (V)	I_{FSM_Max} (A)	I_{FSM_Max} (A)	I_{R_Max} (mA)	Q_{r_Max} (nC)	t_{rr_Max} (ns)	JJM Package
JECR3006SL	30.0	600	270	2.8	5.0	50.0	22	TO-247J-2L
JECR6006SL	60.0	600	600	2.4	5.0	74.0	50	TO-247J-2L

Components Recommended: Auto-grade ESD over CAN Ports

Product Name	Direction	V_{RRM_Max} (V)	V_{BR_Min} (V)	V_{C_Max} (V)	@ I_{PP} (A)	I_{r_Max} (mA)	P_{PP_Max} (W)	$V_{ESD\text{-}Air}$ (kV)	$V_{ESD\text{-}Contact}$ (kV)	C_{J_Typ} (pF)	JJM Package
JEB24T2BH	Bi-dir	24.0	26.7	60.0	6	1.00	350	±30	±30	15	SOT-23

BLDC





Motor based on the BLDC (brush-less direct current) overcomes the congenital defect of brushed DC motor, in which the mechanical commutators are replaced by electronic commutators. As such, BLDC motor offers the benefit of easy speed adjustment of the brushed DC motor as well as the simple structure of typical AC motor. On top, BLDC motor does not create high-voltage sparks when the direction of rotation is changed, operates reliably, and is easy to maintain. Because electronic inverter is used to convert the direct current input into alternating current to drive the respective stator coils, BLDC motor is effectively a three-phase PMAC (permanent magnet synchronous AC motor) with sensor output to tell the rotor position.

The MOSFETs from JJMICROELECTRONICS (a.k.a. JJM®) are being extensively used in motor driving within power tools, fans, electric bicycles, garden tools, vacuum cleaners, electric fans. They exhibit the following properties.

01 Outstanding ON-resistance $R_{DS(ON)}$ to minimize the operating temperature and conduction loss, strong avalanche performance EAS to sustain high surge without damage (e.g. JMTG035N04A)

02 Exceptional input gate charge Qg hence low switching loss and the ability to support high switching frequency. All these allow the operating temperature to be reduced and better longterm reliability to be achieved

03 V_{DS_MIN} ranges from 30V to 200V, $R_{DS(ON)}$ is as low as 0.55mΩ (e.g. JMSL030SAG) and 0.56mΩ (e.g. JMSL040SAG), FOM is as low as 47

04 Assembled in highly thermal efficient power packages like PDFN3x3/5x6-8L, DFN2020-6L, TO-220/247/251/252/263- 3L, SOP-8L, SOT-23, SOT-23-3/6L, etc.

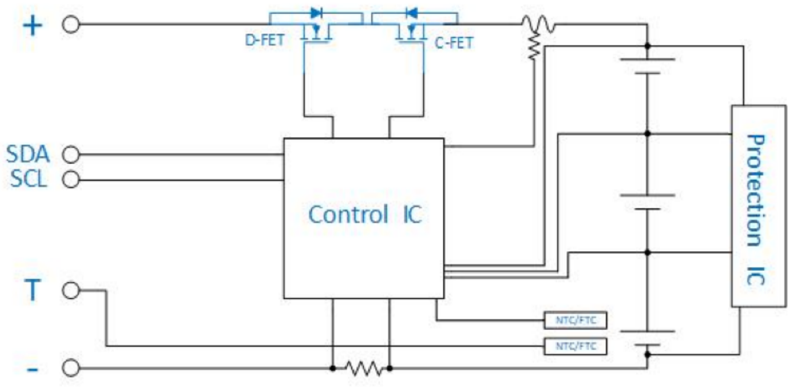
05 All electrical parameters exhibit negligible lot-to-lot variation and good long-term reliability

06 Complete product portfolio to meet the diversified requirement on performance requirement, price expectation, and application space constraint, etc.

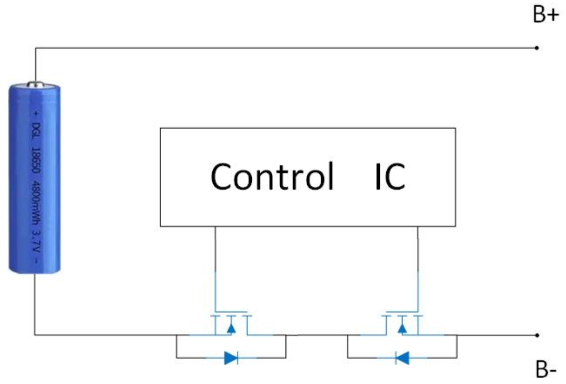
Depending on the breakdown voltage VBR(DSS)_MIN requirement, JJM offers V_{DS_MIN} = 30 ~ 100V Trench & SGT MOSFETs based on trench or SGT technology platform from 30V to 200V for motor driving under various application environment. System engineers simply select the right MOSFETs based on output power and peak/average current requirement.

Components Recommended: MOSFETs

11.1 ~ 21.0V (3 ~ 5 cells in series)		18.5 ~ 29.4V (5 ~ 7 cells in series)		25.9 ~ 36.0V (7 ~ 9 cells in series)		> 36V (> 9 cells in series)	
30V		40V		60V		≥80V	
Product Name							
JMSL030STG	JMTG3002B	JMSL040SPG	JMSL0403AG	JMSL0601TG	JMTG060N06A	JMSH0803MG	JMSH1003NG
JMSL0301TG	JMTG3003A	JMSL0401PG	JMTG4004A	JMSL0601TG	JMTK060N06A	JMSL0803MG	JMSL1004RG
JMSL0302PG	JMTG040N03A	JMSL0401TG	JMTK4004A	JMSL0602MG	JMTK80N06A	JMSH0804NG	JMSH1006PG
JMSL0302PG	JMTG3005A	JMSL0402PG	JMTK4005A	JMSL0603PG	JMTE035N06D	JMSH0803AGS	JMSH1008PG
JMSL0303TG	JMTK3002B	JMSL0402TG	JMSL0406AK	JMSL0606PG	JMTG070N06A	JMSH0805PG	
JMTK3003A	JMTK3004A		JMTG035N04A		JMTG100N06A		
JMTK3005A	JMTK3006B						



High-side Configuration



Low-side Configuration

With our everyday livings being more harmonized with green environment and surrounded by increasingly IA (artificial intelligence) injected merchandise, battery packs based on different chemicals have become part of our digital lifestyle. They exist, in various forms & sizes, inside smart phones, wearables, laptops, electronic toys, robot vacuum cleaners, E-bikes, power tools, UAVs (unmanned aerial vehicles), robots, power banks, portable energy storage, NEVs (new energy vehicles) and the traditional ICE (internal combustion engine) based vehicles. BMS (Battery management system) is instrumental to how well the battery pack operates and how reliable the operation is. In typical operation, BMS first collects the state of charge of the battery pack, analyze the loading and subsequently exchange the key information with the relevant sub-systems outside of the battery pack. Along the way, BMS has to make balance act upon all the units inside the battery pack, determine if any of the units is to be shut down, or be re-charged at a specific rate, or continue to release its stored energy at a specific rate. All these decision must be made depending on the real-time condition inside and outside of the battery pack, while safety must be ensured at all time.

Regardless of the type of materials used in each renewable battery cell, BMS is a system capable of real-time monitoring and management of battery pack. The electrical properties of each battery cell is monitored in real time, diagnosis of the state of charge is subsequently carried out, warning are given and action are taken whenever appropriate, charging/pre-charge/discharge and charge-balancing are executed in accordance to the operating environment like thermal condition. Key objectives are: protect the battery cells from hazardous damage, improve the health of the individual battery cells, ensure the safe operation of the aggregated battery pack.

Why is BMS needed?

01 Safe operation of the battery pack: Over-discharge may cause permanent damage to battery cells. Over-heated and over-charged battery cells may cause unexpected rupture and subsequent explosion.

02 Functional requirements: During operation, it is necessary to know the capacity of the energy stored in the battery pack in real time. Load / Charge balancing must be vigorously taken care of in order to maintain the good health of the battery pack. BMS achieves these by carefully controlling the operating temperature.

The low / medium-voltage power MOSFETs from JJMICROELECTRONICS (a.k.a. JJM®) are extensively used for BMS in battery packs shipped within and outside of domestic China. They offer the following features and advantages.

- With the pitch size between two neighboring cells smaller than 1μm, die area of the MOSFET is optimized to achieve the best power density possible
- Low internal ON-resistance and input gate charge contribute to the excellent condition and switching losses of the MOSFETs
- Because of good consistency upon the ON/OFF threshold voltage level across all MOSFETs manufactured, bin management at FT stage is trivial, multiple MOSFETs can be connected in parallel to facilitate large output current without any of them being falsely turned ON
- All MOSFETs exhibit high UIS avalanche breakdown capability and are 100% screened for their UIS performance at the FT (final test) stage during production
- Because these MOSFETs are housed in packages with outstanding thermal properties (i.e. low thermal resistance), high level of continuous output current can be supported

For BMS application, JJM offers MOSFETs housed in different packages and with V_{DS_MIN} covering 30 ~ 200V. These components are based on either SGT or trench technology platform. System designers simply choose the right MOSFET based on the loading requirement (e.g. power rating of the motor being driven) and the output current needed.

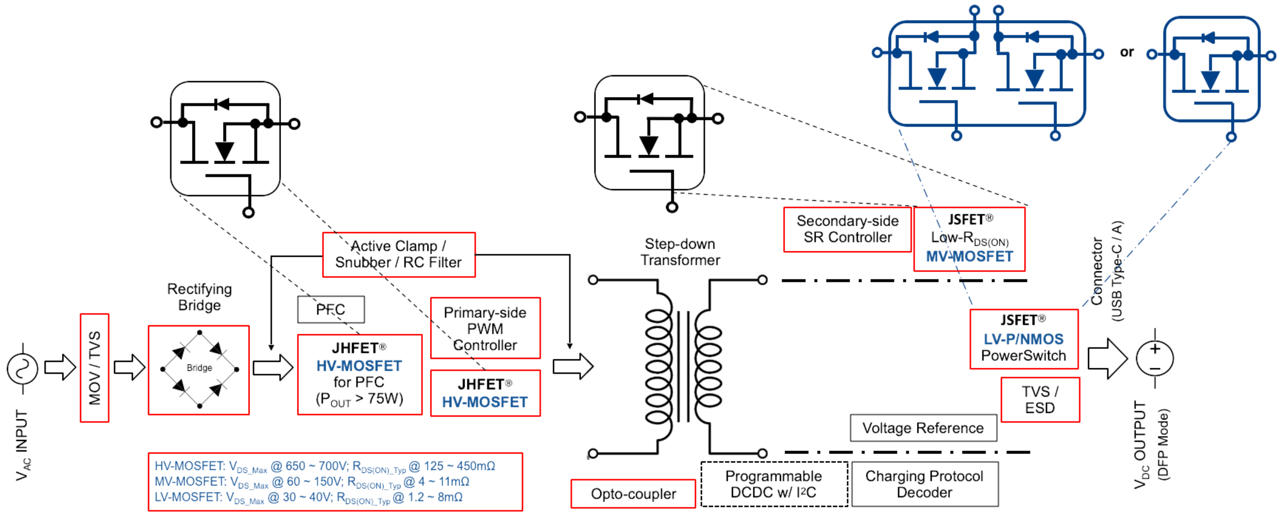
Components Recommended: MOSFETs

Battery Voltage	11.1 ~ 21.0V (3 ~ 5 cells in series)		18.5 ~ 29.4V (5 ~ 7 cells in series)		25.9 ~ 36.0V (7 ~ 9 cells in series)	> 36V (> 9 cells in series)
MOSFET V_{DS}	30V		40V		60V	≥80V
Product Name						
MOSFET Typically Used at Output Terminals of BMS	JMSL030STG	JMTG018N03A	JMSL040SPG	JMSH0403TG	JMSL0606PK	JMSH0803ME
	JMSL0301TG	JMTG3002B		JMTG4004A	JMSL0606PE	JMSH0804NE
	JMSL0302PG	JMTG3003A	JMSL0401PG	JMTK4004A	JMTK060N06A	JMSH1003NE
	JMSL0303TG	JMTG040N03A	JMSL0401TG	JMTK4005A	JMTK80N06A	JMSH1004NE
	JMSL0307PG	JMTG3005A	JMSL0402PG	JMSL0406AK	JMTK70N07A	JMSH1006PE
	JMTK3003A	JMTK3002B	JMSL0402TG	JMTG035N04A	JMTE035N06D	JMSH1008PE
	JMTK3005A	JMTK3004A			JMTK58N06B	
		JMTK3006B				
MOSFET Typically Used for Battery Charging	JMTL3401A	JMTP9435A	JMTL850P04A	JMTP520P04A		
	JMTP4953A	JMTP4435A	JMTP440P04A			

Components Recommended: TVS

Product Name		V_{R_Max}	I_{R_Max} @ VR	V_{BR_Min} @ IT	V_{BR_Max} @ IT	I_{T_Max}	V_{C_Max} @ IPP	I_{IPP_Max}
Uni-Polar	Bi-Polar	(V)	(µA)	(V)	(V)	(mA)	(V)	(A)
SMCJ5.0A	SMCJ5.0CA	5	300	6.4	7	10	9.2	163
SMCJ6.0A	SMCJ6.0CA	6	250	6.67	7.37	10	10.3	145.6
SMAJ5.0A	SMAJ5.0CA	5	120	6.4	7	10	9.2	43.5
SMAJ6.0A	SMAJ6.0C	6	120	6.67	7.37	10	10.3	38.8
SMBJ5.0A	SMBJ5.0CA	5	120	6.4	7	10	9.2	65.2
SMBJ6.0A	SMBJ6.0CA	6	120	6.67	7.37	10	10.3	58.3
SMDJ5.0A	SMDJ5.0CA	5	800	6.4	7	10	9.2	326.1
SMDJ6.0A	SMDJ6.0CA	6	800	6.67	7.37	10	10.3	291.3
5.0SMDJ11A	5.0SMDJ11CA	11	5	12.2	13.5	10	18.2	275
5.0SMDJ12A	5.0SMDJ12CA	12	5	13.3	14.7	10	19.9	252

FAST CHARGER



In view of the latest effort by European Commission for universal chargers announced on Oct. 4, 2022, fast chargers equipped with USB-C® (EN IEC 62680-1-3:2021 Stds.) shall become a common scene from the end of CY2024. As far as the current state stands in Q4CY2022, fast chargers with output power ranging from 18W to 100W (even 120W or greater) and with one or more USB Type-A and Type-C output ports, which support fast charging protocols (USB PD3.0/3.1, USB BC1.2, UFCS T/TAF 083-2022, Qualcomm QCxx, MediaTek PExxx, Huawei S/FCP, Oppo D/FCP, Samsung AFC, Apple 2.4A, etc.) have already been proliferating among consumers who embrace digital life style and green energy. They are commonly used to re-charge the battery embedded in mobile AIoT or EIoT (artificial or edge internet-on-thing) products such as smartphones, tablets, smart watches, AWS earphones, and laptops. The more advanced design are equipped with 3rd-generation WBG (wide-band-gap) power semiconductor devices (gallium nitride D/E-mode HEMT). In spite of the physically compact size, they do not generate excessive high temperature that may cause hand injuries. On top, many of the world's top smartphone OEMs stop bundling chargers with their new generation of smartphones in recent years. This results in the hockey-stick effect such that these compact faster chargers have become mainstream in the market.

Flyback and LLC are the commonly used topologies in the AC/DC power conversion sub-system in the fast chargers. Flyback topology is frequently used in designs with output power less than 65W while LLC topology are typically found in fast chargers with output power of 90W and higher to meet the power efficiency required by the regulatory bodies in the world. Due to the relatively lower BOM cost that those of the LLC topology, ACF-Flyback topology is adopted by more and more medium-power designs. For example, it is favoured by many designs in which the 3rd-generation WBG (wide band-gap) GaN (gallium nitride) based HEMTs (high electron mobility transistor) are incorporated. Independent of the topology used, the internal block diagram of a typical fast charger is shown here.

JJMICROELECTRONICS (a.k.a. JJM®) offers a rich portfolio of discrete semiconductor components to the implementation of fast chargers. These include anti-surge MOV and TVS at the AC input end, FRD (fast recovery diodes) that suppress the voltage spikes caused by the transformer leakage, HV MOSFETs which perform the down conversion (high-voltage DC to low-voltage DC) and PFC (75W+ design) function in the primary-side, MV/LV MOSFETs for synchronous rectification and power-switching at the USB Type-A/C ports, ESD protection for the USB PD (power delivery) protocol decoder IC, etc.

Components Recommended for Primary-side: FRDs used in PFC

Product Name	Charger's O/P (W)	$I_{F(AV)\_Max}$ (A)	VRRM_Max (V)	I^{FSM_Max} (A)	V_{F_Max} (V)	@ I_F (A)	I_{R_Max} (mA)	C_{J_Max} (pF)	t_{rr_Max} (ns)	JJM Package
RS1010FL	20 ~ 65	1.0	1000	25	1.3	1.0	5.0	7.0	500	SOD-123FL
RS1MAF	20 ~ 65	1.0	1000	30	1.3	1.0	5.0	7.0	500	SMAF
RS3MB	90 ~ 120	3.0	1000	100	1.3	3.0	5.0	30.0	500	SMB
US5M	90 ~ 120	5.0	1000	125	1.7	5.0	5.0	35.0	75	SMC

Components Recommended for Secondary-side: ESD Protection over USB Type-A & Type-C Ports

Product Name	Pin(s) Protected	Direction	V_{RWM_Max} (V)	V_{BR_Min} (V)	V_{C_Max} (V)	@ I_{PP} (A)	I_{R_Max} (mA)	P_{PP_Max} (W)	$V_{ESD-Air}$ (kV)	$V_{ESD-Contact}$ (kV)	C_{J_Typ} (pF)	JJM Package
JEU24P3	VBUS	Uni-dir	24.0	26.0	35.0	200	0.50	5,100	±30	±30	750	DFN 2x2-3L
JEU12N3		Uni-dir	12.0	13.0	32.0	180	1.00	4.500	±30	±30	950	
JEU12T-2BL	CC0 / CC1	Uni-dir	12.0	13.0	26.0	20	0.15	500	±30	±30	90	SOT23
US5M		Uni-dir	5.0	6.0	16.7	18	1.00	350	±15	±8	150	
JEB12C	D+ / D-	Bi-dir	12.0	13.3	30.0	12	1.00	350	±30	±30	1.0	SOD-323
JEB03CX		Bi-dir	3.3	3.6	17.5	20	0.10	350	±30	±30	1.0	

01 At the primary-side of a typical AC-DC fast chargers, regardless of whether the HV MOSFETs or the fast proliferating GaN-based e-Mode HEMT is populated, JJM provides the HV SJ (super-junction) MOSFETs which is based on the advanced JHFET® technology platform for PFC switching. At the secondary-side, the MV/LV SGT (shielded-gate trench MOSFETs which is based on the advanced JSFET® technology platform provide reliable and high-efficiency operation for synchronous rectification and output current switches at the USB-C® port.

02 The JHFET-based N-ch SJ MOSFETs at V_{DS_MIN} = 650V from JJM offer ON-resistance $R_{DS(ON)}$ as low as 35 mΩ, Qg at down to 9.7 nC, C_{iss} as small as 333 pF. All these SJ MOSFETs were tested to pass the UIS test during FT (final test) stage at the A/T (assembly & test) sites. The N-ch SGT MOSFETs which is based on the JSFET technology platform offer V_{DS_MIN} at 30 ~ 200V.

03 Their ON-resistance RDS(ON) are as low as 0.55 mΩ, Qg are at down to 2.3 nC, and FOM are as small as 47. Again, all these SGT MOSFETs were tested to pass the UIS test during FT stage at the A/T sites. With extremely low C_{iss}, C_{oss}, C_{rss} and Q_g and superior SOA (safe operation area), etc., these power semiconductor devices effectively address the challenges of soft/hard switching, spurious voltage spikes induced by inductive loadings, EMI, etc. Such outstanding static and dynamic electrical properties are attributed to the patented JSFET and JHFET technology platforms of JJM. Overall, the performance of these SGT and SJ MOSFETs are at world class levels.

Components Recommended for Primary-side: HV MOSFETs used in PFC and PWM Switching

Product Name	JJM Package	Compatible Industry-common Package	Plat-form	Configuration	V_{DS_Max} (V)	I_{D_Max} (A)	$V_{GS(th)\_Typ}$ (V)	$R_{DS(ON)\_Typ}$ @ V_{GS}=10V (mΩ)	$R_{DS(ON)\_Max}$ @ V_{GS}=10V (mΩ)	V_{GS_Max} (V)	C_{iss_Typ} (pF)	Q_{g_Typ} (nC)	E_{AS_Max} (mJ)	FOM	Applicability
JMH65R190APLN	DFN8080-4L	-	SJ	N	650	17	3.5	169	190	±20	1,560	38.0	405	6,422	for P_{OUT} > 100W
JMH65R190AF	TO-220FP-3L	-	SJ	N	650	20	3.5	170	190	±20	1,560	38.0	405	6,460	for P_{OUT} > 100W
JMH65R290APLN	DFN8080-4L	-	SJ	N	650	10	3.5	262	290	±20	1,056	22.0	281	5,764	for P_{OUT} ≤ 100W
JMH65R290ACFP	TO-220FP-NL	-	SJ	N	650	12	3.5	260	290	±20	1,056	22.0	281	5,720	for P_{OUT} ≤ 100W
JMH65R430APLN	DFN8080-4L	-	SJ	N	650	10	3.5	370	430	±20	703	18.4	180	6,808	for P_{OUT} ≤ 65W
JMH65R430AF	TO-220FP-3L	-	SJ	N	650	11	3.5	364	430	±20	703	18.4	180	6,698	for P_{OUT} ≤ 65W
JMH65R430ACFP	TO-220FP-NL	-	SJ	N	650	11	3.5	364	430	±20	703	18.4	180	6,698	for P_{OUT} ≤ 65W
JMH65R430AK	TO-252-3L	DPAK	SJ	N	650	11	3.5	370	430	±20	703	18.4	180	6,808	for P_{OUT} ≤ 65W
JMH65R490AFFD	TO-220FP-3L	-	SJ	N	650	5	3.5	430	490	±20	677	20.0	180	8,600	for P_{OUT} ≤ 45W
JMH65R980AFFD	TO-220FP-3L	-	SJ	N	650	4	3.5	895	980	±20	343	10.1	72	9,040	for P_{OUT} ≤ 20W
JMH65R980AK	TO-252-3L	-	SJ	N	650	4	3.5	900	980	±20	333	9.7	80	8,730	for P_{OUT} ≤ 20W

Components Recommended for Secondary-side: MV MOSFETs used in Synchronous Rectification

Product Name	Package	Compatible Industry-common Package	V_{DS_Max} (V)	I_{D_Max} (A)	$V_{GS(th)\_Typ}$ (V)	$R_{DS(ON)\_Typ}$ @ V_{GS}=10V (mΩ)	$R_{DS(ON)\_Max}$ @ V_{GS}=10V (mΩ)	VGS_Max (V)	Ciss_Typ (pF)	Qg_Typ (nC)	EAS_Max (mJ)	FOM	Applicability
JMSL0608PP	SOP-8L	SOP-8L	60	14	1.7	7.9	10.3	±20	1,178	21.0	74	166	for P_{OUT} < 65W
JMSL0608PG	PDFN5x6-8L	SuperSO8	60	79	1.7	6.9	8.0	±20	1,193	22.0	89	136	for P_{OUT} < 65W
JMSL1004RG	PDFN5x6-8L	SuperSO8	100	98	1.6	4.1	5.4	±20	5,082	80.0	373	328	for P_{OUT} ≥ 100W
JMSL1005PG	PDFN5x6-8L	SuperSO8	100	128	1.6	4.3	5.7	±20	4,892	77.0	402	331	for P_{OUT} ≥ 65W
JMSH1006PG	PDFN5x6-8L	SuperSO8	100	76	3.0	5.0	6.4	±20	3,144	51.0	356	255	for P_{OUT} ≥ 65W
JMSL1009PG	PDFN5x6-8L	SuperSO8	100	83	2.0	5.3	6.4	±20	2,420	43.0	216	228	for P_{OUT} < 65W
JMSL1010PG	PDFN5x6-8L	SuperSO8	100	74	2.0	6.4	7.7	±20	1,959	36.0	96	230	for P_{OUT} < 65W
JMSL1018PG	PDFN5x6-8L	SuperSO8	100	54	1.8	12.8	16.7	±20	969	18.0	74	230	for P_{OUT} < 65W
JMSL1018AP	SOP-8L	SOP-8L	100	8	1.9	15.8	19.8	±20	769	12.7	24	201	for P_{OUT} < 65W
JMSH1207AG	PDFN5x6-8L	SuperSO8	120	94	3.0	5.6	7.0	±20	2,208	35.0	135	196	for P_{OUT} ≥ 65W
JMSH1509PG	PDFN5x6-8L	SuperSO8	150	80	3.2	8.4	9.9	±20	3,569	53.0	542	255	for P_{OUT} > 65W

Components Recommended for Secondary-side: LV/MV MOSFETs used in USB-C (DFPmode) output port for V_{BUS}

Product Name	JJM Package	Compatible Industry-common Package	Platform	Configuration	V_{DS_Max} (V)	I_{D_Max} (A)	$V_{GS(th)\_Typ}$ (V)	$R_{DS(ON)\_Typ}$ @ V_{GS}=10V (mΩ)	$R_{DS(ON)\_Max}$ @ V_{GS}=10V (mΩ)	V_{GS_Max} (V)	C_{iss_Typ} (pF)	Q_{g_Typ} (nC)	E_{AS_Max} (mJ)	FOM	Applicability
JMTQ080P03A	PDFN3x3-8L	PQFN 3x3	Trench	P	-30	-45	-1.5	5.8	7.3	±20	4,650	45.0	144	261	for $I_{OUT} \geq 3A$
JMTQ100P03A	PDFN3x3-8L	PQFN 3x3	Trench	P	-30	-40	-1.6	7.5	10.0	±20	3,564	37.0	121	278	for $I_{OUT} < 3A$
JMSL0302AU	PDFN3x3-8L	PQFN 3x3	SGT	N	30	145	1.7	1.2	1.5	±20	2,975	39.0	101	47	for $I_{OUT} \geq 5A$
JMSL0302BU	PDFN3x3-8L	PQFN 3x3	SGT	N	30	135	1.6	1.5	1.9	±20	2,526	39.0	94	60	for $I_{OUT} \geq 5A$
JMSL0302BU	PDFN3x3-8L	PQFN 3x3	SGT	N	30	119	1.6	1.8	2.2	±20	2,091	39.0	61	58	for $I_{OUT} \geq 5A$
JMSL0310AU	PDFN3x3-8L	PQFN 3x3	SGT	N	30	60	1.7	4.0	5.0	±20	866	13.5	20	54	for $I_{OUT} < 5A$
JMSL0315AU	PDFN3x3-8L	PQFN 3x3	SGT	N	30	43	1.7	7.0	8.8	±20	468	7.7	9	54	for $I_{OUT} < 3A$
JMSL0315AUD	PDFN3x3-8L-D	-	SGT	N + N	30	36	1.7	8.8	11.0	±20	468	7.7	9	68	for $I_{OUT} \leq 2A$
JMSL0402AU	PDFN3x3-8L	PQFN 3x3	SGT	N	40	119	1.5	2.0	2.5	±20	2,131	36.0	126	72	for $I_{OUT} \leq 2A$
JMSL0403PU	PDFN3x3-8L	PQFN 3x3	SGT	N	40	85	1.7	1.9	2.5	±20	2,510	42.0	212	80	for $I_{OUT} \leq 5A$
JMSL0406PU	PDFN3x3-8L	PQFN 3x3	SGT	N	40	59	1.6	3.5	4.5	±20	1,474	27.0	36	95	for $I_{OUT} < 5A$

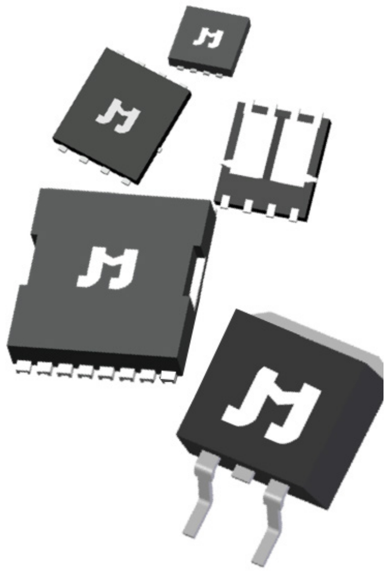
JJM focuses on the end markets of consumer electronics, computing & peripherals, industrial, communication and automotive endsystems. In order to make sure that all the MOSFET produced meet the stringent requirement of the individual applications, JJM spent tremendous effort to study the markets and the needs of the customers. As a result, the electrical properties and performance of each JSFET / JHFET produced always deliver the best energy efficiency and long-term reliability without any compromise to cost-effectiveness. Because of the continual pursuit of compactness by consumers, chargers for mobile 3C (computing, communications, consumer electronics) products are getting smaller and smaller.

The limited application space inside the charger housing inevitably present a hostile operating environment, thus presenting a heavy toll on the long-term reliability and operation stability upon the power semiconductor devices used. JSFETs and JHFETs easily meet such demand at reasonable cost without any let-up in energy efficiency. JSFETs and JHFETs are available in packages like the low-profile PDFN3x3/5x6/8x8, and the legacy TO-220/247/251/252/263 & SOP-8, etc. The lead-frame, wire/ribbon/clip bonding, and epoxy materials used in the assembly of these MOSFETs are optimized to sustain high level of electrical stress to keep the thermal resistance low. Last but not the least, RoHS and halogen-free compliance are always standard with the MOSFETs from JJM.

LEADING PRODUCT INTRODUCTION

100 Auto-grade 40~150V N-ch JSFET®

Increasingly Found Homes in Automobiles



Of these 100 auto-grade devices, the dies inside and the A/T were all produced at manufacturing sites certified for IATF 16949. All devices passed the AEC-Q101 compliant tests. Outstanding electrical characteristics like RDS(ON) of 0.56 ~ 57m Ω, Qg of 5.3 ~ 155.0nC, FOM of 55 ~ 354 ensure reliable operation in harsh operating environment.

In the thermally efficient SM-type PowerJE®10x12, PDFN3x3 / 5x6-8L/-D, TO-252/263-3/7L, materials used (lead frame, solder, epoxy, etc.) and the manufacturing steps (wire/clip bonding, die-attach, polyimide over die-top, etc.) are of MSL1 to minimize mechanical thermal stress. As such, stable operation over TJ = -55 ~ 175 °C are resulted. All devices shipped are halogen-free & RoHS-compliant.

Key Aspects of 40~150V Q-grade JSFET®

Parametric Performance to Meet the Challenge

Exceptional $R_{DS(ON)\_Typ}$ at down to 0.56mΩ, FOM as small as 55, E_{AS_Max} as high as 1,634mJ lead to reliable operation under the harsh working environment typical of automobiles.

Parametric Performance to Meet the Challenge

All devices passed the stringent AEC-Q101 qualification @ 3 lots & T_J = 175°C. Wafer and A/T production facilities are IATF 16949 certified for quality management.

Unclamped Inductive Switching Tested

Fully UIS tested during production to confirm the device's ability to withstand the avalanche energy common in both resistive and inductive type of loads.

Robust & Thermal Efficient Packages

SM-type PowerJE®10x12, PDFN3x3/5x6-8L/-D, TO-252-3L, TO-263-3/7L with high immunity to thermal-mechanical stress enable reliable operation under excessively low / high ambient temperature

Market Applications

01 DC/DC boost for mini/LED backlighting in infotainment, LED driving in matrix headlights

02 Power stages for low / medium-power BLDC/DC motor driving in BCM (body control module) & fuel pump & EPS (electronic power steering), wireless charging

03 High/Low-side switching in POL DC/DC (e.g. HPC for automotive gateway & domain controller, SR rectification in OBC)

04 V_{BUS} power switch for USB PD 3.0/3.1 compatible DC output via USB Type-C® connectors

05 Load switching in various vehicle electrical systems of ICE-based and new-energy PHEV / BEV

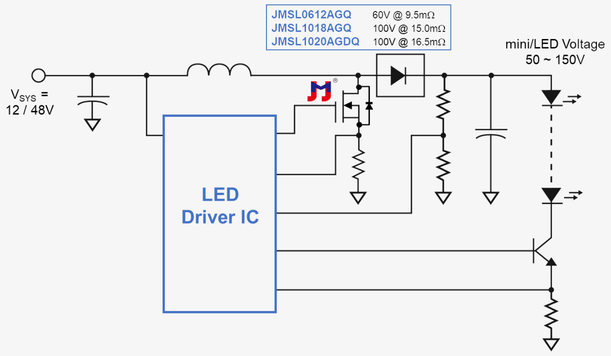


Figure 1: DC/DC Boost in mini/LED Backlighting

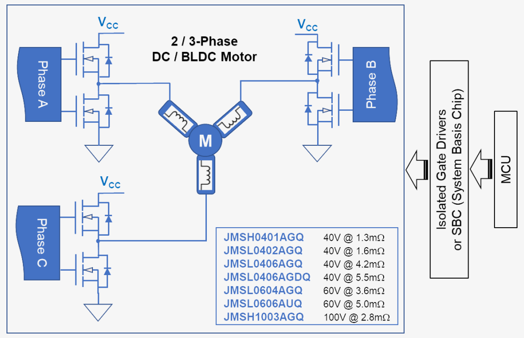
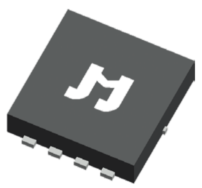
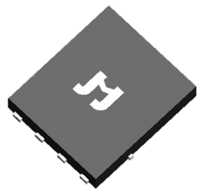


Figure 2: DC/BLDC Motor Driving

These 40 ~ 150V SGT MOSFETs are well suited for applications inside automobiles. Their long-term reliability were tested per AEC-Q101 quality standards. JMSL0406AGQ and its dual-die variant JMSL0406AGDQ are popular in body control module (BCM) for use cases like low-power DC motor driving. With $R_{DS(ON)}$ down to 1.3mΩ, JMSH041AGQ fits the power efficiency requirement of mid/high-power DC motors. Typical applications are: multi-way power seat, power tailgate, centralized door lock, ESC (electronic stability control). At V_{DS_Max} = 100V and assembled in the low-profile PDFN5x6-8L package, JMSH0401AGQ is good for LED backlighting in flat panel display of the infotainment/ADAS unit. In contrast, JMSL1020AGDQ drives two strings of high-brightness LEDs simultaneously for backlighting in larger panel.

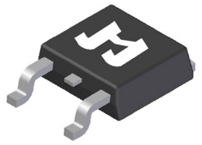


PDFN3x3-8L

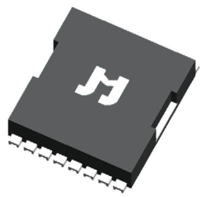


PDFN5x6-8L

PDFN5x6-8L-D

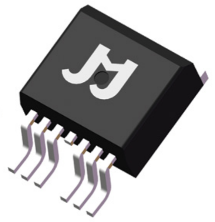


TO-252-3L



PowerJE®10x12

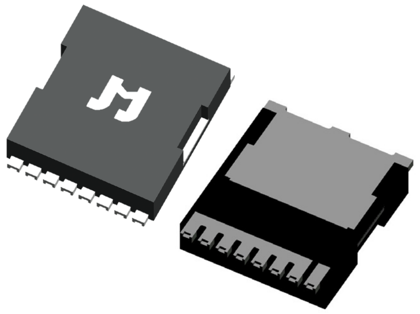
TO-263-3L



TO-263-7L

LEADING PRODUCT INTRODUCTION

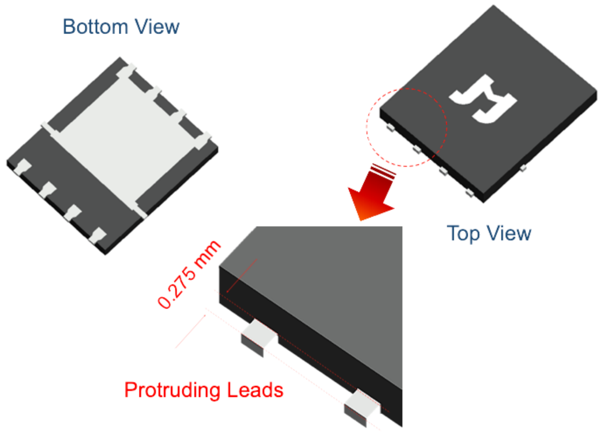
JJMICROELECTRONICS launched its start-of-the-art PowerJE® 10x12 Package and domestically leading SGT MOSFET



JJMICROELECTRONICS has independently developed the high-power, thin-package PowerJE® 10x12, now in large-scale mass production. while significantly antly reducing the f ootprint, it effectively improves the power density, thus suiting extremely compact terminal designs. Excellent thermal resistance contributes to better heat dissipation, which future guarantees the long-term reliability of devices.

Benchmark-ing	Company	Package	V_{DS_Max} (V)	$R_{DS(ON)\_Typ}$ @ V_{GS}=10V (mΩ)	$R_{DS(ON)\_Max}$ @ V_{GS}=10V (mΩ)	C_{iss} (pF)	Q_g (nC)	FOM
JMSL030SAG	JieJie Micro.	PDFN5x6-8L	30	0.55	0.69	7,543	120	66
BSx005N-03Lxx	EU - Inxx	TDSON-8	30	0.48	0.55	8,900	122	59
NTxxx4C020N	US - Onxx	DFN5 5x6	30	0.56	0.67	10,144	139	78
PSxxx58-30Yxx	CN - Nexx	LFPAK56E	30	0.54	0.67	6,912	114	62
CSx-17570Q5B*	US - Texx	SON 5x6	30	0.56	0.69	10,400	185	104
Sixx90Axx	US - Vixx	PDFN5x6	30	0.62	0.78	9,120	130	81

In response to the increasing customer demand for performance and BOM (bill of material) space, JJM launched N-channel JSFET® series of JMSH1001ATL (V_{DS_MIN} = 100V) and JMSH1504ATL (V_{DS_MIN} = 150V) incorporating independent intellectual property rights; both are designed with advanced Power- JE® 10x12 package. When V_{GS}=10V, the measurements of $R_{DS(ON)\_Typ}$ and FOM of the device are 1.3mΩ / 202 (JMSH1001ATL) and 3.3 mΩ / 290 (JMSH1504ATL), respectively. When it comes to electrical properties, JMSH1001ATL outperforms the competition in China, and is not very different from similar products in Europe, the United States and Japan. Furthermore, the top-ranking linear model/safe operation area (SOA) feature enables devices to function in a safe and reliable manner even in the operating state of high current. The extremely low on-resistance helps improve operational efficiency, reduce system cost, and extend the service life of devices. Both products have extensive applications in power tools, light-duty electric vehicles, photovoltaic energy storage inverters, 5G communication and PoE++ and other terminals.



JJM: "Powered by the chips designed by the R&D team of JJM, manufactured by IATF 16949-certified fabs, and subjected to PowerJE® 10x12 assembly test on JJM' car-grade advanced package production lines, JMSH1001ATL's electrical properties are comparable to that of products of international first-line semiconductor IDM manufacturers, having contributed to the high-end breakthrough in the localization of like products. Featuring excellent thermal conductivity and low package parasitic inductance effect, this device is designed to handle up to 411A of current, thus being ideal for applications with stringent requirements for BOM (bill of material) space, electrical performance and long-term device reliability."

Both products are in mass production. Samples are available from JJM Sales Department, contract agents or related business channels. Information such as product specification and auxiliary system circuit design data such as POD (package outline drawing), simulation models H-Spice and P-Spice can be directly viewed or downloaded from the official website: https://www.jjm.com/promosfet1/

Through-Hole Packing Information

Package Name		Quantity (pcs)	CBM (cm^3)
TO-251-3L	Tube	80	53.6 x 2.0 x 0.54
	Small box	4,000	55.5 x 16 x 4.8
	Carton box	20,000	55.5 x 33.5 x 21.5
TO-220-3L	Tube	50	53.0 x 3.3 x 0.7
	Small box	1,000	55 x 14 x 4.5
	Carton box	5,000	57 x 26 x 16
TO-220AS-3L	Tube	50	53.0 x 3.3 x 0.7
	Small box	1,000	55 x 14 x 4.5
	Carton box	5,000	57 x 26 x 16
TO-220C-3L	Tube	50	53.0 x 3.3 x 0.7
	Small box	1,000	55 x 14 x 4.5
	Carton box	5,000	57 x 26 x 16
TO-220FP-3L	Tube	50	53.0 x 3.3 x 0.7
	Small box	1,000	55 x 14 x 4.5
	Carton box	5,000	57 x 26 x 16
TO-220FP-NL	Tube	50	53.0 x 3.3 x 0.7
	Small box	1,000	55 x 14 x 4.5
	Carton box	5,000	57 x 26 x 16
TO-262-3L	Tube	50	53.0 x 3.3 x 0.7
	Small box	1,000	55 x 14 x 4.5
	Carton box	5,000	57 x 26 x 16
TO-247-3L	Tube	30	53 x 4.1 x 0.75
	Small box	450	52 x 13 x 5
	Carton box	2,250	55 x 28 x 18

Surface-Mount Packing Information

Package Name		Quantity (pcs)	CBM (cm^3)
DFN1006-3L	Small box	100,000	21 x 21 x 21
	Carton box	400,000	45 x 45 x 24
DFN2020-6L	Small box	30,000	18.5 x 18.5 x 14
	Carton box	120,000	46 x 40 x 21
DFN3030-8L	Small box	10,000	36.6 x 34.1 x 5.4
	Carton box	50,000	37.5 x 30 x 35.5
DFN3333-8L	Small box	10,000	36.6 x 34.1 x 5.4
	Carton box	50,000	37.5 x 30 x 35.5
DFN8080-4L	Small box	4,000	36.6 x 34.1 x 5.4
	Carton box	20,000	37.5 x 30.0 x 35.5
DFN5060-8L	Small box	10,000	36.6 x 34.1 x 5.4
	Carton box	50,000	37.5 x 30.0 x 35.5
PDFN3x3-8L	Small box	10,000	36.6 x 34.1 x 5.4
	Carton box	50,000	37.5 x 30 x 35.5
PDFN3x3-8L-D	Small box	10,000	36.6 x 34.1 x 5.4
	Carton box	50,000	37.5 x 30 x 35.5
PDFN5x6-8L	Small box	10,000	36.6 x 34.1 x 5.4
	Carton box	50,000	37.5 x 30 x 35.5
PDFN5x6-8L-D	Small box	10,000	36.6 x 34.1 x 5.4
	Carton box	50,000	37.5 x 30 x 35.5
PowerJE®7x8 (sTOLL)	Small box	4,000	36.6 x 34.1 x 5.4
	Carton box	20,000	37.5 x 30 x 35.5
PowerJE®10x12 (TOLL)	Small box	2,000	36.6 x 34.1 x 5.4
	Carton box	10,000	37.5 x 30 x 35.5
SOT-23	Small box	30,000	21 x 21 x 21
	Carton box	120,000	44 x 44 x 23

(continued)

(continued)

Package Name		Quantity (pcs)	CBM (cm^3)
SOT-23-3L	Small box	30,000	21 x 21 x 21
	Carton box	120,000	44 x 44 x 23
SOT-23-6L	Small box	30,000	21 x 21 x 21
	Carton box	120,000	44 x 44 x 23
SOT-89-3L	Small box	8,000	21 x 21 x 21
	Carton box	40,000	45.0 x 44.5 x 23.2
SOT-223-3L	Small box	8,000	35 x 34 x 5
	Carton box	40,000	36.5 x 36 x 25.5
SOT-323-3L	Small box	45,000	21 x 21 x 21
	Carton box	180,000	44 x 44 x 23
SOT-363-6L	Small box	45,000	21 x 21 x 21
	Carton box	180,000	44 x 44 x 23
SOT-523-3L	Small box	30,000	21 x 21 x 21
	Carton box	180,000	44 x 44 x 23
SOT-723-3L	Small box	45,000	21 x 21 x 21
	Carton box	180,000	44 x 44 x 23
TO-252-3L	Small box	2,500	35 x 34 x 5
	Carton box	5,000	36.5 x 36 x 25.5
TO-263-3L	Small box	800	35 x 34 x 5
	Carton box	4,000	36.5 x 36 x 25.5
TO-263-7L	Small box	800	35 x 34 x 5
	Carton box	4,000	36.5 x 36 x 25.5
SOP-8	Small box	8,000	34 x 33 x 5.1
	Carton box	48,000	37 x 37 x 36
TSSOP-8	Small box	10,000	34 x 33 x 5.1
	Carton box	60,000	37 x 37 x 36

Testing Specifications for Product Qualification

Industrial Grade

Test Item	Description	Test Conditions	Duration	DUT Quantity
PreCon	Pre-conditioning & IR Reflow (SMT-type DUTs only)	Bake-out for 24 hrs.: TA = 125ºC; Moisture Soak: {MSL1 @ [TA = 85ºC, RH = 85%] for 168 hrs.} or {MSL3 @ [TA = 30ºC, RH = 60%] for 192 hrs.}; IR Reflow for 3 cycles: 1 cycle {preheat zone @ >185ºC -> main heat zone @ 260 (+5/-0)ºC for at least 30s} for t = 180s; JESD22-A113	Executed before the following tests: C-SAM (22 DUTs), TC, PC, H3TRB or HAST, IOL	330 Devices
HTRB	High Temperature Reverse Bias	T_J = 150ºC Reverse Bias = Specification Limit x 100%; JESD22-A108	1,000 Hrs	77 Devices
HTGB	High Temperature Gate Bias	T_J = 150ºC Gate Bias = Specification Limit x 100%; JESD22-A108	1,000 Hrs	77 Devices
PC (AC)	Pressure Cooker (Au-to-clave)	T_A = 121 ± 2ºC; RH = 100%, P = 15psi; Bias = None; JESD22-A102	96 Hrs	77 Devices (pre-conditioned)
TC	Temperature Cycling	T_A = {[-55ºC @ 15min.] <-> [150ºC @ 15 min.]} per 1-hr cycle (air-to-air); Bias = None; JESD22-A104	1,000 Cycles	77 Devices (pre-conditioned)
H^3TRB	High Humidity High Temperature Reverse Bias	T_A = 85ºC; RH = 85%; 80% rated V_{DS_MAX} up to 100V; JESD22-A101	1,000 Hrs	77 Devices (pre-conditioned)
HAST	Highly Accelerated Temperature & Humidity Stress	T_A = 130ºC; RH = 85%; V_{DS} = ±80% V_{DS_MAX} up to 42V; P = 33.3 psi JESD22-A110	96 Hrs	77 Devices (pre-conditioned)
IOL	Intermittent Operating Life	TA = 25ºC Devices powered to ensure □TJ > 100ºC (not to exceed Absolute Maximum Rating) MIL-STD-750 M1037	15,000 Cycles	77 Devices (pre-conditioned)

Automotive Grade

Test Item	Description	Test Conditions	Duration	DUT Quantity
PreCon	Pre-conditioning & IR Reflow (SMT-type DUTs only)	Bake-out for 24 hrs.: TA = 125ºC; Moisture Soak: {MSL1 @ [TA = 85ºC, RH = 85%] for 168 hrs.} or {MSL3 @ [TA = 30ºC, RH = 60%] for 192 hrs.}; IR Reflow for 3 cycles: 1 cycle {preheat zone @ >185ºC -> main heat zone @ 260 (+5/-0)ºC for at least 30s} for t = 180s; JESD22-A113	Executed prior to the following tests: C-SAM, TC, PC, H3TRB or HAST, IOL	3 Lots x 330 Devices
HTRB	High Temperature Reverse Bias	TJ = 175ºC; Reverse Bias = Specification Limit x 100%; JESD22-A108	1,000 Hrs	3 Lots x 77 Devices
HTGB	High Temperature Gate Bias	TJ = 175ºC; Reverse Bias = Specification Limit x 100%; JESD22-A108	1,000 Hrs	3 Lots x 77 Devices
PC (AC)	Pressure Cooker (Auto-clave)	TA = 121 ± 2ºC; RH = 100%, P = 15psi; Bias = None; JESD22-A102	96 Hrs	3 Lots x 77 Devices (pre-conditioned)
TC	Temperature Cycling	TA = {[-55ºC @ 15min.] <-> [150ºC @ 15 min.]} per 1-hr cycle (air-to-air); Bias = None; JESD22-A104	1,000 Cycles	3 Lots x 77 Devices (pre-conditioned)
H^3TRB	High Humidity High Temperature Reverse Bias	TA = 85ºC; RH = 85%; 80% rated V_{DS_MAX} up to 100V; JESD22-A101	1,000 Hrs	77 Devices (pre-conditioned)
HAST	Highly Accelerated Temperature & Humidity Stress	TA = 130ºC; RH = 85%; VDS = ±80% V_{DS_MAX} up to 42V; P = 33.3 psi JESD22-A110	96 Hrs	77 Devices (pre-conditioned)
IOL	Intermittent Operating Life	TA = 25ºC Devices powered to ensure □TJ > 100ºC (not to exceed Absolute Maximum Rating) MIL-STD-750 M1037	15,000 Cycles	77 Devices (pre-conditioned)