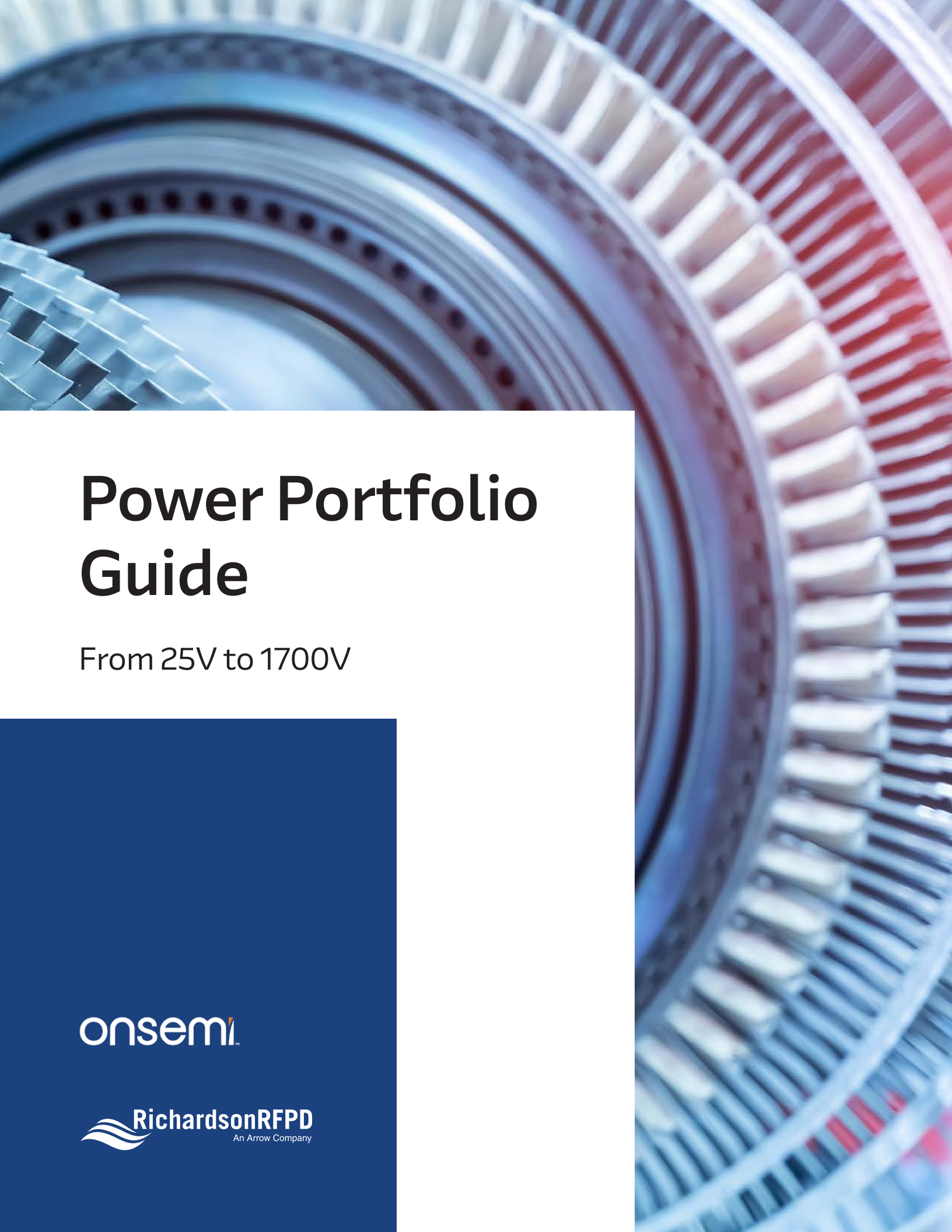

Power Portfolio Guide

From 25V to 1700V

onsemi

RichardsonRFPD
An Arrow Company

onsemi Power Portfolio - Discrete & Modules Portfolio

onsemi power product portfolio offers a full spectrum of high, medium and low voltage power discrete devices along with advanced power module solutions, including silicon-based IGBTs, MOSFETs, and diodes, and silicon carbide-based MOSFETs and diodes.

MOSFETs (25V to 250V)

An extensive product portfolio offering for low, medium, high-voltage and dual MOSFETs across various applications.

Learn More

IGBTs (600V to 1200V)

Insulated Gate Bipolar Transistors (IGBTs) that offer maximum reliability in high-performance power conversion applications.

Learn More

Silicon Carbide (SiC) (600V to 1700V)

A full ecosystem of parts to support wide bandgap power designs, including SiC diodes, SiC MOSFETs, and SiC Modules.

Learn More

Power Modules (650V to 1200V)

Portfolio includes power-integrated modules and intelligent power modules utilizing silicon-based IGBTs, MOSFETs, and diodes, and silicon carbide-based MOSFETs and diodes.

Learn More

Power Portfolio Benefits

- Broad portfolio
- Advanced packaging technology
- Quality and manufacturing
- Ease of integration
- Lower system cost
- Quality
- Increased miniaturization & power density

Applications for onsemi Power Solutions

Energy Infrastructure

- Solar and Energy Storage
- EV Charging Stations
- Uninterruptible Power Supply (UPS)

Industrial Automation

- Robotics
- Industrial Drives
- Pumps and Fans

Automotive

- Body Electronics
- Vehicle Electrification

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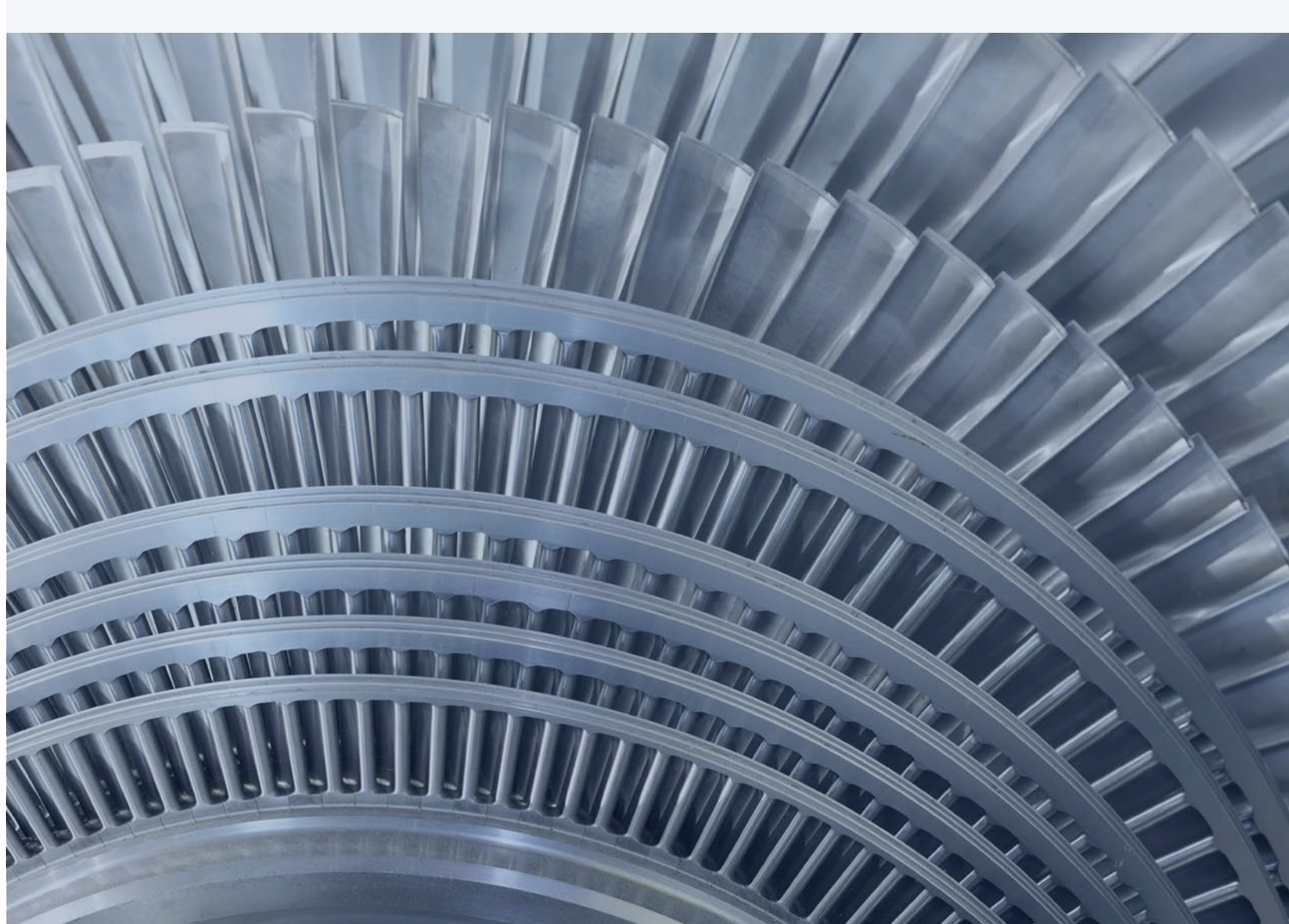
onsemi 25V to 150V MOSFETs

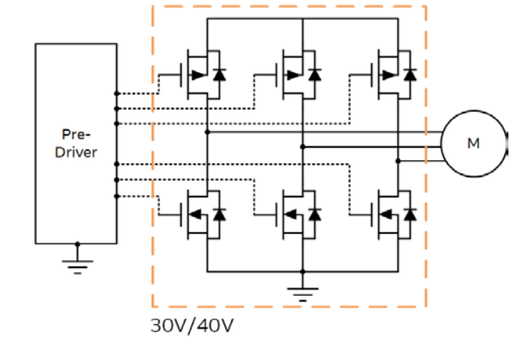


25V to 40V MOSFETs

onsemi is the leading provider of 25V to 40V MOSFETs. The portfolio includes high-performance MOSFETs with low $R_{DS(on)}$ and voltage spikes. Advanced packaging technologies simplify layout and offer compact form-factors.

30V and 40V MOSFETs for Three-Phase Inverter for Motor Control

onsemi 30V and 40V MOSFETs for motor control have high-thermal capacity and high-efficiency. Low $R_{DS(on)}$ and less voltage spikes offer the reliability required for these applications.



Key MOSFET Considerations

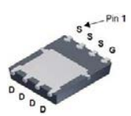
- Lower $R_{DS(on)}$
- Less voltage spikes
- High-thermal capacity
- High-efficiency

30V and 40V MOSFET Portfolio for Motor Control

V_{DS} (V)	Package Size	Package Type	V_{GS} (V)	$R_{DS(on)}$ (mΩ) Max. @ VGS=10V	Coss (pF) Typ.	Qg (nC) Typ. @ 10V
30	3x3 mm	– Power33 – µ8-FL	20	1.3-2.25	1570-1200	45-67
30	5x6 mm	– SO8-FL	20	0.52-2.8	6540-1215	30-178
40	5x6 mm	– SO8-FL – DFN8 DualCool™	20	0.70-3.3	4600-830	23-128
40	8x8 mm	– DFNW8 – DualCool™ 88	20	0.45-0.67	8310-4730	140-251

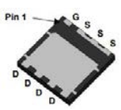
Packages


Power33 3x3, 0.8mm



SO8-FL 5x6, 1.1mm


DFN8 DualCool™



DFNW8 8x8, 1.2mm

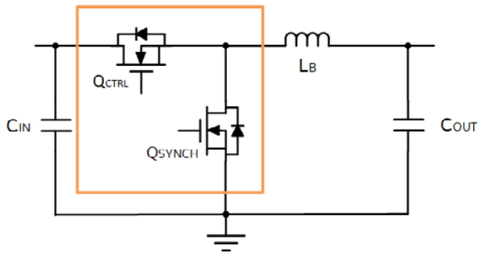

DualCool™ 88 8x8, 0.95mm

Applications
- Drones
- Power tools
- Other battery operated applications

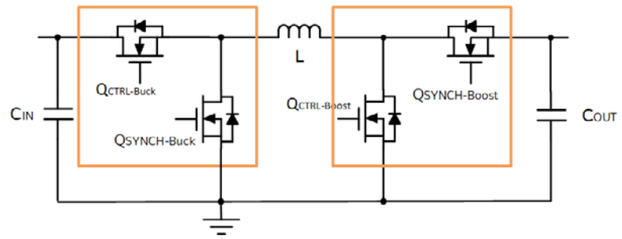
25V, 30V, and 40V MOSFETs in AI and Computing

onsemi MOSFETs for AI and computing applications offer cost-effective solutions with good high-side and low-side switching. High-density PQFN8, PQFN12, and WQFN12 packages enable small form-factor designs.

Synchronous Buck Converter



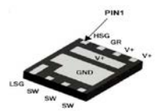
4-Switches Buck-Boost Converter



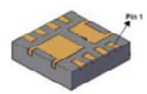
25V, 30V, and 40V Portfolio for AI and Computing

V_{DS} (V)	Package Size	Package Type	V_{GS} (V)	$R_{DS(on)}$ (mΩ) Max. @ Vgs=4.5V	Coss (pF) Typ.	Qg (nC) Typ. @ 4.5V
25	3x3 mm	– PQFN12 Dual	16	1.8-5.3	243-748	5.5-17
25	5x6 mm	– PQFN8 Dual	16	0.95-4.20	320-1355	7.2-30
30	3x3 mm	– WQFN12 Dual	16	3.0-5.4	309-498	6.3-9.5
30	5x6 mm	– PQFN8 Dual	16, 20	1.2-6.5	397-2086	7.9-43
40	3x3 mm	– WQFN12 Dual	20	7.0	271	8.6

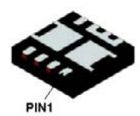
Packages



PQFN8 5x6, 0.8mm



PQFN12 3x3, 0.8mm



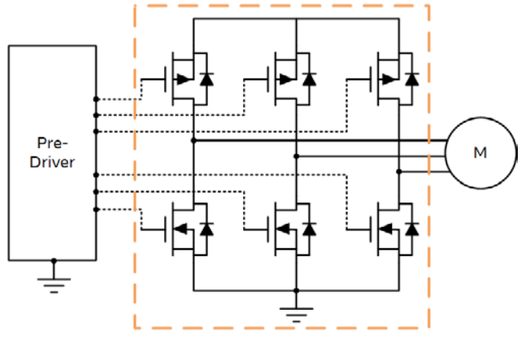
WQFN12 3x3, 0.8mm

Applications
- Mother boards
- GPU card
- Edge AI, Edge computing

60V and 80V MOSFETs

onsemi's 60V and 80V MOSFET portfolio based on the shielded gate (MV7, T6, and T8) technology offers a range of solutions with lower switching and conduction losses for high-efficiency, advanced packaging with compact design options, and reduced voltage ringing, overshoot, and noise. These characteristics make them ideal for a variety of motor control, energy, and industrial power applications.

Three-phase Motion Control

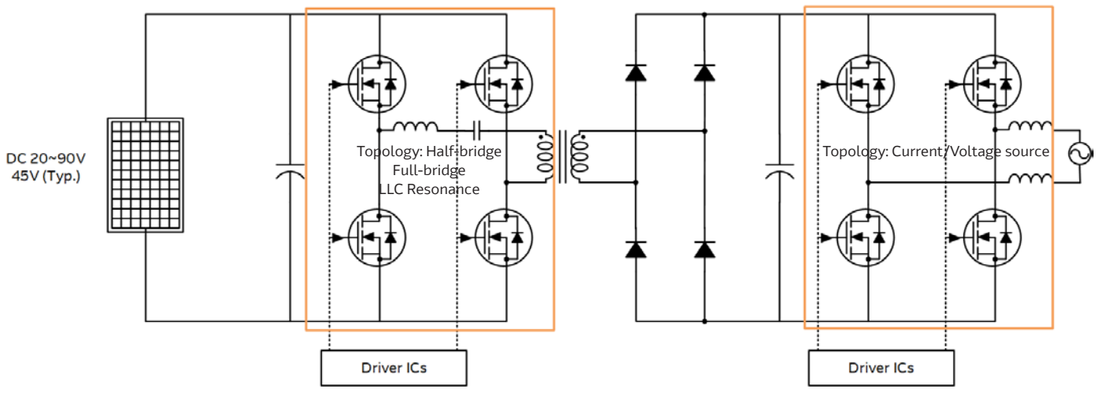


Key MOSFET Parameters:

- $R_{DS(on)}$ (On Resistance)
- Q_{RR} (Reverse Recovery Charge)
- T_{RR} (Reverse Recovery Time)

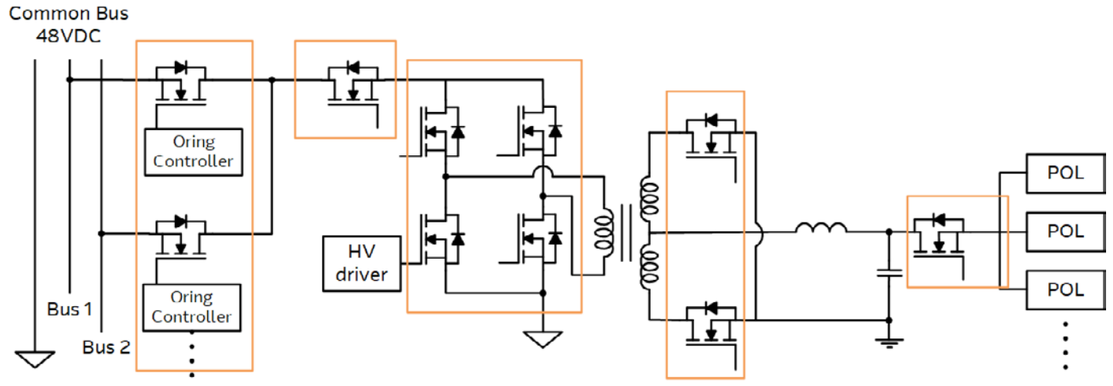
Micro Solar Inverters

onsemi MOSFETs offer very low switching and conduction losses and high-efficiency required for micro solar inverter applications. The DualCool™ package options offer compact solutions due to reduced cooling requirement.



60V and 80V MOSFETs for Brick DC-DCs and POLs

onsemi MOSFETs offer very low $R_{DS(on)}$, high-efficiency, and small form-factor packages needed for Brick DC-DCs and point of load applications.



Applications

Three-phase Motion Control

Power Tools

Drones

Robotics

Industrial Automation

Micro Solar Inverter

Solar and Energy Storage Systems

60V MOSFETs for Brick DC-DCs and POLs

Industrial Power Supply, 5G, Cloud Computing, Networking

60V and 80V MOSFET Portfolio

V_{DS} (V)	Package Size	Package Type	$V_{GS(TH)}$ Max (V)	ID Max (A)	$R_{DS(on)}$ (mΩ) Max. @V_{GS}=10V	Q_G Typ V_{GS} = 10V (nC)
60	3x3 mm	– µ8FL – DualCool™ 33	2-4.5	22-109	3.9-9.3	9.5-32.7
	5x6 mm	– SO-8FL – TDFN9 Source Down – LFPAK-8 – DualCool™ 56 – Power 56 – LFPAK-4	2-4.5	21-276	1.2-27.5	5-120
	6.5x10 mm	– DPAK-3	2.1-4	48-155	2.5-8.9	18.7-78
	8x8 mm	– Power 88 – DualCool™ 88	2.2-4	292-464	0.68-1.1	113-225
	10x12 mm	– TO-LL	4	240-300	1.1-1.5	19-24
	10x15 mm	– D2PAK-7	4	127-342	1.2-4.1	39-139
80	3x3 mm	– LFPAK8 – PQFN-8 – PQFN-8 DualCool – WDFN-8/u8FL	2-4.5	14-84	5.9-50	6-31
	5x6 mm	– DFN-8 DualCool – LFPAK-4 – PQFN-8 – SO-8FL/DFN-5 – SO-8FL Dual/DFN-8	2-4.5	22-224	1.5-29	9-112
	6.5x10 mm	– DPAK-3	4	37	23	7.6
	8x8 mm	– DFNW-8 – DFNW8 DualCool – PQFN-8 DualCool	4	254-335	1.1-1.56	101-159
	10x11 mm	– TO-LL 8L	4	203-351	1.4-3	12-166
	10x15 mm	– D2PAK-7	4-4.5	240-310	1.6-2.4	137-217
	10x29 mm	– TO-220-3	4.5	120-223	2.7-5.3	65.4-137

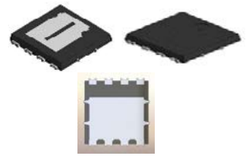
Packages

u8-FL 3.3x3.3 mm
Dual Cool™ 33

SO8FL 5x6 mm
Dual Cool™ 56

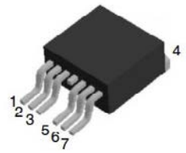
LFPAK 5x6 mm
Source Down 5x6 mm

DPAK-3

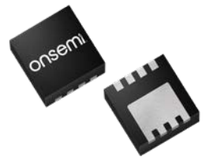


Power 88 8x8 mm
Dual Cool™ 88

TOLL 10x12 mm



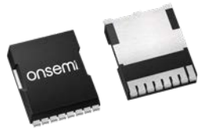
D²PAK7 10x15 mm



PQFN-8

WDFN-8

DFNW-8



TO-LL 8L

TO-220-3

onsemi 100V, 120V, and 150V Discrete MOSFETs

Technology Evolution

80V
100V
120V
150V

MV5

PTNG

Low & Low R_{DS} PTNG

- **Much better than older Trench tech. MV MOS**
  - Smaller On-resistance
  - Good Qg, Qoss and Qrr vs. R_{DS} balanced technology

- **Industry's lowest Qrr and softest body-diode**
  - 80V, 2.5mΩ: FDMS2D5N08C
  - 100V, 3.2mΩ: FDMS86180
  - 120V, 4.0mΩ: FDMS4D0N12C
  - 150V, 8.8mΩ: FDMS8D8N15C

- **LowQ features optimized switching performance**
  - 100V node in development followed by 80V

- **Low R_{DS} PTNG program focus on lower R_{DS} vs PTNG**
  - R_{DS}xQoss, R_{DS}xQg FOM's similar with PTNG

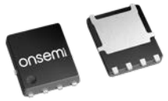
100V MOSFET Portfolio

Package Size	Package Type	$V_{GS(TH)}$ Max (V)	ID Max (A)	$R_{DS(on)}$ (mΩ) Max. @V_{GS}=10V	Q_G Typ V_{GS}= 10V (nC)
3x3 mm	– PQFN-8 – WDFN-8 – WDFN-8/u8FL	3-4	15-57	8.5-82	7.4-22
5x6 mm	– DFN8 Dual Cool – PQFN-8 – SO-8FL/DFN-5	2.2-4	16-364	2.8-56	2.8-97
6.5x10 mm	– DPAK-3	3-4	35-50	10.2-24	7.6-25
8x8 mm	– DFNW-8 – PQFN-8 Dual Cool	4	162-273	2-4.2	50-159
10x11 mm	– TO-LL 8L	4-4.5	200-312	1.5-2.8	11-131
10x15 mm	– D2PAK-3 – D2PAK-7	3-4	30-268	1.7-24	7.6-178
10x29 mm	– TO-220-3 – TO-220-3 FullPak	4	40-222	2.3-15	16.2-108

Packages

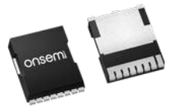

PQFN-8


WDFN-8


SO-8FL


DPAK-3


DFNW-8


TO-LL 8L


D2PAK-7

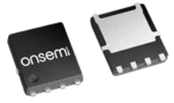

TO-220-3

120V MOSFET Portfolio

Package Size	Package Type	$V_{GS(TH)}$ Max (V)	ID Max (A)	$R_{DS(on)}$ (mΩ) Max. V_{GS}= 10V	Q_G Typ V_{GS}= 10V (nC)
5x6 mm	– DFN-8 Dual Cool – PQFN-8 – SO-8FL/DFN-5	4	49-118	4-11.5	18-58
8x8 mm	– PQFN-8 Dual Cool	4	128	4.2	48
10x29 mm	– TO-220-3	4	181	2.95	98

Packages


PQFN-8


SO-8FL


TO-220-3

150V MOSFET Portfolio

Package Size	Package Type	V_{GS} (V)	$V_{GS(TH)}$ Max (V)	ID Max (A)	$R_{DS(on)}$ (mΩ) Max. @ V_{GS}=10V	Q_G Typ V_{GS} = 10V (nC)
3x3 mm	– PQFN-8 – WDFN-8/u8FL – WQFN-12	±20	2-4.5	25-38	9-34	9.7-17
5x6 mm	– DFN8 Dual Cool – PQFN-8 – SO-8FL/DFN-5	±20	3-4.5	12-85	7.5-56	6.1-38
6.5x10 mm	– DPAK-3	±20	2.8-4.5	18-51	15-77	6.3-27
8x8 mm	– DFNW-8 – PQFN-8 – PQFN-8 Dual Cool	±20	4-4.5	61-174	3.6-14	27-79
10x11 mm	– TOLL 8L	±20	4-4.5	169-187	4.4-6.3	70-90.4
10x15 mm	– D2PAK-3 – D2PAK-7	±20	4-4.5	27-185	4.1-39	14.3-97
10x29 mm	– TO-220-3 – TO-220-3 FullPak	±20	4-4.5	15-139	5-40	14.3-75
15x36 mm	– TO-247-3	±20	4	167	5.9	92

Packages


PQFN-8

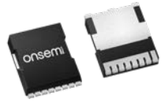

WDFN-8


WQFN-12


DFNW-8


SO-8FL

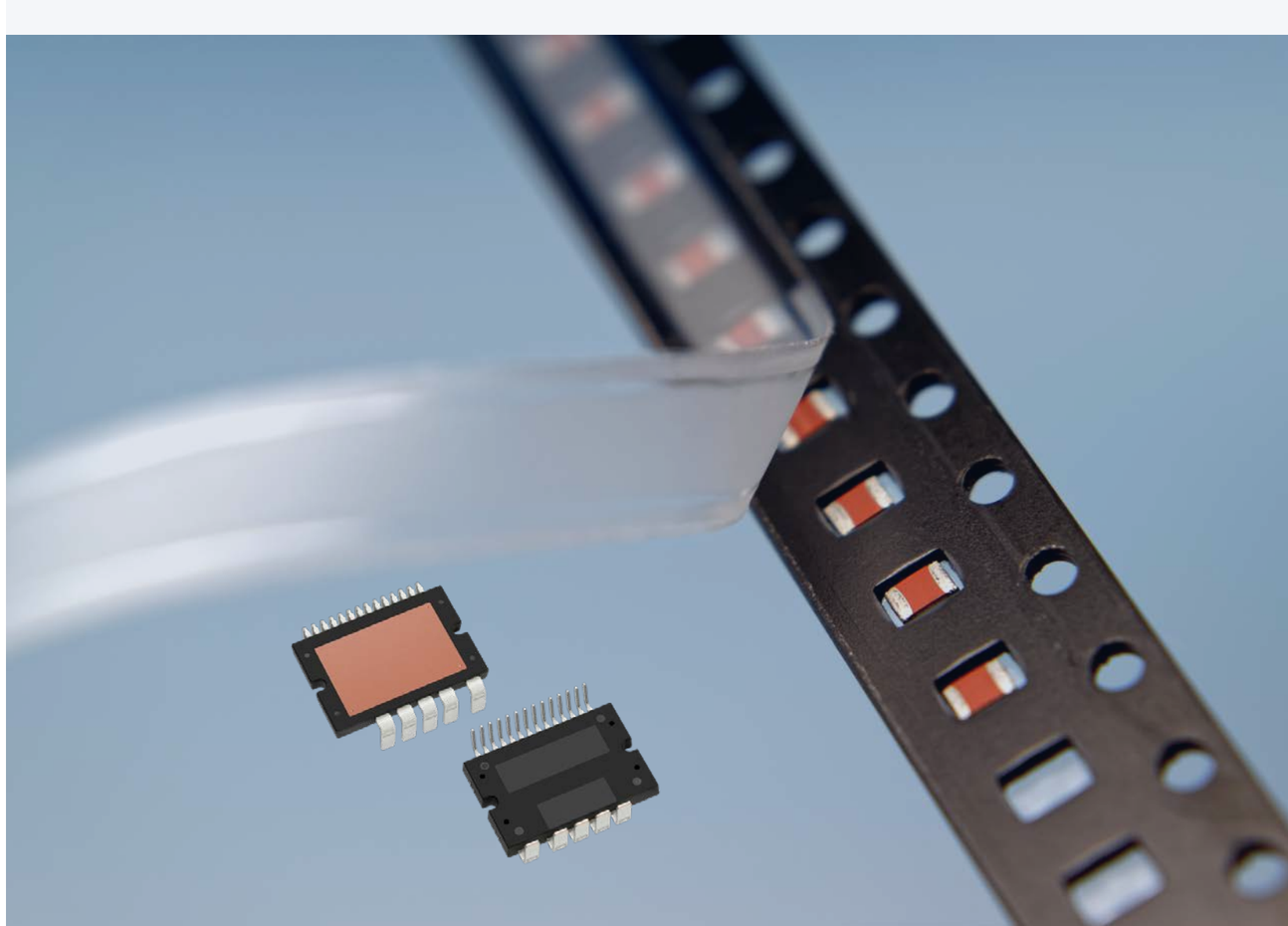

DPAK-3


TO-LL 8L


D2PAK-7


TO-220-3

IGBTs



Discrete IGBTs

onsemi IGBTs products offer an optimum performance by balancing conduction and switching losses. They also offer maximum reliability and performance from positive temperature co-efficient, low saturation voltage (VCE(sat)), very low switching losses, and fast switching. They are well suited for high-performance power conversion applications and are even engineered and qualified for industrial applications like motor control, UPS, solar, and EV-charging applications. onsemi IGBTs range from 600 V to 1200 V.

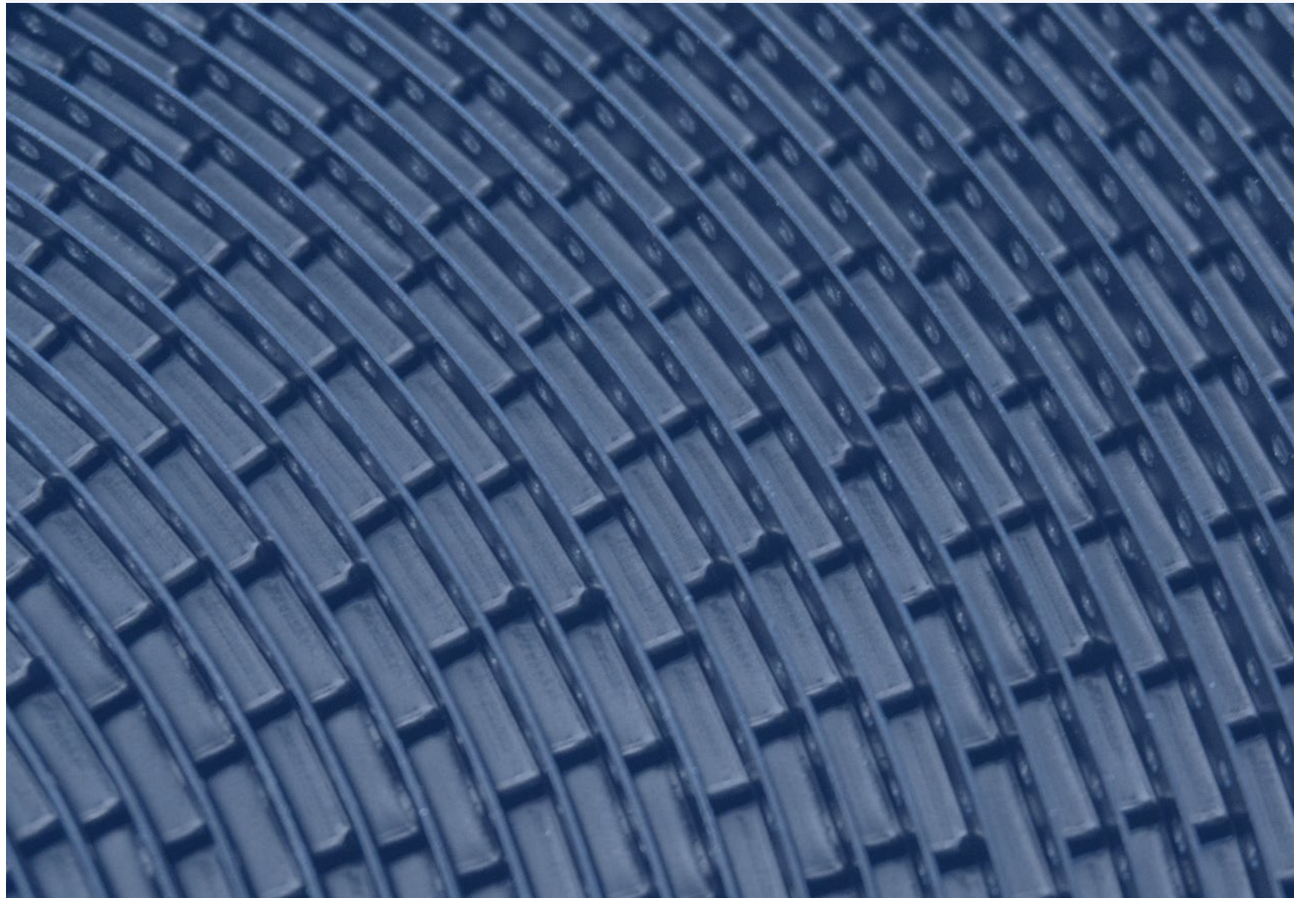
Discrete IGBT Portfolio – 650V and 1200V

650 V IGBTs					
IGBT Rating (A)	Diode Rating (A)	IGBT Selection	Diode Selection	TO247 - 3L	Power TO247 - 4L
40	20	Fast	Fast switching	FGH40T65SQD-F155	
		Medium	Fast switching	FGHL40T65MQD	
	40	Medium	Low VF	FGHL40T65MQDT	
		Low VCE (SAT)	Low VF	FGHL40T65LQDT	
50	30	Fast	Fast switching	FGH50T65SQD-F155	FGH4L50T65SQD
		Medium	Fast switching	FGHL50T65MQD	
	50	Fast	Low VF	FGHL50T65SQDT	
		Medium	Low VF	FGHL50T65MQDT	FGHL50T65MQDTL4
		Low VCE (SAT)	Low VF	FGHL50T65LQDT	FGHL50T65LQDTL4
60	30	Fast	Fast switching	FGH60T65SQD-F155	
75	50	Fast	Fast switching	FGH75T65SQD-F155	
		Medium	Fast switching	FGHL75T65MQD	
	50	Fast	Low VF	FGH75T65SQDT-F155	FGH75T65SQDTL4
		Medium	Low VF	FGHL75T65MQDT	FGHL75T65MQDTL4
		Low VCE (SAT)	Low VF	FGHL75T65LQDT	FGHL75T65LQDTL4

1200 V IGBTs						
IGBT Rating (A)	Diode Rating (A)	IGBT Selection	Diode Selection	TO247 - 3L	Power TO247 - 4L	Power TO247 - 3L
25	20	Fast	Fast switching	NGTB25N120FL3		
40	40	Fast	Low VF	NGTB40N120S3		
			Fast switching	NGTB40N120FL3	FGH40T120SQDNL4	
		Low VCE (SAT)	Low VF	NGTB40N120L3		
			Fast switching		FGH4L40T120LQD	
60	60	Fast	Low VF			FGY60T120SQDN
75	75	Fast	Low VF			* FGY75T120SWD
			Fast switching			FGY75T120SQDN
100	100	Low VCE (SAT)	Low VF			* FGY100T120RWD

* New IGBT7

Silicon Carbide (SiC) Discretes – MOSFETs and Diodes



Ideal Energy and Industrial Applications for SiC

Silicon Carbide (SiC) is ideal for use cases such as solar energy equipment, energy storage, alternative energy modes, and high-voltage applications. SiC semiconductor's higher mechanical, chemical and thermal stability increases its efficiency and reduces cooling requirements for these and other industrial applications. Additionally, using SiC also simplifies design without sacrificing performance by reducing passive components.

EV Charging Stations

Solar Inverters

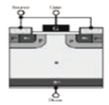
Uninterruptible Power Supplies (UPS)

EliteSiC Portfolio Leadership

Substrates/Epi

- 150/200 mm SiC wafering & epi fully internal in **onsemi** today
- **onsemi** acquisition of GT Advanced Technologies complete

Fab



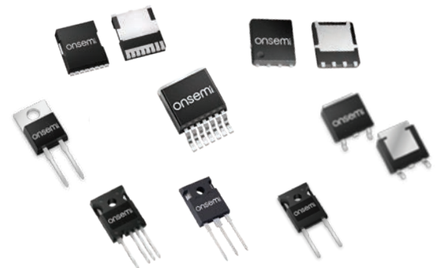
SiC Planar available today

200 mm migration ready

- Fabs ready today for 150 mm — 200 mm migration

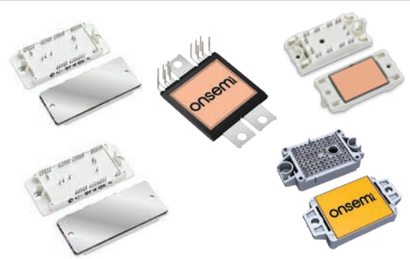
Devices/Die

- Full portfolio of diodes & MOSFETs
- Broad base of packages
- Die only & metal options
- Auto & industrial devices



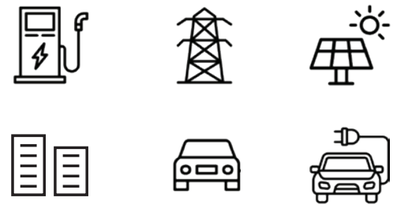
Modules

- Case & transfer molded options
- Full portfolio of hybrid & full SiC modules
- Single & dual cooling, direct & indirect



Systems

- Deep application & system know-how for automotive & industrial
- EMEA, US, Asia-based apps support



onsemi EliteSiC technology has multiple competitive advantages, such as its internal supply chain, fully integrated manufacturing expertise, a diverse offering of devices and packages, compelling performance to price ratio, best-in-class design tools, and in-house Gate Driver solutions. The third generation of Diodes and MOSFETs are currently released with improved performances, dedicated for high frequency operation & increased performance over temperature.

EliteSiC Portfolio for Industrial and Energy Markets

EliteSiC Diodes 650 V/1200 V/1700 V

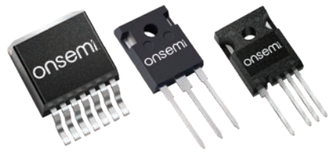
High-efficiency, faster operating frequency, increased power density, reduced EMI, and reduced system size and cost

- No reverse QRR recovery, No forward recovery
- Low VF (lower conduction losses)
- Leakage stability over temperature range
- Switching characteristics independent of temperature
- Higher surge and avalanche capacity
- Positive temperature coefficient
- Higher operating temperature (TJMAX=175°C)
- Multiple packages available
- DPAK-3/TO-252-3LD, D2PAK-2/TO-263-2LD, D2PAK-3/TO-263-2LD, PQFN-4, TO-220-2LD, TO-220-3LD, TO-220FP/TO-220F-2FS, TO-247-2LD, TO-247−3LD

EliteSiC MOSFETs 650 V/900 V/1200 V/1700 V

High-efficiency, faster operating frequency, increased power density, reduced EMI, and reduced system size and cost

- High-power density
- Ultra-low gate charge
- Low effective output capacitance
- Low VF (lower conduction losses)
- Leakage stability over temperature range
- 100% UIL tested
- Higher operating temperature (TJMAX=175°C)
- Multiple packages available
- D2PAK7 (TO-263-7L HV), TO-247-3LD, TO-247-4



EliteSiC Hybrid Modules 650 V/1000 V/1200V /1700 V

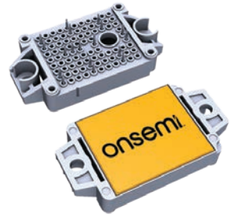
Improved efficiency with SiC diodes & fast switching low VCE (SAT) IGBT

- Range of pin compatible SiC hybrid and full SiC options
- Integrated bypass diodes
- Low thermal impedance baseplate
- Split T-type NPC inverter
- I-Type NPC 1000 V, 350 A/450 A IGBT, 1200 V, 100 A SiC diode
- 3 Channel Symmetric Boost 1000 V, 150 A IGBT, 1200 V, 30 A SiC diode
- 3 Channel 1200 V IGBT + SiC Boost, 80 A IGBT and 20 A SiC diode
- F1 and F2 modules available

EliteSiC Modules 900 V/1200 V

Lower conduction and switching losses, while enabling designers to achieve high-efficiency and superior reliability

- Low thermal resistance from larger die than with trench MOSFETs
- Easy to drive with negative gate voltages
- Industry standard pinout with same pinout for different $R_{DS(on)}$ levels and voltages
- Industry standard pinout option
- Reduced voltage ringing from using capacitors integrated into the module (F2 module)
- Q0 and Q1 Boost modules available



EliteSiC MOSFET and Diode Families

MOSFETs

Family	Series	Optimization	650 V	900 V	1200 V	1700 V	Primary Applications
M1	M1	Low $R_{DS(on)}$ High SCWT			..120SC1	170M1	
M2	M2	Low $R_{DS(on)}$ High SCWT	..065SC1	..090SC1			
M3	M3S	High-speed			..120M3S		
	M3T	Low $R_{DS(on)}$ High SCWT			..120M3x SCWT dependent		

Diodes

Family	Optimization	650 V		1200 V	1700 V	Primary Applications
D1	High IFSM	..065A		..120A	..170A	
D2	Low QC	..065B				
D3	Low QC x VF			..120C		

EV Charging Station | **UPS/Energy Storage** | **Solar** | **High Power Industrial** | **Traction** | **On-board Charger**

EliteSiC Modules

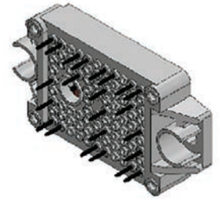
These Silicon Carbide (SiC) Modules from onsemi have integrated SiC MOSFETs and SiC Diodes that provide lower conduction and switching losses, while enabling designers to achieve high-efficiency and superior reliability. These modules have a voltage ratings of 900V and 1200V and are typically used in the DC-DC stages of solar inverters and energy infrastructure. Features of the onsemi SiC modules include:

- Low thermal resistance from larger die than with trench MOSFETs
- Easy to drive with negative gate voltages – Industry standard pinout with same pinout for different $R_{DS(on)}$ levels and voltages
- Industry standard pinout option
- Reduced voltage ringing from using capacitors integrated into the module (F2 module)

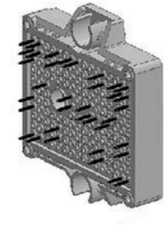
Package Options

Q0

Q1



F1



F2

EliteSiC Full SiC Module Portfolio

SiC Module Type	Product	Description	$R_{DS(on)}$	Module Type
900V M2 SiC MOSFET Vienna Modules in F2 Package	NXH020U90MNF2	SiC Modules, Vienna Module 900V, 2 x 10 mohm SiC MOSFET, 1200V, 2 x 100A, F2 Package	10mΩ	F2
1200V SiC MOSFET 2-PACK Modules in F2 Package	NXH006P120MNF2	Half Bridge 2-PACK 1200V 6mohm SiC MOSFET module	6mΩ	F2
1200V, 900V SiC MOSFET 2-PACK Modules in F1 Package	NXH010P120MNF1	Half Bridge 2-PACK 1200V 10mohm SiC MOSFET module	10mΩ	F1
	NXH020P120MNF1	Half Bridge 2-PACK 1200V 20mohm SiC MOSFET module	20mΩ	F1
	NXH040P120MNF1	Half Bridge 2-PACK 1200V 40mohm SiC MOSFET module	40mΩ	F1
1200V SiC MOSFET 4-PACK Modules in F1 Package	NXH010P120MNF1	Half Bridge 2-PACK 1200V 10mohm SiC MOSFET module	10mΩ	F1
	NXH020P120MNF1	Half Bridge 2-PACK 1200V 20mohm SiC MOSFET module	20mΩ	F1
	NXH040P120MNF1	Half Bridge 2-PACK 1200V 40mohm SiC MOSFET module	40mΩ	F1
Full SiC Boost Modules in Q0 and Q1 Packages	NXH40B120MNQ0SNG	2 channel 40mΩ/1200V SiC MOSFET, 40A SiC Diode	40mΩ	Q0
	NXH80B120MNQ0SNG	2 channel 80mΩ/1200V SiC MOSFET, 20A SiC Diode	80mΩ	Q0
	NXH40B120MNQ1SNG	3 channel 40mΩ/1200V SiC MOSFET, 40A SiC Diode	40mΩ	Q1
	NXH240B120H3Q1PG	3 channel 60A/1200V IGBT, 20A/1200V SiC Diode		Q1
	NXH100B120H3Q0	2 channel 50A/1200V IGBT, 20A/1200V SiC Diode		Q0

Power Modules

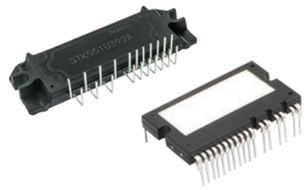
MOSFET, IGBT, and EliteSiC Power Modules

The onsemi power modules portfolio includes a wide range of integrated level solutions for IGBT, MOSFET, SiC, Si/SiC Hybrid, Diode, SiC Diode, and Intelligent Power Modules (IPMs). onsemi offers two types of modules with varying degrees of integration:

Intelligent Power Modules (IPM):

IPM is an electronic device that integrates:

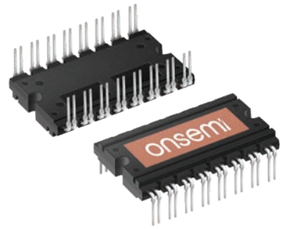
- High-voltage gate drive circuit to draw high-power performance from either and IGBT, MOSFET or combination of all other power devices.
- Intelligent power modules also integrates protection of power systems from: short circuits, under voltage, extreme temperatures & current monitor.



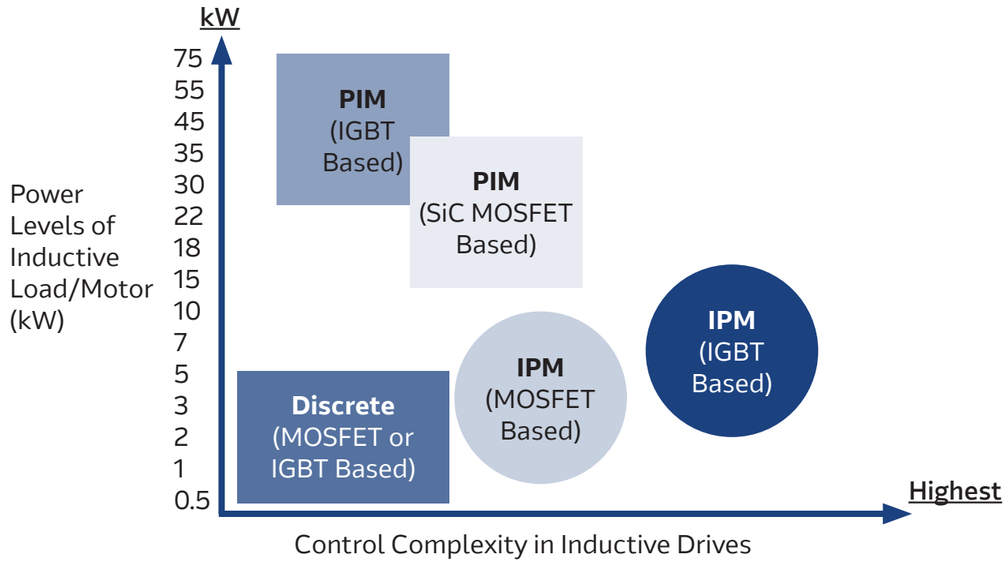
Power Integrated Module (PIM):

A PIM is an electronic device that integrates power switching devices to maximize power delivery combined with reduced footprint/size and where external control and HV gate drive is required:

- IGBT's with hybrid body diodes; Si or SiC
- MOSFET's of Si or SiC Technology or combination of thereof



IPM vs. PIM – When to Use What?



Comparing Solutions – Modules (IPM and PIM) and Discrete Products

Item	Discrete	IPM	PIM	Remark
Product cost	●●●	●●○	●●○	IPM includes cost of gate drivers and isolation substrate
Total board/PCB space saving	●○○	●●●	●●○	Higher integration → Space saving
Design time for user (development resource)	●○○	●●●	●●○	Gate driving block design and evaluation
Reliability, failure rate	●○○	●●●	●●○	IPM is pre-tested with integrated driver. Driver and Rg are optimized for power chips, lower component count
Life time	●●●	●●●	●●○	
Dual source	●●●	●○○	●●○	IPM suppliers have their own PKG. P2P solution is not enough
Line up and portfolio	●●○	●○○	●●●	Discrete: from low, medium to high-voltage. IPM: high-voltage from 500 to 1200V, PIM: high-voltage from 600 to 4500V
Assembly and process for PBCA	●○○	●●●	●●○	More integration → Simple PCBA
Switching speed control	Available	N.A	Available	Gate driver including Rg is integrated in IPM. Rg is fixed
Typical market	Cost driving market, consumer apps	High reliability required market. indus & auto apps	High-power required market. indus & auto apps	Discrete: low cost and low power application. IPM: high reliability and medium power application, PIM: high power application

Benefits of onsemi Power Modules

- High-Power Density Footprint
- High-Temperature Operation
- Low Inductance Design
- Capability to Implement New Technology
- Capability to Integrate Temp Sensing
- Ability to Have Dedicated Drain-Kelvin Pin

Intelligent Power Modules (IPMs)

IPMs contain power switches and gate drivers in one module. In addition to the popular three-phase inverter modules, onsemi offers 2-in-1 PFC modules, which combine the PFC driver stage with a three-phase inverter. IPMs using 600 V IGBTs are used in consumer and industrial applications for driving fans, pumps, and compressors. IPMs using 40 V and 80 V MOSFETs are increasingly used in automotive applications to drive electric fans and pumps.

IPM Module Grouping for Consumer and Industrial Applications

50W to 300W	500W to 3 kW	1 kW to 10 kW
Small industrial pumps and white good appliances (ex: dishwasher, washing machine drain pumps)	HVAC, white good appliances, and various industrial motor drive applications	Industrial motor drive applications

Benefits of Power Modules with Integrated Gate Drivers

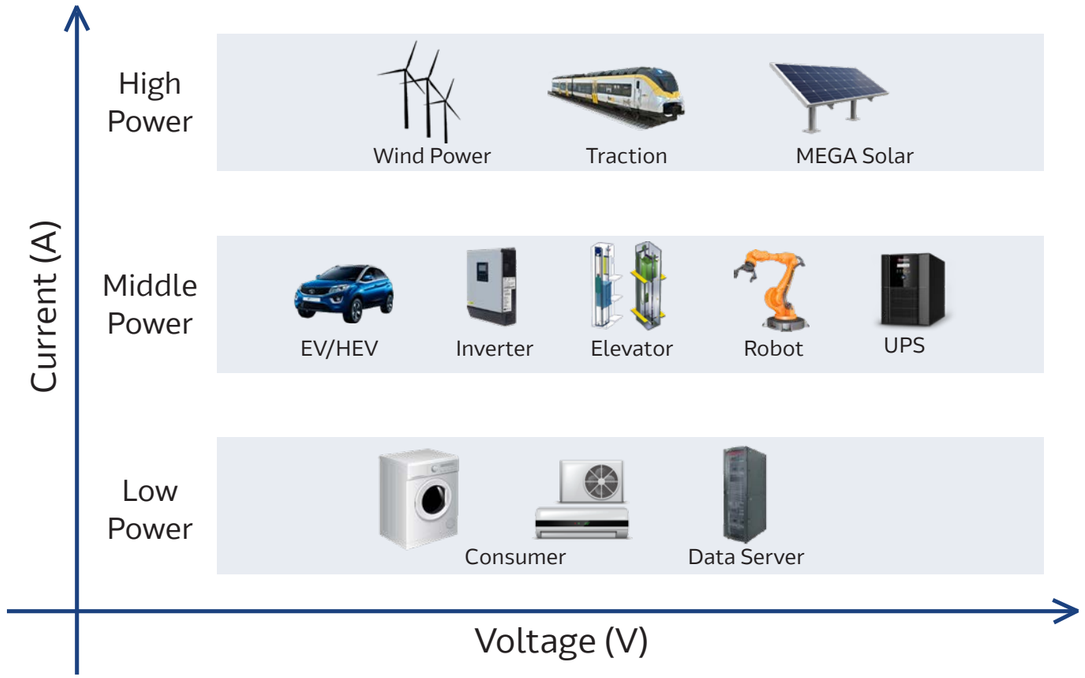
- Reduce system cost thanks to high integration in small footprint packages with excellent cooling performance
- Reduce assembly cost with simple assembly concept
- Reduce time to market with a power stage already optimized to meet the best trade-off between switching characteristics and EMI performance
- Improve reliability with short circuit rated IGBTs driven by rugged gate driver ICs with key protection features, in a rugged transfer mold package

IPM Portfolio Overview

	2020	2021	2022
SPM49 	Pin compatible with M's Large DIP FS4 650V/50A, 75A		
SPM31 	Pin compatible with M's Mini DIP FS4 650V/20A, 30A, 50A		
SPM3V 	SPM3V V6 FS3 600V/30A, 40A, 50A		
SPM45H 	SPM45 V4 FS4 RC 600V/15, 20A		
SIPK	SIP-K/New SIP1 FS3 600V/5A, 10A		
DIPS-6 	DIP-S6 V2 FS3 600V/8, 10A	DIP-S6 V3 FS4 RC 600V/5, 15A	
SPM5 	SPM5 V3 Fast switching UniFET 500V	SPM5 V4 FS4 RC IGBT for high-power (200W)	

IGBT Based Power Integrated Modules (PIM)

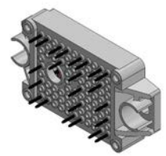
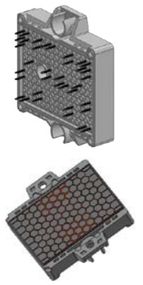
The IGBT Modules portfolio from onsemi can be used for the DC-AC stages of solar inverters, energy storage systems, uninterruptible power supplies (UPS), motor drive applications, and in traction inverters in automotive applications. These products utilize the new arrow mesa IGBT technology in providing high-current density and robust short circuit protection along with higher blocking voltage to deliver outstanding performance.



Overview of the IGBT PIM Module Portfolio

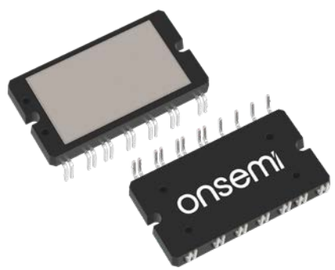
Voltage	Rated Current	Package Type	Featured Products
650V	50-483A	PIM36 93x47 (PRESS FIT) Q2, Q2, DIP27 73.2x40.2, Q1, PIM41 93x47 (PRESS FIT), PIM41 93x47 (SOLDER PIN)	
1000V	309A	PIM51 93x47 (PRESS FIT), PIM51 93x47 (SOLDER PIN)	
1200V	25-160A	Q0, Q1, Q2, and DIP-C2	

Gel-Filled Packages for Power Integrated Modules

F1	Q0	F2	Q1	Q2
				
1.2 mm press-fit pins Solder pins	1.2 mm press-fit pins 1.6 mm press-fit pins Solder pins	1.2 mm press-fit pins Solder pins	1.2 mm press-fit pins 1.6 mm press-fit pins Solder pins	1.6 mm press-fit pins Solder pins
With TIM/no TIM	With TIM/no TIM	With TIM/no TIM	With TIM/no TIM	With TIM/no TIM

Pre-applied TIM (thermal interface material) is an option that customers can use. TIM makes it easier to assemble the power module into their products.

Transfer-Molded for Power Integrated Modules



DIP-26 Package

73 mm X 47 mm X 8 mm

Gel-Filled vs Transfer-Molded Power Modules (TMPIMs)

Motor drive systems for industrial applications are increasing rapidly due to the growth of industrial automation and robotics, and they account for more than half of electrical energy consumed. These systems require highly efficient and reliable components to work within harsh industrial environments. onsemi's new Transfer-Molded power modules (TMPIMs) solve reliability and robustness challenges for high-power industrial drive application such as industrial motors, servo drives and more.

Parameters	Gel-Filled Modules	TMPIM
Power Cycling	1x	3x ↑↑↑
Temp Cycling	1x	10x ↑↑↑
Efficiency	Lower	Higher
Corrosion Resist	Not hermetic	Good

Benefits of TMPIMs

- Enhanced reliability & longer lifetime even in harsh environments
- Full design flexibility
- Lower cooling effort
- Lighter and compact devices
- 6 mm Creepage between pins and heatsink

Featured TMPIM products

Product	Description	Package size	Configuration
NXH50M65L4C2ESG	650V 50A Enhanced Substrate	DIP27	Converter-Inverter-PFC
NXH50M65L4C2SG	650V 50A	DIP27	Converter-Inverter-PFC
NXH25C120L2C2	1200V 25A	DIP-C2	Converter Inverter Brake (CIB)
NXH50C120L2C2ES1G	1200V 35A	DIP-C2	Converter Inverter (CI)
NXH50C120L2C2ESG	1200V 35A	DIP-C2	Converter Inverter Brake (CIB)
NXH35C120L2C2E	1200V 35A Enhanced Substrate	DIP-C2	Converter Inverter Brake (CIB)
NXH50C120L2C2ES1G	1200V 50A Enhanced Substrate		Converter Inverter (CI)
NXH50C120L2C2ESG	1200V 50A Enhanced Substrate		Converter Inverter Brake (CIB)

EliteSiC Hybrid Modules

Available with 1000V and 1200V IGBT MOSFETs – these modules improve efficiency with SiC diodes & fast switching low VCE (SAT) IGBTs. Also, SiC Hybrid circuits with 1000V IGBTs and SiC Diodes allow a higher-power density for circuits of over 100kVA, and improve power density and size by enabling higher-power in a specific module size. They are typically used in the DC-AC stages of solar inverters, energy storage systems and uninterruptible power supplies.

Features include:

- Range of pin compatible SiC hybrid and full SiC options
- Integrated bypass diodes
- Low thermal impedance baseplate
- Split T-Type NPC inverter
- I-Type NPC 1000 V, 350 A/450 A IGBT, 1200 V, 100 A SiC diode
- 3 Channel Symmetric Boost 1000 V, 150 A IGBT, 1200 V, 30 A SiC diode
- 3 Channel 1200 V IGBT + SiC Boost, 80 A IGBT and 20 A SiC diode
- PIM44 (press-fit and solder pin 93x47 mm), Q0, Q1, and Q2 packages available

Packages

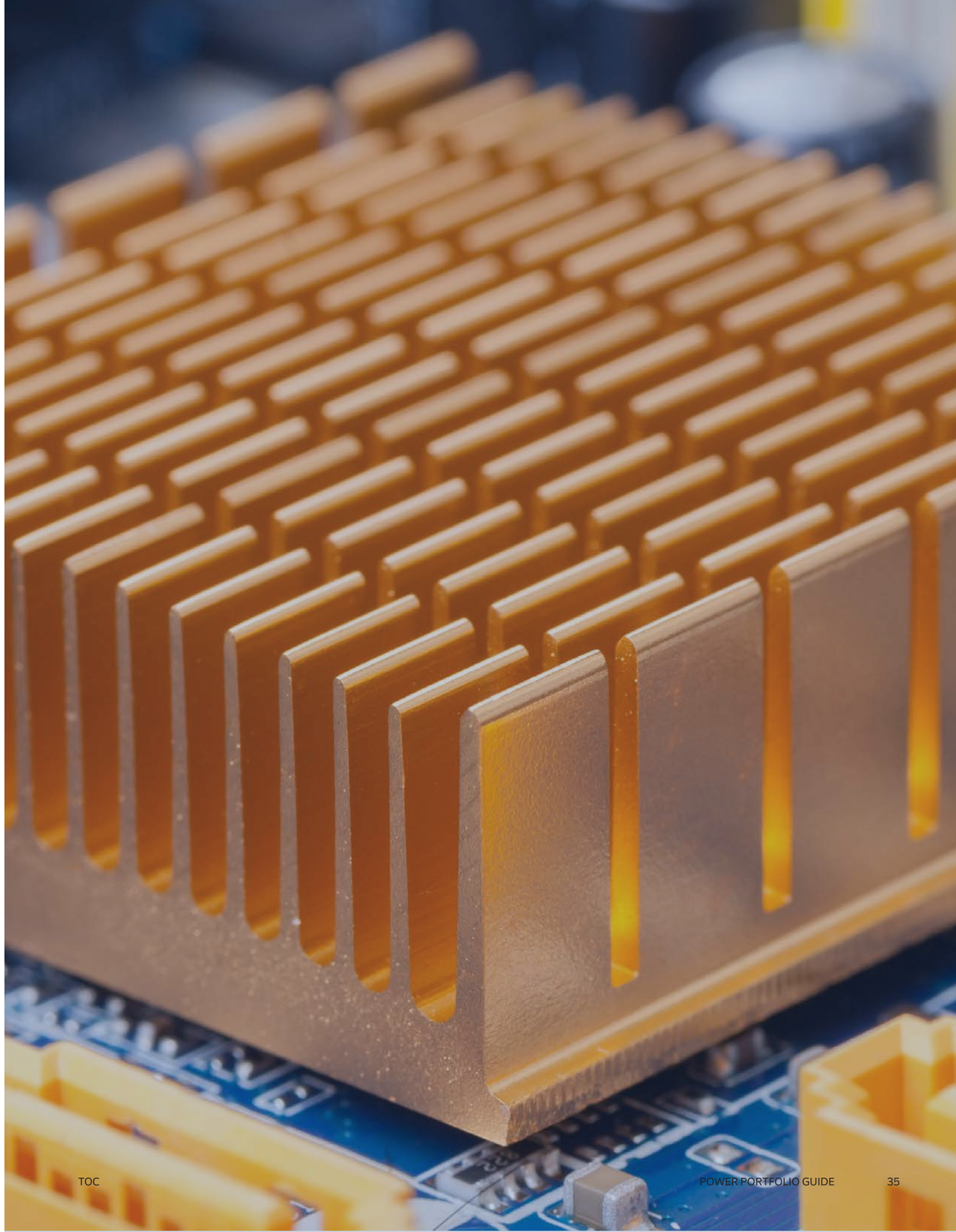
Q0

Q1

Q2

EliteSiC Hybrid Module Portfolio

SiC Module Type	Product	Description	Package Type
Dual Boost Power Integrated Module	NXH100B120H3Q0PG	– 1200V, 50A IGBT – 1200V, 20A EliteSiC Diode	Q0
	NXH100B120H3Q0SG		Q0
	NXH100B120H3Q0STG		Q0
	NXH100B120H3Q0PTG		Q0
Split T-Type NPC 3 Level Inverter	NXH200T120H3Q2F2STG	– Two 200A/1200V half-bridge IGBTs with inverse diodes – Two neutral point 100A/650V EliteSiC diodes – Two 150A/650V neutral point IGBTs with inverse diodes – Two half-bridge 150A/1200V rectifiers and a negative temperature coefficient thermistor	Q2
	NXH200T120H3Q2F2SG		Q2
	NXH200T120H3Q2F2STNG		Q2
3 Channel IGBT + SIC Boost Module	NXH240B120H3Q1PG	– 1200 V, 80 A IGBT – 1200 V, 20 A EliteSiC Diode	Q1
	NXH240B120H3Q1S1G		Q1
	NXH240B120H3Q1S1G	– 1200 V, 80 A IGBT – 1200 V, 30 A EliteSiC Diode	Q1
	NXH240B120H3Q1P1G		Q1
3 Channel Flying Capacitor Boost Module	NXH300B100H4Q2F2SG	– Each channel contains two 1000 V, 100 A IGBTs, two 1200 V, 30 A EliteSiC diodes and two 1600 V, 30 A bypass diodes	Q2
	NXH300B100H4Q2F2PG		Q2
	NXH600B100H4Q2F2S1G	– Each channel contains two 1000 V, 200 A IGBTs and two 1200 V, 60 A EliteSiC diodes	PIM56
I-Type NPC Power Integrated Module	NXH350N100H4Q2F2S1G	– 100 A, 1200 V EliteSiC diodes for the neutral point clamps	Q2
	NXH350N100H4Q2F2P1G	– 350 A, 1000 V IGBTs for the outer IGBTs – 400 A, 1000 V IGBTs for the inner IGBTs – Inverse diodes for the IGBTs are specified at 170 A for switching	Q2
	NXH400N100H4Q2F2SG	– 100 A, 1200 V EliteSiC diodes for the neutral point clamps	Q2
	NXH400N100H4Q2F2PG	– 400 A, 1000 V IGBTs for the outer IGBTs	Q2
3 Channel Symmetric Boost	NXH450B100H4Q2F2PG	– Each channel contains two 1000 V, 150 A IGBTs, two 1200 V, 30 A EliteSiC diodes and two 1600 V, 30 A bypass diodes	Q2
	NXH450B100H4Q2F2SG		Q2
	NXH600B100H4Q2F2PG	– Each channel contains two 1000 V, 200 A IGBTs and two 1200 V, 60 A EliteSiC diodes	PIM44
	NXH600B100H4Q2F2SG		PIM44



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