Fuji Electric Power Semiconductors

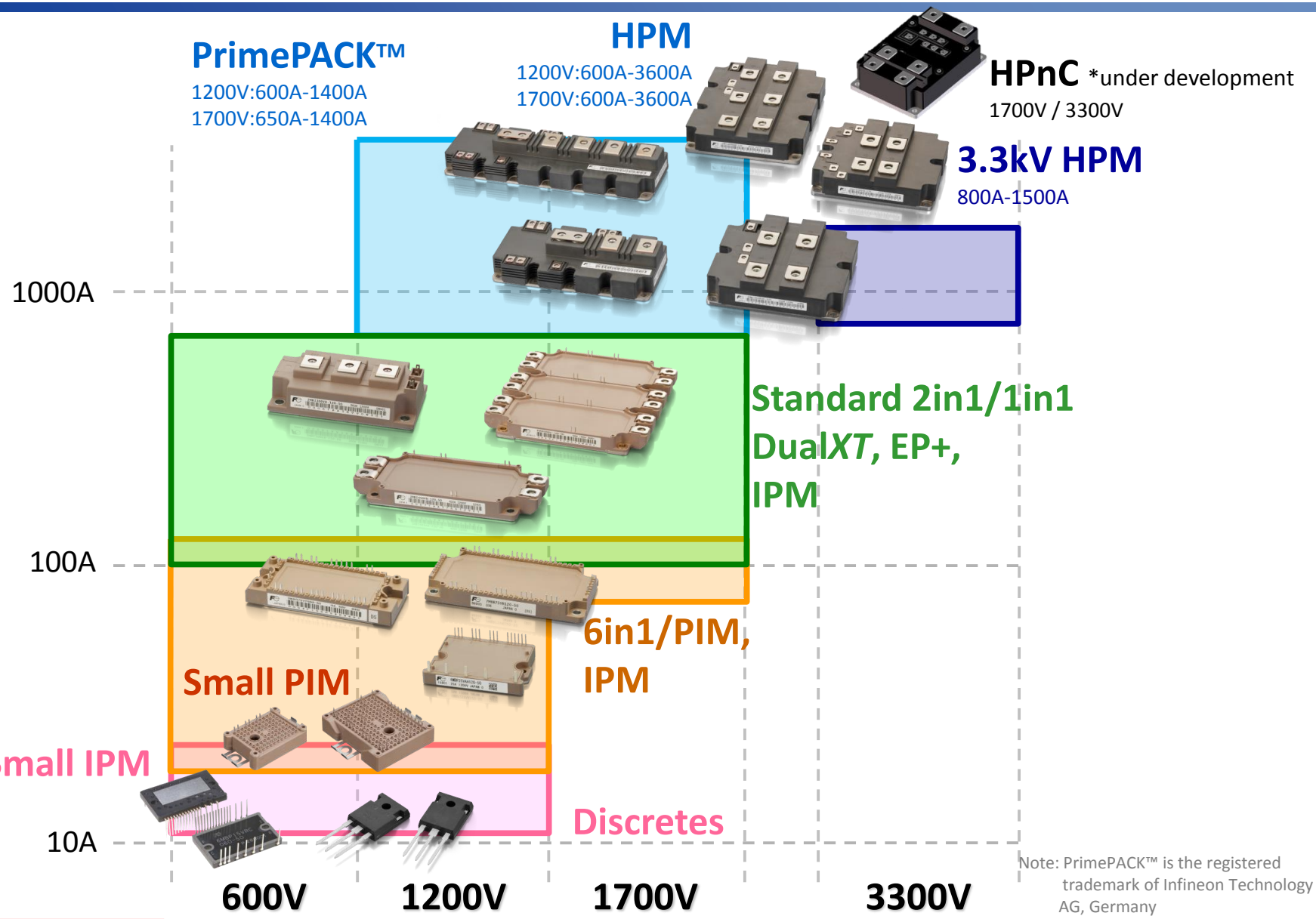
Device Application Technology Dept.
Semiconductors Division-Sales Group
Fuji Electric. Co., Ltd.

July 2018

Fuji Electric
Power Semiconductors and Applications

Fuji Electric IGBT Modules & Discretes

Fuji Electric
Innovating Energy Technology



Note: PrimePACK™ is the registered trademark of Infineon Technology AG, Germany

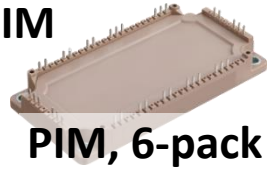
For internal use only

Fuji Electric IGBT Modules - Applications

Fuji Electric
Innovating Energy Technology

Motor Drive

Small-PIM



PIM, 6-pack

Standard 2pack

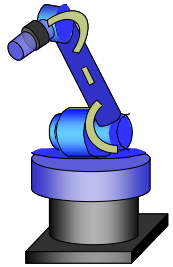
PV, UPS, Wind

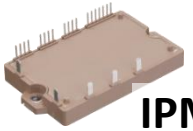
Standard 2pack

3-level module

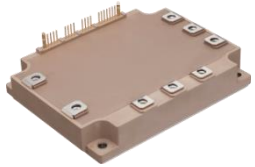
HPM

NC, Servo



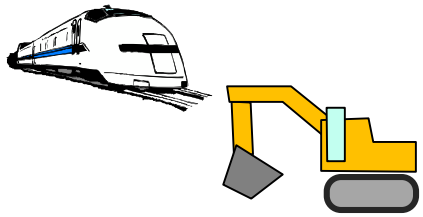


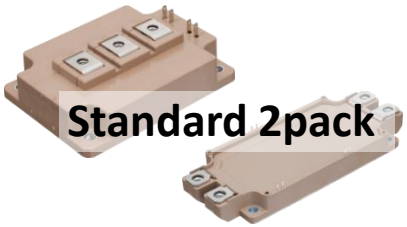
IPM



Small-IPM

Traction





Standard 2pack

PrimePACK™

HPM

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Fuji Electric Semiconductor - Applications

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Automotive

Automotive module

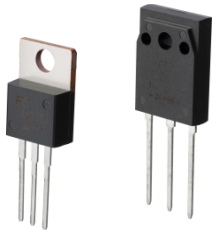
Pressure sensor

Air conditioner

Small-IPM

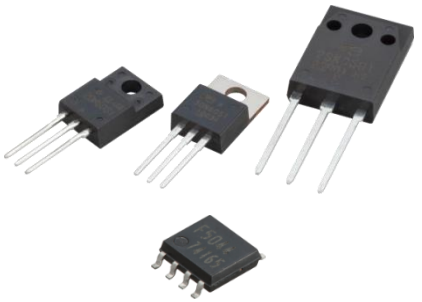
Welding, IH, Medical

High speed



Discrete IGBT/ MOSFET

Power supply



MOSFET / Control IC

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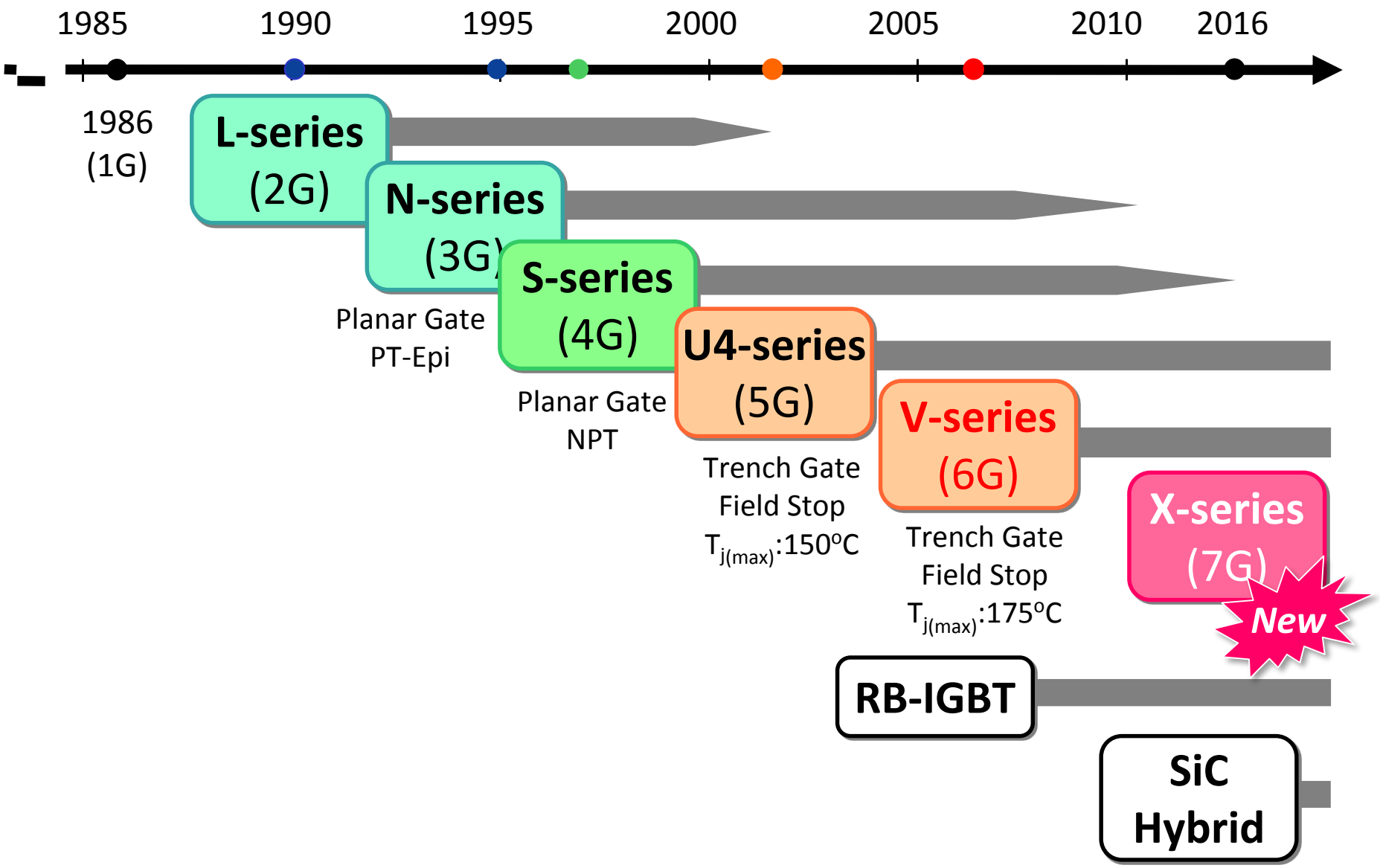
Fuji Electric
Power Semiconductor
IGBT Technology

Evolution of Fuji Electric IGBT Technology

Fuji Electric
Innovating Energy Technology



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Evolution of Fuji Electric IGBT Chip Design

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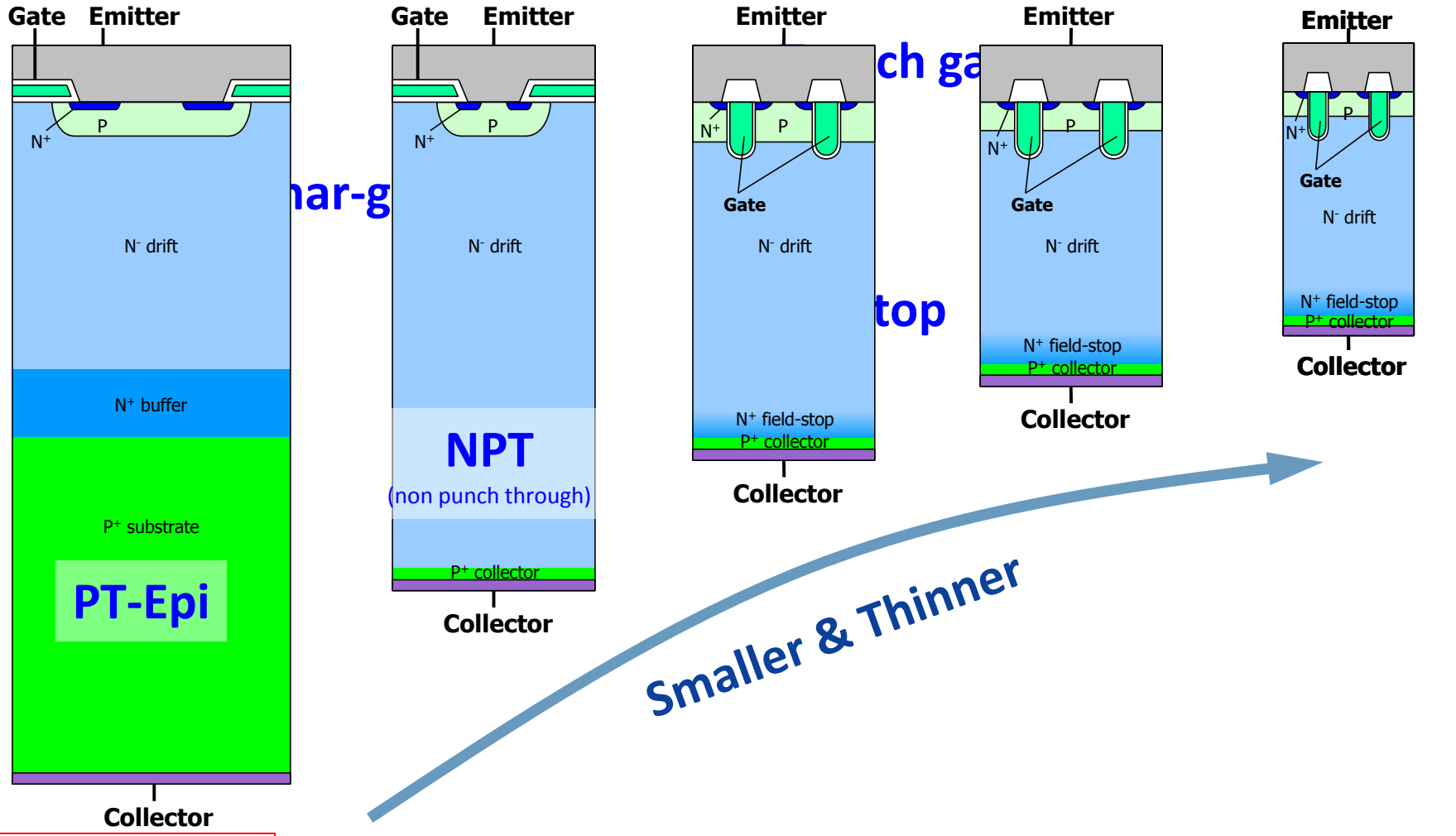
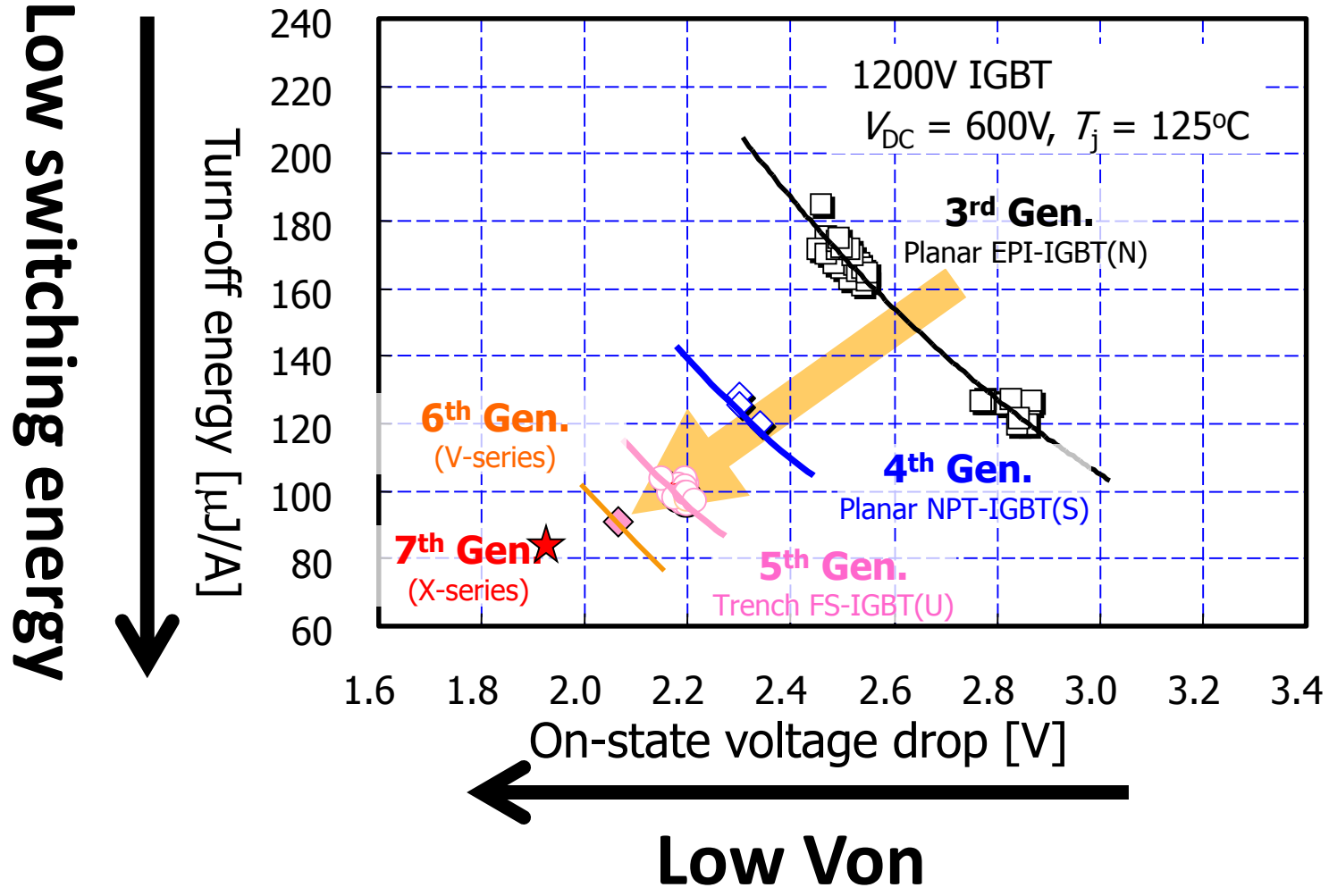
N-series (3G) | **S-series** (4G) | **U4-series** (5G) | **V-series** (6G) | **X-series** (7G)



IGBT Loss Improvement by Generation

Fuji Electric
Innovating Energy Technology

Optimized Trench / Field-stop structure



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Fuji Electric Part Number System

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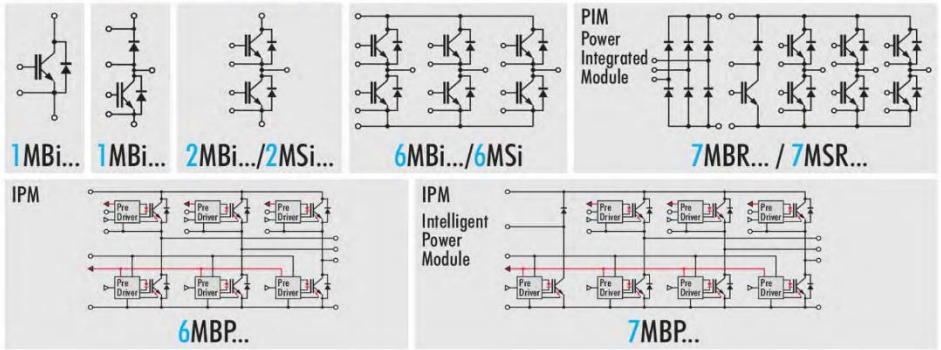
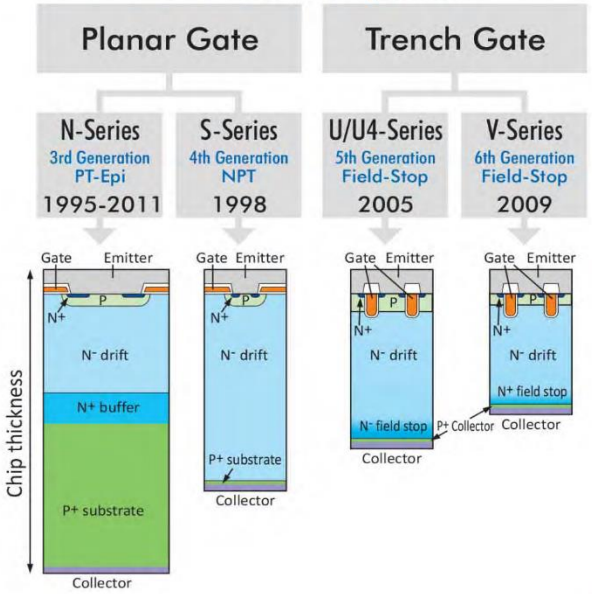
1. Modules with Standard IGBT-Chips

2 MBi 450 V H - 120 - 50

- 2 — Number of IGBT-switches (not chips)
- MBi — Device type
  - MBi : Standard IGBT module (1-, 2- and 6-Pack)
  - MBR : PIM IGBT (Power Integrated Module)
  - MBP : IPM IGBT (Intelligent Power Module)
  - MSi , MSR : The "S" instead of "B" indicates Hybrid module with Si-IGBT & SiC Schottky Free Wheeling Diodes
- 450 — Rated current I_c [A]
- V — IGBT -Series (here V-Series) / IGBT-Technology
- H — Package Style
- 120 — Voltage class: 060 = 600V · 120 = 1200V · 170 = 1700V · 330 = 3300V
- 50 — Suffix -50 = RoHS compliant , -85 = With pre-applied Thermal Interface Material (see next page)



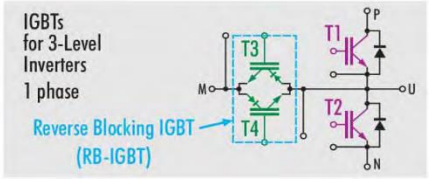
IGBT development



2. Voltage Classification of modules with Reverse Blocking IGBT

4 MBi 300 V G - 120 R1 - 50

- 120 — Voltage class of the Standard IGBTs T1 & T2
  - 060 = 600V
  - 120 = 1200V
  - 170 = 1700V
- R1 — Voltage class of the RB-IGBTs T3 & T4
  - R = 600V
  - R1 = 1200V
  - R2 = 1700V



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Fuji Electric
X Series - 7G
Features and Benefits

7G - Features and Benefits

- Optimized Field-Stop Layer
- Finer Pattern Trench Pitch
- Ultra-Sonic Welding for Higher Joints and Reliability
- **Downsizing of IGBT Modules**
  - **Increased current rating, e.g. 50A → 75A**
  - **36% size reduction**
- **4. Improved Long-Term Reliability (LTR)**
  - **New plastic with CTI>600 for higher anti-cracking.**
  - **High thermal cycling capability even with Cu-baseplate**

7G - Features and Benefits

- New High-Heat Resistant Silicone Gel Developed for 7G
  - Withstands high temperature operation
  - Tj(op) = 175ºC Guaranteed
- Long Term Insulating capability at 175ºC
- Optimized Wire Bonding
  - Wire diameter and length of wire bonds
- Improved Free Wheeling Diode
  - 10% lower switching loss at reverse recovery dv/dt
- Low Internal Leakage Induction by Parallel Cu-bar

Advantages of X-series 7G IGBT Module

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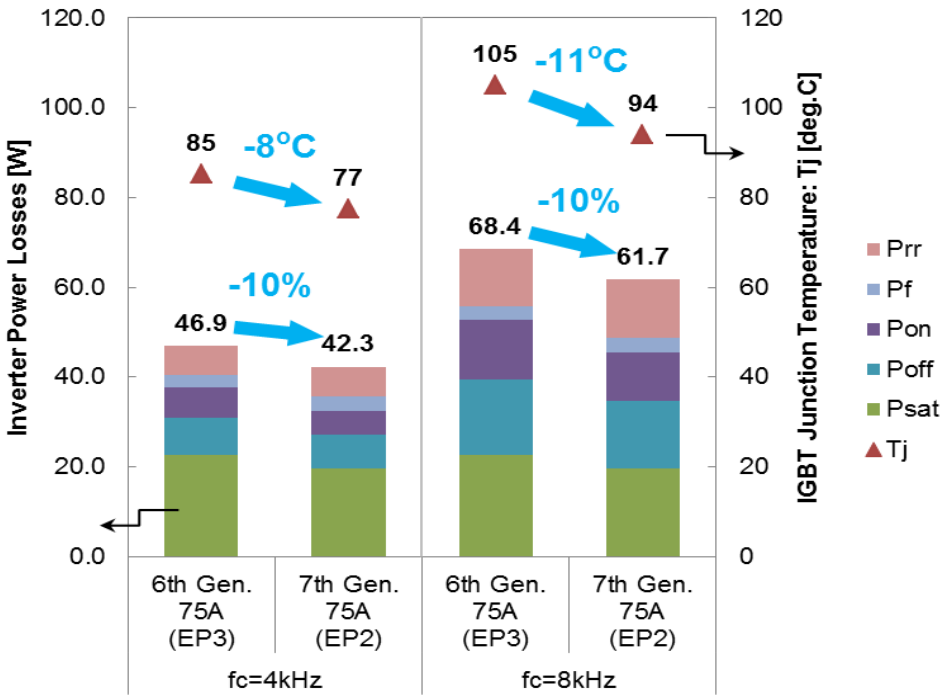
Innovating Energy Technology

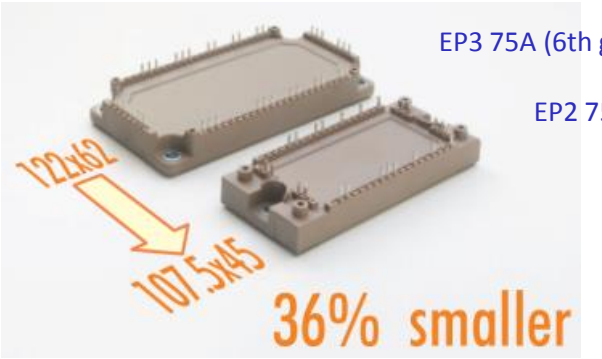
High Efficiency



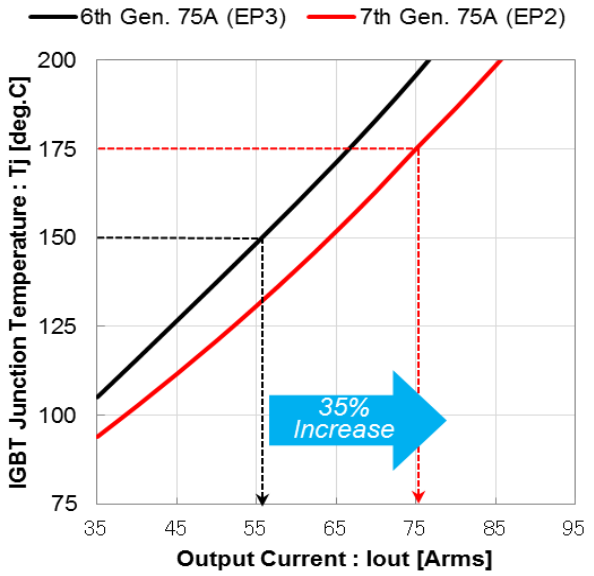
1200V/75A rating

EP: EconoPIM™ is registered trademarks of Infineon Technology AG, Germany

Smaller Package



More output current $T_{j(op)}$=175°C



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X Series 7G - 650V Product Line-Up Plan

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650V

	10A	20A	30A	50A	75A	100A	150A	200A	300A	400A	600A	800A				
Small PIM	Small PIM 1			Small 2												
EP/PC				EP2(M719)		EP3(M720)										
Std.2in1						34mm			45mm		62mm	80mm				

EP: EconoPIM™ is registered trademarks of Infineon Technology AG, Germany.

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X Series 7G - 1200V Product Lineup Plan

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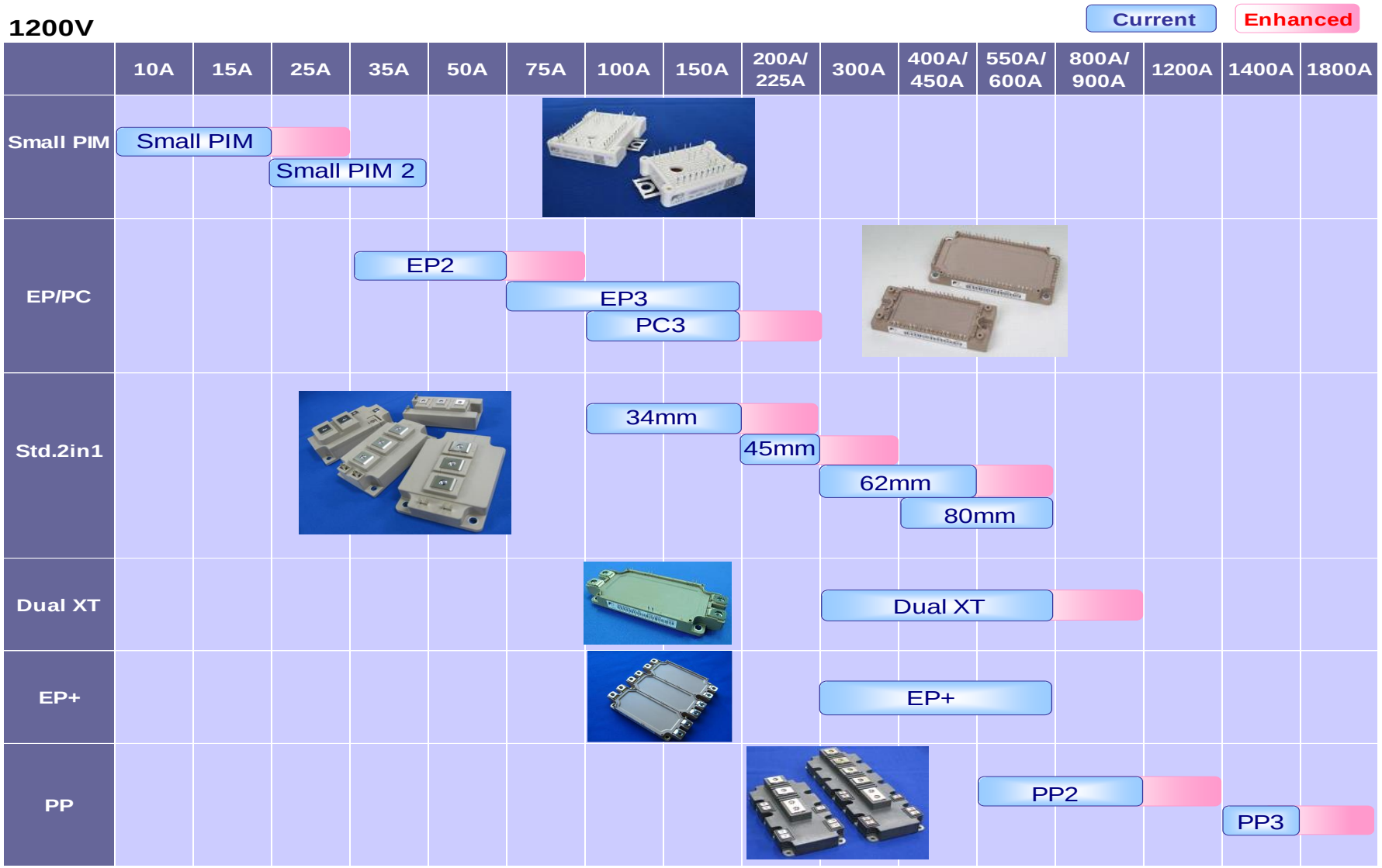
Innovating Energy Technology



EP: EconoPIM™, EP+: EconoPACK™+, PP: PrimePACK™ are registered trademarks of Infineon Technology AG, Germany.

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X Series 7G - 1700V Product Lineup Plan

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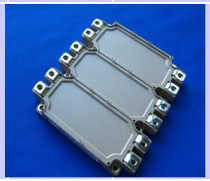
1700V

Current Enhanced

	15A	25A	35A	50A	75A	100A	150A	200A	300A	400A/ 450A	550A	650A	1000A/ 1200A	1400A	1800A	2000A
Std.2in1					34mm		62mm			80mm						
Dual XT									Dual XT							
EP+									EP+							
PP												PP2	PP3			

EP+: EconoPACK™+, PP: PrimePACK™ are registered trademarks of Infineon Technology AG, Germany.

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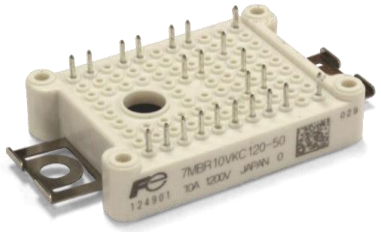
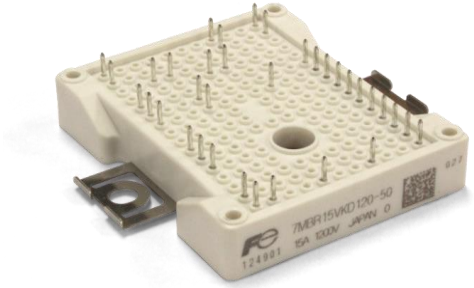
Fuji Electric
Product Line-Up
Standard IGBT Modules
Low-Power Range

Small-PIM



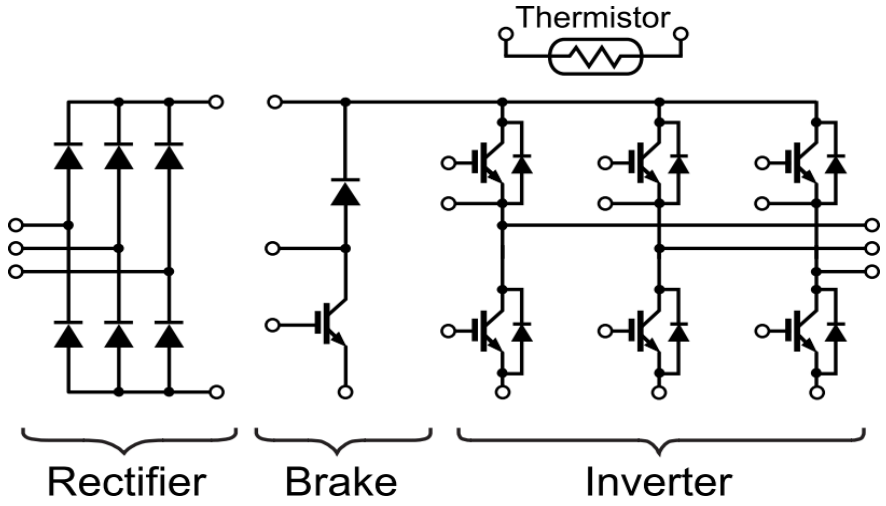
Small PIM1 (AKA Easy1B)

Solder pin type



Small PIM2 (AKA Easy2B)

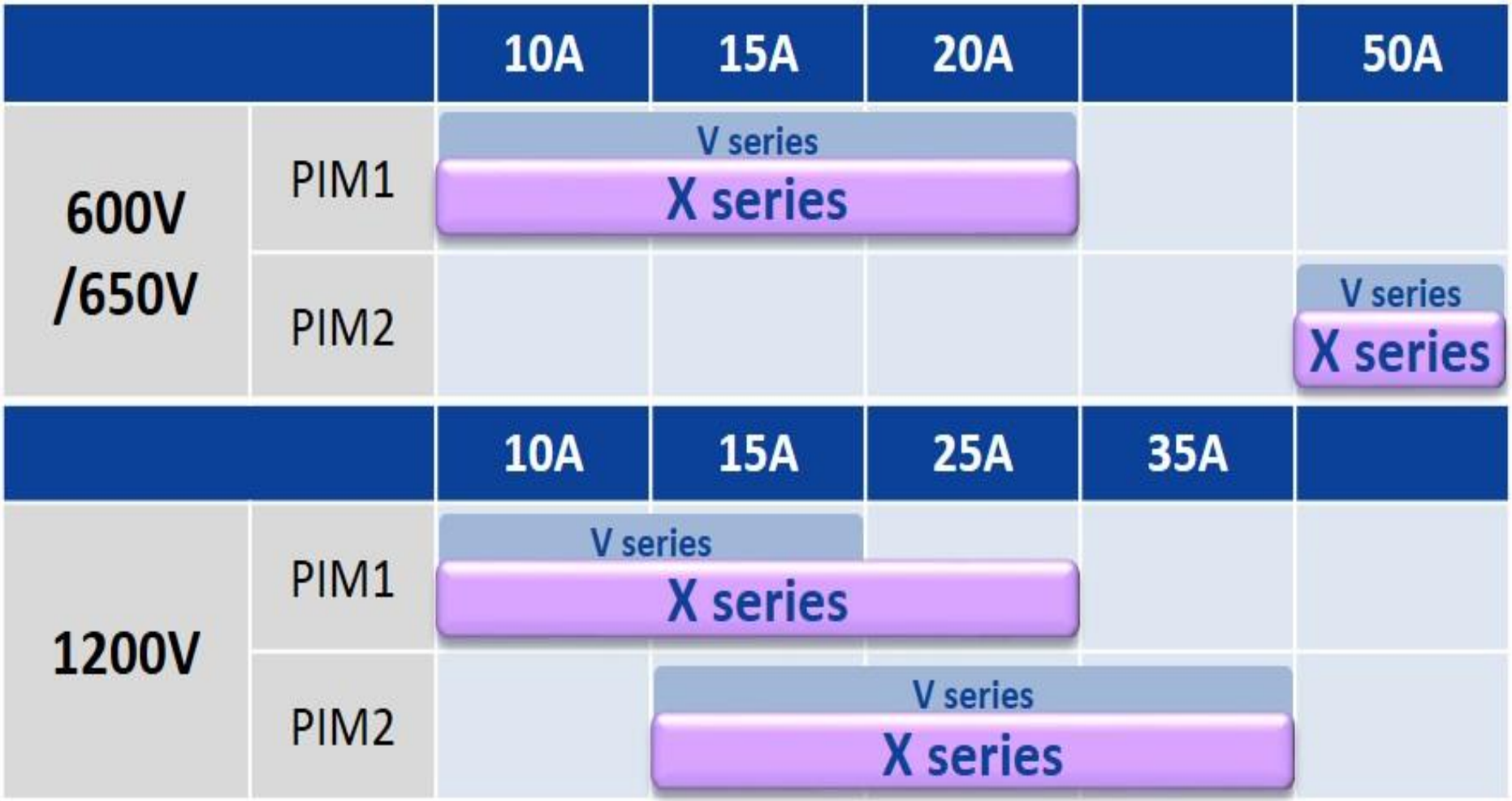
Press-fit type



7-1 Converter - Inverter - Brake (AKA CIB Module)

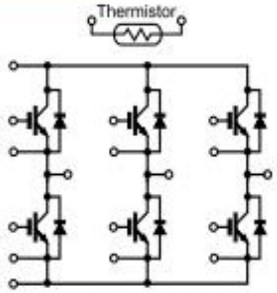
- Compactness
  - Small PIM1 → 65% Smaller than EP2
  - Small PIM2 → 45% Smaller than EP2
- Light weight
- Easy Assembly
  - Solder Pin
  - Press-Fit Pin
- Industry Standard Package

Small-PIM Line-Up

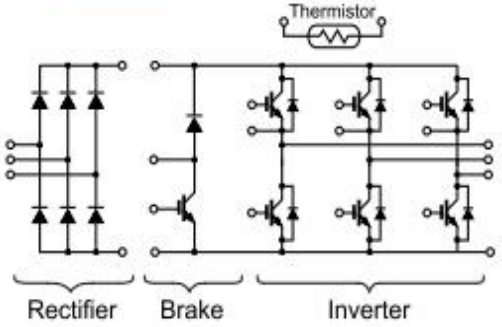


6-pack & PIM

6-pack PC2 / PC3



PIM EP2 / EP3



Solder pin

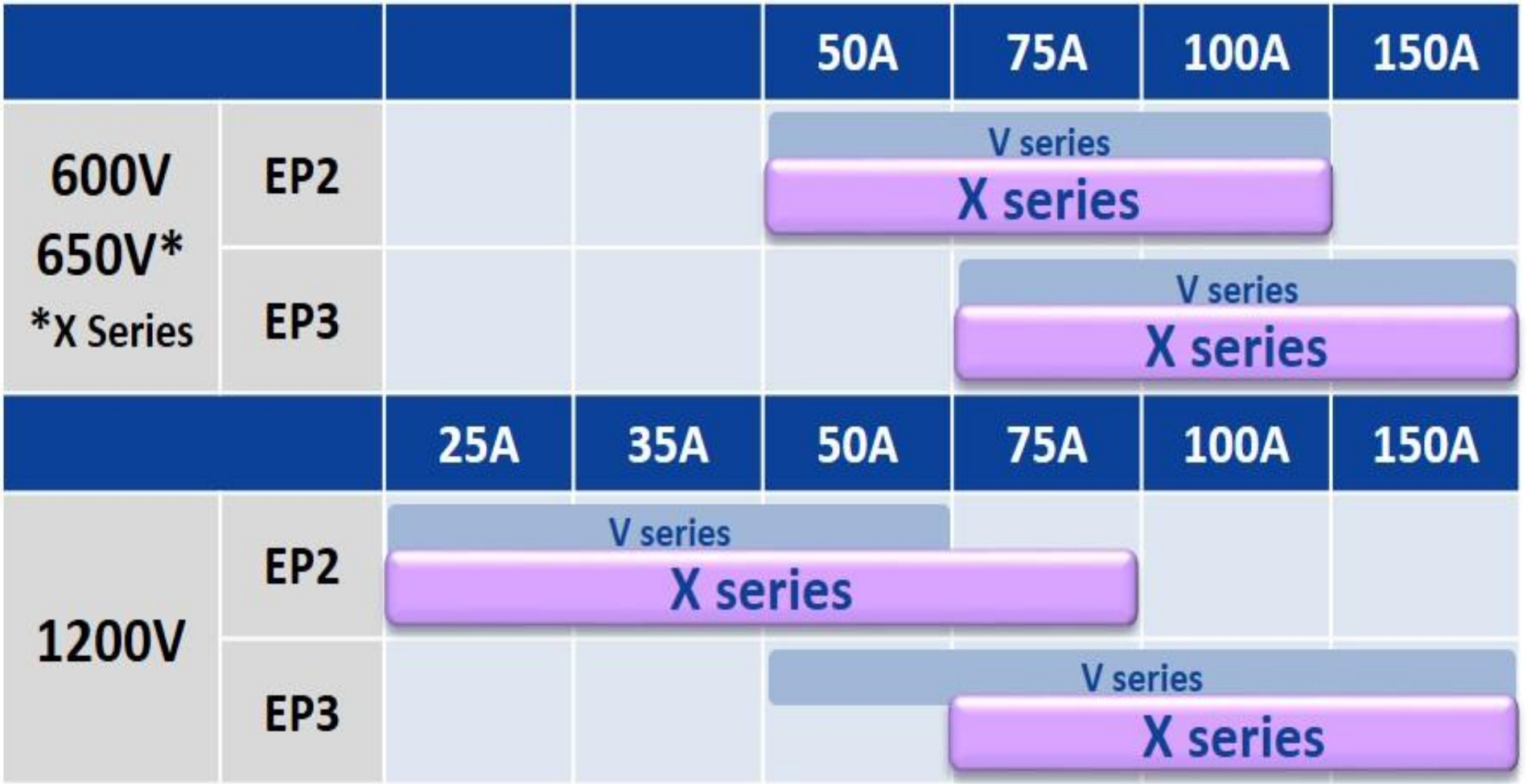
EP2

EP3

Pressfit

- **Compact Design**
  - **EP2/PC2 - 45 X 107.5 mm**
  - **EP3/PC3 - 62 X 122 mm**
- **Easy Assembly**
  - **Solder Pin & Press-Fit Pin**
- **Industry Standard Package**

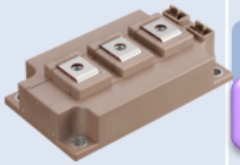
6-pack - PIM Line-UP

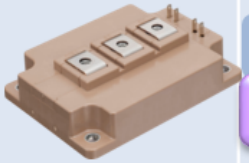


Fuji Electric
Product Line-Up
Standard IGBT Modules
Mid-Power Range

Standard 2-in-1 Package - 1700V Line-Up

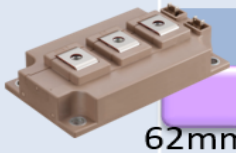
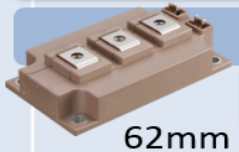
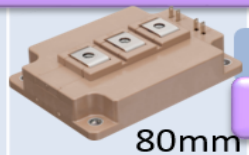
	75A	100A	150A	200A	300A	400A	600A
1700V	V series X series	V series X series		V series X series			





* X-series : under development

Standard 2-in-1 Package 600-650V & 1200V Line-Up

	75A	100A	150A	200A	300A	400A /450A	600A
600V 650V* *7G	 34mm	V series / X series		 45mm	V series / X series	 62mm V series / X series	
1200V	 34mm V series / X series		 45mm V series / X series		 62mm V series / X series	 80mm V series / X series	

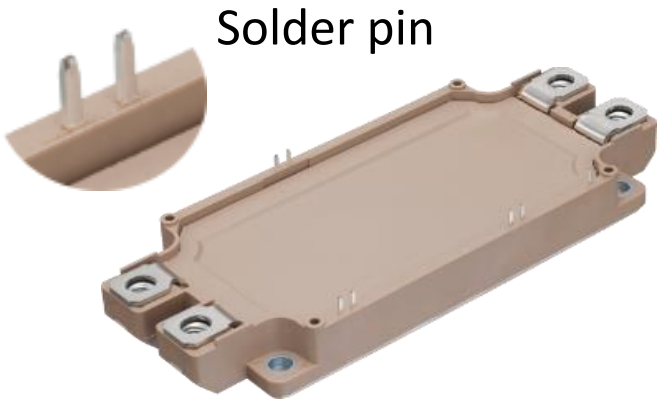
*** X-series : under development**

Dual XT Series - Line-Up

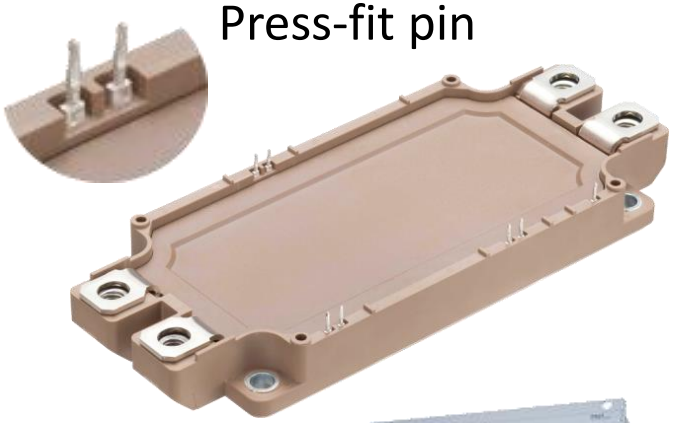
* X-series : under development

Dual XT Series

Solder pin



Press-fit pin



- **Compact Design**
  - **62 X 150 mm**
  - **225A - 600A Rating**
  - **800A Rating with 7G**
- **Easy Assembly**
  - **Solder Pin**
  - **Press-Fit Pin**
  - **Spring Contact**
- **Industry Standard Package**

Fuji Electric
Product Line-Up
Standard IGBT Modules
High-Power Range

Fuji Electric PrimePACK™

M271

M272

- Industry Standard Packages
  - PP2 - 89 X 172 mm
  - PP3 - 89 X 250 mm
- Multiple Configurations
  - PP2 - 2 Pack
  - PP3 - 2 Pack
- 1200V & 1700V
- Low-Inductance Package
- Parallel Easily

Fuji Electric PrimePACK™ - Line-UP

		600A	900A	1200A	1400A	1800A
1200V	M271	V series	X series			
	M272				V series	X series

		650A	1000A	1200A	1400A	1800A
1700V	M271	V series X series		X series		
	M272		V series X series		V series	X series

* X-series : under development

HPM 1in1

M251

HPM 2in1

M256

HPM 1in1

M252

HPM - High Power Module Line-Up

			600A	800A	1000A	1200A	1600A	2400A	3600A
1200V	M151	1 - 1				V Series			
	M152	1 - 1	V Series						
1200V	M256	2 - 1						V Series	

			600A	800A	1000A	1200A	1600A	2400A	3600A
1700V	M151	1 - 1				V Series			
	M152	1 - 1	V Series						
1700V	M256	2 - 1						V Series	

			600A	800A	1000A	1200A	1500A	2400A	3600A
3300V	M151	1 - 1		U Series					
	M152	1 - 1				U Series			

Fuji Electric Product Line-Up Chopper Modules

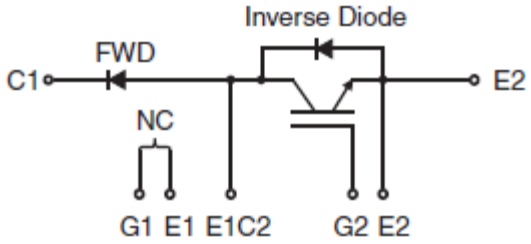
Chopper module - Standard Package

M259

62mm X 108mm

M262

34mm X 94mm

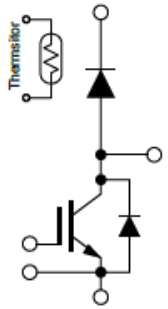


Low Side

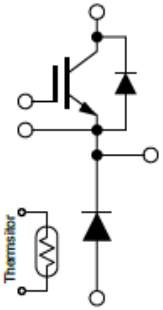
Chopper Module - PrimePACK™

M271

M272



Low Side



High Side

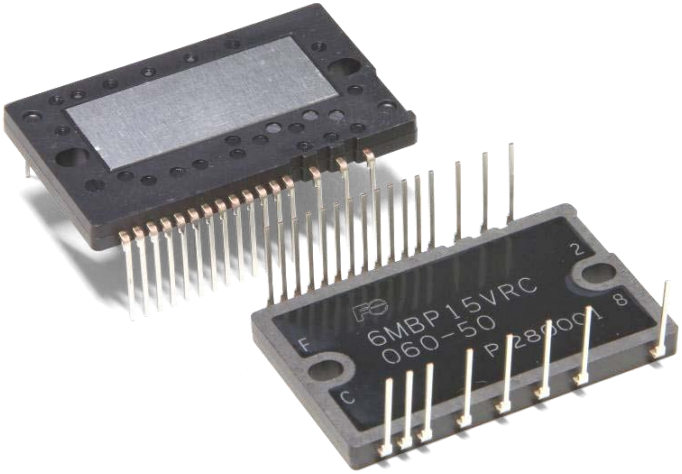
Chopper Module Line-Up

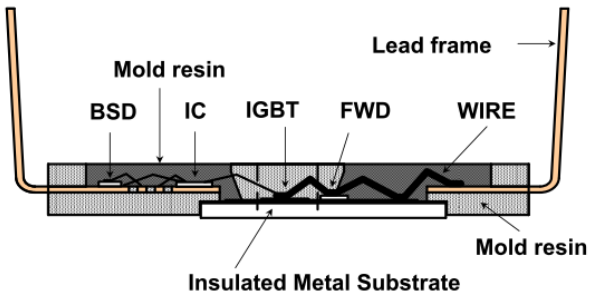
			50A	75A	100A	150A	200A	300A	400A
1200V	M262	Low Side	U Series						
1200V	M262	Low Side				V Series			
600V	M259	Low Side						U Series	
1200V	M259	Low Side					V Series		
								High-Speed Series	

			600A	650A	900A	1000A	1200A	1400A	1800A
1200V	M271 PP2	Low Side			V Series				
1200V	M271 PP2	High Side			V Series				
1200V	M272 PP3	Low Side						V Series	
1200V	M272 PP3	High Side						V Series	
1700V	M271 PP2	H/L Side		X Series					
1700V	M272 PP3	H/L Side				X Series			

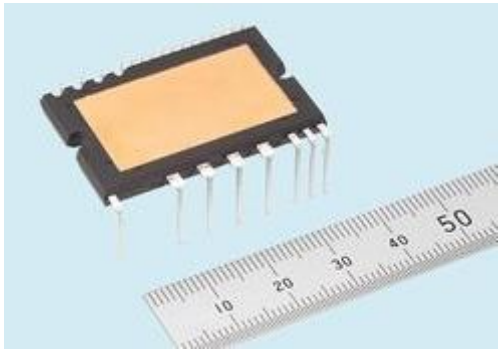
Fuji Electric
Product Line-Up
IPM
(Intelligent Power Module)

Fuji Electric Small-IPM





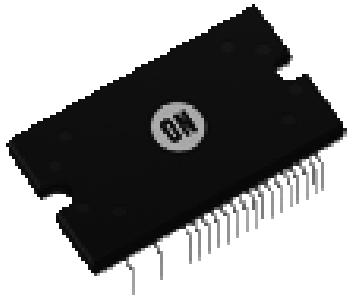
- **Energy Saving Characteristics:**
  - Low loss at light load
  - Low $V_{CE(sat)}$ and low turn-off loss IGBT (X-IGBT)
  - Low V_F, t_{rr} and low noise FWD
- **Built in drive Ics & Boot Strap Diodes**
  - Input interface: 3.3V, 5V line (High active)
  - UVLO, SC, OH or LT (Temperature sensor output)
  - Built in Boot Strap Diodes at all phase
- **Fully Isolated Small Dual In-Line Package**
  - Small size: 43 mm x 26 mm, t = 3.7 mm
  - Conformity of UL508
  - High isolation voltage >1.5kV
  - Aluminum Base
  - Low Thermal Resistance



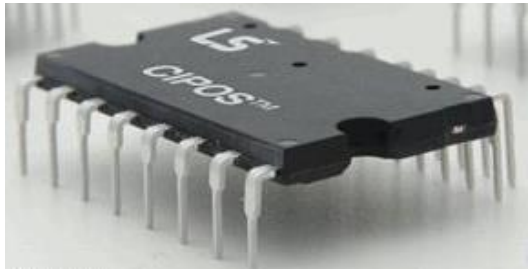
Mitsubishi Electric

Largest share!

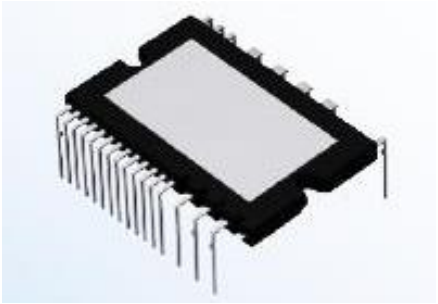
Fairchild Semiconductor



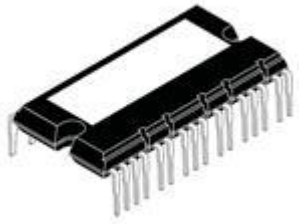
ON Semiconductor



Infineon Technologies



ROHM Semiconductor



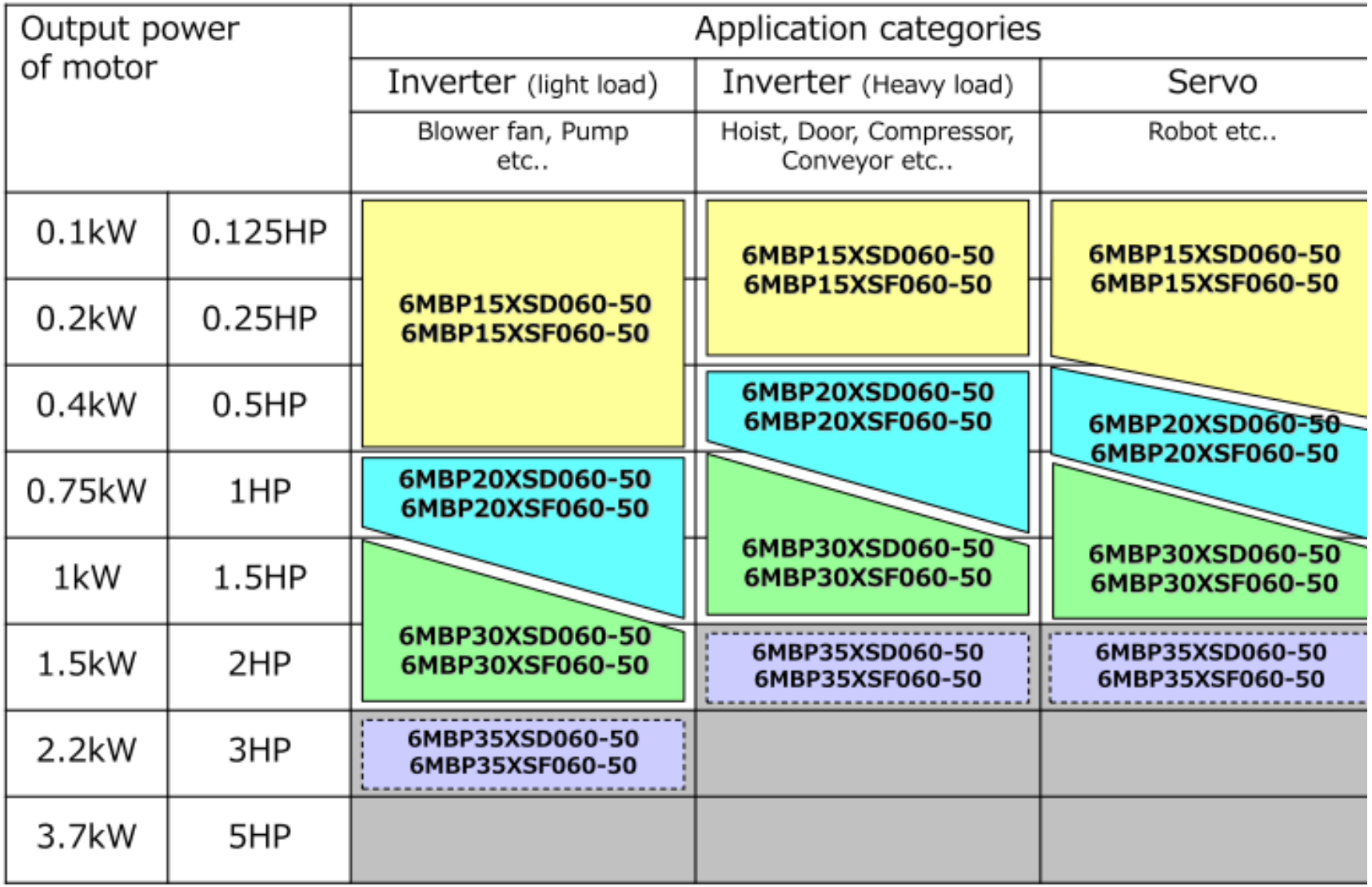
STMicroelectronics

2nd Generation Small-IPM Lineup (Global Model)

Parts Number	IC	VCE(sat) typ.@25℃	VF typ.@25℃	Overheating protection	PKG	Schedule
6MBP15XSD060-50	15A	1.60V	1.60V	V(temp) OUT	P633A	In Mass Production
6MBP15XSF060-50				V(temp) OUT & TOH		
6MBP20XSD060-50	20A	1.60V	1.70V	V(temp) OUT		
6MBP20XSF060-50				V(temp) OUT & TOH		
6MBP30XSD060-50	30A	1.60V	1.70V	V(temp) OUT		MP: June 2016
6MBP30XSF060-50				V(temp) OUT & TOH		
6MBP35XSD060-50	35A	1.40V	1.70V	V(temp) OUT		
6MBP35XSF060-50				V(temp) OUT & TOH		

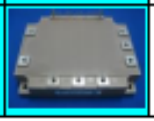
Small IPM for Industrial Applications

Fuji Electric
Innovating Energy Technology



For internal use only

- The current rating of X-IPM will be expanded more than V-IPM.
- This expansion contribute to package down sizing.

650V	20A	30A	50A	75A	100A	150A	200A	250A	300A	400A	500A
1200V	10A	15A	25A	35A	50A	75A	100A	125A	150A	200A	250A
P639  new PKG	P639 (6in1)										
P629 			P629 (6in1)	P629 (6in1)							
P626 			P626 (6in1)		100A/600V 50A/1200V						
P636 			P636 (6in1 & 7in1)								
P638  new PKG			P638 (6in1)								
P630 			P630 (6in1 & 7in1)		High heat radiation type			under consideration			
P631 							P631 (6in1 & 7in1)		P631 (6in1 & 7in1)		under consideration

Expand area

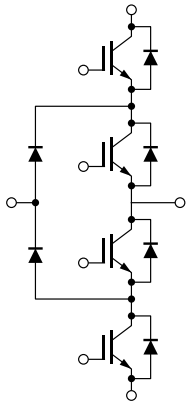
P639 : new → 30A/600V
P629 : 50 → 75A/600V
P626 : 75 → 100A/600V

P638 : new → 150A/600V
P630 : 200 → 250A/600V
P631 : 400 → 500A/600V

Fuji Electric Product Line-Up 3-Level Modules

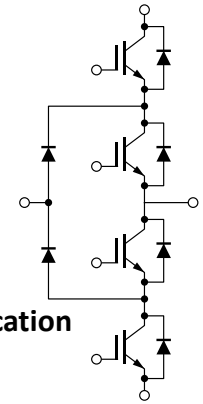
Fuji Electric 3-level Module Topologies

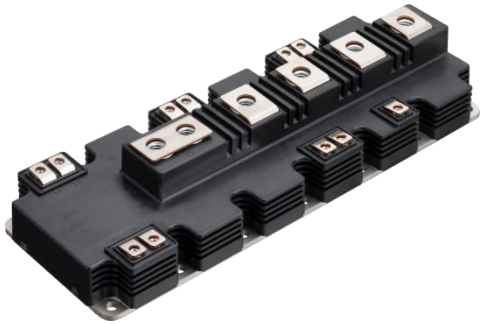
Fuji Electric
Innovating Energy Technology

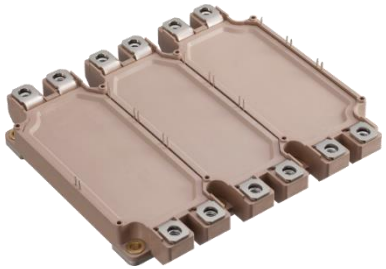


I-NPC

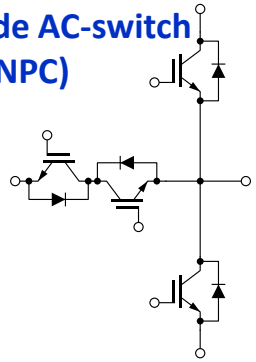
Suitable for DC=1500V application





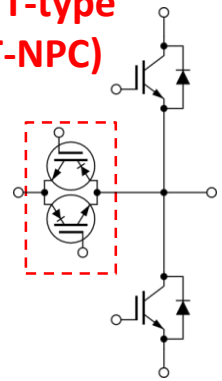


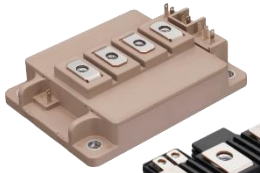
T-type 3-level with cascade AC-switch (T-NPC)

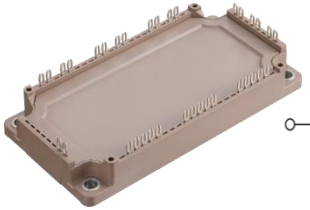


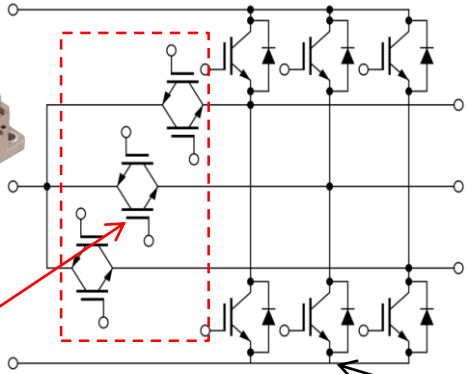
Advanced T-type 3level (AT-NPC)

RB-IGBTs









RB-IGBTs (600V)

Standard IGBT (1200V)

For internal use only

3-Level NPC Module Line-Up

			50A	75A	100A	220A	300A	340A	400A
1700V	M403	4 - 1				V Series 600V AC-SW			
1200V	M1202 M1203	12 - 1	V Series - 600V AC-SW						
	M403	4 - 1					V Series 900V AC-SW	V Series - 600V AC-SW	
600V	M403	4 - 1							V Series 600V AC-SW
600V	TBD 62x122	4 - 1					V Series - 600V AC-SW		

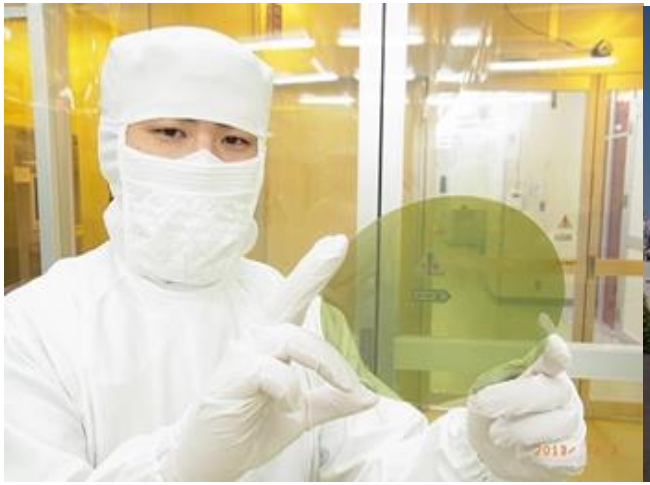
			400A	450A	600A	650A	900A	2400A	3600A
1200V	EP+ I-Type	4 - 1			V Series			V Series	
	PP3 I-Type	4 - 1			V Series				
1200V	PP3 T-Type	4 - 1		V Series - 900V AC-SW					
1700V	M151	1 - 1				V Series 1200V - AC-SW			

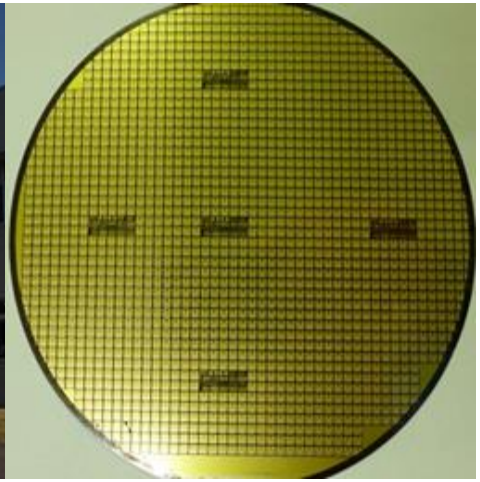
Fuji Electric
Product Line-Up
SiC Hybrid & Full SiC Modules

Fuji Electric SiC Production

Fuji Electric
Innovating Energy Technology

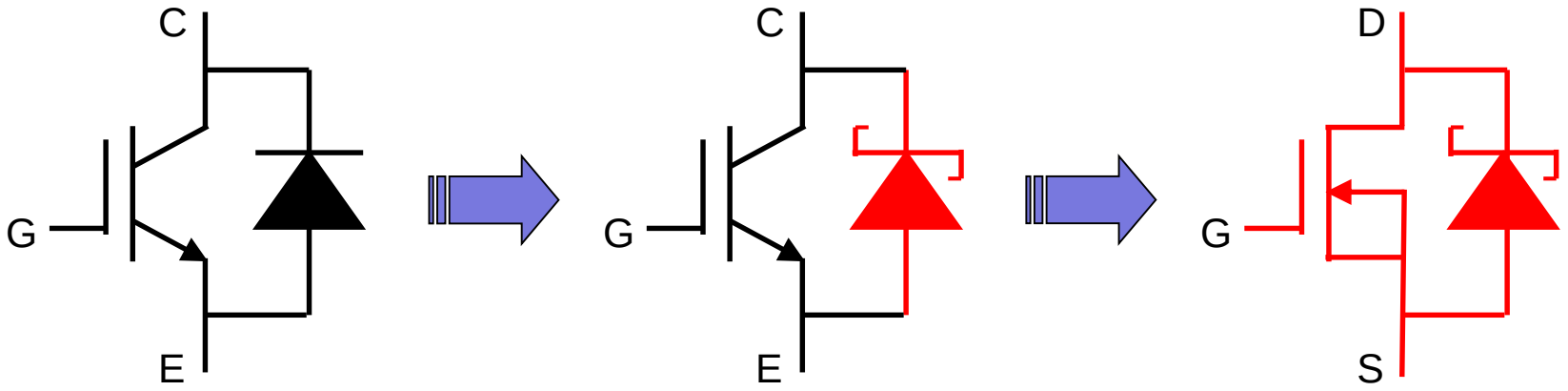
6-inch SiC Front-End Factory in Operation since Oct-2013





Automated SiC Back-End Factory in Operation since Apr-2014

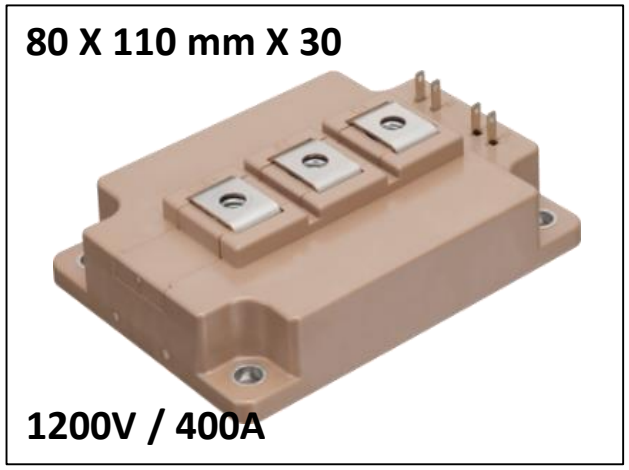
For internal use only



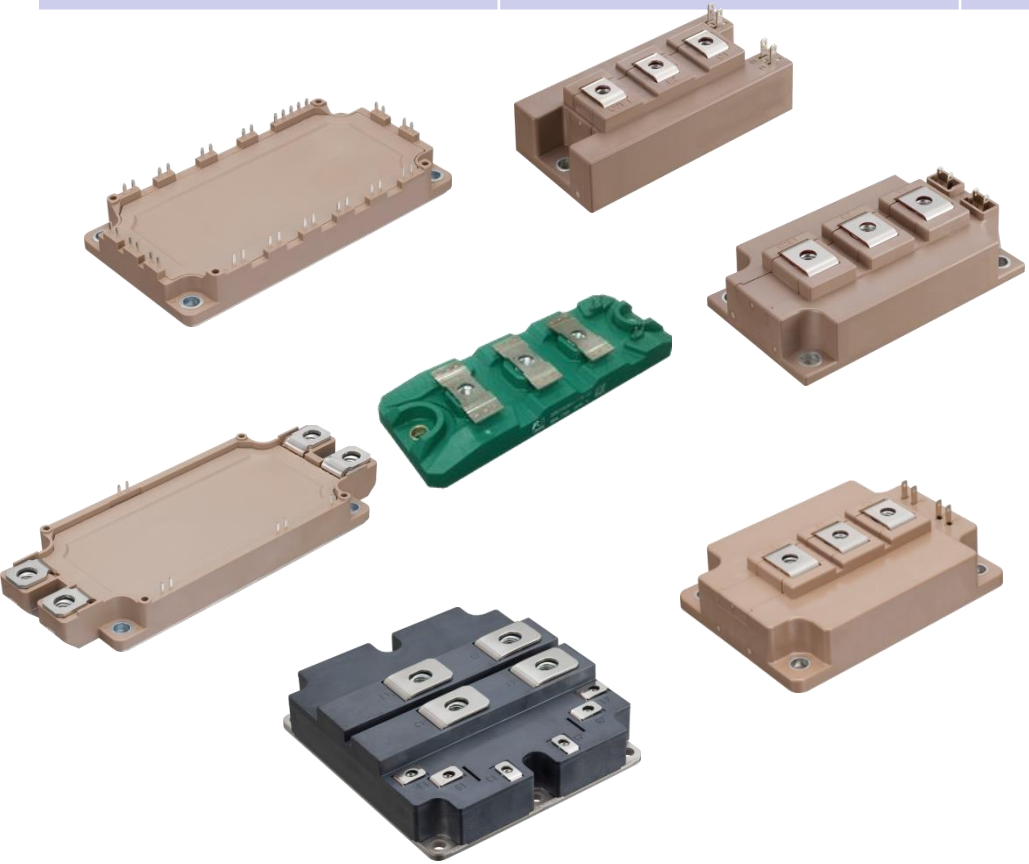
Si-IGBT+Si-FWD
(Conventional - MP)

Si-IGBT+SiC-SBD
(Available)

SiC-MOS+SiC-SBD
(In Development)



Advantage	Si	Si+SiC SBD	SiC MOS + SiC SBD
fsw	100%	200%	400%
LOSS	100%	70%	50%
Filter Down Size	1	¼	1/16



- Lower Power Dissipation
  - Inverter Size Up
  - Smaller Heat Sink
- Higher Switching Frequency
  - Filter Down Size

Hybrid Si IGBT + SiC SBD Module Line-Up

			200A	300A	400A	450A	550A	600A	1200A
1700V	M277 80X110	2 - 1			V Series				
1700V	62X150	2 - 1				V Series			
1700V	140X130	2 - 1							V Series
1200V	45X92	2 - 1	V Series						
	62X108	2 - 1		V Series					
	62X150	2 - 1		V Series					

			35A	50A	75A	100A	900A	2400A	3600A
1200V	62X122	6 -1				V Series			
	62X122	7 - 1 PIM	V Series						
600V	62X122	7 - 1 PIM		V Series					

Fuji Electric
Product Line-Up
Discrete IGBT / Super J MOS(R)

Discrete IGBTs

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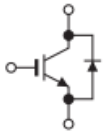
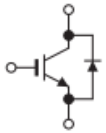
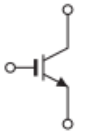
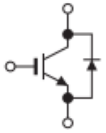
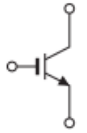
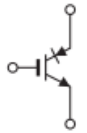
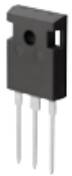
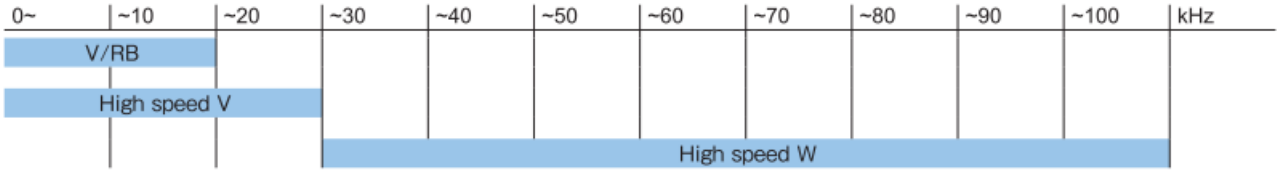
Innovating Energy Technology

Package	V_{CES} (V)	I_C (A)	Trench-FS					RB-IGBT
			V Series	High-Speed V Series		High-Speed W Series		
								
 TO-247-P2	600/650	30	FGW30N60VD					
		35		FGW35N60HD	FGW35N60H			
				FGW35N60HC				
		40				FGW40N65WD	FGW40N65W	
						FGW40N65WE		
		50	FGW50N60VD	FGW50N60HD	FGW50N60H	FGW50N65WD	FGW50N65W	
				FGW50N60HC		FGW50N65WE		
		60				FGW60N65WD	FGW60N65W	
						FGW60N65WE		
		75		FGW75N60HD	FGW75N60H	FGW75N65WD	FGW75N65W	
				FGW75N60HC		FGW75N65WE		
		85						FGW85N60RB
	1200	15	FGW15N120VD	FGW15N120HD	FGW15N120H			
		25	FGW25N120VD			FGW25N120WD	FGW25N120W	
						FGW25N120WE		
		30		FGW30N120HD	FGW30N120H			
		40	FGW40N120VD	FGW40N120HD	FGW40N120H	FGW40N120WD	FGW40N120W	
						FGW40N120WE		

Recommended operating frequency



For internal use only

Discrete IGBT “High-speed W-series”

Fuji Electric
Innovating Energy Technology

- Optimized IGBT and Diode for each application
- Especially, High-Speed W series is suitable for PFC, inverter welding, UPS and solar application.

IGBT series	Target Application	fsw	VCE	IC (100℃)	tsc	Features	Benefits
New High-Speed W Series	PFC Welding UPS Solar etc	10k ~ 100kHz	650V	40~75A	Non-guaranteed	✓ Very low switching loss ✓ Fast recovery diode ✓ tsc=5us (1200V) ✓ Tj(max)=175℃ ✓ Full square RBSOA	✓ High frequency switching ✓ High efficiency ✓ High power density ✓ High reliability
			1200V	25~40A	5us		
High-Speed V series		~30kHz	600V	35~75A	5us	✓ Low switching loss ✓ Fast recovery diode ✓ tsc=5us ✓ Low VCE(sat) ✓ Tj(max)=175℃ ✓ Full square RBSOA	✓ High efficiency ✓ High power density ✓ High reliability
			1200V	15~40A			
V series	Motor Drive	~10kHz	600V	30~50A	10us	✓ tsc=10us ✓ Low VCE(sat) and VF ✓ Tj(max)=175℃ ✓ Full square RBSOA	✓ High efficiency ✓ High power density ✓ High reliability
			1200V	15~40A			

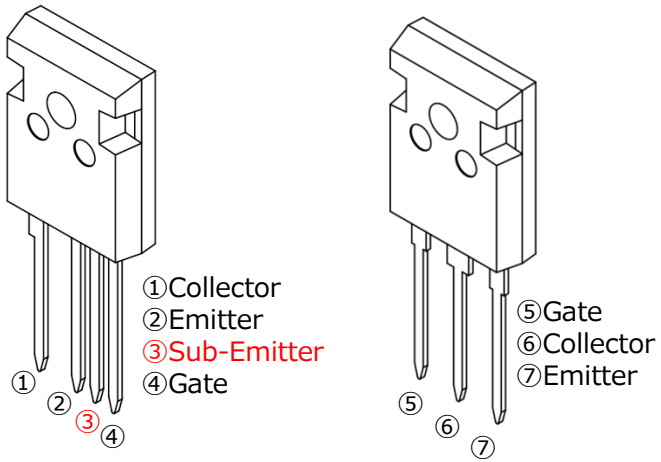
For internal use only

New product, TO-247-4L : Feature (1)

Fuji Electric
Innovating Energy Technology

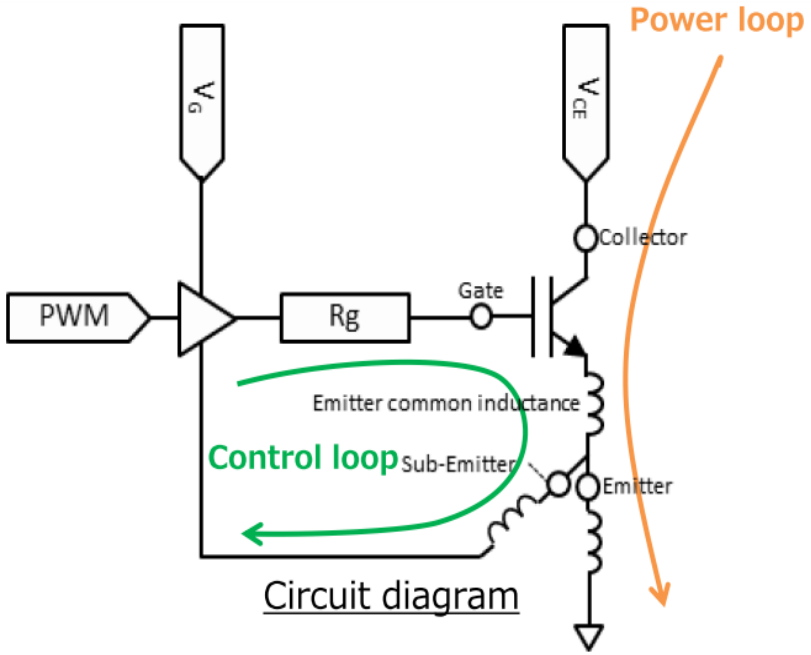
- What is TO-247-4L?
  - Added sub-emitter pin
- Benefits
  - Possible to reduce emitter common inductance
  - Effective gate voltage is higher than standard TO-247 due to lower loop inductance.

➡ Achieved lower switching losses compared with standard TO-247.



TO-247-4L　　Standard TO-247

Pin configuration



Circuit diagram

For internal use only

High-Speed W series : Lineup

Fuji Electric
Innovating Energy Technology

VCE	PKG	IC @ 100℃						Anti-parallel Diode
		25A	30A	40A	50A	60A	75A	
650V	TO-247			FGW40N65WD	FGW50N65WD	FGW60N65WD		w/ (Half Rated)
				FGW40N65WE	FGW50N65WE	FGW60N65WE	FGW75N65WE	w/ (Full Rated)
			FGW30N65W *U.P.	FGW40N65W	FGW50N65W	FGW60N65W	FGW75N65W	w/o
	TO-247 -4L				FGZ50N65WD *2			w/ (Half Rated)
					FGZ50N65WE *2		FGZ75N65WE *1	w/ (Full Rated)
1200V	TO-247	FGW25N120WD		FGW40N120WD				w/ (Half Rated)
		FGW25N120WE		FGW40N120WE				w/ (Full Rated)
		FGW25N120W		FGW40N120W				w/o
	TO-247 -4L			FGZ40N120WE *2				w/ (Full Rated)

Status (calendar year)

*1 : Sample --- available MP --- ’16/Q4

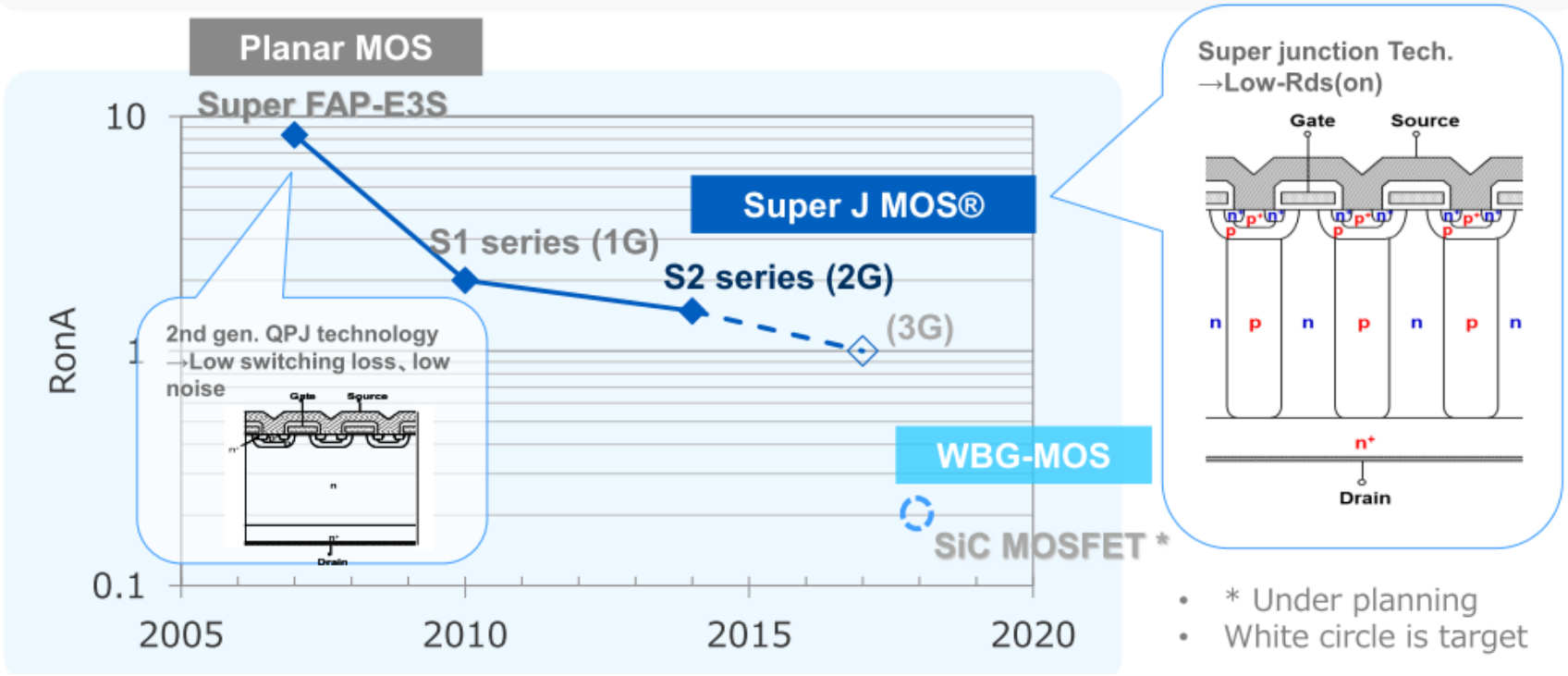
*2 : Sample --- available MP --- ‘17/Q1

For internal use only

Fuji Super J MOS(R)

Fuji Electric
Innovating Energy Technology

600V Fuji Power MOSFET RonA trend



- * Under planning
- White circle is target

For internal use only

Fuji Super J MOS(R)

Fuji Electric
Innovating Energy Technology

Applications

- PFC stages and PWM stages like a Server, Telecom, UPS, LED lighting , Power conditioner system, Power supply.

Feature	Benefit
✓ Low on-state resistance ✓ Low switching loss	✓ High efficiency ✓ High power density
✓ Low gate charge (Q_G) ✓ Low charge and discharge energy (E_{oss}) ✓ Easy to use ➢ more controllable dv/dt by R_G ➢ Low turn-off V_{DS} surge	✓ High efficiency at low load ✓ Easy to design
✓ 100% avalanche tested	✓ High reliability

For internal use only

Super J MOS(R) S2 series

Fuji Electric
Innovating Energy Technology

Super J MOS® S2 series			TO-220	TO-220F (SLS)	TO-3P(Q)	TO-247-P2	TO-252
							
Vds (V)	Ron (Ω)	Id (A)					
600	0.3800	8.1	✓	✓			✓
	0.2800	10.4	✓	✓	✓		✓
	0.1900	15.5	✓	✓	✓	✓	
	0.1600	17.9	✓	✓		✓	
	0.1250	22.7	✓	✓		✓	
	0.0990	29.2	✓	✓		✓	
	0.0880	32.8	✓	✓		✓	
	0.0790	37.1	✓	✓		✓	
	0.0700	39.4		✓		✓	
	0.0550	49.9				✓	
	0.0400	66.2				✓	
	0.0254	95.5				✓	
650V	(0.1010)	(30.6)	✓	✓		✓	
	(0.0790)	(37.1)		✓		✓	
	(0.0450)	(62.4)				✓	
	(0.0287)	(89.8)				✓	

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Fuji Electric
Data Sheet Brief

Maximum Voltage

Fuji Electric
Innovating Energy Technology

■ **Absolute Maximum Ratings (at T_C= 25°C unless otherwise specified)**

Items		Symbols	Conditions		Maximum Ratings	Units
Collector-Emitter voltage		V_{CES}			1200	V
Gate-Emitter voltage		V_{GES}			±20	V
Collector current		I_C	Continuous	T_C=25°C	750	A
				T_C=100°C	600	
		I_C pulse	1ms		1200	
		-I_C			600	
		-I_C pulse	1ms		1200	
Collector power dissipation		P_C	1 device		3750	W
Junction temperature		T_j			175	°C
Operating junction temperature (under switching conditions)		T_{jop}			150	
Case temperature		T_c			125	
Storage temperature		T_{stg}			-40 ~ 125	
Isolation voltage	between terminal and copper base (*1)	V_{iso}	AC: 1min.		2500	VAC
	between thermistor and others (*2)					
Screw Torque	Mounting (*3)	-			3.5	N m
	Terminals (*4)	-			4.5	

(*1) All terminals should be connected together during the test.
(*2) Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.
(*3) Recommendable Value : 2.5-3.5 Nm (M5)
(*4) Recommendable Value : 3.5-4.5 Nm (M6)

Maximum Power Dissipation

Fuji Electric
Innovating Energy Technology

■ **Absolute Maximum Ratings (at T_C= 25°C unless otherwise specified)**

Items		Symbols	Conditions		Maximum Ratings	Units
Collector-Emitter voltage		V_{CES}			1200	V
Gate-Emitter voltage		V_{GES}			±20	V
Collector current		I_C	Continuous	T_C=25°C	750	A
				T_C=100°C	600	
		I_C pulse	1ms		1200	
		$-I_C$			600	
		$-I_C$ pulse	1ms		1200	
Collector power dissipation		P_C	1 device		3750	W
Junction temperature		T_j			175	
Operating junction temperature (under switching conditions)		T_{jop}				
Case temperature		T_c				
Storage temperature		T_{stg}				
Isolation voltage	between terminal and copper base (*1)	V_{iso}	AC: 1min.		2500	VAC
	between thermistor and others (*2)					
Screw Torque	Mounting (*3)	-			3.5	N m
	Terminals (*4)	-			4.5	

(*1) All terminals should be connected together during the test.
(*2) Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.
(*3) Recommendable Value : 2.5-3.5 Nm (M5)
(*4) Recommendable Value : 3.5-4.5 Nm (M6)

$$P_C = (T_{j(max)} - 25^oC) / R_{th(j-c)}$$
$$= (175 - 25) / 0.04 = 3750$$

For internal use only

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Thanks you for your attention;
Any questions?

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Switching Losses

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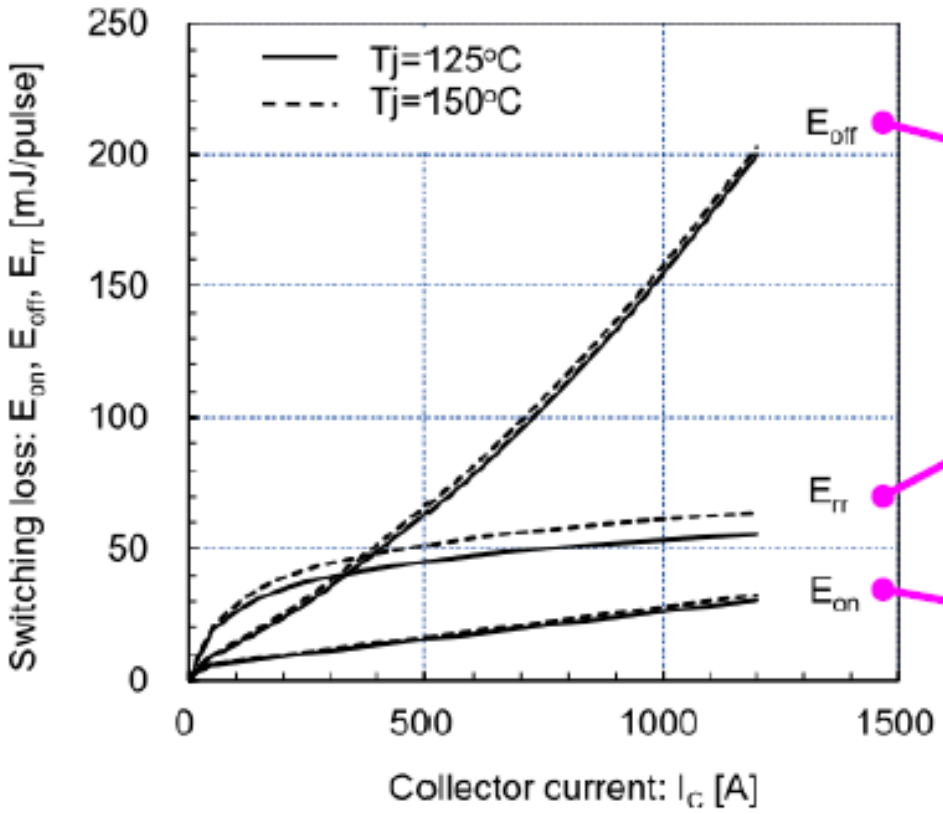
Necessary data for loss calculation, cooling design (thermal rating).

Switching losses are proportional to DC bus voltage

Switching loss vs. Collector current (typ.)
Vcc=600V, VGE=±15V, Rg=0.62Ω, Tj=125°C, 150°C



E_{off} : IGBT Turn-off loss

E_{rr} : FWD Reverse-recovery loss

E_{on} : IGBT Turn-on loss