

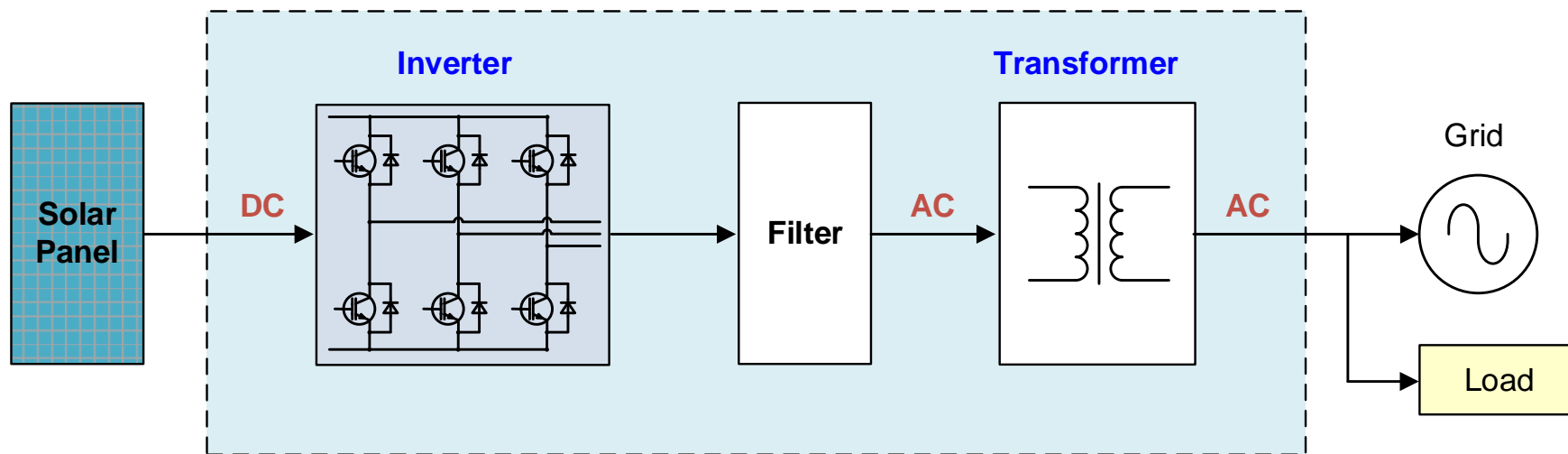
Fuji IGBT Modules for Solar Inverter



Device Application Technology Dept.
Sales Div.
Electronic Devices Business Gr.

- Topology in solar inverter
 - Fuji's solutions for 2 level topology
 - Fuji's solutions for 3 level topology
 - Introduction of Gate Driver Unit (GDU) and Snubber capacitors

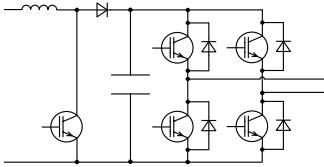
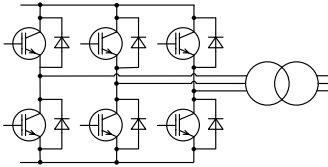
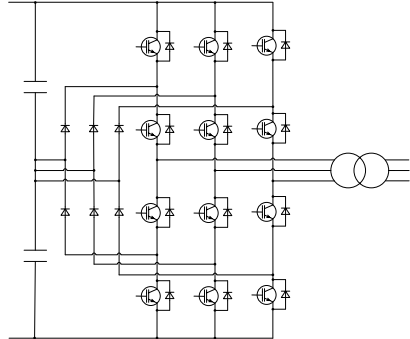
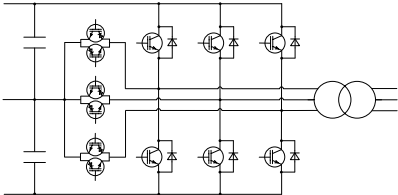
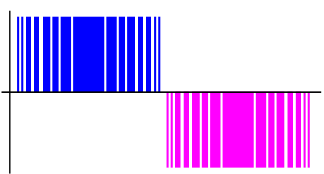
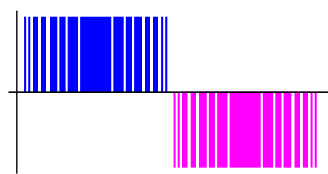
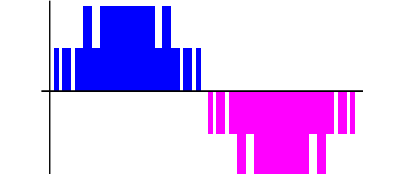

Simple schematics of solar inverter



■ Feature of solar inverter: High efficiency, High reliability.

	General inverter	Solar inverter
Input voltage	AC (Ex. 400V ± 10%)	DC 400 ~ 1000V
Output frequency	Ex. 0.5 ~ 120Hz	50 / 60Hz
Efficiency	90 ~ 95%	> 95%
Overload	150 ~ 200%	100 ~ 120%
Device (ex. 30kW)	1200V / 150A	1200V / 200A

Topology in solar inverter

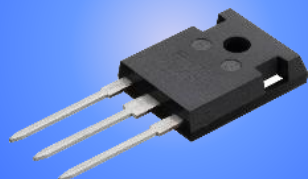
Type	Single-phase inverter	2-level inverter	NPC 3-level inverter	AT-NPC 3-level with RB-IGBT
Circuit				
Device	IGBT:600V	IGBT:1200V	IGBT:600V	IGBT:1200V +600V(RB-IGBT)
Output Voltage				
Capacity	< 10kW	> 10kW	> 10kW	> 10kW

- Topology in solar inverter
- **Fuji's solutions for 2 level topology**
- Fuji's solutions for 3 level topology
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Fuji Dis-IGBT, IGBT modules for 2 level topology

Discrete IGBT

TO-247-P2



Standard 2in1

M263

Size:94 x 34 x 30mm



M274

Size:92 x 45 x 30mm



M275, M276

Size:94 x 34 x 30mm



M277

Size:110 x 80 x 30mm



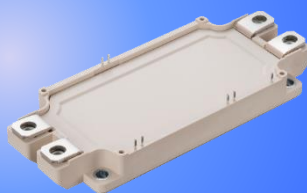
Dual XT

M254, M285

Size:150 x 62 x 17mm

M254

M285



PrimePACK™

M271

Size:172 x 89 x 38mm



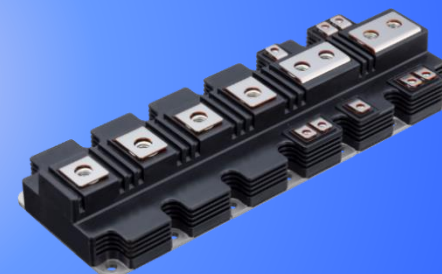
M272

Size:250 x 89 x 38mm





M291

Size:250 x 89 x 38mm


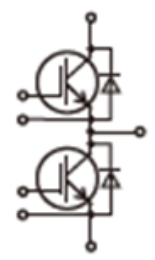






Note: PrimePACK™ is registered trademarks of Infineon Technology AG, Germany.

Fuji Dis-IGBT, IGBT modules for 2 level topology - STD 2in1


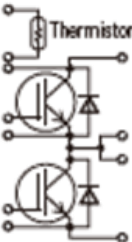


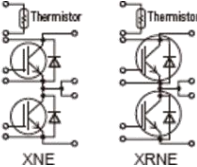

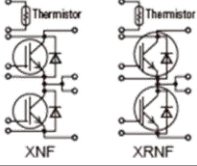
	Device type ^{※1}	Current	Voltage	Package	Equivalent circuit
XS series	FGW**XS120C	40A 75A ^{※2}	1200V	TO-247-P2 	

※1 “**” is rated current. ※2 Under development

	V series		X series		Voltage	Package	Equivalent circuit
	Device type ^{※1}	Current	Device type ^{※1}	Current			
Standard 2in1	2MBI**VA-120-50	75A 100A 150A	2MBI**XAA120-50	100A 150A 200A	1200V	M263:94 x 34 x 30mm 	
	2MBI**VB-120-50	150A 200A	2MBI**XBE120-5	200A 300A	1200V	M274:92 x 45 x 30mm 	
	2MBI**VD-120-50	300A 400A	2MBI**XDE120-50	400A 600A	1200V	M275:108 x 62 x 30.5mm 	
	2MBI**VH-120-50 2MBI**VH-120-80	200A 300A 450A	2MBI**XHA120-50	300A 450A 600A	1200V	M276:108 x 62 x 30.5mm 	
	2MBI**VE-120-50 2MBI**VE-120-80	300A 450A 600A	2MBI**XEE120-50	450A 600A	1200V	M277:110 x 80 x 30mm 	


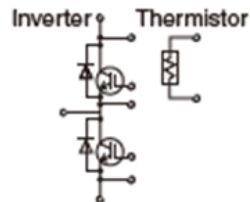

※1 “**” is rated current.


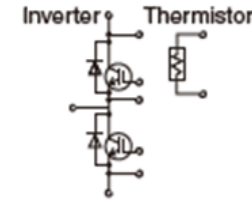


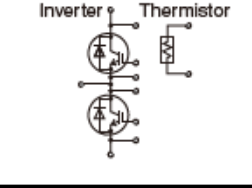
Fuji IGBT modules for 2 level topology - Dual XT

	V series		X series		Voltage	Package	Equivalent circuit
	Device type ^{※1}	Current	Device type ^{※1}	Current			
Dual XT	2MBI**VN-120-50 2MBI**VN-120-80	225A 300A 450A 600A	2MBI**XNA120-50	225A 300A 450A	1200V	M254:150 x 62 x 17mm Solder pins 	
	2MBI**VN-120S-50	225A 300A 450A	2MBI600XNG120-50	600A	1200V		
	2MBI**VN-120S-80	300A 450A	—	—	1200V		
	2MBI**VX-120-50 2MBI**VX-120-80	225A 300A 450A 600A	2MBI**XNB120-50	225A 300A 450A	1200V	M282:150 x 62 x 17mm Press fit pins 	
	—	—	2MBI600XNH120-50	600A	1200V		
	—	—	2MBI**XNE120-50	600A 800A	1200V	M285:150 x 62 x 17mm Solder pins 	
	—	—	2MBI1000XRNE120-50	1000A	1200V		
	—	—	2MBI**XNF120-50	600A 800A	1200V	M286:150 x 62 x 17mm Press fit pins 	
—	—	2MBI1000XRNF120-50	1000A	1200V			

※1 “***” is rated current.

Fuji IGBT modules for 2 level topology - PrimePACK™

	V series				Voltage	Package	Equivalent circuit
	Low switching loss		Soft turn off				
	Device type※1	Current	Device type	Current			
PrimePACK™	2MBI**VXA-120E-50 2MBI**VXA-120E-80 2MBI**VXA-120E-54	600A 900A	2MBI900VXA-120P-50 2MBI900VXA-120P-80 2MBI900VXA-120P-54	900A	1200V	M271:172 x 89 x 38mm 	
	2MBI1400VXB-120E-50 2MBI1400VXB-120E-80 2MBI1400VXB-120E-54	1400A	2MBI1400VXB-120P-50 2MBI1400VXB-120P-80 2MBI1400VXB-120P-54	1400A	1200V	M272:250 x 89 x 38mm 	

	X series		Voltage	Package	Equivalent circuit
	Soft turn off				
	Device type	Current			
PrimePACK™	2MBI900XXA120P-50	900A	1200V	M271:172 x 89 x 38mm 	
	2MBI1200XXE120P-50	1200A	1200V		
	2MBI1400XXB120P-50	1400A	1200V	M272:250 x 89 x 38mm 	
	2MBI1800XXF120P-50	1800A	1200V		
	2MBI2400XRXG120-50	2400A	1200V	M291:250 x 89 x 38mm 	

※1 “***” is rated current.

Note: PrimePACK™ is registered trademarks of Infineon Technology AG, Germany.

Fuji's solutions for 2 level topology (10kW - 50kW)

PCS	Device rating	IGBT V series	IGBT X series / XS series	Number of parallel
10kW	1200V/40A	–	FGW40XS120C	1
15kW	1200V/50A	6MBI50VA-120-50 6MBI50VW-120-50	–	1
20kW	1200V/75A	2MBI75VA-120-50 6MBI75VA-120-50 6MBI75VW-120-50	FGW75XS120C※1	1
30kW	1200V/100A	2MBI100VA-120-50 6MBI100VA-120-50 6MBI100VW-120-50 6MBI100VB-120-50 6MBI100VX-120-50	2MBI100XAA120-50 6MBI100XAE120-50 6MBI100XBA120-50 6MBI100XXA120-50	1
	1200V/150A	2MBI150VA-120-50 2MBI150VB-120-50 6MBI150VB-120-50 6MBI150VX-120-50	2MBI150XAA120-50 6MBI150XBA120-50 6MBI150XXA120-50	1
50kW	1200V/180A	6MBI180VB-120-50 6MBI180VX-120-50	–	1
	1200V/200A	2MBI200VB-120-50 2MBI200VH-120-50	2MBI200XBE120-50 2MBI200XAA120-50 6MBI200XBA120-50 6MBI200XBE120-50 6MBI200XXA120-50 6MBI200XXE120-50	1
	1200V/300A	2MBI300VD-120-50 2MBI300VH-120-50 2MBI300VE-120-50 2MBI300VN-120-50	2MBI300XBE120-50 2MBI300XHA120-50 2MBI300XNA120-50	1

※1 Under development

Fuji's solutions for 2 level topology (100kW - 1000kW)

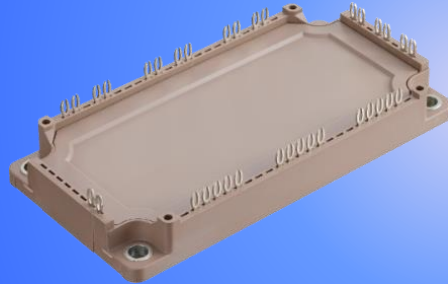
PCS	Device rating	IGBT V series	IGBT X series	Number of parallel
100kW	1200V/450A	2MBI450VH-120-50 2MBI450VE-120-50 2MBI450VN-120-50	2MBI450XHA120-50 2MBI450XEE120-50 2MBI450XNA120-50	1
125kW	1200V/600A	2MBI600VE-120-50 2MBI600VN-120-50 2MBI600VXA-120E-50	2MBI600XDE120-50 2MBI600XHA120-50 2MBI600XEE120-50 2MBI600XNG120-50	1
250kW	1200V/900A	2MBI900VXA-120E-50 2MBI900VXA-120P-50	2MBI900XXA120P-50	1
	1200V/1200A	–	2MBI1200XXE120P-50	1
	1200V/1400A	2MBI1400VXB-120E-50 2MBI1400VXB-120P-50	2MBI1400XXB120P-50	1
500kW	1200V/900A x 2p	2MBI900VXA-120E-50 2MBI900VXA-120P-50	2MBI900XXA120P-50	2
	1200V/1800A	–	2MBI1800XXF120P-50	1
	1200V/1200A x 2p	–	2MBI1200XXE120P-50	2
	1200V/1400A x 2p	2MBI1400VXB-120E-50 2MBI1400VXB-120P-50	2MBI1400XXB120P-50	2
1000kW	1200V/900A x 4p	2MBI900VXA-120E-50 2MBI900VXA-120P-50	2MBI900XXA120P-50	4
	1200V/1200A x 4p	–	2MBI1200XXE120P-50	4
	1200V/1400A x 4p	2MBI1400VXB-120E-50 2MBI1400VXB-120P-50	2MBI1400XXB120P-50	4

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- Introduction of Gate Driver Unit (GDU) and Snubber capacitors

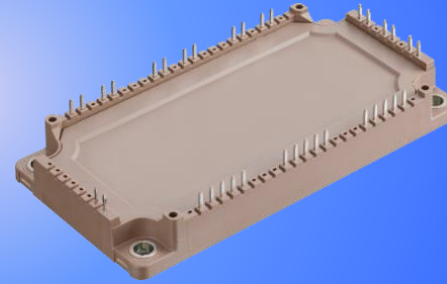
Fuji IGBT modules for 3 level topology

12in1

M1202
Size:122 x 62 x 17mm



M1203
Size:122 x 62 x 17mm



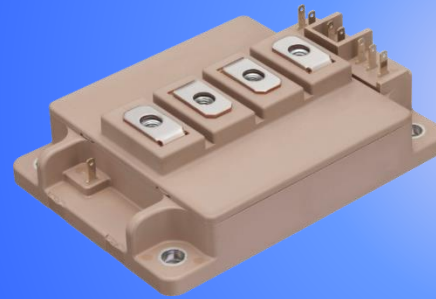
AC Switch

M276
Size:94 x 34 x 30mm



4in1(T-Type, I-Type)

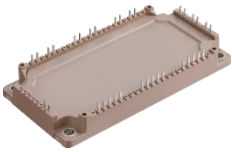
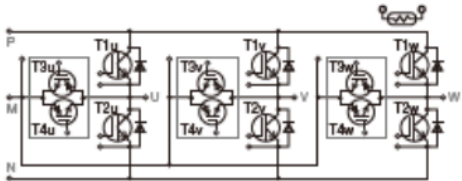

M403
Size:110 x 80 x 30mm




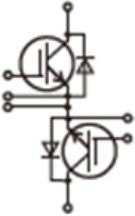
M404
Size:250 x 89 x 30mm



Fuji IGBT modules for 3 level topology - 12in1, AC switch

	Device type ^{※1} (V series)	Current	Voltage	Package	Equivalent circuit
12in1	12MBI**VN-120-50	50A 75A 100A	1200V	M1203:122 x 62 x 17mm 	
	12MBI**VX-120-50	50A 75A 100A	1200V	M1202:122 x 62 x 17mm 	


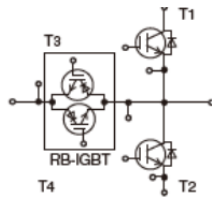
※1 “**” is rated current.

	Device type (V series)	Current	Voltage	Package	Equivalent circuit
AC switch	2MBI450VH-120F-50 2MBI450VH-120F-80	450A	1200V	M276:122 x 62 x 17mm 	


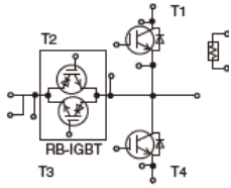
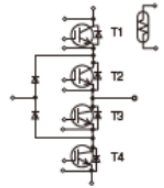
Note)

Please use AC switch in combination with 2MBI450VH-120-50, 2MBI450VH-120-80.

Fuji IGBT modules for 3 level topology - 4in1(T-Type, I-Type)

	Device type ^{※1} (V series)	Current	Voltage (T1, T2)	Voltage (T3, T4)	Package	Equivalent circuit
4in1 (T-Type)	4MBI300VG-120R-50	300A	1200V	1200V	M403:110 x 80 x 30mm 	
	4MBI**VF-120R-50	340A 400A	1200V	1200V		

※1 “**” is rated current.

	Device type ^{※1} (V series)	Current	Voltage (T1, T4)	Voltage (T2, T3)	Package	Equivalent circuit
4in1 (T-Type)	4MBI900VB-120RA-50 4MBI900VB-120RA-60	900A	1200V	600V	M404:110 x 80 x 30mm 	
	4MBI**VB-120R1-50 4MBI**VB-120R1-60	450A 650A 900A	1200V	900V		
4in1 (I-Type)	4MBI600VC-120-50 4MBI600VC-120-60	600A	1200V	1200V		

※1 “**” is rated current.

Fuji IGBT modules for 3 level topology (15kW - 1000kW)

PCS	Device rating	IGBT V series	Number of parallel
15kW	1200V/50A	12MBI50VN-120-50	1
		12MBI50VX-120-50	1
20kW	1200V/75A	12MBI75VN-120-50	1
		12MBI75VX-120-50	1
30kW	1200V/100A	12MBI100VN-120-50	1
		12MBI100VX-120-50	1
50kW	1200V/300A 1200V/340A	4MBI300VG-120R-50	1
		4MBI340VF-120R-50	1
100kW	1200V/400A 1200V/450A	4MBI400VF-120R-50	1
		4MBI450VB-120R1-50	1
		2MBI450VH-120-50 2MBI450VH-120F-50	1
125kW	1200V/300A x 2p 1200V/650A	4MBI300VG-120R-50	2
		4MBI650VB-120R1-50	1
250kW	1200V/300A x 4p 1200V/900A 1200V/600A (for 1500VDC)	4MBI300VG-120R-50	4
		4MBI900VB-120R1-50	1
		4MBI900VB-120RA-50	1
		4MBI600VC-120-50	1
500kW	1200V/900A x 2p 1200V/600A x 2p (for 1500VDC)	4MBI900VB-120R1-50	2
		4MBI900VB-120RA-50	2
		4MBI600VC-120-50	2
1000kW	1200V/900A x 4p 1200V/600A x 4p (for 1500VDC)	4MBI900VB-120R1-50	4
		4MBI900VB-120RA-50	4
		4MBI600VC-120-50	4

Note)
Applicable device might be different by control method, control condition, cooling condition, etc.

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Introduction of GDU for 2 level topology



<https://www.tamuracorp.com/electronics/en/>



V_{CES}		1200V	
Package	I_C rating (A)	IGBT part No.	Driver part No.
Dual XT	225	2MBI225XNA120-50	2DUC51008CXE1
		2MBI225VN-120-50	
	300	2MBI300XNA120-50	
		2MBI300VN-120-50	
	450	2MBI450XNA120-50	
		2MBI450VN-120-50	
	600	2MBI600XNG120-50	
2MBI600VN-120-50			
2MBI600XNE120-50			
800	2MBI800XNE120-50		
1000	2MBI1000XRNE120-50		
PrimePACK™	600	2MBI600VXA-120E-50	2DUD51008CFP*
	900	2MBI900XXA120P-50	2DUD51008CFP*
		2MBI900VXA-120P-50	
		2MBI900VXA-120E-50	
	1200	2MBI1200XXE120P-50	2DUD51008CFP*
		2MBI1400XXB120P-50	
		2MBI1400VXB-120E-50	
1400	2MBI1400VXB-120P-50		
	2MBI1800XXF120P-50		
1800	2MBI1800XXF120P-50		
2400	2MBI2400XRXG120-50	2DUD51008DFQ2	

Note: PrimePACK™ is registered trademarks of Infineon Technology AG, Germany.

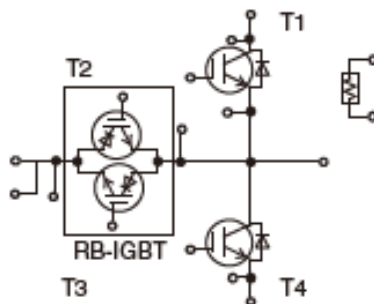
Introduction of GDU for 3 level topology



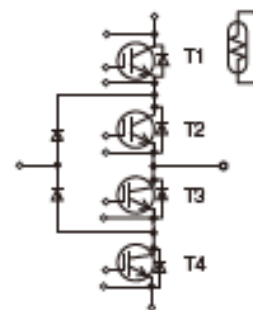
<https://www.tamuracorp.com/electronics/en/>



Package	V _{CES} (V) (T1, T4)	V _{CES} (V) (T2, T3)	I _c rating (A)	IGBT part No.	Driver part No.
M404	1200	900	450	4MBI450VB-120R1-50	4DUC51016CFA*
			650	4MBI650VB-120R1-50	
		600	900	4MBI900VB-120R1-50	4DUC51016CFA1
			900	4MBI900VB-120RA-50	4DUC51016CFA2
		1200	600	4MBI600VC-120-50	4DUC51016CFN1



4MBI**VB-120R1-50^{※1}
4MBI**VB-120RA-50^{※1}



4MBI600VC-120-50

※1 “***” is rated current.

Introduction of GDU for 2 level topology

CONCEPT
 A Power Integrations Company

<http://igbt-driver.com/>



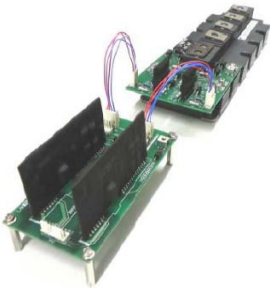
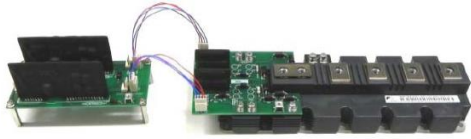
V_{CES}		1200V		
Package	I_C rating (A)	IGBT part No.	Plug-and-Play driver part No.	
Dual XT	225	2MBI225VN-120-50	2SP0115T2Ax-2MBI225VN-120-50	
	300	2MBI300VN-120-50	2SP0115T2Ax-2MBI300VN-120-50	
	450	2MBI450VN-120-50	2SP0115T2Ax-2MBI450VN-120-50	
	600	2MBI600VN-120-50	2SP0115T2Ax-2MBI600VN-120-50	
PrimePACK™	600	2MBI600VXA-120E-50	2SP0320x2Ax-2MBI600VXA-120E-50	
		2MBI900VXA-120E-50	2SP0320x2Ax-2MBI900VXA-120E-50	
	900	2MBI900VXA-120P-50	2SP0320x2Ax-2MBI900VXA-120P-50	
		1400	2MBI1400VXB-120E-50	2SP0320x2Ax-2MBI1400VXB-120E-50
			2MBI1400VXB-120P-50	2SP0320x2Ax-2MBI1400VXB-120P-50

Note: PrimePACK™ is registered trademarks of Infineon Technology AG, Germany.

Introduction of GDU for 2 level topology



<http://www.idc-com.co.jp/>



I_c rating (A)	1200V
50	M5719L/VLA517
75	VLA541/VLA517
100	
150	
200	VLA542/VLA517
225	
300	
400	VLA500
450	
550	
600	
800	
900	
1200	VLA539
1400	
1600	
2400	Under investigation
3600	

Introduction of Snubber capacitors

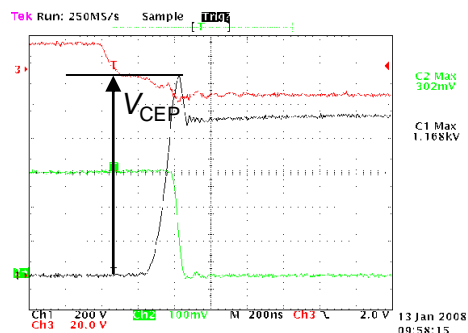
$$C_S = \frac{L * I_o^2}{(V_{CEP} - E_d)^2}$$

L : Main circuit wiring parasitic inductance

I_o : Collector current at IGBT turn-off

V_{CEP} : Snubber capacitor peak voltage

E_d : DC supply voltage



Module rating		DC line inductance	snubber capacitance
V_{CES}	I_c		
1200V/1700V	100A	0.2 μ H	0.47 μ F
	300A	0.1 μ H	3.3 μ F
	450A	0.08 μ H	4.7 μ F
	1000A	0.07 μ H	6.8 μ F
	1400A	0.06 μ H	12 μ F