

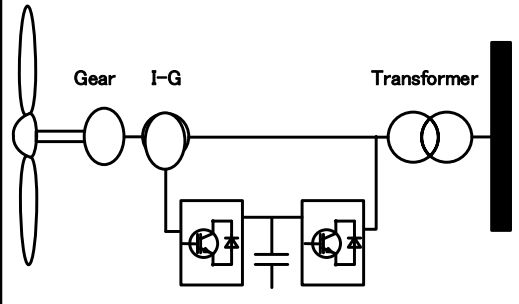
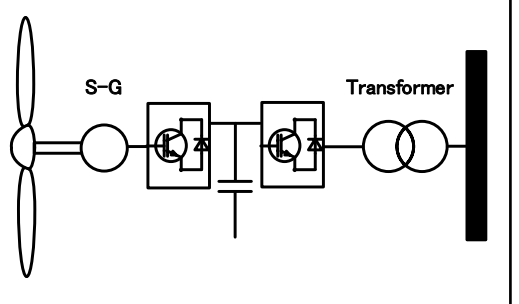
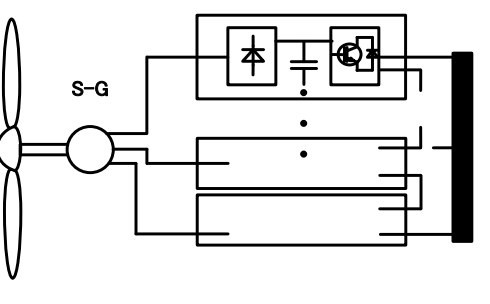


# Fuji IGBT Modules for Wind power system

2022.10

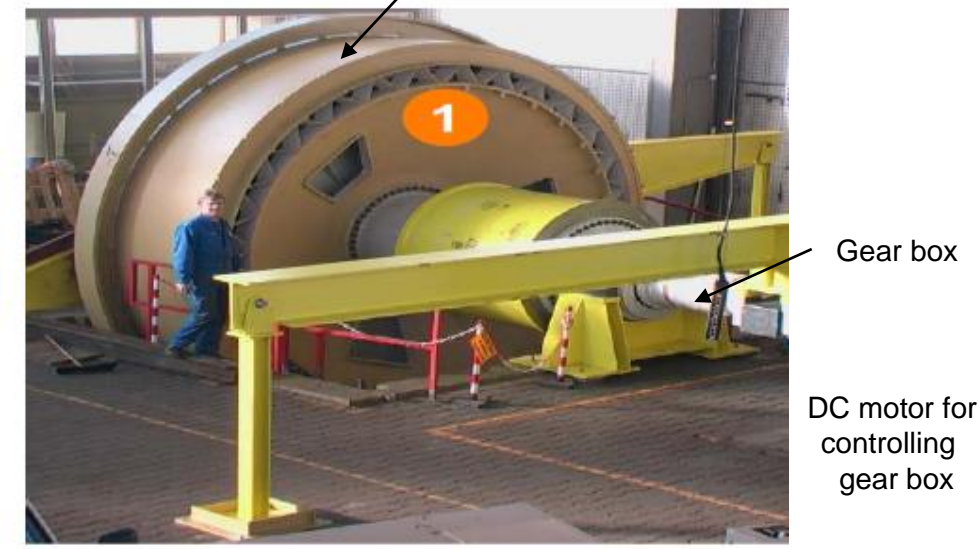
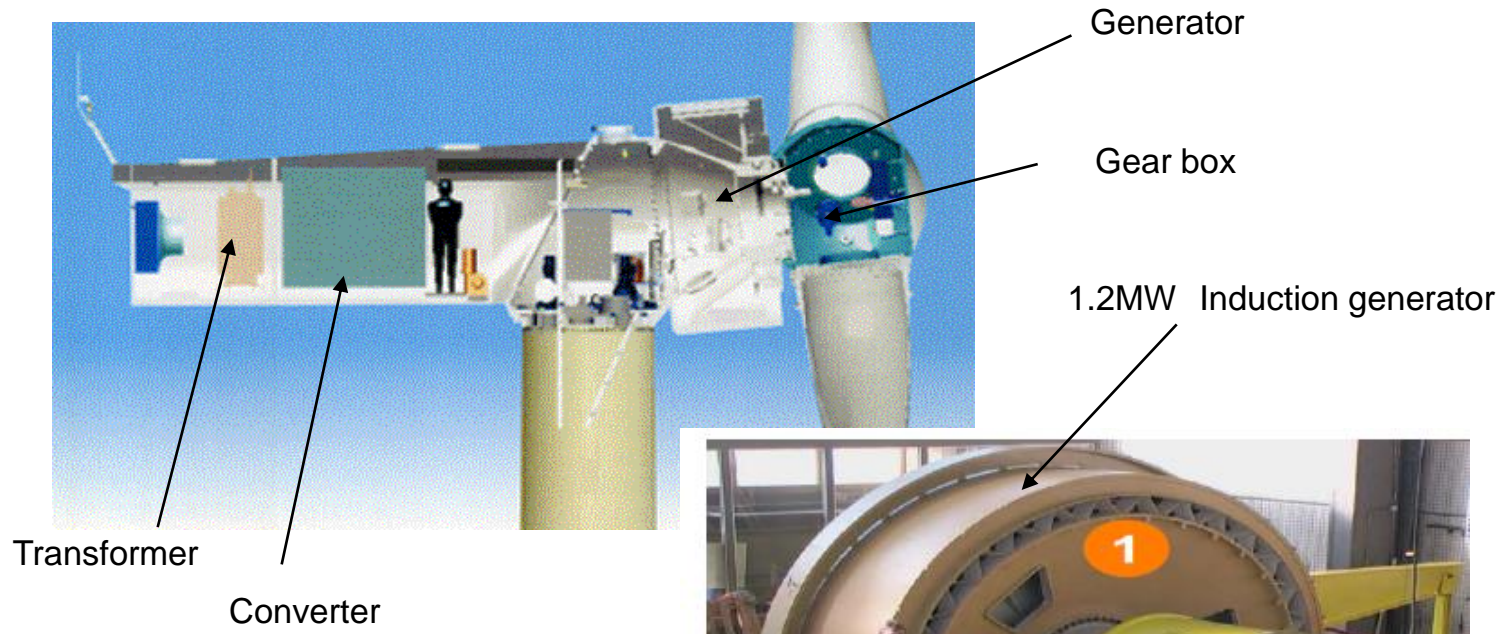
Device Application Technology Dept.  
Sales Division  
Semiconductors Business Group

- Topology in Wind power system
- Fuji's solutions for Wind power system
- Introduction of Gate Driver Unit (GDU) and Snubber capacitors

Topology	Double	Direct	Direct + Multi level
Configuration			
Efficiency	89%	90%	93%
Cost	100%	98~100%	90~95%
Quality	Low	High	High
Gear box	Need	Not need	Not need
Step up Transformer	Need	Need	Not need
Generator	Induction	Synchronous	Synchronous + Multi winding
Converter capacity	15~30%	100%	100%
IGBT	1700V/450A~1000A	1700V/1000A~3600A	3300V/150A~400A

Wind turbine systems will be changed to direct drive system from double fed drive system depend on the high efficiency and without gear box.

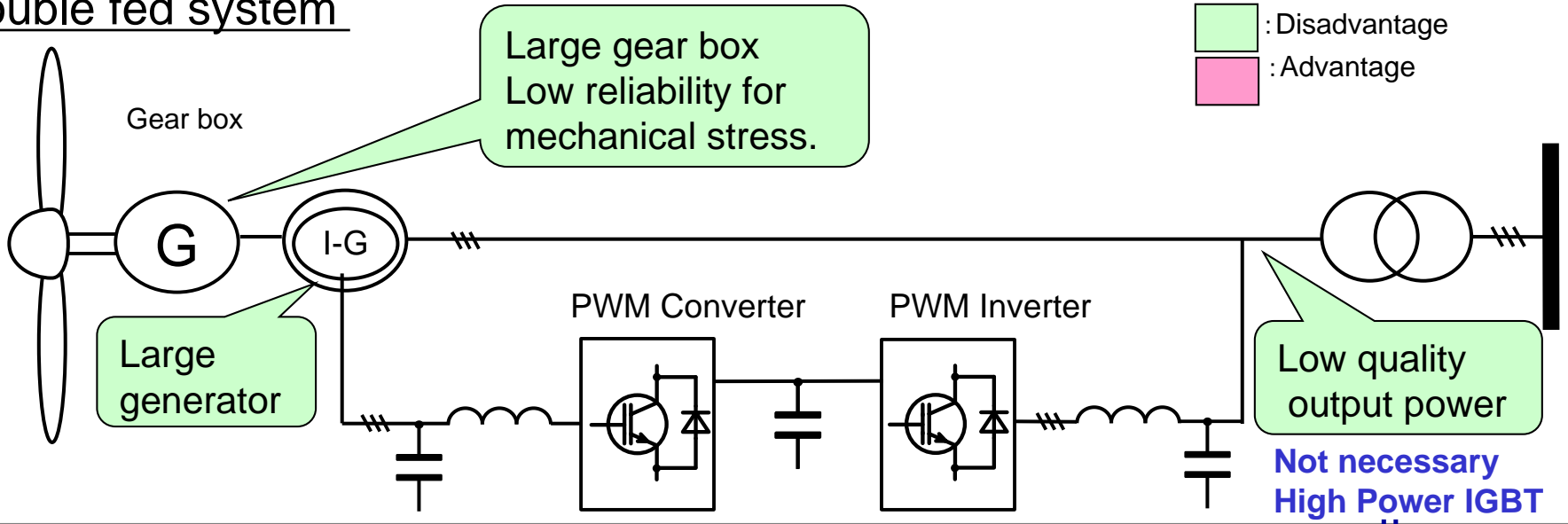
# Outline view of double fed Wind turbine



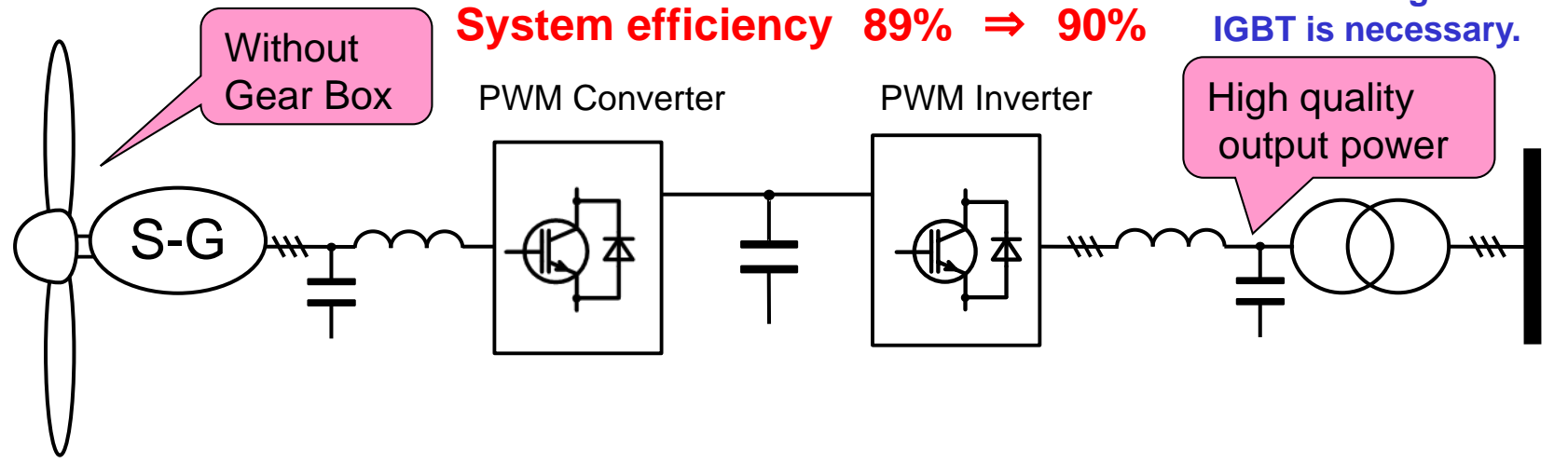
Double fed systems have large gear box and large generator.

# Comparison of double fed system and direct drive system

## Double fed system

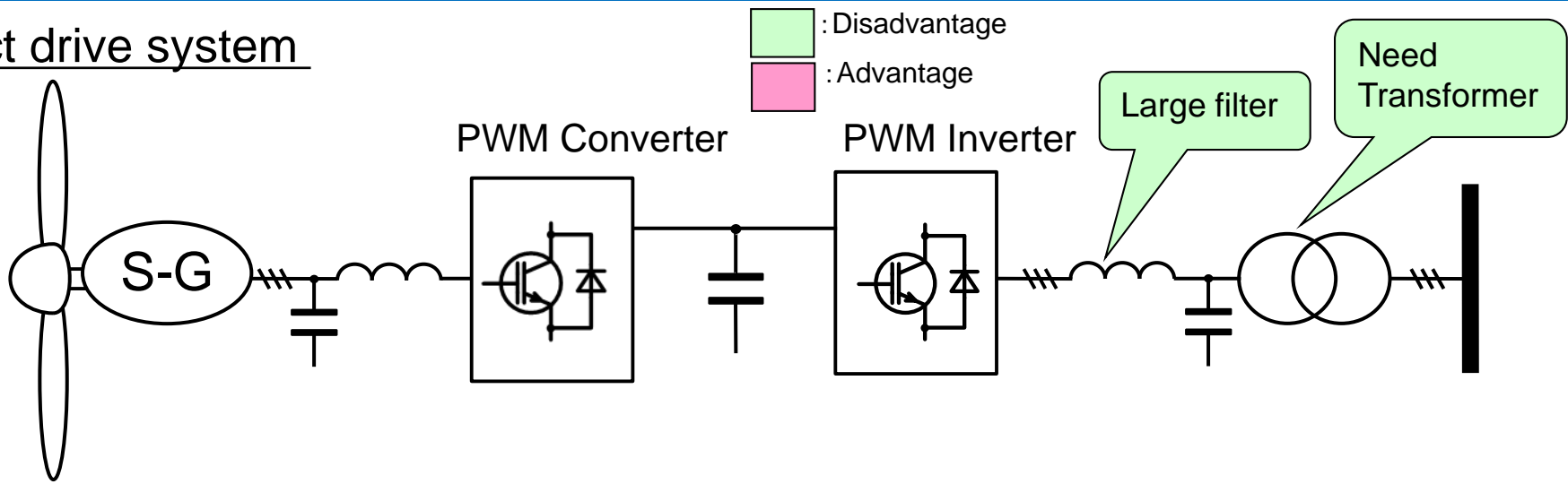


## Direct drive system

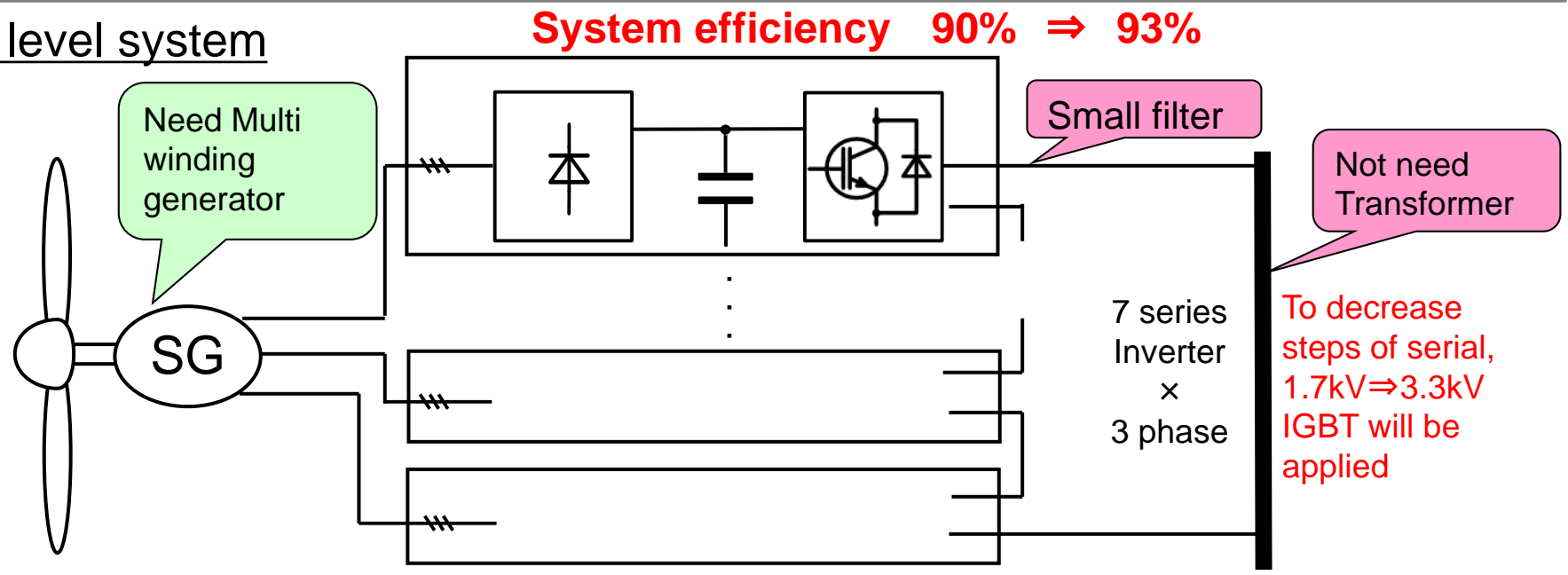


# Comparison of direct drive system and multi level system

## Direct drive system


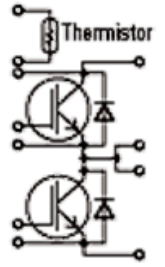

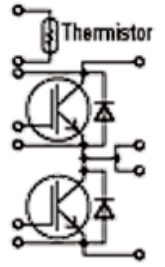

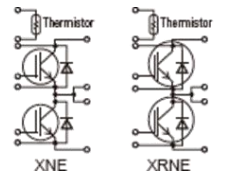

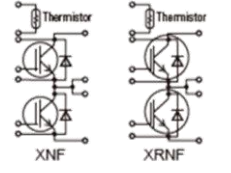


## Multi level system



- Topology in Wind power system
- **Fuji's solutions for Wind power system**
- Introduction of Gate Driver Unit (GDU) and Snubber capacitors


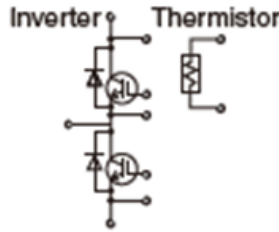

# Fuji IGBT module for Wind power system - Dual XT

	V series		X series		Voltage	Package	Equivalent circuit
	Device type <sup>※1</sup>	Current	Device type <sup>※1</sup>	Current			
Dual XT	2MBI**VN-170-50	300A 450A 550A	2MBI**XNA170-50	225A 300A 450A	1700V	M254:150 x 62 x 17mm Solder pins 	
	—	—	2MBI600XNG170-50	600A	1700V		
	2MBI**VX-170-50	225A 300A 450A 550A	2MBI**XNB170-50	225A 300A 450A	1700V	M282:150 x 62 x 17mm Press fit pins 	
	—	—	2MBI600XNH170-50	600A	1700V		
	—	—	2MBI600XNE170-50	600A	1700V	M285:150 x 62 x 17mm Solder pins 	
	—	—	2MBI800XRNE170-50	800A	1700V		
	—	—	2MBI600XNF170-50	600A	1700V	M286:150 x 62 x 17mm Press fit pins 	
	—	—	2MBI800XRNF170-50	800A	1700V		


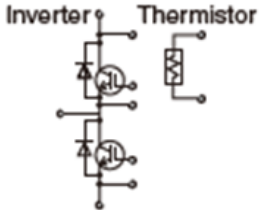


※1 “\*\*” is rated current.



# Fuji IGBT module for Wind power system - PrimePACK™

	V series				Voltage	Package	Equivalent circuit
	Low switching loss		Soft turn off				
	Device type※1	Current	Device type	Current			
PrimePACK™	2MBI650VXA-170E-50 2MBI650VXA-170E-54 2MBI650VXA-170EA-50 2MBI650VXA-170EA-54	650A	—	—	1700V	M271:172 x 89 x 38mm 	
	2MBI**VXB-170E-50 2MBI**VXB-170E-54	1000A 1400A	—	—	1700V	M272:250 x 89 x 38mm 	
	2MBI1000VXB-170EA-50 2MBI1000VXB-170EA-54	1000A	2MBI1400VXB-170P-50 2MBI1400VXB-170P-54	1400A	1700V		

※1 “\*\*” is rated current.

	X series		Voltage	Package	Equivalent circuit
	Low switching loss				
	Device type※1	Current			
PrimePACK™	2MBI650XXA170-50	650A	1700V	M271:172 x 89 x 38mm 	
	2MBI1200XXE170-50	1200A	1700V		
	2MBI**XXB170-50	1000A 1400A	1700V	M272:250 x 89 x 38mm 	
	2MBI1800XXF170-50	1800A	1700V		
	2MBI1800XXG170-50	1800A	1700V	M291:250 x 89 x 38mm 	

※1 “\*\*” is rated current.

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

■ IGBT modules proposal for Double fed system

Wind Power Converter	Package	Rotor side			Grid side		
		IGBT Module		Number of Parallel	IGBT Module		Number of Parallel
		V series	X series		V series	X series	
1.5MW	Dual XT	2MBI450VN-170-50	2MBI450XNA170-50	6	2MBI450VN-170-50	2MBI450XNA170-50	3
		–	2MBI600XNG170-50	4	–	2MBI600XNG170-50	2
	PrimePACK™	2MBI1000VXB-170E-50	2MBI1000XXB170-50	3	2MBI1000VXB-170E-50	2MBI1000XXB170-50	1
		2MBI1400VXB-170P-50	2NBI1400XXB170-50	2	2MBI1400VXB-170P-50	2NBI1400XXB170-50	1
		–	2MBI1800XXF170-50	1	–	2MBI1800XXF170-50	1
		–	2MBI1800XXG170-50	1	–	2MBI1800XXG170-50	1
2.0MW	Dual XT	2MBI450VN-170-50	2MBI450XNA170-50	8	2MBI450VN-170-50	2MBI450XNA170-50	4
		–	2MBI600XNG170-50	6	–	2MBI600XNG170-50	3
	PrimePACK™	2MBI1000VXB-170E-50	2MBI1000XXB170-50	4	2MBI1000VXB-170E-50	2MBI1000XXB170-50	2
		2MBI1400VXB-170P-50	2NBI1400XXB170-50	3	2MBI1400VXB-170P-50	2NBI1400XXB170-50	2
		–	2MBI1800XXF170-50	1	–	2MBI1800XXF170-50	1
		–	2MBI1800XXG170-50	1	–	2MBI1800XXG170-50	1

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

■ IGBT modules proposal for Direct drive system

Wind Power Converter	Package	Rotor side			Grid side		
		IGBT Module		Number of Parallel	IGBT Module		Number of Parallel
		V series	X series		V series	X series	
1.5MW	PrimePACK™	2MBI1000VXB-170E-50	2MBI1000XXB170-50	3	2MBI1000VXB-170E-50	2MBI1000XXB170-50	2
		2MBI1400VXB-170E-50	2NBI1400XXB170-50	2	2MBI1400VXB-170E-50	2NBI1400XXB170-50	2
		–	2MBI1800XXF170-50	1	–	2MBI1800XXF170-50	1
		–	2MBI1800XXG170-50	1	–	2MBI1800XXG170-50	1
2.0MW	PrimePACK™	2MBI1000VXB-170E-50	2MBI1000XXB170-50	3	2MBI1000VXB-170E-50	2MBI1000XXB170-50	3
		2MBI1400VXB-170E-50	2NBI1400XXB170-50	2	2MBI1400VXB-170E-50	2NBI1400XXB170-50	2
		–	2MBI1800XXF170-50	1	–	2MBI1800XXF170-50	1
		–	2MBI1800XXG170-50	1	–	2MBI1800XXG170-50	1

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

- Topology in Wind power system
- Fuji's solutions for Wind power system
- Introduction of Gate Driver Unit (GDU) and Snubber capacitors

# Introduction of GDU for Wind power system ( $V_{CES} = 1700V$ ) Fuji Electric Innovating Energy Technology



Package	$I_c$ rating (A)	IGBT part No.	Driver part No.	
Dual XT	225	2MBI225XNA170-50	2EG01XCCN11N 2EG01XCDN11N	
	300	2MBI300VN-170-50		
		2MBI300XNA170-50		
	450	2MBI450VN-170-50		
		2MBI450XNA170-50		
	550	2MBI550VN-170-50		
	600	2MBI600XNG170-50		
2MBI600XNE170-50				
800	2MBI800XRNE170-50			
PrimePACK™	650	2MBI650VXA-170E-50	Semi-optimized products. Please contact Tamura.	
		2MBI650XXA170-50		
	1000	2MBI1000VXB-170E-50		
		2MBI1000XXB170-50		
	1400	2MBI1400VXB-170E-50		
		2MBI1400VXB-170P-50		
		2MBI1400XXB170-50		
	1800	2MBI1800XXF170-50		2PG010CCC11N 2PG010CDC11N
		2MBI1800XXG170-50		2QG010CDC11N
	2400	2MBI2400XRXG170-50		Semi-optimized products. Please contact Tamura.

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

# Introduction of GDU for Wind power system ( $V_{CES} = 1700V$ ) Fuji Electric Innovating Energy Technology



<https://www.power.com/products/gate-drivers>

Package	$I_C$ rating (A)	IGBT part No.	Driver part No.	"xx" (driver version)
Dual XT	300	2MBI300VN-170-50	2SP0115T2xx -2MBI300VN-170-50	A0, A0C, B0, B0C
	450	2MBI450VN-170-50	2SP0115T2xx -2MBI450VN-170-50	
	550	2MBI550VN-170-50	2SP0115T2xx -2MBI550VN-170-50	
PrimePACK™	650	2MBI650VXA-170E-50	2SP0320xx -2MBI650VXA-170E-50	T2A0, T2A0C, V2A0, V2A0C
	1000	2MBI1000VXB-170E-50	2SP0320xx -2MBI1000VXB-170E-50	
	1400	2MBI1400VXB-170E-50	2SP0320xx -2MBI1400VXB-170E-50	
		2MBI1400VXB-170P-50	2SP0320xx -2MBI1400VXB-170P-50	
1800	2MBI1800XXF170-50	2SP0320xx -2MBI1800XXF170-50		

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

# Introduction of GDU for Wind power system ( $V_{CES} = 1700V$ )



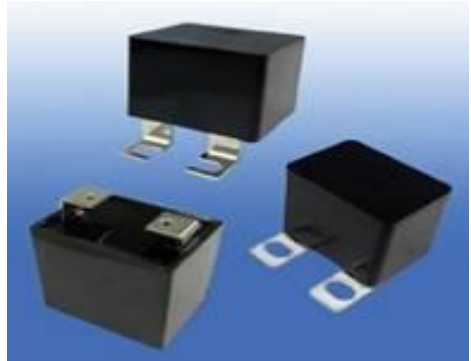
<https://www.idc-com.co.jp/en/>

Package	I <sub>c</sub> rating (A)	IGBT part No.	Driver part No.								
			Hybrid IC type	Mounted unit type	Mounted unit type with clamp circuit	Adapter unit for parallel drive	Drive unit for parallel drive				
Dual XT	225	2MBI225XNA170-50	VLA546, VLA551K, VLA597	VLA598-01R	VLA598-11R	VLB520-01R	GAU220P-15402				
	300	2MBI300VN-170-50	VLA546, VLA551K, VLA597				GAU220P-15402 GAU240P-15405				
		2MBI300XNA170-50	VLA546, VLA551K, VLA597				GAU220P-15402				
	450	2MBI450VN-170-50	VLA574, VLA500K, VLA597				VLA598-01R	VLA598-11R	VLB520-01R	GAU220P-15402 GAU240P-15405	
		2MBI450XNA170-50	VLA546, VLA551K, VLA597								
	550	2MBI550VN-170-50	VLA574, VLA500K, VLA597								
		2MBI550XNA170-50	VLA546, VLA551K, VLA597								
	600	2MBI600XNG170-50	VLA546, VLA597								
2MBI600XNE170-50		VLA546, VLA597									
PrimePACK™	650	2MBI650VXA-170E-50	VLA574, VLA500K, VLA591	-	-	-					-
		2MBI650XXA170-50	VLA574, VLA500K, VLA597		VLA593-11R						
	1000	2MBI1000VXB-170E-50	VLA574, VLA552, VLA591		-						
		2MBI1000XXB170-50	VLA574, VLA500K, VLA591		VLA593-11R						
	1400	2MBI1400VXB-170E-50	VLA574, VLA552, VLA591		-						
		2MBI1400VXB-170P-50	VLA574, VLA552, VLA591		-						
		2MBI1400XXB170-50	VLA574, VLA500K, VLA591		VLA593-11R						
	1800	2MBI1800XXF170-50	VLA574, VLA552, VLA591		VLA593-11R						
		2MBI1800XXG170-50	VLA574, VLA552, VLA591		-						

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

- L: Main circuit wiring parasitic inductance
- I<sub>o</sub>: Collector current at IGBT turn-off
- V<sub>CEP</sub>: Snubber capacitor peak voltage
- E<sub>d</sub>: DC supply voltage



Module rating		DC line inductance	snubber capacitance
V <sub>CES</sub>	I <sub>c</sub>		
1200V/1700V	450A	0.08 μH	4.7 μF
	1000A	0.07 μH	6.8μF
	1400A	0.06 μH	12 μF
	2400A	0.046 μH	27 μF
	3600A	0.046 μH	47 μF





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