MITSUBISHI ELECTRIC
Changes for the Better

Technical Support of Power Stack for LV100 Modules

MITSUBISHI ELECTRIC CORPORATION

C-00356

Merit of Technical Support with Power Stack

By receiving stack support, you will have the following benefits:

① Achieving a power converter with 2MW of output power

② Significantly shortening the development period

③ Improving the difficulty of component selection

Mitsubishi Electric has prepared reference information for inverter design when using IGBT module with LV100 package. When developing the prototype inverter (Power Stack) described in this material, we took into consideration as follow:

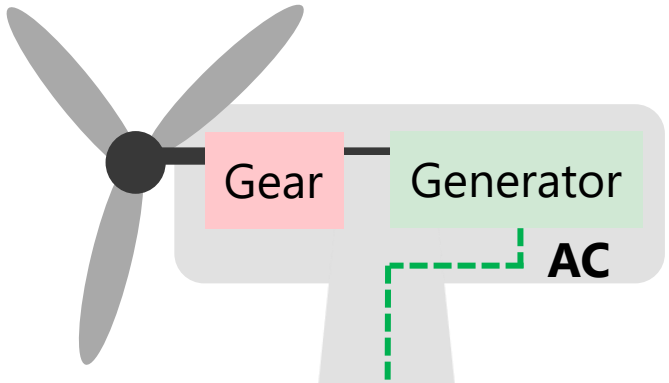
- Relationship between temperature of parallel power modules and pitch distance
- Electrical and thermal design for DC and AC busbar with considering temperature rising and skin effect
- Current balance
- Short circuit protection.

We expect that by user could reduce their developed period in system design by referring to these reference data, hence please contact us to obtain more information.

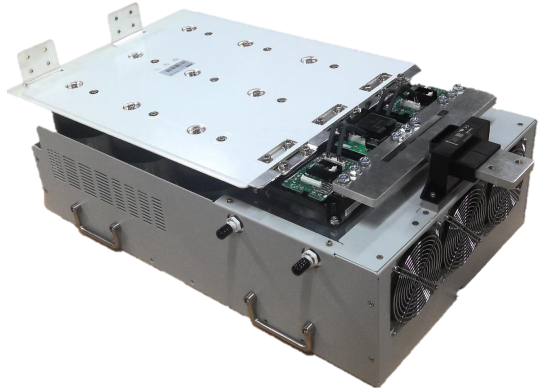
Introduction of Power Stack

Application: Renewable Energy (Ex: wind power)

A power conversion system is equipped with power modules and lots of components.
→Much knowhow is required other than power modules



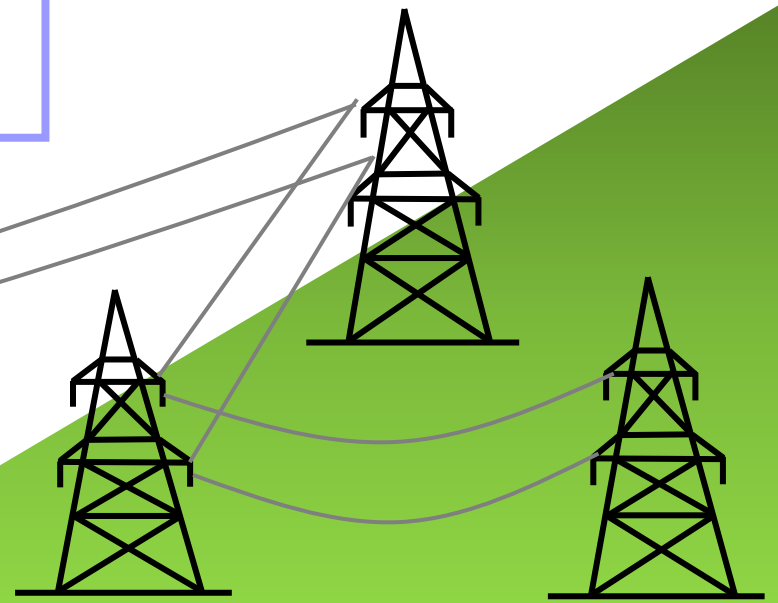
Developed stack is applied in the grid inverter



Grid inverter

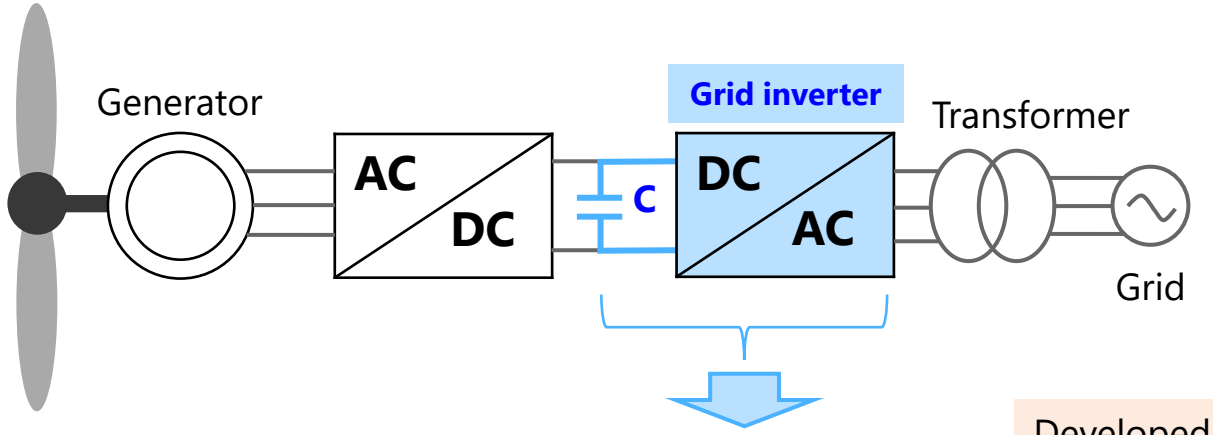
Power conversion system
- Rotor converter (AC/DC)
- **Grid inverter (DC/AC)**

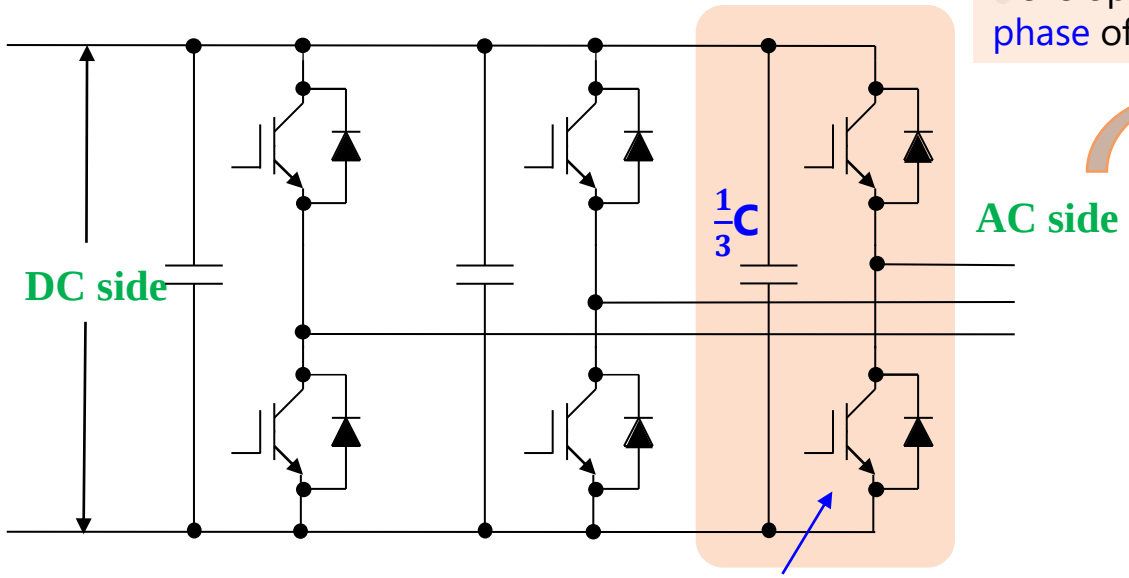
High voltage transformer



What Is Power Stack?

Stack definition: Things that collect and assemble components
→Power modules＋peripheral components





Developed stack is single phase of grid inverter

Use 2 in 1 IGBT module→CM1200DW-34T (1.7kV/1200A)

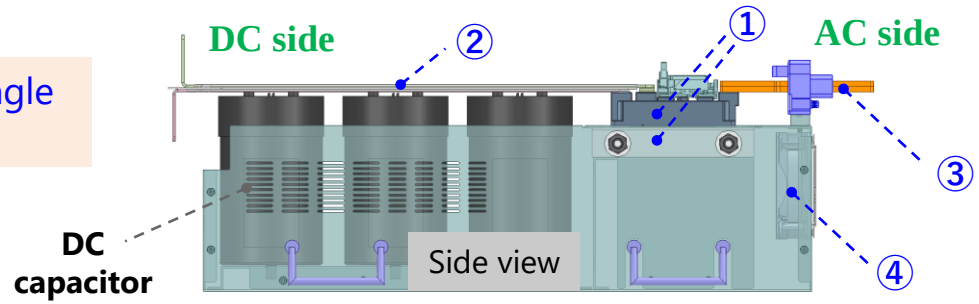
Specification decision：2MW→690Vac/ about 1800A$_{rms}$

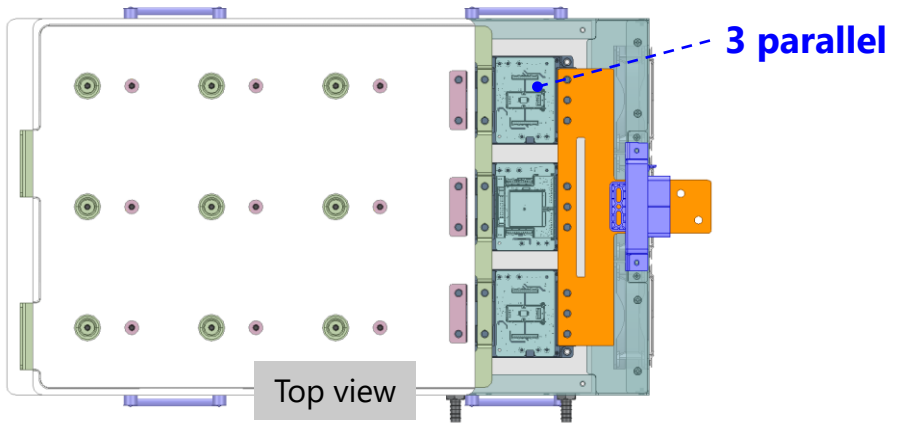
① **Selection of IGBT module and heatsink**
- Parallel number of IGBT modules **(3-parallel)**
- Cooling ability of heatsink (Liquid/ Air)
- Placement of IGBT module (Pitch distance between modules with considering thermal interface)

② **Thermal design of DC laminated busbar**

③ **Thermal and current balance design of and AC busbar**

④ **Comparison of NTC temperature under different cooling method.**





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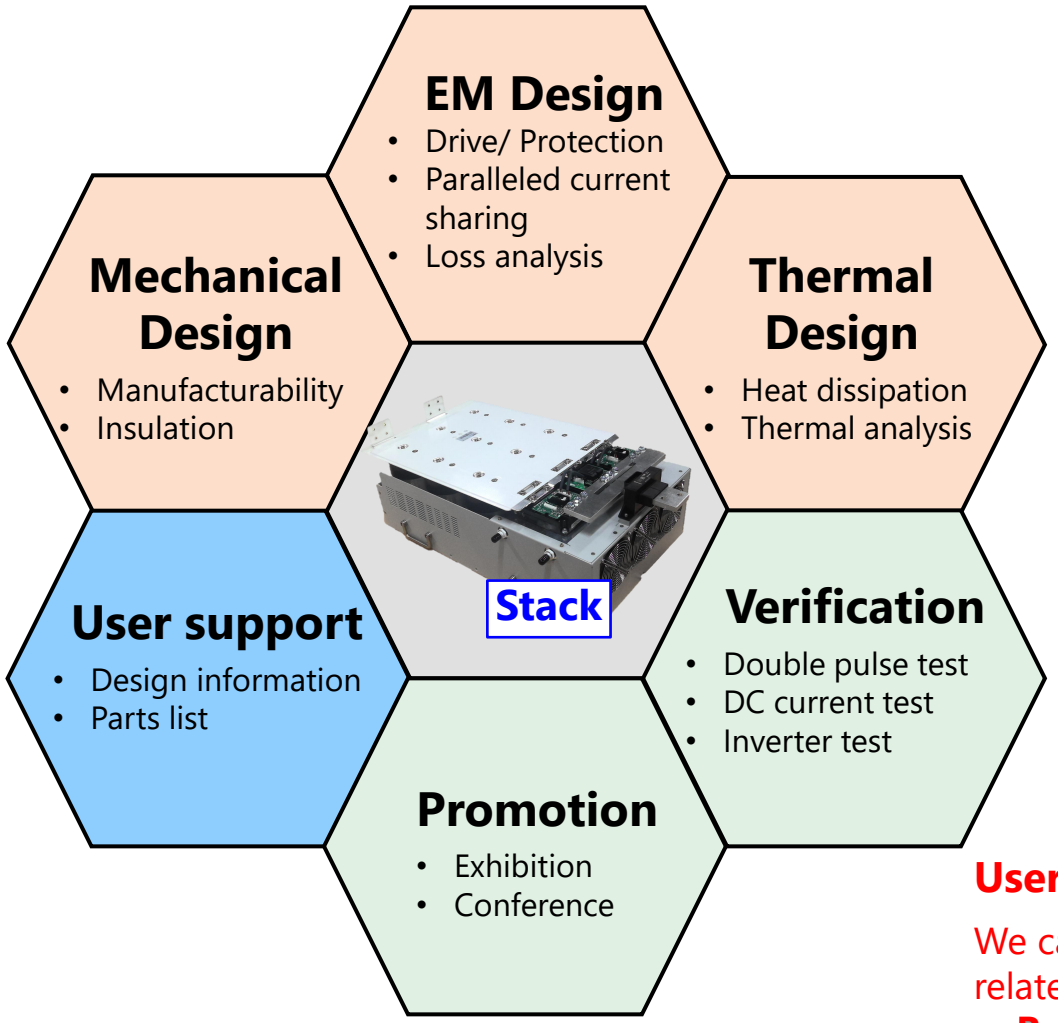
Target of Developing a Stack with Power Module

User's perspective：We want to improve the accuracy of the prototype because it requires a lot of know-how to develop the stack with using power modules, also it takes time, money and effort to design, trail manufacture and evaluate.

⇨The proposal, design and verification data of「total solution」provided by device manufacturer is requested.



Mitsubishi Electric

- R&D and manufacture of power device
- Product promotion

User

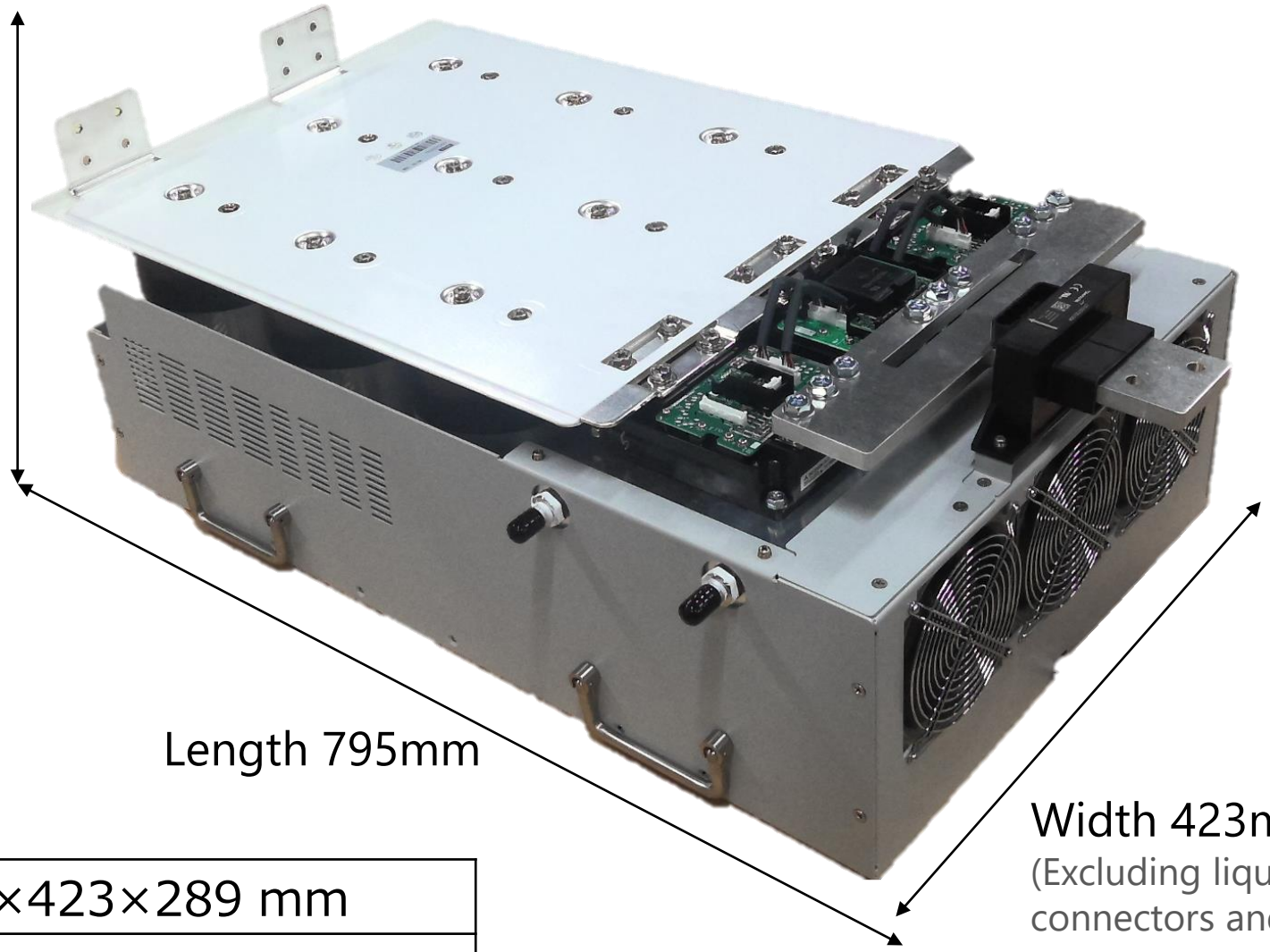
- Investigation of system specification
- Prototype design
- Trial manufacture
- Prototype verification (operated performance)
- Reliability evaluation (long-term performance)
- Order decision

User support by stack

We can support User R&D by providing stack-related information prepared in advance.

→ Reduction of User's development time

Stack Geometry and Weight



Size (L×W×H)	795×423×289 mm
Weight	About 65 kg

Specification of Stack, and Technical Points

Specification of Stack

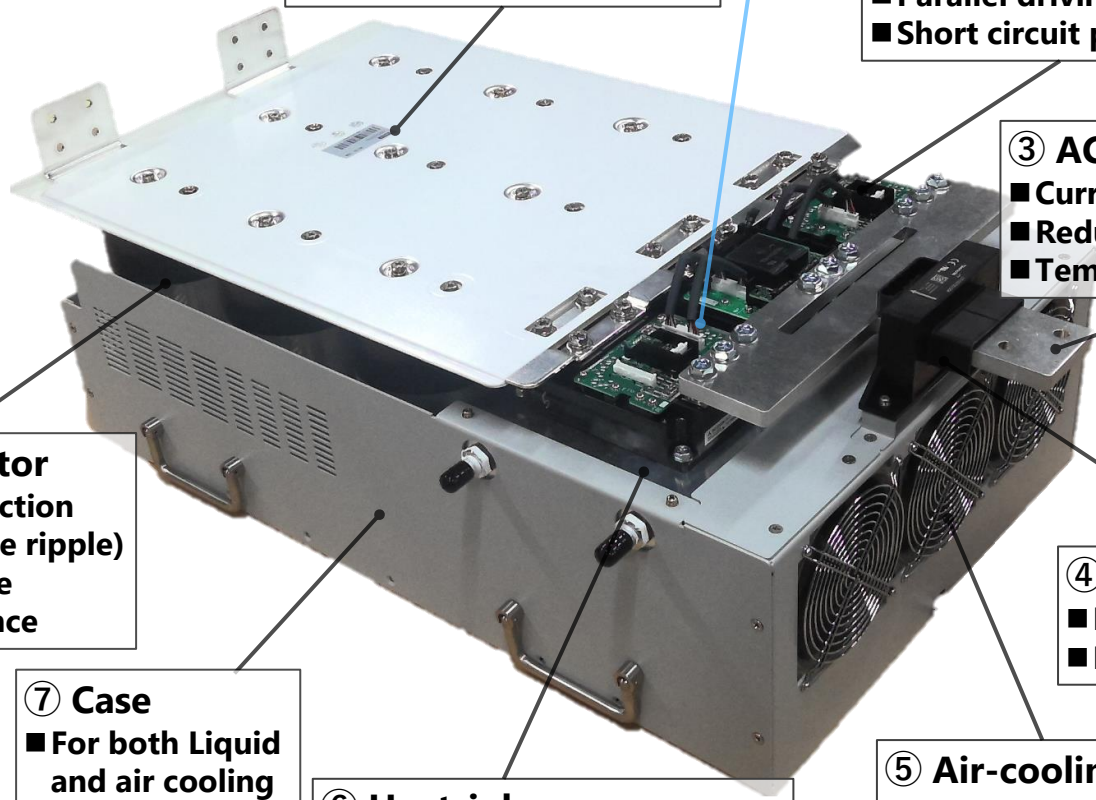
Item	Specification
Topology	2 level
Size (L × W × H)	795 × 423 × 289 mm
Weight	About 65 kg
Output power	2 MW
DC Voltage	1100 V
Current	AC：1800 Arms
Current balance	Within 5%

Remarks
-Thermal was verified by DC current evaluation and CAE.
-Current balance was verified by CAE and DPT.
*DPT=Double Pulse Test
-Short Circuit protection was verified by pulse test.

It can help technical support even if spec. is not just fit to your target.

Technical points

・**IGBT modules: CM1200DW-34T×3-parallel, LV100 series, made by Mitsubishi Electric**



① **DC laminated busbar**
- Insulation
- Temperature rising

② **Gate driver**
- Driving ability
- Parallel driving
- Short circuit protection

③ **AC busbar**
- Current balancing
- Reduction of skin effect
- Temperature rising

④ **Current sensor**
- Measured accuracy
- Responsibility

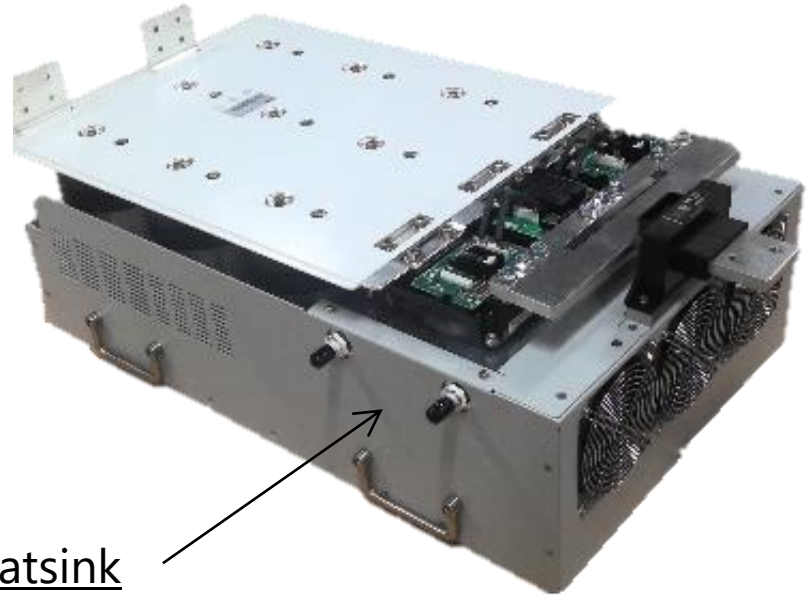
⑤ **Air-cooling fan**
- Static pressure
- Air flow

⑥ **Heatsink**
- Cooling structure (water, air)
- Module placement

⑦ **Case**
- For both Liquid and air cooling
- Ventilation

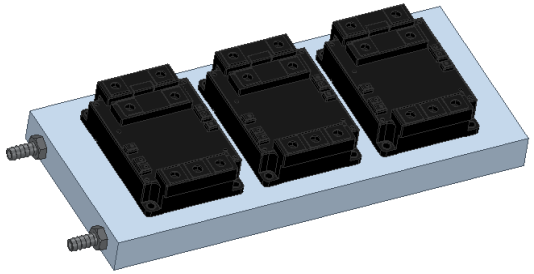
⑧ **DC capacitor**
- Capacity selection (input voltage ripple)
- Rated voltage
- Low inductance

Evaluated Results of Maximum Output Power of Inverter

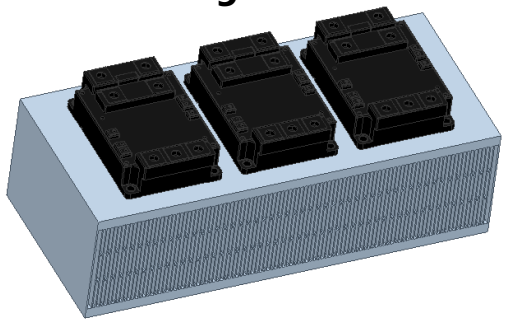


Heatsink
User can select liquid cooling or air cooling

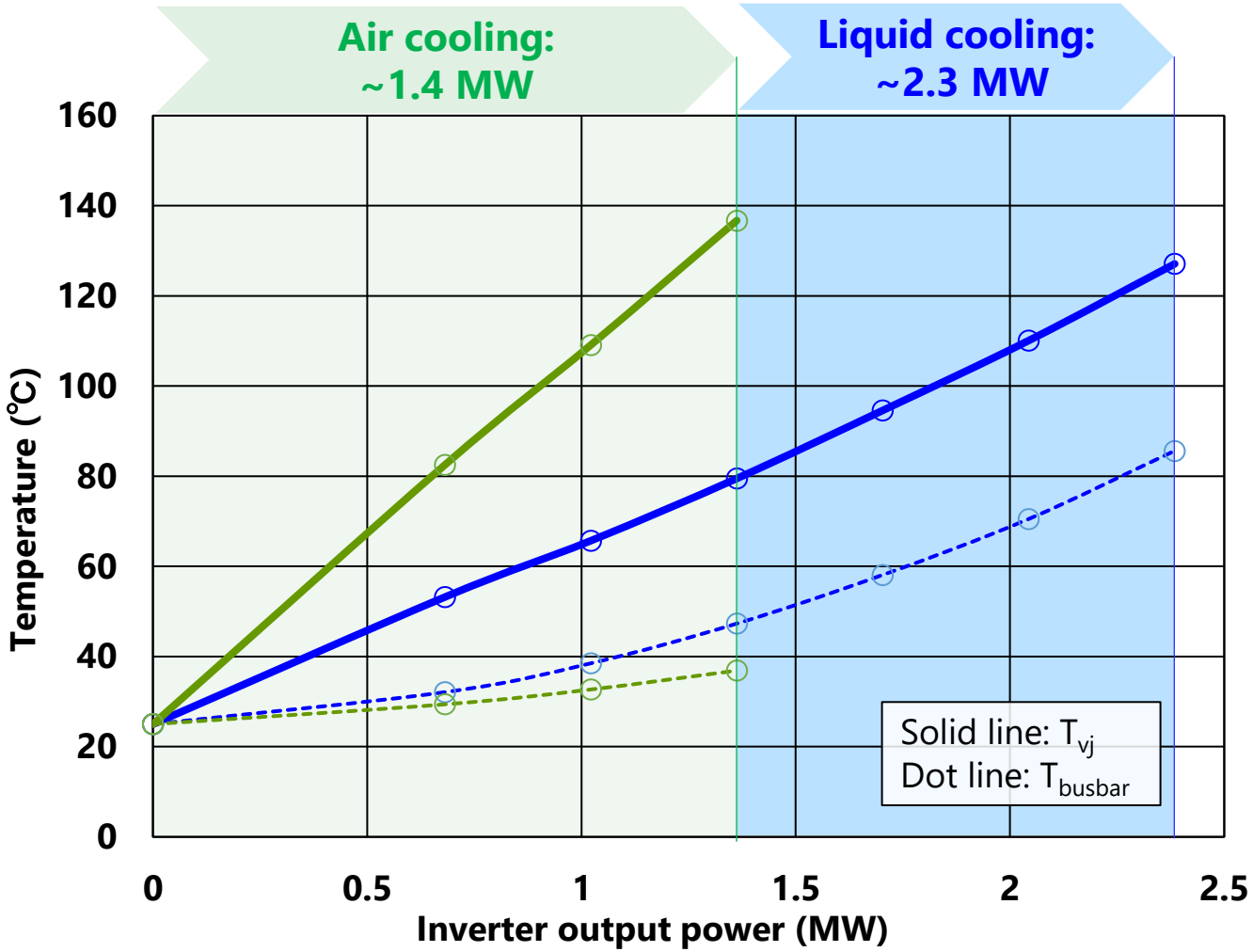
Liquid cooling heatsink



Air cooling heatsink



※The maximum output capacity under 3-phase inverter operation is derived by thermal evaluation result of single phase

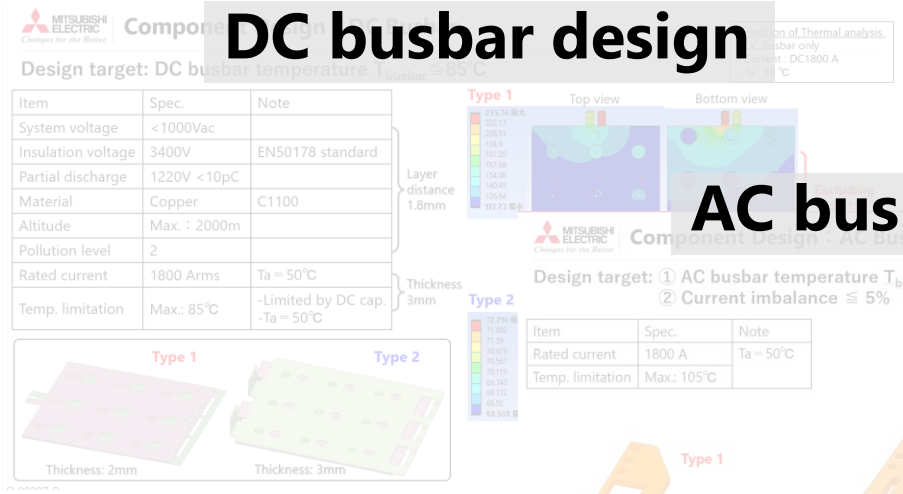


Note
-Output characteristic is evaluated under 25℃ of ambient and water inlet temperature
-Heat generating of DC capacitors is not considered

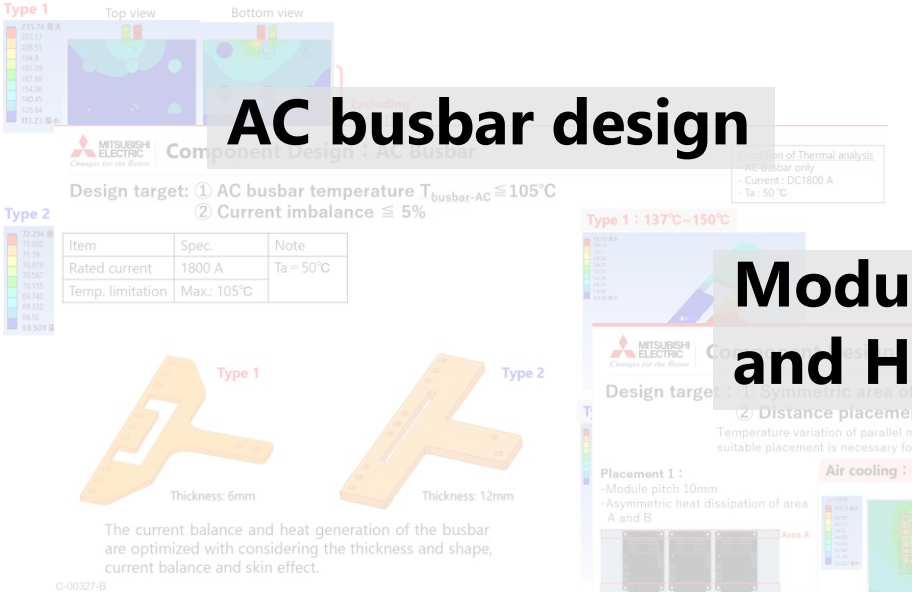
Technical Point of Power Stack

Please contact us to obtain detail design material.

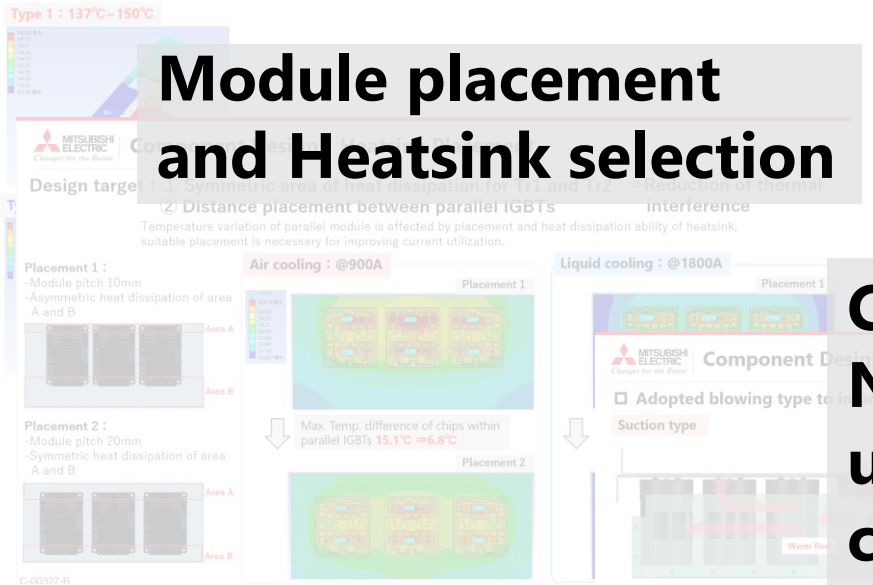
DC busbar design



AC busbar design



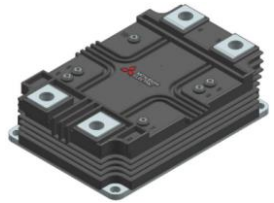
Module placement and Heatsink selection



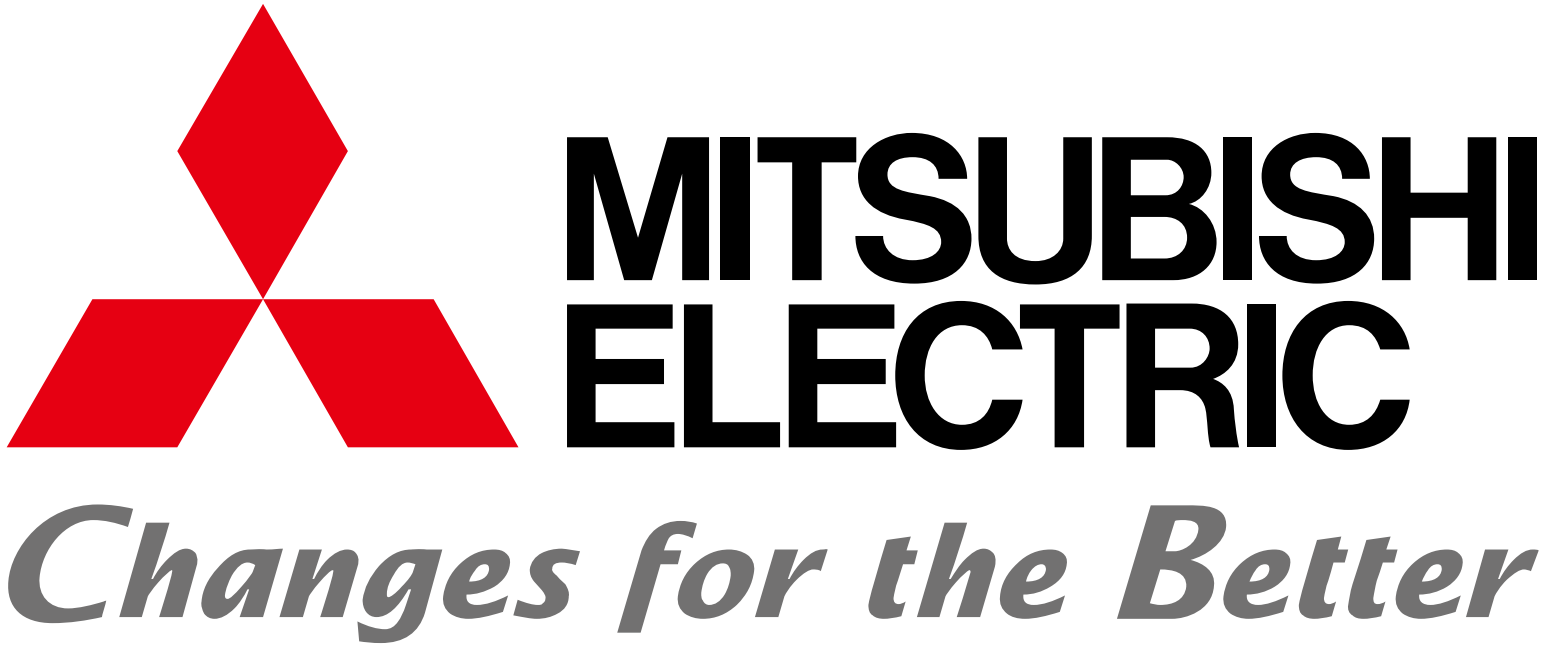
Component and NTC temperature under different cooling condition

LV100 & HV100 by Mitsubishi Electric Corporation

Standardized package / footprint for various voltage and current ratings

Main target	On-shore WP			Off-shore WP			
Line-up	 LV100 (Industrial)			 LV100 (HVIGBT)		 HV100 (HVIGBT)	
Application	Renewable, Industrial, Others			Traction, Power transmission		Traction, Power transmission	
Footprint	100mm × 140mm × 40mm			100mm × 140mm × 40mm		100mm × 140mm × 40mm	
V_{isol}	4kVrms			6kVrms		10kVrms	
Rated Voltage	1.2 kV	1.7 kV	2.0 kV	1.7 kV	3.3 kV	3.3 kV	4.5kV
Rated Current Si	800A 1200A	800A 1200A	1200A	1200A	450A 600A	450A 600A	450A
Hybrid SiC	-	-	-	1200A	600A	-	-
Full SiC	-	-	-	-	2nd chip 185A 375A 750A	3rd chip 200A 400A 800A	-	-

LV100, HV100: New standard package in high power industrial application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