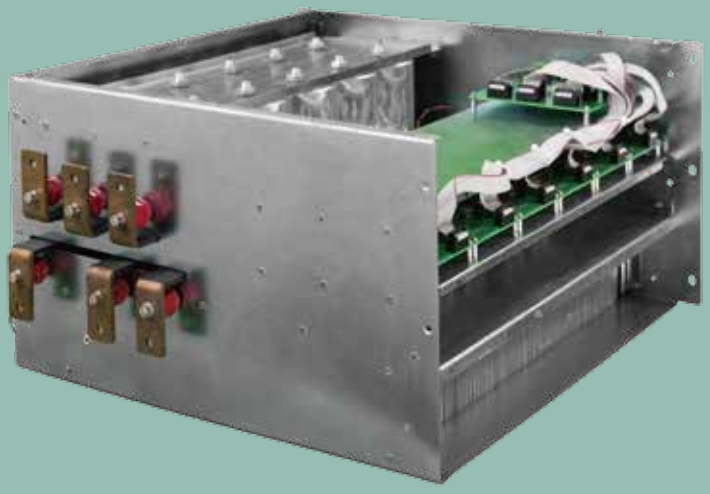


62mm module-based 3-level NPC2 solution —Achieving device loss below 0.8%

To address the market demand from photovoltaic inverter and UPS, Infineon has launched the 600A/1,200V 62mm module both in standard half bridge and common emitter configuration. These modules represent the highest current density in this package footprint. By increasing current density by 33%, this product enables a great improvement in the system's power density.

Chiming in with the promotion of applications of the new product, Infineon has developed, together with Fudan University in Shanghai, PR China, a 175kW three-phase 3-level NPC2 power unit. Three such power units are enough to build a 500kW PV inverter.

The power unit is precisely and optimally designed at Infineon's thermal design laboratory to achieve the high power density and high switching frequency.

The solution can finally become the standard platform for inverter manufacturers. Uniformly packaged modules in different current and voltage classes based on different IGBT chip technologies can achieve different inverter power levels and characteristics.

3-level general inverter platform:

- The best-in-class 62mm module
- The most general module platform
- Low-cost 80mm 11W low-noise axial fan
- 3-level NPC 2
- Three-phase bridge arm 175kW@315Vac
  250kW@480V
- Optimal system cost

IGBT module used in inverter:

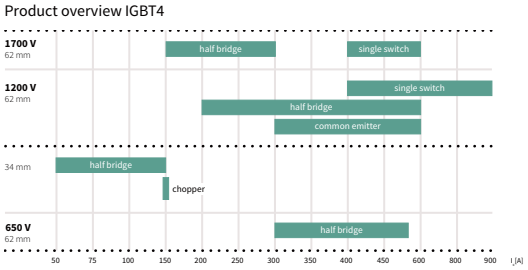
- IGBT4 TRENCHSTOP™ technology
- Best-in-class 600A/1,200V
- The 62mm family representing the highest power density
- The most general industrial standard package
- IGBT4 features:
  - Tjop_max = 150°C
  - Improved power cycle capacity
  - TIM thermal conductivity precoat version

The most general modular platform:

- Various 650V/1,200V/1,700V IGBT chip technologies
- 600A/1,200V (the highest current density)

62mm IGBT4 family

Product overview IGBT4



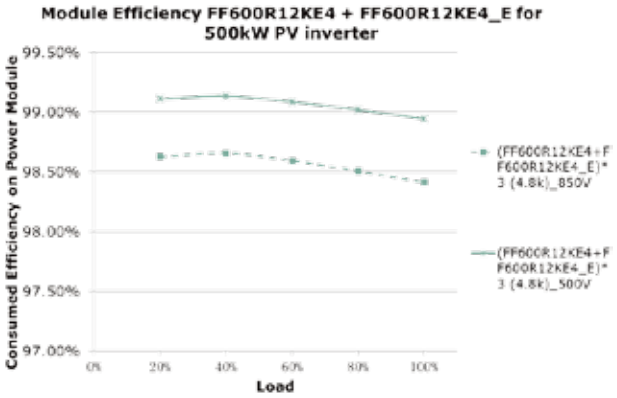
Inverter specifications:

- VDC_max: 1,000V
- Rated output power: 175KW@315V AC output;
  modulation frequency: 4.8kHz
- Maximum output power: 1.1 times the rated output power
- Rated output current: 320A
- Overload current: 353A 30mins

Reference parameters:

IGBT module is the key to system efficiency. The optimal design can minimize module loss.

Efficiency simulation and dynamic losses of IGBTs and diodes are tested and calibrated.



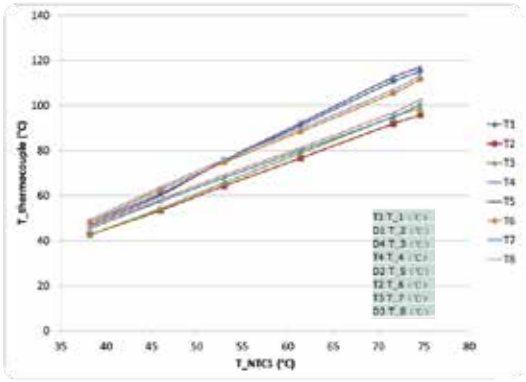
Thermal test result:

High power density design depends on characteristics of power semiconductor and is also closely related to thermal management design of power units. Thermal management is an experimental design-based method. An accurate thermal design is the basis for high power density and low cost, and an enabler of cost and reliability optimization.

Temperature calibration test:

The following can be obtained from the test:

1. NTC temperature and its relationship with each IGBT and diode junction temperature (the figure below)
2. The relationship between temperature and output power



Reliable short-circuit protection is a key point in power system design. Design and evaluation in 3-level system are particularly complex, depending on:

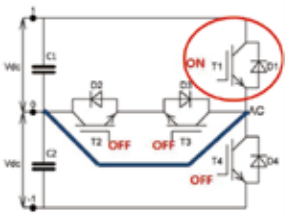
- Low-parasitic inductance module and bus design
- 1,200V IGBT for middle bridge arm
- Vce desaturation short circuit protection design
- Active clamping and soft turn-off

Short-circuit waveform of each switch (selected from the report on six short-circuit test in NPC2 topology):

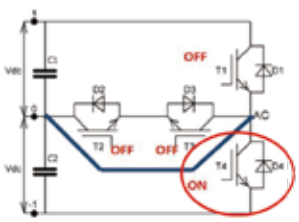
- NPC bridge arm sc-circuit
- Main switch short-circuit waveform:
  The up side switch T1 and low side switch T4 are perfectly symmetrical. Short-circuit currents can be well overlapped.

  Short-circuit current: 3,000A; short-circuit duration: 7us

  Blue: Gate voltage; red: current; green: bus voltage



T1 short-circuit test,
where **T2** and **T3** are short-circuited



T4 short-circuit test,
where **T2** and **T3** are short-circuited