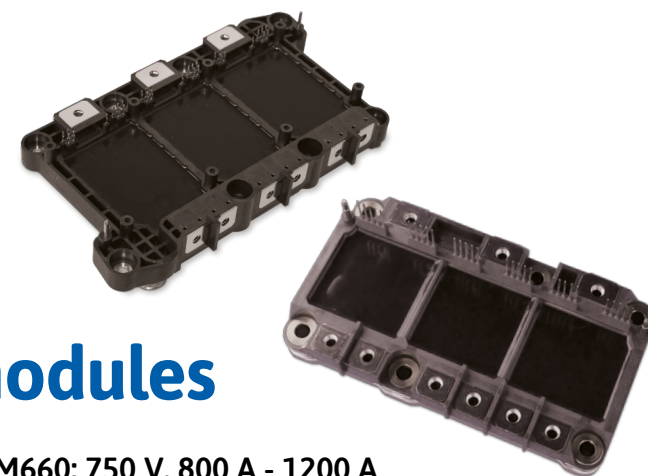




Automotive IGBT modules

6 in 1, direct water cooling

- ▶ **M660: 750 V, 800 A - 1200 A**
- ▶ **M677: 750 V, 600 A**



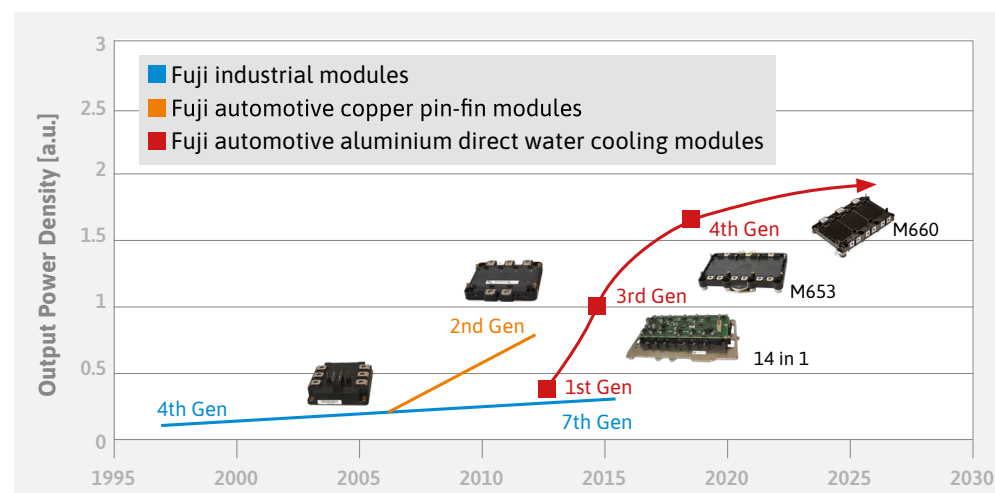
Fuji Electric automotive power modules combine several breakthrough technologies to increase the power density to the next level.

The unique RC-IGBT chips combine the IGBT and the diode in one chip for a very low thermal resistance. Inside the module lead frames are used to connect the chips.

The lead frames have a much higher continuous current capability compared to bond wire connections. Combined with a newly designed, high performance, closed water cooler this leads to a very low thermal resistance and to a very compact module.

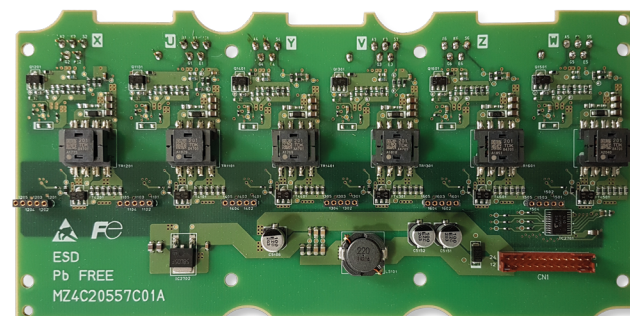
FEATURES

- ▶ Low thermal resistance
- ▶ High continuous operating temperature 175 °C
- ▶ High continuous current
- ▶ Very high hill-hold performance
- ▶ Lightweight
- ▶ Highest power output available on the market

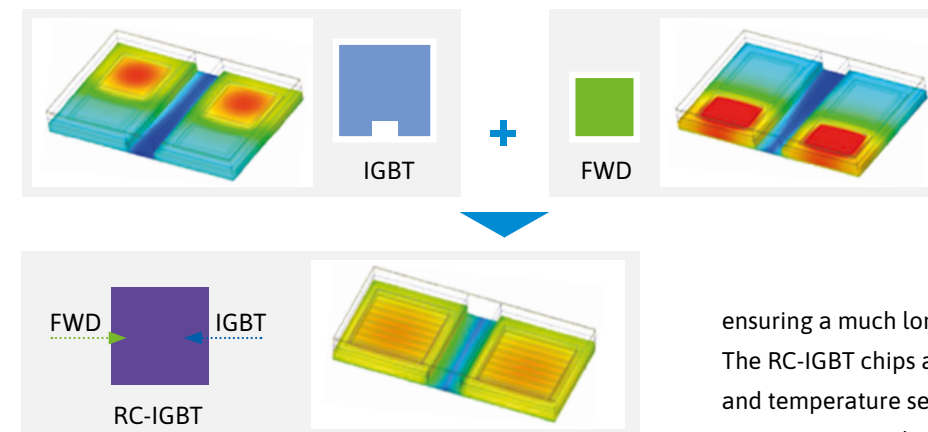


Evaluation kit

For fast and convenient testing Fuji Electric offers a gate driver designed specifically for the M660 module. This evaluation gate driver supports all M660 features like ultra-fast short circuit detection via the on-chip current sensors and precise junction temperature measurement.



RC-IGBT



An RC-IGBT chip comprises of an IGBT and a diode in one chip. This design saves space between the separate chips which have to be used in competing products and allows for a more compact design. The losses are spread more evenly over the chip surface which lowers the thermal resistance and guarantees a superior hill-hold performance. During hill-hold the temperature rise of an RC-IGBT chip is magnitudes below that of separate IGBT and diodes,

ensuring a much longer module lifetime. The RC-IGBT chips are equipped with on-chip current and temperature sensors allowing for fast and precise measurements. The chips can be safely operated at their maximum temperature without the risk of overheating. There are no special gate driver requirements – the RC-IGBTs can be operated like any standard IGBT.

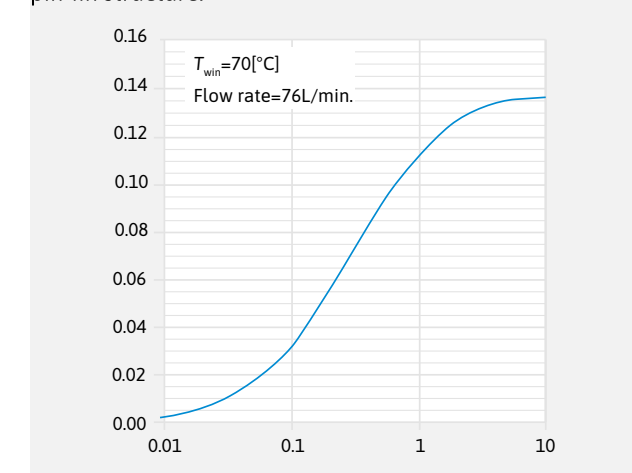
MAIN FEATURES

- ▶ On-chip current and temperature sensors
- ▶ Excellent heat spreading
- ▶ Low thermal resistance
- ▶ Simple driving conditions

Closed water cooler

The modules feature closed water coolers with unique internal structures that perfectly balances a very low thermal resistance with a low pressure drop. The closed design allows for an easy integration into the customers inverter – only two small sealing rings are required. There is no need for the customer to design the water flow as it has been optimized by Fuji Electric.

By using an aluminium alloy the weight of the module is significantly lower compared to modules using a copper pin-fin structure.



MAIN FEATURES

- ▶ Very low R_{th} and low pressure drop
- ▶ Easy to integrate
- ▶ Small sealing area
- ▶ Lightweight aluminium cooler





Automotive small IPM IGBT module

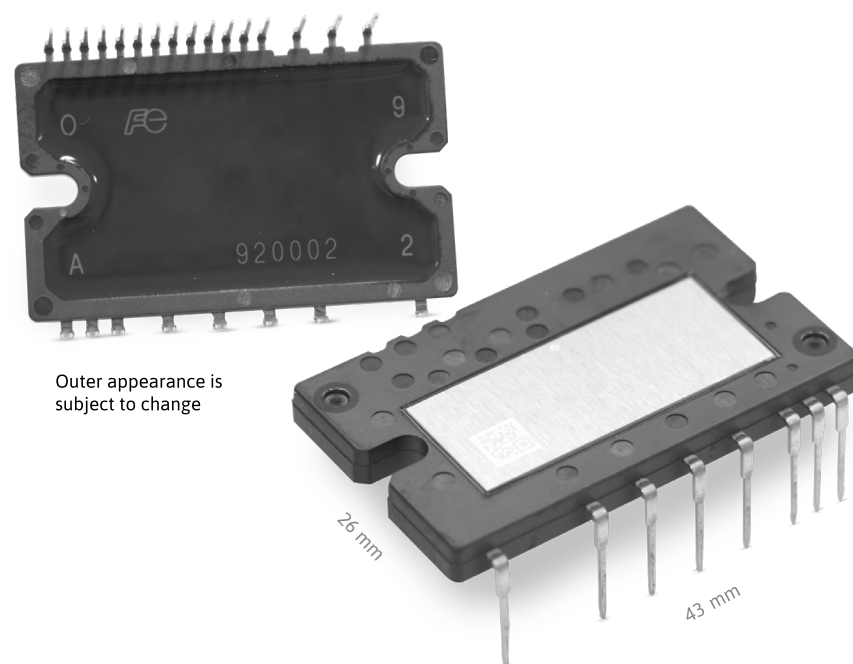
For air conditioning systems

The Fuji Small Intelligent Power Module (Small IPM) offers many features for convenient and easy system integration. It utilizes Fuji Electric's latest chip generation for low losses, the X series. An integrated gate driver IC and highly optimized internal structure allow optimal switching performance. The on-chip current and temperature sensors enable a fast and reliable control of the module. The Small IPM has built-in, short circuit and under voltage protection functions.

All of the features are integrated into an ultra-compact DIP package with very low thermal resistance and a high isolation voltage of > 1.5 kV AC.

FEATURES

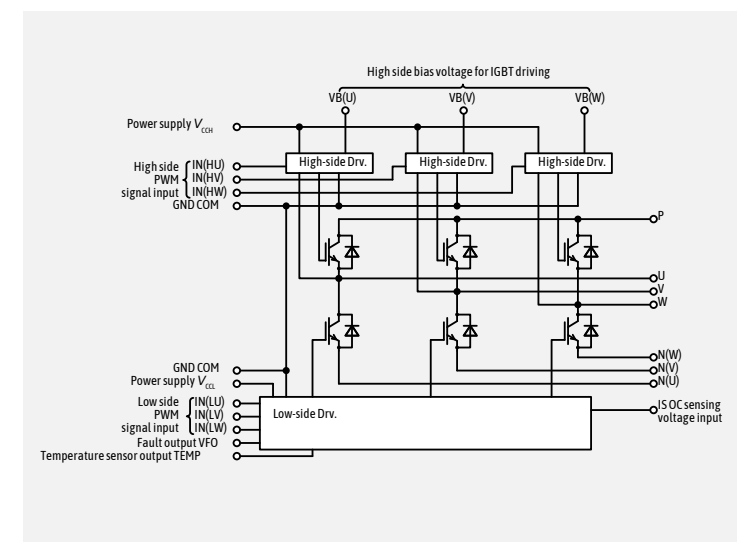
- ▶ Analog temperature output
- ▶ Built-in gate driver IC
- ▶ Short circuit protection
- ▶ Under voltage protection
- ▶ Fault signal output



Fuji Electric's X series Small IPM chips

In Fuji Electric's X series IGBT chips the thickness of the drift layer and the pitch between the trenches was reduced which results in lower $V_{CE(sat)}$ value. Besides this, the field stop layer was improved to fulfil the requirements towards the breakdown voltage and to reduce the leakage current. The FWD forward voltage drop was reduced by applying a thinner drift layer. The good adjustment of the lifetime control ensure a soft Reverse Recovery behaviour.

The IPM chips have on-chip current and temperature sensors for very precise control. The current sensor is used for short circuit detection and offers a high degree of safety. The temperature sensor offers an accuracy. The temperature signal is connected to an analog output pin of the module.



MAIN FEATURES

- ▶ Low switching and saturation losses
- ▶ On-chip temperature sensor
- ▶ On-chip current sensor

Very high performance

IGBT and FWD chips with very low switching and conduction losses, combined with excellent switching behaviour and a low thermal resistance result in an ultra-compact, high performance module.

The total losses are approximately 34 % lower compared to the direct competitor product.

