

F1 module with Trench/Fieldstop IGBT and Emitter Controlled diode and Pressfit/NTC

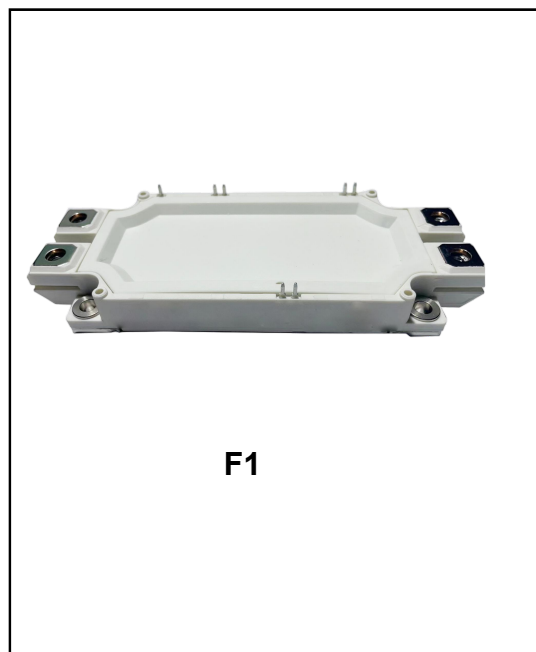
## Features

### • Electrical features

- Low  $V_{CEsat}$
- $V_{CE(sat)}$  with positive temperature coefficient
- 10 $\mu$ s short circuit capability
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD

### • Mechanical features

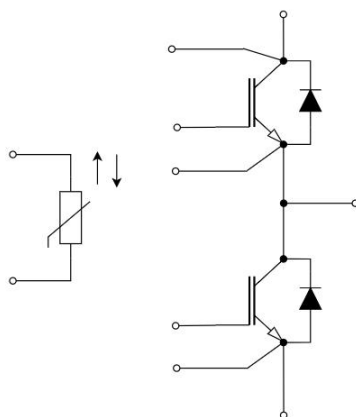
- Isolated Base Plate
- Pressfit Contact Technology



## Typical Applications

- Inverter and power supplies
- Motor Drives
- Servo Drives
- Photovoltaic/Fuel cell

## Description



### Package Insulation coordination

| Symbol      | Description                                | Note or test condition               | Values    | Unit |
|-------------|--------------------------------------------|--------------------------------------|-----------|------|
| $V_{ISOL}$  | Isolation test voltage                     | RMS, f=50Hz, t=60s                   | 3         | kV   |
|             | Material of module baseplate               |                                      | Cu        |      |
|             | Internal isolation                         | basic insulation(class 1, IEC 61140) | $Al_2O_3$ |      |
| $d_{creep}$ | Creepage distance                          | terminal to heatsink                 | 14.5      | mm   |
| $d_{creep}$ | Creepage distance                          | terminal to terminal                 | 13.0      | mm   |
| $d_{clear}$ | Clearance                                  | terminal to heatsink                 | 12.5      | mm   |
| $d_{clear}$ | Clearance                                  | terminal to terminal                 | 10.0      | mm   |
| $CTI$       | Comparative tracking index<br>(electrical) |                                      | >500      |      |

### Package Characteristic values

| Symbol      | Description                              | Note or test condition                        |           | Values |      |      | Unit |
|-------------|------------------------------------------|-----------------------------------------------|-----------|--------|------|------|------|
|             |                                          |                                               |           | Min.   | Typ. | Max. |      |
| $L_{sCE}$   | Stray inductance module                  |                                               |           |        | 20   |      | nH   |
| $R_{CC+EE}$ | Module lead resistance, terminals - chip | TC = 25 °C, per switch                        |           |        | 1.1  |      | mΩ   |
| $T_{STG}$   | Storage Temperature Range                |                                               |           | -40    |      | 125  | °C   |
| M           | Mounting torque for module mounting      | -Mounting according to valid application note | M5, Screw | 3.0    | --   | 6.0  | Nm   |
| M           | Terminal connection torque               | -Mounting according to valid application note | M6, Screw | 3.0    | --   | 6.0  | Nm   |
| G           | Weight                                   |                                               |           | --     | 345  | --   | g    |

## IGBT

### Absolute Maximum Ratings (T<sub>c</sub> = 25°C unless otherwise noted)

| Symbol           | Description                                                                      | Value | Unit |
|------------------|----------------------------------------------------------------------------------|-------|------|
| V <sub>CES</sub> | Collector-Emitter Voltage                                                        | 1200  | V    |
| V <sub>GES</sub> | Gate-Emitter Voltage                                                             | ±30   | V    |
| I <sub>CDC</sub> | Continuous Collector Current @ T <sub>c</sub> = 80°C (T <sub>JMAX</sub> = 175°C) | 450   | A    |
| I <sub>CM</sub>  | Pulsed Collector Current, t <sub>p</sub> limited by T <sub>vj max</sub>          | 900   | A    |

### Characteristics (T<sub>c</sub> = 25°C unless otherwise noted)

| Symbol               | Parameter                            | Test Condition                                                                                                                                                          |                          | Min  | Typ   | Max               | Unit |
|----------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------|-------|-------------------|------|
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage | I <sub>C</sub> =300A, V <sub>GE</sub> = 15 V                                                                                                                            | T <sub>vj</sub> = 25 °C  | --   | 1.50  | 2.30              | V    |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 1.70  | --                |      |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage | I <sub>C</sub> =450A, V <sub>GE</sub> = 15 V                                                                                                                            | T <sub>vj</sub> = 25 °C  | --   | 1.65  | 2.45              | V    |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 1.85  | --                |      |
| V <sub>GE(TH)</sub>  | Gate-Emitter Threshold Voltage       | V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 5 mA, T <sub>vj</sub> = 25°C                                                                                       |                          | 5.0  | 6.0   | 7.0               | V    |
| I <sub>CES</sub>     | Collector-Emitter Cutoff Current     | V <sub>GE</sub> = 0 V, V <sub>CE</sub> =1200V, T <sub>vj</sub> = 25°C                                                                                                   |                          | --   | --    | 1.0               | mA   |
| I <sub>GES</sub>     | Gate-Emitter Leakage Current         | V <sub>GE</sub> = ± 30 V, V <sub>CE</sub> = 0 V, T <sub>vj</sub> = 25°C                                                                                                 |                          | --   | --    | ± 200             | nA   |
| R <sub>Gint</sub>    | Internal Gate Resistance             | T <sub>vj</sub> = 25 °C                                                                                                                                                 |                          | --   | 0.8   | --                | Ω    |
| C <sub>ies</sub>     | Input Capacitance                    | f = 100 kHz, T <sub>vj</sub> = 25 °C, V <sub>CE</sub> = 25 V,<br>V <sub>GE</sub> = 0 V                                                                                  |                          | --   | 64.2  | --                | nF   |
| C <sub>res</sub>     | Reverse Transfer                     |                                                                                                                                                                         |                          | --   | 0.32  | --                | nF   |
| Q <sub>G</sub>       | Gate Charge                          | V <sub>GE</sub> = ±15 V, V <sub>CC</sub> = 960 V                                                                                                                        |                          | --   | 2.2   | --                | μC   |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | I <sub>C</sub> = 450A, V <sub>CC</sub> = 600 V,<br>V <sub>GE</sub> = 15 /-5V, R <sub>G</sub> = 5.0 Ω                                                                    | T <sub>vj</sub> = 25 °C  | --   | 260   | --                | ns   |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 286   | --                |      |
| t <sub>r</sub>       | Rise Time                            | I <sub>C</sub> =450A, V <sub>CC</sub> = 600 V,<br>V <sub>GE</sub> = 15 /-5V, R <sub>G</sub> = 5.0 Ω                                                                     | T <sub>vj</sub> = 25 °C  | --   | 60    | --                | ns   |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 93    | --                |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  | I <sub>C</sub> = 450A, V <sub>CC</sub> = 600 V,<br>V <sub>GE</sub> = 15 /-5V, R <sub>Goff</sub> = 5.0 Ω                                                                 | T <sub>vj</sub> = 25 °C  | --   | 360   | --                | ns   |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 440   | --                |      |
| t <sub>f</sub>       | Fall Time                            | I <sub>C</sub> = 450A, V <sub>CC</sub> = 600 V,<br>V <sub>GE</sub> = 15 /-5V, R <sub>G</sub> = 5.0 Ω                                                                    | T <sub>vj</sub> = 25 °C  | --   | 53    | --                | ns   |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 126   | --                |      |
| E <sub>on</sub>      | Turn-On Switching Loss per Pulse     | I <sub>C</sub> =450A, V <sub>CC</sub> = 600 V,<br>V <sub>GE</sub> = 15 /-5V, R <sub>G</sub> = 5.0 Ω<br>(T <sub>vj max</sub> = 175 °C)                                   | T <sub>vj</sub> = 25 °C  | --   | 26.04 | --                | mJ   |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 52.25 | --                |      |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    | I <sub>C</sub> = 450A, V <sub>CC</sub> = 600 V,<br>V <sub>GE</sub> = 15 /-5V, R <sub>G</sub> = 5.0 Ω<br>(T <sub>vj max</sub> = 175 °C)                                  | T <sub>vj</sub> = 25 °C  | --   | 35.14 | --                | mJ   |
|                      |                                      |                                                                                                                                                                         | T <sub>vj</sub> = 150 °C | --   | 56.80 | --                |      |
| I <sub>SC</sub>      | SC Data                              | V <sub>GE</sub> ≤ 15 V, V <sub>CC</sub> = 800 V,<br>V <sub>CEmax</sub> =V <sub>CES</sub> -L <sub>sCE</sub> ·di/dt<br>t <sub>p</sub> ≤ 10 μs,<br>T <sub>vj</sub> =150 °C | --                       | 2000 | --    | A                 |      |
| R <sub>thJC</sub>    | Thermal resistance                   | Junction-to-Case (per IGBT)                                                                                                                                             |                          | --   | 0.079 |                   | K/W  |
| T <sub>vj op</sub>   |                                      | Temperature under switching conditions                                                                                                                                  |                          | -40  |       | 175 <sup>1)</sup> | °C   |

<sup>1)</sup>T<sub>vj op</sub> > 150 °C is only allowed for operation at overload conditions.

## Diodes

### Absolute Maximum Ratings (T<sub>c</sub> = 25°C unless otherwise noted)

| Symbol           | Description                                             | Value | Unit |
|------------------|---------------------------------------------------------|-------|------|
| V <sub>RRM</sub> | Repetitive Peak Reverse Voltage                         | 1200  | V    |
| I <sub>F</sub>   | Diode Continuous Forward Current @ T <sub>c</sub> =80°C | 450   | A    |
| I <sub>FRM</sub> | Diode Maximum Forward Current t <sub>p</sub> =1ms       | 900   | A    |

### Characteristics (T<sub>c</sub>=25°C unless otherwise noted)

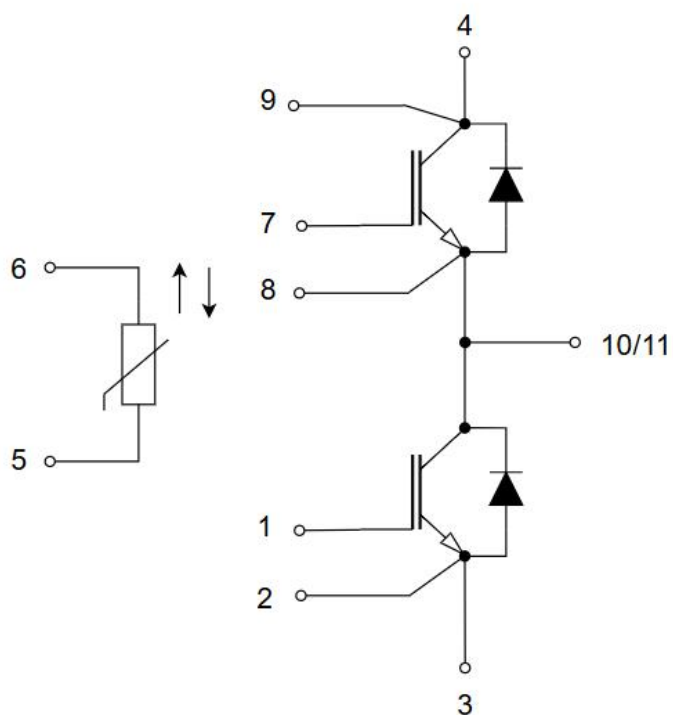
| Symbol             | Parameter                            | Note or Test Condition                                                                                      |                          | Min | Typ   | Max               | Unit |
|--------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------|-----|-------|-------------------|------|
| V <sub>F</sub>     | Diode Forward Voltage                | I <sub>F</sub> = 300 A                                                                                      | T <sub>vj</sub> = 25 °C  | --  | 1.65  | 2.65              | V    |
|                    |                                      |                                                                                                             | T <sub>vj</sub> = 150 °C | --  | 1.55  | --                |      |
| V <sub>F</sub>     | Diode Forward Voltage                | I <sub>F</sub> = 450 A                                                                                      | T <sub>vj</sub> = 25 °C  | --  | 1.80  | 2.80              |      |
|                    |                                      |                                                                                                             | T <sub>vj</sub> = 150 °C | --  | 1.70  | --                |      |
| Q <sub>r</sub>     | Recovered Charge                     | I <sub>F</sub> = 450 A, V <sub>R</sub> = 600 V,<br>R <sub>G</sub> = 5.0 Ω<br>(T <sub>vj max</sub> = 175 °C) | T <sub>vj</sub> = 25 °C  | --  | 10.66 | --                | μC   |
|                    |                                      |                                                                                                             | T <sub>vj</sub> = 150 °C | --  | 33.15 | --                |      |
| I <sub>RM</sub>    | Peak Reverse Recovery Current        | I <sub>F</sub> = 450 A, V <sub>R</sub> = 600 V,<br>R <sub>G</sub> = 5.0 Ω<br>(T <sub>vj max</sub> = 175 °C) | T <sub>vj</sub> = 25 °C  | --  | 139   | --                | A    |
|                    |                                      |                                                                                                             | T <sub>vj</sub> = 150 °C | --  | 199   | --                |      |
| E <sub>rec</sub>   | Reverse recovery energy              | I <sub>F</sub> = 450 A, V <sub>R</sub> = 600 V,<br>R <sub>G</sub> = 5.0 Ω<br>(T <sub>vj max</sub> = 175 °C) | T <sub>vj</sub> = 25 °C  | --  | 9.85  | --                | mJ   |
|                    |                                      |                                                                                                             | T <sub>vj</sub> = 150 °C | --  | 24.38 | --                |      |
| R <sub>thJC</sub>  | Thermal resistance, junction to case | per diode                                                                                                   |                          | --  | 0.098 | --                | K/W  |
| T <sub>vj op</sub> |                                      | Temperature under switching conditions                                                                      |                          | -40 |       | 175 <sup>2)</sup> | °C   |

<sup>2)</sup>T<sub>vj op</sub> > 150°C is only allowed for operation at overload conditions.

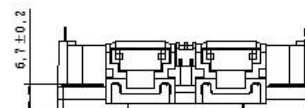
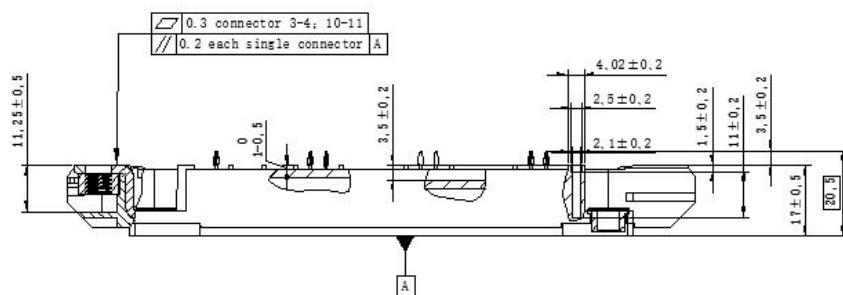
### NTC Characteristics (T<sub>c</sub> = 25°C unless otherwise noted)

| Symbol              | Parameter         | Test Condition                                                                            | Min | Typ  | Max  | Unit |
|---------------------|-------------------|-------------------------------------------------------------------------------------------|-----|------|------|------|
| R <sub>25</sub>     | Rated Resistance  |                                                                                           | --  | 5.0  | --   | kΩ   |
| ΔR/R                | Deviation of R100 | T <sub>c</sub> =100 °C, R <sub>100</sub> =493.3Ω                                          | -5  | --   | 5    | %    |
| P <sub>25</sub>     | Power Dissipation |                                                                                           | --  | --   | 20.0 | mW   |
| B <sub>25/50</sub>  | B-value           | R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/50</sub> (1/T <sub>2</sub> - 1/(298.15K))]  | --  | 3375 | --   | K    |
| B <sub>25/80</sub>  | B-value           | R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/80</sub> (1/T <sub>2</sub> - 1/(298.15K))]  | --  | 3411 | --   | K    |
| B <sub>25/100</sub> | B-value           | R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/100</sub> (1/T <sub>2</sub> - 1/(298.15K))] | --  | 3433 | --   | K    |

**CIRCUIT DIAGRAM**

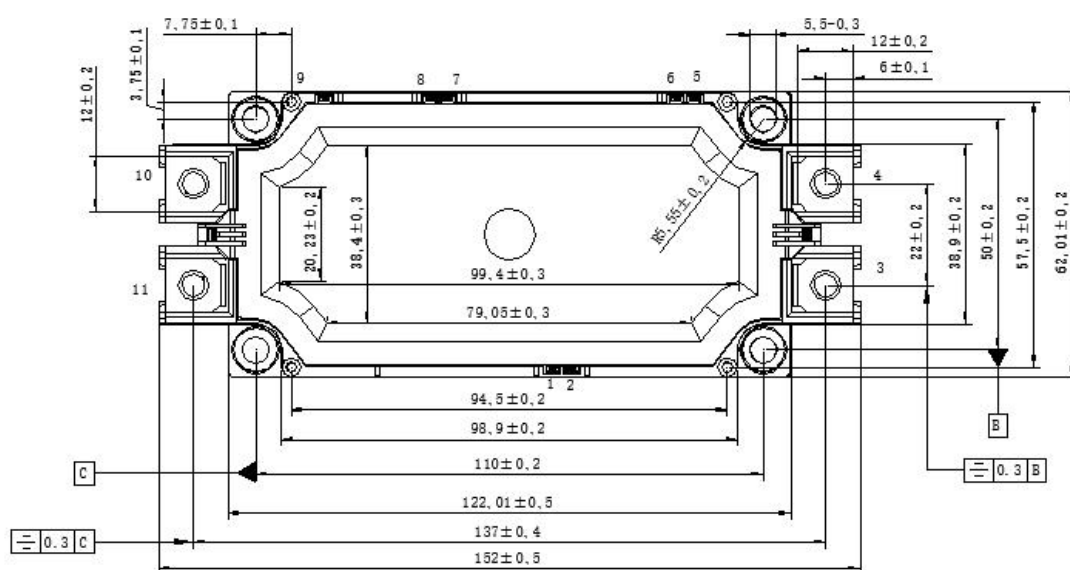


**PACKAGE DIMENSION**



SIDE VIEW

SIDE VIEW



PCB孔位图

