

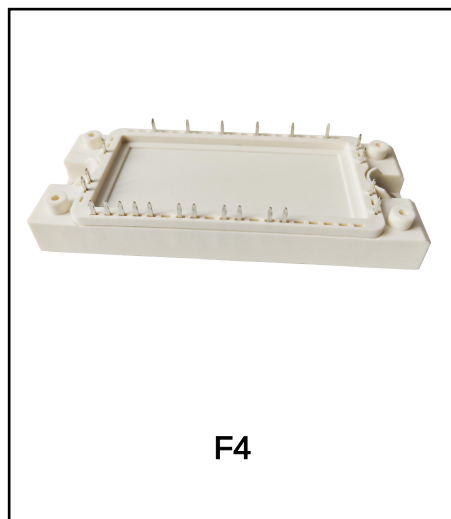
F4 PACK module with Trench/Fieldstop IGBT and Emitter Controlled diode and NTC

## Features

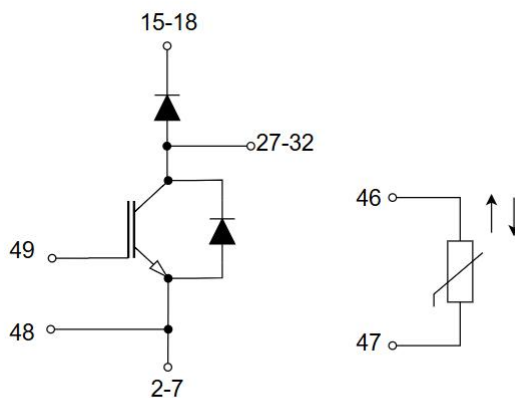
- Low  $V_{CE(sat)}$  Trench IGBT technology
- 10 $\mu$ s short circuit capability
- $V_{CE(sat)}$  with positive temperature coefficient
- Low inductance case
- High power density
- Integrated temperature sensor available

## Typical Applications

- AC motor drives
- Solar inverter
- Medical equipment
- Uninterruptible power supply
- Air-conditioning systems
- Welding equipment
- Switched-mode and resonant-mode power supplies
- Inductive heating, cookers
- Pumps, Fans



## Description



## Package Insulation coordination

| Parameter                                  | Symbol      | Note or test condition               | Values    | Unit |
|--------------------------------------------|-------------|--------------------------------------|-----------|------|
| Isolation test voltage                     | $V_{ISOL}$  | RMS, f=50Hz, t=60s                   | 2.5       | kV   |
| Internal isolation                         |             | basic insulation(class 1, IEC 61140) | $Al_2O_3$ |      |
| Creepage distance                          | $d_{creep}$ | terminal to backside                 | 12        | mm   |
| Creepage distance                          | $d_{creep}$ | terminal to terminal                 | 6         | mm   |
| Comparative tracking index<br>(electrical) | CTI         |                                      | >200      |      |
| RTI Elec.                                  | RTI         | housing                              | 140       | °C   |

## Package Characteristic values

| Parameter                                | Symbol        | Note or test condition | Values |      |      | Unit |
|------------------------------------------|---------------|------------------------|--------|------|------|------|
|                                          |               |                        | Min.   | Typ. | Max. |      |
| Stray Inductance                         | LCE           |                        | --     | 30   | --   | nH   |
| Module Lead Resistance, Terminal to Chip | $R_{CC'+EE'}$ |                        | --     | 2.2  | --   | mΩ   |
| Storage Temperature Range                | $T_{STG}$     |                        | -40    |      | 125  | °C   |
| Mounting Torque, Screw M5                | M             |                        | 3      |      | 6    | N.m  |
| Weight                                   | G             |                        | --     | 176  | --   | g    |

## Boost IGBT

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

| Symbol            | Description                                                                      | Value | Unit |
|-------------------|----------------------------------------------------------------------------------|-------|------|
| V <sub>CES</sub>  | Collector-Emitter Voltage                                                        | 1200V | 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) | 300   | A    |
| I <sub>CM</sub>   | Pulsed Collector Current, t <sub>p</sub> =1ms                                    | 600   | A    |
| T <sub>jmax</sub> | Maximum Junction Temperature                                                     | 175   | °C   |

### 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> = 15V, T <sub>vj</sub> = 25 °C                                                        | --  | 1.60  | 2.20              | V    |
|                      |                                      | T <sub>vj</sub> = 175 °C                                                                                                     | --  | 1.85  | --                |      |
| V <sub>GE(TH)</sub>  | Gate-Emitter Threshold Voltage       | I <sub>C</sub> =8mA, V <sub>CE</sub> =V <sub>GE</sub>                                                                        | 4.0 | --    | 6.0               | V    |
| I <sub>CES</sub>     | Collector-Emitter Cutoff Current     | V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V                                                                              | --  | --    | 800               | μA   |
| 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                                                      | --  | --    | ± 100             | nA   |
| R <sub>gint</sub>    | Internal Gate Resistance             | T <sub>vj</sub> = 25°C                                                                                                       | --  | 0.2   | --                | Ω    |
| C <sub>ies</sub>     | Input Capacitance                    | V <sub>CE</sub> =30V, V <sub>GE</sub> =0V, f=1MHz, T <sub>vj</sub> = 25°C                                                    | --  | 35475 | --                | pF   |
| C <sub>oes</sub>     | Output capacitance                   |                                                                                                                              | --  | 840   | --                | pF   |
| C <sub>res</sub>     | Reverse Transfer                     |                                                                                                                              | --  | 201   | --                | pF   |
| Q <sub>G</sub>       | Gate Charge                          | T <sub>J</sub> = 25°C<br>V <sub>CE</sub> = 600 V, I <sub>C</sub> = 300 A<br>V <sub>GE</sub> = -5 V to +15 V,                 | --  | 1.095 | --                | μC   |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | V <sub>CE</sub> =600V, I <sub>C</sub> =300A,<br>V <sub>GE</sub> = -5 V to +15 V, R <sub>G</sub> =8Ω<br>Inductive Load        | --  | 180   | --                | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                              | --  | 91    | --                |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                              | --  | 123   | --                |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                              | --  | 284   | --                |      |
| E <sub>on</sub>      | Turn-On Switching Loss per Pulse     | V <sub>CE</sub> =600V, I <sub>C</sub> =300A,<br>V <sub>GE</sub> = -5 V to +15 V, R <sub>G</sub> =8Ω<br>T <sub>J</sub> =175°C | --  | 12.99 | --                | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                              | --  | 10.08 | --                |      |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   |                                                                                                                              | --  | 199   | --                | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                              | --  | 100   | --                |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                              | --  | 135   | --                |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                              | --  | 313   | --                |      |
| E <sub>on</sub>      | Turn-on Switching Loss per Pulse     | 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            | --  | 18.81 | --                | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                              | --  | 13.88 | --                |      |
| I <sub>sc</sub>      | SC Data                              | t <sub>p</sub> ≤ 10 μs,<br>T <sub>vj</sub> =150 °C                                                                           | --  | 960   | --                | A    |
|                      |                                      | t <sub>p</sub> ≤ 10 μs,<br>T <sub>vj</sub> =175 °C                                                                           | --  | 905   | --                | A    |
| R <sub>thJC</sub>    | Thermal resistance                   | Junction-to-Case (per IGBT)                                                                                                  | --  | 0.11  | --                | K/W  |
| T <sub>vj op</sub>   |                                      | Temperature under switching conditions                                                                                       | -40 |       | 150 <sup>1)</sup> | °C   |

<sup>1)</sup>T<sub>vj op</sub> > 150°C is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

## Boost 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 | 300   | A    |
| I <sub>FRM</sub> | Diode Maximum Forward Current t <sub>p</sub> =1ms       | 600   | A    |

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

| Symbol             | Parameter                     | Test Condition                                                                                                                 | Min | Typ   | Max               | Unit |
|--------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----|-------|-------------------|------|
| V <sub>F</sub>     | Diode Forward Voltage         | I <sub>F</sub> = 300 A, T <sub>J</sub> = 25°C                                                                                  | --  | 1.90  | 2.80              | V    |
|                    |                               | I <sub>F</sub> = 300 A, T <sub>J</sub> = 175°C                                                                                 | --  | 1.80  | --                |      |
| T <sub>rr</sub>    | Reverse Recovery Time         | V <sub>CE</sub> = 600 V,<br>V <sub>GE</sub> = -5 V to +15 V,<br>I <sub>F</sub> =300A, R <sub>G</sub> =8Ω, T <sub>J</sub> =25°C | --  | 150   | --                | ns   |
| I <sub>RM</sub>    | Peak Reverse Recovery Current |                                                                                                                                | --  | 210   | --                | A    |
| Q <sub>rr</sub>    | Recovered Charge              |                                                                                                                                | --  | 6.15  | --                | μC   |
| E <sub>rec</sub>   | Reverse Recovery Energy       |                                                                                                                                | --  | 5.13  | --                | mJ   |
| T <sub>rr</sub>    | Reverse Recovery Time         | V <sub>CE</sub> = 600 V,<br>V <sub>GE</sub> = -5 V to +15 V,<br>I <sub>F</sub> =300A, R <sub>G</sub> =8Ω T <sub>J</sub> =175°C | --  | 197   | --                | ns   |
| I <sub>RM</sub>    | Peak Reverse Recovery Current |                                                                                                                                | --  | 277   | --                | A    |
| Q <sub>rr</sub>    | Recovered Charge              |                                                                                                                                | --  | 24.75 | --                | μC   |
| E <sub>rec</sub>   | Reverse Recovery Energy       |                                                                                                                                | --  | 6.93  | --                | mJ   |
| R <sub>thJC</sub>  | Thermal resistance            | Junction-to-Case (per diode)                                                                                                   | --  | 0.14  | --                | K/W  |
| T <sub>vj op</sub> |                               | Temperature under switching conditions                                                                                         | -40 |       | 150 <sup>2)</sup> | °C   |

<sup>2)</sup>T<sub>vj op</sub> > 150°C is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

## Free Wheeling 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                   | 1200V | V    |
| I <sub>F</sub>   | Diode Continuous Forward Current                  | 30    | A    |
| I <sub>FRM</sub> | Diode Maximum Forward Current t <sub>p</sub> =1ms | 60    | A    |

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

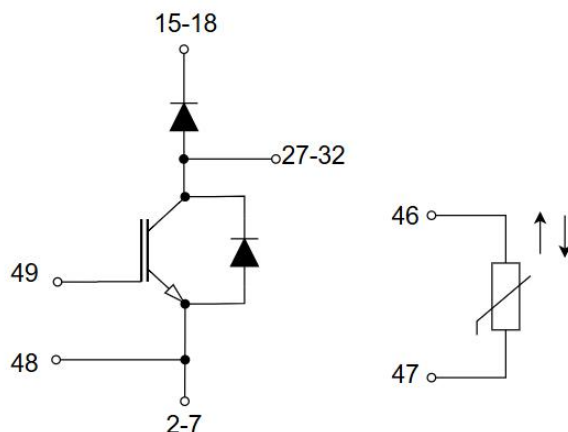
| Symbol             | Parameter               | Test Condition                         | Min | Typ  | Max               | Unit |
|--------------------|-------------------------|----------------------------------------|-----|------|-------------------|------|
| V <sub>F</sub>     | Diode Forward Voltage   | I <sub>F</sub> =20A                    | --  | 1.9  | 2.5               | V    |
|                    |                         | I <sub>F</sub> =40A                    |     | 2.4  | 3.2               |      |
|                    |                         | I <sub>F</sub> =20A                    | --  | 1.8  | --                |      |
|                    |                         | I <sub>F</sub> =40A                    |     | 2.2  | --                |      |
| P <sub>tot</sub>   | total power dissipation | T <sub>c</sub> =25°C                   |     | 126  |                   | W    |
| R <sub>thJC</sub>  | Thermal resistance      | Junction-to-Case (per diode)           |     | 0.89 |                   | K/W  |
| T <sub>vj op</sub> |                         | Temperature under switching conditions | -40 |      | 150 <sup>3)</sup> | °C   |

<sup>3)</sup>T<sub>vj op</sub> > 150°C is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

**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           | $R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15K))]$  | --  | 3375 | --   | K    |
| B <sub>25/80</sub>  | B-value           | $R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15K))]$  | --  | 3411 | --   | K    |
| B <sub>25/100</sub> | B-value           | $R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298.15K))]$ | --  | 3433 | --   | K    |

## CIRCUIT DIAGRAM\*\*



## PACKAGE DIMENSION

