

H6 PACK module with Gen.7 Trench/Fieldstop IGBT and Emitter Controlled diode and NTC

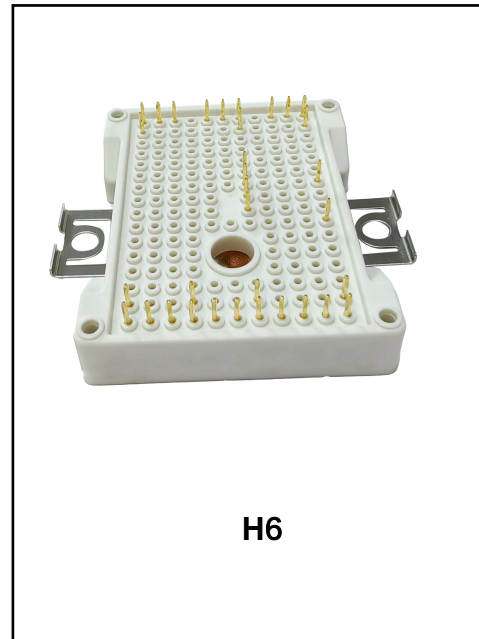
## Features

- Electrical features

- $V_{CES} = 1200\text{ V}$
- $I_{C\text{ nom}} = 35\text{ A} / I_{CRM} = 70\text{ A}$
- Low  $V_{CEsat}$
- $10\mu\text{s}$  short circuit capability
- Overload operation up to  $175^\circ\text{C}$

- Mechanical features

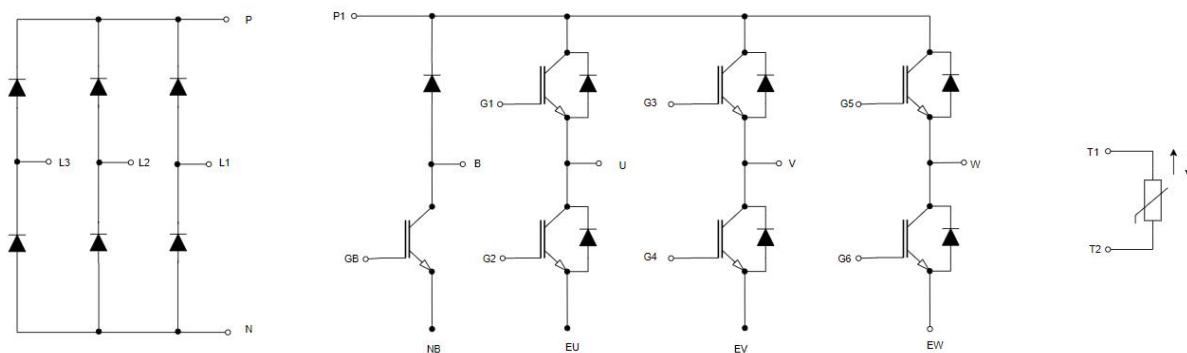
- Integrated NTC temperature sensor
- Isolated heatsink using DBC technology
- Low inductance case
- Solder contact technology



## Typical Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- Uninterruptible power supply

## Description



**Package Insulation coordination**

| Parameter                                  | Symbol      | Note or test condition                | Values                  | Unit |
|--------------------------------------------|-------------|---------------------------------------|-------------------------|------|
| Isolation test voltage                     | $V_{ISOL}$  | RMS, $f=50\text{Hz}$ , $t=60\text{s}$ | 2.5                     | kV   |
| Internal isolation                         |             | basic insulation(class 1, IEC 61140)  | $\text{Al}_2\text{O}_3$ |      |
| Creepage distance                          | $d_{creep}$ | terminal to heatsink                  | 11.5                    | mm   |
| Clearance                                  | $d_{clear}$ | terminal to heatsink                  | 10                      | 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 | $R_{AA'+CC'}$ | $T_c=25^\circ\text{C}$ , per switch | --     | 6.0  | --   | mΩ   |
| Module Lead Resistance, Terminal to Chip | $R_{CC'+EE'}$ | $T_c=25^\circ\text{C}$ , per switch | --     | 5.0  | --   | mΩ   |
| Storage Temperature Range                | $T_{STG}$     |                                     | -40    |      | 125  | °C   |
| Mounting Torque                          | M             | M5, Screw                           | 40     |      | 80   | N.m  |
| Weight                                   | G             |                                     | --     | 39   | --   | g    |

## IGBT, Inverter

### 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>C</sub>   | Collector Current @ T <sub>C</sub> =25°C     | 70    | A    |
|                  | Collector Current @ T <sub>C</sub> =80°C     | 35    | A    |
| I <sub>CM</sub>  | Pulsed Collector Current, t <sub>p</sub> =1S | 105   | 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> =35A, V <sub>GE</sub> =15V                                                                                            | T <sub>Vj</sub> =25°C  | --    | 1.70              | V    |
|                      |                                      |                                                                                                                                      | T <sub>Vj</sub> =175°C | --    | 1.90              |      |
| V <sub>GE(th)</sub>  | Gate Threshold Voltage               | I <sub>C</sub> =1mA, V <sub>CE</sub> =V <sub>GE</sub>                                                                                | 5.0                    | 6.0   | 7.0               | V    |
| I <sub>CES</sub>     | Collector-Emitter Leakage Current    | V <sub>GE</sub> =0V, V <sub>CE</sub> =1200V                                                                                          | --                     | --    | 10                | uA   |
| I <sub>GES</sub>     | Gate-Emitter Leakage Current         | V <sub>GE</sub> =30V, V <sub>CE</sub> =0V                                                                                            | --                     | --    | 200               | nA   |
| R <sub>Gint</sub>    | Internal Gate Resistance             | f=1MHz                                                                                                                               | --                     | 0.6   | --                | Ω    |
| C <sub>ies</sub>     | Input Capacitance                    | V <sub>CE</sub> =25V, V <sub>GE</sub> =0V,<br>f=1MHz                                                                                 | --                     | 4.20  | --                | nF   |
| C <sub>oes</sub>     | Out Capacitance                      |                                                                                                                                      | --                     | 0.107 | --                | nF   |
| C <sub>res</sub>     | Reverse Transfer                     |                                                                                                                                      | --                     | 0.024 | --                | nF   |
| Q <sub>G</sub>       | Gate Charge                          | V <sub>CE</sub> =960V, I <sub>C</sub> =35A, V <sub>GE</sub> =15V                                                                     | --                     | 0.147 | --                | uC   |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | V <sub>CE</sub> =600V, I <sub>C</sub> =35A,<br>V <sub>GE</sub> =0/15V, R <sub>g</sub> =25Ω,<br>Inductive Load                        | --                     | 71    | --                | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                                      | --                     | 53    | --                |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                                      | --                     | 261   | --                |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                                      | --                     | 66.3  | --                |      |
| E <sub>on</sub>      | Turn-On Switching Loss per Pulse     |                                                                                                                                      | --                     | 2.34  | --                | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                                      | --                     | 1.44  | --                |      |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | V <sub>CE</sub> =600V, I <sub>C</sub> =35A,<br>V <sub>GE</sub> =0/15V, R <sub>g</sub> =25Ω,<br>Inductive Load, T <sub>J</sub> =175°C | --                     | TBD   | --                | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                                      | --                     | TBD   | --                |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                                      | --                     | TBD   | --                |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                                      | --                     | TBD   | --                |      |
| E <sub>on</sub>      | Turn-on Switching Loss per Pulse     |                                                                                                                                      | --                     | 3.64  | --                | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                                      | --                     | 2.00  | --                |      |
| I <sub>sc</sub>      | SC Data                              | V <sub>GE</sub> =15V, V <sub>CC</sub> ≤600V,<br>t <sub>sc</sub> ≤10us, T <sub>J</sub> ≤150°C                                         | --                     | 150   | --                | A    |
| R <sub>thJC</sub>    | Thermal resistance                   | Junction-to-Case (per IGBT)                                                                                                          |                        | 0.5   |                   | 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. For detailed specifications please refer to AN 2018-14.

## Diode, Inverter

### Absolute Maximum Ratings (Tc = 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                  | 35    | A    |
| I <sub>FM</sub>  | Diode Maximum Forward Current t <sub>p</sub> =1ms | 105   | A    |

### Characteristics (Tc=25°C unless otherwise noted)

| Symbol             | Parameter                     | Test Condition                                                     |                       | Min | Typ  | Max               | Unit |
|--------------------|-------------------------------|--------------------------------------------------------------------|-----------------------|-----|------|-------------------|------|
| V <sub>F</sub>     | Diode Forward Voltage         | I <sub>F</sub> =35A                                                | T <sub>J</sub> =25°C  | --  | 1.70 | 2.50              | V    |
|                    |                               |                                                                    | T <sub>J</sub> =175°C | --  | 1.90 | --                |      |
| Q <sub>r</sub>     | Recovered Charge              | I <sub>F</sub> =35A, R <sub>g</sub> =25Ω,<br>T <sub>J</sub> =25°C  |                       | --  | 1.01 | --                | μC   |
| I <sub>RM</sub>    | Peak Reverse Recovery Current |                                                                    |                       | --  | 37.7 | --                | A    |
| T <sub>rr</sub>    | Reverse Recovery Time         |                                                                    |                       | --  | 120  | --                | ns   |
| E <sub>rec</sub>   | Reverse Recovery Energy       |                                                                    |                       | --  | 0.42 | --                | mJ   |
| Q <sub>r</sub>     | Recovered Charge              | I <sub>F</sub> =35A, R <sub>g</sub> =25Ω,<br>T <sub>J</sub> =175°C |                       | --  | TBD  | --                | μC   |
| I <sub>RM</sub>    | Peak Reverse Recovery Current |                                                                    |                       | --  | TBD  | --                | A    |
| T <sub>rr</sub>    | Reverse Recovery Time         |                                                                    |                       | --  | TBD  | --                | ns   |
| E <sub>rec</sub>   | Reverse Recovery Energy       |                                                                    |                       | --  | TBD  | --                | mJ   |
| R <sub>thJC</sub>  | Thermal resistance            | Junction-to-Case (per diode)                                       |                       |     | 0.72 |                   | 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. For detailed specifications please refer to AN 2018-14.

## Diode, Rectifier

### Absolute Maximum Ratings (Tc = 25°C unless otherwise noted)

| Symbol           | Description                                       | Value | Unit |
|------------------|---------------------------------------------------|-------|------|
| V <sub>RRM</sub> | Repetitive Peak Reverse Voltage                   | 1600  | V    |
| I <sub>F</sub>   | Diode Continuous Forward Current                  | 35    | A    |
| I <sub>FM</sub>  | Diode Maximum Forward Current t <sub>p</sub> =1ms | 70    | A    |

### Characteristics (Tc=25°C unless otherwise noted)

| Symbol             | Parameter             | Test Condition                                 | Min | Typ  | Max               | Unit |
|--------------------|-----------------------|------------------------------------------------|-----|------|-------------------|------|
| V <sub>F</sub>     | Diode Forward Voltage | I <sub>F</sub> = 35 A, T <sub>J</sub> = 150 °C | --  | 0.95 | --                | V    |
| I <sub>R</sub>     | Reverse Current       | T <sub>J</sub> =175 °C, V <sub>R</sub> =1600V  | --  | 1.0  | --                | mA   |
| R <sub>thJC</sub>  | Thermal resistance    | Junction-to-Case (per diode)                   | --  | 0.53 | --                | K/W  |
| T <sub>vj op</sub> |                       | Temperature under switching conditions         | -40 |      | 175 <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.

## IGBT, Chopper

### 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>C</sub>   | Collector Current @ T <sub>C</sub> =25°C     | 70    | A    |
|                  | Collector Current @ T <sub>C</sub> =80°C     | 35    | A    |
| I <sub>CM</sub>  | Pulsed Collector Current, t <sub>p</sub> =1S | 105   | 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> =35A, V <sub>GE</sub> =15V                                                                                            | T <sub>vj</sub> =25°C  | --    | 1.70              | V    |
|                      |                                      |                                                                                                                                      | T <sub>vj</sub> =175°C | --    | 1.90              |      |
| V <sub>GE(th)</sub>  | Gate Threshold Voltage               | I <sub>C</sub> =1mA, V <sub>CE</sub> =V <sub>GE</sub>                                                                                | 5.0                    | 6.0   | 7.0               | V    |
| I <sub>CES</sub>     | Collector-Emitter Leakage Current    | V <sub>GE</sub> =0V, V <sub>CE</sub> =1200V                                                                                          | --                     | --    | 10                | uA   |
| I <sub>GES</sub>     | Gate-Emitter Leakage Current         | V <sub>GE</sub> =30V, V <sub>CE</sub> =0V                                                                                            | --                     | --    | 200               | nA   |
| R <sub>gint</sub>    | Internal Gate Resistance             | f=1MHz                                                                                                                               | --                     | 0.6   | --                | Ω    |
| C <sub>ies</sub>     | Input Capacitance                    | V <sub>CE</sub> =25V, V <sub>GE</sub> =0V,<br>f=1MHz                                                                                 | --                     | 4.20  | --                | nF   |
| C <sub>oes</sub>     | Out Capacitance                      |                                                                                                                                      | --                     | 0.107 | --                | nF   |
| C <sub>res</sub>     | Reverse Transfer                     |                                                                                                                                      | --                     | 0.024 | --                | nF   |
| Q <sub>G</sub>       | Gate Charge                          | V <sub>CE</sub> =960V, I <sub>C</sub> =35A, V <sub>GE</sub> =15V                                                                     | --                     | 0.147 | --                | uC   |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | V <sub>CE</sub> =600V, I <sub>C</sub> =35A,<br>V <sub>GE</sub> =0/15V, R <sub>g</sub> =25Ω,<br>Inductive Load                        | --                     | 71    | --                | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                                      | --                     | 53    | --                |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                                      | --                     | 261   | --                |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                                      | --                     | 66.3  | --                |      |
| E <sub>on</sub>      | Turn-On Switching Loss per Pulse     |                                                                                                                                      | --                     | 2.34  | --                | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                                      | --                     | 1.44  | --                |      |
| t <sub>d(on)</sub>   | Turn-On Delay Time                   | V <sub>CE</sub> =600V, I <sub>C</sub> =35A,<br>V <sub>GE</sub> =0/15V, R <sub>g</sub> =25Ω,<br>Inductive Load, T <sub>j</sub> =175°C | --                     | TBD   | --                | ns   |
| t <sub>r</sub>       | Rise Time                            |                                                                                                                                      | --                     | TBD   | --                |      |
| t <sub>d(off)</sub>  | Turn-off Delay Time                  |                                                                                                                                      | --                     | TBD   | --                |      |
| t <sub>f</sub>       | Fall Time                            |                                                                                                                                      | --                     | TBD   | --                |      |
| E <sub>on</sub>      | Turn-on Switching Loss per Pulse     |                                                                                                                                      | --                     | 3.64  | --                | mJ   |
| E <sub>off</sub>     | Turn Off Switching Loss per Pulse    |                                                                                                                                      | --                     | 2.00  | --                |      |
| I <sub>sc</sub>      | SC Data                              | V <sub>GE</sub> =15V, V <sub>CC</sub> ≤600V,<br>t <sub>sc</sub> ≤10us, T <sub>j</sub> ≤150°C                                         | --                     | 150   | --                | A    |
| R <sub>thJC</sub>    | Thermal resistance                   | Junction-to-Case (per IGBT)                                                                                                          |                        | 0.5   |                   | K/W  |
| T <sub>vj op</sub>   |                                      | Temperature under switching conditions                                                                                               | -40                    |       | 175 <sup>1)</sup> | °C   |

<sup>4)</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.

## Diode, Chopper

### 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                  | 15    | A    |
| I <sub>FM</sub>  | Diode Maximum Forward Current t <sub>p</sub> =1ms | 30    | 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> =15A                                                |     | T <sub>J</sub> =25°C  | --                | V    |
|                    |                               |                                                                    |     | T <sub>J</sub> =175°C | --                |      |
| Q <sub>r</sub>     | Recovered Charge              | I <sub>F</sub> =15A, R <sub>g</sub> =25Ω,<br>T <sub>J</sub> =25°C  | --  | 0.43                  | --                | μC   |
| I <sub>RM</sub>    | Peak Reverse Recovery Current |                                                                    | --  | 16.3                  | --                | A    |
| T <sub>rr</sub>    | Reverse Recovery Time         |                                                                    | --  | 52                    | --                | ns   |
| E <sub>rec</sub>   | Reverse Recovery Energy       |                                                                    | --  | 0.18                  | --                | mJ   |
| Q <sub>r</sub>     | Recovered Charge              | I <sub>F</sub> =15A, R <sub>g</sub> =25Ω,<br>T <sub>J</sub> =175°C | --  | TBD                   | --                | μC   |
| I <sub>RM</sub>    | Peak Reverse Recovery Current |                                                                    | --  | TBD                   | --                | A    |
| T <sub>rr</sub>    | Reverse Recovery Time         |                                                                    | --  | TBD                   | --                | ns   |
| E <sub>rec</sub>   | Reverse Recovery Energy       |                                                                    | --  | TBD                   | --                | mJ   |
| R <sub>thJC</sub>  | Thermal resistance            | Junction-to-Case (per diode)                                       |     | 0.77                  |                   | K/W  |
| T <sub>vj op</sub> |                               | Temperature under switching conditions                             | -40 |                       | 175 <sup>5)</sup> | °C   |

<sup>5)</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 R <sub>100</sub> | T <sub>C</sub> =100 °C, R <sub>100</sub> =493.3 Ω                                         | -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    |

