MiniSKiiP® AC IPM

3-phase bridge inverter intelligent power module

**SKiiP 25ACI12T4V2**

### Features

- Contact springs for solder-free and quick assembly
- Trench-Field-Stop IGBT
- Freewheeling diodes in CAL technology
- HVIC gate driver in SOI technology with advanced level shifter
- Matched propagation delay
- Over-current and under-voltage detection
- Interlock logic for cross conduction protection
- Multi-purpose error input
- Integrated temperature sensor (NTC)
- RoHs compliant
- UL recognised file no. E63532

### Typical Applications*

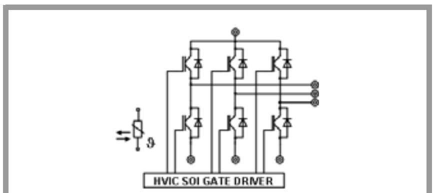
- Industrial & consumer drives
- Power supplies (SMPS & UPS)

### Remarks

- Product reliability results valid for $T_j \leq 150°C$
- Case temp. limited to $T_c$ = 125°C max. (for baseplateless modules $T_c = T_s$

### Footnotes

1) Please refer to Technical Explanations




ACI

**Absolute Maximum Ratings**

| Symbol | Conditions | | Values | Unit |
|---|---|---|---|---|
| **Inverter - IGBT** | | | | |
| $V_{CES}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_C$ | $T_j$ = 175 °C | $T_s$ = 25 °C | 62 | A |
| | | $T_s$ = 70 °C | 50 | A |
| $I_{Cnom}$ | | | 50 | A |
| $I_{CRM}$ | $I_{CRM}$ = 3 x $I_{Cnom}$ | | 150 | A |
| $t_{psc}$ | $V_{CC}$ = 800 V<br>$V_{GE} \leq$ 15 V<br>$V_{CES} \leq$ 1200 V | $T_j$ = 150 °C | 10 | µs |
| $T_j$ | | | -40 ... 175 | °C |
| **Inverse - Diode** | | | | |
| $I_F$ | $T_j$ = 175 °C | $T_s$ = 25 °C | 59 | A |
| | | $T_s$ = 70 °C | 47 | A |
| $I_{Fnom}$ | | | 50 | A |
| $I_{FRM}$ | $I_{FRM}$ = 3 x $I_{Fnom}$ | | 150 | A |
| $I_{FSM}$ | $t_p$ = 10 ms, sin 180°, $T_j$ = 150 °C | | 270 | A |
| $T_j$ | | | -40 ... 175 | °C |
| **Driver** | | | | |
| VCC | VCC-VSS, VCCL-VSSL | | 17 | V |
| VBx | VB1-U, VB2-V, VB3-W | | 17 | V |
| VSx | Voltage to VSS | | -3 ... 1200 | V |
| $V_{in}$ | HINx-VSS, LINx-VSS, /ERRIN-VSS | | VSS-0.3 ... VCC+0.3 | V |
| $V_{oErr}$ | /ERROUT-VSS | | VSS-0.3 ... VCC+0.3 | V |
| $I_{max(EO)}$ | /ERROUT-VSS | | 10 | mA |
| $V_{ITRIP}$ | ITRIP-VSS | | VSS-0.3 ... VCC+0.3 | V |
| **Module** | | | | |
| $T_c$ | | | -40 ... 125 | °C |
| $T_{stg}$ | | | -40 ... 125 | °C |
| $V_{isol}$ | AC sinus 50Hz, all pins to heat sink, 1 min | | 2500 | V |
| $I_{t(RMS)}$ | $T_{terminal}$ = 80 °C, 20A per spring | | 60 | A |

**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **Inverter - IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 50 A<br>$V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 1.85 | 2.10 | V |
| | | $T_j$ = 150 °C | | 2.20 | 2.40 | V |
| $V_{CE0}$ | chiplevel | $T_j$ = 25 °C | | 0.8 | 0.9 | V |
| | | $T_j$ = 150 °C | | 0.7 | 0.8 | V |
| $r_{CE}$ | $V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 21 | 24 | mΩ |
| | | $T_j$ = 150 °C | | 30 | 32 | mΩ |
| $I_{CES}$ | $V_{GE}$ = 0 V<br>$V_{CE}$ = 1200 V | $T_j$ = 25 °C | | 0.1 | 0.3 | mA |
| | | | | | | mA |
| $Q_G$ | 0 V ... +15 V | | | 220 | | nC |
| $t_{d(on)}$ | $V_{CC}$ = 600 V<br>$I_C$ = 50 A<br>$V_{GE}$ = +15/0 V<br>1) | $T_j$ = 150 °C | | 943 | | ns |
| $t_r$ | | $T_j$ = 150 °C | | 47 | | ns |
| $E_{on}$ | | $T_j$ = 150 °C | | 6.6 | | mJ |
| $t_{d(off)}$ | | $T_j$ = 150 °C | | 1613 | | ns |
| $t_f$ | | $T_j$ = 150 °C | | 69 | | ns |
| $E_{off}$ | | $T_j$ = 150 °C | | 5.7 | | mJ |
| $R_{th(j-s)}$ | per IGBT | | | 0.84 | | K/W |

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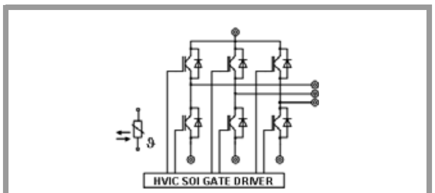


ACI

| Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **Inverse diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 50 A, $V_{GE}$ = 0 V, chiplevel | $T_j$ = 25 °C | | 2.25 | 2.5 | V |
| | | $T_j$ = 150 °C | | 2.2 | 2.5 | V |
| $V_{F0}$ | chiplevel | $T_j$ = 25 °C | | 1.3 | 1.5 | V |
| | | $T_j$ = 150 °C | | 0.9 | 1.1 | V |
| $r_F$ | chiplevel | $T_j$ = 25 °C | | 18 | 21 | mΩ |
| | | $T_j$ = 150 °C | | 26 | 28 | mΩ |
| $I_{RRM}$ | $I_F$ = 50 A, $V_{GE}$ = 0 V, $V_{CC}$ = 600 V | $T_j$ = 150 °C | | 51 | | A |
| $Q_{rr}$ | | $T_j$ = 150 °C | | 8.5 | | µC |
| $E_{rr}$ | | $T_j$ = 150 °C | | 3 | | mJ |
| $R_{th(j-s)}$ | per Diode | | | 0.99 | | K/W |
| **Driver** | | | | | | |
| VCC | VCC-VSS, VCCL-VSSL [1] | | | 15 | | V |
| $ICC_0$ | Quiescent current, VCC=15V [1] | | | | 8.5 | mA |
| VBx | VB1-U, VB2-V, VB2-W [1] | | | 15 | | V |
| IBx | Quiescent high side driver supply current per channel, VBx=15V [1] | | | 80 | 90 | µA |
| $V_{IT+}$ | Input threshold voltage (HIGH) [1] | | | 2 | 2.4 | V |
| $V_{IT-}$ | Input threshold voltage (LOW) [1] | | 0.8 | 0.9 | | V |
| $V_{ITRIP+}$ | ITRIP set threshold voltage [1] | | | 0.47 | 0.6 | V |
| $V_{ITRIP-}$ | ITRIP reset threshold voltage [1] | | 0.35 | 0.41 | | V |
| $V_{oErr}$ | Error output, open drain [1] | | | | 15 | V |
| $V_{UV}$ | Supply under-voltage protection set [1] | | 10.5 | 11.1 | | V |
| $V_{UVr}$ | Supply under-voltage protection reset [1] | | | 11.5 | 12.3 | V |
| $t_{d,ITRIP}$ | ITRIP to LOUTx/HOUTx shutdown propagation delay (W-phase) | | | 820 | | ns |
| $t_{SIS}$ | PWM short pulse suppression | | | 0.5 | | µs |
| $t_{TD}$ | Interlock dead time | | | 0.58 | | µs |
| $f_{SW}$ | Switching frequency | | | | 25 | kHz |
| **Temperatur Sensor** | | | | | | |
| $R_{25}$ | $T_r$ = 25 °C [1] | | | 5.0 ± 5% | | kΩ |
| **Module** | | | | | | |
| $M_s$ | to heat sink | | 2 | | 2.5 | Nm |
| w | weight | | | 55 | | g |

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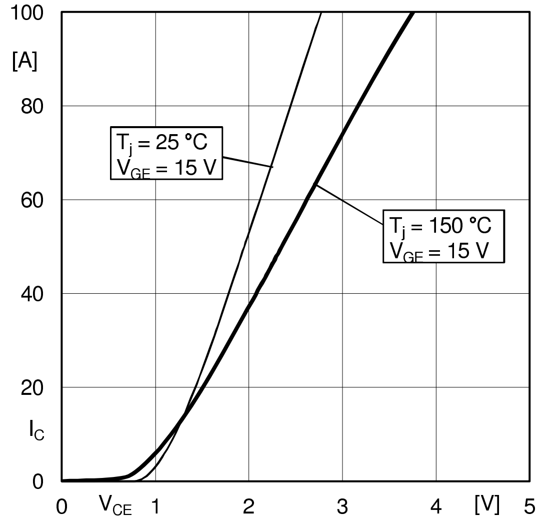



Fig. 1: Typ. output characteristic

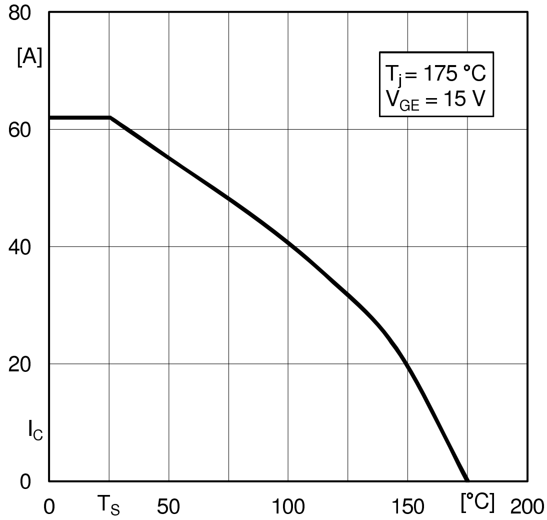



Fig. 2: Typ. rated current vs. temperature $I_C = f(T_S)$

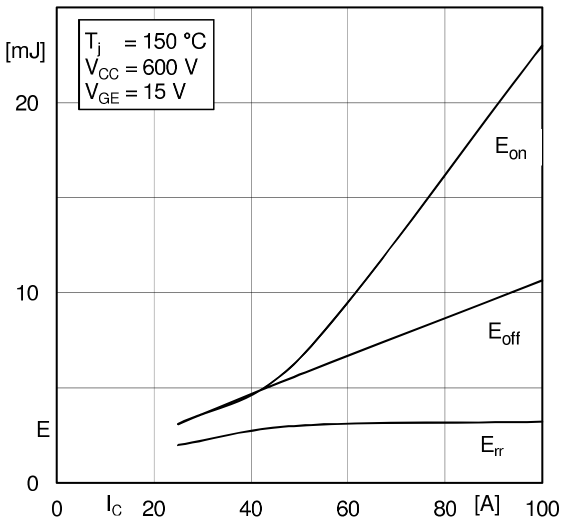



Fig. 3: Typ. turn-on /-off energy = f ($I_C$)

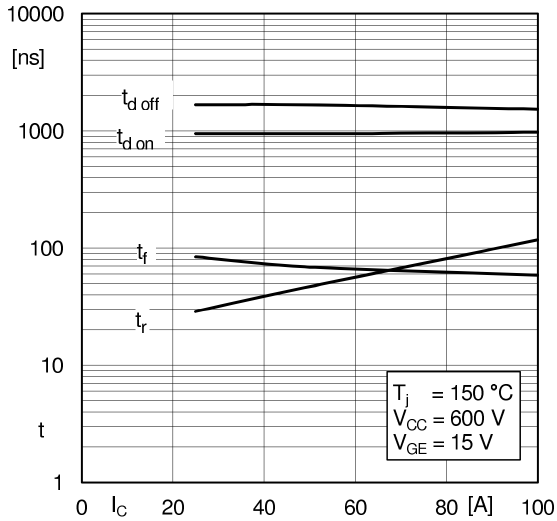



Fig. 4: Typ. switching times vs. $I_c$

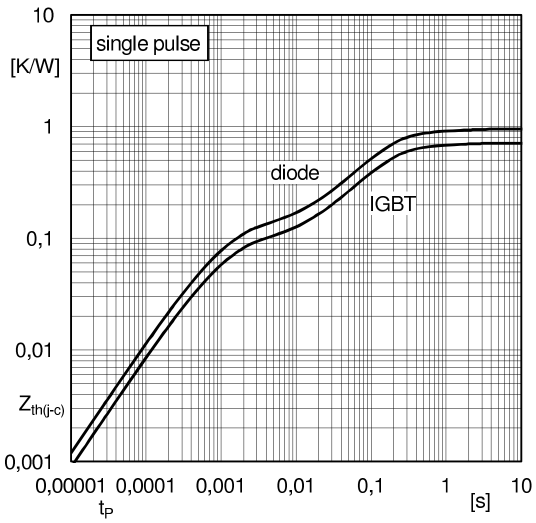



Fig. 5: Transient thermal impedance of IGBT and diode

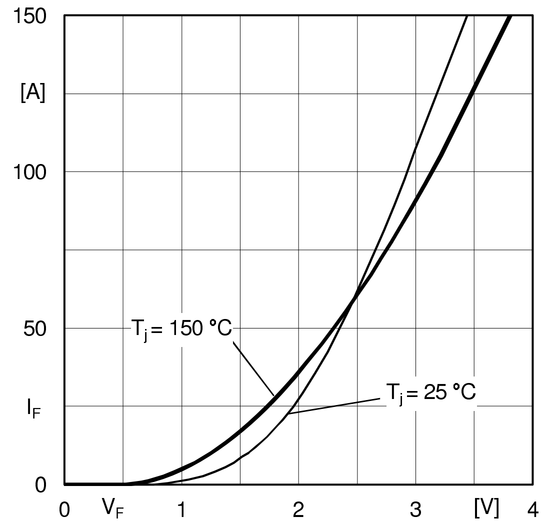
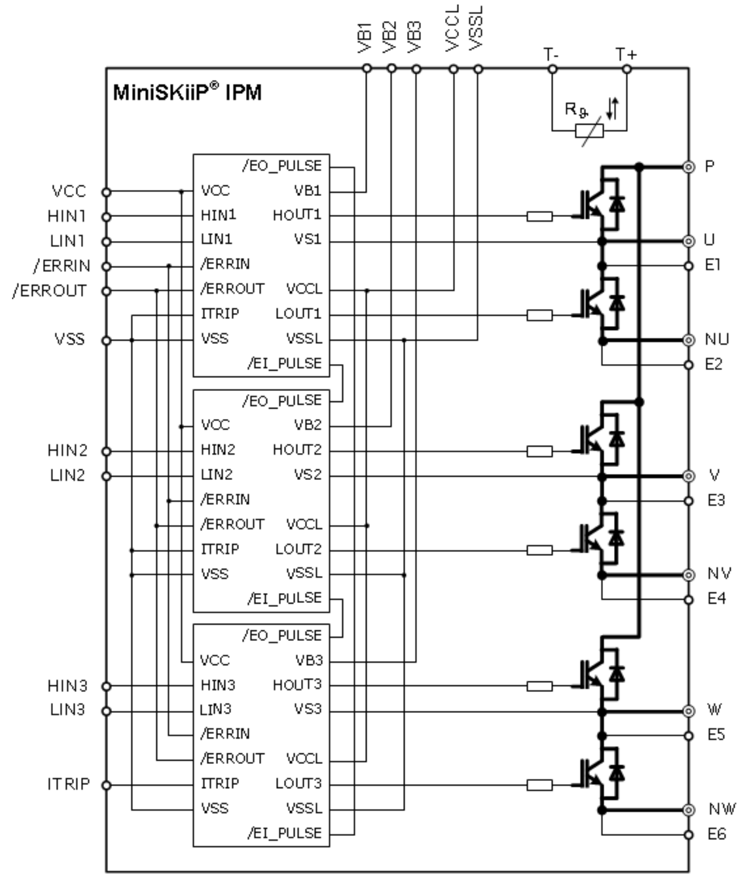


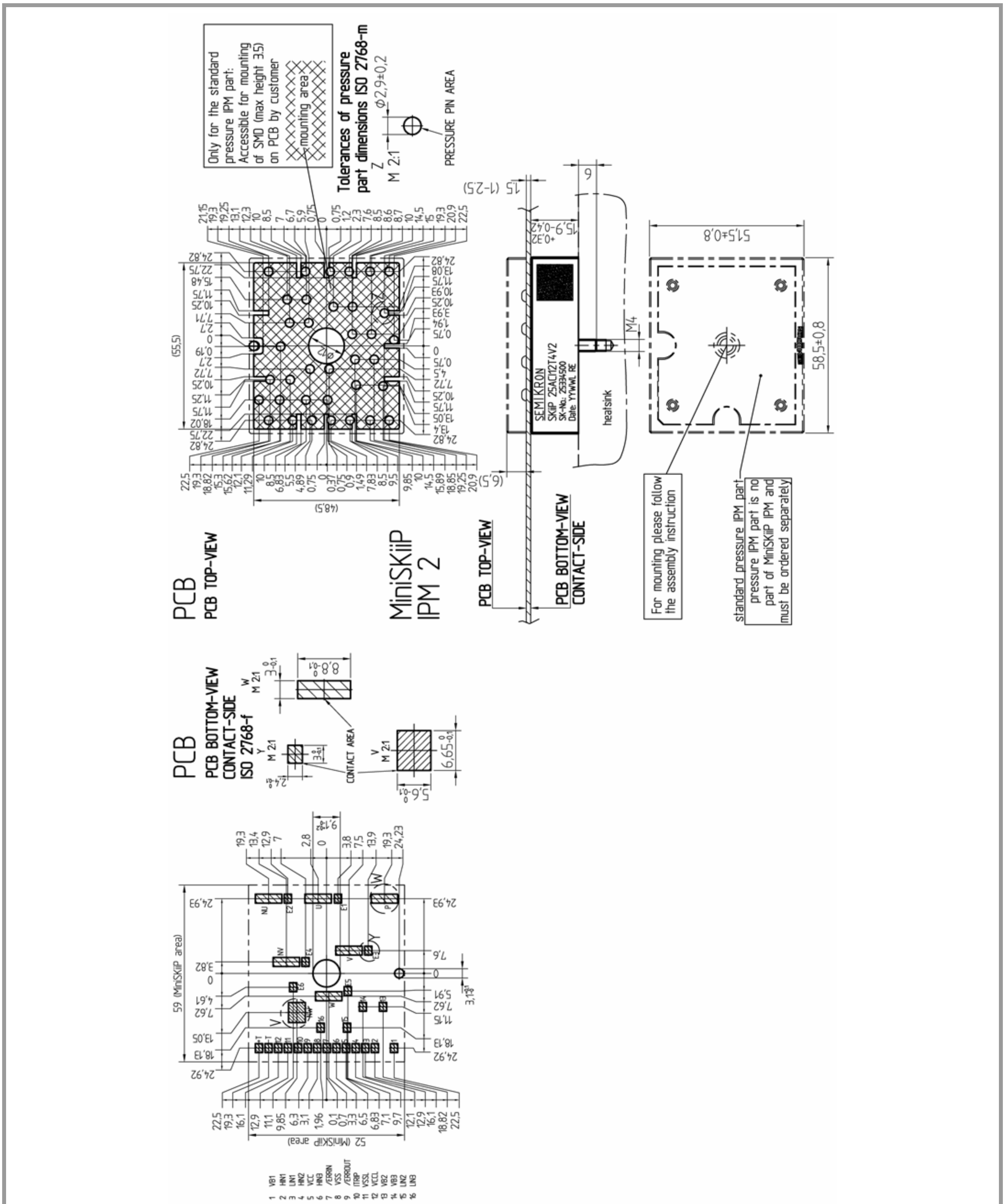

Fig. 6: Typ. freewheeling diode forward characteristic




Internal circuit

| Pin | Signal | Description |
|---|---|---|
| 1 | VB1 | Floating supply voltage for phase U high side IGBT |
| 2 | HIN1 | PWM signal input for phase U high side switch |
| 3 | LIN1 | PWM signal input for phase U low side switch |
| 4 | HIN2 | PWM signal input for phase V high side switch |
| 5 | VCC | Driver IC main supply voltage |
| 6 | HIN3 | PWM signal input for phase W high side switch |
| 7 | /ERRIN | Multi-purpose error input for common shut-down (low active) |
| 8 | VSS | Driver IC supply voltage ground |
| 9 | /ERROUT | Error logic output (low active) |
| 10 | ITRIP | Comparator input / current sense input for overcurrent shut-down |
| 11 | VSSL | Low side supply voltage ground |
| 12 | VCCL | Low side supply voltage |
| 13 | VB2 | Floating supply voltage for phase V high side IGBT |
| 14 | VB3 | Floating supply voltage for phase W high side IGBT |
| 15 | LIN2 | PWM signal input for phase V low side switch |
| 16 | LIN3 | PWM signal input for phase W low side switch |
| U | U | Phase U AC terminal |
| E1 | E1 | Auxiliary emitter terminal of phase U high side IGBT |
| V | V | Phase V AC terminal |
| E3 | E3 | Auxiliary emitter terminal of phase V high side IGBT |
| W | W | Phase W AC terminal |
| E5 | E5 | Auxiliary emitter terminal of phase W high side IGBT |
| NU | NU | Phase U -DC terminal |
| E2 | E2 | Auxiliary emitter terminal of phase U low side IGBT |
| NV | NV | Phase V -DC terminal |
| E4 | E4 | Auxiliary emitter terminal of phase V low side IGBT |
| NW | NW | Phase W -DC terminal |
| E6 | E6 | Auxiliary emitter terminal of phase W low side IGBT |
| P | P | +DC terminal |
| +T | +T | Temperature sensor terminal (+) |
| -T | -T | Temperature sensor terminal (-) |

Pin and signal description




pinout, dimensions

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, Chapter IX

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.