**SEMITOP®E1**

## 3-phase Bridge Rectifier with Chopper

### Engineering Sample

### SK150DGL12T4TE1

Target Data

### Features*

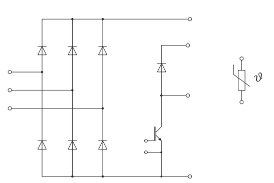
- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- 1200V Trench IGBT4 (T4)
- Robust and soft switching CAL4F diode technology
- PEP rectifier diode technology for enhanced power and environmental robustness
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

### Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

### Remarks

- Recommended $T_{j,op}$=-40 ...+150 °C



**Absolute Maximum Ratings**

| Symbol | Conditions | | Values | Unit |
|---|---|---|---|---|
| **Chopper - IGBT** | | | | |
| $V_{CES}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_C$ | $\lambda_{paste}$=0.8 W/(mK) $T_j$ = 175 °C | $T_s$ = 70 °C | 53 | A |
| | | $T_s$ = 100 °C | 43 | A |
| $I_C$ | $\lambda_{paste}$=2.5 W/(mK) $T_j$ = 175 °C | $T_s$ = 70 °C | 66 | A |
| | | $T_s$ = 100 °C | 55 | A |
| $I_{Cnom}$ | | | 50 | A |
| $I_{CRM}$ | | | 100 | A |
| $V_{GES}$ | | | -20 ... 20 | V |
| $t_{psc}$ | $V_{CC}$ = 800 V<br>$V_{GE}$ = $V_{GE}$ ≤ 15 V<br>$V_{CES}$ = $V_{CES}$ ≤ 1200 V | $T_j$ = 150 °C | 10 | µs |
| $T_j$ | | | -40 ... 175 | °C |
| **Freewheeling - Diode** | | | | |
| $V_{RRM}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_F$ | $\lambda_{paste}$=0.8 W/(mK) $T_j$ = 175 °C | $T_s$ = 70 °C | 17 | A |
| | | $T_s$ = 100 °C | 14 | A |
| $I_F$ | $\lambda_{paste}$=2.5 W/(mK) $T_j$ = 175 °C | $T_s$ = 70 °C | 20 | A |
| | | $T_s$ = 100 °C | 16 | A |
| $I_{FRM}$ | | | 30 | A |
| $I_{FSM}$ | 10 ms sin 180° | $T_j$ = 25 °C | 65 | A |
| | | $T_j$ = 150 °C | 65 | A |
| $T_j$ | | | -40 ... 175 | °C |
| **Rectifier - Diode** | | | | |
| $V_{RRM}$ | $T_j$ = 25 °C | | 1600 | V |
| $I_D$ | $\lambda_{paste}$=0.8 W/(mK) $T_j$ = 175 °C | $T_s$ = 70 °C | 158 | A |
| | | $T_s$ = 100 °C | 127 | A |
| $I_D$ | $\lambda_{paste}$=2.5 W/(mK) $T_j$ = 175 °C | $T_s$ = 70 °C | 196 | A |
| | | $T_s$ = 100 °C | 158 | A |
| $I_{FSM}$ | 10 ms sin 180° | $T_j$ = 25 °C | 635 | A |
| | | $T_j$ = 150 °C | 490 | A |
| $i^2t$ | 10 ms sin 180° | $T_j$ = 25 °C | 2020 | $A^2s$ |
| | | $T_j$ = 150 °C | 1200 | $A^2s$ |
| $T_j$ | | | -40 ... 175 | °C |
| **Module** | | | | |
| $I_{t(RMS)}$ | $\Delta T_{terminal}$ at PCB joint = 30 K, per pin | | 30 | A |
| $T_{stg}$ | module without TIM | | -40 ... 125 | °C |
| $V_{isol}$ | AC, sinusoidal, 1 min | | 2500 | V |

**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **IGBT - Chopper** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 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 | | 0.80 | 0.90 | V |
| | | $T_j$ = 150 °C | | 0.70 | 0.80 | V |
| $r_{CE}$ | $V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 21 | 24 | mΩ |
| | | $T_j$ = 150 °C | | 30 | 32 | mΩ |
| $V_{GE(th)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 1.7 mA | | 5 | 5.8 | 6.5 | V |

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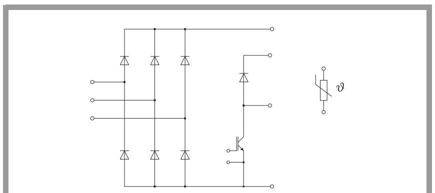


| Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **IGBT - Chopper** | | | | | | |
| $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_j$ = 25 °C | | | - | 1 | mA |
| $C_{ies}$ | $V_{CE}$ = 25 V<br>$V_{GE}$ = 0 V | f = 1 MHz | | 2.77 | | nF |
| $C_{oes}$ | | f = 1 MHz | | 0.21 | | nF |
| $C_{res}$ | | f = 1 MHz | | 0.16 | | nF |
| $Q_G$ | $V_{GE}$ = -15 V ... +15 V | | | 366 | | nC |
| $R_{Gint}$ | $T_j$ = 25 °C | | | 4.0 | | Ω |
| $t_{d(on)}$ | $V_{CC}$ = 600 V<br>$I_C$ = 50 A<br>$V_{GE}$ = +15/-15 V<br>$R_{G\,on}$ = 15 Ω<br>$R_{G\,off}$ = 15 Ω<br>$di/dt_{on}$ = 2100 A/µs<br>$di/dt_{off}$ = 530 A/µs<br>dv/dt = 4000 V/µs | $T_j$ = 150 °C | | 129 | | ns |
| $t_r$ | | $T_j$ = 150 °C | | 42 | | ns |
| $E_{on}$ | | $T_j$ = 150 °C | | 4.8 | | mJ |
| $t_{d(off)}$ | | $T_j$ = 150 °C | | 333 | | ns |
| $t_f$ | | $T_j$ = 150 °C | | 65 | | ns |
| $E_{off}$ | | $T_j$ = 150 °C | | 5 | | mJ |
| $R_{th(j-s)}$ | per IGBT, $\lambda_{paste}$=0.8 W/(mK) | | | 0.77 | | K/W |
| $R_{th(j-s)}$ | per IGBT, $\lambda_{paste}$=2.5 W/(mK) | | | 0.52 | | K/W |
| **Freewheeling - Diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 15 A | $T_j$ = 25 °C | | 2.38 | 2.71 | V |
| | chiplevel | $T_j$ = 150 °C | | 2.44 | 2.77 | V |
| $V_{F0}$ | chiplevel | $T_j$ = 25 °C | | 1.30 | 1.50 | V |
| | | $T_j$ = 150 °C | | 0.90 | 1.10 | V |
| $r_F$ | chiplevel | $T_j$ = 25 °C | | 72 | 81 | mΩ |
| | | $T_j$ = 150 °C | | 103 | 111 | mΩ |
| $I_{RRM}$ | $I_F$ = 15 A<br>$di/dt_{off}$ = 890 A/µs<br>$V_{GE}$ = -15 V<br>$V_R$ = 600 V | $T_j$ = 150 °C | | 16 | | A |
| $Q_{rr}$ | | $T_j$ = 150 °C | | 2.3 | | µC |
| $E_{rr}$ | | $T_j$ = 150 °C | | 0.97 | | mJ |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=0.8 W/(mK) | | | 2.13 | | K/W |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=2.5 W/(mK) | | | 1.74 | | K/W |
| **Rectifier - Diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 26 A | $T_j$ = 25 °C | | 0.97 | 1.20 | V |
| | chiplevel | $T_j$ = 150 °C | | 0.84 | 1.07 | V |
| $V_{F0}$ | chiplevel | $T_j$ = 25 °C | | 0.89 | 1.09 | V |
| | | $T_j$ = 150 °C | | 0.73 | 0.92 | V |
| $r_F$ | chiplevel | $T_j$ = 25 °C | | 3.1 | 4.2 | mΩ |
| | | $T_j$ = 150 °C | | 4.4 | 5.9 | mΩ |
| $I_R$ | $T_j$ = 150 °C, $V_{RRM}$ | | | | 2 | mA |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=0.8 W/(mK) | | | 1.06 | | K/W |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=2.5 W/(mK) | | | 0.76 | | K/W |
| **Module** | | | | | | |
| $L_{CE}$ | | | | - | | nH |
| $M_s$ | to heatsink | | 1.6 | | 2.3 | Nm |
| w | weight | | | 25 | | g |
| **Temperature Sensor** | | | | | | |
| $R_{100}$ | $T_c$=100°C ($R_{25}$=5 kΩ) | | | 493 ± 5% | | Ω |
| $B_{100/125}$ | $R_{(T)}=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; T[K]; | | | 3550<br>±2% | | K |

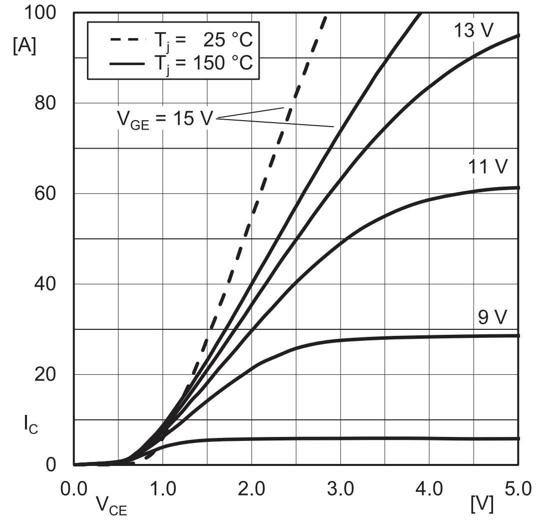


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

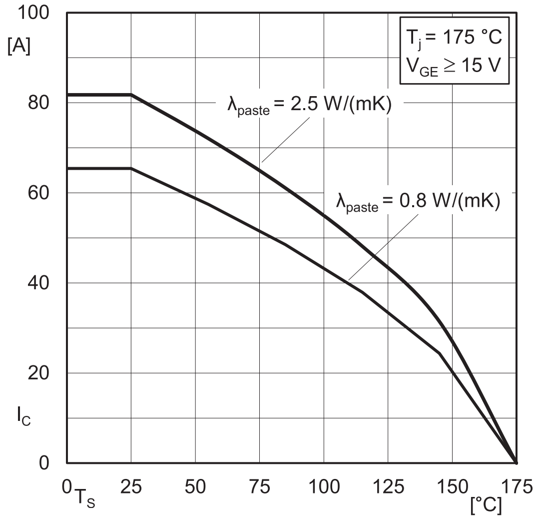


Fig. 2: IGBT rated current vs. temperature Ic=f(Ts)

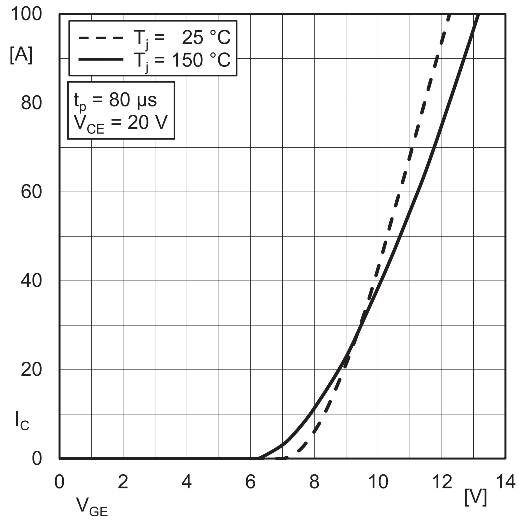


Fig. 5: Typ. IGBT transfer characteristic

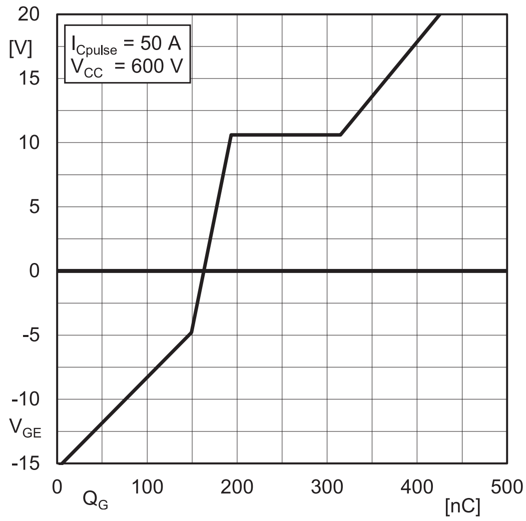


Fig. 6: Typ. IGBT gate charge characteristic

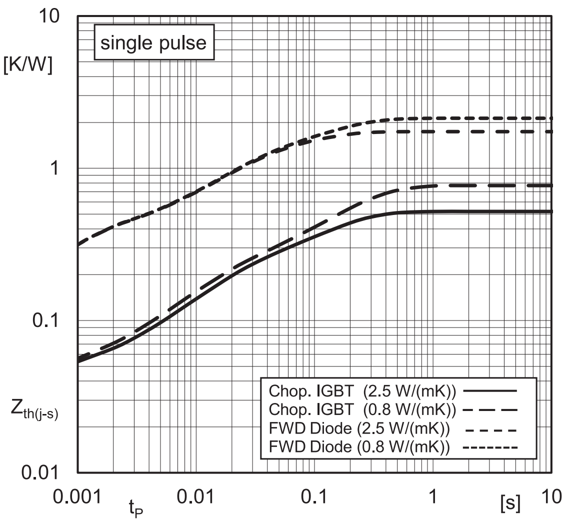


Fig. 9: Typ. transient thermal impedance

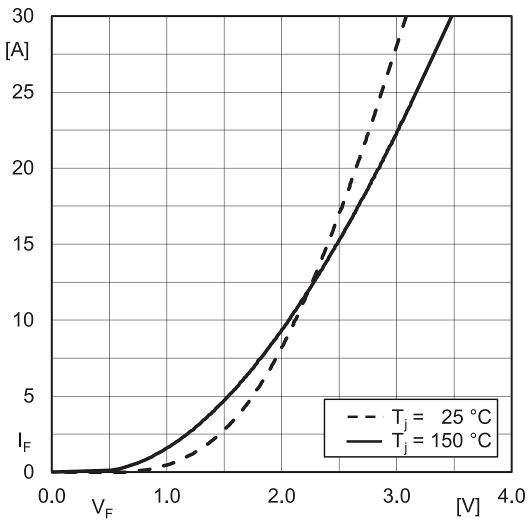


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

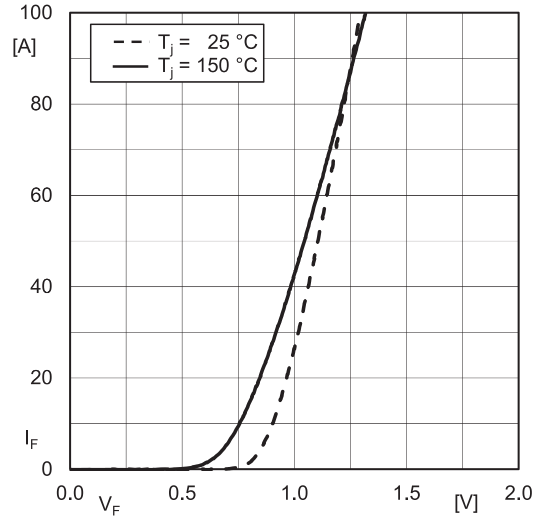
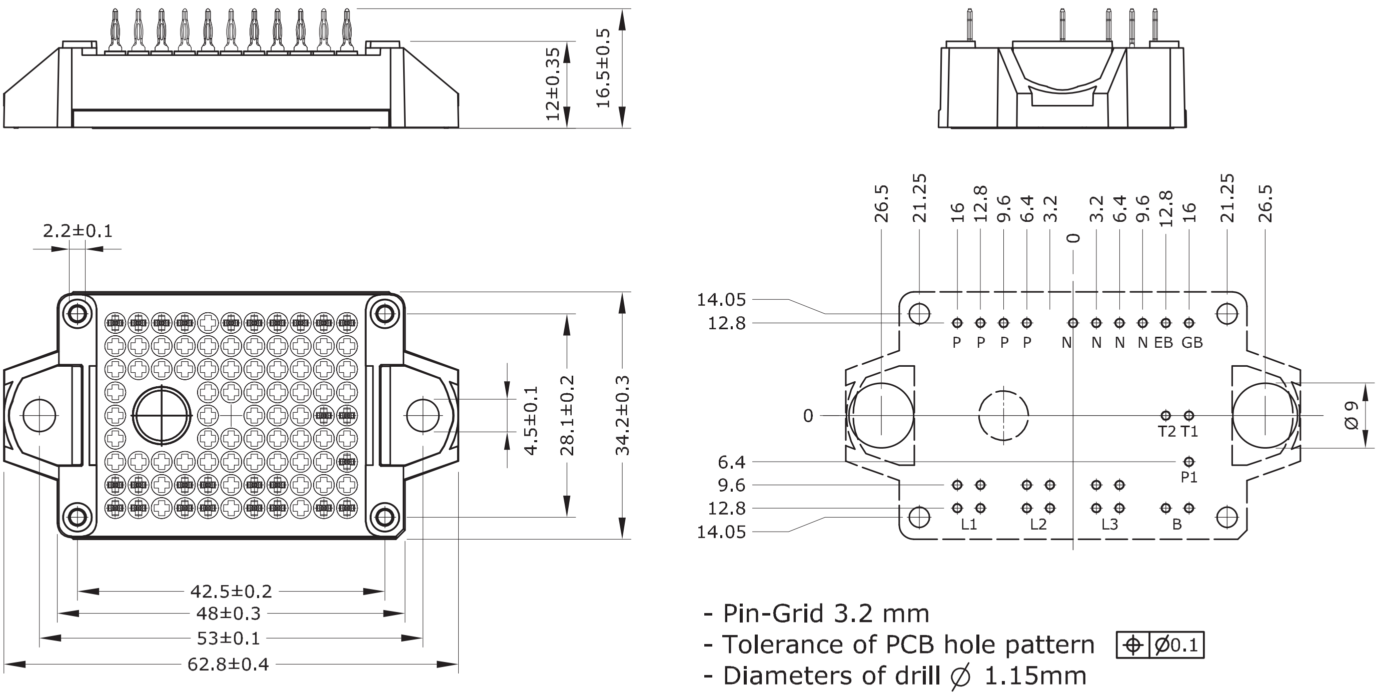
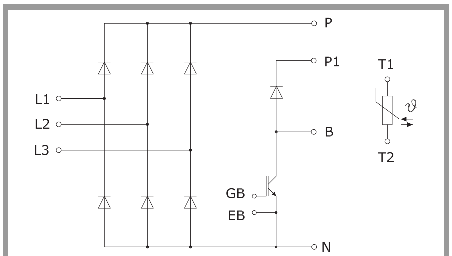



Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+ EE'}$




- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern ⌖ Ø0.1
- Diameters of drill Ø 1.15mm
- Copper thickness in hole 25 - 50 µm
- Hole specification for contacts:
  refer to SEMITOP E1/E2 Mounting Instruction

**SEMITOP®E1**



This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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