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**Data sheet 5SYA 1514-01 Aug 2024**

# 5SNG 0900R120501

LoPak phase leg IGBT module

- $V_{CE}$ = 1200 V
- $I_C$ = 2x 900 A
- Solder Signal pins for reliable auxiliary contacts
- Ultra low-loss rugged Trench IGBT chipset
- NTC thermistor for temperature sensing
- Cu baseplate for low thermal resistance
- Industry standard package

**Maximum rated values** [1)]

| Parameter | Symbol | Conditions | | Min. | Max. | Unit |
|---|---|---|---|---|---|---|
| Collector-emitter voltage | $V_{ces}$ | $V_{GE}$ = 0 V, $T_{vj}$ ≥ 25 °C | | | 1200 | V |
| DC collector current | $I_c$ | $T_C$ = 105 °C, $T_{vj}$ = 175 °C | | | 900 | A |
| Peak collector current | $I_{cm}$ | $t_p$ = 1 ms | | | 1800 | A |
| Average terminal-chip power dissipation | $P_{CC'-EE'}$ | Per DC terminal, $T_C$ = 105 °C, $T_{Terminal}$ ≤ 150 °C | | | 486 | W |
| Gate-emitter voltage | $V_{ges}$ | | | -20 | 20 | V |
| DC forward current | $I_f$ | | | | 900 | A |
| Peak forward current | $I_{frm}$ | $t_p$ = 1 ms | | | 1800 | A |
| Surge current | $I_{fsm}$ | $T_{vj\ start}$ = 175 °C, $t_p$ = 10 ms, half-sinewave | | | 3000 | A |
| IGBT short circuit SOA | $t_{psc}$ | $V_{GE}$ ≤ 15 V, $V_{CC}$ = 900 V $V_{CE,max}$ ≤ 1200 V | $T_{vj,start}$ ≤ 150 °C | | 8 | µs |
| | | | $T_{vj,start}$ ≤ 175 °C | | 6 | |
| Isolation voltage | $V_{isol}$ | 1 min, f = 50 Hz | | | 4000 | V |
| Max Junction temperature | $T_{vj}$ | | | -40 | 175 | °C |
| Junction operating temperature | $T_{vj(op)}$ | | | -40 | 175 | °C |
| Case temperature | $T_c$ | | | -40 | 125 [2)] / 150 | °C |
| Storage temperature | $T_{stg}$ | | | -40 | 125 | °C |
| Mounting torques [3)] | $M_s$ | Base-heatsink, M5 screws | | 3 | 6 | Nm |
| | $M_{t1}$ | Main terminals, M6 screws | | 3 | 6 | |

[1)] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747

[2)] For UL1557 compliance $T_{Cmax}$ must be limited to 125°C

[3)] For detailed mounting instructions refer to application note 5SYA 2142

**IGBT characteristic values** [4]

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0 V, $I_C$ = 5 mA | $T_{vj}$ = 25 °C | 1200 | | | V |
| Collector-emitter [5] saturation voltage | $V_{CEsat}$ | $I_C$ = 900 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 1.53 | | V |
| | | | $T_{vj}$ = 125 °C | | 1.71 | | V |
| | | | $T_{vj}$ = 175 °C | | 1.83 | | V |
| Collector cut-off current | $I_{CES}$ | $V_{CE}$ = 1200 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 0.1 | mA |
| | | | $T_{vj}$ = 125 °C | | 0.7 | | mA |
| | | | $T_{vj}$ = 175 °C | | 17 | | mA |
| Gate leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = ± 20 V | $T_{vj}$ = 125 °C | -150 | | 150 | nA |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 36 mA, $V_{CE}$ = $V_{GE}$ | $T_{vj}$ = 25 °C | | 5.5 | | V |
| Gate charge | $Q_G$ | $I_C$ = 900 A, $V_{CE}$ = 600 V, $V_{GE}$ = -15 V ..15 V | | | 6.1 | | µC |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 1 MHz | $T_{vj}$ = 25 °C | | TBD | | nF |
| Internal gate resistance | $R_{g,int}$ | per switch | | | 1.3 | | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 600 V, $I_C$ = 900 A, $R_G$ = 0.51 Ω, $C_{GE}$ = 0 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 25 nH, inductive load | $T_{vj}$ = 25 °C | | 435 | | ns |
| | | | $T_{vj}$ = 125 °C | | 500 | | ns |
| | | | $T_{vj}$ = 175 °C | | 528 | | ns |
| Rise time | $t_r$ | | $T_{vj}$ = 25 °C | | 135 | | ns |
| | | | $T_{vj}$ = 125 °C | | 180 | | ns |
| | | | $T_{vj}$ = 175 °C | | 202 | | ns |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 600 V, $I_C$ = 900 A, $R_G$ = 0.51 Ω, $C_{GE}$ = 0 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 25 nH, inductive load | $T_{vj}$ = 25 °C | | 395 | | ns |
| | | | $T_{vj}$ = 125 °C | | 418 | | ns |
| | | | $T_{vj}$ = 175 °C | | 437 | | ns |
| Fall time | $t_f$ | | $T_{vj}$ = 25 °C | | 140 | | ns |
| | | | $T_{vj}$ = 125 °C | | 162 | | ns |
| | | | $T_{vj}$ = 175 °C | | 176 | | ns |
| Turn-on switching energy | $E_{on}$ | $V_{CC}$ = 600 V, $I_C$ = 900 A, $R_G$ = 0.51 Ω, $C_{GE}$ = 0 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 25 nH, inductive load | $T_{vj}$ = 25 °C | | 153 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 220 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 267 | | mJ |
| Turn-off switching energy | $E_{off}$ | $V_{CC}$ = 600 V, $I_C$ = 900 A, $R_G$ = 0.51 Ω, $C_{GE}$ = 0 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 25 nH, inductive load | $T_{vj}$ = 25 °C | | 122 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 160 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 178 | | mJ |
| Short circuit current | $I_{SC}$ | $V_{CC}$ = 900 V, $V_{GE}$ = 15 V, $V_{CEM\ CHIP}$ ≤ 1200 V | $T_{vj}$ = 175 °C | | 3550 | | A |

[4] Characteristic values according to IEC 60747 – 9
[5] Collector-emitter saturation voltage is given at chip level

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**Diode characteristic values** [6]

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Forward voltage [7] | $V_F$ | $I_F$ = 900 A | $T_{vj}$ = 25 °C | | 1.67 | | V |
| | | | $T_{vj}$ = 125 °C | | 1.71 | | V |
| | | | $T_{vj}$ = 175 °C | | 1.65 | | V |
| Peak reverse recovery current | $I_{rm}$ | $V_{CC}$ = 600 V, $I_F$ = 900 A, $V_{GE}$ = ±15 V, $R_G$ = 0.51 Ω, $C_{GE}$ = 0 nF, $L_\sigma$ = 25 nH, dI/dt = 4.3 kA / µs, inductive load | $T_{vj}$ = 25 °C | | 502 | | A |
| | | | $T_{vj}$ = 125 °C | | 518 | | A |
| | | | $T_{vj}$ = 175 °C | | 543 | | A |
| Recovered charge | $Q_{rr}$ | | $T_{vj}$ = 25 °C | | 78 | | µC |
| | | | $T_{vj}$ = 125 °C | | 128 | | µC |
| | | | $T_{vj}$ = 175 °C | | 173 | | µC |
| Reverse recovery time | $t_{rr}$ | | $T_{vj}$ = 25 °C | | 297 | | ns |
| | | | $T_{vj}$ = 125 °C | | 553 | | ns |
| | | | $T_{vj}$ = 175 °C | | 680 | | ns |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25 °C | | 19 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 33 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 46 | | mJ |

[6] Characteristic values according to IEC 60747 – 2

[7] Forward voltage is given at chip level

**NTC Thermistor**

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Rated resistance | $R_{25}$ | $T_c$ = 25 °C | | 5 | | kΩ |
| R100 | $R_{100}$ | $T_c$ = 100 °C | 468 | | 517 | Ω |
| B-value | $B_{25/85}$ | $R_{25} = R_{25} \exp [B_{25/85}(1/T_2 – 1/(298.15K))]$ | | 3375 | | K |
| B-value | $B_{25/100}$ | $R_{25} = R_{25} \exp [B_{25/100}(1/T_2 – 1/(298.15K))]$ | | 3433 | | K |

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**Package properties**

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| IGBT thermal resistance junction to case | $R_{th(j-c)IGBT}$ | per switch | | | | 0.043 | K/W |
| Diode thermal resistance junction to case | $R_{th(j-c)DIODE}$ | per switch | | | | 0.095 | K/W |
| IGBT thermal resistance case to heatsink | $R_{th(c-s)IGBT}$ | IGBT per switch, $\lambda_{Grease}$ = 1 W/m x K | | | 0.034 | | K/W |
| Diode thermal resistance case to heatsink | $R_{th(c-s)DIODE}$ | Diode per switch, $\lambda_{Grease}$ = 1 W/m x K | | | 0.045 | | K/W |
| Comparative tracking index | CTI | | | 200 | | | |
| Module stray inductance | $L_{\sigma CE}$ | per switch | | | 20 | | nH |
| Resistance, terminal-chip | $R_{CC'+EE'}$ | per switch | $T_C$ = 25 °C | | 0.95 | | mΩ |
| | | | $T_C$ = 125 °C | | 1.35 | | |
| | | | $T_C$ = 175 °C | | 1.55 | | |

**Mechanical properties** [8)]

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Dimensions | L x W x H | Typical | | | 152 x 62 x 17 | | mm |
| Clearance distance in air | $d_a$ | According to IEC 60664-1 and EN 50124-1 | Term. to base: | 12.5 | | | mm |
| | | | Term. to term: | 10 | | | |
| Surface creepage distance | $d_s$ | | Term. to base: | 14.5 | | | |
| | | | Term. to term: | 13 | | | |
| Mass | m | | | | 350 | | g |

[8)] Package and mechanical properties according to IEC 60747 – 15

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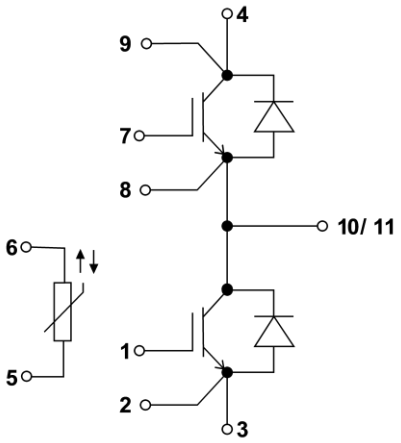
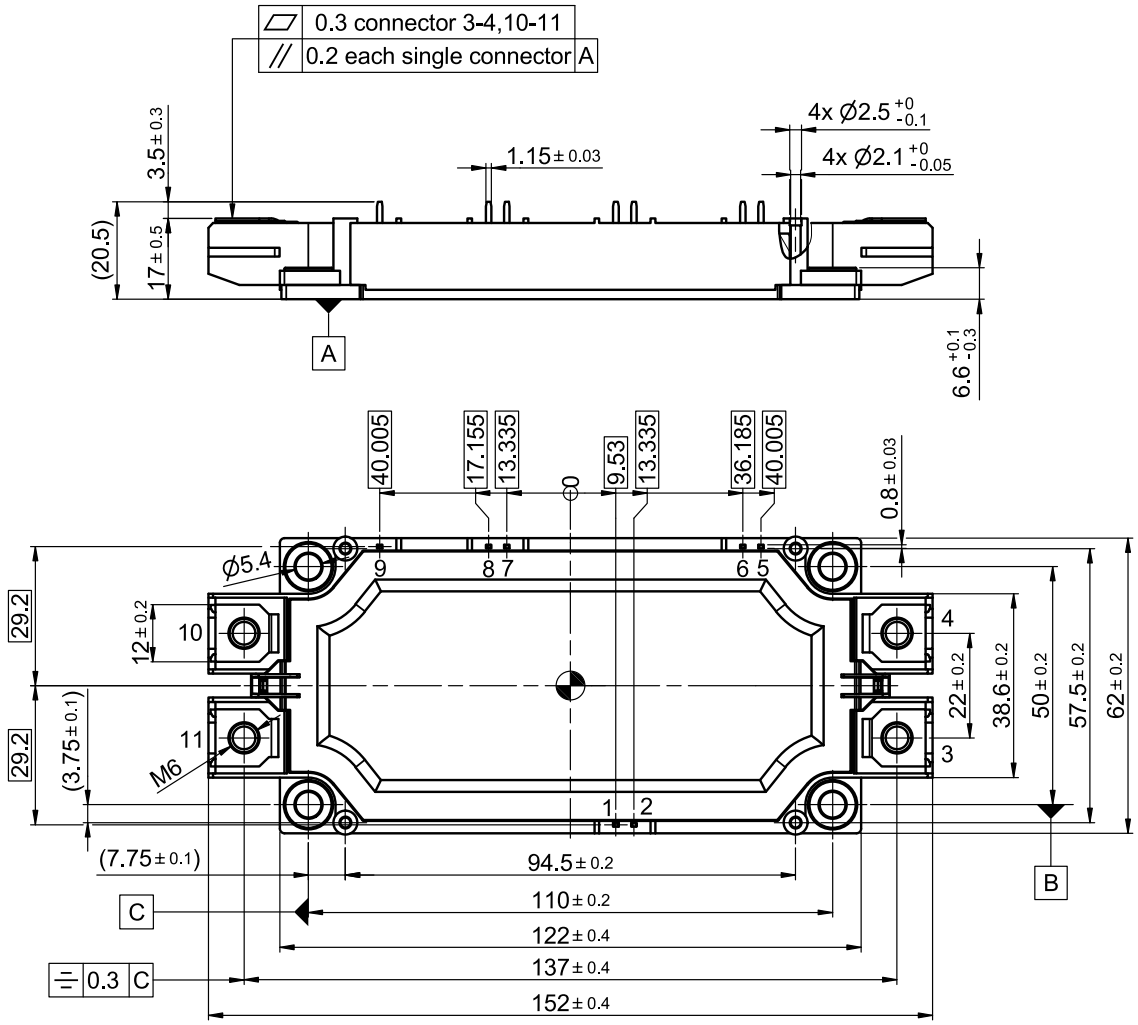
**Electrical configuration**




**Mechanical drawing**




**Note: all dimensions are shown in millimeters**

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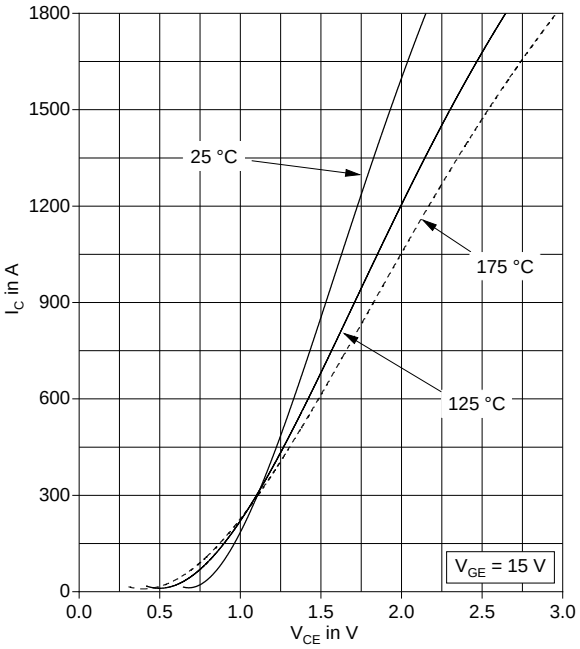


Fig. 1 Typical on-state characteristics, chip level

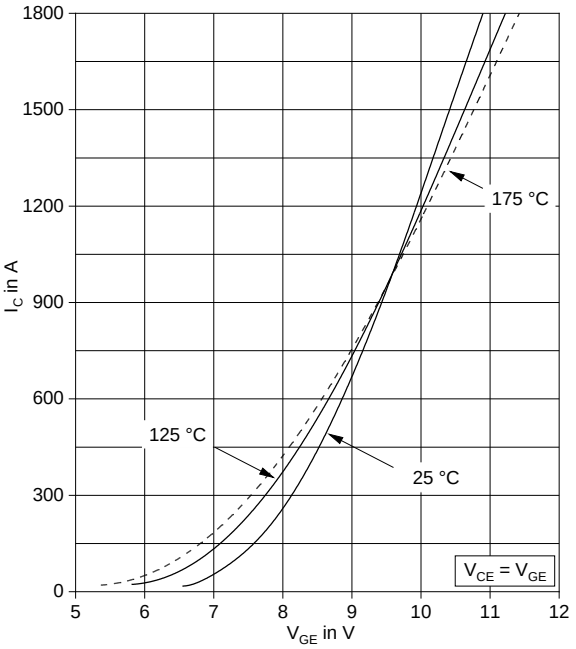


Fig. 2 Typical transfer characteristics, chip level

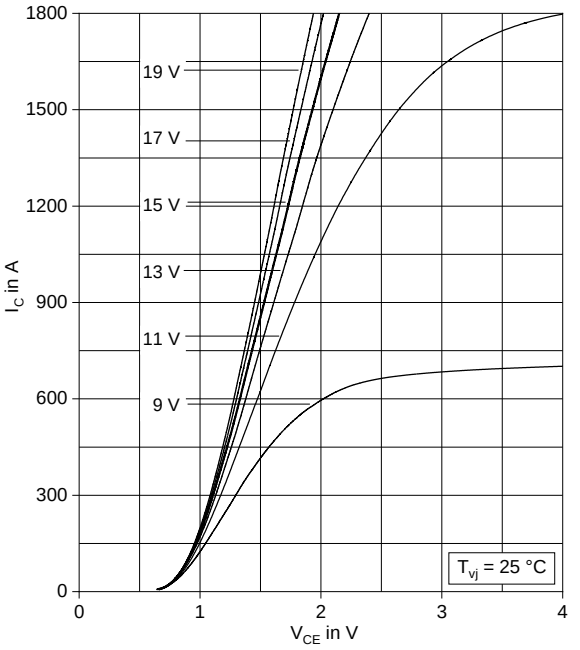


Fig. 3 Typical output characteristics, chip level

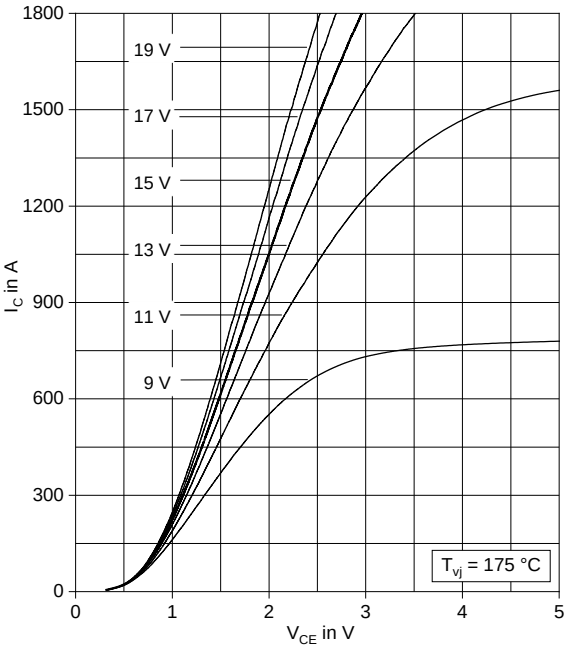


Fig. 4 Typical output characteristics, chip level

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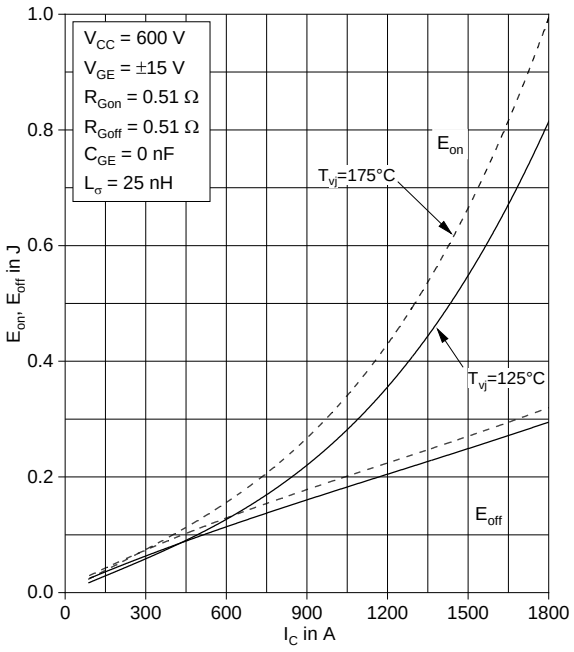


Fig. 5 Typical switching energies per pulse vs. collector current

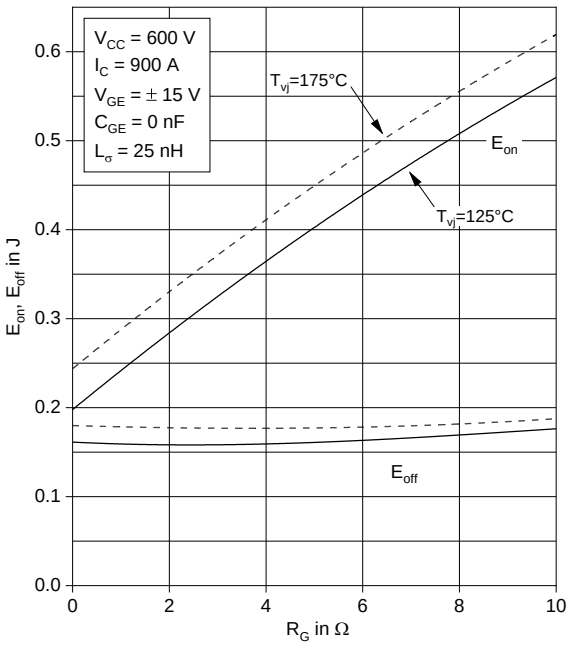


Fig. 6 Typical switching energies per pulse vs. gate resistor

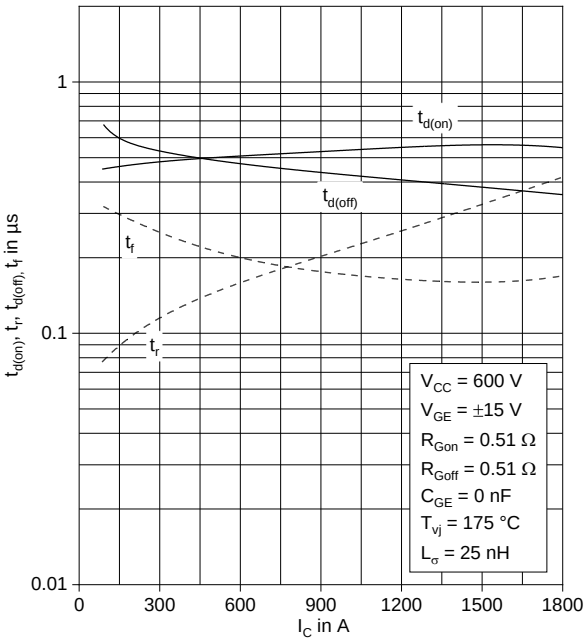


Fig. 7 Typical switching times vs. collector current

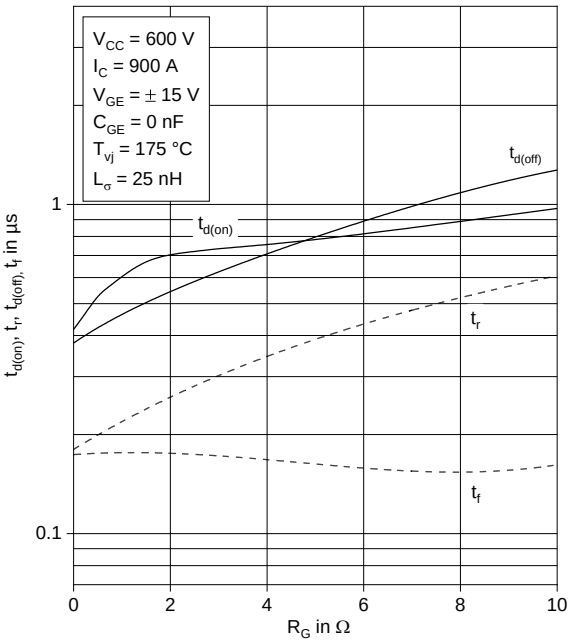


Fig. 8 Typical switching times vs. gate resistor

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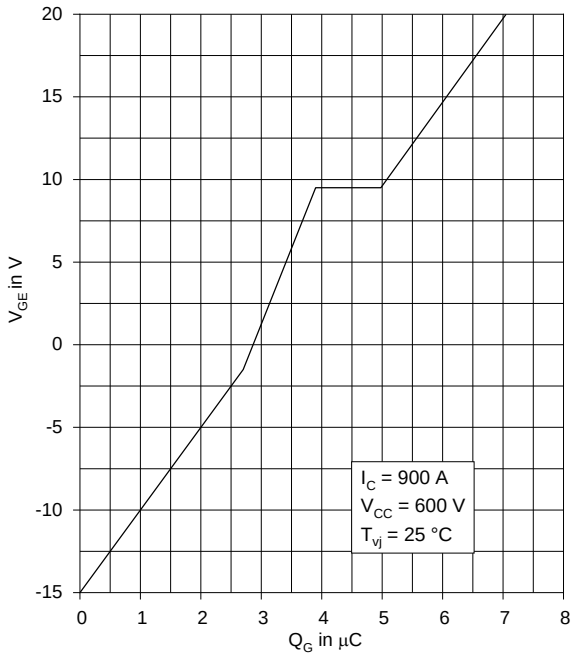


Fig. 9 Typical gate charge characteristics

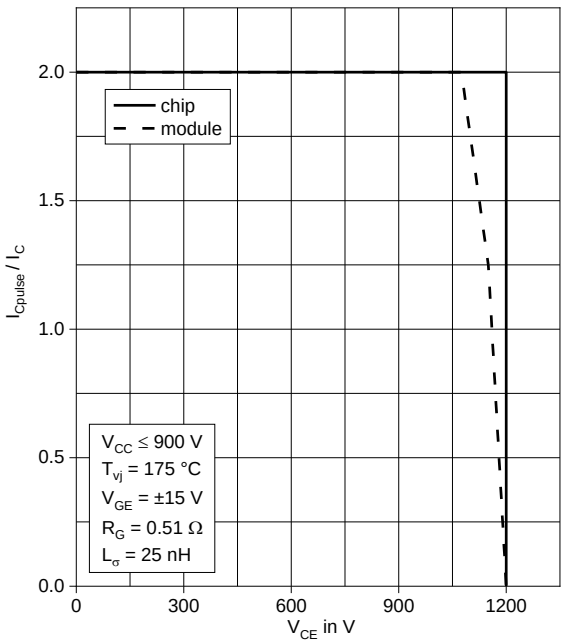


Fig. 10 Turn-off safe operating area (RBSOA)

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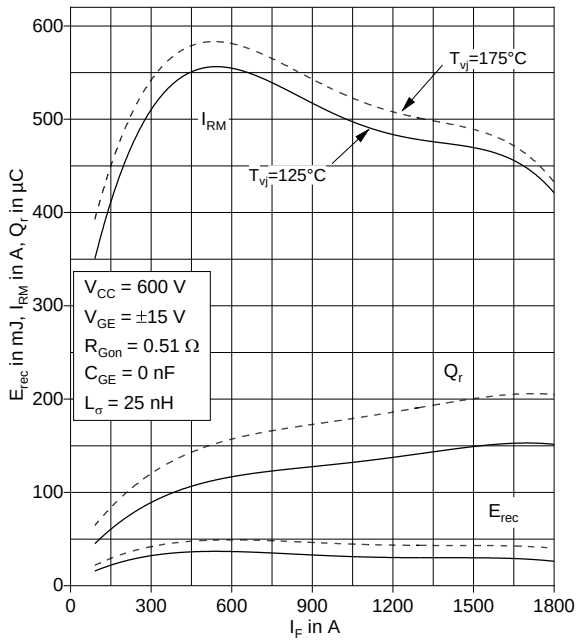


Fig. 11 Typical reverse recovery characteristics vs. forward current

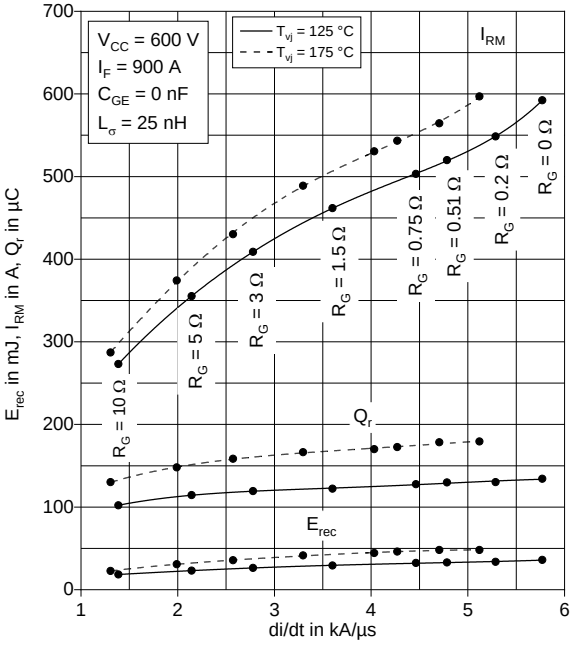


Fig. 12 Typical reverse recovery characteristics vs. di/dt

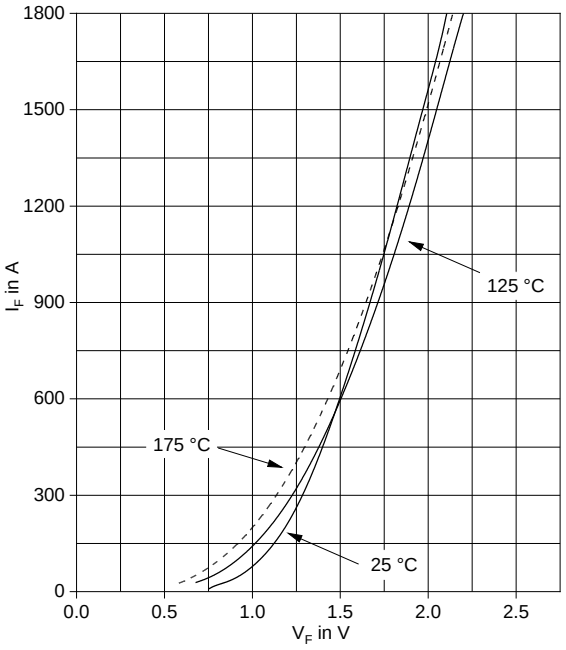


Fig. 13 Typicial diode forward characteristics chip level

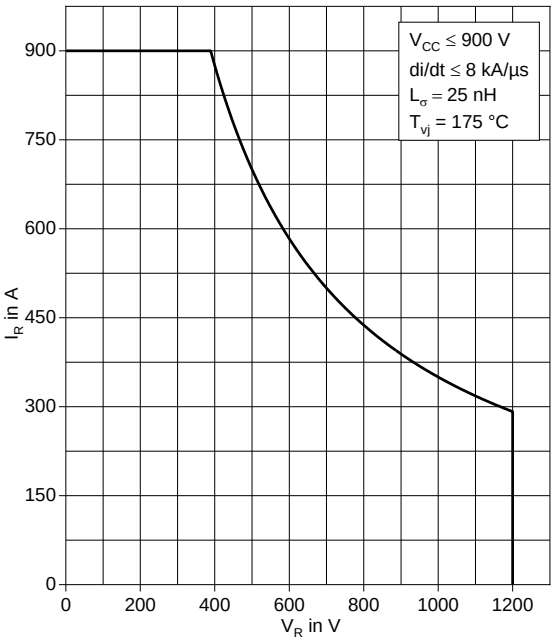


Fig. 14 Diode turn-off safe operating area (DSOA)

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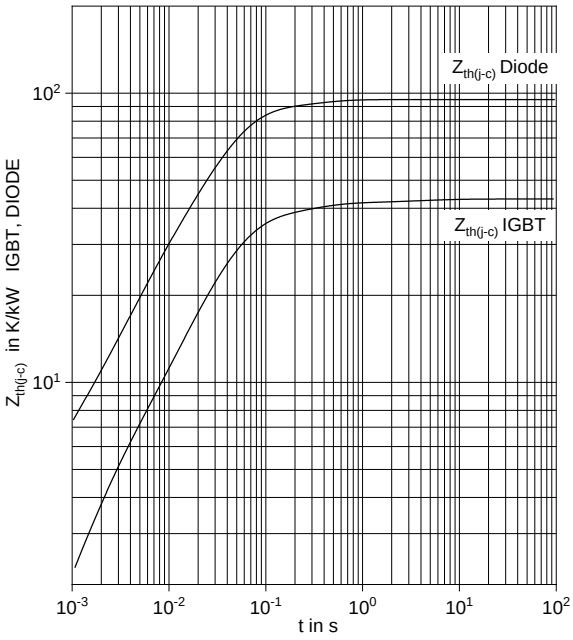


Analytical function for transient thermal impedance:

$$Z_{th\,(j\text{-}c)}(t) = \sum_{i=1}^{n} R_i\,(1 - e^{-t/\tau_i})$$

| | i | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| IGBT | Ri(K/kW) | 3.05 | 6.65 | 31.8 | 1.53 | |
| | τi(ms) | 1.92 | 229.4 | 35.1 | 3923 | |
| DIODE | Ri(K/kW) | 3.52 | 9.96 | 72 | 9.53 | |
| | τi(ms) | 0.4 | 263.8 | 35.4 | 4.4 | |

Fig. 15 Thermal impedance vs time

## Related documents:

5SYA 2042 Failure rates of IGBT modules due to cosmic rays
5SYA 2045 Thermal runaway during blocking
5SYA 2053 Applying IGBT
5SYA 2057 IGBT diode safe operating area (SOA)
5SYA 2058 Surge currents for IGBT diodes
5SYA 2093 Thermal design of IGBT modules
5SYA 2098 Paralleling of IGBT modules
5SYA 2142 LoPak modules use and installation

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