

Reverse-Conducting IGBT with monolithic body diode

Features

- $V_{CE} = 1400\text{ V}$
- $I_C = 40\text{ A}$
- Powerful monolithic body diode with low forward voltage designed for soft commutation only
- Very tight parameter distribution
- High ruggedness, temperature stable behavior
- Very low V_{CEsat}
- Easy paralleling capability due to positive temperature coefficient in V_{CEsat}
- Low EMI
- Qualified according to JESD-022 for target applications
- Pb-free lead plating; RoHS compliant
- Halogen free (according to IEC 61249-2-21)
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

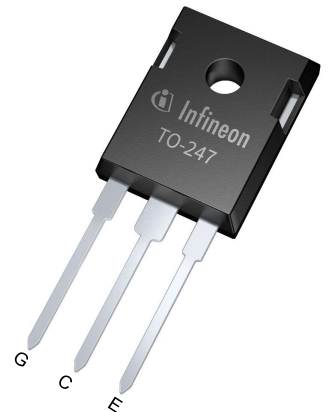
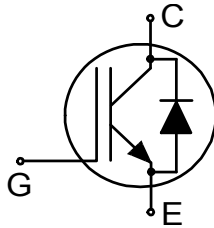
Potential applications

- Induction cooker
- Microwave ovens

Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description



| Type | Package | Marking |
|--------------|----------------------|---------|
| IHW40N140R5L | PG-TO247-3-STD-NN2.5 | H40QR5L |

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1 Package

Table 1 Characteristic values

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---------------|--|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Internal emitter inductance measured 5 mm (0.197 in.) from case | L_E | | | 13 | | nH |
| Storage temperature | T_{stg} | | -55 | | 150 | °C |
| Soldering temperature | T_{sold} | wave soldering 1.6 mm (0.063 in.) from case for 10 s | | | 260 | °C |
| Mounting torque | M | M3 screw, Maximum of mounting processes: 3 | | | 0.6 | Nm |
| Thermal resistance, junction-ambient | $R_{th(j-a)}$ | | | | 40 | K/W |
| IGBT thermal resistance, junction-case | $R_{th(j-c)}$ | | | | 0.41 | K/W |
| Diode thermal resistance, junction-case | $R_{th(j-c)}$ | | | | 0.41 | K/W |

2 IGBT

Table 2 Maximum rated values

| Parameter | Symbol | Note or test condition | Values | Unit | |
|--|--------------|--|-----------------------|------|---|
| Collector-emitter voltage | V_{CE} | $T_{vj} \geq 25\text{ °C}$ | 1400 | V | |
| DC collector current, limited by T_{vjmax} | I_C | limited by bondwire | $T_c = 25\text{ °C}$ | 80 | A |
| | | | $T_c = 100\text{ °C}$ | 72 | |
| Pulsed collector current, t_p limited by T_{vjmax} | I_{Cpulse} | | 120 | A | |
| Non repetitive peak collector current ¹⁾ | I_{CSM} | | 200 | A | |
| Turn-off safe operating area ²⁾ | | $V_{CE} \leq 1400\text{ V}, T_{vj} \leq 175\text{ °C}$ | 120 | A | |
| Gate-emitter voltage | V_{GE} | | ±20 | V | |
| Transient gate-emitter voltage | V_{GE} | $t_p \leq 10\text{ }\mu\text{s}, D < 0.01$ | ±25 | V | |
| Power dissipation | P_{tot} | | $T_c = 25\text{ °C}$ | 366 | W |
| | | | $T_c = 100\text{ °C}$ | 183 | |

1) capacitor charging saturation current limited by $T_{vjmax} < 175\text{ °C}$ and $t_p < 3\text{ }\mu\text{s}$

2) $dV/dt < 1\text{ kV}/\mu\text{s}$

Table 3 Characteristic values

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|--------------------------------------|--------------|--|--|------|------|------------------|
| | | | Min. | Typ. | Max. | |
| Collector-emitter breakdown voltage | V_{BRCES} | $I_C = 0.5 \text{ mA}, V_{GE} = 0 \text{ V}$ | 1400 | | | V |
| Collector-emitter saturation voltage | V_{CEsat} | $I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 1.65 | 1.95 | V |
| | | | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 1.8 | | |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 1.9 | | |
| Gate-emitter threshold voltage | V_{GEth} | $I_C = 0.63 \text{ mA}, V_{CE} = V_{GE}$ | 4 | 5.6 | 6.2 | V |
| Zero gate-voltage collector current | I_{CES} | $V_{CE} = 1400 \text{ V}, V_{GE} = 0 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | | 100 | μA |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | | 920 | |
| Gate-emitter leakage current | I_{GES} | $V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$ | | | 100 | nA |
| Transconductance | g_{fs} | $I_C = 40 \text{ A}, V_{CE} = 20 \text{ V}$ | | 35.4 | | S |
| Input capacitance | C_{ies} | $V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$ | | 2020 | | pF |
| Output capacitance | C_{oes} | $V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$ | | 57 | | pF |
| Reverse transfer capacitance | C_{res} | $V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$ | | 48 | | pF |
| Gate charge | Q_G | $V_{CC} = 1120 \text{ V}, I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}$ | | 260 | | nC |
| Turn-off delay time | $t_{d(off)}$ | $V_{GE} = 0/15 \text{ V},$ $R_{G(off)} = 10 \text{ } \Omega, C_r = 270 \text{ nF},$ $L = 77 \text{ } \mu\text{H}, R = 2.2 \text{ } \Omega$ | $T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$ | 225 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$ | | 235 | |
| Fall time (inductive load) | t_f | $V_{GE} = 0/15 \text{ V},$ $R_{G(off)} = 10 \text{ } \Omega, C_r = 270 \text{ nF},$ $L = 77 \text{ } \mu\text{H}, R = 2.2 \text{ } \Omega$ | $T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$ | 1005 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$ | | 1775 | |
| Soft turn-off energy | E_{off} | $V_{GE} = 0/15 \text{ V},$ $R_{G(off)} = 10 \text{ } \Omega, C_r = 270 \text{ nF},$ $L = 77 \text{ } \mu\text{H}, R = 2.2 \text{ } \Omega$ | $T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$ | 0.24 | | mJ |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$ | | 0.64 | |
| Operating junction temperature | T_{vj} | | -40 | | 175 | $^\circ\text{C}$ |

3 Diode

Table 4 Maximum rated values

| Parameter | Symbol | Note or test condition | Values | Unit | |
|--|--------------|------------------------|-----------------------|------|---|
| Diode forward current, limited by T_{vjmax} | I_F | limited by bondwire | $T_c = 25\text{ °C}$ | 80 | A |
| | | | $T_c = 100\text{ °C}$ | 71 | |
| Diode pulsed current, t_p limited by T_{vjmax} | I_{Fpulse} | | 120 | A | |

Table 5 Characteristic values

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|--------------------------------|----------|------------------------|--------------------------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Diode forward voltage | V_F | $I_F = 40\text{ A}$ | $T_{vj} = 25\text{ °C}$ | 1.7 | 1.95 | V |
| | | | $T_{vj} = 125\text{ °C}$ | 1.9 | | |
| | | | $T_{vj} = 175\text{ °C}$ | 2 | | |
| Operating junction temperature | T_{vj} | | -40 | | 175 | °C |

Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

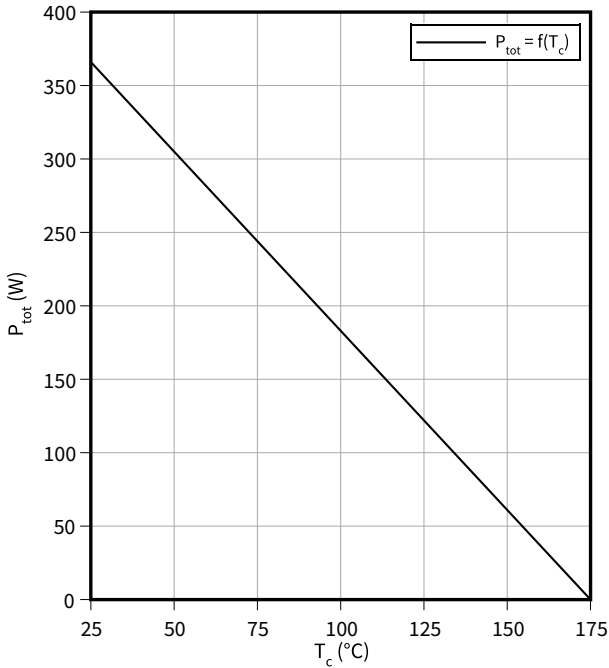
Electrical Characteristic, at $T_{vj} = 25\text{ °C}$, unless otherwise specified.

Dynamic test circuit, energy losses include “tail” according to Figure B. (Test circuit Figure E).

4 Characteristics diagrams

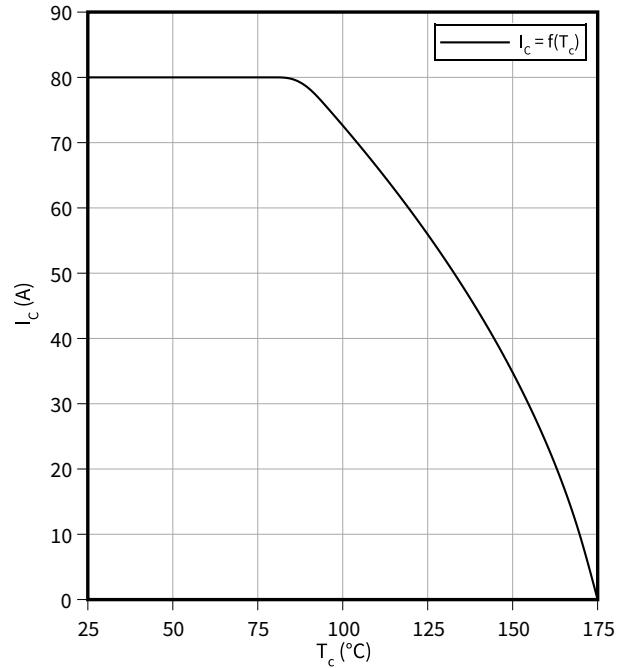
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$
 $T_{vj} \leq 175\text{ °C}$



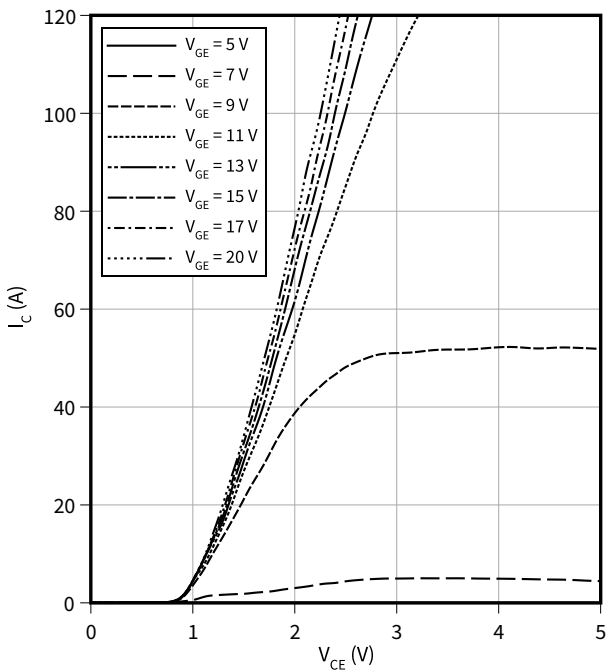
Collector current as a function of case temperature

$I_C = f(T_c)$
 $T_{vj} \leq 175\text{ °C}, V_{GE} \geq 15\text{ V}$



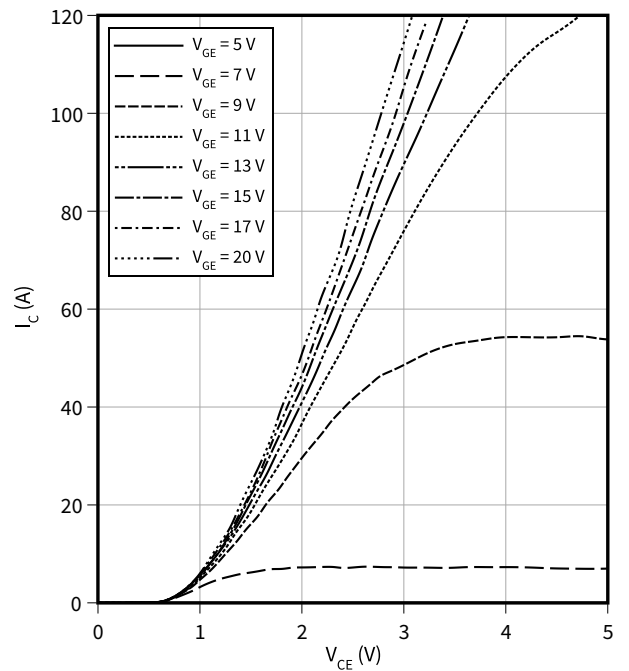
Typical output characteristic

$I_C = f(V_{CE})$
 $T_{vj} = 25\text{ °C}$



Typical output characteristic

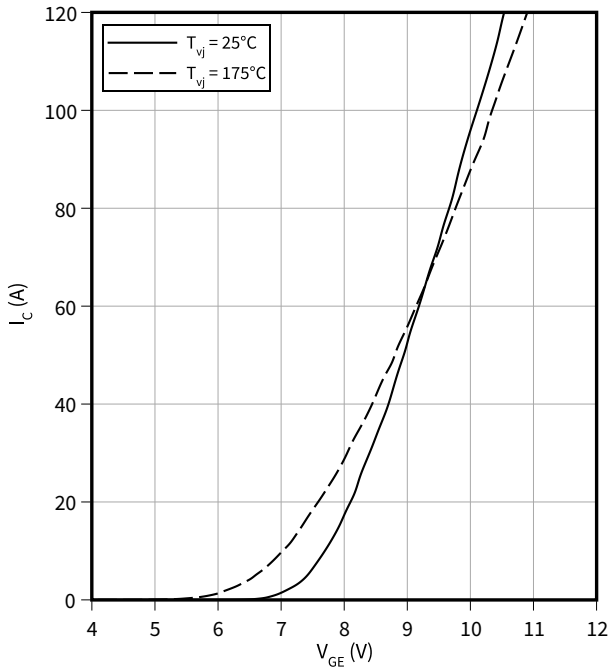
$I_C = f(V_{CE})$
 $T_{vj} = 175\text{ °C}$



4 Characteristics diagrams

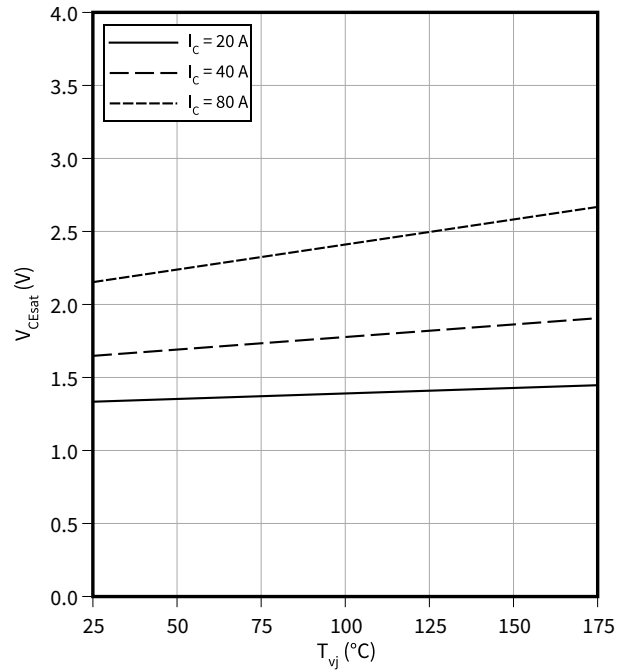
Typical transfer characteristic

$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



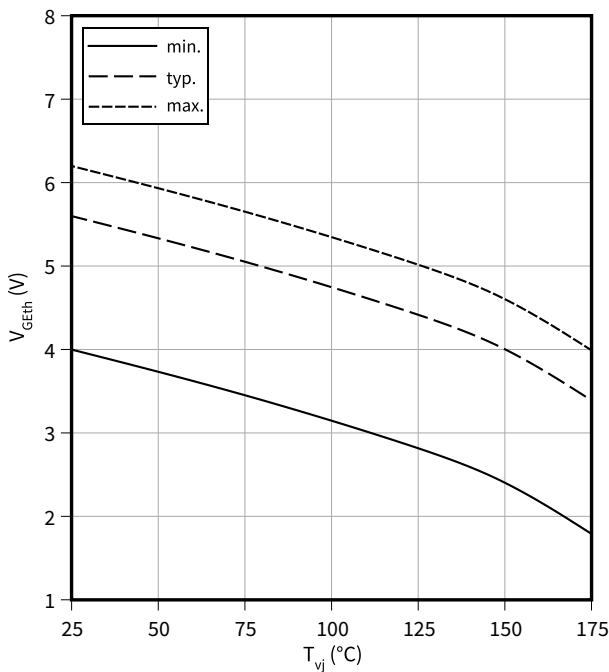
Typical collector-emitter saturation voltage as a function of junction temperature

$V_{CEsat} = f(T_{vj})$
 $V_{GE} = 15\text{ V}$



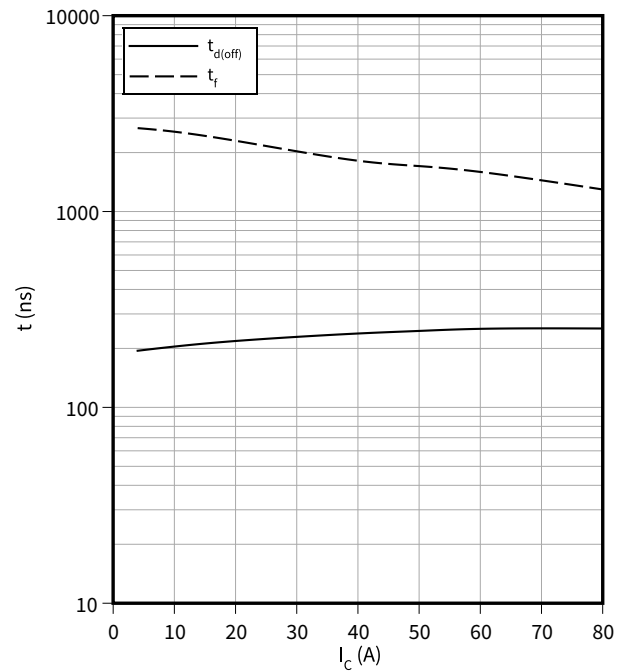
Gate-emitter threshold voltage as a function of junction temperature

$V_{GEth} = f(T_{vj})$
 $I_C = 0.63\text{ mA}$



Typical switching times as a function of collector current

$t = f(I_C)$
 $T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15\text{ V}, C_r = 270\text{ nF}, R_G = 10\ \Omega$

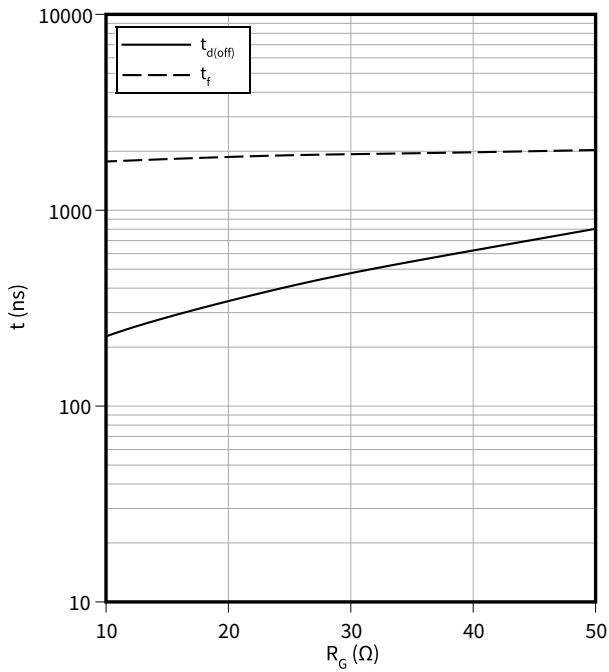


4 Characteristics diagrams

Typical switching times as a function of gate resistor

$t = f(R_G)$

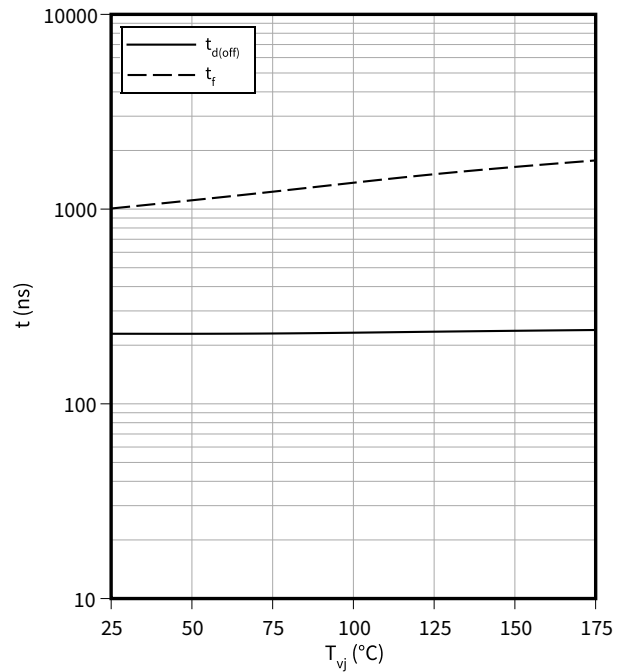
$I_C = 40 \text{ A}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $C_r = 270 \text{ nF}$



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

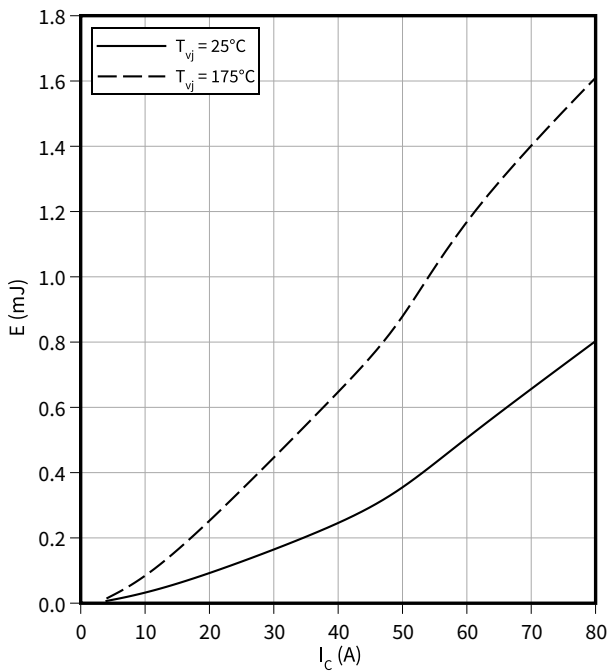
$I_C = 40 \text{ A}$, $V_{GE} = 0/15 \text{ V}$, $C_r = 270 \text{ nF}$, $R_G = 10 \text{ } \Omega$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

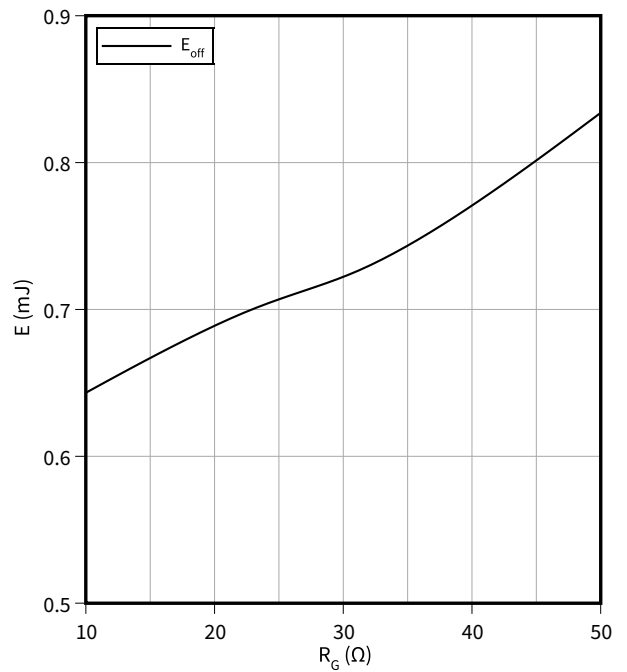
$V_{GE} = 0/15 \text{ V}$, $C_r = 270 \text{ nF}$, $R_G = 10 \text{ } \Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

$I_C = 40 \text{ A}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $C_r = 270 \text{ nF}$

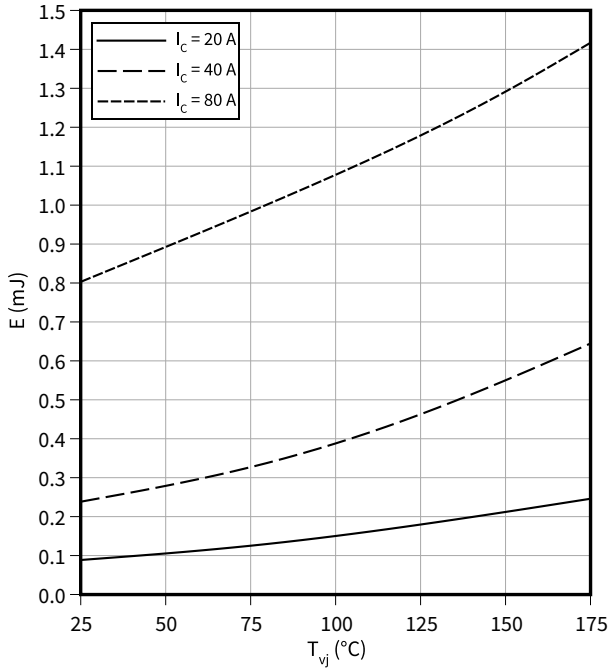


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

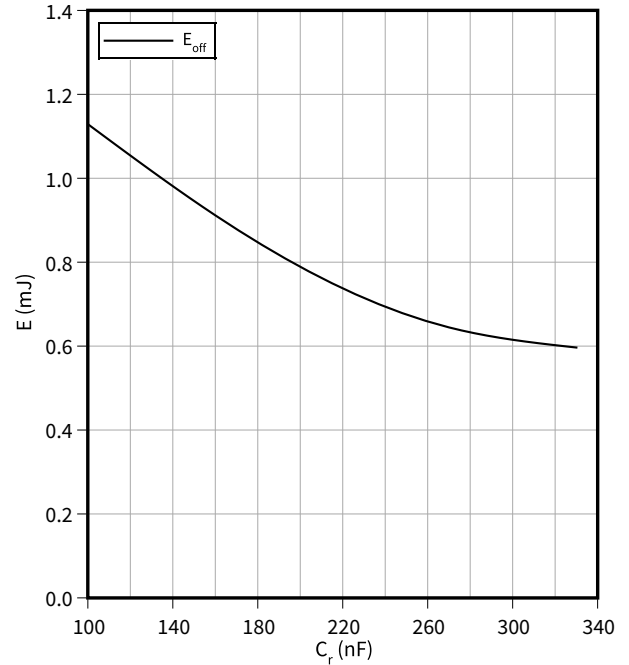
$V_{GE} = 0/15 \text{ V}$, $C_r = 270 \text{ nF}$, $R_G = 10 \text{ } \Omega$



Typical switching energy losses as a function of resonant capacitance

$E = f(C_r)$

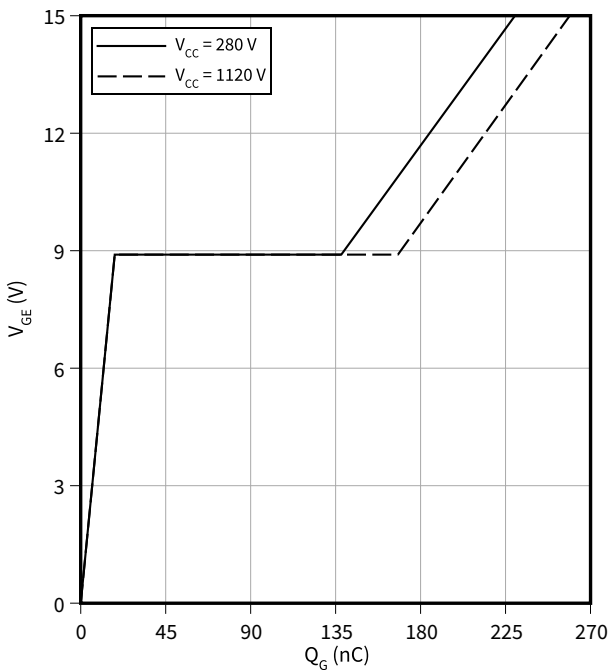
$I_C = 40 \text{ A}$, $T_{vj} = 175 \text{ } ^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \text{ } \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

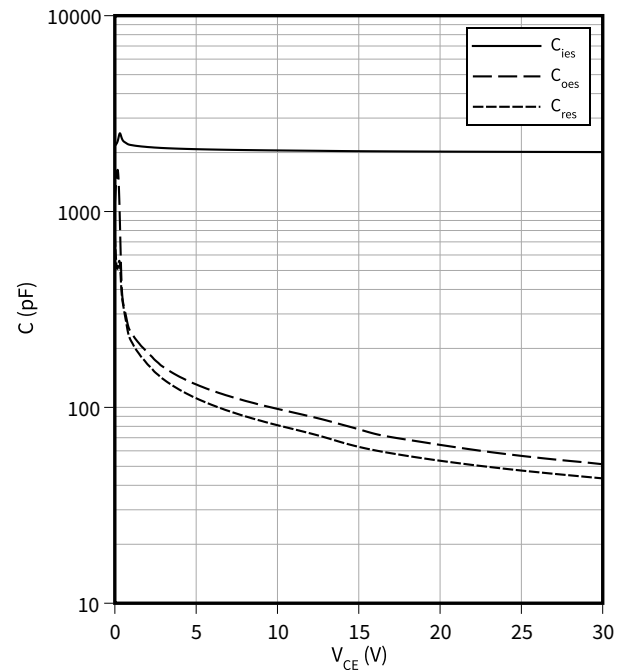
$I_C = 40 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

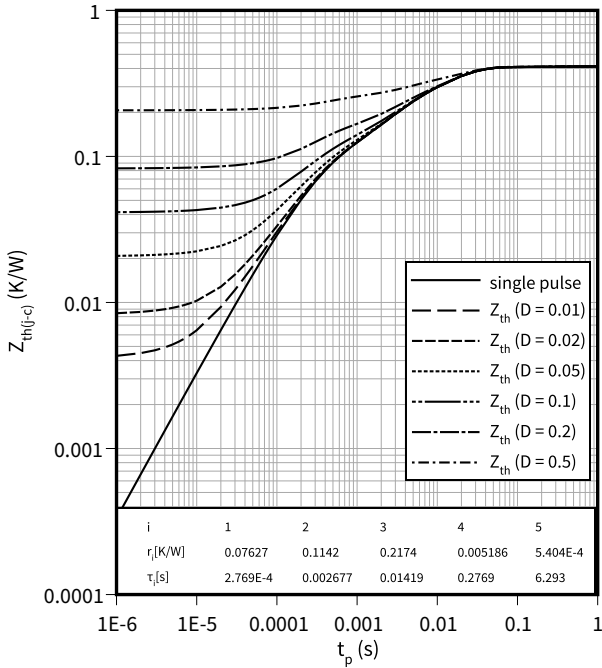
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$



4 Characteristics diagrams

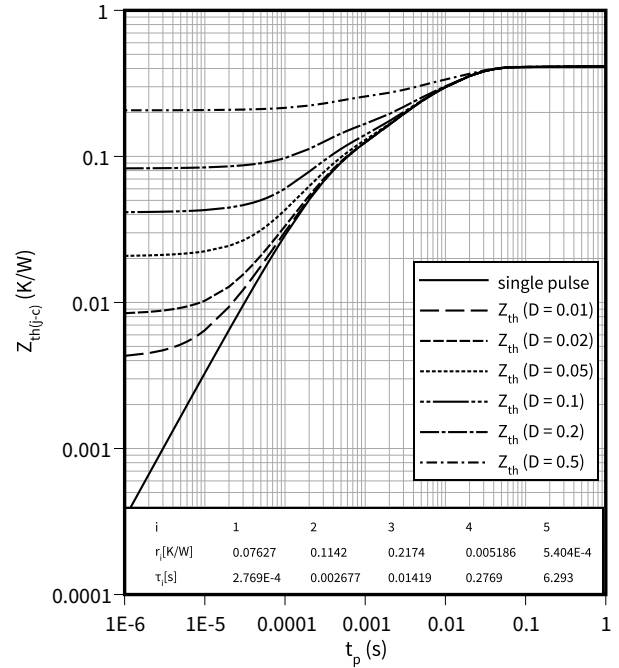
IGBT transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



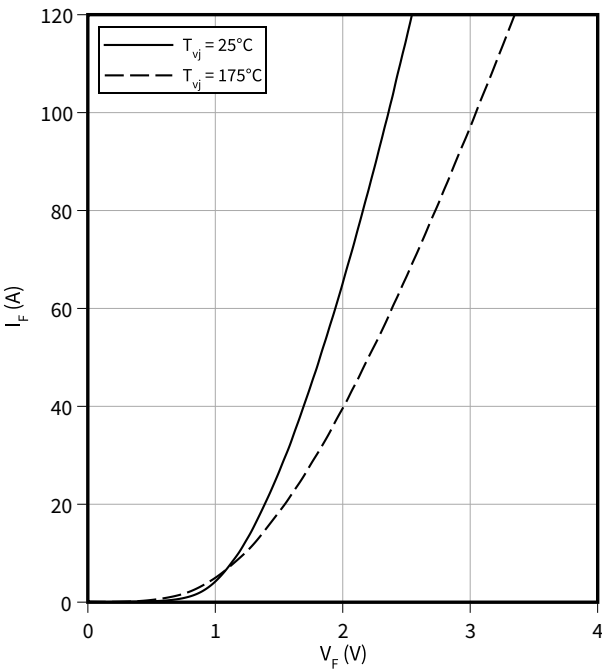
Diode transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



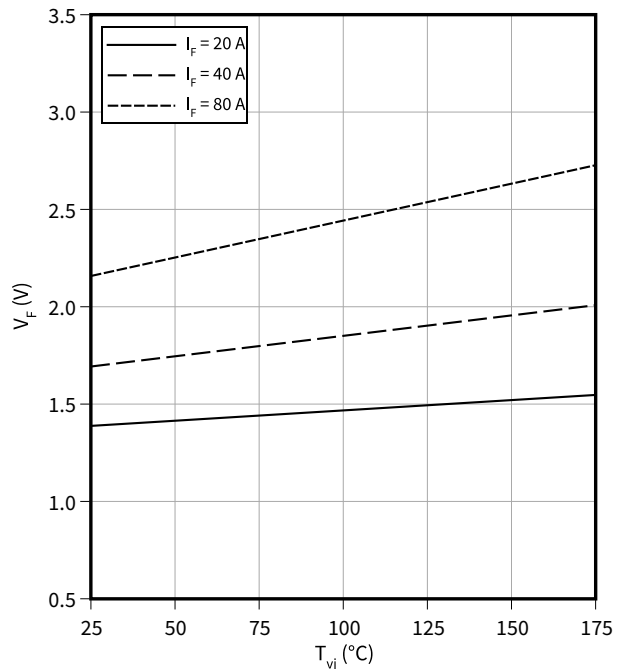
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



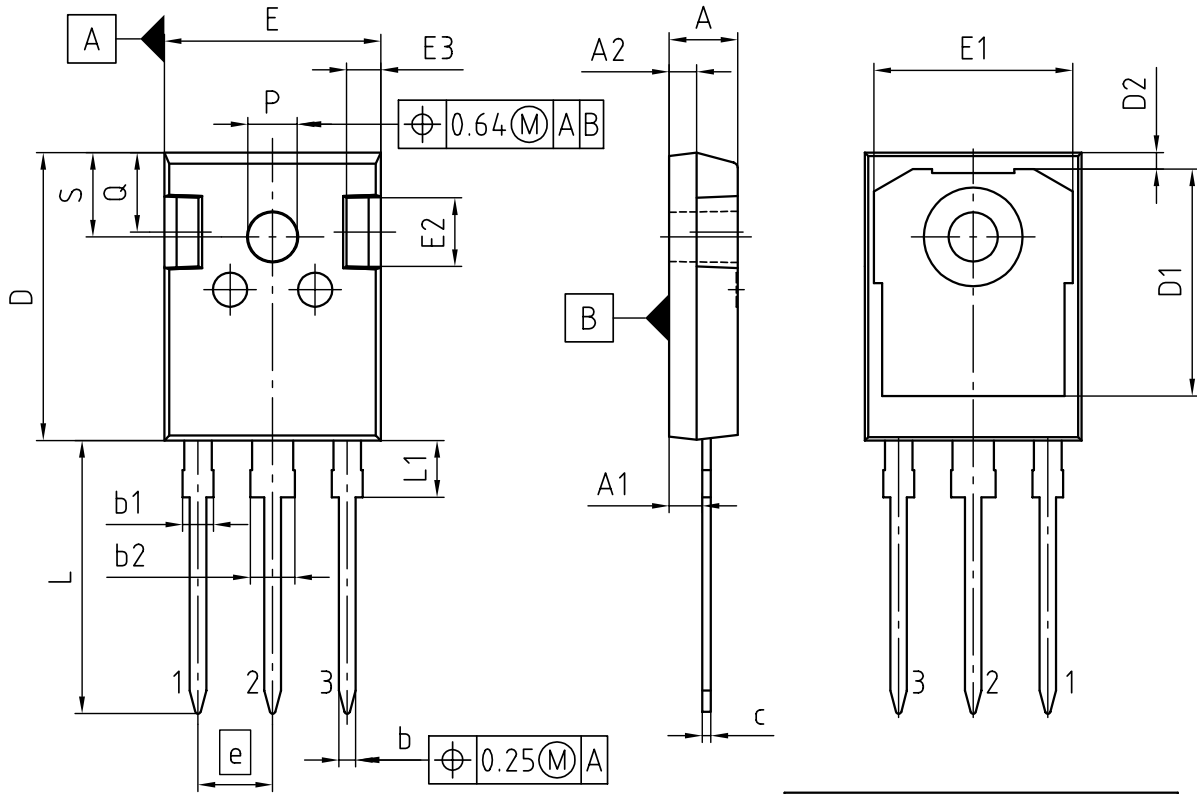
Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$



5 Package outlines

PG-TO247-3-STD-NN2.5



| PACKAGE - GROUP NUMBER: PG-TO247-3-U06 | | |
|--|-------------|-------|
| DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. |
| A | 4.83 | 5.21 |
| A1 | 2.27 | 2.54 |
| A2 | 1.85 | 2.16 |
| b | 1.07 | 1.33 |
| b1 | 1.90 | 2.41 |
| b2 | 2.87 | 3.38 |
| c | 0.55 | 0.68 |
| D | 20.80 | 21.10 |
| D1 | 16.25 | 17.65 |
| D2 | 0.95 | 1.35 |
| E | 15.70 | 16.13 |
| E1 | 13.10 | 14.15 |
| E2 | 3.68 | 5.10 |
| E3 | 1.00 | 2.60 |
| e | 5.44 | |
| N | 3 | |
| L | 19.80 | 20.32 |
| L1 | 4.10 | 4.47 |
| ϕP | 3.50 | 3.70 |
| Q | 5.49 | 6.00 |
| S | 6.04 | 6.30 |

NOTE:
DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GATE BURRS

Figure 1

6 Testing conditions

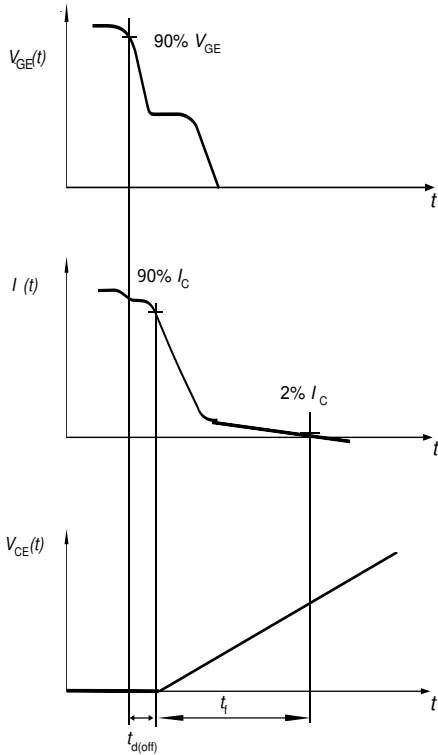


Figure A. Definition of switching times

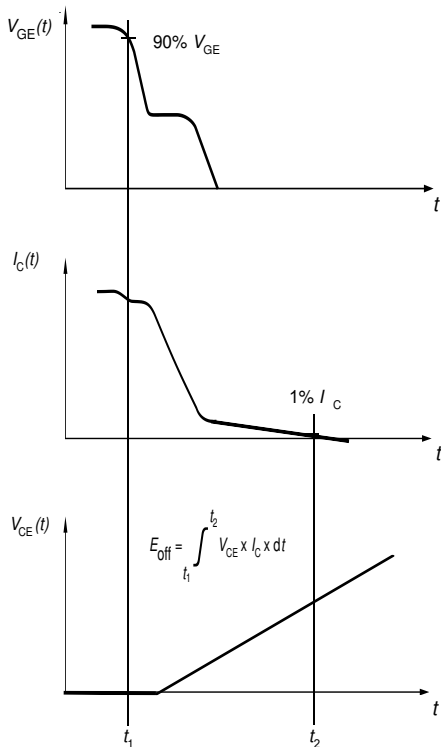


Figure B. Definition of switching losses

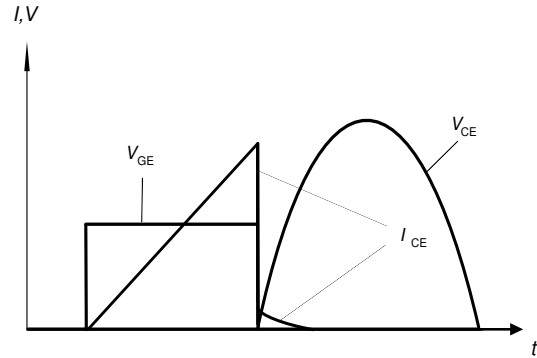


Figure C. Typical switching behavior in resonant applications

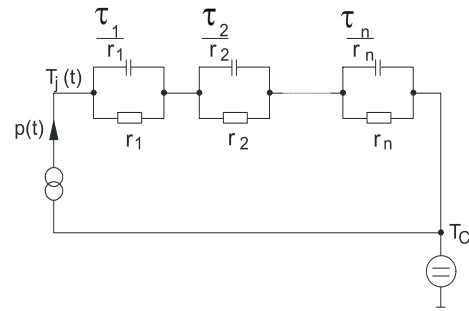


Figure D. Thermal equivalent circuit

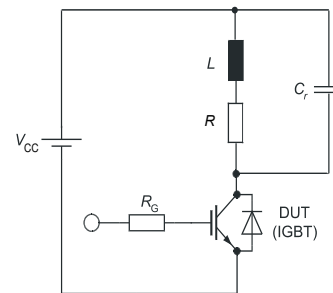


Figure E. Dynamic test circuit
Resonant capacitor, C_r
Damping resistor, R

Figure 2

Revision history

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|------------------------|
| 0.10 | 2022-11-25 | Preliminary datasheet |
| 1.00 | 2023-05-19 | Final datasheet |

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