

Resonant Switching Series

Reverse Conducting IGBT with monolithic body diode

IHW20N120R5

Data sheet

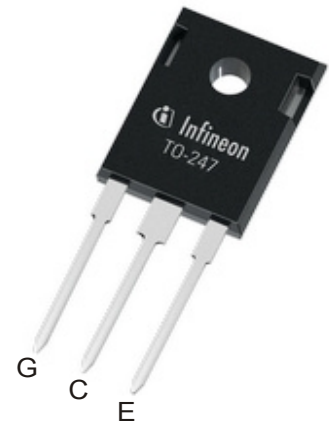
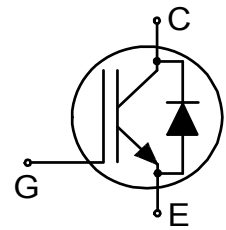
Industrial Power Control

Resonant Switching Series

Reverse Conducting IGBT with monolithic body diode

Features:

- Powerful monolithic body diode with low forward voltage designed for soft commutation
- TRENCHSTOP™ technology offering:
 - very tight parameter distribution
 - high ruggedness, temperature stable behavior
 - low V_{CEsat}
 - easy parallel switching capability due to positive temperature coefficient in V_{CEsat}
- Low EMI
- 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/>

**Applications:**

- Inductive cooking
- Inverterized microwave ovens
- Resonant converters
- Soft switching applications

Product Validation:

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

Package pin definition:

- Pin 1 - gate
- Pin 2 & backside - collector
- Pin 3 - emitter

**Key Performance and Package Parameters**

| Type | V_{CE} | I_C | $V_{CEsat}, T_{vj}=25^{\circ}C$ | T_{vjmax} | Marking | Package |
|-------------|----------|-------|---------------------------------|-------------|---------|------------|
| IHW20N120R5 | 1200V | 20A | 1.55V | 175°C | H20MR5 | PG-TO247-3 |

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Resonant Switching Series

Maximum Ratings

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

| Parameter | Symbol | Value | Unit |
|---|-------------|----------------------|--------------------|
| Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$ | V_{CE} | 1200 | V |
| DC collector current, limited by T_{vjmax} $T_c = 25^{\circ}\text{C}$ $T_c = 100^{\circ}\text{C}$ | I_C | 40.0 20.0 | A |
| Pulsed collector current, t_p limited by T_{vjmax} | I_{Cpuls} | 60.0 | A |
| Non repetitive peak collector current ¹⁾ | I_{CSM} | 200 | A |
| Turn off safe operating area $V_{CE} \leq 1200\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$ | - | 60.0 | A |
| Diode forward current, limited by T_{vjmax} $T_c = 25^{\circ}\text{C}$ $T_c = 100^{\circ}\text{C}$ | I_F | 40.0 20.0 | A |
| Diode pulsed current, t_p limited by T_{vjmax} | I_{Fpuls} | 60.0 | A |
| Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}$, $D < 0.010$) | V_{GE} | ± 20 ± 25 | V |
| Power dissipation $T_c = 25^{\circ}\text{C}$ Power dissipation $T_c = 100^{\circ}\text{C}$ | P_{tot} | 288.0 144.0 | W |
| Operating junction temperature | T_{vj} | -40...+175 | $^{\circ}\text{C}$ |
| Storage temperature | T_{stg} | -55...+150 | $^{\circ}\text{C}$ |
| Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s | | 260 | $^{\circ}\text{C}$ |
| Mounting torque, M3 screw Maximum of mounting processes: 3 | M | 0.6 | Nm |

Thermal Resistance

| Parameter | Symbol | Conditions | Value | | | Unit |
|--|---------------|------------|-------|------|------|------|
| | | | min. | typ. | max. | |
| R_{th} Characteristics | | | | | | |
| IGBT thermal resistance, junction - case | $R_{th(j-c)}$ | | - | - | 0.52 | K/W |
| Diode thermal resistance, junction - case | $R_{th(j-c)}$ | | - | - | 0.52 | K/W |
| Thermal resistance junction - ambient | $R_{th(j-a)}$ | | - | - | 40 | K/W |

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

Resonant Switching Series

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

| Parameter | Symbol | Conditions | Value | | | Unit |
|--------------------------------------|---------------|--|-------|------|------|---------------|
| | | | min. | typ. | max. | |
| Static Characteristic | | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE} = 0\text{V}, I_C = 0.50\text{mA}$ | 1200 | - | - | V |
| Collector-emitter saturation voltage | V_{CEsat} | $V_{GE} = 15.0\text{V}, I_C = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | 1.55 | 1.75 | V |
| | | | - | 1.75 | - | |
| | | | - | 1.80 | - | |
| Diode forward voltage | V_F | $V_{GE} = 0\text{V}, I_F = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | 1.60 | 1.85 | V |
| | | | - | 1.75 | - | |
| | | | - | 1.85 | - | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C = 0.50\text{mA}, V_{CE} = V_{GE}$ | 5.1 | 5.8 | 6.4 | V |
| Zero gate voltage collector current | I_{CES} | $V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | - | 100 | μA |
| | | | - | 300 | - | |
| Gate-emitter leakage current | I_{GES} | $V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$ | - | - | 100 | nA |
| Transconductance | g_{fs} | $V_{CE} = 20\text{V}, I_C = 20.0\text{A}$ | - | 15.2 | - | S |
| Integrated gate resistor | r_G | | | none | | Ω |

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

| Parameter | Symbol | Conditions | Value | | | Unit |
|--|-----------|---|-------|-------|------|---------------|
| | | | min. | typ. | max. | |
| Dynamic Characteristic | | | | | | |
| Input capacitance | C_{ies} | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$ | - | 1340 | - | μF |
| Output capacitance | C_{oes} | | - | 43 | - | |
| Reverse transfer capacitance | C_{res} | | - | 34 | - | |
| Gate charge | Q_G | $V_{CC} = 1080\text{V}, I_C = 20.0\text{A},$ $V_{GE} = 15\text{V}$ | - | 170.0 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | L_E | | - | 13.0 | - | nH |

Switching Characteristic, Inductive Load

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|--------------|--|-------|------|------|------|
| | | | min. | typ. | max. | |
| IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ | | | | | | |
| Turn-off delay time | $t_{d(off)}$ | $T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 600\text{V}, I_C = 20.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 10.0\Omega, R_{G(off)} = 10.0\Omega,$ $L\sigma = 175\text{nH}, C\sigma = 40\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 260 | - | ns |
| Fall time | t_f | | - | 50 | - | ns |
| Turn-off energy | E_{off} | | - | 0.75 | - | mJ |

Resonant Switching Series

Switching Characteristic, Inductive Load

| Parameter | Symbol | Conditions | Value | | | Unit |
|--|--------------|--|-------|------|------|------|
| | | | min. | typ. | max. | |
| IGBT Characteristic, at $T_{vj} = 175^{\circ}\text{C}$ | | | | | | |
| Turn-off delay time | $t_{d(off)}$ | $T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 20.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 10.0\Omega$, $R_{G(off)} = 10.0\Omega$, $L_{\sigma} = 175\text{nH}$, $C_{\sigma} = 40\text{pF}$ L_{σ} , C_{σ} from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 350 | - | ns |
| Fall time | t_f | | - | 90 | - | ns |
| Turn-off energy | E_{off} | | - | 1.55 | - | mJ |

Resonant Switching Series

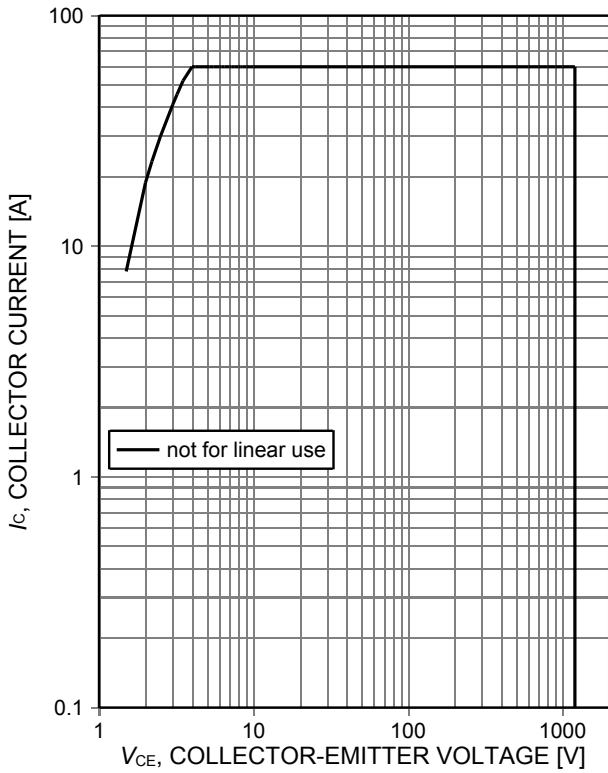


Figure 1. **Forward bias safe operating area**
 ($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$, $t_p=1\mu\text{s}$)

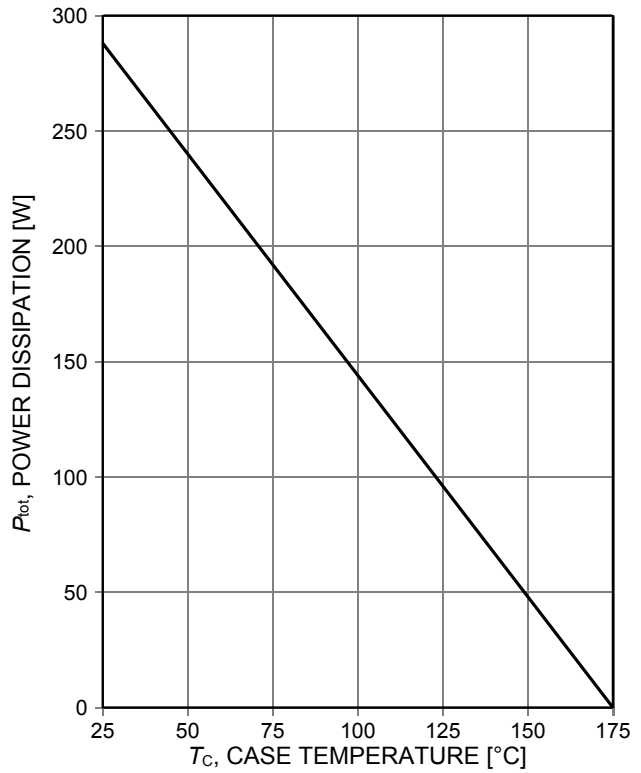


Figure 2. **Power dissipation as a function of case temperature**
 ($T_{vj}\leq 175^\circ\text{C}$)

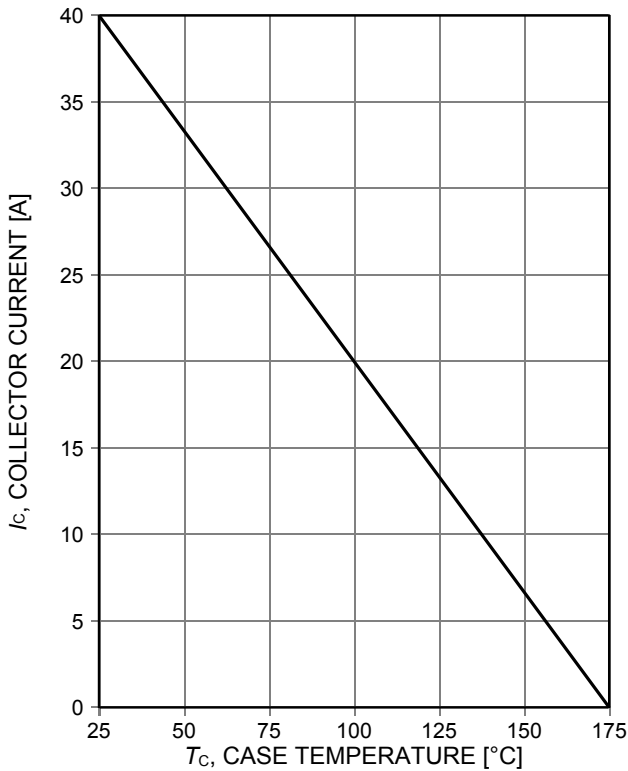


Figure 3. **Collector current as a function of case temperature**
 ($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

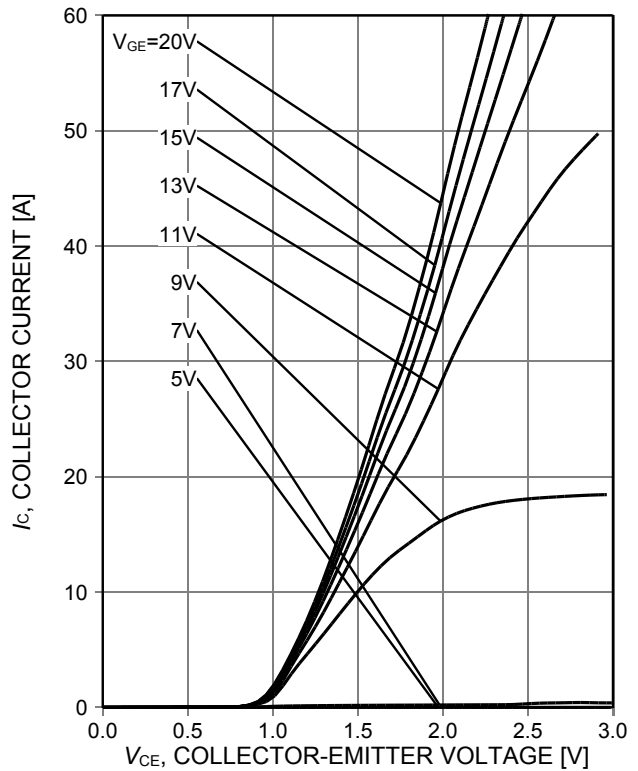


Figure 4. **Typical output characteristic**
 ($T_{vj}=25^\circ\text{C}$)

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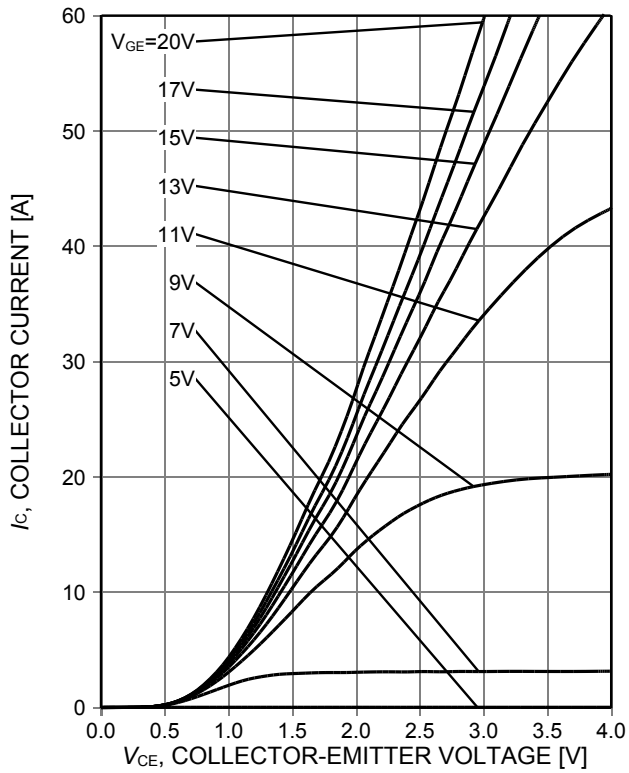


Figure 5. Typical output characteristic ($T_{vj}=175^\circ\text{C}$)

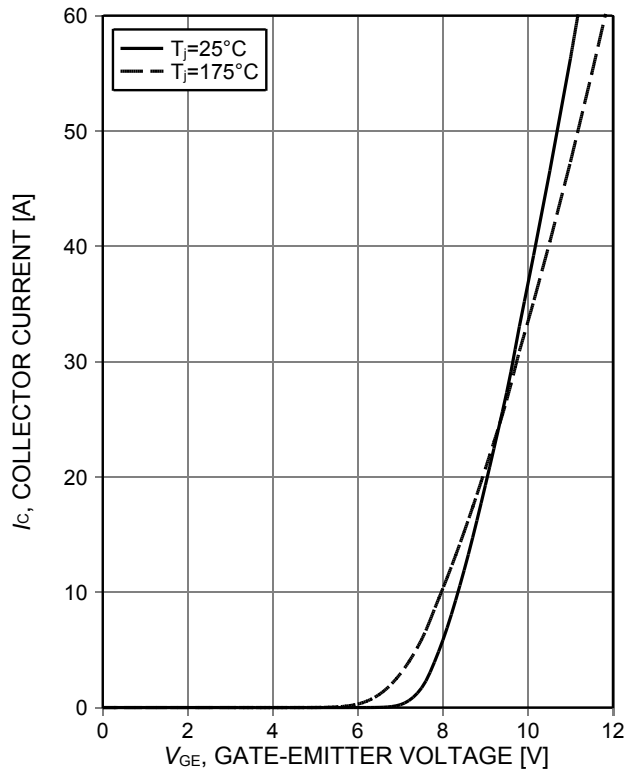


Figure 6. Typical transfer characteristic ($V_{CE}=20\text{V}$)

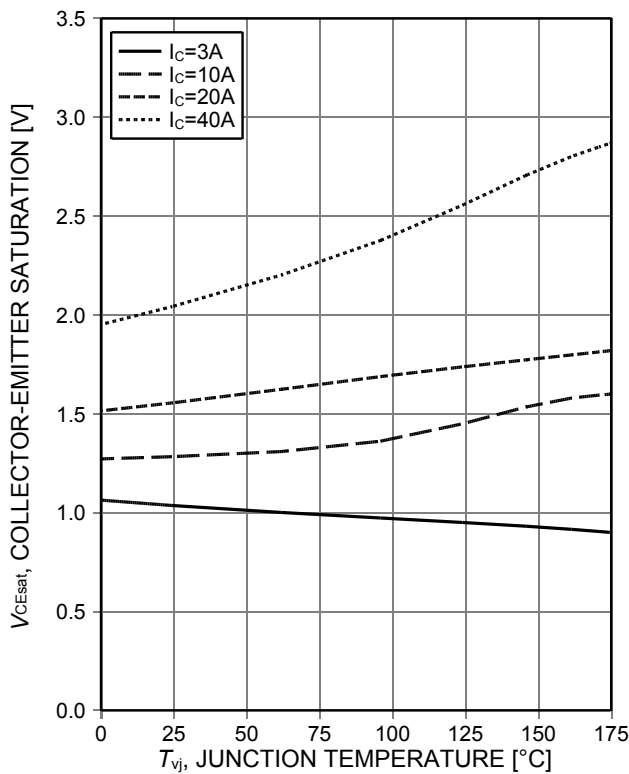


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{GE}=15\text{V}$)

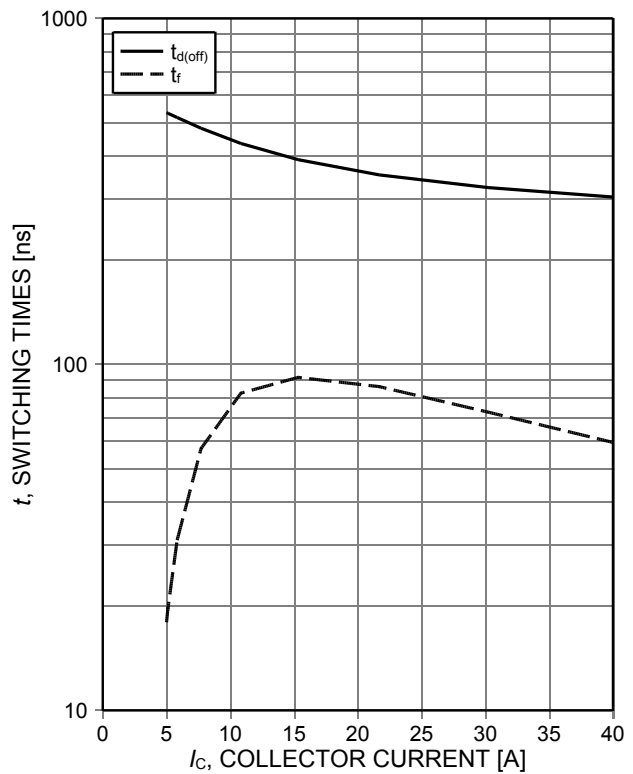


Figure 8. Typical switching times as a function of collector current (inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

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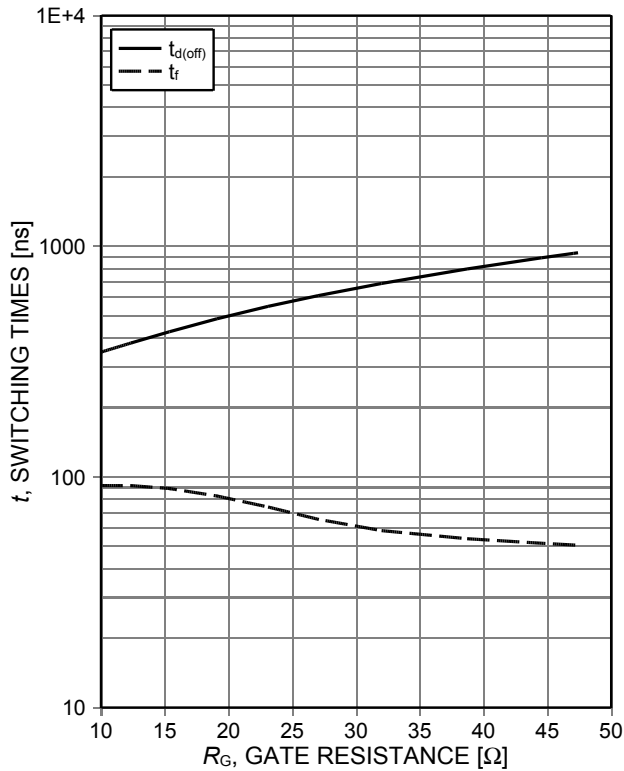


Figure 9. **Typical switching times as a function of gate resistance**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, dynamic test circuit in Figure E)

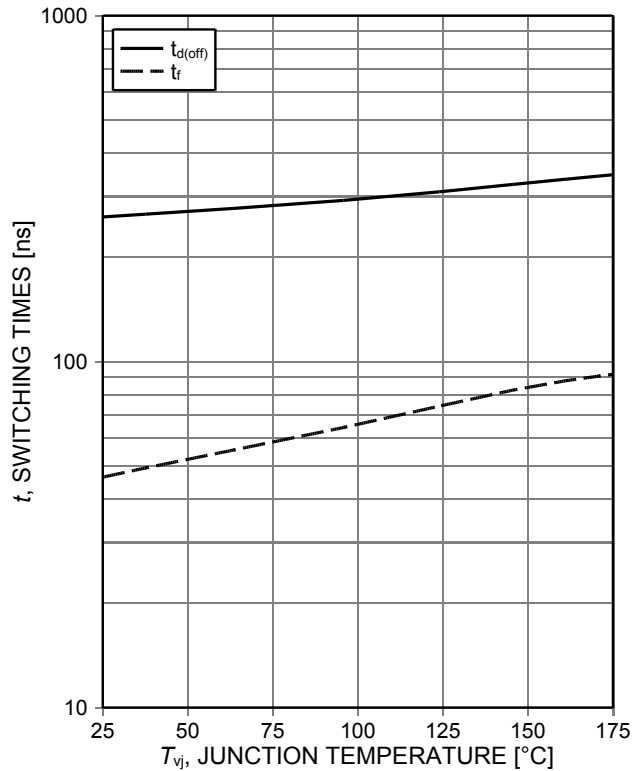


Figure 10. **Typical switching times as a function of junction temperature**
 (inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

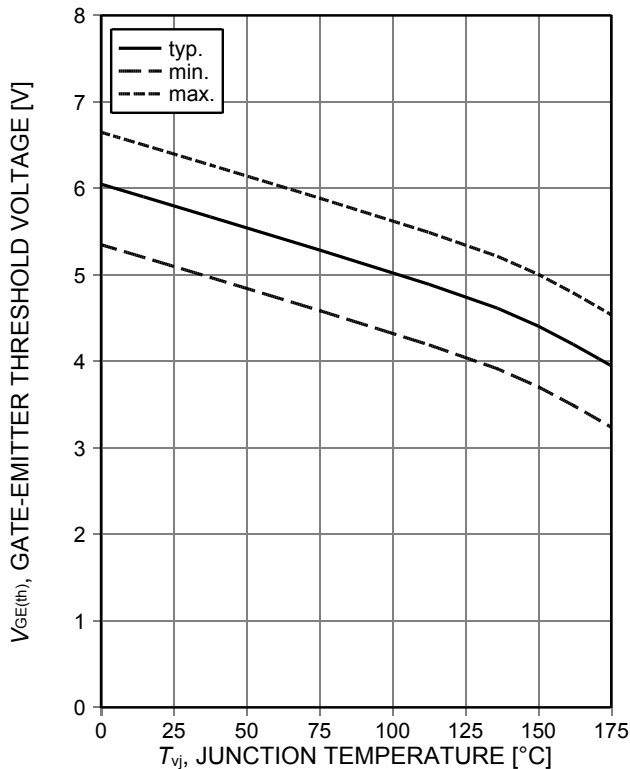


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
 ($I_C=0.5\text{mA}$, min / max values verified by chip design)

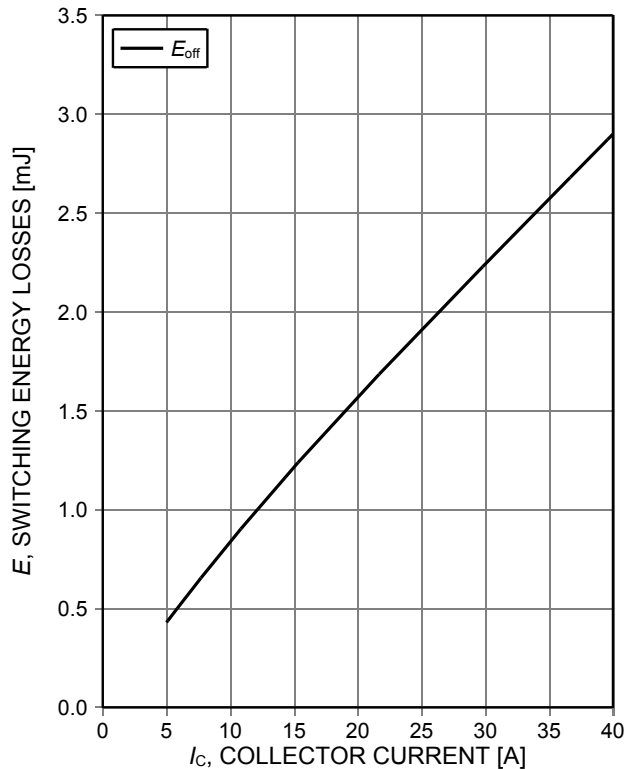


Figure 12. **Typical switching energy losses as a function of collector current**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

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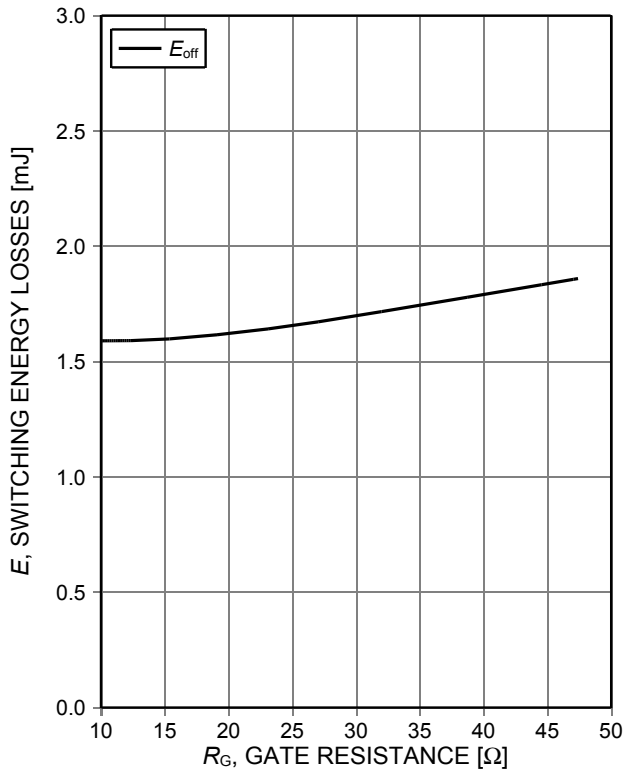


Figure 13. **Typical switching energy losses as a function of gate resistance**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, dynamic test circuit in Figure E)

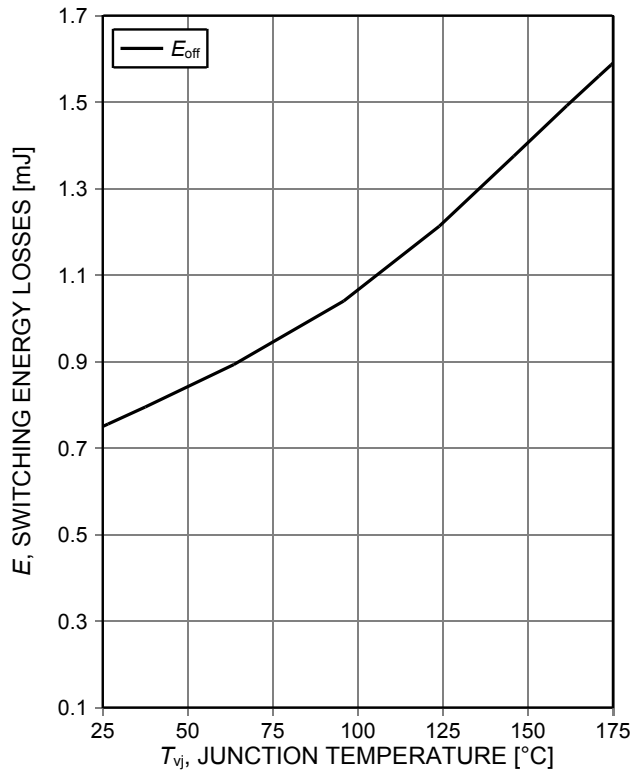


Figure 14. **Typical switching energy losses as a function of junction temperature**
 (inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

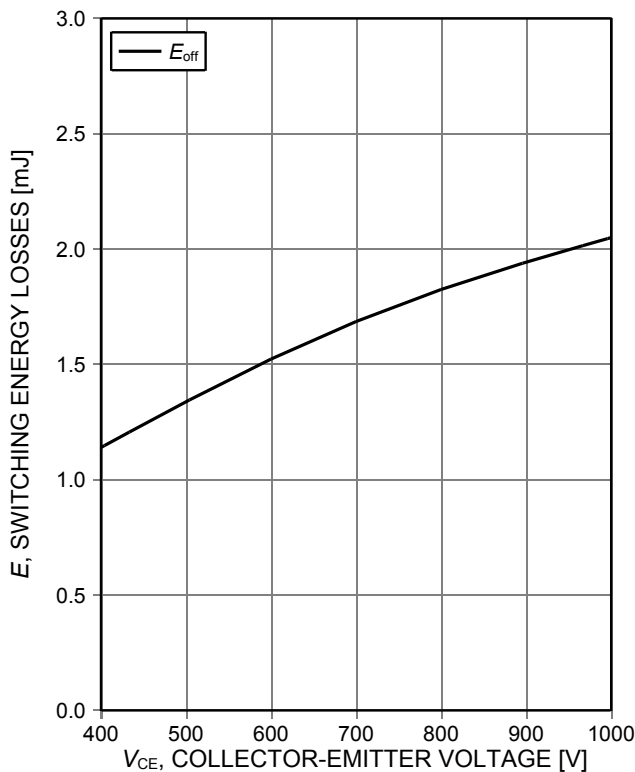


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

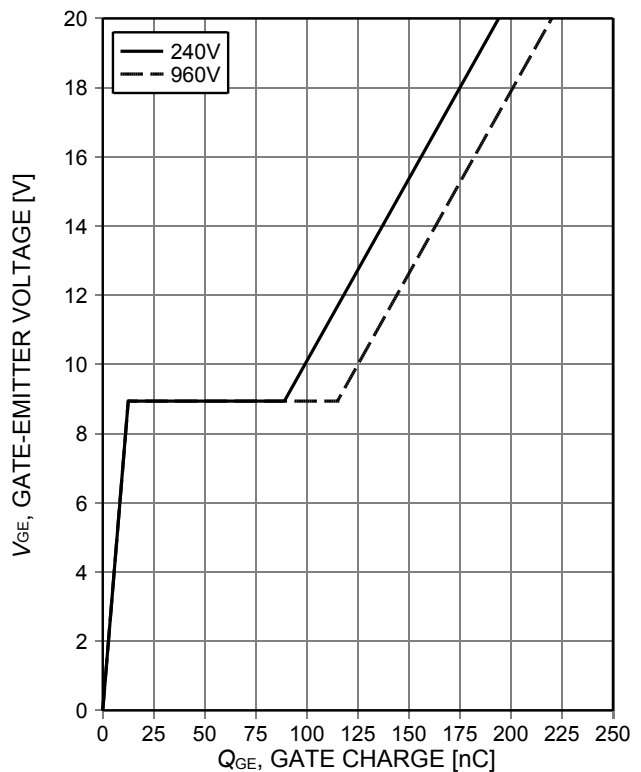


Figure 16. **Typical gate charge**
 ($I_C=20\text{A}$)

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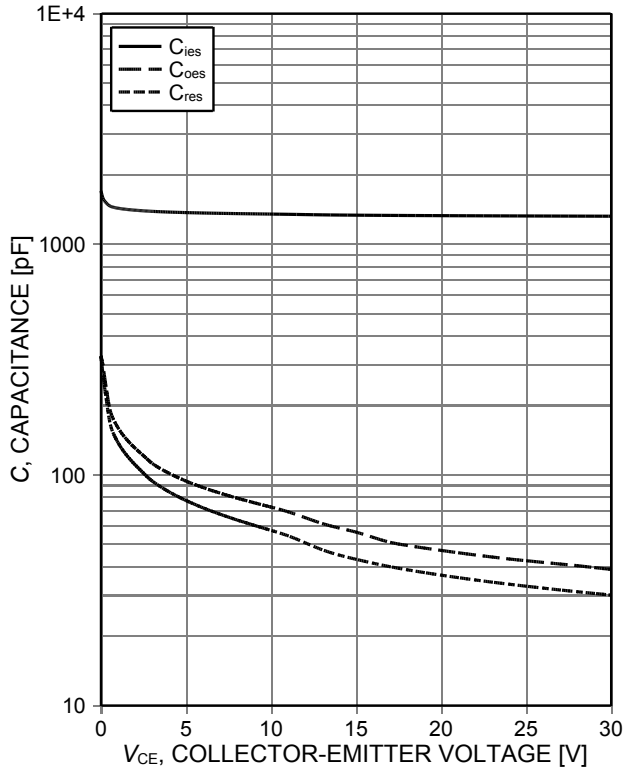


Figure 17. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V$, $f=1MHz$)

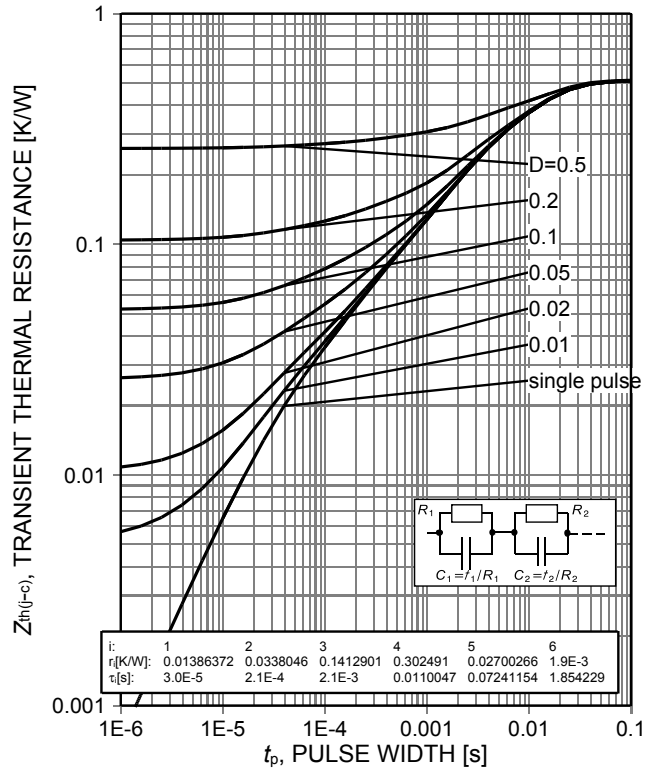


Figure 18. IGBT transient thermal resistance ($D=t_p/T$)

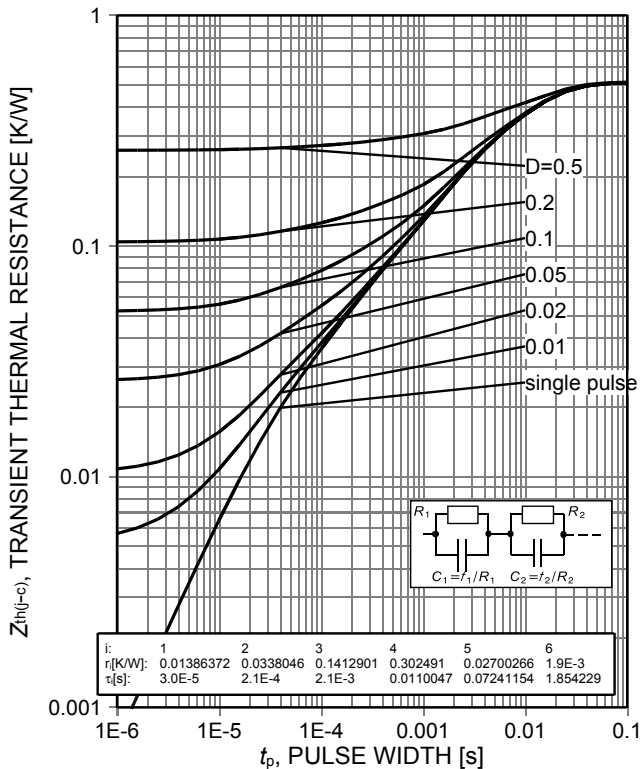


Figure 19. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

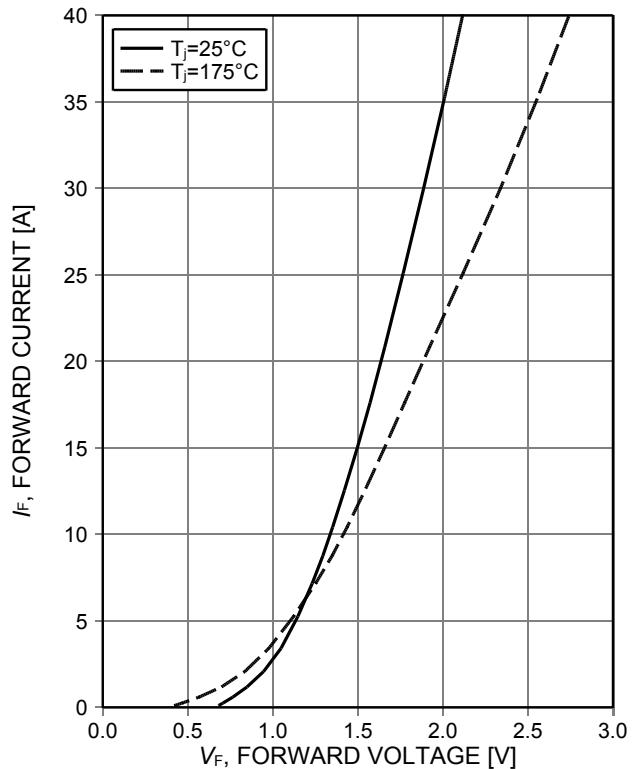


Figure 20. Typical diode forward current as a function of forward voltage

Resonant Switching Series

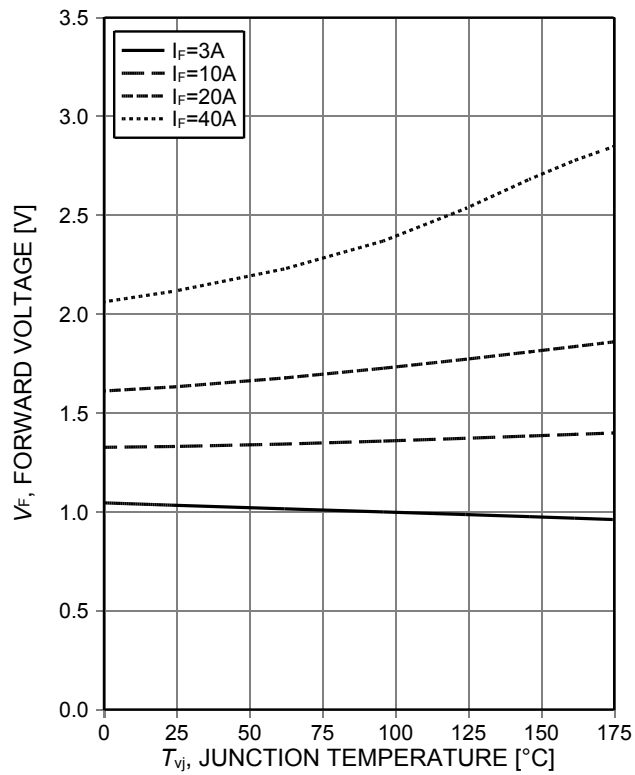
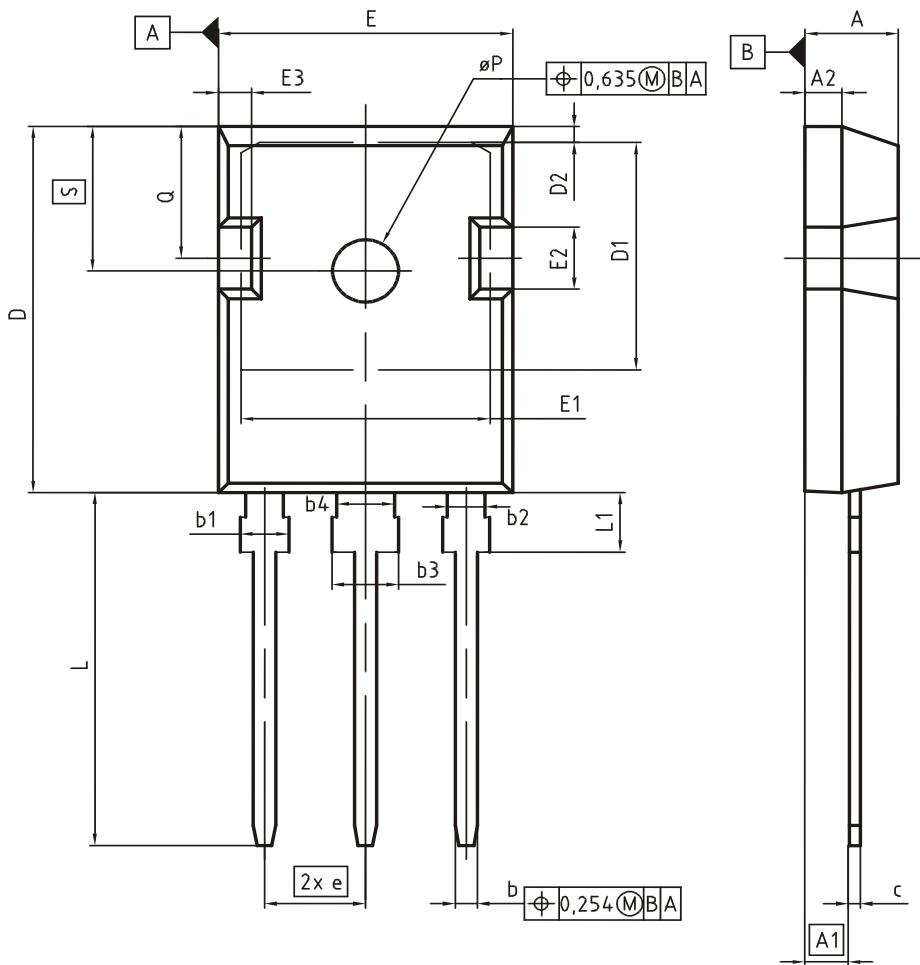


Figure 21. Typical diode forward voltage as a function of junction temperature

Package Drawing PG-TO247-3



| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.83 | 5.21 | 0.190 | 0.205 |
| A1 | 2.27 | 2.54 | 0.089 | 0.100 |
| A2 | 1.85 | 2.16 | 0.073 | 0.085 |
| b | 1.07 | 1.33 | 0.042 | 0.052 |
| b1 | 1.90 | 2.41 | 0.075 | 0.095 |
| b2 | 1.90 | 2.16 | 0.075 | 0.085 |
| b3 | 2.87 | 3.38 | 0.113 | 0.133 |
| b4 | 2.87 | 3.13 | 0.113 | 0.123 |
| c | 0.55 | 0.68 | 0.022 | 0.027 |
| D | 20.80 | 21.10 | 0.819 | 0.831 |
| D1 | 16.25 | 17.65 | 0.640 | 0.695 |
| D2 | 0.95 | 1.35 | 0.037 | 0.053 |
| E | 15.70 | 16.13 | 0.618 | 0.635 |
| E1 | 13.10 | 14.15 | 0.516 | 0.557 |
| E2 | 3.68 | 5.10 | 0.145 | 0.201 |
| E3 | 1.00 | 2.60 | 0.039 | 0.102 |
| e | 5.44 (BSC) | | 0.214 (BSC) | |
| N | 3 | | 3 | |
| L | 19.80 | 20.32 | 0.780 | 0.800 |
| L1 | 4.10 | 4.47 | 0.161 | 0.176 |
| øP | 3.50 | 3.70 | 0.138 | 0.146 |
| Q | 5.49 | 6.00 | 0.216 | 0.236 |
| S | 6.04 | 6.30 | 0.238 | 0.248 |

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EUROPEAN PROJECTION

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REVISION
05

Resonant Switching Series

Testing Conditions



Figure A. Definition of switching times

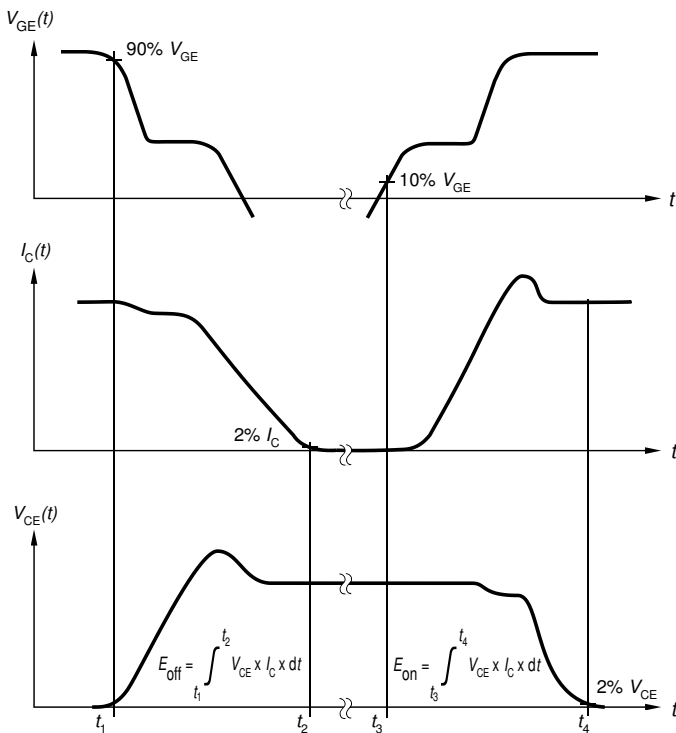


Figure B. Definition of switching losses



Figure C. Definition of diode switching characteristics



Figure D. Thermal equivalent circuit



Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

Resonant Switching Series

Revision History

IHW20N120R5

Revision: 2019-09-19, Rev. 2.2

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 1.1 | 2014-04-17 | Preliminary data sheet |
| 2.1 | 2015-01-26 | Final data sheet |
| 2.2 | 2019-09-19 | additional parameter in maximum ratings table: non repetitive peak collector current |

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