## Reverse-Conducting IGBT with monolithic body diode

### Features

- $V_{CE}$ = 1600 V
- $I_C$ = 30 A
- Powerful monolithic body diode with low forward voltage
- 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 IEC 61249-2-21)
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Lead-Free
Green
Halogen-Free
RoHS

### Potential applications

- Induction cooking
- Microwave ovens

### Product validation

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

### Description

| Type | Package | Marking |
|---|---|---|
| IHW30N160R5 | PG-TO247-3 | H30SR5 |

# Table of contents


| | | |
|---|---|---|
| | **Description** | 1 |
| | **Features** | 1 |
| | **Potential applications** | 1 |
| | **Product validation** | 1 |
| | **Table of contents** | 2 |
| **1** | **Package** | 3 |
| **2** | **IGBT** | 3 |
| **3** | **Diode** | 5 |
| **4** | **Characteristics diagrams** | 6 |
| **5** | **Package outlines** | 12 |
| **6** | **Testing conditions** | 13 |
| | **Revision history** | 14 |
| | **Disclaimer** | 15 |

# 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 | $L_E$ | | | 13.0 | | nH |
| Storage temperature | $T_{stg}$ | | -55 | | 175 | °C |
| Soldering temperature | | wave soldering 1.6 mm (0.063 in.) from case for 10 s | | | 260 | °C |
| Mounting torque | $M$ | M3 screw Maximum of mounting process: 3 | | | 0.6 | Nm |
| Thermal resistance, junction-ambient | $R_{th(j-a)}$ | | | | 40 | K/W |

# 2 IGBT

**Table 2 Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Collector-emitter voltage | $V_{CE}$ | $T_{vj} \geq 25$ °C | | 1600 | V |
| DC collector current, limited by $T_{vjmax}$ | $I_C$ | | $T_c = 25$ °C | 60 | A |
| | | | $T_c = 100$ °C | 39 | |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpulse}$ | | | 90 | A |
| Non repetitive peak collector current[1)] | $I_{CSM}$ | | | 200 | A |
| Turn-off safe operating area | | $V_{CE} = 1600$ V, $t_p = 1$ µs, $T_{vj} \leq 175$ °C | | 90 | A |
| Gate-emitter voltage | $V_{GE}$ | | | ±20 | V |
| Transient gate-emitter voltage | $V_{GE}$ | $t_p \leq 10$ µs, $D < 0.01$ | | ±25 | V |
| Power dissipation | $P_{tot}$ | | $T_c = 25$ °C | 263 | W |
| | | | $T_c = 100$ °C | 131.5 | |

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

**Table 3 Characteristic values**

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Collector-emitter breakdown voltage | $V_{BRCES}$ | $I_C = 0.5$ mA, $V_{GE} = 0$ V | 1600 | | | V |

**(table continues...)**

**Table 3 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $I_C$ = 30 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 1.85 | 2.15 | V |
| | | | $T_{vj}$ = 125 °C | | 2.2 | | |
| | | | $T_{vj}$ = 175 °C | | 2.4 | | |
| Gate-emitter threshold voltage | $V_{GEth}$ | $I_C$ = 0.75 mA, $V_{CE}$ = $V_{GE}$ | | 4.5 | 5.1 | 5.8 | V |
| Zero gate-voltage collector current | $I_{CES}$ | $V_{CE}$ = 1600 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 100 | µA |
| | | | $T_{vj}$ = 175 °C | | 800 | | |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = 20 V | | | | 100 | nA |
| Transconductance | $g_{fs}$ | $I_C$ = 30 A, $V_{CE}$ = 20 V | | | 20.5 | | S |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 1500 | | pF |
| Output capacitance | $C_{oes}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 42 | | pF |
| Reverse transfer capacitance | $C_{res}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 38 | | pF |
| Gate charge | $Q_G$ | $I_C$ = 30 A, $V_{GE}$ = 15 V, $V_{CC}$ = 1280 V | | | 205 | | nC |
| Turn-off delay time | $t_{doff}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{Gon}$ = 10 Ω, $R_{Goff}$ = 10 Ω, $L_\sigma$ = 175 nH, $C_\sigma$ = 40 pF | $T_{vj}$ = 25 °C, $I_C$ = 30 A | | 290 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 30 A | | 330 | | |
| Fall time (inductive load) | $t_f$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{Gon}$ = 10 Ω, $R_{Goff}$ = 10 Ω, $L_\sigma$ = 175 nH, $C_\sigma$ = 40 pF | $T_{vj}$ = 25 °C, $I_C$ = 30 A | | 47 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 30 A | | 81 | | |
| Turn-off energy | $E_{off}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{Gon}$ = 10 Ω, $R_{Goff}$ = 10 Ω, $L_\sigma$ = 175 nH, $C_\sigma$ = 40 pF | $T_{vj}$ = 25 °C, $I_C$ = 30 A | | 2 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 30 A | | 3 | | |
| Total switching energy | $E_{ts}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{Gon}$ = 10 Ω, $R_{Goff}$ = 10 Ω, $L_\sigma$ = 175 nH, $C_\sigma$ = 40 pF | $I_C$ = 30 A | | 0.35 | | mJ |
| | | | $I_C$ = 30 A | | 1.27 | | |
| Soft turn-off energy | $E_{off}$ | $V_{CC}$ = 600 V, $dv/dt$ = 300 V/µs | $T_{vj}$ = 25 °C | | 0.35 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 1.27 | | |
| IGBT thermal resistance, junction to case | $R_{thjc}$ | | | | | 0.57 | K/W |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

*Note: Electrical Characteristic, at $T_{vj}$ = 25°C, unless otherwise specified.*

# 3 Diode

**Table 4 Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Repetitive peak reverse voltage | $V_{RRM}$ | $T_{vj} \geq 25$ °C | | 1600 | V |
| Diode forward current, limited by $T_{vjmax}$ | $I_F$ | | $T_c = 25$ °C | 55 | A |
| | | | $T_c = 100$ °C | 36 | |
| Diode pulsed current, limited by $T_{vjmax}$ | $I_{Fpulse}$ | | | 90 | A |

**Table 5 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode forward voltage | $V_F$ | $I_F = 30$ A | $T_{vj} = 25$ °C | | 2 | 2.3 | V |
| | | | $T_{vj} = 125$ °C | | 2.4 | | |
| | | | $T_{vj} = 175$ °C | | 2.6 | | |
| Diode thermal resistance, junction to case | $R_{thjc}$ | | | | | 0.57 | K/W |
| 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.*

# 4 Characteristics diagrams

**Reverse bias safe operating area**
$I_C = f(V_{CE})$
$D = 0$ , $T_{vj} \leq 175$ °C, $V_{GE} = 15$ V, $T_c = 25$ °C

**Power dissipation as a function of case temperature**
$P_{tot} = f(T_c)$
$T_{vj} \leq 175$ °C

**Collector current as a function of heatsink temperature**
$I_C = f(T_c)$
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V

**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 25$ °C

**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 150\ °C$

**Typical transfer characteristic**
$I_C = f(V_{GE})$
$V_{CE} = 20\ V$

**Typical collector-emitter saturation voltage as a function of junction temperature**
$V_{CEsat} = f(T_{vj})$
$V_{GE} = 15\ V$

**Typical switching times as a function of collector current**
$t = f(I_C)$
$V_{CC} = 600\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$, $R_G = 10\ \Omega$

**Typical switching times as a function of gate resistor**
$t = f(R_G)$
$I_C = 30$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V

**Typical switching times as a function of junction temperature**
$t = f(T_{vj})$
$I_C = 30$ A, $V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$

**Gate-emitter threshold voltage as a function of junction temperature**
$V_{GEth} = f(T_{vj})$
$I_C = 0.75$ mA

**Typical switching energy losses as a function of collector current**
$E = f(I_C)$
$V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$

**Typical switching energy losses as a function of gate resistor**

$E = f(R_G)$

$I_C = 30$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V

**Typical switching energy losses as a function of junction temperature**

$E = f(T_{vj})$

$I_C = 30$ A, $V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$

**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

$I_C = 30$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$

**Typical resonant switching energy losses as a function of collector current**

$E = f(I_C)$

$V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$

### Typical gate charge

$V_{GE} = f(Q_{GE})$

$I_C = 30$ A

### Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

$f = 1000$ kHz, $V_{GE} = 0$ V

### IGBT transient thermal impedance as a function of pulse width

$Z_{th} = f(t_p)$

$D = t_p/T$

### Diode transient thermal impedance as a function of pulse width

$Z_{th} = f(t_p)$

$D = t_p/T$

| **Typical diode forward current as a function of forward voltage**<br>$I_F = f(V_F)$ | **Typical diode forward voltage as a function of junction temperature**<br>$V_F = f(T_{vj})$ |
|---|---|
| | |

# 5 Package outlines

## Package Drawing PG-TO247-3

| DIMENSIONS | MILLIMETERS | |
|---|---|---|
| | MIN. | MAX. |
| **A** | 4.70 | 5.30 |
| **A1** | 2.20 | 2.60 |
| **A2** | 1.50 | 2.50 |
| **b** | 1.00 | 1.40 |
| **b1** | 1.60 | 2.41 |
| **b2** | 2.57 | 3.43 |
| **c** | 0.38 | 0.89 |
| **D** | 20.70 | 21.50 |
| **D1** | 13.08 | 17.65 |
| **D2** | 0.51 | 1.35 |
| **E** | 15.50 | 16.30 |
| **E1** | 12.38 | 14.15 |
| **E2** | 3.40 | 5.10 |
| **E3** | 1.00 | 2.60 |
| **e** | 5.44 | |
| **L** | 19.80 | 20.40 |
| **L1** | 3.85 | 4.50 |
| **P** | 3.50 | 3.70 |
| **Q** | 5.35 | 6.25 |
| **S** | 6.04 | 6.30 |

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**Figure 1**

# 6 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 $L_\sigma$,
parasitic capacitor $C_\sigma$,
relief capacitor $C_r$,
(only for ZVT switching)

**Figure 2**

## Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| V2.1 | 2018-08-28 | Final Data Sheet |
| V2.2 | 2019-09-19 | additional parameter in maximum ratings table: non repetitive peak collector current |
| n/a | 2020-11-30 | Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy |
| 1.10 | 2022-04-05 | “Forward bias safe operating area” diagram renamed to “Reverse bias safe operating area”<br>$T_{vj}$ condition in table “Maximum rated values ” of IGBT at “Turn off safe operating area” changed to 175°C |

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