# STGW20H60DF, STGWT20H60DF

## 600 V, 20 A high speed trench gate field-stop IGBT

**Datasheet - production data**

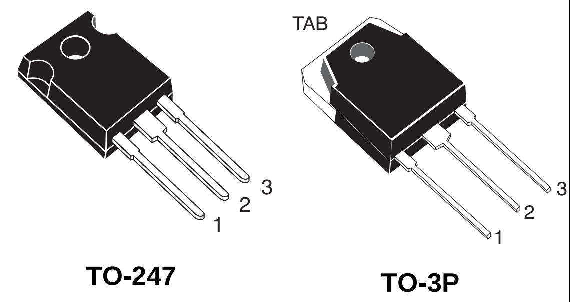
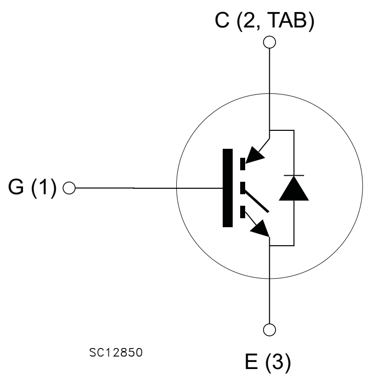



**Figure 1. Internal schematic diagram**




## Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Ultrafast soft recovery antiparallel diode

## Applications

- Motor control
- UPS, PFC

## Description

This device is an IGBT developed using an advanced proprietary trench gate and field stop structure. This IGBT series offers the optimum compromise between conduction and switching losses, maximizing the efficiency of very high frequency converters. Furthermore, a positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in easier paralleling operation.

**Table 1. Device summary**

| Order codes | Marking | Packages | Packaging |
|---|---|---|---|
| STGW20H60DF | GW20H60DF | TO-247 | Tube |
| STGWT20H60DF | GWT20H60DF | TO-3P | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage ($V_{GE}$ = 0) | 600 | V |
| $I_C$ | Continuous collector current at $T_C$ = 25 °C | 40 | A |
| | Continuous collector current at $T_C$ = 100 °C | 20 | A |
| $I_{CP}$ (1) | Pulsed collector current | 80 | A |
| $V_{GE}$ | Gate-emitter voltage | ±20 | V |
| $I_F$ | Continuous forward current $T_C$ = 25 °C | 40 | A |
| | Continuous forward current at $T_C$ = 100 °C | 20 | |
| $I_{FP}$(2) | Pulsed forward current | 80 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 167 | W |
| $T_{STG}$ | Storage temperature range | - 55 to 150 | °C |
| $T_J$ | Operating junction temperature | - 55 to 175 | |

1. Limited by maximum junction temperature.
2. Pulse width limited by maximum junction temperature and turn-off within RBSOA.

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJC}$ | Thermal resistance junction-case IGBT | 0.9 | °C/W |
| $R_{thJC}$ | Thermal resistance junction-case diode | 2.5 | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 62.5 | °C/W |

# 2 Electrical characteristics

$T_J$ = 25 °C unless otherwise specified.

**Table 4. Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage ($V_{GE}$ = 0) | $I_C$ = 2 mA | 600 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 20 A | | 1.6 | 2.0 | V |
| | | $V_{GE}$ = 15 V, $I_C$ = 20 A $T_J$ = 125 °C | | 1.75 | | |
| | | $V_{GE}$ = 15 V, $I_C$ = 20 A $T_J$ = 175 °C | | 1.8 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA | 5 | 6 | 7 | V |
| $I_{CES}$ | Collector cut-off current ($V_{GE}$ = 0) | $V_{CE}$ = 600 V | | | 25 | µA |
| $I_{GES}$ | Gate-emitter leakage current ($V_{CE}$ = 0) | $V_{GE}$ = ± 20 V | | | 250 | nA |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 25 V, f = 1 MHz, $V_{GE}$ = 0 | - | 2750 | - | pF |
| $C_{oes}$ | Output capacitance | | - | 110 | - | pF |
| $C_{res}$ | Reverse transfer capacitance | | - | 65 | - | pF |
| $Q_g$ | Total gate charge | $V_{CC}$ = 400 V, $I_C$ = 20 A, $V_{GE}$ = 15 V | - | 115 | - | nC |
| $Q_{ge}$ | Gate-emitter charge | | - | 22 | - | nC |
| $Q_{gc}$ | Gate-collector charge | | - | 45 | - | nC |

**Table 6. Switching characteristics (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V | | 42.5 | - | ns |
| $t_r$ | Current rise time | | | 11.9 | - | ns |
| (di/dt)on | Turn-on current slope | | | 1345 | - | A/μs |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V $T_J$ = 175 °C | | 42.5 | - | ns |
| $t_r$ | Current rise time | | | 13.4 | | ns |
| (di/dt)on | Turn-on current slope | | | 1180 | | A/μs |
| $t_{r(Voff)}$ | Off voltage rise time | $V_{CE}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V | | 20 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 177 | - | ns |
| $t_f$ | Current fall time | | | 55 | - | ns |
| $t_{r(Voff)}$ | Off voltage rise time | $V_{CE}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V $T_J$ = 175 °C | | 26 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 173 | - | ns |
| $t_f$ | Current fall time | | | 86 | - | ns |
| $t_{sc}$ | Short-circuit withstand time | $V_{CC} \leq$ 360 V, $V_{GE}$ = 15 V | 3 | 5 | - | μs |

**Table 7. Switching energy (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Eon (1) | Turn-on switching losses | $V_{CE}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V | - | 209 | - | μJ |
| $E_{off}$ (2) | Turn-off switching losses | | - | 261 | - | μJ |
| $E_{ts}$ | Total switching losses | | - | 470 | - | μJ |
| Eon (1) | Turn-on switching losses | $V_{CE}$ = 400 V, $I_C$ = 20 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V $T_J$ = 175 °C | - | 480 | - | μJ |
| $E_{off}$ (2) | Turn-off switching losses | | - | 416 | - | μJ |
| $E_{ts}$ | Total switching losses | | - | 896 | - | μJ |

1. Energy losses include reverse recovery of the diode.
2. Turn-off losses include also the tail of the collector current.

Table 8. Collector-emitter diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward on-voltage | $I_F$ = 20 A<br>$I_F$ = 20 A, $T_J$ = 175 °C | - | 1.8<br>1.3 | 2.2 | V<br>V |
| $t_{rr}$ | Reverse recovery time | $V_r$ = 60 V; IF = 20 A;<br>$di_F/dt$ = 100 A / µs | - | 90 | - | ns |
| $Q_{rr}$ | Reverse recovery charge | | | 110 | | nC |
| $I_{rrm}$ | Reverse recovery current | | | 2.4 | | A |
| $t_{rr}$ | Reverse recovery time | $V_r$ = 60 V; IF = 20 A;<br>$di_F/dt$ = 100 A / µs<br>$T_J$ = 175 °C | - | 180 | - | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 466 | - | nC |
| $I_{rrm}$ | Reverse recovery current | | - | 5.2 | - | A |

## 2.1 Electrical characteristics (curves)

**Figure 2. Output characteristics ($T_J$ = 25°C)**

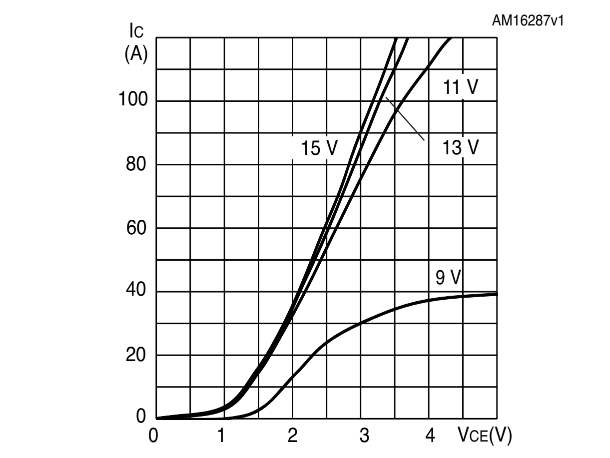



**Figure 3. Output characteristics ($T_J$ = 175°C)**

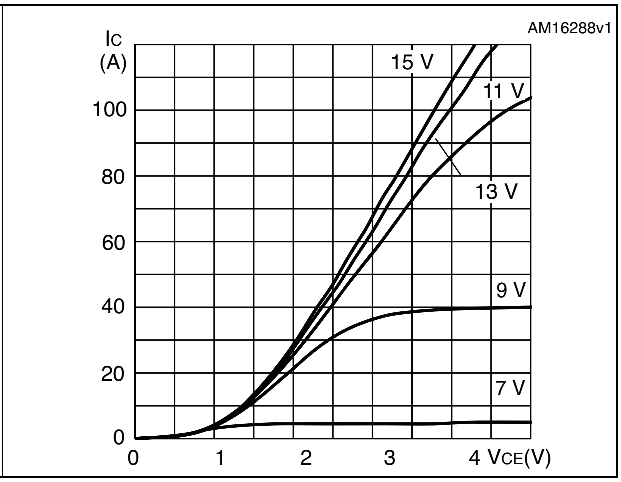



**Figure 4. Transfer characteristics**

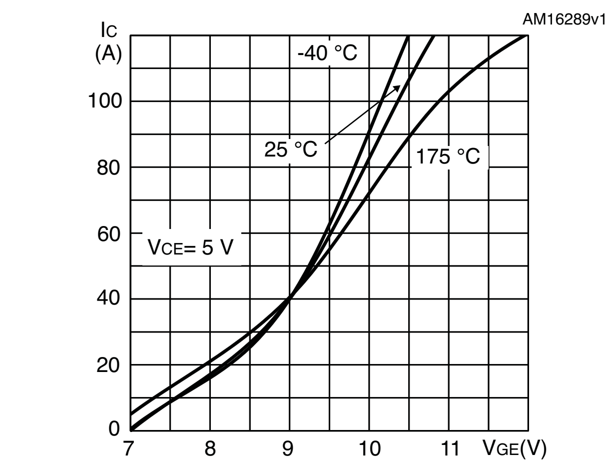



**Figure 5. Normalized $V_{GE(th)}$ vs junction temperature**

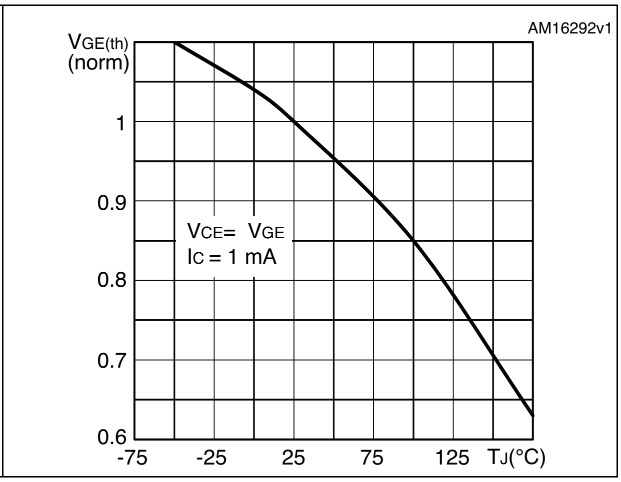


**Figure 6. Collector current vs. case temperature**

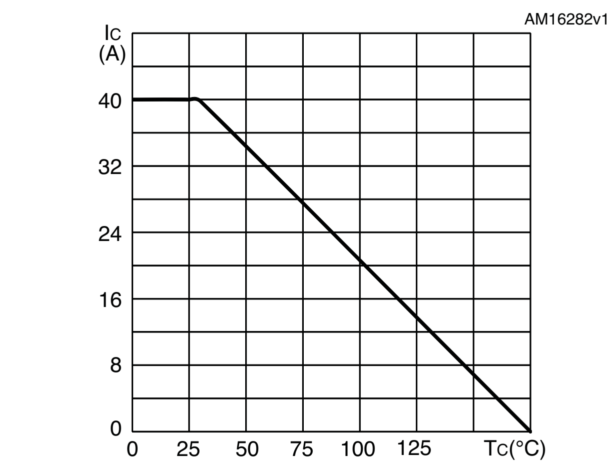



**Figure 7. Collector current vs. frequency**

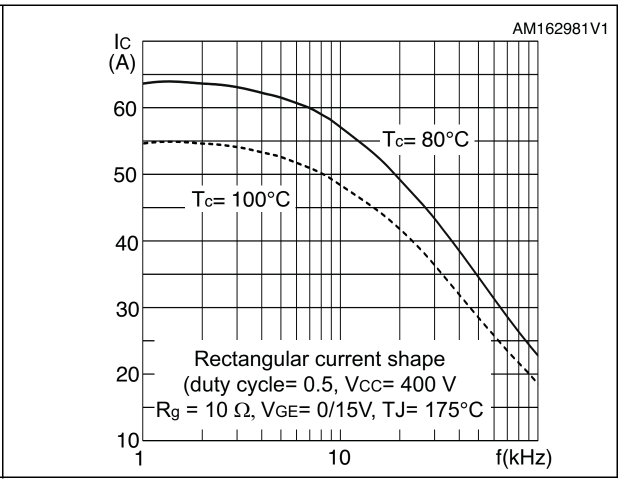



**Figure 8. $V_{CE(sat)}$ vs. junction temperature**

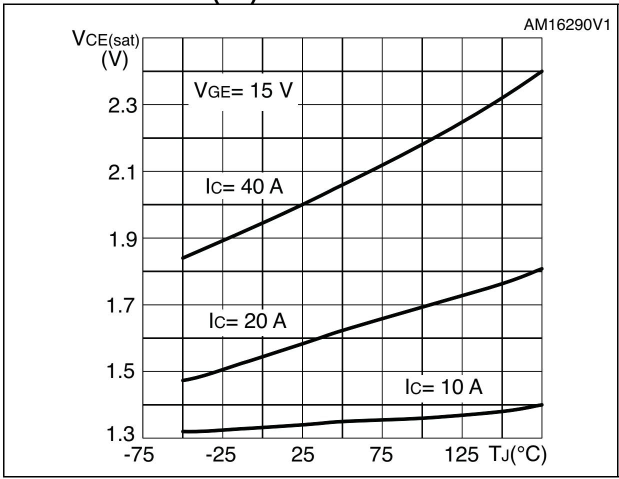



**Figure 9. $V_{CE(sat)}$ vs. collector current**

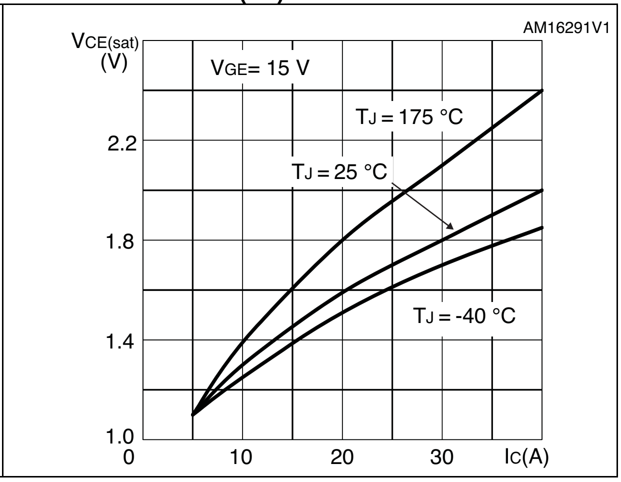



**Figure 10. Forward bias safe operating area**

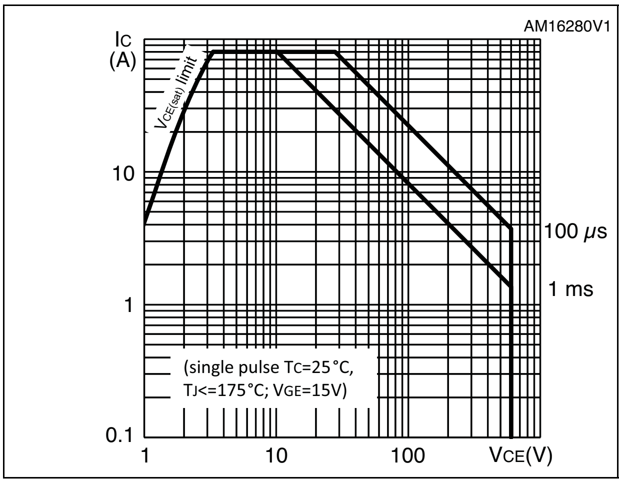



**Figure 11. Thermal impedance**

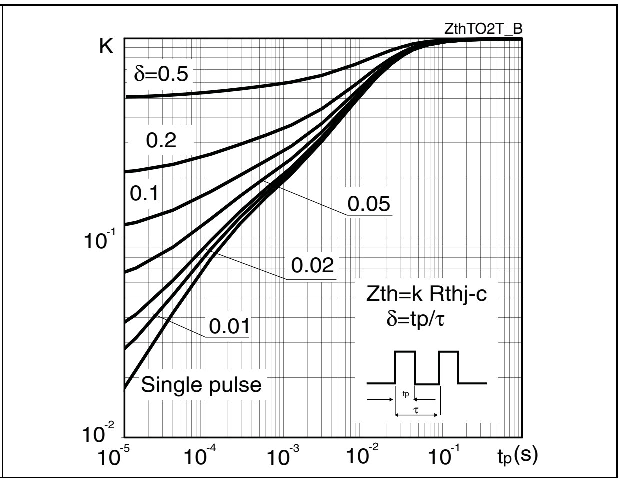


**Figure 12. Diode $V_F$ vs. forward current**

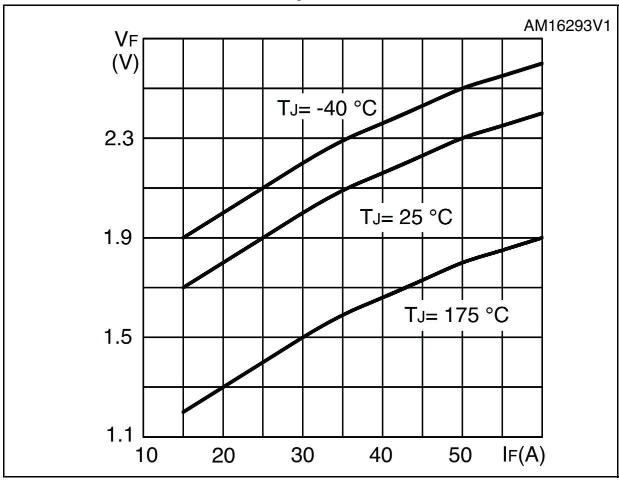



**Figure 13. Gate charge vs. gate-emitter voltage**

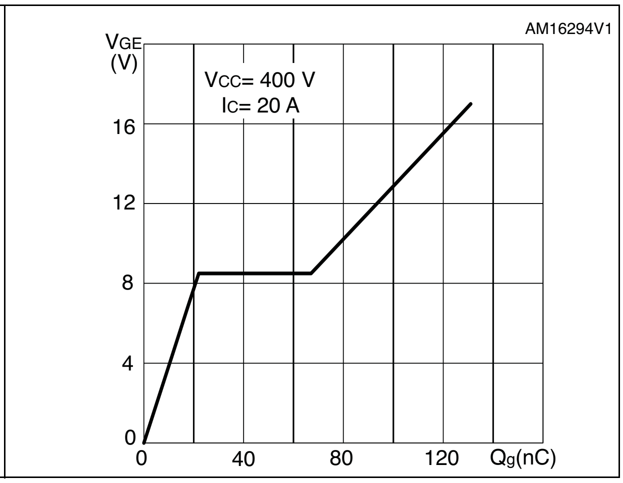



**Figure 14. Capacitance variations vs. $V_{CE}$**

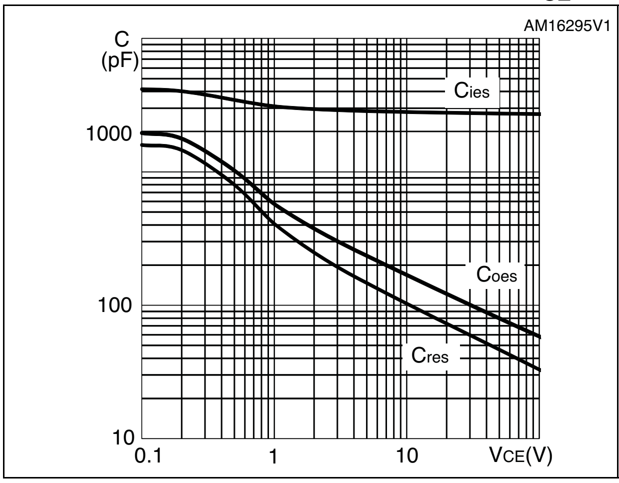



**Figure 15. Switching losses vs. gate resistance**

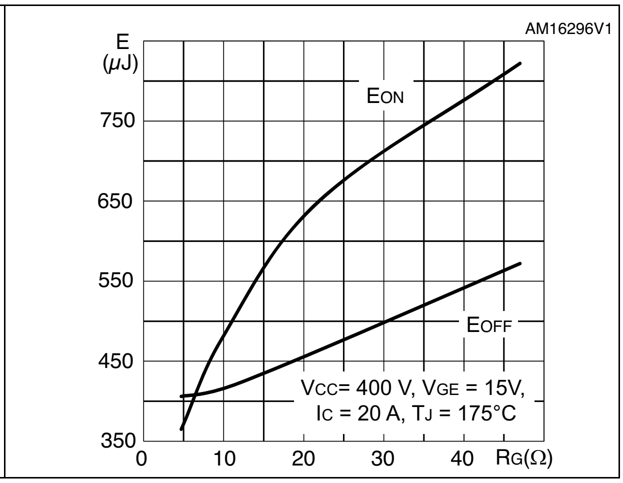



**Figure 16. Switching losses vs. collector current**

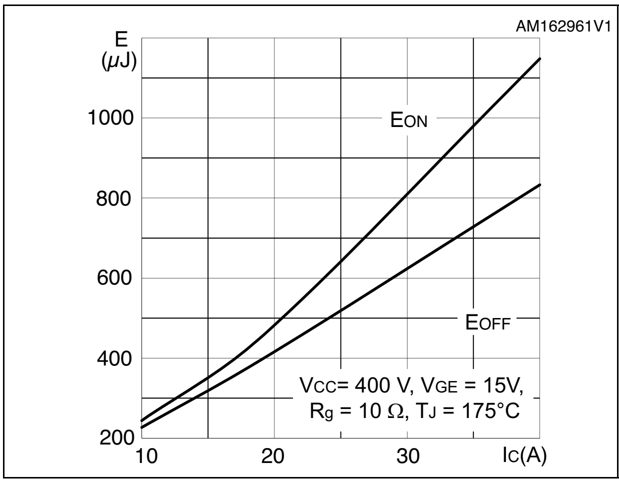



**Figure 17. Switching losses vs. temperature**

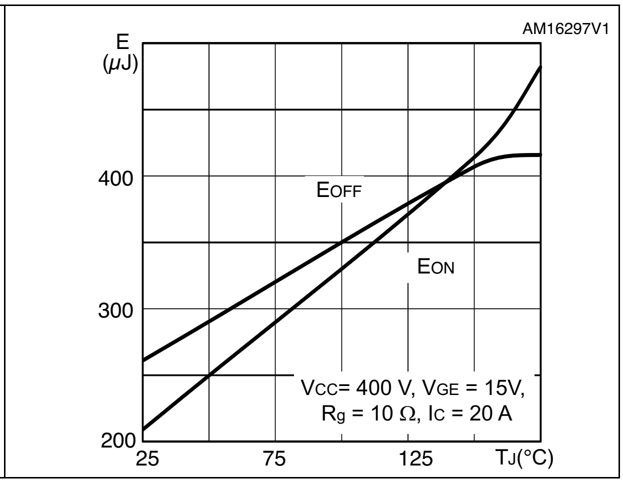


**Figure 18. Short-circuit time and current vs. $V_{GE}$**

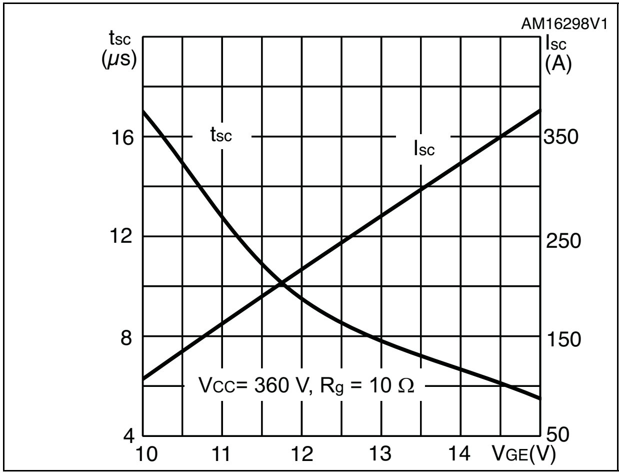
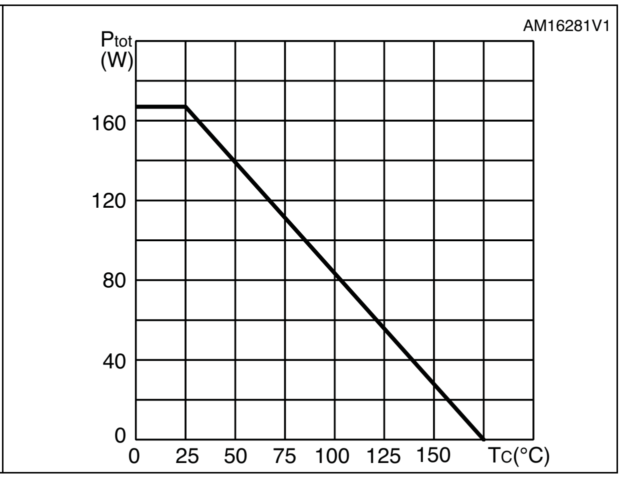



**Figure 19. Power dissipation vs. case temperature**



# 3 Test circuits

**Figure 20. Test circuit for inductive load switching**

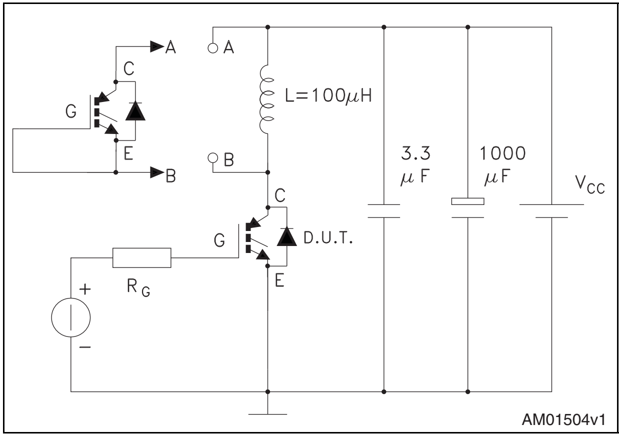



**Figure 21. Gate charge test circuit**

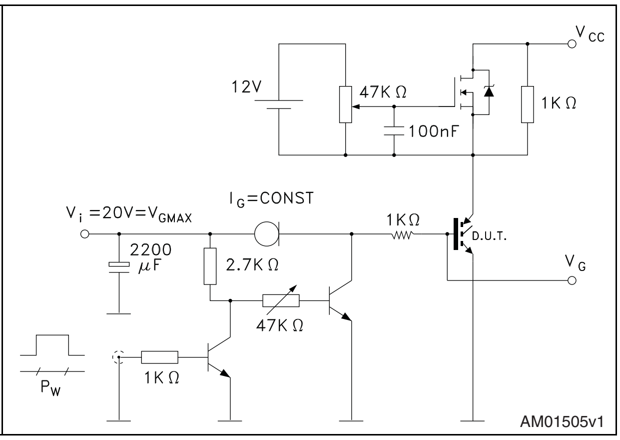



**Figure 22. Switching waveform**

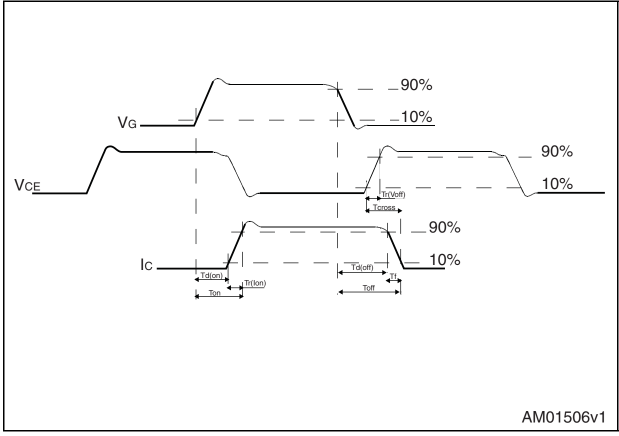
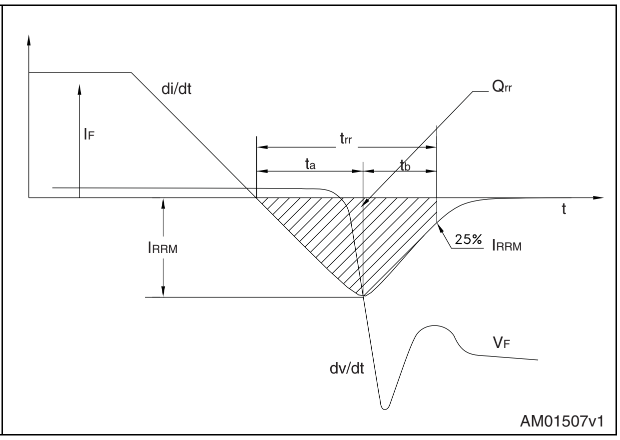



**Figure 23. Diode recovery time waveform**



# 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

**Table 9. TO-247 mechanical data**

| Dim. | mm. | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ∅P | 3.55 | | 3.65 |
| ∅R | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

**Figure 24. TO-247 drawing**

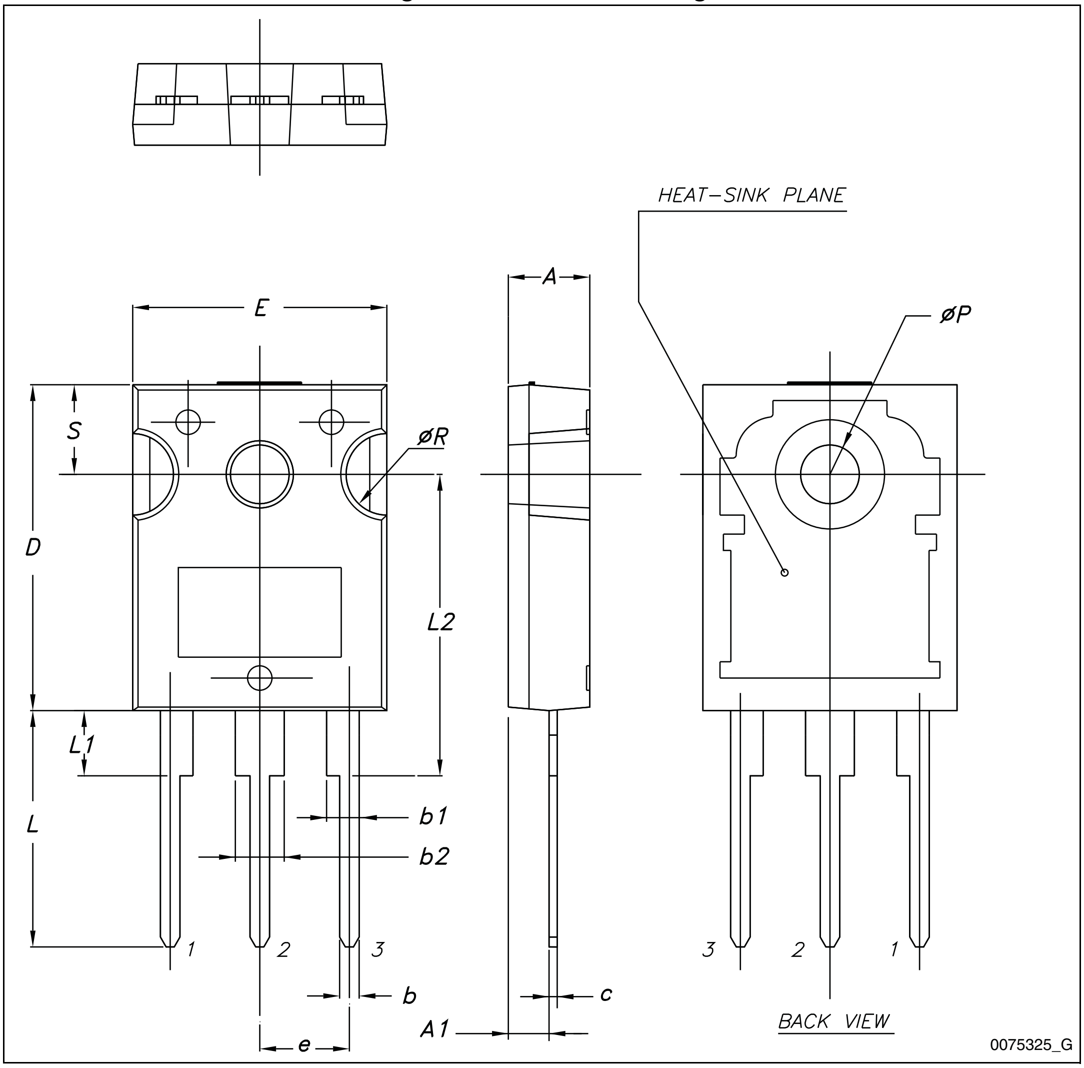
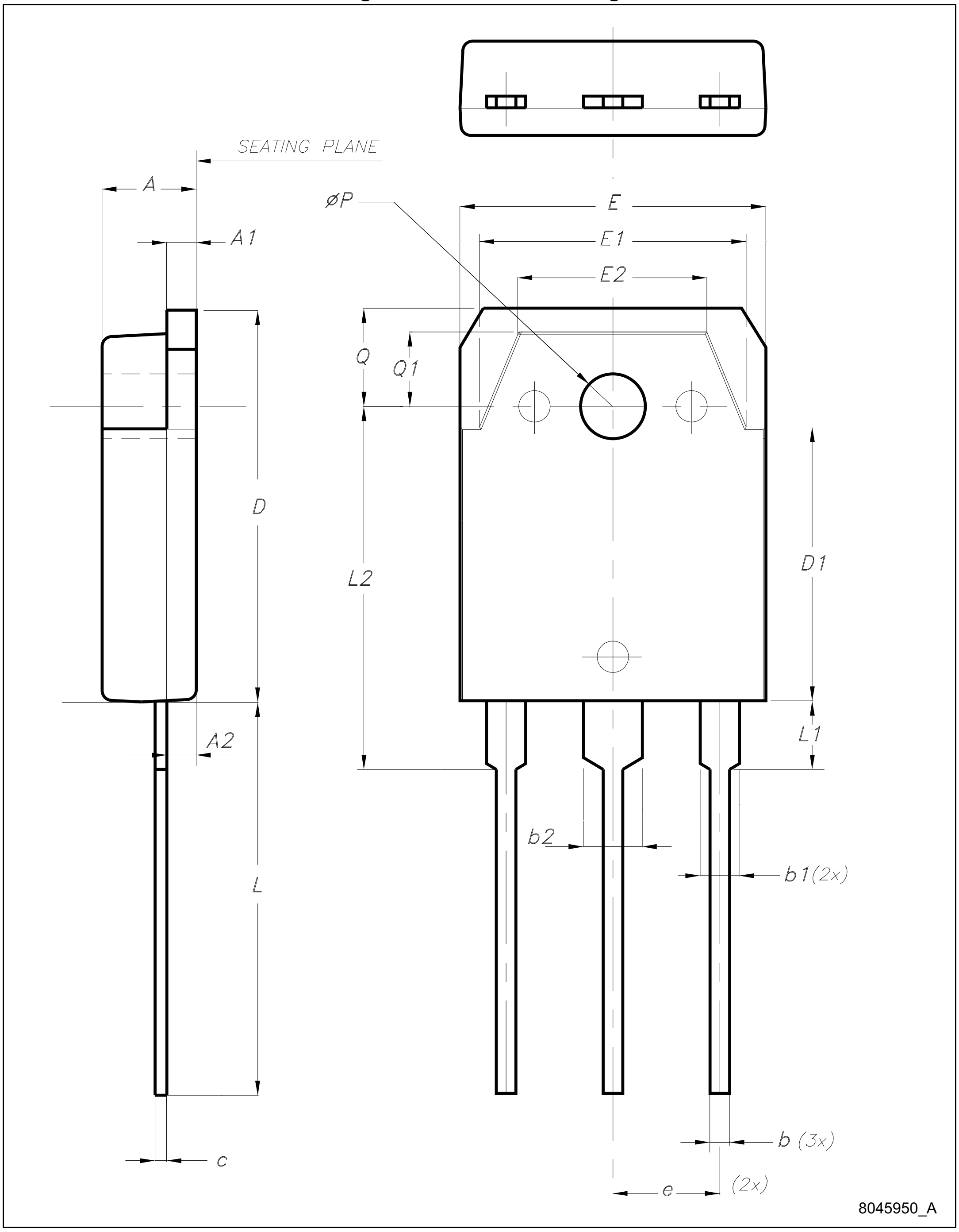


**Table 10. TO-3P mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.60 | | 5 |
| A1 | 1.45 | 1.50 | 1.65 |
| A2 | 1.20 | 1.40 | 1.60 |
| b | 0.80 | 1 | 1.20 |
| b1 | 1.80 | | 2.20 |
| b2 | 2.80 | | 3.20 |
| c | 0.55 | 0.60 | 0.75 |
| D | 19.70 | 19.90 | 20.10 |
| D1 | | 13.90 | |
| E | 15.40 | | 15.80 |
| E1 | | 13.60 | |
| E2 | | 9.60 | |
| e | 5.15 | 5.45 | 5.75 |
| L | 19.50 | 20 | 20.50 |
| L1 | | 3.50 | |
| L2 | 18.20 | 18.40 | 18.60 |
| øP | 3.10 | | 3.30 |
| Q | | 5 | |
| Q1 | | 3.80 | |

**Figure 25. TO-3P drawing**



# 5 Revision history

**Table 11. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 06-Jun-2013 | 1 | Initial release. |

Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.


**Как с нами связаться**

**Телефон:** 8 (812) 309 58 32 (многоканальный)
**Факс:** 8 (812) 320-02-42
**Электронная почта:** org@eplast1.ru
**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.