STGW60H65F

60 A, 650 V field stop trench gate IGBT

Datasheet — production data

Features

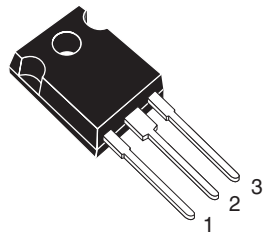
- High speed switching
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- 6 µs short-circuit withstand time
- Lead free package

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- High switching frequency converters

Description

Using advanced proprietary trench gate and field stop structure, this IGBT leads to an optimized compromise between conduction and switching losses maximizing the efficiency for high switching frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and a very tight parameter distribution result in an easier paralleling operation.



TO-247

Figure 1. Internal schematic diagram

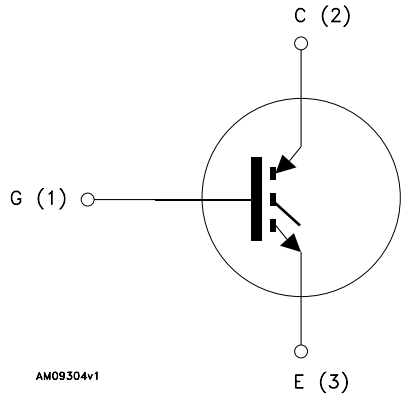


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW60H65F	GW60H65F	TO-247	Tube

This is information on a product in full production. www.st.com

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	650	V
I_C	Continuous collector current at T_C = 25 °C	120	A
I_C	Continuous collector current at T_C = 100 °C	60	A
I_{CP} (1)	Pulsed collector current	240	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at T_C = 25 °C	360	W
t_{SC}	Short-circuit withstand time at V_{CC} = 400 V, V_{GE} = 15 V	6	µs
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature		

1. 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	0.35	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°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	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 60 A		1.9		V
		V_{GE} = 15 V, I_C = 60 A T_J = 125 °C		2.1		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA		6.0		V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 650 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} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE}=0	-	7150 275 140	-	pF pF pF
Q_g	Total gate charge	V_{CC} = 400 V, I_C = 60 A, V_{GE} = 15 V		217		nC
Q_{ge}	Gate-emitter charge			67		nC
Q_{gc}	Gate-collector charge			97		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ (1) t_r (1) $(di/dt)_{on}$ (1)	Turn-on delay time Current rise time Turn-on current slope	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V	-	65 30 2000	-	ns ns A/µs
$t_{d(on)}$ (1) t_r (1) $(di/dt)_{on}$ (1)	Turn-on delay time Current rise time Turn-on current slope	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 125 °C	-	63 33 1800	-	ns ns A/µs

Table 6. Switching on/off (inductive load)

$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V	-	35 180 43	-	ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 125 °C	-	46 210 85	-	ns ns ns

1. Eon is the turn-on losses when a SiC diode (STPSC1206D) is used in the test circuit in *Figure 17*. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C).

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Eon (1) E_{off} (2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V	-	0.75 1.05 1.80	-	mJ mJ mJ
Eon (1) E_{off} (2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 125 °C	-	0.8 1.4 2.2	-	mJ mJ mJ

1. Eon is the turn-on losses when a SiC diode (STPSC1206D) is used in the test circuit in *Figure 17*. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C).
2. Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics (T_J = -40 °C)

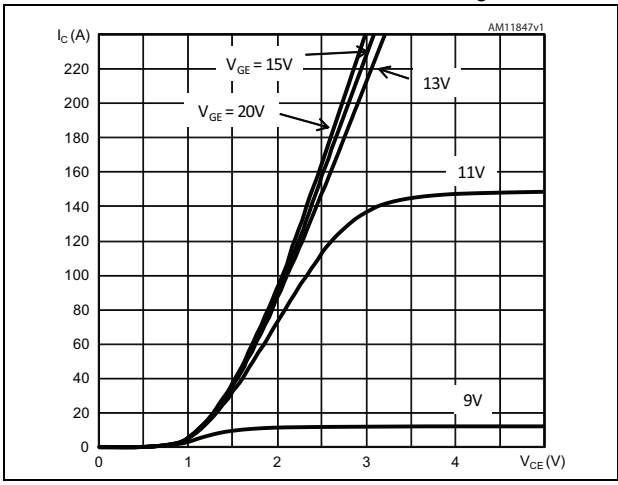


Figure 3. Output characteristics (T_J = 25 °C)

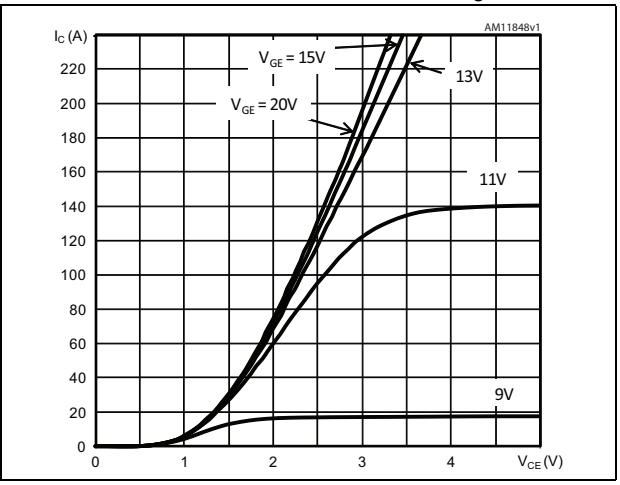


Figure 4. Output characteristics (T_J = 150 °C)

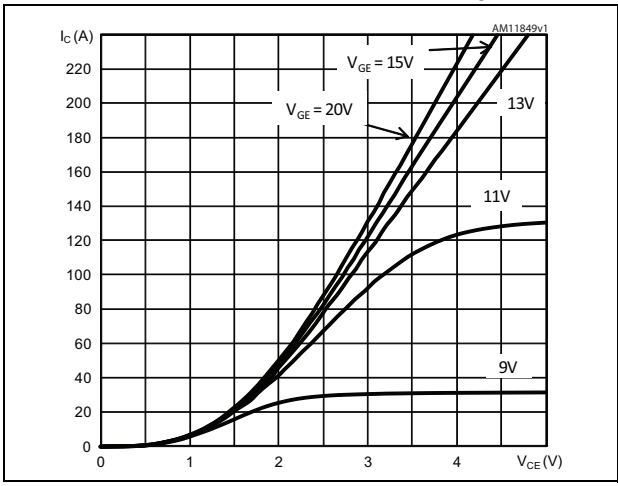


Figure 5. Transfer characteristics

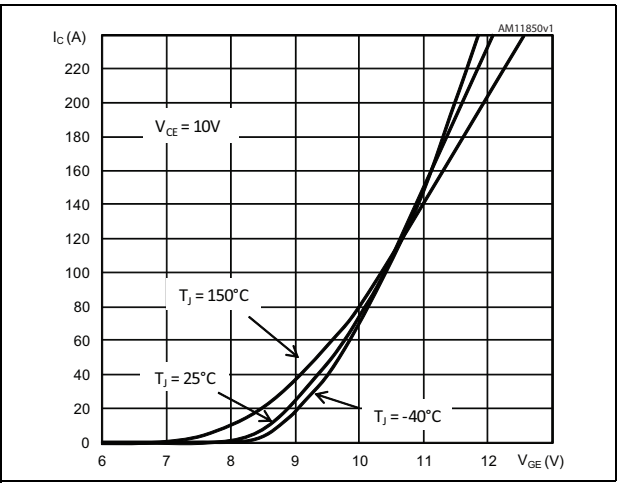


Figure 6. $V_{CE(SAT)}$ vs. junction temperature

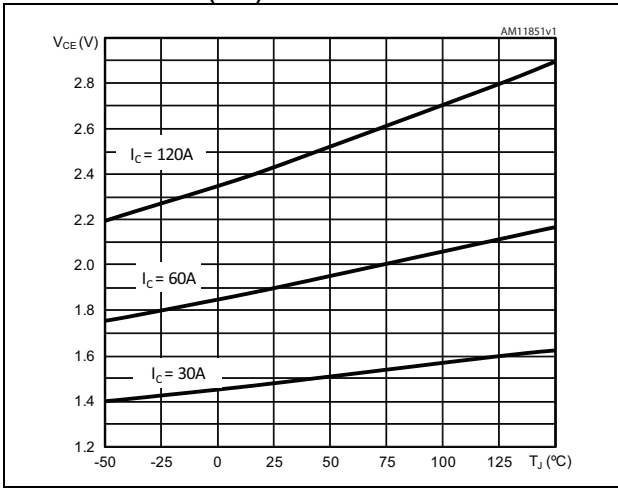


Figure 7. $V_{CE(SAT)}$ vs. collector current

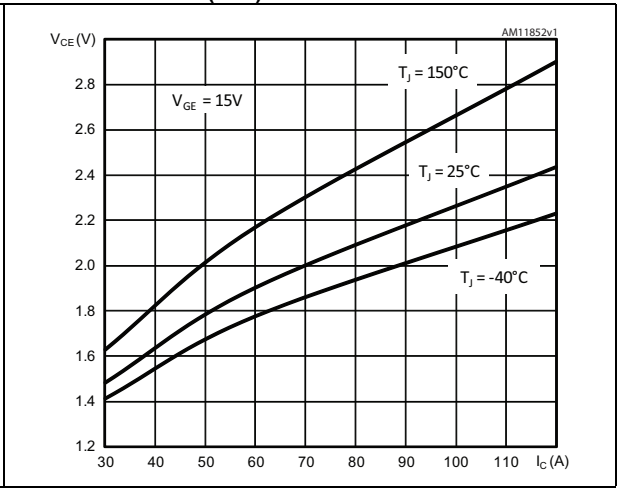


Figure 8. Normalized $V_{GE(th)}$ vs. junction temperature

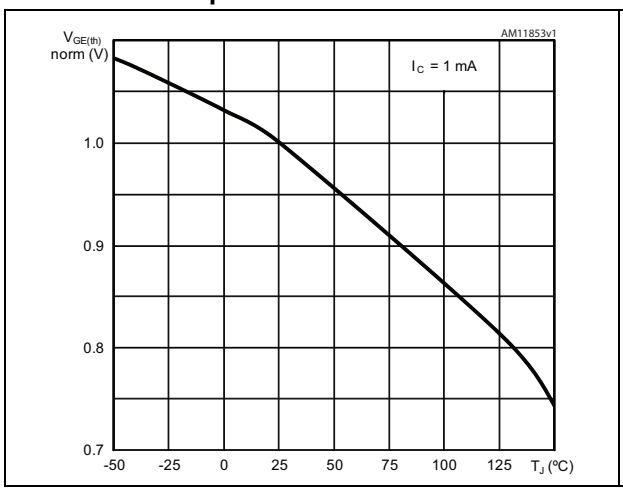


Figure 9. Gate charge vs. gate-emitter voltage

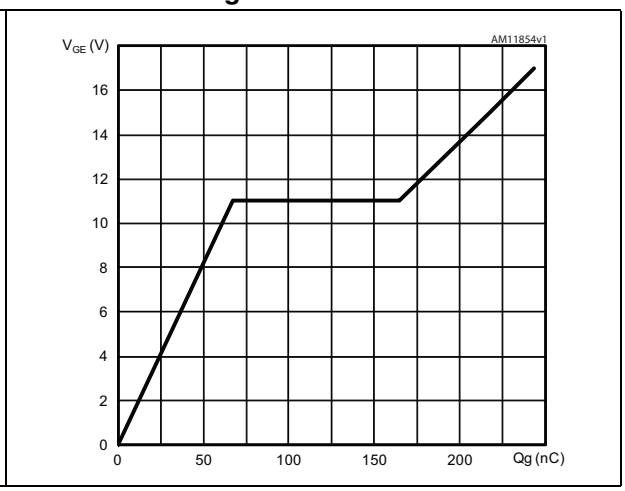


Figure 10. Capacitance variations (f = 1 MHz, V_{GE} = 0)

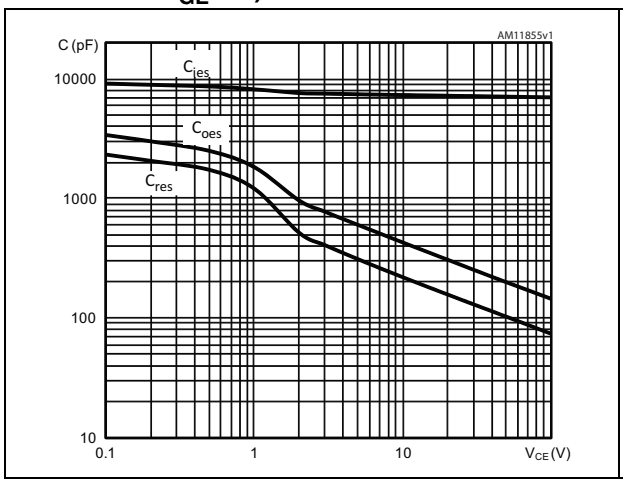


Figure 11. Switching losses vs. collector current

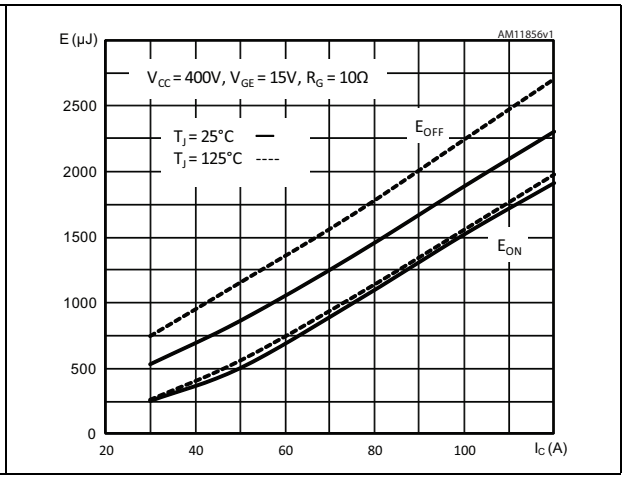


Figure 12. Switching losses vs. gate resistance

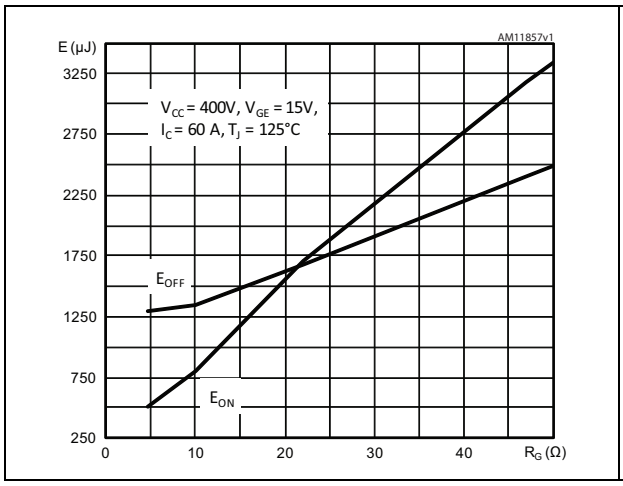


Figure 13. Switching losses vs. temperature

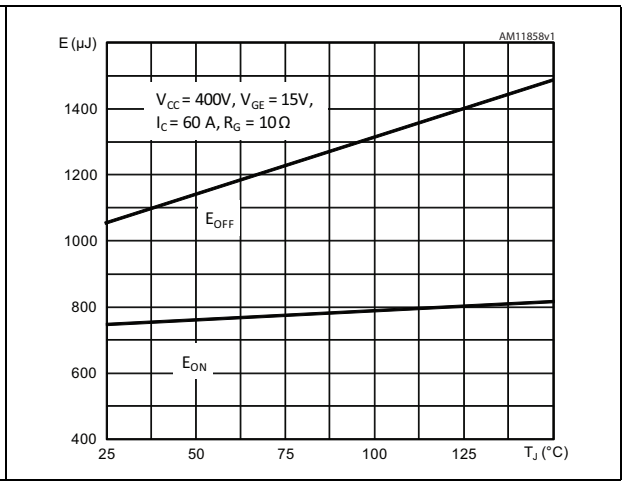


Figure 14. Turn-OFF SOA

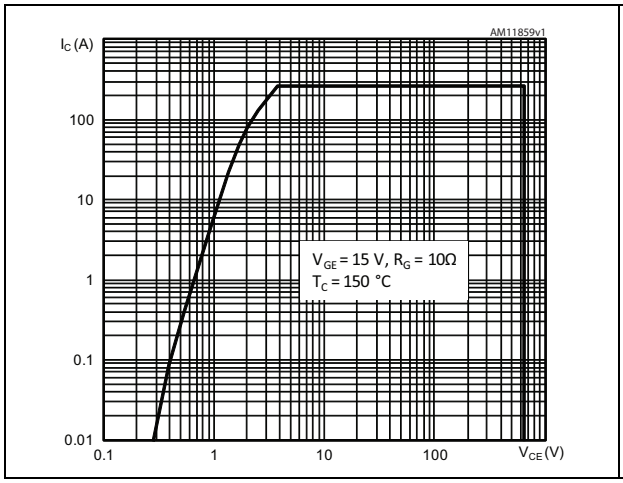


Figure 15. Short circuit time & current vs. V_{GE}

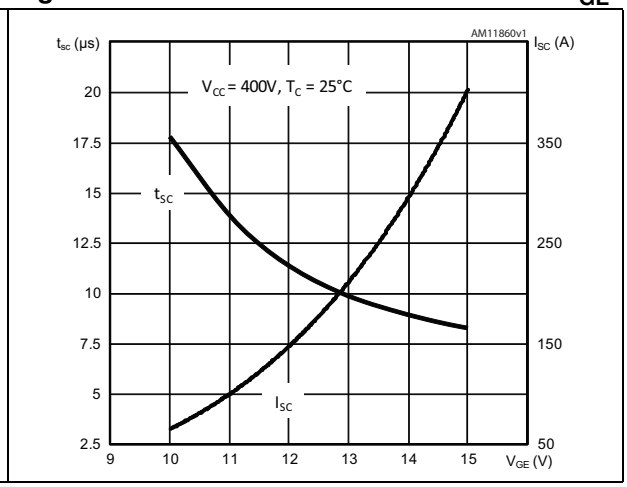
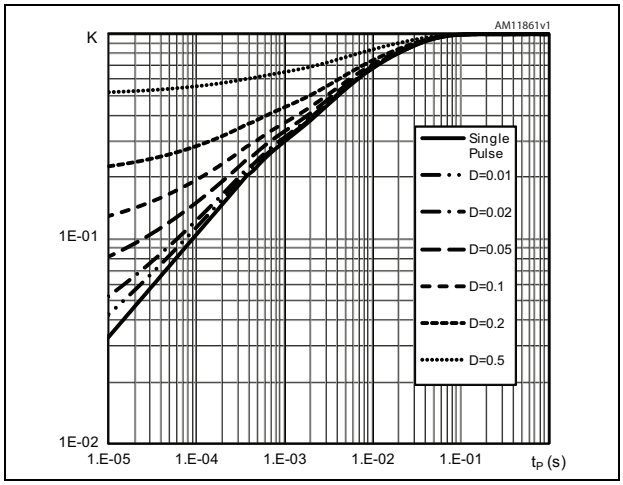


Figure 16. Maximum normalized Z_{th} junction to case (IGBT)



3 Test circuits

Figure 17. Test circuit for inductive load switching

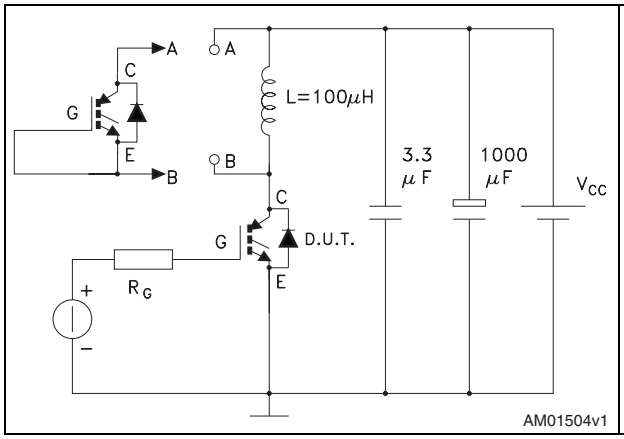


Figure 18. Gate charge test circuit

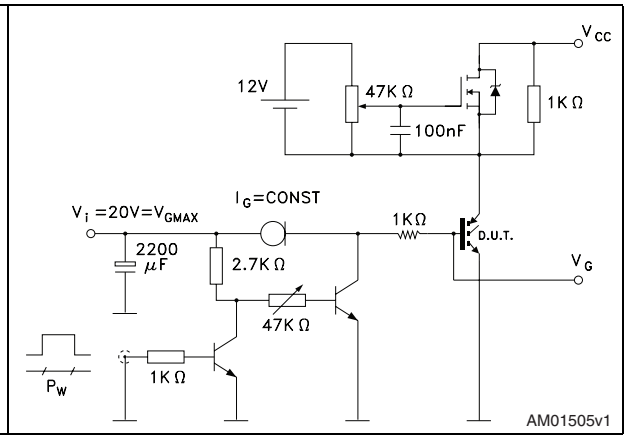
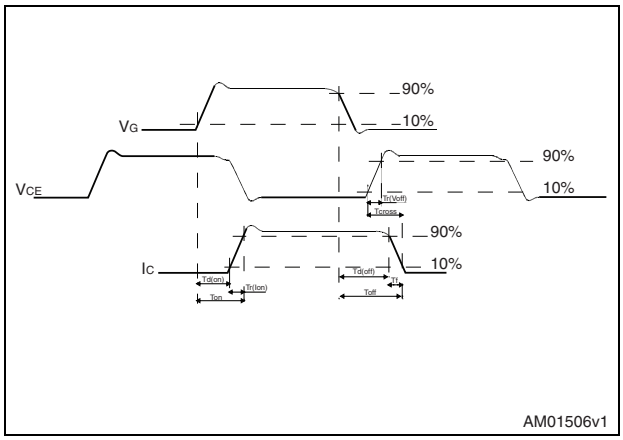


Figure 19. Switching waveform



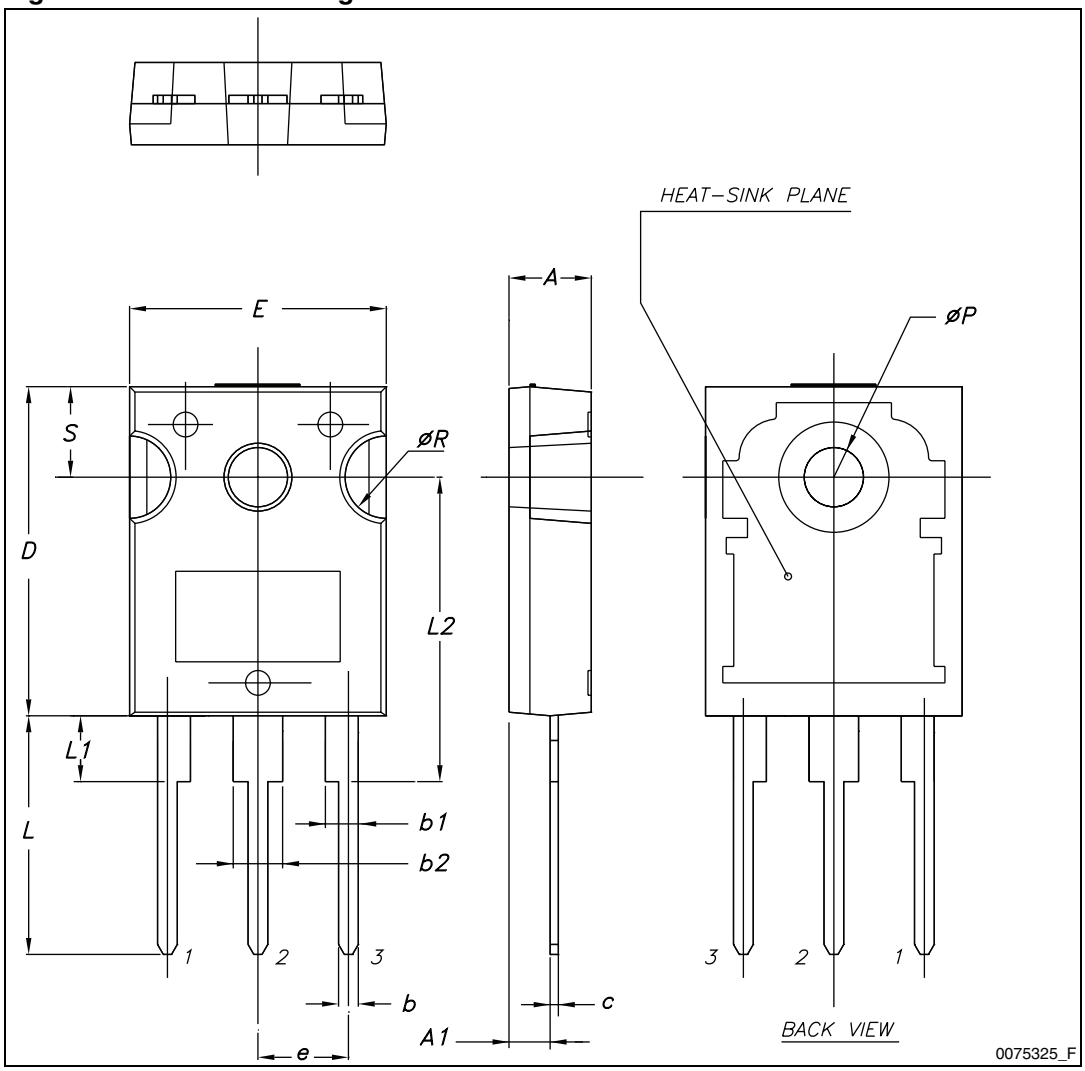
4 Package mechanical data

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 8. 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		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
∅P	3.55		3.65
∅R	4.50		5.50
S		5.50	

Figure 20. TO-247 drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
05-Jul-2011	1	Initial release.
12-Jan-2012	2	Document status promoted from preliminary data to datasheet.
10-Feb-2012	3	Added: *Section 2.1: Electrical characteristics (curves)*.
31-Jul-2012	4	Updated: *Figure 8 on page 6*.

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