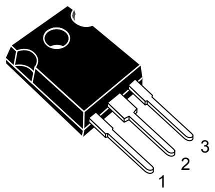
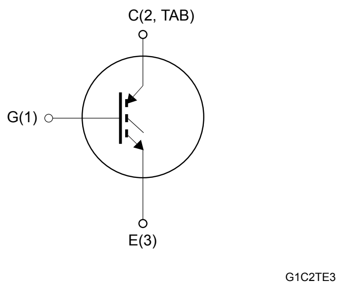
STGW60V60F

Datasheet

Trench gate field-stop, 600 V, 60 A, very high speed, V series IGBT in a TO-247 package



TO-247



Product status link
STGW60V60F

Product summary	
Order code	STGW60V60F
Marking	GW60V60F
Package	TO-247
Packing	Tube

Features

- Maximum junction temperature: T_J = 175 °C
- Tail-less switching off
- $V_{CE(sat)}$ = 1.85 V (typ.) @ I_C = 60 A
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very high frequency converters

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the V series IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of very high frequency converters. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600	V
I_C	Continuous collector current at T_C = 25 °C	80(1)	A
	Continuous collector current at T_C = 100 °C	60	
I_{CP}(2)	Pulsed collector current	240	A
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total dissipation at T_C = 25 °C	375	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. *Current level is limited by bond wires.*
2. *Pulse width limited by maximum junction temperature and turn-off within RBSOA*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.4	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 2 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 60 A		1.85	2.3	V
		V_{GE} = 15 V, I_C = 60 A, T_J = 125 °C		2.15		
		V_{GE} = 15 V, I_C = 60 A, T_J = 175 °C		2.35		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5.0	6.0	7.0	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 600 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	8000	-	pF
C_{oes}	Output capacitance		-	280	-	pF
C_{res}	Reverse transfer capacitance		-	170	-	pF
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 60 A, V_{GE} = 0 to 15 V (see Figure 22. Gate charge test circuit)	-	334	-	nC
Q_{ge}	Gate-emitter charge		-	130	-	nC
Q_{gc}	Gate-collector charge		-	58	-	nC

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ (1)	Turn-on delay time	V_{CE} = 400 V, I_C = 60 A, R_G = 4.7 Ω, V_{GE} = 15 V (see Figure 21. Test circuit for inductive load switching)	-	60	-	ns
t_r (1)	Current rise time		-	20	-	ns
(di/dt)on(1)	Turn-on current slope		-	2365	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	208	-	ns
t_f	Current fall time		-	14	-	ns
E_{on}(1)	Turn-on switching energy		-	0.75	-	mJ
E_{off}(2)	Turn-off switching energy		-	0.55	-	mJ
E_{ts}	Total switching energy		-	1.3	-	mJ

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$[(1)]	Turn-on delay time	V_{CE} = 400 V, I_C = 60 A, R_G = 4.7 Ω, V_{GE} = 15 V, T_J = 175 °C (see Figure 21. Test circuit for inductive load switching)	-	57	-	ns
t_r[(1)]	Current rise time		-	23	-	ns
(di/dt)on[(1)]	Turn-on current slope		-	2191	-	A/μs
$t_{d(off)}$	Turn-off delay time		-	216	-	ns
t_f	Current fall time		-	27	-	ns
E_{on}[(1)]	Turn-on switching energy		-	1.5	-	mJ
E_{off}[(2)]	Turn-off switching energy		-	0.8	-	mJ
E_{ts}	Total switching energy		-	2.3	-	mJ

1. *Switching-on times and energy have been calculated applying the STGW60V60DF's co-pack diode in the high side of the test circuit shown in Figure 21. Test circuit for inductive load switching. Both the IGBT and the diode are at the same temperature. The turn-on switching energies include the reverse recovery of the diode.*
2. *Including the tail of the collector current.*

2.1 Electrical characteristics (curves)

Figure 1. **Power dissipation vs case temperature**

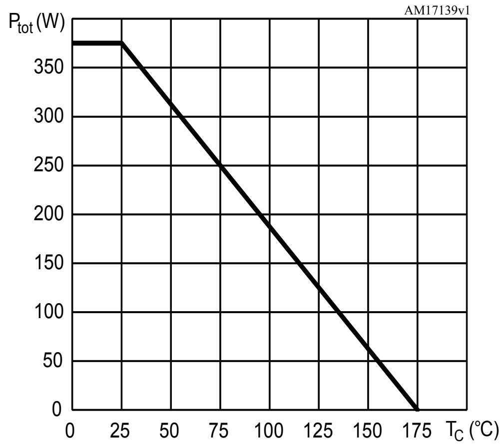


Figure 2. **Collector current vs case temperature**

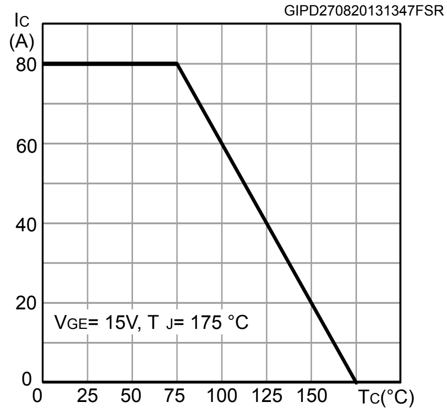


Figure 3. **Output characteristics (T_J = 25°C)**

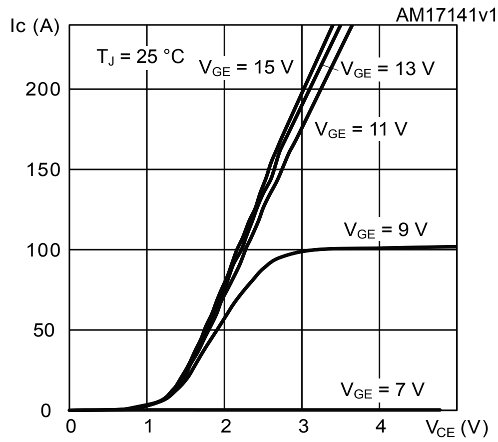


Figure 4. **Output characteristics (T_J = 175°C)**

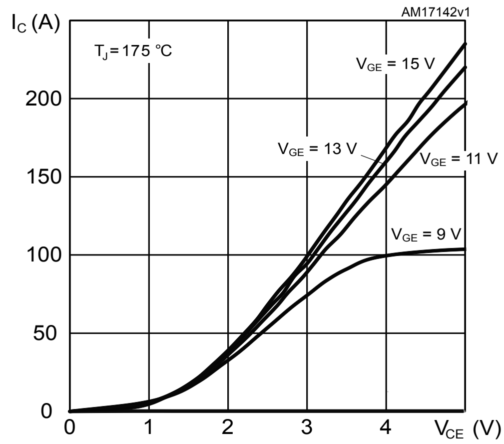


Figure 5. $V_{CE(sat)}$ **vs junction temperature**

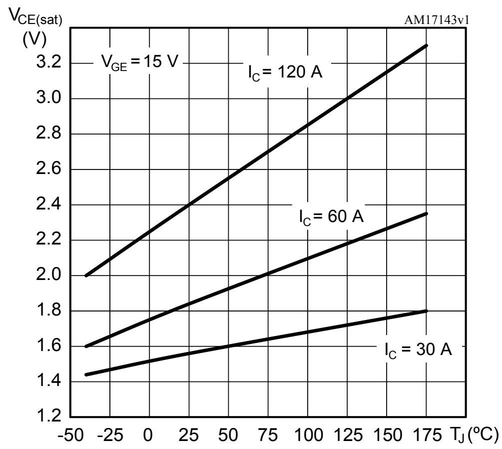


Figure 6. $V_{CE(sat)}$ **vs collector current**

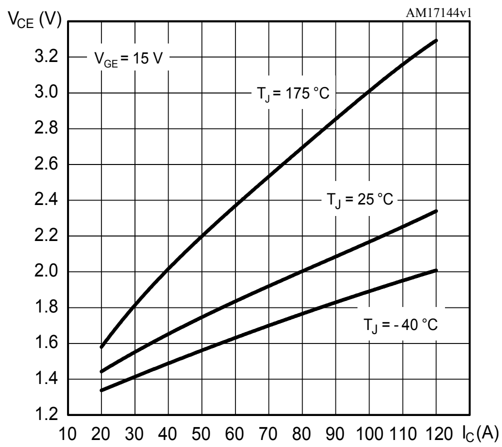


Figure 7. **Collector current vs switching frequency**

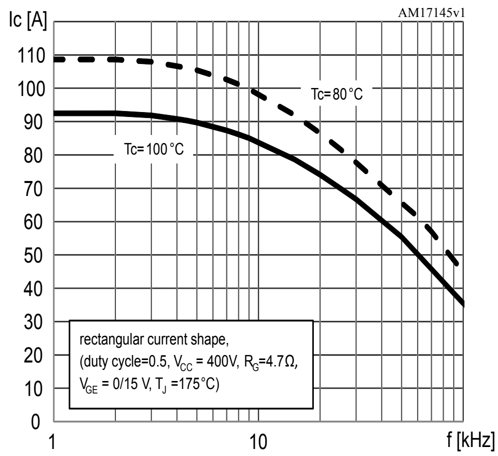


Figure 8. **Forward bias safe operating area**

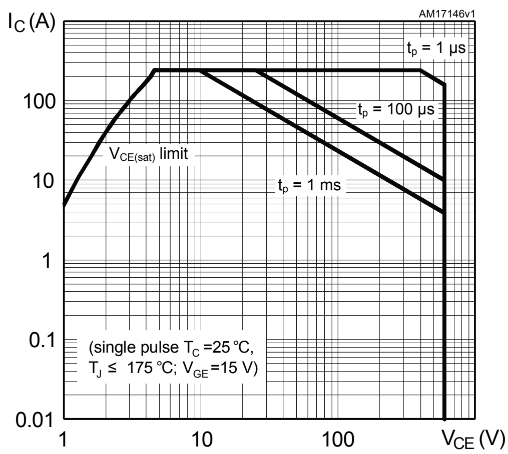


Figure 9. **Transfer characteristics**

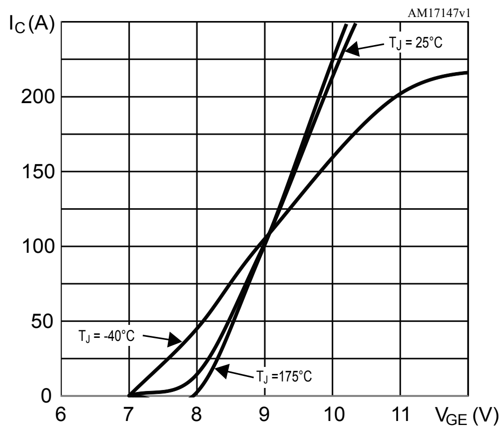


Figure 10. **Normalized** $V_{GE(th)}$ **vs junction temperature**

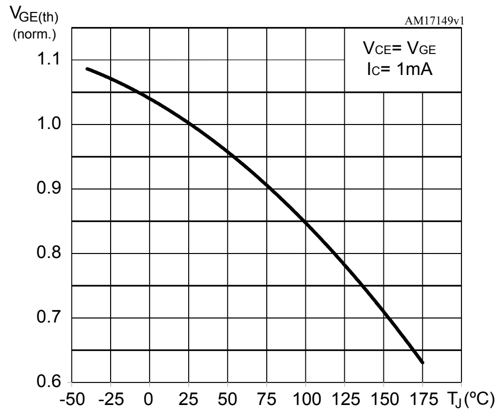


Figure 11. Normalized $V_{(BR)CES}$ vs junction temperature

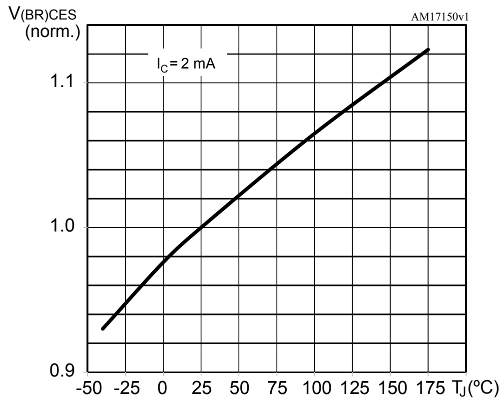


Figure 12. Capacitance variation

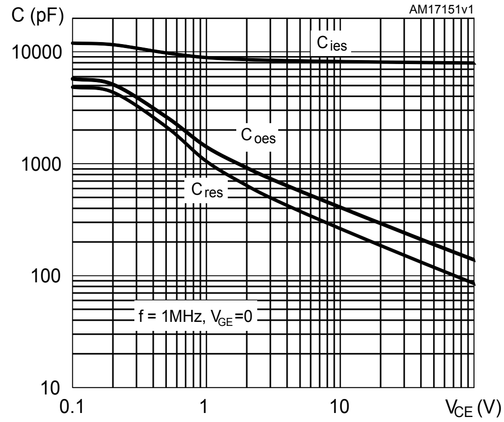


Figure 13. Gate charge vs gate-emitter voltage

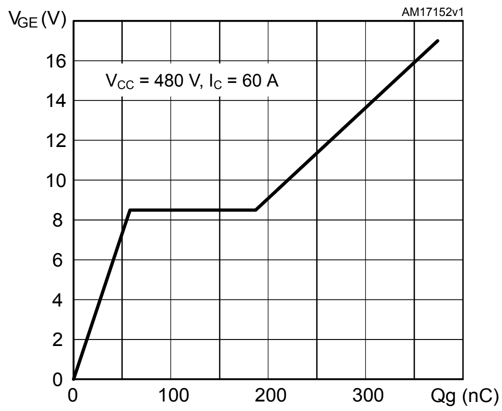


Figure 14. Switching energy vs collector current

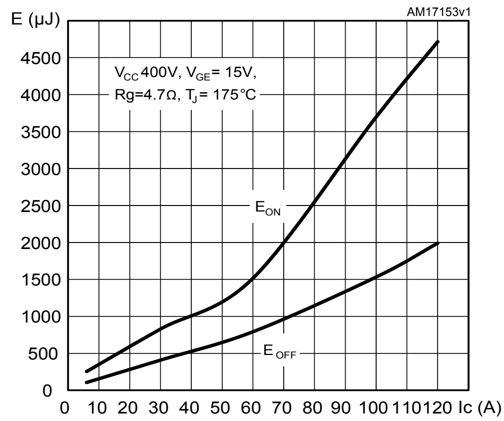


Figure 15. Switching energy vs gate resistance

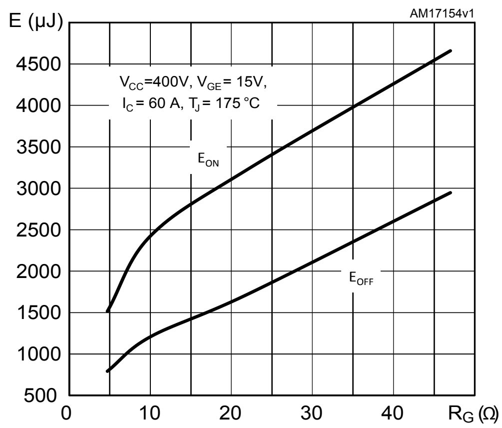


Figure 16. Switching energy vs temperature

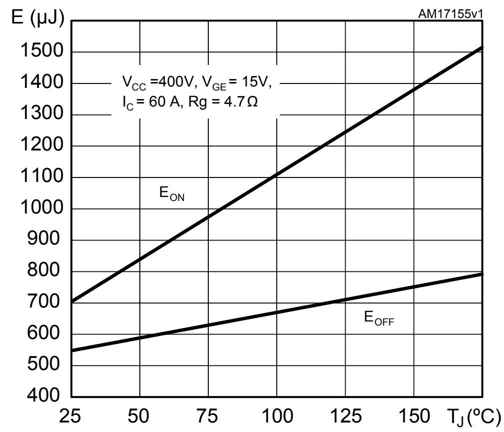


Figure 17. Switching energy vs collector-emitter voltage

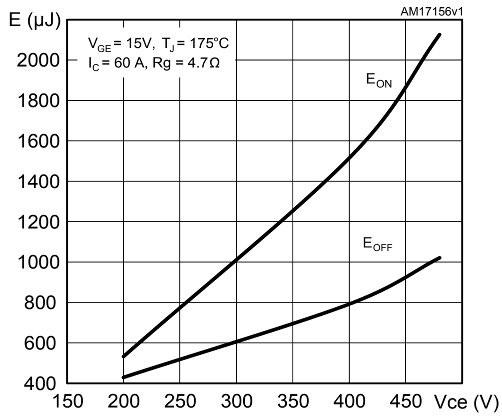


Figure 18. Switching times vs collector current

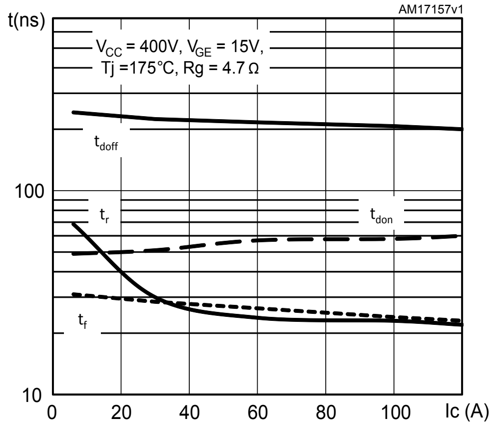


Figure 19. Switching times vs gate resistance

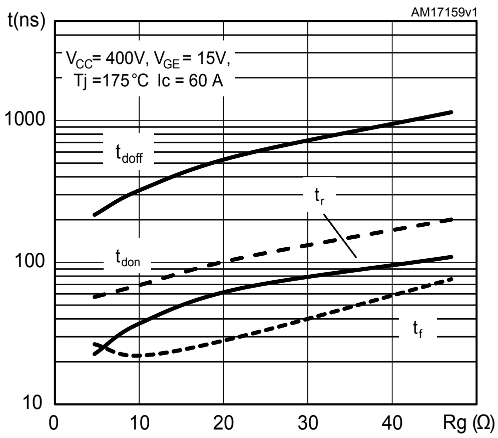
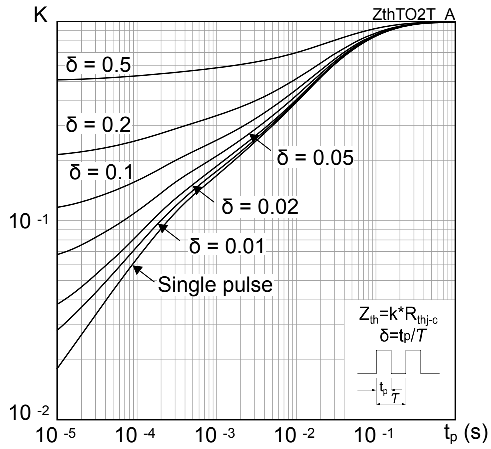


Figure 20. Thermal impedance



3 Test circuits

Figure 21. Test circuit for inductive load switching

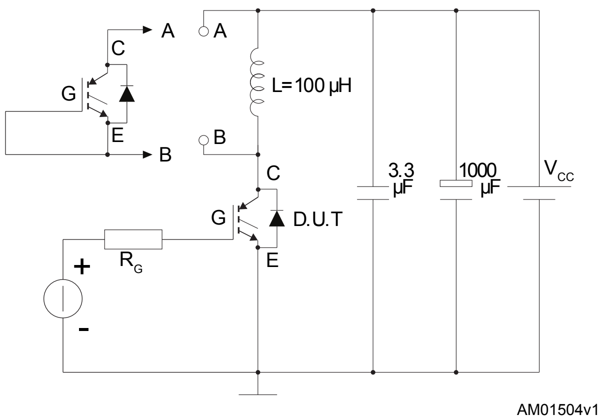


Figure 22. Gate charge test circuit

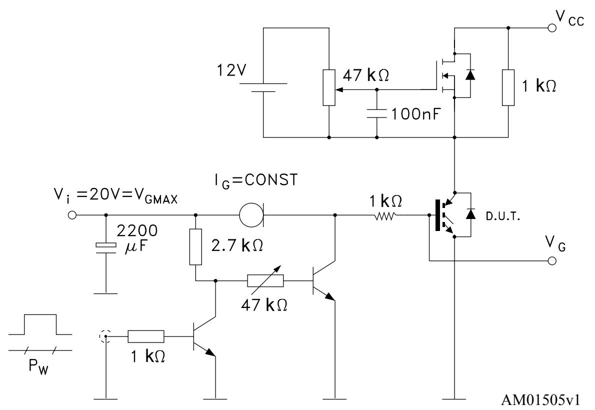
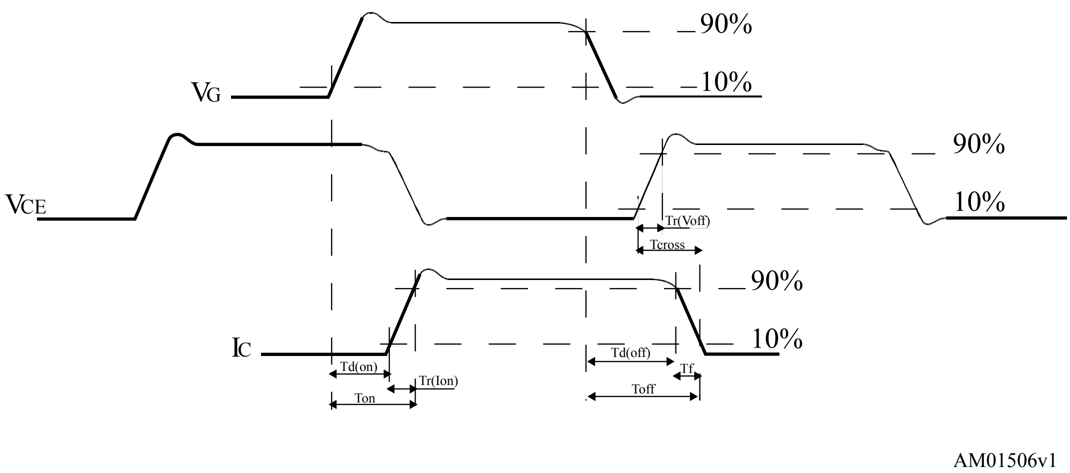


Figure 23. Switching waveform



4 Package information

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.

4.1 TO-247 package information

Figure 24. TO-247 package outline

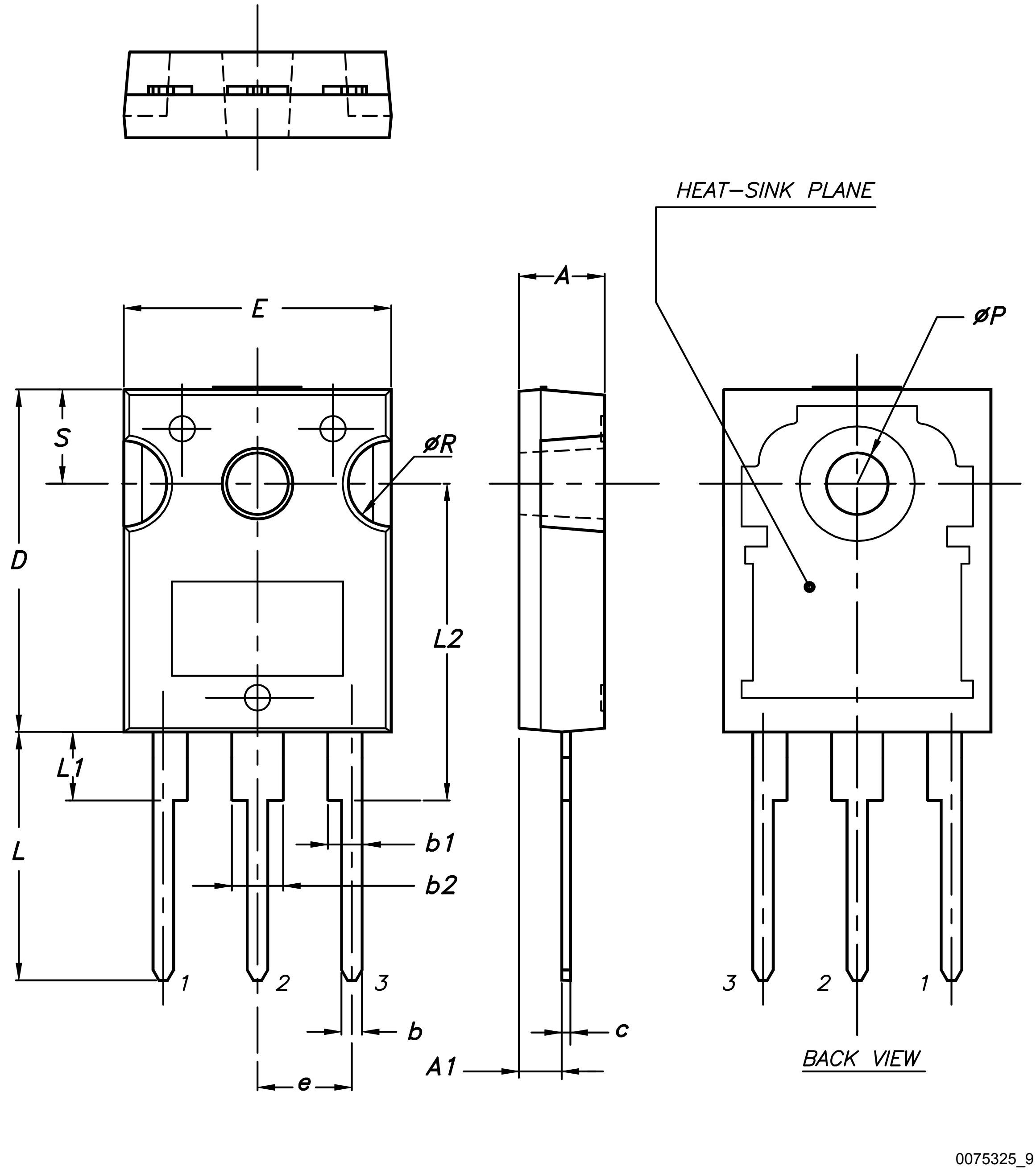


Table 6. **TO-247 package mechanical data**

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	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Revision history

Table 7. **Document revision history**

Date	Revision	Changes
04-Jun-2013	1	First release
06-Feb-2014	2	Updated *Figure 1: Internal schematic diagram*. Updated title, features and description in cover page. Minor text changes.
21-Jun-2017	3	Modified title, features and internal schematic on cover page. Modified *Table 3. Static characteristics* and *Table 5. IGBT switching characteristics (inductive load)*. Updated Package information. Minor text changes.
17-Sep-2018	4	Updated Section 2.1 Electrical characteristics (curves). Minor text changes

Contents