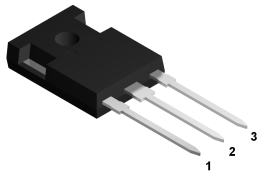
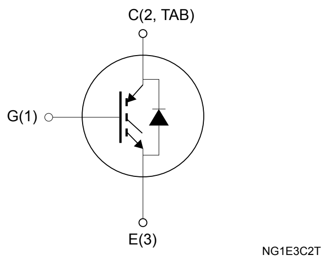
Trench gate field-stop 650 V, 40 A, soft-switching IH series IGBT in a TO-247 long leads package



TO-247 long leads



Product status link
STGWA40IH65DF

Product summary	
Order code	STGWA40IH65DF
Marking	G40IH65DF
Package	TO-247 long leads
Packing	Tube

Features

- Designed for soft commutation only
- Maximum junction temperature: T_J = 175 °C
- $V_{CE(sat)}$ = 1.5 V (typ.) @ I_C = 40 A
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Low drop voltage freewheeling co-packaged diode
- Positive $V_{CE(sat)}$ temperature coefficient

Applications

- Induction heating
- Resonant converters
- Microwave ovens

Description

The newest IGBT 650 V soft-switching IH series has been developed using an advanced proprietary trench gate field-stop structure, whose performance is optimized both in conduction and switching losses for soft commutation. A freewheeling diode with a low drop forward voltage is included. The result is a product specifically designed to maximize efficiency for any resonant and soft-switching applications.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	80	A
	Continuous collector current at T_C = 100 °C	40	
I_{CP} (1)	Pulsed collector current	120	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at T_C = 25 °C	40	A
	Continuous forward current at T_C = 100 °C	20	
I_{FP} (1)	Pulsed forward current	120	
P_{TOT}	Total power dissipation at T_C = 25 °C	238	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature range	- 55 to 175	

1. *Pulse width limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.63	°C/W
	Thermal resistance junction-case diode	2.08	
R_{thJA}	Thermal resistance junction-ambient	50	

2 Electrical characteristics

T_C = 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 = 250 µA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 40 A		1.50	2.00	V
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C		1.75		
		V_{GE} = 15 V, I_C = 40 A, T_J = 175 °C		1.90		
V_F	Forward on-voltage	I_F = 20 A		1.85	2.65	V
		I_F = 20 A, T_J = 125 °C		1.60		
		I_F = 20 A, T_J = 175 °C		1.55		
		I_F = 40 A		2.30		
$V_{GE(th)}$	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, V_{CE} = 650 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	-	2210	-	pF
C_{oes}	Output capacitance		-	105	-	
C_{res}	Reverse transfer capacitance		-	63	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 40 A, V_{GE} = 0 to 15 V (see Figure 23. Gate charge test circuit)	-	114	-	nC
Q_{ge}	Gate-emitter charge		-	21	-	
Q_{gc}	Gate-collector charge		-	49	-	

Table 5. **IGBT switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	V_{CC} = 400 V, I_C = 40 A, V_{GE} = 15 V, R_G = 22 Ω (see Figure 21. Test circuit for inductive load switching)	-	210	-	ns
t_f	Current fall time		-	12.5	-	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 400 V, I_C = 40 A, V_{GE} = 15 V, R_G = 22 Ω, T_J = 175 °C (see Figure 21. Test circuit for inductive load switching)	-	216	-	ns
t_f	Current fall time		-	47	-	ns

Table 6. **IGBT switching characteristics (capacitive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{off}(1)	Turn-off switching energy	V_{CC} = 320 V, R_G = 10 Ω, I_C = 40 A, L = 100 µH, C_{snub} = 22 nF (see Figure 22. Test circuit for snubbed inductive load switching)	-	190	-	µJ
		V_{CC} = 320 V, R_G = 10 Ω, I_C = 40 A, L = 100 µH, C_{snub} = 22 nF, T_J = 175 °C (see Figure 22. Test circuit for snubbed inductive load switching)	-	385	-	

1. *Including the tail of the collector current.*

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

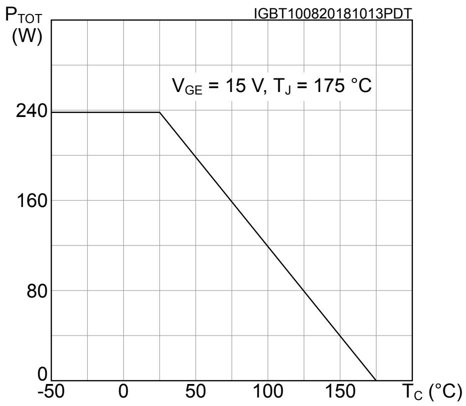


Figure 2. Collector current vs case temperature

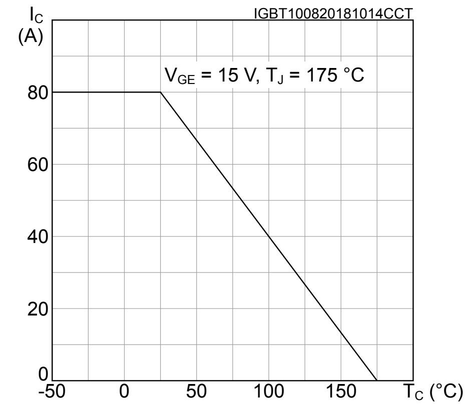


Figure 3. Output characteristics (T_J = 25 °C)

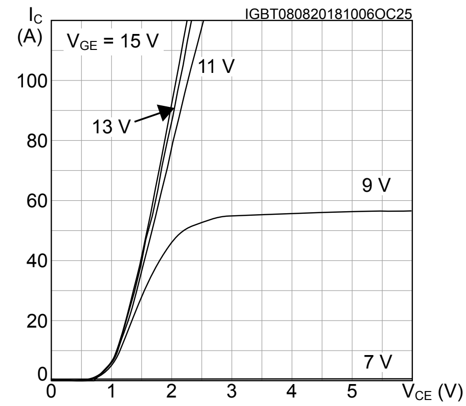


Figure 4. Output characteristics (T_J = 175 °C)

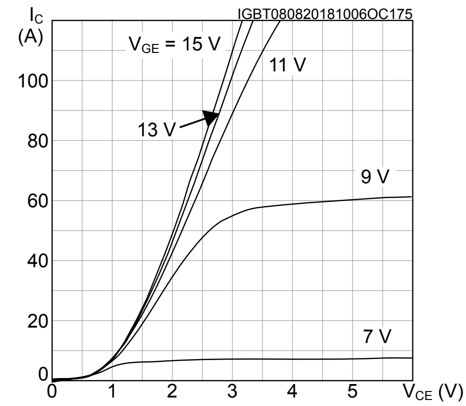


Figure 5. $V_{CE(sat)}$ vs junction temperature

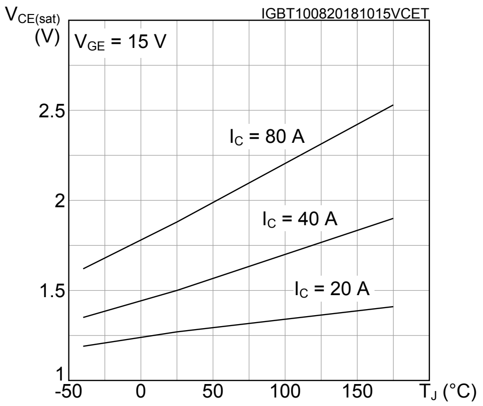


Figure 6. $V_{CE(sat)}$ vs collector current

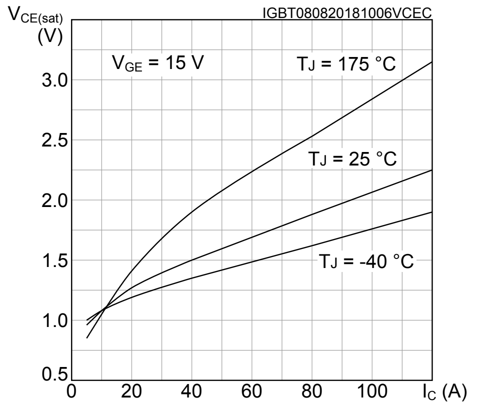


Figure 7. **Forward bias safe operating area**

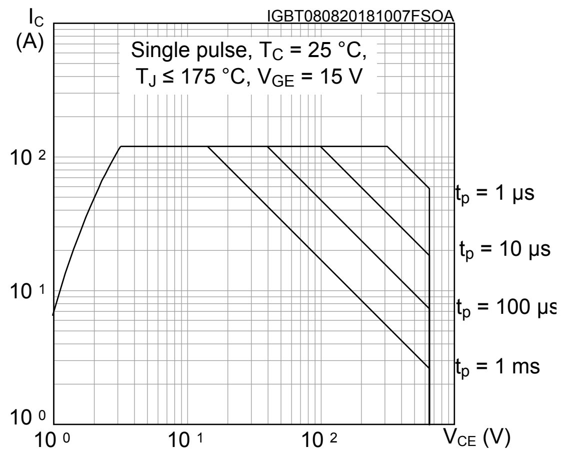


Figure 8. **Transfer characteristics**

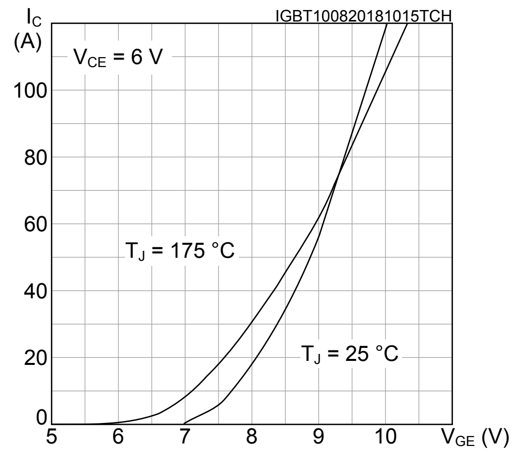


Figure 9. **Diode V_F vs forward current**

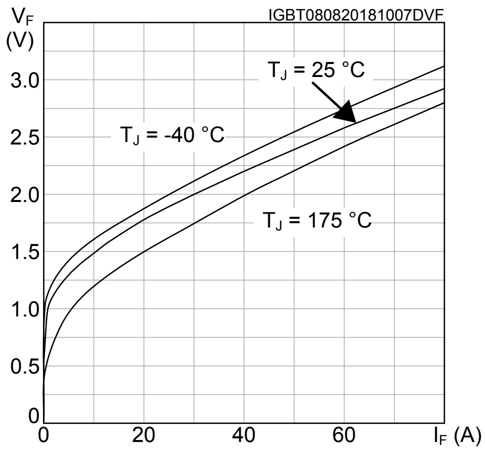


Figure 10. **Normalized $V_{GE(th)}$ vs junction temperature**

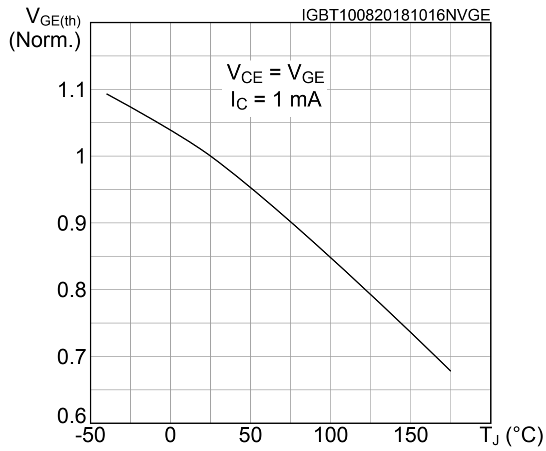


Figure 11. **Normalized $V_{(BR)CES}$ vs junction temperature**

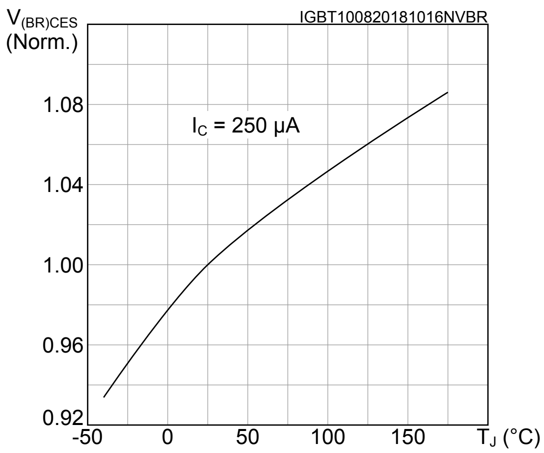


Figure 12. **Capacitance variations**

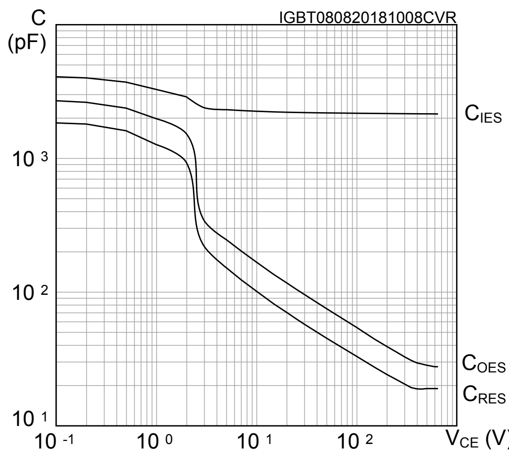


Figure 13. Gate charge vs gate-emitter voltage

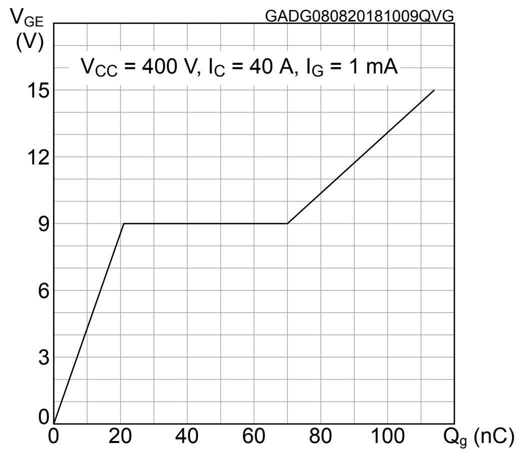


Figure 14. Switching energy vs collector current

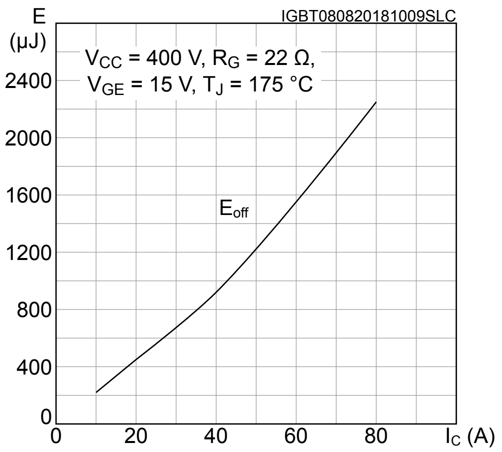


Figure 15. Switching energy vs temperature

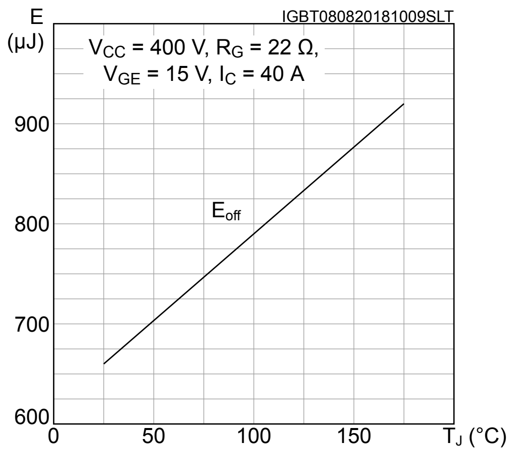


Figure 16. Switching energy vs collector emitter voltage

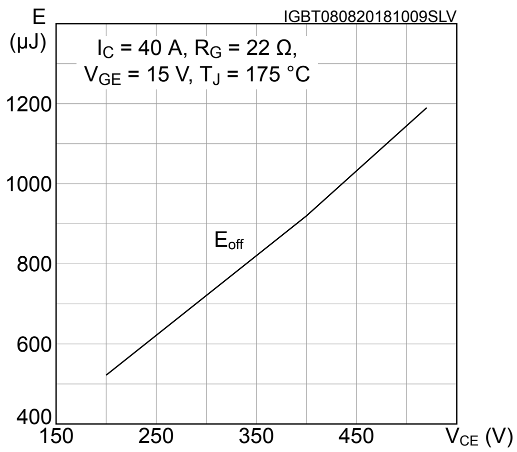


Figure 17. Switching times vs collector current

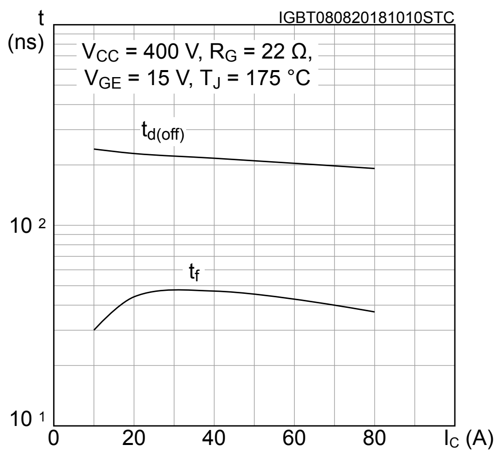


Figure 18. Switching energy vs snubber capacitance

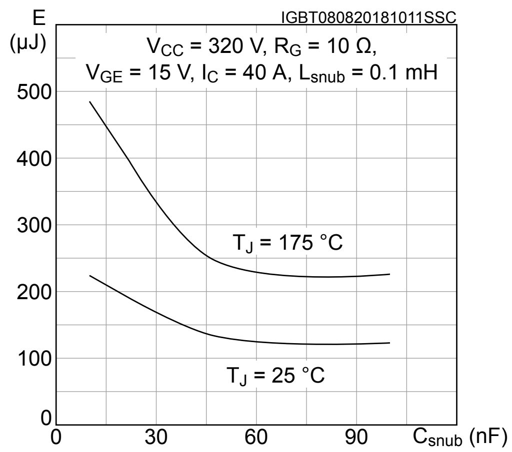


Figure 19. Thermal impedance for IGBT

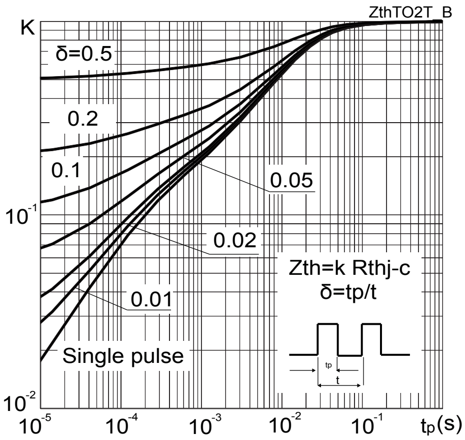
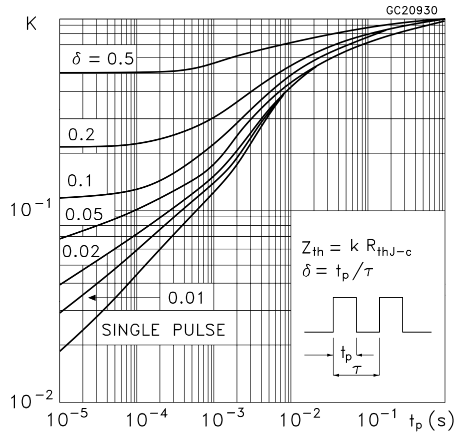


Figure 20. Thermal impedance for diode



3 Test circuits

Figure 21. Test circuit for inductive load switching

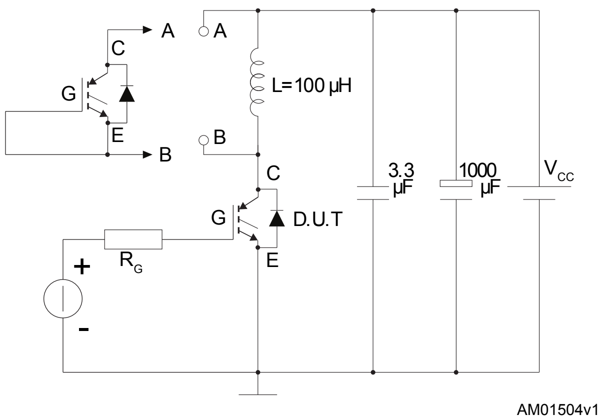


Figure 22. Test circuit for snubbed inductive load switching

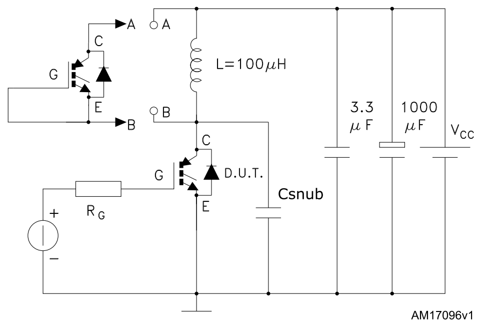


Figure 23. Gate charge test circuit

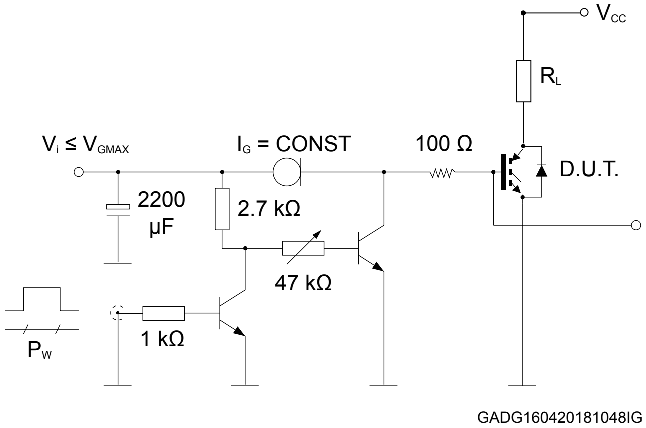
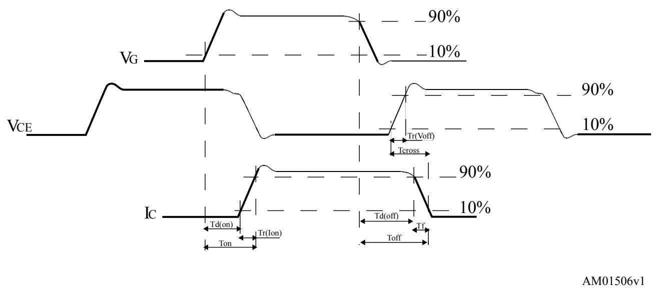


Figure 24. Switching waveform



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 long leads package information

Figure 25. TO-247 long leads package outline

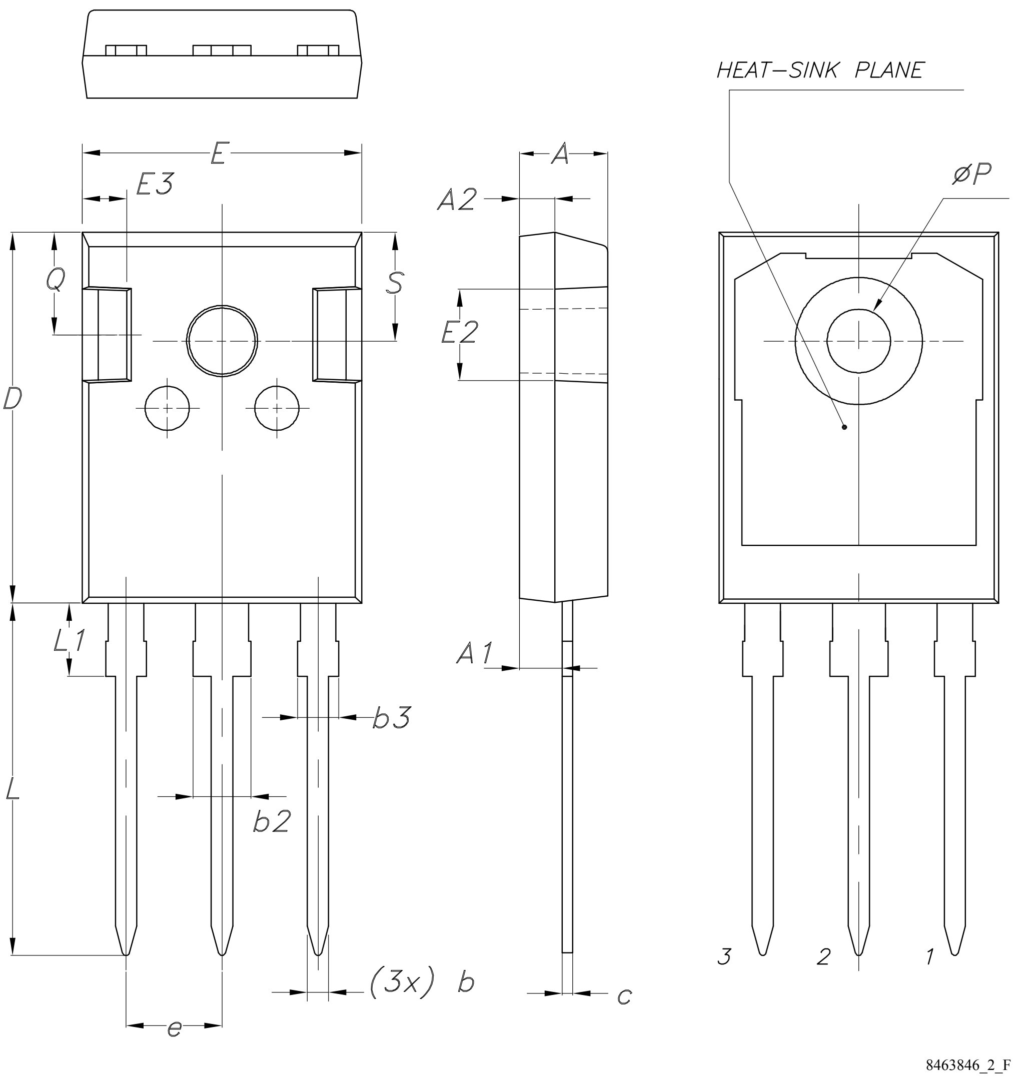


Table 7. TO-247 long leads package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

Revision history

Table 8. **Document revision history**

Date	Revision	Changes
02-Sep-2016	1	First release.
10-Aug-2018	2	Updated features on cover page. Updated *Section 1 Electrical ratings* and *Section 2 Electrical characteristics*. Added *Section 2.1 Electrical characteristics (curves)*. Minor text changes.
24-Sep-2018	3	Updated schematic on cover page. Updated Section 2.1 Electrical characteristics (curves). Minor text changes

Contents