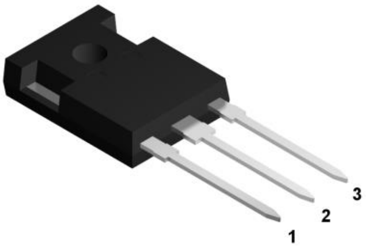
STGWA40H60DLFB

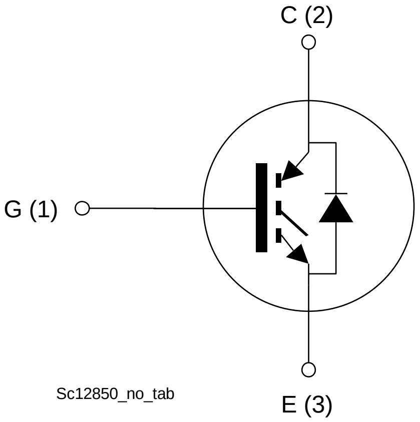
Trench gate field-stop IGBT, HB series 600 V, 40 A high speed in a TO-247 long leads package

Datasheet - production data



TO-247 long leads

Figure 1: Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- Low saturation voltage: $V_{CE(sat)}$ = 1.6 V (typ.) @ I_C = 40 A
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Low V_F soft recovery co-packaged diode

Applications

- Induction heating
- Microwave oven
- Resonant converters

Description

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

Table 1: Device summary

Order code	Marking	Package	Packaging
STGWA40H60DLFB	G40H60DLFB	TO-247 long leads	Tube

This is information on a product in full production.

Contents

1 Electrical ratings

Table 2: 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	A
I_C	Continuous collector current at T_C = 100 °C	40	A
I_{CP}(1)	Pulsed collector current	160	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at T_C = 25 °C	80	A
I_F	Continuous forward current at T_C = 100 °C	40	A
I_{FP}(1)	Pulsed forward current	160	A
P_{TOT}	Total dissipation at T_C = 25 °C	283	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

Notes:

(1)Pulse width limited by maximum junction temperature.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.53	°C/W
R_{thJC}	Thermal resistance junction-case diode	1.47	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 4: 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 = 40 A		1.6	2	V
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C		1.7		
		V_{GE} = 15 V, I_C = 40 A, T_J = 175 °C		1.8		
V_F	Forward on-voltage	I_F = 40 A		1.55	1.8	V
		I_F = 40 A, T_J = 125 °C		1.3		
		I_F = 40 A, T_J = 175 °C		1.25		
$V_{GE(th)}$	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} = 600 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	nA

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE}= 25 V, f = 1 MHz, V_{GE} = 15 V	-	5412	-	pF
C_{oes}	Output capacitance		-	198	-	
C_{res}	Reverse transfer capacitance		-	107	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 40 A, V_{GE} = 0 to 15 V (see *Figure 27: "Gate charge test circuit"*)	-	210	-	nC
Q_{ge}	Gate-emitter charge		-	39	-	
Q_{gc}	Gate-collector charge		-	82	-	

Table 6: IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V, R_G = 10 Ω (see *Figure 25: "Test circuit for inductive load switching"*)	-	142	-	ns
t_f	Current fall time		-	27.6	-	ns
E_{off}[(1)]	Turn-off switching energy		-	363	-	µJ
$t_{d(off)}$	Turn-off delay time	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see *Figure 25: "Test circuit for inductive load switching"*)	-	141	-	ns
t_f	Current fall time		-	61	-	ns
E_{off}[(1)]	Turn-off switching energy		-	764	-	µJ

Notes:

(1)Including the tail of the collector current.

Table 7: 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} = 20 nF (see *Figure 26: "Test circuit for capacitive load switching"*)	-	190	-	µJ
		V_{CC} = 320 V, R_G = 10 Ω, I_C = 40 A, L = 100 µH, C_{snub} = 20 nF, T_J = 175 °C, (see *Figure 26: "Test circuit for capacitive load switching"*)	-	290	-	

Notes:

(1)Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature

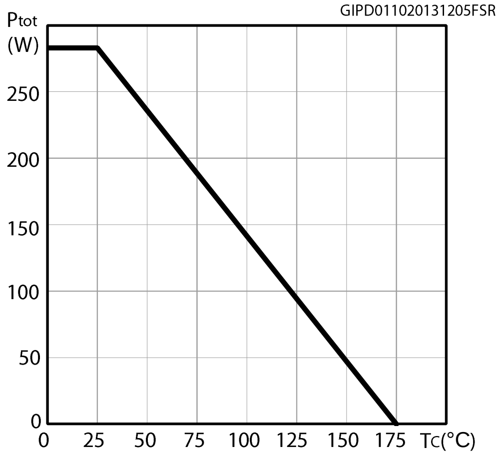


Figure 3: Collector current vs. case temperature

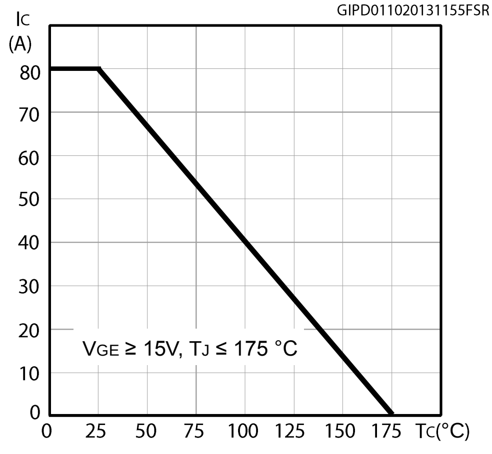


Figure 4: Output characteristics (T_J = 25°C)

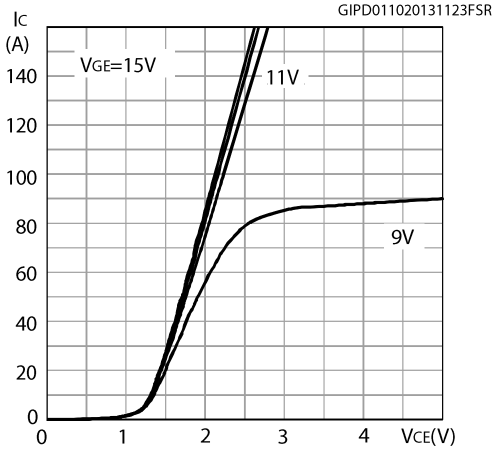


Figure 5: Output characteristics (T_J = 175°C)

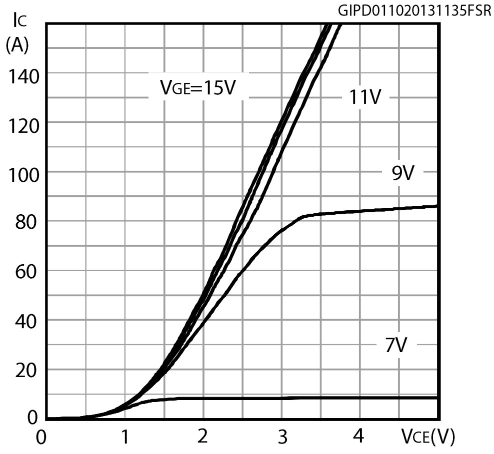


Figure 6: $V_{CE(sat)}$ vs. junction temperature

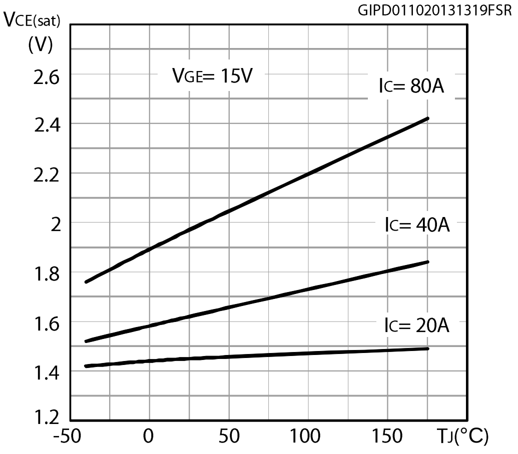


Figure 7: $V_{CE(sat)}$ vs. collector current

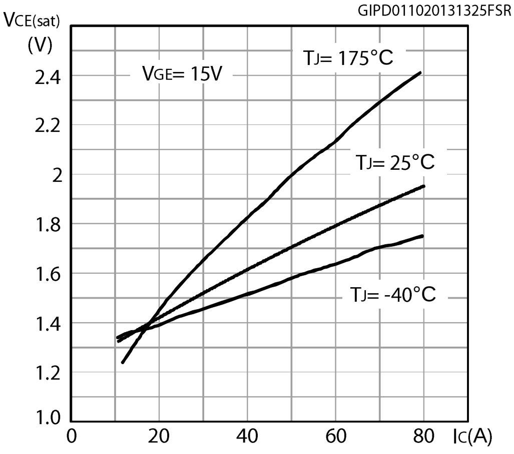


Figure 8: Collector current vs. switching frequency

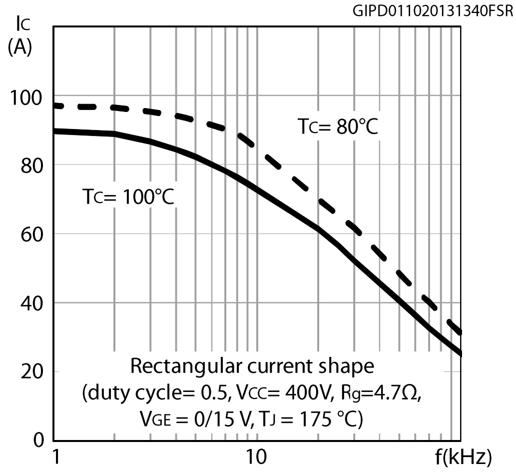


Figure 9: Forward bias safe operating area

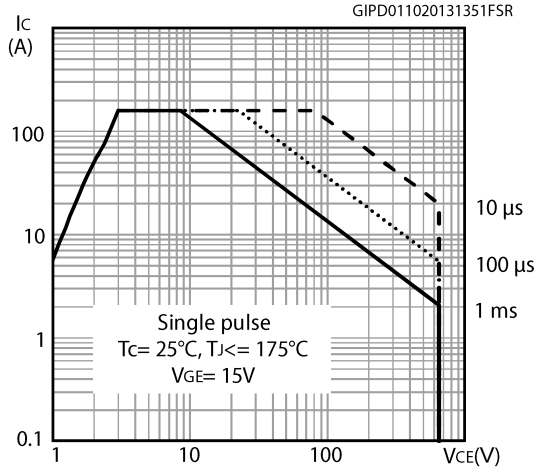


Figure 10: Transfer characteristics

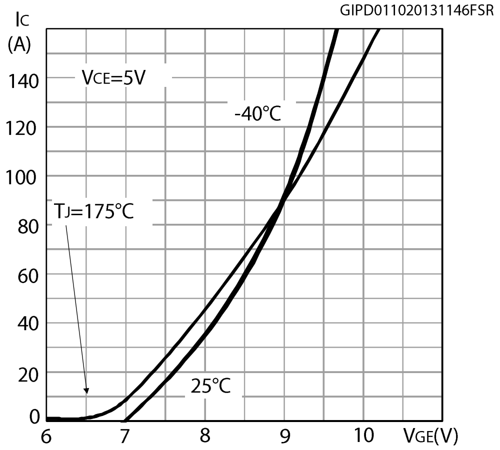


Figure 11: Diode V_F vs. forward current

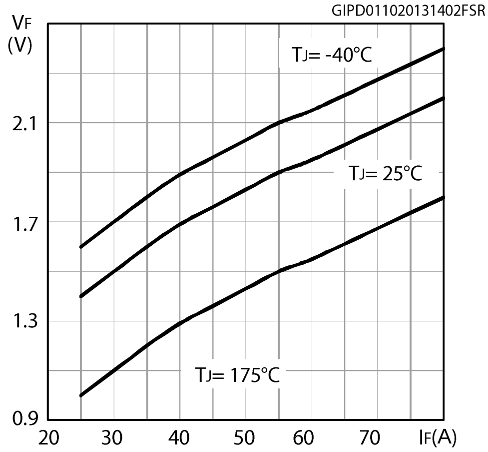


Figure 12: Normalized $V_{GE(th)}$ vs junction temperature

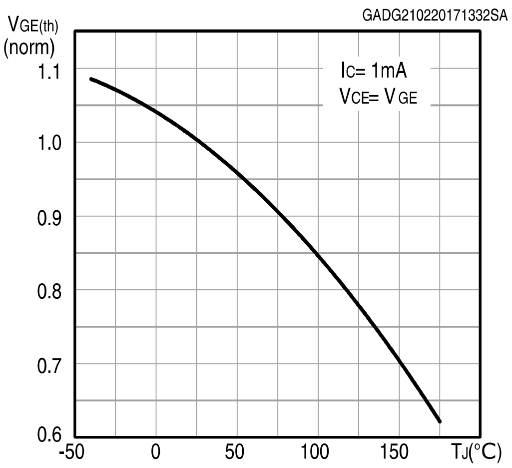


Figure 13: Normalized $V_{(BR)CES}$ vs. junction temperature

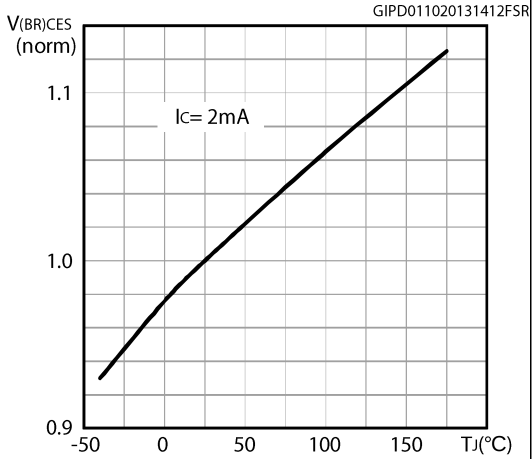


Figure 14: Capacitance variations

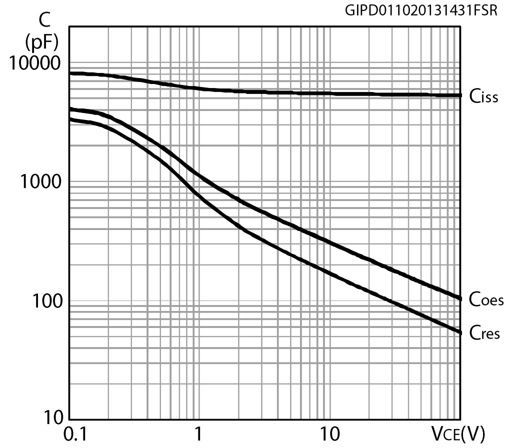


Figure 15: Gate charge vs. gate-emitter voltage

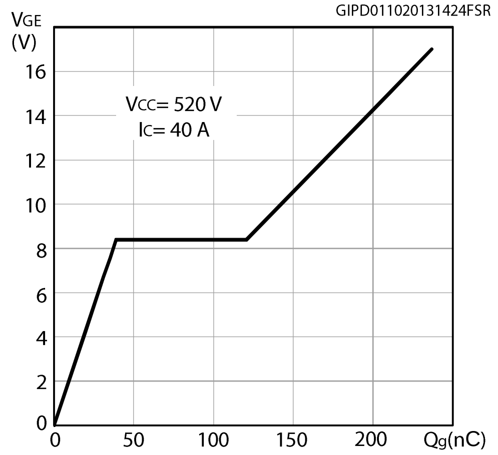


Figure 16: Switching energy vs collector current

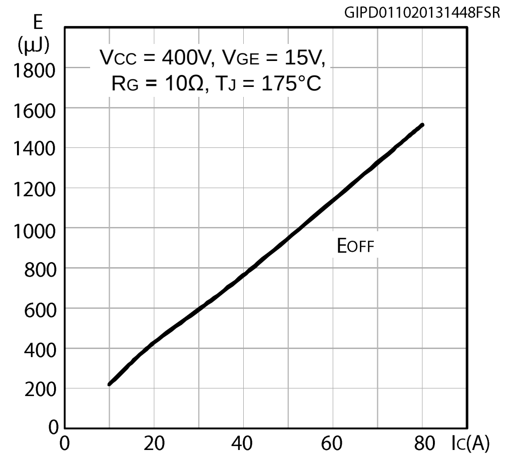


Figure 17: Switching energy vs gate resistance

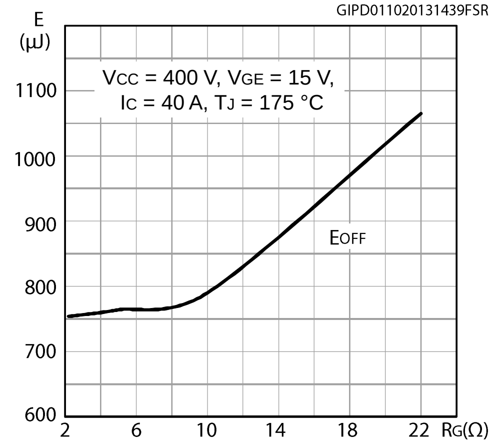


Figure 18: Switching energy vs temperature

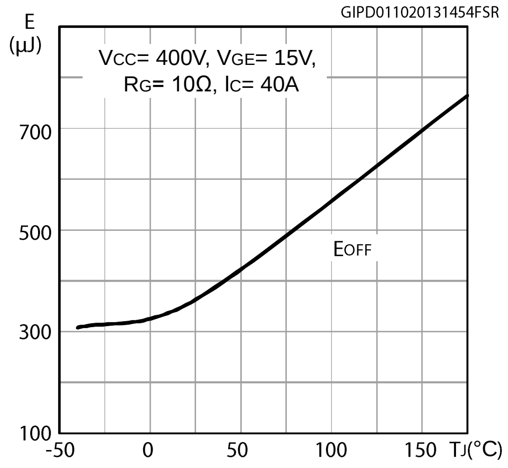


Figure 19: Switching energy vs. collector emitter voltage

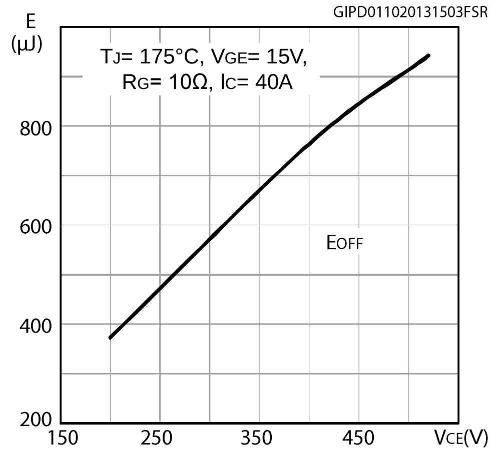


Figure 20: Switching times vs. collector current

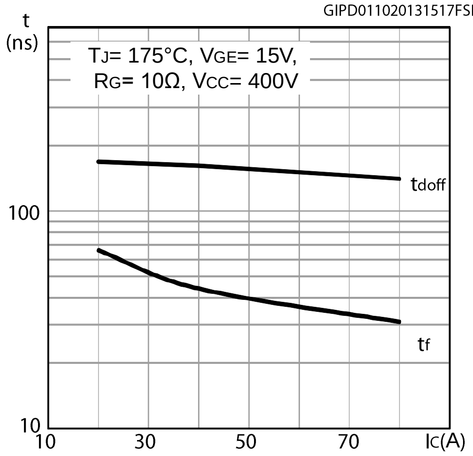


Figure 21: Switching times vs. gate resistance

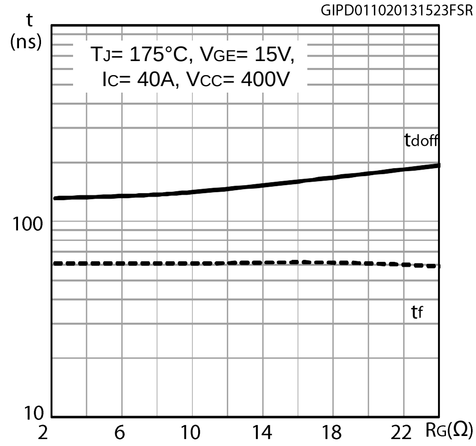


Figure 22: Switching-off energy vs. capacitive load

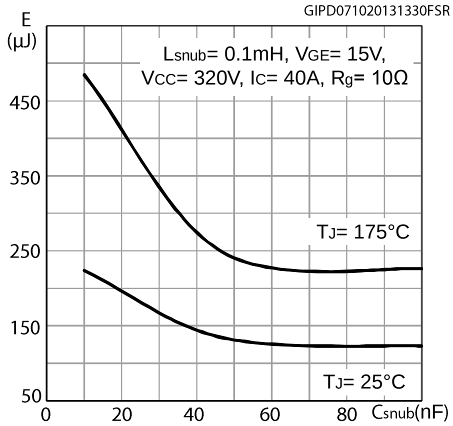


Figure 23: Thermal impedance

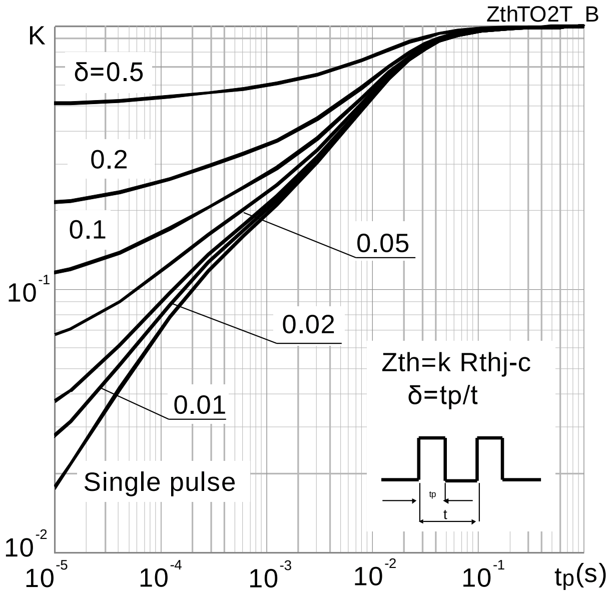
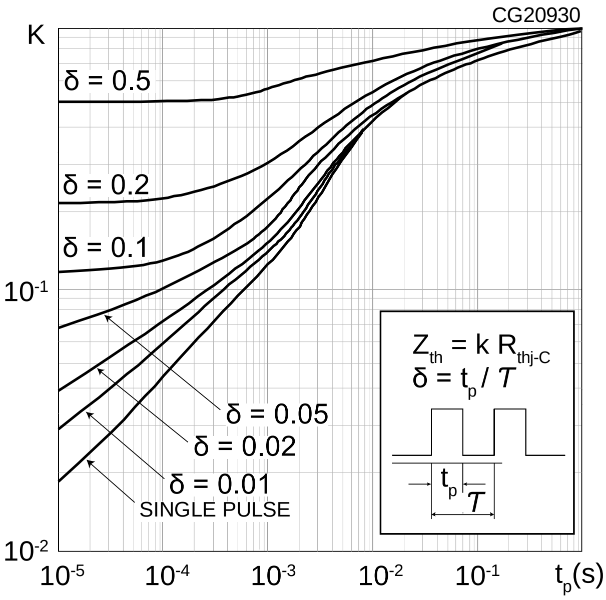


Figure 24: Thermal impedance for diode



3 Test circuits

Figure 25: Test circuit for inductive load switching

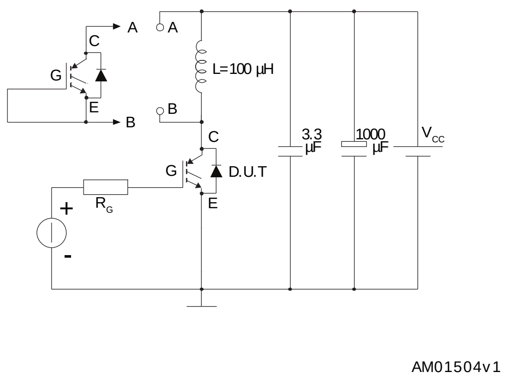


Figure 26: Test circuit for capacitive load switching

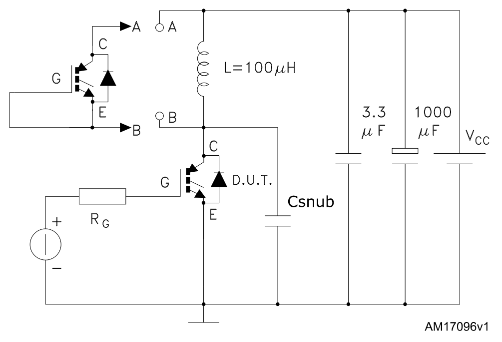


Figure 27: Gate charge test circuit

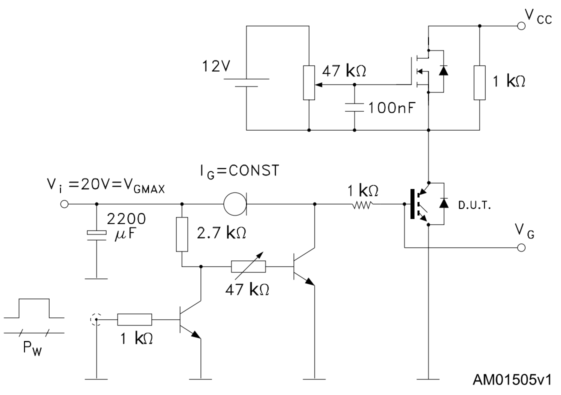
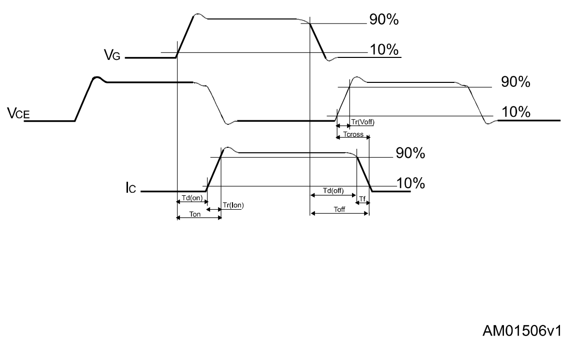


Figure 28: Switching waveform



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.

4.1 TO247 long leads package mechanical data

Figure 29: TO-247 long leads package outline

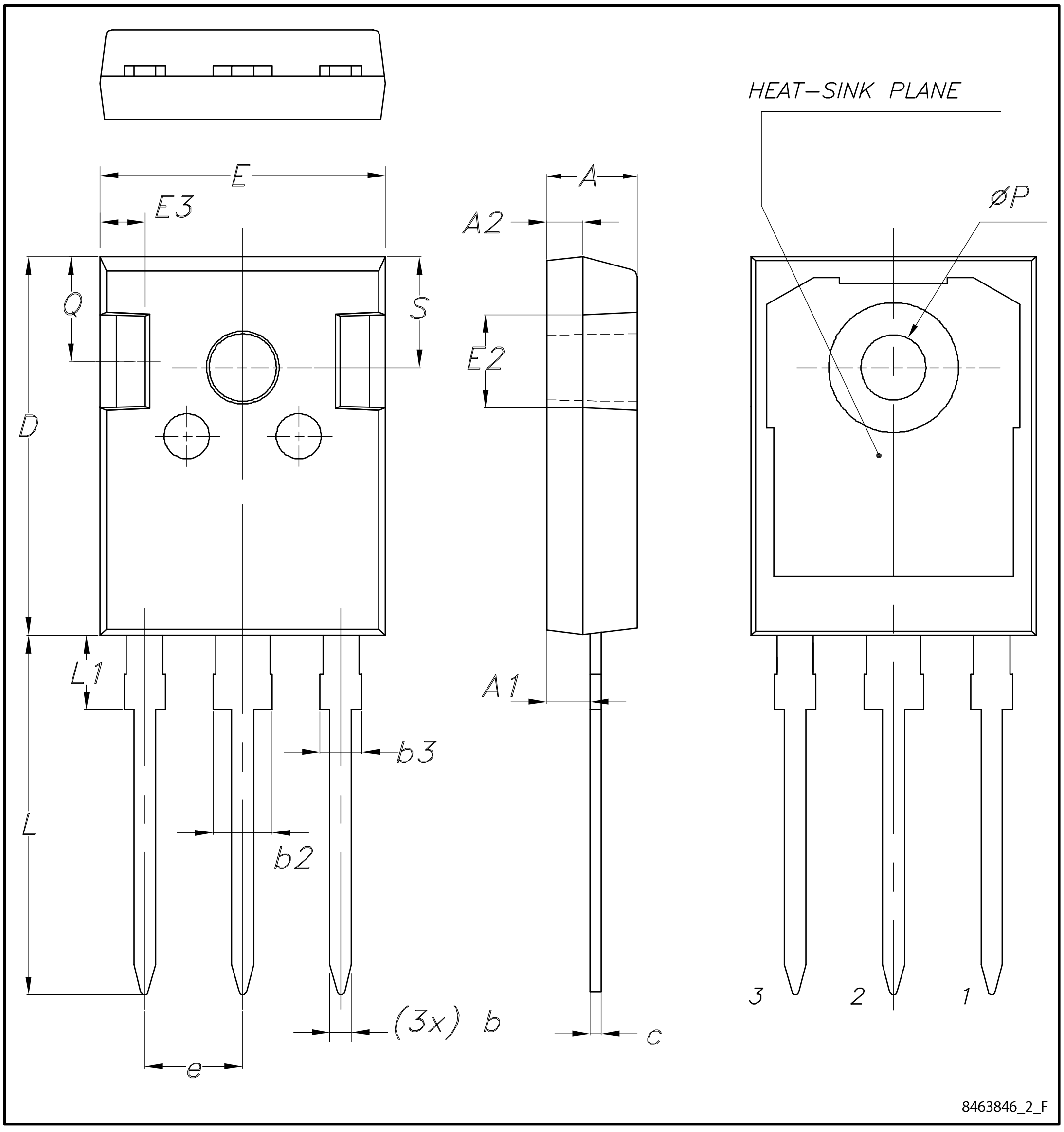


Table 8: TO-247 long leads package mechanical data

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

5 Revision history

Table 9: Document revision history

Date	Revision	Changes
03-Mar-2017	1	First release.