

Trench gate field-stop IGBT, 650 V, 50 A soft switching IH series in a TO-247 long leads package

Datasheet - production data

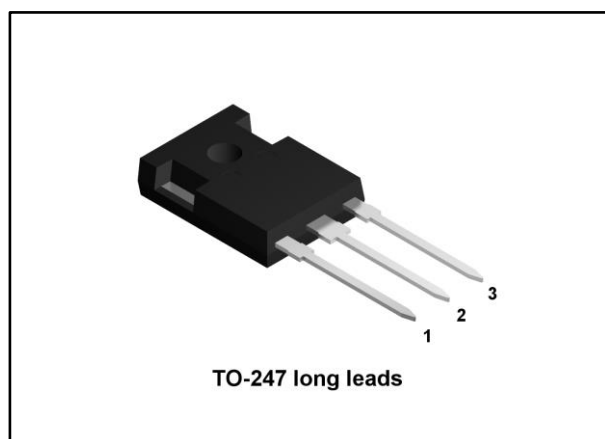
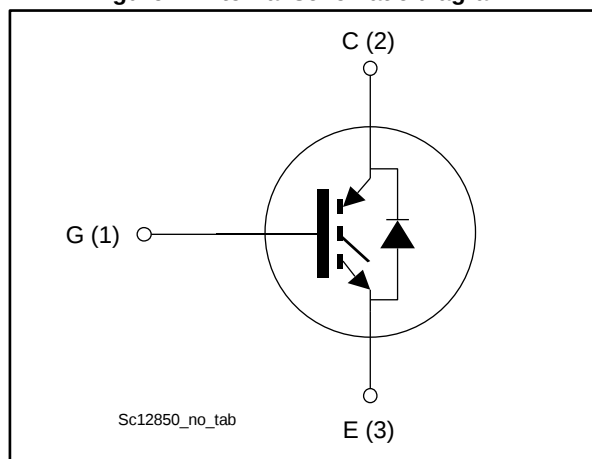


Figure 1: Internal schematic diagram



Features

- Designed for soft-commutation only
- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- $V_{CE(sat)} = 1.5\text{ V (typ.) @ } I_C = 50\text{ A}$
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Low voltage drop freewheeling co-packaged diode

Applications

- Induction heating
- Resonant converters
- Microwave oven

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.

Table 1: Device summary

Order code	Marking	Package	Packing
STGWA50IH65DF	G50IH65DF	TO-247 long leads	Tube

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1 Electrical ratings

Table 2: 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	100	A
	Continuous collector current at $T_C = 100$ °C	50	
$I_{CP}^{(1)}$	Pulsed collector current	150	
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current at $T_C = 25$ °C	50	A
	Continuous forward current at $T_C = 100$ °C	25	
$I_{FP}^{(1)}$	Pulsed forward current	150	
P_{TOT}	Total dissipation at $T_C = 25$ °C	300	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature range	- 55 to 175	

Notes:

⁽¹⁾Pulse width limited by maximum junction temperature.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.5	°C/W
	Thermal resistance junction-case diode	1.47	
R_{thJA}	Thermal resistance junction-ambient	50	

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 250\text{ }\mu\text{A}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 50\text{ A}$		1.50	2.00	
		$V_{GE} = 15\text{ V}$, $I_C = 50\text{ A}$, $T_J = 125\text{ °C}$		1.75		
		$V_{GE} = 15\text{ V}$, $I_C = 50\text{ A}$, $T_J = 175\text{ °C}$		1.90		
V_F	Forward on-voltage	$I_F = 25\text{ A}$		1.75	2.50	
		$I_F = 25\text{ A}$, $T_J = 125\text{ °C}$		1.50		
		$I_F = 25\text{ A}$, $T_J = 175\text{ °C}$		1.40		
		$I_F = 50\text{ A}$		2.15		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$			25	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 250	nA

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	2980	-	pF
C_{oes}	Output capacitance		-	150	-	
C_{res}	Reverse transfer capacitance		-	81	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 24: "Gate charge test circuit")	-	158	-	nC
Q_{ge}	Gate-emitter charge		-	25	-	
Q_{gc}	Gate-collector charge		-	72	-	

Table 6: IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off-delay time	$V_{CC} = 400\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 22\text{ }\Omega$ (see Figure 22: "Test circuit for inductive load switching")	-	260	-	ns
t_f	Current fall time		-	17	-	
$t_{d(off)}$	Turn-off-delay time	$V_{CC} = 400\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 22\text{ }\Omega$, $T_J = 175\text{ °C}$ (see Figure 22: "Test circuit for inductive load switching")	-	270	-	ns
t_f	Current fall time		-	24	-	

Table 7: IGBT switching characteristics (snubbed inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{off}^{(1)}$	Turn-off switching energy	$V_{CC} = 320\text{ V}$, $R_G = 10\ \Omega$, $I_C = 50\text{ A}$, $L = 100\ \mu\text{H}$, $C_{snub} = 22\text{ nF}$ (see Figure 23: "Test circuit for capacitive load switching")	-	284	-	μJ
		$V_{CC} = 320\text{ V}$, $R_G = 10\ \Omega$, $I_C = 50\text{ A}$, $L = 100\ \mu\text{H}$, $C_{snub} = 22\text{ nF}$ $T_J = 175\text{ }^\circ\text{C}$ (see Figure 23: "Test circuit for capacitive load switching")	-	469	-	

Notes:

⁽¹⁾Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature

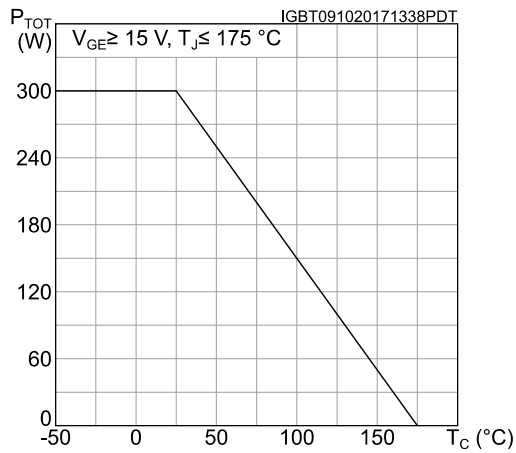


Figure 3: Collector current vs. case temperature

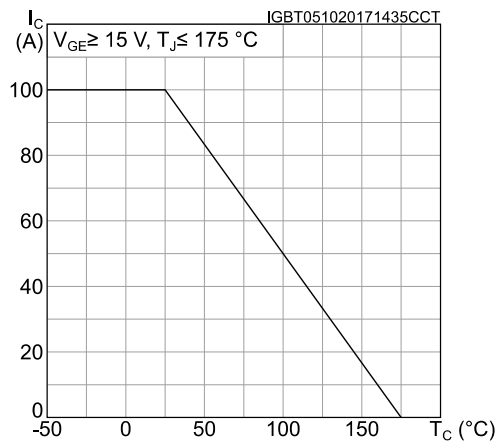
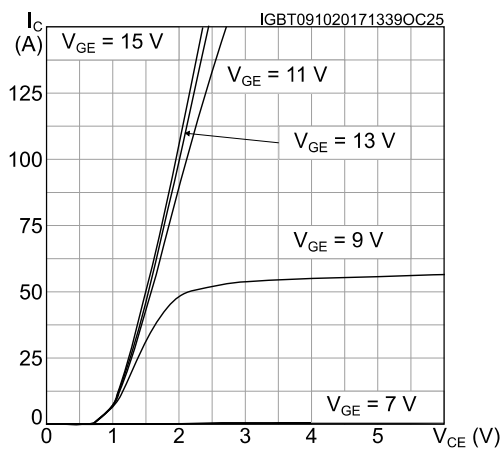
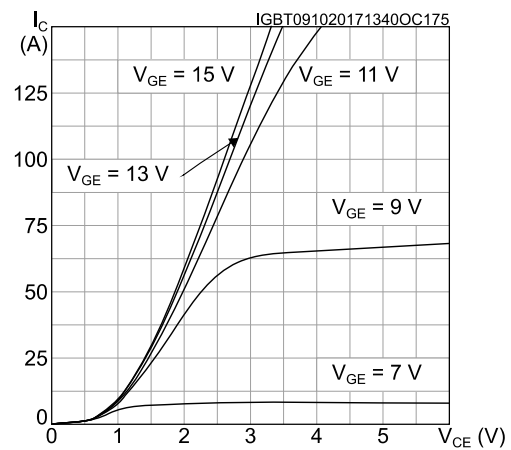
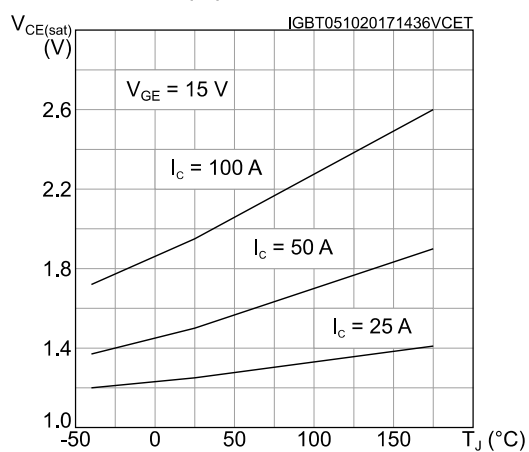
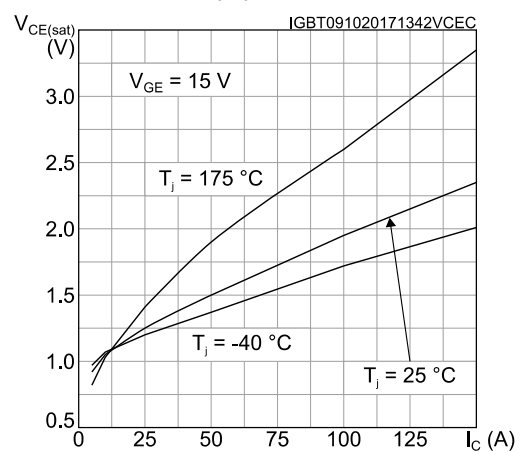
Figure 4: Output characteristics ($T_J = 25$ °C)Figure 5: Output characteristics ($T_J = 175$ °C)Figure 6: $V_{CE(sat)}$ vs. junction temperatureFigure 7: $V_{CE(sat)}$ vs. collector current

Figure 8: Forward bias safe operating area

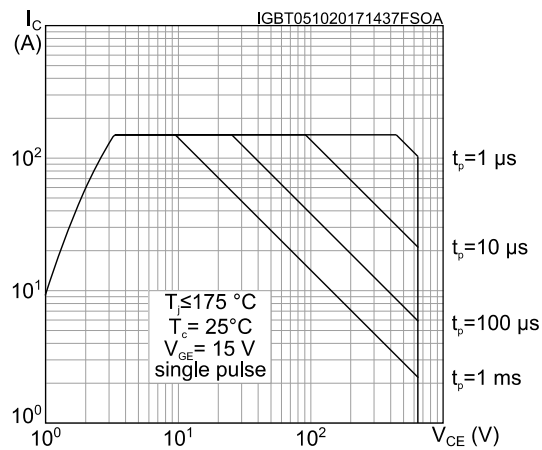


Figure 9: Transfer characteristics

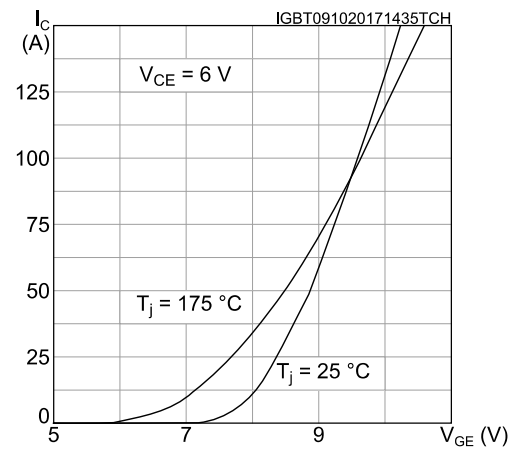
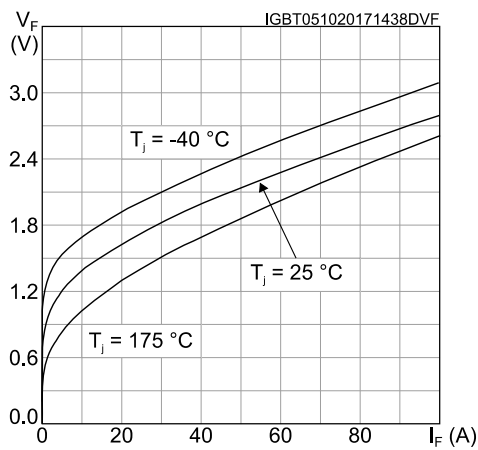
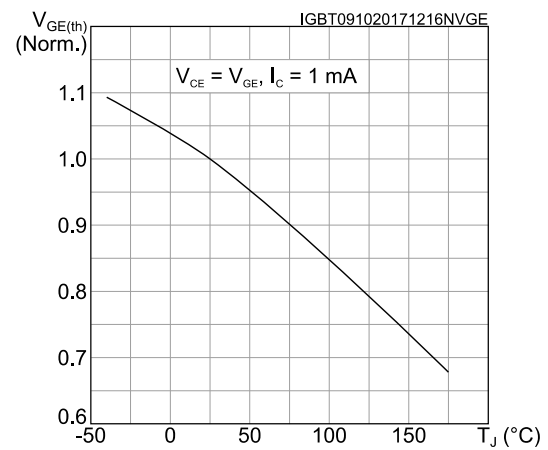
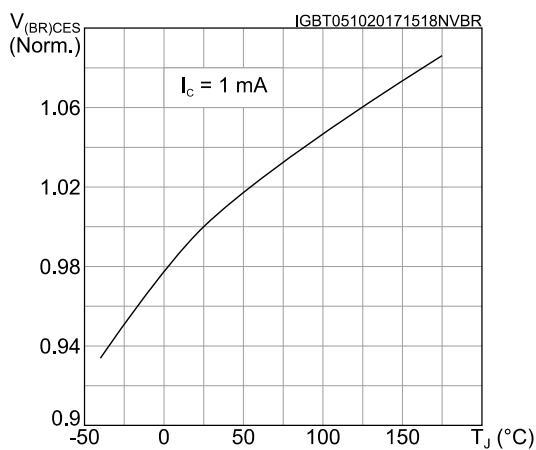
Figure 10: Diode V_F vs. forward currentFigure 11: Normalized $V_{GE(th)}$ vs. junction temperatureFigure 12: Normalized $V_{(BR)CES}$ vs. junction temperature

Figure 13: Capacitance variations

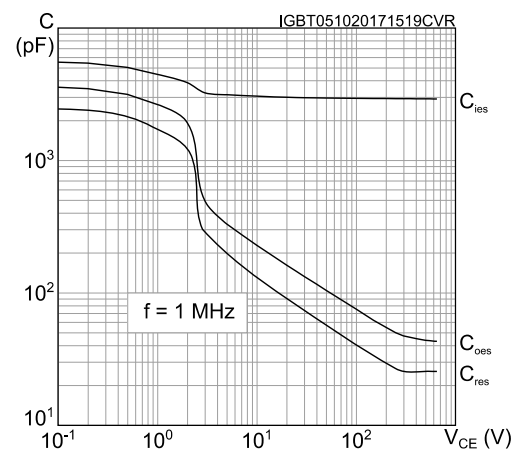


Figure 14: Gate charge vs. gate-emitter voltage

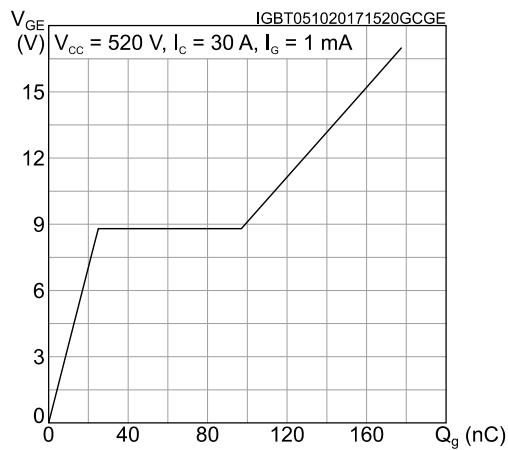


Figure 15: Switching-off energy vs. collector current

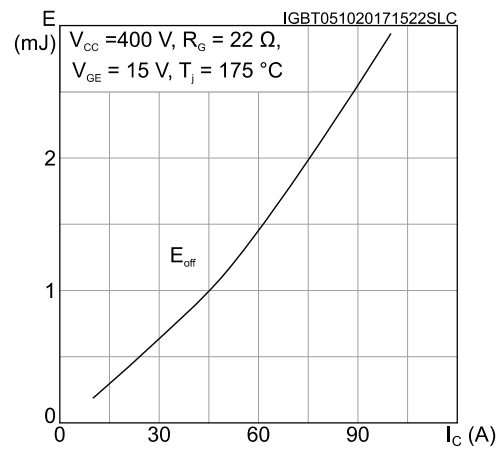


Figure 16: Switching-off energy vs. temperature

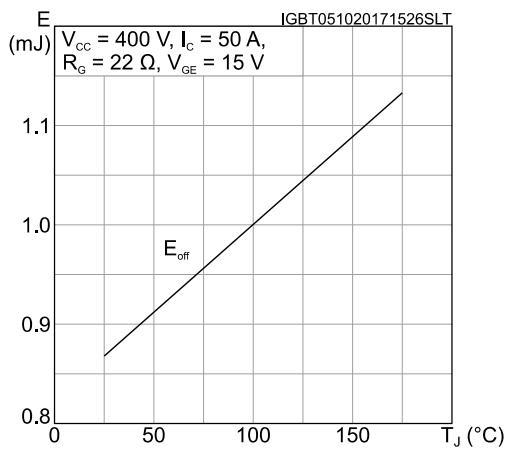


Figure 17: Switching-off energy vs. collector emitter voltage

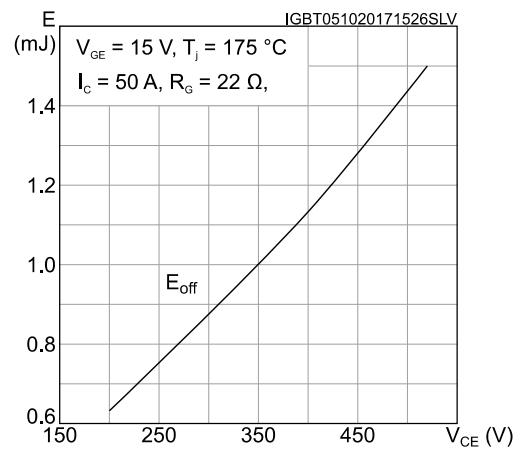


Figure 18: Switching-off times vs. collector current

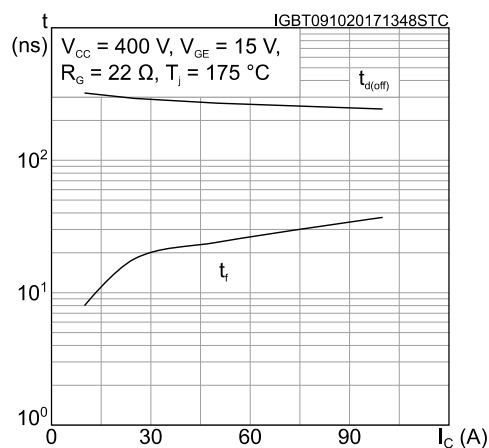


Figure 19: Switching-off energy vs. snubber capacitance

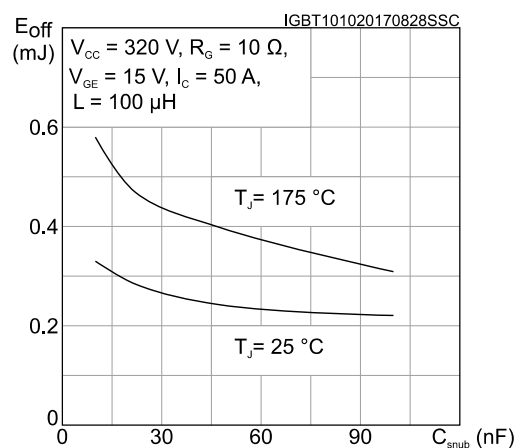


Figure 20: Thermal impedance

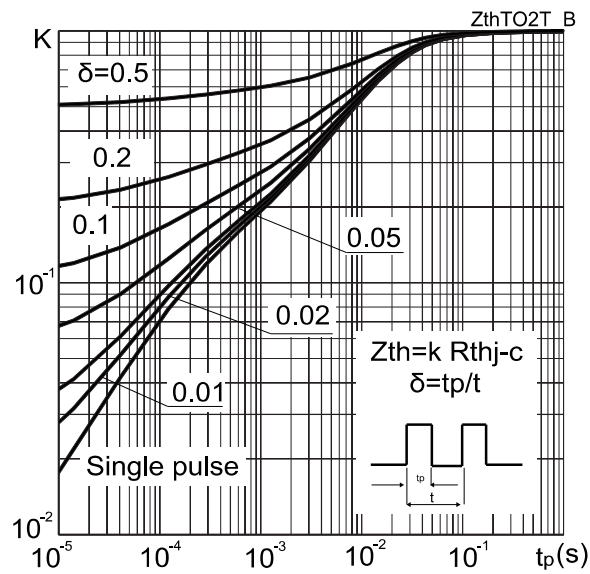
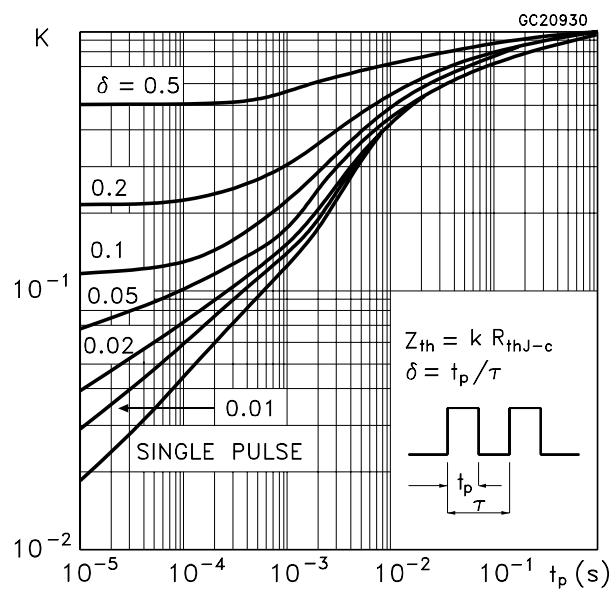
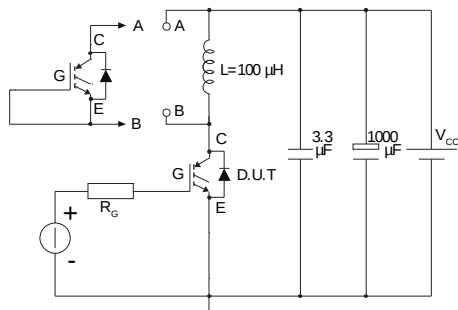


Figure 21: Thermal impedance for diode



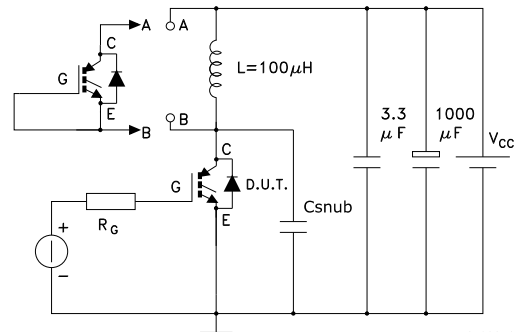
3 Test circuits

Figure 22: Test circuit for inductive load switching



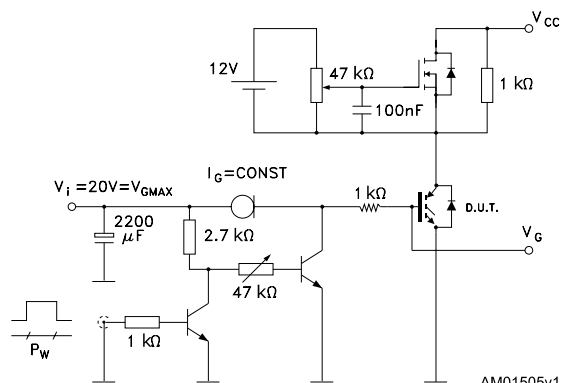
AM01504v1

Figure 23: Test circuit for snubbed inductive load switching



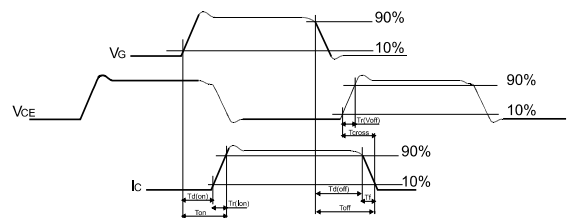
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Figure 24: Gate charge test circuit



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Figure 25: Switching waveform



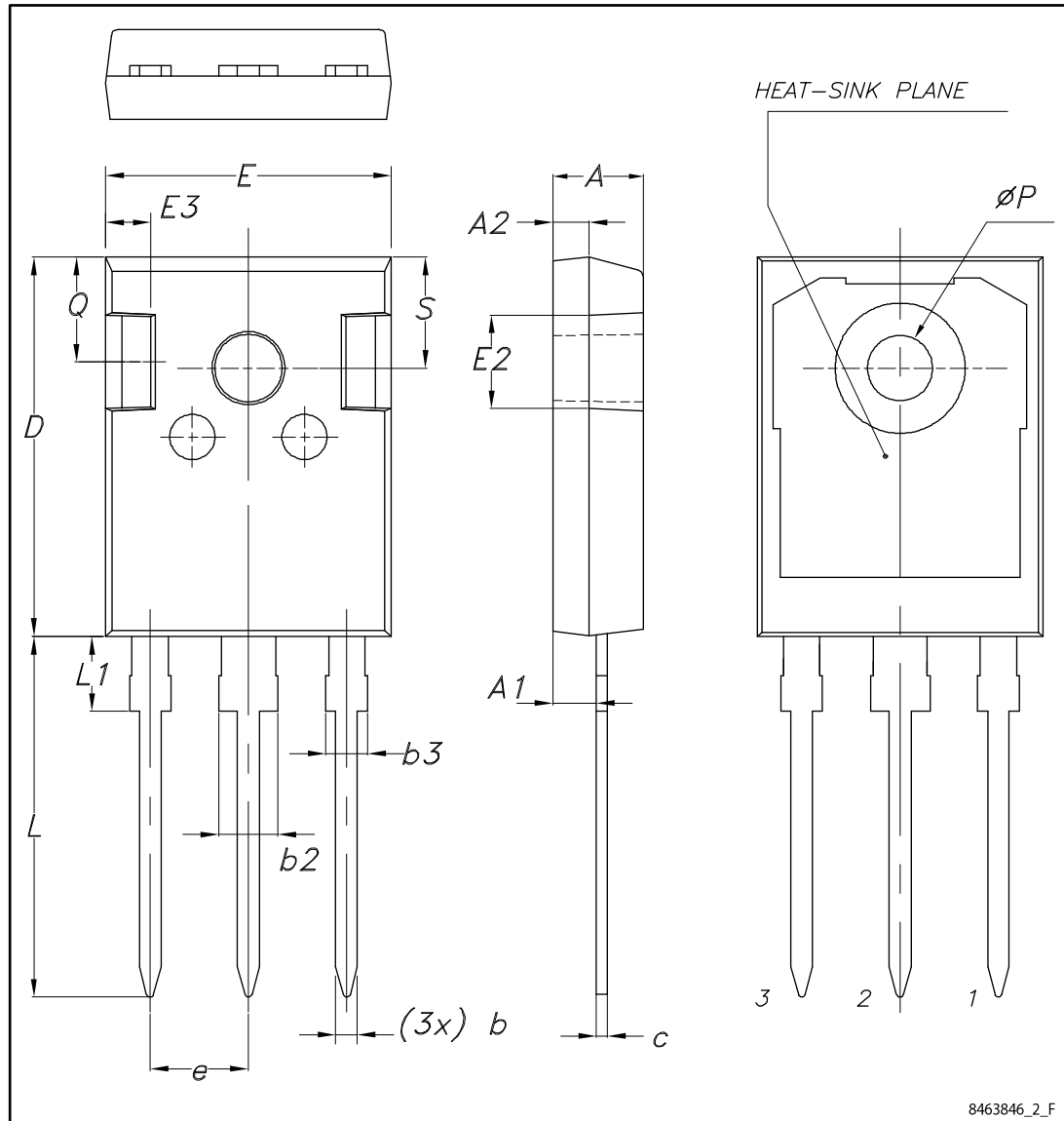
AM01506v1

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 26: TO-247 long leads package outline



8463846_2_F

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
02-Sep-2016	1	First release.
05-Oct-2017	2	Modified title, silhouette, features and description. Modified Table 2: "Absolute maximum ratings" , Table 3: "Thermal data" , Table 4: "Static characteristics" , Table 5: "Dynamic characteristics" , Table 6: "IGBT switching characteristics (inductive load)" and Table 7: "IGBT switching characteristics (snubbed inductive load)" . Added Section 2.1: "Electrical characteristics (curves)" . Minor text changes.

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