STGWT20HP65FB

Trench gate field-stop IGBT, HB series 650 V, 20 A high speed

Datasheet - production data

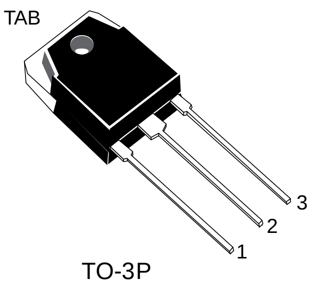
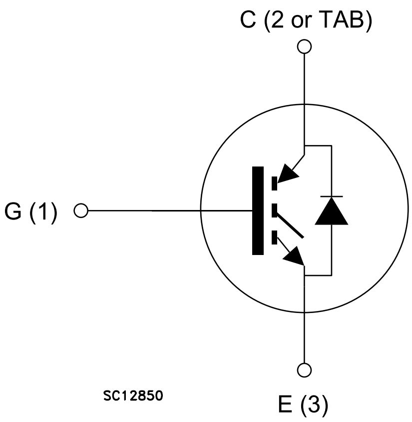


Figure 1: Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- Minimized tail current
- $V_{CE(sat)}$ = 1.55 V (typ.) @ I_C = 20 A
- Tight parameter distribution
- Co-packed diode for protection
- Safe paralleling
- Low thermal resistance

Applications

- Power factor corrector (PFC)

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	Packing
STGWT20HP65FB	GWT20HP65FB	TO-3P	Tube

Contents

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	40	A
	Continuous collector current at T_C = 100 °C	20	
I_{CP}(1)	Pulsed collector current	80	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at T_C = 25 °C(2)	5	A
	Continuous forward current at T_C = 100 °C	5	
I_{FP}(3)	Pulsed forward current	10	A
P_{TOT}	Total dissipation at T_C = 25 °C	168	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

(2)Limited by wires

(3)Pulsed forward current

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.9	°C/W
R_{thJC}	Thermal resistance junction-case diode	5	
R_{thJA}	Thermal resistance junction-ambient	50	

2 Electrical characteristics

T_J = 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	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 20 A		1.55	2.0	V
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C		1.65		
		V_{GE} = 15 V, I_C = 20 A, T_J = 175 °C		1.75		
V_F	Forward on-voltage	I_F = 5 A		2		V
		I_F = 5 A, T_J = 125 °C		1.85		
		I_F = 5 A, T_J = 175 °C		1.75		
$V_{GE(th)}$	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 5: 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	-	2764	-	pF
C_{oes}	Output capacitance		-	80	-	
C_{res}	Reverse transfer capacitance		-	60	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 20 A, V_{GE} = 15 V (see *Figure 27: "Gate charge test circuit"*)	-	120	-	nC
Q_{ge}	Gate-emitter charge		-	20	-	
Q_{gc}	Gate-collector charge		-	50	-	

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 = 20 A, V_{GE} = 15 V, R_G = 10 Ω (see *Figure 26: "Test circuit for inductive load switching"*)	-	139	-	ns
t_f	Current fall time		-	20	-	ns
E_{off}(1)	Turn-off switching energy		-	170	-	µJ
$t_{d(off)}$	Turn-off-delay time	V_{CE} = 400 V, I_C = 20 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see *Figure 26: "Test circuit for inductive load switching"*)	-	147	-	ns
t_f	Current fall time		-	38	-	ns
E_{off}(1)	Turn-off switching energy		-	353	-	µJ

Notes:

(1)Including the tail of the collector current

Table 7: Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 5 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs (see *Figure 26: "Test circuit for inductive load switching"*)	-	140	-	ns
Q_{rr}	Reverse recovery charge		-	21	-	nC
I_{rrm}	Reverse recovery current		-	6.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	430	-	A/µs
E_{rr}	Reverse recovery energy		-	1.6	-	µJ
t_{rr}	Reverse recovery time	I_F = 5 A, V_R = 400 V, V_{GE} = 15 V, T_J = 175 °C, di/dt = 1000 A/µs (see *Figure 26: "Test circuit for inductive load switching"*)	-	200	-	ns
Q_{rr}	Reverse recovery charge		-	47.3	-	nC
I_{rrm}	Reverse recovery current		-	9.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	428	-	A/µs
E_{rr}	Reverse recovery energy		-	3.2	-	µJ

2.1 Electrical characteristics (curves)

Figure 2: Output characteristics (T_J = 25 °C)

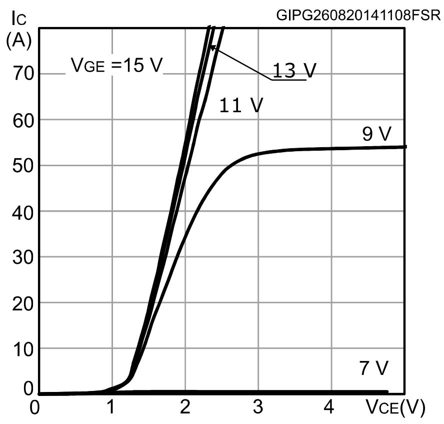


Figure 3: Output characteristics (T_J = 175 °C)

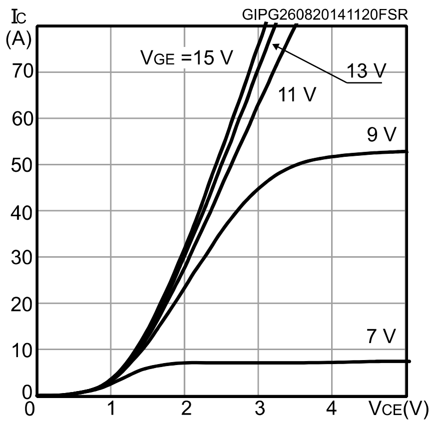


Figure 4: Transfer characteristics

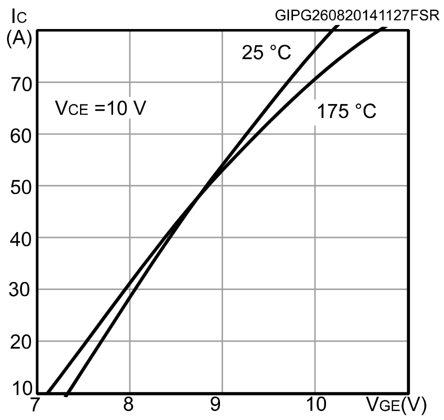


Figure 5: Collector current vs. case temperature

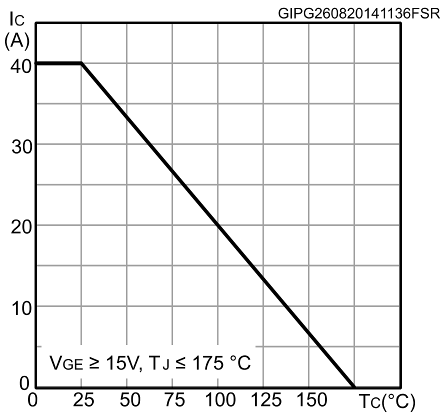


Figure 6: $V_{CE(sat)}$ vs. junction temperature

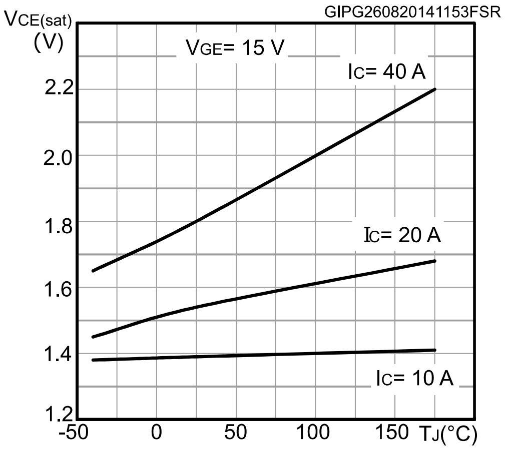


Figure 7: Power dissipation vs. case temperature

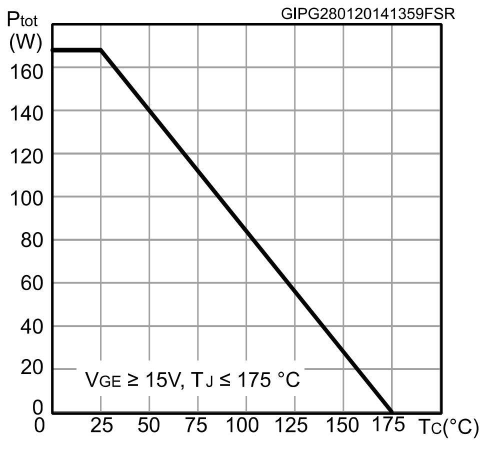


Figure 8: Forward bias safe operating area

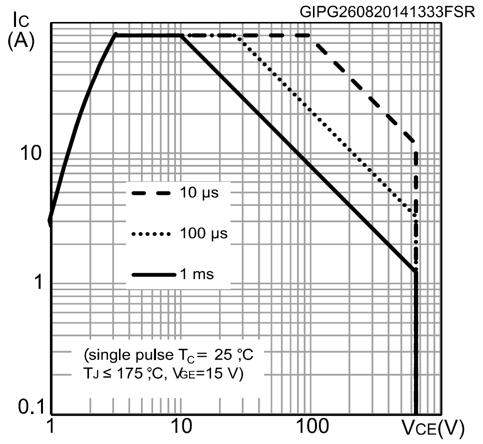


Figure 9: Collector current vs. switching frequency

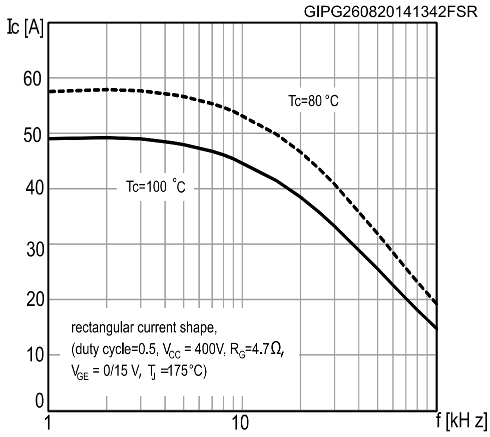


Figure 10: Normalized $V_{GE(th)}$ vs. junction temperature

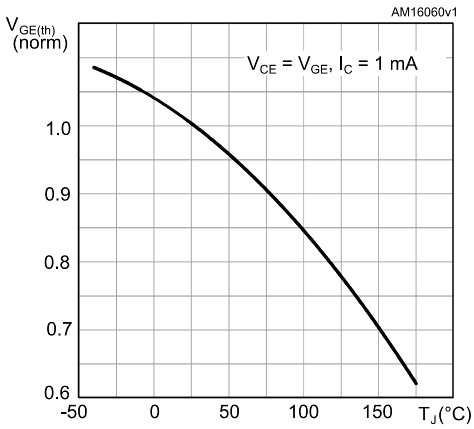


Figure 11: Normalized $V_{(BR)CES}$ vs. junction temperature

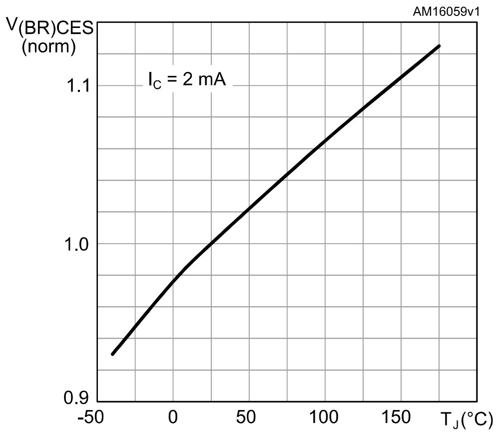


Figure 12: Switching energy vs. collector current

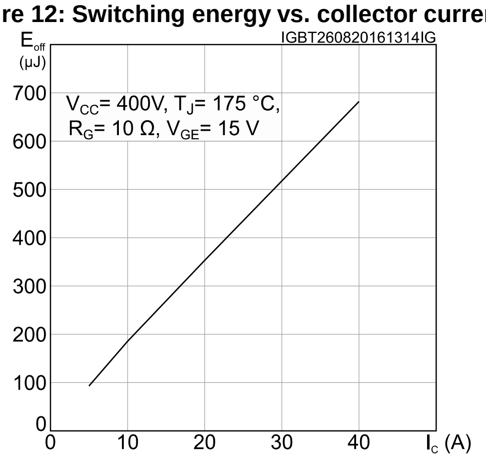


Figure 13: Switching energy vs. gate resistance

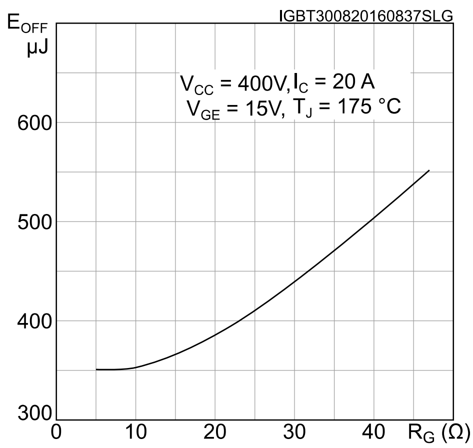


Figure 14: Switching energy vs. temperature

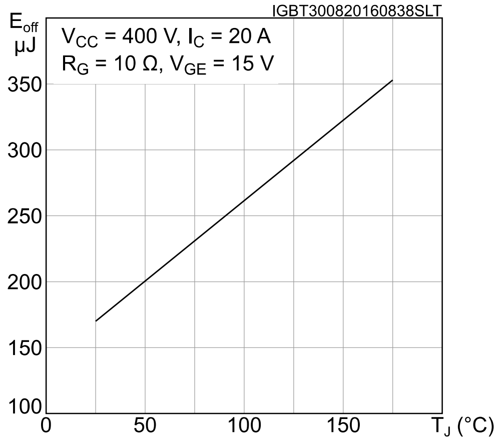


Figure 15: Switching energy vs. collector emitter voltage

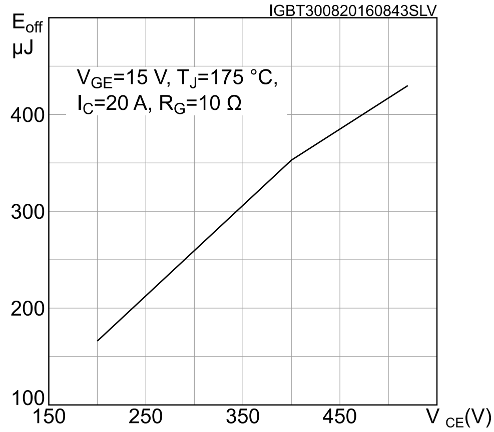


Figure 16: Switching times vs. collector current

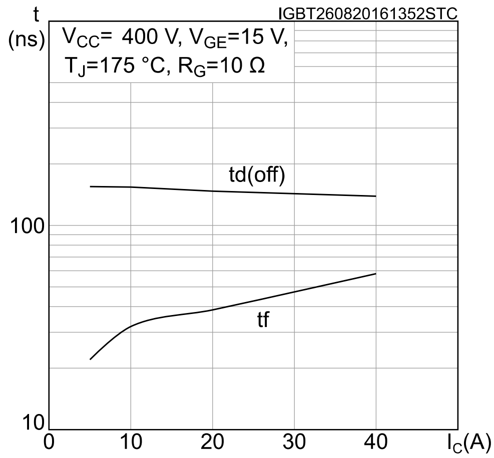


Figure 17: Switching time vs. gate resistance

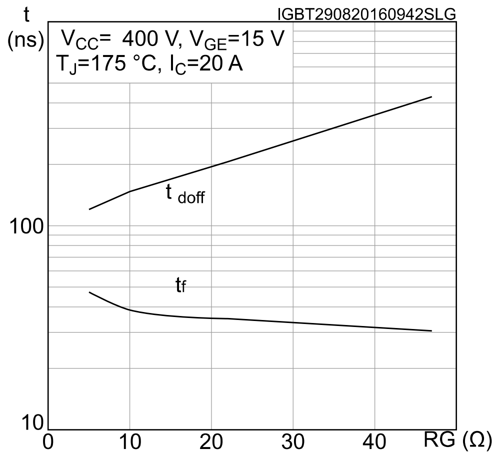


Figure 18: Capacitance variations

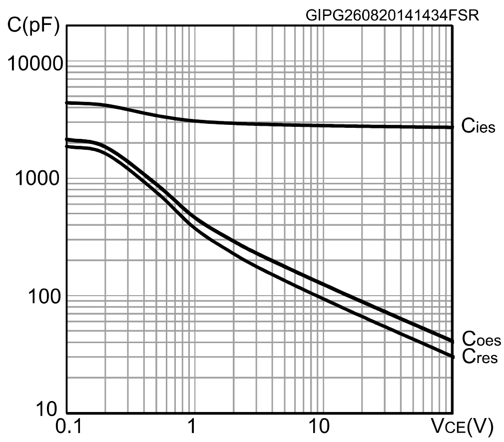


Figure 19: Gate charge vs. gate-emitter voltage

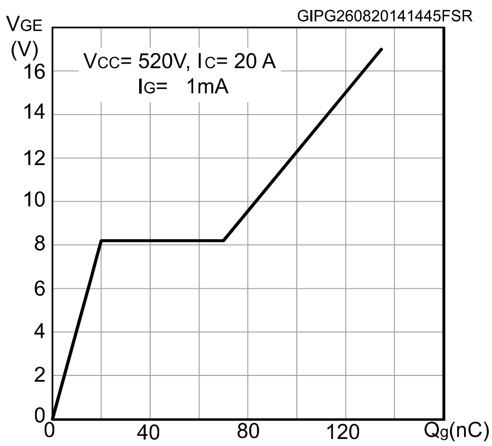


Figure 20: Diode V_F vs. forward current

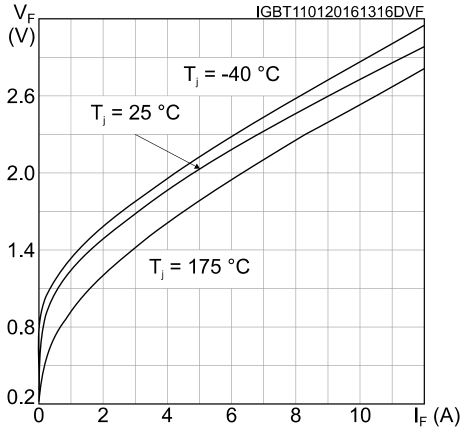


Figure 21: Reverse recovery current vs. diode current slope

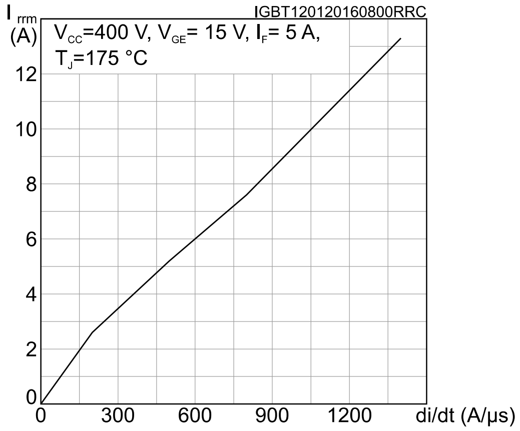


Figure 22: Reverse recovery time vs. diode current slope

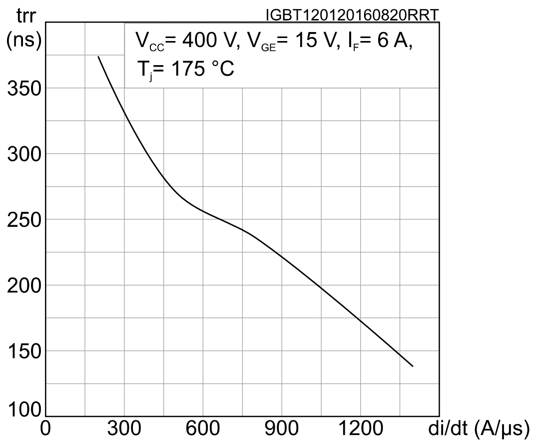


Figure 23: Reverse recovery charge vs. diode current slope

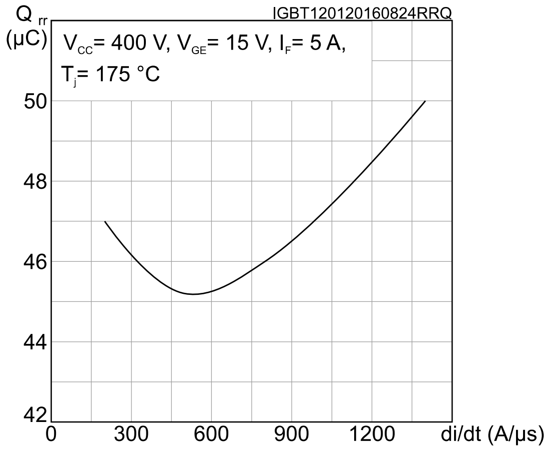


Figure 24: Reverse recovery energy vs. diode current slope

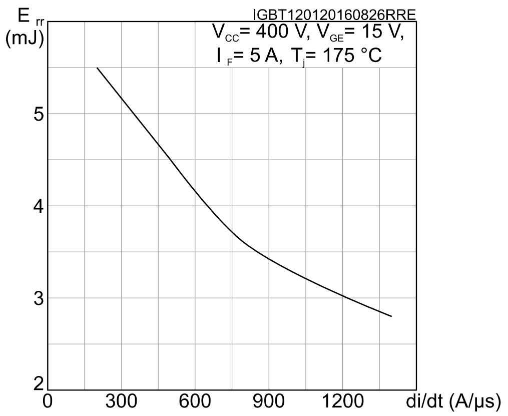
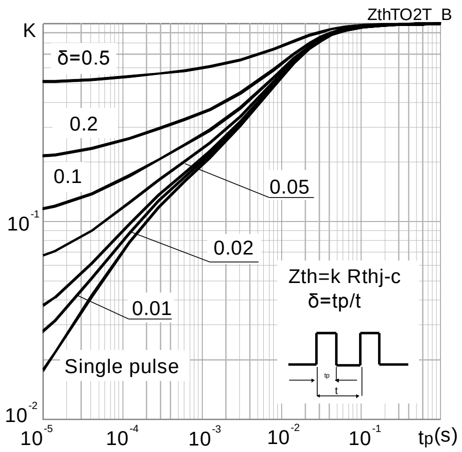


Figure 25: Thermal impedance



3 Test circuits

Figure 26: Test circuit for inductive load switching

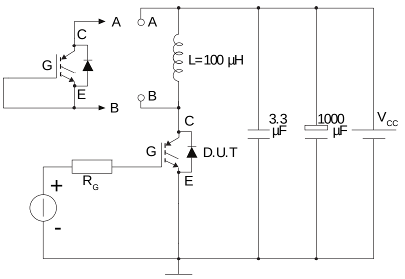


Figure 27: Gate charge test circuit

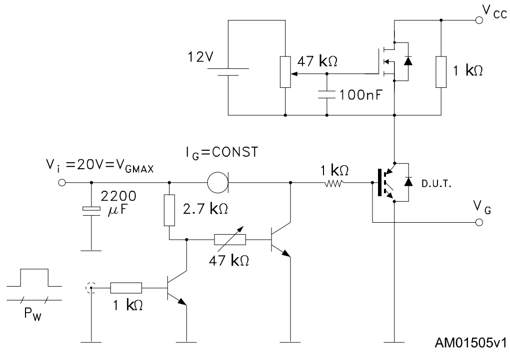
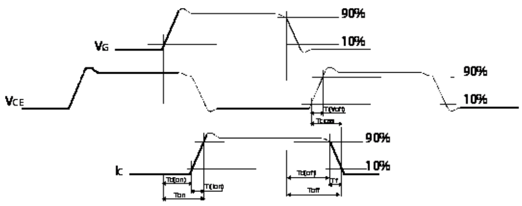


Figure 28: Switching waveform



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-3P package information

Figure 29: TO-3P package outline

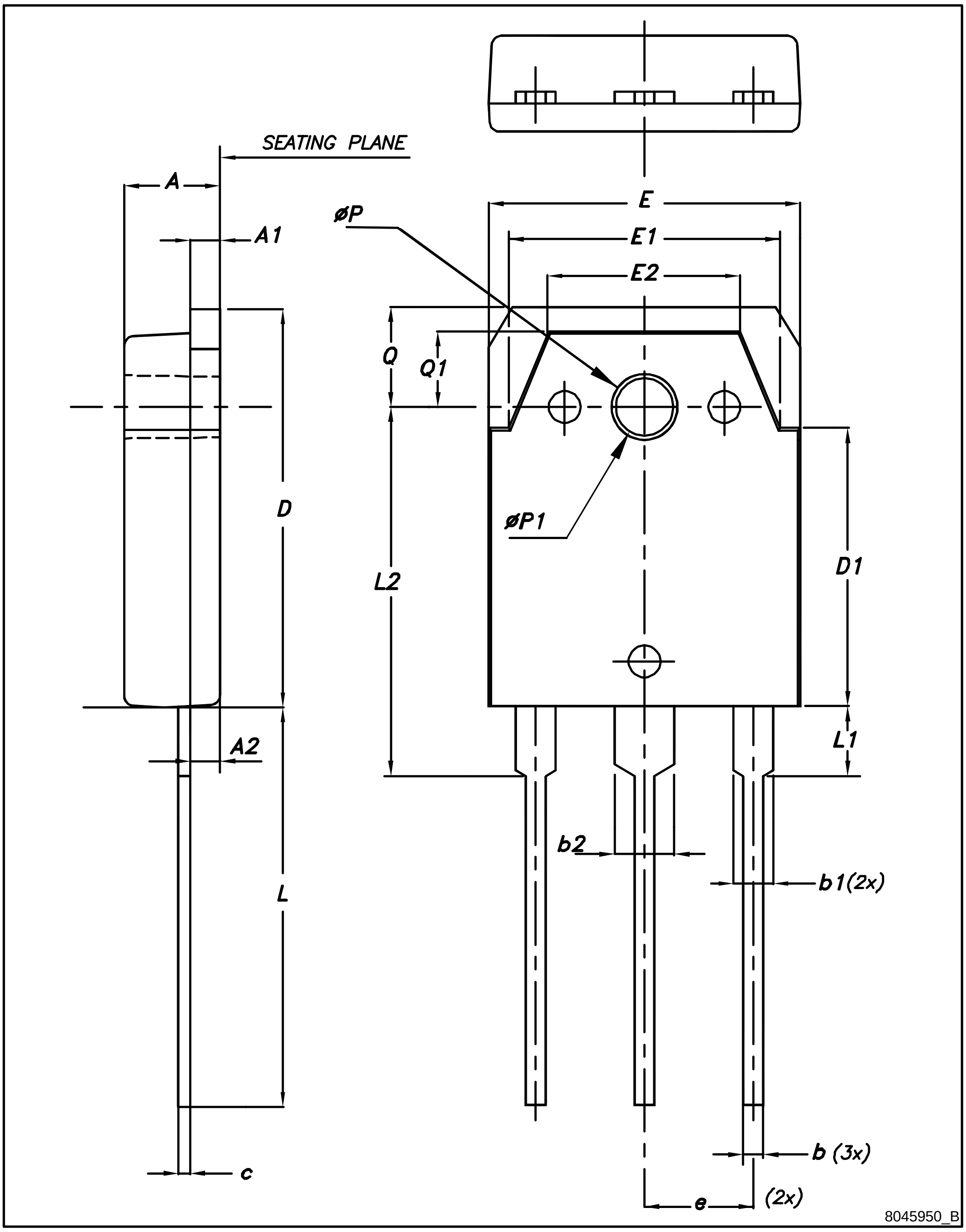


Table 8: TO-3P package mechanical data

Dim.	mm		
	Min.	**Typ.**	**Max.**
A	4.60	4.80	5.00
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1.00	1.20
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1	13.70	13.90	14.10
E	15.40	15.60	15.80
E1	13.40	13.60	13.80
E2	9.40	9.60	9.90
e	5.15	5.45	5.75
L	19.80	20.00	20.20
L1	3.30	3.50	3.70
L2	18.20	18.40	18.60
ØP	3.30	3.40	3.50
ØP1	3.10	3.20	3.30
Q	4.80	5.00	5.20
Q1	3.60	3.80	4

5 Revision history

Table 9: Document revision history

Date	Revision	Changes
31-Aug-2016	1	First release.
28-Sep-2016	2	Datasheet promoted from preliminary to production data.
13-Dec-2016	3	Updated *Figure 1: "Internal schematic diagram"*. Updated *Table 4: "Static characteristics"* and *Table 7: "Diode switching characteristics (inductive load)"*. Added *Figure 20: "Diode VF vs. forward current"*, *Figure 21: "Reverse recovery current vs. diode current slope"*, *Figure 22: "Reverse recovery time vs. diode current slope"*, *Figure 23: "Reverse recovery charge vs. diode current slope"* and *Figure 24: "Reverse recovery energy vs. diode current slope"*. Updated *Figure 2: "Output characteristics (TJ = 25 °C)"*, *Figure 12: "Switching energy vs. collector current"* and *Figure 17: "Switching time vs. gate resistance"*. Minor text changes