

Trench gate field-stop IGBT, H series 600 V, 15 A high speed

Datasheet - production data

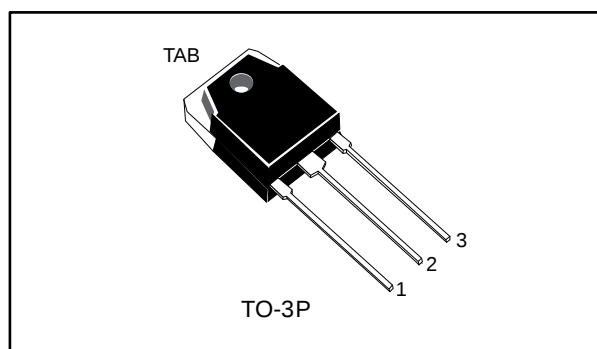
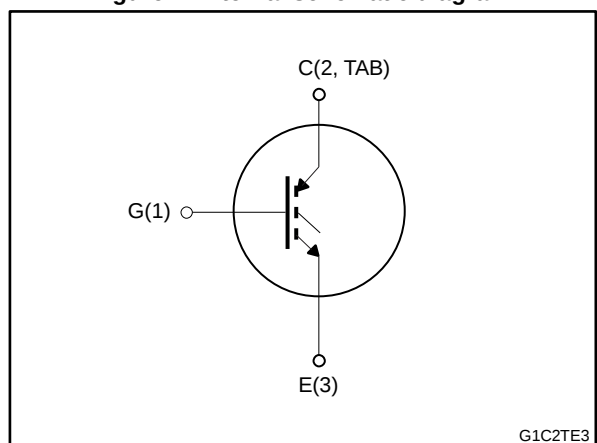


Figure 1: Internal schematic diagram



Features

- High speed switching
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated

Applications

- Motor control
- UPS
- PFC

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the H series of IGBTs, which represents an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converters. Furthermore, a 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
STGWT15H60F	G15H60F	TO-3P	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves).....	6
3	Test circuits	10
4	Package information	11
	4.1 TO-3P package information	12
5	Revision history	14

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0\text{ V}$)	600	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	30	A
	Continuous collector current at $T_C = 100\text{ °C}$	15	
$I_{CP}^{(1)}$	Pulsed collector current	60	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	115	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

Notes:

⁽¹⁾Pulse width is limited by maximum junction temperature.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case	1.3	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

$T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$		1.6	2	V
		$V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.7		
		$V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		1.8		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$			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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	1952	-	pF
C_{oes}	Output capacitance		-	78	-	pF
C_{res}	Reverse transfer capacitance		-	45	-	pF
Q_g	Total gate charge	$V_{CC} = 480\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 24: "Gate charge test circuit")	-	81	-	nC
Q_{ge}	Gate-emitter charge		-	8	-	nC
Q_{gc}	Gate-collector charge		-	42	-	nC

Table 6: Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$		24.5	-	ns
t_r	Current rise time			8.2	-	ns
$(di/dt)_{on}$	Turn-on current slope			1470	-	A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 23: "Test circuit for inductive load switching")		25	-	ns
t_r	Current rise time			9	-	ns
$(di/dt)_{on}$	Turn-on current slope			1370	-	A/ μ s
$t_{r(voff)}$	Off voltage rise time	$V_{CE} = 400\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$		18	-	ns
$t_{d(off)}$	Turn-off delay time			118	-	ns
t_f	Current fall time			69	-	ns
$t_{r(voff)}$	Off voltage rise time	$V_{CE} = 400\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 23: "Test circuit for inductive load switching")		27	-	ns
$t_{d(off)}$	Turn-off delay time			124	-	ns
t_f	Current fall time			101	-	ns
t_{sc}	Short-circuit withstand time	$V_{CC} \leq 360\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$	3	5	-	μ s

Table 7: Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on(1)}$	Turn-on switching energy	$V_{CE} = 400\text{ V}$, $I_C = 15\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$	-	136	-	μ J
$E_{off(2)}$	Turn-off switching energy		-	207	-	μ J
E_{ts}	Total switching energy		-	343	-	μ J
$E_{on(1)}$	Turn-on switching energy	$V_{CE} = 400\text{ V}$, $I_C = 15\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$	-	224	-	μ J
$E_{off(2)}$	Turn-off switching energy		-	329	-	μ J
E_{ts}	Total switching energy		-	553	-	μ J

Notes:

(1)Including the reverse recovery of the external diode. The diode is the same of the co-packed STGP15H60DF.

(2)Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature

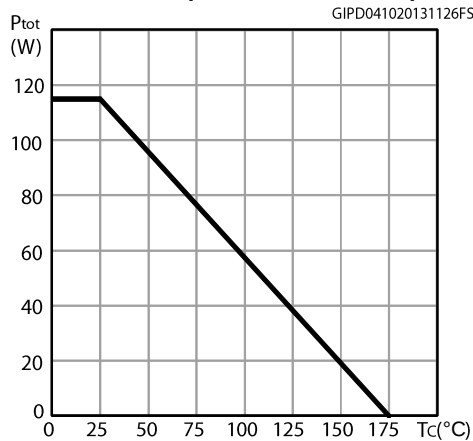


Figure 3: Collector current vs. case temperature

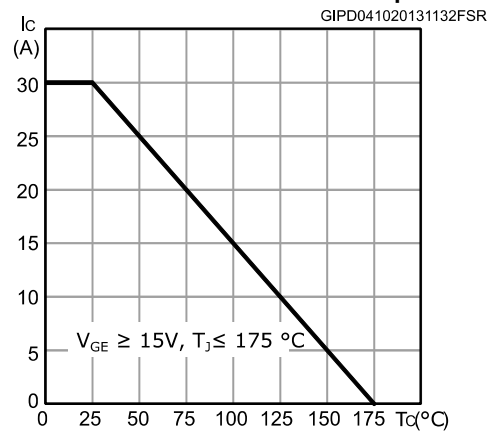
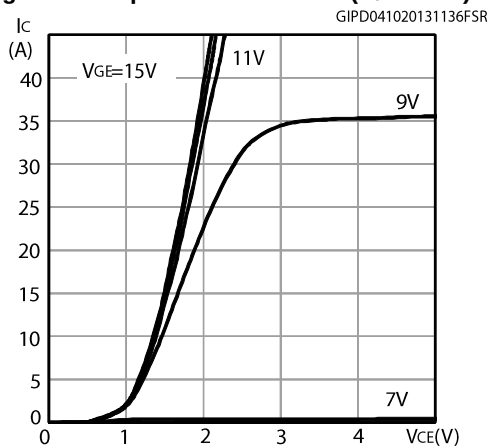
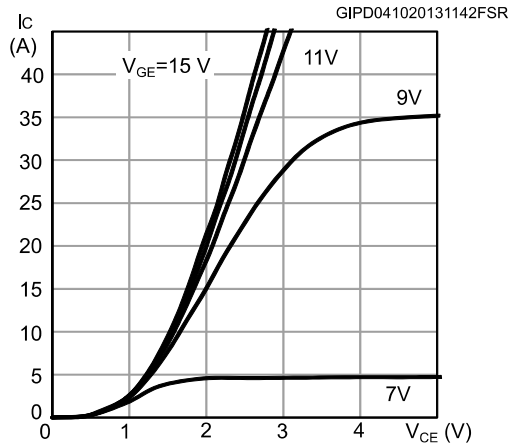
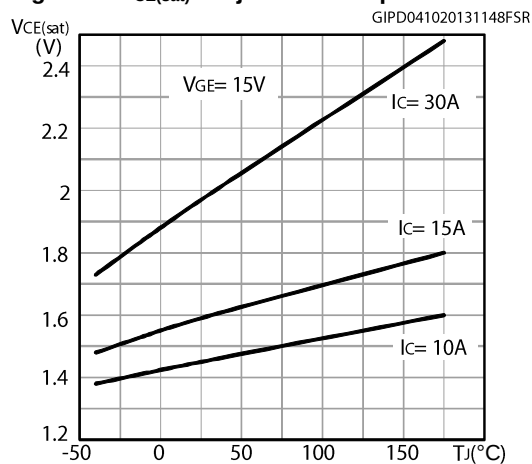
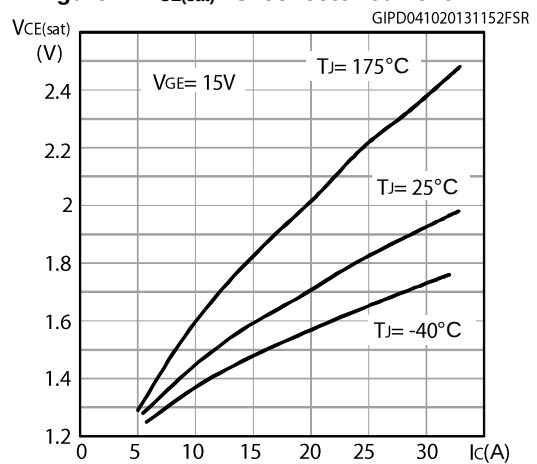
Figure 4: Output characteristics ($T_J = 25^\circ C$)Figure 5: Output characteristics ($T_J = 175^\circ C$)Figure 6: $V_{CE(sat)}$ vs. junction temperatureFigure 7: $V_{CE(sat)}$ vs. collector current

Figure 8: Collector current vs. switching frequency

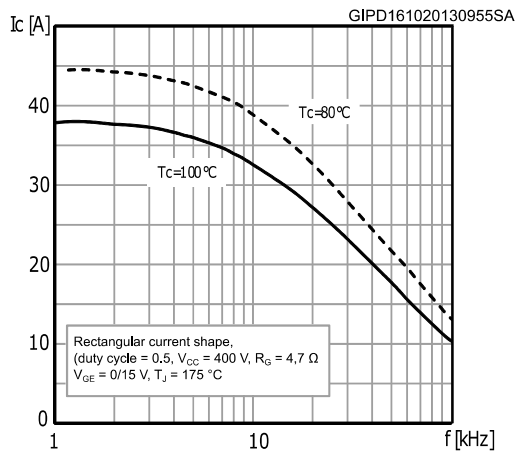


Figure 9: Forward bias safe operating area

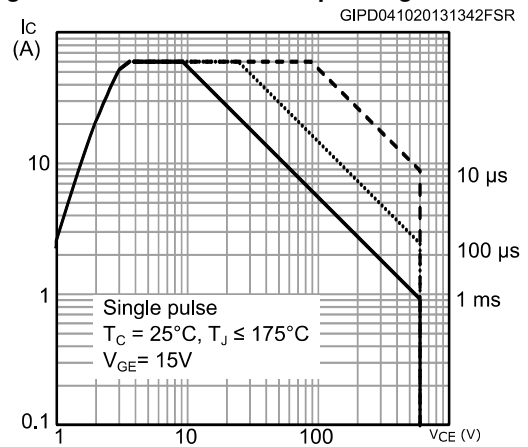


Figure 10: Transfer characteristics

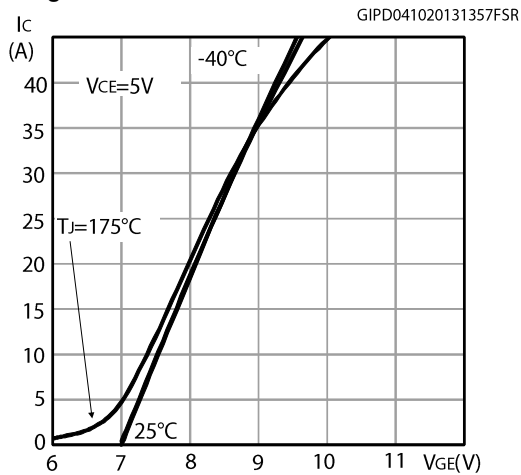
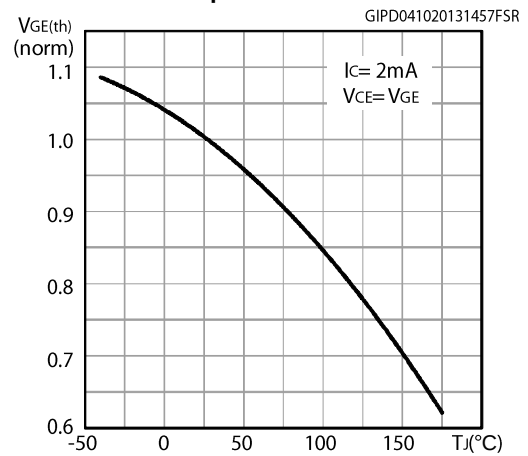
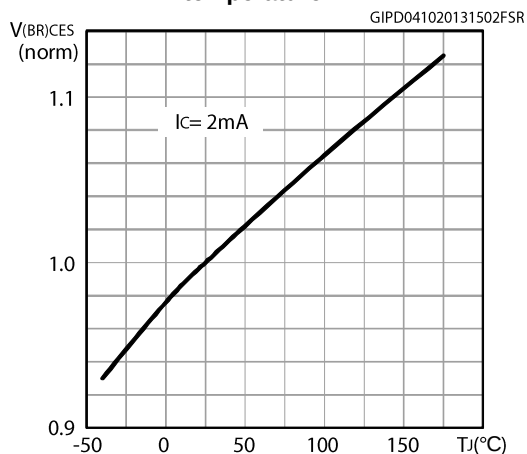
Figure 11: Normalized $V_{GE(th)}$ vs junction temperatureFigure 12: Normalized $V_{(BR)CES}$ vs. junction temperature

Figure 13: Capacitance variation

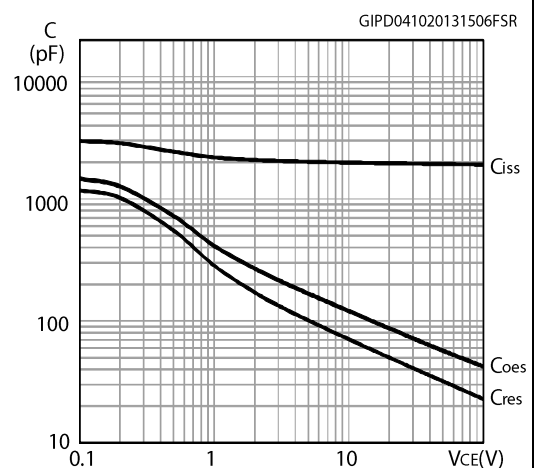


Figure 14: Gate charge vs. gate-emitter voltage

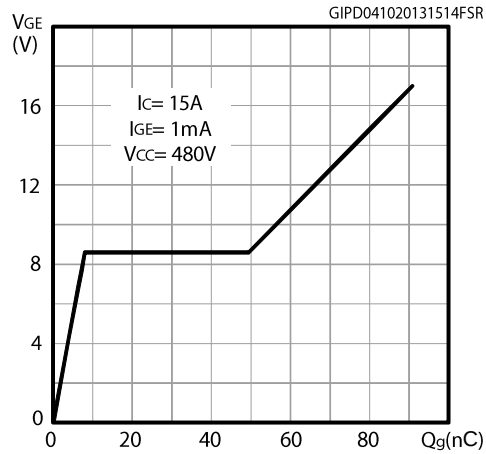


Figure 15: Switching energy vs collector current

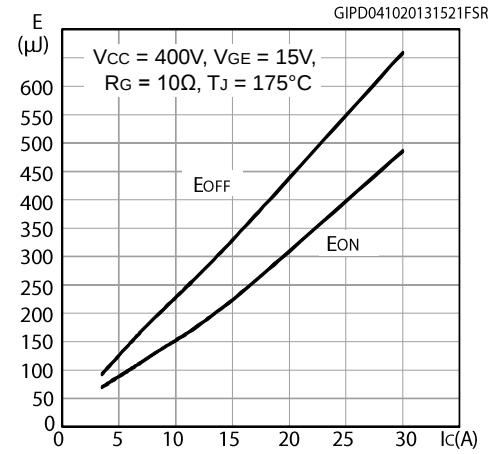


Figure 16: Switching energy vs gate resistance

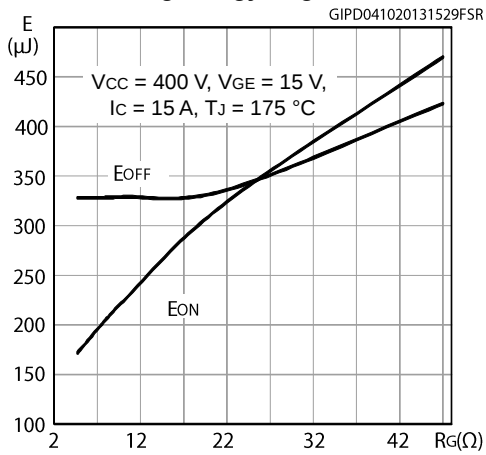


Figure 17: Switching energy vs temperature

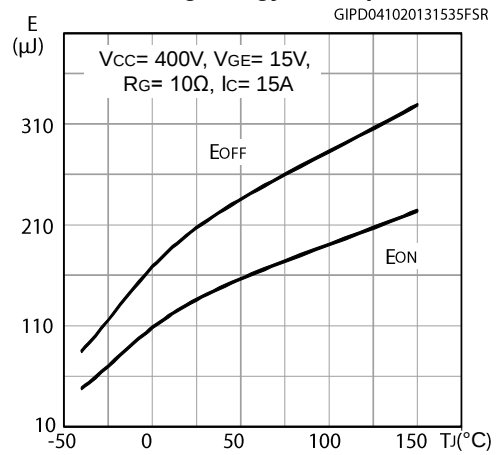


Figure 18: Switching energy vs collector-emitter voltage

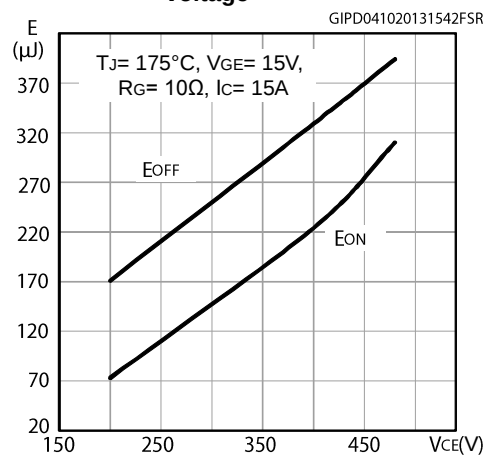


Figure 19: Short circuit time and current vs VGE

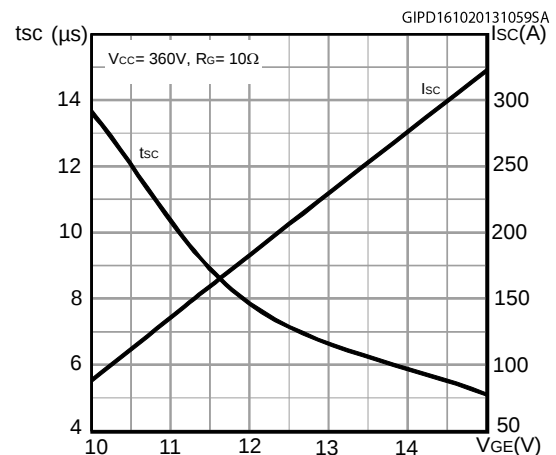


Figure 20: Switching times vs. collector current

GIPD041020131549FSR

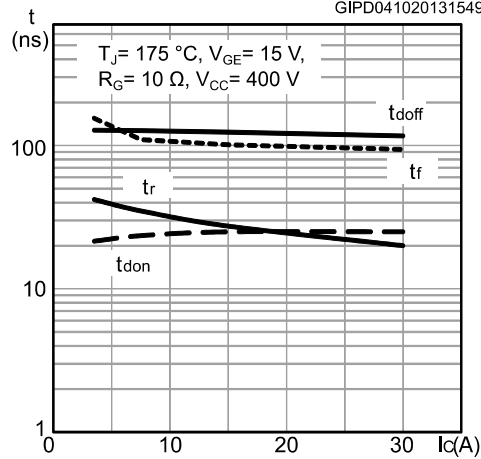


Figure 21: Switching times vs. gate resistance

GIPD041020131556FSR

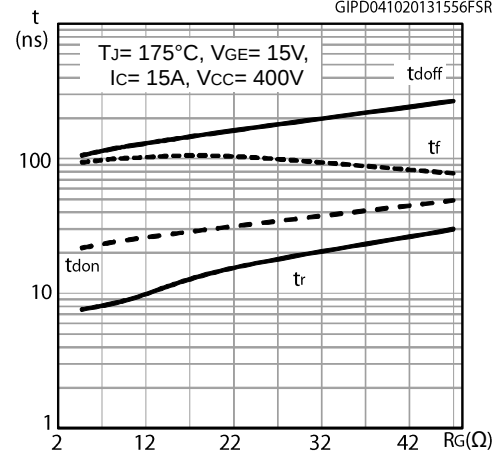
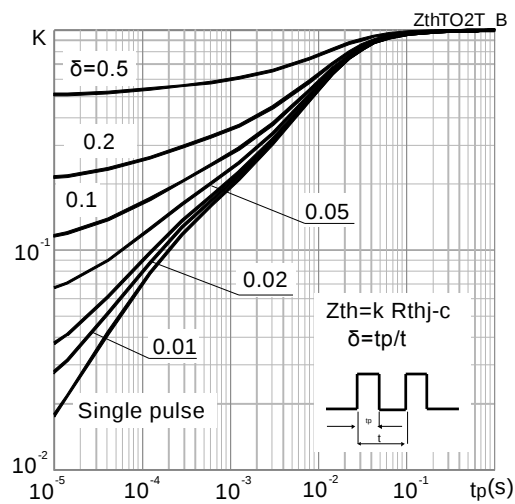
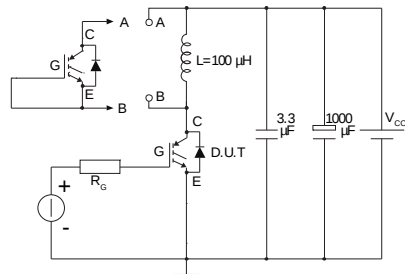


Figure 22: Thermal impedance



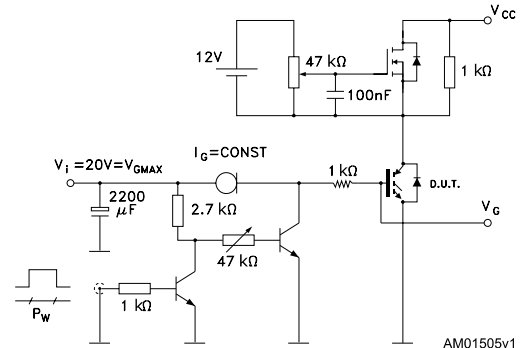
3 Test circuits

Figure 23: Test circuit for inductive load switching



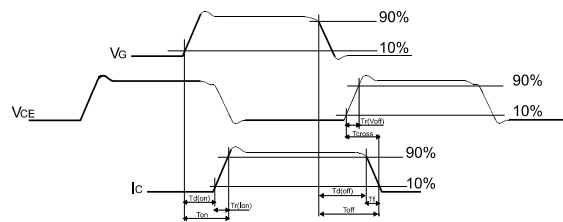
AM01504v1

Figure 24: Gate charge test circuit



AM01505v1

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-3P package information

Figure 26: TO-3P package outline

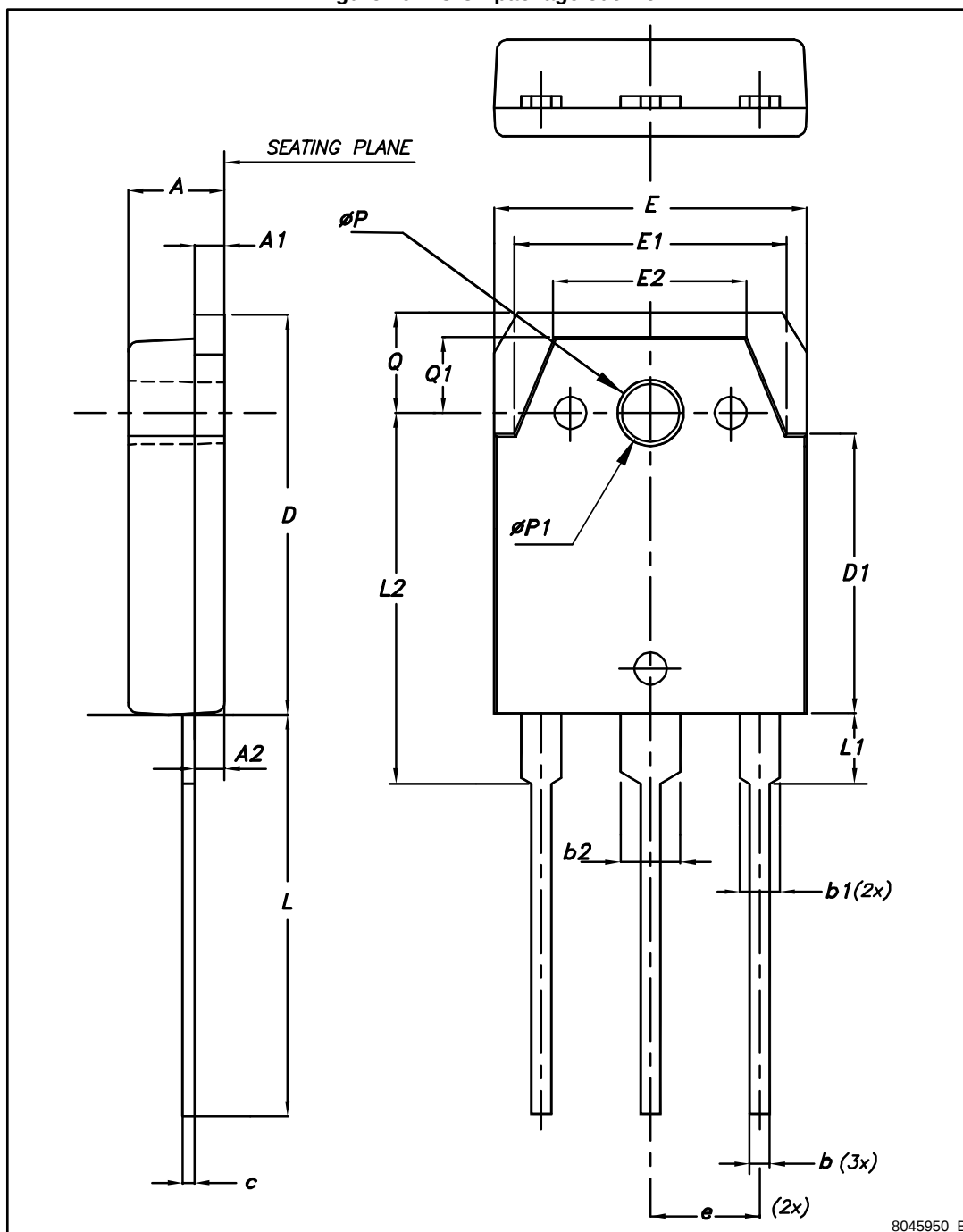


Table 8: TO-3P package mechanical data

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
10-Feb-2017	1	First release

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2017 STMicroelectronics – All rights reserved