

Trench gate field-stop IGBT, HB series 650 V, 80 A high speed in TO247-4 package

Datasheet - production data

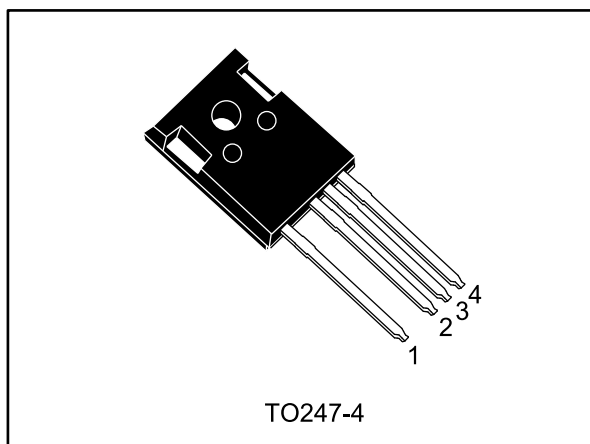
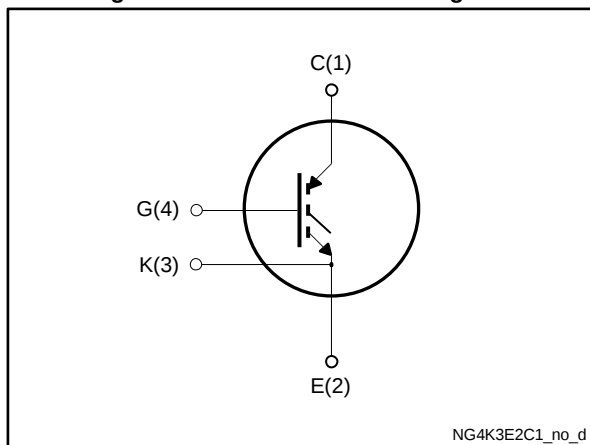


Figure 1: Internal schematic diagram



Features

- $V_{CE(sat)} = 1.6 \text{ V (typ.) @ } I_c = 80 \text{ A}$
- Maximum junction temperature: $T_J = 175 \text{ °C}$
- High speed switching series
- Minimized tail current
- Safe paralleling
- Tight parameter distribution
- Low thermal resistance
- Kelvin pin

Applications

- Photovoltaic inverter
- High frequency converter

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
STGW80H65FB-4	G80H65FB	TO247-4	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	120 ⁽¹⁾	A
	Continuous collector current at $T_C = 100$ °C	80	
I_{CP} ⁽²⁾⁽³⁾	Pulsed collector current	300	A
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total dissipation at $T_C = 25$ °C	469	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	

Notes:

⁽¹⁾Current level is limited by bond wires.

⁽²⁾Pulse width is limited by maximum junction temperature ($t_p < 1$ ms, $T_J < 175$ °C).

⁽³⁾Defined by design, not tested.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case	0.32	°C/W
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	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$		1.6	2.0	V
		$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$, $T_J = 125\text{ °C}$		1.8		
		$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$, $T_J = 175\text{ °C}$		1.9		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$			100	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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	10.5	-	nF
C_{oes}	Output capacitance		-	0.38	-	
C_{res}	Reverse transfer capacitance		-	0.21	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 23: "Gate charge test circuit")	-	414	-	nC
Q_{ge}	Gate-emitter charge		-	78	-	
Q_{gc}	Gate-collector charge		-	170	-	

Table 6: IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ (see Figure 22: "Test circuit for inductive load switching")	-	75	-	ns
t_r	Current rise time		-	35	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1750	-	A/ μ s
$t_{d(off)}$	Turn-off-delay time		-	336	-	ns
t_f	Current fall time		-	23	-	ns
$E_{on(1)}$	Turn-on switching energy		-	1	-	mJ
$E_{off(2)}$	Turn-off switching energy		-	1.7	-	mJ
E_{ts}	Total switching energy		-	2.7	-	mJ
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 22: "Test circuit for inductive load switching")	-	66	-	ns
t_r	Current rise time		-	38	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1670	-	A/ μ s
$t_{d(off)}$	Turn-off-delay time		-	403	-	ns
t_f	Current fall time		-	45	-	ns
$E_{on(1)}$	Turn-on switching energy		-	1.5	-	mJ
$E_{off(2)}$	Turn-off switching energy		-	2.47	-	mJ
E_{ts}	Total switching energy		-	3.97	-	mJ

Notes:

(1) Including the reverse recovery of the external diode. The diode is the same of the co-packed STGW80H65DFB-4.

(2) Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature

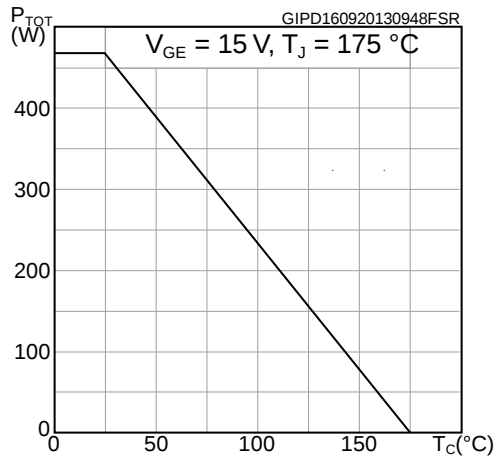


Figure 3: Collector current vs. case temperature

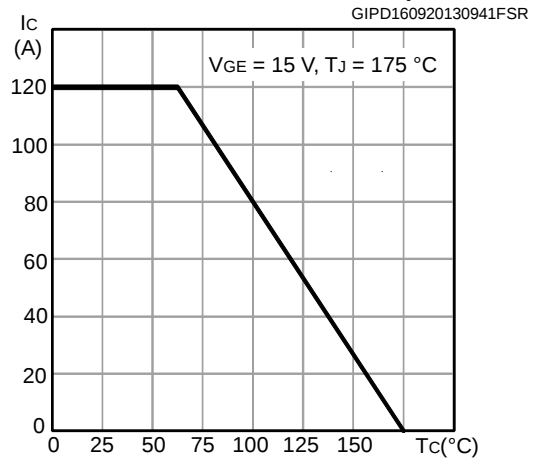
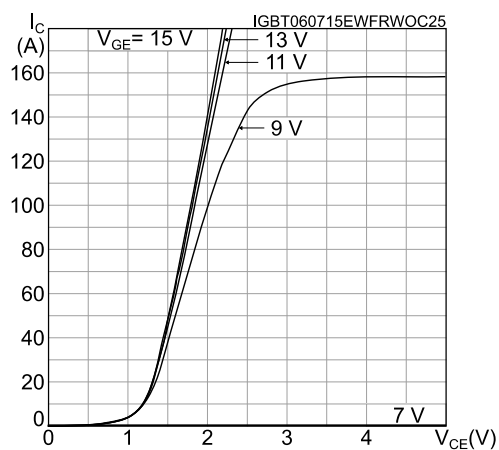
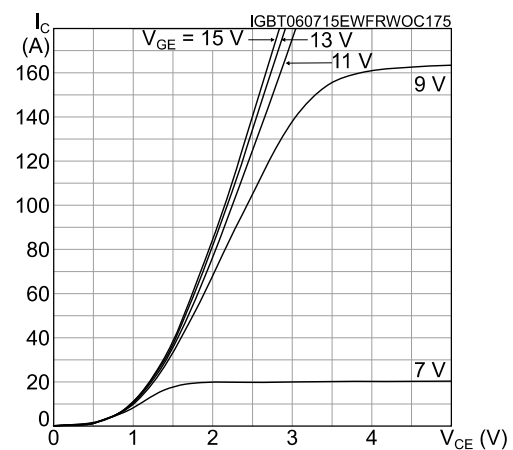
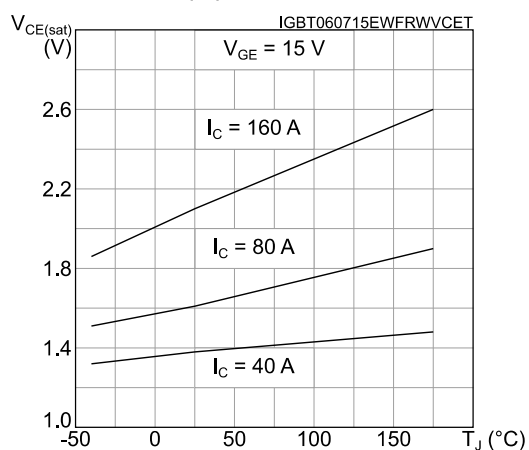
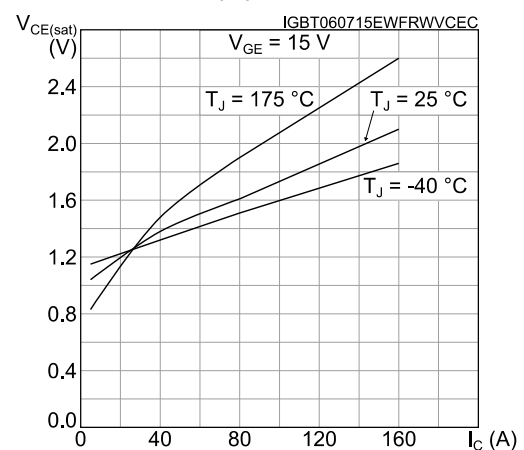
Figure 4: Output characteristics ($T_J = 25\text{ °C}$)Figure 5: Output characteristics ($T_J = 175\text{ °C}$)Figure 6: $V_{CE(sat)}$ vs. junction temperatureFigure 7: $V_{CE(sat)}$ vs. collector current

Figure 8: Collector current vs. switching frequency

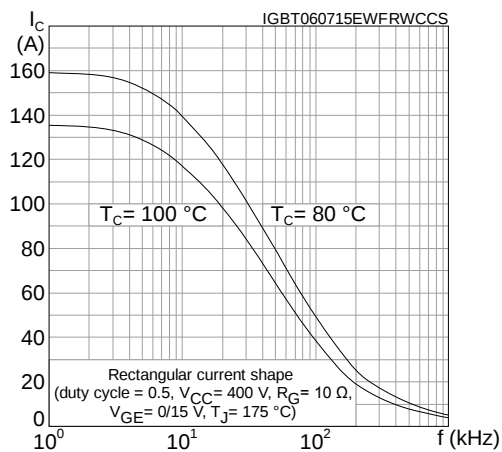


Figure 9: Forward bias safe operating area

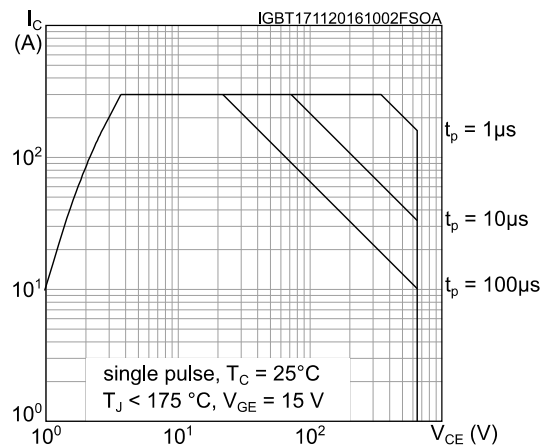


Figure 10: Transfer characteristics

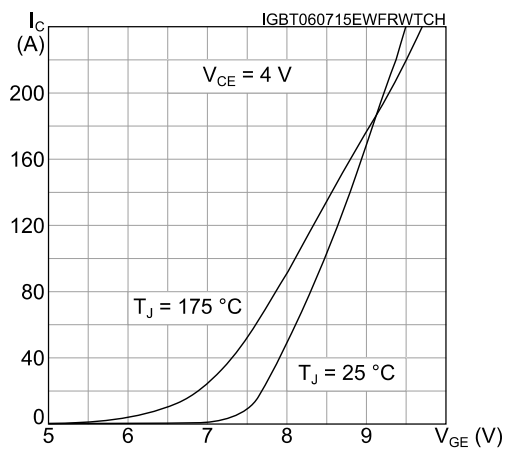
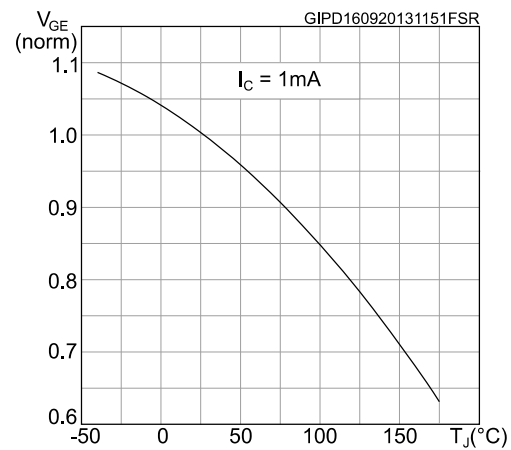
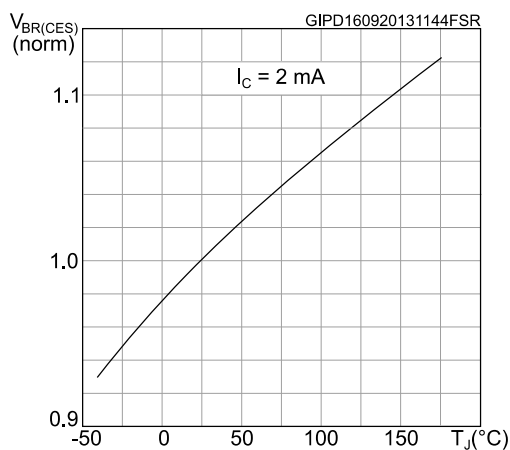
Figure 11: Normalized $V_{GE(th)}$ vs. junction temperatureFigure 12: Normalized $V_{(BR)CES}$ vs. junction temperature

Figure 13: Capacitance variations

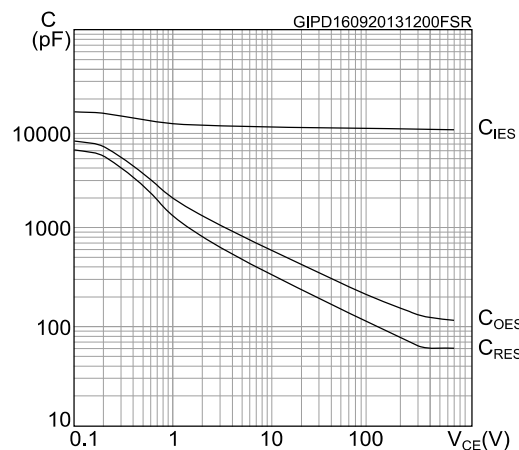


Figure 14: Gate charge vs. gate-emitter voltage

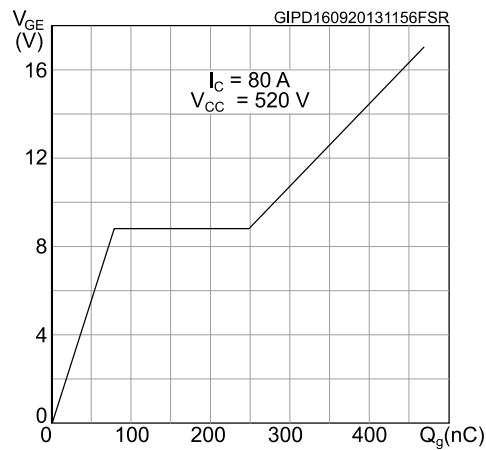


Figure 15: Switching energy vs. collector current

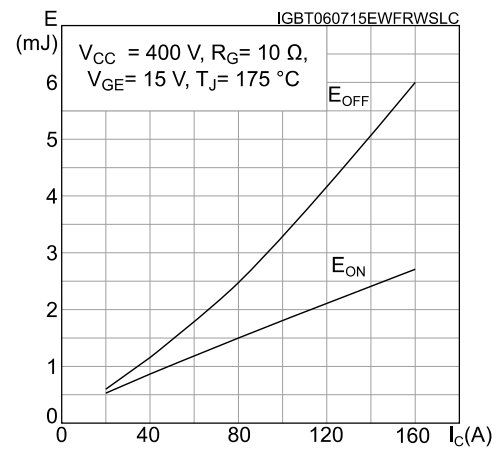


Figure 16: Switching energy vs. gate resistance

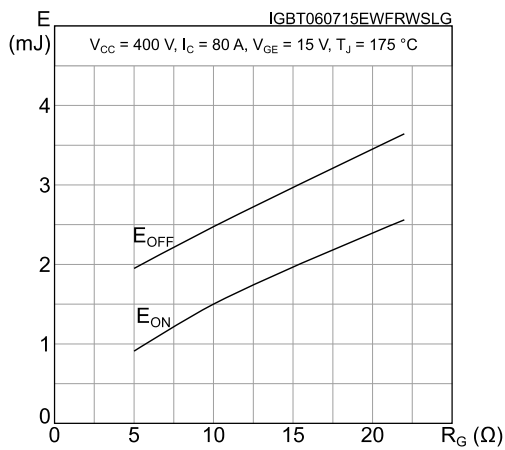


Figure 17: Switching energy vs. temperature

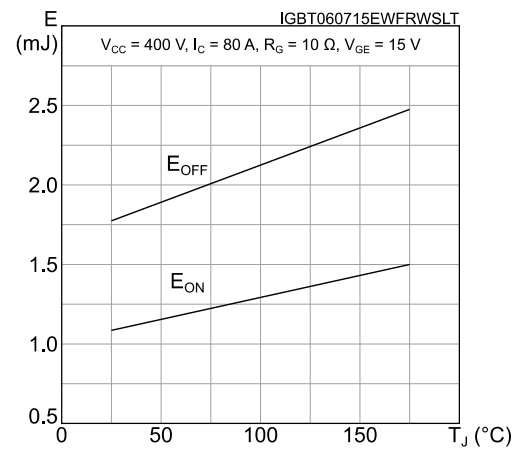


Figure 18: Switching energy vs. collector emitter voltage

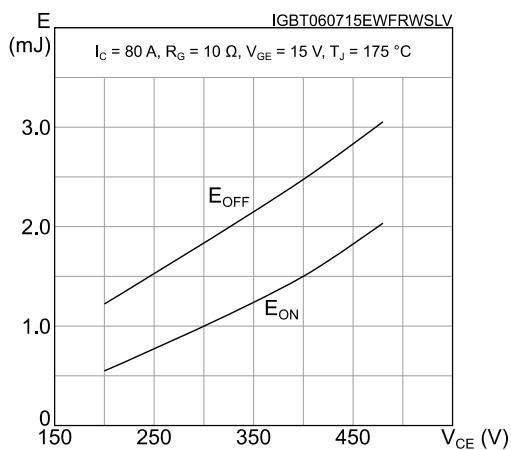


Figure 19: Switching times vs. collector current

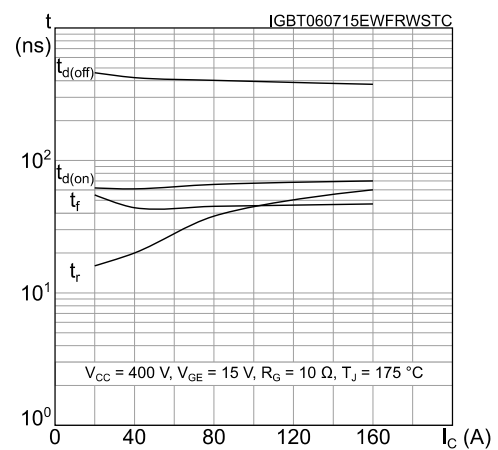


Figure 20: Switching times vs. gate resistance

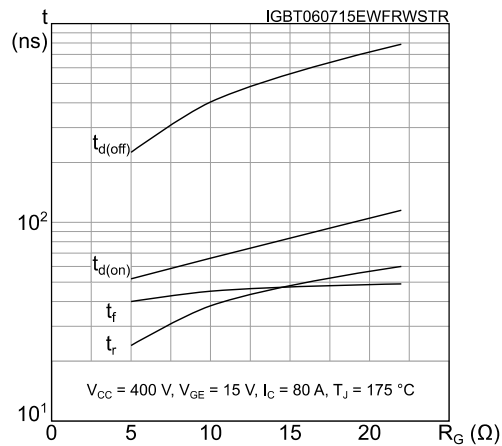
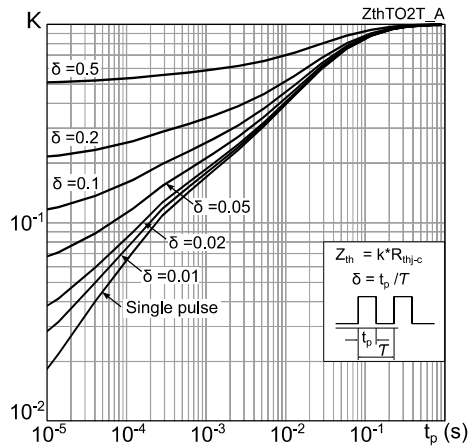


Figure 21: Thermal impedance



3 Test circuits

Figure 22: Test circuit for inductive load switching

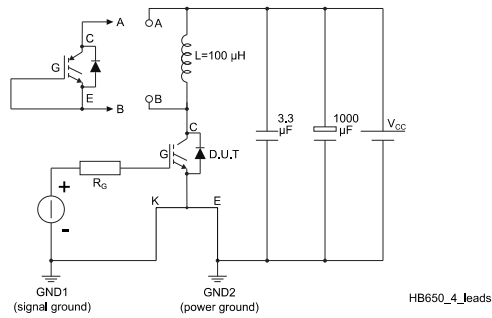


Figure 23: Gate charge test circuit

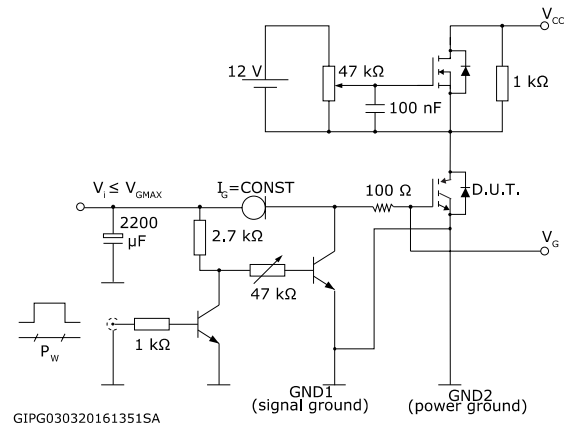
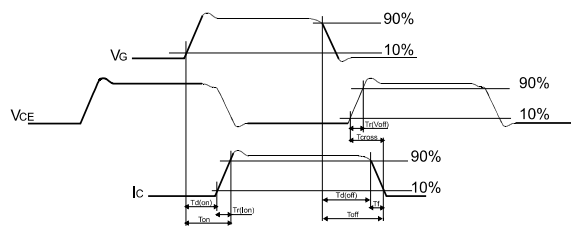


Figure 24: Switching waveform



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 TO247-4 package information

Figure 25: TO247-4 package outline

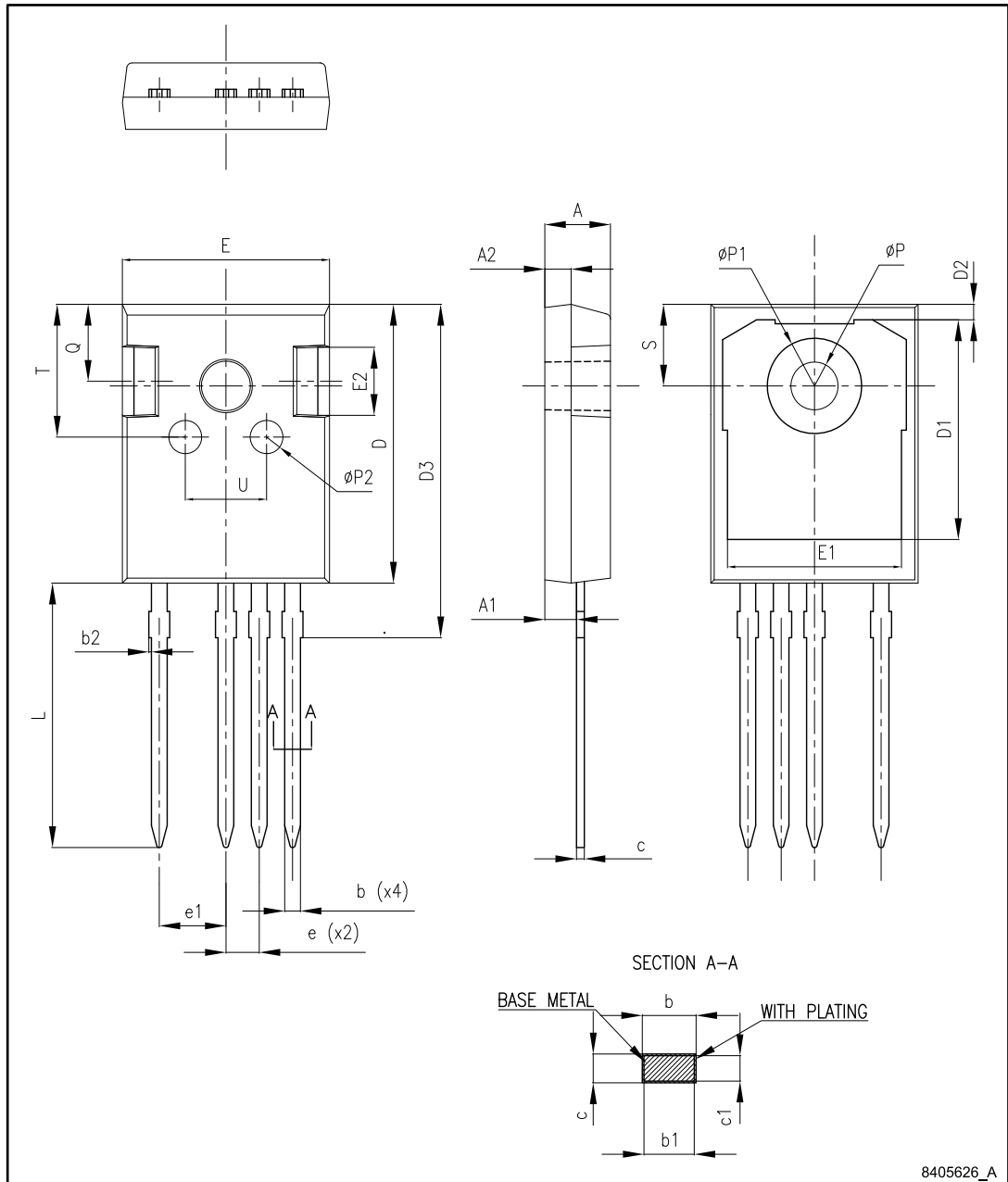


Table 7: TO247-4 mechanical data

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		1.29
b1	1.15	1.20	1.25
b2	0		0.20
c	0.59		0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
D3	24.97	25.12	25.27
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
L	19.80	19.92	20.10
P	3.50	3.60	3.70
P1			7.40
P2	2.40	2.50	2.60
Q	5.60		6.00
S		6.15	
T	9.80		10.20
U	6.00		6.40

5 Revision history

Table 8: Document revision history

Date	Revision	Changes
13-Apr-2016	1	First release
22-Apr-2016	2	Minor text changes to improve the document readability
03-Apr-2017	3	Updated title and features on cover page. Updated Table 2: "Absolute maximum ratings" . Updated Figure 9: "Forward bias safe operating area" . Minor text changes

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