

Figure 1: Internal schematic diagram

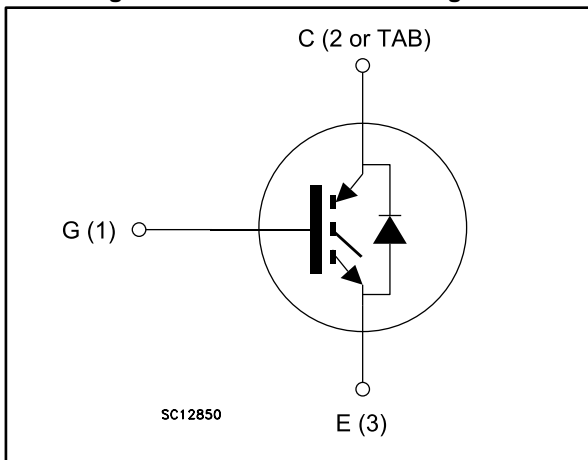


Table 1: Device summary

Order code	Marking	Package	Packing
STGW80H65DFB	GW80H65DFB	TO-247	Tube
STGWT80H65DFB	GWT80H65DFB	TO-3P	Tube

### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 1.6\text{ V(typ)}$  @  $I_C = 80\text{ A}$
- Safe paralleling
- Tight parameter distribution
- Low thermal resistance
- Very fast soft recovery antiparallel diode

### Applications

- Photovoltaic inverters
- High frequency converters

### Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the new HB series of IGBTs, which represent 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.

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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 <sup>(1)</sup>	A
	Continuous collector current at $T_C = 100$ °C	80	
$I_{CP}$ <sup>(2)(3)</sup>	Pulsed collector current	300	A
$V_{GE}$	Gate-emitter voltage	± 20	V
$I_F$	Continuous forward current at $T_C = 25$ °C	120 <sup>(1)</sup>	A
	Continuous forward current at $T_C = 100$ °C	80	
$I_{FP}$ <sup>(2)(3)</sup>	Pulsed forward current	300	A
$P_{TOT}$	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:**

<sup>(1)</sup>Current level is limited by bond wires

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

<sup>(3)</sup>Defined by design, not tested.

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	0.32	°C/W
$R_{thJC}$	Thermal resistance junction-case diode	0.66	
$R_{thJA}$	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	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		
$V_F$	Forward on-voltage	$I_F = 80\text{ A}$		1.9	2.3	V
		$I_F = 80\text{ A}$ , $T_J = 125\text{ °C}$		1.6		
		$I_F = 80\text{ A}$ , $T_J = 175\text{ °C}$		1.5		
$V_{GE(th)}$	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	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 250$	nA

**Table 5: Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	10524	-	pF
$C_{oes}$	Output capacitance		-	385	-	
$C_{res}$	Reverse transfer capacitance		-	215	-	
$Q_g$	Total gate charge	$V_{CC} = 520\text{ V}$ , $I_C = 80\text{ A}$ , $V_{GE} = 15\text{ V}$ (see <a href="#">Figure 29</a> : "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 <a href="#">Figure 28: "Test circuit for inductive load switching"</a> )	-	84	-	ns
$t_r$	Current rise time		-	52	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1270	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time		-	280	-	ns
$t_f$	Current fall time		-	31	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	2.1	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy		-	1.5	-	mJ
$E_{ts}$	Total switching energy		-	3.6	-	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 <a href="#">Figure 28: "Test circuit for inductive load switching"</a> )	-	77	-	ns
$t_r$	Current rise time		-	51	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1270	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time		-	328	-	ns
$t_f$	Current fall time		-	30	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	4.4	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy		-	2.1	-	mJ
$E_{ts}$	Total switching energy		-	6.5	-	mJ

**Notes:**

(1)Including the reverse recovery of the diode.

(2)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	$I_F = 80\text{ A}$ , $V_R = 400\text{ V}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ $V_{GE} = 15\text{ V}$ , (see <a href="#">Figure 28: "Test circuit for inductive load switching"</a> )	-	85	-	ns
$Q_{rr}$	Reverse recovery charge		-	1105	-	nC
$I_{rrm}$	Reverse recovery current		-	26	-	A
$dl_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$		-	722	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy		-	267	-	$\mu$ J
$t_{rr}$	Reverse recovery time	$I_F = 80\text{ A}$ , $V_R = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ $di/dt = 1000\text{ A}/\mu\text{s}$ (see <a href="#">Figure 28: "Test circuit for inductive load switching"</a> )	-	149	-	ns
$Q_{rr}$	Reverse recovery charge		-	4920	-	nC
$I_{rrm}$	Reverse recovery current		-	66	-	A
$dl_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$		-	546	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy		-	1172	-	$\mu$ J

## 2.1 Electrical characteristics (curves)

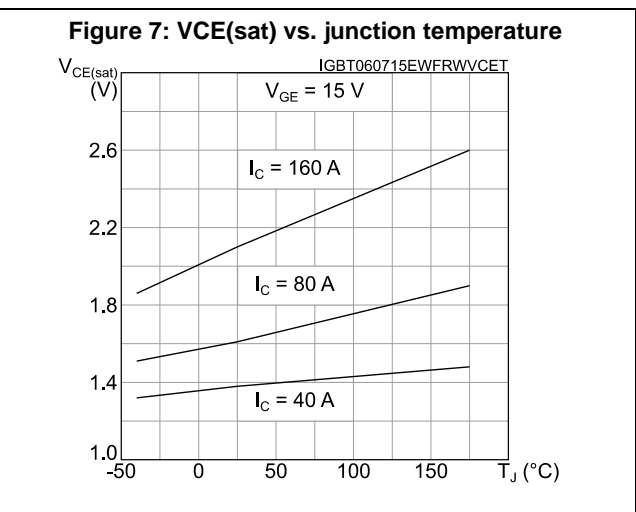
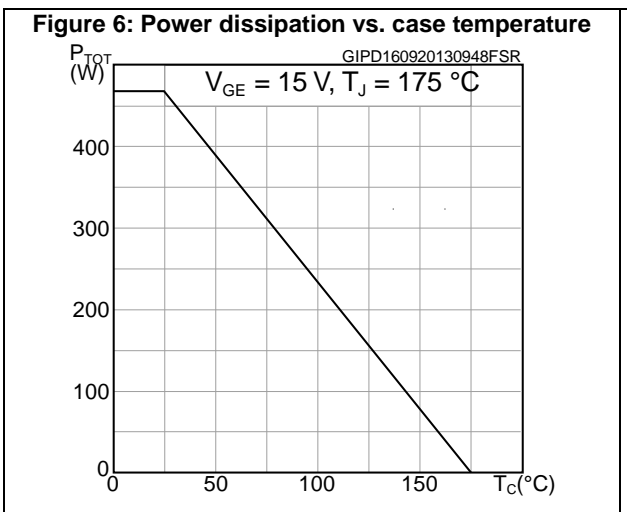
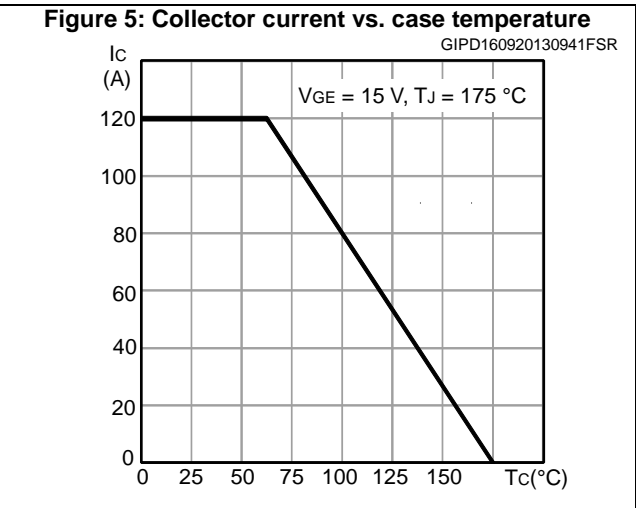
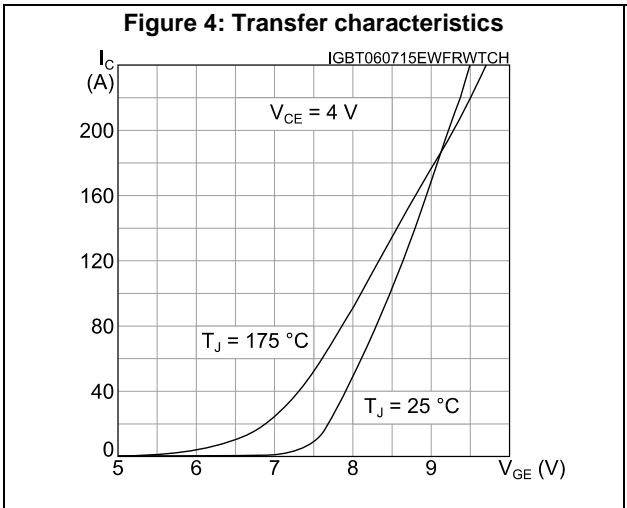
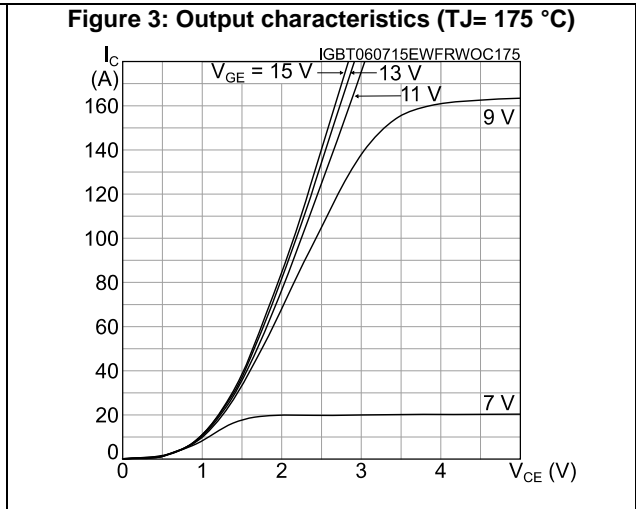
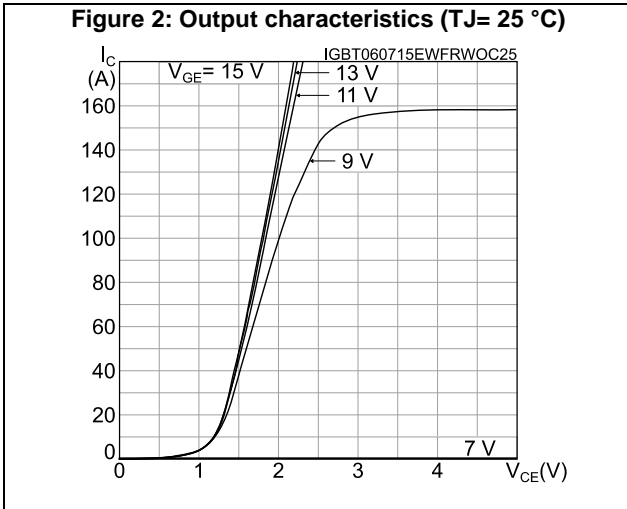


Figure 8: VCE (sat) vs. collector current

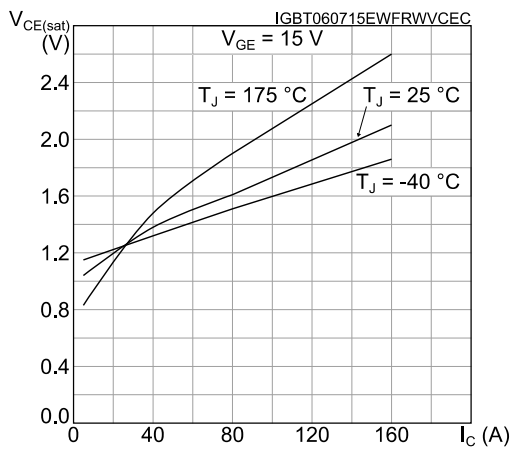


Figure 9: Forward bias safe operating area

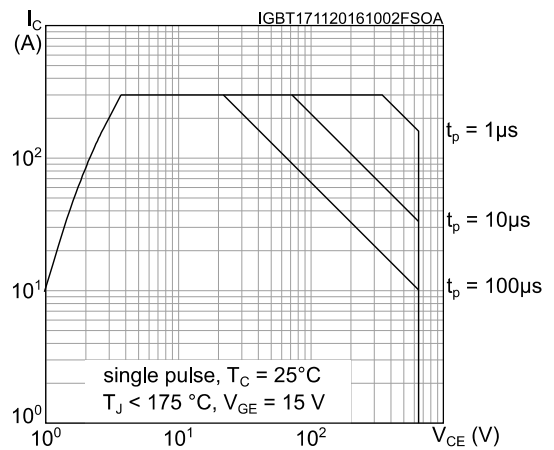


Figure 10: Diode VF vs. forward current

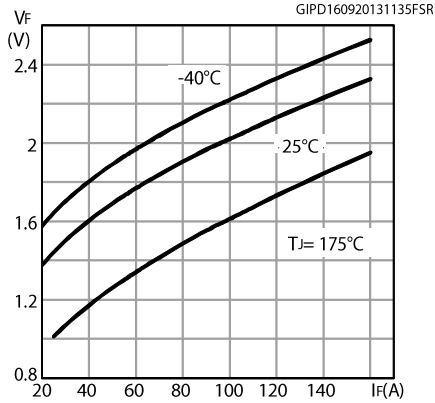


Figure 11: Normalized V(BR)CES vs. junction temperature

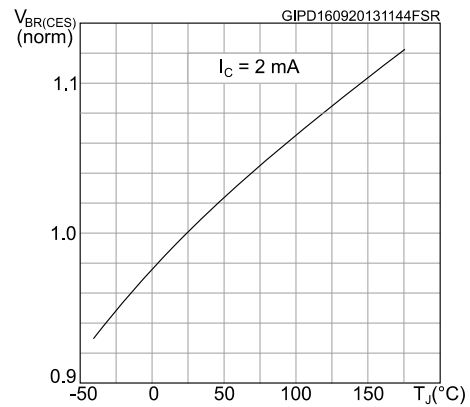


Figure 12: Normalized VGE(th) vs. junction temperature

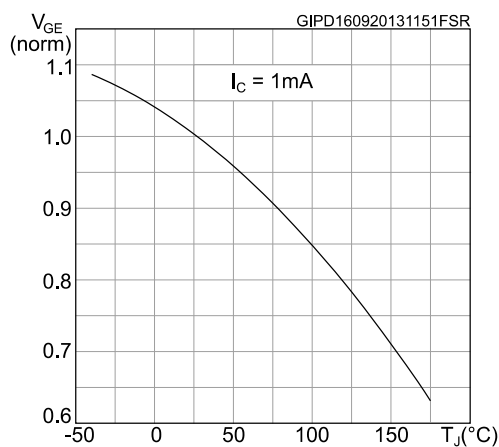
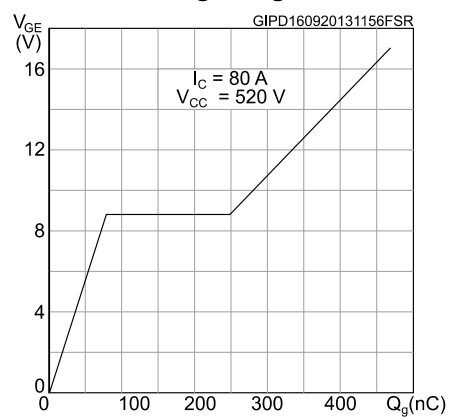


Figure 13: Gate charge vs. gate-emitter voltage



Electrical characteristics

STGW80H65DFB, STGWT80H65DFB

Figure 14: Switching energy vs. temperature

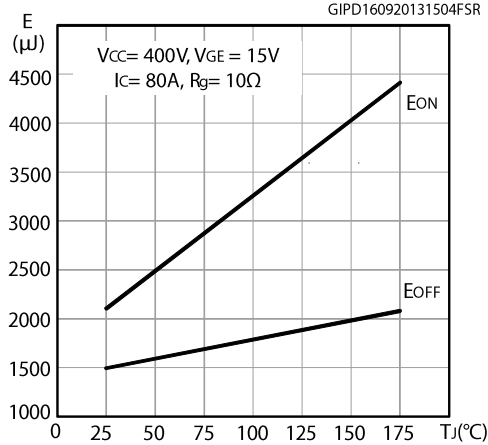


Figure 15: Switching energy vs. gate resistance

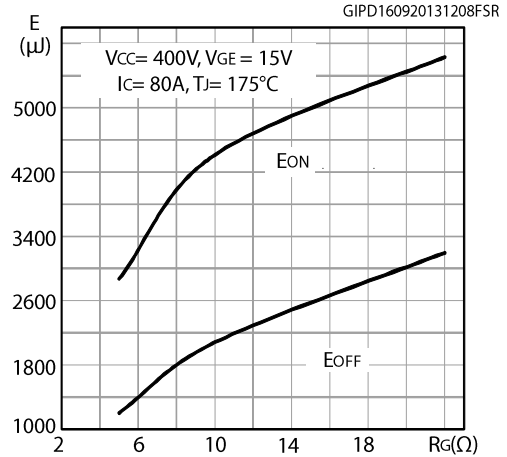


Figure 16: Switching energy vs. collector current

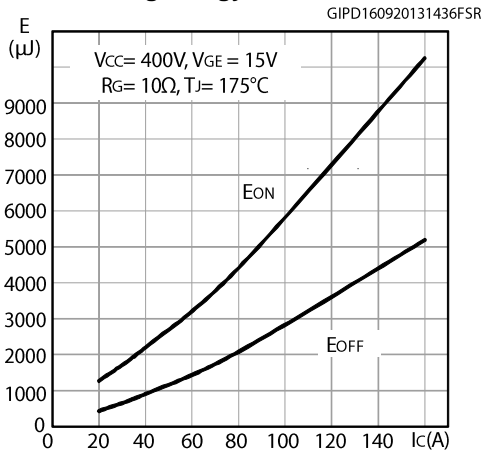


Figure 17: Switching energy vs. collector emitter voltage

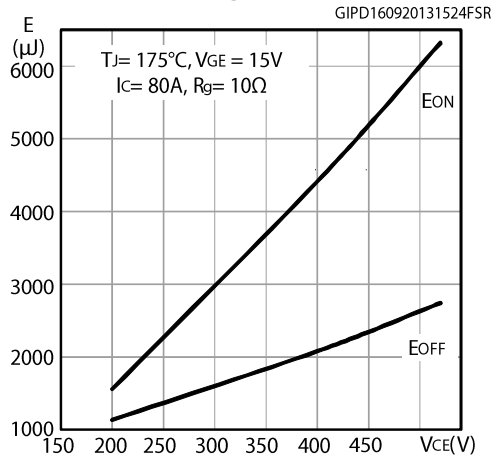


Figure 18: Switching time vs. collector temperature

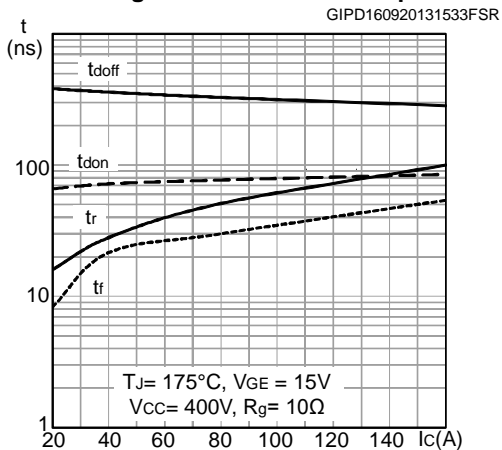


Figure 19: Switching time vs. gate resistance

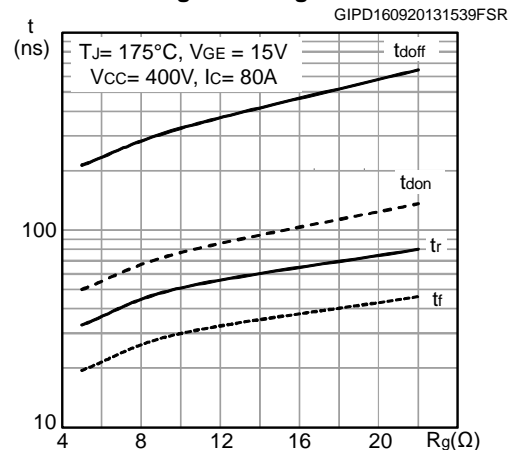




Figure 20: Reverse recovery current vs. diode current slope

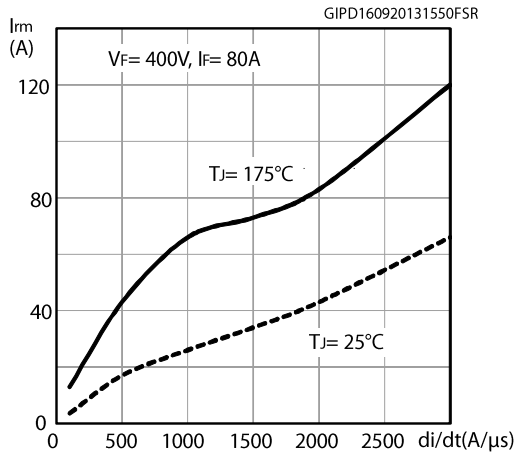


Figure 21: Reverse recovery time vs. diode current slope

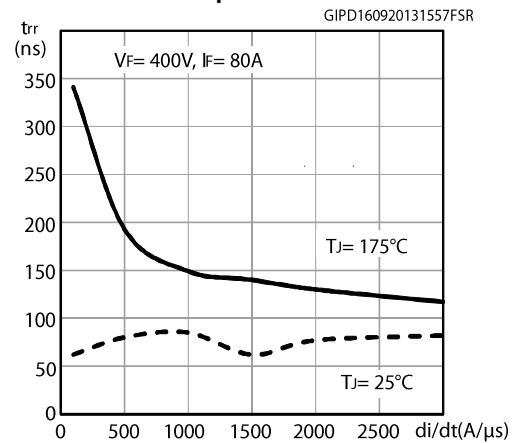


Figure 22: Reverse recovery charge vs. diode current slope

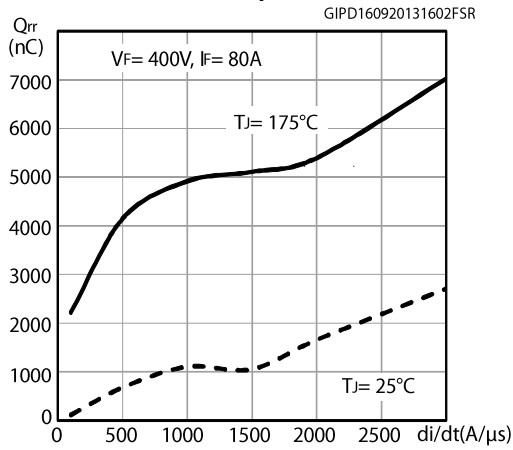


Figure 23: Reverse recovery energy vs. diode current slope

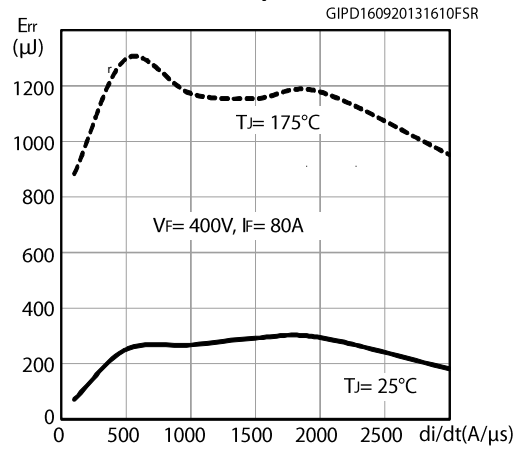


Figure 24: Capacitance variations

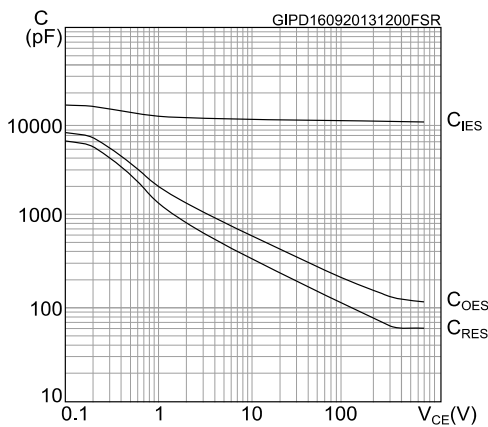


Figure 25: Collector current vs. switching frequency

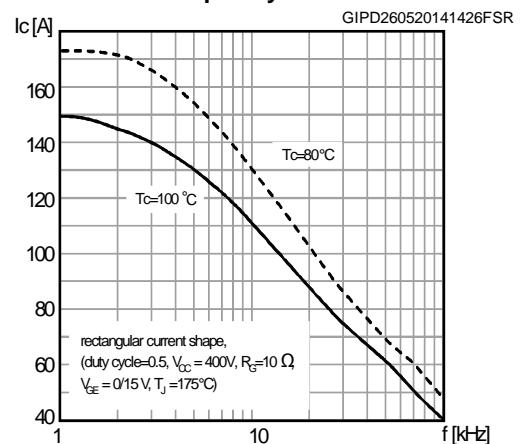


Figure 26: Thermal impedance for IGBT

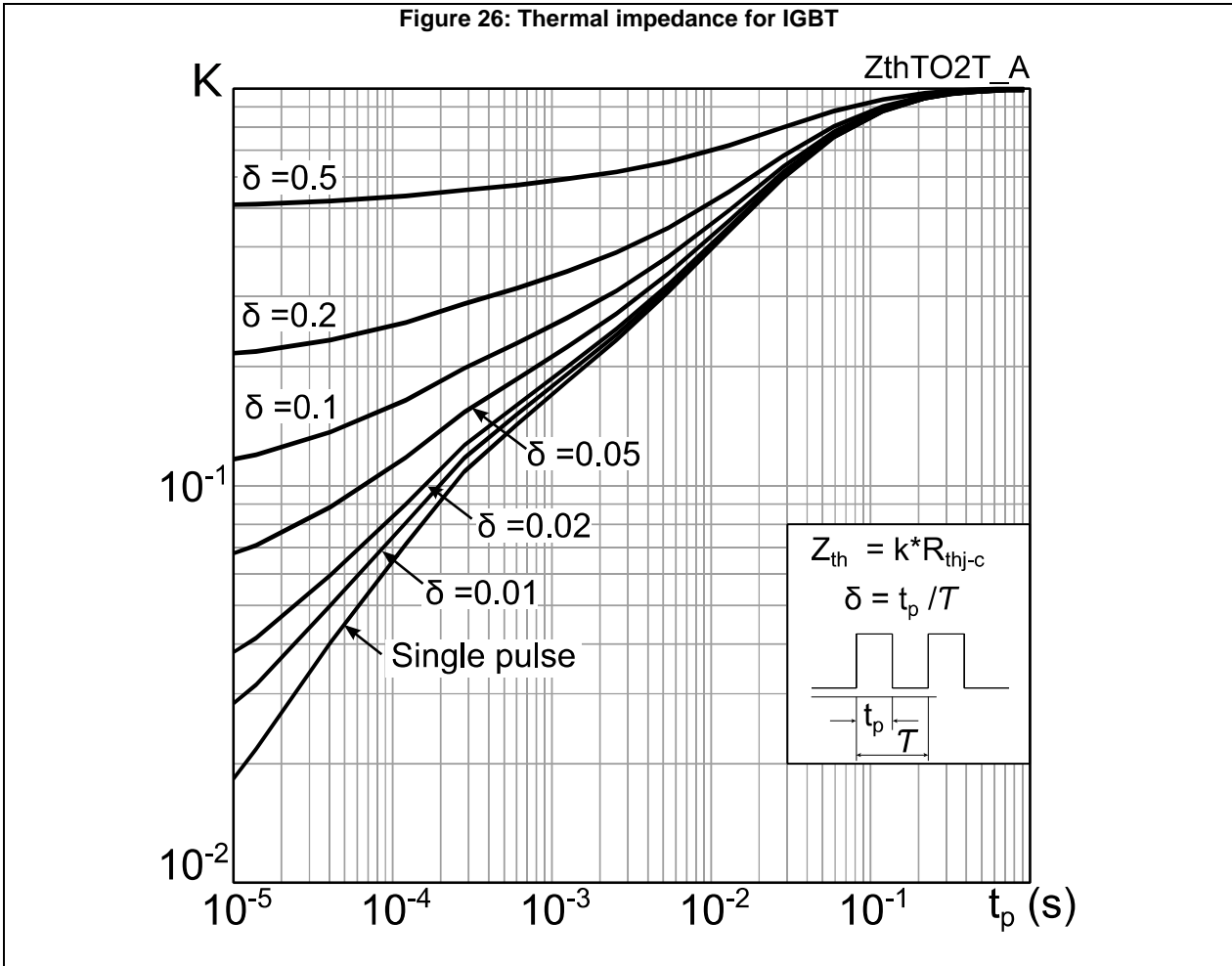
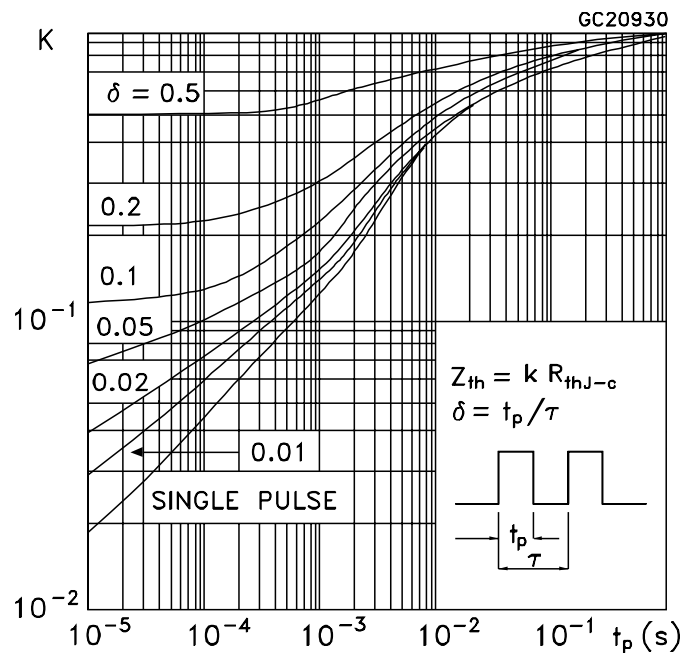
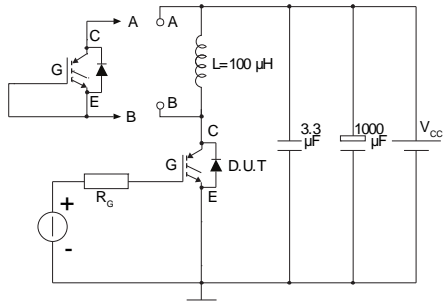


Figure 27: Thermal impedance for diode



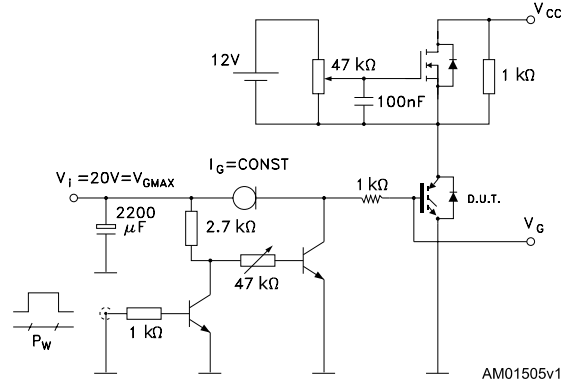
### 3 Test circuits

**Figure 28: Test circuit for inductive load switching**



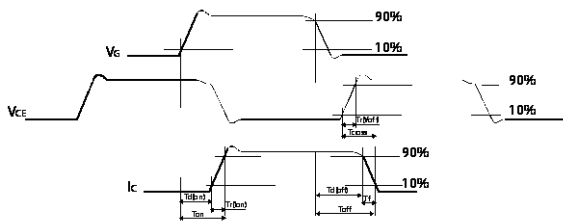
AM01504v1

**Figure 29: Gate charge test circuit**



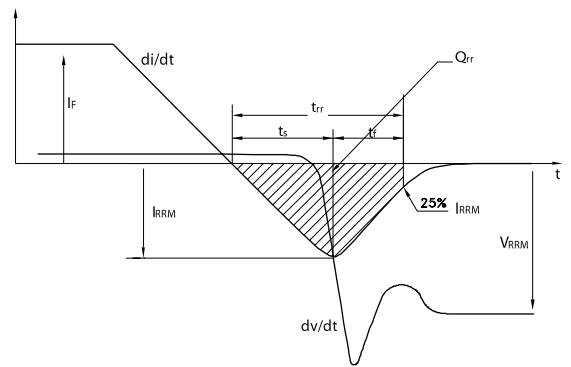
AM01505v1

**Figure 30: Switching waveform**



AM01506v1

**Figure 31: Diode reverse recovery waveform**



AM01507v1

## 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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 TO-247 package information

Figure 32: TO-247 package outline

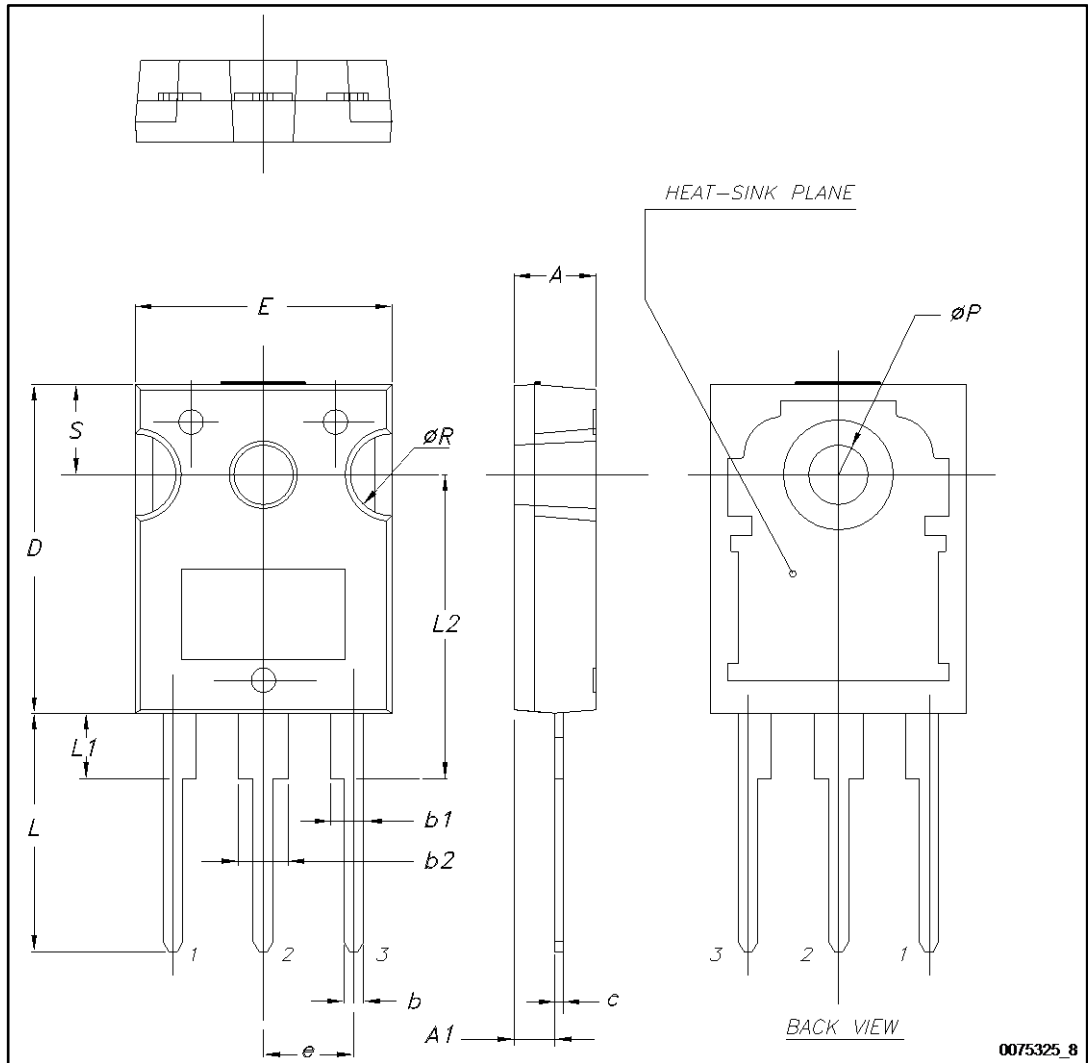


Table 8: TO-247 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

### 4.2 TO-3P package information

Figure 33: TO-3P package outline

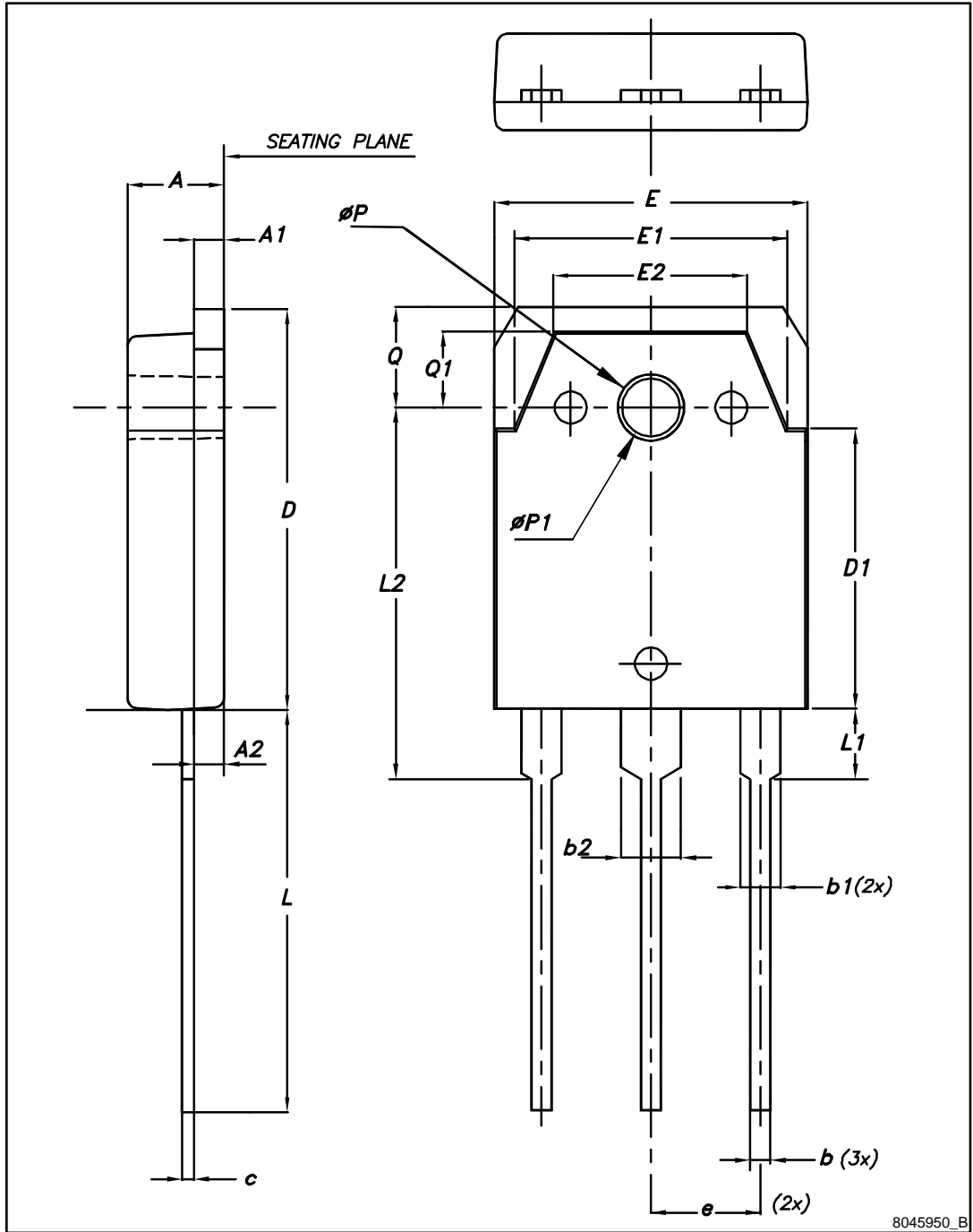


Table 9: TO-3P package mechanical data

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 10: Document revision history

Date	Revision	Changes
12-Mar-2013	1	First release.
18-Sep-2013	2	Document status promoted from preliminary to production data. Added Section 2.1: <i>Electrical characteristics (curves)</i>
20-Nov-2013	3	Added device in Max247. Modified Table 1 accordingly.  Updated Section 4: <i>Package information</i> . Minor text changes in cover page.
24-Jan-2014	4	Updated title and description in cover page. Updated Table 6: <i>IGBT switching characteristics (inductive load)</i> , Table 7: <i>Diode switching characteristics (inductive load)</i> , Figure 9: <i>Forward bias safe operating area</i> and Figure 14: <i>Switching energy vs. temperature</i> .
13-Jun-2014	5	Updated Figure 5: <i>Collector current vs. case temperature</i> , Figure 6: <i>Power dissipation vs. case temperature</i> , Figure 18: <i>Switching times vs. collector current</i> , Figure 19: <i>Switching times vs. gate resistance</i> and Figure 24: <i>Capacitance variations</i> . Added Figure 25: <i>Collector current vs. switching frequency</i> . Updated Section 4: <i>Package information</i> . Minor text changes.
07-May-2015	6	Added TO-247 long leads package information.
21-Sep-2016	7	Updated Figure 2: <i>"Output characteristics (T<sub>J</sub>= 25 °C)"</i> , Figure 3: <i>"Output characteristics (T<sub>J</sub>= 175 °C)"</i> , Figure 4: <i>"Transfer characteristics"</i> , Figure 7: <i>"V<sub>CE</sub>(sat) vs. junction temperature"</i> and Figure 8: <i>"V<sub>CE</sub>(sat) vs. collector current"</i> . The part number STGY80H65DFB has been moved to a separate datasheet. Minor text changes.
17-Nov-2016	8	Updated Table 2: <i>"Absolute maximum ratings"</i> and Figure 9: <i>"Forward bias safe operating area"</i> . The part number STGWA80H65DFB has been moved to a separate datasheet. Updated document accordingly.

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