

## Trench gate field-stop IGBT, M series 1200 V, 8 A low-loss

Datasheet - production data

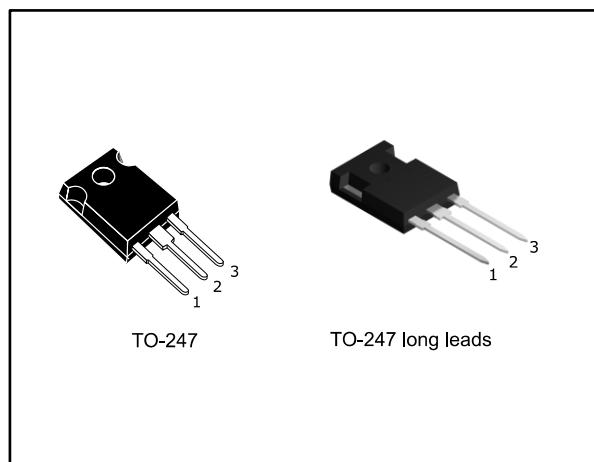
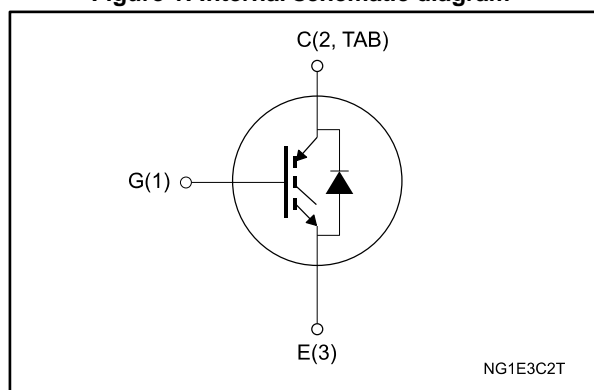


Figure 1: Internal schematic diagram



### Features

- 10  $\mu$ s of short-circuit withstand time
- $V_{CE(sat)} = 1.85$  V (typ.) @  $I_C = 8$  A
- Tight parameter distribution
- Safer paralleling
- Low thermal resistance
- Soft and very fast recovery antiparallel diode

### Applications

- Industrial drives
- UPS
- Solar
- Welding

### Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where low-loss and short-circuit functionality are essential. Furthermore, the positive  $V_{CE(sat)}$  temperature coefficient and tight parameter distribution result in safer paralleling operation.

Table 1: Device summary

Order code	Marking	Package	Packing
STGW8M120DF3	G8M120DF3	TO-247	Tube
STGWA8M120DF3		TO-247 long leads	

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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)	1200	V
$I_C$	Continuous collector current at $T_C = 25$ °C	16	A
$I_C$	Continuous collector current at $T_C = 100$ °C	8	A
$I_{CP}^{(1)}$	Pulsed collector current	32	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Continuous forward current at $T_C = 25$ °C	16	A
$I_F$	Continuous forward current at $T_C = 100$ °C	8	A
$I_{FP}^{(1)}$	Pulsed forward current	32	A
$P_{TOT}$	Total dissipation at $T_C = 25$ °C	167	W
$T_{STG}$	Storage temperature range	-55 to 150	°C
$T_J$	Operating junction temperature range	-55 to 175	°C

**Notes:**

<sup>(1)</sup>Pulse width limited by maximum junction temperature.

**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	1.47	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	50	°C/W

## 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	$V_{GE} = 0\text{ V}$ , $I_C = 2\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$ , $I_C = 8\text{ A}$		1.85	2.3	V
		$V_{GE} = 15\text{ V}$ , $I_C = 8\text{ A}$ , $T_J = 125\text{ °C}$		2.1		
		$V_{GE} = 15\text{ V}$ , $I_C = 8\text{ A}$ , $T_J = 175\text{ °C}$		2.2		
$V_F$	Forward on-voltage	$I_F = 8\text{ A}$		2.4	3.35	V
		$I_F = 8\text{ A}$ , $T_J = 125\text{ °C}$		1.75		
		$I_F = 8\text{ A}$ , $T_J = 175\text{ °C}$		1.55		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 500\text{ }\mu\text{A}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}$ , $V_{CE} = 1200\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$ , $V_{CE} = 0\text{ V}$			$\pm 250$	nA

**Table 5: Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	542	-	pF
$C_{oes}$	Output capacitance		-	74.4	-	
$C_{res}$	Reverse transfer capacitance		-	21	-	
$Q_g$	Total gate charge	$V_{CC} = 960\text{ V}$ , $I_C = 8\text{ A}$ , $V_{GE} = 0\text{ to }15\text{ V}$ (see <a href="#">Figure 30: "Gate charge test circuit"</a> )	-	32	-	nC
$Q_{ge}$	Gate-emitter charge		-	4.5	-	
$Q_{gc}$	Gate-collector charge		-	18.5	-	

Table 6: IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$ , $I_C = 8\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 33\ \Omega$ (see <a href="#">Figure 29: "Test circuit for inductive load switching"</a> )		20	-	ns
$t_r$	Current rise time			8.4	-	ns
$(di/dt)_{on}$	Turn-on current slope			800	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time			126	-	ns
$t_f$	Current fall time			136	-	ns
$E_{on(1)}$	Turn-on switching energy			0.39	-	mJ
$E_{off(2)}$	Turn-off switching energy			0.37	-	mJ
$E_{ts}$	Total switching energy			0.76	-	mJ
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$ , $I_C = 8\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 33\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (see <a href="#">Figure 29: "Test circuit for inductive load switching"</a> )		19	-	ns
$t_r$	Current rise time			9.8	-	ns
$(di/dt)_{on}$	Turn-on current slope			656	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time			134	-	ns
$t_f$	Current fall time			222	-	ns
$E_{on(1)}$	Turn-on switching energy			0.66	-	mJ
$E_{off(2)}$	Turn-off switching energy			0.58	-	mJ
$E_{ts}$	Total switching energy			1.24	-	mJ
$t_{sc}$	Short-circuit withstand time	$V_{CC} \leq 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $T_{Jstart} \leq 150\text{ }^\circ\text{C}$	10		-	$\mu$ s

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	$I_F = 8\text{ A}$ , $V_R = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $R_G = 33\ \Omega$ $(di/dt = 1000\text{ A}/\mu\text{s})$ (see <a href="#">Figure 29: "Test circuit for inductive load switching"</a> )	-	103	-	ns	
$Q_{rr}$	Reverse recovery charge			-	0.87	-	$\mu$ C
$I_{rrm}$	Reverse recovery current			-	19.2	-	A
$dl_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$			-	720	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	211	-	$\mu$ J
$t_{rr}$	Reverse recovery time	$I_F = 8\text{ A}$ , $V_R = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ , $R_G = 33\ \Omega$ ( $di/dt = 840\text{ A}/\mu\text{s}$ ) (see <a href="#">Figure 29: "Test circuit for inductive load switching"</a> )	-	280	-	ns	
$Q_{rr}$	Reverse recovery charge			-	1.9	-	$\mu$ C
$I_{rrm}$	Reverse recovery current			-	21.8	-	A
$dl_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$			-	450	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	404	-	$\mu$ J

## 2.1 Electrical characteristics (curves)

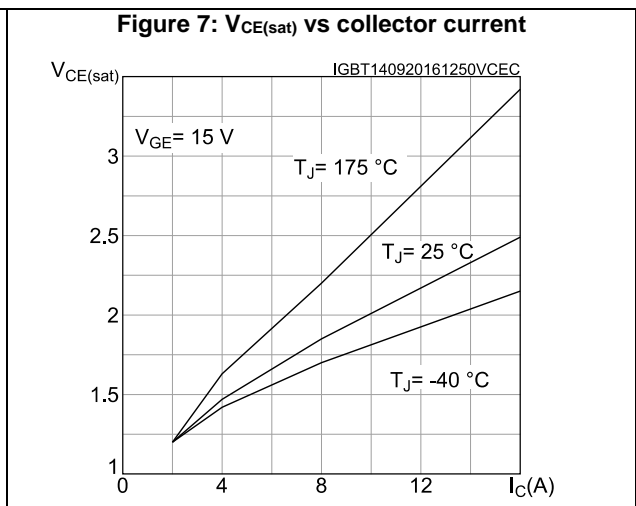
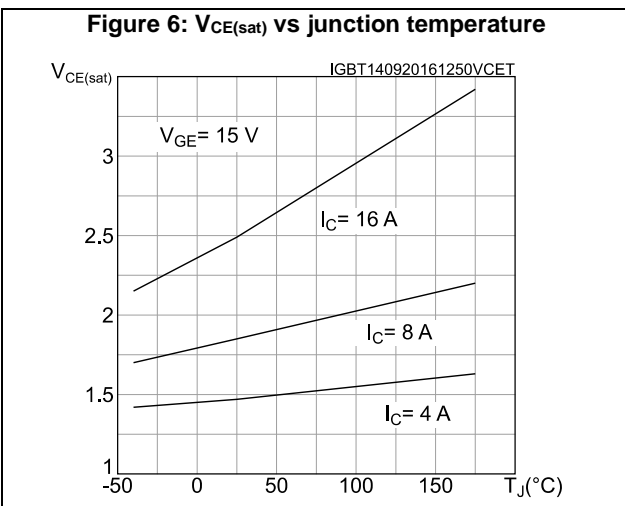
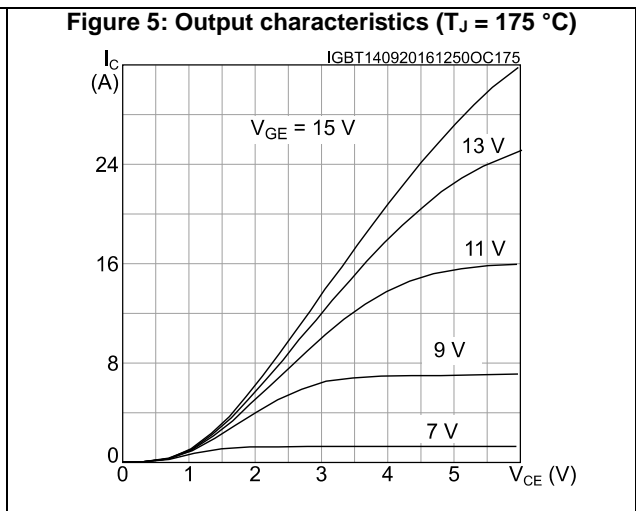
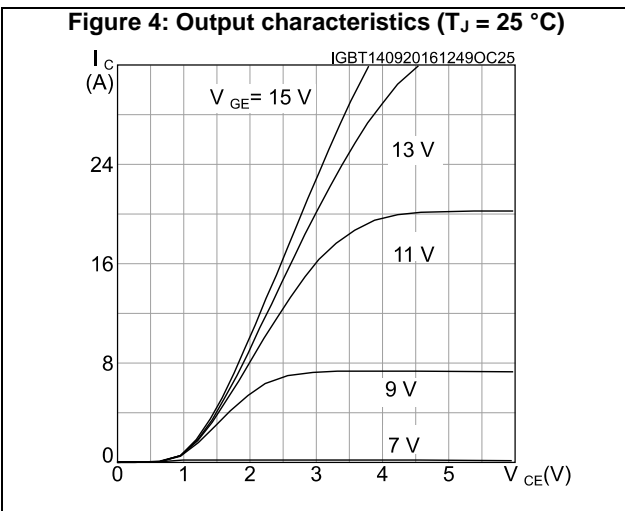
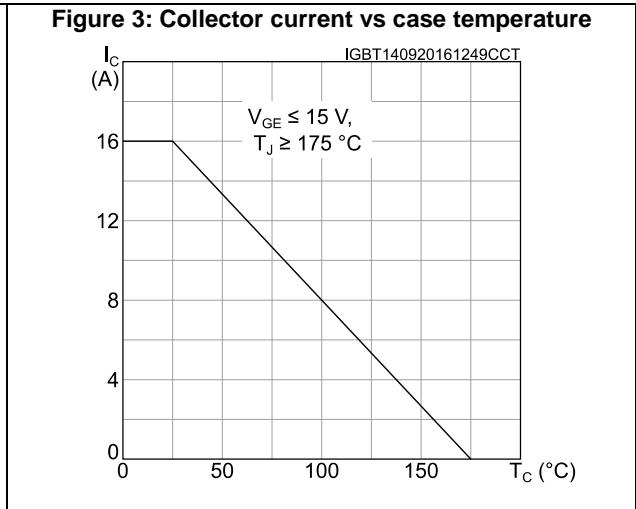
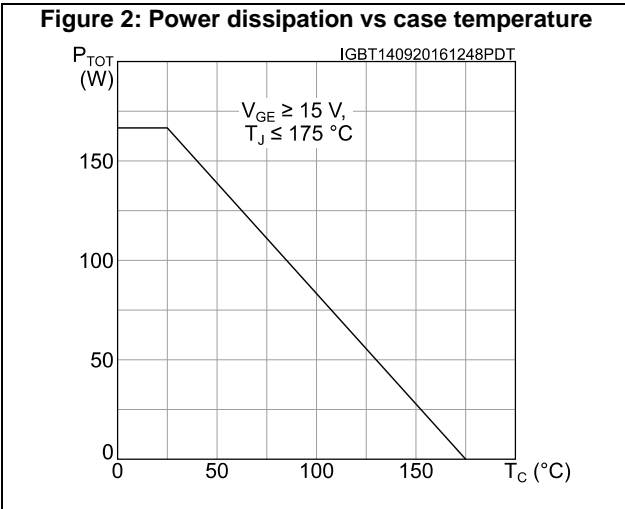


Figure 8: Collector current vs switching frequency

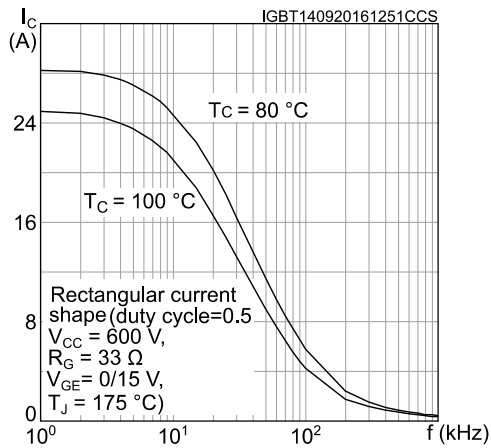


Figure 9: Forward bias safe operating area

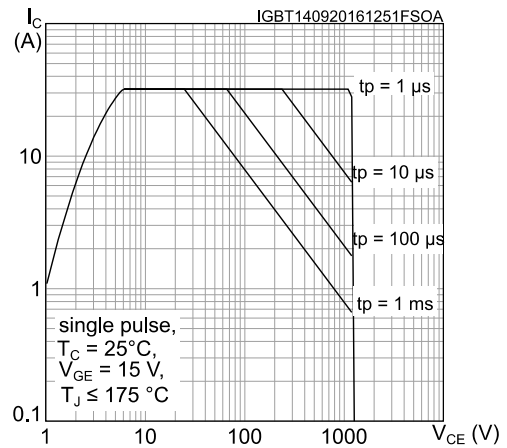


Figure 10: Transfer characteristics

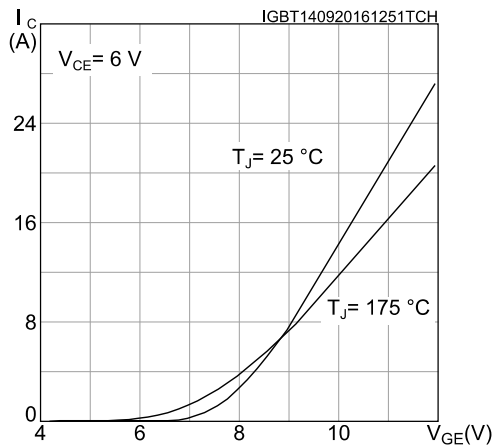


Figure 11: Diode VF vs forward current

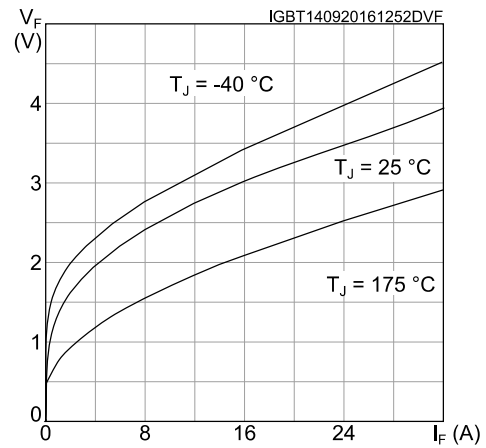


Figure 12: Normalized VGE(th) vs junction temperature

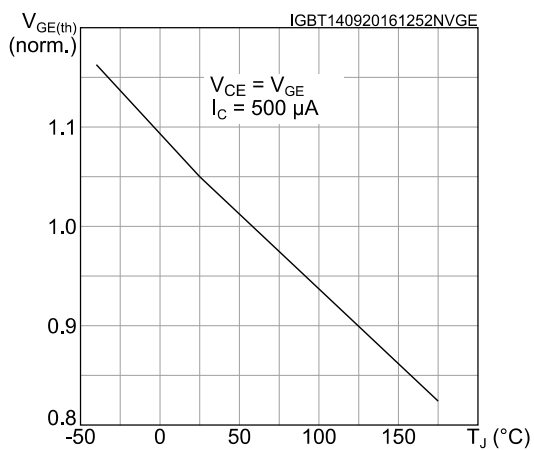
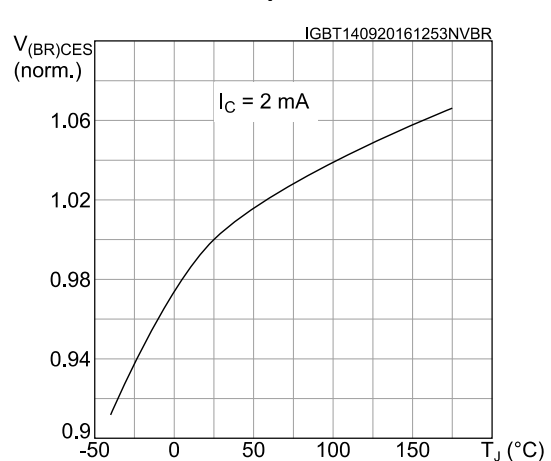


Figure 13: Normalized V(BR)CES vs junction temperature



Electrical characteristics

STGW8M120DF3, STGWA8M120DF3

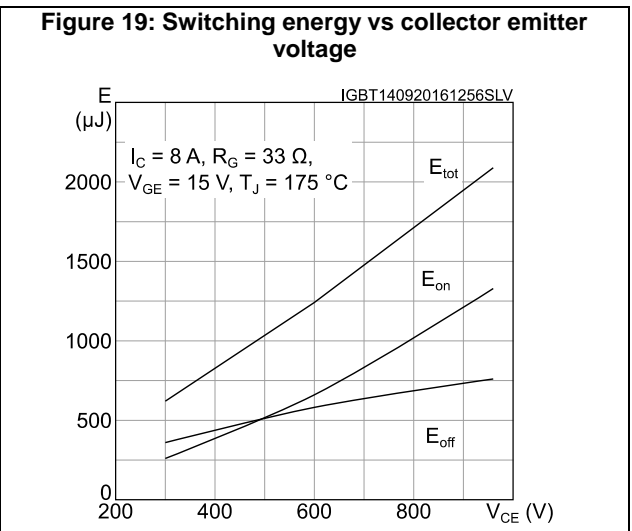
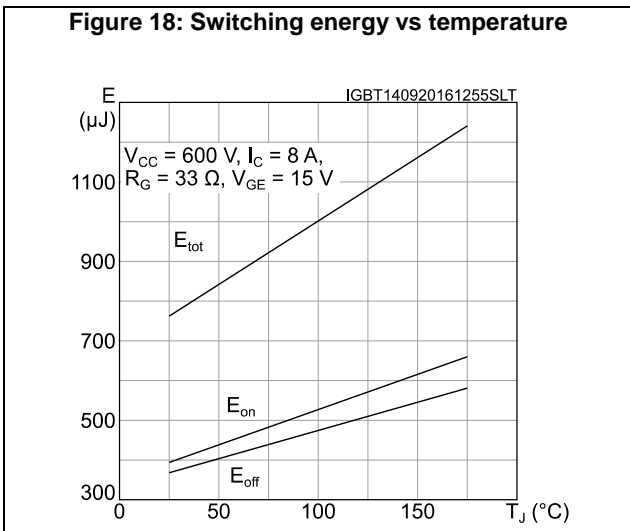
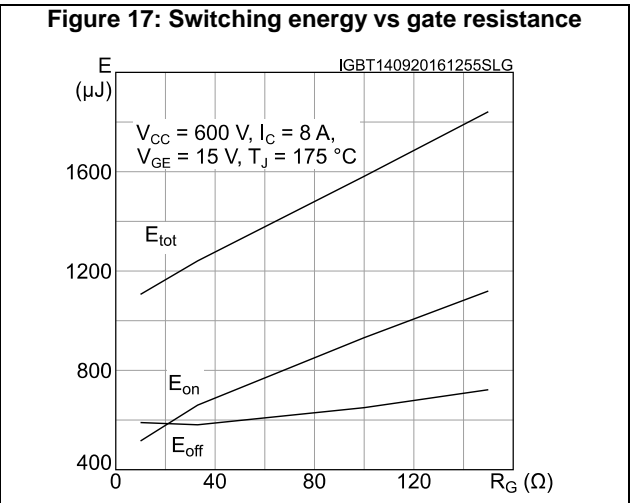
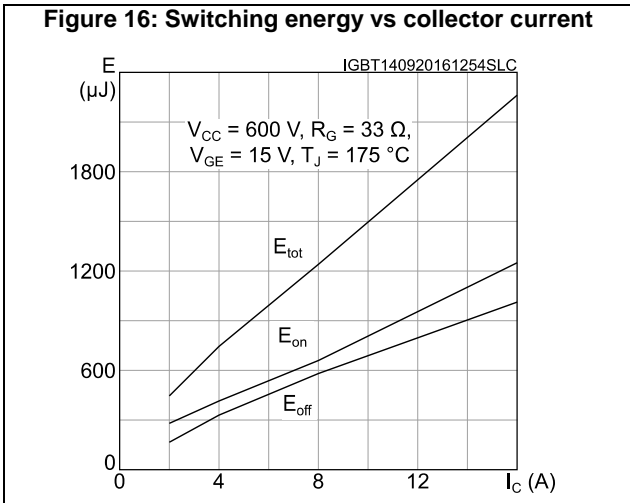
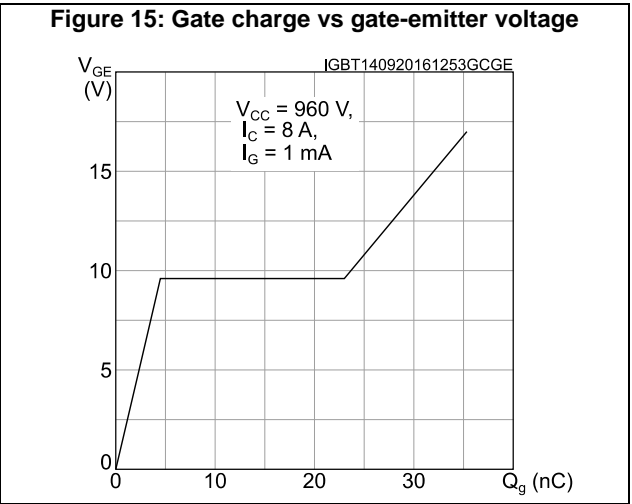
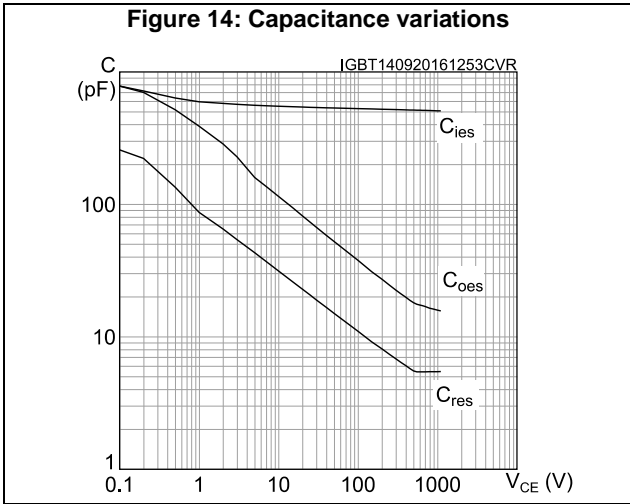




Figure 20: Short-circuit time and current vs  $V_{GE}$

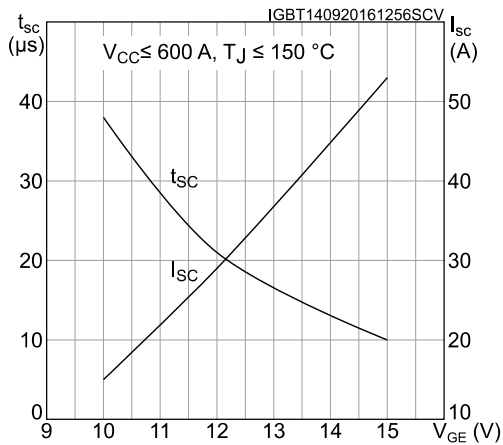


Figure 21: Switching times vs collector current

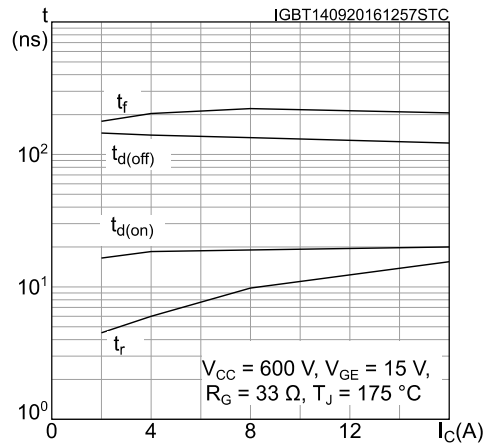


Figure 22: Switching times vs gate resistance

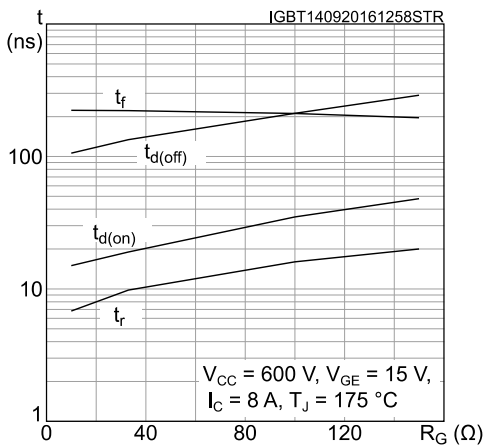


Figure 23: Reverse recovery current vs diode current slope

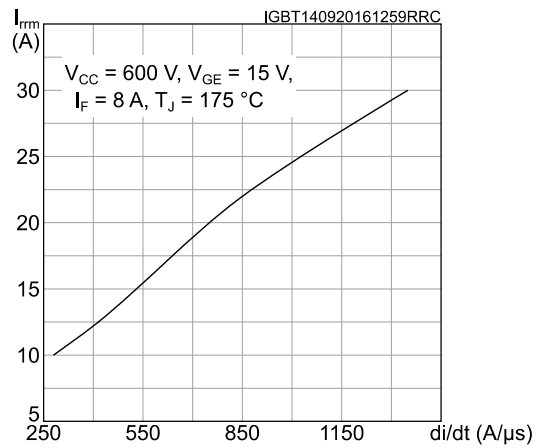


Figure 24: Reverse recovery time vs diode current slope

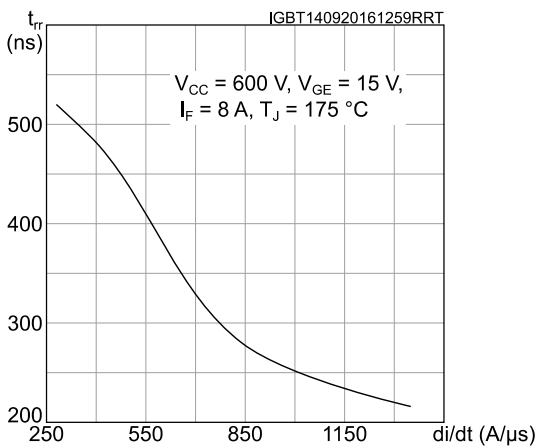


Figure 25: Reverse recovery charge vs diode current slope

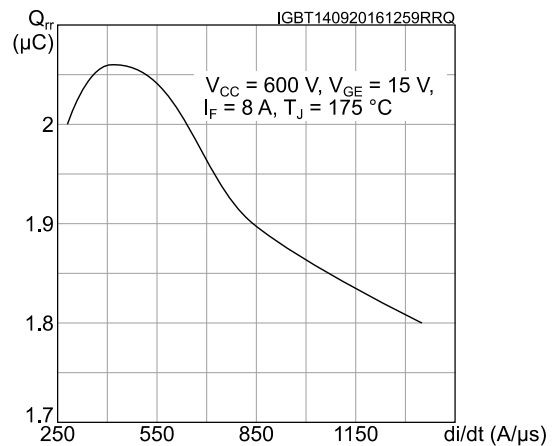


Figure 26: Reverse recovery energy vs diode current slope

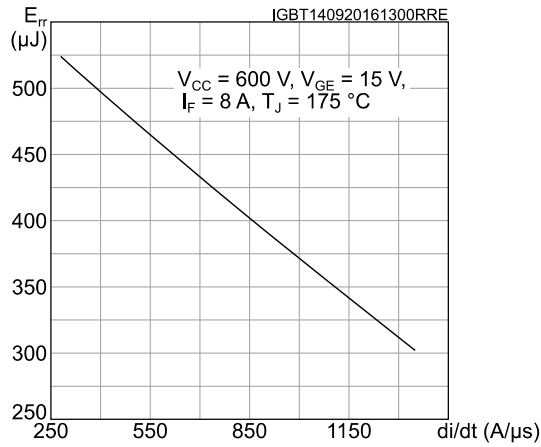


Figure 27: Thermal impedance for IGBT

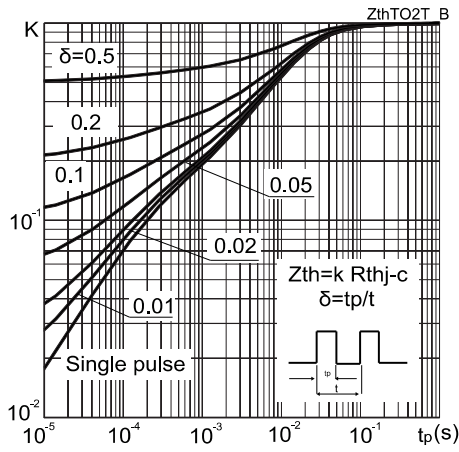
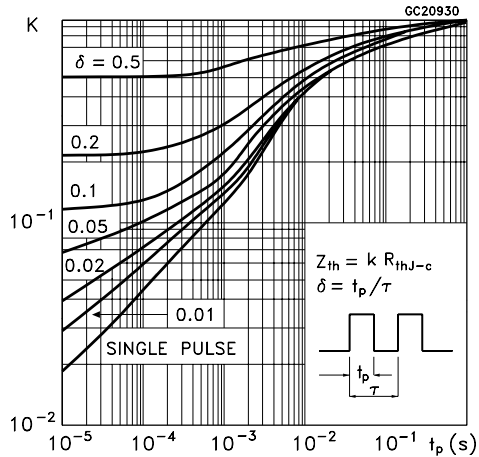
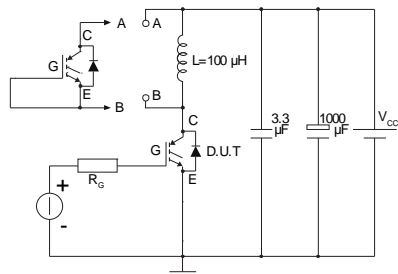


Figure 28: Thermal impedance for diode



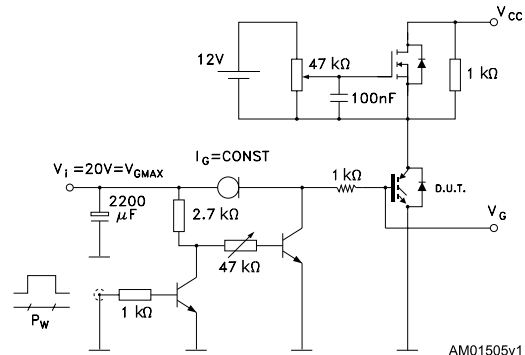
### 3 Test circuits

Figure 29: Test circuit for inductive load switching



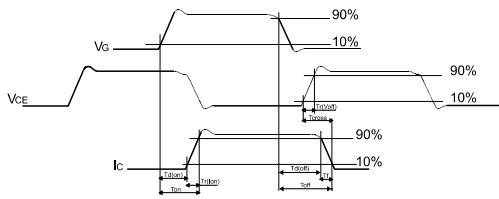
AM01504v1

Figure 30: Gate charge test circuit



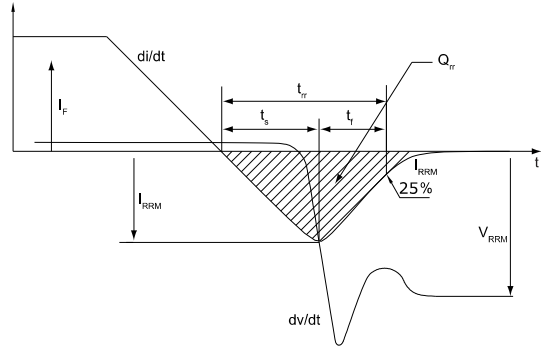
AM01505v1

Figure 31: Switching waveform



AM01506v1

Figure 32: 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 33: TO-247 package outline

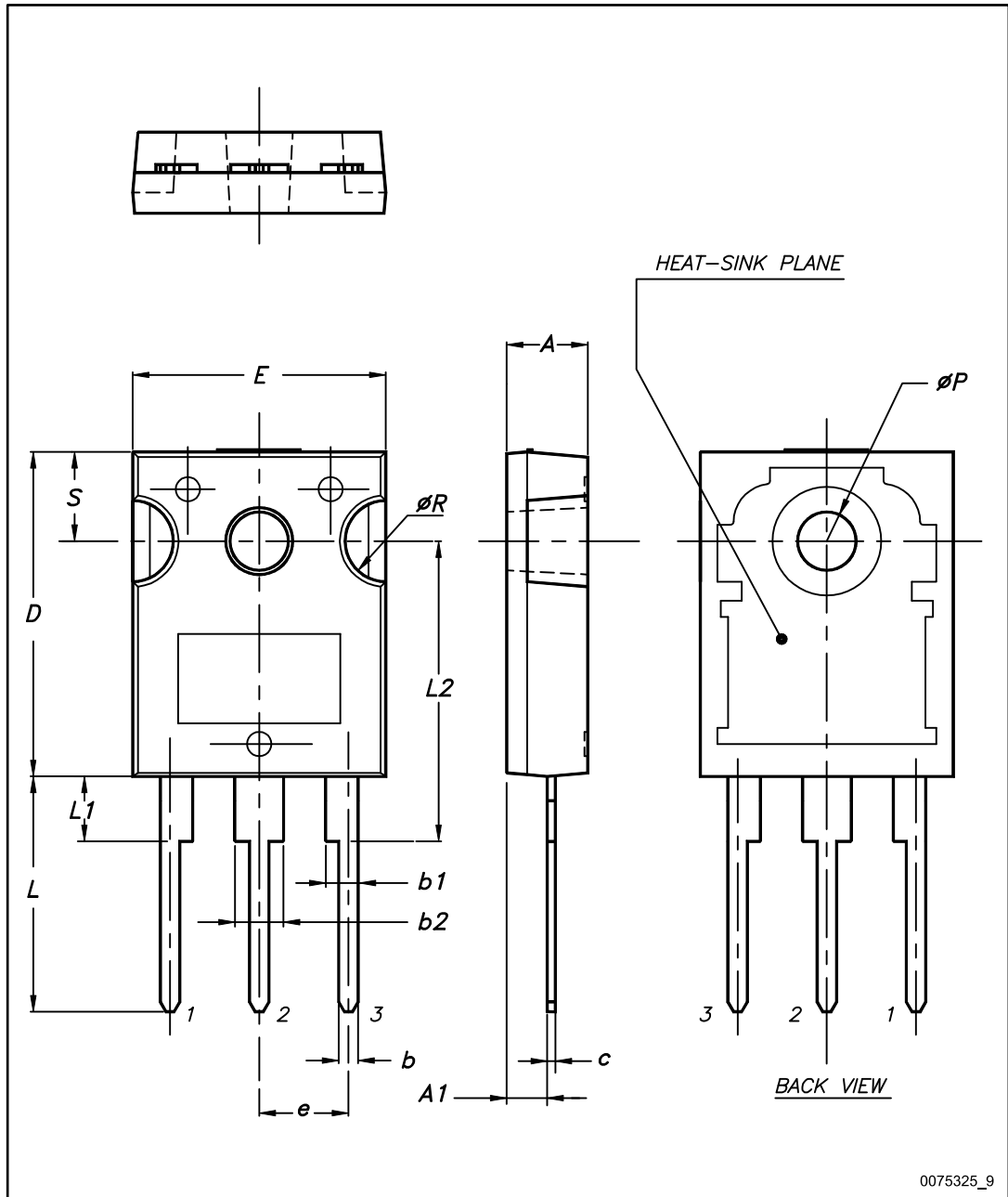


Table 8: TO-247 package mechanical data

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-247 long leads package information

Figure 34: TO-247 long leads package outline

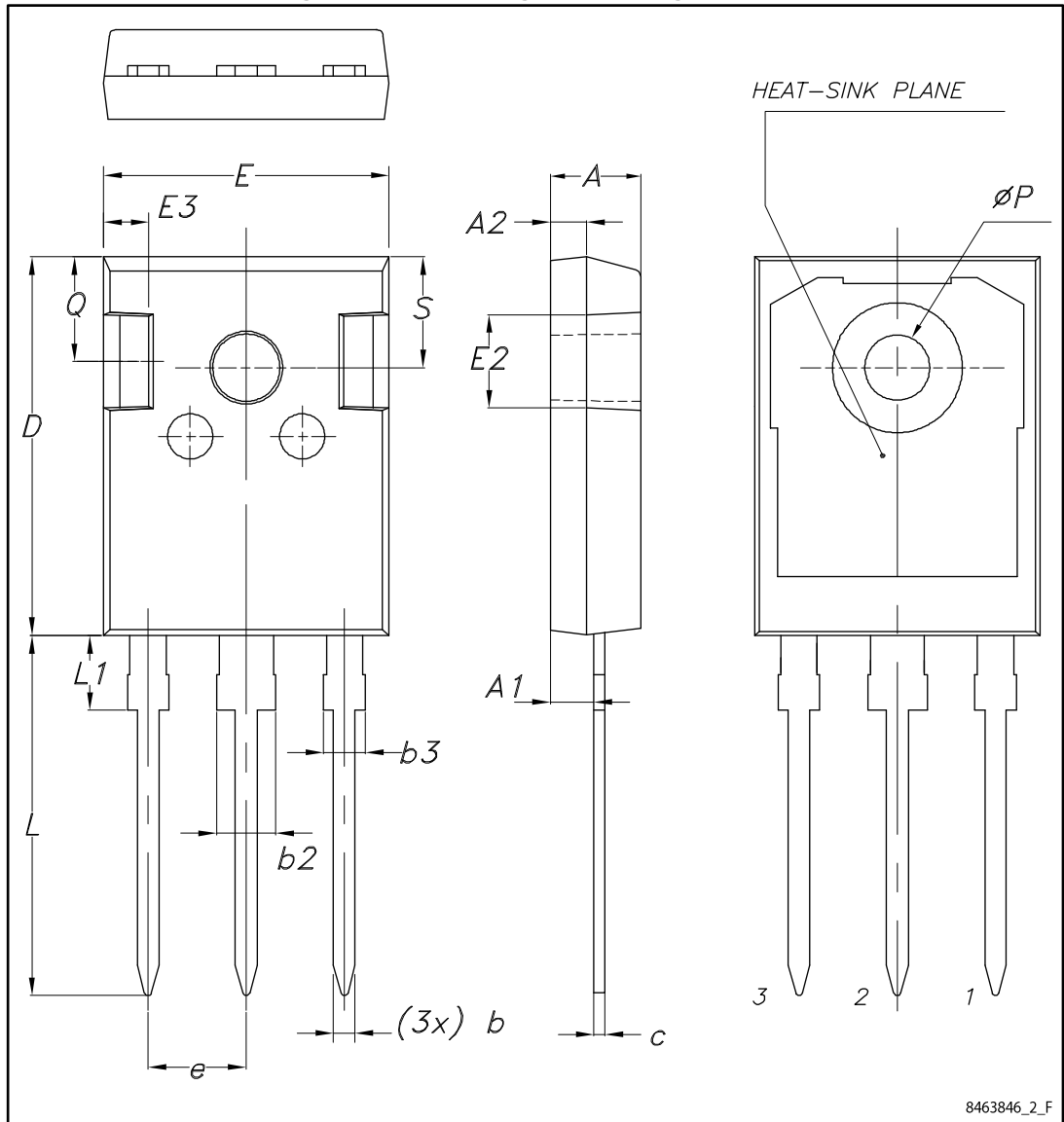


Table 9: TO-247 long leads package mechanical data

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 10: Document revision history

Date	Revision	Changes
11-May-2016	1	First release.
19-Sep-2016	2	Datasheet promoted from preliminary to production data. Updated <i>Table 2: "Absolute maximum ratings"</i> . Updated <i>Section 2: "Electrical characteristics"</i> . Added <i>Section 2.1: "Electrical characteristics (curves)"</i> .
31-Oct-2017	3	Updated package silhouette on cover page. Updated <i>Table 4: "Static characteristics"</i> and <i>Table 5: "Dynamic characteristics"</i> . Minor text changes



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