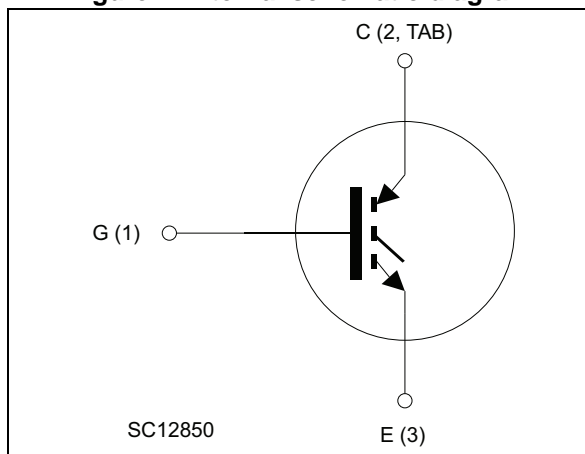


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 2.1\text{ V (typ.) @ } I_C = 40\text{ A}$
- $5\text{ }\mu\text{s}$  minimum short-circuit withstand time at  $T_J = 150\text{ °C}$
- Safe paralleling
- Low thermal resistance

### Applications

- Uninterruptible power supply
- Welding machines
- Photovoltaic inverters
- Power factor correction
- High frequency converters

### Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the H series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converters. Moreover, 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	Packaging
STGW40H120F2	G40H120F2	TO-247	Tube
STGWA40H120F2	G40H120F2	TO-247 long leads	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	1200	V
$I_C$	Continuous collector current at $T_C = 25\text{ °C}$	80	A
$I_C$	Continuous collector current at $T_C = 100\text{ °C}$	40	A
$I_{CP}^{(1)}$	Pulsed collector current	160	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	468	W
$T_{STG}$	Storage temperature range	-55 to 150	°C
$T_J$	Operating junction temperature	-55 to 175	°C

1. Pulse width limited by maximum junction temperature

**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	°C/W

## 2 Electrical characteristics

$T_J = 25\text{ °C}$  unless otherwise specified.

**Table 4. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$		2.1	2.6	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $T_J = 125\text{ °C}$		2.4		
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $T_J = 175\text{ °C}$		2.5		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 2\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 1200\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			250	nA

**Table 5. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	3200	-	pF
$C_{oes}$	Output capacitance		-	220	-	pF
$C_{res}$	Reverse transfer capacitance		-	80	-	pF
$Q_g$	Total gate charge	$V_{CC} = 960\text{ V}, I_C = 40\text{ A},$ $V_{GE} = 15\text{ V},$ see <a href="#">Figure 24</a>	-	158	-	nC
$Q_{ge}$	Gate-emitter charge		-	17	-	nC
$Q_{gc}$	Gate-collector charge		-	85	-	nC

Table 6. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$ , $I_C = 40\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , see <a href="#">Figure 23</a>		18	-	ns
$t_r$	Current rise time			37	-	ns
$(di/dt)_{on}$	Turn-on current slope			1755	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off delay time			152	-	ns
$t_f$	Current fall time			83	-	ns
$E_{on}^{(1)}$	Turn-on switching losses			1.0	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			1.32	-	mJ
$E_{ts}$	Total switching losses		2.32	-	mJ	
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$ , $I_C = 40\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 23</a>		36	-	ns
$t_r$	Current rise time			20	-	ns
$(di/dt)_{on}$	Turn-on current slope			1580	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off delay time			161	-	ns
$t_f$	Current fall time			190	-	ns
$E_{on}^{(1)}$	Turn-on switching losses			1.81	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			2.46	-	mJ
$E_{ts}$	Total switching losses		4.27	-	mJ	
$t_{sc}$	Short-circuit withstand time	$V_{CE} = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ ,	5		-	$\mu$ s

1. Energy losses include reverse recovery of the external diode. The diode is the same of the co-packed STGW40H120DF2
2. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

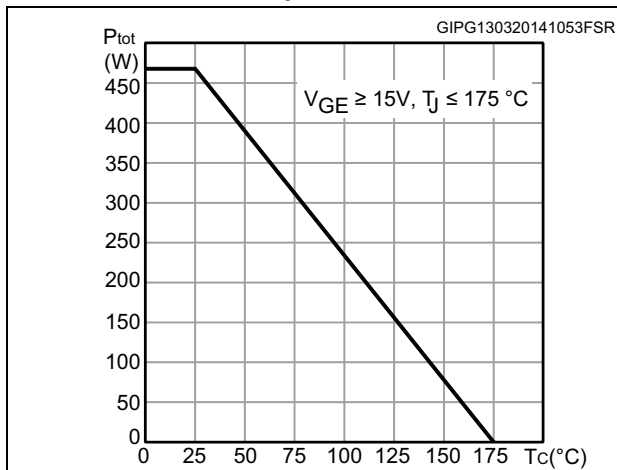


Figure 3. Collector current vs. case temperature

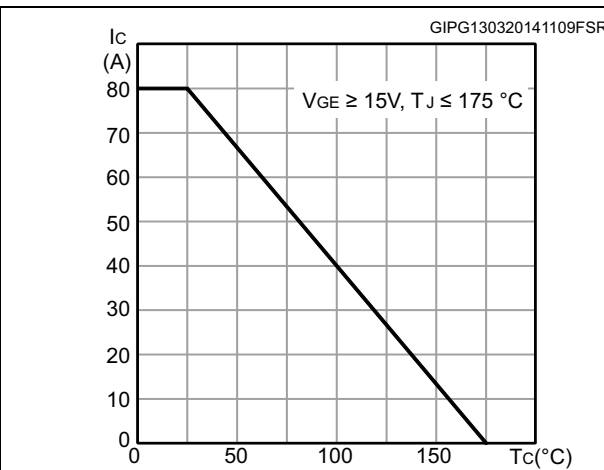


Figure 4. Output characteristics (T<sub>J</sub> = 25°C)

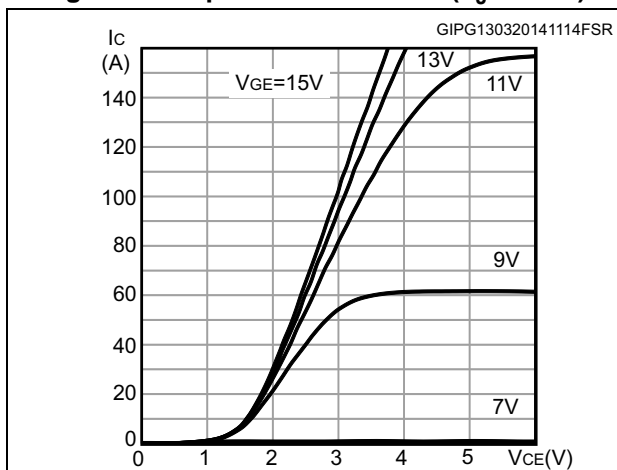


Figure 5. Output characteristics (T<sub>J</sub> = 175°C)

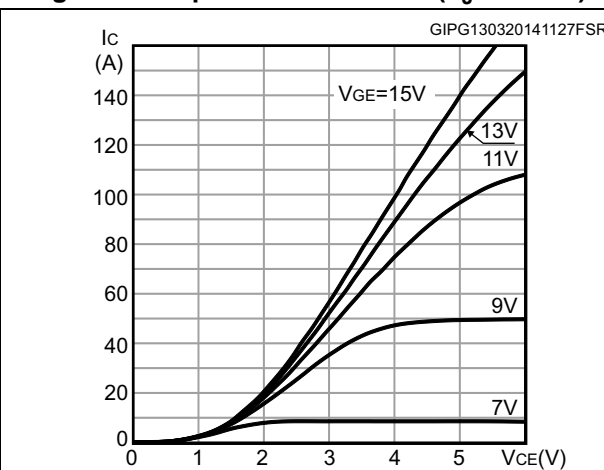


Figure 6. V<sub>CE(sat)</sub> vs. junction temperature

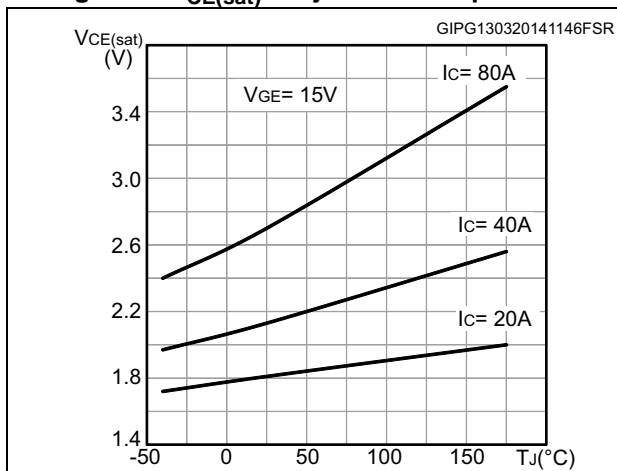


Figure 7. V<sub>CE(sat)</sub> vs. collector current

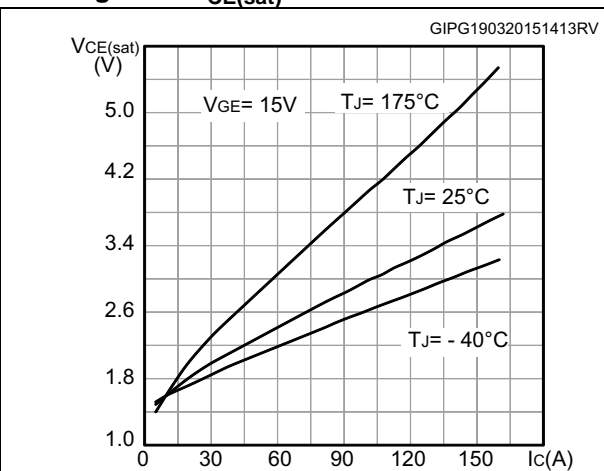


Figure 8. Collector current vs. switching frequency

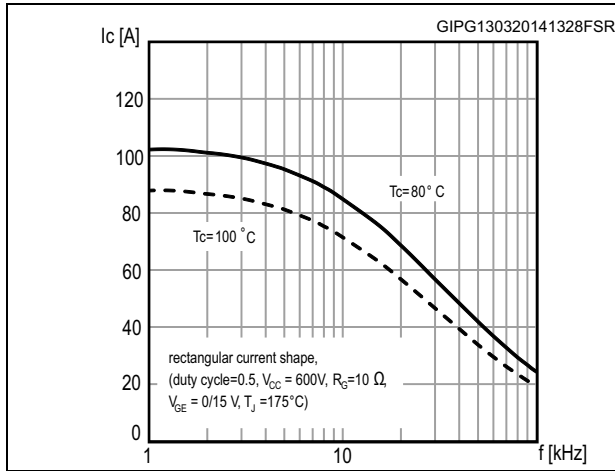


Figure 9. Forward bias safe operating area

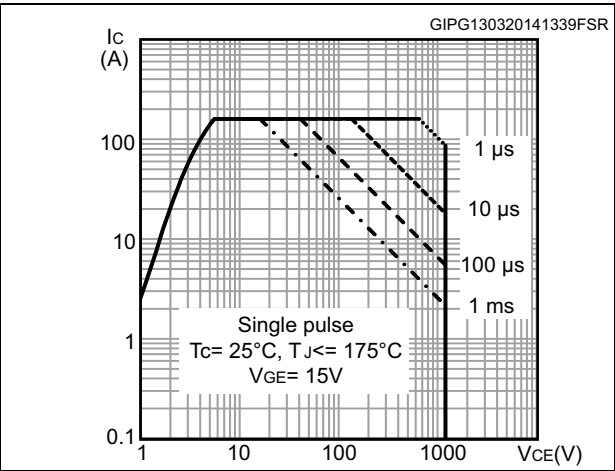


Figure 10. Transfer characteristics

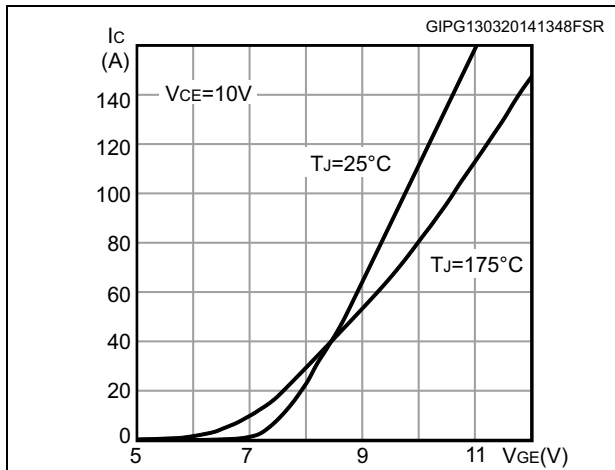


Figure 11. Normalized  $V_{GE(th)}$  vs junction temperature

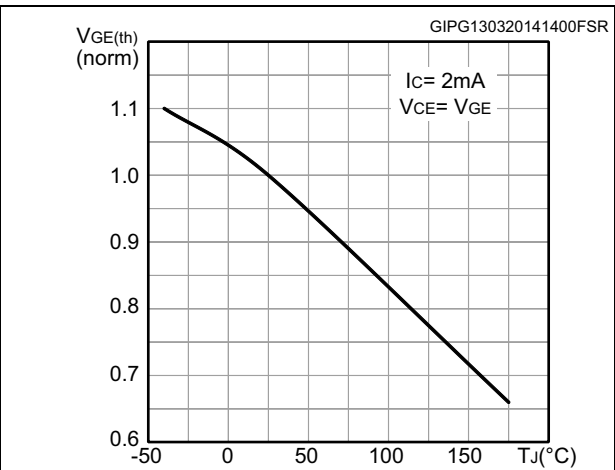


Figure 12. Normalized  $V_{(BR)CES}$  vs. junction temperature

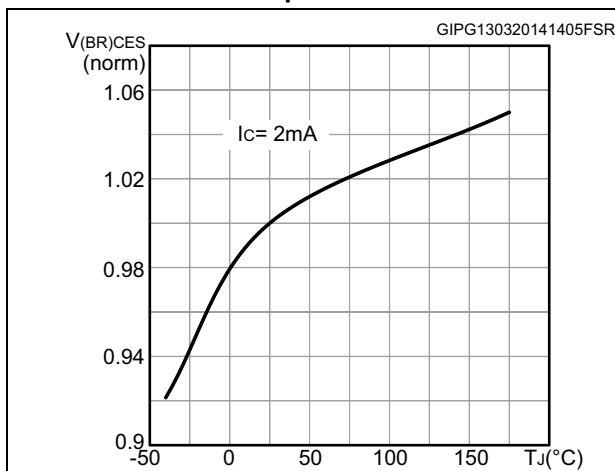


Figure 13. Capacitance variation

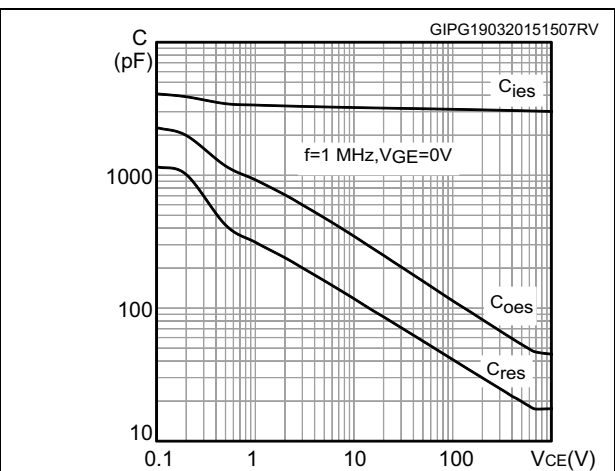


Figure 14. Gate charge vs. gate-emitter voltage      Figure 15. Switching loss vs collector current

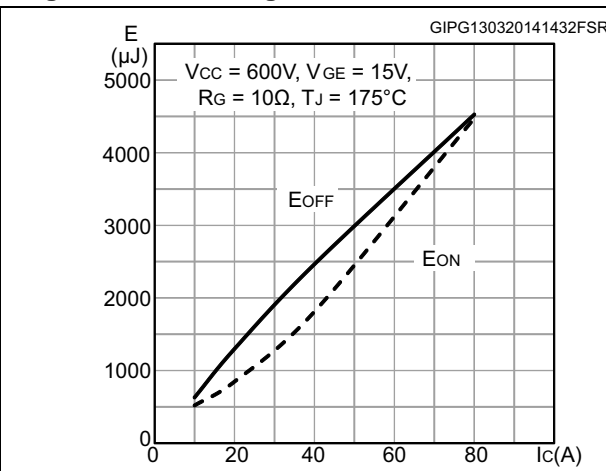
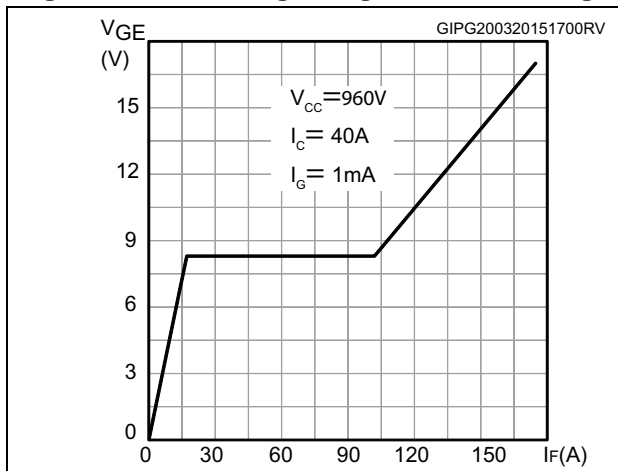


Figure 16. Switching loss vs gate resistance      Figure 17. Switching loss vs temperature

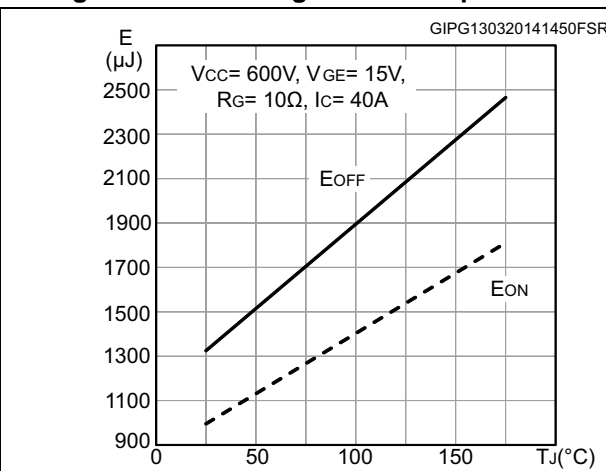
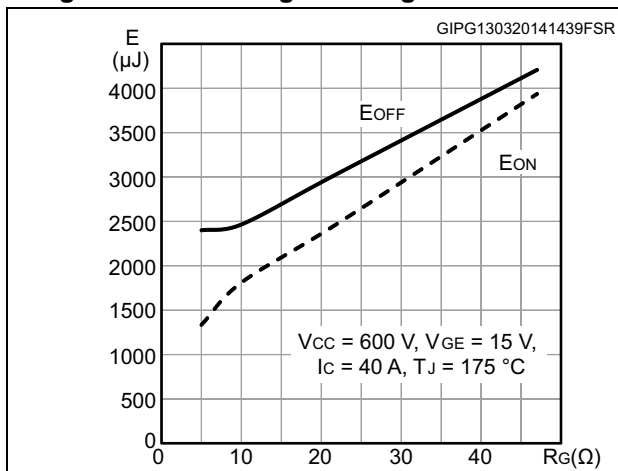


Figure 18. Switching loss vs collector-emitter voltage      Figure 19. Switching times vs. collector current

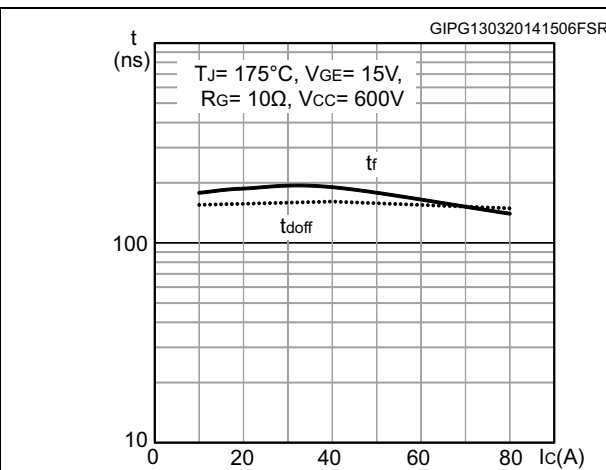
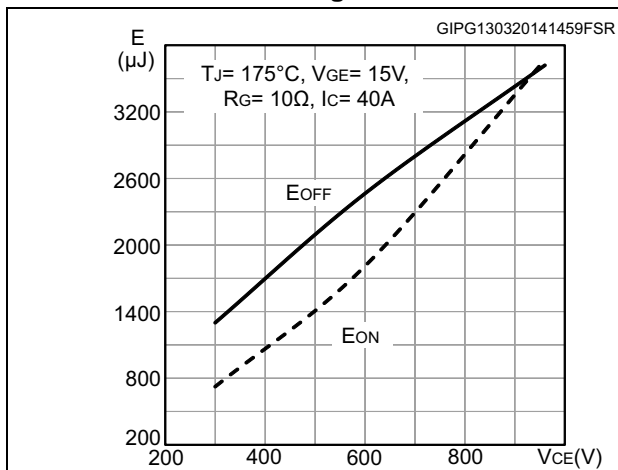




Figure 20. Switching times vs. gate resistance      Figure 21. Short circuit time and current vs.VGE

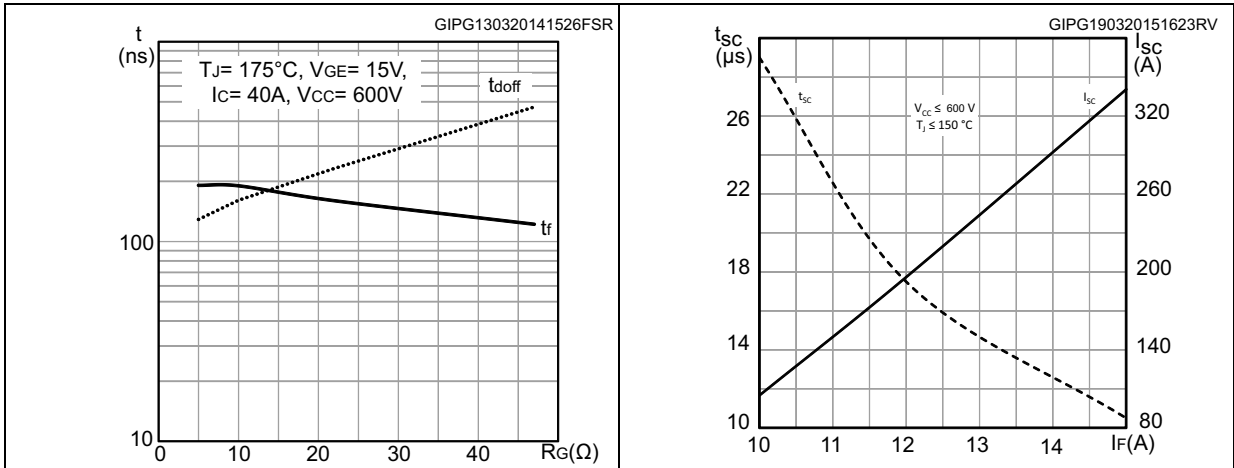
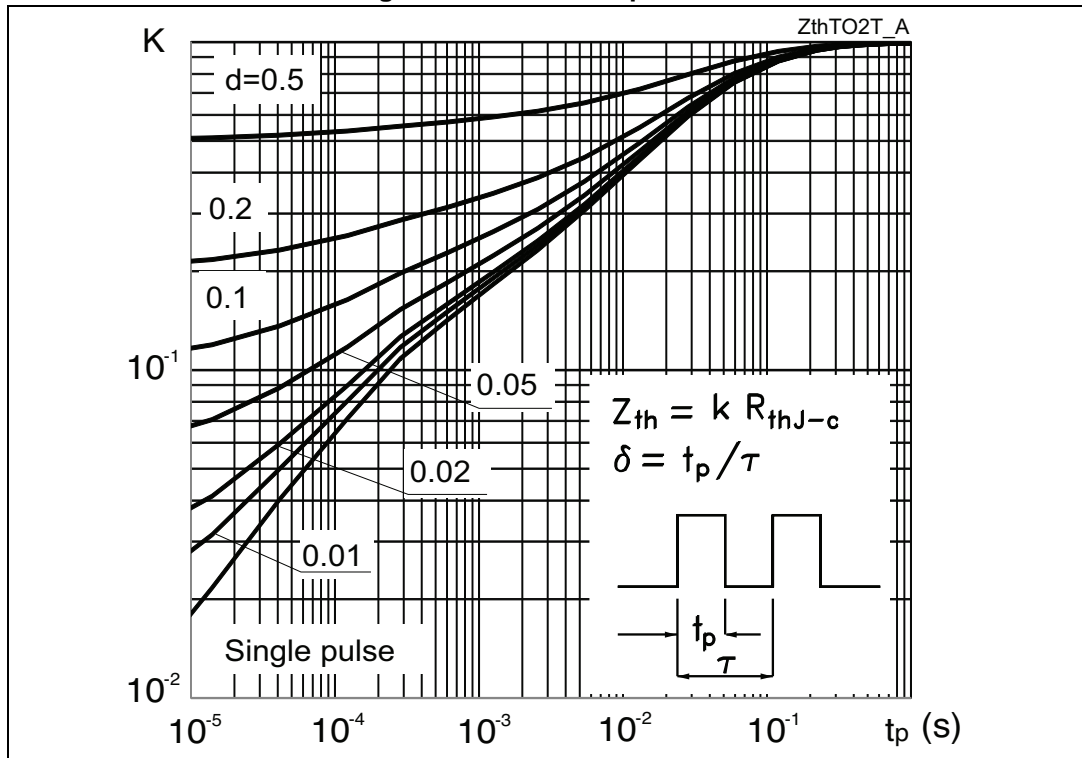


Figure 22. Thermal impedance



### 3 Test circuits

Figure 23. Test circuit for inductive load switching

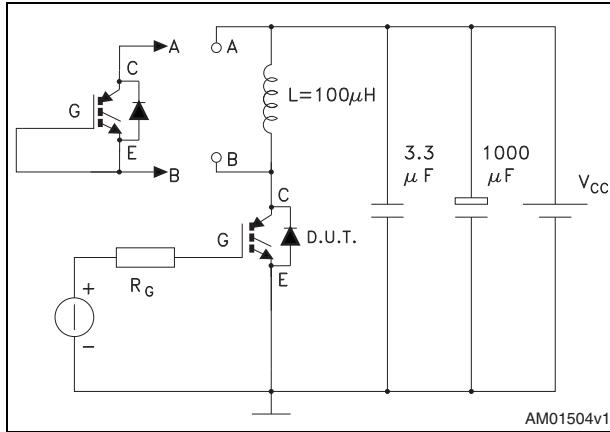


Figure 24. Gate charge test circuit

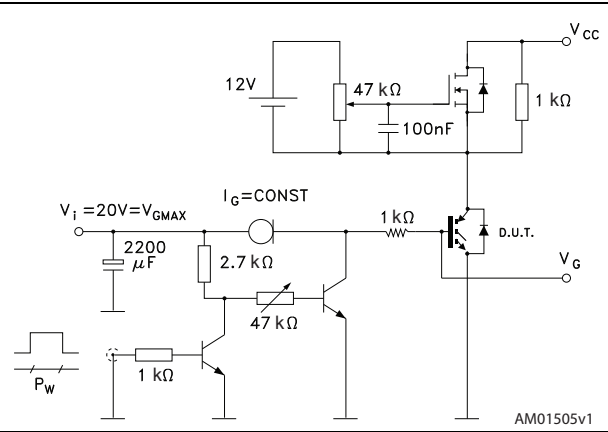
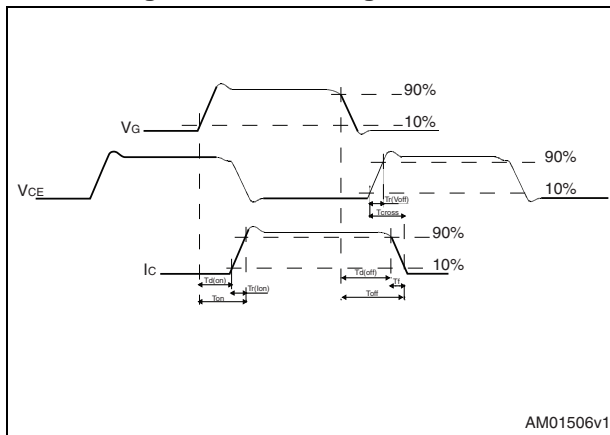


Figure 25. Switching waveform



## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 4.1 TO-247, STGW40H120F2

Figure 26. TO-247 drawing

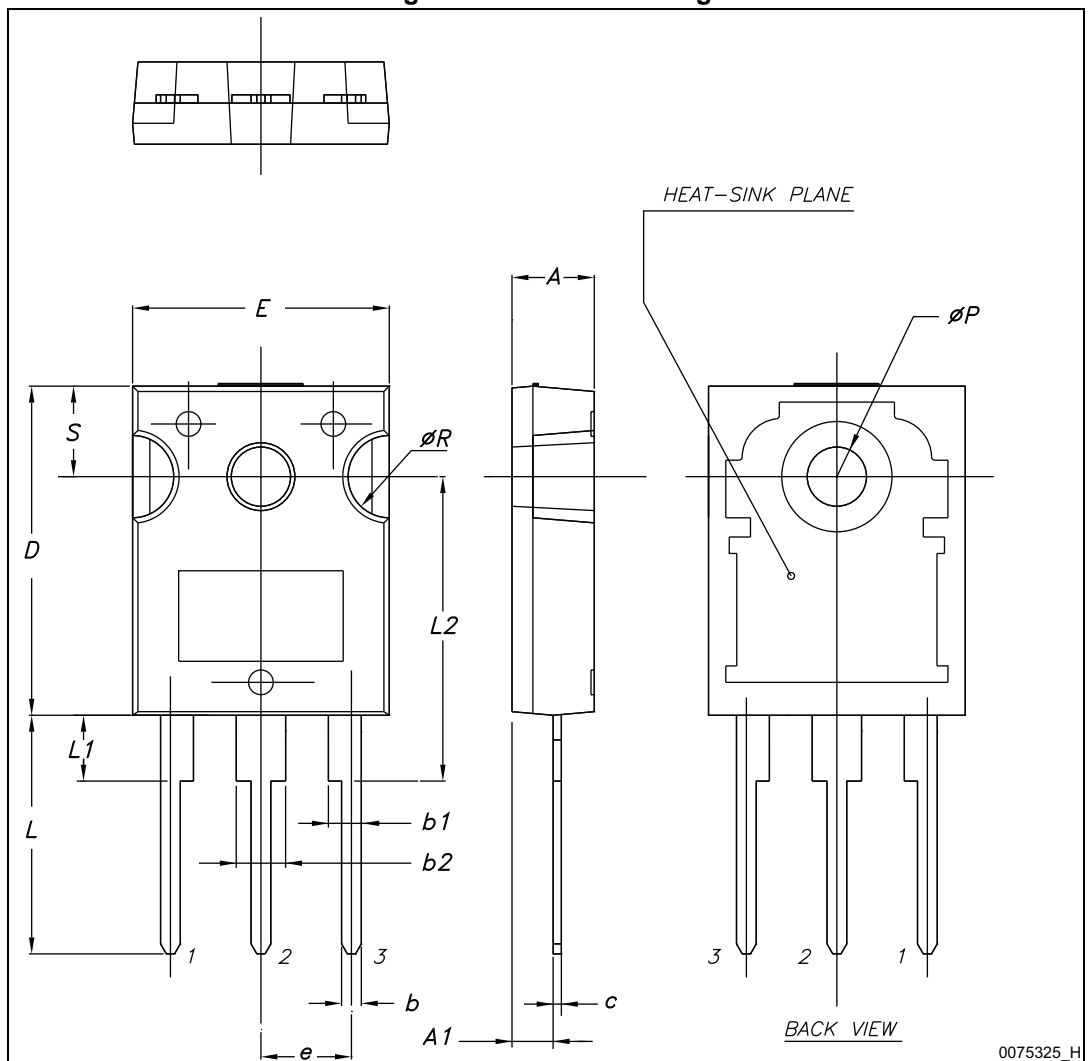
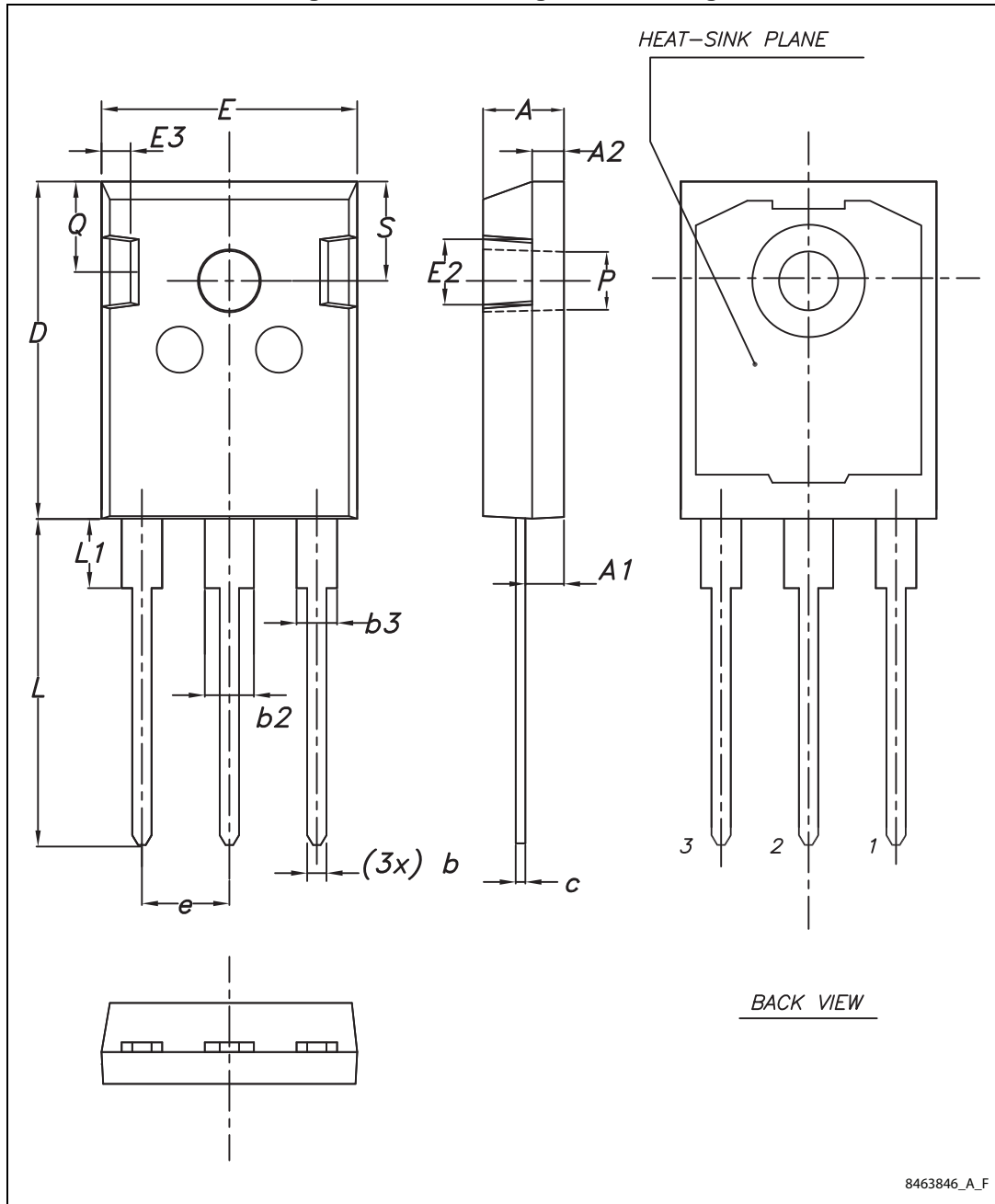


Table 7. TO-247 mechanical data

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, STGWA40H120F2

Figure 27. TO-247 long leads drawing



8463846\_A\_F

Table 8. TO-247 long leads 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 9. Document revision history

Date	Revision	Changes
29-Jan-2014	1	Initial release.
14-Mar-2014	2	Updated <a href="#">Table 4: Static characteristics</a> and <a href="#">Table 5: Dynamic characteristics</a> . Added <a href="#">Section 2.1: Electrical characteristics (curves)</a> . Updated title in cover page. Minor text changes.
25-Mar-2015	3	Added <a href="#">4.2: TO-247 long leads, STGWA40H120F2</a> Updated <a href="#">4: Package mechanical data</a> Minor text changes.



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### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

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