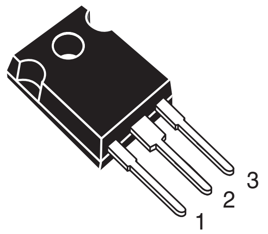
STGW40H120F2

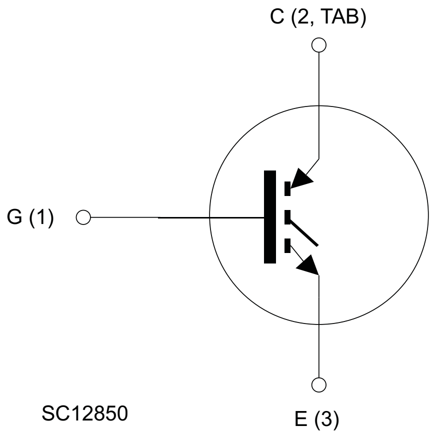
Trench gate field-stop IGBT, H series 1200 V, 40 A high speed

Datasheet - production data



TO-247

Figure 1. Internal schematic diagram



Features

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

Applications

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

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the improved H series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of high 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 codes	Marking	Package	Packaging
STGW40H120F2	GW40H120F2	TO-247	Tube

Contents

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 °C	80	A
I_C	Continuous collector current at T_C = 100 °C	40	A
I_{CP}(1)	Pulsed collector current	160	A
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total dissipation at T_C = 25 °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 °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 mA	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 40 A		2.1	2.6	V
		V_{GE} = 15 V, I_C = 40 A T_J = 125 °C		2.4		
		V_{GE} = 15 V, I_C = 40 A T_J = 175 °C		2.5		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 2 mA	5	6	7	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 1200 V			25	µA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ± 20 V			250	nA

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	3200	-	pF
C_{oes}	Output capacitance		-	202	-	pF
C_{res}	Reverse transfer capacitance		-	88	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 40 A, V_{GE} = 15 V, see *Figure 23*	-	187	-	nC
Q_{ge}	Gate-emitter charge		-	17	-	nC
Q_{gc}	Gate-collector charge		-	115	-	nC

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 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 V, see *Figure 22*	-	18	-	ns
t_r	Current rise time		-	37	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1755	-	A/µs
$t_{d(off)}$	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 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C, see *Figure 22*	-	36	-	ns
t_r	Current rise time		-	20	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1580	-	A/µs
$t_{d(off)}$	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 V, V_{GE} = 15 V, T_J = 150 °C,	5		-	µJ

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

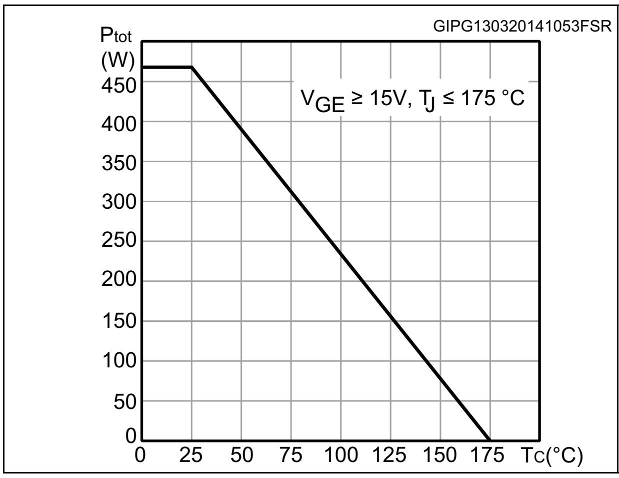


Figure 3. Collector current vs. case temperature

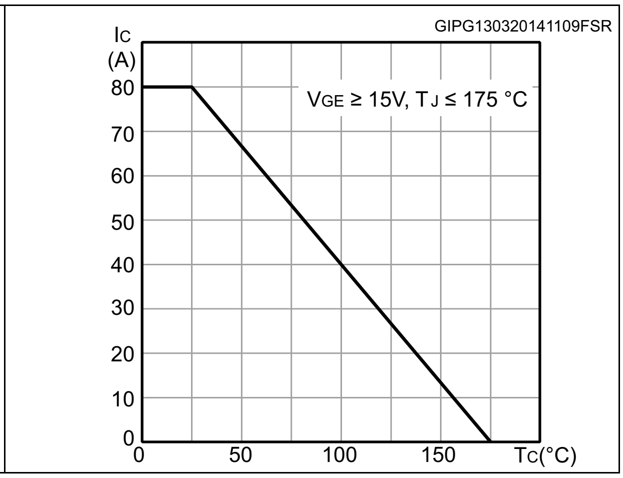


Figure 4. Output characteristics (T_J = 25°C)

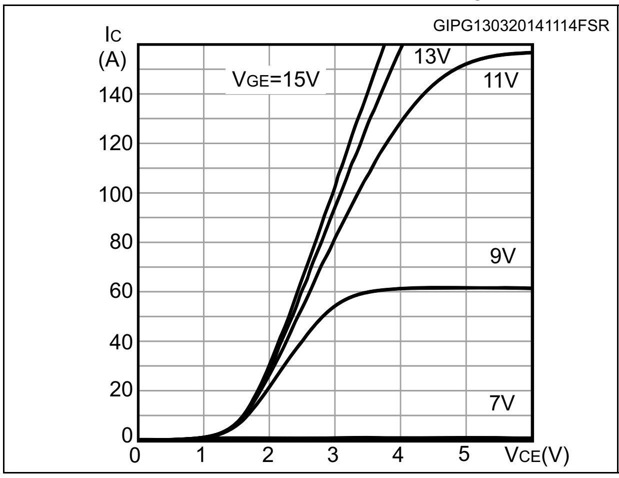


Figure 5. Output characteristics (T_J = 175°C)

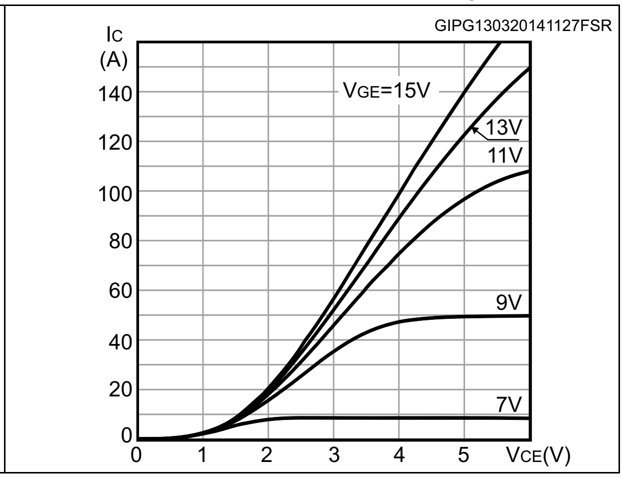


Figure 6. $V_{CE(sat)}$ vs. junction temperature

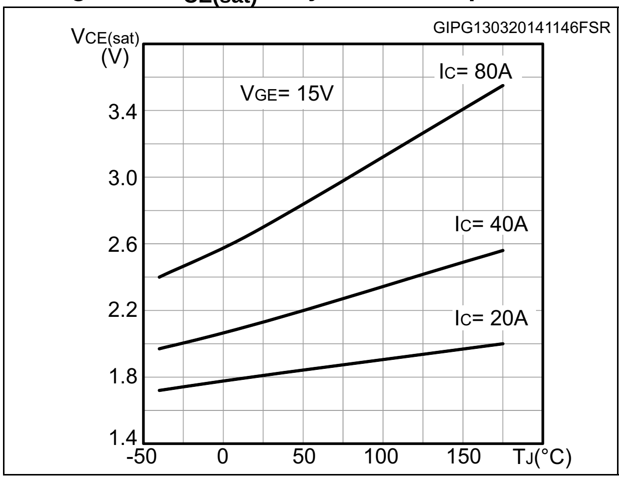


Figure 7. $V_{CE(sat)}$ vs. collector current

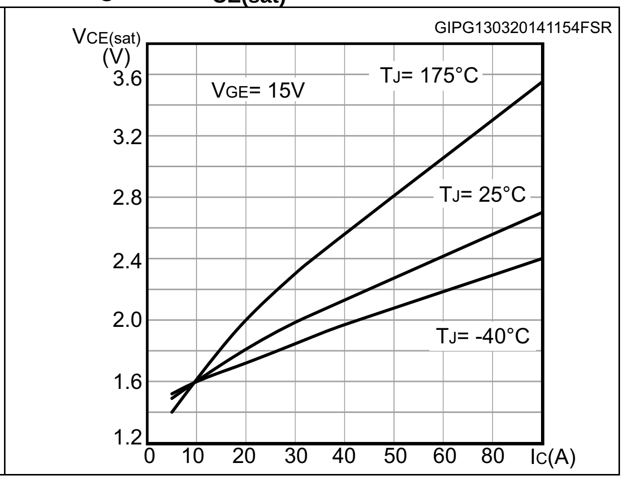


Figure 8. Collector current vs. switching frequency

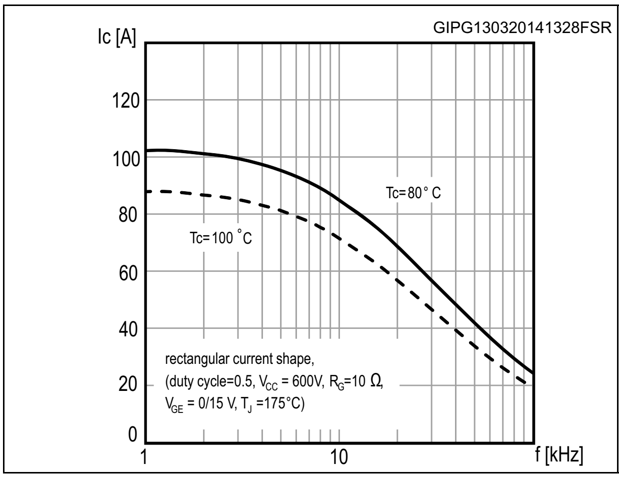


Figure 9. Forward bias safe operating area

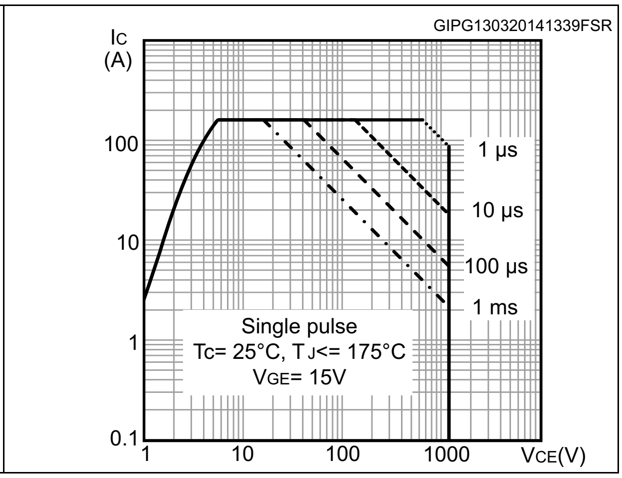


Figure 10. Transfer characteristics

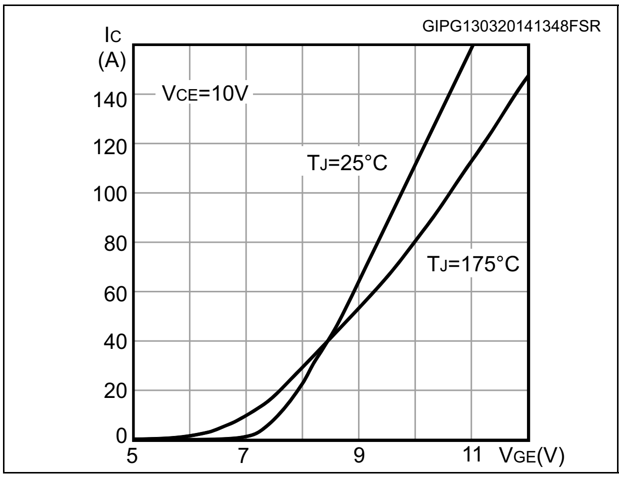


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

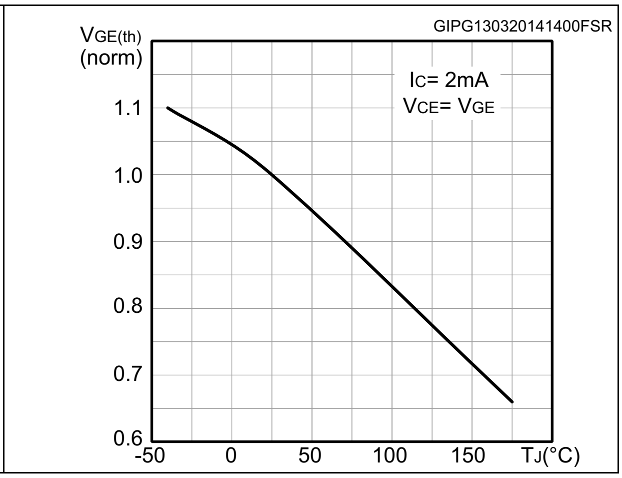


Figure 12. Normalized $V_{(BR)CES}$ vs. junction temperature

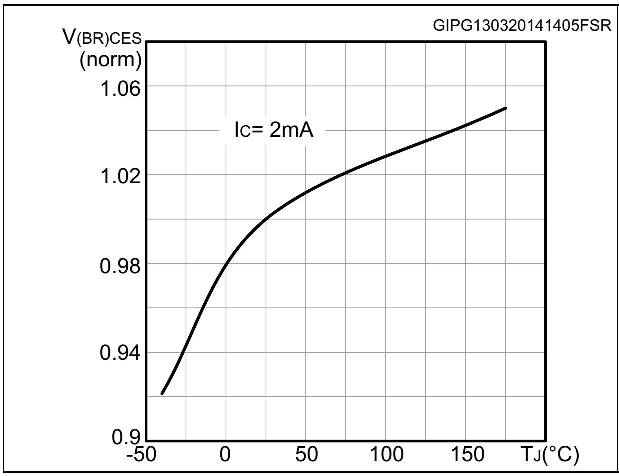


Figure 13. Capacitance variation

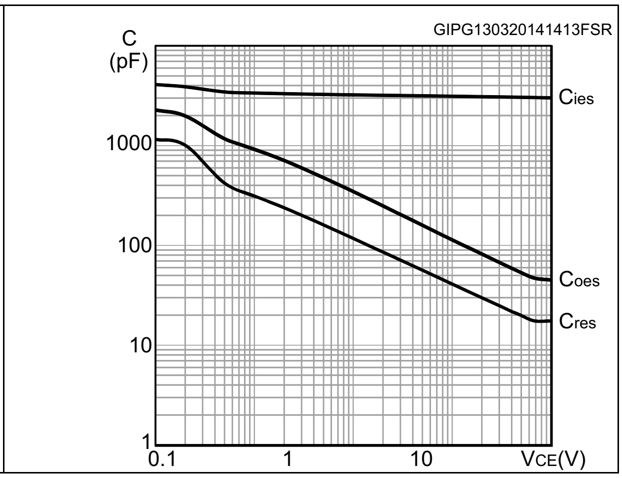


Figure 14. Gate charge vs. gate-emitter voltage

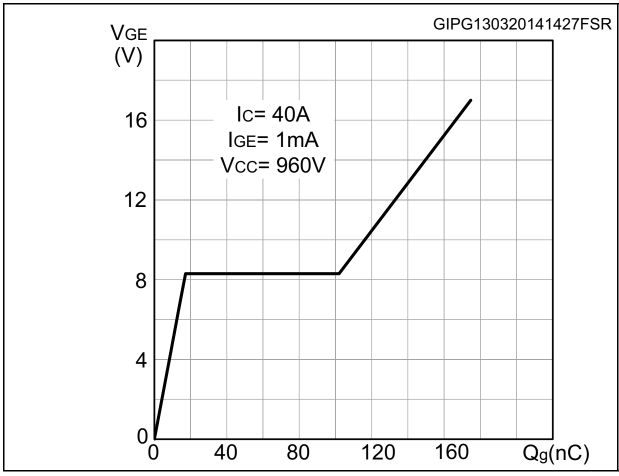


Figure 15. Switching loss vs collector current

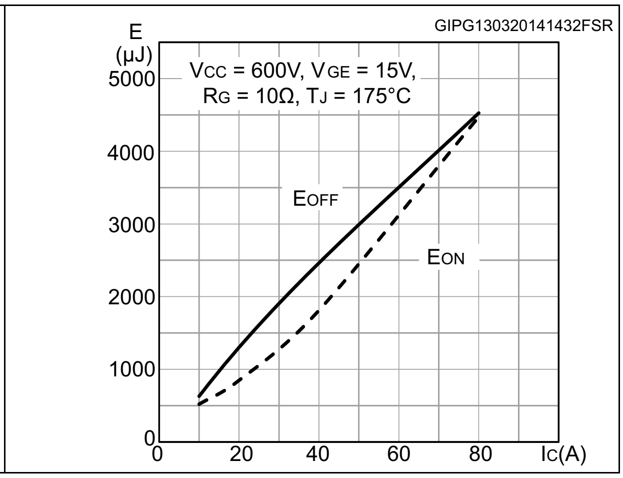


Figure 16. Switching loss vs gate resistance

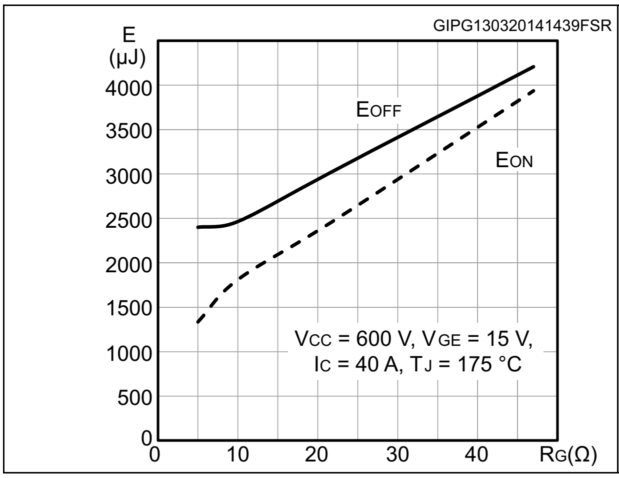


Figure 17. Switching loss vs temperature

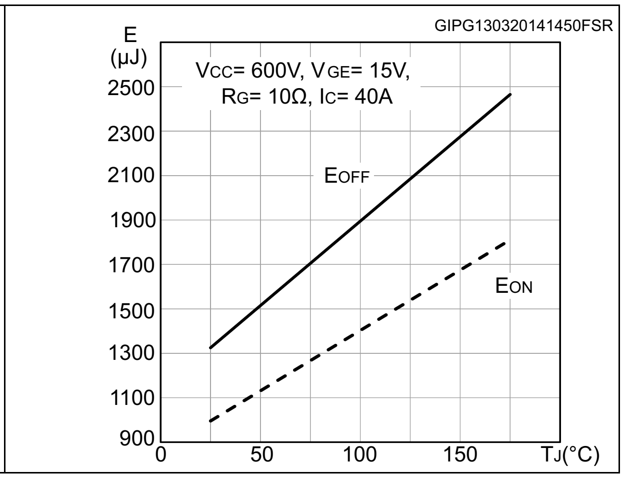


Figure 18. Switching loss vs collector-emitter voltage

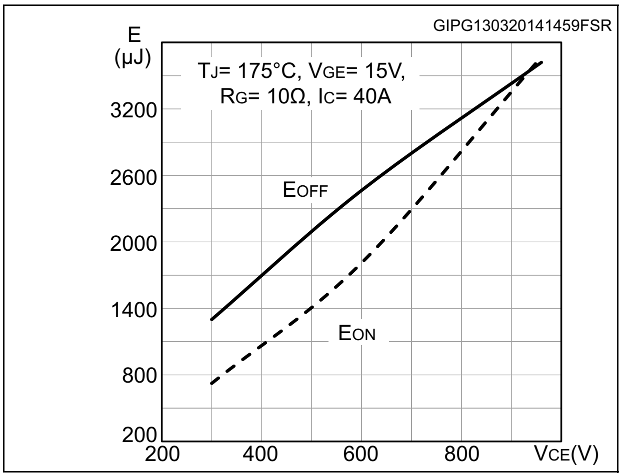


Figure 19. Switching times vs. collector current

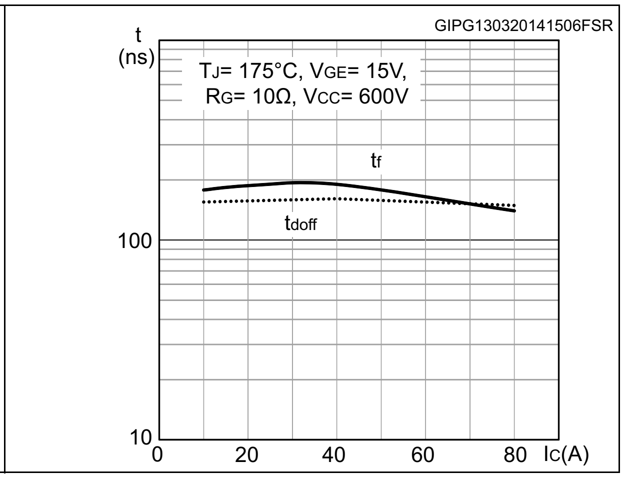


Figure 20. Switching times vs. gate resistance

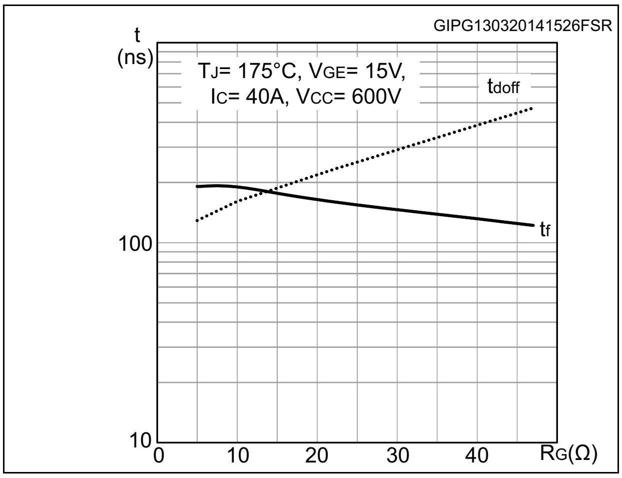
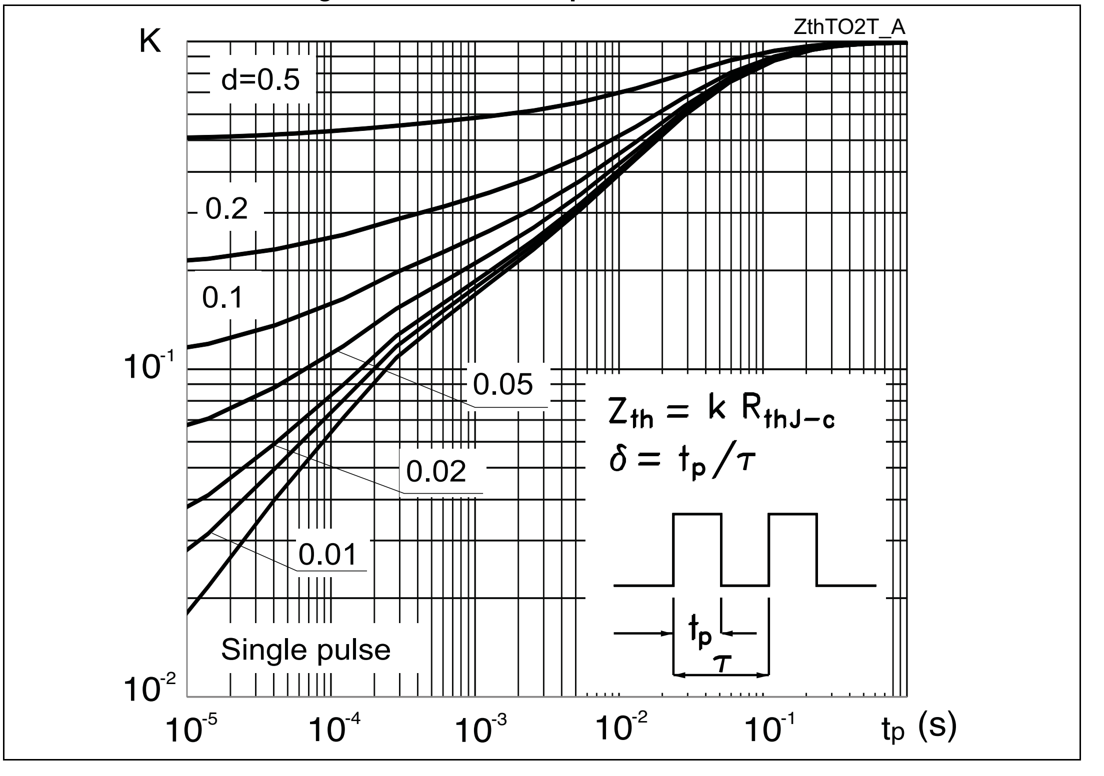


Figure 21. Thermal impedance for IGBT



3 Test circuits

Figure 22. Test circuit for inductive load switching

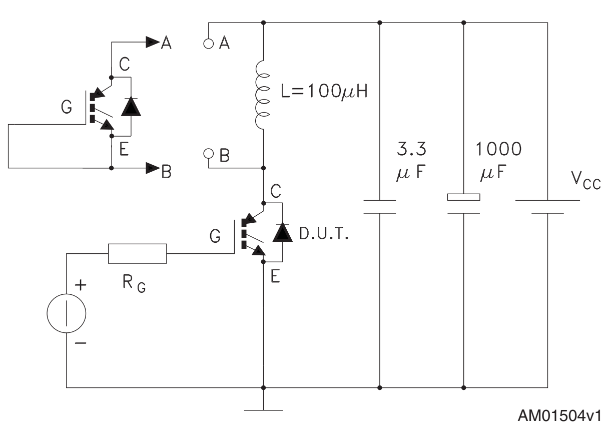


Figure 23. Gate charge test circuit

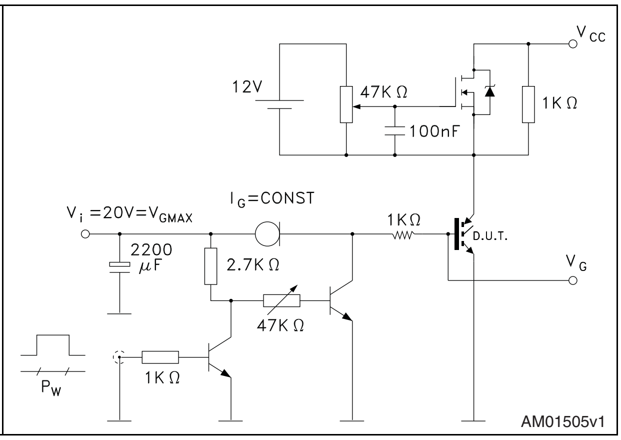
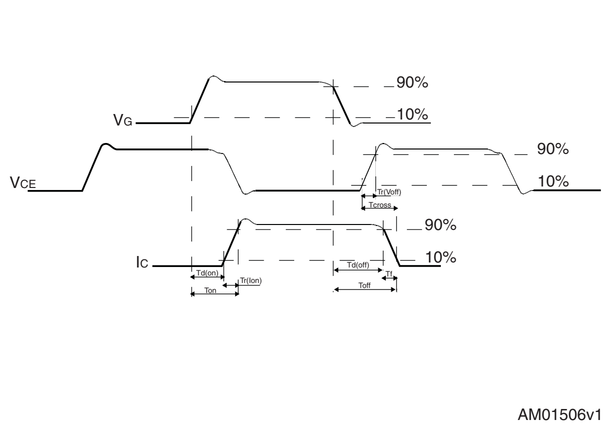


Figure 24. Switching waveform



4 Package mechanical data

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.

Figure 25. TO-247 drawing

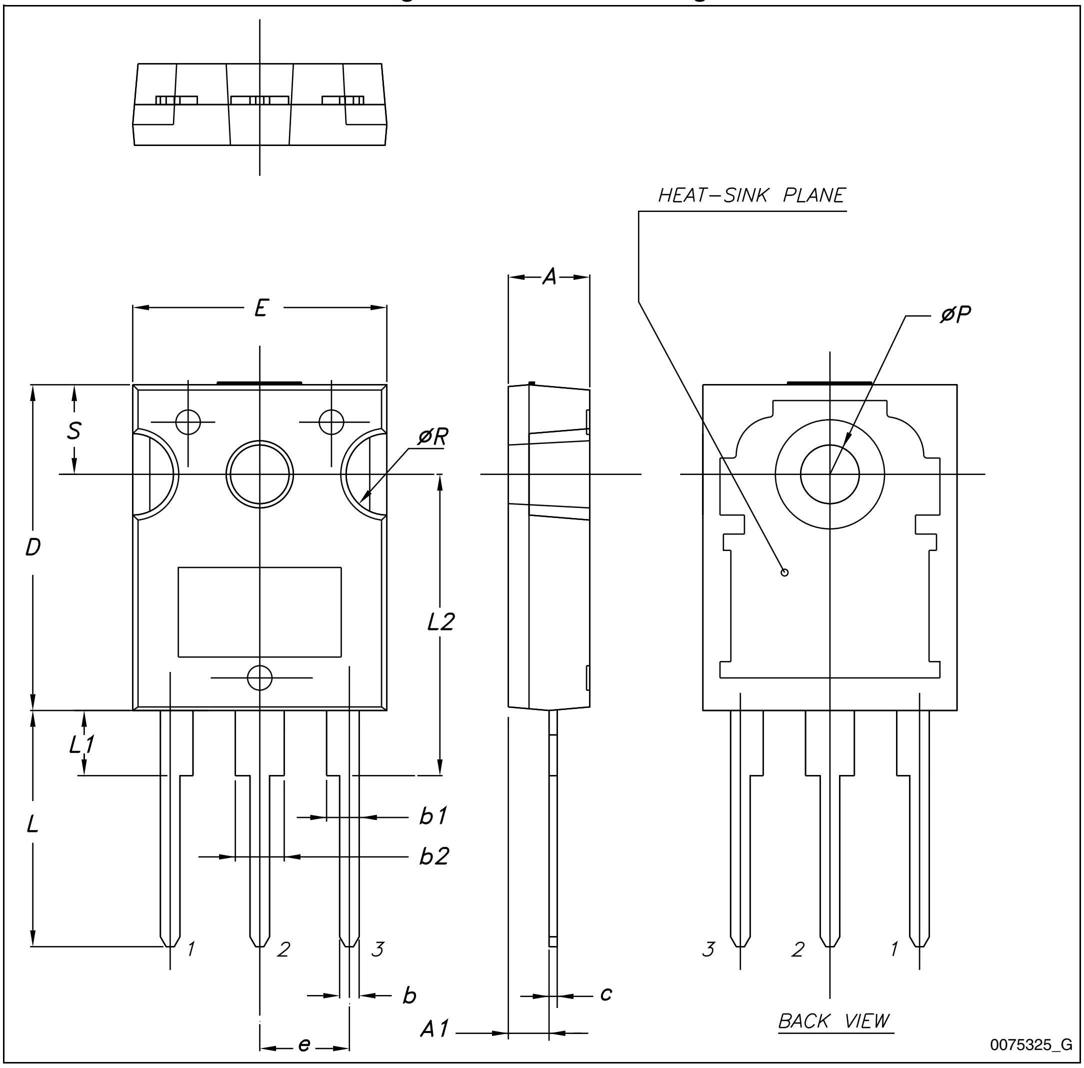


Table 7. TO-247 mechanical data

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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

5 Revision history

Table 8. Document revision history

Date	Revision	Changes
29-Jan-2014	1	Initial release.
14-Mar-2014	2	Updated *Table 4: Static characteristics* and *Table 5: Dynamic characteristics*. Added *Section 2.1: Electrical characteristics (curves)*. Updated title in cover page. Minor text changes.

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