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STGW15H120DF2, STGWA15H120DF2

Trench gate field-stop IGBT, H series 1200 V, 15 A high speed

Datasheet - production data

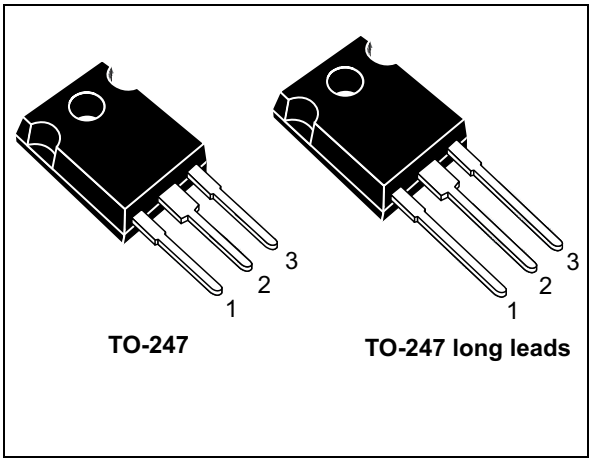
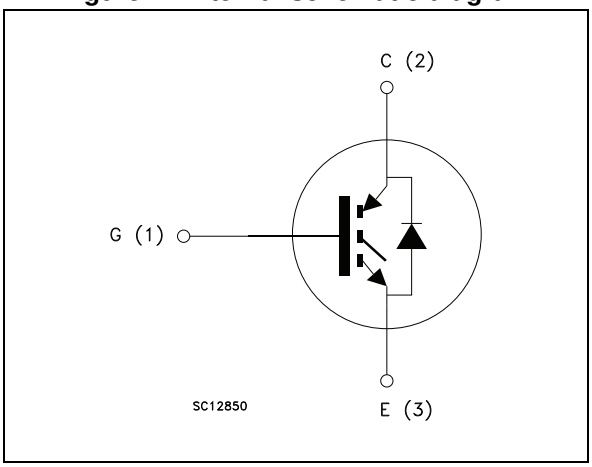


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- $V_{CE(sat)}$ = 2.1 V (typ.) @ I_C = 15 A
- 5 µs minimum short circuit withstand time at T_J=150 °C
- Safe paralleling
- Very fast recovery antiparallel diode
- 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 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 code	Marking	Package	Packaging
STGW15H120DF2	G15H120DF2	TO-247	Tube
STGWA15H120DF2	G15H120DF2	TO-247 long leads	Tube

Contents

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2 **Electrical characteristics** 4

2.1 Electrical characteristics (curves) 6

3 **Test circuits** 11

4 **Package mechanical data** 12

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4.2 TO-247 long leads, STGWA15H120DF2 15

5 **Revision history** 17

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	30	A
	Continuous collector current at T_C = 100 °C	15	A
I_{CP} (1)	Pulsed collector current	60	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous collector current at T_C = 25 °C	30	A
	Continuous collector current at T_C = 100 °C	15	A
I_{FP} (1)	Pulsed forward current	60	A
P_{TOT}	Total dissipation at T_C = 25 °C	259	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 IGBT	0.58	°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_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 = 15 A		2.1	2.6	V
		V_{GE} = 15 V, I_C = 15 A T_J = 125 °C		2.4		
		V_{GE} = 15 V, I_C = 15 A T_J = 175 °C		2.5		
V_F	Forward on-voltage	I_F = 15 A		3.5	4.4	V
		I_F = 15 A, T_J = 125 °C		2.6		
		I_F = 15 A, T_J = 175 °C		2.2		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 500 µA	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	-	1300	-	pF
C_{oes}	Output capacitance		-	105	-	pF
C_{res}	Reverse transfer capacitance		-	32	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 15 A, V_{GE} = 15 V, see *Figure 29*	-	67	-	nC
Q_{ge}	Gate-emitter charge		-	8	-	nC
Q_{gc}	Gate-collector charge		-	38	-	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 = 15 A, R_G = 10 Ω, V_{GE} = 15 V, see *Figure 28*	-	23	-	ns
t_r	Current rise time		-	7.4	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1621	-	A/µs
$t_{d(off)}$	Turn-off delay time			111	-	ns
t_f	Current fall time		-	111	-	ns
E_{on} (1)	Turn-on switching losses		-	0.38	-	mJ
E_{off} (2)	Turn-off switching losses		-	0.37	-	mJ
E_{ts}	Total switching losses		-	0.75	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 600 V, I_C = 15 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C, see *Figure 28*	-	23.5	-	ns
t_r	Current rise time		-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1525	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	118	-	ns
t_f	Current fall time		-	253	-	ns
E_{on} (1)	Turn-on switching losses		-	0.65	-	mJ
E_{off} (2)	Turn-off switching losses		-	0.93	-	mJ
E_{ts}	Total switching losses		-	1.58	-	mJ
t_{sc}	Short-circuit withstand time	V_{CE} = 600 V, V_{GE} = 15 V, T_J = 150 °C,	5		-	µs

1. Energy losses include reverse recovery of the external diode.
2. Turn-off losses include also 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 = 15 A, V_R = 600 V, di/dt=1000 A/µs, V_{GE} = 15 V, see *Figure 28*	-	231	-	ns
Q_{rr}	Reverse recovery charge		-	0.72	-	µC
I_{rrm}	Reverse recovery current		-	14.5	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	1200	-	A/µs
E_{rr}	Reverse recovery energy		-	0.4	-	mJ
t_{rr}	Reverse recovery time	I_F = 15 A, V_R = 600 V, di/dt=1000 A/µs, V_{GE} = 15 V, T_J = 175 °C, see *Figure 28*	-	414	-	ns
Q_{rr}	Reverse recovery charge		-	2.2	-	µC
I_{rrm}	Reverse recovery current		-	21.5	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	632	-	A/µs
E_{rr}	Reverse recovery energy		-	1.3	-	mJ

2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

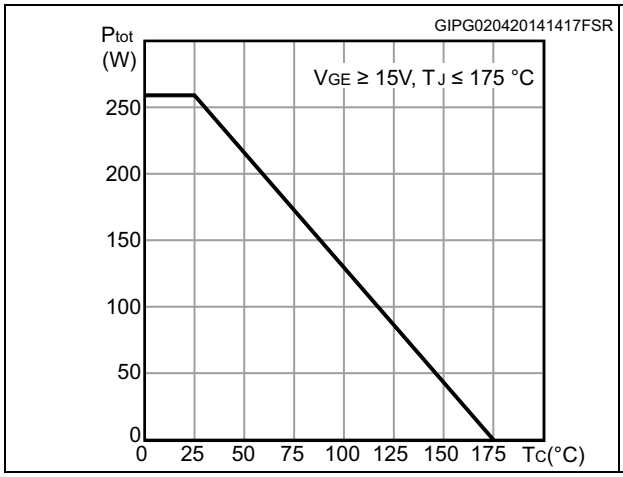


Figure 3. Collector current vs. case temperature

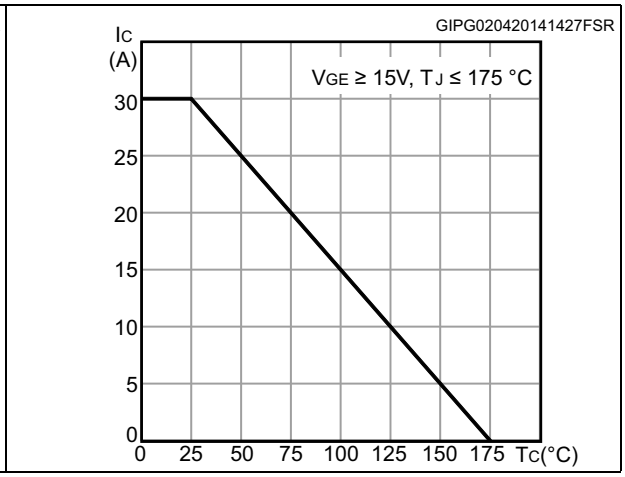


Figure 4. Output characteristics (T_J = 25°C)

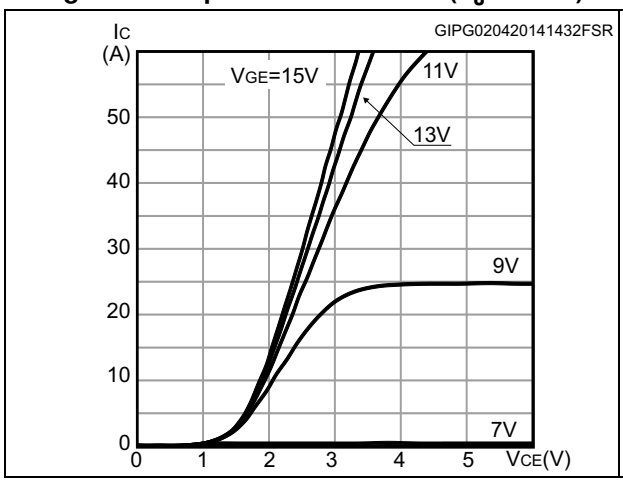


Figure 5. Output characteristics (T_J = 175°C)

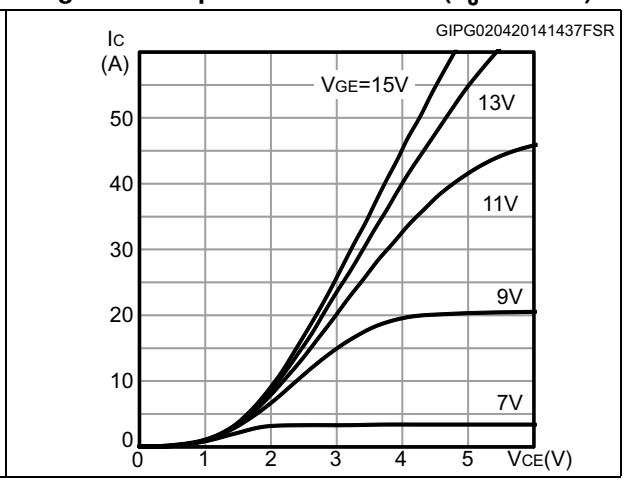


Figure 6. $V_{CE(sat)}$ vs. junction temperature

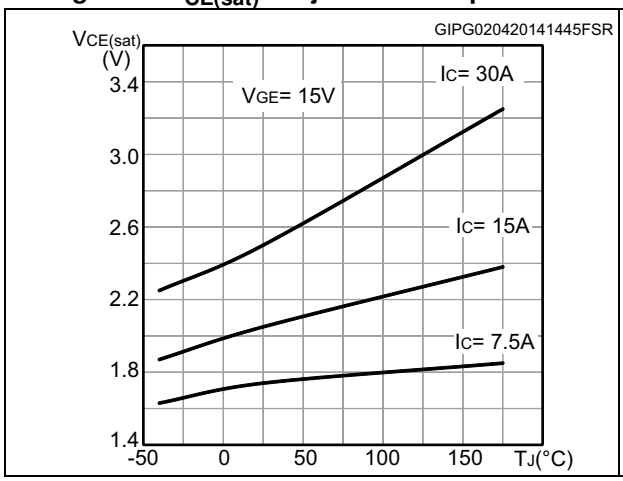


Figure 7. $V_{CE(sat)}$ vs. collector current

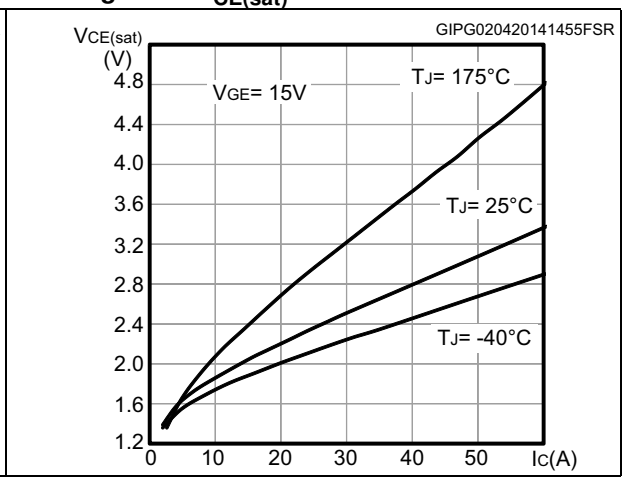


Figure 8. Collector current vs. switching frequency

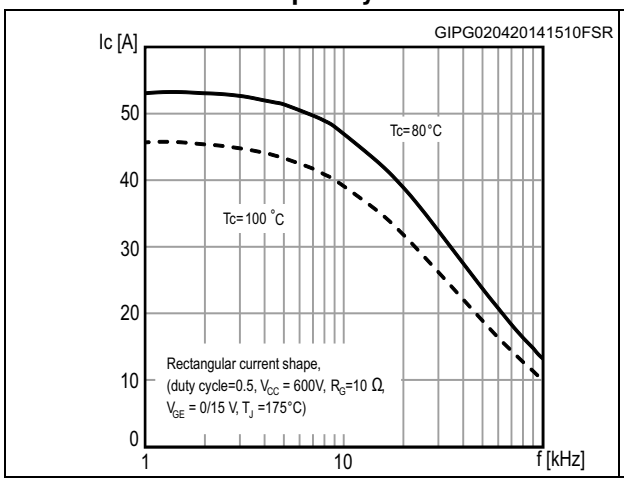


Figure 9. Forward bias safe operating area

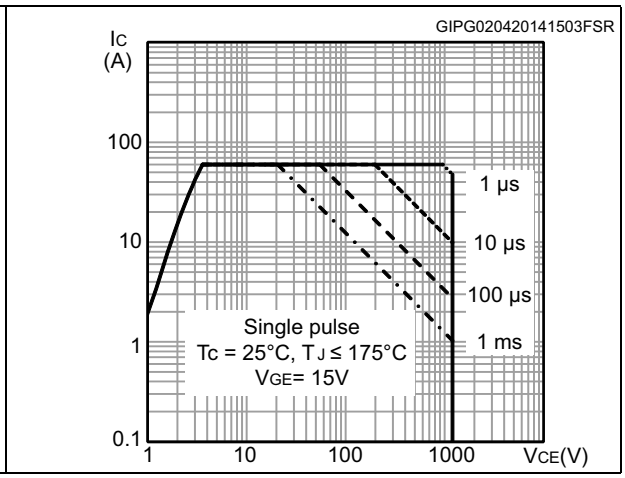


Figure 10. Transfer characteristics

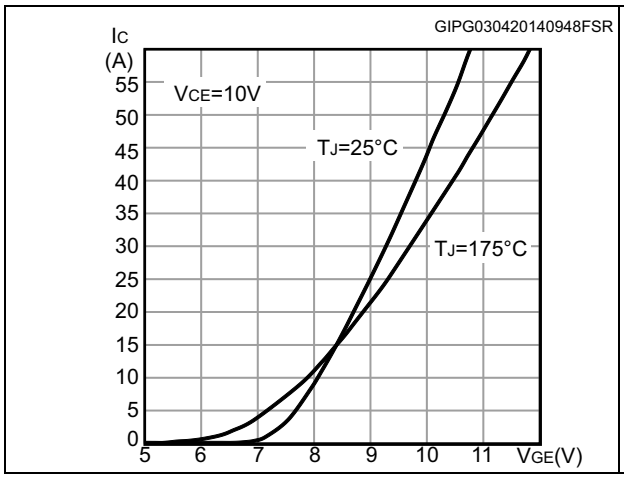


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

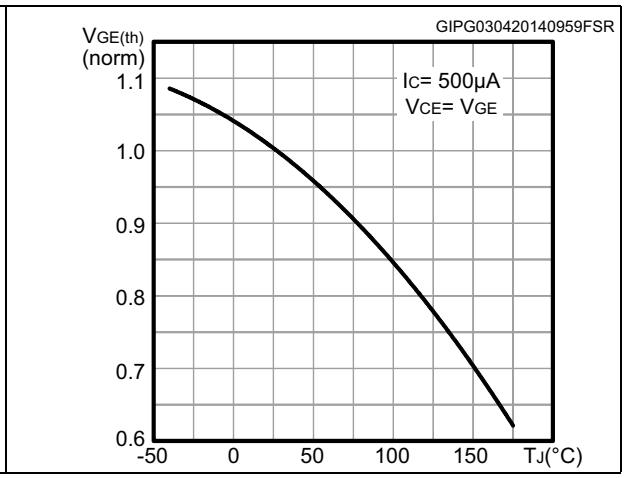


Figure 12. Normalized $V_{(BR)CES}$ vs. junction temperature

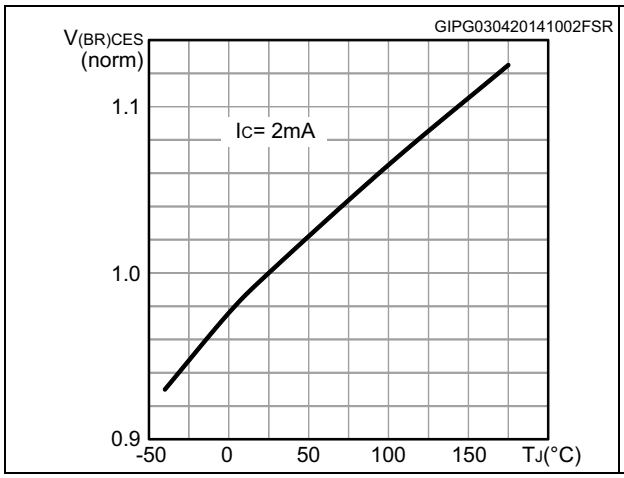


Figure 13. Capacitance variation

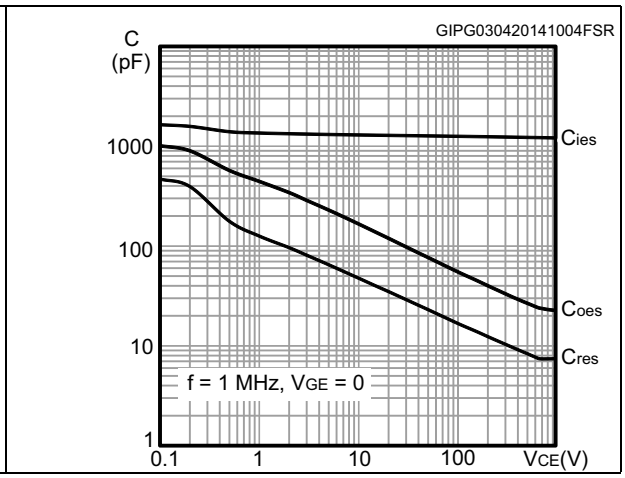


Figure 14. Gate charge vs. gate-emitter voltage

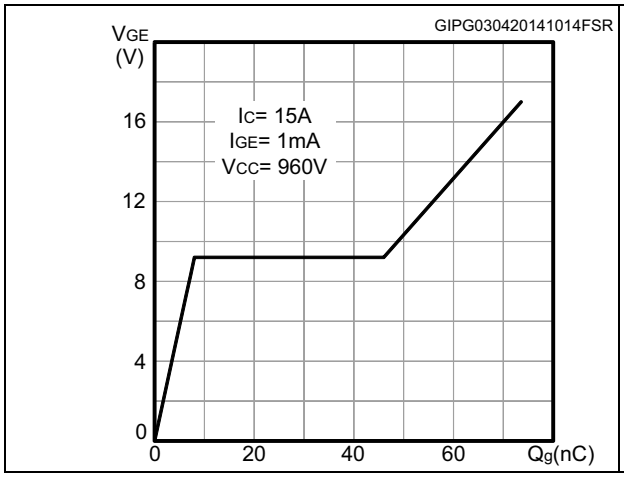


Figure 15. Switching loss vs collector current

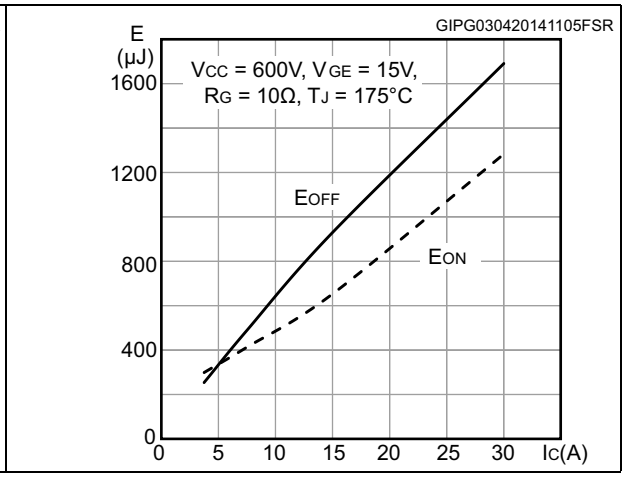


Figure 16. Switching loss vs gate resistance

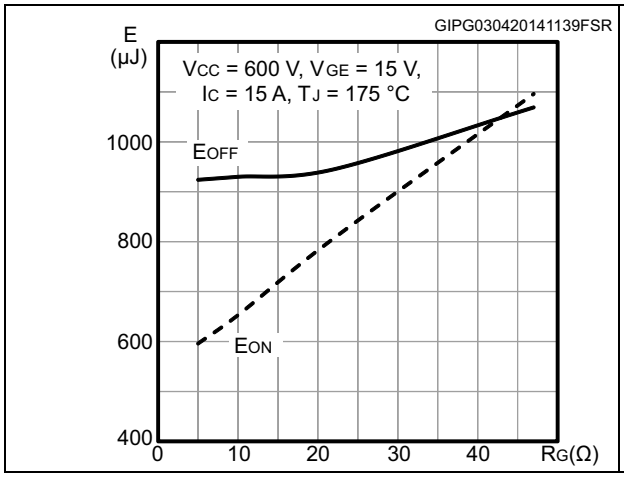


Figure 17. Switching loss vs temperature

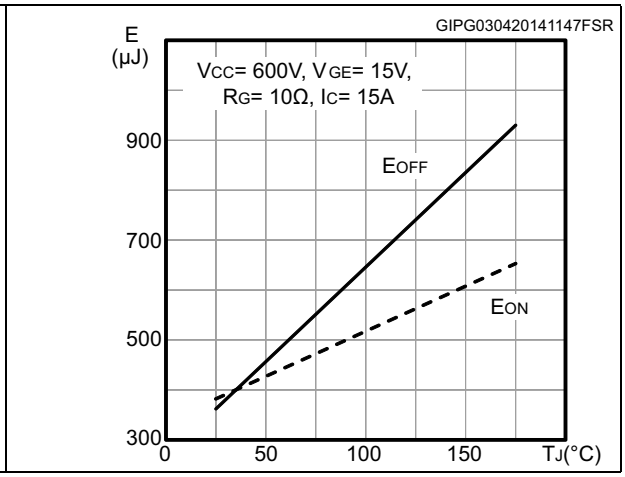


Figure 18. Switching loss vs collector-emitter voltage

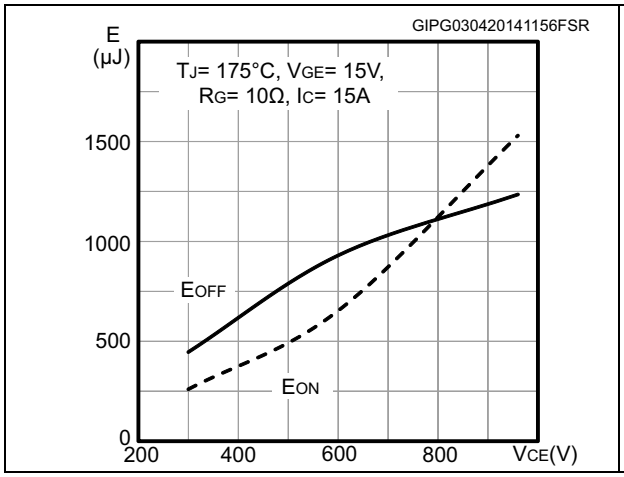


Figure 19. Switching times vs. gate resistance

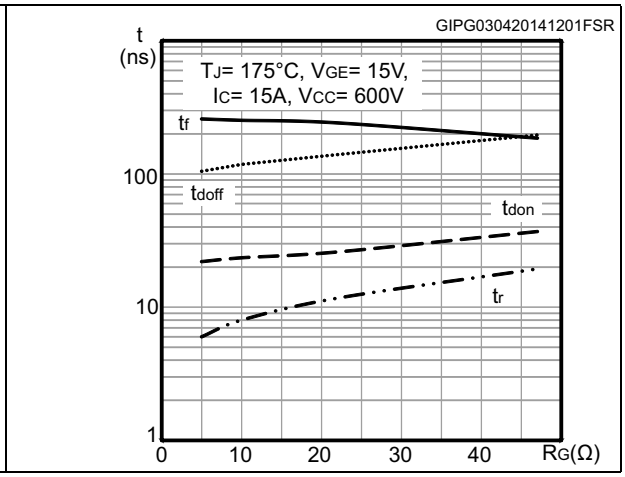


Figure 20. Switching times vs. collector current

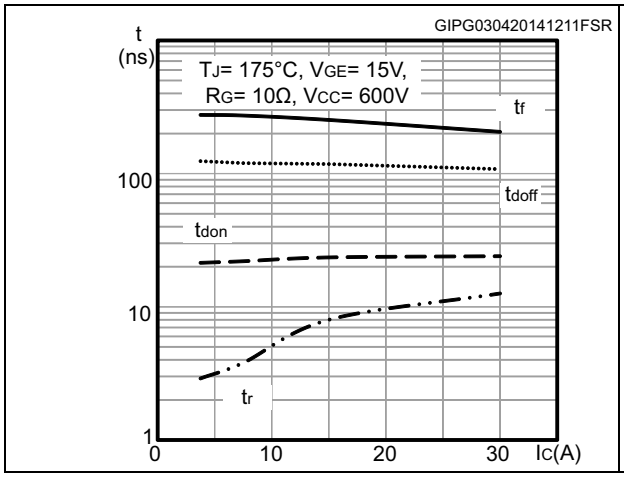


Figure 21. Diode V_F vs. forward current

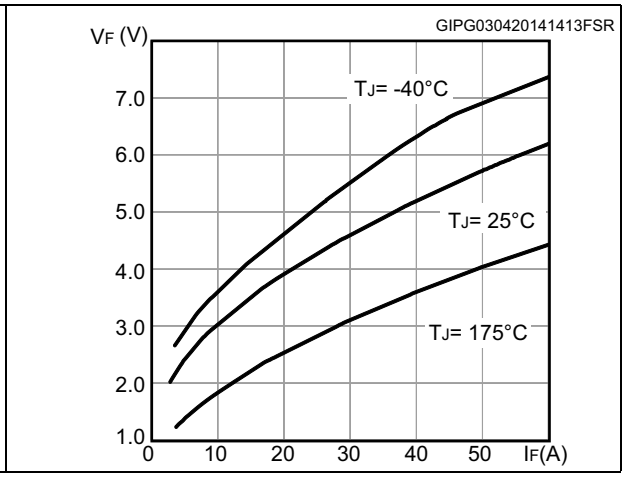


Figure 22. Reverse recovery current vs. diode current slope

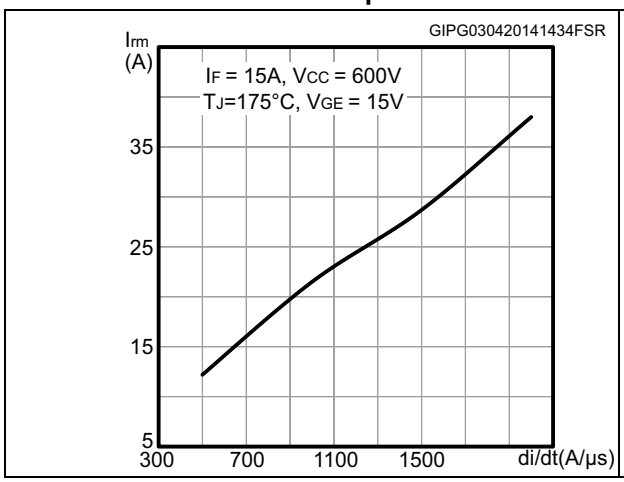


Figure 23. Reverse recovery time vs. diode current slope

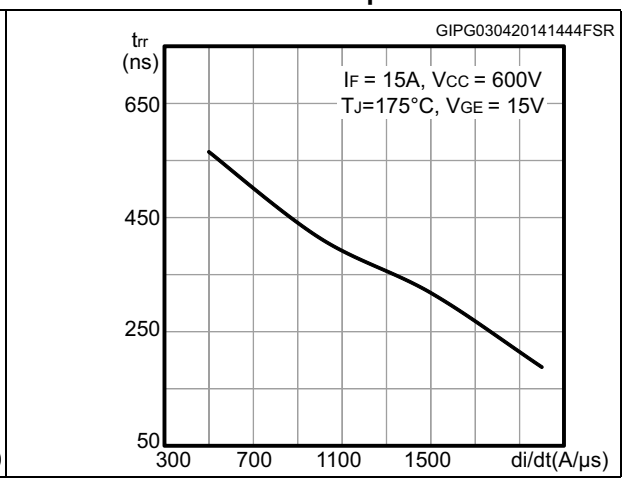


Figure 24. Reverse recovery charge vs. diode current slope

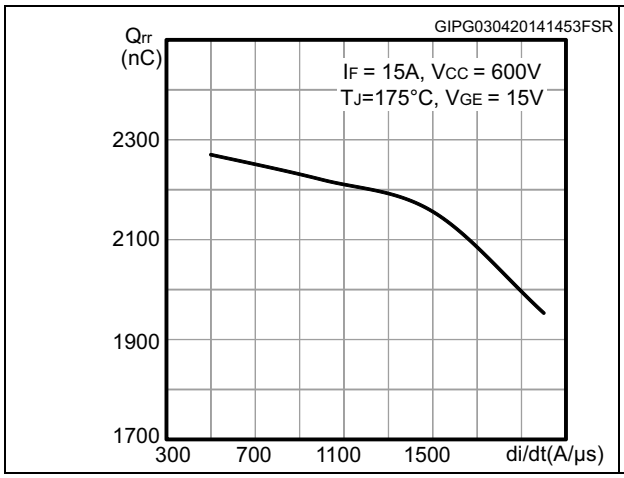


Figure 25. Reverse recovery energy vs. diode current slope

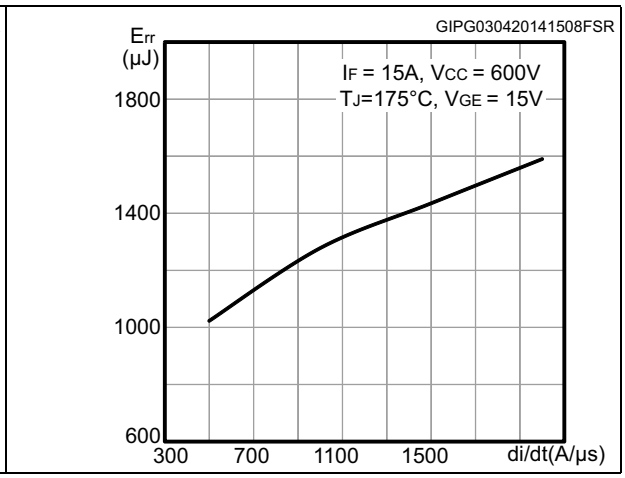


Figure 26. Thermal impedance for IGBT

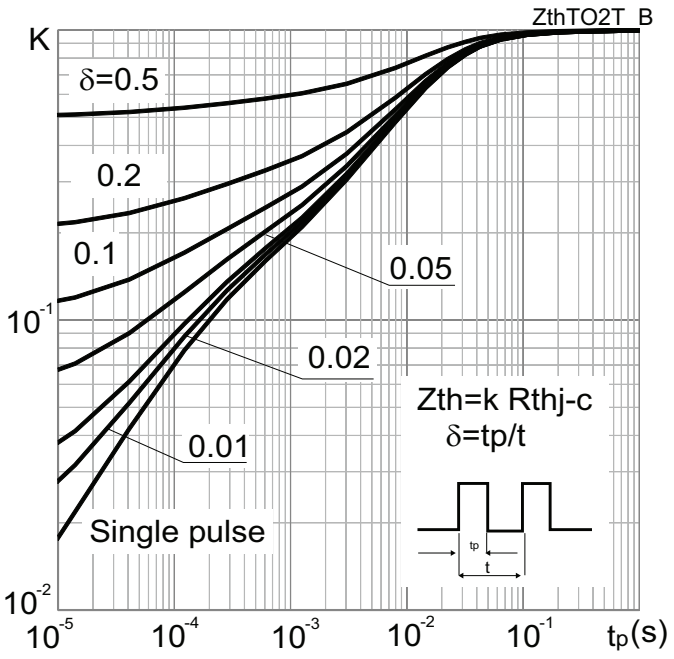
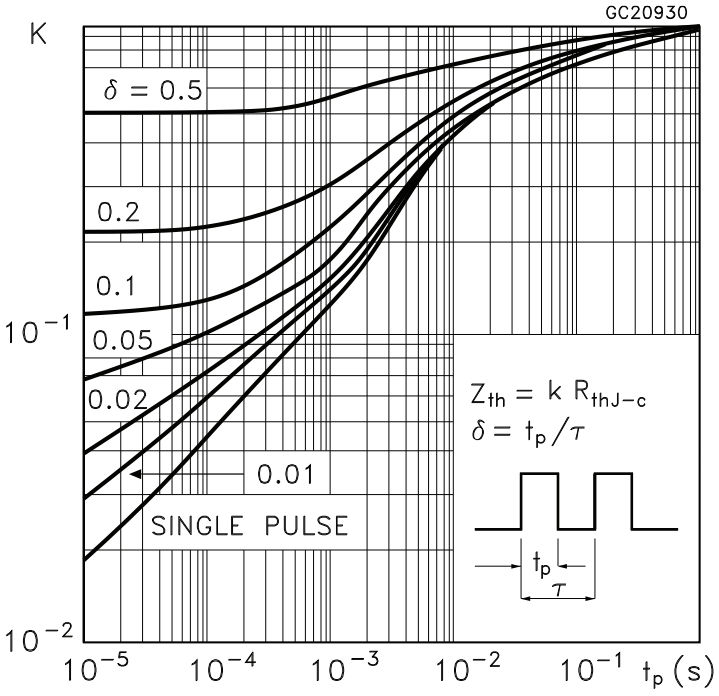


Figure 27. Thermal impedance for diode



3 Test circuits

Figure 28. Test circuit for inductive load switching

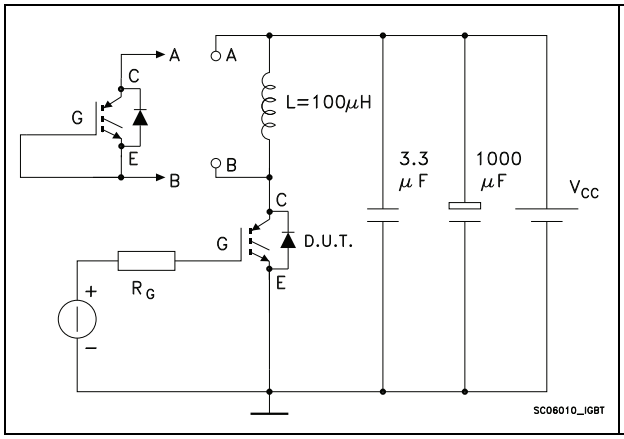


Figure 29. Gate charge test circuit

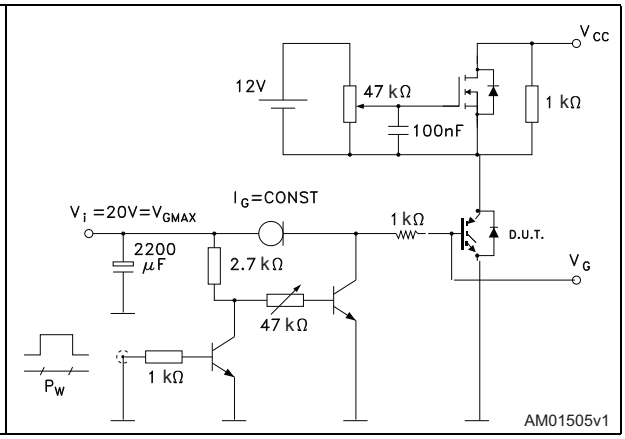


Figure 30. Switching waveform

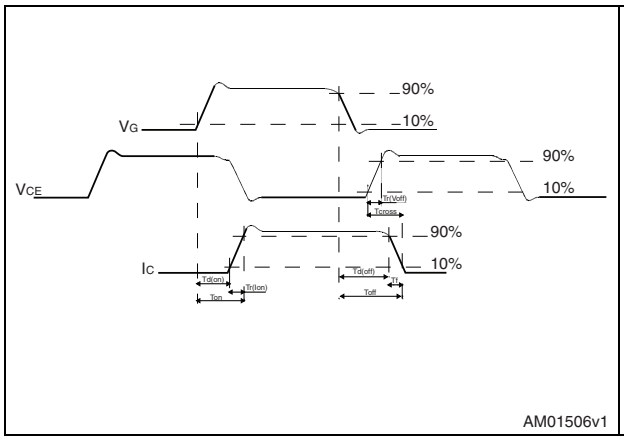
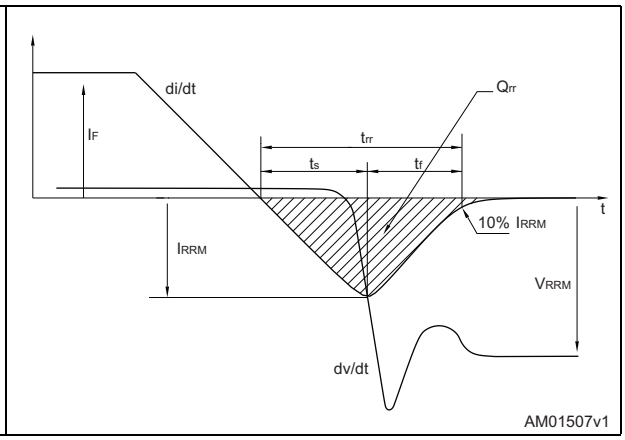


Figure 31. Diode reverse recovery waveform



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.

4.1 TO-247, STGW15H120DF2

Figure 32. TO-247 drawing

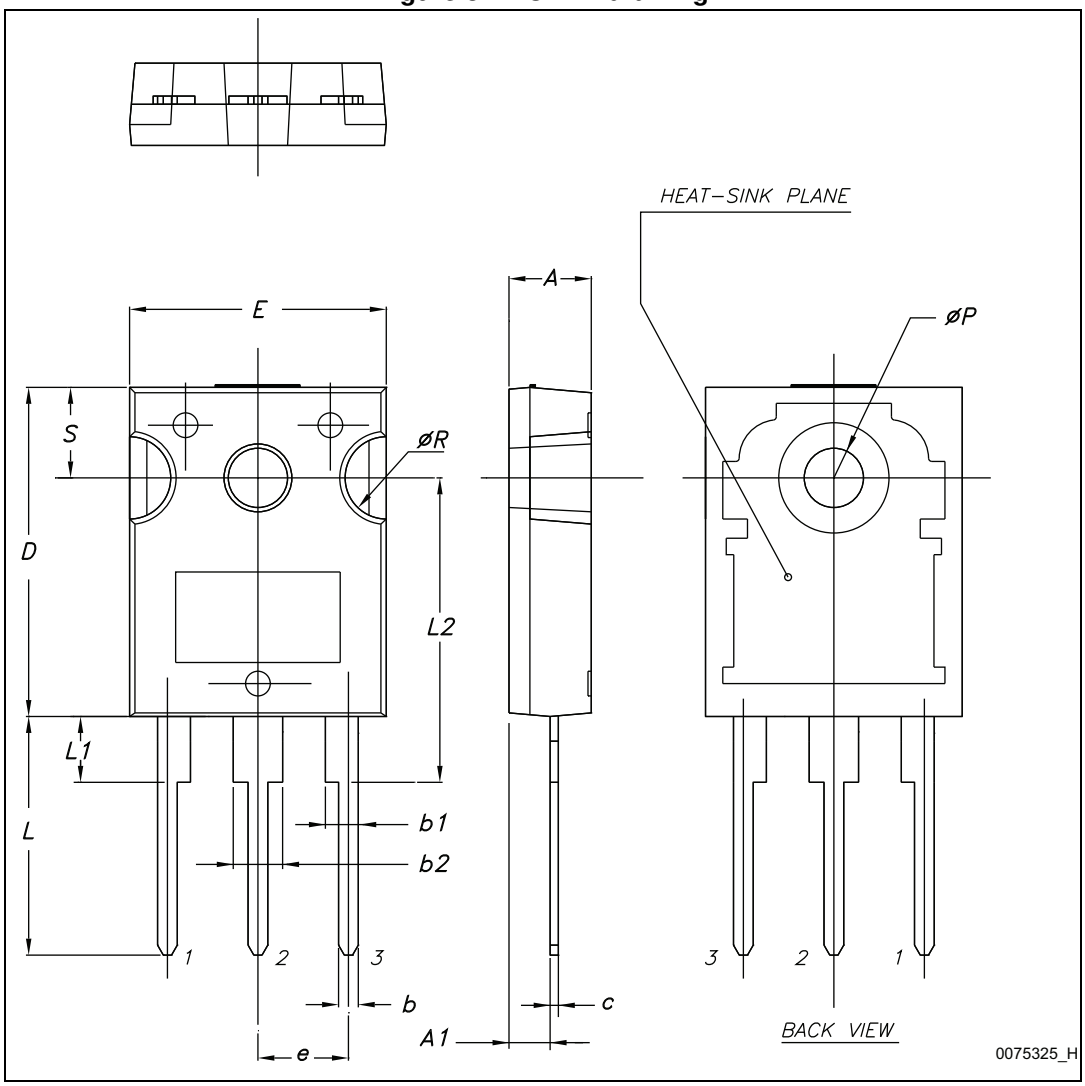


Table 8. TO-247 mechanical data

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

4.2 TO-247 long leads, STGWA15H120DF2

Figure 33. TO-247 long leads drawing

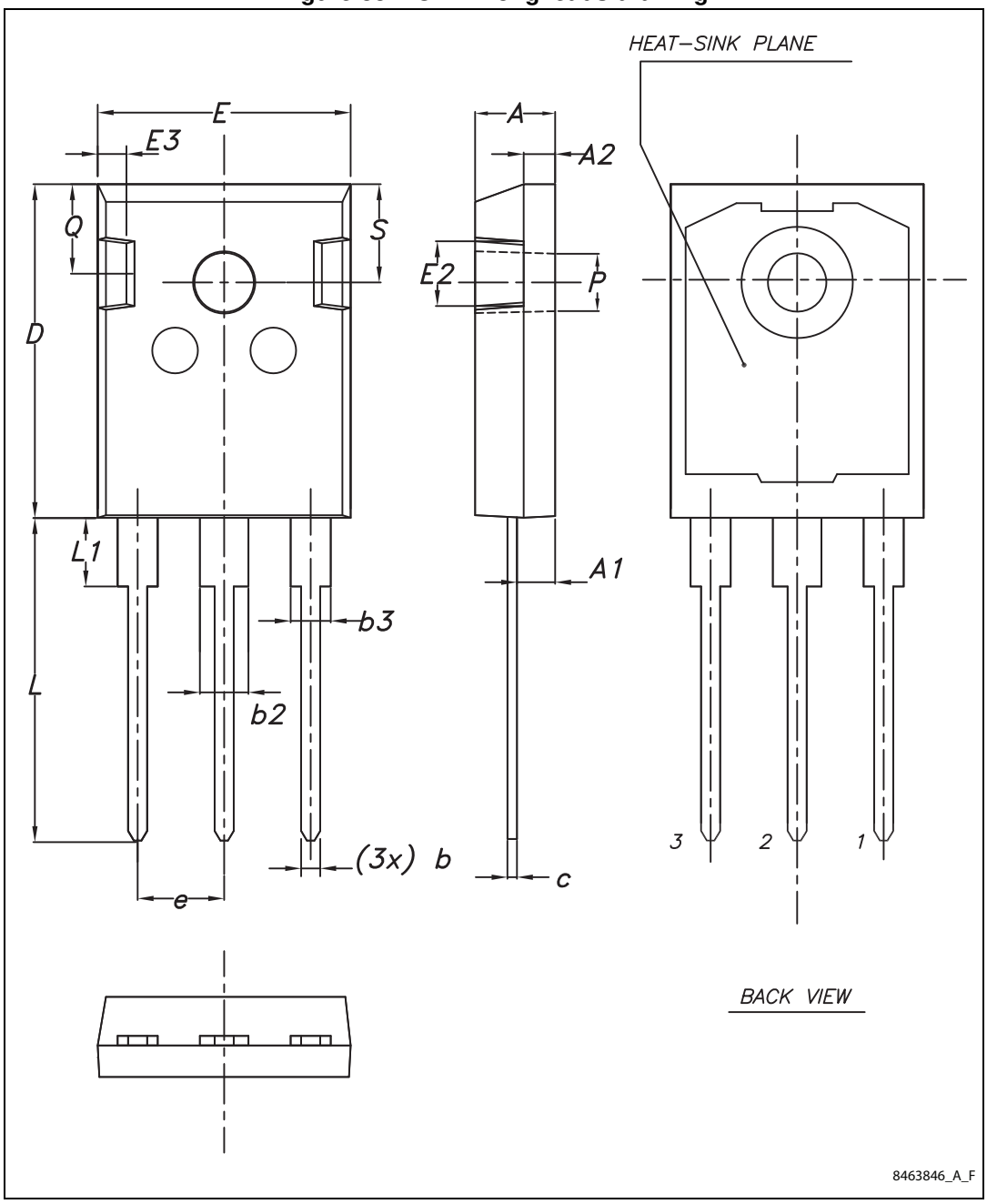


Table 9. TO-247 long leads mechanical data

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 10. Document revision history

Date	Revision	Changes
03-Oct-2012	1	Initial release.
03-Mar-2014	2	Updated title and features in cover page. Updated *Section 4: Package mechanical data*. Minor text changes.
08-Apr-2014	3	Added *Section 2.1: Electrical characteristics (curves)*. Minor text changes.
29-Jan-2015	4	Added *4.2: TO-247 long leads, STGWA15H120DF2*. Updated *Figure 29.: Gate charge test circuit*. Updated *Figure 30.: Switching waveform* and *Figure 31.: Diode reverse recovery waveform*. Minor text changes.
04-Mar-2015	5	Updated *Figure 5.: Output characteristics (T_J = 175°C)* Minor text changes.