STGW15S120DF3, STGWA15S120DF3

Trench gate field-stop IGBT, S series
1200 V, 15 A low drop

Datasheet - production data

TO-247
TO-247 long leads

Figure 1. Internal schematic diagram

C (2 or TAB)

G (1)

E (3)

SC12850
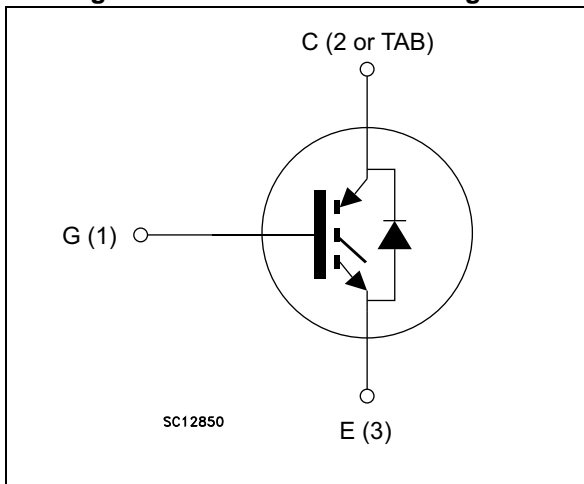
Features

- 10 µs of short-circuit withstand time
- $V_{CE(sat)}$ = 1.55 V (typ.) @ I_C = 15 A
- Tight parameter distribution
- Safer paralleling
- Low thermal resistance
- Soft and fast recovery antiparallel diode

Applications

- Industrial drives
- UPS
- Solar
- Welding

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the S series of 1200 V IGBTs which is tailored to maximize efficiency of low frequency industrial systems. Furthermore, a positive $V_{CE(sat)}$ temperature coefficient and tight parameter distribution result in safer paralleling operation.

Table 1. Device summary

Order code	Marking	Package	Packing
STGW15S120DF3	G15S120DF3	TO-247	Tube
STGWA15S120DF3	G15S120DF3	TO-247 long leads	Tube

This is information on a product in full production.

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	30	A
I_C	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 forward current at T_C = 25 °C	30	A
I_F	Continuous forward 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	1.3	°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		1.55	2.05	V
		V_{GE} = 15 V, I_C = 15 A, T_J = 125 °C		1.75		
		V_{GE} = 15 V, I_C = 15 A T_J = 175 °C		1.85		
V_F	Forward on-voltage	I_F = 15 A		2.7	3.8	V
		I_F = 15 A T_J = 125 °C		2.05		V
		I_F = 15 A T_J = 175 °C		1.75		V
$V_{GE(th)}$	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	-	981	-	pF
C_{oes}	Output capacitance		-	82	-	pF
C_{res}	Reverse transfer capacitance		-	37	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C =15 A, V_{GE} = 15 V, see *Figure 30*	-	53	-	nC
Q_{ge}	Gate-emitter charge		-	7.8	-	nC
Q_{gc}	Gate-collector charge		-	28.2	-	nC

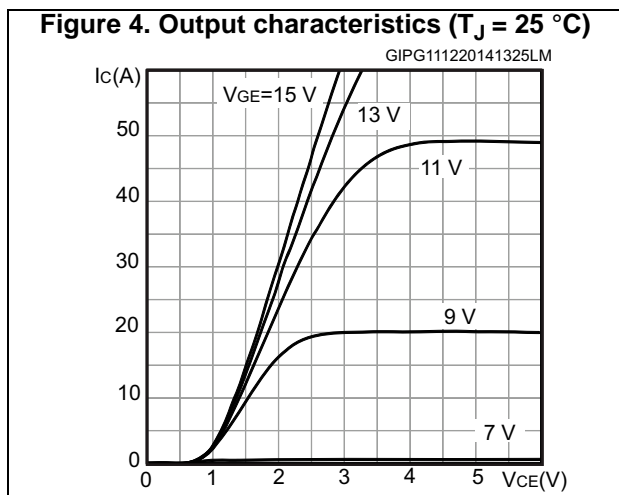**Table 6. IGBT switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 600 V, I_C = 15 A, V_{GE} = 15 V, R_G= 22 Ω *see Figure 29*	-	23	-	ns
t_r	Current rise time		-	10	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1200	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	140	-	ns
t_f	Current fall time		-	282	-	ns
E_{on}[1]	Turn-on switching losses		-	0.54	-	mJ
E_{off}[2]	Turn-off switching losses		-	1.375	-	mJ
E_{ts}	Total switching losses		-	1.912	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 600 V, I_C = 15 A, R_G= 22 Ω, V_{GE} = 15 V, T_J = 175 °C, see *Figure 29*	-	22	-	ns
t_r	Current rise time		-	9.2	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	983	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	146	-	ns
t_f	Current fall time		-	438	-	ns
E_{on}[1]	Turn-on switching losses		-	0.923	-	mJ
E_{off}[2]	Turn-off switching losses		-	1.85	-	mJ
E_{ts}	Total switching losses		-	2.772	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 600 V, V_{GE}= 15 V, T_{Jstart} ≤ 150 °C, V_P < 1200 V	10		-	µs

1. Energy losses include reverse recovery of the diode.

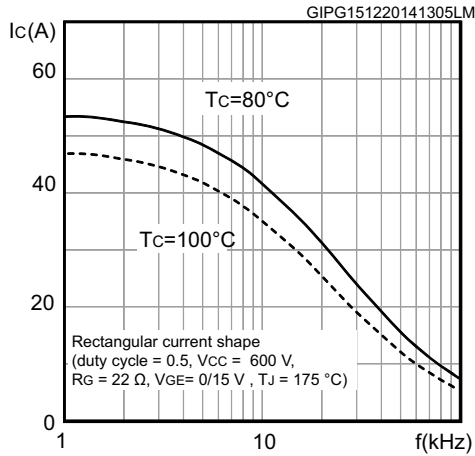2. Turn-off losses also include the tail of the collector current.

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, V_{GE} = 15 V, see *Figure 29* di/dt = 1000 A/µs	-	270	-	ns
Q_{rr}	Reverse recovery charge		-	960	-	nC
I_{rrm}	Reverse recovery current		-	15	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	935	-	A/µs
E_{rr}	Reverse recovery energy		-	0.18	-	mJ
t_{rr}	Reverse recovery time	I_F = 15 A, V_R = 600 V, V_{GE} = 15 V, T_J = 175 °C, see *Figure 29* di/dt = 1000 A/µs	-	534	-	ns
Q_{rr}	Reverse recovery charge		-	3456	-	nC
I_{rrm}	Reverse recovery current		-	23	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	266	-	A/µs
E_{rr}	Reverse recovery energy		-	0.55	-	mJ

3 Electrical characteristics curves

Figure 2. Power dissipation vs. case temperature

$V_{GE} \geq 15$ V, $T_J \leq 175$ °C

Figure 3. Collector current vs. case temperature

$V_{GE} \geq 15$ V, $T_J \leq 175$ °C

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

$V_{GE} = 15$ V, 13 V, 11 V, 9 V, 7 V

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

$V_{GE} = 15$ V, 13 V, 11 V, 9 V, 7 V

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

$V_{GE} = 15$ V, $I_C = 30$ A, $I_C = 15$ A, $I_C = 7.5$ A

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

$V_{GE} = 15$ V, $T_J = 175$°C, $T_J = 25$°C, $T_J = 40$°C

Figure 8. Collector current vs. switching frequency

Figure 9. Forward bias safe operating area
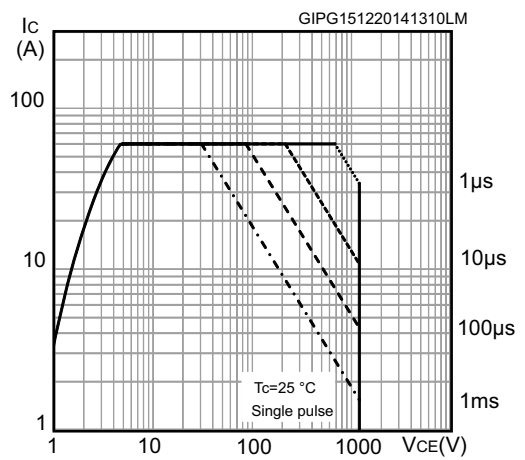
Figure 10. Transfer characteristics
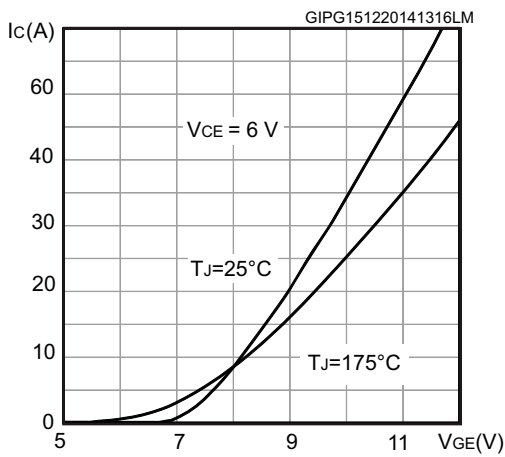
Figure 11. Diode V_F vs. forward current
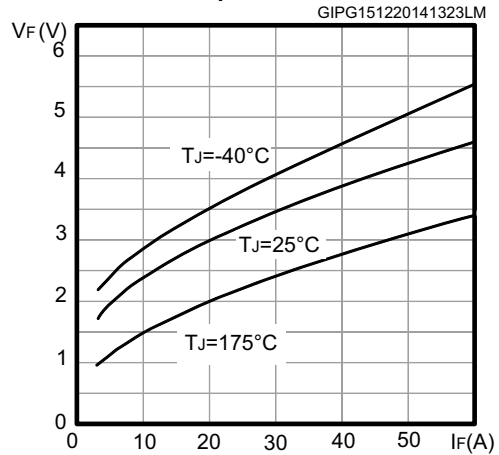
Figure 12. Normalized $V_{GE(th)}$ vs. junction temperature
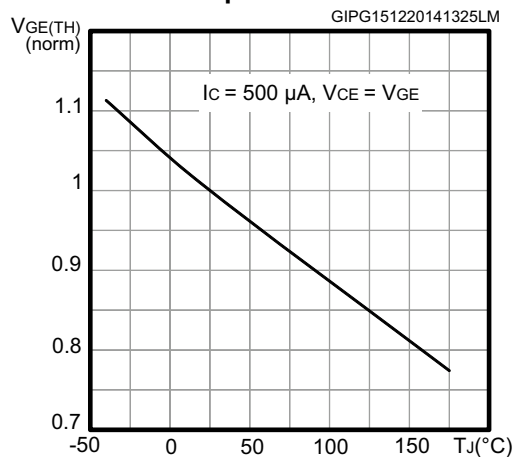
Figure 13. Normalized $V_{BR(CES)}$ vs. junction temperature
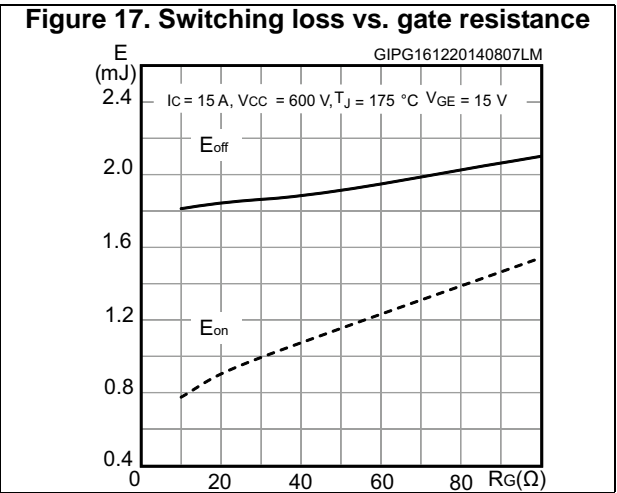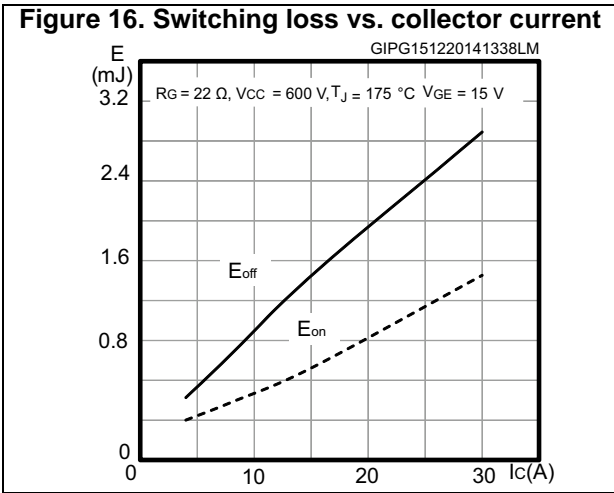
Figure 14. Capacitance variations

Figure 15. Gate charge vs. gate-emitter voltage

Figure 16. Switching loss vs. collector current

Figure 17. Switching loss vs. gate resistance

Figure 18. Switching loss vs. temperature

Figure 19. Switching loss vs. collector emitter voltage
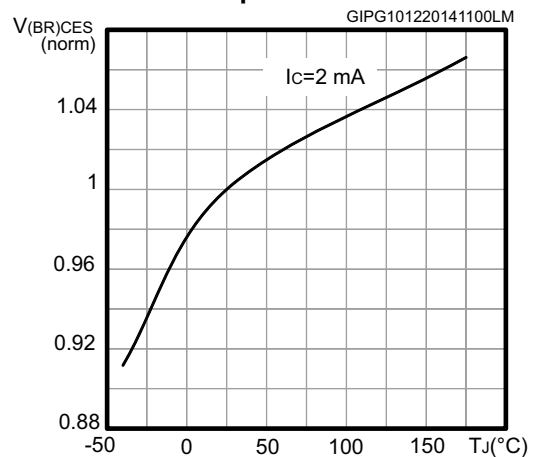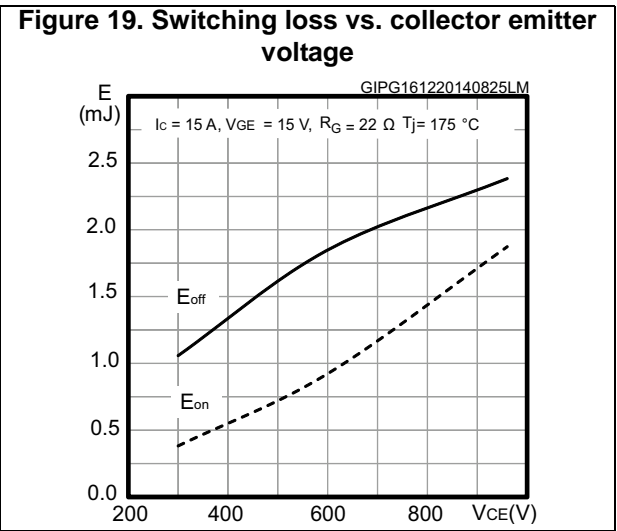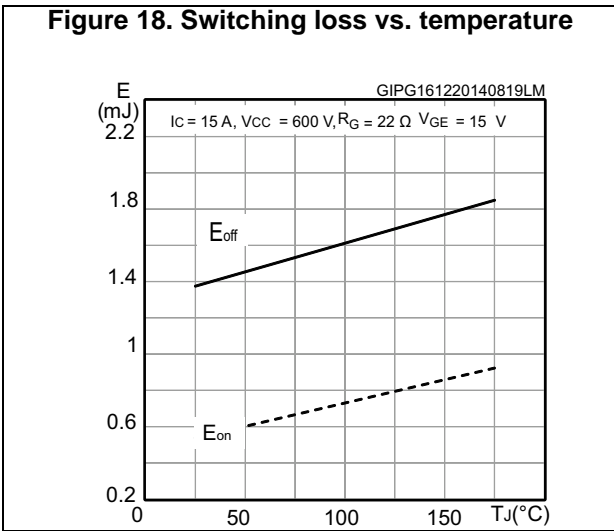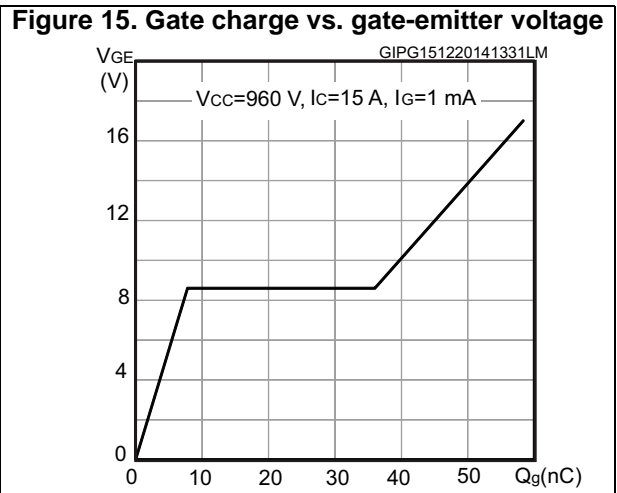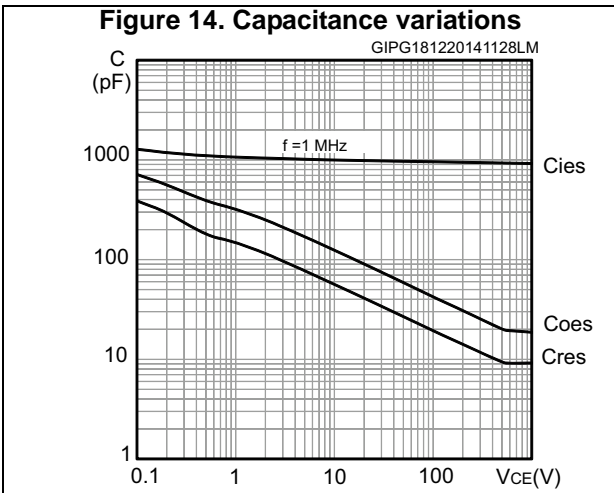
Figure 20. Short-circuit time and current vs V_GE
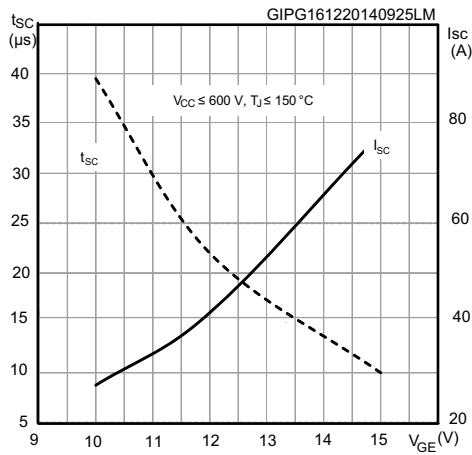
Figure 21. Switching times vs. collector current
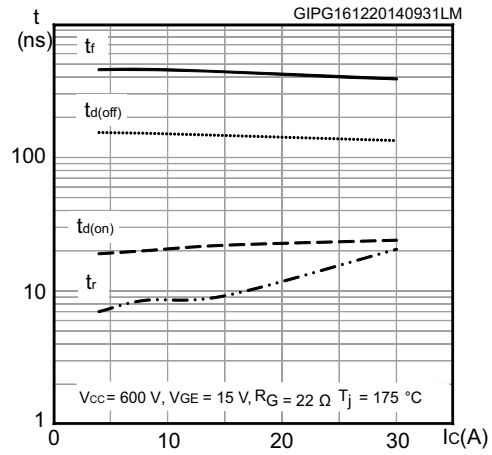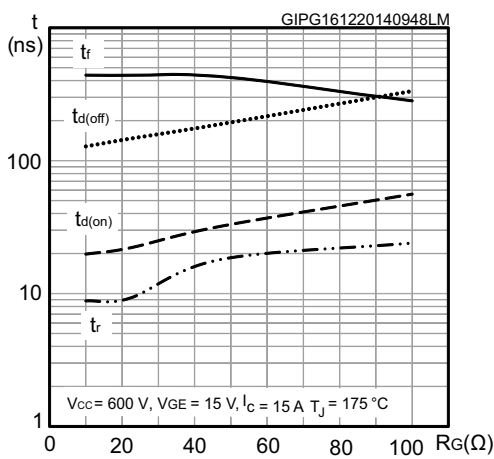

Figure 22. Switching times vs. gate resistance

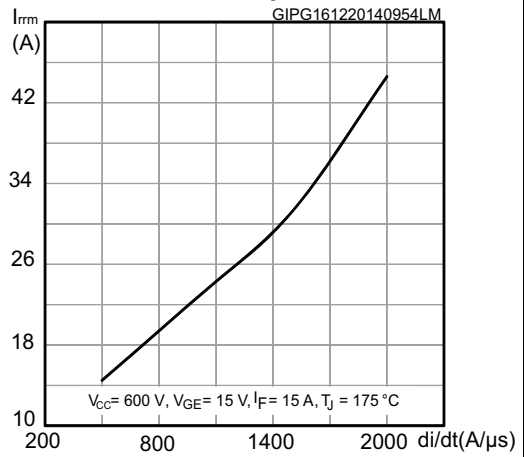**Figure 23. Reverse recovery current vs. diode current slope**

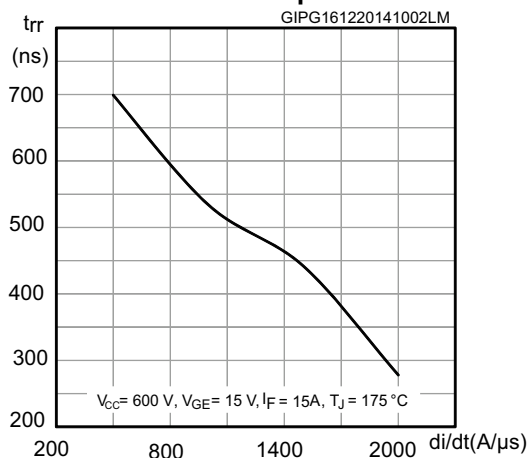**Figure 24. Reverse recovery time vs. diode current slope**

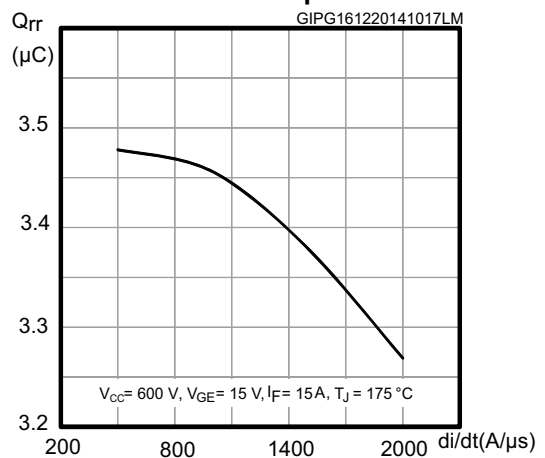**Figure 25. Reverse recovery charge vs. diode current slope**
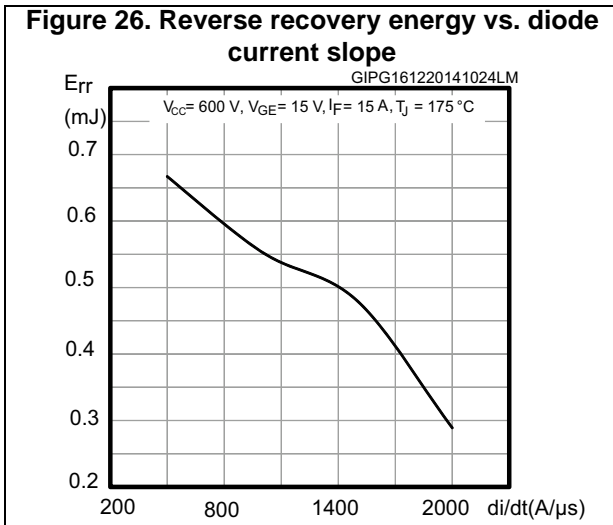
Figure 26. Reverse recovery energy vs. diode current slope

Figure 27. Thermal impedance for IGBT
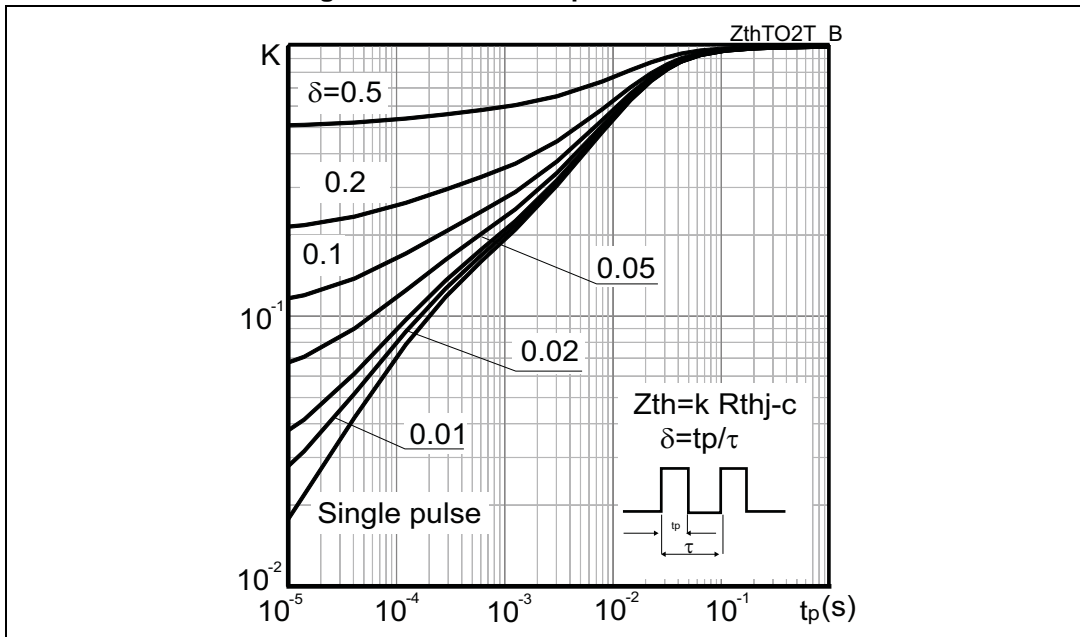
Figure 28. Thermal impedance for diode
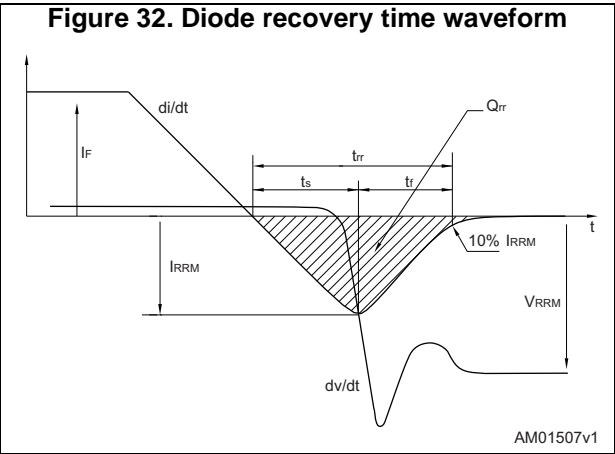
4   Test circuits

Figure 29. Test circuit for inductive load switching

AM01504v1

Figure 30. Gate charge test circuit

AM01505v1

Figure 31. Switching waveform

AM01506v1

Figure 32. Diode recovery time waveform

AM01507v1
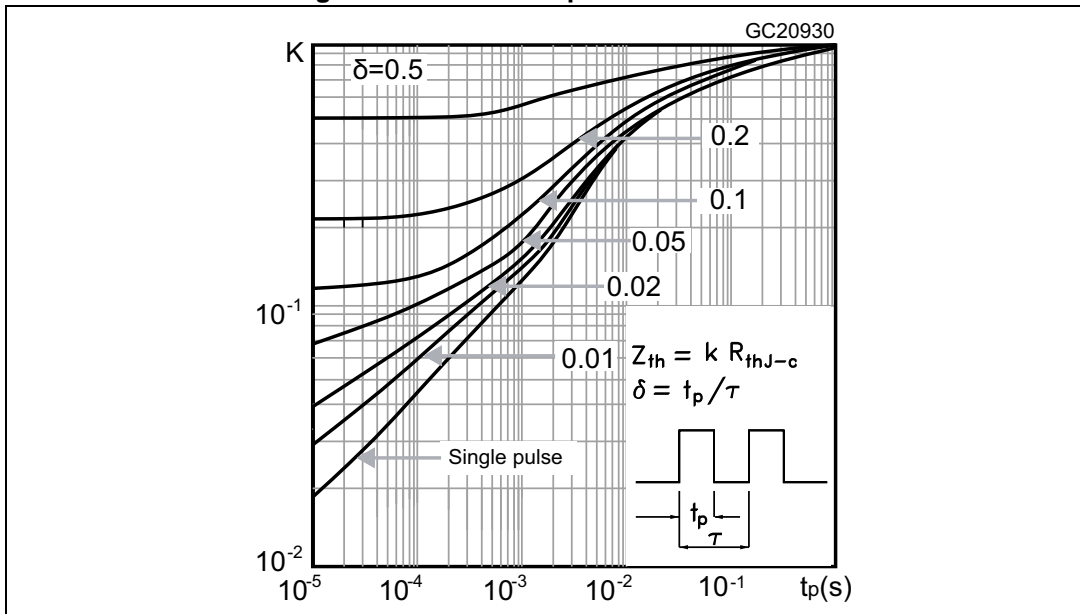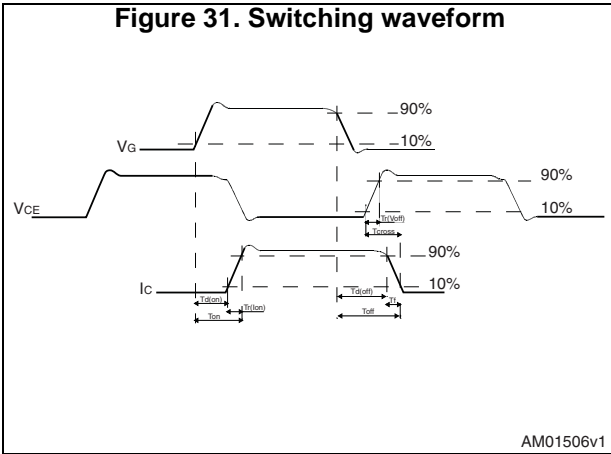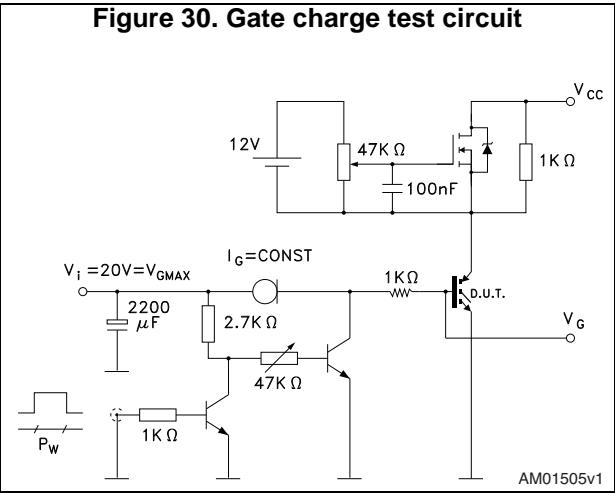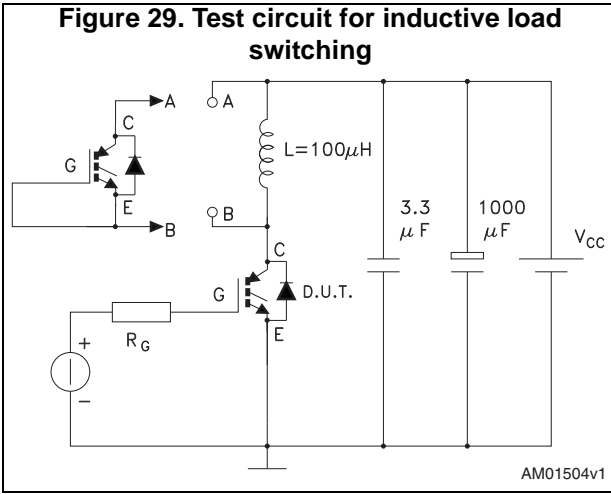
5 Package information

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. ECOPACK is an ST trademark.

5.1 TO-247, STGW15S120DF3

Figure 33. TO-247 outline

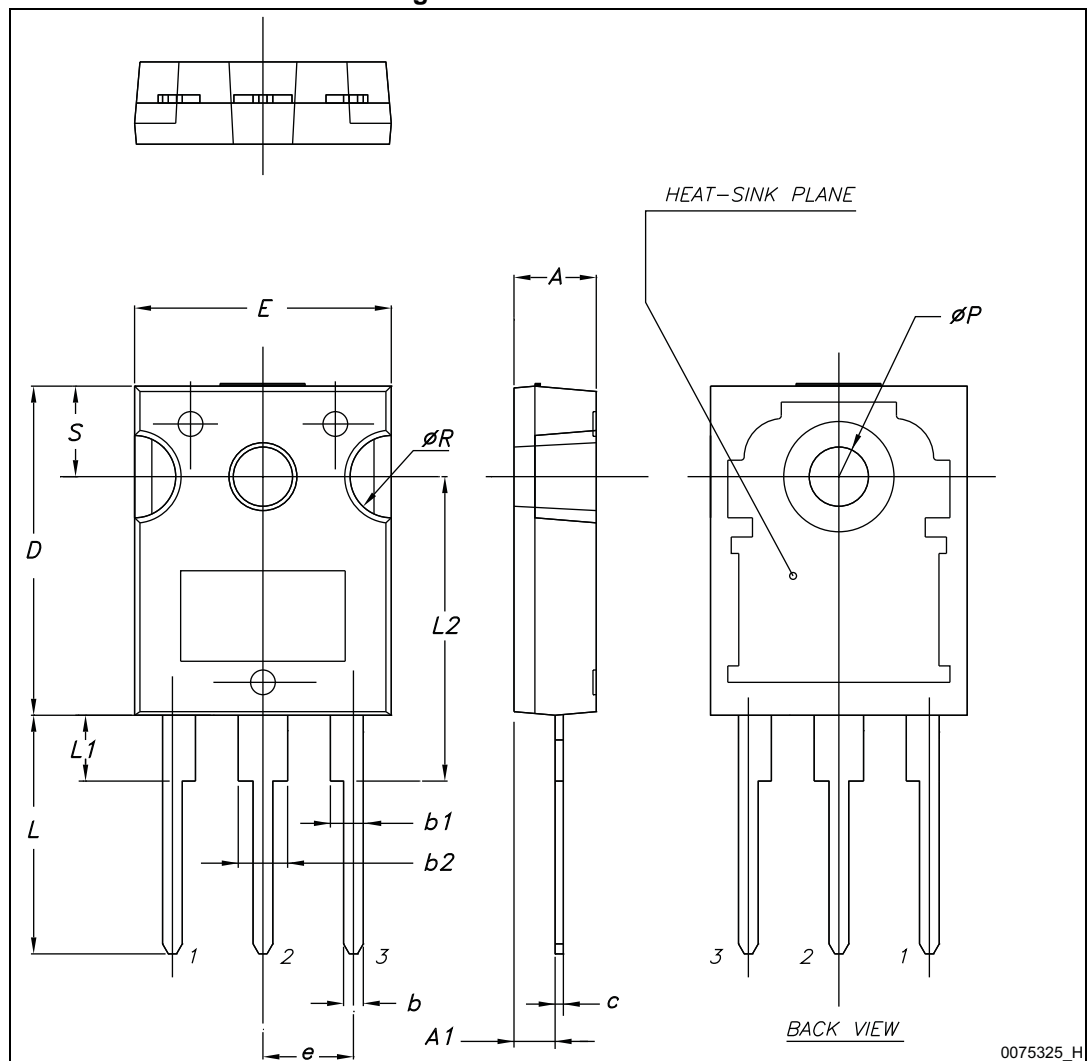**Table 8. TO-247 mechanical data**

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

5.2 TO-247 long leads, STGWA15S120DF3

Figure 34. TO-247 long lead outline
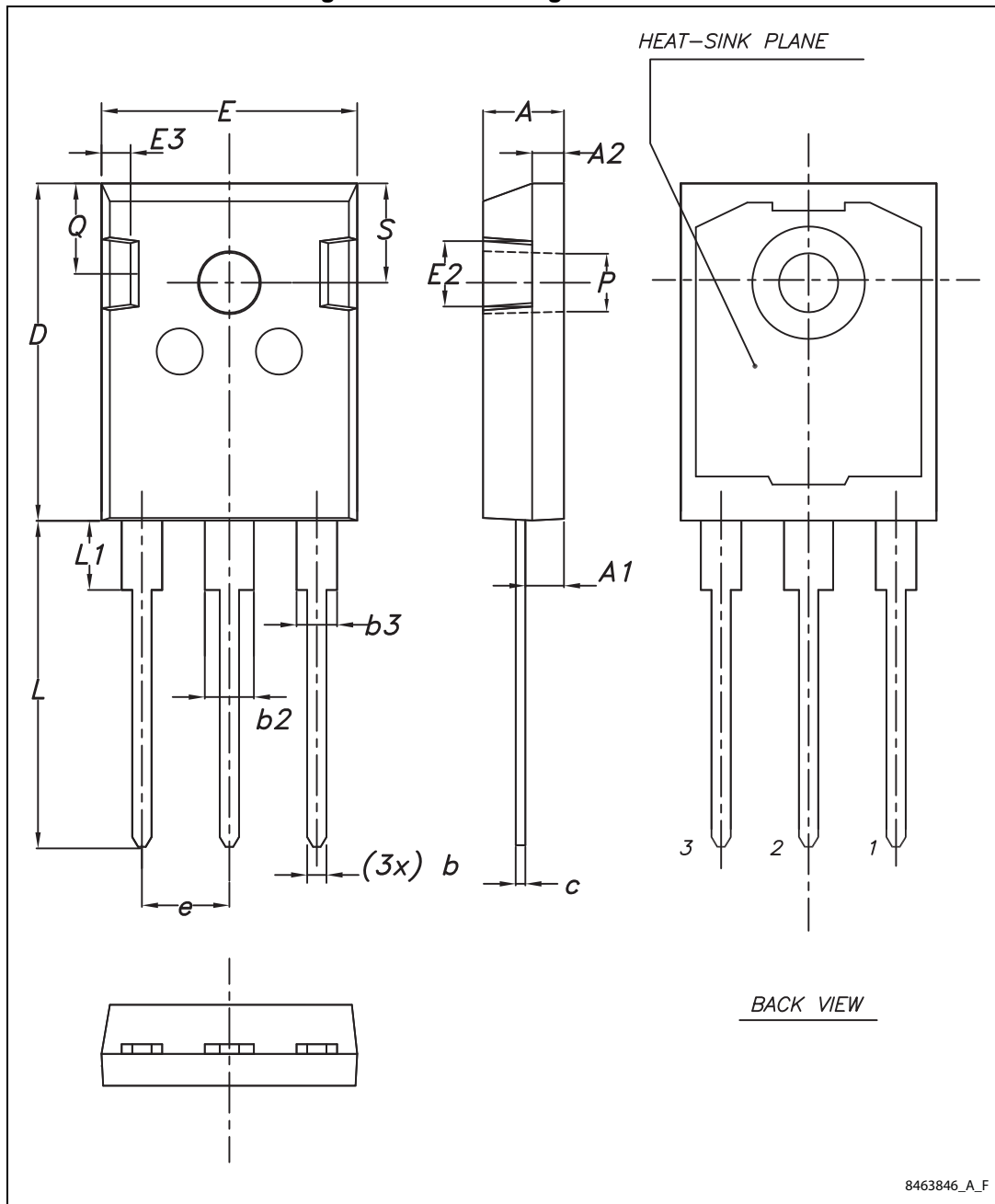
Table 9. TO-247 long leads mechanical data

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

6 Revision history

Table 10. Document revision history

Date	Revision	Changes
16-May-2014	1	Initial release.
18-Dec-2014	2	Updated *Section 1* and *Section 2*. Inserted *Section 3*.