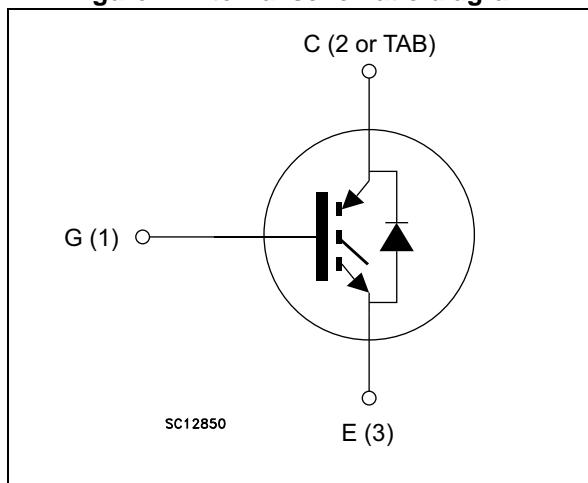


Figure 1. Internal schematic diagram



Features

- 10 μ s 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

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 $T_C = 25^\circ\text{C}$	30	A
I_C	Continuous collector current at $T_C = 100^\circ\text{C}$	15	A
$I_{CP}^{(1)}$	Pulsed collector current	60	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current at $T_C = 25^\circ\text{C}$	30	A
I_F	Continuous forward current at $T_C = 100^\circ\text{C}$	15	A
$I_{FP}^{(1)}$	Pulsed forward current	60	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	259	W
T_{STG}	Storage temperature range	- 55 to 150	$^\circ\text{C}$
T_J	Operating junction temperature	- 55 to 175	$^\circ\text{C}$

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	$^\circ\text{C}/\text{W}$
R_{thJC}	Thermal resistance junction-case diode	1.3	$^\circ\text{C}/\text{W}$
R_{thJA}	Thermal resistance junction-ambient	50	$^\circ\text{C}/\text{W}$

2 Electrical characteristics

$T_J = 25^\circ\text{C}$ unless otherwise specified

Table 4. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{CES}}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 2 \text{ mA}$	1200			V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 15 \text{ A}$		1.55	2.05	V
		$V_{GE} = 15 \text{ V}, I_C = 15 \text{ A}, T_J = 125^\circ\text{C}$		1.75		
		$V_{GE} = 15 \text{ V}, I_C = 15 \text{ A}, T_J = 175^\circ\text{C}$		1.85		
V_F	Forward on-voltage	$I_F = 15 \text{ A}$		2.7	3.8	V
		$I_F = 15 \text{ A} T_J = 125^\circ\text{C}$		2.05		V
		$I_F = 15 \text{ A} T_J = 175^\circ\text{C}$		1.75		V
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 500 \mu\text{A}$	5	6	7	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 1200 \text{ V}$			25	μA
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	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$	-	981	-	pF
C_{oes}	Output capacitance		-	82	-	pF
C_{res}	Reverse transfer capacitance		-	37	-	pF
Q_g	Total gate charge	$V_{CC} = 960 \text{ V}, I_C = 15 \text{ A}, V_{GE} = 15 \text{ V}$, 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	$V_{CE} = 600 \text{ V}, I_C = 15 \text{ A}, V_{GE} = 15 \text{ V}, R_G = 22 \Omega$ 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	$V_{CE} = 600 \text{ V}, I_C = 15 \text{ A}, R_G = 22 \Omega, V_{GE} = 15 \text{ V}, T_J = 175 \text{ }^\circ\text{C}$, 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	$V_{CC} \leq 600 \text{ V}, V_{GE} = 15 \text{ V}, T_{Jstart} \leq 150 \text{ }^\circ\text{C}, V_P < 1200 \text{ V}$	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	$I_F = 15 \text{ A}, V_R = 600 \text{ V}, V_{GE} = 15 \text{ V}$, see Figure 29 $di/dt = 1000 \text{ A}/\mu\text{s}$	-	270	-	ns
Q_{rr}	Reverse recovery charge		-	960	-	nC
I_{rrm}	Reverse recovery current		-	15	-	A
dl_{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	$I_F = 15 \text{ A}, V_R = 600 \text{ V}, V_{GE} = 15 \text{ V}, T_J = 175 \text{ }^\circ\text{C}$, see Figure 29 $di/dt = 1000 \text{ A}/\mu\text{s}$	-	534	-	ns
Q_{rr}	Reverse recovery charge		-	3456	-	nC
I_{rrm}	Reverse recovery current		-	23	-	A
dl_{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

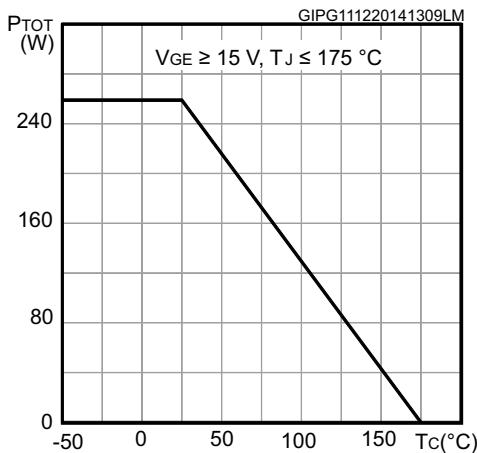


Figure 3. Collector current vs. case temperature

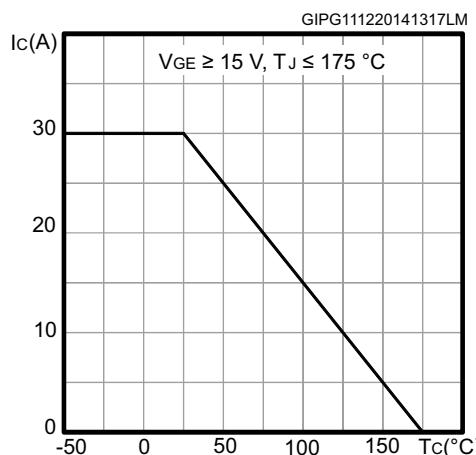


Figure 4. Output characteristics ($T_J = 25^\circ\text{C}$)

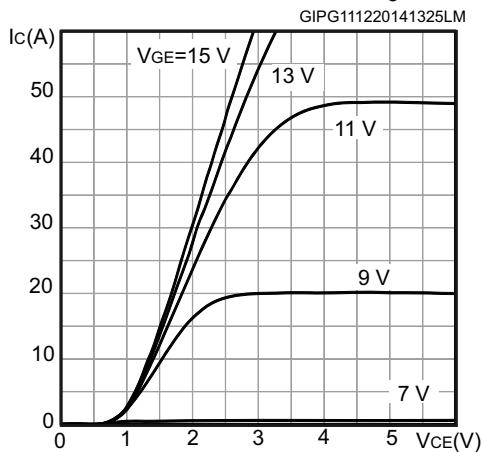


Figure 5. Output characteristics ($T_J = 175^\circ\text{C}$)

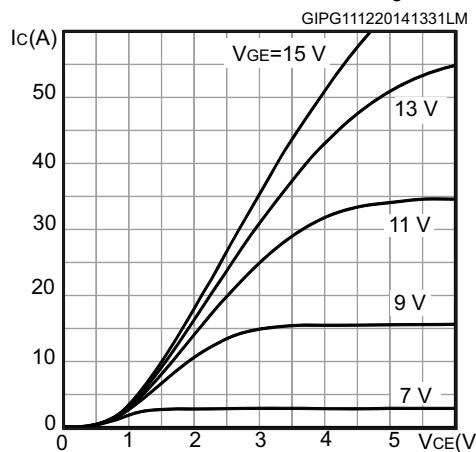


Figure 6. $V_{CE(\text{sat})}$ vs. junction temperature

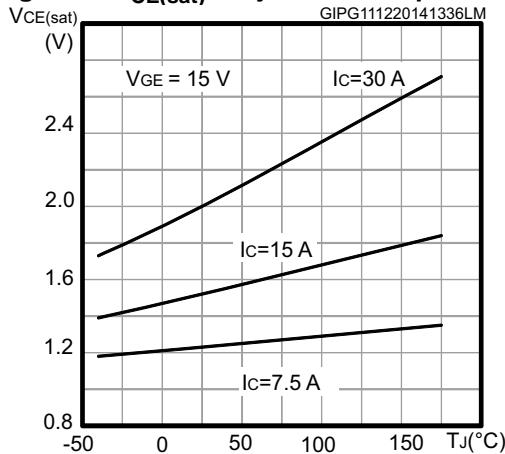


Figure 7. $V_{CE(\text{sat})}$ vs. collector current

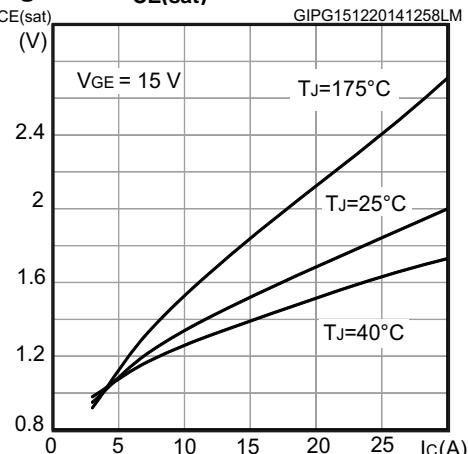


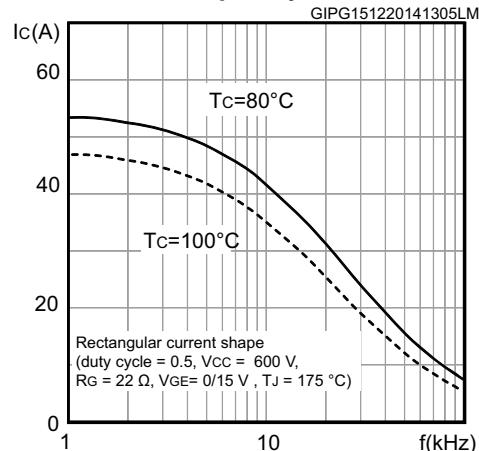
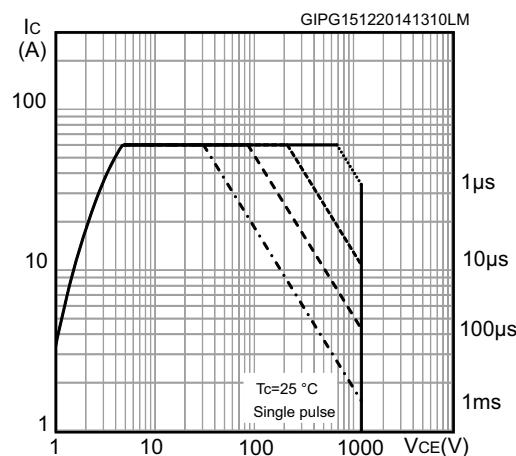
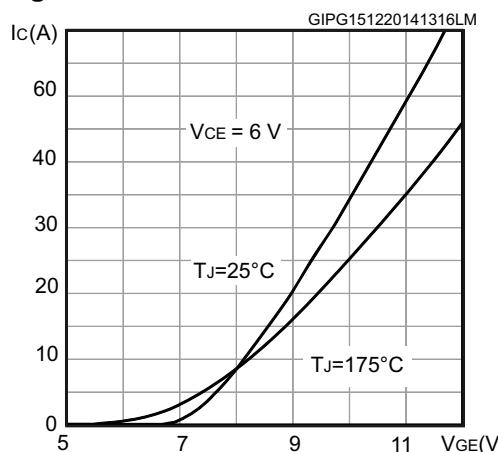
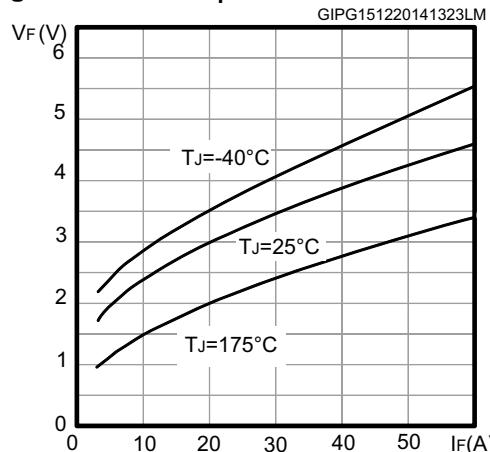
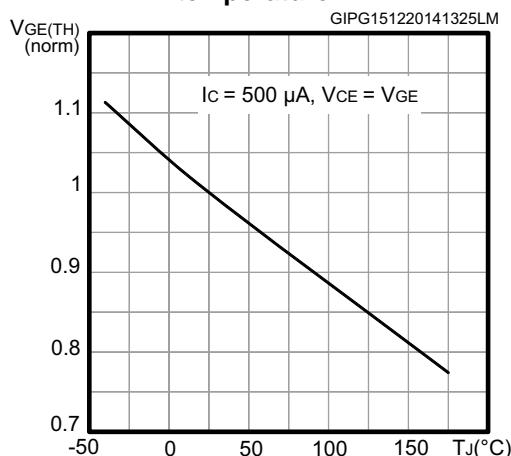
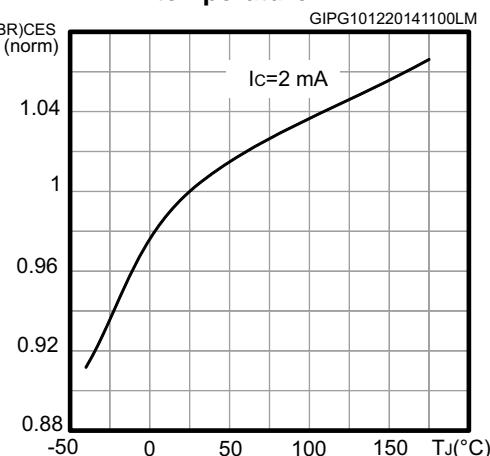
Figure 8. Collector current vs. switching frequency**Figure 9. Forward bias safe operating area****Figure 10. Transfer characteristics****Figure 11. Diode V_F vs. forward current****Figure 12. Normalized $V_{GE(\text{th})}$ vs. junction temperature****Figure 13. Normalized $V_{BR(\text{CES})}$ vs. junction temperature**

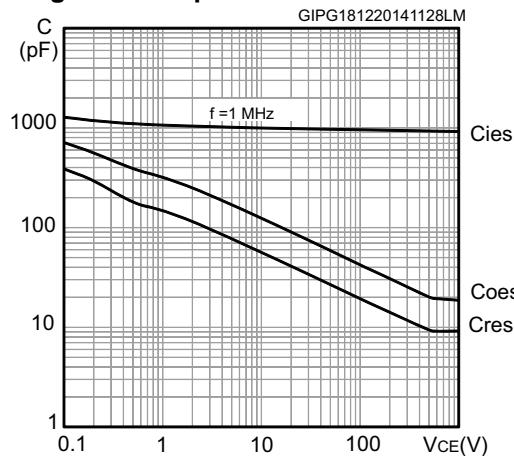
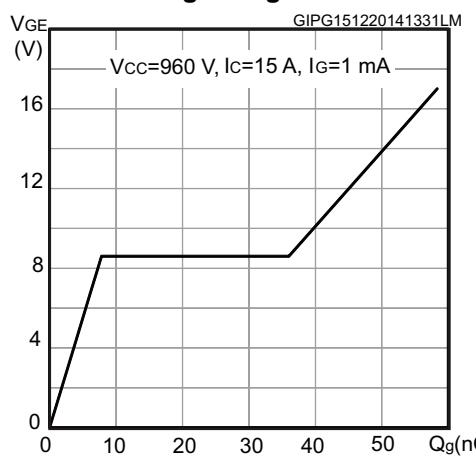
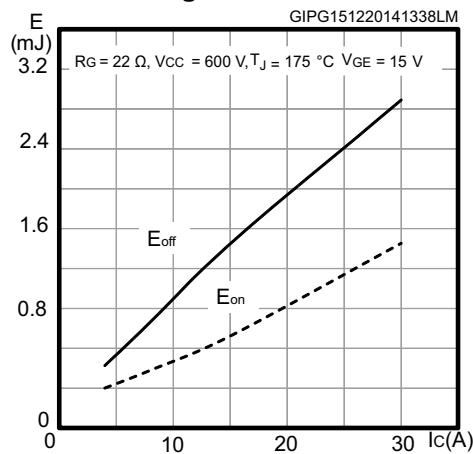
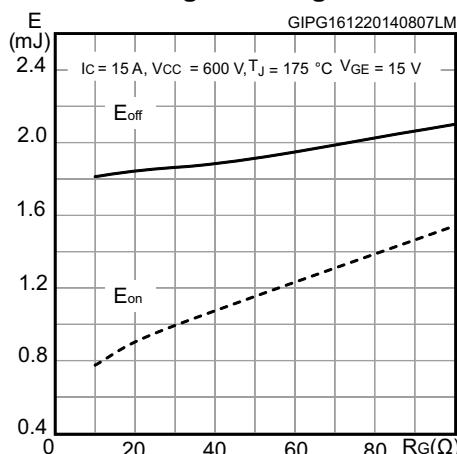
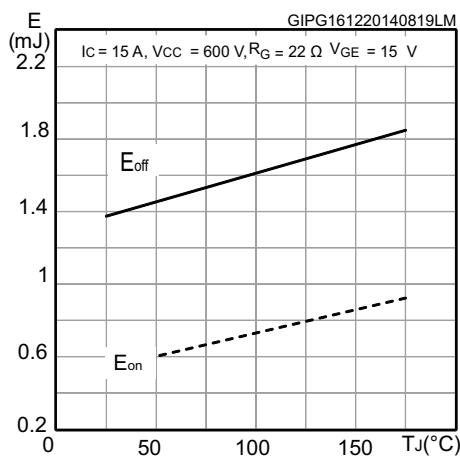
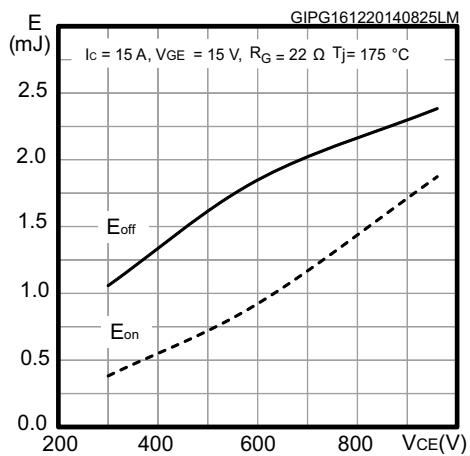
Figure 14. Capacitance variations**Figure 15. Gate charge vs. gate-emitter voltage****Figure 16. Switching loss vs. collector current****Figure 17. Switching loss vs. gate resistance****Figure 18. Switching loss vs. temperature****Figure 19. Switching loss vs. collector-emitter voltage**

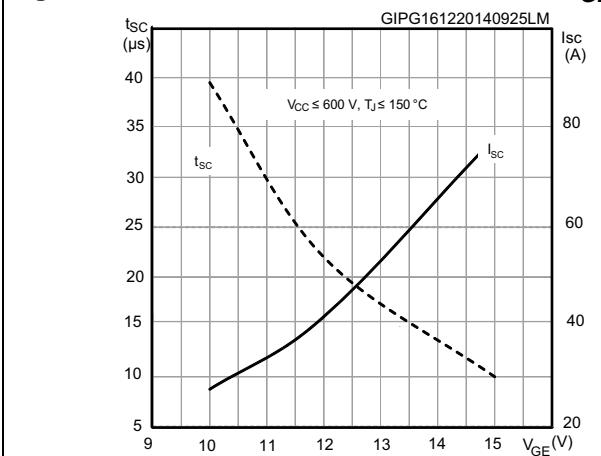
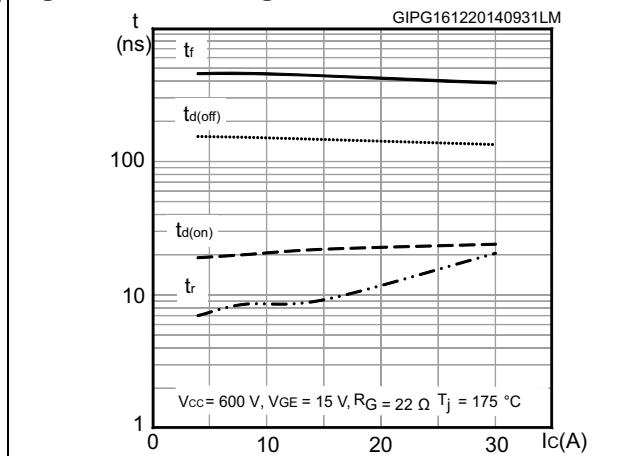
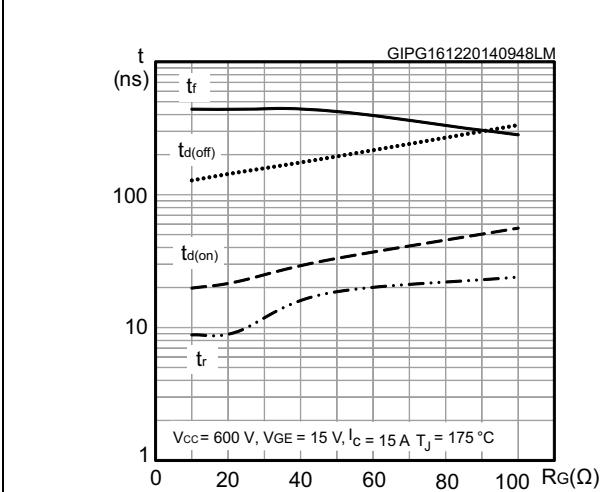
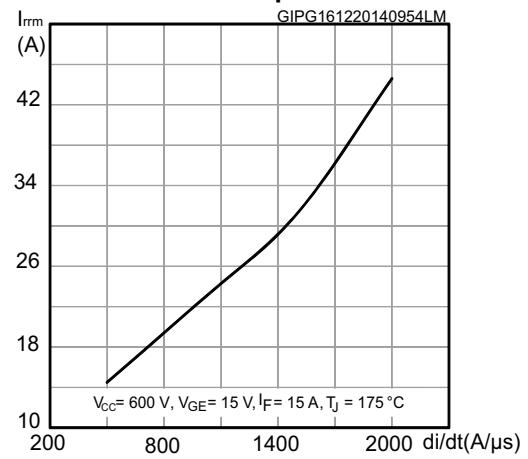
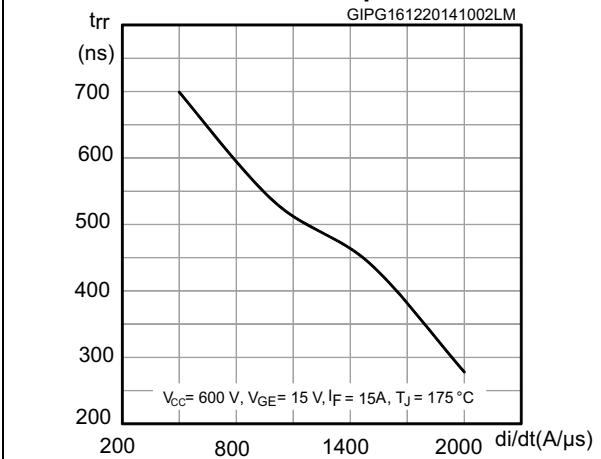
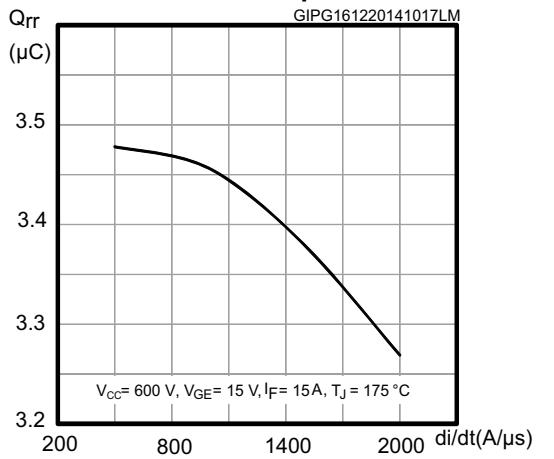
Figure 20. Short-circuit time and current vs V_{GE} **Figure 21. Switching times vs. collector current****Figure 22. Switching times vs. gate resistance****Figure 23. Reverse recovery current vs. diode current slope****Figure 24. Reverse recovery time vs. diode current slope****Figure 25. Reverse recovery charge vs. diode current slope**

Figure 26. Reverse recovery energy vs. diode current slope

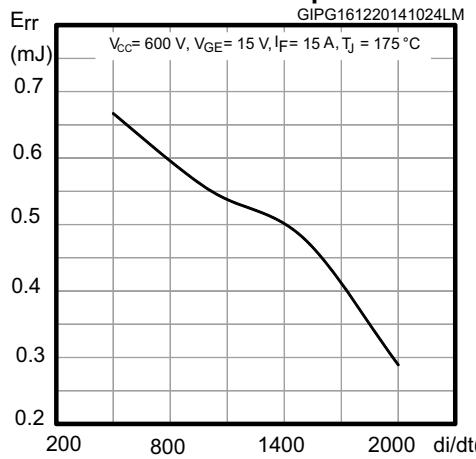


Figure 27. Thermal impedance for IGBT

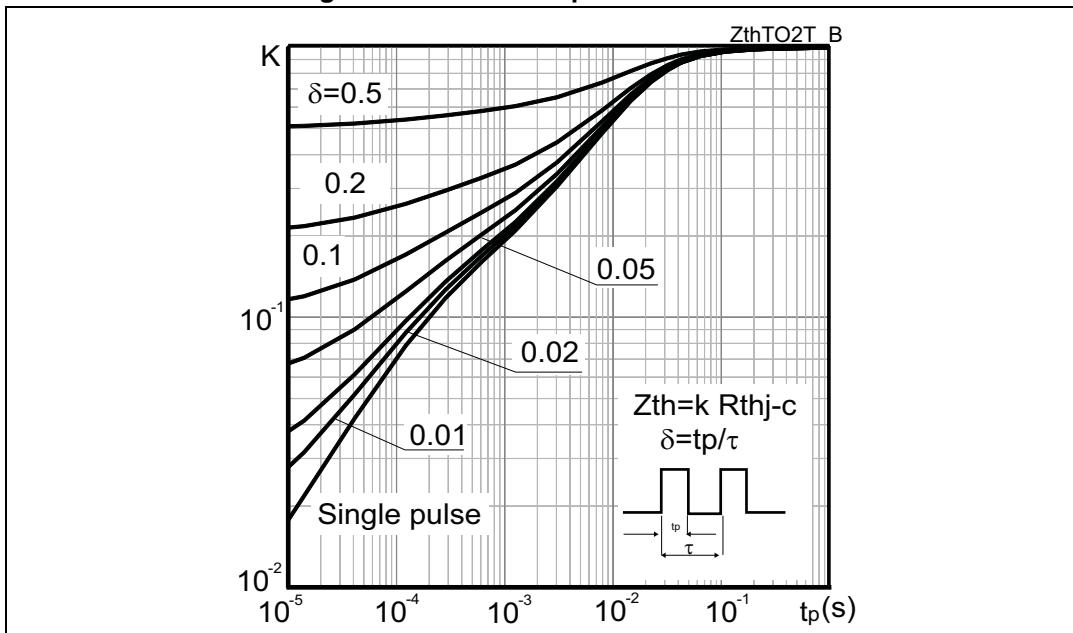
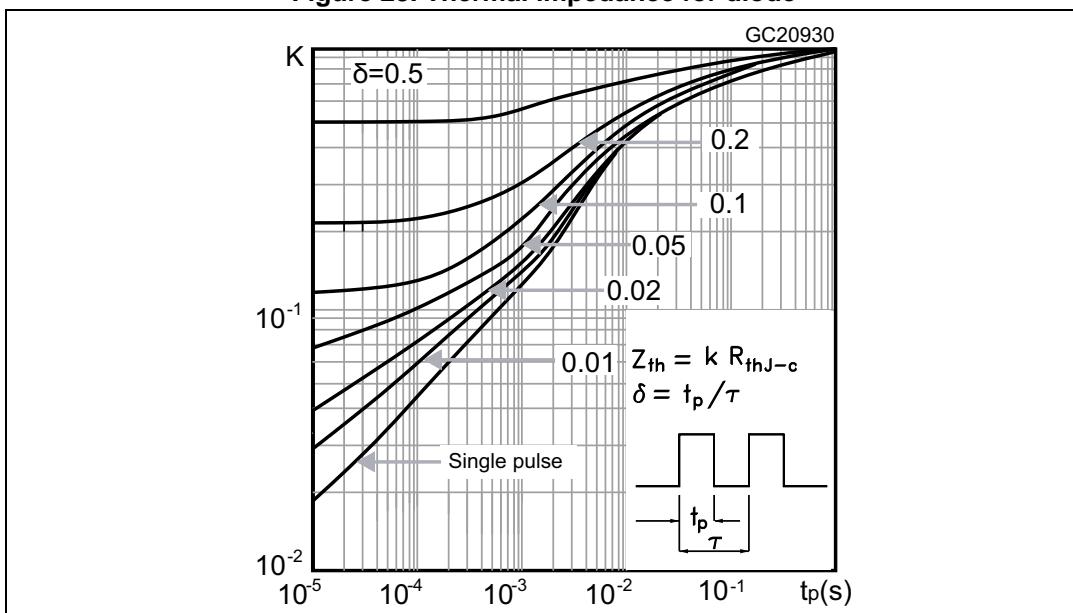


Figure 28. Thermal impedance for diode



4 Test circuits

Figure 29. Test circuit for inductive load switching

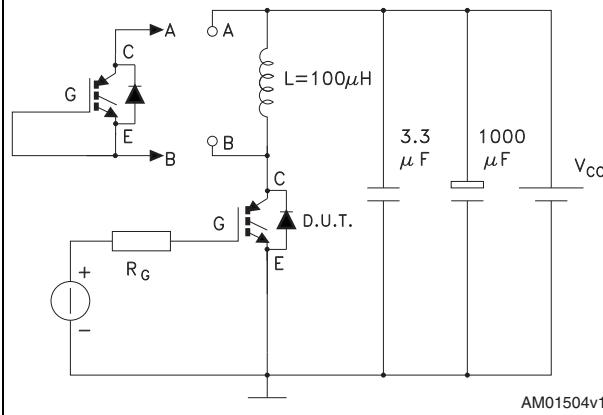


Figure 30. Gate charge test circuit

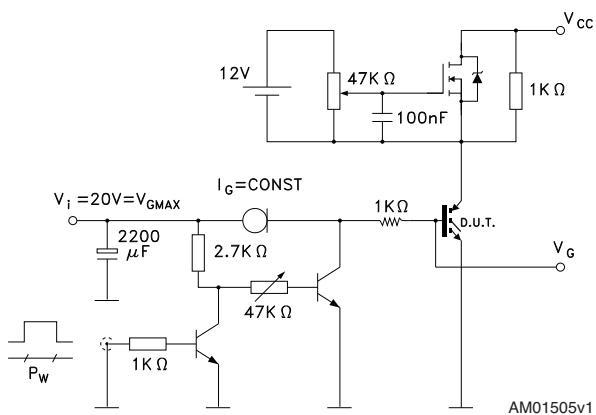
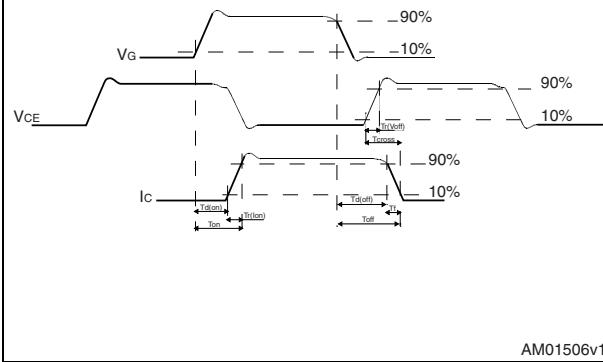
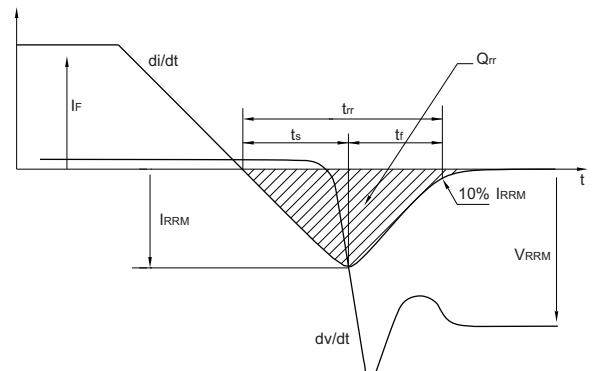


Figure 31. Switching waveform



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

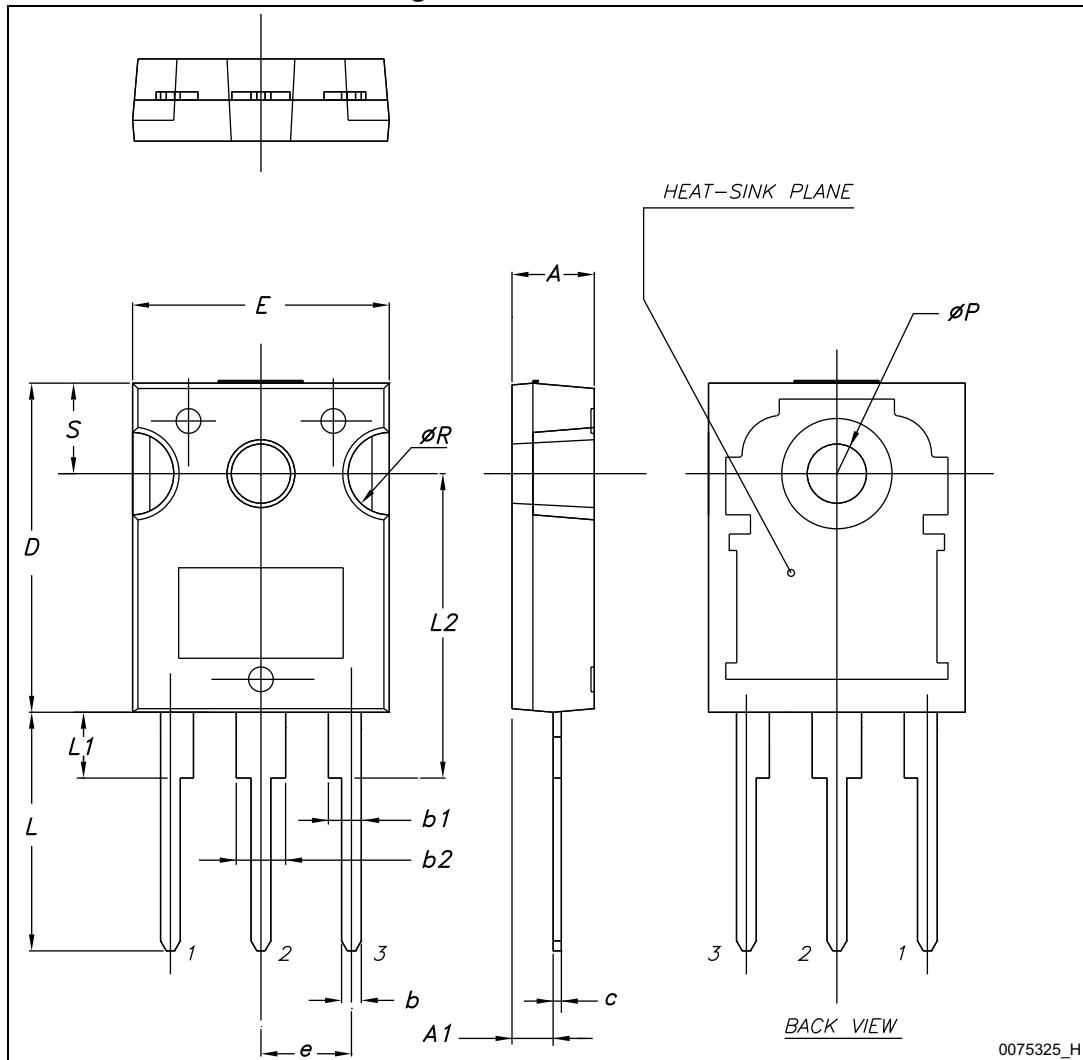


Table 8. TO-247 mechanical data

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	
ØP	3.55		3.65
ØR	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

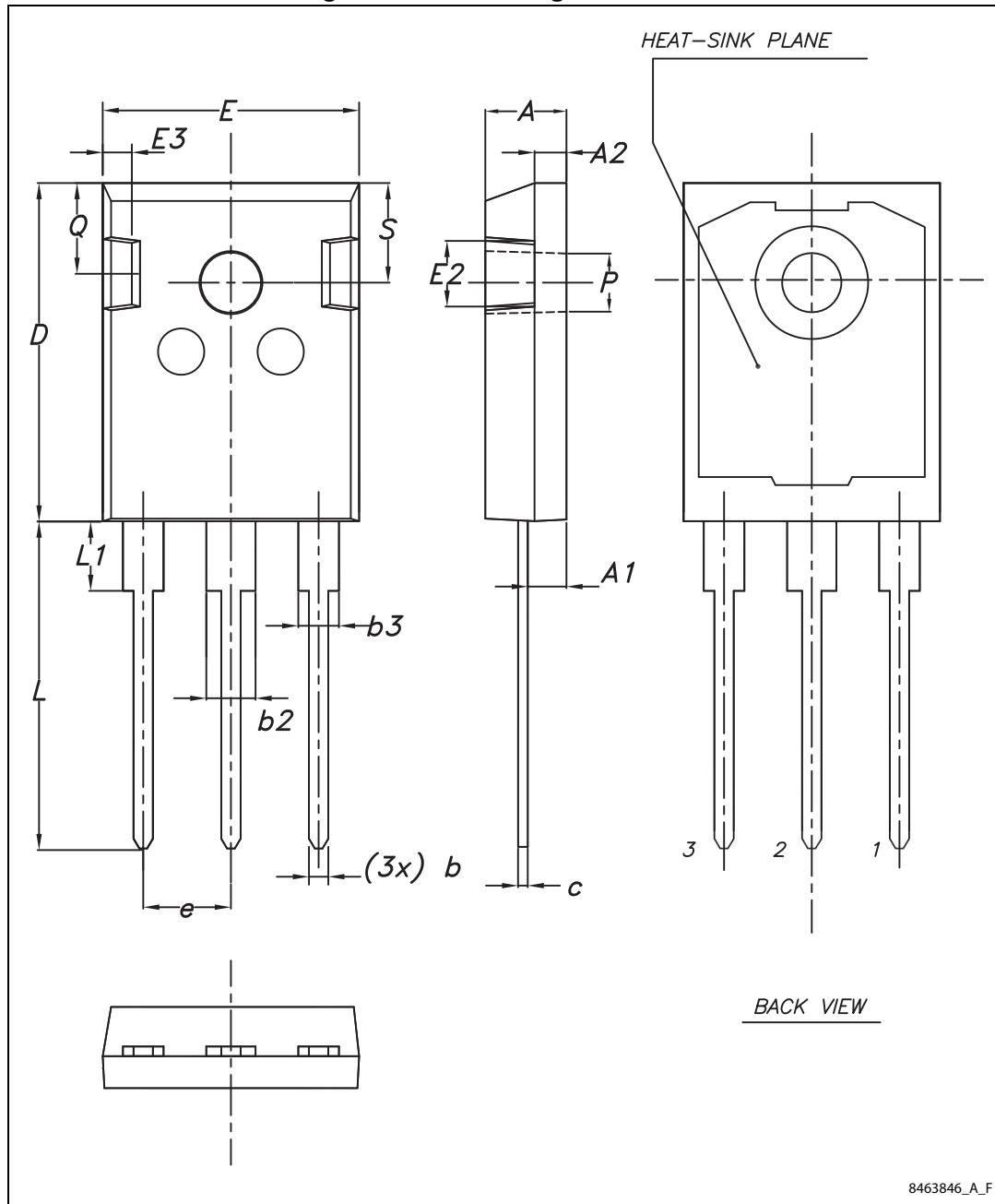


Table 9. TO-247 long leads mechanical data

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 .

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- Техническая поддержка проекта;
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