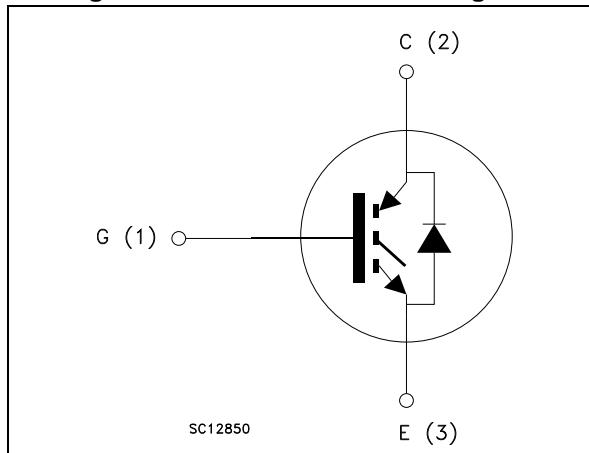


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175 \text{ }^\circ\text{C}$
- High speed switching series
- Minimized tail current
- $V_{CE(\text{sat})} = 2.1 \text{ V (typ.)} @ I_C = 40 \text{ A}$
- 5 μs minimum short circuit withstand time at $T_J=150 \text{ }^\circ\text{C}$
- 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 $V_{CE(\text{sat})}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Table 1. Device summary

Order code	Marking	Package	Packing
STGW40H120DF2	G40H120DF2	TO-247	Tube
STGWA40H120DF2	G40H120DF2	TO-247 long leads	Tube

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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 $T_C = 25^\circ\text{C}$	80	A
	Continuous collector current at $T_C = 100^\circ\text{C}$	40	A
$I_{CP}^{(1)}$	Pulsed collector current	160	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous collector current at $T_C = 25^\circ\text{C}$	80	A
	Continuous collector current at $T_C = 100^\circ\text{C}$	40	A
$I_{FP}^{(1)}$	Pulsed forward current	160	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	468	W
T_J	Operating junction temperature	– 55 to 175	$^\circ\text{C}$
T_{STG}	Storage temperature range	– 55 to 150	$^\circ\text{C}$

1. Pulse width limited by maximum junction temperature.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.32	$^\circ\text{C}/\text{W}$
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	$V_{GE} = 15 \text{ V}, I_C = 40 \text{ A}$		2.1	2.6	V
		$V_{GE} = 15 \text{ V}, I_C = 40 \text{ A}$ $T_J = 125^\circ\text{C}$		2.4		
		$V_{GE} = 15 \text{ V}, I_C = 40 \text{ A}$ $T_J = 175^\circ\text{C}$		2.5		
V_F	Forward on-voltage	$I_F = 40 \text{ A}$		3.9	4.9	V
		$I_F = 40 \text{ A}, T_J = 125^\circ\text{C}$		3.05		
		$I_F = 40 \text{ A}, T_J = 175^\circ\text{C}$		2.8		
$V_{GE(\text{th})}$	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	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	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$	-	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 Figure 30	-	158	-	nC
Q_{ge}	Gate-emitter charge		-	17	-	nC
Q_{gc}	Gate-collector charge		-	85	-	nC

Table 6. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600 \text{ V}, I_C = 40 \text{ A}, R_G = 10 \Omega, V_{GE} = 15 \text{ V}$, see Figure 31		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}	Turn-on switching losses			1	-	mJ
$E_{off}^{(1)}$	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 Figure 31		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}	Turn-on switching losses			1.81	-	mJ
$E_{off}^{(1)}$	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		-	μs

1. 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	$I_F = 40 \text{ A}, V_R = 600 \text{ V}, di/dt=500 \text{ A}/\mu\text{s}, V_{GE} = 15 \text{ V}$, see Figure 31	-	488	-	ns
Q_{rr}	Reverse recovery charge		-	2.59	-	μC
I_{rrm}	Reverse recovery current		-	11.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	406	-	A/ μs
E_{rr}	Reverse recovery energy		-	0.38	-	mJ
t_{rr}	Reverse recovery time	$I_F = 40 \text{ A}, V_R = 600 \text{ V}, di/dt=500 \text{ A}/\mu\text{s}, V_{GE} = 15 \text{ V}, T_J = 175 \text{ }^\circ\text{C}$, see Figure 31	-	484	-	ns
Q_{rr}	Reverse recovery charge		-	4.5	-	μC
I_{rrm}	Reverse recovery current		-	18.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	170	-	A/ μs
E_{rr}	Reverse recovery energy		-	0.94	-	mJ

2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

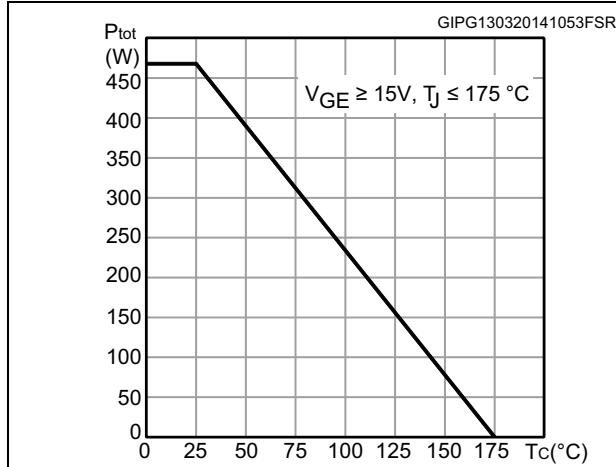


Figure 3. Collector current vs. case temperature

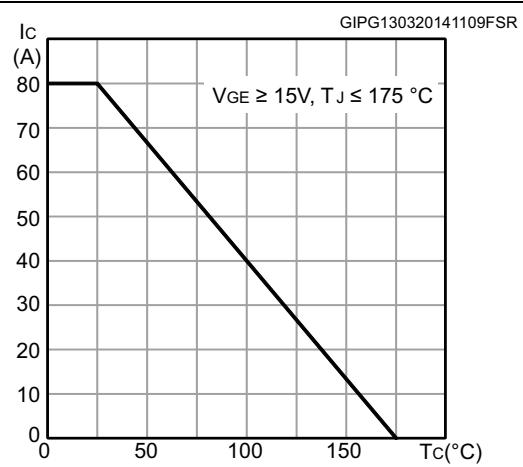


Figure 4. Output characteristics ($T_J = 25^{\circ}C$)

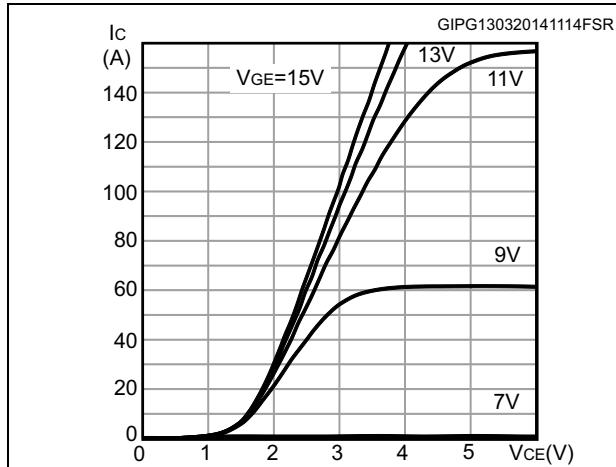


Figure 5. Output characteristics ($T_J = 175^{\circ}C$)

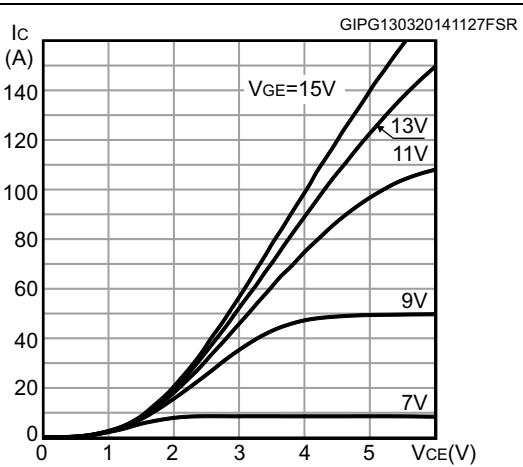


Figure 6. $V_{CE(sat)}$ vs. junction temperature

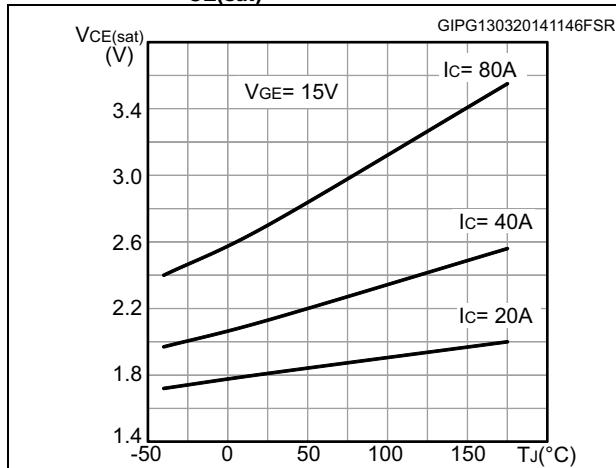


Figure 7. $V_{CE(sat)}$ vs. collector current

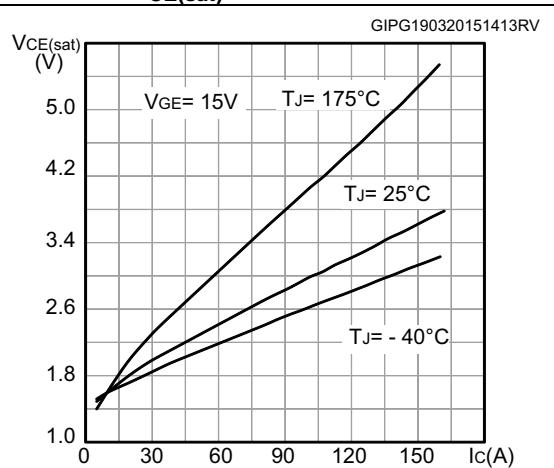


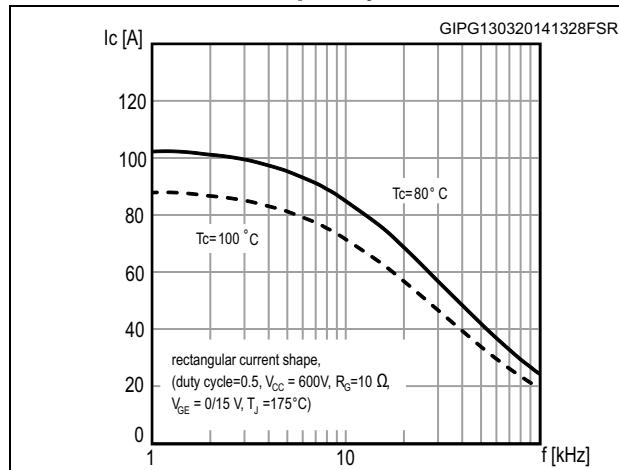
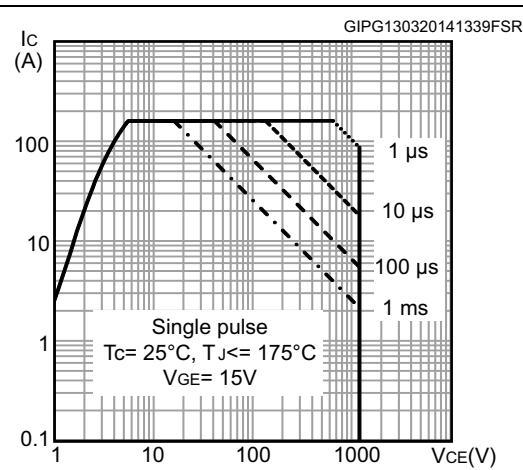
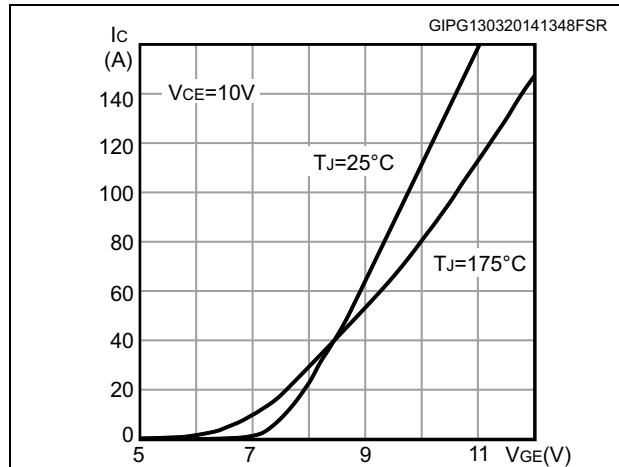
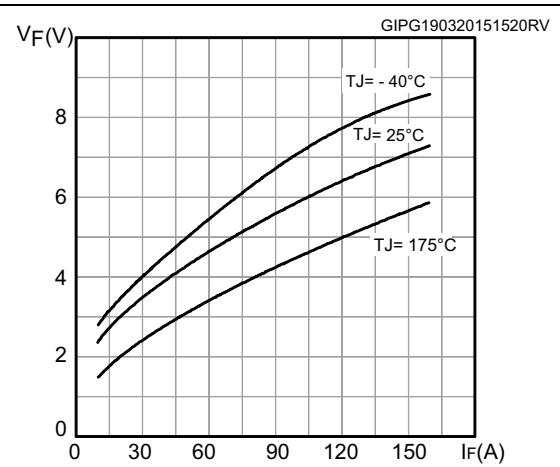
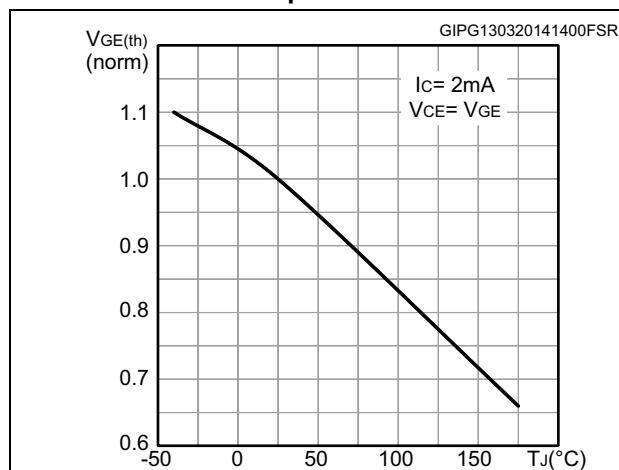
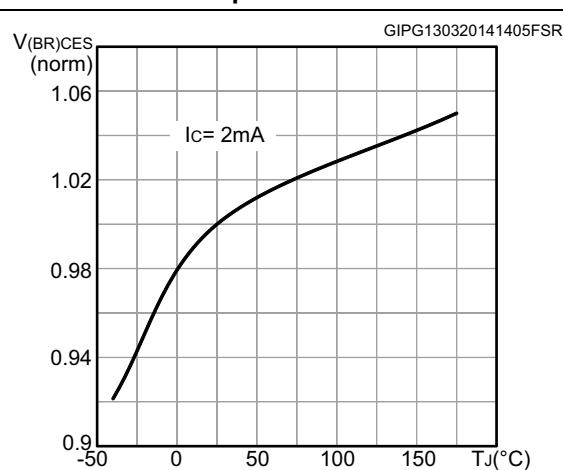
Figure 8. Collector current vs. switching frequency**Figure 9. Forward bias safe operating area****Figure 10. Transfer characteristics****Figure 11. Diode V_F vs. forward current****Figure 12. Normalized $V_{GE(\text{th})}$ vs junction temperature****Figure 13. Normalized $V_{(\text{BR})CES}$ vs. junction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

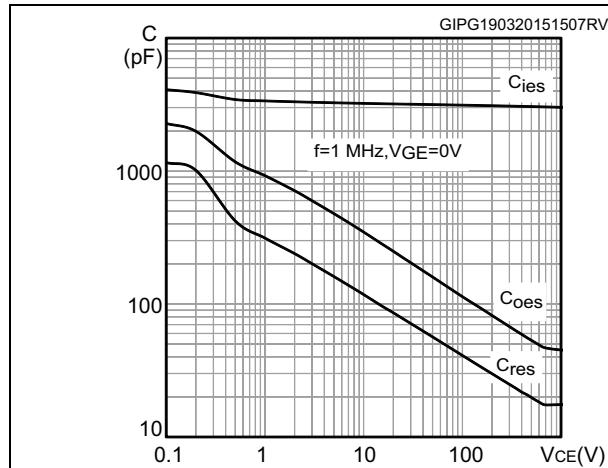
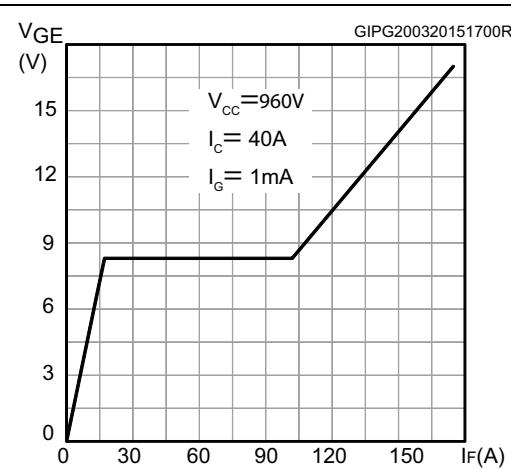
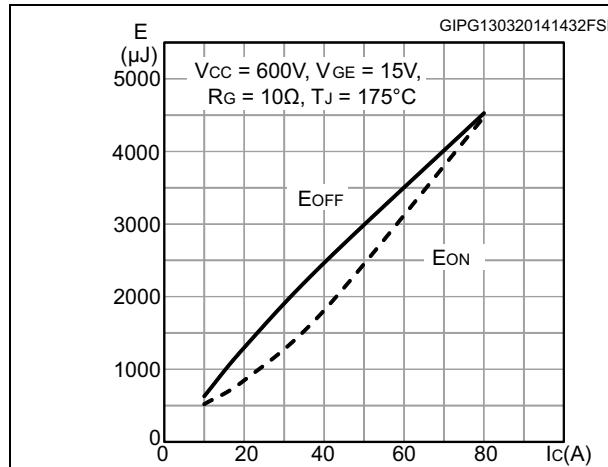
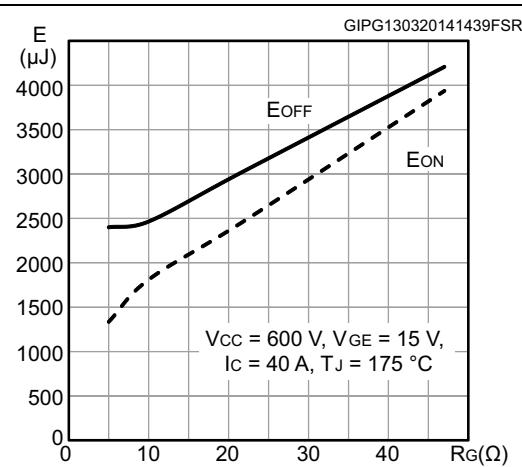
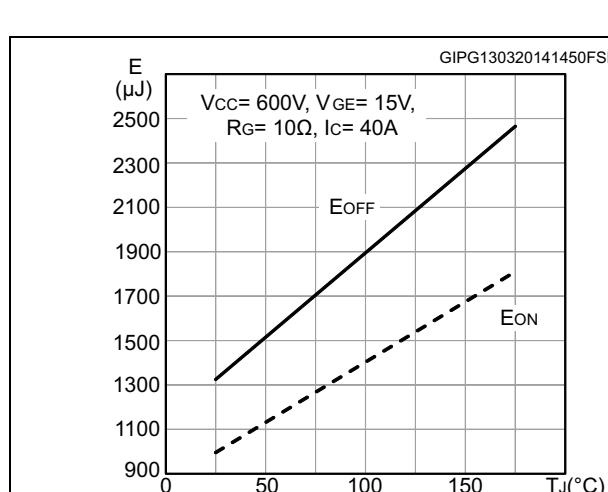
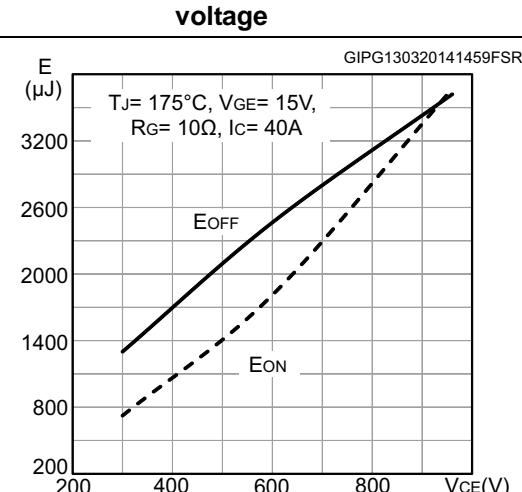
Figure 14. Capacitance variation**Figure 15. Gate charge vs. gate-emitter voltage****Figure 16. Switching loss vs collector current****Figure 17. Switching loss vs gate resistance****Figure 18. Switching loss vs temperature****Figure 19. Switching loss vs collector-emitter voltage**

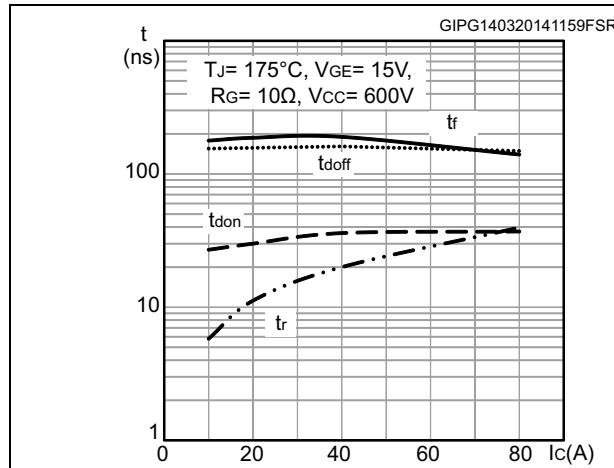
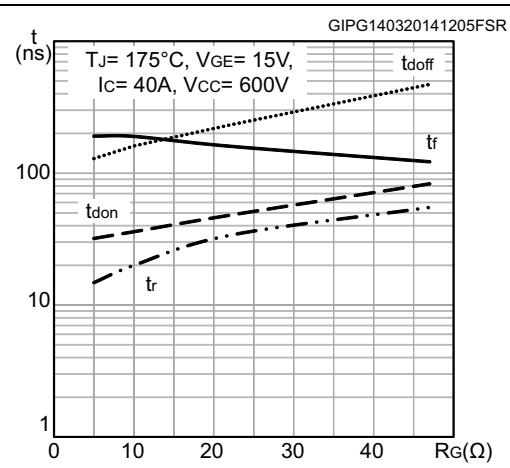
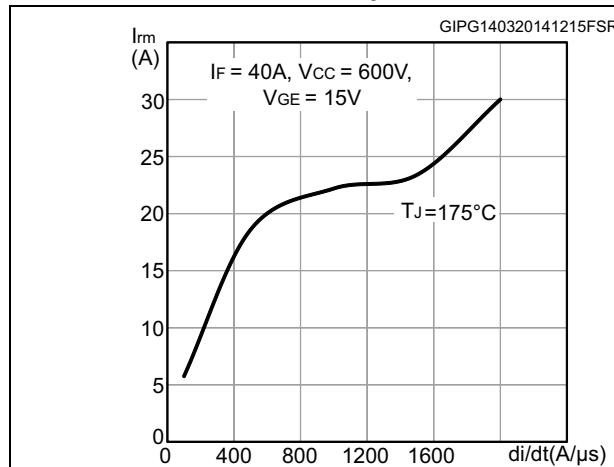
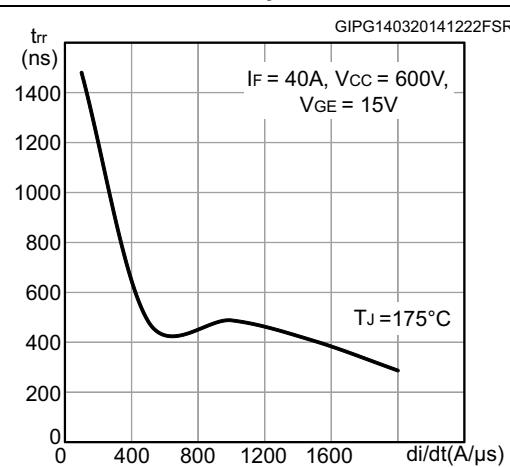
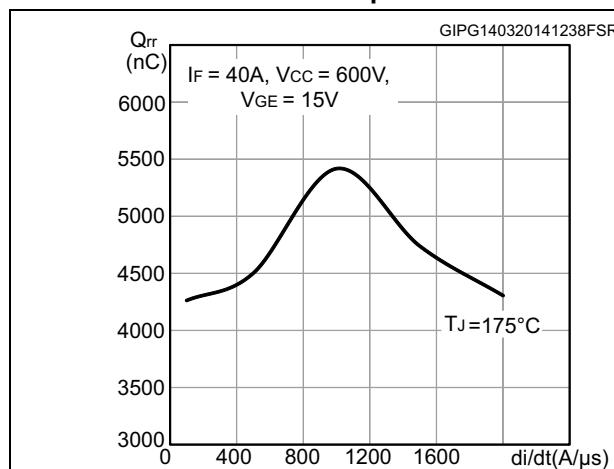
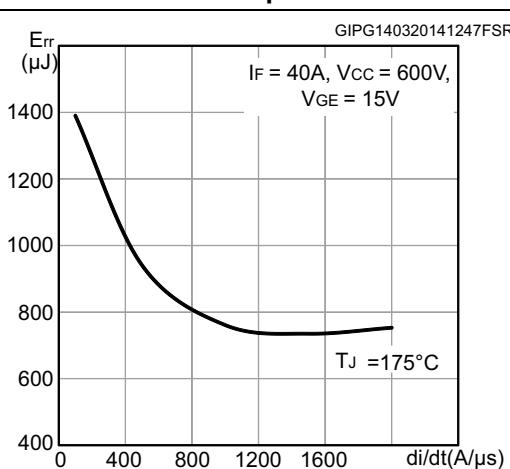
Figure 20. Switching times vs. collector current**Figure 21. Switching times vs. gate resistance****Figure 22. Reverse recovery current vs. diode current slope****Figure 23. Reverse recovery time vs. diode current slope****Figure 24. Reverse recovery charge vs. diode current slope****Figure 25. Reverse recovery energy vs. diode current slope**

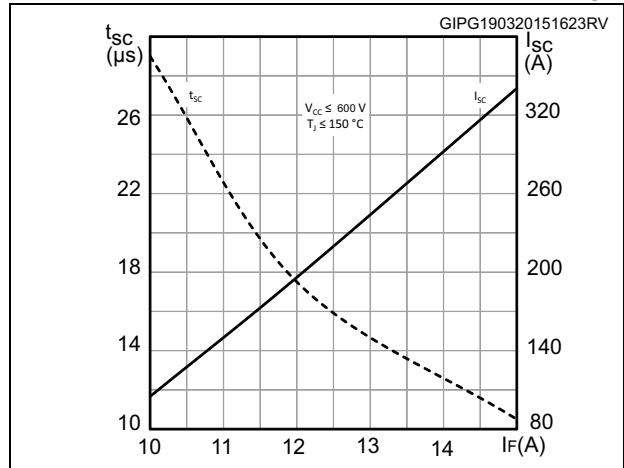
Figure 26. Short circuit time and current vs. V_{GE} 

Figure 27. Thermal impedance for IGBT

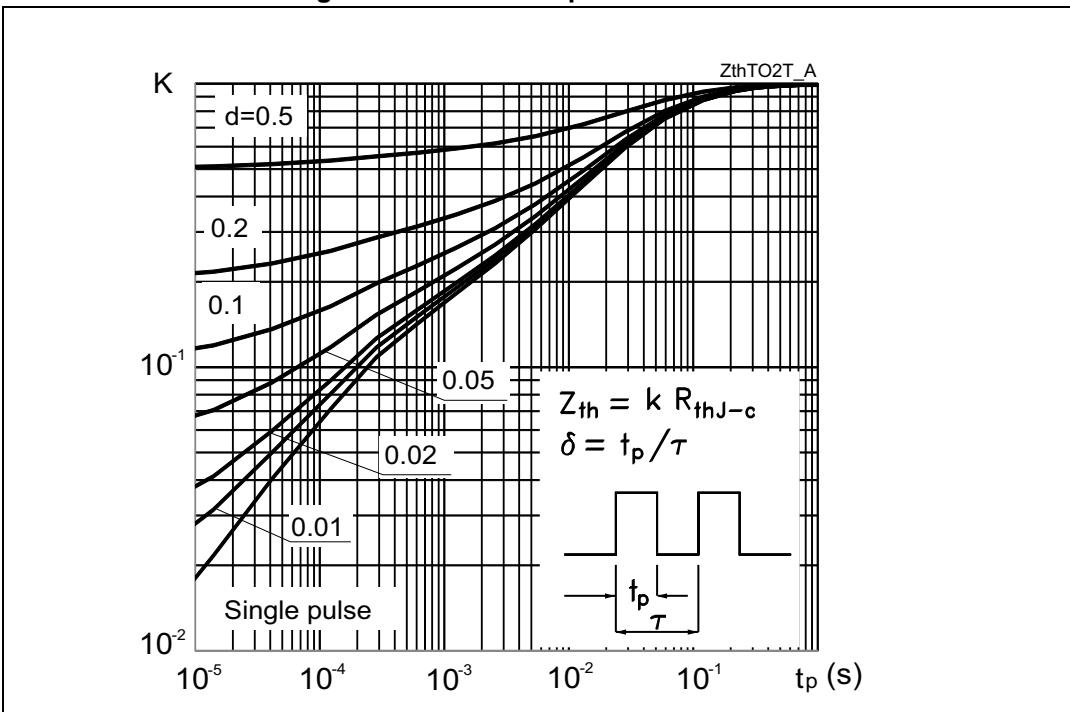
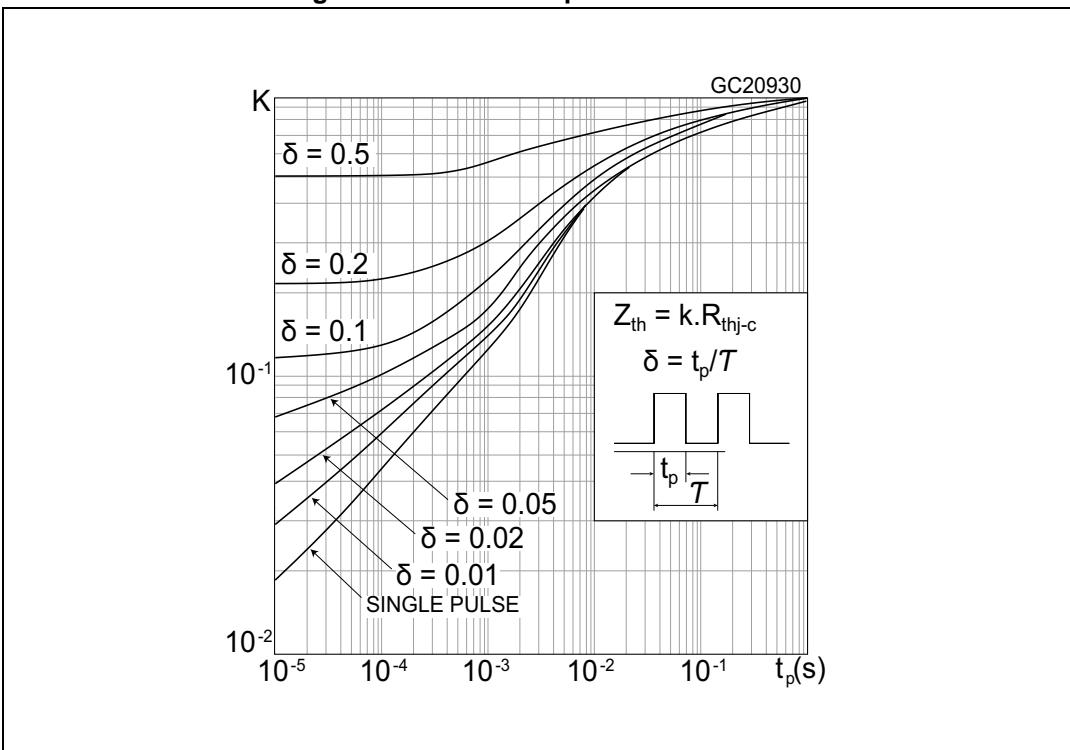


Figure 28. Thermal impedance for diode



3 Test circuits

Figure 29. Test circuit for inductive load switching

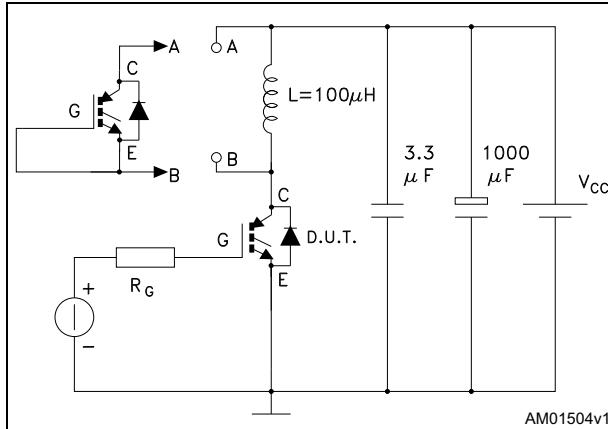


Figure 30. Gate charge test circuit

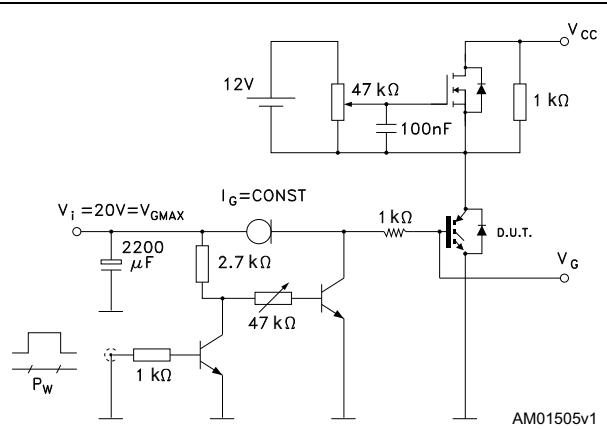


Figure 31. Switching waveform

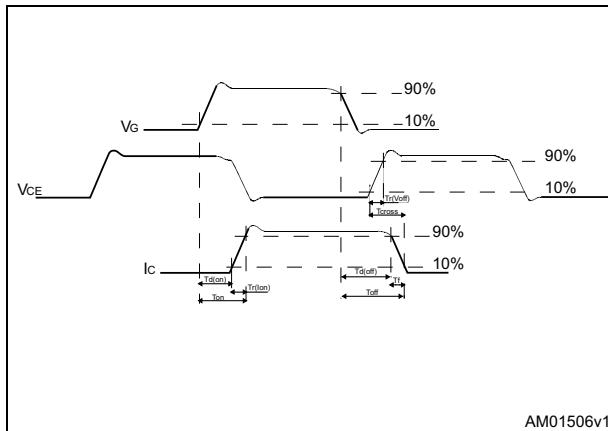
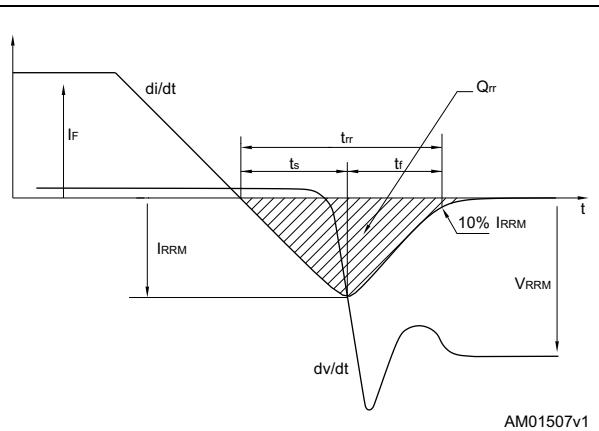


Figure 32. Diode reverse recovery waveform



4 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.

4.1 TO-247 package information

Figure 33. TO-247 package outline

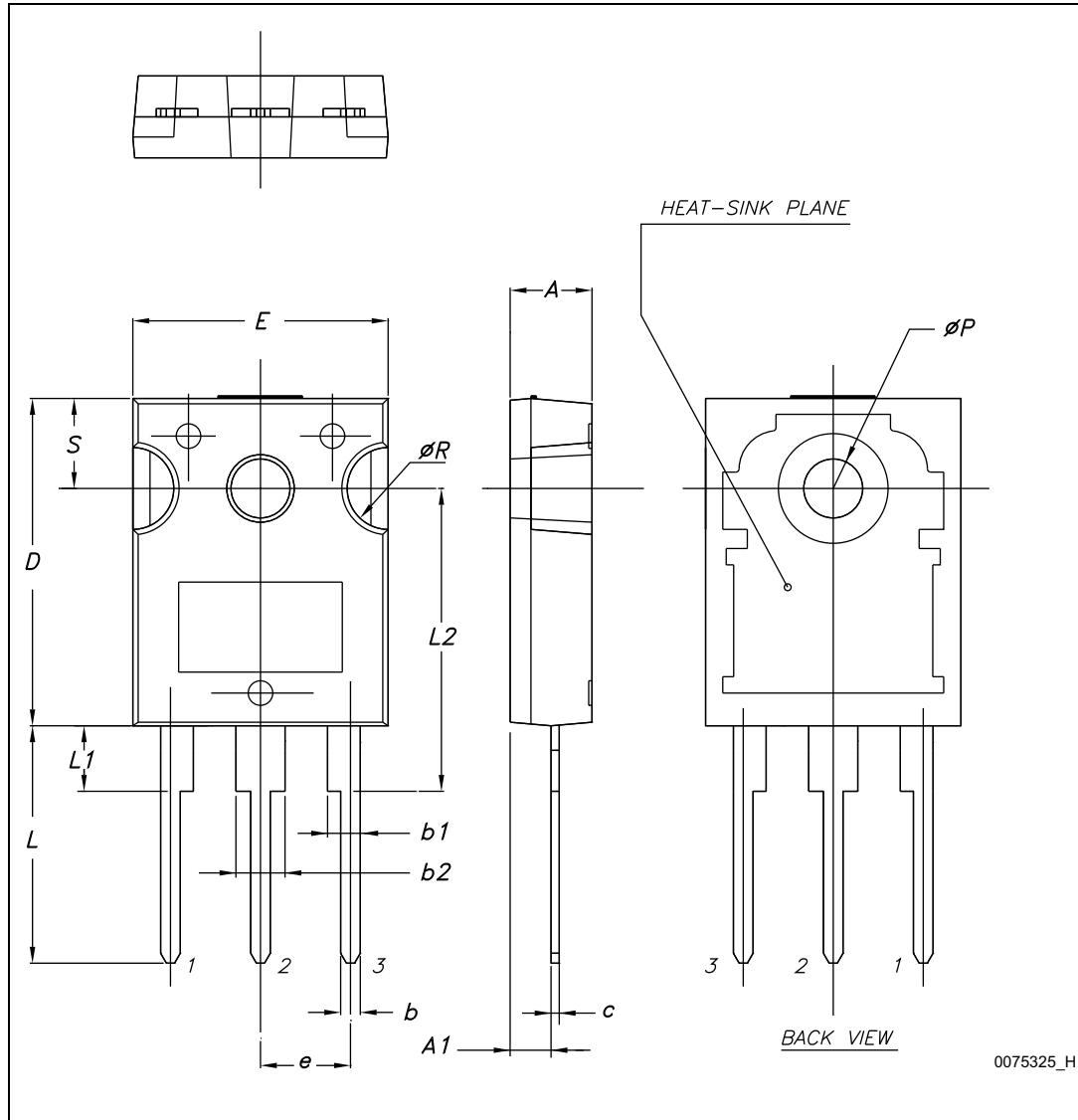


Table 8. TO-247 package mechanical data

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 package information

Figure 34. TO-247 long leads package outline

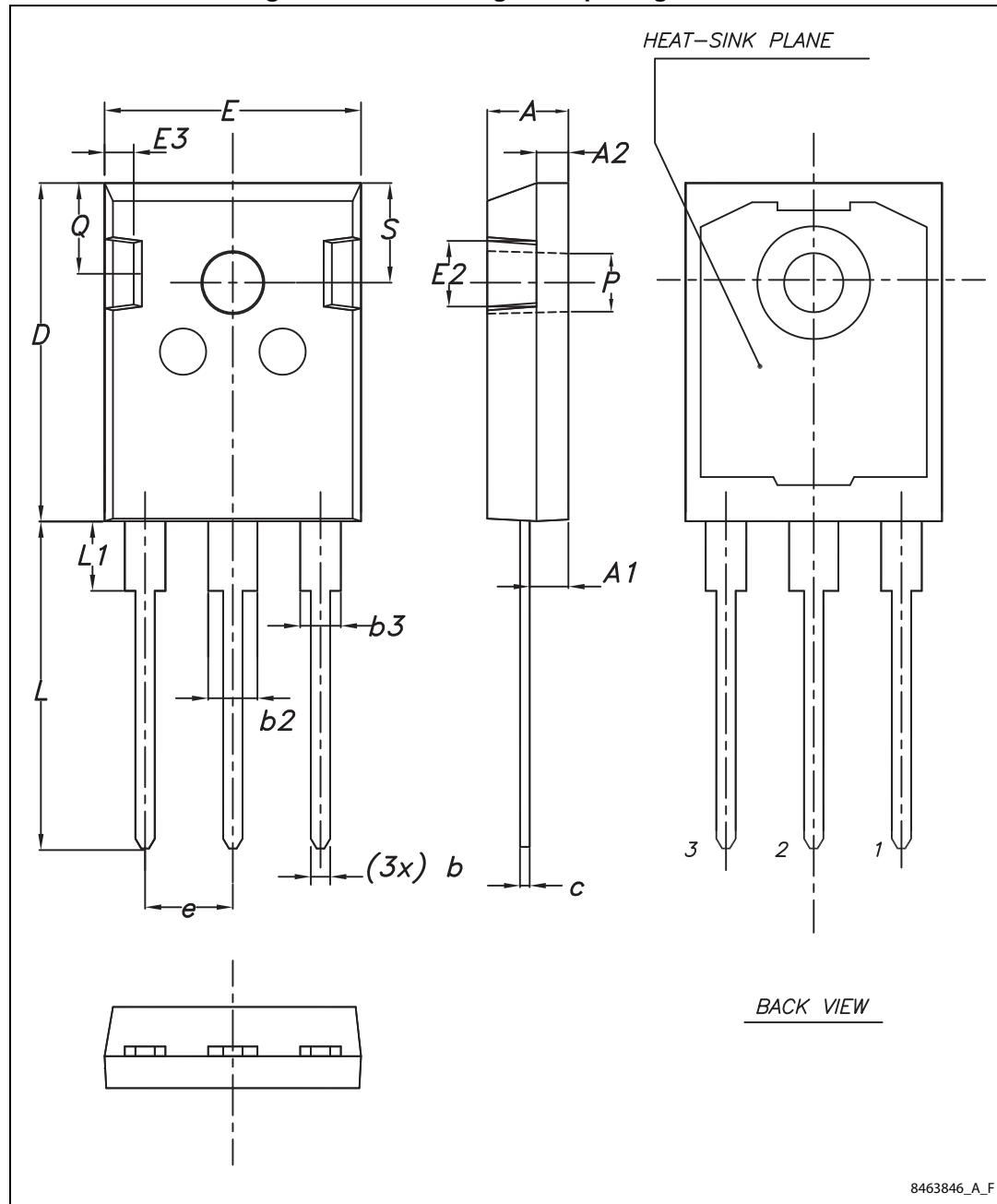


Table 9. TO-247 long leads package mechanical data

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.
29-Jan-2014	2	Updated features in cover page. Updated Table 4: Static characteristics , Table 5: Dynamic characteristics and Table 7: Diode switching characteristics (inductive load) . Minor text changes.
24-Mar-2014	3	Updated title and description in cover page. Updated Table 4: Static characteristics , Table 5: Dynamic characteristics and Table 7: Diode switching characteristics (inductive load) . Added Section 2.1: Electrical characteristics (curves) .
31-Mar-2015	4	Added device in TO-247 long leads Updated 4: Package information Updated Figure 7 , Figure 11 , Figure 14 , Figure 15 , Figure 20 , Figure 21 and added Figure 26 . Minor text changes.

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