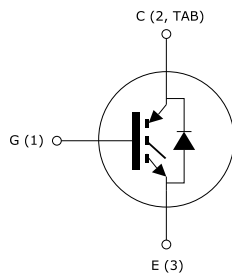
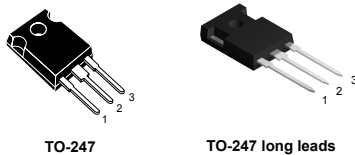


Trench gate field-stop IGBT, H series 1200 V, 40 A high speed



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 2.1\text{ V (typ.) @ } I_C = 40\text{ A}$
- $5\text{ }\mu\text{s}$ minimum short circuit withstand time at $T_J = 150\text{ }^{\circ}\text{C}$
- Safe paralleling
- Low thermal resistance
- Very fast recovery antiparallel diode

Applications

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

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. The device is part of the H series IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of high-switching frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status links

[STGW40H120DF2](#)

[STGWA40H120DF2](#)

Product summary

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

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0\text{ V}$)	1200	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	80	A
	Continuous collector current at $T_C = 100\text{ °C}$	40	
$I_{CP}^{(1)}$	Pulsed collector current	160	A
V_{GE}	Gate-emitter voltage	± 20	V
	Transient gate-emitter voltage ($t_p \leq 10\text{ }\mu\text{s}$, $D \leq 0.01$)	± 30	
I_F	Continuous forward current at $T_C = 25\text{ °C}$	80	A
	Continuous forward current at $T_C = 100\text{ °C}$	40	
$I_{FP}^{(1)}$	Pulsed forward current	160	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	468	W
T_J	Operating junction temperature range	- 55 to 175	°C
T_{STG}	Storage temperature range	- 55 to 150	°C

1. Pulse width limited by maximum junction temperature.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case IGBT	0.32	°C/W
	Thermal resistance, junction-to-case diode	1.3	
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

$T_J = 25\text{ °C}$ unless otherwise specified.

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$		2.1	2.6	V
		$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 125\text{ °C}$		2.4		
		$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 175\text{ °C}$		2.5		
V_F	Forward on-voltage	$I_F = 40\text{ A}$		3.9	4.9	V
		$I_F = 40\text{ A}$, $T_J = 125\text{ °C}$		3.05		
		$I_F = 40\text{ A}$, $T_J = 175\text{ °C}$		2.8		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$			25	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	3200	-	pF
C_{oes}	Output capacitance		-	220	-	pF
C_{res}	Reverse transfer capacitance		-	80	-	pF
Q_g	Total gate charge	$V_{CC} = 960\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 29)	-	158	-	nC
Q_{ge}	Gate-emitter charge		-	17	-	nC
Q_{gc}	Gate-collector charge		-	85	-	nC

Table 5. 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 28)		18	-	ns
t_r	Current rise time			37	-	ns
$(di/dt)_{on}$	Turn-on current slope			1755	-	A/ μ s
$t_{d(off)}$	Turn-off delay time			152	-	ns
t_f	Current fall time			83	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			1	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy			1.32	-	mJ
E_{ts}	Total switching energy			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 28)		36	-	ns
t_r	Current rise time			20	-	ns
$(di/dt)_{on}$	Turn-on current slope			1580	-	A/ μ s
$t_{d(off)}$	Turn-off delay time			161	-	ns
t_f	Current fall time			190	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			1.81	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy			2.46	-	mJ
E_{ts}	Total switching energy			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		-	μ s

1. Including the reverse recovery of the diode.

2. Including the tail of the collector current.

Table 6. 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 28)	-	488	-	ns
Q_{rr}	Reverse recovery charge		-	2.59	-	μ C
I_{rrm}	Reverse recovery current		-	11.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	406	-	A/ μ s
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 28)	-	484	-	ns
Q_{rr}	Reverse recovery charge		-	4.5	-	μ C
I_{rrm}	Reverse recovery current		-	18.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	170	-	A/ μ s
E_{rr}	Reverse recovery energy		-	0.94	-	mJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature

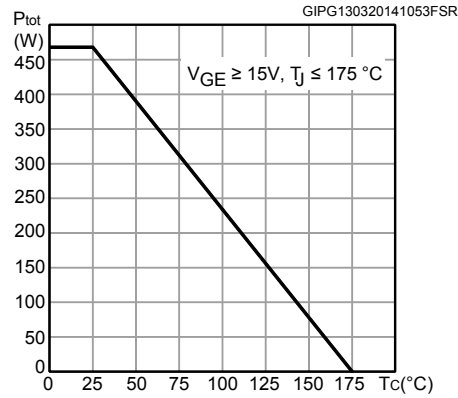


Figure 2. Collector current vs. case temperature

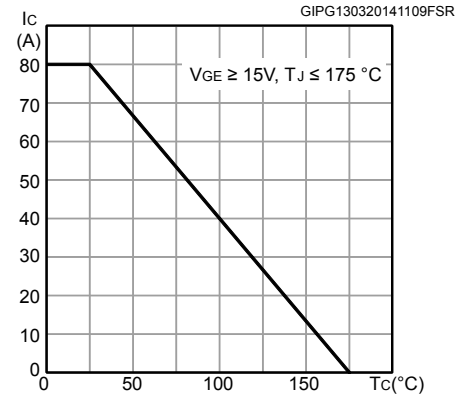


Figure 3. Output characteristics ($T_J = 25^\circ\text{C}$)

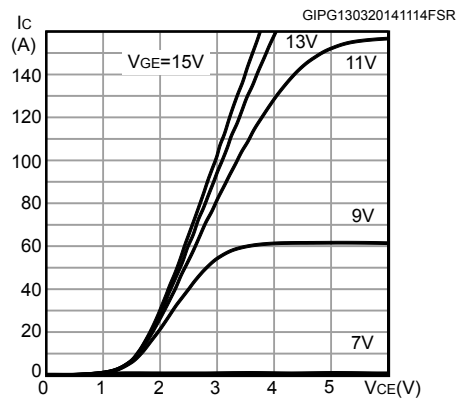


Figure 4. Output characteristics ($T_J = 175^\circ\text{C}$)

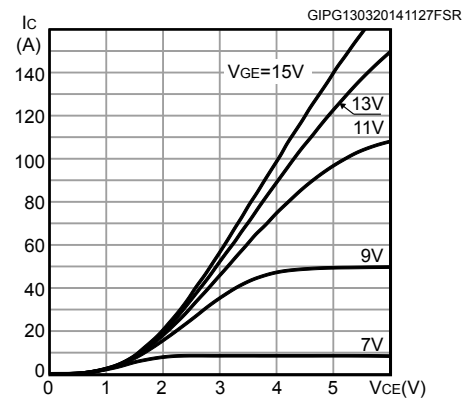


Figure 5. $V_{CE(sat)}$ vs. junction temperature

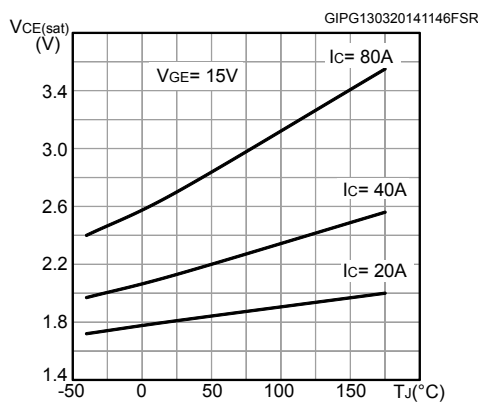


Figure 6. $V_{CE(sat)}$ vs. collector current

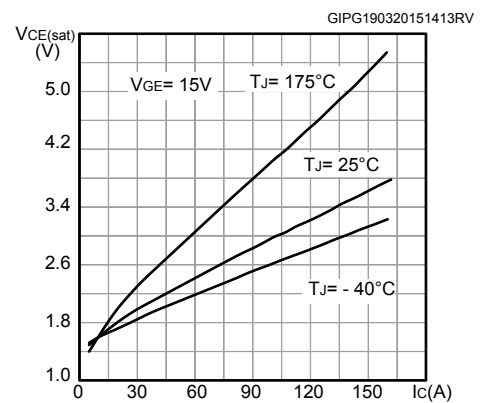


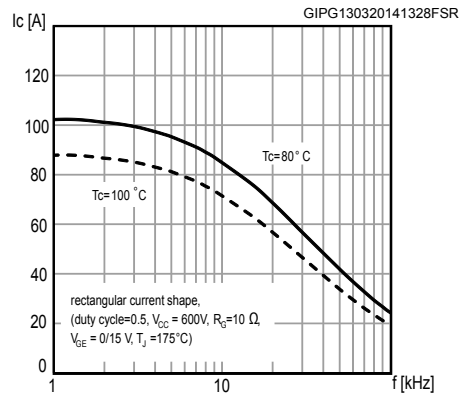
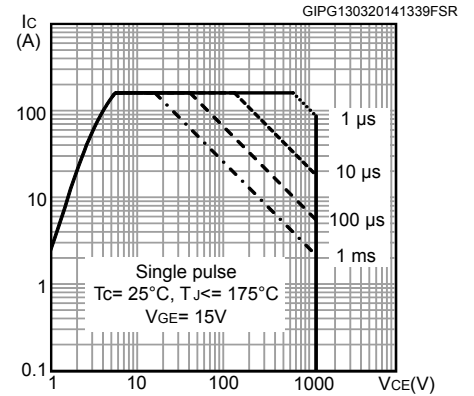
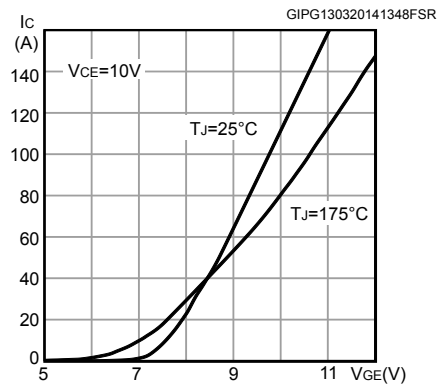
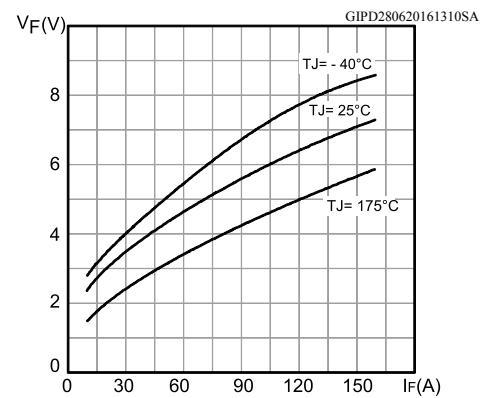
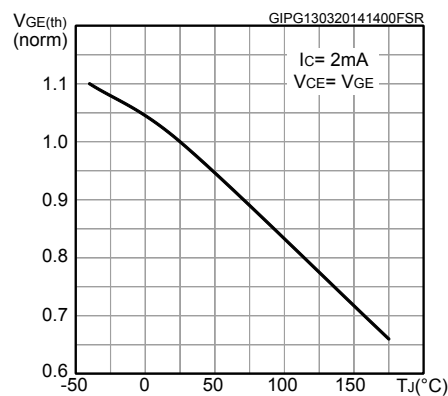
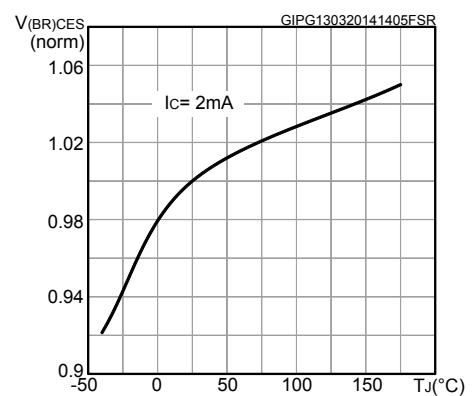
Figure 7. Collector current vs. switching frequency

Figure 8. Forward bias safe operating area

Figure 9. Transfer characteristics

Figure 10. Diode VF vs. forward current

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

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


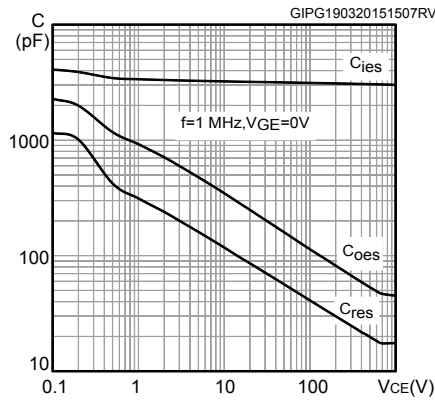
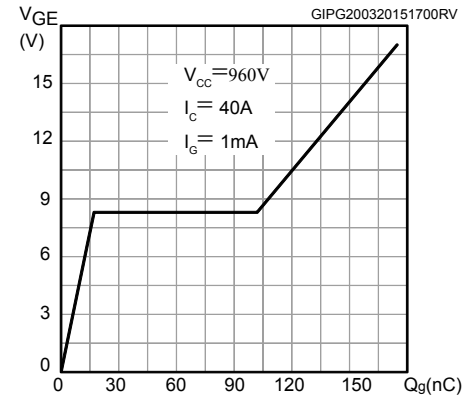
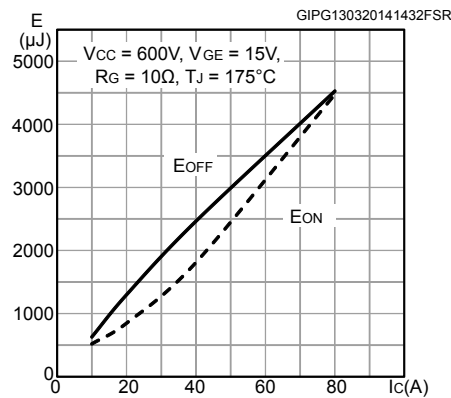
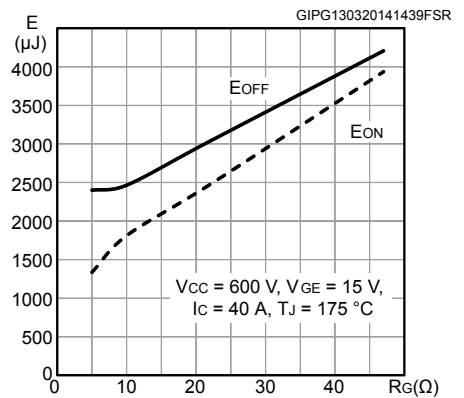
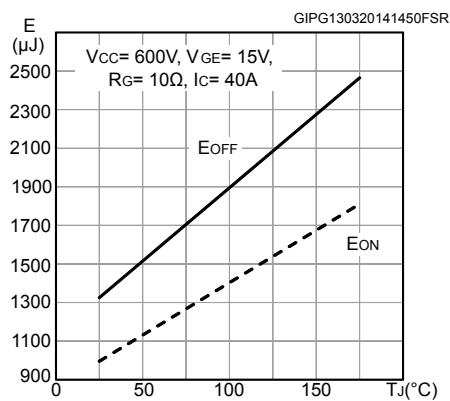
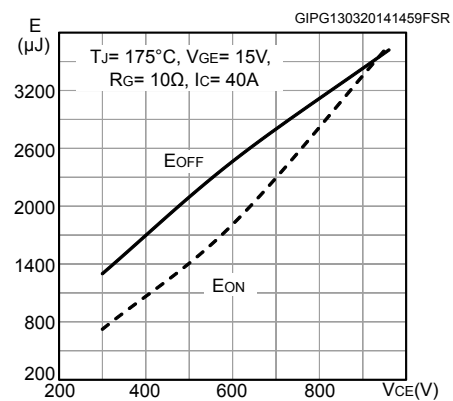
Figure 13. Capacitance variations

Figure 14. Gate charge vs. gate-emitter voltage

Figure 15. Switching energy vs. collector current

Figure 16. Switching energy vs. gate resistance

Figure 17. Switching energy vs. temperature

Figure 18. Switching energy vs. collector emitter voltage


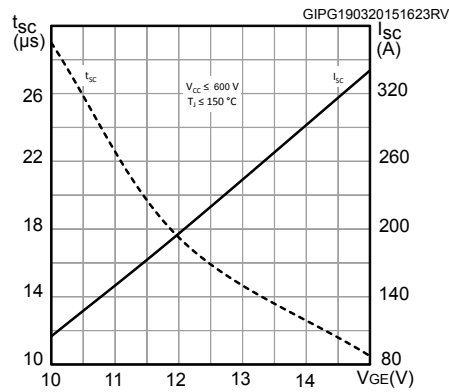
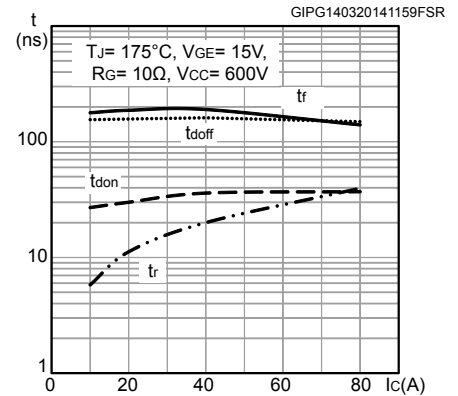
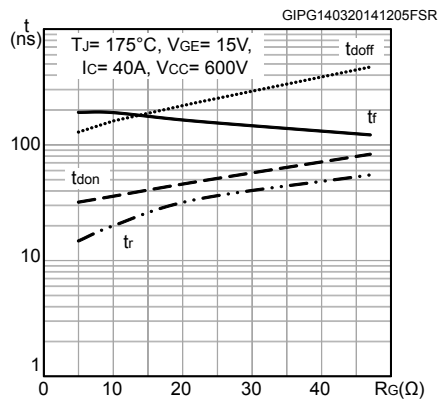
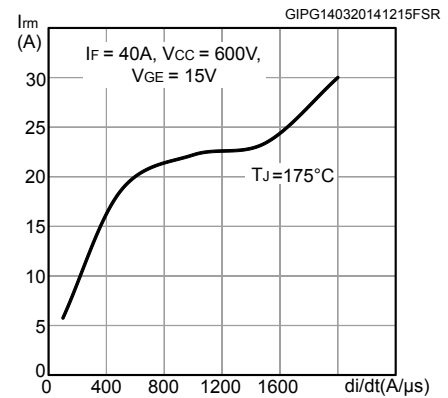
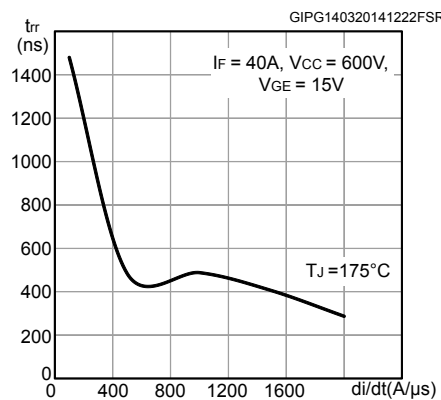
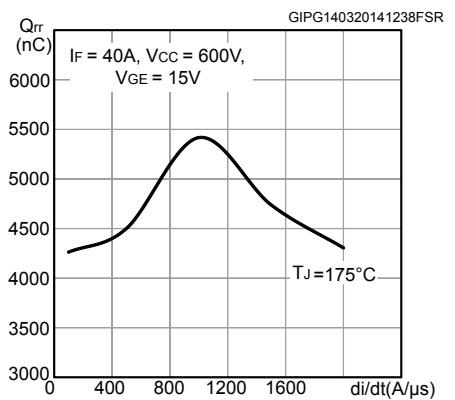
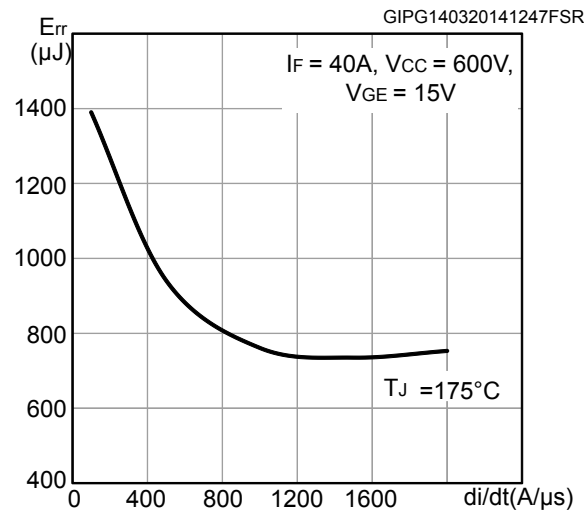
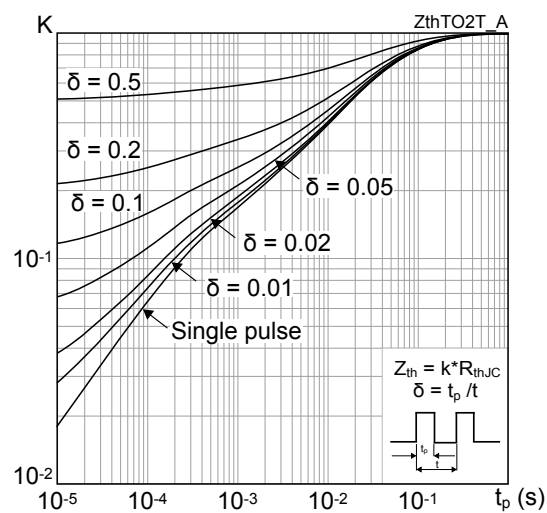
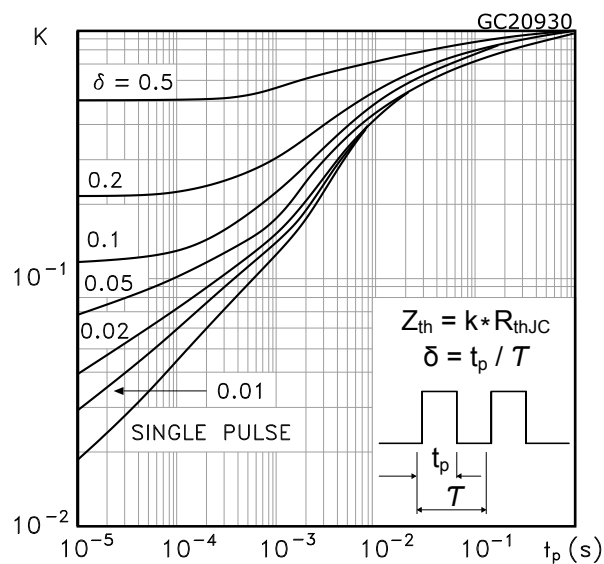
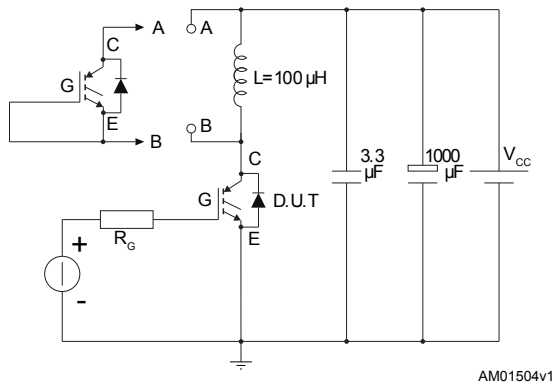
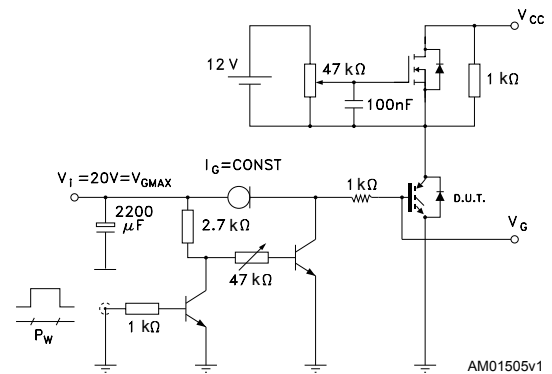
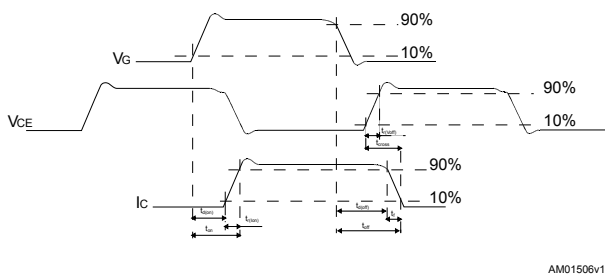
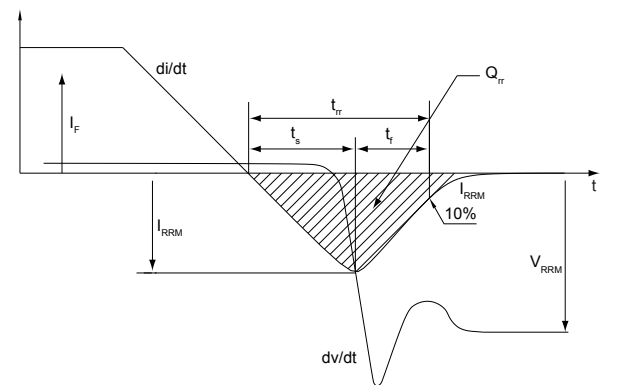
Figure 19. Short-circuit time and current vs. V_{GE}

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. Thermal impedance for IGBT

Figure 27. Thermal impedance for diode


3 Test circuits

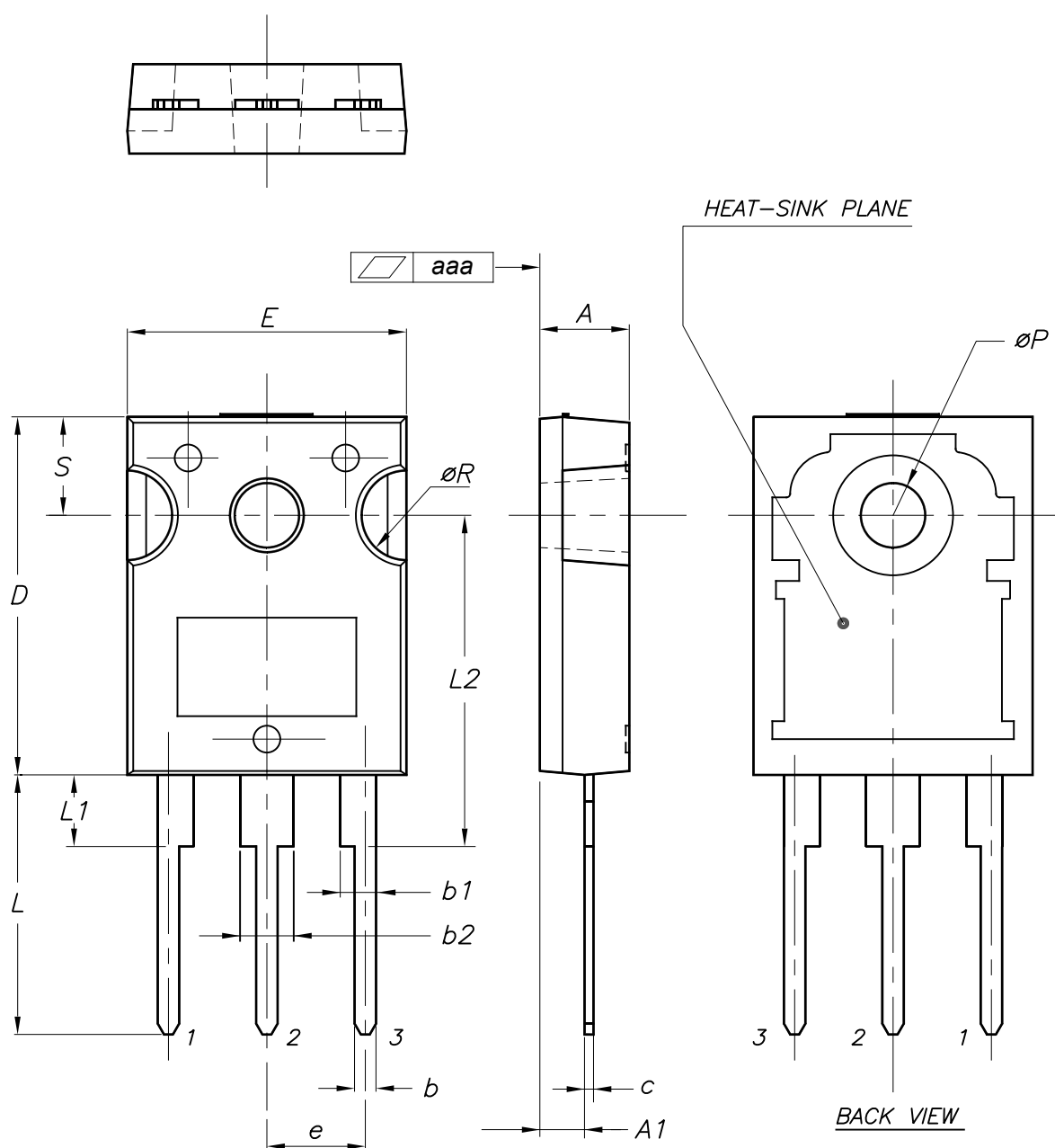
Figure 28. Test circuit for inductive load switching

Figure 29. Gate charge test circuit

Figure 30. Switching waveform

Figure 31. Diode reverse recovery waveform


4 Package information

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 32. TO-247 package outline



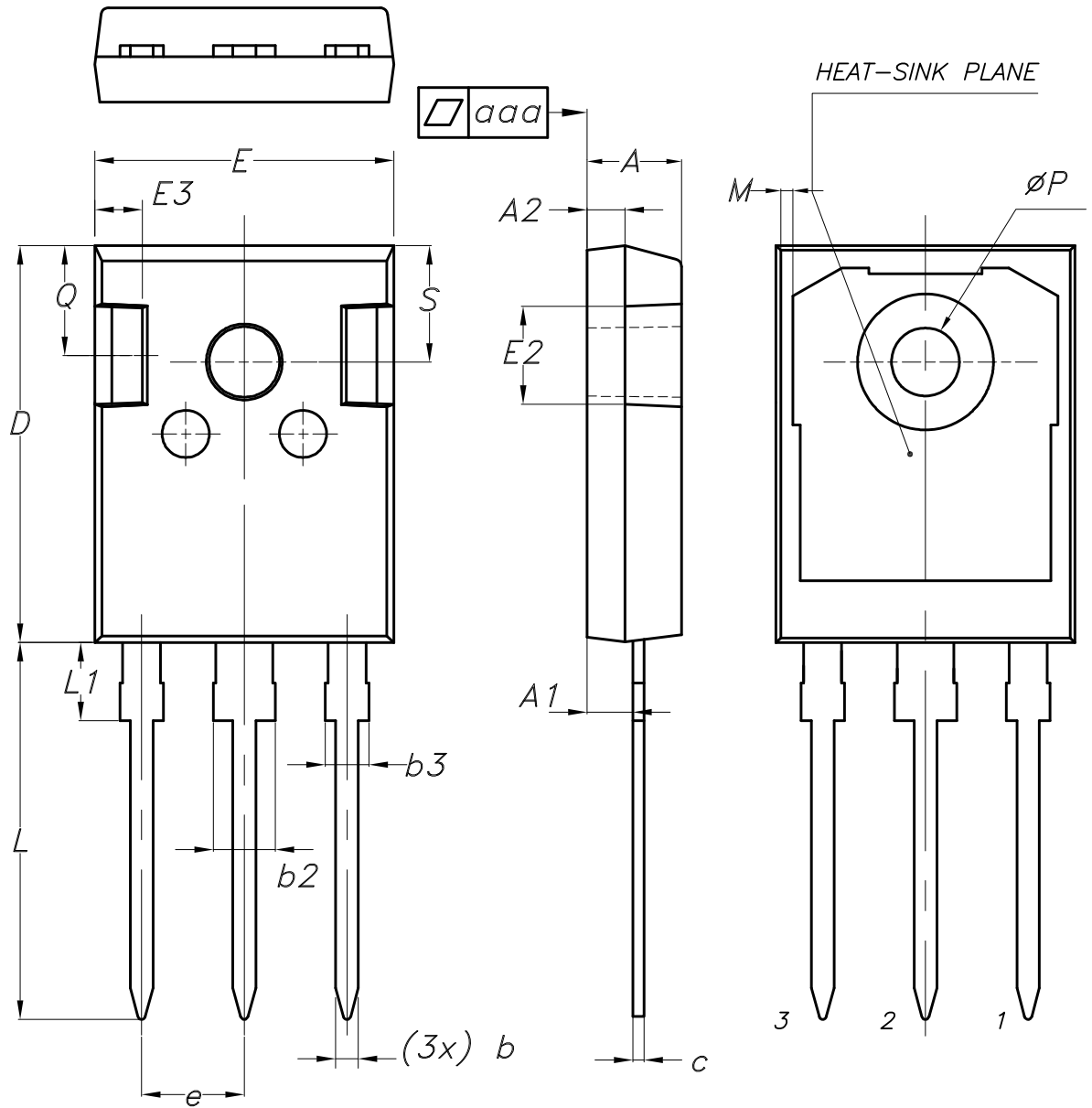
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Table 7. TO-247 package mechanical data

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
aaa		0.04	0.10

4.2 TO-247 long leads package information

Figure 33. TO-247 long leads package outline



BACK VIEW

8463846_5

Table 8. 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
M	0.35		0.95
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

Revision history

Table 9. Document revision history

Date	Revision	Changes
03-Oct-2012	1	Initial release.
29-Jan-2014	2	Updated features in cover page. Updated <i>Table 4: Static characteristics</i> , and <i>Table 7: Diode switching characteristics (inductive load)</i> . Minor text changes.
24-Mar-2014	3	Updated title and description in cover page. Updated <i>Table 4: Static characteristics</i> , <i>Table 5: Dynamic characteristics</i> and <i>Table 7: Diode switching characteristics (inductive load)</i> . Added Section 2.1: Electrical characteristics (curves).
31-Mar-2015	4	Added device in TO-247 long leads. Updated 4: <i>Package information</i> . Updated <i>Figure 7</i> , <i>Figure 11</i> , <i>Figure 14</i> , <i>Figure 15</i> , <i>Figure 20</i> , <i>Figure 21</i> and added <i>Figure 26</i> . Minor text changes.
28-Jun-2016	5	Modified: <i>Table 2: "Absolute maximum ratings"</i> , <i>Section 2: "Electrical characteristics"</i> , <i>Table 6: "IGBT switching characteristics (inductive load)"</i> . Minor text changes.
11-Feb-2025	6	Updated Section 4.1: TO-247 package information , and Section 4.2: TO-247 long leads package information . Minor text changes.



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