Trench gate field-stop IGBT, H series 1200 V, 25 A high speed
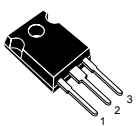
TO-247

TO-247 long leads

C (2, TAB)

G (1)

E (3)
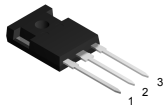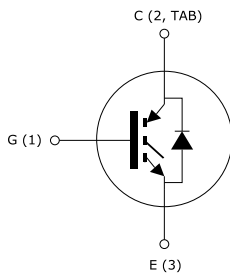
Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- $V_{CE(sat)}$ = 2.1 V (typ.) @ I_C = 25 A
- 5 µs minimum short circuit withstand time at T_J = 150 °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

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the H series of IGBTs, which represents 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.

STPOWER

Product status links
STGW25H120DF2
STGWA25H120DF2

Product summary	
Order code	**STGW25H120DF2**
Marking	G25H120DF2
Package	TO-247
Packing	Tube
Order code	**STGWA25H120DF2**
Marking	G25H120DF2
Package	TO-247 long leads
Packing	Tube

DS9297 - Rev 5 - March 2021
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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	1200	V
I_C	Continuous collector current at T_C = 25 °C	50	A
	Continuous collector current at T_C = 100 °C	25	
I_{CP}[1]	Pulsed collector current	100	A
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage (t_p ≤ 10 µs, D ≤ 0.01)	±30	
I_F	Continuous forward current at T_C = 25 °C	50	A
	Continuous forward current at T_C = 100 °C	25	
I_{FP}[1]	Pulsed forward current	100	A
P_{TOT}	Total power dissipation at T_C = 25 °C	375	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	0.4	°C/W
	Thermal resistance, junction-to-case diode	1.47	
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

T_J = 25 °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 V, I_C = 2 mA	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 25 A		2.1	2.6	V
		V_{GE} = 15 V, I_C = 25 A, T_J = 125 °C		2.4		
		V_{GE} = 15 V, I_C = 25 A, T_J = 175 °C		2.5		
V_F	Forward on-voltage	I_F = 25 A		3.8	4.9	V
		I_F = 25 A, T_J = 125 °C		3.05		
		I_F = 25 A, T_J = 175 °C		2.8		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 1200 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	2010	-	pF
C_{oes}	Output capacitance		-	146	-	pF
C_{res}	Reverse transfer capacitance		-	49	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 25 A, V_{GE} = 0 to 15 V (see Figure 28. Gate charge test circuit)	-	100	-	nC
Q_{ge}	Gate-emitter charge		-	11	-	nC
Q_{gc}	Gate-collector charge		-	52	-	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 V, I_C = 25 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 27. Test circuit for inductive load switching)		29	-	ns
t_r	Current rise time			12	-	ns
$(di/dt)_{on}$	Turn-on current slope			1774	-	A/μs
$t_{d(off)}$	Turn-off delay time			130	-	ns
t_f	Current fall time			106	-	ns
E_{on}[1]	Turn-on switching energy			0.6	-	mJ
E_{off}[2]	Turn-off switching energy			0.7	-	mJ
E_{ts}	Total switching energy			1.3	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 600 V, I_C = 25 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)		27.5	-	ns
t_r	Current rise time			13.5	-	ns
$(di/dt)_{on}$	Turn-on current slope			1522	-	A/μs
$t_{d(off)}$	Turn-off delay time			139	-	ns
t_f	Current fall time			200	-	ns
E_{on}[1]	Turn-on switching energy			1.05	-	mJ
E_{off}[2]	Turn-off switching energy			1.65	-	mJ
E_{ts}	Total switching energy			2.7	-	mJ
t_{sc}	Short-circuit withstand time	V_{CE} = 600 V, V_{GE} = 15 V, T_J = 150 °C,	5		-	μs

1. *Including the reverse recovery of the diode.*
2. *Including the tail of the collector current.*

Table 6. Diode switching characteristics (inductive load)

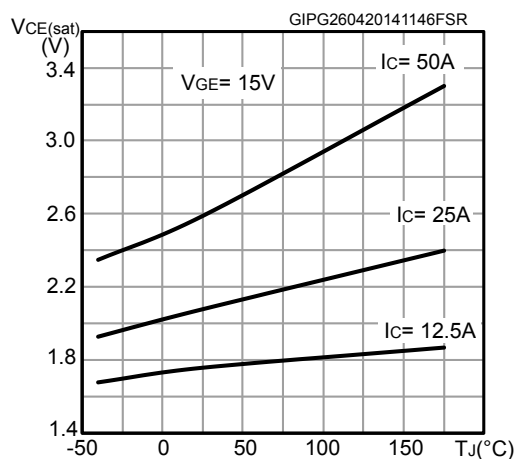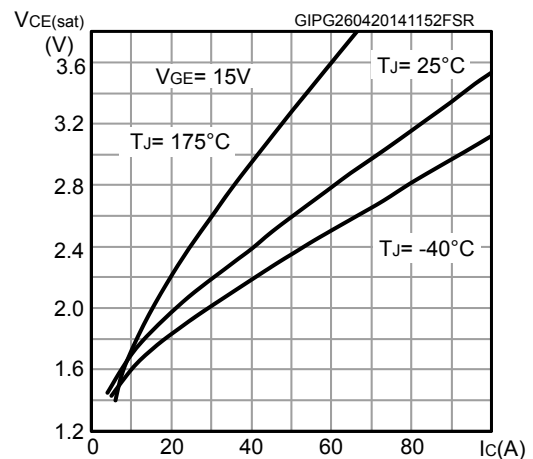| Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 25 A, V_R = 600 V, di/dt = 500 A/μs, V_{GE} = 15 V (see Figure 27. Test circuit for inductive load switching)	-	303	-	ns
Q_{rr}	Reverse recovery charge		-	0.93	-	μC
I_{rrm}	Reverse recovery current		-	15.3	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	400	-	A/μs
E_{rr}	Reverse recovery energy		-	0.52	-	mJ
t_{rr}	Reverse recovery time	I_F = 25 A, V_R = 600 V, di/dt = 500 A/μs, V_{GE} = 15 V, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)	-	508	-	ns
Q_{rr}	Reverse recovery charge		-	2.71	-	μC
I_{rrm}	Reverse recovery current		-	23	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	680		A/μs
E_{rr}	Reverse recovery energy		-	1.56		mJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature
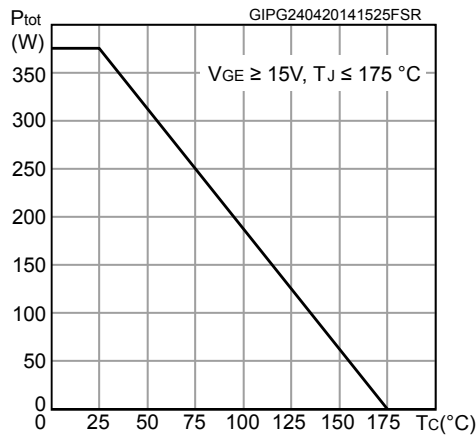
Figure 2. Collector current vs case temperature
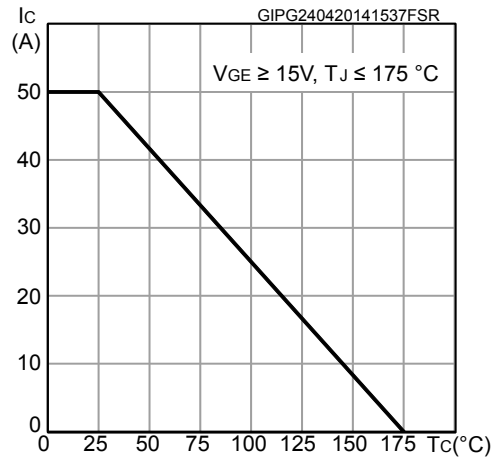
Figure 3. Output characteristics (T$_J$ = 25 °C)
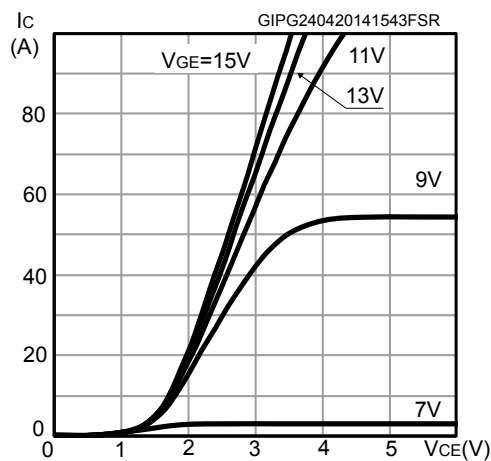
Figure 4. Output characteristics (T$_J$ = 175 °C)
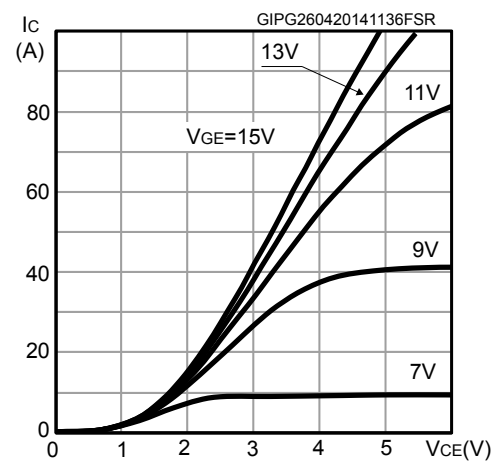
Figure 5. V$_{CE}$(sat) vs junction temperature
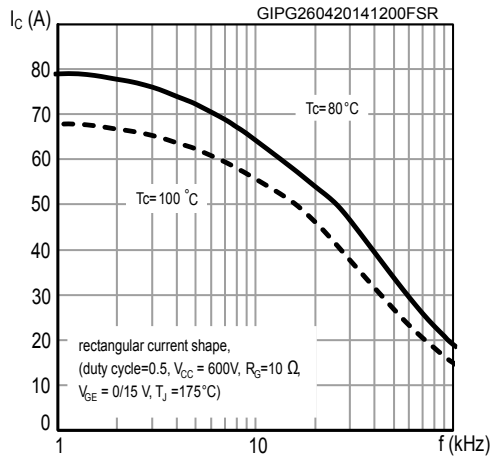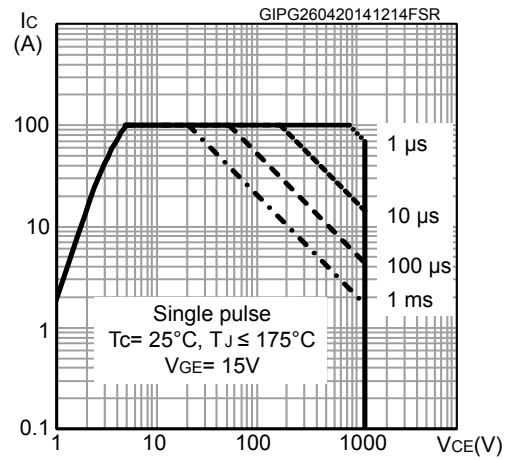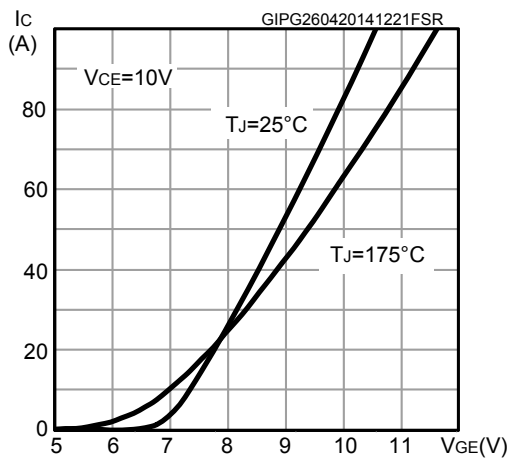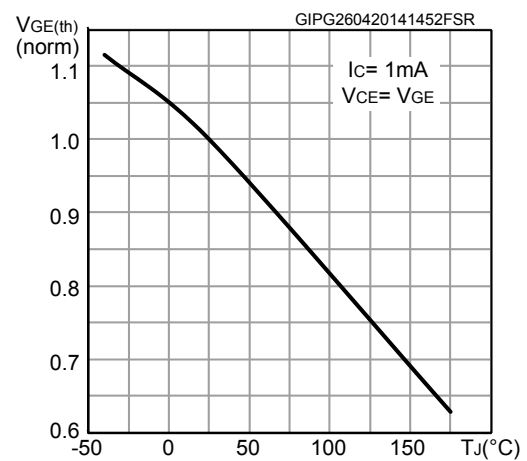

Figure 6. V$_{CE}$(sat) vs collector current

Figure 7. Collector current vs switching frequency

GIPG260420141200FSR

Tc=80°C

Tc= 100 °C

rectangular current shape,
(duty cycle=0.5, V_{CC} = 600V, R_G=10 Ω,
V_{GE} = 0/15 V, T_J =175°C)

I_C (A) / f (kHz)

Figure 8. Safe operating area

GIPG260420141214FSR

1 µs
10 µs
100 µs
1 ms

Single pulse
Tc= 25°C, T_J ≤ 175°C
V_{GE}= 15V

I_C (A) / V_{CE}(V)

Figure 9. Transfer characteristics

GIPG260420141221FSR

V_{CE}=10V

T_J=25°C

T_J=175°C

I_C (A) / V_{GE}(V)

Figure 10. Diode V_F vs forward current

GIPG260420141452FSR

I_C= 1mA
V_{CE}= V_{GE}

$V_{GE(th)}$ (norm) / T_J(°C)

Figure 11. Normalized $V_{(BR)CES}$ vs junction temperature

GIPG260420141502FSR

I_C= 2mA

$V_{(BR)CES}$ (norm) / T_J(°C)
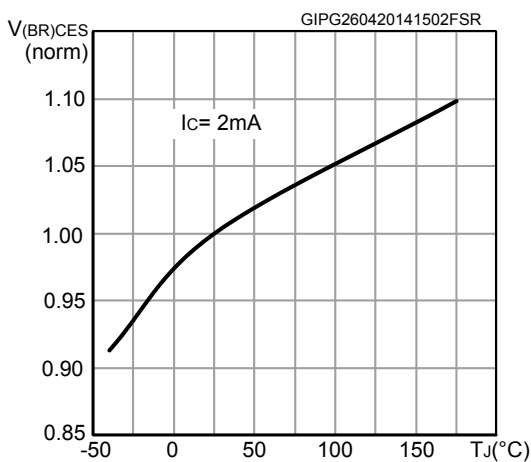
Figure 12. Capacitance variations

GIPG260420141508FSR

C_{ies}
C_{oes}
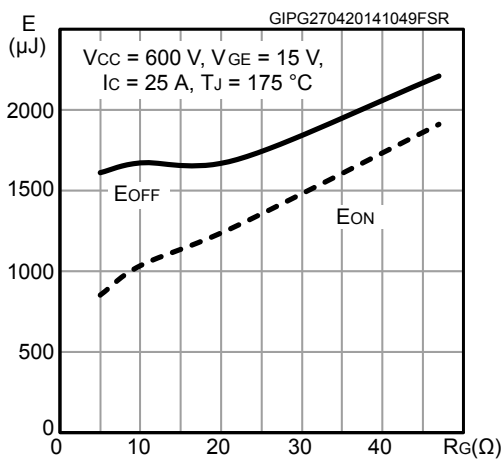C_{res}

f = 1 MHz, V_{GE} = 0
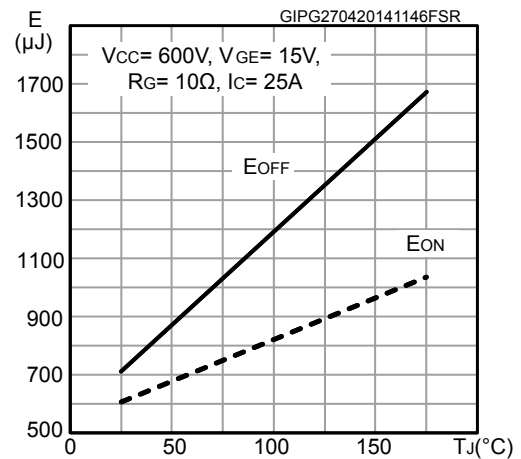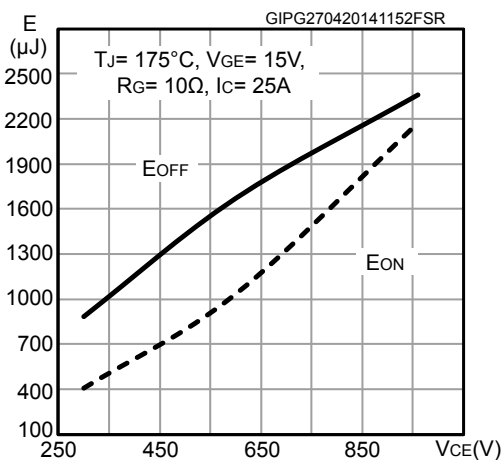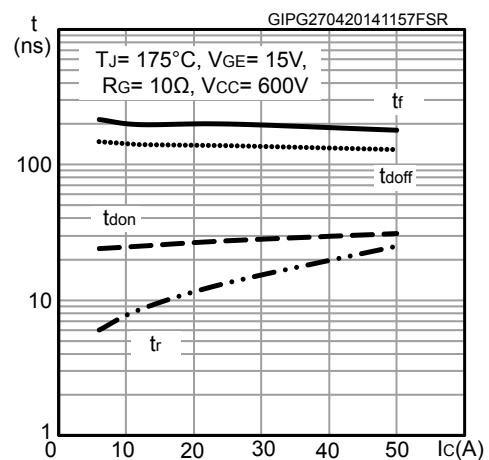
C (pF) / V_{CE}(V)
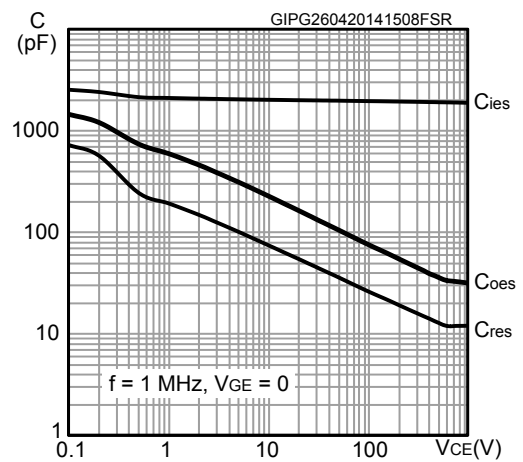
Figure 13. Gate charge vs gate-emitter voltage
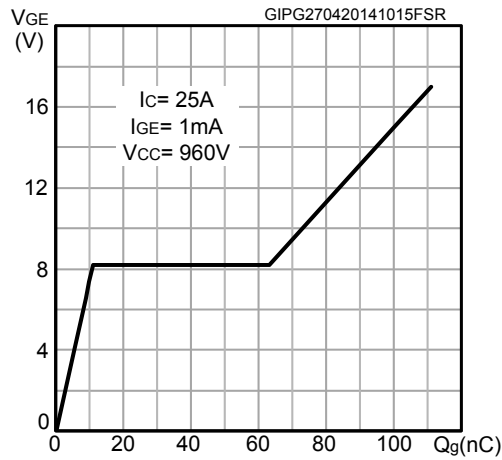
Figure 14. Switching energy vs collector current
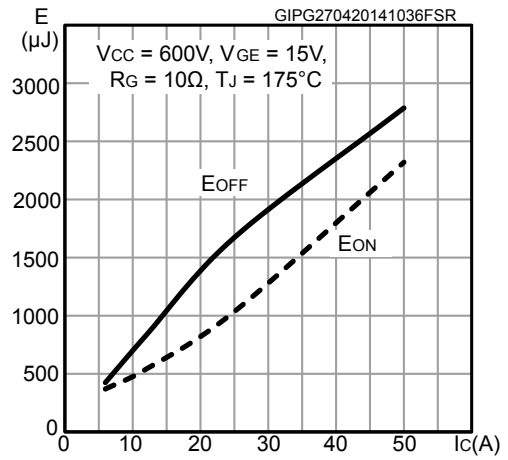
Figure 15. Switching energy vs gate resistance

Figure 16. Switching energy vs junction temperature

Figure 17. Switching energy vs collector-emitter voltage

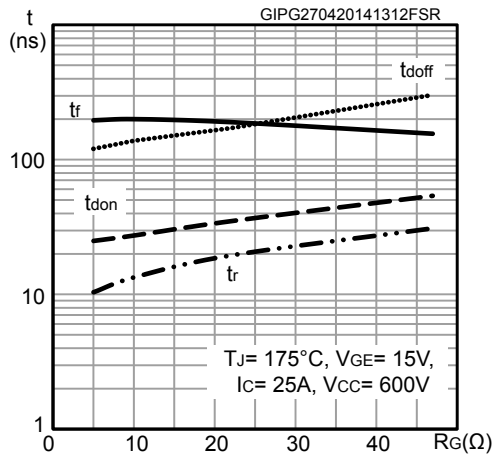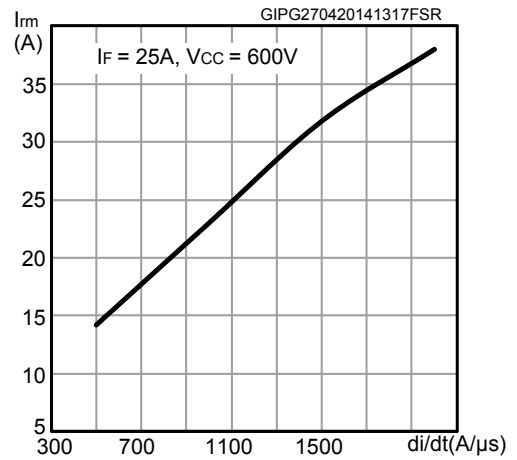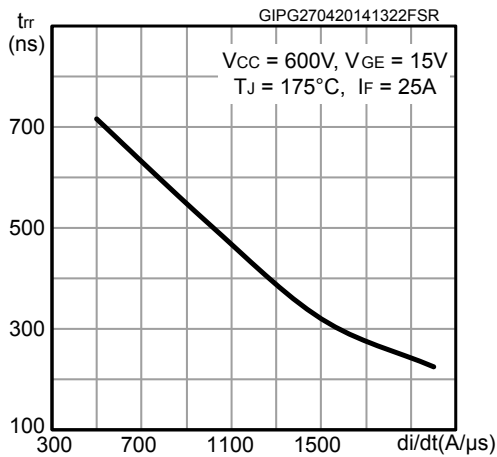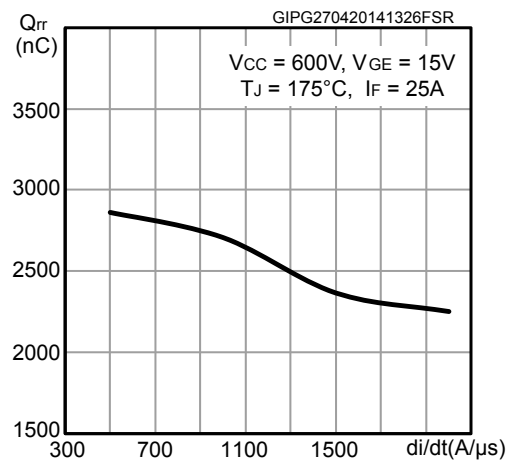**Figure 18. Switching times vs collector current**

Figure 19. Switching times vs gate resistance

GIPG270420141312FSR

$T_J = 175°C$, $V_{GE} = 15V$, $I_C = 25A$, $V_{CC} = 600V$

Figure 20. Reverse recovery current vs diode current slope

GIPG270420141317FSR

$I_F = 25A$, $V_{CC} = 600V$

Figure 21. Reverse recovery time vs diode current slope

GIPG270420141322FSR

$V_{CC} = 600V$, $V_{GE} = 15V$
$T_J = 175°C$, $I_F = 25A$

Figure 22. Reverse recovery charge vs diode current slope

GIPG270420141326FSR

$V_{CC} = 600V$, $V_{GE} = 15V$
$T_J = 175°C$, $I_F = 25A$

Figure 23. Reverse recovery energy vs diode current slope

GIPG270420141330FSR

$V_{CC} = 600V$, $V_{GE} = 15V$
$T_J = 175°C$, $I_F = 25A$
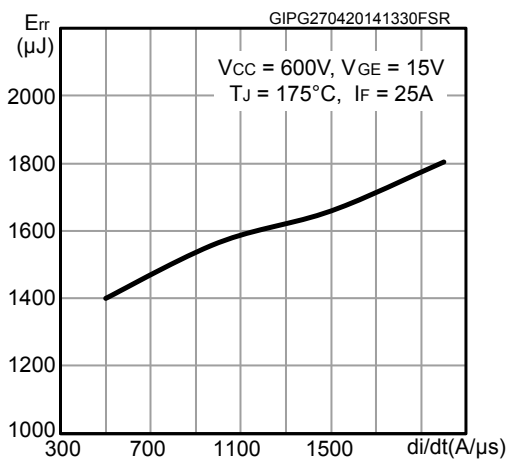
Figure 24. Diode V_F vs forward current

GIPG270420141355FSR

$T_J = -40°C$
$T_J = 25°C$
$T_J = 175°C$
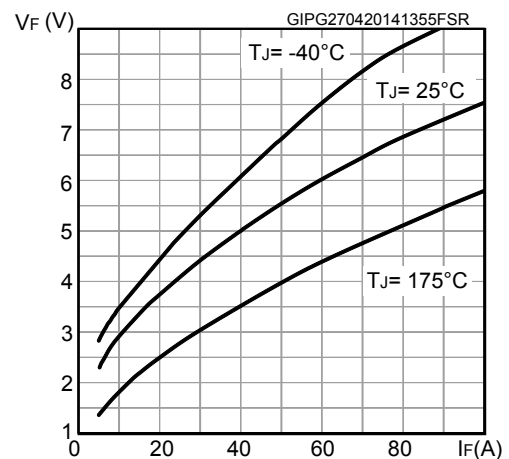
Figure 25. Thermal impedence for IGBT
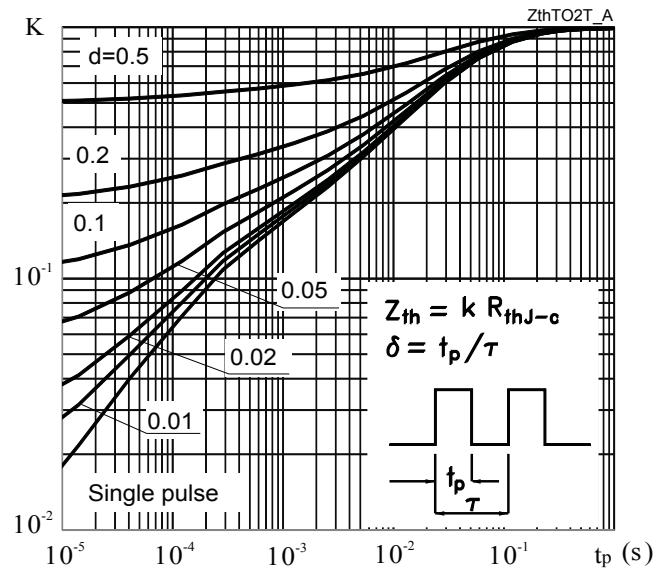
Figure 26. Thermal impedance for diode
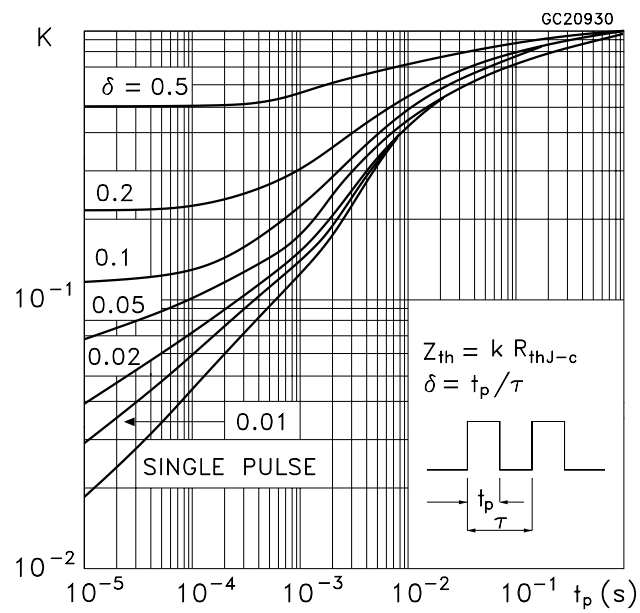
3 Test circuits

Figure 27. Test circuit for inductive load switching

AM01504v1

Figure 28. Gate charge test circuit

AM01505v1
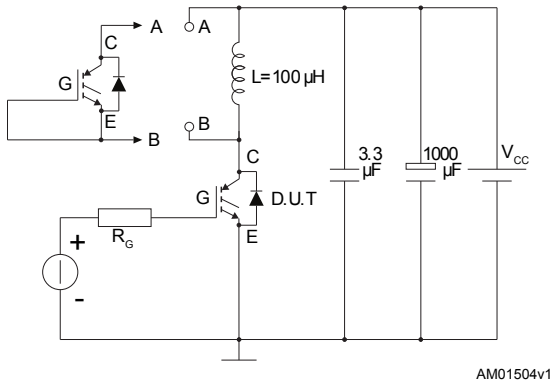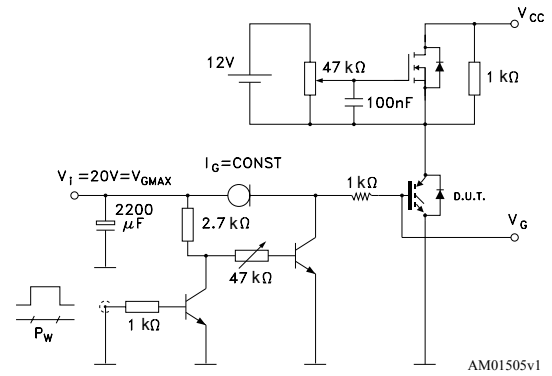
Figure 29. Switching waveform

AM01506v1
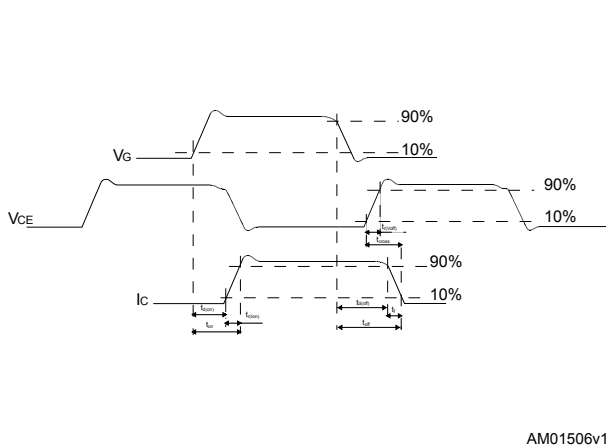
Figure 30. Diode reverse recovery waveform

AM01507v1
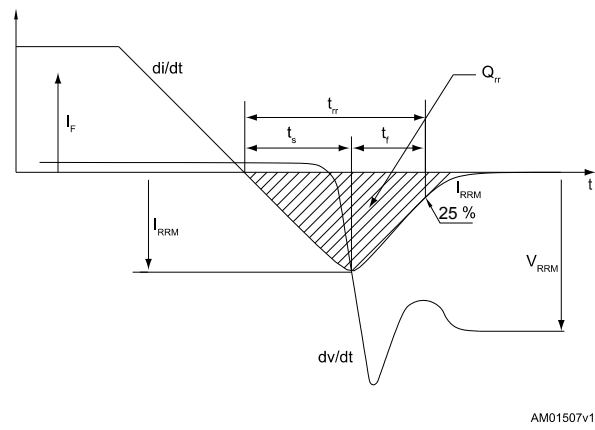
4 Package information

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 31. TO-247 package outline
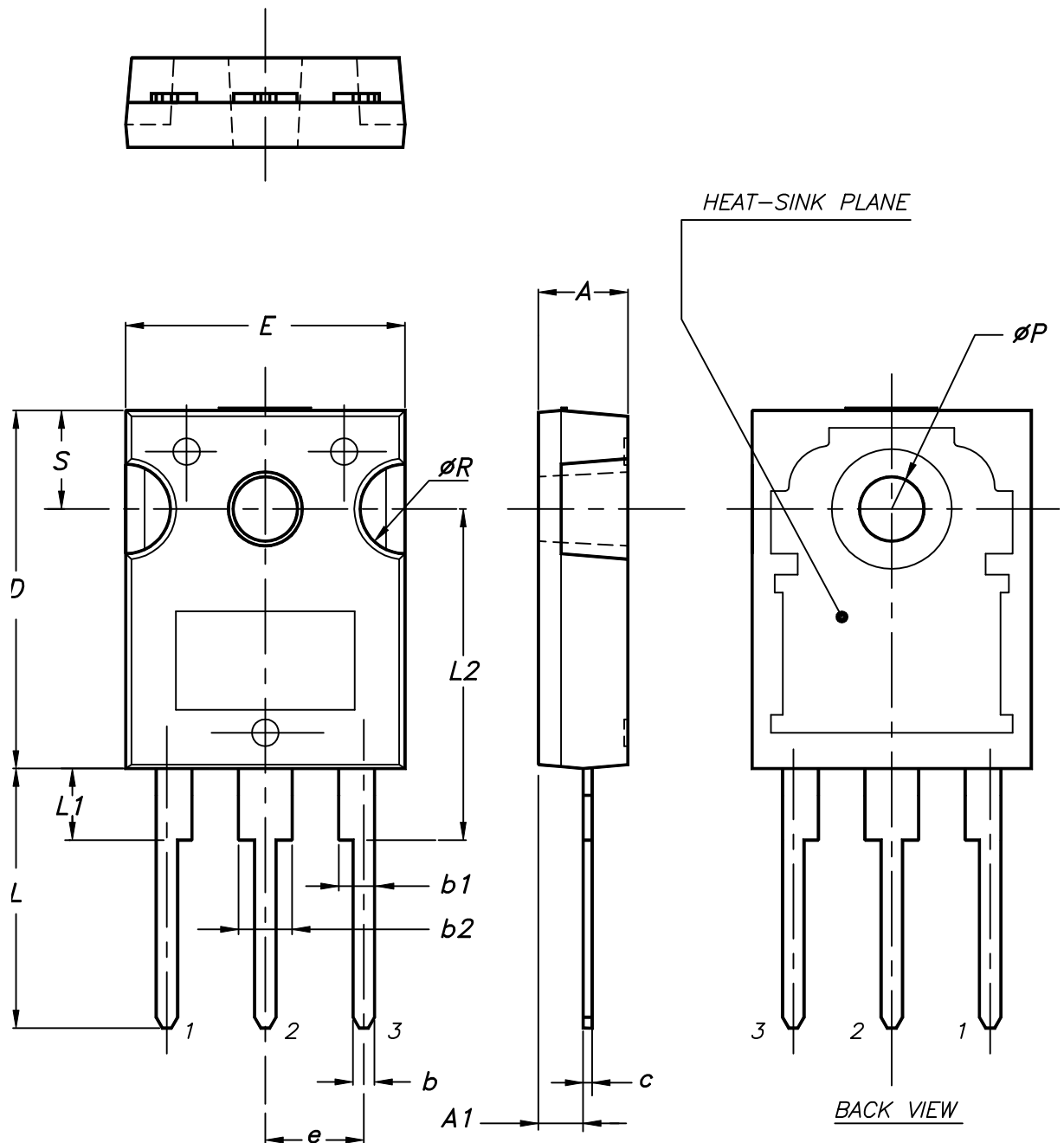
0075325_9

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

4.2 TO-247 long leads package information

Figure 32. TO-247 long leads package outline
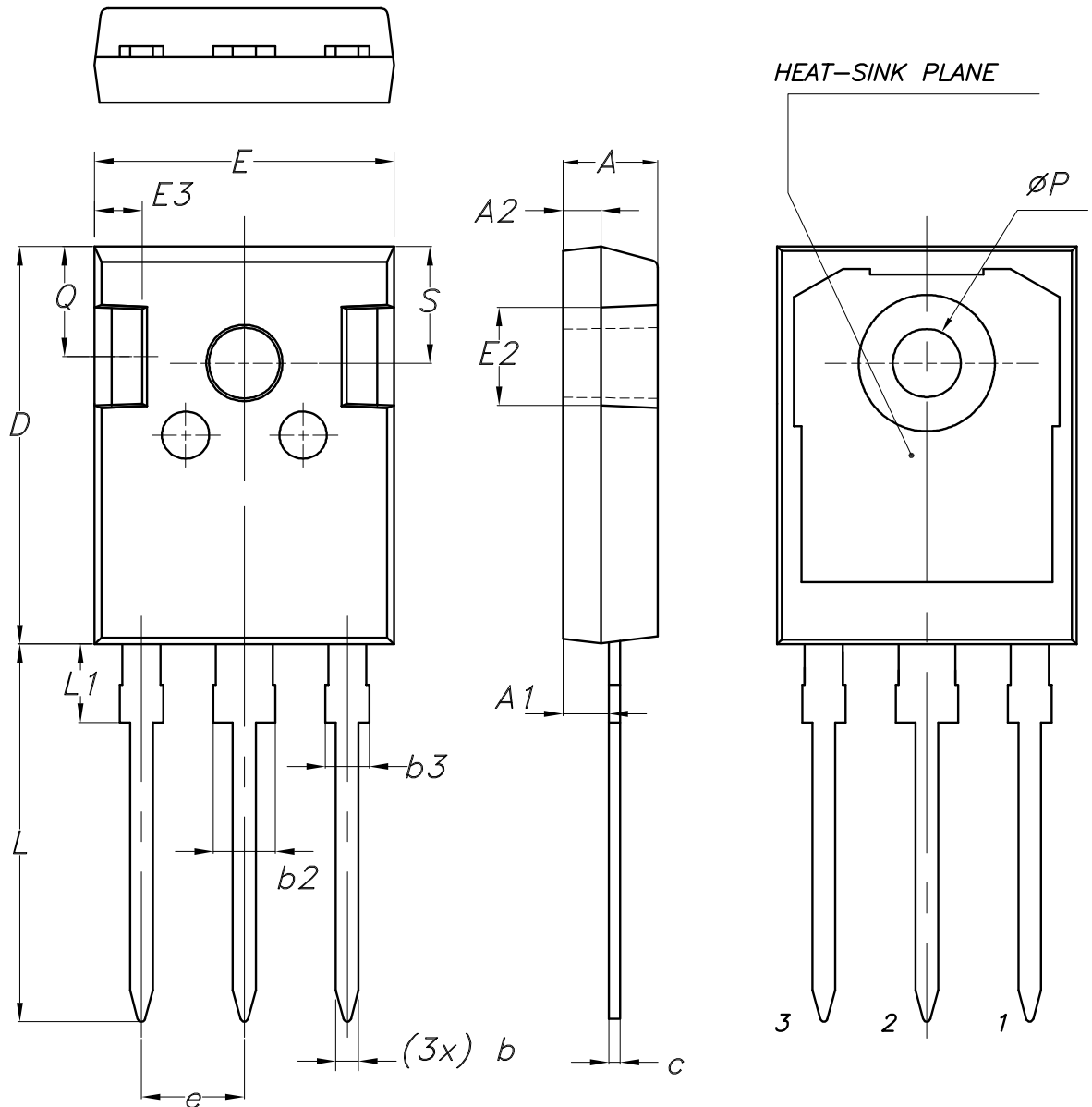
8463846_2_F

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
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

Revision history

Table 9. Document revision history

Date	Revision	Changes
03-Oct-2012	1	Initial release.
28-Feb-2014	2	Updated title and features in cover page. Minor text changes.
31-Mar-2014	3	Document status promoted from preliminary to production data. Updated *Table 4: Static characteristics* and *Table 6: IGBT switching characteristics (inductive load)*. Added Section 2.1: Electrical characteristics (curves).
06-Mar-2015	4	Added *4.2: TO-247 long leads, package information*. Minor text changes.
10-Mar-2021	5	Updated Table 1. Absolute maximum ratings. Minor text changes.

Contents

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IXA40RG1200DHGLB APT70GR65B2DU40 NTE3320 IHFW40N65R5SXKSA1 APT70GR120J APT35GP120JDQ2

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