



Trench gate field-stop 1200 V, 15 A low-loss M series IGBT in a TO-247 and TO-247 long leads packages

Features

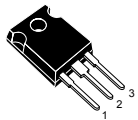
- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- 6 μs of minimum short-circuit withstand time
- $V_{CE(sat)} = 1.85\text{ V}$ (typ.) @ $I_C = 15\text{ A}$
- Tight parameter distribution
- Safer paralleling
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Soft and very fast-recovery antiparallel diode

Applications

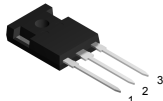
- Industrial motor control
- Industrial drives
- Solar inverters
- Uninterruptable power supplies (UPS)

Description

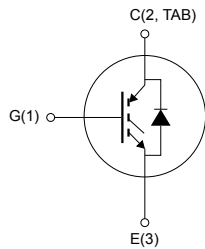
These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. The devices are part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where the low-loss and the short-circuit functionality are essential. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and the tight parameter distribution result in safer paralleling operation.



TO-247



TO-247 long leads



Product status links

[STGW15M120DF3](#)

[STGWA15M120DF3](#)

Product summary

Order code	STGW15M120DF3
Marking	G15M120DF3
Package	TO-247
Packing	Tube
Order code	STGWA15M120DF3
Marking	G15M120DF3
Package	TO-247 long leads
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$ V)	1200	V
I_C	Continuous collector current at $T_C = 25$ °C	30	A
	Continuous collector current at $T_C = 100$ °C	15	
$I_{CP}^{(1)}$	Pulsed collector current	60	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at $T_C = 25$ °C	30	A
	Continuous forward current at $T_C = 100$ °C	15	
$I_{FP}^{(1)}$	Pulsed forward current	60	A
P_{TOT}	Total power dissipation at $T_C = 25$ °C	259	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature range	- 55 to 175	°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	0.58	°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	$V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$		1.85	2.3	V
		$V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $T_J = 125\text{ °C}$		2.1		
		$V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $T_J = 175\text{ °C}$		2.2		
V_F	Forward on-voltage	$I_F = 15\text{ A}$		2.7	3.8	V
		$I_F = 15\text{ A}$, $T_J = 125\text{ °C}$		2.05		
		$I_F = 15\text{ A}$, $T_J = 175\text{ °C}$		1.75		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 500\text{ }\mu\text{A}$	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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	985	-	pF
C_{oes}	Output capacitance		-	118	-	pF
C_{res}	Reverse transfer capacitance		-	38	-	pF
Q_g	Total gate charge	$V_{CC} = 960\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 29. Gate charge test circuit)	-	53	-	nC
Q_{ge}	Gate-emitter charge		-	8	-	nC
Q_{gc}	Gate-collector charge		-	32	-	nC

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$, $I_C = 15\text{ A}$, $R_G = 22\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 28. Test circuit for inductive load switching)		26	-	ns
t_r	Current rise time			12	-	ns
$(di/dt)_{on}$	Turn-on current slope			1000	-	A/ μ s
$t_{d(off)}$	Turn-off delay time			122	-	ns
t_f	Current fall time			163	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			0.55	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy			0.85	-	mJ
E_{ts}	Total switching energy			1.4	-	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 28. Test circuit for inductive load switching)		25	-	ns
t_r	Current rise time			14	-	ns
$(di/dt)_{on}$	Turn-on current slope			857	-	A/ μ s
$t_{d(off)}$	Turn-off delay time			136	-	ns
t_f	Current fall time			270	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			1.1	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy			1.13	-	mJ
E_{ts}	Total switching energy			2.23	-	mJ
t_{sc}	Short-circuit withstand time	$V_{CE} = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	10		-	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	$I_F = 15\text{ A}$, $V_R = 600\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $V_{GE} = 15\text{ V}$ (see Figure 28. Test circuit for inductive load switching)	-	270	-	ns
Q_{rr}	Reverse recovery charge		-	0.96	-	μ C
I_{rrm}	Reverse recovery current		-	15	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	935	-	A/ μ s
E_{rr}	Reverse recovery energy		-	0.18	-	mJ
t_{rr}	Reverse recovery time	$I_F = 15\text{ A}$, $V_R = 600\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28. Test circuit for inductive load switching)	-	534	-	ns
Q_{rr}	Reverse recovery charge		-	3.45	-	μ C
I_{rrm}	Reverse recovery current		-	23	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	266	-	A/ μ s
E_{rr}	Reverse recovery energy		-	0.55	-	mJ

2.1 Electrical characteristics (curves)

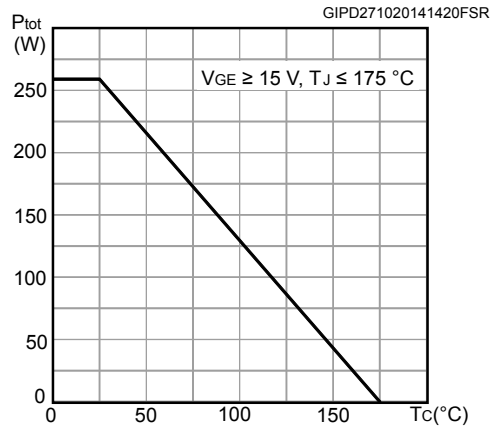
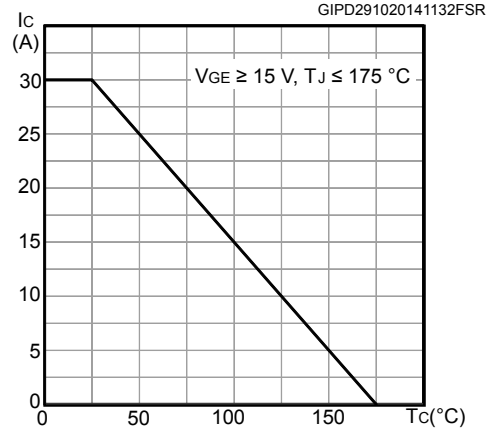
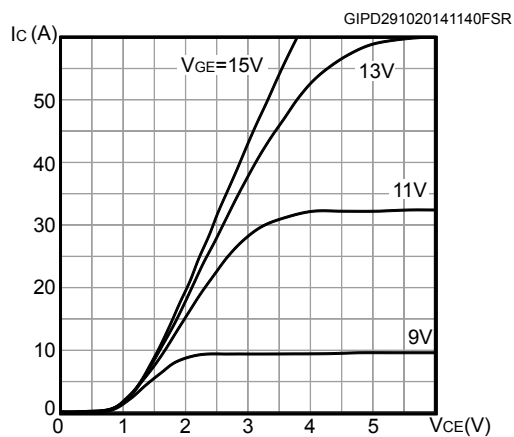
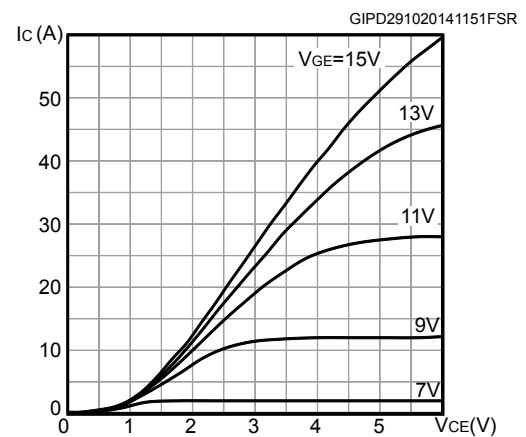
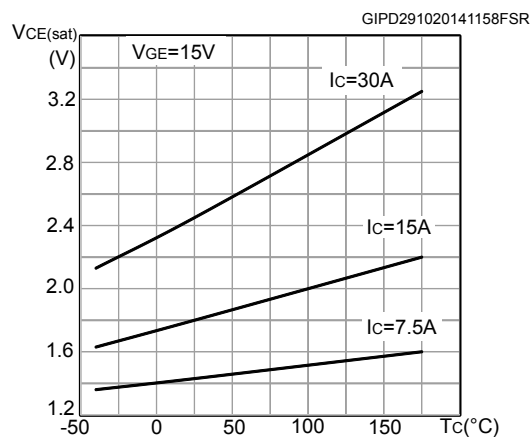
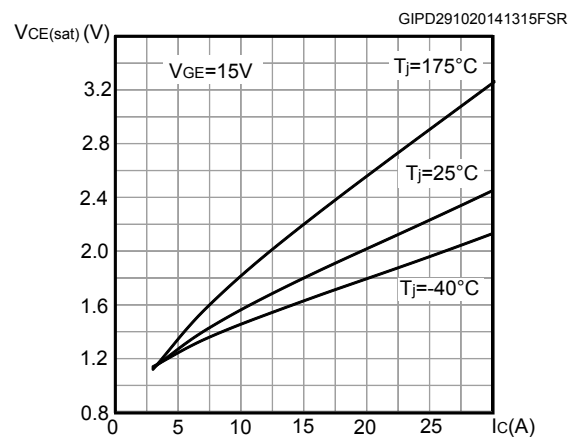
Figure 1. Power dissipation vs case temperature

Figure 2. Collector current vs case temperature

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

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

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

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


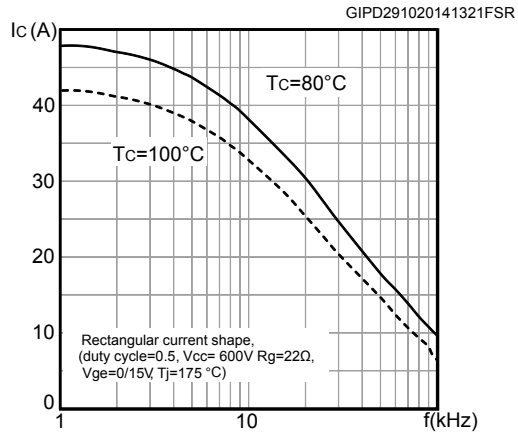
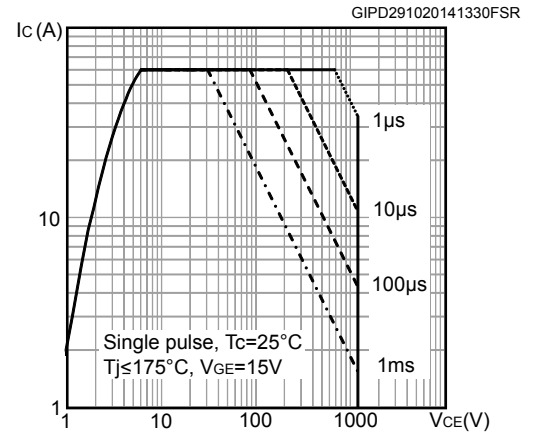
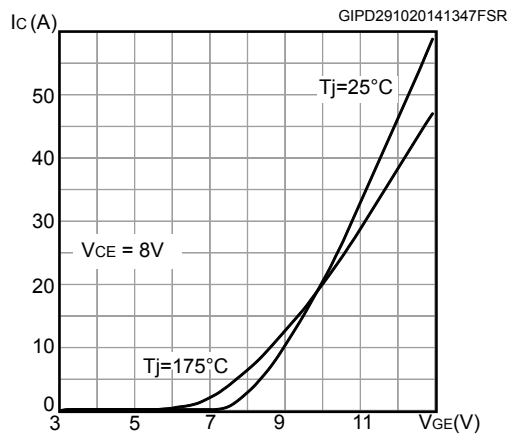
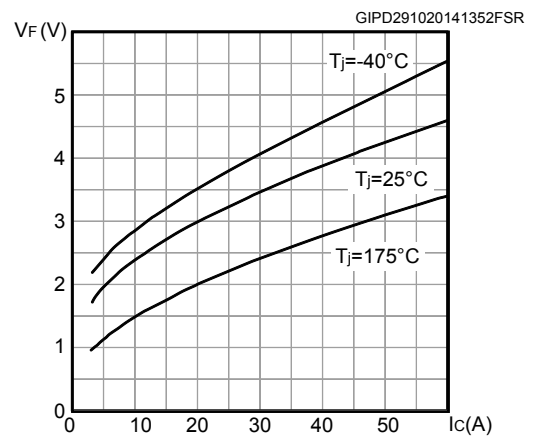
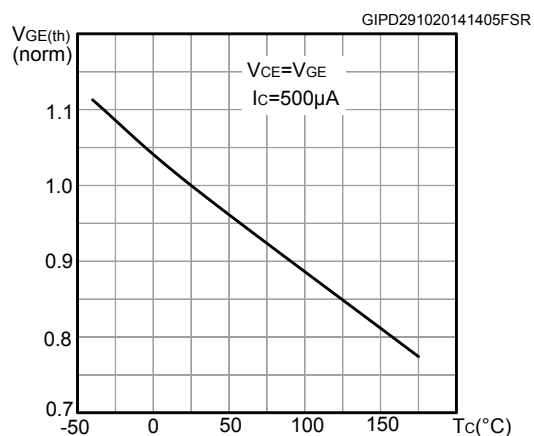
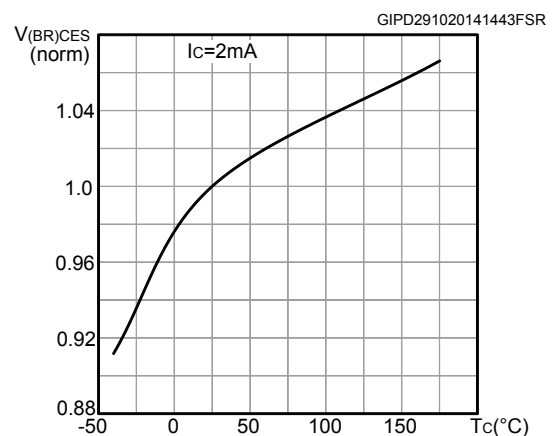
Figure 7. Collector current vs switching frequency

Figure 8. Safe operating area

Figure 9. Transfer characteristics

Figure 10. Diode V_F vs forward current

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

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


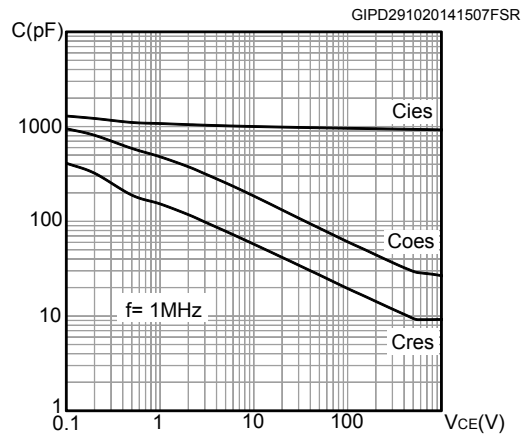
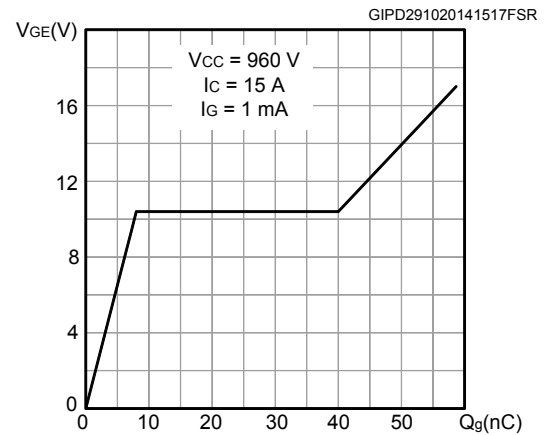
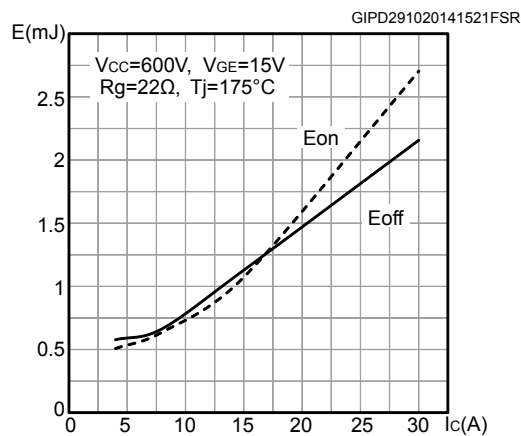
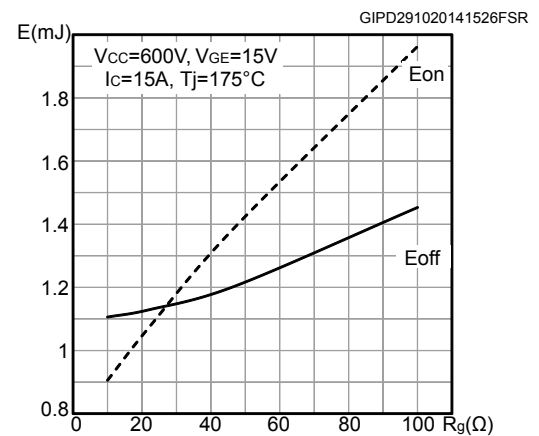
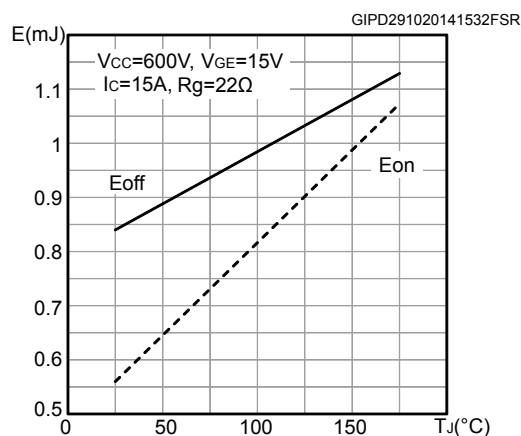
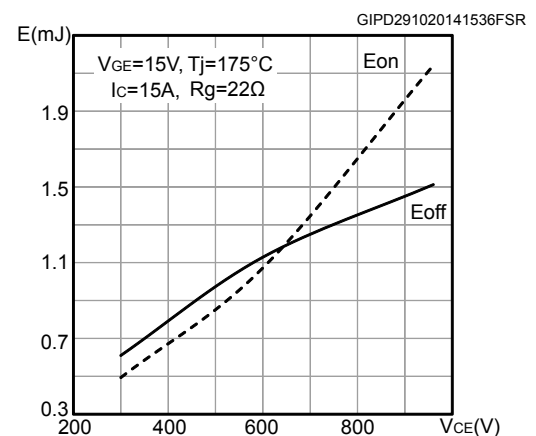
Figure 13. Capacitance variations

Figure 14. Gate charge vs gate-emitter voltage

Figure 15. Switching loss vs. collector current

Figure 16. Switching loss vs. gate resistance

Table 7. Switching energy vs
Figure 17. Switching loss vs junction temperature

Figure 18. Switching loss vs collector emitter voltage


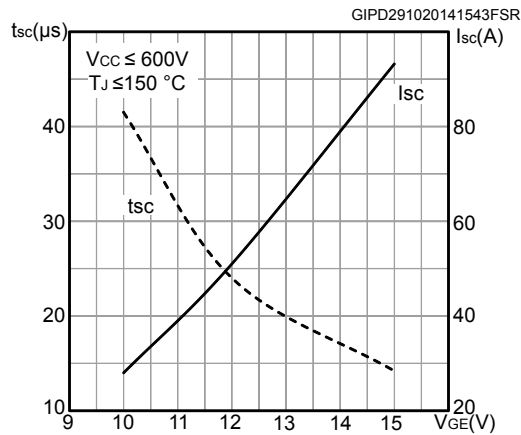
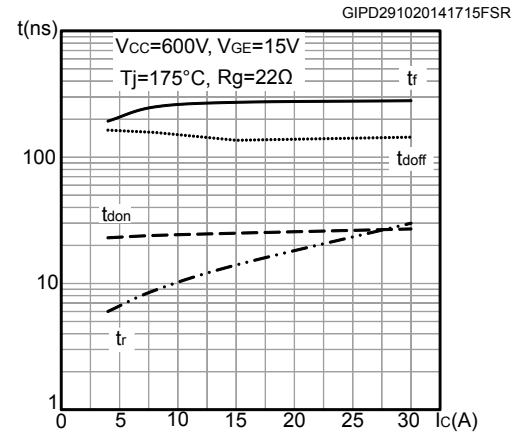
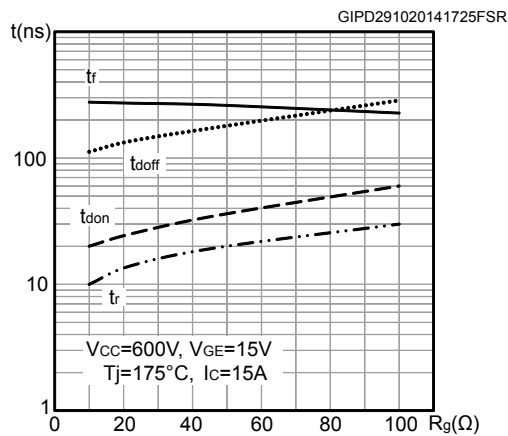
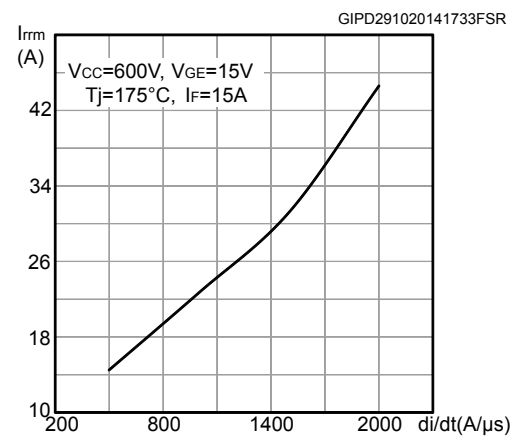
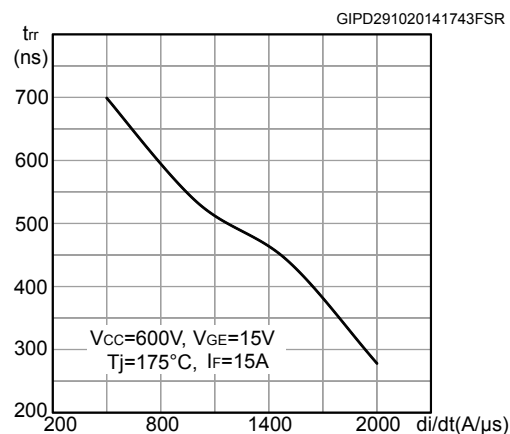
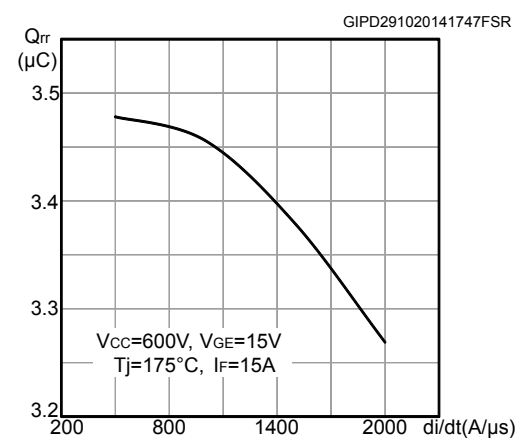
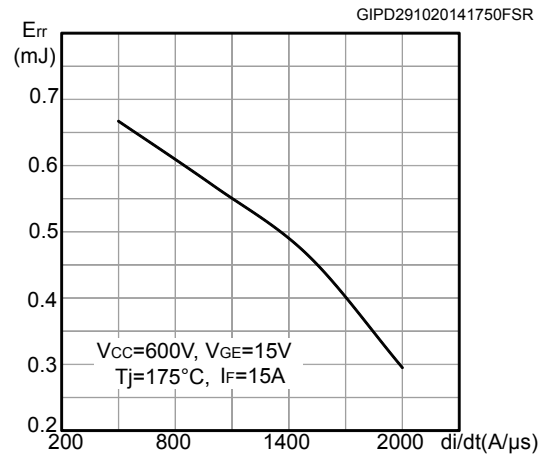
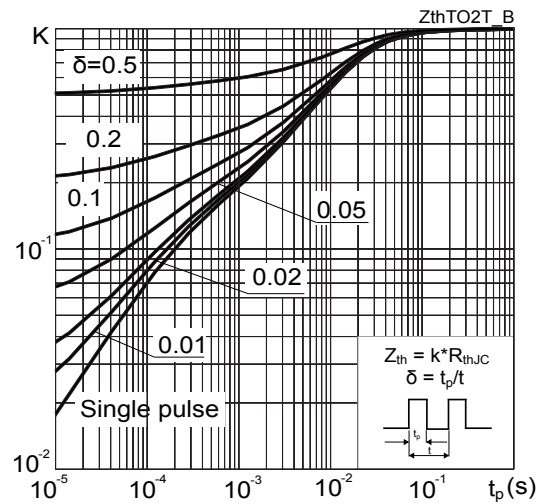
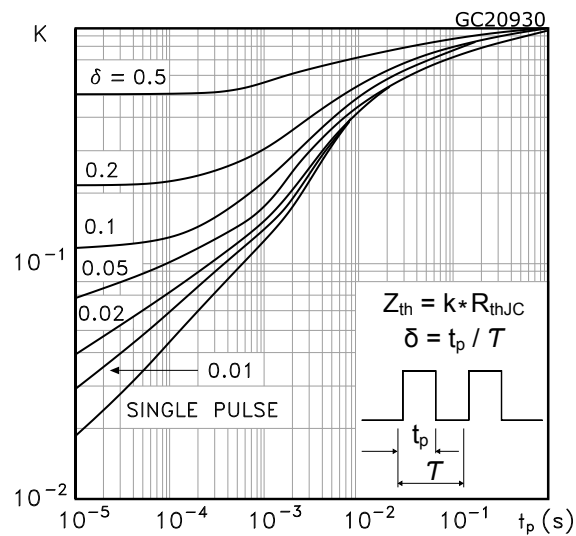
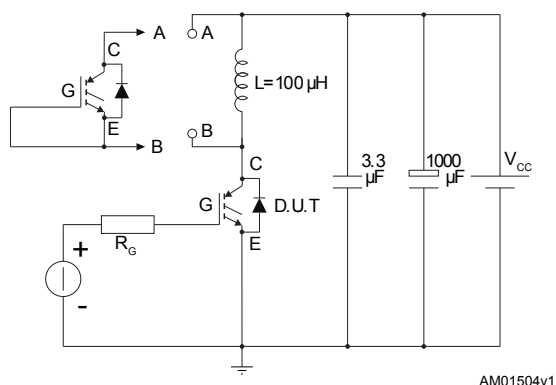
Figure 19. Short-circuit time and current vs. V_{GE}

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


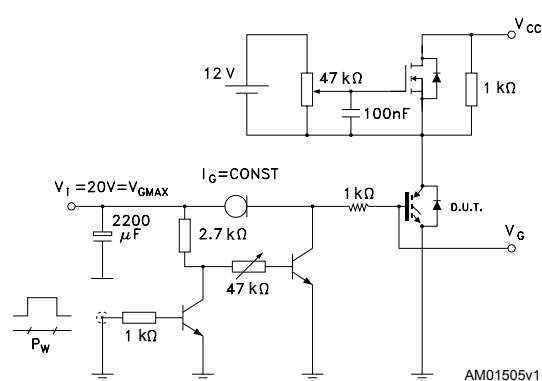
3 Test circuits

Figure 28. Test circuit for inductive load switching



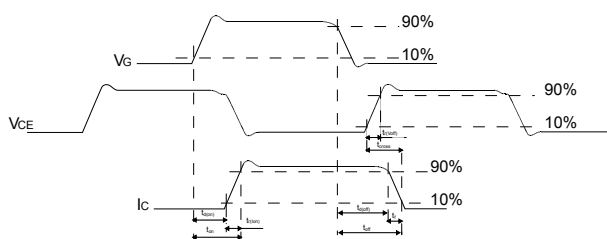
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Figure 29. Gate charge test circuit



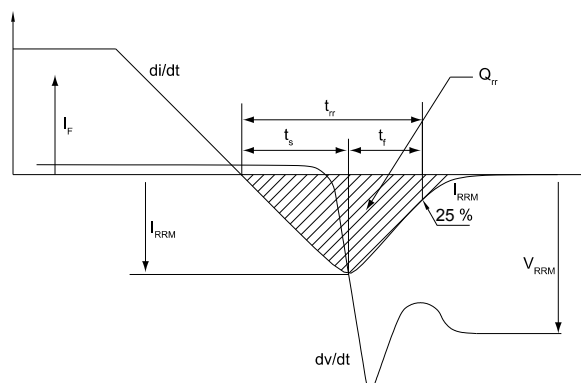
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Figure 30. Switching waveform



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Figure 31. Diode reverse recovery waveform



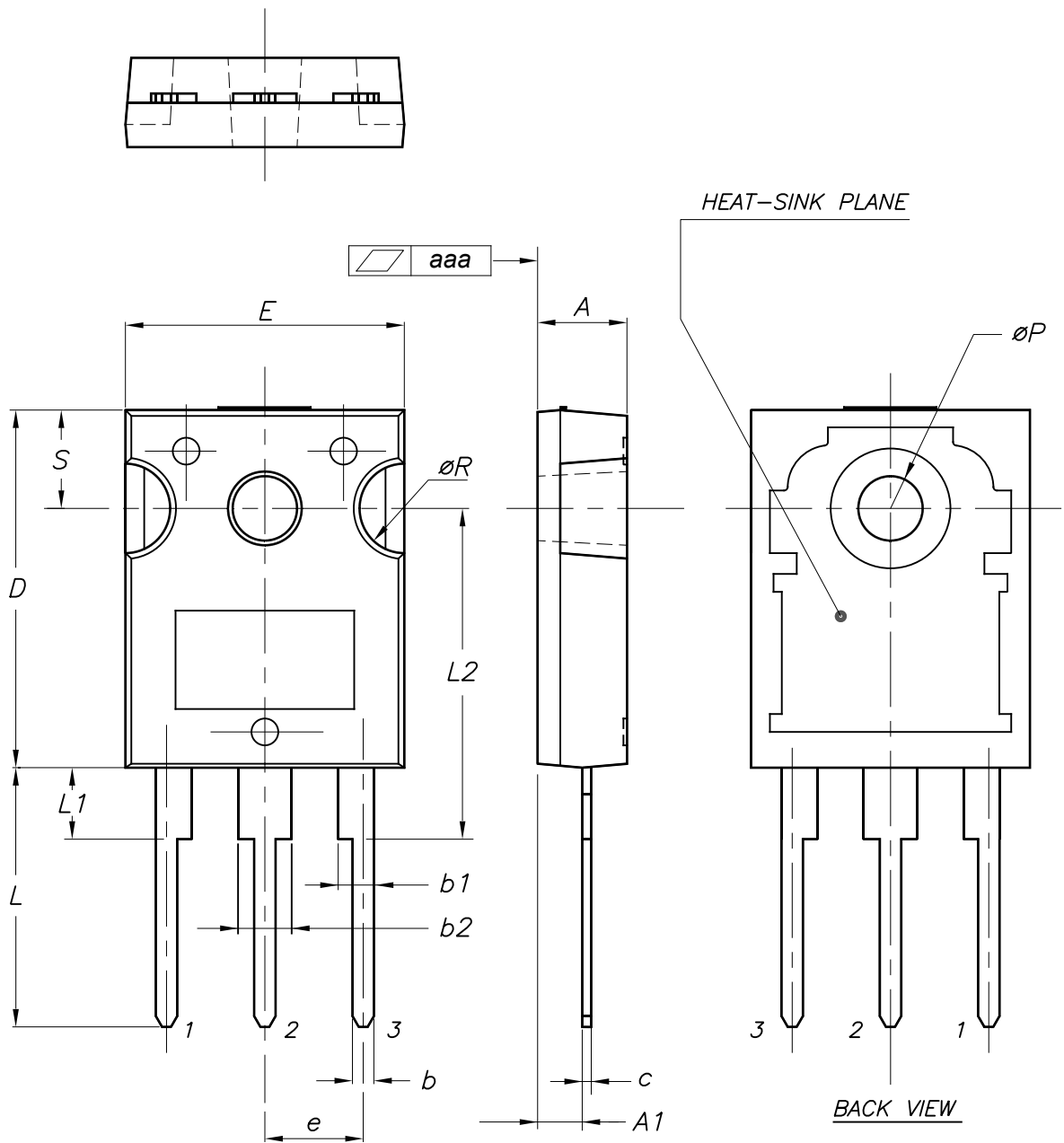
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4 Package information

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



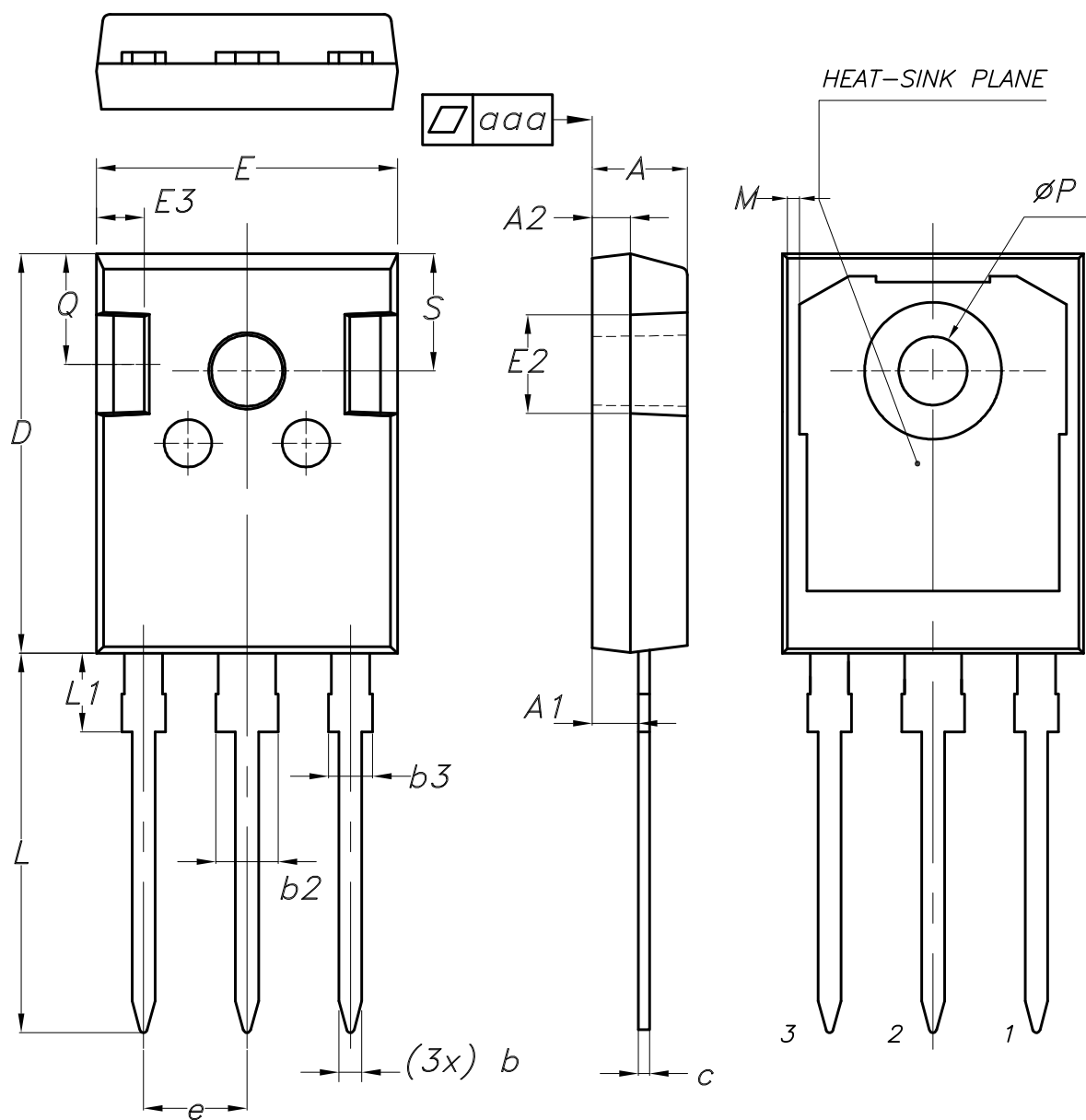
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Table 8. TO-247 package mechanical data

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
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 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
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 10. Document revision history

Date	Revision	Changes
22-Apr-2014	1	Initial release.
31-Oct-2014	2	Document status promoted from preliminary to production data. Updated all the document accordingly. Added Section 2.1: Electrical characteristics (curves). Updated Section 4: Package mechanical data.
22-Jan-2025	3	Updated Section 4.1: TO-247 package information, and Section 4.2: TO-247 long leads package information. Updated document title on cover page. Minor text changes.



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