Trench gate field-stop, 1200 V, 8 A, low-loss M series IGBT in a TO-220 package

TO-220

C(2, TAB)

G(1)

E(3)

NG1E3C2T
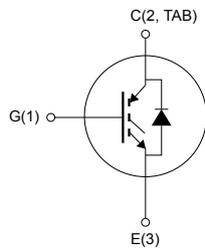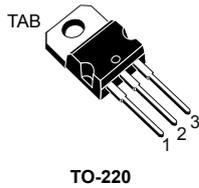
Features

- 10 μs of minimum short-circuit withstand time
- $V_{CE(sat)}$ = 1.85 V (typ.) @ I_C = 8 A
- Tight parameter distribution
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Soft and very fast recovery antiparallel diode
- Maximum junction temperature: T_J = 175 °C

Applications

- Industrial drives
- UPS
- Solar
- Welding
- General-purpose inverters

Description

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

Product status link
STGP8M120DF3

Product summary	
Order code	STGP8M120DF3
Marking	G8M120DF3
Package	TO-220
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	16	A
	Continuous collector current at T_C = 100 °C	8	A
I_{CP}[1]	Pulsed collector current	32	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at T_C = 25 °C	16	A
	Continuous forward current at T_C = 100 °C	8	A
I_{FP}[1]	Pulsed forward current	32	A
P_{TOT}	Total dissipation at T_C = 25 °C	167	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. Pulse width is limited by maximum junction temperature.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.9	°C/W
	Thermal resistance junction-case diode	1.47	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

T_C = 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 = 8 A		1.85	2.3	V
		V_{GE} = 15 V, I_C = 8 A, T_J = 125 °C		2.1		
		V_{GE} = 15 V, I_C = 8 A, T_J = 175 °C		2.2		
V_F	Forward on-voltage	I_F = 8 A		2.4	3.35	V
		I_F = 8 A, T_J = 125 °C		1.75		
		I_F = 8 A, T_J = 175 °C		1.55		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 500 µA	5	6	7	V
I_{CES}	Collector cut-off current	V_{CE} = 1200 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{GE} = ± 20 V			±250	µA

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	-	542	-	pF
C_{oes}	Output capacitance		-	74.4	-	
C_{res}	Reverse transfer capacitance		-	21	-	
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 8 A, V_{GE} = 0 to 15 V (see Figure 29. Gate charge test circuit)	-	32	-	nC
Q_{ge}	Gate-emitter charge		-	4.5	-	
Q_{gc}	Gate-collector charge		-	18.5	-	

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 = 8 A, V_{GE} = 15 V, R_G = 33 Ω (see Figure 28. Test circuit for inductive load switching)		20	-	ns
t_r	Current rise time			8.4	-	ns
$(di/dt)_{on}$	Turn-on current slope			800	-	A/µs
$t_{d(off)}$	Turn-off-delay time			126	-	ns
t_f	Current fall time			136	-	ns
E_{on}[1]	Turn-on switching energy			0.39	-	mJ
E_{off}[2]	Turn-off switching energy			0.37	-	mJ
E_{ts}	Total switching energy			0.76	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 600 V, I_C = 8 A, V_{GE} = 15 V, R_G = 33 Ω, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)		19	-	ns
t_r	Current rise time			9.8	-	ns
$(di/dt)_{on}$	Turn-on current slope			656	-	A/µs
$t_{d(off)}$	Turn-off-delay time			134	-	ns
t_f	Current fall time			222	-	ns
E_{on}[1]	Turn-on switching energy			0.66	-	mJ
E_{off}[2]	Turn-off switching energy			0.58	-	mJ
E_{ts}	Total switching energy			1.24	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 600 V, V_{GE} = 15 V, T_{Jstart} ≤ 150 °C	10		-	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 = 8 A, V_R = 600 V, V_{GE} = 15 V, R_G = 33 Ω, di/dt = 1000 A/µs (see Figure 28. Test circuit for inductive load switching)	-	103	-	ns
Q_{rr}	Reverse recovery charge		-	0.87	-	µC
I_{rrm}	Reverse recovery current		-	19.2	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	720	-	A/µs
E_{rr}	Reverse recovery energy		-	211	-	µJ
t_{rr}	Reverse recovery time	I_F = 8 A, V_R = 600 V, V_{GE} = 15 V, R_G = 33 Ω, T_J = 175 °C, di/dt = 840 A/µs (see Figure 28. Test circuit for inductive load switching)	-	280	-	ns
Q_{rr}	Reverse recovery charge		-	1.9	-	µC
I_{rrm}	Reverse recovery current		-	21.8	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	450	-	A/µs
E_{rr}	Reverse recovery energy		-	404	-	µJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature
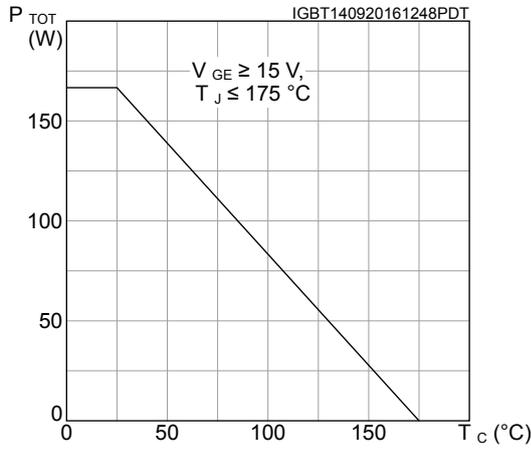

Figure 2. Collector current vs case temperature
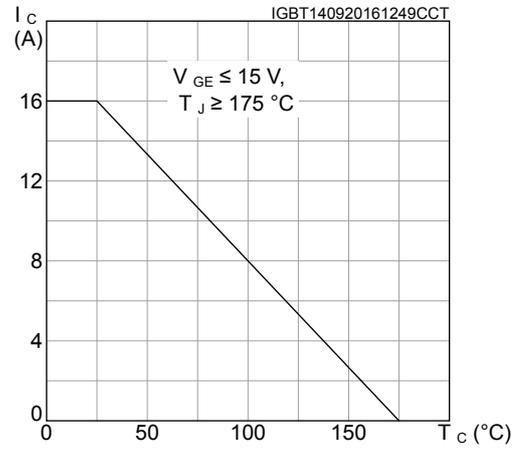
**Figure 3. Output characteristics (T$_J$ = 25 °C)**
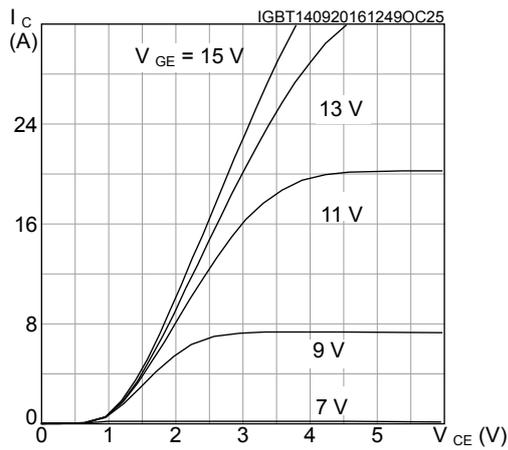
**Figure 4. Output characteristics (T$_J$ = 175 °C)**
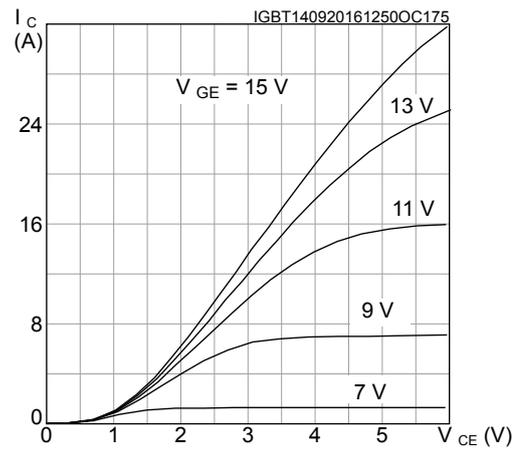
**Figure 5. V$_{CE(sat)}$ vs junction temperature**
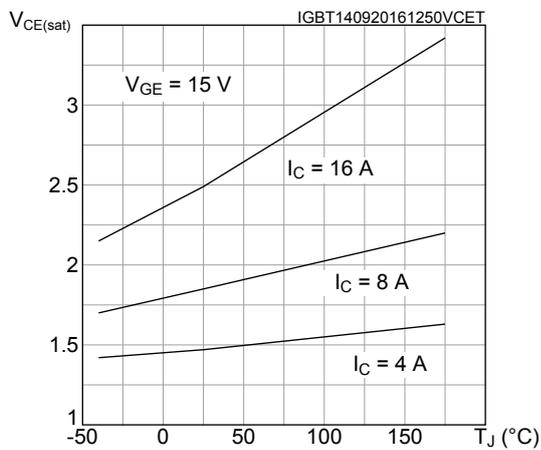

Figure 6. V$_{CE(sat)}$ vs collector current
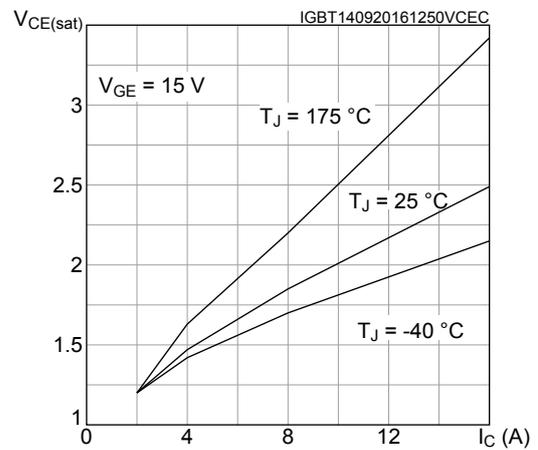
**Figure 7. Collector current vs switching frequency**
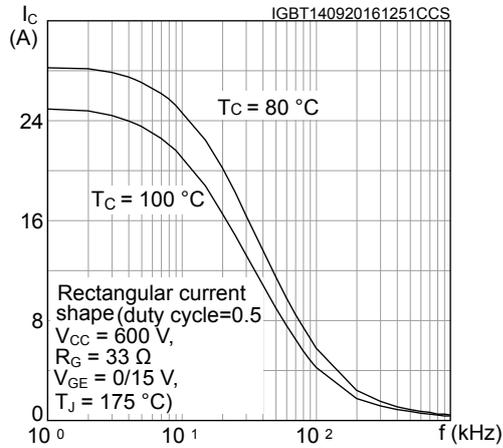

Figure 8. Forward bias safe operating area
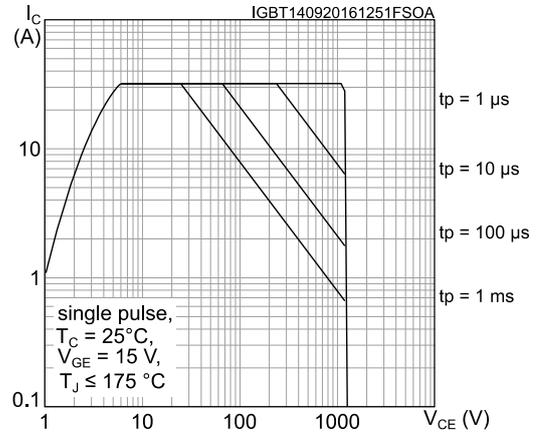
Figure 9. Transfer characteristics
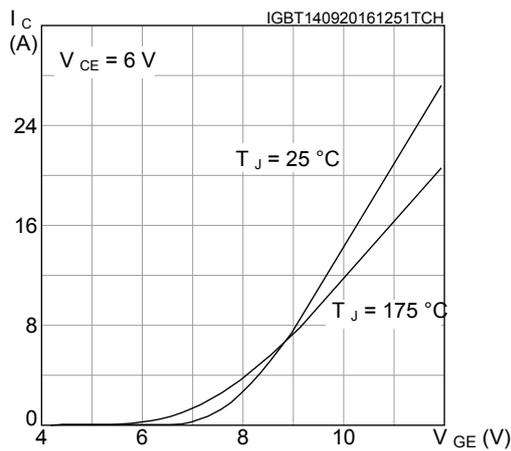
Figure 10. Diode V_F vs forward current
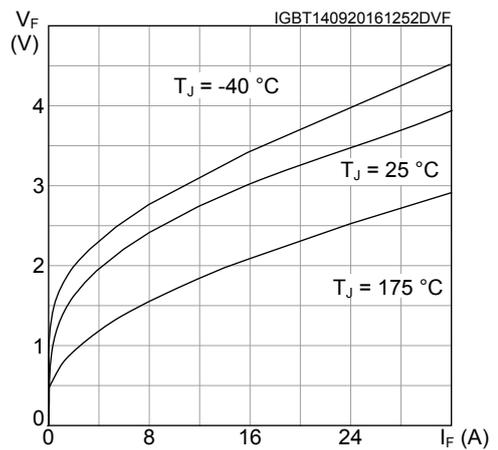
Figure 11. Normalized $V_{GE(th)}$ vs junction temperature
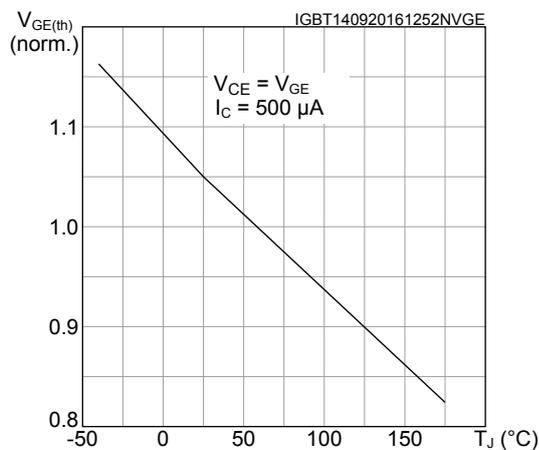
Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature
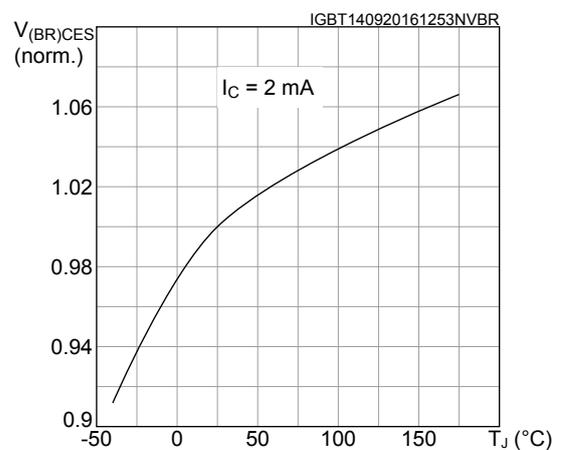
Figure 13. Capacitance variations
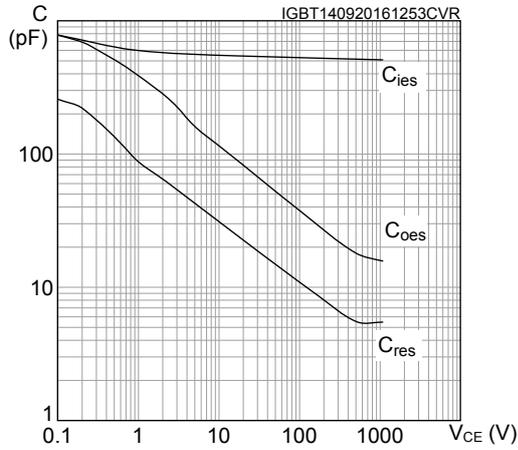
Figure 14. Gate charge vs gate-emitter voltage
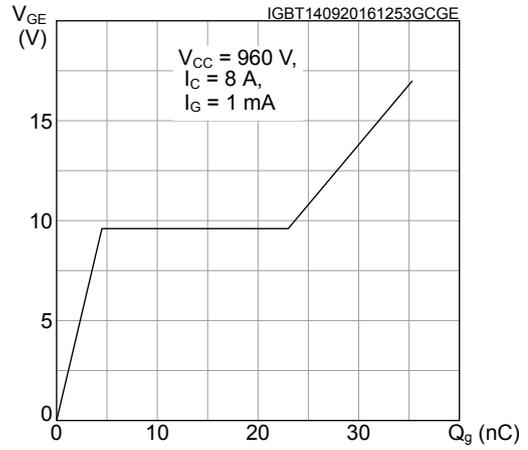
Figure 15. Switching energy vs collector current
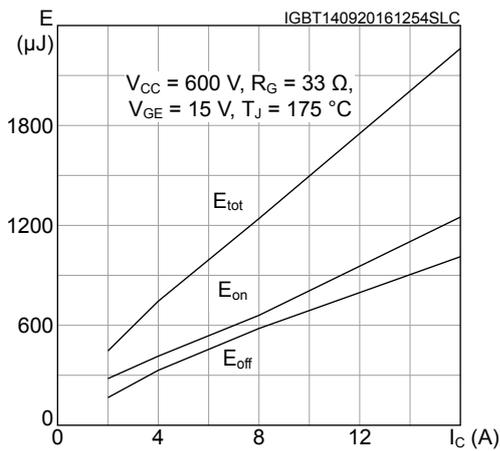
Figure 16. Switching energy vs gate resistance
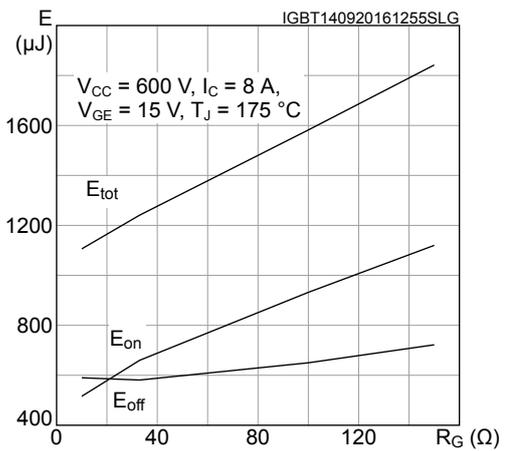
Figure 17. Switching energy vs temperature
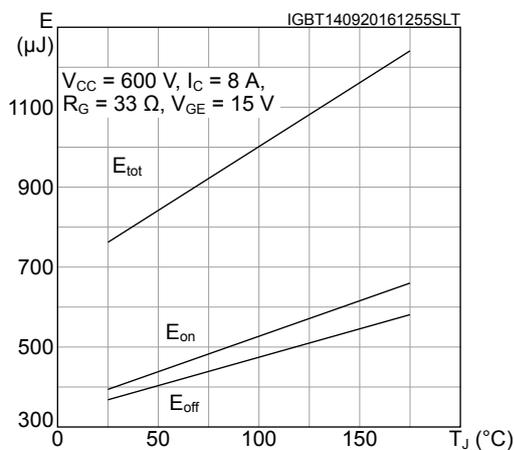
Figure 18. Switching energy vs collector emitter voltage
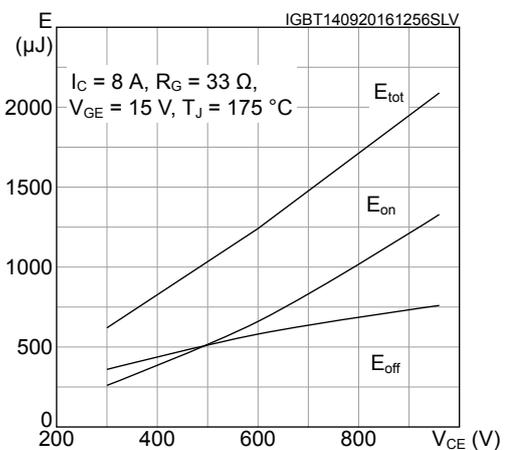
Figure 19. Short-circuit time and current vs V_{GE}
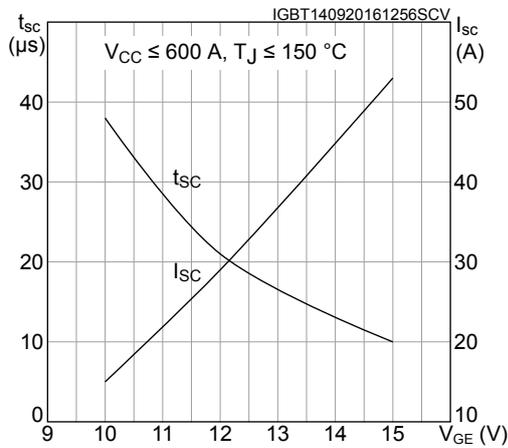
Figure 20. Switching times vs collector current
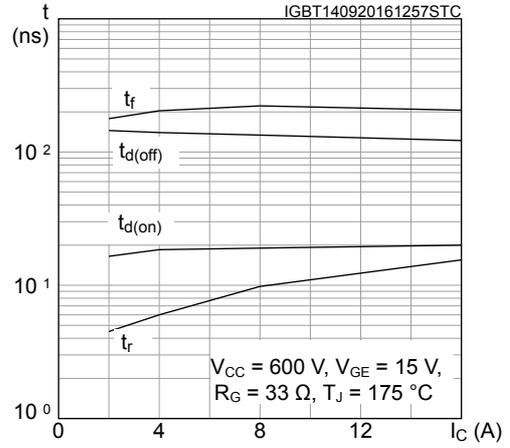
Figure 21. Switching times vs gate resistance
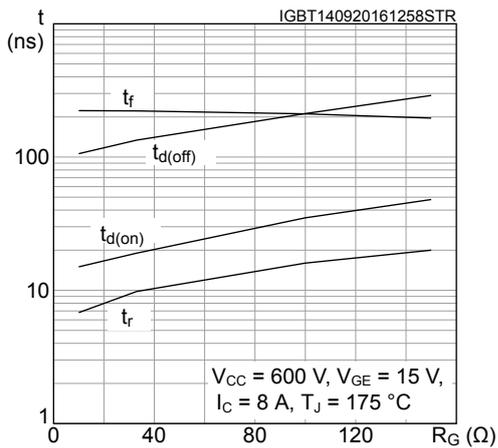
Figure 22. Reverse recovery current vs diode current slope
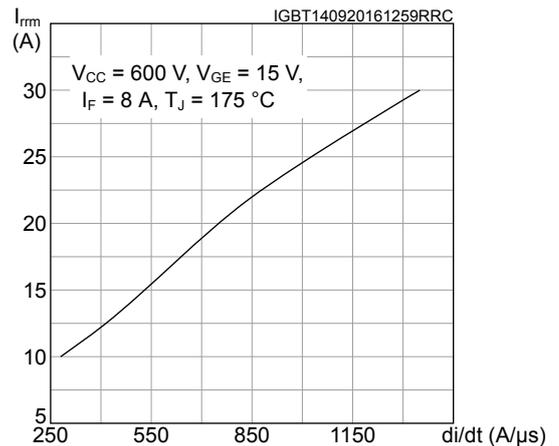
Figure 23. Reverse recovery time vs diode current slope
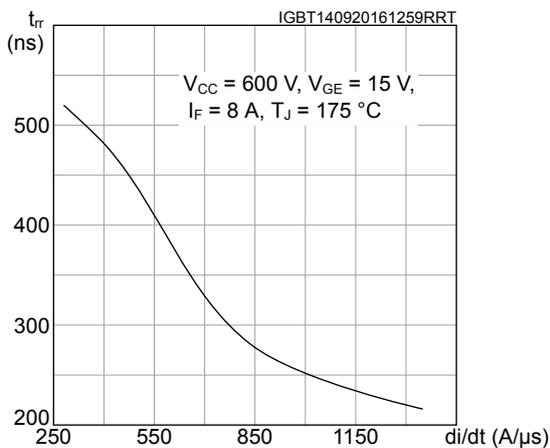
Figure 24. Reverse recovery charge vs diode current slope
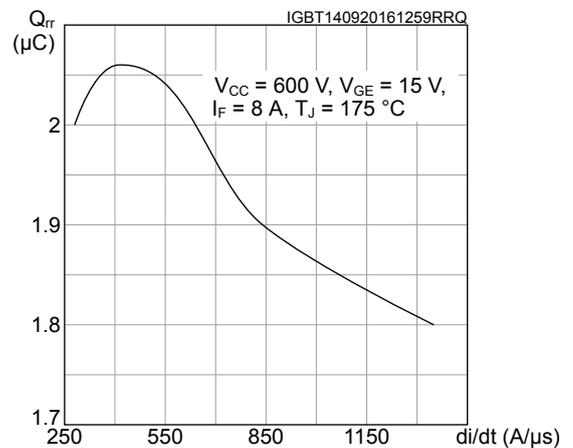
Figure 25. Reverse recovery energy vs diode current slope
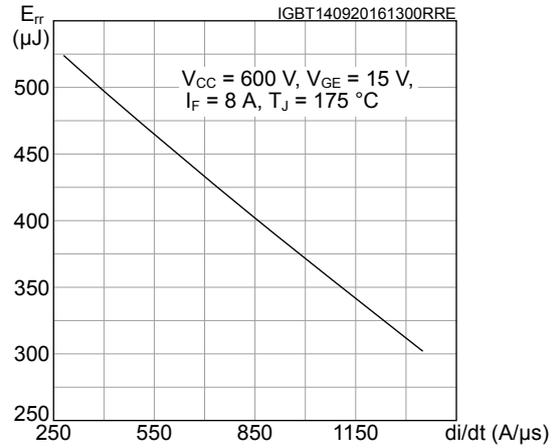

**Figure 26. Thermal impedance for IGBT**
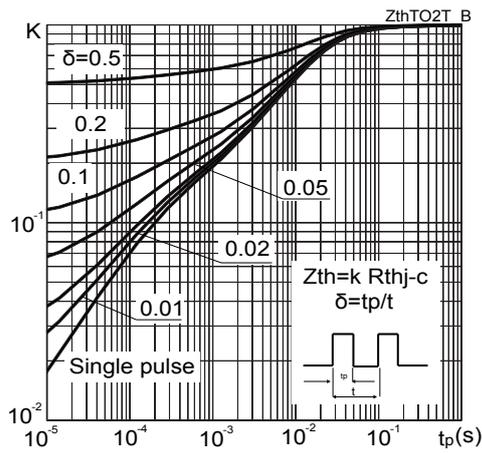
Figure 27. Thermal impedance for diode
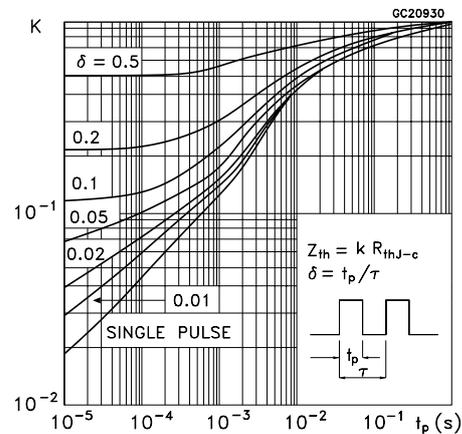
3 Test circuits

**Figure 28. Test circuit for inductive load switching**
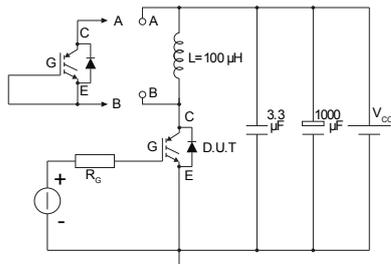
AM01504v1

Figure 29. Gate charge test circuit
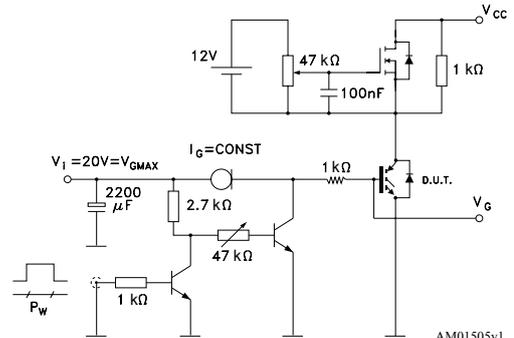
AM01505v1

Figure 30. Switching waveform
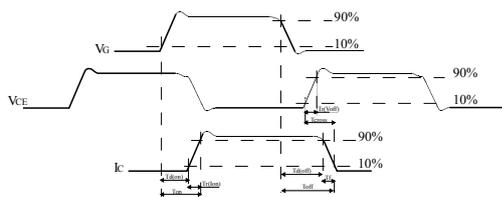
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**Figure 31. Diode reverse recovery waveform**
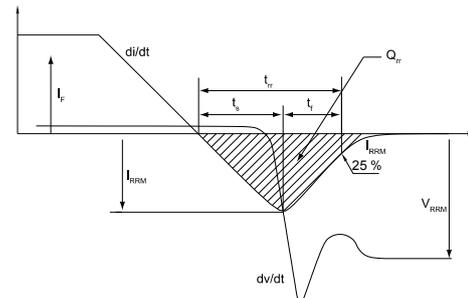
AM01507v1

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-220 type A package information

Figure 32. TO-220 type A package outline
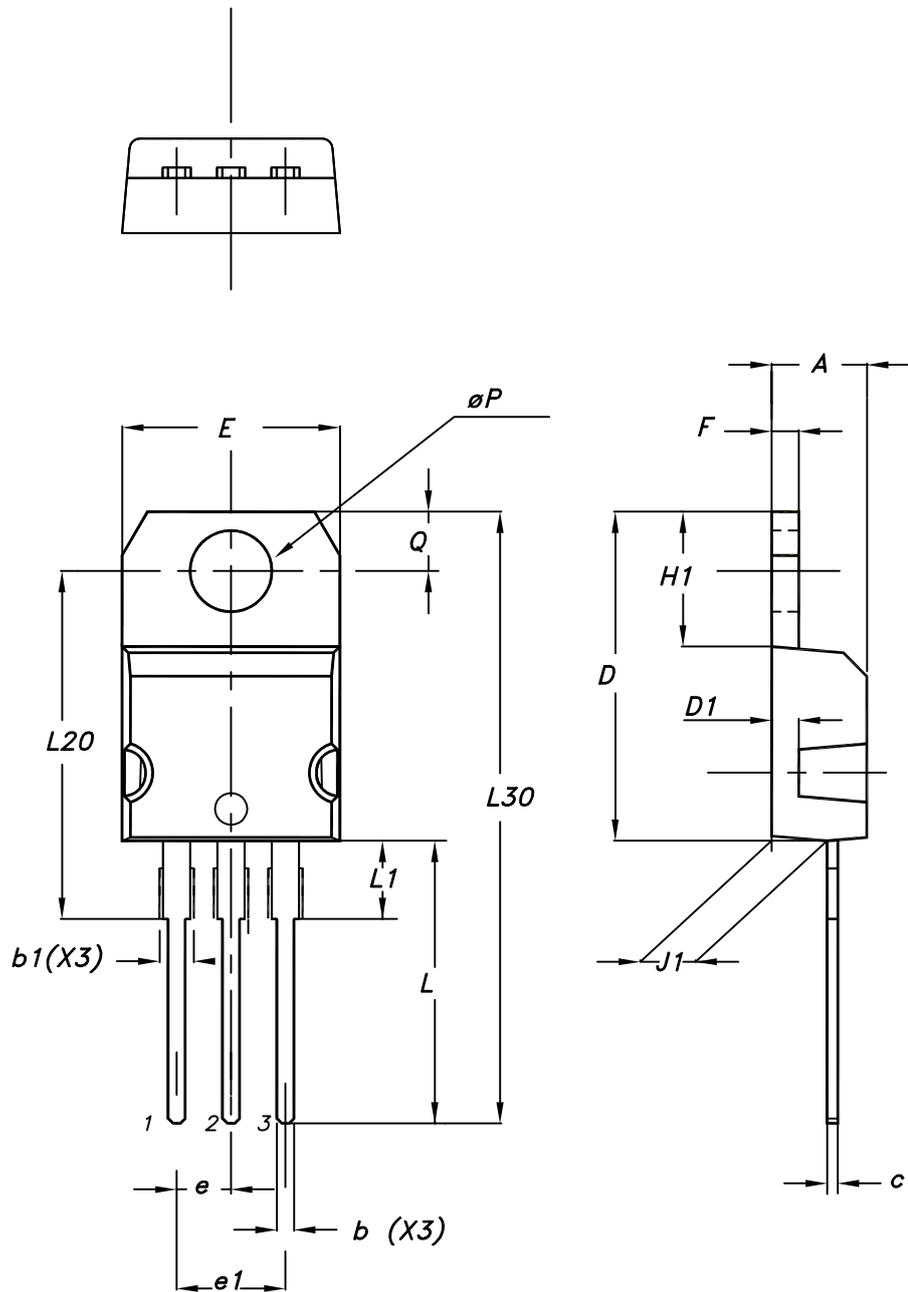
0015988_typeA_Rev_21

Table 7. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

Revision history

Table 8. Document revision history

Date	Revision	Changes
26-Sep-2016	1	First release.
19-Apr-2018	2	Removed maturity status indication from cover page. The document status is production data. Updated features and applications. Minor text changes

IMPORTANT NOTICE – PLEASE READ CAREFULLY