STGB20V60F, STGP20V60F

600 V, 20 A very high speed trench gate field-stop IGBT

Datasheet - production data

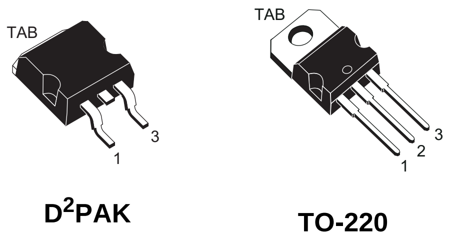
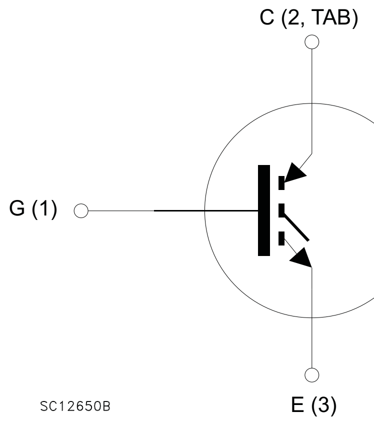


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- Very high speed switching series
- Tail-less switching off
- Low saturation voltage: $V_{CE(sat)}$ = 1.8 V (typ.) @ I_C = 20 A
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Lead free package

Applications

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

Description

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

Table 1. Device summary

Order code	Marking	Package	Packaging
STGB20V60F	GB20V60F	D²PAK	Tape and reel
STGP20V60F	GP20V60F	TO-220	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C	Continuous collector current at T_C = 25 °C	40	A
I_C	Continuous collector current at T_C = 100 °C	20	A
I_{CP}(1)	Pulsed collector current	80	A
V_{GE}	Gate-emitter voltage	±20	V
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	- 55 to 175	°C

1. Pulse width limited by maximum junction temperature.

Table 3. Thermal data

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

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 4. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage (V_{GE} = 0)	I_C = 2 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 20 A		1.8	2.2	V
		V_{GE} = 15 V, I_C = 20 A T_J = 125 °C		2.15		
		V_{GE} = 15 V, I_C = 20 A T_J = 175 °C		2.3		
$V_{GE(th)}$	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_{CE} = 600 V			25	µA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ± 20 V			250	nA

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	2800	-	pF
C_{oes}	Output capacitance		-	110	-	pF
C_{res}	Reverse transfer capacitance		-	64	-	pF
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V, see *Figure 22*	-	116	-	nC
Q_{ge}	Gate-emitter charge		-	24	-	nC
Q_{gc}	Gate-collector charge		-	50	-	nC

Table 6. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 20 A, V_{GE} = 15 V, di/dt = 100 A/μs *see Figure 21*	-	38	-	ns
t_r	Current rise time		-	10	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1556	-	A/μs
$t_{d(off)}$	Turn-off delay time		-	149	-	ns
t_f	Current fall time		-	15	-	ns
E_{on} (1)	Turn-on switching losses		-	200	-	μJ
E_{off} (2)	Turn-off switching losses		-	130	-	μJ
E_{ts}	Total switching losses		-	330	-	μJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 20 A, di/dt = 100 A/μs, V_{GE} = 15 V, T_J = 175 °C, see *Figure 21*	-	37	-	ns
t_r	Current rise time		-	12	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1340	-	A/μs
$t_{d(off)}$	Turn-off delay time		-	150	-	ns
t_f	Current fall time		-	23	-	ns
E_{on} (1)	Turn-on switching losses		-	430	-	μJ
E_{off} (2)	Turn-off switching losses		-	210	-	μJ
E_{ts}	Total switching losses		-	640	-	μJ

1. Energy losses include reverse recovery of the external diode. The diode is the same of the copacked STGW20V60DF
2. Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

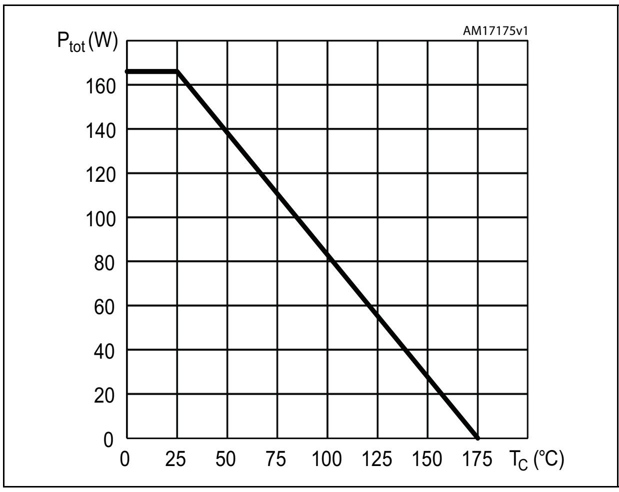


Figure 3. Collector current vs. case temperature

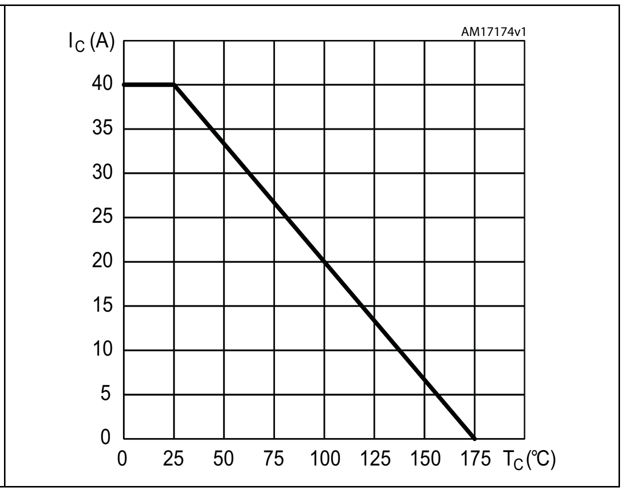


Figure 4. Output characteristics (T_J = 25 °C)

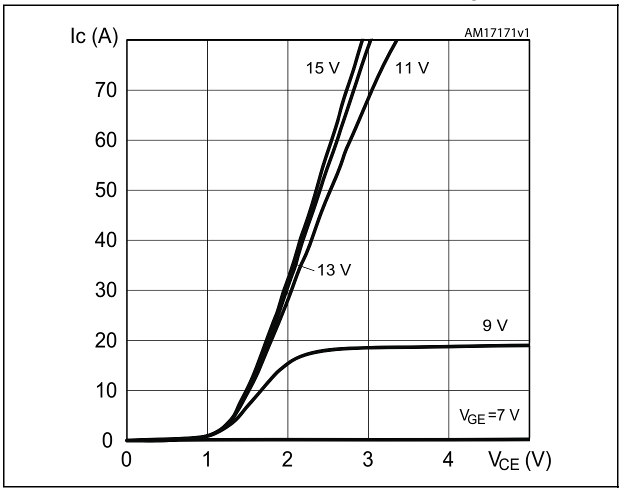


Figure 5. Output characteristics (T_J = 175 °C)

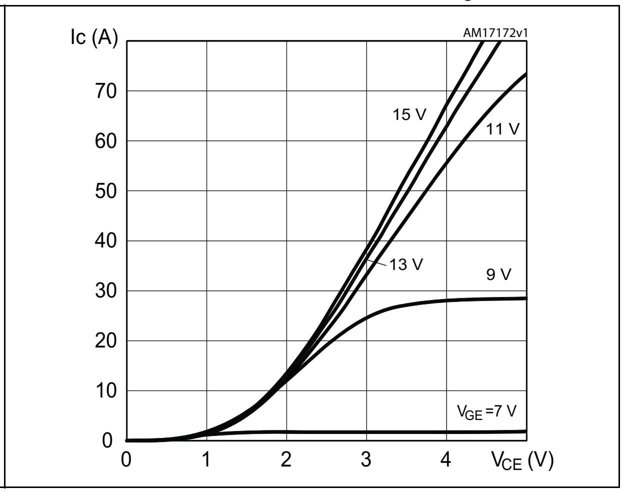


Figure 6. $V_{CE(SAT)}$ vs. junction temperature

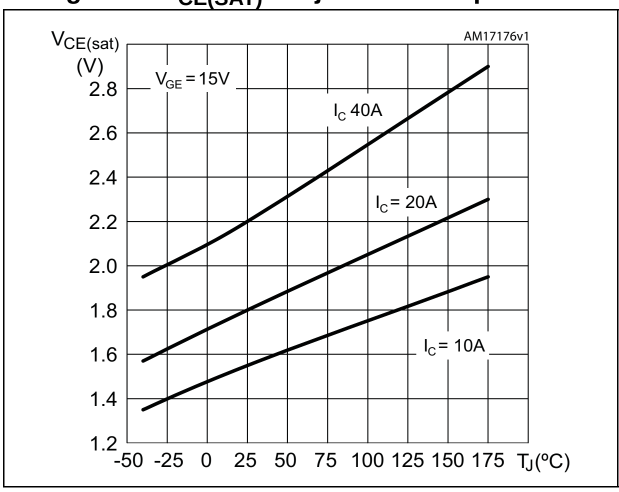


Figure 7. $V_{CE(SAT)}$ vs. collector current

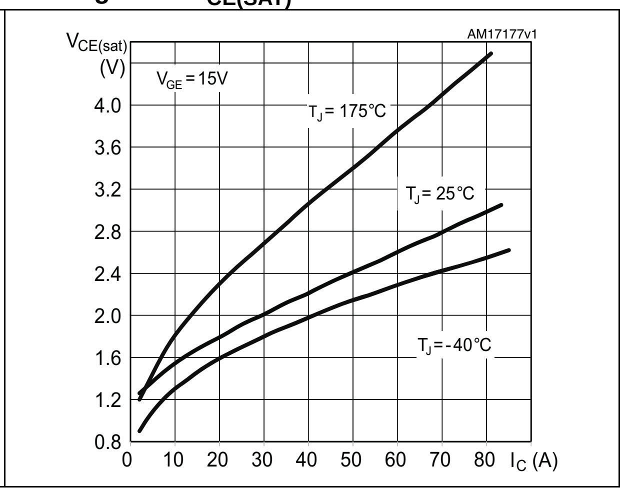


Figure 8. Safe operating area

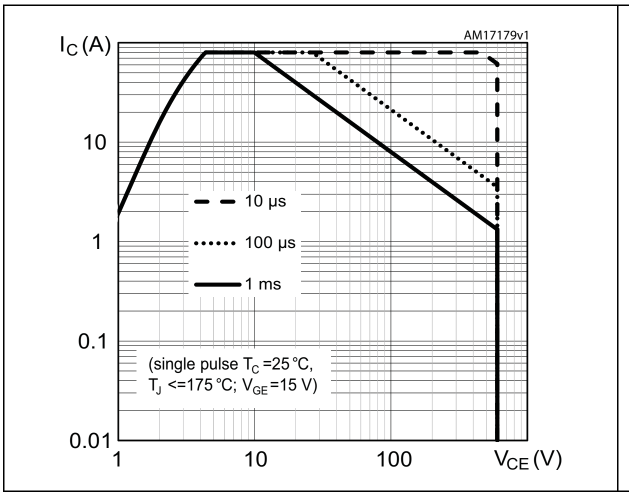


Figure 9. Transfer characteristics

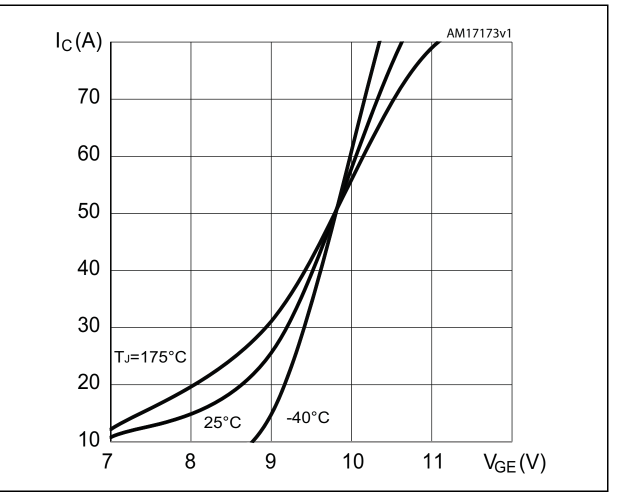


Figure 10. Normalized $V_{GE(th)}$ vs. junction temperature

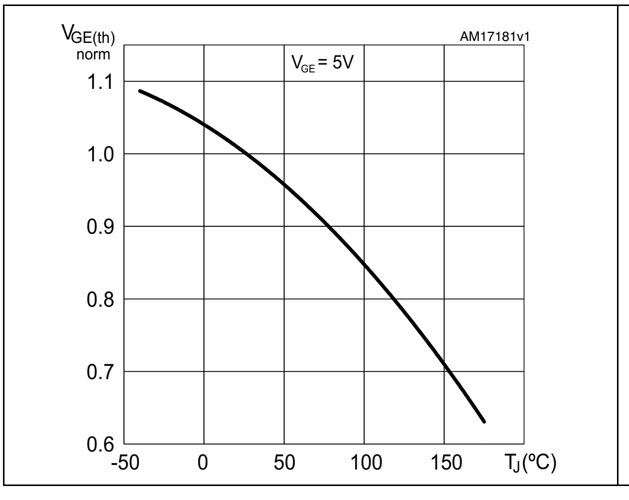


Figure 11. Normalized $V_{(BR)CES}$ vs. junction temperature

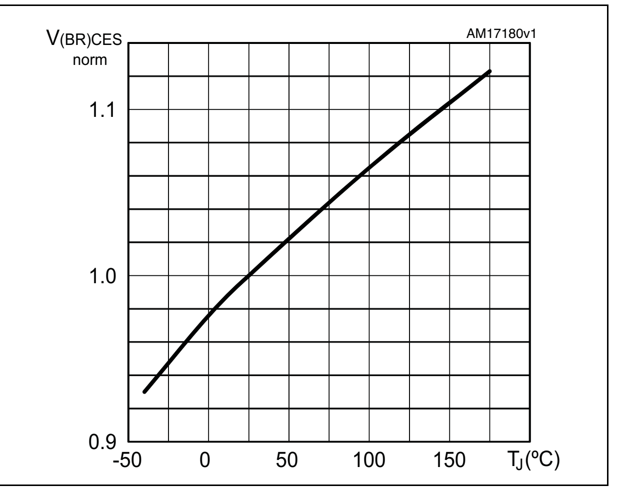


Figure 12. Capacitance variations

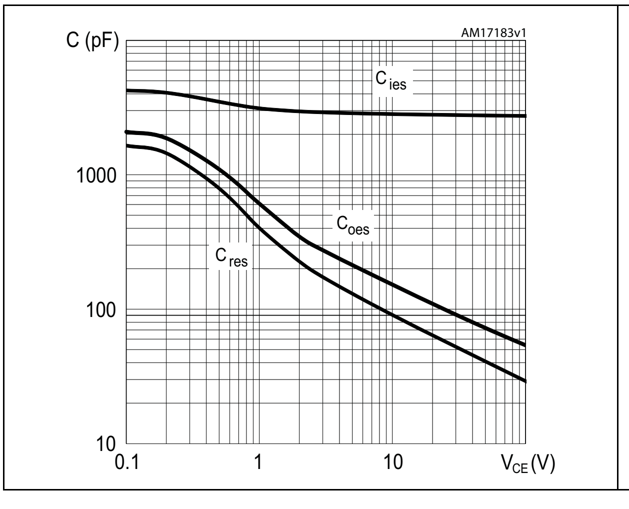


Figure 13. Gate charge vs. gate-emitter voltage

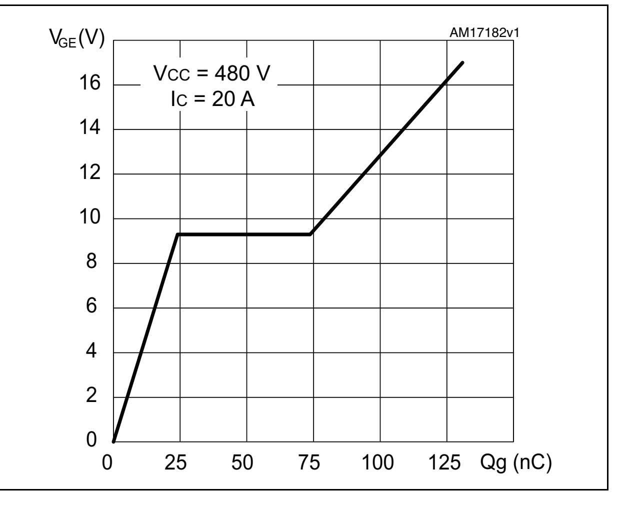


Figure 14. Switching losses vs. collector current

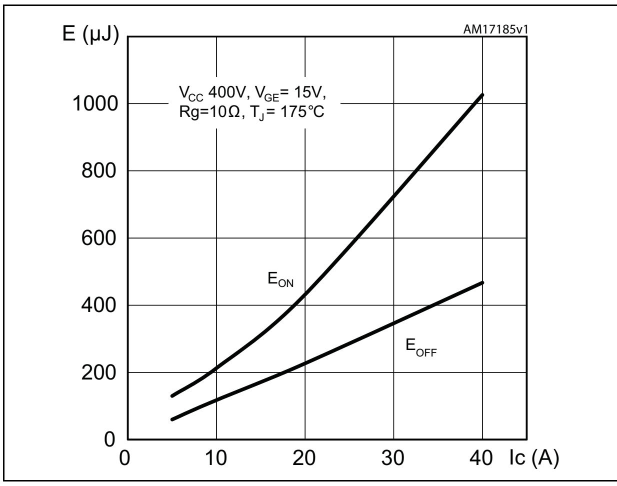


Figure 15. Switching losses vs. gate resistance

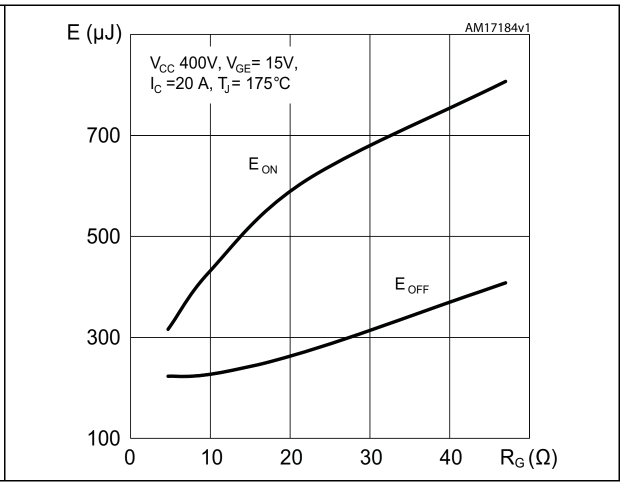


Figure 16. Switching losses vs. junction temperature

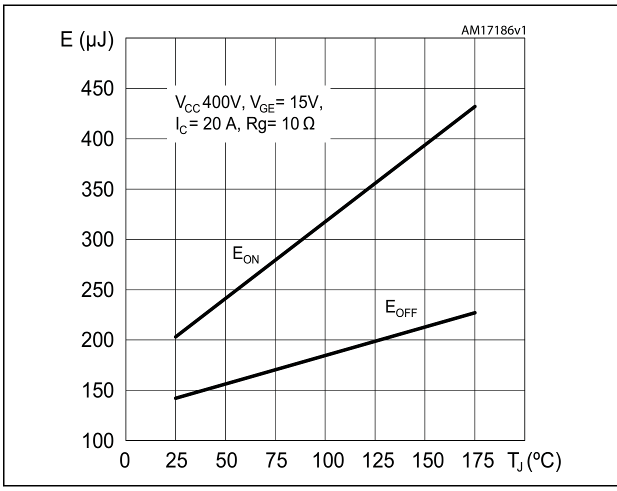


Figure 17. Switching losses vs. collector emitter voltage

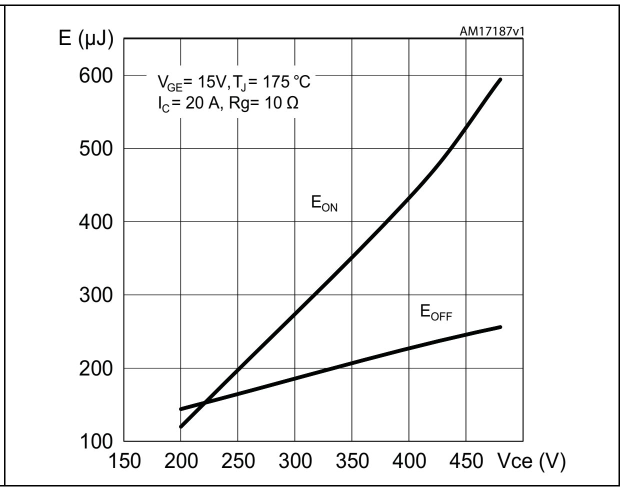


Figure 18. Switching times vs. collector current

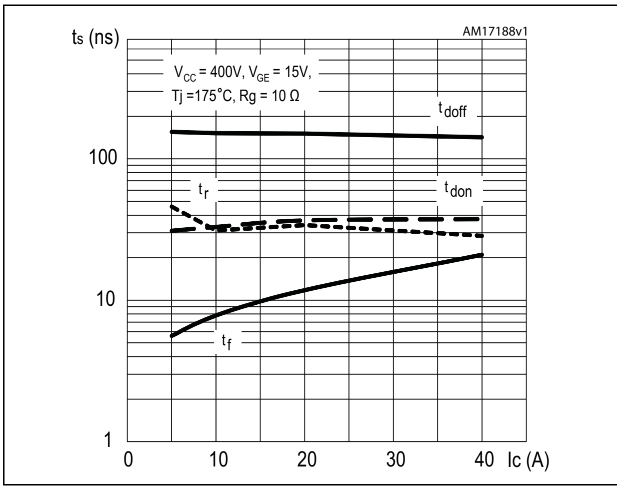


Figure 19. Switching times vs. gate resistance

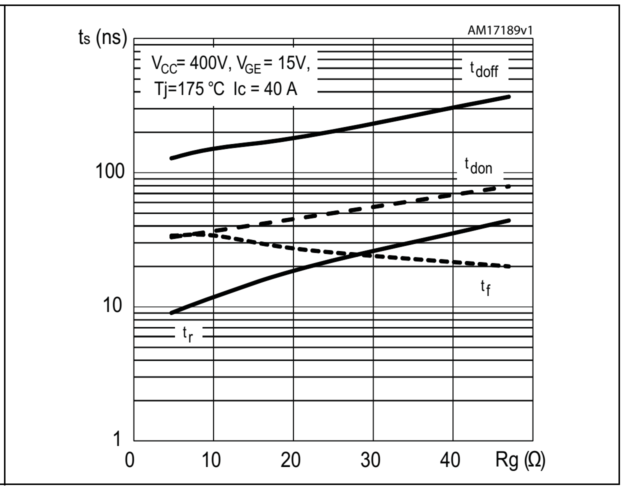
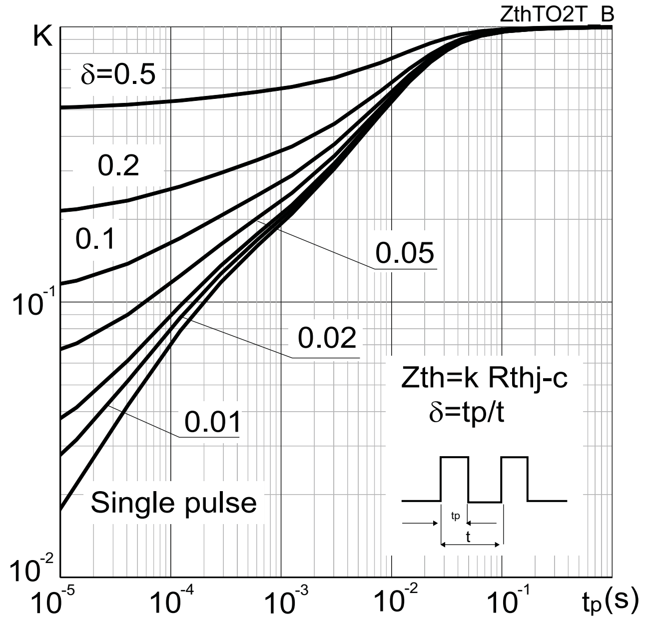


Figure 20. Thermal data



3 Test circuits

Figure 21. Test circuit for inductive load switching

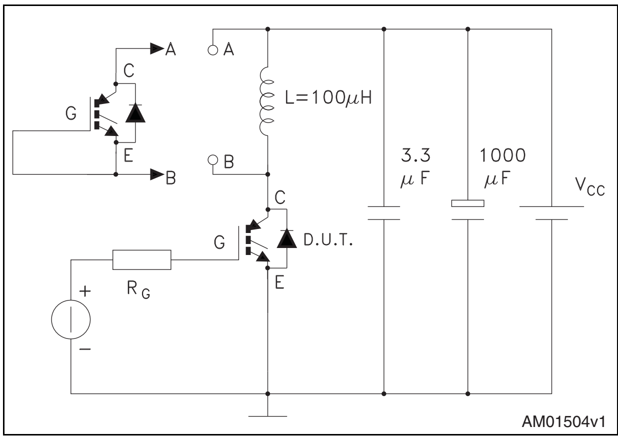


Figure 22. Gate charge test circuit

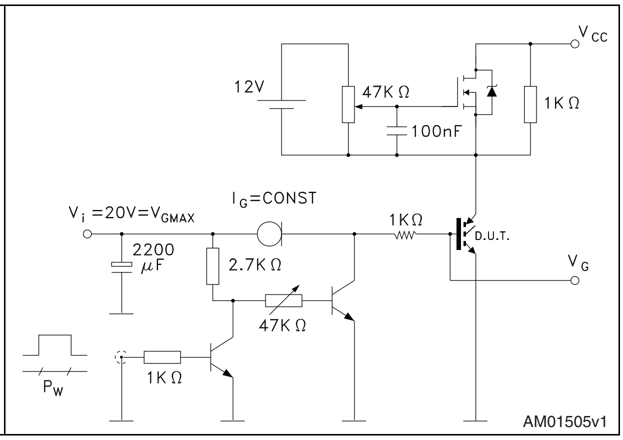
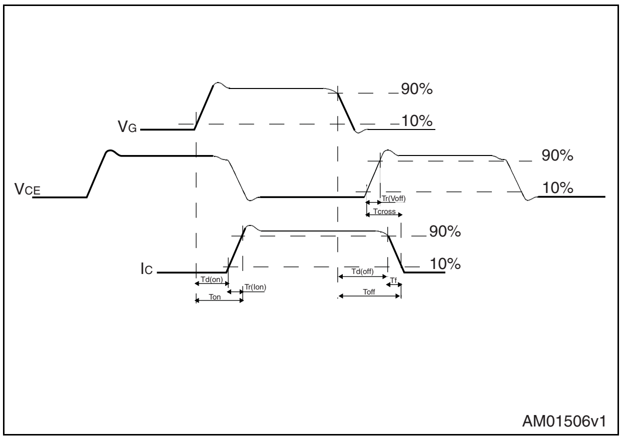


Figure 23. Switching waveform



4 Package mechanical data

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.

Table 7. D²PAK (TO-263) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 24. D²PAK (TO-263) drawing

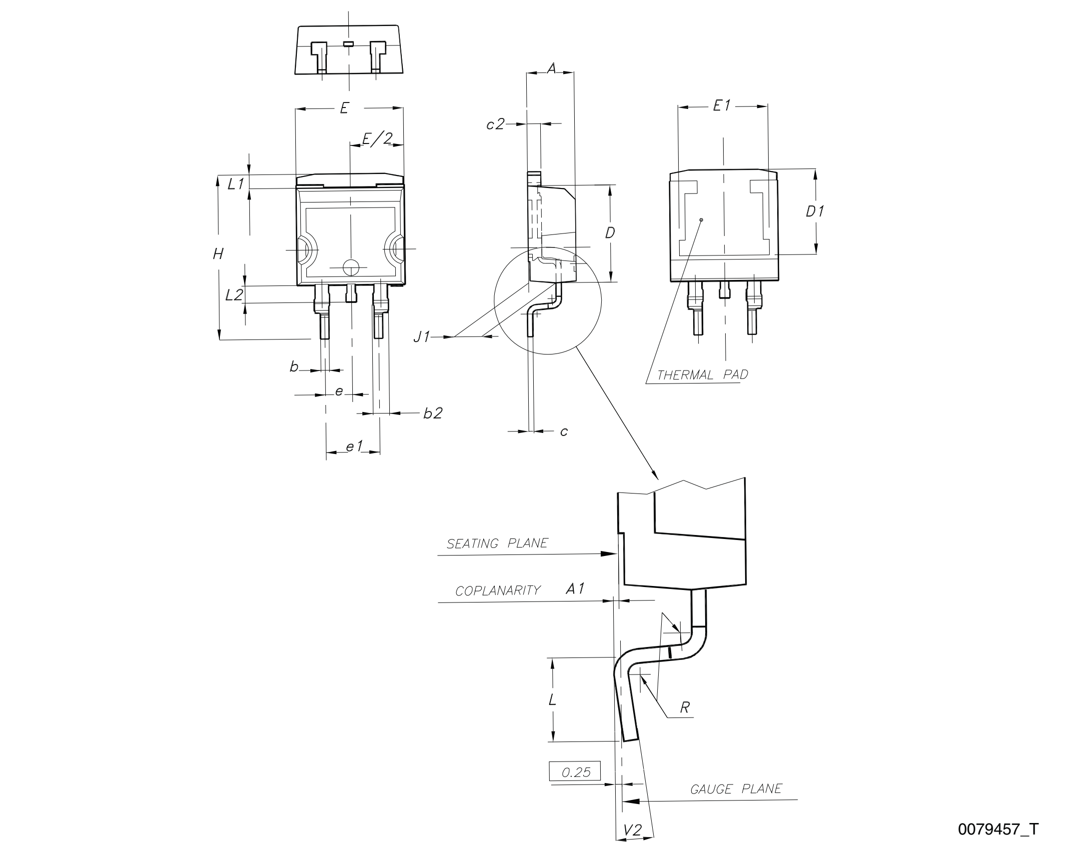
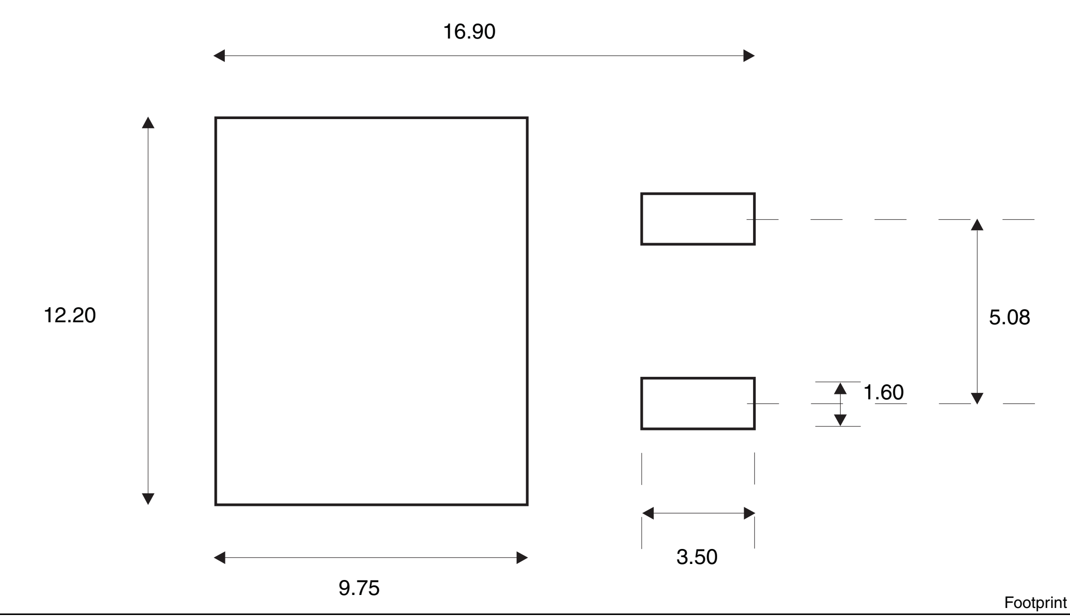


Figure 25. D²PAK footprint[(a)]

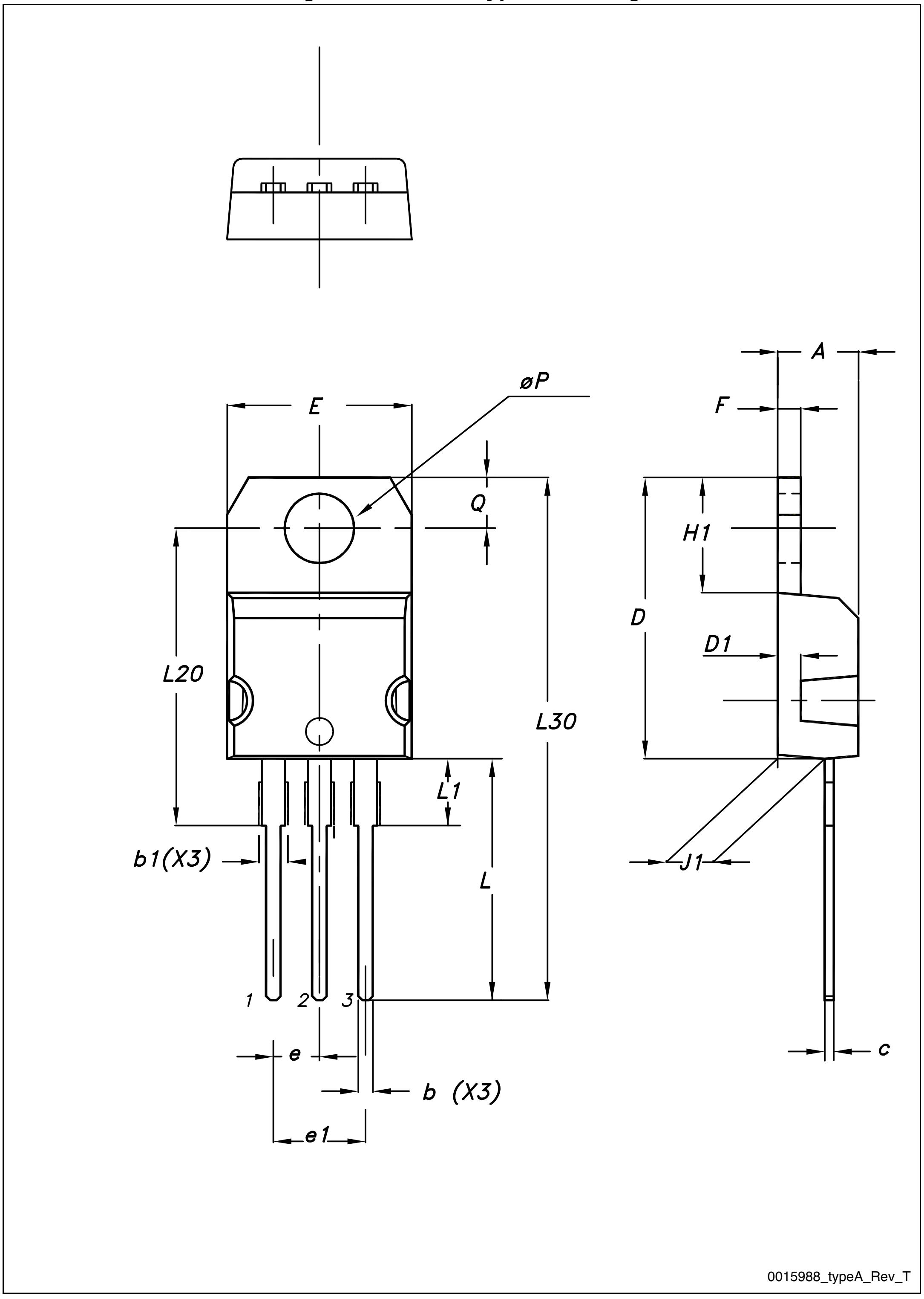


a. All dimension are in millimeters

Table 8. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		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		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

Figure 26. TO-220 type A drawing



5 Packaging mechanical data

Table 9. D²PAK (TO-263) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Figure 27. Tape

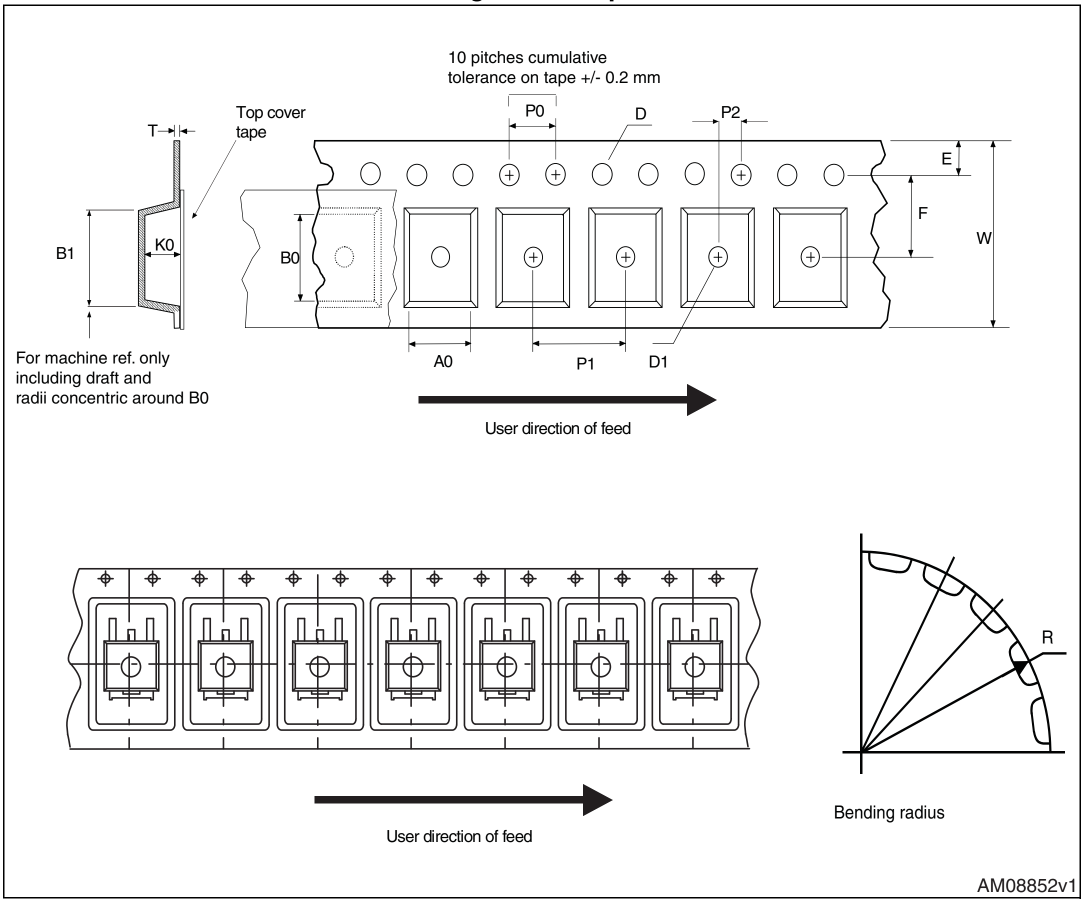
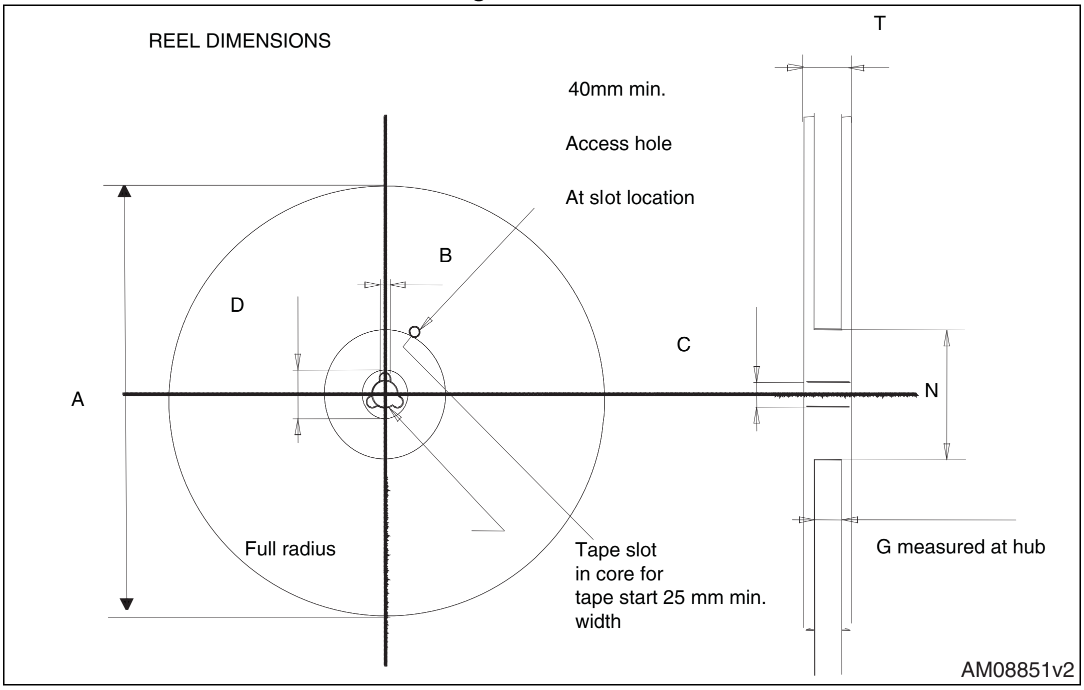


Figure 28. Reel



6 Revision history

Table 10. Document revision history

Date	Revision	Changes
11-Jul-2013	1	Initial release.