STGB20H60DF, STGF20H60DF, STGP20H60DF

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

Datasheet - production data

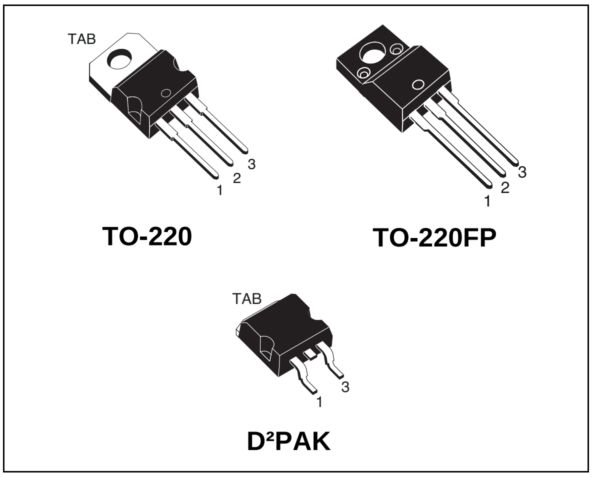
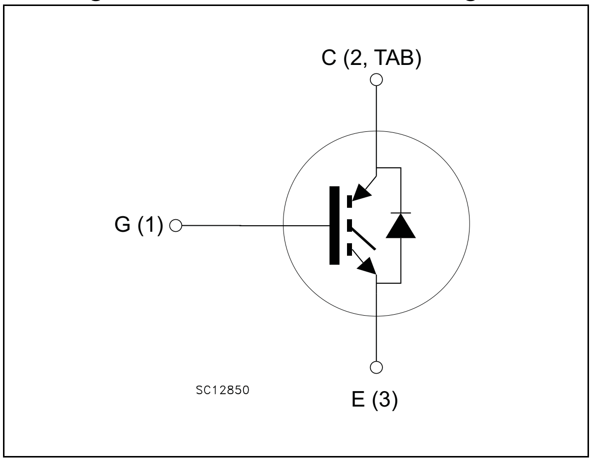


Figure 1. Internal schematic diagram



Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Ultrafast soft recovery antiparallel diode

Applications

- Motor control
- UPS, PFC

Description

This device is an IGBT developed using an advanced proprietary trench gate and field stop structure. This IGBT series offers the optimum compromise between conduction and switching losses, maximizing the efficiency of very high frequency converters. Furthermore, a positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in easier paralleling operation.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STGB20H60DF	GB20H60DF	D²PAK	Tape and reel
STGF20H60DF	GF20H60DF	TO-220FP	Tube
STGP20H60DF	GP20H60DF	TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	TO-220 D²PAK	TO-220FP	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600		V
I_C	Continuous collector current at T_C = 25 °C	40	40(1)	A
	Continuous collector current at T_C = 100 °C	20	20(1)	A
I_{CP} (2)	Pulsed collector current	80	80(1)	A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Continuous forward current T_C = 25 °C	40	40(1)	A
	Continuous forward current at T_C = 100 °C	20	20(1)	
I_{FP}(2)	Pulsed forward current	80	80(1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	167	37	W
T_{STG}	Storage temperature range	- 55 to 150		°C
T_J	Operating junction temperature	- 55 to 175		

1. Limited by maximum junction temperature.
2. Pulse width limited by maximum junction temperature and turn-off within RBSOA.

Table 3. Thermal data

Symbol	Parameter	TO-220 D²PAK	TO-220FP	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.9	4	°C/W
R_{thJC}	Thermal resistance junction-case diode	2.5	5.6	°C/W
R_{thJA}	Thermal resistance junction-ambient	62.5		°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 4. Static

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		1.6	2.0	V
		V_{GE} = 15 V, I_C = 20 A T_J = 125 °C		1.75		
		V_{GE} = 15 V, I_C = 20 A T_J = 175 °C		1.8		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5.0	6.0	7.0	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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	2750	-	pF
C_{oes}	Output capacitance		-	110	-	pF
C_{res}	Reverse transfer capacitance		-	65	-	pF
Q_g	Total gate charge	V_{CC} = 400 V, I_C = 20 A, V_{GE} = 15 V	-	115	-	nC
Q_{ge}	Gate-emitter charge		-	22	-	nC
Q_{gc}	Gate-collector charge		-	45	-	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, R_G = 10 Ω, V_{GE} = 15 V		42.5	-	ns
t_r	Current rise time			11.9	-	ns
(di/dt)on	Turn-on current slope			1345	-	A/µs
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C		42.5	-	ns
t_r	Current rise time			13.4		ns
(di/dt)on	Turn-on current slope			1180		A/µs
$t_{r(Voff)}$	Off voltage rise time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V		20	-	ns
$t_{d(off)}$	Turn-off delay time			177	-	ns
t_f	Current fall time			55	-	ns
$t_{r(Voff)}$	Off voltage rise time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C		26	-	ns
$t_{d(off)}$	Turn-off delay time			173	-	ns
t_f	Current fall time			86	-	ns
t_{sc}	Short-circuit withstand time	$V_{CC} \leq$ 360 V, V_{GE} = 15 V	3	5	-	µs

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Eon (1)	Turn-on switching losses	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V	-	209	-	µJ
E_{off} (2)	Turn-off switching losses		-	261	-	µJ
E_{ts}	Total switching losses		-	470	-	µJ
Eon (1)	Turn-on switching losses	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C	-	480	-	µJ
E_{off} (2)	Turn-off switching losses		-	416	-	µJ
E_{ts}	Total switching losses		-	896	-	µJ

1. Energy losses include reverse recovery of the diode.
2. Turn-off losses include also the tail of the collector current.

Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 20 A I_F = 20 A, T_J = 175 °C	-	1.8 1.3	2.2	V V
t_{rr}	Reverse recovery time	V_r = 60 V; IF = 20 A; di_F/dt = 100 A / µs	-	90	-	ns
Q_{rr}	Reverse recovery charge			110		nC
I_{rrm}	Reverse recovery current			2.4		A
t_{rr}	Reverse recovery time	V_r = 60 V; IF = 20 A; di_F/dt = 100 A / µs T_J = 175 °C	-	180	-	ns
Q_{rr}	Reverse recovery charge		-	466	-	nC
I_{rrm}	Reverse recovery current		-	5.2	-	A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics (T_J = 25°C)

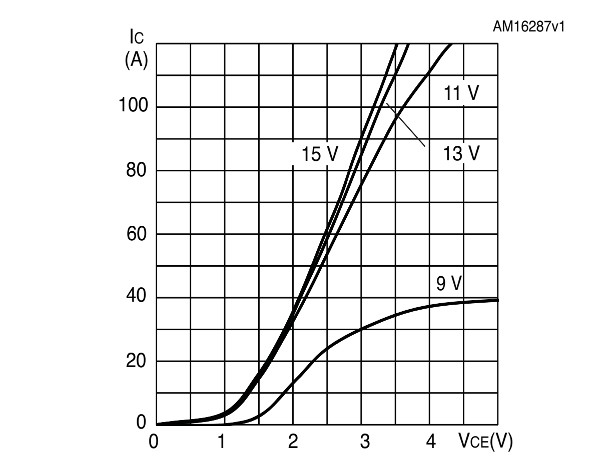


Figure 3. Output characteristics (T_J = 175°C)

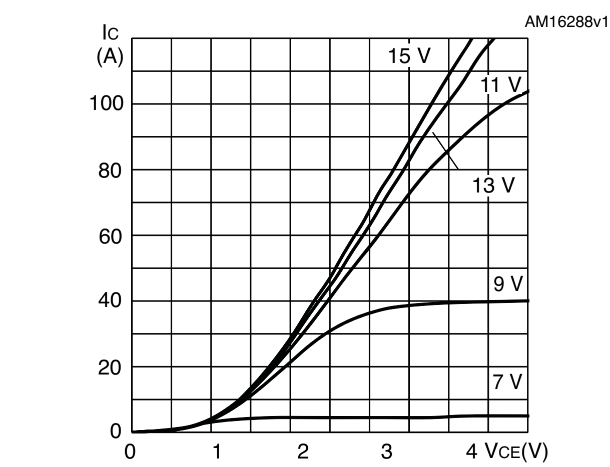


Figure 4. Transfer characteristics

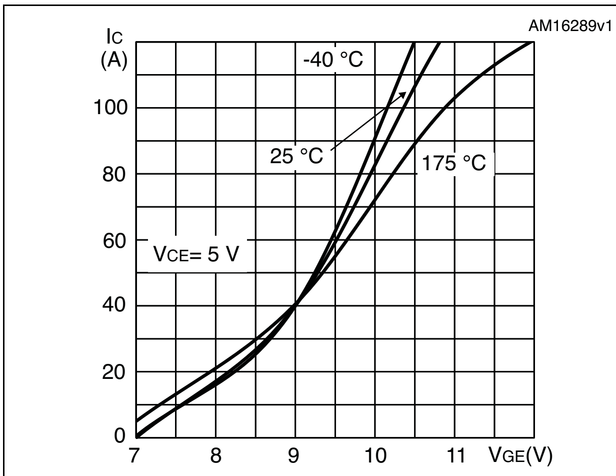
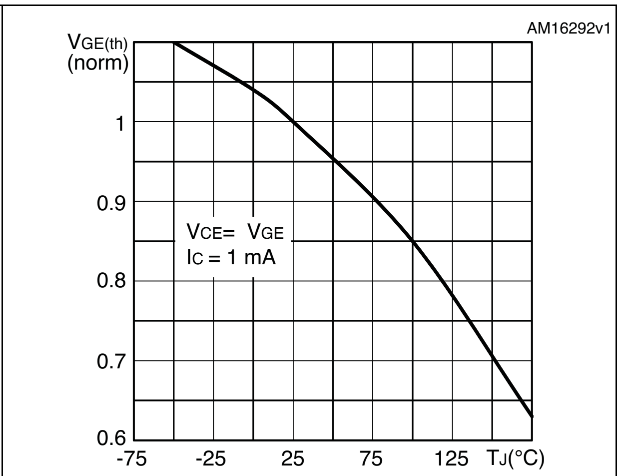


Figure 5. Normalized $V_{GE(th)}$ vs junction temperature



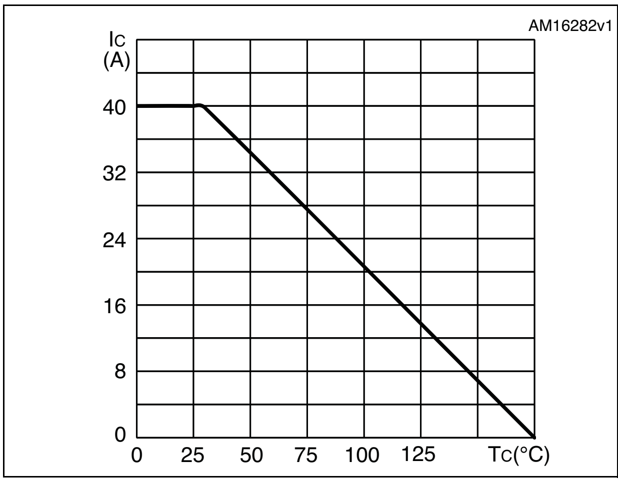


Figure 6. Collector current vs. case temperature for D²PAK and TO-220

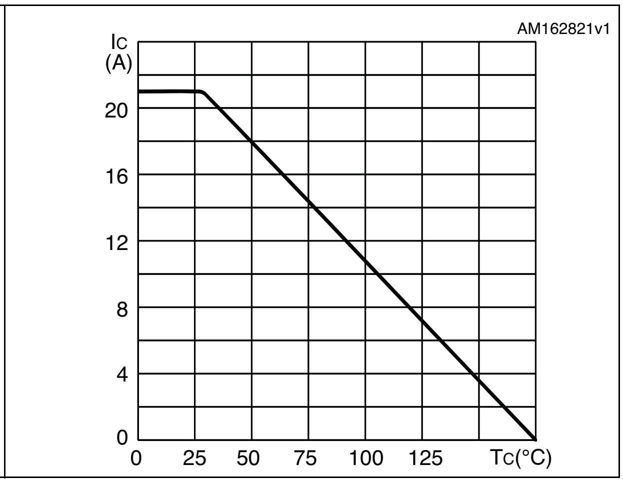


Figure 7. Collector current vs. case temperature for TO-220FP

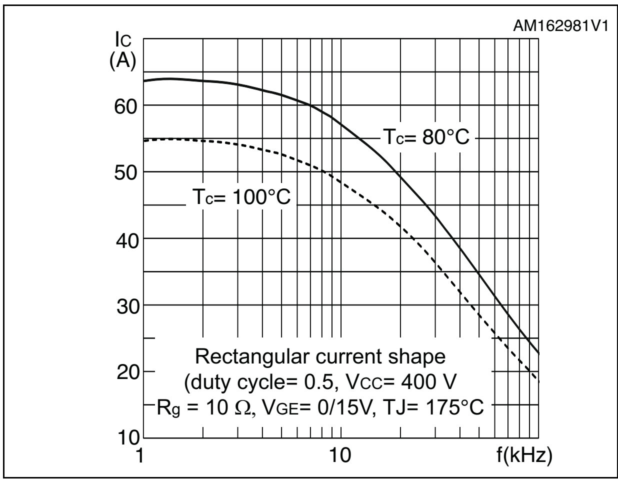


Figure 8. Collector current vs. frequency for D²PAK and TO-220

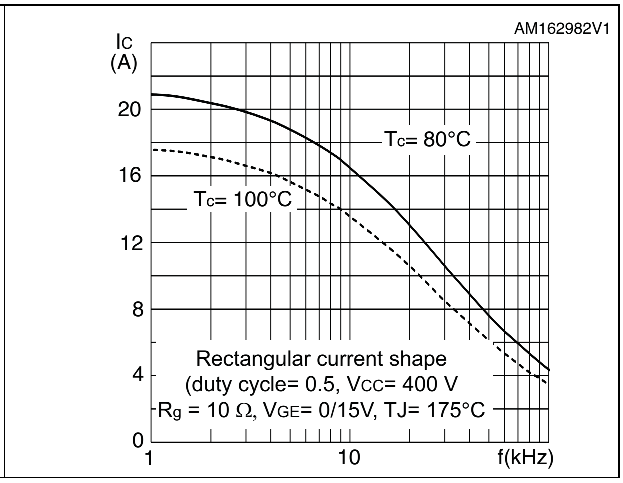


Figure 9. Collector current vs. frequency for TO-220FP

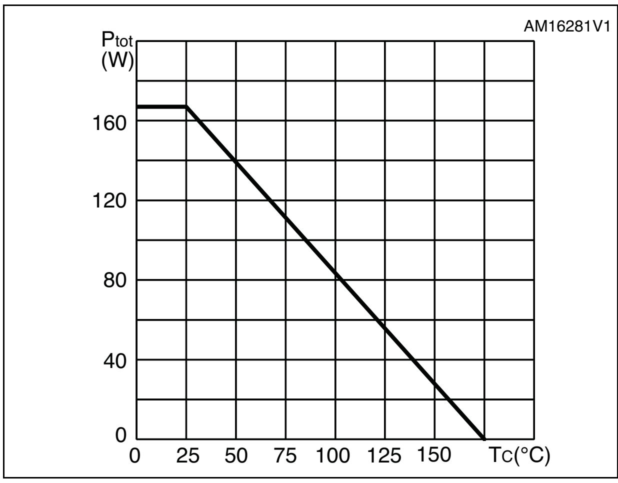


Figure 10. Power dissipation vs. case temperature for D²PAK and TO-220

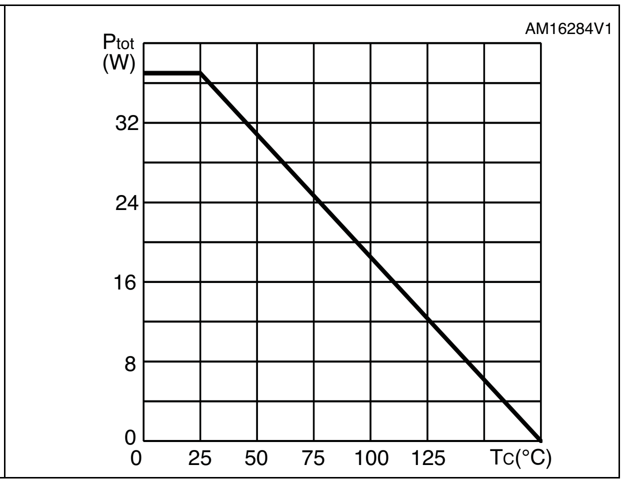


Figure 11. Power dissipation vs. case temperature for TO-220FP

Figure 12. $V_{CE(sat)}$ vs. junction temperature

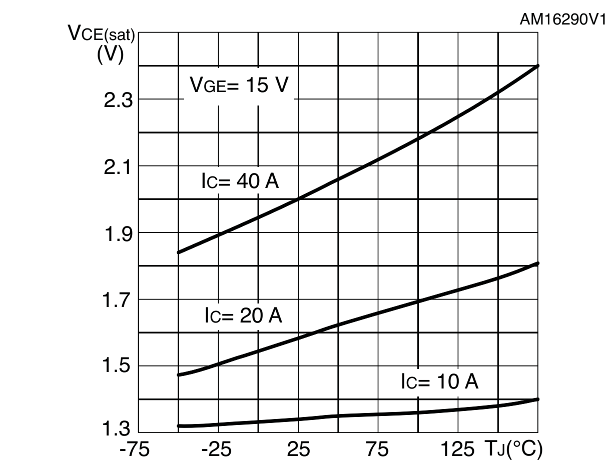


Figure 13. $V_{CE(sat)}$ vs. collector current

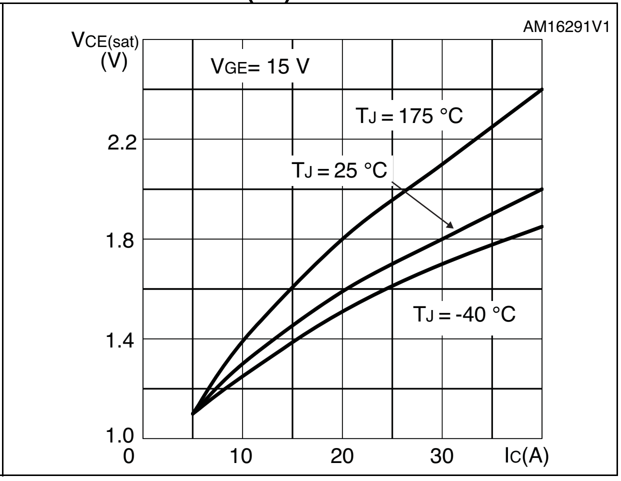


Figure 14. Forward bias safe operating area for D²PAK and TO-220

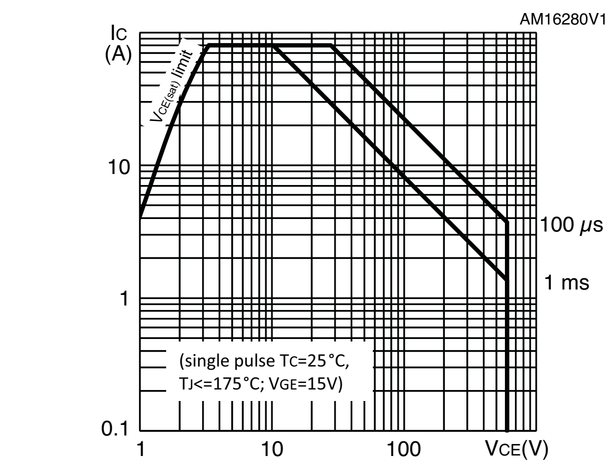


Figure 15. Thermal impedance for D²PAK and TO-220

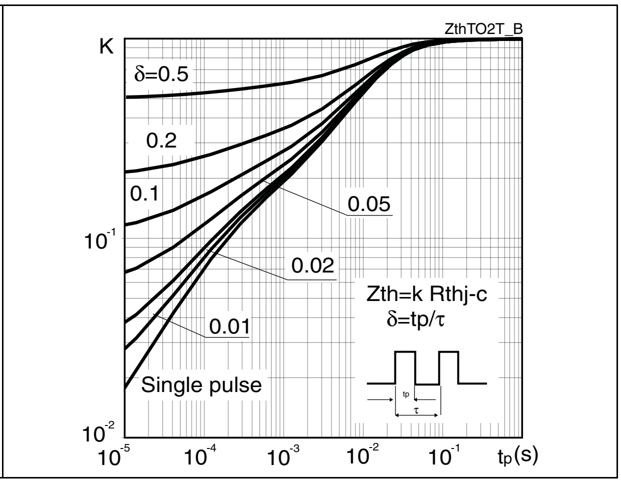


Figure 16. Forward bias safe operating area for TO-220FP

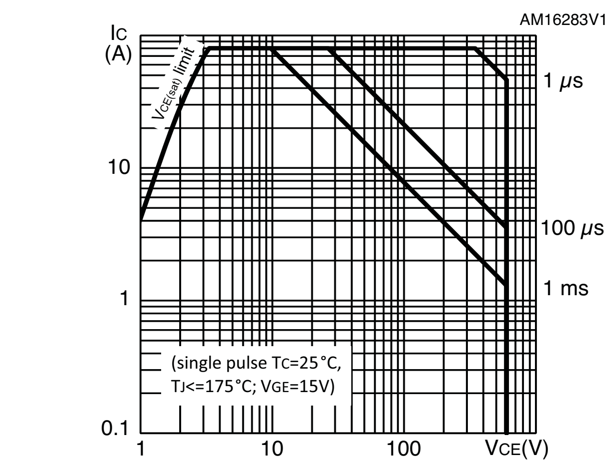


Figure 17. Thermal impedance for TO-220FP

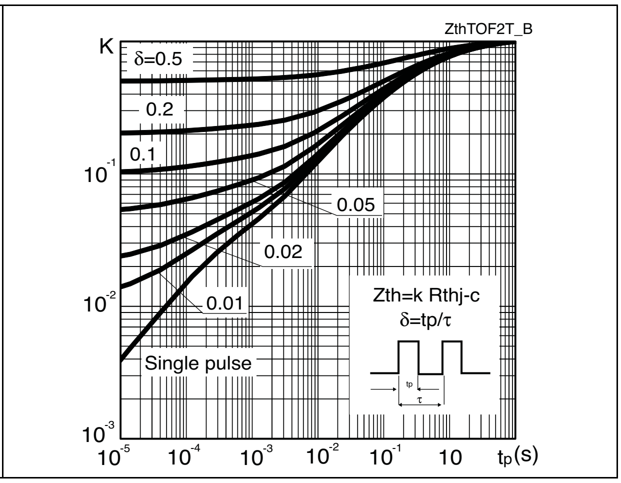


Figure 18. Diode V_F vs. forward current

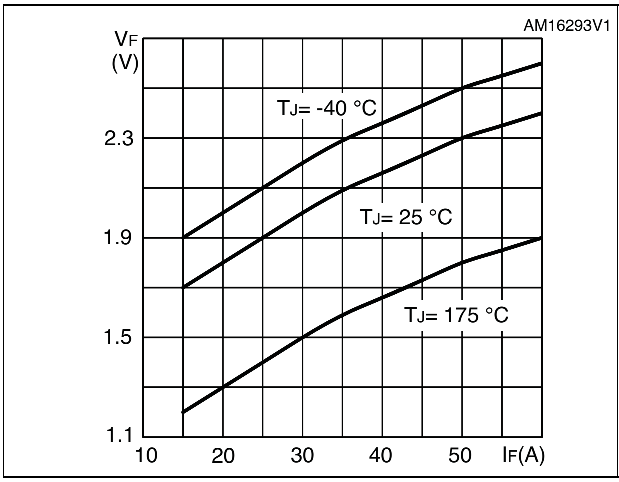


Figure 19. Gate charge vs. gate-emitter voltage

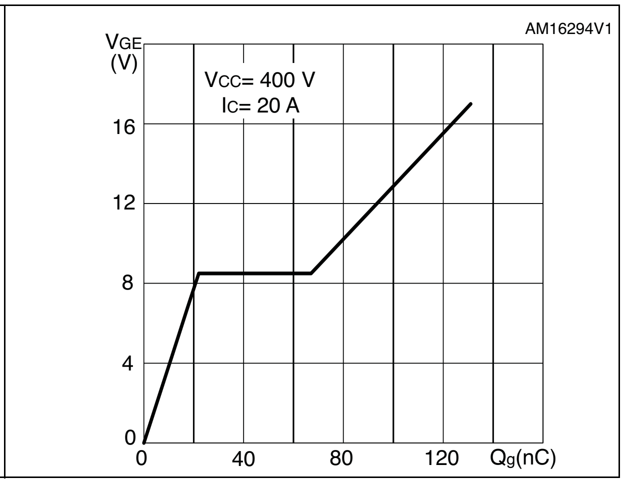


Figure 20. Capacitance variations vs. V_{CE}

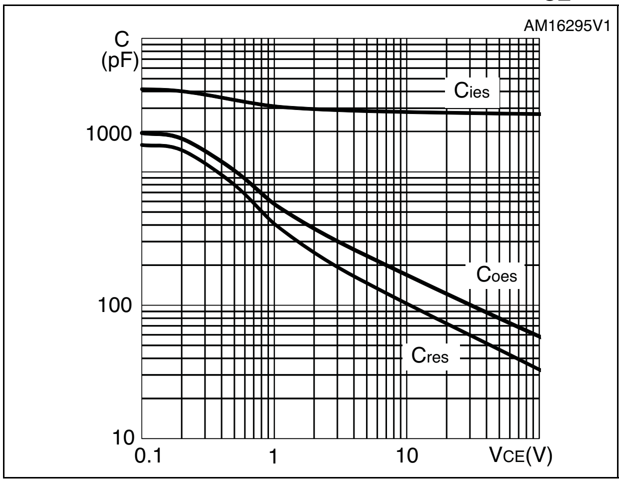


Figure 21. Switching losses vs. gate resistance

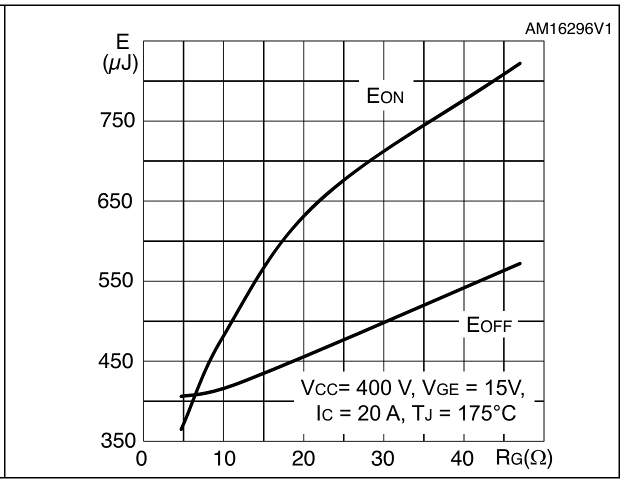


Figure 22. Switching losses vs. collector current

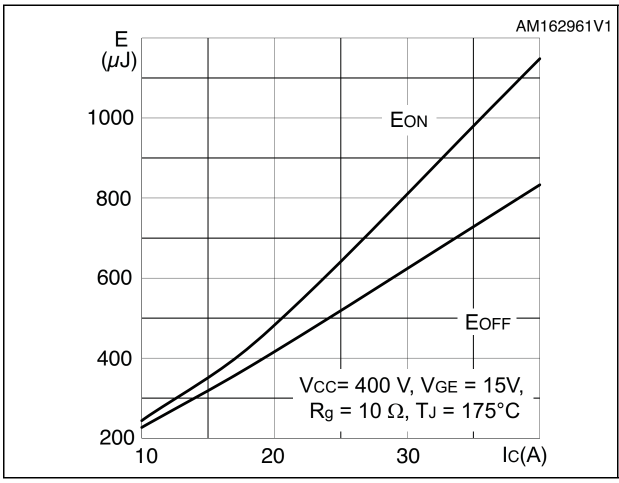


Figure 23. Switching losses vs. temperature

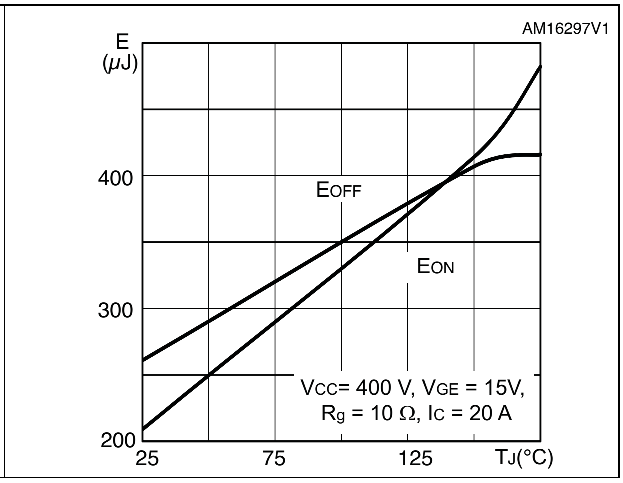
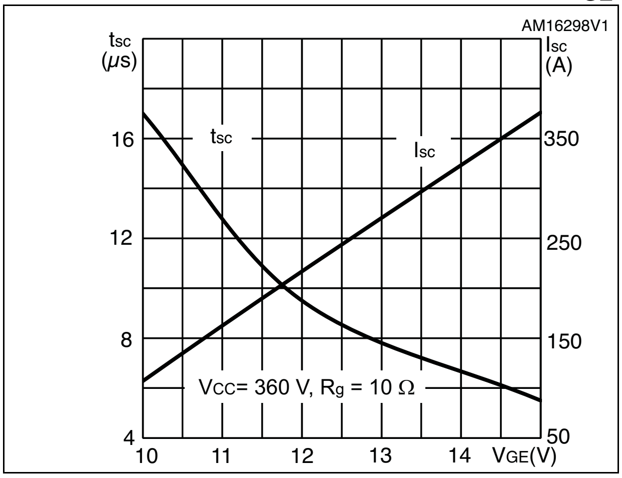


Figure 24. Short-circuit time and current vs. V_{GE}



3 Test circuits

Figure 25. Test circuit for inductive load switching

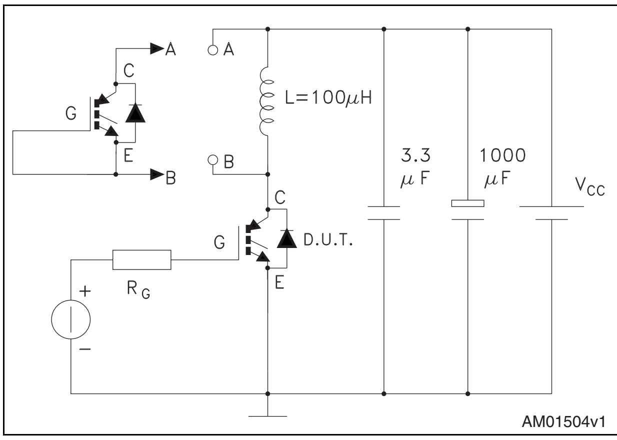


Figure 26. Gate charge test circuit

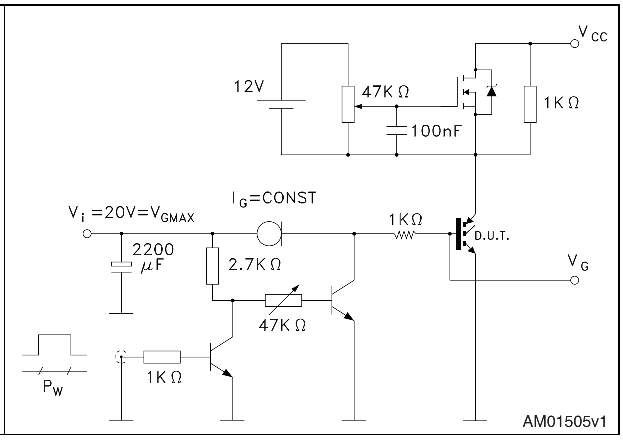


Figure 27. Switching waveform

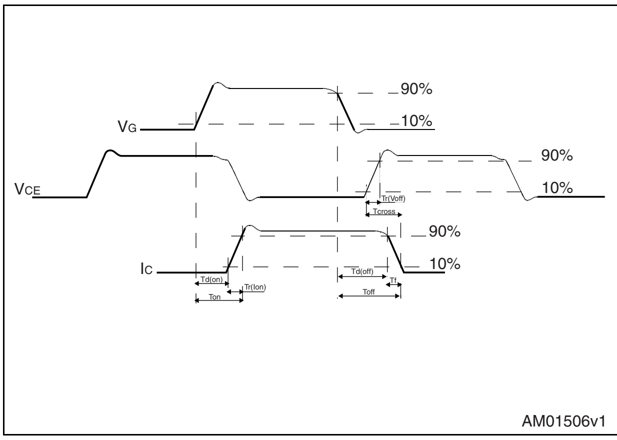
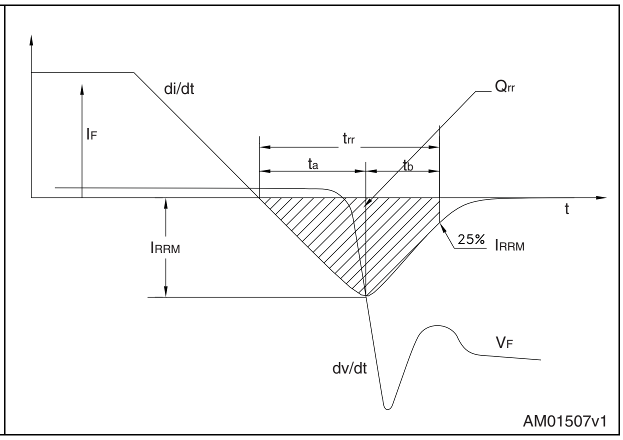


Figure 28. Diode recovery time waveform



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 9. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 29. TO-220FP drawing

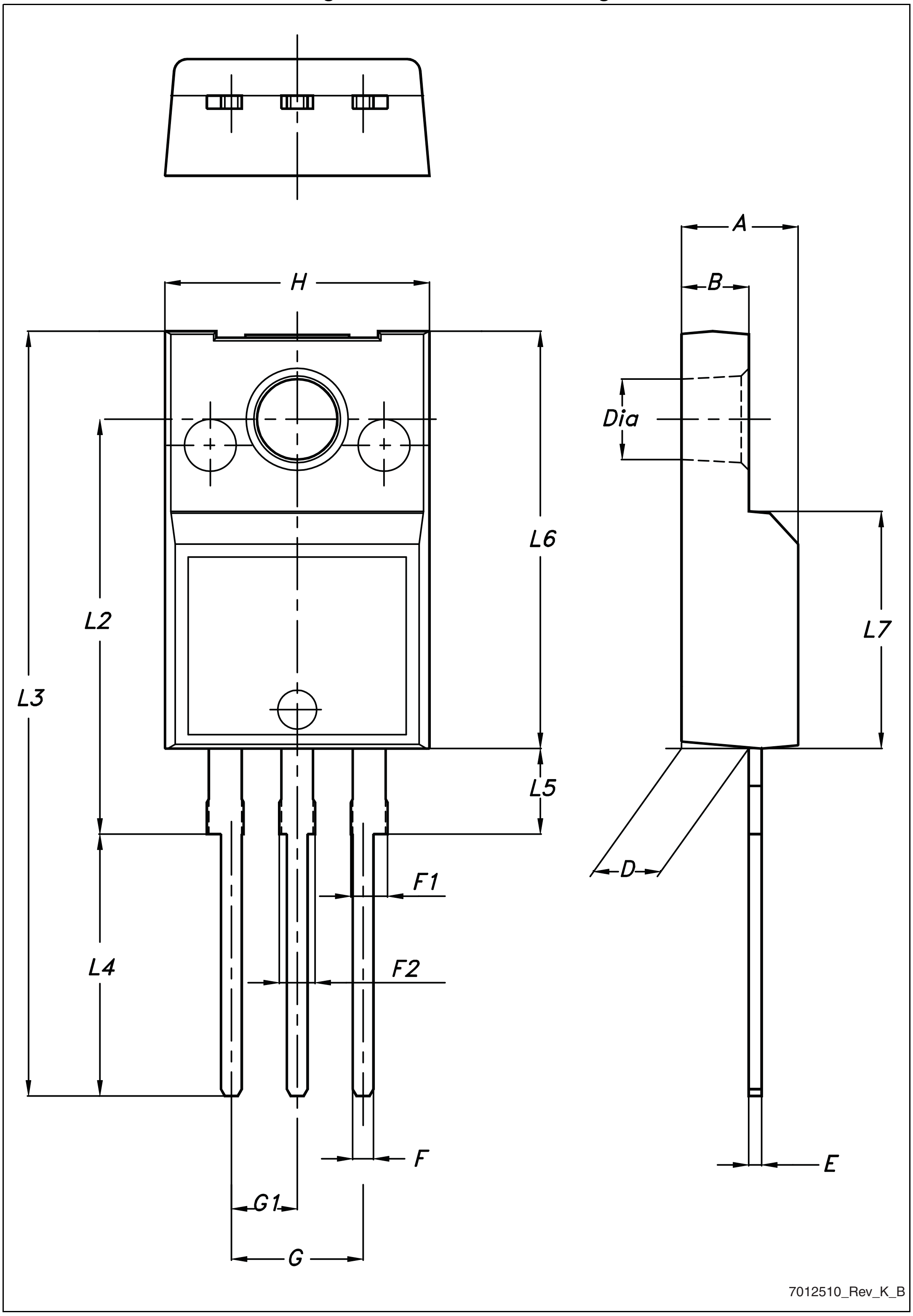


Table 10. TO-220 type A mechanical data

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 30. TO-220 type A drawing

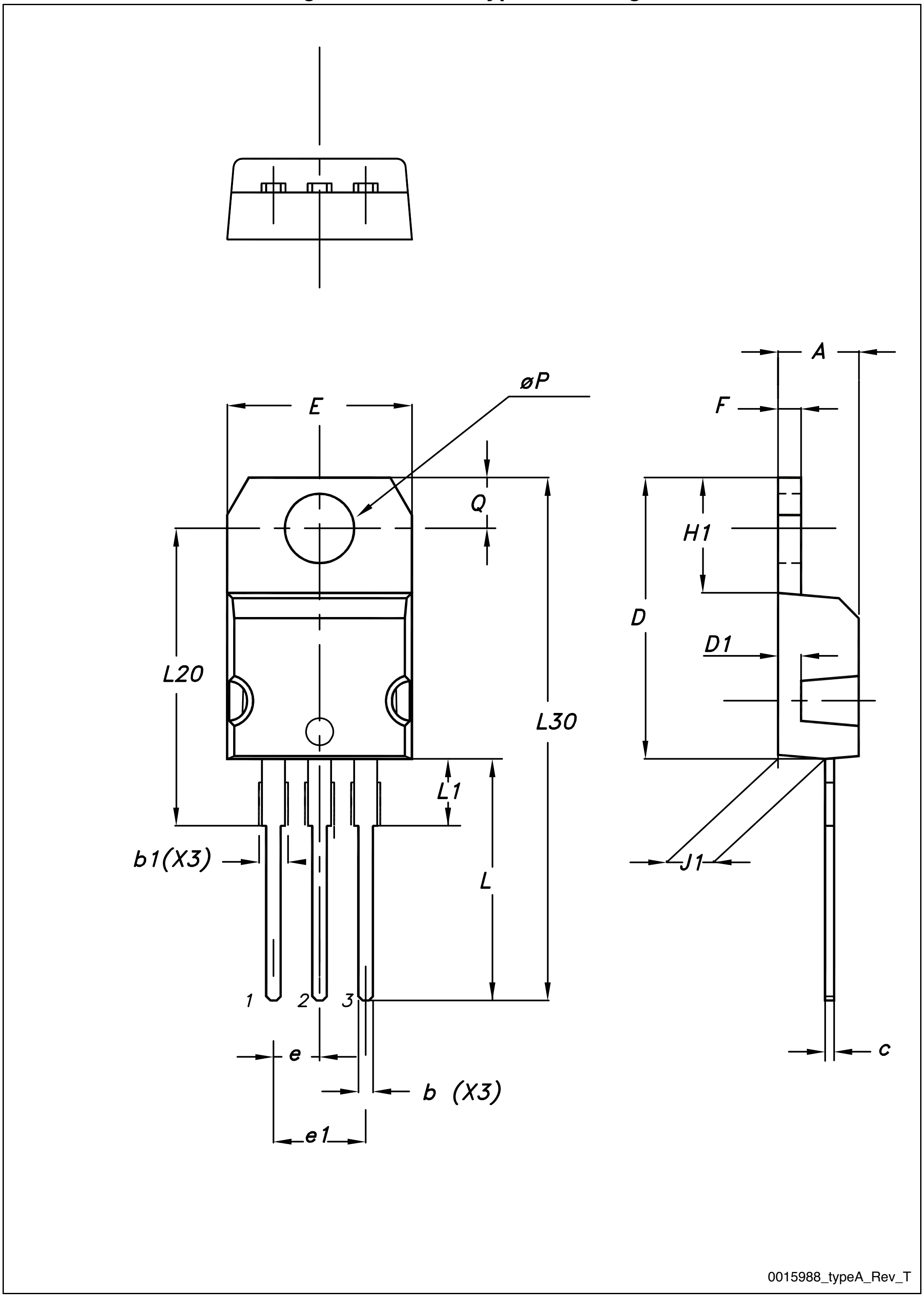


Table 11. D²PAK mechanical data

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 31. D²PAK drawing

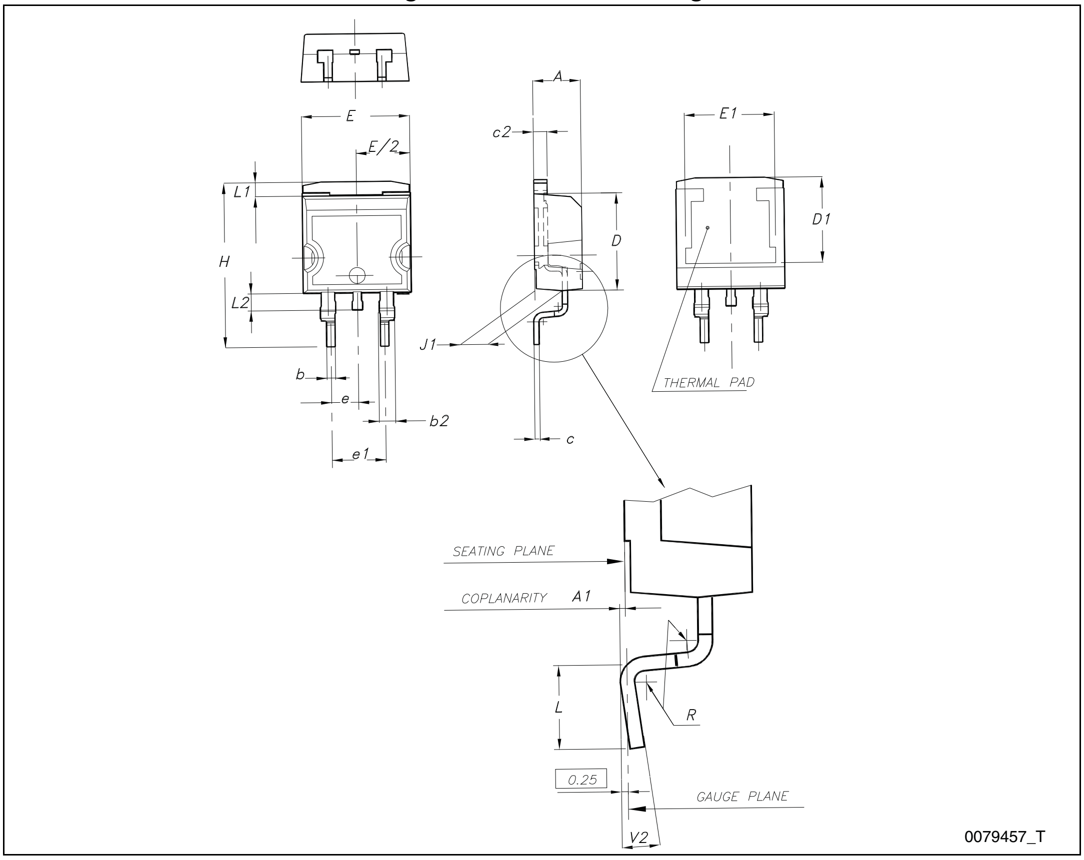
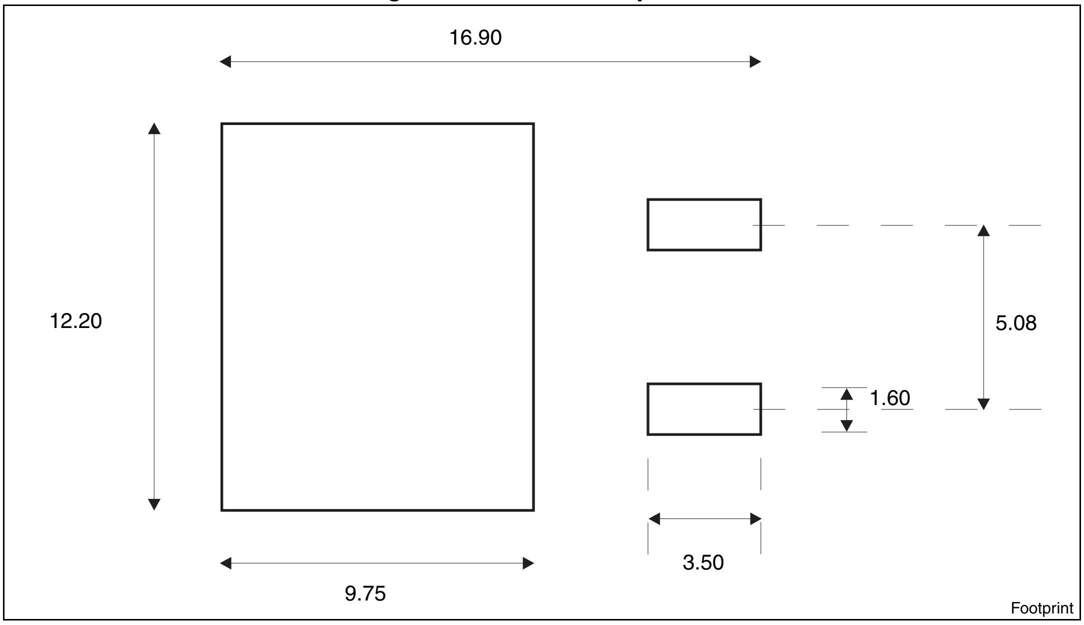


Figure 32. D²PAK footprint[(a)]



a. All dimension are in millimeters

5 Packaging mechanical data

Table 12. D²PAK 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 33. Tape

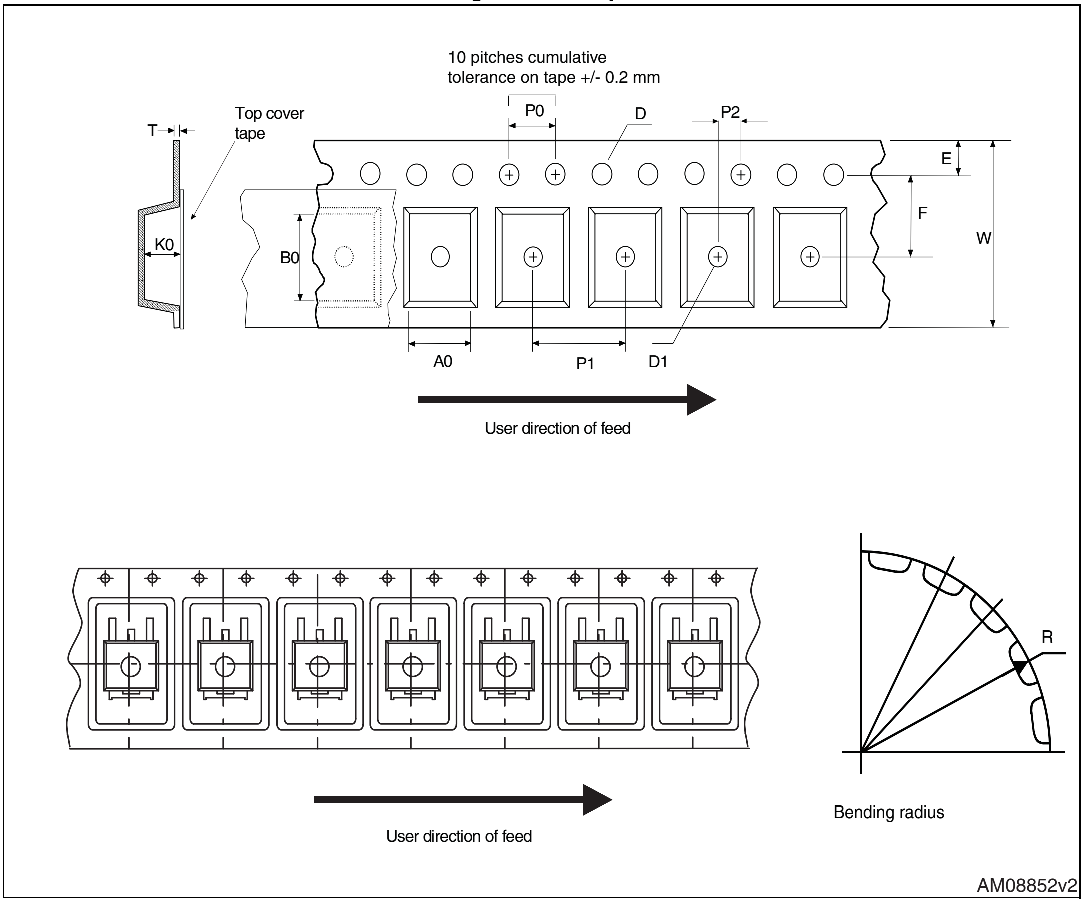
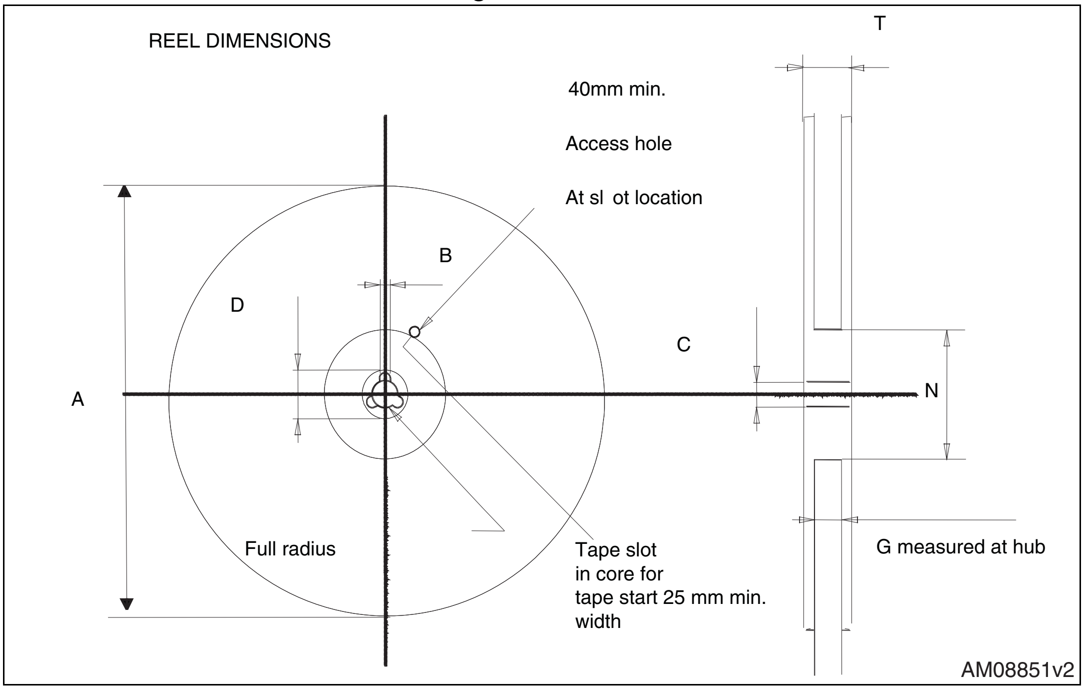


Figure 34. Reel



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
03-Oct-2012	1	Initial release.
18-Mar-2013	2	Added new order code STGF20H60DF, mechanical data *Table 9* and *Figure 29 on page 14*. Added *Chapter 2.1: Electrical characteristics (curves)*.
22-Mar-2013	3	Document status promoted from preliminary to production data.
03-Jun-2013	4	Updated P_{TOT} in *Table 2: Absolute maximum ratings*, R_{thJC} in *Table 3: Thermal data* and *Figure 10: Power dissipation vs. case temperature for D²PAK and TO-220*. Updated *Section 4: Package mechanical data* for TO-220.

Стандарт Электрон Связь

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

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