STGB30H60DF, STGF30H60DF, STGP30H60DF, STGW30H60DF

600 V, 30 A high speed trench gate field-stop IGBT

Datasheet - production data

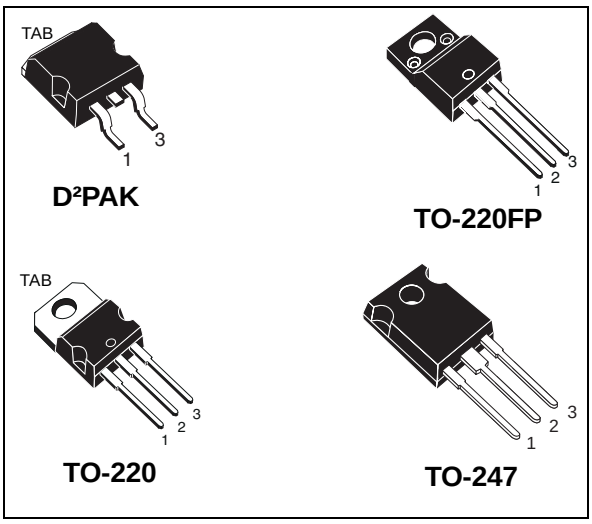
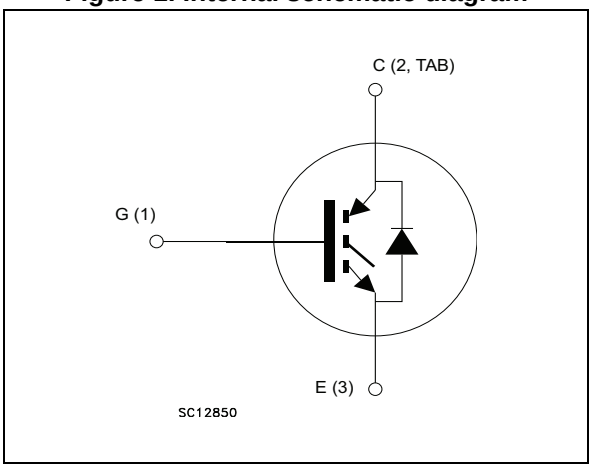


Figure 1. Internal schematic diagram



Features

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

Applications

- Inverter
- 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	Package	Packaging
STGB30H60DF	GB30H60DF	D²PAK	Tape and reel
STGF30H60DF	GF30H60DF	TO-220FP	Tube
STGP30H60DF	GP30H60DF	TO-220	
STGW30H60DF	GW30H60DF	TO-247	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	TO-220 D²PAK TO-247	TO-220FP	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600		V
I_C	Continuous collector current at T_C = 25 °C	60	60 (1)	A
I_C	Continuous collector current at T_C = 100 °C	30	30(1)	A
I_{CP} (2)	Pulsed collector current	120	120(1)	A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Continuous forward current T_C = 25 °C	60	60(1)	A
I_F	Continuous forward current at T_C = 100 °C	30	30(1)	A
I_{FP} (2)	Pulsed forward current	120	120(1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	260	37(1)	W
T_{STG}	Storage temperature range	- 55 to 150		°C
T_J	Operating junction temperature	- 40 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	Value				Unit
		D²PAK	TO-220FP	TO-220	TO-247	
R_{thJC}	Thermal resistance junction-case IGBT	0.58	4	0.58		°C/W
R_{thJC}	Thermal resistance junction-case diode	2.5	5.6	2.5		°C/W
R_{thJA}	Thermal resistance junction-ambient	62.5			50	°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 4. Static

Symbol	Parameter	Test condition	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 = 30 A		2.0	2.4	V
		V_{GE} = 15 V, I_C = 30 A T_J = 175 °C		2.4		V
$V_{GE(th)}$	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 condition	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	3600	-	pF
C_{oes}	Output capacitance			130		pF
C_{res}	Reverse transfer capacitance			65		pF
Q_g	Total gate charge	V_{CC} = 400 V, I_C = 30 A, V_{GE} = 15 V	-	105	-	nC
Q_{ge}	Gate-emitter charge		-	30	-	nC
Q_{gc}	Gate-collector charge		-	35	-	nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 30 A, R_G = 10 Ω, V_{GE} = 15 V	-	50	-	ns
t_r	Current rise time			15		ns
$(di/dt)_{on}$	Turn-on current slope			1600		A/µs
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 30 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C	-	47	-	ns
t_r	Current rise time			17		ns
$(di/dt)_{on}$	Turn-on current slope			1400		A/µs
$t_r(V_{off})$	Off voltage rise time	V_{CE} = 400 V, I_C = 30 A, R_G = 10 Ω, V_{GE} = 15 V	-	20	-	ns
$t_{d(off)}$	Turn-off delay time			160		ns
t_f	Current fall time			60		ns
$t_r(V_{off})$	Off voltage rise time	V_{CE} = 400 V, I_C = 30 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C	-	22	-	ns
$t_{d(off)}$	Turn-off delay time			146		ns
t_f	Current fall time			88		ns
t_{sc}	Short circuit withstand time	$V_{CC} \leq$ 360 V, V_{GE} = 15 V	3	6	-	µs

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Eon (1)	Turn-on switching losses	V_{CE} = 400 V, I_C = 30 A, R_G = 10 Ω, V_{GE} = 15 V	-	0.35	-	mJ
E_{off} (2)	Turn-off switching losses			0.40		mJ
E_{ts}	Total switching losses			0.75		mJ
Eon (1)	Turn-on switching losses	V_{CE} = 400 V, I_C = 230 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C		0.61		mJ
E_{off} (2)	Turn-off switching losses			0.84		mJ
E_{ts}	Total switching losses			1.45		mJ

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 condition	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 30 A	-	2.0	2.3	V
		I_F = 30 A, T_J = 175 °C		1.5		V
t_{rr}	Reverse recovery time	V_r = 400 V, I_F = 30 A; di_F/dt = 400 A / µs	-	110	-	ns
Q_{rr}	Reverse recovery charge			136		nC
I_{rrm}	Reverse recovery current			2.5		A
t_{rr}	Reverse recovery time	V_r = 400 V, I_F = 30 A; di_F/dt = 400 A / µs T_J = 175 °C	-	190	-	ns
Q_{rr}	Reverse recovery charge			506		nC
I_{rrm}	Reverse recovery current			5.3		A

2.1 Electrical characteristics (curves)

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

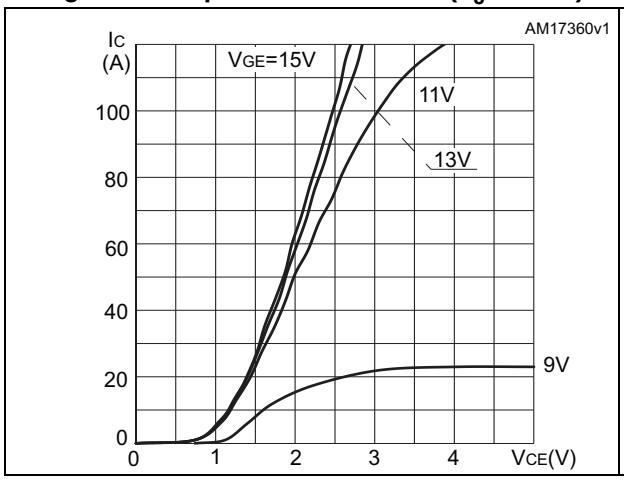


Figure 3. Output characteristics (T_J = 175°C)

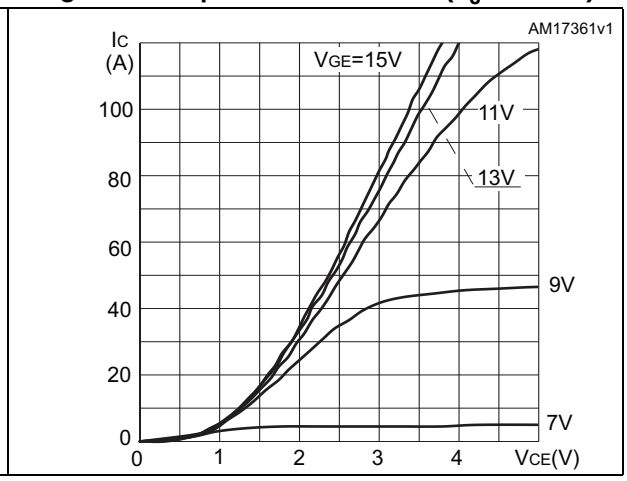


Figure 4. Transfer characteristics

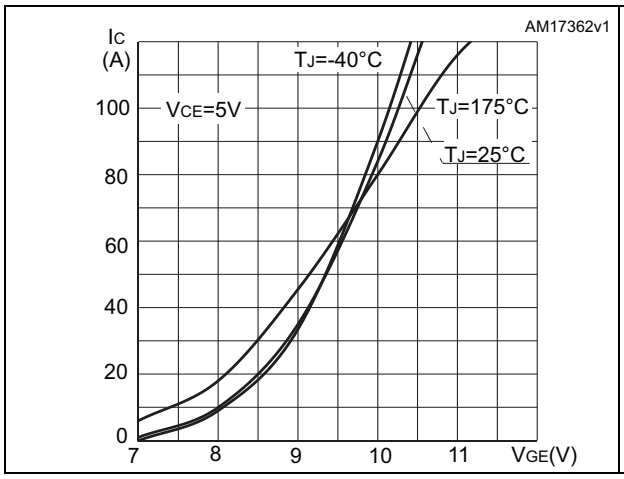


Figure 5. Normalized $V_{GE(th)}$ vs. junction temperature

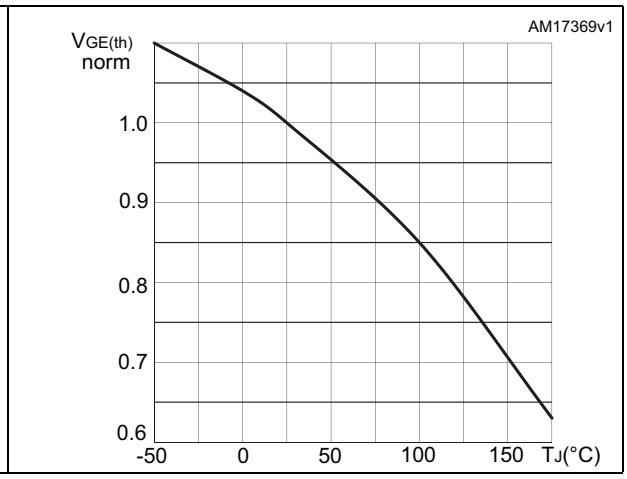


Figure 6. Power dissipation vs. case temperature for D²PAK, TO-220 and TO-247

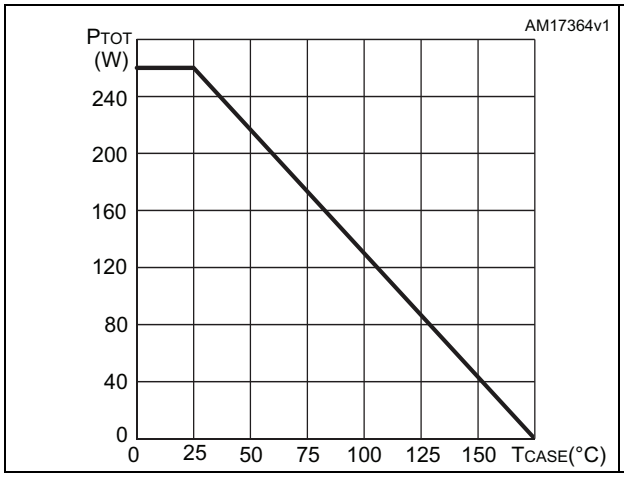


Figure 7. Power dissipation vs. case temperature for TO-220FP

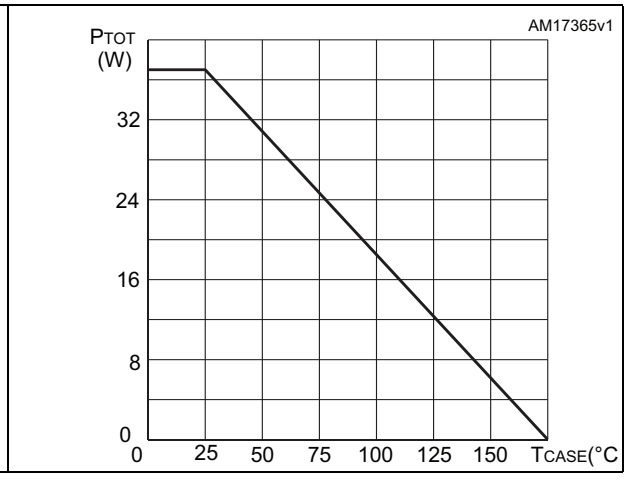


Figure 8. Collector current vs. frequency for D²PAK, TO-220 and TO-247

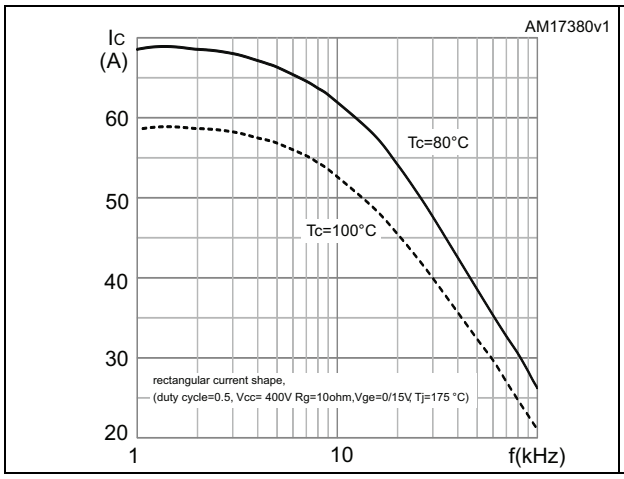


Figure 9. Collector current vs. frequency for TO-220FP

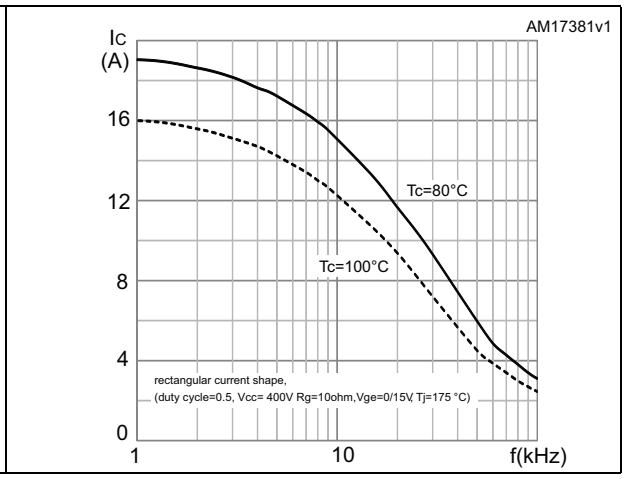


Figure 10. $V_{CE(sat)}$ vs. junction temperature

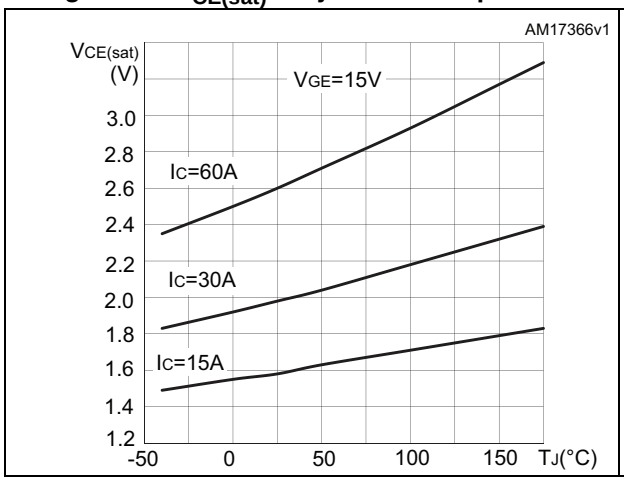


Figure 11. $V_{CE(sat)}$ vs. collector current

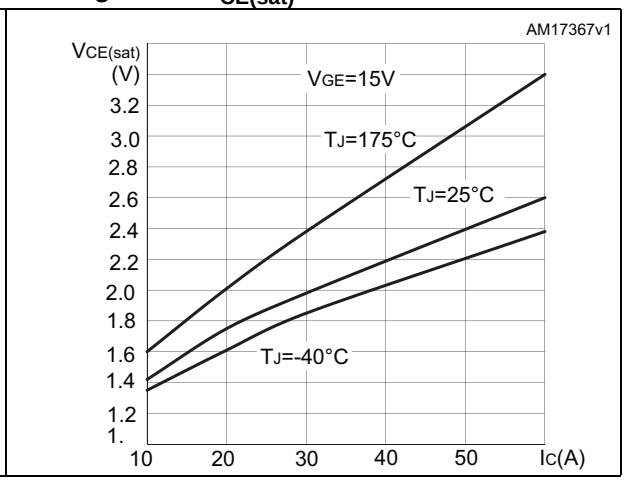


Figure 12. Collector current vs. case temperature for D²PAK, TO-220 and TO-247

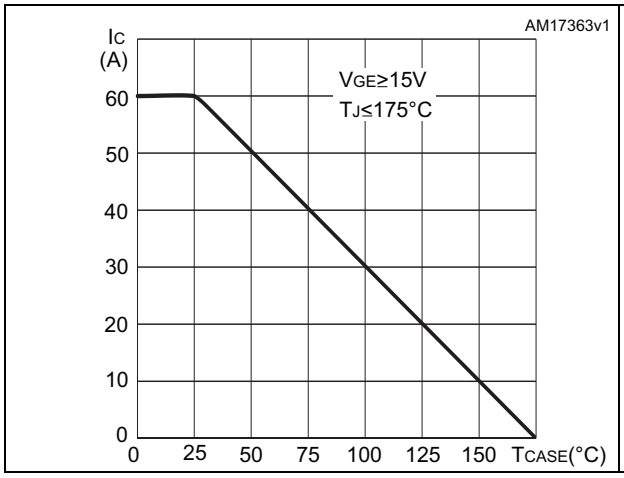


Figure 13. Collector current vs. case temperature for TO-220FP

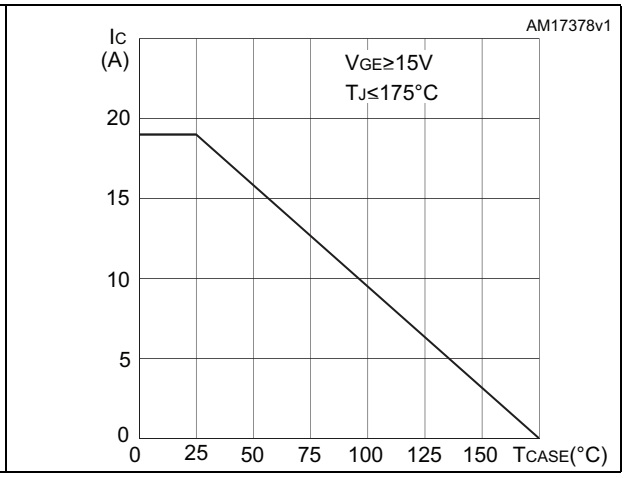


Figure 14. Forward bias safe operating area for TO-220, D²PAK and TO-247

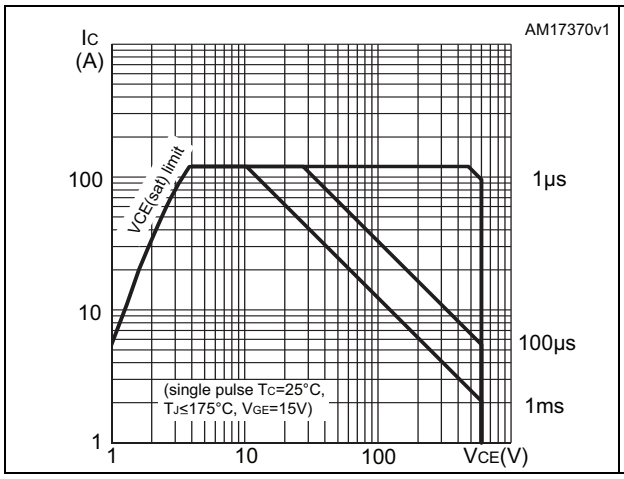


Figure 15. Thermal impedance for TO-220, D²PAK and TO-247

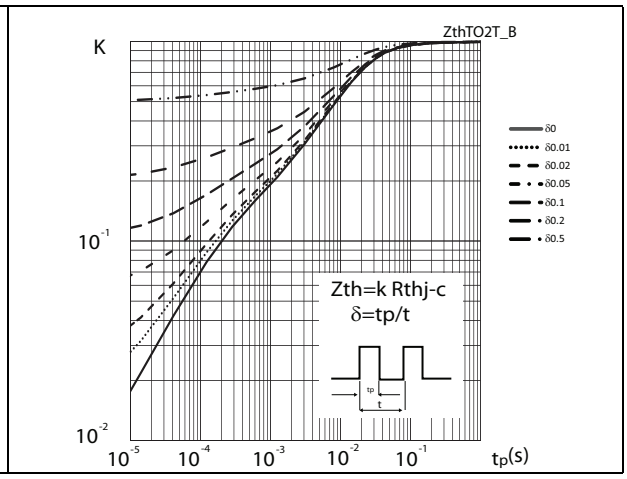


Figure 16. Forward bias safe operating area for TO-220FP

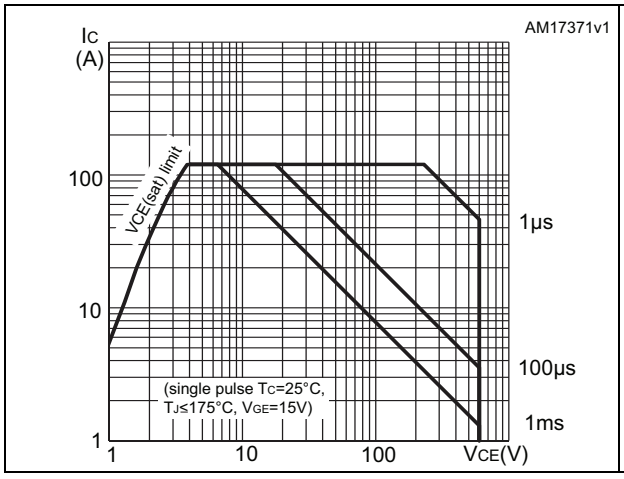


Figure 17. Thermal impedance for TO-220FP

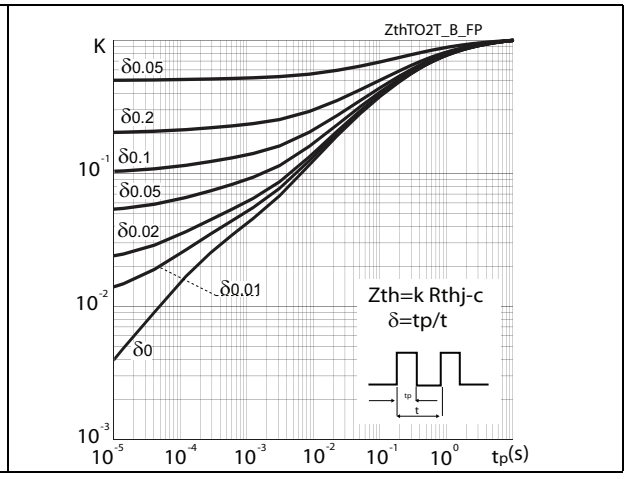


Figure 18. Gate charge vs. gate-emitter voltage

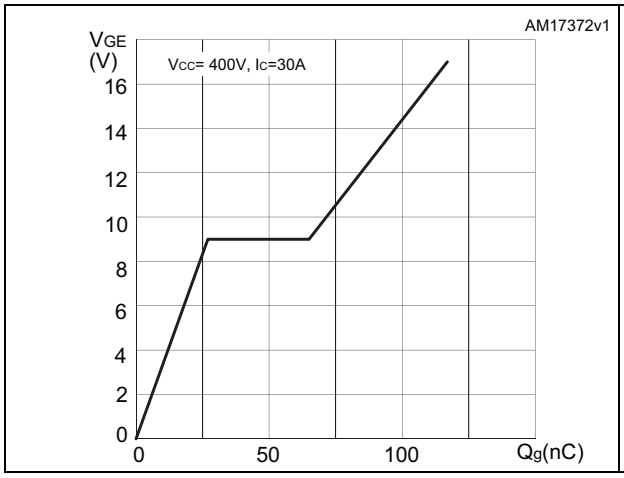


Figure 19. Capacitance variations vs. V_{CE}

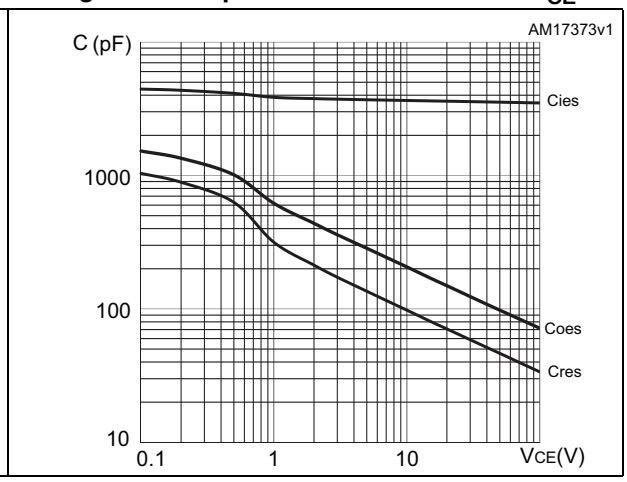


Figure 20. Diode VF vs. forward current

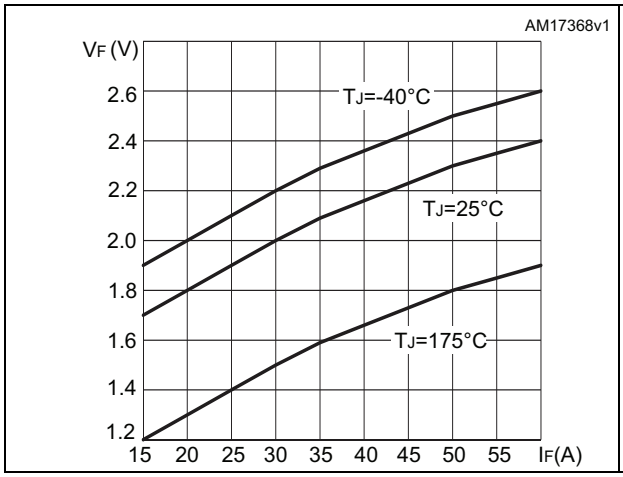


Figure 21. Switching losses vs. gate resistance

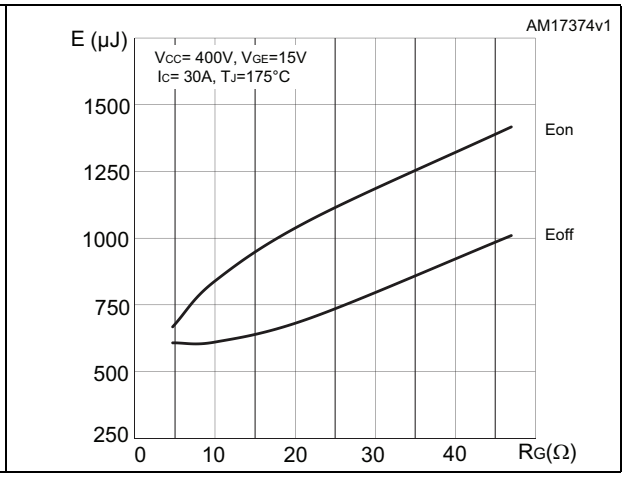


Figure 22. Switching losses vs. collector current

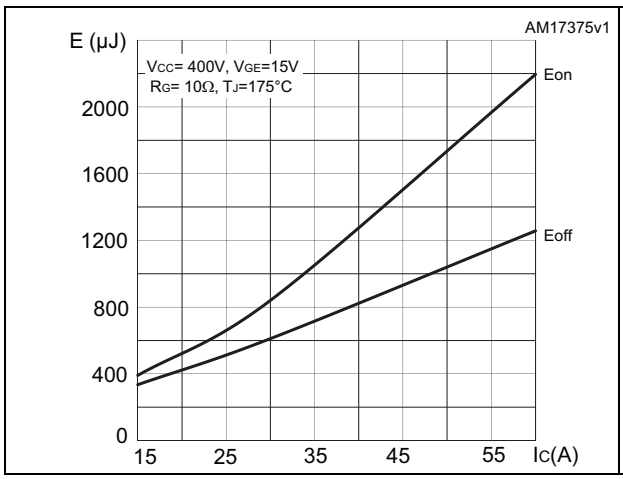


Figure 23. Switching losses vs temperature

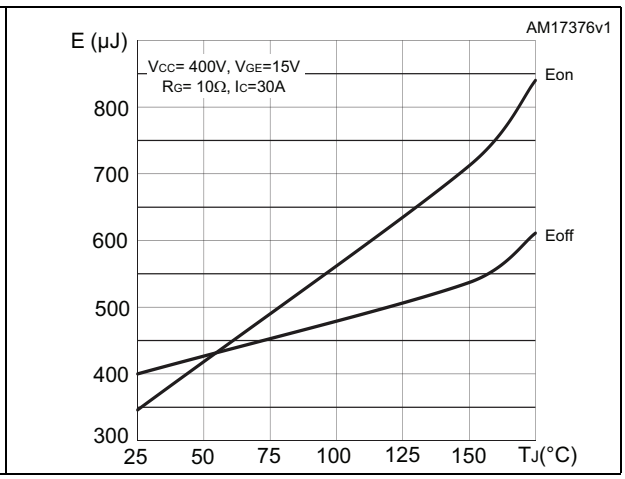
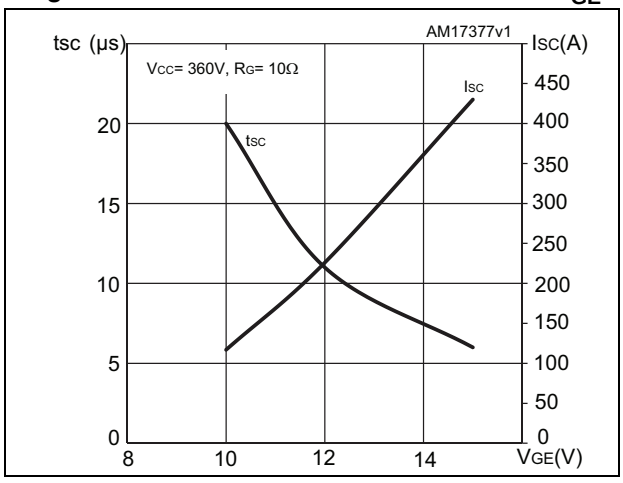


Figure 24. Short circuit time & current vs. V_{GE}



3 Test circuits

Figure 25. Test circuit for inductive load switching

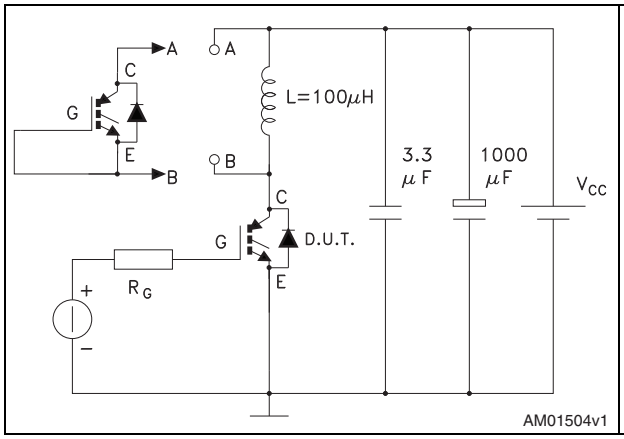


Figure 26. Gate charge test circuit

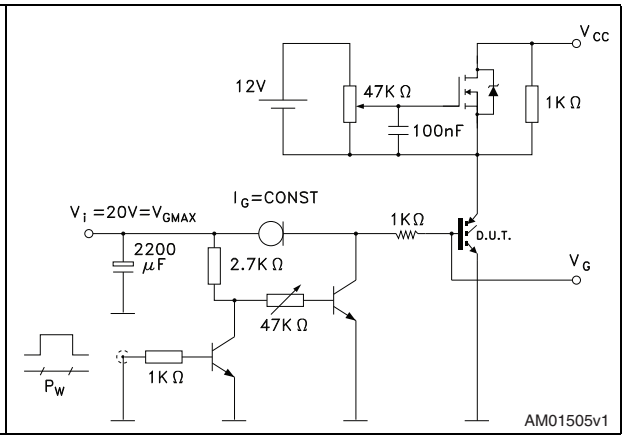


Figure 27. Switching waveform

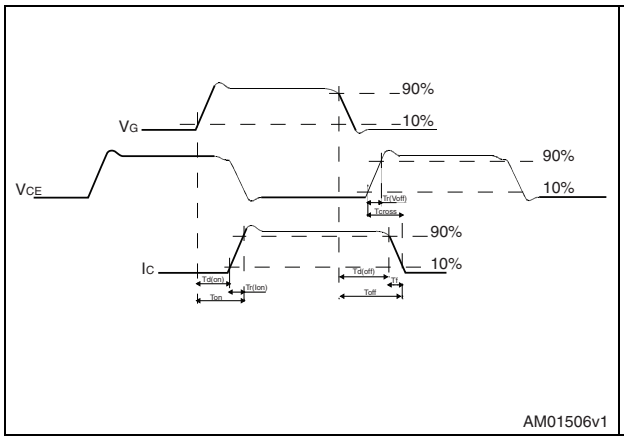
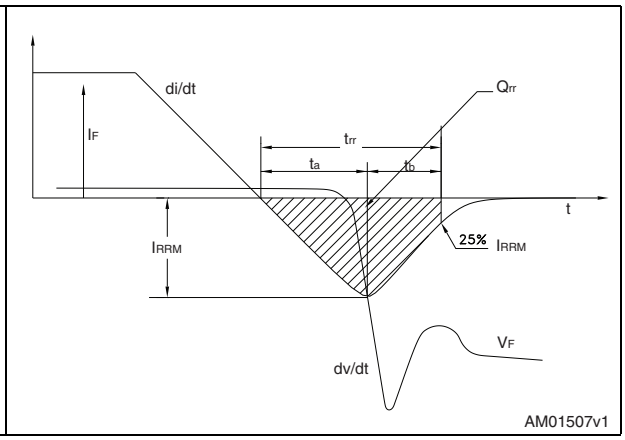


Figure 28. Diode recovery time waveform



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. 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 29. D²PAK (TO-263) drawing

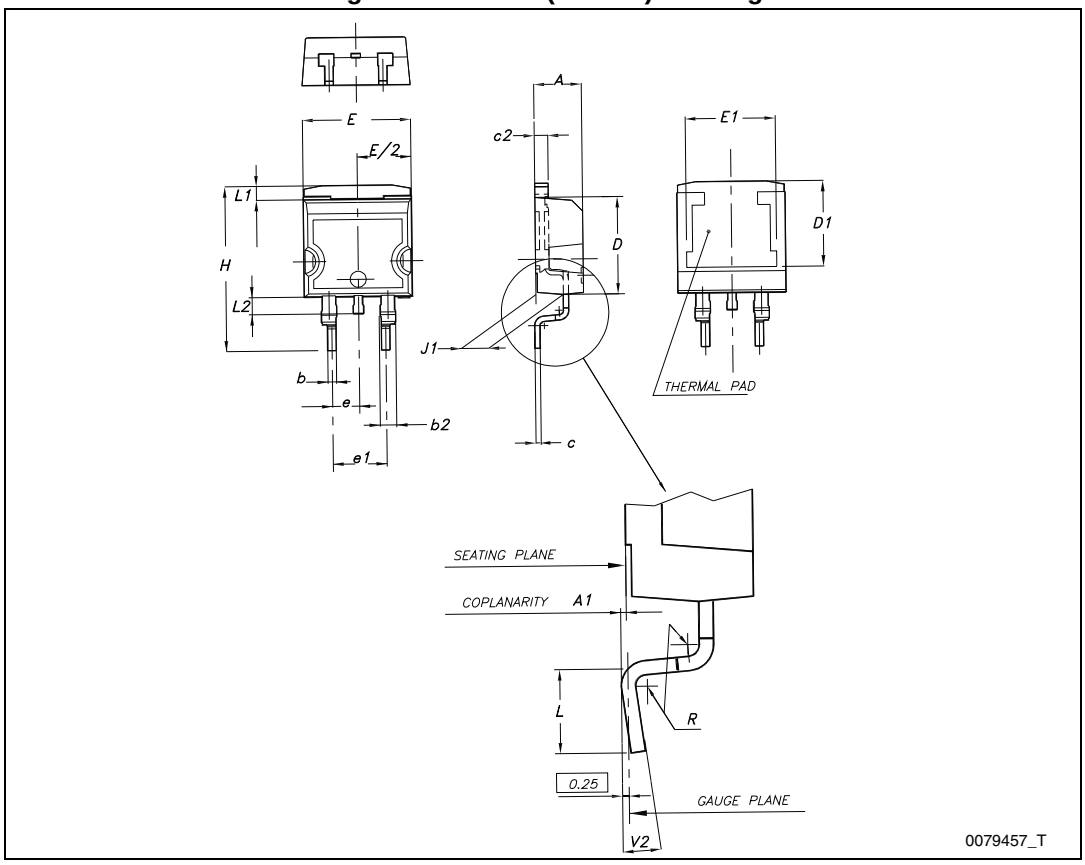


Table 10. TO-220FP mechanical data

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 30. TO-220FP drawing

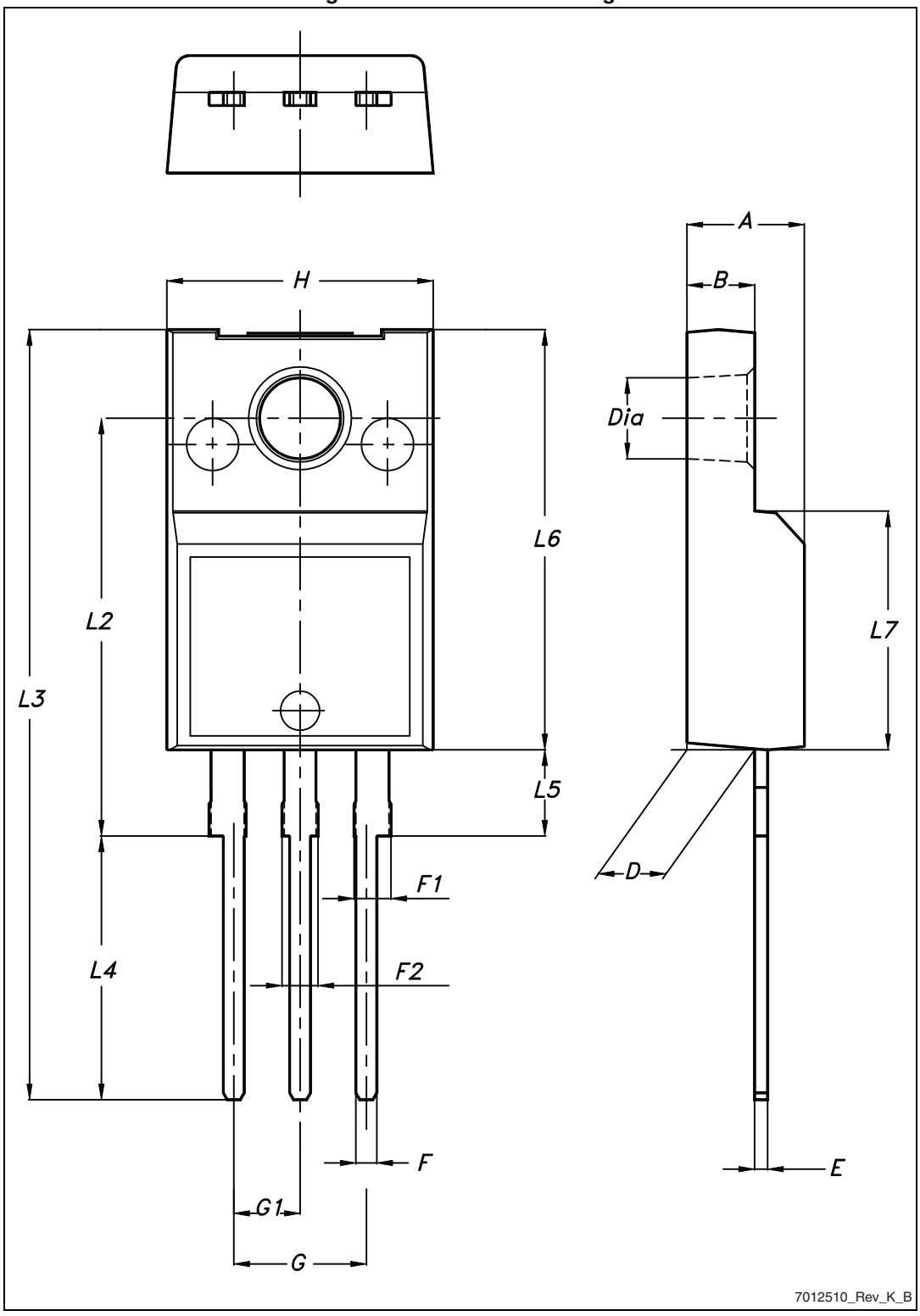


Table 11. TO-220 type A mechanical data

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 31. TO-220 type A drawing

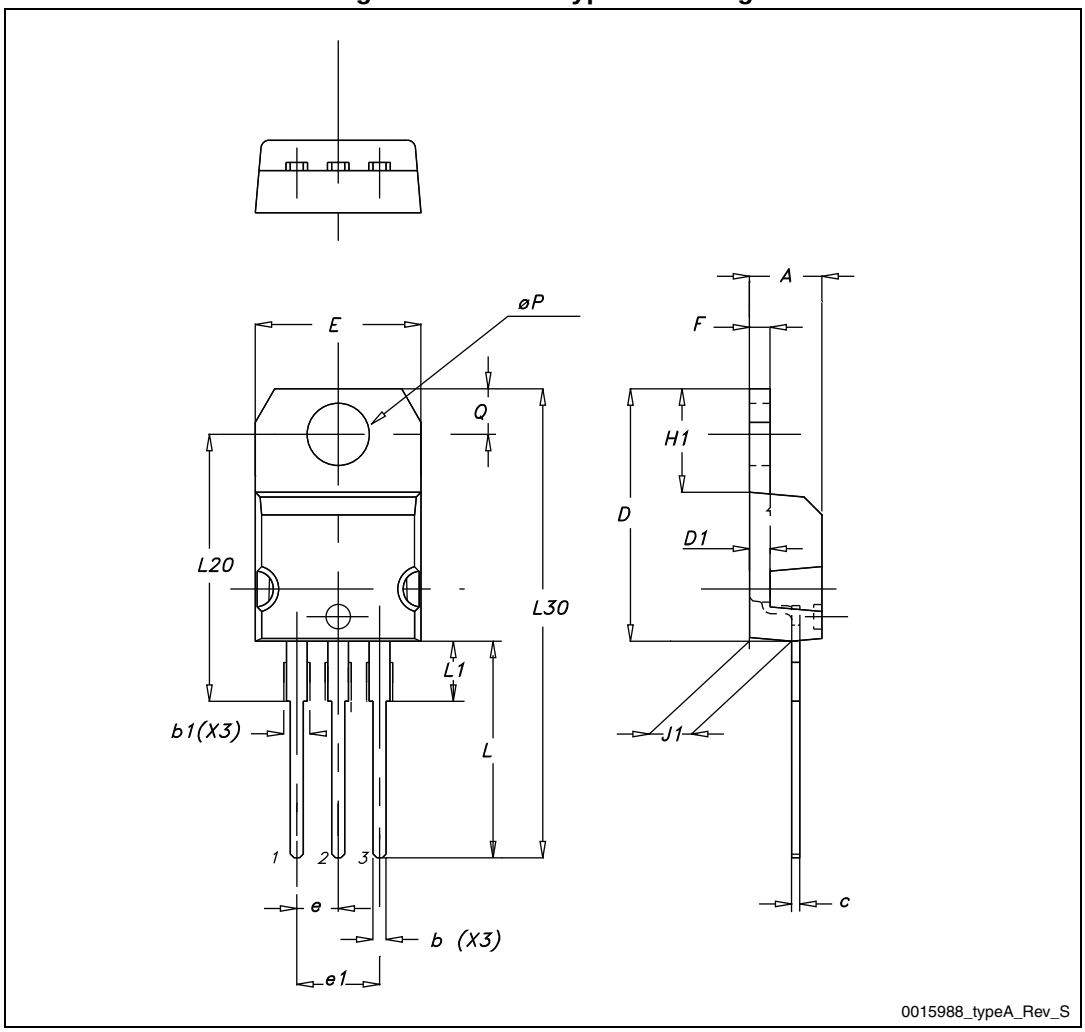
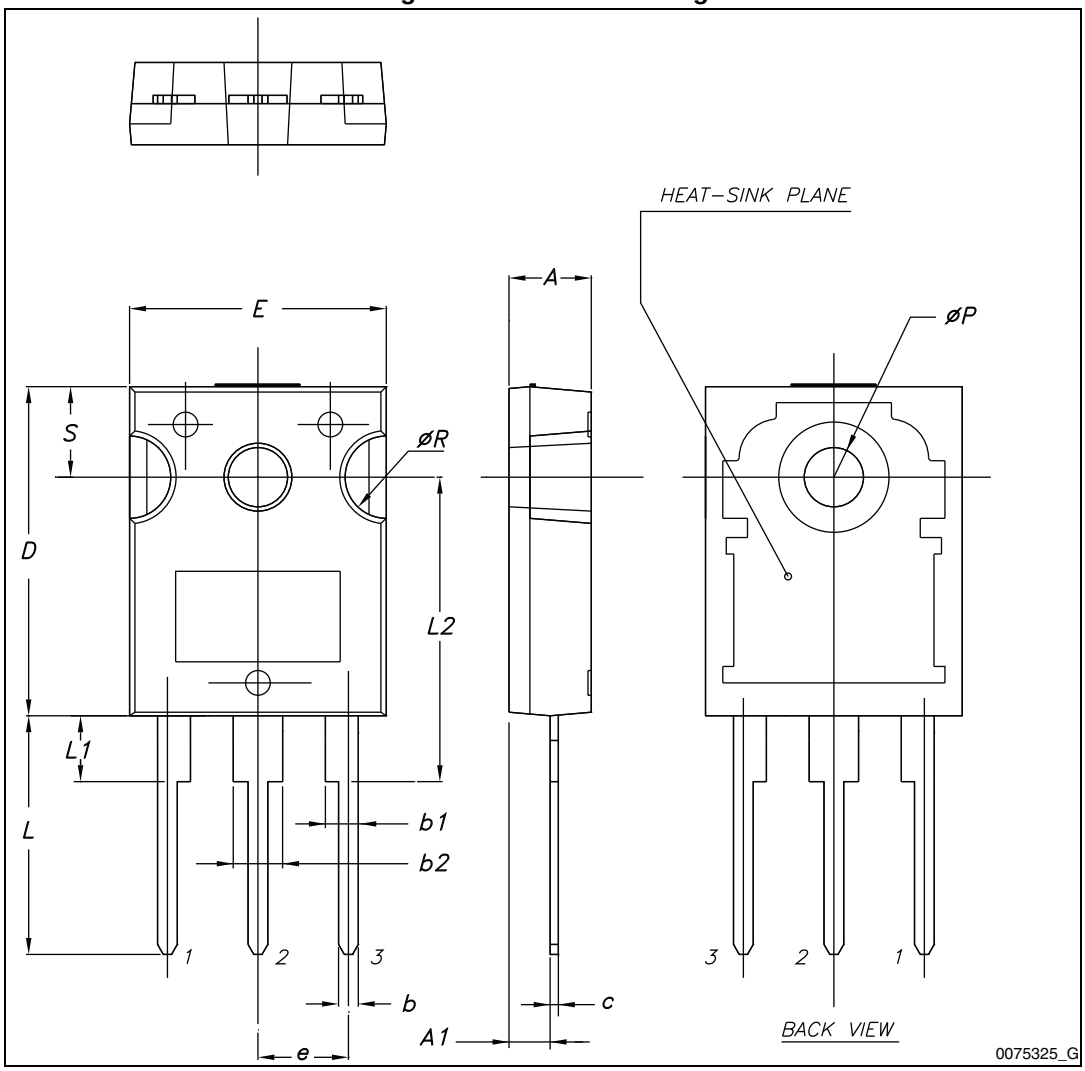


Table 12. TO-247 mechanical data

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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

Figure 32. TO-247 drawing



5 Packaging mechanical data

Table 13. 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 33. D²PAK footprint(a)

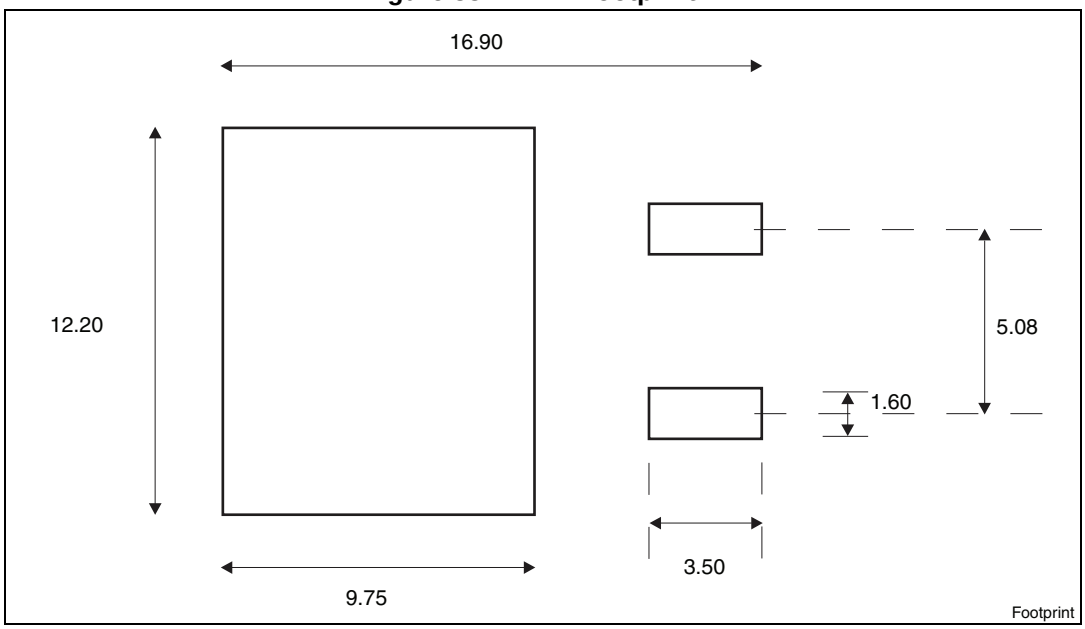
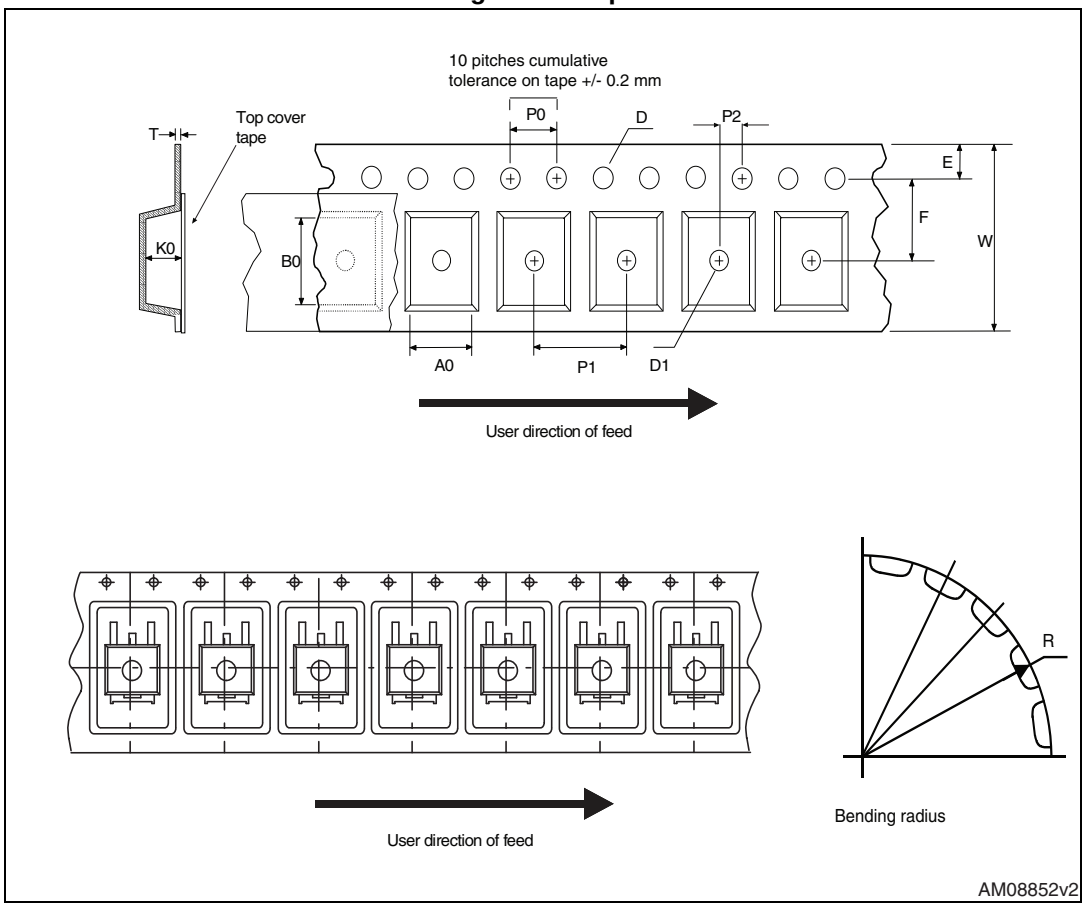
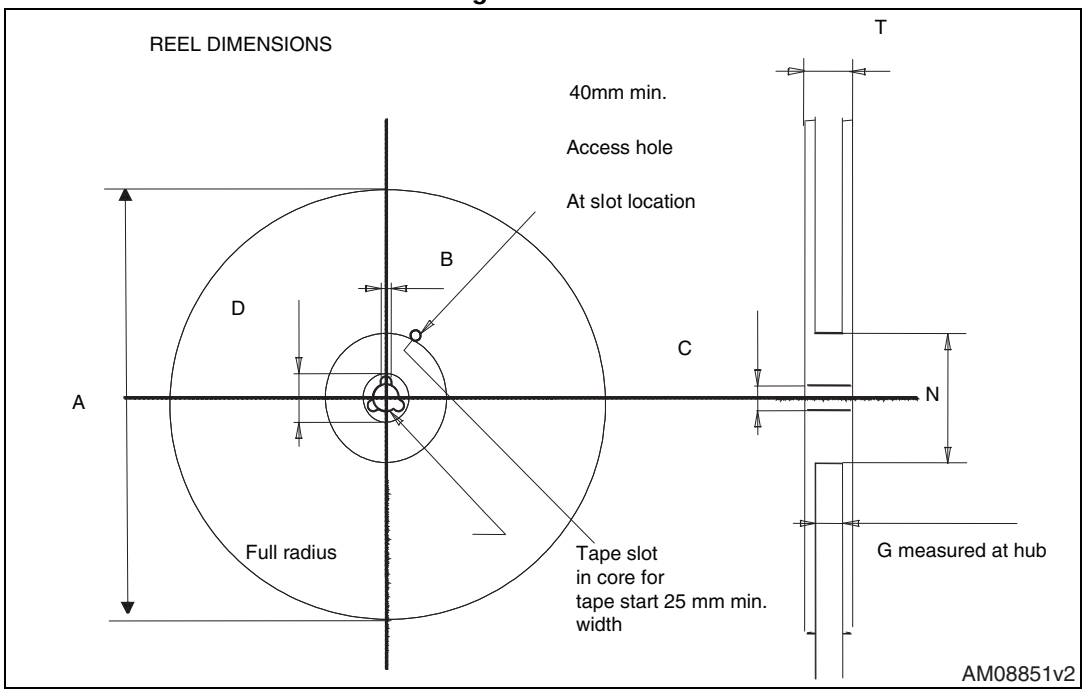


Figure 34. Tape



a. All dimensions are in millimeters

Figure 35. Reel



6 Revision history

Table 14. Document revision history

Date	Revision	Changes
14-Oct-2011	1	Initial release.
03-Oct-2012	2	Document status promoted from target specification ti preliminary data.
20-Mar-2013	3	Document status promoted from preliminary data to production data. Added new root part number STGF30H60DF in TO-220FP package. Added new root part number STGW30H60DF in TO-247 package.