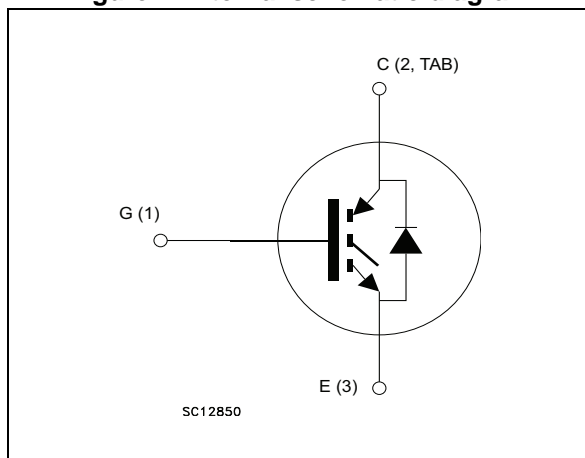


Figure 1. Internal schematic diagram



### 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	D <sup>2</sup> PAK	Tape and reel
STGF30H60DF	GF30H60DF	TO-220FP	Tube
STGP30H60DF	GP30H60DF	TO-220	
STGW30H60DF	GW30H60DF	TO-247	

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220 D <sup>2</sup> PAK TO-247	TO-220FP	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0)	600		V
I <sub>C</sub>	Continuous collector current at T <sub>C</sub> = 25 °C	60	60 <sup>(1)</sup>	A
I <sub>C</sub>	Continuous collector current at T <sub>C</sub> = 100 °C	30	30 <sup>(1)</sup>	A
I <sub>CP</sub> <sup>(2)</sup>	Pulsed collector current	120	120 <sup>(1)</sup>	A
V <sub>GE</sub>	Gate-emitter voltage	±20		V
I <sub>F</sub>	Continuous forward current T <sub>C</sub> = 25 °C	60	60 <sup>(1)</sup>	A
I <sub>F</sub>	Continuous forward current at T <sub>C</sub> = 100 °C	30	30 <sup>(1)</sup>	A
I <sub>FP</sub> <sup>(2)</sup>	Pulsed forward current	120	120 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	260	37 <sup>(1)</sup>	W
T <sub>STG</sub>	Storage temperature range	- 55 to 150		°C
T <sub>J</sub>	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
		D <sup>2</sup> PAK	TO-220FP	TO-220	TO-247	
R <sub>thJC</sub>	Thermal resistance junction-case IGBT	0.58	4	0.58		°C/W
R <sub>thJC</sub>	Thermal resistance junction-case diode	2.5	5.6	2.5		°C/W
R <sub>thJA</sub>	Thermal resistance junction-ambient	62.5			50	°C/W

## 2 Electrical characteristics

$T_J = 25\text{ °C}$  unless otherwise specified.

**Table 4. Static**

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$		2.0	2.4	V
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $T_J = 175\text{ °C}$		2.4		V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5.0	6.0	7.0	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			250	nA

**Table 5. Dynamic**

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	3600	-	pF
$C_{oes}$	Output capacitance			130		pF
$C_{res}$	Reverse transfer capacitance			65		pF
$Q_g$	Total gate charge	$V_{CC} = 400\text{ V}, I_C = 30\text{ A},$ $V_{GE} = 15\text{ V}$	-	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	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	50	-	ns
$t_r$	Current rise time			15		ns
$(di/dt)_{on}$	Turn-on current slope			1600		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$	-	47	-	ns
$t_r$	Current rise time			17		ns
$(di/dt)_{on}$	Turn-on current slope			1400		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	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	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$	-	22	-	ns
$t_{d(off)}$	Turn-off delay time			146		ns
$t_f$	Current fall time			88		ns
$t_{sc}$	Short circuit withstand time	$V_{CC} \leq 360\text{ V}$ , $V_{GE} = 15\text{ V}$	3	6	-	$\mu$ s

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	0.35	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			0.40		mJ
$E_{ts}$	Total switching losses			0.75		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$ , $I_C = 230\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$	-	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	$I_F = 30 \text{ A}$	-	2.0	2.3	V
		$I_F = 30 \text{ A}, T_J = 175 \text{ °C}$		1.5		V
$t_{rr}$	Reverse recovery time	$V_r = 400 \text{ V}, I_F = 30 \text{ A};$ $di_F/dt = 400 \text{ A} / \mu\text{s}$	-	110	-	ns
$Q_{rr}$	Reverse recovery charge			136		nC
$I_{rrm}$	Reverse recovery current			2.5		A
$t_{rr}$	Reverse recovery time	$V_r = 400 \text{ V}, I_F = 30 \text{ A};$ $di_F/dt = 400 \text{ A} / \mu\text{s}$ $T_J = 175 \text{ °C}$	-	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 ( $T_J = 25^\circ\text{C}$ )

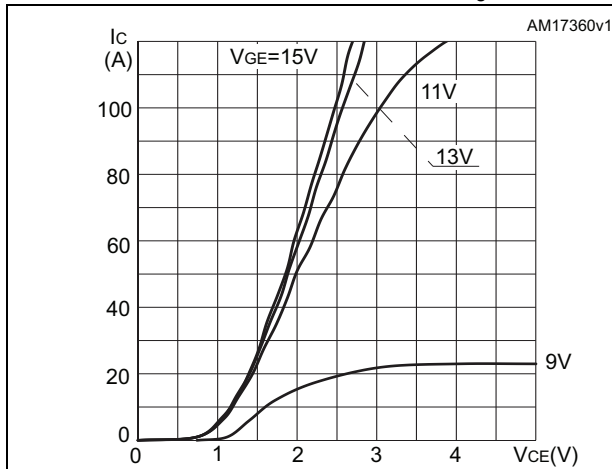


Figure 3. Output characteristics ( $T_J = 175^\circ\text{C}$ )

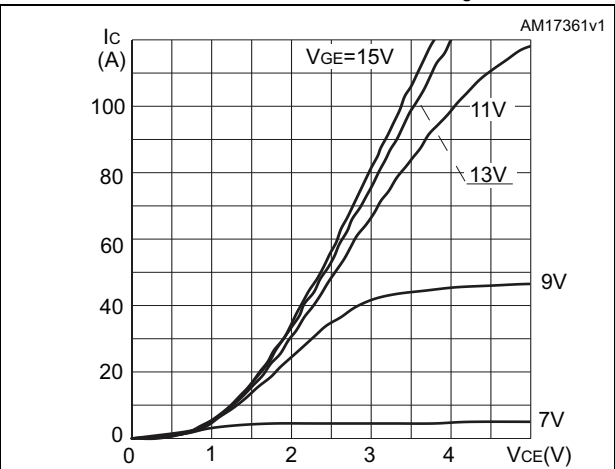


Figure 4. Transfer characteristics

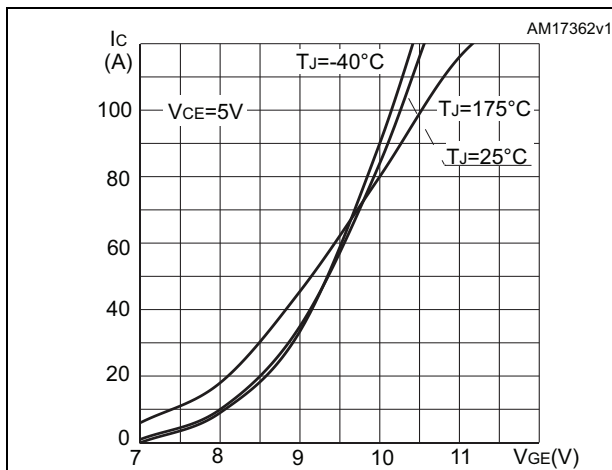


Figure 5. Normalized  $V_{GE(th)}$  vs. junction temperature

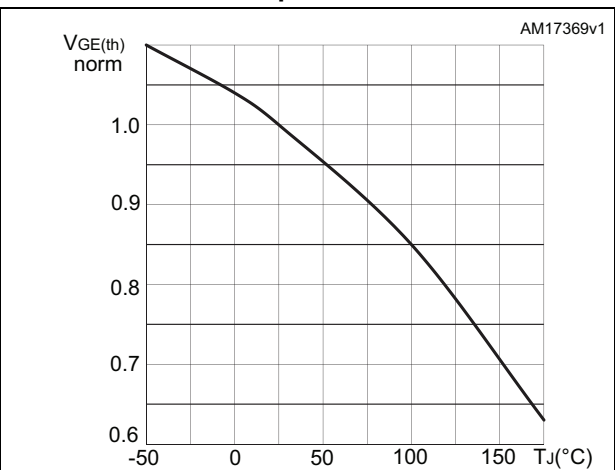


Figure 6. Power dissipation vs. case temperature for D<sup>2</sup>PAK, TO-220 and TO-247

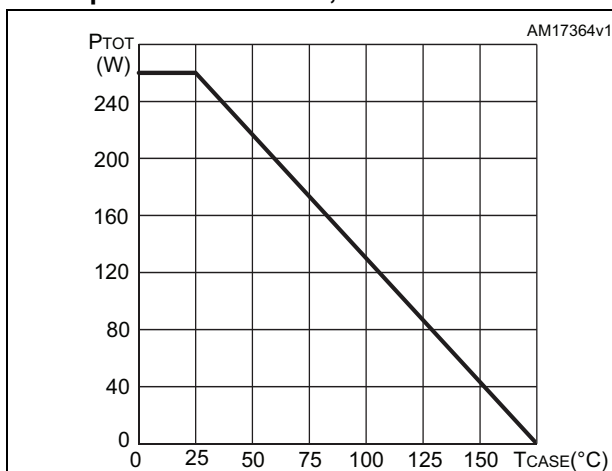


Figure 7. Power dissipation vs. case temperature for TO-220FP

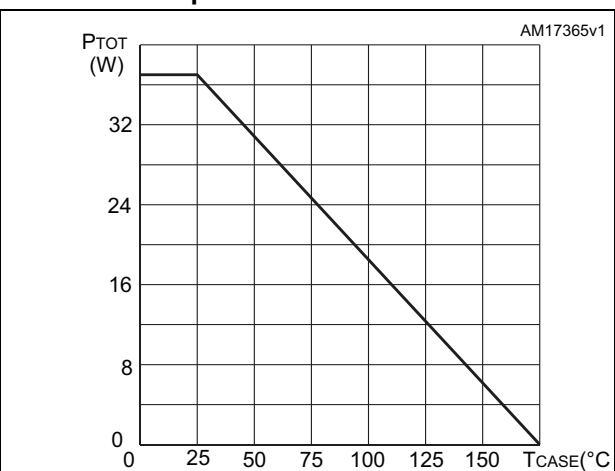


Figure 8. Collector current vs. frequency for D<sup>2</sup>PAK, TO-220 and TO-247

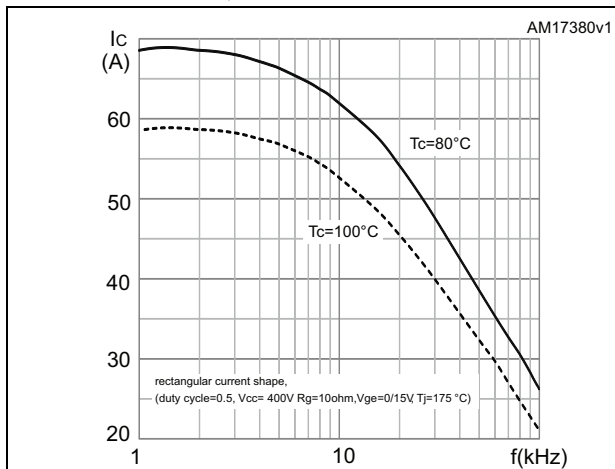


Figure 9. Collector current vs. frequency for TO-220FP

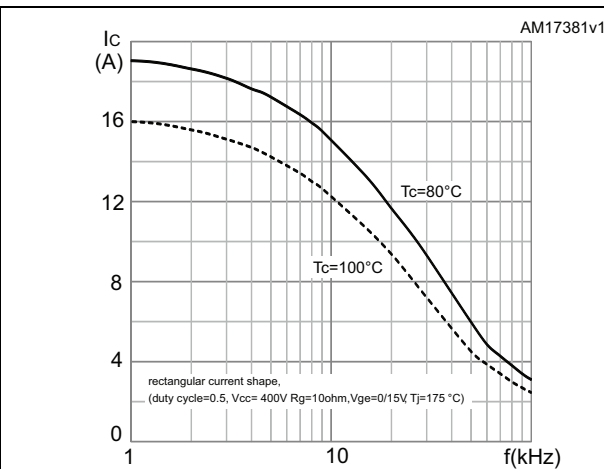


Figure 10. V<sub>CE(sat)</sub> vs. junction temperature

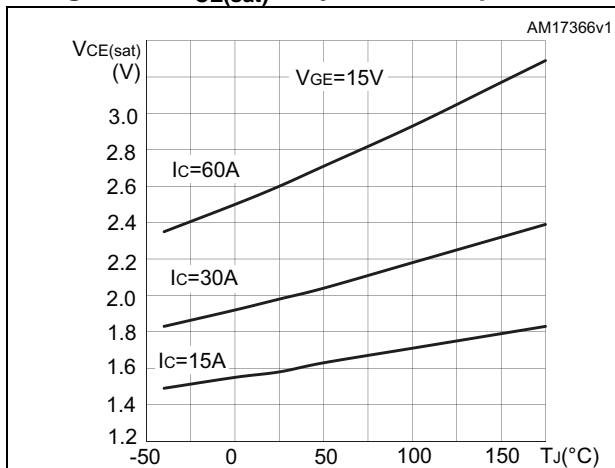


Figure 11. V<sub>CE(sat)</sub> vs. collector current

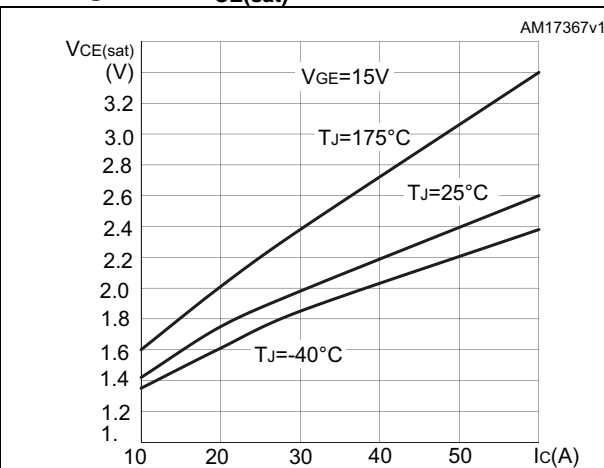


Figure 12. Collector current vs. case temperature for D<sup>2</sup>PAK, TO-220 and TO-247

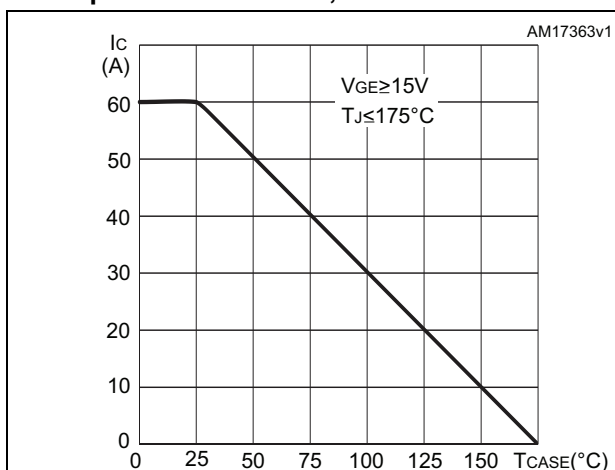


Figure 13. Collector current vs. case temperature for TO-220FP

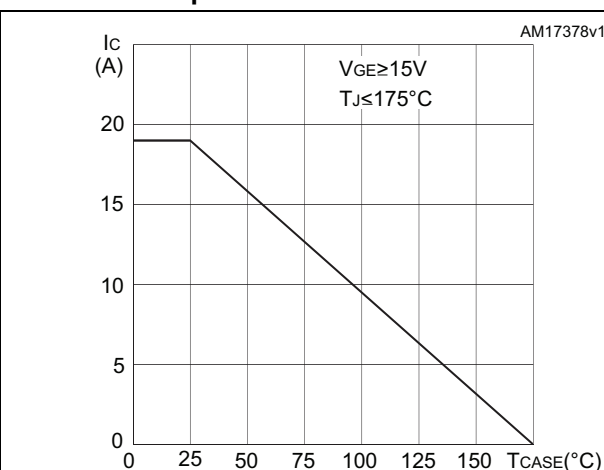




Figure 14. Forward bias safe operating area for TO-220, D<sup>2</sup>PAK and TO-247

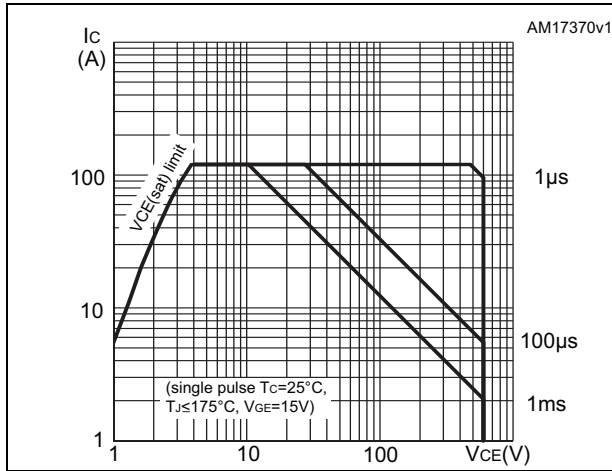


Figure 15. Thermal impedance for TO-220, D<sup>2</sup>PAK and TO-247

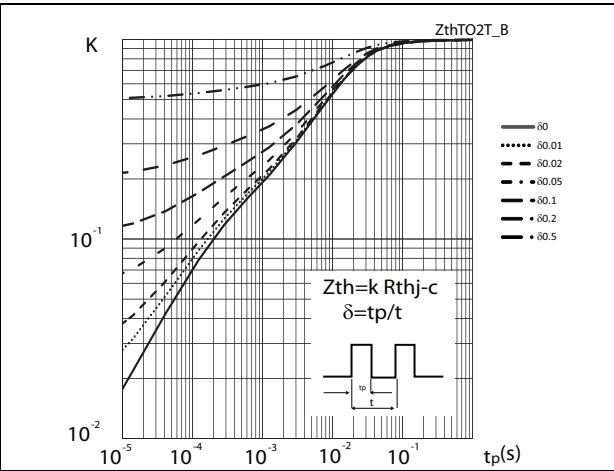


Figure 16. Forward bias safe operating area for TO-220FP

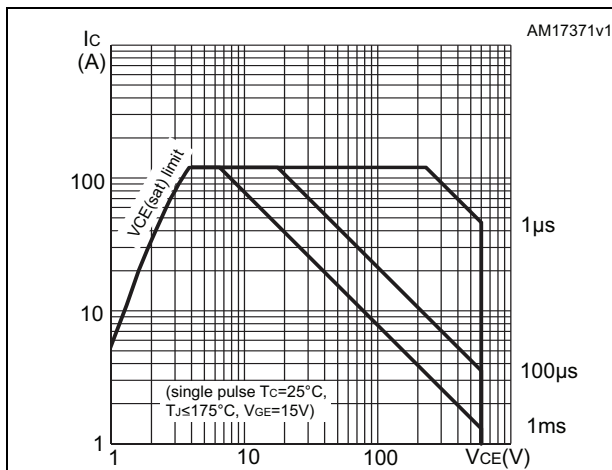


Figure 17. Thermal impedance for TO-220FP

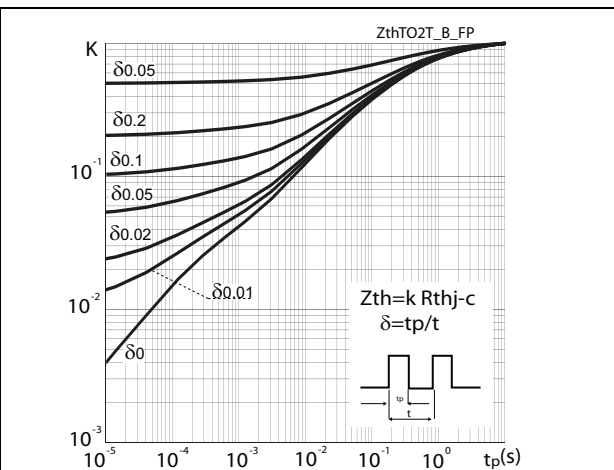


Figure 18. Gate charge vs. gate-emitter voltage

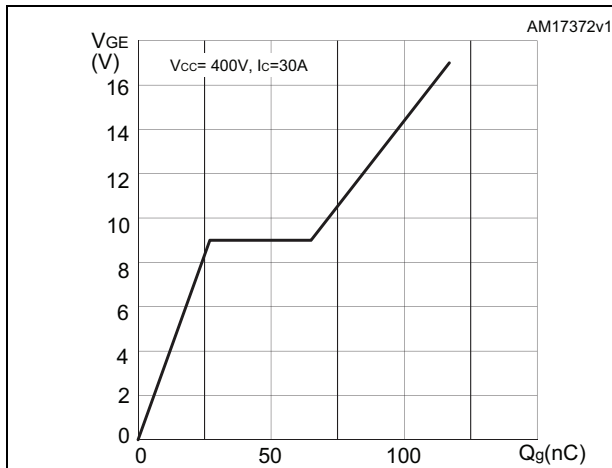


Figure 19. Capacitance variations vs. V<sub>CE</sub>

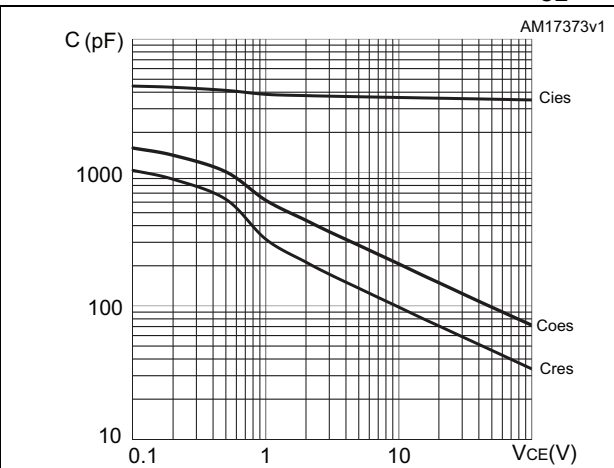


Figure 20. Diode VF vs. forward current

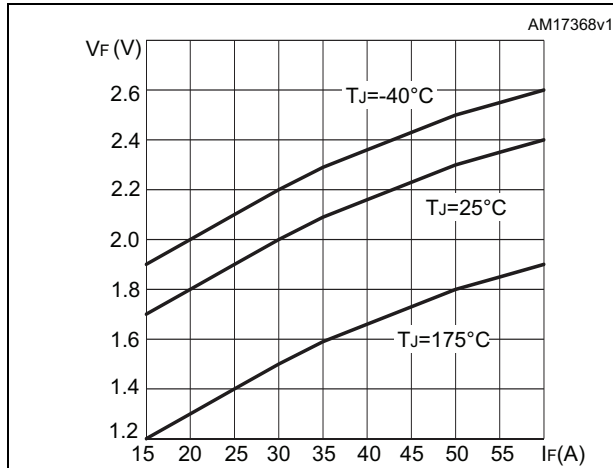


Figure 21. Switching losses vs. gate resistance

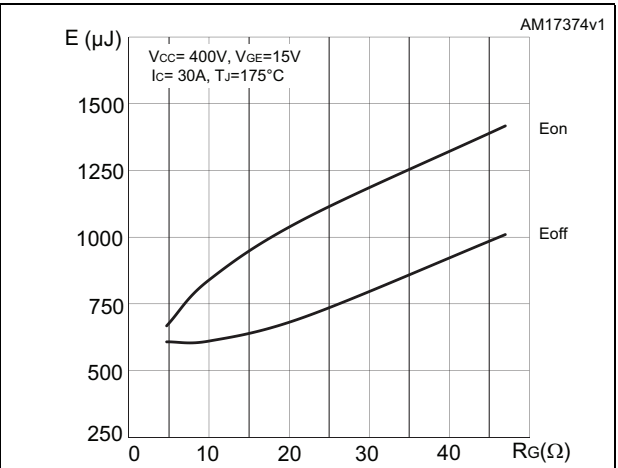


Figure 22. Switching losses vs. collector current

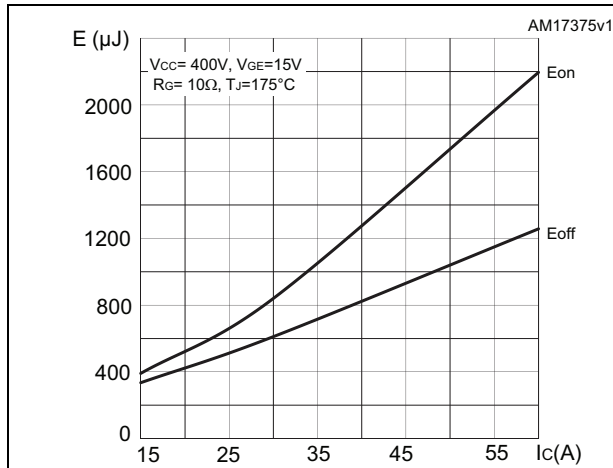


Figure 23. Switching losses vs temperature

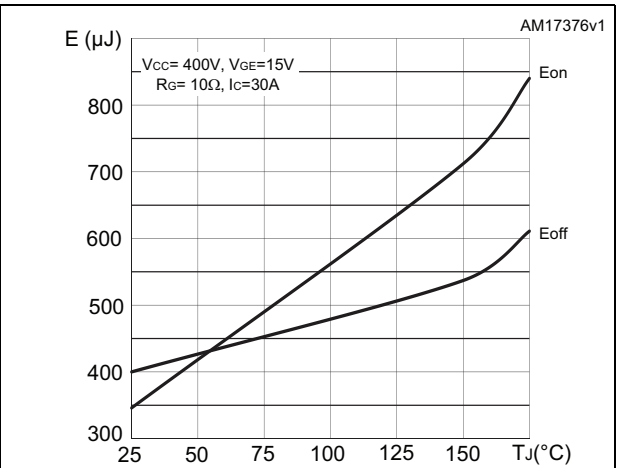
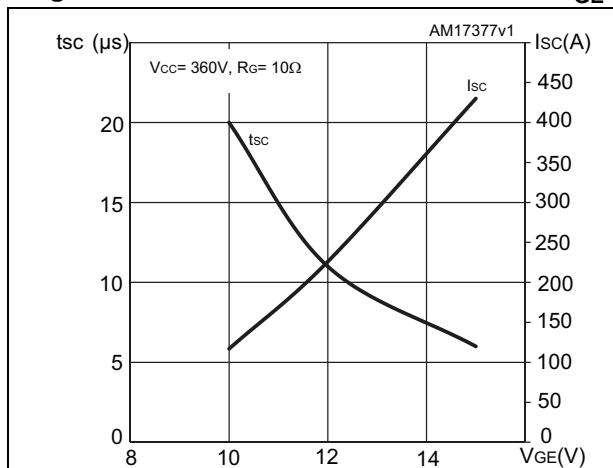
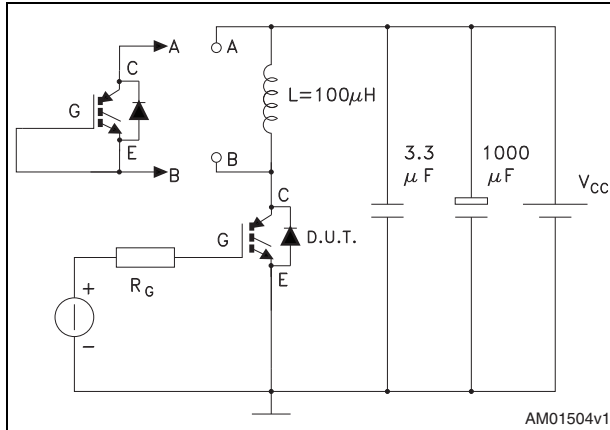


Figure 24. Short circuit time & current vs. VGE



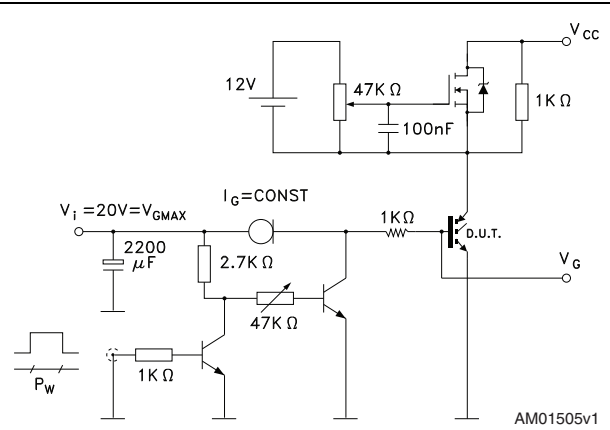
### 3 Test circuits

Figure 25. Test circuit for inductive load switching



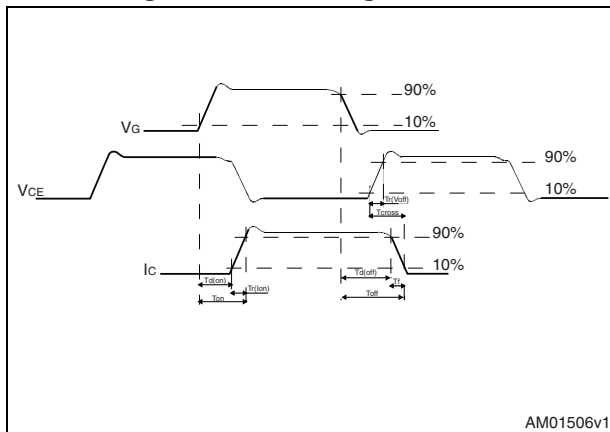
AM01504v1

Figure 26. Gate charge test circuit



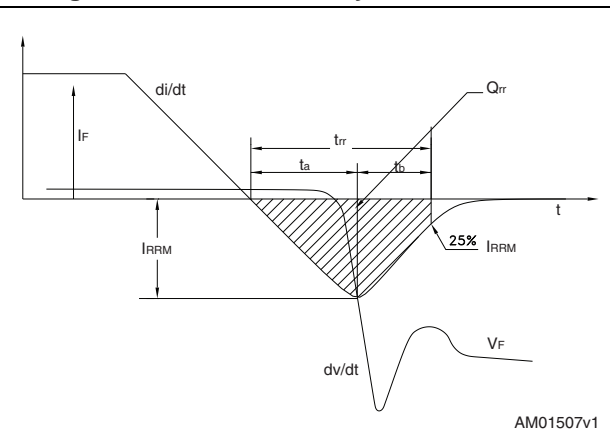
AM01505v1

Figure 27. Switching waveform



AM01506v1

Figure 28. Diode recovery time waveform



AM01507v1

## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

**Table 9. D<sup>2</sup>PAK (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. D<sup>2</sup>PAK (TO-263) drawing

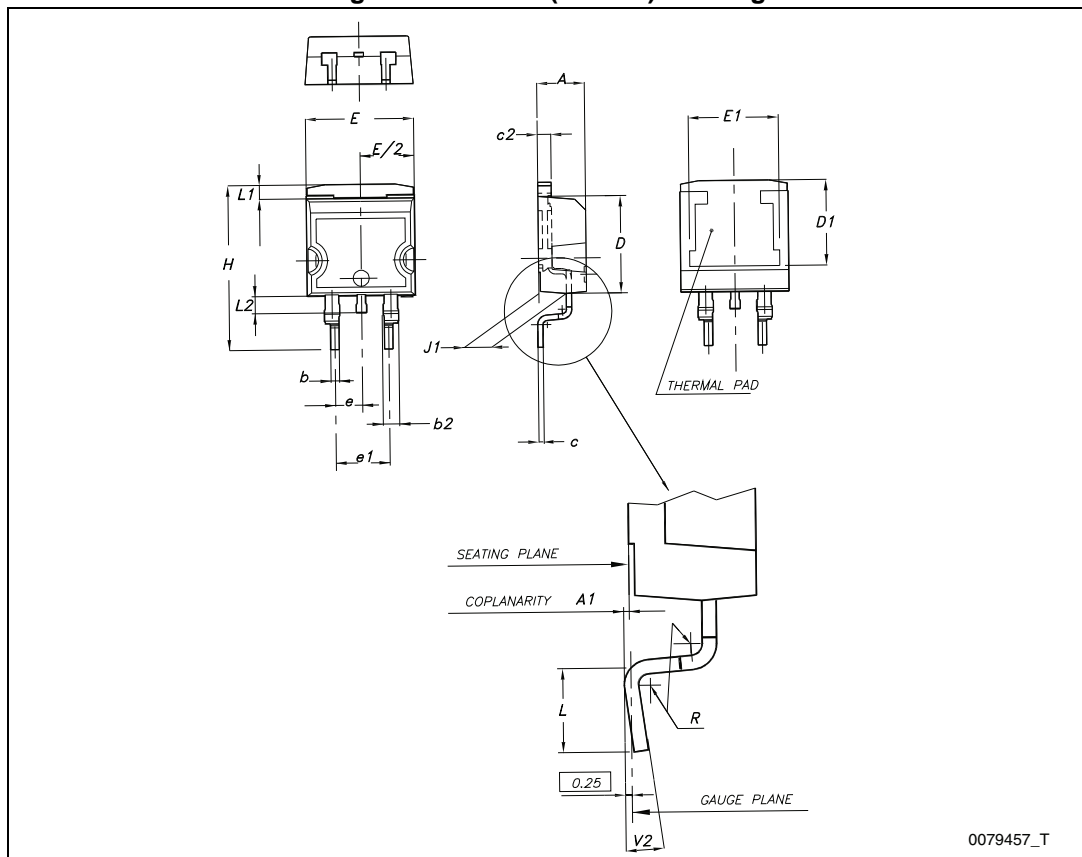
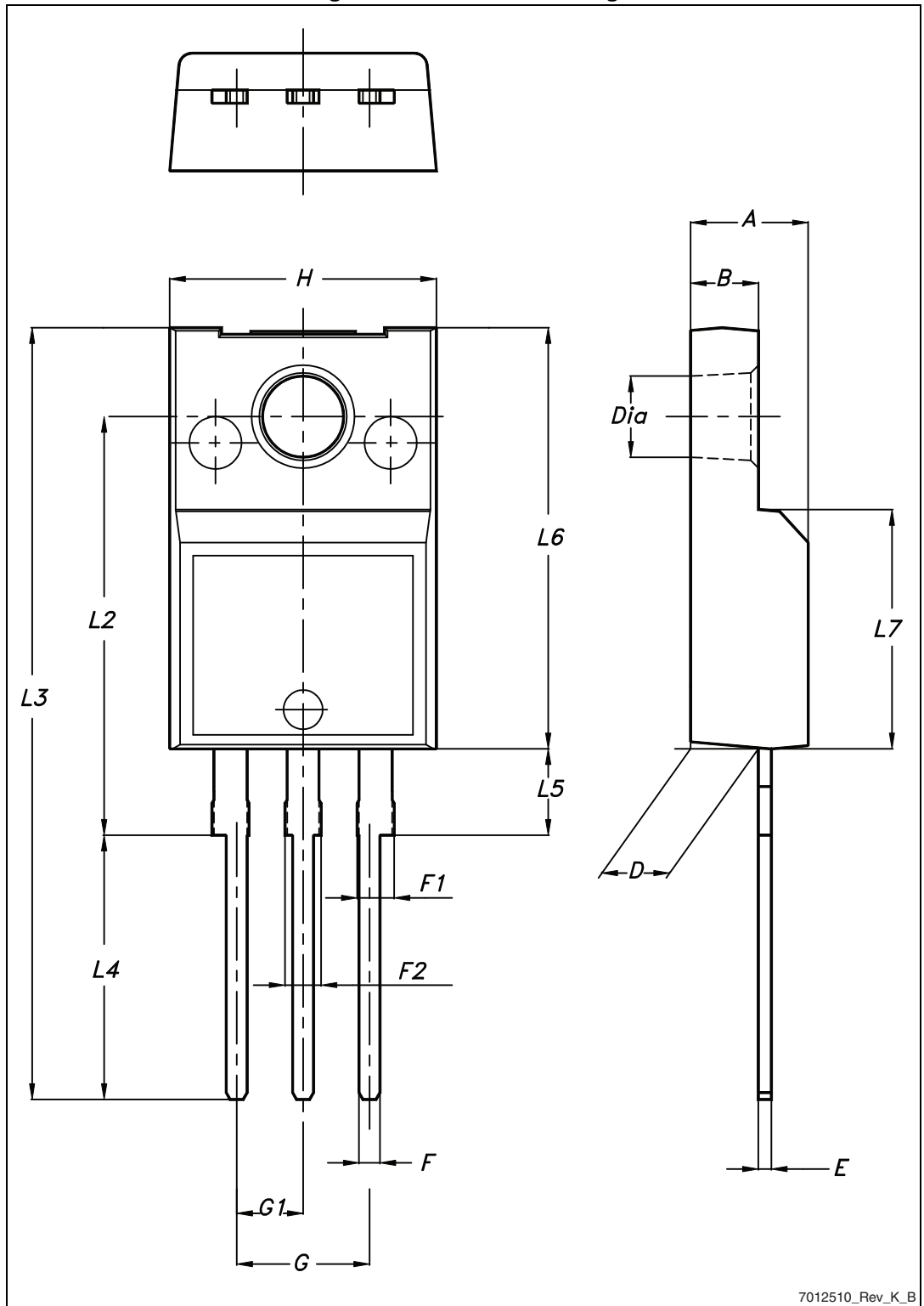


Table 10. TO-220FP mechanical data

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



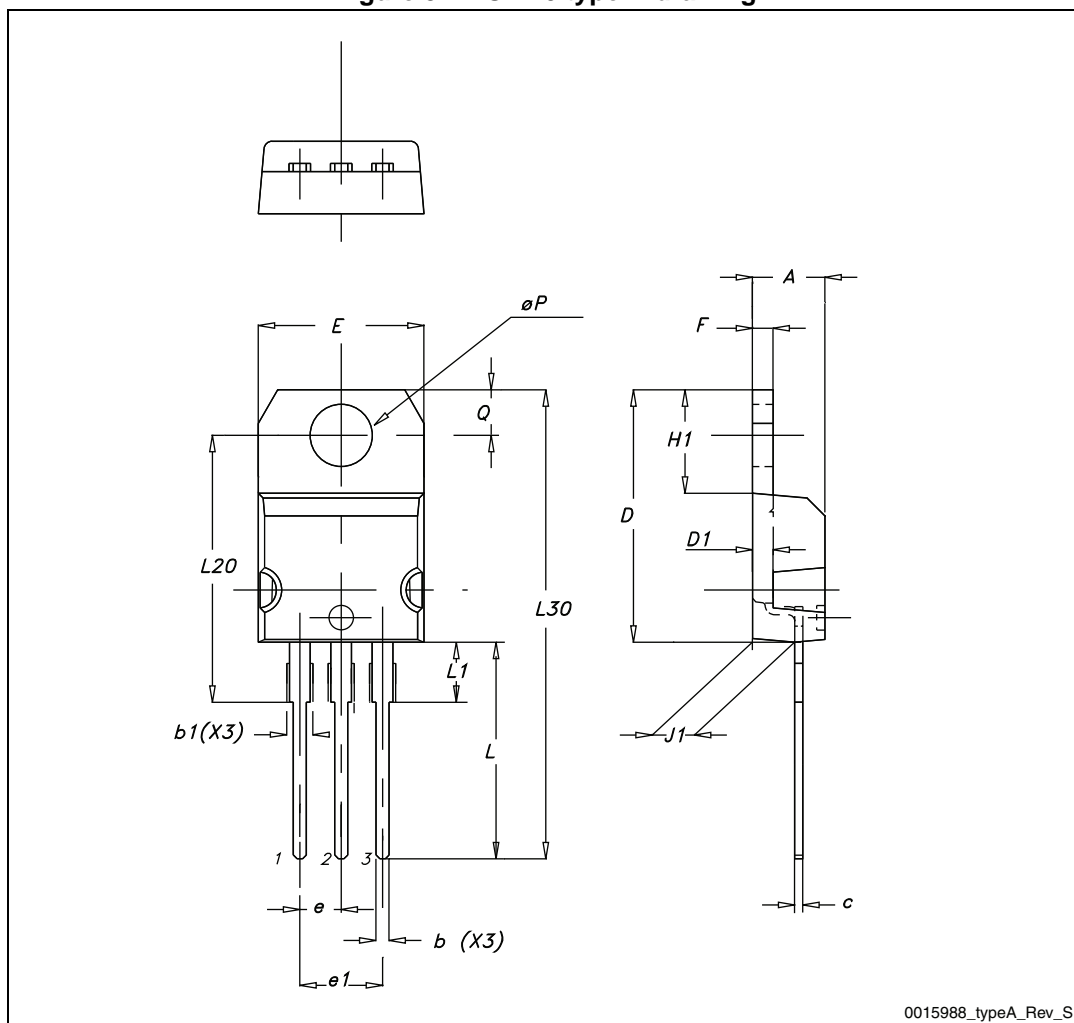
7012510\_Rev\_K\_B

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	
ØP	3.75		3.85
Q	2.65		2.95



Figure 31. TO-220 type A drawing

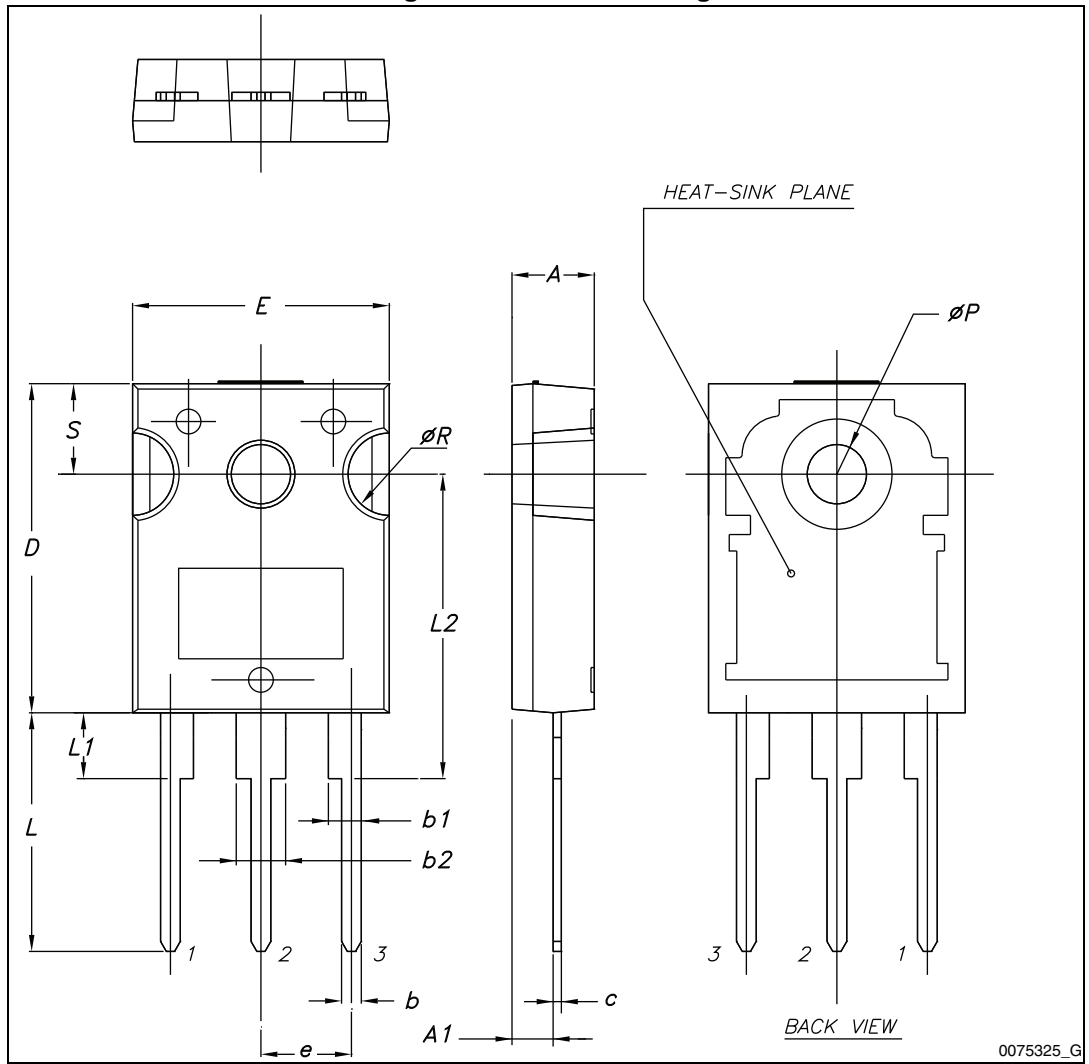


0015988\_typeA\_Rev\_S

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	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 32. TO-247 drawing



0075325\_G

## 5 Packaging mechanical data

Table 13. D<sup>2</sup>PAK (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. D<sup>2</sup>PAK footprint<sup>(a)</sup>

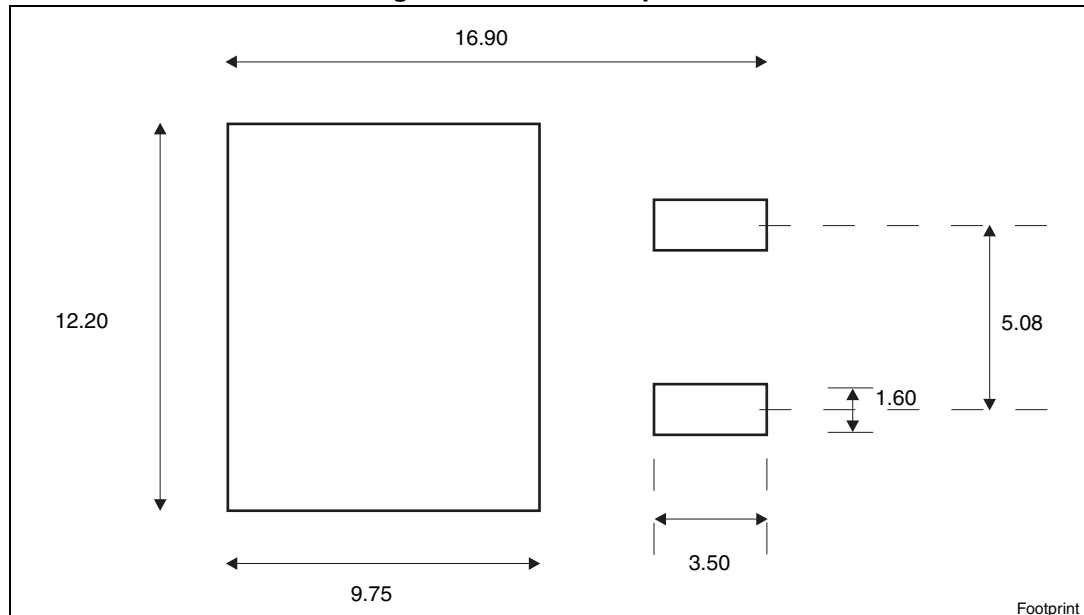
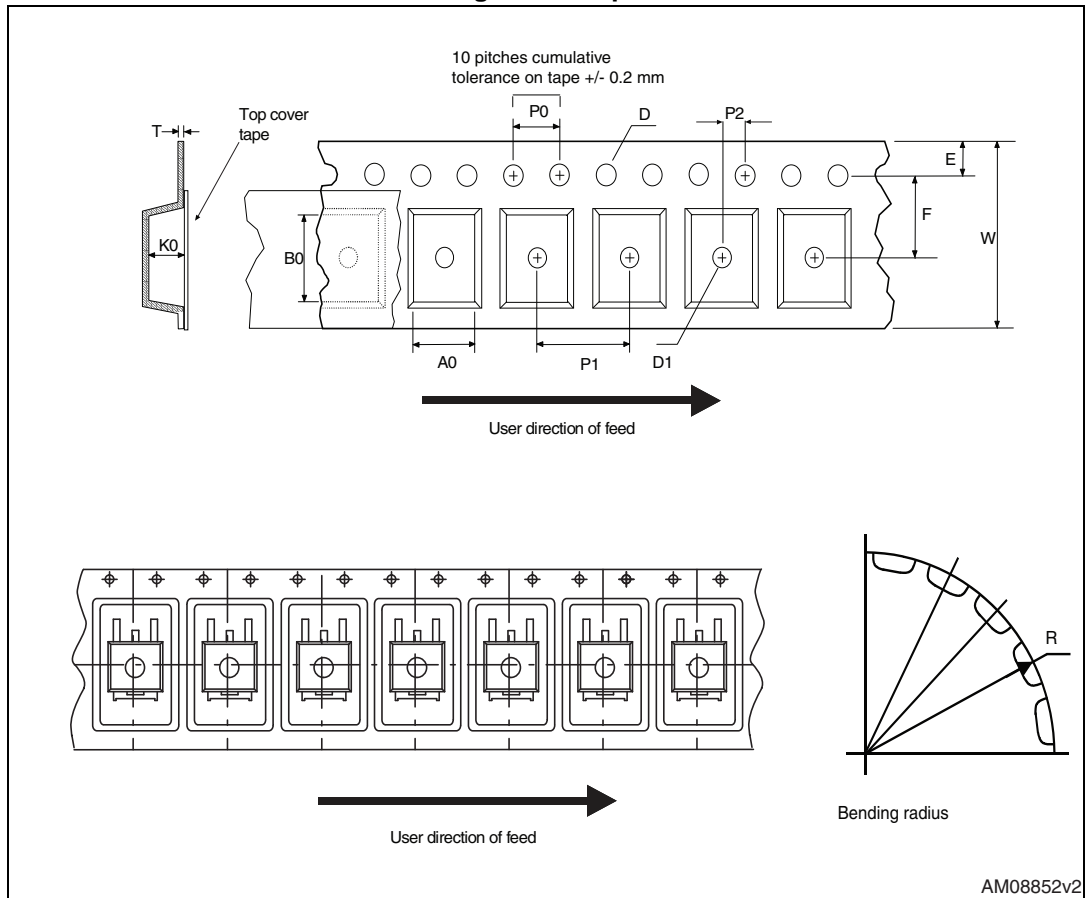
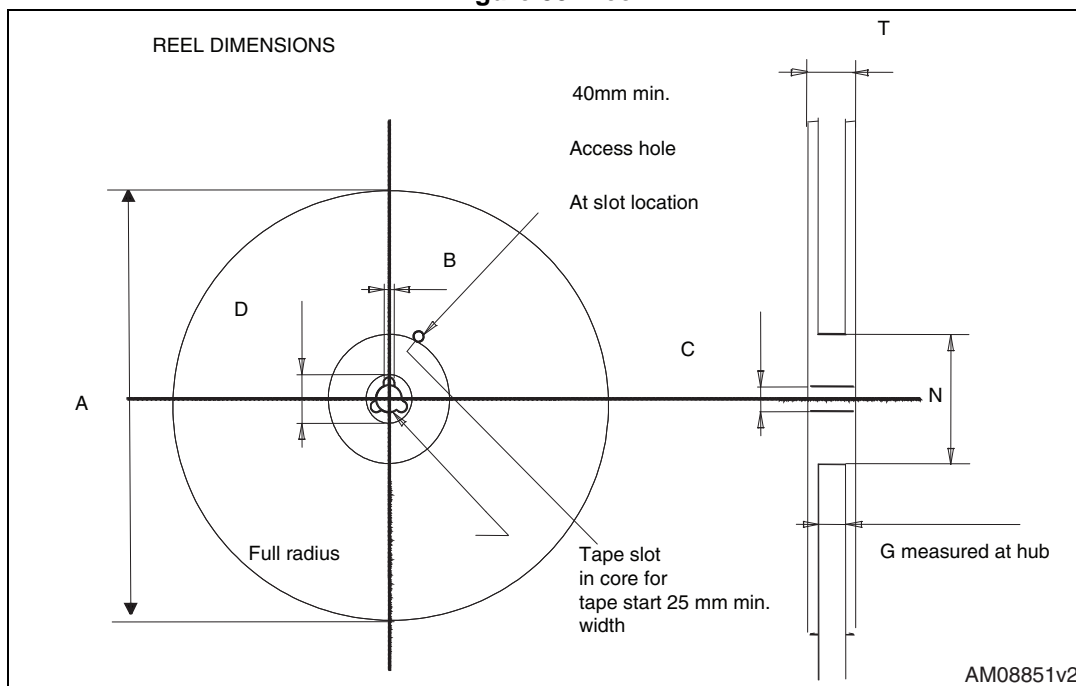


Figure 34. Tape



a. All dimensions are in millimeters

Figure 35. Reel



## 6 Revision history

**Table 14. Document revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
14-Oct-2011	1	Initial release.
03-Oct-2012	2	Document status promoted from target specification to 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.

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