STGB30V60DF, STGP30V60DF, STGW30V60DF, STGWT30V60DF

Trench gate field-stop IGBT, V series
600 V, 30 A very high speed

**Datasheet** - production data

D²PAK TO-220

TO-247 TO-3P
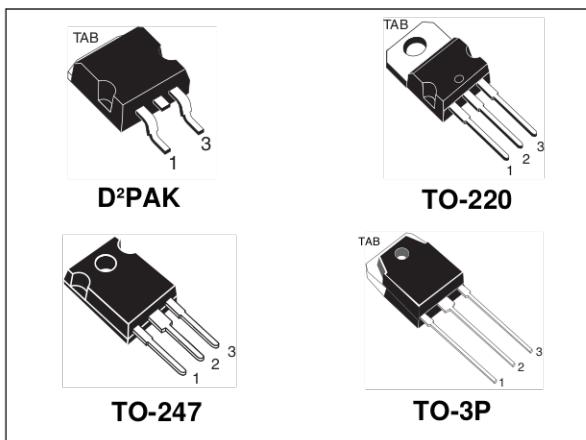
Figure 1. Internal schematic diagram
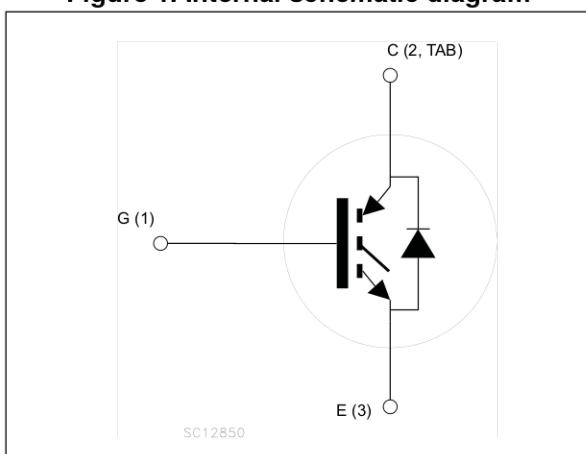
Features

- Maximum junction temperature: $T_J = 175\ °C$
- Tail-less switching off
- $V_{CE(sat)} = 1.85\ V$ (typ.) @ $I_C = 30\ A$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode

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 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 codes	Marking	Package	Packaging
STGB30V60DF	GB30V60DF	D²PAK	Tape and reel
STGP30V60DF	GP30V60DF	TO-220	Tube
STGW30V60DF	GW30V60DF	TO-247	Tube
STGWT30V60DF	GWT30V60DF	TO-3P	Tube

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	60	A
I_C	Continuous collector current at $T_C = 100$ °C	30	A
I_{CP}[1]	Pulsed collector current	120	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at $T_C = 25$ °C	60	A
I_F	Continuous forward current at $T_C = 100$ °C	30	A
I_{FP}[1]	Pulsed forward current	120	A
P_{TOT}	Total dissipation at $T_C = 25$ °C	258	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 IGBT	0.58	°C/W
R_{thJC}	Thermal resistance junction-case diode	2.08	°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, $I_C = 30$ A		1.85	2.3	V
		$V_{GE} = 15$ V, $I_C = 30$ A $T_J = 125$ °C		2.15		
		$V_{GE} = 15$ V, $I_C = 30$ A $T_J = 175$ °C		2.35		
V_F	Forward on-voltage	$I_F = 30$ A		2	2.6	V
		$I_F = 30$ A, $T_J = 125$ °C		1.7		V
		$I_F = 30$ A, $T_J = 175$ °C		1.6		V
$V_{GE(th)}$	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 ($V_{CE} = 0$)	$V_{GE} = \pm 20$ 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, $V_{GE} = 0$	-	3750	-	pF
C_{oes}	Output capacitance		-	120	-	pF
C_{res}	Reverse transfer capacitance		-	77	-	pF
Q_g	Total gate charge	$V_{CC} = 480$ V, $I_C = 30$ A, $V_{GE} = 15$ V, see *Figure 29*	-	163	-	nC
Q_{ge}	Gate-emitter charge		-	28	-	nC
Q_{gc}	Gate-collector charge		-	72	-	nC

Table 6. IGBT 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 = 30 A, R_G = 10 Ω, V_{GE} = 15 V, see *Figure 28*	-	45	-	ns
t_r	Current rise time		-	16	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1500	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	189	-	ns
t_f	Current fall time		-	19	-	ns
E_{on}[1]	Turn-on switching losses		-	383	-	µJ
E_{off}[2]	Turn-off switching losses		-	233	-	µJ
E_{ts}	Total switching losses		-	616	-	µJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 30 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C, see *Figure 28*	-	42	-	ns
t_r	Current rise time		-	17	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1337	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	193	-	ns
t_f	Current fall time		-	32	-	ns
E_{on}[1]	Turn-on switching losses		-	794	-	µJ
E_{off}[2]	Turn-off switching losses		-	378	-	µJ
E_{ts}	Total switching losses		-	1172	-	µJ

1. Energy losses include reverse recovery of the diode.

2. Turn-off losses include also the tail of the collector current.

Table 7. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 30 A, V_R = 400 V, di/dt=1000 A/µs, V_{GE} = 15 V, (see *Figure 28*)	-	53	-	ns
Q_{rr}	Reverse recovery charge		-	384	-	nC
I_{rrm}	Reverse recovery current		-	14.5	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	788	-	A/µs
E_{rr}	Reverse recovery energy		-	104	-	µJ
t_{rr}	Reverse recovery time	I_F = 30 A, V_R = 400 V, di/dt=1000 A/µs, V_{GE} = 15 V, T_J = 175 °C, (see *Figure 28*)	-	104	-	ns
Q_{rr}	Reverse recovery charge		-	1352	-	nC
I_{rrm}	Reverse recovery current		-	26	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	310	-	A/µs
E_{rr}	Reverse recovery energy		-	407	-	µJ

2.1   Electrical characteristics (curves)

Figure 2. Power dissipation vs. case
temperature
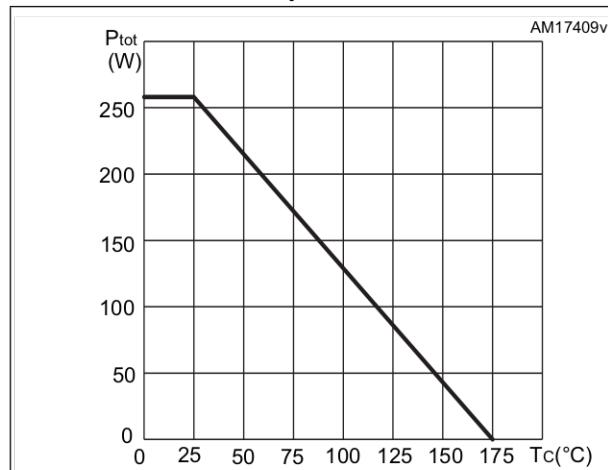
Figure 3. Collector current vs. case temperature
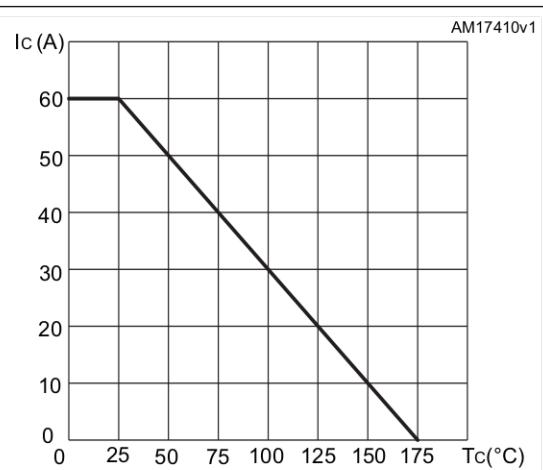
Figure 4. Output characteristics (T_J=25°C)
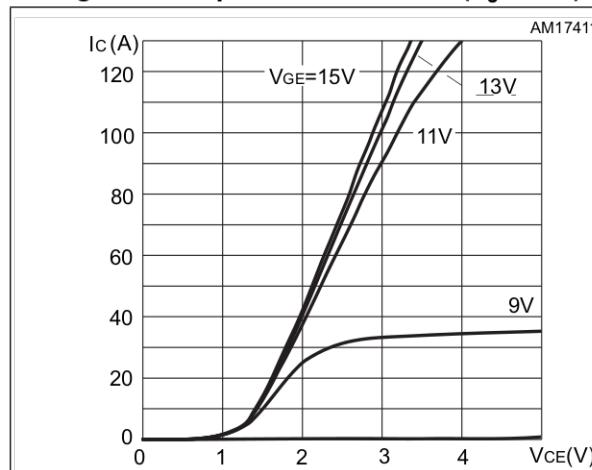
Figure 5. Output characteristics (T_J=175°C)
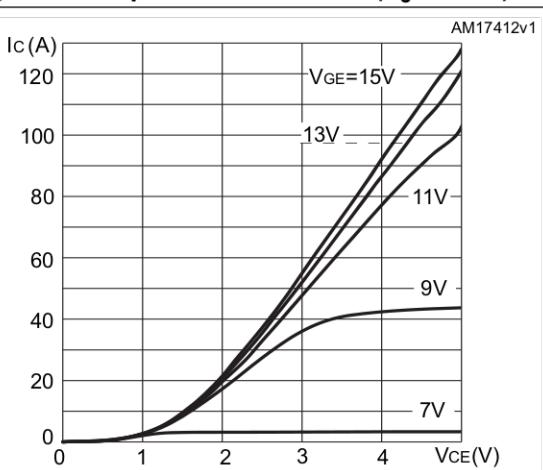
Figure 6. $V_{CE(sat)}$ vs. junction temperature
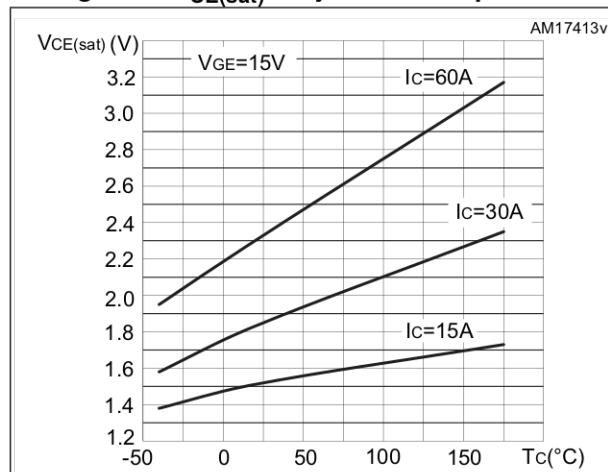
Figure 7. $V_{CE(sat)}$ vs. collector current
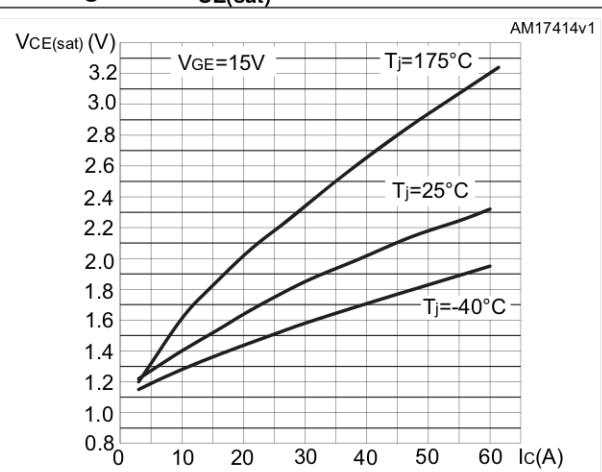
### Figure 8. Collector current vs. switching frequency

AM17415v1

I_C (A) vs f(kHz); T_C=80°C, T_C=100°C

rectangular current shape, (duty cycle=0.5, Vcc= 400V Rg=10Ω, Vge=0/15V, Tj=175 °C)
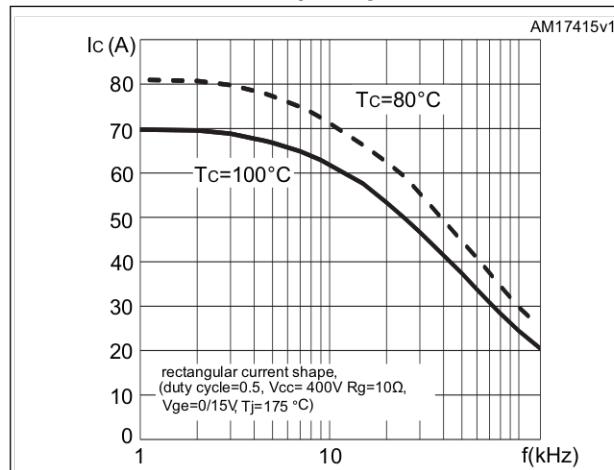
Figure 9. Forward bias safe operating area

AM17416v1

I_C (A) vs V_{CE}(V); 10µs, 100µs, 1ms

Single pulse, Tc=25°C Tj≤175°C, V_{GE}=15V
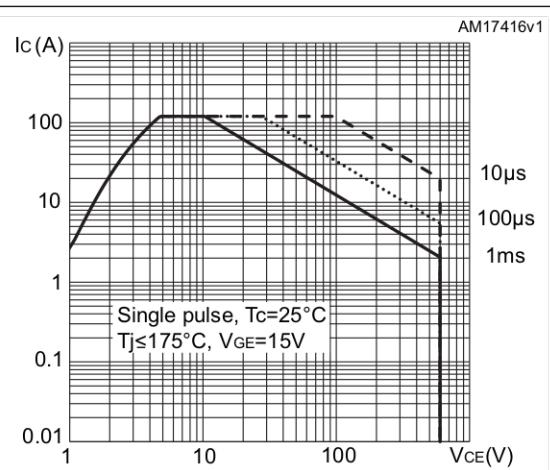
Figure 10. Transfer characteristics

AM17417v1

I_C (A) vs V_{GE}(V); Tj=-40°C, Tj=175°C, Tj=25°C
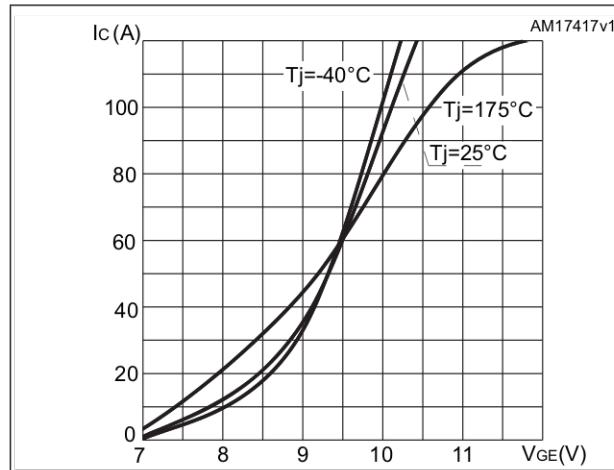
Figure 11. Diode V_F vs. forward current

AM17418v1

V_F(A) vs I_F(A); Tj=-40°C, Tj=25°C, Tj=175°C
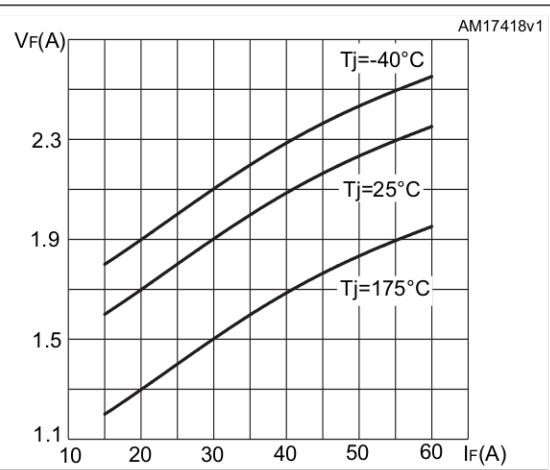
Figure 12. Normalized $V_{GE(th)}$ vs junction temperature

AM17419v1

$V_{GE(th)}$ (norm) vs T_C(°C); V_{CE}=V_{GE} Ic=1mA
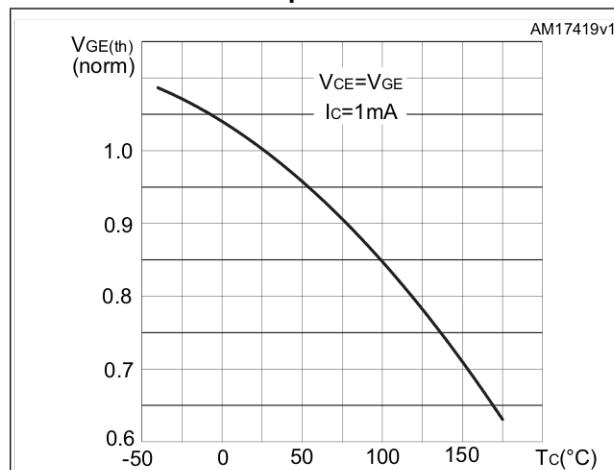
Figure 13. Normalized $V_{(BR)CES}$ vs. junction temperature

AM17420v1

$V_{(BR)CES}$ (norm) vs T_C(°C); Ic=2mA
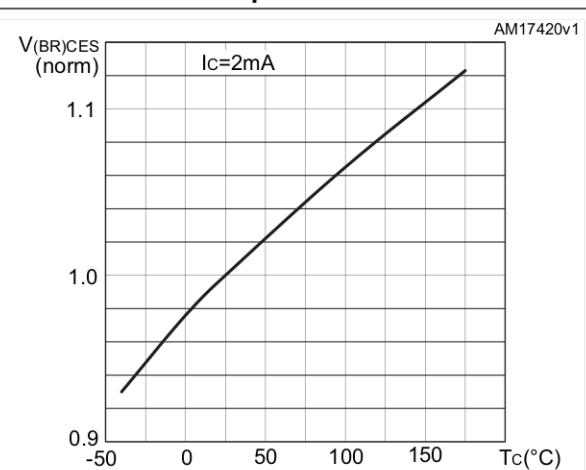
Figure 14. Capacitance variations
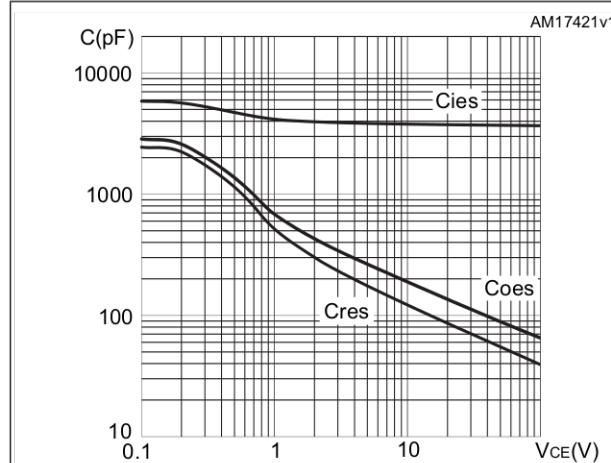
Figure 15. Gate charge vs. gate-emitter voltage
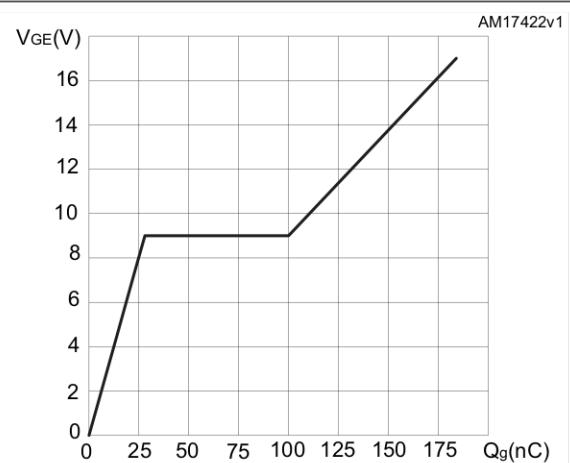
Figure 16. Switching losses vs. collector current
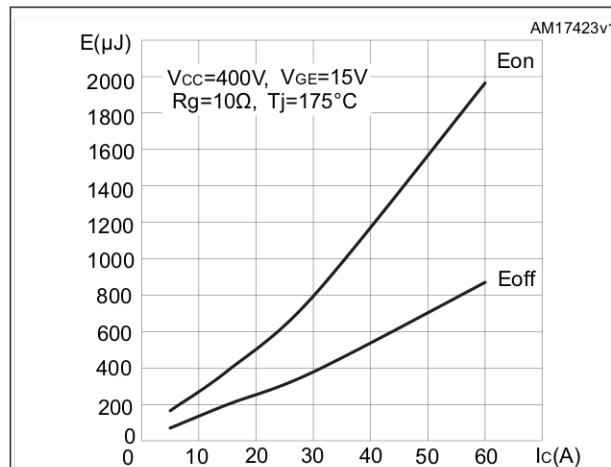
Figure 17. Switching losses vs. gate resistance
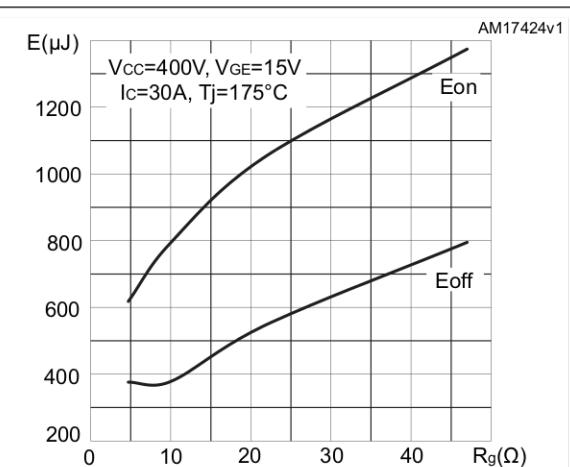

Figure 18. Switching losses vs. junction temperature
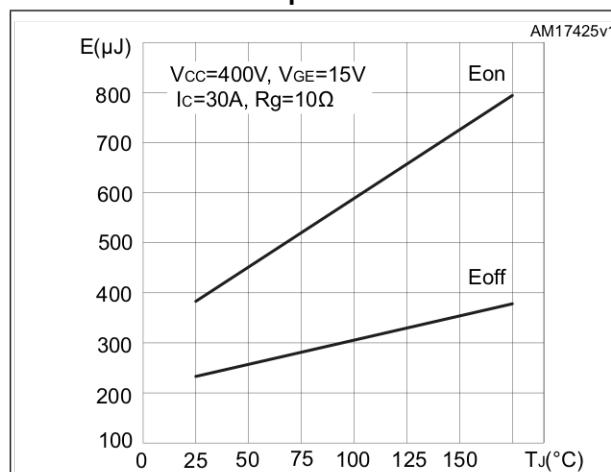

### Figure 19. Switching losses vs. collector emitter voltage
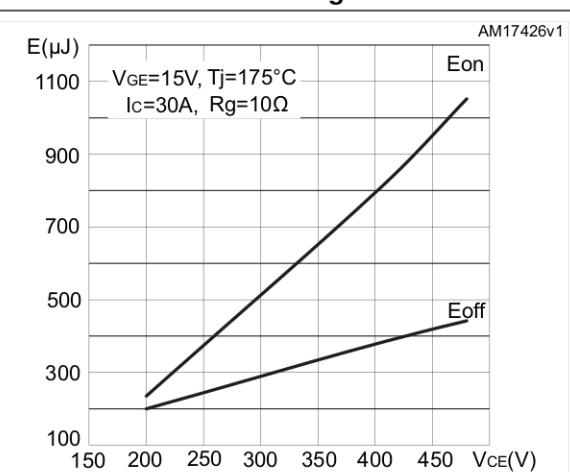
Figure 20. Switching times vs. collector current
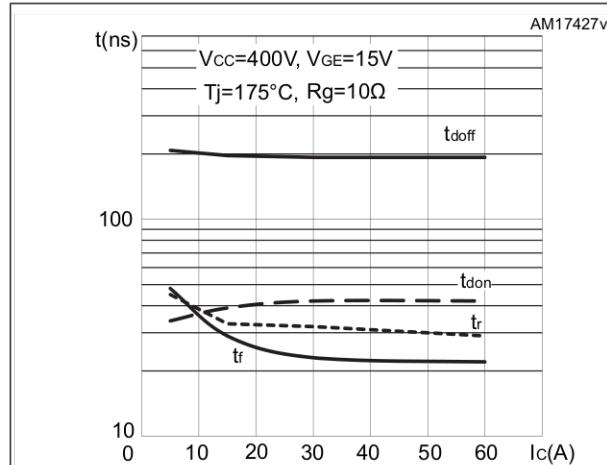

Figure 21. Switching times vs. gate resistance
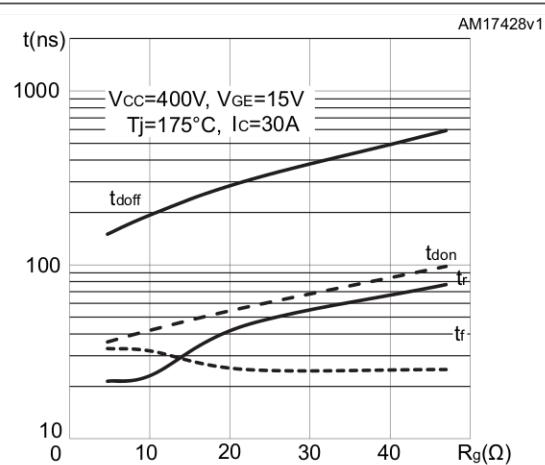
**Figure 22. Reverse recovery current vs. diode current slope**
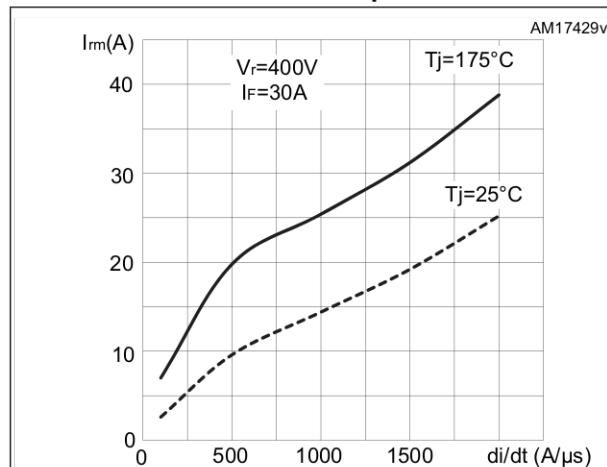
**Figure 23. Reverse recovery time vs. diode current slope**
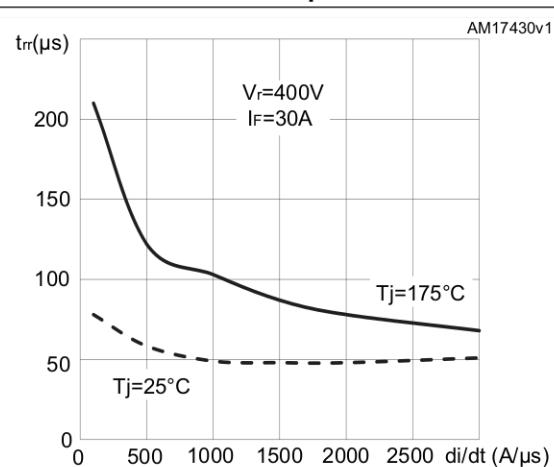
**Figure 24. Reverse recovery charge vs. diode current slope**
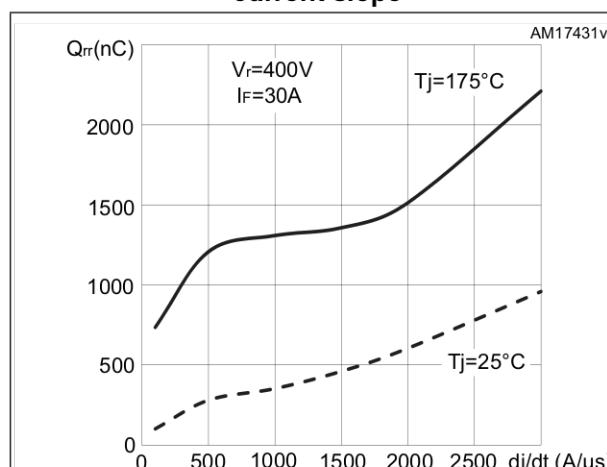

Figure 25. Reverse recovery energy vs. diode current slope
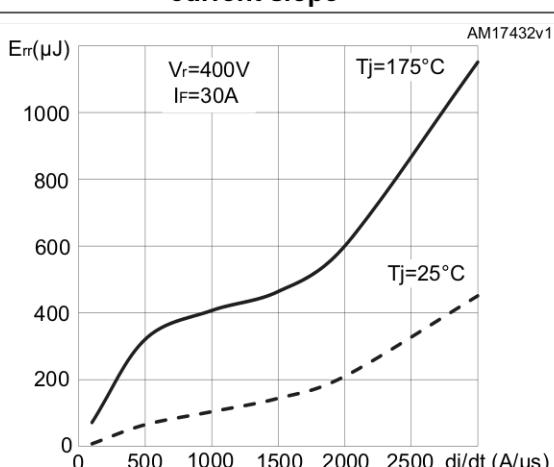
Figure 26. Thermal data for IGBT
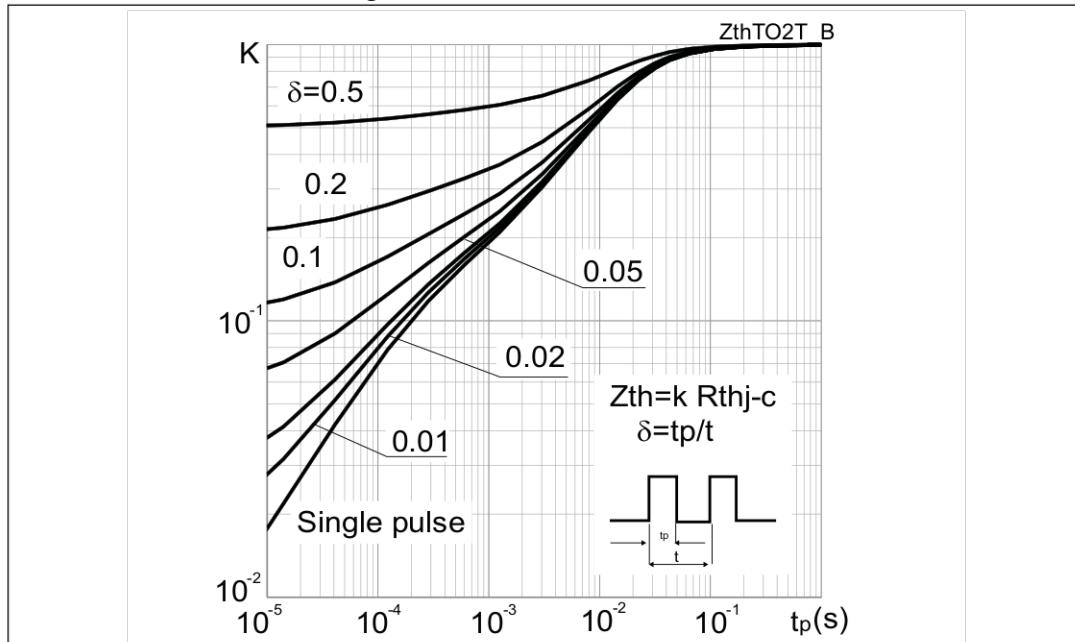
Figure 27. Thermal data for diode
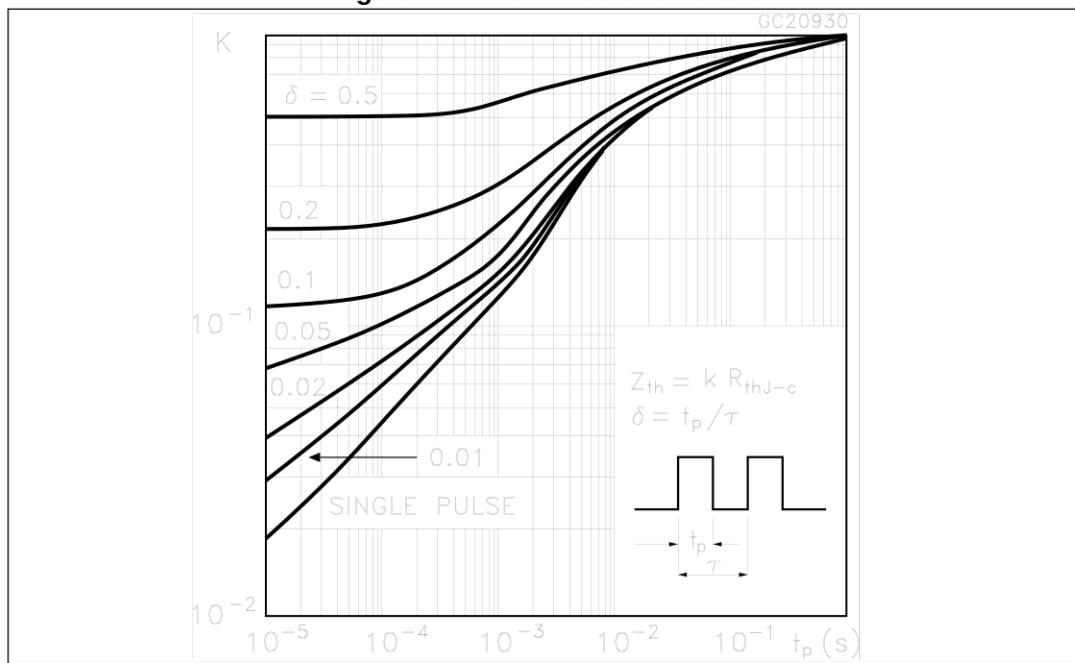
3   Test circuits

Figure 28. Test circuit for inductive load switching


AM01504v1
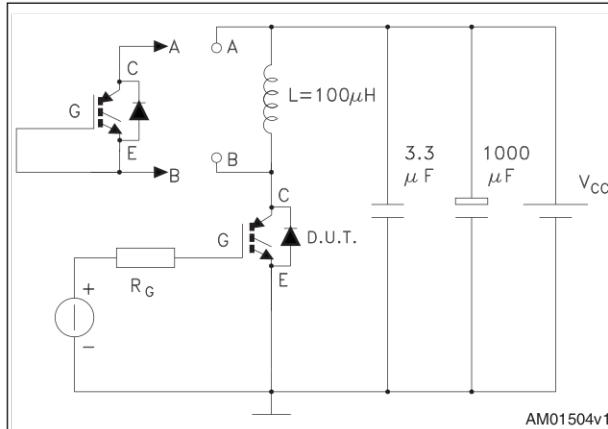
Figure 29. Gate charge test circuit

AM01505v1
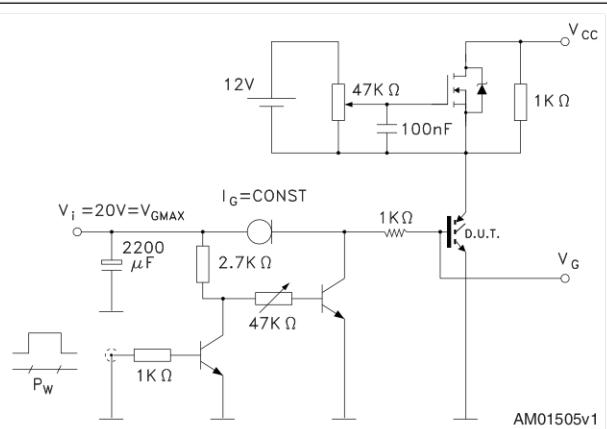
**Figure 30. Switching waveform**

AM01506v1
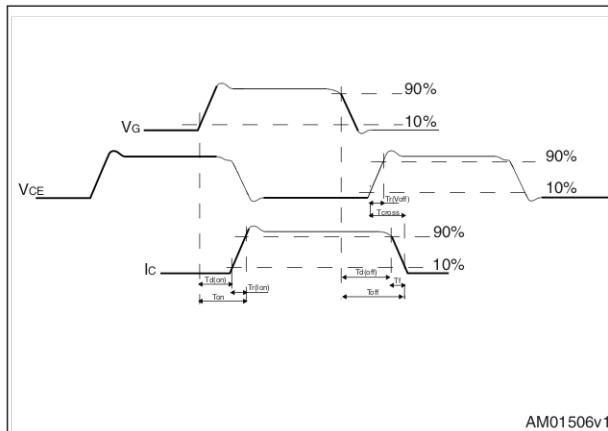
Figure 31. Diode recovery time waveform

AM01507v1
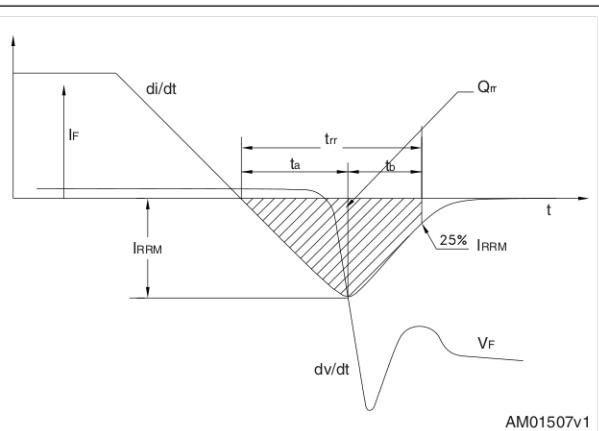
4   Package mechanical data

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 8. 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 32. D²PAK (TO-263) drawing

0079457_T
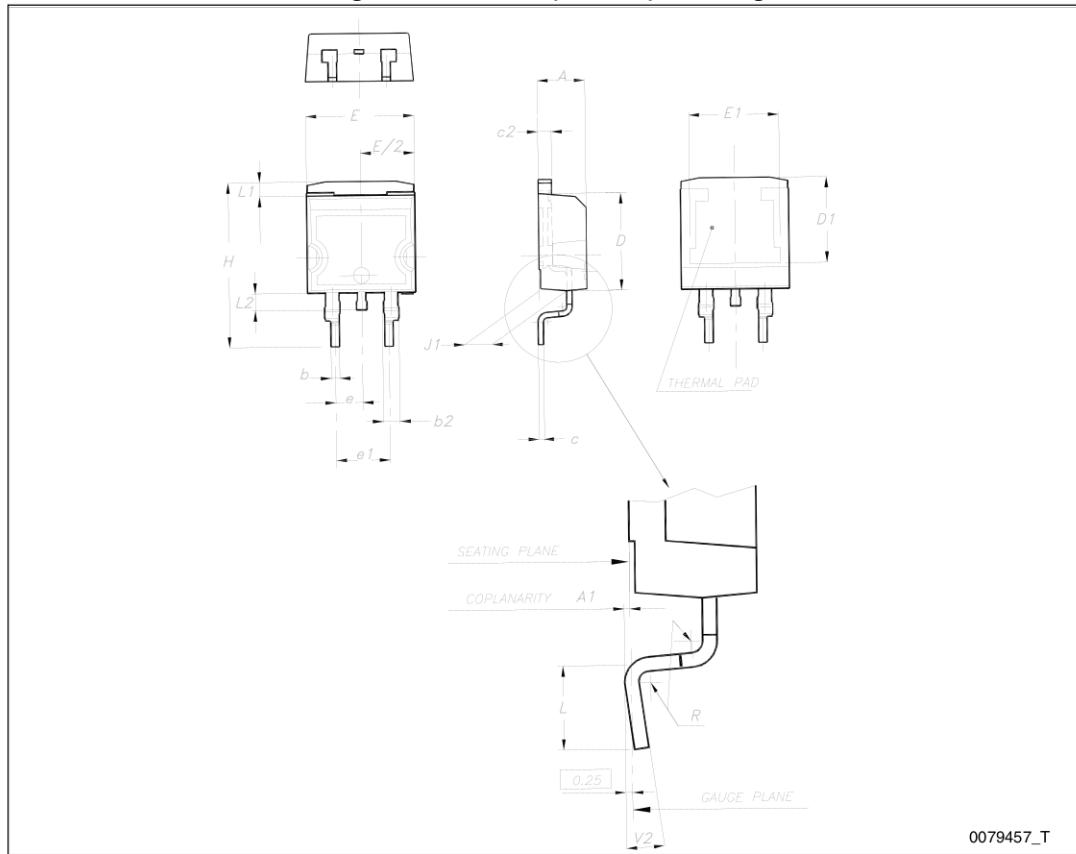
Figure 33. D²PAK footprint[a]

Footprint

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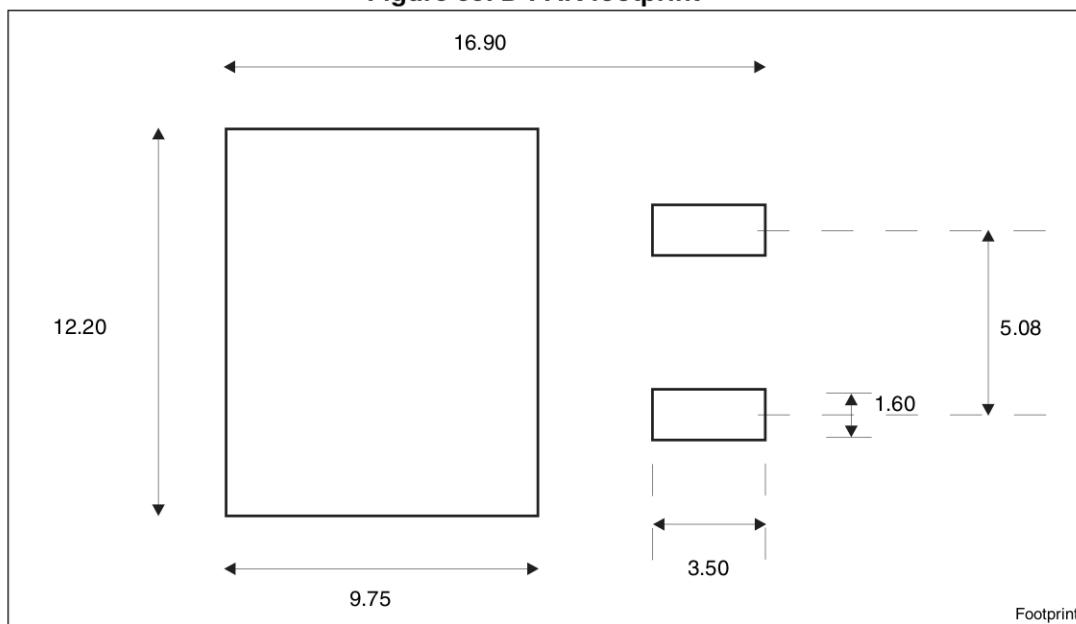
a. All dimensions are in millimeters

Table 9. 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	
$\varnothing$P	3.75		3.85
Q	2.65		2.95

Figure 34. TO-220 type A drawing

0015988_typeA_Rev_S
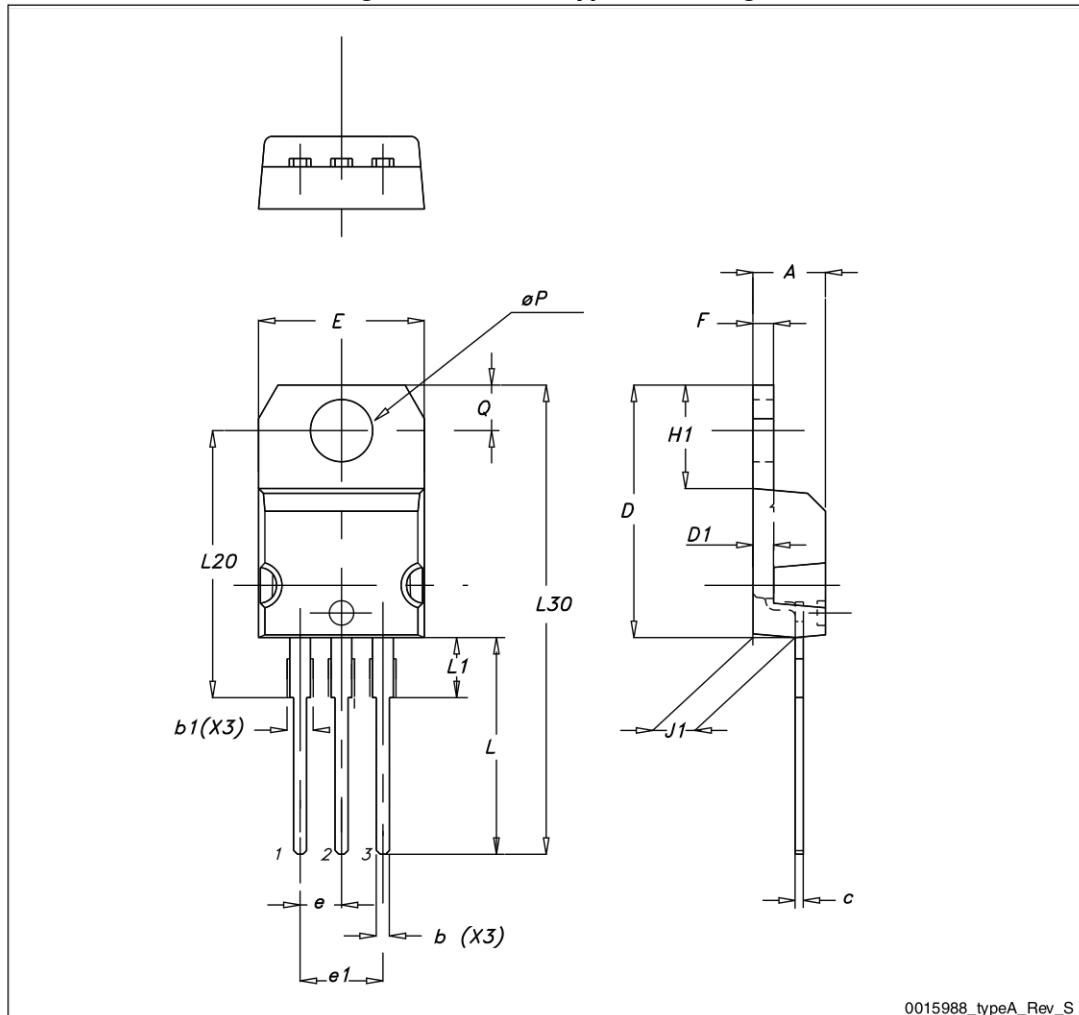
Table 10. TO-247 mechanical data

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 35. TO-247 drawing
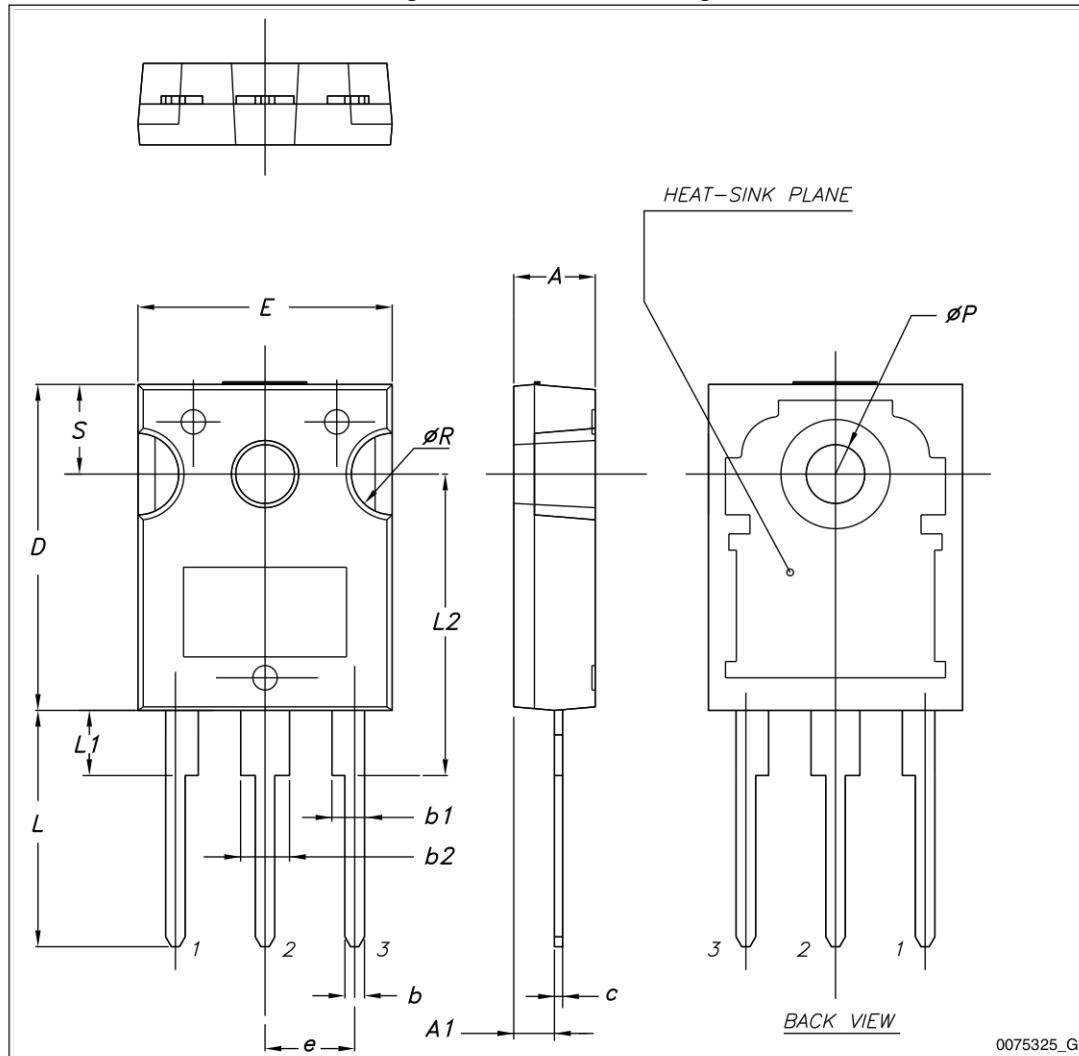
Table 11. TO-3P mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60		5
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1	1.20
b1	1.80		2.20
b2	2.80		3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1		13.90	
E	15.40		15.80
E1		13.60	
E2		9.60	
e	5.15	5.45	5.75
L	19.50	20	20.50
L1		3.50	
L2	18.20	18.40	18.60
øP	3.10		3.30
Q		5	
Q1		3.80	

Figure 36. TO-3P drawing

8045950_A
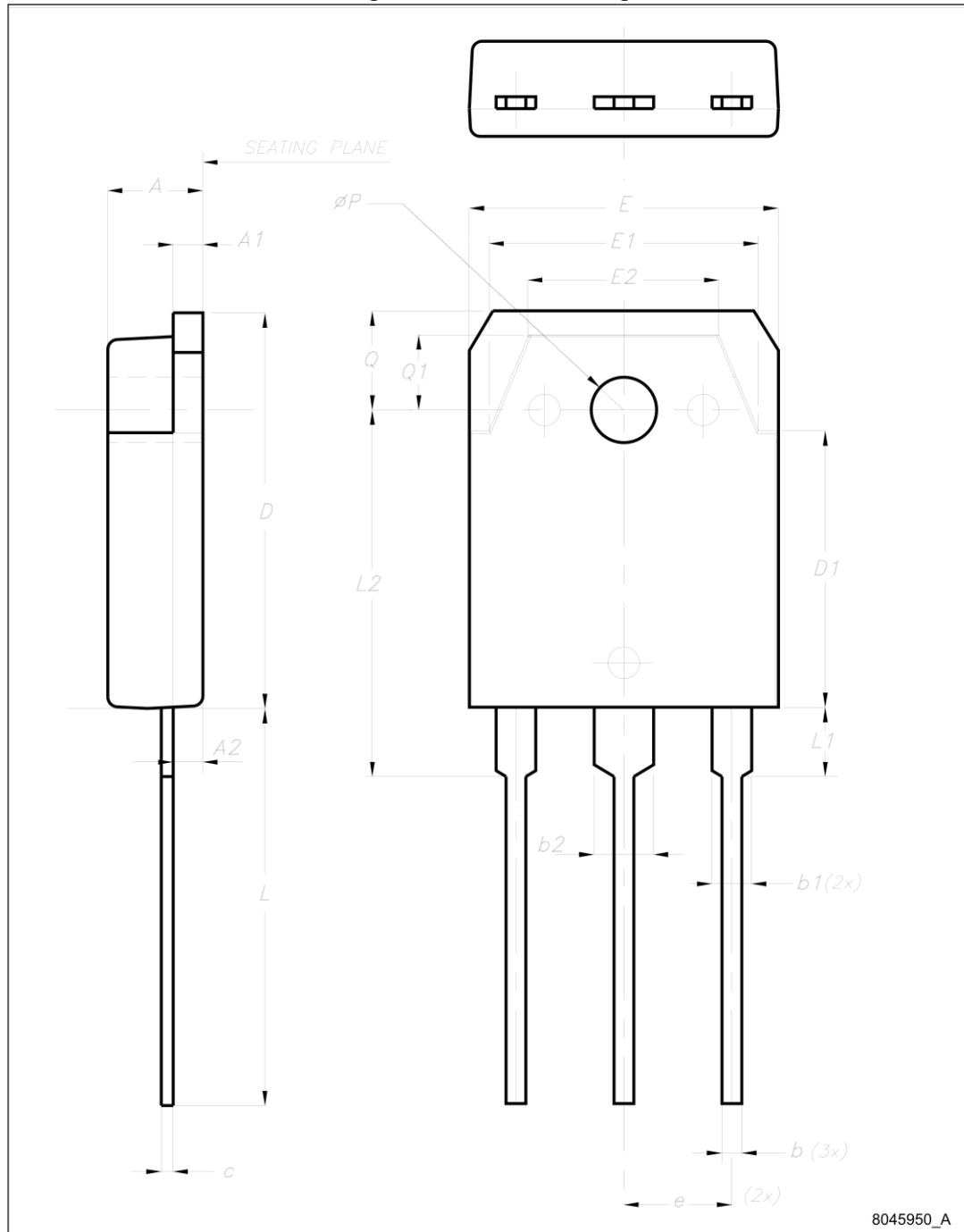
5   Packaging mechanical data

Table 12.   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 37. Tape
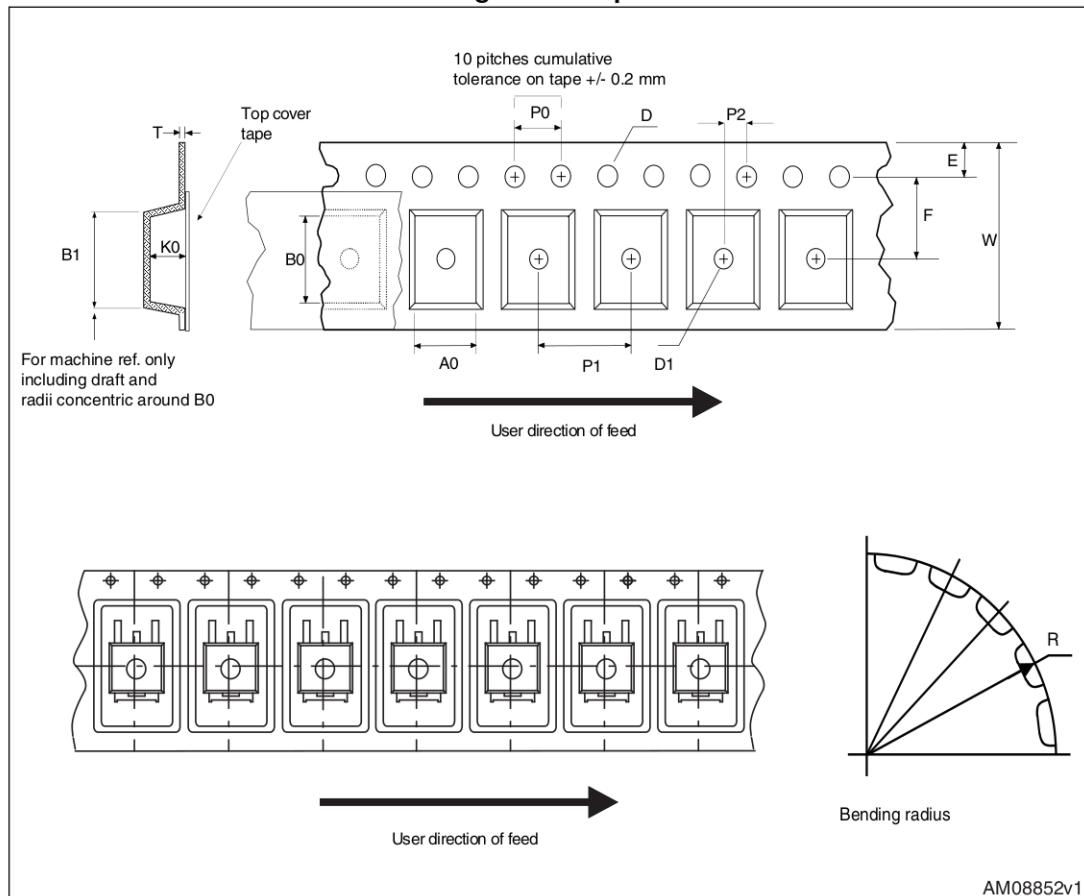
Figure 38. Reel
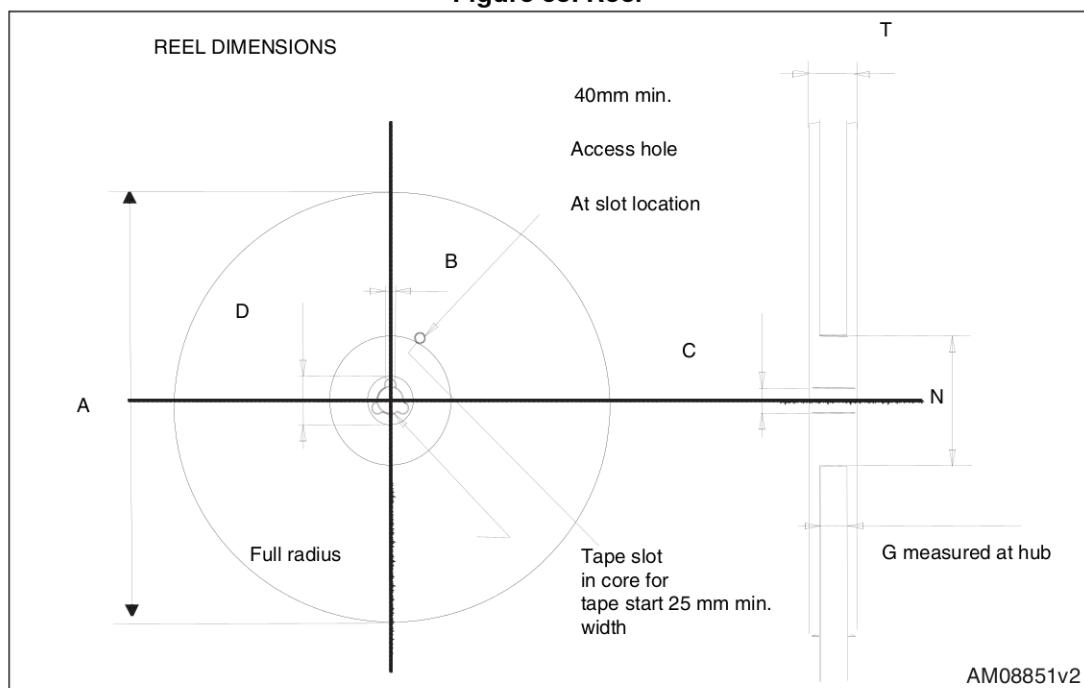
6   Revision history

Table 13. Document revision history

Date	Revision	Changes
14-Mar-2013	1	Initial release.
03-May-2013	2	Added: *Section 2.1: Electrical characteristics (curves)*
04-Jun-2013	3	Added minimum and maximum values for $V_{GE(th)}$ in *Table 4: Static characteristics*.
08-Oct-2013	4	Updated title, features and description in cover page.

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