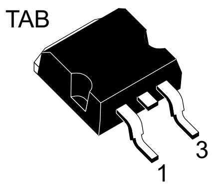
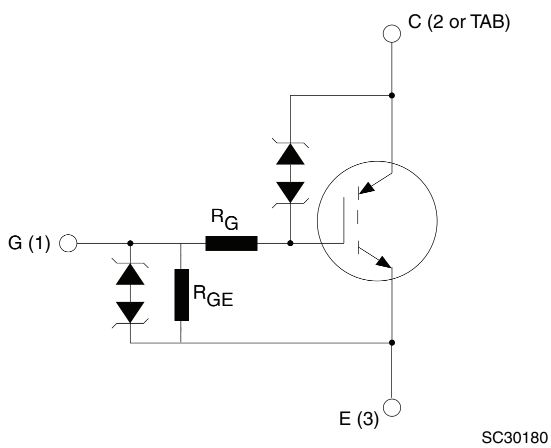
Automotive 390 V internally clamped IGBT E_{SCIS} 180 mJ

Datasheet - preliminary data



D2PAK

Figure 1. Internal schematic diagram



Features

- Designed for automotive applications
- 180 mJ of avalanche energy @ T_C = 150 °C, L = 3 mH
- ESD gate-emitter protection
- Gate-collector high voltage clamping
- Logic level gate drive
- Low saturation voltage
- High pulsed current capability
- Gate and gate-emitter resistor

Applications

- Pencil coil electronic ignition driver

Description

This application-specific IGBT utilizes the most advanced PowerMESH™ technology. The built-in Zener diodes between gate-collector and gate-emitter provide overvoltage protection capabilities. The device also exhibits low on-state voltage drop and low threshold drive for use in automotive ignition systems.

Table 1. Device summary

Order code	Marking	Packages	Packing
STGB19N40LZ	GB19N40LZ	D²PAK	Tape and reel

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	$V_{CES(clamped)}$	V
V_{ECS}	Emitter collector voltage (V_{GE} = 0)	20	V
I_C (1)	Collector current (continuous) at T_C = 100 °C	25	A
I_{CP} (2)	Pulsed collector current	40	A
V_{GE}	Gate-emitter voltage	$V_{GE(clamped)}$	V
P_{TOT}	Total dissipation at T_C = 25 °C	150	W
E_{SCIS} (3)	Single pulse energy T_C = 25 °C, L = 3 mH, V_{CC} = 50 V	300	mJ
	Single pulse energy T_C =150 °C, L = 3 mH, V_{CC} = 50 V	180	mJ
I_{SCIS}	Avalanche current T_C = 25 °C, L = 3 mH, V_{CC} = 50 V	13.1	A
	Avalanche current T_C = 150 °C, L = 3 mH, V_{CC} = 50 V	10.2	A
ESD	Human body model, R = 1.5 kΩ, C = 100 pF	8	kV
	Machine model, R = 0, C = 100 pF	800	V
	Charged device model	2	kV
T_{STG}	Storage temperature	– 55 to 175	°C
T_J	Operating junction temperature		

1. Calculated according to the iterative formula

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. Pulse width limited by max. junction temperature allowed
3. For E_{SCIS} test circuit refer to *Figure 16*. (Inductive load switching), with A and B not connected.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.0	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient device in free air	62.5	

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 4. Static electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CES(clamped)}$	Collector emitter clamped voltage (V_{GE} = 0)	I_C = 2 mA		390		V
		I_C = 2 mA, T_J = - 40 °C to 175 °C	365		425	V
$V_{(BR)ECS}$	Emitter collector break-down voltage (V_{GE} = 0)	I_C = 75 mA		28		V
		I_C = 75 mA, T_J = - 40 °C to 175 °C	20			V
$V_{GE(clamped)}$	Gate emitter clamped voltage	I_G = ±2 mA T_J = - 40 °C to 175 °C	12		16	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 15 V, T_J = 175 °C			20	µA
		V_{CE} = 200 V, T_J = 175 °C			100	µA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±10 V		625		µA
		V_{GE} = ±10 V, T_J = - 40 °C to 175 °C	450		830	µA
R_{GE}	Gate emitter resistance	0 < V_{GE} < V_{GE} (clamped)	12	16	22	kΩ
R_G	Gate resistance			1.6		kΩ
$V_{GE(th)}$	Gate threshold voltage	V_{GE} =V_{CE}, I_C = 1 mA, T_J = - 40 °C	1.75	2.3	2.9	V
		V_{GE} =V_{CE}, I_C = 1 mA	1.55	2.0	2.6	V
		V_{GE} =V_{CE}, I_C = 1 mA, T_J = 175 °C	1.05	1.4	2.0	V
$V_{CE(sat)}$	Collector emitter saturation voltage	V_{GE} = 4.5 V, I_C = 10 A		1.5		V
		V_{GE} = 4.5 V, I_C = 10 A, T_J = - 40 °C to 175 °C			1.85	V
		V_{GE} = 3.8 V, I_C = 6 A		1.35		V
		V_{GE} = 3.8 V, I_C = 6 A, T_J = - 40 °C to 175 °C			1.65	V

Table 5. Dynamic electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	730	-	pF
C_{oes}	Output capacitance		-	85	-	pF
C_{res}	Reverse transfer capacitance		-	4	-	pF
Q_g	Gate charge	V_{CE} = 280 V, I_C = 10 A, V_{GE} = 5 V	-	17	-	nC

Table 6. Switching on/off

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Resistive load Turn-on delay time Rise time	V_{CC} = 14 V, R_L = 1 Ω, V_{GE} = 5 V R_G = 1 kΩ	-	0.65 3.5	-	µs µs
$t_{d(on)}$ t_r	Resistive load Turn-on delay time Rise time	V_{CC} = 14 V, R_L = 1 Ω, V_{GE} = 5 V, R_G = 1 kΩ, T_J = 150 °C	-	0.65 3.8	-	µs µs
$t_{d(off)}$ t_f dv/dt	Inductive load Turn-off delay time Fall time Turn-off voltage slope	V_{CC} = 300 V, L = 1 mH I_C = 10 A, V_{GE} = 5 V, R_G = 1 kΩ	-	13.5 5.5 105	-	µs µs V/µs
$t_{d(off)}$ t_f dv/dt	Inductive load Turn-off delay time Fall time Turn-off voltage slope	V_{CC} = 300 V, L = 1 mH I_C = 10 A, V_{GE} = 5 V, R_G = 1 kΩ, T_J = 150 °C	-	14.2 8 97	-	µs µs V/µs

2.1 Electrical characteristics (curves)

Figure 2. Collector-emitter on voltage vs. temperature (I_C = 6 A)

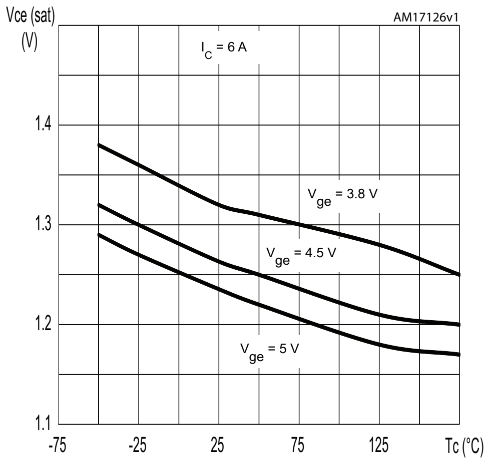


Figure 3. Collector-emitter on voltage vs. temperature (I_C = 10 A)

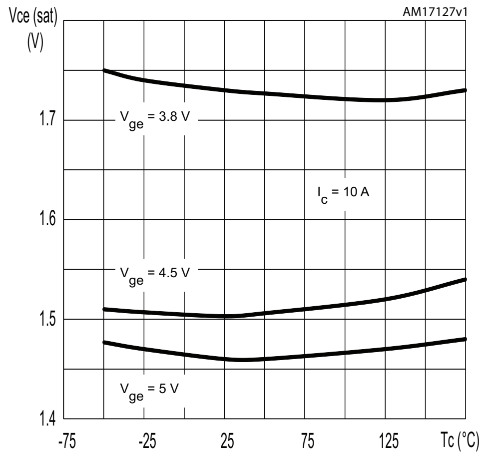


Figure 4. Collector-emitter on voltage vs. temperature (V_{GE} = 4.5 V)

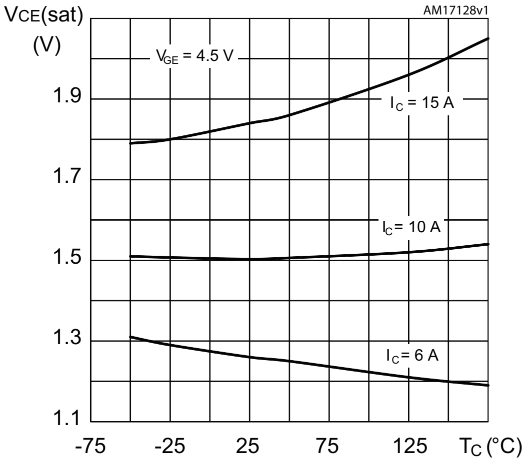


Figure 5. Self clamped inductive switch

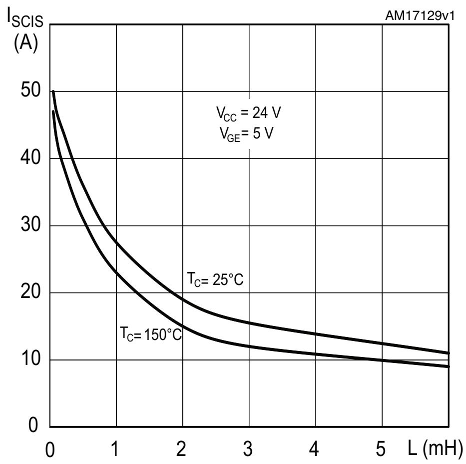


Figure 6. Output characteristics (T_J= 25 °C)

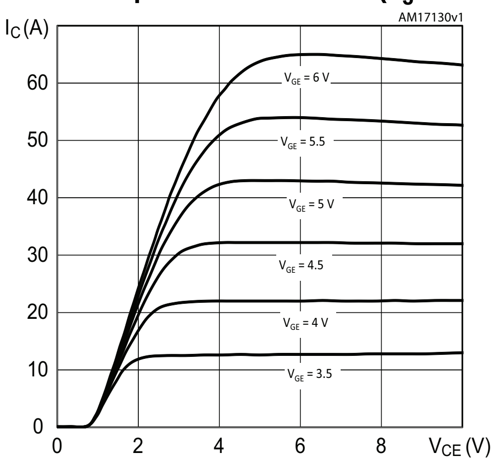


Figure 7. Output characteristics (T_J= -40 °C)

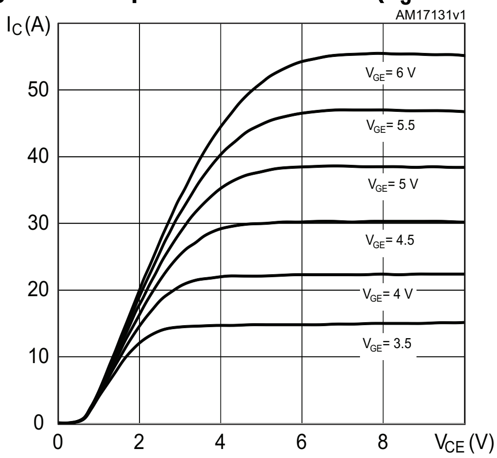


Figure 8. Output characteristics (T_J= 175 °C)

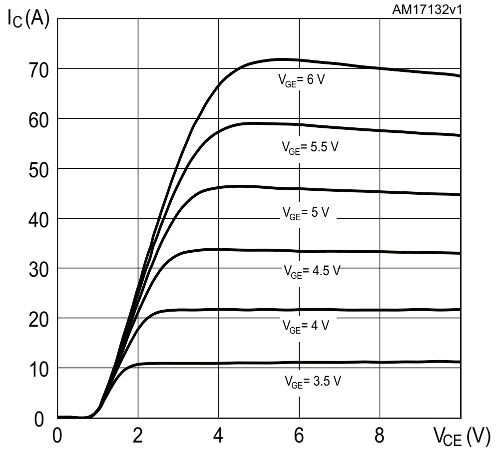


Figure 9. Transfer characteristics

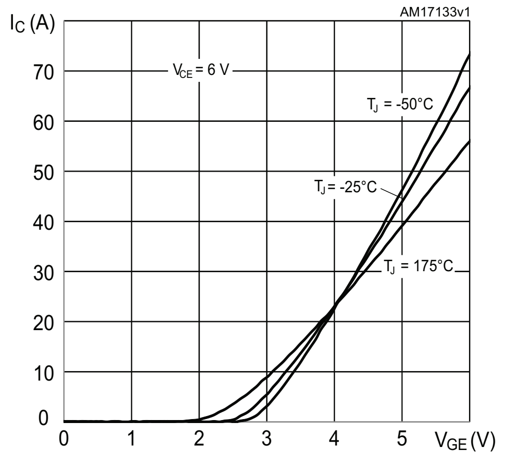


Figure 10. Collector cut-off current vs. temperature

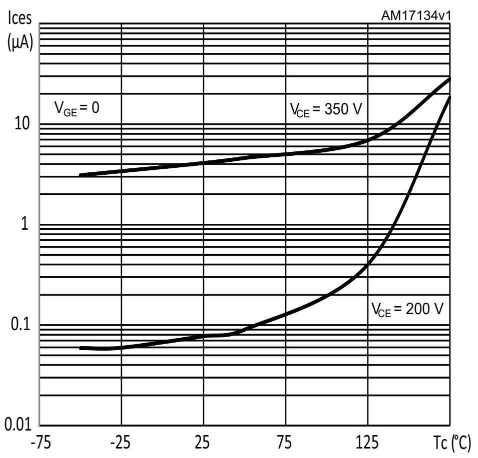


Figure 11. Normalized collector emitter voltage vs. temperature (I_C = 2 mA)

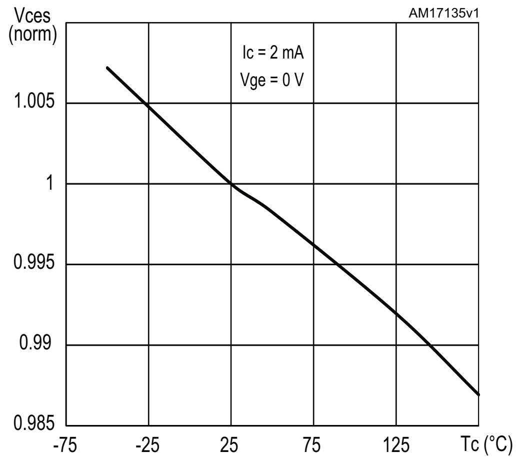


Figure 12. Normalized gate threshold voltage vs. temperature

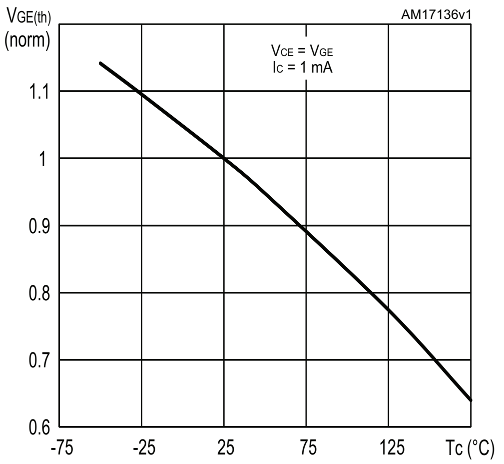


Figure 13. Normalized collector emitter on voltage vs. temperature (I_C = 10 A)

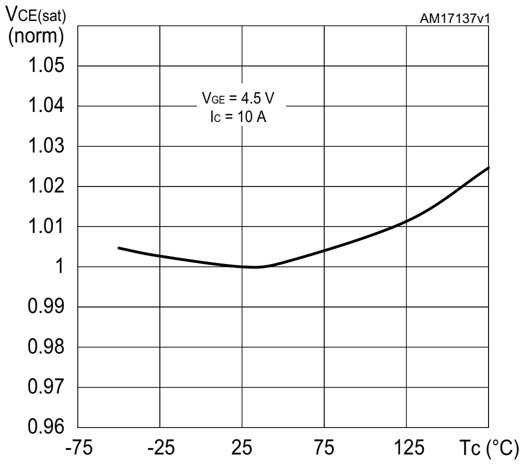


Figure 14. Thermal impedance

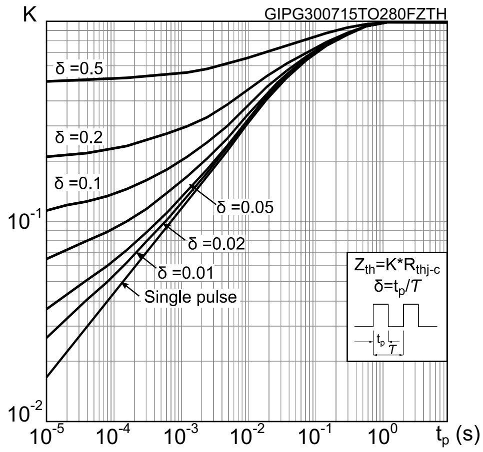
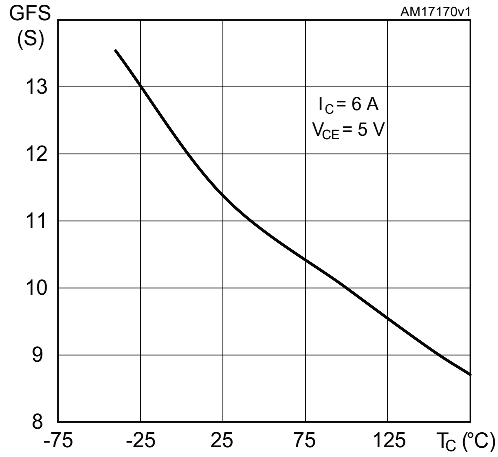


Figure 15. Transconductance vs. temperature



3 Test circuits

Figure 16. Inductive load switching and E_{SCIS} test circuit

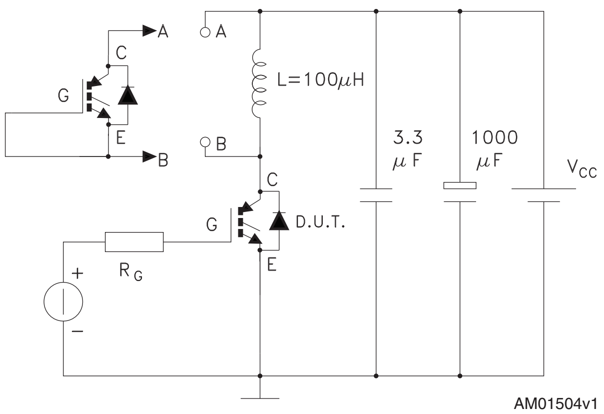


Figure 17. Resistive load switching

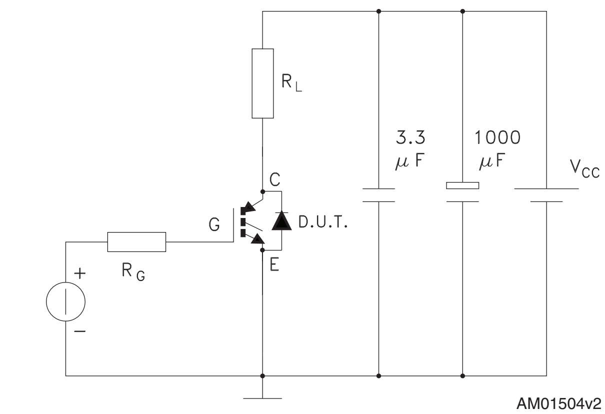


Figure 18. Gate charge test circuit

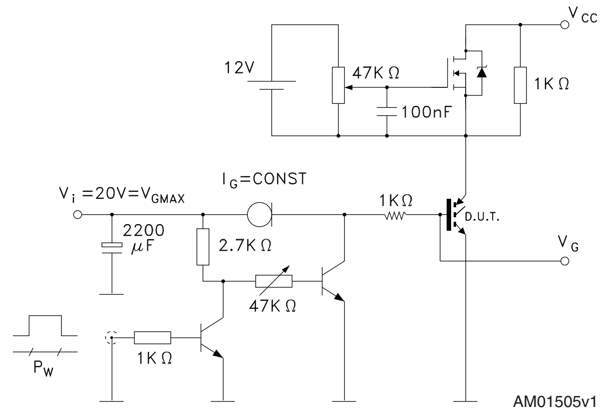
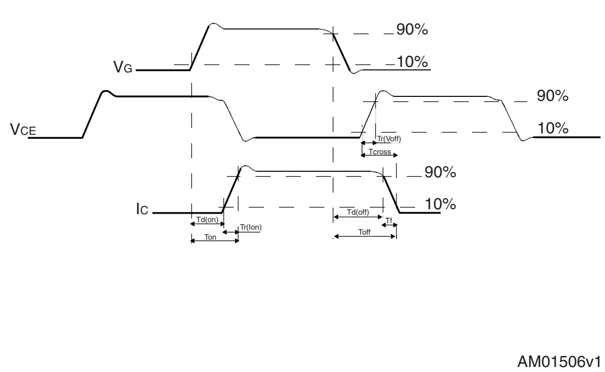


Figure 19. Switching waveform



4 Package information

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.

4.1 D²PAK (TO-263) type A package information

Figure 20. D²PAK (TO-263) type A package outline

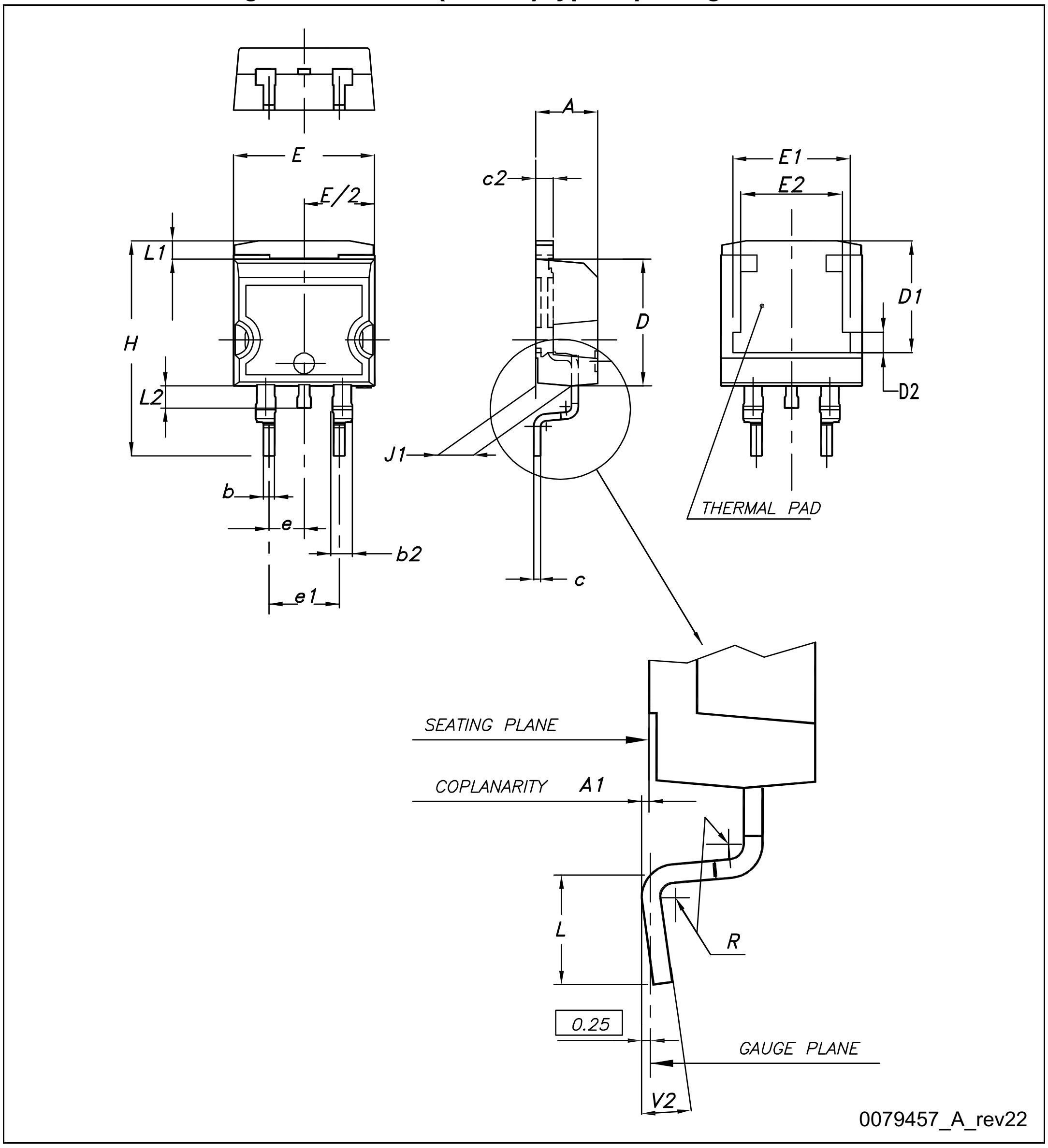
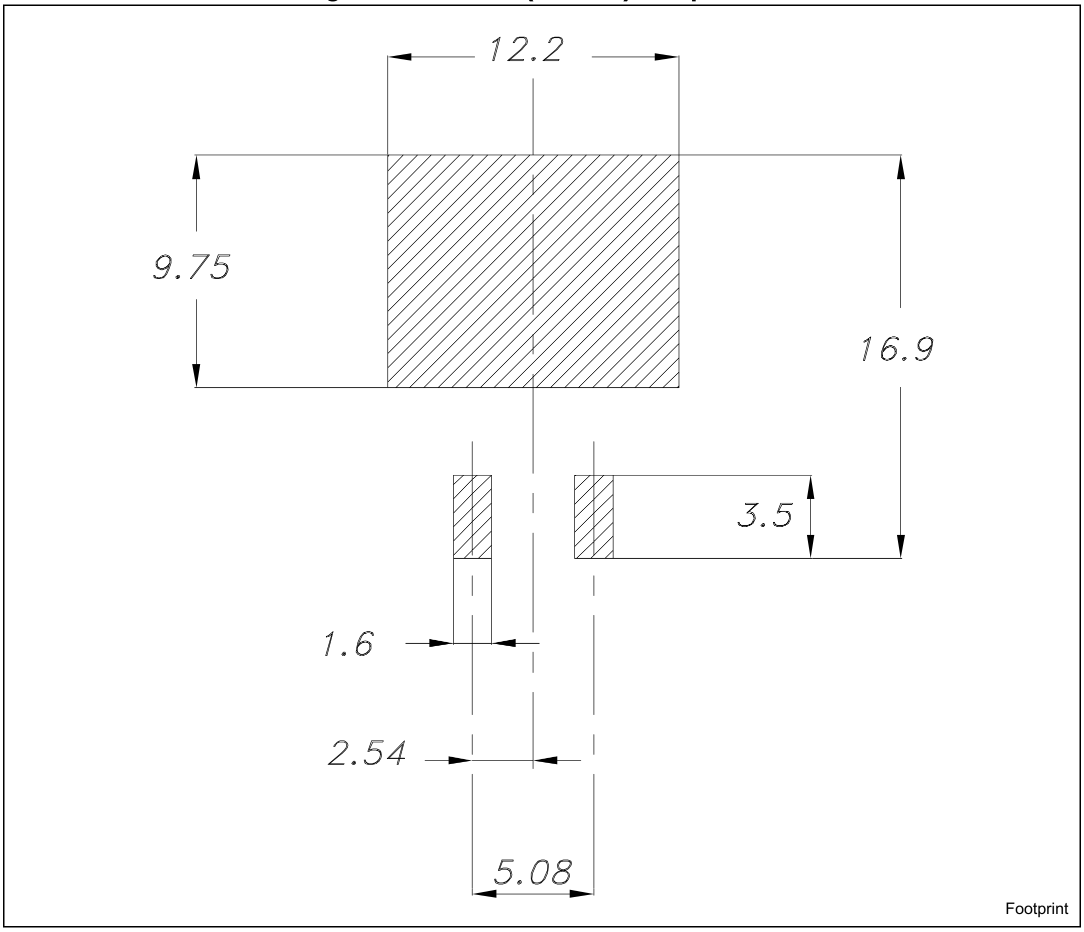


Table 7. D²PAK (TO-263) type A package mechanical data

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	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
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 21. D²PAK (TO-263) footprint [(a)]



a. All dimensions are in millimeters

4.2 Packing information

Figure 22. Tape outline for D²PAK (TO-263)

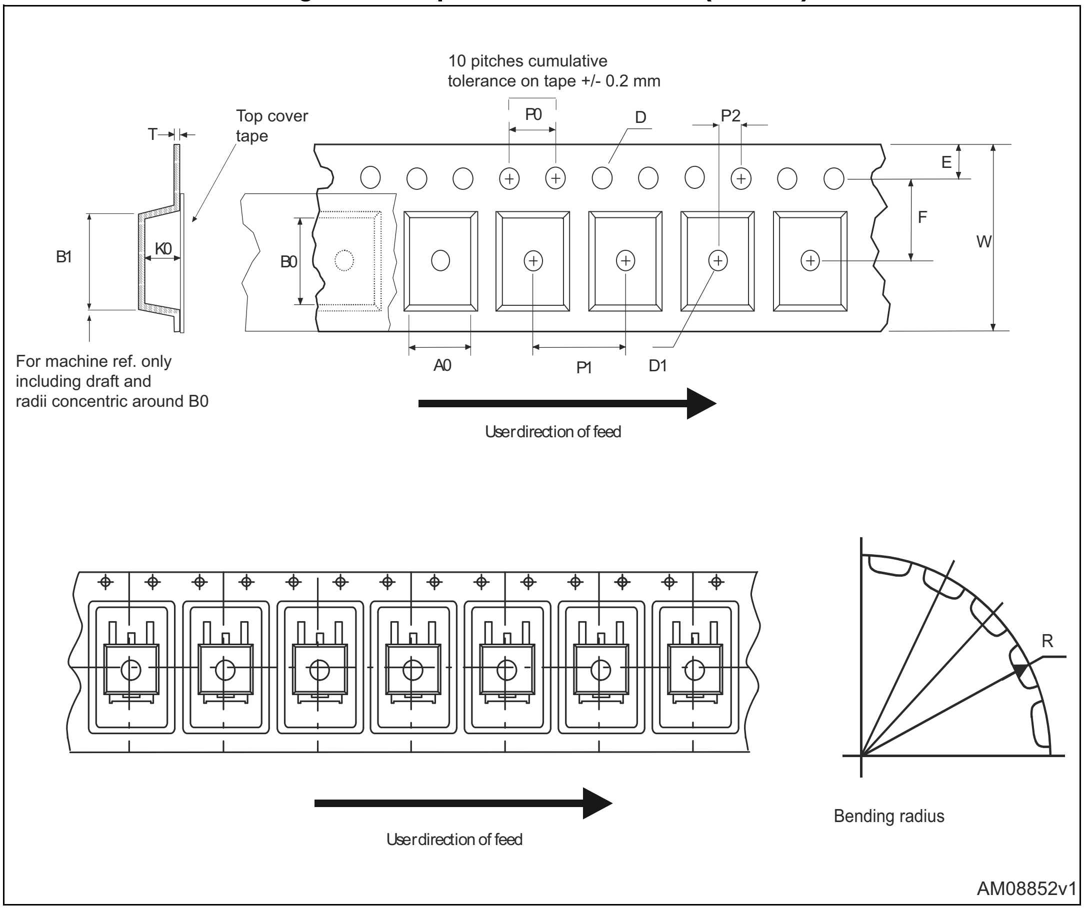


Figure 23. Reel outline for DPAK (TO-252)

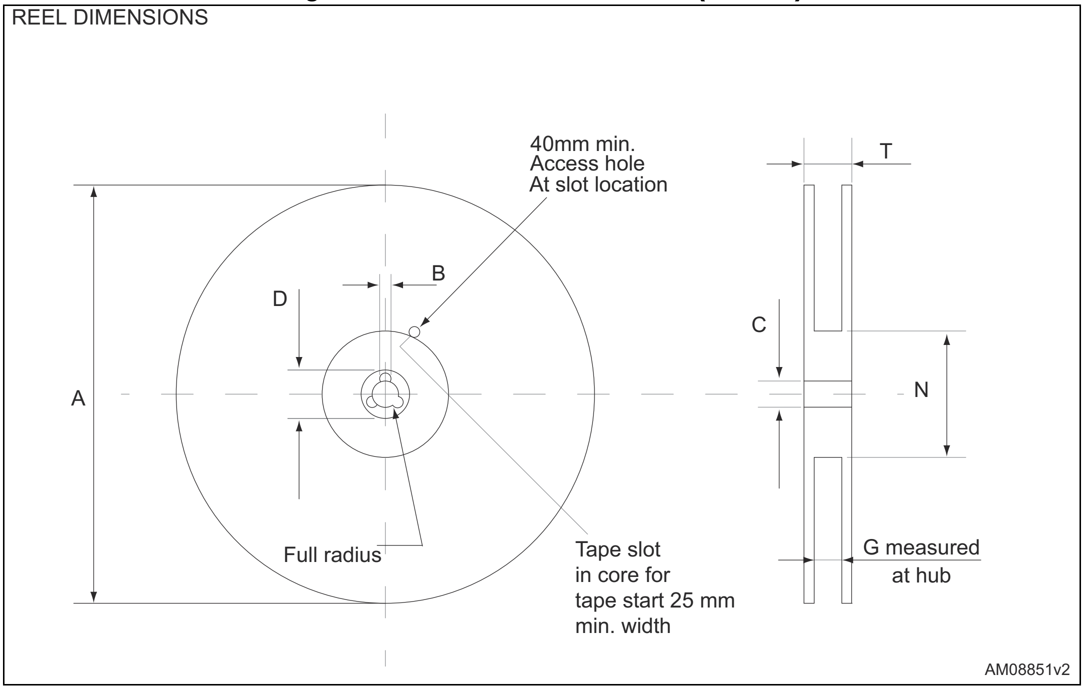


Table 8. D²PAK (TO-263) tape and reel mechanical data

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			

5 Revision history

Table 9. Document revision history

Date	Revision	Changes
30-Jul-2015	1	Initial release.