STGB20N45LZAG, STGD20N45LZAG

Automotive-grade 450 V internally clamped IGBT E_{SCIS} 300 mJ

Datasheet - production data

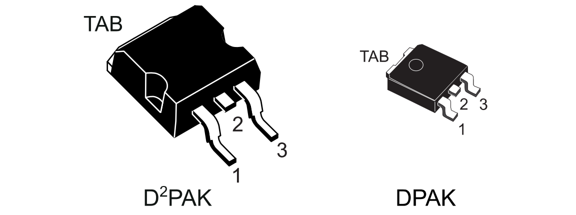
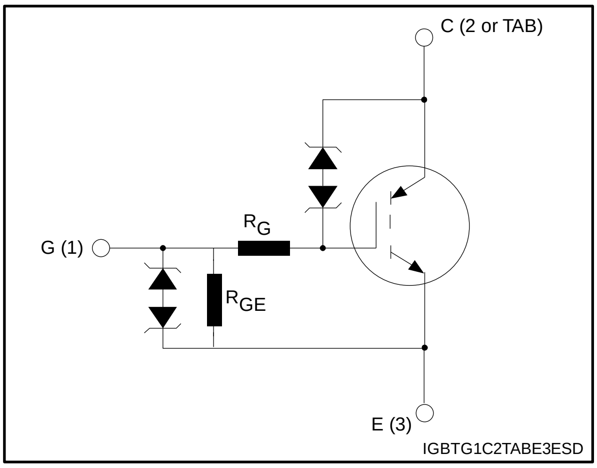


Figure 1: Internal schematic diagram



Features

- AEC-Q101 qualified
- SCIS energy of 300 mJ @ T_J = 25 °C
- Parts are 100% tested in SCIS
- ESD gate-emitter protection
- Gate-collector high voltage clamping
- Logic level gate drive
- Very low saturation voltage
- High pulsed current capability
- Gate and gate-emitter resistor

Applications

- Automotive ignition coil driver circuit

Description

This application-specific IGBT utilizes the most advanced PowerMESH™ technology optimized for coil driving in the harsh environment of automotive ignition systems. These devices show very low on-state voltage and very high SCIS energy capability over a wide operating temperature range. Moreover, ESD-protected logic level gate input and an integrated gate resistor means no external protection circuitry is required.

Table 1: Device summary

Order code	Marking	Package	Packing
STGB20N45LZAG	GB20N45LZ	D²PAK	Tape and reel
STGD20N45LZAG	GD20N45LZ	DPAK	

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK	DPAK	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	$V_{CES(clamped)}$		V
V_{ECS}	Emitter-collector voltage (V_{GE} = 0 V)	20		V
I_C	Continuous collector current at T_C = 25 °C, V_{GE} = 4 V	25		A
	Continuous collector current at T_C = 100 °C, V_{GE} = 4 V	25		A
I_{CP}(1)	Pulsed collector current	50		A
V_{GE}	Gate-emitter voltage	V_{GE}(clamped)		V
P_{TOT}	Total dissipation at T_C = 25 °C	150	125	W
E_{SCIS_25}(2)	Self clamping inductive switching energy	300		mJ
E_{SCIS_150}(3)	Self clamping inductive switching energy @ T_J = 150 °C	170		mJ
ESD	Human body model, R = 1.5 kΩ, C = 100 pF	4		kV
	Charged device model	2		kV
T_{STG}	Storage temperature range	- 55 to 175		°C
T_J	Operating junction temperature range			

Notes:

(1)Pulse width limited by maximum junction temperature.

(2)Starting T_j = 25 °C, L = 3 mH, R_g = 1 kΩ, V_{cc}= 50 V during inductor charging and V_{cc}= 0 V during the time in clamp. Parts are 100% electrically tested in production.

(3)Starting T_j = 150 °C, L = 3 mH, R_g = 1 kΩ, V_{cc}= 50 V during inductor charging and V_{cc}= 0 V during the time in clamp.

Table 3: Thermal data

Symbol	Parameter	Value		Unit
		D²PAK	DPAK	
$R_{thj-case}$	Thermal resistance junction-case	1	1.2	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	100	°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CES(clamped)}$	Collector-emitter clamped voltage	I_C = 2 mA, V_{GE} = 0 V		450		V
		I_C = 2 mA, V_{GE} = 0 V, T_j = - 40 °C to 175 °C	425		485	V
$V_{(BR)ECS}$	Emitter-collector break-down voltage	I_C = 75 mA, V_{GE} = 0 V	20			V
$V_{GE(clamped)}$	Gate-emitter clamped voltage	I_G = ±2 mA, T_j= - 40 °C to 175 °C	12		16	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 4 V, I_C = 6 A		1.1	1.25	V
		V_{GE} = 4.5 V, I_C = 10 A, T_J = 175 °C		1.25	1.55	V
$V_{GE(th)}$	Gate-threshold voltage	V_{GE} = V_{CE}, I_C = 1 mA		1.65		V
		V_{GE} = V_{CE}, I_C = 1 mA, T_J = 175 °C		1.05		V
I_{CES}	Collector cut-off current	V_{CE} = 15 V, V_{GE} = 0 V, T_J = 150 °C			20	µA
		V_{CE} = 200 V, V_{GE} = 0 V, T_J = 150 °C			100	µA
I_{GES}	Gate-emitter leakage current	V_{GE} = ±10 V, V_{CE} = 0 V		625		µA
		V_{GE} = ±10 V, V_{CE} = 0 V, T_J = -40 °C to 175 °C	450		900	µA
R_{GE}	Gate emitter resistance		11	16	22	kΩ
R_G	Gate resistance			120		Ω

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 V	-	1011	-	pF
C_{oes}	Output capacitance		-	87	-	
C_{res}	Reverse transfer capacitance		-	14	-	
Q_g	Total gate charge	V_{CE} = 13 V, I_C = 10 A, V_{GE} = 0 to 5 V	-	26	-	nC

Table 6: Resistive load switching characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 14 V, V_{GE} = 5 V, R_L = 1 Ω, R_G = 1 kΩ (see *Figure 18: " Test circuit for resistive load switching"*)	-	1.1	-	µs
t_r	Rise time		-	3.6	-	µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 14 V, V_{GE} = 5 V, R_L= 1 Ω, R_G = 1 kΩ, T_J = 150 °C (see *Figure 18: " Test circuit for resistive load switching"*)	-	1.06	-	µs
t_r	Rise time		-	3.5	-	µs

Table 7: Inductive load switching characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	V_{CC} = 300 V, L = 1 mH, I_C = 10 A, V_{GE} = 5 V, R_G = 1 kΩ (see *Figure 17: " Test circuit for inductive load switching"*)	-	4.6	-	µs
t_f	Fall time		-	8.4	-	µs
dV/dt	Turn-off voltage slope		-	165	-	V/µs
$t_{d(off)}$	Turn-off delay time	V_{CC} = 300 V, L = 1 mH, I_C = 10 A, V_{GE} = 5 V, R_G = 1 kΩ, T_J = 150 °C (see *Figure 17: " Test circuit for inductive load switching"*)	-	4.7	-	µs
t_f	Fall time		-	9.8	-	µs
dV/dt	Turn-off voltage slope		-	116	-	V/µs

2.1 Electrical characteristics (curves)

Figure 2: $V_{CE(sat)}$ vs. junction temperature (I_C = 6.0 A)

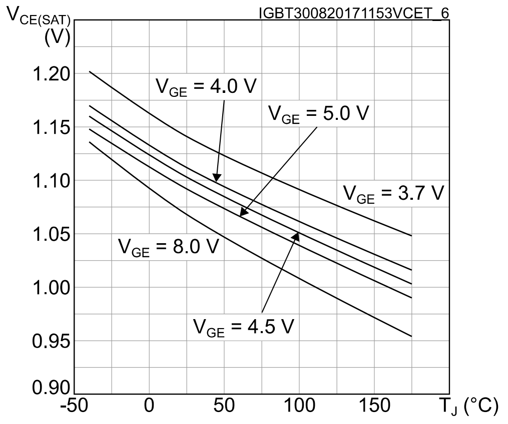


Figure 3: $V_{CE(sat)}$ vs. junction temperature (I_C = 10.0 A)

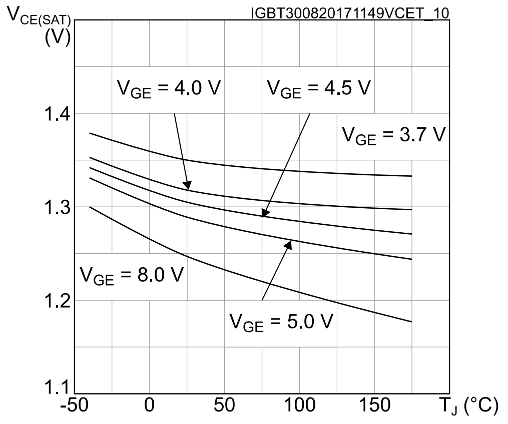


Figure 4: Self clamped inductive switching current vs. inductance

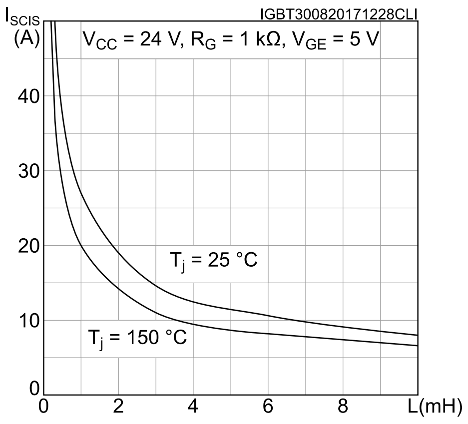


Figure 5: Output characteristics (T_J = 25 °C)

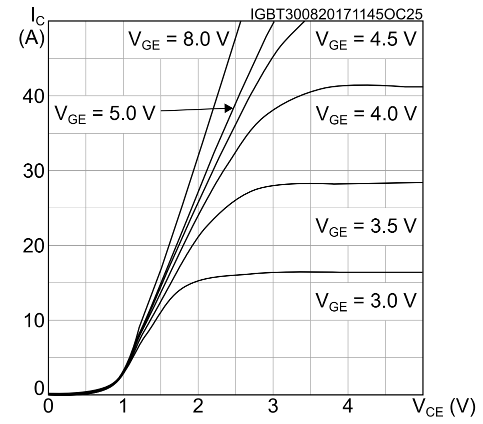


Figure 6: Output characteristics (T_J = -40 °C)

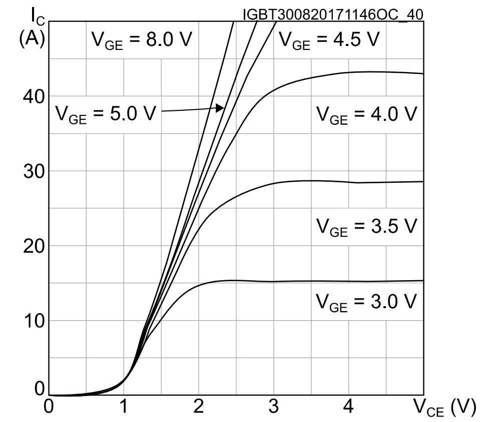


Figure 7: Output characteristics (T_J = 175 °C)

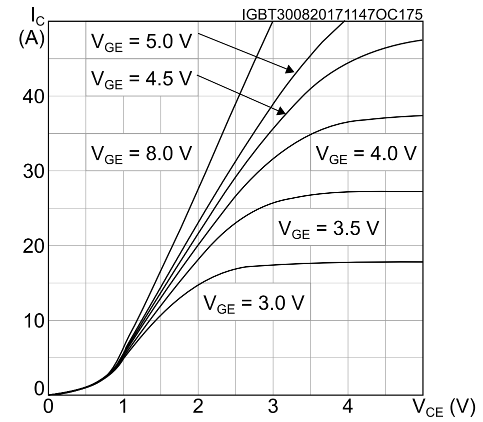


Figure 8: Transfer characteristics

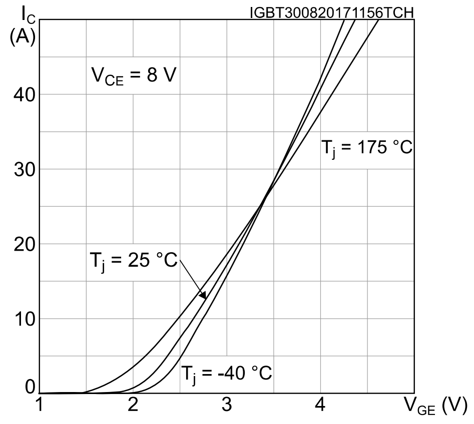


Figure 9: Collector current vs. case temperature

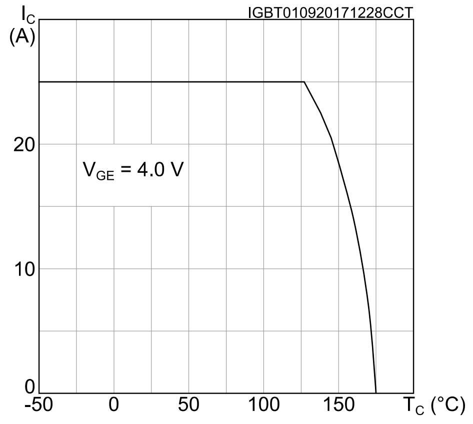


Figure 10: Leakage current vs. junction temperature

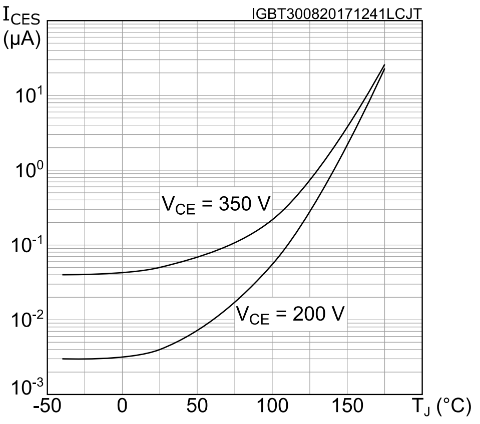


Figure 11: Normalized $V_{CES(clamped)}$ vs. junction temperature

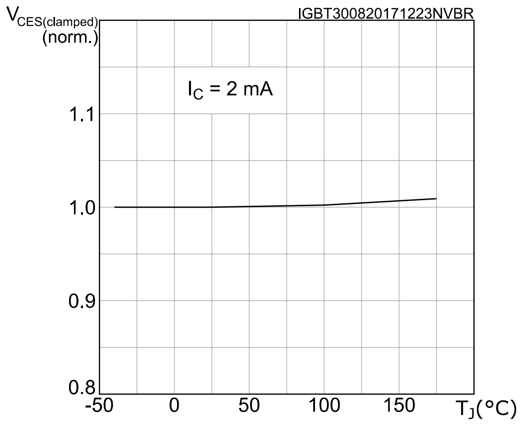


Figure 12: Normalized $V_{GE(th)}$ vs. junction temperature

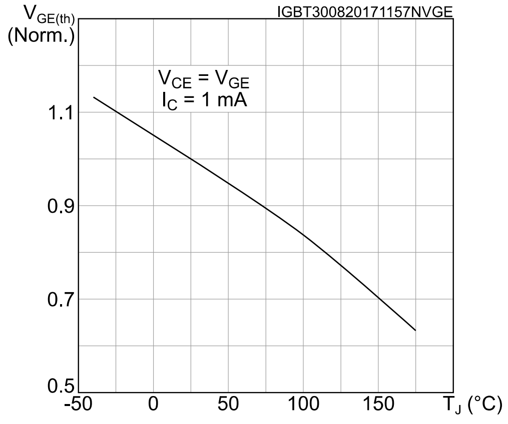


Figure 13: Gate charge vs. gate-emitter voltage

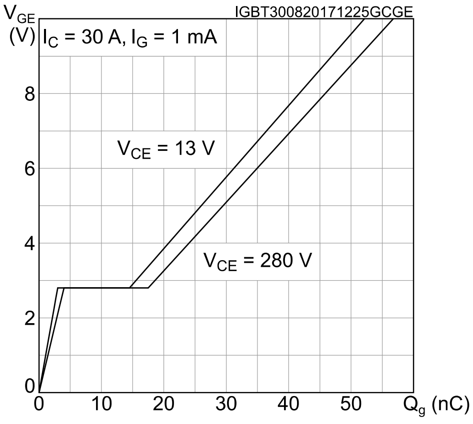


Figure 14: Capacitance variations

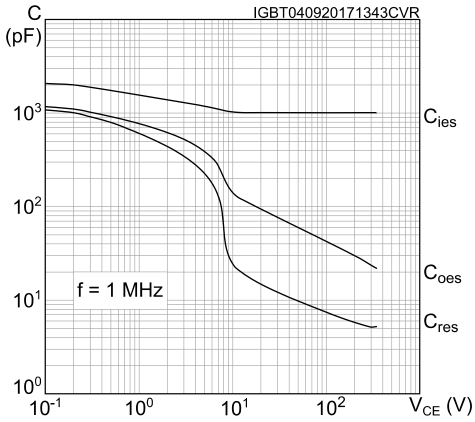


Figure 15: Thermal impedance for D²PAK

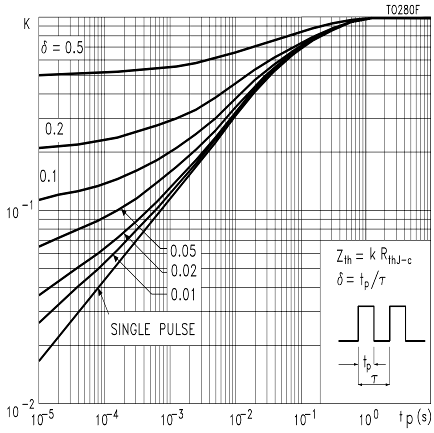
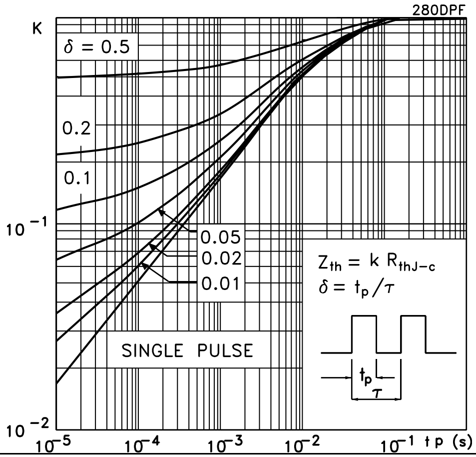


Figure 16: Thermal impedance for DPAK



3 Test circuits

Figure 17: Test circuit for inductive load switching

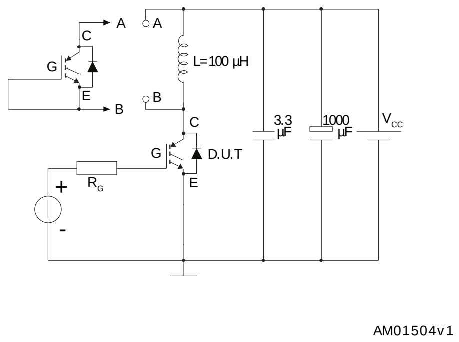


Figure 18: Test circuit for resistive load switching

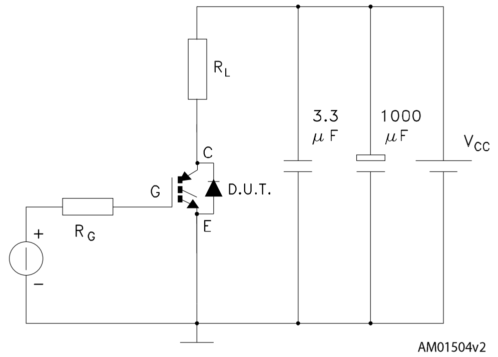


Figure 19: Gate charge test circuit

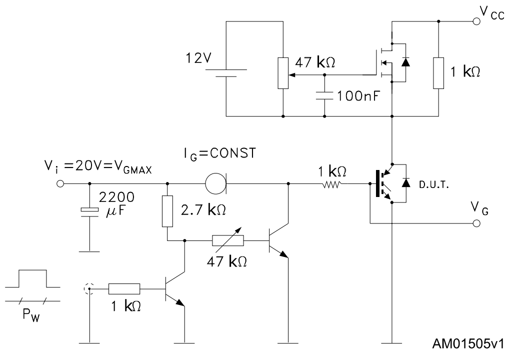
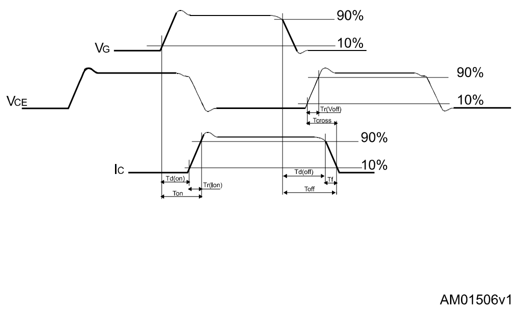


Figure 20: Switching waveform



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 21: D²PAK (TO-263) type A package outline

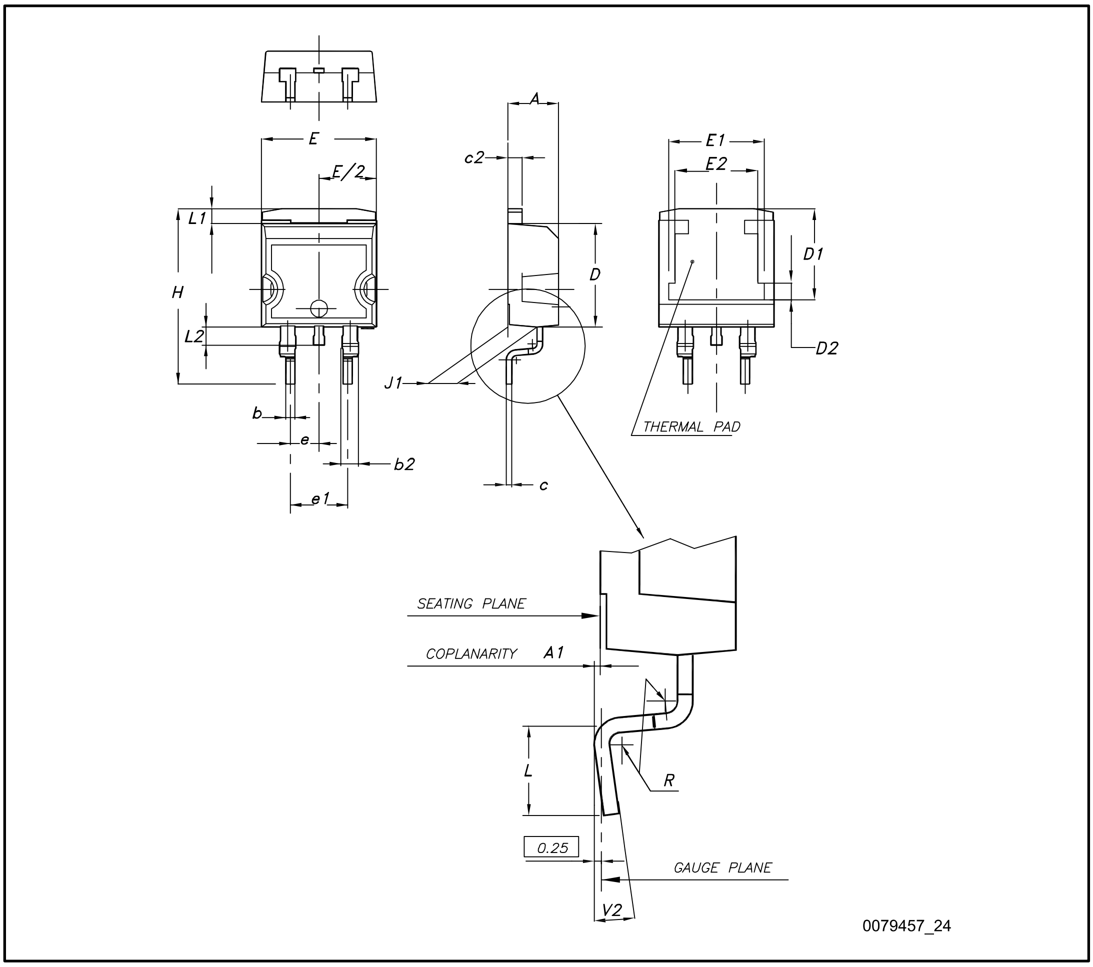
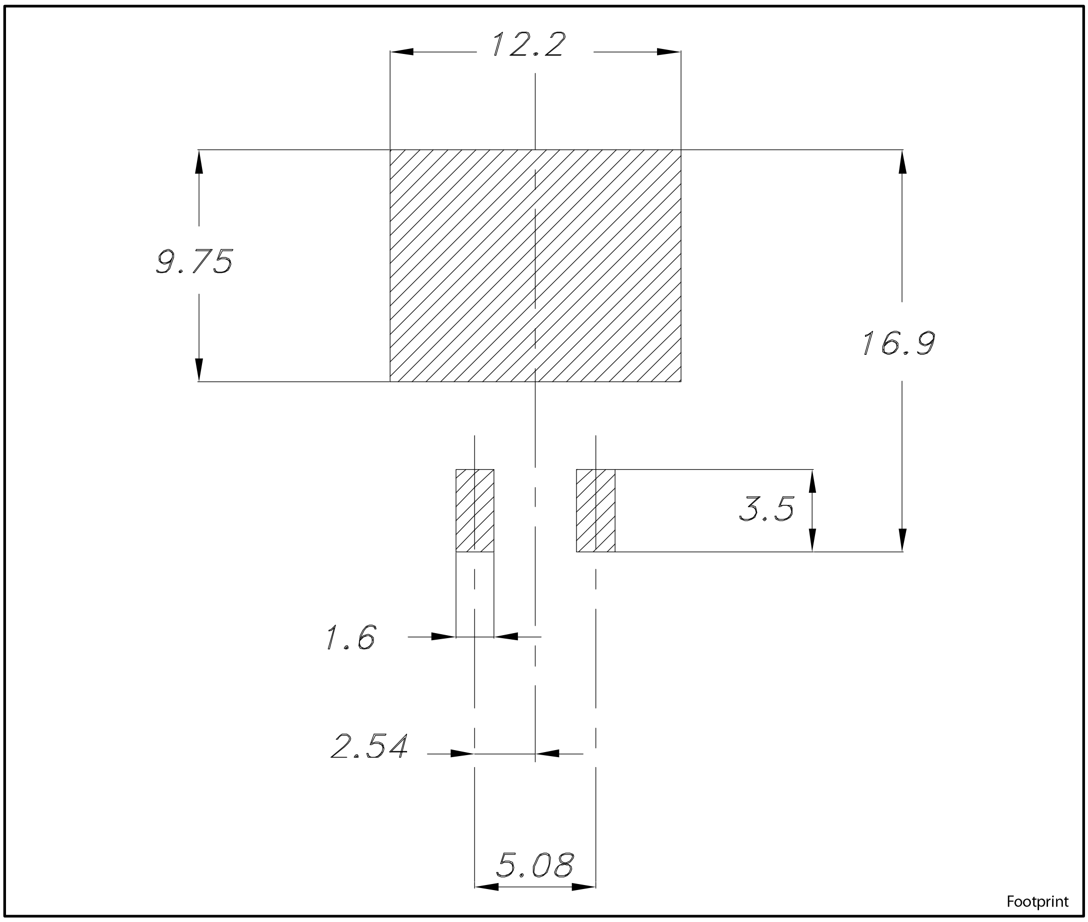


Table 8: D²PAK (TO-263) type A package mechanical data

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	10.00		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	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 22: D²PAK (TO-263) type A recommended footprint (dimensions are in mm)



4.2 DPAK (TO-252) type A2 package information

Figure 23: DPAK (TO-252) type A2 package outline

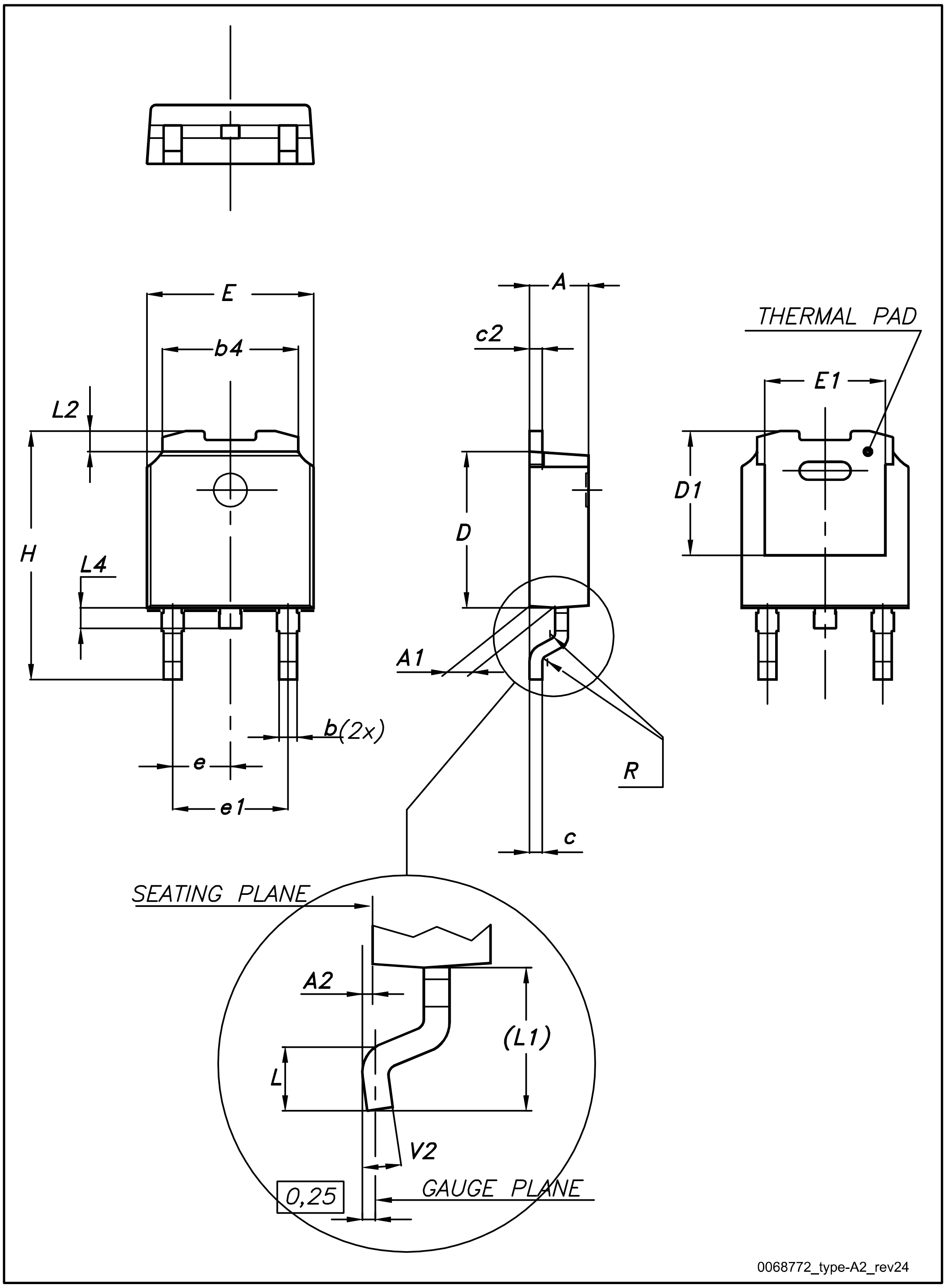
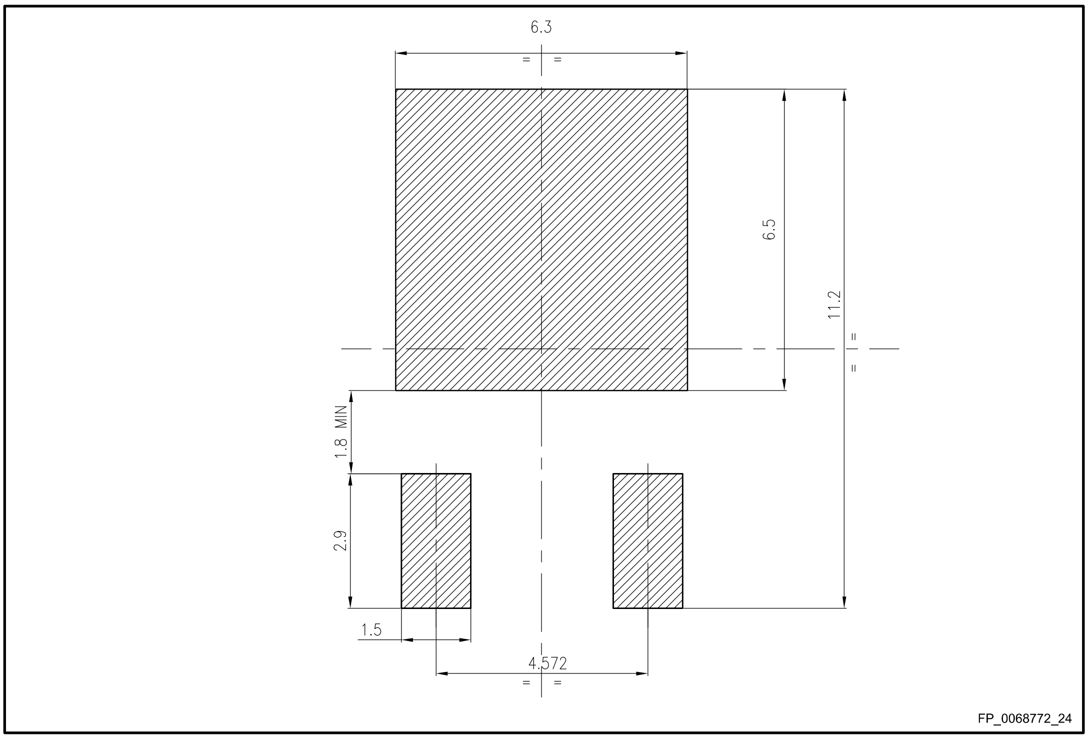


Table 9: DPAK (TO-252) type A2 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1	4.95	5.10	5.25
E	6.40		6.60
E1	5.10	5.20	5.30
e	2.16	2.28	2.40
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
L1	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 24: DPAK (TO-252) type A2 recommended footprint (dimensions are in mm)



4.3 Packing information

Figure 25: Tape outline

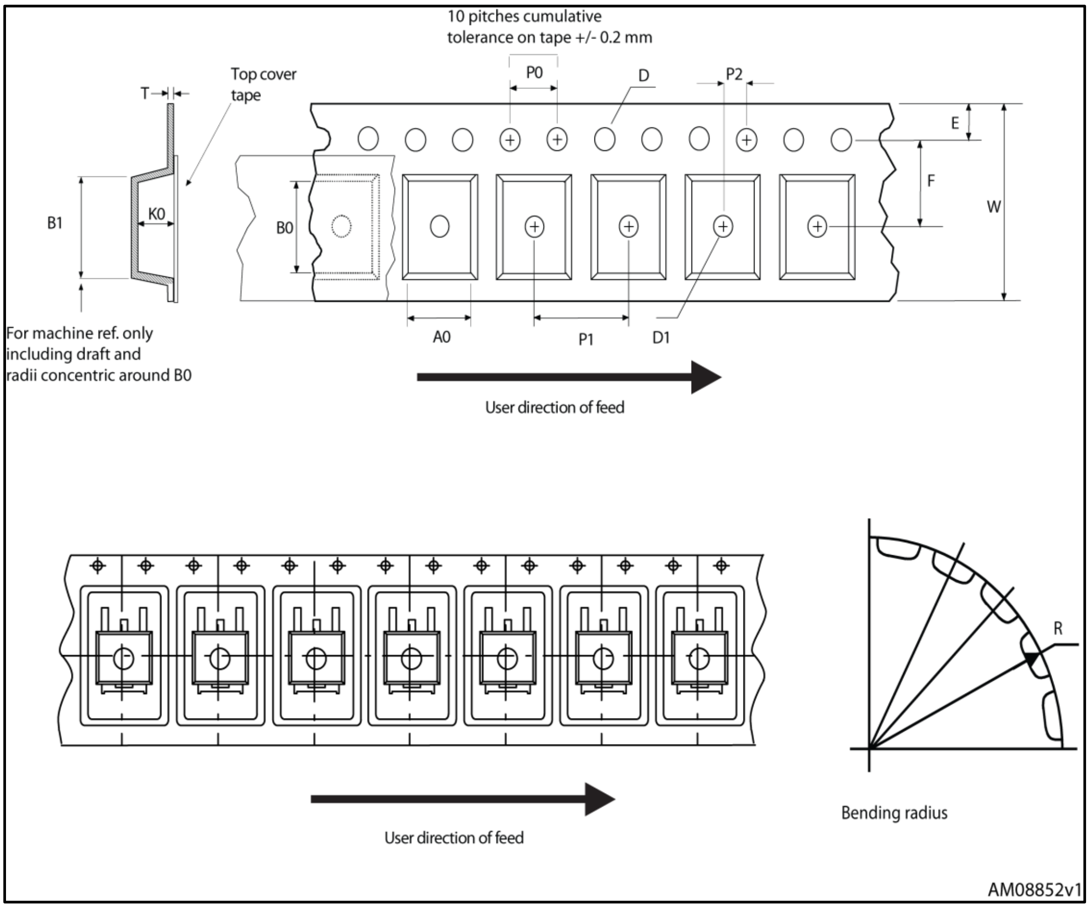


Figure 26: Reel outline

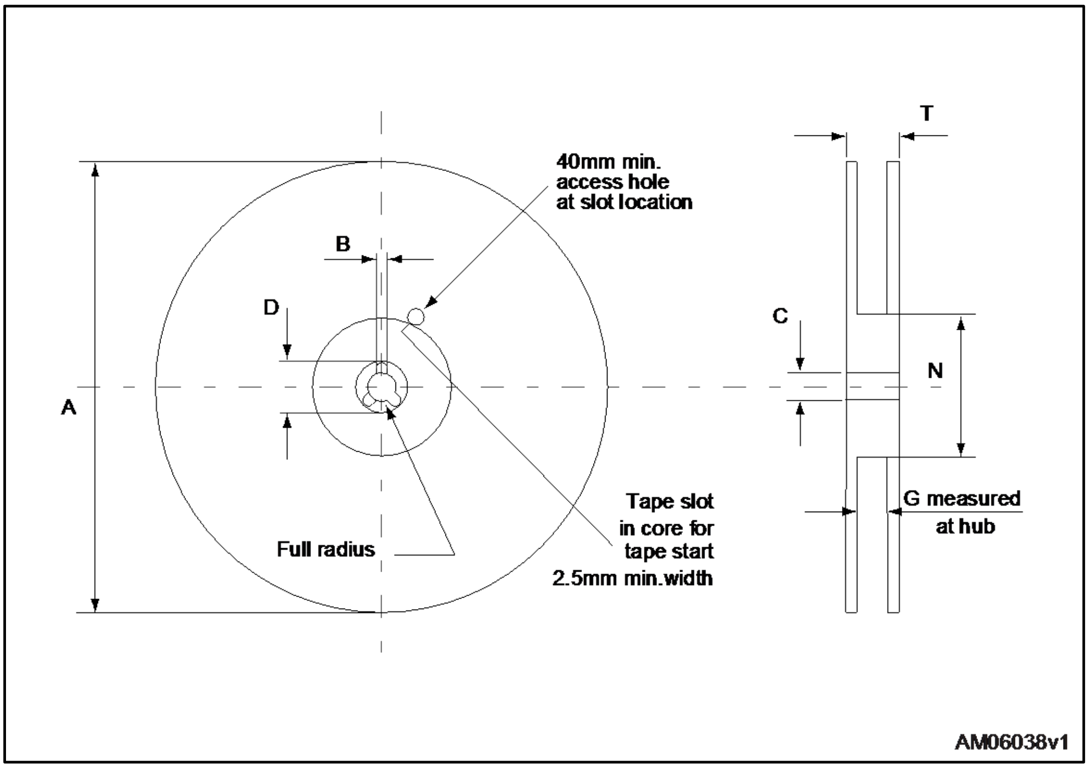


Table 10: D²PAK tape and reel mechanical data

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 quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Table 11: DPAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

5 Revision history

Table 12: Document revision history

Date	Revision	Changes
30-Oct-2015	1	First release.
01-Sep-2017	2	Modified *Table 2: "Absolute maximum ratings", Table 3: "Thermal data", Table 4: "Static characteristics"* and *Table 5: "Dynamic characteristics"*. Added *Section 2.1: "Electrical characteristics (curves)"*. Modified *Section 4: "Package information"*. Minor text changes.
06-Sep-2017	3	Modified *Figure 2: "$V_{CE(sat)}$ vs. junction temperature (I_C = 6.0 A)", Figure 4: "Self clamped inductive switching current vs. inductance"* and *Figure 11: "Normalized $V_{CES(clamped)}$ vs. junction temperature"*. Minor text changes.
11-Sep-2017	4	Modified *Section 4.1: "D²PAK (TO-263) type A package information"*. Minor text changes.