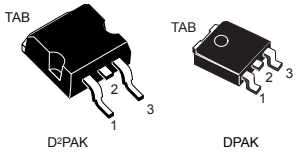
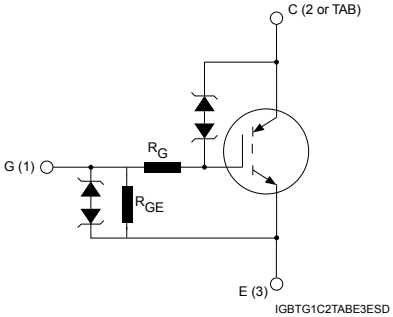
STGB20N45LZAG, STGD20N45LZAG

Datasheet

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



D²PAK DPAK



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.

Product status
STGB20N45LZAG
STGD20N45LZAG

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

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
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 power dissipation at T_C = 25 °C	150	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		°C

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 2. Thermal data

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

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 3. 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	415		475	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	1.3	1.7	2.1	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 4. 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 5. 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,	-	1.1	-	µs
t_r	Current rise time	R_L = 1 Ω, R_G = 1 kΩ (see Figure 17. Test circuit for resistive load switching)	-	3.6	-	µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 14 V, V_{GE} = 5 V,	-	1.06	-	µs
t_r	Current rise time	R_L= 1 Ω, R_G = 1 kΩ, T_J = 150 °C (see Figure 17. Test circuit for resistive load switching)	-	3.5	-	µs

Table 6. 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,	-	8.4	-	µs
t_f	Current fall time	I_C = 10 A, V_{GE} = 5 V, R_G = 1 kΩ	-	5.5	-	µs
dV/dt	Turn-off voltage slope	(see Figure 16. Test circuit for inductive load switching)	-	165	-	V/µs
$t_{d(off)}$	Turn-off delay time	V_{CC} = 300 V, L = 1 mH,	-	8.9	-	µs
t_f	Current fall time	I_C = 10 A, V_{GE} = 5 V, R_G = 1 kΩ, T_J = 150 °C	-	8.2	-	µs
dV/dt	Turn-off voltage slope	(see Figure 16. Test circuit for inductive load switching)	-	116	-	V/µs

2.1 Electrical characteristics (curves)

Figure 1. $V_{CE(sat)}$ vs junction temperature (I_C = 6 A)

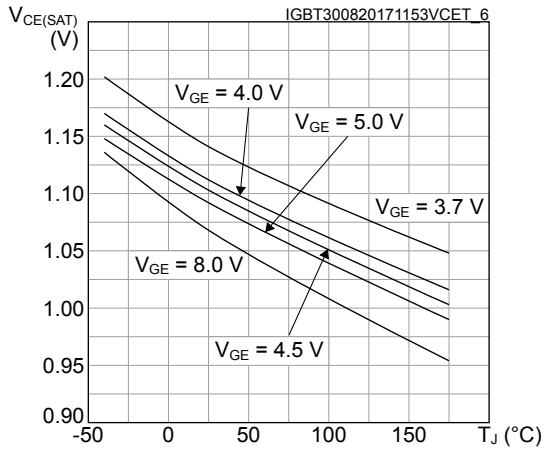


Figure 2. $V_{CE(sat)}$ vs junction temperature (I_C = 10 A)

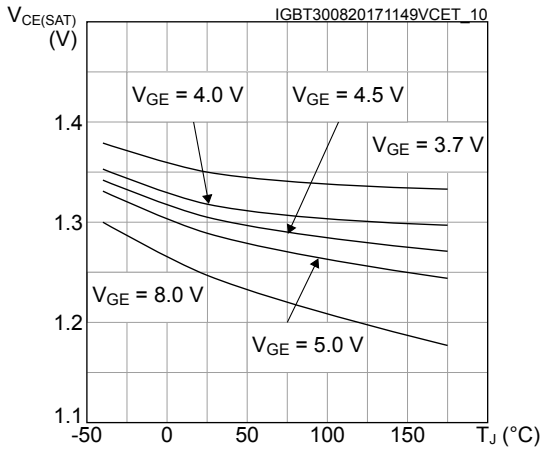


Figure 3. Self-clamped inductive switching current

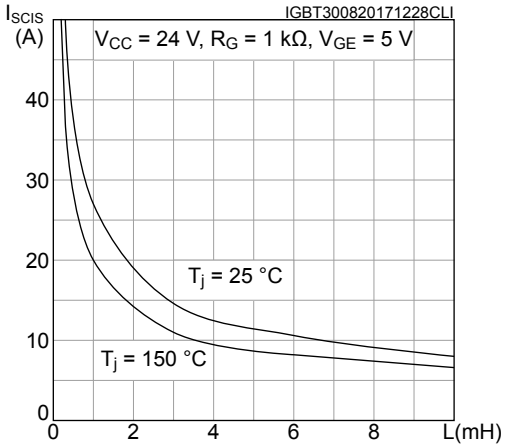


Figure 4. Output characteristics (T_J = 25 °C)

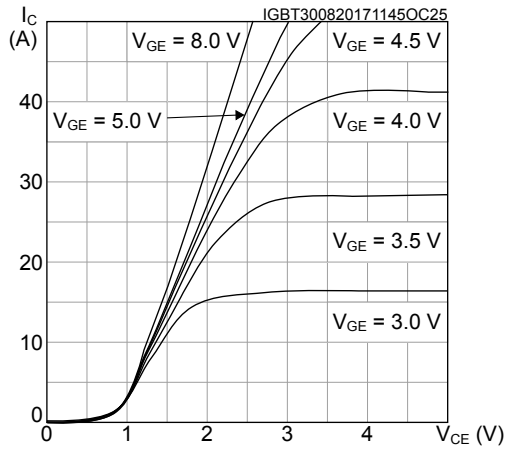


Figure 5. Output characteristics (T_J = -40 °C)

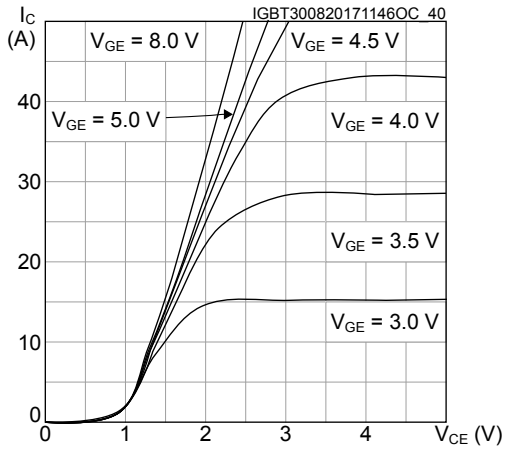


Figure 6. Output characteristics (T_J = 175 °C)

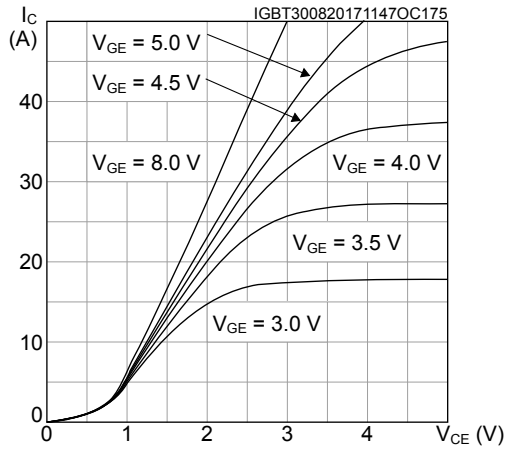


Figure 7. Transfer characteristics

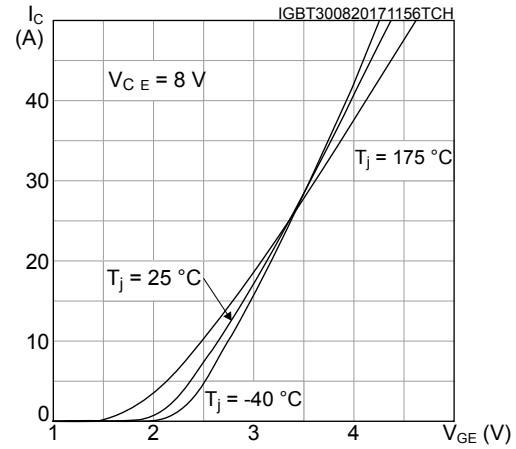


Figure 8. Collector current vs case temperature

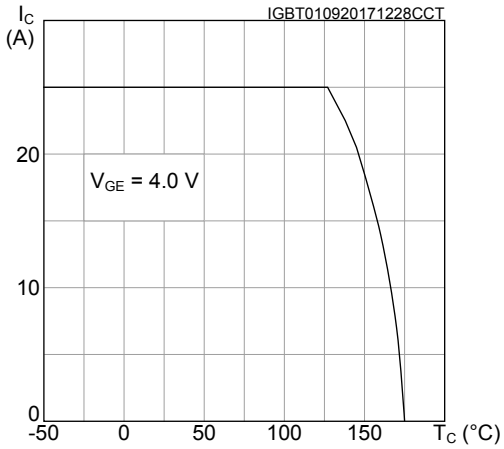


Figure 9. Leakage current vs temperature

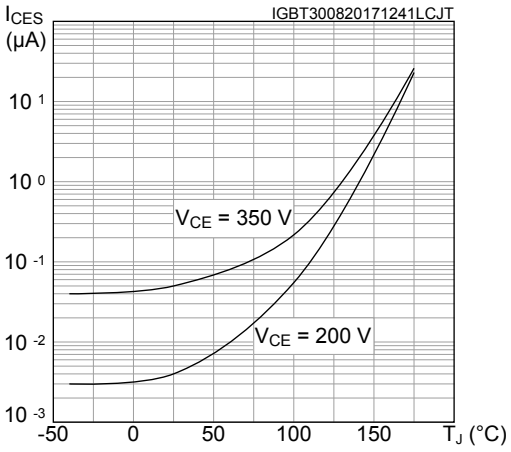


Figure 10. Normalized $V_{CES(clamped)}$ vs temperature

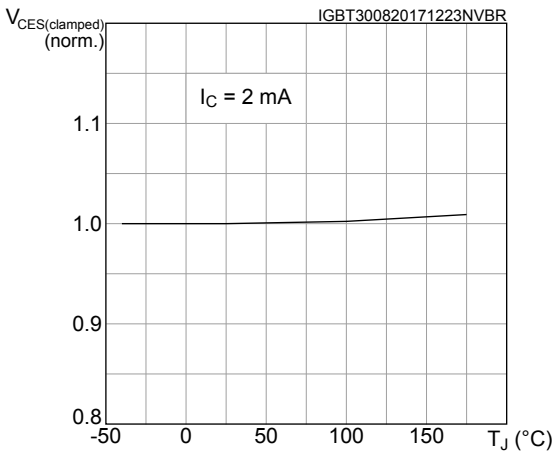


Figure 11. Normalized $V_{GE(th)}$ vs temperature

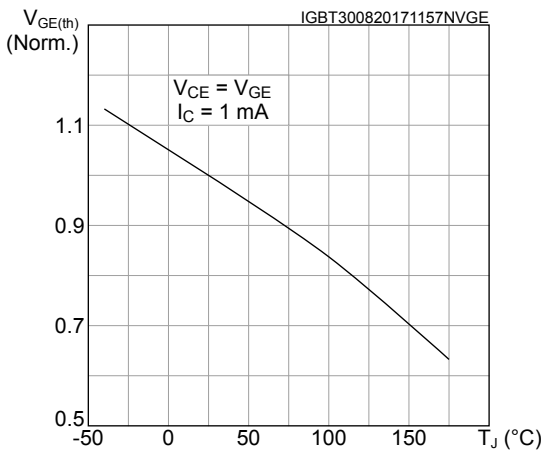


Figure 12. Gate charge vs gate-emitter voltage

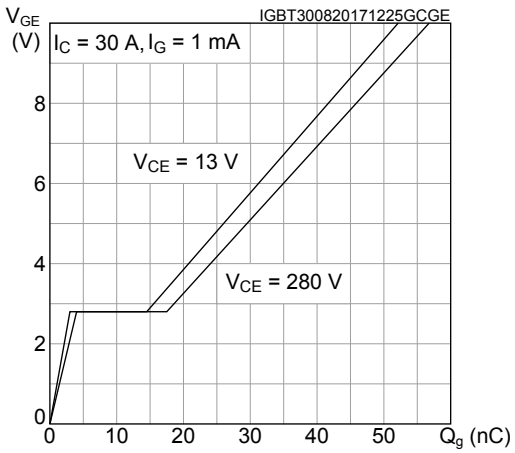


Figure 13. Capacitance variations

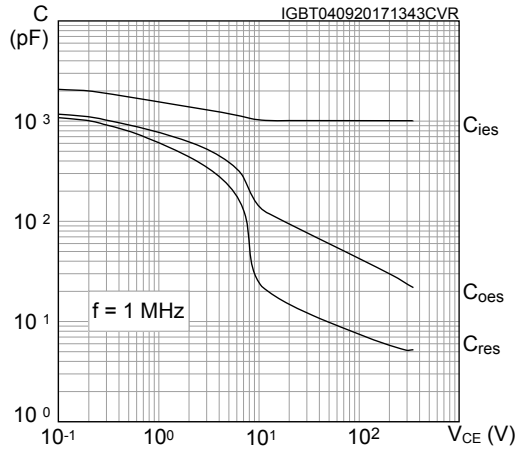


Figure 14. Thermal impedance for D²PAK

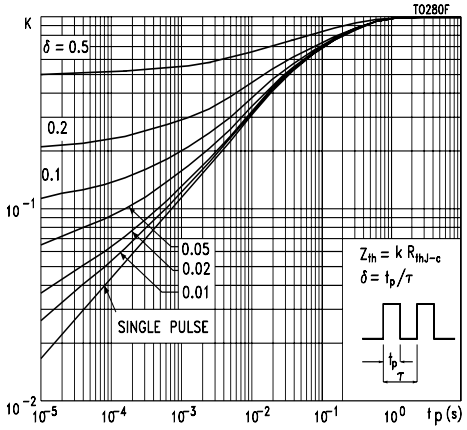
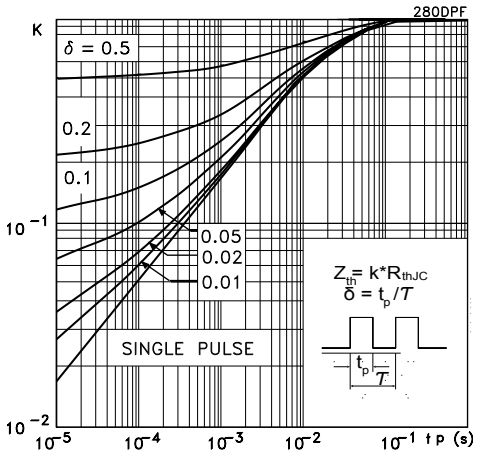


Figure 15. Thermal impedance for DPAK



3 Test circuits

Figure 16. Test circuit for inductive load switching

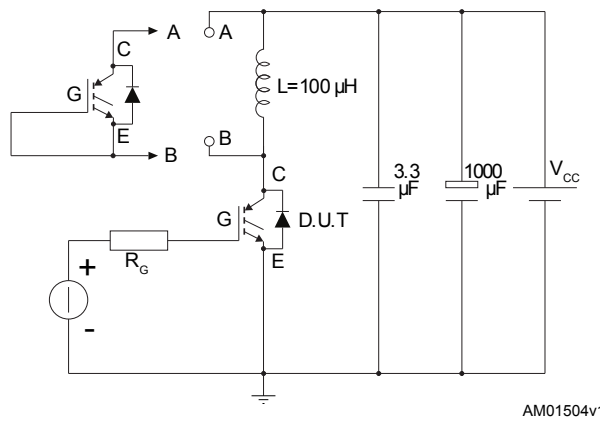


Figure 17. Test circuit for resistive load switching

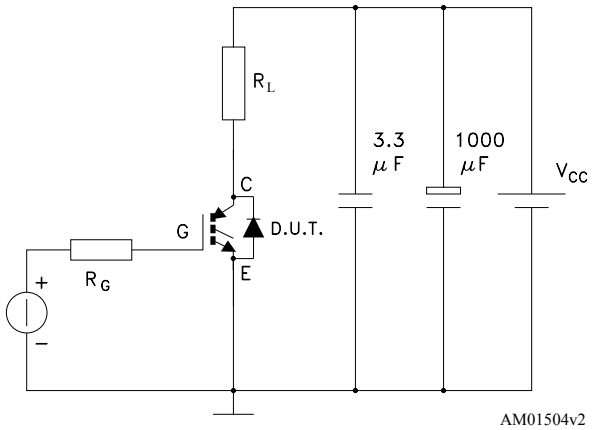


Figure 18. Gate charge test circuit

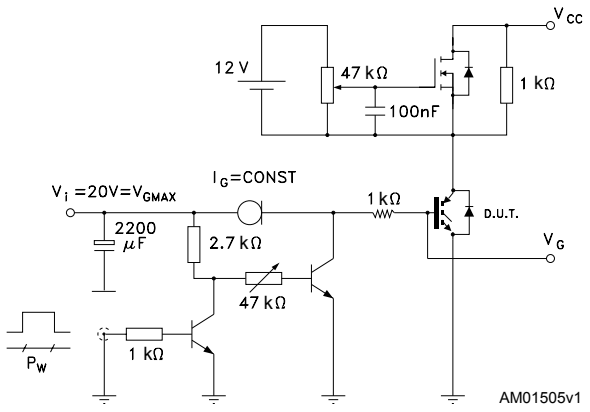
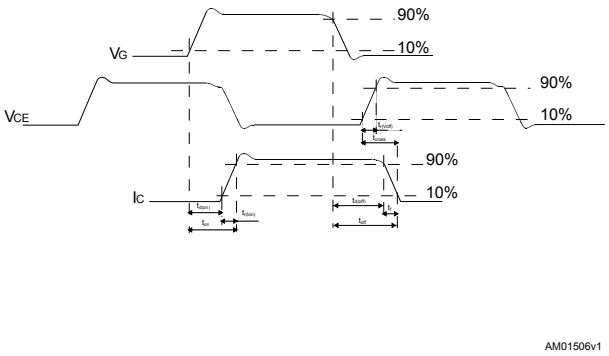


Figure 19. Switching waveform



4 Package information

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**

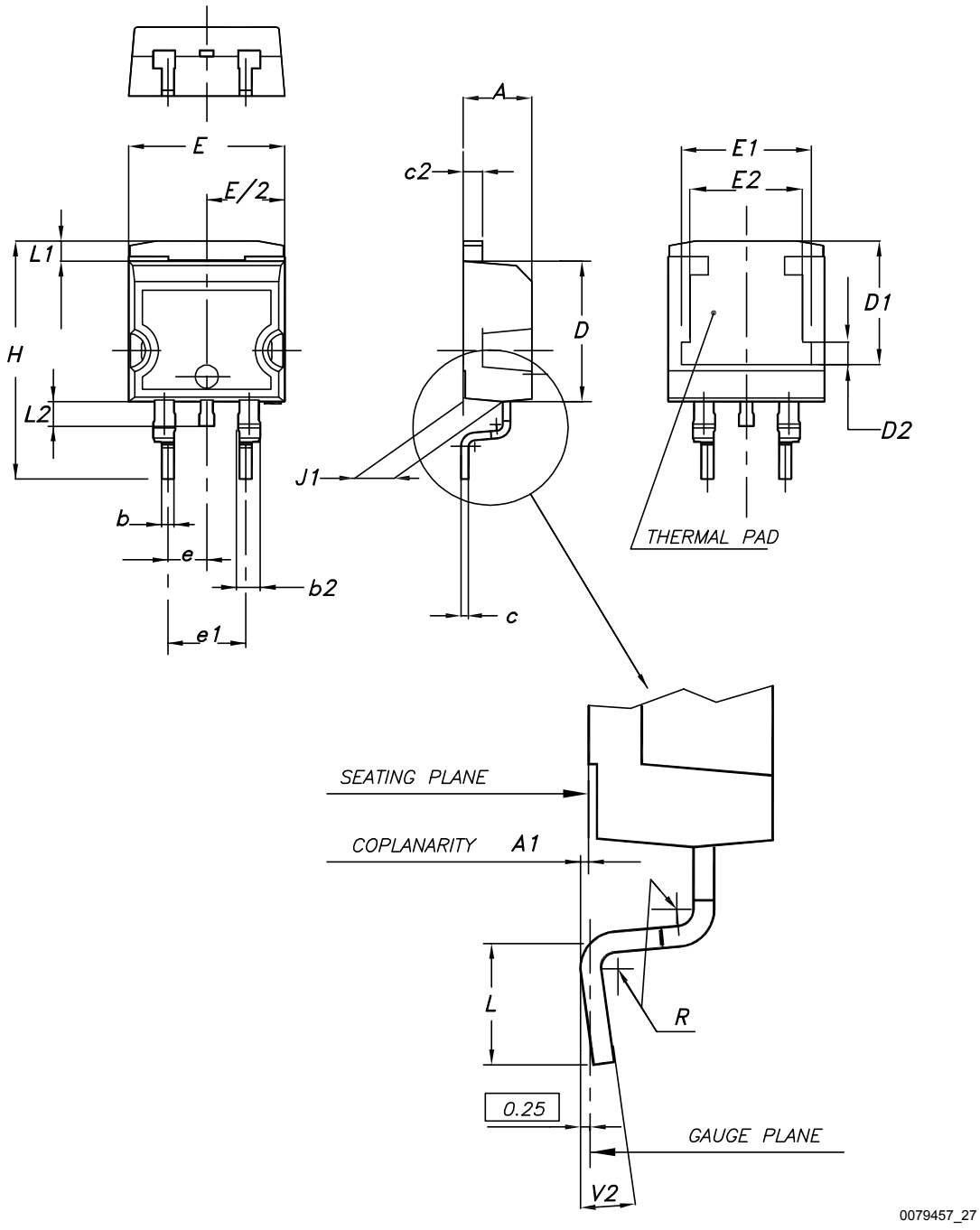
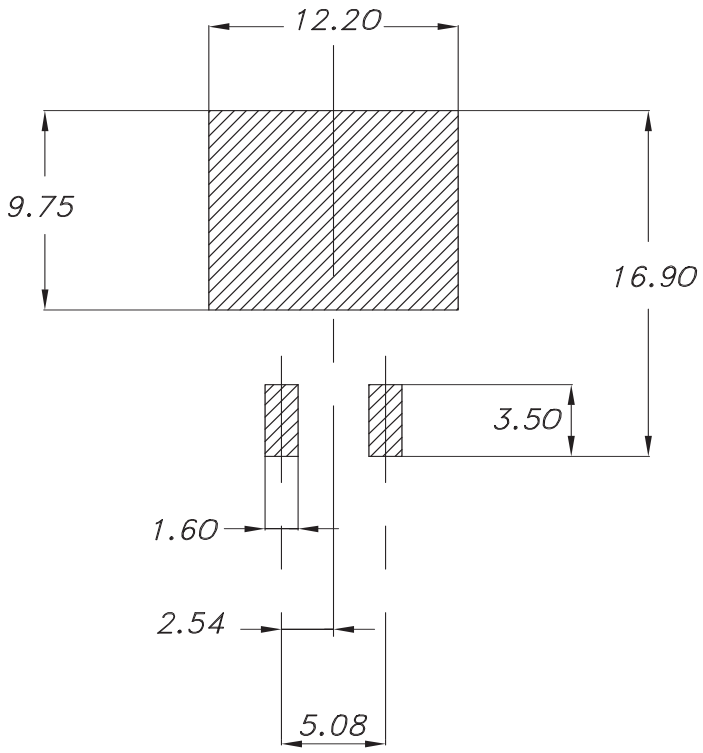


Table 7. D²PAK (TO-263) type A package mechanical data

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	10.00		10.40
E1	8.30	8.50	8.70
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 21. D²PAK (TO-263) recommended footprint (dimensions are in mm)



4.2 DPAK (TO-252) type A2 package information

Figure 22. **DPAK (TO-252) type A2 package outline**

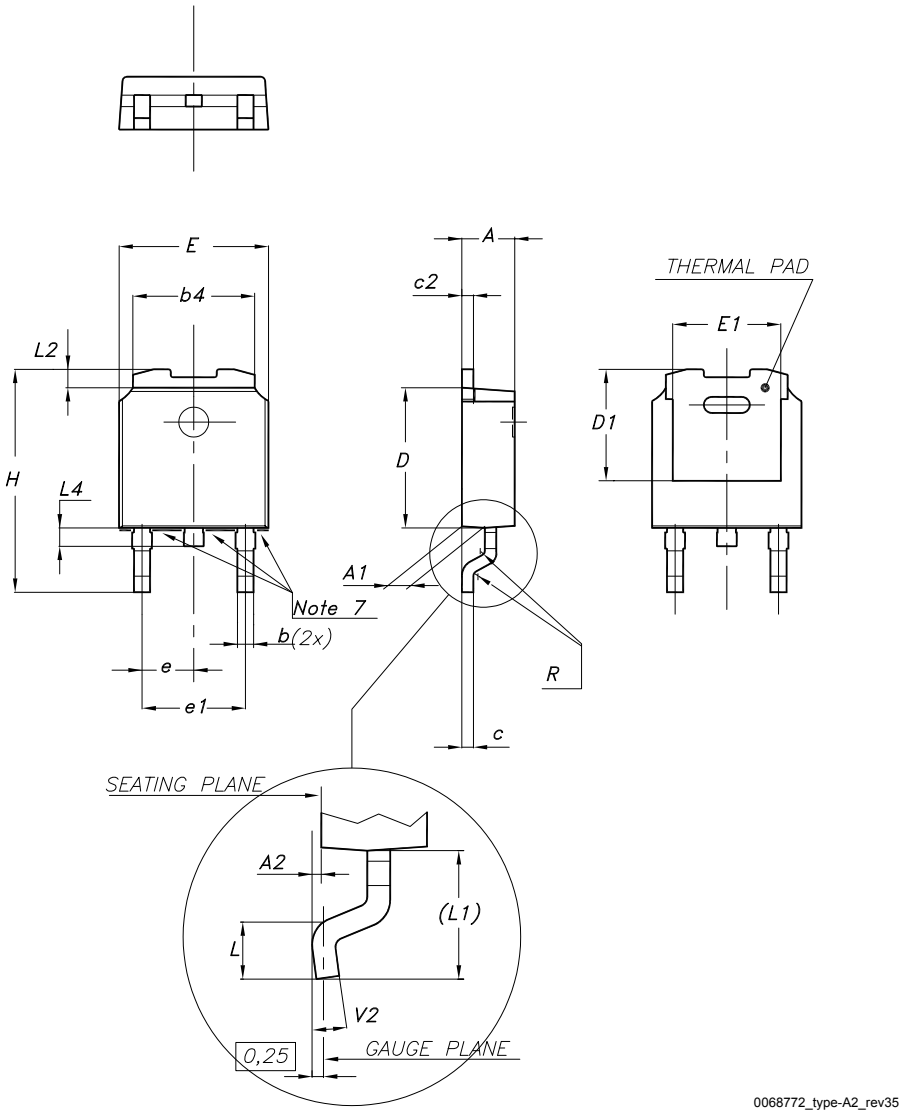
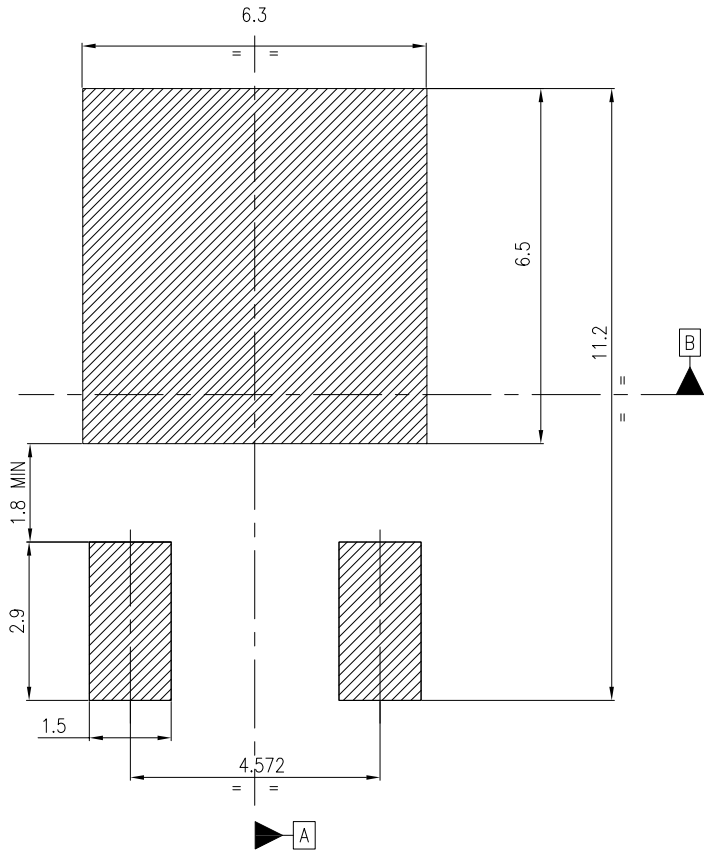


Table 8. **DPAK (TO-252) type A2 mechanical data**

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	2.159	2.286	2.413
e1	4.445	4.572	4.699
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 23. DPAK (TO-252) recommended footprint (dimensions are in mm)



Notes:

1) This footprint is able to ensure insulation up to 630 Vrms (according to CEI IEC 664−1)

2) The device must be positioned within ⌖ 0.05 A B

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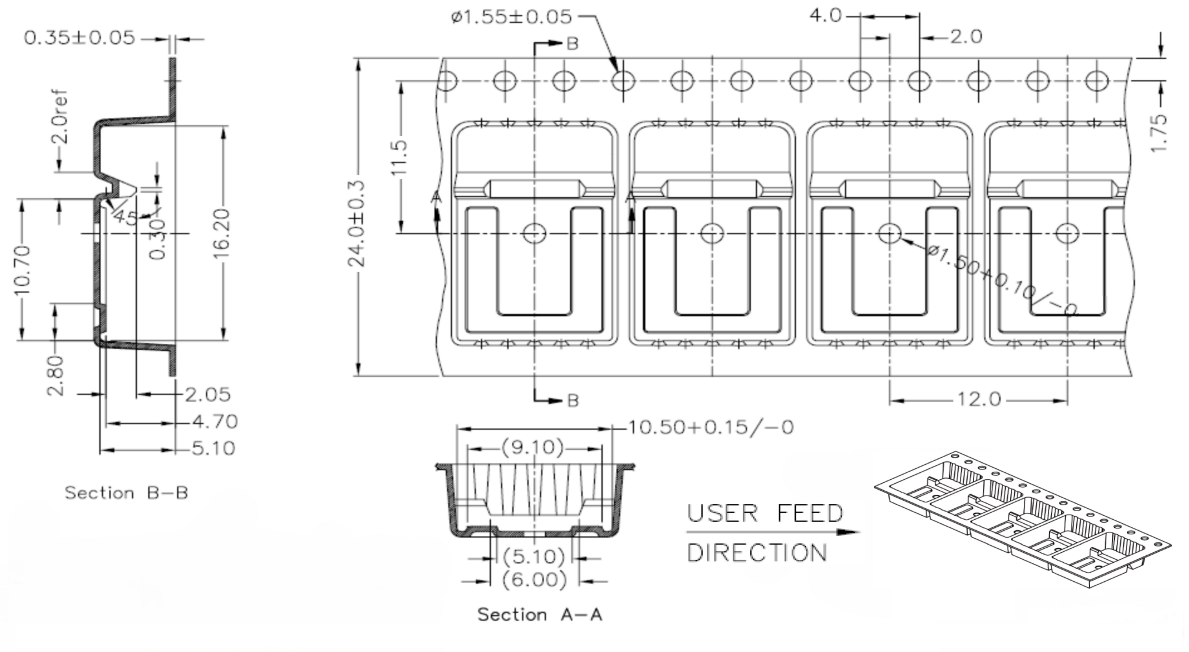
4.3 D²PAK packing information

Figure 24. D²PAK tape drawing (dimensions are in mm)



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4.4 DPAK packing information

Figure 25. **DPAK tape outline**

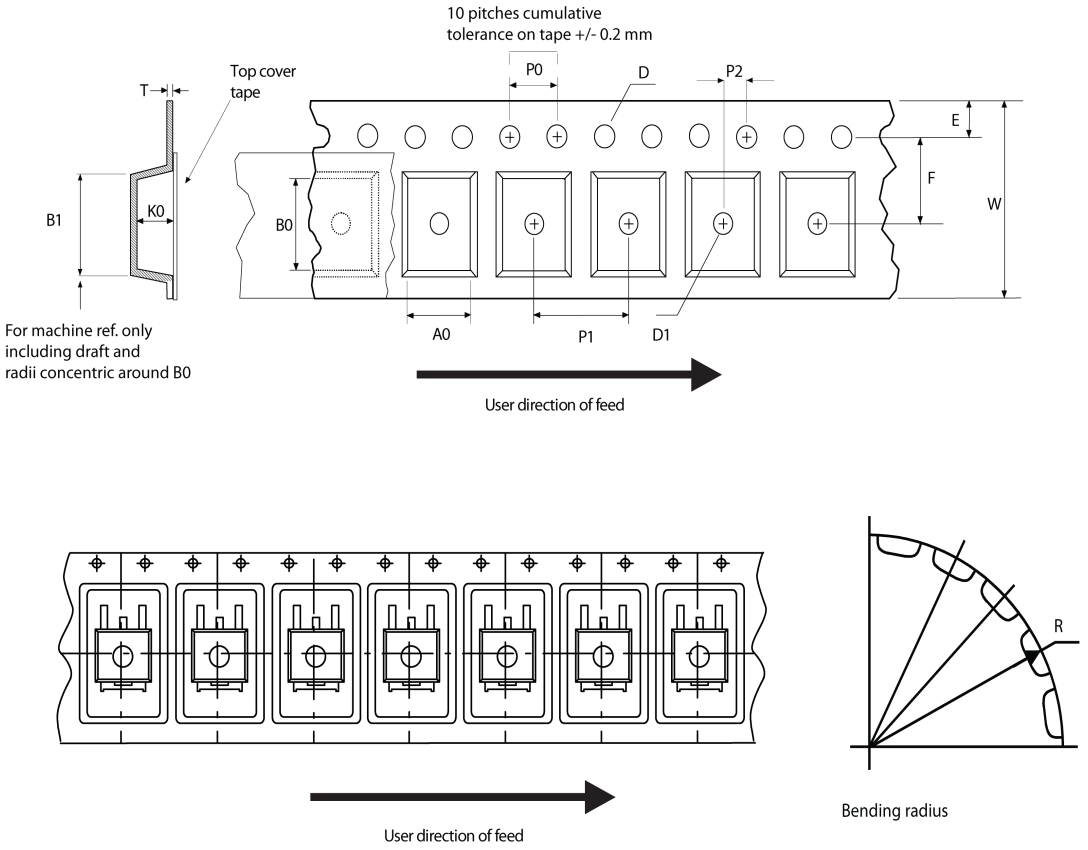

Figure 26. **DPAK reel outline**

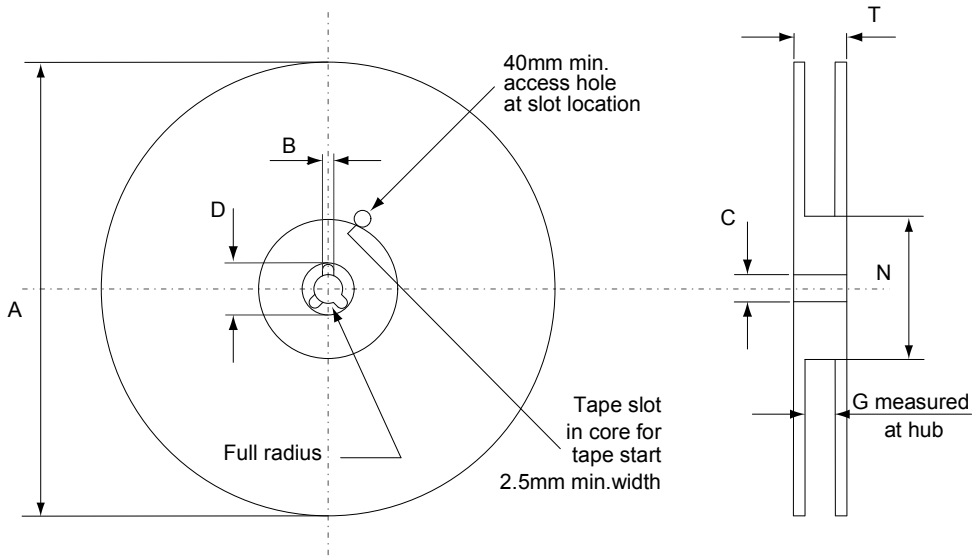

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Table 9. **DPAK tape and reel mechanical data**

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			

Revision history

Table 10. **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.
02-Nov-2017	5	Updated *Table 4: "Static characteristics"*. Minor text changes
21-Feb-2018	6	Removed maturity status indication from cover page. The document status is production data. Updated *Section 1 Electrical ratings*, *Table 2. Thermal data* and *Table 3. Static characteristics*. Minor text changes
08-Feb-2023	7	Updated *Section 1 Electrical ratings*. Updated *Table 6. Inductive load switching characteristics*.
06-Oct-2023	8	Updated *Table 6. Inductive load switching characteristics*.
05-May-2025	9	Updated Section 4: Package information.

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4.4 DPAK packing information 16
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