STGD19N40LZ

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

Datasheet - production data

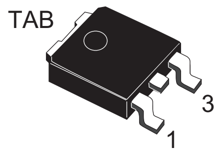
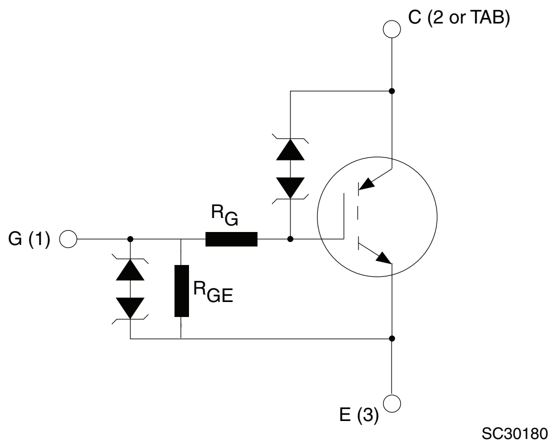


Figure 1. Internal schematic diagram



Features

- Designed for automotive applications and AEC-Q101 qualified
- 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 system.

Table 1. Device summary

Order code	Marking	Packages	Packaging
STGD19N40LZ	GD19N40LZ	DPAK	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	125	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	1.2	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient device in free air	100	°C/W

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)

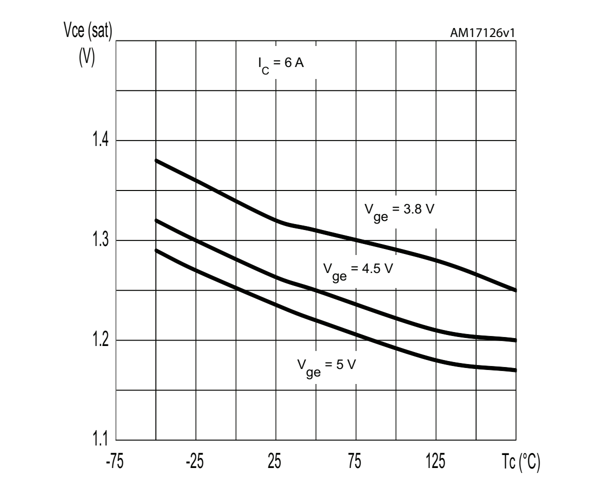


Figure 3. Collector-emitter on voltage vs. temperature (I_C = 10 A)

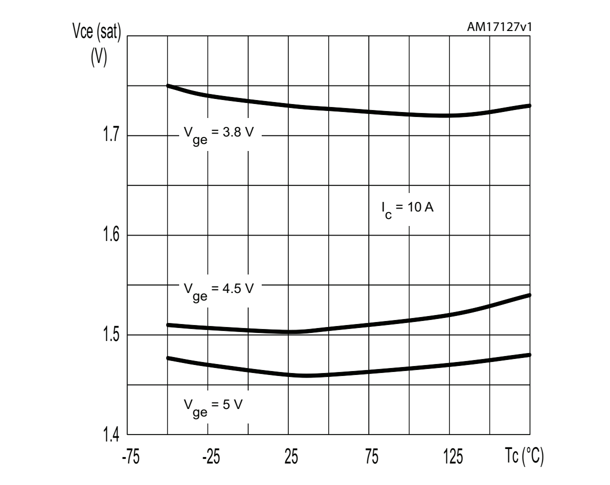


Figure 4. Collector-emitter on voltage vs. temperature (V_{GE} = 4.5 V)

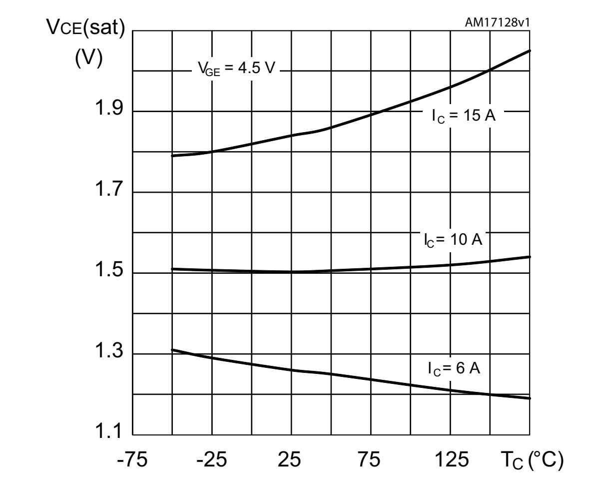


Figure 5. Self clamped inductive switch

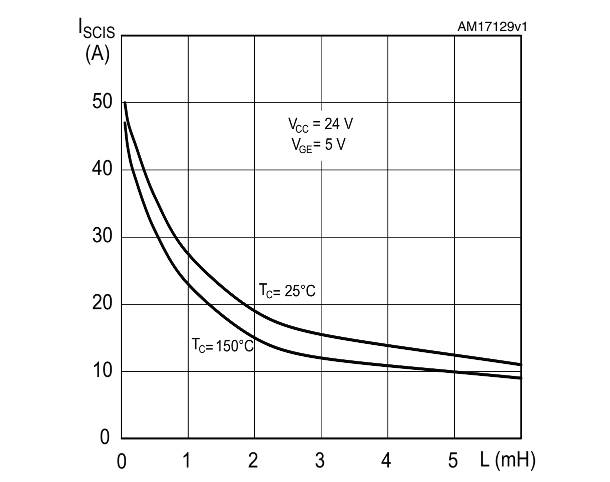


Figure 6. Output characteristics (T_J= 25 °C)

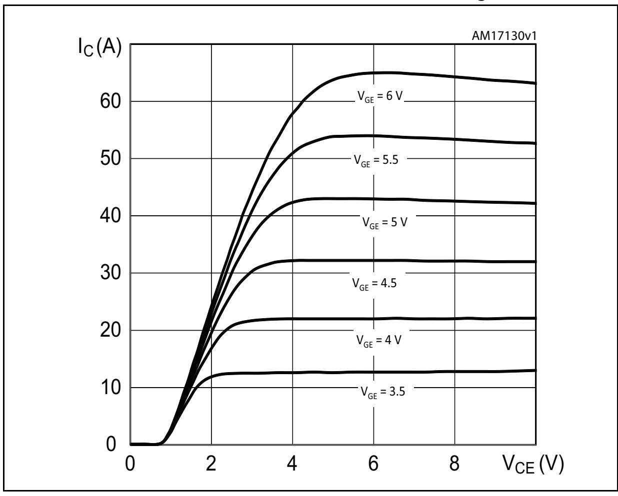


Figure 7. Output characteristics (T_J= -40 °C)

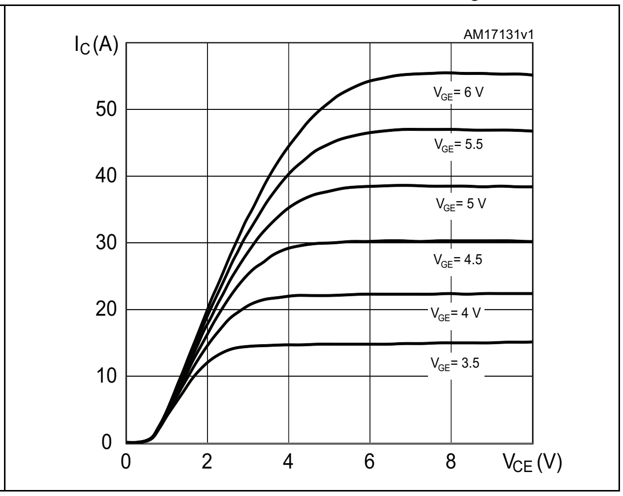


Figure 8. Output characteristics (T_J= 175 °C)

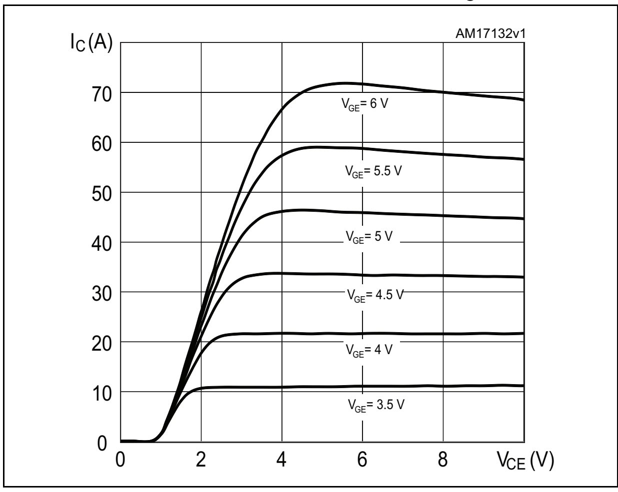


Figure 9. Transfer characteristics

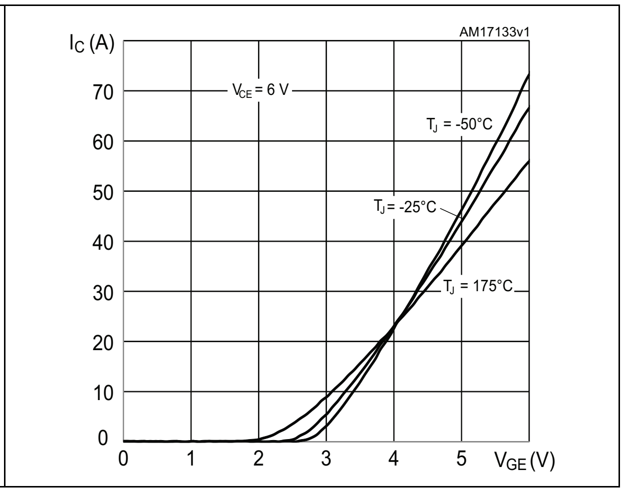


Figure 10. Collector cut-off current vs. temperature

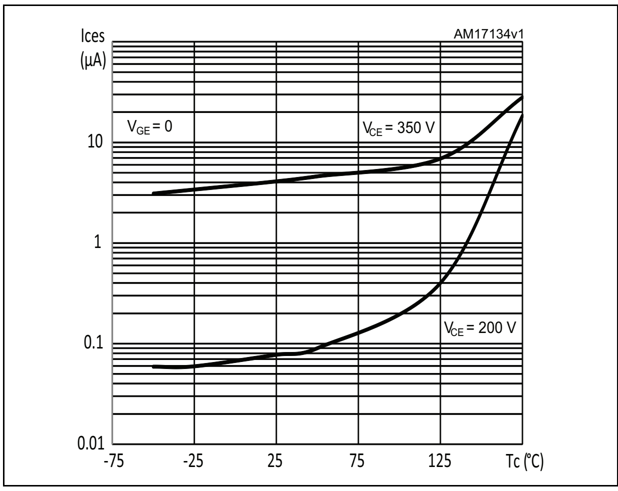


Figure 11. Normalized collector emitter voltage vs. temperature (I_C = 2 mA)

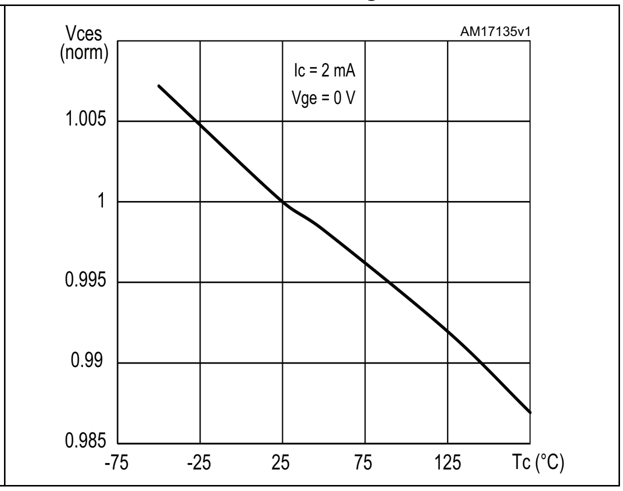


Figure 12. Normalized gate threshold voltage vs. temperature

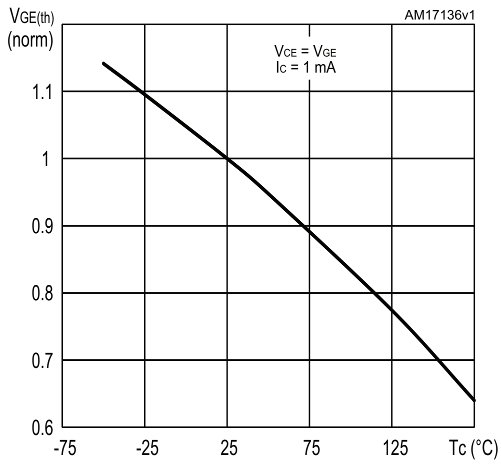


Figure 13. Normalized collector emitter on voltage vs. temperature (I_C = 10 A)

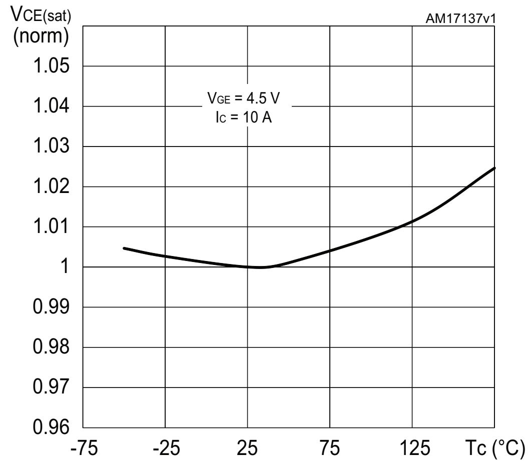


Figure 14. Thermal impedance

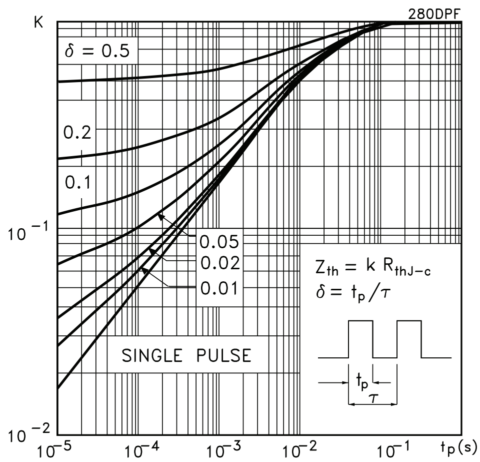
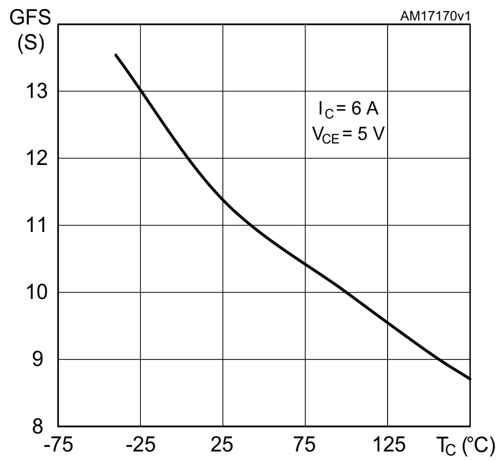


Figure 15. Transconductance vs. temperature



3 Test circuits

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

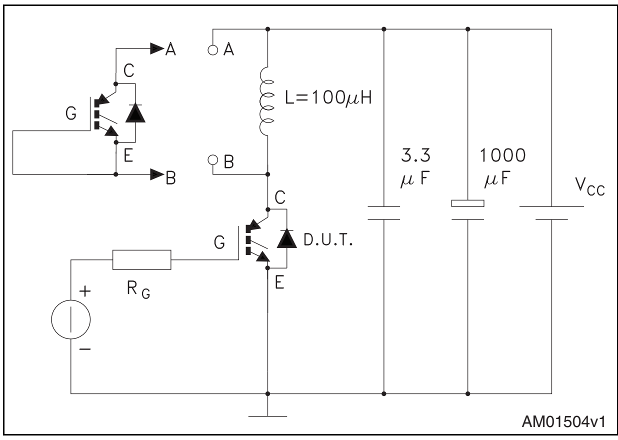


Figure 17. Resistive load switching

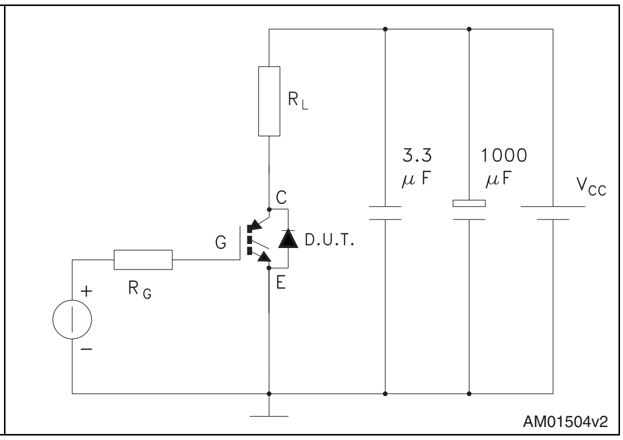


Figure 18. Gate charge test circuit

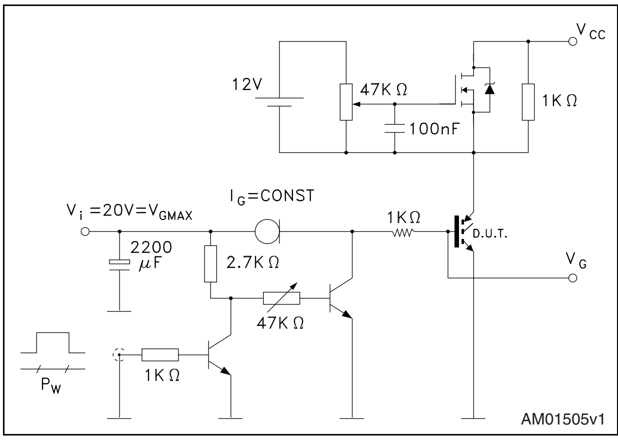
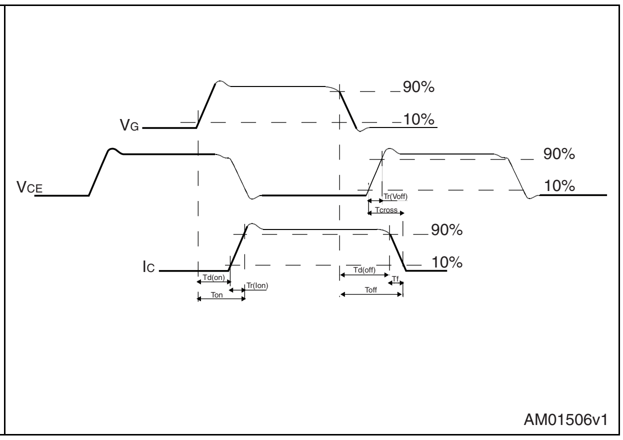


Figure 19. Switching waveform



4 Package 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.

Figure 20. DPAK (TO-252) type A drawing

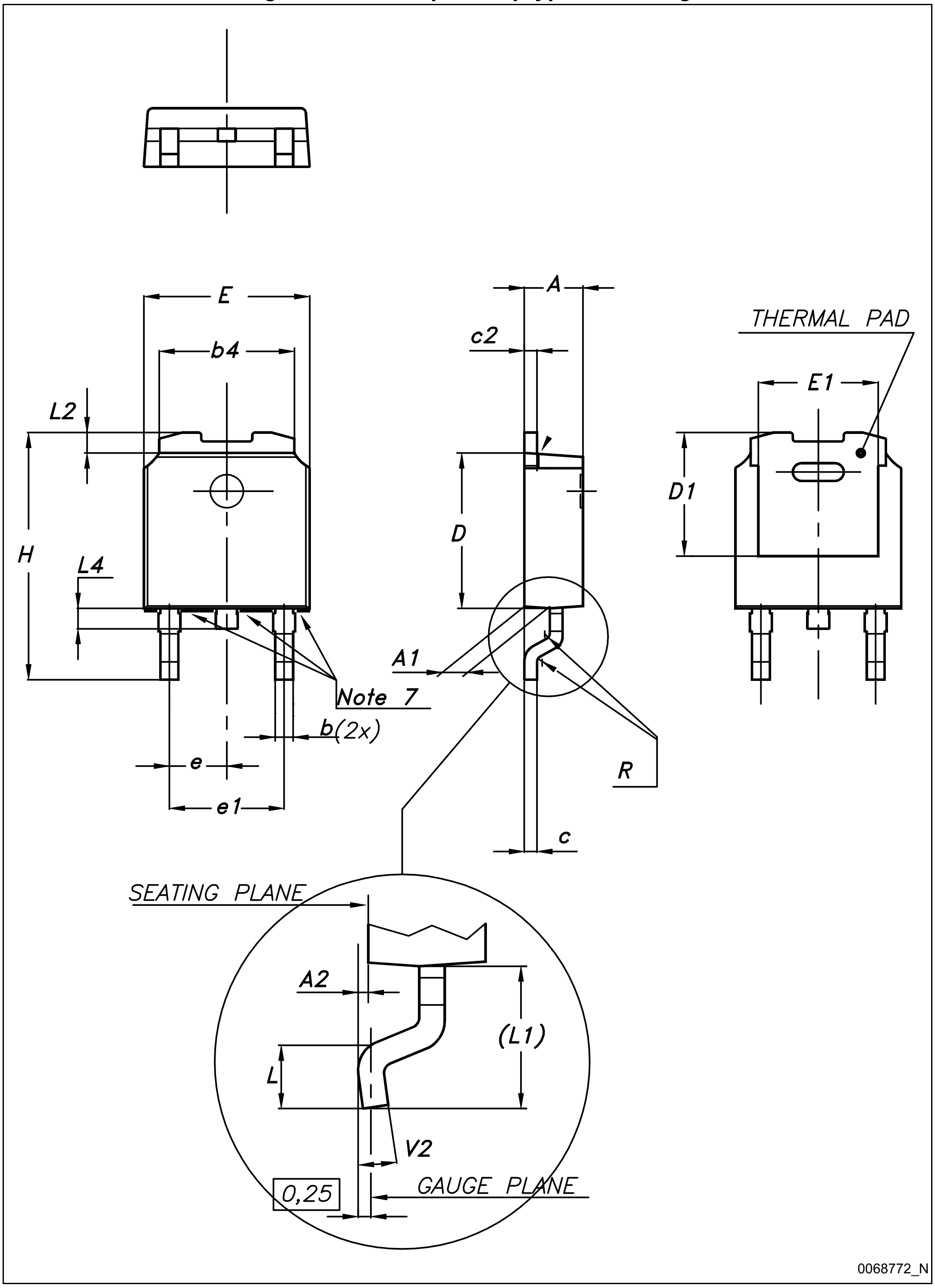
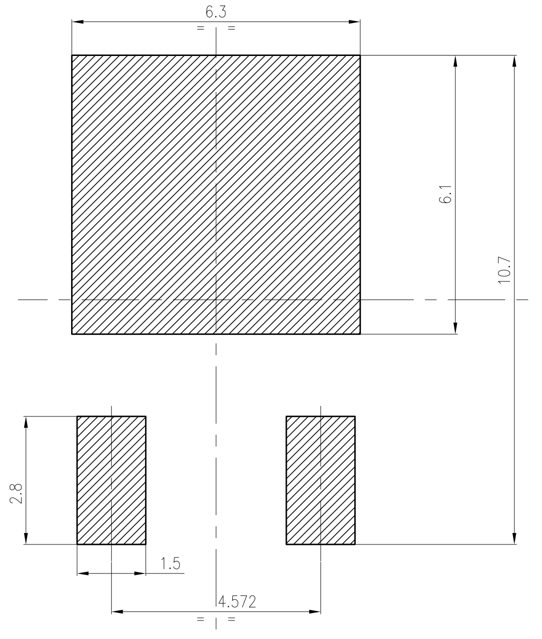


Table 7. DPAK (TO-252) type A mechanical data

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		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 21. DPAK (TO-252) type A footprint [(a)]



a. All dimensions are in millimeters

5 Packaging mechanical data

Figure 22. Tape for DPAK (TO-252)

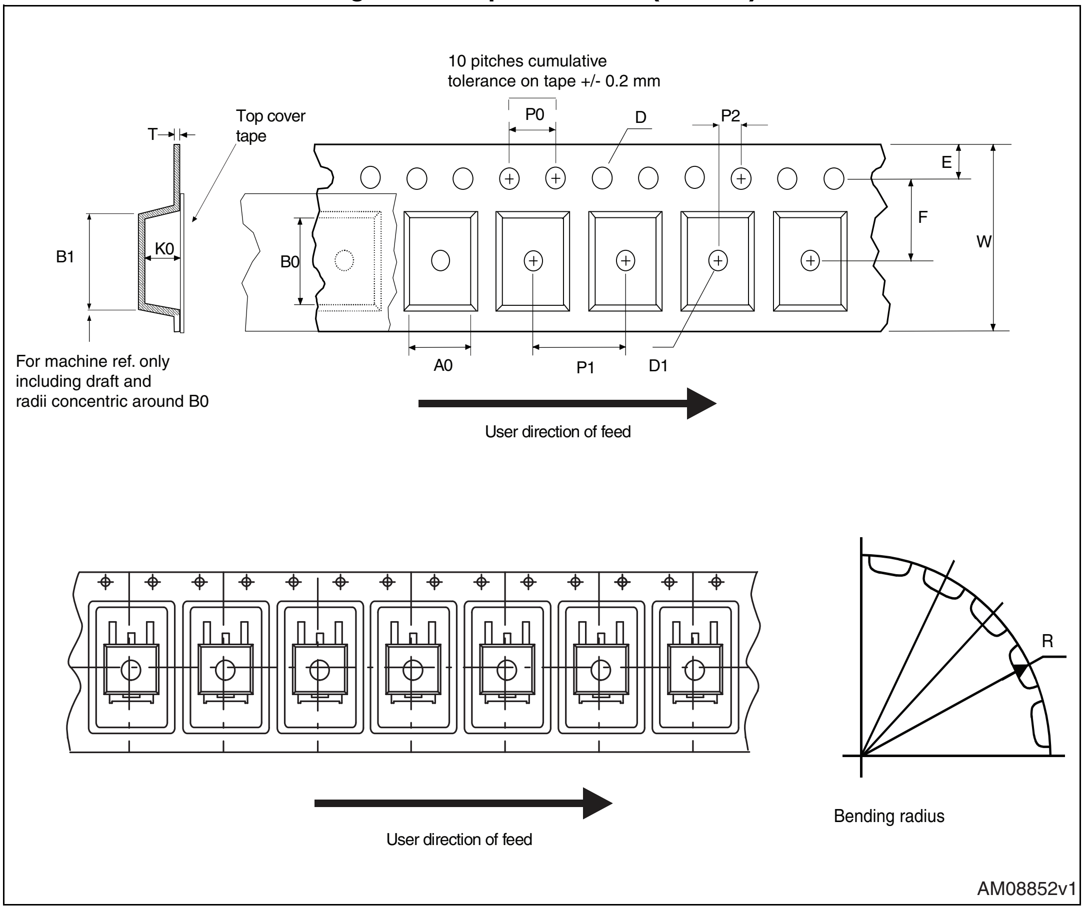


Figure 23. Reel for DPAK (TO-252)

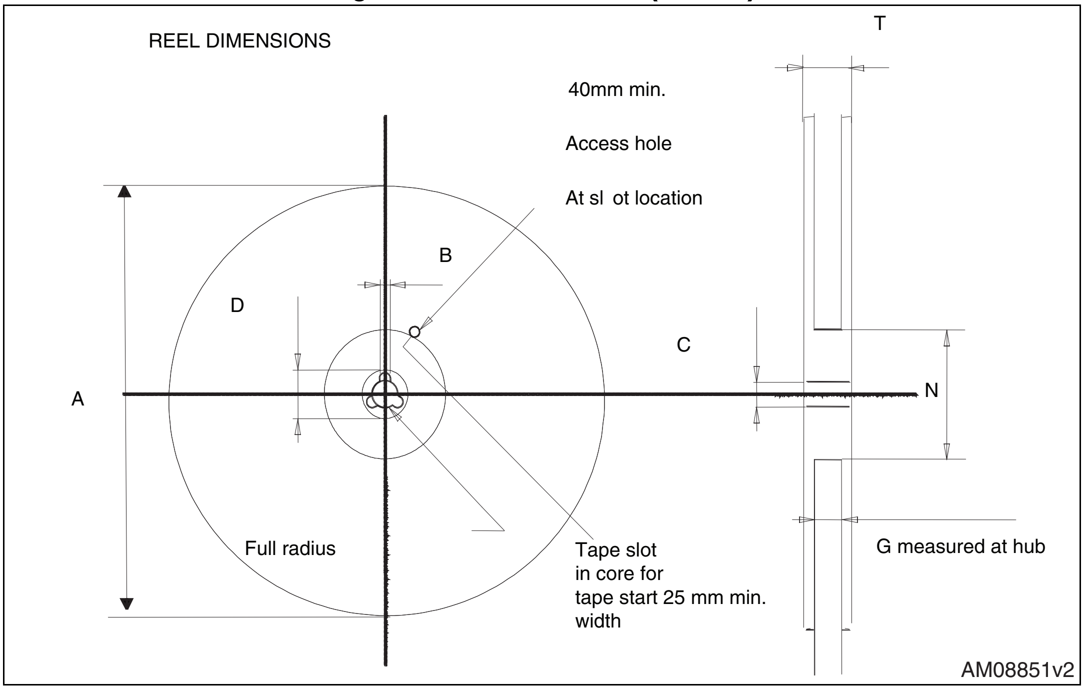


Table 8. DPAK (TO-252) tape and reel mechanical data

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			

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
22-Apr-2013	1	Initial release.
20-May-2013	2	Added: *Figure 15 on page 8*.
17-Apr-2014	3	– Modified: title and features – Modified: $V_{CES(clamped)}$, $V_{(BR)ECS}$ and I_{GES} test conditions – Modified: *Figure 5* and *9* – Updated: *Section 4: Package mechanical data* – Minor text changes
04-Jun-2014	4	– Updated features in cover page.