

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

Datasheet - production data

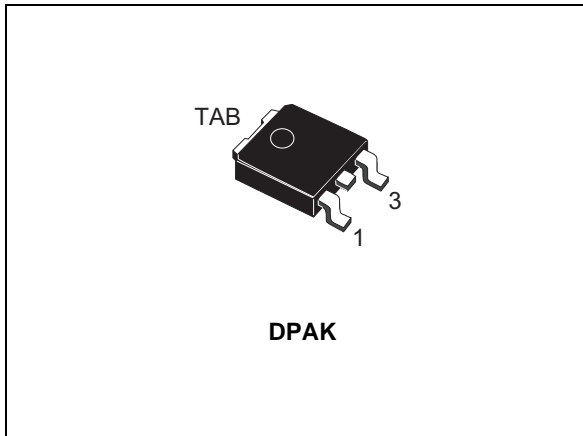
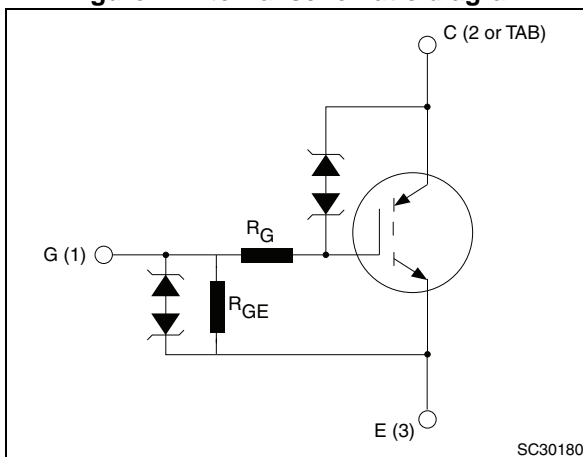


Figure 1. Internal schematic diagram



Features

- Designed for automotive applications and AEC-Q101 qualified
- 180 mJ of avalanche energy @ $T_C = 150\text{ }^\circ\text{C}$, $L = 3\text{ mH}$
- 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

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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 $T_C = 100\text{ °C}$	25	A
$I_{CP}^{(2)}$	Pulsed collector current	40	A
V_{GE}	Gate-emitter voltage	$V_{GE(clamped)}$	V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	125	W
$E_{SCIS}^{(3)}$	Single pulse energy $T_C = 25\text{ °C}$, $L = 3\text{ mH}$, $V_{CC} = 50\text{ V}$	300	mJ
	Single pulse energy $T_C = 150\text{ °C}$, $L = 3\text{ mH}$, $V_{CC} = 50\text{ V}$	180	mJ
I_{SCIS}	Avalanche current $T_C = 25\text{ °C}$, $L = 3\text{ mH}$, $V_{CC} = 50\text{ V}$	13.1	A
	Avalanche current $T_C = 150\text{ °C}$, $L = 3\text{ mH}$, $V_{CC} = 50\text{ V}$	10.2	A
ESD	Human body model, $R = 1.5\text{ k}\Omega$, $C = 100\text{ pF}$	8	kV
	Machine model, $R = 0$, $C = 100\text{ pF}$	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
$R_{thj-case}$	Thermal resistance junction-case	1.2	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient device in free air	100	°C/W

2 Electrical characteristics

$T_J = 25\text{ °C}$ unless otherwise specified.

Table 4. Static electrical characteristics

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

Table 5. Dynamic electrical characteristics

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

Table 6. Switching on/off

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

2.1 Electrical characteristics (curves)

Figure 2. Collector-emitter on voltage vs. temperature ($I_C = 6\text{ A}$)

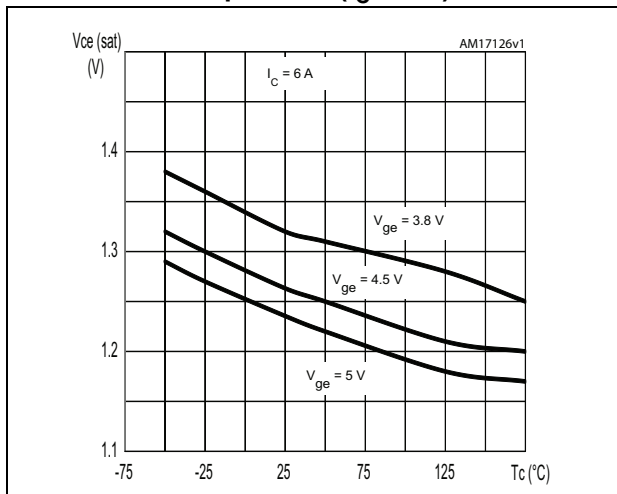


Figure 3. Collector-emitter on voltage vs. temperature ($I_C = 10\text{ A}$)

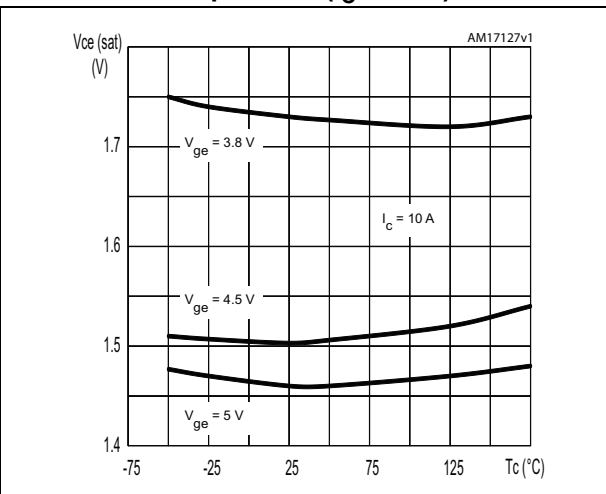


Figure 4. Collector-emitter on voltage vs. temperature ($V_{GE} = 4.5\text{ V}$)

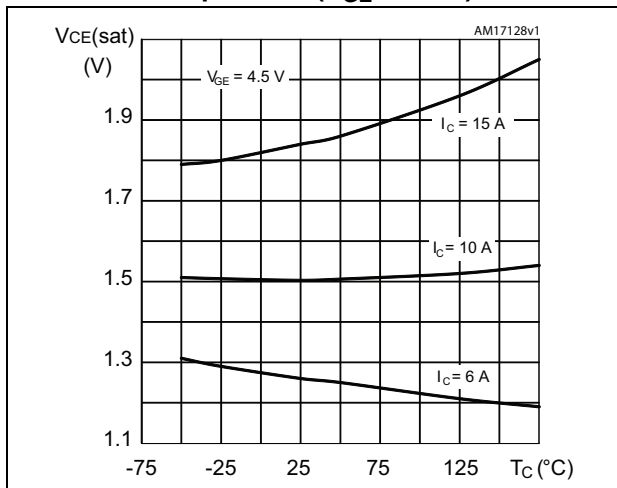


Figure 5. Self clamped inductive switch

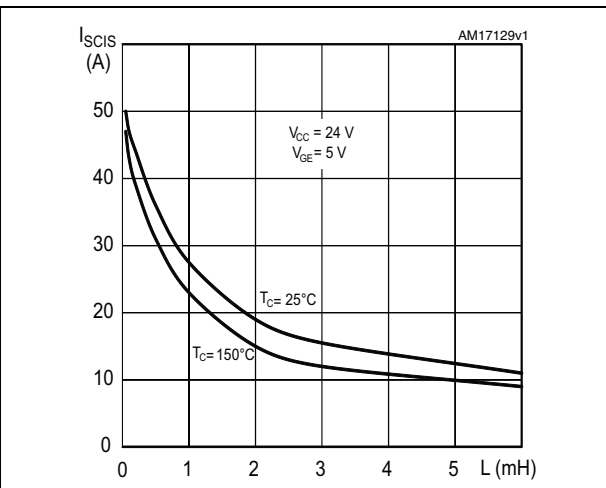


Figure 6. Output characteristics ($T_J = 25\text{ }^\circ\text{C}$)

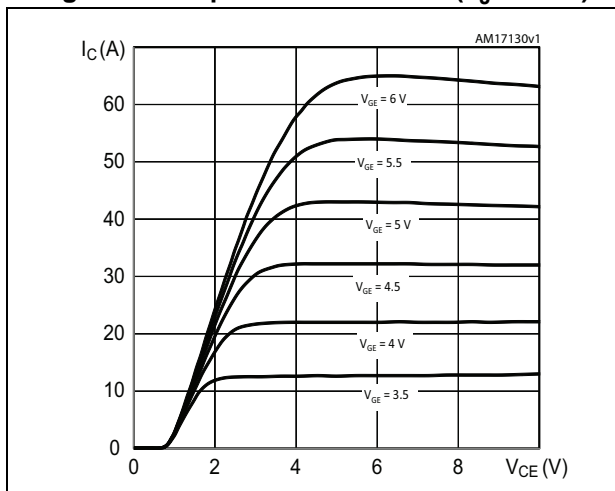


Figure 7. Output characteristics ($T_J = -40\text{ }^\circ\text{C}$)

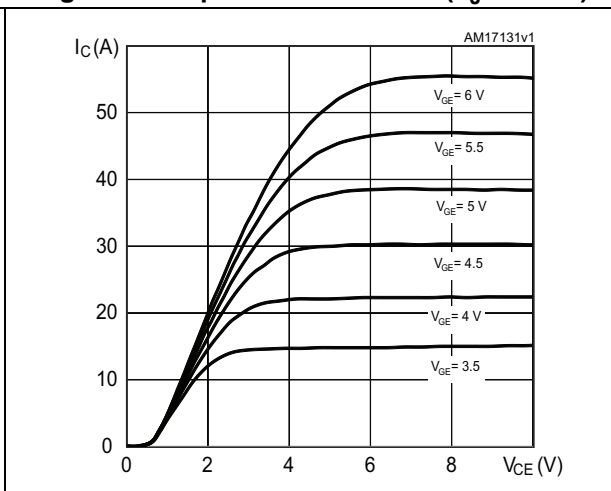


Figure 8. Output characteristics ($T_J = 175\text{ }^\circ\text{C}$)

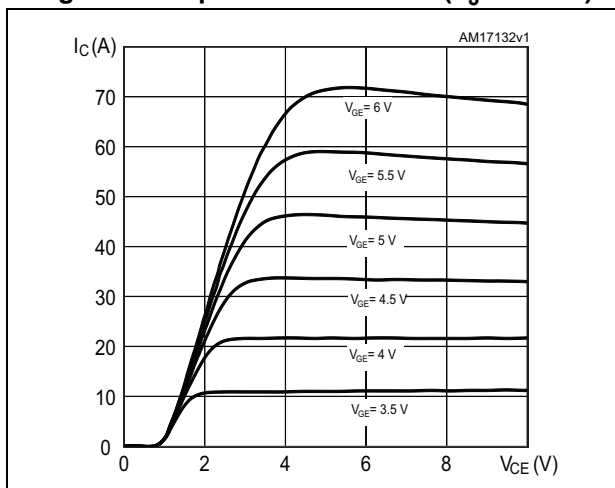


Figure 9. Transfer characteristics

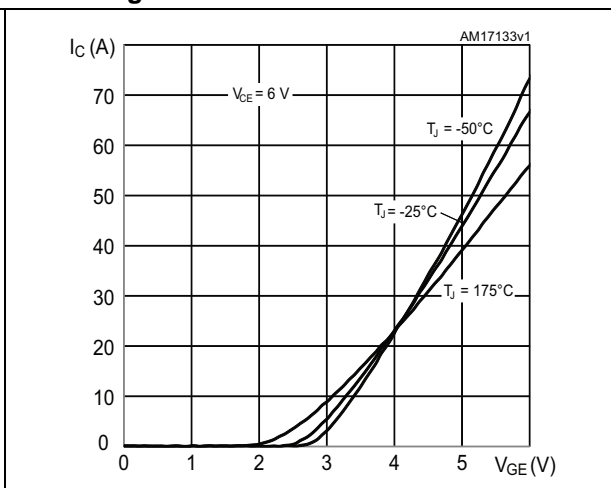


Figure 10. Collector cut-off current vs. temperature

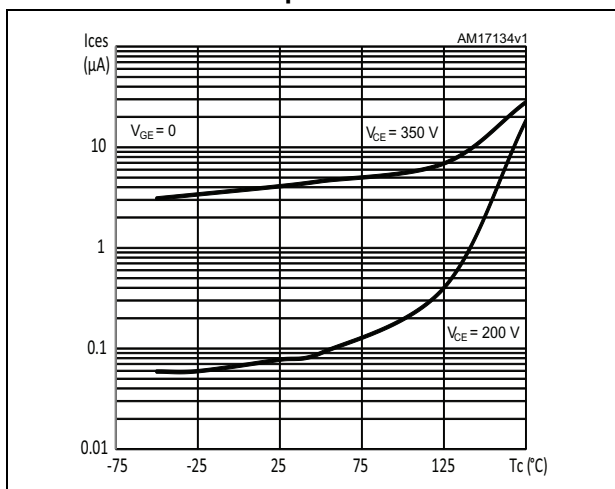


Figure 11. Normalized collector emitter voltage vs. temperature ($I_C = 2\text{ mA}$)

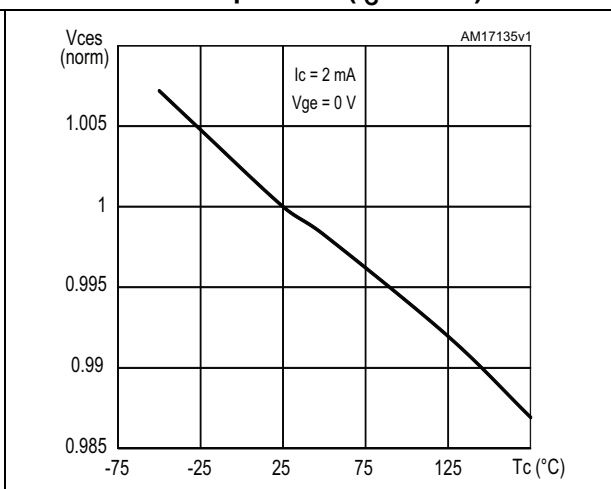


Figure 12. Normalized gate threshold voltage vs. temperature

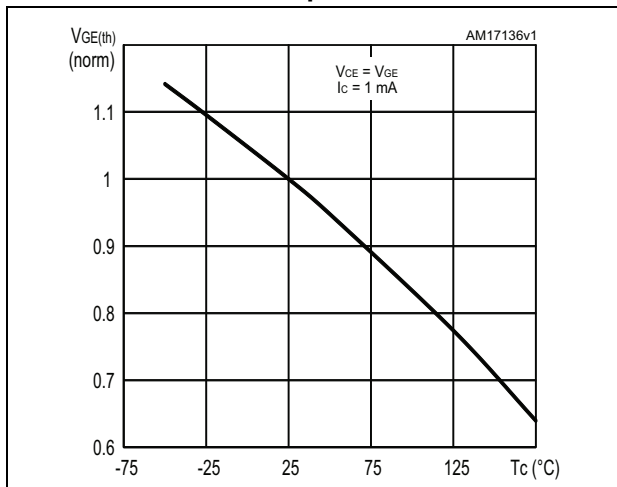


Figure 13. Normalized collector emitter on voltage vs. temperature (IC = 10 A)

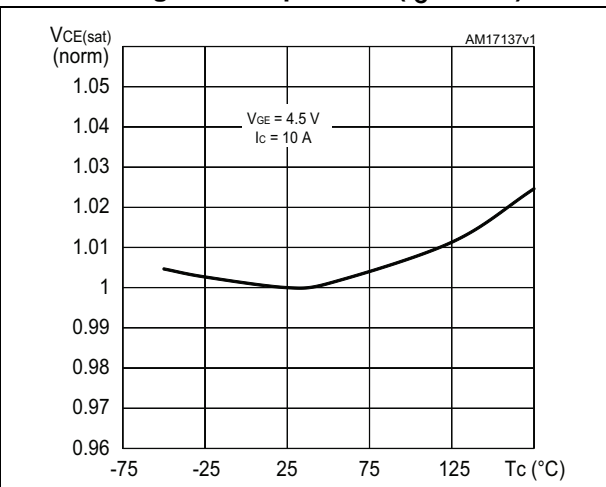


Figure 14. Thermal impedance

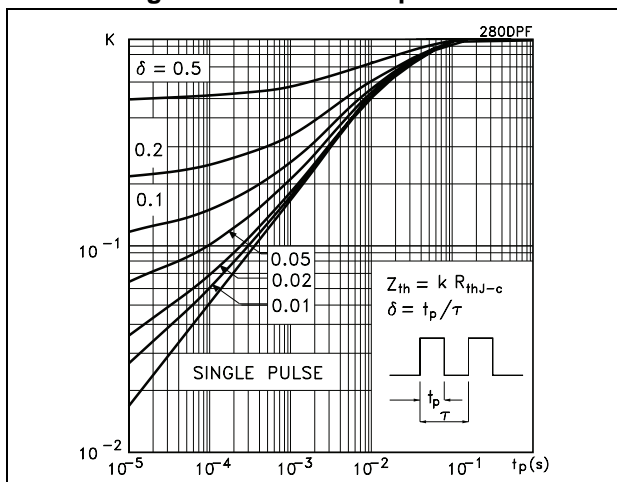
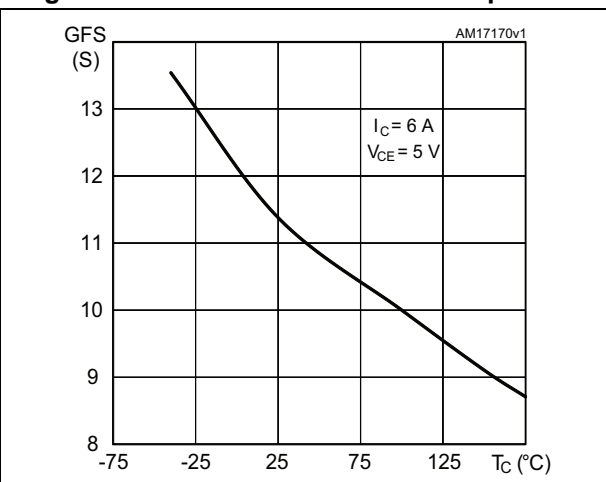


Figure 15. Transconductance vs. temperature



3 Test circuits

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

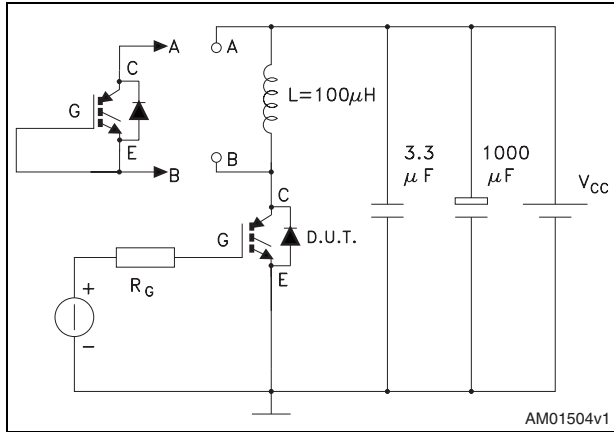


Figure 17. Resistive load switching

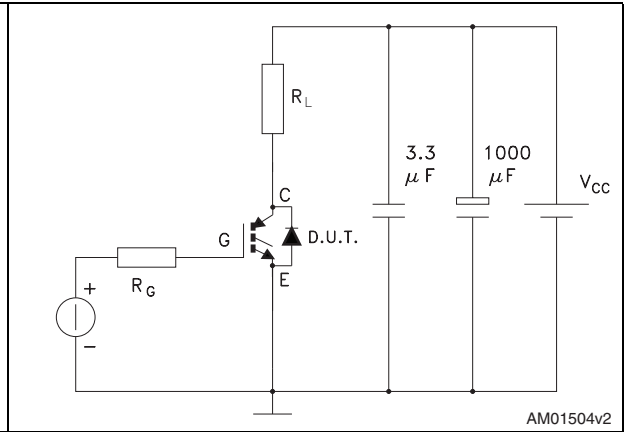


Figure 18. Gate charge test circuit

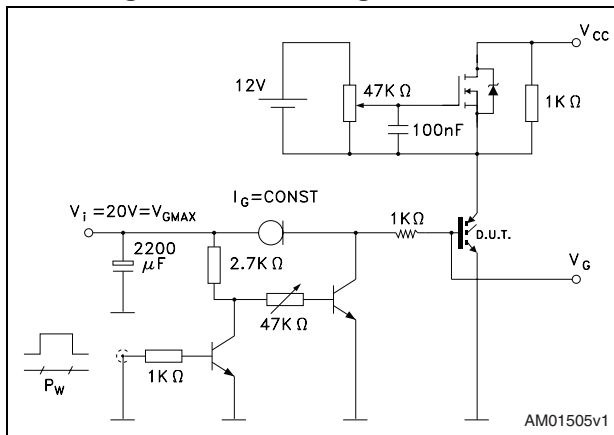
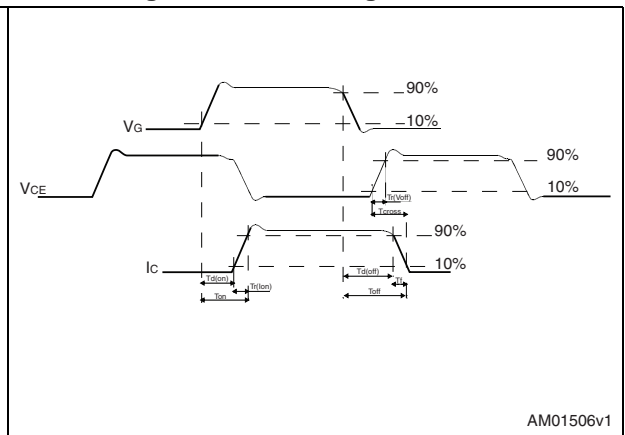


Figure 19. Switching waveform



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

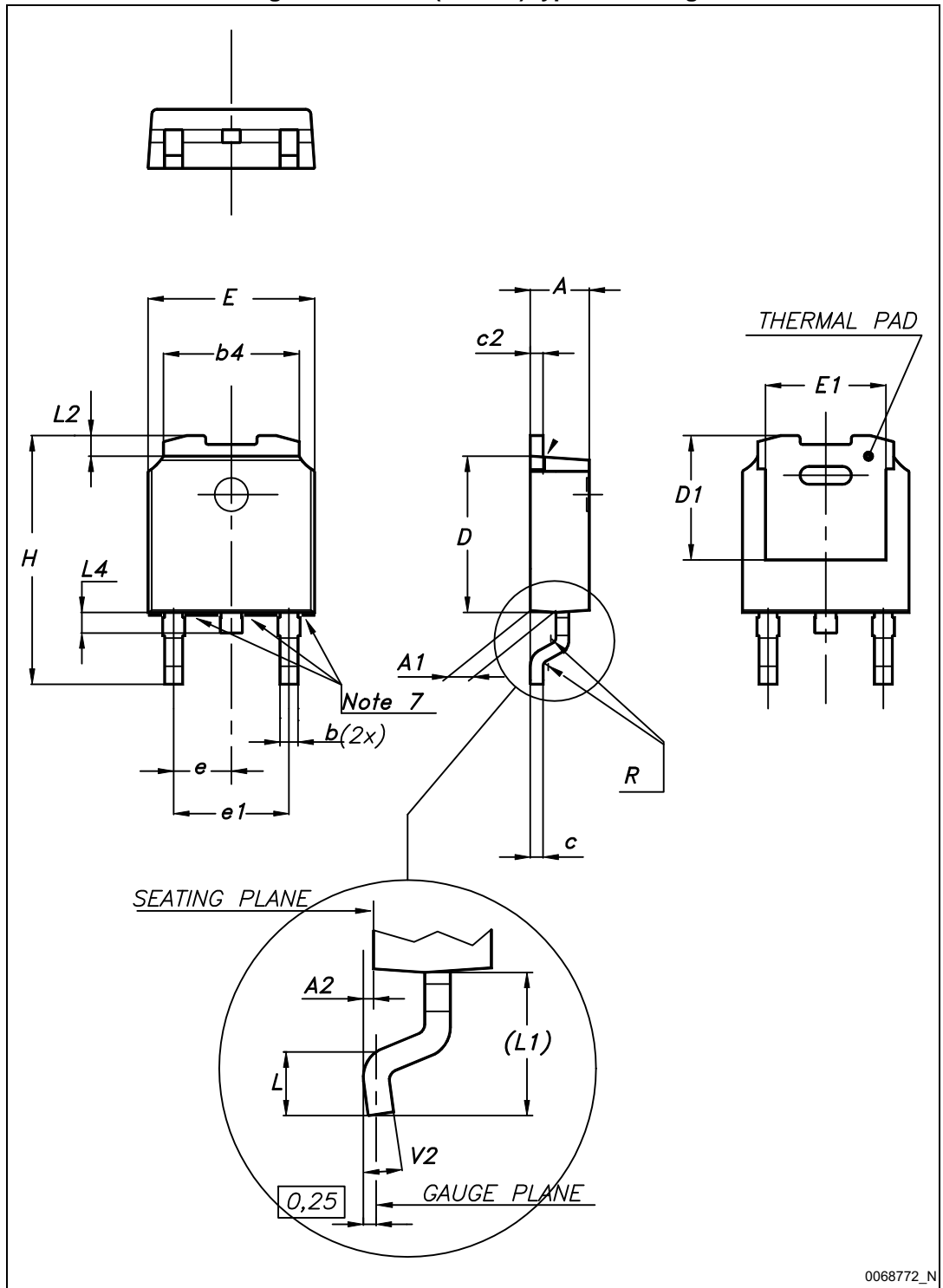
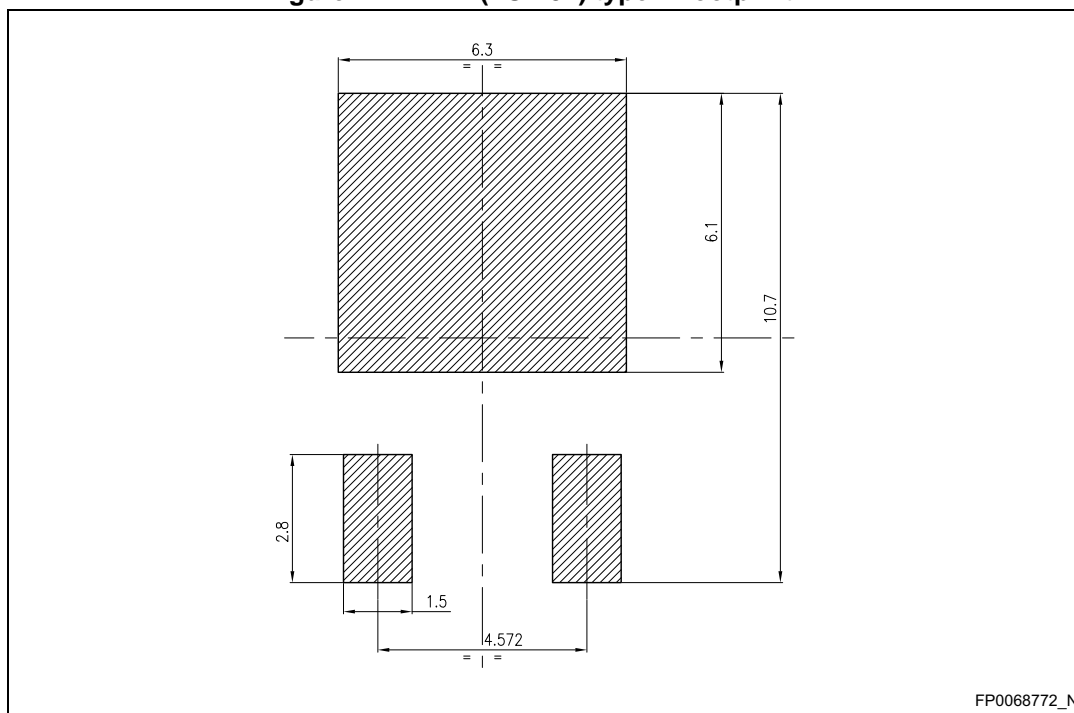


Table 7. DPAK (TO-252) type A mechanical data

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)

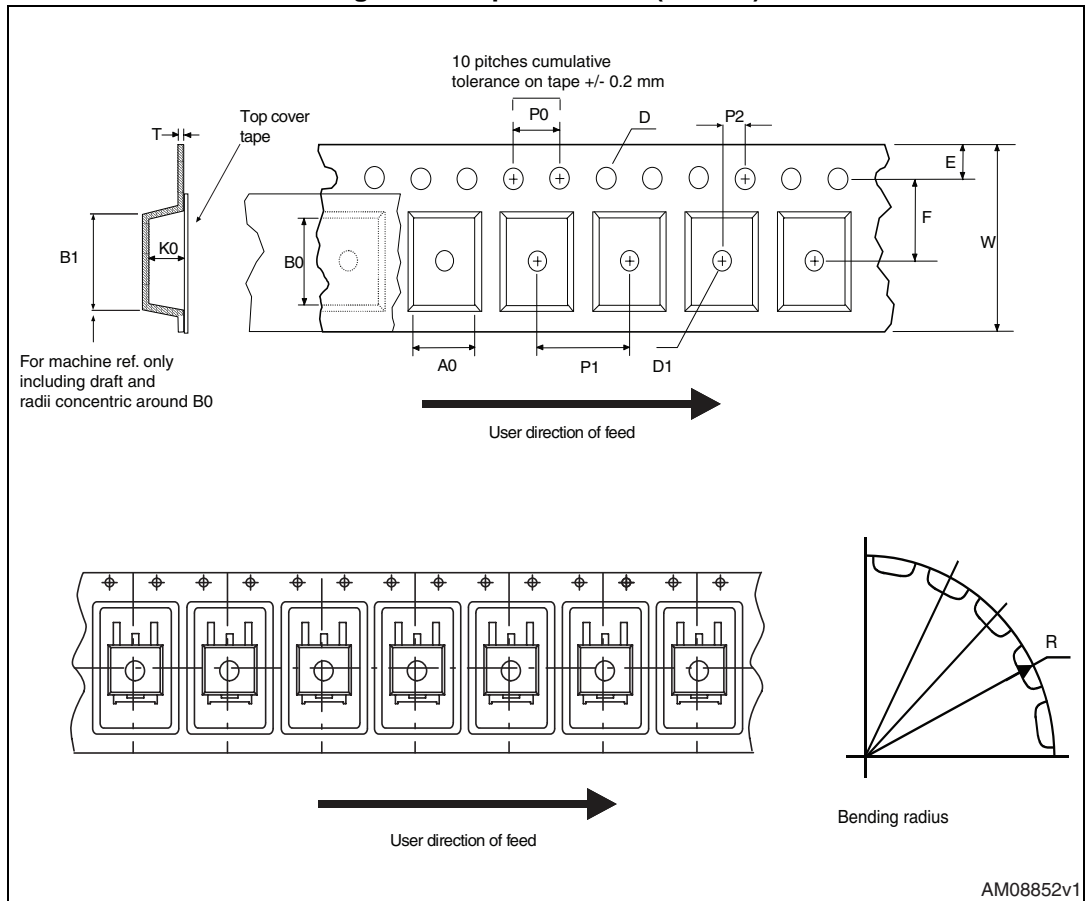


Figure 23. Reel for DPAK (TO-252)

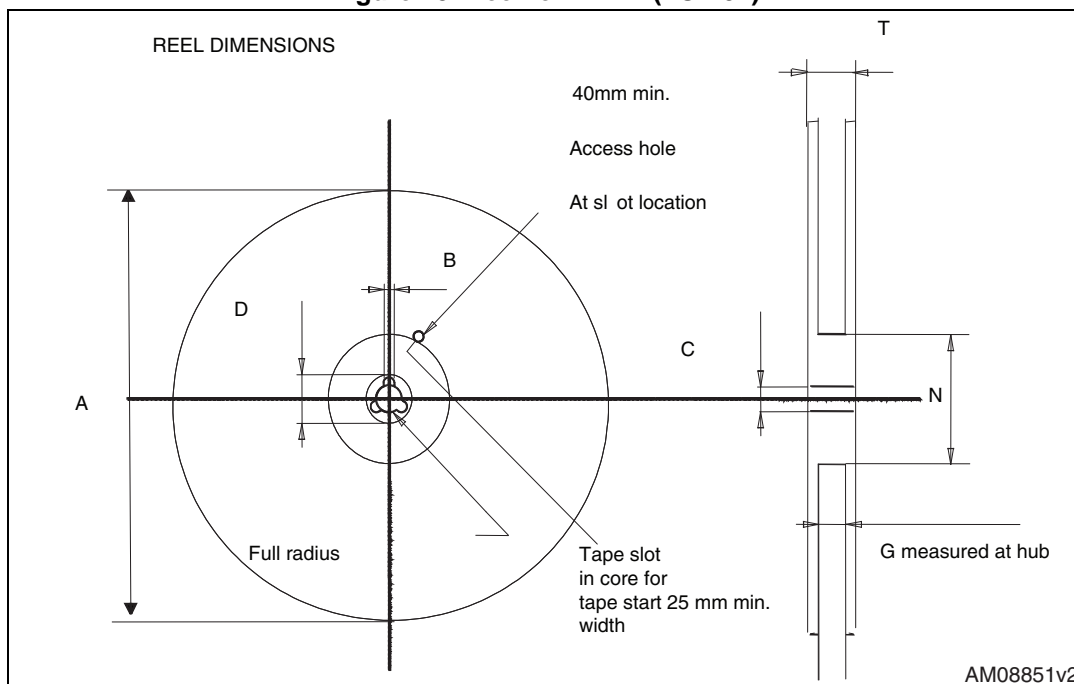


Table 8. DPAK (TO-252) tape and reel mechanical data

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	<ul style="list-style-type: none">– Modified: title and features– Modified: $V_{CES(\text{clamped})}$, $V_{(BR)ECS}$ 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.

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