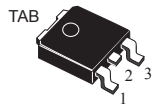
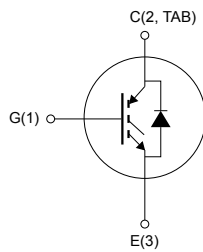


## N-channel 600 V, 7 A very fast IGBT


**DPAK**


NG1E3C2T

### Features

Order codes	$V_{CES}$	$V_{CE(sat)}$ max.	$I_C$ (at $T_C = 100\text{ }^\circ\text{C}$ )
STGD6NC60HDT4	600 V	2.5 V	7 A

- Low on-voltage drop ( $V_{CE(sat)}$ )
- Low CRES / CIES ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- High frequency operation

### Applications

- High-frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers

### Description

This device is a very fast IGBT developed using advanced PowerMESH™ technology. This process guarantees an excellent trade-off between switching performance and low on-state behavior. This device is well-suited for resonant or soft-switching applications.



#### Product status link

[STGD6NC60HDT4](#)

#### Product summary

<b>Order code</b>	STGD6NC60HDT4
<b>Marking</b>	GD6NC60HD
<b>Package</b>	DPAK
<b>Packing</b>	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ V)	600	V
$I_C$	Continuous collector current at $T_C = 25$ °C	15	A
	Continuous collector current at $T_C = 100$ °C	7	A
$I_{CP}^{(1)}$	Pulsed collector current	21	A
$V_{GE}$	Gate-emitter voltage	±20	V
$I_F$	Diode RMS forward current at $T_C = 25$ °C	10	A
$P_{TOT}$	Total power dissipation at $T_C = 25$ °C	63	W
$T_{STG}$	Storage temperature range	-55 to 150	°C
$T_J$	Operating junction temperature range		°C

1. Pulse width limited by maximum junction temperature.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case	2	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	100	°C/W

## 2 Electrical characteristics

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

**Table 3. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 3\text{ A}$		1.9	2.5	V
		$V_{GE} = 15\text{ V}, I_C = 3\text{ A}, T_C = 125\text{ °C}$		1.7		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$			10	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_C = 125\text{ °C}$ <sup>(1)</sup>			1	mA
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA

1. Defined by design, not subject to production test.

**Table 4. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	205	-	pF
$C_{oes}$	Output capacitance		-	32	-	
$C_{res}$	Reverse transfer capacitance		-	5.5	-	
$Q_g$	Total gate charge	$V_{CC} = 390\text{ V}, I_C = 3\text{ A},$ $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 17. Gate charge test circuit)	-	13.6	-	nC
$Q_{ge}$	Gate-emitter charge		-	3	-	
$Q_{gc}$	Gate-collector charge		-	6	-	
$I_{CL}$	Turn-off SOA minimum current	$V_{clamp} = 390\text{ V}, T_j = 150\text{ °C},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V}$	-	19	-	A

**Table 5. Switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 390\text{ V}, I_C = 3\text{ A},$ $V_{GE} = 15\text{ V}, R_G = 10\text{ }\Omega$ (see Figure 16. Test circuit for inductive load switching)	-	12	-	ns
$t_r$	Current rise time		-	5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	612	-	A/ $\mu\text{s}$
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 390\text{ V}, I_C = 3\text{ A},$ $V_{GE} = 15\text{ V}, R_G = 10\text{ }\Omega,$ $T_j = 125\text{ °C}$ (see Figure 16. Test circuit for inductive load switching )	-	13	-	ns
$t_r$	Current rise time		-	4.3	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	560	-	A/ $\mu\text{s}$

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off voltage rise time	$V_{CE} = 390\text{ V}$ , $I_C = 3\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ (see Figure 16. Test circuit for inductive load switching)	-	40	-	ns
$t_{d(off)}$	Turn-off delay time		-	76	-	ns
$t_f$	Current fall time		-	100	-	ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CE} = 390\text{ V}$ , $I_C = 3\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ , $T_J = 125\text{ }^\circ\text{C}$ (see Figure 16. Test circuit for inductive load switching)	-	60	-	ns
$t_{d(off)}$	Turn-off delay time		-	98	-	ns
$t_f$	Current fall time		-	124	-	ns

**Table 6. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 390\text{ V}$ , $I_C = 3\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ (see Figure 16. Test circuit for inductive load switching)	-	20	-	$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching energy		-	68	-	$\mu\text{J}$
$E_{ts}$	Total switching energy		-	88	-	$\mu\text{J}$
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 390\text{ V}$ , $I_C = 3\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ , $T_J = 125\text{ }^\circ\text{C}$ (see Figure 16. Test circuit for inductive load switching)	-	37	-	$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching energy		-	93	-	$\mu\text{J}$
$E_{ts}$	Total switching energy		-	130	-	$\mu\text{J}$

1. Including the reverse recovery of the diode
2. Including the tail of the collector current

**Table 7. Collector-emitter diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_F$	Forward on-voltage	$I_F = 1.5\text{ A}$	-	1.6	2.1	V
		$I_F = 1.5\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$	-	1.3		
$t_{rr}$	Reverse recovery time	$I_F = 3\text{ A}$ , $V_R = 40\text{ V}$ ,	-	21		ns
$Q_{rr}$	Reverse recovery charge	$di_F/dt = 100\text{ A}/\mu\text{s}$ (see Figure 19. Diode reverse recovery waveform)	-	14		nC
$I_{rrm}$	Reverse recovery current		-	1.36		A
$t_{rr}$	Reverse recovery time	$I_F = 3\text{ A}$ , $V_R = 40\text{ V}$ ,	-	34		ns
$Q_{rr}$	Reverse recovery charge	$di_F/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 125\text{ }^\circ\text{C}$ (see Figure 19. Diode reverse recovery waveform)	-	32		nC
$I_{rrm}$	Reverse recovery current		-	1.88		A

## 2.1 Electrical characteristics (curves)

Figure 1. Switching energy vs gate resistance

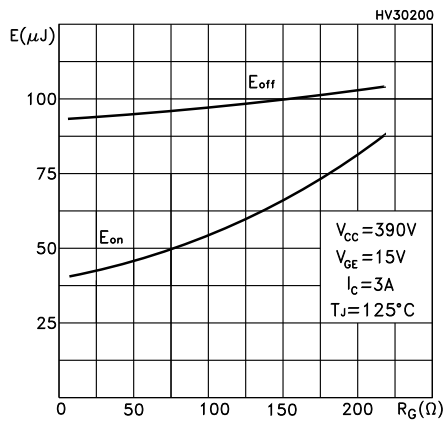


Figure 2. Switching energy vs collector current

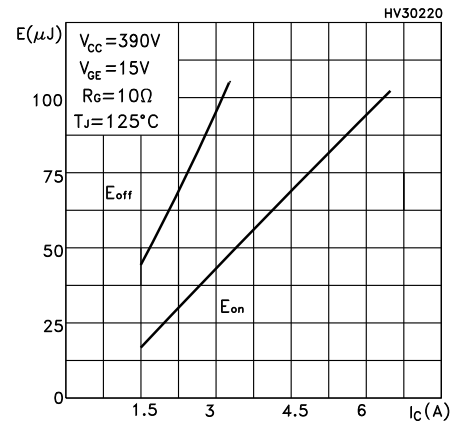


Figure 3. Normalized breakdown voltage vs temperature

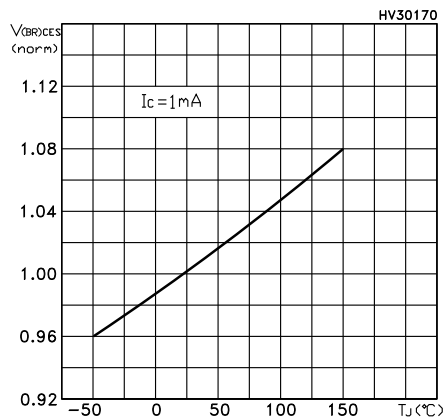


Figure 4. Switching energy vs temperature

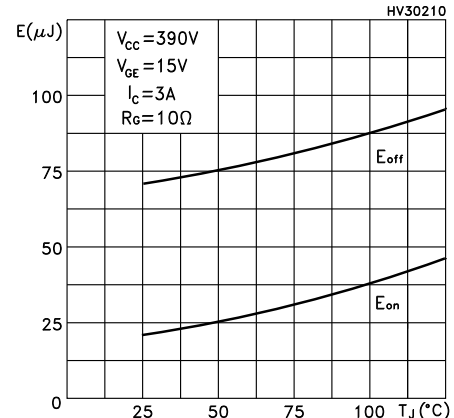


Figure 5. Normalized gate threshold voltage vs temperature

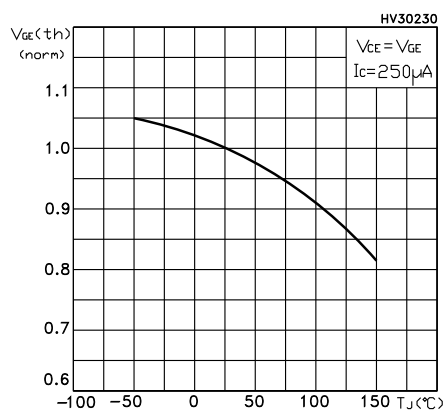
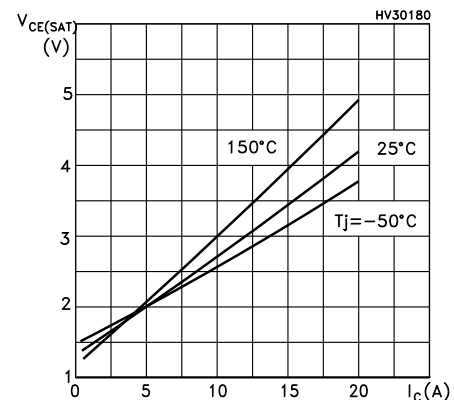
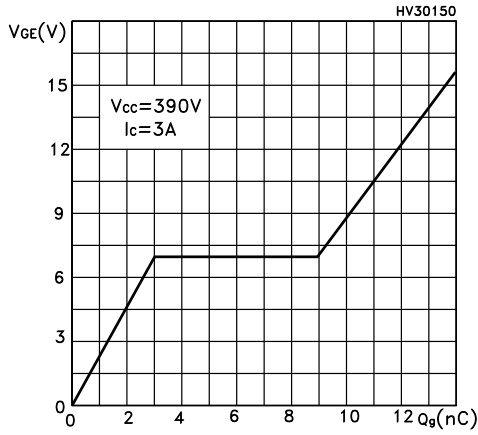


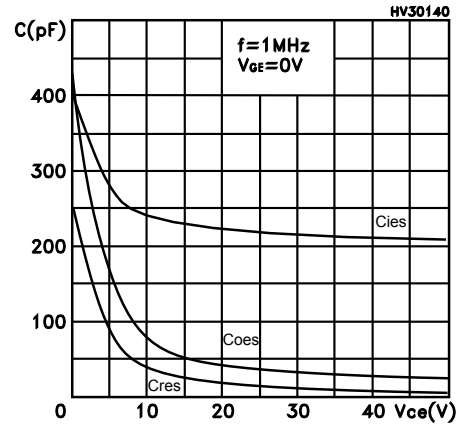
Figure 6. Collector-emitter on voltage vs collector current



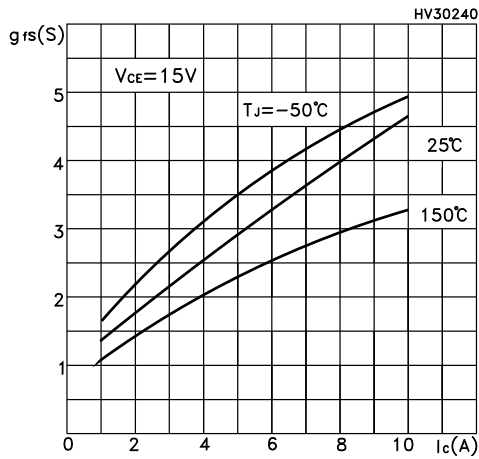
**Figure 7. Gate charge vs gate-source voltage**



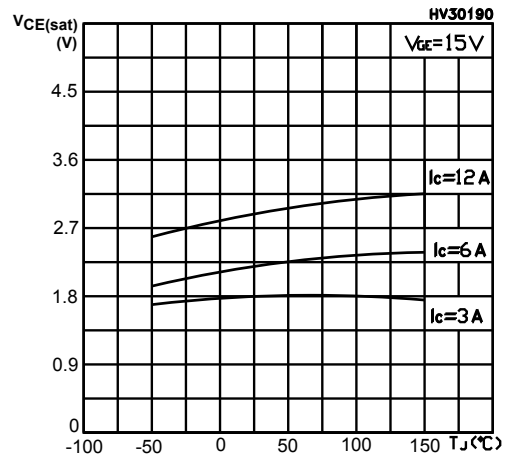
**Figure 8. Capacitance variations**



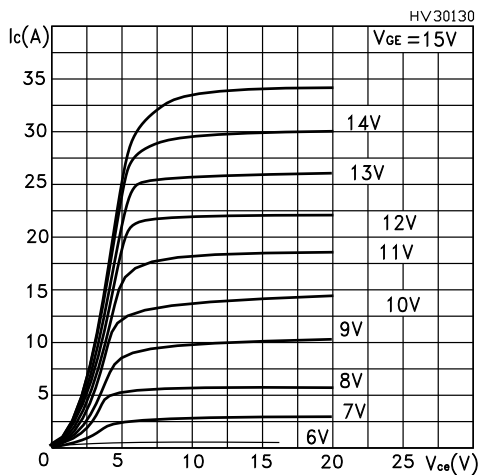
**Figure 9. Transconductance**



**Figure 10. Collector-emitter on-voltage vs temperature**



**Figure 11. Output characteristics**



**Figure 12. Transfer characteristics**

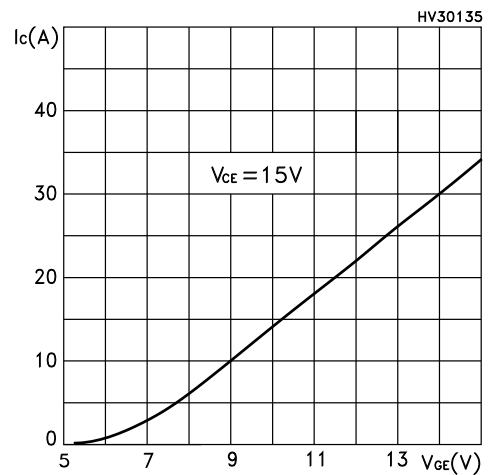


Figure 13. Thermal impedance

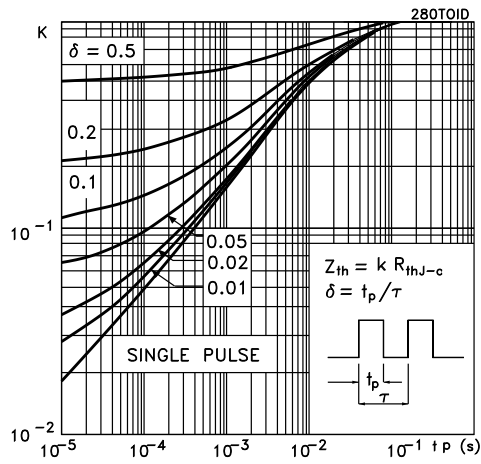


Figure 14. Turn-off SOA

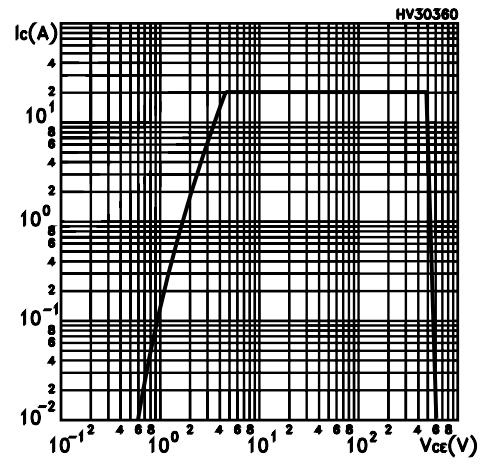
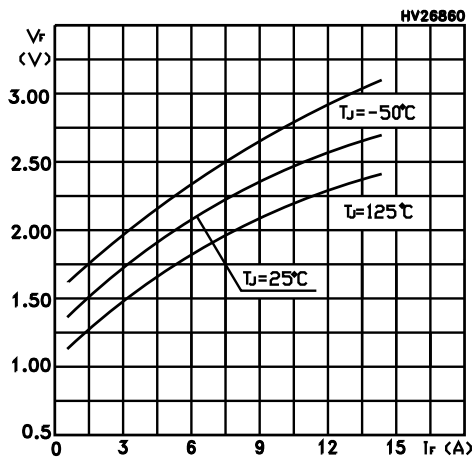
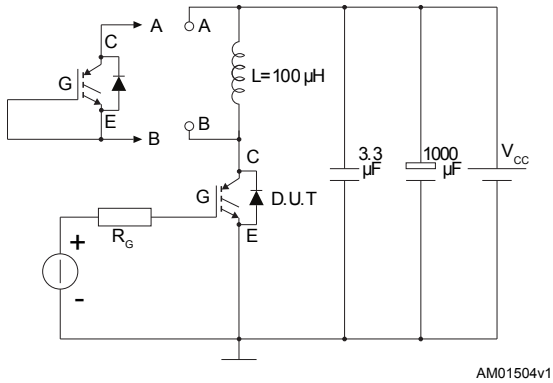
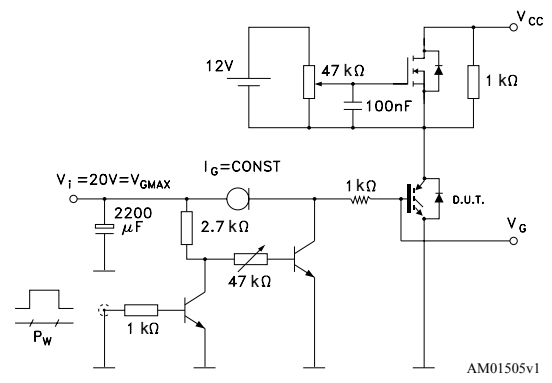
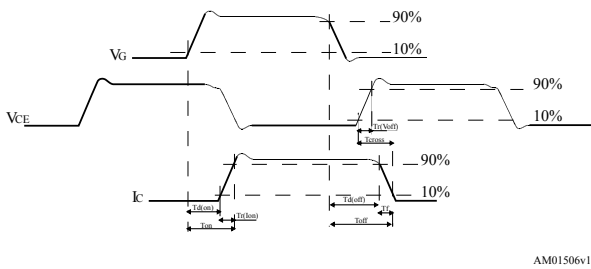
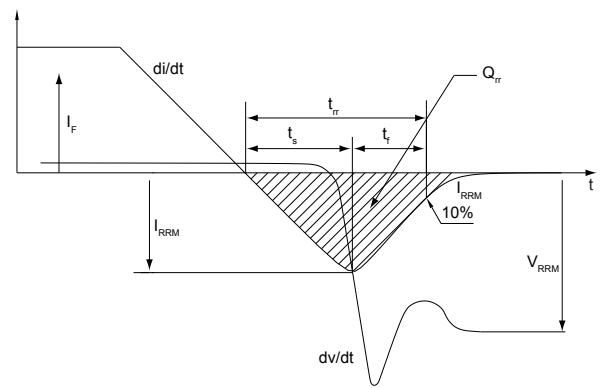


Figure 15. Emitter-collector diode characteristics



### 3 Test circuits

**Figure 16. Test circuit for inductive load switching**

**Figure 17. Gate charge test circuit**

**Figure 18. Switching waveform**

**Figure 19. Diode reverse recovery waveform**




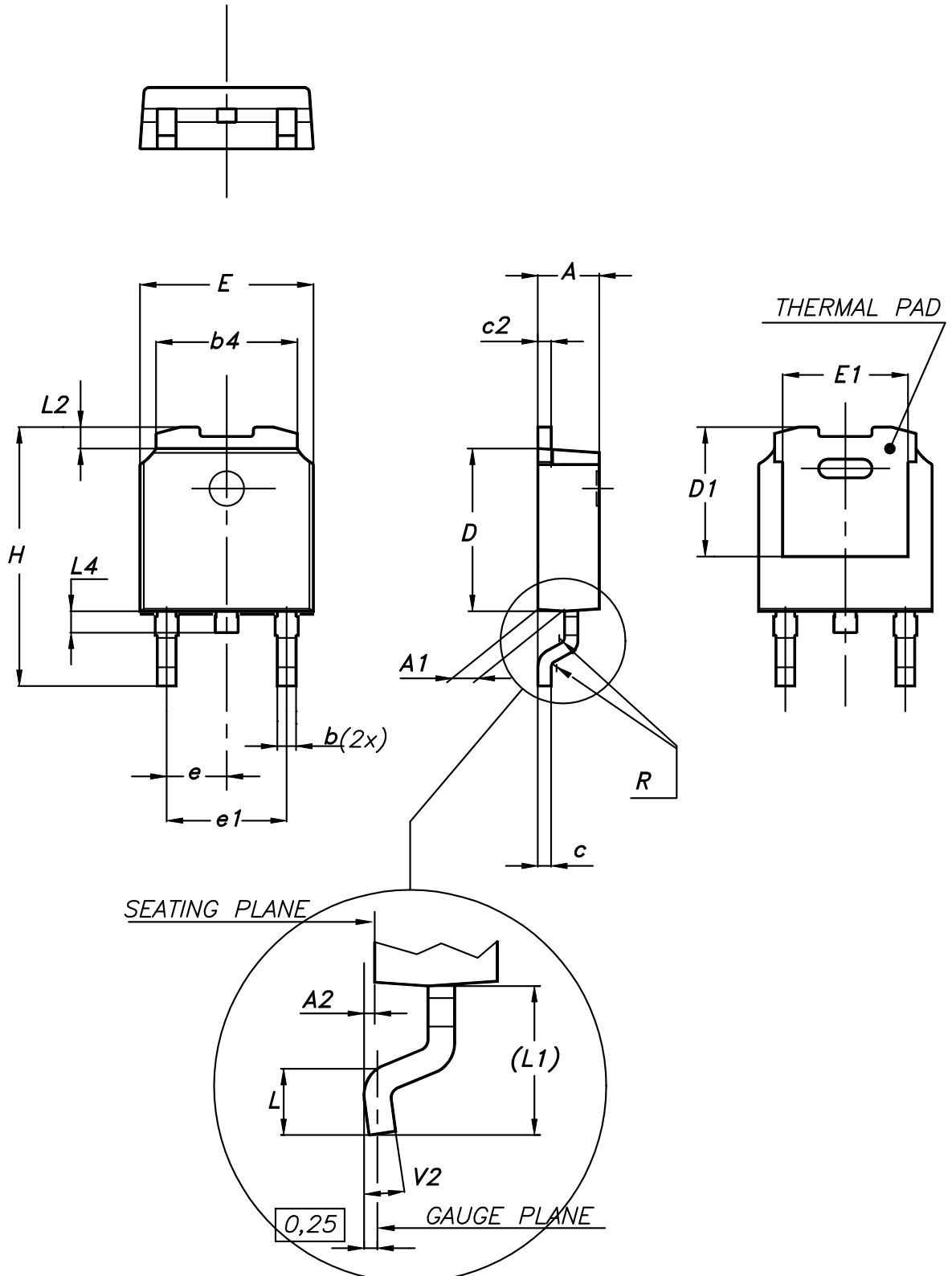
## 4 Package information

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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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 DPAK (TO-252) type A2 package information

Figure 20. DPAK (TO-252) type A2 package outline



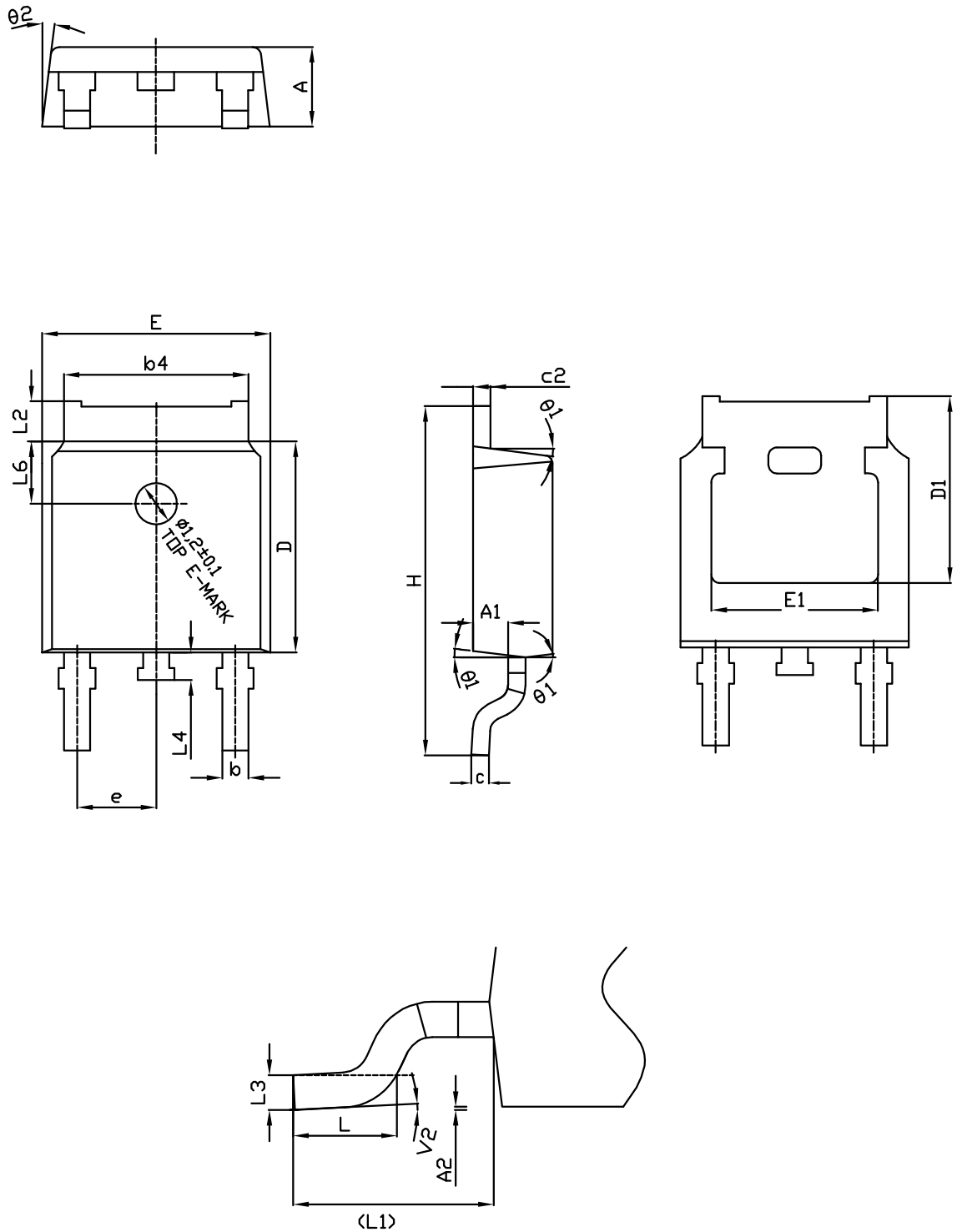
0068772\_type-A2\_rev26

**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°

## 4.2 DPAK (TO-252) type C2 package information

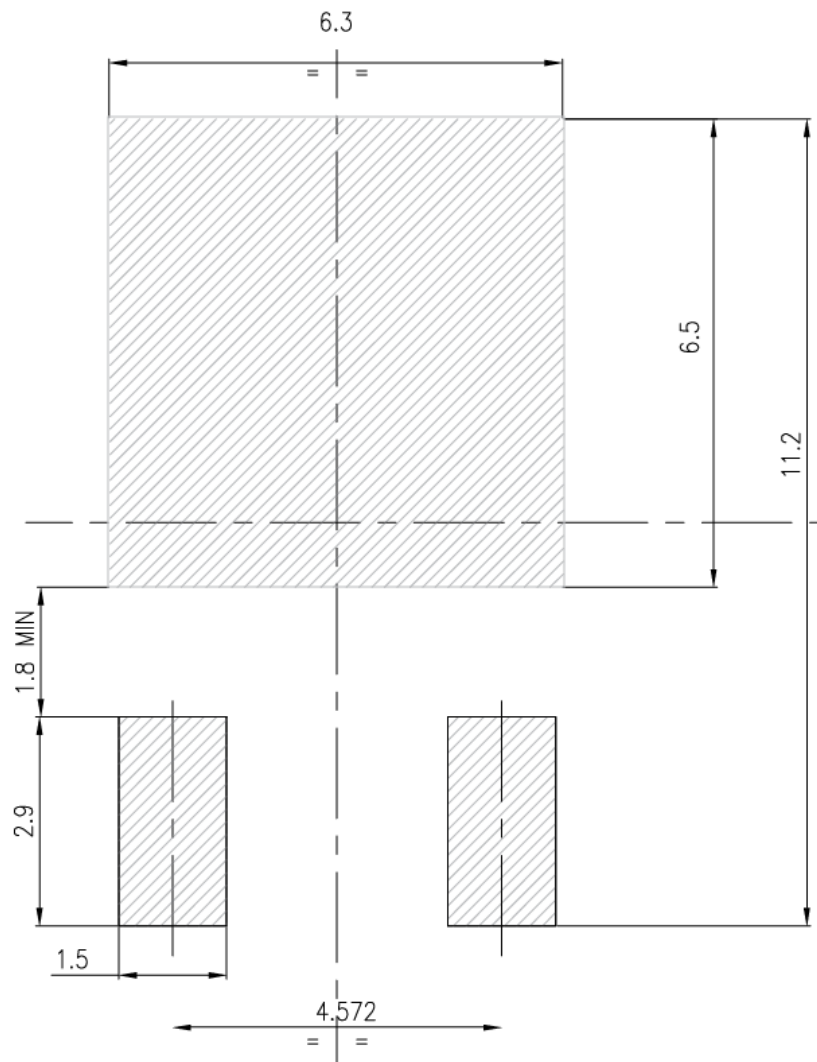
Figure 21. DPAK (TO-252) type C2 package outline



**Table 9. DPAK (TO-252) type C2 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1	2.90 REF		
L2	0.90		1.25
L3	0.51 BSC		
L4	0.60	0.80	1.00
L6	1.80 BSC		
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

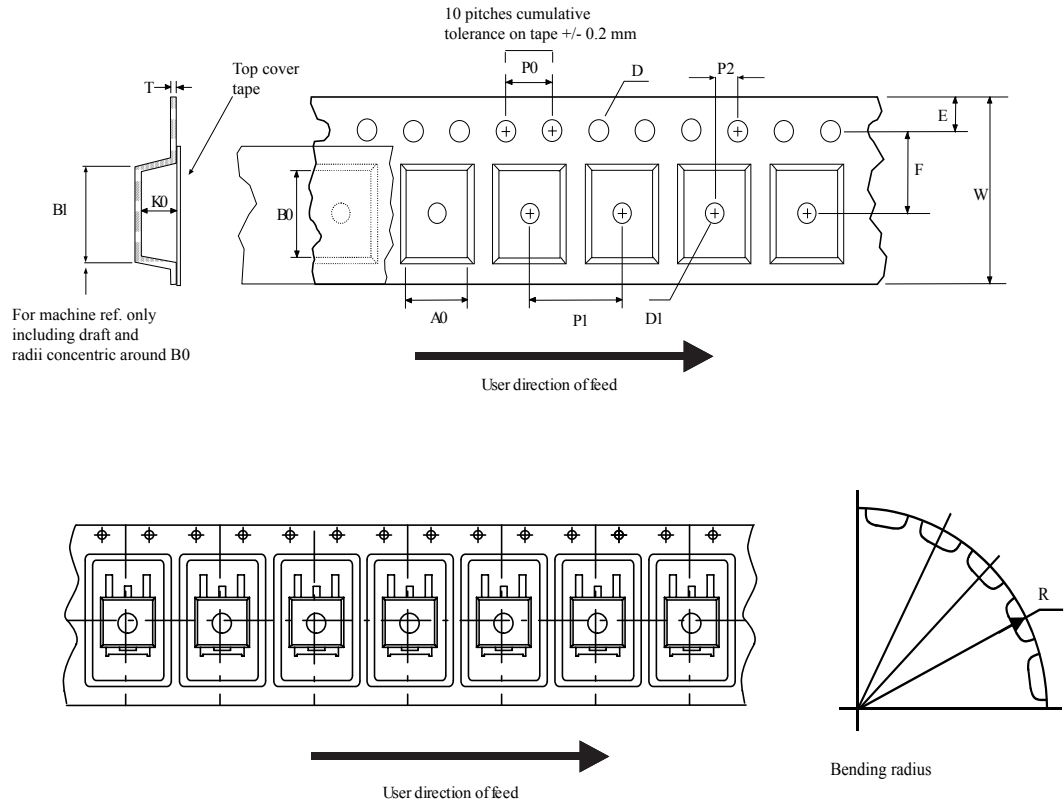
Figure 22. DPAK (TO-252) recommended footprint (dimensions are in mm)



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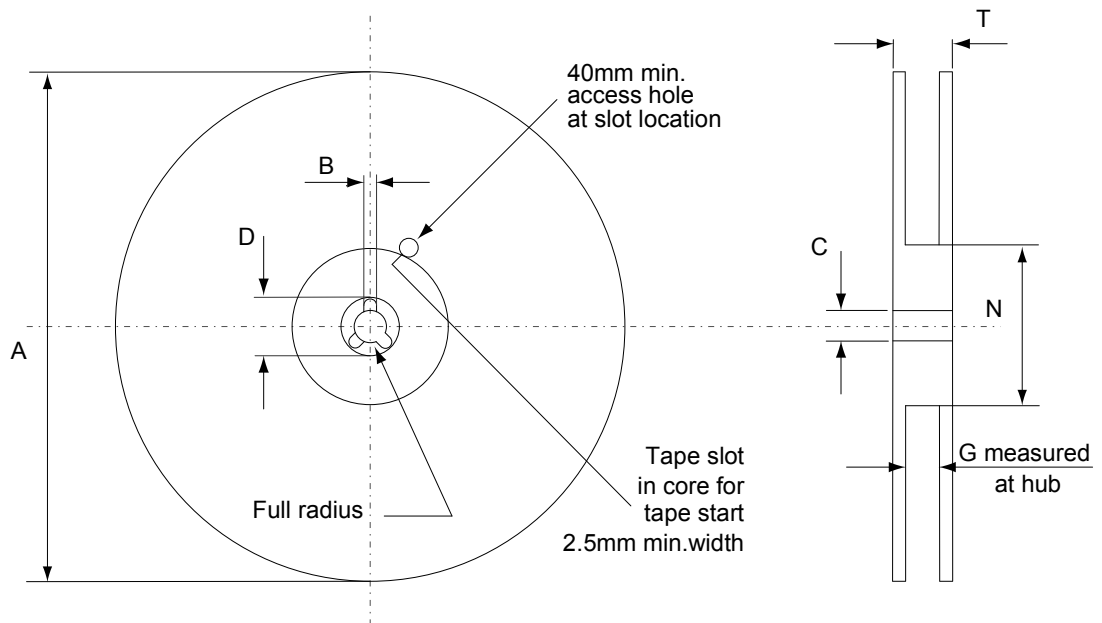
### 4.3 DPAK (TO-252) packing information

Figure 23. DPAK (TO-252) tape outline



AM08852v1

**Figure 24. DPAK (TO-252) reel outline**



AM06038v1

**Table 10. DPAK (TO-252) tape and reel mechanical data**

Dim.	Tape		Dim.	Reel	
	mm			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 11. Document revision history**

Date	Revision	Changes
01-Oct-2018	1	First release.
04-Dec-2018	2	Added Section 4.1 DPAK (TO-252) type A2 package information and Section 4.2 DPAK (TO-252) type C2 package information.

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