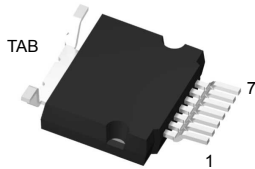
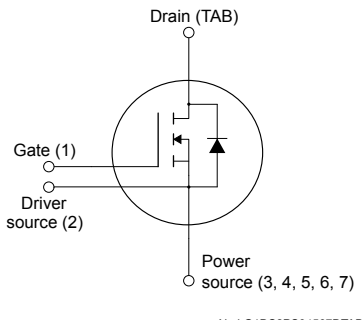


# Automotive-grade silicon carbide Power MOSFET 1200 V, 40 mΩ typ., 40 A in an HU3PAK package




HU3PAK



## Features

Order code	$V_{DS}$	$R_{DS(on)}$ typ.	$I_D$
SCT040HU120G3AG	1200 V	40 mΩ	40 A

- AEC-Q101 qualified 
- Very low  $R_{DS(on)}$  over the entire temperature range
- High speed switching performances
- Very fast and robust intrinsic body diode
- Source sensing pin for increased efficiency

## Applications

- DC/DC converter for EV/HEV
- Main inverter (electric traction)
- On board charger (OBC)

## Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 3<sup>rd</sup> generation SiC MOSFET technology. The device features a very low  $R_{DS(on)}$  over the entire temperature range combined with low capacitances and very high switching operations, which improve application performance in frequency, energy efficiency, system size and weight reduction.

### Product status link

[SCT040HU120G3AG](#)

### Product summary

Order code	SCT040HU120G3AG
Top-side marking	40HU12AG
Back-side marking	SCT40HU12G3AG
Package	HU3PAK
Packing	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	1200	V
$V_{GS}$	Gate-source voltage	-10 to 22	V
	Gate-source voltage (recommended operating values)	-5 to 18	
	Gate-source transient voltage, $t_p < 1 \mu s$ , $t \leq 10$ hours over lifetime	-11 to 25	
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25 \text{ }^\circ\text{C}$	40	A
	Drain current (continuous) at $T_C = 100 \text{ }^\circ\text{C}$	39	
$I_{DM}^{(2)}$	Drain current (pulsed)	156	A
$P_{TOT}$	Total power dissipation at $T_C = 25 \text{ }^\circ\text{C}$	300	W
$T_{stg}$	Storage temperature range	-55 to 175	$^\circ\text{C}$
$T_J$	Operating junction temperature range		$^\circ\text{C}$

- $I_D$  is limited by package.
- Pulse width is limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.50	$^\circ\text{C}/\text{W}$
$R_{thJA}$	Thermal resistance, junction-to-ambient	50	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

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

**Table 3. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$				V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = V$			10	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = -10\text{ to }22\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 5\text{ mA}$	1.8	3.0	4.2	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 15\text{ V}$ , $I_D = 16\text{ A}$		49		m $\Omega$
		$V_{GS} = 18\text{ V}$ , $I_D = 16\text{ A}$				
		$V_{GS} = 18\text{ V}$ , $I_D = 16\text{ A}$ , $T_J = 175\text{ °C}$		72		

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 800\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	1329	-	pF
$C_{oss}$	Output capacitance		-	78	-	pF
$C_{rss}$	Reverse transfer capacitance		-	10	-	pF
$Q_g$	Total gate charge	$V_{DD} = 800\text{ V}$ , $V_{GS} = -5\text{ to }18\text{ V}$ , $I_D = 16\text{ A}$	-	54	-	nC
$Q_{gs}$	Gate-source charge		-	14	-	nC
$Q_{gd}$	Gate-drain charge		-	20	-	nC
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	1.6	-	$\Omega$

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 800\text{ V}$ , $I_D = 16\text{ A}$ ,	-	267	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy	$R_G = 15\text{ }\Omega$ , $V_{GS} = -5\text{ V to }18\text{ V}$	-	117	-	$\mu\text{J}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 800\text{ V}$ , $I_D = 16\text{ A}$ , $R_G = 15\text{ }\Omega$ , $V_{GS} = -5\text{ to }18\text{ V}$	-	12.9	-	ns
$t_r$	Rise time		-	21.1	-	ns
$t_{d(off)}$	Turn-off delay time		-	36.3	-	ns
$t_f$	Fall time		-	19.2	-	ns

**Table 7. Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Continuous diode forward current	$T_C = 25\text{ }^\circ\text{C}$	-		40	A
		$T_C = 100\text{ }^\circ\text{C}$	-		39	
$V_{SD}$	Diode forward voltage	$I_{SD} = 16\text{ A}, V_{GS} = 0\text{ V}$	-	2.6		V
$t_{rr}$	Reverse recovery time	$I_{SD} = 16\text{ A}, di/dt = 1000\text{ A}/\mu\text{s},$ $V_{DD} = 800\text{ V}, V_{GS} = -5\text{ V}$	-	14.7		ns
$Q_{rr}$	Reverse recovery charge		-	94.2		nC
$I_{RRM}$	Reverse recovery current		-	10.6		A

1.  $I_{SD}$  is limited by package.

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

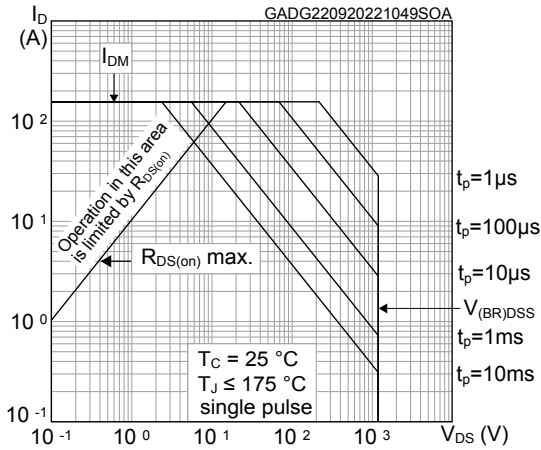


Figure 2. Maximum transient thermal impedance

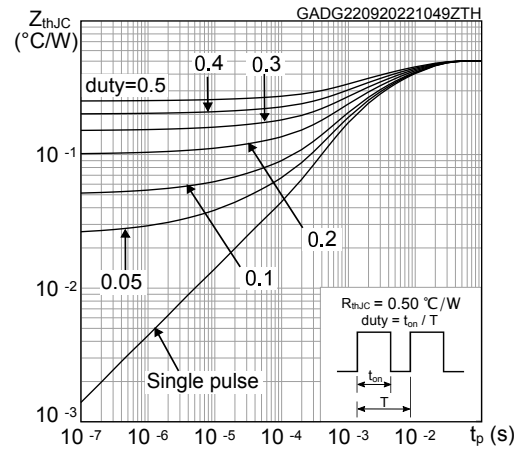


Figure 3. Typical output characteristics ( $T_J = 25^\circ\text{C}$ )

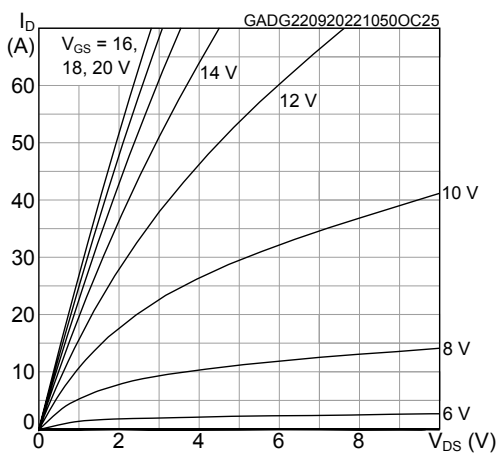


Figure 4. Typical output characteristics ( $T_J = 175^\circ\text{C}$ )

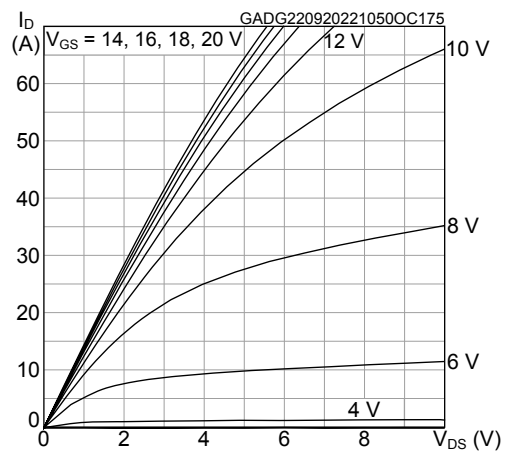


Figure 5. Typical transfer characteristics

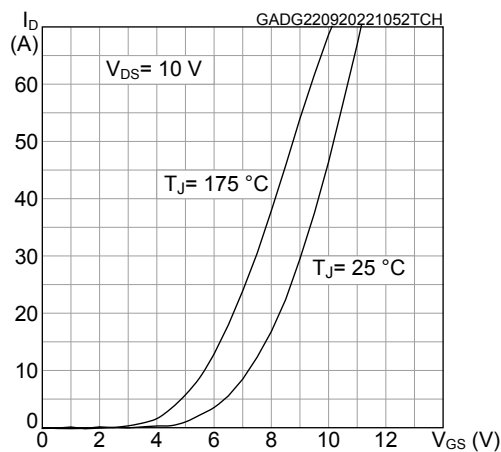


Figure 6. Total power dissipation

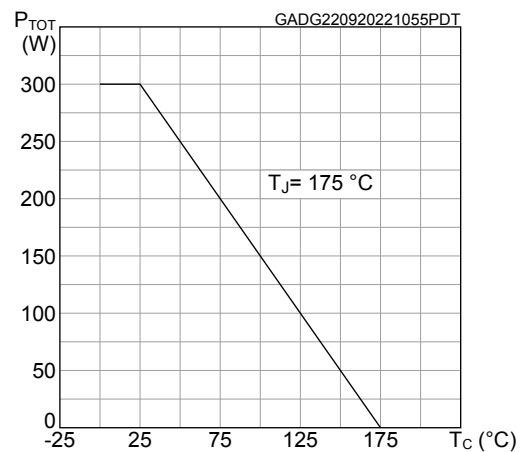


Figure 7. Typical gate charge characteristics

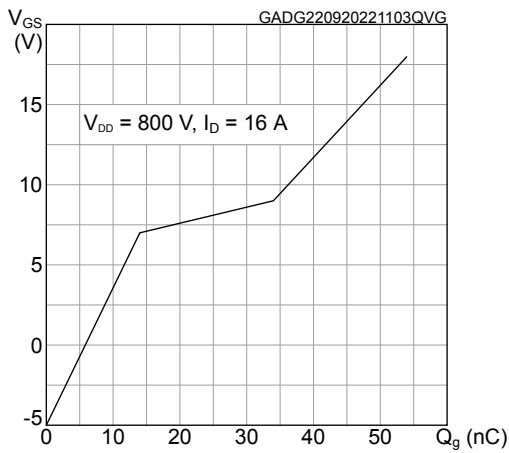


Figure 8. Typical capacitance characteristics

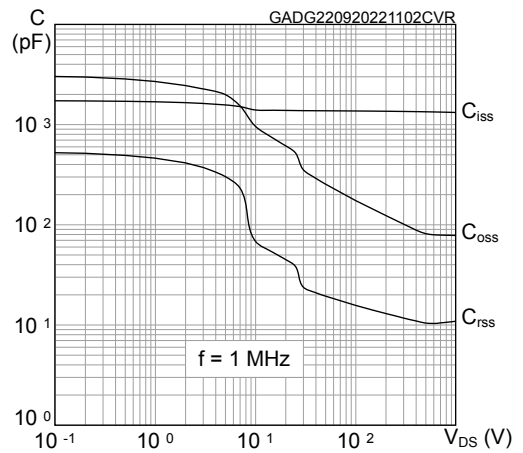


Figure 9. Typical switching energy vs  $R_G$

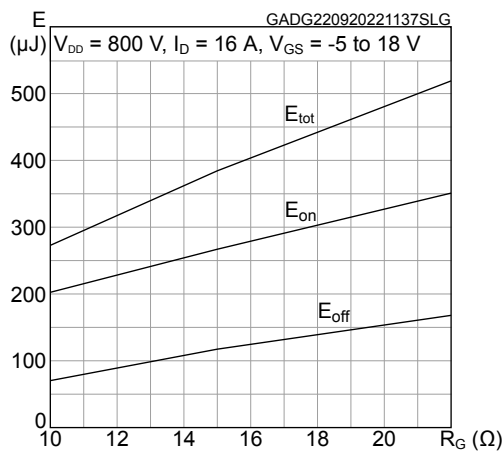


Figure 10. Typical switching energy vs  $V_{DS}$

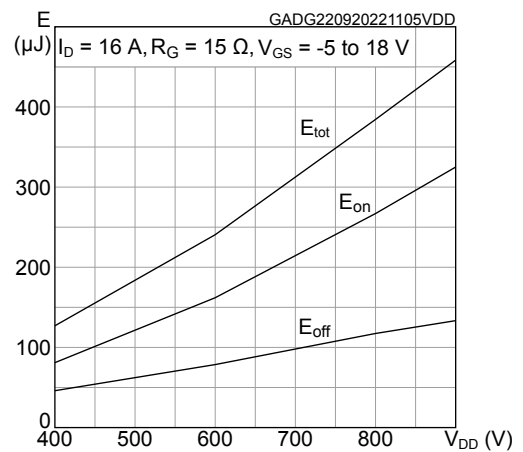


Figure 11. Typical switching energy vs drain current

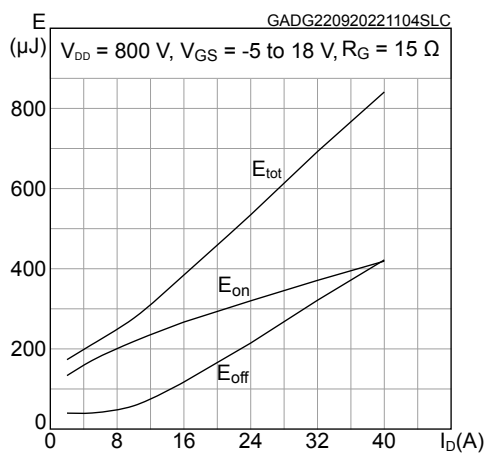
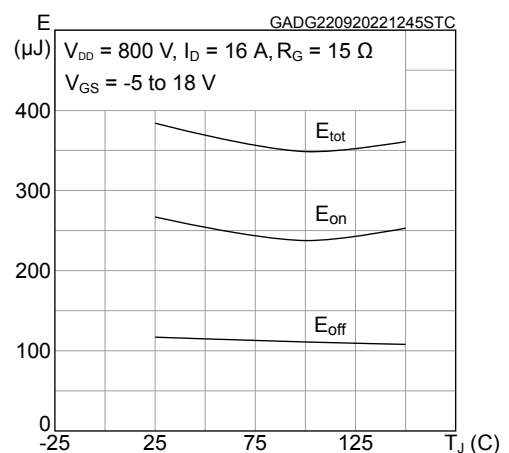
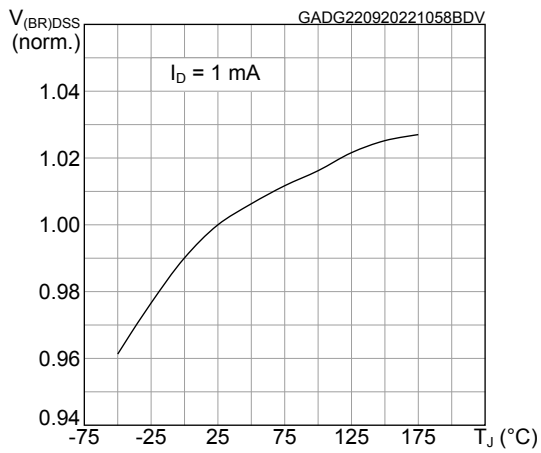
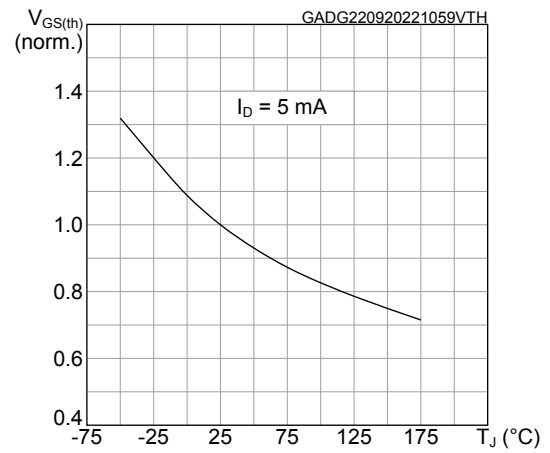
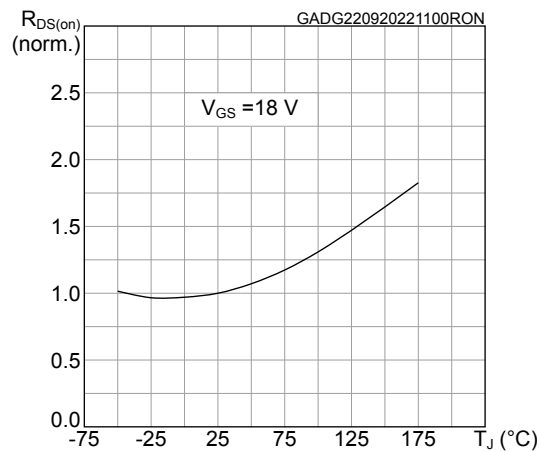
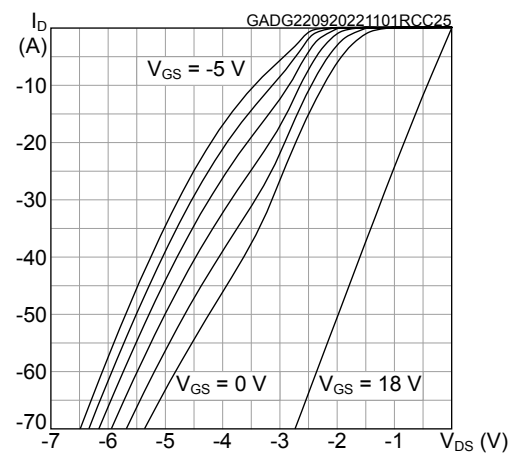
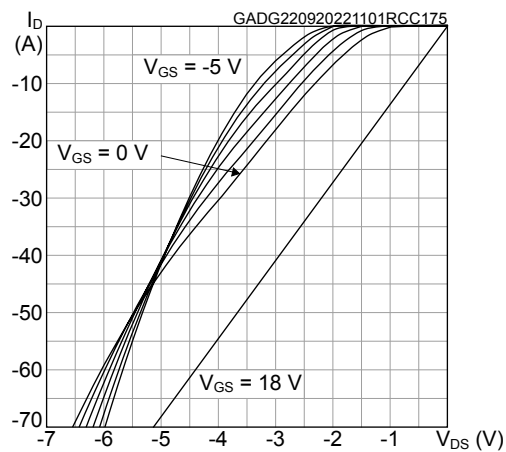


Figure 12. Typical switching energy vs  $T_C$



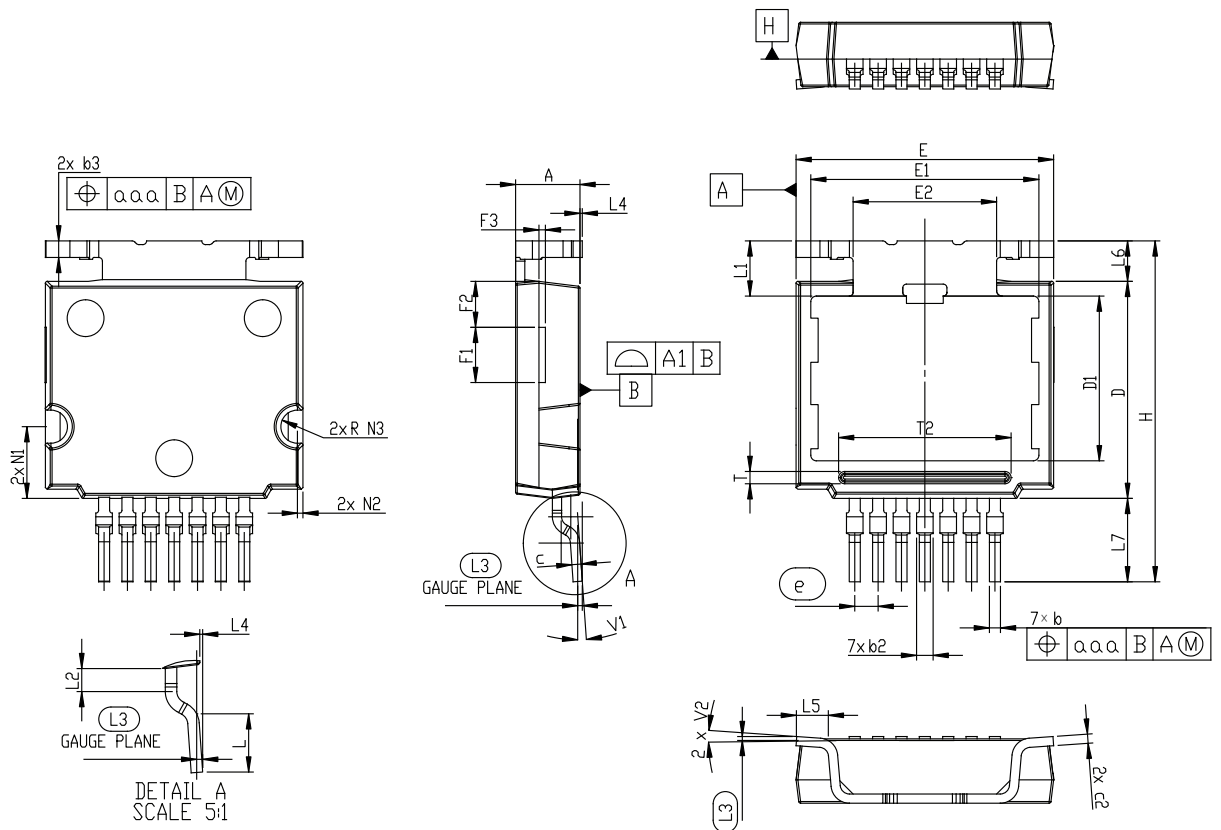
**Figure 13. Normalized breakdown voltage vs temperature**

**Figure 14. Normalized gate threshold vs temperature**

**Figure 15. Normalized on-resistance vs temperature**

**Figure 16. Typical reverse conduction characteristics ( $T_J = 25^\circ\text{C}$ )**

**Figure 17. Typical reverse conduction characteristics ( $T_J = 175^\circ\text{C}$ )**


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

#### 3.1 HU3PAK package information

Figure 18. HU3PAK package outline



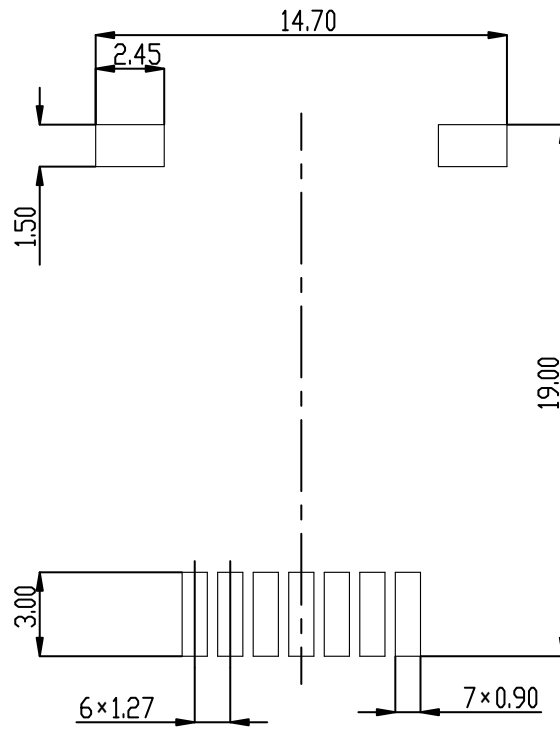
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**Table 8. HU3PAK package mechanical data**

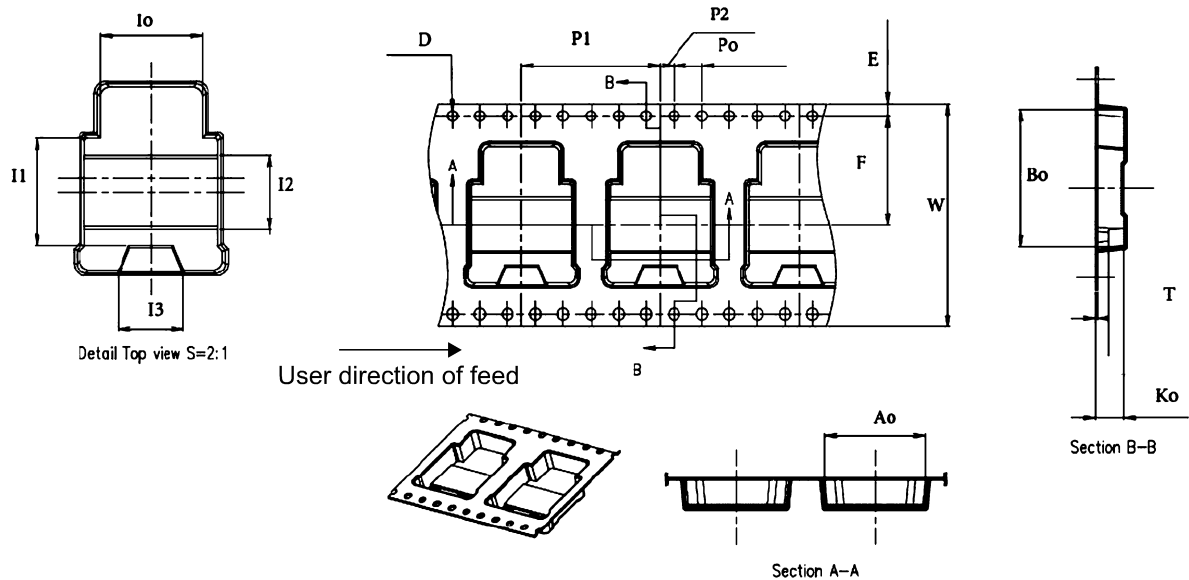
Ref.	Dimensions		
	mm		
	Min.	Typ.	Max.
A	3.40	3.50	3.60
A1		0.05	
b	0.50	0.60	0.70
b2	0.50	0.70	1.00
b3	0.80	0.90	1.00
c	0.40	0.50	0.60
c2	0.40	0.50	0.60
D	11.70	11.80	11.90
D1	8.80	8.955	9.10
E	13.90	14.00	14.10
E1	12.30	12.40	12.50
E2	7.75	7.80	7.85
e		1.27	
H	18.00	18.58	19.00
aaa		0.10	
L	2.40	2.52	2.60
L1		3.05	
L2	0.90	1.00	1.10
L3		0.26	
L4	0.075	0.125	0.175
L5	1.83	1.93	2.03
L6	2.14	2.24	2.34
L7	4.44	4.54	4.64
F1	2.90	3.00	3.10
F2	2.40	2.50	2.60
F3	0.25	0.35	0.45
N1	3.80	3.90	4.00
N2	0.25	0.30	0.45
N3	0.80	0.90	1.00
T	0.50	0.67	0.70
T2	9.18	9.38	9.43
V1		0°	8°
V2		0°	8°

Figure 19. HU3PAK recommended footprint (dimensions in mm)



### 3.2 HU3PAK packing information

Figure 20. HU3PAK carrier tape outline

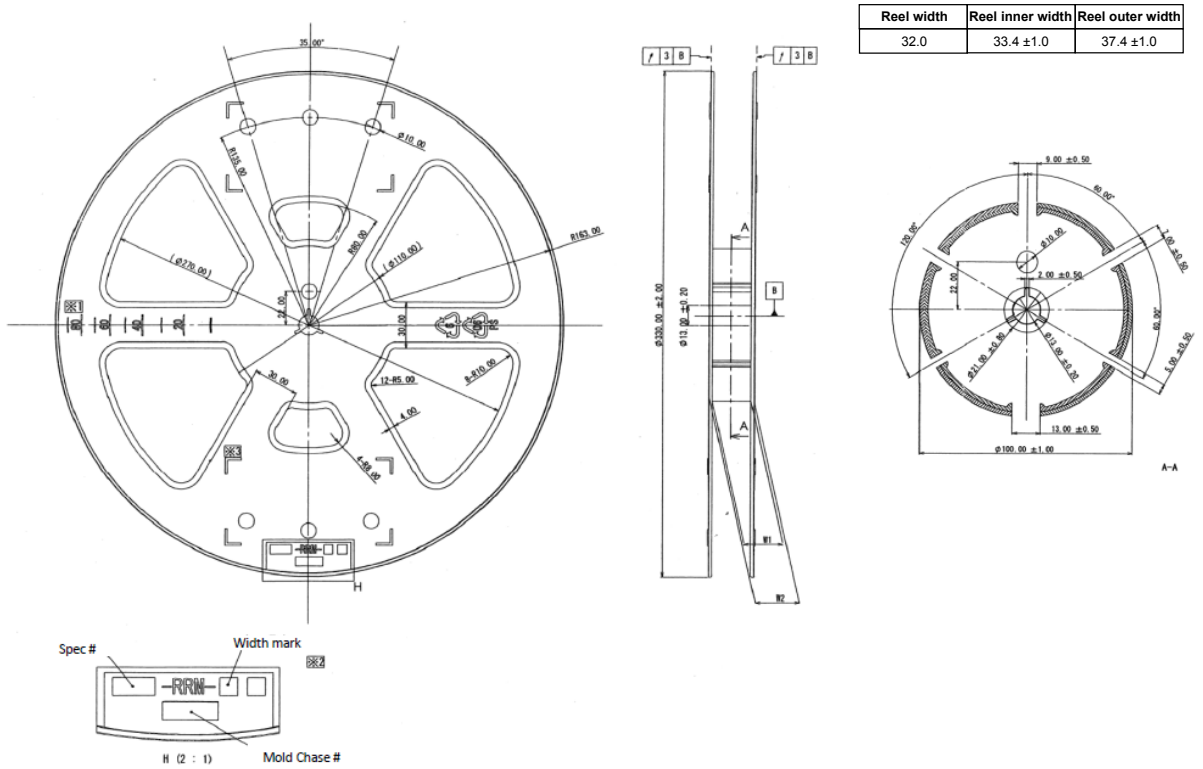


DM00345054\_3

Table 9. HU3PAK tape mechanical data

Dimension	Value
	mm
A0	14.40 ±0.10
B0	19.70
D	1.50 ±0.10
E	1.75 ±0.10
F	15.65 ±0.10
I0	11.00
I1	11.60 ±0.10
I2	8.00
I3	7.00
K0	4.20
P0	4.00 ±0.10
P1	20.00 ±0.10
P2	2.00 ±0.10
T	0.40 ±0.50
W	32.00 ±0.30

Figure 21. HU3PAK reel outline (dimensions are in mm)



Reel width	Reel inner width	Reel outer width
32.0	33.4 ±1.0	37.4 ±1.0

DM00345054\_3\_reel

## Revision history

**Table 10. Document revision history**

Date	Revision	Changes
03-Oct-2022	1	First release.
16-Sep-2024	2	Updated <a href="#">Section product summary</a> on cover page.

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