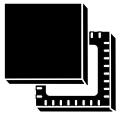
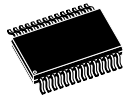


Long-term evolution TPM 2.0 device with an I²C interface



VFQFPN32
(5 × 5 mm)



TSSOP28
(9.7 × 6.4 mm,
4.4 mm body width)

Features

TPM features

- Flash-memory-based Trusted Platform Module (TPM)
- For TPM 2.0, compliant with Trusted Computing Group (TCG) Trusted Platform Module (TPM) Library specifications 2.0, Level 0, Revision 138 and TCG PC Client Specific TPM Platform Specifications 1.03
- Fault-tolerant firmware loader that keeps the TPM fully functional when the loading process is interrupted (self-recovery)
- SP800-193 compliant for protection, detection and recovery requirements
- Targeted certifications:
 - CC according to TPM 2.0 PP at EAL4+ (with AVA_VAN.5), resistant to high potential attacks
 - FIPS 140-2 level 2 (physical security level 3)
 - TCG certification
- I²C support at up to 400 kHz
- Supports up to 4 GPIOs mapped on NV storage indices

Hardware features

- Arm® SecurCore® SC300™ 32-bit RISC core
- Highly reliable Flash memory technology
- Extended temperature range: -40 °C to 105 °C
- ESD (electrostatic discharge) protection up to 4 kV (HBM)
- 1.8 V or 3.3 V supply voltage range

Security features

- Active shield and environmental sensors
- Monitoring of environmental parameters (power)
- Hardware and software protection against fault injection
- FIPS compliant RNG built on an SP800-90A compliant SHA256 DRBG and an AIS-31 Class PTG2 compliant true random number generator (TRNG)
- Cryptographic algorithms:
 - RSA key generation (1024 or 2048 bits)
 - RSA signature (RSASSA-PSS, RSASSAPKCS1v1_5)
 - RSA encryption (RSAES-OAEP, RSAESPKCS1-v1_5)
 - SHA-1, SHA-2 (256 and 384 bits), SHA-3 (256 and 384 bits)
 - HMAC SHA-1, SHA-2 and SHA-3
 - AES-128, 192 and 256 bits
 - TDES-192 bits
 - ECC (NIST P-256, P-384 curves): key generation, ECDH and ECDSA, EC-Schnorr
 - ECDA (BN-256 curve)
- Device provided with 3 EK and EK certificates (RSA2048, ECC NIST P_256 and ECC NIST P_384)

Product status link

[ST33TPHF2XI2C](#)



- Device provisioned with 3 RSA key pairs to reduce the TPM provisioning time

Product compliance

- TPM 2.0 compliant with Microsoft® Windows® Internet of things (IoT) core
- Compliant with TCG test suite for TPM 2.0

1 Description

The STSAFE-TPM (trusted platform module) family of products offers a broad portfolio of standardized solutions for embedded, PC, mobile and computing applications. STSAFE is an ST trademark.

It includes turnkey products compliant with the Trusted Computing Group (TCG) standards that provide services to protect the confidentiality, integrity and authenticity of information and devices.

These devices are easy to integrate thanks to the variety of supported interfaces and the availability of TPM ecosystem software solutions.

The STSAFE-TPM devices are all Common Criteria (EAL4+) and FIPS certified.

They embed an Arm® SecurCore® SC300™ processor with additional security features to help protect against advanced forms of attack.

The ST33TPHF2XI2C offers an I²C interface compliant with the TCG PC Client TPM Profile specifications.

It offers resilience services during the TPM firmware upgrade process, and self-recovery of TPM firmware and critical data upon failure detection.

The ST33TPHF2XI2C operates in the –25 to +85 °C commercial temperature range at 1.8 V, or in the –40 °C to 105 °C extended temperature range at 3.3 V.

The device is offered in TSSOP28 and VFQFPN32 ECOPACK2 packages. ECOPACK is an ST trademark.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

arm



Signal	Type	Description
PIRQ	Output	Parallel IRQ used by the TPM to generate an interrupt
RESET	Input	Reset used to re-initialize the device
GPIO_C	Input/ output	General-purpose input/output. Defaults to low. The GPIO function could be modified by activating GPIOs mapped on the NV storage index feature.
GPIO_D	Input/ output	General-purpose input/output. Defaults to low. The GPIO function could be modified by activating GPIOs mapped on the NV storage index feature.
GPIO_PP	Input	Physical Presence , active high, internal pull-down. Used to indicate Physical Presence to the TPM. The GPIO function could be modified by activating GPIOs mapped on the NV storage index feature.
GPIO_LP	Input	By default: Used for activation and deactivation of the TPM Standby mode (not found). The GPIO function could be modified by activating GPIOs mapped on the NV storage index feature.
NiC	-	Not internally connected : not connected to the die. May be left unconnected, but has no impact on the TPM if connected.

Note: The VQFN32 package has a central pad (PIN33) on the bottom that is not connected to the die. This pin can be connected or left unconnected with no impact on the TPM.

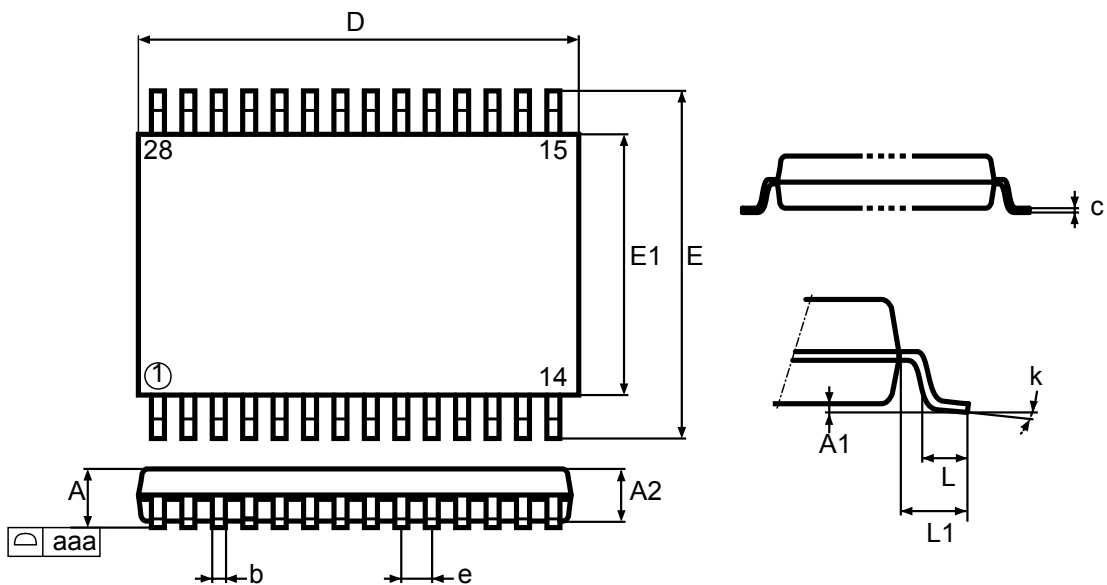
3 Package information

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.

3.1 TSSOP28 package information

TSSOP28 is a 28-pin, 9.7 × 6.4 mm, 4.4 mm body width, 0.65 mm pitch, thin shrink small outline package. Unless otherwise specified, general tolerance is ± 0.1 mm.

Figure 3. TSSOP28 - outline



1. Drawing is not to scale.

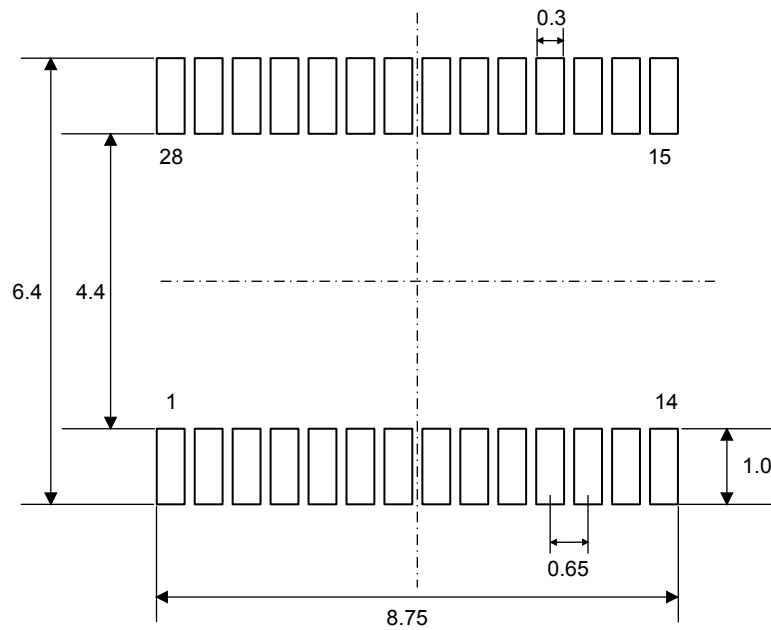
Table 2. TSSOP28 - mechanical data

Symbol	millimeters			inches ⁽¹⁾		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	-	-	1.200	-	-	0.0472
A1	0.050	-	0.150	0.0020	-	0.0059
A2	0.800	1.000	1.050	0.0315	0.0394	0.0413
b	0.190	-	0.300	0.0075	-	0.0118
c	0.090	-	0.200	0.0035	-	0.0079
D	9.600	9.700	9.800	0.3780	0.3819	0.3858
E	6.200	6.400	6.600	0.2441	0.2520	0.2598
E1	4.300	4.400	4.500	0.1693	0.1732	0.1772
e	-	0.650	-	-	0.0256	-
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1	-	1.000	-	-	0.0394	-

Symbol	millimeters			inches ⁽¹⁾		
	Min.	Typ.	Max.	Min.	Typ.	Max.
k	0°	-	8°	0°	-	8°
aaa	-	-	0.100	-	-	0.0039

1. Values in inches are converted from mm and rounded to 4 decimal digits.

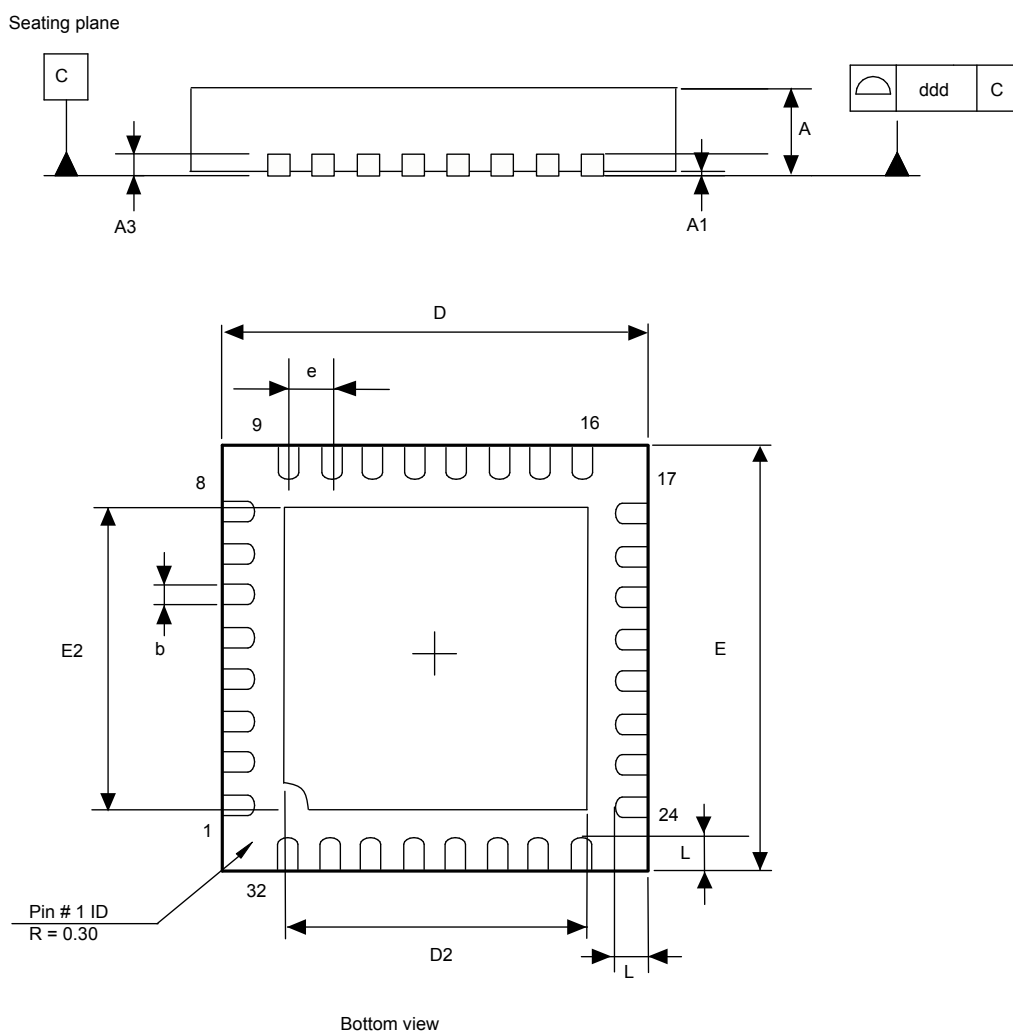
Figure 4. TSSOP28 - recommended footprint



1. All dimensions are in millimeters.

3.2 VFQFPN32 package information

VFQFPN32 is a 32-lead, 5 × 5 mm, 0.5 mm pitch, very thin fine pitch quad flat pack no-lead package.

Figure 5. VFQFPN32 - outline


1. Drawing is not to scale.

Table 3. VFQFPN32 - mechanical data

Symbol	millimeters			inches ⁽¹⁾		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.800	0.900	1.000	0.0315	0.0354	0.0394
A1	0.000	0.020	0.050	0.0000	0.0008	0.0020
A3	-	0.200	-	-	0.0079	-
b	0.180	0.250	0.300	0.0071	0.0098	0.0118
D	4.850	5.000	5.150	0.1909	0.1969	0.2028
D2	3.500	3.600	3.700	0.1378	0.1417	0.1457
E	4.850	5.000	5.150	0.1909	0.1969	0.2028
E2	3.500	3.600	3.700	0.1378	0.1417	0.1457
e	-	0.500	-	-	0.0197	-

3.3 Thermal characteristics of packages

The table below provides the thermal characteristics of the TSSOP28 and VFQFPN32 packages.

Table 4. Thermal characteristics

Parameter		Symbol	Value
Recommended operating temperature range	Ambient temperature	T_A	-40 to 105 °C
	Case temperature	T_C	-
	Junction temperature	T_J	-43 to 108 °C
Absolute maximum junction temperature		-	125 °C
Maximum power dissipation		-	63 mW
Theta-JA, -JB and -JC	Junction to ambient thermal resistance	θ_{JA}	35.8 at 0 lfpm ⁽¹⁾
	Junction to case thermal resistance	θ_{JC}	1.48 at 0 lfpm ⁽¹⁾
	Junction to board thermal resistance	θ_{JB}	13.9 at 0 lfpm ⁽¹⁾

1. Linear feet per minute.

4 Delivery packing

Surface-mount packages can be supplied with tape and reel packing. The reels have a 13" typical diameter. Reels are in plastic, either anti-static or conductive, with a black conductive cavity tape. The cover tape is transparent anti-static or conductive.

The devices are positioned in the cavities with the identifying pin (normally Pin "1") on the same side as the sprocket holes in the tape.

The STMicroelectronics tape and reel specifications are compliant to the EIA 481-A standard specification.

Table 5. Packages on tape and reel

Package	Description	Tape width	Tape pitch	Reel diameter	Quantity per reel
TSSOP 28	Thin shrink small outline package	16 mm	8 mm	13 in.	2500
VFQFPN 32	Very thin fine pitch quad flat pack no-lead package	12 mm	8 mm	13 in.	3000

Figure 7. Reel diagram

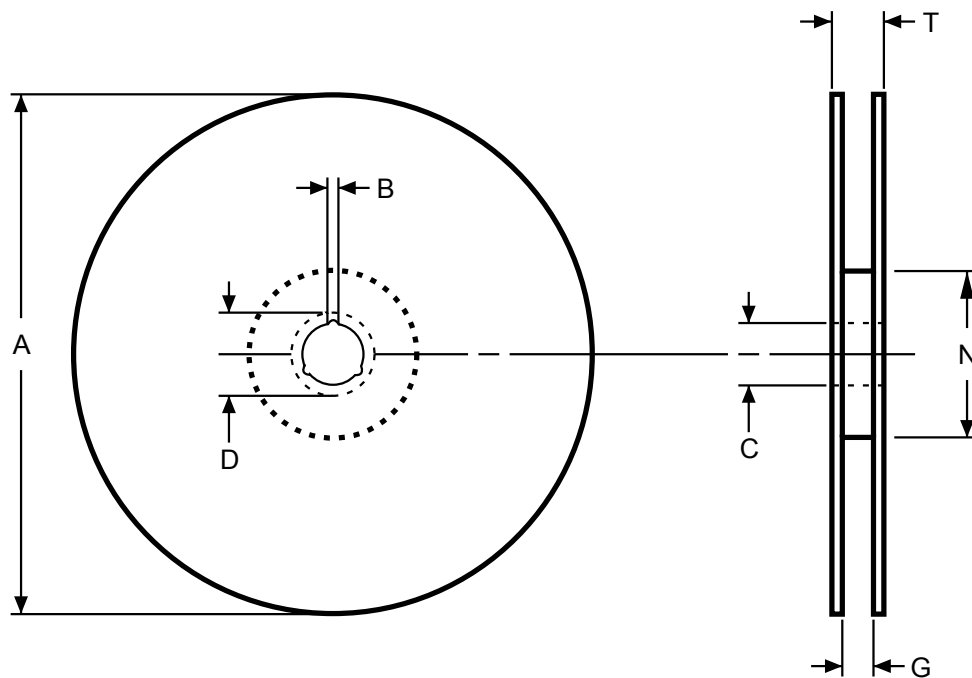
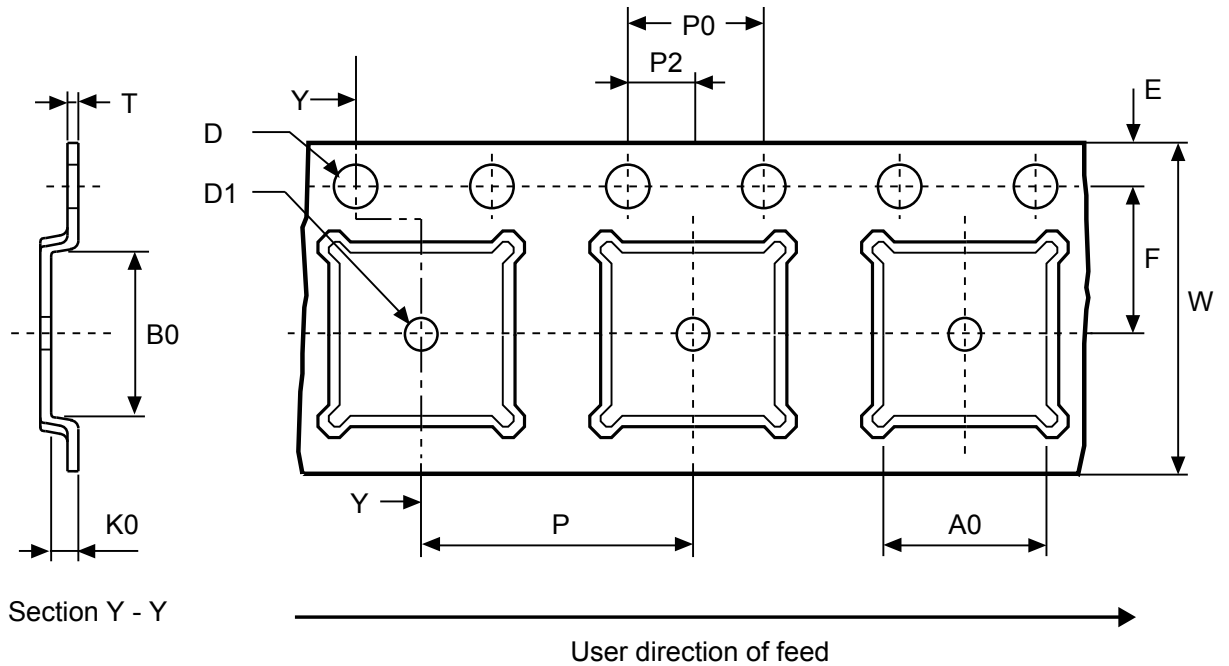


Table 6. Reel dimensions

Reel size	Tape width	A Max.	B Min.	C	D Min.	G Max.	N Min.	T Max.	Unit
13"	16	330	1.5	13 ±0.2	20.2	16.4 +2/-0	100	22.4	mm
	12					12.6		18.4	

Figure 8. Embossed carrier tape for VFQFPN 5 × 5 mm



1. Drawing is not to scale.

Figure 9. Chip orientation in the embossed carrier tape for VFQFPN 5 × 5 mm

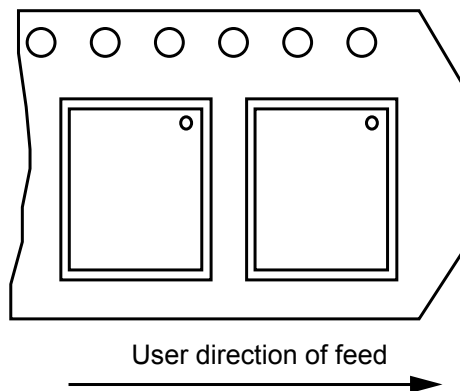
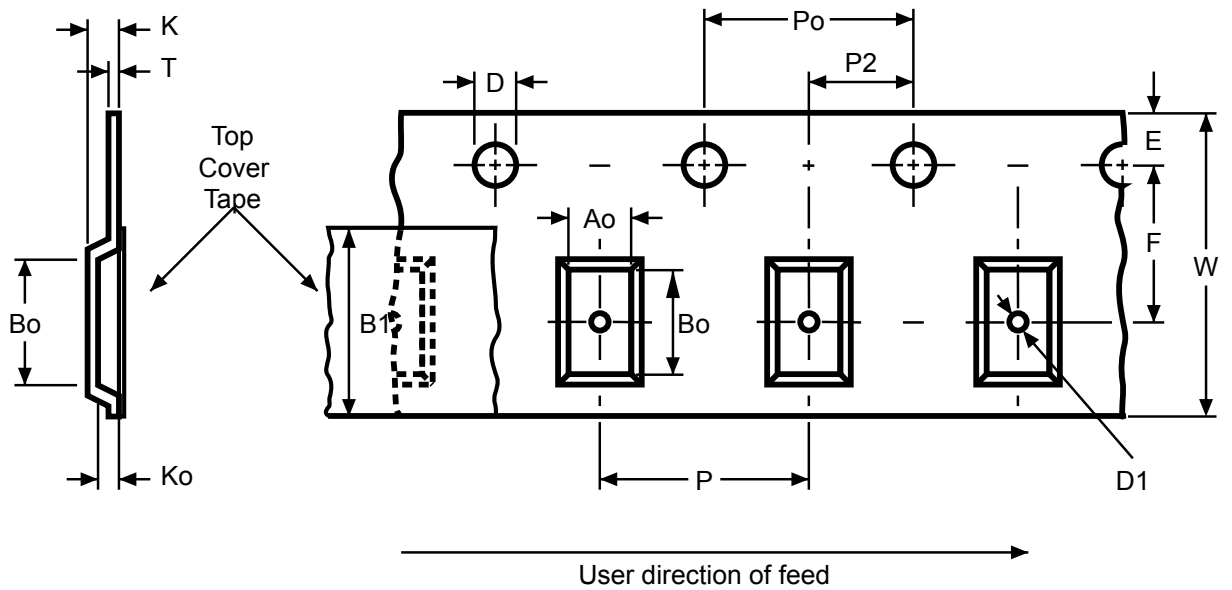
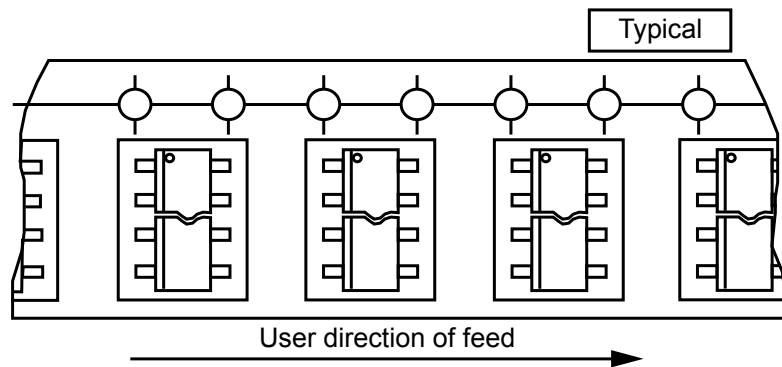


Table 7. Carrier tape dimensions for VFQFPN 5 × 5 mm

Package	A0	B0	K0	D1 Min.	P	P2	D	P0	E	F	W	T Max.	Unit
VFQFPN 5x5	5.25 ±0.1	5.25 ±0.1	1.1 ±0.1	1.5	8 ±0.1	2 ±0.1	1.55 ±0.05	4 ±0.1	1.75 ±0.1	5.5 ±0.1	12 ±0.3	0.3 ±0.05	mm

Figure 10. Embossed carrier tape for TSSOP28 4.4 mm body width


1. Drawing is not to scale.

Figure 11. Chip orientation in the embossed carrier tape for TSSOP28 4.4 mm body width

Table 8. Carrier tape constant dimensions for TSSOP 4.4 mm body width

Tape size	Ao, Bo, Ko ⁽¹⁾	D	E	Po	T Max.	Unit
16 mm	See note.	1.5 +0.1 / -0	1.75 ±0.1	4 ±0.1	0.4	mm

1. Ao, Bo, Ko, are determined by components sizes. The clearance between the component and the cavity must be within 0.05 mm (Min.) to 0.90 mm (Max.)

5 Package marking information

The two figures below illustrate the typical markings of the TSSOP28 and the VQFN32 device packages, respectively.

Figure 12. TSSOP28 device package marking area

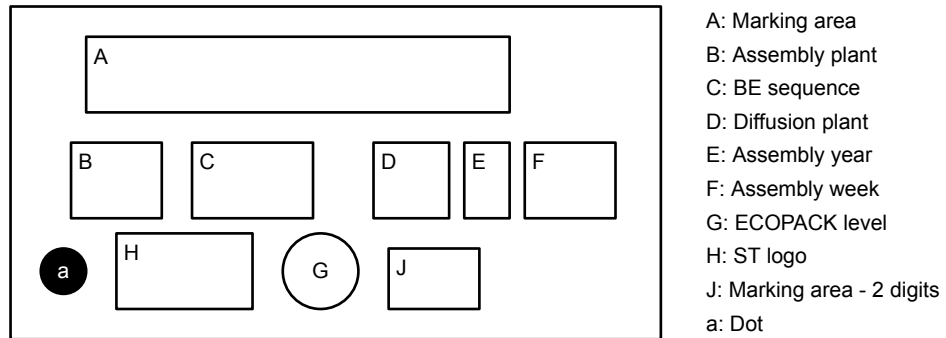
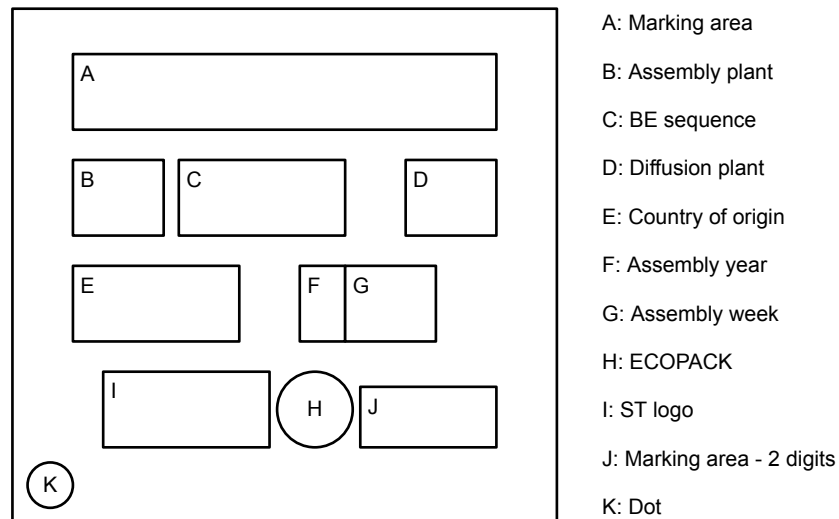


Figure 13. VQFN32 device package marking area



For both packages, the 6-digit 'A' marking area is equal to "PXYZZZ", with:

- Y = Hardware revision
- ZZZ = Product identifier

6 Ordering information

Table 9. Ordering information for ST33TPHF2XI2C products

Ordering code	Firmware version	Operating temperature range	Maximum I ² C clock frequency	Package	Marking (area A)	Minimum ordering quantity	Product status
ST33HTPH2X28AHC5	0x00.0x02.0x01.0x00 (0x0002.0x0100) (2.256)	-40 °C to +105 °C	400 kHz	TSSOP28	PXAHC5	2500	Active
ST33HTPH2X32AHC5				VQFN32		3000	
ST33HTPH2X32AHD5	0x00.0x02.0x.01.0x10 (0x0002.0x0110) (2.272)			VQFN32	PXAHD5	3000	Active and recommended for new design

7 Support and information

Additional information regarding ST TPM devices can be obtained from the www.st.com website.
For any specific support information you can contact STMicroelectronics through the following e-mail:
TPMsupport@list.st.com.

Appendix A Terms and abbreviations

Table 10. List of abbreviations

Term	Meaning
AES	Advanced Encryption Standard
CC	Common Criteria
DAM	Dictionary attack mitigation mechanism
Data byte	Byte from the TPM command or answer or register value.
DES	Data Encryption Standard
DRBG	Deterministic random bit generator
EC	Elliptic curve
ECC	Elliptic curve cryptography
ECDA	Elliptic curve direct anonymous attestation
ECDH	Elliptic curve Diffie–Hellman
ECDSA	Elliptic curve digital signature algorithm
EK	Endorsement key
FIPS	Federal Information Processing Standard
GPIO	General-purpose I/O
HMAC	Keyed-Hashing for Message Authentication
I ² C	Inter IC interface (Philips protocol)
IoT	Internet of things
NIST	National Institute of Standards and Technology
NV	Non-volatile (memory)
OAEP	Optimal asymmetric encryption padding
PKCS	Public key cryptographic standards
PSS	Probabilistic signature scheme
RNG	Random number generator
RSA	Rivest Shamir Adelman
RSAES	Rivest Shamir Adelman encryption/decryption scheme
RSASSA	Rivest Shamir Adelman signature scheme with appendix
SHA	Secure Hash algorithm
TCG	Trusted Computed Group
TDES	Triple Data Encryption Standard
TPM	Trusted Platform Module
TRNG	True random number generator

Revision history

Table 11. Document revision history

Date	Version	Changes
09-Dec-2019	1	Initial release.
18-Jun-2020	2	Updated TPM features. Replaced IRQ with PIRQ in Pin descriptions. Updated Section 6 Ordering information.

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