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ST87M01

Datasheet

Ultra-compact, low-power NB-IoT industrial module series with GNSS capability

Product status link

ST87M01

Product label

SUSTAINABLE TECHNOLOGY

Product label

LONGEVITY 15 YEARS COMMITMENT

Features

- LTE, category NB2, Release 15
- Worldwide regional band coverage
- Single tone/Multi tone/Extended TBS and 2 HARQ
- Up to DL: 127 kbps, UL: 159 kbps
- eDRX and PSM support
- Ultralow power mode 1.2 uA typical (0.5 uA typical in power-off)
- Ultra-compact size
- Embedded IoT internet protocols
- Differential FOTA support
- Up to 23 dBm power-out
- Multiple I/F and GPIO
- GCF certified
- RED certified
- Optional eSIM GSMA compliant with an additional secure element
- Optional GNSS and A-GNSS

Description

The ST87M01 is a high-performance, fully programmable, ultra-compact, low-power, certified LTE Cat NB2 NB-IoT and GNSS industrial module series offering worldwide band coverage, with advanced security features.

1 General information

1.1 Acronyms and terms

Table 1. Definitions of terms

Term	Definition
PSM	Power Saving Mode
eDRX	Extended Discontinuous Reception
PA	Power amplifier
SIM / eSIM	Subscriber Identity Module / embedded Subscriber Identity Module
LDO regulator	Low Dropout regulator
MCU	Microcontroller Unit
RF	Radio frequency
DFOTA	Differential FOTA

1.2 Reference documents

The documents listed in Table 2 provide further information.

Table 2. Reference documents

Reference	Document
[1]	3GPP TS 36.521-1

2 Product description

This section provides an overview of the principal technical data describing the ST87M01 narrow-band Internet of Things (NB-IoT) and GNSS cellular module family. An ultra-compact, ultralow power, cost-efficient, certified NB-IoT, and GNSS module family, offering multiband data transmission, is hereby introduced along with its super compact form factor.

2.1 Overview

The ST87M01 is a high-performance, with ultralow power consumption, NB-IoT (LTE Cat NB2) 3GPP Release 15 and GNSS certified module family.

The ST87M01 module family supports multifrequency bands, with an extended multiregional coverage, enabling almost complete worldwide NB-IoT data communication. In addition, the presence of the GNSS receiver allows to support multiple satellite constellations to address high-accuracy localization applications.

Moreover, the ultra-compact module form factor makes the ST87M01 family the perfect choice for size critical applications, allowing for miniaturization. In fact, the ultra-compactness is a crucial characteristic addressed by the ST87M01 family, hereby presented in an LGA package of only 10.6 mm x 12.8 mm (with 51 pins).

Furthermore, thanks to the ultralow power consumption and industrial qualification grade over the industrial temperature range, the ST87M01 family represents the best choice for a wide range of IoT applications: ranging from smart grid, energy smart metering, smart city, factory automation, industrial IoT, and asset tracking to any smart monitoring applications matching Low Power Wide Area Network (LPWAN) communication requirements.

In addition, the ST87M01 family can receive firmware updates and additional features via firmware upgrades over the air with optimized firmware upgrade procedures (Differential FOTA).

STMicroelectronics may update the firmware provided with the modules at any time. STMicroelectronics recommends that users regularly check for documentation and the current firmware version available at www.st.com/en/wireless-connectivity/st87m01.html.

Additionally, the ST87M01 family embeds PDU SMS service and internet protocols for NB-IoT products, including TCP/IP, TLS/DTLS, CoAP, LwM2M, MQTT, and HTTP/HTTPS, which enable a multiple and broad set of IoT applications.

Lastly, full support of Power Saving Mode (PSM) and Extended Discontinuous Reception (eDRX) mechanisms, along with ultralow power silicon technology adoption and a dedicated interface to wake up the module on an interrupt-base, allow the ST87M01 family to achieve an extra long battery life on a single cell primary battery.

The ST87M01 family is designed and qualified according to industrial grade: each manufactured module is fully tested, traced, and satisfies STMicroelectronics' stringent reliability and quality requirements, to meet the highest levels of product quality and reliability for 15 years of long-term use in the field.

2.2 Safety information

The ST87M01 is typically used in well-defined applications such as metering equipment, however it can be used in any application requiring NB-IoT connectivity so an assessment of the human risk associated with the usage of an RF cellular terminal should be done, and precautions must be observed, in all phases of the operations of the terminal incorporating the ST87M01, by the terminal manufacturer.

The terminal manufacturer must notify users and personnel of this safety information. STMicroelectronics is not liable if the terminal manufacturer does not properly notify the user of the precautions.

The ST87M01 is compliant with the normative related to EMC, RF exposure, and electrical safety listed in Section 5.2.1 Table 7, however the terminal manufacturer should verify the compliance with specific norms related to the specific application, considering also the following general precautions:

- Mobile communication equipment should not be used while driving according to specific laws and regulations.
- Wireless devices must be switched off on aircraft during the flight to prevent interference. More specific restrictions should be verified by airline staff.
- Wireless devices could create interference with some medical equipment.
- Cellular communication cannot be ensured in all network conditions. Emergency communication can be done only with adequate cellular signal strength.
- RF interference can occur if the terminal is used close to radios, computers, or other electric equipment.
- In areas with a risk of explosion, specific indications and signs must be followed.

2.3 Key features

Module family name

ST87M01

Cellular radio access technology

LTE Cat NB2, 3GPP Release 15

Hardware

Module form factor: metallic shielded LGA package (51 pin)

Dimensions [mm]: 10.6 x 12.8 x 2.4

LTE FDD certified frequency bands

B1, B3, B5, B8, B20, B28 selected for GCF certification over a hardware capability for almost WW coverage [B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/B20/B25/B26/B28/B65/B66/B70/B71/B85, supported by the same hardware]

Transmit power

Class-3: +23 dBm

Data transmission

Single tone: DL: 26 kbps, UL: 16 kbps

Multi-tone: DL: 26 kbps, UL: 66 kbps

Extended TBS and 2 HARQ (Cat NB2): DL: 127 kbps, UL: 159 kbps

Embedded protocol stacks

IPv6, TCP/UDP, CoAP/LWM2M, MQTT, HTPP/HTTPS, DTLS

Firmware upgrade

Host via UART and DFOTA over LWM2M, ext. SPI flash (for production only)

SMS

Only PDU mode

AT commands

3GPP & STMicroelectronics Extended AT commands

Interfaces

Control: reset and wake-up

Peripherals: 1xUSIM (1.8 V only), 2xUART, 2xI^2C, 1xSPI, up to 2xADC and 28xGPIO

RF ports: 50 Ω antennas for NB-IoT and GNSS

Localization services

Optional A-GNSS: GPS, Galileo, optimized concurrent mode

Optional eSIM with additional secure element

Typical power supply range

VIO: 1.8 V to 3.3 V

VPMU_x/VDCDC/VPA: 2.2 to 3.0 V (3.3 V under qualification)

Industrial grade: -40 °C to +85 °C

2.4 Product variants

ST87M01-ABCD is the product family name that is specified for each single PN as described below:

“A” indicates the subset of FDD certified frequency bands addressed by the specific PN.

“B” indicates the secondary mode of operation addressed by the specific PN.

“C” indicates the presence or absence of the eSIM for the specific PN.

“D” indicates specific application features.

Table 3. Ordering codes table

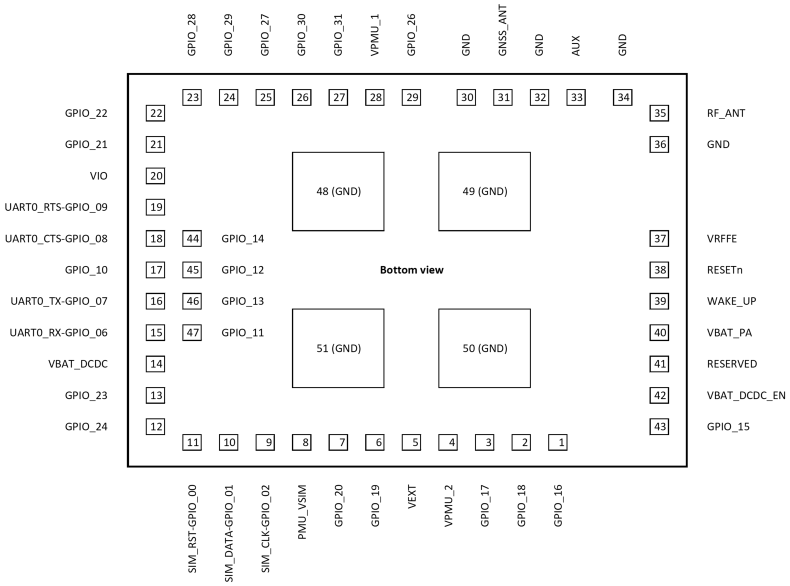
Commercial product	Description
ST87M01-1000	NB-IoT only (B1, B3, B5, B8, B20, B28 LTE bands)
ST87M01-1100	NB-IoT (B1, B3, B5, B8, B20, B28 LTE bands) and GPS

Commercial product	Description
ST87M01-1101	NB-IoT (B1, B3, B5, B8, B20, B28 LTE bands), GPS and extra ADC
ST87M01-1111	NB-IoT (B1, B3, B5, B8, B20, B28 LTE bands), GPS, Vodafone eSIM and extra ADC

3 Module pad

3.1 Pad assignment overview

Figure 1. ST87M01 pin assignment



4 SMT production guide

4.1 Reflow profile

Figure 2. **JEDEC STD020 reflow profile**

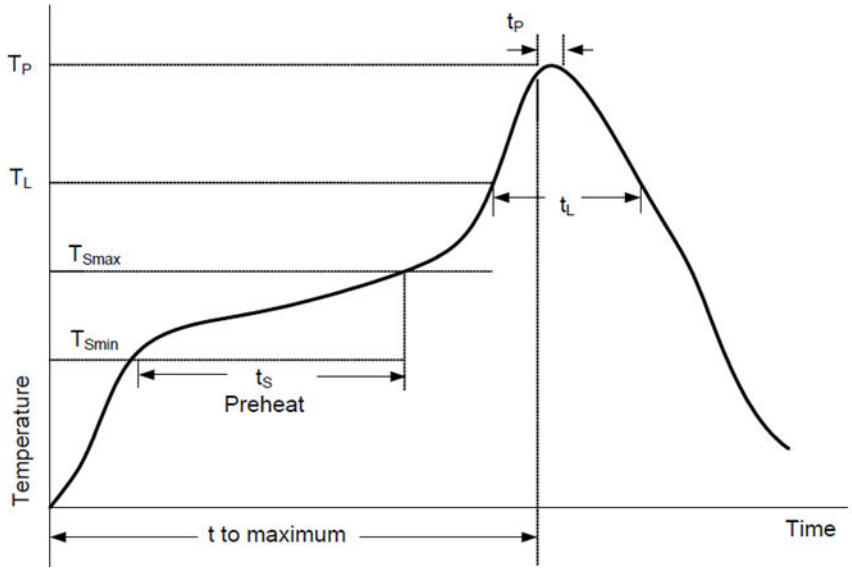


Table 4. **Reflow profile parameters**

Profile parameter	Value
Preheat time (t_s)	60 – 120 seconds
Preheat temperatures (Tsmin - Tsmax)	150 – 200 °C
T_L	217 °C
Total time above T_L	60 – 150 seconds
Peak temperature (T_P)	245 – 250 °C
Time within 5 °C of peak	30 – 40 seconds
Ramp-up (from 217 °C to peak)	0.0 – 3.0 degrees / seconds
Ramp-down (from peak to 217 °C)	-6.0 – -1.0 degrees / seconds
Time from 25 °C to peak	5 – 8 minutes

4.2 Baking requirements

The module is rated MSL3 as defined in JEDEC J-STD-020 and it is shipped in a sealed bag reporting the sealing date.

4.3 Module marking information

Figure 3. **Module marking information**

5 Environmental and certifications

5.1 Environmental specifications

Table 5. Operating condition

Parameter	Min.	Typ.	Max.	Unit
Extended operating temperature	-40		+85	°C

Note: In the extended operating temperature, the module remains fully functional during and after environmental exposure.

Table 6. Storage condition

Parameter	Min.	Typ.	Max.	Unit
Storage temperature	-40		+85	°C

Note: The module is delivered in tape and reel carriers and must be stored in sealed, moisture barrier, antistatic bags.

Note: The module is not powered.

5.2 Regulatory

The ST87M01 is designed to comply with the directives and standards listed in the following sections.

5.2.1 RED

RED certification covers the bands FDD 1, FDD 3, FDD 8, FDD 20, and FDD 28.

Table 7. RED information

EMC [Radio]	EMC testing according to: • EN 301 489-1 V2.2.3: common technical requirements • EN 301 489-19 V2.2.1: GNSS • EN 301 489-52 V1.2.1: LTE NB-IoT
RF [NB-IoT]	LTE NB-IoT RF conducted testing according to EN 301 908-13 V13.2.1
RF [NB-IoT]	LTE NB-IoT Radiated Spurious Emissions (RSE) testing according to EN 301 908-1 V15.1.1
RF [NB-IoT]	LTE NB-IoT RF conducted assessment according to EN 301 908-13 V13.2.1
RF [GNSS]	GNSS RF testing according to EN 303 413 V1.2.1 for the following constellations • GPS: L1
MPE	RF exposure report according to EN 62311:2020 standard
Safety	Electrical safety testing according to EN 62368-1:2014/AC:2015

The full text of the EU declaration of conformity is available online at the following address:
https://www.st.com/

5.2.2 GCF

GCF certification covers the bands FDD 1, FDD 3, FDD 5, FDD 8, FDD 20, and FDD 28.

Table 8. GCF information

RSE	LTE: 3GPP TS 36.124
LTE NB-IoT	RF: 3GPP TS 36.521-1 RRM: 3GPP TS 36.521-3 Protocol: 3GPP TS 36.523-2
UICC USIM/USAT	USIM: 3GPP TS 31.121 UICC (Electrical SIM): ETSI TS 102 230-1

5.3 RoHS directive compliance

Product meets EU RoHS requirement (RoHS Directive 2011/65/EU - 8 June 2011 – Annex II amended by delegated directive 2015/863 - 31 March 2015) without any exemptions.

6 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.

6.1 Mechanical information

Figure 4. POA (side and top view)

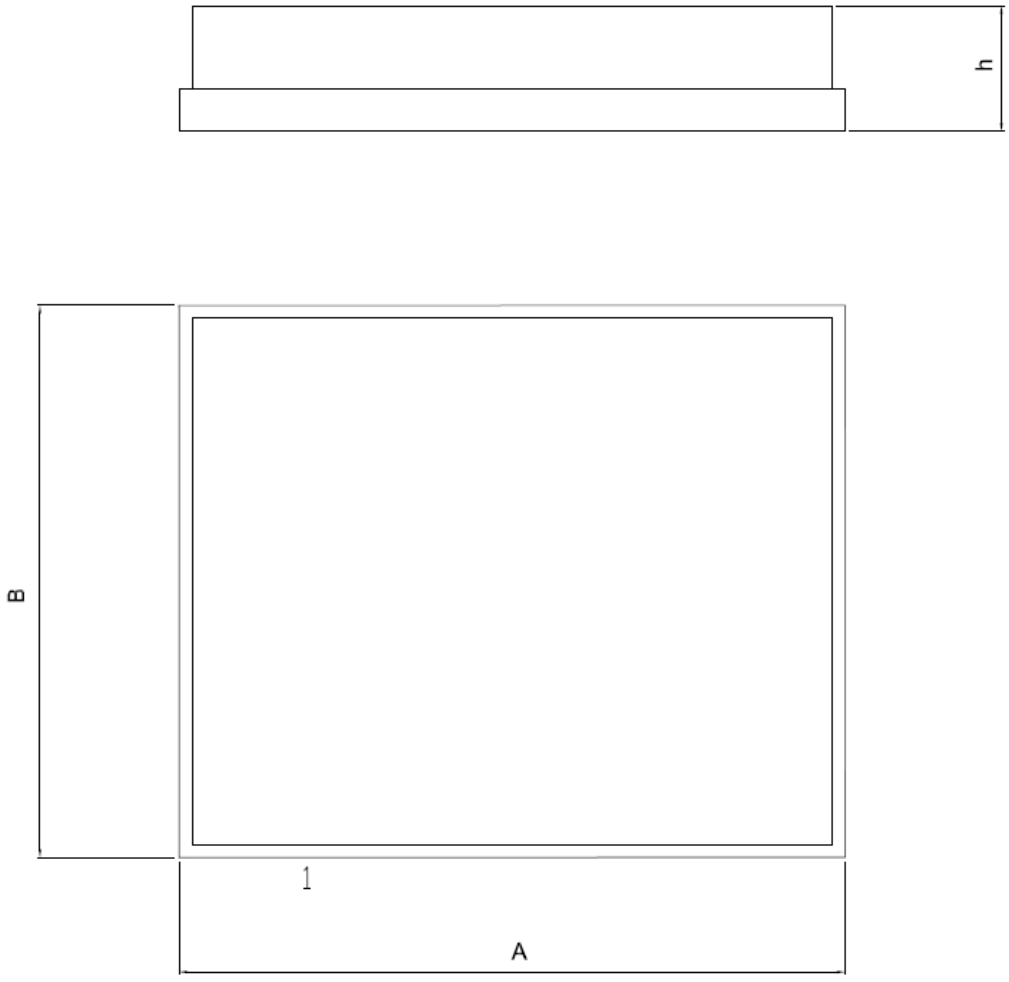


Figure 5. **POA (bottom view)**

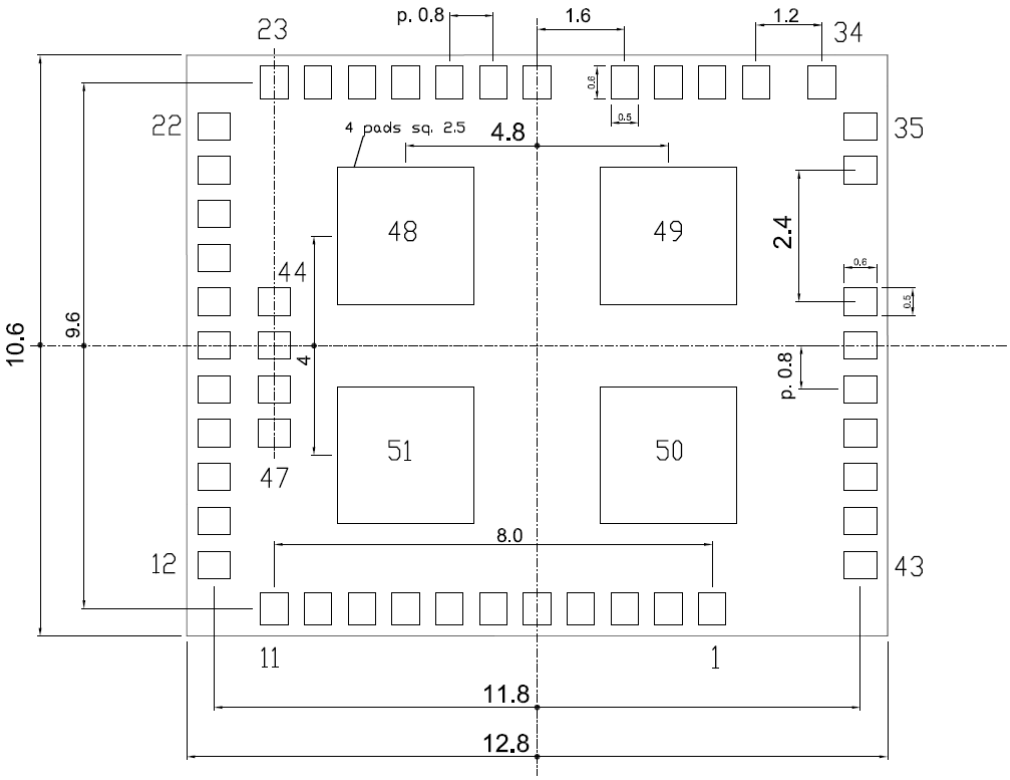
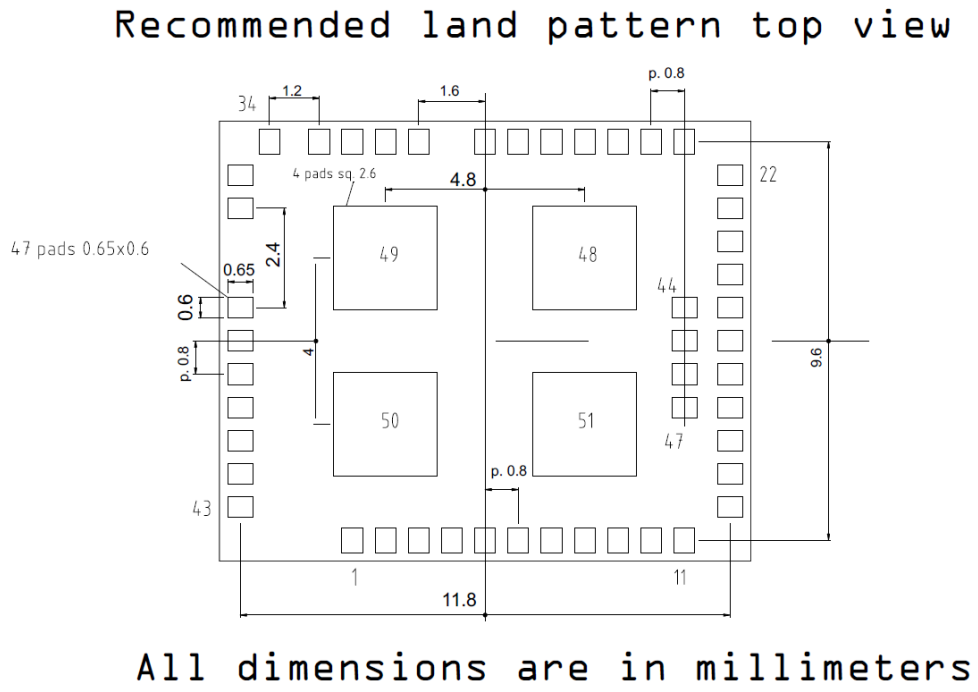


Table 9. **Mechanical dimensions**

Item	Dimensions (mm)	Tolerance (mm)
A	12.8	+/- 0.15
B	10.6	+/- 0.15
h (height)	2.4 nom.	+/- 0.2
Pad size	n 47 x (0.5x0.6)	
Pad size	n 4 x Sq. 2.5	
Pitch	See Figure 5. POA (bottom view)	

6.2 Footprint recommendation (land pattern)

Figure 6. **Land pattern (top view)**

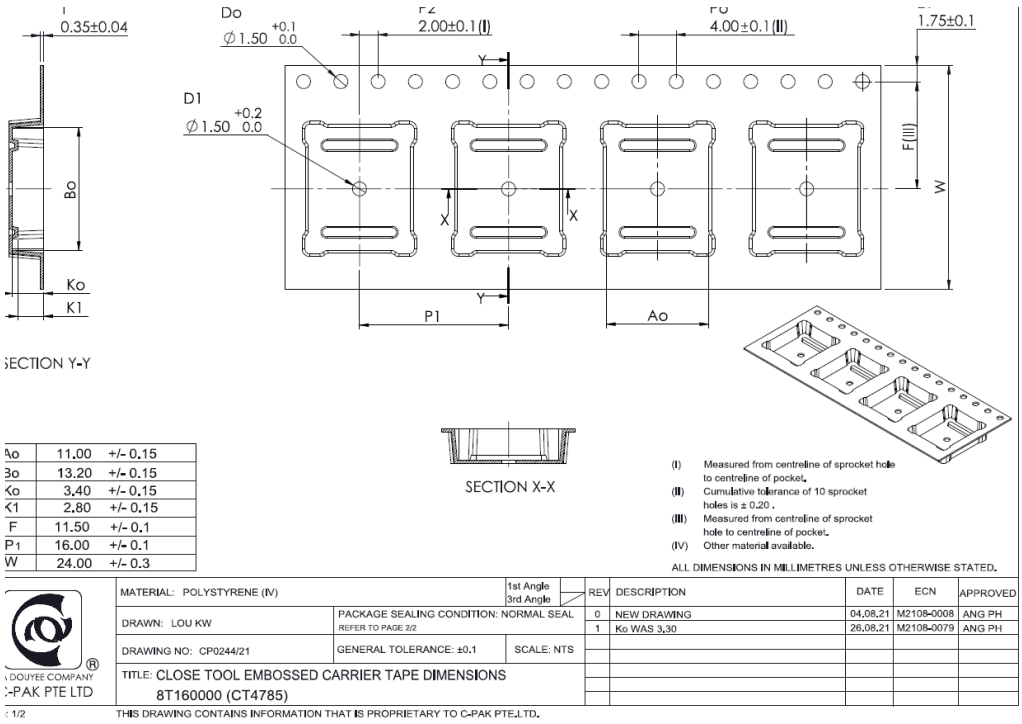


7 Packaging

The module is shipped in an ESD protected vacuum-sealed bag. The bag should be opened respecting the moisture sensitivity level specified in Section 4.2 Baking requirements.

7.1 Tape and reel packaging

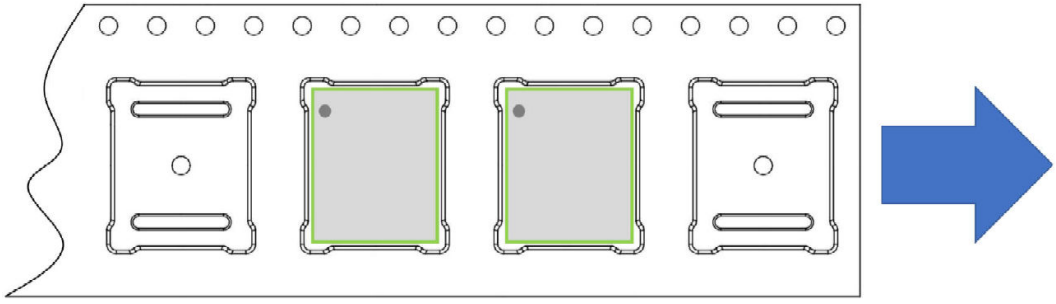
Figure 7. Tape dimensions (mm)



Ao	11.00	+/- 0.15
Bo	13.20	+/- 0.15
Ko	3.40	+/- 0.15
K1	2.80	+/- 0.15
F	11.50	+/- 0.1
P1	16.00	+/- 0.1
W	24.00	+/- 0.3

REV	DESCRIPTION	DATE	ECN	APPROVED
0	NEW DRAWING	04.08.21	M2108-0008	ANG PH
1	Ko WAS 3.30	26.08.21	M2108-0079	ANG PH

Figure 8. Module orientation in tape



8 Ordering information

Table 10. **Order codes**

Order code	Package
ST87M01-1000	LGA 51pins 10.6mm x 12.8mm
ST87M01-1100	LGA 51pins 10.6mm x 12.8mm
ST87M01-1101	LGA 51pins 10.6mm x 12.8mm
ST87M01-1111	LGA 51pins 10.6mm x 12.8mm

Revision history

Table 11. **Document revision history**

Date	Version	Changes
17-Jun-2024	1	Initial release.

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