

# **HY0020**

## **Bluetooth<sup>®</sup> low energy module with Slot Antenna Built into Shielded Package**

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- FDK Corporation is granted a license to use Slot Antenna on Shielded Package Technology patented by Toshiba Corporation.

Version	Date	Description
1.0	Apr.19, 2024	First edition issued
1.1	Jun.24, 2024	Figure7-5, Figure7-6 corrected
1.2	Oct.21, 2024	Table6-4 RF Specifications Maximum output power changed
2.0	May 29, 2025	Revision for compliance with FCC/ISED RF exposure requirements (sections 8.1.2.4 and 8.1.3.1)

## 1 Product Overview and Features

### 1.1 Product Overview

Bluetooth® low energy module with "Slot Antenna on Shielded Package Technology" is a 2.4GHz wireless communication (Bluetooth®) blank radio module with Nordic Semiconductor nRF52832. A basic protocol stack can be installed via Flash mounted on the IC, and various applications can be developed with this module alone. In addition, the module has acquired various radio and SIG certifications on its own, which simplifies various certifications for customers.

### 1.2 Features

- Slot Antenna on Shielded Package
  - Ultra-compact module with antenna pattern designed on the shield. Size: 3.5 x 10 x 1 mm
  - Large keep out areas are not required. World's smallest occupied area for printed circuit boards. (As of September 1, 2023. According to our research.)
- Bluetooth® ver.5.4 low energy conformity
  - Low energy 2 Mbps
  - Output power: +4 dBm to -20 dBm (4 dB step)
  - Sensitivity: -94 dBm (1 Mbps)
- Integrated Processor System
  - Arm® Cortex®-M4 32-bit processor with FPU, 64MHz
  - Flash 512KB
  - Soft Device (protocol stack) is offered
  - Serial wire debug (SWD)
- RAM 64KB
- Configurable 16 pin GPIO
  - UART, SPI, TWI (I2C), QDEC
  - Wake-up function for sleep and deep sleep
  - 4-channel PWM output for LED and buzzer control
  - PDM input for microphone
  - 12-bit, 200 ksps ADC - 6 configurable channels
- Flexible power management, fully automatic LDO and DC/DC regulator system
  - 1.7 V–3.6 V supply voltage range
  - Low power mode
    - ✧ 1.9 µA at 3 V in System ON mode, no RAM retention, wake on RTC
- Weight: 0.08 g (Typ.)

## 2 Outline

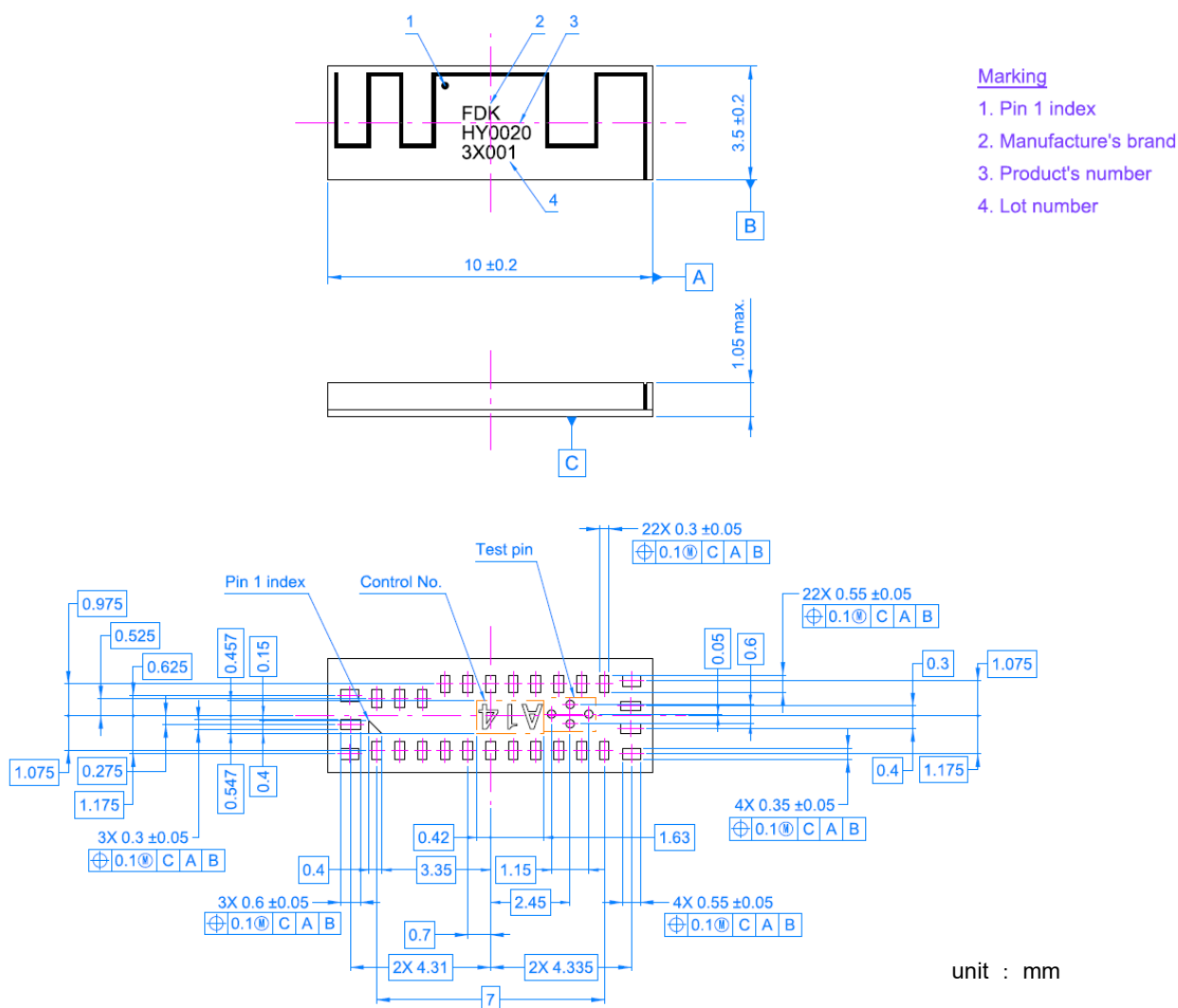


Figure 2-1 Outline

## 3 Block Diagram

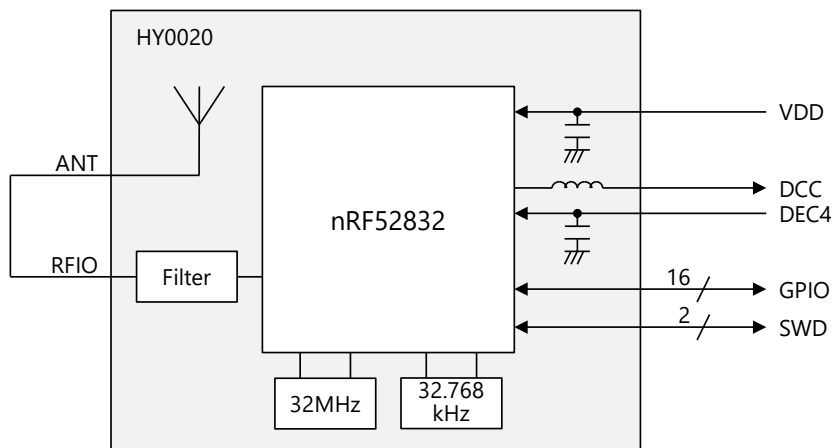


Figure 3-1 Block Diagram

## 4 Pin Definitions

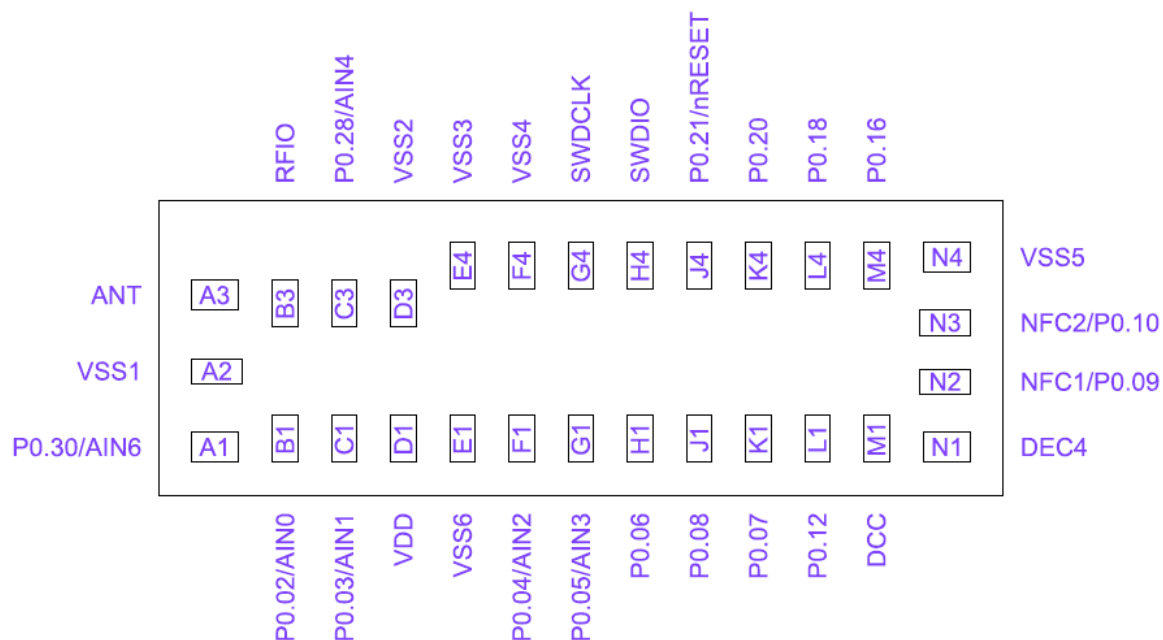


Figure 4-1 Pinout Diagram (Bottom View)

Table 4-1 Pinout

Pin	Name	Type	Description
J4	P0.21/nRESET	Digital I/O	General purpose I/O Configurable as pin reset
B3	RFIO		RF I/O pin. It should be connected to Pin A3.
A3	ANT		Internal antenna I/O pin. It should be connected to Pin B3. This product has a built-in 50 $\Omega$ matching circuit and antenna, so no additional external elements are required.
K4 L4 M4 L1 J1 K1 H1	P0.20 P0.18 P0.16 P0.12 P0.08 P0.07 P0.06	Digital I/O	General purpose I/O
A1 C3 G1 F1 C1 B1	P0.30/AIN6 P0.28/AIN4 P0.05/AIN3 P0.04/AIN2 P0.03/AIN1 P0.02/AIN0	Digital I/O Analog input	General purpose I/O SAADC/COMP/LPCOMP input
N3 N2	NFC2/P0.10 NFC1/P0.09	NFC input Digital I/O	NFC antenna connection General purpose I/O
G4	SWDCLK	Digital input	Serial wire debug clock input for debug and programming
H4	SWDIO	Digital I/O	Serial wire debug I/O for debug and programming
D1	VDD	Power	Power supply
M1	DCC	Power	DC/DC converter output
N1	DEC4	Power	1.3 V regulator supply decoupling. Input from DC/DC converter. Output from 1.3 V LDO.
E1 N4 F4 E4 D3 A2	VSS6 VSS5 VSS4 VSS3 VSS2 VSS1	Power	Ground

## 5 Reference Circuits

Connect the RFIO and ANT terminals with the shortest possible length of 50Ω transmission line. Connect the DCC and DEC4 pins as shown in Figure 5-1 when using the built-in LDO and Figure 5-2 when using the built-in DC/DC converter. Regardless of the circuit connection status, a register setting by software is required.

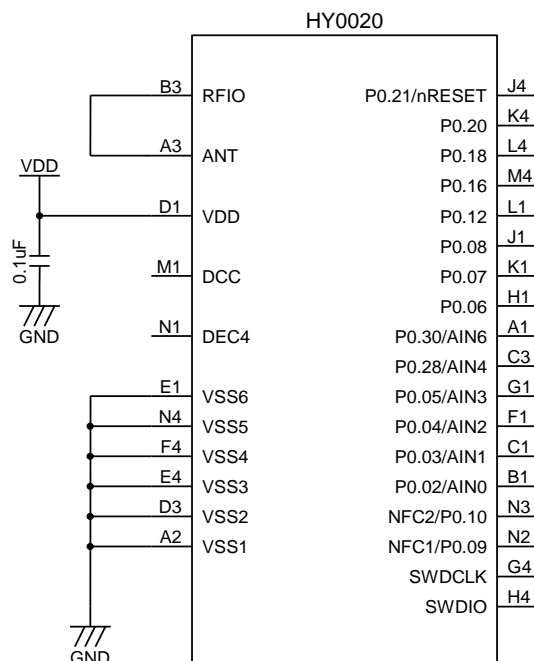


Figure 5-1 Built-in LDO regulator circuit example

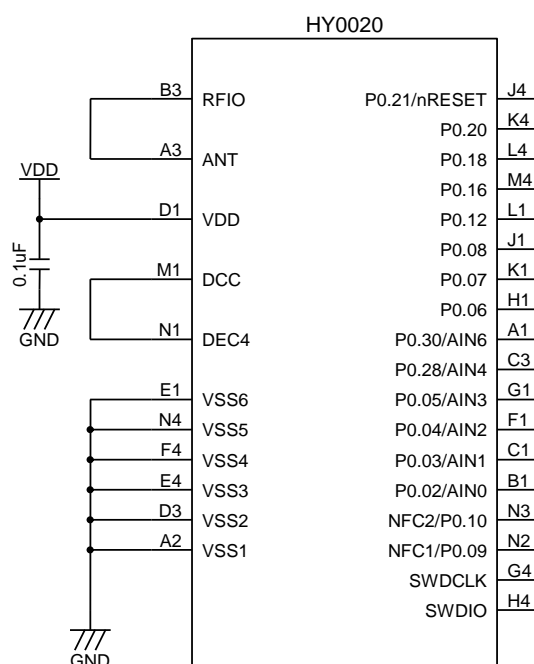


Figure 5-2 Built-in DC/DC converter circuit example

## 6 Electrical specification

### 6.1 Absolute maximum ratings

Absolute maximum ratings are standards that must not be exceeded even momentarily. Exceeding the absolute maximum ratings may cause deterioration or damage to internal components and may also destroy, damage, or degrade external circuits other than the module. The application equipment should be designed to ensure that the absolute maximum ratings are not exceeded under any operating conditions.

**Table 6-1 Absolute maximum ratings**

Parameter	Symbol	Condition	Min.	Max.	Unit
Supply voltage	VDD		-0.3	+3.9	V
I/O pin voltage	V <sub>I/O</sub>	VDD ≤ 3.6V	-0.3	VDD + 0.3	V
		VDD > 3.6V	-0.3	+3.9	V
RF input level	RFIO		-	+10	dBm
Storage temperature	Tstg		-40	+85	°C

\*1. VSS = GND = 0V

### 6.2 Recommended operating conditions

Recommended operating conditions refer to the conditions under which this product operates normally with a certain level of quality. If any one of the operating conditions is not met, the product may malfunction. Therefore, please ensure design of the applied equipment is such that the operating conditions of this product do not exceed the specified range of the operating conditions.

**Table 6-2 Recommended operating conditions**

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	VDD		1.7	3.0	+3.6	V
Supply rise time	t <sub>R VDD</sub>	0V to 1.7V	-	-	60	ms
Operating temperature	Ta		-40	+25	+85	°C

\*1. VSS = GND = 0V

\*2. Be sure to connect a bypass capacitor near the module for use.

\*3. The on-chip power-on reset circuitry may not function properly for rise times longer than the specified maximum.

\*4. After power off, it must start up from below 0.3V.



## 6.3 DC Specifications

The DC electrical characteristics at ambient operating temperature ( $T_a$ ) = 25°C, VDD = 3.0 V, and DC/DC = ON are shown in Table 6-3.

**Table 6-3 DC Specifications**

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input high voltage	$V_{IH}$		$0.7 \times VDD$	-	-	V
Input low voltage	$V_{IL}$		-	-	$0.3 \times VDD$	V
Output high voltage	$V_{OH}$	$I_{OH} = 5mA$	$VDD - 0.4$	-	-	V
Output low voltage	$V_{OL}$	$I_{OL} = 5mA$	-	-	0.4	V
Pull-up resistance	$R_{PU}$		11	13	16	kΩ
Pull-down resistance	$R_{PD}$		11	13	16	kΩ
TX only run current	$I_{TX1}$	DC/DC, $P_{RF} = +4dBm$	-	7.5	-	mA
	$I_{TX2}$	DC/DC, $P_{RF} = 0dBm$	-	5.3	-	mA
	$I_{TX3}$	LDO, $P_{RF} = +4dBm$	-	16.6	-	mA
	$I_{TX4}$	LDO, $P_{RF} = 0dBm$	-	11.6	-	mA
RX only run current	$I_{RX1}$	DC/DC, 1Mbps BLE	-	5.4	-	mA
	$I_{RX2}$	LDO, 1Mbps BLE	-	11.7	-	mA
Sleep current	$I_{sleep}$	System Off		0.3		uA

\*1. VSS = GND = 0V

## 6.4 RF Specifications

The RF electrical characteristics at ambient operating temperature ( $T_a$ ) = 25°C, VDD = 3.0 V, and DC/DC = ON are shown in Table 6-4.

**Table 6-4 RF Specifications**

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating frequencies	$f_{OP}$		2402		2480	MHz
Frequency deviation	$f_{\Delta 1M}$	BLE 1Mbps	-	±250	-	kHz
	$f_{\Delta 2M}$	BLE 2Mbps	-	±500	-	kHz
Maximum output power	$P_{RF}$		-	4	5.8	dBm
RF power control range	$P_{RFC}$		-	24	-	dB
1st Adjacent Channel Transmit Power 2MHz	$P_{RF1}$	2Mbps BLE mode	-	-20	-	dBc
2nd Adjacent Channel Transmit Power 4MHz	$P_{RF2}$	2Mbps BLE mode	-	-50	-	dBc
Receiver sensitivity 1Mbps BLE ideal transmitter	$P_{SENS\_1M\_DCDC}$	DC/DC	-	-93.5	-	dBm
	$P_{SENS\_1M\_LDO}$	LDO		-94.5		dBm
Receiver sensitivity 2Mbps BLE ideal transmitter	$P_{SENS\_2M\_DCDC}$	DC/DC	-	-90	-	dBm
	$P_{SENS\_2M\_LDO}$	LDO		-91		dBm

\*1. VSS = GND = 0V

## 7 Packaging

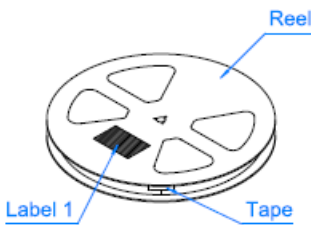
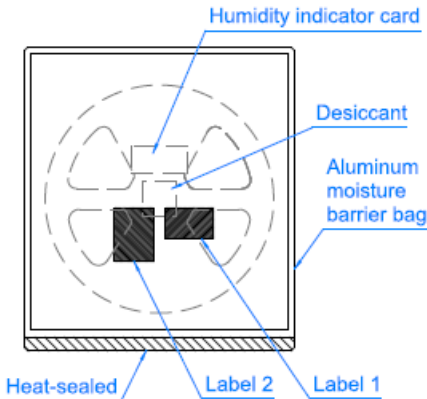
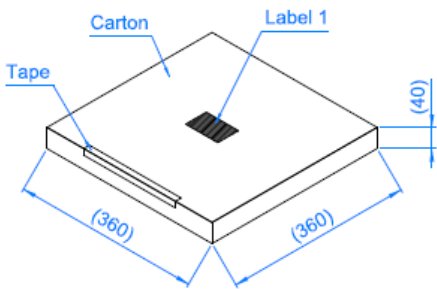
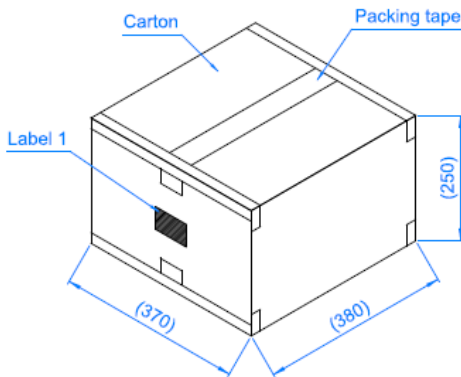
### 7.1 Packaging specifications

#### (1) Packaging materials

**Table 7-1 Packaging materials**

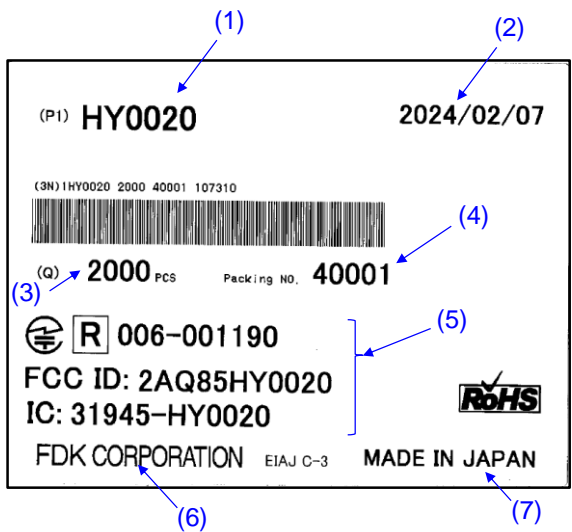
Name	Materials	Appearance	Note
Embossed carrier tape	Polystyrene	Figure 7-5	Conductivity
Cover tape	Polyethylene terephthalate Polyethylene Polystyrene		Antistatic
Reel	Polystyrene	Figure 7-6	Conductivity
Aluminum moisture barrier bag	Polyester		Antistatic
Desiccant	Silica gel		
Humidity indicator card			
Label			
Inner carton	Corrugated paper	Figure 7-1	
Outer carton	Corrugated paper	Figure 7-1	

#### (2) Packaging style

<p><b>1. Taping</b></p>  <p>Packing quantity: 2,000pcs</p>	<p><b>2. Aluminum moisture barrier bag</b></p>  <p>Packing quantity: 2,000pcs</p>
<p><b>3. Inner carton</b></p>  <p>Packing quantity: 2,000pcs</p> <p>unit = mm</p>	<p><b>4. Outer carton</b></p>  <p>Packing quantity: 10,000pcs max. (5 inner cartons max.)</p> <p>unit = mm</p>

**Figure 7-1 Packaging style**

(3) Label



(1)	Product's number	HY0020
(2)	Packing date (yyyy/mm/dd)	2024/02/07
(3)	Quantity	2,000pcs
(4)	Packing NO.	40001
(5)	Certification ID Japan: USA (FCC): Canada (ISED):	006-001190 2AQ85HY0020 31945-HY0020
(6)	Manufacturer	FDK CORPORATION
(7)	Country of origin	MADE IN JAPAN

Figure 7-2 Label 1

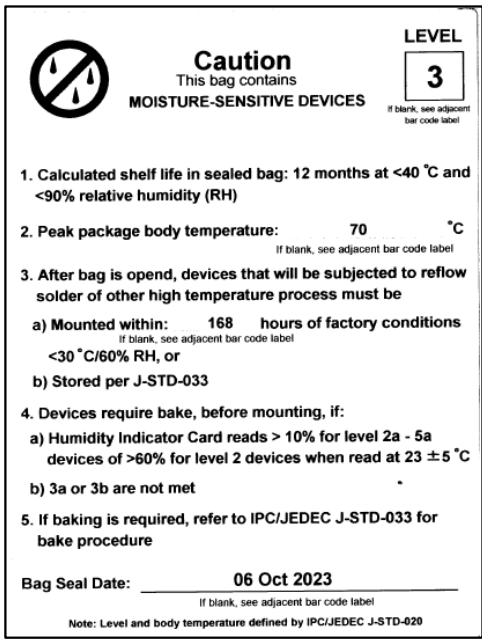


Figure 7-3 Label 2

## 7.2 Tape specifications

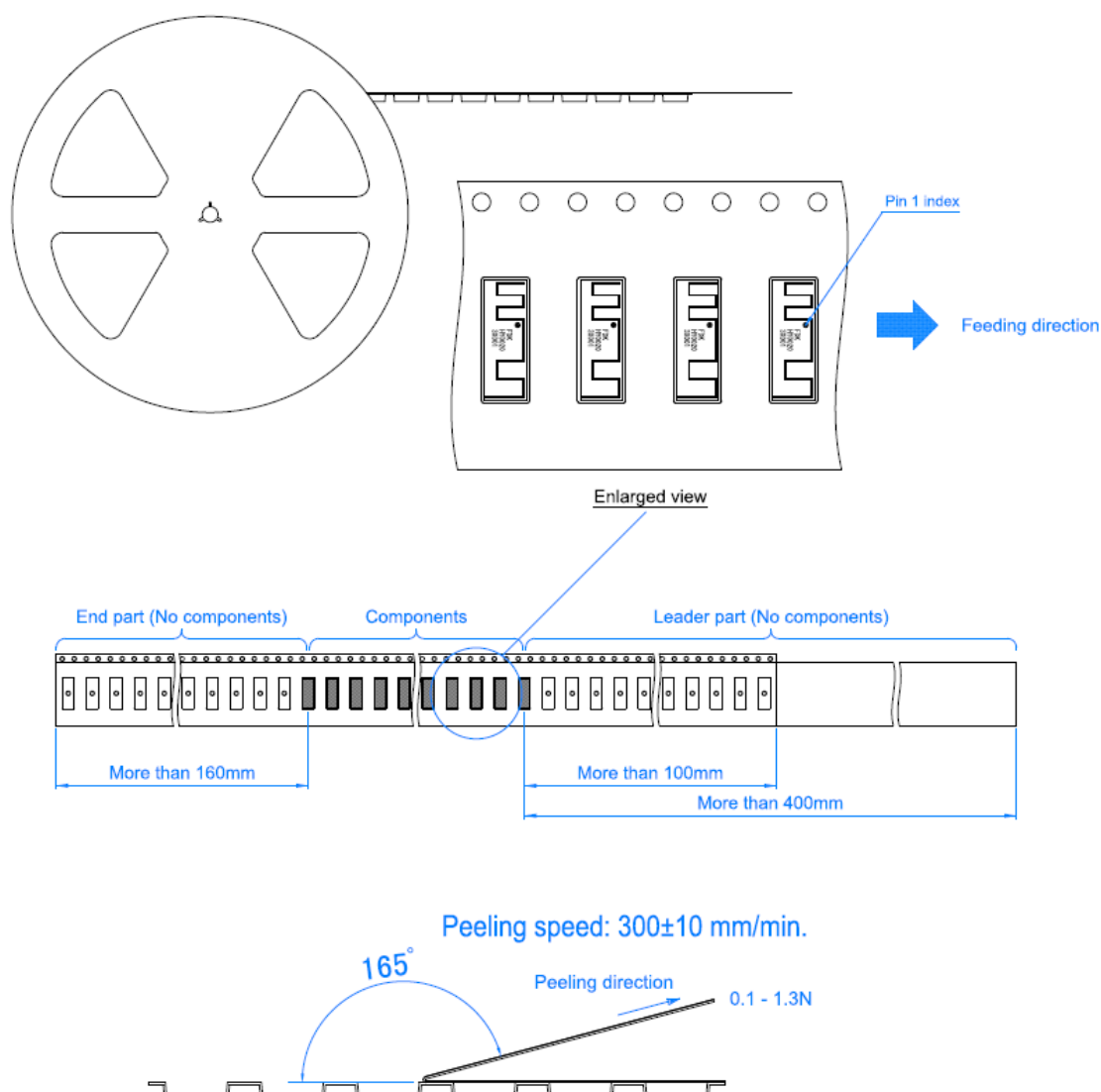
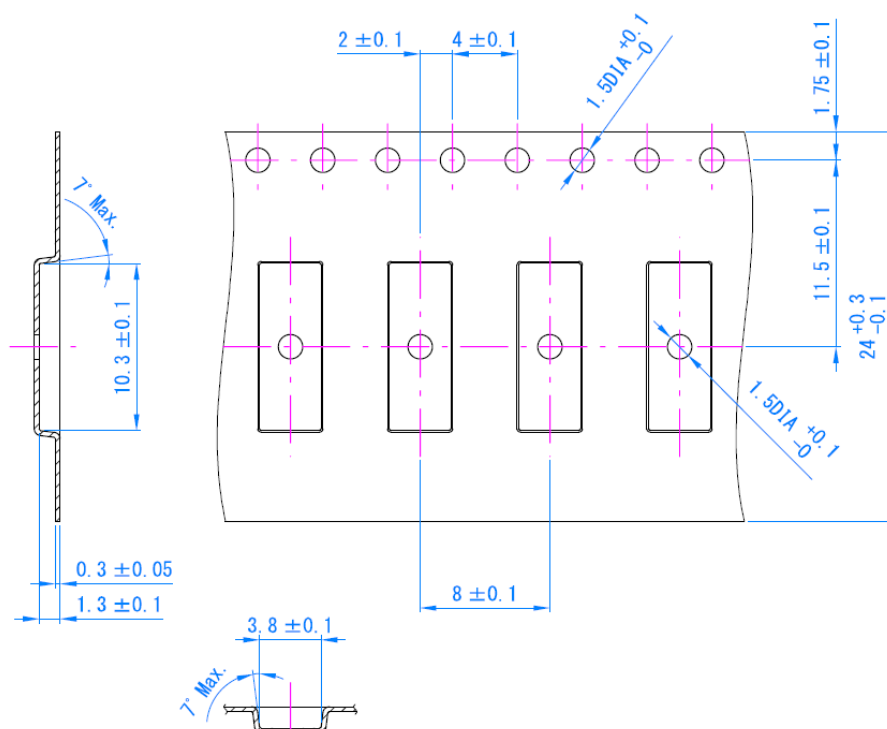


Figure 7-4 Tape specifications

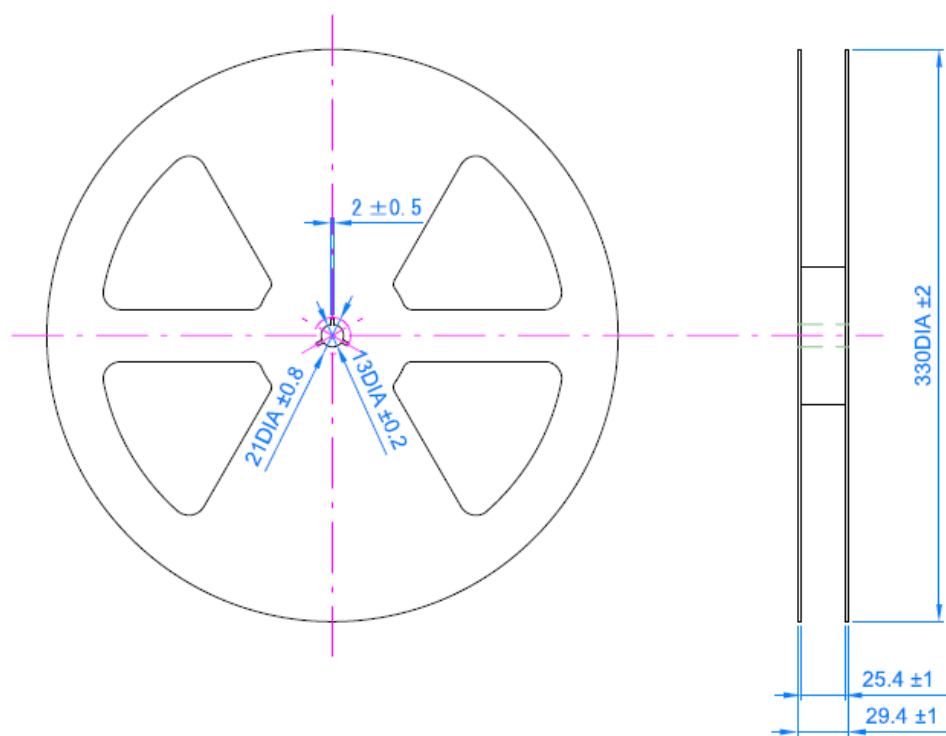
## 7.3 Dimensions of Embossed carrier tape



unit : mm

Figure 7-5 Embossed carrier tape dimensions

## 7.4 Dimensions of Reel



unit : mm

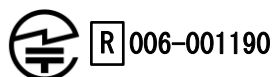
Figure 7-6 Reel dimensions

## 8 Certification/Qualification information

### 8.1 Radio Certification

#### 8.1.1 Japan

This product has obtained construction design certification as a radio station for low-power data communication system based on the Radio Law.



#### 8.1.2 USA (FCC)

##### 8.1.2.1 FCC Warning

###### 15.19 Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

###### 15.21 Information to user

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The Integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

##### 8.1.2.2 Limit module procedures

Not applicable

##### 8.1.2.3 Trace antenna designs

Not applicable

##### 8.1.2.4 FCC RF Radiation Exposure Statement

This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated, keeping the radiator at least 1mm or more away from the person's body.

##### 8.1.2.5 Labeling instruction for Host product integrator

The end product must carry a physical label or shall use e-labeling followed KDB784748D01 and KDB 784748 stating "Contains Transmitter Module FCC ID: 2AQ85HY0020

##### 8.1.2.6 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when contains digital circuitry.

### 8.1.2.7 FCC Statement

(OEM) Integrator has to assure compliance of the entire end-product incl. the integrated RF Module. For 15 B (§15.107 and if applicable §15.109) compliance, the host manufacturer is required to show compliance with 15 while the module is installed and operating.

Furthermore the module should be transmitting and the evaluation should confirm that the module's intentional emissions (15C) are compliant (fundamental / out-of-band). Finally the integrator has to apply the appropriate equipment authorization (e.g. Verification) for the new host device per definition in §15.101.

Integrator is reminded to assure that these installation instructions will not be made available to the end-user of the final host device.

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the FCC ID of the RF Module, such as "Contains FCC ID: 2AQ85HY0020

"Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

The Integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

### 8.1.2.8 Module statement

The single-modular transmitter is a self-contained, physically delineated, component for which compliance can be demonstrated independent of the host operating conditions, and which complies with all eight requirements of § 15.212(a)(1) as summarized below.

- 1) The radio elements have the radio frequency circuitry shielded.
- 2) The module has buffered modulation/data inputs to ensure that the device will comply with Part 15 requirements with any type of input signal.
- 3) The module contains power supply regulation on the module.
- 4) The module contains a permanently attached antenna.
- 5) The module demonstrates compliance in a stand-alone configuration.
- 6) The device is too small and therefore the FCC ID is in the manual in accordance with 2.925(f). Doing this complies with the labeling requirements in 15.212.
- 7) The module complies with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee.
- 8) The module complies with RF exposure requirements.

### 8.1.3 Canada (ISED)

#### 8.1.3.1 ISED Statement

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the IC of the RF Module, such as" Contains transmitter module IC: 31945-HY0020

Le périphérique hôte final, dans lequel ce module RF est intégré "doit être étiqueté avec une étiquette auxiliaire indiquant le CI du module RF, tel que" Contient le module émetteur IC: 31945-HY0020

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) L'appareil ne doit pas produire de brouillage;
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**Caution: Exposure to Radio Frequency Radiation**

1. To comply with the Canadian RF exposure compliance requirements, this device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

**Attention: exposition au rayonnement radiofréquence**

1. Pour se conformer aux exigences de conformité RF canadienne l'exposition, cet appareil et son antenne ne doivent pas être co-localisés ou fonctionnant en conjonction avec une autre antenne ou transmetteur.

2. To comply with RSS 102 RF exposure compliance requirements, this equipment should be installed and operated, keeping the radiator at least 1mm or more away from the person's body.

2. Pour se conformer aux exigences de conformité CNR 102 RF exposition, cet équipement doit être installé et utilisé en maintenant le radiateur à au moins 1mm ou plus du corps de la personne.

#### **8.1.4 EU (CE)**

This product complies with the following regulation tests.

ETSI EN300 328 V2.2.2

EN 62479: 2010

#### **8.2 Bluetooth® Qualification**

QDID: 232479

Product Type: Component (Tested)



## 9 Precautions

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 - equipment whose malfunction could endanger life or body, cause extensive property damage, or have a serious impact on society.  
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