

2.4 GHz telecommand module

NK-2.4Y



Operation Guide

Version 2.4 (June 2021)

- This product requires electrical and radio knowledge for setup and operation.
 - To ensure proper and safe operation, please read this operation guide thoroughly prior to use.
 - Please keep this operation guide for future reference.
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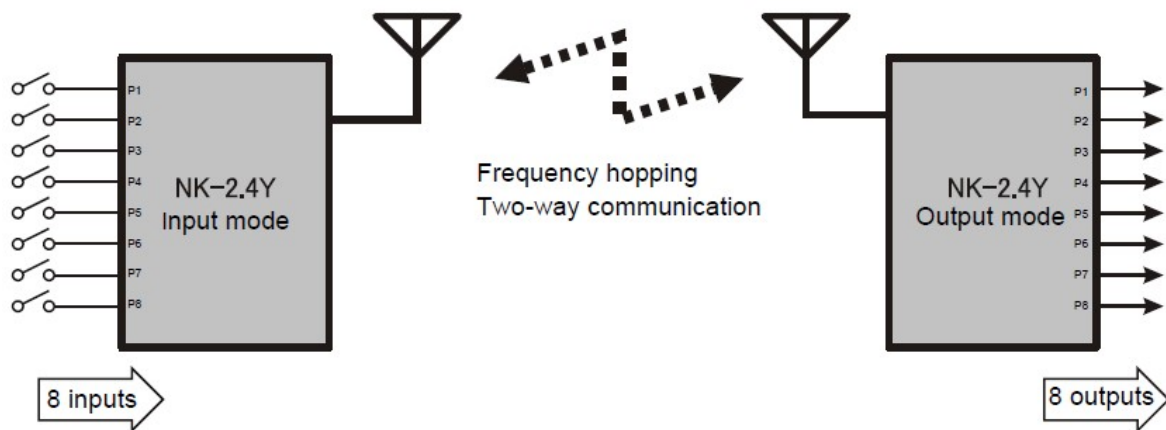
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1. Outline

The NK-2.4Y is a 2.4 GHz embedded telecommand module with 8 on/off signal inputs/outputs.

The NK-2.4Y transmits/receives on/off signal by pairing one module set to Input mode with another module set to Output mode. For example, you can connect button switches to the Input-mode module and drivers to the Output-mode module to control relays or motors.

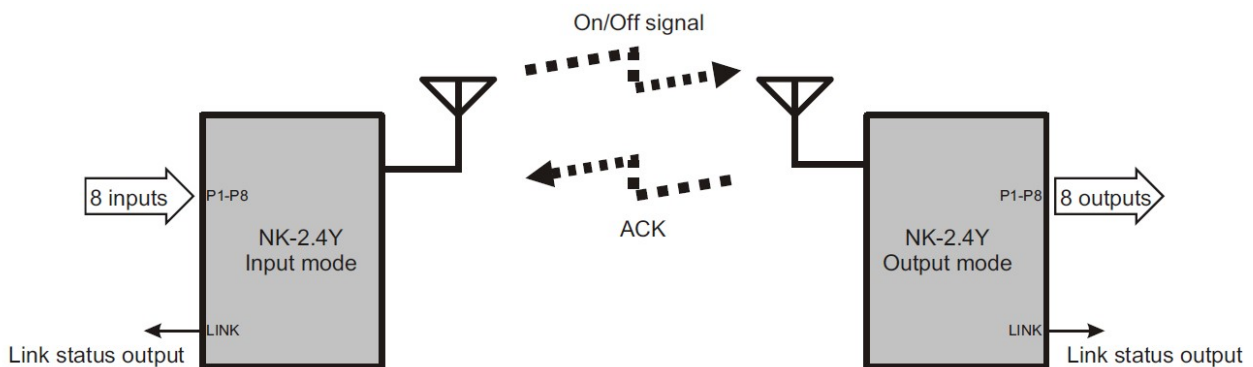


The NK-2.4Y operates with low voltage and low current consumption, achieving long time operation on two 1.5V AA batteries. Operation on one lithium coin battery (CR2032) is also possible.

The communication mode is 1:1 (Neither 1:N nor N:1 is possible) and the communication range is approx. 100 m LOS.

The NK-2.4Y performs fast two-way communication between the Input-mode module and Output-mode module by switching its transmission and reception to constantly confirm the link status.

The link status can be monitored through the use of the link status output terminal, which helps the user to stay within the signal coverage area.



It is also possible that the Output-mode module continuously outputs signal as long as the button switch connected to the Input-mode module is pressed.

The NK-2.4Y uses a frequency hopping scheme to avoid interference from other radio systems operating in 2.4 GHz and to provide robust wireless communication.

2. Features and applications

Features

- The module can be set to either Input mode or Output mode
- CRC-16 error detection
- Control a maximum of 8 on/off signals by connecting simple external circuits
- Achieves a hamming distance of 6 to minimize malfunction
- Communication range 100m LOS
- Battery operation on 2 x1.5 V AA batteries or 1 coin battery (CR2032) possible
- Communication status monitor via link status output
- Good response and continuous operability achieved by fast two way communication
- 1 : 1 communication only (Neither 1:N nor N:1 is possible)
- Low current consumption
- Frequency hopping scheme enabling simultaneous use of multiple systems within one area without concern about radio channel management

Applications

- Remote tail lifts on trucks
- Remote control of care lifts on welfare vehicles
- Shutter open and close

3. Main specifications

Item	Specification	Remarks
Compatible standards	FCC Part 15 / IC RSS-247 / EU EN 300 440 ARIB STD-T66	
Frequency range	2403 to 2479 MHz	
Communication method	Simplex	Two-way between the paired modules
RF output power	1.4 mW (+20%, -80%)	
Communication bit rate	250 kbps	
Hamming distance	6	
Operation mode	Input mode / Output mode	
Communication mode	1 : 1 (Input mode: Output mode)	
On/Off inputs/outputs	P1 to P8 (Input mode) P1 to P8 (Output mode)	
Input-Output response	30 to 60 ms	
Output holding time when communication shut off	400 ms (Typ.)	
Guaranteed operating voltage	DC 2.3 to 5.5 V	
Operation stop voltage	2.2 to 2.3 V	
Current consumption	Input mode: Typ. 3 mA ave. Output mode: Typ. 7mA ave. (when linked) Typ. 14mA ave. (during link search)	
Antenna	Internal pattern antenna or specified external antennas*	
Operating temperature range	-30 to +65 °C	
Weight	3.2 g	
External dimensions	35.3 x 17.8 x 3.5 mm	
Soldering conditions	Hand soldering Soldering iron temp.: 350°C within 3 seconds	

*For the detail of specified external antennas, refer to "Approved antenna list for NK-2.4Y".

Interface specifications

Item		Specification	Remarks
P1 to P8 inputs (Input mode) PM, SEL inputs	Input voltage range	-0.3 to REG+0.3 V	REG=Internal voltage 2.058 to 2.142 V
	L level threshold voltage	0.4 V (max)	
	H level threshold voltage	1.7 V (min)	
P1 to P8 outputs (Output mode) LINK, VLow outputs	Output voltage range	0.3 to REG+0.3 V	REG=Internal voltage 2.058 to 2.142 V
	L level output voltage	0.9 V (max)	I _{ol} =0.5 mA
	H level output voltage	1.1 V (min)	I _{oh} =-0.5 mA
CONT input	Threshold voltage for ON	1.5 V (min)	max.= V _{IN} +0.3V
	Threshold voltage for OFF	0.3 V (max)	
REG output current		10 mA (max)	V _{IN} ≥ 2.2 V
		80 mA (max)	V _{IN} ≥ 2.5V

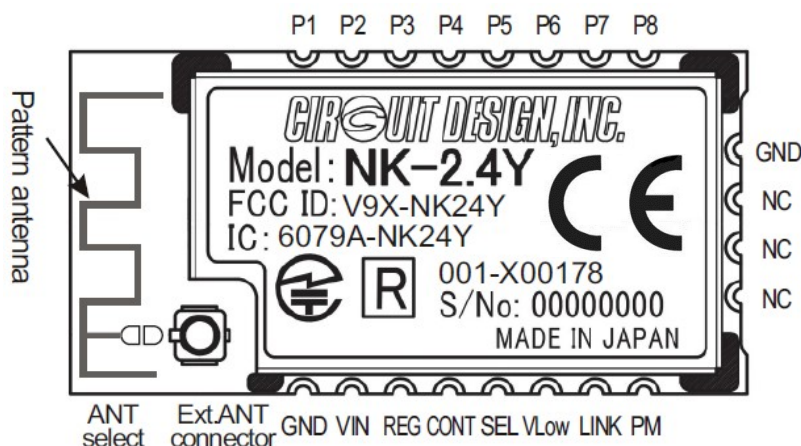
4. Operation mode setting

The NK-2.4Y has Input mode and Output mode and the mode can be set with the SEL terminal (see drawing below).

For Input mode, do not connect the SEL terminal.

For Output mode, connect the SEL terminal to GND.

*Operation mode setting is performed only when the module is turned on.



5. Method of antenna switching

With the NK-2.4Y, the internal pattern antenna or the specified external antennas* can be used. The factory setting is for use of the external antenna.

To use the internal pattern antenna, short out the ANT select JP (see drawing above).

To use an external antenna, leave the ANT select JP open and connect the antenna to the External ANT connector.

*For the detail of specified external antennas, refer to "Antenna list for NK-2.4Y".

6. Operating precautions

In the Input mode, the NK-2.4Y does not start communicating if it is turned on (CONT=VIN) while any input terminal is set to GND (for safety purpose during the power-on state). In this case, please set the terminal to Open and then turn it on again.

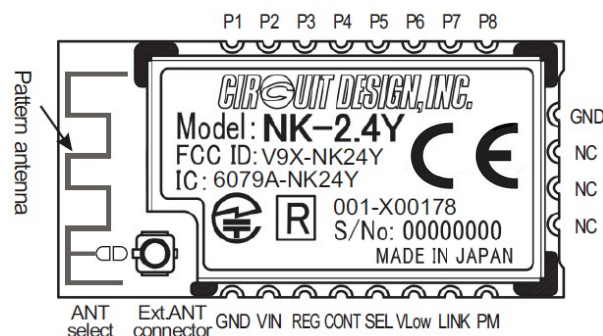
The VLow (low voltage detection) monitors the voltage of the CONT terminal. Note that the voltage of the VIN is not monitored. Use the same voltage for the CONT and VIN terminals, when the module is turned on.

When the NK-2.4Y which uses the internal pattern antenna is mounted on a PCB, any wiring pattern should be avoided from being placed close to the internal pattern antenna.

If the module is mounted on a PCB, use hand-soldering instead of reflow soldering.

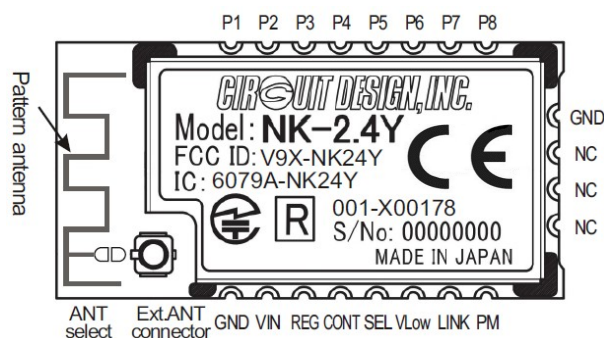
7. Terminal specifications

Input mode



Terminal Name	Description	Internal equivalent circuit
Ext.ANT connector	Connector for the external antenna Connector type : I-PEX MHF connector	
P1 to P8	On/Off signal input terminals. When connected to GND, the corresponding terminal of the Output-mode module outputs Low level.	
PM	Pairing mode setting terminal. Pairing mode is enabled when power (VIN) is applied with this terminal connected to GND.	
LINK	Link status output terminal. Linked: Low Link search: Low /High repeating (200ms/1300ms) Module not working: High For operation in the pairing mode, refer to '8. Pairing procedures'.	
VLow	CONT(VIN) voltage status output terminal (Low voltage detection) CONT > 2.3 V: High CONT = 2.3 to 2.2 V: Low /High repeating (200ms/1300ms) CONT < 2.2V: High For operation in the pairing mode, refer to '8. Pairing procedures'.	
SEL	Do not connect in the Input mode.	
CONT	Internal voltage supply ON/OFF terminal / Vlow detection terminal. Connecting this terminal to VIN turns on the internal circuit to start transmission.	
REG	This terminal outputs 2.1 V of the internal circuit voltage.	
VIN	Power supply terminal. DC 2.2 to 5.5 V	
GND	GND terminal.	
NC	Do not connect.	

Output mode



Terminal Name	Description	Internal equivalent circuit
Ext.ANT connector	Connector for the external antenna Connector type : I-PEX MHF connector	
P1 to P8	On/Off signal output terminals. Outputs Low level when the input terminal of the Input-mode module is connected to GND. In case of communication shutoff, High level is output after the elapse of the output holding time.	
PM	Pairing mode setting terminal. Pairing mode is enabled when the power (VIN) is applied with this terminal set to GND level.	
LINK	Link status output terminal. Linked: Low Link search: Low /High repeating (200ms/1300ms) Module not working: High For operation in the pairing mode, refer to '8. Pairing procedures'.	
VLow	CONT(VIN) voltage status output terminal (Low voltage detection) CONT > 2.3 V: High CONT = 2.3 to 2.2 V: Low /High repeating (200ms/1300ms) CONT < 2.2V: High For operation in the pairing mode, refer to '8. Pairing procedures'.	
SEL	Connect to GND to enable the Output mode.	
CONT	Internal voltage supply ON/OFF terminal / Vlow detection terminal. Connecting this terminal to VIN turns on the internal circuit to start transmission.	
REG	This terminal outputs 2.1 V of the internal circuit voltage.	
VIN	Power supply terminal DC 2.2 to 5.5 V	
GND	GND terminal	
NC	Do not connect.	

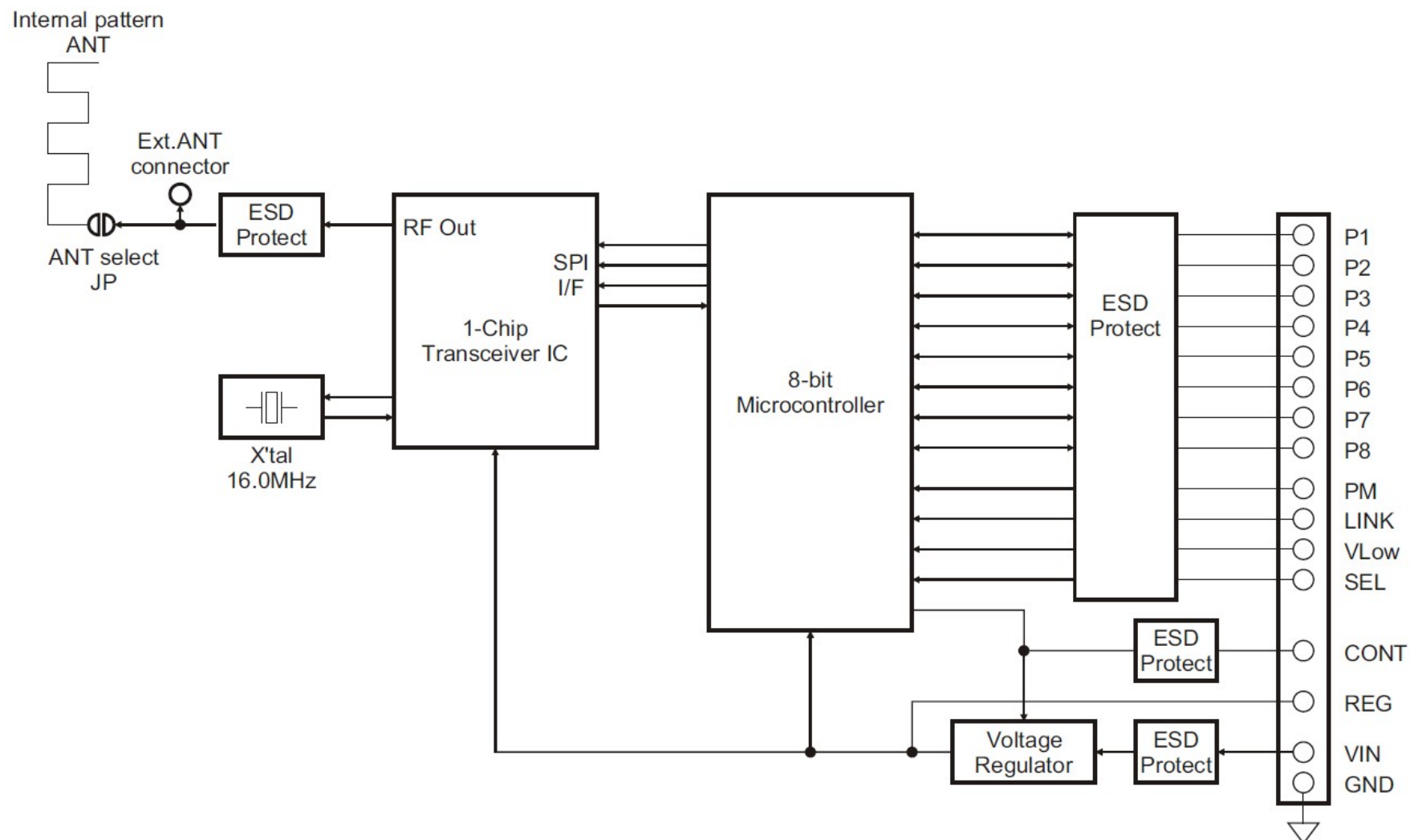
8. Pairing procedures

The NK-2.4Y operates in one-to-one communication.

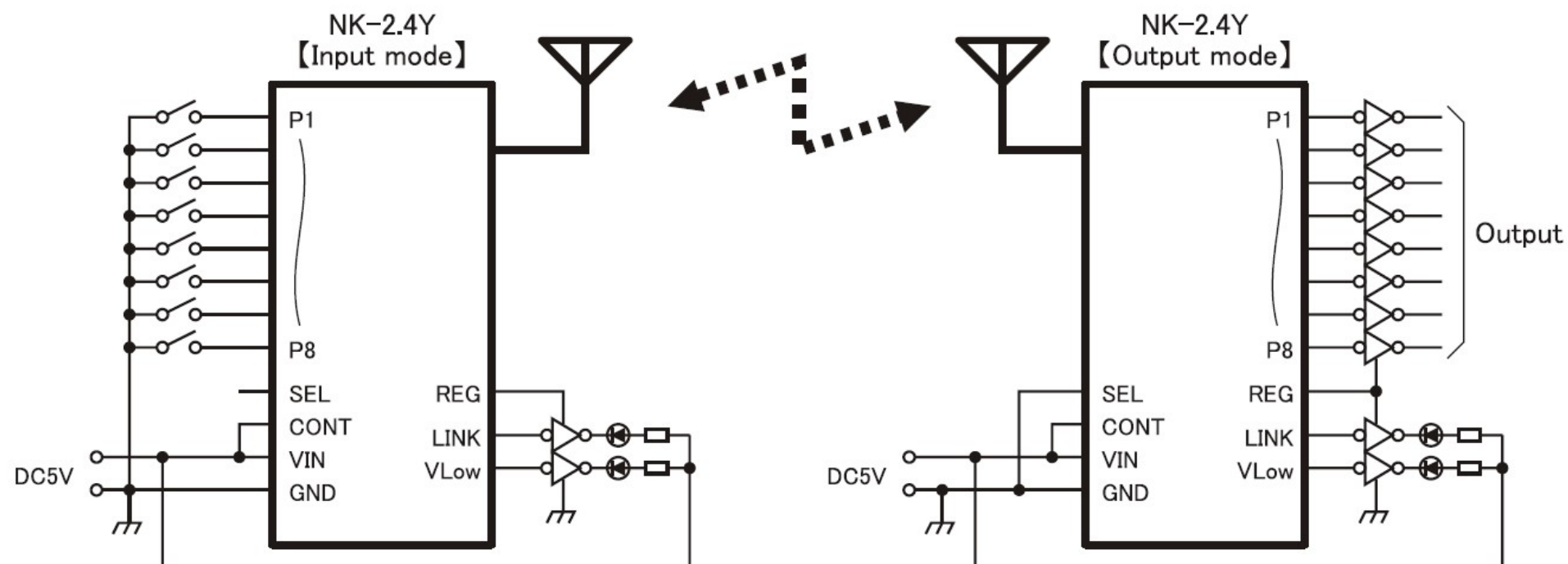
Pairing is needed between the Input-mode module and the Output-mode module before use.

	Input-mode module	Output-mode module
Step 1	Turn the power on while connecting the PM terminal to GND. ⇒ LINK: High, VLow: Low	Turn the power on while connecting the PM terminal to GND. ⇒ LINK: High, VLow: Low
Step 2	Set the PM terminal to Open	Set the PM terminal to Open <i>The module starts receiving for pairing.</i>
Step 3	Connect the P1 to GND. ⇒ LINK: Low, VLow: High <i>The module starts transmission for pairing.</i>	
Step 4		<i>The module receives pairing information from the Input mode module.</i> ⇒ LINK: Low, VLow: High
Step 5	Connect the P2 to GND. ⇒ LINK: Low, VLow: Low <i>The module sends pairing complete information.</i>	
Step 6		<i>The module receives pairing complete information.</i> ⇒ LINK: Low, VLow: Low <i>Pairing completed.</i>
Step 7	Turn off the power.	Turn off the power.

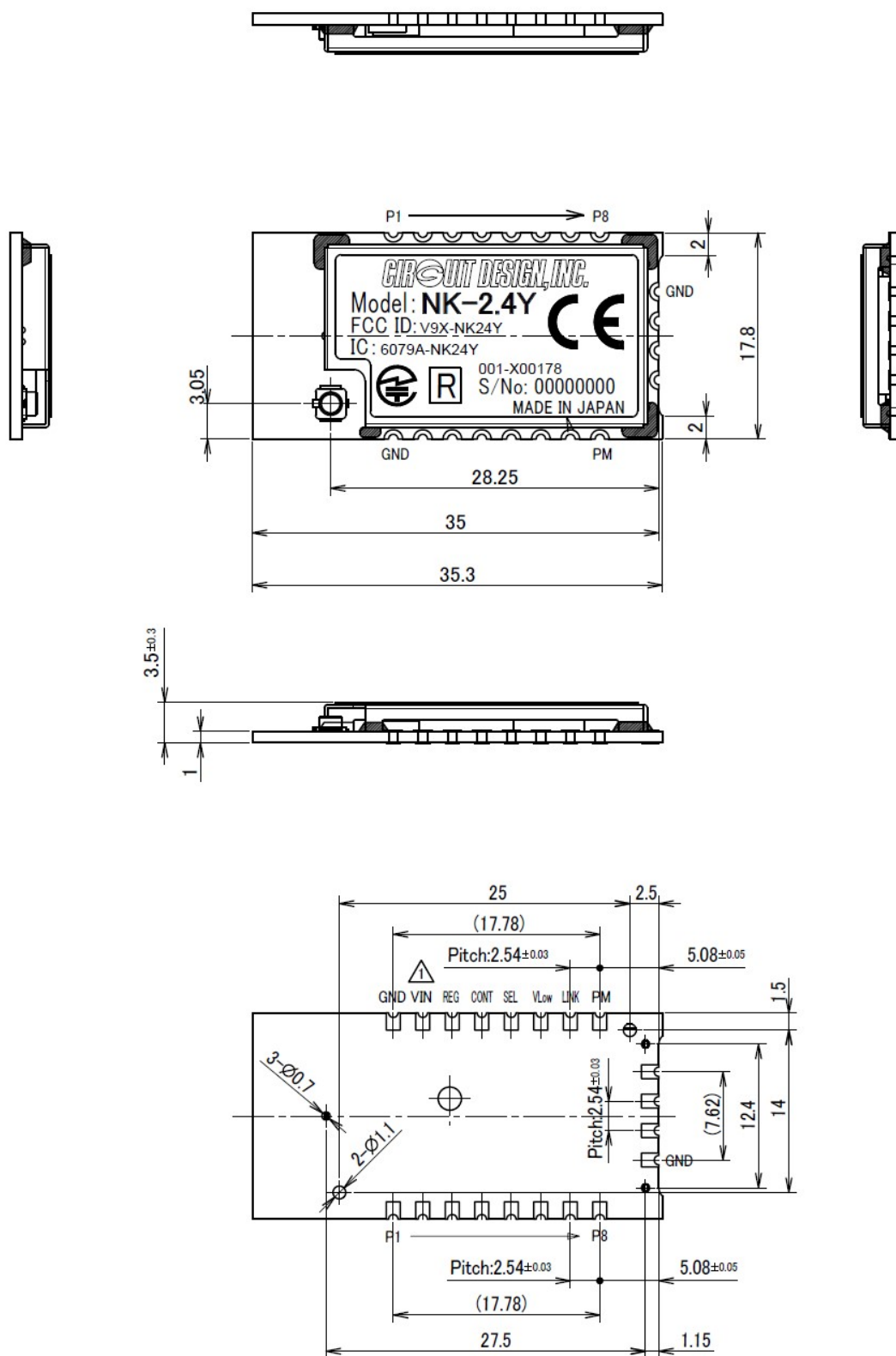
9. Block diagram

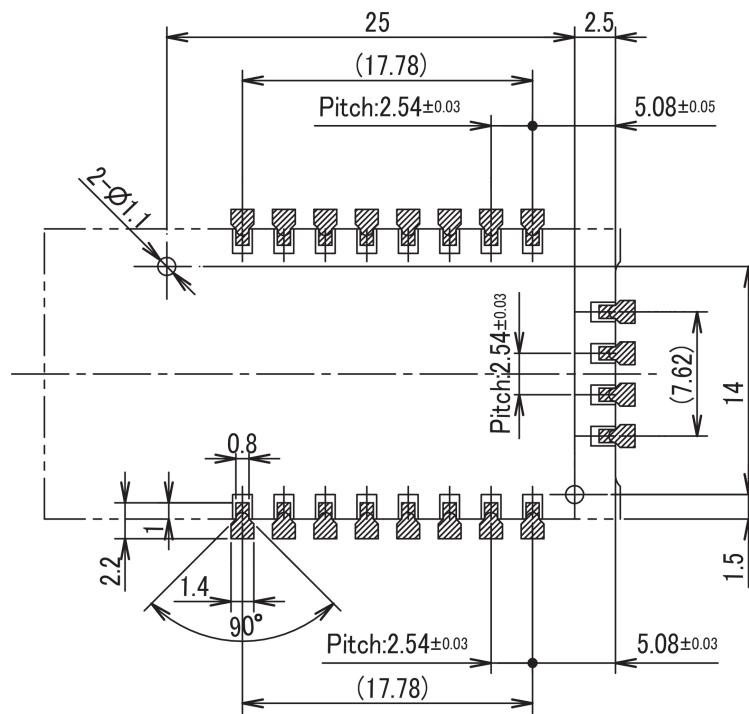


10. Connection example



11. External dimensions





Caution: No trace allowed underneath the module

Regulatory compliance information

Regulatory Statement for FCC

Antenna

This NK-2.4Y (FCC ID: V9X-NK24Y) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

The antenna used this module is as follows;

Antenna Type & Antenna Gain;

Sleeve Antenna (ANT-2G4S2) 2.14 dBi

Whip Antenna (ANT-2G4S3) 2.14 dBi

Whip Antenna (ANT-2400-SF/ANT-2400-SFW) 1.7 dBi

Pattern antenna -2.0 dBi

Instructions to the final system integrators

The final system integrator must ensure there is no instruction provided in the user manual or customer documentation indicating how to install or remove the transmitter module.

This module should be installed in the host device according to the interface specification.

Labeling

FCC ID: V9X-NK24Y

The proposed FCC ID label format is to be placed on the module. If FCC ID is not visible when the module is installed into the system, "Contains FCC ID: V9X-NK24Y shall be placed on the outside of final host system.

The following information must be indicated on the host device of this module.

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.

*If it is difficult to describe this statement on the host product due to the size, please describe in the User's manual.

The following statements or equivalent must be described on the user manual of the host device of this module;

Caution: Any changes or modifications not expressly approved by the party responsible for product compliance could void the user's authority to operate the equipment.

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

Caution: Exposure to radio frequency radiation

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This equipment has very low levels of RF energy that are deemed to comply without testing of specific absorption rate(SAR).

Regulatory Statement for IC**Antenna**

The NK-2.4Y (IC Number 6079A-NK24Y) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

The antenna used this module is as follows;

Antenna Type & Antenna Gain;

Sleeve Antenna (ANT-2G4S2) 2.14 dBi

Whip Antenna (ANT-2G4S3) 2.14 dBi

Whip Antenna (ANT-2400-SF/ANT-2400-SFW) 1.7 dBi

Pattern antenna -2.0 dBi

Instructions to the final system integrators

The final system integrator must ensure there is no instruction provided in the user manual or customer documentation indicating how to install or remove the transmitter module.

This module should be installed in the host device according to the interface specification.

Labeling:

IC Number: 6079A-NK24Y

The proposed IC Number label format is to be placed on the module. If IC Number is not visible when the module is installed into the system, "Contains IC: 6079ANK-24Y" shall be placed on the outside of final host system.

The following statements or equivalent must be described on the user manual of the host device of this module;

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

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

Le présent appareil est conforme aux CNR d'Industrie 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'utilisateur de 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

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment and meets RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment has very low levels of RF energy that are deemed to comply without testing of specific absorption rate (SAR).

Cet équipement est conforme aux limites d'exposition aux rayonnements énoncées pour un environnement non contrôlé et respecte les règles d'exposition aux fréquences radioélectriques (RF) CNR-102 de l'IC. Cet équipement émet une énergie RF très faible qui est considérée conforme sans évaluation du débit d'absorption spécifique (DAS).

DoC and restrictions for CE**Declaration of Conformity**

Hereby, Circuit Design, Inc. declares that the NK-2.4Y is in compliance with RE Directive (2014/53/EU).

The full text of the EU Declaration of Conformity is available at www.circuitdesign.jp.

Remark:

This module is for a portable application. The final system integrator will need to conduct full EMC testing in accordance with EN301 489-3 in the final use configuration.

Also the final system needs to fulfill the safety requirements in the final product configuration.

Cautions:**Antenna**

The conformity assessment of the NK-2.4Y was performed using the following antennas:

Antenna Type & Antenna Gain;

Sleeve Antenna (ANT-2G4S2) 2.14 dBi

Whip Antenna (ANT-2G4S3) 2.14 dBi

Whip Antenna (ANT-2400-SF/ANT-2400-SFW) 1.7 dBi

Pattern antenna -2.0 dBi

Only those antennas with same type and lesser gain can be used with this module. If you use an antenna other than the recommended antennas, further radio conformity assessment may be required.

Enclosure

To fulfill the requirements of EMC and safety requirements, the NK-2.4Y should be mounted on the circuit boards of the final products and must be enclosed in the cases of the final products. No surface of the NK-2.4Y should be exposed.

Exposure to radio frequency radiation

This module must not be co-located or operating in conjunction with any other antenna or transmitter.

Conformity assessment of the final product

The manufacturer of the final product is responsible for ascertaining the conformity of the final product to the requirements of the RE Directive.

Cautions and guidance for use in Japan

The NK-2.4Y has obtained a Technical Regulations Conformity Certification as a second generation low power radio communication system (ARIB STD-T66) based on the Radio Law in Japan.
Certification Number : 001-X00178

Warnings

- Do not take apart or modify the module. If do so, you may be punished by the Radio law.
- Do not remove the product label on which the technical conformity mark and certification number are printed. It can be an infringement of the Radio law if you use radio equipment which has no Technical conformity mark.
- The conformity assessment of the NK-2.4Y was performed using the specified antennas. If you use an antenna other than the specified antennas, further conformity assessment will be required. For details, refer to the *Approved antenna list* on our Web site.

This product shares a frequency band with a wide range of equipment: e.g. industrial, scientific, and medical equipment such as microwave ovens, premises radio stations (radio stations requiring licenses) and specified low-power radio stations (radio stations not requiring licenses) for RFID used for factory production lines as well as amateur radio stations (radio stations requiring licenses).

1. Before use, confirm that no premises radio stations and specified low-power radio stations for RFID or amateur radio stations operate in your vicinity.
2. In the event that this product causes harmful interference to any premises radio station for RFID, immediately change frequencies or halt radio wave emission and contact us for consultation on interference avoidance measures.
3. Contact us if this product causes harmful interference to any specified low-power radio stations for RFID or amateur radio stations or if other problems arise.

When operating the radio system embedding the NK-2.4Y, we recommend that you follow the instructions in the “ARIB STD-T66 Operation Guidance for Second-generation Low-power Data Communication Systems Radio Stations”. For details, refer to the Guidance.

Indication of symbols on equipment (defined in “ARIB STD-T66 Operation Guidance for Second-generation Low-power Data Communication Systems Radio Stations”)

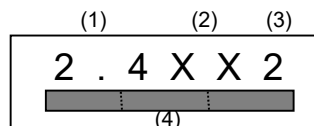
In the case of the NK-2.4Y,

(1) Frequency band: 2.4 GHz

(2) Modulation system: XX

(3) Estimated interference-causing radius: Within 20 m

(4) Frequency-changing capability: The system uses the entire band and is unable to avoid the band used by RFID systems.



Indication of information on fixed, outdoor-installed equipment

When operating the radio system embedding the NK-2.4Y as a fixed outdoor radio station, indicate the following information at a prominent location on the on the main unit, antenna or casing of the system.

(Example from “ARIB STD-T66 Operation Guidance for Second-generation Low-power Data Communication Systems Radio Stations”)

2.4 GHz band low-power data communications system radio station	
Operator	XX Communication Co., Ltd.
	IP Division Customer Service Center
To contact : TEL :	03- XXXX - XXXX
	: URL: http://www.XX.co.jp

- (1) Indication of radio station : The equipment shall be clearly labeled as “2.4 GHz band low-power data communications system radio station.”
- (2) Name of owner or operator : The name of the individual shall be indicated if the radio station is owned or operated by that individual. The names of the relevant entity and section or person in charge shall be indicated if the radio station is owned or operated by that entity.
- (3) Contact information : Telephone number, e-mail address, or URL shall be indicated.
- (4) Others : Useful information on interference avoidance may be indicated, as necessary.

For more details, please contact Circuit Design, Inc.

Important notice

- Customers are advised to consult with Circuit Design sales representatives before ordering. Circuit Design believes the provided information is accurate and reliable. However, Circuit Design reserves the right to make changes to this product without notice.
- Circuit Design products are neither designed nor intended for use in life support applications where malfunction can reasonably be expected to result in significant personal injury to the user. Any use of Circuit Design products in such safety-critical applications is understood to be fully at the risk of the customer and the customer must fully indemnify Circuit Design, Inc for any damages resulting from any improper use.
- As the radio module communicates using electronic radio waves, there are cases where transmission will be temporarily cut off due to the surrounding environment and method of usage. The manufacturer is exempt from all responsibility relating to resulting harm to personnel or equipment and other secondary damage.
- The manufacturer is exempt from all responsibility relating to secondary damage resulting from the operation, performance and reliability of equipment connected to the radio module.

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Cautions

- Do not use the equipment within the vicinity of devices that may malfunction as a result of electronic radio waves from the radio module.
- Communication performance will be affected by the surrounding environment, so communication tests should be carried out before actual use.
- Ensure that the power supply for the radio module is within the specified rating. Short circuits and reverse connections may result in overheating and damage and must be avoided at all costs.
- Ensure that the power supply has been switched off before attempting any wiring work.
- The case is connected to the GND terminal of the internal circuit, so do not make contact between the '+' side of the power supply terminal and the case.
- When batteries are used as the power source, avoid short circuits, recharging, dismantling, and pressure. Failure to observe this caution may result in the outbreak of fire, overheating and damage to the equipment. Remove the batteries when the equipment is not to be used for a long period of time. Failure to observe this caution may result in battery leaks and damage to the equipment.
- Do not use this equipment in vehicles with the windows closed, in locations where it is subject to direct sunlight, or in locations with extremely high humidity.
- The radio module is neither waterproof nor splash proof. Ensure that it is not splashed with soot or water. Do not use the equipment if water or other foreign matter has entered the case.
- Do not drop the radio module or otherwise subject it to strong shocks.
- Do not subject the equipment to condensation (including moving it from cold locations to locations with a significant increase in temperature.)
- Do not use the equipment in locations where it is likely to be affected by acid, alkalis, organic agents or corrosive gas.
- Do not bend or break the antenna. Metallic objects placed in the vicinity of the antenna will have a great effect on communication performance. As far as possible, ensure that the equipment is placed well away from metallic objects.
- The GND for the radio module will also affect communication performance. If possible, ensure that the case GND and the circuit GND are connected to a large GND pattern.

Warnings

- Do not take apart or modify the equipment.
- Do not remove the product label (the label attached to the upper surface of the module.) Using a module from which the label has been removed is prohibited.

Revision History

Version	Date	Description	Remark
1.0	Feb. 2016		
1.1	Apr. 2016	CE related information added	
1.2	Oct. 2016	6. Operating precautions added Terminal description updated (CONT/VLow)	
1.4	June 2017	Update according to RED requirements	
2.0	Dec. 2019	DoC updated for RED	
2.1	Jan. 2020	Antenna information added to Regulatory Compliance Information	
2.2	Aug. 2020	Correction of erroneous description	
2.3	Mar. 2021	Operating voltage changed from '2.2 to 5.5 V' to '2.3 to 5.5 V'	
2.4	June 2021	7. Terminal specifications - Internal equivalent circuit modified	