

CTR-003 Series  
Specified Low Power Radio  
Station Device  
User manual

Ver 1.0

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Cathay Tri-Tech., inc.

【Revision History】

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|     |                 |            |            |         |

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## First

This product CTR-003 is communication device which is using specified low power radio. It has digital input/output and analog input/output as terminal interface. Also, it is capable to communicate measurement information such as AC, DC4-20mA, pulse, and contact via the wireless networks.

## 1. Appearance and parts name

### 1.1. Appearance

Appearance of this device indicated below



<Front appearance>



<Back side appearance and IO plug>

### 1.2. Appearance and parts name specification

#### 1.2.1. Front face

LED for operation status display, power supply terminal, RS-232C terminal, micro USB terminal, and SMA connector for the antenna connection are placed on the front face of this device.

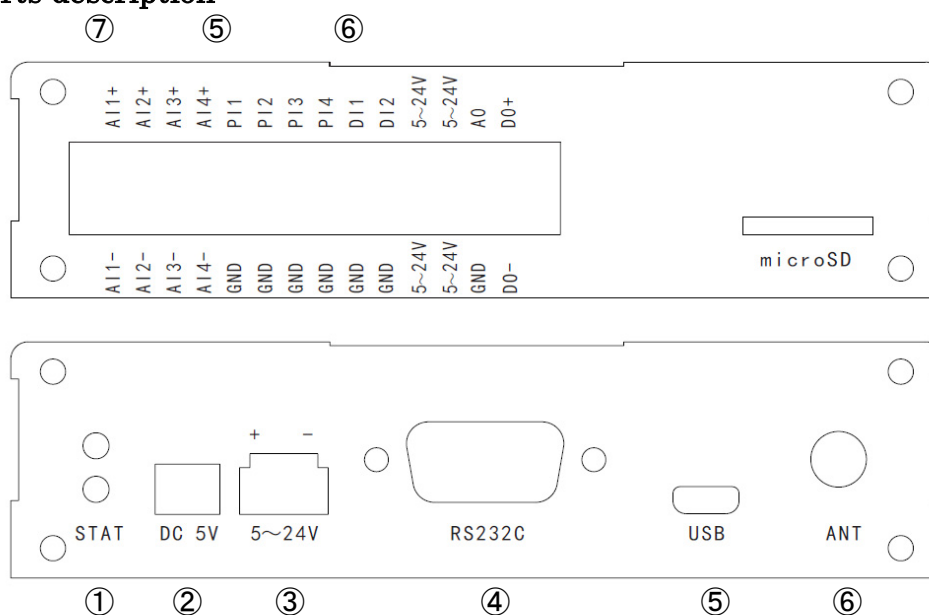
#### 1.2.2. Back face

IO terminal block with dedicated IO connector of the interface for signal source connection, micro SD card slot are placed on back face. Power terminal has Molex 3 pins terminal and terminal for the AC adaptor connection, both of them will be connected by using accessories are 3 terminals power cable, and power adaptor.

### 1.2.3. Top and bottom face

The bottom face of this device are united with flange for attachment and fixity. Also, the nameplate are sealed on the top face.

### 1.3. Panel parts description



Details of panel parts

| Panel      | Numbers | Printing                                                                 | Description                                                                                                                  |
|------------|---------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Front face | ①       | STAT                                                                     | Top is red, below is green. LED functions (below) indicates conditions such as power, communication, abnormal status.        |
|            | ②       | DC 5V                                                                    | The valuate input range of EIAJ jack (below) ,connect with AC adaptor.                                                       |
|            | ③       | + -<br>5~24V                                                             | Power source polarity (top) , voltage input range of 3 pins power cable. Connect with 3 pins power connector of power Molex. |
|            | ④       | RS232C                                                                   | Protocol of serial (below) Connect with D-SUB9 (female)                                                                      |
|            | ⑤       | USB                                                                      | miniUSB terminal (below) Connect with miniUSB cable                                                                          |
|            | ⑥       | ANT                                                                      | SMA connector (below) Connect with 824MHz ~ 960MHz corresponding antenna                                                     |
| Back face  | ⑦       | AI1+ AI2+ AI3+ AI4+<br>PI1 PI2 PI3 PI4 DI 1<br>DI2 5~24V 5~24V A0<br>D0+ | Connection characteristics of upper IO connector (top)<br>Connect with two integrated dedicated stacking connectors(14x2)    |
|            | ⑧       | AI1- AI2- AI3- AI4-<br>GND GND GND GND GND<br>GND 5~24V 5~24V GND<br>D0- | Connection characteristics of bottom IO connector (below) Connect with two integrated dedicated stacking connectors(14x2)    |
|            | ⑨       | microSD                                                                  | microSD card slot (top) use for microSD card                                                                                 |

## 2. Spec specification

### 2.1. Body

Spec of this device indicated below

| Items                        |                             | Specification                                                                              |
|------------------------------|-----------------------------|--------------------------------------------------------------------------------------------|
| Product name                 |                             | Specified Low Power Radio Station Device                                                   |
| dimension (W x H x D, mm)    |                             | 103×30×70 (without protrusion)                                                             |
| weight                       |                             | Approximately 260g                                                                         |
| Power supply allowance input |                             | DC 5 ~ 24V±5%                                                                              |
| Current consumption          |                             | MAX: 200mA (by 5V)                                                                         |
| interface                    | Power supply input terminal | Molex 3Pin x 1, EIAJ-2 ○ x 1                                                               |
|                              | RS-232C terminal            | D-SUB 9Pin male x 1                                                                        |
|                              | USB terminal                | Micro USB-B jack x 1                                                                       |
|                              | Antenna terminal            | SMA jack x 1                                                                               |
|                              | IO terminal block           | Separate insertion type x 28                                                               |
|                              | microSD slot                | Insert type x 1                                                                            |
| LED indication               |                             | 2 (green x 1, red x 1)                                                                     |
| Abnormality monitoring       |                             | By watchdog                                                                                |
| Environmental condition      | Operation guarantee         | temperature : 45°C<br>humidity : 15~85%                                                    |
|                              | Storage guarantee           | temperature : -20~70°C<br>humidity : 5~95%                                                 |
| Wireless communication       | module                      | SIMCOM product using SIM20-433/868/915                                                     |
|                              | Frequency band              | CTR-003A : 433.33~434.79MHz<br>CTR-003B : 863.55~870.00 MHz<br>CTR-003C : 900.84~928.00MHz |
|                              | Antenna power               | Less than 20mW                                                                             |
|                              | Distance                    | Approximately<br>1000m (open Sky)                                                          |
|                              | Communication rate          | 9600bps                                                                                    |
| CPU                          |                             | Freescale KinetisL26 ARM Cortex M0 48MHz                                                   |
| ROM/RAM                      |                             | 32kB/256kB                                                                                 |
| OS                           |                             | FreeRTOS8.2.2                                                                              |

### 3. Interface specification

#### 3.1. IO port

IO port specification

| Items          | Standard                    |                                                                         | Remarks                                                                                          |
|----------------|-----------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Digital input  | Number of input             | 6 channels                                                              | pules x 4 : PI1~PI4、GND<br>contact x 2 : DI1~DI2、GND                                             |
|                | Input format                | Photo coupler non insulated                                             | Pull up resistor (1.8k $\Omega$ )                                                                |
|                | Input voltage               | DC5V~24V ( $\pm 1$ V)                                                   | Same as power input voltage                                                                      |
|                | Input current               | OFF : less than 0.1mA<br>ON : more than 1mA                             |                                                                                                  |
|                | Chattering removal          | <1ms                                                                    | More than 1ms supposed to be soft configuration, capable to be range 10~100ms                    |
|                | Response speed              | <10ms                                                                   |                                                                                                  |
| Digital output | Number of output            | 1 channels                                                              | DO+, DO-                                                                                         |
|                | Output format               | Photo coupler, open collector output                                    |                                                                                                  |
|                | Output voltage              | MAX DC12V                                                               |                                                                                                  |
|                | Output current              | MAX 20mA (per 1 point)                                                  |                                                                                                  |
|                | Output ON residual current  | Less than 1V (output current<20mA)                                      |                                                                                                  |
| Analog input   | Number of input             | 4channels                                                               | AI1+, AI1-~AI4+, AI4-                                                                            |
|                | Input format                | DC input of 4~20mA sensor<br>AC input of current sensor CT              | AC and DC use 4CH<br>By setting it is capable to convert input format                            |
|                | Termination resistance      | AC : 8 $\Omega$ 、120 $\Omega$ 、1.8K $\Omega$<br>4~20mADC : 120 $\Omega$ | When AC is used, it automatically convert resistance depending on current range of signal source |
|                | Measurement range (current) | AC : 0.01~125mAAC<br>4~20mADC : 0~25mADC                                | Numbers indicated by AC are 3 resistance patterns and total range                                |
|                | Measurement accuracy        | AC : $\pm 2\%$ F.S.<br>4~20mA : $\pm 1\%$ F.S.                          |                                                                                                  |
|                | Conversion rate             | 10 times/sec                                                            |                                                                                                  |
| Analog output  | Number of output            | 1 channel                                                               |                                                                                                  |
|                | Output format               | Op amp output                                                           |                                                                                                  |
|                | Output voltage              | DC1.5V $\pm$ 1.4V                                                       |                                                                                                  |
|                | Output current              | MAX 20mA (per 1 point)                                                  |                                                                                                  |
|                | Output ON residual current  | Less than 1V (output current<20mA)                                      |                                                                                                  |
| Power output   | Number of input             | 4 channels                                                              |                                                                                                  |
|                | output voltage              | DC5V~24V ( $\pm 0.45$ V)                                                | Same as power input voltage                                                                      |
|                | Output current              | MAX 1800mA                                                              | When AC adaptor is used, it will be total current value of 4 channels                            |

### 3.2. RS-232C port

RS-232C specification

| Items                     | Standard                                                                     | Remarks                          |
|---------------------------|------------------------------------------------------------------------------|----------------------------------|
| Interface                 | RS-232C compliance、 DCE type                                                 |                                  |
| Connector                 | RS-232C 9Pin male                                                            | DCE type but uses male connector |
| Signal                    | TxD, RxD, DTR, DSR, RTS, CTS, DCD, RI, GND<br>※please refer annotation below | Signal name is seen from DTE     |
| Communication protocol    | Asynchronous type                                                            |                                  |
| Communication speed (bps) | 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k, 115.2k                          |                                  |
| Communication method      | Full duplex / Half duplex                                                    |                                  |
| Data length               | 7bit, 8bit                                                                   |                                  |
| Start bit                 | 1bit                                                                         |                                  |
| Stop bit                  | 1bit/2bit                                                                    |                                  |
| Parity bit                | none/even/odd                                                                |                                  |
| Flow control              | none, hardware flow control (RTS/CTS)                                        |                                  |

### 3.3. Power interface

Power interface specification

| Items                         | Standard                                                          | Remarks                                                                   |
|-------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------|
| 3 pins DC power terminal      | Molex70553-0002 3 pins                                            | 2 pins will be used (+/-)                                                 |
| Power terminal for AC adaptor | EIAJ-2 round shape                                                | Connect within the substrate                                              |
| Input voltage                 | +5~+24V $\pm 5\%$                                                 |                                                                           |
| Current consumption           | When output is 5V less than MAX1.0 A                              | Average less than 0.85A                                                   |
| 3 pins power cable            | Molex plug - open length 1 m                                      | Product number 50-57-9403(old 70066-0177) + 2x16-02-0087 (old 70058-0024) |
| AC adaptor                    | AC input 100~240V 50/60Hz 0.3A<br>DC output 5V $\pm 5\%$ , MAX 2A | Cable length 2m                                                           |

### 3.4. Antenna interface

Antenna interface specification

| Items             | Standard                                                                         | Remarks                     |
|-------------------|----------------------------------------------------------------------------------|-----------------------------|
| Connector type    | SMA jack type                                                                    | Antenna SMA plug for mating |
| Nominal impedance | 50 $\Omega$                                                                      |                             |
| frequency         | CTR-003A :433.05~434.79MHz<br>CTR-003B :868.00-869.70MHz<br>CTR-003C: 902-928MHz |                             |

## 4. Function specification

### 4.1. Wireless communication function

Wireless communication function specification

| Items                                                     |                         | Specification                                                                                                                                                                       | Remarks                                                                                                                  |
|-----------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Wireless communication module                             |                         | SIMCOM product SIM20-433/868/915                                                                                                                                                    |                                                                                                                          |
| Wireless communication function                           | Frequency band          | CTR-003A : 433.33~434.79MHz<br>CTR-003B : 863.55~870.00 MHz<br>CTR-003C : 900.84~928.00MHz                                                                                          | A band range : 330kHz、4 CH<br>B band range : 450kHz、14 CH<br>C band range : 480kHz、60CH                                  |
|                                                           | Communication speed     | 9600bps                                                                                                                                                                             |                                                                                                                          |
|                                                           | Destination designation | It is capable to set serial number of communication module                                                                                                                          | Channel of Communication frequency should be same                                                                        |
| Measurement data response function                        |                         | According to request of <b>master device</b> , it will send measurement time and data from SD card                                                                                  |                                                                                                                          |
| Master and slave device automatic identification function |                         | It will be operated by connection of serial port and communication as <b>master device</b>                                                                                          | Changing the registration of the slave device connected to the wireless network must be performed via the master device. |
| Wireless relay function                                   |                         | When the master device / slave device can not communicate directly with distance.→<br>Automatically scans the slave device radio waves, make the connection and data communication. | Without <b>master device</b> , it can relay 3 levels                                                                     |
| Maintenance control function                              |                         | FW version, import and export of setting file, getting event log, and maintenance control command can be received and operated                                                      |                                                                                                                          |

### 4.2. Serial communication function (only master device)

Serial communication function specification

| Items                                            |                          | Specification                                                                                                                                              | Remarks |
|--------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Serial communication function                    | Connecting device        | Our product CTL-001                                                                                                                                        |         |
|                                                  | Connector specification  | RS232C port                                                                                                                                                |         |
|                                                  | Data communication speed | 115200bps                                                                                                                                                  |         |
| <b>Slave device</b> change registration function |                          | It notifies update of measurement information received from the host device, registers, changes, and deletes each channel measurement of the slave device. |         |
| Collection data notification function            |                          | Regularly patrol the slave device that is registered in the management information, you can be notified of the collected measurement data.                 |         |
| Facility status notification function            |                          | Regularly monitor the slave device that was registered in the management information, it is possible to notice the connection and disconnection state.     |         |
| Maintenance control function                     |                          | FW version, import and export of setting file,                                                                                                             |         |

|  |                                                                                 |  |
|--|---------------------------------------------------------------------------------|--|
|  | getting event log, and maintenance control command can be received and operated |  |
|--|---------------------------------------------------------------------------------|--|

### 4.3. Measurement function

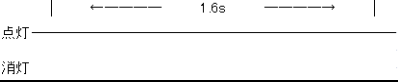
#### Measurement function specification

| Item                                         | Specification                                                                                                                                                                                                                                                                     | Remarks                                                                |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| CT alternating current measurement function  | Measure the single-phase or three-phase AC power supply through the current CT sensor on the general purpose secondary side of 0.01 mA to 125 mA and calculate the effective current. With the specified sampling period, time and accumulated value can be saved on the SD card. | It automatically convert the resistance by range of signal measurement |
| 4 ~ 20mA direct current measurement function | Measure 4 to 20 mA DC current signal and calculate by moving average count by setting. It is possible to save the time and the accumulated value to the SD card at the specified sampling period.                                                                                 | it doesn't filter current value if it is out of normal range.          |
| Pulse count measurement function             | It is possible to count on the sampling cycle that specifies the pulse signal and save the time and count value to the SD card.                                                                                                                                                   |                                                                        |
| Contact state monitoring function            | When monitoring the on / off status of the connected contact signal at all times and detecting a state change (ON ⇒ OFF, OFF ⇒ ON), it is possible to save the occurrence time and state value to the SD card.                                                                    |                                                                        |

#### 4.4. Operating function LED indication

LED indication specification

| Mode        | Status                                         |            | LED   | On       | Off  | Lighting waveform (1.6s period)        |
|-------------|------------------------------------------------|------------|-------|----------|------|----------------------------------------|
| Maintenance | All                                            |            | Red   | 0.4s     | 0.4s |                                        |
|             |                                                |            | Green | ×        | ○    |                                        |
| Operating   | Initial activation                             |            | Red   | ○        | ×    |                                        |
|             |                                                |            | Green | ×        | ○    |                                        |
|             | Disconnected                                   |            | Red   | 0.8s     | 0.8s |                                        |
|             |                                                |            | Green | ○        | ×    |                                        |
|             | Wireless communication (Slave matches)         | Strength 1 | Red   | ×        | ○    |                                        |
|             |                                                |            | Green | 0.1s     | 1.5s |                                        |
|             |                                                | Strength 2 | Red   | ×        | ○    |                                        |
|             |                                                |            | Green | 0.1s * 2 | 1.2s |                                        |
|             |                                                | Strength 3 | Red   | ×        | ○    |                                        |
|             |                                                |            | Green | 0.1s * 3 | 0.9s |                                        |
|             | Serial communication (master device)           |            | Red   | ×        | ○    |                                        |
|             |                                                |            | Green | 0.2s     | 0.2s |                                        |
|             | Abnormal status 1<br>※ IO device access failed |            | Red   | 0.1s     | 1.5s |                                        |
|             |                                                |            | Green | —        | —    | Maintain status when soothing happened |
|             | Abnormal status 2<br>※SD card loading failed   |            | Red   | 0.1s * 2 | 1.2s |                                        |
|             |                                                |            | Green | —        | —    | Maintain status when soothing happened |
|             | Abnormal status 3<br>※ Flash access failed     |            | Red   | 0.1s * 3 | 0.9s |                                        |
|             |                                                |            | Green | —        | —    | Maintain status when soothing happened |

|  |                                    |       |   |   |                                                                                   |
|--|------------------------------------|-------|---|---|-----------------------------------------------------------------------------------|
|  | Abnormal status<br>4<br>※the other | red   | ○ | × |  |
|  |                                    | green | — | — | Maintain status when soothing happened                                            |

## 5. Before using

### 5.1. Inspection

Before shipping this device, it is inspected enough but please confirm below.

- 1) Please confirm case corruption due to shipping accident.
- 2) Please confirm LED is correctly working such as red LED and green LED lighting. Please use SD card (need first setting) and connect power cable when you check.
- 3) Please check all accessories in and not broken.

### 5.2. Installation condition

Please hesitate to use in these circumstance

- 1) Dusty place, place where corrosive gas drifts.
- 2) High temperature and humidity, place intensely changes air condition
- 3) Place gets strong vibration or continuous vibration.
- 4) Direct sunlight place or windy place
- 5) Around strong magnetic field, electric filed, and high frequency filed
- 6) Dangerous place without space
- 7) Place where explosive gas drifts

### 5.3. Electrical connection

- 1) For your safety, please use ground wire.
- 2) Please only use AC adaptor from accessories or 3 pins power cable. If you use different one, it may cause troubles.
- 3) Please use electromagnetic shield wire for analog signals

### 5.4. Use of microSD

SD card have to be initialize before you use. How to initialize is indicated below

- 1) You insert microSD card to PC (when microSD slot is not worn, please use SD adaptor)
- 2) Format to SD drive is recognized by OS tool
  - ① . file system : FAT32
  - ② . allocation unit size : 32kbyte
- 3) Make folders in SD drive
  - ① . cfg ⇒ folder stores setting file (CTRConfigFile.cfg)
  - ② . dat ⇒ folder stores measurement data from slave device (S\_YYMMDD.DAT)
  - ③ . evt ⇒ folder stores event log file for maintenance (E\_YYMMDD.LOG)
  - ④ . fw ⇒ folder stores update firmware (XXYYZZ\_YYYYMMDD.srec)
  - ⑤ . log ⇒ folder stores system information (COMMPARA.LOG) , serial number (SNSRINFO.LOG) , and debug log file (R\_YYMMDD.LOG)
  - ⑥ . trx ⇒ folder stores measurement data of **master device** collected from **slave device** (M\_YYMMDD.DAT)
  - ⑦ . tmp ⇒ folder stores processing file such as file transfer
- 4) In 「cfg」 , you make text file of 「CTRConfigFile.cfg」 , edit like below, and save.

```
# CTR-003 ConfigFile: (temp)Created by sys initial.
# You can edit parameters and a file version.
FILE_VERSION=01_00_201511250000;

#START
SIM20_CFG_CHA=0;
SIM20_CFG_CID=1;
PULSE_EDGE=0;
SEND_NEW_DATA=0;
RENTENTION_DAYS=10;
LOG_OUT_LEVEL=3;
LOG_FILE_NUM=10;
FW_UPDATE_FLAG=0;
GW_HEALTH_TIME=90;
CTR_HEALTH_TIME=120;
CHATTER_TIMES=10;
#END
```

※ Setting values are indicated below

| Items                                  |                 | Specification                                                                                                                                       | Remarks                                     |
|----------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Configuration version                  | FILE_VERSION    | 01_00_201511250000                                                                                                                                  | Capable to change freely by setting         |
| Wireless channel ID                    | SIM20_CFG_CHA   | 0~3/13/59                                                                                                                                           | Specific low power channel number           |
| Wireless network ID                    | SIM20_CFG_CID   | 1~255                                                                                                                                               | Wireless network ID                         |
| PI edge method                         | PULSE_EDGE      | 0 : Falling<br>1 : Rising                                                                                                                           | When pulse counting, this edge is target.   |
| New data transmission flag             | SEND_NEW_DATA   | 0 : Send all unsent data<br>1 : Send only new data                                                                                                  | Only new data will be sent flag             |
| Days to keep data                      | RENTENTION_DAYS | 1~30                                                                                                                                                | Days to keep measurement data               |
| Log output level                       | LOG_OUT_LEVEL   | 0 : None output<br>1 : Startup & abnormal<br>2 : Disconnection & synchronize measurement information<br>3 : Change & maintenance & synchronize time | Output message level to log file            |
| days to keep log                       | LOG_FILE_NUM    | 1~30                                                                                                                                                | Days to keep debug and event log            |
| FW update flag                         | FW_UPDATE_FLAG  | 0 : Unavailable<br>1 : Available                                                                                                                    | Firmware update flag                        |
| GW alive monitoring interval           | GW_HEALTH_TIME  | 60~120                                                                                                                                              | HC interval ( sec ) to Communication GW     |
| Slave device alive monitoring interval | CTR_HEALTH_TIME | 60~300                                                                                                                                              | HC interval (sec) between master and device |
| DI/PI chatter time                     | CHATTER_TIMES   | 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100                                                                                                          | Chattering prevention time by digital input |

5) Take SD drive out from OS.

## FCC Statement

This equipment has been tested and found to comply with the limits for a **Class B** digital device,

pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## **FCC Radiation Exposure 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.

### **Caution!**

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

Hereby, **Cathay Tri-Tech.,Inc**, declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The full text of the EU declaration of conformity is available at the following internet address:

<http://www.cathay.jp/support/oversea/eu-doc.html>

**Warning:** Operation of this equipment in a residential environment could cause radio interference.

Contract us:

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