# Raspberry Pi Expansion Card
## Isolated 32-bit Up/Down Counter Card
# CPI-CNT-3201I

This product is an expansion card that adds an counts input interface to the Raspberry Pi.

It has one channel of 32-bit up/down counters, allowing external devices such as a rotary encoder and a linear scale to be connected. The pulse signal interface is an opto-coupler isolated input.

\* Specifications, color and design of the products are subject to change without notice.

\*The contents in this document are subject to change without notice.

\*Visit the CONTEC website to check the latest details in the document.

\*The information in the data sheets is as of October, 2021.

## Features

### 32-bit up-and-down counter
The 32 bit up-and-down counter could have four channels and up to 500kHz maximum speed pulse input. Moreover, it can count 2-phase signals and mono-phase signals such as a rotary encoder and a linear scale.

### Opto-coupler bus isolation
As the GPIO 40PIN connector on Raspberry Pi is isolated from the input and output interfaces by opto-couplers, this product has excellent noise performance.

### Built-in interrupt notification signal
This product can output a signal to a Raspberry Pi's GPIO pins to notify of changes in the input signal (pin selection possible). This signal can be used as an interrupt notification signal for notifying of input signal changes without the need for I2C communication.

### Control input/output signals
One control input signal and one control output signal are provided. This product can generate an interrupt, output an external signal, preset the counter, and clear it to zero when the count value matches the arbitrary value that is set.

### Connectivity for up to 8 cards
Connect up to 8 expansion cards of the same series. Use the Board ID setting switch on the main body to identify connected expansion cards.

### Adaptable to a wide range of temperature between -20 and +60°C
The product is capable of operating in the temperature between -20 and + 60°C. It can be installed in the various environments.

### No electrolytic capacitor
Without an electrolytic capacitor, which has a limited life, we are creating the product with a longer life.

### Linux compatible driver software
Using the counter input driver API-CNT(LNX) makes it possible to create applications of Linux.

## List of Option

| Product Name | Model type | Description |
|---|---|---|
| RAS card | CPI-RAS | RAS/RTC function, 8 to 28 VDC input function expansion. |
| DIN RAIL ADAPTER | CPI-DIN01 | |

\*    Information about the option products, see the Contec's website.

## Specifications

### Function specification

| Item | | Description |
|---|---|---|
| Input | | |
| Counter | | |
| | Channel count | 1 channel |
| | Count system | Up/down counting (2-phase/Single-phase/Single-phase Input with Gate Control Attached) |
| | Max. count | FFFFFFFFh (binary data, 32Bit) |
| | Input type | Optocoupler isolated input |
| | Input signal | Phase-A/UP 1 x 1 channel, Phase-B/DOWN 1 x 1 channel Phase-Z/CLR 1 x 1 channel |
| | Input resistance | 220 Ω (5V external power supply), 690 Ω (12V external power supply) |
| | Response frequency | 500kHz 50% duty |
| | External Power | 5VDC±10% or 12VDC±10% |
| | Digital filter | 0.1µsec - 1.6384msec or not used |
| | Counter start trigger | Software/External start input |
| | Counter stop trigger | Software/External stop input |
| Control | | |
| | Control input signal type | Optocoupler isolated input |
| | Control input channel | 1 channel |
| | Control input signal | - Preset (Select Rise or Fall) - Zero-clear (Select Rise or Fall) - Counter start/stop (Select Rise or Fall) - General-purpose input (positive logic) Software-selected from among the above four options |
| | Response time | 100µsec (Max.) |
| | Interrupt event | Count match (2 points), Counter error (2 points), Carry/Borrow (1 points) |
| Output | | |
| Control | | |
| | Control output signal type | Optocoupler isolated open collector output |
| | Control output channel | 1 channel |
| | Control output signal | - Count match 0 output(one-shot pulse output) - Count match 1 output(one-shot pulse output) - Digital filter error output(one-shot pulse output) - Abnormal input error output(one-shot pulse output) - General-purpose output(Level output) Software-selected from among the above five options (Positive/negative logic is selected with the software.) |
| | One shot output signal amplitude | Selected between 10µsec, 100µsec, 1msec, 10msec and 100 msec (within precision + 1µsec) |
| | Response time | 5µsec (Max.) |
| | Output rating | 35VDC, 50mA(MAX) |
| | External Power | 5V - 12VDC±10% |
| Interrupt notification | | |
| | Function *1 | 5 interrupt input signals are arranged into a single output of interrupt signal. An interrupt is generated at the rising edge (HIGH-to-LOW transition) or falling edge (LOW-to-HIGH transition). |
| | Output type | Open collector output (Pull-up: 15kΩ) |
| | Output signal amplitude | 2µs (min.) |
| | Notification destination | Select from GPIO 4, 5, 6, or 22 (using DIP switch) |

| Item | Description |
|------|-------------|
| Common section | |
| Voltage resistance (input/output) | 1000VAC |
| Bus specification | I2C bus (I2C1) |
| Max. module count for connection | Maximum of 8cards can be install in a same system. (Excluding RAS cards) |
| Connector | 2 pieces 3.81mm pitch 10-pin terminal |
| Applicable wire | AWG28 - 16 |
| Electricity consumption | 5VDC 100mA<br>3.3VDC 1mA |
| Physical dimensions (mm) | 65.0(W) x 56.5(D) (No protrusions)<br>Spacer height : 12.5mm |
| Weight | 50g |

*1    For details on the interrupt notification function, see Reference Manual.

### Installation Environment Requirements

| Item | | Description |
|------|--|-------------|
| Operating Temperature | | -20 - +60℃ |
| Storage Temperature | | -20 - +60℃ |
| Humidity | | 10 - 90%RH (No condensation) |
| Floating dust particles | | Not to be excessive |
| Corrosive gases | | None |
| Line-noise resistance *1 | Line noise | Signal Line /±1kV (IEC61000-4-4 Level 3, EN61000-4-4 Level 3) |
| | Static electricity resistance | Indirect discharge /±4kV (IEC61000-4-2 Level 2, EN61000-4-2 Level 2) |
| Vibration resistance | Sweep resistance | 10 - 57Hz/semi-amplitude vibration 0.15mm, 57 - 150Hz/2.0G<br>40minutes each in X, Y, and Z directions (JIS C60068-2-6-compliant, IEC60068-2-6-compliant) |
| Shock resistance | | 15G half-sine shock for 11ms in X, Y, and Z directions<br>(JIS C 60068-2-27 -compliant, IEC 60068-2-27 -compliant) |
| Standard | | VCCI Class A, FCC Class A,<br>CE Marking (EMC Directive Class A, RoHS Directive) |

*1    When using the CPI-RAS.

## Packing List

Product [CPI-CNT-3201I] ...1
10-pin Connector ...1 (Attached to the product)
40-pin Pin-header...1
Plastic Spacer for CPU Card...1
Hexagonal Spacers...4 (Height 12.5mm)
Three-point Sems Screw...4
Nuts...4
Product Guide & Warranty Certificate...1
Serial Number Label ...1

## Support Software

You can use CONTEC support software according to your purpose and development environment. For more details on the supported OS, applicable languages, or to download the latest version of software, visit the CONTEC Web site.

| Name | Contents | How to get |
|------|----------|------------|
| Driver software API-CNT(LNX) | This is the Linux version driver software provided in API function formats. The software includes various sample programs such as gcc (C, C++) and Python programs. | Download from the CONTEC website |

Download the files from the following URL.    https://www.contec.com/download/
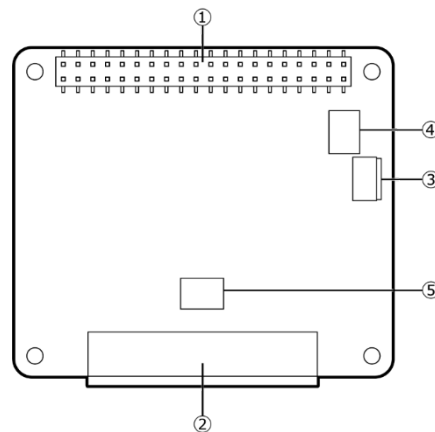
## Physical Dimensions

### Main body only
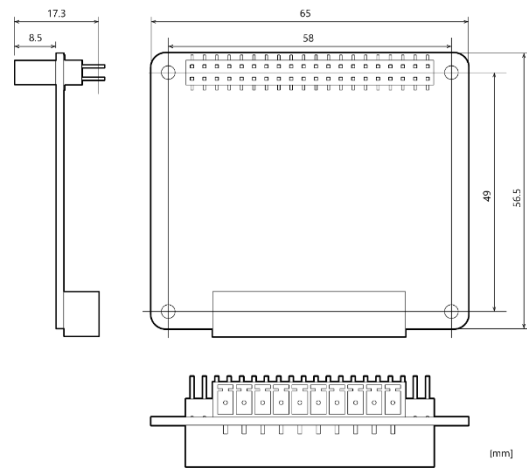


### With connector attached
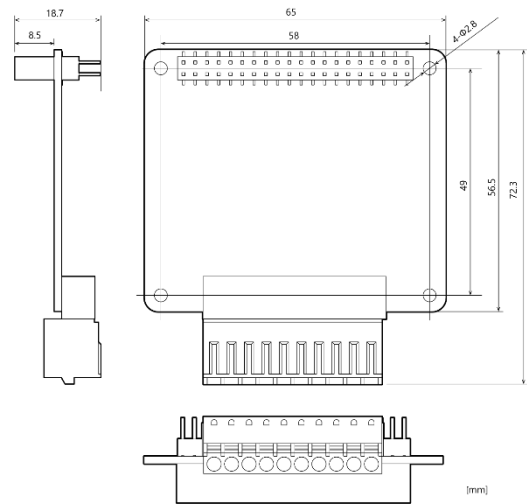


## Component Name



| No. | Name | Function |
|-----|------|----------|
| 1 | GPIO 40 pin connector | This connector is used to connect to a Raspberry Pi or an expansion card. |
| 2 | Interface connector | This connector is used for counter input. It uses the included 10-pin connector. |
| 3 | Board ID setting switch | This setting switch is used to identify I2C communication expansion cards. The switch is used to change the I2C address. |
| 4 | DIP switch | This switch sets the GPIO pins to use for outputting the interrupt notification signal. |
| 5 | Input resistance setting switch | This is an input resistance setting switch of counter input signal and control input signal. |

## Connection to external devicese

### GPIO 40 pin connector
This connector is used to connect to a Raspberry Pi or an expansion card.
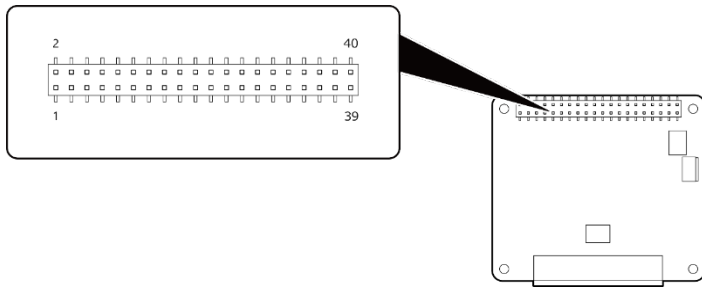


#### Pin Assignment

| Pin No. | Signal Name | Description | Pin No. | Signal Name | Description |
|---------|-------------|-------------|---------|-------------|-------------|
| 1 | 3.3V Power | 3.3V power supply | 2 | 5V Power | 5V power supply |
| 3 | GPIO 2(I2C1 SDA) | I2C1 SDA | 4 | 5V Power | 5V power supply |
| 5 | GPIO 3(I2C1 SCL) | I2C1 SCL | 6 | Ground | GND |
| 7 | GPIO 4(GPCLK0) | INT_1 | 8 | GPIO 14(UART TX) | (Don't use) |
| 9 | Ground | GND | 10 | GPIO 15(UART RX) | (Don't use) |
| 11 | GPIO 17 | (Don't use) | 12 | GPIO 18(PCM CLK) | (Don't use) |
| 13 | GPIO 27 | (Don't use) | 14 | Ground | GND |
| 15 | GPIO 22 | INT_2 | 16 | GPIO 23 | (Don't use) |
| 17 | 3.3V Power | 3.3V power supply | 18 | GPIO 24 | (Don't use) |
| 19 | GPIO 10(SPI0 MOSI) | (Don't use) | 20 | Ground | GND |
| 21 | GPIO 9(SPI0 MISO) | (Don't use) | 22 | GPIO 25 | (Don't use) |
| 23 | GPIO 11(SPI0 SCLK) | (Don't use) | 24 | GPIO 8(SPI0 CE0) | (Don't use) |
| 25 | Ground | GND | 26 | GPIO 7(SPI0 CE1) | (Don't use) |
| 27 | GPIO 0(EEPROM SDA) | I2C0 SDA | 28 | GPIO 1(EEPROM SCL) | I2C0 SCL |
| 29 | GPIO 5 | INT_3 | 30 | Ground | GND |
| 31 | GPIO 6 | INT_4 | 32 | GPIO 12(PWM0) | (Don't use) |
| 33 | GPIO 13(PWM1) | (Don't use) | 34 | Ground | GND |
| 35 | GPIO 19(PCM FS) | (Don't use) | 36 | GPIO 16 | (Don't use) |
| 37 | GPIO 26 | (Don't use) | 38 | GPIO 20(PCM DIN) | (Don't use) |
| 39 | Ground | GND | 40 | GPIO 21(PCM DOUT) | (Don't use) |

### Interface connector
This connector is used for counter input. It uses the included 10-pin connector.
Connector type: DEGSON 15EDGKD-3.81-10P-13-00A(H)
PHOENIX CONTACT FK-MCP 1.5/10-ST-3.81 (or equivalent)
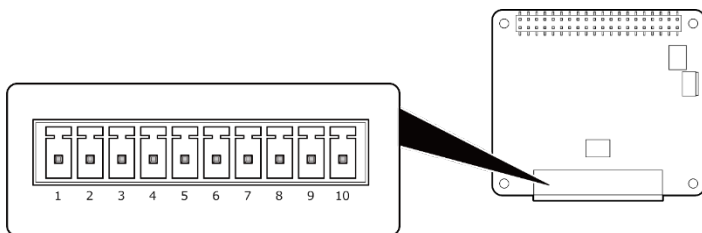


#### Pin Assignment

| Pin No. | Signal Name | Description |
|---------|-------------|-------------|
| 1 | N.C. | This pin is not connected. |
| 2 | N.C. | This pin is not connected. |
| 3 | EQ.N | Negative common of equal output<br>Connect the negative side of external power supply |
| 4 | EQ | Count equal output/General-purpose output |
| 5 | EQ.P | Plus common of equal output<br>Connect the positive side of external power supply |
| 6 | DI | Control input<br>(this can be used as a general-purpose input/hardware event) |
| 7 | Z | Phase-Z input |
| 8 | B | Phase-B input |
| 9 | A | Phase-A input |
| 10 | PCOM | Plus common of input signal<br>Connect the positive side of external power supply |

### Board ID setting switch
This setting switch is used to identify I2C communication expansion cards. The Board ID setting switch can be used to switch I2C addresses. The following table shows the switch settings and the corresponding I2C addresses.
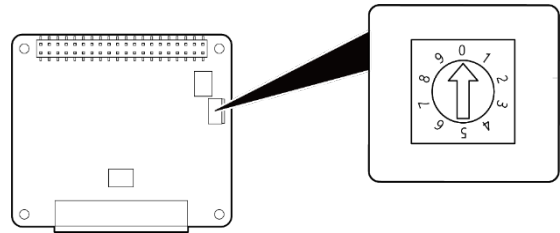


#### Switch settings and the corresponding I2C addresses

| Setting the Board ID | Extended I/O (I2C1)<br>I2C address | EEPROM(I2C0)<br>I2C address |
|----------------------|-----------------------------------|----------------------------|
| 0 | 0x20 (Factory setting) | 0x50 (Factory setting) |
| 1 | 0x21 | 0x51 |
| 2 | 0x22 | 0x52 |
| 3 | 0x23 | 0x53 |
| 4 * | 0x24 | 0x54 |
| 5 | 0x25 | 0x55 |
| 6 | 0x26 | 0x56 |
| 7 | 0x27 | 0x57 |
| 8 | Do not use this setting. | |
| 9 | | |

### DIP switch
This switch sets the GPIO pins to use for outputting the interrupt notification signal. Use the factory default setting (all OFF) when not using the interrupt function.
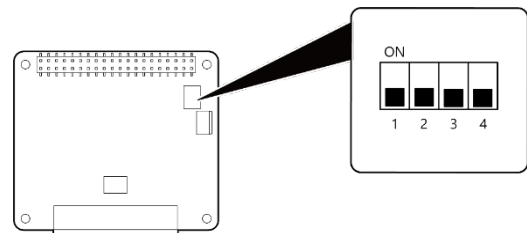


| Pin No. | Signal Name | Setting | Description |
|---------|-------------|---------|-------------|
| 1 | INT_1 | OFF | Interrupt notification signal not connected to GPIO4 (Pin 7) (Factory setting) |
| | | ON | Interrupt notification signal connected to GPIO4 |
| 2 | INT_2 | OFF | Interrupt notification signal not connected to GPIO22 (Pin 15) (Factory setting) |
| | | ON | Interrupt notification signal connected to GPIO22 (Pin 15) |
| 3 | INT_3 | OFF | Interrupt notification signal not connected to GPIO5 (Pin 29) (Factory setting) |
| | | ON | Interrupt notification signal connected to GPIO5 (Pin 29) |
| 4 | INT_4 | OFF | Interrupt notification signal not connected to GPIO6 (Pin 31) (Factory setting) |
| | | ON | Interrupt notification signal connected to GPIO6 (Pin 31) |

## Input resistance setting switch

Sets the input resistance of the counter input signal and the control input signal. 5V or 12V is available by switching the switch.
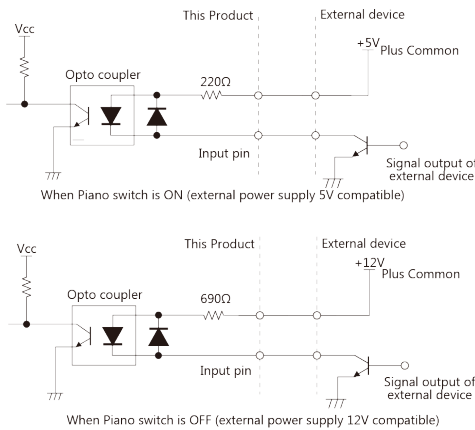


ON

1 2 3 4
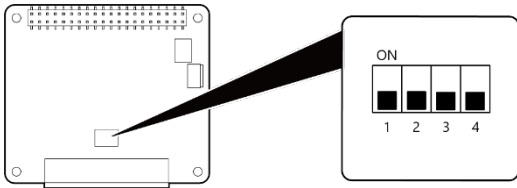
The factory default settings are all OFF.

| Switch number | Description |
|---|---|
| 1 | Set the input resistance of phase-A.<br>ON : 220Ω (When using 5V)<br>OFF : 690Ω (When using 12V) |
| 2 | Set the input resistance of phase-B.<br>ON : 220Ω (When using 5V)<br>OFF : 690Ω (When using 12V) |
| 3 | Set the input resistance of phase-Z.<br>ON : 220Ω (When using 5V)<br>OFF : 690Ω (When using 12V) |
| 4 | Set the input resistance of control input.<br>ON : 220Ω (When using 5V)<br>OFF : 690Ω (When using 12V) |

## Counter Input Circuit and Control Input Circuit

The figure below shows the equivalent circuit of counter input section and control input section of this product. The signal input section consists of an opto-coupler isolated input (compatible with current sink output). Set an external power voltage and input resistance value according to the output specification of the external device to be connected. As for the counter input section, connect both phase A and phase B for a two-phase input. Connect either phase A or phase B for a single-phase input. If not using the Z phase, this does not need to be connected. In addition, the control input section can also be used as the input section for the start / stop signal of general-purpose input and count operation, preset signal of count value.



When Piano switch is ON (external power supply 5V compatible)



When Piano switch is OFF (external power supply 12V compatible)

### CAUTION

To use external power (other than 5V or 12V); insert a current limiting resistor at the R position.
The following expression is used to calculate current limiting resistance R with the external power supply as PV:



When Piano switch is OFF (external power supply other than 5V or 12V)
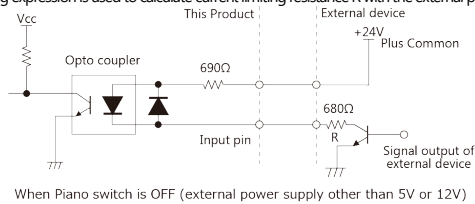
The expression is as follows;

$$\frac{PV-12}{20} < Rk\Omega < \frac{PV-12}{15}$$

If PV=24V, use a 600Ω < R < 800Ω resistor.

## Control Output Circuit

The figure below shows the output circuit of control output section of this product. The signal output section consists of an opto-coupler isolated open collector output (current sink type). An external power supply is therefore required to drive the output section of this product. The maximum output current rating per channel is 50 mA for the product.
Zener diodes are connected to the output transistor to protect against surge voltages.
As for the control output section, it is also possible to output a one-shot pulse signal at the time of hardware event occurs, such as a general-purpose output and count match.
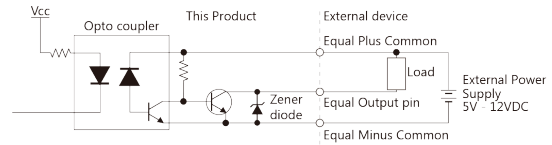


### CAUTION

- Negative logic is set as default. (Negative logic is also set when setting is empty)
- When the power is turned on, all output will be OFF.

## Block Diagram