**Features**

**Multi-function**
Analog I/O can be implemented in a compact system. The series consists of two different models from which you can select the best model to suit your application.

This product contains the analog input (12bit, 16ch), analog output (12bit, 2ch).

This model includes bi-directional digital inputs / outputs (16points, TTL level) and a counter (32bit 1ch, TTL level). You can select the input/output by the application software in eight signals units.

**Analog I/O can be synchronized with an internal timer or external clock.**
Analog I/O can both be performed at fixed time intervals and synchronized with an external signal.

**Digital filter function to prevent wrong recognition of external signal chattering is provided.**
This product has analog input / output control signal, digital input signal and digital filter function to prevent it from chattering in counter input signal. (Counter gate signal)

**Buffer memory available for background processing independent of software**
The boards include buffer memory (1K Word each for analog input and output) which can be used in either FIFO or ring format. This allows analog I/O to be performed independently of the operating state of the PC or software.

**Software-based calibration function**
Calibration of analog input/output can be all performed by software. Apart from the adjustment information prepared before shipment, additional adjustment information can be stored according to the use environment.

**Compact design not restricting installation location (188.0(W) x 78.0(D) x 30.5(H))**
Compact design of 188.0(W) × 78.0(D) × 30.5(H) does not require special installation location.

**Compatible to USB1.1/USB2.0**
Compatible to USB1.1/USB2.0 and capable to achieve high speed transfer at HighSpeed (480 Mbps).

**This product is a USB2.0-compliant analog I/O unit that extends the analog I/O function of USB port of PCs.**
Compact design not restricting installation location (188.0(W) × 78.0(D) × 30.5(H)) makes it easy to install the product within the panel or device using DIN rail mounting jigs, or on the floor or wall.

Windows driver library is supplied. Possible to be used as a data recording device for LabVIEW, with dedicated libraries.

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

#### Windows version of analog I/O driver API-AIO(WDM)
[Stored on the bundled CD-ROM driver library API-USBP(WDM)]

It is the library software, and which supplies command of hardware produced by our company in the form of standard Win32 API function (DLL). Using programming languages supporting Win32API functions, such as Visual Basic and Visual C++ etc., you can develop high-speed application software with feature of hardware produced by our company. In addition, you can verify the operation of hardware using Diagnostic programs.

< Operating environment >
- Adaptation language: Visual Basic, Visual C++, Visual C# .etc

You can download the updated version from the CONTEC’s Web site (http://www.contec.com/product/device/apiusbp/). For more details on the supported OS, applicable language and new information, please visit the CONTEC’s Web site.

#### Data Logger Software C-LOGGER
[Stored on the bundled CD-ROM driver library API-USBP(WDM)]

C-LOGGER is a data logger software program compatible with our analog I/O products. This program enables the graph display of recorded signal data, zoom observation, file saving, and dynamic transfer to the spreadsheet software “Excel”. No troublesome programming is required.

CONTEC provides download services (at http://www.contec.com/clogger) to supply the updated drivers. For details, refer to the C-LOGGER Users Guide or our website.

< Operating environment >

#### Data acquisition VI library for LabVIEW VI-DAQ (Available for downloading (free of charge) from the CONTEC web site.)

This is a VI library to use in National Instruments LabVIEW. VI-DAQ is created with a function form similar to that of LabVIEW’s Data Acquisition VI, allowing you to use various devices without complicated settings.

See http://www.contec.com/vidaq/ for details and download of VI-DAQ.

### Analog Input

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated specification</td>
<td>Un-isolated</td>
</tr>
<tr>
<td>Number of input channels</td>
<td>8 channels (Single-Ended Input), 8 channels (Differential Input)</td>
</tr>
<tr>
<td>Input range</td>
<td>±10V, ±15V, ±20V or Unipolar 0 - +10V</td>
</tr>
<tr>
<td>Absolute max. input voltage</td>
<td>±15V</td>
</tr>
<tr>
<td>Input impedance</td>
<td>1MΩ or more</td>
</tr>
<tr>
<td>Resolution</td>
<td>12bit</td>
</tr>
<tr>
<td>Non-Linearity error *1</td>
<td>±20LSB</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>2(16ch/Max.) *2 [500KSPS]*3</td>
</tr>
<tr>
<td>Buffer memory</td>
<td>1K data FIFO or 1K data RING</td>
</tr>
<tr>
<td>Conversion start trigger</td>
<td>Software / external trigger</td>
</tr>
<tr>
<td>Conversion stop trigger</td>
<td>Number of sampling times / external trigger/software</td>
</tr>
<tr>
<td>External start signal</td>
<td>TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External stop signal</td>
<td>TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External clock signal</td>
<td>TTL level (Rising or falling edge can be selected by software)</td>
</tr>
</tbody>
</table>

### Analog Output

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated specification</td>
<td>Un-isolated</td>
</tr>
<tr>
<td>Number of output channels</td>
<td>2ch</td>
</tr>
<tr>
<td>Output range</td>
<td>Bipolar -10V, ±15V or Unipolar 0 - +10V, 0 - +5V</td>
</tr>
<tr>
<td>Output current ability</td>
<td>±3mA</td>
</tr>
<tr>
<td>Output impedance</td>
<td>1Ω or less</td>
</tr>
<tr>
<td>Resolution</td>
<td>12bit</td>
</tr>
<tr>
<td>Non-Linearity error *1</td>
<td>±20LSB</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>12usec (Max.) *3 [83KSPS]*3</td>
</tr>
<tr>
<td>Buffer memory</td>
<td>1K data FIFO or 1K data RING</td>
</tr>
<tr>
<td>Conversion start trigger</td>
<td>Software / external trigger</td>
</tr>
<tr>
<td>Conversion stop trigger</td>
<td>Number of sampling times / external trigger/software</td>
</tr>
<tr>
<td>External start signal</td>
<td>TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External stop signal</td>
<td>TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External clock signal</td>
<td>TTL level (Rising or falling edge can be selected by software)</td>
</tr>
</tbody>
</table>

### Digital I/O

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of I/O Channels</td>
<td>16-bit input lines, 8-bit input/output lines, 16-bit output lines (programmable)</td>
</tr>
<tr>
<td>I/O signal level</td>
<td>TTL level (positive logic)</td>
</tr>
</tbody>
</table>

### Counter

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
<td>1channels</td>
</tr>
<tr>
<td>Counting system</td>
<td>Up count</td>
</tr>
<tr>
<td>Max. count</td>
<td>FFRRRRRR (Binary data, 32bit)</td>
</tr>
<tr>
<td>Number of external inputs</td>
<td>TTL level : 2 (Gate/Up), Gate (High level), Up (Rising edge)</td>
</tr>
<tr>
<td>Number of external outputs</td>
<td>TTL level : 1ch, Count match output (positive logic, pulse output)</td>
</tr>
<tr>
<td>Frequency response</td>
<td>5MHz (Max.)</td>
</tr>
</tbody>
</table>

### USB

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus specification</td>
<td>USB Specification 2.0/1.1 standard</td>
</tr>
<tr>
<td>USB transfer rate</td>
<td>12Mbps (Full-speed), 480Mbps (High-speed) *4</td>
</tr>
<tr>
<td>Power supply</td>
<td>Bus power</td>
</tr>
</tbody>
</table>

### Common section

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector</td>
<td>10 pin (screw-terminal) plug header x6</td>
</tr>
<tr>
<td>Number of terminals used at the same time</td>
<td>127 terminals (Max.) *5</td>
</tr>
<tr>
<td>Power consumption (Max.)</td>
<td>5VDC 450mA</td>
</tr>
<tr>
<td>Operating condition *6</td>
<td>0 - 50°C, 10 - 90%RH (No condensation)</td>
</tr>
<tr>
<td>Physical dimensions (mm)</td>
<td>180(L) x 140(D) x 34(H) (No protrusions)</td>
</tr>
<tr>
<td>Weight</td>
<td>300g</td>
</tr>
<tr>
<td>Attached cable length</td>
<td>USB Cable 1.8m</td>
</tr>
</tbody>
</table>

---

*1: A linearity error approximately 0.1% of full-range may occur when operated at 0°C or 55°C ambient temperature.

*2: The required time is indicated in the analog to digital conversion time of one channel. When AD of two or more channels is converted, time of the a few minutes of the channel is necessary.

*3: SPS = Samplings Per Second. The number of data that can be converted in one second is shown.

*4: The USB transfer speed depends on the host PC environment used (OS and USB host controller).

*5: As a USB hub is also counted as one device, you cannot just connect 127 USB terminals.

*6: To suppress the heating, ensure that there are spaces for ventilation (about 5cm) around this product.
### Packing List

- Unit (AIO-121602LN-USB) …1
- USB cable (1.8m) …1
- USB cable attachment on the main unit’s side (For Mini B connector side) …1
- First step guide …1
- I/O connector …6
- Rubber feet …4
- Magnet …2
- CD-ROM *1 [API-USBP(WDM)] …1

*1 The CD-ROM contains the driver software and User’s Guide (this guide)

### Block Diagram

![Block Diagram](image)

### Physical Dimensions

![Physical Dimensions](image)

### Installation Method

#### Mounting on a DIN Rail

**Mounting procedure**

1. Push the fixing hook up using a slotted screwdriver to make it unlockable.

![Mounting Procedure 1](image)

2. Hook the product from the upper part of the DIN rail, and press the lower part on to the DIN rail.

![Mounting Procedure 2](image)

3. Push the fixing hook up using a slotted screwdriver to make it lockable.

![Mounting Procedure 3](image)

**Removal procedure**

1. Pull down the fixing hook of the unit to unlock it.

![Removal Procedure 1](image)

2. With the fixing hook unlocked, pull the lower part of this unit toward you.

![Removal Procedure 2](image)

3. By lifting this unit, you can easily remove it from the DIN rail.

![Removal Procedure 3](image)
Desktop Installation
Using the rubber feet
When required to mount the product on the desktop, mount it on a horizontal platform. The rubber feet can be mounted in their mounting holes as shown in the following figure.

Wall Installation
To mount the product on the wall, purchase the commercially available screw (fitting for \( \phi 3.5 \)) separately.

Installation Using the Magnet
Attaching the magnet supplied with the product makes it easy to mount or remove the product on or from a metal surface such as steel desk or partition.

⚠️ CAUTION
- Do not let the magnet go near objects that can be affected by magnetic fields, such as monitors and floppy disks.
- If the product is shifted while mounted on the steel surface, the surface paint may be scratched.
- When using the magnet, stack connection is not possible.

Mounting/ removing the magnet
To mount the magnet, press down the entire length of the magnet into its mounting hole while pushing the magnet in the direction of arrow 1. Next, slide the magnet in the direction of arrow 2 to fix it in position.

To remove the magnet, slide the magnet in the direction of arrow 1 as shown in the following figure, and then lift it out in the direction of arrow 2.

Mounting onto the steel wall
Mount the product directly onto the steel wall. Pull it gently after mounting to confirm that it will not drop off from the body.

Installation Conditions

Installation orientation
It is possible to mount it in the orientations shown in the following figure. Other orientations would cause problems in usage, such as inadequate heat dissipation.

DIN rail fixation
Vertical installation

Horizontal installation
Installation on a ceiling
Screws / magnet fixation

Vertical installation

CAUTION
When using the product in a high temperature environment, cool it by blowing air even when the temperature is within the specified range.

Spacing between the system unit and any surrounding objects
Secure a distance of at least 50mm between the top of the main unit (single use) and any surrounding objects. Do not locate the unit in a fully enclosed housing.

Connecting an Interface Connector
When connecting to the unit to an external device, you can use the supplied connector plug. For wiring, strip off approximately 7mm of the covered part of a wire rod and then insert it to the opening. After the insertion, secure the wire rod with screws. Compatible wires are AWG 28 - 16.

Connection Method

• Connector used:
  2.5mm pitch, 10 pin type of rated current 0.6A
  STL1600O-3.5-6-BRENN (add by 7TR)
  Compatible plug (supplied): AK1680V3.5-6-BRENN (add by FTR)
  Compatible wires: AWG28-16

CAUTION
Removing the connector plug by grasping the cable can break the wire.
### Analog Input Signal Connection

The procedure for connecting analog signals depends on whether the analog input signals are single-ended or differential. The sections below describe how to connect the signals using flat cable and shielded cable.

#### Single-ended Input

The following figure shows an example of flat cable connection. Connect separate signal and ground wires for each analog input channel on interface connector.

![Flat Cable Connection Diagram](image-url)

- **CAUTION**
  - If the signal source contains over 500 kHz signals, the signal may affect the cross-talk noise between channels.
  - If the unit and the signal source receive noise or the distance between the unit and the signal source is too long, data may not be input properly.
  - An input analog signal should not exceed the maximum input voltage (relate to the product analog ground). If it exceeds the maximum voltage, the unit may be damaged.
  - Connect all the unused analog input channels to analog ground.

In the channel switching, the multiplexer does the electrical charge and discharge on the internal capacitor according to the signal voltage. Therefore, the voltage from the previous switching state may go into the next channel. It might cause the error of the signal source action. If this occurs, insert a high-speed amplifier as a buffer between the signal source andough the analog input pin to reduce the fluctuation.

- An input pin may fail to obtain input data normally when the signal source connected to the pin has high impedance. If this is the case, change the signal source to one with lower output impedance or insert a high-speed amplifier buffer between the signal source and the analog input pin to reduce the effect.

#### Analog Input Signal Names

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Input 00–15</td>
<td>Analog input signal. The numbers correspond to channel numbers.</td>
</tr>
<tr>
<td>Analog Ground (for AD)</td>
<td>Analog ground for analog input signals.</td>
</tr>
<tr>
<td>Analog Output 00–15</td>
<td>Analog output signal. The numbers correspond to channel numbers.</td>
</tr>
<tr>
<td>Analog Ground (for AO)</td>
<td>Analog ground for analog output signals.</td>
</tr>
</tbody>
</table>

#### Single-ended Input Connections

1. **External Start Trigger Input**
   - Connect the external start trigger input to the analog input pin.
2. **External Stop Trigger Input**
   - Connect the external stop trigger input to the analog input pin.
3. **External Sampling Clock Input**
   - Connect the external sampling clock input to the analog input pin.
4. **Digital Input/Output**
   - Connect the digital input/output pins to the analog input pins.
5. **Counter Output**
   - Connect the counter output to the analog input pin.
6. **Counter Input**
   - Connect the counter input to the analog input pin.
7. **Digital Ground**
   - Connect the digital ground to the analog input pin.
8. **Reserved Pins**
   - These pins are reserved for future use.
**Differential Input**

The following figure shows an example of flat cable connection. For each analog input channel on interface connector, connect the "+" input to the signal and connect the "-" input to the signal source ground. Also connect the analog ground on the unit to the signal source ground.

![Flat Cable Connection Diagram](image1)

The following figure shows an example of shielded cable connection. Use shielded cable if the distance between the signal source and unit is long or if you want to provide better protection from noise. For each analog input channel on interface connector, connect the "+" input to the signal and connect the "-" input to the signal source ground. Also connect the analog ground on the unit and the signal source ground to the shielding.

![Shielded Cable Connection Diagram](image2)

CAUTION
- If the signal source contains over 500 kHz signals, the signal may affect the cross-talk noise between channels.
- When the analog ground is not connected, the conversion data is not determined.
- If the unit and the signal source receive noise or the distance between the unit and the signal source is too long, data may not be input properly.
- An input analog signal should not exceed the maximum input voltage (relative to the unit analog ground). If it exceeds the maximum voltage, the unit may be damaged.
- Connect all the unused analog input channels to analog ground.
- In the channel switching, the multiplexer does the electrical charge and discharge on the internal capacitor according to the signal voltage. Therefore, the voltage from the previous switching state may go into the next channel. It might cause the error of the signal source action. If this occurs, insert a high-speed amplifier as a buffer between the signal source and the analog input pin to reduce the fluctuation.
- An input pin may fail to obtain input data normally when the signal source connected to the pin has high impedance. If this is the case, change the signal source to one with lower output impedance or insert a high-speed amplifier buffer between the signal source and the analog input pin to reduce the effect.

**Analog Output Signal Connection**

This section shows how to connect the analog output signal by using a flat cable or a shielded cable. The following figure shows an example of flat cable connection. Connect the signal source and ground to the interface connector analog output.

![Flat Cable Connection Diagram](image3)

The following figure shows an example of shielded cable connection. Use shield cable if the distance between the signal source and this product is long or if you want to provide better protection from noise. For the interface connector analog output, connect the core wire to the signal line and connect the shielding to ground.

![Shielded Cable Connection Diagram](image4)

CAUTION
- If this product or the connected wire receives noise, or the distance between this product and the target is long, data may not be outputted properly.
- For analog output signal, the current capacity is ±3mA (Max.). Check the specification of the connected device before connecting this product.
- Do not short the analog output signal to analog ground, digital ground, and/or power line. Doing so may damage this product.
- Do not connect an analog output signal to any other analog output, either on this product or on an external device, as this may cause a fault on this product.
- Analog output signal outputs hundreds of microvolts when USB cable is inserted.

**Connecting I/O Signals**

The following sections show examples of how to connect digital I/O signals. All the I/O signals are TTL level, and input or output can be set in 8 bit unit by software.

**I/O Circuit**

![I/O Circuit Diagram](image5)
Example of Connection

When switch is "ON", the corresponding bit is "0". When switch is "OFF" in contrast, the corresponding bit is "1".
When "1" is output to a relevant bit, the corresponding LED comes on. When "0" is output to the bit, in contrast, the LED goes out.

CAUTION
Take care not to short the outputs to digital ground as this may cause a fault.

Counter signals and Control signals Connection

Counter signals and Control signals Connection
The following sections show examples of how to connect counter I/O signals, and other control I/O signals (external trigger input signals, sampling clock input signals, etc.). All the counter I/O signals and control signals are TTL level signals.

About the counter input control signal
Counter Gate Control Input (refer to the user’s manual - chapter 3 Connector Pin Assignment) acts as an input that validate or invalidate the input of an external clock for the counter. This function enables the control of an external clock input for the counter. The external clock for the counter is effective when input is "High" and invalid when input is "Low". If unconnected, it is a pull-up in this product and remains "High". Therefore the external clock for the counter is effective when the counter gate control input is not connected.

CAUTION
- Do not short the output signals to analog ground, digital ground, and/or power line. Doing so may damage the product.
- If connected to each output, a pull-up resistor must be about 10kΩ to pull up with a 5V power source.
- Each input accepts 5V TTL signals.

Reference
For the operation timings for control signal input, see the user’s manual - “Control Signal Timings” in Chapter 6 “Hardware”.