B-04

DIGITAL I/O

Product Lineup / Basic Knowledge

PCI

Compact PCI

PC Card

USB

Product Lineup (ISA)

ISA

Types of Digital I/O Boards

1. Digital I/O

Board-level data acquisition facilitates communication between external machinery and the host computer by using the ON-OFF signals generated by the computer. Through the use of digital I/O boards, control circuit relays and operation switches can be supervised while controller input / output and digitized data can be easily monitored.

2. Types of Digital I/O Boards / Common Applications

■ Opto-isolated I/O

In opto-isolated I/O boards, logic and input / output circuits are isolated by the use of an optical photo-coupler. Information sent in the signal is converted and transmitted via light thereby avoiding the electric noise generated in the operating circuit. However, since a photo-coupler requires additional power, an external DC power supply is required.

These boards are used with light electrical machinery with operating circuits of 5-24VDC, such as a digital switch or display machine.

● **High-speed opto-isolated I/O**
Supplies high-speed photo-coupler isolation I/O.

Used when high-speed I/O is required.

● **Opto-isolated I/O w/on-board power supply**
Features an internal logic circuit that carries an isolated DC power supply making it possible to furnish the power necessary to operate the photo-coupler from an on board DC-DC converter.

Used when external power cannot be supplied.

■ Relay Output

Relay boards use a mechanical contact relay to isolate their logic and output circuits and can handle both DC and AC loads.
These boards are used to control high voltage electrical machinery where the operating circuit is AC or exeeds 24VDC.


■ TTL I/O

TTL level boards supply a high-speed direct link between the input / output and logic circuits of the boards. Since the boards provide no additional isolation they are best used in environments where electrical noise is at a minimum and the wiring distance is short.

These boards are used when a small TTL level (5VDC) relay is needed.

● **Bi-directional TTL I/O**
Bi-directional TTL level boards provide direct links between the input / output and logic circuits through the use of an i8255 (or equivalent) chipset and can carry out variable eight-point bi-directional I/O.

Bi-directional TTL I/O boards are also used for TTL level (5VDC) connections.
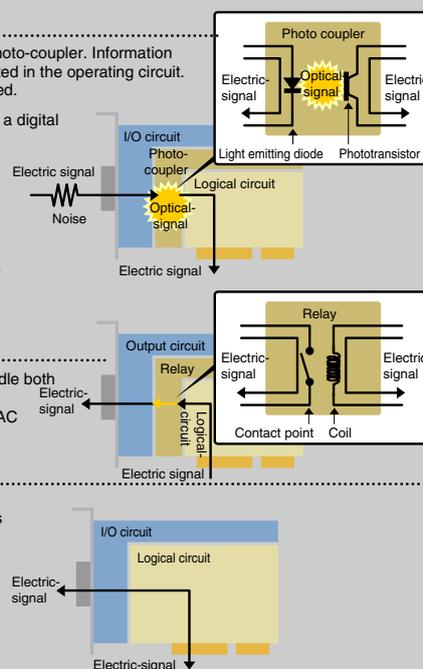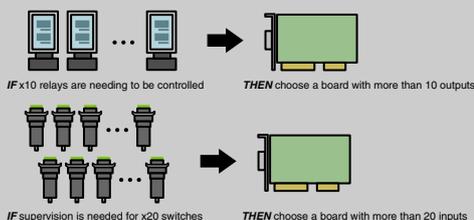

3. Considerations for Digital I/O Selection

CONTEC offers a number of digital I/O boards to choose from, each with varying specifications.
The following steps are a guide to help chose the optimal board for each application.

STEP 1 How many input &/or output channels are needed?
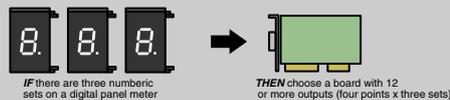
EXAMPLE 1 [for relay control and/or switch monitoring]

To decide how many I/O channels are needed take into consideration the number of relays or switches (on/off) on the equipment that will be monitored and determine their functions; i.e. alarms, reset, handshake.
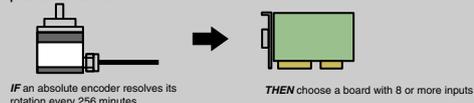
IF x10 relays are needing to be controlled   *THEN* choose a board with more than 10 outputs

IF supervision is needed for x20 switches   *THEN* choose a board with more than 20 inputs

EXAMPLE 2 [7 segment display unit BCD - binary code with digital switches]

If decimals or hexadecimals are used, usually 4 bits (four points) of output or input are needed for each digit.

IF there are three numeric sets on a digital panel meter   *THEN* choose a board with 12 or more outputs (four points x three sets)

EXAMPLE 3 [rotary encoder/absolute-type* - binary output]

Based on the time it takes to complete one rotation. For example, if one rotation is resolved every 256 minutes, $(256 = 2^8 \rightarrow 8$ bits) eight points of input is needed.

IF an absolute encoder resolves its rotation every 256 minutes   *THEN* choose a board with 8 or more inputs

* For a rotary encoder/incremental form use a counter board (page B-40)

STEP 2 What type of circuitry is suitable for the application?

EXAMPLE 1

IF the equipment has open collector and input circuit designs & the output circuit of the machinery / input voltage (DC) to the board does not exceed DC24V

→ *THEN* choose opto-isolated I/O boards [i.e. PIO-32/32L(PCI)]

EXAMPLE 2

IF the input /output of equipment require high-speed TTL level communication

→ *THEN* choose non-insulated TTL-level I/O [i.e. PIO-32/32T(PCI)]
→ *OR* if greater insulation is required, choose insulated TTL-level I/O [i.e. PIO-16/16TB(PCI)]

STEP 3 What other factors need to be considered?

● Desired response speed, number of needed interrupts, additional functions.

● Support software (take into consideration control needs & development environment)

4. Types of Output Circuits

Based on applications and electrical characteristics, output circuits for digital input/output are available in the following groups.

Transistor output (Non-contact output)

Transistor or non-contact output circuits, utilize a microchip transistor, that can drive, open and close the machinery's DC load.

■ Opto-coupler isolation open collector output (sink type)

With these output circuits, the collector of the output transistor serves as the output terminal and the circuit is left open. The internal logic is [ON (short):1, OFF(open):0].

With sink type, when an output transistor is ON (load being applied), the electric current will flow from the load to an output terminal.

Opto-coupler isolation open collector output boards are used for signal output to light electric appliances with a voltage of 12 to 24VDC.
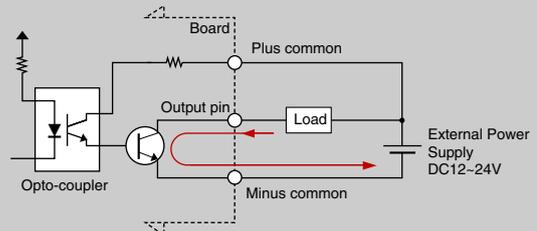
■ Opto-coupler isolation output (source type)

In opto-coupler isolation output circuits the output transistor emitter serves as the output terminal. The internal logic is [ON(short):1, OFF(open):0].

With source type, when an output transistor is ON (load being applied), the electric current will flow from an output terminal to the load.

Due to its high resistance to electro magnetic interference, source type is favored among European countries and is used for the signal output to light electric appliances with a voltage of 12 to 24VDC.
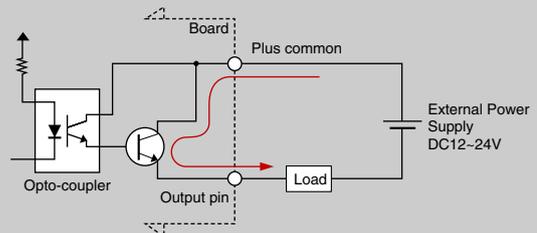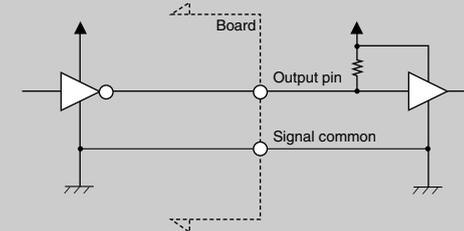
■ Non-isolated TTL level driver output (negative logic)

In non-isolated TTL-level output circuits, the collector of the output transistor serves as the output terminal and is pulled up by PC Vcc (5VDC).

The internal logic is negative at [Low:1, High:0].

These boards are used for signal output to TTL internal circuits and 5VDC appliances.
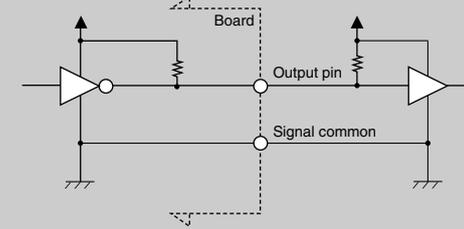
■ Non-isolated TTL open collector output (negative logic)

In non-isolated open collector output the collector of the output transistor serves as the output terminal and the pull-up is conducted on the input circuit side on an open output circuit.

The internal logic is negative at [Low(short):1 and High(open):0].

These are used for signal output to 5VDC appliances with TTL internal circuits.

■ Opto-coupler isolation TTL driver output (negative logic)

In opto-coupler isolated TTL level output circuits, the collector of an output transistor serves as the output terminal.

The internal logic is negative at [Low:1, High:0].

Opto-isolated boards are used in applications where the wiring distance is long or when the isolation is neccessary on internal TTL circuit (5VDC appliances).
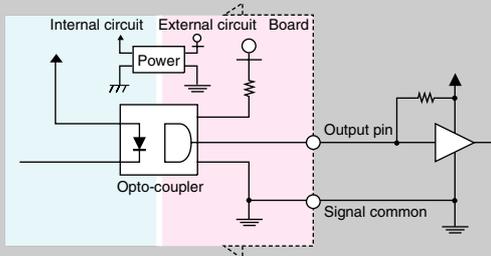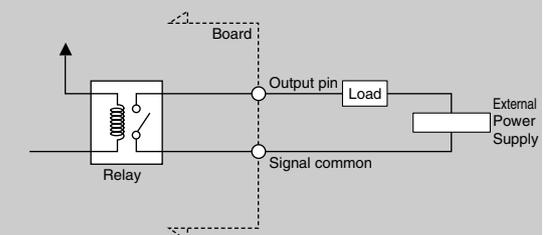
Contact Output

Contact output boards utilize a relay contact, insulating itself from the internal logic circuit. This contact is used to drive, open and close the load.
Since there is no limit on the direction of the electric current flow, these can be connected to either DC or AC loads.
Contact output boards are used for signal output to heavy electric appliances (AC) or those running on higher-than 24 VDC.

B-05

DIGITAL I/O

Product Lineup / Basic Knowledge

PCI

Compact PCI

PC Card

USB

Product Lineup (ISA)

ISA

Types of Digital I/O Boards

5. Types of input circuits

Input circuits can be divided into the following groups.

DC inputs

An input circuit in which the transistor output and operation circuit can connect with a DC contact output circuit.

■ Opto-coupler isolation (supports sink output)

In a sink output opto-coupler isolated input circuit the cathode side of a photo coupler serves as the input terminal. It can input sink type transistor output or relay output signals.

The internal logic is [ON (short):1, OFF (open): 0]. The input terminal is a source type from which the electric current flows out.

Opto-coupler isolated input boards are used for signal input from light electric appliances with voltages from12 to 24VDC.
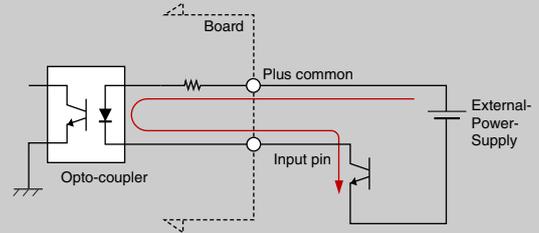
■ Opto-coupler isolation (supports source output)

In a source output opto-coupler isolated input circuit the anode side of a photo coupler serves as an input terminal. It can input source type transistor output or relay switch output signals.

The internal logic is [ON (short): 1, OFF (open): 0]. The input terminal is a sink type from which the electric current flows in.

Due to its high resistance to electro magnetic interference, it is favored among European countries. These boards are used for signal input from light electric appliances with voltages from 12 to 24VDC.
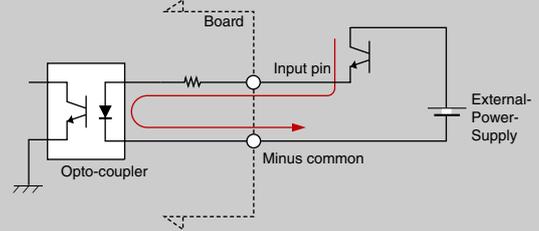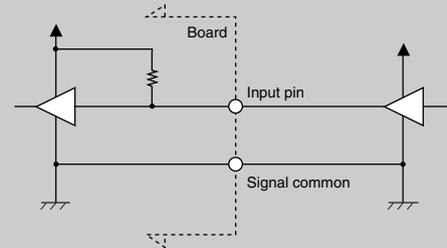
■ Non-isolated TTL level (negative logic)

In non-isolated TTL level boards the transistor base serves as an input terminal and pull-up occurs at 5VDC.

The internal logic is negative at [Low: 1, High: 0".

Non-isolated TTL level boards are used for signal input from appliances with TTL output circuits or 5VDC appliances.
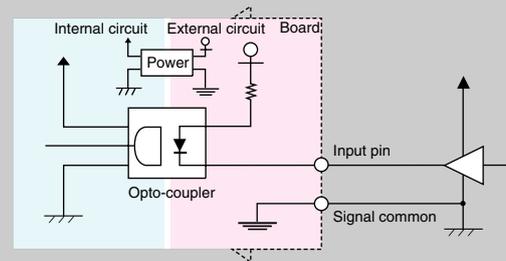
■ Photo coupler isolation TTL level (negative logic)

In TTL-level photo coupler isolated boards the cathode of the photo coupler serves as the input terminal.

The internal logic is negative at "Low: 1, High: 0].

These boards are used with TTL output circuit or 5VDC appliances when the wiring distance needs to be extended or when isolation is necessary.
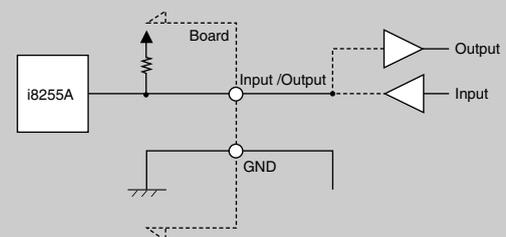
Bilateral circuits

■ Non-isolated TTL level input/output (positive logic)

The input/output circuits of these boards are based on the i8255 PPI (or equivalent) chipset with a 5VDC pull-up type also available.

The internal logic is positive at [Low (short): 0, High (open): 1].

These boards are used for signal input/output on appliances with TTL input/output circuits and 5VDC appliances as well as those requiring bilateral 5VDC TTL-level input/output.

■ Non-isolated buffered TTL level input/output (positive logic)

The input/output circuits of these boards have an added buffer IC at the i8255 PPI (or equivalent) to provide enhanced drive capacity.

The internal logic is positive at [Low: 0, High: 1].

These boards are used for signal input/output on appliances with TTL input/output circuits and 5VDC appliances as well as those requiring bilateral 5VDC TTL-level input/output.

Product Lineup
/ Basic
Knowledge

PCI

Compact PCI

PC Card

USB

Product Lineup
(ISA)

ISA
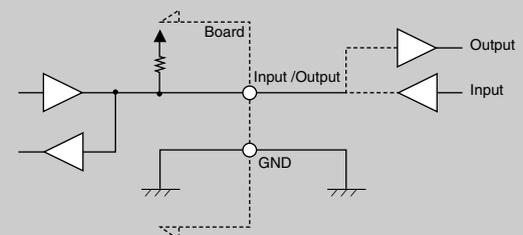
6. Explanation of add-on functions

Extended functions

A number of CONTEC's digital I/O boards are available with the following additional functions.

● **Digital filter**
A digital filter sets up a frequency band in all input terminals. This filter prevents invalid communication due to electrical noise or relay contact chattering.

● **Output data echo back**
The state (ON/OFF) of all output terminals can be read at any time.

● **Handshake**
Handshake communication by the STB/ACK signal is easily performed. (Interrupts are generated by the STB signal)

● **Interrupt edge setting**
Logic reversal of an incoming interrupt signal and gate control (momentary input prohibition) can be performed.

● **Input-and-output of a bit unit**
Performance of arbitrary 1-bit input / output can be performed.

Interrupt input function

Interrupt input functions allow the external device to connect specific inputs to the IRQ of the host computer. External signals then give instructions to the computer to perform high priority processing.

There are two ways that this function is handled.

● **Multiple inputs communicate with single IRQ**
In addition the signal reads and checks the status information from the board. [i.e. four inputs would require only 1 IRQ]

● **Each input communicates with single IRQ**
[i.e. four inputs would require 4 IRQ levels]

Normal routine

①Interrupt

②Jump

③Interrupt routine

④Return

Normal routine
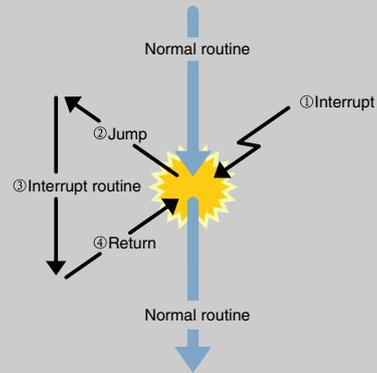
Commons

Groups of input-and-output circuits that can be set up independently. Type and description are as follows.

● **[X] points to 1 common**
This is when a certain number of points share a common operating circuit. The board can then be configured to different circuit voltages depending on the application's needs [i.e. a 32 channel with 16 channels sharing a single common can be set up for 16 inputs at 12VDC and 16 inputs at 24VDC]

● **All points share 1 common**
All channels [input and output] share a common operating circuit. The exrternal machinery MUST match the on-board circuitry to be compatible.

● **All points are independent**
Every channel can be set up independently. Machinery with multiple operating circuit levels can effectively work with these boards.

Common A — DC24V
Input A0
⋮
Input A15
1 common

Common B — DC12V
Input B0
⋮
Input B15
1 common