

A1J0101

Economical Input Amplifier Module

TRM



Constanta · Sand · Pyrite(R.I)

A1J0101(Pyrite) R1T1

## Economical Input Amplifier Module Rev.1 Typ. 1

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### Technical Reference Manual

#### Product Highlights

##### 1.Highly Economical

- Ultra low cost implementation of isolating amplification functionality
- Single isolated optocoupler input with 1000V isolating voltage
- Single isolated relay output with 250V AC 10A capacity for both NO & NC

##### 2.Highly Flexible

- High-level or low-level is selected
- The optocoupler input and relay output may be separated into two non-interference functionality
- Multiple power supply voltage versions e.g. 5/9/12/24V available with complementary voltage customization services

##### 3.Good Reliability

- Basic protection against supply polarity inversion, overcurrent, electrostatic discharge, electrical fast transient and voltage surge
- The creepage slots on the PCB isolating the high voltage side strictly follow the safety standards

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## Revision History

| Version | Date<br>(YYYY-MM-DD) | Notes           |
|---------|----------------------|-----------------|
| R1T1    | 2020-09-02           | Initial Release |

## Chapter 1 Product Introduction

### 1.1 Preface

This product is an optocoupler isolated input amplifier module. It may be powered from 5V, 9V, 12V, 18V or 24V. After the product is powered up, if a voltage signal is applied to the optocoupler terminal, the relay will make, and if the signal is removed, the relay will break. The polarity of the input signal may be selected between a high-level or low-level.

### 1.2 Structural Description

There are seven screw terminals, a set of cross pin headers and three LED indicators on the product. The description of each terminal and component are shown in the figure and table below.

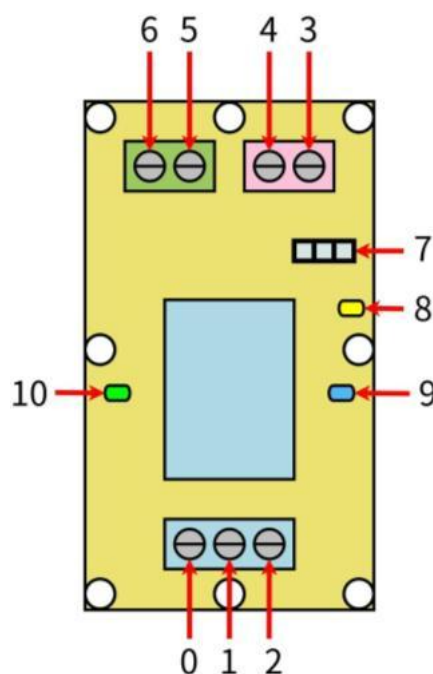


Figure 1-1 Product Front-side Marking Drawing

Table 1-1 Product Front-side Marking

| Name                  | No. | Meaning                                                                                                                                                                                |
|-----------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Normally open contact | 0   | The Normally Open (NO) contact of the relay. When the relay makes, this is connected to the common contact. Blue. For transistor output type products, this serves as the load ground. |
| Common contact        | 1   | The COMmon (COM) contact of the relay. Blue. For transistor output type products, this serves as the load-side power supply ground.                                                    |

| Name                    | No. | Meaning                                                                                                                                                                                                           |
|-------------------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Normally closed contact | 2   | The Normally Closed (NC) contact of the relay, when the relay breaks, this is connected to the common contact. Blue. For transistor output type, this serves as the common terminal of load and load-side supply. |
| Positive supply         | 3   | Positive power supply. The typical current consumption when the relay makes is 40mA. Red.                                                                                                                         |
| Negative supply         | 4   | Negative power supply. The typical current consumption when the relay makes is 40mA. Red.                                                                                                                         |
| Positive input          | 5   | Isolating positive input. Green.                                                                                                                                                                                  |
| Negative input          | 6   | Isolating negative input. Green.                                                                                                                                                                                  |
| Level selection         | 7   | The jumper. Select the input level that makes the relay. Jump to the right side to select high-level, and jump to the left side to select low-level <sup>[1]</sup> .                                              |
| Input indicator         | 8   | The indicator for input level status. Yellow.                                                                                                                                                                     |
| Action indicator        | 9   | The indicator for the relay status. Blue.                                                                                                                                                                         |
| Power indicator         | 10  | The indicator for the power status. Green.                                                                                                                                                                        |

### 1.3 Wiring Methods

The power supply terminals are directly connected to the DC power input. The normally open and normally closed relay terminals are connected according to the application needs and they are connected in series with the load and load power supply. For the transistor output type, the wiring diagram is described in [3.2](#).

A typical wiring diagram of the relay output type is shown below.

<sup>[1]</sup> When the low-level is selected, the input status indicator will keep illuminated.

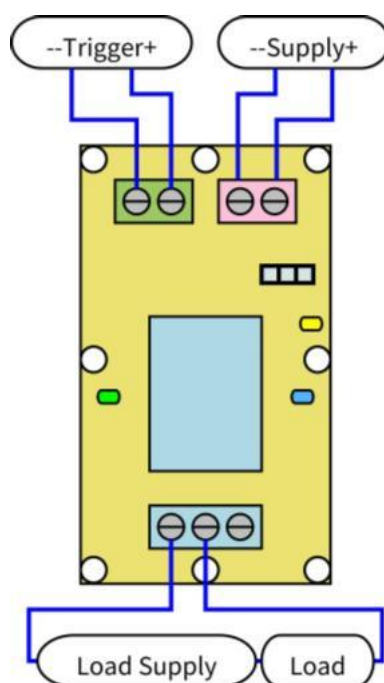


Figure 1-2 Typical Wiring Diagram of a Relay Output Type Product

## 1.4 Mechanical Dimensions

The PCB mechanical dimensions of the product are shown in the table below. The tolerance of all mechanical dimensions is 5%. All dimensions are in millimeters.

Table 1-2 PCB Mechanical Dimensions

| Dimension                                       | Value |
|-------------------------------------------------|-------|
| PCB length                                      | 55    |
| PCB width                                       | 30    |
| Distance between upper and lower mounting holes | 49    |
| Distance between left and right mounting holes  | 24.5  |
| Terminal spacing                                | 5.08  |

This product comes with an optional miniature case. The mechanical dimensions of the case are shown in the figure below. All dimensions are in millimeters.

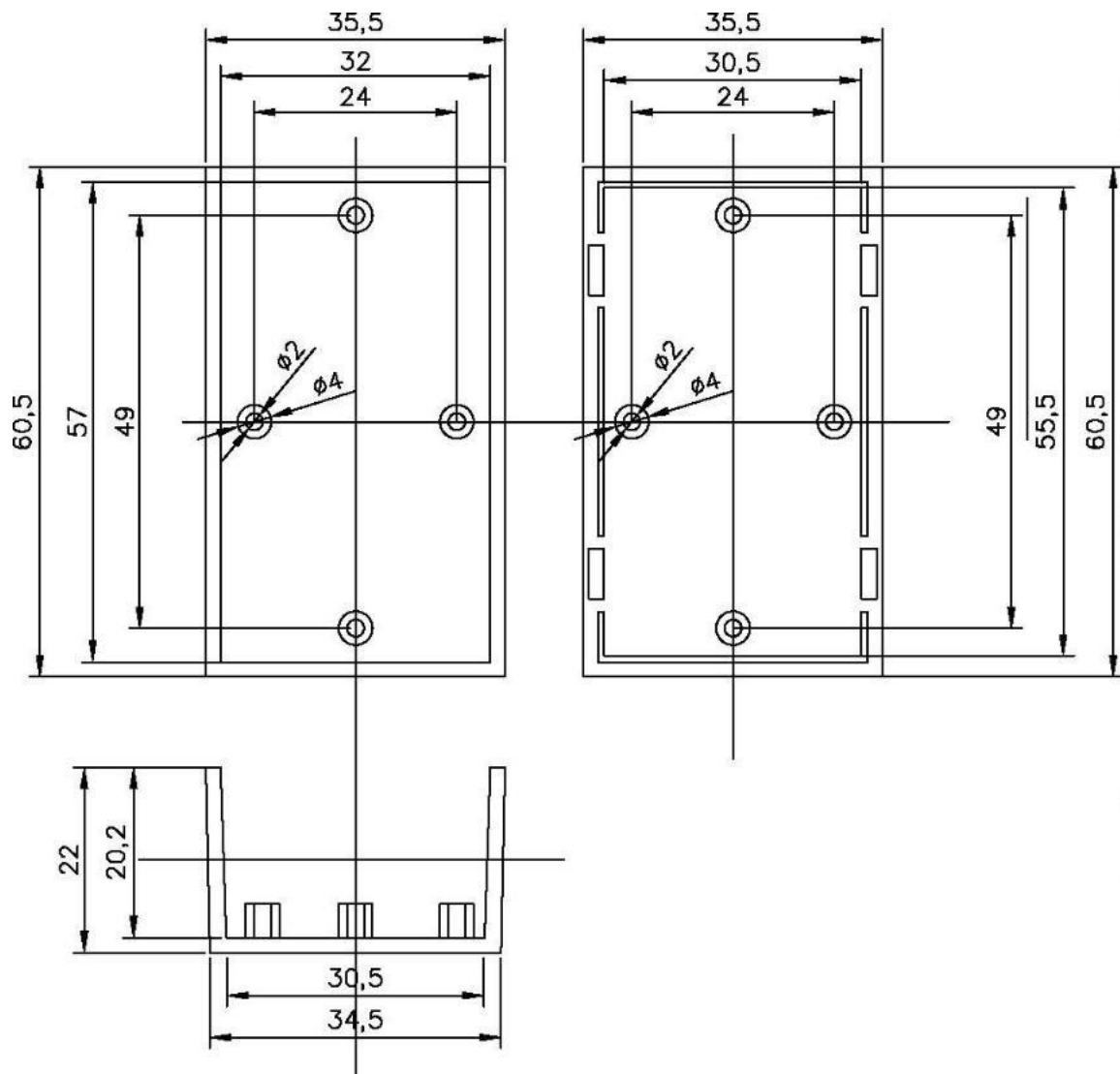


Figure 1-3 Mechanical Drawing of the Small Case

When the product lacks a case, it is only recommended for controlling the safe voltage (0-36V) rather than the AC mains. Special care should be taken to prevent electric shock when a caseless product is used to control the AC mains. Please be gentle when tightening the screws to avoid stressing the product PCB. Long-term reliability of the product may be affected when the screw is too overtightened.

When the product has a case, it can be used to control the AC mains. It can optionally be glued onto a flat surface with double-sided adhesive tape.

## Chapter 2 Detailed Function Description

### 2.1 Basic Function Description

If there is a valid signal connected to the optocoupler terminal of this product, the relay will make, and if there is no signal, the relay will break. The input polarity of the signal may be inverted, or the relay may be configured to be normally open or normally closed on power up.

### 2.2 Input Polarity Setting Description

Jump the jumper cap between "o" and "+" to select high-level operation, i.e. the relay will make when the optocoupler terminal perceives a high-level and break when the optocoupler terminal perceives a low-level. Jump the jumper cap between "o" and "-" to select low-level operation, i.e. the relay will make when the optocoupler terminal perceives a low-level and break when the optocoupler terminal perceives a high-level. When the product is configured for low-level operation, the input status indicator will keep illuminated.

The relay of this product may also be configured to a constant make or break, independent of the optocoupler signal. Jumping the jumper cap between "o" and "V" permanently makes the relay, and jumping the jumper cap between "o" and "G" permanently breaks the relay. The "V" and "G" terminals are shipped unpopulated by default, and needs to be soldered when required.

### 2.3 Discrete Module Using Description

The optocoupler and relay terminals of this product may be used separately, i.e. as one standalone optocoupler isolated input and one standalone relay isolated output. When using the product in this way, the jumper cap on the product needs to be removed. The functions of the five jumper terminals on the product are listed below. These five terminals may be used according to specific applications in a flexible manner.

Table 2-1 Jumper Terminal Function under Discrete Module

| Terminal Name | Function                                                                                                                                    |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| "V"           | Connects directly to the power supply terminal of the product, as a high-level reference voltage.                                           |
| "G"           | Connects directly to the ground terminal of the product, as a low-level reference voltage.                                                  |
| "+"           | When there is a high-level at the optocoupler terminal, the output is the same high-level as the supply voltage, otherwise it is low-level. |
| "-"           | When there is a low-level at the optocoupler terminal, the output is the                                                                    |

| Terminal Name | Function                                                                                                       |
|---------------|----------------------------------------------------------------------------------------------------------------|
|               | same high-level as the supply voltage, otherwise it is low-level.                                              |
| “o”           | If connected to a high-level above 2V, the relay will make; if connected to a low-level, the relay will break. |

## Chapter 3 Modification Description

### 3.1 Preface

This product has the following modifications whose ordering numbers are in the form of A1J01[aa]R[b]T[c]M[dd]. The [aa] field is fixed as 01, as the module only has a single-channel version; the [b] field and [c] field are the main version number and sub-version number of the module respectively; the [dd] field determines the specific modification of the module. The module modification classes are mutually independent. If no specific requirement is designated when the product is shipped, the default option is the 12V relay output type, that is, M31. The specific meanings of the [dd] field are as follows.

Table 3-1 The Meanings of the [dd] Field

| Digit  | Description                  | Meaning                  |
|--------|------------------------------|--------------------------|
| First  | Supply voltage of the module | 1 5V supply type         |
|        |                              | 2 9V supply type         |
|        |                              | 3 12V supply type        |
|        |                              | 4 18V supply type        |
|        |                              | 5 24V supply type        |
| Second | Output modes of the module   | 1 Relay output type      |
|        |                              | 2 Transistor output type |

### 3.2 Transistor Output Type Description

This version is connected to the circuit in open-drain mode as shown below. The transistor has a rated working voltage of 12-48V DC and a rated current of 10A. With a 10A freewheeling diode on the transistor, it can directly power an inductive load up to 10A<sup>[1]</sup>.

Compared to relays, transistors are far more sensitive. Thus, when the module is being powered on or off and the input is left unconnected, the transistor may make for a moment<sup>[2]</sup> and then break. This issue is nonexistent on the relay version, but must be accounted for when using transistor version modules, especially when the devices connected to the output may respond to such momentary pulses. A effective countermeasure is to use power sequencing: make sure that the product is powered on before the output is powered on, and that the output is powered off before the product is powered off.

<sup>[1]</sup> Usually heavy-duty electromagnets and motors, etc.

<sup>[2]</sup> Around 100 milliseconds

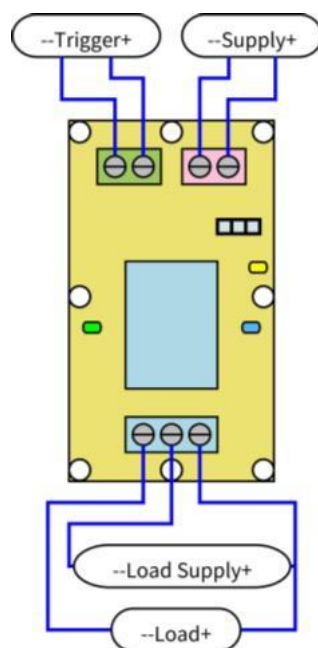


Figure 3-1 Typical Wiring Diagram of a Transistor Output Type Product

## Chapter 4 Electrical Specification Description

### 4.1 Normal Working Conditions

The normal working conditions of this module are shown in the table below. Only within this condition can the normal operation be guaranteed.

Table 4-1 Normal Working Conditions

| Description              | Range           |                           |
|--------------------------|-----------------|---------------------------|
| Supply voltage           | 5V              | DC 4.8 - 5.2V             |
|                          | 9V              | DC 8.5 - 11V              |
|                          | 12V             | DC 11 - 14V               |
|                          | 18V             | DC 16 - 20V               |
|                          | 24V             | DC 20 - 28V               |
| Power supply ripple      | ----            | Less than 1Vp-p           |
| Supply current           | ----            | Less than 50mA            |
| Input stress             | ----            | DC 0 - 30V                |
| Output stress            | Relay type      | DC 30V or AC 0 - 220V, 8A |
|                          | Transistor type | DC 12 - 48V, 8A           |
| Input isolating voltage  | ----            | Less than 250V            |
| Output isolating voltage | Relay type      | Less than 250V            |
|                          | Transistor type | Less than 130V            |
| Operating temperature    | ----            | -20 - 60°C                |

### 4.2 Absolute Maximum Ratings

The extreme conditions that this module can withstand are shown in the following table. Stresses at or above those listed here may permanently damage the module.

Table 4-2 Absolute Maximum Ratings

| Description    | Range |          |
|----------------|-------|----------|
| Supply voltage | 5V    | DC 5.3V  |
|                | 9V    | DC 11.5V |
|                | 12V   | DC 15V   |
|                | 18V   | DC 22V   |
|                | 24V   | DC 30V   |

|                          |                 |                                                                                         |
|--------------------------|-----------------|-----------------------------------------------------------------------------------------|
| Self-resettable fuse     | ----            | DC 30V, 500mA                                                                           |
| Input stress             | ----            | DC 50V                                                                                  |
| Output stress            | Relay type      | AC 250V, 10A                                                                            |
|                          | Transistor type | DC 55V, 10A                                                                             |
| Input isolating voltage  | ----            | DC 1000V, 60s (Type test only)                                                          |
| Output isolating voltage | Relay type      | DC 1000V, 60s (Type test only)                                                          |
|                          | Transistor type | DC 250V, 60s (Type test only)                                                           |
| Relay mechanical life    | Relay type      | More than 100,000 times (Actual life varies with load, > 10,000 times under heavy load) |
| Storage temperature      | ----            | -40 - 85°C                                                                              |

### 4.3 Other Parameters and Certifications

The other parameters and certifications of this module are listed as follows. These parameters and certifications include electrostatic discharge, electrical fast transient and voltage surge tests that comply with the requirements of [IEC61000-6-2-2016](#) (Edition 3.0, 2016-08) for basic industry purposes. During all of these tests, the modules are powered by a well-grounded 12V supply and in active delay operation.

Table 4-3 Other Parameters and Certifications

| Item                                                 | Details                                                                         | Passing Criterion                                                        |
|------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Electrostatic discharge resistance<br>IEC61000-4-2   | 6kV, discharge on all terminals.                                                | (A) module functions normally.                                           |
| Electrical fast transient resistance<br>IEC61000-4-4 | 2kV, 5kHz, 2min, applied to all terminals.                                      | (B) module functions normally, the relay may jitter to a certain degree. |
| Electrical fast transient resistance<br>IEC61000-4-4 | 4kV, 5kHz, 2min, applied to all terminals.                                      | (C) module is not permanently damaged.                                   |
| Surge resistance<br>IEC61000-4-5                     | 1kV voltage surge to ground, applied to power terminals. (Guaranteed by design) | (C) module is not permanently damaged.                                   |
| Creepage distance                                    | Pollution degree 3, material category IIIa                                      | The actual distance is above                                             |

|                                  |                                                                                                                          |                                                                   |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| IEC60950-2L/2N                   | and IIIb, basic isolation from relay terminal <sup>[1]</sup> to logic side <sup>[2]</sup> , creepage distance above 6mm. | 6.05mm, which meets the requirements.                             |
| Electrical clearance IEC60950-2H | Pollution degree 3, basic isolation from relay terminal to logic side, electrical clearance above 2mm.                   | The actual distance is above 2.2mm, which meets the requirements. |
| CCC-002008                       | Category 002: accessories for household appliances, product category 002007: programmable controller                     | Certificate No.: (Applying)                                       |

#### 4.4 Notes on Reliability

This product has enhanced stability thus well resists interferences in general industrial environments<sup>[3]</sup>, and may be used as a general product in industrial applications. If additional stability is still required, a switching power supply<sup>[4]</sup> with Electrical Fast Transient (EFT) resistance or a supply line filter is required to power the product and the power supply cord must be shorter than 3m.

During all tests, the negative supply of the product is directly connected to the earth by default. The same connection should be made to obtain the reliability performance in the table above.

<sup>[1]</sup> Primary circuit.

<sup>[2]</sup> Extra low voltage(ELV). Take note that it is not designed according to Safety Extra Low Voltage circuit standards, that is, not SELV.

<sup>[3]</sup> It withstands 2kV EFT, which greatly exceeds the requirement to withstand 1kV EFT in IEC61000-6-2-2016.

<sup>[4]</sup> Preferably isolated.

## Chapter 5 Appendix

### 5.1 Typical Application

A certain tank has a water level detector that gives warnings. The float in the liquid level sensor switches on and off as the liquid rises or falls. When the water level raises above the warning line, an alarm is powered on.

#### 5.1.1 Requirement Analysis

One relay output is used in this application, and the power supply voltage of the liquid level sensor and the module is 12V. The application may be fulfilled with the [A1J0101M31](#) module.

#### 5.1.2 Circuit Design

According to the requirements above, connect the circuit as shown in the figure:

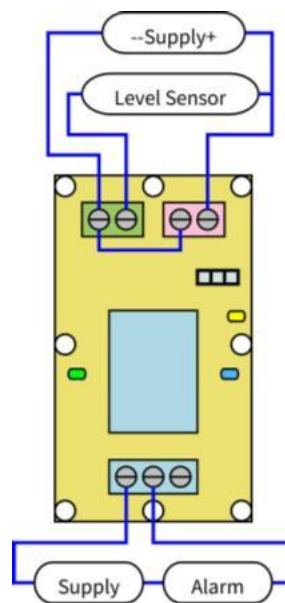


Figure 5-1 Typical Wiring Diagram of Application Cases

Connect the jumper cap to the right to select high-level triggering. Once the liquid level sensor detects an water level above the limit, the switch will turn on, which makes the relay and turns on the alarm.

### 5.2 Legal Statement

The company reserves the right to further modify, upgrade and amend the product and its manuals without notifications. The user should confirm that the information is complete and up-to-date before placing an order. The company is not responsible for the specific application

of the customer and only guarantees that the module functions properly under normal working conditions. This product may be protected by one or more patents or other forms of intellectual properties and may contain third-party intellectual properties; the use of this product does not authorize the user to the patented technologies and intellectual properties contained in this product, nor does it authorize the user to the potentially involved third-party intellectual properties, either expressly or implicitly. Reproduction of this technical manual in part or in whole is allowed only on the premise of maintaining the integrity of the technical data in this technical manual and this legal statement. The company is not responsible for such copies and their uses.

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