

B2J0601

Economical Intelligent Trigger Delay Module

TRM



Constanta · Sand · Cuprite(R.II)

B2J0601(Cuprite) R1T1

Economical Intelligent Trigger Delay Module Rev.1 Typ. 1

Technical Reference Manual

Product Highlights

1.Highly Economical

- Ultra low cost implementation of all standard time-delay functionality
- Supports adjusting delay time in seconds, minutes and hours, supports ultra long delay time
- Single voltage threshold detection input that allows battery level monitoring or analog sensor input
- Single isolated relay output with 250V AC 10A capacity for both NO & NC
- Multiple power supply voltage versions e.g. 5/9/12/24V with available complementary voltage customization services

2.High Accuracy

- Ultra long delay time accuracy up to 30ppm precisely set by the button
- No accuracy drift w.r.t. temperature, humidity and supply voltage

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

4.Fully Customizable

- Supports specifying factory delay parameters for bulk orders
- Supports specifying non-standard functionality for bulk orders

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Revision History

Version	Date (YYYY-MM-DD)	Notes
R1T1	2020-02-01	Initial Release

Chapter 1 Product Introduction

1.1 Preface

This product is an intelligent delay module implemented with smart ASIC technology. It may be powered from 5V, 9V, 12V, 18V or 24V. This product supports 26 delay modes, which basically covers all common occasions. The delay mode and unit may be easily adjusted through a button. The high delay accuracy of the product is one of the outstanding features compared to competing products, and its long delay accuracy may be as high as 30 ppm. The additional voltage detection function may be performed on the input terminal of the product which makes it even more flexible.

The functionality of the product is completely customizable per requested in mass production.

1.2 Structural Description

There are six screw terminals, one button, one potentiometer, one jumper and two LED indicators on the product. The description of each terminal and component are shown in the figure and table below.

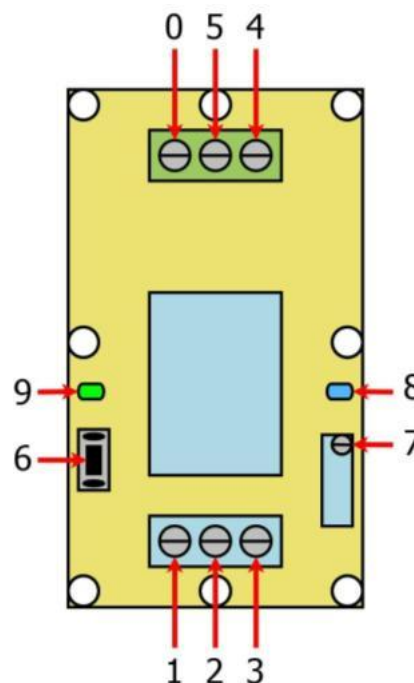


Figure 1-1 Product Front-side Marking Drawing

Table 1-1 Product Front-side Marking

Name	No.	Meaning
------	-----	---------

Name	No.	Meaning
Trigger terminal	0	With voltage threshold detection functionality. Green.
Normally open contact	1	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	2	The COMmon (COM) contact of the relay. Blue. For transistor output type products, this serves as the load-side power supply ground.
Normally closed contact	3	The Normally Closed (NC) contact of the relay, when the relay breaks, this is connected to the common contact. Blue. For transistor output type products, this serves as the common terminal of load and load-side supply.
Positive supply	4	Positive power supply. The typical current consumption when the relay makes is 40 mA. Green.
Negative supply	5	Negative power supply. The typical current consumption when the relay makes is 40 mA. Green.
Adjusting button	6	The button for adjusting the delay mode, method and time. Black.
Adjusting knob	7	The knob for adjusting the voltage threshold. Blue.
Action indicator	8	The indicator for the relay status. Blue.
Power indicator	9	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. The trigger terminal is connected to a voltage input to trigger the product according to the voltage threshold. For the transistor output type, the wiring diagram is described in [3.2](#).

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

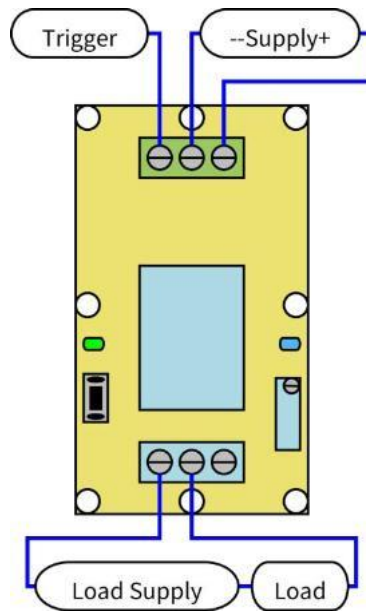


Figure 1-2 Typical Wiring Diagram of a Relay Output Type Product

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.

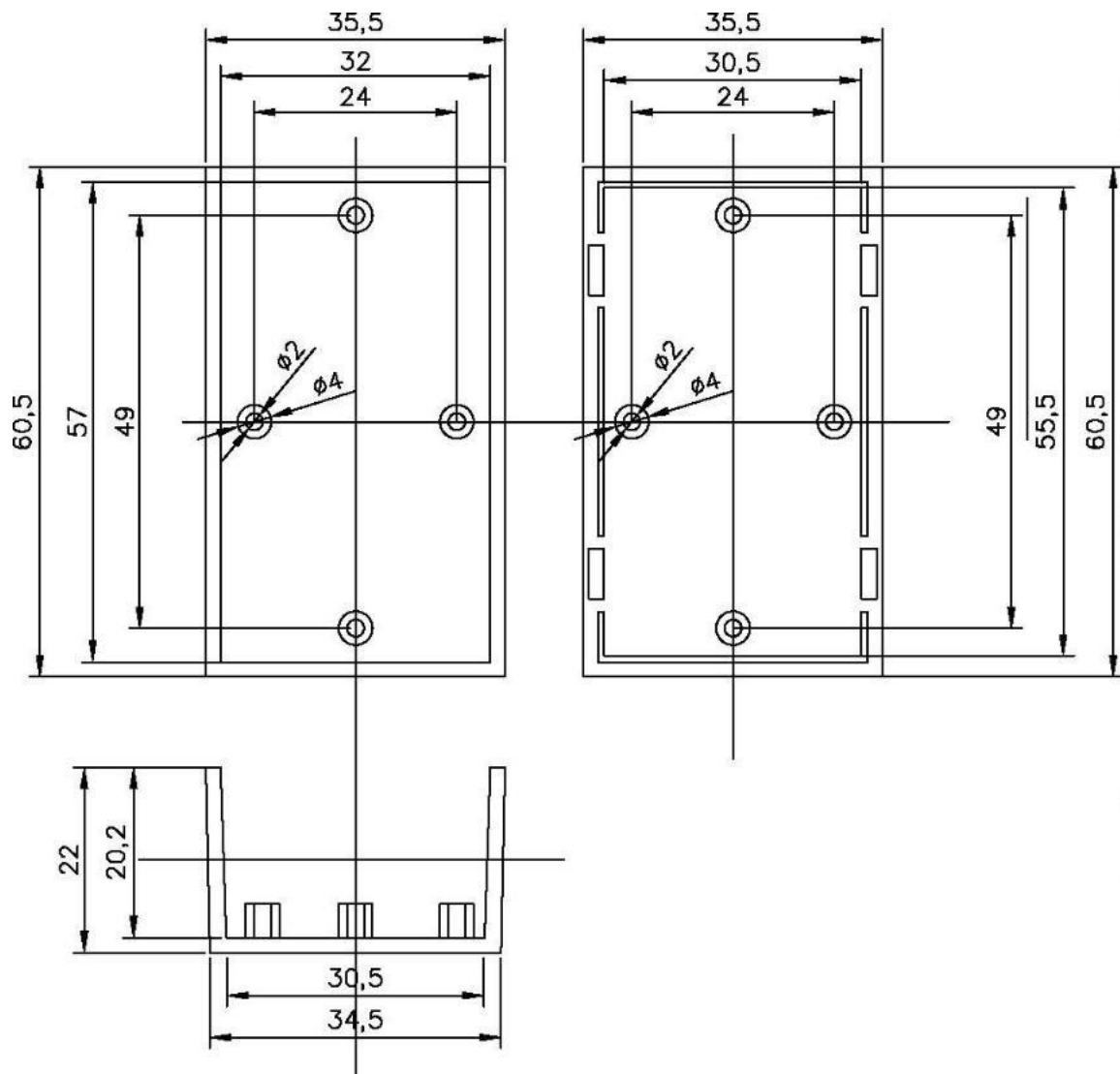


Figure 1-3 Mechanical Drawing of the Small Case

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 Configuration Unlocking Description

To adjust the delay mode and time, unlocking the settings is needed first. To unlock the settings, keep the button pressed then connect the power supply to the module. After about 3 seconds, the relay on the product will make and the indicator light will turn on, and the unlocking is complete. At this point, release the button and keep the product powered on to unlock the product's delay mode and time settings for this power cycle only. Then both the delay time and mode may be configured as described in the following sections.

After the configuration is complete, release the button and power cycle the product. The product will not respond to the key press unless the settings are unlocked, ensuring that the delay mode and time will not be unintentionally tempered during normal operation.

2.2 Configuration Reset Description

To reset the delay mode and time to factory defaults^[1], press and hold the button then connect the power supply to the module. After about 3 seconds, the product will be unlocked; keep holding the button for more than 10 seconds, until the product's relay and indicator alternates rapidly on and off, indicating that the configuration reset is complete.

After the configuration reset is complete, the new delay mode and time may be set directly without power cycling again as the configuration has been unlocked.

2.3 Delay Mode Description

This product has 3 delay time units and 8 basic delay templates built-in, which are combined to form 24 delay modes, plus two self-locking modes, for a total of 26 delay modes. Short press the button will cycle through all 26 delay modes of the product. For each short press, the delay mode will switch to the next one in the table, while the indicator light will flash according to certain patterns to indicate the current selected delay mode. The specific pattern is that the indicator first flashes 1-4 times at an interval of 0.5 seconds to represent the delay time unit, and then flashes 1-8 times at an interval of 0.5 seconds after a pause of 1.5 seconds to indicate the basic delay template.

Since the indicator is connected to the relay, the relay will also toggle when the delay mode is adjusted. Therefore, when adjusting the delay mode, it is recommended to disconnect all

^[1] For retail products, the factory configuration is "High-level trigger, disconnect after 10 seconds delay".

electrical connections on the relay when adjusting the delay mode^[1], unless it is confirmed that the toggling of the relay will not affect the load.

The specific 26 delay modes are listed in the table below.^[2]

Table 2-1 List of Delay Modes

No.	Delay Unit	Delay Action	Indicator Light Flashes
11	Second	High-level triggers, breaks after a delay period	Flashes once, then flashes again after a short pause
12	Second	Low-level triggers, breaks after a delay period	Flashes once, then flashes twice after a short pause
13	Second	Rising edge triggers, breaks after a delay period	Flashes once, then flashes 3 times after a short pause
14	Second	Falling edge triggers, breaks after a delay period	Flashes once, then flashes 4 times after a short pause
15	Second	High-level sustains, on-off-on toggling with delay intervals	Flashes once, then flashes 5 times after a short pause
16	Second	Low-level sustains, on-off-on toggling with delay intervals	Flashes once, then flashes 6 times after a short pause
17	Second	Rising edge triggers, on-off-on toggling with delay intervals	Flashes once, then flashes 7 times after a short pause
18	Second	Falling edge triggers, on-off-on toggling with delay intervals	Flashes once, then flashes 8 times after a short pause
21	Minute	High-level triggers, breaks after a delay period	Flashes twice first, then flashes once after a short pause
22	Minute	Low-level triggers, breaks after a delay period	Flashes twice first, then flashes twice after a short pause
23	Minute	Rising edge triggers, breaks after a delay period	Flashes twice first, then flashes 3 times after a short pause
24	Minute	Falling edge triggers, breaks after a delay period	Flashes twice first, then flashes 4 times after a short pause
25	Minute	High-level sustains, on-off-on toggling	Flashes twice first, then flashes 5

^[1] And delay time.

^[2] If the low-level trigger method is selected and the trigger terminal is not connected, the relay indicator may be directly on after flashing, as the low-level on the trigger terminal will trigger the product directly at this time. This is normal and does not represent a product failure.

No.	Delay Unit	Delay Action	Indicator Light Flashes
		with delay intervals	times after a short pause
26	Minute	Low-level sustains, on-off-on toggling with delay intervals	Flashes twice first, then flashes 6 times after a short pause
27	Minute	Rising edge triggers, on-off-on toggling with delay intervals	Flashes twice first, then flashes 7 times after a short pause
28	Minute	Falling edge triggers, on-off-on toggling with delay intervals	Flashes twice first, then flashes 8 times after a short pause
31	Hour	High-level triggers, breaks after a delay period	Flashes 3 times first, then flashes once after a short pause
32	Hour	Low-level triggers, breaks after a delay period	Flashes 3 times first, then flashes twice after a short pause
33	Hour	Rising edge triggers, breaks after a delay period	Flashes 3 times first, then flashes 3 times after a short pause
34	Hour	Falling edge triggers, breaks after a delay period	Flashes 3 times first, then flashes 4 times after a short pause
35	Hour	High-level sustains, on-off-on toggling with delay intervals	Flashes 3 times first, then flashes 5 times after a short pause
36	Hour	Low-level sustains, on-off-on toggling with delay intervals	Flashes 3 times first, then flashes 6 times after a short pause
37	Hour	Rising edge triggers, on-off-on toggling with delay intervals	Flashes 3 times first, then flashes 7 times after a short pause
38	Hour	Falling edge triggers, on-off-on toggling with delay intervals	Flashes 3 times first, then flashes 8 times after a short pause
43	Self-locking	Rising edge triggers, toggles on and off on each trigger in a self-locking manner	Flashes 4 times first, then flashes 3 times after a short pause
44	Self-locking	Falling edge triggers, toggles on and off on each trigger in a self-locking manner	Flashes 4 times first, then flashes 4 times after a short pause

When the retail version products are shipped, the selected delay mode is always 11. The full-featured retail version has all 26 delay modes; the simplified retail version has 12 delay modes in total, including 11, 12, 13, 14, 21, 22, 23, 24, 31, 32, 33 and 34.

2.4 Delay Time Description

The delay time of this product is also adjusted by the same button. To adjust the delay time, press and hold the button until the indicator starts to flash. Each complete blink of the indicator light represents one unit of delay time. Incomplete blinks will not be counted.^[1]

The range of delay time setting is 0-255. When the delay time is set to 0^[2], in the high-level or low-level triggering templates, the only function that remains is voltage detection and thresholding. The delay capability is lost, and the rising edge and falling edge trigger templates are invalid. If the delay time is set to 0 when one of the on-off-on toggling templates are chosen, the delay time will be regarded as 500 ms^[3].

2.5 High-Level Thresholding Description

The trigger terminal of this product may accept an input voltage from 0-30V. The voltage threshold decides whether a particular input voltage is high level or low level. A voltage above the threshold is considered high-level, and a voltage below the threshold is considered low-level. This threshold is adjusted through a knob. Rotating it clockwise will set the threshold higher, and vice versa.

The trigger terminal of this product may withstand up to 50V over long period of time, but may be damaged if this is exceeded. Any voltage exceeding 35V is treated as high-level regardless of the knob setting.

2.6 Mass Customization Description

The core of this product is a dedicated intelligent delay integrated circuit, so its delay time, mode and voltage threshold may be arbitrarily customized. When customizing, all delay or action sequences different from the factory standard ones may be used. All parameters may be preconfigured to any value at factory and the wiring terminals, buttons, indicators and potentiometers may be omitted to lower the costs.

You may also return a preconfigured retail-version product that has been fully set up to us and ask us to produce a version with the exact same presets, which helps to reduce the tedious process of confirming the demand details.

^[1] For example, if you have been holding the button and the indicator light has flashed 8 times, and you release the button now, the delay time set is 8 seconds; if the 9th flashing has started, but the indicator not turned off yet, and you release the button now, the delay time set is still 8 seconds. Only when the 9th flashing is completed and the indicator light is off, and you release the button now, the delay time set is 9 seconds.

^[2] That is, the button is released even before the first flashing is completed.

^[3] That is, the "on-off" interval is 1 second.

Chapter 3 Modification Description

3.1 Preface

This product has the following modifications whose ordering numbers are in the form of B2J06[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 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^[1].

Certain loads e.g. filament lamps, mercury lamps exhibit a current spike during startup; some other loads e.g. heavy-duty motors, speakers and electromagnets emit extremely strong EMI during operation. Due to size limitations, it is impossible to implement good power line filters on this module; thus when the power of such loads exceed 1W it is recommended to use standalone power sources for the module^[2] and to place these loads as far as possible from the module, or the module may repeatedly reset when the load powers on.

Compared to relays, transistors are far more sensitive. Thus, when the module is being powered on or off, the internal states of the microcomputer may become invalid; even if the

^[1] Usually heavy-duty electromagnets and motors, etc.

^[2] Use one dedicated DC power supply for the module, and one power supply for the load and other devices.

delay is untriggered, the transistor may make for a moment^[1] 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.

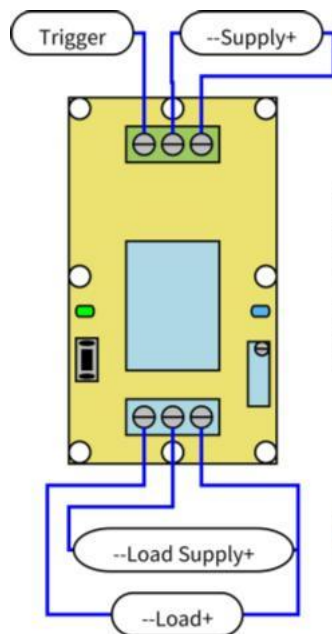


Figure 3-1 Typical Wiring Diagram of a Transistor Output Type Product

^[1] Around 100 milliseconds

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
	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
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
	24V	DC 30V
Self-resettable fuse	----	DC 30V, 500mA
Input stress	----	DC 50V
Output stress	Relay type	AC 250V, 10A

Output isolating voltage	Transistor type	DC 55V, 10A
	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 [IEC61000-6-1-2016](#) (Edition 3.0, 2016-08) for light 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 IEC61000-4-2	1kV, discharge on all terminals.	(A) module functions normally.
Electrostatic discharge resistance IEC61000-4-2	2kV, discharge on all terminals.	(C) module is not permanently damaged.
Electrical fast transient resistance IEC61000-4-4	500V, 5kHz, 2min, applied to all terminals.	(A) module functions normally.
Electrical fast transient resistance IEC61000-4-4	1kV, 5kHz, 2min, applied to all terminals.	(C) module is not permanently damaged.
Surge resistance 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 ^[1] to logic side ^[2] , creepage distance above 6mm.	9.2mm, 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.

4.4 Notes on Reliability

This product is only qualified^[3] for commercial applications due to its miniature size, thus it is not recommended for formal industry situations with strong interference. Additional power filters and / or port filters are required if it must be used in this way. If such additional filters are not desired, a switching power supply^[4] with Electrical Fast Transient (EFT) resistance is required to power the product and the power supply cord must be shorter than 3m.

In addition, if the load exhibits current spikes during startup or emit extremely strong EMI during operation, it is recommended to use standalone power sources for the module^[5] and to place these loads as far as possible from the module, or the module may repeatedly reset when the load powers on, especially in cases where the power source has poor transient responsiveness or the 5V version is used.

During the test, the negative supply of the product is directly connected to the earth by default. The same connection should be made to obtain the stability index in the table above.

^[1] Primary circuit.

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

^[3] It complies with the requirement to withstand 500V EFT in [IEC61000-6-1](#), but does not comply with the requirement to withstand 1kV EFT in [IEC61000-6-2](#).

^[4] Preferably isolated.

^[5] Use one dedicated DC power supply for the module, and one power supply for the load and other devices.

Chapter 5 Appendix

5.1 Typical Applications

5.1.1 Edge Triggering Delay Application

A pump needs to be controlled by a button so that it draws exactly 1 cubic decimeter of water to a sink each time the button is pressed. The pump is known to pump water at a rate of 10 cubic centimeters per second.

5.1.1.1 Requirement Analysis

One input and one relay output are used in this application, and the power supply voltage of the product and pump is 12V, which may be fulfilled by the [B2J0601M31](#) product. We use rising edge triggering so that the timing starts when the button is pressed rather than it is released. Even if the button is pressed continuously for a period of time, this time will not affect the accuracy of the water volume.

5.1.1.2 Circuit Design

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

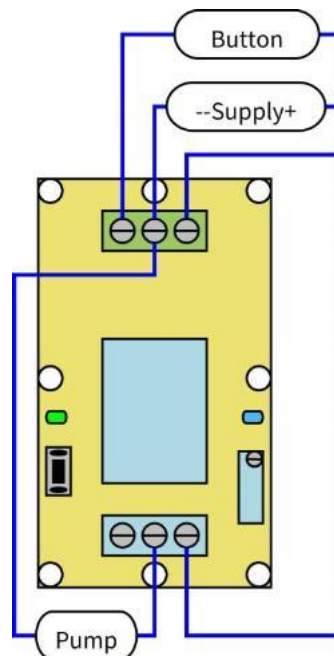


Figure 5-1 Wiring Diagram of Edge Triggering Delay Application Case

Since the pumping rate is 10 cubic centimeters per second and the total pumping volume is 1 cubic decimeter, we set the product to be triggered by the rising edge with a delay of 100

seconds. The voltage threshold is adjusted to about 6V^[1] through the knob on the potentiometer to obtain the maximum noise tolerance.

5.1.2 Voltage Thresholding Delay Application

Computers and other devices tend to accumulate heat and then overheat inside when working for a long periods of time, so it is necessary to turn on the cooling fan when the temperature of the devices reaches a certain threshold. When the temperature is below the threshold, the fan needs to be delayed for 5 minutes before shutting down to completely dissipate the heat. Since the cooling fan starts and stops more frequently, we want to use a solution that can be switched on and off frequently.

5.1.2.1 Requirement Analysis

One analog input and one output are used in this application, and the power supply voltage of the product and fan is 12V. Since the fan is required to be toggled frequently, it is more appropriate to use a transistor to control, which may be fulfilled by the [B2J0601M32](#) product. The temperature sensor will output a voltage that is linear to the temperature value, so we need to set the voltage discriminant threshold at the voltage corresponding to the temperature threshold.

5.1.2.2 Circuit Design

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

^[1] That is, half of the supply voltage.

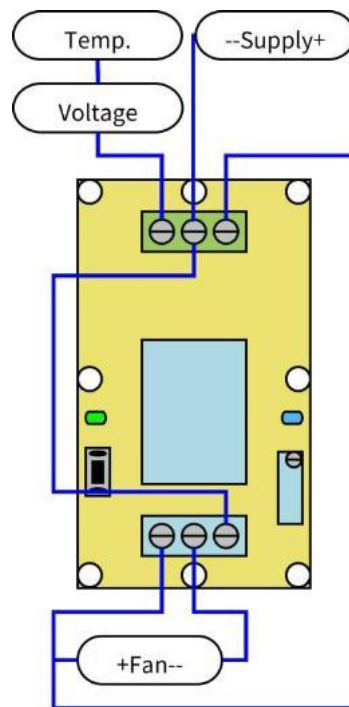


Figure 5-2 Wiring Diagram of Voltage Thresholding Application Case

In this application, we set the product to trigger at a high-level with a delay of 5 minutes. The high-level discriminant voltage threshold needs to be adjusted by the knob on the potentiometer so that the fan starts to operate when the temperature reaches the threshold.

5.1.3 Cyclic Delay Application

There is a mixer on the construction site, and the warning light is required to flash at 2-second intervals to warn workers when the mixer is on. It is known that the warning light is a 12V powered red LED module and the controller continuously outputs a high-level signal when the mixer is turned on.

5.1.3.1 Requirement Analysis

One input and one relay output are used in this application, and the power supply voltage of the product and warning light is 12V. As the flashing light only occurs during the operation of the mixer, the relay has a sufficient open and closed life, so it may be fulfilled by the [B2J0601M31](#) product. Since the light is required to keep flashing cyclically during the start-up of the mixer, we use a high-level maintained cyclic delay mode and need to set the delay time to 2 seconds.

5.1.3.2 Circuit Design

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

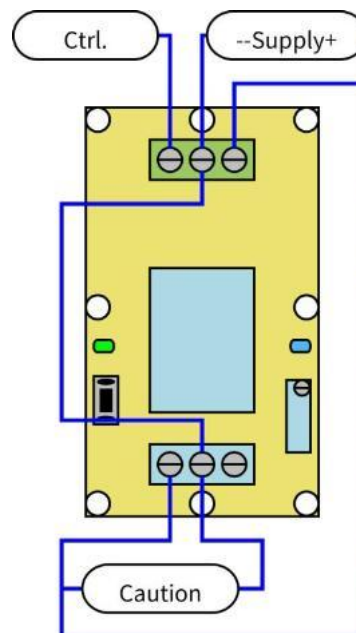


Figure 5-3 Wiring Diagram of Cyclic Delay Application Case

In this application, we set the product to trigger at a high-level with a delay of 2 seconds, so that the warning light will flash at 2-second intervals. The high level discriminant voltage threshold needs to be adjusted by the knob on the potentiometer to adapt to the level output of the controller.

5.1.4 Trigger Self-locking Application

An exhaust fan controlled by a button needs to be installed in a toilet, and the state of the exhaust fan switch is required to change when the button is pressed. That is, when the exhaust fan is off, press the button to turn on, and when the exhaust fan is on, press the button to turn off. The exhaust fan is powered by 220V AC mains.

5.1.4.1 Requirement Analysis

One input and one relay output are used in this application, and the power supply voltage of the product is 12V generated by 220V AC mains power adapter, which may be fulfilled by the [B2J0601M31](#) product. Since the relay is required to change state each time the button is pressed, we use a rising edge triggered self-locking mode. This mode has no delay time and the state of the relay will remain until the next rising edge comes.

5.1.4.2 Circuit Design

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

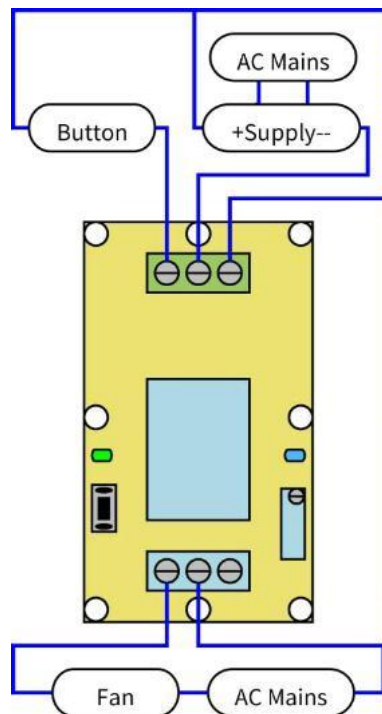


Figure 5-4 Wiring Diagram of Trigger Self-locking Application Case

In this application, we set the product to a rising edge triggered self-locking mode, and no delay time is needed. The high-level discriminant voltage threshold needs to be adjusted by the knob on the potentiometer to adapt to the power supply voltage.

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 custom itself 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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apply the product to such uses. If the customer applies this product to the above-mentioned uses, the company is not responsible for the associated losses caused by the failure of the product.

The company does not take responsibility for the user configurations of the product and only guarantees the correct operation of the product according to these configuration. Nor does the company guarantee that the specific configuration is suitable for a specific purpose. The company shall not be held liable for any losses in cases where the user configurations do not fit the specific purpose.