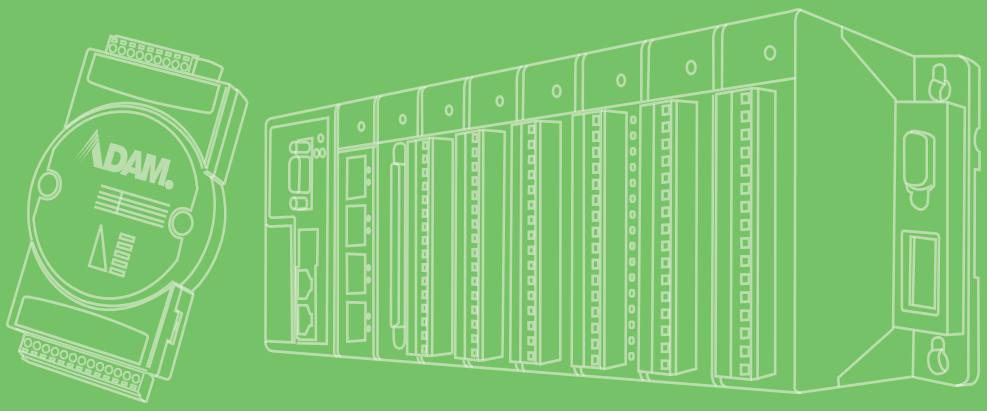

User Manual

APAX-5000 Series

I/O Modules

ADVANTECH

Enabling an Intelligent Planet

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If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain an RMA (return merchandize authorization) number from your dealer. This allows us to process your return more quickly.
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5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

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Declaration of Conformity

CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Advantech. Please contact your local supplier for ordering information.

FCC Class A

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FM

This equipment has passed the FM certification. According to the National Fire Protection Association, work sites are classified into different classes, divisions and groups, based on hazard considerations. This equipment is compliant with the specifications of Class I, Division 2, Groups A, B, C and D indoor hazards.

Technical Support and Assistance

1. Visit the Advantech web site at www.advantech.com/support where you can find the latest information about the product.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before you call:
   - Product name and serial number
   - Description of your peripheral attachments
   - Description of your software (OS, version, application software, etc.)
   - A complete description of the problem
   - The exact wording of any error messages

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

- To avoid electrical shock, always disconnect the power from your PC chassis before you work on it. Don't touch any components on the CPU card or other cards while the PC is on.

Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.

Safety Instructions

1. Install the system only in area with restricted access.
2. Read these safety instructions carefully.
3. Keep this User Manual for later reference.
4. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
5. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
6. Keep this equipment away from humidity.
7. Put this equipment on a reliable surface during installation. Dropping it or letting it fall may cause damage.
8. The openings on the enclosure are for air convection. Protect the equipment from overheating. DO NOT COVER THE OPENINGS.
9. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
10. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
11. All cautions and warnings on the equipment should be noted.
12. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.
13. Never pour any liquid into an opening. This may cause fire or electrical shock.
14. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
15. If one of the following situations arises, get the equipment checked by service personnel:
16. The power cord or plug is damaged.
17. Liquid has penetrated into the equipment.
18. The equipment has been exposed to moisture.
19. The equipment does not work well, or you cannot get it to work according to the user's manual.
20. The equipment has been dropped and damaged.
21. The equipment has obvious signs of breakage.
22. DO NOT LEAVE THIS EQUIPMENT IN AN ENVIRONMENT WHERE THE STORAGE TEMPERATURE MAY GO BELOW -20° C (-4° F) OR ABOVE 60° C (140° F). THIS COULD DAMAGE THE EQUIPMENT. THE EQUIPMENT SHOULD BE IN A CONTROLLED ENVIRONMENT.
23. CAUTION: DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE RECOMMENDED BY THE MANUFACTURER, DISCARD USED BATTERIES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS.
24. The sound pressure level at the operator's position according to IEC 704-1:1982 is no more than 70 dB (A).

DISCLAIMER: This set of instructions is given according to IEC 704-1. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

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Chapter 1

Overview

1.1 Introduction

This manual will discuss the specifications, functions and application wiring of the APAX-5000 series of I/O modules. Advantech provides different APAX-5000 I/O modules for various applications. The following table outlines Advantech's supported I/O modules.

Table 1.1: Supported I/O Module List

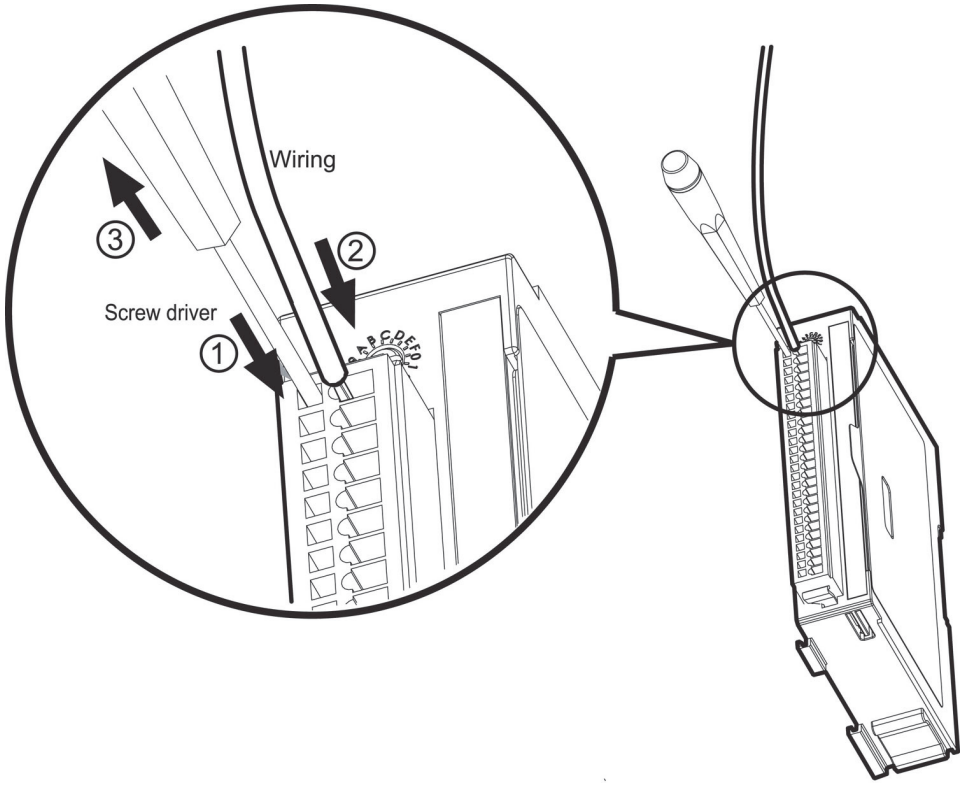
Module	Name	Specifications
Analog I/O	APAX-5013	8-ch RTD Module
	APAX-5017	12-ch Analog Input Module
	APAX-5018	12-ch Thermocouple Input Module
	APAX-5017H	12-ch High Speed Analog Input Module
	APAX-5028	8-ch Analog Output Module
Digital I/O	APAX-5040	24-ch Digital Input Module
	APAX-5045	24-ch Digital Input/Output Module
	APAX-5046	24-ch Digital Output Module
	APAX-5046SO	20-ch Source Type Digital Output Module
Relay Output	APAX-5060	12-ch Relay Output Module
Counter	APAX-5080	Counter/Frequency and DIO module
Communication	APAX-5490	4-port RS-232/422/485 Communication Module by APAX-5402
	APAX-5090	4-port RS-232/422/485 Communication Module by APAX Bus
	APAX-5435	APAX iDoor Technology Expansion Module

1.2 I/O Wiring

APAX-5000 I/O modules leverage detachable clamp type terminal blocks. Comparing with traditional screw type terminal blocks, clamp type terminal blocks can save up to 75% wiring time and provide better reliability for shock and vibration. Follow the procedures below for wiring your APAX-5000 I/O module.

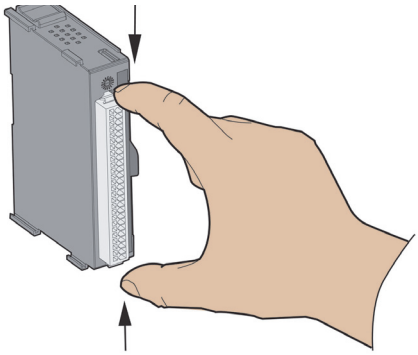
1. Insert the screw driver into the left hole of the terminal.
2. Insert the wiring into the right hole of the terminal.

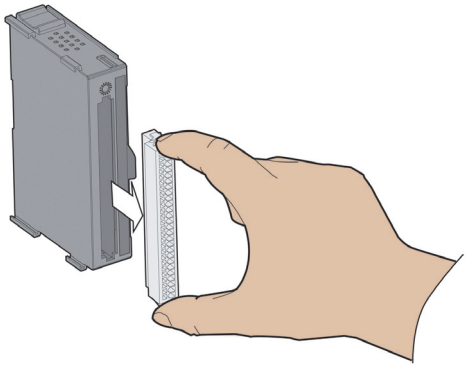
Note! *Please use # 14 AWG ~ 28 AWG wire for terminal block.*



1.3 Removing the I/O Terminal

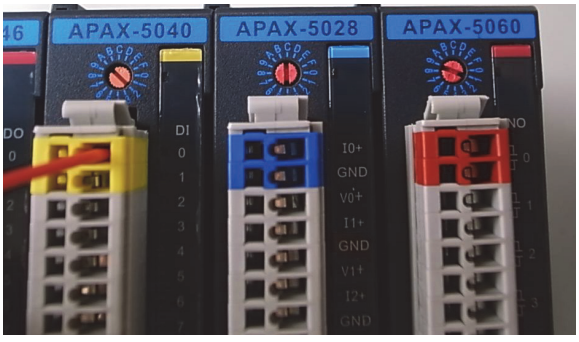
APAX-5000 I/O modules provide detachable terminal blocks that are convenient when wiring needs to be changed, because the terminal block can removed and the module doesn't need to be. Refer to the figures below to remove the terminal block.





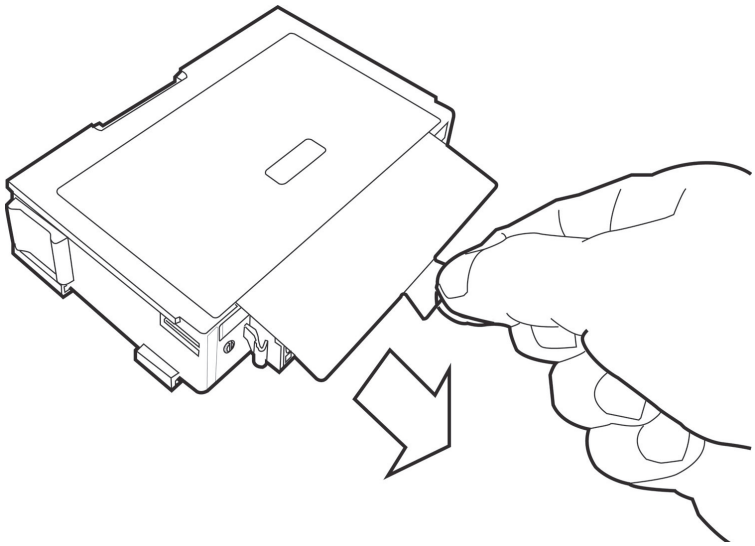
Warning! *APAX-5000 I/O modules can be categorized into four categories: AI, AO, DI and DO. If you insert a terminal block into a module which has a different function, it might damage the modules (for example, inserting a DO terminal block on DI module). In order to prevent this, APAX-5000 modules color the terminal block and label on the front side. Remember to match the terminal block with the module as below.*

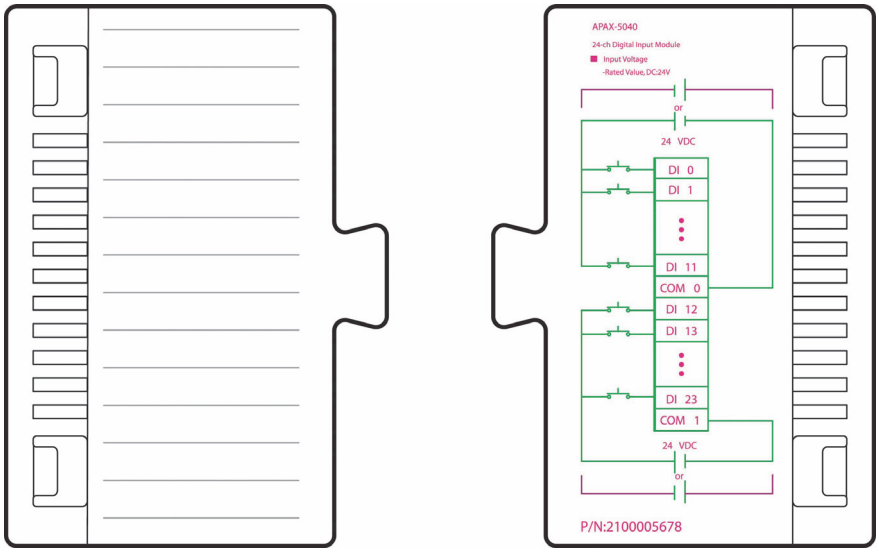
Function	Color
Analog Input	Green
Analog Output	Blue
Digital Input	Yellow
Digital Output	Red

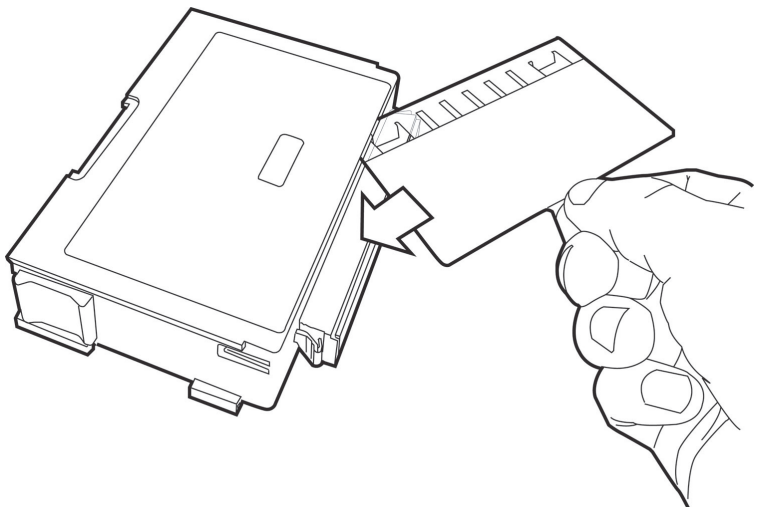


1.4 Labeling the Terminal

Advantech provides write-on labels for each APAX-5000 I/O module. This write-on label has two sides, one with the model name, specifications and a wiring diagram, while the other side allows users to write information in by themselves. Refer to the figures below for the write-on label details.



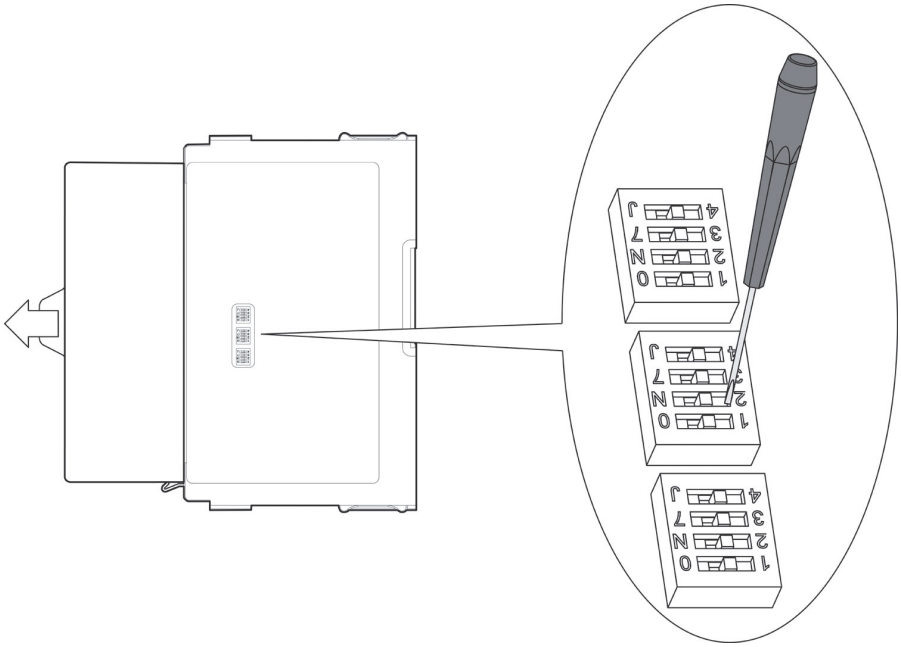


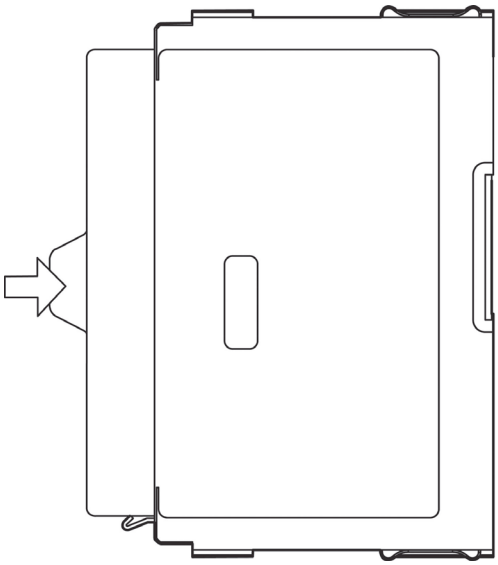


1.5 Jumper Settings

Some I/O modules need to be configured manually through the onboard jumpers. This section will show you how to adjust the jumper settings.

1. Pull out the write-on label and you can see the location of the jumper.
2. You can use the screw driver to adjust the jumper setting.
3. Once the jumper setting is done, slide the write-on label back to its position.

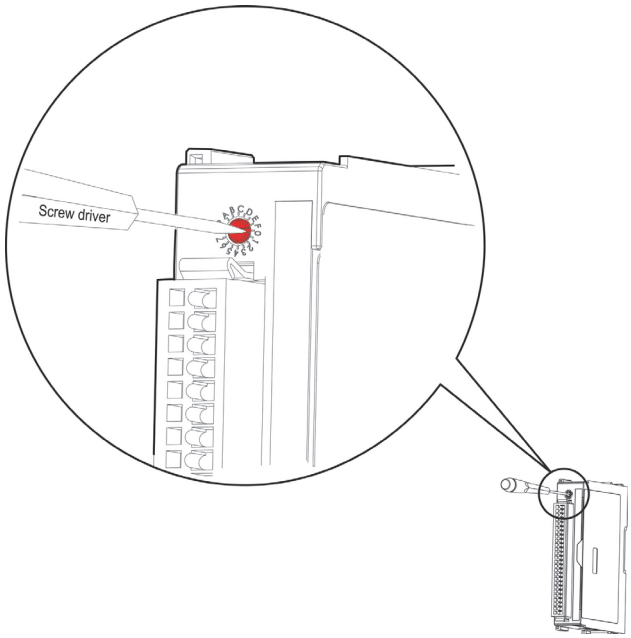


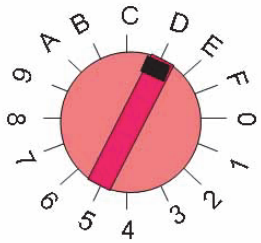


1.6 ID Switch Setting

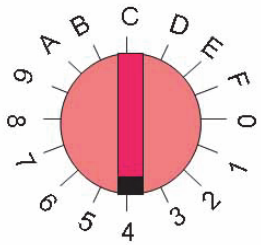
The controller identifies each APAX-5000 I/O module through the ID number. Therefore, you need to set ID number for each I/O module by the rotary ID switch on the front side. Rotate that ID switch and point the hole on the central axis to corresponding ID number ("0" ~ "F"). Refer to figures below for the location of the rotary ID switch and how to set the ID number by the rotary ID switch.

Note! *APAX supports locate functionality. It means the selected APAX I/O module will flash its LED to let you identify through Apax/Adam utility. Refer to related APAX controller or coupler software manual for how to operate it.*





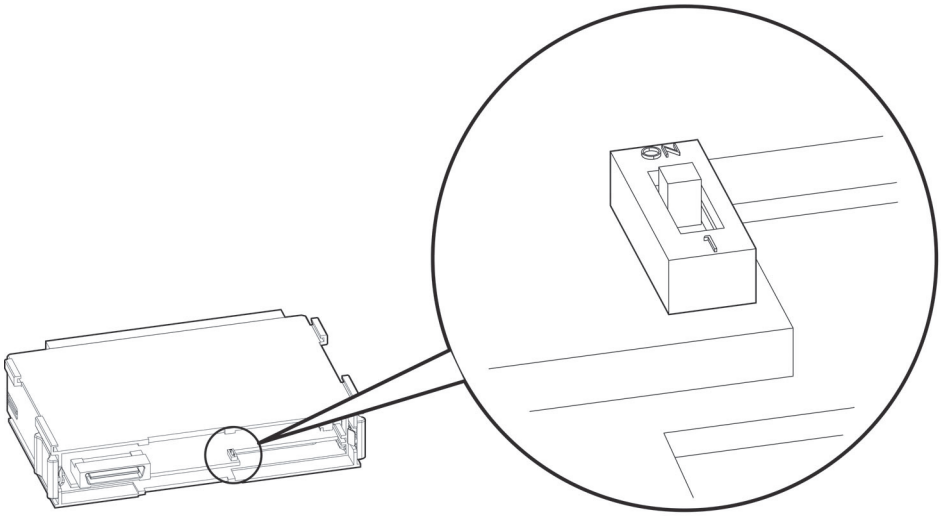
The ID for I/O module is “D”



The ID for I/O module is “4”

From the figures above, you can choose ID number 0 ~ 15 from the rotary ID switch ("0" ~ "F"). Therefore, the maximum number for analog module in one system is 16. For digital modules, there is another ID switch on the PCB that it can double the available ID number. Thus, the maximum number for digital module in one system is 32.

You can distinguish if the ID number is doubled by the front LED. When the LED color is green, only 0 ~ 15 ID number is used (0 ~ 15 according to the rotary ID switch). Once the LED color is orange, the ID number is doubled (16~31 according to the rotary ID switch). Refer to figure below for its location and how to configure it.



DIP Switch Setting	ID	LED Color
	16 ~ 31 according to the rotary ID swich	Orange
	0 ~ 15 according to the rotary ID swich	Green

Warning! *Avoid two modules with the same ID number in the same system, or you cannot see the module in the software utility. The LED on the front side will flash four times if two or more modules have the same ID number in one system. If this happens, simply change the ID number for these conflicted modules and all of them can be found in utility again.*

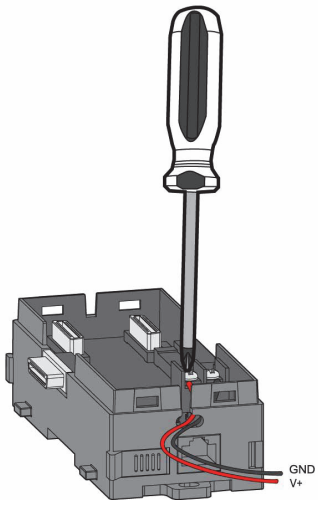
1.7 Mechanical Assembly and Power Connection

1.7.1 Wiring Power Input to the Backplane

There are two ways that APAX-5000 I/O mdoules can be powered. One is to connect the DC power supply wire directly to the power connector on the backplane. Another way is using APAX-5343E power supply module.

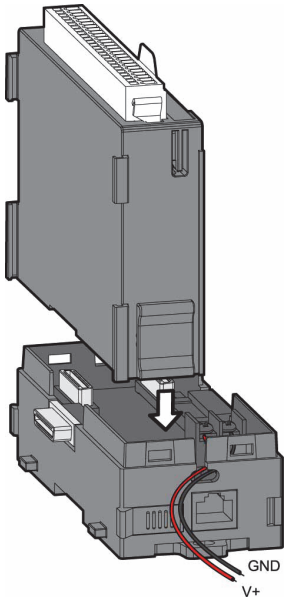
When you wire the power supply to the backplane, the power is transferred between backplanes, and provides to all APAX-5000 I/O modules inserted on the backplanes. Refer to figures below for how to wiring the power to the backplane, and how to assembly APAX-5000 I/O modules with backplanes:

1. Connect the power supply wire to the power connectors on the 2-slot APAX-5002 backplane module.

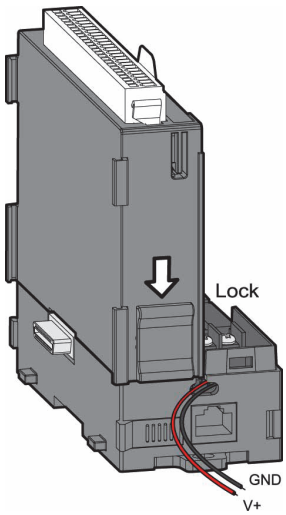


Warning! *If you use APAX-5000 digital modules in the same system, use different power supplies for the system and the the digital channels on the modules to ensure isolation protection between digital channels and system.*

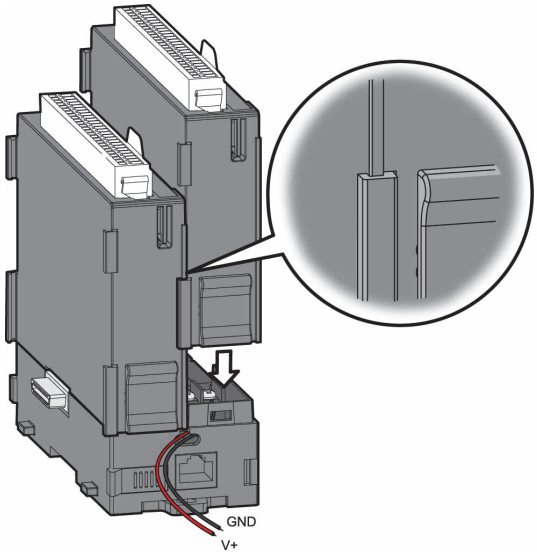
2. Insert one APAX-5000 I/O module on that APAX-5002 backplane module.



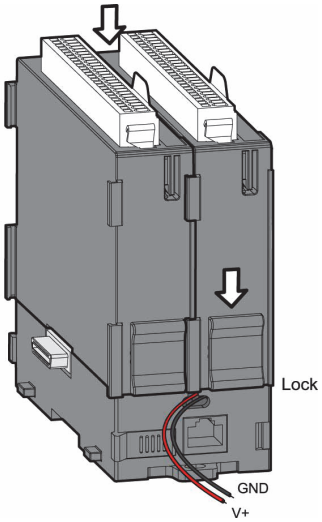
3. Lock that APAX-5000 I/O module to the APAX-5002 backplane by pulling down the module locks.



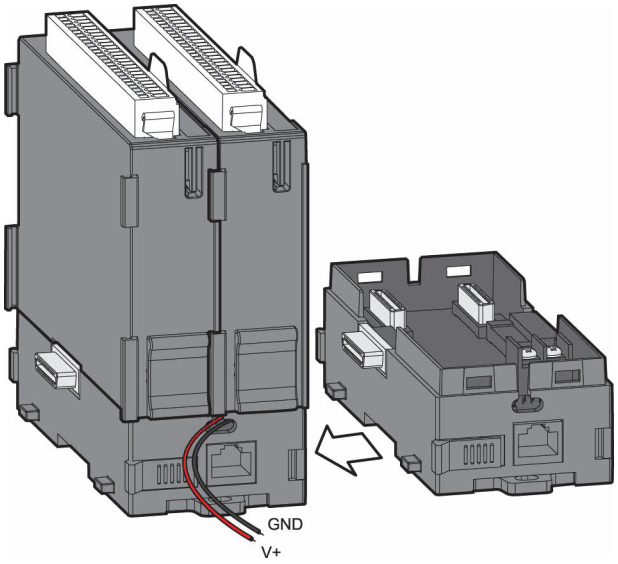
4. Insert another APAX-5000 I/O module on the same APAX-5002 backplane. Use tongue-and-groove slots to move the module.



5. Lock that APAX-5000 I/O module to the APAX-5002 backplane by pulling down the module locks.

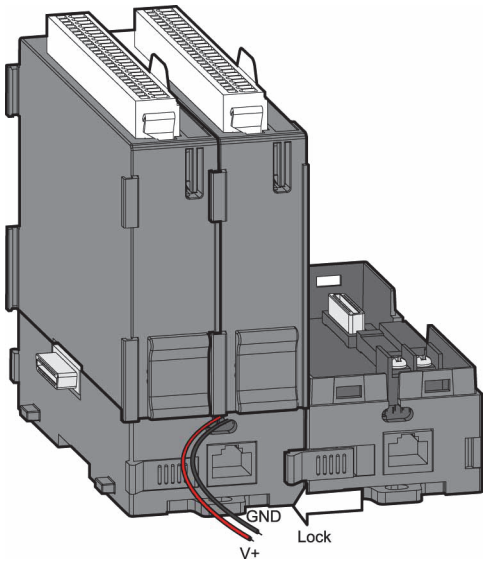


6. If you need more than one APAX-5000 I/O module, stack another APAX-5002 backplane to the original APAX-5002 backplane.



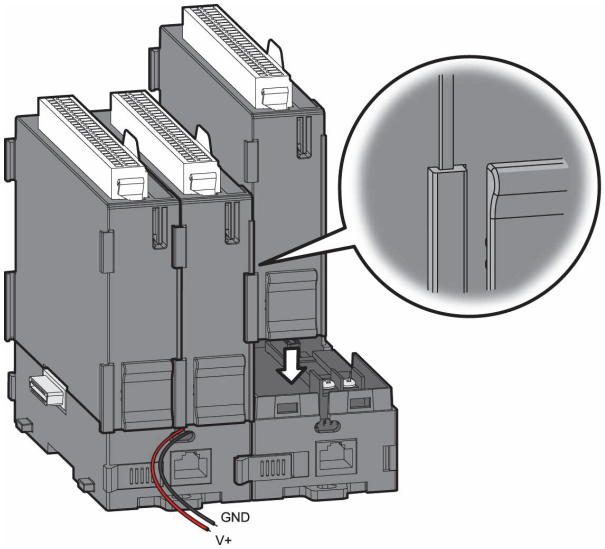
Warning! *When you assembly different backplanes together, remember to turn off the power connected to the backplane. If not, the backplanes may be damaged. Turn on the power again after you complete the assembly for all backplanes.*

7. Lock the stacked APAX-5002 backplane to the original APAX-5002 backplane by the backplane locks.



Note! *If you want to provide more power to the system, you can connect another power supply wire to the power connections on the second APAX-5002 backplane. (The wiring procedure is the same as step 1)*

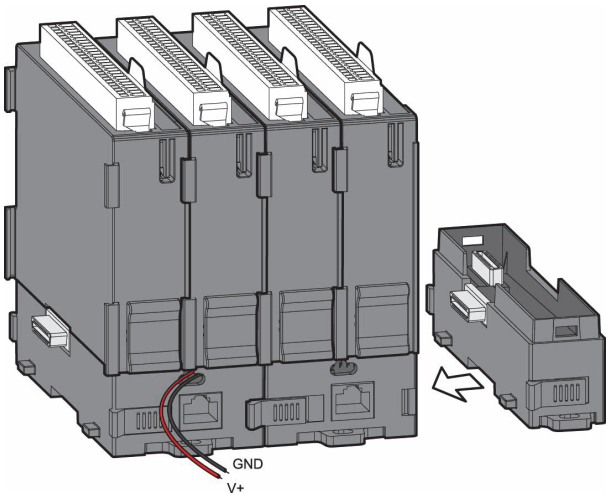
8. Insert another APAX-5000 I/O module on the second APAX-5002 backplane.

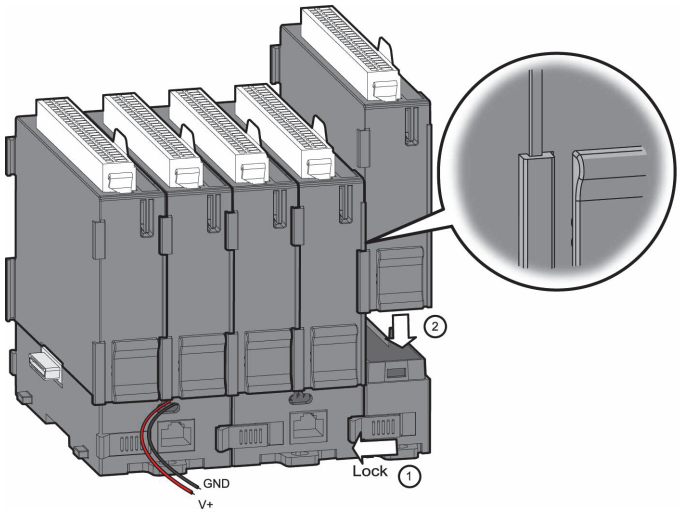


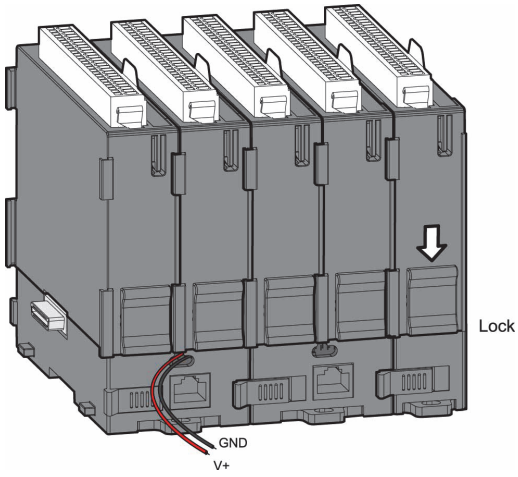
9. Lock that APAX-5000 I/O module to the second APAX-5002 backplane by pull down the module locks, similar as step 5.
10. If needed, repeat step 8 ~ 9 to have another APAX-5000 I/O module on the same APAX-5002 backplane.

If you need more APAX-5000 I/O module, repeat Step 6 ~ Step 10 until all necessary APAX-5000 I/O modules are inserted on the backplanes.

When the total number of APAX-5520 and APAX-5000 I/O modules is odd, you can use 1-slot APAX-5001 backplane module as the last backplane in the system.





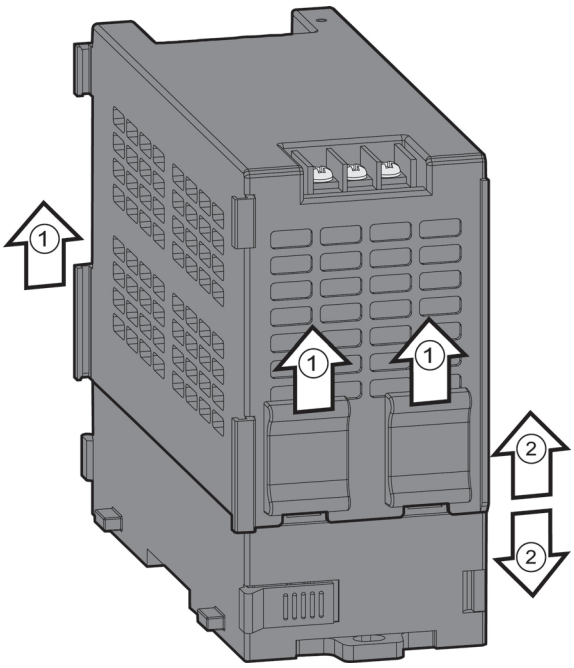


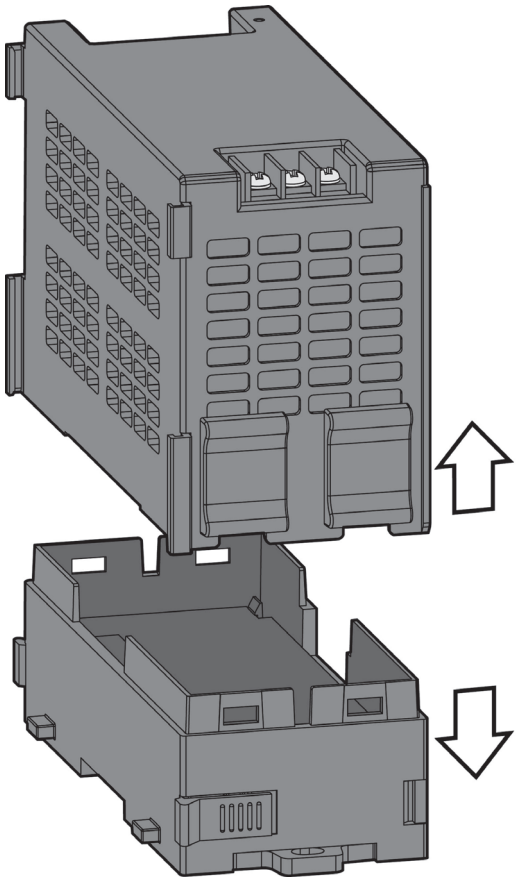
1.7.2 Using the APAX-5343E Power Supply Module

APAX-5000 I/O modules can also be powered by the APAX-5343E power supply module, connected to the left side of the whole system. The power can be transferred to APAX-5000 I/O modules though the backplanes.

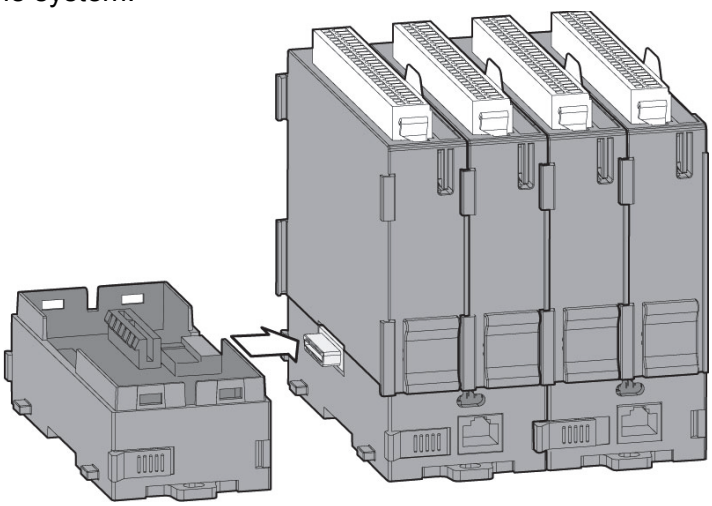
Note! *Refer to Chapter 5 for APAX-5343E specifications.*

1. Follow the procedure described in Section 1.7.1 to assembly APAX-5000 I/O modules into one complete system. The only difference is that you don't need to connect the power supply wiring to the power connectors on the backplane (step 1 in Section 1.7.1).
2. Pull up the module locks on the upper case of one APAX-5343E. Then you can separate the upper case of APAX-5343E from its backplane.

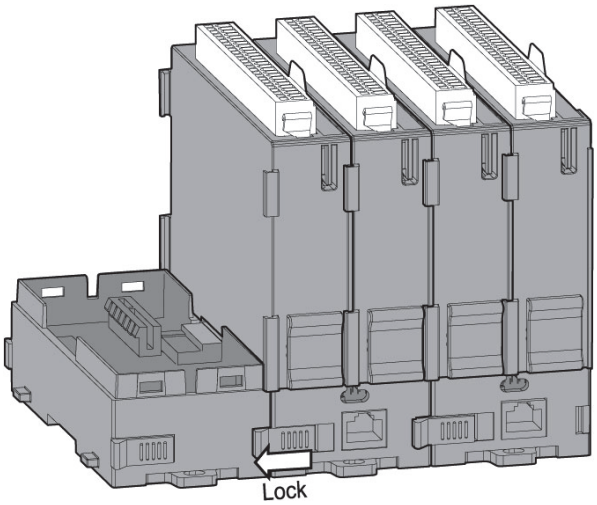

1
1
1
2
2



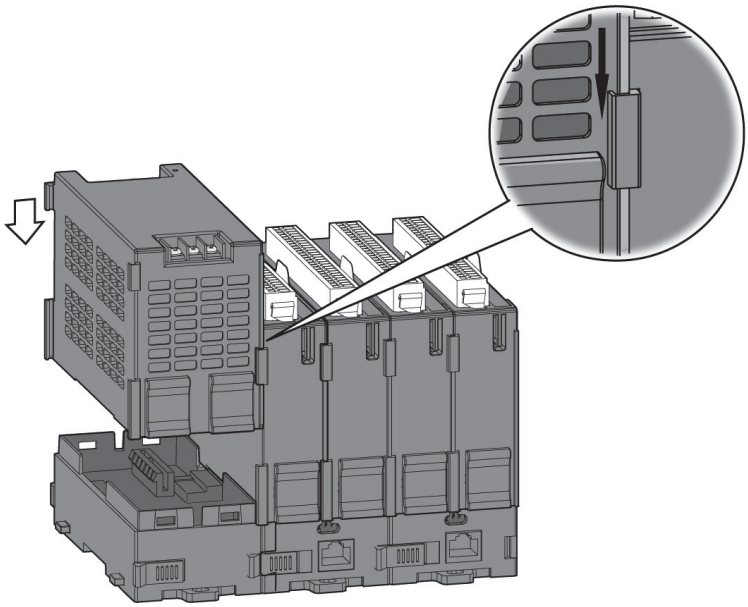
3. Stack the backplane of APAX-5343E to the left side of the first APAX-5002 backplane in the system.



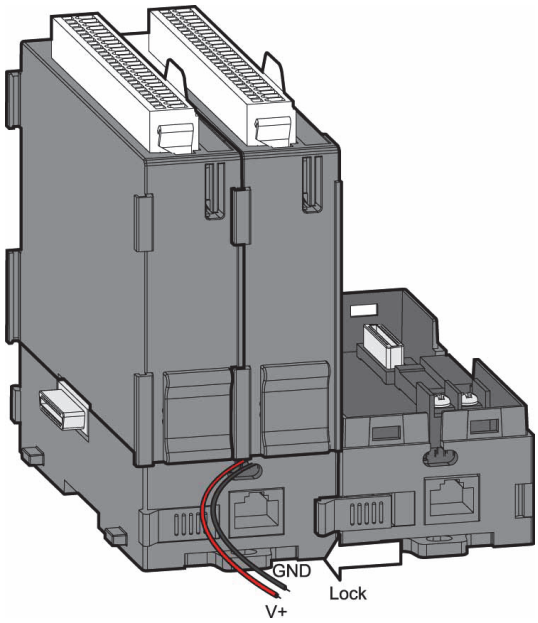
4. Lock the stacked APAX-5343E backplane with the APAX-5002 backplane by the backplane locks on the APAX-5002 backplane.



5. Insert the upper case of APAX-5343E back to its backplane. Use tongue-and-groove slots to move the upper case.



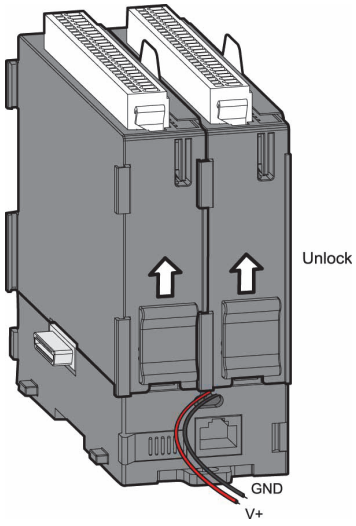
6. Lock the upper case of APAX-5343E to its backplane by pulling down the module locks on the upper case. Connect AC power code to the power connectors on the upper case of APAX-5343E. Then the whole system is powered-on.



1.8 Decommission and Disposal

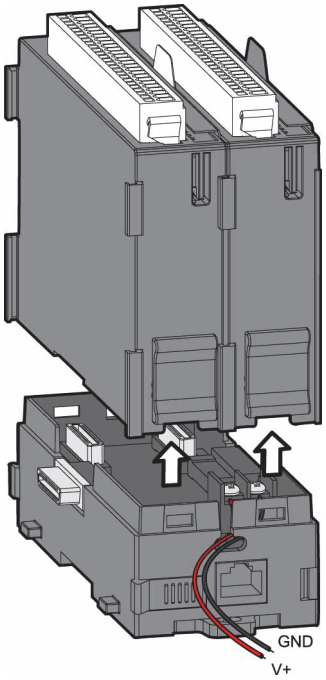
APAX-5000 I/O modules support hot-swap functionality. It means the I/O module can be removed from the backplane or inserted on the backplane when the complete system is power-on. This can significantly help to make it more convenient for system maintenance. Changing one module won't affect operation of other modules. The hot-swap functionality is implemented by the module locks. Refer to figure below for how to dismantle APAX-5000 I/O modules:

1. Pull up the two module locks on side of APAX-5000 I/O modules first. This action disconnects the power between the I/O module and backplane.



Note! *If you only want to remove one module , the procedure is similar. (Pull up the module locks and then remove the module without shutting down the power)*

2. Detach APAX-5000 I/O module from the backplane.



Repeat Step 1 ~ Step 2 for all the APAX-5000 I/O modules you want to remove.

It is the similar when you insert APAX-5000 I/O modules back to the backplane. First, insert APAX-5000 I/O module to backplane. Then, pull down the two module locks to lock on the backplane, and APAX-5000 I/O module will be power-on and can be used.

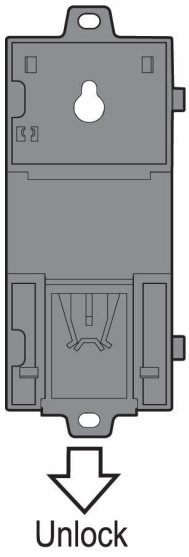
The device must be fully dismantled in order to dispose of it. Electronic parts must be disposed of in accordance with national electronics scrap regulations.

1.9 Mounting

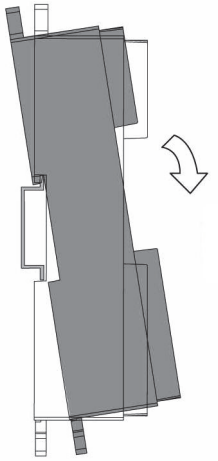
1.9.1 DIN-rail Mounting

APAX-5000 I/O module can be mounted through backplane to the following DIN rails: 35 x 7.5 mm or 35 x 15 mm. Below are the procedures for the DIN rails mounting.

1. Pull down the DIN rail lock at the back of APAX-5002 backplane.



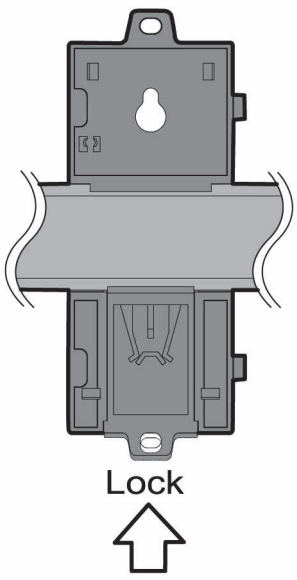
2. Attach the APAX-5002 backplane on the DIN rail.



3. Repeat Step 1 ~ Step 2 until necessary APAX-5002 backplanes are all attached on the DIN rail.

Note! *When the total number of APAX-5520 and APAX-5000 I/O modules is odd, you can use APAX-5001 (1-slot backplane) as the last backplane in the system. And the procedure to attach APAX-5001 on the DIN rail is similar as APAX-5002.*

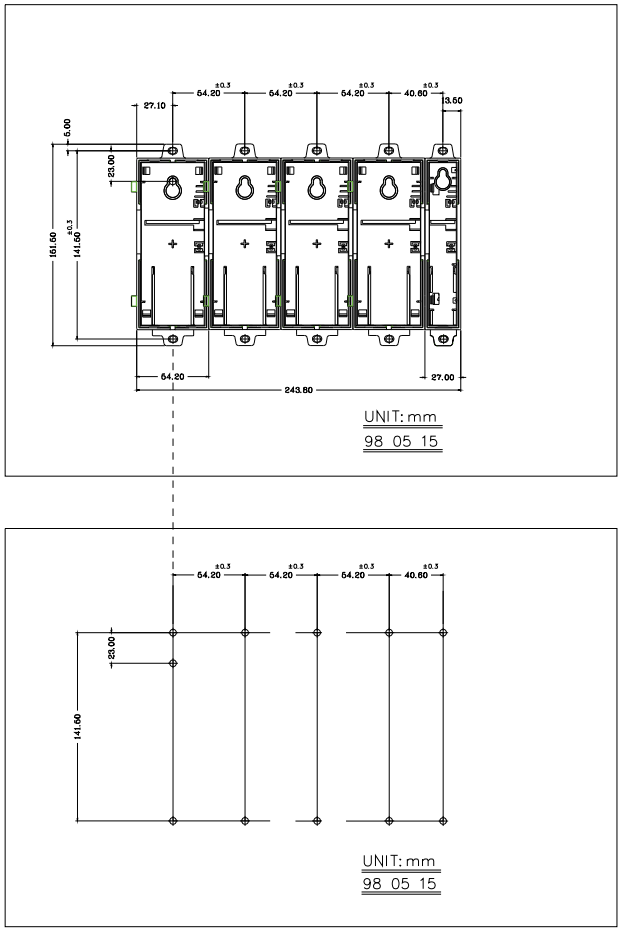
4. Move all backplanes to stack them together. Then slide the backplane locks on the backplanes to fasten all backplanes. (Similar to Step 6 and 7 in section 1.7.1)
5. Slide the DIN rail lock of all backplanes into the position, to fix all backplanes to the DIN rail.



6. Insert all necessary APAX-5000 I/O modules to the backplanes. (Similar to Step 2, Step 4 and Step 8 in section 1.7.1)
7. Slide the module lock of those APAX-5000 I/O modules into the position, to fix these modules to related backplanes. (Similar to Step 3, Step 5 and Step 9 in section 1.7.1)

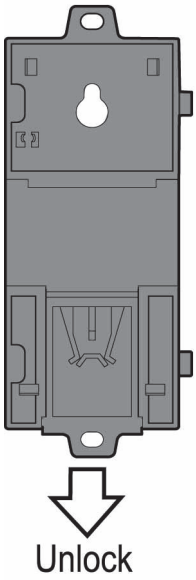
1.9.2 Wall (Panel) Mounting

Mount the APAX-5000 I/O module to a wall (panel) through backplane using two screws per module. Use M4 or #8 panhead screws. Refer to figure below for the dimensional template:

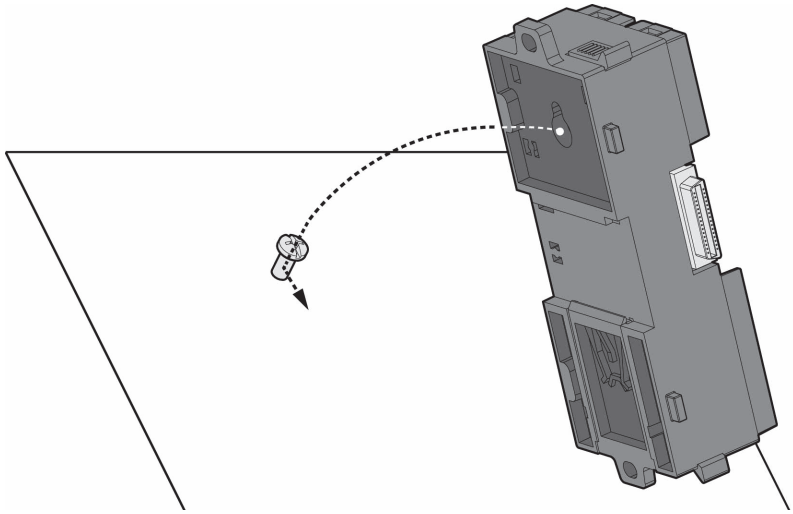


Below are the procedures for the wall (panel) mounting:

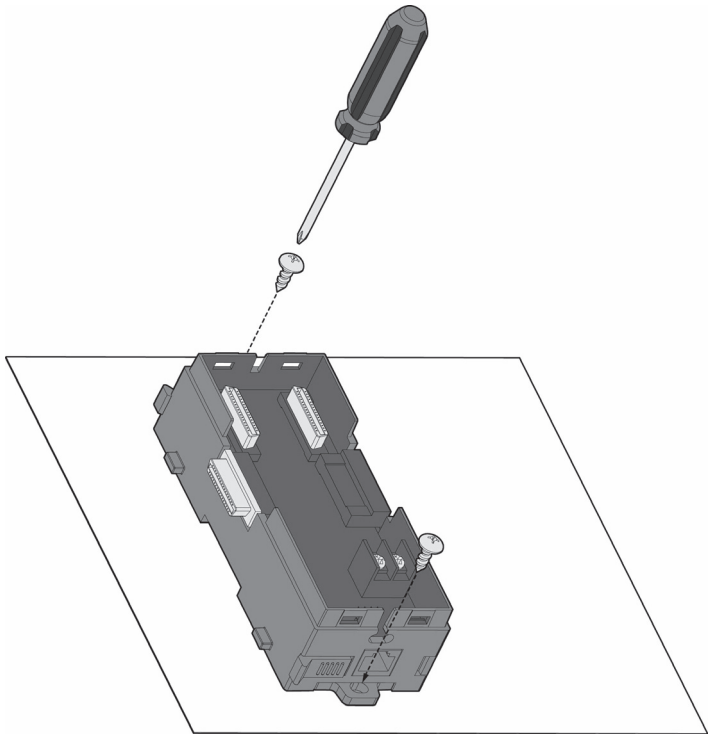
1. Pull down the DIN-rail lock at the back of the first APAX-5002 backplane.



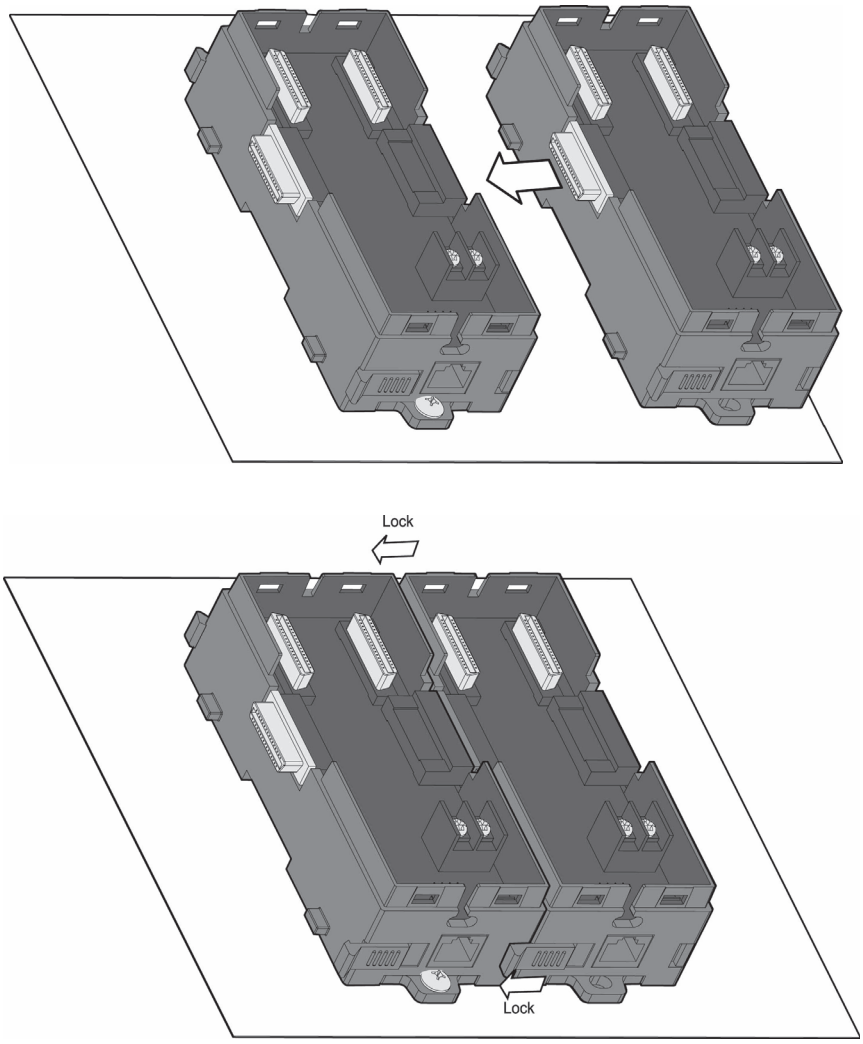
2. Hang the APAX-5002 backplane onto the screw on the wall (panel). The screw for APAX-5002 to hang should be special-designed. We have provided it in accessory. (Diameter: 9 mm, length: 16 mm, height of head: 2.7 mm)



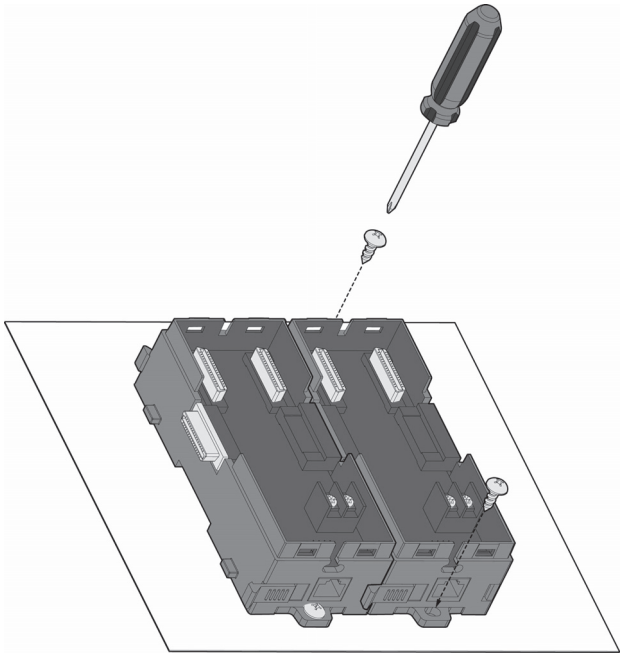
3. Mount the first APAX-5002 backplane to the wall (panel) using two standard M4 or #8 panhead screws. We also provide the two screws in accessory. (Diameter: 7 mm, length: 8 mm, height of head: 2.6 mm)



4. Stack Another APAX-5002 backplane to original backplane. Lock the two backplanes together.

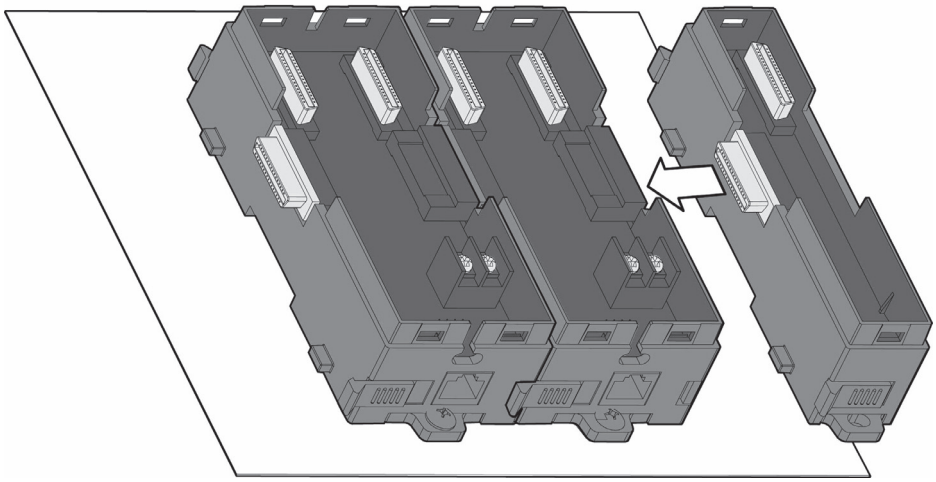


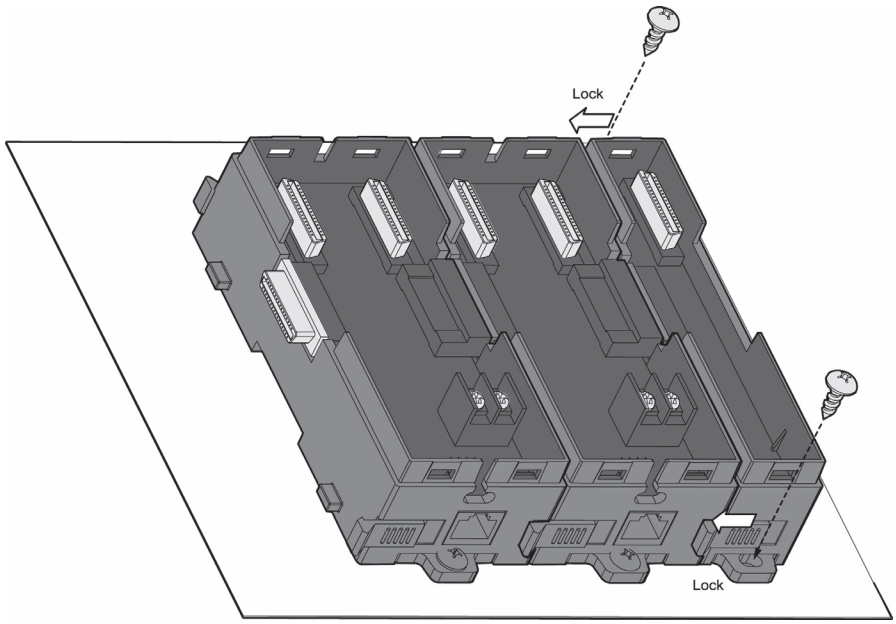
5. Mount the second APAX-5002 backplane to the wall (panel) using two standard M4 or #8 panhead screws.



6. Repeat Step 4 ~ Step 5 until all necessary APAX-5002 backplane are screwed on the wall (panel).

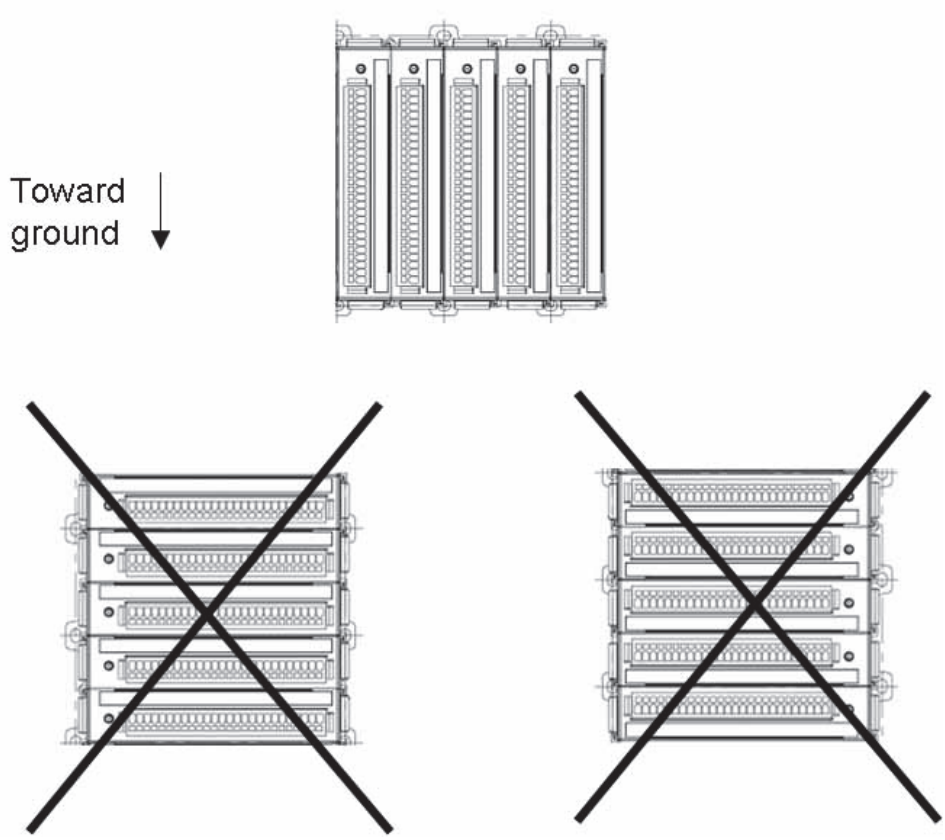
Note! *When the total number of APAX-5000 I/O modules is odd, you can use APAX-5001 (1-slot backplane) as the last backplane in the system. The procedure to attach APAX-5001 on the wall is similar as APAX-5002.*



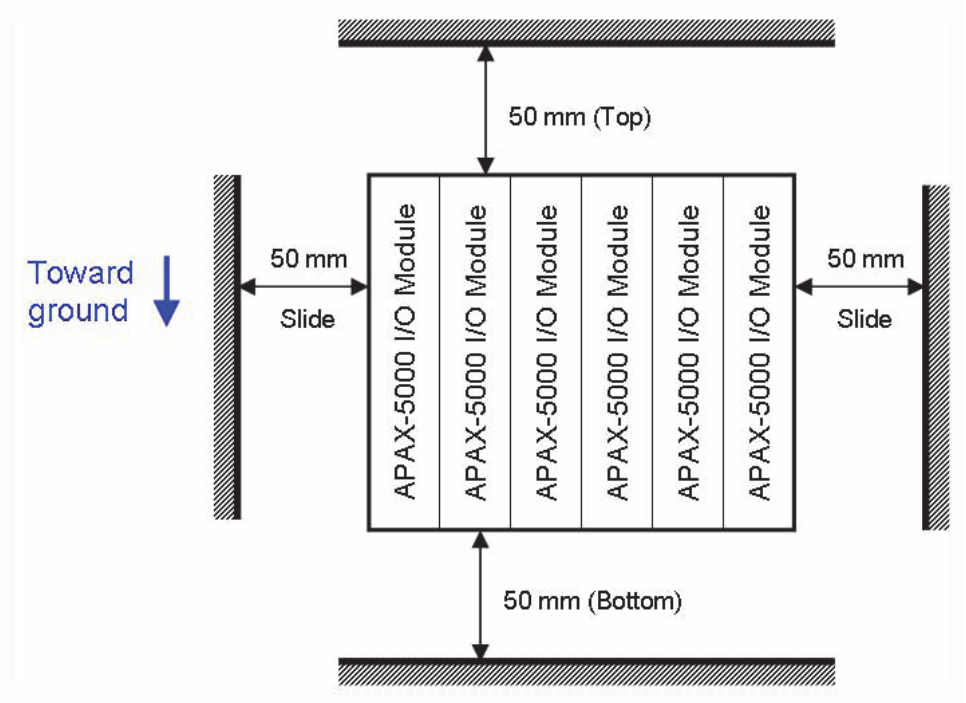


7. Insert all necessary APAX-5000 I/O modules to the backplanes. (Similar to Step 2, Step 4 and Step 8 in section 1.7.1)
8. Lock APAX-5520 and all necessary APAX-5000 I/O module to the backplane by pull down the buckle. (Similar to Step 3, Step 5 and Step 9 in section 1.7.1)

Warning! *In order to have better ventilation remember to align the APAX-5000 I/O modules as follows:*



We suggest remaining enough clearance space from enclosure walls and adjacent equipments. Allow 50 mm (2 in.) of space on all sides, as shown below. This provide ventilation and makes assembly more easily.



Chapter 2

Analog Input/Output Modules

2.1 Analog Input Modules

Analog input modules use an A/D converter to convert sensor voltage, current, thermocouple or RTD signals into digital data. The analog input modules protect your equipment from ground loops and power surges by providing opto-isolation of the A/D input and transformer based isolation up to 2,500 VDC.

2.1.1 APAX-5013 8-ch RTD Module

The APAX-5013 is a 16-bit, 8-channel RTD input module that features programmable input ranges on all channels. This module is an extremely cost-effective solution for industrial measurement and monitoring applications. Its opto-isolated inputs provide 2,500 VDC of isolation between the analog input and the module, protecting the module and peripherals from damage due to high input line voltage.

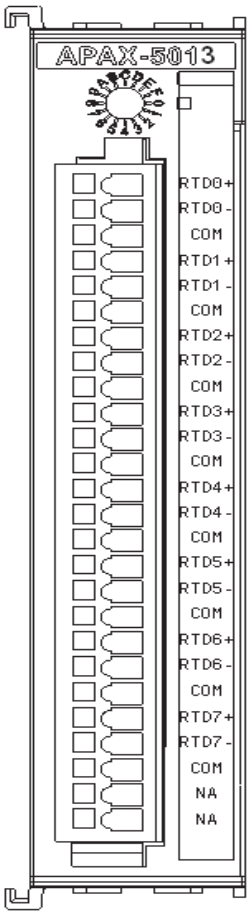


Figure 2.1 APAX-5013 Module Front View

Application Wiring

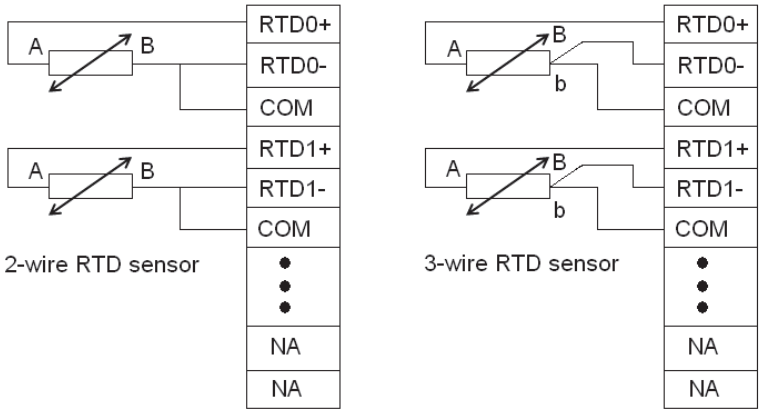


Figure 2.2 Wiring for APAX-5013

APAX-5013 Technical Specifications

Channels: 8

- **Input Impedance:** >10 MΩ
- **Input Type:** Pt-100, Pt-200, Pt-500, Pt-1000, Balco, Ni 518 RTD (2-wire and 3-wire)
- **Temperature Range:** Pt-100,Pt-200,Pt-500,Pt-1000: -120~130°C, -200~850°C
  - Supports IEC 60751 ITS90 (0.03851Ω/Ω/° C) and JIS C 1604 (0.03916 Ω/Ω/° C)
  - Balco 500: -30 ~ 120° C
  - Ni 518: -80 ~ 100° C, 0 ~ 100° C
- **Configure Different Range for Each Channel:** Yes
- **Resolution:** 16-bit
- **Accuracy:** ±0.1 % of FSR (at 25° C)
- **Sampling Rate:** 50 Hz filter: 8 sample/second (total)
  60 Hz filter: 10 sample/second (total)
- **CMR @ 50/60 Hz:** 90 dBs
- **NMR @ 50/60 Hz:** 60 dBs
- **Noise Suppression for Frequency:** 50/60 Hz
- **Span Drift:** 15 ppm/° C
- **Input Characteristic Curve:** According to IEC 61131-2
- **Wire Burnout Detection:** All RTD type

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane)

Environment

- **Operating Temperature:** -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 170 g
- **Power Consumption:** 2.5 W @ 24 VDC (typical)

2.1.2 APAX-5017 12-ch Analog Input Module

The APAX-5017 is a 16-bit, 12-channel analog differential input module that provides programmable input ranges on all channels, and different channels can be configured using different ranges. It accepts voltage and current inputs. Adjust the switch (refer to Section 1.5) to define each channel as voltage or current input. Refer to the figure below to see how to define the input type by the jumper. Besides, you can use software (APAX utility) to configure range type for each channel. This module is an extremely cost-effective solution for industrial measurement and monitoring applications. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

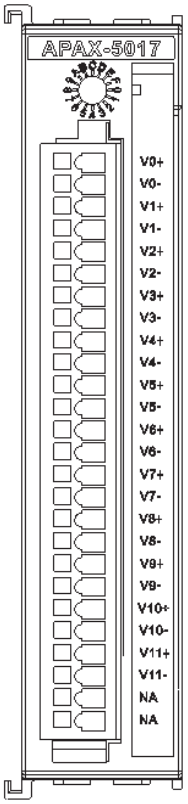


Figure 2.3 APAX-5017 Module Front View

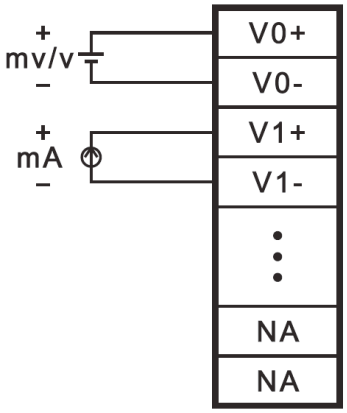


Figure 2.4 Wiring for APAX-5017

Note! *To keep measurement accuracy please short the channels that are not in use.*

Note! *You can use the jumpers to configure each analog input channel type (voltage or current). Refer to Section 1.5 for the location of the jumpers. There are a total of 12 jumpers and each is specific for one channel.*

Technical Specifications of APAX-5017

- **Channels:** 12 (Differential)
- **Input Impedance:** >10 MΩ (Voltage), 120Ω (Current)
- **Input Type:** V, mV, mA
- **Voltage/Current Range:** ±150mV,±500mV,±1V,±5V,±10V,±20mA,0~20mA,4~20 mA
- **Configure Different Range for Each Channel:** Yes
- **Accuracy:** ±0.1% or better (Voltage), ±0.2% or better (Current) at 25° C
- **Resolution:**

Voltage	
Range	**Resolution**
±150 mV	16 bit
±500 mV	16 bit
±1 V	16 bit
±5 V	16 bit
±10 V	16 bit

Current	
Range	**Resolution**
±20 mA	15 bit
0 ~ 20 mA	14 bit
4 ~ 20 mA	14 bit

Note! *Please base on 16 bit to convert your raw data to engineer unit in the current mode.*

- **Sampling Rate:** 12 samples/second (total)
- **CMR @ 50/60 Hz:** 90 dB
- **NMR @ 50/60 Hz:** 67 dB
- **Noise Suppression for Frequency:** 50/60 Hz
- **Span Drift:** ±30 ppm/° C
- **Zero Drift:** ±6 μV/° C
- **Input Characteristic Curve:** According to IEC 61131-2
- **Common Mode Voltage**: up to 200 VDC
- **Wire Burnout Detection:** Only for 4 ~ 20 mA range

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Over Voltage Protection:** ±35 VDC

Environment

- **Operating Temperature:** -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 170 g
- **Power Consumption:** 4 W @ 24 VDC (typical)

2.1.3 APAX-5017H 12-ch High Speed Analog Input Module

APAX-5017H is an 12-ch analog differential input module that provides programmable input ranges on each channel. Its sampling rate depends on the data format received: up to 1000 sample/second (per channel). The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

Note! *There is no built-in filter on APAX-5017H, so please try to use it in an environment with less noise.*

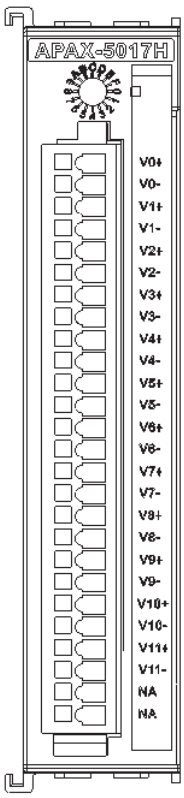


Figure 2.5 APAX-5017H Module Front View

Application Wiring

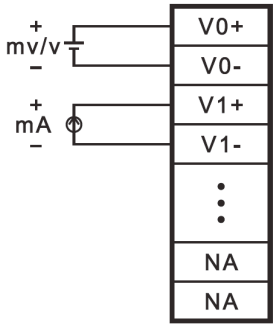


Figure 2.6 Wiring for APAX-5017H

Note! *You can use the jumpers to configure each analog input channel type (voltage or current). Refer to Section 1.5 for the location of the jumpers. There are a total of 12 jumpers and each is specific for one channel.*

APAX-5017H Specifications

- **Channels:** 12
- **Input Impedance:** 2MΩ (Voltage), 120 Ω (Current)
- **Input Type:** V, mV, mA
- **Input Range:** 0 ~ 500 mV, ±10 V, 0 ~ 10 V, 0 ~ 20 mA, 4 ~ 20 mA
- **Configure Different Range for Each Channel:** Yes
- **Accuracy:** ±0.1% or better (voltage), ±0.2% or better (current) at 25° C
- **Resolution:** 12-bit
- **Sampling Rate:** 1,000 sample/second (per channel)
- **Span Drift:** ±25 ppm/° C
- **Zero Drift**: ±6 μV/° C
- **Input Characteristic Curve:** According to IEC 61131-2
- **Wire Burnout Detection:** Only for 4 ~ 20 mA range

Protection

- **Over Voltage Protection:** ±35 VDC
- **Isolation:** 2,500 VDC (Between channels and backplane bus)

Note! *The voltage between any two pins must not exceed 15 V*

Environment

- **Operating Temperature**: -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 175 g
- **Power Consumption:** 3.5 W @ 24 VDC (typical)

Warning! *There is no built-in filter on APAX-5017H module, so it is not very suitable to use it in a very noisy environment.*

2.1.4 APAX-5018 12-ch Thermocouple Input Module

The APAX-5018 is a 16-bit, 12-channel thermocouple input module that features programmable input ranges on all channels. It accepts millivolt inputs (±50 mV, ±100 mV, ±500 mV), voltage inputs (±1 V, ±2.5 V), current input (±20 mA, 0~20mA, 4~20mA) and thermocouple input (Type J, K, T, R, S, E, B). An external CJC on the plug-in terminal is designed for accurate temperature measurement. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

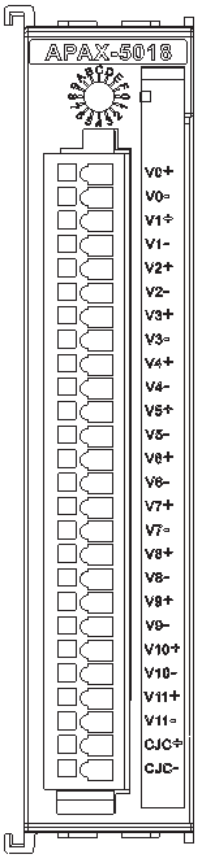


Figure 2.7 APAX-5018 Module Front View

Application Wiring

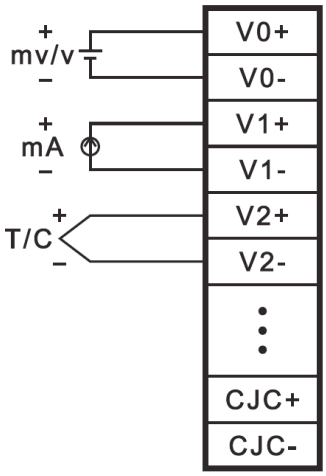


Figure 2.8 Wiring for APAX-5018

Note! *You can use the jumpers to configure each analog input channel type (voltage/thermocouple or current). Refer to Section 1.5 for the location of the jumpers. There are a total of 12 jumpers and each is specific for one channel.*

APAX-5018 Specifications

- **Channels:** 12 (Differential)
- **Input Type:** V, mV, mA, Thermocouple
- **Voltage/Current Range:**
  ±50mV, ±100mV, ±500mV, ±1V, ±2.5V, ±20mA, 0~20mA, 4~20 mA
- **Voltage and Current Accuracy:** ±0.1% or better (Voltage), ±0.2% or better (Current) at 25° C
- **Temperature Range and Accuracy:**

Type	Range	Accuracy
Type J	-210 ~ -150 ° C	±2.5 ° C
	-150 ~ 1200 ° C	±2 ° C
Type K	-230 ~ -150 ° C	±4 ° C
	-150 ~ 1372 ° C	±2.5° C
Type T	-230 ~ -150 ° C	±2° C
	-150 ~ 400 ° C	±1.5 ° C
Type E	-230 ~ -150 ° C	±2.5 ° C
	-150 ~ 1000 ° C	±2 ° C
Type R	0 ~ 100 ° C	±2.5° C
	100 ~ 1768 ° C	±2 ° C
Type S	0 ~ 100 ° C	±2.5 ° C
	100 ~ 1768 ° C	±2 ° C
Type B	200 ~ 400 ° C	±4 ° C
	400 ~ 1820 ° C	±3 ° C

Note! *This accuracy information only relates to the operating error, not including cold connection CJC error. The CJC error can be eliminated by performing CJC compensation.*

- **Configure Different Range for Each Channel:** Yes
- **Resolution:**

Voltage	
Range	**Resolution**
±50 mV	16 bit
±100 mV	16 bit
±250 mV	16 bit
±500 mV	16 bit
±1 V	16 bit
±2.5 V	16 bit

Current	
Range	**Resolution**
±20 mA	15 bit
0 ~ 20 mA	14 bit
4 ~ 20 mA	14 bit
Thermocouple	
Range	**Resolution**
Type J	14 bit
Type K	14 bit
Type T	15 bit
Type E	15 bit
Type R	14 bit
Type S	14 bit
Type B	14 bit

- **Sampling Rate:** 12 samples/second (total)
- **CMR @ 50/60 Hz:** 90 dB
- **NMR @ 50/60 Hz:** 67 dB
- **Noise Suppression for Frequency:** Hardware Filter (50/60 Hz)
- **Span Drift:** ±25 ppm/° C
- **Zero Drift:** ±6 μV/° C
- **Thermocouple Wire Burn-out Detection:** Yes
  (When the loop resistance > 1KΩ, it will detect as wire burn-out)
- **Input Characteristic Curve:** According to IEC 61131-2
- **Common Mode Voltage:** up to 200 VDC
- **Wire Burnout Detection:** For 4 ~ 20 mA range and all thermocouple type

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)

Environment

- **Operating Temperature:** -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 170 g
- **Power Consumption:** 3.5 W @ 24 VDC (typical)

2.1.5 APAX-5017PE 12-ch Analog Input Module for P&E Applications

The APAX-5017PE is a 16-bit, 12-channel analog differential input module that provides programmable input ranges on all channels, and different channels can be configured using different ranges. It accepts voltage and current inputs. You can use software (APAX utility) to configure range type for each channel. This module is an IEC-61850-3 compliant I/O modules, and suitable for measurement and monitoring for power and energy related application. The highly anti-electromagnetic interference make it more robust and reliable to survive in the hush environment.The module also provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

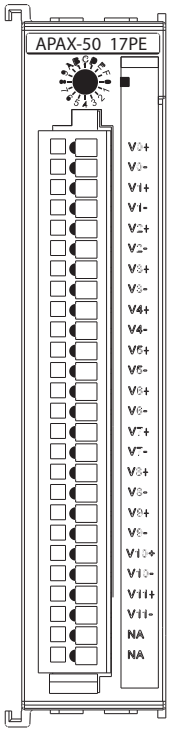


Figure 2.9 APAX-5017PE Module Front View

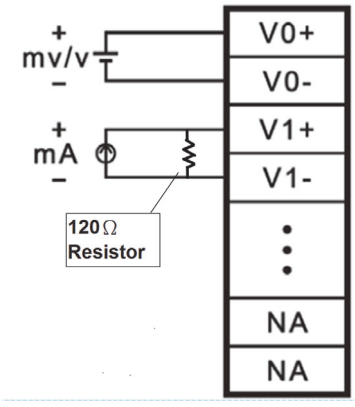


Figure 2.10 Wiring for APAX-5017PE

Note! *To keep measurement accuracy please short the channels that are not in use.*

Technical Specifications of APAX-5017PE

- **Channels:** 12 (Differential)
- **Input Impedance:** >10 MΩ (Voltage)
- **Input Type:** V, mV, mA (for current mode, 120Ω resistors is required to be connected in parallel)
- **Voltage/Current Range:** ±150mV,±500mV,±1V,±5V,±10V,±20mA,0~20mA,4~20 mA
- **Configure Different Range for Each Channel:** Yes
- **Accuracy:** ±0.1% or better (Voltage), ±0.2% or better (Current) at 25° C
- **Resolution:**

Voltage	
Range	**Resolution**
±150 mV	16 bit
±500 mV	16 bit
±1 V	16 bit
±5 V	16 bit
±10 V	16 bit

Current	
Range	**Resolution**
±20 mA	15 bit
0 ~ 20 mA	14 bit
4 ~ 20 mA	14 bit

- **Sampling Rate:** 12 samples/second (total)
- **CMR @ 50/60 Hz:** 90 dB
- **NMR @ 50/60 Hz:** 67 dB
- **Noise Suppression for Frequency:** 50/60 Hz
- **Span Drift:** ±30 ppm/° C
- **Zero Drift:** ±6 μV/° C
- **Input Characteristic Curve:** According to IEC 61131-2
- **Common Mode Voltage**: up to 200 VDC
- **Wire Burnout Detection:** Only for 4 ~ 20 mA range

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Over Voltage Protection:** ±35 VDC

Environment

- **Operating Temperature:** -20 ~ 70°C (when mounted vertically)
- **Storage Temperature:** -40 ~ 85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 170 g
- **Power Consumption:** 2 W @ 5 VDC (typical)

2.2 Analog Output Modules

2.2.1 APAX-5028 8-ch Analog Output Module

The APAX-5028 is a 8-channel analog output module. It uses the D/A converter controlled by the system module to convert the digital data into output signals. You can specify slew rates and start up currents through the configuration software. For each channel, voltage and current can be used by connecting to different terminal. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

Note! *The slew rate is defined as the slope indicated the ascending or descending rate per second of the analog output from the present to the required.*

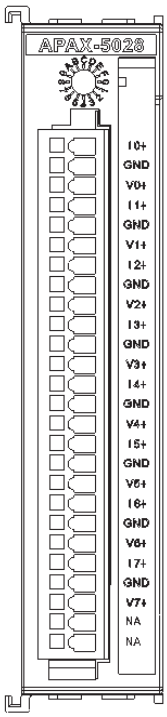


Figure 2.11 APAX-5028 Module Frontal View

Application Wiring

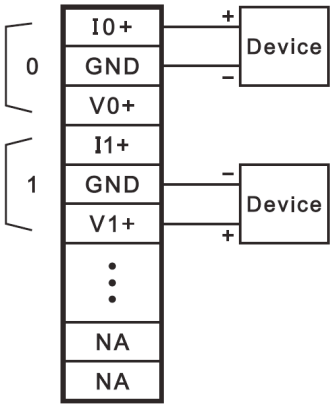


Figure 2.12 Wiring for APAX-5028

Note! *The common terminals are physically connected together and to the backplane power supply ground.*

2.2.2 APAX-5028 Specifications

- **Channels:** 8
- **Output Type:** V, mA
- **Output Range:** ±2.5 V, ±5 V, ±10 V, 0~2.5 V, 0~5 V, 0~10 V, 0~20 mA, 4~20 mA
- **Configure Different Range for Each Channel:** Yes
- **Resolution:** 14-bit
- **Accuracy:** ±0.1% of FSR at 25° C
- **Settling Time:** About 50 μs to 0.01%
- **Output Latency:** 500 μs
- **Slew Rate:** 0.7 VDC/μs (per channel)
- **Span Drift:** ±60 ppm/° C
- **Zero Drift:** ±250 μV/° C
- **Load:** Voltage: 1000 Ω (minimum), Current: 0 ~ 500 Ω

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Short Circuit Protection**
- **Fail Safe Protection***

* When I/O module lose its communication with controller or coupler, the output channel will generate a pre-defined value

Environment

- **Operating Temperature:** -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)
-

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 175 g
- **Power Consumption:** 3.5 W @ 24 VDC (typical)

Chapter 3

Digital Input/Output Modules

3.1 Digital Input/Output Modules

3.1.1 APAX-5040 24-ch Digital Input Module

The APAX-5040 features 24 digital input (sink/source) channels. The APAX-5040 module's digital input channels can accept a 2-wiring input from a DC voltage source, to determine the state of limits, standard switches or proximity switches. The digital input channels offer LED to indicate digital status. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

Warning! *Please use different power supply modules for digital channels and system to ensure isolation effect.*

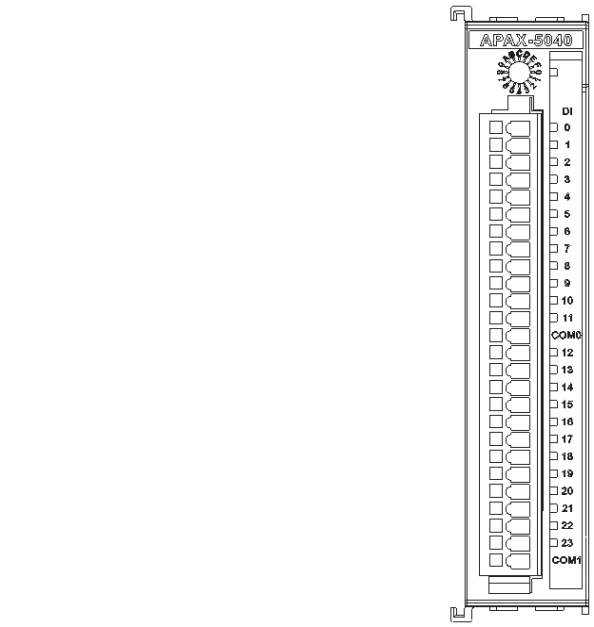


Figure 3.1 APAX-5040 Module Front View

Application Wiring

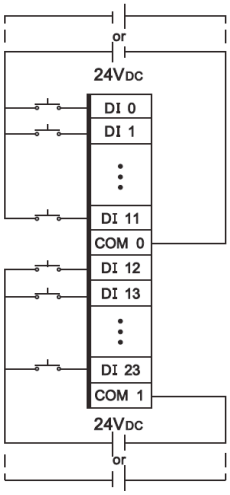


Figure 3.2 Wiring for APAX-5040

APAX-5040 Specifications

Digital Input

- **Channels:** 24
- **Points per Common:** 12
- **Type:** Sink/Source (Wet Contact)
- **Input Voltage Rated Value:** 24 VDC
  - **For "0" signal:** -5 ~ 5 VDC
  - **For "1" signal:** 15 ~ 30 VDC and -15 ~ -30 VDC
- **Input Impedance:** 5.4 kΩ
- **Typical Input Current:** 4.4 mA (At signal "1")
- **Maximum Input Current:** 7.3 mA
- **Input Filter:** 3 ms
- **Input Characteristic Curve:** According to IEC 61131-2, type 1

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Over Voltage Protection:** ±70 VDC

Environment

- **Operating Temperature:** -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 160 g
- **Power Consumption:** 2 W @ 24 VDC (typical)
- **Status Display:** LED per channel
  - **On:** Logic level “1”
  - **Off:** Logic level “0”

3.1.2 APAX-5045 24-ch Digital Input/Output Module

The APAX-5045 features 12 digital input (sink/source) and 12 digital output (sink) channels. The APAX-5045 module's digital input channels can accept a 2-wiring input from a DC voltage source, to determine the state of limits, standard switches or proximity switches. The APAX-5045 module's digital output channels can generate discrete signal to external devices and change its output value to control the devices. The digital output channels offer short-circuit protection and LED to indicate digital status. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

Warning! *Please use different power supply modules for digital channels and system to ensure isolation effect.*

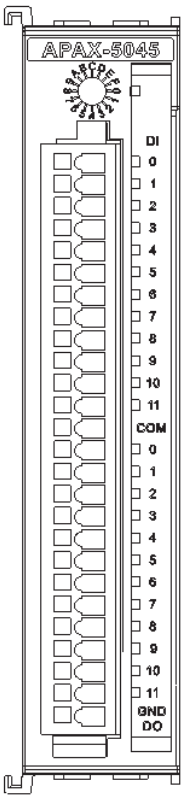


Figure 3.3 APAX-5045 Module Frontal View

Application Wiring

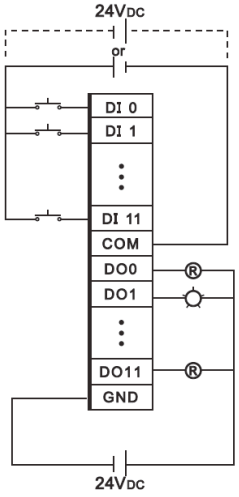
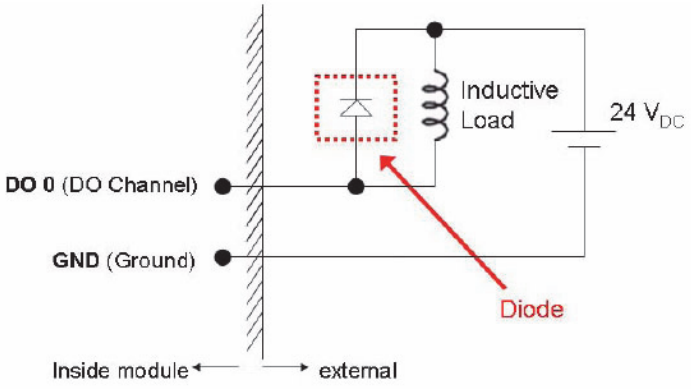


Figure 3.4 Wiring for APAX-5045

Warning! *When you connect DO channel with inductive load, we suggest adding one diode in the circuit to protect the APAX-5045 module. (Refer to figure below)*



APAX-5045 Specifications

Digital Input

- **Channels:** 12
- **Points per Common:** 12
- **Type:** Sink/Source (Wet Contact)
- **Input Voltage Rated Value:** 24 VDC
  - **For "0" signal:** -5 ~ 5 VDC
  - **For "1" signal:** 15 ~ 30 VDC and -15 ~ -30 VDC
- **Input Impedance:** 5.4 kΩ
- **Input Current:** typical 4.4 mA (At signal "1")
- **Input Filter:** 3 ms
- **Input Characteristic Curve:** According to IEC 61131-2, type 1

Digital Output

- **Channels:** 12
- **Type:** Sink
- **Voltage Range:** 8 ~ 35 VDC
- **Rated Output Current at signal "1":** 0.5 A (per channel)
- **Permitted Output Current (at signal "1"):** max. 0.75 A
- **Output Current at signal "0" (leakage current):** 0.1 mA
- **Lamp Load:** max. 5W
- **On-State Voltage Drop:** 0.15 V at 0.5 A
- **Switch Rate:**
  - **For resistive load:** max. 300 Hz
  - **For inductive load:** max. 20 Hz
  - **For lamp load:** max. 200 Hz (Using 5W lamp and tested under 50 Ω, 24 V)

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Over Voltage Protection:** ±70 VDC (for DI channel)
- **Short Circuit Protection** (For DO channel)
- **Thermal Shutdown Protection** (For DO channel)
- **Fail Safe Protection***

* When I/O module lose its communication with controller or coupler, the output channel will generate a pre-defined value

Environment

- **Operating Temperature**: -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 165 g
- **Power Consumption:** 2.5 W @ 24 VDC (typical)
- **Status Display:** LED per channel
  - **On:** Logic level “1”
  - **Off:** Logic level “0”

3.1.3 APAX-5046 24-ch Digital Output Module

The APAX-5046 features 24 digital output (sink) channels. The digital output channels offer short-circuit protection and LED to indicate digital status. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

Warning! *Please use different power supply modules for digital channels and system to ensure isolation effect.*

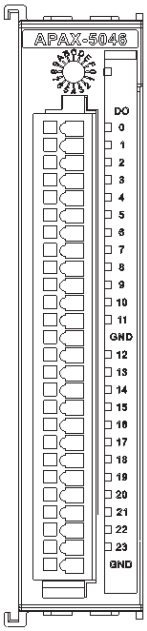


Figure 3.5 APAX-5046 Module Front View

Application Wiring

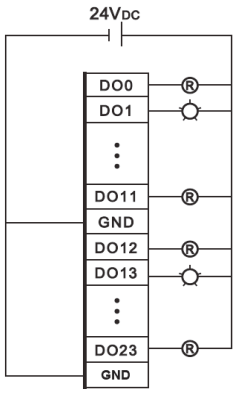
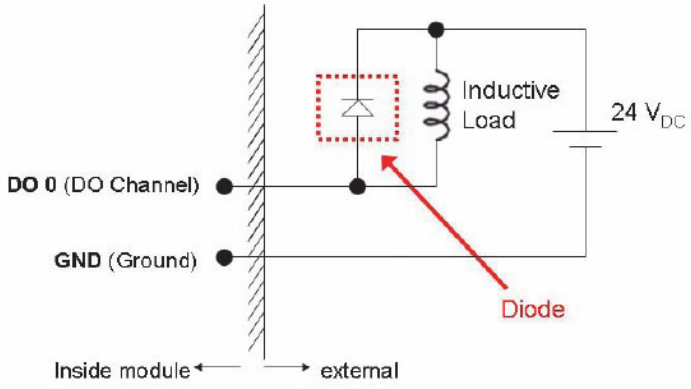


Figure 3.6 Wiring for APAX-5046

Warning! *When you connect DO channel with inductive load, we suggest adding one diode in the circuit to protect the APAX-5046 module. (Refer to figure below)*



APAX-5046 Specifications

Digital Output

- **Channels:** 24
- **Type:** Sink
- **Voltage Range:** 8 ~ 35 VDC
- **Rated Output Current at signal "1":** 0.5 A (per channel)
- **Permitted Output Current (at signal "1"):** max. 0.75 A
- **Output Current at signal "0" (leakage current):** 0.1 mA
- **Lamp Load:** max. 5W
- **On-State Voltage Drop:** 0.15 V at 0.5 A
- **Switch Rate:**
  - **For resistive load:** max. 300 Hz
  - **For inductive load:** max. 20 Hz
  - **For lamp load:** max. 200 Hz (Using 5W lamp and testing under 24 V)

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Short Circuit Protection**
- **Thermal Shutdown Protection**
- **Fail Safe Protection***

* When I/O module lose its communication with controller or coupler, the output channel will generate a pre-defined value

Environment

- **Operating Temperature:** -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 165 g
- **Power Consumption:** 2.5 W @ 24 VDC (typical)
- **Status Display:** LED per channel
  - **On:** Logic level “1”
  - **Off:** Logic level “0”

3.1.4 APAX-5040PE 24-ch Digital Input Module for P&E Applications

The APAX-5040PE features 24 digital input (sink/source) channels. The APAX-5040PE module's digital input channels can accept a 2-wiring input from a DC voltage source, to determine the state of limits, standard switches or proximity switches. The digital input channels offer LED to indicate digital status. This module is an IEC-61850-3 compliant I/O modules, and suitable for power and energy related application. The highly anti-electromagnetic interference make it more robust and reliable to survive in the hush environment.The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

Warning! *Please use different power supply modules for digital channels and system to ensure isolation effect.*

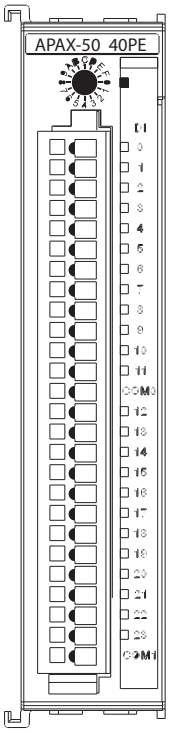


Figure 3.7 APAX-5040PE Module Front View

Application Wiring

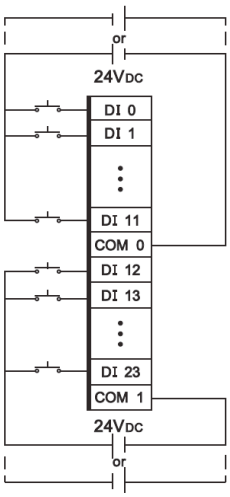


Figure 3.8 Wiring for APAX-5040PE

APAX-5040 Specifications

Digital Input

- **Channels:** 24
- **Points per Common:** 12
- **Type:** Sink/Source (Wet Contact)
- **Input Voltage Rated Value:** 24 VDC
  - **For "0" signal:** -5 ~ 5 VDC
  - **For "1" signal:** 15 ~ 30 VDC and -15 ~ -30 VDC
- **Input Impedance:** 5.4 kΩ
- **Typical Input Current:** 4.4 mA (At signal "1")
- **Maximum Input Current:** 7.3 mA
- **Input Filter:** 3 ms
- **Input Characteristic Curve:** According to IEC 61131-2, type 1

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Over Voltage Protection:** ±70 VDC

Environment

- **Operating Temperature:** -20 ~ 75°C (when mounted vertically)
- **Storage Temperature:** -40 ~ 85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 160 g
- **Power Consumption:** 2 W @ 24 VDC (typical)
- **Status Display:** LED per channel
  - **On:** Logic level “1”
  - **Off:** Logic level “0”

3.1.5 APAX-5046SO 20-ch Digital Output Module

The APAX-5046SO features 20 digital output (source) channels. The digital output channels offer short-circuit protection and LED to indicate digital status. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

The APAX-5046SO supports two independent power sources with different voltage levels. For example, one can be 24VDC while the other is 12VDC.

Warning! *Please use different power supply modules for digital channels and system to ensure isolation effect.*

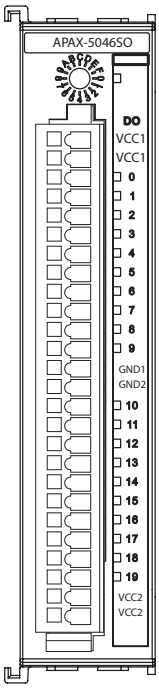


Figure 3.9 APAX-5046SO Module Front View

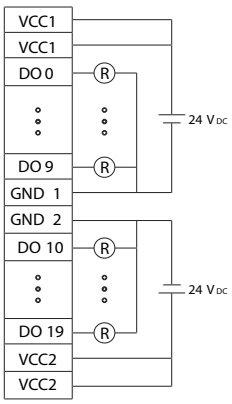


Figure 3.10 Wiring for APAX-5046SO

APAX-5046SO Specifications

Digital Output

- **Channels**: 20
- **Type**: Source
- **Voltage Range**: 10 ~ 35 V_{DC}
- **Rated Output Current at signal "1"**: 1A (per channel)
- **Permitted Output Current (at signal "1")**: max. 1.2A
- **Output Current at signal "0" (leakage current)**: 0.1 mA
- **Lamp Load**: max. 10 W
- **On-State Voltage Drop**: 0.15 V at 0.5 A
- **Switch Rate**:
  - **For resistive load**: max. 300 Hz
  - **For inductive load**: max. 20 Hz
  - **For lamp load: max**. 200 Hz (Using 5W lamp and testing under 24 V)

Protection

- **Isolation**: 2,500 V_{DC} (Between channels and backplane bus)
- **Short Circuit Protection**
- **Thermal Shutdown Protection**
- **Fail Safe Protection***

* When I/O module lose its communication with controller or coupler, the output channel will generate a pre-defined value

Environment

- **Operating Temperature**: -10 ~ 60^{o}C (when mounted vertically)
- **Storage Temperature**: -40 ~ 70^{o}C
- **Relative Humidity**: 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D)**: 30 x 139 x 100 mm
- **Weight**: 165 g
- **Power Consumption**: 2.5 W @ 24 V_{DC} (typical)
- **Status Display**: LED per channel
  - **On**: Logic level "1"
  - **Off**: Logic level "0"

3.2 Relay Output Modules

3.2.1 APAX-5060 12-ch Relay Output Module

The APAX-5060 relay output module provides 12 relay channels of Form A. Switches can be used to control the relays. The digital output channels offer short-circuit protection and LED to indicate digital status. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

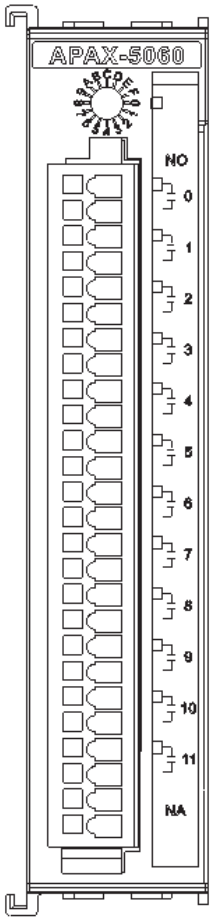


Figure 3.11 APAX-5060 Module Frontal View

Application Wiring

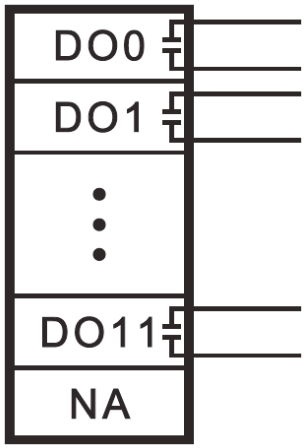
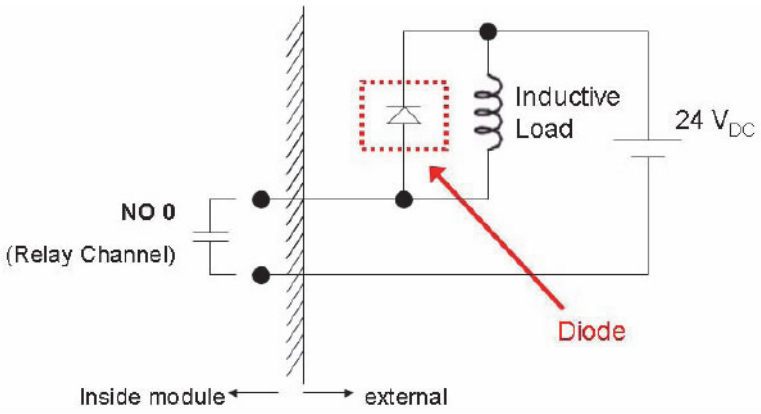


Figure 3.12 Wiring for APAX-5060

Warning! *When you connect DO channel with inductive load, we suggest adding one diode in the circuit to protect the APAX-5060 module. (Refer to figure below)*



APAX-5060 Specifications

Relay Output

- **Channels:** 12
- **Relay Type:** Form A (SPST)
- **Switching Capacity and Lifetime of the Contact (For Resistive Load)**
  - VDE: 30,000 operations (5 A @ 250 VAC, 10 operations/minute at 8° C)
    70,000 operations (5 A @ 30 VDC, 10 operations/ minute at 85° C)
  - UL: 60,000 operations (5 A @ 250 VAC)
    100,000 operations (5 A @ 30 VDC)
  - Mechanism: 20,000,000 operations (no load, 300 operations/minute)
- **Breakdown Voltage:** 500 VAC (50/60 Hz)
- **Contact Resistance:** 30 mΩ (maximum)
- **Insulation Resistance:** 1 GΩ (minimum) at 500 VDC
- **Operating Time:** 10 ms maximum at rated voltage (excluding bounce time)
- **Release Time:** 5 ms maximum at rated voltage (excluding bounce time)

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Fail Safe Protection***

* When I/O module lose its communication with controller or coupler, the output channel will generate a pre-defined value

Environment

- **Operating Temperature:** -10 ~ 60° C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 195 g
- **Power Consumption:** 2 W @ 24 VDC (typical)
- **Status Display:** LED per channel
  - **On:** Logic level “1”
  - **Off:** Logic level “0”

3.2.2 APAX-5060PE 12-ch Relay Output Module for P&E Applications

The APAX-5060PE relay output module provides 12 relay channels of Form A. Switches can be used to control the relays. The digital output channels offer short-circuit protection and LED to indicate digital status.This module is an IEC-61850-3 compliant I/O modules, and suitable for power and energy related application. The highly anti-electromagnetic interference make it more robust and reliable to survive in the hush environment. The module provides 2500 VDC optical isolation between channels and backplane bus. If any high voltage or current damage the channels, the whole system (backplanes, other modules, and control unit) won't be affected because it is already isolated.

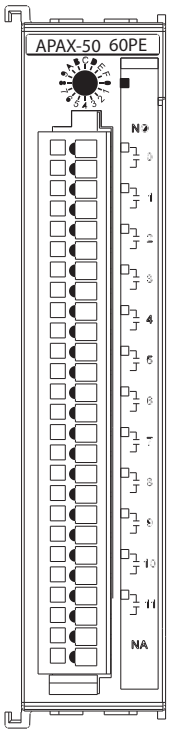


Figure 3.13 APAX-5060PE Module Frontal View

Application Wiring

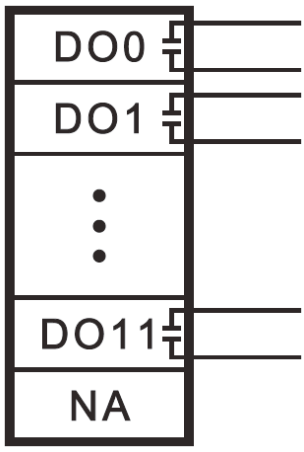
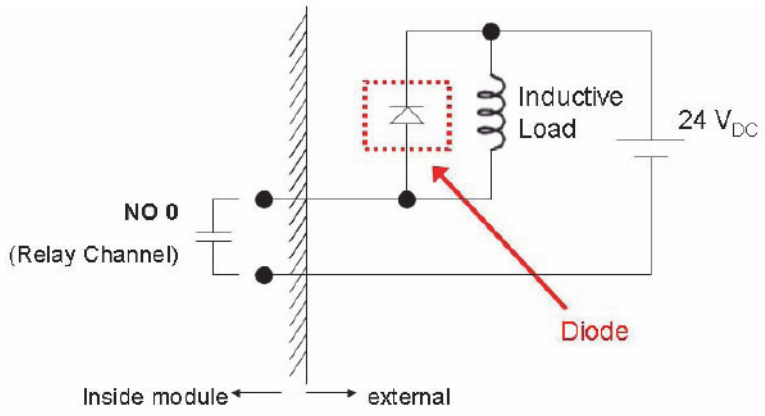


Figure 3.14 Wiring for APAX-5060PE

Warning! *When you connect DO channel with inductive load, we suggest adding one diode in the circuit to protect the APAX-5060PE module. (Refer to figure below)*



APAX-5060PE Specifications

Relay Output

- **Channels:** 12
- **Relay Type:** Form A (SPST)
- **Switching Capacity and Lifetime of the Contact (For Resistive Load)**
  - VDE: 30,000 operations (5 A @ 250 VAC, 10 operations/minute at 8° C)
    70,000 operations (5 A @ 30 VDC, 10 operations/ minute at 85° C)
  - UL: 60,000 operations (5 A @ 250 VAC)
    100,000 operations (5 A @ 30 VDC)
  - Mechanism: 20,000,000 operations (no load, 300 operations/minute)
- **Breakdown Voltage:** 500 VAC (50/60 Hz)
- **Contact Resistance:** 30 mΩ (maximum)
- **Insulation Resistance:** 1 GΩ (minimum) at 500 VDC
- **Operating Time:** 10 ms maximum at rated voltage (excluding bounce time)
- **Release Time:** 5 ms maximum at rated voltage (excluding bounce time)

Protection

- **Isolation:** 2,500 VDC (Between channels and backplane bus)
- **Fail Safe Protection***

* When I/O module lose its communication with controller or coupler, the output channel will generate a pre-defined value

Environment

- **Operating Temperature:** -20 ~ 70°C (when mounted vertically)
- **Storage Temperature:** -40 ~ 85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 195 g
- **Power Consumption:** 2 W @ 24 VDC (typical)
- **Status Display:** LED per channel
  - **On:** Logic level “1”
  - **Off:** Logic level “0”

3.3 Counter Modules

3.3.1 APAX-5080 Counter/Frequency and DIO Module

The APAX-5080 features counter/frequency and DIO functions. For the digital input function, the APAX-5080 supports 4 isolated digital input and Gate function. For digital output function, the APAX-5080 supports 4 general isolated digital output and specific alarm function with counter. For counter/frequency function, the APAX-5080 can support many modes of counter input type such as A/B phase and CW/CCW types. And the frequency input range can support from 0.1Hz to 1MHz. Here is the APAX-5080 module view and application wiring below.

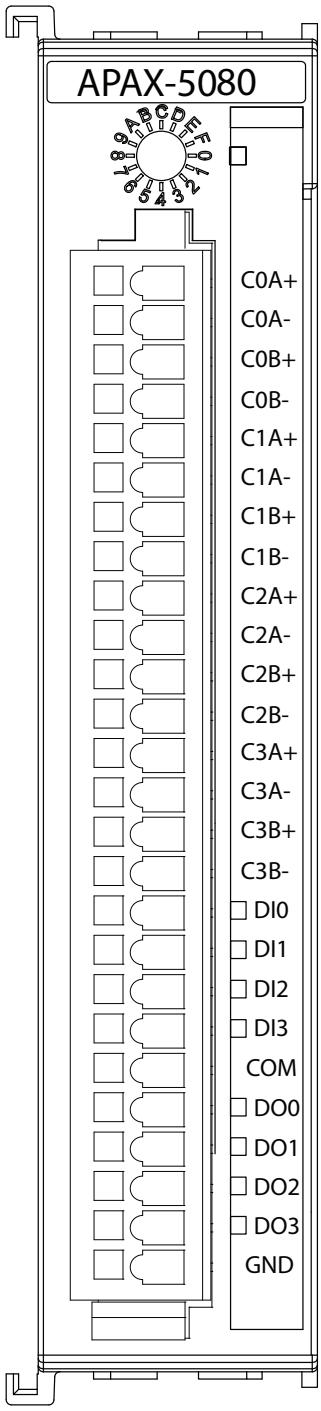


Figure 3.15 APAX-5080 Module Front View

Application Wiring

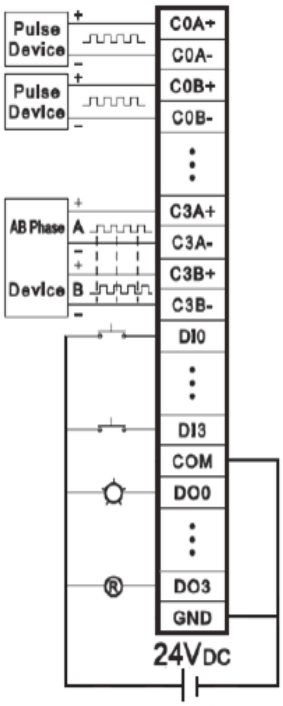
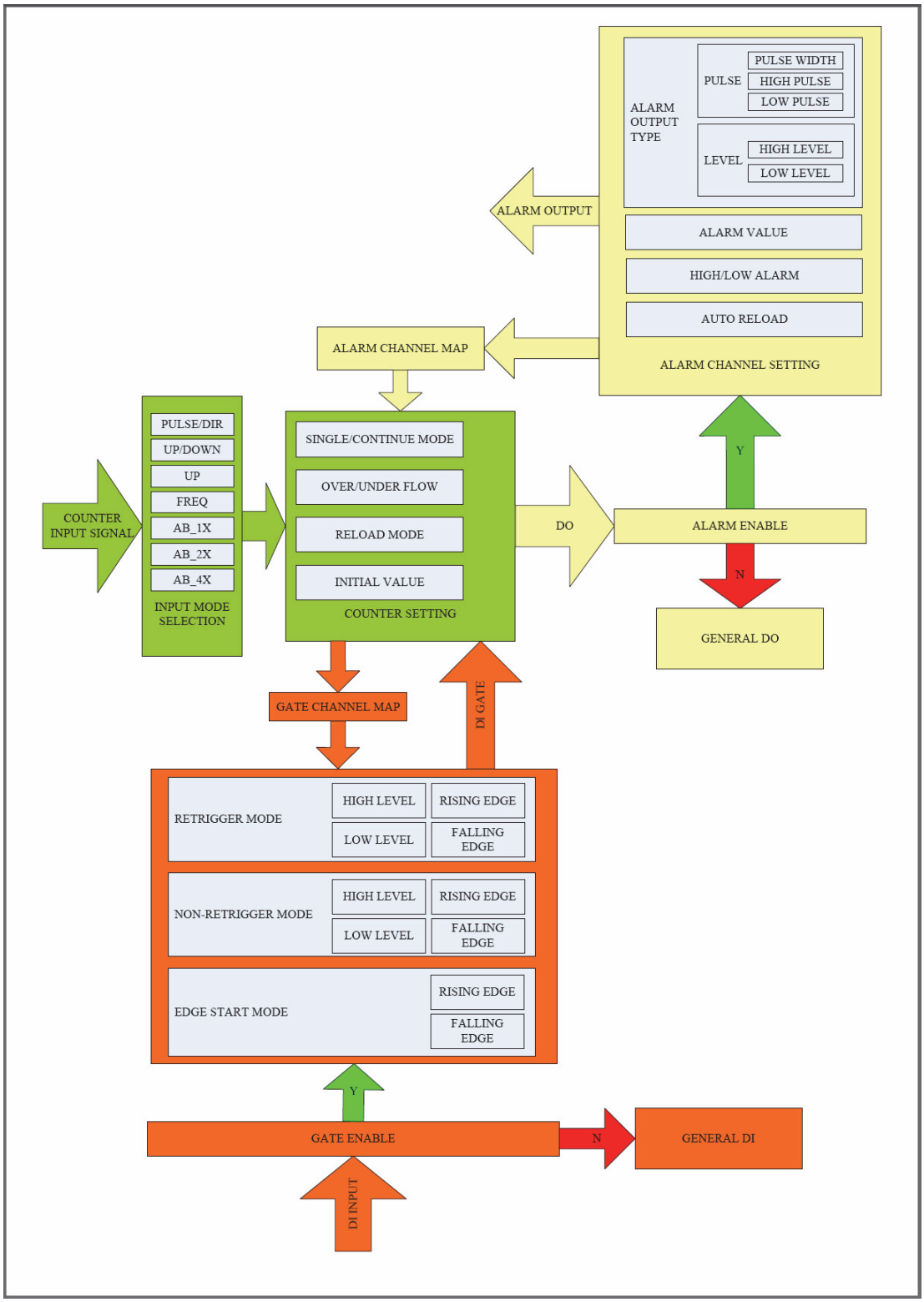


Figure 3.16 Wiring for APAX-5080

Warning! *Please use different power supply modules for digital channels and system to ensure isolation effect.*

APAX-5080 Function Block



APAX-5080 Specifications

Digital Input

- **Channels:** 4
- **Input Voltage**
  - For “0” Signal: 0 ~ 3 VDC
  - For “1” Signal: 10 ~ 30 VDC
- **Input Current:** 5~15 mA (For Signal “1”, typical)
- **Minimum Pulse Width:** 500 ns (Max. Input Frequency)

Digital Output

- **Channels:** 4
- **Voltage Range:** 8 ~ 35 VDC
- **Output Current at Signal “1”**
  - Rated: 0.5 A
  - Permitted: 0.75 A (max.)
- **Output Current at Signal “0”10A**
  - (Leakage Current)
- **Output Delay at Resistive Load**
  - From logic level “0” to “1”100 s (max.)
  - From logic level “1” to “0”200 s (max.)

Counter Input

- **Modes:** Pulse and Direction, Up/Down, Up Pulse, A/B phase and Frequency
- **Channels:** 4 (Pulse and Direction, Up/Down, and A/B phase mode)
  - 8 (Up Pulse and Frequency mode)
- **Counting Range:** 32-bit + 1-bit overflow/underflow
- **Minimum Pulse Width:** 500 ns
- **Input Frequency (max.):** 1 MHz
- **Input Voltage**
  - For “0” Signal0 ~ 3 VDC
  - For “1” Signal10 ~ 30 VDC
- **Input Current:** 5~15 mA (For Signal “1”, typical)
- **Digital Noise Filter:** 1~65000 s (programmable)

Protection

- **Isolation:** 2500 VDC (Between channels and backplane bus)
- **Over Voltage Protection:** 50 VDC (all channels)
  - 110 VDC (single channel) (for DI and Counter Input channels)
- **Short Circuit Protection:** Yes (for DO channels)

Environment

- **Operating Temperature:** -10 ~ 70° C (14 ~ 158° F)
- **Storing Temperature:** -25 ~ 85° C (-13 ~ 185° F)
- **Storing Humidity:** 5 ~ 95% RH (non-condensing)

General

- **Dimensions (W x H x D):** 30 x 139 x 100 mm
- **Weight:** 165 g
- **Power Consumption:** 2.5 W @ 24 VDC (typical)
- **Status Display:** LED per channel
  - On: Logic level “1”
  - Off: Logic level “0”

APAX-5080 Counter Mode No Gate No Alarm

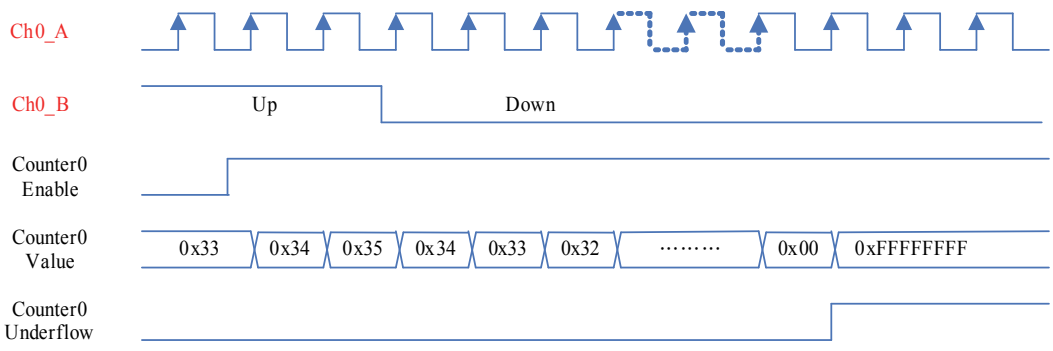
There are so many counter modes in APAX-5080 and below will use counter0 as an example to explain every counter mode operation principle.

Below are the definitions of counter mode.

- **Pulse/DIR:** Ch0_A provides the counting function, one pulse, one count, and Ch0_B provides the clockwise and counter clockwise function.
- **Up/Down:** CH0_A provides the counter up function, one pulse one up count, and CH0_A provides the counter down function, one pulse one down count.
- **UP:** CH0_A provides the counter up function, one pulse one up count.
- **A/B Phase 1X:** counter mode A/B Phase x 1--If the signal “A” leads “B” by a rising or falling edge, then the number of steps will be added by one, and vice versa.
- **A/B Phase 2X:** counter mode A/B Phase x 2
- **A/B Phase 4X:** counter mode A/B Phase x 4
- **With Reload:** When the counter0 value is overflow, the value will be reset to the initial value.
- **No Reload:** If the counter0 value is overflow, the value will be 0. If the counter0 value is overflow, the value will be the max value.
- **Count Once:** It means if the counter0 is overflow, it won’t count again.
- **Count Repetitively:** when counter value is overflow or underflow, it will reset to the default value and continuous to count.
- **Frequency:** CH0_A provides the frequency function from 0.1Hz~1MHz.

Pulse/DIR, No Reload, Count Once

Figure 3.3 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will show the minimum (0x00) or maximum (0xFFFFFFFF) value and not count continuously.



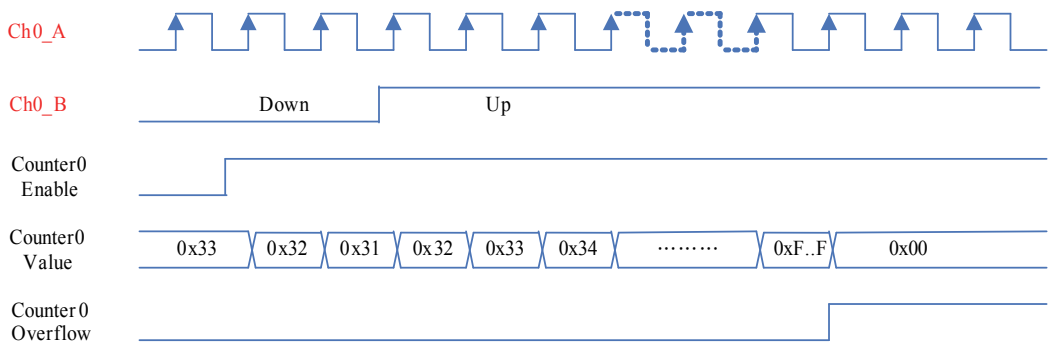


Figure 3.17 Pulse/DIR, No Reload, Count Once

Pulse/DIR, With Reload, Count Once

Figure 3.4 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting.

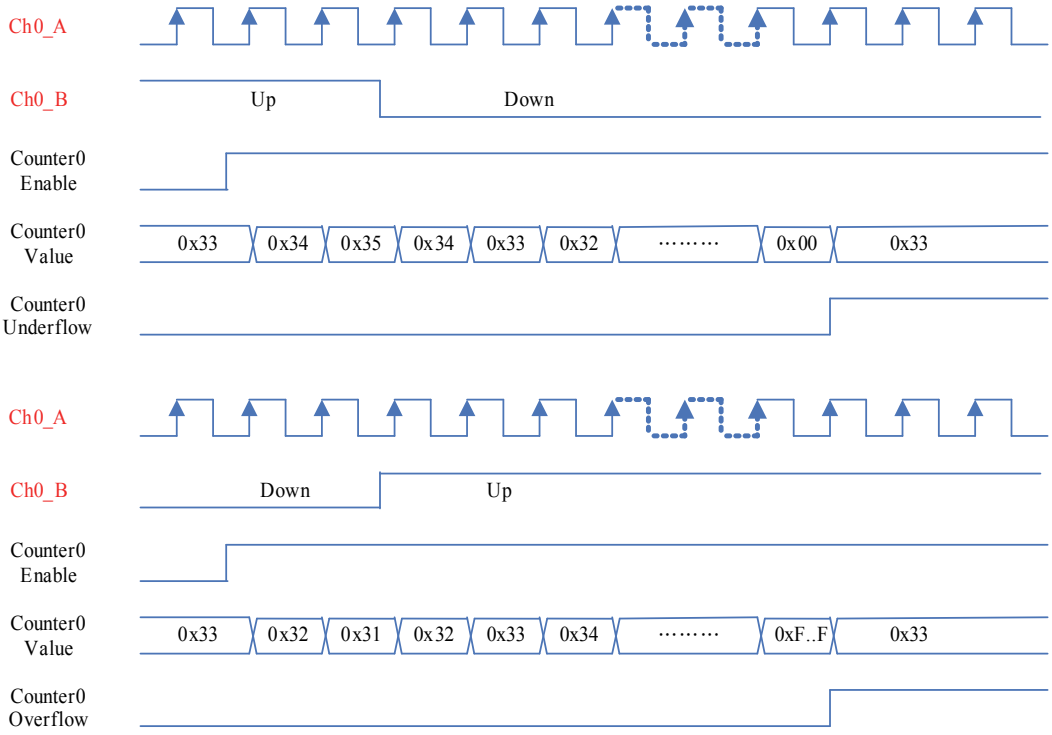


Figure 3.18 Pulse/DIR, With Reload, Count Once

Pulse/DIR, With Reload, Count Repetitively

Figure 3.5 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

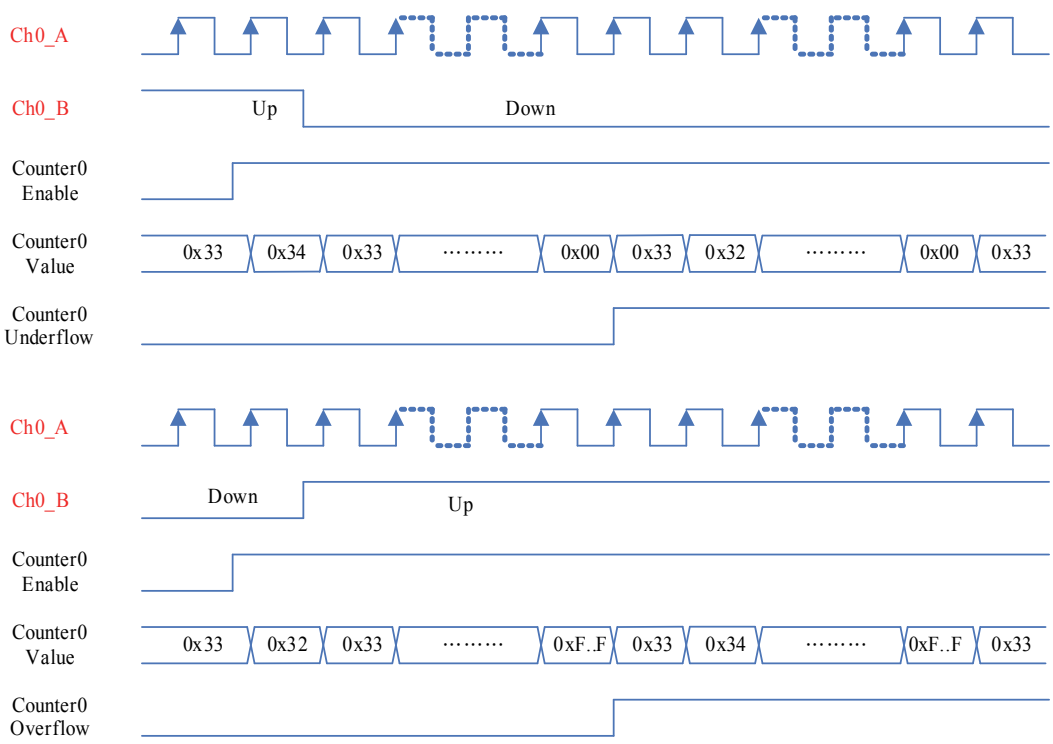


Figure 3.19 Pulse/DIR, With Reload, Count Repetitively

Up/Down, No Reload, Count Once

Figure 3.6 shows up/down mode, Ch0_A provides the counting up function, one pulse, one up count. Ch0_B provides the counting down function, one pulse, one down count. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will show the minimum (0x00) or maximum (0xFFFFFFFF) value and not count continuously.

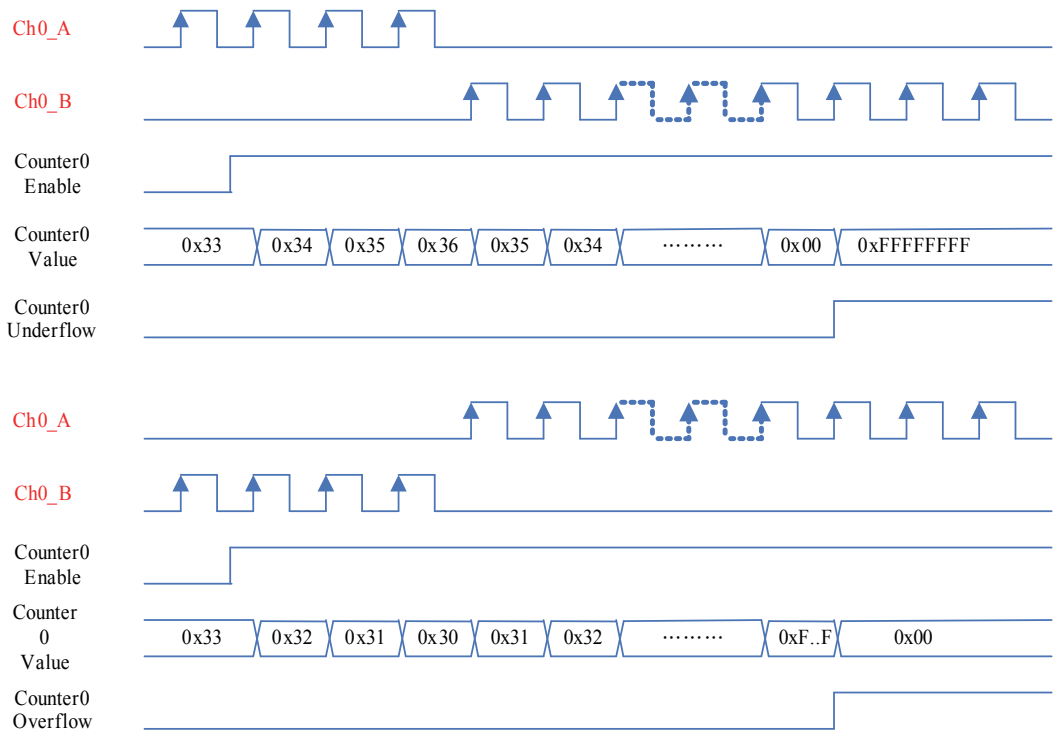


Figure 3.20 Up/Down, No Reload, Count Once

Up/Down, With Reload, Count Once

Figure 3.7 shows up/down mode, Ch0_A provides the counting up function, one pulse, one up count. Ch0_B provides the counting down function, one pulse, one down count. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting.

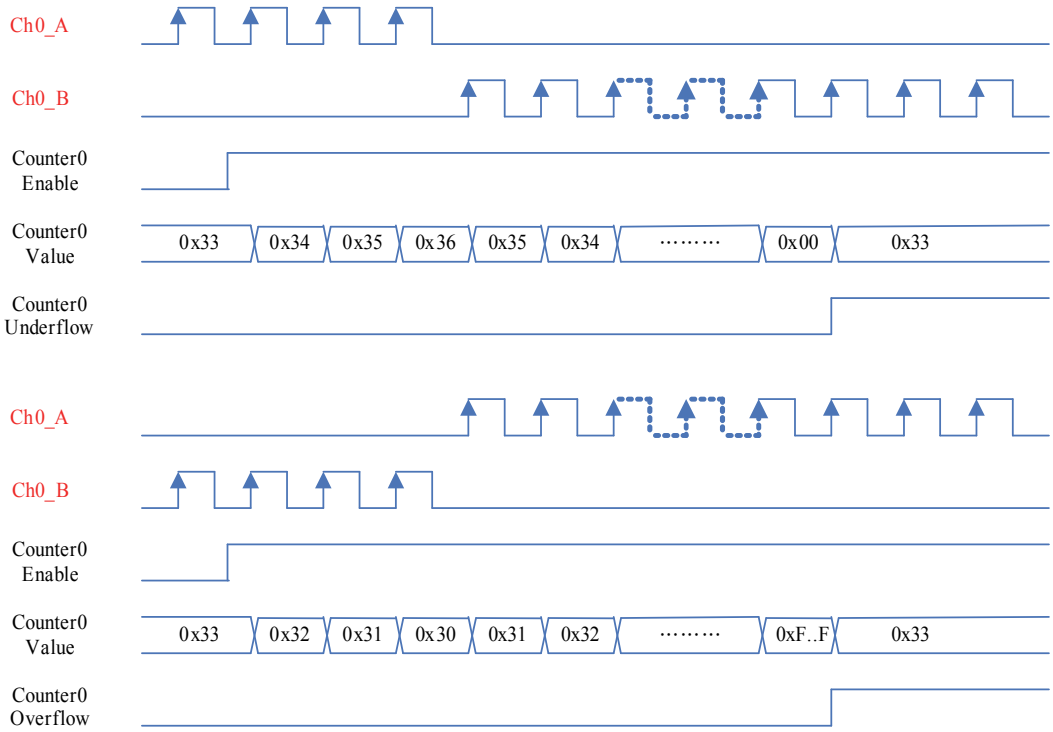


Figure 3.21 Up/Down, With Reload, Count Once

Up/Down, With Reload, Count Repetitively

Figure 3.8 shows up/down mode, Ch0_A provides the counting up function, one pulse, one up count. Ch0_B provides the counting down function, one pulse, one down count. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

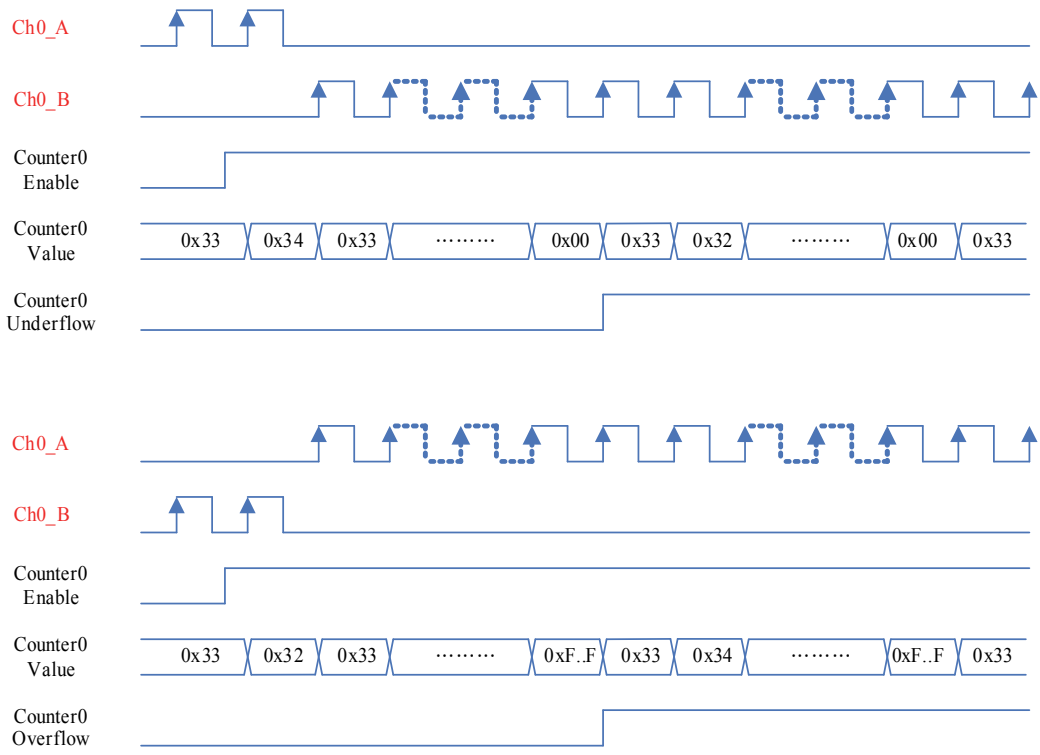


Figure 3.22 Up/Down, With Reload, Count Once

Up, No Reload, Count Once

Figure 3.9 shows counter up mode, Ch0_A provides the counting up function, one pulse, one up count. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will show the minimum (0x00) or maximum (0xFFFFFFFF) value and not count continuously.

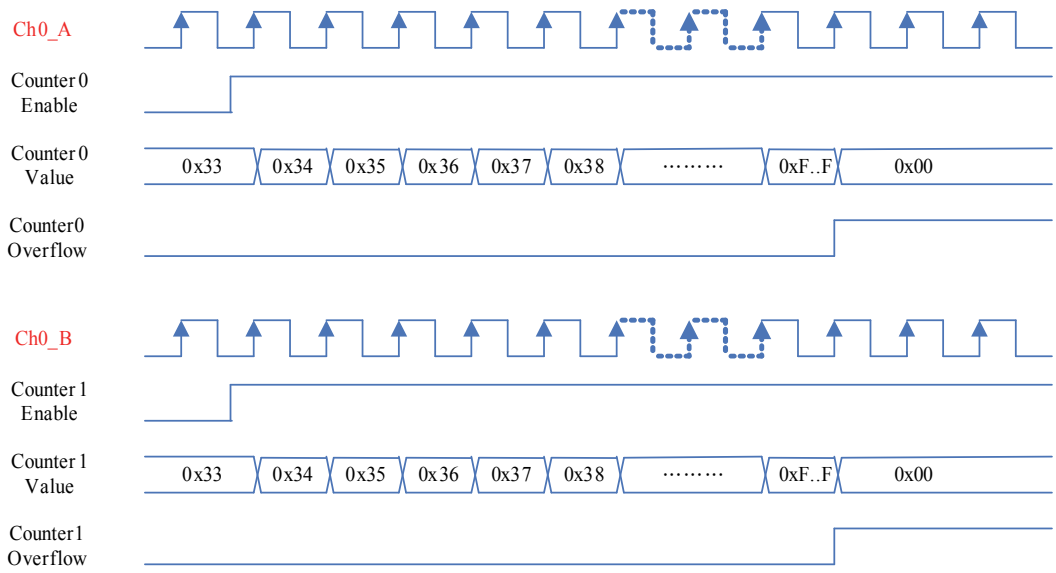


Figure 3.23 Up, No Reload, Count Once

Up, With Reload, Count Once

Figure 3.10 shows counter up mode, Ch0_A provides the counting up function, one pulse, one up count. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting.

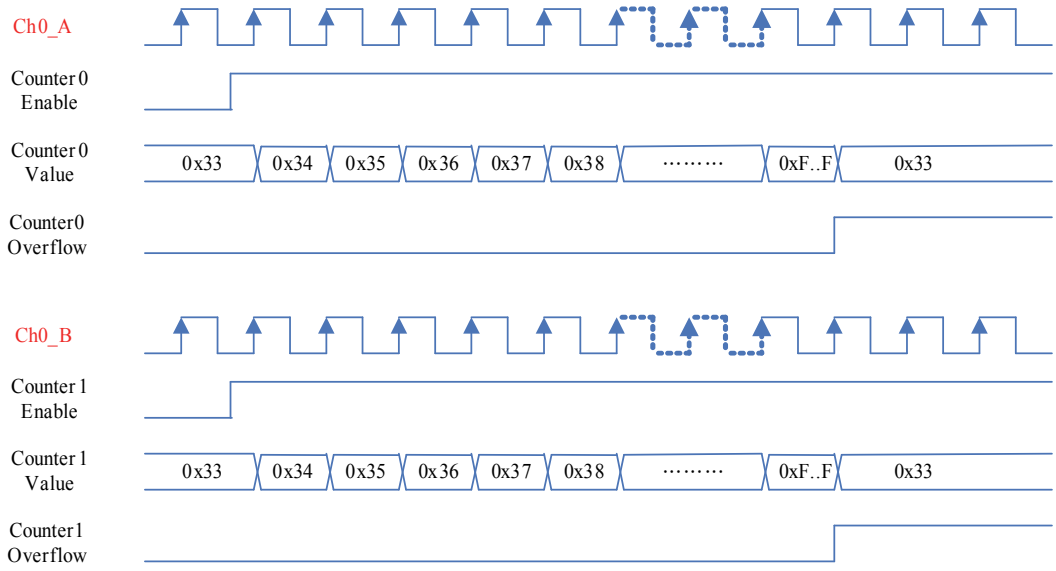


Figure 3.24 Up, With Reload, Count Once

Up, With Reload, Count Repetitively

Figure 3.11 shows up/down mode, Ch0_A provides the counting up function, one pulse, one up count. Ch0_B provides the counting down function, one pulse, one down count. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

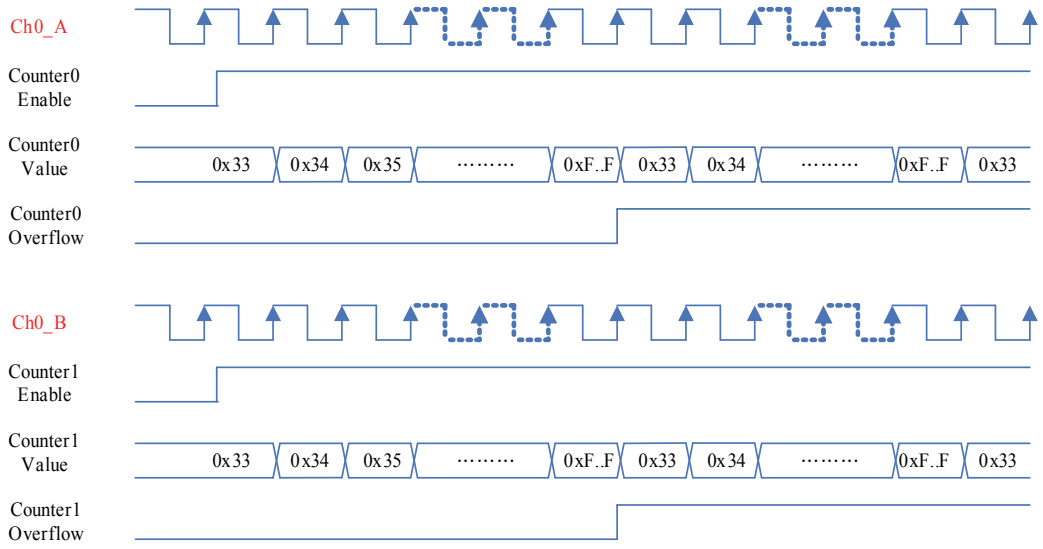


Figure 3.25 Up, With Reload, Count Repetitively

Frequency

Figure 3.12 shows the frequency function. Every counter channel can measure the frequency of assigned time window and the range is from 0.1Hz~1MHz.

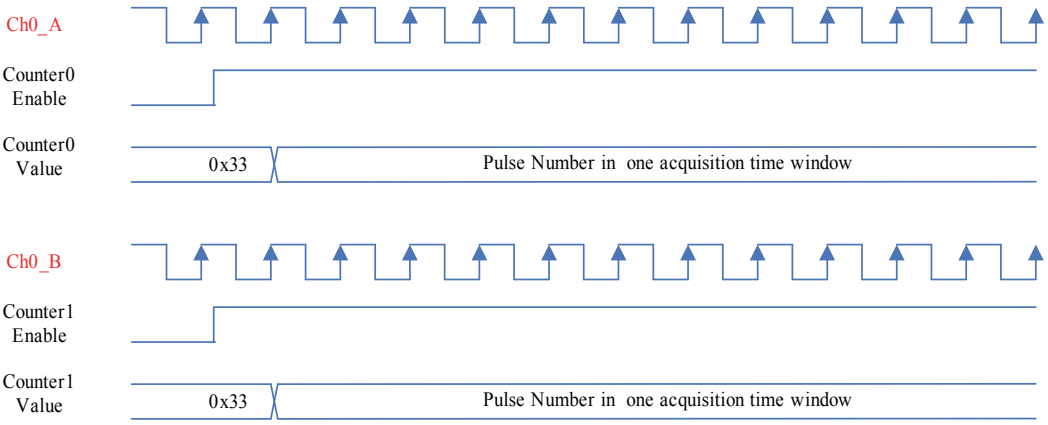


Figure 3.26 Frequency

A/B Phase 1X, No Reload, Count Once

Figure 3.13 shows A/B Phase 1X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will show the minimum (0x00) or maximum (0xFFFFFFFF) value and not count continuously.

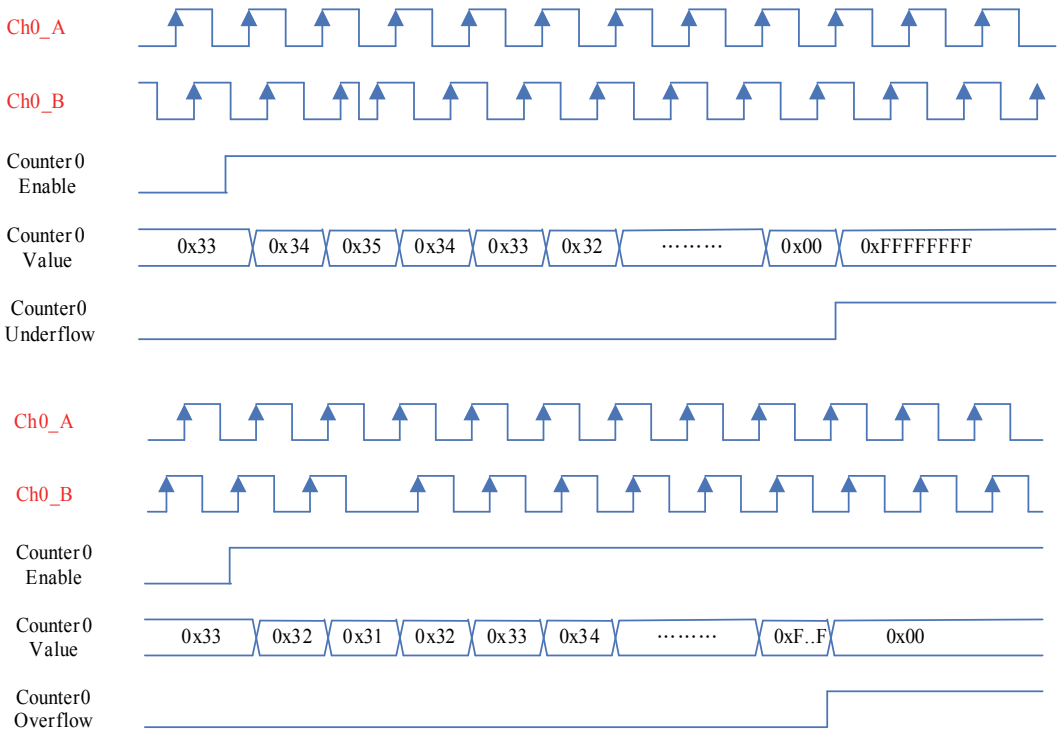


Figure 3.27 A/B Phase 1X, No Reload, Count Once

A/B Phase 1X, With Reload, Count Once

Figure 3.14 shows A/B Phase 1X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting.

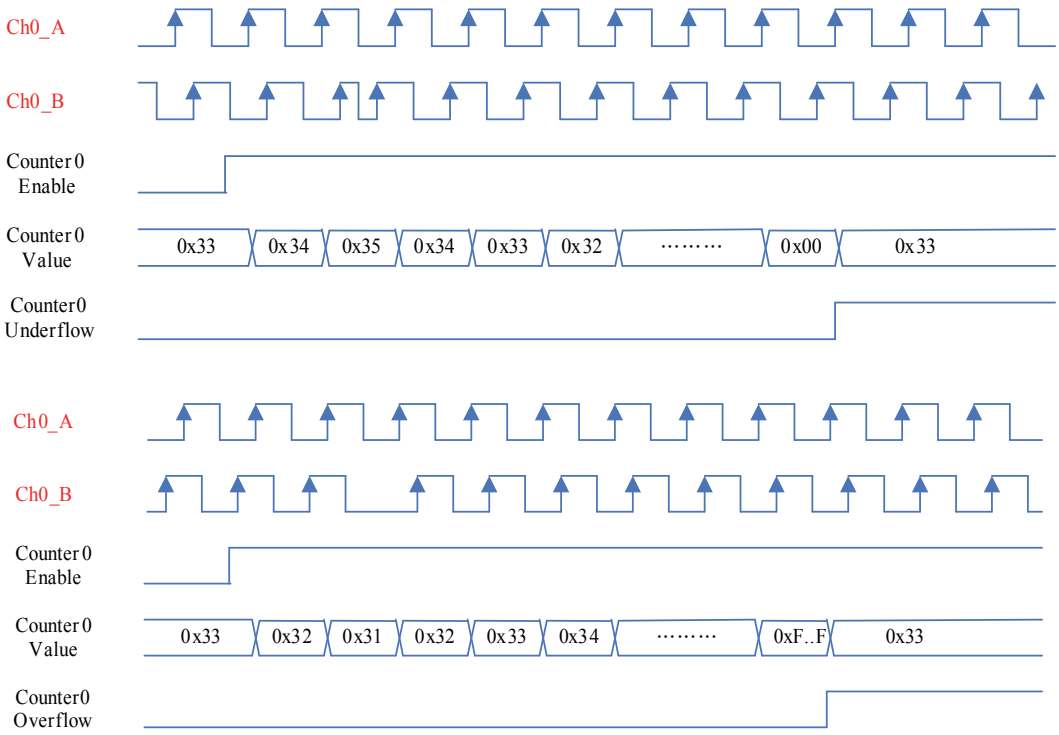


Figure 3.28 A/B Phase 1X, With Reload, Count Once

A/B Phase 1X, With Reload, Count Repetitively

Figure 3.15 shows A/B Phase 1X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

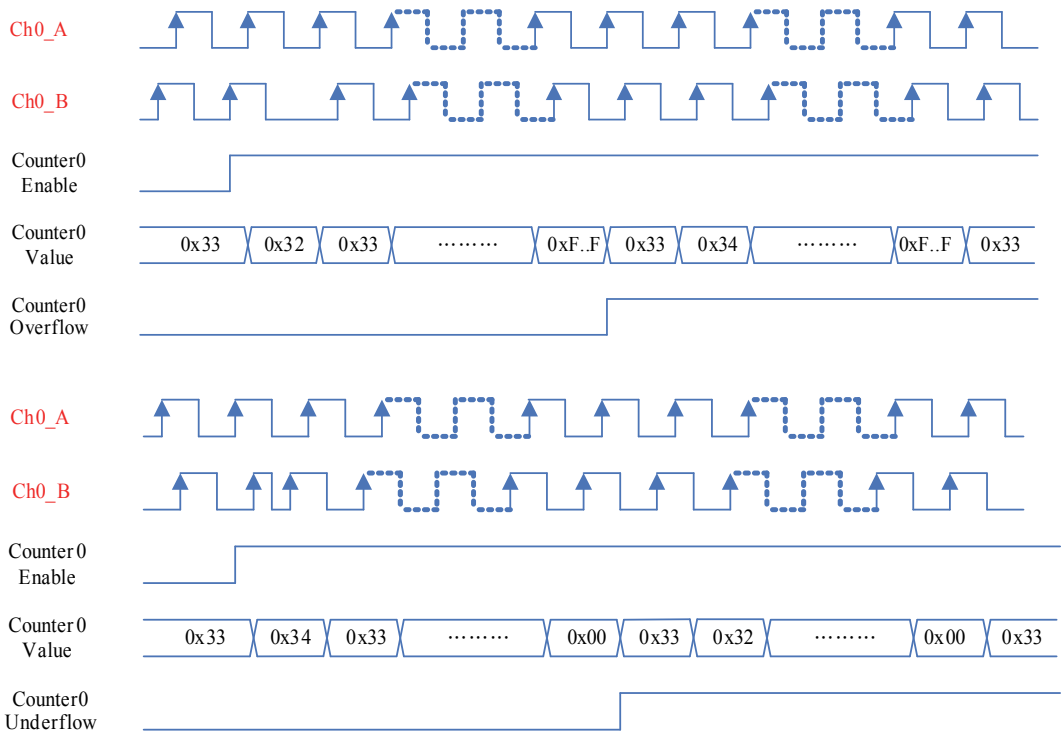


Figure 3.29 A/B Phase 1X, With Reload, Count Repetitively

A/B Phase 2X, No Reload, Count Once

Figure 3.16 shows A/B Phase 2X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting.

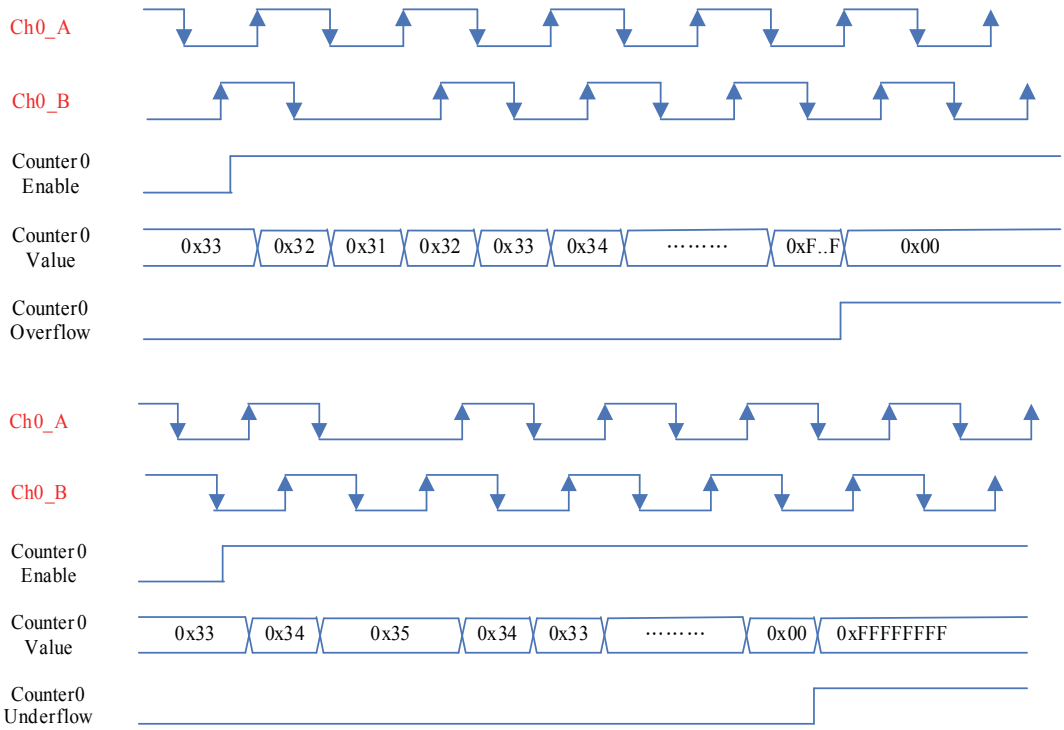


Figure 3.30 A/B Phase 2X, No Reload, Count Once

A/B Phase 2X, With Reload, Count Once

Figure 3.17 shows A/B Phase 2X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

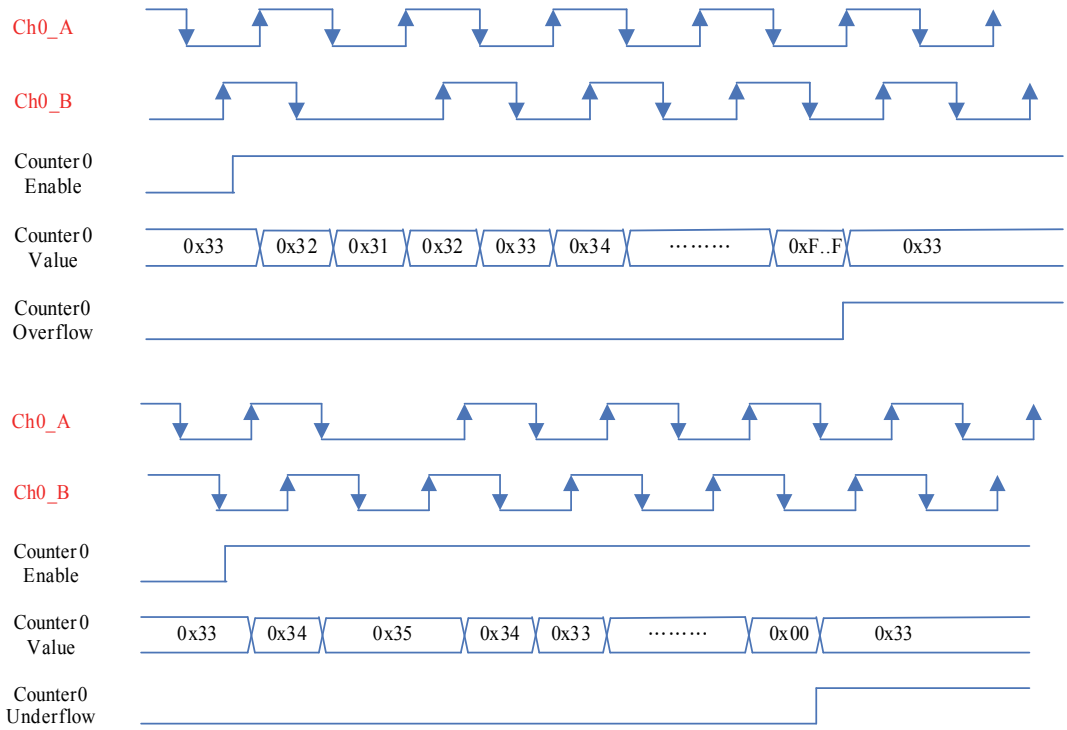


Figure 3.31 A/B Phase 2X, With Reload, Count Once

A/B Phase 2X, With Reload, Count Repetitively

Figure 3.18 shows A/B Phase 2X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

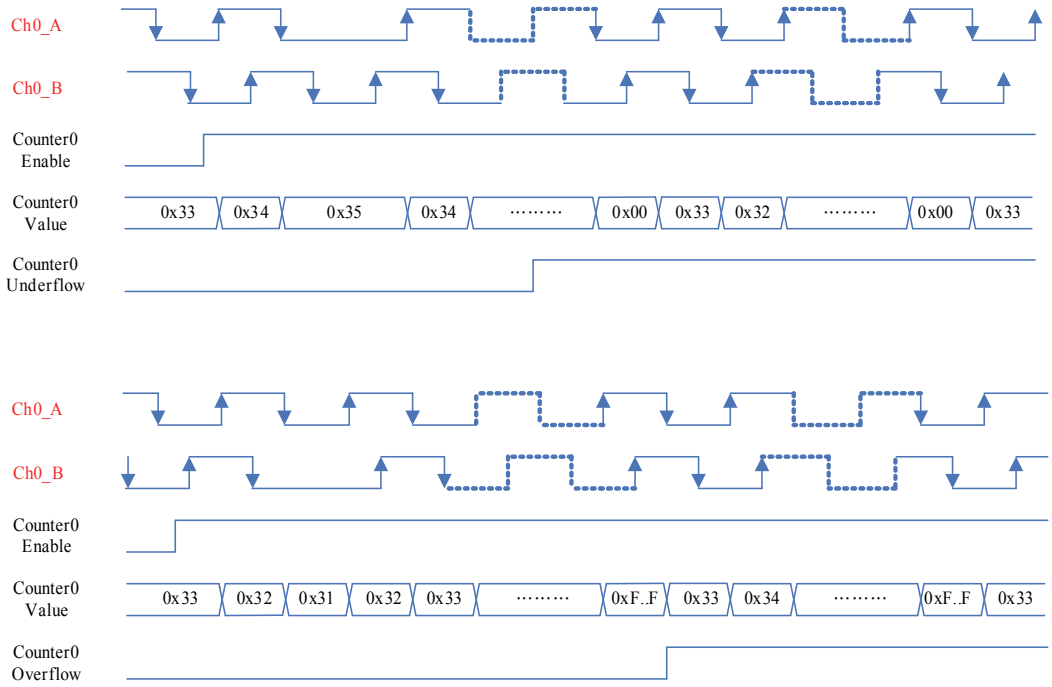


Figure 3.32 A/B Phase 2X , With Reload , Count Repetitively

A/B Phase 4X, No Reload, Count Once

Figure 3.19 shows A/B Phase 4X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting.

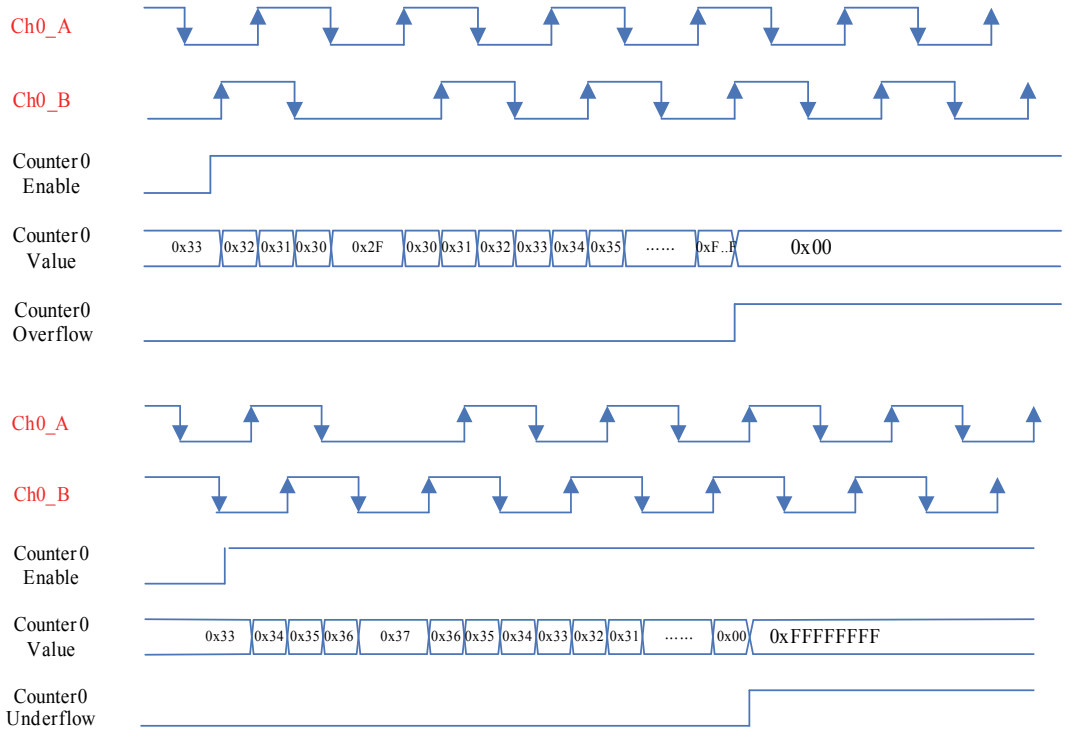


Figure 3.33 A/B Phase 4X, No Reload, Count Once

A/B Phase 4X, With Reload, Count Once

Figure 3.20 shows A/B Phase 4X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

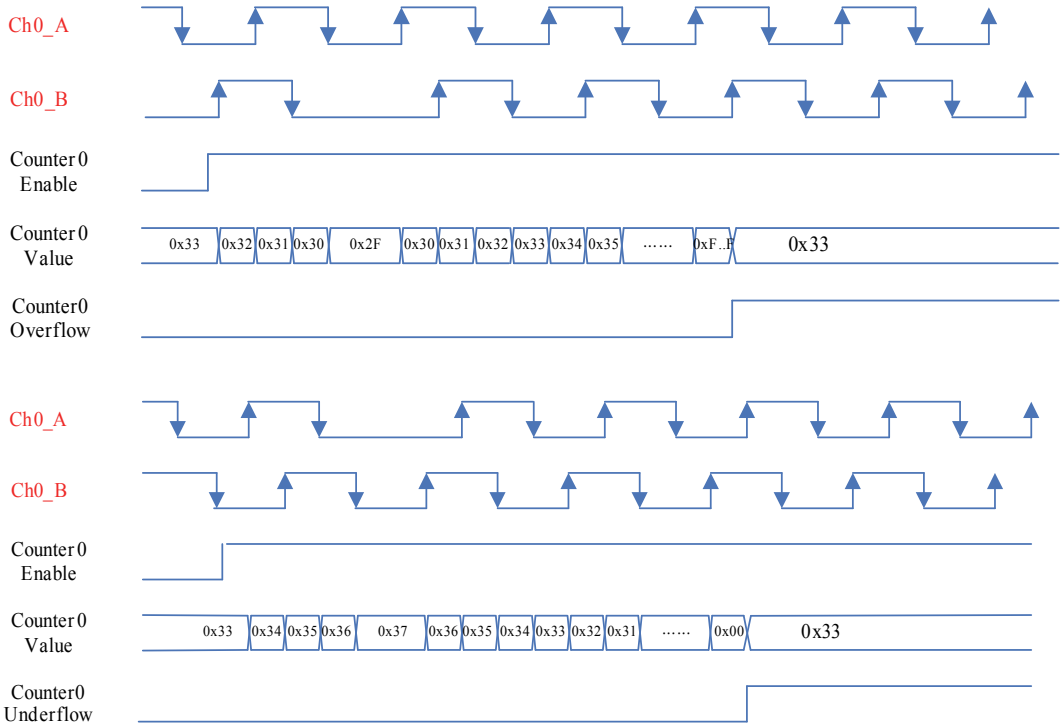


Figure 3.34 A/B Phase 4X, With Reload, Count Once

A/B Phase 4X, With Reload, Count Repetitively

Figure 3.21 shows A/B Phase 2X mode, Ch0_A and Ch0_B provide the counting function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.

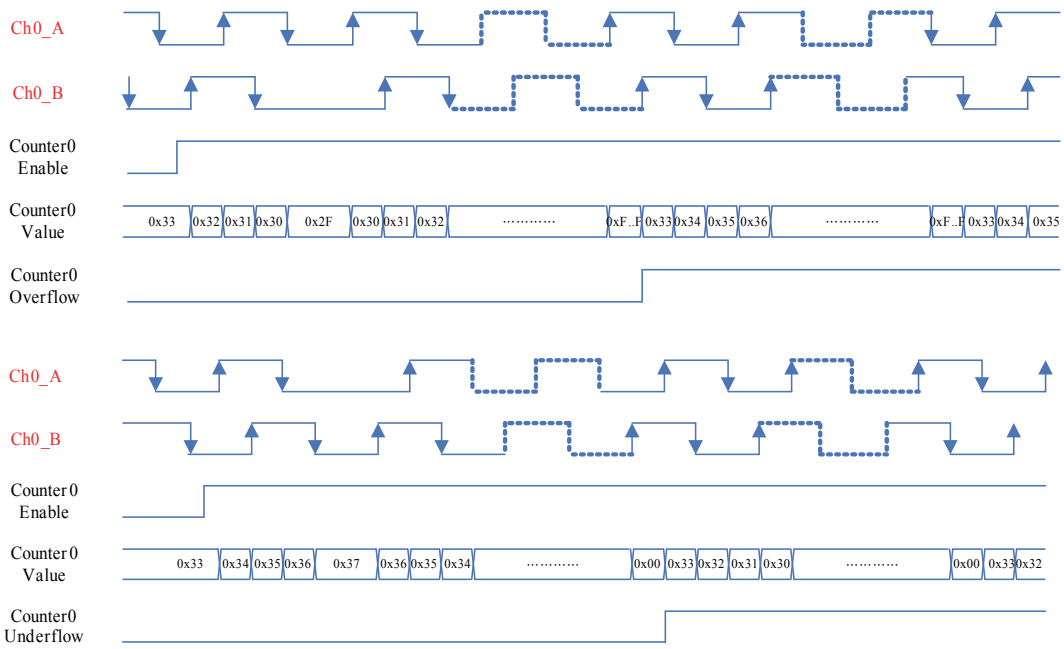


Figure 3.35 A/B Phase 4X, With Reload, Count Repetitively

DI Gate Function No Alarm

- **DI Gate Disable :** Whatever the DI value is, the counter still continuously counts
- **DI Gate Enable :** If the DI value is set to high, the counter can count. Otherwise, the counter will be stopped counting.
- **Not Retriggerable :** It means DI0 only can trigger the counter to count once.
- **Retriggerable :** It means DI0 can trigger the counter to count anytime.
- **High level :** the DI0 trigger level
- **Low level :** the DI0 trigger level
- **Rising Edge :** the DI0 trigger edge
- **Falling Edge :** the DI0 trigger edge
- **Rising Edge Start :** When DI0 status changes from low to high, the counter will start to count. After start, whatever the DI0 status, the counter still counts until the counter0 is disabled.
- **Falling Edge Start :** When DI0 status changes from high to low, the counter will start to count. After start, whatever the DI0 status, the counter still counts until the counter0 is disabled.

Pulse/DIR, With Reload, Count Once, DI Gate Disable

Figure 3.22 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will show the minimum (0x00) or maximum (0xFFFFFFFF) value and not count continuously. Whatever the DI value is, the counter still continuously counts.

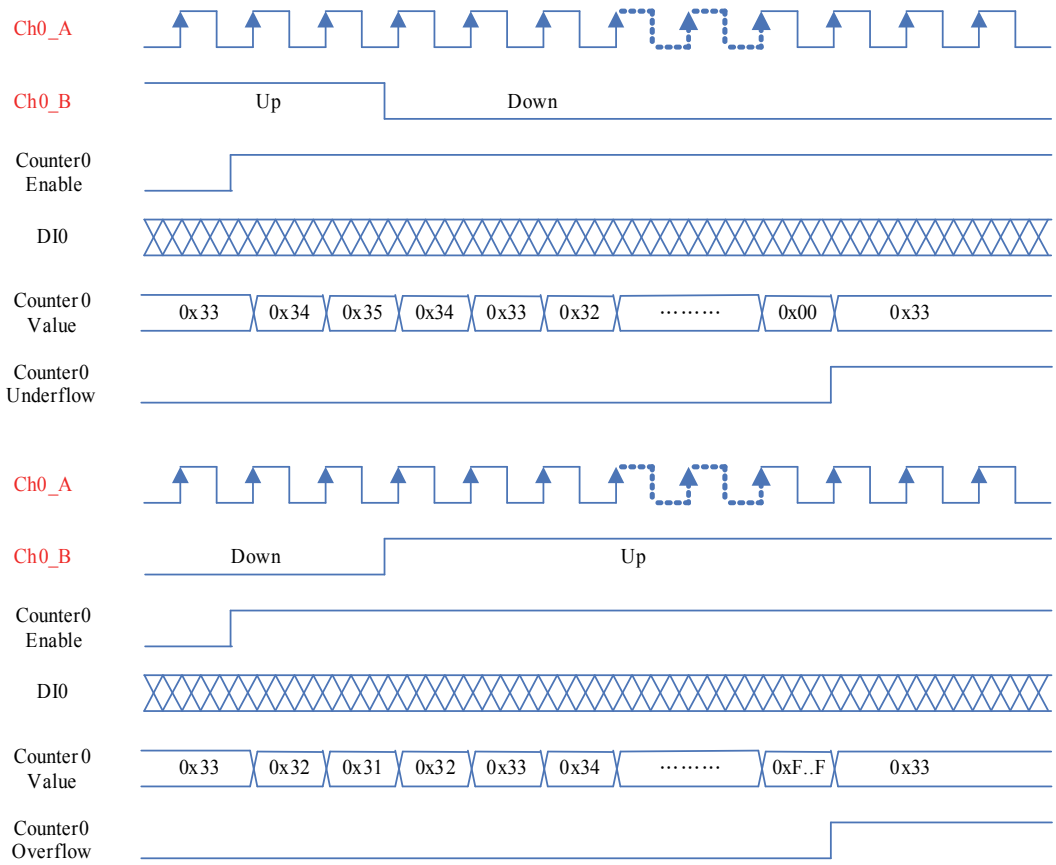


Figure 3.36 Pulse/DIR, With Reload, Count Once, DI Gate Disable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Disable

Figure 3.23 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting. Whatever the DI value is, the counter still continuously counts.

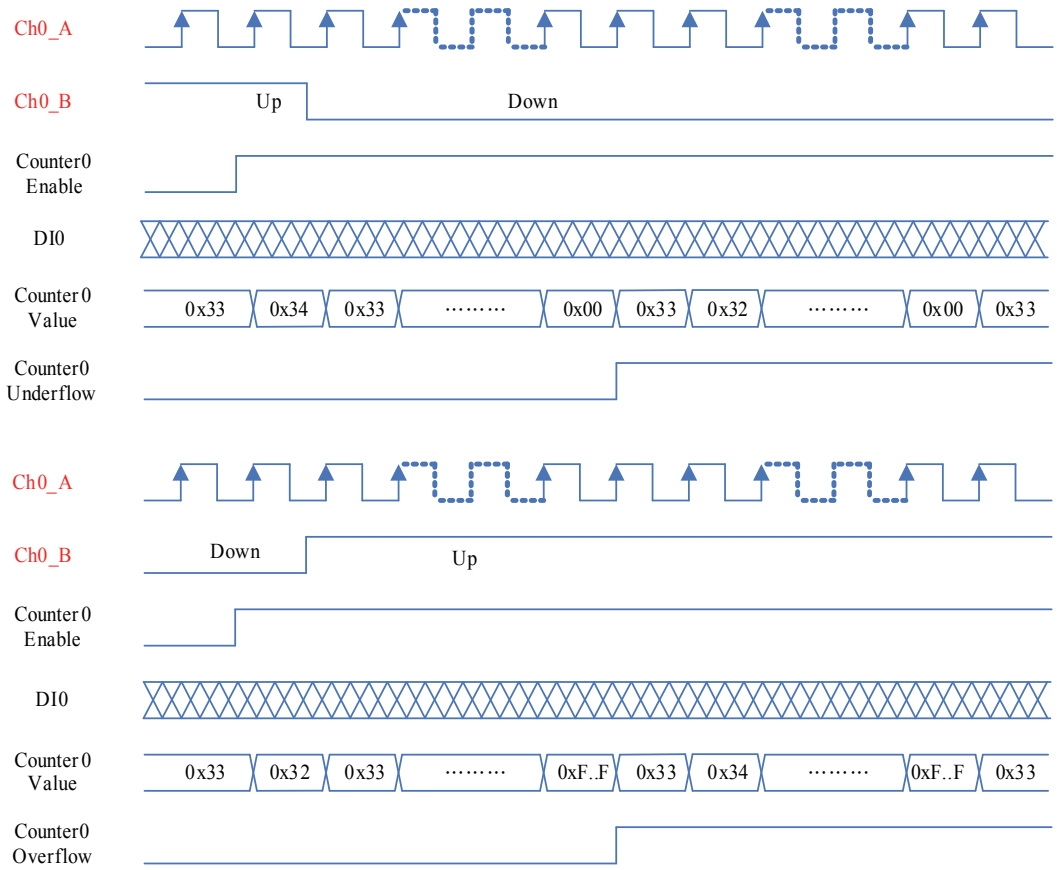


Figure 3.37 Pulse/DIR, With Reload, Count Repetitively, DI Gate Disable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, High level, Not Retriggerable

Figure 3.24 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 value is high level, the counter0 will starts to count but cannot retriggered. Otherwise, the counter0 will stop counting.

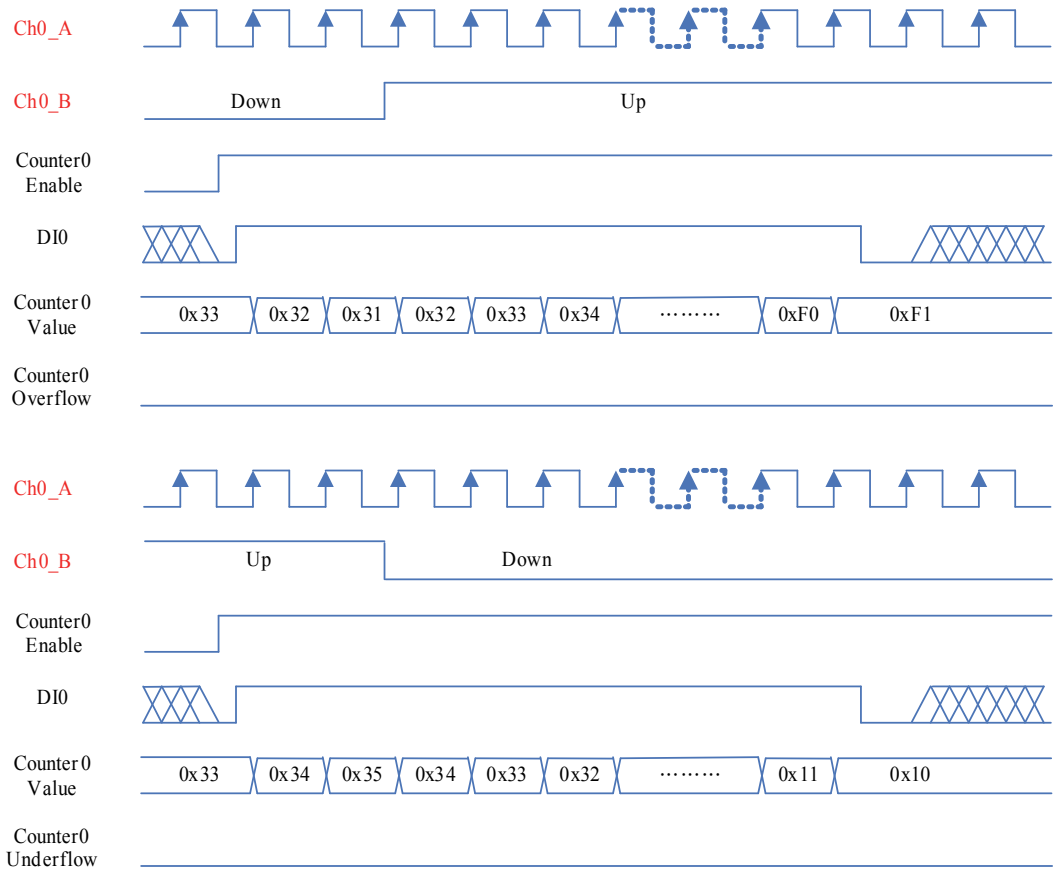


Figure 3.38 Pulse/DIR, With Reload, Count Once, DI Gate Enable, High level, Not Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, High level, Not Retriggerable

Figure 3.25 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, t will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 value is high level, the counter0 will starts to count but cannot retriggered. Otherwise, the counter0 will stop counting.

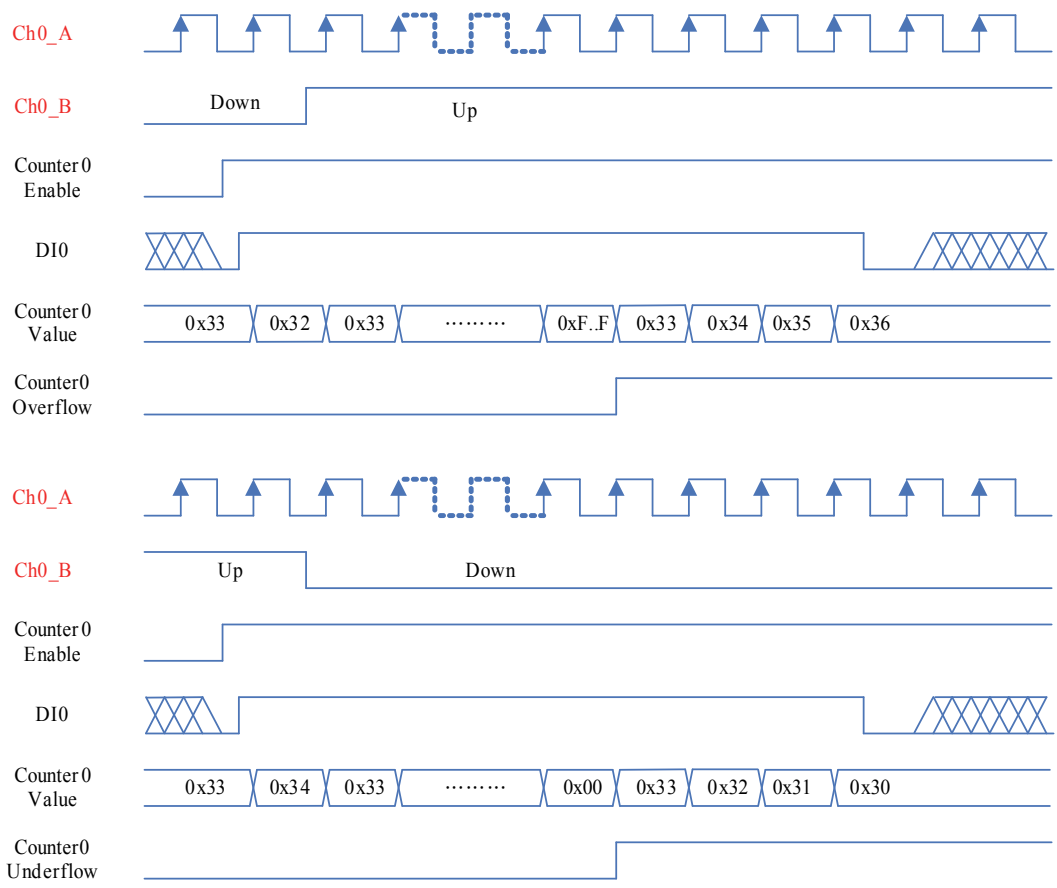


Figure 3.39 Pulse/DIR , With Reload , Count Repetitively, DI Gate Enable, High level, Not Retriggerable

Pulse/DIR, With Reload , Count Once, DI Gate Enable, High level, Retriggerable

Figure 3.26 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively.. If the DI0 value is high level, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

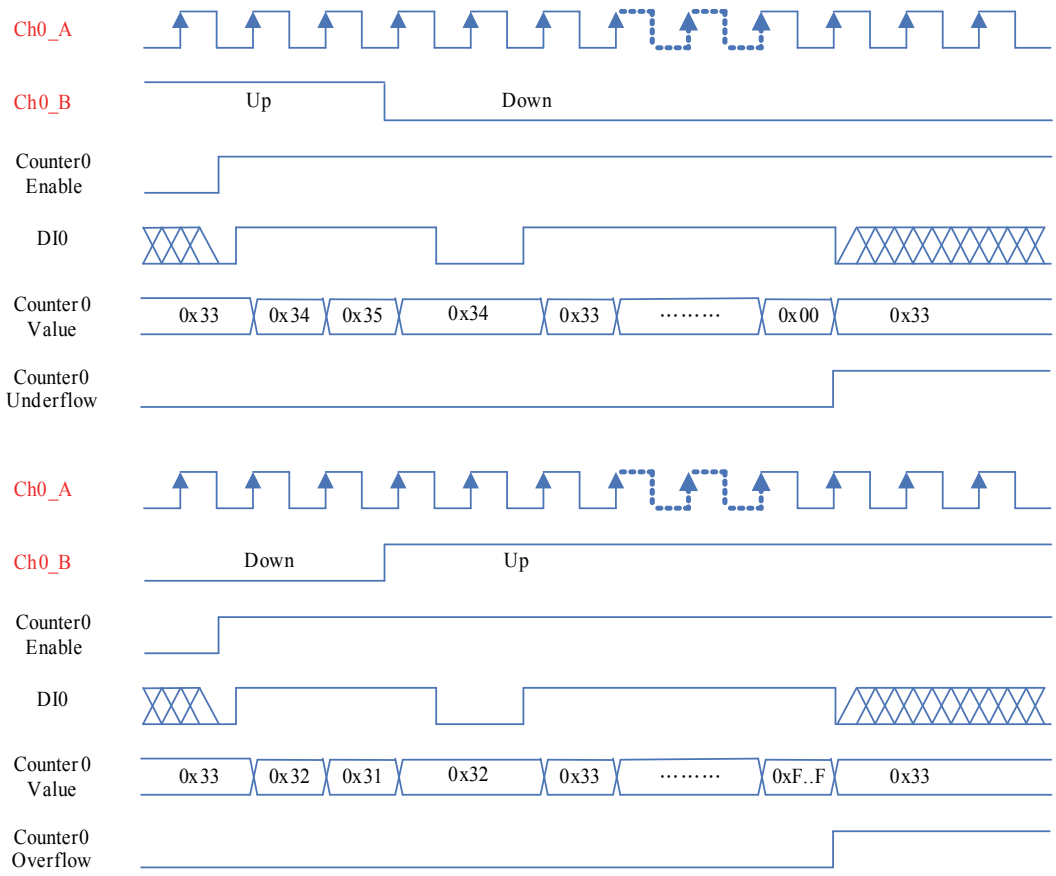


Figure 3.40 Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, High level, Not Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, High level, Retriggerable

Figure 3.27 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively. If the DI0 value is high level, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

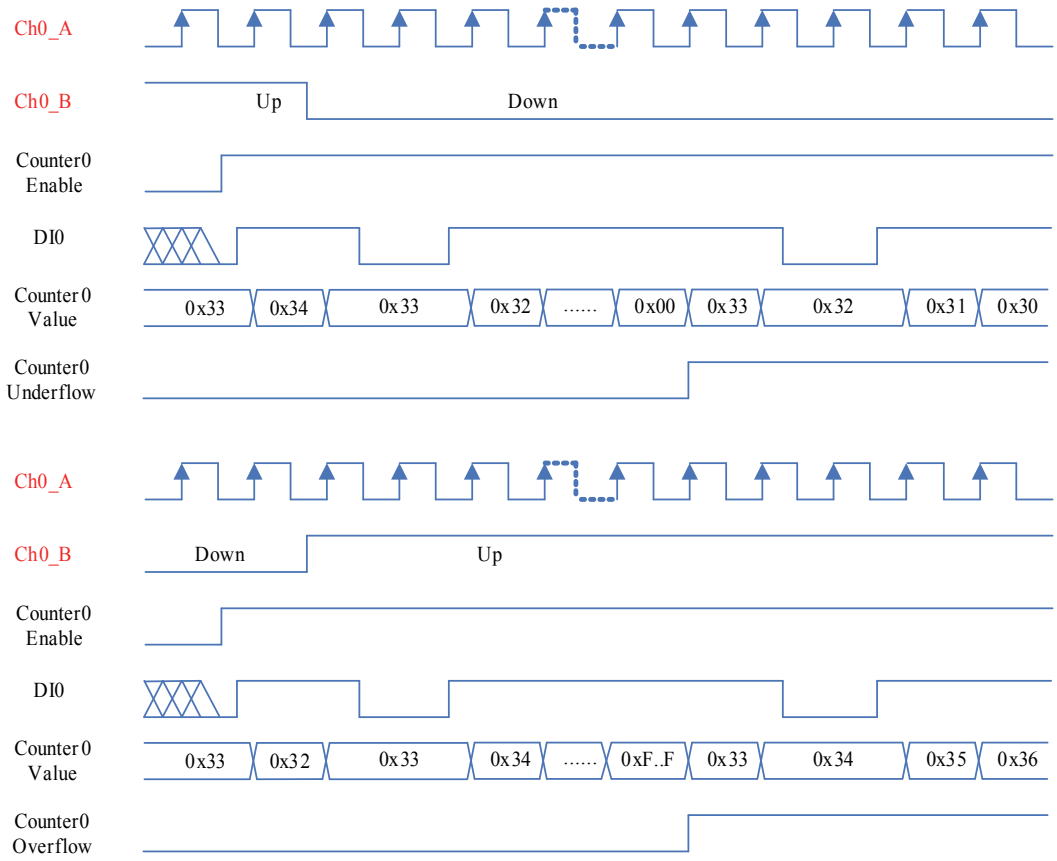


Figure 3.41 Pulse/DIR, With Reload , Count Repetitively, DI Gate Enable, High level, Retriggerable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Low level, Not Retriggerable

Figure 3.28 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 value is low level, the counter0 will starts to count but cannot retriggered. Otherwise, the counter0 will stop counting.

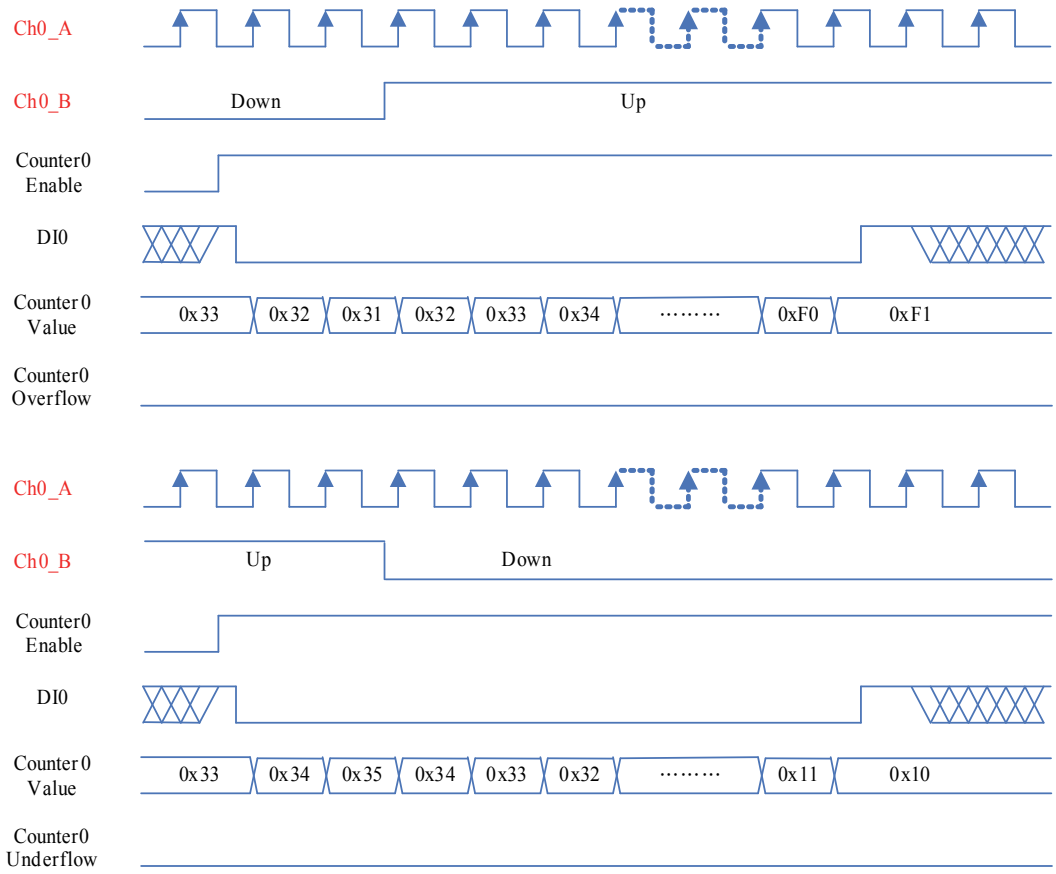


Figure 3.42 Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Low level, Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Low level, Not Retriggerable

Figure 3.29 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, t will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 value is low level, the counter0 will start to count but cannot be retriggered. Otherwise, the counter0 will stop counting.

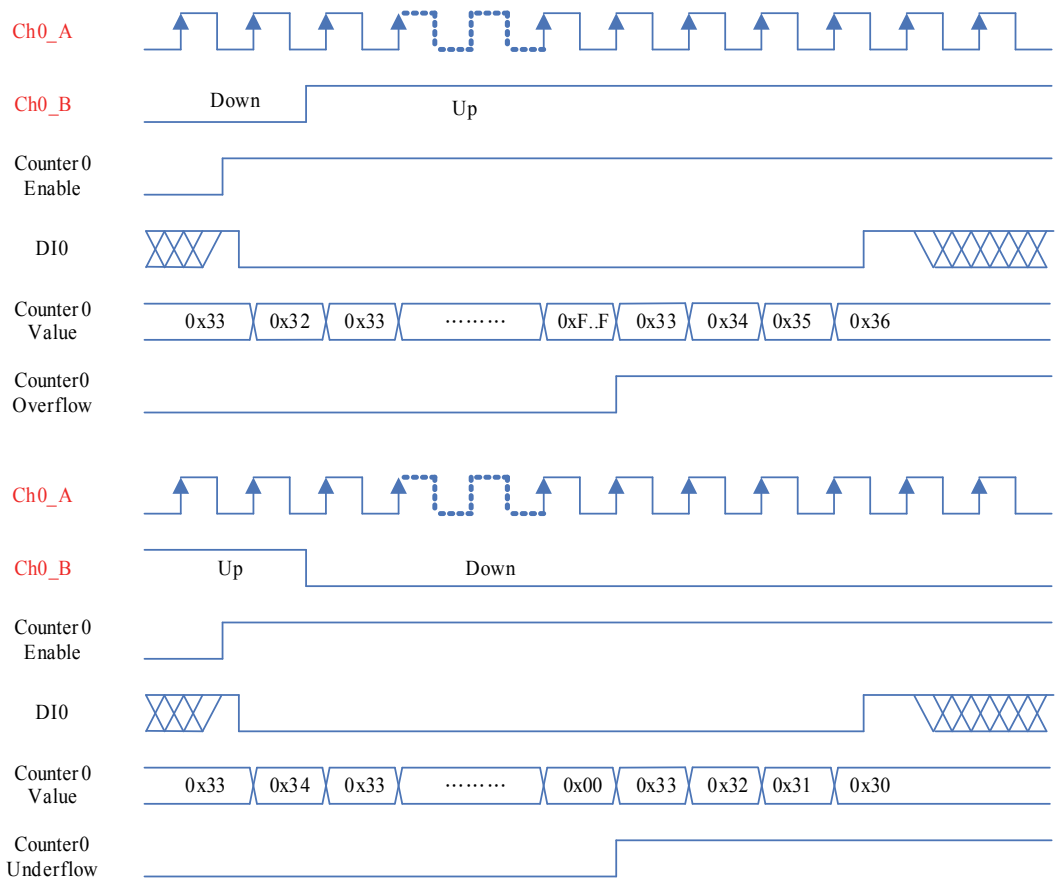


Figure 3.43 Pulse/DIR , With Reload , Count Repetitively, DI Gate Enable, Low level, Not Retriggerable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Low level, Retriggerable

Figure 3.29 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively. If the DI0 value is low level, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

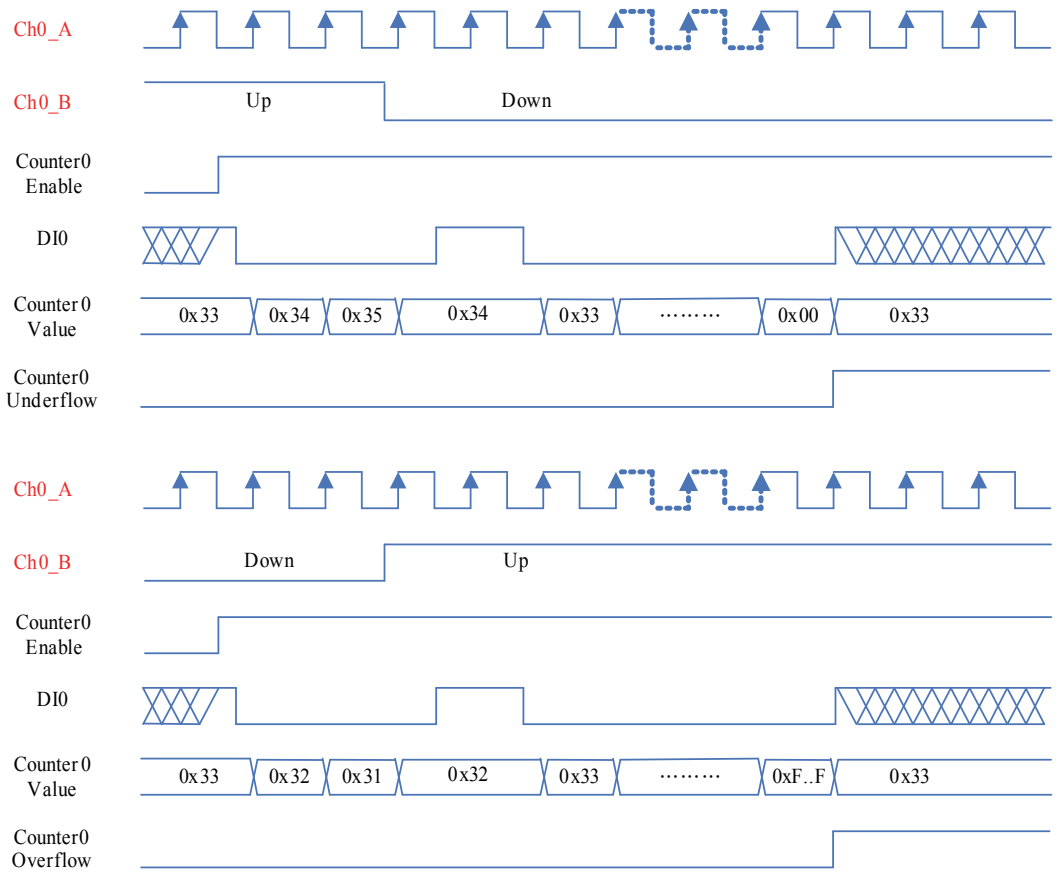


Figure 3.44 Pulse/DIR, With Reload, Count Once, DI Gate Enable, Low level, Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Low level, Retriggerable

Figure 3.30 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively. If the DI0 value is low level, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

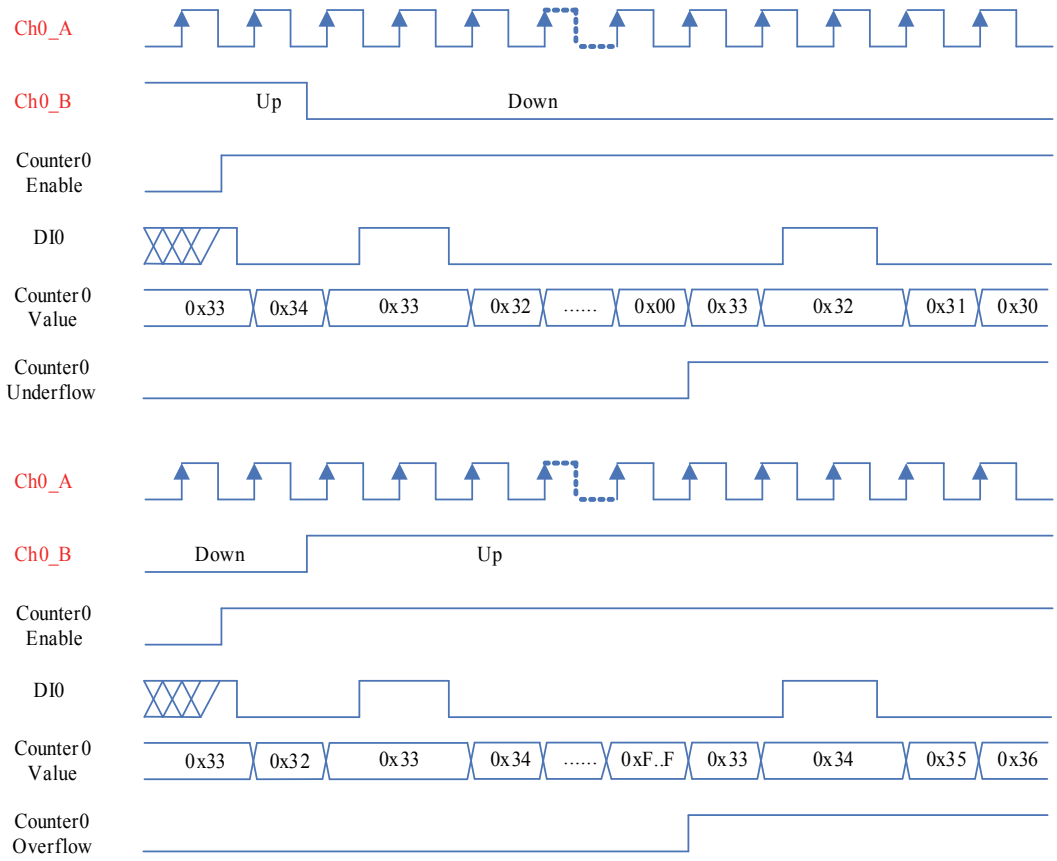


Figure 3.45 Pulse/DIR , With Reload , Count Repetitively, DI Gate Enable, Low level, Retriggerable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Rising Edge, Not Retriggerable

Figure 3.31 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 status is rising edge, the counter0 will starts to count but cannot retriggered. Otherwise, the counter0 will stop counting.

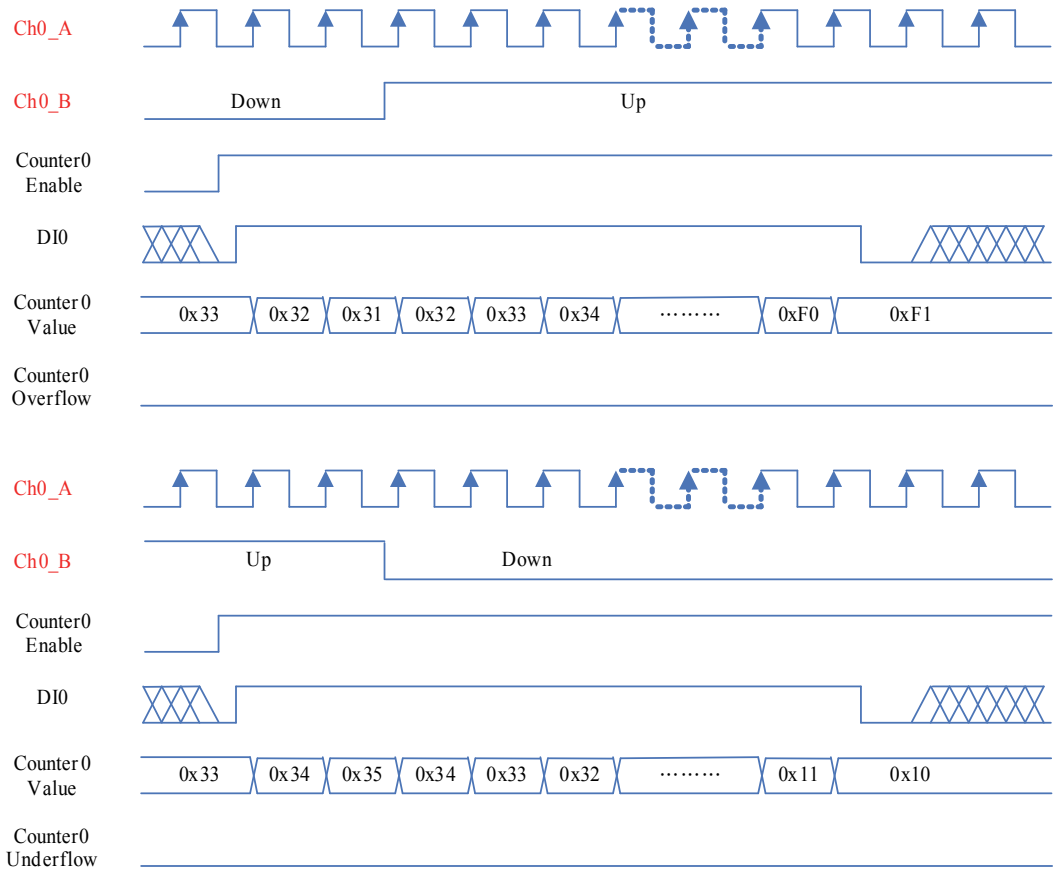


Figure 3.46 Pulse/DIR, With Reload, Count Once, DI Gate Enable, Rising Edge, Not Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Rising Edge, Not Retriggerable

Figure 3.32 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, t will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 status is rising edge, the counter0 will start to count but cannot be retriggered. Otherwise, the counter0 will stop counting.

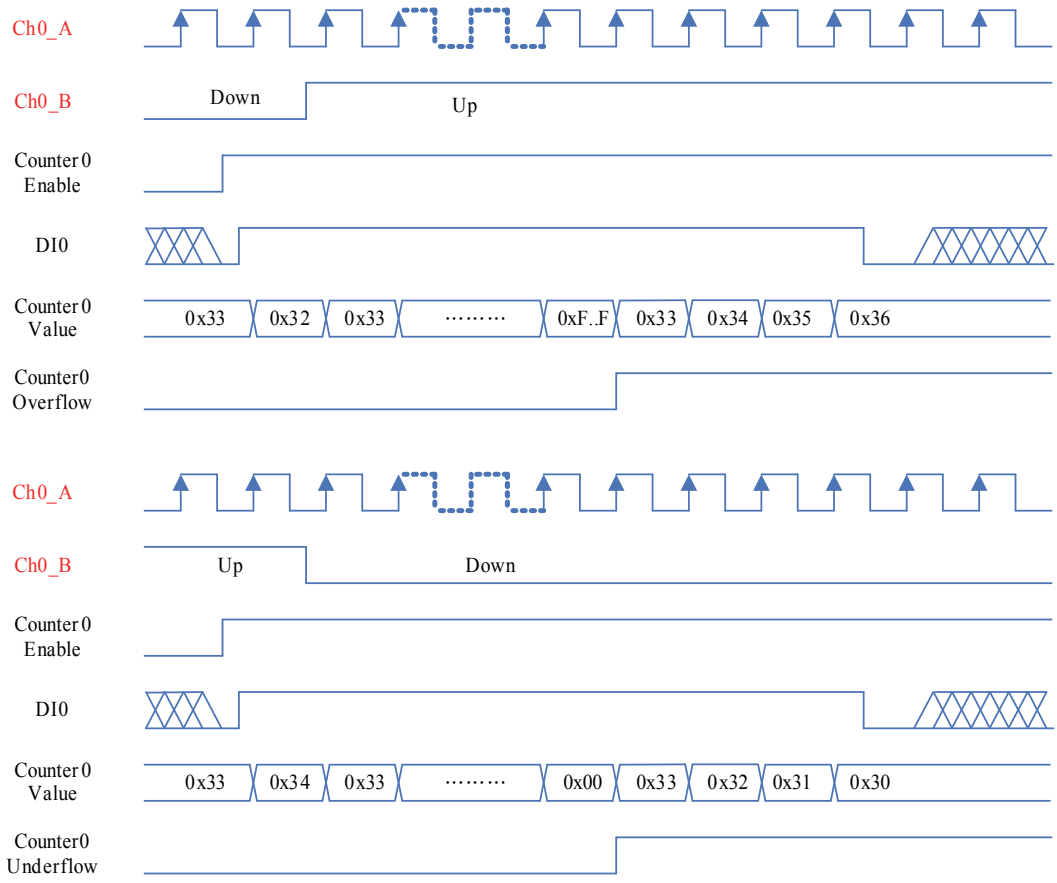


Figure 3.47 Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Rising Edge, Not Retriggerable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Rising Edge, Retriggerable

Figure 3.33 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively. If the DI0 status is rising edge, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

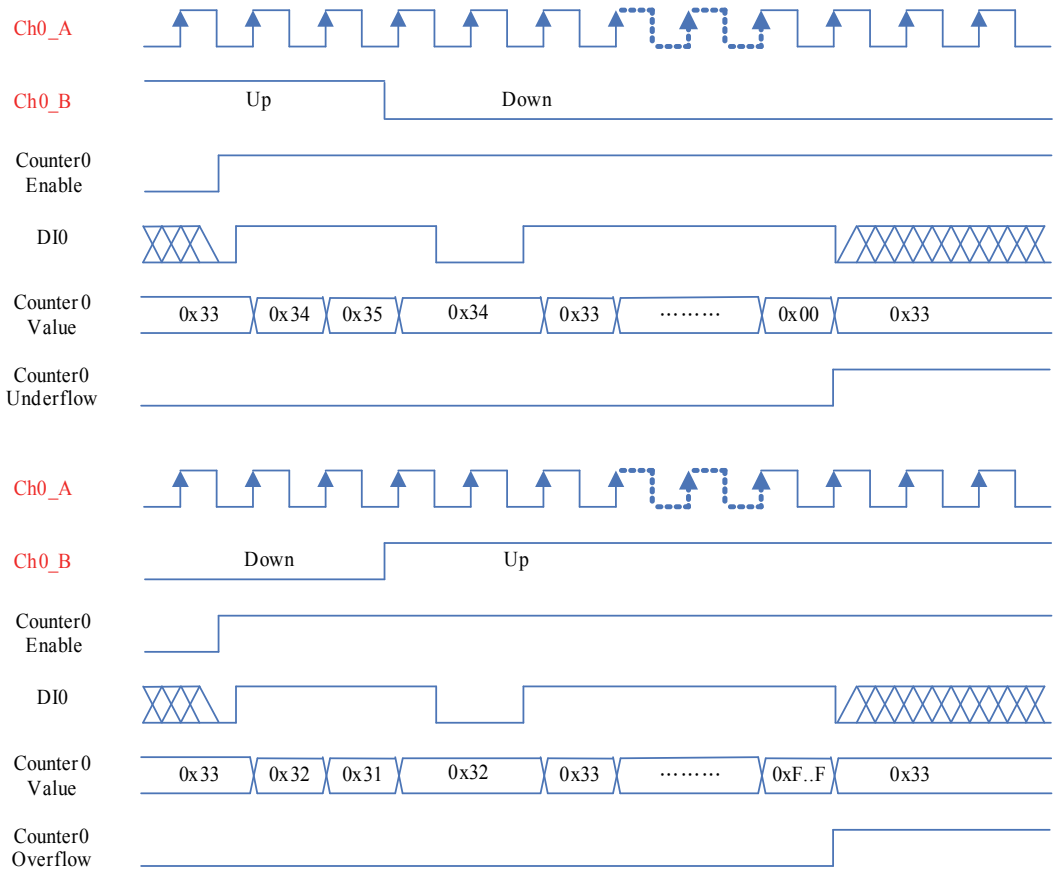


Figure 3.48 Pulse/DIR , With Reload , Count Once, DI Gate Enable, Rising Edge, Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Rising Edge, Retriggerable

Figure 3.34 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively. If the DI0 status is rising edge, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

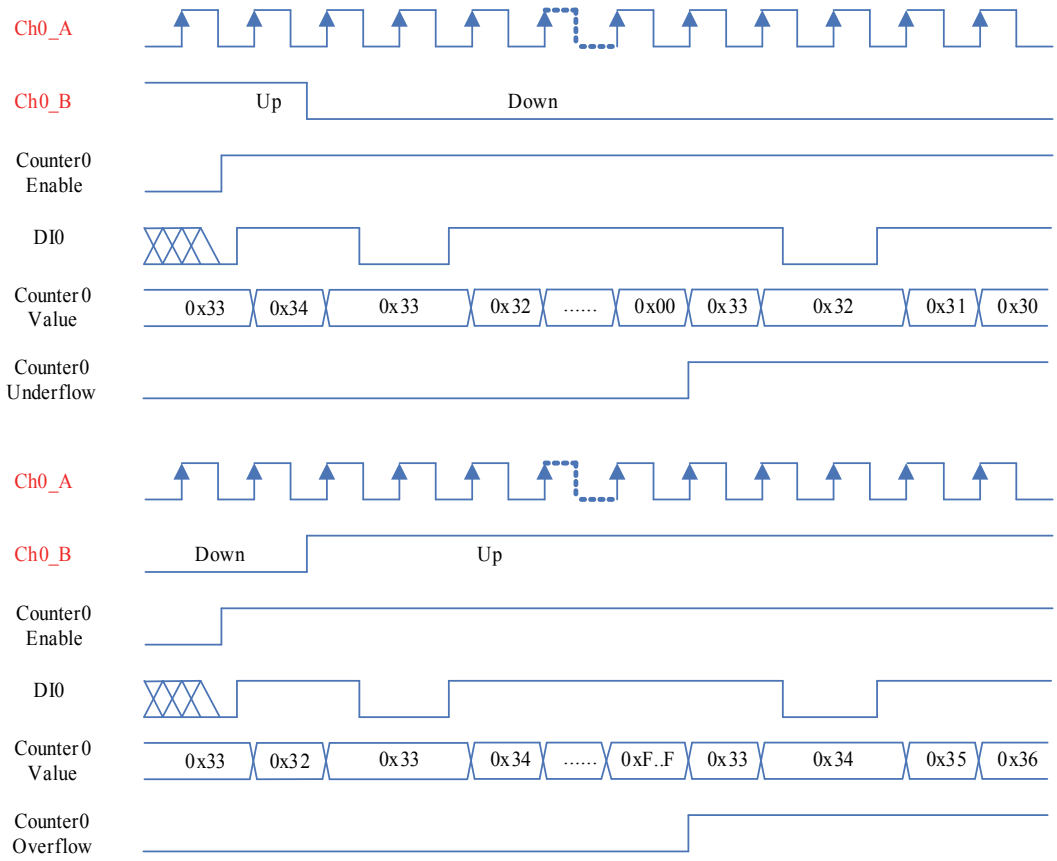


Figure 3.49 Pulse/DIR , With Reload , Count Repetitively, DI Gate Enable, Rising Edge, Retriggerable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Falling Edge, Not Retriggerable

Figure 3.35 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 status is falling edge, the counter0 will starts to count but cannot retriggered. Otherwise, the counter0 will stop counting.

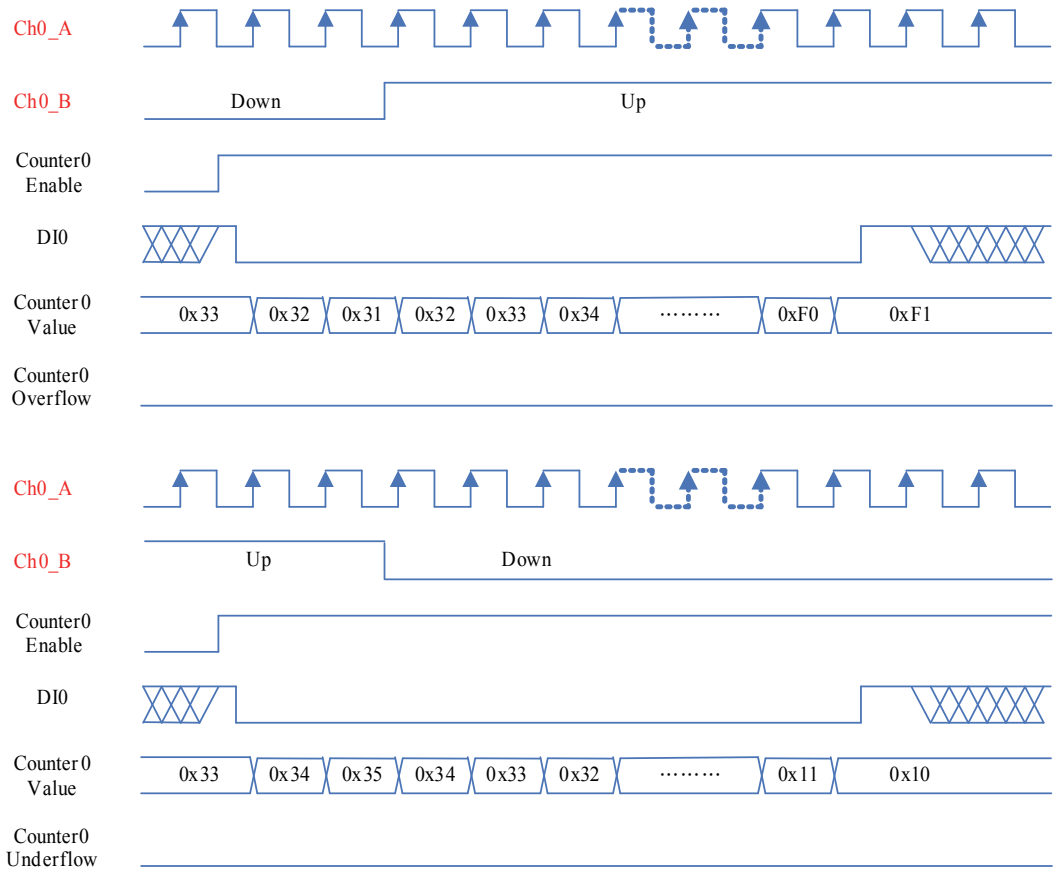


Figure 3.50 Pulse/DIR, With Reload, Count Once, DI Gate Enable, Falling Edge, Not Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Falling Edge, Not Retriggerable

Figure 3.36 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting. If the DI0 status is falling edge, the counter0 will start to count but cannot be retriggered. Otherwise, the counter0 will stop counting.

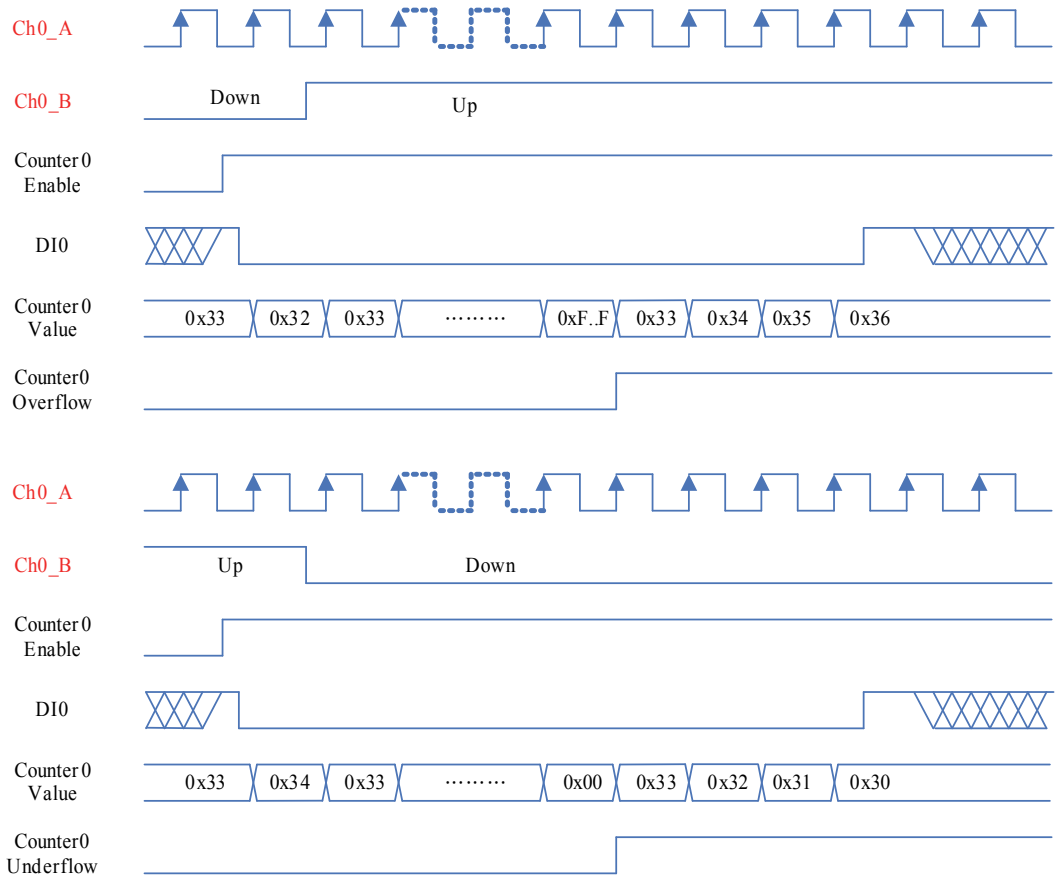


Figure 3.51 Pulse/DIR , With Reload , Count Repetitively, DI Gate Enable, Falling Edge, Not Retriggerable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Falling Edge, Retriggerable

Figure 3.37 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively. If the DI0 status is falling edge, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

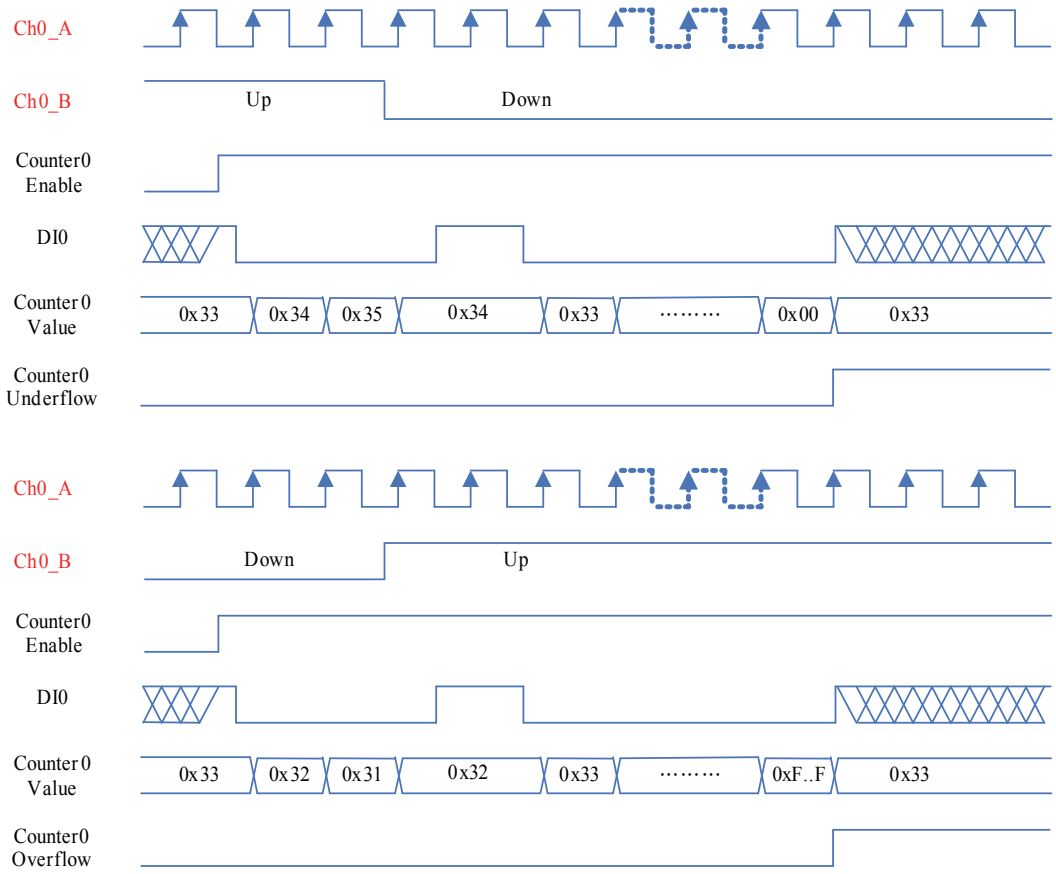


Figure 3.52 Pulse/DIR, With Reload, Count Once, DI Gate Enable, Falling Edge, Retriggerable

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Falling Edge, Retriggerable

Figure 3.38 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting repetitively. If the DI0 status is falling edge, the counter0 will starts to count and can be retriggered. Otherwise, the counter0 will stop counting.

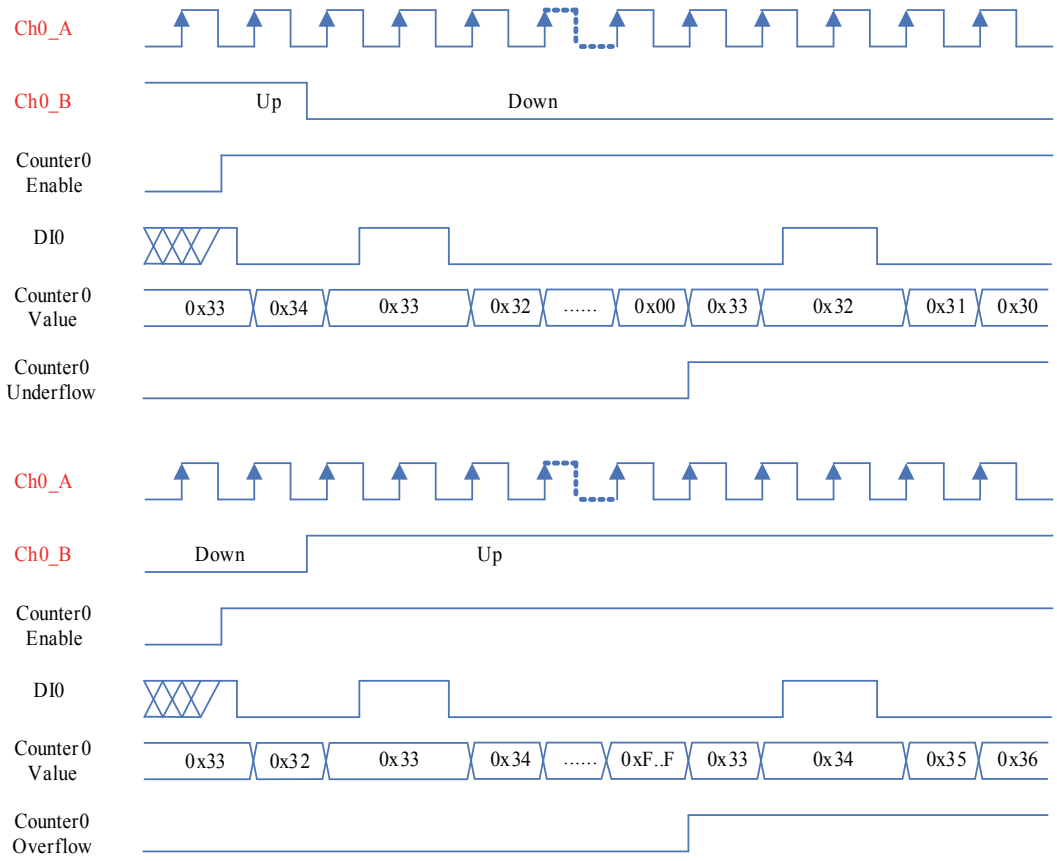


Figure 3.53 Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Falling Edge, Retriggerable

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Rising Edge Start

Figure 3.39 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 status is rising edge, the counter0 will starts to count and won't be retriggered.

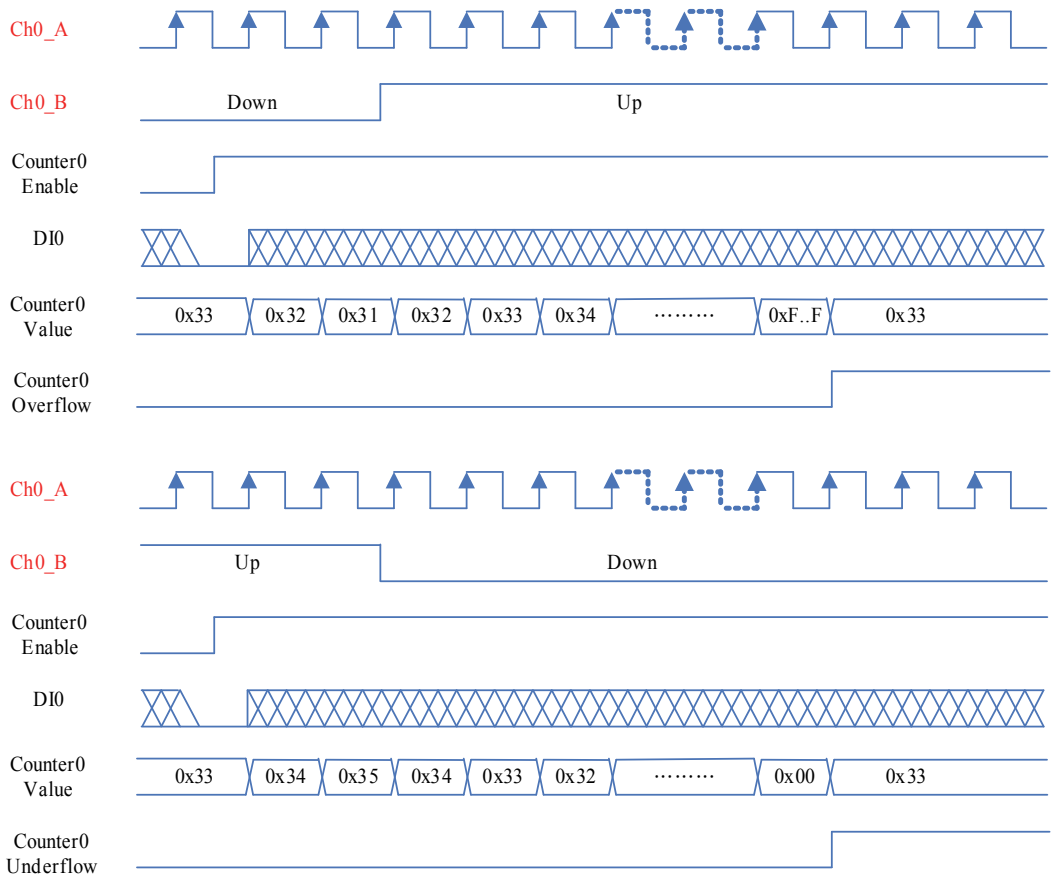
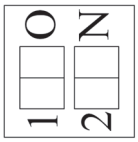


Figure 3.54 Pulse/DIR, With Reload, Count Once, DI Gate Enable, Rising Edge Start

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Rising Edge Start

Figure 3.40 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the 

s enabled, the couner0 starts to count. If the counter value is overflow c it will reset to the defined value (e.g. 0x33) and keep counting. If the DI0 ing edge, the counter0 will starts to count and won't be retriggered.

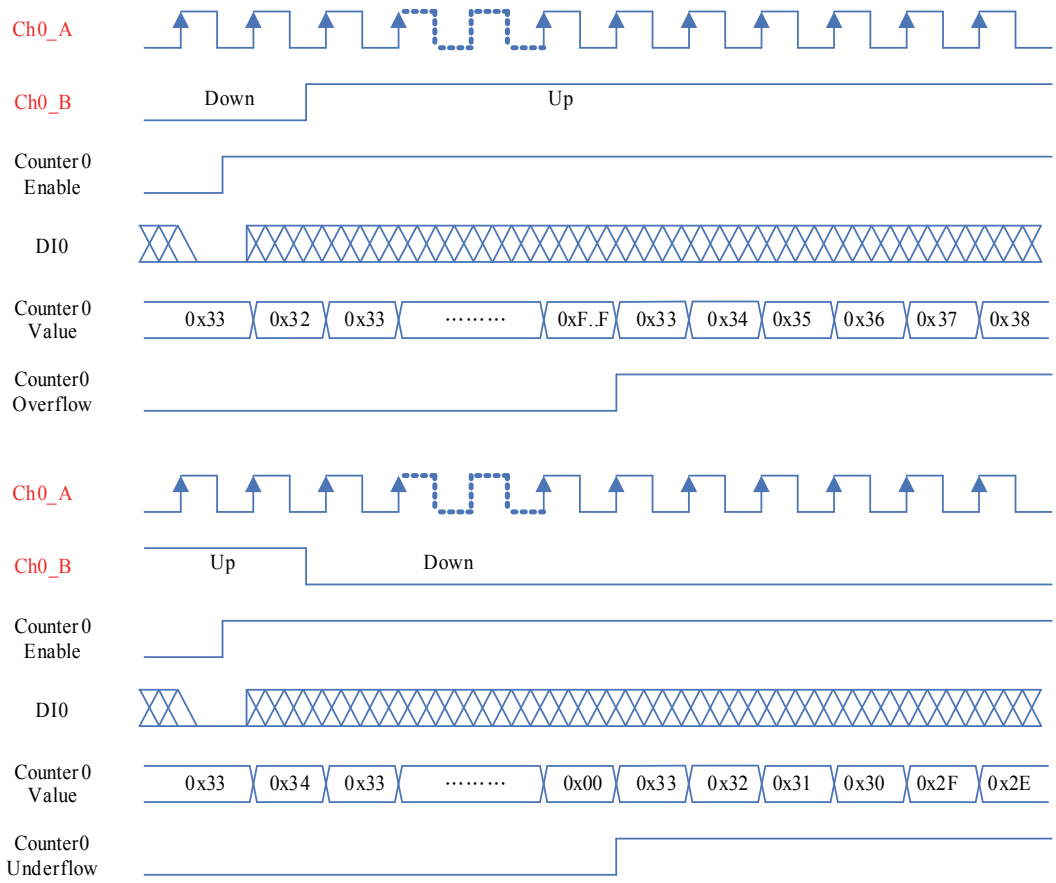


Figure 3.55 Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Rising Edge Start

Pulse/DIR, With Reload, Count Once, DI Gate Enable, Falling Edge Start

Figure 3.41 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) but won't keep counting. If the DI0 status is falling edge, the counter0 will starts to count and won't be retriggered.

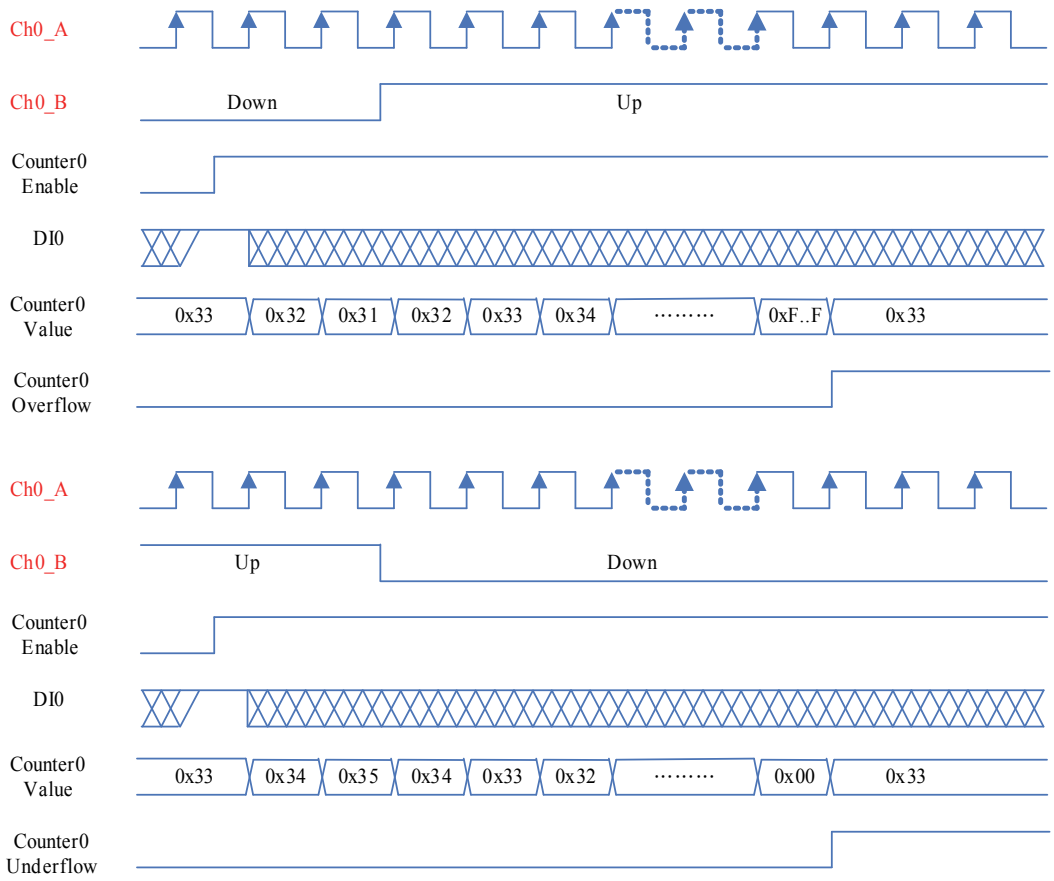


Figure 3.56 Pulse/DIR, With Reload, Count Once, DI Gate Enable, Falling Edge Start

Pulse/DIR, With Reload, Count Repetitively, DI Gate Enable, Rising Edge Start

Figure 3.42 shows pulse/direction mode, Ch0_A provides the counting function, one pulse, one count. Ch0_B provides the clockwise and counter clockwise function. When the counter0 is enabled, the couner0 starts to count. If the counter value is overflow or underflow, it will reset to the defined value (e.g. 0x33) and keep counting. If the DI0 status is rising edge, the counter0 will starts to count and won't be retriggered.

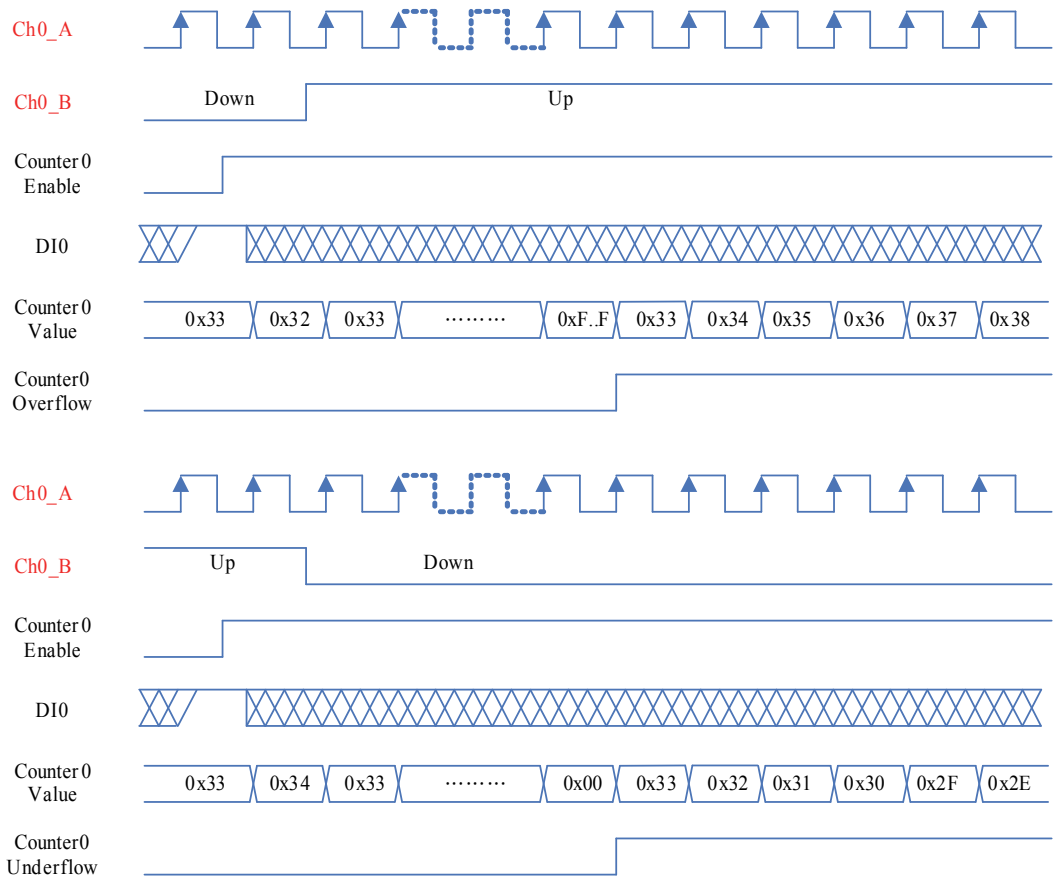


Figure 3.57 Pulse/DIR , With Reload, Count Repetitively, DI Gate Enable, Rising Edge Start

DO Alarm Function No Gate

- **High Pulse:** the DO original status will be low and when the counter value counts to defined alarm value, the DO status will change low to high.
- **Low Pulse:** the DO original status will be high and when the counter value counts to defined alarm value, the DO status will change high to low.
- **No Auto Reload:** When the counter is overflow or underflow, the value will be reset to the initial value but not count again.
- **Auto Reload:** When the counter is overflow or underflow, the value will be reset to the initial value and count again.
- **High Alarm:** when the counter value is greater than the assigned counter alarm value, the DO will be active.
- **Low Alarm:** When the counter value is less than the assigned counter alarm value, the DO will be active.

Because the DI gate is disabled, whatever the DI value is, the counter still continuously counts. When the counter0 value is overflow, the value will be reset to the initial value like 0x33. Count once means if the counter0 is overflow, it won't count again.

Chapter 4

Interface Module

4.1 APAX-5490 4-port RS-232/422/485 Communication Module

The APAX-5490 is equipped with four RS232/422/485 ports, which can issue commands to control other devices. It is fully integrated with the APAX-5580 series and transmits data to through the COM port. The integrated system is an intelligent standalone system and can connect and issue commands to control devices such as printers and PLCs in remote factory location.

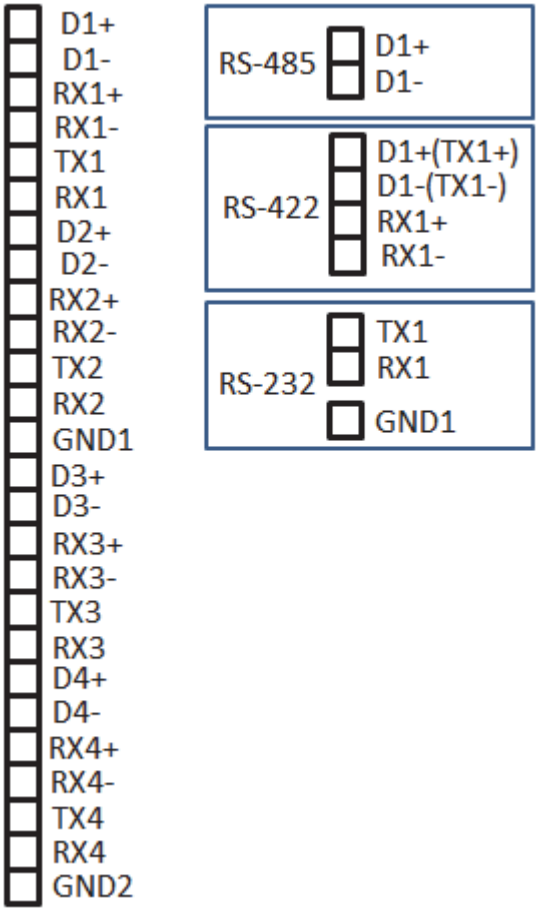


Figure 4.1 APAX-5490 Module Front View and connection example

APAX-5490 Specifications

Communications

- Channels
  COM1, COM2: RS-232/422/485 (Isolated)
  COM3, COM4: RS-232/422/485 (Isolated)
- **Data bits**: 5, 6, 7, 8
- **Stop bits**: 1, 1.5, 2
- **Parity**: none, even, odd
- **Communication Controller**: EXAR XR17V354
- **Communication Speed (bps)**: 50 ~ 230.4kbps
- **Data Signals**:
  RS-232: TxD, RxD, GND
  RS-422: TxD+, RxD+, TxD-, RxD-
  RS-485: Data+, Data-
- **Isolation**: 2500 V_{DC}
- **Connector**: PLUG_26_3.81mm

Environment

- **Operating Temperature**: 0 ~ 60°C (when mounted vertically)
- **Relative Humidity**: 5 ~ 95%
- **Storage Temperature**: -40 ~ 70°C (non-condensing)

Configuration Settings

SW4:COM1, SW5:COM2, SW6:COM3, SW7:COM4

SW4~7	Status	Function
PIN1	ON	Force Disable RS-232 RxD
	OFF	Enable RS-232 RxD (default)
PIN2	ON	Force Disable RS-485 RxD
	OFF	Enable RS-485 RxD (default)
PIN3	ON	Terminal Resistor: 120ohm (RS-422 TxD/RS-485)
	OFF	Disable (default)
PIN4	ON	Terminal Resistor: 120ohm(RS-422 RxD)
	OFF	Disable (default)

SW3	Status	Function
PIN1 (COM1)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)
PIN2 (COM2)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)
PIN3 (COM3)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)
PIN4 (COM4)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)

4.2 APAX-5435 APAX iDoor Expansion module

The APAX-5435 is equipped with one mini PCI express, which can support Advantech iDoor module to expand 5580 interface, including filedbus and wireless communication. It is fully integrated with the APAX-5580 series. The integrated system is an intelligent standalone system and can connect and issue commands to control devices such as printers and PLCs in remote factory location.

Specifications

Module Interface

- Mini PCIEPCIE 2.0
- mSATA
- Supports SATA GENI/GENII/GENIII

Environment

- Operating Temperature: -10 ~ 60°C (when mounted vertically)
- Relative Humidity: 5 ~ 95%
- Storage Temperature: -40 ~ 85°C (non-condensing)

Supported iDoor Modules

PCM-26D2CA	SJA1000 CANBUS, CANOpen, DB9
PCM-26D1DB	1-Port Hilscher netX100 FieldBus mPCIe, ProfiBus, DB9
PCM-26R2PN	2-Port Hilscher netX100 FieldBus mPCIe, PROFINET, RJ45
PCM-26R2EC	2-Port Hilscher netX100 FieldBus mPCIe, EtherCAT, RJ45
PCM-26R2EI	2-Port Hilscher netX100 FieldBus mPCIe, EtherNet/IP, RJ45
PCM-24S2WF	Wi-Fi 802.11 a/b/g/n 2T2R w/ Bluetooth4.0, Half-size mPCIe, 2-port SMA
PCM-24S33G	Wide-Temp 3.75G HSPA and GPS, 2-in-1, Full-size mPCIe w/ dual SIM Card holder, Antenna, cable
PCM-24R2GL	2-port GbE BaseT(X) 10/100/1000 Mbps, mPCIe Card
PCM-24R2PE	GbE, IEEE 802.3af (PoE) Compliant, mPCIe, RJ45 x2
PCM-24R1TP	Intel® 82574L, GbE, RJ45 x 1
PCM-23U1DG	USB Slot w/ Lock for USB Dongle, Half-size mPCIe
PCM-2300MR	MRAM, 2 MByte

Note! Make sure the system is powered off when you want to setup the APAX-5435 with APAX-5580. The APAX-5435 doesn't support hot swap.

Configuration Settings

SW2

		mPCIe Mode(default)	SATA Mode
SW2	PIN1	ON	ON
	PIN2	ON	OFF

4.3 APAX-5090 4-port RS-232/422/485 Communication Module

The APAX-5090 is equipped with four RS232/422/485 ports, which can issue commands to control other devices. It is fully integrated with the APAX-5580 series and transmits data to through the COM port. APAX-5090 communicate with APAX-5580 by APAX local bus, means it can support distributed topology by APAX bus.

APAX-5090 Specifications

Communications

- **Interface**
  COM 1, COM 2: RS-232/422/485*
  COM 3, COM 4: RS-232/422/485*
  * Change Mode with the switch
- **Data Bits:** 8
- **Stop Bits:** 1, 1.5, 2
- **Parity**: None
- **Baud Rate:** 600bps~115.2 kbps
- **Data Signals**:
  RS-232: TxD, RxD, GND
  RS-422: TxD+, RxD+, TxD-, RxD
  RS-485: Data+, Data-
- **FIFO**: 256 bytes
- **Operation Mode:** Virtual COM
- **Maximum Support**: Up to 8 pcs with one controller

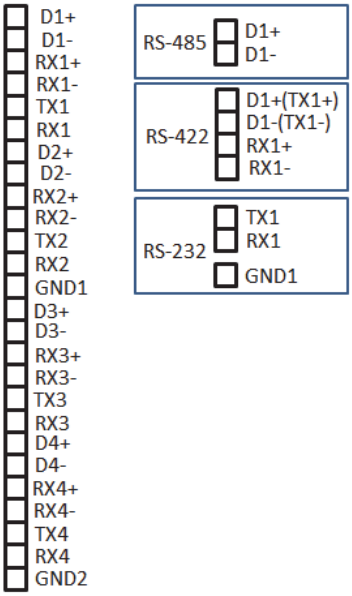
Protection

- **ESD Protection:**15 kV
- **EFT Protection**: 2,500 VDC
- **Isolation Protection**:2500 VDC (between COM port and backplane)

Note! The APAX-5090 doesn't support hot swap.

The APAX-5090 have to be used with APAX-5402L-E2A2AE

Pin assignment



Configuration Settings

SW4:COM1, SW5:COM2, SW6:COM3, SW7:COM4

SW4~7	Status	Function
PIN1	ON	Force Disable RS-232 RxD
	OFF	Enable RS-232 RxD (default)
PIN2	ON	Force Disable RS-485 RxD
	OFF	Enable RS-485 RxD (default)
PIN3	ON	Terminal Resistor: 120ohm (RS-422 TxD/RS-485)
	OFF	Disable (default)
PIN4	ON	Terminal Resistor: 120ohm(RS-422 RxD)
	OFF	Disable (default)

SW8	Status	Function
PIN1 (COM1)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)
PIN2 (COM2)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)
PIN3 (COM3)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)
PIN4 (COM4)	ON	RS-422 Master
	OFF	RS-422 Slave/RS-485 (default)

4.4 APAX-5430 SATA Interface Module

APAX-5430 is a SATA interface module providing SATA SSD installation to an APAX system. User can install one 2.5" HDD/SSD on the APAX-5430 module and then attach to the APAX-5580 system. Two APAX-5430 modules can be installed on one system and function as RAID 0/1 through the configuration in BIOS.

Note! *APAX is a DIN-Rail Mounted system, do not recommend using HDD which is spindle component on these environment. Highly recommend using SSD which is without spindle component, which would help system gaining better reliability.*

4.4.1 Specification

4.4.1.1 Function

- **Interface:** SATA
- **RAID:** Supports RAID 0/1
- **Support SATA I/II/III 2.5" SSD**
- **Power control switch for safe swapping**

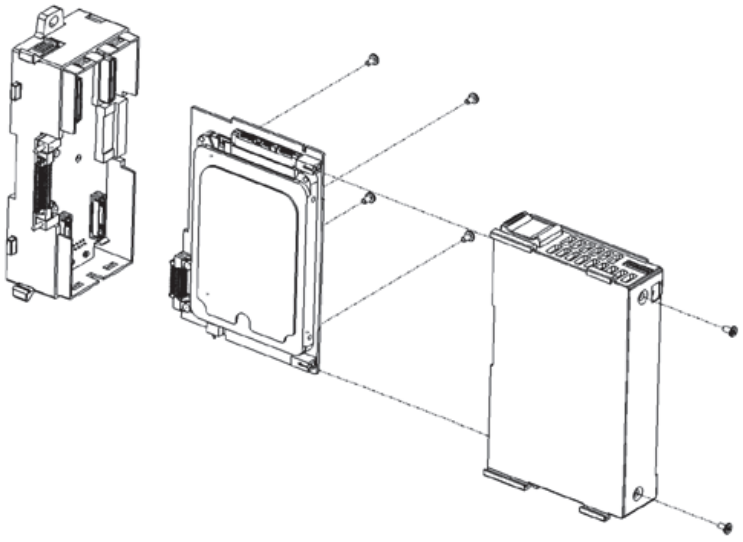
4.4.1.2 Environment

- **Operating Temperature:** -10 ~ 60°C (when mounted vertically)
- **Storage Temperature:** -40 ~ 70°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

4.4.2 Installation Process

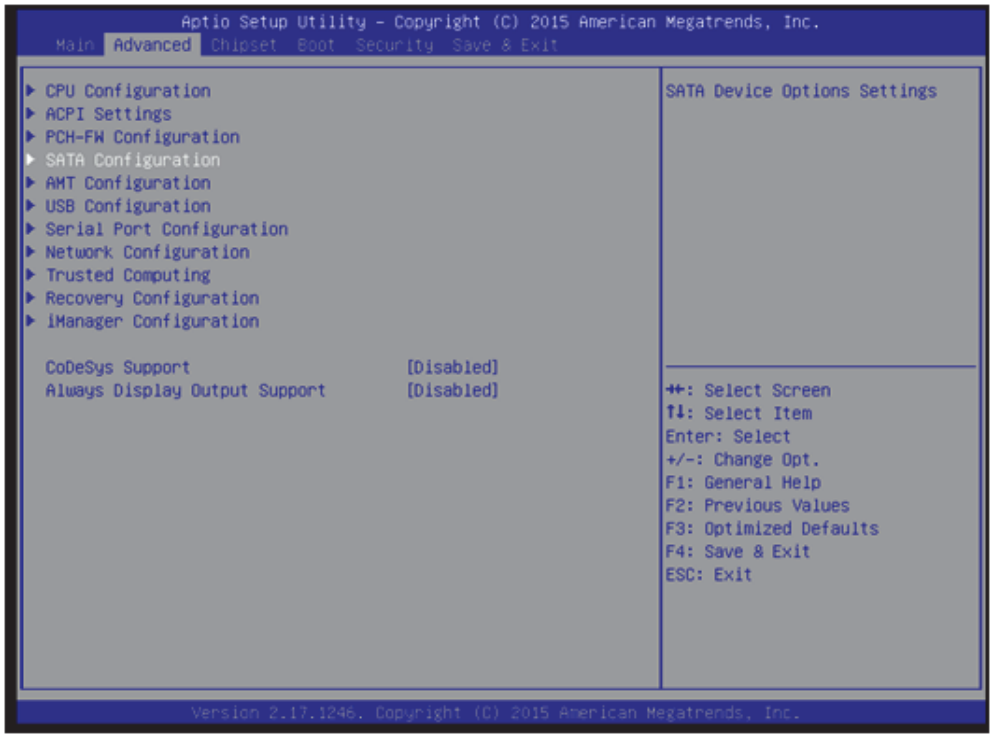
Please follow below steps for the SSD installation

1. Remove the screws on the front panel and release the lock on the upper and bottom side, and then remove the PCB out from the APAX IO case.
2. Plug the SATA SSD into the SATA connector and fix it with the 4x screws provided.
3. Insert the PCB into the case and fix it with 2 screws on the front panel.
4. Power off the system and plug the module into the APAX-5402 series backplane

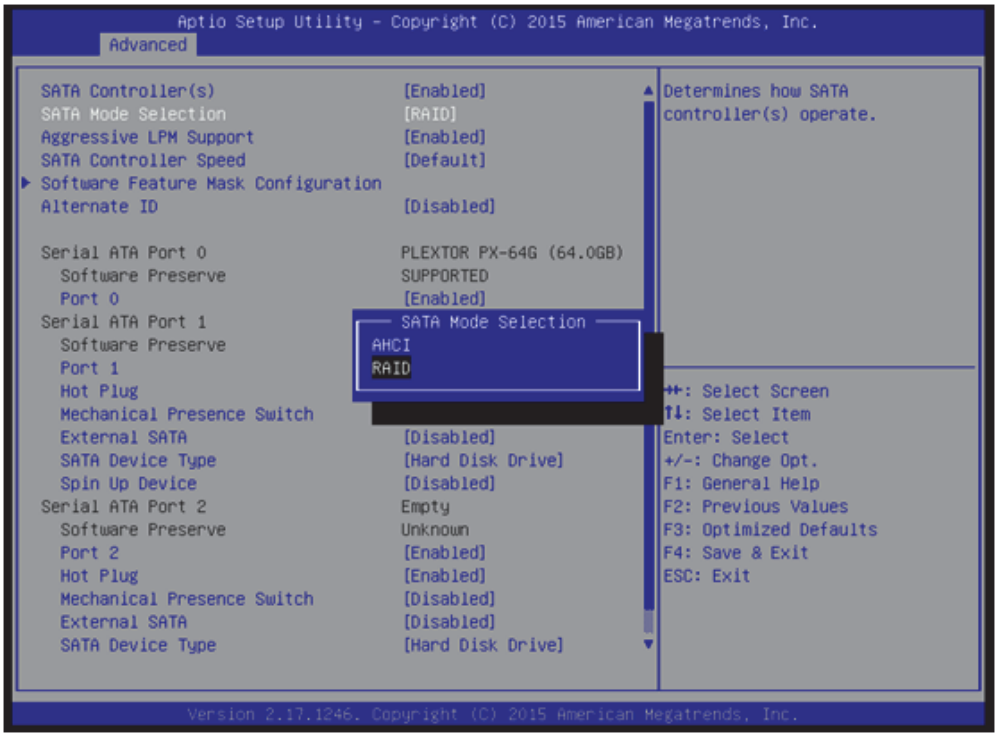


4.4.3 Setup RAID function in BIOS

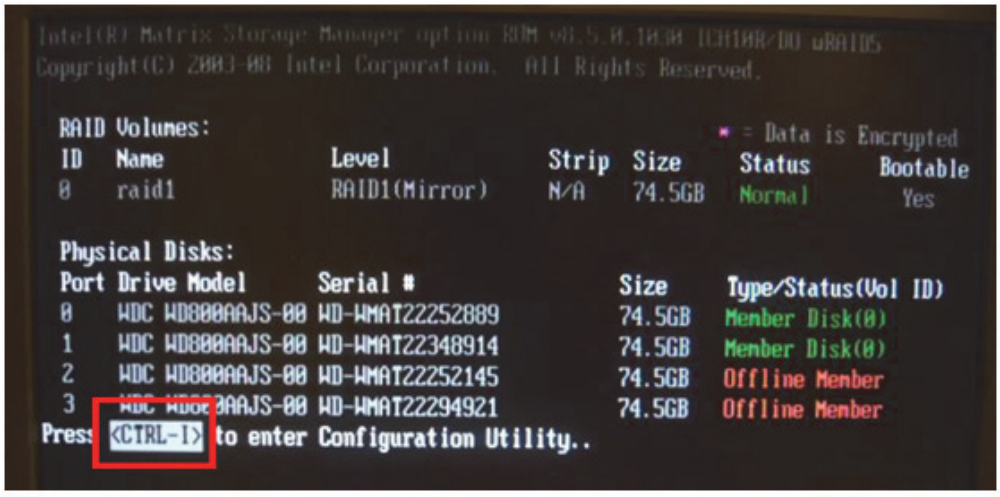
1. Enter the BIOS and choose the “Advanced” tab and select SATA Configuration



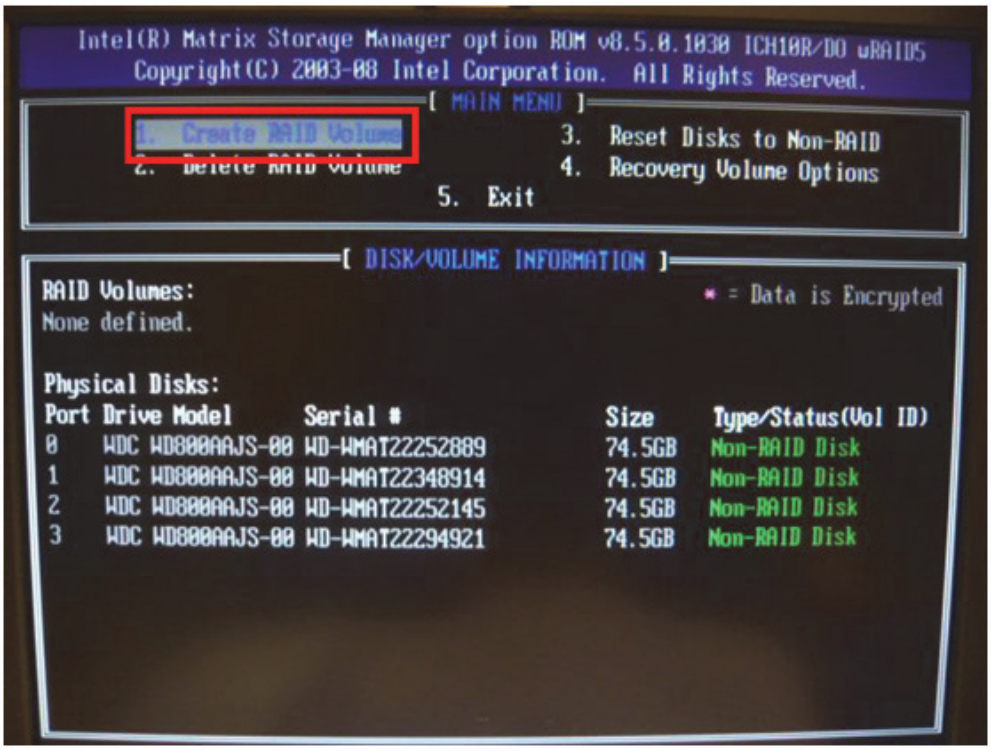
2. In the item SATA Mode Selection and select “RAID” to enable the Activate the RAID function



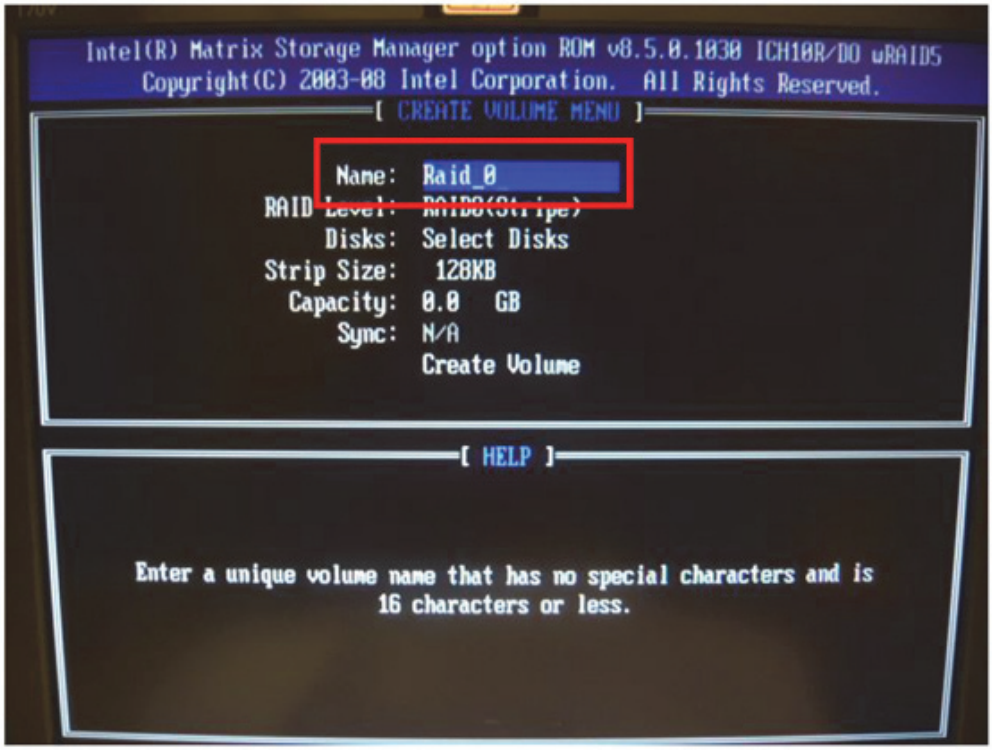
3. Reboot the system and enter the RAID option ROM by, pressing “Ctrl + I”



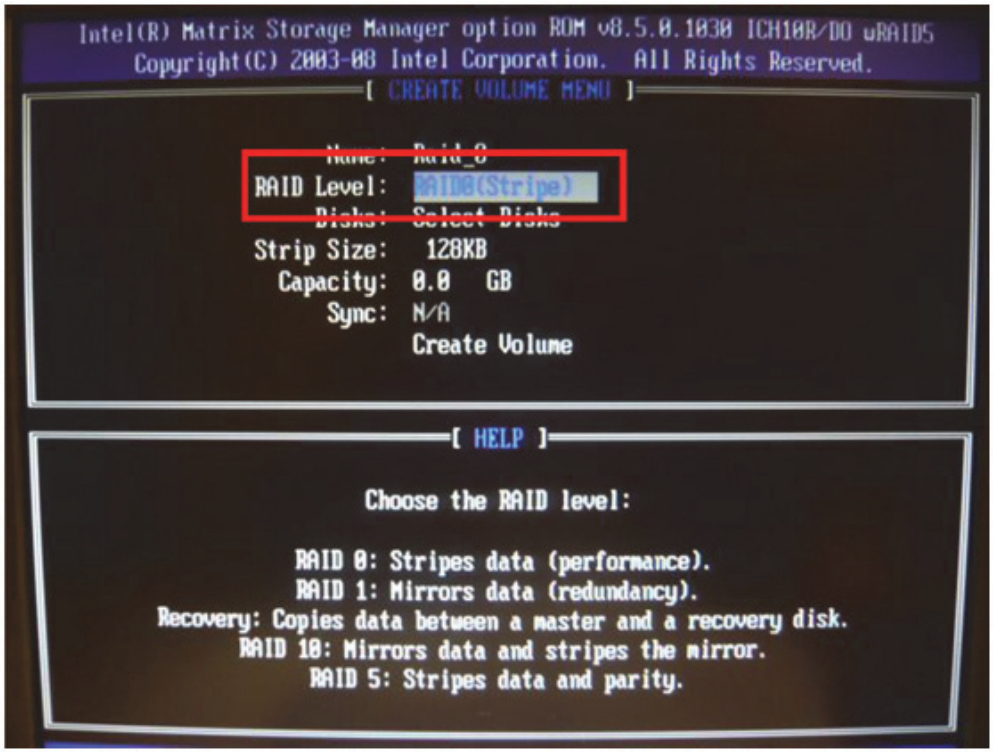
4. Select Create RAID Volume to create RAID mode



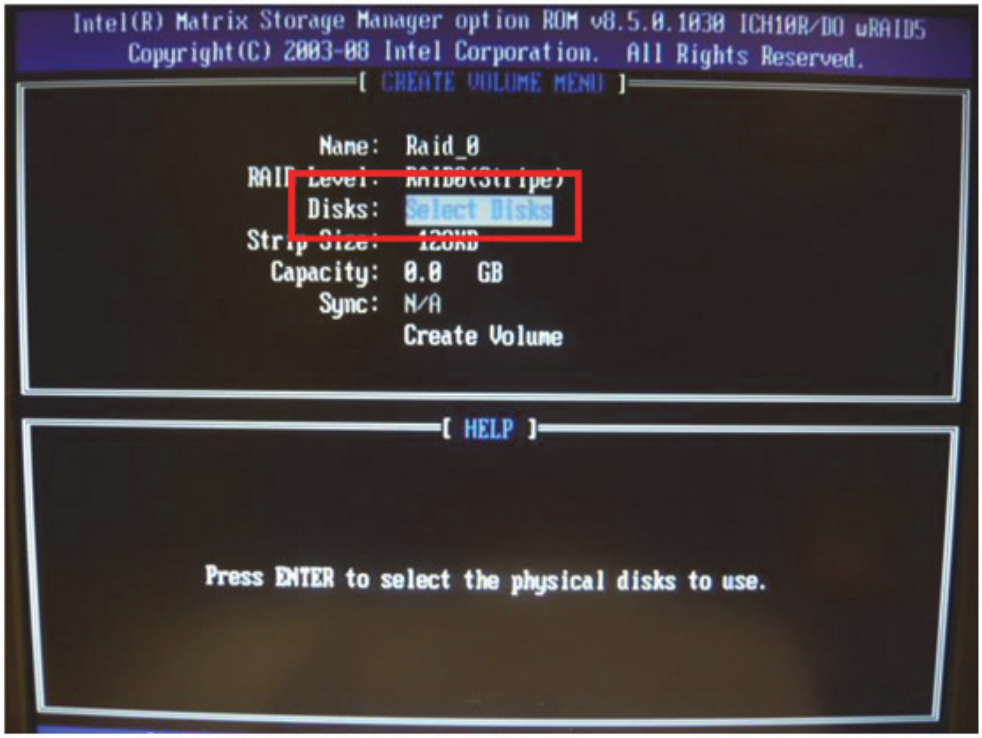
5. Enter a name

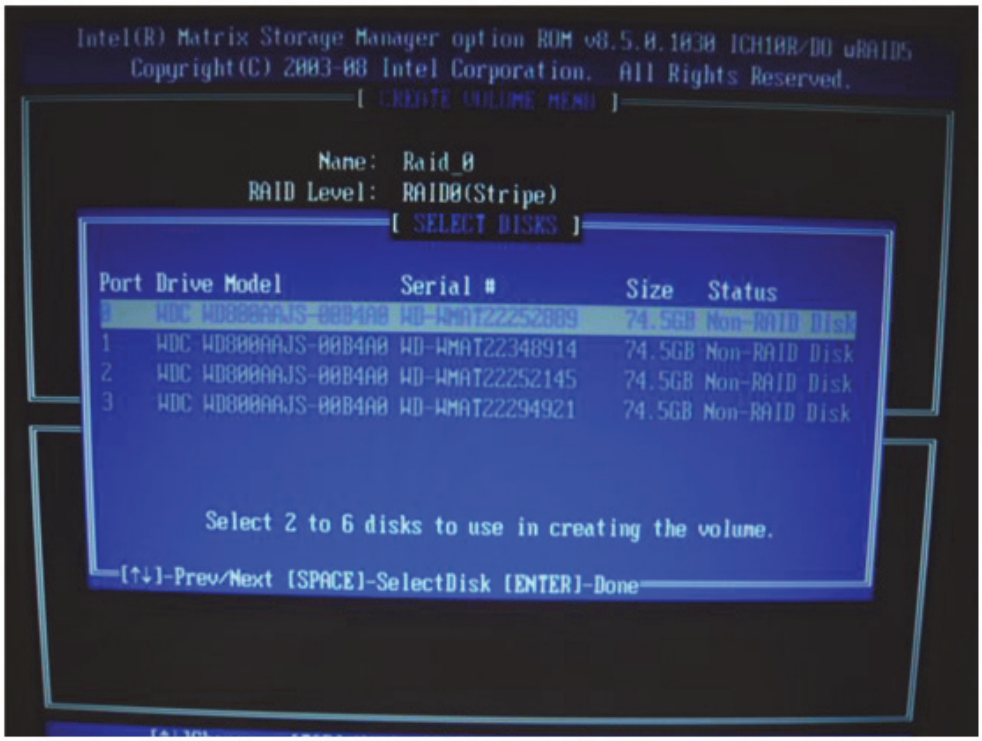


6. Select the RAID mode in the RAID Level.

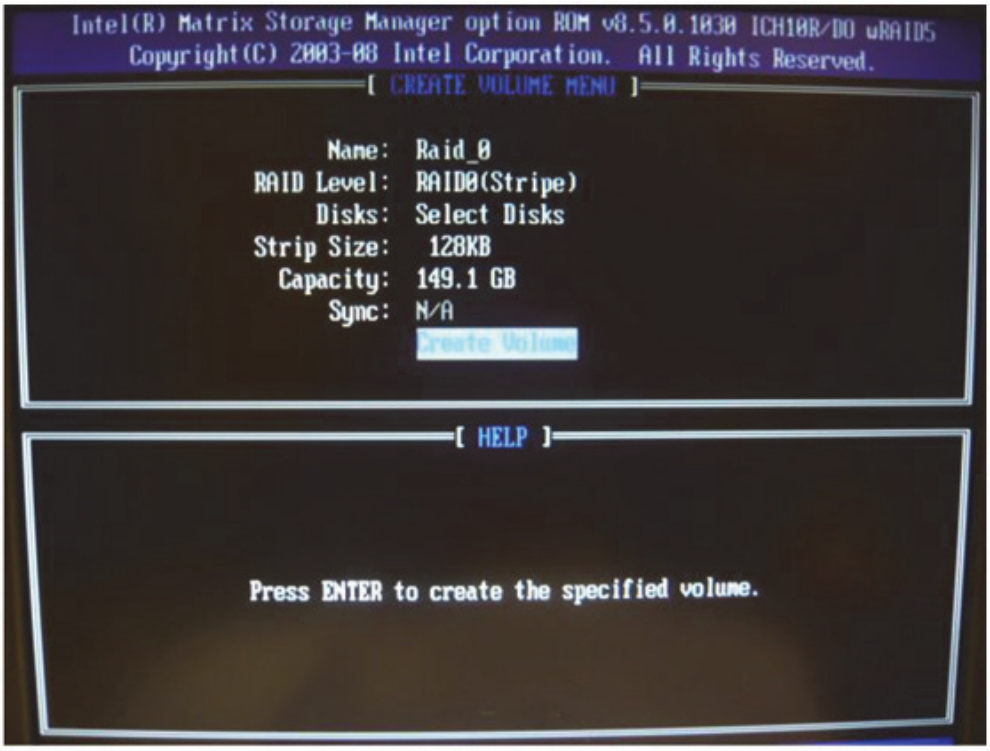


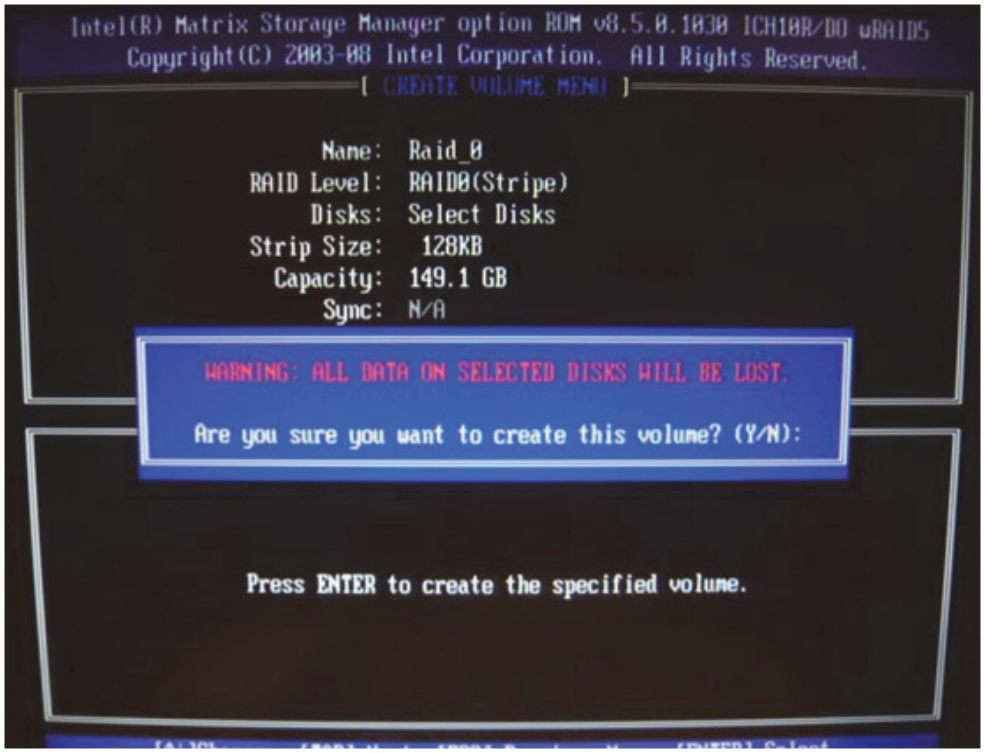
7. Select Disks



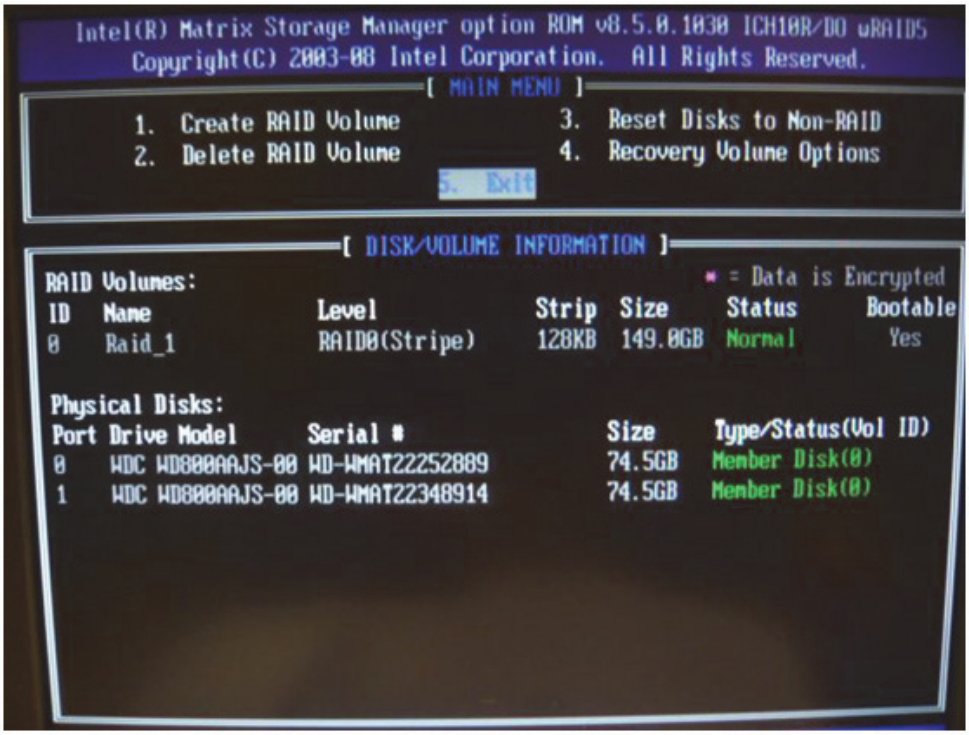


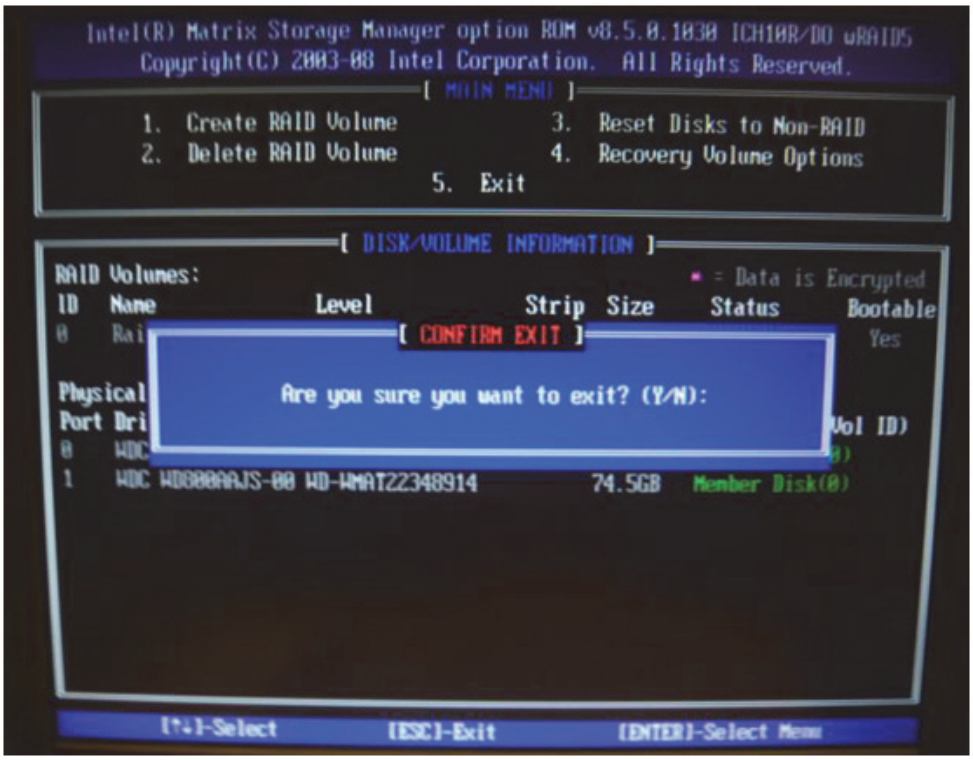
8. Finish the setting and Enter the “Create Volume”, And Y to create the volume.





9. Save and Exit





Chapter 5

Backplane Modules

5.1 APAX-5002/5002L 2-slot Backplane Module

APAX-5002/5002L is an interface between CPU module, coupler and I/O modules. Different APAX-5002/5002L can be stacked together. Power and data can be transferred to I/O modules inserted on the APAX-5002/5002L. You can use external power supply or APAX-5343E power supply module to give power to the backplanes and I/O modules.But only APAX-5002 equips the screw terminal for the external power supply wiring. Refer to Section 1.7.1 and 1.7.2 for the operation procedure.

There is an expansion port on front side of APAX-5002 (APAX-5002L is not equipped with this feature). With this port, users can build a remote expansion architecture, remaining fast local-bus data transmission speed. Standard Ethernet cables can be used to connect any two APAX-5002. However, shielded industrial Ethernet cable MUST be used instead of standard Ethernet cable when the system is used in harsh environment, such as factory automation. Unmanaged industrial Ethernet switches (such as Advantech EKI-2528) with 100 Mbps transmission speed can also be used between two APAX-5002. Therefore, you can flexibly build any remote expansion with line, tree or star topology. All the APAX-5000 I/O modules can benefit from the remote expansion architecture with local bus speed.

Warning! *1. DO NOT use managed switch, hub or router between backplanes for expansion.*

2. The network for the expansion should be a local network, NOT to connect with other external network (such as public network in enterprise network, including Internet).

3. Cat 6 Ethernet cable is strongly recommended for better data transmission quality.

4. It is suggested to power on all the I/O modules together to avoid any unpredictable situation.

APAX-5002 Specifications

Environment

- **Operating Temperature:** APAX-5002: -10~60°C
  APAX-5002L: -20~70°C
- **Storage Temperature:** APAX-5002: -40~70°C
  APAX-5002L: -40~85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)
- **Shock Resistance:** 20 G @ wall mounting, duration 11 ms
  (tested to IEC 60068 2-27)
- **Vibration Resistance:** 2 Grms @ wall mounting, random, 5 ~ 500 Hz, 3-axes, 1 hr/axis. (Tested to IEC 60068-2-64)

General

- **Dimensions (W x H x D):** 54 x 151 x 38 mm
- **Weight:** 120 g
- **Mounting:** DIN-rail, wall (panel)
- **Power Input:** 24 VDC*
- **Power Consumption:** 1.3 W @ 24 VDC

*: When you stack more than one APAX-5002 backplanes together, there could be more than one power supplies connected to different backplane.

5.2 APAX-5001 1-slot Backplane Module

APAX-5001 functionality is the same as APAX-5002. And it is used to be connected at the right side of APAX-5002 when the total I/O module number is odd. Power and data can be transferred to I/O modules inserted on the APAX-5001. If the APAX-5001 is power-on, you can see the LED lit on to indicate the module is working well.

APAX-5001 Specifications

Environment

- **Operating Temperature**: -10 ~ 60°C
- **Storage Temperature:** -40 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)
- **Shock Resistance:** 20 G @ wall mounting, duration 11 ms (tested to IEC 60068 2-27)
- **Vibration Resistance**: 2 Grms @ wall mounting, random, 5 ~ 500 Hz, 3-axes, 1 hr/axis. (Tested to IEC 60068-2-64)

General

- **Dimensions (W x H x D):** 28 x 151 x 38 mm
- **Weight:** 70 g
- **Mounting:** DIN-rail, wall (panel)
- **Power Input:** 24 VDC
- **Power Consumption:** 0.3 W @ 24 VDC

Chapter 6

Power Supply Modules

6.1 APAX-5343E Power Supply for Expansion Modules

APAX-5343E Specifications

Input

- **Rated Voltage:** 115/230 VAC
- **Voltage Range:** 90 ~ 264 VAC
- **Input Current:** 1.5 A (at rated load)
- **Input Frequency Range:** 47 ~ 63 Hz
- **Inrush Current:** 50 A (one cycle at 25° C)
- **Installed Input Fuse:** F 3.15 A/ 250 V (not accessible)

Output

- **Output Power:** 72 watts
- **Power Loss at rated load:** approximated 8 ~ 9 W
- **Residual Ripple:** <240 mVpp
- **Startup Delay:** < 3 second
- **Rated Voltage:** 24 VDC
- **Voltage Rise:** typical 60 ms
- **Rated Output Current:** 3 A
- **Output Current Limitation:** 3.5 ~ 4.3 A
- **Efficiency:** > 87% (at 115/230 VAC Input Voltage, Rated load)

Protection

- **Isolation Protection (In/Out):** 42/42 VDC
- **Over Voltage Protection:** Shutdown at approx. 25~27 VDC, latch off mode
- **Over Load Protection:** Auto-recovery mode
- **Short Circuit Protection:** Auto-recovery mode

General

- **Certifications:** CE, FCC Class A, UL 508 (UL/cUL approval), Energy Star
- **Enclosure:** ABS + PC
- **Diagnostics LEDs:** 1 x Power
- **Dimensions (W x H x D):** 75 x 151 x 115 mm
- **Operating Temperature:** -10 ~ 55° C
- **Storage Temperature:** -20 ~ 70° C
- **Relative Humidity:** 5 ~ 95% (non-condensing)
- **Leakage Current:** < 3.5 mA

Note! *Refer to Section 1.7.2 for how to assembly APAX-5343E with APAX-5000 I/O modules.*

6.2 APAX-5342 48VDC Power Supply for APAX-5580 series

6.2.1 Product Specifications

Input

- **Rated Voltage:** 48 VDC
- **Voltage Range:** 36~58 VDC
- **Rated Input Current:** 2.2A (Max.) @48 VDC

Output

- **Output Power:** 96 W
- **Efficiency:** >88% (at rated load)
- **Rated Voltage:** 24 VDC
- **Rated Output Current:** 4A
- **Output Current Limit:** 4.8 A
- **Reverse voltage Protection (RVP)**Yes
- **Shout Circuit Protection**Yes

Input Protection

- **Over Voltage Protection (OVP):** 58 VDC
- **Under voltage protection (UVP):** 36 VDC
- **Over current protection (OCP):**3.33 A

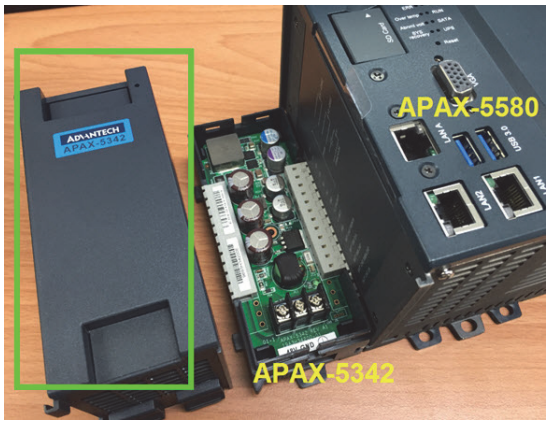
Output Protection

- **Over Current Protection (OCP):** 4.8A
- **Shout Circuit Protection:** Yes

6.2.2 Wiring

For the power input wiring, you need to remove the upper cover:

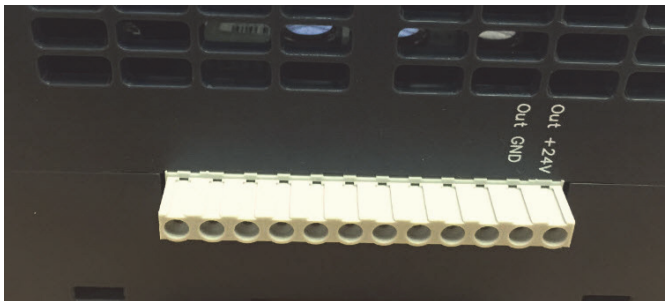
You will find three pins connect with label **48V, GND** (0V) and **earth ground**. After screwed your power cable, you can mount this backplane with 5580 first. Please note that keep your power status in off. And then put the cover back to finish the whole installation.



6.2.3 Connectors

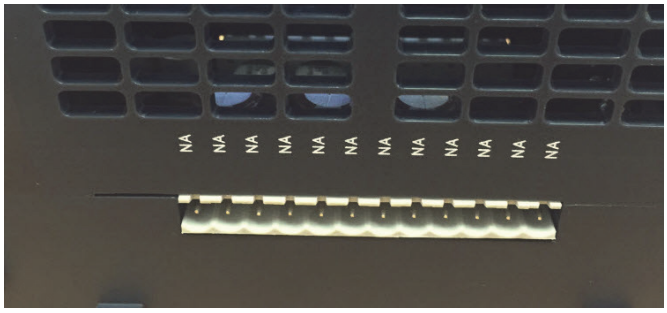
The right side:

Connects to APAX-5580



The left side:

N/A



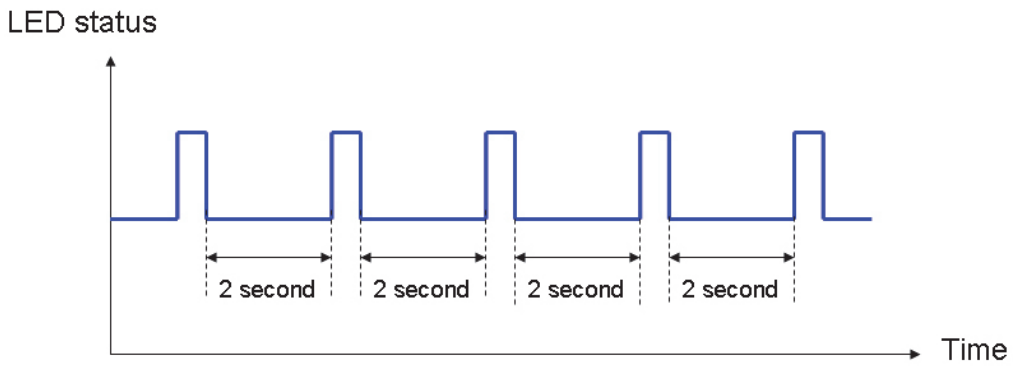
Chapter 6

Error Handling and Diagnostics

6.1 Error Handling and Diagnostics

There is one power LED on the front panel of any APAX-5000 I/O module. When the module is power-on, the LED will be lit. For analog I/O module, the LED color is green. For digital I/O module, the LED color is green or orange, depending on the module ID number. Refer to Section 1.6 for more details. Except for showing the module power status and ID number, this LED is also designed to diagnose module status.

- LED continues flashing one time every 2 seconds

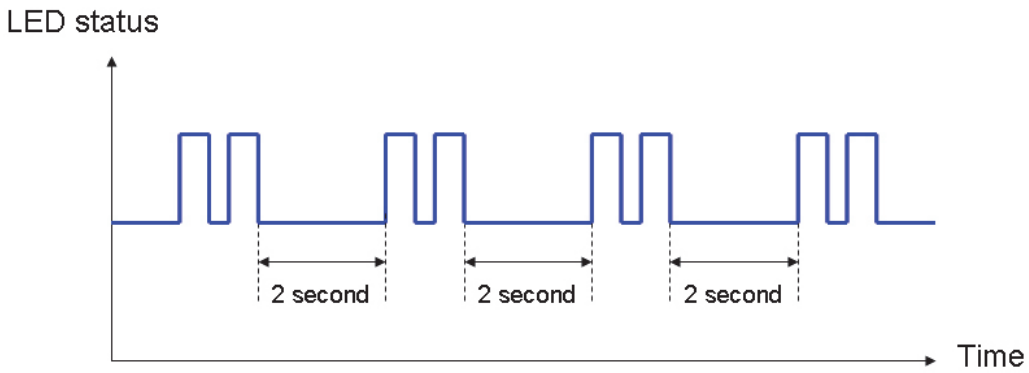


Representation: The I/O modules has problem itself

Solution:

1. Download latest firmware again to see if it works well.
2. If the LED continues flashing after updating firmware, then you need to contact Advantech for technical support.

- LED continues flashing 2 times every 2 seconds

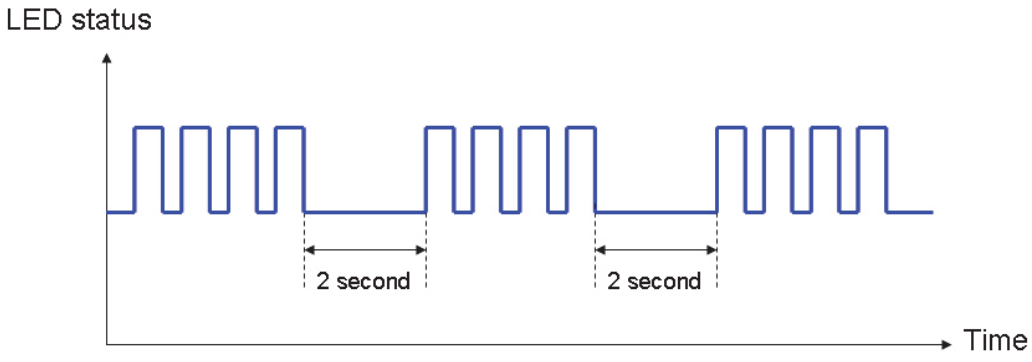


Representation: The I/O modules has communication problem

Solution:

1. Check if the controller or coupler is installed and power-on.
2. If controller or coupler is installed, check if the Ethernet connection is broken when you have remote expansion.
3. If the networking is okay (or there is remote expansion in the system), check if any backplane is broken.
4. If backplanes are all fine, download latest firmware again to see if it works well.
5. If the LED continues flashing after updating firmware, then you need to contact Advantech for support.

- LED continues flashing 4 times every 2 seconds



Representation: ID number of that I/O module conflicts with ID number of another I/O module

Solution:

1. Check ID number of all I/O modules in the same system. Adjust the ID number to avoid different I/O modules with the same ID number. Refer to Section 1.6 for how to adjust ID number. Then reboot the system and it should work fine. (The LED should stop flashing)
2. If the LED continues flashing after you have adjusted the ID number, then you need to contact Advantech for technical support.

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