Category: Application Note
Sub-category: Hardware, Application
Model: All Cameras
Firmware: N/A
Software: N/A
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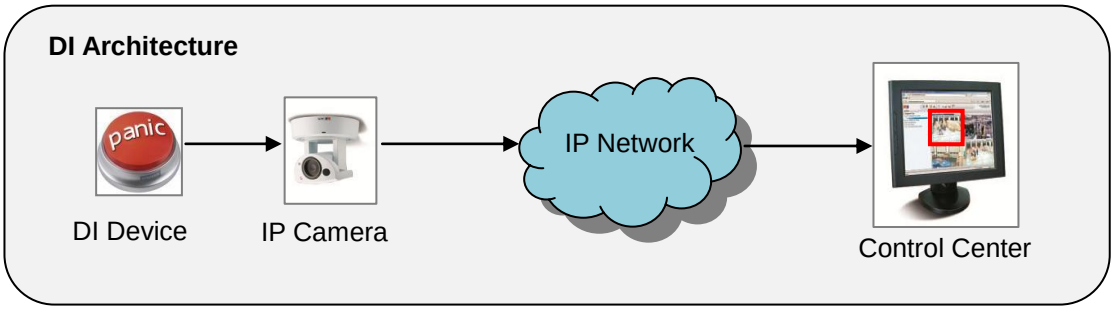
Published: 2010/01/04
Reviewed: 2013/12/31

All about Digital Input and Digital Output

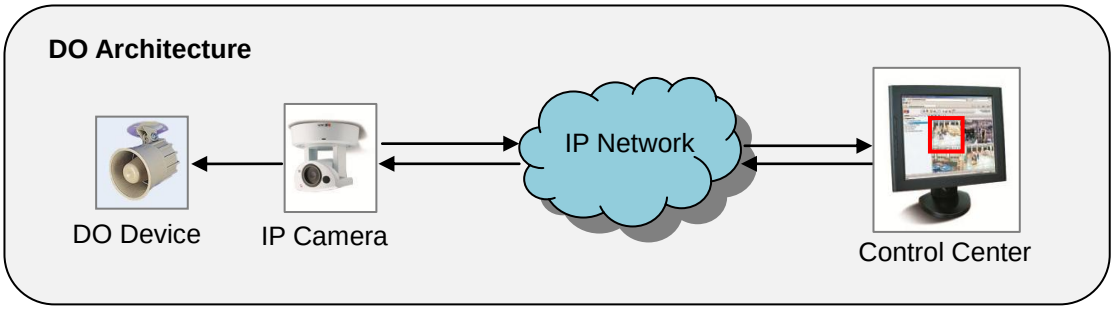
Contents

Introduction

Digital Input or **DI** is the pair of pins in the camera's terminal block through which it is possible to connect an external device (a switch or some kind of sensor) with the camera, allowing the external device to notify the camera about an activity in camera site. For example, it is possible to connect a **"panic button"** with the camera, and when the button is pressed then the alarm signal is sent through the camera all the way to the control center. You can think of the devices that are connected to DI as the triggers of events.



Digital Output or **DO** is the pair of pins in the camera's terminal block through which to connect an external device with the camera. That external device can be activated by the camera upon an event inside the camera or by the command from the control center. For example, an **"alarm horn"** is a typical device that can be connected to camera's Digital Output. You can think of the devices that are connected to DO as the responders to events.



Since Digital Input and Digital output are most often seen as the applications for alarm system, therefore sometimes the expressions **Alarm Input** and **Alarm Output** are used respectively in order to emphasize their alarm-related function. However, sometimes there may be DI and DO based applications that have nothing to do with alarm system and are merely functions of convenience that take a good use of IP-network with the help of camera's DI and DO ports. Therefore **we suggest you to refer to those features using the general terms "Digital Input" and "Digital Output".**

The Benefits of DI and DO

The main benefit of using camera's Digital Input is to **save cabling effort** between the trigger (for example a panic button) and the control site – using the camera's cat5 network cable, the alarm event can be sent to the control center over the IP-network.

Furthermore it is possible to set the camera to **respond to the event instantly** without waiting for the command from the control center. For example, when a panic button is pressed then the PTZ camera that was originally pointed elsewhere will instantly turn itself towards the area where the button was pressed.

The benefits of camera's Digital Output are quite similar. In addition to saving the cabling effort, it is even possible to give instant commands from the camera to external device. For example, if the camera detects a motion either by video motion or passive infrared (PIR) sensor, then the camera can turn on the lights in the room that are connected to DO, so the moving object will be nicely exposed with proper lighting.

Applications of Digital Input

There are countless possibilities of applying external devices to ACTi cameras through DI terminal block. The examples below illustrate several practical usages of DI. The following DI devices are used in those examples:

- Panic Button
- Emergency Button
- Smoke Detector
- Passive Infrared Sensor
- Magnetic Contacts of Windows and Doors
- Glass Break Detector

Panic Button

Camera Site	Control Center
	

Example: **Panic Button** connected to PTZ camera's DI can serve several purposes at one time. When the button is pressed the following actions are done:

- the alarm signal is sent to control center over the IP network, telling the security officer about the ongoing crime
- the NVR starts to record all the related channels with highest frame rate
- the bit rate is increased for enhanced video quality
- the PTZ camera sends a command to itself to point towards the panic button area.

Emergency Button	
Camera Site	Control Center
	

Example: **Emergency Button** is located at the platform of the railway station. It can be used in case of emergencies, such as accidents on the platform or at the doors of the train, or in case of robbery or abusement. When pressed, the following actions are done:

- the alarm signal is sent to control center over the IP network, telling the security officer about the ongoing emergency
- the NVR starts to record all the related channels with highest frame rate
- the bit rate is increased for enhanced video quality
- several PTZ cameras around the area will automatically be pointed and zoomed towards the emergency button area in order to get the clear view of the incident.

Smoke Detector	
Camera Site	Control Center
	

Example: There is a **Smoke Detector** in every room. If there is a DI-supported camera installed in the room then you can connect the smoke detector to the DI of the camera. When the smoke is detected by the smoke detector, the following actions are done:

- the alarm signal is sent to control center over the IP network, telling the security officer about the fire alarm
- the NVR starts to record all the channels in that room with highest frame rate
- the bit rate is increased for enhanced video quality

In larger buildings there is usually a centralized fire alarm system and all the smoke detectors are connected to that. It is possible to use the DI mechanism of that alarm system box to trigger cameras but it will not serve its purpose well – the cameras are located near the smoke detectors and may be quite far from the fire alarm system box. But at least it is possible to deliver the overall fire alarm signal from the box to the control center over the IP network using the DI connector of one of the cameras nearby that box.

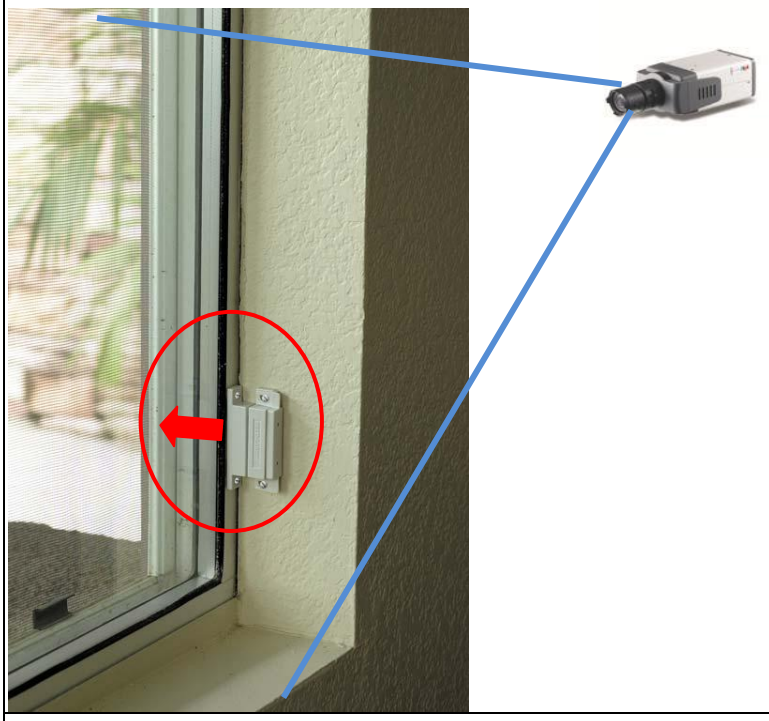
You can also consider to connecting each smoke detector directly to the cameras of the same room regardless of the existence of centralized fire alarm system. This gives the possibility to identify the exact room that is under fire emergency and allows to make video related responses specifically for that room.

Passive Infrared Sensor	
Camera Site	Control Center
	

Example: There is a **Passive Infrared Sensor** (PIR) pointed at the emergency exits that are normally not used. There is also a PTZ camera that is pointed by default at opposite direction where the the regular motion activity is more likely to occur. When the PIR detects the motion around the exit, it sends the signal to the camera's DI and the following actions are done:

- the alarm signal is sent to control center over the IP network, telling the security officer about PIR detected motion in the area that is commonly a quiet zone
- The PTZ camera turns instantly towards the emergency exit and zooms in if set to do so
- the NVR starts to record all the channels around that area with highest frame rate
- the bit rate is increased for enhanced video quality

PIR is also a great help even for fixed cameras – for example in very low light conditions when the video motion detection may have difficulty detecting motion (for example, a daytime only camera is used in the scene), PIR with its high sensitivity can still produce alarm. In that case, it is better to combine it with external lighting connected to camera's DO terminal block – when the event is triggered by PIR, the lights turns on instantly, exposing the suspicious activity for clear video recording.

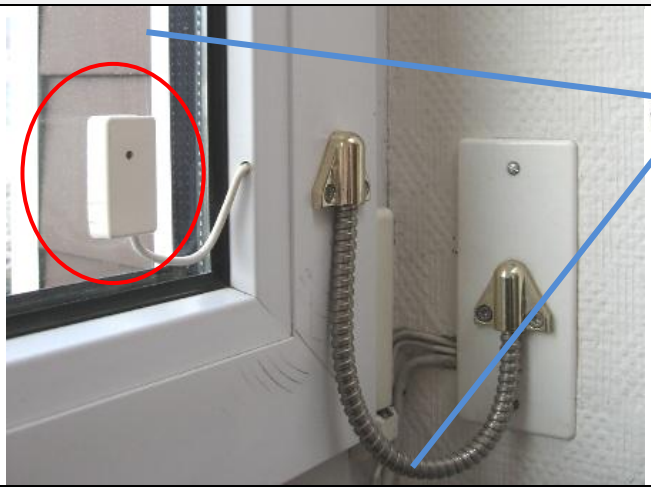
Magnetic Contacts of Windows and Doors	
Camera Site	Control Center
	

Example: Each window is equipped with a **Magnetic Contact** with a simple mechanism – whenever the window is opened, the magnet attached to the window also moves away, which turns on the switch on the contact attached to the window frame. The same method can be applied to doors and hatches. The magnetic contact is connected to DI of the camera. When the window or door is opened, the following actions are triggered:

- the alarm signal is sent to control center over the IP network, telling the security officer about the opened window or door
- the NVR starts to record all the channels around that area with highest frame rate
- the bit rate is increased for enhanced video quality

This is a very inexpensive solution, but it adds a lot to the security of the guarded object.

Glass Break Detector

Camera Site	Control Center
	

Example: A **Glass Break Detector** is a sensor used in electronic burglar alarms that detects if a pane of glass is shattered or broken. These sensors are commonly used near glass doors or glass store-front windows to detect if an intruder broke the glass and entered.

Glass break detectors use a microphone, which monitors any noise or vibrations coming from the glass. If the vibrations exceed a certain threshold -which is usually set by the user- the sensor will trigger an alarm. When the alarm is triggered, the following actions are done:

- the alarm signal is sent to control center over the IP network, telling the security officer about broken window or door glass
- the NVR starts to record all the channels around that area with highest frame rate
- the bit rate is increased for enhanced video quality

More Example Applications of Digital Input

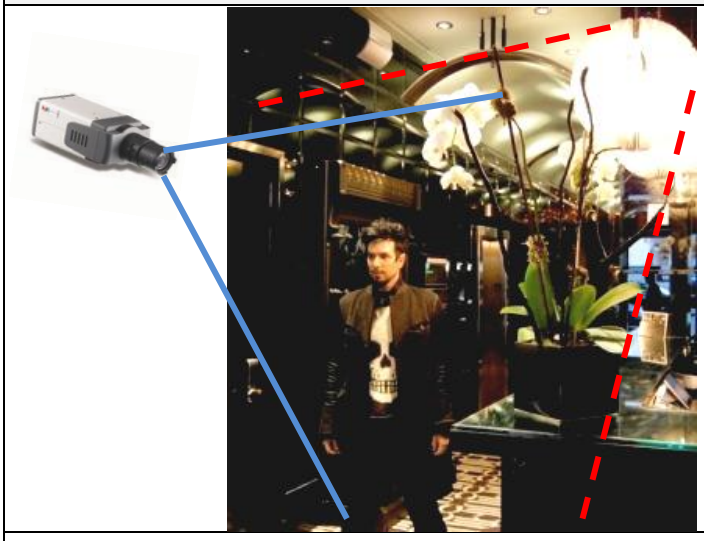
Below there is the list of more devices that could be applied as DI triggers of the camera.

- Thermometer – trigger an event when a temperature reaches a certain level
- Sound Detector – trigger an event when the sound is above the threshold (dB)
- Air Pressure Sensor – trigger an event when there is a sudden change of air pressure
- Speed Detector – when the over speeding car is detected, the video is recorded
- Gas Detector – similar application with smoke detector

Applications of Digital Output

There are countless possibilities for digital output applications as well. Almost any external device you want to be activated upon the alarm can be connected to DO terminal block of the camera. The examples below cover several applications that are most often used in security solutions. For simplicity, all the examples below use the video as the trigger for DO actions.

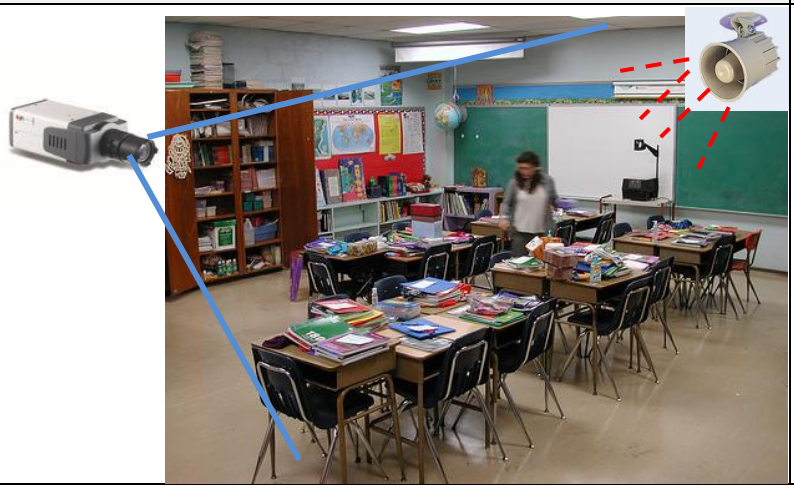
Lights

Camera Site	Control Center
	**Video Motion Detected!** **Turn on all the lights!** 

Example: The additional ceiling **Lights** of the room are connected to DO terminal block of the camera. During the night time the room is too dark and the quality of the captured video will not be as good as the daytime video. Therefore, it would be great if the extra lights of the room could turn on automatically whenever motion occurs in the room, exposing the suspicious activity to the camera. In this example, when the video motion is detected, the following actions are done:

- the lights are turned on
- the alarm signal is sent to control center over the IP network, telling the security officer about the motion in the area
- the NVR starts to record all the channels around that area with highest frame rate
- the bit rate is increased for enhanced video quality

While designing the system of “motion detection activating DO-lights”, the endless loop of the events has to be avoided as the lights turning on or off will cause video motion detection by themselves. The avoid the endless event loop, please set the motion detection interval to be longer than the DO interval. For example, use Web Configurator to set the motion detection interval to 30 seconds and use NVR’s Event Manager to set the DO (lights on) activation time to 25 seconds. Motions caused by lighting change will be properly ignored.

Alarm Horn	
Camera Site	Control Center
	**Video Motion Detected!** **Turn on the alarm horn!** 

Example: The **Alarm Horn** connected to the DO of the camera is an effective way of shocking the intruders and letting the personnel know that there is an activity in restricted area. Usually, the shocking sound effect of the horn is sufficient enough make the intruder abort his activity and leave immediately.

In this example, when the video motion is detected, the following actions are done:

- the horn in the room will sound out loud
- the alarm signal is sent to control center over the IP network, telling the security officer about the motion in the area
- the NVR starts to record all the channels around that area with highest frame rate
- the bit rate is increased for enhanced video quality

Motor to Open the Gate

Control Center

The car has been identified!

Run the motor to open the gate!

Example: The car is stopping at the entrance of a parking lot, waiting the gate to be opened. The IVS (video intelligence server) analyses the video image and detects and identifies the licence plate number. If the licence plate number belongs to the car that has the permission to enter, the command will be sent **Motor of the Gate** through the DO of th camera and the motor opens the gate. In this example, when the car enters the video display area, the following actions are done:

- the IVS recognizes the license plate and compares it against the database of permitted license numbers
- the number exists in the database and the command is sent to activate the DO of the camera resulting with activated motor that opens the gate of the parking lot
- the NVR will log the event and the video clip of the event will be recorded, too
- It is also possible to charge the account of the car owner through the same system for the convenience

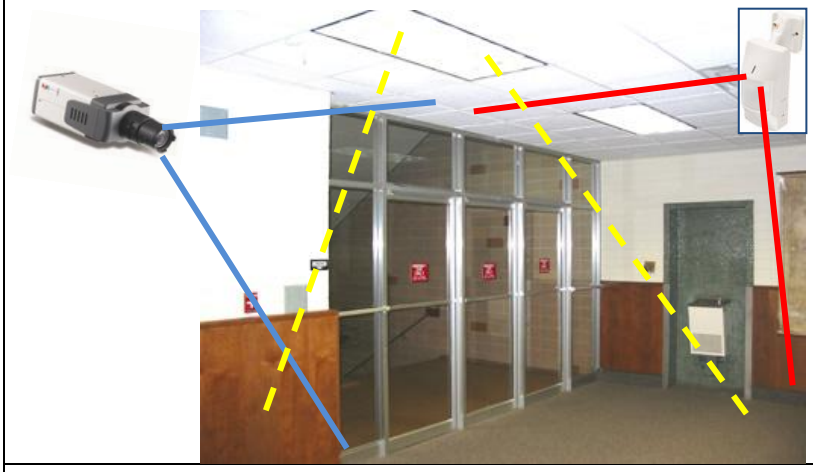
More Example Applications of Digital Output

- Traffic Light – the traffic lights can be regulated based on Video analytics
- Electric fence – when the motion is detected, the wired fences can be electrified
- Magnetic locks – lock or unlock the doors when the events happen

Applications of Combined Digital Input and Digital Output

There are applications where both DI and DO can be used – the device connected to DI acts as a trigger and the device connected to DO acts as the response to that triggered event.

Passive Infrared Sensor (DI) + Ceiling Lights Switch (DO)

Camera Site	Control Center
	**PIR Motion Detected!!** **Turn on the lights!!** 

Example: There is a DI/DO supported IP camera that is pointed at the area in front of the emergency exits. There is a **Passive Infrared Sensor** (PIR) pointed at the emergency exits that are normally not used. The PIR is connected to the DI of the camera. The ceiling lights are connected to the DO of the camera. At night time, when the PIR detects the motion around the exit, it sends the signal to the camera's DI and the following actions are done:

- the alarm signal is sent to control center over the IP network, telling the security officer about PIR detected motion in the area that is commonly a quiet zone
- The DO will be triggered and the lights in the area turn on, exposing the suspicious activity even at night time
- the NVR starts to record all the channels around that area with highest frame rate
- the bit rate is increased for enhanced video quality

GOOD TO KNOW: The series of cube cameras with **built-in PIR** and **DI/DO** support were released on October 2010. By implementing such cube camera in application above you do not need to add an external PIR device. It makes the whole solution **more reliable and cost-effective**.

Built-in PIR

The models that will contain PIR and DI/DO are: **ACM-4001, ACM-4201, TCM-4001, TCM-4201.**

Connection Types of DI and DO

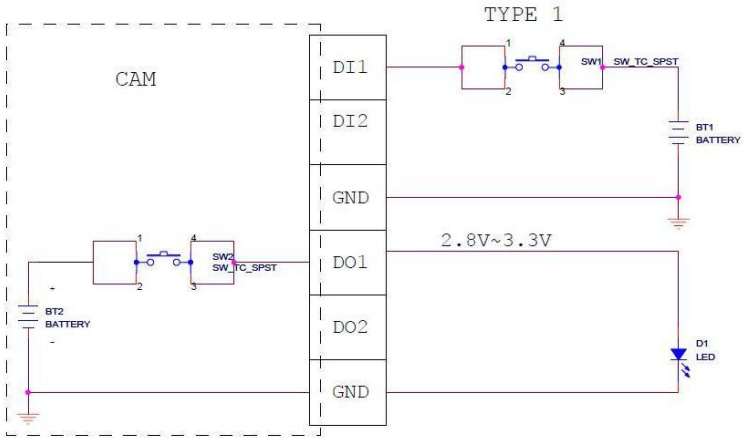
There are four possible connection types of DI and DO among all the ACTi products. We explain each type in this chapter, and show the mapping table in the next chapter. The connections types are ACTi's internally method of grouping ACTi devices based on their electrical circuits and their specifications.

There are two ways to approach to the connection types. The first way is to study the connection types and see if there is a type that is necessary for you. If so, then you can refer to the device list in the chapter **"Connection Types of ACTi Devices"** to make a choice among the cameras that support your requested connection type.

Alternatively, if you have already purchased a device and want to know how its DI and DO work, then you can first refer to the device list, find the connection type of your device from there and then come back to this chapter to study deeply about the specifications of this particular type.

Connection Type 1

The oldest ACTi devices use the type 1 connection for DI and DO. Please note that some devices may have more than one DI or DO, however, for simplicity the circuits are drawn only for one DI and one DO.



Scheme 1: Connection Type 1

The example of DI is based on a simple switch, perhaps a "panic button". By default, the switch is open, so there is no flow of electricity in circuit. Because type 1 DI does not provide its own power supply, therefore an external power supply has to be added, for example a battery. The circuit of DI looks like this: *DI 1 –> Switch (open by default) –> +[battery]- –> Ground*

When the panic button is pressed then the DI1 will be triggered.

Please make sure that the voltage of the external battery would be in the range of 2.31V ~ 5.3V, for example a 3V or 4.5V battery.

A panic button is the simplest DI design. However, there may be more complex DI devices, such as smoke detector, sound detector, passive IR detector, etc. In those cases you have to

refer to the specifications of those devices. If their event output is an on/off switching action done by a built-in relay (for more information about the term “relay” see the chapter “Reference: Important Terminology”), then you can connect that DI device to the circuit in the same way as the panic button. If the event output of the DI device is the power supply coming from the battery built in the DI device then you do not have to have the additional external battery that was shown in the panic button example. Just make sure that the voltage provided by the DI device is within the range of 2.31V ~ 5.3V.

The DO of connection type 1 is following: there is an internal power supply within ACTi device, with the voltage 3.3V. Simply connect an external DO device, for example a small LED into DO 1 and Ground. When the event is triggered and received by the camera then the circuit of DO will be powered and the LED will turn on. If your DO device is using high voltage then you may need to add an external relay. Please refer to the **Scheme 7** for external relay design.

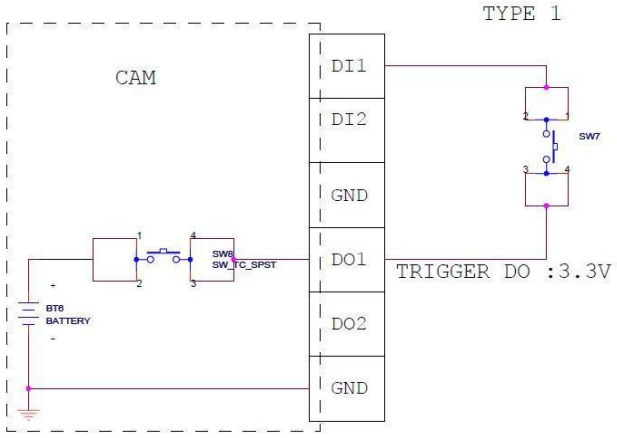
Below you can find the specifications of connection type 1:

Connection Type 1			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (high)	Logic level 1: **2.31V ~ 5.3V**
		Normal (low)	Logic level 0: **0V ~ 0.8V**
	Current		**10mA ~ 100mA**
DO	Connection design		TTL-compatible logic levels
	Voltage	To trigger (high)	Logic level 1: **2.8V ~ 3.3V**
		Normal (low)	Logic level 0: **0V ~ 0.5V**
	Current		**50mA**

The logic levels have the following meaning: 1 stands for high voltage range, 0 stands for low voltage range. Whether the high voltage range is the triggering mode or normal mode depends on the design of the device. Quite often the logic level 1 (high voltage) is used to indicate the triggered event, but not always. For connection type 1, the logic level 1 means to trigger and logic level 0 means to be in normal mode.

DO connected to DI – a special solution for Connection Type 1

Please note that even though the DI of type 1 does not have its own power source and it has to be powered externally, there is a possibility to create a panic button



Scheme 2: Connection type 1 using DO-to-DI connection

type of circuit without an external battery, just as shown on the **Scheme 2**– connect the DO 1 into DI 1 and put the panic button between them. The idea of such connection is to make DO 1 simulate a power supply (just like the battery on the previous scheme). However, in order to be similar to battery, the DO has to be constantly in triggered mode. To trigger DO 1, you can use a simple URL command that works with all product series:

http://ip:port/cgi-bin/cmd/mpeg4?DIO_OUTPUT=0x01

Please note that for ACM/ACD and TCM/TCD platform devices in addition to URL command you can even use the firmware user interface (Web Configurator, just above the live video display area) to trigger the DO manually. The buttons appear as follows:

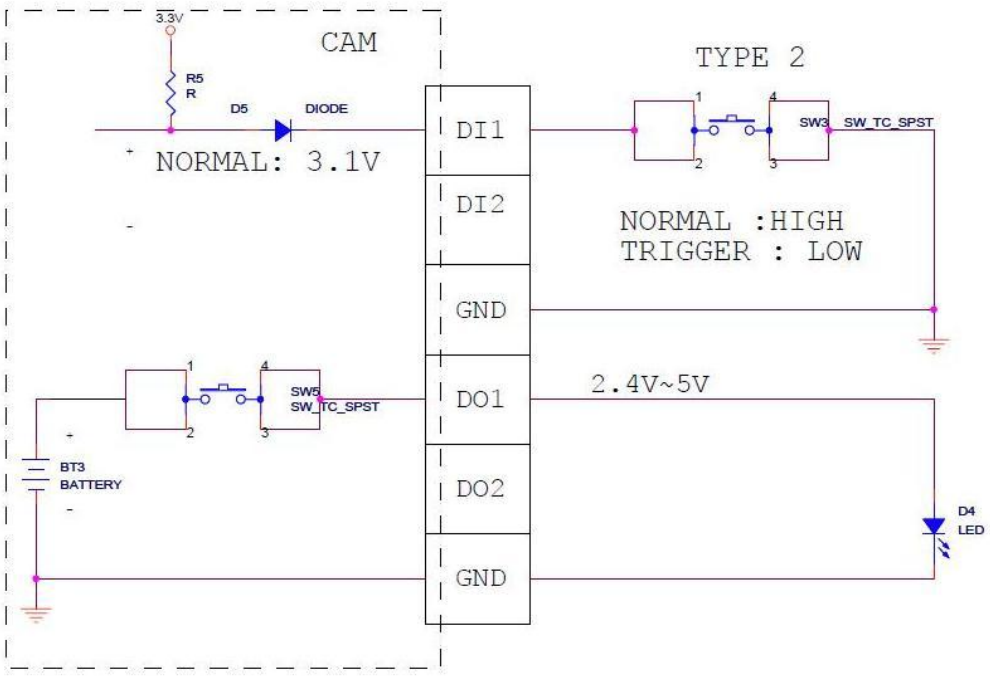
ACM-series: 

TCM-series: 

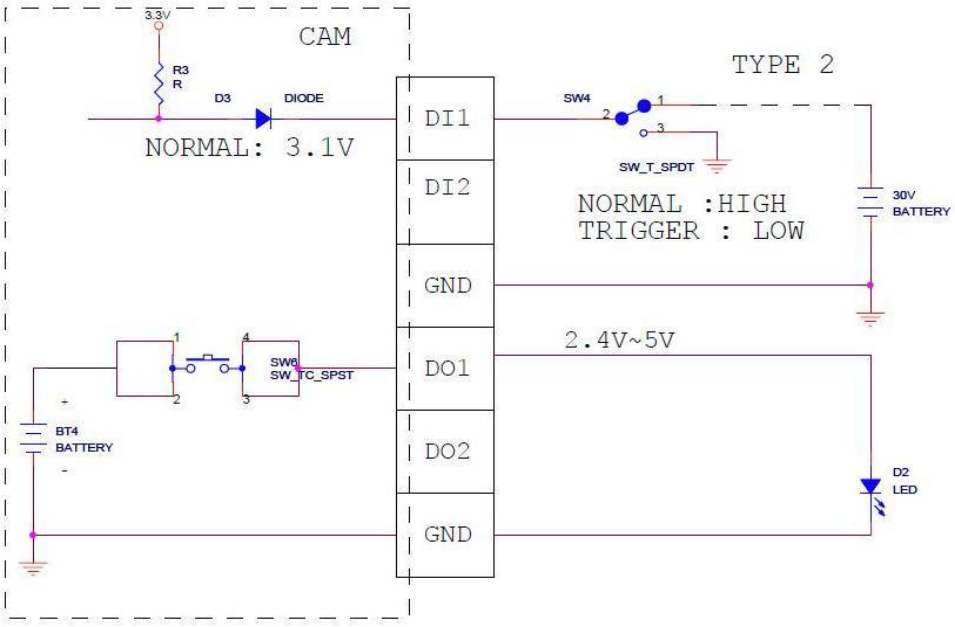
Simply click on “1” button to trigger the DO 1. Please note that the button will not appear as pressed once you have clicked on it, but it works properly.

Connection Type 2

The DI of connection type 2 has its internal power supply. It means, simply by connecting DI 1 with GND with a single wire the DI will be instantly triggered. The benefit of such design is the simplicity – you do not have to have an external battery to make the “panic button” work.



Scheme 3: Connection Type 2, DI powered by ACTi device



Scheme 4: Connection Type 2, DI with external power supply

The voltage of DI is 3.1V, however, the DI allows the voltage range of 3.1V ~ 30V. What does it mean? It means that even though DI has its own power supply, it is possible to add external DI devices that have their own power supply into same circuit. On the **Scheme 4** there is an example of 30V external battery added to DI 1. That battery represents the power given by DI device, such as smoke detector, etc. Please make sure that the voltage of the external DI device is within the range of 3.1V ~ 30V.

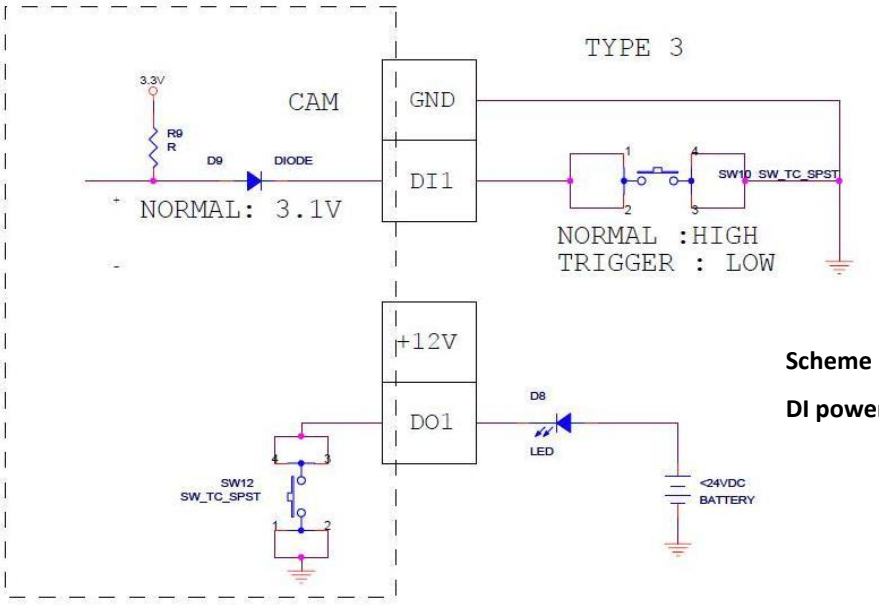
The DO design of Connection Type 2 is very similar to Connection Type 1. The only difference is the voltage range – the triggering range is 2.4V ~ 5V while the normal mode range is 0.1V ~ 0.6V. If your DO device is not within this voltage range then you may need to add an external relay. Please refer to the **Scheme 7** for external relay design.

Below you can find the specifications of connection type 2:

Connection Type 2			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (low)	Logic level 0: **0V ~ 0.4V**
		Normal (high)	Logic level 1: **3.1V ~ 30V**
	Current		**10mA ~ 100mA**
DO	Connection design		TTL-compatible logic levels
	Voltage	To trigger (high)	Logic level 1: **2.4V ~ 5V**
		Normal (low)	Logic level 0: **0.1V ~ 0.6V**
	Current		**50mA**

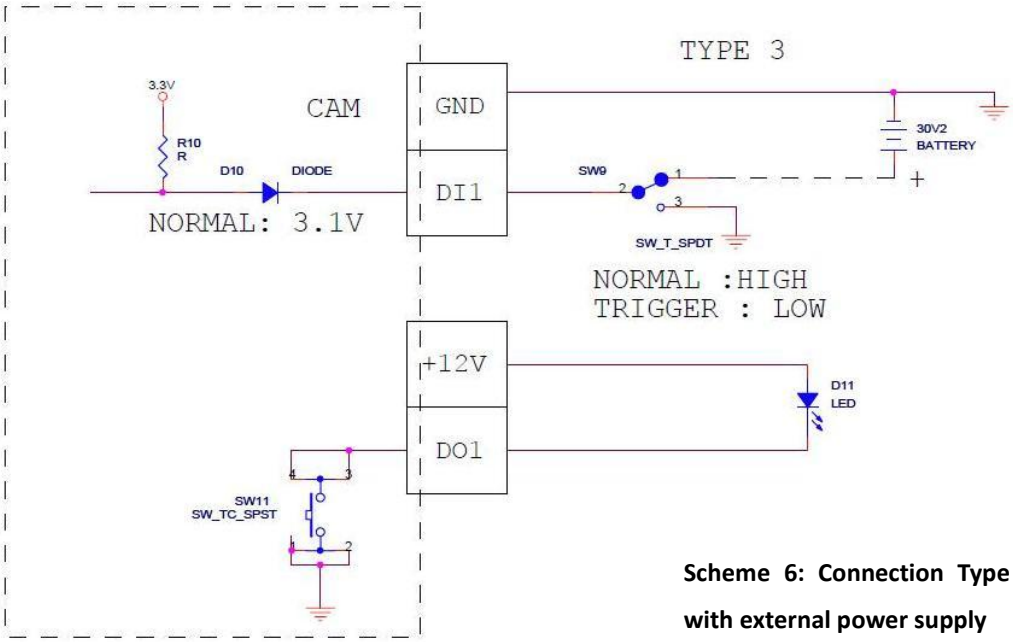
Connection Type 3

Most of the modern ACTi devices today use connection type 3. The DI designs on the **Scheme 5** and **Scheme 6** are exactly the same as for connection type 2.



Scheme 5: Connection Type 3, DI powered by ACTi device

There are 4 pins on the terminal block of ACTi devices that belong to connection type 3. Since there are no words on the device explaining the pins, therefore you have to refer to the documentation before completing the design. Please use the pins **1** (GND) and **3** (DI) for DI design.



Scheme 6: Connection Type 3, DI with external power supply

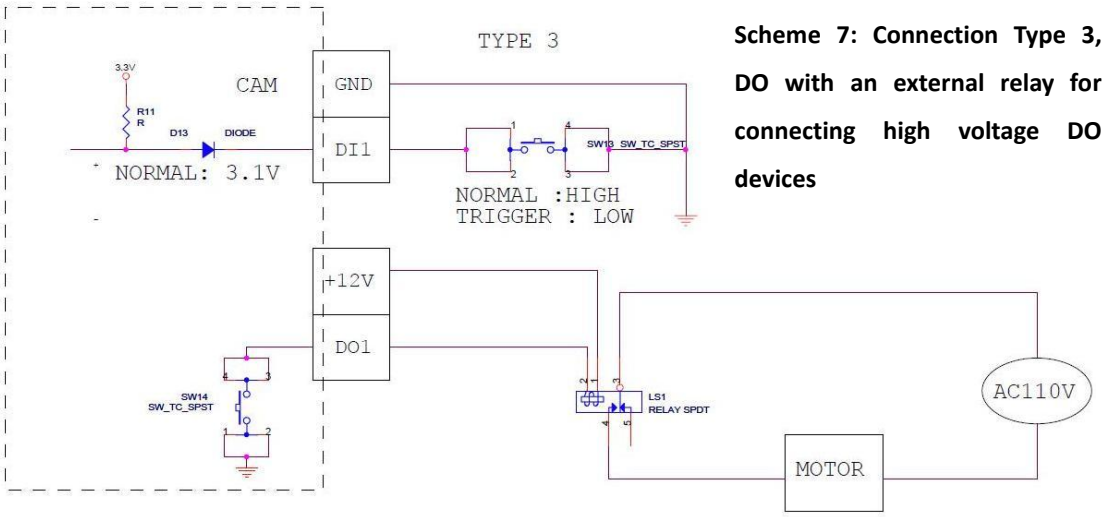
The main difference is in the DO design – it uses an open-collector NPN transistor with the

emitter connected to the GND pin. On the 4-pin terminal block, please use the pins **2** (DC+12V) and **4** (transistor output) for DO design.

Even though the DO of connection type 3 provides 12V power, it may not always be enough for external DO devices, such as ceiling lights or a motor that opens or closes the gates or doors. In those cases the additional external relay is needed (for more information about the term “relay” see the chapter “Reference: Important Terminology”).

Having the external relay in the DO design, you can connect to a high voltage device that has its own power supply. Relay acts as a switch for the external power circuit, commanded by the DO. For example, that way you can use the DO of the ACTi device to control a motor that is running on AC 110V.

While choosing the proper relay, please refer to its specifications and make sure they match with the current design. The triggering circuit voltage has to be around 12V DC (+- 20%) and the switch-controlled circuit voltage has to match with the external power supply (for example 110V AC or 220V AC).



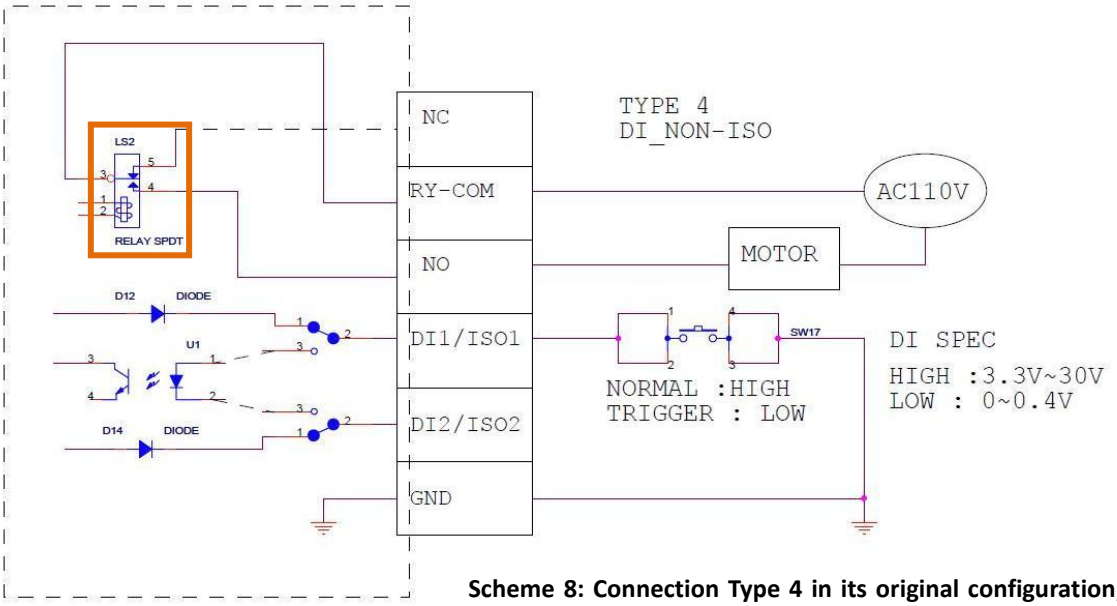
Scheme 7: Connection Type 3, DO with an external relay for connecting high voltage DO devices

Below you can find the specifications of connection type 3:

Connection Type 3			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (low)	Logic level 0: **0V ~ 0.4V**
		Normal (high)	Logic level 1: **3.1V ~ 30V**
	Current		**10mA ~ 100mA**
DO	Connection design		Transistor (Open Collector)
	Voltage & Current		**< 24V DC, < 50mA**

Connection Type 4

The design of connection type 4 is the most advanced one. The two DIs use the same design as the connection types 2 and 3. Please refer to the detailed explanation of the DI of the connection type 2.



Scheme 8: Connection Type 4 in its original configuration, two non-isolated DI and one isolated DO. The highlighted area is the relay for DO circuit.

The main difference of the type 4 is the **isolated digital output**. Please look at the **Scheme 8**. There is a relay inside the ACTi device controlled by the CPU through pins 1 and 2 of the relay. While in normal mode, the magnet inside the relay keeps the pins 3 and 5 connected. When an event happens and DO is triggered, the CPU sends a signal to the relay and the magnet pulls the switch that disconnects pins 3 and 5, and connects pins 3 and 4 instead.

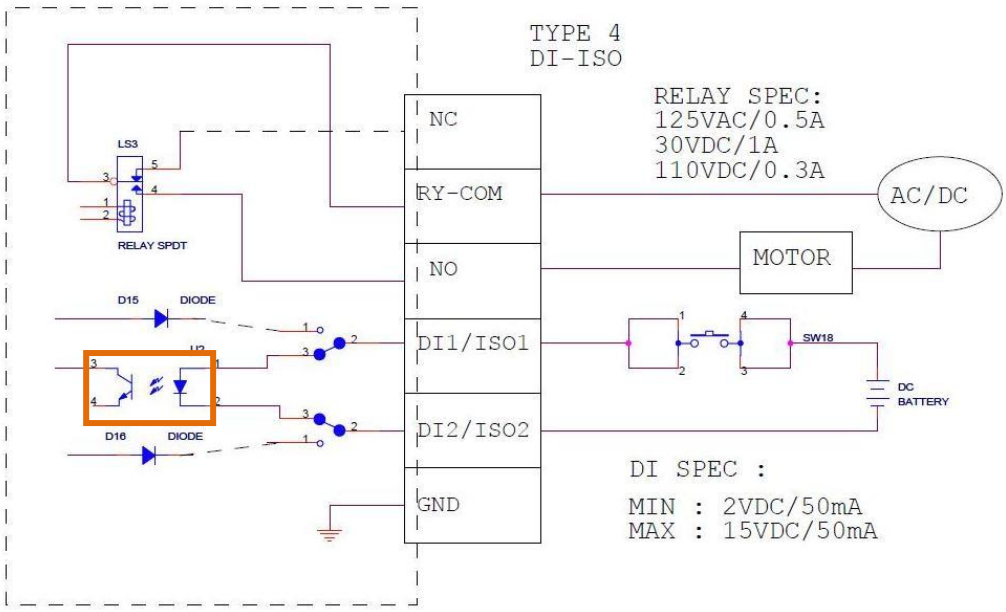
Note that the pin 5 of the relay is connected to the NC *(Normal Close)* of the terminal block while the pin 4 of the relay is connected to the NO *(Normal Open)* of the terminal block. Pin 3 connects to the RY-COM(*Relay Common*).

You can connect a self-powered external DO device, such as motor, into NC and RY-COM, for example. It means, while no event is happening, the circuit is connected and the motor keeps running. When the event happens, the magnet inside relay pulls the switch and disconnects the circuit, and the motor will stop working.

Alternatively, you can connect your self-powered external DO device into NO and RY-COM if you want the circuit be disconnected while no event is happening. When event happens, the

relay will pull the switch, connect relay pins 3 and 4, and the external motor will start to work.

Please also note that only certain voltages have been tested and issued as a formal specification of the built-in relay: 125V AC / 0.5A; 30V DC / 1A; 110V DC / 0.3A.



Scheme 9: Connection Type 4(upon request), one isolated DI and one isolated DO.

The highlighted area is the photocoupler of the isolated DI.

The main benefit of the connection type 4 is the convenience that the internal relay brings – there is no need to build an external relay based solution to support the 110V powered external devices, such as lamps and motors. There is one extra feature available in this type – the **isolated digital input**.

The isolated DI is only available upon request before purchase. Two non-isolated DI-s will become one isolated DI by the switch of an internal jumper. This operation can only be done by an ACTi engineer to not lose the existing device warranty.

The isolated digital input allows the connection of self-powered DI device. It can be connected to the pins DI 1 and DI 2 of the terminal block to complete the circuit. When the circuit is powered by the external DI device (upon the DI event) then the photocoupler inside the ACTi device will transmit the signal to CPU. (Pins 1 and 2 inside the photocoupler will activate the LED of photocoupler, and the photo detector will detect the light coming from the LED and connect the circuit of pins 3 and 4 of the photocoupler, thereby sending the DI event to CPU.)

Below you can find the specifications of connection type 4:

Connection Type 4			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (low)	Logic level 0: **0V ~ 0.4V**
		Normal (high)	Logic level 1: **3.1V ~ 30V**
	Current		**10mA ~ 100mA**
Isolated DI * (only by request)	Connection Design		Photocoupler
	Voltage	To trigger	**2V ~ 15V**
		Normal	**0V**
	Current		**50mA**
DO	Connection design		Relay
	Voltages accepted		**125V AC / 0.5A** **30V DC / 1A** **110V DC / 0.3A**

Connection Types of ACTi Devices

Referring to the cross table below, you can find out the type of connection that your device is using. Please note that some of the models may have more than one DI and DO. The devices that do not support DI and DO are not listed.

Model		DI and DO Connection Type			
		Type 1	Type 2	Type 3	Type 4
Video Encoder	SED-2100	●			
	SED-2120		●		
	SED-2140		●		
	SED-23xxQ		●		
	SED-2420		●		
	SED-2610		●		
	ACD-2100		**●**		
	ACD-2200		●		
	ACD-2300		**●**		
	ACD-2400		**●**		
	ACD-2000Q		**●**		
	TCD-2500				**●**
	TCD-2100			**●**	
Video Decoder	SED-3200		●		
	SED-33x0		●		
	ACD-3100		**●**		
Indoor Box Camera	CAM-5100	●			
	CAM-5120	●			
	CAM-5130		●		
	CAM-5140		●		
	CAM-5150		●		
	CAM-52xx		●		
	CAM-53xx		●		
	ACM-5001		●		
	TCM-5001		●		
	ACM-5711		●		
	ACM-56xx			●	
	TCM-5311			**●**	
	ACM-58x1			●	
	TCM-56xx			●	
	KCM-5111			**●**	
	KCM-5211			**●**	
	KCM-5311			**●**	

Fixed Dome Camera	CAM-7xxx		●		
	ACM-7411			●	
	TCM-7411			●	
	ACM-75x1			●	
	TCM-7811			●	
	TCM-7011			●	
	KCM-7111			●	
	KCM-7211			●	
	KCM-7311			●	
	KCM-3211			●	
	ACM-3001*			●	
	TCM-3001			●	
	ACM-3011*			●	
	TCM-3011			●	
	ACM-3401*			●	
	TCM-3401			●	
	ACM-3411*			●	
	TCM-3411			●	
	ACM-3511*			●	
	TCM-3511			●	
Speed Dome Camera	**CAM-61xx**		●		
	CAM-6510**	Yes**			
	CAM-6610**	Yes**			
	CAM-6620**	Yes**			
	CAM-6630**	Yes**			
	TCM-6630**	**Yes****			
Bullet Camera & Outdoor Box Camera	**TCM-1231**			●	
	TCM-1511			●	
	TCM-1011			●	
	KCM-5211E			●	
	KCM-5311E			●	
PTZ Camera	ACM-82x1			●	
	ACM-8511			●	
Cube Camera	ACM-4001*			●	
	ACM-4201*			●	
	TCM-4001			●	
	TCM-4201			●	

The production of **grayed** devices has been discontinued. However, you may keep using those models and this document will help you to use their DI and DO functions.

***** These are the models that were enhanced by adding the DI/DO function while keeping the same model name as before. You can distinguish the enhanced model either by visual

examination or by the serial number – the enhanced model serial number contains “E” letter instead of “X”. Example: ACM****-***-E-*****

**** CAM-65xx, CAM-66xx and TCM-6630 have **8 DI** and **1 DO**. Only the products with serial number CAM-65xx/CAM-66xx-08H (since August 2008) or higher and all the TCM-6630 can send an alarm signal from two DIs to remote software via IP-network. For physical connection they are different than other models. The basic information is given in the table below. For more details, please refer to their hardware manual.

Speed Dome CAM/TCM-6xxx DIO Connection			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (low)	Logic level 0: **0V ~ 0.8V**
		Normal (high)	Logic level 1: **2V ~ 5.5V**
	Input		**5V 10kΩ pull up**
DO	Connection design		Relay
	Voltages accepted		**120V AC / 3A** **24V DC / 3A**

Video Clips of DI and DO Integration with NVR

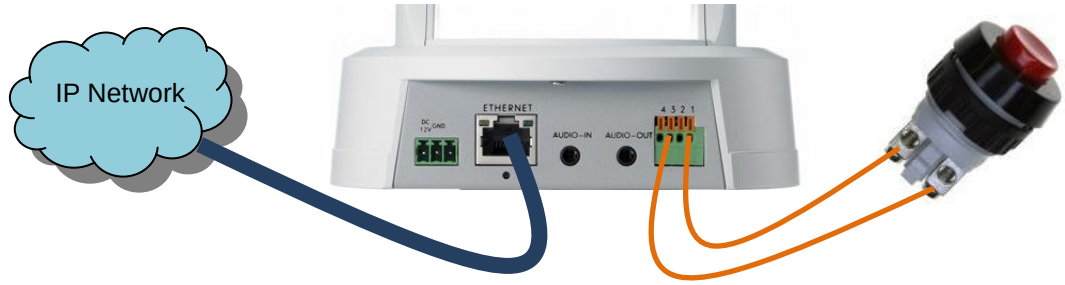
Among the series of educational video clips introducing the functions of NVR there are also videos of the integration of digital input and digital output of the ACTi IP-camera with NVR.

Video clip of DI integration with NVR

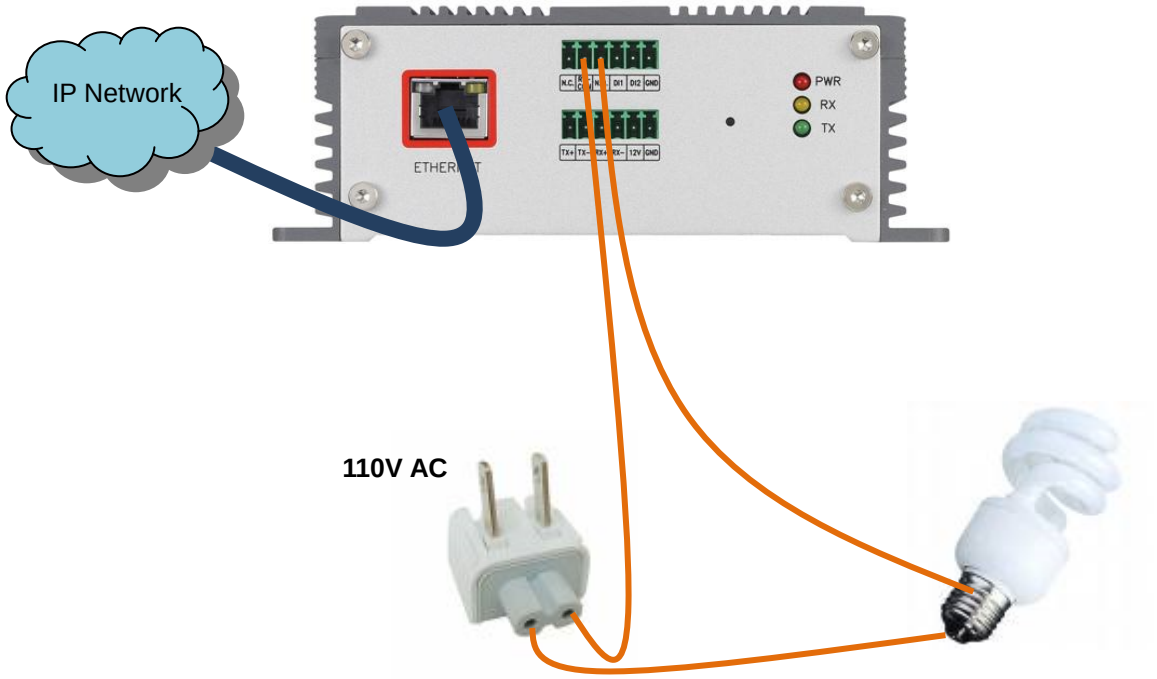
Video clip of DO integration with NVR

Examples of DI and DO Connections

Digital Input: Emergency button connected to PTZ camera ACM-8511 pins 1 and 3, and the camera is connected to the IP-network with cat-5 cable. It is the **connection type 3**.



Digital Output: An external lamp connected to the video encoder TCD-2500 pins RY-COM (relay common) and N.O. (normal open), and the camera is connected to the IP-network with cat-5 cable. It is the **connection type 4**. Note that the external lamp has its own power supply (110V AC) and the relay inside the video encoder acts as a switch to open and close the external circuit. By connecting it to N.O. the lamp will stay turned off during normal mode and will turn on during the event.



Reference: Table of All Connection Types

Connection Type 1			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (high)	Logic level 1: **2.31V ~ 5.3V**
		Normal (low)	Logic level 0: **0V ~ 0.8V**
	Current		**10mA ~ 100mA**
DO	Connection design		TTL-compatible logic levels
	Voltage	To trigger (high)	Logic level 1: **2.8V ~ 3.3V**
		Normal (low)	Logic level 0: **0V ~ 0.5V**
	Current		**50mA**
Connection Type 2			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (low)	Logic level 0: **0V ~ 0.4V**
		Normal (high)	Logic level 1: **3.1V ~ 30V**
	Current		**10mA ~ 100mA**
DO	Connection design		TTL-compatible logic levels
	Voltage	To trigger (high)	Logic level 1: **2.4V ~ 5V**
		Normal (low)	Logic level 0: **0.1V ~ 0.6V**
	Current		**50mA**
Connection Type 3			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (low)	Logic level 0: **0V ~ 0.4V**
		Normal (high)	Logic level 1: **3.1V ~ 30V**
	Current		**10mA ~ 100mA**
DO	Connection design		Transistor (Open Collector)
	Voltage & Current		**< 24V DC, < 50mA**
Connection Type 4			
DI	Connection design		TTL-compatible logic levels
	Voltage	To trigger (low)	Logic level 0: **0V ~ 0.4V**
		Normal (high)	Logic level 1: **3.1V ~ 30V**
	Current		**10mA ~ 100mA**
Isolated DI * (only by request)	Connection Design		Photocoupler
	Voltage	To trigger	**2V ~ 15V**
		Normal	**0V**
	Current		**50mA**
DO	Connection design		Relay
	Voltages accepted		**125VAC/0.5A 30VDC/1A 110VDC/0.3A**

Reference: Important Terminology

Isolated Contact

Isolated contact, sometimes referred to as ***dry contact*****,** is the pair of pins on some terminal block which is physically isolated from powered circuits. Usually the isolated contact is merely a switch – you can connect your own power supply into those contacts to create a circuit. For example, the DO contacts of the video encoder TCD-2500, RY-COM and N.O. in the previous chapter are isolated contacts – they are NOT connected to any of the power supplies inside the device. In fact, there is just a magnetic switch between RY-COM and N.O which simply opens and closes the connection between these two pins from the inside of the device.

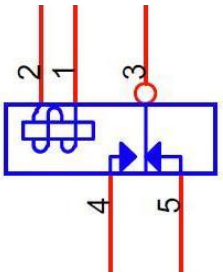
Typically, the isolated contacts are controlled by some sort of switching mechanism – either by a Relay or by a Photocoupler.

In simple words, if you put the fingers into an isolated contact, it would be 100% impossible to be electrocuted regardless of circumstances.

Non-isolated Contact

Non-isolated contact, sometimes referred to as ***wet contact***, is the contact which is physically connected to a powered circuit, even if it is temporarily disconnected by some other switches. For example the DI pins 1 and 3 in the previous chapter are non-isolated contacts – there is a possibility that in some condition, there will be a power directed through those pins from the camera.

Relay



Relay is an electrically operated switch. This allows a low powered circuit to control another high powered circuit. Its function for IP-surveillance devices is to connect and disconnect DI or DO circuits. Look at the scheme – the pins 1 and 2 are connected to the CPU of the camera. When the event occurs, the CPU releases the power into the circuit through pins 1 and 2, thereby activating the small magnet inside relay. The magnet pulls a switch closer to itself, and the wires 3 and 4 will be connected.

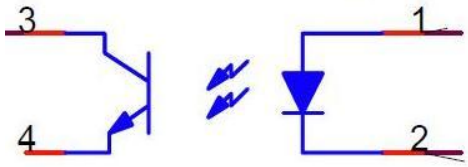
As you can see, the pins 3 and 4 are isolated (dry) contacts – there is no way the power from pins 1 and 2 could possibly get into the circuit of 3 and 4.

Relays are especially useful where the external device uses a totally different power range from the internal circuit of the pins 1 and 2. Thanks to relay, you can add a 110V AC lamp to the DO of the camera while the internal voltage of pins 1 and 2 is merely 3.3V DC.

It is important to know that every relay has its own specifications – the voltage and current limitation for the magnet trigger circuit, and the voltage and current limitation for the switch that controls the external high-voltage circuit. If you are going to build your own external relay based system then remember to choose the relay that matches with the power voltage in your region, for example 220V AC compatible relay.

Here are some images of commonly used relays.

Photocoupler



It is an element capable of transmitting signal to another circuit while electrically insulating the output signal from the input signal. It is essentially a light-activated relay that provides more protection for the circuit on the receiving end, which connects to the CPU in ACTi devices.

An electrical signal is first converted into an optical signal by the LED, and converted back into the electrical signal by the phototransistor on the receiving side. The whole assembly is sealed inside to protect from external light. As the signal passes by light, it insulates the two circuits more completely, allowing for a wider input voltage range than electromagnetic relays.

Below the examples of the photocouplers are shown.