User Manual

iDAQ-731, iDAQ-751, iDAQ-763D

Digital I/O and Relay Industrial DAQ Modules

ADVANTECH

Enabling an Intelligent Planet

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Product Warranty (2 years)

Advantech warrants the original purchaser that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products that have been repaired or altered by persons other than repair personnel authorized by Advantech, or products that have been subject to misuse, abuse, accident, or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced free of charge during the warranty period. For out-of-warranty repairs, customers will be billed according to the cost of replacement materials, service time, and freight. Please consult your dealer for more details.

If you believe your product is defective, follow the steps outlined below.

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 displayed 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 a return merchandise authorization (RMA) number from your dealer. This allows us to process your return more quickly.

4. Carefully pack the defective product, a completed Repair and Replacement Order Card, and a proof of purchase date (such as a photocopy of your sales receipt) into a shippable container. Products returned without a proof of purchase date are not eligible for warranty service.

5. Write the RMA number clearly on the outside of the package and ship the package prepaid to your dealer.

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 type of cable is available from Advantech. Please contact your local supplier for ordering information.

Test conditions for passing also include the equipment being operated within an industrial enclosure. In order to protect the product from damage caused by electrostatic discharge (ESD) and EMI leakage, we strongly recommend the use of CE-compliant industrial enclosure products.

FCC Class A

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 such cases, users are required to correct the interference at their own expense

警告使用者

這是甲類測試產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

Technical Support and Assistance

1. Visit the Advantech website at www.advantech.com/support to obtain the latest product information.
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 calling:
   – Product name and serial number
   – Description of your peripheral attachments
   – Description of your software (operating system, version, application software, etc.)
   – A complete description of the problem
   – The exact wording of any error messages

Warnings, Cautions, and Notes

Warning! *Warnings indicate conditions that if not observed can cause personal injury!*

Caution! *Cautions are included to help prevent hardware damage and data losses. For example,*

"Batteries are at risk of exploding if incorrectly installed. Do not attempt to recharge, force open, or heat the battery. Replace the battery only with the same or equivalent type as recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions."

Note! *Notes provide additional optional information.*

Document Feedback

To assist us with improving this manual, we welcome all comments and constructive criticism. Please send all such feedback in writing to support@advantech.com.

Packing List

Before system installation, check that the items listed below are included and in good condition. If any item does not accord with the list, contact your dealer immediately.

- iDAQ-731
  - iDAQ-731 x 1
  - 20-pin terminal block x 2
  - Startup Manual x 1

- iDAQ-751
  - iDAQ-751 x 1
  - Startup Manual x 1

- iDAQ-763D
  - iDAQ-731 x 1
  - 20-pin terminal block x 2
  - Startup Manual x 1

Safety Instructions

1. Read these safety instructions carefully.
2. Retain this user manual for future reference.
3. Disconnect the equipment from all power outlets before cleaning. Use only a damp cloth for cleaning. Do not use liquid or spray detergents.
4. For pluggable equipment, the power outlet socket must be located near the equipment and easily accessible.
5. Protect the equipment from humidity.
6. Place the equipment on a reliable surface during installation. Dropping or letting the equipment fall may cause damage.
7. The openings on the enclosure are for air convection. Protect the equipment from overheating. Do not cover the openings.
8. Ensure that the voltage of the power source is correct before connecting the equipment to a power outlet.
9. Position the power cord away from high-traffic areas. Do not place anything over the power cord.
10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage from transient overvoltage.
12. Never pour liquid into an opening. This may cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If any of the following occurs, have the equipment checked by service personnel:
    – The power cord or plug is damaged.
    – Liquid has penetrated the equipment.
    – The equipment has been exposed to moisture.
    – The equipment is malfunctioning, or does not operate according to the user manual.
    – The equipment has been dropped and damaged.
    – The equipment show obvious signs of breakage.
15. Do not leave the equipment in an environment with a storage temperature of below -20 °C (-4 °F) or above 60 °C (140 °F) as this may damage the components. The equipment should be kept in a controlled environment.
16. CAUTION: Batteries are at risk of exploding if incorrectly replaced. Replace only with the same or equivalent type as recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.
17. In accordance with IEC 704-1:1982 specifications, the sound pressure level at the operator's position does not exceed 70 dB (A).

DISCLAIMER: These instructions are provided according to IEC 704-1 standards. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

Wichtige Sicherheishinweise

1. Bitte lesen sie Sich diese Hinweise sorgfältig durch.
2. Heben Sie diese Anleitung für den späteren Gebrauch auf.
3. Vor jedem Reinigen ist das Gerät vom Stromnetz zu trennen. Verwenden Sie Keine Flüssig-oder Aerosolreiniger. Am besten dient ein angefeuchtetes Tuch zur Reinigung.
4. Die NetzanschluBsteckdose soll nahe dem Gerät angebracht und leicht zugänglich sein.
5. Das Gerät ist vor Feuchtigkeit zu schützen.
6. Bei der Aufstellung des Gerätes ist auf sicheren Stand zu achten. Ein Kippen oder Fallen könnte Verletzungen hervorrufen.
7. Die Belüftungsöffnungen dienen zur Luftzirkulation die das Gerät vor über-hitzung schützt. Sorgen Sie dafür, daB diese Öffnungen nicht abgedeckt werden.
8. Beachten Sie beim. AnschluB an das Stromnetz die AnschluBwerte.
9. Verlegen Sie die NetzanschluBleitung so, daB niemand darüber fallen kann. Es sollte auch nichts auf der Leitung abgestellt werden.
10. Alle Hinweise und Warnungen die sich am Geräten befinden sind zu beachten.
11. Wird das Gerät über einen längeren Zeitraum nicht benutzt, sollten Sie es vom Stromnetz trennen. Somit wird im Falle einer Überspannung eine Beschädigung vermieden.
12. Durch die Lüftungsöffnungen dürfen niemals Gegenstände oder Flüssigkeiten in das Gerät gelangen. Dies könnte einen Brand bzw. elektrischen Schlag aus-lösen.
13. Öffnen Sie niemals das Gerät. Das Gerät darf aus Gründen der elektrischen Sicherheit nur von authorisiertem Servicepersonal geöffnet werden.
14. Wenn folgende Situationen auftreten ist das Gerät vom Stromnetz zu trennen und von einer qualifizierten Servicestelle zu überprüfen:
    – Netzkabel oder Netzstecker sind beschädigt.
    – Flüssigkeit ist in das Gerät eingedrungen.
    – Das Gerät war Feuchtigkeit ausgesetzt.
    – Wenn das Gerät nicht der Bedienungsanleitung entsprechend funktioniert oder Sie mit Hilfe dieser Anleitung keine Verbesserung erzielen.
    – Das Gerät ist gefallen und/oder das Gehäuse ist beschädigt.
    – Wenn das Gerät deutliche Anzeichen eines Defektes aufweist.
15. VOSICHT: Explisionsgefahr bei unsachgemaben Austausch der Batterie.Ersatz nur durch densellben order einem vom Hersteller empfohlene-mahnlichen Typ. Entsorgung gebrauchter Batterien navh Angaben des Herstellers.
16. ACHTUNG: Es besteht die Explosionsgefahr, falls die Batterie auf nicht fach-männische Weise gewechselt wird. Verfangen Sie die Batterie nur gleicher oder entsprechender Type, wie vom Hersteller empfohlen. Entsorgen Sie Batterien nach Anweisung des Herstellers.
17. Der arbeitsplatzbezogene Schalldruckpegel nach DIN 45 635 Teil 1000 beträgt 70dB(A) oder weiger.

Haftungsausschluss: Die Bedienungsanleitungen wurden entsprechend der IEC-704-1 erstellt. Advantech lehnt jegliche Verantwortung für die Richtigkeit der in die-sem Zusammenhang getätigten Aussagen ab.

Safety Precautions - 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 the PC chassis before manual handling. Do not touch any components on the CPU card or other cards while the PC is powered on.

■ Disconnect the power before making any configuration changes. A sudden rush of power after connecting a jumper or installing a card may damage sensitive electronic components.

Contents

Chapter 1

Start Using IDAQ-731/751/763D

1.1 Product Overview

This chapter provides an overview of Advantech industrial data acquisition (iDAQ) module for iDAQ-731, iDAQ-751 and iDAQ-763D, ranging the product lineups, features, driver, utility and accessories.

The iDAQ-731, iDAQ-751 and iDAQ-763D are digital I/O modules. The function for these models are isolated digital I/O, TTL I/O and solid-state relay (SSR) respectively.

All of the iDAQ modules could be used in all kinds of iDAQ chassis. In the following sections, the detailed use instruction and functions will be described.

Figure 1.1 iDAQ-731

iDAQ-751
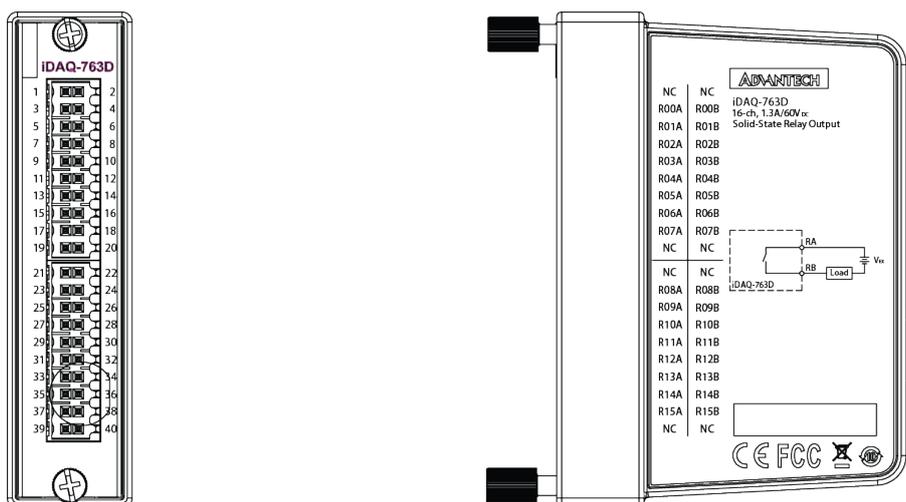

Figure 1.2 iDAQ-751

iDAQ-763D

Figure 1.3 iDAQ-763D

1.2 Product Features

1.2.1 Power Input

The power input of all the iDAQ I/O modules comes from iDAQ chassis through the DB 15-pin connector. The iDAQ I/O modules would be powered on when the power of iDAQ chassis is connected. For the power consumption information, please refer to A4. General for detail information.

1.2.2 BoardID

A board ID can be assigned to the iDAQ chassis by the rotary switch and slot number. The board ID will be shown in the software and can be used to distinguish modules. The number shown around the rotary switch is in hexadecimal format. For example, "A" represent 10 in decimal format, and "F" represents 15 in decimal format. The number assigned to each iDAQ module follows a rule combining the ChassisID and slot number. Refer to section 3.4 for all the detailed information.

1.2.3 Plug and Play Device

iDAQ modules are hot-swappable in iDAQ chassis. The modules are recognized instantly in the software when they're plugged into the iDAQ slots, the same when they are unplugged. Therefore, it's strongly recommended not to perform this while the system is in acquisition mode - the system should be in idle mode.

1.3 Driver Installation

The driver package could be found on Advantech Support Portal (https://www.advantech.com/support). Search for iDAQ on the support portal, then the corresponded driver/SDK package could be found. You'll get the XNavi installer after the download session finishes.

Execute the installer, then it will guide you through the session. You can choose the device and software components you'd like to install in the system (figure 1.4). After the selection, click on "start" to begin the installation.
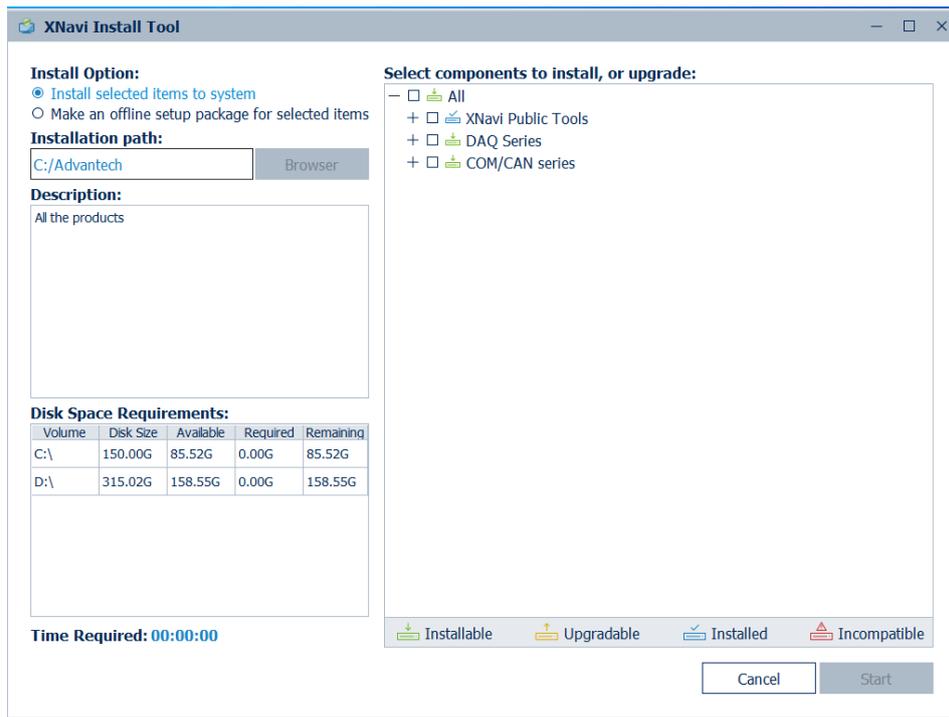
Figure 1.4 XNavi Installer

1.4 Software Utility

Advantech offers device drivers, SDKs, third-party driver support and application software to help fully exploit the functions of your iDAQ system. All these software packages are available on Advantech website: http://www.advantech.com/.

The Advantech Navigator is a utility that allows you to set up, configure and test your device, and later stores your settings in a proprietary database.

1. To set up the I/O device for your card, you could first run the Advantech Navigator program (by accessing Start/Programs/Advantech Automation/DAQNavi/ Advantech Navigator). The settings could also be saved to

2. You can then view the device(s) already installed on your system (if any) on the Installed Device tree view. If the software and hardware installation are completed, you will see iDAQ modules in the Installed Devices list.

1.5 Software Development Using DAQNavi SDK

DAQNavi SDK is the software development kit for programming applications with Advantech DAQ products. The necessary runtime DLL, header files, software manual and tutorial videos could be installed via XNavi installer. They could be found under C:\Advantech\DAQNavi (default directory) after the finishing the installation.

1.6 Application Software DAQNavi MCM

DAQNavi MCM is an application software focusing on high-speed data acquisition, data monitoring and network access. It provides graphical interface for users to achieve DAQ configuration, data pre-processing, feature extraction, user-defined formula calculation and the output settings to upload data. All the settings could also be saved to a project file for further parameter management. On top of that, the datalogging function is also available in DAQNavi/MCM. All the data could be saved not only in local storage, but also in remote storage.

By introducing the DAQNavi/MCM, the DAQ system could become an IoT-solution-ready edge device. For more information, please search for DAQNavi/MCM on the Advantech Support Portal (https://www.advantech.com/support).

1.7 FPGA Code Update

The FPGA can also be updated via the interface in Navigator. However, it isn't normal to make an FPGA update. Advantech strongly suggests you to consult your technical support before starting an FPGA update.

1.8 Ordering Information

iDAQ-731-AE	16-ch IDI and 16-ch Universal IDO iDAQ module
iDAQ-751-AE	48-ch TTL Digital I/O iDAQ Module
iDAQ-763D-AE	16-ch SSR iDAQ module

1.9 Accessories

All of the followings are the accessories for iDAQ-751

PCL-10162-1E	DB-62 Shielded Cable, 1m
PCL-10162-3E	DB-62 Shielded Cable, 3m
ADAM-3962-AE	DB-62 Wiring Terminal, DIN-rail Mount

Chapter 2

Installation and Field Application

2.1 Installation

This section provides guides from module installation to signal wiring for the iDAQ modules.

Below are the steps to insert the iDAQ modules into the iDAQ chassis.

1. Insert the module and follow the guide rail to the end.
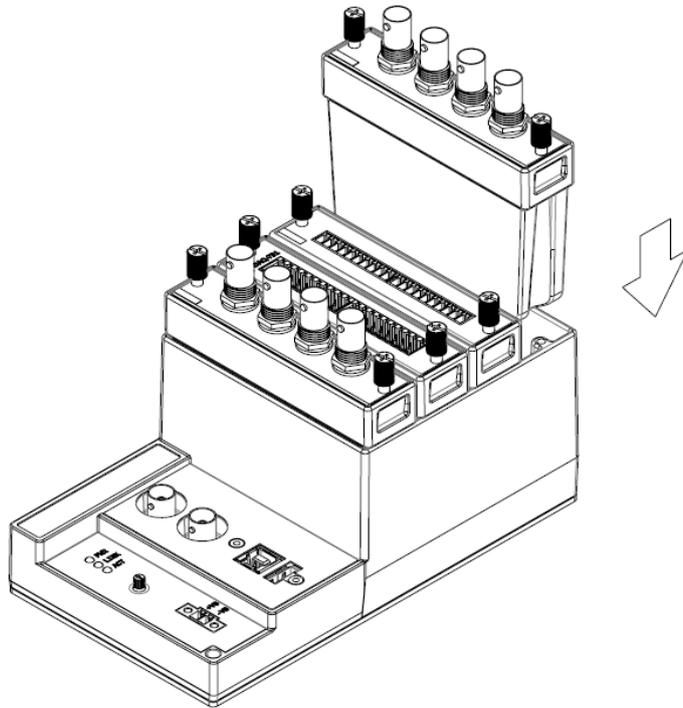2. Fix the two screws tight onto the chassis.

Figure 2.1 Installing iDAQ modules into the iDAQ chassis

2.2   Signal Connection and Pin Assignment

2.2.1   Isolated Digital Input Connection

A digital input channel senses the state of the external sensor or switch, and passes it through a galvanic isolator to the internal circuit. Figure 2.2 shows the digital input signal connection.
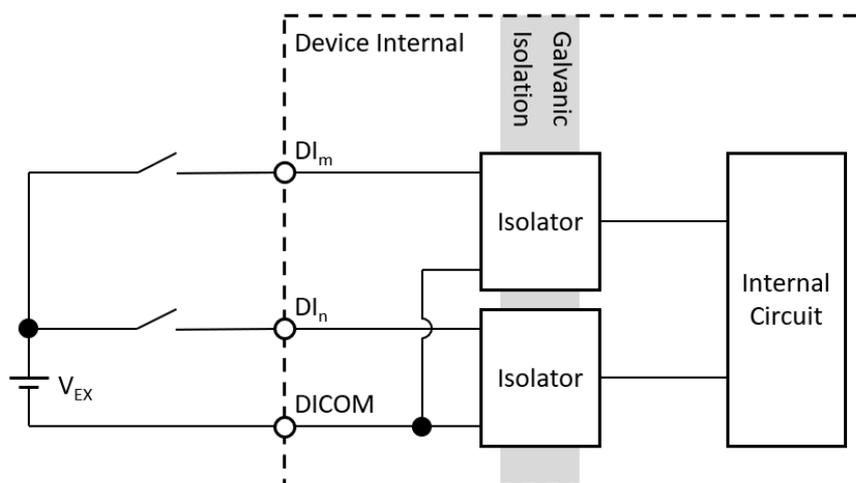

Figure 2.2 Digital input signal connection.

There are several digital input common (DICOM) pins which are shorted together inside the device. All digital input signals are referenced to DICOM. Therefore, the negative terminal of the external voltage sources should be connected to DICOM for proper operation.

If the input voltage is within OFF or ON state logic level, a logic low (0) or high (1) will be sensed, respectively. If the input voltage is between the OFF and ON state logic levels, the result is undetermined, which may be low or high. User should ensure the ON/OFF state voltages of the sensors or switches meet the required values. Do not input a voltage higher than the maximum value of ON state logic level or lower than the minimum value of OFF state logic level. The device may be damaged under such circumstance. Refer to A1. Isolated Digital Input (iDAQ-731) for OFF and ON state logic level for the device.

Each digital input channel is equipped with a galvanic isolator, which can withstand a large continuous voltage between external side and internal side. This prevents internal circuit from damaging when such fault condition happens.

2.2.2 Isolated Digital Output Connection

A digital output channel sends a signal through a galvanic isolator to control the ON/OFF state of a MOSFET switch. The state of the MOSFET switch then decides if the load is conducting or not. The universal digital output channel supports both sink (NPN) type and source (PNP) type connection as shown in Figure 2.3.
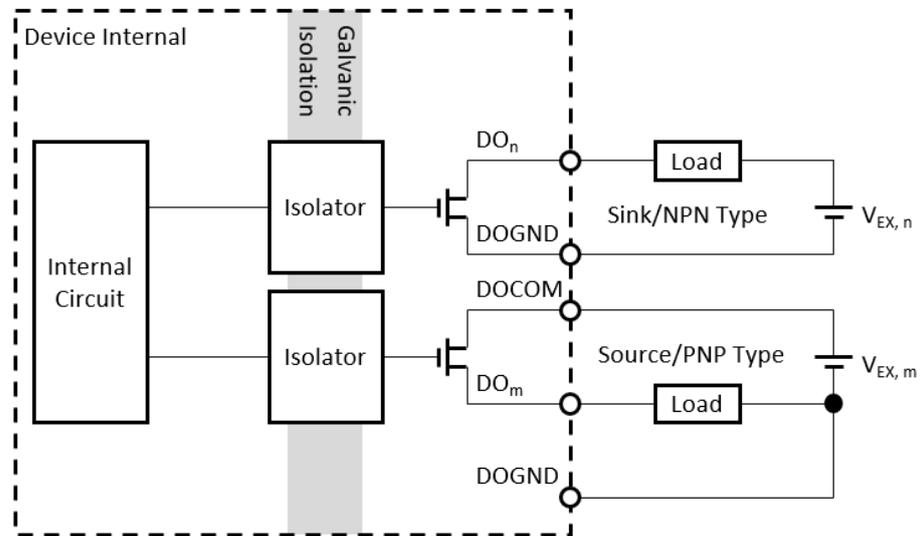

Figure 2.3 Digital output signal connection.

For a sink type digital output, the current which flows through the load is sunk by the digital output (DO) terminal, and returns to the external source through the digital output ground (DOGND) terminal. This is shown in Figure 2.4.
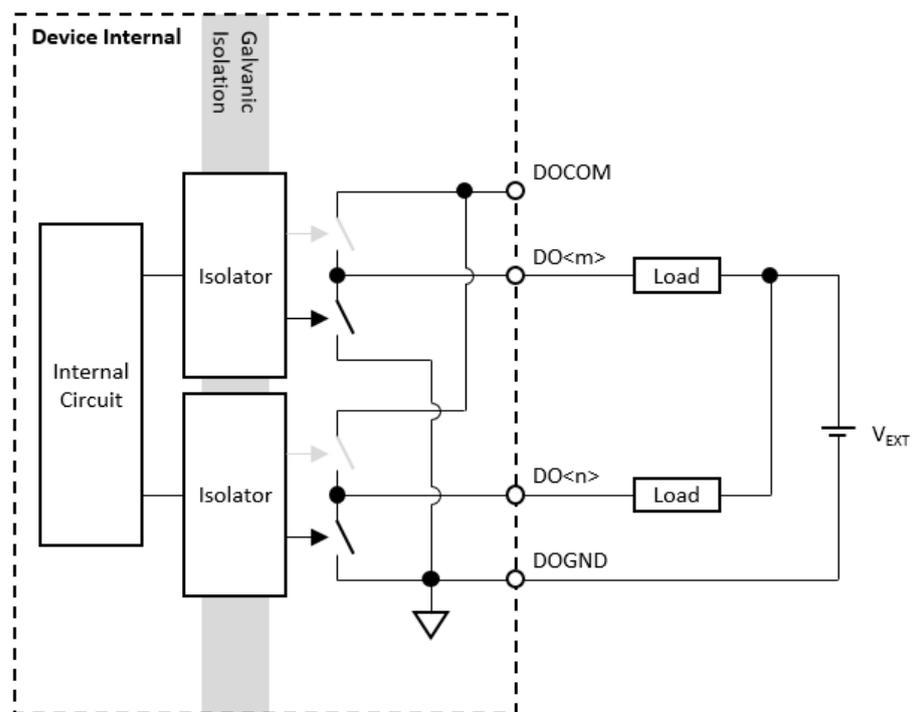

Figure 2.4 Sink (NPN) type digital output signal connection.

For a source type digital output, the external source is connected to the digital output common (DOCOM) terminal. The current which flows through the load is sourced from the DO terminal. This is shown in Figure 2.5. Connect the negative terminal of the external source to the DOGND terminal for a correct potential reference.
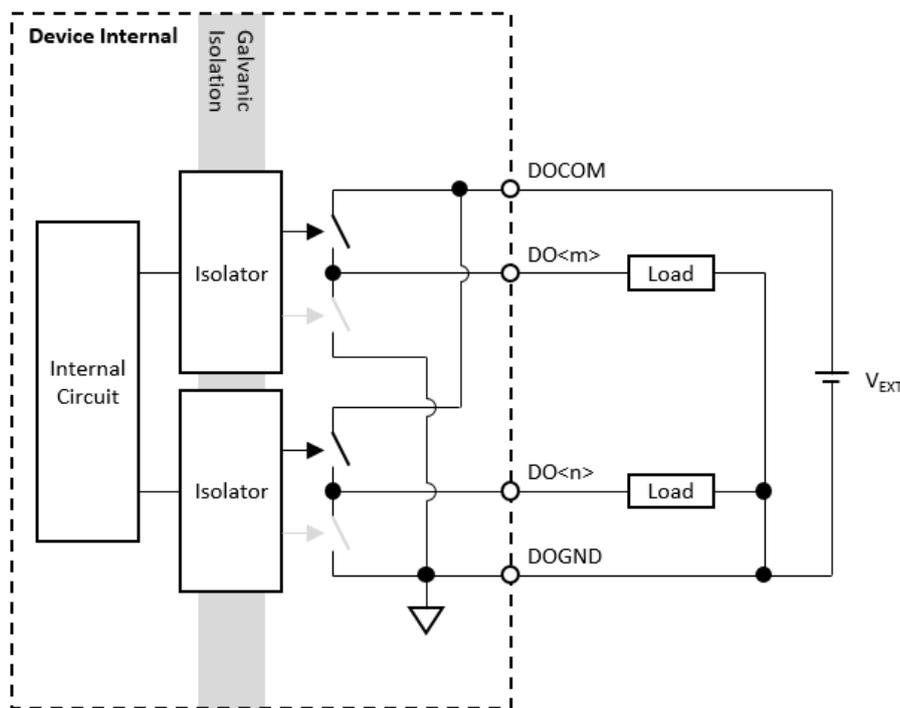

Figure 2.5 Source (PNP) type digital output signal connection.

Both the voltage of the external source and the load current must be within the range as specified in the device specifications for proper operation and to prevent the device from damaging. The expected load current in amps can be calculated by the following equation.

$$I_{LOAD} = \frac{V_{EXT}}{R_{LOAD} + R_{INT}}$$

where...

V_{EXT} is the voltage of the external source in volts,

R_{LOAD} is the load resistance in ohms, and

R_{INT} is the internal resistance of the switch in ohms, which can be found in the device specifications.

The device is also equipped with flyback diodes and resettable fuses (polyswitches) for each channel. The flyback diode provides a continuous current path for inductive load to dissipate energy when the digital output channel becomes OFF. This prevents the inductive load from generating a large back EMF which may damage the device. The resettable fuse disconnects the circuit when over-current condition occurs, which prevents the internal MOSFET switch from begin damaged. It automatically resets (reconnects circuit) after over-current condition is removed.

2.2.3 TTL Digital Input

A digital input/output (DI/O) channel can be configured by software to perform digital input measurement, which is the power-on default configuration, or digital output generation. When performing digital input measurement, the voltage logic level between the digital input (DI) terminal and the digital ground (DGND) terminal is measured. To prevent undetermined or fluctuating results when input is floating, the digital input channel is internally pulled-down. This is shown in Figure 2.6.
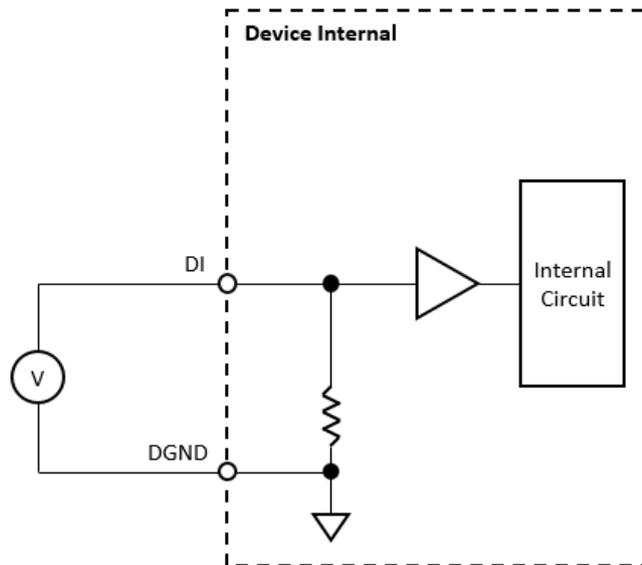

Figure 2.6 Digital input signal connection.

The input voltage must be either higher than the minimum value of ON state or lower than the maximum value of OFF state for deterministic result. If the input voltage is between these two values, the result is undetermined, which may be ON or OFF. In addition, do not input a voltage higher than the maximum allowable value of ON state or lower than the minimum allowable value of OFF state. The device may be damaged under such circumstance. Refer to the device specifications for ON and OFF state voltage ranges.

The digital input channel can also sense the status of an external switch. The status of an external switch which is connected between the external source and the DI terminal is sensed as shown in Figure 2.7. Be sure the voltage of the external source is within the allowable range of ON state as specified in the device specifications.
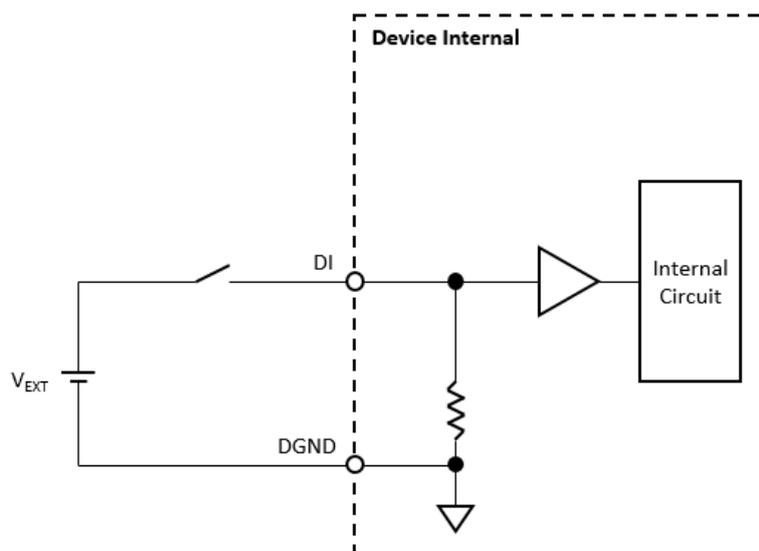
Figure 2.7 Digital input signal connection using a switch with internally pulled-down.

2.2.4 TTL Digital Output

A digital input/output (DI/O) channel can be configured by software to perform digital input measurement, which is the power-on default configuration, or digital output generation. When performing digital output generation, a voltage logic level is generated between the digital output (DO) terminal and the digital ground (DGND) terminal. This is shown in Figure 2.8.
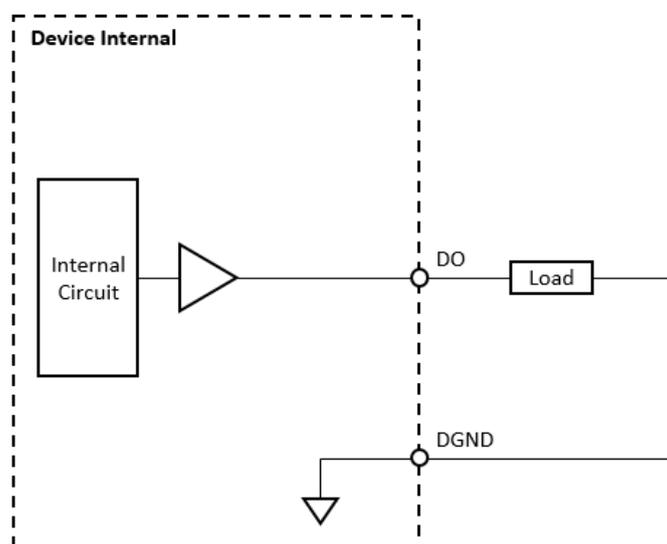

Figure 2.8 Digital output signal connection.

Each digital output channel can source or sink only finite amount of current. If this limit is exceeded, the output voltage will not stay in the specified voltage logic level. Refer to the device specifications for the maximum source and skin current values.

2.2.5 Solid-state Relay (SSR) Output Connection

A solid-state relay (SSR) output channel sends a signal to control the ON/OFF state of an SSR. The state of the SSR then decides if the load is conducting or not. This is shown in Figure 2.9.
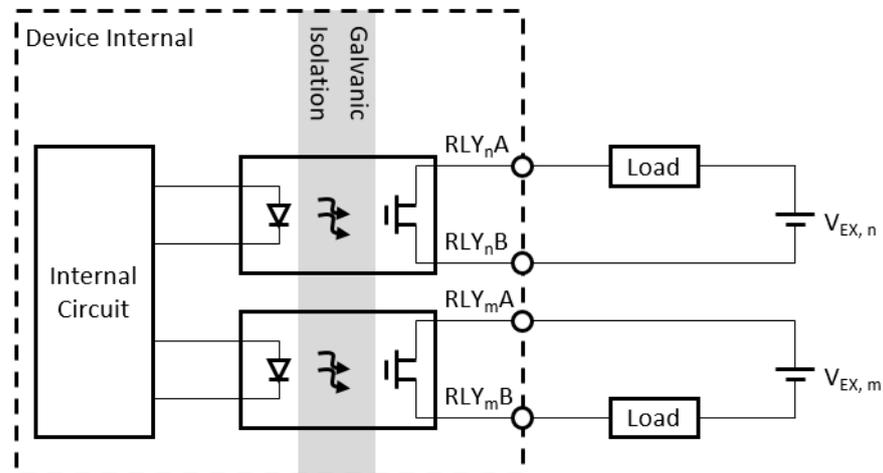

Figure 2.9 Solid-state relay output signal connection.

The SSR is non-directional. The load voltage polarity can be either direction. Both the voltage of the external voltage source and the load current must be within the range as specified in A5. Solid-State Relay (SSR) Output. The device may be damaged if the voltage or current is beyond the maximum value.

The SSR provides galvanic isolation protection, which can withstand a large continuous voltage between external side and internal side. This prevents device damage when such fault condition happens.

The device is also equipped with a transient voltage suppressor for each channel. When the relay which is connected to an inductive load becomes OFF, a large back EMF will be generated. The suppressor clamps the EMF to a maximum value which does not damage the device.

2.2.6 Pin Assignment

iDAQ-731
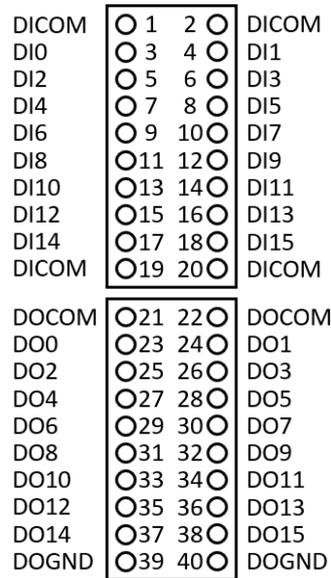
Figure 2.10 Pin assignment of iDAQ-731

Pin Name	Description	Pin Number
DICOM	Digital input common point	1, 2, 19, 20
DI<n>	Digital input n, n = 0~15	3~18
DOCOM	Digital output common point (for source/PNP type)	21, 22
DO<n>	Digital output n, n = 0~15	23~38
DOGND	Digital output ground (for sink/NPN type)	39, 40

iDAQ-751

Figure 2.11 Pin assignment of iDAQ-751

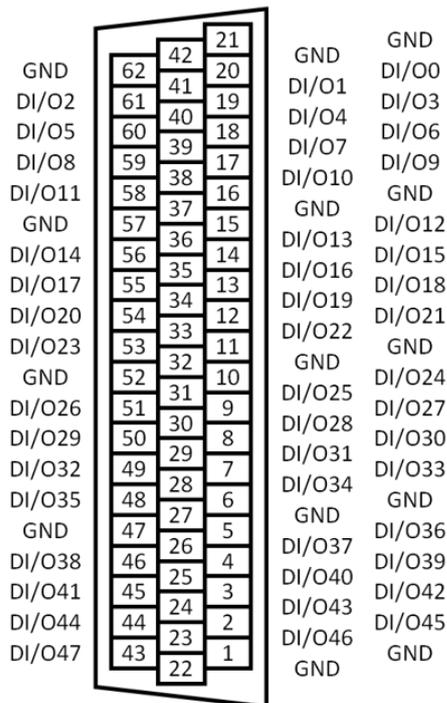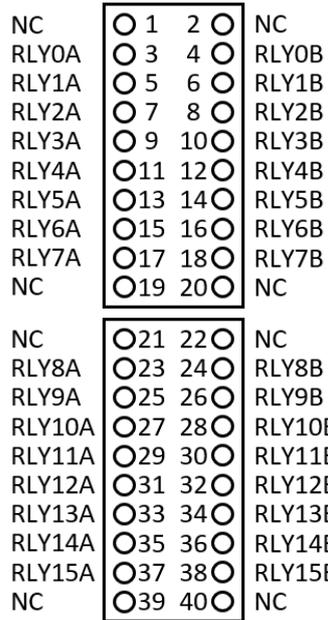| Pin Name	Description	Pin Number	Pin Name	Description	Pin Number
DI/O0	Digital input/output 0	20	DI/O24	Digital input/output 24	10
DI/O1	Digital input/output 1	41	DI/O25	Digital input/output 25	31
DI/O2	Digital input/output 2	61	DI/O26	Digital input/output 26	51
DI/O3	Digital input/output 3	19	DI/O27	Digital input/output 27	9
DI/O4	Digital input/output 4	40	DI/O28	Digital input/output 28	30
DI/O5	Digital input/output 5	60	DI/O29	Digital input/output 29	50
DI/O6	Digital input/output 6	18	DI/O30	Digital input/output 30	8
DI/O7	Digital input/output 7	39	DI/O31	Digital input/output 31	29
DI/O8	Digital input/output 8	59	DI/O32	Digital input/output 32	49
DI/O9	Digital input/output 9	17	DI/O33	Digital input/output 33	7
DI/O10	Digital input/output 10	38	DI/O34	Digital input/output 34	28
DI/O11	Digital input/output 11	58	DI/O35	Digital input/output 35	48
DI/O12	Digital input/output 12	15	DI/O36	Digital input/output 36	5
DI/O13	Digital input/output 13	36	DI/O37	Digital input/output 37	26
DI/O14	Digital input/output 14	56	DI/O38	Digital input/output 38	46
DI/O15	Digital input/output 15	14	DI/O39	Digital input/output 39	4
DI/O16	Digital input/output 16	35	DI/O40	Digital input/output 40	25
DI/O17	Digital input/output 17	55	DI/O41	Digital input/output 41	45
DI/O18	Digital input/output 18	13	DI/O42	Digital input/output 42	3
DI/O19	Digital input/output 19	34	DI/O43	Digital input/output 43	24
DI/O20	Digital input/output 20	54	DI/O44	Digital input/output 44	44
DI/O21	Digital input/output 21	12	DI/O45	Digital input/output 45	2
DI/O22	Digital input/output 22	33	DI/O46	Digital input/output 46	23
DI/O23	Digital input/output 23	53	DI/O47	Digital input/output 47	43
GND	Ground	1, 6, 11, 16, 21, 22, 27, 32, 37, 42, 47, 52, 57, 62			

iDAQ-763D

```
NC     ⭘ 1    2 ⭘   NC
RLY0A  ⭘ 3    4 ⭘   RLY0B
RLY1A  ⭘ 5    6 ⭘   RLY1B
RLY2A  ⭘ 7    8 ⭘   RLY2B
RLY3A  ⭘ 9   10⭘   RLY3B
RLY4A  ⭘11   12⭘   RLY4B
RLY5A  ⭘13   14⭘   RLY5B
RLY6A  ⭘15   16⭘   RLY6B
RLY7A  ⭘17   18⭘   RLY7B
NC     ⭘19   20⭘   NC

NC     ⭘21   22⭘   NC
RLY8A  ⭘23   24⭘   RLY8B
RLY9A  ⭘25   26⭘   RLY9B
RLY10A ⭘27   28⭘   RLY10B
RLY11A ⭘29   30⭘   RLY11B
RLY12A ⭘31   32⭘   RLY12B
RLY13A ⭘33   34⭘   RLY13B
RLY14A ⭘35   36⭘   RLY14B
RLY15A ⭘37   38⭘   RLY15B
NC     ⭘39   40⭘   NC
```

Figure 2.12 Pin assignment of iDAQ-763D

Pin Name	Description	Pin Number
RLY<n>A	Solid-state relay (SSR) n terminal A	3, 5, 7, … , 17 ,23 ,25, 27, … ,37
RLY<n>B	Solid-state relay (SSR) n terminal B	4, 6, 8, … , 18, 24, 26, 28, … , 38
NC	Not connected	1, 2, 19, 20, 21, 22, 39, 40

Chapter **3**

Function Details

3.1 Function Details

The iDAQ system rely on the chassis module as a platform to compromise all the signals together, in order to achieve functions including synchronization, data streaming and timing control. This chapter describes all the functions that the iDAQ systems provide and how they work. For detailed software settings, please refer to the software manual.

3.2 Trigger and Timing Signal Output

According to the configuration, the module can generate a start trigger signal and a stop trigger signal. This will be described in the following sections.

3.2.1 Digital Trigger

One of the digital input channel can be selected as the signal source for the specified trigger signal. The trigger signal can be configured as rising edge active or falling edge active, as shown in Figure 3-1 and 3-2, respectively.
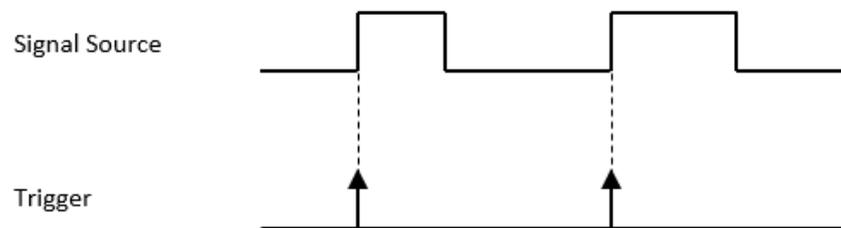

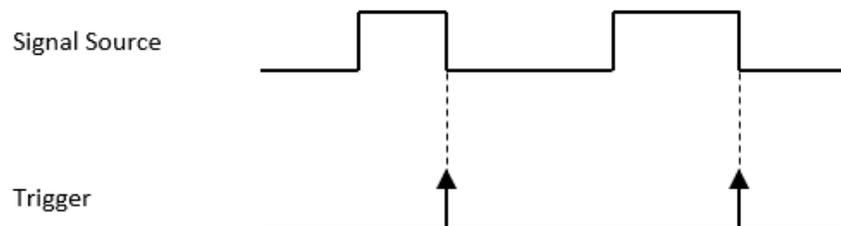
Figure 3.1 Rising edge active digital trigger.

Figure 3.2 Falling edge active digital trigger.

3.3 Digital Input

Insert an iDAQ module supporting digital input function to perform digital input measurement. The following sections describe the digital input acquisition mechanism. For detailed specifications of the functions, refer to the document of the corresponded iDAQ module.

3.3.1 Digital Input Functions

There are two functions, interrupt and debounce filter other than the input value reading function. This section lists all the details about these functions.

3.3.1.1 Digital Input Interrupt

All digital input channels can generate software interrupts (or events) to notice the application about the state change of input signals. Interrupts can occur at rising edge, falling edge, or both edges of the digital input signal as shown in Figure 3.3, Figure 3.4, and Figure 3.5, respectively. The enable/disable interrupt function and the selection of interrupt edges can be configured independently for each digital input channel.
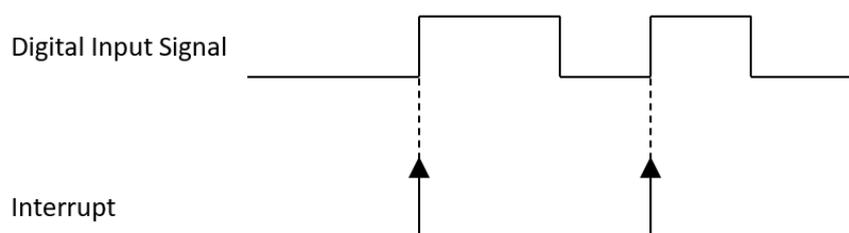

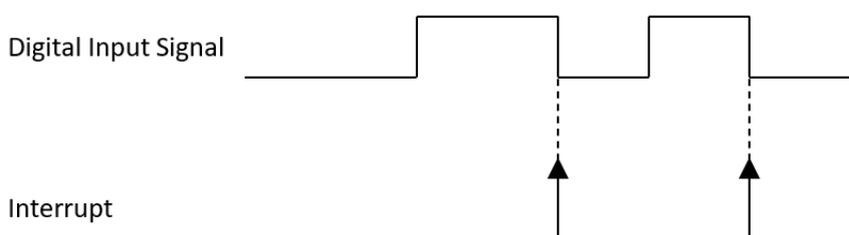**Figure 3.3 Digital input rising edge interrupts.**

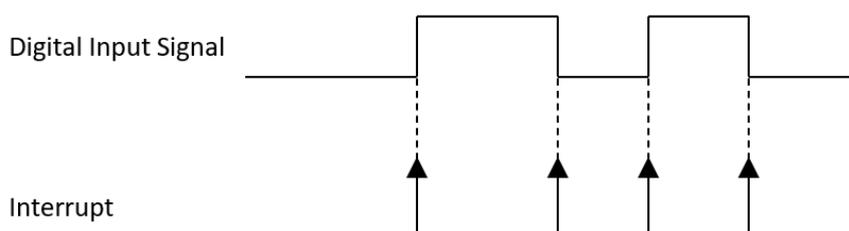**Figure 3.4 Digital input falling edge interrupts.**

Figure 3.5 Digital input both edges interrupts.

3.3.1.2 Digital Input Pattern Match Interrupt

Digital input channels can also generate an interrupt by detecting a specific pattern. The pattern can be configured by ports, and each channel can be enabled or disabled the detection independently. For example, if channels 0, 1, 2, 3, 6, and 7 of a digital input port is pattern match detect enabled, and the pattern is "10xx0100" (channel 7 through 0, where x indicates don't care bit), the pattern match interrupt will be generated as shown in Figure 3.6.
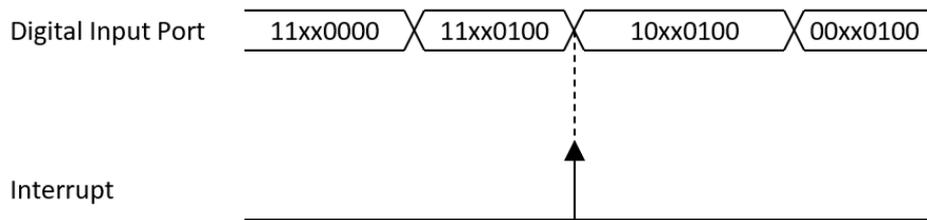

Figure 3.6 Digital input pattern match interrupt for pattern "10xx0100".

3.3.1.3 Digital Input Debounce Filter

To prevent false interrupts due to noise or bouncing in the signal, the digital input signals can be filtered. If digital input filter is enabled, transient signals with duration smaller than the filter duration will be considered as glitches and will not generate interrupts as shown in Figure 3.7. Digital input debounce filter can be enabled or disabled independently for each channel, and filter duration can be configured by ports (8 channels).
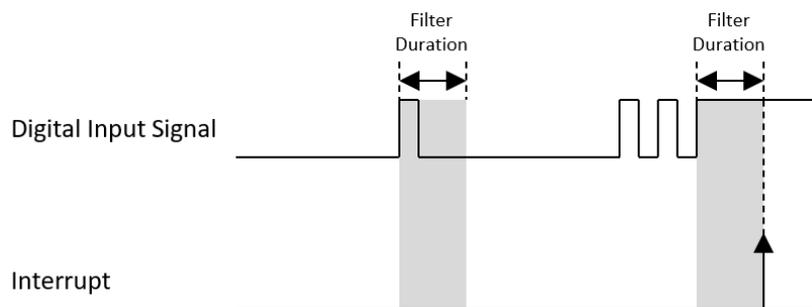

Figure 3.7 Digital input debounce filter.

3.3.2 Instant Digital Input Acquisition

With instant digital input acquisition, the software controls the sample timing. Each time the software sends a "read instant digital input sample" command, the state of all digital input channels is sampled as shown in Figure 3.8.
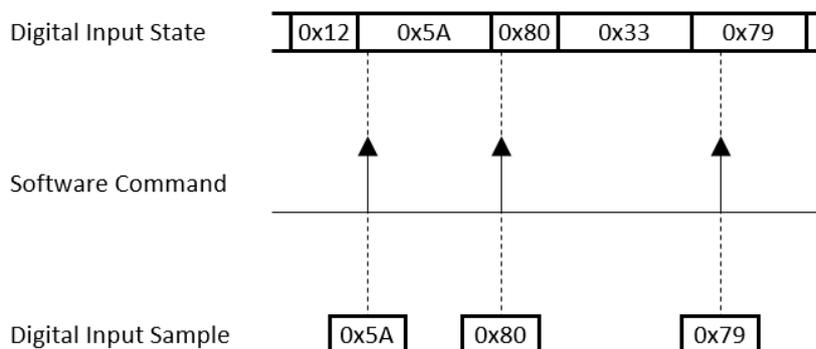

Figure 3.8 Instant digital input acquisition.

3.3.3 Buffered Digital Input Acquisition

With buffered acquisition, a hardware signal called sample clock controls the rate and time of acquisition as shown in Figure 3.9. The sample clock can be generated internally on the device or be provided externally. Refer to the device specifications for supported sample clock sources and the maximum allowable frequency of sample clock.
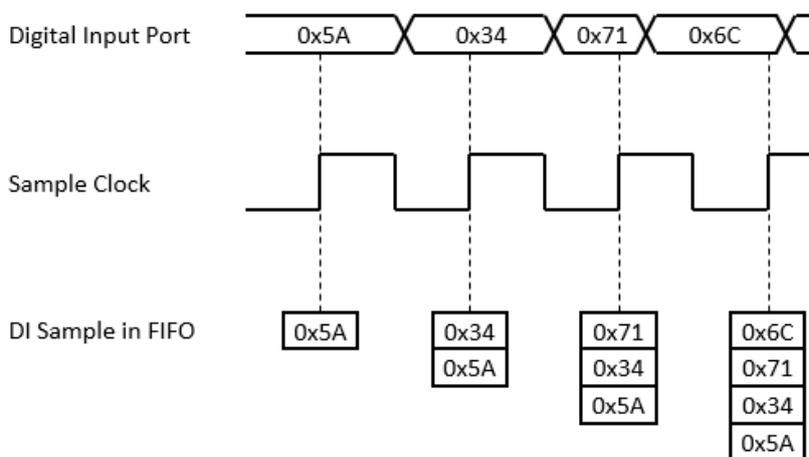

Figure 3.9 Digital input buffered (hardware-timed) acquisition.

The acquired samples are first accumulated in the onboard first-in-first-out (FIFO) memory of the device, and then moved to the buffer in the PC by a direct memory access (DMA) engine. A buffer is a block of memory in the PC for temporarily storing the data to be transferred to the application memory. Because the data is moved in large blocks instead of one point at a time, buffered acquisition typically allow much higher transfer rates. Buffered acquisition is also called hardware-timed acquisition.

The advantages of buffered acquisition over instant acquisition include:

■ The sample rate can be much higher.
■ The time of sample is deterministic.
■ Hardware triggers can be used.

3.4 Configuration for Buffered Digital Input Acquisition

According to software configurations, buffered digital input acquisition can be classified into two types:

- One-buffered digital input acquisition
- Streaming digital input acquisition

3.4.1 One-buffered Digital Input Acquisition

For one-buffered acquisition, only a specified number of samples is acquired. The start or stop of acquisition can be controlled by a software command or a hardware signal. Three types of acquisitions can be achieved: post-trigger acquisition, pre-trigger acquisition, and about-trigger acquisition.

3.4.1.1 Post-Trigger Acquisition

A post-trigger acquisition acquires a specified number of samples after the start trigger. The acquisition starts when a start trigger is received and automatically stops when the specified number of samples is acquired. An example of 5-sample post-trigger acquisition is shown in Figure 3.10.
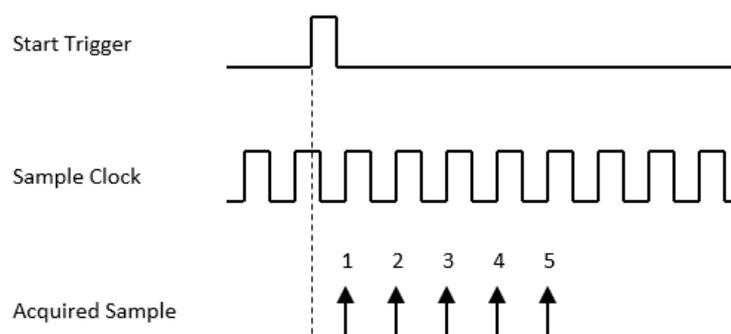

Figure 3.10 Post-trigger acquisition.

The start trigger can be a software command or a hardware signal. If a hardware signal is used as the start trigger, the start of acquisition can be delayed for a specified number of sample clock cycles after a start trigger is received. Figure 3.11 shows an example of a 2-sample delay post-trigger acquisition. Refer to the device specifications for possible signal sources.
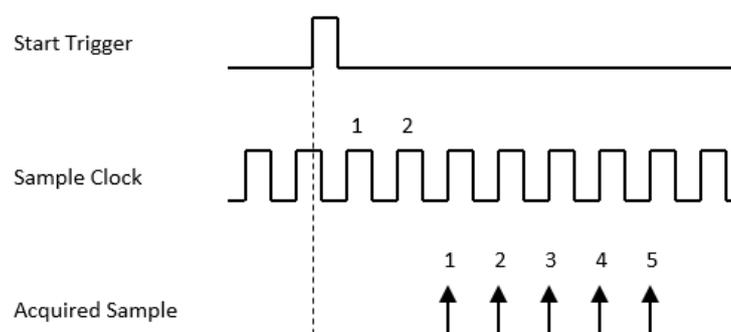

Figure 3.11 Post-trigger acquisition with delay.

3.4.1.2 Pre-Trigger Acquisition

A pre-trigger acquisition acquires a specified number of samples before the stop trigger. The acquisition is started by a software command and stops when a hardware stop trigger is received. Figure 3.12 shows an example of a 5-sample pre-trigger acquisition. Only the samples in the shaded area are returned.
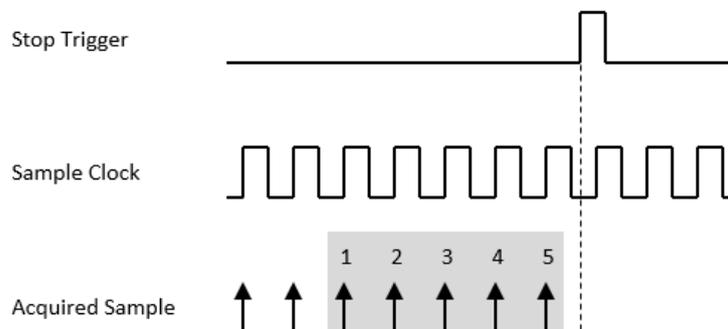

Figure 3.12 Pre-trigger acquisition.

The stop trigger can only be a hardware signal. Refer to the device specifications for possible signal sources.

3.4.1.3 About-Trigger Acquisition

An about-trigger acquisition is the same as a pre-trigger acquisition except that the time when the acquisition stops can be delayed by a specified number of sample clock cycles. Figure 3.13 shows an example of a 5-sample about-trigger acquisition with 2 cycles of stop delay. Only the samples in the shaded area are returned.
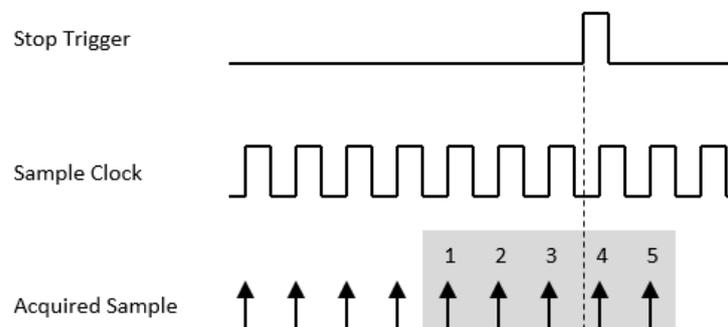

Figure 3.13 About-trigger acquisition.

The stop trigger can only be a hardware signal. Refer to the device specifications for possible signal sources.

3.4.2 Streaming Digital Input Acquisition

For a streaming acquisition, the number of samples to be acquired is set to infinite. The acquisition starts when a start trigger is received and continues until a stop trigger is received as shown in Figure 3.14.
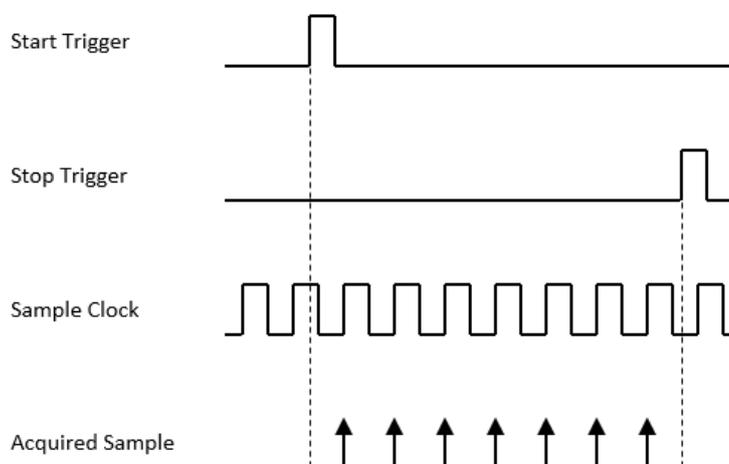

Figure 3.14 Streaming acquisition.

Both the start trigger and the stop trigger can come from a software command or a hardware signal. If a hardware signal is used, the start (for the start trigger) or the stop (for the stop trigger) of the acquisition can also be delayed. Refer to the device specifications for possible signal sources.

3.4.3 Retriggerable Digital Input Acquisition

The acquisition can be retriggerable. When re-trigger is enabled, after the acquisition stops, it restarts whenever the required trigger is received, and reconfiguration of the acquisition is not required.

Figures 3.15 to 3.18 show examples of retrigger acquisition for post-trigger, pre-trigger, about-trigger, and streaming acquisitions, respectively. In a post-trigger acquisition, a start trigger is ignored while the acquisition is in progress. In an about-trigger acquisition, a stop trigger is ignored while the acquisition is being stopped.
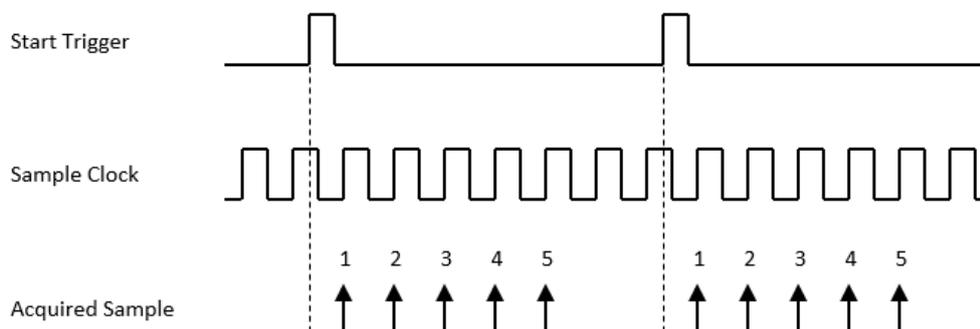

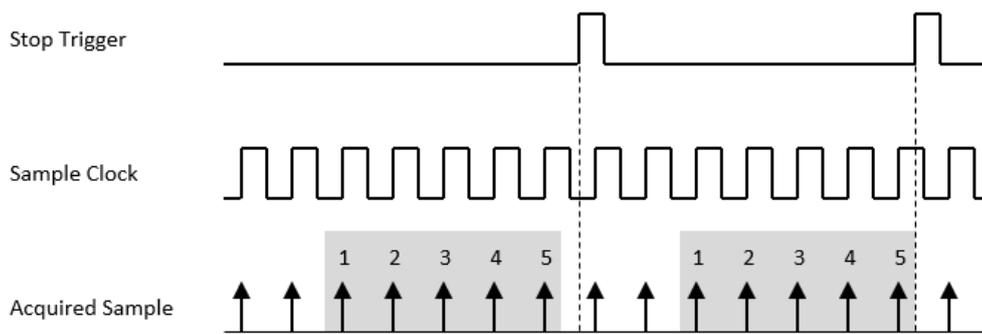**Figure 3.15 Post-trigger acquisition with retrigger.**

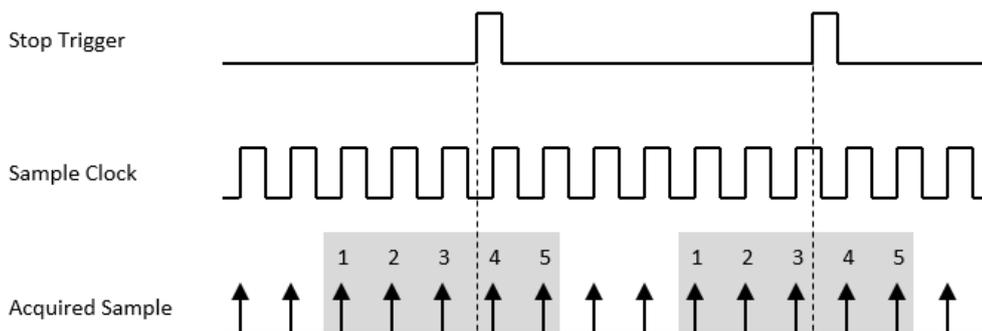**Figure 3.16 Pre-trigger acquisition with retrigger.**

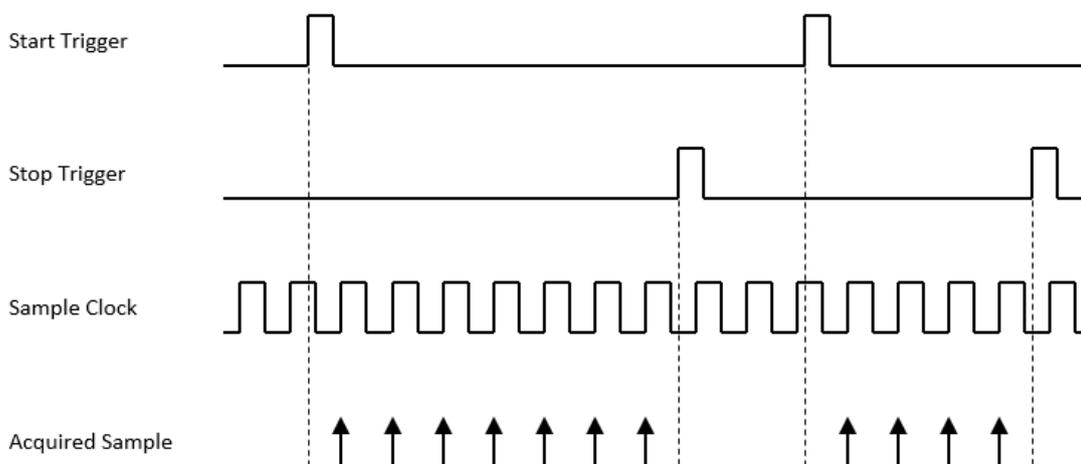**Figure 3.17 About-trigger acquisition with retrigger.**

Figure 3.18 Streaming acquisition with retrigger

3.5 Digital Output

Insert an iDAQ module supporting digital output function to perform digital output update/generation. The following sections describe the digital output update/generation mechanism. These output functions are applied to TTL digital output, isolated digital output and SSR/Mechanical relay output, i.e. all the digital output modules. For detailed specifications of the functions, refer to the document of the corresponding iDAQ module.

3.5.1 Static Digital Output Update

With static digital output update, the digital output state is updated only when the software sends a "write static digital output sample" command. The digital output state remains unchanged at other times. This is shown in Figure 3.19.

Figure 3.19 Static digital output update.

3.5.2 Buffered Digital Output Waveform Generation

With buffered digital output waveform generation, the rate and duration of the generation is controlled by hardware timing signals. The digital output waveform to be generated are first programmed and stored in the buffer memory. The digital output state then is updated for each sample clock as shown in Figure 3.20.

Figure 3.20 Buffered digital output waveform generation.

The start and stop of the generation are controlled by the start trigger and stop trigger, respectively. When configuration is completed, the acquisition engine of the iDAQ chassis is at standby state. After receiving a start trigger, generation becomes active and each rising edge of the sample clock converts one analog output sample. The generation active period lasts until a stop trigger is received, which ends the generation. This is shown in Figure 3.21.
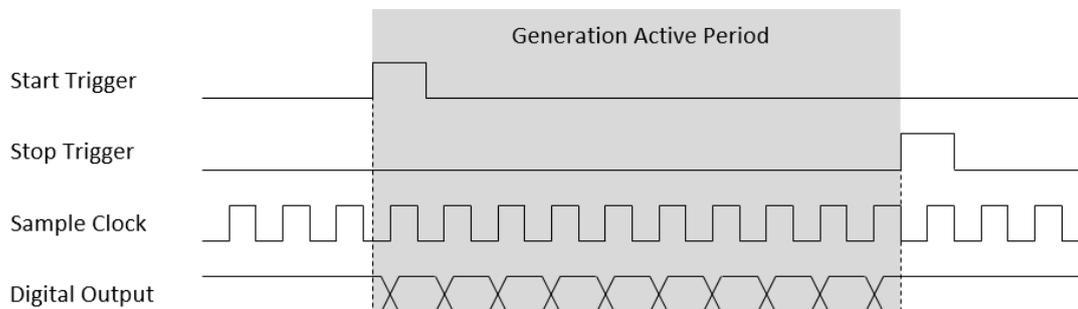

Figure 3.21 Start and stop of the digital output waveform generation.

The start and stop of generation can also be delayed in number of samples after receiving the corresponding trigger signal. As shown in Figure 3.22, the start of generation is delayed by 3 samples after receiving a start trigger, and the stop of generation is delayed by 2 samples after receiving a stop trigger.
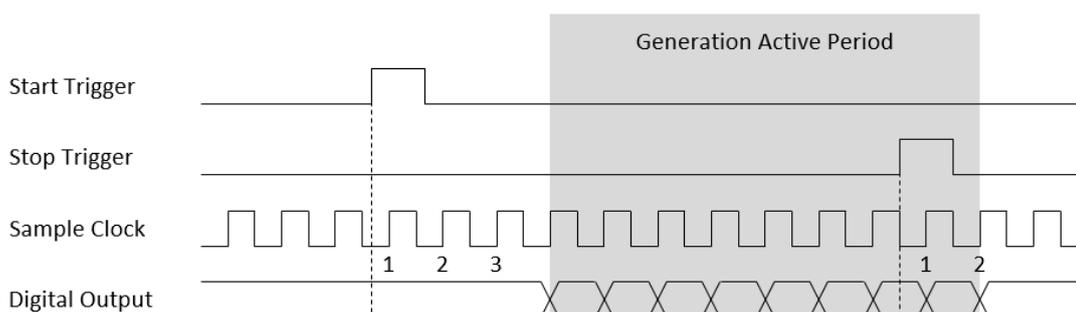

Figure 3.22 Start and stop of the digital output waveform generation with delay.

Refer to section 3.1 Trigger and Timing Signal Output for possible signal routings and configurations for these timing signals (start trigger, stop trigger, and sample clock).

Buffered digital output waveform generation has several advantages over static digital output update:

- The start and stop time of generation (or duration of the generation) can be precisely controlled by hardware trigger signals.
- Update rate can be much higher by using hardware sample clock signal.
- Time between samples is deterministic.

3.5.3 Digital Output Fail-Safe Function

When upstream communication is disconnected, the state of the digital output channels cannot be controlled by the software anymore and will keep at the last state before disconnection. This may cause harmful operation for the external devices which is begin controlled by the digital output channels.

The digital output fail-safe function can be enabled to solve this problem. If enabled, the state of the digital output channels will be automatically set to the pre-programmed fail-safe values when disconnection occurs. After reconnection, the state can again be controlled by the software.

3.6 Configuration for Buffered Digital Output Generation

According to software configurations, buffered digital output generation can be classified into two types:

- One-buffered digital output generation
- Streaming digital output generation

3.6.1 One-Buffered Digital Output Generation

For one-buffered generation, only a specified number of samples is generated. The generation starts when a start trigger is received and automatically stops when the specified number of samples is generated. An example of 5-sample generation is shown in Figure 3.23.
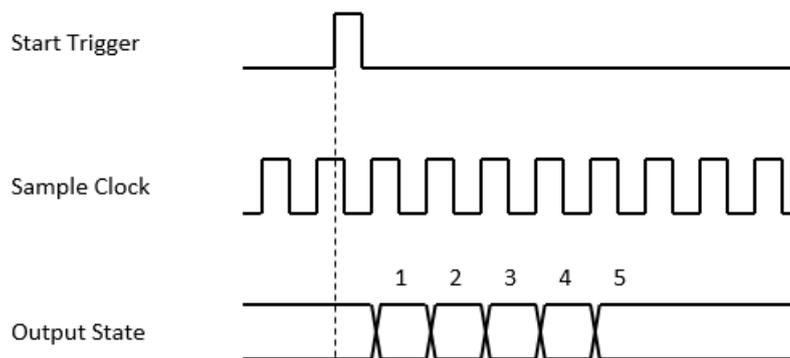

Figure 3.23 One-buffered generation.

The start trigger can be a software command or a hardware signal. If a hardware signal is used as the start trigger, the start of generation can be delayed for a specified number of sample clock cycles after a start trigger is received. Figure 2-6 shows an example of a 2-sample delay post-trigger generation. Refer to the device specifications for possible signal sources.
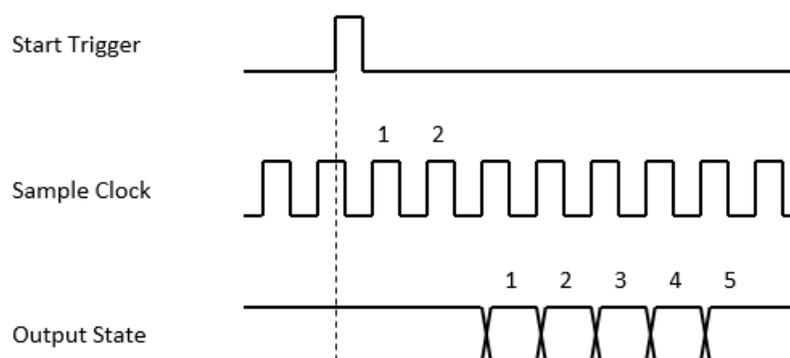

Figure 3.24 One-buffered generation with delay.

3.6.2 Streaming Digital Output Generation

For a streaming generation, the number of samples to be generated is set to infinite. The generation starts when a start trigger is received and continues until a stop trigger is received as shown in Figure 3.25.
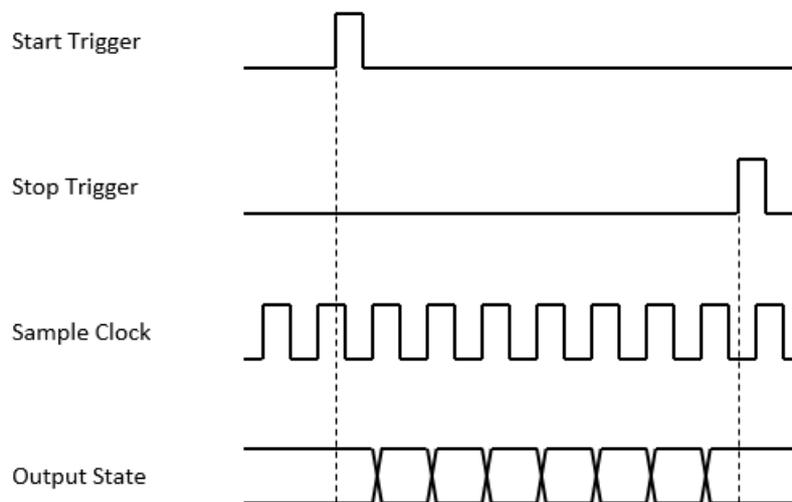

Figure 3.25 Streaming generation.

Both the start trigger and the stop trigger can come from a software command or a hardware signal. If a hardware signal is used, the start (for the start trigger) or the stop (for the stop trigger) of the generation can also be delayed. Refer to the device specifications for possible signal sources.

3.6.3 Retriggerable Digital Output Generation

The generation can be retriggerable. When re-trigger is enabled, after the generation stops, it restarts whenever the required trigger is received, and reconfiguration of the generation is not required.

Figures 3.26 and Figure 3.27 show examples of one-buffered generation with retrigger and streaming generation with retrigger, respectively. A start trigger is ignored while the generation is in progress, and a stop trigger is ignored while the generation is stopped.
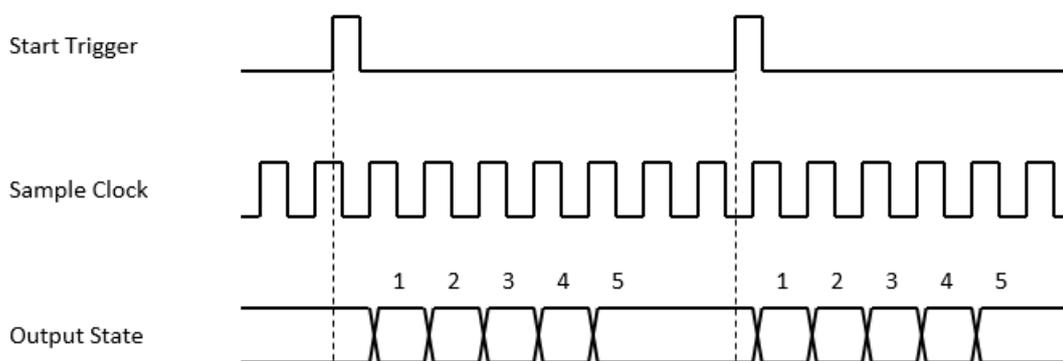

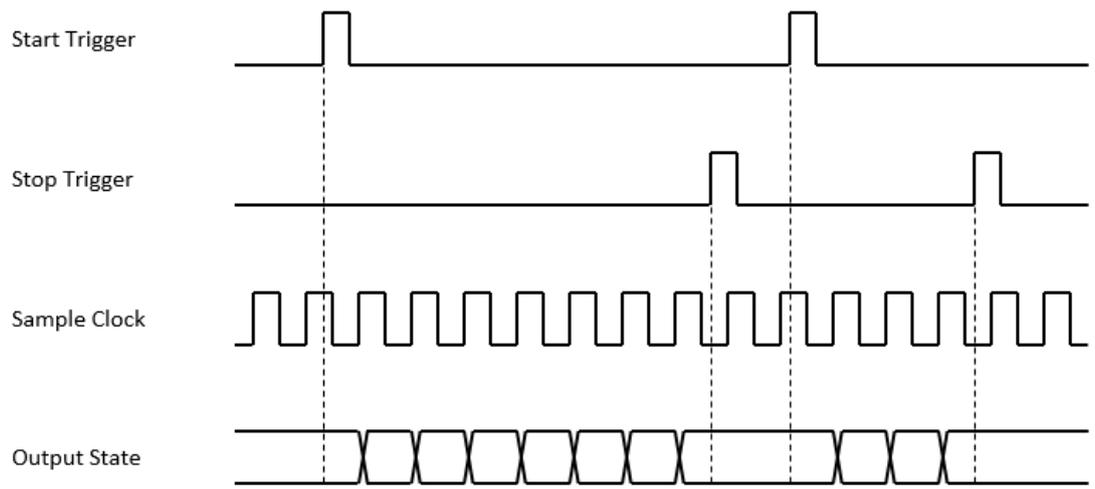**Figure 3.26 One-buffered generation with retrigger.**

Figure 3.27 Streaming generation with retrigger.

3.7 Device Description and Configuration

The Device Description is used to differentiate the modules in the iDAQ system. It's given following a naming rule of combining chassis ID, model name and slot number. You can change the description in Navigator, or just leave it as default. The description is used in your own program, in order to get control or device handler from the device.
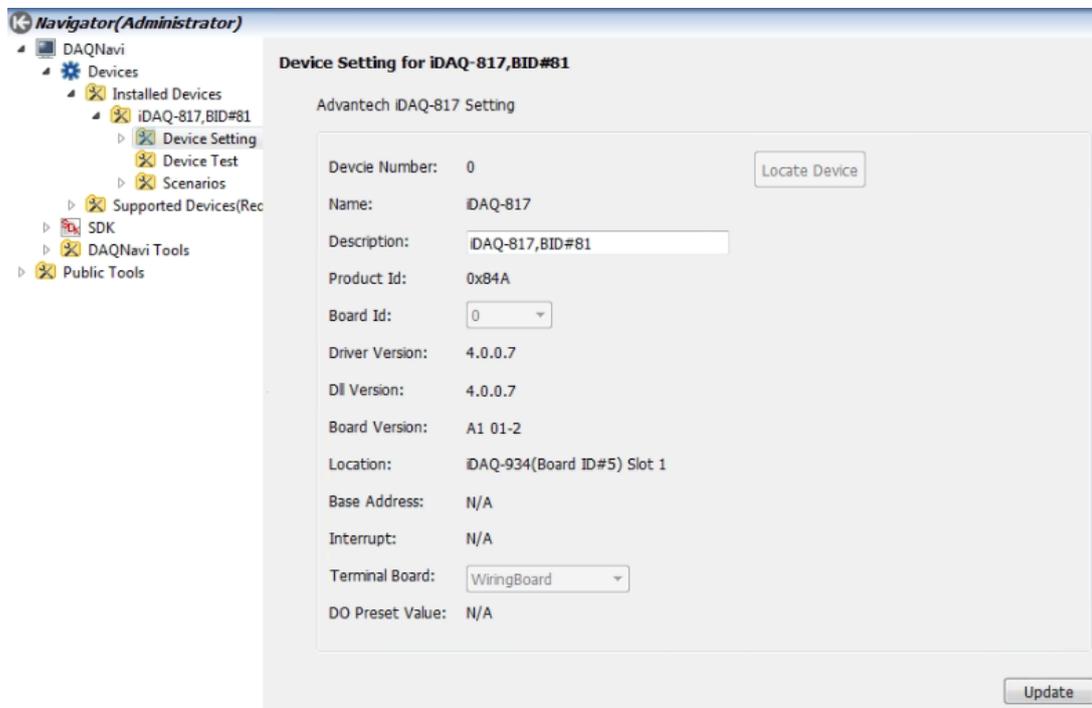

Figure 3.28 Device description shown in Navigator.

Appendix A

Specifications

A.1 Isolated Digital Input (iDAQ-731)

- **Channels:** 16
- **Input type:** Sink (NPN)
- **Input logic level (referenced to DICOM)**
  - **OFF state:** 0 V ~ +3 V
  - **ON state:** +10 V ~ +40 V
- **Input current draw**
  - **OFF state:** 1 mA max.
  - **ON state:** 3 mA max.
- **Input protection voltage:** +60 V max, -8 V min.
- **Response time:** 100 µs max.
- **Debounce filter:** 10 µs ~ 84 ms, software configurable
- **Isolation protection:** 600 V_{RMS}
- **Acquisition type:** Instant or buffered, software configurable
- **Buffered acquisition**
  - **Sample rate:** 10 kHz max., software configurable
  - **Internal data buffer (FIFO) size:** 512 samples, each sample contains state of all channels Interrupt
  - **Edge detection:** Rising edge, falling edge, or both edges, software configurable for each channel independently
  - **Pattern match detection:** By port detection, each channel can be enabled or disabled by software independently
  - **Frequency:** 1 kHz max.
- **Other feature:** Latch digital input states when interrupt occurs
- **Timing signal output to chassis:** From one of the digital input channels or digital input pattern match event, software configurable

A.2 TTL Digital Input (iDAQ-751)

- **Input logic level**
  - **Logic high:** 2.3 V min.
  - **Logic low:** 1.0 V max.
- **Working voltage:** -0.25 V ~ 5.25 V
- **Input protection voltage:** -0.5 V ~ +6.5 V
- **Isolation protection:** 60 VDC
- **Pull-down resistor:** 50 kΩ
- **Response time:** 5 µs max.
- **Debounce filter:** 40 ns ~ 84 ms, software configurable
- **Acquisition type:** Instant or buffered, software configurable
- **Buffered acquisition**
  - **Sample rate:** 200 kHz max., software configurable
  - **Internal data buffer (FIFO) size:** 512 samples, each sample contains state of all channels
- **Interrupt**
  - **Edge detection:** Rising edge, falling edge, or both edges, software configurable for each channel independently
  - **Pattern match detection:** By port detection, each channel can be enabled or disabled by software independently

- **Frequency:** 1 kHz max.
- **Other feature:** Latch digital input states when interrupt occurs
- **Timing signal to chassis:** From one of the digital input channels or pattern match output, software configurable

A.3   Universal Digital Output (iDAQ-731)

- **Channels:** 16
- **Output type:** Sink (NPN) or source (PNP), software configurable per port (8-channel)
- **Load voltage:** +10 V ~ +40 V
- **Load current:** 350 mA max. per channel
- **Output impedance:** 0.2 Ω max.
- **Response time:** 100 μs max.
- **Isolation protection:** 600 V_{RMS}
- **Current limit protection:** Yes
- **Flyback diode protection:** Yes
- **Power-on output state:** OFF state
- **Acquisition type:** Static or buffered, software configurable
- **Buffered output**
  - **Update rate:** 10 kHz max., software configurable
  - **Internal data buffer (FIFO) size:** 512 samples, each sample contains state of all channels

A.4   TTL Digital Output (iDAQ-751)

- **Output logic level**
  - **Logic high:** 4.0 V min. @ 2 mA source, 5.2 V max.
  - **Logic low:** 0.3 V max. @ 2 mA sink
- **Output current**
  - **One channel:** 5 mA max.
  - **All channels summed:** 64 mA max.
- **Isolation protection:** 60 V_{DC}
- **Response time:** 5 μs max.
- **Default output state:** Logic low
- **Acquisition type:** Static or buffered, software configurable
- **Buffered output**
  - **Update rate:** 200 kHz max., software configurable
  - **Internal data buffer (FIFO) size:** 512 samples, each sample contains state of all channels

A.5   Solid-State Relay (SSR) Output

- **Channels:** 16
- **Load voltage:** 60 V_{DC} max.
- **Load current:** 1.3 A max. per channel
- **Peak load current:** 4 A (100 ms, 1 pulse)
- **Output impedance:** 0.13 Ω max./0.5 Ω max.
- **OFF-state leakage current:** 1 μA max.

- ■ **Response time**
  - – **Turn-on time:** 1.0 ms typ./1.3 ms max.
  - – **Turn-off time:** 0.6 ms typ./0.8 ms max.
- ■ **Isolation protection:** 600 V_{RMS}
- ■ **Power-on output state:** OFF state
- ■ **Acquisition type:** Static or buffered, software configurable
- ■ **Buffered output**
  - – **Update rate:** 500 Hz max., software configurable
  - – **Internal data buffer (FIFO) size:** 512 samples, each sample contains state of all channels

A.6 General

- ■ **Power consumption from chassis:**
  iDAQ-731: 425 mW typ./ 450 mW max.
  iDAQ-751: 1050 mW typ./ 1500 mW max.
  iDAQ-763D: 225 mW typ./ 800 mW max.
- ■ **Module dimensions:** 100 x 80 x 25 mm (3.94 x 3.15 x 0.98 in.)
- ■ **Operating temperature:** -20 °C to 60 °C (-4 °F to 140 °F)
- ■ **Storage temperature:** -40 °C to 70 °C (-40 °F to 158 °F)
- ■ **Operating humidity:** 10% to 90% RH, non-condensing
- ■ **Storage humidity:** 5% to 95% RH, non-condensing
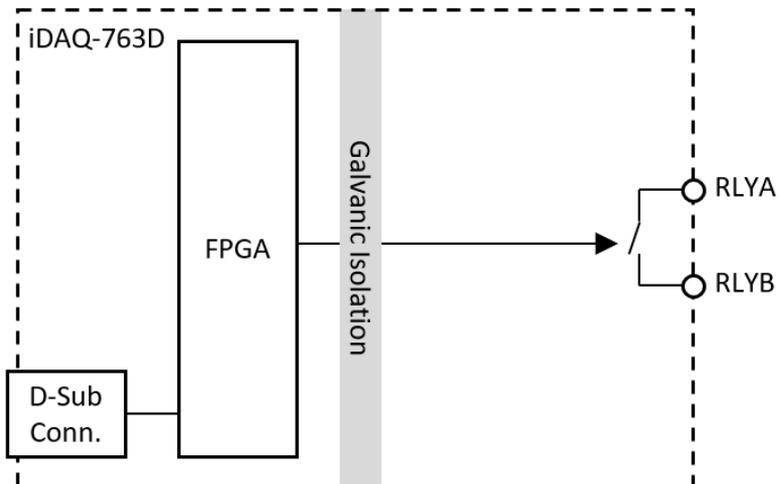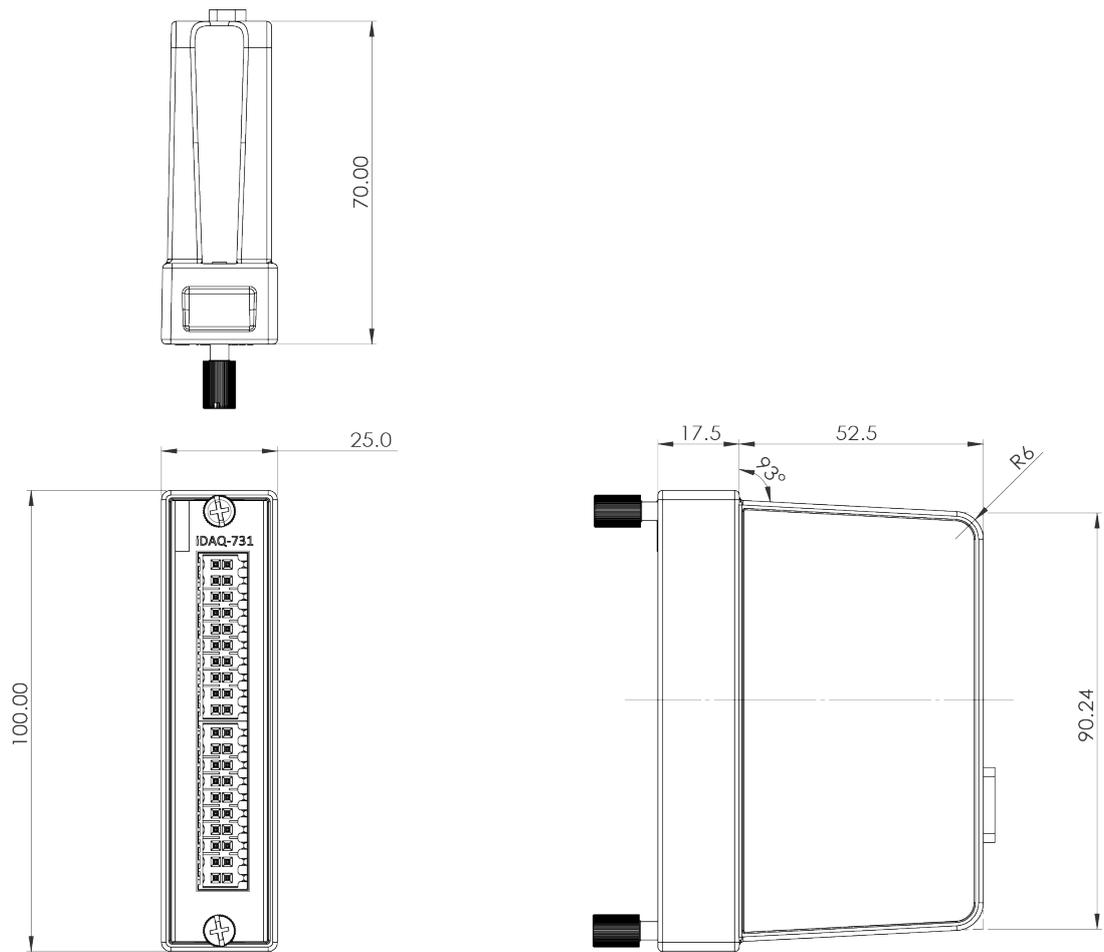
A.7   Function Block

iDAQ-731
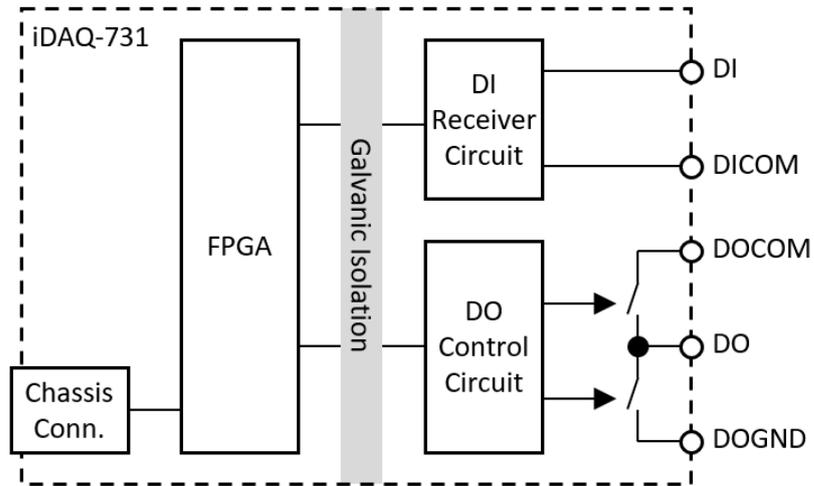
iDAQ-751
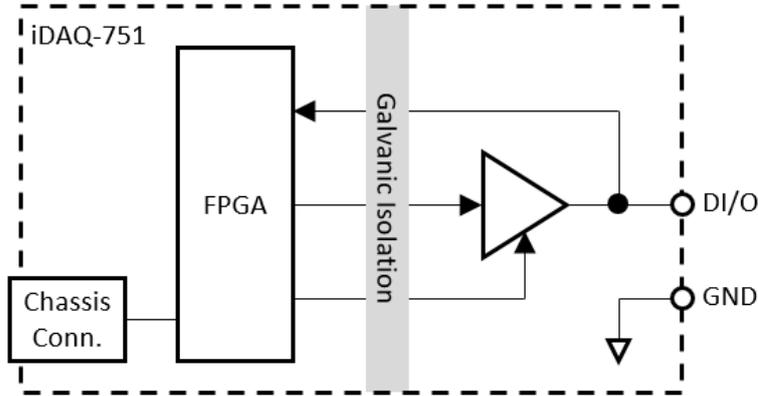
iDAQ-763D

Appendix B

System Dimensions

B.1 iDAQ Modules

ADVANTECH

Enabling an Intelligent Planet

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