



# **Magnetic Immunoassay Analyzer**

## **XacPro-E301**

### **Operation & Maintenance Manual**

(Version: 201309)



**MagQu Co., Ltd.**

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# Safety Instructions

Please review following safety warnings to avoid personal injuries and damages to the product and any related product.

In order to avoid potential risk, please use the product in compliance with relevant instructions.

Only qualified maintenance personnel can conduct maintenance procedure.

## **Prevent Fire or Personal Injury**

**Use Proper Power Line.** Please use only the power line designated for the product and approved in the country where the product is used.

**Correct Connection & Disconnection.** Before connecting a computer, please confirm whether the computer is started. Switch on power of the product after starting the computer. Before shutting down the product and disconnecting the computer, please interrupt and remove relevant software at first.

**Ground the product.** The product is grounded through a ground conductor of the power cord. In order to avoid electric shock, the grounding conductor must be connected to the ground. Please confirm whether the product is grounded correctly before connecting the input and output terminal of the product.

**Observe power of all terminals.** Please notice power and relevant mark of the product in order to prevent any risk of fire or electric shock. Before connecting the product, please read the product manual so as to further understand relevant power information.

**Disconnect power.** Please refer to concerned instructions to confirm the position to disconnect the product from power. Please do not hinder the power switch and it is accessible at any time when the product is in use.

**Please do not operate before the cover is fitted on.** Please do not operate the product when the cover is taken off.

**Please do not operate when doubting there is a fault.** If you doubt the product is damaged, please allow qualified maintenance personnel to check it.

**Prevent circuit exposed.** Please do not touch any exposed connector and component when the current is conveyed.

**Please do not operate under a moist condition.**

**Please do not operate in the flammable and combustible air.**

**Please keep the product surface clean and dry.**

**Keep good ventilation.** Please refer to installation instructions of the manual for detailed information on how to install the product and provide it with good ventilation.



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*Warnings indicate the operation conditions that may cause injury or death.*

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*Cautions suggest conditions or operations that may cause damage to the product or other objects.*

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# Environmental Considerations

The section provides information relevant to the impact of the product on the environment.

## **Disposal of Product Discarded**

Please refer to following instructions when recycling any instrument or component.

**Equipment Recycling:** nature resources of the equipment need to be recycled and reused. In the event that the equipment is not disposed correctly during discard, it may produce substances hazardous to the environment or human health. In order to avoid emission of such substances in the environment and reduce use of natural resources, recycling the product with a proper system is recommended for the purpose of ensuring most materials can be recycled and reused appropriately.



## Chapter I Brief Introduction to Applications of Magnetic

### Immunoassay Analyzer

The Magnetic Immunoassay Analyzer XacPro-E301 launched by MagQu Co., Ltd. is used to measure the change in the ac magnetic susceptibility of a sample over time. If the sample is a mixture of a magnetic reagent and an object to be detected, it can be used to detect the concentration of bio-molecules in the object according to the change in the ac magnetic susceptibility. XacPro-E301 is advantageous for bio-molecular assays in many ways, such as its operation is very simple, there is no need for users to calibrate concentration of the to-be-detected bio-molecules, it adopts CAA (Computer Automatic Analysis) with high accuracy and sensitivity and can detect low-concentration bio-molecules. Therefore XacPro-E301 can be applied in not only research, but clinical diagnosis and field trials.

To-be-detected bio-molecules mentioned above include protein, cytohormone, virus, nuclei acids, bacteria, even small molecular compounds. XacPro-E301 can help you to establish standard detection curves for new kinds of bio-molecules to be detected, further to measure content of the bio-molecules in the samples. So it is expected that XacPro-E301 can be applied in the fields of in-vitro quantitative detection including agriculture, forest, fishing, stockbreeding, food and human body.

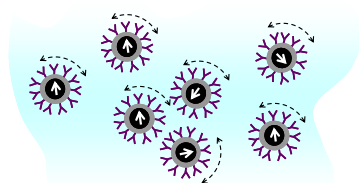


## Chapter II Principle of Magnetic Reduction Immunoassay

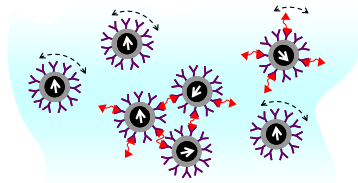
The Magnetic Immunoassay Analyzer XacPro-E301 utilizes the so-called immunomagnetic reduction (IMR) as its assay principle. The principle of immunomagnetic reduction is described as follows.

Under external ac magnetic fields of which frequencies range from tens to millions of hertz, individual magnetic beads in a magnetic reagent will be driven by the external ac magnetic fields and swirl. The magnetic reagent produces ac magnetic signals ( $\chi_{ac}$ ) accordingly. When the magnetic reagent is mixed with the sample containing to-be-detected bio-molecules, bio-molecules will bind with magnetic beads via bioprobes (e.g. antibodies) on surface of the magnetic beads. In this way, part of magnetic beads in the reagent will get enlarged, even many magnetic beads will gather together. In such case, compared with the number of swirling magnetic beads before the magnetic reagent is mixed with the sample, number of swirling magnetic beads in the reagent driven by external field is much fewer. So the ac magnetic signal ( $\chi_{ac}$ ) of magnetic reagent will reduce due to the binding between bio-molecules in the sample with magnetic beads; that's why we call the detection method as magnetic reduction immunoassay detection. According to the description above, more bi-molecules the sample contains, more bindings between magnetic beads and bi-molecules will occur, and more magnetic reduction will appear. Thus we can detect amounts of bi-molecule in the sample in reference to measurement on magnetic reduction of magnetic reagent. In Chapter III, every component of XacPro-E301 will be described in detail:

$$\chi_{ac,o}$$



$$\chi_{ac,\phi} (< \chi_{ac,o})$$



## Chapter III Introduction of Magnetic Immunoassay Analyzer

### XacPro-E301

Picture and scheme of XacPro-E301 is as shown in Fig. 1. XacPro-E301 is consisted of two modules:

1. Detection Box (AC/DC, DSP, Coils, Amplifiers, Micro-Control unit and TE cooler indicated by Fig. 1)
2. Temperature Control Box (Electronics shown in Fig. 1)

Specifications and functions of these two modules are described in the following sections.

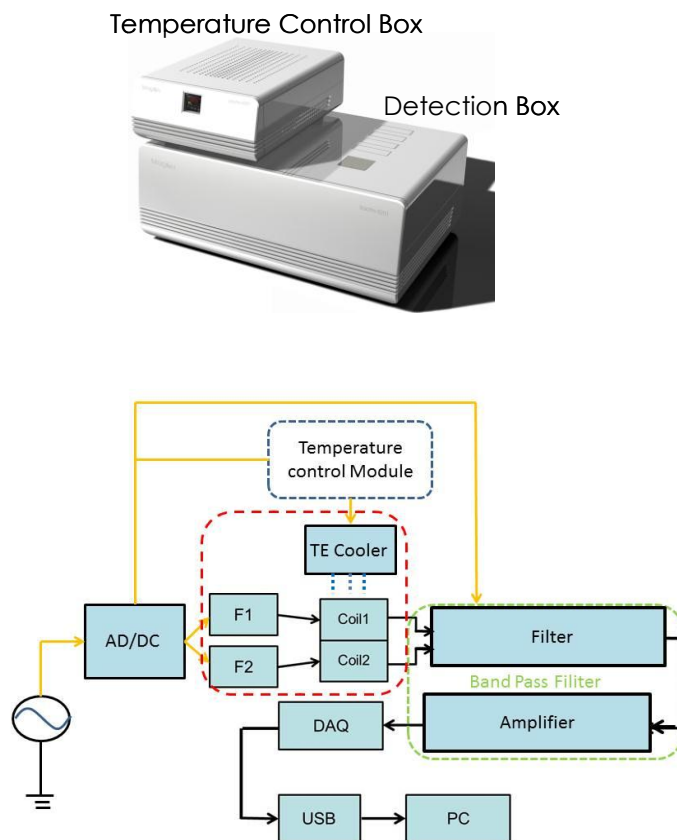


Fig. 1. Picture and scheme of XacPro-E301.



## Section I Power Converter (AC/DC)

The section will introduce icon and function of the power converter (AC/DC).

### 1. Diagram

The power converter is as shown in Fig. 2. Input voltage of the power converter ranges from 100 V to 240 V. The output is direct-current voltage  $\pm 11\text{V}$  which used as the power necessary for operation amplifier in other circuits.

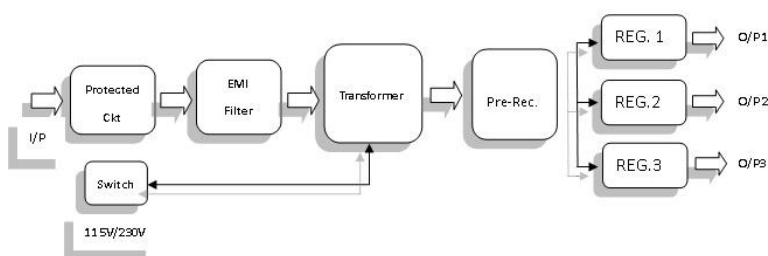


Fig 2. XacPro-E301 Power supply diagram.

### 2. Function

Since electric circuits of other components of XacPro-E301 are driven by DC voltage, the power converter is used to convert AC power of city mains into the DC power required by the electric circuits when XacPro-E301 works. The DC power after conversion provides  $\pm 11\text{ V}$  DC voltage.

## Section II Function generating circuit (F1 & F2)

### 1. Circuit Diagram

The digital AC waves to drive coils are generated by Function generating circuit (F1 and F2). The AC waves typically involve two frequencies: one is at hundreds of hertz and the other is at dozens of kilohertz. The AC waves of two frequencies are connected with coils through digital/analog converter (D/A) shown in Fig. 3.

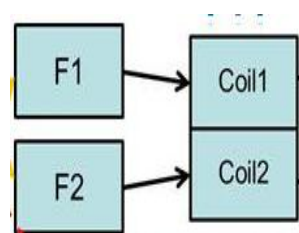


Fig. 3. Circuit diagram of digital/analog converter for AC waves

### 2. Function

The AC wave generator is used to supply AC voltages at multiple frequencies to generate AC currents flowing through the coils. The coils then generate AC magnetic fields.

## Section III Coils

### 1. Structure Diagram

Structure of coils is shown as Fig. 4, including three different coaxial solenoids shown on the right of Fig. 4 and made of plastic steel and wound with copper wires.

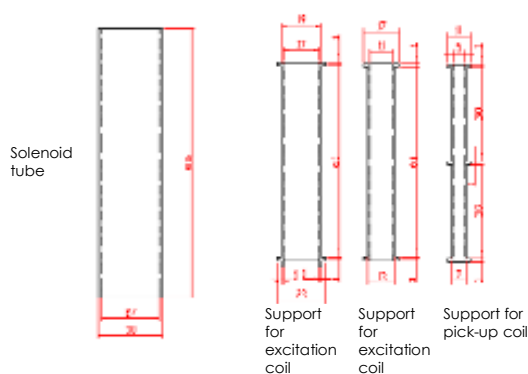


Fig. 4. Scheme of coils.

## 2. Function

After the AC signals generated by DSP mentioned above pass through copper wires of two excitation coils, respectively. Each coil generates an AC magnetic field to magnetize magnetic reagent located inside the pick-up coil. The two excitation coils and the pick-up coil are assembled co-axially. The AC magnetic signals generated by the magnetic reagent are sensed by the pick-up coil, and are guided to the amplifier and feedback control circuit.

## Section IV Signal Amplification Circuit (Amplifier)

Actually AC magnetic signals generated by the magnetic reagent and sensed by the pick-up coil are consisted of weak signals at multiple frequencies. For the purpose of amplifying the weak signals at specific frequency which is to be measured, the amplifier is adopted to filter and amplify the signals sensed by the pick-up coil.

## Section V Signal Output Module (Micro-control)

### 1. Circuit Diagram

Circuit diagram of the micro-control is shown as Fig. 5. The amplified signals are input by DSP and output to the computer (USB to PC in Fig. 5) after passing through the micro processor (MCU in Figure 5) and USB signal output converter.

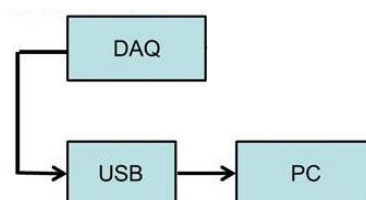


Fig. 5. Diagram of Micro-control

### 2. Function

When the amplified signals are input at terminal P8 of DSP shown in Fig. 5, the instantaneous signals will be converted

into spectrum signals in DSP and MCU. Then the signal at specific frequency will be selected out by MCU and input to the external computer. XacPro-E301 is connected to the external PC by USB, so a USB signal output converter (USB 2.0) is fitted between MCU and the external PC.

## Section VI Thermoelectric Cooler (TE Cooler)

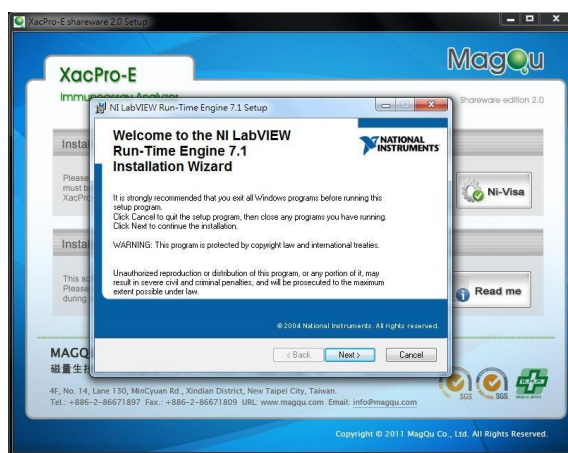
XacPro-E301 uses a cooling chip to control temperature in the test box; the thermoelectric cooler (TE Cooler) will conduct cooling process automatically when the temperature is higher than the set value and TE Cooler will conduct heating process automatically when the temperature is lower than the set value. The control circuit of TE Cooler is fitted in the temperature control box.

## Chapter IV Operation Procedure

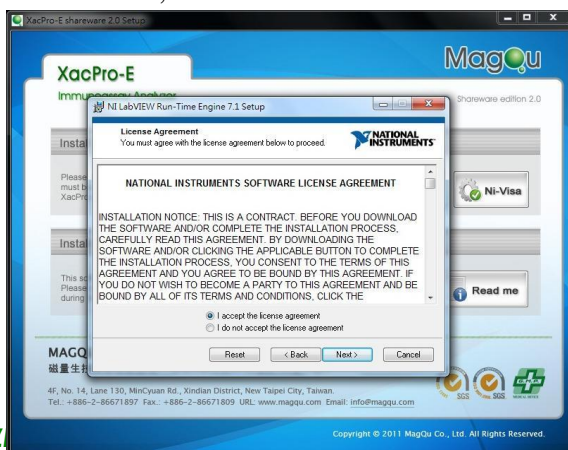
1. Driver used with the operating software is provided by Adlink Technology and National Instruments without amendments by our company and can be requested from the former two companies directly.
2. It is required to calibrate XacPro-E301 with the standard solution produced by our company every three months to ensure accuracy of the instrument.
3. The following operational programs are the series product of Windows launched by Microsoft, which are used as OS and not applicable for Mac series and Linux System.

### Section I Installation of Software

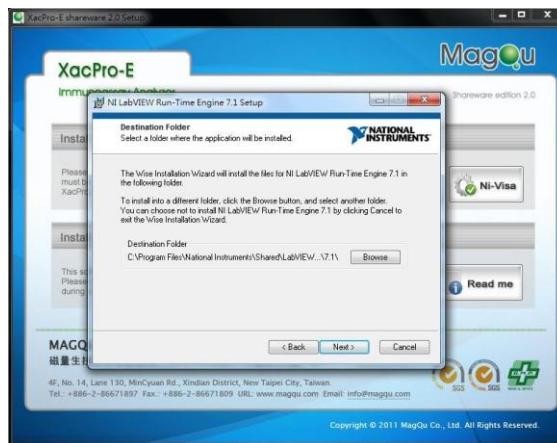
1. Put the software disk in to cd-rom of the computer. Then, double click “Labview driver.” Click “Next.”



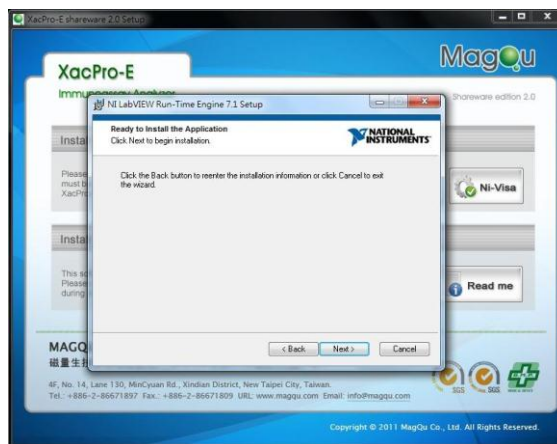
2. Labview driver is provided by National Instruments named Labview run time Engine. Users must follow the terms of use from NI, and click “next.”



1. Set the installing pathway and click “next.”

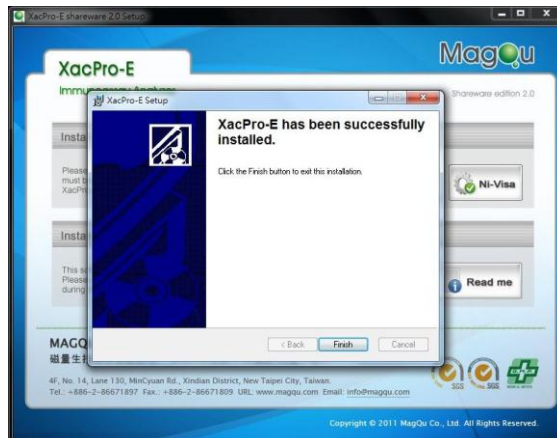


2. Follow the guild and click “next” for starting installation.



3. Please wait for installation.

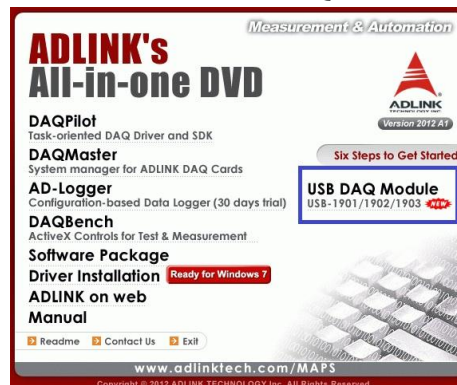
4. Click “Finish” and end the installation.



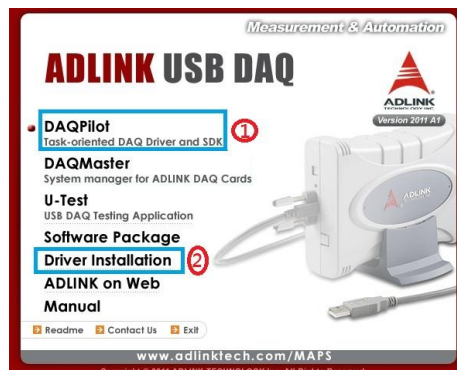
5. Enter the Adlink file folder and double click Setup file.

名稱	修改日期	類型	大小
目前在碟片的檔案 (10)			
Bin	2012/1/31 下午 0...	檔案資料夾	
Driver Installation	2012/1/4 上午 11...	檔案資料夾	
Manual	2012/1/3 下午 05...	檔案資料夾	
Software Package	2012/1/18 下午 0...	檔案資料夾	
ADLink	2000/1/14 下午 0...	圖示	2 KB
AUTORUN	2001/2/23 上午 1...	安裝資訊	1 KB
Readme	2012/1/12 下午 0...	Adobe Acrobat ...	39 KB
setup	2010/10/12 下午 ...	應用程式	32 KB
SETUP	2001/5/15 下午 0...	組態設定	1 KB
SIX Steps To Get Started	2009/4/30 上午 1...	Adobe Acrobat ...	2,372 KB

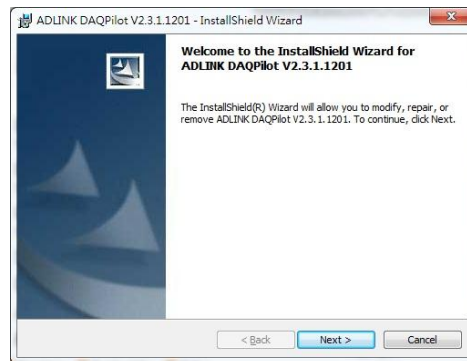
6. Double click "USB DAQ Module."



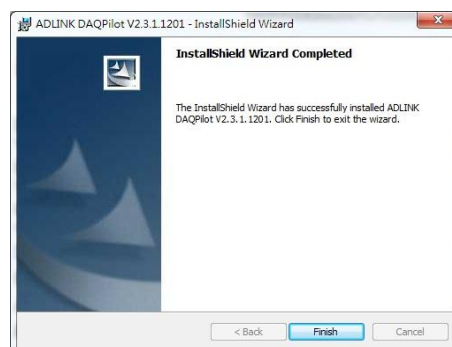
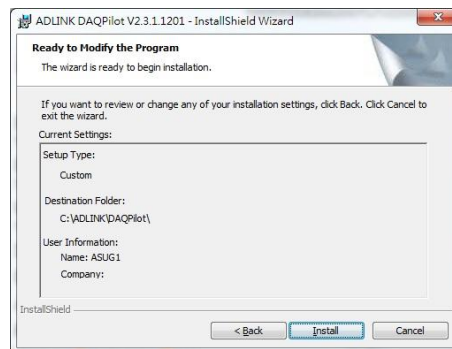
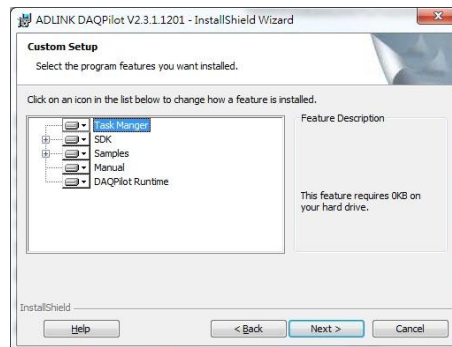
7. Both DAQ Pilot & Driver installation should be installed.



8. DAQ Pilot is provided by ADLink Technology. Users must follow the terms of use of ADLink Technology. Then click “Next.”

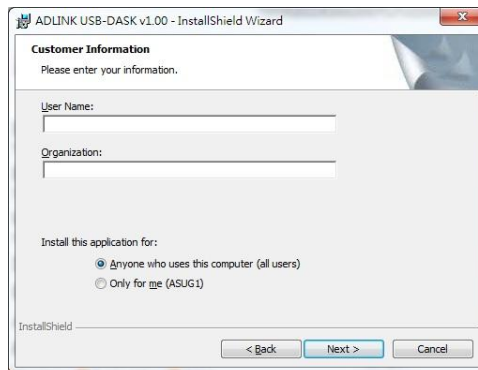


9. Follow the installing guild and click “Next” and “Install.”

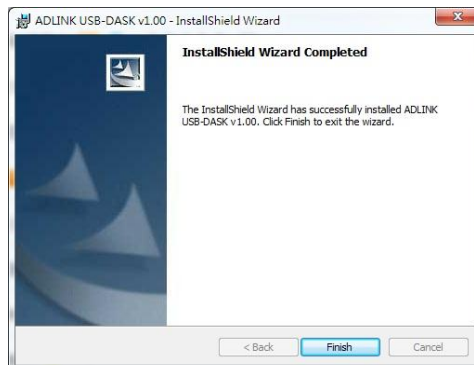
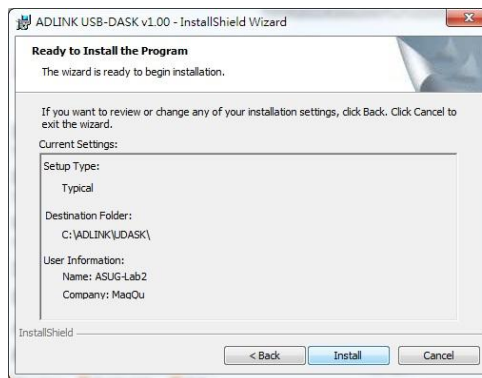
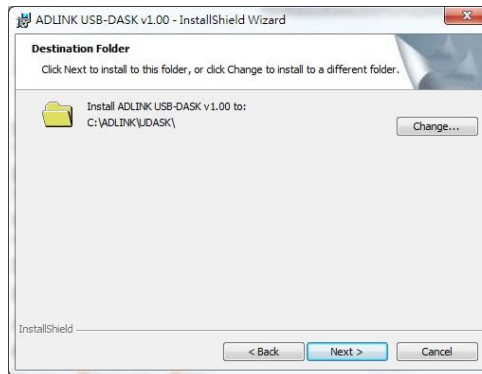




10. After finish installation of DAQ Pilot, click Driver installation in step 7. Follow the guide to undergo next installation.



11. Choose the folder path and click “next.” The installation will start after users click “Install,” and finish when users click “Finish.”



12. Click exit and X to finish the installation.



## Section II Setting & Start-up Procedure of XacPro-E301

1. XacPro-E301 is consisted of a temperature control box and detection box. Please put the detection box on a flat table gently at first; then place the temperature box on it or a flat table gently.



2. There are three switches on the back of temperature box, which are designed for the temperature box and the detection box, and need to be switch on and off simultaneously. A power line should be connected on the left of the switches and the 15-pin connector on the left of the power line should be jointed to the 15-pin connector on the detection box. There are two 9-pin connectors on the right of the switches, between which the left one should be jointed to the 9-pin connector on the left of the 15-pin connector on the detection box and the right one should be jointed to the 9-pin connector on the right of the 15-pin connector mentioned above.



3. There is a control panel in the front of the temperature box. After opening the acryl cover, push down the green button “<”; and then adjust the temperature with  $\wedge \vee$  (green numbers below). Commonly the most appropriate working temperature is about 5 to 10 degrees above room temperature.



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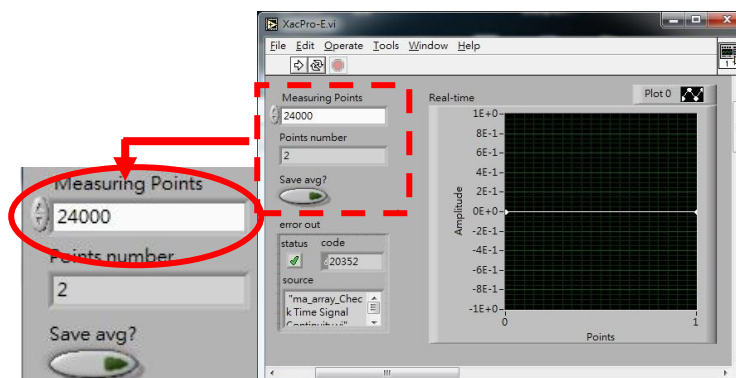
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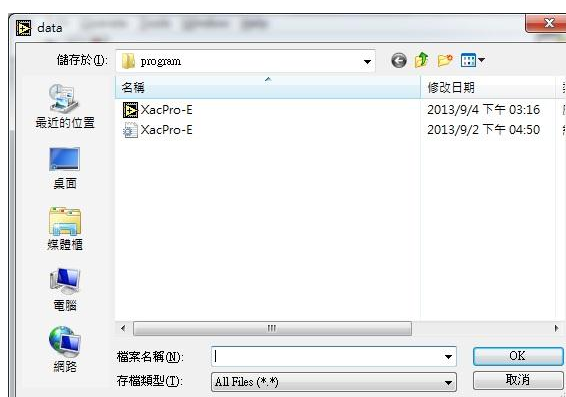
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### Section III Xac Measurement Procedure

1. Launch XacPro-E and setting the measuring points (1 point for 5 seconds).



2. Setting the path of data file.



3. Prepared the samples before measurement and put them in the thermostatic box side to the sensor coil. After few minutes, put the sample in the sensor coil and click OK to start the measurement.



## Section IV Reagent Preparation Method

1. Take the magnetic reagent and the sample to be detected out of frig and shake them with Vortex for about 15 seconds separately.
2. Add 40  $\mu\text{l}$  magnetic reagent and 60  $\mu\text{l}$  sample to be detected into a detector tube commonly.
3. Shake the glass tube with Vortex for about 15 seconds to mix the magnetic reagent with the sample to be detected.
4. Place the detector tube into the thermostatic bath of XacPro-E301 to measure the AC magnetic permeability  $\chi_{ac}$ .

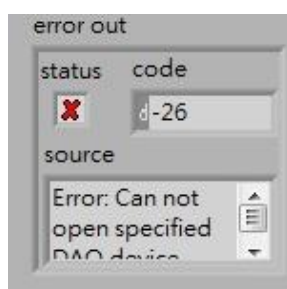
## Section V Magnetic Reduction Signal Analysis

1. Open the notepad file saved with data process software and plot.
2. Calculate the mean values for relevant points before and after the reaction and adopt them in the following formula:  
$$\text{IMR (\%)} = (\chi_{ac,o} - \chi_{ac,\phi}) / \chi_{ac,o} \times 100\%$$
in which  $\chi_{ac,o}$  is the ac magnetic susceptibility signal before the reaction and  $\chi_{ac,\phi}$  is the ac magnetic susceptibility signal after the reaction.

## Chapter V Debugging and Maintenance

Common error information and simple troubleshooting are shown as following:

1. The “X” signal shows in the status of error out diagram (shown as below) refers to the program fails to seize signal from the instrument. Please restart PC and the program after confirming the connection is in good condition.



2. Frequent "Cease and Save" and "Stop warming" will lead to a fault of the instrument. It is recommended sending the instrument back to our company for repair every season if you use the two commands above frequently.
3. If it is impossible to achieve balanced for the temperature control system with specified usage pattern, please send the instrument back to our company for repair.
4. If the lights at the back of temperature box are not bright after start, please send the instrument back to our company for repair.
5. If the program is damaged or unable to start, please reinstall it. If there is any other fault, please reinstall or repair the Window system in PC. If there is still any problem unsolved, please contact our company as soon as possible.

As for any situation not listed in the error information mentioned above, please contact our company as soon as possible. Tel: +886-2-86671897.



## Chapter VI Attentions

- Please confirm whether the transformer suitable for the voltage in the situation where the analyzer is used before using it.
- Please connect the analyzer with power supply to warm up for an hour before using it.
- Please store the analyzer in a location without direct sunlight at room temperature.
- Do not place the analyzer in a location with much dust please.
- Please store the analyzer in a location unlikely to shake and please do not keep it under heavy pressure during transportation.
- Please operate the analyzer with genuine consumables from our company (please contact our company if you need to order the consumables at telephone number 02-8667-1897)



**Do not place the analyzer XacPro-E301 close to a strong magnetic field or high-power electrical products.**

### Section I Cleaning & Maintenance

1. You only need to use a piece of soft cloth soaked with water or mild solvent to wipe and clean the analyzer.
2. Please do not use any organic solvent to clean the housing or accessories.
3. Please do not detach the analyzer discretionally; contact the distributor if you need to repair it.
4. Please use the original packing container when transporting the analyzer.

### Section II After-sale Services & Guarantee

1. The product is provided with 1 year of free warranty term after sale.

2. As for the following cases, the services will be charged properly even in the warranty term:
  - (a) Any damage or fault due to improper use or act of God such as lightning etc.
  - (b) Any damage or fault due to discretionary repair, modification or repair by any other third party.
  - (c) Any damage or fault due to change of installation location, transportation or falling down etc.
3. Please deliver the analyzer XacPro-E301 to distributors when requiring repair. As the analyzer is a precision instrument, it must be transported carefully in compliance with the following instructions.
  - (a) Please use the original packing container for transportation.
  - (b) Convey shall not be conducted until the power is shut off.
  - (c) Prevent the product from pressing or falling.

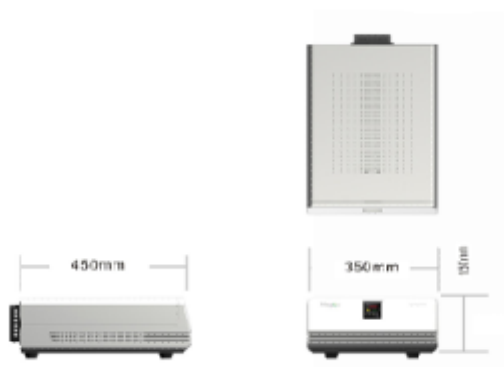
## Appendix A Structural Block of XacPro-E301

Dimensional drawing of Magnetic Immunoassay Analyzer XacPro-E301 is shown as the following:

Detection Box:



Temperature Box:



※ Net weight 15.8 kg





## Appendix B Specifications of XacPro-E301

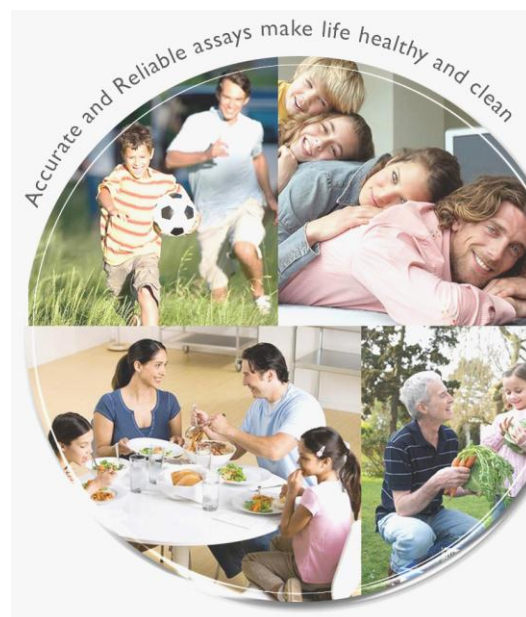
- Refer to Addendum A for detailed dimensions of the analyzer
- Specifications of the power converter:  
Input: 100 – 230 VAC  
Output: Max. 24VDC/200 W
- Specifications of AC Wave Generator:  
Output power: AC +/- 3V to AC +/- 24V, 50mA/50mA  
Output Frequency: 100 to 50 kHz
- Specifications of amplifier circuit:  
Wave band: 1 k to 30 kHz  
Voltage magnification: 1 to 2000
- Specifications of solenoid assembly:  
Excitation coil: resistance = 100 ~ 200  $\Omega$   
coil density = 400 ~ 550 turns/cm  
Pick-up coil: resistance = 40 ~ 70  $\Omega$   
coil density = 400 ~ 550 turns/cm
- Software platform: Windows XP , Windows 7

## Appendix C List of Packing Inserts

Accessory Name	Quantity
XacPro-E301 Detection Box	1
XacPro-E301Temperature Control Box	1
USB Transmission Line	1
Power Line	2
9-pin Signal Transmission Line	1
15-pin Signal Transmission Line	1
Original Software Disk	1
Operation Manual	1

## Appendix D Warning Icon Description

	This Way Up
	Careful Fragile
	Keep Dry
	Away From Magnetic Field



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