Magnetic Immunoassay Analyzer

XacPro-S361

Operation & Maintenance Manual

(Rev. May-2022)

Table of Contents

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Safety Instructions

Please review the 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 lunching computer, please confirm whether the power is switching on. Switch off the power after shutting down the computer.

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. Be careful for refill liquid nitrogen and putting samples.

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.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

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.

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

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

Biohazard suggest conditions or operations that may cause environmental bio-pollution.

Other Guidelines: Indoor Use

Altitude: 2000 m

Temperature: 5 ^{o}C to 40 ^{o}C

Humidity: Maximum 80 % RH at 31 ^{o}C decreasing to 50 % RH at 40 ^{o}C

Transient overvoltage at Mains Supply: 2500 V

Pollution Degree: 2

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Environmental Considerations

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

Disposal of Product Discarded

Please refer to the 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 Applications of Magnetic Immunoassay Analyzer

The magnetic immunoassay analyzer (Model: XacPro-S361) 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 of the mixture. XacPro-S361 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. XacPro-S361 can be applied to not only research, but also to clinical diagnosis and field trials.

To-be-detected bio-molecules mentioned above include protein [1-3], cytohormone, virus [4], nuclei acids [5], bacteria, and even small molecular compounds. XacPro-S361 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. It is expected that XacPro-S361 can be applied in the fields of *in-vitro* quantitative detection including agriculture, forest, fishing, stockbreeding, food and human body.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Chapter II Design of Magnetic Immunoassay Analyzer

Section I Principle of Magnetic Reduction Immunoassay

The magnetic immunoassay analyzer (Model: XacPro-S361) utilizes the so-called immunomagnetic reduction (IMR) as its assay principle [6,7], which 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 (χ_{ac}) accordingly. Hereafter, the χ_{ac} of pure magnetic reagent is referred as to $\chi_{ac,o}$, as shown in Fig. 2.1.

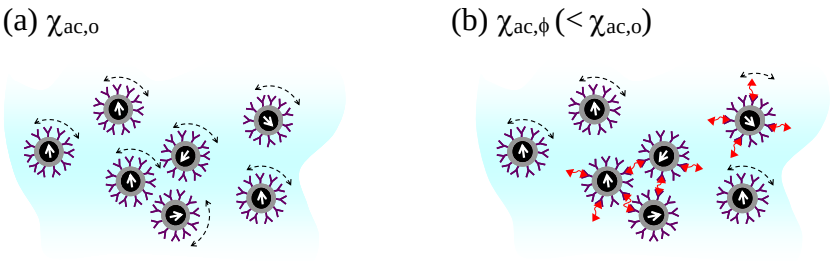


Fig. 2.1 Illustration of mechanism of immunomagnetic reduction to detect biotargets. (a) Each magnetic nanoparticle oscillates individually with the applied alternative-current magnetic field before binding with biotargets. (b) Portions of magnetic nanoparticles become larger due to the binding with biotargets. The bound magnetic nanoparticles in (b) contribute to the reduction in the alternative-current magnetic susceptibility χ_{ac} of the reagent.

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 [8,9]. 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 (χ_{ac}) of

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

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. Hereafter, the χ_{ac} of magnetic reagent mixed with a sample is denoted with $\chi_{ac,\phi}$. 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.

To quantify the reduction in the χ_{ac} of magnetic reagent due to the binding between magnetic nanoparticles and biomolecules hereafter is defined as:

$$\text{IMR}\ (\%) = (\chi_{ac,o} - \chi_{ac,\phi})/\chi_{ac,o} \times 100\%, \qquad (2.1)$$

where IMR(%) is referred as to IMR signal.
Furthermore, IMR signal was found as function of the biomolecular concentration ϕ via logistic function [1-5]

$$\text{IMR}\,(\%) = \frac{A - B}{1 + (\frac{\phi}{\phi_o})^{\gamma}} + B, \qquad (2.2)$$

where A, B, ϕ_o, and γ are fitting parameters.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

According the mechanism of IMR, ac magnetic fields are applied to magnetic reagent. The time-evolution ac magnetic signal of magnetic reagent is detected. Thus, the magnetic immunoassay analyzer XacPro-S361 is equipped with sets of excitation coils, which generate ac magnetic fields to magnetize magnetic reagents [10,11]. A signal generator is used to applied ac current through the excitation coils. Once magnetic reagent is placed inside excitation coils, the reagent is magnetized. An ac magnetic signal of reagent is induced. To sense the induced ac magnetic signal of reagent, a pick-up coil is used, as schematically shown in Fig. 2.2 Then, the sensed ac magnetic signal of reagent is transferred to a

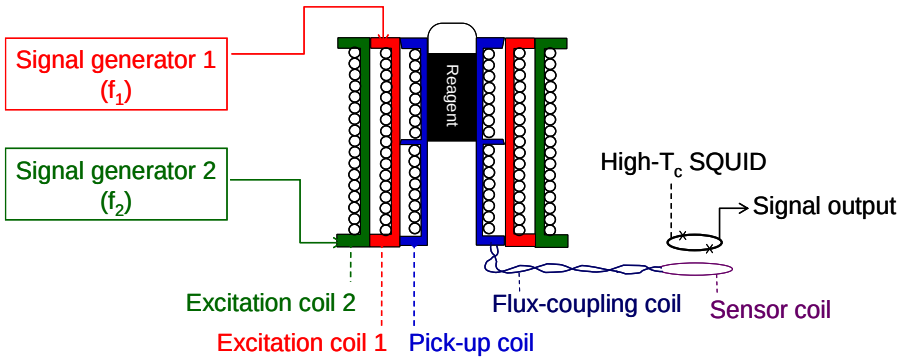


Fig. 2.2. Schematic configuration of XacPro-S361 for detecting ac magnetic signal of magnetic reagent.

magnetic sensor via a flux-coupling coil. One end of the flux-coupling coil is connected in serious with the pick-up coil, the other end of the flux-coupling coil is connected in serious with the sensor coil. A high-T_c superconducting quantum interference device (SQUID) magnetometer is used to detect the transferred magnetic signal at the sensor coil. Thus, the ac magnetic signal of reagent can be detected. With the time-evolution ac magnetic signal of reagent, the IMR signal can be measured. All the details of working principle of XacPro-S361 are available in Refs. 10 and 11

We will introduce main components consisting XacPro-S361 in the Chapter III.

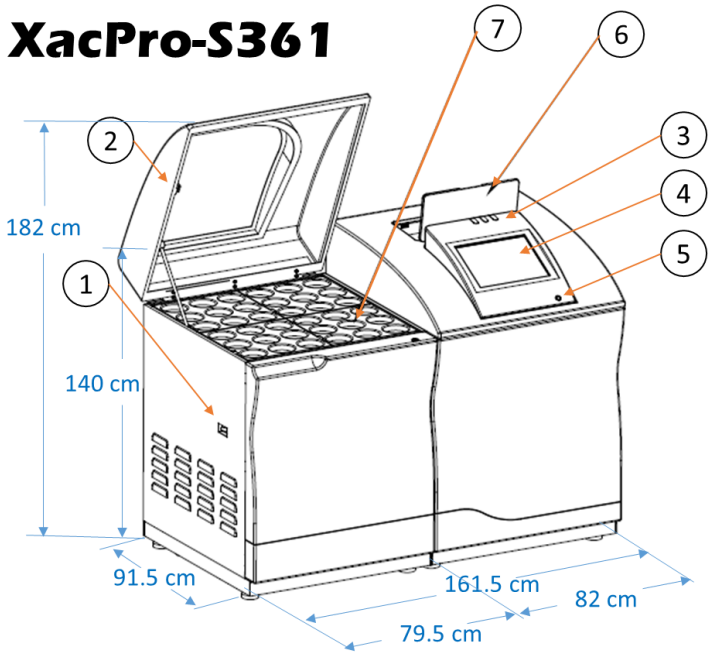
MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Chapter III Hardware of Magnetic Immunoassay Analyzer

Section I Key Components

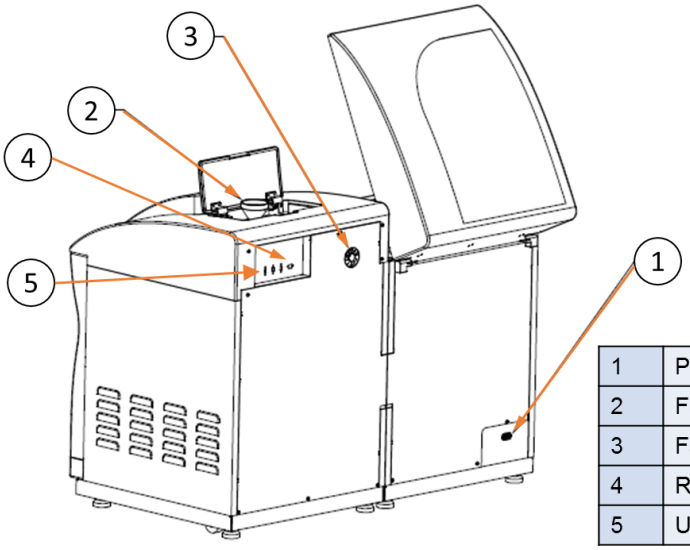
The Fig. 3.1 is the face photo of XacPro-S361.

Fig. 3.1. Magnetic immunoassay analyzer XacPro-S361 is consisted of two modules: controlling part, and assaying part.



1	Power switch
2	Cover(Sample wells)
3	LED lights
4	Touch panel
5	PC on/off switch
6	Cover(for filling LN_2)
7	Sample wells

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809



1	Power plug
2	Funnel
3	Fan
4	RJ-45 port
5	USB Port *3

Briefly speaking, XacPro-S361 is consisted of two modules:

1. Controlling part

   This part mainly contains a high-T_c SQUID magnetometer and its controller, a 5-L Dewar, and electromagnetically shielded can and the main controlling computer. The high-T_c SQUID magnetometer is dc SQUID. A SQUID is a superconducting quantum interference device, serving as an extremely sensitive magnetometer. It is formed by a superconducting loop incorporating a weak link. The working mechanism of dc SQUID is described.

   The dc SQUID is formed by a superconducting loop incorporating a weak link, a so-called Josephson junction, as shown in Fig. 3.2. The

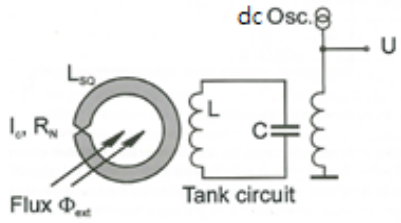


Fig. 3.2. Illustration and photo of dc SQUID magnetometer.

   laws of physics demand that the magnetic flux enclosed by a superconducting ring is quantized. The critical current of the Josephson junction, I_c its Ohmic resistance in the normal conducting state, R_N, and the inductance of the ring, L, are the

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

fundamental parameters governing the behavior of the SQUID. The SQUID is read out inductively by means of a tank circuit, a L_C resonance circuit operated close to its dc resonance. The main specifications of the dc SQUID magnetometer are as follows.

- Input voltage: 100~240 V, 50/60 Hz
- AC Output voltage: 0-20 V
- AC Output frequency: 0-1 MHz
- DC Output: 5 ± 0.5 V

To achieve the Josephson effect, the SQUID must be at temperatures lower than its critical temperature T_c. For high-T_c SQUID, the SQUID is usually emerged in liquid nitrogen, which temperature is 77 K, lower than T_c. The dc SQUID magnetometer in XacPro-S361 is posited inside a 5-L Dewar containing liquid nitrogen.

Since the dc SQUID magnetometer is very sensitive to DC or AC magnetic signals, the ambient magnetic signals must be isolated. To do this, an electromagnetically shielded box is used. The Dewar with the dc SQUID magnetometer sits inside the electromagnetically shielded box. The to-be-detected signal generated by the sample at an excitation/pick-up coil is guided to the dc SQUID magnetometer via a flux-coupling coil. The main specifications of the electromagnetically shielded box are listed below.

- Many layers consisted of Al and μ metal.
- The shielding factor is 40-60 dB at 0.1 – 10 Hz, and is 100 dB at 1000 Hz.
- The dimension of shielding box is 50cm(W) x 50cm(L) x 60cm(H).

2. Assaying part

   The assaying part contains sets of coils include excitation coils, pick-up coils, flux-coupling coil, and sensor coil and function generating electronics. Samples are located inside excitation coils. The multi-excitation coils are located symmetrically as a square. Each excitation coil is equipped with a pick-up coil. The size of an excitation coil is 120 ± 5 mm in diameter and 32 ± 2

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

mm in length. The size of a pick-up coil is 8.0 ± 1 mm in diameter and 6 ± 1 mm in length, as shown in Fig. 3.3.

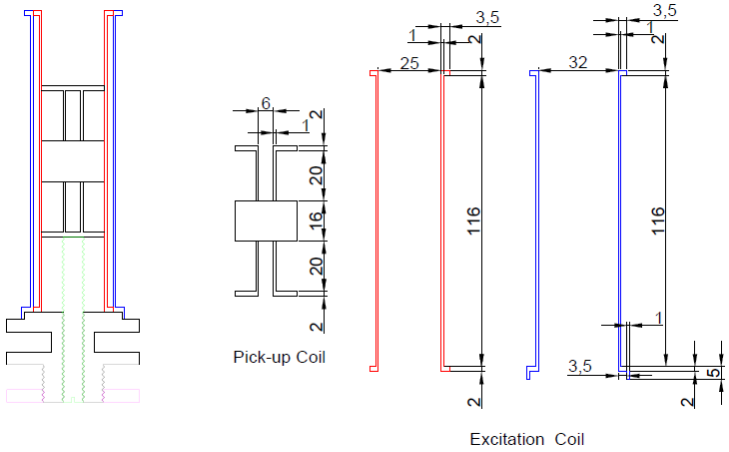


Fig. 3.3. Sizes of excitation coils and pick-up coil.

3. Information of the electronics

   Electronics are consisted of a signal generator board (Kentec Inc.), switchboards (Kentec Inc.), and DAQ card (NI USB-6216 OEM). These electrical board are located in the assaying part underneath to the coils. Main power switch is located side of the assaying part. Also, the main controlling computer with touch panel is set on the top of controlling part.

4. Multi-Channeled SQUID-Based ac Magnetosusceptometer

   The sample-magnetization component is a set of coils, including two excitation coils (referred to as excitation coil 1 and excitation coil 2, respectively) and one pick-up coil. The inductances and resistance of the three coils are listed in Table 1. The three coils are assembled coaxially, with the pick-up coil being innermost. Excitation coils are driven with an ac signal generator, generating two independent ac voltages at two different frequencies, f1 and f2, to excitation coils 1 and 2. The pick-up coil is an axial gradiometer. The ac magnetic signal from the sample is detected by the pick-up coil and is transmitted to the flux coupling component.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

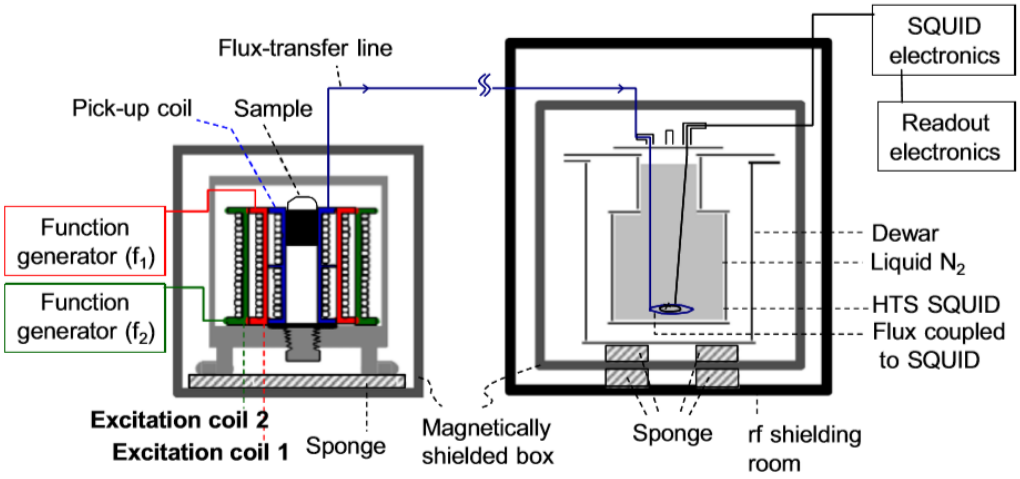


Fig. 3.4 Configuration of the single-channel high-Tc SQUID ac magnetosusceptometer for IMR measurement

The flux-coupling component is a pair of twisted wires, as illustrated in Fig. 3.5. One end of the wires is connected to the pick-up coil. The other end of the wires is terminated with a coil. Once the output ac voltage of the pick-up coil is activated, an ac electric current I is induced along the wires, and an ac magnetic field B is generated at the coil terminal. The ac magnetic field B at the coil terminal is detected with the high-Tc SQUID magnetometer, which is the superconducting–sensing component. By utilizing the flux-coupling coil, the ac magnetic flux originally generated at the sample component is efficiently transferred to the sensor component of the SQUID-based ac magnetosusceptometer. With this setup, the SQUID magnetometer is not seriously disturbed by the two excitation fields, because the excitation fields are distant from the SQUID magnetometer. Thus, the system is very stable and is suitable for long-term operation. Note that the flux-coupling coil is enveloped with electromagnetically shielded shells.

The SQUID magnetometer and the coil terminal are immersed in liquid nitrogen. The Dewar is placed inside an electromagnetically shielded box, showing 100 dB for the shielding factor at the operating frequency (*20 kHz). The SQUID magnetometer is controlled electronically, and the output signals are sent to a personal computer (PC).

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

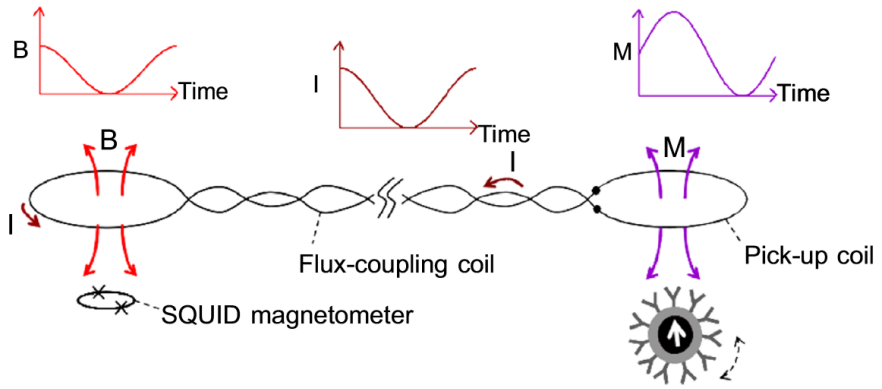


Fig. 3.5 Illustration of the working principle of the flux-coupling module used with the high-Tc SQUID ac magnetosusceptometer

With increases in the channel numbers, more electrical technologies are integrated into the magnetosusceptometer. For example, to prevent electromagnetic crosstalk among coil sets, two neighboring coil sets are separated by 15 cm or each coil set is surrounded with an electromagnetic absorber. The coil sets are activated in sequence. Only one coil set is activated at one instance. To manipulate the activation of each coil set, low-noise electric switches are cascaded between the ac signal generator and excitation coils and between the pick-up coil and the flux-coupling coil component.

Section II Important Specifications

The functional features of XacPro-S361 are listed below.

-
- Signal to noise ratio > 10 for the mixture of 80-μl 0.3 emu/g magnetic fluid and 40-μl PBS solution
- Signal stability: CV < 3 %
- Amplitude of applied ac magnetic field < 5 Gauss
- Input voltage: 100~240 V_{ac}, 50/60 Hz, 1.5 A
- Magnetic-signal sensor: HTS SQUID Magnetometer
- Noise level < 65 $\mu V/Hz^{1/2}$ at operating frequency
- Operation humidity < 50 %
- Sample volume = 120 μl

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Chapter IV Operation Procedure

Before installing or operating XacPro-S361, please read these notifications carefully.

- It is required to calibrate XacPro-S361 with the standard solution produced by our company every year to ensure accuracy of the instrument.
- 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. Do not try to change or reinstall the OS of the device.

In this chapter, operation procedures of installation, parameter setting, measurement start up, sample preparation, and data analysis are introduced.

Section I Operating Procedure for Installation

1. The equipment will be installed all needed software befor shipment. No need for additional installation except for plugging the power cable.
2. Fill the Liquid Nitrogen into funnel by engineers of MagQu or authority agents.

Section II Channel configuration

the channel array is depicted as Figure 4.1. The 36 channels are designated as A1-A6, B1-B6,...F1-F6. For duplicate testing, each sample occupies two channels designated as Figure 4.1. The default left half channels are set to measure Tau; the default right half channels are for $A\beta_{1\text{-}42}$. E3 and F3 are for Control Solution of Tau. E6 and F6 are for Control Solution of Aβ1-42. The reagent volume, sample volume, and the corresponding Calibrator are listed in Table 1.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

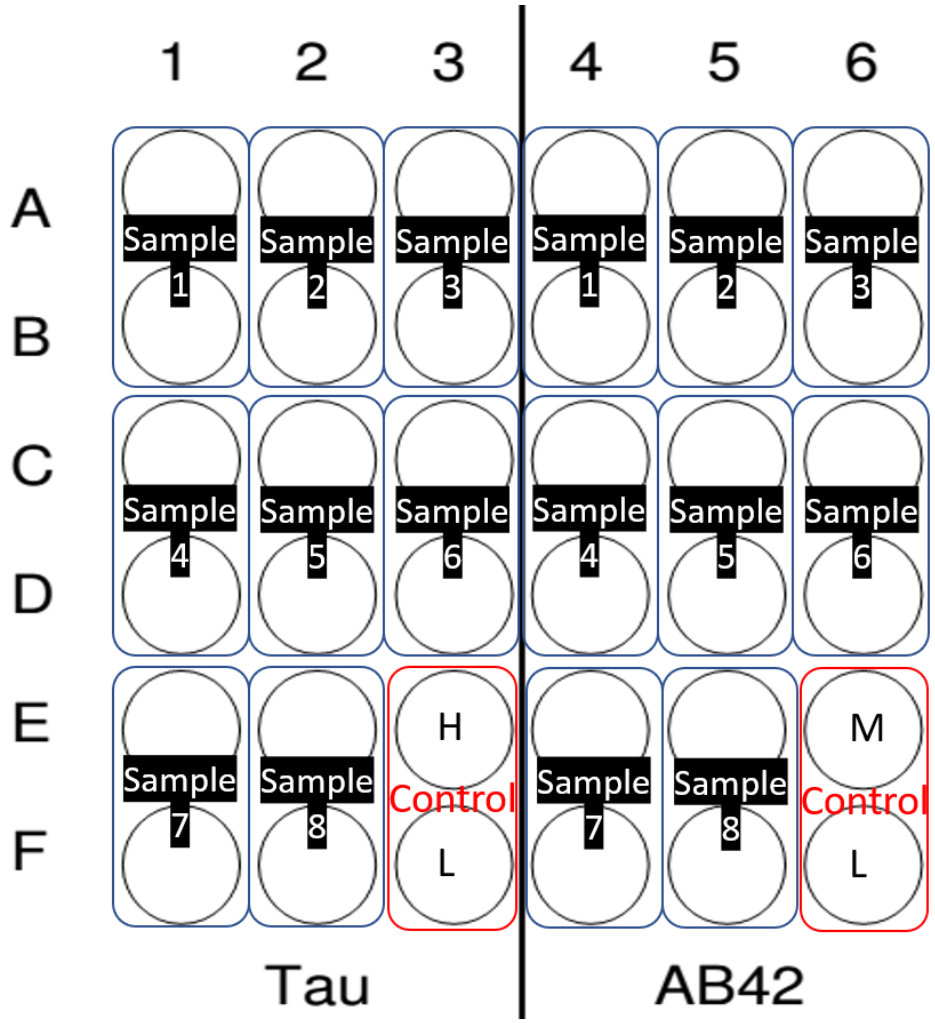


Figure 4.1

Table 1

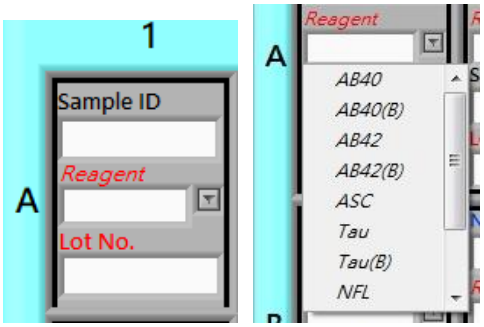
IMR assay	Reagent volume	Sample volume	Total volume	Calibrator
Tau, $A\beta_{1-40}$, p-Tau, α-syn	80 µl	40 µl	120 µl	Calibrator 80
$A\beta_{1-42}$, NfL, p-α-syn, TDP-43	60 µl	60 µl	120µl	Calibrator 60

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Section III: Input sample information to IMR

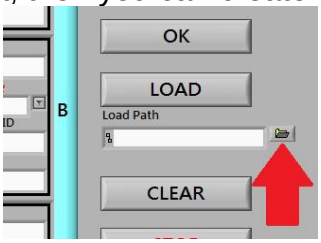
1. Launch the program “Sample information table generator”

2. Fill the blanks accordingly, please make sure all the other three blanks are filled, or the well(s) won’t be enabled. Leave them blank if the well(s) won’t be used.



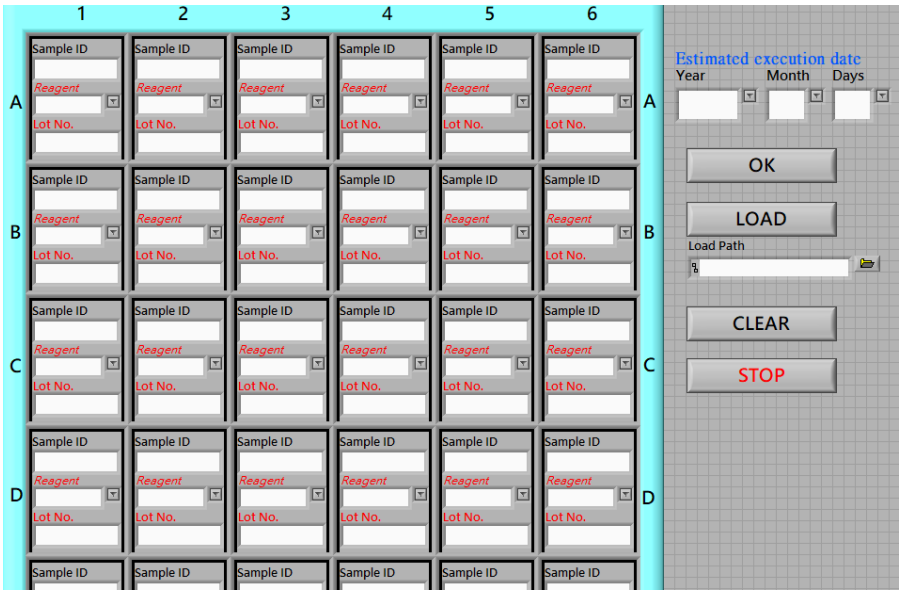
Reagent: Click the button and select the reagent assigned for this channel
Sample ID: Enter the given ID.
Sample ID (Control solution): Please follow the rule below to fill sample ID of control solution (channel E3, F3, E6, F6) and put control solutions’ Lot No. in brackets)
H control: H(Lot No.)
M control: M(Lot No.)
L control: L(Lot No.)
ex: H(210101A), L(200501A)
the first character (H, M, L) should be uppercase, no space between the first character and left bracket
Lot. No.: Reagent's lot No.

If template (the output file of sample information table) is available on this computer and meet our needs after modify a little bit, click the folder (indicated with a red arrow), select one template, click button “LOAD”, the template selected will be input, then you can create a new one from the template.



3. Click button “OK” after finished.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809



4. csv. will be generated, this csv. file can be input to IMR. Create a folder on IMR, copy the csv. file and put into the folder via USB flash drive.

Section IV: Start-Up and Setting Procedure of XacPro-S361

1. Confirm that (i) the analyzer's total power supply is connected to the uninterruptible power system (UPS), and (ii) the uninterruptible power system is normally operating.
2. Turn on Power (main power on the left side, Figure 1b ①) and Computer (button near the logo of MagQu in Figure 1).
3. Launch the program “Main-dc 1.0.exe” at desktop and the starting window is shown in Figure 2. Confirm that the LN2 content is greater than 40% (red Box in Figure 2，If not, follow the LN_2 refill procedure in section 5).

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

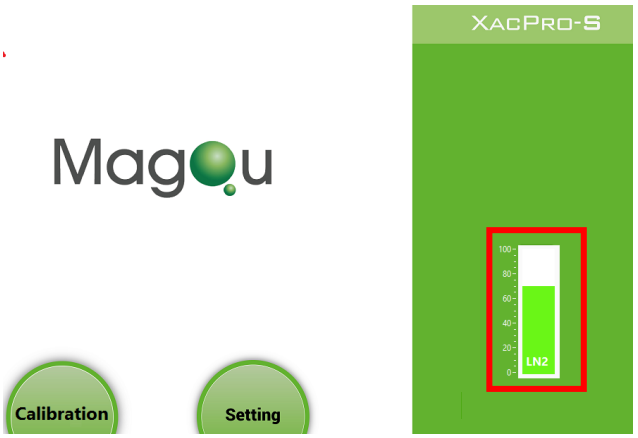
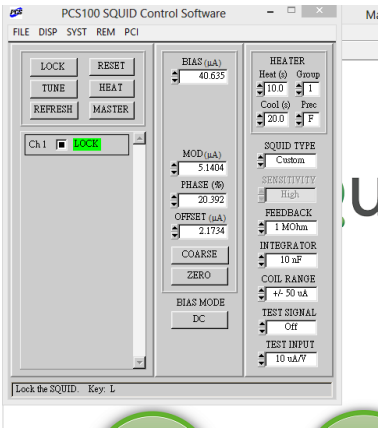
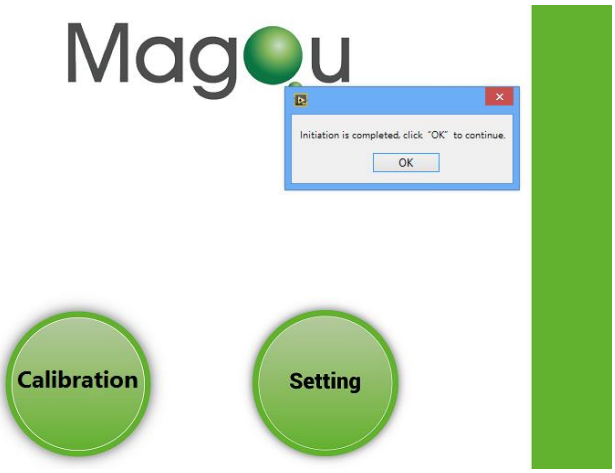


figure 2

4. Click "OK" to initiate the process and it takes a few seconds, please don't click any button during initiation; a confirmation message will pop-up after the process is completed.



MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809



5. Take Calibrator and Reagents out of 4 ℃ refrigerator, and the testing sample and Control Solution out of -20 ℃ or -80 ℃ freezer for room temperature recovery. If testing sample and Control Solution are going to stay more than 30 minutes before testing, please place them on crushed ice first, and then place them at ambient temperature right before testing for temperature recovery.

6. Open the cover of the XacPro-S machine on the left side (shown in Figure1) and hold the stand (red dash circle shown in Figure 3a. Caution!! Notice to fix the stand well to prevent the cover from falling to damage the operator !!). Remove the sample testing tubes that have been measured from all the 36 wells if the previous testing sample are still in the wells. Please check the quality and volume of Calibrator. Please refer to Figure 4. If the appearance of the previous prepared Calibrator looks abnormal, please replace it by freshly-prepared Calibrator. Homogenize the Calibrators by vortexing for about 3 seconds. Place them in 2 ml Eppendorf without lid and then spin down by micro centrifuge for about 3 seconds. Then place the Calibrators into 36 wells and close the cover. (The F3 channel is Calibration Channel for SQUID Offset adjustment and a Calibrator** with testing sample tube must be placed during any measurement.)

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

** Calibrators are pure magnetic fluid without conjugating any biomolecules. The function of Calibrators is to finetune the output magnetic signal.

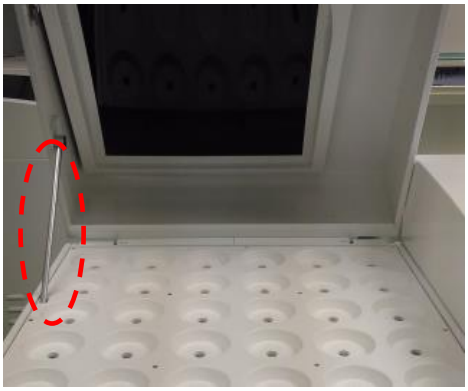


Figure 3a

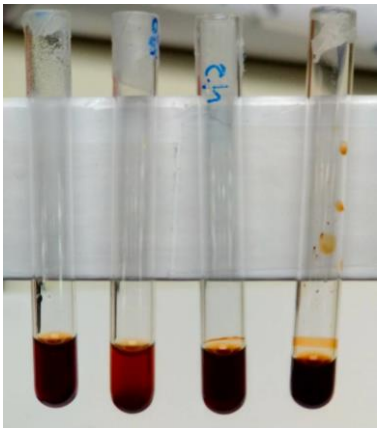


Figure 4 From Left to right: Calibrator (normal), precipitated (abnormal), evaporated (abnormal)

Notice: Please do not use mobile phone within 2 m around the analyzer, because it may cause disturbance for IMR signals!! If you need to take pictures or shoot a video, please turn on airplane mode.

7. **Automatic calibration**: start automatic calibration by the following steps:
   a. click the “Calibration” button in Figure 5a, then select the sample information table created for this run.

Figure 5a

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

b. when it is switched to "Calibration Mode" as Figure 5b (The box at upper right side indicates "**Calibration"** Mode). The wells selected on the sample information table will become orange after input (as figure 5b)

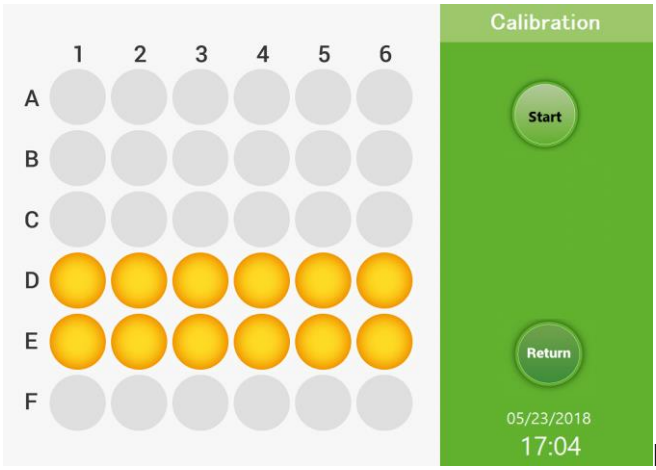


Figure 5b

c. Press "Start" button to calibrate, then this selected channel will start flashing to calibrate and the next channel will flash to calibrate after this channel is calibrated.

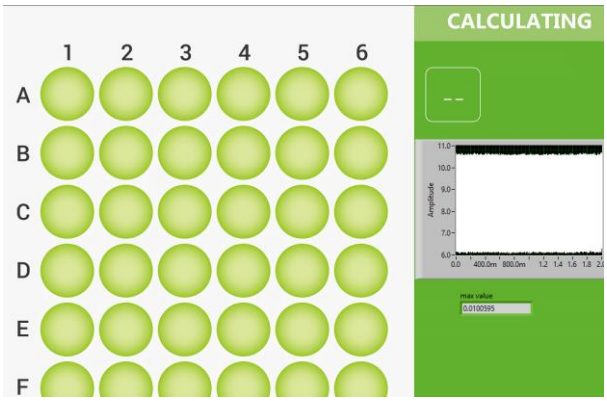


Figure 5c

d. After calibration is ready, the program window is shown as Figure 6. Click the "Execution" button and then it is switched to " Execution Mode" Figure 7 (The top right box indicates "Execution mode").

e. If any selected channel fails calibration, it will be gray, including that this channel is not successfully calibrated. The gray channel cannot be measured. Then stop the gray channel measurement from measurement plan or follow the Manual adjustment procedure in section 5 to re-adjust the parameters of the gray channels.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Figure 6

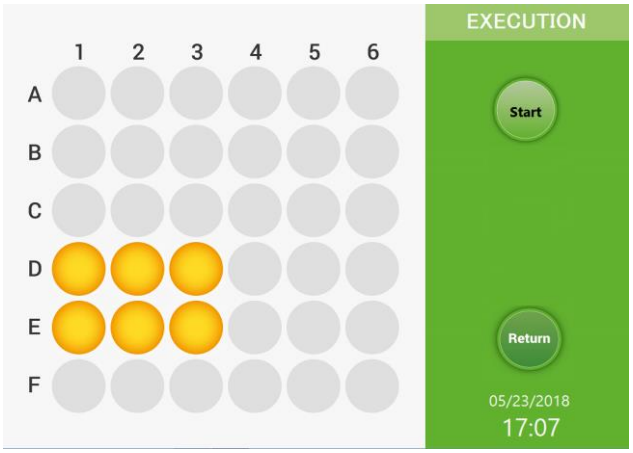


Figure 7

Section V: Sample preparation and execute measurement

1. Start sample preparation: mark the sample testing tubes with channel number; ***this could be done in advance***. After the frozen samples have been fully dissolved, vortex the sample tubes and spin them down to make the sample solution homogenous. Use a micropipette with low retention tip to take appropriate amount of the sample into the corresponding detection tube. (For example, take 40 µl sample to measure Tau protein, 60 µl for $A\beta_{1\text{-}42}$ protein; as shown in Table 1).

2. Before proceeding to the next step. Go to the machine to check that all selected channels have been calibrated, then take out the Calibrators from 36 wells, store them in 4 °C refrigerator for reuse.

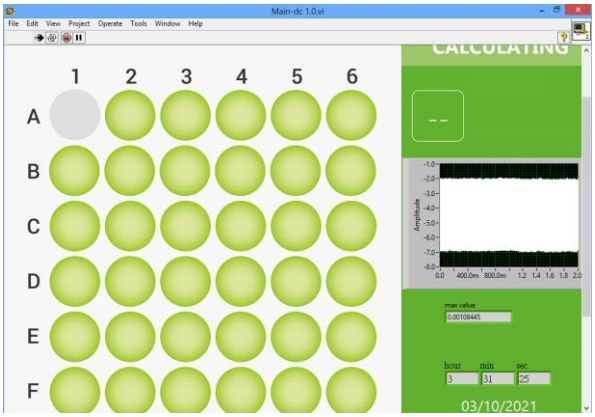
3. Use a micropipette with low retention tip to take appropriate amounts of reagents into the corresponding detection tube (e.g. take 80 µl to measure Tau protein; take 80 µl; take 60 µl

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

for $A\beta_{1-42}$ protein; as shown in Table 1). Seal all detection tubes with paraffin. Mix tubes by vortexing for about 3 seconds. Place them in 2 ml Eppendorf without lid and then spin down by micro centrifuge for about 3 seconds (as shown in Figure 8).

Figure 8

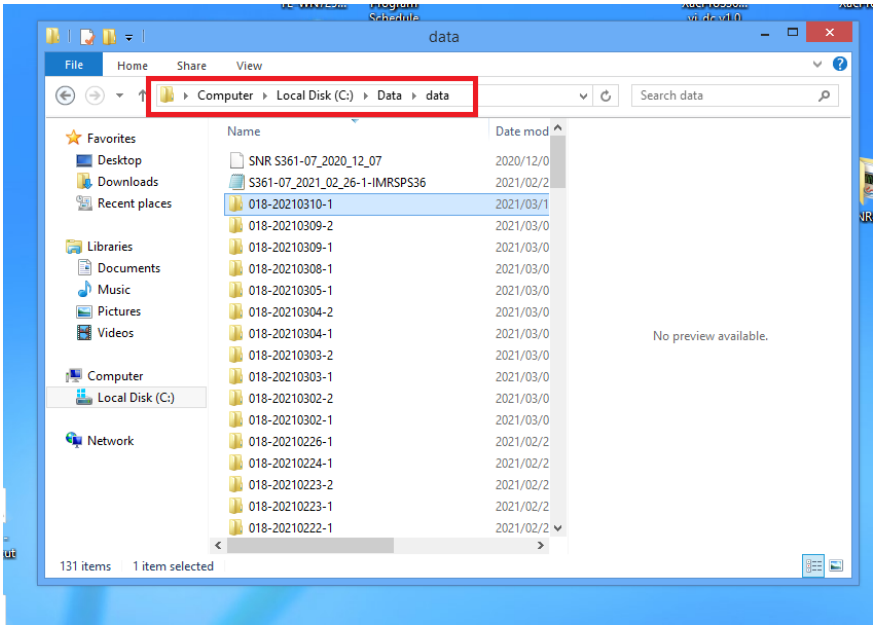
Place the sample testing tubes into the corresponding wells. Click on the “Start” button (shown in Figure 7) to measure the IMR reaction. The well which is flashing indicates it’s being measuring



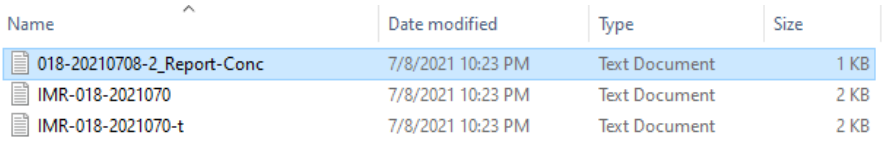
The time interval between adding the reagent to the testing tube with sample and the starting measurement must be less than 20 minutes.

Section VI: After program is finished (around 5 hours after start)

Data will be generated as text files and put in drive C:\Data\data



Find the filename with "*******_Report-Conc", please refer to the picture below, copy the text file to computer via USB flash drive



Open the text file with Excel or Notepad and check the data

	A	B	C	D	E	F
1	ID	Reagent	Conc. 1	Conc. 2	Mean	CV
2	L(210601A	Tau-new	11.458		5.73	1.41
3	S3(210601	Tau-new	40.628	50.325	45.48	0.15
4	S8(210601	Tau-new	8.656		4.33	1.41
5	S9(210601	Tau-new	29.065	37.979	33.52	0.19
6	L(210301A	Aβ42-new	12.237		6.12	1.41
7	S9(10000)	Aβ42-new	15.524	19.339	17.43	0.15
8	S9(210301	Aβ42-new	15.552	20.747	18.15	0.2

File Edit Format View Help

ID	Reagent	Conc. 1	Conc. 2	Mean	CV
L(210601A)	Tau-new	11.458		5.73	1.41
S3(210601A)	Tau-new	40.628	50.325	45.48	0.15
S8(210601A)	Tau-new	8.656		4.33	1.41
S9(210601A)	Tau-new	29.065	37.979	33.52	0.19
L(210301A)	Aβ42-new	12.237		6.12	1.41
S9(10000)	Aβ42-new	15.524	19.339	17.43	0.15
S9(210301A)	Aβ42-new	15.552	20.747	18.15	0.20

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Section VII: Manual adjustment procedure: only used as automatic calibration fails

1. Close the program “Main.exe” and follow the steps as below, Figure 10 red marked arrow

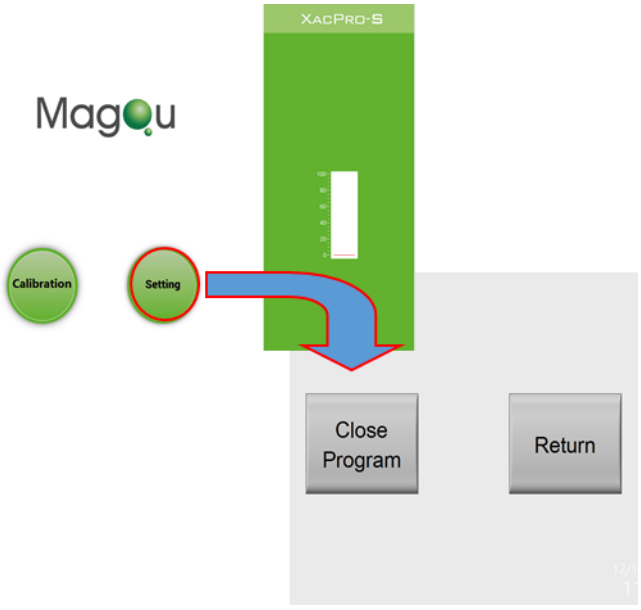


Figure 10

2. Launch the program “**Test channel tuning v1.0.exe**” at desktop (the starting window is shown as Figure 11a) to tune channel output:

   a. Set the channel values

      1) Select the channel (blue dotted box in Figure 5.2).
      2) Adjust the output intensity to18050 Hz (purple dotted box in Figure 11a) then click “Change Output” button (yellow dotted box) to right to change the setting. Make the value in the “peak-18430” (green dotted box; also, the Intensity in red box in Figure 5.2) of each channel be around at 0.0009~0.0011.
      3) Then select the next channel (blue dotted box in Figure 11e) and repeat the step 2.
      4) After adjustment, stop the program by click【 】(At the left side of second-row toolbar, show as red arrow).

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

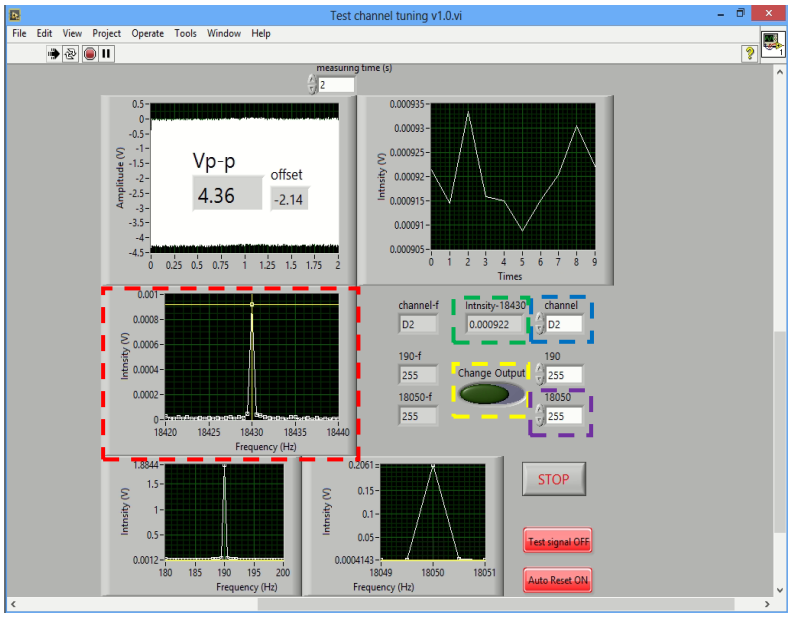


Figure 5.2

b. Close the program by click “X” in the top right corner. Launch again the program “**Main-dc 1.0.exe**” at desktop to repeat “**automatic calibration**” steps in section IV.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Chapter V Debugging and Maintenance

The meaning of indicator light and buzzer is shown below:

Figure 5.1

Indicator light of XacPro-S361. The light below the touch panel (circle green) mean the computer is on the work. The red light will light up for two reasons, the cover of the assaying part is open (when the computer on) or the computer off when main power on. The yellow light lights up when the liquid nitrogen level is too low. The green light indicates that the device is on measuring.

LN_2 refill procedure:

If the LN_2 level is less than 40%, open the cover of the XacPro-S machine on the right side (See Figure 1b ⑥), unscrew the plug of the injection hole, fitted the funnel (See Figure 1c ②) and then add the Liquid Nitrogen through the funnel. (Figure 5.2) To replenish the liquid nitrogen level to more than 80%. (After adding liquid nitrogen, the funnel may get frozen. Please put tissue papers into the funnel to absorb moisture (Figure 5.3) and wait for a moment

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

(~10 min) to unscrew the funnel, and remember to replace it with the plug. (After refill LN_2, please close the “Main.exe”, turn off the computer and the main power. **Stop measuring for at least 8 hours.**)

Caution!! Please wear goggles and gloves to prevent the frostbite or damage while operating LN_2 refilling.

Caution!! For step-wise LN_2 refilling by thermos, please notice that the time interval between two refilling should be less than 2 min; otherwise more than 10 min of break is needed before staring the next round of refilling.

This step is to prevent from damaging the pipe. After refilling LN_2, the pipe will get frozen. As stopping refilling for more than 2 min, the pipe will start to warm up, and at this phase, sudden freezing by refilling again may break the pipe. The frozen pipe can be recovered for next round of refilling after around 10 min.

Figure 5.2

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Figure 5.3

If there are any problems to refill LN_2 (tube may be broken), please contact MagQu's engineer.

As for any situation listed or not listed in the error information mentioned above, please contact our company as soon as possible. Do not try to repair or move the equipment by your own self. The contact information is:

Tel: +886-2-86671897

Email: info@magqu.com

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Chapter VI Attentions

- Please confirm whether the transformer suitable for the voltage in the situation where the analyzer is used before using it (100 V~240 V).
- 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 ensure the liquid nitrogen level is always under working area.
- 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-S361 close to a strong magnetic field or high-power electrical products. Be careful to open or close the door.

Section I Cleaning & Maintenance

1. Wipe and clean the analyzer by using a piece of soft cloth soaked with water or mild solvent.
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. Do not try to transport or move the analyzer; contact the distributor if you need to move it.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Section II After-sale Services & Guarantee

1. Normally, 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 discretional 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.

   (d) Any damage or fault due to misuse, abuse or connect with any devices that are not authority by MagQu.

3. Please contact to distributors when the analyzer required repair. As the analyzer is a precision instrument, it must be transported by distributor.

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Appendix A List of Packing Inserts

XacPro-S361 packing list	
Accessory name	Quantity
XacPro-S361 Machine body	1
Power Cable	1
Liquid Nitrogen refill funnel	1
Manual	1

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Appendix B Specialist of Device

Device dimensions:

Length: 161.5 cm
Width: 91.5 cm
Height: 138.4 cm
Weight: 220 kg

Working area:

Length: 200 cm
Width: 135 cm
Height: 220 cm

Input power:

Voltage: 100V~240 V, 50-60 Hz
Max Current: 1.5 A

Output power:

Magnetic field: Lower than 5 Gauss
Bandwidth: 30 kHz

Sensitivity:

Better than 1 pg/ml

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Appendix C Warning Icon Description

This Way Up

Careful Fragile

Keep Dry

Away From Magnetic Field

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Appendix D IMR Assay Storage Condition

Calibrator	Calibrator 60	**2-8 °C** ** away from high magnetic field, e.g. refrigerator compressor motor ** not stored at refrigerator door, which has large temperature variation
	Calibrator 80	
Reagent	Amyloid Beta 1-42 IMR Reagent	
	Amyloid Beta 1-40 IMR Reagent	
	Tau Protein IMR Reagent	
	Phosphorylated Tau Protein [pT181] IMR Reagent	
	Alpha-Synuclein IMR Reagent	
	Phospho-Alpha-Synuclein IMR Reagent	
	TDP-43 IMR Reagent	
	NfL IMR Reagent	
Control Solution	Amyloid Beta 1-42 Protein Control Solution-L	**-20 °C** ** not stored at freezer door, which has large temperature variation
	Amyloid Beta 1-42 Protein Control Solution-H	
	Amyloid Beta 1-40 Protein Control Solution-L	
	Amyloid Beta 1-40 Protein Control Solution-H	
	Tau Protein Control Solution-L	
	Tau Protein Control Solution-H	
	Phosphorylated Tau Protein [pT181] Control Solution-L	
	Phosphorylated Tau Protein [pT181] Control Solution-H	
	Alpha-Synuclein Protein Control Solution-L	
	Alpha-Synuclein Protein Control Solution-H	
	Phospho-Alpha-Synuclein Control Solution-L	
	Phospho-Alpha-Synuclein Control Solution-H	
	TDP-43 Control Solution-L	
	TDP-43 Control Solution-H	
	NfL Control Solution-L	
	NfL Control Solution-H	
Testing Sample	Plasma, CSF, or serum samples	**-80 °C**

MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809

Appendix E Glossary/symbol definition

SYMBOL	DESCRIPTION
REF	Catalogue number
SN	Serial number
	manufacturer
EC REP	Authorized representative in the European Community/ European Union
CE	CE MARK = CONFORM WITH EEC DIRECTIVES
IVD	In Vitro diagnostic medical device
	Consult the instructions for use
	Biological risks
	Caution, refer to accompanying documents
TW 2022-04-29	Country and date of manufacture

manufacturer

MagQu Co., Ltd.

Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan

Website: www.magqu.com Email: info@magqu.com

Tel: +886-2-86671897 Fax: +886-2-86671809

EC REP Authorized representative in the EC/ EU

MedNet EC-REP GmbH

Borkstraβe 10, 48163Muenster, Germany

References

1. K.W. Huang, S. Y. Yang, C.Y. Yu, J.J. Chieh, Che-Chuan Yang, Herng-Er Horng, Chin-Yih Hong, Hong-Chang Yang, and Chau-Chung Wu, “Exploration of the relationship between the tumor burden and the concentration of vascular endothelial growth factor in liver-cancer-bearing animals using immunomagnetic reduction assay”, J. Biomed. Nanotechnol. **7**, 535 (2011).

2. S.Y. Yang, J.J. Chieh, C.C. Yang, S.H. Liao, H.H. Chen, H.E. Horng, H.C. Yang, C.Y. Hong, M.J. Chiu, T.F. Chen, K.W. Huang, and C.C. Wu, “Clinic applications in assaying ultra-low-concentration bio-markers using HTS SQUID-based AC magnetosusceptometer”, IEEE Trans. Appl. Supercond. **23**,1600604 (2013).

3. M.J. Chiu, Y.F. Chen, T.F. Chen, S.Y. Yang, F.P. Gloria Yang, T.W. Tseng, J.J. Chieh, J.C. Rare Chen, K.Y. Tzen, M.S. Hua, and H.E. Horng, “Plasma tau as a window to the brain-negative associations with brain volume and memory function in mild cognitive impairment and early alzheimer's disease”, Human Barin Mapping, 15 Oct. (2013).

4. S.Y. Yang, J.J. Chieh, W.C. Wang, C.Y. Yu, C.B. Lan, J.H. Chen, H.E. Horng, Chin-Yih Hong, and H.C. Yang, “Ultra-highly sensitive and wash-free bio-detections for H5N1 virus via magnetoreduction assays”, J. Virol. Methods **153**, 250 (2008).

5. S.Y. Yang, J.J. Chieh, W.C. Wang, C.Y. Yu, N.S. Hing, H.E. Horng, Chin-Yih Hong, H.C. Yang, C.F. Chang, and H.Y. Lin, “Magnetic nanoparticles for high-sensitivity detection on nuclei acids via superconducting-quantum-interference-device-based immunomagnetic reduction assay”, J. Magn. Magn. Mater. **323**, 681 (2011).

6. Chin-Yih Hong, C.C. Wu, Y.C. Chiu, S.Y. Yang, H.E. Horng, and H.C. Yang, “Magnetic Susceptibility Reduction Method for Magnetically Labeled Immunoassay”, Appl. Phys. Lett. **88**, 212512 (2006).

7. C.C. Yang, S.Y. Yang, H.H. Chen, W.L. Weng, H.E. Horng, J.J. Chieh, C.Y. Hong, and H.C. Yang, “Effect of molecule-particle binding on the reduction in the mixed-frequency ac magnetic susceptibility of magnetic bio-reagents”, J. Appl. Phys.**112**, 24704 (2012).

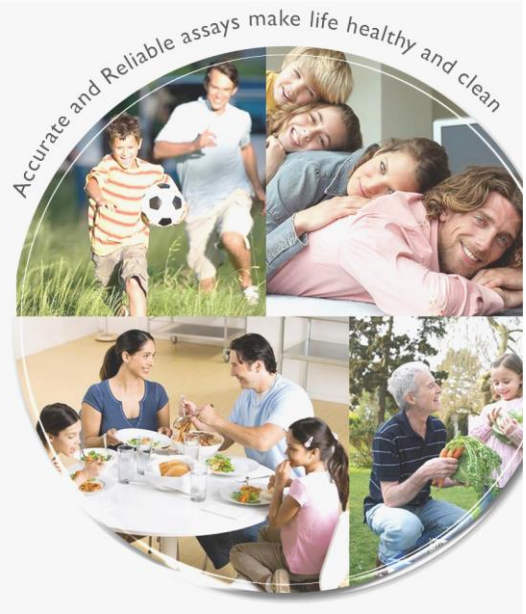
8. Wanquan Jiang, H.C. Yang, S.Y. Yang, H.E. Horng, J.C. Hung, Y.C. Chen, and Chin-Yih Hong, “Preparation and properties of superparamagnetic

nanoparticles with narrow size distribution and biocompatible", J. Magn. Magn. Mater. **283**, 210 (2004).

9. S.Y. Yang, Z.F. Jian, H.E. Horng, Chin-Yih Hong, H.C. Yang, C.C Wu, and Y.H. Lee, "Dual immobilization and magnetic manipulation of magnetic nanoparticles", J. Magn. Magn. Mater. **320**, 2688 (2008).

10. J.J. Chieh, S.Y. Yang, Z.F. Jian, W.C. Wang, H.E. Horng, H.C. Yang, and Chin-Yih Hong, "Hyper-high-sensitivity wash-free magnetoreduction assay on bio-molecules using high-T_c superconducting quantum interference devices", J. Appl. Phys. **103**, 14703 (2008).

11. M. J. Chiu, H. E. Horng, J. J. Chieh, S. H. Liao, C. H. Chen, B. Y. Shih, C. C. Yang, C. L. Lee, T. F. Chen, S. Y. Yang, C. Y. Hong, and H. C. Yang, "Multi-channel SQUID-based ultra-high-sensitivity in-vitro detections for bio-markers of Alzheimer's disease via Immunomagnetic Reduction", IEEE Trans. Appl. Supercond. **21**, 477 (2011).



MagQu Co., Ltd.
Rm. 3, 6F., No. 95, Minquan Rd., Xindian Dist., New Taipei City 231625, Taiwan
Website: www.magqu.com Email: info@magqu.com
Tel: +886-2-86671897 Fax: +886-2-86671809