# USB-MCA software

# Instruction Manual

Ver. 1.1.0. April 2017

# - Contents

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# 1．Revision history

Jan. 2011 Edition 1.0.0. First edition

May. 2011 Edition 1.0.1. Windows 7 support

May. 2011 Edition 1.0.2. Changed the Reset-time 160ns to 300ns

                       Changed the Dead-time 360ns to 500ns

Sep. 2013 Edition 1.0.3. Additional Instructions, recommendable USB cable length is 1m or 2m and less.

Dec. 2013 Edition 1.0.4. Description of the ADC gain fixed 16384 to 128.

Jan. 2014 Edition 1.0.5. Windows 8 support

Nov. 2014 Edition 1.0.6. Add a description of the "Data acquisition by the GATE signal timing"

Nov. 2015 Edition 1.0.7. Postscript warranty card, guarantee rule and description of the ADC Gain upper limit.

Apr. 2017 Edition 1.1.0. Windows 10 OS available, delete "Config" of menu, periodical preservation added

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## 2. Safety instruction and disclaimer

Before using USB-MCA (hereafter this device) and USB-MCA software (hereafter this software), please read this "Safety instruction and disclaimer", be sure to observe the contents and please use it correctly.

We are not responsible for any damage caused by the use of this software, including damage to equipment, detectors, connection equipment, applications, damage to failure, and other secondary damage Hmm.

## 🚫 Prohibited

· Can not be used for applications requiring special quality or reliability related to human life or accident.

· Can not be used in high temperature, high humidity, highly vibrating places, etc.

· Do not give strong shock or vibration.

· Do not disassemble or modify.

· Do not expose it to water or condensation. Please do not operate with wet hands.

· In case of fever, deformation, discoloration, odor, etc. stop using it immediately and contact us.

## ⚠️ Caution

· Use this product at room temperature in the operating temperature range, and use it so that there is no condensation.

· In case of smoke or abnormal heat generation, immediately disconnect the USB cable from this unit.

· This instrument is precision electronic equipment. Be careful of static electricity.

· Do not store this unit in dusty places or hot and humid places.

· Do not place devices that emit strong radio waves, such as mobile phones and transceivers, close to each other.

· In environments with high electric noise, malfunction may occur.

· Specifications of this device and related document contents are subject to change without notice.

*Please be sure to check the red letters and "Caution on use" stated in this manual.

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# 3. Overview

## Overview

USB-MCA (USB-multichannel analyzer) made by TechnoAP Co., Ltd. APG7300A and APG7300L (hereinafter referred to as APG7300A (L)) are equipped with a high-speed successive approximation ADC, and operate lightweight with only USB bus power without using an AC adapter It is a compact MCA.

The preamplifier signal from the detector is input to the spectroscope amplifier (linear amplifier), and the output signal amplified and waveform-shaped (shaped) by the analog circuit is input to the USB-MCA. The amplitude (wave height value, peak value) of this signal includes radiation energy information. MCA is a wave height analyzer that detects the signal and digitally converts the maximum crest value to generate a spectrum (histogram).

"Dead time" is an indicator of MCA performance. The dead time is a time period when MCA can not measure peak value. New events can not be measured while events occur irregularly, such as radiation, while events are being detected, peak detection, digitization of wave height values, memory rewriting, resetting of crest value. Normally, the dead time of MCA is said to be 1 μsec with a fast one, but the dead time of our MCA is fixed at 500 nsec.

As a method of peak detection, there is a "first peak detection mode" in addition to a general "absolute mode" in which AD conversion is performed after peak detection. In this mode, AD conversion is started immediately after detecting the pulse peak. Detection conversion processing can be finished within the pulse until 0.25 μs pulse shaping, which is regarded as high speed in the spectroscopic amplifier.

As measurement data, there is a "histogram" data. The histogram is the peak value. Transfer measurement data to PC via USB cable.

Drivers and applications that run on Windows are included as software.

This manual explains the handling of our USB-MCA product.

# Specifications

Model: APG7300A and APG7300L

(1) Analog input

| | |
|---|---|
| The number of the channels | 1CH |
| Input range | 0 to 10V |
| Input impedance | 1kΩ |
| Possible input pulse width | Minimum 100 nsec up to Maximum 100 μsec (*the period exceeding the threshold) |

(2) ADC

| | |
|---|---|
| Conversion method | Successive approximation type |
| Resolution | 16bit |
| Conversion time | 200 ns |
| Reset time | 300 ns |
| ADC GAIN | 16384, 8192, 4096, 2048, 1024, 512 channels |
| Threshold | Full scale 0 to 50% set by PC |
| LLD | Full scale 0 to 100% set by PC |
| ULD | Full scale 0 to 100% set by PC |

(3) Performance

| | |
|---|---|
| Dead time | Fixed at 500 nsec |
| Integral nonlinearity | ± 0.025% (typ.) or less |
| Differential nonlinearity | ± 1% (typ.) or less |

(4) External input

| | |
|---|---|
| External input | GATE and VETO |

(5) Function

| | |
|---|---|
| Measurement mode | Histogram mode |
| Communication I/F | USB 2.0 |

\* It is recommended that the length of the USB cable be 2 meters or less.

(6) Software

| | |
|---|---|
| USB-MCA software | Windows version, a driver and application |

(7) External form

| | |
|---|---|
| Dimensions | : 70mm(W) x 140mm (D) x 20mm (H) |
| Weight | : 180g |
| Placement | : |

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(3)
(4)
(5)
(6)
(1)
(2)
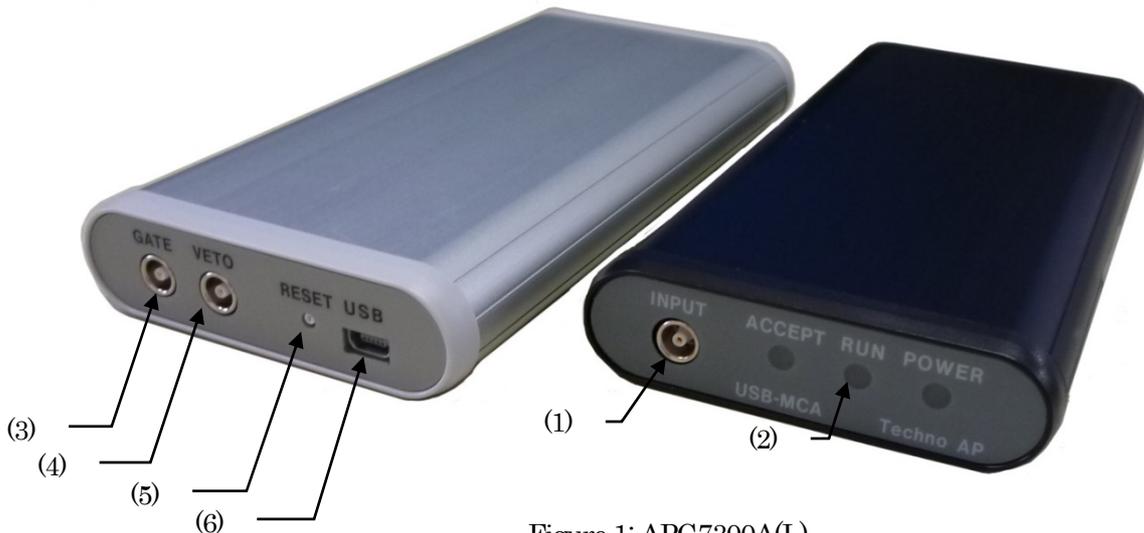
Figure 1: APG7300A(L)

[Front]
　（1）　INPUT　　　LEMO (EPL.00.250.NTN) connector for amplifier signal input
　（2）　LED　　　　LED for operation check
　　　　　POWER　　It turn on at the time of connected with PC
　　　　　RUN　　　It turn on at the time of a measurement start
　　　　　ACCEPT　　It turn on at the time of the signal detection

[Back]
　（3）　GATE　　　LEMO connector for outside GATE signal input.
　　　　　　　　　　Input the signal of the TTL level.
　　　　　　　　　　"High" means data acquisition, "Low" means data non-acquisition.
　（4）　VETO　　　LEMO connector for outside VETO signal input.
　　　　　　　　　　Input the signal of the TTL level.
　　　　　　　　　　"High" means data non-acquisition, "Low" means data acquisition.
　（5）　RESET　　　Reset button
　（6）　USB　　　　USB 2.0 Mini-B receptacle (Female terminal)


※ Introduction of the conversion adapter
The input and output connector of this product is used EPL.00.250.NTN made in LEMO company and the other same size connector. In the case of use BNC connector cable to use this product, it is possible to connect to it by having you use the following conversion adapters.
Manufacturer:　　　　HUBER+SUHNER AG
Model:　　　　　　33_QLA-BNC-01-1/1--_NE
Contents:　　　　　QLA-01 to BNC
　　　　　　　　　　Connector Gender 1 Interface QLA-01
　　　　　　　　　　Connector Gender 2 Interface BNC


（8）Accessories
・　Instruction manual
・　CD (a driver and application and instruction manual)
・　USB cable (a connector the cable of USB (A) male and the USB (Mini-B) male)

# 4.　　Preparations

## Connection
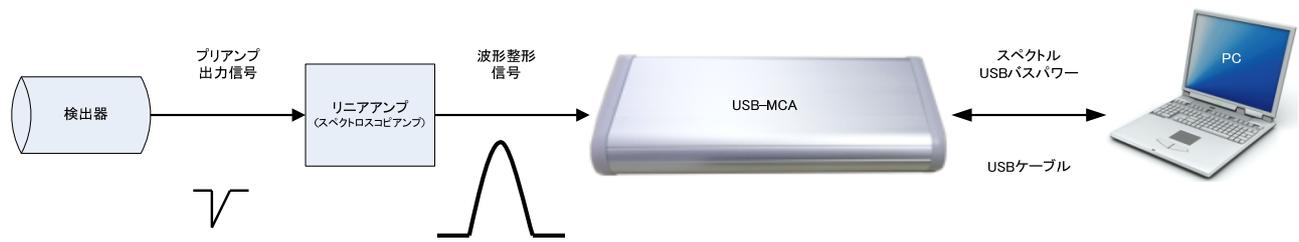


Figure 2: Connection at the time to use of the MCA

（１）　　Connect USB-MCA and a PC with an USB cable.

（２）　　"POWER" LED turns on.

（３）　　Connect the pre-amp output signal of the detector to a linear amplifier (spectroscopic-amp).

（４）　　Connect an output signal got the wave pattern of the linear amplifier (spectroscopic-amp) fixed to "INPUT" of USB-MCA.

（５）　　* It is necessary to install a driver in a PC to connect for the first time. Please refer description for the installation method of the driver later.

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## Installation of the driver software

It is necessary to install a driver software by attached CD in a PC to connect for the first time.

## In the case of Windows 7

（１）　(REQUIRED) Log in as Administrator or an account of Administrative right.
（２）　Connect USB-MCA to a PC with a USB cable.
（３）　It is displayed it when "Install device driver software" in the desktop lower right.
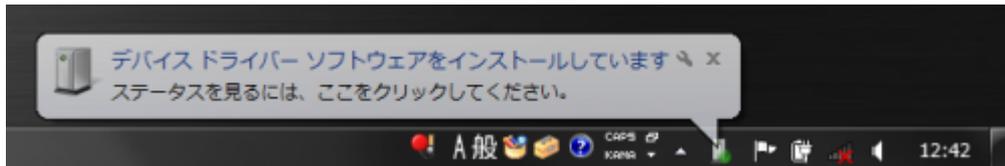


When it is displayed when "The device driver software was not installed "after this, please open device mangers and confirm an icon of "USB-MCA". You click the right button on an icon and click "The update of the driver software".





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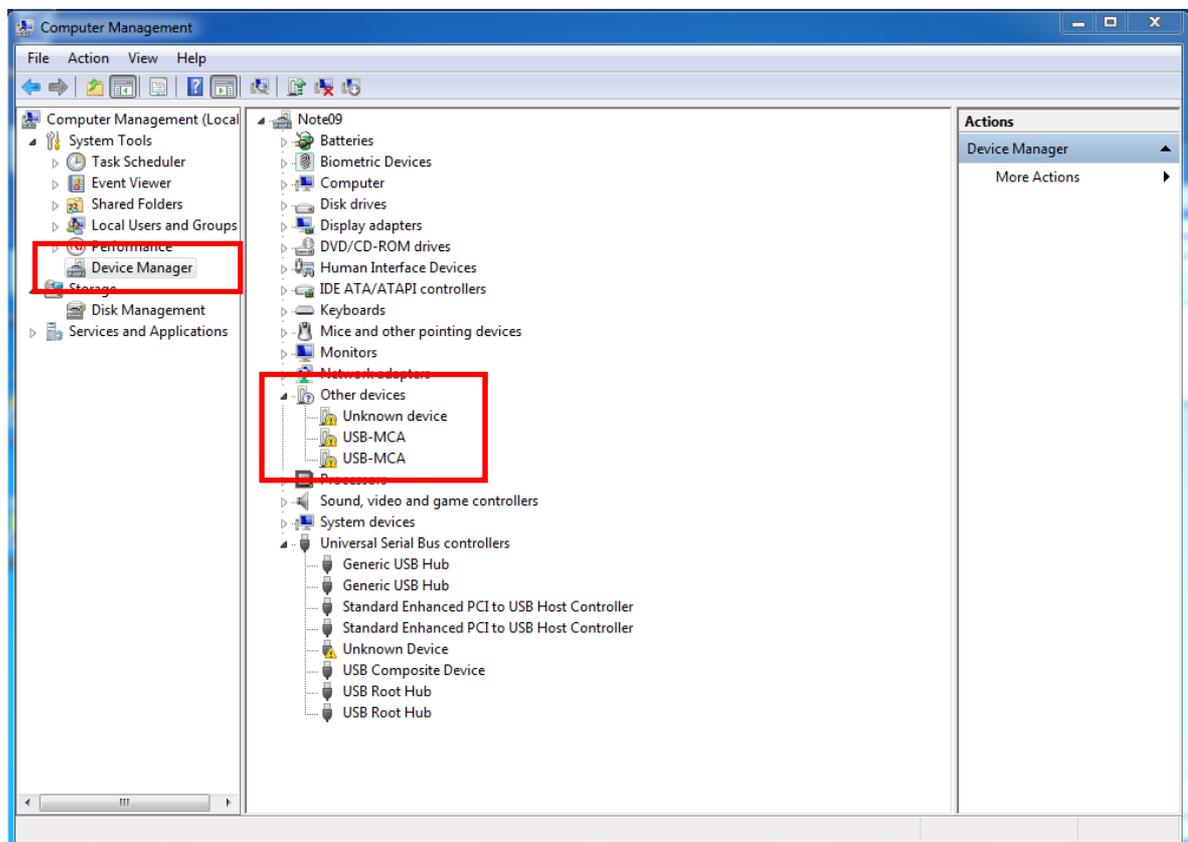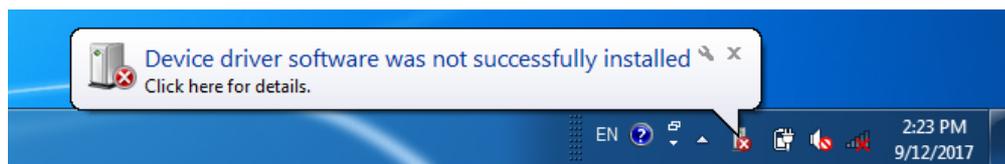
（１） Installation on an interactive basis
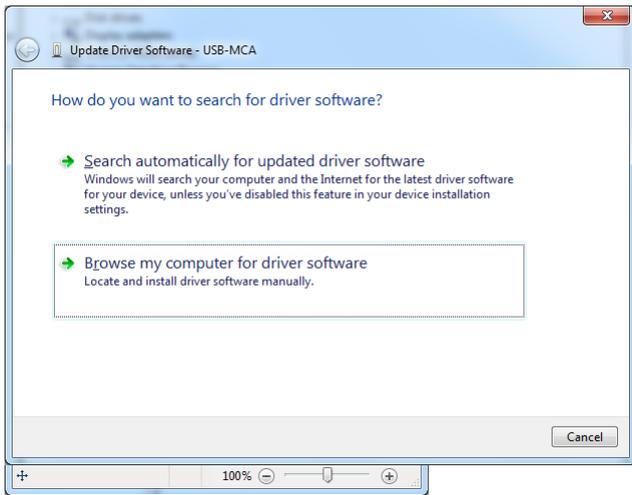




Please refer to attached CD "Driver" folder
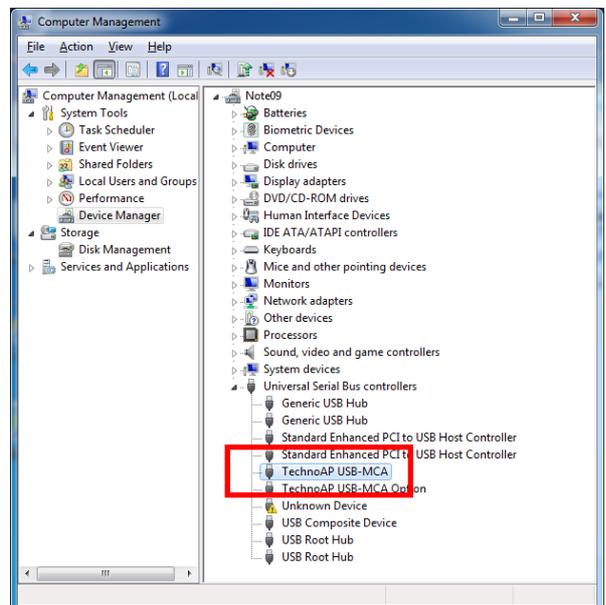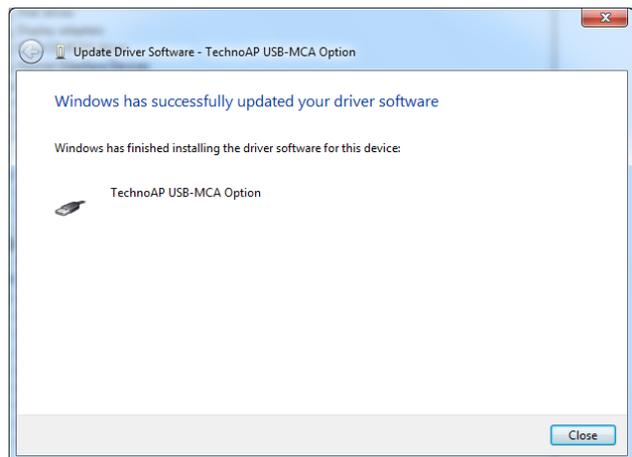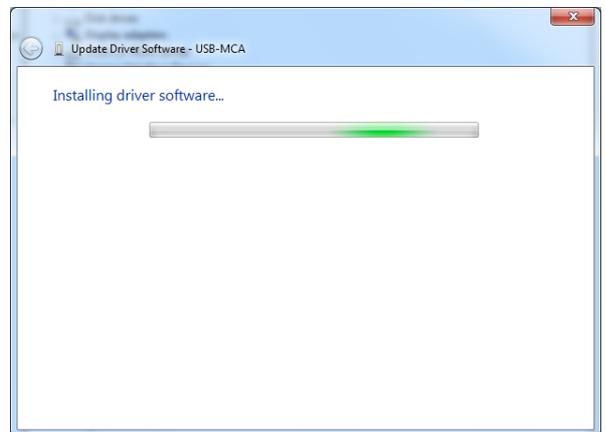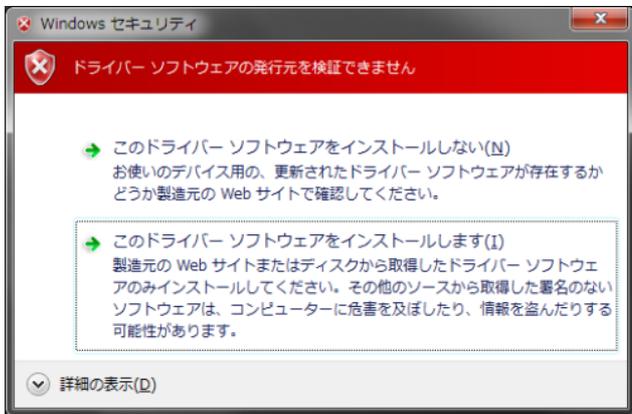








Install "TechnoAP USB-MCA Option" now. After "TechnoAP USB-MCA" driver installation, you install "TechnoAP USB-MCA Option" in the same procedure. Confirm that two icons of "TechnoAP USB-MCA" and "TechnoAP USB-MCA Option" are normal in device managers. You install application after having been able to install a driver correctly. The installation procedure in a following chapter.

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## In the case of Windows 8 (64bit)

The driver software without the digital signature becomes unable to install it by default to prevent it from a user being wrong installing a driver software in Windows8 (64bit). This driver software does not have a digital signature, so it is necessary "Invalidate the compulsion of the driver signature" before installing it in the following procedures.

（１）　　Display a charm with a start screen.
　　　　　* In the case of mouse operation: You move a pointer in the top right corner of the screen or the lower right corner.

　　　　　* In the case of touch operation: You swipe towards the center from the screen right side.
（２）　　Choose "setting" at a charm, and choose "a change of the PC setting" at a setting menu.
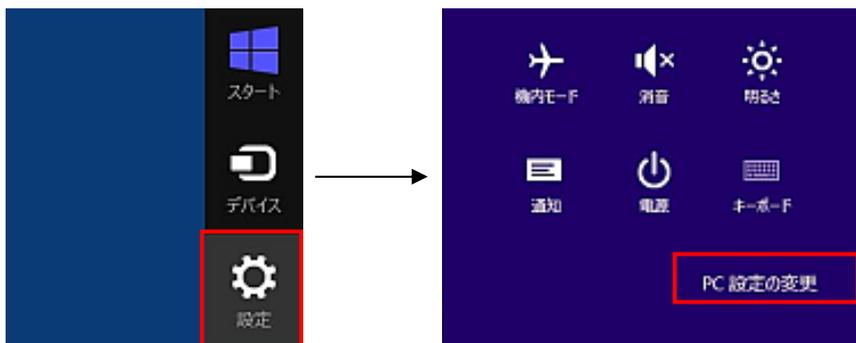


（３）　　Choose "General" at a "PC setting" screen, and choose "Customizing the start of the PC" and chooses "Rebooting right now".



（４）　　Choose "Troubleshooting" at an "Optional choice" screen, and choose "Advanced options" at a "Troubleshooting" screen.



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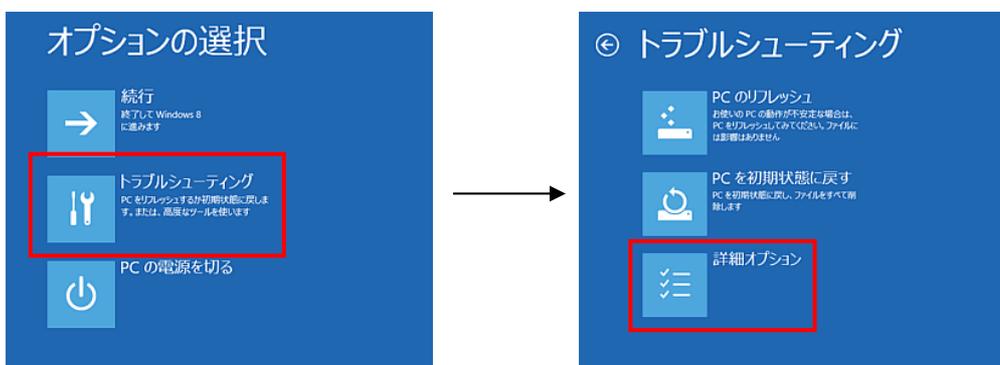
（５）　Choose "Startup setting" than a "Advanced options" screen, and choose "Reboot" at a "Startup setting" screen.



（６）　Press key "7" at a "Startup setting" screen after the reboot, and choose "7) Invalid the compulsion of driver signatures".
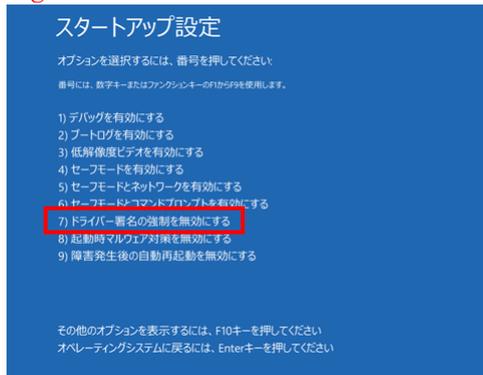


（７）　(REQUIRED) Log in as Administrator or an account of Administrative right after reboot in Administrator.

（８）　Connect USB-MCA to a PC with a USB cable.

（９）　Click the right button with a start screen and display "Application bar" and choose "All application" and choose "Control Panel" at an "Application" view.



（１０）　Choose "Device manager" at a "Control Panel" and display "Device manager".



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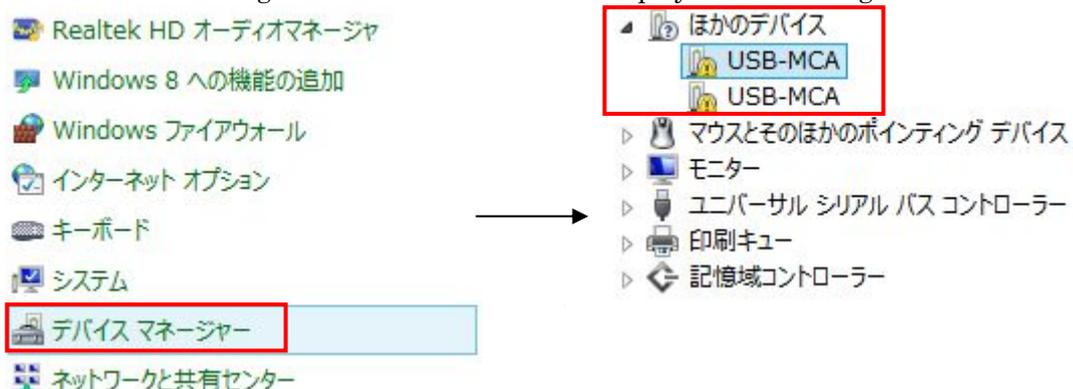
（１１） Click the right button of "USB-MCA" and choose "Update of the driver software (P)" and choose "Searching a driver software regarding a computer (R) ".
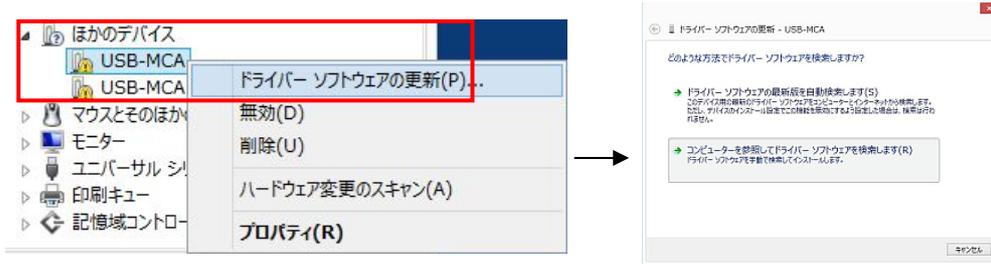


（１２） Choose "Reference (R)" when it is displayed an "Update screen of the driver software" and choose drive that a stored driver of "USB-MCA" if a "Reference screen of the folder" is displayed, and choose "OK". Choose "Next (N)" when you return to an "Update screen of the driver software".



（１３） "Windows security" screen is displayed, choose "Installing this driver software (I) ". Choose "Closed (C)" when it displayed "a driver software was updated normally".

（１４） "TechnoAP USB-MCA" is displayed at a "Device manager" screen, click the right button of left "USB-MCA" and update a remaining driver repeatedly from (11).
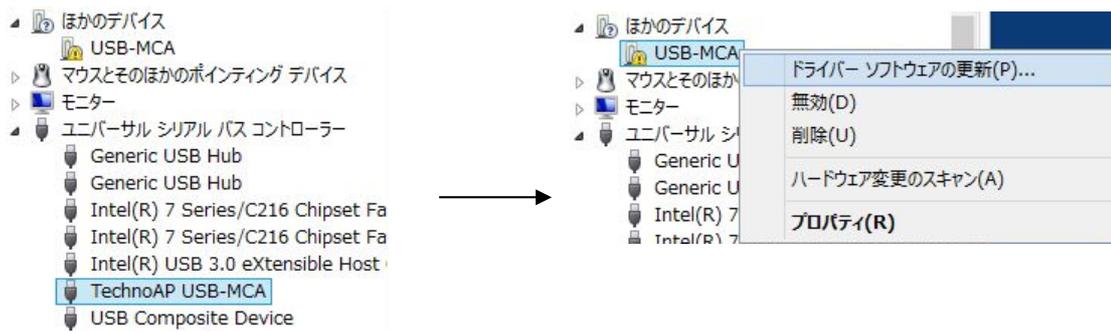


（１５） "TechnoAP USB-MCA Option" is displayed at a "Device manager" screen, and the installation of the device driver is completed.



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# In the case of Windows10 (64bit)

In Windows 10 (64 bit), in order to prevent users from accidentally installing driver software, driver software without a digital signature can not be installed as standard. Since this driver software does not have a digital signature, you need to "disable driver signature compulsion" before installation according to the following procedure.

（１）　Click the　　"Windows" mark in the lower left of the screen to display "Start Menu".

（２）　Select "Settings" from the start menu and select "Change and security" from the setting menu.



（３）　Select "Recovery" from the "Change and Security" screen and select "Customize PC startup" - "Restart now".



（４）　Select "Troubleshooting" from the "Select Options" screen and select "Advanced Options" from the "Troubleshooting" screen.
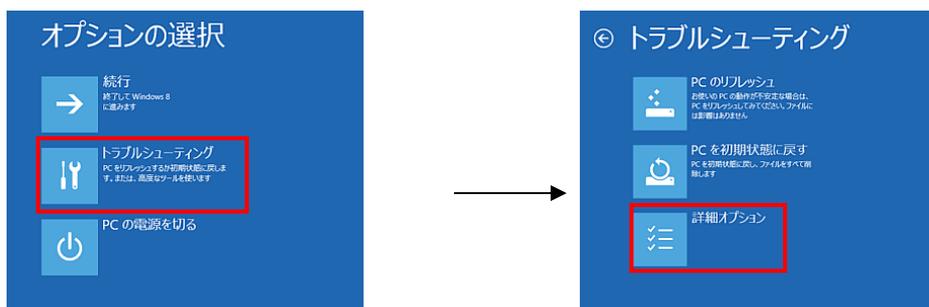


（５）　Select "Startup Settings" from the "Advanced Options" screen, and select "Restart" on the "Startup Settings" screen.
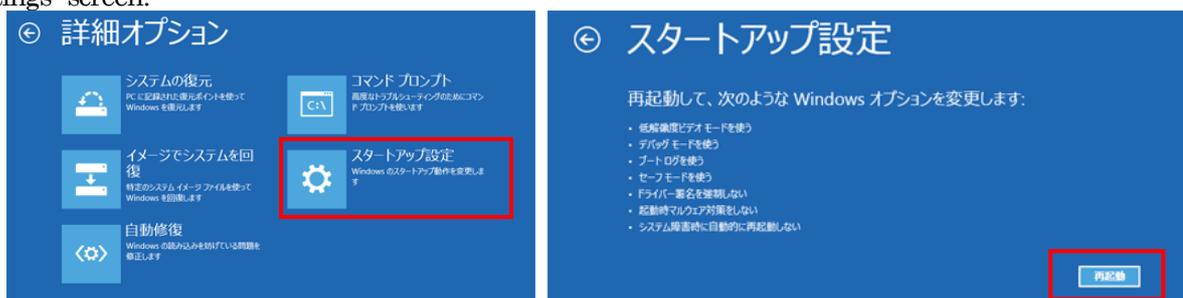
（６）　On the "Startup Settings" screen after rebooting, press the "7" key and select "7) Disable Driver Signature Enforcement".
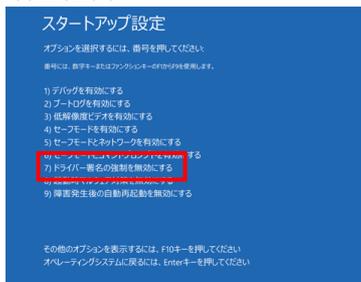


（７）　(Required) After rebooting, log in as an administrator or log in with an account with administrator privileges.

（８）　Connect the USB-MCA to the PC with a USB cable.

（９）　Right-click the [Windows] "Windows" mark on the lower left of the screen, display "Menu" and select "Device Manager".



（１０）　Right-click "USB-MCA", select "Update Driver Software (P)" and select "Search for driver software by computer (R)".
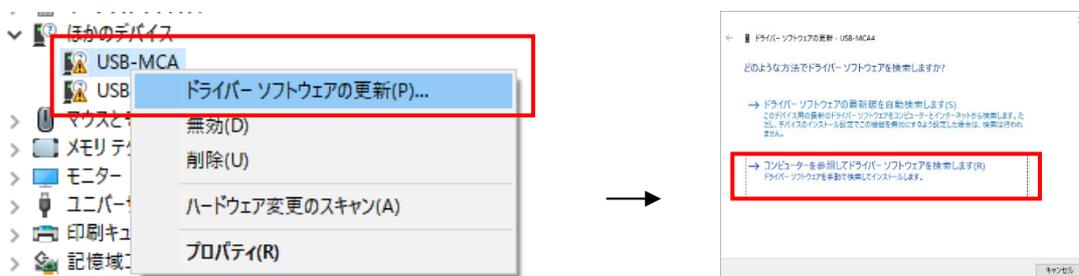


（１１）　Select "Browse (R)" when the "Update Driver Software" screen is displayed and when the "Browse for Folder" screen appears, select the drive where the driver software of "USB-MCA" is stored Then select "OK". When you return to the "Update Driver Software" screen, select "Next (N)".



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（１２）　When the "Windows Security" screen appears, select "Install this driver software (I)".
When "Driver software has been successfully updated" is displayed, select "Close (C)".



（１３）　After confirming that "TechnoAP USB - MCA" is displayed on the "Device Manager" screen, right click on another "USB - MCA" and repeat from (11) and update the remaining driver software
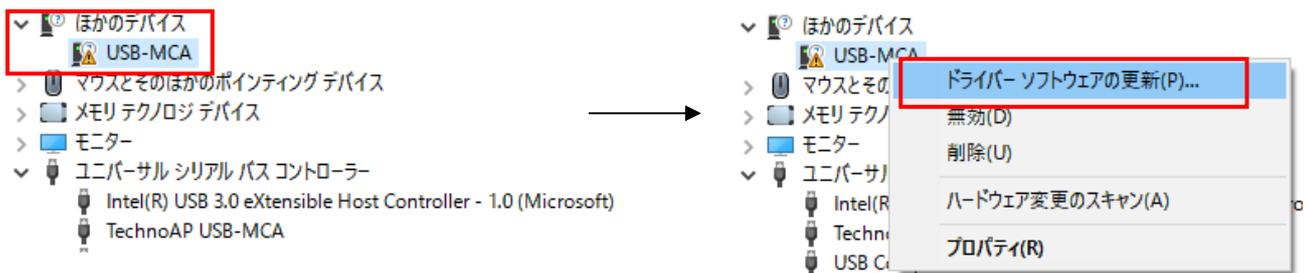


（１４）　If "TechnoAP USB-MCA" is not displayed on the "Device Manager" screen, select "Show hidden devices" from "Display" on the device menu.
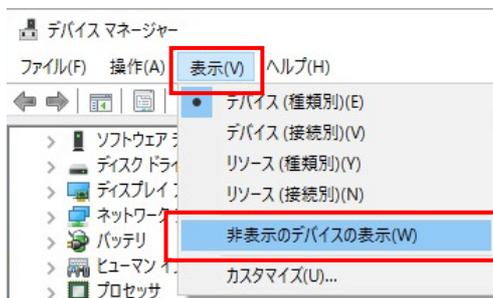


（１５）　"TechnoAP USB-MCA Option" is displayed on the "Device Manager" screen and installation of driver software is completed.



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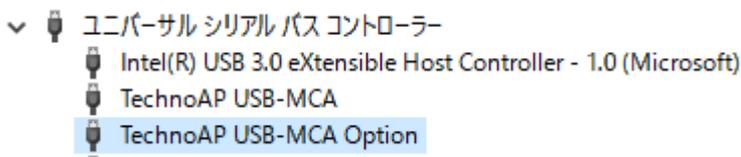
## Installation of the applications software

After a driver was installed correctly, it is necessary to install application (Executable file) of USB-MCA and a run time engine of LabVIEW which is a development environment. Application of USB-MCA and a run time engine of LabVIEW are included in the installer in the attached CD for and can install it at the same time.
The installation procedures are as follows.

（１）　　　(REQUIRED) Log in as Administrator or an account of Administrative right.
（２）　　　Run "Setup.exe" in the "Application" folder in the attached CD.
　　　　　　Installation on an interactive basis
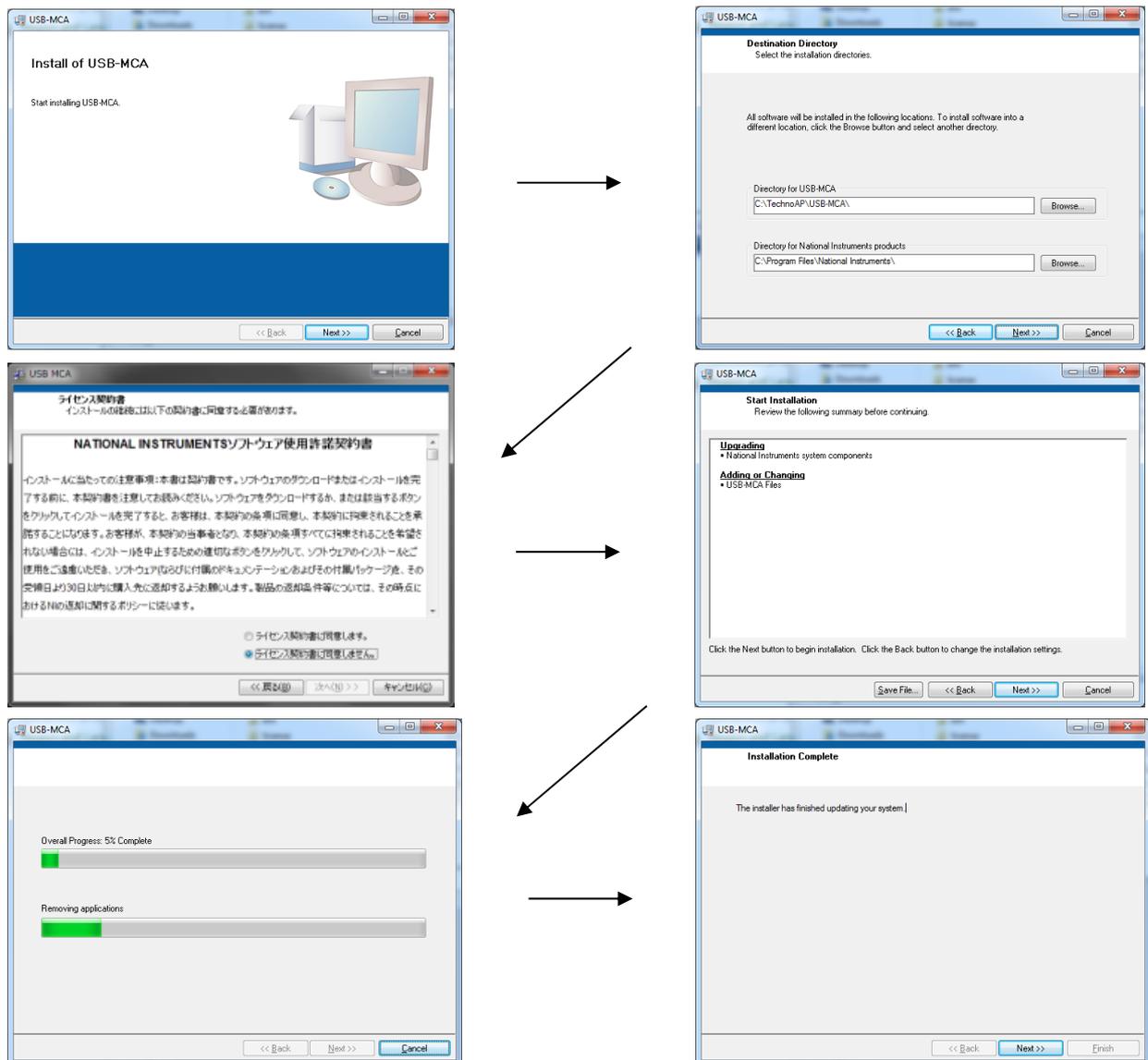


（３）　　　Execute "Start button" - "TechnoAP" - "USB-MCA".
（４）　　　Application "USB-MCA" starts up.

If the "connection error" dialog box appears immediately after startup, please confirm whether USB - MCA is connected correctly with PC or USB - MCA is recognized by Device Manager.

To uninstall, select "USB-MCA" from "Add / Remove Programs" and delete it.

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# 5.　　　Screen

## Opening window

### In the case of Windows 7, Windows 10

When "Start button" - "TechnoAP" - "USB - MCA" is executed, the following startup screen will be displayed.

### In the case of Windows 8

When "USB-MCA" is executed in the start screen or "APPLICATION" view, the following startup screen will be displayed.
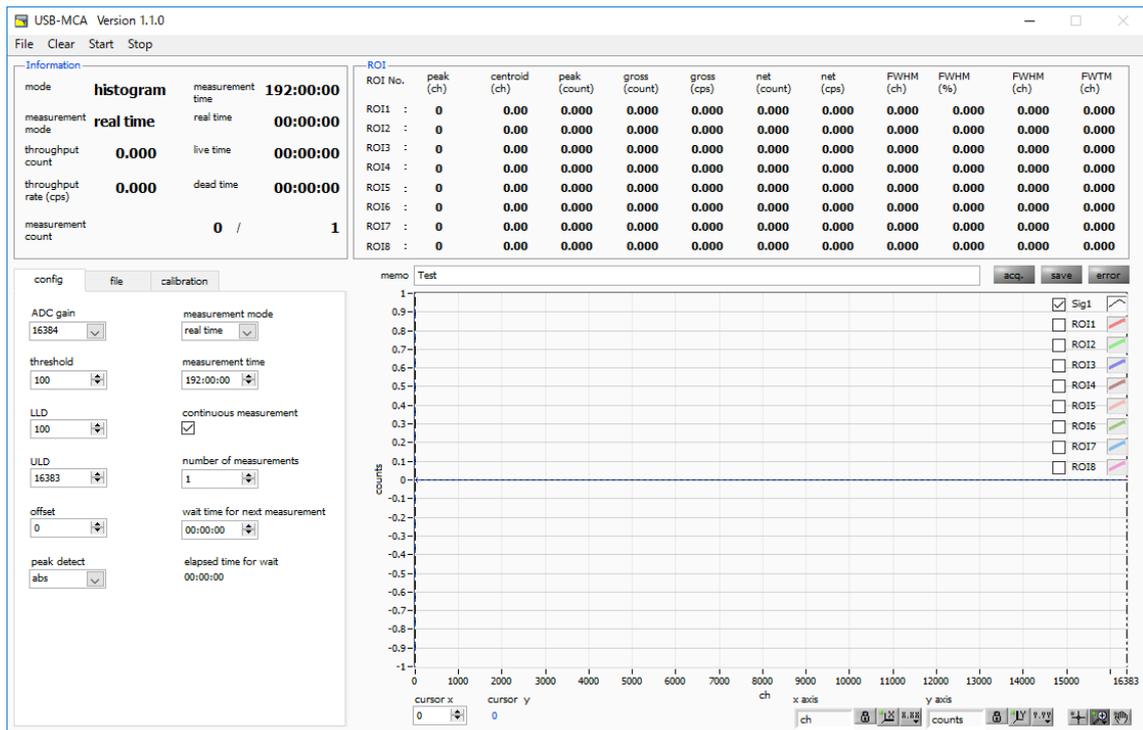


igure 3: USB-MCA opening window

* Menu

It composed by "File", "Config", "Clear", "Start", "Stop".

| | |
|---|---|
| "File" - "open config" | Reading of the configuration file |
| "File" - "open histogram" | Reading of the histogram data file |
| "File" - "save config" | Save current setting in a file |
| "File" - "save histogram" | Save current histogram data in a file |
| "File" - "save image" | Save USB-MCA screen with PNG form image |
| "File" - "quit" | Quit |
| "Config" | Transmit all setting to USB-MCA |
| "Clear" | Initialize histogram data of USB-MCA |
| "Start" | Transmit a measurement start to USB-MCA |
| "Stop" | Transmit a measurement stop to USB-MCA |

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* Tab

   It composed by "config", "file", "calibration".
   "config"       Setting about the measurement
   "file"        Setting about the file
   "calibration"      Setting such as ROI (Region of Interest) about the energy calibration

* Information part
   "mode"        Mode. Indicate "histogram"
   "measurement mode"    Measurement mode. Display "Real time" or "Live time"
   "throughput count"    Total count. The number of the handled events
   "throughput rate(cps)"   Count rate. The number of the handled events for one second
   "measurement time"    Setting measurement time
   "real time"       Real time (real measurement time)
   "live time"       Live thyme (effective measurement time). real time - dead time
   "dead time"       Dead time (invalidity measurement time). real time - live time

   Display a calculation result between ROI.
   "peak(ch)"       ch of the maximum count
   "centroid(ch)"      Center level (ch) calculated by the grand total of all counts
   "peak(count)"      Maximum count
   "gross(count)"      Grand total of the count between ROI
   "net(count)"      Grand total of the count that deducted a background between ROI
   "FWHM(ch)"      Half bandwidth (ch)
   "FWHM"       Half bandwidth
   "FWTM"       1/10 width

* acq.  LED   It flashes on and off during a measurement
* save LED    (unused)
* error LED    Point of error outbreak light

## End window

When you finish application, click menu "File" - "quit". After that, confirmation window of end is displayed.
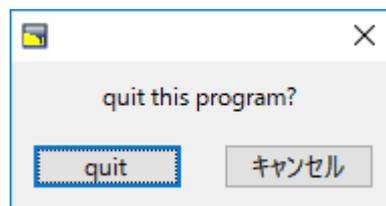


Figure 4: end confirmation window

When you finish application, click "quit" button. An application window disappears after you did.
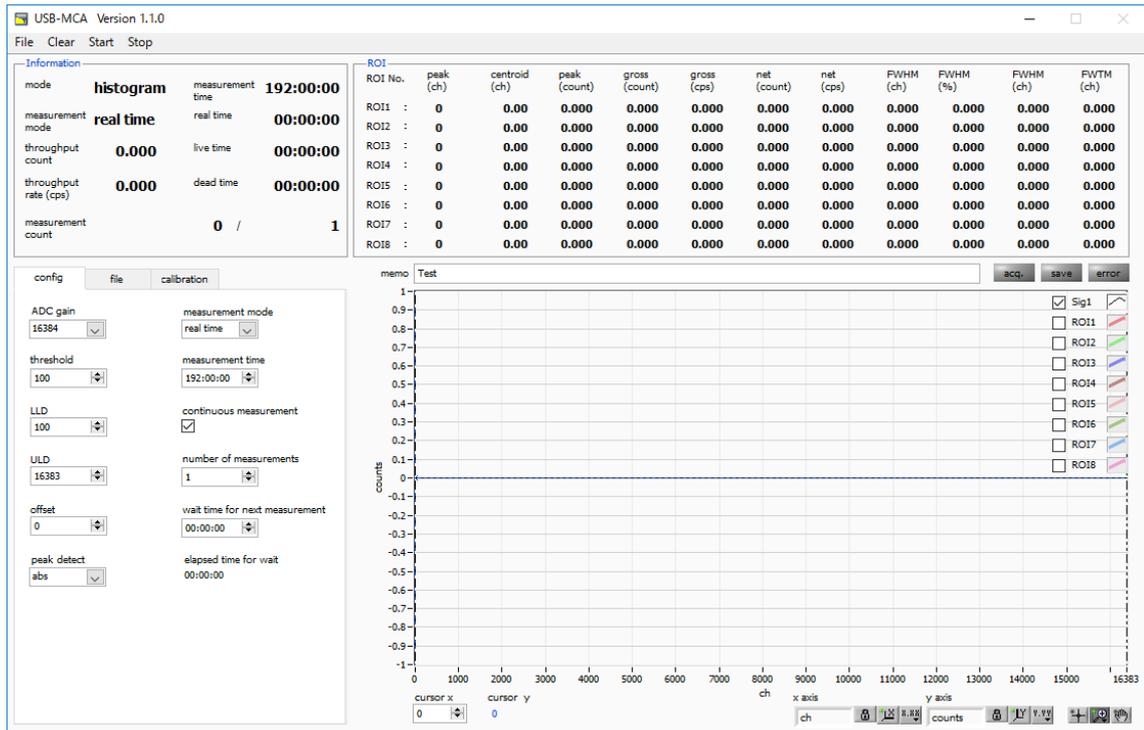
Figure 5 config tab

Be setting about measurement.

| | |
|---|---|
| * ADC gain | Gain of ADC. Select from 16384, 8192, 4096, 2048, 1024, and 512 channels (ch). The input voltage range of the amplifier output signal of each channel is 0 to 10V. Divide this range by the above channel. For high energy resolution detectors such as Ge semiconductor detectors, you can obtain data with fine resolution by selecting 16384. However, when the count is small, it takes time to acquire the peak. Since energy resolution is somewhat inferior such as NaI (Tl) scintillation detector, if it can not be divided finely, set 4096 channels and so on.<br>Select from 16384, 8192, 4096, 2048, 1024, and 512 channels (ch). |

<span style="color:red">※ Attention ※<br>The upper limit is as follows without being able to use all domains of the number of the channels.</span>

| ADC gain | 16384 | 8192 | 4096 | 2048 | 1024 | 512 |
|---|---|---|---|---|---|---|
| The channel upper limit | 16127 | 8063 | 4031 | 2015 | 1008 | 504 |

| | |
|---|---|
| threshold | Sets the threshold (threshold) of the waveform acquisition start timing. The unit is digit. The setting range is 0 to 16383. Set to the value less than LLD. Waveform shaping Triggers for peak detection and AD conversion from the timing when the input signal exceeds the threshold setting value. If this setting is set too high, we can not acquire peak value of low energy. Conversely, if the setting is too small, noise will be picked up. For example, when "ADC gain" is "16384", set "threshold" and "LLD" at around 100 in the beginning. While looking at the histogram "input rate / throughput rate", gradually lower it, it discriminates the boundary with the noise where the value increases, and sets the threshold value slightly above it. |
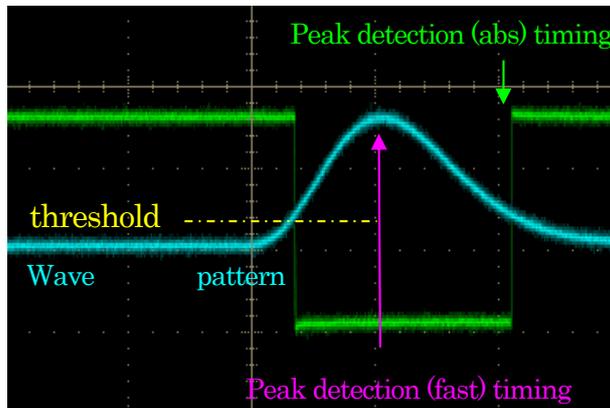
Figure 6: threshold and peak detection (abs / fast) timing

· Set LLD energy LLD (Lower Level Discriminator). The unit is ch. We do not count ch below this threshold. Set it to a value greater than or equal to threshold and less than ULD.

· Set ULD energy ULD (Upper Level Discriminator). The unit is ch. We do not count ch above this threshold. Set it to a value larger than LLD.
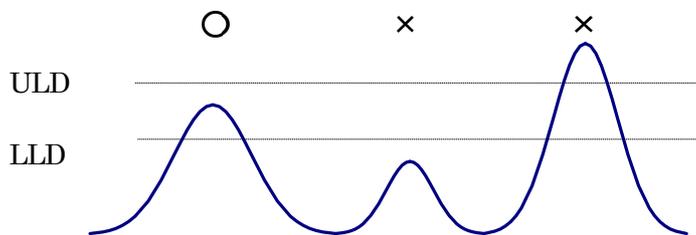


Figure 7: UUD and ULD

* offset          Set the offset of the positive direction. The unit is Ch.
* peak detect     Select "abs" or "fast" for a detection method of the peaks (high peak value)
  abs             Absolute mode. Start AD conversion when it arrives at the peak after surpassing threshold and it damps less than threshold. Acquirable high peak value more certainty.
  fast            Fast mode. It always seeks a high peak value and start AD conversion just after it arrives at the peak value. It is for high count measurement.
* mode            The mode is only "Histogram". Stores away a high peak value from the linear amplifier signal in up to 16,384 ch and makes histogram.
* measurement mode     Select "Real time" or "Live time" as a measurement mode.
  real time       It measure the time data which you set beforehand.
  live time       It measure it until the time that it set beforehand in effective measurement time (difference of real time and the dead time)
* measurement time     Measurement time setting. The set range is from 0 for 192 hours (8 days).
* continuous measurement     Possibility of continuous measurement execution.   When ON, repeat measurement for the number of "number of measurements".
* number of measurements     Number of measurements during continuous measurement execution. 1 to 1,000,000.
* wait time for next measurement    Standby time before measurement starts at continuous measurement. 0 to 1 hour.
* elapsed time for wait       Waiting elapsed time.

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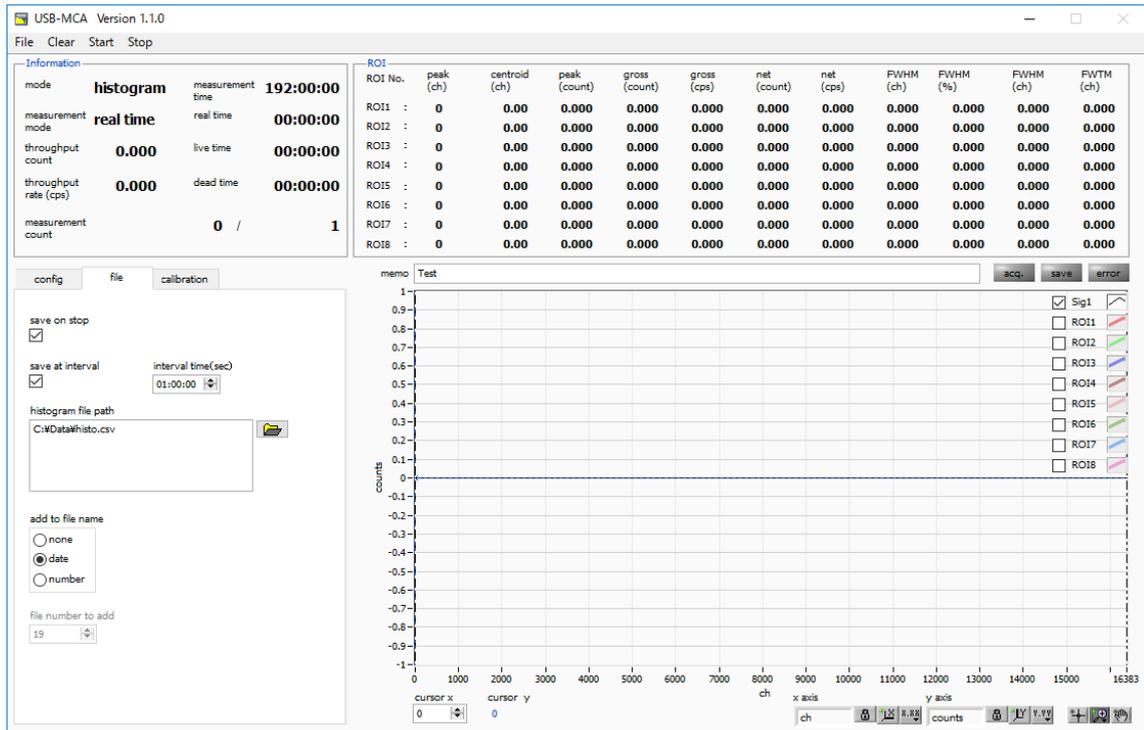
Figure 8: file tab

| * save on stop | When measurement is completed, histogram data is saved in a file. The file is saved in the same format as described above. |
|---|---|
| * save at interval | Sets whether to save histogram data to file at preset time intervals. |
| * interval time(sec) | Sets the time interval of consecutive saving of histogram data. The unit is seconds. The setting range is from 5 seconds to 3600 seconds. |
| * histogram file path | Sets the absolute path of the histogram data file. No extension is allowed. |
| | Depending on the setting of "add to file name", it will be in the following format based on this file name. |
| | As an example, set "C: ¥ TechnoAP ¥ histogram.csv" in "histogram file path", "10" in "histogram file save time (sec)", "date" in "add to file name" When the date / time is 2010/09/01 12:00:00, data storage starts with the file name "C: ¥ TechnoAP ¥ histogram_20100901_120000.csv". After 10 seconds, save as "C: ¥ TechnoAP ¥ histogram_20100901_120010.csv" file. |
| * add to file name | Selection of additional entry of histogram data file name. |
| | none No additional notes. ※ Caution ※ If you perform continuous measurement or regular saving, it will be overwritten. |
| | date Added measurement end date and time. |
| * file number to add | Initial measurement number for appendix. The 9-digit number of 0 is appended to the file name. When it exceeds the maximum value 999999, it returns to 0. If there is a file with the same name, it will be overwritten. |

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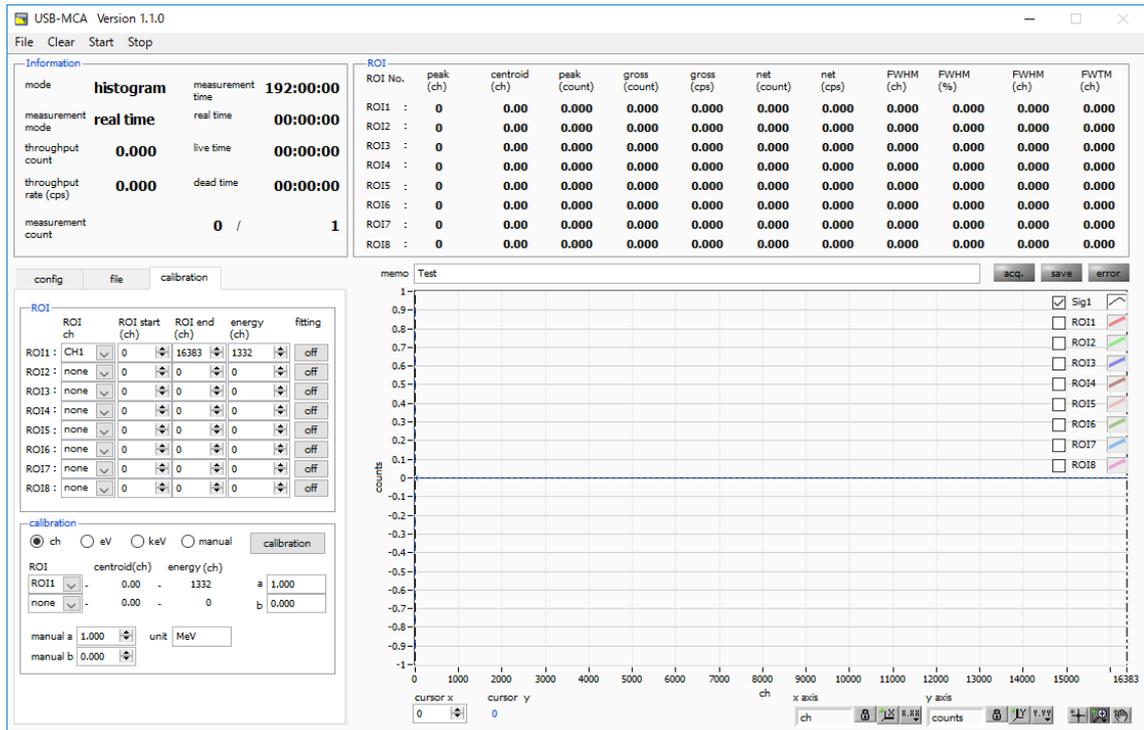
Figure 9: Calibration tab

Set ROI (region of residence) and the energy calibration. It calculates the number of the counts or the half bandwidth of the peak by setting ROI at the spectrum peak.

"ROI" part

| | |
|---|---|
| ROI CH | Choose the CH number that ROI intends for. It is stable in up to 8 ROI for 1 CH signal. |
| ROI start | Set a start position of ROI. The unit depends on the situation of the energy calibration. |
| ROI end | Set an end position of ROI. The unit depends on the situation of the energy calibration. |
| Energy | Define the energy level of the peak position (ch). In the case of 60Co, you set it 1173 or 1332. When you choose "ch" in next "calibration" part, it detects a peak between ROI and calculate keV/ch from the peak position (ch) and energy level that you set and do a summary for a calculation result of the half bandwidth. |
| Fitting | Set whether it applies gauss fitting for a spectrum between ROI. Even a state with a few counts can calculate half bandwidth when you make "ON" such as the chart below. |
| | ※ Caution ※ The CPU load may be higher by PC. In that case, please use "OFF". |



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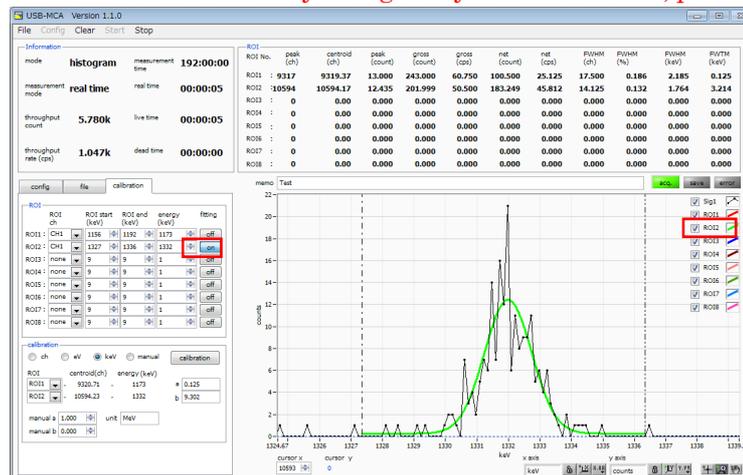
Types of calibration: Choose the unit of the X-axis among following three.

ch  ch (channel) unit indication
The unit of "FWHM" of "FWTM" of ROI is optional.

eV  eV unit indication. Calculate degree of leaning a and graft b of linear function y=ax+b so that ch is eV with two kinds of peaks (center level) in one spectrum and two points of calibration of the energy level and set it in the X-axis. The unit of "FWHM" of "FWTM" of ROI is "eV".

keV  keV unit indication. Calculate degree of leaning a and graft b of linear function y=ax+b so that ch is eV with two kinds of peaks (center level) in one spectrum and two points of calibration of the energy level and set it in the X-axis. The unit of "FWHM" of "FWTM" of ROI is "keV".

(Example) When there is 1173.24keV of 60Co in 5717.9ch, and there is 1332.5keV of 60Co in 6498.7ch, it calculates automatically "a" is 0.20397 and "b" is 6.958297 by two-point calibration.

Manual Set degree of leaning a and graft b and a unit label of linear function y=ax+b optionally in "manual a" and "manual b" by "unit" and, it used for energy calibration.

ROI  Choose ROI targeted for the energy calibration. In "centroid" and "energy of the right neighbor," a central value of choose ROI and energy set level are indicated. For example, it performed one-point calibration by peak center level of ROI1 and "energy" which you set beforehand when you choose "ROI1" and "none", and in case of two points of calibration by peak center level of ROI1 and ROI2 and "energy" which you set beforehand, when you choose "ROI1" and "ROI2".

Manual "a" and "b"  The degree of leaning in linear function y=ax+b to make the cross axle of the graph indicate a, the graft with b as a calculation result of the energy calibration.

Calibration button  Execute energy calibration depending on a type of calibration. Degree of leaning (a) and the graft (b) of the graph are calculated after execution. It is a linear function to be applied to the cross axle (y= ax+b), and t is displayed by "a" and "b" of the bottom. Please refer to "9.5. Calculation method of two-point calibration" later.

For example, choose "keV" in a calibration part and click "calibration" button. the cross-axle unit of graph, a set point of ROI, the unit of the calculation result of ROI become "keV" like the chart below.
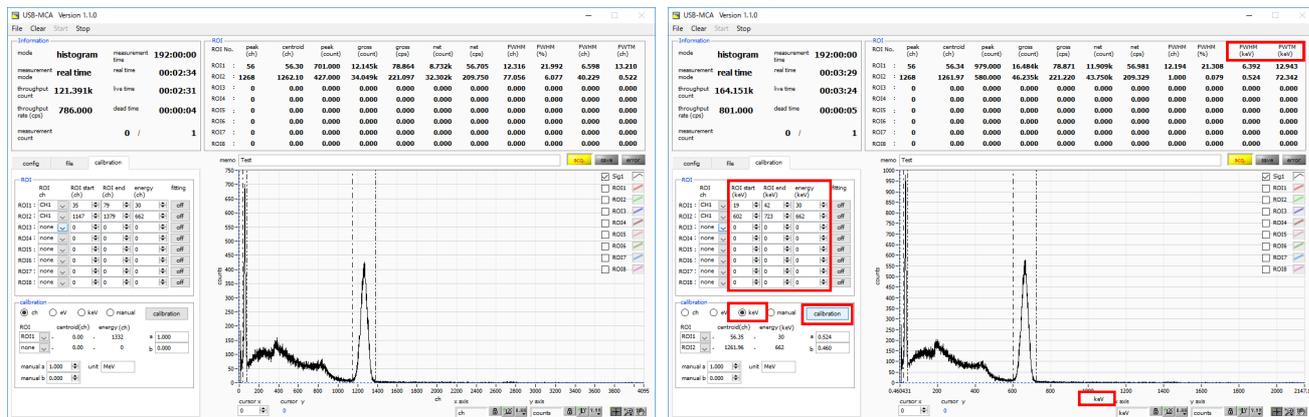


Figure 10: When "keV" is selected in the calibration section

(Left figure: before energy calibration execution, right figure: after energy calibration execution)

## Graph

| Graph | Indicate the spectrum which gauss fitted by data between spectrum of CH1 and each ROI. |
| --- | --- |
| X-axis range | Click the right button on the X-axis and check "an automatic scale", it becomes the automatic scale. Not an automatic scale, the minimum and the maximum of the X-axis become fixed when you exclude a check. When you change the minimum or the maximum, you put the pointer of the mouse on the numerical value to change and it click or double-clicking. |
| Y-axis range | Click the right button on the Y-axis and check "an automatic scale", it becomes the automatic scale. Not an automatic scale, the minimum and the maximum of the Y-axis become fixed when you exclude a check. When you change the minimum or the maximum, you put the pointer of the mouse on the numerical value to change and it click or double-clicking. |

In the X-axis, set the automatic scale and precision, mapping (linear / logarithm).

In the Y-axis, set the automatic scale and precision, mapping (linear / logarithm).
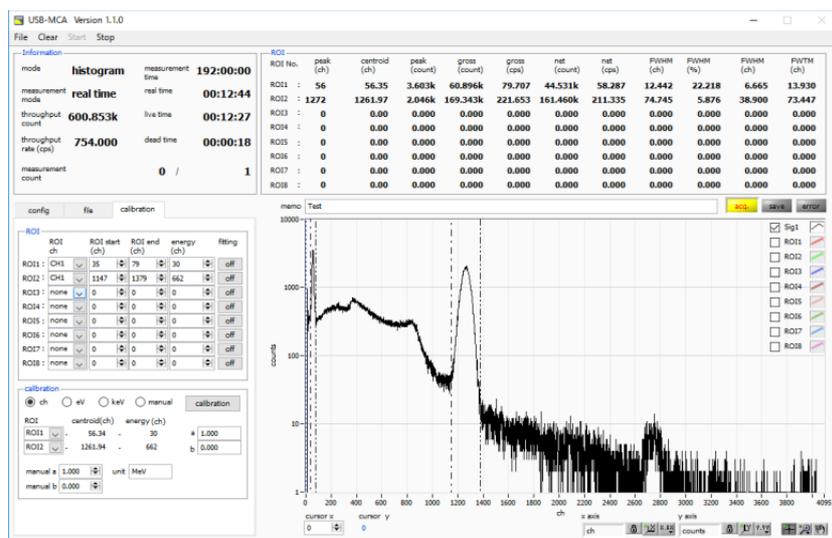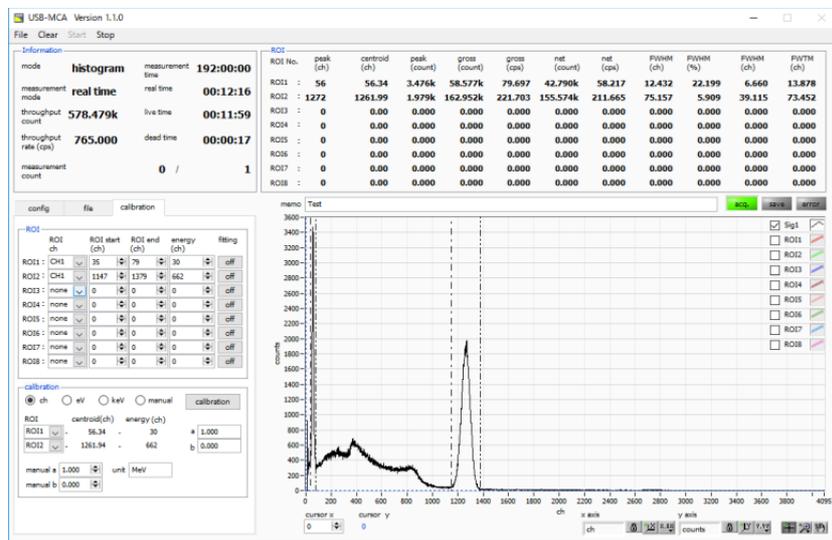
Figure 11: Select "linear" (upper) and "logarithm" (lower) in Y axis "mapping mode"

Cursor movement tool. The cursor can be moved on the graph when setting the ROI.

Zoom                    You can select and execute the following six zoom in and zoom out by clicking.

(1)    (2)    (3)

(4)    (5)    (6)
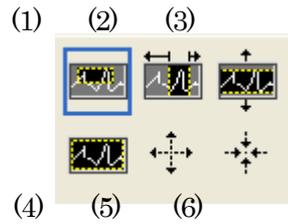
Figure 12: Graph zooming in and zoom out tool

(1) Rectangle Zoom Use this option to click on a point on the display as the corner of the zoom area and drag the tool until the rectangle occupies the zoom area.

(2) X - Zoom Zooms in the area of the graph along the X axis.

(3) Y - Zoom Zoom in on the graph area along the Y axis.

(4) Fit zoom Auto scales all X and Y scales on the graph.

(5) Zoom out centering on points. Click the center point to zoom out.

(6) Zoom in around the points. Click the center point to zoom in.

Pan tool. You can grab a plot and move on the graph.

cursor x                Set the X axis value of the blue dotted cursor on the graph. The count value on the spectrum is displayed in blue numerical value.

# 6.    Setting

## Setting of thresholds

The threshold setting starts AD conversion and peak detection from when this threshold is exceeded.

If this setting is set too high, we can not acquire peak value of low energy. Conversely, if the setting is too small, noise will be picked up.

Initially, set "threshold" and "LLD" around 100, lower gradually while looking at the throughput rate (cps) and histogram, and discriminate the boundary with the noise increase value.

## Setting of the peak detection mode

As a method of detecting the maximum crest value, select "abs" or "fast" at "peak detect" on the "config" tab.

"Abs" is the "absolute mode", AD conversion is executed when reaching the peak after reaching the threshold and decaying and falling below the threshold. It is possible to acquire the maximum crest value more definitely.

"Fast" is "Fast mode", always monitors the maximum crest value and executes the AD conversion immediately after arrival. It is for measurement at high count.

Waveform of spectroscopic amplifier

threshold

In case of absolute mode

AD

In the case of fast mode

AD
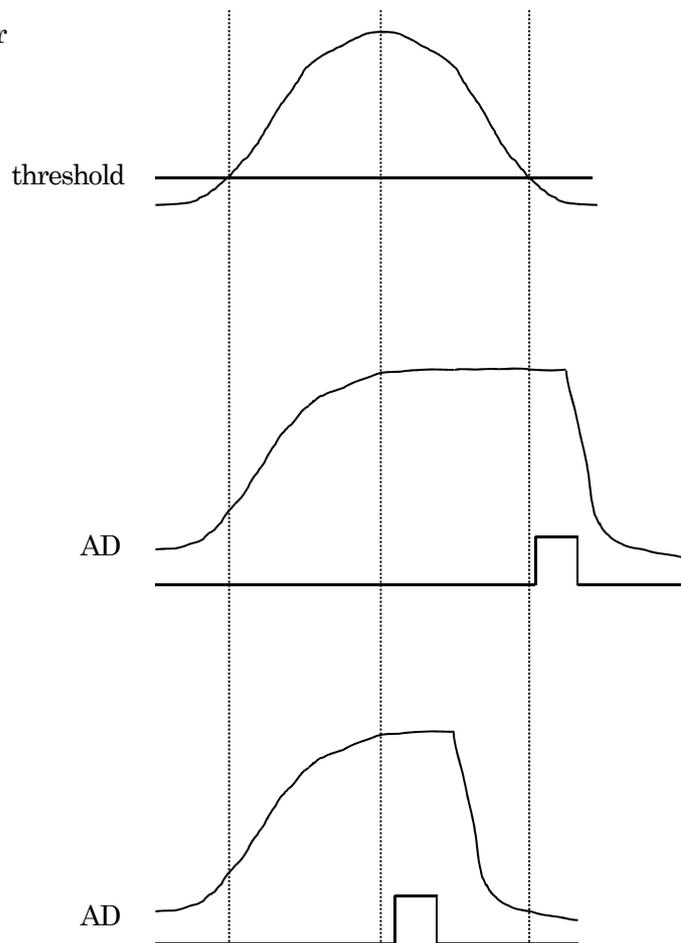
Figure 13: Peak detection method (absolute mode and fast mode)

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# 7.　　　Measurement

## Initialization setting

（１）　　　Click the menu "Clear". The histogram data in the USB-MCA is initialized. To continue the histogram or measurement result measured last time, start the next measurement without clicking "Clear".

## Start Measurement

- ・ When you click the menu "Start", measurement starts.
- ・ The measurement status is displayed in the "Information" section.
- ・ "Acq" LED flashes.
- ・ Measurement set time is displayed in "measurement time".
- ・ Real time acquired from USB-MCA is displayed in "real time".
- ・ Live time (real time - dead time) acquired from USB - MCA is displayed in "live time".
- ・ "Dead time" shows the dead time acquired from USB-MCA.
- ・ "Dead time ratio" shows the ratio of "dead time" / "real time".
- ・ "Histogram" is displayed in "mode".
- ・ Each "ROI No." in "ROI", "calibration" central value in tub ROI range, gloss count (range summation) and rate (net counts minus background from the sum in the range) Net Count And the calculation result such as rate, half width, 1/10 width etc. are displayed.
- ・ A histogram is displayed on the graph.
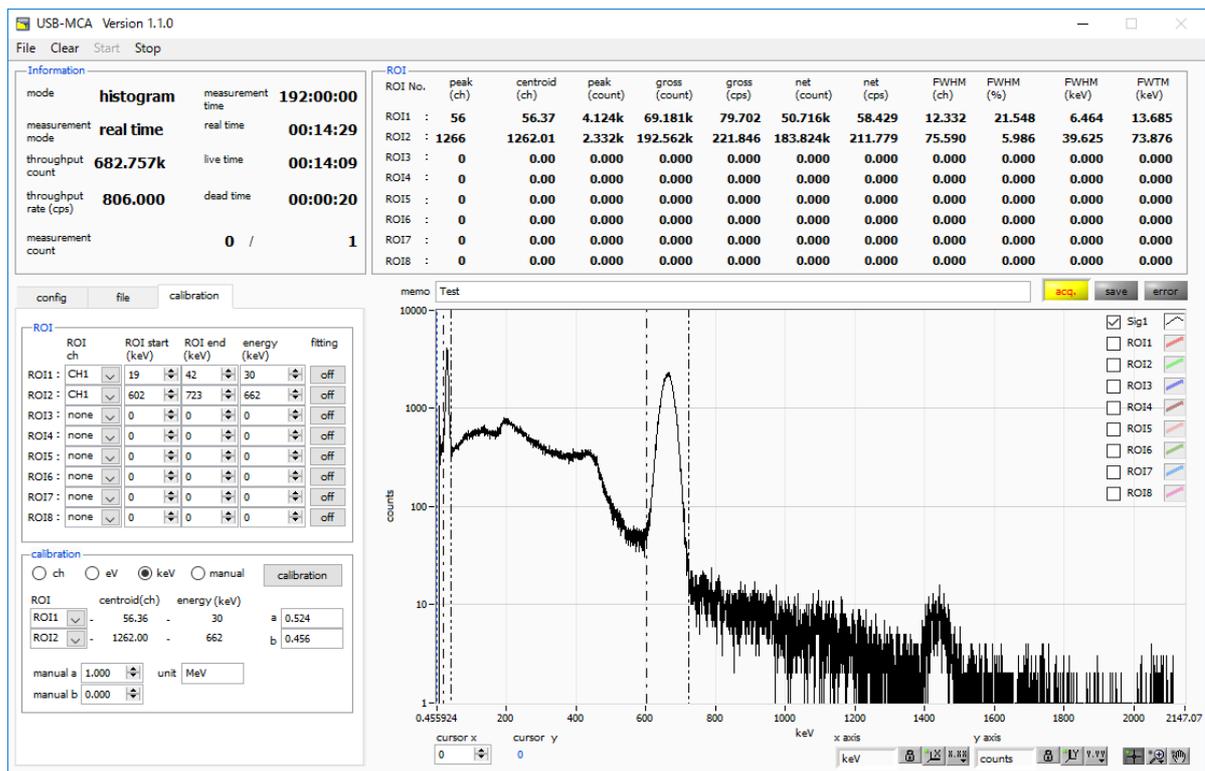


Figure 14: Measurement screen

## Stop Measurement

- ・ When "measurement mode" is "real time", measurement will end when "real time" reaches "measurement time".
- ・ When "measurement mode" is "live time", measurement will end when "live time" reaches "measurement time".
- ・ To stop during measurement, click the menu "Stop". Stop measurement after execution.

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# 8.　　　File

## Histogram data file

    (1) File format
        Comma-separated text format
    (2) File name
        No regulation
    (3) Constitution
        It consists of "Header" part, "Calculation" part, "Status" part and "Data" part

- **Header section**

  Measurement mode Measurement mode. Real time or Live time
  Measurement time Measurement time. Unit is seconds
  Real time real time
  Live time live time
  Dead time Dead time
  Start Time Measurement start time
  End Time Measurement end time
  * Saved for each CH below
  ADG ADC gain
  THR FAST system threshold
  LLD energy LLD
  ULD Energy ULD
  OFF offset
  ※ For each CH so far
  MOD mode
  MMD measurement mode
  MTM measurement time
  Method for detecting PDS peak (maximum crest value). 0: abs, 1: fast
  Cursor X position (ch), count

- **Calculation section**

  * Save for each ROI
  ROI No. Input channel number subject to ROI.
  ROI start ROI start position (ch)
  ROI end ROI end position (ch)
  energy (unit) peak energy value
  fitting It is possible to execute fitting. 0: Non execution, 1: Execute
  peak (ch) peak position between ROI (ch)
  centroid (ch) Center position between ROI (ch)
  gross (count) Sum of counts between ROI
  gross (cps) gross (count) per second
  net (count) Sum of counts obtained by subtracting the background between ROIs
  net (cps) net (count) for 1 second
  FWHM (ch) FWHM between ROI (ch)
  FWHM (%) FWHM between ROI (%)
  FWHM (keV) FWHM between ROI (keV etc.)
  FWTM (keV) 1/10 width (keV etc.) between ROI

- **Status section**

  * Saved for each CH below
  throughput count Number of events processed
  throughput rate Number of events processed per second

- **Data section**

  Histogram data for each channel. Maximum 16384 points.

# 9.　　Function

## Data acquisition by the GATE signal timing

To acquire event data at that time based on external conditions when an event occurs, input the LV - TTL level signal to the LEMO connector "GATE" on the front panel. Measurement is performed when it is High, but not when it is Low.

Please input the external GATE input signal in a range sufficient to cover the waveform shaping input signal (see the figure below).
In particular, when the waveform shaping input signal exceeds the threshold level Vth from the baseline, the external GATE input signal should be held high. Waveform shaping A / D conversion processing is performed when the input signal falls below the threshold level, and the peak value is determined after 1.2 μs processing time.
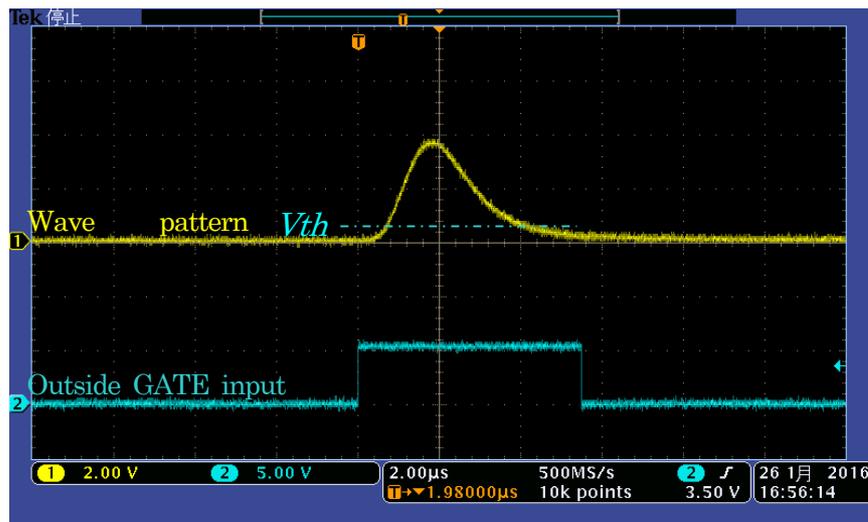


Figure 15: External GATE input signal timing

※　The external GATE input signal is LV - TTL level, and 0.8 V or less is judged as LOW level 2.0 V or higher as High level. The maximum input voltage is 5V.

## Data discard by the VETO signal timing

If you want to discard the event data at that time due to external conditions at the occurrence of an event, input the LV - TTL level signal to the LEMO connector "VETO" on the front panel. In contrast to "GATE", measurements are made when Low, but not measured when Low. The timing is the same as GATE mentioned above.

## Calculation method of FWHM (half bandwidth)

FWHM (Full Width at Half Maximum) in the "status" tab is calculated as follows.
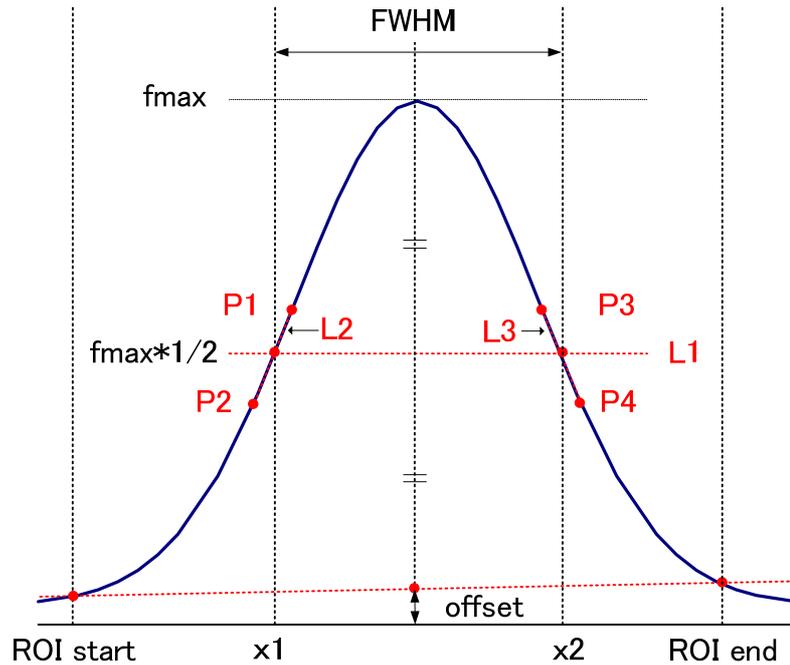


Figure 16: FWHM calculation

（１）　Detect the maximum value fmax between ROI Start and ROI end in the histogram.

（２）　Connect the intersection of the histogram and ROI start with the intersection of the histogram and ROI end with a straight line. Calculate the background offset (offset) by obtaining the intersection of the straight line and the line drawn vertically from the peak value fmax to the x axis.

（３）　Calculate 1/2 of the part obtained by subtracting offset from fmax, and draw a straight line L1 parallel to the X axis.

（４）　To find the two points where the histogram and L1 intersect, we detect the intersecting before and after points P1 and P2, and P3 and P4.

（５）　Draw a straight line L2 connecting P1 and P2, and a straight line L3 connecting P3 and P4

（６）　Find the X coordinate x1 of the intersection of L1 and L2 and the X coordinate x2 of the intersection point of L1 and L3.

（７）　The difference between x2 and x1 is FWHM.

## Calculation of gross count and the net count

The "gross" count in the "ROI" department and the "net" count calculate it by the co-bell method.



ns

ne

net

background
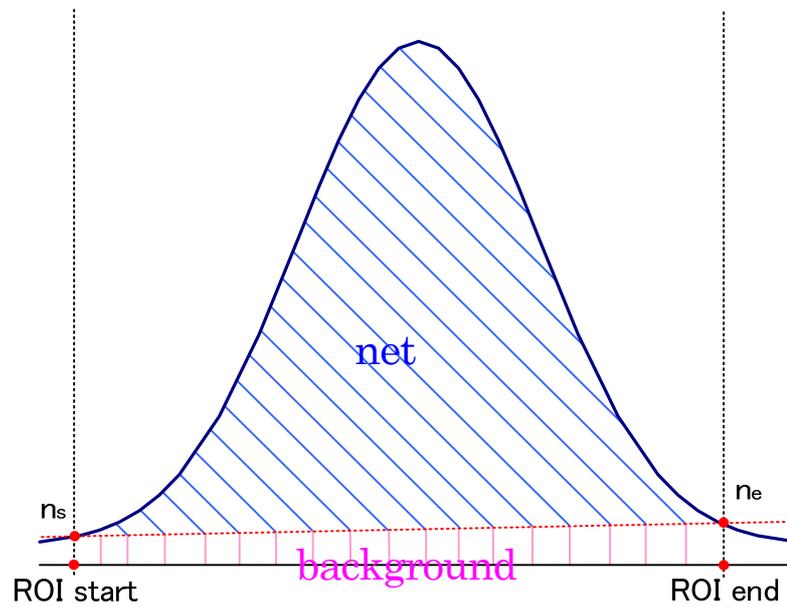
ROI start

ROI end

**Figure 17: Gross and net calculation**

（１） The "gross" count is a grand total of the counts between ROI Start and ROI end.

（２） "net" count is a net count of the peaks that deducted background (background) count from "gross" count (slanted line part of the blue of the figure).

（３） The background (background) count links point of intersection ne of point of intersection ns of the spectrum and ROI end and the spectrum to ROI start by a straight line.　Be the quadrangular areas to surround four points of ROI start and ns and ne and ROI end (pink line part of the figure).

## Calculation method of Two-points of calibration

In order to make energy scale (e.g. keV) on the X axis unit scale of the graph as an energy calibration, we perform Two-point calibration using the centroid of the energy peak and the peak energy value. One-point calibration is also possible.



With reference to the "centroid (ch)" value of ROI 1 / ROI 2 displayed in the "ROI" located at the top of the graph, "ROI start (keV)" and " Set "ROI end (keV)" or set the range of ROI 1 and ROI 2 by moving the cursor on the graph.



In the "calibration" tab located under the "calibration" tab, select the radio button "keV". In the "calibration" located under the "calibration" tab, select "ROI 1" and "ROI 2" for the ROI.



Set to "peak (keV)" to what keV the energy of each peak of ROI 1 / ROI 2 corresponds.



When clicking the "calibration" button, the slope a and the intercept b of the linear equation y = ax + b calculated by the following formula are automatically reflected in "a" and "b" located on the bottom side.
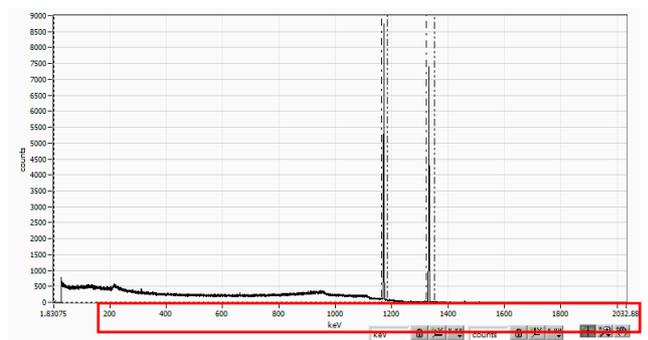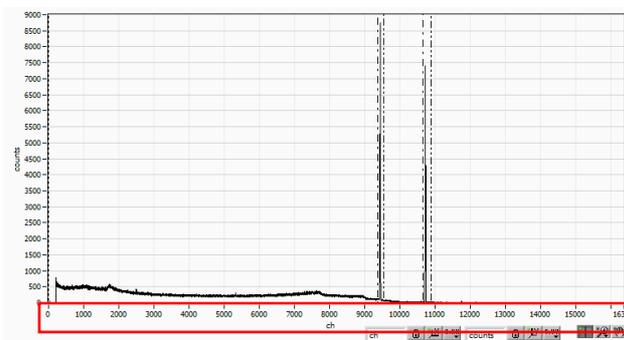


Figure 18: Before Energy Calibration (Left) After Energy Calibration (Right)

a = (peak 1 - peak 2) / (centroid 1 - centroid 2)

b = y - ax

As an example, if the centroid at 1173 keV of 60 Co is 9446.99 ch and the centroid at 1332 keV is 10729.53 ch,

a = (1332 - 1173) / (10729.53 - 9446.99) = 0.124

b = 1332 - 0.124 * 10729.53 = 1.831

Thus, 0.124 is automatically added to "a" and 1.831 to "b", and the unit scale on the X axis is created with the linear expression 0.124 * ch + 1.831.

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# 10. Guarantee provision

The warranty conditions of "our products" are as follows.

・ Warranty Period Purchase is one year.

・ Warranty details Warranty repair or replacement will be carried out in the event of failure, even though we have used correctly in accordance with this instruction manual within the warranty period.

・ Not covered by warranty We do not warranty if the cause of the failure falls under any of the following.

(1) Failure or damage due to misuse or improper repair or modification or disassembly.

(2) Failure and damage due to falling etc.

(3) Breakdown / damage in harsh environments (high temperature / high humidity, under zero, condensation etc.).

(4) Causes other than the above, other than "our products".

(5) Consumables.

(6) Natural disasters such as fire, earthquake, flood damage, lightning, etc. and breakdown due to theft.

(7) When judged to be wet.

When using our products, we assume that you accepted all of the above items.

【Contact Information】

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e-mail: order@techno-ap.com

Business hours: 9: 30 to 17: 00 on weekdays by Telephone

# Warranty

## This product warranty promises to guarantee the product free of charge within the warranty period within the warranty period.

| | |
|---|---|
| Product name | USB-MCA |
| Model | APG7300A, APG7300L |
| Serial Number | |
| Warranty period | One year from date of purchase |
| Purchase date | |
| Sales outlet | |
| Customer's Name | |
| Customer's Address | |
| Customer's phone number | |

\* Please keep product certificate and proof of purchase date. It is necessary for warranty and repair.

\* This product warranty will not be reissued, please keep it in a safe place.

\* Even during the warranty period, there may be charges. Please read "Disclaimer" carefully and always observe the contents.

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