USB-MCA-AMP
Software

User Manual

Version 1.0.1
May 2019

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1. Revision history

22 January 2019	Version 1. 0. 0	First edition
7 May 2019	Version 1. 0. 1	Screen image update
16 October 2019	Version 1. 1. 0	Added display and saving of cursor count value

2. Safety Precautions / Disclaimer

Thank you very much for purchasing the USB-MCA-AMP, Model: APG7305A (hereinafter "This device") of TechnoAP Co., Ltd. (hereinafter "We"). Please read this "Safety Precautions / Disclaimer" before using this device, be sure to observe the contents, and use it correctly.

We are not responsible for any damage caused by abnormality of device, detector, connected device, application, damage to failure, other secondary damage, even if accident caused by using this device.

Prohibited matter

- This device cannot be used for applications requiring special quality and reliability related to human life, accident.
- This device cannot be used in places with high temperature, high humidity and high vibration.
- Do not give a strong shock or vibration.
- Do not disassemble or remodel.
- Do not wet this device with water or condensation. Please do not operate with wet hands.
- If there is heat generation, deformation, discoloration, odor, etc. in this device, stop using it immediately and contact us.

Cautions

- Use this device at room temperature in the operating temperature range and use it so that there is no condensation.
- If there is smoking or abnormal heat generation in this device, turn off the power immediately.
- Be careful of static electricity because this device is a precision electronic device.
- Do not store this device in a dusty place or high temperature / high humidity place.
- Do not place devices that emit strong electromagnetic waves, such as mobile phones and transceivers, close to this device.
- This device may malfunction in environments with high electrical noise.
- The specifications of this device and related documents may be subject to change without prior notice.

*** Please be sure to read the notes on red letters and "Caution on use" described in this manual.**

3. Overview

3. 1. Overview

USB-MCA-AMP (One-channel Multi Channel Analyzer with built-in spectroscopy amplifier) Model: APG7305A (hereinafter this device) is connected to a semiconductor detector, proportional counter, scintillation detector, etc. is an MCA that can directly input the preamp output signal. This device is equipped with a traditional analog circuit spectroscopy amplifier function, and parameters such as shaping time, gain and pole zero are set from the application on the PC. Based on the setting, the peak value is calculated by digital signal processing of semi-Gaussian waveform shaping. It does not use an AC adapter for power. A lightweight and compact MCA that operates only with USB bus power.

There are usually two operations related to measurement: histogram mode and waveform mode.
In the histogram mode, spectral data is generated with energy wave height values such as keV on the horizontal axis and counts on the vertical axis.
In waveform mode, input signal such as detector preamplifier output to this device, timing processing signal (fast), semi-Gaussian waveform (slow) to PC. It can be used for gain or pole zero adjustment.

The software that comes with this device is driver software and applications that run on Windows.

This manual explains the handling of this device.

3. 2. Specifications

Model: APG7305A、APG7305A-DM18

Analog Input	1 channel, LEMO connectors
Input range	±1.5V, preamplifier decay signal
Waveform processing	Semi-Gaussian peaking time 2.2 τ
Shaping time	0.25 / 0.5 / 1 / 2 / 3 / 4 / 5 / 6 / 8 / 10 / 12 / 16 μs
Baseline restorer	Auto active gate
Gain	×1 to ×500
ADC Gain	16384, 8192, 4046, 2048, 1024, 512, 256 channel
Peak detection mode	Absolute pulse
Throughput	50 kcps or more
Integral nonlinearity	± 0.025% or less
Derivative non-linearity	± 1% or less
Threshold	0 to 50% Full-scale from PC
ADC LLD	0 to 100% Full-scale from PC
ADC ULD	0 to 100% Full-scale from PC
External GATE input	LEMO connector, TTL, High / Low Active High
External VETO input	LEMO connector, TTL, High / Low Active Low
Operation mode	Histogram and waveform
Communication I / F	USB 2.0, USB mini B, Plug: Receptacle
Power consumption	3W (power supply voltage + 5V, current consumption less than 0.6A)
Power supply	USB bus power, AC adapter unnecessary
Operation system	Windows 10, 8.1, 7 (32 or 64-bit)
Accessories	CD-ROM (for Driver and Application software installation) USB cable Instruction Manual
Dimension	70 (W) x 160 (D) x 20 (H) unit: mm
Weight	About 202g

NOTE: Connect this device to a USB port capable of supplying power of USB 3.0 or more and 0.6A or more. If the power supply capacity of the USB 2.0 port is 0.5A, it may not work properly or may cause a failure.

NOTE: USB cable length of 2 m or less is recommended. In the case of laptop PC, please cancel if there is a low power consumption setting in the USB port or use a USB hub with power supply by AC adapter. Some USB hubs may require a ground connection with the detector or PC.

Connection port layout:

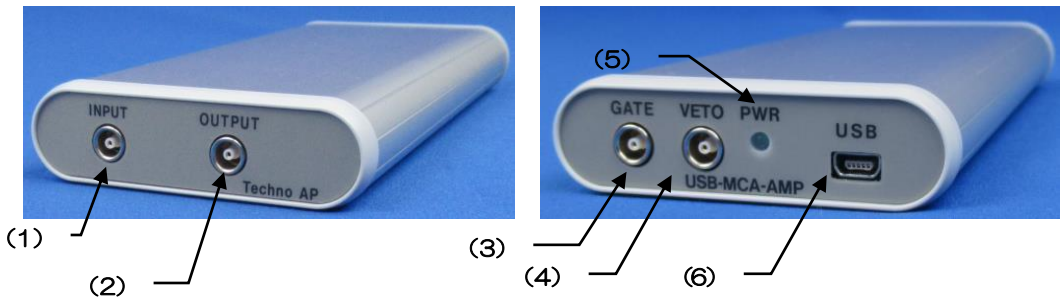


Fig. 1 APG7305A

Front		
(1)	INPUT	Input connector for preamplifier output signal
(2)	OUTPUT	Output connector for signal processing result selection DAC.
Back		
(3)	GATE	LEMO connector for external GATE signal input. Input LV-TTL level signal. Data acquisition with input "High", data acquisition not with "Low".
(4)	VETO	LEMO connector for external VETO signal input. Input LV-TTL level signal. Data is not acquired at input "High", data acquired at "Low".
(5)	PWR	LED lights up when the power is on (connected to a PC).
(6)	USB	USB 2.0 Mini-B receptacle (female) **NOTE: Please connect with USB port more than USB 3.0 or power supply ability more than 0.6A. There is also a product that states this with a yellow label in this part.**

***Conversion adapter**

For the signal input connector to this device, use LEMO EPL.00.250.NTN or a connector of equivalent shape.

When using a signal cable with a BNC connector, it is possible to connect to this device by using the following conversion adapter.

Manufacturer	HUBER+SUHNER
Web	https://www.hubersuhner.com/en
Model	33_QLA-BNC-01-1/1--__NE
Specifications	QLA-01 to BNC Connector Gender 1: Interface QLA-01 Connector Gender 2: Interface BNC

4. Preparation

4. 1. Connection

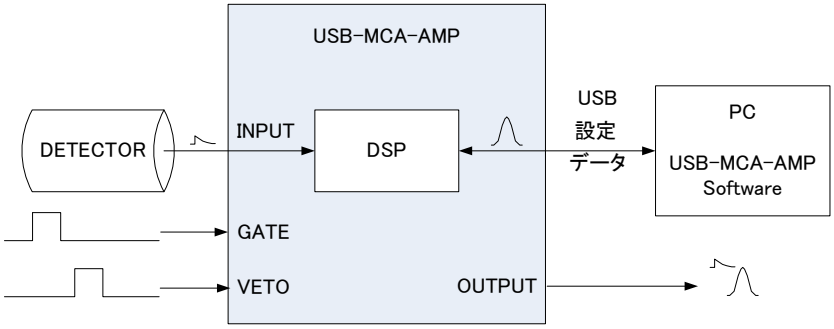


Fig. 2 Connection example (Possible to disconnect GATE, VETO and OUTPUT)

1	Connect USB-MCA-AMP and PC with the supplied USB cable. **NOTE: It is necessary to install the driver software on the PC to be connected for the first time. See below for how to install the driver software.** **NOTE: Do not connect the signal cable from the detector when the power of this device is OFF.**
2	Check that the "PWR" LED lights up to indicate that the power is on.
3	Connect the preamp output signal of the detector (DETECTOR shown above) to the "INPUT" of this device.
4	If control by an external signal is required, input the LV-TTL level to the GATE or VETO terminal. When a peak is detected with a cable connected to the GATE terminal, data is acquired when the signal is open or high. Or when detecting a peak with a cable connected to the VETO terminal, data is acquired when the signal is open, or the signal is low.

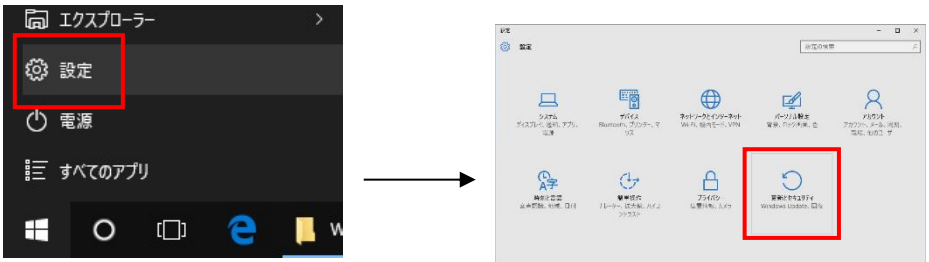
4. 2. Installation of the driver software

The first time you connect this device to the computer, you need to install the driver software from the included CD-ROM.

For Windows 10 (64-bit)

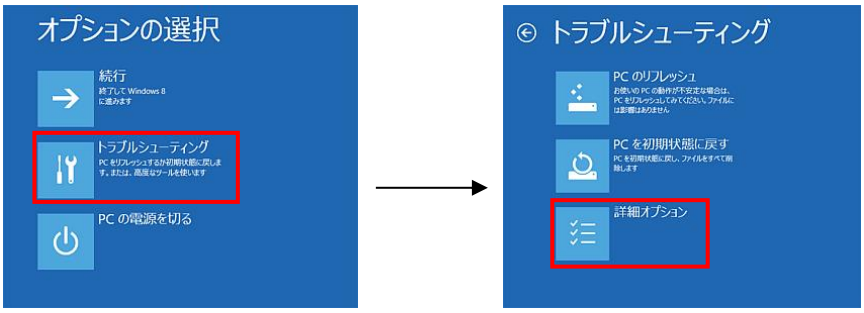
In Windows 10 (64-bit), driver software without digital signature cannot be installed by default to prevent the user from installing driver software by mistake. Since this driver software does not have a digital signature, it is necessary to "disable force driver signature enforcement" before installing it according to the following procedure.

（1） Click the "Windows" mark at the bottom left of the screen to display the "Start Menu".
（2） Select "Settings" from the start menu and select "Change & Security" from the settings menu.

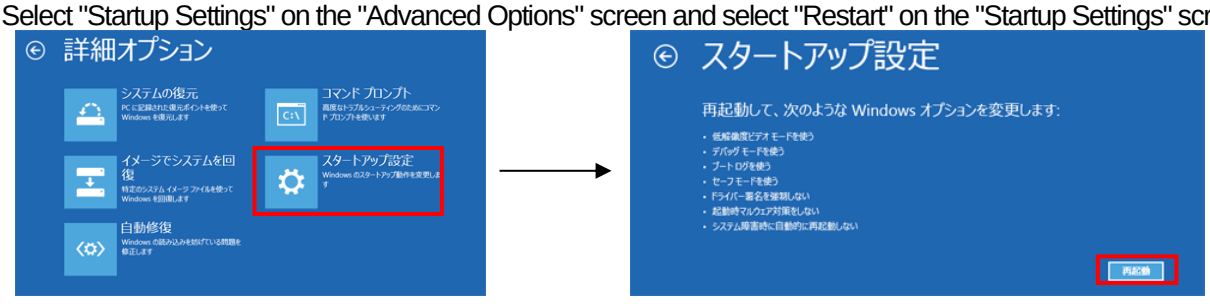


（3） On the "Change and Security" screen, select "Recovery" and select "Customize PC Startup" and "Restart Now".

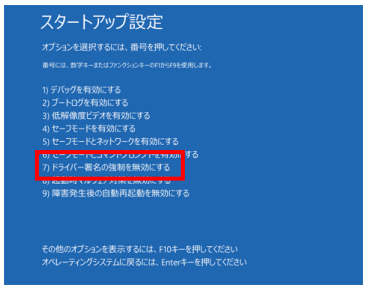
（4） Select "Troubleshooting" on the "Select Option" screen and select "Advanced Option" on the "Troubleshooting" screen.



（5） Select "Startup Settings" on the "Advanced Options" screen and select "Restart" on the "Startup Settings" screen.



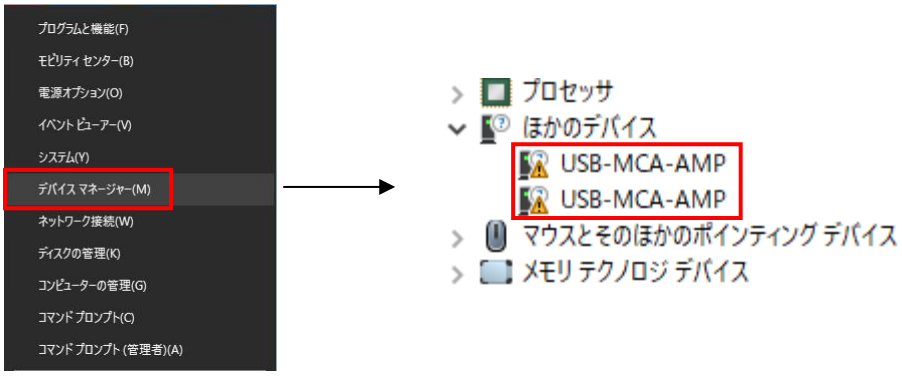
（6） On the "Startup Setting" screen after rebooting, press the "7" key and select "**7) Disable Force Driver Signing**".



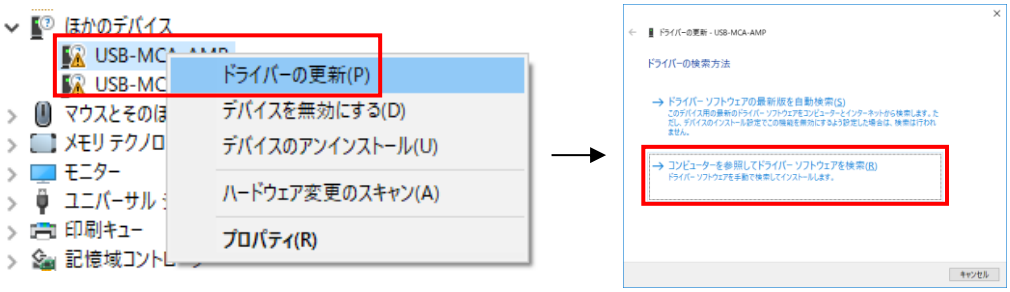
（7） **(Required) After rebooting, log in as Administrator or log in with an account with administrator privileges.**

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

（9） Right-click the "Windows" mark  at the bottom left of the screen to display "Menu", and select "Device Manager".

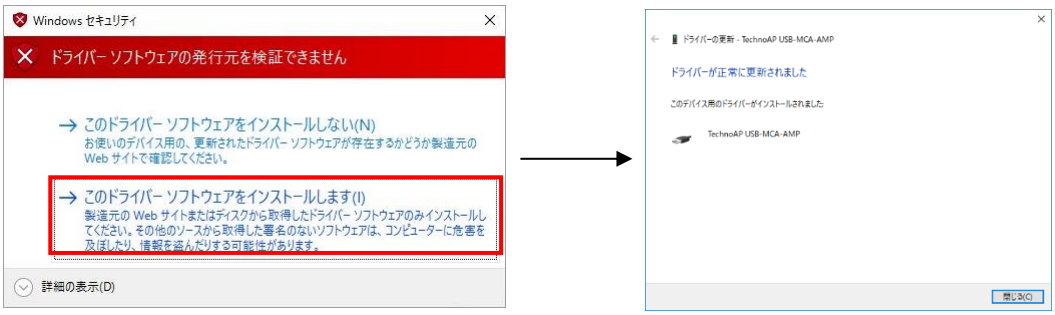


（10） Right-click "USB-MCA-AMP", select "Update Driver Software (P)", and select "Browse my computer for driver software (R)".

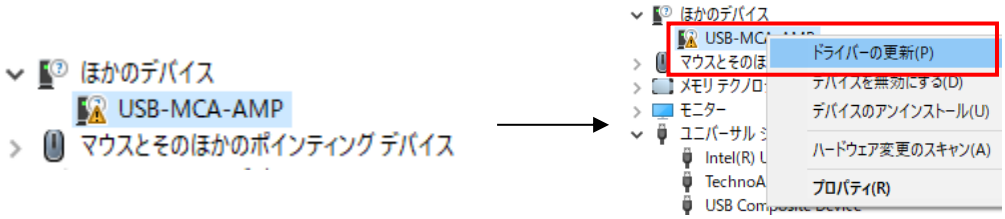


（11） When "Update Driver Software" screen is displayed, select "Reference (R)", and when "Browse Folder" screen is displayed, select the drive where the driver software of "USB-MCA-AMP" is stored. Select when you return to the "Update Driver Software" screen, select "Next (N)".

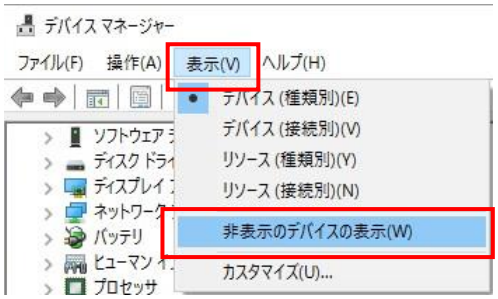
（１２） When the "Windows Security" screen is displayed, select "Install this driver software (I)". When "Driver software has been updated successfully" is displayed, select "Close (C)".



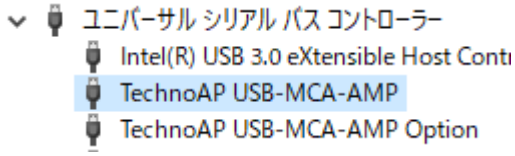
（１３） When "TechnoAP USB-MCA-AMP" is displayed on the "Device Manager" screen, right-click the remaining "USB-MCA-AMP", repeat from (11), and update the remaining driver software.



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



（１５） The “TechnoAP USB-MCA-AMP Option” is displayed on the “Device Manager” screen, and installation of the driver software is complete.

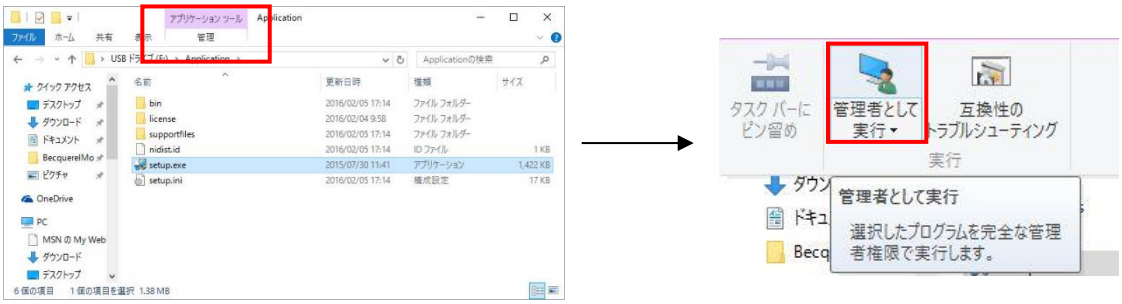


4. 3. Installation of the application software

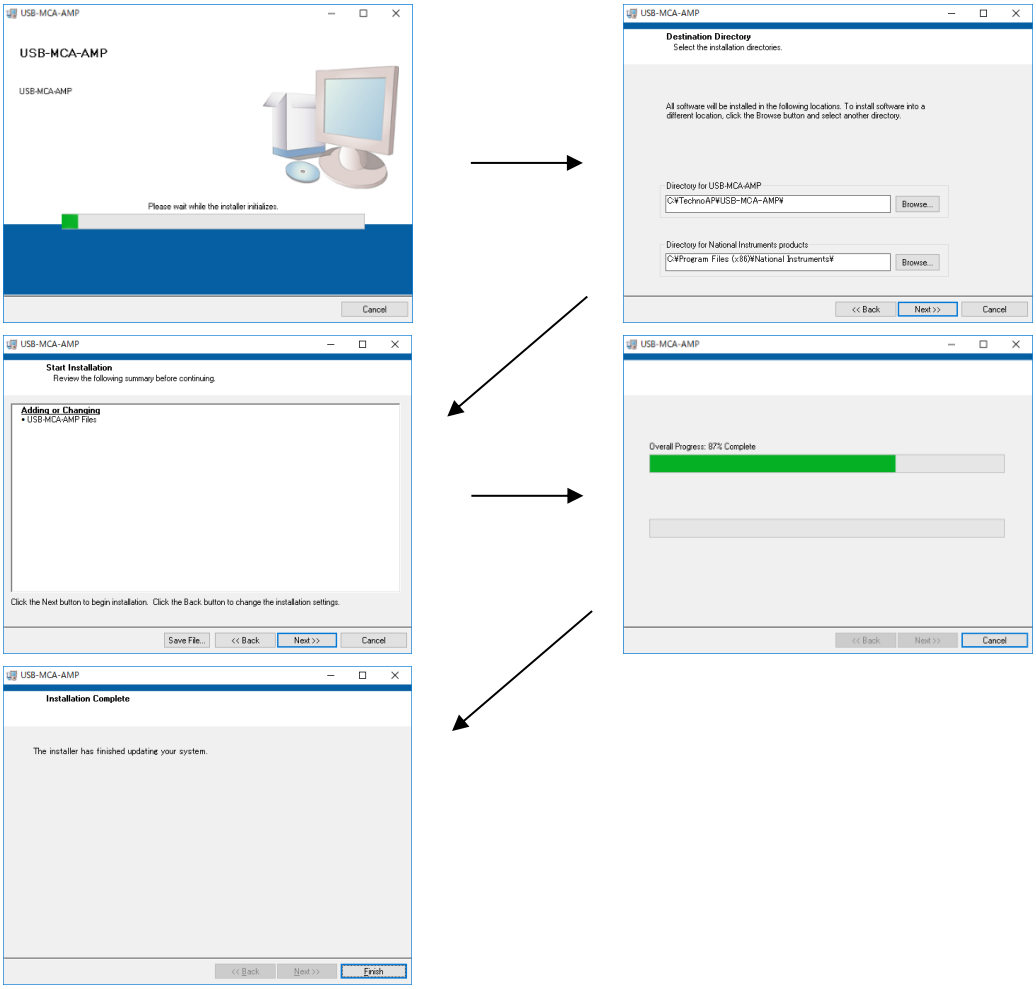
After the driver software has been successfully installed as described in the previous chapter, you need to install the USB-MCA-AMP application (the executable file) and the LabVIEW runtime engine, which is the development environment. The installer on the included CD contains the USB-MCA-AMP application and the LabVIEW runtime engine, which can be installed at the same time. The installation procedure is as follows.

For Windows 10

（1） Select "Setup.exe" in the "Application" folder in the supplied CD. Select "Manage" in the application tool of the menu and select "Run as administrator".

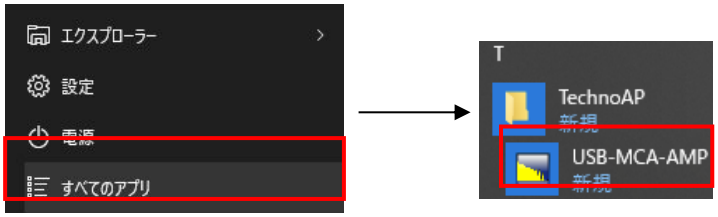


（2） Run "Setup.exe" in the "Application" folder in the supplied CD. Proceed with the installation interactively.



（3） You will be prompted to restart your computer, so click the "Restart" button to restart.

（4） Right-click the "Windows" mark  at the bottom left of the screen to display "Menu" and execute "All apps"-"TechnoAP"-"USB-MCA-AMP".



（5） The application "USB-MCA-AMP" starts up.

If a "connection error" dialog is displayed immediately after startup, check if the device is correctly connected to the PC or if the device manager recognizes the device.

NOTE: Uninstall

To uninstall, select "USB-MCA-AMP" from "Settings"-"System"-"Apps and Features" and select "Uninstall".

"Uninstall this application and its related information will be stalled easily" is displayed. Select "Uninstall".

5. Configuration

5. 1. Startup screen

Execute in order of start button, TechnoAP, USB-MCA-AMP. Alternatively, if you execute the shortcut icon "USB-MCA-AMP" on the desktop, the following startup screen will be displayed.

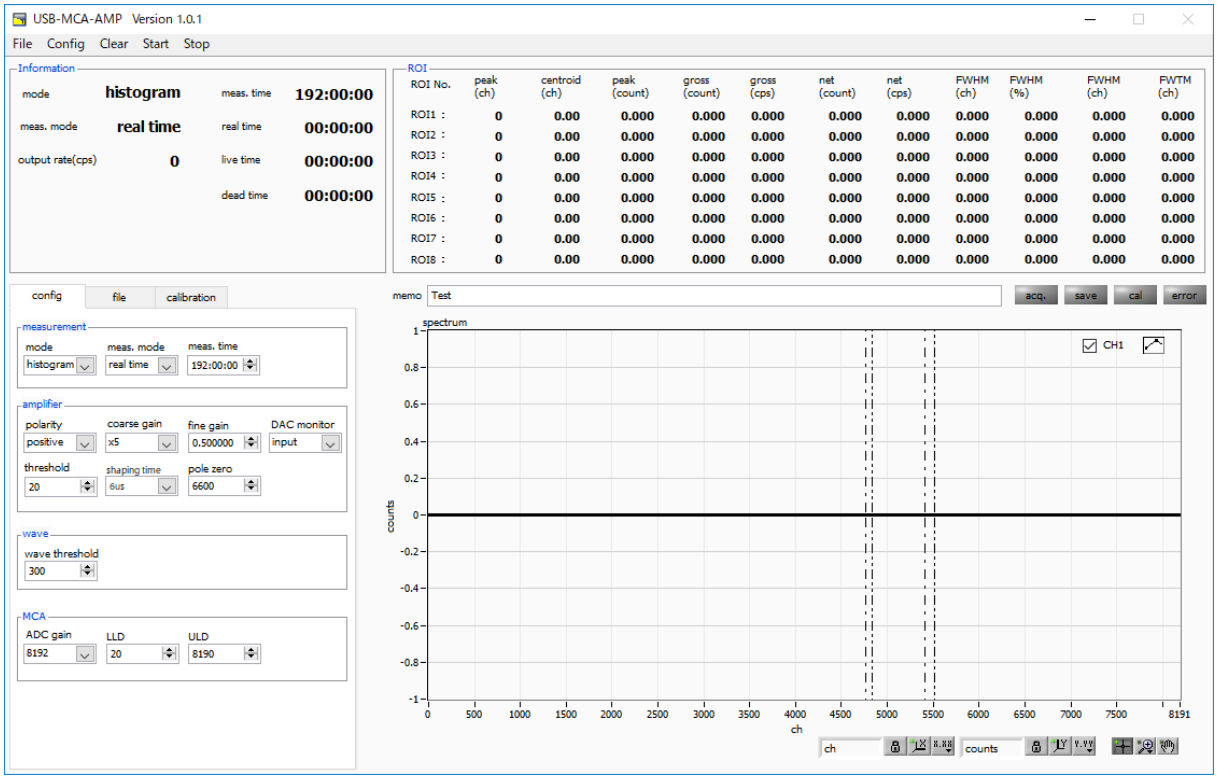


Fig. 3 Startup screen of USB-MCA-AMP

Menu section

It is consisting of "File", "Clear", "Start", and "Stop".

“File” - “open config”	Reading the configuration file
“File” - “open histogram”	Reading histogram data file
“File” - “open wave”	Reading waveform data file
“File” - “save config”	Save the current settings to a file
“File” - “save histogram”	Save current histogram data to file
“File” - “save wave”	Save waveform data to file
“File” - “save image”	Save this device screen as PNG format image
“File” - “quit”	Application termination
“Config”	Send all settings to this device
“Clear”	Initialize histogram data in this device
“Start”	After sending all settings to this device, send measurement start to this device
“Stop”	Send measurement stop to this device

Tab section

It is consisting of “config”, "file" and "calibration".

“config”	Measurement settings
“file”	File settings
“calibration”	Settings such as ROI (Region Of Interest) for energy calibration

Information section

“mode”	Display "mode", "histogram", "wave"
“meas. mode”	Measurement mode. Display "real time" or "live time"
“meas. time”	Set measurement time
“output rate (cps)”	Number of counts per second between LLD and ULD, secured as a peak
“real time”	Real time (actual measurement time)
“live time”	Live time (effective measurement time). Real time minus dead time (see below)
“dead time”	Dead time (invalid measurement time). real time minus live time This is the dead time from when the input signal exceeds "threshold" (described later) to when a peak is detected, and its peak value is determined.

“ROI” section

Display the calculated result between ROIs for each channel.

"Peak (ch)"	Channel with maximum count
"Centroid (ch)"	Center value (ch) calculated from the sum of all counts
"Peak (count)"	Maximum count
"Gross (count)"	Sum of counts between ROIs
"Gross (cps)"	Sum of counts between ROIs per second
"Net (count)"	Sum of counts minus background between ROIs
"Net (cps)"	Sum of counts minus background between ROIs for 1 second
"FWHM (ch)"	Half width (ch)
"FWHM (%)"	Half width / Peak value * 100
"FWHM"	Half width
"FWTM"	1/10 the width of the peak

acq. LED	Blinks during measurement
save LED	Lights up while saving data
cal LED	Lights up while calculating data between ROIs
error LED	Lights up when an error occurs

5. 2. Quit screen

To exit the application, click "File" and then "quit" on the menu bar. After execution, the following confirmation screen for ending is displayed.

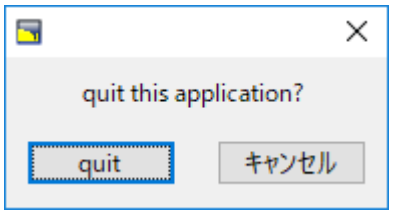


Fig. 4 Quit confirmation window

Click the "quit" button to finish. After execution, the application screen disappears and ends.

5. 3. config tab

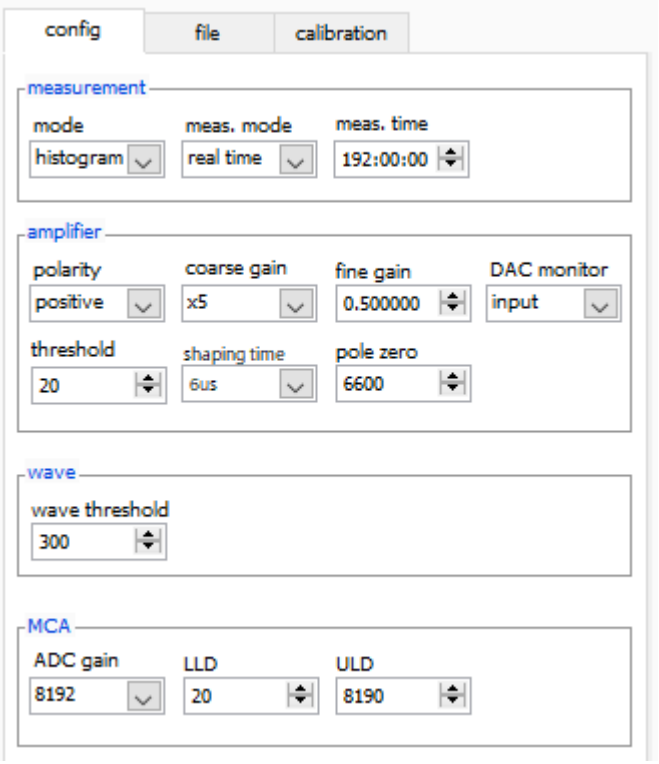
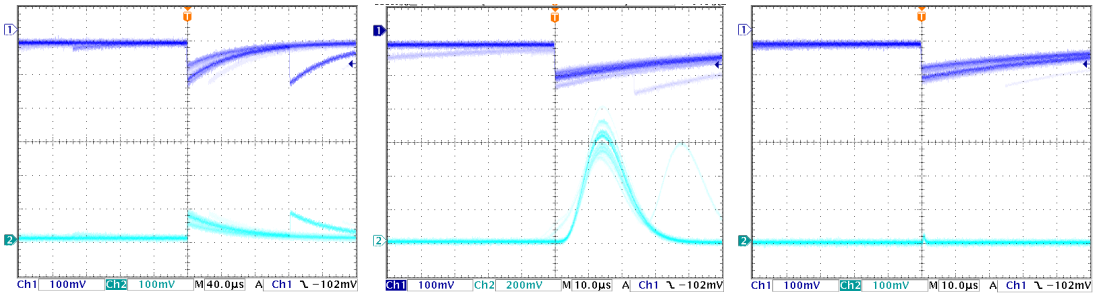
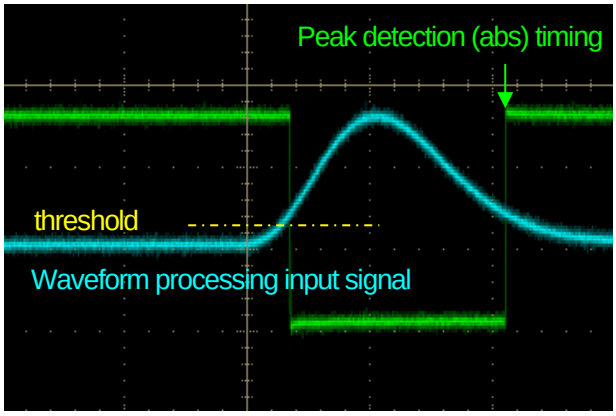


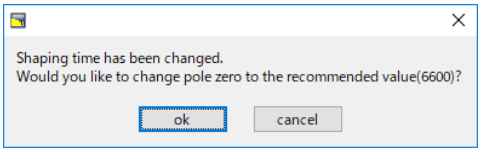
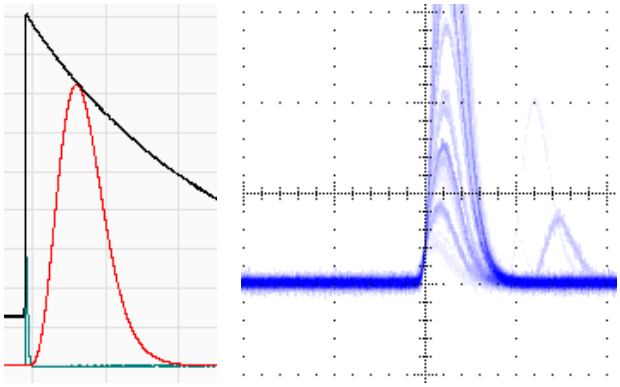
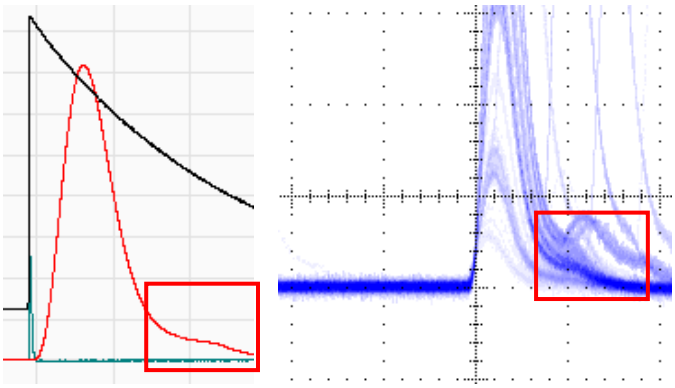
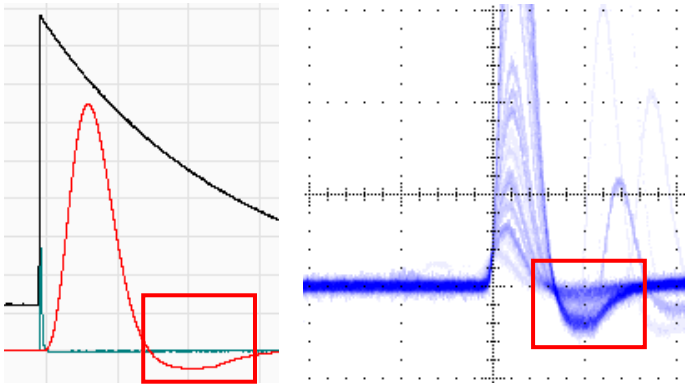
Fig. 5 config tab

measurement section

mode	Operation mode selection	
	histogram	Store the preamp signal peak value on up to 16384 channels. A histogram with energy on the horizontal axis and counts on the vertical axis is created.
	wave	Displays the waveform of the input signal (such as the preamplifier output from the detector) to this device, the timing processing signal (fast) inside this device, and the semi-Gaussian waveform (slow) preamplifier signal.
meas. mode	Select "real time" or "live time" as the measurement mode.	
	real time	Measures preset time data.
	live time	It measures until the effective measurement time (the difference between real time and dead time) reaches a preset time.
meas. time	Measurement time setting. The setting range is 0 to 192 hours (8 days). When set to 0, there is no stop by the measurement time, and even if it exceeds 192 hours, the measurement is continued until you click "Stop" on the menu bar.	

amplifier section

polarity	Input signal polarity selection. Select “positive” for positive polarity and “negative” for negative polarity.
coarse gain	Selection of course gain. For the analog input signal, select from “× 1”, “× 2”, “× 5”, “× 10” and amplify by the magnification. The recommendation is "× 1", but if the wave height of the input signal is small, increase it to "× 2" or more. As described later, select “input” in “DAC monitor”, display the signal from the OUTPUT terminal with an oscilloscope, and set so that it can be settled within 2 V without saturation.
fine gain	Fine gain setting. Multiply the generated semi-gaussian waveform.
DAC monitor	The status of the input signal or signal processing acquired by this device is analog output from the OUTPUT terminal on the front panel. The waveform to be output is selected from one of "input", "slow" and "fast". Make sure that all are within 2 V and not saturated.  **Detector signal** and **input**, **Detector signal** and **slow**, **Detector signal** and **fast**
threshold	Set the threshold for the waveform acquisition start timing. The unit is digit. The setting range is 0 to 16383. Set to a value less than or equal to LLD. Triggers peak detection and AD conversion when the waveform shaping input signal exceeds the threshold setting value. If you set this setting too high, you will not get low energy peak values. Conversely, if the setting is too small, noise will be spread out. If "ADC gain" is "16384", set "threshold" and "LLD" to about 100 at first. While looking at the "output rate" and the histogram, gradually lower it to determine the boundary between noise that increases in value and use the value slightly higher as the threshold.  Fig. 6 threshold and peak detection (abs) timing
shaping time	Performs semi-Gaussian waveform shaping on the preamp output signal to improve S / N. The setting value is selected from the following. 0.25 / 0.5 / 1/2/3/4/5/6/8/10/12/16 μs

	The shaping time constant (peaking time) is 2.2τ (tau). If you change the settings, you also need to change "pole zero" described later. By clicking on the "ok" button in the following dialog that appears when changing this setting, you can see the standard value of pole zero.  Fig. 7 Dialog asking for confirmation of pole zero
pole zero	This setting is for the end of the semi-Gaussian shaped signal. The default value is 6600 (when shaping time is 6 μs). Select slow in wave mode or DAC monitor and check the output signal of the OUTPUT terminal with an oscilloscope. Adjust this value so that it is flat if there is an overshoot or undershoot as shown below.  Fig. 8 **Correct** (Left: wave mode, Right: OUTPUT terminal slow output, pole zero at 6600)  Fig. 9 **Overshoot** (Left: wave mode, Right: OUTPUT terminal slow output, pole zero at 6600)  Fig. 10 **Undershoot** (Left: wave mode, Right: OUTPUT terminal slow output, pole zero at 6600)

wave section

wave threshold	The threshold for the preamp output signal at the start of waveform acquisition. Acquire a waveform that exceeds this value.

MCA section

ADC gain	ADC gain. Select from 16384, 8192, 4096, 2048, 1024 and 512 channels. The maximum non-saturating range of the waveform shaped signal is divided by the channels described above. For high energy resolution detectors such as HPGe semiconductor detectors, selecting 16384 allows you to acquire data with finer resolution. However, when the count is low, it takes time to acquire the peak. Since the energy resolution of NaI (Tl) scintillation detectors etc. is slightly inferior, if it cannot be divided finely, 4096 channels etc. are set.
LLD	Set the energy LLD (Lower Level Discriminator). The unit is ch. Channels below this threshold are not counted. Set to a value greater than threshold and less than ULD.
ULD	Set the energy ULD (Upper Level Discriminator). The unit is ch. Channels above this threshold are not counted. Set to a value larger than LLD.

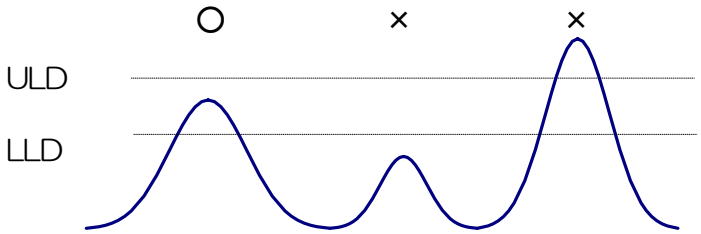


Fig. 11　UUD and ULD

5. 4. file tab

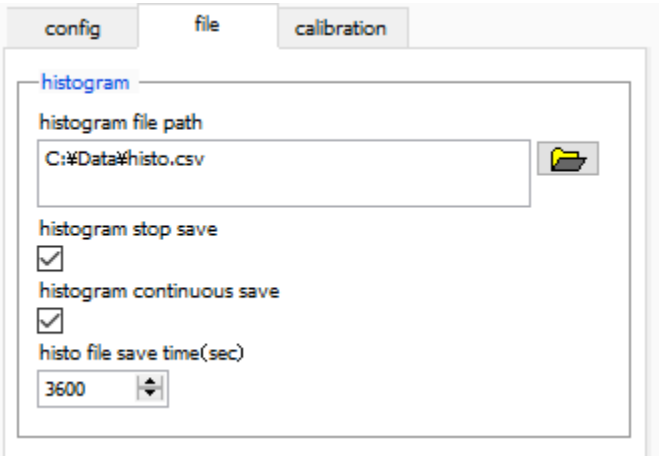


Fig. 12 file tab

histogram section

histogram file path	Set the absolute path of the histogram data file. **NOTE** It is not saved with this file name, but based on this file name, it has the following format. As an example, set "C: ¥ Data ¥ histogram. Csv" in "histogram file path" and "10" in "histogram file save time (sec)", and the date and time is 2015/12/23 12: 34:00. If so, start saving data with the file name "C: ¥ Data ¥ histogram_20151223_123400.csv". After 10 seconds, save the file as "C: ¥ Datahistogram_20151223_123510.csv".
histogram stop save	The histogram data is saved to a file at the end of measurement. The file save destination is the same as the above format.
histogram continuous save	Set whether to save histogram data to a file at set time intervals. **NOTE** Depending on the processing status, the save interval may be shifted. Used for simple backup.
histo file save time (sec.)	Set the time interval for continuous storage of histogram data. The unit is seconds. The setting range is 5 seconds to 3600 seconds.

5. 5. calibration tab

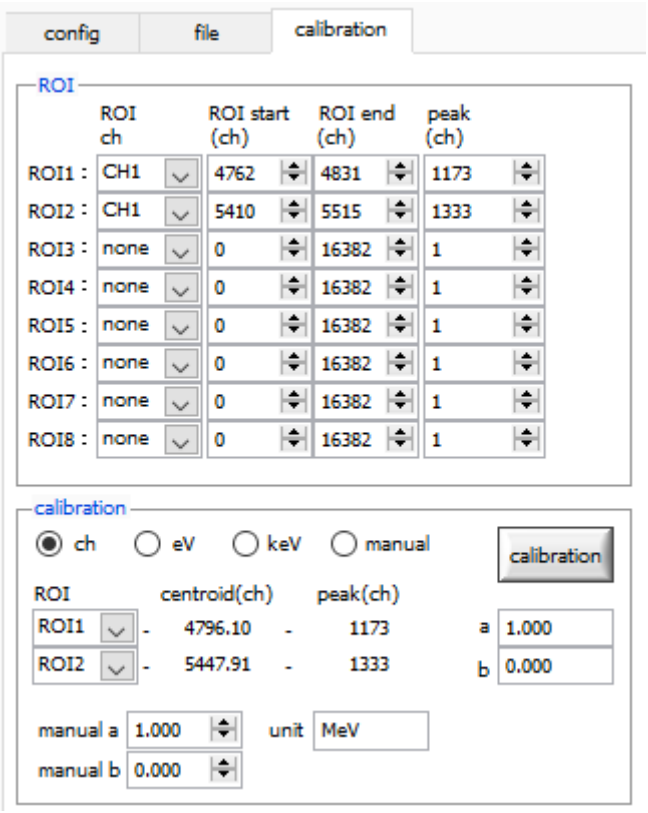


Fig. 13 calibration tab

Set ROI (Region Of Interest) and energy calibration. By setting the ROI to the spectral peak, the peak count number and half width are calculated.

ROI section

ROI CH	Select the channel number of ROI target. Up to 8 ROIs can be set for one channel signal
ROI start	Set the start position of the ROI. The unit depends on the energy calibration situation.
ROI end	Set the end position of the ROI. The unit depends on the energy calibration situation.
peak (ch)	Defines the energy value of the peak position (ch). For Co-60, set this to 1173 or 1332. When "ch" is selected in the next "calibration" section, a peak between ROIs is detected, and keV / ch is calculated from the peak position (ch) and the set energy value, and the calculation result of the half width It becomes.

calibration section

Type of calibration	Select the unit of the X axis from the following three.
ch	Unit display of Ch (channel) Units such as ROI “FWTM” “FWHM” are arbitrary.
eV	Unit display of eV. Calculate the slope a and intercept b of the linear function y = ax + b so that ch becomes eV by two-point calibration of two types of peaks (center value) and energy value in one spectrum, and set as the X axis You The unit such as "FWTM" of "FWTM" of ROI is "eV".
keV	Unit display of keV. Calculate the slope a and intercept b of the linear function y = ax + b so that ch

	becomes keV by two-point calibration of two types of peaks (center value) and energy value in one spectrum, and set as the X axis You The unit such as "FWTM" of "FWTM" of ROI is "keV". As an example, if there are 1173.24keV of Co-60 in 5717.9ch and 1332.5keV of Co-60 in 6498.7ch, a is calculated automatically as 0.20397 and b as 6.958297 from 2-point calibration.
manual	Setting of slope a, intercept b and unit label of linear function y = ax + b. Set at “manual a”, “manual b” and “unit” as needed and use for energy calibration.
ROI	Select the target ROI number for energy or time calibration. The “centroid” and “peak” next to the right show the center value of the selected ROI and the energy value being set. For example, when "ROI1" and "none" are selected, one-point calibration is performed using the peak center value of ROI1 and the preset "peak". When “ROI1” and “ROI2” are selected, 2-point calibration is performed using the peak center values of ROI1 and ROI2 and the preset “peak”.
manual a and b	The slope of the linear function y = ax + b is displayed as a, and the intercept as b to create the graph of the energy calibration calculation result.
Calibration button	Perform energy calibration according to the type of calibration. The slope a and the intercept b of the linear function y = ax + b applied to the horizontal axis of the graph after execution are calculated and displayed in the lower "a" and "b". For the calculation method, refer to “7.7. Calculation method of 2-point calibration” below. For example, select "keV" in the "calibration" section as shown in the figure below, and click the "calibration" button. Each peak will be each from the "centroid" and "peak" values of "ROI1" and "ROI2". The energy calibration is performed to obtain the energy value of, and the horizontal axis unit of the graph, the setting value of the ROI, and the unit of the calculation result of the ROI are also "keV".

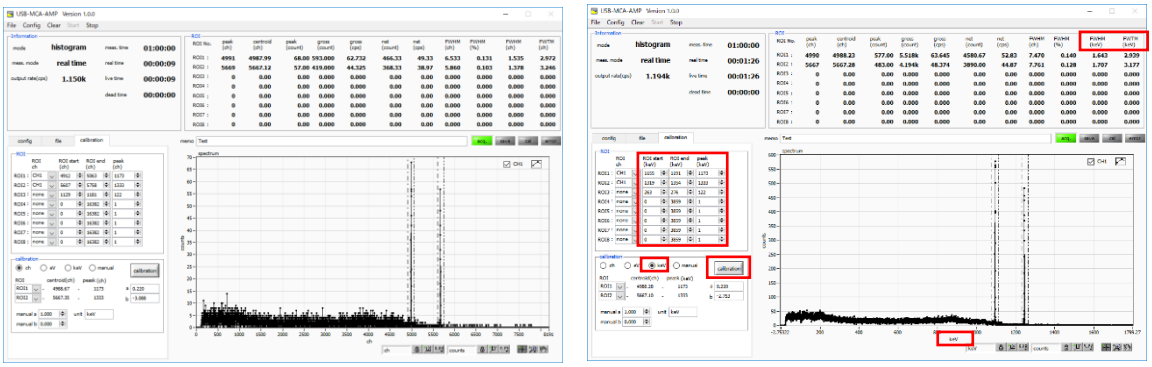
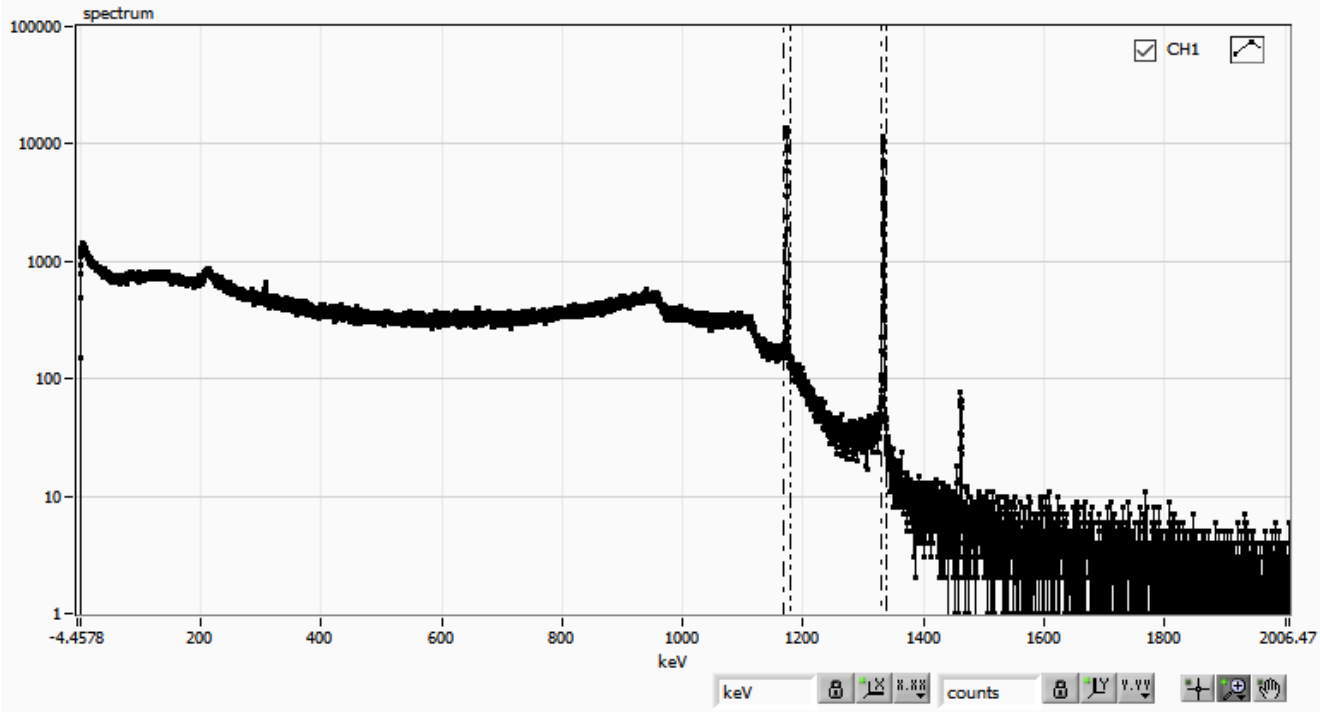


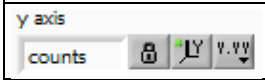
Fig. 34 When "keV" is selected in the calibration section
(Left: before energy calibration, Right: after energy calibration)

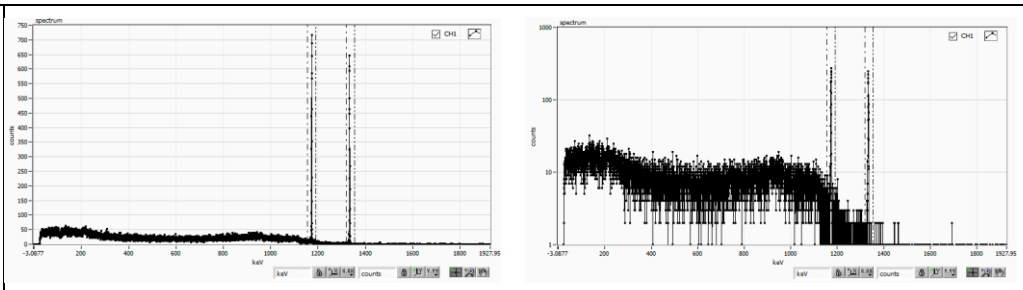
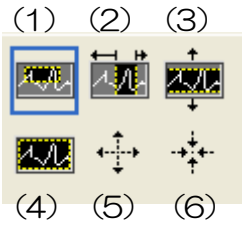
5. 6. Graph

histogram graph: In histogram mode, the horizontal axis is energy, and the vertical axis is count histogram.

Cursor x	Set the position of the dotted line cursor in the graph. The count value on the spectrum at the set position is displayed in “cursor y”.
Cursor y	Set the position of the dotted line cursor in the graph. To set the cursor X direction, use “cursor x” or drag and drop the cursor.



wave graph	Displays the input waveform, semi-Gaussian processed waveform, and timing processed waveform. It is possible to adjust gain and pole zero while checking the semi-Gaussian processed waveform.
accumulation	The waveform is displayed by overlapping the last 16 times read last time.
Common Items	Common functions in histogram and waveform graph
Plot legend	Set the graph color, line type, etc. You can switch on / off at the submenu on the graph.
X axis range	Right-click on the X axis and select "Auto scale" to make it auto scale. When deselected, auto scaling is canceled, and the X axis minimum and maximum values are fixed. If you want to change the minimum or maximum value, place the mouse pointer over the number you want to change and click or double-click to change it.
Y axis range	Right-click on the Y axis and select "Auto scale" to make it auto scale. When deselected, auto scaling is canceled, and the Y axis minimum and maximum values are fixed. If you want to change the minimum or maximum value, place the mouse pointer over the number you want to change and click or double-click to change it.
	In the X-axis, set whether auto-scaling, accuracy, mapping (linear / logarithm).
	In the Y-axis, set whether auto-scaling, accuracy, mapping (linear / logarithm).

	 Fig. 15 Y axis "mapping mode". Select "Linear" (left) and "Log" (right)
	It is a cursor movement tool. The cursor can be moved on the graph when setting the ROI.
	zoom. Click to select and execute the following 6 types of zoom in and zoom out.  Fig. 16 Graph, tools for zoom-in and zoom-out **(1)** Square. Zoom Use this option to click a point on the display that you want to be a corner of the zoom area and drag the tool until the rectangle occupies the zoom area. **(2)** X-Zoom. Zooms in on the area of the graph along the x-axis. **(3)** Y-Zoom. Zooms in on the area of the graph along the Y axis. **(4)** Fit zoom. Auto scale all X and Y scales on the graph. **(5)** Zoom out around the point. Click the center point to zoom out. **(6)** Zoom in around the point. Click the center point to zoom in.
	Pan tool. You can grab the plot and move it over the graph.

6. Measurement

6. 1. Histogram mode

1	Select "histogram" in "mode" in "config" tab.
2	Click "Clear" on the menu bar. The histogram data in this device is initialized. If you want to continue the previously measured histogram or measurement results, start the next measurement without clicking "Clear".
3	Click “Start” on the menu bar to start measurement after all settings have been sent to this device.
4	After starting measurement, transition to the following state. 1. "acq" LED blinks. 2. The measurement status is displayed in the "Information" section. 3. “histogram” is displayed for “mode”. 4. The measurement setup time is displayed in "meas. Time". 5. Real time acquired from this device is displayed in "real time". 6. The "live time" of each channel will display the live time acquired from this device. 7. The dead time obtained from this device is displayed in "dead time" of each channel. 8. For “ROI” for each “ROI No.”, center value, gross count (total within range) and rate, net count (total within range total minus background) by setting “ROI range” in “calibration” tab Calculation results such as net count), rate, half width, 1/10 width etc are displayed. 9. The graph displays the histogram of the peak value on the horizontal axis.

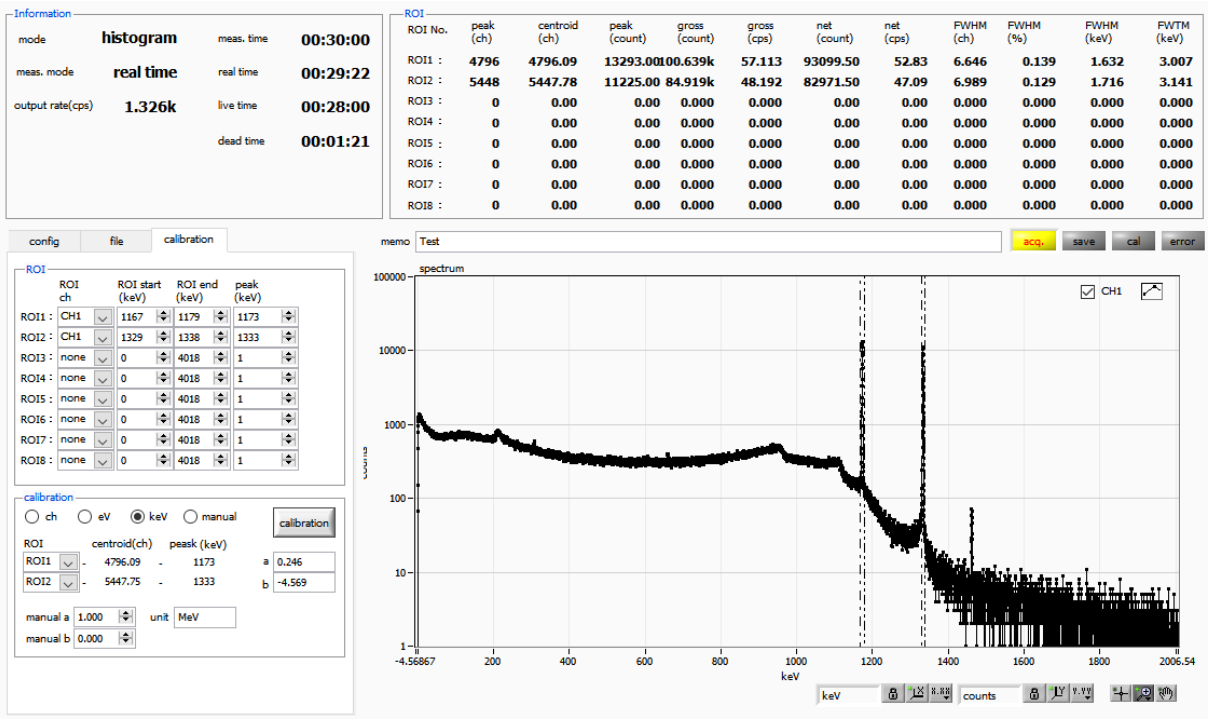
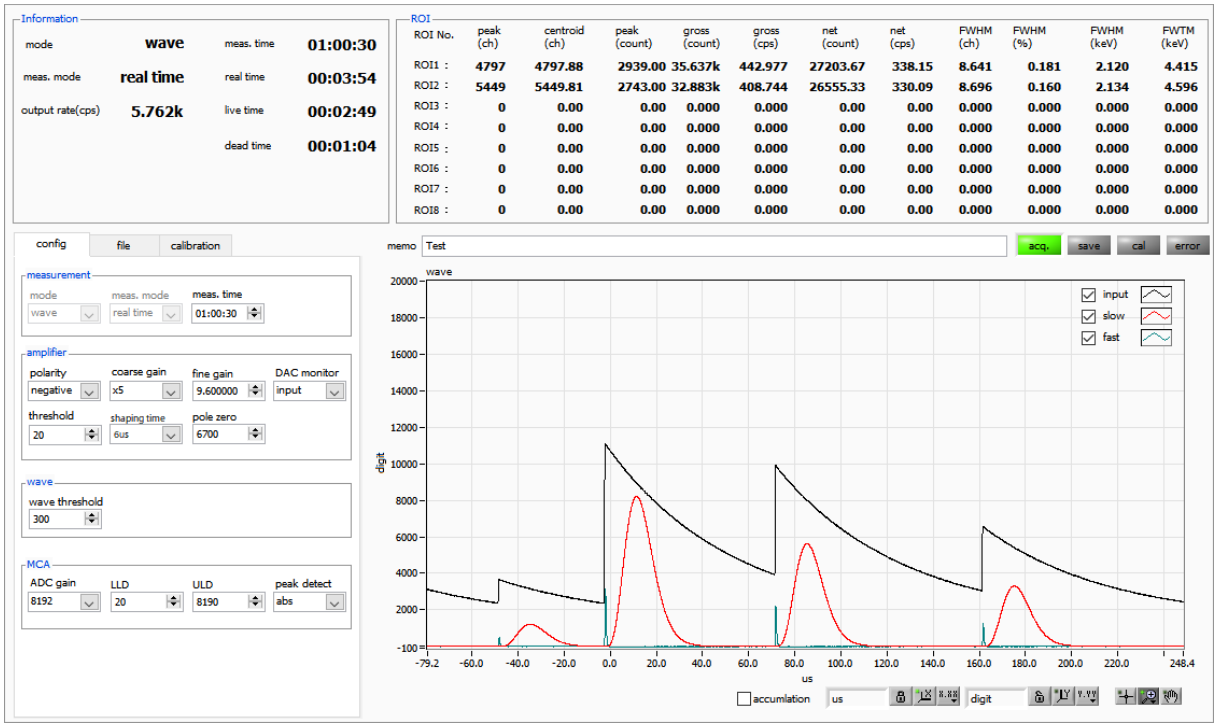


Fig. 47 Histogram mode measurement screen

6. 2. Waveform mode

1	It is used to check the input waveform and signal processing waveform before histogram mode measurement.
2	Select "wave" in "mode" in the "config" tab.
3	Click “Start” on the menu bar to start measurement after all settings have been sent to this device.
4	After starting measurement, transition to the following state. 1. "acq" LED blinks. 2. “save” LED blinks. 3. The measurement status is displayed in the "Information" section. 4. “histogram” is displayed for “mode”. 5. The measurement setup time is displayed in "meas. Time". 6. Real time acquired from this device is displayed in "real time".  Fig. 58 Waveform mode measurement screen

6. 3. Measurement stop

When "meas. Mode" is "real time", the measurement ends when "real time" reaches "meas. Time".

When "meas. Mode" is "level time", the measurement ends when the latest "live time" reaches "meas. Time".

Click “Stop” on the menu bar to stop during measurement. Stop measurement after execution.

7. File

7. 1. Histogram data file

1	File format	Text format separated by comma (csv)
2	File name	Create arbitrarily
3	Configuration	
	[Header]	**Header section**
	memo	Memo
	meas. mode	Measurement mode. Real time or live time.
	meas. time	Measurement time. Unit is seconds
	real time	Real time per channel. Unit is seconds
	live time	Live time per channel. Unit is seconds
	dead time	Dead time per channel. Unit is seconds
	start Time	Measurement start date time
	end Time	Measurement end date time
	mode	Histogram or wave
	polarity	Polarity
	coarse gain	Coarse gain
	fine gain	Fine gain
	shaping time	Shaping time
	pole zero	Pole zero
	wave threshold	100
	ADC gain	8192
	threshold	24
	LLD	20
	ULD	8190
	peak detect	Peak detection method (abs.)
	[Calculation]	**Calculation section, NOTE: The following is saved for each ROI**
	ROI No.	Input channel number targeted by ROI.
	ROI start	ROI start position (ch.)
	ROI end	ROI end position (ch.)
	peak (arbitrarily)	Definition energy value of peak between ROI
	peak (ch.)	Peak position between ROIs (ch.)
	centroid (ch.)	Center position between ROIs (ch.)
	gross (count)	Sum of counts between ROIs
	gross (cps.)	1 second gross (count)
	net (count)	Sum of counts minus background between ROIs
	net (cps.)	1 second net (count)
	FWHM (ch.)	Half-width between ROIs (ch)
	FWHM (%)	Half-width between ROIs (%)

	FWHM (keV)	Half-width between ROIs (keV etc)
	FWTM (keV)	1/10 width between ROIs (keV etc)
	[Status]	**Status section**
	output rate (cps)	Number of events processed per second
	[Data]	**Data section**
	X-axis data (channel or eV, keV, arbitrary), histogram data. Up to 16384 points.	

7. 2. Waveform data file

This is the format of the data file saved in waveform mode.

1	File format	Text format separated by comma (csv)
2	File name	Create arbitrarily
3	Configuration	
	[Header]	**Header section**
	memo	Memo
	meas. mode	Measurement mode. Real time or live time.
	meas. time	Measurement time. Unit is seconds
	real time	Real time per channel. Unit is seconds
	live time	Live time per channel. Unit is seconds
	dead time	Dead time per channel. Unit is seconds
	start Time	Measurement start date time
	end Time	Measurement end date time
	mode	Histogram or wave
	polarity	Polarity
	coarse gain	Coarse gain
	fine gain	Fine gain
	shaping time	Shaping time
	pole zero	Pole zero
	wave threshold	100
	ADC gain	8192
	threshold	24
	LLD	20
	ULD	8190
	peak detect	Peak detection method (abs.)
	[Status]	**Status section**
	output rate (cps)	Number of events processed per second
	[Data]	**Data section**
	Time (us), input, slow, fast. Up to 16384 points.	

7. 3. Data acquisition by external GATE input signal timing

When you want to acquire event data at that time from an external condition when an event occurs, input a LV-TTL level signal to the LEMO connector "GATE" on the front panel. When it is high, it measures. When it is low, it does not measure.

Set the external GATE input signal to slow with the DAC monitor, and input it in such a range (see the figure below) that the slow output signal from the OUTPUT terminal is sufficiently covered. The guideline for the pulse width of the external GATE input signal is × 8 for shaping time.
Adjust so slow pole zero does not overshoot or undershoot. Keep the external GATE input signal high until the slow output input signal goes from the baseline to the point where it exceeds the threshold level Vth.

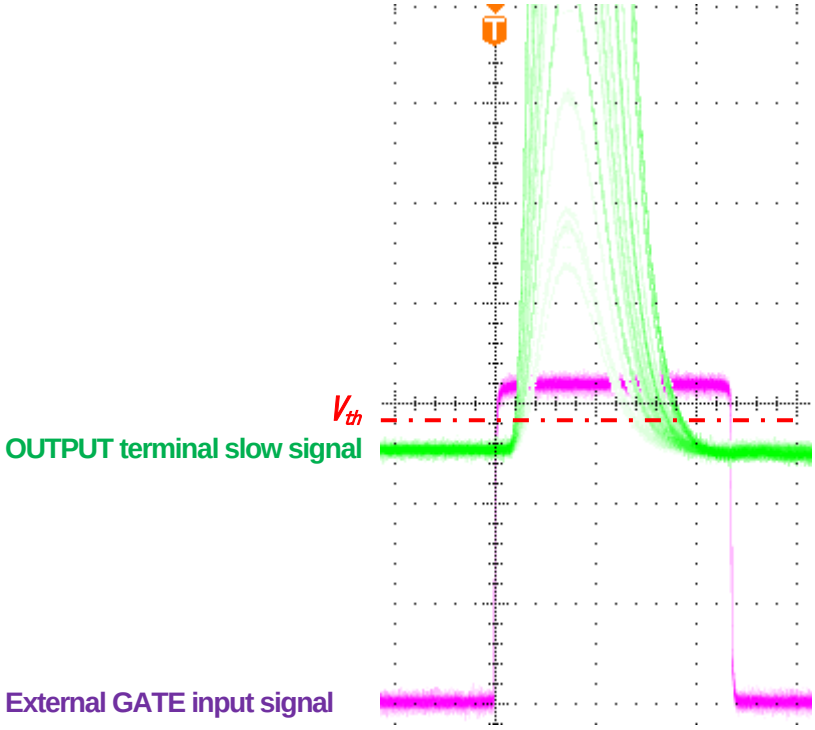


Fig. 19 External GATE input signal timing

NOTE: As for the external GATE input signal, at LV-TTL level, 0.8 V or less is judged as LOW level and 2.0 V or more is judged as High level. The maximum input voltage is 5V.

7. 4. Data discard by external VETO signal timing

When you want to acquire event data at that time from an external condition when an event occurs, input a LV-TTL level signal to the LEMO connector "VETO" on the front panel. Contrary to the "GATE" function, it measures when it is low and does not measure when it is low. The timing is the same as GATE described above.

7. 5. Calculation method of FWHM (half width)

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

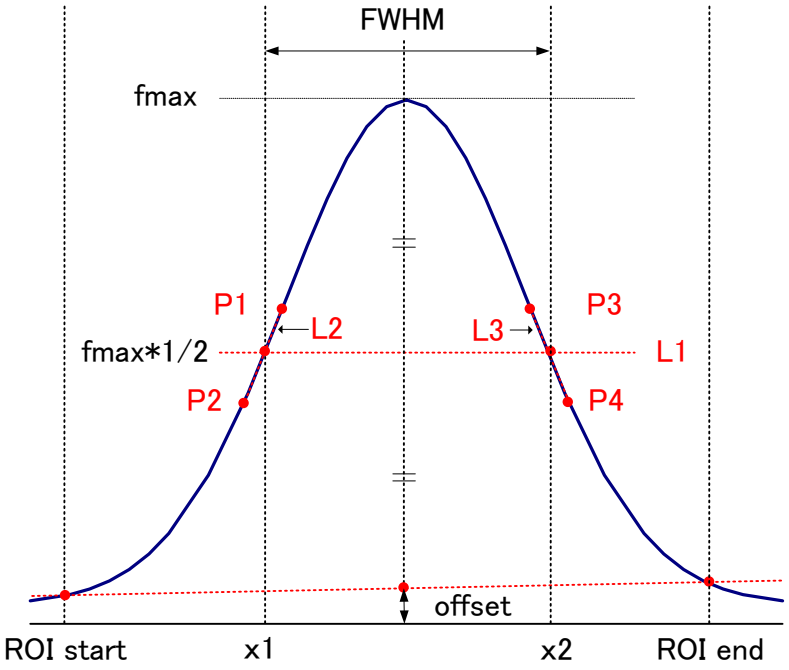


Fig. 20 Calculation of FWHM

1	The maximum value fmax between ROI Start and ROI end in the histogram is detected.
2	Connect the intersection point of histogram and ROI start with the intersection point of histogram and ROI end. The background offset (offset) is calculated by finding 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 fmax minus offset and draw a straight line L1 parallel to the X axis.
4	In order to find two points where the histogram and L1 intersect, the crossing points P1 and P2 and P3 and P4 are detected.
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 of L1 and L3.
7	The difference between x2 and x1 is FWHM

7. 6. Calculation of gross count and net count

The "gross" and "net" counts in the "ROI" part are calculated by the Covell method.

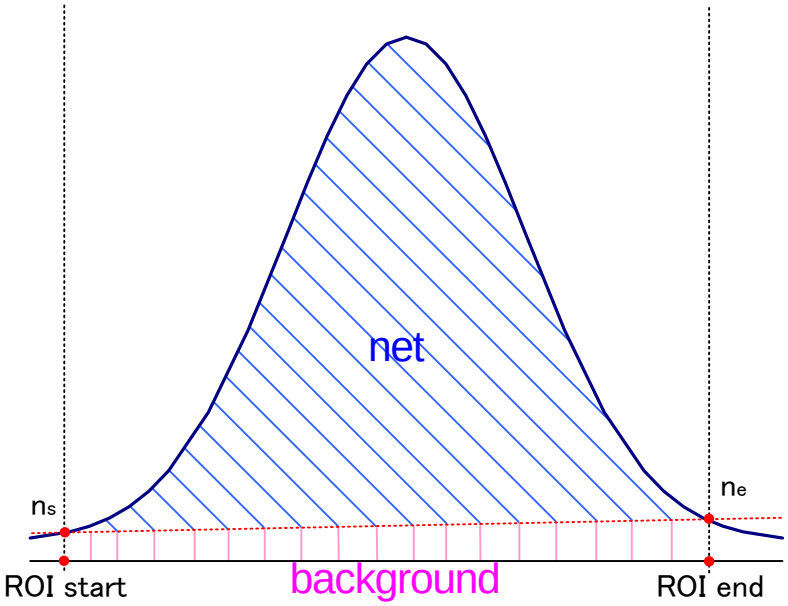


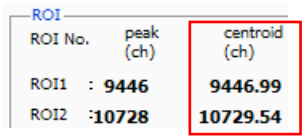
Fig. 21 Calculation of gross count and net count

1	"Gross" count is the sum of counts between ROI Start and ROI end.
2	The "net" count is the net count of the peak minus the background count from the "gross" count (blue shaded area above).
3	Background (background) count connects ROI start and spectrum intersection ns with ROI end and spectrum intersection ne by a straight line. This is the area of the rectangle surrounding the four points of ROI start, ns, ne and ROI end (pink line in the above figure).

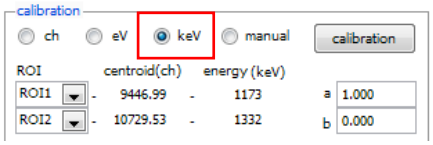
7. 7. Calculation method of two-point calibration

In histogram mode

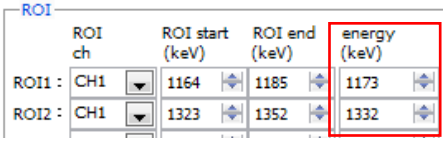
Perform a two-point calibration using the centroid of the two energy peaks and the peak energy value to make the unit scale of the X axis of the graph an energy (e.g., keV). One-point calibration is also possible.



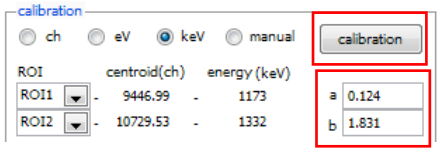
Set "ROI start (keV)" and "ROI end (keV)" in the upper "ROI" in the "calibration " tab, referring to the "centroid (ch)" value of ROI1 / ROI2 displayed in "ROI "at the top of the graph. Or set the range of ROI1 and ROI2 by cursor movement of the graph.



Select the radio button "keV" in "calibration" at the bottom of the "calibration" tab. Select "ROI1" and "ROI2" as the ROI in "calibration" at the bottom of the "calibration" tab.



Set the peak energy of each of ROI1 / ROI2 to "keV" for how many keV it corresponds.



When you click the "calibration" button, the slope a and intercept b of the linear equation y = ax + b, which are calculated by the following equation, are automatically reflected in the lower positions of "a" and "b" .

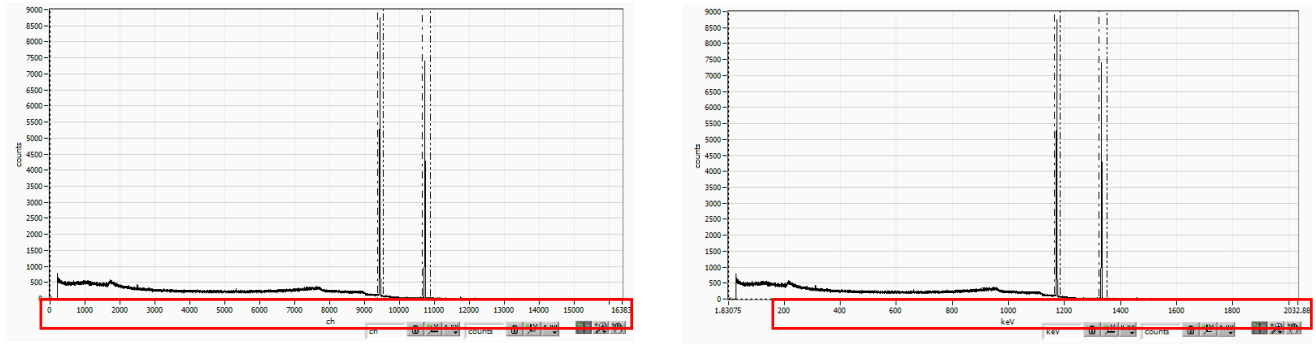


Fig. 22 Before energy calibration (Left), After energy calibration (Right)

a = (peak1-peak2) / （centroid1-centroid2）
b = y – ax

For example, using Co-60, with 1473 keV centroid 9446.99 ch. And 1332 keV centric 10729.53 ch.

a = (1332 - 1173) / (10729.53 – 9446.99) = 0.124
b = 1332 – 0.124 * 10729.53 = 1.831

As described above, “a” is automatically reflected as “0.124” and “b” is automatically reflected as “1.831”, and the unit scale of the X axis is created by the linear expression 0.124 * ch + 1.831.

8. Terms of warranty

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

Warranty period	1 year from date of purchase
Description of warranty	Even if the product is used correctly according to this instruction manual within the warranty period, if it breaks down, it will be repaired or replaced.
Not covered by warranty	If the cause of failure falls under any of the following, we do not guarantee it. 1. Errors in use. Failure or damage due to improper repair, remodeling or disassembly. 2. Failure or damage due to falling. 3. Failure or damage due to use in severe environments (such as high temperature, high humidity or below zero, condensation, etc.). 4. Causes other than the above, causes other than "Our products". 5. Consumables. 6. Failure due to natural disasters such as fire, earthquake, flood and lightning. Failure or damage due to theft. 7. When it is judged that it is wet

We consider your use of our products to be agreed with all the above.

Manufacturer

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FAX: +81-29-352-9013
URL: http://www.techno-ap.com
E-mail: order@techno-ap.com
Business Hours: 9:30 AM to 17:00 PM, Monday to Friday

Warranty

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

Product	USB-MCA-AMP
Model	APG7305A、APG7305A-DM18
Serial number (S/N)	
Warranty period	1 year from date of purchase
Date of purchase	
Distributor	
Name of buyer	
Address of buyer	
Telephone number of buyer	

* Please store the product warranty card and other proof of purchase date.
Needed for warranty or repair.

* This product warranty will not be reissued.
Please keep it in a safe place.

* Repairs may be charged during the warranty period.
Please read the "Disclaimer" carefully and follow the conditions of use.