Multi Channel Analyzer

APU7308-16k
APU7308-8k

Instruction Manual

Version 1.0.0
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Safety Precautions / Disclaimer

Thank you very much for purchasing this product from TechnoAP Co., Ltd. Before using this product, please read this "Safety Precautions and Disclaimer" and be sure to observe the contents and use the product properly.

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 apply a power supply that exceeds the rating.
Do not turn the power on while other metals are in contact with the board surface.

Note

If there is smoking or abnormal heat generation in this device, turn off the power immediately.
This board may not work properly in noisy environments.
Be careful with static electricity.
The specifications of this board and the contents of the related documents are subject to change without notice.

Warranty policy

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

Warranty period: One year from date of purchase.
Guarantee contents: Repair or replacement will be carried out in case of breakdown even though you have used correctly according to this instruction manual within the warranty period.
Out of 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. Consumables.

Contents

1 Overview

The Techno AP Corporation Multi-Channel Analyzer APU7308 (hereinafter referred to as “this instrument”) is an MCA equipped with a high-speed successive approximation ADC on each of the eight signal input channels.

The preamplifier signal from the detector is input to a spectroscopy amplifier (linear amplifier, hereinafter referred to as “amplifier”), and the output signal processed through amplification and waveform shaping by analog circuitry is then input to this instrument. The amplitude (pulse height, peak value) of this signal contains information such as radiation energy. The MCA is a pulse height analyzer that detects this signal, converts the maximum pulse height into digital (AD) data, and generates a histogram.

One indicator of MCA performance is dead time. Dead time refers to the period during which the MCA cannot measure pulse height values. For randomly occurring events such as radiation, while the system is executing processes from event occurrence through peak detection, digital conversion of the pulse height, memory update, and pulse height reset, new events cannot be measured. The dead time of this instrument is fixed at 1 μsec.

This instrument supports four measurement modes: histogram mode, list mode, MCS (Multi Channel Scaler) mode, and the optional coincidence mode.

Histogram mode generates a histogram with energy pulse height values such as keV on the horizontal axis and counts on the vertical axis.

List mode detects valid events when the signal from the amplifier exceeds the threshold and the pulse height lies between LLD and ULD. It transfers the elapsed time from the start of measurement, pulse height value, and channel number to a PC as list data and stores them in a file. In either mode, data are transferred to the PC via a LAN cable.

MCS mode generates histogram data with time (ranging from nanoseconds to seconds) on the horizontal axis and counts on the vertical axis. For the horizontal axis, the dwell time, which is the time width per channel, can be selected in advance from a minimum of 40 nanoseconds to a maximum of 100 seconds, and up to 2^{32} counts can be accumulated per channel. When a valid event within the LLD and ULD range is detected, counts are added to the corresponding elapsed-time channel based on the timing information at which the threshold was exceeded.

The optional coincidence mode uses CH1 and CH2 to acquire the detection time, channel number, and pulse height of events detected simultaneously within a specified time window. The configurable time range is from a minimum of ±40 ns to a maximum of ±10 μsec. It can save simultaneous two-channel list data in list mode or generate a two-dimensional histogram (2048 × 2048 channels) with CH1 PHA on the horizontal axis and CH2 PHA on the vertical axis.

This document explains how to operate this instrument.

*This document describes the standard product specifications. Depending on the presence of options or special specifications, the actual product in use may differ.

*Additional functions can be added to this instrument as options. In this document, such functions are indicated as “(Option)”.

*The contents of this document are subject to change without prior notice.

2 Specifications

(1) Analog Input

• Number of channels	8CH
• Input range	0 to +10 V
• Input impedance	1 kΩ
• Acceptable pulse width	Minimum 100 nsec to maximum 100 μsec
	※ Duration during which the signal exceeds the threshold

(2) ADC

• Conversion method	Successive approximation type
• Resolution	16 bit
• Conversion time	650 nsec
• ADC gain	16384 (APU7308-16k only),
	8192, 4096, 2048, 1024, 512 channels
• Threshold	Full scale 0 to 50%, configurable from PC
• LLD	Full scale 0 to 100%, configurable from PC
• ULD	Full scale 0 to 100%, configurable from PC

(3) Performance

• Dead time	Fixed at 1 μsec
	※ Amplifier processing time is not included
• Integral nonlinearity	Within ±0.025% (typ)
• Differential nonlinearity	Within ±1% (typ)

(4) External Input

• External input	GATE and VETO
	Input signal level: LV-TTL
	※ During LIST mode execution, VETO functions as CLR (clearing time information)
	※ During MCS mode execution, VETO functions as CLR (clearing MCS time count)

(5) Functions

• Operating modes	Histogram mode
	(APU7308-16k: maximum 16384 ch, 2^{32} counts/ch)
	(APU7308-8k: maximum 8192 ch, 2^{31} counts/ch)
	List mode (time information per event, CH number, pulse height value)
	MCS mode
• Communication I/F	RJ45 connector, Ethernet 1000Base-T TCP/IP and UDP

(6) Options

• Function	Coincidence mode

(7) External Dimensions	210 (W) × 250 (D) × 37 (H) mm (including protrusions)
(8) Weight	Approx. 765 g

3 Appearance

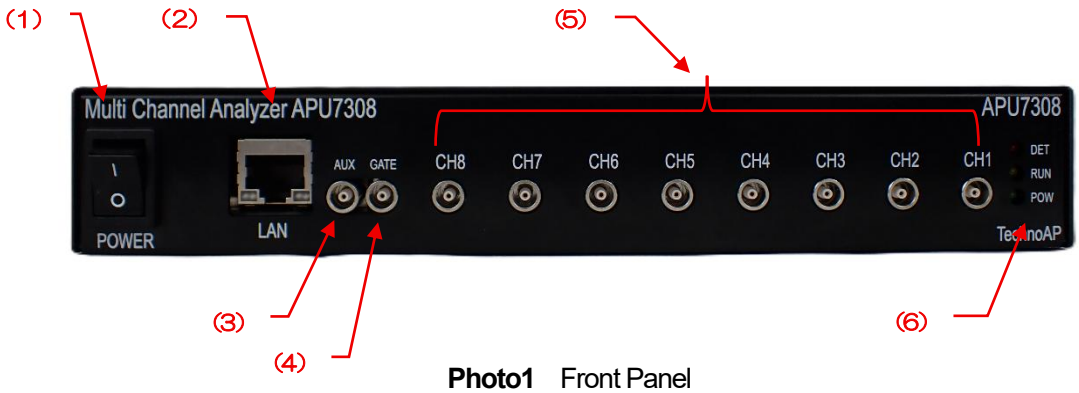


Photo1 Front Panel

Photo2 Rear Panel

【Front Panel】

(1) POWER	Main power switch of this instrument. “O” side is OFF, “I” side is ON.
(2) LAN	RJ45 connector for Ethernet cable. Supports 1000Base-T.
(3) AUX	LEMO connector for external VETO signal input. Input signal level: LV-TTL.
	Data acquisition is disabled while the signal is High.
	※ During LIST mode execution, VETO functions as CLR (clearing time information)
	※ During MCS mode execution, VETO functions as CLR (clearing MCS time count)
(4) GATE	LEMO connector for external GATE signal input. Input signal level: LV-TTL.
	Data acquisition is enabled while the signal is High.
(5) CH1 to CH8	LEMO connector (EPL.00.250.NTN) for amplifier signal input.
(6) LED	POW (green) lights when power is ON. RUN (orange) and DET (red) are not implemented.

【Rear Panel】

(7) DC-IN (+12V)	Power input plug. Connect the supplied AC adapter.
	Use the supplied screw-lock AC adapter plug as shown in the photo below.
(8) F.G	Connect a grounding wire to this terminal when a wall outlet with grounding is unavailable or when the grounding connection is insufficient.

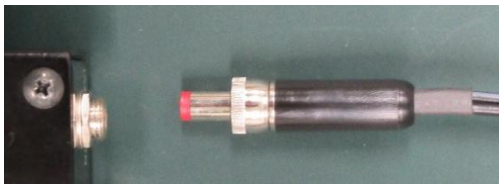


Photo3 Screw-lock plug

*Introduction of Conversion Adapter

The signal input connector of this instrument uses the LEMO EPL.00.250.NTN connector or an equivalent form factor. If using a BNC connector cable, connection to this instrument can be achieved by using a conversion adapter such as the one shown below.

Manufacturer	Huber & Suhner
Manufacturer Model	33_QLA-BNC-01-1/1--_NE
Description	QLA-01 to BNC
Connector Gender 1	Interface QLA-01 Photo 4 33_QLA-BNC-01-1/1--_NE
Connector Gender 2	Interface BNC

However, if interference occurs when using adjacent channels such as CH1 and CH2, use a LEMO-to-BNC conversion cable as shown in the photo below.

Photo 5 Example of LEMO-to-BNC Conversion Cable

4 Setup

4.1 Installation of Application Software

This application runs on Windows. To use it, you must install both the EXE (executable) file of this application and the LabVIEW Runtime Engine from National Instruments on the target PC.

Installation of this application is performed using the installer included on the supplied CD. The installer contains both the EXE (executable) file and the LabVIEW Runtime Engine, allowing simultaneous installation. The installation procedure is as follows.

If installing on a PC where other LabVIEW applications are already installed, close all LabVIEW applications before proceeding.

(1) Log in to Windows with administrator privileges.

(2) Run setup.exe in the Application (or Installer) folder on the supplied CD-ROM.
Proceed with the installation interactively. The default installation directory is C:¥TechnoAP¥APP7308. The executable file of this application (extension: .exe) and the configuration file storing settings (extension: .ini) will be installed in this folder.

(3) Click Start – TechnoAP – APP7308 to launch the application.

To uninstall, select this application from Add or Remove Programs and remove it.

4.2 Network Setup

Check the communication status between this instrument and the application according to the procedure below.

(1) Turn ON the PC and modify the PC network adapter settings.

IP Address　192.168.10.2　※ Any address other than the one assigned to this instrument

Subnet Mask　255.255.255.0

Default Gateway　192.168.10.1

(2) Turn ON the power of this instrument. Wait approximately 10 seconds after power-up.

(3) Check the communication status between the PC and this instrument. Execute the ping command from the Windows Command Prompt and confirm that the PC can communicate with this instrument. The IP address of this instrument is shown on the rear or bottom side of the enclosure. The factory default network settings of this instrument are as follows.

IP Address　192.168.10.128

Subnet Mask　255.255.255.0

Default Gateway　192.168.10.1

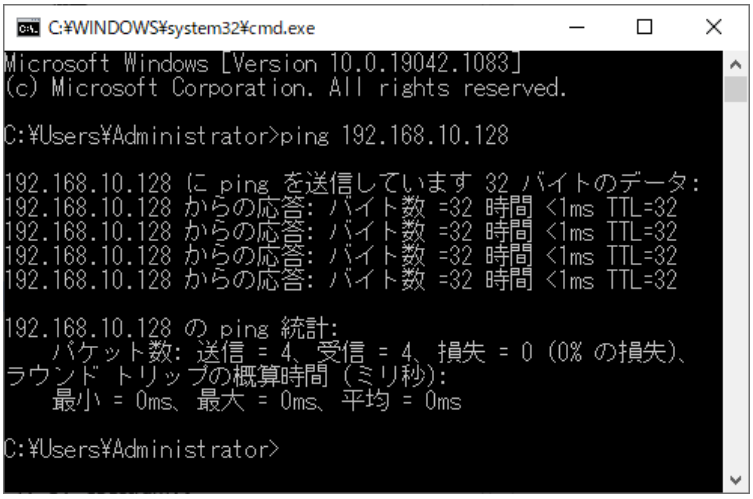


Figure 1　Communication Connection Check – Executing the ping Command

(4) Launch the application by clicking the APP7308 shortcut icon on the desktop.

If an error message indicating failure to connect to this instrument appears when launching the application, refer to the troubleshooting section described later.

5 Application Screen

5.1 Startup Screen

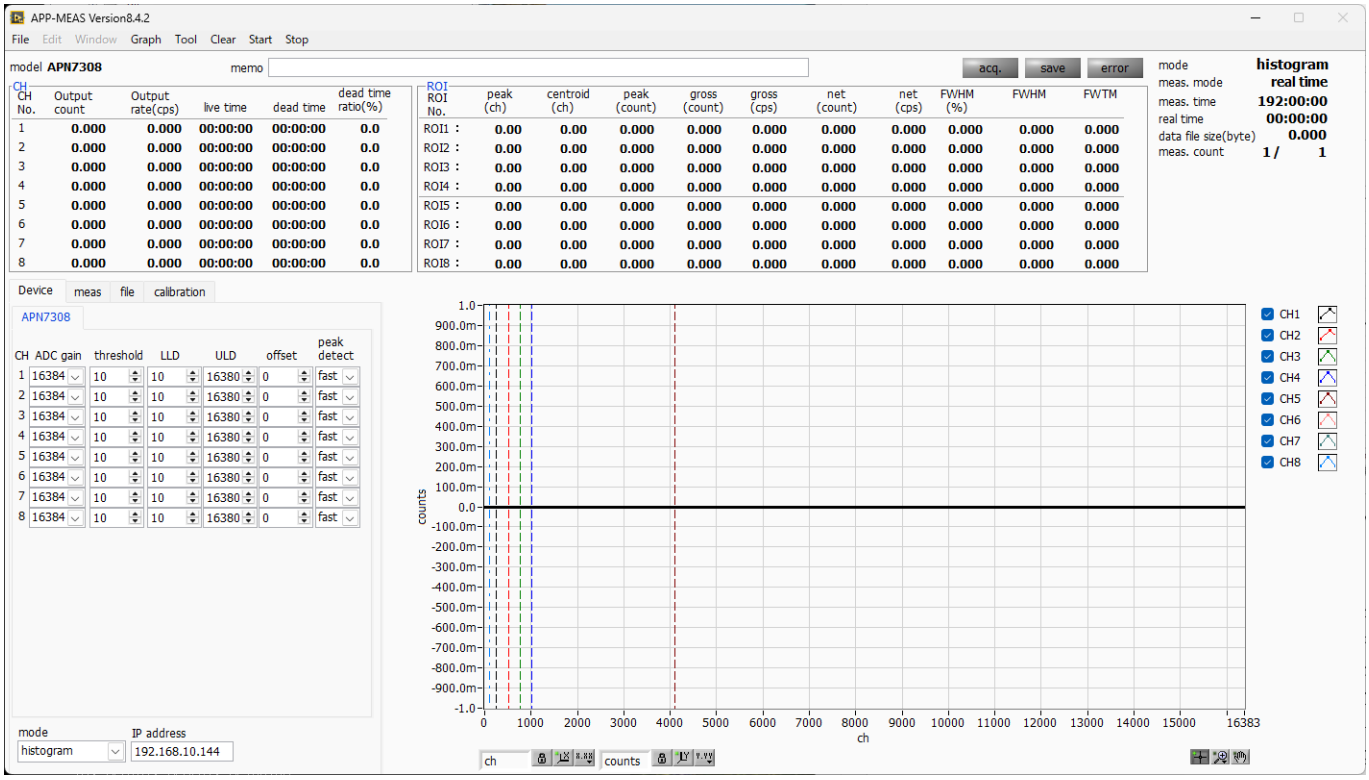


Figure 2 APP7308 Startup Screen

· Menu Section

File - open config	Load configuration file
File - open histogram	Load histogram data file
File - open 2D histogram	(Option) Load coincidence 2D histogram data file
File - save config	Save current settings to a file
File - save histogram	Save current histogram data to a file
File - save 2D histogram	(Option) Save current coincidence 2D histogram data to a file
File - save image	Save the application screen as a PNG image
File - convert to text from binary list data file	Open the screen for converting list data files into CSV format
File – reconnect	Reconnect to this instrument
File – quit	Exit the application
Graph – histogram	Display the histogram graph screen.
Graph - 2D histogram	(Option) Display the 2D histogram graph screen.
Tool – gauss fit analysis	Display the Gaussian fitting screen. Execute Gaussian fitting on the selected peak and perform analysis such as FWHM evaluation.
Tool – peak search analysis	Display the peak search screen. Execute peak detection on histogram data and perform analysis such as FWHM evaluation.
Clear	Initialize histogram data stored in this instrument
Start	Send all settings to this instrument, then start measurement
Stop	Send measurement stop command to this instrument

· Tab Section

Device	Settings related to measurement of this instrument
meas	Settings related to measurement operation and measurement time
file	File-related settings
calibration	Settings related to energy calibration, ROI (Region Of Interest), etc.
option	Settings for MCS, coincidence (option), etc.

· Outside Tab Area

model	Displays APU7308-8k or APU7308-16k model
memo	Free text box for measurement data management
acq. LED	Blinks during measurement
save LED	Lights while saving data
error LED	Lights when an error occurs
mode	Displays current operating mode such as histogram, list, coincidence, or MCS
meas. mode	Measurement mode. Displays either real time or live time. Explained later in the meas tab.
meas. time	Configured measurement time
real time	Real-time (actual measurement time)
data file size (byte)	Size of the saved file
meas. count	Measurement count. Displays current measurement count / total measurement count. Total measurement count is specified by repeat count in the DSP section of the config tab described later.

• CH Section

input rate (cps)	Number of counts per second where input signal level exceeds the threshold level
throughput rate (cps)	Throughput count rate. Number of events processed per second relative to input
live time	Live time (effective measurement time)
real time	(actual measurement time) – dead time
dead time	Dead time (ineffective measurement time)

real time – live time

The insensitive period from when the input signal exceeds the threshold described later until peak detection, AD conversion, and reset are completed.

dead time ratio (%)	Dead time ratio (%). Instantaneous value for each acquisition.

• ROI Section

Displays calculation results within the ROI range.

peak (arbitrary unit)	Channel with maximum count. Unit depends on energy calibration status.
centroid (arbitrary unit)	Center value (channel) calculated from the sum of all counts
peak (count)	Maximum count

gross (count)	Total counts within ROI
gross (cps)	Total counts per second within ROI
net (count)	Total counts within ROI after subtracting background
net (cps)	Total counts per second within ROI after subtracting background
FWHM (%)	Full width at half maximum / peak value × 100
FWHM (arbitrary unit)	Full width at half maximum. Unit depends on energy calibration status.
FWTM (arbitrary unit)	One-tenth maximum width of the peak. Unit depends on energy calibration status.

5.2 Exit Screen

To close the application, click File - quit from the menu. After doing so, the following confirmation screen will appear.

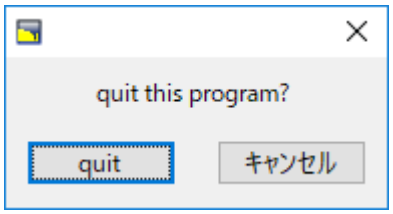


Figure 3: Exit Confirmation Screen

To exit, click the quit button. The application screen will close, and the application will terminate.

5.3 Device Tab

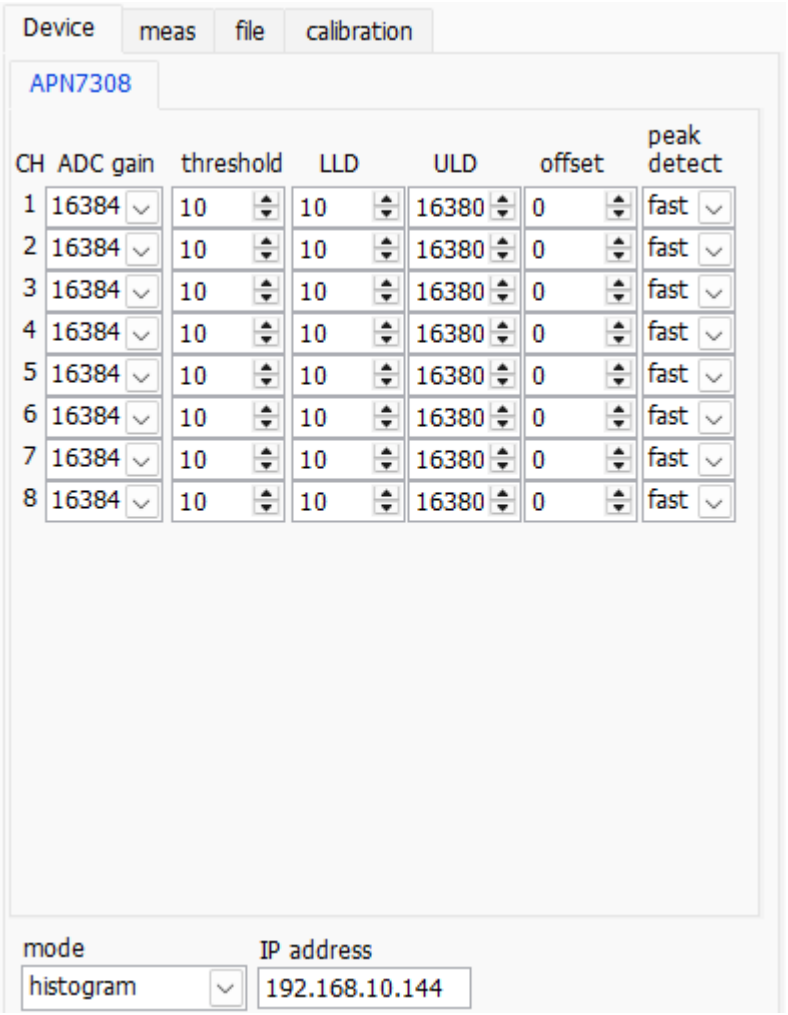


Figure 4 Device Tab

ADC gain

Select ADC gain (pulse height division) from 16384 (APU7308-16k only), 4096, 2048, 1024, or 512 channels (ch).
The input voltage range of each channel is 0 to 10 V. This range is divided according to the selected channel setting.

threshold

Set the threshold timing for waveform acquisition start. Unit: digit. Setting range is 0 to 16384 (up to 8192 for APU7308-8k). Set below the LLD value. Peak detection and AD conversion are triggered when the shaped input signal exceeds the threshold setting. If set too high, low-energy pulse heights cannot be acquired. If set too low, noise may be detected. Gradually lower the setting while monitoring input rate, throughput rate, and histogram, determine the boundary where noise begins to increase, and set the threshold slightly above that point.

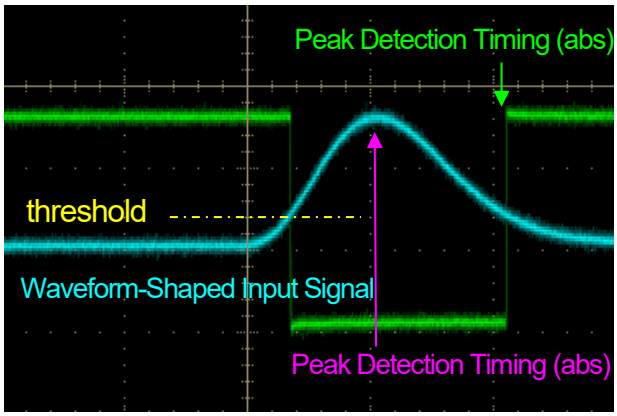


Figure 5 Threshold and Peak Detection Timing (abs/fast)

LLD	Set energy LLD (Lower Level Discriminator). Unit: channel (ch). Channels below this threshold are not counted. Set to a value greater than or equal to threshold and smaller than ULD.
ULD	Set energy ULD (Upper Level Discriminator). Unit: channel (ch). Channels above this threshold are not counted. Set to a value greater than LLD.
offset	Set positive offset. Unit: channel (ch). Adding an offset shifts the histogram to the right (toward higher pulse heights). Useful for peak position adjustment.
peak detect	Select peak (maximum pulse height) detection method. Refer to the previous figure.
	abs: After the input signal exceeds threshold, reaches the peak, decays, and falls below threshold, AD conversion is executed. Allows more deterministic acquisition of the maximum pulse height.
	fast: After the input signal exceeds threshold, AD conversion is executed at the first detected peak timing. Suitable for high count-rate measurements (several kcps or more) and pile-up mitigation.
mode	Select operating mode.
	Histogram: Stores amplifier signal pulse heights into up to 16384 channels (8192 for APU7308-8k) and creates a histogram with energy on the horizontal axis and counts on the vertical axis.
	list: When the amplifier signal exceeds threshold, time information, maximum pulse height, and channel number are treated as one event, continuously transferred to the PC, and continuously saved to file.
	Coincidence: (Option) Uses any two channels to acquire time and pulse height of events detected simultaneously within a specified time window. The configurable range is from ±40 ns minimum to ±10 μsec maximum. It can save

simultaneous two-channel list data or generate a 2D histogram (2048 × 2048 channels) with CH1 PHA on the horizontal axis and CH2 PHA on the vertical axis.

MCS Generates histogram data with time (nanoseconds to seconds) on the horizontal axis and counts on the vertical axis. The horizontal axis uses a preselected dwell time from 40 nanoseconds to 100 seconds per channel. The number of channels is 16384 (8192 for APU7308-8k), and up to 2^{32} counts can be accumulated per channel. When a valid event within the LLD and ULD range is detected, counts are added to the corresponding elapsed-time channel based on the timing at which the threshold was exceeded.

5.4 MeasTab

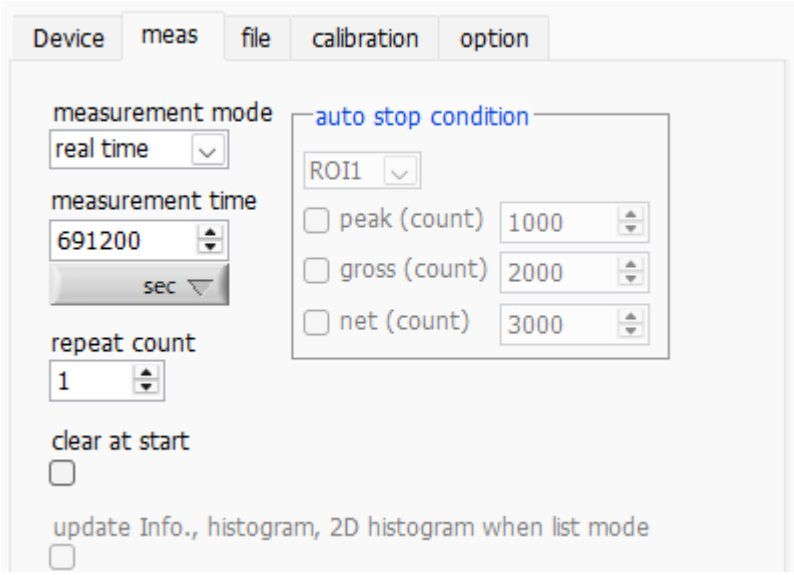


Figure 1 meas Tab

Measurement Section

measurement mode — Select real time, live time, or auto stop.

- real time — Measures data until the real time reaches the set measurement time (described later).
- live time — Measures data until the effective measurement time (real time minus dead time) reaches the preset value.
- auto stop — Measures data until the condition specified in the auto stop condition section (described later) is met. This option is available only when the mode is set to histogram.

measurement time — Sets the measurement duration. The range is from 00:00:00 to 192:00:00. In the case of auto stop, this setting is ignored and automatically set to 192:00:00. If the unit is set to seconds, the range is 0 to 691200 seconds.

repeat count — Specifies the number of measurement repetitions.

clear at start — Determines whether to initialize histogram data at the start of measurement.

update Info., histogram, 2D histogram when list mode: During measurement in list mode, retrieves and displays data in the Information section. Additionally, creates and displays histograms from the received event data. This option is available only when the mode is set to list or coincidence.

Note: Depending on the PC specifications, it may not be possible to receive all event data if processing cannot keep up.

Auto Stop Condition Section

This section is effective only when auto stop is selected in the measurement mode. It specifies the stop conditions for a single measurement. Measurement will stop when any one of the checked conditions is satisfied.

ROI selection	Selects one ROI to target for the following counts.
peak(count)	Stops the measurement when the peak(count) of the selected ROI reaches or exceeds the specified value.
gross(count)	Stops the measurement when the gross(count) of the selected ROI reaches or exceeds the specified value.
net(count)	Stops the measurement when the net(count) of the selected ROI reaches or exceeds the specified value.

5.5 File Tab

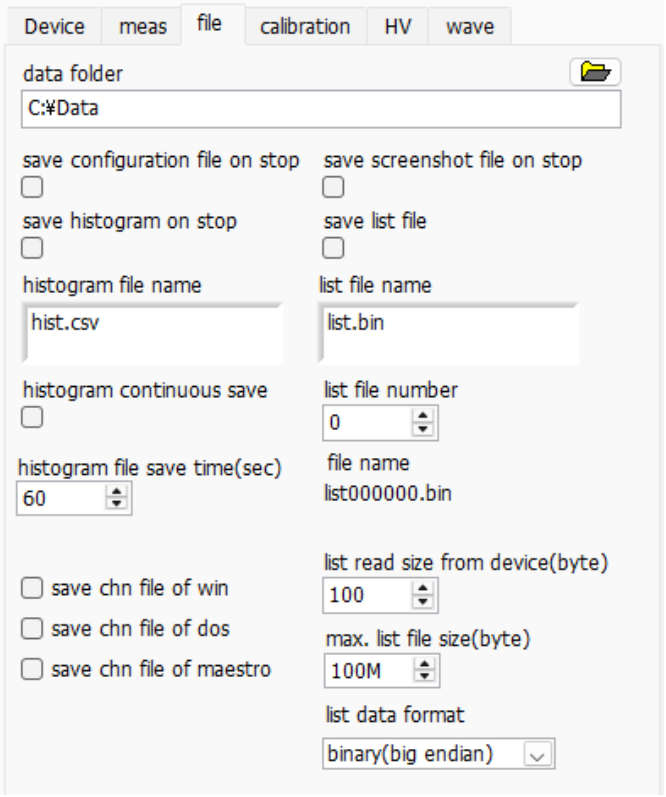


Figure7 file Tab

File Section

data folder	Specifies the common folder for storing data files, using an absolute path.
save configuration file at stop	When checked, the configuration file is automatically saved each time the measurement stops. The file extension is .ini.
save screenshot file at stop	When checked, the entire screen displayed at the time of measurement stop is saved as a file. The file extension is .png.
save histogram at stop	When checked, the histogram data at the time of measurement stop is saved as a file. The file extension is .csv.
histogram file name	Sets the name of the histogram data file. Subfolders can be specified, and file extensions can be omitted.

Note:

The actual saved file name uses this as a base according to a specific format.

For example, if the data folder is set to C:¥Data, the histogram file name is histogram.csv, and the date/time is 2025/09/01 12:00:00, the saved file name will be C:¥Data¥histogram_20250901_120000.csv.

histogram continuous save	Determines whether the histogram data is saved at a set time interval. **Note:** Depending on system conditions, the save interval may deviate. This function is intended for simple backup purposes.
histo file save time (sec)	Sets the time interval for continuous histogram saving, in seconds. The range is 5 to 3600 seconds.
save list file	Specifies whether list data is saved to a file. This option is valid only in list mode.
list file name	Sets the name of the list data file. Subfolders can be specified, and extensions can be omitted. **Note:** The actual saved file name uses this as a base according to a specific format. For example, if the data folder is C:¥Data, the list file name is list_.bin, and the list file number is 0, the saved file will be C:¥Data¥list_000000.bin.
list file number:	Sets the starting number appended to the list data file. The valid range is 0 to 999999. If the number exceeds 999999, it resets to 0.
file name	Displays the actual file name generated from the list file name and list file number when saving.
list read size from device (byte)	Sets the minimum read data length in list mode, in bytes. The default is 10000 bytes. For high count rates, this can be increased to 20000 bytes to allow the PC to receive more events. For low count rates, this can be decreased to reduce the amount of data per read.
max. list file size (byte)	Sets the maximum size for saving list data files. SI notation is used (e.g., 1M, 10M, 100M), with a range from 1 MB to 2 GB.

list data format	Selects the file format for saving list data, either binary or text.	
	binary (big endian)	Big-endian binary format. File size is compact, with the most significant byte at the lowest memory address. Commonly used as network byte order. Data sequence is easy to inspect visually.
	binary (little endian)	Little-endian binary format. File size is compact, with the least significant byte at the lowest memory address. Used on Windows, Mac OS X, and Linux. Data sequence is difficult to inspect visually.
	txt (CSV)	Comma-separated text format. Data can be easily viewed in text editors or Excel. **Note:** Commas and line breaks are included, and as measurement time increases, the length of timestamp data grows, increasing the file size per event.
save chn file of win	Outputs a CHN file for Windows version when "save histogram at stop" is checked.	
save chn file of dos	Outputs a CHN file for DOS version when "save histogram at stop" is checked.	
save chn file of maestro	Outputs a CHN file for Maestro version when "save histogram at stop" is checked. Example: If the data folder is C:¥Data, histogram file name is histogram.csv, and the date/time is 2025/09/01 12:00:00, the saved files will be: C:¥Data¥histogram_20250901_120000_win_CH1.chn C:¥Data¥histogram_20250901_120000_dos_CH1.chn C:¥Data¥histogram_20250901_120000_maestro_CH1.chn	

5.6 Calibration Tab

We will set the ROI (Region of Interest) and perform energy calibration. By defining the ROI on the histogram peaks, we can calculate parameters such as the peak counts and full width at half maximum (FWHM).

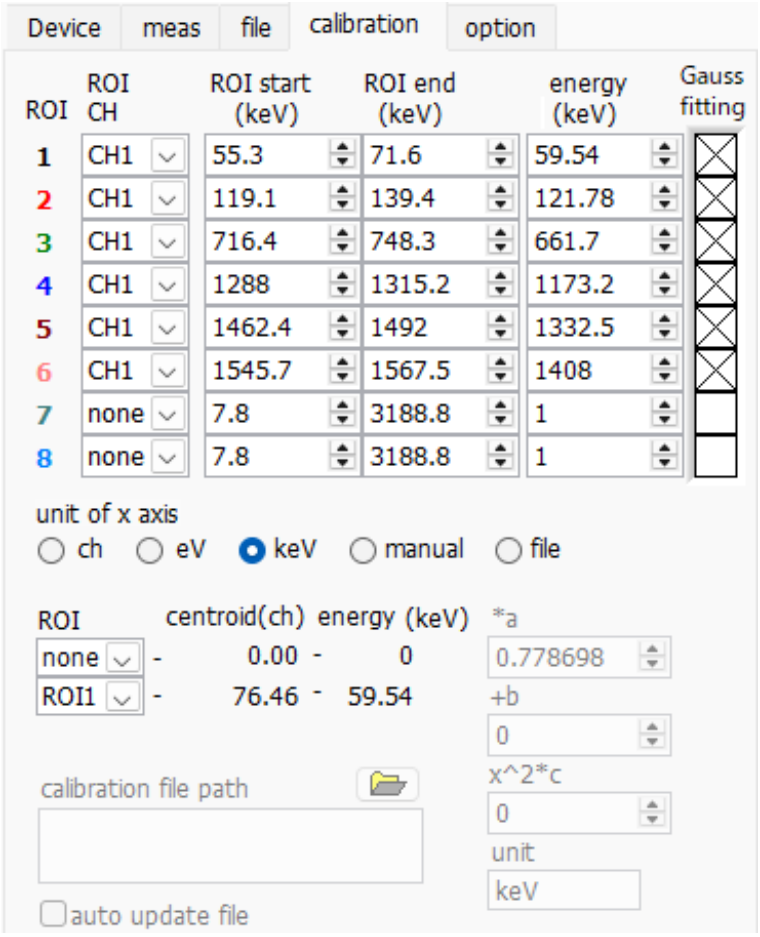


Figure 8 Calibration Tab

ROI Section

ROI CH	Selects the CH number for the ROI target. Up to 8 ROIs can be set.
ROI start	Sets the start position of the ROI. The unit depends on the energy calibration.
ROI end	Sets the end position of the ROI. The unit depends on the energy calibration.
Energy	Defines the energy value of the peak position (in ch). The unit depends on the energy calibration. For example, for ^{60}Co, set values such as 1173.2 or 1332.5. If "ch" is selected in the "unit of x areas" section, the system detects peaks within the ROI, calculates keV/ch from the peak position (ch) and the set energy value, and applies it to the FWHM calculation results.

unit of x areas Section

Specifies the unit of the X-axis. The X-axis label changes according to this setting.

Ch	Displays the X-axis in channel (ch) units. The units of *peak*, *centroid*, *FWTM*, and *FWHM* in the ROI section are also expressed in ch.
eV	Displays the X-axis in electron volts (eV). Using two peaks (centroid values) and their corresponding energy values within one histogram, a linear calibration function (y = ax + b) is calculated so that the channel (ch) values are converted to eV. The slope (a) and intercept (b) are automatically determined and applied to the X-axis. The units of *peak*, *centroid*, *FWTM*, and *FWHM* in the ROI section become eV.
keV	Displays the X-axis in kilo-electron volts (keV). Similar to the eV mode, two calibration points (centroid and energy values) are used to calculate the linear function (y = ax + b), which converts channels (ch) to keV. The units of *peak*, *centroid*, *FWTM*, and *FWHM* in the ROI section become keV. *Example:* If 5717.9 ch corresponds to 1173.24 keV (from ^60Co) and 6498.7 ch corresponds to 1332.5 keV, the two-point calibration automatically calculates (a = 0.20397) and (b = 6.958297).
Manual	Applies a quadratic function (y = ax + b + cx^2). The unit can be set arbitrarily.
File	Uses an energy calibration file created with Tool → Create Calibration File. The file extension is fixed as ".ec". For details on the energy calibration file, refer to *Tool Section – Create Calibration File*.
ROI	Selects the ROI number used for energy or time calibration. The adjacent *centroid* and *peak* fields display the centroid value and set energy of the selected ROI. For example: Selecting *ROI1* and *none* performs single-point calibration using the centroid and set energy of ROI1.Selecting *ROI1* and *ROI2* performs two-point calibration using the centroid and set energy values of both ROI1 and ROI2.
Gauss fitting	When checked, performs Gaussian function fitting. The calculation results are displayed in the ROI section.
a, +b, x^2c	Enter arbitrary values used when the manual option described above is selected. When eV, keV, or file is selected, the values calculated at that time are displayed.
Unit	When *manual* is selected, allows you to freely define the unit name used for the histogram's X-axis label and the unit used in ROI calculations.

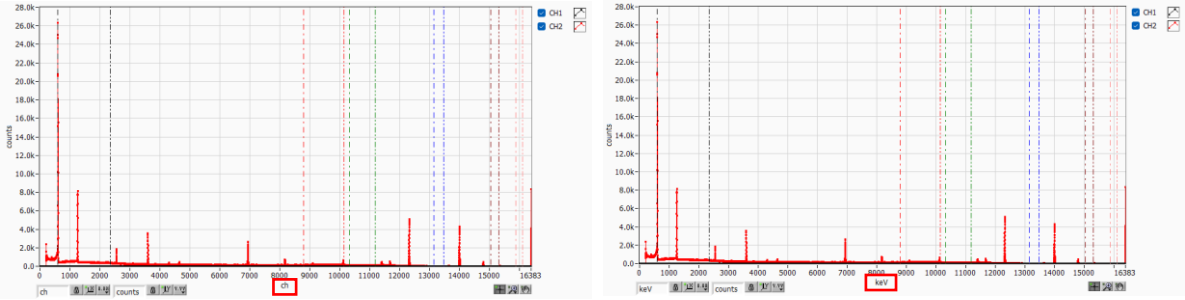


Figure 9 When "keV" is selected in the Calibration section

(Left: Before energy calibration execution Right: After energy calibration execution)

5.7 Option Tab

In the Option tab, you can configure settings for functions such as MCS (Multi Channel Scaler) and coincidence (simultaneous measurement).

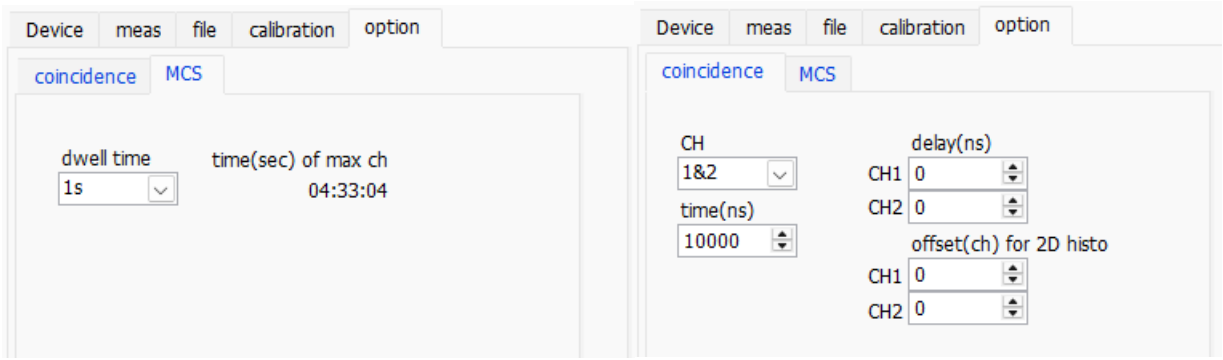


Figure10 Option Tab

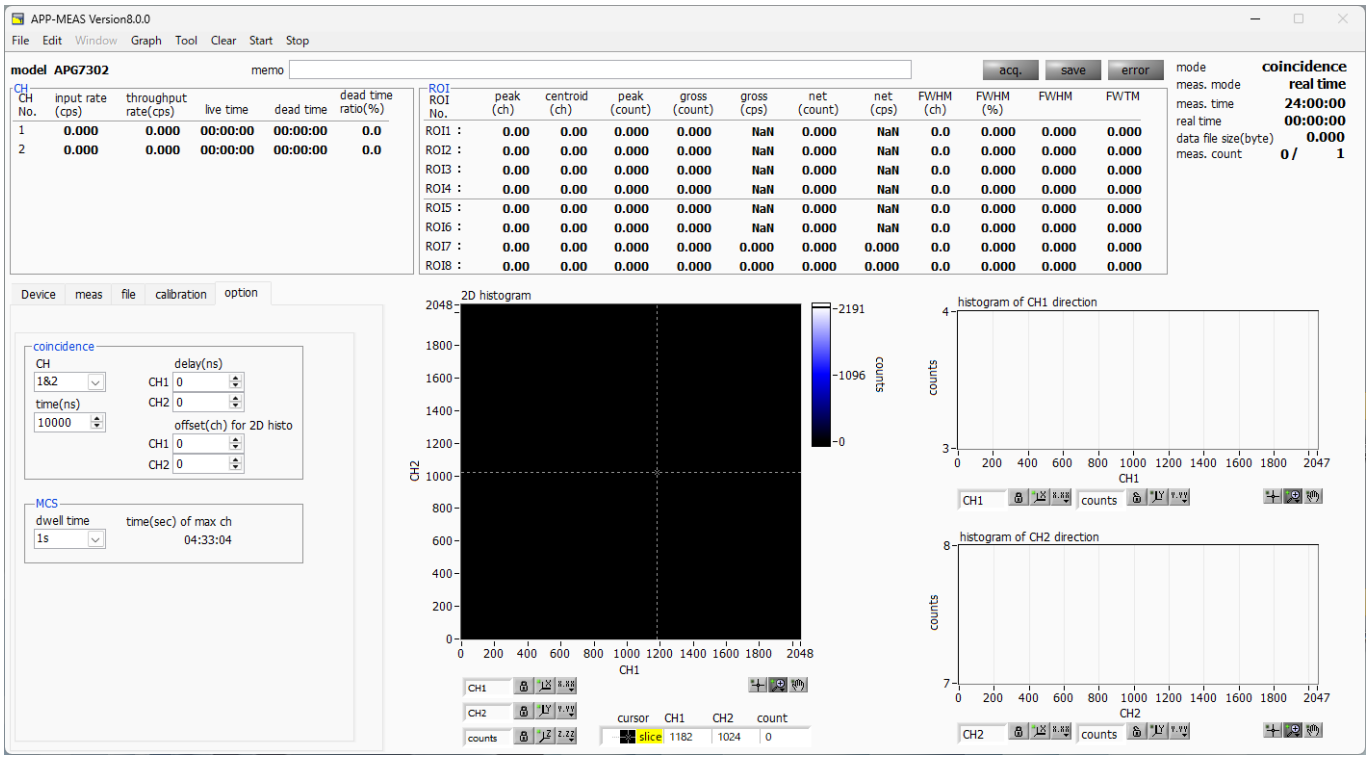


Figure 11 Coincidence 2D Histogram

MCS Section

dwell time

Specifies the time width per channel on the horizontal time histogram. The selectable range is from a minimum of 40 ns to a maximum of 100 s. The available options are as follows:

40 ns,	80 ns,	120 ns,	160 ns,	200 ns,	240 ns,	280 ns,	320 ns,	360 ns,
400 ns,	440 ns,	480 ns,	520 ns,	560 ns,	600 ns,	640 ns,	680 ns,	720 ns,
760 ns,	800 ns,	840 ns,	880 ns,	920 ns,	960 ns,	1 μs,	2 μs,	5 μs,
10 μs,	20 μs,	50 μs,	100 μs,	200 μs,	500 μs,	1 ms,	2 ms,	5 ms,
10 ms,	20 ms,	50 ms,	100 ms,	200 ms,	500 ms,	1 s,	2 s,	5 s,
10 s,	20 s,	50 s,	100 s					

time (sec) of max. ch

Displays the time corresponding to the maximum channel based on the dwell time setting.
For the APU7308-16k, since it has 16384 channels, when the minimum dwell time of 40 ns is selected:
40 ns × 16384 channels = 655,360 ns (655.36 μs).

For the APU7308-8k, since it supports up to 8192 channels, when the minimum dwell time of 40 ns is selected:
40 ns × 8192 channels = 327,680 ns (327.68 μs).

Coincidence Section

CH — Specifies the target channels. Only 1 & 2 (CH1 and CH2) can be selected.

time (ns) — Defines the time window for coincidence counting. The range is from 40 ns to 10,000 ns (10 µs). If the time between one channel exceeding its threshold and the other channel exceeding its threshold falls within this range, the events are counted as coincident. The time information, channel number, and pulse height of each channel are read out and saved.

delay (ns) — Sets the coincidence delay time. This allows adjustment for signal transmission delays between channels. The range is from 0 to 10,000 ns (10 µs) and can be used to correct for time differences caused by factors such as cable length.

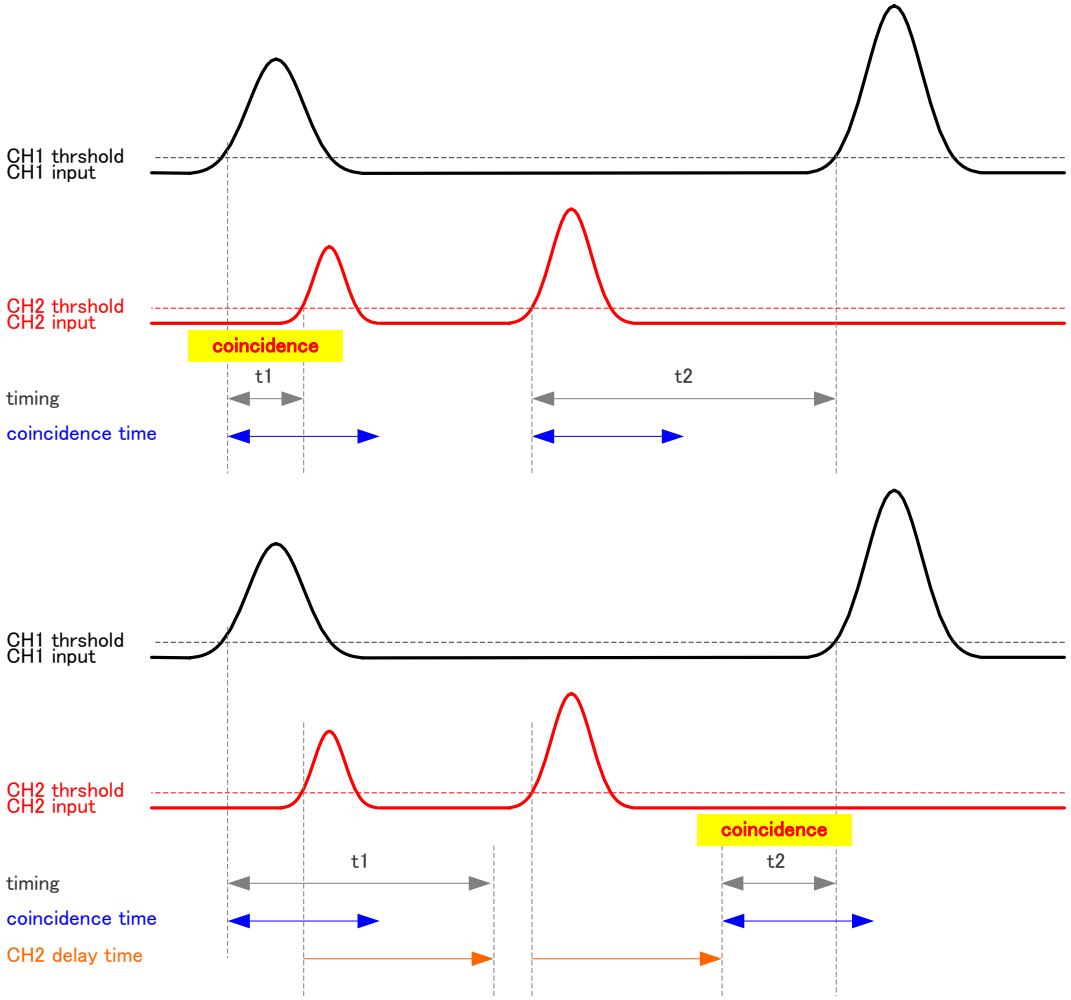


Figure 12: Example of Coincidence Timing (Top: without delay, Bottom: with CH2 delay time)

offset (ch) for 2D histo — Sets the offset channel for the 2D coincidence histogram. The range is 0 to 2048 (4096−2048) channels. Adjust the offset so that the peaks fit within the 2048 × 2048 display range.

Graph — Displays the 2D histogram. The horizontal axis represents the pulse height of CH1 (in channels), the vertical axis represents the pulse height of CH2 (in channels), and the Z-axis represents the counts. The maximum number of channels for both the horizontal and vertical axes is 2048.

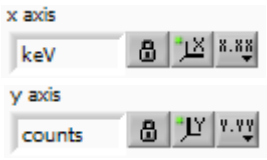
spectrum of CH1 direction — Displays a 1D channel-summed histogram from the CH1 side.

spectrum of CH2 direction — Displays a 1D channel-summed histogram from the CH2 side.

5.8 Graph

Displaying the histogram from CH1 to CH2

spectrum graph	Histogram (spectrum) in histogram mode, with the horizontal axis representing energy and the vertical axis representing counts.
cursor x	Sets the position of the dashed cursor on the graph. The count value at this position is displayed in cursor y.
cursor y	Displays the count value at the intersection of the dashed cursor. The X-axis position of the cursor can be set via cursor x or by drag-and-drop.
plot legend	Sets the color, line style, etc., of the graph. Visibility can be toggled via the sub-menu on the graph.
horizontal axis range	Right-click on the horizontal axis and check “auto-scale” to enable automatic scaling. Uncheck to fix the minimum and maximum values. To change the min or max, hover the mouse over the value, then click or double-click to modify. Options include auto-scale enable/disable, precision, and mapping type (linear/logarithmic).
vertical axis range	Right-click on the vertical axis and check “auto-scale” to enable automatic scaling. Uncheck to fix the minimum and maximum values. To change the min or max, hover the mouse over the value, then click or double-click to modify. Options include auto-scale enable/disable, precision, and mapping type (linear/logarithmic).



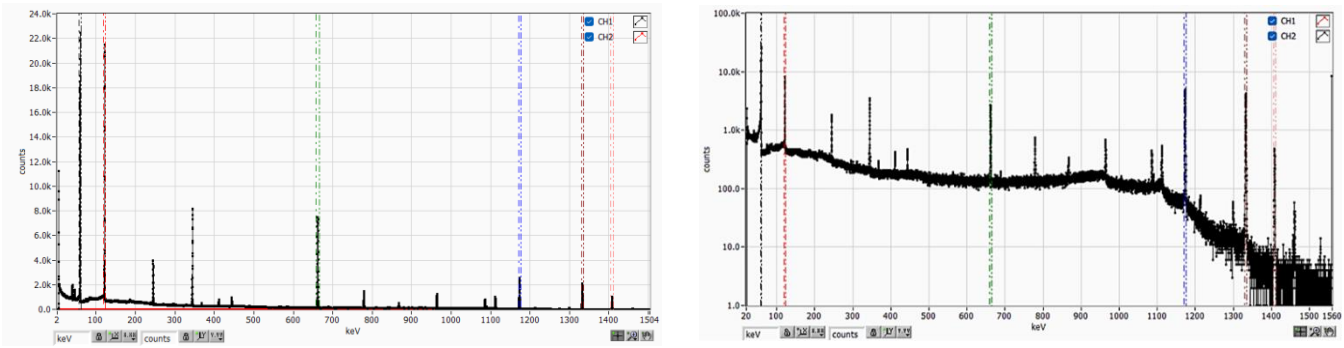


Figure 13 – Histogram Graph (Left: Linear vertical axis mapping, Right: Logarithmic)

	Cursor movement tool. The cursor can be moved on the graph when setting ROI.
	Zoom. Clicking allows you to choose from six types of zoom-in and zoom-out operations and execute them.

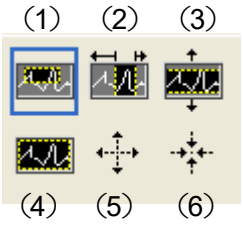


Figure 14 Graph Zoom In and Zoom Out Tools

(1) Rectangle Zoom — Use this option by clicking a point on the display to define one corner of the zoom area, then drag the tool until the rectangle covers the desired zoom region.

(2) X-Zoom — Zoom into a region of the graph along the horizontal axis.

(3) Y-Zoom — Zoom into a region of the graph along the vertical axis.

(4) Fit Zoom — Automatically scales all X and Y axes to fit the graph.

(5) Zoom Out Around Point — Click the point to use as the center of zooming out.

(6) Zoom In Around Point — Click the point to use as the center of zooming in.

Pan Tool Grab and move the plot within the graph.

6 Measurement

6.1 Histogram Mode

(1) Select histogram in mode under the Device tab. “histogram” will be displayed in the mode indicator at the upper right of the screen. Click the Clear menu. The histogram data stored in this instrument will be initialized. To continue using the previously measured histogram or measurement results, start the next measurement without clicking Clear.

(2) Click the Start menu. After all settings are sent to this instrument, measurement will begin.

(3) After measurement starts, the screen transitions to the following state.

• acq. LED blinks.

• Measurement status is displayed at the upper right of the screen.

• Real time acquired from this instrument is displayed in real time at the upper right of the screen.

• Live time acquired from this instrument is displayed in live time for each CH.

• Dead time acquired from this instrument is displayed in dead time for each CH.

• In ROI, calculation results are displayed for each ROI No. according to the ROI range settings in the calibration tab, including centroid value, gross count (total within range) and rate, net count (gross count minus background) and rate, full width at half maximum (FWHM), full width at tenth maximum (FWTM), and others.

• The graph displays a histogram with pulse height values on the horizontal axis.

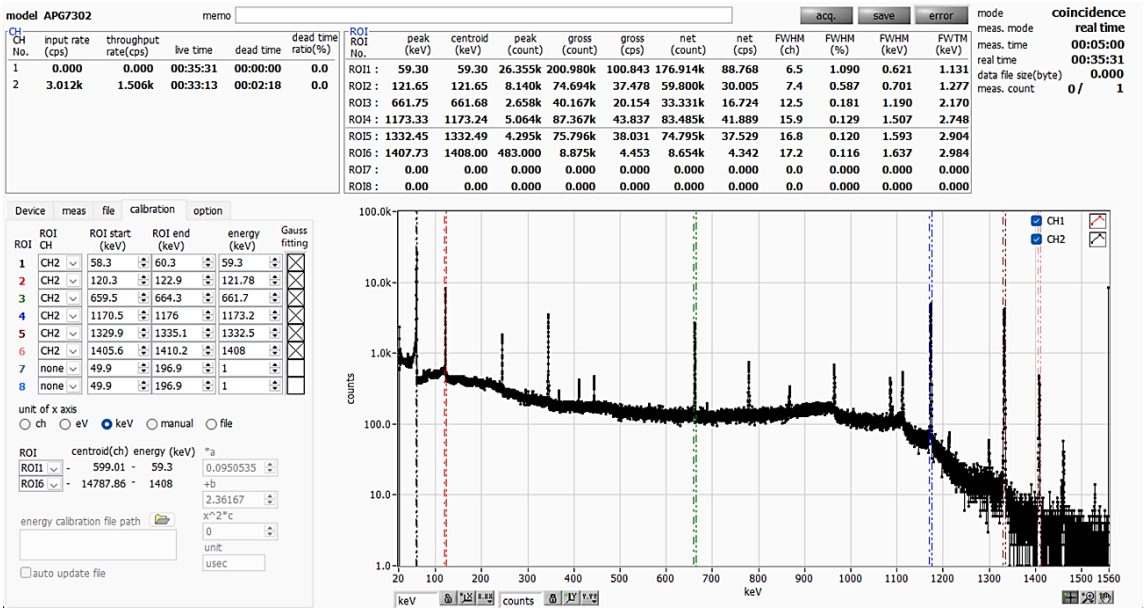


Figure 15 Histogram Mode Measurement Screen

6.2 List Mode

(1) Perform measurement in the histogram mode described above in advance and confirm the histogram status and count rate.

(2) Select list in mode under the Device tab.

(3) Set the data save destination in list file name under the file tab.

(4) Click the Clear menu. The buffer data for list measurement stored in this instrument will be initialized.

(5) Click the Start menu. After all settings are sent to this instrument, measurement will begin.

After measurement starts, the screen transitions to the following state.

- "list" is displayed in mode at the upper right of the screen.
- The save LED blinks, and the current file size being saved is displayed in list file size (byte).
- The file name currently being saved is displayed in file name under the file tab, and the current file size is displayed in file size.
- When max. list file size (byte) is reached, the currently saved file is closed. Then list file number is incremented by one, file name changes to a new file name, and saving continues.

If update Info., histogram, 2D histogram when list mode is checked in the file tab, ROI displays calculation results for each ROI No. according to the ROI range settings in the calibration tab, including centroid value, gross count (total within range) and rate, net count (gross count minus background) and rate, full width at half maximum (FWHM), full width at tenth maximum (FWTM), and others, and the histogram is displayed in the graph.

※ Note ※

Displaying the histogram during list mode imposes a high processing load, so use sufficient caution during high-count-rate measurements.

By using the VETO (CLR) terminal, it is possible to clear the time information of list data even during measurement. When a rising edge LV-TTL signal (pulse width of 100 ns or more) is detected, the time information is cleared.

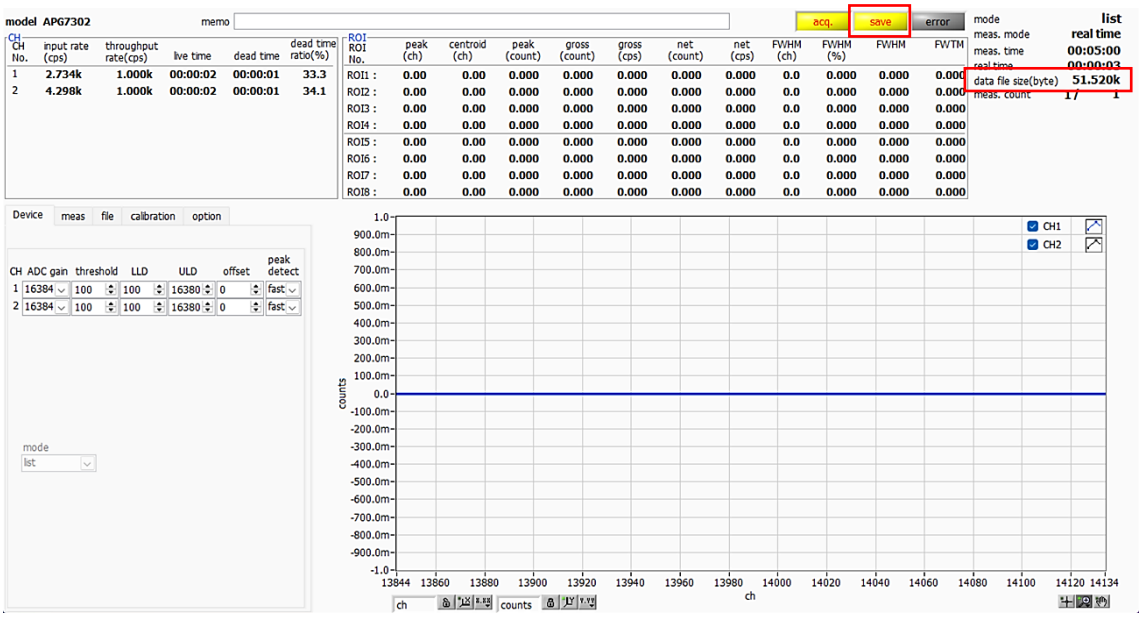


Figure 16 List Mode Measurement Screen

6.3 Coincidence Mode

(1) Connect signals from amplifiers or other sources to CH1 and CH2.

(2) Select histogram in mode under the Device tab.

(3) Check the current histograms of CH1 and CH2 in histogram mode and confirm the center channel of the peak of interest.

(4) Set LLD and ULD in the Device tab to wider ranges.

(5) Click Clear → Start from the menu. After all settings are sent to this instrument, measurement will begin.

(6) Set ROI for the selected peaks acquired on CH1 and CH2, and confirm the centroid (ch) value.

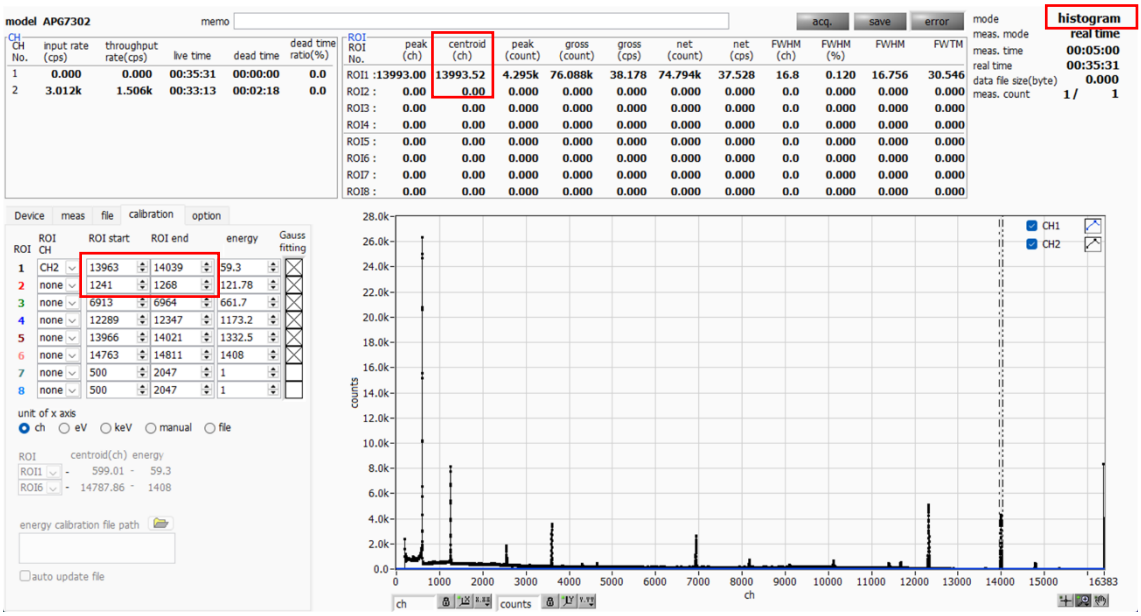


Figure 17 Confirming the Centroid (ch) of the Peak of Interest in Histogram Mode

(7) After confirming the centroid (ch) value, click Stop from the menu to stop measurement.

(8) Set LLD and ULD, then perform measurement again in histogram mode and confirm that the histogram within the LLD and ULD range can be acquired.

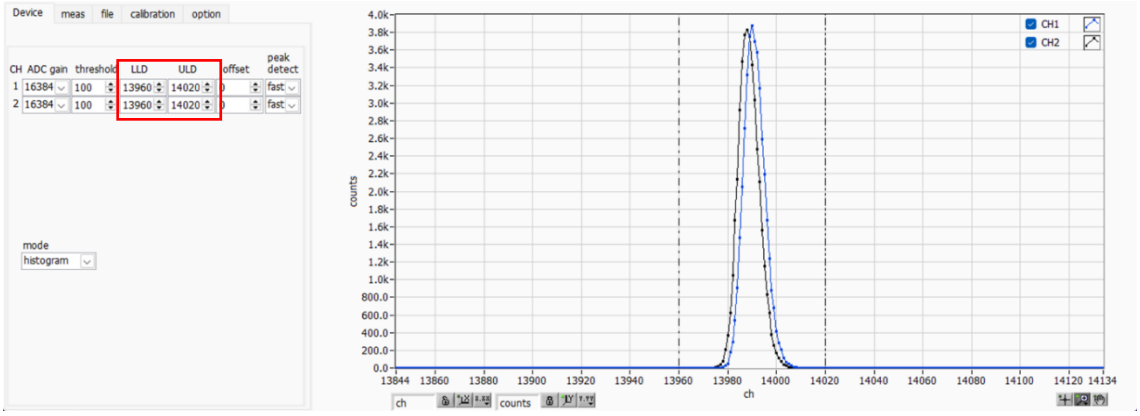


Figure 18 Confirming the LLD and ULD Configuration in Histogram Mode

(9) Select coincidence in mode under the Device tab.

(10) Before starting measurement for the coincidence 2D histogram, click Graph - 2D histogram from the menu to switch to the 2D histogram display screen.

(11) Coincidence 2D histogram data is generated within this application based on list data. Therefore, for display and saving, use the save list file option in the file tab and the update Info., histogram, 2D histogram when list mode checkbox in the meas tab.

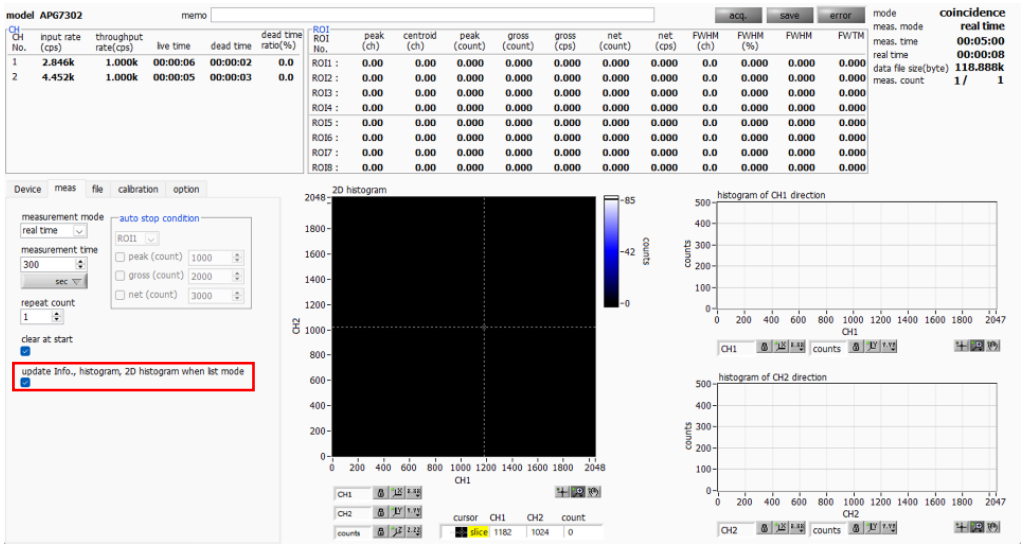


Figure 19 meas Tab Settings

(12) Configure the coincidence settings in the option tab. In this example, the centroid values of the energy range for which coincidence is to be observed exceed the 2D histogram range of (CH1) 2048 × (CH2) 2048 on both axes, so offset (ch) for 2D histo must be configured. To position each centroid at the center value of 1024, set the offset to centroid value (13993 in this example) − 1024 ch, resulting in a setting of 12969 ch.

(13) Click the Clear menu. The buffer data for list measurement stored in this instrument will be initialized.

(14) Click the Start menu. After all settings are sent to this instrument, measurement will begin.

(15) After measurement starts, the screen transitions to the following state.

- acq LED blinks.
- coincidence is displayed in mode.
- The configured measurement time is displayed in meas. time.
- Real time acquired from this instrument is displayed in real time.

The following applies when update Info., histogram, 2D histogram when list mode is checked:

• Measurement status is displayed in the Information section.

• A map graph is displayed in the coincidence 2D histogram graph.

• Histograms are displayed in the graph viewed from the CH1 direction and in the graph on the CH2 direction side.

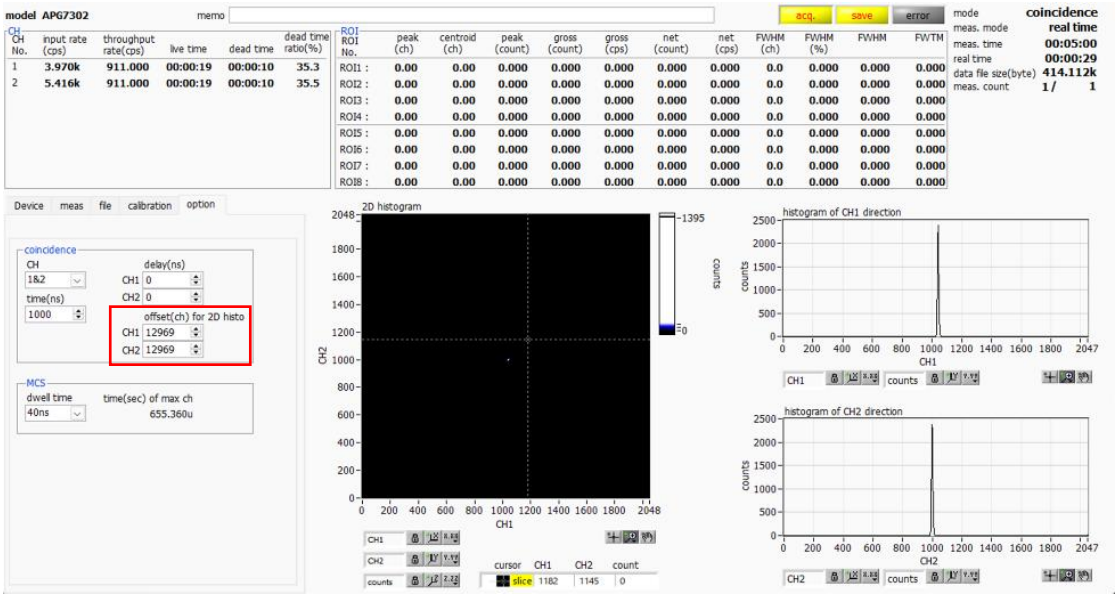


Figure 20 Coincidence 2D Histogram

6.4 MCS Mode

(1) Select MCS in mode under the Device tab.
(2) Set LLD and ULD in the Device tab. The timing of acquired pulse heights within this range will be used.
(3) Select the measurement time per channel in dwell time under the option tab.
(4) Configure calibration of the graph horizontal axis in the calibration tab. If the peak timing is known in advance, select ns, us, ms, or sec and set that time value in ROI peak. If unknown, check manual, enter the time selected in dwell time into manual a, and enter the unit name in unit.
(5) In MCS mode, two measurement methods are available depending on whether an external elapsed-time reset signal is used.

Use Reset — Connect a periodic event that resets elapsed time to the VETO (CLR) terminal as the reset signal. A histogram of elapsed time from reset to event detection is generated. When a rising edge LV-TTL signal (pulse width of 100 ns or more) is detected at the VETO (CLR) terminal, elapsed time is reset. After reset, elapsed time is accumulated until the input signal exceeds the threshold. When a valid event with a maximum pulse height within the LLD to ULD range is detected, one count is added to the channel corresponding to that elapsed time in a histogram with channels spaced according to dwell time. Adjust the reset signal period or dwell time so that the reset cycle remains below time (sec) of max ch.

Do Not Use Reset — Based on elapsed time from the start of measurement to event detection, one count is added to the corresponding elapsed-time channel in a histogram with channels spaced according to dwell time. Since elapsed time is not reset, the accumulation target channel shifts toward larger channel numbers as measurement time progresses. This mode can be used for applications such as half-life measurements.

(6) Click the Clear menu. MCS histogram data stored in this instrument will be initialized.
(7) To continue using the histogram or measurement results from a previous measurement, clear the clear at start checkbox in the meas tab and start the next measurement without clicking the Clear menu.
(8) Click the Start menu. After all settings are sent to this instrument, measurement will begin.

(9) After measurement starts, the screen transitions to the following state.

• acq LED blinks.

• Measurement status is displayed in the Information section.

• MCS is displayed in mode.

• The configured measurement time is displayed in meas. time.

• Real time acquired from this instrument is displayed in real time.

• The graph displays an MCS histogram with time on the horizontal axis.

• Events exceeding time (sec) of max ch are accumulated into the final channel.

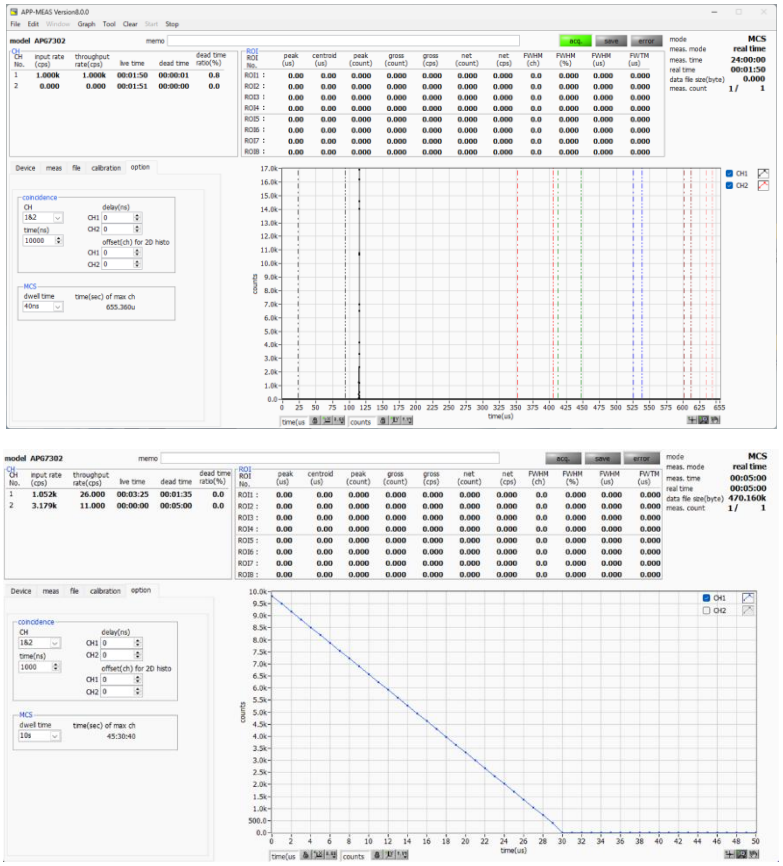


Figure 21 MCS Histogram Mode Measurement Screen

(Upper figure: With reset. Measurement repeated for events occurring 100 µsec after reset.

Lower figure: Without reset. Measurement of a waveform sweeping from 1 kHz to 10 Hz with dwell time set to 10 sec.)

6.5 Measurement Stop

• When meas. mode is set to real time, measurement ends when real time reaches meas. time.

• When meas. mode is set to live time, measurement ends when the slowest live time reaches meas. time.

• To stop measurement during operation, click Stop from the menu. Measurement will stop after execution.

7 File

7.1 Histogram Data File

(1) File Format

Comma-separated (CSV) text format

(2) File Name

Arbitrary

(3) Structure

[Header]	Header Section
Memo	Memo
mode	Mode (histogram)
meas. mode	Measurement mode: real time, live time, or auto stop
meas. time(sec)	Measurement time (unit: seconds)
Real time(sec)	Real time
Live time(sec)	Live time for each channel (unit: seconds)
Dead time(sec)	Dead time for each channel (unit: seconds)
Dead time ratio(%)	Dead time ratio for each channel (unit: percent)
Start Time	Measurement start date and time
Stop Time	Measurement end date and time
[APN7308]	APN7308 Specific Section
*Saved for each CH below	
ADC gain	ADC gain
threshold	Threshold
LLD	Energy LLD
ULD	Energy ULD
offset	Offset
[Calculation]	Calculation Section
*Saved for each ROI below	
ROI No.	ROI number
ROI CH.	Input channel number corresponding to the ROI
ROI start (arbitrary)	ROI start position (keV, etc.)
ROI end (arbitrary)	ROI end position (keV, etc.)
Energy (arbitrary)	Peak energy value within ROI (keV, etc.)
peak (arbitrary)	Peak position within ROI (keV, etc.)
centroid(ch)	Center position within ROI (ch)
peak(count)	Maximum peak count within ROI
gross(count)	Total counts within ROI
gross(cps)	gross(count) per second
net(count)	Total counts within ROI after subtracting background

net(cps)	net(count) per second
FWHM(arbitrary)	Full width at half maximum within ROI (keV, etc.)
FWHM(%)	Full width at half maximum within ROI (%)
FWHM(arbitrary)	Full width at half maximum within ROI (keV, etc.)
FWTM(arbitrary)	One-tenth maximum width within ROI (keV, etc.)

[Status] Status Section

*Saved for each CH below

output count	Output count
output rate(cps)	Output count rate

[Data] Data Section

calibration a	Slope a
calibration b	Intercept b

X-axis data (channel, eV, keV, arbitrary) and histogram data

Maximum 16384 points (maximum 8192 points for APU7308-8k)

7.2 List Data File

This section describes the format of data files saved in list mode. Data saved in coincidence mode uses the same format.

(1) File Format

Binary, Big Endian / Little Endian format, or text (CSV) format

(2) File Name

The file name consists of the name set in list file name under the file tab with file number appended as a six-digit zero-padded value.

Example:

If data folder is set to “C:¥Data”, list file name is set to “123456.bin”, and number is set to “1”, the resulting file name becomes:

“C:¥Data¥123456_000001.bin”

When list file size is reached, the currently saved file is closed. After that, list file number is automatically incremented by one, a new file is opened, and data saving continues.

(3) Structure (for Big Endian format)

80 bits per event (10 Bytes, 5 WORDs)

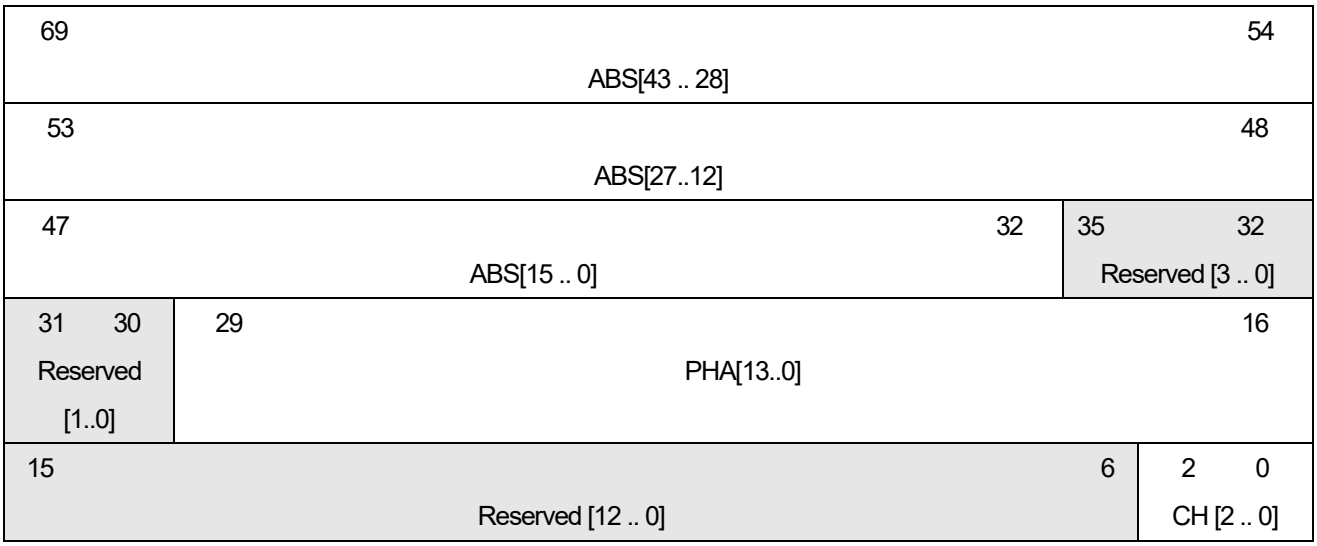


Figure 22 List Data (80 bit) Structure, Big Endian Format

- Bits 79 to 36 — ABS (Absolute) count. 44 bits.
  Each bit represents 40 ns.
  Maximum measurement time is approximately 96 hours (96 hours ≒ 2^{44} × 40 ns).
- Bits 35 to 30 — Reserved. 6 bits.
- Bits 29 to 16 — PHA (Pulse Height).
  When ADC gain is set to the maximum value of 16384, PHA uses 14 bits and ranges from 0 to 16383.
- Bits 15 to 3 — Reserved. 13 bits.
- Bits 2 to 0 — CH number. 3 bits.

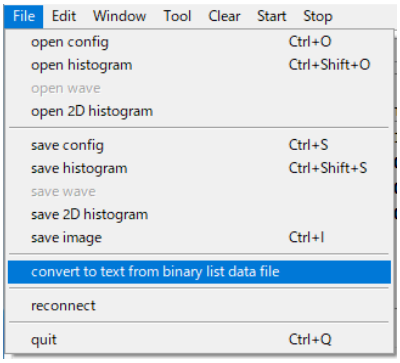
7.3 Conversion of List Data File to Text Format

Binary-format list data files saved in list mode measurement can be converted into comma-separated text (CSV) format. Data is saved in one line per event in the format: ABS (time information), CH number, and PHA (pulse height).

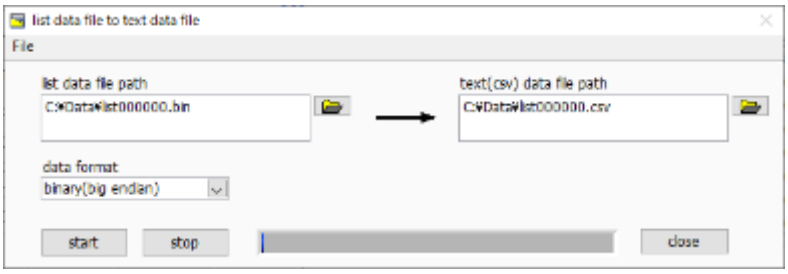
- ABS (Absolute) Count — Binary: 40 ns units Text: ns units
- CH Number — Binary: 0–2 Text: 1–8
- PHA (Pulse Height) — Binary/Text: 0–16383

Convert the binary-format list data file into text (CSV) format using the following procedure.

(1) Click File - convert to text from binary list data file from the menu.

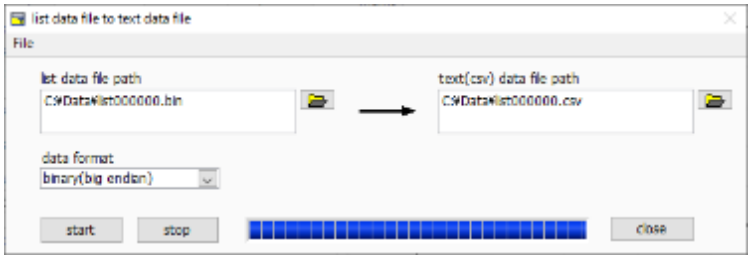


The following list data file to text data file screen opens.



- list data file path — Set the absolute path of the target binary-format list data file saved during list mode measurement to be converted.
- data format — Set the binary-format list data file format used during list mode measurement. Select either binary (big endian) or binary (little endian).
- text (csv) data file path — Set the absolute path where the converted comma-separated text (CSV) format list data file will be saved. After setting list data file path, a path with the .csv extension is automatically generated.

(2) Click the start button to begin conversion. Conversion is complete when the blue status bar at the bottom of the screen is filled. To interrupt conversion, click the stop button.



(3) Click the close button to close this screen.

7.4 (Option) Coincidence 2D Histogram Data File

After measurement in coincidence mode, coincidence 2D histogram data can be saved to a file at any time by clicking File - save 2D histogram from the menu.

(1) File Format

Comma-separated (CSV) text format

(2) File Name

Arbitrary

(3) Structure

[Header]	Header Section
Memo	Memo
Mode	Mode (coincidence)
meas. Mode	Measurement mode: real time or live time
meas. time(sec)	Measurement time (unit: seconds)
Real time(sec)	Real time
Live time(sec)	Live time for each channel (unit: seconds)
Dead time(sec)	Dead time for each channel (unit: seconds)
Dead time ratio(%)	Dead time ratio for each channel (unit: percent)
Start Time	Measurement start date and time
Stop Time	Measurement end date and time
[APN7308]	APN7308 Specific Section
*Saved for each CH below	
ADC gain	ADC gain
threshold	Threshold
LLD	Energy LLD
ULD	Energy ULD
offset	Offset
[Calculation]	Calculation Section
*Saved for each ROI below	
ROI No.	ROI number
ROI CH.	Input channel number corresponding to the ROI
ROI start (arbitrary)	ROI start position (keV, etc.)
ROI end (arbitrary)	ROI end position (keV, etc.)
Energy (arbitrary)	Peak energy value within ROI (keV, etc.)
peak (arbitrary)	Peak position within ROI (keV, etc.)
centroid(ch)	Center position within ROI (ch)
peak(count)	Maximum peak count within ROI
gross(count)	Total counts within ROI
gross(cps)	gross(count) per second

net(count)	Total counts after subtracting background within ROI
net(cps)	net(count) per second
FWHM(ch)	Full width at half maximum within ROI (ch)
FWHM(%)	Full width at half maximum within ROI (%)
FWHM(arbitrary)	Full width at half maximum within ROI (keV, etc.)
FWTM(arbitrary)	One-tenth maximum width within ROI (keV, etc.)

[Status] Status Section

*Saved for each CH below

input rate(cps)	Number of events detected per second
throughput rate(cps)	Number of events processed per second

[2DHistogram Header]

CH1 Offset(ch)	Offset channel for CH1 coincidence 2D histogram
CH2 Offset(ch)	Offset channel for CH2 coincidence 2D histogram

[2DHistogram]

CH1(ch)

CH2(ch)

Counts

[2DHistogramCH1Direction]

CH1

Counts

[2DHistogramCH2Direction]

CH2

Counts

[Data] Data Section

calibration a	Slope a
calibration b	Intercept b

X-axis data (channel, eV, keV, arbitrary) and histogram data

Maximum 16384 points (maximum 8192 points for APU7308-8k)

7.5 MCS Data File

(1) File Format

Comma-separated (CSV) text format

(2) File Name

Arbitrary

(3) Structure

[Header]	Header Section
Memo	Memo
mode	Mode (MCS)
meas. Mode	Measurement mode: real time or live time
meas. time(sec)	Measurement time (unit: seconds)
Real time(sec)	Real time
Live time(sec)	Live time for each channel (unit: seconds)
Dead time(sec)	Dead time for each channel (unit: seconds)
Dead time ratio(%)	Dead time ratio for each channel (unit: percent)
Start Time	Measurement start date and time
Stop Time	Measurement end date and time
[APN7308]	APN7308 Specific Section
*Saved for each CH below	
ADC gain	ADC gain
threshold	Threshold
LLD	Energy LLD
ULD	Energy ULD
offset	Offset
[Calculation]	Calculation Section
*Saved for each ROI below	
ROI No.	ROI number
ROI CH.	Input channel number corresponding to the ROI
ROI start (arbitrary)	ROI start position (keV, etc.)
ROI end (arbitrary)	ROI end position (keV, etc.)
Energy (arbitrary)	Peak energy value within ROI (keV, etc.)
peak (arbitrary)	Peak position within ROI (keV, etc.)
centroid(ch)	Center position within ROI (ch)
peak(count)	Maximum peak count within ROI
gross(count)	Total counts within ROI
gross(cps)	gross(count) per second
net(count)	Total counts after subtracting background within ROI
net(cps)	net(count) per second
FWHM(ch)	Full width at half maximum within ROI (ch)

FWHM(%)	Full width at half maximum within ROI (%)
FWHM(arbitrary)	Full width at half maximum within ROI (keV, etc.)
FWTM(arbitrary)	One-tenth maximum width within ROI (keV, etc.)

[Status]	Status Section
*Saved for each CH below	
input rate(cps)	Number of events detected per second
throughput rate(cps)	Number of events processed per second

[Data]	Data Section
calibration a	Slope a
calibration b	Intercept b

X-axis data (channel, eV, keV, arbitrary) and histogram data

Maximum 16384 points (maximum 8192 points for APU7308-8k)

8 Functions

8.1 Data Acquisition Using External GATE Input Signal Timing

If event data at the time of occurrence is to be acquired based on an external condition, input an external GATE signal of LV-TTL level to the GATE input terminal on the rear panel. Measurement is performed when the signal is High and is not performed when the signal is Low.

Input the external GATE signal within a range that sufficiently covers the waveform-shaped input signal as shown in the figure below.

In particular, the external GATE input signal must remain at the High level during the period when the waveform-shaped input signal rises from the baseline and exceeds the threshold level Vth. A/D conversion processing is executed when the waveform-shaped input signal falls below the threshold level, and the peak value is determined after a processing time of 1.2 µs.

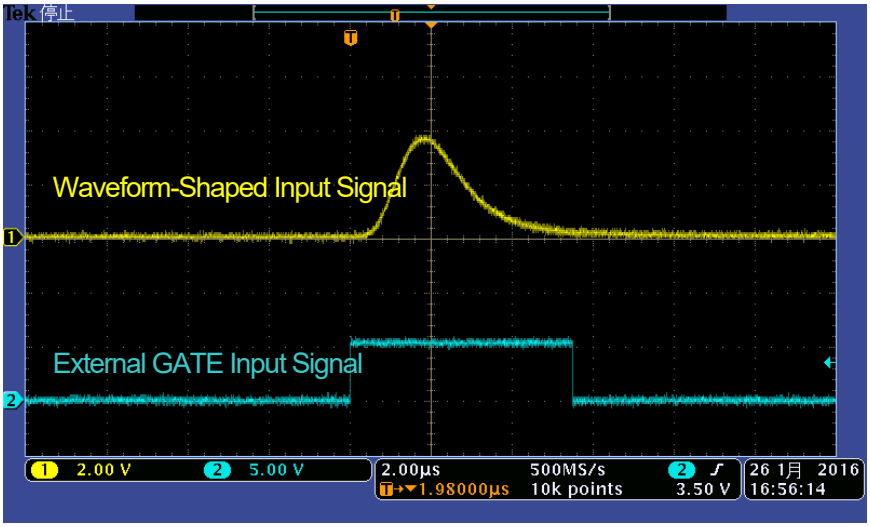


Figure 23 External GATE Input Signal Timing

*The external GATE input signal uses LV-TTL levels, where 0.8 V or lower is determined as Low level and 2.0 V or higher is determined as High level. The maximum input voltage is 5 V.

8.2 Data Rejection Using VETO Signal Timing

If event data at the time of occurrence is to be discarded based on an external condition, input an LV-TTL level signal to the VETO input terminal on the rear panel. Unlike GATE, measurement is performed when the signal is Low and is not performed when the signal is High. The timing is the same as that described previously for GATE.

8.3 FWHM (Full Width at Half Maximum) Calculation Method

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

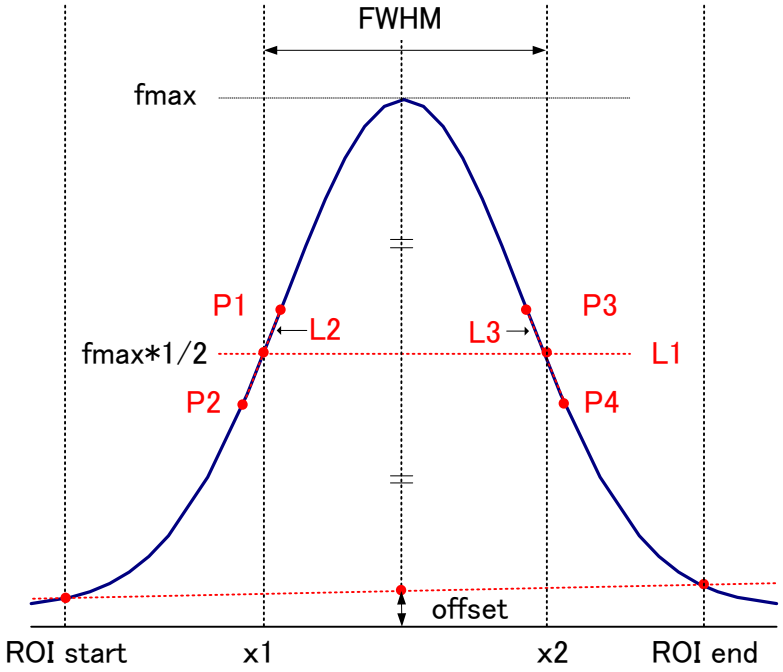


Figure 24 FWHM Calculation

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

(2) Draw a straight line connecting the intersection point of the histogram and ROI start to the intersection point of the histogram and ROI end. Determine the intersection between this line and the line drawn vertically from the peak value fmax to the horizontal axis, and calculate the background offset (offset).

(3) Calculate one-half of the value obtained by subtracting offset from fmax, and draw a straight line L1 parallel to the horizontal axis.

(4) To determine the two intersection points between the histogram and L1, detect the points immediately before and after the intersections: P1 and P2, and P3 and P4.

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

(6) Determine the X-coordinate x1 of the intersection between L1 and L2, and similarly determine the X-coordinate x2 of the intersection between L1 and L3.

(7) Define the difference between x2 and x1 as the FWHM.

8.4 Calculation of gross Count and net Count

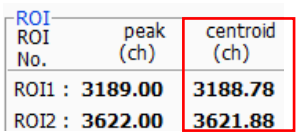
The gross count and net count displayed in the ROI section are calculated using the Covell method.

For details, refer to “3.4 ROI Calculation Using the Covell Method” in the reference document *Application Tool Edition Instruction Manual*.

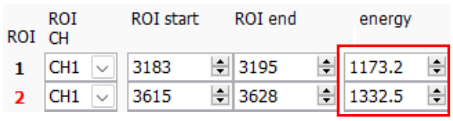
8.5 Two-Point Calibration Calculation Method

(1) In Histogram Mode

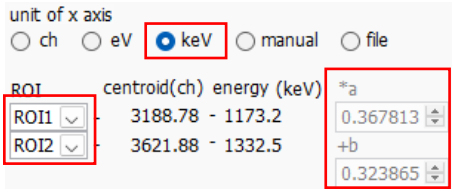
To perform energy calibration and display the horizontal axis scale of the graph in energy units (for example, keV), two-point calibration is performed using the centroid values and peak energy values of two energy peaks. One-point calibration is also supported.



Referring to the centroid (ch) values of ROI1/ROI2 displayed in the ROI section located above the graph, set ROI start (keV) and ROI end (keV) in the ROI section located in the upper part of the calibration tab, or define the ROI1 and ROI2 ranges by moving the graph cursor



Set the energy corresponding to each peak of ROI1/ROI2 in peak (keV).



In unit of x axis located in the lower section of the calibration tab, select the keV radio button. Then select ROI1 and ROI2 in the ROI section located below. The slope a and intercept b of the linear equation y = ax + b, calculated using the following formula, are automatically applied to a and b displayed on the right side.

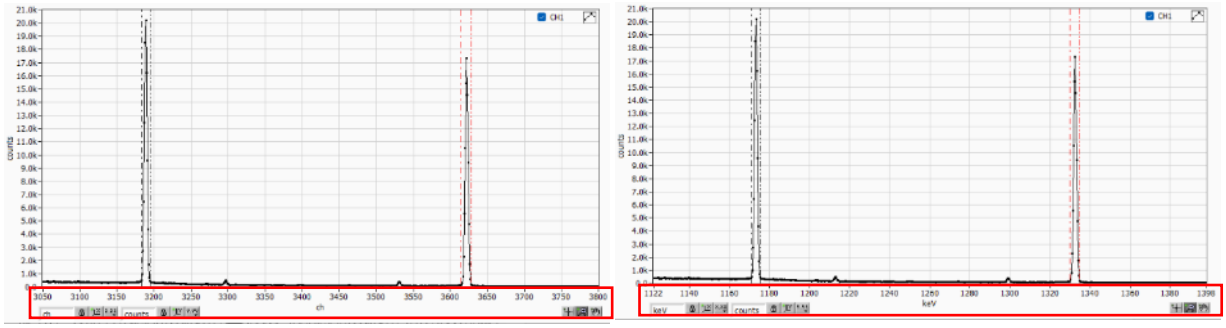


Figure 25 Left: Before Energy Calibration (ch), Right: After Energy Calibration (keV)

a = （peak1-peak2） / （centroid1-centroid2）

b = y – ax

For example, when the centroid of 1173 keV for ^{60}Co is 9446.99 ch and the centroid of 1332 keV is 10729.53 ch:

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

b = 1332 – 0.124 * 10729.53 = 1.831

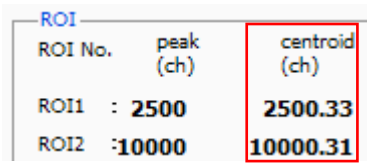
As a result, a is automatically set to 0.124 and b is automatically set to 1.831, and the horizontal axis scale is generated using the linear equation:

0.124 × ch + 1.831

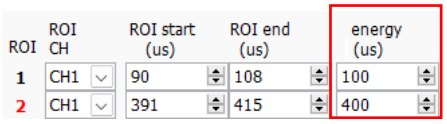
(2) In MCS Mode

Time calibration can be performed by selecting manual in the calibration tab, setting manual a to dwell time, and setting manual b to 0.

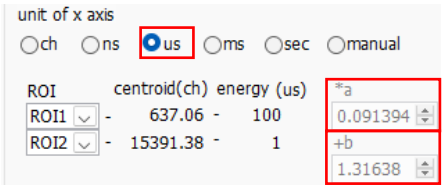
In addition, similar to the energy calibration described above, two-point calibration is performed for time calibration to display the graph horizontal axis scale in time units (for example, us), using the centroid values and peak time values of two peaks. One-point calibration is also supported.



Set dwell time and calibration to ch and start measurement. Referring to the centroid (ch) values of ROI1/ROI2 displayed in the ROI section located above the graph, set ROI start (ch) and ROI end (ch) in the ROI section located in the upper part of the calibration tab, or define the ROI1 and ROI2 ranges by moving the graph cursor.



Set the time corresponding to each peak of ROI1/ROI2 in energy (us).



In unit of x axis located in the lower section of the calibration tab, select the us radio button. Then, in calibration located in the lower section of the calibration tab, select ROI1 and ROI2. The slope a and intercept b of the linear equation y = ax + b, calculated using the following formula, are automatically applied to a and b displayed below.

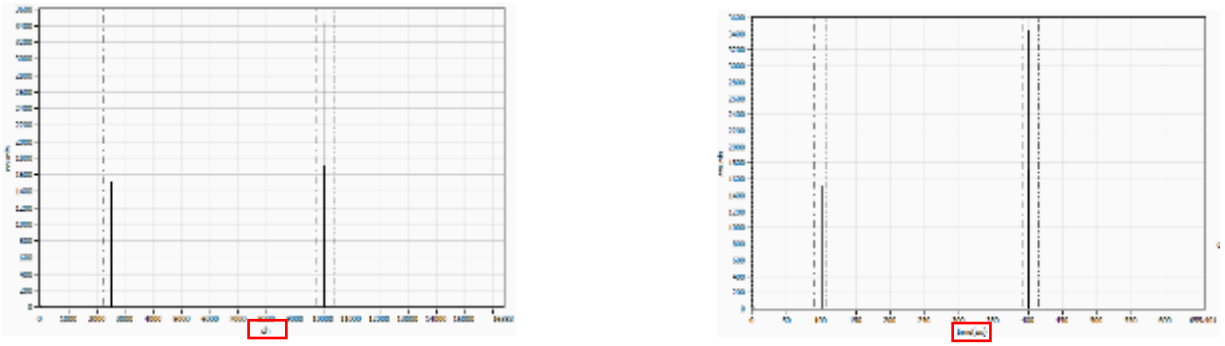


Figure 26 Left: Before Energy Calibration (ch), Right: After Energy Calibration (time (us))

a = (peak1-peak2) / (centroid1 - centroid2)

b = y – ax

For example, if the centroid of the peak with a time difference of 100 us is 2500 ch and the centroid of 400 us is 10000 ch:

a = (400 − 100) / (10000 − 2500) = 0.04
b = 400 − 0.04 × 10000 = 0

As a result, a is automatically set to 0.04 and b is automatically set to 0, and the horizontal axis scale is generated using the linear equation:

0.04 × ch + 0

In general, the value of a becomes equal to the value set in dwell time.

9 Reference Documents

This instruction manual primarily describes the hardware of this instrument and the parameters of the application.
For detailed explanations of the Tool that enables advanced analysis functions, please refer to the separate document.

・Detailed Description of Tool
“Application Tool Edition Instruction Manual”

10 Troubleshooting

For solutions to various issues related to the application, please also refer to the following:
"https://www.techno-ap.com/support_app.html"

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