Multi Channel Analyzer

USB-MCA
APG7300

Instruction Manual

Version 1.5.4
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TechnoAP Co., Ltd.

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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 USB-MCA (USB-Multi Channel Analyzer) APG7300 (hereinafter referred to as “this device”) is a compact and lightweight MCA that features a high-speed successive approximation ADC on a single signal input channel and operates solely on USB bus power without using an AC adapter.

The preamplifier signal from the detector is input to a spectroscopy amplifier (linear amplifier, hereinafter “amplifier”), and the output signal, which has been amplified and waveform-shaped (shaping) by the analog circuit, is input to this device. The amplitude of this signal (pulse height, peak value) contains information such as the energy of radiation. The MCA detects this signal, converts the maximum pulse height to digital (AD) form, and generates a histogram, functioning as a pulse height analysis device.

A key performance indicator of an MCA is the dead time. Dead time refers to the period during which the MCA cannot measure pulse heights. For events that occur irregularly, such as radiation, the MCA cannot measure new events while performing peak area determination, digital conversion of the pulse height, memory rewriting, and pulse height reset. The dead time of this device is fixed at 1 μs.

Regarding measurement operation, there is a histogram mode.
Histogram mode generates a histogram with the horizontal axis representing energy pulse height (e.g., in keV) and the vertical axis representing counts.
The included software consists of driver software that runs on Windows and the USB-MCA application (hereinafter “this application”).

This manual describes the handling and operation of this device.

2. Specifications

Product Name: USB-MCA (The included application has the same name)

Model: APG7300 (Also includes products with additional designations following the model number)

1. Analog Input
- Number of Channels: 1CH
- Input Range: 0 to +10 V
- Input Impedance: 1 kΩ
- Acceptable Pulse Duration: Minimum 100 nsec to Maximum 100 μsec (duration exceeding the threshold)

2. ADC
- Conversion Method: Successive approximation
- Resolution: 16 bit
- Conversion Time: 650 ns
- ADC Gain: 16,384; 8,192; 4,096; 2,048; 1,024; 512 channels
- Threshold: Full scale 0–50%, set via PC
- LLD (Lower Level Discriminator): Full scale 0–100%, set via PC
- ULD (Upper Level Discriminator): Full scale 0–100%, set via PC

3. Performance
- Dead Time: Fixed 1 μs (Does not include amplifier processing time)
- Integral Nonlinearity: ±0.025% (typical) or less
- Differential Nonlinearity: ±1% (typical) or less

4. External Input
- External Inputs: GATE and VETO

5. Functions
- Measurement Mode: Histogram mode (maximum 16,384 channels, 232 counts/channel)
- Communication Interface: USB 2.0
    - USB cable length should be 2 m or less. Use with a USB 3.0 port is recommended. If the USB port has a low-power setting, disable it if possible, or consider using a USB hub with AC adapter power.

6. Software
- Application: USB-MCA software for Windows
- Driver Software

7. Dimensions: 70 (W) × 140 (D) × 20 (H) mm
8. Weight: Approximately 180 g
9. Accessories
- User Manual
- CD (driver software, application, and user manual)
- USB Cable (USB Type-A male to USB Mini-B male)

3. Appearance

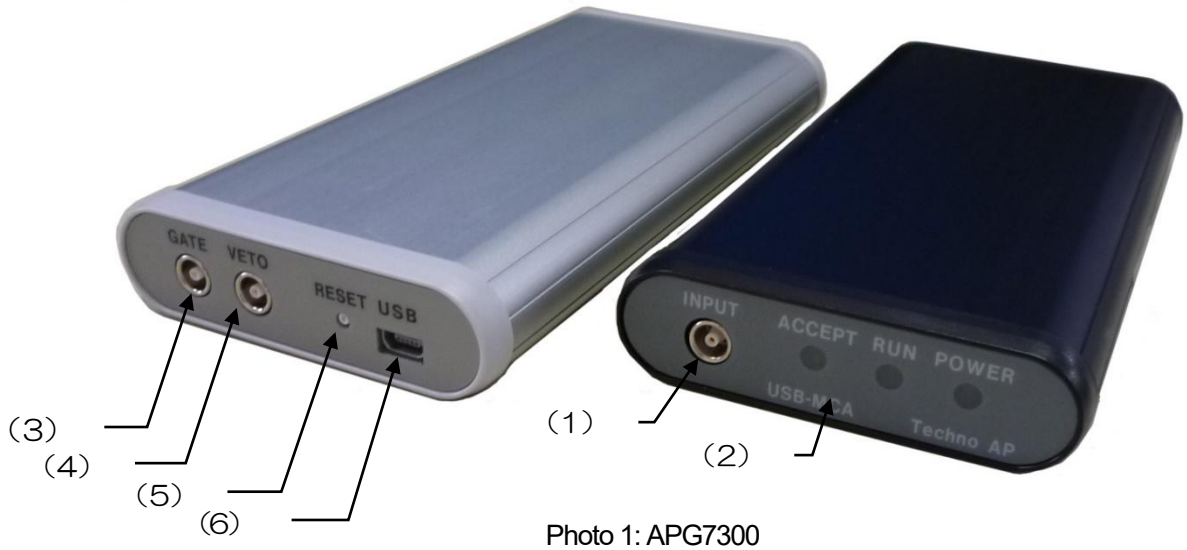


Photo 1: APG7300

【Front Panel】

(1) INPUT: LEMO connector (EPL.00.250.NTN) for amplifier signal input.

(2) LED: Operation status LEDs

- POWER: Lights when the device is powered on (connected to PC)
- RUN: Lights when measurement starts
- ACCEPT: Lights when a signal is detected

【Rear Panel】

(3) GATE: LEMO connector for external GATE signal input. Accepts LV-TTL level signals.

- Data is acquired when input is “High” and not acquired when “Low.”

(4) VETO: LEMO connector for external VETO signal input. Accepts LV-TTL level signals.

- Data is not acquired when input is “High” and acquired when “Low.”

(5) RESET: Reset button

(6) USB: USB 2.0 Mini-B receptacle (female)

*Introduction to Conversion Adapters

The signal input connector of this device uses the LEMO EPL.00.250.NTN or equivalent.

When using a BNC connector cable, the device can be connected using a conversion adapter as follows:

Manufacturer: Huber & Suhner

Model Number: 33_QLA-BNC-01-1/1--_NE

Description: QLA-01 to BNC

Connector Gender 1: Interface QLA-01

Connector Gender 2: Interface BNC

Photo 2: 33_QLA-BNC-01-1/1--_NE

Figure 3: Example of LEMO-to-BNC Conversion Cable

4. Setup

1.4 Connection

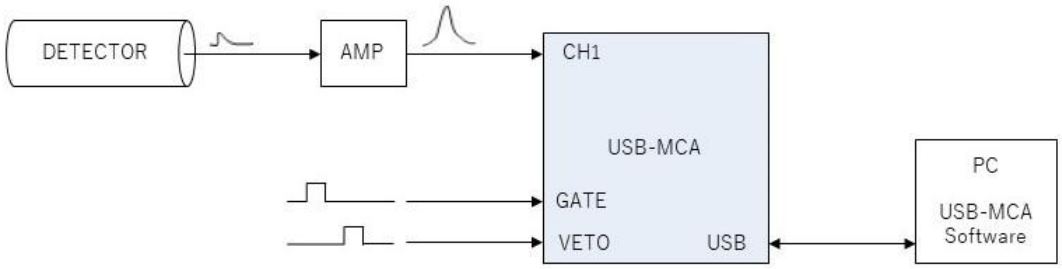


Figure 1: Connection When Using the MCA

(1) Connect the USB-MCA to the PC using the supplied USB cable.
*For a PC connecting for the first time, the driver software must be installed. Refer to the instructions below for driver installation.
*Do not connect signal cables while the device power is OFF.

(2) Confirm that the PWR LED is lit.

(3) Connect the preamplifier output signal from the detector (DETECTOR in the figure above) to the amplifier (AMP in the figure above).

(4) Connect the amplifier's shaped output signal to the INPUT of the device.

(5) If control via external signals is required, input an LV-TTL level to the GATE or VETO terminal.
When a cable is connected to the GATE terminal and a peak is detected at INPUT, data is acquired if the terminal is open or the GATE signal is High.
When a cable is connected to the VETO terminal and a peak is detected at INPUT, data is acquired if the terminal is open or the VETO signal is Low.

2.4 Driver Software Installation

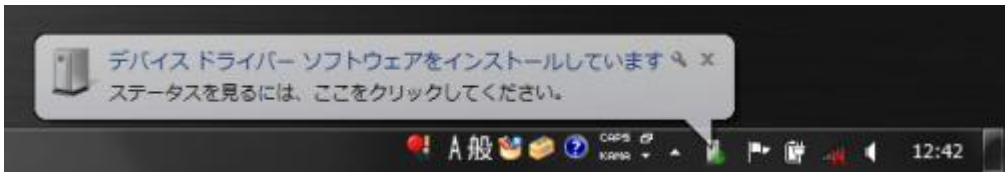
For a PC connecting to this device for the first time, it is necessary to install the driver software from the included CD before use.

For Windows 7

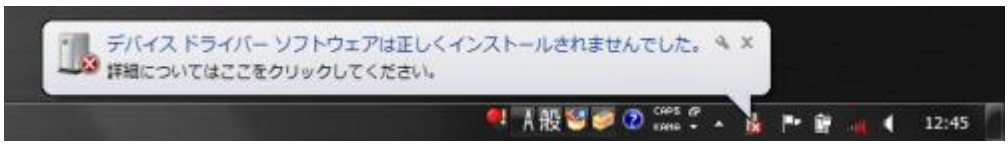
(1) (Required) Log in as Administrator or with an account that has administrator privileges.

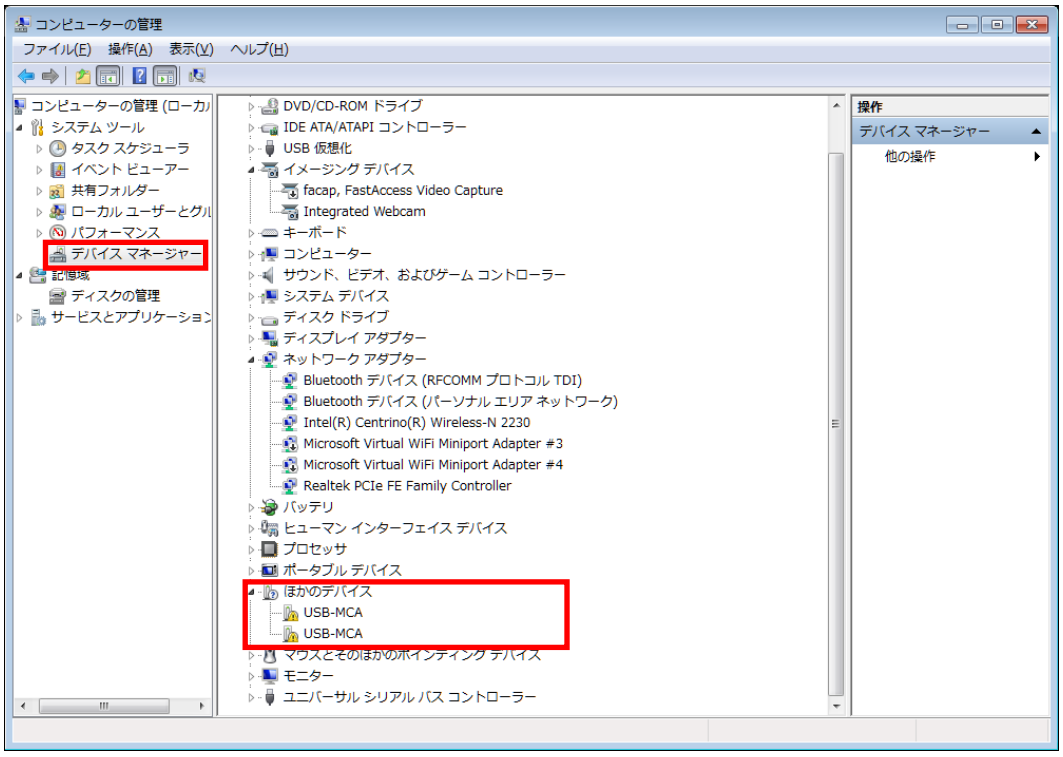
(2) Connect the device to the PC using a USB cable.

(3) A message will appear at the bottom right of the desktop: “Installing device driver software.”

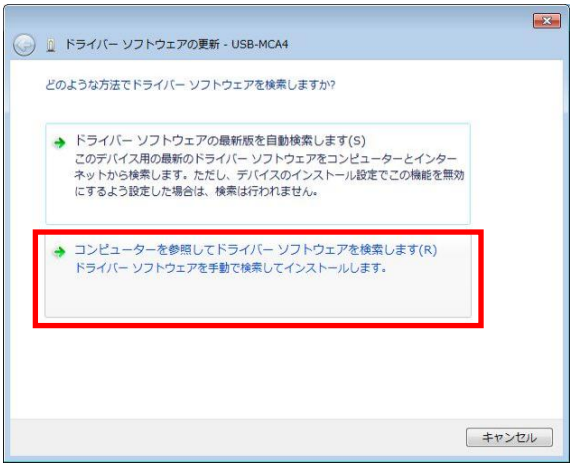


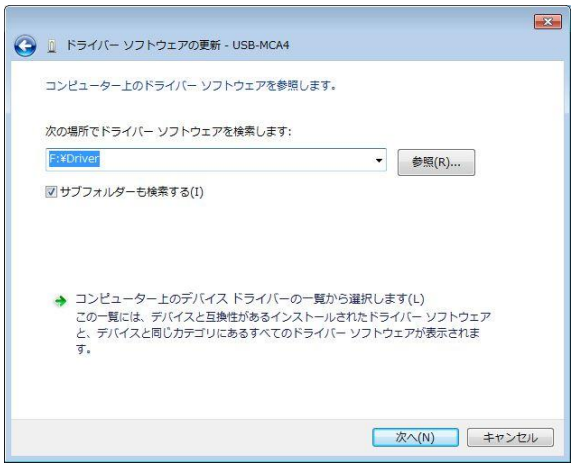
If the message “The device driver software was not installed correctly” appears, open Device Manager and check the icon for “USB-MCA.” Right-click the icon and select “Update Driver Software.”



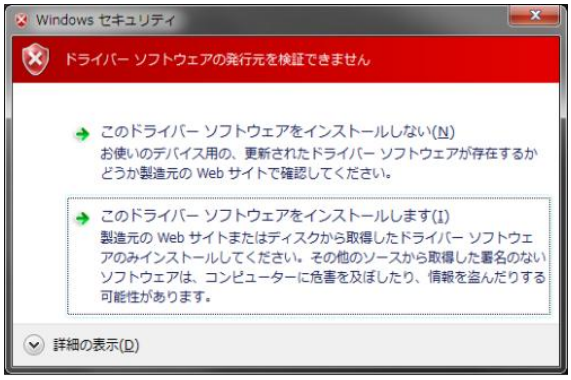


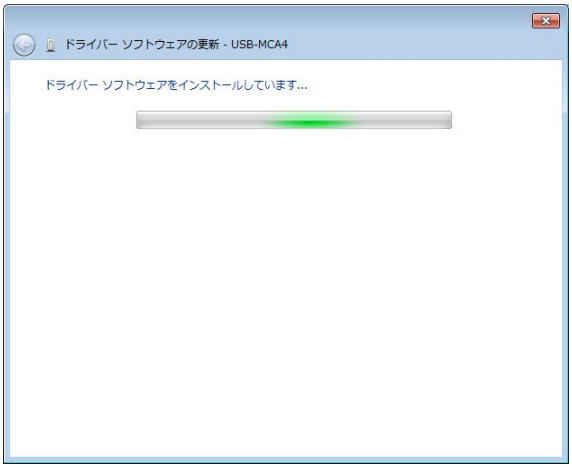
(4) Proceed with the installation using the interactive setup.

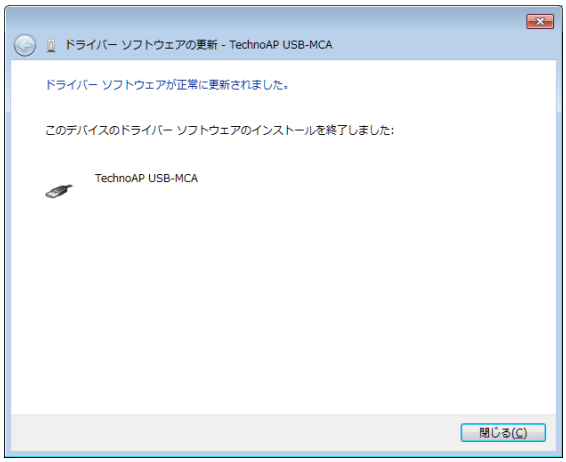


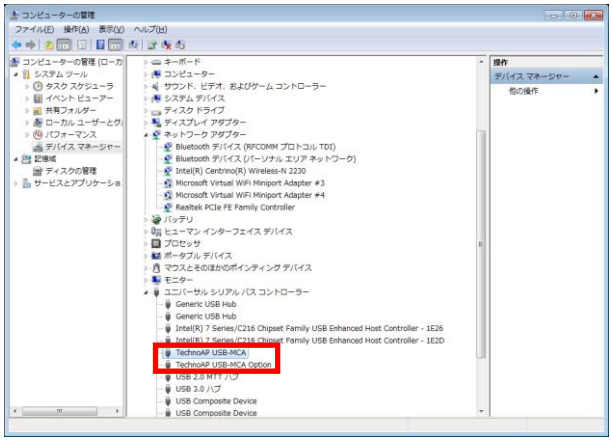


Browse to the "Driver" folder on the included CD.









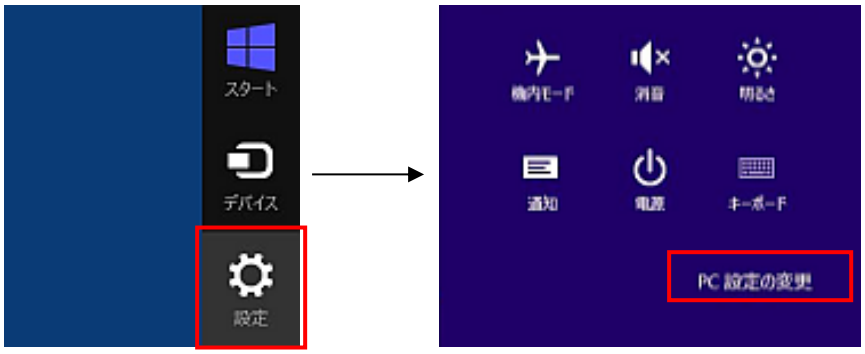
Next, install the “TechnoAP USB-MCA Option.” After installing the “TechnoAP USB-MCA” driver software, install the “TechnoAP USB-MCA Option” following the same procedure. Verify in Device Manager that both the “TechnoAP USB-MCA” and “TechnoAP USB-MCA Option” icons are functioning correctly. Once the driver software is installed properly, proceed to install the application. The installation steps are described in the next chapter.

For Windows 8 (64-bit)

In Windows 8 (64-bit), unsigned driver software cannot be installed by default to prevent users from accidentally installing unverified drivers. Since this driver software is unsigned, you must disable “Driver Signature Enforcement” using the following steps before installation.

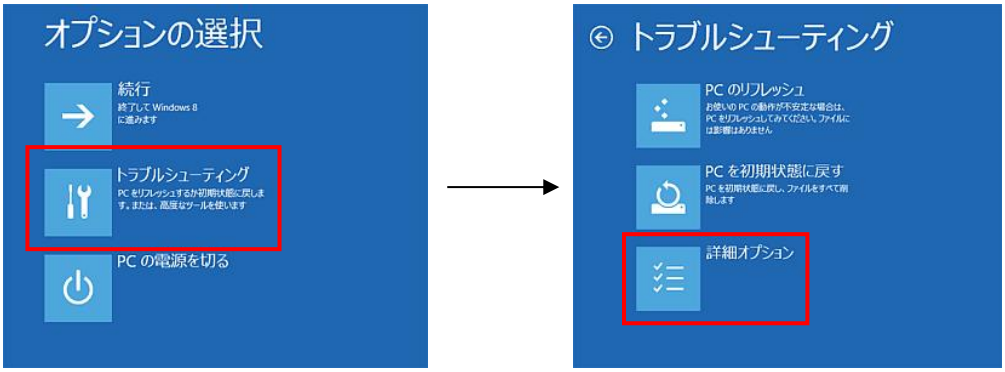
(1) Display the Charms bar on the Start screen.
For mouse operation: move the mouse to the upper-right or lower-right corner of the screen.

(2) For touch operation: swipe from the right edge of the screen toward the center.
From the Charms bar, select “Settings,” then choose “Change PC settings” from the settings menu.



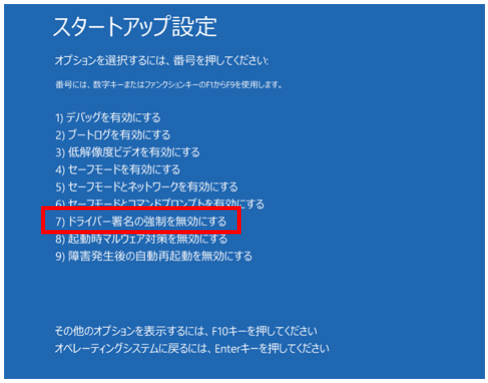
(3) In the “PC Settings” screen, select “General,” then under “Advanced startup,” choose “Restart now.”

(4) On the “Choose an option” screen, select “Troubleshoot,” then on the “Troubleshoot” screen, select “Advanced options.”



(5) On the “Advanced options” screen, select “Startup Settings,” then on the “Startup Settings” screen, choose “Restart.”

(6) On the “Startup Settings” screen after the restart, press the “7” key to select “7) Disable driver signature enforcement.”



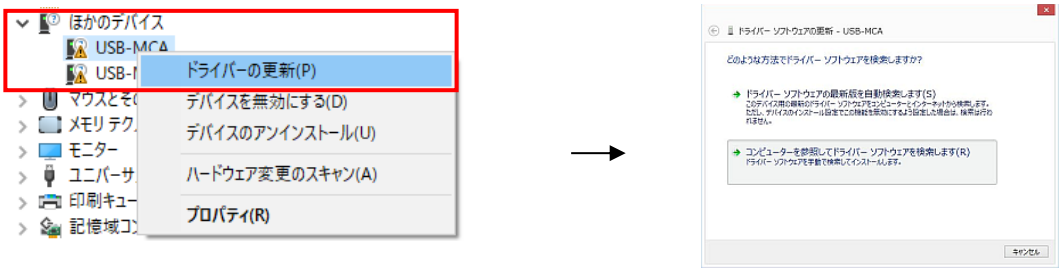
(7) (Required) After restarting, log in as Administrator or with an account that has administrator privileges.

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

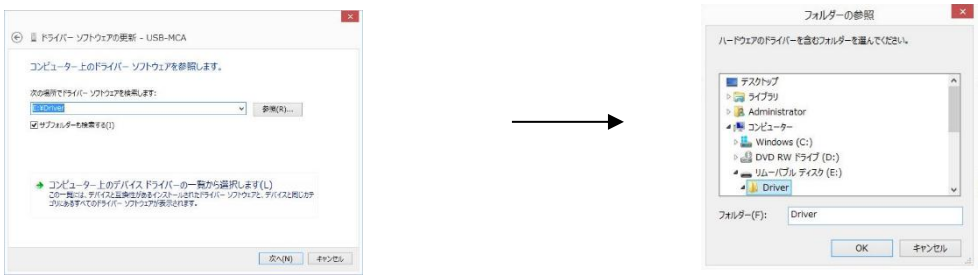
(9) Right-click on the Start screen to display the App Bar, select “All apps,” and then choose “Control Panel” from the Apps view.

(10) From the “Control Panel,” select “Device Manager” to display the Device Manager.

(11) Right-click “USB-MCA,” select “Update Driver Software,” and then choose “Browse my computer for driver software.”

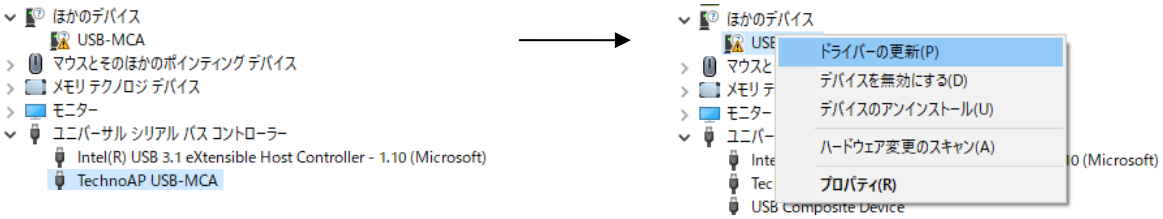


(12) When the “Update Driver Software” screen appears, select “Browse.” On the “Browse For Folder” screen, choose the drive where the USB-MCA driver software is stored, then select “OK.” Back on the “Update Driver Software” screen, select “Next.”

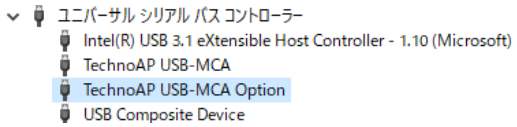


(13) When the “Windows Security” screen appears, select “Install this driver software.” When the message “The driver software has been successfully updated” appears, select “Close.”

(14) When “TechnoAP USB-MCA” appears in the Device Manager, right-click the remaining “USB-MCA” and repeat the steps from (11) to update the remaining driver software.



(15) When “TechnoAP USB-MCA Option” appears in the Device Manager, the driver software installation is complete.

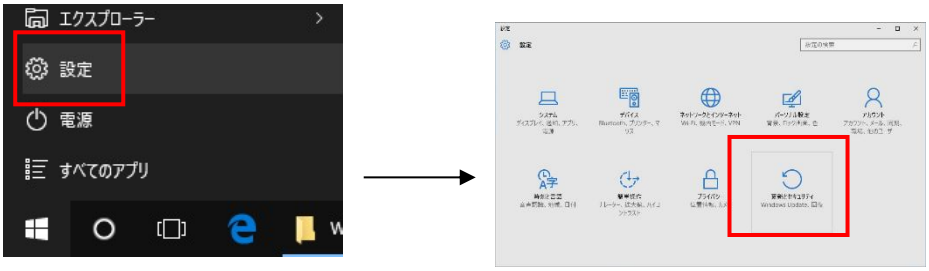


For Windows 10 (64-bit)

In Windows 10 (64-bit), unsigned driver software cannot be installed by default to prevent users from accidentally installing unverified drivers. Since this driver software is unsigned, you must disable “Driver Signature Enforcement” using the following steps before installation.

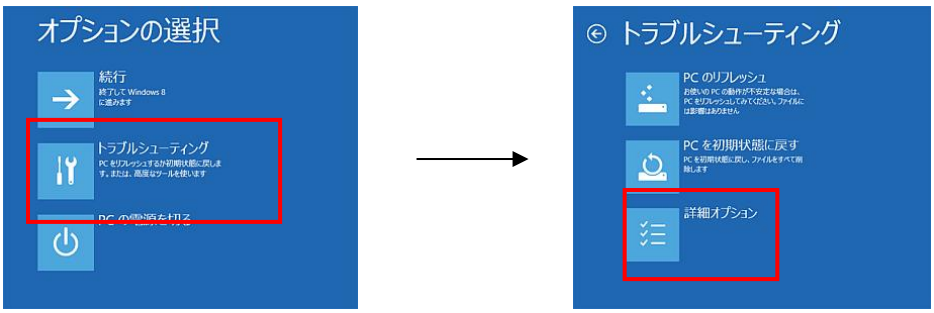
(1) Right-click the Start button at the bottom-left of the screen and select “Settings” from the popup menu.

(2) In the “Settings” screen, select “Update & Security.”

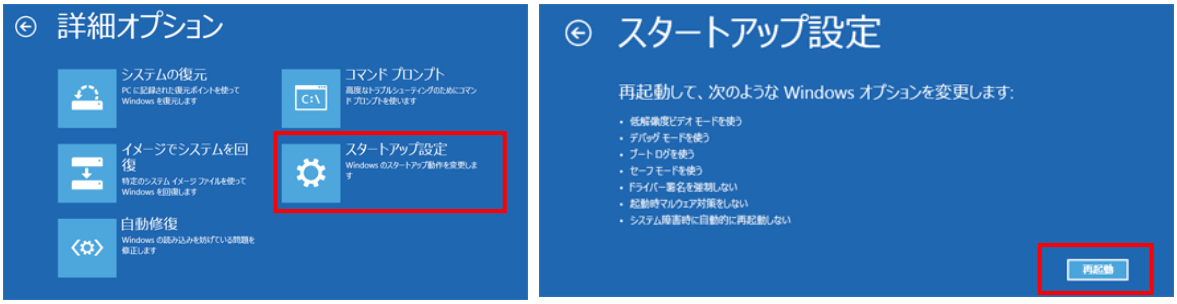


(3) In the “Update & Security” screen, select “Recovery,” then under “Advanced startup,” choose “Restart now.”

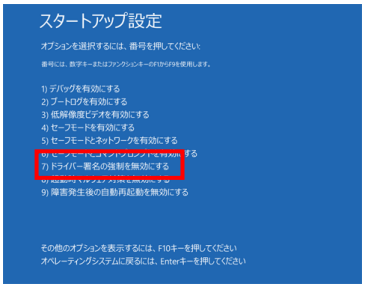
(4) On the “Choose an option” screen, select “Troubleshoot,” then on the “Troubleshoot” screen, select “Advanced options.”



(5) On the “Advanced options” screen, select “Startup Settings,” then on the “Startup Settings” screen, choose “Restart.”



(6) On the “Startup Settings” screen after the restart, press the “7” key to select “7) Disable driver signature enforcement.”

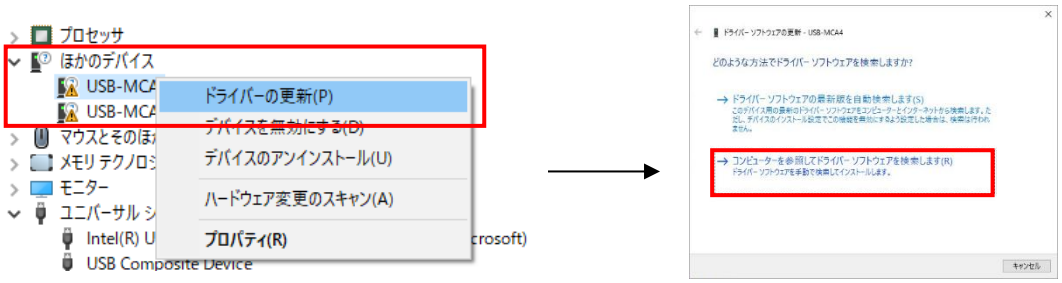


(7) (Required) After restarting, log in as Administrator or with an account that has administrator privileges.

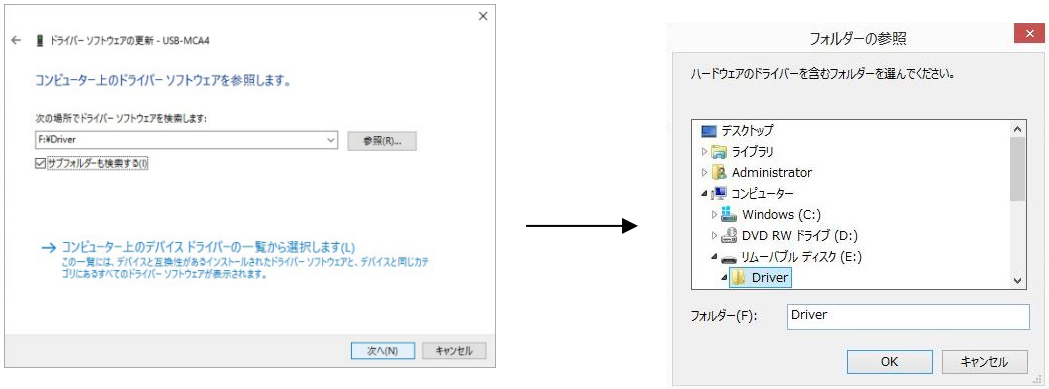
(8) Connect the USB-MCA to the PC using a USB cable.

(9) Right-click the Start button at the bottom-left of the screen and select “Device Manager” from the popup menu.

(10) Right-click “USB-MCA,” select “Update driver,” and then choose “Browse my computer for driver software.”

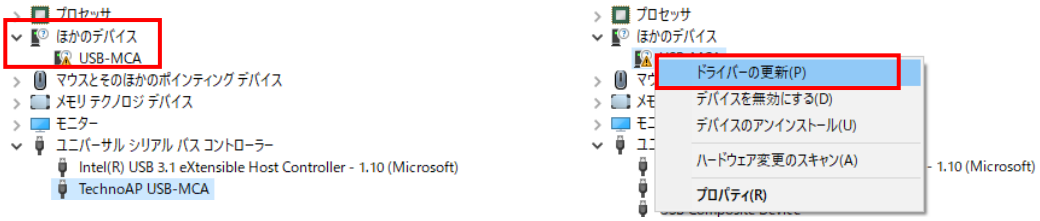


(11) When the “Update Driver Software” screen appears, select “Browse.” On the “Browse For Folder” screen, choose the drive where the USB-MCA driver software is stored, then select “OK.” Back on the “Update Driver Software” screen, select “Next.”

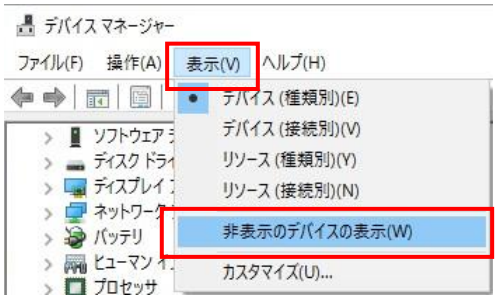


(12) When the “Windows Security” screen appears, select “Install this driver software.” When the message “The driver software has been successfully updated” appears, select “Close.”

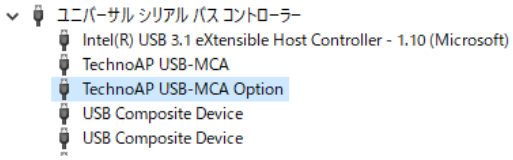
(13) When “TechnoAP USB-MCA” appears in the Device Manager, right-click the remaining “USB-MCA” and repeat the steps from (11) to update the remaining driver software.



(14) If “TechnoAP USB-MCA” does not appear in the Device Manager, select “Show hidden devices” from the “View” menu in the Device Manager.



(15) When “TechnoAP USB-MCA Option” appears in the Device Manager, the driver software installation is complete.



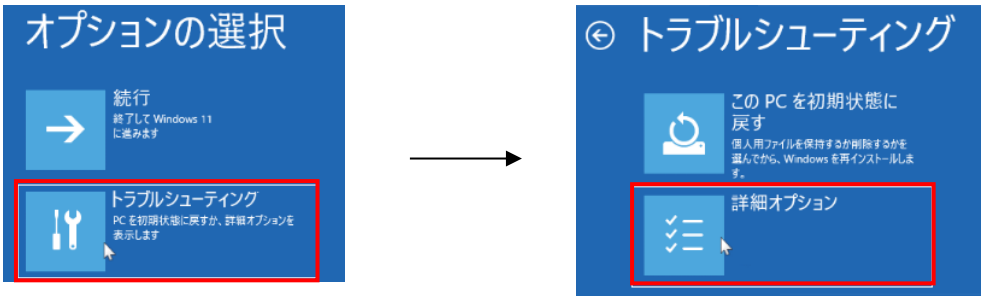
For Windows 11

In Windows 11, unsigned driver software cannot be installed by default to prevent users from accidentally installing unverified drivers. Since this driver software is unsigned, you must disable “Driver Signature Enforcement” using the following steps before installation.

(1) Right-click the Start button at the bottom of the screen, select “Settings” from the popup menu, and open the “System” screen.

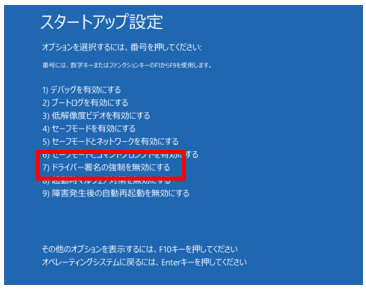
(2) In the “System” screen, select “Recovery,” then under “Advanced startup,” choose “Restart now.”

(3) On the “Choose an option” screen, select “Troubleshoot,” then on the “Troubleshoot” screen, select “Advanced options.”



(4) On the “Advanced options” screen, select “Startup Settings,” then on the “Startup Settings” screen, choose “Restart.”

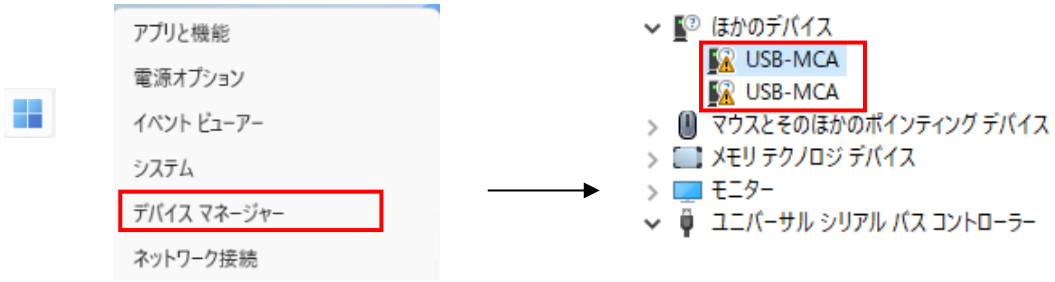
(5) On the “Startup Settings” screen after the restart, press the “7” key to select “7) Disable driver signature enforcement.”



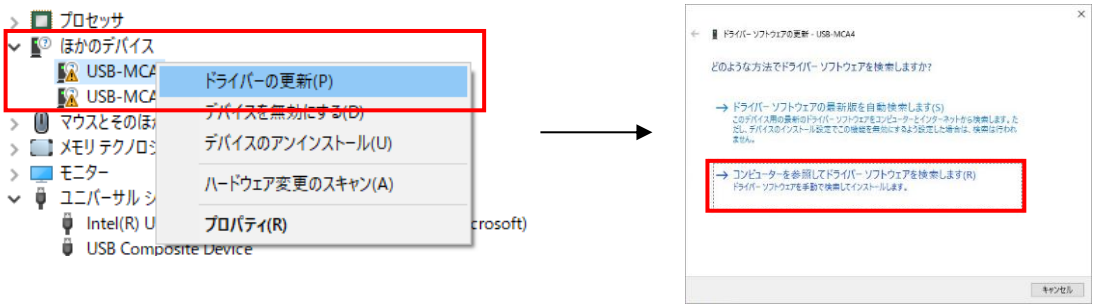
(6) (Required) After restarting, log in as Administrator or with an account that has administrator privileges.

(7) Connect the USB-MCA to the PC using a USB cable.

(8) Right-click the Start button at the bottom of the screen and select “Device Manager” from the popup menu.



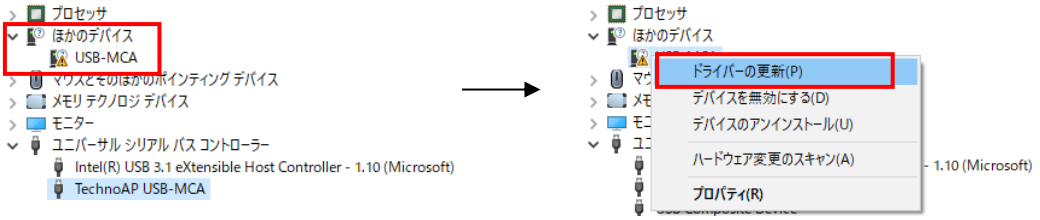
(9) Right-click “USB-MCA,” select “Update driver,” and then choose “Browse my computer for driver software.”



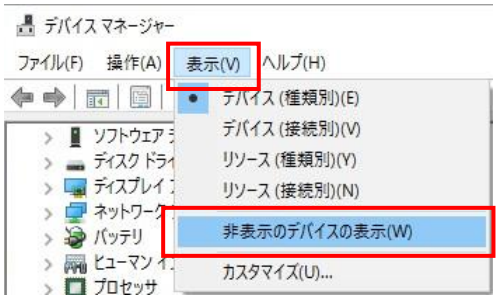
(10) When the “Update Driver Software” screen appears, select “Browse.” On the “Browse For Folder” screen, choose the drive where the USB-MCA driver software is stored, then select “OK.”
Back on the “Update Driver Software” screen, select “Next.”

(11) When the “Windows Security” screen appears, select “Install this driver software.” When the message “The driver software has been successfully updated” appears, select “Close.”

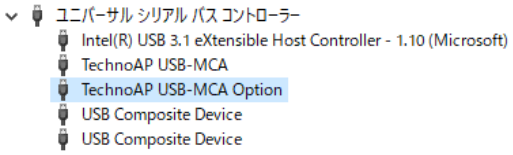
(12) When “TechnoAP USB-MCA” appears in the Device Manager, right-click the remaining “USB-MCA” and repeat the steps from (11) to update the remaining driver software.



(13) If “TechnoAP USB-MCA” does not appear in the Device Manager, select “Show hidden devices” from the “View” menu in Device Manager.



(14) When “TechnoAP USB-MCA Option” appears in the Device Manager, the driver software installation is complete.



3.4 Application Software Installation

After the driver software has been successfully installed following the previous chapter, you need to install the USB-MCA application (executable file) and the LabVIEW runtime engine, which is the development environment. The installer on the included CD contains both the USB-MCA application and the LabVIEW runtime engine, allowing them to be installed simultaneously.

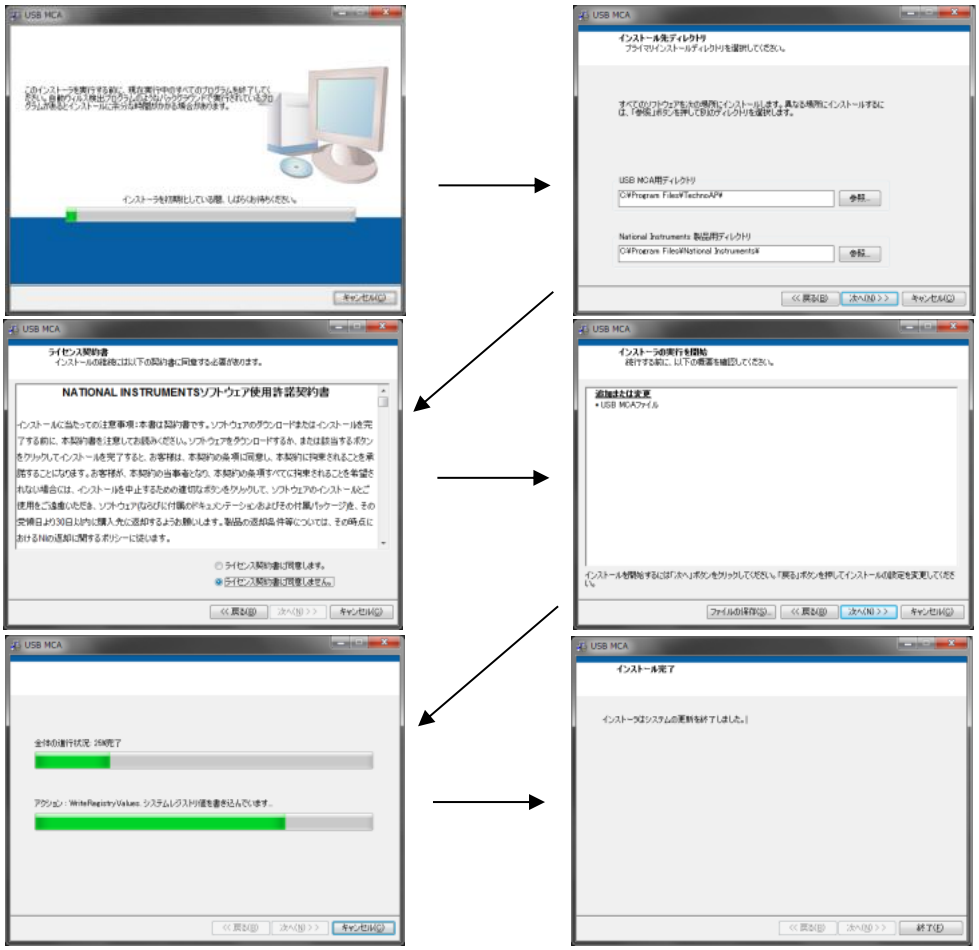
The installation steps are as follows.

If installing on a PC that already has other LabVIEW applications, make sure to close all LabVIEW applications before proceeding.

For Windows 7 (the same procedure applies for Windows 8)

(1) (Required) Log in as Administrator or with an account that has administrator privileges.

(2) Run “setup.exe” in the “Application” folder on the included CD and proceed with the installation using the interactive setup.



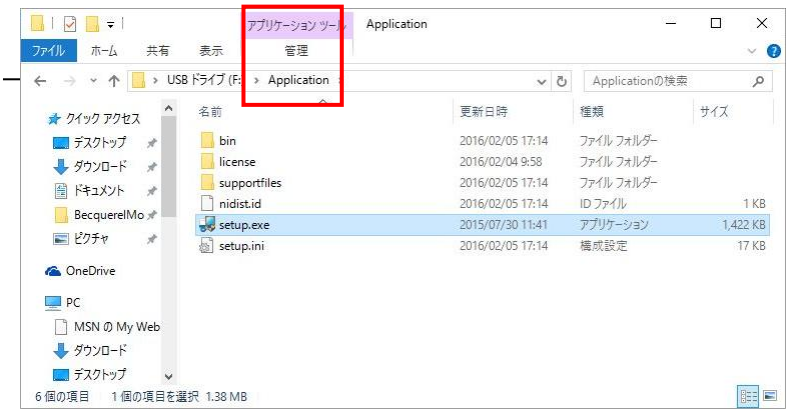
(3) Click the “Start” button, navigate to “TechnoAP,” and run “USB-MCA.”

(4) The “USB-MCA” application will start.

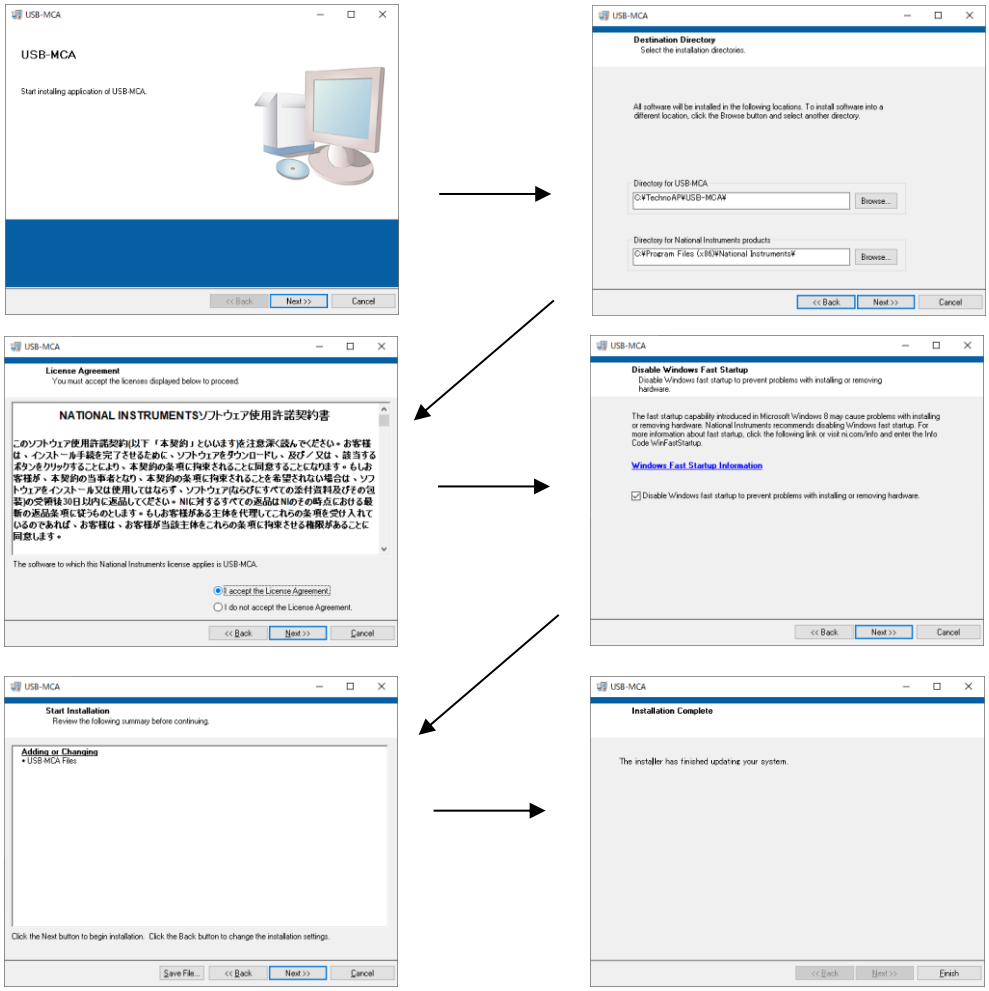
If a “connection error” dialog appears immediately after startup, check whether the device is properly connected to the PC and whether it is recognized in the Device Manager.

For Windows 10 (the same procedure applies for Windows 11)

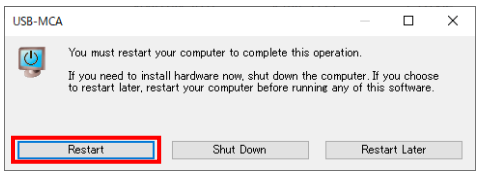
(1) Select “setup.exe” in the “Application” folder on the included CD. From the application tools menu, choose “Run as administrator.”



(2) Run “setup.exe” in the “Application” folder on the included CD and proceed with the installation using the interactive setup.



(3) When prompted to restart the computer, click the “Restart” button to reboot.

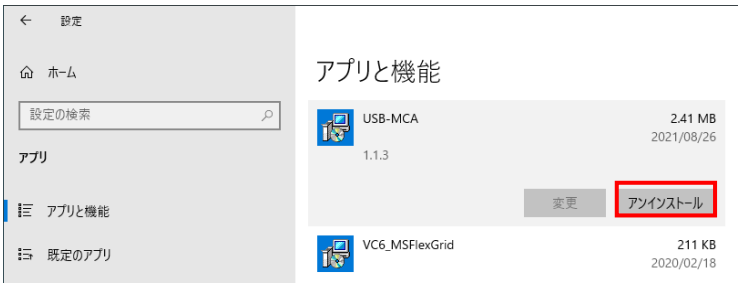


(4) An “USB-MCA” icon will be created on the desktop; double-click it to launch the application.

If a “connection error” dialog appears immediately after startup, check whether the device is properly connected to the PC and whether it is recognized in Device Manager.

※Uninstallation

To uninstall, right-click the Start button, select “Apps & features,” choose “USB-MCA,” and then select “Uninstall.”



(5) When the message “This app and its related information will be uninstalled” appears, select “Uninstall.”

5. Application Screen

5.1 Startup Screen

When you run USB-MCA from the Start button → TechnoAP → USB-MCA, the Start screen, or the Apps view (for Windows 8), the following startup screen will be displayed.

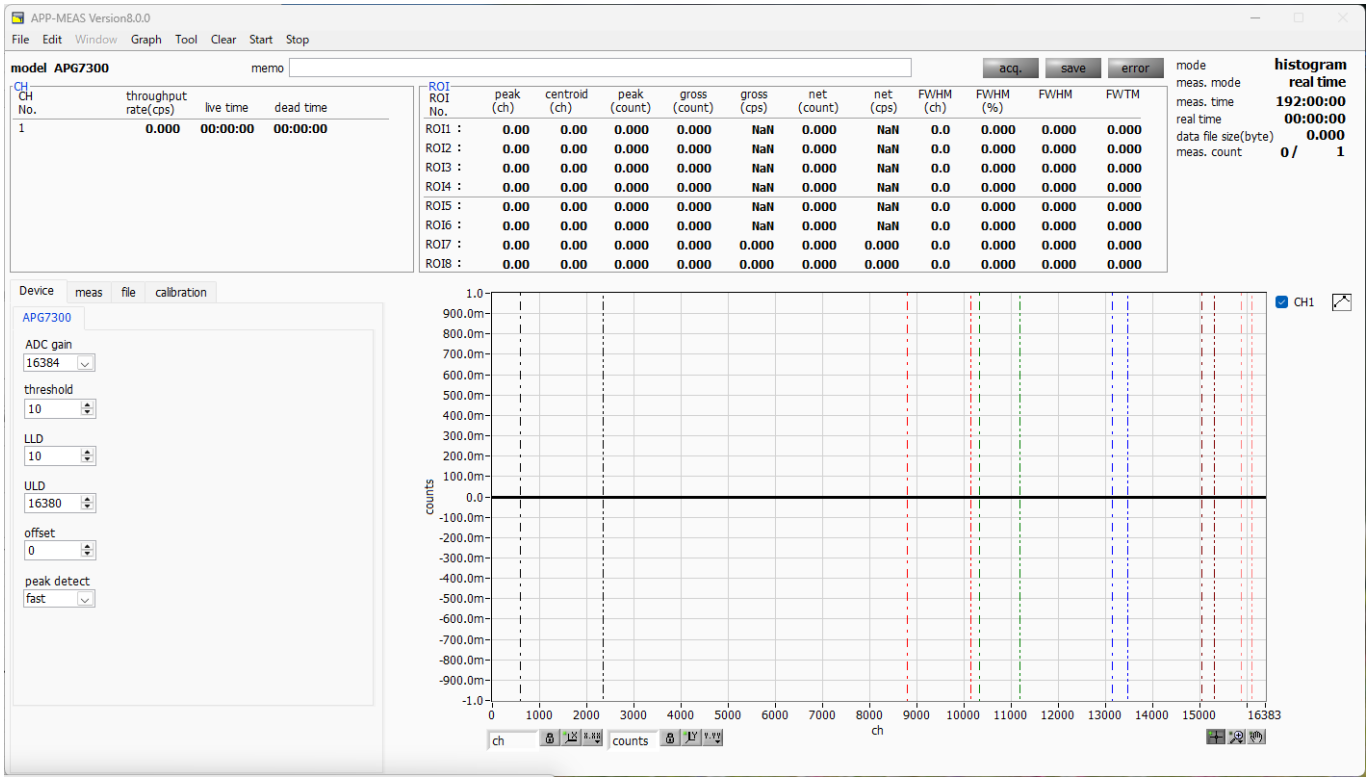


Figure2: USB-MCA Launch Screen

- **Menu Section**

File - open config	Load a configuration file
File - open histogram	Load a histogram data file
File - save config	Save the current settings to a file
File - save histogram	Save the current histogram data to a file
File - save image	Save the device screen as a PNG image
File – reconnect	Reconnect to the device
File – quit	Exit the application
Graph – histogram	Display the histogram graph screen
Tool - gauss fit analysis	Display the Gaussian fitting screen. Performs Gaussian fitting on a specified peak and analyzes full width at half maximum (FWHM), etc.
Tool - peak search analysis	Display the peak search screen. Detects peaks in histogram data and performs FWHM analysis, etc.

Tool - create calibration file	Display the screen to create energy calibration and FWHM calibration files
Clear	Initialize histogram data in the device
Start	Send all settings to the device and start measurement
Stop	Send a stop measurement command to the device

- **Tab Section**

Device	Settings related to device measurement
meas	Settings for measurement operation and measurement time
file	File-related settings
calibration	Settings for energy calibration including ROI (Region Of Interest)
Option	Settings for MCS, coincidence, etc.

- **Other than Tabs**

model	Displays the device model, APG7300
memo	Optional text box for managing measurement data
acq. LED	Blinks during measurement
save LED	Lights up when saving data
error LED	Lights up when an error occurs
mode	Displays the current operation mode
meas. mode	Measurement mode, displays real time or live time (explained in the meas tab)
meas. time	Measurement time, the configured measurement duration real time: Real-time (actual measurement time)
data file size (byte)	Size of the saved file
meas. count	Measurement count, displays current/total measurement counts. Total count is set in the meas tab under repeat count

- **CH Section**

input rate (cps)	(Not displayed)
throughput rate (cps)	Throughput count rate. Number of events processed per second of input
live time	Live time (effective measurement time). real time – dead time
dead time	Dead time (ineffective measurement time). real time – live time. The time from when the input signal exceeds the threshold until the peak is detected, AD-converted, and reset
dead time ratio (%)	Dead time ratio (%), instantaneous value per acquisition

- **ROI Section**

  Displays calculated results for each ROI

peak (ch)	Channel of maximum count
centroid (ch)	Center value calculated from the total counts
peak (count)	Maximum count
gross (count)	Total count within the ROI
gross (cps)	Total count within the ROI per second
net (count)	Total count within the ROI after subtracting background
net (cps)	Total count per second within the ROI after subtracting background
FWHM (ch)	Full width at half maximum (channels)
FWHM (%)	FWHM / peak × 100
FWHM	Full width at half maximum
FWTM	Full width at one-tenth maximum

5.2 Exit Screen

To close the application, click File - quit in the menu. After doing so, the following confirmation screen will be displayed.

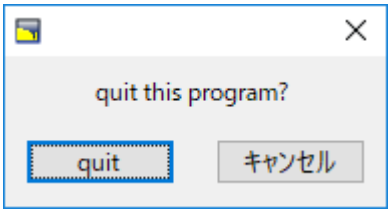


Figure 3: Exit Confirmation Screen

To exit, click the quit button. After doing so, the application screen will close and the program will terminate.

5.3 Device Tab

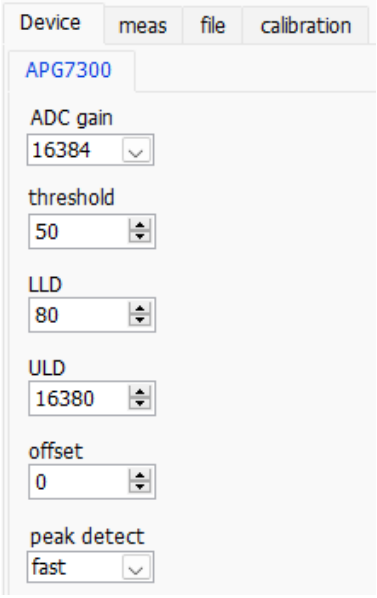


Figure 4: Device Tab

ADC gain

Select the ADC gain (number of divisions of pulse height) from 16384, 8192, 4096, 2048, 1024, or 512 channels. The input voltage range is 0 to 10 V. This range is divided by the selected number of channels. For high-energy-resolution detectors such as Ge semiconductor detectors, selecting 16384 allows data to be acquired with fine resolution. However, if the count rate is low, it will take longer to obtain peaks. For detectors with somewhat lower energy resolution, such as NaI(Tl) scintillation detectors, it may not be possible to divide finely, so a setting such as 4096 channels is used.

Threshold

Set the threshold for the timing to start waveform acquisition. The unit is digit. The setting range is 0 to 16383. Set it to a value lower than the LLD. From the moment the shaped input signal exceeds the threshold setting, peak detection and AD conversion are triggered. If this setting is too high, low-energy pulse heights cannot be acquired. Conversely, if it is set too low, noise will be picked up. For example, when the ADC gain is 16384, initially set the threshold and LLD to about 100. Then, while monitoring the input rate, throughput rate, and histogram, gradually lower the value, determine the boundary where noise increases, and set the threshold slightly above that point.

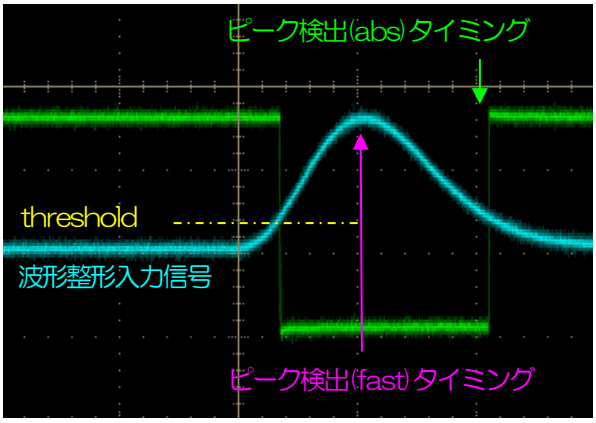


Figure 5 Threshold and Peak Detection (abs/fast) Timing

LLD — Set the energy LLD (Lower Level Discriminator). The unit is ch. Channels below this threshold are not counted. Set it to a value equal to or higher than the threshold and lower than the ULD.

ULD — Set the energy ULD (Upper Level Discriminator). The unit is ch. Channels above this threshold are not counted. Set it to a value higher than the LLD.

Offset — Set the positive offset. The unit is ch. By adding the offset value, the histogram can be shifted to the right (toward higher pulse heights). It can be used for peak position adjustment, etc.

peak detect — Select the method for peak (maximum pulse height) detection. See the figure on the previous page.

- Abs — After the input signal exceeds the threshold and reaches the peak, AD conversion is executed when it decays and falls below the threshold. This allows more definite acquisition of the maximum pulse height.
- Fast — AD conversion is executed at the timing when the input signal first reaches the peak after exceeding the threshold. Suitable for high count measurements (several kcps or more) and pile-up handling.

5.4 Meas Tab

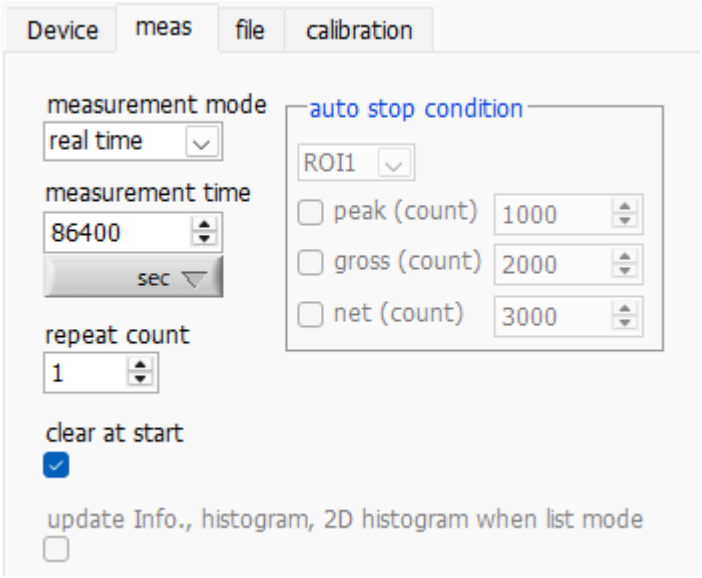


Figure6: Meas Tab

• measurement section

measurement mode	Select real time, live time, or auto stop.
real time	Data is measured in real time until the measurement time described below is reached.
live time	Data is measured until the preset effective measurement time (real time minus dead time) is reached.
auto stop	Data is measured until the condition specified in the auto stop condition section below is met.
measurement time	Set the measurement time. The setting range is from 00:00:00 to 192:00:00. For auto stop mode, this setting is ignored and automatically set to 192:00:00. If sec is selected as the unit, the range is 0 to 691,200 seconds.
repeat count	Specify the number of repeated measurements.
clear at start	Set whether to initialize histogram data at the start of measurement.
update Info, histogram, 2D histogram when list mode	Not supported, as this device does not have a list mode.

• auto stop condition section

Specify the stopping condition for a single measurement. If any of the checked conditions below are met, the measurement stops.

ROI selection	Select one ROI to be targeted for the various counts below.
peak(count)	The stop condition is met when the peak(count) of the selected ROI reaches or exceeds the value specified here.
gross(count)	The stop condition is met when the gross(count) of the selected ROI reaches or exceeds the value specified here.
net(count)	The stop condition is met when the net(count) of the selected ROI reaches or exceeds the value specified here.

5.5 file Tab

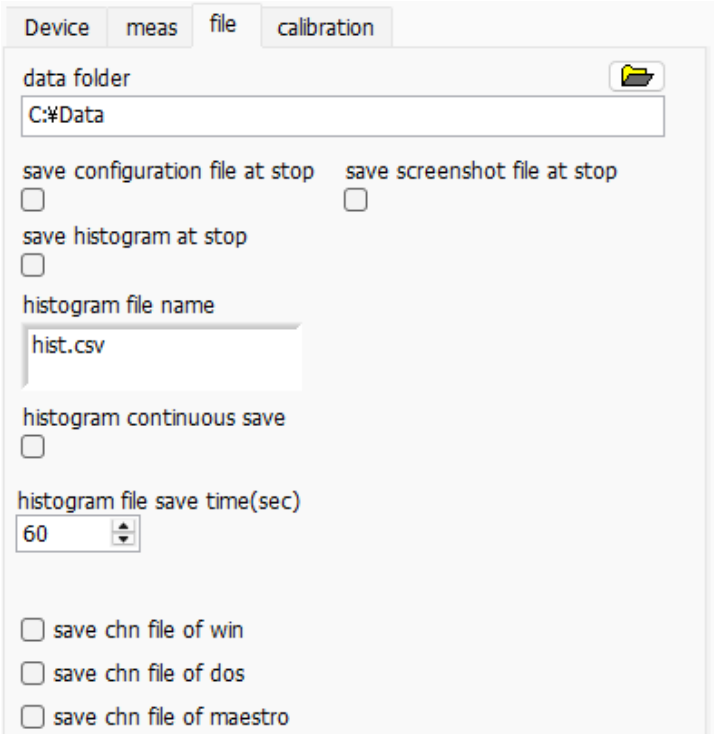


Figure7: File Tab

• file section

data folder	Specify the common folder for storing data files described below, using an absolute path.
save configuration file at stop	If checked, the configuration file is automatically saved each time the measurement stops. The file extension will be .ini.
save screenshot file at stop	If checked, the entire screen displayed at the time of measurement stop will be saved to a file.The file extension will be .png. *Note※ Only the currently displayed tabs at the time of measurement stop are saved (top half: CH, config, status tabs; bottom half: wave, histogram tabs). Not all tab contents are saved, so be careful.
save histogram at stop	If checked, histogram data at the time of measurement stop is saved to a file. The file extension will be .csv.
histogram file name	Set the name of the histogram data file. You can also start from a subfolder. The extension is optional. *Note* The file is not saved exactly with this name; the following format is used based on this name. Example: If the data folder is set to C:¥Data, histogram file name to histogram.csv, and the date/time is 2025/09/01 12:00:00, the data will be saved as: C:¥Data¥histogram_20250901_120000.csv

histogram continuous save	Set whether histogram data is saved to a file at set time intervals. *Note* Due to processing conditions, there may be deviations in the save interval. Use only for simple backup purposes.
histo file save time (sec)	Set the interval for continuous saving of histogram data in seconds. Range: 5 seconds to 3600 seconds.
save chn file of win	If “save histogram at stop” is checked, outputs a chn file (Windows version).
save chn file of dos	If “save histogram at stop” is checked, outputs a chn file (DOS version).
save chn file of maestro	If “save histogram at stop” is checked, outputs a chn file (Maestro version). 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 files are saved as: 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

Set the ROI (Region Of Interest) and energy calibration. By setting an ROI on a histogram peak, the peak count, full width at half maximum, and other parameters can be calculated.

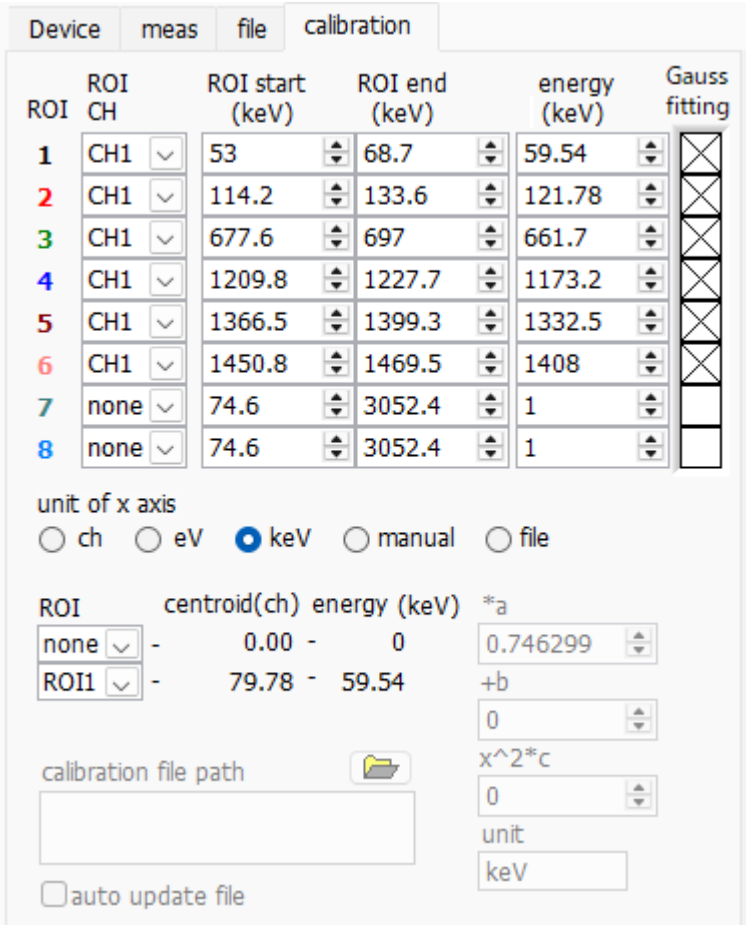


Figure8: calibration Tab

• ROI section

ROI CH	Select the CH number for the ROI. Up to 8 ROIs can be set.
ROI start	Set the start position of the ROI. The unit depends on the energy calibration.
ROI end	Set the end position of the ROI. The unit depends on the energy calibration.
Energy	Define the energy value of the peak position (ch). The unit depends on the energy calibration. For Co^{60}, set values such as 1173.2 or 1332.5. If “ch” is selected in the next unit of x areas section, peaks between ROIs are detected, and keV/ch is calculated from the peak position (ch) and the set energy value, which is then applied to the full width at half maximum calculation.

• unit of x areas section

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

Ch	Display in CH (channel) units. The units of peak, centroid, FWTM, and FWHM in the ROI section will be in CH.
eV	Display in eV units. Using two-point calibration with two peaks (centroids) and their energy values in a single histogram, the slope (a) and intercept (b) of the linear function (y = ax + b) are calculated so that CH is converted to eV, and applied to the X-axis. The units of peak, centroid, FWTM, and FWHM in the ROI section will be in eV.
keV	Display in keV units. Using two-point calibration with two peaks (centroids) and their energy values in a single histogram, the slope (a) and intercept (b) of the linear function (y = ax + b) are calculated so that CH is converted to keV, and applied to the X-axis. The units of peak, centroid, FWTM, and FWHM in the ROI section will be in keV. Example: If Co^{60} peaks are at 5717.9 CH (1173.24 keV) and 6498.7 CH (1332.5 keV), the two-point calibration automatically calculates (a = 0.20397) and (b = 6.958297).
manual	Apply a quadratic function ($y = ax + b + cx^2$). Units can be set arbitrarily.
File	Use the energy calibration file created with Tool - create calibration file. The file extension is fixed as ".ec". For details on energy calibration files, see the Tool section, create calibration file.
ROI	Select the ROI number for energy or time calibration. The centroid and peak next to it display the center value and the set energy value of the selected ROI. For example, selecting ROI1 and none performs one-point calibration using the peak center of ROI1 and the preset peak. Selecting ROI1 and ROI2 performs two-point calibration using the peak centers of ROI1 and ROI2 and the preset peaks.
Gauss fitting	If checked, Gaussian function fitting is performed. The results are displayed in the ROI section.
manual a and b	Displays the slope (a) and intercept (b) of the linear function (y = ax + b) used to create the horizontal axis of the graph, based on the energy calibration result.
Unit	If manual is selected, the unit name of the histogram graph X-axis and the unit name of calculation results between ROIs can be set arbitrarily.

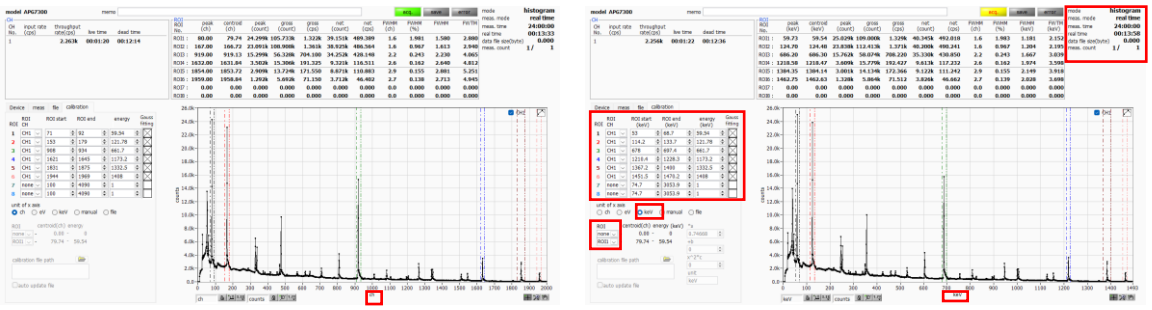


Figure 9 When keV is selected in the calibration section

(Left: before energy calibration, Right: after energy calibration)

5.7 Graph

Graph	Displays the histogram.
spectrum graph	Histogram in histogram mode with energy on the X-axis and counts on the Y-axis (spectrum).
cursor x	Set the position of the dashed cursor within the graph. The count value at this position on the spectrum is displayed in cursor y.
cursor y	Displays the count value at the intersection of the dashed cursor within the graph. The X-axis position of the cursor can be set via cursor x or by dragging and dropping the cursor.
plot legend	Set the color, line style, etc., of the graph. Visibility can be toggled via the sub-menu on the graph.
X-axis range	Right-click on the X-axis and check auto-scale to enable automatic scaling. Uncheck to disable auto-scale, fixing the minimum and maximum values. To change the minimum or maximum, place the mouse pointer over the value to be changed and click or double-click.
Y-axis range	Right-click on the Y-axis and check auto-scale to enable automatic scaling. Uncheck to disable auto-scale, fixing the minimum and maximum values. To change the minimum or maximum, place the mouse pointer over the value to be changed and click or double-click.

X-axis Set whether auto-scale is enabled, the scale precision, and the mapping (linear or logarithmic).

Y-axis Set whether auto-scale is enabled, the scale precision, and the mapping (linear or logarithmic).

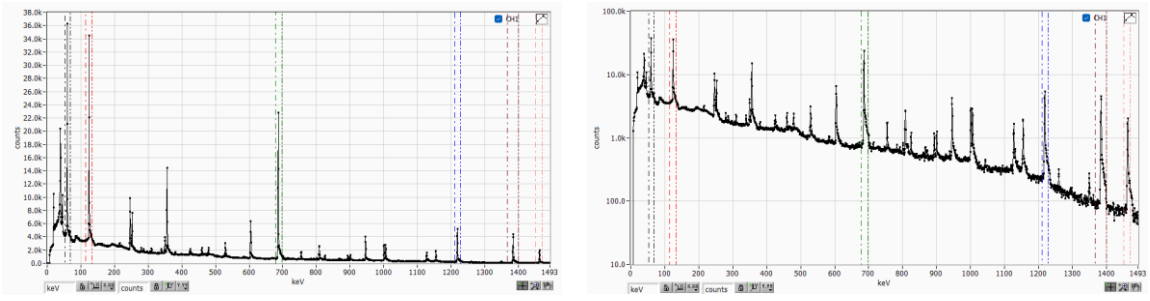


Figure 10 Histogram Graph (Left: linear Y-axis mapping, Right: logarithmic)

	Cursor Move Tool	Allows the cursor to be moved on the graph, useful when setting ROIs.
	Zoom	Click to select and execute one of six types of zoom in or zoom out.

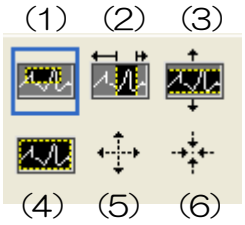


Figure 11 Graph Zoom In and Zoom Out Tools

(1) Rectangle Zoom	Use this option to click a point on the display as a corner of the zoom area, then drag the tool until the rectangle covers the desired zoom area.
(2) X-Zoom	Zoom in along the X-axis of the graph.
(3) Y-Zoom	Zoom in along the Y-axis of the graph.
(4) Fit Zoom	Automatically scales all X and Y axes on the graph.
(5) Zoom Out Centered on Point	Click the point that will serve as the center for zooming out.
(6) Zoom In Centered on Point	Click the point that will serve as the center for zooming in.
Pan Tool	
	Grab the plot to move it across the graph.

6. Measurement

6.1 Start Measurement

(1) Click the Clear menu. Histogram data in the device will be initialized. If you want to continue from the previously measured histogram or results, do not click Clear before starting the next measurement.

(2) Click the Start menu to begin measurement after all settings have been sent to the device.

(3) After measurement starts, the following states occur:

- The acq. LED blinks.
- Measurement status is displayed at the top right of the screen.
- Real time acquired from the device is displayed under “real time” at the top right of the screen.
- Live time for each CH acquired from the device is displayed under “live time” for each CH.
- Dead time for each CH acquired from the device is displayed under “dead time” for each CH.
- In the ROI section, for each ROI number, the center value, gross count (total within the range) and rate, net count (total minus background) and rate, FWHM, 1/10 width, and other calculation results are displayed according to the ROI range settings in the calibration tab.
- The graph displays a histogram of pulse heights on the X-axis.

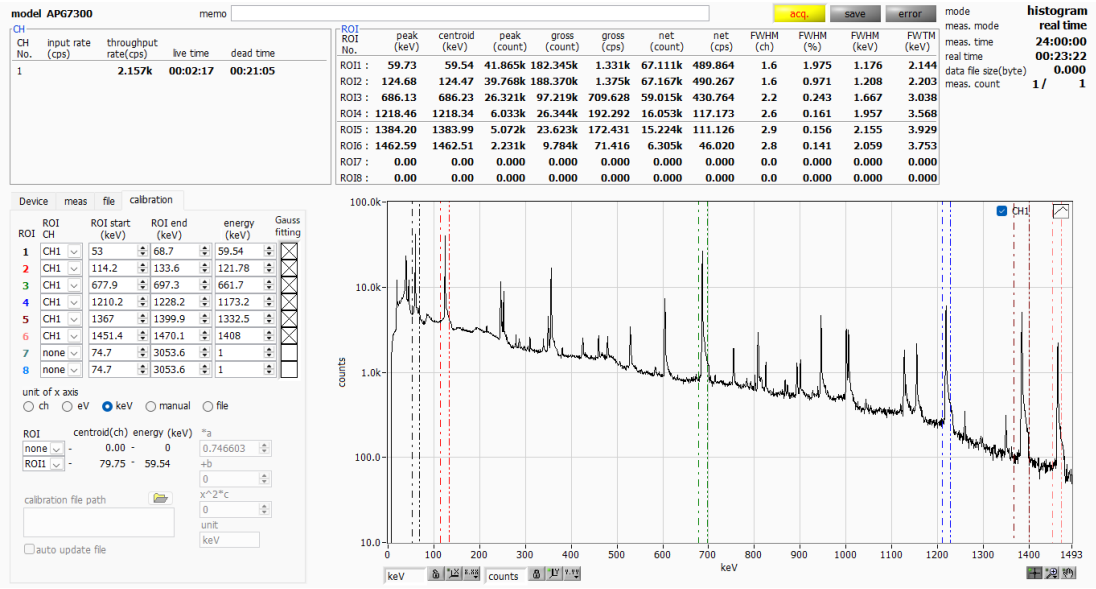


Figure 12: Histogram Mode Measurement Screen

6.2 Stop Measurement

- If meas. mode is real time, Measurement automatically stops when real time reaches the set measurement time.
- If meas. mode is live time, Measurement automatically stops when the longest live time reaches the set measurement time.
- To stop manually during measurement,Click the Stop menu to halt the measurement.

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	Notes
Mode	Mode (fixed as histogram)
meas. mode	Measurement mode (real time or live time)
meas. time (sec)	Measurement time in seconds
Real time (sec)	Real time
Live time (sec)	Live time for each channel, in seconds
Dead time (sec)	Dead time for each channel, in seconds
Dead time ratio (%)	Dead time ratio for each channel, in percent
Start time	Measurement start date and time
Stop time	Measurement end date and time
[APG7300]	Device-Specific Section
ADC gain	ADC gain
Threshold	Threshold
LLD	Energy LLD
ULD	Energy ULD
Offset	Offset
peak detect	Peak detection method (abs or fast; unused)
[Calculation]	Calculation Section
*Saved for each ROI	
ROI No	ROI number
ROI CH	Input channel number targeted by the ROI
ROI start (optional)	ROI start position (keV, etc.)
ROI end (optional)	ROI end position (keV, etc.)
Energy (optional)	Peak energy value between ROIs (keV, etc.)
peak (optional)	Peak position between ROIs (keV, etc.)
centroid (ch)	Center position between ROIs (ch)
peak (count)	Maximum peak count between ROIs
gross (count)	Total count between ROIs
gross (cps)	Gross count per second
net (count)	Total count between ROIs after subtracting background
net (cps)	Net count per second

FWHM (ch)	Full width at half maximum between ROIs (ch)
FWHM (%)	Full width at half maximum between ROIs (%)
FWHM (optional)	Full width at half maximum between ROIs (keV, etc.)
FWTM (optional)	1/10 width between ROIs (keV, etc.)
[Status]	Status Section
input rate (cps)	0 (fixed)
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, or arbitrary)	Histogram data, up to 16,384 points

8. Function

8.1 Data Acquisition Using External GATE Input Signal Timing

To acquire event data triggered by an external condition, input an LV-TTL level external GATE signal to the GATE input terminal on the rear panel. Measurement occurs when the signal is High and does not occur when it is Low.
The external GATE input signal should cover the waveform-shaped input signal as shown below. In particular, the external GATE signal must remain High while the waveform-shaped input signal exceeds the threshold level V^{th} from the baseline. When the waveform-shaped input signal falls below the threshold level, A/D conversion is performed, and the peak value is finalized after a 1.2 µs processing time.

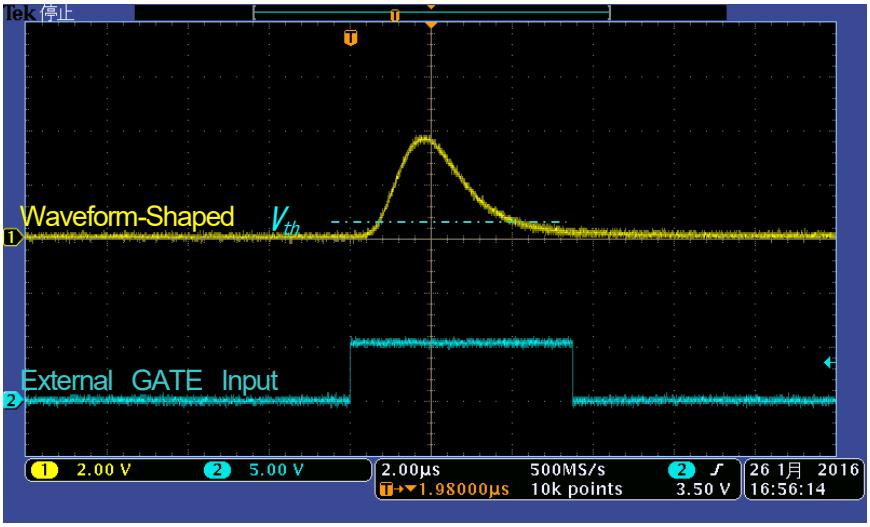


Figure 13 External GATE Input Signal Timing

*The external GATE input signal is LV-TTL level, with ≤0.8 V recognized as Low and ≥2.0 V recognized as High.
The maximum input voltage is 5 V.

8.2 Data Rejection Using VETO Signal Timing

To discard event data triggered by an external condition, input an LV-TTL level signal to the VETO input terminal on the rear panel. Unlike the GATE signal, measurement occurs when the signal is Low and is inhibited when the signal is High. The timing requirements are the same as for the GATE signal described above.

8.3 Calculation Method of FWHM (Full Width at Half Maximum)

The FWHM displayed in the Status tab is calculated as follows.

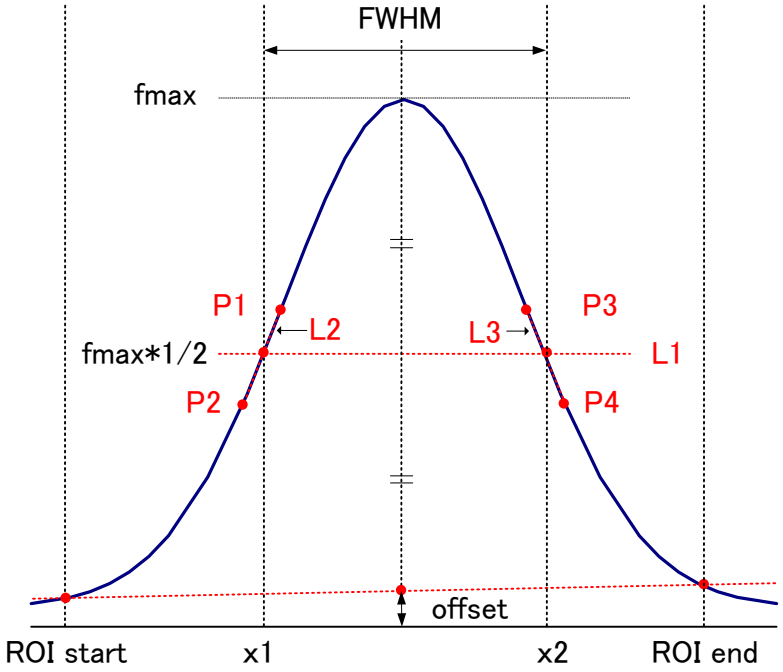


Figure 14 FWHM Calculation

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

(2) Connect the intersections of the histogram with ROI start and ROI end using a straight line. Determine the intersection of this line with a vertical line from the peak value fmax to the X-axis to calculate the background offset.

(3) Subtract the offset from fmax, take half of this value, and draw a horizontal line L1 at this level.

(4) To find the two points where the histogram intersects L1, detect the points immediately before and after the intersections, P1 and P2, as well as P3 and P4.

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

(6) Determine 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 x2 - x1 is the FWHM.

8.4 Calculation of Gross and Net Counts

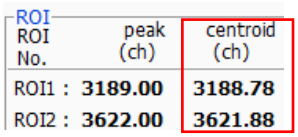
The gross count and net count in the ROI section are calculated using the Covell method.

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

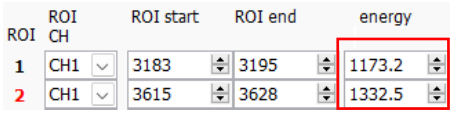
8.5 Two-Point Calibration Calculation Method

(1) In Histogram Mode

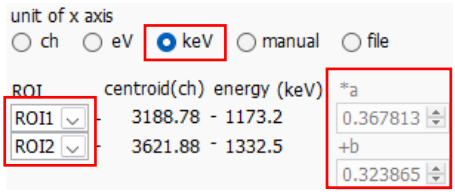
For energy calibration, the X-axis of the graph is converted to energy units (e.g., keV) using two-point calibration with the centroids of two energy peaks and their corresponding peak energy values. One-point calibration is also possible.



Using the centroid (ch) values of ROI1/ROI2 displayed in the ROI located at the top of the graph as a reference, set the ROI start (keV) and ROI end (keV) in the ROI positioned at the top of the calibration tab, or define the range of ROI1 and ROI2 by moving the cursor on the graph.



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



In the unit of X-axis section located at the bottom of the calibration tab, select the keV radio button. Then, in the ROI located below, select ROI1 and ROI2. The slope a and intercept b of the linear equation y = ax + b, calculated using the following formula, will be automatically displayed on the right.

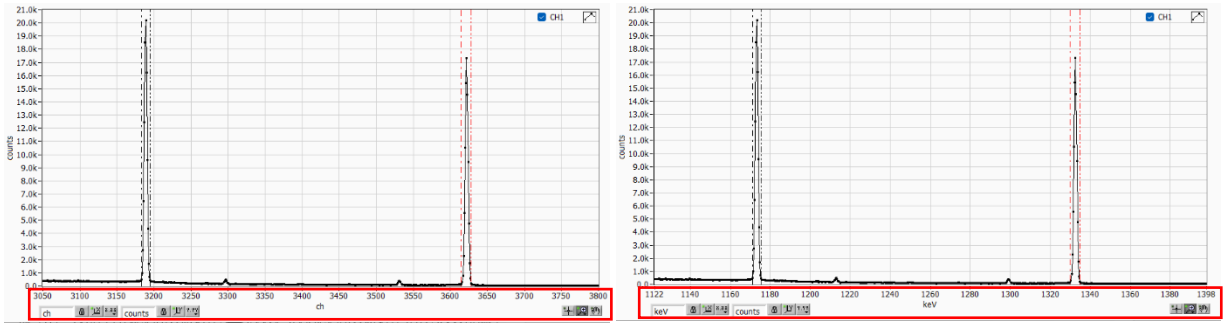


Figure 15 Left: ch before energy calibration, Right: keV after energy calibration

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

b = y – ax

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

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

b = 1332 – 0.124 * 10729.53 = 1.831

As a result, a is automatically set to 0.124 and b to 1.831, and the X-axis scale is generated using the linear equation 0.124 × ch + 1.831.

9. Reference Material

This manual mainly describes the hardware of the device and the application parameters.

For detailed explanations of the Tool, which enables advanced analysis, please refer to the separate document:

Detailed Tool Description

“Application Tool Edition User Manual”

10. Troubleshooting

For solutions to various issues related to the application, please also refer to:

"https://www.techno-ap.com/support_app.html"

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