# Digital Pulse Processor
# APV8108-14

# Instruction Manual

Version 1.4
September 2018

**TechnoAP Co., Ltd.**

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# 1. Safety Precautions / Disclaimer

Thank you very much for purchasing the digitizer APV8108-14 (hereinafter "This board") of TechnoAP Co., Ltd. (hereinafter "We"). Please read this "Safety Precautions / Disclaimer" before using this device, be sure to observe the contents, and use it correctly.

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

## Prohibited matter

- This device cannot be used for applications requiring special quality and reliability related to human life, accident.
- This device cannot be used in places with high temperature, high humidity and high vibration.
- Do not 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.<br>1. Failure or damage due to misuse or improper repair or modification or disassembly.<br>2. Failure and damage due to falling etc.<br>3. Breakdown / damage in harsh environments (high temperature / high humidity, under zero, condensation etc.).<br>4. Causes other than the above, other than "our products".<br>5. Consumables. |

# 2. Overview

## 2. 1. Overview

The APV8108-14 is a waveform analysis board that uses a high-speed, high-resolution ADC. Real-time analysis at 1 GHz with FPGA, high speed processing without dead time by signal processing is realized with high time resolution and high throughput. All ADCs operate synchronously with a 1 GHz clock and can be used for signal analysis from multiple high-speed scintillation detectors. In addition, it supports synchronous processing of multiple boards, and can easily be extended to multi-channel analysis.

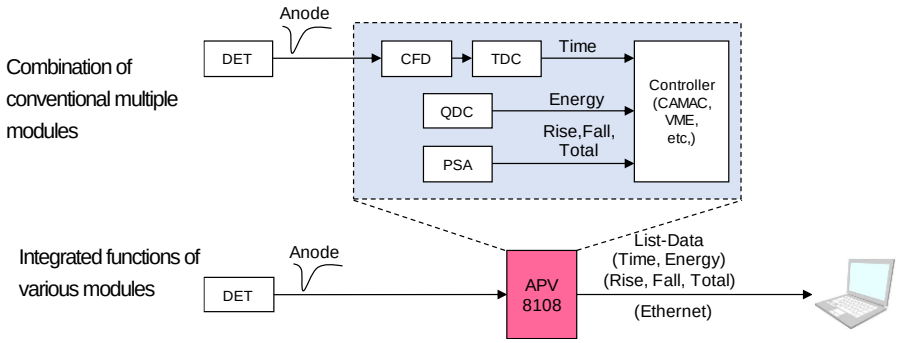



**Fig. 1 Function**

This manual describes the software for measuring and controlling this device.

* "list" and "event" in the text are equivalent.
* "hist" and "spectrum" in the text are equivalent.

## 2. 2. Specifications

（1） Analog Input

- Number of channel : 8 channel
- Input range : ±1 V
- Input impedence : 50 Ω

（2） ADC

- Sampling frecuency : 1 GHz
- Resolution : 14-bit
- SNR : 68.3 dBFS @ 605 MHz

（3） Performance

- QDC output : 2 Mcps and more
- Time resolution : 3.90625 ps

（4） MCA

- Measurement mode : Wave mode, Histogram mode, List mode, List-Common mode
- Tranfer rate : Appx. 20 Mbyte per second

（5） Interface

- LAN : Ethernet TCP/IP 1000 Base-T (at List data acquisition)
  UDP (When sending / receiving config data, receiving status data)

（6） Form

- VME type : APV8108-14

（7） Consumption current

+ 5 V : 6.0 A (Max.)
+ 12 V : 1.0 A (Max.)

（8） Application

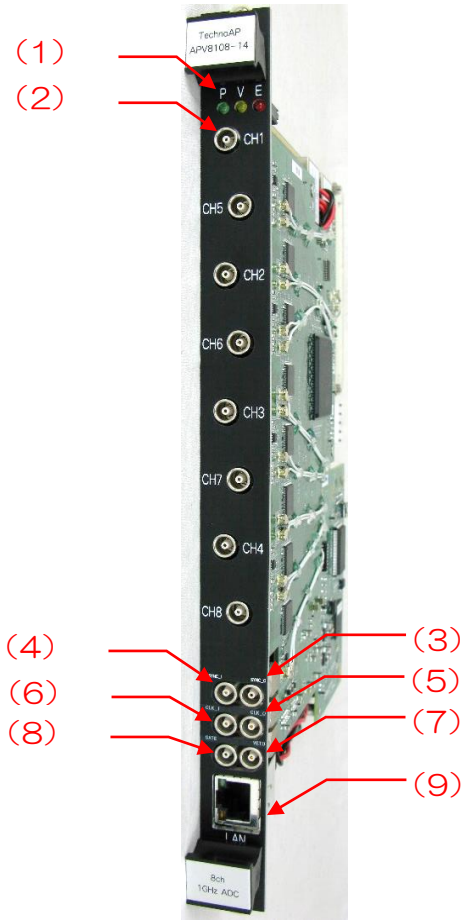
- OS : Windows 7 version or later, 32-bit or 64-bit
- Screen resolution : Recommend HD (1366 x 768) or more

## 2. 3. Revision History

| | | |
|---|---|---|
| Version 1.0 | May 2018 | First edition |
| Version 1.1 | June 2018 | Correction of errors |
| Version 1.2 | July 2018 | Correction of errors |
| Version 1.3 | August 2018 | Correction of errors |
| Version 1.4 | September 2018 | Correction of errors |

# 3. Appearamce

## 3. 1. Appearance




**Pic. 1: APV8108-14**

| | | |
|---|---|---|
| **1** | LED | P: Power ON, V: Not used. E: Not used. |
| **2** | CH1 to CH8 | LEMO connector for signal input. Input range: ± 1 V, input impedance: 50 Ω. |
| **3** | SYNC-O | LEMO connector for synchronous timing signal output.<br>Outputs a timing signal to adjust the time between boards. |
| **4** | SYNG-I | LEMO connector for synchronous timing signal input.<br>Input a timing signal to adjust the time between boards. |
| **5** | CLK-O | LEMO connector for external clock signal output.<br>Outputs a 25 MHz TTL signal. |
| **6** | CLK-I | LEMO connector for external clock signal input.<br>It can be operated using an external clock.<br>Turn on the power after inputting the 25 MHz TTL signal. |
| **7** | VETO | LEMO connector for external signal input.<br>Disable data acquisition during “High”. |
| **8** | GATE | LEMO connector for external gate signal input. Input TTL signal.<br>Data acquisition is enabled while the input is "High". |
| **9** | LAN | RJ45 connector for Ethernet cables. 1000Base-T. |

**NOTE:** Connect the SYNC-O and SYNC-I by using a cable.

# 4. Setup

## 4. 1. Instration of the application

The application for APV8108-14 (hereinafter referred to as “the application”) runs on Windows. When using it, it is necessary to install this application's EXE (executable) file and National Instruments' LabVIEW Run-Time Engine on the PC used for measurement.
Installation of this application is performed by the installer included in the attached CD. The installer includes an EXE (executable) file and the LabVIEW Run-Time Engine, which can be installed at the same time.

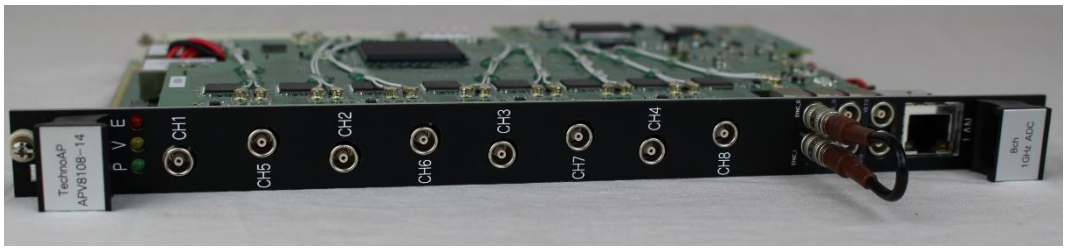
The installation procedure is as follows.

| | |
|---|---|
| **1** | Log in to Windows with administrator privileges. |
| **2** | "Setup.exe" in the "Installer" folder in the supplied CD-ROM. Proceed with the installation interactively. The default installation destination is "C: ¥ TechnoAP". |
| **3** | "Start button"-"TechnoAP"-"APV8108-TOTAL-FALL" is executed. |

To uninstall, select "APV8108-TOTAL-FALL" from "Add or Remove Programs" to remove.

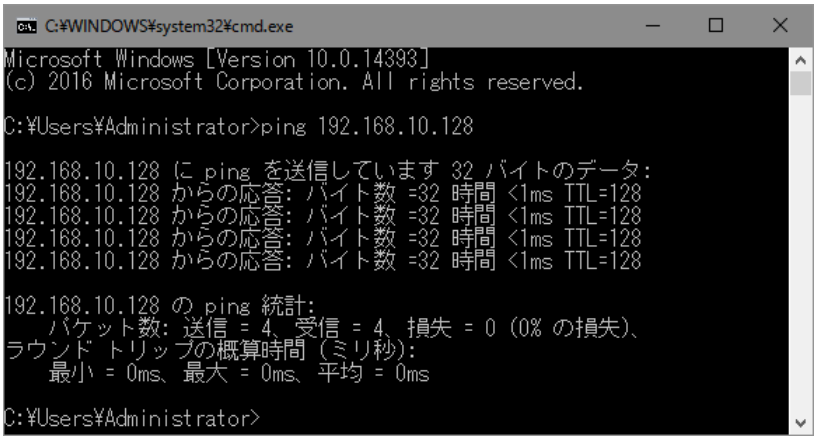
## 4. 2. Connection

| | |
|---|---|
| **1** | Connect this device and PC with an Ethernet cable. Use a cross cable depending on the PC. Use a switching hub when using a hub. |
| **2** | SYNC-O terminal-SYNC-I terminal connection<br>Connect the APV8108-14 SYNC-O and SYNC-I pins together. |




**Pic. 2: SYNC-I / O terminal connection example**

## 4. 3. Setup of the network

<table>
<tr><td rowspan="4">1</td><td colspan="2">Turn on the power of the PC and change the network information of the PC.</td></tr>
<tr><td>IP Address</td><td>192.168.10.2<br>*Any value except 192.168.10.128</td></tr>
<tr><td>Sub-net mask</td><td>255.255.255.0</td></tr>
<tr><td>Default gateway</td><td>192.168.10.1</td></tr>
<tr><td>2</td><td colspan="2">Power on the VME rack. Do not operate anything for 10 seconds after power on.</td></tr>
<tr><td rowspan="5">3</td><td colspan="2">Check the communication connection between the PC and this device. Execute the ping command at the Windows command prompt to check whether the device and PC can be connected. The IP address of this device is on the board. The network information of this device at the time of shipment from the factory is as follows.</td></tr>
<tr><td>IP Address</td><td>192.168.10.125<br>*The following is an example at 192.168.10.128.</td></tr>
<tr><td>Sub-net mask</td><td>255.255.255.0</td></tr>
<tr><td>Default gateway</td><td>192.168.10.1</td></tr>
<tr><td colspan="2">> ping 192.168.10.128<br> 

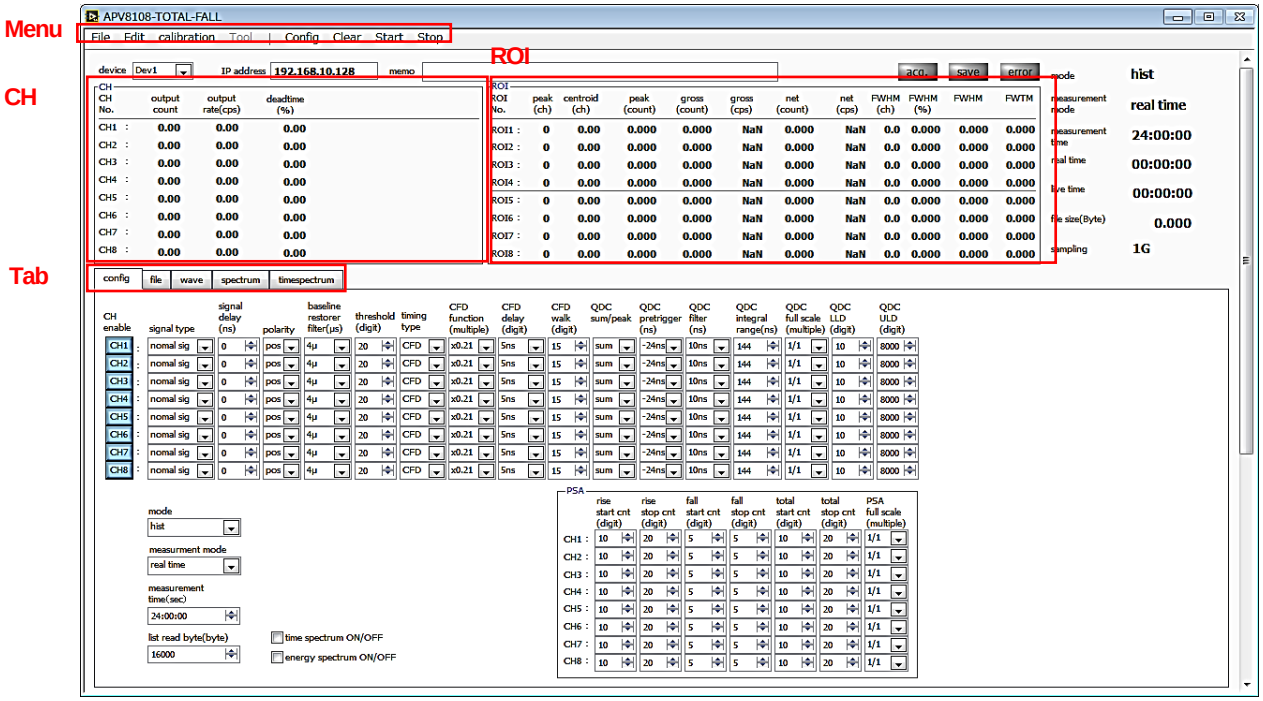
Pic. 3: Communication connection check, ping command execution</td></tr>
<tr><td rowspan="3">4</td><td colspan="2">Launch this application on a PC.</td></tr>
<tr><td colspan="2">*When starting this application, an error message of the content that failed to connect with the device may be displayed. The main causes are as follows.</td></tr>
<tr><td colspan="2">1. The port definition in the "System" section in the configuration file "config.ini" has an incorrect value. In particular, "DevConfigPort = 4660", "DevDataPort = 24", "SubnetMask =" 255.255.255.0 "", "Gateway =" 192.168.10.1 "", "ChNumber = 16" are important.<br>2. The LAN cable on the PC side is not fully inserted.<br>3. The LAN cable on the device side is not fully inserted.<br>4. The power of this device remains OFF or the LAN cable is broken.<br>5. The network setting on the PC side is DHCP.<br>6. The network settings on the PC side are not configured with private addresses (192.168.10.2 to 255 excluding 192.168.10.128).<br>7. The power saving mode of the PC is functioning.</td></tr>
</table>

| | |
|---|---|
| | 8. Wireless LAN of PC is enabled.<br>If the above cause does not start up properly, please try the following method.<br>After confirming the cable connection etc., restart this application. |

# 5. Screen of the application

## 5. 1. Startup screen

The following opening screen is displayed when you launch “Start”-“TechnoAP”-“APV8108-14”




**Pic. 4: Startup screen**

The contents of each item are as follows.

### Menu

It consists of "File", "Edit", "Calibration", "Config", "Clear", "Start" and "Stop".

| | |
|---|---|
| File - open config | Load configuration file |
| File - save config | Save current settings to a file |
| File - save histogram | Save current histogram data to file |
| File - save wave | Save current waveform data to file |
| File - save image | Save this application screen as PNG format image |
| File - quit | Finish |
| Edit - copy setting of CH1 | Reflects the setting of CH1 in the "CH" tab to the settings of all other CHs |
| Edit - IP configuration | Change IP address of display device |
| Calibration | Run calibration. Execute if there is a disturbance in the wave waveform |
| Help | Open the description of the current tab in pdf format |
| Config | Send all settings to this device |
| Clear | Initialize the histogram data in this device |
| Start | Send measurement start to this device |
| Stop | Send measurement stop to this device |

**Tab**

| | |
|---|---|
| config | Settings related to this device settings and measurement |
| file | Settings for saving waveform and list data |
| save | Display of input waveform, CFD waveform, QDC waveform |
| spectrum | Histogram display |
| timespectrum | Display time difference spectrum from time information of list data |

**CH section**

Display the status of each CH.

| | |
|---|---|
| output count | The total number of output events |
| output rate (cps) | Number of output events per second |
| deadtime (%) | Ratio of dead time |

**ROI section**

Display the calculated result between ROIs.

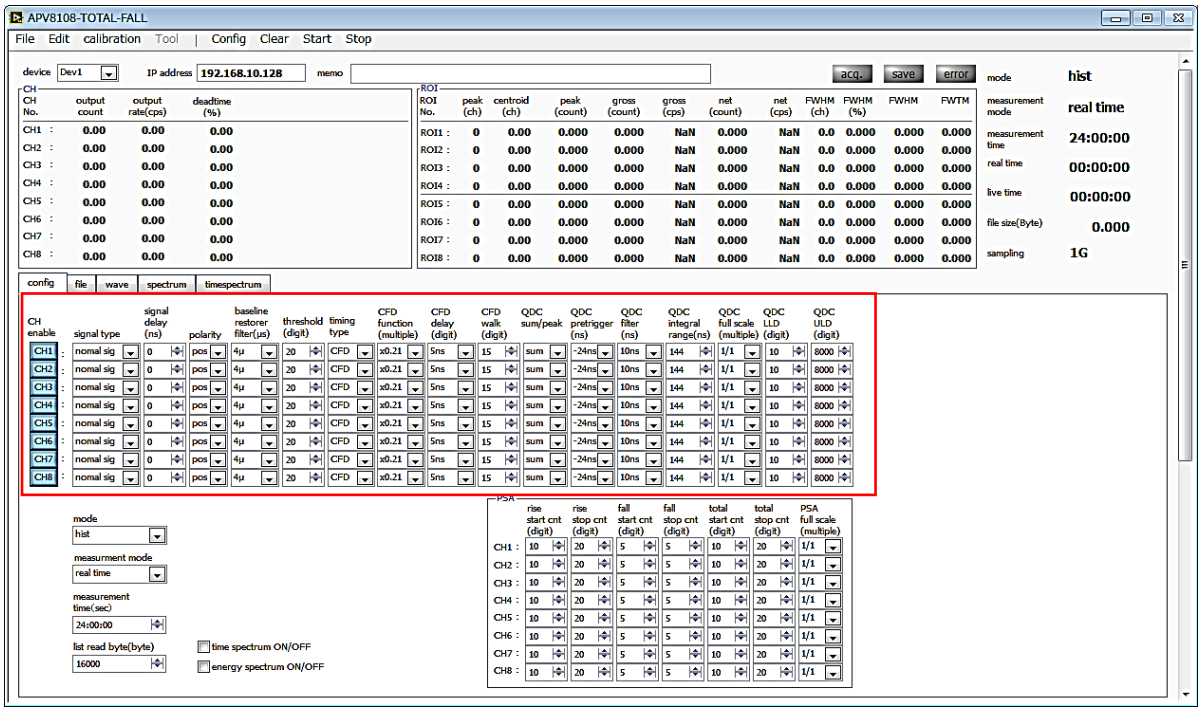
| | |
|---|---|
| peak (ch) | ch of the maximum count |
| centroid (ch) | Center value (ch) calculated from the sum of all counts |
| peak (count) | Maximum count |
| gross (count) | Sum of counts between ROIs |
| gross (cps) | CPS of counts between ROIs |
| net (count) | Sum of counts minus background between ROIs |
| net (cps) | CPS of the count minus the background between ROIs |
| FWHM (ch) | Half width (ch) |
| FWHM (%) | Half width (%). Half-width ÷ ROI defined energy × 100 |
| FWHM | Half width |
| FWTM | 1/10 width |

**Other**

| | |
|---|---|
| device | Select the device to be measured |
| IP address | It is defined in the configuration file, and the IP address of the device selected by "Module" is displayed. |
| memo | You can enter a memo for image storage. |
| acq. LED | Blink while measurement |
| save LED | Blink while saving list data |
| error LED | Lights up when an error occurs |
| mode | Display "hist", "wave", "list" or "list-com". Please note that the above modes may not be available depending on the configuration of the option. |
| measurement mode | Display "real time" and "live time" |
| measurement time | Set measurement time |

| | |
|---|---|
| real time | Real time of the effective first CH (actual measurement time). It is equal to measurement time at the end of measurement |
| live time | Effective first CH live time (effective measurement time). The value of real time minus the value of dead time. |
| file size (Byte) | Display the file capacity (Byte) while saving event data. |
| sampling | Display sampling frequency of display device |

## 5. 2. Config tab

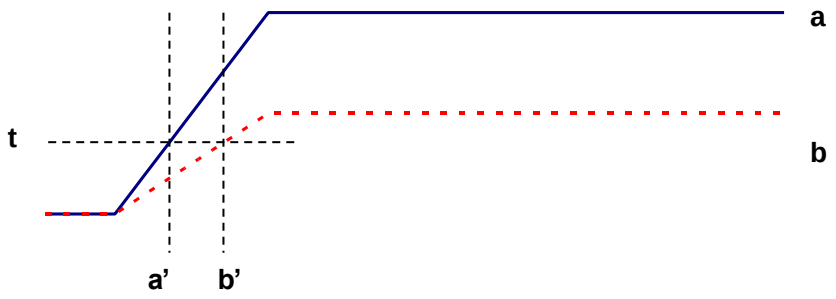



**Pic. 5-1: config tab, upper part**

The contents of each item are as follows.

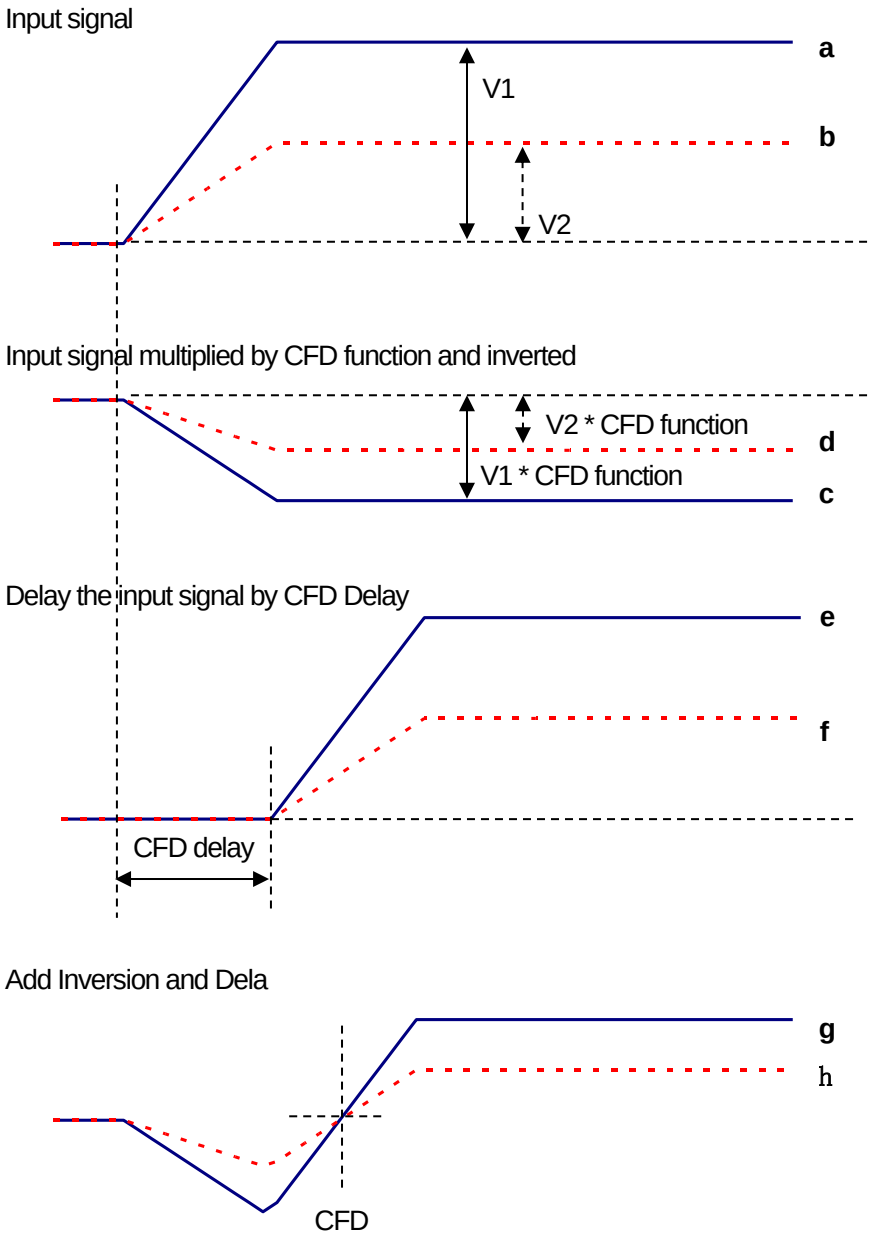
| | |
|---|---|
| CH enable | CH availability.<br>Normally, set all channels to enable (pressed). |
| signal type | Select the type of input waveform.<br>Set to “fast sig” when inputting NIM signals or timing signals.<br>For others, set "nomal sig". |
| signal delay | The input signal is delayed internally in this device.<br>The maximum delay time is 2 µs. |
| polarity | Select the polarity of the input signal from “pos” for positive polarity and “neg” for negative polarity. |
| baseline restorer filter | Set the time constant of baseline restorer.<br>Set from Ext (without AutoBLR), Fast, 4 µs, 85 µs, 129 µs, and 260 µs.<br>Normally set to 85 µs. |
| threshold | Set the threshold for waveform acquisition of the input signal. The unit is digit. The setting range is 0 to 8191. While watching the "raw" waveform in wave mode, set the value higher than the noise level.<br>  |

| | |
|---|---|
| timing type | Select the waveform for time stamp from CFD waveform and LED (raw waveform).<br>Leading-Edge Timing (LET)<br>It is the timing when a certain trigger level t is reached.<br>Trigger acquisition timing is different if the wave height changes as a 'and b'. |




**Pic. 6: Concept of Leading-Edge Timing (LET)**

**Constant Fraction Discriminator Timing (CFD)**

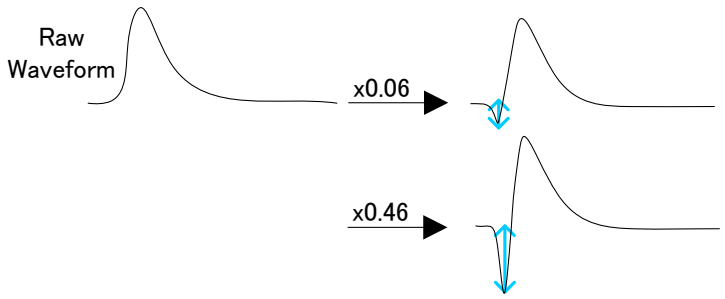
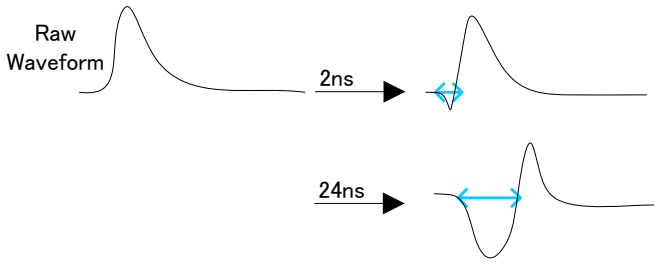
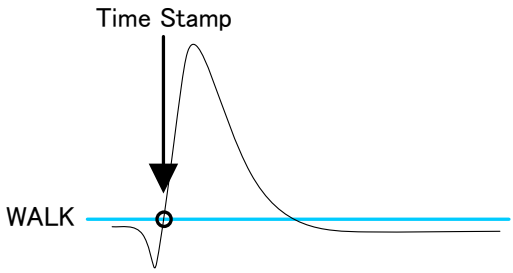
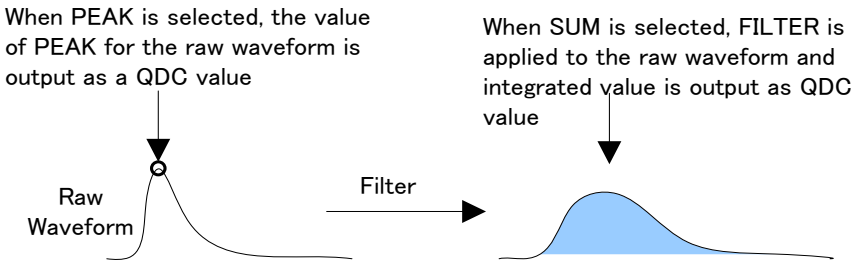


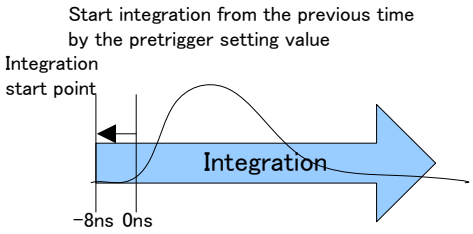
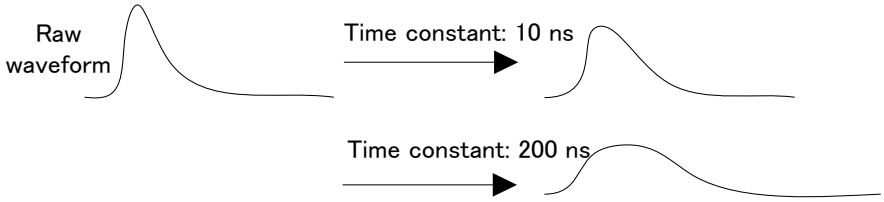
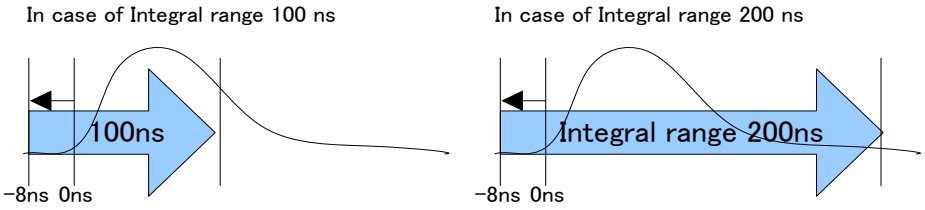
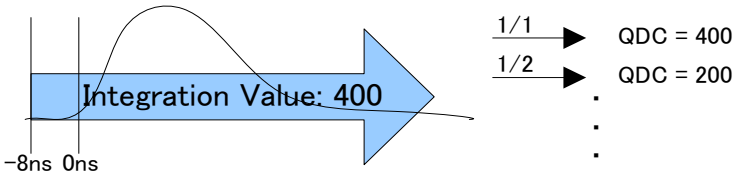

**Pic. 7: Concept of Constant Fraction Discriminator Timing**

Generate the waveforms "c, d", "e, f" and "g, h" in the table below for the different waveforms "a, b" in the figure above.

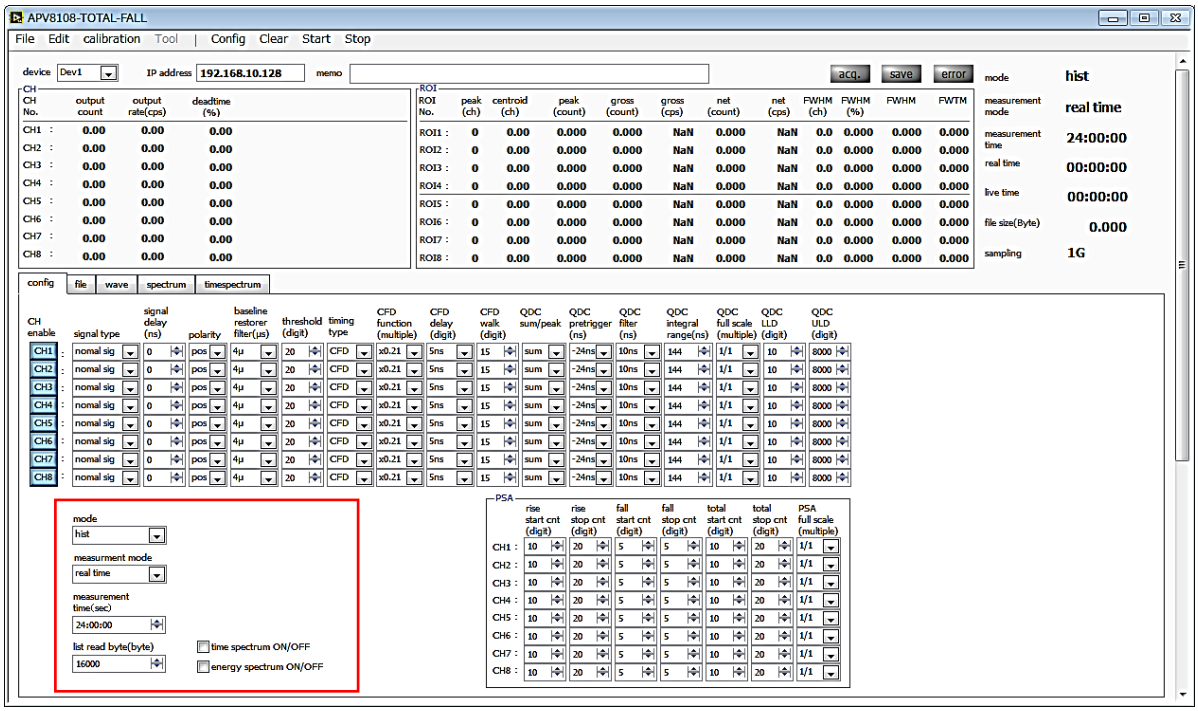
| | |
|---|---|
| Waveforms c and d | Waveforms a and b multiplied by the CFD function and inverted |
| Waveforms e and f | Waveforms obtained by delaying the waveforms a and b by the CFD delay |
| Waveforms g and h | Waveforms obtained by adding waveforms c and e and waveforms obtained by adding d and f |

CFD, which is the zero-cross timing of waveforms g and h, is characterized in that its value remains constant even if the wave height changes, provided that the rise time of the waveform is the same.

| | |
|---|---|
| CFD function | Magnification to reduce the original waveform for CFD waveform shaping.<br>Set from 0.03 times, 0.06 times, 0.09 times, 0.12 times, 0.15 times, 0.18 times, 0.21 times, 0.21 times, 0.25 times, 0.28 times, 0.31 times, 0.34 times, 0.37 times, 0.40 times, 0.43 times, 0.46 times.<br>  |
| CFD delay | Set the CFD delay time.<br>This board sets in 1 ns step from 1 ns to 24 ns.<br>  |
| CFD walk | Set the threshold for timestamping. The unit is digit.<br>While viewing the waveform of "CFD" in wave mode, set the value near the zero-cross position.<br>  |
| QDC sum or peak | Select the output format of QDC data.<br>Select from PEAK value and SUM value.<br>  |

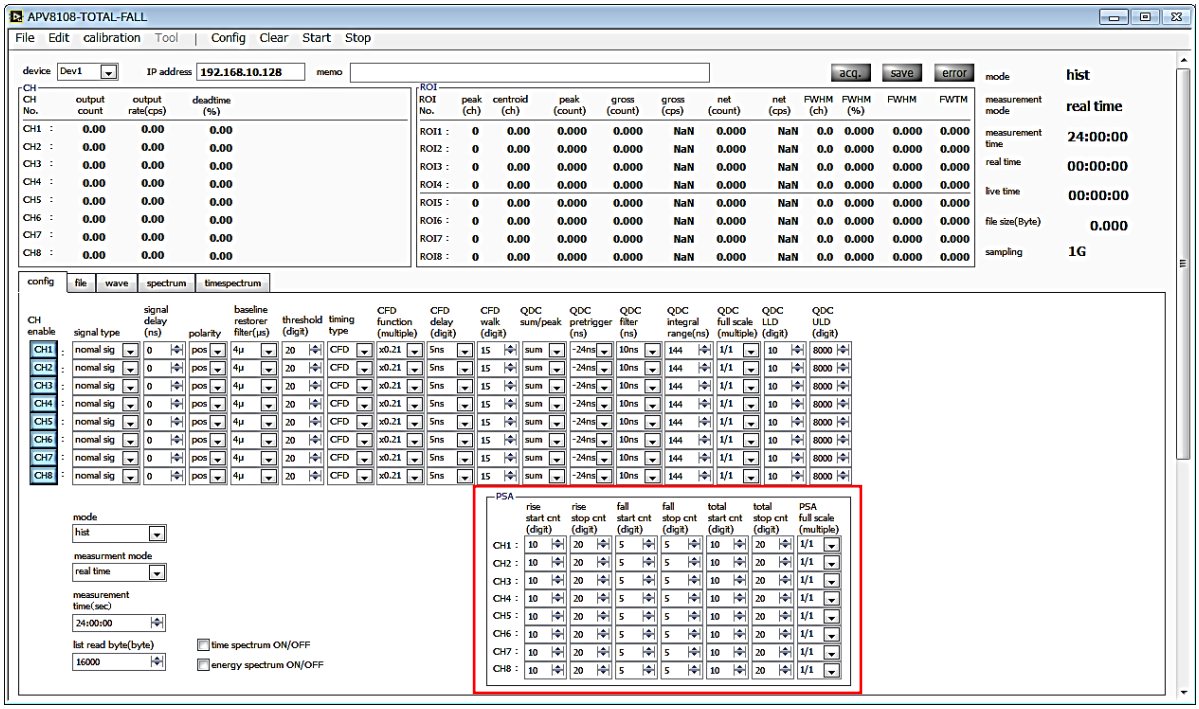
| | |
|---|---|
| QDC pre trigger | Set the timing to start waveform shaping for integral value calculation.<br>Select from 0 ns, -8 ns, -16 ns, -32 ns, -40 ns.<br>  |
| QDC filter | Set the time constant for shaping the waveform for integral value calculation.<br>The setting is selected from Ext, 10 ns, 20 ns, 50 ns, 100 ns and 200 ns.<br>  |
| QDC integral range | Select QDC integration time.<br>The range is 0 ns to 32000 ns.<br>  |
| QDC full scale | Set the gain of QDC data.<br>The setting is selected from 1/1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512.<br>Make the QDC value be less than 8191.<br>  |
| QDC LLD | Set the Lower Level Discriminator (LDC) of QDC. The unit is digit.<br>Integration values below this threshold do not acquire timestamp data and integration value data. Set to a value smaller than ULD. The setting range is 0 to 8191. |
| QDC ULD | Set the Upper Level Discriminator (UDC) of QDC. The unit is digit.<br>Integrated values above this threshold do not acquire time stamp data and integrated value data. Set to a value larger than LLD. The setting range is 0 to 8191. |
| OR eable | Set the OR output to the front panel AUX terminal. It can be set for each CH.<br>One pulse TTL logic is output for the event after passing LLD and ULD. (optional)<br>* Not shown in the photo on page 13. |

| | |
|---|---|
| OR length | Set the TTL logic pulse width. It can be set from 8ns to 1000ns. (optional)<br>* Not shown in the photo on page 13. |




**Pic. 5-2: config tab, lower left part**

| | |
|---|---|
| mode | Select from hist, list, wave, and list_com |
| | **hist**: Integrate the input signal and display the spectrum. |
| | **wave**: Digitize the input signal and display the waveform. |
| | **list**: Regarding the input signal, time information, CH information and integration information are regarded as one event, and output and stored as a binary file. Also used when acquiring the time spectrum. |
| | **list_com**: Use when measuring in time between boards. Use CH1 as a common signal input terminal and input a fast-rising pulse with little jitter after start. |
| mesurement mode | Select from real time and live time.<br>The measurement is completed in the selected time mode. |
| mesurement time | Set the measurement time. It is up to 8760 hours. |
| list read byte | Set the unit reading number. It will be fixed at 16,000 bytes. |
| time spectrum on/off | Select whether to display time spectrum while acquiring list data in list mode. If you want to obtain only list data, uncheck it.<br>**NOTE: Selecting that check box during high count measurement will delay the acquisition of list data.** |
| energy spectrum on/off | Select the presence or absence of spectrum display while acquiring list data in list mode. If you want to obtain only list data, do not select the check box.<br>**NOTE: Selecting that check box during high count measurement will delay the acquisition of list data.** |




**Pic. 5-3: config tab, lower right part**

## PSA section

Settings related to PSA (Pulse Height Analysis) calculation. Set three integration ranges: RISE (rising portion of acquired waveform), FALL (falling portion), and TOTAL (entire waveform), which are data in list mode.

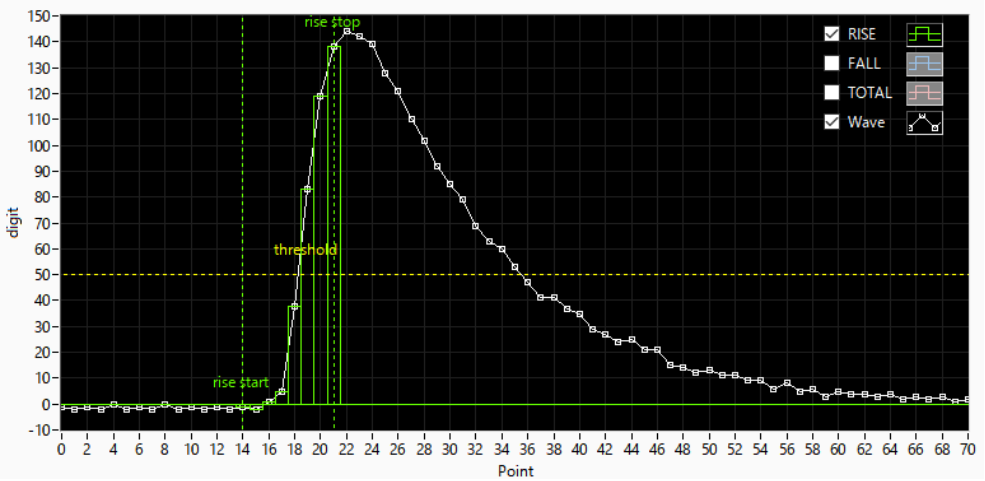
In PSA calculation, if the input waveform is negative, it is inverted to be positive and the waveform is always considered positive.

| | |
|---|---|
| rise start cnt | Start position of the target range of integrated value RISE in the rising part.<br>Set the range in front of the position beyond the threshold.<br>The setting range is 1 to 498 (498 ns = 498 × 1 ns). |
| rise stop cnt | End position of the target range of the integral value RISE of the rising part.<br>Set the range to integrate from the above "rise start cnt".<br>The setting range is 1 to 16383 (16363 ns = 16383 × 1 ns). |

**Example of calculation of RISE value**:

* Please refer to the image on the next page.

In the case of set threshold: 50, rise start cnt: 5, rise stop cnt: 8 and PSA full scale: 1/1, integrate the green frame part, starting 8 points from 5 points before the threshold You The integral value is multiplied by PSA full scale to obtain the RISE value of the list data.

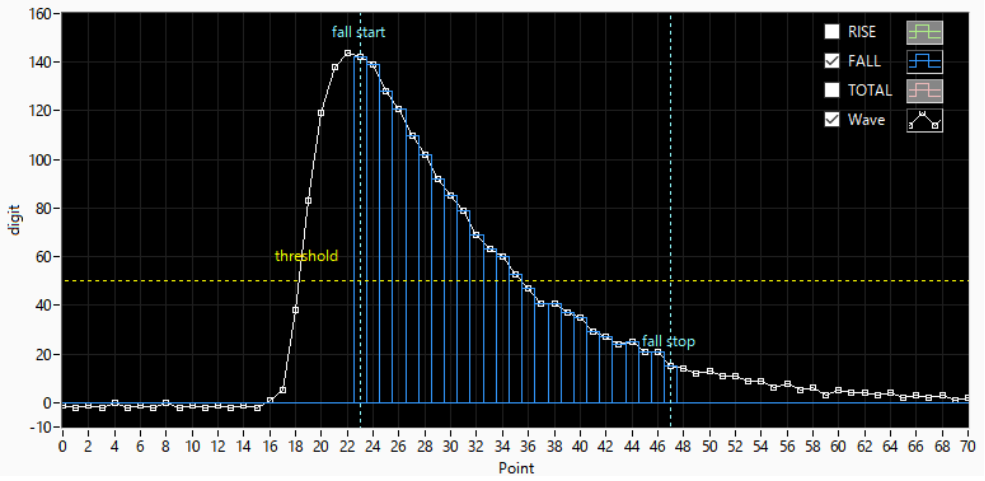



**Pic. 6: Setting example of rise start cnt and rise stop cnt**

| | |
|---|---|
| fall start cnt | Start position of the target range of the integrated value FALL at the falling edge.<br>Set the start position of integration range from the position exceeding threshold.<br>The setting range is 1 to 16383 (16383 ns = 16383 × 1 ns).<br>Set a value smaller than "fall stop cnt" described below |
| fall stop cnt | End position of the target range of integral value FALL of falling part.<br>Set the range of integration from the above "fall start cnt".<br>The setting range is 1 to 16383 (16383 ns = 16383 × 1 ns).<br>Set a value larger than the "fall start cnt" described above. |

**Example of calculation of FALL value:**

In the case of set threshold: 50, fall start cnt: 5, fall stop cnt: 25, PSA full scale: In the case of 1/1, the FALL value exceeds threshold and integrates the blue frame part in the figure below for the 5th to 25 points. You The integral value is multiplied by PSA full scale to obtain the FALL value of the list data.

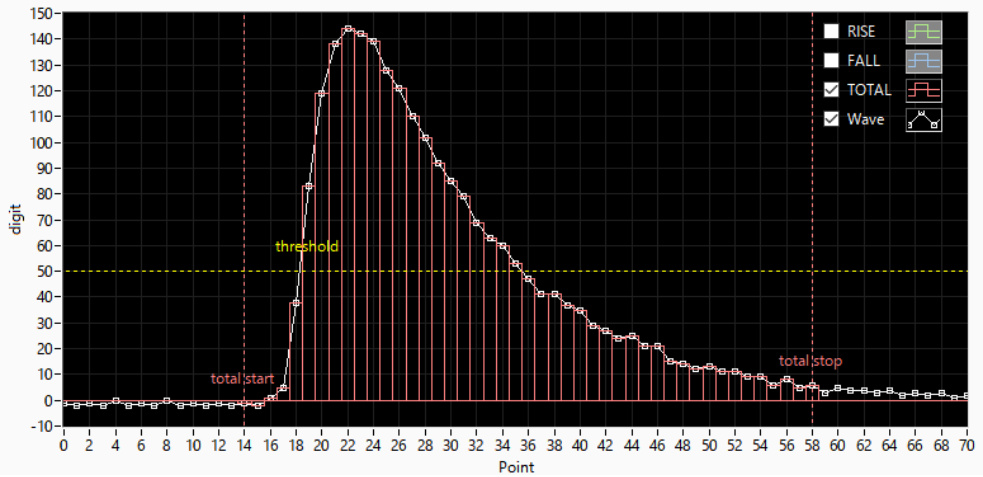



**Pic. 7: Setting example of fall start cnt and fall stop cnt**

| | |
|---|---|
| total start cnt | Start position of the target range of the waveform integral value TOTAL.<br>Set the range in front of the position beyond the threshold.<br>The setting range is 1 to 498 (498 ns = 498 × 1 ns). |
| total stop cnt | End position of the target range of the waveform integral value TOTAL.<br>Set the range for integration from the above "total start cnt".<br>The setting range is 1 to 16383 (16383 ns = 16383 × 1 ns). |

**Example of calculation of TOTAL value:**

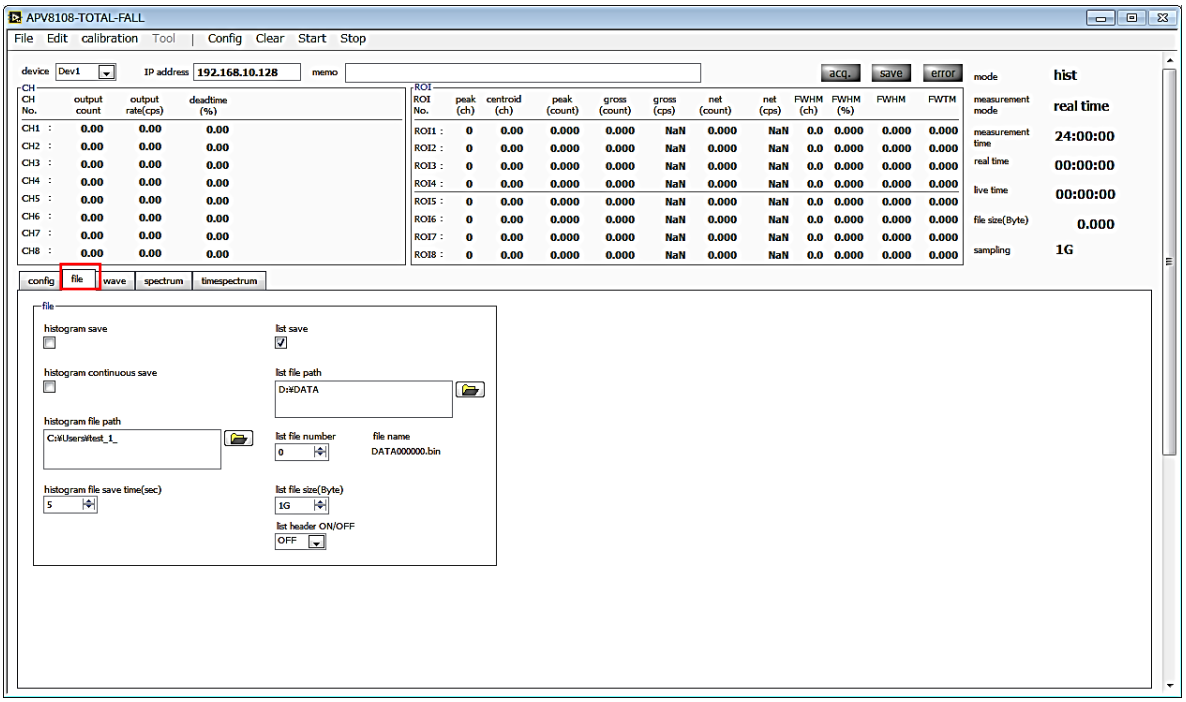
In the case of set threshold: 50, total start cnt: 5, total stop cnt: 50, PSA full scale: In case of 1/1, integrate the red frame part in the figure below 50 points from 5 points before the position of threshold . The integral value is multiplied by PSA full scale to obtain the TOTAL value of the list data.




**Pic. 8: Setting example of total start cnt and total stop cnt**

| | |
|---|---|
| PSA full scale | Set the reduction ratio of RISE value, FALL value and TOTAL value of list data |

## 5. 3. file tab



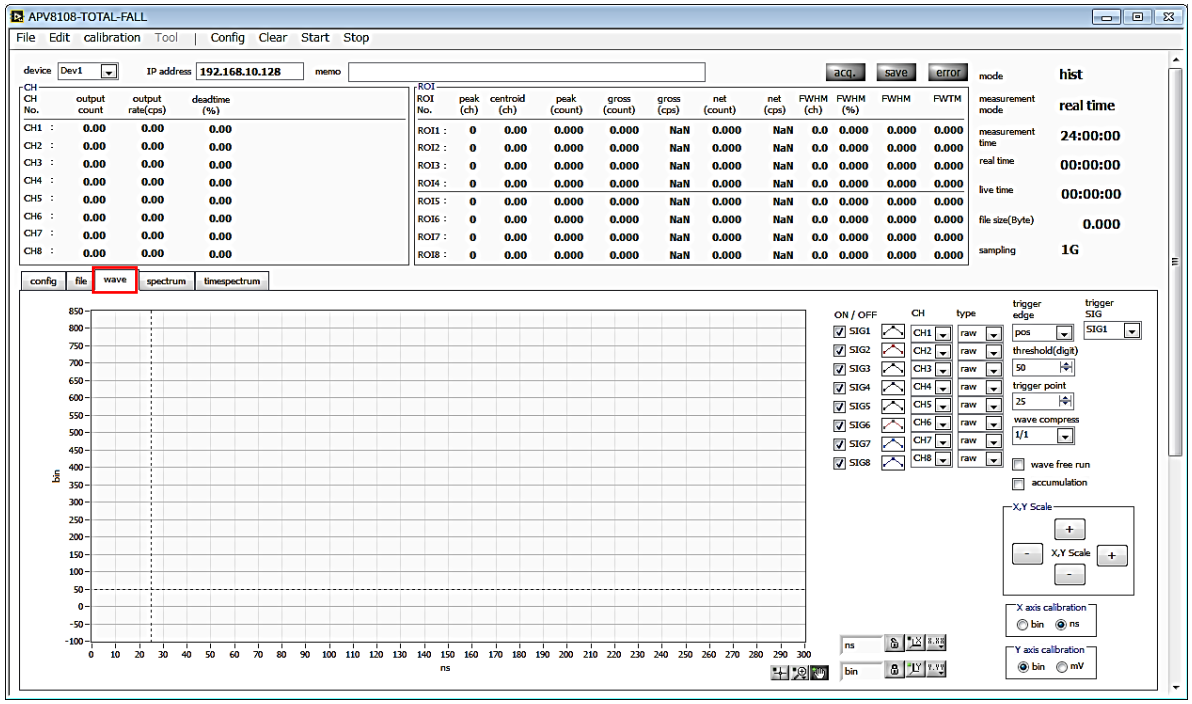

**Pic. 9: file tab**

Setting section for saving.

| | |
|---|---|
| histogram save | Save the histogram data displayed in the "spectrum tab" at the end of measurement to a file. The file save destination will be in the format described later. It is valid only when "hist" is selected in "mode" |
| histogram continuous save | Set whether to save histogram data to file continuously at set time interval. It is valid only when "hist" is selected in "mode". |
| histogram file path | Set absolute path of histogram data file. No extension is also possible.<br>**NOTE: It is not saved with this file name, but based on this file name, it will be the following format.**<br>Example: When "C: ¥ Data ¥ histogram.csv" is set in "histogram file path" and "10" is set in "histogram file save time (sec)", and the date and time is 2010/09/01 12:00:00 Will start saving data with the file name "C: ¥ Data ¥ histogram_20100901_120000.csv". After 10 seconds, save the file as "C: ¥ Data ¥ histogram_2010001_1200.csv".<br>*** The above "120010" may be "120009" or "120011".** |
| hisutogram file save time (sec) | Set the time interval for continuous storage of histogram data. The unit is seconds. The setting range is 5 seconds to 3600 seconds. |
| list save | Set whether to save list data to file. Valid only when "list" is selected in "mode" in the Config tab. |
| list file number | Set the start number of the number added to the list data file. From 0 to 99,999. It will be reset to 0 if it exceeds 999999. |

| | |
|---|---|
| list file size (Byte) | Set the maximum file size of the list data file. If this size is exceeded while saving list data, the file is closed, and data saving is continued with a new file name that is incremented by one "list file number". "File size (Byte)" located on the right side of the setting displays the size of the file currently being saved. |
| list header ON/OFF | Set header ON / OFF when acquiring list data. The header is an IP address. When OFF, data without IP address header is saved. |

## 5. 4. wave tab

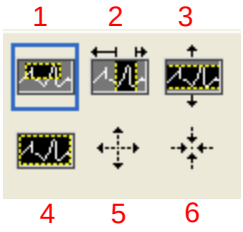



**Pic. 10: wave tab**

Settings related to waveform display.

| | |
|---|---|
| Graph | Waveform graph.<br>When "wave" is selected in "mode" in the "config" tab, the waveform is displayed. |
| on/off | Set whether to display the waveform |
| CH | Select the CH of the waveform to be displayed. |
| Type | Select the type of waveform to be displayed.<br>**raw**: Waveform digitized by the ADC and BLR processed<br>**CFD**: Waveform shaped waveform of CFD.<br>**Filter**: Waveform integrated by QDC<br>**PTG**: Square wave at piled up timing |
| trigger edge | Select the trigger polarity. In general, select pos. |
| threshold | Set the trigger threshold.<br>*You can also set the cursor in the graph. |
| trigger point | Sets the waveform display start point.<br>*You can also set the cursor in the graph. |
| trigger SIG | Select a SIG (Signal) to trigger. Normally, select SIG1. |
| wave compress | Set the time scale compression of X axis.<br>Used to display waveforms with long fall times. |
| wave free run | When the check box is not selected, the triggered waveform is displayed, and when it is checked, the trigger free waveform is displayed.<br>It can also be used to view baseline levels and noise levels. |

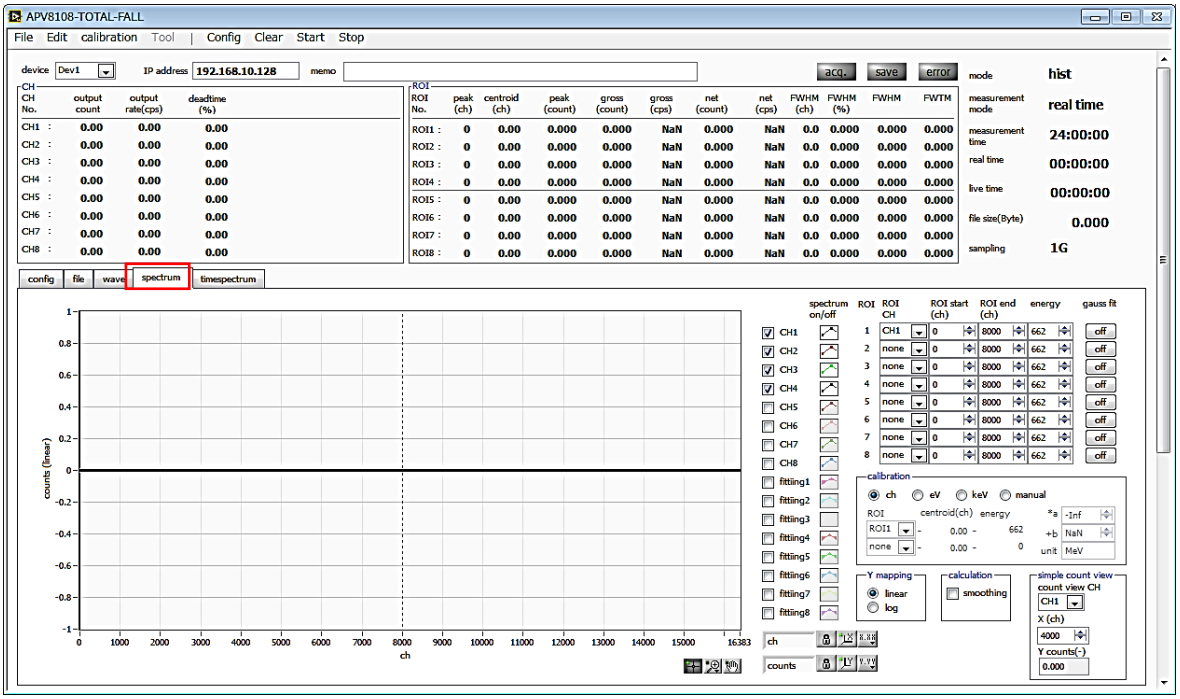
| | |
|---|---|
| accumlation | Selection of valid / invalid of superposition of waveform data |
| XY Scale | Button to adjust the scale of X axis and Y axis.<br>Expansion is + (plus), reduction is-(minus) |
| X axis calibration | Select the unit of X axis |
| Y axis calibration | Select the unit of Y axis.<br>*Please use the mV display as a reference. |
| X-axis range | When you right-click on the X-axis and select "Auto scale", it becomes auto scale. When deselected, it will not be in automatic scale, and the minimum value and maximum value of X axis will be fixed.<br>If you want to change the minimum or maximum value, you can place the mouse pointer over the number you want to change and click or double-click to change it. |
| Y-axis range | When you right-click on Y-axis and select "Auto scale", it becomes auto scale. When deselected, it will not be in automatic scale, and the minimum and maximum values of the Y axis will be fixed.<br>If you want to change the minimum or maximum value, you can place the mouse pointer over the number you want to change and click or double-click to change it. |
|  | Cursor movement tool.<br>The cursor can be moved on the graph when setting the ROI. |
|  | Zoom.<br>When selected, the following six zooms in and zoom out options can be selected and executed. |
|  | Pan tool.<br>You can grab the plot and move it over the graph. |




**Pic. 11: For zooming in and out**

| | | |
|---|---|---|
| 1 | Rectangle | Use this option to click the point on the display that you want to be the corner of the zoom area and drag the tool until the rectangle occupies the zoom area. |
| 2 | X-Zoom | Zooms in to the area of the graph along the X axis. |
| 3 | Y-Zoom | Zooms in to the area of the graph along the Y axis. |
| 4 | Fit Zoom | Automatically scales all X and Y scales on the graph. |
| 5 | Zoom out around point | Click the center point to zoom out. |
| 6 | Zoom in around point | Click the center point to zoom in. |

## 5. 5. spectrum tab



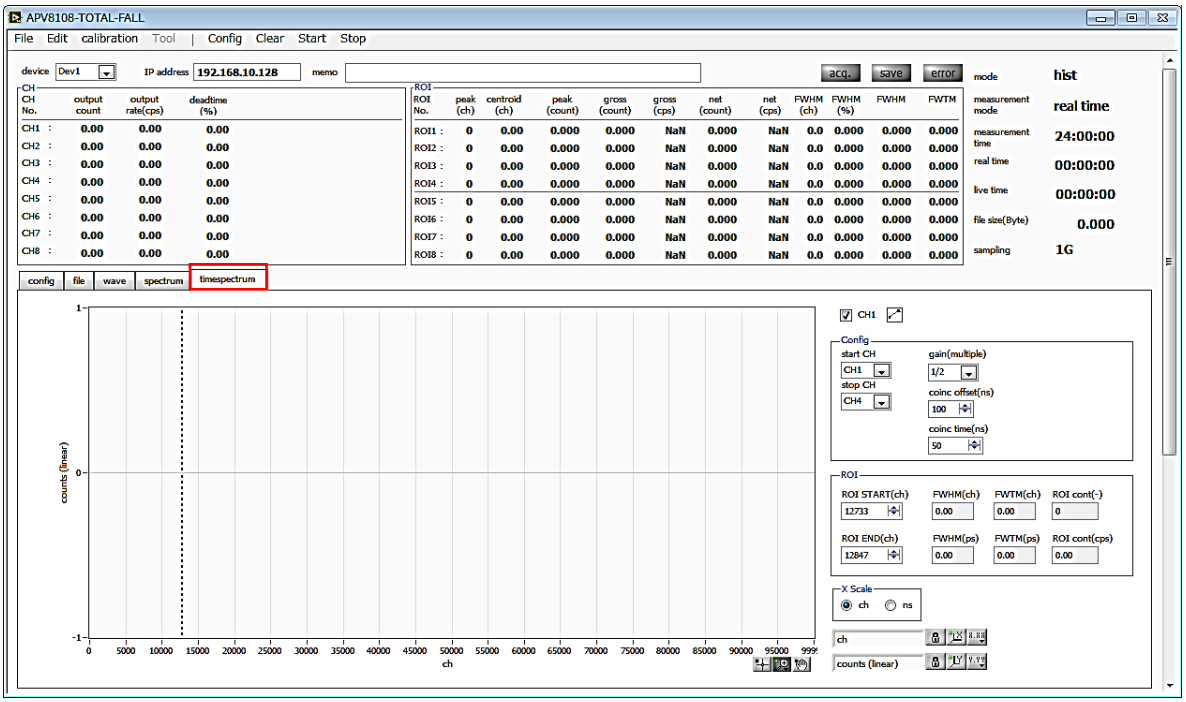

**Pic. 12: spectrum tab**

Settings related to spectrum display.

| | |
|---|---|
| Graph | Energy spectrum. The spectrum is displayed when "hist" is selected for "mode" in the "config" tab or when "list" is selected for "mode" in the "config" tab and "spectrum ON / OFF" is enabled. |
| Check box | Sets whether to display the histogram for each channel on the graph. |
| ROI CH | Select the CH number to apply ROI (Region Of Interest).<br>Up to 8 (eight) ROIs can be set for one CH signal |
| ROI start (ch) | Set the start position of ROI. The unit is ch |
| ROI end (ch) | Set the end position of the ROI. The unit is ch |
| energy | Defines the energy value of peak position (ch).<br>In the case of 60 Co, it is set to 1173 (keV) or 1332 (keV). When "ch" is selected in "calibration", the peak between the ROIs is detected, keV / ch is calculated from the peak position (ch) and the set energy value, and the calculated half width is calculated. |
| calibration | Select the unit of X axis.<br>The label of the X axis is also changed along with the setting.<br>**ch**: Unit ch (channel) display. Units such as “FWTM” of “FWTM” of ROI are arbitrary.<br>**eV**: Unit eV display. Calculate the slope a and intercept b of the linear function y = ax + b so that ch becomes eV by two-point calibration of two types of peaks (center value) and energy value in one histogram, and set as the X axis You The unit such as "FWTM" of "FWTM" of ROI is "eV". |

| | |
|---|---|
| | **keV**: Unit keV display. Calculate the slope a and intercept b of the linear function y = ax + b so that ch becomes keV by two-point calibration of two kinds of peaks (center value) and energy value in one histogram, and set as the X axis You The unit such as "FWTM" of "FWTM" of ROI is "keV". Example: When there are 1173.24keV of 60Co in 5717.9ch and 1332.5keV of 60Co in 6498.7ch, a is calculated automatically as 0.20397 and b is 6.958297 from 2-point calibration.<br>**manual**: Set the slope a and intercept b of the linear function y = ax + b, and the unit label to the X axis. The unit is set arbitrarily. |
| Y mapping | Select mapping of Y axis of graph.<br>The label of the Y axis is also changed along with the setting.<br>linear: straight line<br>log: log |
| smoothing | Smoothing (5-point second order smoothing) function to calculate the half-width when there are few statistics. |
| simple count view | You can easily read the count displayed on the graph. |
| gauss fit | Apply Gaussian fitting to the spectrum. |

## 5. 6. timespectrum tab




**Pic. 2: timespectrum tab**

Settings related to timespectrum display. It is a measurement limitation in the board.

*Timespectrum is generated based on the list data acquired in list mode.

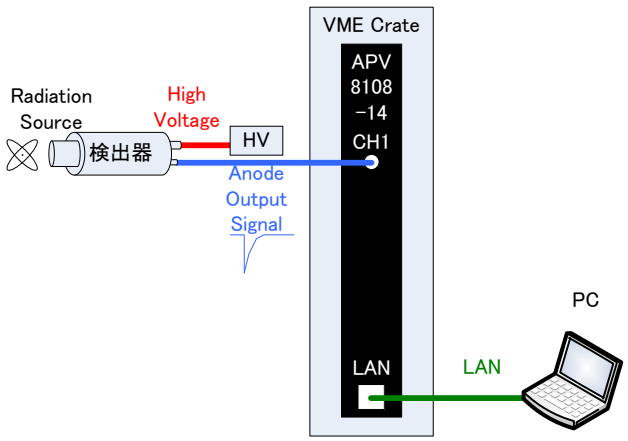
| | |
|---|---|
| Graph | Time difference spectrum. If "list" is selected for "mode" in the "config" tab and "timespectrum on / off" is selected, the time difference spectrum is displayed during measurement. |
| Check box | Select whether to display spectrum or not. |
| Config part | Setting of time spectrum.<br>**start CH**: Select the CH number for acquiring the start timing.<br>**stop CH**: Select the CH number for acquiring stop timing.<br>**gain**: You can select from 1x to 1 / 128x. At 1-time, full scale about 780 ns (about 3.9 ps per 1 digit), 1/128 full scale is about 100 μs (0.5 ns per 1 digit).<br>**coinc offset**: Sets the offset in units of 1 ns.<br>**coinc time**: Set the coincidence time in units of 1 ns. If the time difference between event detection in the above "start CH" and "stop CH" is within this setting range, it is considered as coincidence (simultaneous) and it is considered as valid data. |
| ROI | Settings related to calculation.<br>**ROI START**: ROI start channel<br>**ROI END**: end channel of ROI<br>**FWHM**: The calculated half width is displayed.<br>**FWTM**: Displays the calculated full value range. |
| Xscale | Select the unit of X axis, "ch" channel or "ns" display. |

# 6. Measurement

As an example, the operation procedure of energy spectrum measurement, list measurement, and time spectrum measurement when using LaBr3 (Ce) detector (hereinafter referred to as detector) is described.

## 6. 1. Energy Spectrum measurement

（1） Environment

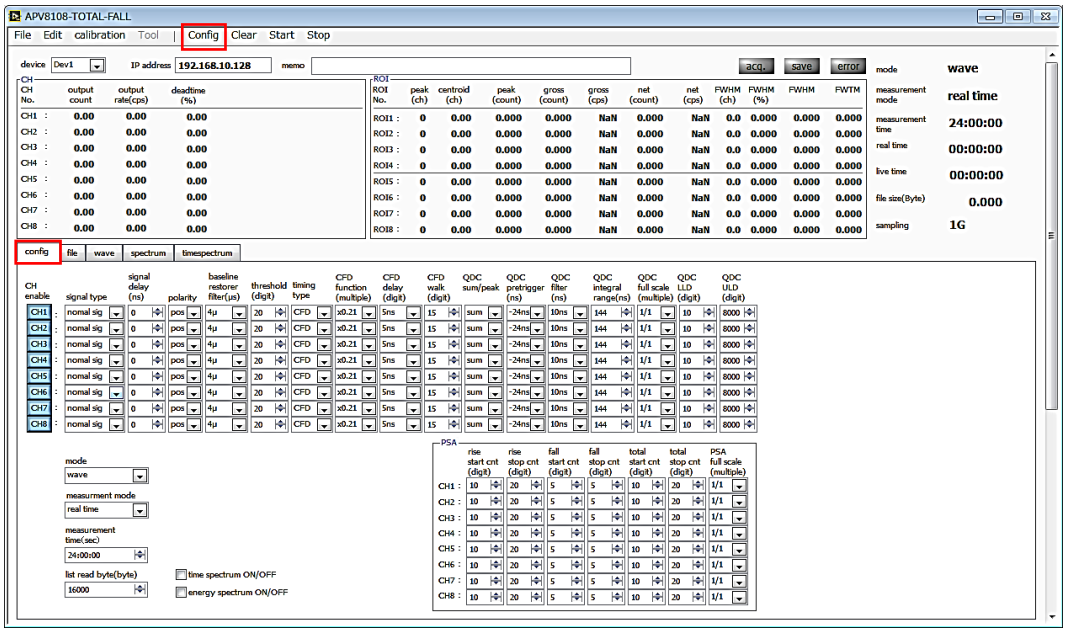



**Pic. 3: Configuration for energy spectrum measurement**

| | |
|---|---|
| | Check that all devices (VME rack, High voltage power supply and PC) are off. |
| | Connect the detector and HV with the SHV connector cable. |
| | Connect the anode output signal from the detector to CH1 of APV8108-14 with LEMO connector coaxial cable. In the case of a BNC connector, use a BNC-LEMO conversion adapter. |
| | Connect APV8108-14 and PC with LAN cable. |
| | Power on the VME rack. |
| | Turn on the PC. Launch the application. |
| | Turn on the high voltage power supply and apply the voltage according to the detector. |
| | In this example, Cs-137 is used for the radiation source. |

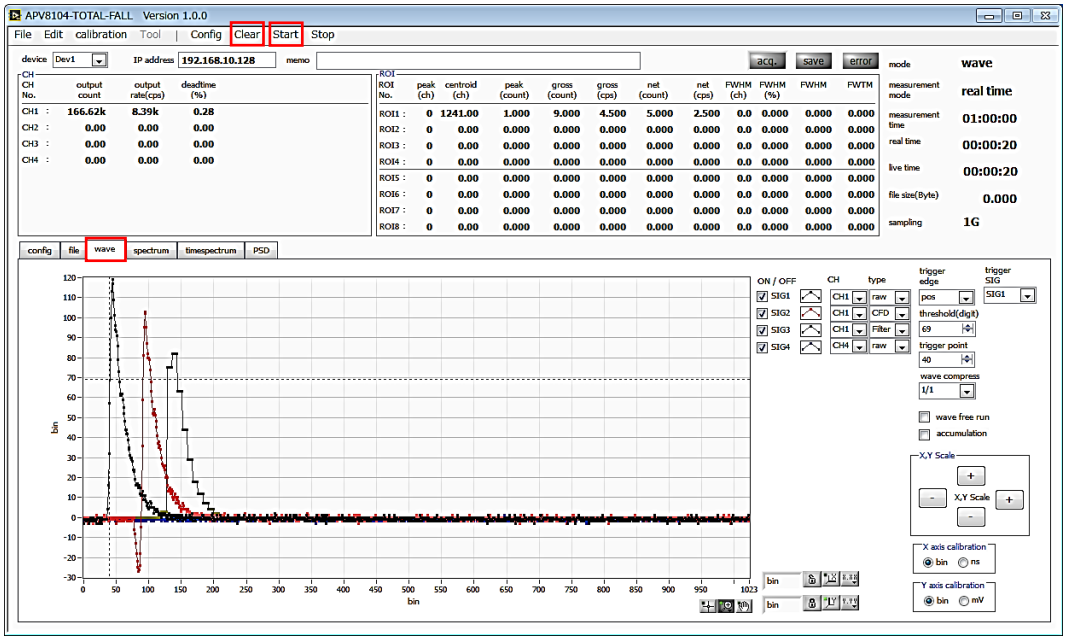
## （2） Waveform measurement

First, check the signal from the detector that is input in waveform mode.
Make the following settings in the "config" tab, and then click the "Config" menu.




**Pic.4 Setting of waveform measurement**

Open the "wave" tab, check the settings shown below, click "Clear" in the menu and then click "Start".
The waveform from the detector is displayed on the graph.



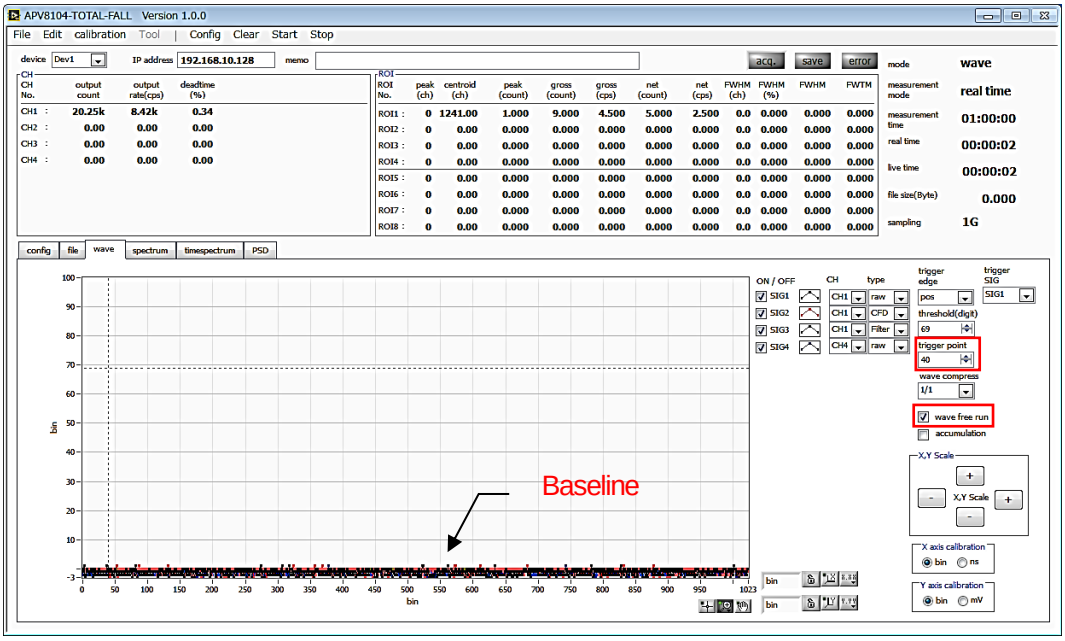

**Pic.5: Screen of waveform measurement**

**Note the following points**

If no signal is displayed, the trigger may not have been applied.

Select "wave free run" in the "wave" tab to check the baseline, click "Config" on the menu bar, then "Clear" and finally "Start".

You can see how many wave heights are at the baseline and roughly.




**Pic. 6: Screen of baseline check**

Next, deselect "wave free run", gradually increase the "threshold" value from about 10, and confirm the "threshold" value at which the waveform can be captured firmly as shown on the previous page. This value will be used for later configuration.

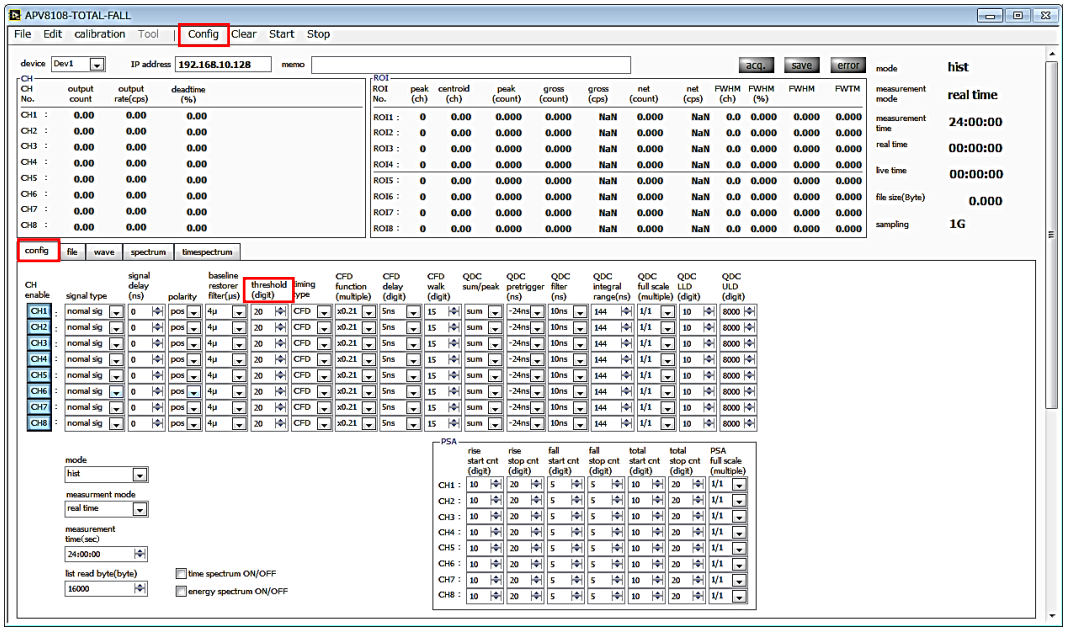
* Check if the wave height is too large to saturate.

Decrease the applied high voltage to reduce the amplitude of the input signal to the device.

Measured data can be saved with "save wave" in "File" of the menu bar.

## （3） Measurement of Energy Spectrum

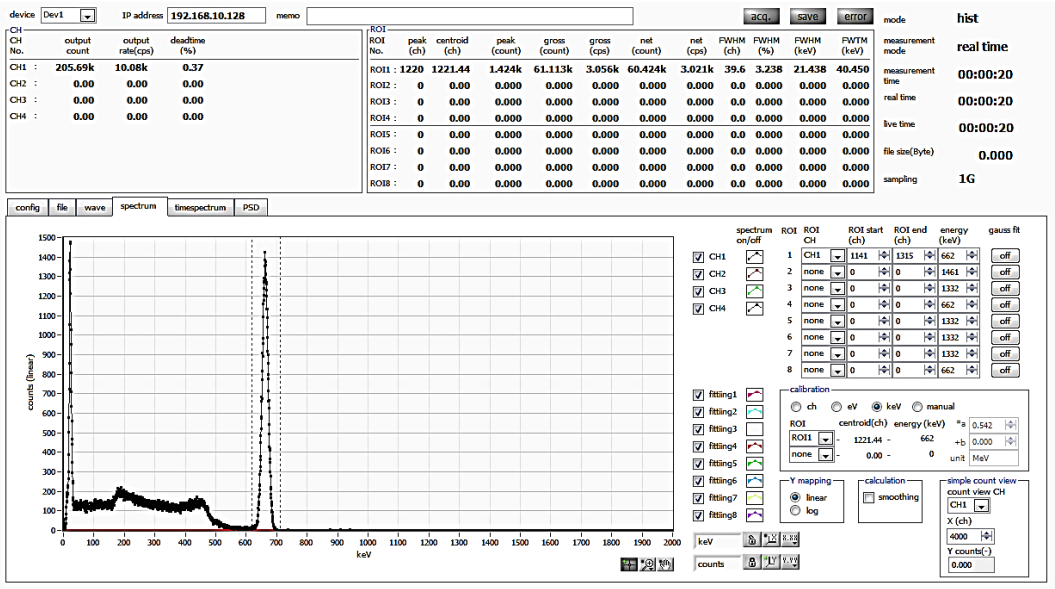
For spectrum measurement, click the "Config" on the menu bar after making the following settings on the "config" tab. Set the "threshold" value set during waveform measurement to "threshold" in the "config" tab.




**Pic. 7: Config tab**

Open the "spectrum" tab, check the settings shown below, then click "Clear" and then "Start" in the menu bar.

The following spectrum is displayed after execution.




**Pic. 8: Screen of Energy spectrum measurement**

**Please note the following points.**

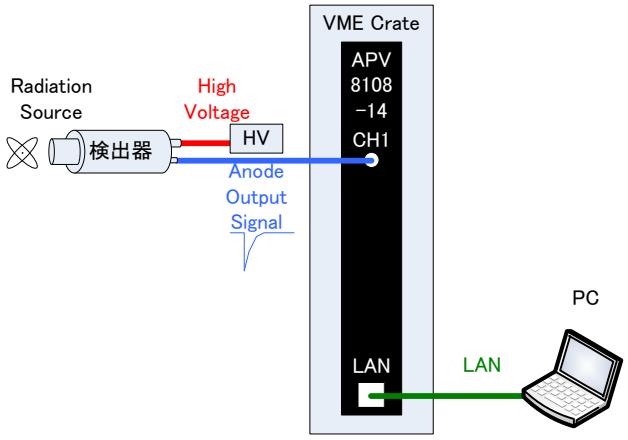
- Select “spectrum on / off” CH1 and display the spectrum of CH1.
- When analyzing peaks, set the ROI. Refer to "5.5. Spectrum tab" for details.

Measured data is saved with "save histogram" in "File" of the menu bar.

When you finish measurement, click "Stop" on the menu bar.

## 6. 2. List measurement

### （1） Environment




**Pic. 9: Configuration for energy spectrum measurement**

| | |
|---|---|
| | Check that all devices (VME rack, High voltage power supply and PC) are off. |
| | Connect the detector and HV with the SHV connector cable. |
| | Connect the anode output signal from the detector to CH1 of APV8108-14 with LEMO connector coaxial cable. In the case of a BNC connector, use a BNC-LEMO conversion adapter. |
| | Connect APV8108-14 and PC with LAN cable. |
| | Power on the VME rack. |
| | Turn on the PC. Launch the application. |
| | Turn on the high voltage power supply and apply the voltage according to the detector. |
| | In this example, Cs-137 is used for the radiation source. |

### （2） Confirmation of input waveform

Confirm the same as in “6. 1. Energy Spectrum Measurement (2) Waveform Measurement” above.

### （3） Confirmation of Energy spectrum

Confirm the same as in “6. 1. Energy Spectrum Measurement (3) Measurement of Energy Spectrum” above.

NOTE: the following points in this software.

| | |
|---|---|
| output rate (cps) | It is the number of events to be acquired in one second, and it is checked whether it is too low or too high for the assumption (See No. 1 in the figure on the next page).<br>In list mode, 16 bytes of data are acquired for each event.<br>For example, if "output rate (cps)" is 500 kcps, data of 8 MB / s (500 kcps x 16 Bytes) will be saved per second. |
| spectrum tab | Check that there is no abnormality in the shape of the spectrum, and if excessive noise data is acquired. (See No. 2 on the next page) |

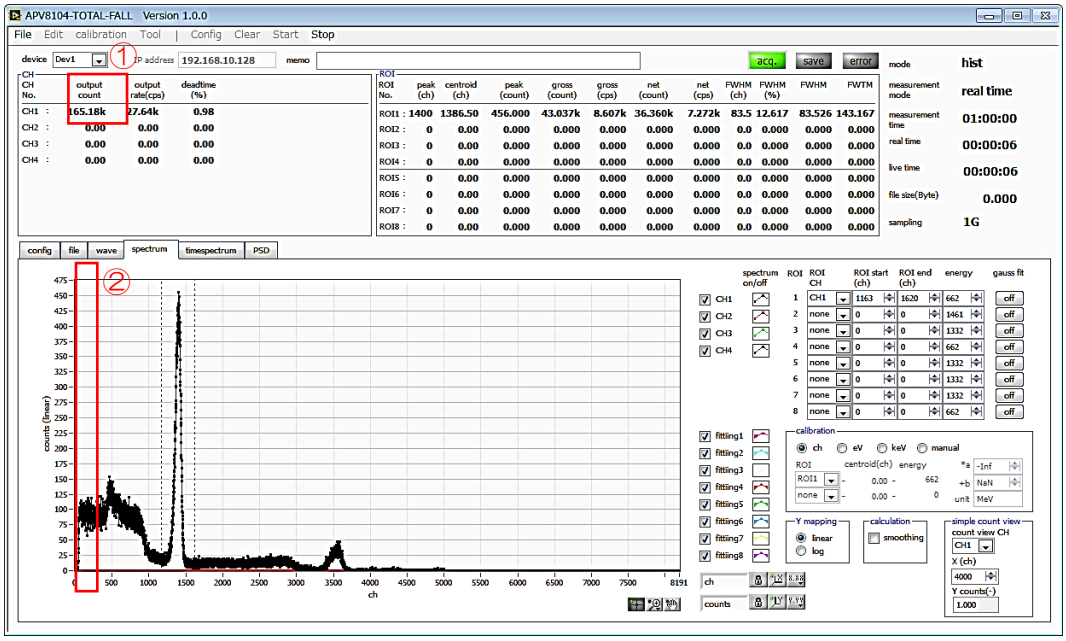



**Fig. 10: Point to make note of before measurement in list mode**

## （4） List measurement

Start list measurement. Set "mode" to "list" in the "config" tab.

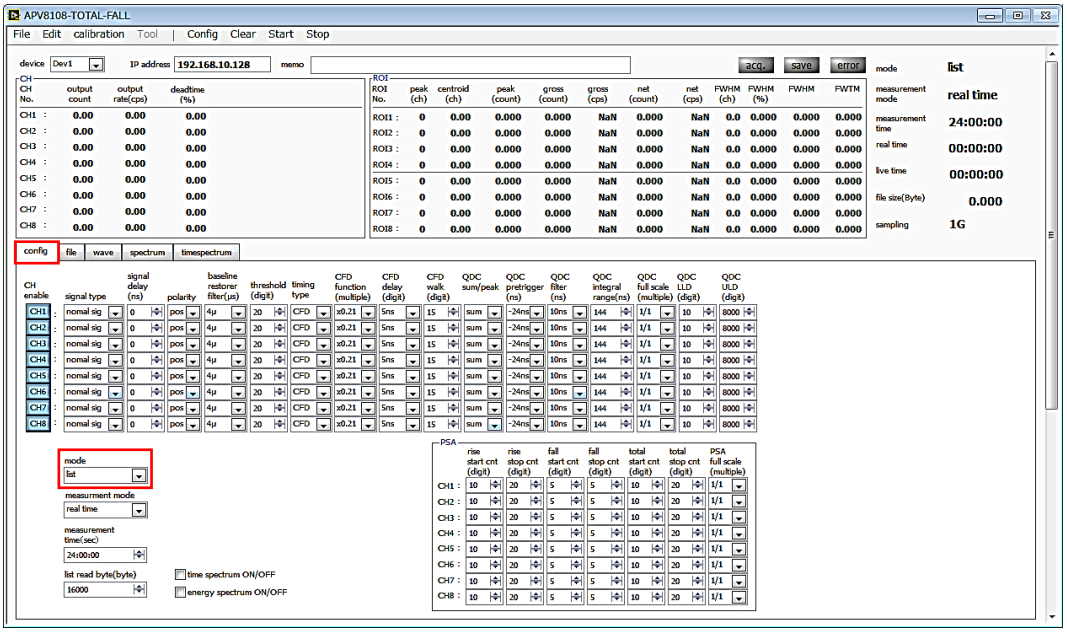



**Fig. 11: config tab**

To save list data, set the following items in the "file" tab.

| | |
|---|---|
| list save | Check |
| list file path | File path to be a reference |
| list file number | Set arbitrarily in the range from 0 to 999999. Please be careful not to duplicate. |
| list file size (Byte) | Size of list data file. When this size is exceeded, "list file number" is automatically incremented by one and saved to a new file. |

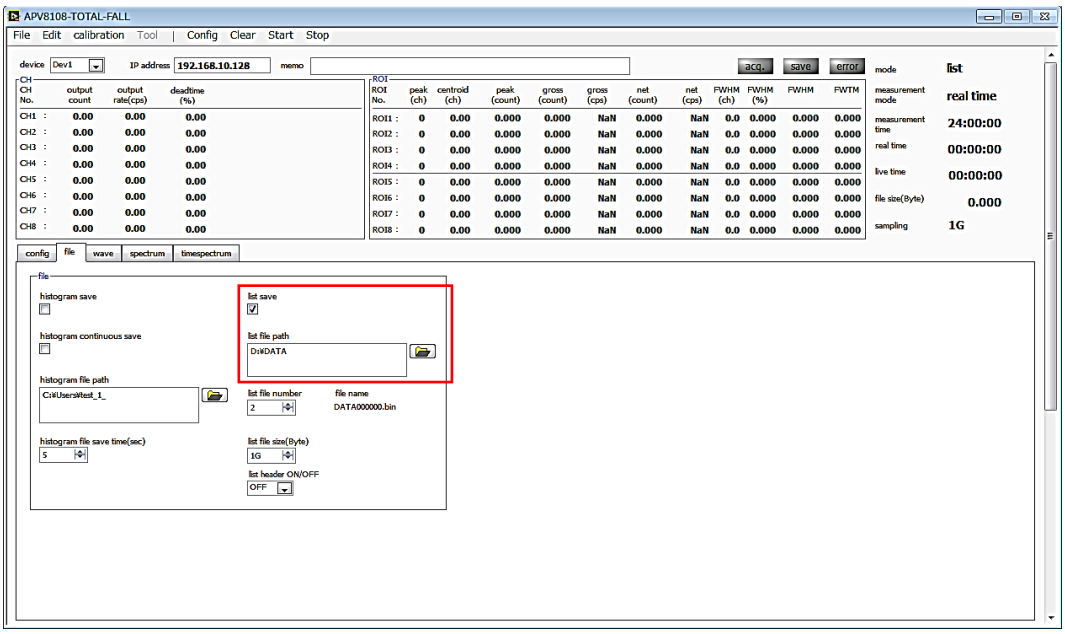



**Fig.12: Settings for saving list data in file tab**

Click in the order of "Config" "Clear" "Start" on the menu bar.

After execution, when the event is detected and list data is acquired, the following "file size (Byte)" is increased.

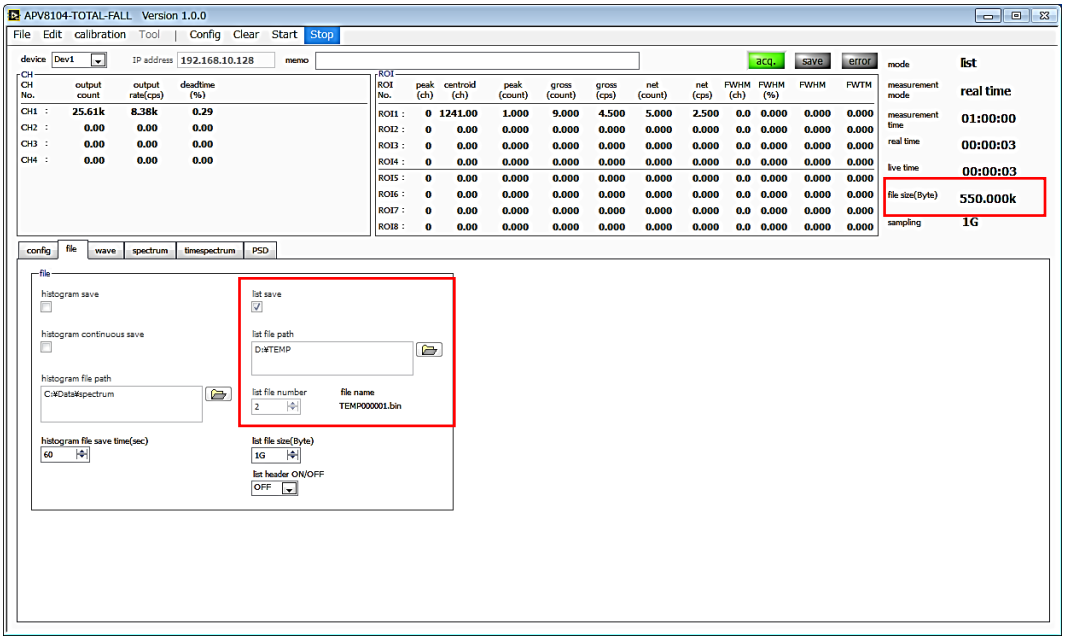



**Fig. 13: Screen of list data measurement and saving**

When you finish measurement, click "Stop" on the menu bar.

## 6. 3. Time Spectrum measurement

### （1） Environment

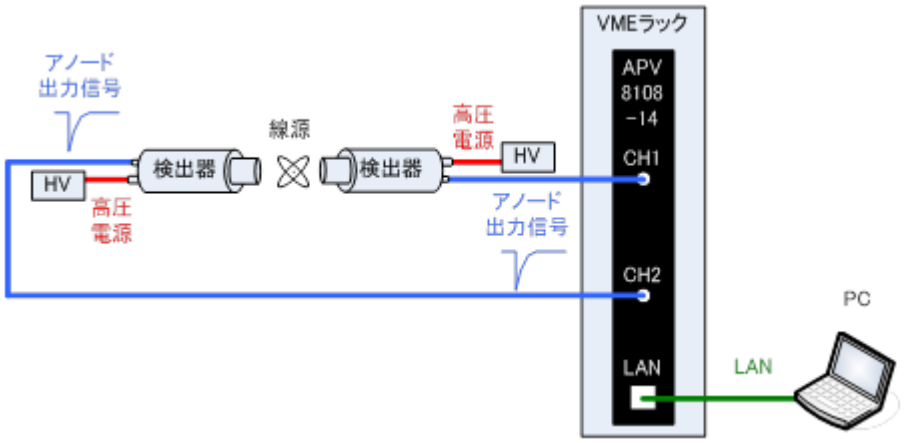



**Fig. 14: Configuration of time spectrum measurement**

| | |
|---|---|
| | Check that all devices (VME rack, High voltage power supply and PC) are off. |
| | Connect the detector and HV with the SHV connector cable. |
| | Connect the anode output signal from the detector to CH1 of APV8108-14 with LEMO connector coaxial cable. In the case of a BNC connector, use a BNC-LEMO conversion adapter. |
| | Connect APV8108-14 and PC with LAN cable. |
| | Power on the VME rack. |
| | Turn on the PC. Launch the application. |
| | Turn on the high voltage power supply and apply the voltage according to the detector. |
| | In this example, Na-22 is used for the radiation source. |

### （2） Waveform measurement

Confirm the same as in “6. 1. Energy Spectrum Measurement (2) Waveform Measurement” above.

## （3） Energy Spectrum measurement

While checking the signal from the detector, specify the range of energy for time measurement.

First, perform the energy spectrum measurement with the following settings. Make the following settings on the "config" tab, and then click "Config" on the menu bar.

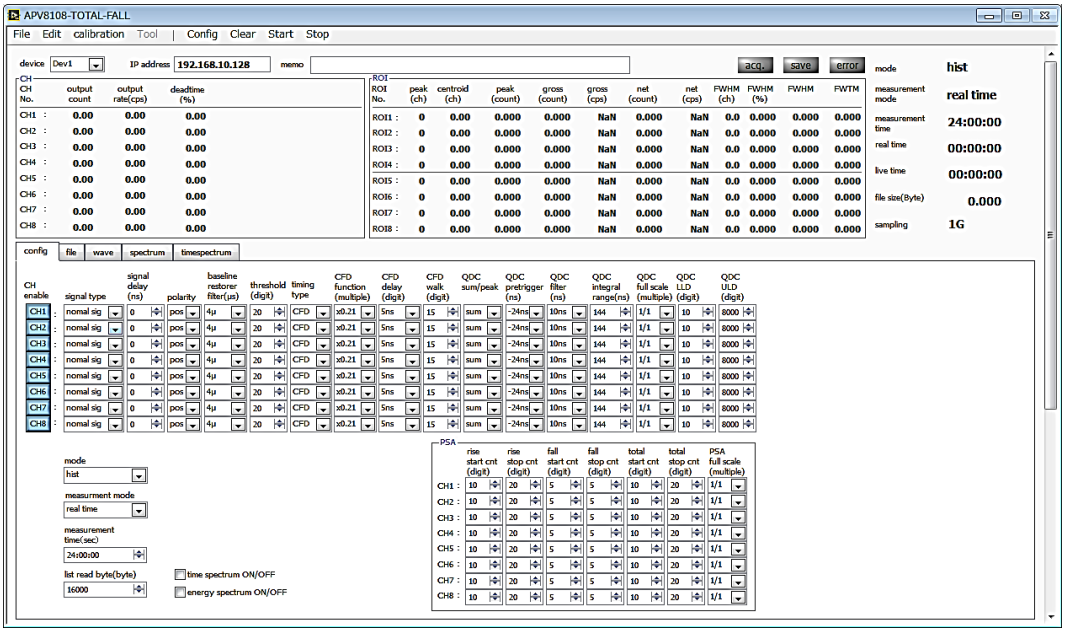



**Fig. 15: Energy spectrum measurement setting before time spectrum measurement (full energy range)**

Open the "spectrum" tab and click "Clear" and then "Start" in the menu bar.

The following spectrum is displayed after execution. While checking the shape of the spectrum and counting, set the target of the peak range with "ROI start" and "ROI end".

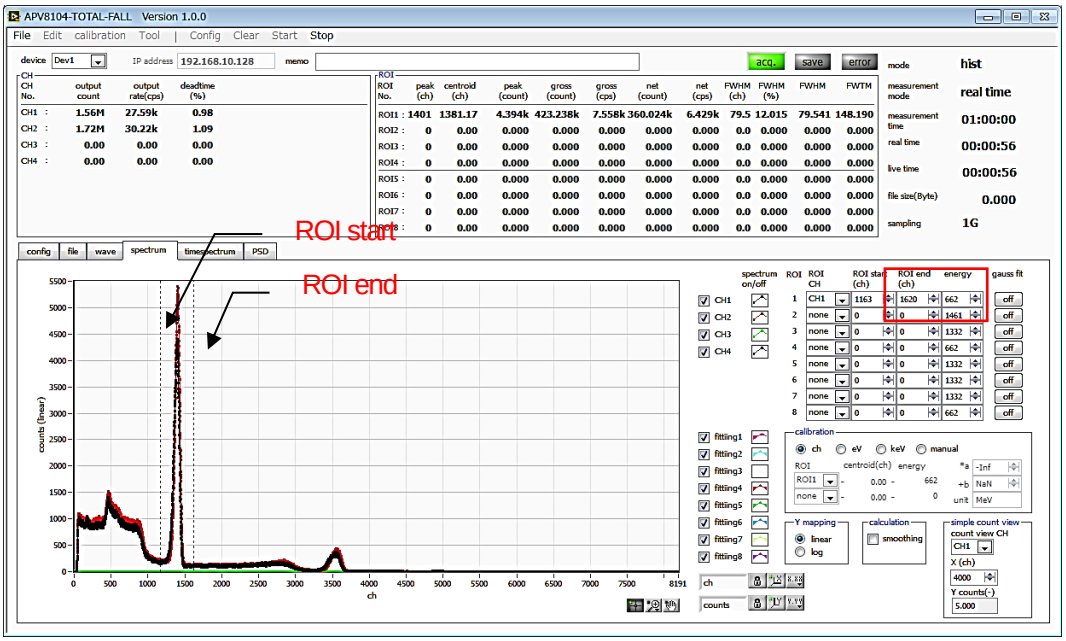



**Fig. 16: Energy spectrum measurement setting before time spectrum measurement (full energy range)**

Next, set the following to narrow down to the energy to be measured (in this case, the 511 keV peak of Na-22).

Set the reference values for "ROI start" and "ROI end" on the previous page in the "config" tab in the red frame below. Enter a value for "ROI start" for "QDC LLD" and a value for "ROI end" for "QDC ULD."

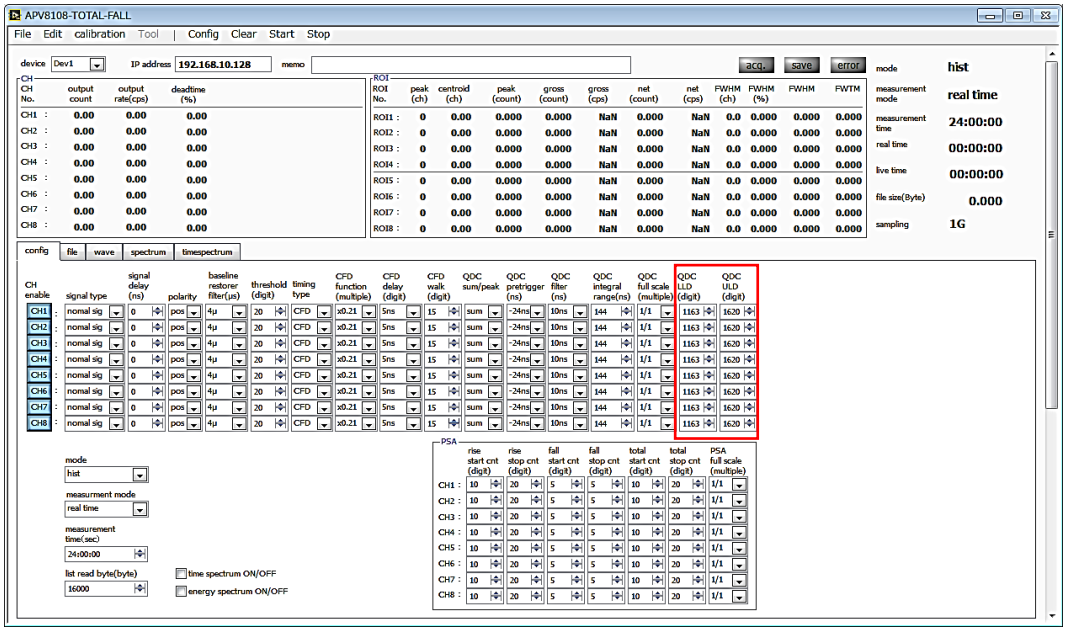



**Fig. 17: Energy spectrum measurement setting before time spectrum measurement (Setting of energy range narrowing)**

Open the "spectrum" tab and click "Clear" and then "Start" in the menu bar. The following spectrum is displayed after execution. The energy peaks shown in the figure below, which are narrowed down in the range of "QDC LLD" and "QDC ULD", are displayed.

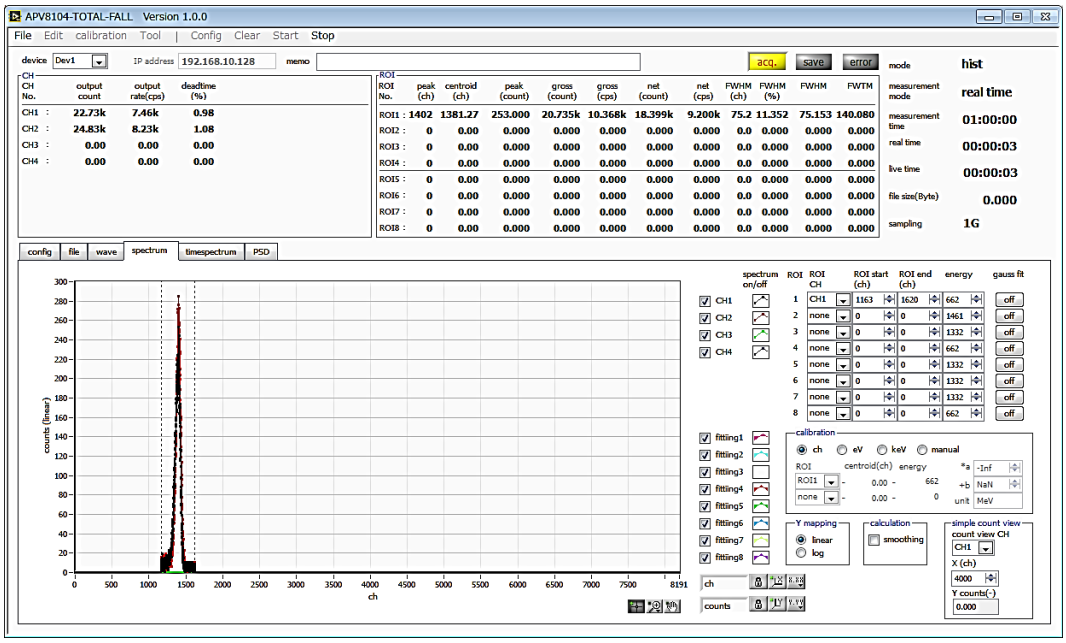



**Fig. 18: Energy spectrum measurement setting before time spectrum measurement (Setting of energy range narrowing)**

## （4） Time Spectrum measurement

If you want to measure the spectrum, select "timespectrum ON / OFF", make the following settings on the "config" tab, and then click "Config" on the menu bar.

**NOTE: When "mode" is selected in "list" mode. Note that if you use high counting in this mode, the load on your computer may be unstable and the behavior may become unstable.**

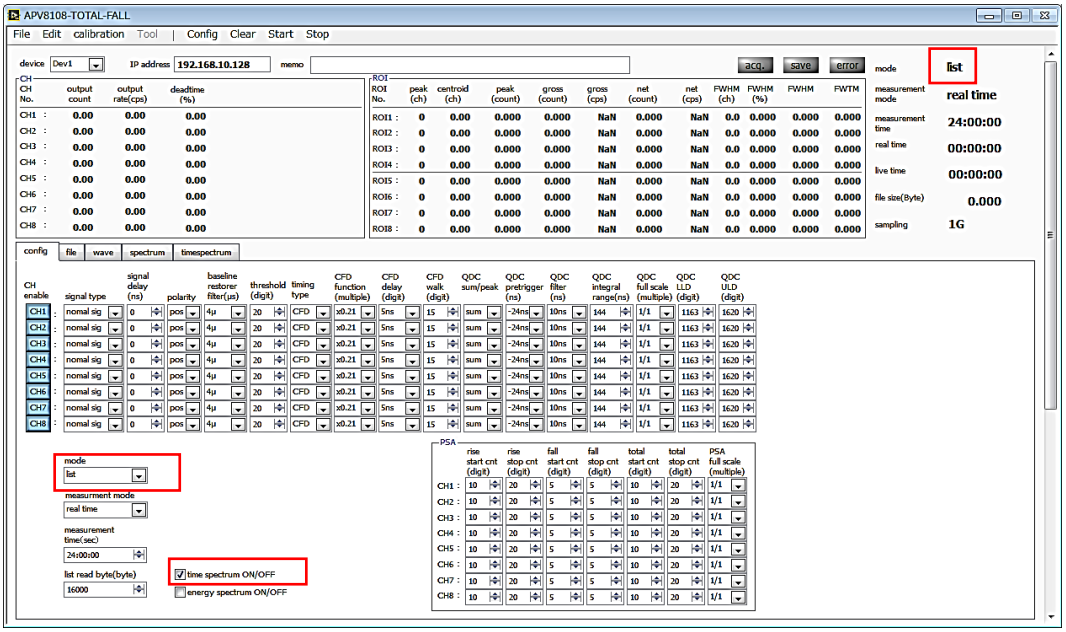



**Fig. 19: Setting of time spectrum measurement**

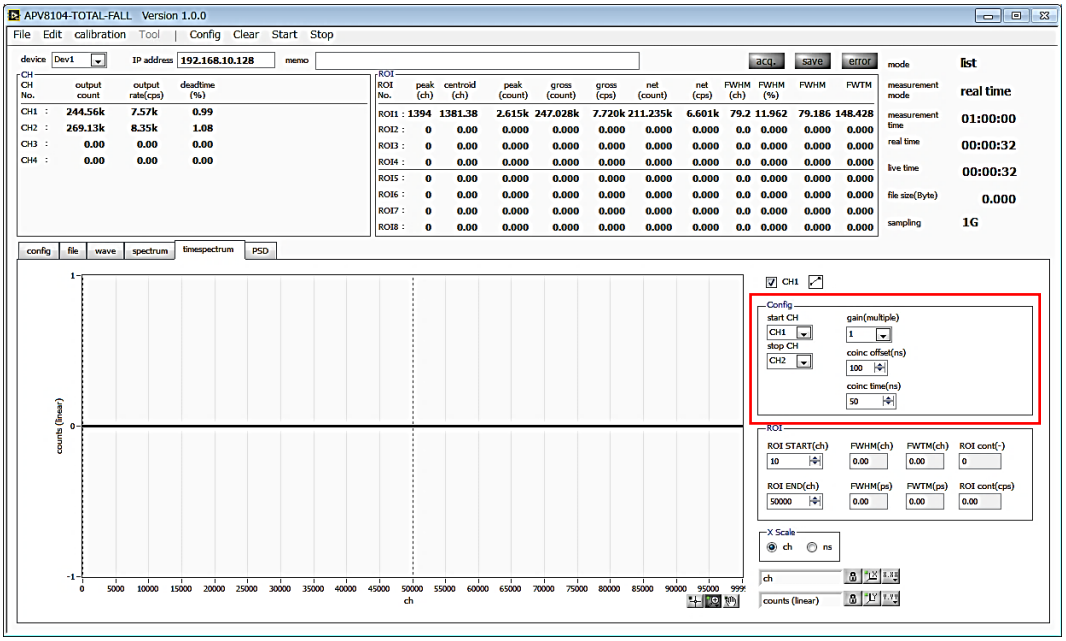



**Fig. 20: Setting of time spectrum measurement**

Open the "spectrum" tab and click "Clear" and then "Start" in the menu bar. The following spectrum is displayed after execution. The time resolution "FWHM (ps)" is calculated by setting the "ROI" section at the lower right of the screen.

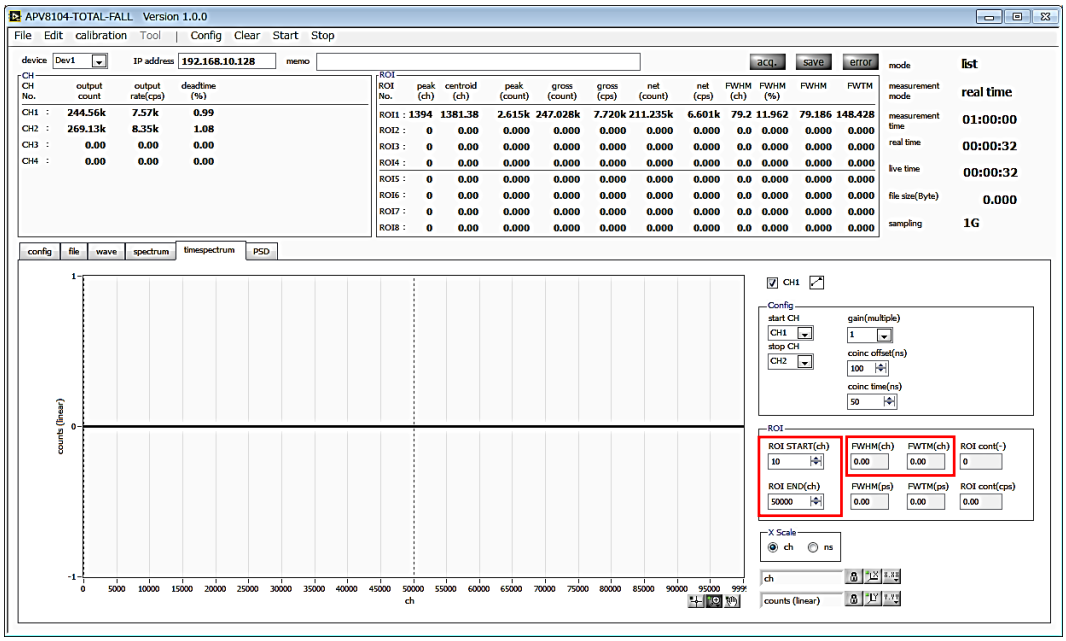



**Fig.21: Time spectrum measurement**

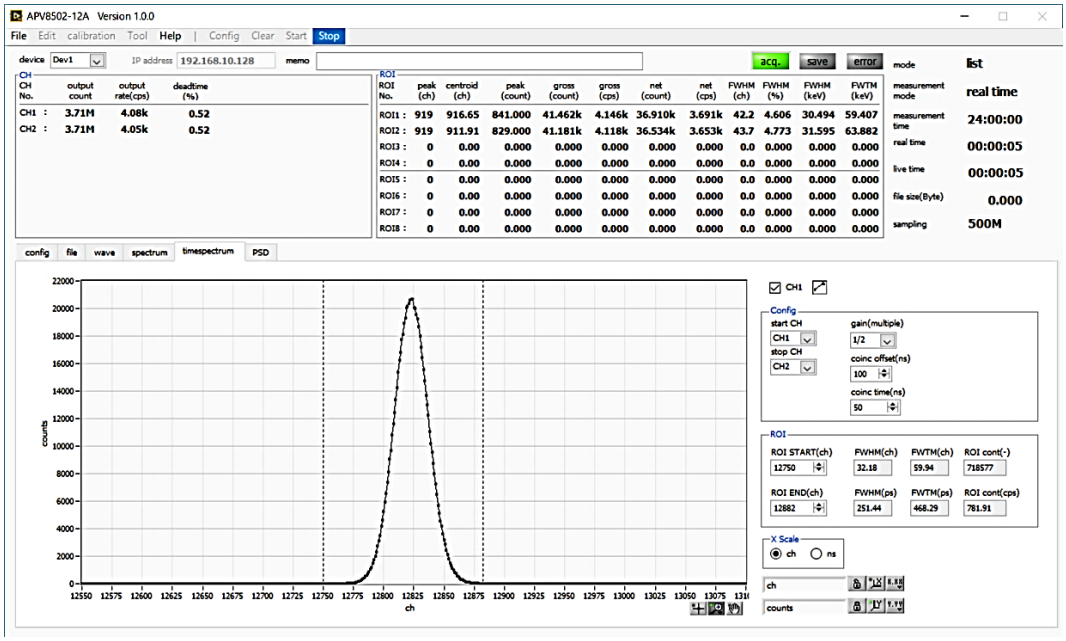



**Fig. 22: Time spectrum measurement (When the horizontal axis is magnified)**

When you finish measurement, click "Stop" on the menu bar.

# 7. File

## 7. 1. Histogram data file

（1）File format

CSV text format, separated by commas

（2）File name

Set arbitrarily

（3）Component

It consists of 4 parts: "Header" part, "Calculation" part, "Status" part and "Data" part

**Header part**

| | |
|---|---|
| Measurement mode | Measurement mode. |
| Measurement time | Measurement set time. Unit is seconds |
| Real time | Real time |
| Start Time | Measurement start time |
| End Time | Measurement end time |
| * Save for each CH | |
| POL | Polarity |
| TGE | Waveform display trigger CH |
| TGC | Waveform acquisition polarity |
| RJT | Waveform acquisition threshold |
| CCF | CFD Function |
| CDL | CFD Delay |
| CWK | CFD walk |
| CTH | CFD threshold |
| FLK | Baseline time constant |
| PTS | QDC pre-trigger |
| LIG | QDC filter time constant |
| LIT | QDC thumb or peak |
| AFS | QDC integral reduction |
| CLD | QDC Lower Limit Discriminator |
| CUD | QDC Upper Limit Discriminator |
| TTY | Timing type |
| MOD | mode |
| MTM | Measurement time |
| MEMO | Memo or Notes |

**Calculation part**

*The following is saved for each ROI

| | |
|---|---|
| ROI_ch | Input channel number targeted for ROI. |
| ROI_start | ROI start position (ch) |
| ROI_end | ROI end position (ch) |
| energy (keV) | ROI setting energy (keV) |
| peak (ch) | Peak position between ROIs (ch) |
| centroid (ch) | Center position between ROIs (ch) |
| peak (count) | Peak ch count between ROIs |
| gross (count) | Total number of counts between ROIs |
| gross (cps) | Cps of counts between ROIs |
| net (count) | Total number of counts minus background between ROIs |
| net (cps) | Sum of cps of the number of counts minus background between ROIs |
| FWHM (ch) | Half width between ROIs (ch) |
| FWHM (%) | Resolution between ROIs (%) |
| FWHM (keV) | Half-width between ROIs (keV) |
| FWTM (keV) | Full width between ROIs (keV) |

**Status part**

*The following is saved for each ROI

| | |
|---|---|
| outtput count | Output count |
| outtput rate | Output count rate |
| dead time | Dead time ratio |

**Data part**

Histogram data for each channel. Up to 8192 points.

## 7. 2. Wave data file

（1）File format

CSV text format, separated by commas

（2）File name

Set arbitrarily

（3）Component

It consists of 4 parts: "Header" part, "Calculation" part, "Status" part and "Data" part

**Header part**

| | |
|---|---|
| Measurement mode | Measurement mode. |
| Measurement time | Measurement set time. Unit is seconds |
| Real time | Real time |
| Start Time | Measurement start time |
| End Time | Measurement end time |
| * Save for each CH | |
| POL | Polarity |
| TGE | Waveform display trigger CH |
| TGC | Waveform acquisition polarity |
| RJT | Waveform acquisition threshold |
| CCF | CFD Function |
| CDL | CFD Delay |
| CWK | CFD walk |
| CTH | CFD threshold |
| FLK | Baseline time constant |
| PTS | QDC pre-trigger |
| LIG | QDC filter time constant |
| LIT | QDC thumb or peak |
| AFS | QDC integral reduction |
| CLD | QDC Lower Limit Discriminator |
| CUD | QDC Upper Limit Discriminator |
| TTY | Timing type |
| MOD | mode |
| MTM | Measurement time |
| MEMO | Memo or Notes |

**Status part**

*The following is saved for each ROI

| | |
|---|---|
| outtput count | Output count |
| outtput rate | Output count rate |
| dead time | Dead time ratio |

**Data part**

Waveform data of device being displayed

## 7. 3. List data file

（1）File format

Binary, network byte order (big endian, MSB first)

（2）Configuration

The APV8108-14 sends binary data of the following format to the PC sequentially in the list mode.

<table>
<tr><td colspan="4">Bit127<br>TOTAL[15..0]<br>112</td></tr>
<tr><td colspan="4">111<br>FALL[15..0]<br>96</td></tr>
<tr><td colspan="4">95<br>RISE[15..0]<br>80</td></tr>
<tr><td colspan="4">79<br>TDC[55..40]<br>64</td></tr>
<tr><td colspan="4">63<br>TDC[39..24]<br>48</td></tr>
<tr><td colspan="4">47<br>TDC[23..8]<br>32</td></tr>
<tr><td colspan="2">31<br>TDC[7..0]<br>24</td><td colspan="2">23<br>TDCFP[7..0]<br>16</td></tr>
<tr><td>15<br>CH[2..0]<br>13</td><td colspan="3">12<br>QDC [12..0]<br>0</td></tr>
</table>

**Fig. 23: list data format (16 Byte (128-bit))**

Details of list data

| | |
|---|---|
| Bit 127 to Bit 112 | TOTAL (total waveform integral) value. Unsigned 16-bit integer. |
| Bit 111 to Bit 96 | FALL (falling waveform partial integration) value. Unsigned 16-bit integer. |
| Bit 95 to Bit 80 | RISE (Rise of waveform partial integration) value. Unsigned 16-bit integer. |
| Bit 79 to Bit 24 | TDC count. 56-bit. 1 ns per bit. |
| Bit 23 to Bit 16 | TDCFP (fractional part) count. 8-bit. 3.90625 ps per bit.<br>Interpolation between sampling points (1 ns 256 256 = 3.90625 ps) |
| Bit 15 to Bit 13 | CH number.<br>0: CH1, 1: CH2, 2: CH3, 3: CH4, 4: CH5, 5: CH6, 6: CH7, 7: CH8 |
| Bit 12 to Bit 0 | QDC integrated value. Unsigned 13-bit integer.<br>The collected waveform is filtered, and the integrated value of the waveform between the set range from where the threshold is exceeded. |

# 8. Command

## 8. 1 Overview

Configuration and data acquisition for the APV 8108 are performed via TCP / IP and UDP via Ethernet. Since special libraries are not used, DPP can be controlled by any application if it conforms to the communication format (command).

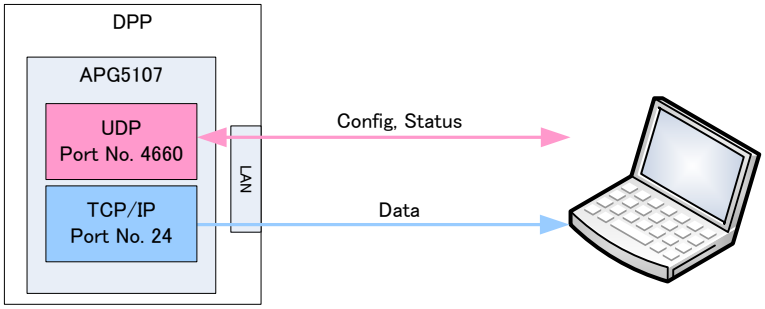
A communication board is mounted on DPP.

| Model Number | Standard | Protocol | Command method |
|---|---|---|---|
| APG5107 | 1000 Mbps | TCP/IP and UDP | Address + parameter |

This chapter describes commands when the APG5107 is mounted as a communication board.

The APG5107 uses SiTCP to realize high-speed data communication. SiTCP is a technology for connecting devices developed by the High Energy Accelerator Research Organization (http://www.kek.jp/ja/ (hereinafter referred to as KEK), which is a university shared use corporation, to Ethernet. The technology has been transferred to Bee Beans Technologies Co., Ltd. (http://www.bbtech.co.jp, hereinafter BBT), which is a venture company from KEK. We use SiTCP under license from BBT. For details on SiTCP and data transmission / reception, please refer to each manual on the BBT company website.

The command types are roughly divided into two types: "Configuration and Status" and "Data". In SiTCP, two protocols, TCP / IP and UDP, are operating so that these two types of commands can be sent and received without competition, and each has a communication port on the device side defined. Configuration and Status are UDP and port number is 4660 by default. Data is TCP / IP and the port number is 24 by default.




The format and type of command are described below.

## 8. 2 Format of command

The command format is divided into the case of Configuration write, the case of Status read, and the case of Data read. Each consists of "header", "address", "parameter" and "data".

“Header part” contains 6 items of Ver / Type / CMD / FLAG / ID and Data Length conforming to the SiTCP specification. In DPP, Data Length (data length) is fixed 2-byte and the size of the header part is 4-byte.

"Address part" is the 4-byte address of the DPP register.

"Parameter part" is a 2-byte value set in the DPP register.

"Data part" is measurement data from DPP.

# 8. 3 Type of command

## （1） Config command

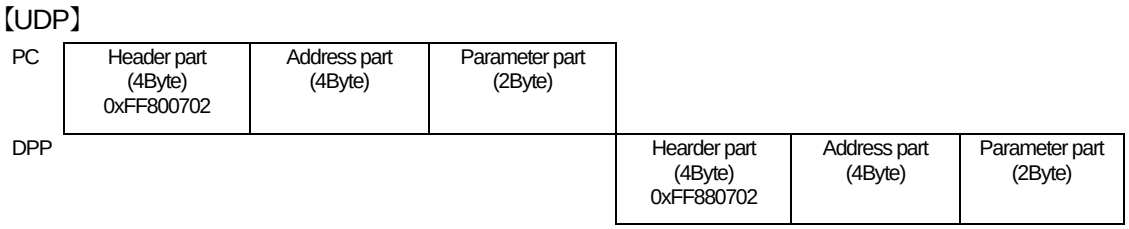



**Fig. 1: In case of Config command**

The Config command responds from the DPP to the configuration from the PC.

【Setting from PC】

“Header part” is 4-byte, hexadecimal number “FF800702”.

The contents are F (Ver.) F (Type) 8 (CMD) 0 (FLG) 07 (ID) 02 (Data Length).

"Address part" sets 4-byte, parameter address value.

"Parameter part" is 2-byte, the parameter value to be set.

【Response from DPP】

“Header part” is 4-byte, hexadecimal number “FF880702”.

The contents are F (Ver.) F (Type) 8 (CMD) 8 (FLG) 07 (ID) 02 (Data Length).

If normal, the ACK bit of FLG becomes 1 and becomes 8.

"Address part" returns 4 bytes, the address value of the set parameter.

## （2） Status command

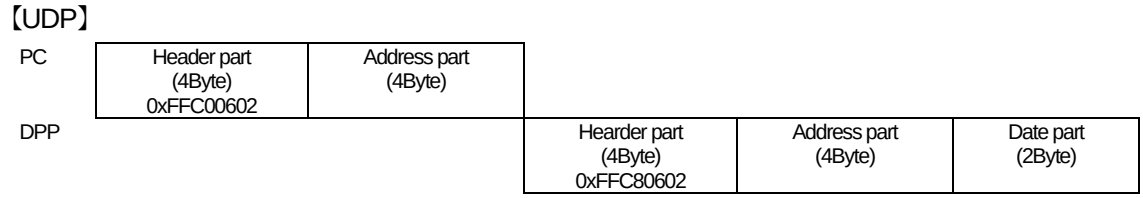



**Fig.2: In case of Status command**

The Status command responds to requests from the PC from DPP.

【Requirements from PC】

“Header part” is 4-byte, hexadecimal number “FFC00602”.

The contents are F (Ver.) F (Type) C (CMD) 0 (FLG) 06 (ID) 02 (Data Length).

"Address part" sets 4-byte, the address value of status data.

【Response from DPP】

“Header part” is 4-byte, hexadecimal number “FFC 80602”.

The contents are F (Ver.) F (Type) C (CMD) 8 (FLG) 06 (ID) 02 (Data Length).

If normal, the ACK bit of FLG becomes 1 and becomes 8.

"Address section", 4-byte, the address value of the requested parameter is returned.

"Data part" is 2-byte, status data value.

### （3） Data command

Read list data to PC with Data command.

First, list data is requested by UDP, and DPP responds by TCP / IP.

【TCP / IP DPP data transmission】

When the list mode is set and started by UDP, the list data starts to accumulate on the communication board.

【TCP / IP PC data reception】

It is possible to read only arbitrary bytes by TCP.

Since list data is in units of 16 bytes, read in units of 16 bytes.

# 8. 4 List of command

| No. | Type | No. of port | Address (Hexadecimal) | Content | Setting range (Digit) | Operation | Command length (Byte) | Response (Byte) |
|---|---|---|---|---|---|---|---|---|
| 1 | CH setting | UDP 4660 | B40001DE | Input waveform type | 0, 1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 2 | | | B400011A | Input polarity switching | 0, 1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 3 | | | B4000160 | CFD Function | 1..15 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 4 | | | B4000162 | CFD Delay | 0..23 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 5 | | | B4000164 | CFD Walk | 0.. $2^{10}$-1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 6 | | | B4000166 | Threshold | 0.. $2^{13}$-1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 7 | | | B400016E | Baseline restoration filter | 0..254 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 8 | | | B40001C0 | QDC pre-trigger | 0..4 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 9 | | | B40001C6 | QDC Filter | 0..5 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 10 | | | B40001C8 | QDC sum/peak | 0, 1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 11 | | | B400010C | QDC full scale | 0..9 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 12 | | | B40001DC | QDC integral range | 1.. $2^{12}$-1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 13 | | | B4000168 | QDC LLD | 0.. $2^{13}$-1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 14 | | | B400016A | QDC ULD | 0.. $2^{13}$-1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 15 | | | B40001D0 | Time stamp timing | 0, 1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |

| No. | Type | No. of port | Address (Hexadecimal) | Content | Setting range (Digit) | Operation | Command length (Byte) | Response (Byte) |
|---|---|---|---|---|---|---|---|---|
| 16 | CH setting | UDP 4660 | B40001D8 | PSA falling start position | 1..16383 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 17 | | | B40001DA | PSA falling end position | 1..16383 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 18 | | | B40001E8 | PSA rising start position | 1..498 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 19 | | | B40001EA | PSA rising end position | 1..16383 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 20 | | | B40001EC | PSA overall start position | 1..498 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 21 | | | B40001EE | PSA overall end position | 1..16383 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 22 | | | B40001D6 | PSA reduction ratio | 0..9 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 23 | | | B4000176 | Input delay | 0..511 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |

NOTE: The above address is that of CH1. The start address of CH1 / CH5 is B4000100 / B4008100. The start address of CH2 / CH6 is B4000200 / B4008200. The address to which 0x100 is added in this way becomes the top of each CH setting.

| No. | Type | No. of port | Address (Hexadecimal) | Content | Setting range (Digit) | Operation | Command length (Byte) | Response (Byte) |
|---|---|---|---|---|---|---|---|---|
| 24 | Single setting | UDP 4660 | B4004000 | Mode | 0,1,2,5 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 25 | | | B4004002 | Measurement mode | 0,1 | Configuration | 10 | 10 |
| | | | | | | Setting request | 8 | 10 |
| 26 | | | B4004006 B4004008 B400400A B400400C | Measurement time setting | 0..$2^{54}$-1 | Configuration | 10*4 times | 10*4 times |
| | | | | | | Setting request | 8*4 times | 10*4 times |
| 27 | | | B4004004 | Start measurement | 0, 1 | Configuration | 10 | 10 |
| 28 | | | B4004090 | Time and data clear | 0, 1 | Configuration | 10 | 10 |
| 29 | | | B4004028 | Time clear | 0, 1 | Configuration | 10 | 10 |
| 30 | Status | UDP 4660 | B4000004 | Measurement status | - | Status request | 10 | 10 |
| 31 * | | | B4000120 B4000122 | Output count total | | | 10*2 times | 10*2 times |
| 32 * | | | B4000130 B4000132 | Output count rate | | | 10*2 times | 10*2 times |
| 33 * | | | B4000144 B4000146 B4000148 B400014A | Live count | | | 10*3 times | 10*3 times |
| 34 * | | | B40001E0 B40001E2 B40001E4 B40001E6 | Dead count | | | 10*4 times | 10*4 times |
| 35 | | | B400000E B4000010 B4000012 B4000014 | Real time | | | 10*4 times | 10*4 times |
| 36 | Configuration | UDP 4660 | B400009A B400809A | Histgram CH date | O..7 | Configuration | 10 | 32768 |

NOTE: The address marked with * in the above number column is for CH1. The addresses for CH1 to CH4 address 0x100 and CH6 to 8 CH5 start address: 4008100 plus 0x100 are the values for each CH setting. (Legend CH1: B4000146 CH CH2: B4000246, .., CH4: B4000446, CH5: B4008146, .. CH8: B4008446)

# 8．5 Explanation of command

Setting of CH

（1） Select input waveform type

| Description | Select input waveform type |
|---|---|
| Address | 0xB40001DE |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 or 1<br>0: Normal waveform * Factory default<br>1: NIM waveform |

（2） Select Input polarity switching

| Description | Select input polarity switching |
|---|---|
| Address | 0xB40001A |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 or 1<br>0: Negative polarity * Factory default<br>1: Positive polarity |

（3） CFD Function

| Description | CFD function settings.<br>Signal reduction factor used for CFD waveform calculation. |
|---|---|
| Address | 0xB4000160 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 15<br>1: 0.03 times, 2: 0.06 times, 3: 0.09 times, 4: 0.12 times, 5: 0.15 times,<br>6: 0.18 times, 7: 0.21 times*, 8: 0.25 times, 9: 0.28 times, 10: 0.31 times,<br>11: 0.34 times, 12: 0.37 times, 13: 0.40 times, 14: 0.43 times, 15: 0.46 times |

（4） CFD Delay

| Description | CFD delay settings.<br>Delay time of inverted signal used for CFD waveform calculation. |
|---|---|
| Address | 0xB4000162 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 23<br>0: 1 ns, 1: 2 ns, 2: 3 ns, 3: 4 ns, 4: 5 ns*, 5: 6 ns, 6: 7 ns, 7: 8 ns, 8: 9 ns,<br>9: 10 ns, 10: 11 ns, 11: 12 ns, 12: 13 ns, 13: 14 ns, 14: 15 ns, 15: 16 ns,<br>16: 17 ns, 17: 18 ns, 18: 19 ns, 19: 20 ns, 20: 21 ns, 21: 22 ns, 22: 23 ns,<br>23: 24 ns |

（5） CFD Walk

| Description | Setting value for timestamping ADC data |
|---|---|
| Address | 0xB4000164 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 1023<br>10 * Factory default |

（6） Theshold

| Description | Input waveform threshold setting |
|---|---|
| Address | 0xB4000166 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 8191<br>100 * Factory default |

（7） Baseline restorer filter

| Description | Baseline restorer filter time constant |
|---|---|
| Address | 0xB400016E |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 254<br>0: ext<br>64: fast<br>128: 4 µs<br>250: 85 µs<br>252:129 µs<br>254: 260µs* |

（8） QDC pre-trigger

| Description | Set the timing to start the addition |
|---|---|
| Address | 0xB40001C0 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 4<br>0: 0 ns<br>1: Addition starts minus 8 ns before the timing of the threshold<br>2: Addition starts minus 16 ns before the timing of the threshold*<br>3: Addition starts minus 24 ns before the timing of the threshold<br>4: Addition starts minus 32 ns before the timing of the threshold |

（9） QDC Filter

| | |
|---|---|
| Description | Filter time constant of the original waveform to be integrated by QDC |
| Address | 0xB40001C6 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 5<br>0: ext<br>1: 10 ns*<br>2: 20 ns<br>3: 50 ns<br>4: 100 ns<br>5: 200 ns |

（10） QDC sum / peak

| | |
|---|---|
| Description | QDC output data type |
| Address | 0xB40001C8 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 or 1<br>0: Output the peak value of the peak waveform as QDC data<br>1: Output the integrated value of the waveform applied with sum Filter as QDC data * |

（11） QDC full scale

| | |
|---|---|
| Description | QDC data gain |
| Address | 0xB400010C |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 9<br>0: 1/1<br>1: 1/2 times<br>2: 1/4 times*<br>3: 1/8 times<br>4: 1/16 times<br>5: 1/32 times<br>6: 1/64 times<br>7: 1/128 times |

（１２） QDC Integral range

| Description | Integration time setting including QDC pre-trigger setting time |
|---|---|
| Address | 0xB40001DC |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 4095<br>1: 1 digit corresponds to 8 ns. * 25 (200 ns) Factory default<br>To<br>4095: 32760 ns |

（１３） QDC LLD

| Description | LLD of integral value of QDC |
|---|---|
| Address | 0xB4000168 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 8191<br>10 * Factory default |

（１４） QDC ULD

| Description | ULD of integrated value of QDC |
|---|---|
| Address | 0xB400016A |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 8191<br>8000 * Factory default |

（１５） Time stamp timing

| Description | Select which waveform to use for the time stamp of time information. |
|---|---|
| Address | 0xB40001D0 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 or 1<br>0: The timing set by CFDWALK for the CFD waveform |

（１６） PSA falling start position

| Description | Set start position of fall integration target range in PSA operation |
|---|---|
| Address | 0xB40001D8 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 16383 * 1 digit: 1 ns |

（１７） PSA falling end position

| | |
|---|---|
| Description | Set the end position of fall integration target range in PSA operation |
| Address | 0xB40001DA |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 16383 * 1 digit: 1 ns |

（１８） PSA rising start position

| | |
|---|---|
| Description | Set the start position of rising integration target range in PSA operation |
| Address | 0xB40001E8 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 498 * 1 digit: 1 ns |

（１９） PSA rising end position

| | |
|---|---|
| Description | Set the end position of rising integration target range in PSA operation |
| Address | 0xB40001EA |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 16383 * 1 digit: 1 ns |

（２０） Overall PSA start position

| | |
|---|---|
| Description | Set the start position of the whole integration target range in PSA operation |
| Address | 0xB40001EC |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 498 * 1 digit: 1 ns |

（２１） Overall PSA end position

| | |
|---|---|
| Description | Set the end position of the whole integration target range in PSA operation |
| Address | 0xB40001EC |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 16383 * 1 digit: 1 ns |

（２２） PSA reduction ratio

| | |
|---|---|
| Description | Set the reduction ratio of each integration result of rising, falling, and whole |
| Address | 0xB40001D6 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0 to 9<br>0: 1/1, 1: 1/2, 2: 1/4, 3: 1/8, 4: 1/16, 5: 1/32, 6: 1/64, 7: 1/128, 8: 1/256, 9: 1/512 |

（23） Input delay

| | |
|---|---|
| Description | Set delay of input waveform |
| Address | 0xB4000176 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 1 to 511 * 8 ns delay per digit |

Single setting

### （24） Mode

| | |
|---|---|
| Description | Operation mode.<br>Select hist (histogram) mode, wave (waveform) mode, or list (list) mode |
| Address | 0xB4004000 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0, 1 or 2<br>0: Histo mode<br>1: Waveform mode *<br>2: List mode<br>5: List common mode<br>In list common mode, the GATE / VETO signal is invalid for CH1 only. |

### （25） Measurement mode

| | |
|---|---|
| Description | Select real time or live time |
| Address | 0xB4004002 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Channel setting |
| Range | 0, 1 or 2<br>0: Real time *<br>1: Live time |

### （26） Measurement time setting

| | |
|---|---|
| Description | Measurement time |
| Address | 0xB4004006 (MSB)<br>0xB4004008<br>0xB400400A<br>0xB400400C (LSB) |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Single setting |
| Range | 0 to $2^{54} – 1$<br>$2^{54} – 1$ * Factory default<br>8 ns per bit. The maximum setting range is 40031 hours from ($2^{54}$-1) x 8 ns |

（27） Measurement starts

| Description | Set start or stop of measurement |
|---|---|
| Address | 0xB4004004 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Single setting |
| Range | 0 or 1<br>0: Measurement stop *<br>1: Measurement start |

（28） Time and data clear

| Description | Clear setting of time and data |
|---|---|
| Address | 0xB4004090 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Single setting |
| Range | When clearing, set data sequentially in the order of 0, 1, 0 |

（29） Time clear

| Description | Time clear |
|---|---|
| Address | 0xB4004028 |
| Setting | Command length 10 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Single setting |
| Range | When clearing, set data sequentially in the order of 0, 1, 0 |

Status

（30） Measurement status

| Description | Confirm measurement status |
|---|---|
| Address | 0xB4000004 |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Status |
| Range | 0 or 1<br>0: Measurement stopped<br>1: During measurement |

（31） Output count total

| Description | Total count number processed by signal within QDC LLD and QDC ULD |
|---|---|
| Address | 0xB4000120 (MSB)<br>0xB4000122 (LSB) |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Status (CH) |
| Contents | Total counts processed by signal processing |

（32） Output count rate

| Description | 1 second output count rate |
|---|---|
| Address | 0xB4000130 (MSB)<br>0xB4000132 (LSB) |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Status (CH) |
| Contents | Signaled counts per second |

（33） Live count

| Description | Total live count (8 ns / count) |
|---|---|
| Address | 0xB4000144 (MSB)<br>0xB4000146<br>0xB4000148<br>0xB400014A (LSB) |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Status (CH) |
| Contents | The time obtained by subtracting the dead time from the real time per CH<br>(Conversion to time is converted by count value x 8ns) |

（34） Dead count

| Description | Total dead count (8 ns / count) |
|---|---|
| Address | 0xB40001E0 (MSB)<br>0xB40001E2<br>0xB40001E4<br>0xB40001E6 (LSB) |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Status (CH) |
| Contents | Signal processing time operating within QDC LLD, QDC ULD<br>(Conversion to time is converted by count value x 8ns) |

（35） Real time

| Description | Real time (8 ns / count) |
|---|---|
| Address | 0xB400000E (MSB)<br>0xB4000010<br>0xB4000012<br>0xB4000014 (LSB) |
| Request | Command length 8 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Status (CH) |
| Contents | Elapsed time after about 2.1 seconds from the start of measurement.<br>Signals of CH1 to 8 will not be received for about 2.1 seconds after the start of measurement.<br>(Conversion to time is converted by count value x 8ns) |

（36） Histogram CH data

| Description | Request Histogram Data |
|---|---|
| Address | 0xB400009A<br>0xB400809A |
| Setting | Command length 10 Byte, Response 10 Byte |
| Port number | 4660 (UDP) |
| Type | Status (CH) |
| Contents | 0xB400009A setting<br>0: CH1 histogram request<br>1: CH2 histogram request<br>2: CH3 histogram request<br>3: CH4 histogram request<br><br>0xB400809A setting<br>0: CH5 histogram request<br>1: CH6 histogram request<br>2: CH7 histogram request<br>3: CH8 histogram request<br><br>NOTE: When you want to acquire the histogram data of CH1, if you set data 0x0000 to address 0xB400009A, there is a data response of 32768 bytes of histogram data of CH1 in TCP. |

## 8. 6 Setting command at startup and config

The application for the APV 8108-14 is set from the PC to DPP by combining the setting command described in "8.4 Command List" and the APV 8108-14 unique setting command when starting up after power on and when operating the Config menu before starting measurement. to hold.

The following shows an example of setting command list at startup and at configuration (does not include DPP response). Please refer to it when creating your own application.

Except for the setting commands in "8.4 Commands" and "8.5 Commands", these commands are APV8108-14 specific setting commands, so please be careful not to delete or change them.

**1) Startup setup command list example**

UDP send 0xFF800702B40040000001
UDP send 0xFF800702B40040060000
UDP send 0xFF800702B40040080000
UDP send 0xFF800702B400400A2540
UDP send 0xFF800702B400400CBE40
UDP send 0xFF800702B400402E0100
UDP send 0xFF800702B40040300001
UDP send 0xFF800702B400403200FF
UDP send 0xFF800702B400008C0007
UDP send 0xFF800702B400011A0001
UDP send 0xFF800702B400021A0001
UDP send 0xFF800702B400031A0001
UDP send 0xFF800702B400041A0001
UDP send 0xFF800702B400811A0001
UDP send 0xFF800702B400821A0001
UDP send 0xFF800702B400831A0001
UDP send 0xFF800702B400841A0001
UDP send 0xFF800702B40040360000
UDP send 0xFF800702B400010C0004
UDP send 0xFF800702B400020C0004
UDP send 0xFF800702B400030C0004
UDP send 0xFF800702B400040C0004
UDP send 0xFF800702B400810C0004
UDP send 0xFF800702B400820C0004
UDP send 0xFF800702B400830C0004
UDP send 0xFF800702B400840C0004
UDP send 0xFF800702B40001600007
UDP send 0xFF800702B40002600007
UDP send 0xFF800702B40003600007
UDP send 0xFF800702B40004600007
UDP send 0xFF800702B40081600007
UDP send 0xFF800702B40082600007
UDP send 0xFF800702B40083600007
UDP send 0xFF800702B40084600007
UDP send 0xFF800702B40001620009
UDP send 0xFF800702B40002620009
UDP send 0xFF800702B40003620009
UDP send 0xFF800702B40004620009
UDP send 0xFF800702B40081620009
UDP send 0xFF800702B40082620009
UDP send 0xFF800702B40083620009
UDP send 0xFF800702B40084620009
UDP send 0xFF800702B40001640019
UDP send 0xFF800702B40002640019
UDP send 0xFF800702B40003640019
UDP send 0xFF800702B40004640019
UDP send 0xFF800702B40081640019
UDP send 0xFF800702B40082640019
UDP send 0xFF800702B40083640019
UDP send 0xFF800702B40084640019
UDP send 0xFF800702B4000166001E
UDP send 0xFF800702B4000266001E
UDP send 0xFF800702B4000366001E
UDP send 0xFF800702B4000466001E
UDP send 0xFF800702B4008166001E
UDP send 0xFF800702B4008266001E
UDP send 0xFF800702B4008366001E
UDP send 0xFF800702B4008466001E
UDP send 0xFF800702B4000168001E
UDP send 0xFF800702B4000268001E
UDP send 0xFF800702B4000368001E
UDP send 0xFF800702B4000468001E
UDP send 0xFF800702B4008168001E
UDP send 0xFF800702B4008268001E
UDP send 0xFF800702B4008368001E
UDP send 0xFF800702B4008468001E
UDP send 0xFF800702B400016A1F40
UDP send 0xFF800702B400026A1F40
UDP send 0xFF800702B400036A1F40
UDP send 0xFF800702B400046A1F40
UDP send 0xFF800702B400816A1F40
UDP send 0xFF800702B400826A1F40
UDP send 0xFF800702B400836A1F40
UDP send 0xFF800702B400846A1F40
UDP send 0xFF800702B400016E0080
UDP send 0xFF800702B400026E0080

**UDP send 0xFF800702B400036E0080**
**UDP send 0xFF800702B400046E0080**
**UDP send 0xFF800702B400816E0080**
**UDP send 0xFF800702B400826E0080**
**UDP send 0xFF800702B400836E0080**
**UDP send 0xFF800702B400846E0080**
**UDP send 0xFF800702B40000600000**
**UDP send 0xFF800702B40001C00001**
**UDP send 0xFF800702B40002C00001**
**UDP send 0xFF800702B40003C00001**
**UDP send 0xFF800702B40004C00001**
**UDP send 0xFF800702B40081C00001**
**UDP send 0xFF800702B40082C00001**
**UDP send 0xFF800702B40083C00001**
**UDP send 0xFF800702B40084C00001**
**UDP send 0xFF800702B40001C20000**
**UDP send 0xFF800702B40002C20100**
**UDP send 0xFF800702B40003C20200**
**UDP send 0xFF800702B40004C20300**
**UDP send 0xFF800702B40005C20400**
**UDP send 0xFF800702B40006C20500**
**UDP send 0xFF800702B40007C20600**
**UDP send 0xFF800702B40008C20700**
**UDP send 0xFF800702B40081C20000**
**UDP send 0xFF800702B40082C20100**
**UDP send 0xFF800702B40083C20000**
**UDP send 0xFF800702B40084C20100**
**UDP send 0xFF800702B40085C20000**
**UDP send 0xFF800702B40086C20100**
**UDP send 0xFF800702B40087C20000**
**UDP send 0xFF800702B40088C20100**
**UDP send 0xFF800702B40001C60002**
**UDP send 0xFF800702B40002C60002**
**UDP send 0xFF800702B40003C60002**
**UDP send 0xFF800702B40004C60002**
**UDP send 0xFF800702B40081C60002**
**UDP send 0xFF800702B40082C60002**
**UDP send 0xFF800702B40083C60002**
**UDP send 0xFF800702B40084C60002**
**UDP send 0xFF800702B40001C80001**
**UDP send 0xFF800702B40002C80001**
**UDP send 0xFF800702B40003C80001**
**UDP send 0xFF800702B40004C80001**
**UDP send 0xFF800702B40081C80001**
**UDP send 0xFF800702B40082C80001**
**UDP send 0xFF800702B40083C80001**
**UDP send 0xFF800702B40084C80001**
**UDP send 0xFF800702B400010E0001**
**UDP send 0xFF800702B400020E0000**
**UDP send 0xFF800702B400030E0001**
**UDP send 0xFF800702B400040E0000**
**UDP send 0xFF800702B400810E0001**
**UDP send 0xFF800702B400820E0000**
**UDP send 0xFF800702B400830E0001**
**UDP send 0xFF800702B400840E0000**
**UDP send 0xFF800702B40001700800**
**UDP send 0xFF800702B40002700800**
**UDP send 0xFF800702B40003700800**
**UDP send 0xFF800702B40004700800**
**UDP send 0xFF800702B40081700800**
**UDP send 0xFF800702B40082700800**
**UDP send 0xFF800702B40083700800**
**UDP send 0xFF800702B40084700800**
**UDP send 0xFF800702B40001B00001**
**UDP send 0xFF800702B40002B00001**
**UDP send 0xFF800702B40003B00001**
**UDP send 0xFF800702B40004B00001**
**UDP send 0xFF800702B40081B00001**
**UDP send 0xFF800702B40082B00001**
**UDP send 0xFF800702B40083B00001**
**UDP send 0xFF800702B40084B00001**
**UDP send 0xFF800702B40001B400EB**
**UDP send 0xFF800702B40002B400E8**
**UDP send 0xFF800702B40003B400E4**
**UDP send 0xFF800702B40004B400DA**
**UDP send 0xFF800702B40005B400F0**
**UDP send 0xFF800702B40006B400E8**
**UDP send 0xFF800702B40007B400EB**
**UDP send 0xFF800702B40008B400E6**
**UDP send 0xFF800702B40081B40000**

**UDP send 0xFF800702B40082B40000**
**UDP send 0xFF800702B40083B40000**
**UDP send 0xFF800702B40084B40000**
**UDP send 0xFF800702B40085B40000**
**UDP send 0xFF800702B40086B40000**
**UDP send 0xFF800702B40087B40000**
**UDP send 0xFF800702B40088B40000**
**UDP send 0xFF800702B40001B600DD**
**UDP send 0xFF800702B40002B600DB**
**UDP send 0xFF800702B40003B600E6**
**UDP send 0xFF800702B40004B600E6**
**UDP send 0xFF800702B40005B600E1**
**UDP send 0xFF800702B40006B600E6**
**UDP send 0xFF800702B40007B600DD**
**UDP send 0xFF800702B40008B600F5**
**UDP send 0xFF800702B40081B60000**
**UDP send 0xFF800702B40082B60000**
**UDP send 0xFF800702B40083B60000**
**UDP send 0xFF800702B40084B60000**
**UDP send 0xFF800702B40085B60000**
**UDP send 0xFF800702B40086B60000**
**UDP send 0xFF800702B40087B60000**
**UDP send 0xFF800702B40088B60000**
**UDP send 0xFF800702B40001CC0050**
**UDP send 0xFF800702B40002CC0064**
**UDP send 0xFF800702B40003CC000A**
**UDP send 0xFF800702B40004CC000A**
**UDP send 0xFF800702B40005CC0000**
**UDP send 0xFF800702B40006CC0000**
**UDP send 0xFF800702B40007CC0000**
**UDP send 0xFF800702B40008CC0000**
**UDP send 0xFF800702B40081CC0000**
**UDP send 0xFF800702B40082CC0000**
**UDP send 0xFF800702B40083CC0000**
**UDP send 0xFF800702B40084CC0000**
**UDP send 0xFF800702B40085CC0000**
**UDP send 0xFF800702B40086CC0000**
**UDP send 0xFF800702B40087CC0000**
**UDP send 0xFF800702B40088CC0000**
**UDP send 0xFF800702B40001CE0000**
**UDP send 0xFF800702B40002CE003C**
**UDP send 0xFF800702B40003CE0000**
**UDP send 0xFF800702B40004CE0032**
**UDP send 0xFF800702B40005CE0014**
**UDP send 0xFF800702B40006CE0000**
**UDP send 0xFF800702B40007CE0000**
**UDP send 0xFF800702B40008CE000A**
**UDP send 0xFF800702B40081CE0000**
**UDP send 0xFF800702B40082CE0000**
**UDP send 0xFF800702B40083CE0000**
**UDP send 0xFF800702B40084CE0000**
**UDP send 0xFF800702B40085CE0000**
**UDP send 0xFF800702B40086CE0000**
**UDP send 0xFF800702B40087CE0000**
**UDP send 0xFF800702B40088CE0000**
**UDP send 0xFF800702B40001B8000E**
**UDP send 0xFF800702B40002B8000E**
**UDP send 0xFF800702B40003B8000E**
**UDP send 0xFF800702B40004B8000E**
**UDP send 0xFF800702B40005B8000E**
**UDP send 0xFF800702B40006B8000E**
**UDP send 0xFF800702B40007B8000E**
**UDP send 0xFF800702B40008B8000E**
**UDP send 0xFF800702B40081B80000**
**UDP send 0xFF800702B40082B80000**
**UDP send 0xFF800702B40083B80000**
**UDP send 0xFF800702B40084B80000**
**UDP send 0xFF800702B40085B80000**
**UDP send 0xFF800702B40086B80000**
**UDP send 0xFF800702B40087B80000**
**UDP send 0xFF800702B40088B80000**
**UDP send 0xFF800702B40001BA000E**
**UDP send 0xFF800702B40002BA000E**
**UDP send 0xFF800702B40003BA000E**
**UDP send 0xFF800702B40004BA000E**
**UDP send 0xFF800702B40005BA000E**
**UDP send 0xFF800702B40006BA000E**
**UDP send 0xFF800702B40007BA000E**
**UDP send 0xFF800702B40008BA000E**
**UDP send 0xFF800702B40081BA0000**

**UDP send 0xFF800702B40082BA0000**
**UDP send 0xFF800702B40083BA0000**
**UDP send 0xFF800702B40084BA0000**
**UDP send 0xFF800702B40085BA0000**
**UDP send 0xFF800702B40086BA0000**
**UDP send 0xFF800702B40087BA0000**
**UDP send 0xFF800702B40088BA0000**
**UDP send 0xFF800702B40001BC007B**
**UDP send 0xFF800702B40002BC007E**
**UDP send 0xFF800702B40003BC0088**
**UDP send 0xFF800702B40004BC0080**
**UDP send 0xFF800702B40005BC0080**
**UDP send 0xFF800702B40006BC008E**
**UDP send 0xFF800702B40007BC0085**
**UDP send 0xFF800702B40008BC007D**
**UDP send 0xFF800702B40081BC0000**
**UDP send 0xFF800702B40082BC0000**
**UDP send 0xFF800702B40083BC0000**
**UDP send 0xFF800702B40084BC0000**
**UDP send 0xFF800702B40085BC0000**
**UDP send 0xFF800702B40086BC0000**
**UDP send 0xFF800702B40087BC0000**
**UDP send 0xFF800702B40088BC0000**
**UDP send 0xFF800702B40001BE0085**
**UDP send 0xFF800702B40002BE0082**
**UDP send 0xFF800702B40003BE0078**
**UDP send 0xFF800702B40004BE0080**
**UDP send 0xFF800702B40005BE0080**
**UDP send 0xFF800702B40006BE0072**
**UDP send 0xFF800702B40007BE007B**
**UDP send 0xFF800702B40008BE0083**
**UDP send 0xFF800702B40081BE0000**
**UDP send 0xFF800702B40082BE0000**
**UDP send 0xFF800702B40083BE0000**
**UDP send 0xFF800702B40084BE0000**
**UDP send 0xFF800702B40085BE0000**
**UDP send 0xFF800702B40086BE0000**
**UDP send 0xFF800702B40087BE0000**
**UDP send 0xFF800702B40088BE0000**
**UDP send 0xFF800702B40001D80005**
**UDP send 0xFF800702B40002D80005**
**UDP send 0xFF800702B40003D80005**
**UDP send 0xFF800702B40004D80005**
**UDP send 0xFF800702B40081D80005**
**UDP send 0xFF800702B40082D80005**
**UDP send 0xFF800702B40083D80005**
**UDP send 0xFF800702B40084D80005**
**UDP send 0xFF800702B40001DA0005**
**UDP send 0xFF800702B40002DA0005**
**UDP send 0xFF800702B40003DA0005**
**UDP send 0xFF800702B40004DA0005**
**UDP send 0xFF800702B40081DA0005**
**UDP send 0xFF800702B40082DA0005**
**UDP send 0xFF800702B40083DA0005**
**UDP send 0xFF800702B40084DA0005**
**UDP send 0xFF800702B40001DC0017**
**UDP send 0xFF800702B40002DC0017**
**UDP send 0xFF800702B40003DC0017**
**UDP send 0xFF800702B40004DC0017**
**UDP send 0xFF800702B40081DC0017**
**UDP send 0xFF800702B40082DC0017**
**UDP send 0xFF800702B40083DC0017**
**UDP send 0xFF800702B40084DC0017**
**UDP send 0xFF800702B40001DE0000**
**UDP send 0xFF800702B40002DE0000**
**UDP send 0xFF800702B40003DE0000**
**UDP send 0xFF800702B40004DE0000**
**UDP send 0xFF800702B40081DE0000**
**UDP send 0xFF800702B40082DE0000**
**UDP send 0xFF800702B40083DE0000**
**UDP send 0xFF800702B40084DE0000**
**UDP send 0xFF800702B40001100032**
**UDP send 0xFF800702B40002100032**
**UDP send 0xFF800702B40003100032**
**UDP send 0xFF800702B40004100032**
**UDP send 0xFF800702B40081100032**
**UDP send 0xFF800702B40082100032**
**UDP send 0xFF800702B40083100032**
**UDP send 0xFF800702B40084100032**
**UDP send 0xFF800702B40001D00000**

**UDP send 0xFF800702B40002D00000**
**UDP send 0xFF800702B40003D00000**
**UDP send 0xFF800702B40004D00000**
**UDP send 0xFF800702B40081D00000**
**UDP send 0xFF800702B40082D00000**
**UDP send 0xFF800702B40083D00000**
**UDP send 0xFF800702B40084D00000**
**UDP send 0xFF800702B40040900000**
**UDP send 0xFF800702B40040900001**
**UDP send 0xFF800702B40040900000**
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**UDP send 0xFF800702B4000274000A**
**UDP send 0xFF800702B4000374000A**
**UDP send 0xFF800702B4000474000A**
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**UDP send 0xFF800702B4008274000A**
**UDP send 0xFF800702B4008374000A**
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**UDP send 0xFF800702B4000172000F**
**UDP send 0xFF800702B4000272000F**
**UDP send 0xFF800702B4000372000F**
**UDP send 0xFF800702B4000472000F**
**UDP send 0xFF800702B4008172000F**
**UDP send 0xFF800702B4008272000F**
**UDP send 0xFF800702B4008372000F**
**UDP send 0xFF800702B4008472000F**
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**UDP send 0xFF800702B400837A0010**
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**UDP send 0xFF800702B40082800000**
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**UDP send 0xFF800702B40004E8000A**
**UDP send 0xFF800702B40081E8000A**
**UDP send 0xFF800702B40082E8000A**
**UDP send 0xFF800702B40083E8000A**
**UDP send 0xFF800702B40084E8000A**

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**UDP send 0xFF800702B40004EA0014**
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**UDP send 0xFF800702B40083EA0014**
**UDP send 0xFF800702B40084EA0014**
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**UDP send 0xFF800702B40003EC000A**
**UDP send 0xFF800702B40004EC000A**
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**UDP send 0xFF800702B40083EC000A**
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**UDP send 0xFF800702B40082EE0014**
**UDP send 0xFF800702B40083EE0014**
**UDP send 0xFF800702B40084EE0014**
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**UDP send 0xFF800702B40003D60000**
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**UDP send 0xFF800702B40001400000**
**UDP send 0xFF800702B40081400000**
**UDP send 0xFF800702B40081400001**
**UDP send 0xFF800702B40081400000**

**2) Config setting command list example**

**UDP send 0xFF800702B40040000001**
**UDP send 0xFF800702B40040060000**
**UDP send 0xFF800702B40040080000**
**UDP send 0xFF800702B400400A2540**
**UDP send 0xFF800702B400400CBE40**
**UDP send 0xFF800702B400402E0100**
**UDP send 0xFF800702B40040300001**
**UDP send 0xFF800702B400403200FF**
**UDP send 0xFF800702B400008C0007**
**UDP send 0xFF800702B400011A0001**
**UDP send 0xFF800702B400021A0001**
**UDP send 0xFF800702B400031A0001**
**UDP send 0xFF800702B400041A0001**
**UDP send 0xFF800702B400811A0001**
**UDP send 0xFF800702B400821A0001**
**UDP send 0xFF800702B400831A0001**
**UDP send 0xFF800702B400841A0001**
**UDP send 0xFF800702B40040360000**
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**UDP send 0xFF800702B400030C0004**
**UDP send 0xFF800702B400040C0004**
**UDP send 0xFF800702B400810C0004**
**UDP send 0xFF800702B400820C0004**
**UDP send 0xFF800702B400830C0004**
**UDP send 0xFF800702B400840C0004**
**UDP send 0xFF800702B40001600007**
**UDP send 0xFF800702B40002600007**
**UDP send 0xFF800702B40003600007**
**UDP send 0xFF800702B40004600007**
**UDP send 0xFF800702B40081600007**
**UDP send 0xFF800702B40082600007**
**UDP send 0xFF800702B40083600007**
**UDP send 0xFF800702B40084600007**
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**UDP send 0xFF800702B40002620009**
**UDP send 0xFF800702B40003620009**
**UDP send 0xFF800702B40004620009**
**UDP send 0xFF800702B40081620009**
**UDP send 0xFF800702B40082620009**
**UDP send 0xFF800702B40083620009**
**UDP send 0xFF800702B40084620009**
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**UDP send 0xFF800702B4008366001E**
**UDP send 0xFF800702B4008466001E**
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**UDP send 0xFF800702B400836A1F40**
**UDP send 0xFF800702B400846A1F40**
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**UDP send 0xFF800702B400026E0080**

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**UDP send 0xFF800702B400826E0080**
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**UDP send 0xFF800702B400846E0080**
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**UDP send 0xFF800702B40083B00001**
**UDP send 0xFF800702B40084B00001**
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## 9. End

Click "quit" in "File" of the menu bar. After clicking, this application ends, and the screen disappears. The next time you start up, the settings at the end will be reflected.

CONTACT INFORMATION

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