## 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.
	Repair or replacement will be carried out in case of breakdown even though you
Guarantee contents	have used correctly according to this instruction manual within the warranty
	period
	We do not warranty if the cause of the failure falls under any of the following.
	1. Failure or damage due to misuse or improper repair or modification or
	disassembly.
Out of worroot	2. Failure and damage due to falling etc.
Out of warranty	3. Breakdown / damage in harsh environments (high temperature / high
	humidity, under zero, condensation etc.).
	4. Causes other than the above, other than "our products".
	5. Consumables.

# 2.Overview2.1.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.



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
<ul> <li>Input impedence</li> </ul>	:	50 Ω
(2) ADC		
<ul> <li>Sampling frecuency</li> </ul>	:	1 GHz
<ul> <li>Resolution</li> </ul>	:	14-bit
• SNR	:	68.3 dBFS @ 605 MHz
(3) Performance		
QDC output	:	2 Mcps and more
<ul> <li>Time resolution</li> </ul>	:	3.90625 ps
(4) MCA		
<ul> <li>Measurement mode</li> </ul>	:	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		
<ul> <li>VME type</li> </ul>	:	APV8108-14
(7) Consumption curren	t	
+ 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
<ul> <li>Screen resolution</li> </ul>	:	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: $\pm$ 1 V, input impedance: 50 $\Omega$ .
2	SYNC-O	LEMO connector for synchronous timing signal output.
3		Outputs a timing signal to adjust the time between boards.
4		LEMO connector for synchronous timing signal input.
4	3110-1	Input a timing signal to adjust the time between boards.
5	CLK-O	LEMO connector for external clock signal output.
5		Outputs a 25 MHz TTL signal.
	CLK-I	LEMO connector for external clock signal input.
6		It can be operated using an external clock.
		Turn on the power after inputting the 25 MHz TTL signal.
7	VETO	LEMO connector for external signal input.
1		Disable data acquisition during "High".
0	GATE	LEMO connector for external gate signal input. Input TTL signal.
0		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.		
ſ	"Setup.exe" in the "Installer" folder in the supplied CD-ROM. Proceed with the installation		
2	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	
1	a switching hub when using a hub.	
•	SYNC-O terminal-SYNC-I terminal connection	
2	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

	Turn on the power of the PC ar	nd change the network information of the PC.			
	ID Addroop	192.168.10.2			
1	IF Address	*Any value except 192.168.10.128			
	Sub-net mask	255.255.255.0			
	Default gateway	192.168.10.1			
2	Power on the VME rack. Do not operate anything for 10 seconds after power on.				
	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 l	board. The network information of this device at the time of shipment			
	from the factory is as follows.				
	ID Addross	192.168.10.125			
	IF Address	*The following is an example at 192.168.10.128.			
	Sub-net mask	255.255.255.0			
	Default gateway	192.168.10.1			
	> ping 192.168.10.128				
3	C:¥WINDOWS¥system32¥cmd.exe —				
	Microsoft Windows [Version 10.0.14393] ^				
	C:¥Users¥Administrator>ping 192.168.10.128				
	192.168.10.128 に ping を送信しています 32 バイトのデータ: 192.168.10.128 からの応答: バイト数 =32 時間 <1ms TTL=128 192.168.10.128 からの応答: バイト数 =32 時間 <1ms TTL=128 192.168.10.128 からの応答: バイト数 =32 時間 <1ms TTL=128 192.168.10.128 からの応答: バイト数 =32 時間 <1ms TTL=128				
	192.168.10.128 の ping 統計: パケット数: 送信 = 4、受信 = 4、損失 = 0(0% の損失)、 ラウンド トリップの概算時間 (ミリ秒): 最小 = Oms、最大 = Oms、平均 = Oms C:¥Users¥Administrator>				
	Pic. 3: Communication connection check, ping command execution				
Launch this application on a PC.		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.				
	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.				
4	2. The LAN cable on the PC side is not fully inserted.				
	3. The LAN cable on the device side is not fully inserted.				
	4. The power of this device remains OFF or the LAN cable is broken.				
	5. The network setting on the PC side is DHCP.				
	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)				
	7. The power saving mode of the	ne PC is functioning.			

	8. Wireless LAN of PC is enabled.
	If the above cause does not start up properly, please try the following method.
	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							
ID address	It is defined in the configuration file, and the IP address of the device							
IP address	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							
mada	Display "hist", "wave", "list" or "list-com". Please note that the above modes							
mode	may not be available depending on the configuration of the option.							
measurement mode	Display "real time" and "live time"							
measurement time	Set measurement time							

roal 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

APV81	08-TOTAL-F	ALL																				Θ Σ
File Ed	it calibrati	on Tool	Config	, Clea	r Star	t Stop	)															
device [	Dev1 💌	IP addre	s 192.168.	.10.128	m	emo		ROI							]		1	acq.	save	error	mode	hist
CH No.	output count	output rate(cps)	deadtime (%)					ROI No.	peak (ch)	centro (ch)	pid (c	peak count)	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
CH1 : CH2 :	0.00	0.00	0.00					ROI1 : ROI2 :	0	0.	00 ( 00 (	).000 ).000	0.000	NaN NaN	0.000	NaN NaN	0.0	0.000	0.000	0.000	measurement time	24:00:00
снз:	0.00	0.00	0.00					ROI3 :	0	0.	00 0	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	real time	00:00:00
CH4 : CH5 :	0.00	0.00	0.00					ROI4 : ROI5 :	0	0.	00 ( 00 (	0.000 0.000	0.000	NaN NaN	0.000	NaN NaN	0.0	0.000	0.000	0.000	live time	00:00:00
CH6 :	0.00	0.00	0.00					RO16 :	0	0.	00 0	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file size(Byte)	0.000
CH8 :	0.00	0.00	0.00					ROI7 : ROI8 :	0	0.	00 C	).000 ).000	0.000	NaN NaN	0.000	NaN NaN	0.0 0.0	0.000	0.000	0.000	sampling	1G
config	file wave	spectrum	n timespect	rum																		
CH enable CH1 CH2 CH3 CH4 CH4 CH4 CH4 CH4 CH4 CH4 CH4 CH4 CH4	signal type nomal sig [ nomal sig [ nomal sig [ nomal sig [ nomal sig [ nomal sig [ nomal sig [	signal delay (ns) • 0 0 0 • 0 0 0 0 0 0 • 0 0 0 0 0 0 • 0 0 0 0 0 0 0 • 0 0 0 0 0 0 0 • 0 0 0 0 0 0 0 0 • 0 0 0 0 0 0 0 0 0 • 0 0 0 0 0 0 0 0 0 0 • 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ba polarity filt pos v 4µ pos v 4µ		threshold (digit) 20 (4) 20 (4) 20 (4) 20 (4) 20 (4) 20 (4) 20 (4) 20 (4) 20 (4)	timing type CFD V CFD V CFD V CFD V CFD V CFD V CFD V CFD V	CFD function (multiple x0.21 [ x0.21 [	CFD delay (digit) Sns Sns Sns Sns Sns Sns Sns Sns Sns Sns		FD           (alk           digit)           5           5           5           5           5           5           5           5           5           5           5           5           5           5           5           5           6           7           6           7	QDC sum/peak sum v sum v sum v sum v sum v sum v sum v	QDC pretrigg (ns) -24ns -24ns -24ns -24ns -24ns -24ns -24ns -24ns -24ns -24ns -24ns	<pre>QDC filter (ns) 10ns 10ns 10ns 10ns 10ns 10ns 10ns 10ns</pre>	QDC integral range(ns 144 4 144 4	QDC           full scale           i) (multiple)           ii/1	QDC LLD ) (digit) 10 44 10 44 10 44 10 44 10 44 10 44 10 44	QDC ULD (digit) H 8000 H 8000 H 8000 H 8000 H 8000 H 8000 H 8000	<u></u>				
	mode hist real time measurement time(sec) 24:00:00 list read byte 16000	t (byte)	time specific ti	ectrum Of	N/OFF ON/OFF					CH1 : CH2 : CH3 : CH4 : CH5 : CH5 : CH6 : CH7 : CH8 :	start cnt (digit) 10   ↓ 10   ↓ 10   ↓ 10   ↓ 10   ↓ 10   ↓ 10   ↓	Stop cn         4         20         4           20         4         20         4           20         4         20         4           20         4         20         4           20         4         20         4           20         4         20         4           20         4         20         4           20         4         20         4           20         4         20         4           20         4         20         4	tell         start cnl           (digit)         5         4           5         4         5         4           5         4         5         4           5         4         5         4           5         4         5         4           5         4         5         4           5         4         5         4           5         4         5         4           5         4         5         4           5         5         4         5	stop cnt (digit)           5<	10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +             10          +	total stop cnt (digit) 20  �  20  �	FDR       full scale       (multiple       1/1       1/1       1/1       1/1       1/1       1/1       1/1       1/1       1/1       1/1       1/1       1/1					

Pic. 5-1: config tab, upper part

The contents of each item are as follows.

	CH availability.										
	Normally, set all channels to enable (pressed).										
	Select the type of input waveform.										
signal type	Set to "fast sig" when inputting NIM signals or timing signals.										
	For others, set "nomal sig".										
signal dolay	The input signal is delayed internally in this device.										
signal delay	The maximum delay time is 2 µs.										
polarity	Select the polarity of the input signal from "pos" for positive polarity and "neg" for nega	tive									
polarity	polarity.										
basalina	Set the time constant of baseline restorer.										
rostoror filtor	Set from Ext (without AutoBLR), Fast, 4 $\mu s,$ 85 $\mu s,$ 129 $\mu s,$ and 260 $\mu s.$										
	Normally set to 85 µs.										
	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.										
threshold	threshold TDC, QDC calc enable rise edge										

	Select the waveform for time stamp from CFD waveform and LED (raw waveform).
timing the	Leading-Edge Timing (LET)
uming type	It is the timing when a certain trigger level t is reached.
	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
Moveforme g and b	Waveforms obtained by adding waveforms c and e and waveforms obtained
vvaveiorns g and n	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.



	Set the timing to start waveform shaping for integral value calculation.											
	Select from 0 ns, -8 ns, -16 ns, -32 ns, -40 ns.											
QDC pre trigger	Start integration from the previous time by the pretrigger setting value Integration start point -8ns Ons											
	Set the time constant for shaping the waveform for integral value calculation.											
	The setting is selected from Ext, 10 ns, 20 ns, 50 ns, 100 ns and 200 ns.											
QDC filter	Raw waveform											
	Time constant: 200 ns											
	Soloct ODC integration time											
	The range is 0 ns to 32000 ns.											
	In case of Integral range 100 ns In case of Integral range 200 ns											
QDC integral	-8ns Ons											
	Set the gain of QDC data.											
	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.											
	Make the QDC value be less than 8191.											
QDC full scale	$\frac{1/1}{1/2} \qquad QDC = 400  QDC = 200  -8ns 0ns$											
	Set the Lower Level Discriminator (LDC) of QDC. The unit is digit.											
QDC LLD	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.											
	Set the Upper Level Discriminator (UDC) of QDC. The unit is digit.											
QDC ULD	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.											
	Set the OR output to the front panel AUX terminal. It can be set for each CH.											
OR eable	One pulse TTL logic is output for the event after passing LLD and ULD. (optional)											
	* 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) \* Not shown in the photo on page 13.

APV8108-TOTAL-FALL		
File Edit calibration Tool   Config Clear Start Stop		
device Dev1 v IP address 192.168.10.128 memo	acq. save error mode	hist
CH output output deadtime No. count rate(cps) (%)	ROI         peak         centroid         peak         gross         net         net         PWHM         FWHM         FWTM         measurement           No.         (ch)         (ch)         (count)         (cps)         (count)         (cps)         (ch)         (%)	real time
CH1 : 0.00 0.00 0.00	ROI1: 0 0.00 0.000 NaN 0.000 NaN 0.00 0.000 0.000 measurement	24:00:00
CH3 : 0.00 0.00 0.00	ROI2: 0 0.00 0.000 0.000 NaN 0.000 NaN 0.0 0.000 0.000 real time	00:00:00
CH4 : 0.00 0.00 0.00	ROI4 : 0 0.00 0.000 0.000 NaN 0.000 NaN 0.0 0.000 0.000 live time	00.00.00
CH5 : 0.00 0.00 0.00 CH6 : 0.00 0.00	ROIS : 0 0.00 0.000 NaN 0.000 NaN 0.000 0.000 0.000 0.000	00.00.00
CH7 : 0.00 0.00 0.00	ROI7 : 0 0.00 0.000 NaN 0.000 NaN 0.000 0.000 0.000 0.000	0.000
CH8 : 0.00 0.00 0.00	R018: 0 0.00 0.000 NaN 0.000 NaN 0.00 0.000 0.000 0.000 0.000	1G
onfig         file         vave         spectrum         timespectrum           CH enable         signal signal signal enable         same files (u)         baseline files (u)         threshold timing threshold timing timespectrum         CPD funct (u)         CPD timespectrum         threshold timing timespectrum         CPD timespectrum         threshold timing timespectrum         CPD timespectrum         threshold timing timespectrum         CPD timespectrum         threshold timing timespectrum         CPD timespectrum         timespectrum         timespectrum <t< td=""><td><math display="block"> \begin{array}{c c c c c c c c c c c c c c c c c c c </math></td><td></td></t<>	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	

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

	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.									
modo	list: Regarding the input signal, time information, CH information and integration									
mode	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.									
magurament made	Select from real time and live time.									
mesurement mode	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.									
	Select whether to display time spectrum while acquiring list data in list mode. If you									
time coectrum on/off	want to obtain only list data, uncheck it.									
ume specirum on/on	NOTE: Selecting that check box during high count measurement will delay									
	the acquisition of list data.									
	Select the presence or absence of spectrum display while acquiring list data in list									
energy spectrum	mode. If you want to obtain only list data, do not select the check box.									
on/off	NOTE: Selecting that check box during high count measurement will delay									
	the acquisition of list data.									

APV8108	B-TOTAL-FALL																			
File Edit	calibration	Tool   Con	fig Clear	Start	: Stop															
device Dev	v1 💌 IP	address 192.16	8.10.128	me	mo		ROL								1	acq.	save	error	mode	hist
CH No.	output outpu count rate(cp	t deadtime s) (%)					ROI No.	peak (ch)	centroid (ch)	peak (count)	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
CH1 :	0.00 0.0	0.00					ROI1 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement time	24:00:00
CH2 :	0.00 0.0	0 0.00					ROI2 : ROI3 :	0	0.00	0.000	0.000	NaN NaN	0.000	NaN NaN	0.0	0.000	0.000	0.000	real time	00:00:00
CH4 :	0.00 0.0	0.00					ROI4 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	live time	00-00-00
CH5 : CH6 :	0.00 0.0	0 0.00					ROIS :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	(I - (D + )	00.00.00
СН7 :	0.00 0.0	0.00					ROI7 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file size(Byte)	0.000
CH8 :	0.00 0.0	0 0.00					ROI8 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	1G
config	file wave sp	ectrum timespe	ectrum																	
CH enable (741) : (742) : (743) : (744) : (744	signal type (ns normal sig v normal sig v no	nal polity () 000 v ()	baseline treatment of the fiber ( $\mu$ s) of the	/OFF	tining type CFD V CFD V CFD V CFD V CFD V CFD V CFD V CFD V CFD V	CFD function (multiple) x0.21 v x0.21 v x0.21 v x0.21 v x0.21 v x0.21 v	CFD delay (digit) Sns Sns Sns Sns Sns Sns Sns Sns Sns Sns		-D QDC -D Q	QDC (ns)         QDC (ns)           -24ms         -24ms           -20ms         -24ms           -20ms         -20ms           -20ms         -20ms           -20ms         -20ms           -20ms         -20ms           -20ms         -20ms           -20ms         -20ms           -20ms         -20ms	ger Def         filter           10ns         .           10ns         . </td <td>ODD           Integral           range(n           144           5           5           5           5           5           5           5</td> <td>OpE           full scale           (multiple           +         1/1           +&lt;</td> <td>QDC           LLD           10</td> <td>QDC ULD (digit, 8000 19000 1900 19</td> <td></td> <td></td> <td></td> <td></td> <td></td>	ODD           Integral           range(n           144           5           5           5           5           5           5           5	OpE           full scale           (multiple           +         1/1           +<	QDC           LLD           10	QDC ULD (digit, 8000 19000 1900 19					

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.						
	Set the range in front of the position beyond the threshold.						
	The setting range is 1 to 498 (498 ns = $498 \times 1$ ns).						
rise stop cnt	End position of the target range of the integral value RISE of the rising part.						
	Set the range to integrate from the above "rise start cnt".						
	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.
	Set the start position of integration range from the position exceeding threshold.
	The setting range is 1 to 16383 (16383 ns = 16383 × 1 ns).
	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.
	Set the range of integration from the above "fall start cnt".
	The setting range is 1 to 16383 (16383 ns = 16383 × 1 ns).
	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.
	Set the range in front of the position beyond the threshold.
	The setting range is 1 to 498 (498 ns = $498 \times 1$ ns).
total stop cnt	End position of the target range of the waveform integral value TOTAL.
	Set the range for integration from the above "total start cnt".
	The setting range is 1 to 16383 (16383 ns = $16383 \times 1$ 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

### 5. 3. file tab

APV8108-TOTAL-FALL						
File Edit calibration Tool   Config Clear Start Stop						
device Dev1 v IP address 192.168.10.128 memo	ROL			acq. save	error mode	hist
CH output output deadtime No. count rate(cps) (%)	ROI peak ( No. (ch)	centroid peak g (ch) (count) (c	gross gross net count) (cps) (count)	net FWHM FWHM FWHM (cps) (ch) (%)	FWTM measurement mode	real time
CH1 : 0.00 0.00 0.00	ROI1 : 0	0.00 0.000	0.000 NaN 0.000	NaN 0.0 0.000 0.000	0.000 measurement	24:00:00
CH2 0.00 0.00 0.00 CH3 0.00 0.00	ROI2 : 0	0.00 0.000	0.000 NaN 0.000	NaN 0.0 0.000 0.000 NaN 0.0 0.000 0.000	0.000 real time	00:00:00
CH4 : 0.00 0.00 0.00	ROI4 : 0	0.00 0.000	0.000 NaN 0.000	NaN 0.0 0.000 0.000	0.000 live time	
CH5 : 0.00 0.00 0.00	ROIS : 0	0.00 0.000	0.000 NaN 0.000	NaN 0.0 0.000 0.000	0.000	00:00:00
CH6 : 0.00 0.00 0.00 CH7 : 0.00 0.00 0.00	ROI6 : 0	0.00 0.000	0.000 NaN 0.000	NaN 0.0 0.000 0.000	0.000 file size(Byte)	0.000
CH8 : 0.00 0.00 0.00	ROI8 : 0	0.00 0.000	0.000 NaN 0.000	NaN 0.0 0.000 0.000 NaN 0.0 0.000 0.000	0.000 sampling	1G
confin file wave spectrum timespectrum						=
file     lst sove       hidogram sove     lst file path       DisDATA     hidogram file path       Culturantet_t_     lst file number       Culturantet_t_     lst file sove(5)/40       Ist file sove(5)/40     lst file sove(5)/40       Ist hasker ON/OFF     OFF ↓	ile name Art Adococo bin					

Pic. 9: file tab

#### Setting section for saving.

	Save the histogram data displayed in the "spectrum tab" at the end of measurement							
histogram save	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	Set whether to save histogram data to file continuously at set time interval. It is valid							
continuous save	only when "hist" is selected in "mode".							
	Set absolute path of histogram data file. No extension is also possible.							
	NOTE: It is not saved with this file name, but based on this file name, it will be							
	the following format.							
	Example: When "C: ¥ Data ¥ histogram.csv" is set in "histogram file path" and "10"							
histogram file path	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".							
	* The above "120010" may be "120009" or "120011".							
hisutogram file	Set the time interval for continuous storage of histogram data. The unit is seconds.							
save time (sec)	The setting range is 5 seconds to 3600 seconds.							
list source	Set whether to save list data to file. Valid only when "list" is selected in "mode" in the							
list save	Config tab.							
list file seconds an	Set the start number of the number added to the list data file. From 0 to 99,999. It							
list flie number	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.								
Giapri	When "wave" is selected in "mode" in the "config" tab, the waveform is displayed.								
on/off	Set whether to display the waveform								
СН	Select the CH of the waveform to be displayed.								
	Select the type of waveform to be displayed.								
	raw: Waveform digitized by the ADC and BLR processed								
Туре	CFD: Waveform shaped waveform of CFD.								
	Filter: Waveform integrated by QDC								
	PTG: Square wave at piled up timing								
trigger edge	Select the trigger polarity. In general, select pos.								
throphold	Set the trigger threshold.								
Infestioid	*You can also set the cursor in the graph.								
trigger point	Sets the waveform display start point.								
tngger point	*You can also set the cursor in the graph.								
trigger SIG	Select a SIG (Signal) to trigger. Normally, select SIG1.								
	Set the time scale compression of X axis.								
wave compress	Used to display waveforms with long fall times.								
	When the check box is not selected, the triggered waveform is displayed, and when								
wave free run	it is checked, the trigger free waveform is displayed.								
	It can also be used to view baseline levels and noise levels.								

accumlation	Selection of valid / invalid of superposition of waveform data
	Button to adjust the scale of X axis and Y axis.
XY Scale	Expansion is + (plus), reduction is-(minus)
X axis calibration	Select the unit of X axis
V avia adibratian	Select the unit of Y axis.
Y axis calibration	*Please use the mV display as a reference.
	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
X-axis range	maximum value of X axis will be fixed.
	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.
	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
Y-axis range	of the Y axis will be fixed.
	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.
<b>NU</b>	Cursor movement tool.
<u>-</u>	The cursor can be moved on the graph when setting the ROI.
	Zoom.
•,⊕	When selected, the following six zooms in and zoom out options can be selected
	and executed.
: m.	Pan tool.
<b>6</b> .9	You can grab the plot and move it over the graph.



Pic. 11: For zooming in and out

		Use this option to click the point on the display that you want to be
1	Rectangle	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

APV8108	-TOTAL-	FALL																					• 🛛
File Edit	calibrat	tion Tool	Config	g Clear	r Star	t Ste	op																
device Dev	1 💌	IP addre	ss <b>192.168</b>	3.10.128	m	emo									7			acq.	save	error	mode	hist	L L
СН	output	output	deadtime					ROI	pea	k cer	troid	peak	gross (sound)	gross (ms)	net	net	FWHM (ch)	FWHM	FWHM	FWTM	measurement	real time	
CHI :	0.00	rate(cps)	(%)					NO.	(cr	<u> </u>	cn)	(count)	(count)	(cps)	(count)	(cps)	(cn)	(%)	0.000	0.000	mode		
CH2 :	0.00	0.00	0.00					ROL			0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement time	24:00:00	
СНЗ :	0.00	0.00	0.00					ROIS			0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	real time	00:00:00	
CH4 :	0.00	0.00	0.00					ROI4	H: (		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	6		
CH5 :	0.00	0.00	0.00					ROIS	. (	)	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	live time	00:00:00	
CH6 :	0.00	0.00	0.00					ROIG	i: (		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file size(Byte)	0.000	
CH7 :	0.00	0.00	0.00					ROI7	7: <b>(</b>		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000		10	
CH8 :	0.00	0.00	0.00					ROI8			0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	IG	E
config	file way	e spectrum	timespec	trum																			
																	SDP	ctrum F	OT ROL	ROI st	art ROI end	energy gauss fit	
1.								{									on	off	СН	(ch)	(ch)		
0.8-																A C	11	<u> </u>	1 CH1	<b>↓</b> 0	8000	662 🔶 off	
								1								V C	-12	4	2 none	• 0	I 8000 I €	662 🗢 off	
0.6	-		_	_			_	-	_	_			_			C C	-13	4	a none	• •	♥  8000  ♥   ▲  9000  ▲	662 🔍 off	
								1								A C	-14	4	5 none	- 0	► 0000 ►	662 V 01	
0.4 -								1									15	<u> </u>	6 none	- 0	<b>↓</b>   8000   <b>↓</b>	662 🔷 off	
~ 0.2	_															C C		_	7 none	v 0	l⇔ 8000 l⇔	662 🗢 off	
Lear																	1/ l	<u> </u>	8 none [	<b>v</b> 0	응 8000 🔄	662 🔷 off	
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8								1											() ch	⊙ eV (	🗇 keV 🔘 mar	nual	
-0.2																	iing3 [	- 1	ROI	centroid(	ch) energy	*a -Inf 🔶	
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								1								E fit	ing5		none 👻	- 0.	00 - 0	unit MeV	
-0.6								1								E fit	iing6	<b>-</b>	-Y mapping		culation	-simple count view-	-
-0.8-																🗂 fit	iing7 [	~	Inear		smoothing	count view CH	
…								1								E fit	iing8	~	🔘 log			V (ch)	
-1-	-			-	1	1				-								o [*x];				4000	
	0 10	00 2000	3000 4	-000 50	-00 60	000	7000 80	000 ch	9000	10000	11000	12000	13000 14	000 1500	0 163	33 Jch		<u>e 10</u>				Y counts(-)	
															+ 🔍 🖑	coun	ts _	8 <u>1</u>				0.000	

Pic. 12: spectrum tab

Settings related to spectrum display.

	Energy spectrum. The spectrum is displayed when "hist" is selected for "mode" in							
Graph	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.							
	Select the CH number to apply ROI (Region Of Interest).							
RUICH	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							
	Defines the energy value of peak position (ch).							
	In the case of 60 Co, it is set to 1173 (keV) or 1332 (keV). When "ch" is selected in							
energy	"calibration", the peak between the ROIs is detected, ${\rm keV}/{\rm ch}$ is calculated from the							
	peak position (ch) and the set energy value, and the calculated half width is							
	calculated.							
	Select the unit of X axis.							
	The label of the X axis is also changed along with the setting.							
	ch: Unit ch (channel) display. Units such as "FWTM" of "FWTM" of ROI are arbitrary.							
calibration	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".							

	<b>keV</b> : 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.
	<b>manual</b> : 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.
	Select mapping of Y axis of graph.
V monoing	The label of the Y axis is also changed along with the setting.
тпарріпу	linear: straight line
	log: log
omoothing	Smoothing (5-point second order smoothing) function to calculate the half-width
smoothing	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

	APV81	08-T	OTAL-F	ALL																				• 🛛
Fi	e Ed	it c	alibrat	i <b>on</b> Too	Co	nfig (	Clear S	tart	Stop															
	evice [	Dev1	•	IP add	es <b>192.</b> 1	168.10.	128	memo		BOI								1	acq.	save	error	mode	hist	Â
	H 0.	out	iput unt	output rate(cps)	deadtim (%)	e				ROI No.	peak (ch)	centroid (ch)	peak (count)	gross (count)	gross (cps)	net (count)	net i (cps)	WHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time	
	н1 :	0	.00	0.00	0.0	0				ROI1 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement	24:00:00	
	H2 :	0	.00	0.00	0.0	0 0				ROI2 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	real time	00:00:00	
•	H4 :	0	.00	0.00	0.0	0				ROI4 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	hun time		
•	H5 :	0	.00	0.00	0.0	0				ROIS :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	ave tane	00:00:00	
	H6 : H7 :	0	.00	0.00	0.0	0				ROI6 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file size(Byte)	0.000	
	н8 :	0	.00	0.00	0.0	0				ROI7 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	1G	
	confin	file	waw	e spectra	m times	pectrum																		=
۱Ľ	coning		1	e specie														_						
		1-																	C	11 🖊				
																			Config					л I I I
																			CH1	H T	gain(mul	tipie)		
					1														stop C	н	coinc off	iset(ns)		
																			CH4	-	100	H		
					1																coinc tim	e(ns)		
		(Liear																			50			
		~ 12																						ו ר
		8																	ROIS	TART(ch)	FWHM(	ch) FWTM(ch)	ROI cont(-)	
																			12/33		0.00	0.00	U	
																			ROIE	ND(ch)	FWHM(	ps) FWTM(ps)	ROI cont(cps)	
																			1204/	<b>I*</b> 1	0.00	0.00	0.00	
																			-X Scal	e	1			
																			) d	🔘 ns				
		-1-	-		:	-	-										_		ch		قر 8	8.83		
			0 5	000 10000	15000	20000 1	25000 30	000 35	000 40000	45000 50 cł	000 <u>5</u> 1	5000 6000	0 65000 :	70000 7500	0 80000 0	85000 9000	0 95000	9999 1	counts	(linear)	8 JY	8.93		
																			<i>´</i>					

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.

	Time difference spectrum. If "list" is selected for "mode" in the "config" tab and
Graph	"timespectrum on / off" is selected, the time difference spectrum is displayed during
	measurement.
Check box	Select whether to display spectrum or not.
	Setting of time spectrum.
	start CH: Select the CH number for acquiring the start timing.
	stop CH: Select the CH number for acquiring stop timing.
	gain: You can select from 1x to 1 / 128x. At 1-time, full scale about 780 ns (about
Config part	3.9 ps per 1 digit), 1/128 full scale is about 100 $\mu$ s (0.5 ns per 1 digit).
	coinc offset: Sets the offset in units of 1 ns.
	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.
	Settings related to calculation.
	ROI START: ROI start channel
ROI	ROI END: end channel of ROI
	FWHM: The calculated half width is displayed.
	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.

APV8108-T	TOTAL-FALL		_																	0
File Edit o	calibration Tool	Confi	g Clea	r Star	t Stop	)														
device Dev1	IP addr	== 192.168	8.10.128	m	emo		-801-								1	acq.	save	error	mode	wave
CH OU No. cc	utput output count rate(cps)	deadtime (%)					ROI No.	peak (ch)	centroid (ch)	peak (count)	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
СН1 : 0	0.00 0.00	0.00					ROI1 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement	24:00:00
снз: с	0.00 0.00	0.00					ROI2 : ROI3 :	0	0.00	0.000	0.000	NaN NaN	0.000	NaN NaN	0.0	0.000	0.000	0.000	real time	00:00:00
CH4 : 0	0.00 0.00	0.00					ROI4 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	live time	00:00:00
Сн6 : 0	0.00 0.00	0.00					ROIS :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file size(Byte)	0.000
CH7 : 0	0.00 0.00	0.00					ROI7 :	0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	1G
confin . 614			taun .				NOIS .	U	0.00	0.000	0.000	nan	0.000	nan	0.0	0.000	0.000	0.000		
CH enable sign CH = 100 CH = 1	signal type         disp           disp         (ns)           omal sig         0         4           omal sig         0         14           odd         0         14           odd         0         14           odd         14         14	polarity # 1 pos + 4 1 pos + 4	aseline estorer t iter(µs) ( µ v µ v µ v µ v µ v µ v µ v µ v µ v µ v	threshold (digit) 20 (4) 20 (4) (2) (2) (2) (2) (2) (2) (2) (2) (2) (2	timing type CFD CFD CFD CFD CFD CFD CFD CFD CFD CFD	CFD function (multiple) 3 x0.21 [ x0.21 ] x0.21 [ x0.21 ] x0.21 [ x0.21 ]	CFD delay delay delay v Srs Srs Srs Srs Srs Srs Srs Srs Srs Srs Srs		D         QCC           alk         sum,           igit)         sum,	ODC         ODC           0         -         24na           10         20         20           10         20         20           10         20         20           10         20         20	QDC (ns)           10ns           10ns	QDC integral range(n) 144 144 144 144 144 144 144 144 144 14	QDC full scale 5 (multiple sca	QDC           LLD           (digit)           10      1	QDC ULD (digit) 3000 4 0000 4 00000 4 000000 00000000					

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.

APV8108	-TOTAL-F	ALL	_	_																	
File Edit	calibrati	on Tool	Conf	îg Cle	ar St	art S	top														
device Dev	/1 🗸	IP addre	= 192.16	8.10.12	8	memo [		ROI								1	acq.	save	error	mode	hist
CH No.	output count	output rate(cps)	deadtime (%)					ROI No.	peak (ch)	centroid (ch)	i peai (cour	t) (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
CH1 :	0.00	0.00	0.00					ROI1 :	0	0.0	0.00	0.00	) NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement time	24:00:00
сна :	0.00	0.00	0.00					ROI3 :	0	0.0	D 0.00	0.00	) nan ) NaN	0.000	NaN	0.0	0.000	0.000	0.000	real time	00:00:00
CH4 :	0.00	0.00	0.00					ROI4 :	0	0.0	0.00	0.00	) NaN	0.000	NaN	0.0	0.000	0.000	0.000	live time	00:00:00
CH5 : CH6 :	0.00	0.00	0.00					ROIS :	0	0.0	0.00	0.00	) NaN	0.000	NaN	0.0	0.000	0.000	0.000	(he size (h. da)	00100100
СН7 :	0.00	0.00	0.00					ROI7 :	0	0.0	D 0.00	0.00	) NaN	0.000	NaN	0.0	0.000	0.000	0.000	ine acceptory	0.000
CH8 :	0.00	0.00	0.00					ROI8 :	0	0.0	0.00	0.00	) NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	1G
config	file wave	spectrum	timespe	ctrum																	
CH enable [011] : [012] : [013] : [014] : [014] : [015] : [016] : [016	signal type nomal sig [ nomal sig [] nomal sig [ nomal sig [] nomal sig [_] nomal sig [] nomal sig [] n	signal delay (ns) v 0 40 v 0 4	polarity pos v 4 pos v 4 po	baselne restorer iµ v iµ v iµ v iµ v iµ v iµ v iµ v iµ v	threshol (digit) 20 4 20 4 20 4 20 4 20 4 20 4 20 4 20 4		CFD Function (multiple) v x0.21 v x0.21 v x0.21 v x0.21 v x0.21 v x0.21 v x0.21 v x0.21	ar delay Aley delay V Srs V Srs V Srs V Srs V Srs V Srs V Srs V Srs V Srs V Srs		FFD         C           5	DCC         Q           sum /peak         pr           sum /v         -           sup /v         -           10         -	DC system         QD constrained (res)         QD constrained (res)           Varia         Units (res)         Units (res)         Units (res)           Varia         Units (res)         Varia         Varia           Varia         Units (res)         Varia         Varia           Varia	QDC           integrar           rangel           144           145           146           147           148           149           141           144           144           145           146           147           148           149 </td <td>opcode         opcode           n         full scale           n         (multiple           i         1/1           i         1/1</td> <td>QDC           LLD           10</td> <td>QDC ULD (digit) (digit</td> <td></td> <td></td> <td></td> <td></td> <td></td>	opcode         opcode           n         full scale           n         (multiple           i         1/1           i         1/1	QDC           LLD           10	QDC ULD (digit) (digit					

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.

	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).
ouipui raie (cps)	In list mode, 16 bytes of data are acquired for each event.
	For example, if "output rate (cps)" is 500 kcps, data of 8 MB / s (500 kcps x 16
	Bytes) will be saved per second.
	Check that there is no abnormality in the shape of the spectrum, and if excessive
spectrum tab	noise data is acquired. (See No. 2 on the next page)

NOTE: the following points in this software.



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.

APV81	08-TOTAL-F	ALL																				
ile Edi	t calibrat	ion Tool	Con	nfig Cle	ar St	art S	ор															
device C	ev1 🖵	IP addr	·ess 192.1	68.10.12	8	memo		POI									i i	acq.	save	error	mode	list
CH No.	output count	output rate(cps)	deadtime (%)					ROI No.	pea (ch	k cen ) (a	ntroid ch)	peak (count)	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
эн1 :	0.00	0.00	0.00	)				ROI1	: 0		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement	24:00:00
H2 : H3 :	0.00	0.00	0.00	)				ROI2	: 0		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	real time	00:00:00
H4 :	0.00	0.00	0.00					ROI4	: 0		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	luo timo	
45 :	0.00	0.00	0.00	)				ROIS	: 0		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	ave one	00:00:00
15 · H7 :	0.00	0.00	0.00	)				ROI6	. 0		0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file size(Byte)	0.000
18 :	0.00	0.00	0.00	5				ROIS			0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	1G
onfig	file wav	e spectru	m timesp	ectrum																		
CH1 : CH2 : CH3 : CH4 : CH4 : CH4 : CH4 : CH5 : CH6 : CH6 : CH6 : CH6 :	sgnal type nomal sig nomal sig nomal sig nomal sig nomal sig nomal sig nomal sig		polarity           Pois           Pois	htter(μs)       4μ       4μ	(digit) 20    20    20	CFD CFD CFD CFD CFD CFD CFD CFD CFD CFD	(multij x0.21 x0.21 x0.21 x0.21 x0.21 x0.21 x0.21 x0.21 x0.21 x0.21 x0.21 x0.21	(di           Sns           Sns		(digit) 15 15 15 15 15 15 15 15 15 15	수 Sum 수 Sum 수 Sum 수 Sum 수 Sum 수 Sum 수 Sum 수 Sum	(rs) -24ns	(ns)	range(n: 144 + 144 +	s)         (multiple)           \$\frac{1}{1}\$         \$\frac{1}{1}\$           \$\frac{1}{1}\$         \$\frac{1}{1}\$	digit)           10	(digit 3000 3000 3000 3000 3000 4 3000 4 3000 4 3000 4 3000 4 3000	<u></u>				
	mode list real time measuremer time(sec) 24:00:00 list read byte 16000	e(byte)	ime ener	spectrum -	ON/OFF im ON/OI	Ŧ				8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	start (dig) 1 : 10 2 : 10 3 : 10 4 : 10 5 : 10 6 : 10 7 : 10 8 : 10	cnt stop c (digit) (digit) (2) (4) 20 (4) (4) (4) (4) (4) (4) (4) (4) (4) (4)	nt start on (digit)	t stop cnt (digit) N S PA S PA S PA S PA S PA S PA S PA S PA	total         total           start cnt         s           (digit)         (i)           10         (ii)           10         (iii)           10         (iii)	20 (\$) 20 (\$)	F3n           full scale           (multiple           1/1           1/1           1/1           1/1           1/1           1/1           1/1           1/1           1/1           1/1           1/1           1/1           1/1           1/1					

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 (D: to)	Size of list data file. When this size is exceeded, "list file number" is automatically
list lie size (Byte)	incremented by one and saved to a new file.

APV8108-TOTAL-FALL														- 0
le Edit calibration ⊤ool   Config C	lear Start Stop													
device Dev1 v IP address 192.168.10.1	28 memo	101							1	acq.	save	error	mode	list
CH output output deadtime No. count rate(cps) (%)	F	OI peak lo. (ch)	centroid (ch)	peak (count)	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
CH1 : 0.00 0.00 0.00	F	: <b>0</b>	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement	24:00:00
CH2 : 0.00 0.00 0.00	1	012 : 0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	time real time	00-00-00
2H3 0.00 0.00 0.00		013:0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000		00:00:00
CH5 : 0.00 0.00 0.00		015: 0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	live time	00:00:00
2H6 : 0.00 0.00 0.00		016 : 0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file size(Byte)	0.000
347 : 0.00 0.00 0.00	1	017: 0	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000		10
H8 : 0.00 0.00 0.00	F	0 : 810	0.00	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	16
file         hidogram save         □         hidogram continuous save         □         hidogram file path         Caliversheet 1_         hidogram file save time(sec)         s         i=0	tet sove	0.bin												

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.

APV8	104-TOTA	L-FAL	L Version	n 1.0.0																	
File E	dit calib	ration	Tool	Config C	lear Start	top															
device	Dev1	-	IP address	192.168.10.1	128 memo		ROL										acq.	save	error	mode	list
CH No.	coun	ıt t	output rate(cps)	deadtime (%)			ROI No.	peak (ch)	cent (c	troid h) (	peak (count)	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
CH1 :	25.61	lk 10	8.38k	0.29			ROI1 :	0	1241	1.00	1.000	9.000	4.500	5.000	2.500	0.0	0.000	0.000	0.000	measurement	01:00:00
СНЗ :	0.0	00	0.00	0.00			ROI3 :	0	Ì	0.00	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000	real time	00:00:03
CH4 :	0.0	00	0.00	0.00			ROI4 :	0		0.00	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000	has been	
							ROIS :	0	(	0.00	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000	ive une	00:00:03
							RO16 :	0		0.00	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000	file size(Byte)	550.000k
							ROI7 :	0		0.00	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000		10
							ROI8 :	0		0.00	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000	sampung	10
config	file 1	wave	spectrum	timespectrum	PSD																
fik									_												
hi	stooram save				list save																
E	]				<b>V</b>				- 1												
					tot file and				- 1												
h	stogram con	tnuous	save		Ist file path																
					Dist Line			ک	-												
hi	stogram file p	path							- 1												
C	:¥Data¥spec	trum			list file number	file nam	e		- 1												
					2 🔍	TEMPOO	0001.bin		- 1												
								_	-												
6	stogram file s	save tim	e(sec)		IST file size(Byte)																
	1.01				list boarder ON/O																
					OFF V																
-																					

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.

Bit       Config	APV810	8-TOTAL-FA	L																				
with       P addre       Space       Space <t< td=""><td>File Edi</td><td>t calibration</td><td>n Tool</td><td>  Config</td><td>g Clear</td><td>Star</td><td>t Stop</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	File Edi	t calibration	n Tool	Config	g Clear	Star	t Stop																
Order         output         output </td <td>device D</td> <td>ev1 💌</td> <td>IP addres</td> <td>= 192.168</td> <td>.10.128</td> <td>me</td> <td>mo</td> <td></td> <td>POI</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>acq.</td> <td>save</td> <td>error</td> <td>mode</td> <td>hist</td>	device D	ev1 💌	IP addres	= 192.168	.10.128	me	mo		POI									1	acq.	save	error	mode	hist
Gil I       0.00	CH No.	output count ra	utput te(cps)	deadtime (%)					ROI No.	peak (ch)	centroi (ch)	id p (o	eak punt) (	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time
GO 1       0.00	CH1 : CH2 :	0.00 0.00	0.00	0.00 0.00					ROI1 : ROI2 :	0	0.0	0000 0000	.000	0.000	NaN NaN	0.000	NaN NaN	0.0 0.0	0.000	0.000	0.000	measurement time	24:00:00
Chi I:       0.00       0.00       0.00       0.00       0.00       NAM       0.00       NAM       0.00       NAM       0.00       0.00       0.000	снз :	0.00	0.00	0.00					ROI3 :	0	0.0	0 0	.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	real time	00:00:00
Column (Column (Colum (Column (Column (Column (Column (Column (	CH4 :	0.00	0.00	0.00					ROI4 :	0	0.0	0 0	.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	live time	00:00:00
C1       0.00       <	CH6 :	0.00	0.00	0.00					ROI5 :	0	0.0	0 0	.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	file circ(P) do)	
Cr01       0.00       0.00       0.00       0.00       0.00       0.00       NaN       0.00       NaN       0.00       NaN       0.00       0.000	СН7 :	0.00	0.00	0.00					ROI7 :	0	0.0	0 0	.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	the sale(oyle)	0.000
Cord         Re         wave         gendus         measurement           Cir         signal type         max         max/min         GPC         GPC <td>CH8 :</td> <td>0.00</td> <td>0.00</td> <td>0.00</td> <td></td> <td></td> <td></td> <td></td> <td>RO18 :</td> <td>0</td> <td>0.0</td> <td>0 0</td> <td>.000</td> <td>0.000</td> <td>NaN</td> <td>0.000</td> <td>NaN</td> <td>0.0</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>sampling</td> <td>1G</td>	CH8 :	0.00	0.00	0.00					RO18 :	0	0.0	0 0	.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	1G
digual grand ymp         mathem grand ymp <thmathem grand ymp         <thmathem grand ymp<td>config</td><td>file wave</td><td>spectrum</td><td>timespect</td><td>trum</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></thmathem </thmathem 	config	file wave	spectrum	timespect	trum																		
mode         starter         tip port         tip port <thtip port<="" th="">         tip port         <t< td=""><td>CH enable CH1 : CH2 : CH3 : CH4 : CH4 : CH5 : CH6 : CH6 : CH6 :</td><td>signal type nomal sig v nomal sig v nomal sig v nomal sig v nomal sig v nomal sig v nomal sig v</td><td>signal delay (ns) 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>ba           polarity           pos           pos           μ           pos           μ           μ           μ           μ           μ           μ           μ           μ           μ           μ           μ           ψ           μ</td><td>sselme storer til v v v v v v v v v v v v v v v v v v v</td><td>rreshold digit) 20 4 20 4 20 4 20 4 20 4 20 4 20 4 20 4</td><td>timing type CFD • CFD • CFD • CFD • CFD • CFD • CFD • CFD • CFD •</td><td>CFD function (multiple x0.21 . x0.21 .</td><td><ul> <li>CFD delay (digit)</li> <li>Sns</li> </ul></td><td></td><td>FD salk : iligit) 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4</td><td>QDC sum/peak sum v sum v sum v sum v sum v sum v sum v sum v</td><td>QDC pretrigge (ns) -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼</td><td>q DC           filter           (na)           10ns           10ns</td><td>QDC integral range(ns 144  4 144  4 144  4 144  4 144  4 144  4 144  4 144  4 144  4</td><td>QDC full scale (multiple) 1/1 v 1/1 v</td><td>QDC LLD (digit) 10 (+) 10 (+)</td><td>QDC ULD (digit) 8000 8000 8000 8000 8000 8000 8000</td><td></td><td></td><td></td><td></td><td></td></t<></thtip>	CH enable CH1 : CH2 : CH3 : CH4 : CH4 : CH5 : CH6 : CH6 : CH6 :	signal type nomal sig v nomal sig v nomal sig v nomal sig v nomal sig v nomal sig v nomal sig v	signal delay (ns) 0 0 0 0 0 0 0 0 0 0 0 0 0	ba           polarity           pos           pos           μ           pos           μ           μ           μ           μ           μ           μ           μ           μ           μ           μ           μ           ψ           μ	sselme storer til v v v v v v v v v v v v v v v v v v v	rreshold digit) 20 4 20 4 20 4 20 4 20 4 20 4 20 4 20 4	timing type CFD • CFD • CFD • CFD • CFD • CFD • CFD • CFD • CFD •	CFD function (multiple x0.21 . x0.21 .	<ul> <li>CFD delay (digit)</li> <li>Sns</li> </ul>		FD salk : iligit) 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4	QDC sum/peak sum v sum v sum v sum v sum v sum v sum v sum v	QDC pretrigge (ns) -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼ -24ns ▼	q DC           filter           (na)           10ns           10ns	QDC integral range(ns 144  4 144  4 144  4 144  4 144  4 144  4 144  4 144  4 144  4	QDC full scale (multiple) 1/1 v 1/1 v	QDC LLD (digit) 10 (+) 10 (+)	QDC ULD (digit) 8000 8000 8000 8000 8000 8000 8000					
24:00:00     (4)       Id read byte(byte)     Times spectrum ON/OFF       16000     (4)       In read byte(byte)     Times spectrum ON/OFF       16000     (4)       In read byte(byte)     Times spectrum ON/OFF       16000     (4)       In read byte(byte)     Times spectrum ON/OFF       16000     (4)       Image: spectrum ON/OFF     CH7:       10     (4) <td></td> <td>mode hist real time measurement time(sec)</td> <td>v ode</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>CH1 : CH2 : CH3 : CH4 :</td> <td>start ent (digit) 10 🗢 10 🗢 10 🗢</td> <td>stop cnt (digit) 20 ↓ 20 ↓ 20 ↓ 20 ↓ 20 ↓</td> <td>start cnt (digit) 5  \$ 5  \$ 5  \$ 5  \$</td> <td>stop cnt (digit) 5 4 5 4 5 4 5 4</td> <td>start cnt s (digit) ( 10   4   10   4   10   4   10   4  </td> <td>top cnt ( digit) ( 20  �  20  �  20  �  20  � </td> <td>ull scale multiple 1/1 v 1/1 v 1/1 v 1/1 v</td> <td></td> <td></td> <td></td> <td></td> <td></td>		mode hist real time measurement time(sec)	v ode								CH1 : CH2 : CH3 : CH4 :	start ent (digit) 10 🗢 10 🗢 10 🗢	stop cnt (digit) 20 ↓ 20 ↓ 20 ↓ 20 ↓ 20 ↓	start cnt (digit) 5  \$ 5  \$ 5  \$ 5  \$	stop cnt (digit) 5 4 5 4 5 4 5 4	start cnt s (digit) ( 10   4   10   4   10   4   10   4	top cnt ( digit) ( 20  �  20  �  20  �  20  �	ull scale multiple 1/1 v 1/1 v 1/1 v 1/1 v					
Ide read byte(byte)         Time spectrum ON/OFF         Cv77         10         40         5         40         10         40         20         41         1/L         v           16000         (4)         energy spectrum ON/OFF         Cv8         10         (20         (4)         10         (20         (4)         10         (20         (4)         1/L         v		24:00:00	)¢I								CH6 :	10 🗢	20 🗢	5	1 > 🖤	10 🔍	20 🔍	1/1 -					
Law         Law <thlaw< th=""> <thlaw< th=""> <thlaw< th=""></thlaw<></thlaw<></thlaw<>		list read byte(b	yte)	time spe	ectrum ON	OFF					СН7 :	10 🗢	20 🗢	5 🗢	5 🔶	10 🗢	20 🔶	1/1 🖵					
		10000		energy	spectrum	ON/OFF					CH8 :	10 🗢	20 🗢	5 🗢	5 🔶	10	20 🔶	1/1 👻					

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."

APV8108-TOTAL-FALL												
File Edit calibration Tool	Config Clear Start Stop											
device Dev1 V IP addre	memo	0.01				]		acq.	save	error	mode	hist
CH output output No. count rate(cps)	deadtime (%)	ROI peak No. (ch)	centroid pe (ch) (co	ak gross unt) (count)	gross (cps)	net (count)	net Fl (cps) (	VHM FWHM (%)	FWHM	FWTM	measurement mode	real time
CH1 : 0.00 0.00 CH2 : 0.00 0.00	0.00	ROI1 : 0	0.00 0.0	000.0 000	NaN	0.000	NaN	0.0 0.000	0.000	0.000	measurement time	24:00:00
CH3 : 0.00 0.00	0.00	ROI3 : 0	0.00 0.0	000 0.000	NaN	0.000	NaN	0.0 0.000	0.000	0.000	real time	00:00:00
CH4 : 0.00 0.00	0.00	ROI4 : 0	0.00 0.0	000.0 000	NaN	0.000	NaN	0.0 0.000	0.000	0.000	live time	00:00:00
CHS : 0.00 0.00	0.00	ROIS : 0	0.00 0.0	000.000	NaN	0.000	NaN	0.0 0.000	0.000	0.000	(he size (D. da))	00100100
CH7 : 0.00 0.00	0.00	ROI7: 0	0.00 0.0	000.000	NaN	0.000	NaN	0.0 0.000	0.000	0.000	the sce(byte)	0.000
CH8 : 0.00 0.00	0.00	ROI8 : 0	0.00 0.0	000.0 000	NaN	0.000	NaN	0.0 0.000	0.000	0.000	sampling	1G
config         file         wave         spectrue           CH         signal type         dialy           CH         signal type         dialy           CH         inormal sig         0           Mode         inormal sig         0 <td>a         Breepedrum         CP           polarty         Merchiol         Breinio         Breinio         Breinio           polarty         Mail         Breinio         CP         Breinio         Breinio           polarty         Mail         Breinio         CP         Breinio         Brei</td> <td>CFD         C           deby         (reg)           (reg)         Sra         1           Sra         1         1</td> <td>FD         QOC           sum/pass         sum/pass           fg1)         sum/pass           fg1         sum/pass     <td>QPC         QPC         QPC           (m)         (m)         (m)           24min         Mon         (m)           20         (m)         S           20         (m)         S           20         (m)         S           20         (m)         S</td><td>QDC integral range(ns 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   50 144   50 155   50 1</td><td>QOC full scale (multiple)           1/1         -           1/</td><td>QDC LLD (digit) 1163 44 1163 44 1170 0 10 10 1171 100 100 100 100 100 100 100 1</td><td>000 (digit) 1620 44 1620 44</td><td></td><td></td><td></td><td></td></td>	a         Breepedrum         CP           polarty         Merchiol         Breinio         Breinio         Breinio           polarty         Mail         Breinio         CP         Breinio         Breinio           polarty         Mail         Breinio         CP         Breinio         Brei	CFD         C           deby         (reg)           (reg)         Sra         1           Sra         1         1	FD         QOC           sum/pass         sum/pass           fg1)         sum/pass           fg1         sum/pass <td>QPC         QPC         QPC           (m)         (m)         (m)           24min         Mon         (m)           20         (m)         S           20         (m)         S           20         (m)         S           20         (m)         S</td> <td>QDC integral range(ns 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   50 144   50 155   50 1</td> <td>QOC full scale (multiple)           1/1         -           1/</td> <td>QDC LLD (digit) 1163 44 1163 44 1170 0 10 10 1171 100 100 100 100 100 100 100 1</td> <td>000 (digit) 1620 44 1620 44</td> <td></td> <td></td> <td></td> <td></td>	QPC         QPC         QPC           (m)         (m)         (m)           24min         Mon         (m)           20         (m)         S           20         (m)         S           20         (m)         S           20         (m)         S	QDC integral range(ns 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   40 144   50 144   50 155   50 1	QOC full scale (multiple)           1/1         -           1/	QDC LLD (digit) 1163 44 1163 44 1170 0 10 10 1171 100 100 100 100 100 100 100 1	000 (digit) 1620 44 1620 44				

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.

APV81	08-TOTAL-	FALL																					• 8
File Ed	it calibrat	tion Tool	Con	fig Clea	r Sta	t Stop	•																
device [	Dev1 💌	IP addres	s <b>192.1</b> 6	58.10.128		emo		-801-									į.	acq.	save	error	mode	list	ſ
CH No.	output count	output rate(cps)	deadtime (%)					ROI No.	peak (ch)	centro (ch)	xid p ) (c	oeak xount)	gross (count)	gross (cps)	net (count)	net (cps)	FWHM (ch)	FWHM (%)	FWHM	FWTM	measurement mode	real time	
CH1 :	0.00	0.00	0.00					ROI1 :	0	0.	00 0	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	measurement	24:00:00	
CHB :	0.00	0.00	0.00	6				ROI2 :	0	0.	00 0	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	real time	00:00:00	
CH4 :	0.00	0.00	0.00					ROI4 :	0	0.	00 O	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	live time	00.00.00	
CH5 :	0.00	0.00	0.00					ROIS :	0	0.0	00 0	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	River (De das)	00.00.00	
СН7 :	0.00	0.00	0.00					ROI7 :	o	0.	00 0	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	the sate(oyve)	0.000	
CH8 :	0.00	0.00	0.00					ROI8 :	0	0.	00 0	0.000	0.000	NaN	0.000	NaN	0.0	0.000	0.000	0.000	sampling	1G	,
config	file wav	e spectrum	timespe	ectrum																			
CH enable CH1 CH2 CH3 CH4 CH5 CH6 CH6 CH7 CH8	signal type nomal sig nomal sig nomal sig nomal sig nomal sig nomal sig nomal sig nomal sig	signal delay (ns) (ns)	polarity pos + pos + pos + pos + pos + pos + pos +	baseline restorer fitter( $\mu$ s) $4\mu$ $\checkmark$ $4\mu$ $\checkmark$ $4\mu$ $\checkmark$ $4\mu$ $\checkmark$ $4\mu$ $\checkmark$ $4\mu$ $\checkmark$ $4\mu$ $\checkmark$ $4\mu$ $\checkmark$	threshold (digit) 20 우 20 우 20 우 20 우 20 우 20 우 20 우 20 우	timing type CFD V CFD V CFD V CFD V CFD V CFD V CFD V CFD V	CFD function (multiple x0.21 [ x0.21 [ x0.2	CFD delay (digit Sns Sns Sns Sns Sns Sns Sns Sns Sns Sns		FD alk ligit) 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4	QDC sum/peak sum v sum v sum v sum v sum v sum v sum v	QDC pretrigge (ns) -24ns v -24ns v	QDC           filter           10ns           10ns	QDC integral range(ns 144 k 144 k 144 k 144 k 144 k 144 k 144 k	QOC           full scale           )         (multiple)           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +           1/1         +	QDC LLD (digit) 1163 (+) 1163 (+	QDC ULD (digit) 1620 1620 1620 1620 1620 1620 1620	<u></u>					
	mode lat measurmen real time measuremen time(sec) 24:00:00 list read byt 16000	t mode t mod	time s	spectrum O! gy spectrum	N/OFF					CH1 : CH2 : CH3 : CH4 : CH5 : CH5 : CH5 : CH7 : CH8 :	start cnt (digit) 10   ↓ 10   ↓ 10   ↓ 10   ↓ 10   ↓ 10   ↓ 10   ↓	stop cnt (digit)           20                     20                     20                     20                     20                     20                     20                     20                     20                     20                     20                     20                     20                     20                     20	start ent (digit) 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4	stop cnt (digit) 5 (A) 5	start cnt s (digit) 10  \$  10  \$	top ent f digit) ( 20 4 2 20 4 20 4	ull scale multiple; 1/1 v 1/1 v						

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
СТН	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**

<sup>^</sup> The following is saved for each ROI	*The	follow	ing 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.

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## 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
СТН	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

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## 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.

Bit127					112
TOTAL[150]					
111					96
FALL[150]					
95					80
RISE[150]					
79					64
TDC[5540]					
63					48
TDC[3924]					
47					32
TDC[238]					
31			24	23	16
TDC[70]				TDCFP[70]	
15	13	12			0
CH[20]		QDC [120]			

#### 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.					
Dit 22 to Dit 16	TDCFP (fractional part) count. 8-bit. 3.90625 ps per bit.					
	Interpolation between sampling points (1 ns $256256 = 3.90625$ ps)					
Dit 15 to Dit 12	CH number.					
	0: CH1, 1: CH2, 2: CH3, 3: CH4, 4: CH5, 5: CH6, 6: CH7, 7: CH8					
	QDC integrated value. Unsigned 13-bit integer.					
Bit 12 to Bit 0	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.	Туре	No. of port	Address (Hexadecimal)	Content	Setting range (Digit)	Operation	Command length (Byte)	Response (Byte)	
				Input waveform	0, 1	Configuration	10	10	
1			B40001DE	type		Setting request	8	10	
			D 4000 4 4 A	Input polarity	arity	Configuration	10	10	
2			B400011A	switching	0, 1	Setting request	8	10	
			D 40004 C0		4 45	Configuration	10	10	
3			B4000160	CFD Function	115	Setting request	8	10	
4			B4000462		0.00	Configuration	10	10	
4			B4000162	CFD Delay	023	Setting request	8	10	
F			P4000164		0. 210 1	Configuration	10	10	
5			B4000104		0 2 -1	Setting request	8	10	
6			P4000166	Threshold	0.013.4	Configuration	10	10	
0			B4000100	Thieshold	0 2 -1	Setting request	8	10	
7			B400016E	Baseline	0.254	Configuration	10	10	
1				restoration filter	Setting request	8	10		
8	UDP	B40001C0	QDC pre-trigger	0.4	Configuration	10	10		
0	Criseung	4660	660	QDC pre-ingger	04	Setting request	8	10	
٩		B40001C6	ODC Filter	05	Configuration	10	10		
5				D4000100		00	Setting request	8	10
10		B400	B40001C8	QDC sum/peak	0, 1	Configuration	10	10	
10			5400100	QDO Sumpeak	0, 1	Setting request	8	10	
11			B4000100 0004	ODC full scale	0.9	Configuration	10	10	
			5400100		0	Setting request	8	10	
12			B40001DC	QDC integral	1 2 <sup>12</sup> -1	Configuration	10	10	
12			04000100	range	12 -1	Setting request	8	10	
13			B4000168	QDC LLD	0 2 <sup>13</sup> -1	Configuration	10	10	
10			D-000100		U 2 <sup></sup> -1	Setting request	8	10	
14			B400016A		0 213 4	Configuration	10	10	
17					V Z -1	Setting request	8	10	
15			P40004D0	Time stamp	0.1	Configuration	10	10	
15	15			timing	U, I	Setting request	8	10	

No.	Туре	No. of port	Address (Hexadecimal)	Content	Setting range (Digit)	Operation	Command length (Byte)	Response (Byte)
16			D (000) ( D0	PSA falling	1 16282	Configuration	10	10
10			B40001D6	start position	110303	Setting request	8	10
17			B40001DA	PSA falling	1 16292	Configuration	10	10
17			640001DA	end position	110303	Setting request	8	10
10			B40001E9	PSA rising	1 408	Configuration	10	10
10			D40001E0	start position	1498	Setting request	8	10
10			B40001EA	PSA rising	1 16292	Configuration	10	10
19	СН	UDP		end position	110303	Setting request	8	10
20	setting	4660	B40001EC	PSA overall	1 409	Configuration	10	10
20				start position	1490	Setting request	8	10
21			B40001EE	PSA overall	116383	Configuration	10	10
21				end position		Setting request	8	10
22			B40001D6	PSA reduction	0.0	Configuration	10	10
22				ratio	09	Setting request	8	10
22			D 4000470	Lange of shallow a	0.544	Configuration	10	10
23			D4000170	input deidy	0011	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.	Туре	No. of port	Address (Hexadecimal)	Content	Setting range (Digit)	Operation	Command length (Byte)	Response (Byte)
			D 400 4000	N de sta	0405	Configuration	10	10
24			B4004000	Wode	0,1,2,5	Setting request	8	10
25			B4004000	Measurement	0.1	Configuration	10	10
25			D4004002	mode	0,1	Setting request	8	10
			B4004006			Configuration	10*4 times	10*4 times
26		ססט	B4004008	Measurement	0.054.4			
20	Single setting	0DP	B400400A	time setting	02*-1	Setting request	8*4 times	10*4 times
		4000	B400400C					
27			B4004004	Start	0, 1	Configuration	10	10
	-			measurement				
28			B4004090	Time and data	0, 1	Configuration	10	10
	-			clear				
29			B4004028	Time clear	0, 1	Configuration	10	10
30			B4000004	Measurement			10	10
				status				
31			B4000120	Output count			10*2 times	10*2 times
*			B4000122	total				
32			B4000130	Output count			10*2 times	10*2 times
*			B4000132	rate				
			B4000144					
33			B4000146	Live count			10*3 times	10*3 times
*	Status	UDP	B4000148		-	Status request		
	-	4660	B400014A					
			B40001E0					
34			B40001E2	Dead count			10*4 times	10*4 times
*			B40001E4					
	-		B40001E6					
			B400000E					
35		B40000 B40000	B4000010	Real time			10*4 times	10*4 times
			B4000012					
			B4000014					
36	Configuration	UDP	B400009A	Histgram CH	O7	Configuration	10	32768
		4660	B400809A	date				

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)		
Туре	Channel setting		
	0 or 1		
Range	0: Normal waveform * Factory default		
	1: NIM waveform		

### (2) Select Input polarity switching

Description	
Description	
Address	0xB40001A
Setting	Command length 10 Byte, Response 10 Byte
Request	Command length 8 Byte, Response 10 Byte
Port number	4660 (UDP)
Туре	Channel setting
	0 or 1
Range	0: Negative polarity * Factory default
	1: Positive polarity

#### (3) CFD Function

Description	CFD function settings.
Description	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)
Туре	Channel setting
	1 to 15
Pongo	1: 0.03 times, 2: 0.06 times, 3: 0.09 times, 4: 0.12 times, 5: 0.15 times,
Range	6: 0.18 times, 7: 0.21 times*, 8: 0.25 times, 9: 0.28 times, 10: 0.31 times,
	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. Delay time of inverted signal used for CED waveform calculation
Address	0xB4000162
Setting	Command length 10 Byte, Response 10 Byte
Request	Command length 8 Byte, Response 10 Byte
Port number	4660 (UDP)
Туре	Channel setting
Range	0 to 23 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, 9: 10 ns, 10: 11 ns, 11: 12 ns, 12: 13 ns, 13: 14 ns, 14: 15 ns, 15: 16 ns, 16: 17 ns, 17: 18 ns, 18: 19 ns, 19: 20 ns, 20: 21 ns, 21: 22 ns, 22: 23 ns, 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)
Туре	Channel setting
Panga	0 to 1023
Range	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)
Туре	Channel setting
Pongo	0 to 8191
Range	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)		
Туре	Channel setting		
	0 to 254		
	0: ext		
	64: fast		
Range	128: 4 µs		
	250: 85 µs		
	252:129 µs		
	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)
Туре	Channel setting
Range	0 to 4 0: 0 ns 1: Addition starts minus 8 ns before the timing of the threshold 2: Addition starts minus 16 ns before the timing of the threshold* 3: Addition starts minus 24 ns before the timing of the threshold 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)
Туре	Channel setting
	0 to 5
	0: ext
	1: 10 ns*
Range	2: 20 ns
	3: 50 ns
	4: 100 ns
	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)
Туре	Channel setting
Range	<ul> <li>0 or 1</li> <li>0: Output the peak value of the peak waveform as QDC data</li> <li>1: Output the integrated value of the waveform applied with sum Filter as QDC data *</li> </ul>

### (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)
Туре	Channel setting
Range	0 to 9 0: 1/1 1: 1/2 times 2: 1/4 times* 3: 1/8 times 4: 1/16 times 5: 1/32 times 6: 1/64 times 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)
Туре	Channel setting
Range	1 to 4095
	1: 1 digit corresponds to 8 ns. * 25 (200 ns) Factory default
	То
	4095: 32760 ns

## (<u>13</u>) 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)
Туре	Channel setting
Range	0 to 8191
	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)
Туре	Channel setting
Range	0 to 8191
	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)
Туре	Channel setting
Range	0 or 1
	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)
Туре	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)	
Туре	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)
Туре	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)
Туре	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)
Туре	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)
Туре	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)
Туре	Channel setting
Range	0 to 9
	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
	in iput uoluy

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)
Туре	Channel setting
Range	1 to 511 * 8 ns delay per digit

#### Single setting

## (24) Mode

Description	Operation mode. 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)
Туре	Channel setting
Range	0, 1 or 2 0: Histo mode 1: Waveform mode * 2: List mode 5: List common mode 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)
Туре	Channel setting
	0, 1 or 2
Range	0: Real time *
	1: Live time

### (26) Measurement time setting

Description	Measurement time
Address	0xB4004006 (MSB)
	0xB4004008
	0xB400400A
	0xB400400C (LSB)
Setting	Command length 10 Byte, Response 10 Byte
Request	Command length 8 Byte, Response 10 Byte
Port number	4660 (UDP)
Туре	Single setting
Range	$0 \text{ to } 2^{54} - 1$
	2 <sup>54</sup> –1 * Factory default
	8 ns per bit. The maximum setting range is $40031$ hours from $(2^{54}-1) \times 8$ 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)
Туре	Single setting
	0 or 1
Range	0: Measurement stop *
	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)
Туре	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)	
Туре	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)
Туре	Status
	0 or 1
Range	0: Measurement stopped
	1: During measurement

## (31) Output count total

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

#### (32) Output count rate

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

## (<u>33) Live count</u>

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

#### (34) Dead count

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

#### (35) Real time

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

### (36) Histogram CH data

Description	Request Histogram Data
Address	0xB400009A
	0xB400809A
Setting	Command length 10 Byte, Response 10 Byte
Port number	4660 (UDP)
Туре	Status (CH)
Contents	0xB400009A setting
	0: CH1 histogram request
	1: CH2 histogram request
	2: CH3 histogram request
	3: CH4 histogram request
	0xB400809A setting
	0: CH5 histogram request
	1: CH6 histogram request
	2: CH7 histogram request
	3: CH8 histogram request
	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
	I 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. 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	0xFF800/02B40002C80001
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
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UDP send	0xFF800702B40008CE000A
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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
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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 UDP send 0xFF800702B40040020000 UDP send 0xFF800702B4000174000A UDP send 0xFF800702B4000274000A UDP send 0xFF800702B4000374000A UDP send 0xFF800702B4000474000A UDP send 0xFF800702B4008174000A UDP send 0xFF800702B4008274000A UDP send 0xFF800702B4008374000A UDP send 0xFF800702B4008474000A UDP send 0xFF800702B4000172000F UDP send 0xFF800702B4000272000F UDP send 0xFF800702B4000372000F UDP send 0xFF800702B4000472000F UDP send 0xFF800702B4008172000F UDP send 0xFF800702B4008272000F UDP send 0xFF800702B4008372000F UDP send 0xFF800702B4008472000F UDP send 0xFF800702B40040260000 UDP send 0xFF800702B40001760000 UDP send 0xFF800702B40002760000 UDP send 0xFF800702B40003760000 UDP send 0xFF800702B40004760000 UDP send 0xFF800702B40081760000 UDP send 0xFF800702B40082760000 UDP send 0xFF800702B40083760000 UDP send 0xFF800702B40084760000 UDP send 0xFF800702B40001780000 UDP send 0xFF800702B40002780000 UDP send 0xFF800702B40003780000 UDP send 0xFF800702B40004780000

UDP send	0xFF800702B40081780000
UDP send	0xFF800702B40082780000
UDP send	0xFF800702B40083780000
UDP send	0xFF800702B40084780000
UDP send	0xFF800702B400017A0010
UDP send	0xFF800702B400027A0010
UDP send	0xFF800702B400037A0010
UDP send	0xFF800702B400047A0010
UDP send	0xFF800702B400817A0010
UDP send	0xFF800702B400827A0010
UDP send	0xFF800702B400837A0010
UDP send	0xFF800702B400847A0010
UDP send	0xFF800702B40040700019
UDP send	0xFF800702B40001800000
UDP send	0xFF800702B40002800000
UDP send	0xFF800702B40003800000
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UDP send	0xFF800702B40081800000
UDP send	0xFF800702B40082800000
UDP send	0xFF800702B40083800000
UDP send	0xFF800702B40084800000
UDP send	0xFF800702B40000480001
UDP send	0xFF800702B400404A0008
UDP send	0xFF800702B40001840037
UDP send	0xFF800702B40002840023
UDP send	0xFF800702B4000384003C
UDP send	0xFF800702B4000484003E
UDP send	0xFF800702B4008184004B
UDP send	0xFF800702B4008284004E
UDP send	0xFF800702B40083840046
UDP send	0xFF800702B40084840049
UDP send	0xFF800702B400008A0000
UDP send	0xFF800702B40001E8000A
UDP send	0xFF800702B40002E8000A
UDP send	0xFF800702B40003E8000A
UDP send	0xFF800702B40004E8000A
UDP send	0xFF800702B40081E8000A
UDP send	0xFF800702B40082E8000A
UDP send	0xFF800702B40083E8000A
UDP send	0xFF800702B40084E8000A

UDP send 0xFF800702B40001EA0014 UDP send 0xFF800702B40002EA0014 UDP send 0xFF800702B40003EA0014 UDP send 0xFF800702B40004EA0014 UDP send 0xFF800702B40081EA0014 UDP send 0xFF800702B40082EA0014 UDP send 0xFF800702B40083EA0014 UDP send 0xFF800702B40084EA0014 UDP send 0xFF800702B40001EC000A UDP send 0xFF800702B40002EC000A UDP send 0xFF800702B40003EC000A UDP send 0xFF800702B40004EC000A UDP send 0xFF800702B40081EC000A UDP send 0xFF800702B40082EC000A UDP send 0xFF800702B40083EC000A UDP send 0xFF800702B40084EC000A UDP send 0xFF800702B40001EE0014 UDP send 0xFF800702B40002EE0014 UDP send 0xFF800702B40003EE0014 UDP send 0xFF800702B40004EE0014 UDP send 0xFF800702B40081EE0014 UDP send 0xFF800702B40082EE0014 UDP send 0xFF800702B40083EE0014 UDP send 0xFF800702B40084EE0014 UDP send 0xFF800702B40001D60000 UDP send 0xFF800702B40002D60000 UDP send 0xFF800702B40003D60000 UDP send 0xFF800702B40004D60000 UDP send 0xFF800702B40081D60000 UDP send 0xFF800702B40082D60000 UDP send 0xFF800702B40083D60000 UDP send 0xFF800702B40084D60000 UDP send 0xFF800702B40001820001 UDP send 0xFF800702B40002820001 UDP send 0xFF800702B40003820001 UDP send 0xFF800702B40004820001 UDP send 0xFF800702B40081820001 UDP send 0xFF800702B40082820001 UDP send 0xFF800702B40083820001 UDP send 0xFF800702B40084820001

UDP send	0xFF800702B400017C0001
UDP send	0xFF800702B400027C0001
UDP send	0xFF800702B400037C0001
UDP send	0xFF800702B400047C0001
UDP send	0xFF800702B400817C0001
UDP send	0xFF800702B400827C0001
UDP send	0xFF800702B400837C0001
UDP send	0xFF800702B400847C0001
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UDP send	0xFF800702B40002860005
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UDP send	0xFF800702B40001400000
UDP send	0xFF800702B40001400001
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 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
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UDP send	0xFF800702B4000368001E
UDP send	0xFF800702B4000468001E
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UDP send	0xFF800702B4008368001E
UDP send	0xFF800702B4008468001E
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UDP send	0xFF800702B400036A1F40
UDP send	0xFF800702B400046A1F40
UDP send	0xFF800702B400816A1F40
UDP send	0xFF800702B400826A1F40
UDP send	0xFF800702B400836A1F40
UDP send	0xFF800702B400846A1F40
UDP send	0xFF800702B400016E0080
UDP send	0xFF800702B400026E0080

0xFF800702B400036E0080 UDP send UDP send 0xFF800702B400046E0080 UDP send 0xFF800702B400816E0080 UDP send 0xFF800702B400826E0080 0xFF800702B400836E0080 UDP send UDP send 0xFF800702B400846E0080 UDP send 0xFF800702B40000600000 UDP send 0xFF800702B40001C00001 UDP send 0xFF800702B40002C00001 0xFF800702B40003C00001 UDP send 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 0xFF800702B40084C20100 UDP send UDP send 0xFF800702B40085C20000 UDP send 0xFF800702B40086C20100 0xFF800702B40087C20000 UDP send UDP send 0xFF800702B40088C20100 0xFF800702B40001C60002 UDP send 0xFF800702B40002C60002 UDP send UDP send 0xFF800702B40003C60002 0xFF800702B40004C60002 UDP send 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 0xFF800702B40082C80001 UDP send UDP send 0xFF800702B40083C80001 UDP send 0xFF800702B40084C80001 0xFF800702B400010E0001 UDP send UDP send 0xFF800702B400020E0000 0xFF800702B400030E0001 UDP send UDP send 0xFF800702B400040E0000 UDP send 0xFF800702B400810E0001 0xFF800702B400820E0000 UDP send UDP send 0xFF800702B400830E0001 UDP send 0xFF800702B400840E0000 UDP send 0xFF800702B40001700800 UDP send 0xFF800702B40002700800 0xFF800702B40003700800 UDP send UDP send 0xFF800702B40004700800 UDP send 0xFF800702B40081700800 UDP send 0xFF800702B40082700800 0xFF800702B40083700800 UDP send UDP send 0xFF800702B40084700800 UDP send 0xFF800702B40001B00001 UDP send 0xFF800702B40002B00001 UDP send 0xFF800702B40003B00001 0xFF800702B40004B00001 UDP send 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
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UDP send	0xFF800702B40006BA000E
UDP send	0xFF800702B40007BA000E
UDP send	0xFF800702B40008BA000E
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UDP send	0xFF800702B400017A0010
UDP send	0xFF800702B400027A0010
UDP send	0xFF800702B400037A0010
UDP send	0xFF800702B400047A0010
UDP send	0xFF800702B400817A0010
UDP send	0xFF800702B400827A0010
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UDP send	0xFF800702B400847A0010
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UDP send	0xFF800702B400404A0008
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UDP send	0xFF800702B40004880005
UDP send	0xFF800702B40081880005
UDP send	0xFF800702B40082880005
UDP send	0xFF800702B40083880005
UDP send	0xFF800702B40084880005
UDP send	0xFF800702B40040720000

## 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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