Real-time Digital Signal Processing
Model: APV8516-14

Instruction Manual

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Disclaimer

We thank you for your continued confidence and patronage.
Thank you very much for truly about using our product.

Take no responsibility in the folling cases of using our product.
・Damage claim about equipment and connection epuipment and software damage.
・All of the damage compensation , including secondary damages.
Please use is self-responsibility.

DON'T

- Please do not use in applications requiring reliability such as related to human life or accident.
- Please do not use in special environment such as high temperature, high humidity, a vibration-prone area. (The measures the product is excluded.)
- Please do not turn on the power in a state contacting the metal with the board.
- Please do not apply a voltage exceedin the rating.
- Resale is prohibited.

CAUTION

- Please immediately turn off the power if smoke or abnormal heat generation.
- It may not work properly in a noisy environment.
- Please be aware of the static electricity.
- The contents of specifications and related document of the product are subject to change without notice.

Guarantee conditions

Warranty conditions are as follows:

- Warranty period　　Buy after one year.
- Warranty information　　If you have trouble in use within the warrantry period, We will do the repair or replacement.
- Out of warranty as follows:
  (1)　If you use in other than the above methods of use.
  (2)　The trouble due to causes other than our product and natural disaster.
  (3)　Expendables, etc.

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Contents

1. Abstracts

The APV8516-14 is a waveform analysis board for scintillation detectors. Each channel (16CH) is equipped with high-speed, high resolution ADC (500MHz, 14 bit). The APV8516-14 can correspond to the high rates of more than 200 kcps per CH in the list mode with using the Gigabit Ethernet (Gb Ether) connection.

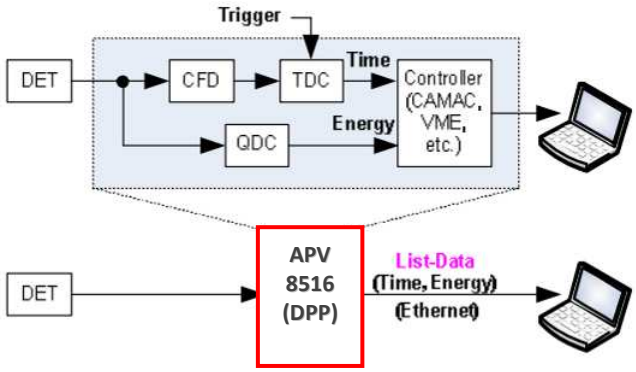


Fig. 1-0-1. DPP structure

※In this instruction manual, “List” and “Event” are equivalences.
※In this instruction manual, “Histogram” and “Spectrum” are equivalences.

1. 1. Specification

(1) Analog Input
- Number of Channel : 16CH
- Input Range : ±1V
- Input Impedance : 50Ω

(2) ADC
- Sampling Frequency : 500MHz
- Resolution : 14bit
- SNR : 68.3dBFS@605MHz

(3) Performance
- QDC Throughput : More than 1Mcps
- Time Resolution : 7.8ps(LSB)

(4) MCA
- Measurement Mode : Wave Mode, Histogram Mode, List Mode
- Event Transmission Rate : Approx. 10Mbyte / sec. In case of 10Byte (80Bit) / Event, CH total is 1Mcps.

(5) I/F
- LAN I/F : Ethernet TCP/IP1000Base-T (List data acquisition), UDP/IP (config data, states data sent / received)

(6) Form
- VME type : APV8516-14(4CH)

(7) Wattage
+5V : 6.0A (Max.)
+12V : 0.8A (Max.)
−12V : 0.4A (Max.)

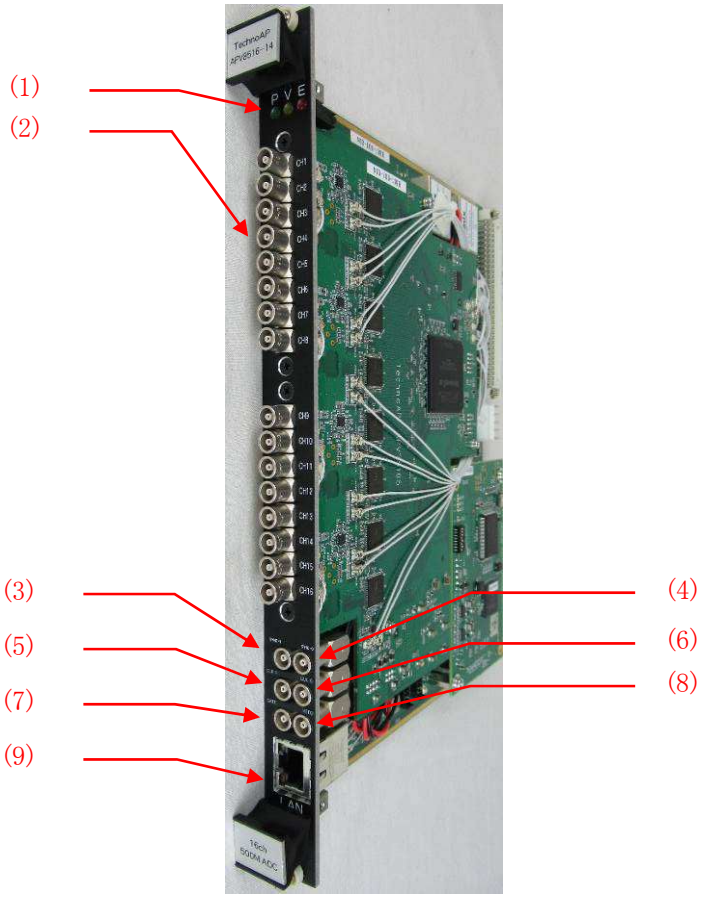
1. 2. System Requirements

- Microsoft Windows 7 or later

1. 3. Revision History

Dec./10/2019	1.0.0	First Edition
Oct./15/2020	1.0.1	Fixed some images

2. External



(1)	LED	Turn on a power; light a red lamp.
(2)	CH1～CH16	LEMO00 series connector for signal input.
(3)	SYNC-I	LEMO00 series connector for synchronization input. Connect to SYNC-O.
(4)	SYNC-O	LEMO00 series connector for synchronization output. Connect to SYNC-I.
(5)	CLK-I	LEMO00 series connector for external signal (TTL Signal) input. APV8516 work with external clock. Turn on the power after input of 25MHz of theTTL signal.
(6)	CLK-O	LEMO00 series connector for external signal (TTL Signal) output. This connector outputs the 25MHz of the TTL signal.
(7)	GATE	LEMO00 series connector for external signal (TTL Signal) input. This connector enters the GATE signal. You can acquire the data while input is high.
(8)	VETO	LEMO00 series connector for external signal (TTL Signal) input. “This connector enters the VETO signal. To disable the date acquisition when the input is high.
(9)	LAN	RJ45 connector for Ethernet.

3. Preparation

3. 1. Installation of the application

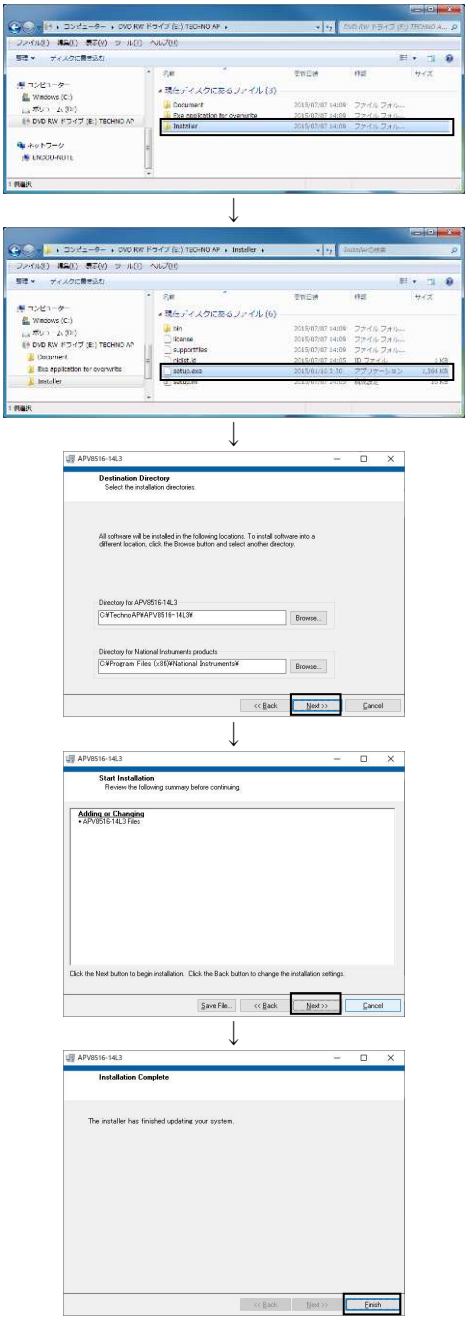
Application is upgraded. You are able to install application after uninstalling current application.

(1) Recommended computer environment is below.
Microsoft Corp. Windows 7 32Bit, recommended screen resolution is FullHD (1920×1080) or more.

(2) Log in with administrative privileges.

(3) Insert the installation CD to your computer. Run「Installer」folder「setup.exe」.

(4) After finished of installation, restart PC.



Uninstall is「Start- Control panel - Add or Remove Programs.

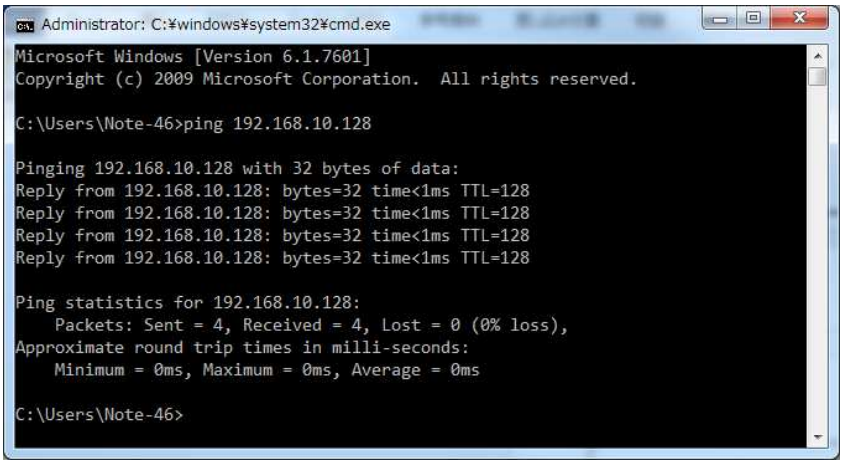
3. 2. Power ON and IP Connection Confirmation

(1) Confirm power on the PC and Hub, and ON the VME power switch.

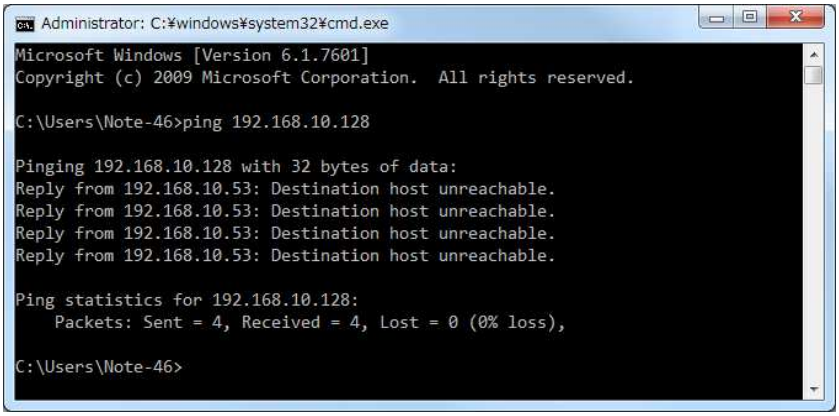
(2) Please wait 30 second

(3) Start the windows application “cmd.exe”. Confirm Ethernet connection as follows.
「ping 192.168.10.131」 and「ping 192.168.10.132」 and「ping 192.168.10.133」and「ping 192.168.10.134」

※Case of success

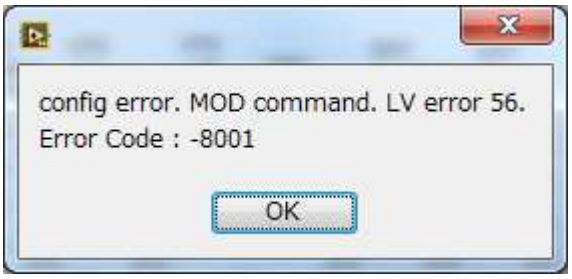


※Case of failure



(4) Start application「APV8516-14」.

※When it fail to start application, display as follows message.



※It will show the main cause below.

・ It is insufficient insertion of LAN cable.

・ PC network setting is “DHCP”.

・ IP address of TCP/IPv4 is not the range ”192.168.10.2” to “192.168.10.255”.

※Please try again following.

・ After application is closed, it will restart the VME power.

・ Confirm connection of “EXT clock”.

3. 3. Display

Recommended monitor resolution is more than FullHD(1920x1080).

4. Screen

4. 1. Startup Screen

The following opening screen is displayed when you carry out “Start”-“TechnoAP”-“APV8516-14”.

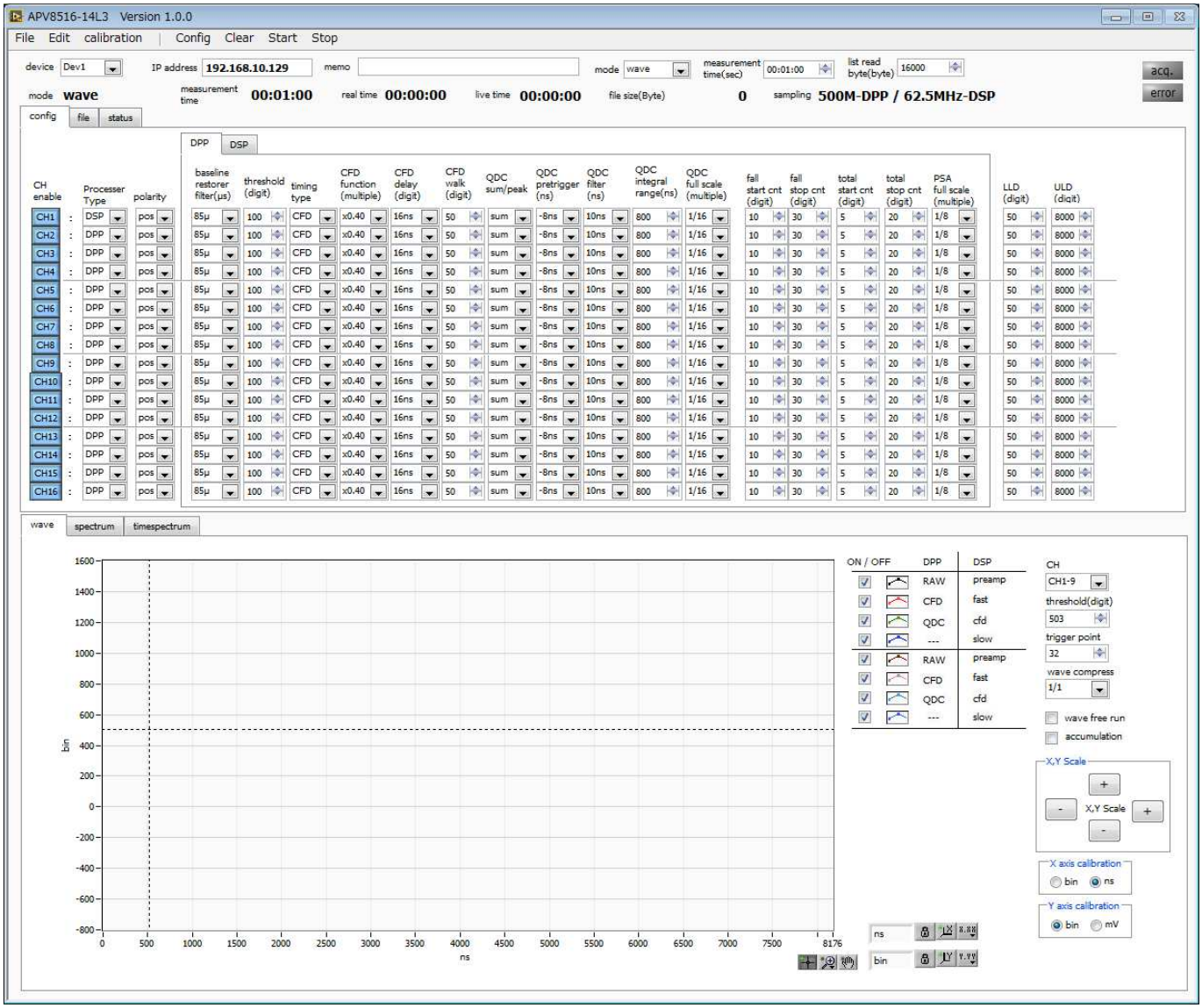


Fig. 4-1-1 DPP MCA Start screen

The following description is about Start screen.

•Menu

The configuration of “File”, “Edit”, “Config”, “Clear”, “Start”, “Stop”.

“File”-“open config”	:	Reading of the config file
“File”-“save config”	:	Save current setting in a config file
“File”-“save histogram”	:	Save current histogram data in a file
“File”-“save wave”	:	Save the wave data
“File”-“save image”	:	Save the DPP MCA screen in PNG format image
“File”-“quit”	:	Quit of the application
“Edit”-“copy setting of CH1”	:	Setting of CH1 in the “CH” tab is reflected by setting of all other CH
“Edit”-”IP configuration”	:	Change IP address of current display device
“Edit”-”calibration”	:	Calibrate the device when wave data is errow.
“Config”	:	Send all setting to each module

"Clear" : Initialize histogram data in each module
"Start" : Send "Measurement start" to each module
"Stop" : Send "Measurement stop" to each module

・Tab

"config" : Each module setting and Setting about the measurement
"file" : Setting of waveform and save of list data
"state" : Display state of each ch.
"wave" : Display of input waveform, When processer is DPP, Display waveform is RAW, CFD, QDC waveform. When processer is DSP, Display waveform is preamp, fast, cfd, slow waveform.
"spectrum" : Display of histogram from QDC or PEAK of list data
"timespectrum" : Display a time lag spectrum of CH1 and CH2 from time information of list data.

・Device : Choose the DPP for targeted measurement.
・IP Address : IP address. IP address of the selected device will be display
・memo : You can enter notes
・mode : You can select next mode. wave mode, hist mode, list mode
・list read byte : When list mode, list data be saved per this parameter.
・mode : It display your setting mode.
・measurement time : It display your setting measurement time.
・real time : It display state of real time.
・live time : It display state of live time.
・file Size (Byte) : It is a capacity of the list mode saved current file
・sampling : DPP is 500MHz. DSP is 62.5MHz.
・acq. LED : Blinking LED when during measure.
・error LED : Blinking LED when during occurrence of an error.

4. 2. Config Tab

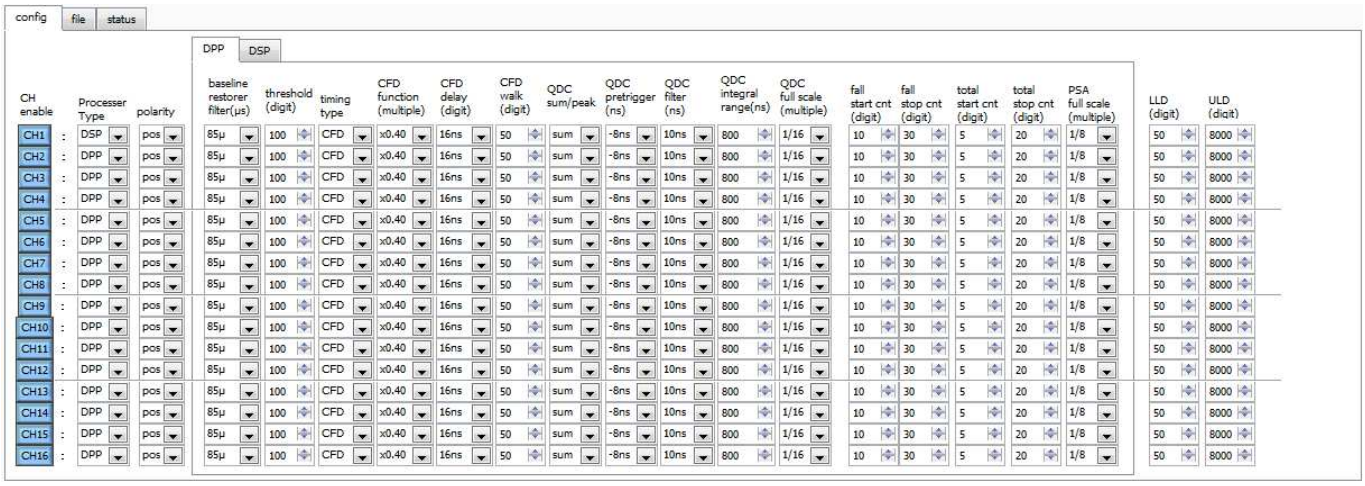


Fig. 4-2-1 Config Tab

- common setteing

・Enable : Please enable all CH

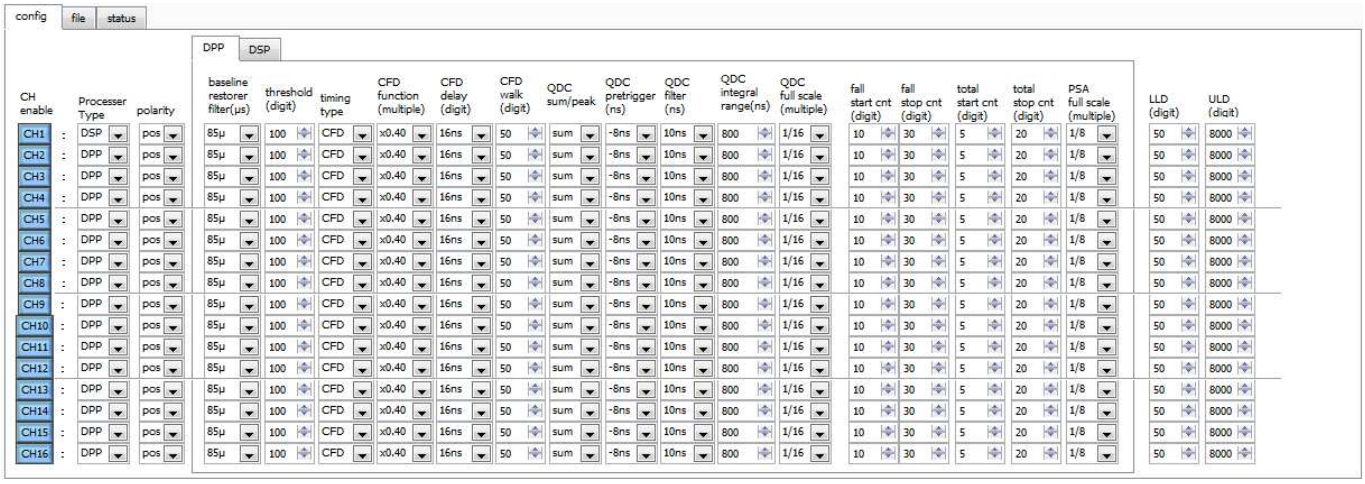
・processe type : You can select DSP or DPP. DSP sampling rate is 62.5MHz. Main measurement purpose is Semiconductor detector. Energy data generate from peak of trapezoidal filter. DPP sampling rate is 500 MHz. Main measurement purpose is direct anode signal from scintillator. Energy data generate from integral of raw wave or filter wave

・Polarity : This select the polarity of the input signal.

・LLD : Set the LLD(Lower Level Discriminator) . It does not get the time stamp data and energe data if the energy data smaller than LLD. Please set LLD smaller than ULD. Range is 0 from 8191 digit.

・ULD : Set the ULD(Upper Level Discriminator). It does not get the time stamp data and energy data if the energy data greater than ULD. Range is 0 from 8191 digit.

- DPP setteing



・Baseline Restorer Filter : This set the time constat of the baseline restorer filter. Ext (AutoBLR off)、Fast、4μs、85μs、129μs、260μs. Nomally set to 85μs.

・Threshold : Set the threshold. Unit is digit. Range is 0 to 8191.

・Timing Type : Select the wavefrom for time stamp. You can select the CFD waveform and the LED (raw) waveform.

"LET" : Leading Edge Timing
It is the timing that has been reached to trigger. Timestamp timing is different by the signal height.

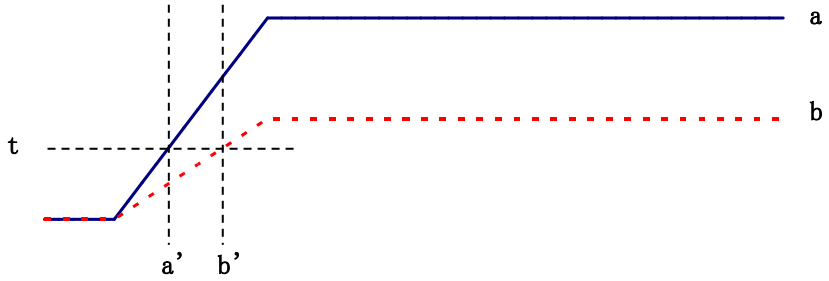


Fig. 4-2-2 How to use Leading Edge Timing

“CFD” : Constant Fraction Disicriminator Timing

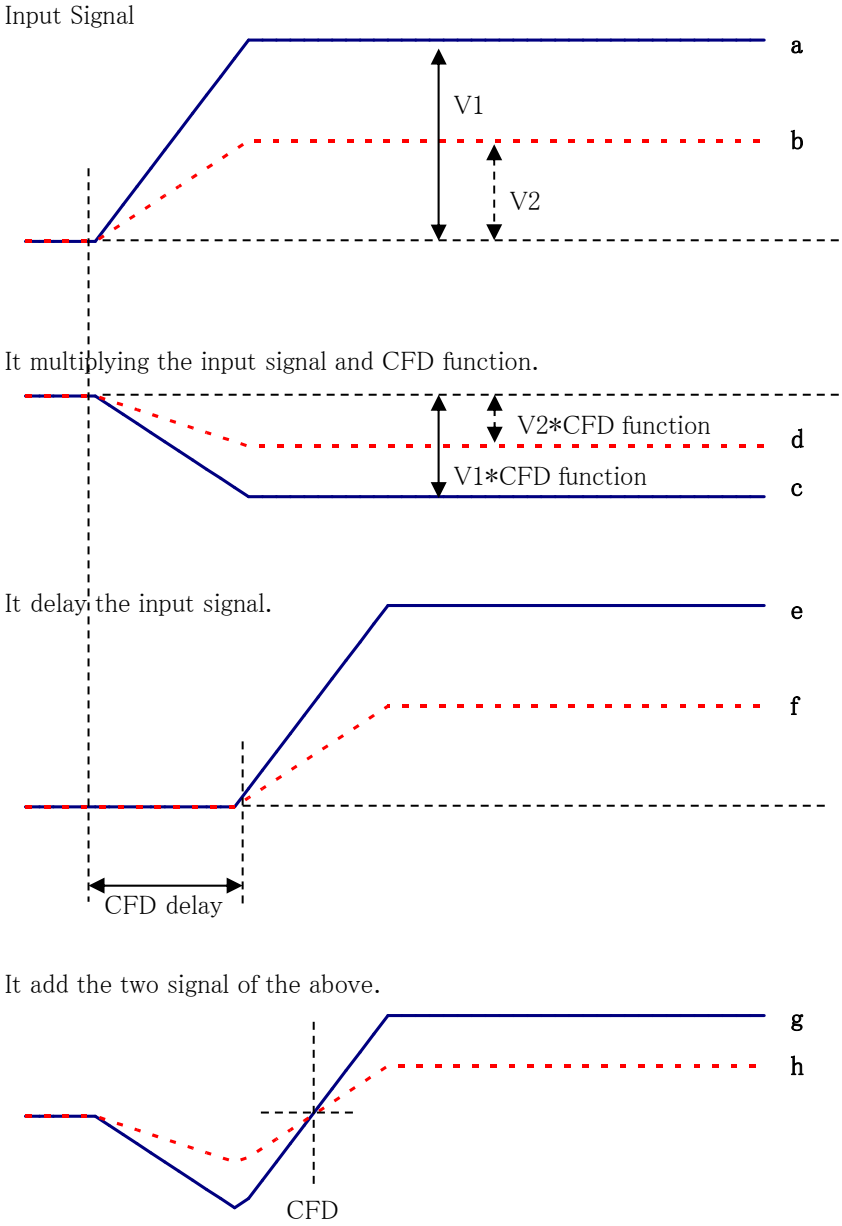
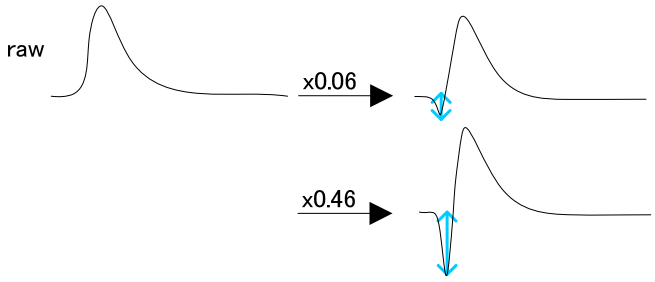


Fig. 4-2-3 How to use Constant Fraction Disicriminator Timing

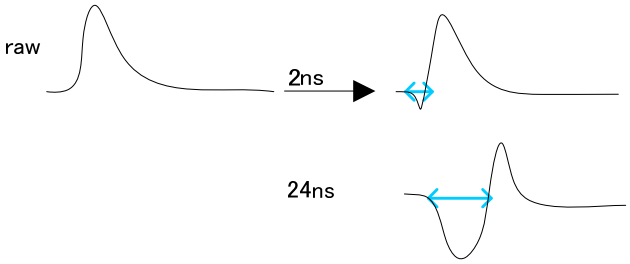
Timestamp timing is the same by CFD wave generation.
c, d : a and b multiplying the input signal and CFD function.
e, f : a and b delay the setting value.
g, h : it sam the each wave.

Features of CFD wave form is the same even though different wave high.

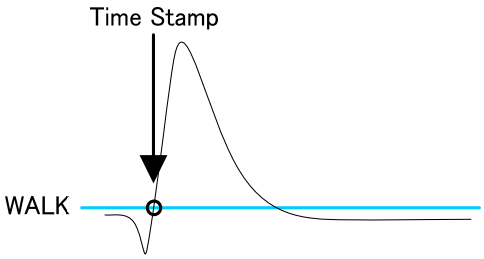
・CFD Function : This magnification use to reduce the input signal. Set value is ×0.03, ×0.06, ×0.09, ×0.12, ×0.15, ×0.18, ×0.21, ×0.25, ×0.28, ×0.31, ×0.34, ×0.37, ×0.40, ×0.43, ×0.46.



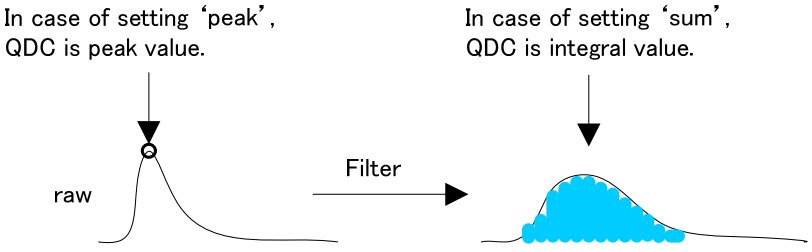
・CFD Delay : Set the time of delay for CFD signal generation. Set velue is 1ns to 24ns every 1ns.



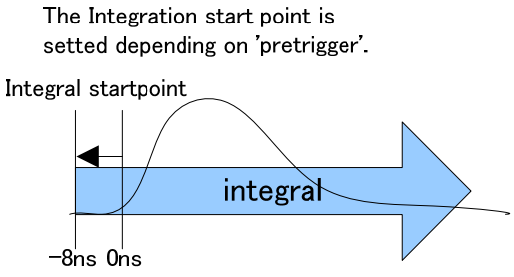
・CFD Walk : Set the value for timestamp. Nomally set 15 digits.



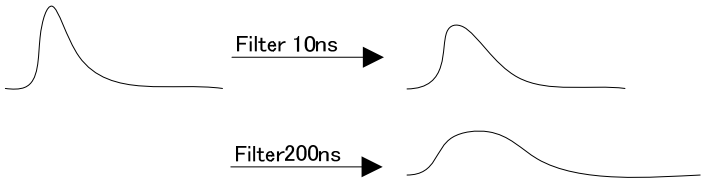
・QDC Sum or Peak : Set the type of QDC data. Type select from the PEAK and SUM. PEAK is the peak value of raw signal. SUM is the integral value of QDC waveform.



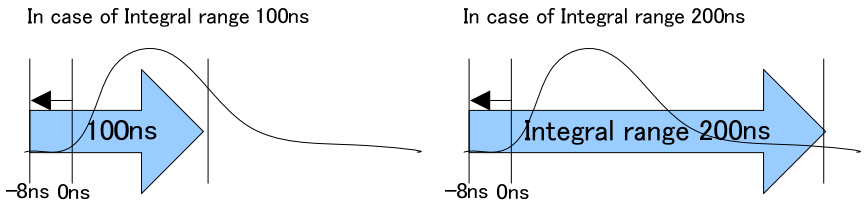
・QDC Pretrigger : Set the time of the integral start point for QDC waveform. Value select 0ns, −8ns, −16ns, −32ns, −40ns, −48ns, −56ns, −60ns.



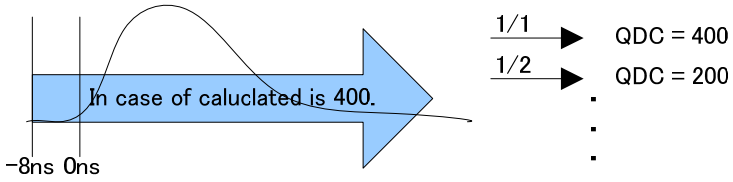
・QDC Filter : Set the time constant of QDC waveform generation. Value select Ext, 10ns, 20ns, 50ns, 100ns, 200ns



・QDC Integral Range : Set the integral time of QDC waveform. Range is 0ns from 32000ns.



・QDC Full Scale : Set the gain of QDC integral value. Value selet 1/1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512.



・fall start cnt : This is start position to calculate a fall integral. The point that exceeded the threshold is start point. Setting range is 1 to 16383(16383ns=16383x1ns).

・fall stop cnt : This is stop position to calculate a fall integral. Set range of integral. Setting range is 1 to 16383(16383ns=16383x1ns). Setted value must be greater than the fall start cnt.

Example:
In case of Threshold=50, fall start cnt=5, fall stop cnt=25, PSA full scale=1/1, Start point is 5th point that exceeded the threshold. Integration range is 25 point from start point. And integraled value is multiplied by PSA full scale. Integration range is blue frame of below picture.

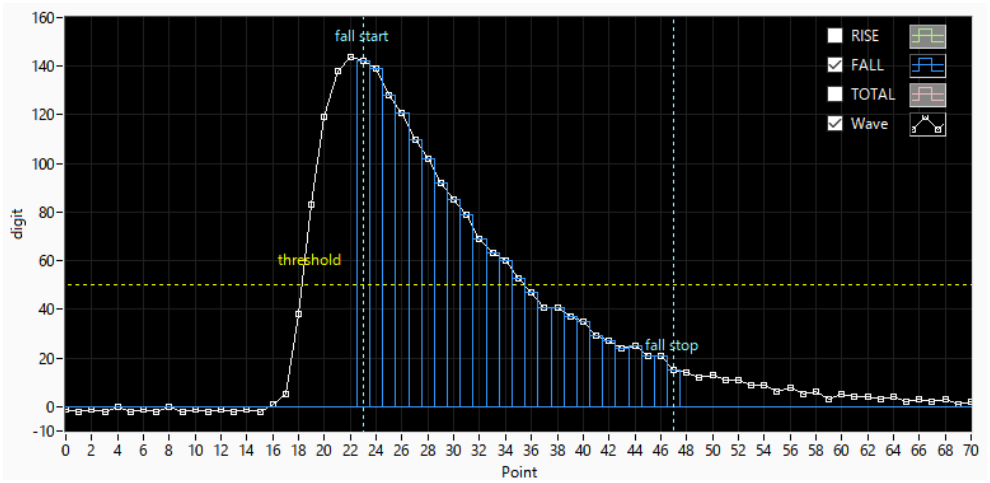


Fig. 4-2-4 How to calucurated FALL value

・total start cnt : This is start position to calculate a total integral. Set the range in front of the threshold. Setting range is 1 to 498(498ns=498x1ns).

・total stop cnt : This is stop position to calculate a total integral. Set range of integral. Setting range is 1 to 16383(16383ns=16383x1ns).

Example:
In case of Threshold=50, total start cnt=5, total stop cnt=50, PSA full scale=1/1, Start point is in front of 5 point that is exceed threshold. Integral range is 8 point. Integral range is red frame in below picture. And integraled value is multiplied by PSA full scale.

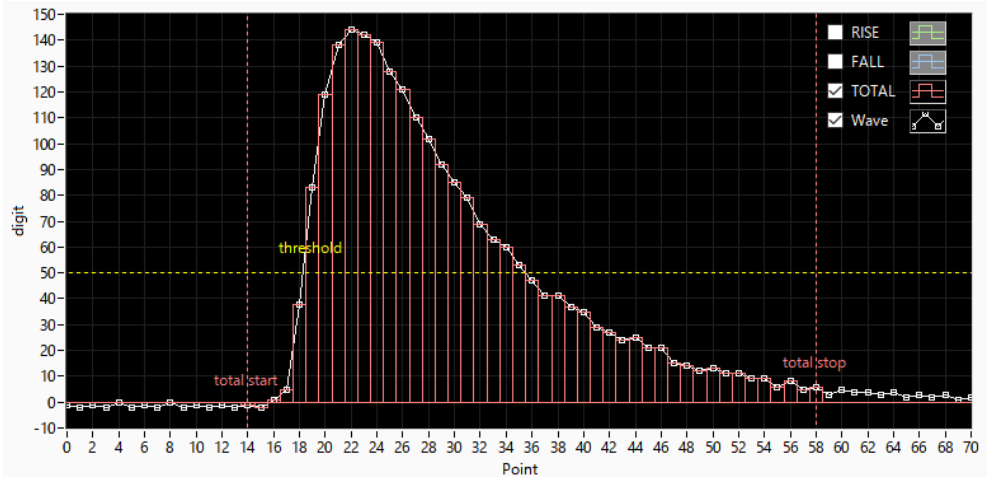
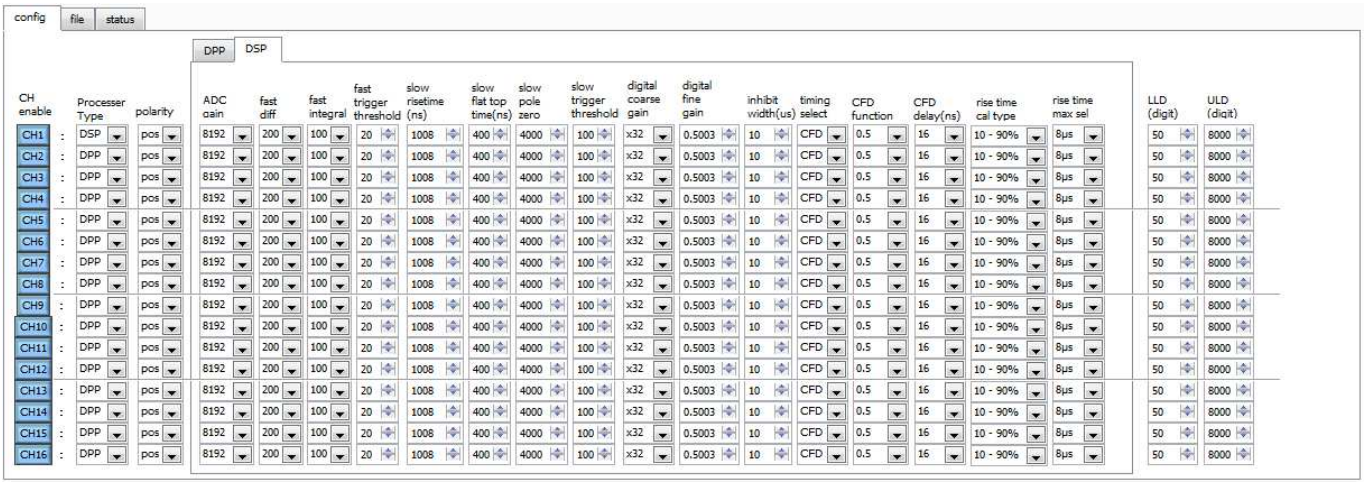


Fig. 4-2-4 How to calucurated TOTAL value

・PSA full scale : You can select from next. 1/1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512.

・Time Spectrum On/Off ： Select the enable of the time spectrum. Please do not ON If you want to get only the list data. If you ON at the high rate count, the acquisition of data is slow.

- DSP setteing



- ADC gain : You can select maximum ch. 8192, 4096, 2048, 1024, 512, 256 ch.
- fast diff : This is differential value of fast timing signal.
- fast integral : This is integral value of fast timing signal.
- fast trigger threshold : You can set threshold of fast timing signal. The unit is digit. Fast timing signal be generated from ADC value of preamp input signal. Timing signal be used timestamp timing of time information.
- slow rise time : You can set rise time of slow filter. Slow filter is trapezoidal filter. The unit is nano second.
- slow flattop time : You can set flat top time of slow filter. The unit is nano second.
- slow pore zero : You can set the pole zero of slow filter.
- slow trigger thereshlold : You can set threshold of slow filter signal. The unit is digit. If upper this threshold on slow filter, energy value be gifted from the peak of slow filter.
- digital coarse gain : You can select the digital gain of slow filter.
- digital fine gain : You can select the fine gain of slow filter.
- inhibit width : You can adjust the inhibit width of reset type Ge detector.
- timing select : You can select the timestamp timing to CFD or LE. The detail this function sees DPP.
- CFD function : You can select the function of CFD. The detail this function sees DPP.
- CFD delay : You can select the delay of CFD. The detail this function sees DPP.
- rise time cal type : You can select the ratio of rise time measurement time.
- rise time max sel : You can select the maximum time of rise time measurement. If you select the 8us value, the minimize value of time bin is 2ns. Another the minimize time bin is 4ns.

4. 3. File Tab

Fig. 4-3-1 File Tab

・Histogram Save : It will save the histogram data at the time of measurement end. It is enable when「mode」select「hist」.

・Histogram Continuous Save : It can select the enable of continues save at the set time intervals. It is enable when「mode」select「hist」.

・Histogram File Path : Set the absolute path of the histogram data. You can also choose not to extension.
※Caution※
File name format is as follow.
example:
「histogram file path」set「C:¥Data¥histogram.csv」,「histogram file save time(sec)」set「10」, date is 2010/09/01 and 12:00:00.
File name format of the start is「C:¥Data¥histogram_20100901_120000.csv」.
After 10 second is「C:¥Data¥histogram_20100901_120010.csv」.
※It may be off by one second increments.

・Hisutogram File Save Time (sec) : Set the time interval of continue save of histogram data. Unit is second. Range is 3600 second from 5 second.

・List Save : Choose whether you want to save the data. It is enable when「mode」select「list」.

・List File Number : Set the start value of the list data number. Range is 999999 from 0. It will return to 0 if it exceeds 999999.

4. 4. Status Tab

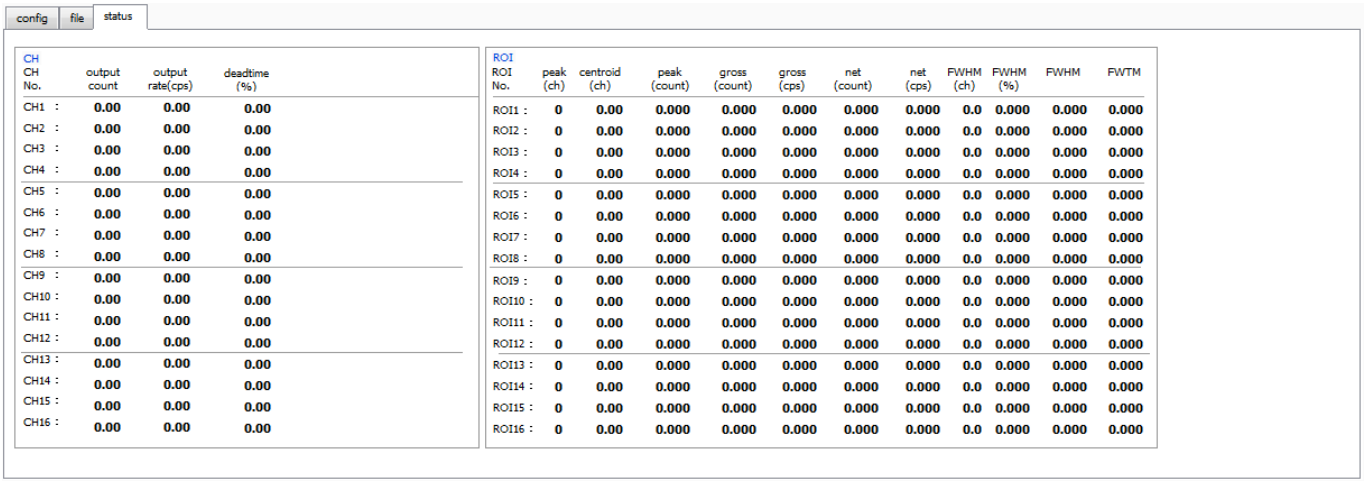


Fig. 4-3-1 Status Tab

・output count : Output total count. Output event number of total.
・output rate (cps) : Output count rate. Number of the output events / second.
・deadtime (%) : Deadtime ratio
・peak (ch) : CH of the maximum count
・centroid (ch) : Calculated center value (CH) by the total of all counts
・peak (count) : Maximum count
・gross (count) : The sum of the count between ROI
・net (count) : The sum of the count obtained by subtracting the background between the ROI
・net (cps) : Count of CPS obtained by subtracting the background between the ROI
・FWHM (ch) : Half Width at Half Maximum (ch)
・FWHM (%) : Half Width at Half Maximum (%) .Half Width at Half Maximum / ROI Definition Energy x 100
・FWHM : Half Width at Half Maximum
・FWTM : 1/10 width

4. 5. Wave Tab

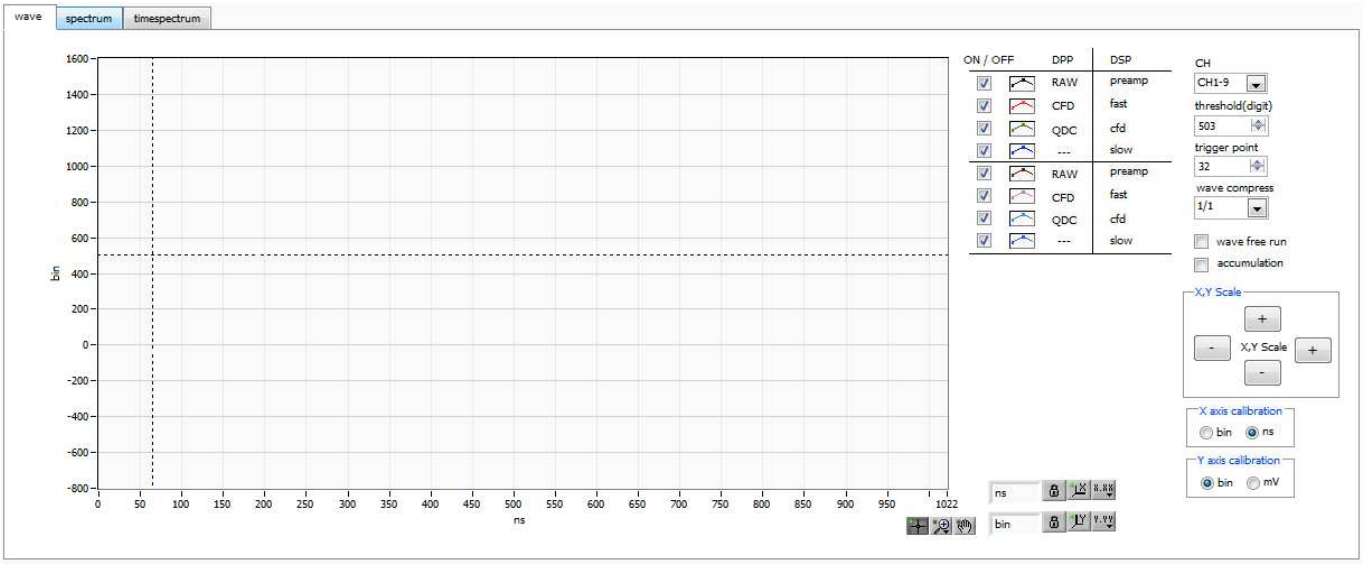


Fig. 4-4-1 wave tab

Graph : Waveform graph.It is enable when「mode」select「wave」.
・On/Off : Select the ON/OFF of the wave display. APV8516 can display the 8 waveforms.
・CH : Select the CH of the waveform display.
・Type : Select the type of the waveform display.
「raw」 — 'raw' is the raw waveform that was BLR processing from DPP. 1point is 2ns.
「CFD」 — 'CFD' is the CFD waveform that was CFD shaping.
「Filter」 — 'Filter' is the waveform tha was the filter shaping.
「preamp」 — 'preamp' is the waveform from DSP. 1point is 16ns.
「fast」 — 'fast' is timing signal from DSP.
「cfd」 — 'cfd' is the waveform from DSP.
「slow」 — 'slow' is the fileter waveform from DSP.

・Threshold : Set the threshold value of the trigger. Set is possible by moving the cursor in the graph.
・Trigger Point : Set the start point of the display waveform. Set is possible by moving the cursor in the graph.
・wave compress : You can see the compress waveform.
・Wave Free Run : 'ON' is displayed the waveform of the trigger free. 'OFF' is displayed the waveform of the triggered.
・Accumlation : Select the accumulation of the waveform.
・XY Scale : Adjust 'Xscale' and 'Yscale' at the button. Extension is '＋'. Reduction is '－'.
・X Axis Calibration : Select the unit of 'X-axis'.
・Y Axis Calibration : Select the unit of 'Y-axis'. ※ 'mV' is a reference value.

・X Axis Range : Dialog will be displayed if you right-click on the graph.「自動スケール」is auto scale. If you want to change the minimum or maximamu value, placed the mouse pointer on top of the numerical value, it can be changed by clicking or double-click.
・Y Axis Range : Dialog will be displayed if you right-click on the graph.「自動スケール」is auto scale. If you want to change the minimum or maximamu value, placed the mouse pointer on top of the numerical value, it can be changed by clicking or double-click.


: This is tool of the cursor moving. It can move the ROI cursor on the graph if you want to set the ROI.


: This is zoom. It can select the zoom type as the follow.

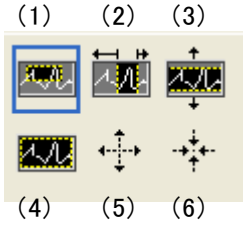


Fig. 4-4-2 zoom in or zoom out Tool

(1)Tetragon :It surrounds the area using the mouse. And it will be zoom.
(2)X-Zoom :This will zoom along the X-axis.
(3)Y-Zoom :This will zoom along the Y-axis.
(4)Fit Zoom :This will be auto scale.
(5)Zoom out to center a point :Click a center point of the zoom out.
(6)Zoom in to center a point :Click a center point of the zoom in.


: Pan tool. It can move the graph by this icon.

4. 6. Spectrum Tab

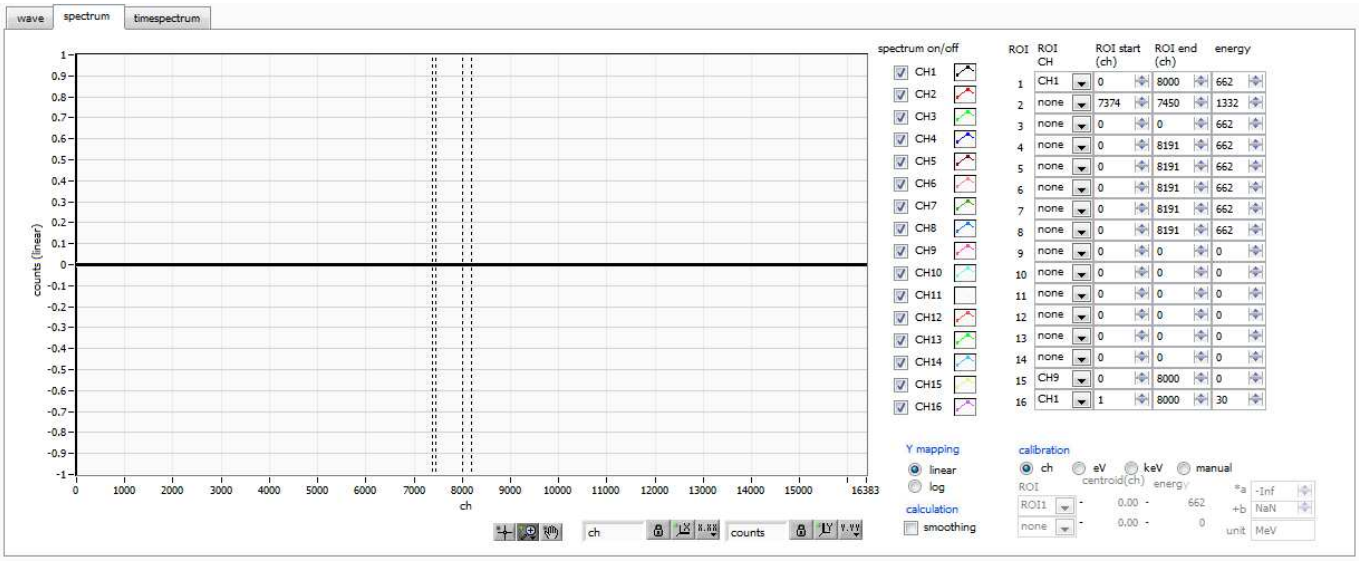


Fig. 4-5-1 Spectrum Tab

Graph : Energy Spectrum. It is enable when 「mode」 select 「hist」 or 「list」. If 「mode」 is 「list」, you need to ON of 「spectrum ON/OFF」

Check BOX : It make the setting of wether or not to display the histogram of each CH in the graph.

ROI CH : Set the CH of the ROI. It can set the maximum eight ROI per a CH.

ROI Start (ch) : Set the start point of the ROI. Unit is ch.

ROI End (ch) : Set the end point of the ROI. Unit is ch.

Energy : It define the energy value of the peak ch. Example 60Co set 1173(keV) or 1332(keV). If set 「ch」 of 「calibration」, it will detect the peak between the ROI. The FWHM is calculate by the peak and the energy.

Calibration : Select the unit of X-axis. X-axis Label will be changed by the setting.

- ch : Display unit is ch.
- eV : Display unit is eV. If you set the two ROI, it run a two-point calibration. X-axis will be converted to the unit eV by the slope and intercept of the primary function y=ax+b.
- keV : Display unit is KeV. If you set the two ROI, it run a two-point calibration. X-axis will be converted to the unit KeV by the slope and intercept of the primary function y=ax+b.
- Example : If 5717.9ch is 1173.24keV of 60Co and 6498.7ch is 1332.5keV of 60Co, it be calculated 0.20397 of slope and 6.958297 of intercept.
- manual : You can set manual value of the slope and the intercept.

Y mapping : Select the mapping of Y-axis. Y-axis Label will be changed by the setting.

- Linear : Linear
- Log : Log

Smoothing : This is a smoothing function if the statistics are less. You can get a FWHM faster than nomal.

Simple count view : Set the view CH and x-ch. Count will be displayed.

Gauss fit : It runs a Gaussian fit between ROI.

5. File

5. 1. Histogram Data File

(1) File format
Tab-delimited text format

(2) File name
Arbitrary file name

(3) Structure
"Header" and "Calculation" and "Status" and "Data".

・Header parts
This parts save every CH as follow.

Measurement Mode	:	Measurement Mode
Measurement Time	:	Measurement Time (Unit: sec)
Real Time	:	Real Time
Start Time	:	Measurement Start Time
End Time	:	Measurement End Time

※Be saved each CH.

POL	:	Polarity
TGE	:	Waveform display trigger CH
TGC	:	Waveform trigger polarity
RJT	:	Waveform getting threshold
CCF	:	CFD Function
CDL	:	CFD Delay
CWK	:	CFD Walk
CTH	:	CFD Threshold
FLK	:	Baseline Time Constant
PTS	:	QDC Pretrigger
LIG	:	QDC Filter Time Constant
LIT	:	QDC Sum or Peak
AFS	:	QDC Integral reduction
CLD	:	QDC LLD
CUD	:	QDC ULD
TTY	:	Timing Type

Only once is saved as follow.

MOD	:	Mode
MTM	:	Measurement Time
MEMO	:	Memo

・Calculation Parts

This parts save every ROI. They are the calculated value between ROI. They saved only devicd in the display.

ROI_Ch	:	Set CH.
ROI_Start	:	ROI Start position CH
ROI_End	:	ROI End position CH
Enegy (keV)	:	ROI energy(keV)
Peak (ch)	:	Peak CH at calculated(ch)
Centroid (ch)	:	Centroid CH at calculated(ch)
Peak (count)	:	Peak counts at calculated
Gross (count)	:	Gross sum counts at calculated.
Gross (cps)	:	Gross cps at calculated.
Net (count)	:	Sum counts that attracted a background.
Net (cps)	:	Csp that attracted a background.
FWHM (ch)	:	Full width at half maximum(ch)
FWHM (%)	:	Energy resorution of full width at half maximum(%)
FWHM (keV)	:	Energy value of Full width at half maximum(keV)
FWTM (keV)	:	Energy resorution of full width at tenth maximum(keV)

・Status Parts

※This parts save every CH

Input Total Count	:	Total Counts
Throughput Count	:	Throughput Counts
Input Total Rate	:	Total Count Rate
Throughtput Rate	:	Throughput Count Rate
Dead Time	:	Dead Time Ratio

・Data Parts

Histogram data of each CH. Maximamu: 8192 points

5. 2. Wave Data File

(1) File Format
Tab Separated Values Type

(2) File Name
Arbitrarily Name

(3) Structure
"Header" and "Calculation" and "Status" and "Data".

・Header Parts

Measurement Mode	:	Measurement Mode
Measurement Time	:	Measrement Time (Unit: sec)
Real Time	:	Real Time
Start Time	:	Measurement Start Time
End Time	:	Measurement End Time

※Be saved each CH.

POL	:	Polarity
TGE	:	Waveform display trigger CH
TGC	:	Waveform trigger polarity
RJT	:	Waveform getting threshold
CCF	:	CFD Function
CDL	:	CFD Delay
CWK	:	CFD Walk
CTH	:	CFD Threshold
FLK	:	Baseline Time constant
PTS	:	QDC Pretrigger
LIG	:	QDC Filter Time Constat
LIT	:	QDC Sum or Peak
AFS	:	QDC Integral reduction
CLD	:	QDC LLD
CUD	:	QDC ULD
TTY	:	Timing Type

Only once is saved as follow.

MOD	:	Mode
MTM	:	Measurement Time
MEMO	:	Memo

・Status Parts

※This parts save every CH

Outtput Count	:	Output Counts
Outtput Rate	:	Output Rate
Dead Time	:	Dead Time Ratio

・Data Parts
Waveform data of each CH.

5. 3. List Data File

(1) File Format
Binary File, Big Endian File

(2) Structure
When you select DPP.
128Bit (16Byte, 8WORD) / event

Bit127			112
TDC[55..40]			
111			96
TDC[39..24]			
95			80
TDC[23..8]			
79	72	71	64
TDC[7..0]		TDCFP[7..0]	
63	61	60	48
0		Energy[12..0]	
47	46	36	35 32
0	0		CH[3..0]
31			16
FALL[15..0]			
15			0
TOTAL[15..0]			

Fig. 5-3-1 List Data (128 Bit)

- Bit127 to Bit72 TDC counts. 56Bit. 1Bit = 2ns
- Bit71 to Bit64 TDCFP counts. 8Bit. 1Bit = 7.8125ps
- Bit60 to Bit48 Energy. 13Bit.
- Bit47 Selected proceccer type. 0: DPP, 1:DSP
- Bit35 to Bit32 CH. 4Bit.
  0:CH1, 1:CH2・・・15:CH16.
- Bit31 to Bit16 FALL value. 16Bit.
- Bit31 to Bit16 TOTAL value. 16Bit.

When you select DSP.
128Bit （16Byte, 8WORD） / event

Bit127															112
TDC[52..39]															
111															96
TDC[38..23]															
95															80
TDC[22..7]															
79							73	72		69	68				
TDC[6..0]								TDCFP[3..0]			64				
											0				
63			61	60											48
0				Energy[12..0]											
47	46									36	35			32	
0	0										CH[3..0]				
31	30		28	27										16	
SEL	0			RISE[11..0]											
15															0
0															

Fig. 5-3-1 List Data （128 Bit）

・Bit127 to Bit72	TDC counts. 53Bit. 1Bit = 16ns
・Bit71 to Bit64	TDCFP counts. 4Bit. 1Bit = 1ns
・Bit60 to Bit48	Energy. 13Bit.
・Bit47	Selected proceccer type. 0: DPP, 1:DSP
・Bit35 to Bit32	CH. 4Bit. 0:CH1, 1:CH2・・・15:CH16.
・Bit31	Rise Max Sel. 0: rise time max8 μ s and 1Bit = 2ns, 1: rise time max16 μ s 1Bit = 4ns. If the rise time data is 4095, data is error. In next case, error occur. When the wave data is pileup. When calculated value is overflow.
・Bit27 to Bit16	RISE time value. 12Bit.

End