How to Extract Data from the File of Siglent Oscilloscope

Revise Record：

Date	Edition	Revise Reason	Revise content	Revise people
2017/10/25		SDS1000X SDS2000X		
2018/03/01		Added SDS1xx2X-E, SDS1xx4X-E		
2018/06/12		Added SDS5000X SDS2000X-E		
2019/07/22		Added SDS2000X Plus		
2021/06/18		Added Measure Logger, Sample Logger		
Note: When the file is first to be pigeonholed, 'Revise Reason' and ' Revise Content' are write to 'None'.				

Index

Binary File of Waveform

SDS1000X || SDS2000X

Update date: 2017-10-25

Table 1 Format of the Binary File

Parameter	Address	Description
wave_length	0x00-0x03	Reserved
mso_wave_length	0x04-0x07	Digital channels wave length
mso_ch_open_num	0x10-0x13	Wave length in units of sample points. 32-bit integer
mso_ch_open_stats	0x14-0x23	on/off status of d0-d15, 1 - ON, 0 - OFF 32-bit integer d0:0x14 d8:0x15 d1:0x16 d9:0x17 d2:0x18 d10: 19 d3:0x1a d11: 1b d4: 0x1c d12:0x1d d5: 0x1e d13:0x1f d6: 0x20 d14:0x21 d7: 0x22 d15:0x23
ch1_volt_div_val	0xbc-0xbf	V/div value of CH1, in units of mV. Such as 2.48 mV/div. 32-bit float point, little endian.
ch2_volt_div_val	0xc0-0xc3	V/div value of CH2.
ch3_volt_div_val	0xc4-0xc7	V/div value of CH3.
ch4_volt_div_val	0xc8-0xcb	V/div value of CH4.
ch1_vert_offset	0xdc-0xdf	Offset value of CH1, with the unit of pixel. Refer to “Calculate the Vertical Offset” to get the actual offset voltage. 32-bit signed integer, little endian.
ch2_vert_offset	0xe0-0xe3	Offset value of CH2.
ch3_vert_offset	0xe4-0xe7	Offset value of CH3.
ch4_vert_offset	0xe8-0xeb	Offset value of CH4.
ch1_on	0x100-0x103	on/off status of CH1, 1 - ON, 0 - OFF 32-bit signed integer, little endian.
ch2_on	0x104-0x107	on/off status of CH2.
ch3_on	0x108-0x10b	on/off status of CH3.
ch4_on	0x10c-0x10f	on/off status of CH4.
time_div	0x248-0x24b	T/div index. Refer to Table 2 for the details.

		32-bit signed integer, little endian.
time_delay	0x250-0x253	Time delay (Trigger delay) value, in units of pixel. Refer to “Calculate the Time Delay” to get the actual time delay. 32-bit signed integer, little endian.
data	0x1470-end	Data. Analog data first, and then digital data. Only data of the enabled channel(s) are stored to the file. 8-bit unsigned integer for analog data. 1-bit binary integer for digital data.

Table 2 T/div Table

Index	SDS1000X	SDS2000X
0		1 ns/div
1	2 ns/div	2 ns/div
2	5 ns/div	5 ns/div
3	10 ns/div	10 ns/div
4	20 ns/div	20 ns/div
5	50 ns/div	50 ns/div
6	100 ns/div	100 ns/div
7	200 ns/div	200 ns/div
8	500 ns/div	500 ns/div
9	1 us/div	1 us/div
10	2 us/div	2 us/div
11	5 us/div	5 us/div
12	10 us/div	10 us/div
13	20 us/div	20 us/div
14	50 us/div	50 us/div
15	100 us/div	100 us/div
16	200 us/div	200 us/div
17	500 us/div	500 us/div
18	1 ms/div	1 ms/div
19	2 ms/div	2 ms/div
20	5 ms/div	5 ms/div
21	10 ms/div	10 ms/div
22	20 ms/div	20 ms/div
23	50 ms/div	50 ms/div
24	100 ms/div	100 ms/div
25	200 ms/div	200 ms/div
26	500 ms/div	500 ms/div
27	1 s/div	1 s/div
28	2 s/div	2 s/div
29	5 s/div	5 s/div
30	10 s/div	10 s/div
31	20 s/div	20 s/div
32	50 s/div	50 s/div

Table 3 V/div Table

Index	SDS1000X	SDS2000X
0	500uV/div	1 mV/div
1	1 mV/div	2 mV/div
2	2 mV/div	5 mV/div

Index	SDS1000X	SDS2000X
3	5 mV/div	10 mV/div
4	10 mV/div	20 mV/div
5	20 mV/div	50 mV/div
6	50 mV/div	100 mV/div
7	100 mV/div	200 mV/div
8	200 mV/div	500 mV/div
9	500 mV/div	1 V/div
10	1 V/div	2 V/div
11	2 V/div	5 V/div
12	5 V/div	10 V/div
13	10 V/div	

Calculate the Sample Rate

sample_rate = (wave_length) /(hori_div_num*time_div_val)

[example]

hori_div_num = 14 # total horizontal divisions, on SDS2000X is 14

wave_length = 700 pts # length of each frame. Could be got by calculating the length of the data section in the file

time_div_val = 50 ns/div # use the T/div index got from the binary file to search Table 2

So:

sample_rate = 700/(14*50e-9) = 1e9(Sa/s)

Calculate the Vertical Offset

vert_offset = (ch_vert_offset-220)*(ch_volt_div_val / pixel_per_div)

[example]

pixel_per_div = 50 # total display pixels in a vertical division, on SDS2000X is 50

ch_vert_offset = 270 # offset value, with the unit of pixel, got from the binary file

ch_volt_div_val = 50 mV/div # use the V/div index got from the binary file to search Table 3

So:

vert_offset = (270-220)/(50/50) = 50(mV)

Calculate the Time Delay

hori_offset_time = (time_offset-349)*(time_div_val / pixel_per_div)

[example]
pixel_per_div = 50 # total display pixels in a horizontal division, on SDS2000X is 50
time_offset = 299 # offset value, with the unit of pixel, got from the binary file
time_div_val = 50 ns/div # use the T/div index got from the binary file to search Table 2

So:
hori_offset_time = (299-349)*(50/50) = -50(ns)

Convert the Data to Voltage

voltage = (data-128) * ch_volt_div_val /1000/code_per_div + ch_vert_offset
[example]
code_per_div = 25 # total data code in a horizontal division, on SDS2000X is 25
data = 194 # got from the binary file
ch_volt_div_val = 5000 mV/div # V/div, in units of mV
ch_vert_offset = -7.7 V # vertical offset

So:
voltage = (194-128)*5000/1000/25+(-7.7) = 5.5(V)

SDS1xx2X-E Before 1.3.21 || SDS1xx4X-E 6.1.20~6.1.25

Update date: 2018-3-1

Table 4 Format of the Binary File

Parameter	Address	Description
time_div	0xa84-0xa93	Time div (time base) value, Such as 2.48 ms/div. Unit of value, such as s from 0xa90-0xa93, refer to Table 6 for the details. Units of value's magnitude from 0xa8c-0xa8f, refer to Table 5 for the details. 64-bit float point, data of value from 0xa84-0xa8b
time_delay	0xa94-0xaa3	Time delay (Trigger delay) value, Such as 2.48 ms. Unit of value, such as s from 0xaa0-0xaa3, refer to Table 6 for the details. Units of value's magnitude from 0xa9c-0xa9f, refer to Table 5 for the details. 64-bit float point, data of value from 0xa94-0xa9b.
wave_length	0xaa4-0xaa7	Wave length in units of sample points. 32-bit integer
Sample_rate	0xaa8-0xab7	Sample Rate value, Such as 500M Sa/s. units of value's magnitude from 0xab0-0xab3, Refer to Table 6 for the details. 64-bit float point, data of value from 0xaa8-0xaaf.
ch1_on	0x44-0x47	on/off status of CH1, 1 - ON, 0 - OFF 32-bit signed integer, little endian.
ch1_volt_div_val	0x90-0x9f	V/div value of CH1, such as 2.48 mV/div. Unit of value, such as V from 0x9c-0x9f, refer to Table 6 for the details. Units of value's magnitude from 0x98-0x9b, refer to Table 5 for the details. 64-bit float point, data of value from 0x90-0x97.
ch1_vert_offset	0xa0-0xaf	Offset value of CH1, such as 2.48 mV. Unit of value, such as V from 0xac-0xaf, refer to Table 6 for the details. Units of value's magnitude from 0xa8-0xab, refer to Table 5 for the details.

		64-bit float point, data of value from 0xa0-0xa7.
ch2_on	0xc0-0xc3	on/off status of CH2 32-bit integer
ch2_volt_div_val	0x10c-0x11b	V/div value of CH2, such as 2.48 mV/div. Unit of value, such as V from 0x118-0x11b, refer to Table 6 for the details. Units of value from 0x114-0x117, refer to Table 5 for the details. 64-bit float point, data of value from 10c-0x113.
ch2_vert_offset	0x11c-0x12b	Offset value of CH2, such as 2.48 mV. Unit of value, such as V from 0x128-0x12b, refer to Table 6 for the details Units of value's magnitude from 0x124-0x127, refer to Table 5 for the details. 64-bit float point, data of value from 0x11c-0x123
ch3_on	0x13c-0x13f	on/off status of CH3 32-bit integer
ch3_volt_div_val	0x188-0x197	V/div value of CH3, such as 2.48 mV/div. Unit of value, such as V from 0x194-0x197, refer to Table 6 for the details. Units of value's magnitude from 0x190-0x193 refer to Table 5 for the details. 64-bit float point, data of value from 0x188-0x18f.
ch3_vert_offset	0x198-0x1a7	Offset value of CH3, such as 2.48 mV. Unit of value, such as V from 0x1a4-0x1a7, refer to Table 6 for the details. Units of value's magnitude from 0x1a0-0x1a3, refer to Table 5 for the details. 64-bit float point, data of value from 0x198-0x19f.
ch4_on	0x1b8-0x1bb	on/off status of CH4 32-bit integer
ch4_volt_div_val	0x204-0x213	V/div value of CH4, such as 2.48 mV/div. Unit of value, such as V from 0x210-0x213, refer to Table 6 for the details. units of value's magnitude from 0x20c-0x20f, Refer to Table 5 for the details. 64-bit float point,data of value from 0x204-0x20b.
ch4_vert_offset	0x214-0x223	Offset value of CH4, such as 2.48 mV. Unit of value, such as V from 0x220-0x223, refer to Table 6 for the details Units of value's magnitude from 0x21c-0x21f,

		refer to Table 5 for the details 64-bit float point, data of value from 0x214-0x21b.
reserved	0x8a04-0x8a07	reserved
reserved	0x82f8-0x82fb	reserved
reserved	0x83f4-0x83f7	reserved
reserved	0x83f8-0x83fb	reserved
reserved	0x83fc-0x83ff	reserved
reserved	0x8400-0x8403	reserved
reserved	0x8404-0x8407	reserved
reserved	0x8408-0x840b	reserved
reserved	0x840c-0x840f	reserved
reserved	0x8410-0x8413	reserved
reserved	0x8414-0x8417	reserved
reserved	0x8418-0x841b	reserved
reserved	0x841c-0x841f	reserved
reserved	0x8420-0x8423	reserved
reserved	0x8424-0x8427	reserved
reserved	0x8428-0x842b	reserved
reserved	0x842c-0x842f	reserved
reserved	0x8430-0x8433	reserved
data	0x8a60-end	Data from analog channel 1 to channel 4. Only data of the enabled channel(s) are stored to the file. 8-bit unsigned integer for analog data

Table 5 Magnitude Table

Index	SDS1000X-E
0	YOCTO
1	ZEPTO
2	ATTO
3	FEMTO
4	PICO
5	NANO
6	MICRO
7	MILLI
8	IU
9	KILO
10	MEGA
11	GIGA
12	TERA
13	PETA

Table 6 Units Table

Index	SDS1000X-E	Index	SDS1000X-E
0	V	14	S
1	A	15	SA
2	VV	16	PTS
3	AA	17	NULL
4	OU	18	DB
5	W	19	DBV
6	SQRT_V	20	DBA
7	SQRT_A	21	VPP
8	INTEGRAL_V	22	VDC
9	INTEGRAL_A	23	DBM
10	DT_V		
11	DT_A		
12	DT_DIV		
13	Hz		

Convert the Data to Voltage

voltage = (data-128) * ch_volt_div_val /1000/code_per_div + ch_vert_offset

[example]

```
code_per_div = 25              # total data code in a horizontal division, on SDS1000X-E is 25
data = 194                     # got from the binary file
ch_volt_div_val = 5000 mV/div  # V/div, in units of mV
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ch_vert_offset = -7.7 V # vertical offset

So:

voltage = (194-128) * 5000/1000/25+(-7.7) = 5.5 V

SDS1xx2X-E After 1.3.21 || SDS1xx4X-E After 6.1.26 || SDS2000X-E After 1.1.8 || SDS5000X 0.6.7~0.8.5R2 || SDS2000X+ 1.1.6~1.2.3

Update date: 2018-6-15

Table 7 Format of the Binary File

Parameter	Address	Description
ch1_on	0x00-0x03	on/off status of CH1, 1 - ON, 0 - OFF 32-bit signed integer.
ch2_on	0x04-0x07	on/off status of CH2, 1 - ON, 0 - OFF 32-bit integer
ch3_on	0x08-0x0b	on/off status of CH3, 1 - ON, 0 - OFF 32-bit integer
ch4_on	0x0c-0x0f	on/off status of CH4, 1 - ON, 0 - OFF 32-bit integer
ch1_volt_div_val	0x10-0x1f	V/div value of CH1, such as 2.48 mV/div. Unit of value, such as V from 0x1c-0x1f, refer to Table 8 for the details. Units of value's magnitude (MICRO) from 0x18-0x1b, refer to Table 8 for the details. 64-bit float point, data of value from 0x10-0x17.
ch2_volt_div_val	0x20-0x2f	V/div value of CH2, such as 2.48 mV/div. Unit of value, such as V from 0x2c-0x2f, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x28-0x2b, refer to Table 8 for the details. 64-bit float point, data of value from 0x20-0x27.

ch3_volt_div_val	0x30-0x3f	V/div value of CH3, such as 2.48 mV/div. Unit of value, such as V from 0x3c-0x3f, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x38-0x3b, refer to Table 8 for the details. 64-bit float point, data of value from 0x30-0x37.
ch4_volt_div_val	0x40-0x4f	V/div value of CH4, such as 2.48 mV/div. Unit of value, such as V from 0x4c-0x4f, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x48-0x4b, refer to Table 8 for the details. 64-bit float point, data of value from 0x40-0x47.
ch1_vert_offset	0x50-0x5f	Offset value of CH1, such as 2.48 mV. Unit of value, such as V from 0x5c-0x5f, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x58-0x5b, refer to Table 8 for the details. 64-bit float point, data of value from 0x50-0x57.
ch2_vert_offset	0x60-0x6f	Offset value of CH2, such as 2.48 mV. Unit of value, such as V from 0x6c-0x6f, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x68-0x6b, refer to Table 8 for the details. 64-bit float point, data of value from 0x60-0x67.
ch3_vert_offset	0x70-0x7f	Offset value of CH3, such as 2.48 mV. Unit of value, such as V from 0x7c-0x7f, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x78-0x7b, refer to Table 8 for the details. 64-bit float point, data of value from 0x70-0x77.
ch4_vert_offset	0x80-0x8f	Offset value of CH4, such as 2.48 mV. Unit of value, such as V from 0x8c-0x8f, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x88-0x8b, refer to Table 8 for the details. 64-bit float point, data of value from 0x80-0x87.

digital_on	0x90-0x93	on/off status of digital, 1 - ON, 0 - OFF 32-bit integer
d0_d15_on	0x94-0xd3	on/off status of d0-d15, 1 - ON, 0 - OFF 32-bit integer d0:0x94-0x97 d8:0xb4-0xb7 d1:0x98-0x9b d9:0xb8-0xbb d2:0x9c-0x9f d10:0xbc-0xbf d3:0xa0-0xa3 d11:0xc0-0xc3 d4: 0xa4-0xa7 d12:0xc4-0xc7 d5: 0xa8-0xab d13:0xc8-0xcb d6: 0xac-0xaf d14:0xcc-0xcf d7: 0xb0-0xb3 d15:0xd0-0xd3
time_div	0xd4-0xe3	Time div (time base) value, Such as 2.48 ms/div. Unit of value, such as s from 0xe0-0xe3, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0xdc-0xdf, refer to Table 8 for the details. 64-bit float point, data of value from 0xd4-0xdb.
time_delay	0xe4-0xf3	Time delay (Trigger delay) value, Such as 2.48 ms. Unit of value, such as s from 0xf0-0xf3, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0xec-0xef, refer to Table 8 for the details. 64-bit float point, data of value from 0xe4-0xeb
wave_length	0xf4-0xf7	Wave length of the data points for analog channel. 32-bit integer
Sample_rate	0xf8-0x107	Sample Rate value for analog channel, Such as 500M Sa/s. Unit of value, such as Sa from 0x104-0x107, refer to Table 9 for the details. Units of value's magnitude (MEGA) from 0x100-0x103, Refer to Table 8 for the details. 64-bit float point, data of value from 0xf8-0xff.

digital_wave_length	0x108-0x10b	Wave length of the data points for digital. 32-bit integer
digital_sample_rate	0x10c-0x11b	Sample Rate value for digital, Such as 500M Sa/s. Unit of value, such as Sa from 0x118-0x11b, refer to Table 9 for the details. Units of value's magnitude (MEGA) from 0x114-0x117, Refer to Table 8 for the details. 64-bit float point, data of value from 0x10c-0x113.
reserved	0x11c~	reserved
…	…	…
reserved	~0x7ff	reserved
Wave_data	0x800-end	Data from CH1 to D15. Only data of the enabled channel(s) are stored to the file. I.E. if there are data of all channels(Ch1 to D15), and wave_length from 0xf4-0xf7 is 700(0x2bc). Data of CH1 is from 0x800 to 0xabb. Data of CH2 is from 0xabc to 0xd77. CH3 and CH4 are the same. Next block is the data of D0. The data length (digital_wave_length) from 0x108-0x10b is 1400. Data of D0 is from 0x12f0 to 0x1867. D1~D15 are the same.

Table 8 Magnitude Table

Index	Magnitude	Index	Magnitude
0	YOCTO	7	MILLI
1	ZEPTO	8	IU
2	ATTO	9	KILO
3	FEMTO	10	MEGA
4	PICO	11	GIGA
5	NANO	12	TERA
6	MICRO	13	PETA

Table 9 Units Table

Index	Unit	Index	Unit

Index	Unit	Index	Unit
0	V	12	DT_DIV
1	A	13	Hz
2	VV	14	S
3	AA	15	SA
4	OU	16	PTS
5	W	17	NULL
6	SQRT_V	18	DB
7	SQRT_A	19	DBV
8	INTEGRAL_V	20	DBA
9	INTEGRAL_A	21	VPP
10	DT_V	22	VDC
11	DT_A	23	DBM

Convert the Data to Voltage

voltage = (data-128) * ch_volt_div_val /1000/code_per_div + ch_vert_offset

[example]
code_per_div = 25 # total data code in a horizontal division, on SDS1000X is 25
data = 194 # got from the binary file
ch_volt_div_val = 5000 mV/div # V/div, in units of mV
ch_vert_offset = -7.7 V # vertical offset

So:
voltage = (194-128) * 5000/1000/25+(-7.7) = 5.5 V

Calculate the Time Value of the Data

time value(S) = -(time_div *grid /2)+index*(1/ Sample_rate)

[example]
grid = 14 # The grid numbers in horizontal direction
time_div = 2 us # s/div, in units of us
Sample_rate = 1 GSa/s # Sa/s, in units of GSa/s

So:
The time value of the first point: -(2e-6*14/2)+0*(1/1e9) = -14e-6 s.
The time value of the second point: -(2e-6*14/2)+1*(1/1e9) = -14.001e-6 s.

SDS5000X After 0.8.6 || SDS2000X+ After1.2.6

Update date: 2019-7-22

Table 7 Format of the Binary File

Parameter	Address	Description
version	0x00-0x03	Version number of the file. 0 or 1,use V2.0 to extract data. 2,use V3.0 to extract data.
ch1_on	0x04-0x07	on/off status of CH1, 1 - ON, 0 - OFF 32-bit signed integer.
ch2_on	0x08-0x0b	on/off status of CH2, 1 - ON, 0 - OFF 32-bit integer
ch3_on	0x0c-0x0f	on/off status of CH3, 1 - ON, 0 - OFF 32-bit integer
ch4_on	0x10-0x13	on/off status of CH4, 1 - ON, 0 - OFF 32-bit integer
ch1_volt_div_val	0x14-0x3b	V/div value of CH1, such as 2.48 mV/div. Unit of value, such as V from 0x20-0x3b, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x1c-0x1f, refer to Table 8 for the details. 64-bit float point, data of value from 0x14-0x1b.
ch2_volt_div_val	0x3c-0x63	V/div value of CH2, such as 2.48 mV/div. Unit of value, such as V from 0x48-0x63, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x44-0x47, refer to Table 8 for the details. 64-bit float point, data of value from 0x3c-0x43.

ch3_volt_div_val	0x64-0x8b	V/div value of CH3, such as 2.48 mV/div. Unit of value, such as V from 0x70-0x8b, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x6c-0x6f, refer to Table 8 for the details. 64-bit float point, data of value from 0x64-0x6b.
ch4_volt_div_val	0x8c-0xb3	V/div value of CH4, such as 2.48 mV/div. Unit of value, such as V from 0x98-0xb3, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x94-0x97, refer to Table 8 for the details. 64-bit float point, data of value from 0x8c-0x93.
ch1_vert_offset	0xb4xdb	Offset value of CH1, such as 2.48 mV. Unit of value, such as V from 0xc0-0xdb, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0xbc-0xbf, refer to Table 8 for the details. 64-bit float point, data of value from 0xb4-0xbb.
ch2_vert_offset	0xdc-0x103	Offset value of CH2, such as 2.48 mV. Unit of value, such as V from 0xe8-0x103, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0xe4-0xe7, refer to Table 8 for the details. 64-bit float point, data of value from 0xdc-0xe3.
ch3_vert_offset	0x104-0x12b	Offset value of CH3, such as 2.48 mV. Unit of value, such as V from 0x110-0x12b, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x10c-0x10f, refer to Table 8 for the details. 64-bit float point, data of value from 0x104-0x10b.
ch4_vert_offset	0x12c-0x153	Offset value of CH4, such as 2.48 mV. Unit of value, such as V from 0x138-0x153, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x134-0x137, refer to Table 8 for the details. 64-bit float point, data of value from 0x12c-0x133.

digital_on	0x154-0x157	on/off status of digital, 1 - ON, 0 - OFF 32-bit integer
d0_d15_on	0x158-0x197	on/off status of d0-d15, 1 - ON, 0 - OFF 32-bit integer d0:0x158-0x15b d8: 0x178-0x17b d1: 0x15c-0x15f d9: 0x17c-0x17f d2: 0x160-0x163 d10: 0x180-0x183 d3: 0x164-0x167 d11: 0x184-0x187 d4: 0x168-0x16b d12: 0x188-0x18b d5: 0x16c-0x16f d13: 0x18c-0x18f d6: 0x170-0x173 d14: 0x190-0x193 d7: 0x174-0x177 d15: 0x194-0x197
time_div	0x198-0x1bf	Time div (time base) value, Such as 2.48 ms/div. Unit of value, such as s from 0x1a3-0x1bf, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x1a0-0x1a3, refer to Table 8 for the details. 64-bit float point, data of value from 0x198-0x19f.
time_delay	0x1c0-0x1e7	Time delay (Trigger delay) value, Such as 2.48 ms. Unit of value, such as s from 0x1cc-0x1e7, refer to Table 9 for the details. Units of value's magnitude (MICRO) from 0x1c8-0x1cb, refer to Table 8 for the details. 64-bit float point, data of value from 0x1c0-0x1c7
wave_length	0x1e8-0x1eb	Wave length of the data points for analog channel. 32-bit integer
Sample_rate	0x1ec-0x213	Sample Rate value for analog channel, Such as 500M Sa/s. Unit of value, such as Sa from 0x1f8-0x213, refer to Table 9 for the details. Units of value's magnitude (MEGA) from 0x1f4-0x1f7, Refer to Table 8 for the details. 64-bit float point, data of value from 0x1ec-0x1f3.

digital_wave_length	0x214-0x217	Wave length of the data points for digital. 32-bit integer
digital_sample_rate	0x208-0x23f	Sample Rate value for digital, Such as 500M Sa/s. Unit of value, such as Sa from 0x214-0x23f, refer to Table 9 for the details. Units of value's magnitude (MEGA) from 0x210-0x213, Refer to Table 8 for the details. 64-bit float point, data of value from 0x208-0x20f.
ch1_probe	0x240-0x247	Probe value of CH1,64-bit float point
ch2_probe	0x248-0x24f	Probe value of CH2,64-bit float point
ch3_probe	0x250-0x257	Probe value of CH3,64-bit float point
ch4_probe	0x258-0x25f	Probe value of CH4,64-bit float point
Date width	0x260	Data width of the waveform data, 0 – 8-bit, 1 – 16-bit, 8-bit unsigned integer
reserved	0x261~	reserved
…	…	…
reserved	~0x7ff	reserved
Wave_data	0x800-end	Data from CH1 to D15. Only data of the enabled channel(s) are stored to the file. I.E. If there are data of all channels(Ch1 to D15), wave_length from 0x1e8-0x1eb is

		700(0x2bc).,and data width from 0x260 is 0(8-bit). Data of CH1 is from 0x800 to 0xabb. Data of CH2 is from 0xabc to 0xd77. CH3 and CH4 are the same. Next block is the data of D0. The data length (digital_wave_length) from 0x214-0x217 is 1400. Data of D0 is from 0x12f0 to 0x1867. D1~D15 are the same.

Table 8 Magnitude Table

Index	Magnitude	Index	Magnitude
0	YOCTO	9	KILO
1	ZEPTO	10	MEGA
2	ATTO	11	GIGA
3	FEMTO	12	TERA
4	PICO	13	PETA
5	NANO	14	EXA
6	MICRO	15	ZETTA
7	MILLI	16	YOTTA
8	IU		

Table 9 Units Table

First 32-bit is basic unit type:

Index	Unit	Index	Unit
0	Is composed of V,A and S.	8	DT_DIV
1	DBV	9	PTS
2	DBA	10	NULL_SENSE
3	DB	11	DEGREE
4	VPP	12	PERCENT
5	VDC		
6	DBM		
7	SA		

The next 64-bit describes the power of V, in which the first half represents the numerator and the next half represents the denominator.

The next 64-bit describes the power of A, in which the first half represents the numerator and the next half represents the denominator.

The next 64-bit describes the power of S, in which the first half represents the numerator and the next half represents the denominator.

For example,{0,1,1,0,1,0,1} represents the unit V. The first number 0 means the unit is composed of V,A and S. The second number 1 and the third number 1 mean the power of V is 1/1. The fourth number 0 and the fifth number 1 mean the power of A is 0/1. The sixth number 0 and

the seventh number 1 mean the power of S is 0/1.So the unit is V.

Convert the Data to Voltage

voltage = (data-128) * ch_volt_div_val /1000/code_per_div + ch_vert_offset

[example]
code_per_div = 25 # total data code in a horizontal division, on SDS1000X is 25
data = 194 # got from the binary file
ch_volt_div_val = 5000 mV/div # V/div, in units of mV
ch_vert_offset = -7.7 V # vertical offset

So:
voltage = (194-128) * 5000/1000/25+(-7.7) = 5.5 V

Calculate the Time Value of the Data

time value(S) = -(time_div *grid /2)+index*(1/ Sample_rate)

[example]
grid = 14 # The grid numbers in horizontal direction
time_div = 2 us # s/div, in units of us
Sample_rate = 1 GSa/s # Sa/s, in units of GSa/s

So:
The time value of the first point: -(2e-6*14/2)+0*(1/1e9) = -14e-6 s.
The time value of the second point: -(2e-6*14/2)+1*(1/1e9) = -14.001e-6 s.

*.mlg File of Measure Logger

Table 10 Format of the Measure Logger File

Parameter	Address	Description
file_type	0x00-0x07	Type of the file, the value is always “MSLG”. Array of 8 char.
file_version	0x08-0x0b	Version number of the file. 32-bit unsigned integer. 0: V1.0
model_number	0x0c-0x2b	Model number of the product. Array of 32 char.

<table>
<tr><td>serial_number</td><td>0x2c-0x4b</td><td>Serial number of the product.
Array of 32 char.</td></tr>
<tr><td>software_version</td><td>0x4c-0x6b</td><td>Version of the software.
Array of 32 char.</td></tr>
<tr><td>start_time</td><td>0x6c-0x87</td><td>Start time of logging.
Array of 7 32-bit unsigned integer.<table><tr><td>Index</td><td>Element</td></tr><tr><td>0</td><td>Year</td></tr><tr><td>1</td><td>Mouth</td></tr><tr><td>2</td><td>Day</td></tr><tr><td>3</td><td>Hour</td></tr><tr><td>4</td><td>Minute</td></tr><tr><td>5</td><td>Second</td></tr><tr><td>6</td><td>Millisecond</td></tr></table></td></tr>
<tr><td>stop_time</td><td>0x88-0xa3</td><td>Stop time of logging.
Array of 7 32-bit unsigned integer.<table><tr><td>Index</td><td>Element</td></tr><tr><td>0</td><td>Year</td></tr><tr><td>1</td><td>Mouth</td></tr><tr><td>2</td><td>Day</td></tr><tr><td>3</td><td>Hour</td></tr><tr><td>4</td><td>Minute</td></tr><tr><td>5</td><td>Second</td></tr><tr><td>6</td><td>Millisecond</td></tr></table></td></tr>
<tr><td>log_interval_ms</td><td>0xa4-0xa7</td><td>Logging interval in milliseconds.
32-bit unsigned integer.</td></tr>
<tr><td>points_number</td><td>0xa8-0xab</td><td>Points per trace.
32-bit unsigned integer.</td></tr>
<tr><td>traces_number</td><td>0xac-0xaf</td><td>Number of enabled traces.
32-bit unsigned integer.</td></tr>
<tr><td>traces_switch</td><td>0xb0-0xcf</td><td>Trace switch status.
Array of 8 32-bit unsigned integer.
0: OFF
1: ON</td></tr>
<tr><td>source</td><td>0xd0-0xef</td><td>Source of log.
Array of 8 32-bit unsigned integer.
0: Measure
1: Meter</td></tr>
<tr><td>measure_source_A</td><td>0xf0-0x10f</td><td>The first source of measurement.
Array of 8 32-bit unsigned integer.
Only for the measure logger on scope to recall, refer to the parameter “measure_source_A_string” for details.</td></tr>
</table>

<table>
<tr><td>measure_source_B</td><td>0x110-0x12f</td><td>The second source of measurement.
Array of 8 32-bit unsigned integer.
Only for the measure logger on scope to recall, refer to the parameter “measure_source_B_string” for details.</td></tr>
<tr><td>measure_type</td><td>0x130-0x14f</td><td>Type of measurement.
Array of 8 32-bit unsigned integer.
Only for the measure logger on scope to recall, refer to the parameter “measure_type_string” for details.</td></tr>
<tr><td>unit_type</td><td>0x150-0x16f</td><td>Unit.
Array of 8 32-bit unsigned integer.
Only for the measure logger on scope to recall, refer to the parameter “unit_string” for details.</td></tr>
<tr><td>precision</td><td>0x170-0x18f</td><td>Precision of data.
Array of 8 32-bit signed integer.
Only for the measure logger on scope to recall.</td></tr>
<tr><td>precision_type</td><td>0x190-0x1af</td><td>Type of precision.
Array of 8 32-bit unsigned integer.
Only for the measure logger on scope to recall.</td></tr>
<tr><td>source_string</td><td>0x1b0-0x1ef</td><td>Source of log.
Array of 8 arrays of 8 char.</td></tr>
<tr><td>measure_source_A_string</td><td>0x1f0-0x22f</td><td>The first source of measurement.
Array of 8 arrays of 8 char.</td></tr>
<tr><td>measure_source_B_string</td><td>0x230-0x26f</td><td>The second source of measurement.
Array of 8 arrays of 8 char.</td></tr>
<tr><td>measure_type_string</td><td>0x270-0x2ef</td><td>Type of measurement.
Array of 8 arrays of 16 char.</td></tr>
<tr><td>unit_string</td><td>0x2f0-0x32f</td><td>Unit.
Array of 8 arrays of 8 char.</td></tr>
<tr><td>Reserved.</td><td>0x330-0x7cf</td><td>Reserved.</td></tr>
<tr><td>Data</td><td>0x7d0-End</td><td>Log data. Array of 32-bit float.
Example:
Status of traces:
<table>
<tr><td>Trace1</td><td>Trace2</td><td>Trace3</td><td>Trace4</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
</table>
Data:
<table>
<tr><td>Index</td><td>Data</td></tr>
<tr><td>0 (Offset = 0x7d0)</td><td>Trace2_data[0]</td></tr>
<tr><td>1</td><td>Trace4_data[0]</td></tr>
<tr><td>2</td><td>Trace2_data[1]</td></tr>
<tr><td>3</td><td>Trace4_data[1]</td></tr>
</table></td></tr>
</table>

		4	Trace2_data[2]
		5	Trace4_data[2]
		.....	.....

*.slg File of Sample logger

Table 11 Format of the Sample Logger File.

Parameter	Address	Description
product_info	0x00-0x7f	Product information. See the Table 12 Format of Product Information. (Base offset = 0x00) for details.
record_info	0x80-0x17f	Record information. See the Table 13 Format of Record Information. (Base offset = 0x80)
Reserved	0x180-0x27f	Reserved.
ch_1_info	0x280-0x37f	Channel 1 information. See the Table 14 Format of Channel Information
ch_2_info	0x380-0x47f	Channel 2 information.
ch_3_info	0x480-0x57f	Channel 3 information.
ch_4_info	0x580-0x67f	Channel 4 information.
Reserved	0x680-0x1000fff	Reserved.
Data	0x1001000-End	Due to memory limitation, data is written by sector, see the Table 15 Format of Sector Information.

Table 12 Format of Product Information. (Base offset = 0x00)

Parameter	Offset	Description
file_type	0x00-0x07	Type of file. Array of 8 char. The value is always “SPLG”.
file_version	0x08-0x0b	Version number of the file. 0: V1.0
model_number	0x0c-0x2b	Model number of the product. Array of 32 char.
serial_number	0x2c-0x4b	Serial number of the product. Array of 32 char.
software_version	0x4c-0x6b	Version of the software. Array of 32 char.
Reserved	0x6c-0x7f	Reserved.

Table 13 Format of Record Information. (Base offset = 0x80)

<table>
<tr><th>Parameter</th><th>Offset</th><th>Description</th></tr>
<tr><td>enable_ch_num</td><td>0x00-0x03</td><td>Number of enabled channels.
32-bit unsigned integer.</td></tr>
<tr><td>sector_num</td><td>0x04-0x07</td><td>Number of sectors per channel.
32-bit unsigned integer.</td></tr>
<tr><td>tdiv_value</td><td>0x08-0x0f</td><td>Timebase when log start. (s/div)
64-bit double precision floating point.</td></tr>
<tr><td>sample_rate</td><td>0x10-0x17</td><td>Sample rate. (Sa/s)
64-bit double precision floating point.</td></tr>
<tr><td>record_time</td><td>0x18-0x1f</td><td>Recorded time in second.
64-bit double precision floating point.</td></tr>
<tr><td>points_number</td><td>0x20-0x27</td><td>Number of data points per channel.
64-bit unsigned integer.</td></tr>
<tr><td>start_sector_offset</td><td>0x28-0x2f</td><td>File offset of the first sector.
64-bit unsigned integer.</td></tr>
<tr><td>end_sector_offset</td><td>0x30-0x37</td><td>File offset of the last sector.
64-bit unsigned integer.</td></tr>
<tr><td>start_data_offset</td><td>0x38-0x3f</td><td>The start offset of the data area.
64-bit unsigned integer.</td></tr>
<tr><td>end_data_offset</td><td>0x40-0x47</td><td>The end offset of the data area.
64-bit unsigned integer.</td></tr>
<tr><td>data_bit_index</td><td>0x48-0x4b</td><td>Bits number of data.
32-bit unsigned integer.
8: 8-bit 11: 11-bit 14: 14-bit
9: 9-bit 12: 12-bit 15: 15-bit
10: 10-bit 13: 13-bit 16: 16-bit</td></tr>
<tr><td>start_time</td><td>0x4c-0x67</td><td>Start time of logging.
Array of 7 32-bit unsigned integer.<table><tr><td>Index</td><td>Element</td></tr><tr><td>0</td><td>Year</td></tr><tr><td>1</td><td>Mouth</td></tr><tr><td>2</td><td>Day</td></tr><tr><td>3</td><td>Hour</td></tr><tr><td>4</td><td>Minute</td></tr><tr><td>5</td><td>Second</td></tr><tr><td>6</td><td>Millisecond</td></tr></table></td></tr>
<tr><td>Reserved</td><td>0x68-0xff</td><td>Reserved.</td></tr>
</table>

Table 14 Format of Channel Information

(Base offset: CH1 = 0x280, CH2 = 0x380, CH3 = 0x480, CH4 = 0x580)

Parameter	Offset	Description
ch_act	0x00-0x03	Switch status of channel. 32-bit unsigned integer.

		0: OFF 1: ON
probe_index	0x04-0x07	Probe value index of channel. 32-bit unsigned integer.
probe_custom_val	0x08-0x0f	Custom configured probe of channel. 64-bit double precision floating point
vdiv_val	0x10-0x17	V/div value of channel. 64-bit double precision floating point.
vpos_val	0x18-0x1f	Offset value of channel. 64-bit double precision floating point.
value_per_adc_code	0x20-0x27	Vertical value per ADC code. 64-bit double precision floating point.
zero_adc_code	0x28-0x2b	Reference code of value zero. 32-bit unsigned integer.
unit_index	0x2c-0x2f	Type of channel unit. 32-bit unsigned integer. 0: V 1: A
unit_string	0x30-0x37	Unit of channel. Array of 8 char.
Reserved	0x38-0xff	Reserved.

Table 15 Format of Sector Information

Parameter	Offset	Description
sector_index	0x00-0x07	Sector index. 64-bit unsigned integer.
data_index_start	0x08-0x0f	Data index of the first data in current sector. 64-bit unsigned integer.
data_index_end	0x10-0x17	Data index of the last data in current sector. 64-bit unsigned integer.
data_num	0x18-0x1f	Number of data in current sector. 64-bit unsigned integer.
ch	0x20-0x23	Channel. 32-bit unsigned integer.
Reserved	0x24-0x3b	Reserved.
Data	0x3c-0x9ff	Waveform data. 8-bit or 16-bit unsinged integer. 2500 points per sector.

Example:

```
ch_act[0] = OFF          #Channel 1 is off.
ch_act[1] = ON           #Channel 2 is on.
ch_act[2] = OFF          #Channel 3 is off.
```

ch_act[3] = ON #Channel 4 is on.

data_bit_index = 8 #8bit per point. So the size of sector is 2560 bytes.

start_sector_offset = 0x1001000

points_number = 3000 #2500 points are in the first sector, and the other 500 points are in the second sector. The left space in the second sector will be filled with zero.

So the file structure is shown in Figure 1.

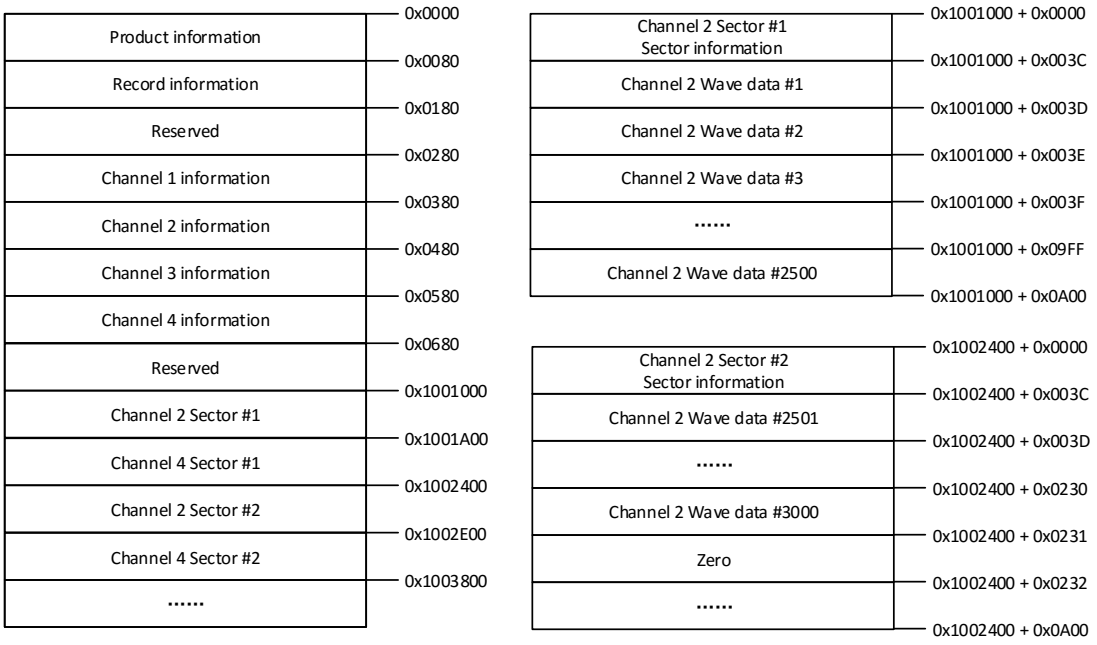

Figure 1 Example for Sample Logger File Structure

Convert the Data to Voltage

$$\text{voltage} = (\text{data} - \text{zero\_adc\_code}) \cdot \text{value\_per\_adc\_code} - \text{vpos\_val}$$

Example:

unit_string = “V”

data = 145

zero_adc_code = 128

value_per_adc_code = 0.04 V

vpos_val = -1.0 V

So:

$$\text{voltage} = (145 - 128) \times 0.04 - (-1.0) = 1.68\ \text{V}$$

Calculate the Time Value of Data

$$\text{time\_value} = \text{data\_index}/\text{sample\_rate}$$

Where:

$$\text{data\_index} = \text{sector\_index} \cdot 2500 + \text{data\_index\_in\_sector}$$

Example:

sector_index = 10

data_index_in_sector = 8

sample_rate = 25000 Sa/s

So:

$$\text{data\_index} = 10 \times 2500 + 8 = 25008$$

$$\text{time\_value} = 25008 \div 25000 = 1.00032\ \text{s}$$