Name :	(1)Saisao Kham (2)Haoru Xie
Assignment:	Experiment 2 report
Lab session:	Friday
Instructor:	Dr. Liu
Due Date	9/24/2016

“This report is prepared by **Saisao Kham**, who is the first author and prepared the original draft of the report, and **Haoru Xie**, who is the second author and revised the report.”

Scoring Sheet

Cover and Score Sheet

Experiment 2 - RC Filters and Diodes

Author: SAISAO KHAM Partner: Haoru Xie

Score

Item	Credit	Score
Data	3	
Low Pass Filter		
Circuit Diagram With Values of Components		
Measured and Fitted Frequency Plot; -3dB Point		
Transient, Time Response		
High Pass Filter		
Circuit Diagram With Values of Components		
Measured and Fitted Frequency Plot; -3dB Point		
Transient, Time Response		
Diode		
IV Plot		
Curve Fitting; I_S, η		
Transient Response With Delay Time		
Conclusion	1	
Total	4	

TA Signature: [illegible] Date: 9/16/16

Note: **Saisao Kham EE312** has the different form of Score sheet and failed to attach because of technical issue(scanner/photo)

Abstract

Design, build, and characterize the first-order RC filters. Learn characteristics of diodes. Practice how to use instruments to measure frequency dependence, transient response, and how to perform data analysis and curve fitting. Filter design is quite simple. Consider a low pass filter with f_0 = 20 kHz. There are two components, R and C. To prevent excessive loading to the signal source, we will be using the resistance in the kΩ range. A specific value of capacitance in the right order of magnitude can be chosen according to the collection of capacitors available on hand, e.g., C = 2.2 nF. Since $2\pi f_0 = 1/RC = 1.25\text{x}10^5$, R = 3.6 kΩ. In putting the circuit together, you can use a standard resistor with a resistance of 3.1 kΩ which is a reasonably close match. You can add a 470 Ω resistor in series.For example, we can use a 10-kΩ potentiometer and adjust it to get the exact resistance. Of course, there are many combinations of R and C to accomplish the design goal. Use resistors in the kΩ range so that you won't load down the output of the function generator.

Introduction

In this experiment 3, we will be introduced to RC circuit, Diode. We will alo learn high pass and low pass filters of RC circuit.

Procedures

For RC circuit, we will use the formula of f = 1/(2 pi RC) to get high pass and low pass filter waveforms with f= 20 kHz for lowpass and f = 20 Hz for highpass.

For sinusoidal ac signals, the amplitude attenuation and the phase shift of R · C filters can be modeled in the frequency domain by using the complex impedance of capacitor: where $\omega_0 = 1/(R \cdot C)$. It is the angular frequency, $2\pi f_0$, at which the amplitude of the output voltage is reduced by a factor of 1/√2 or 70.7%. Since the power is proportional to voltage square, the power is reduced to 1/2 or 50%. For signal throughput, we often use the log scale. Decibel or dB is defined as 10 x log (P_{out}/P_{in}). When the throughput drops to 50%, it is -3 dB from its maximum. Therefore, f_0 is called the -3 dB cutoff point of the low pass filter. The cutoff frequency of a low pass filter usually occurs at high frequency. Likewise, for the high pass filter where $j = -1$. R · C filters can be treated as voltage dividers.

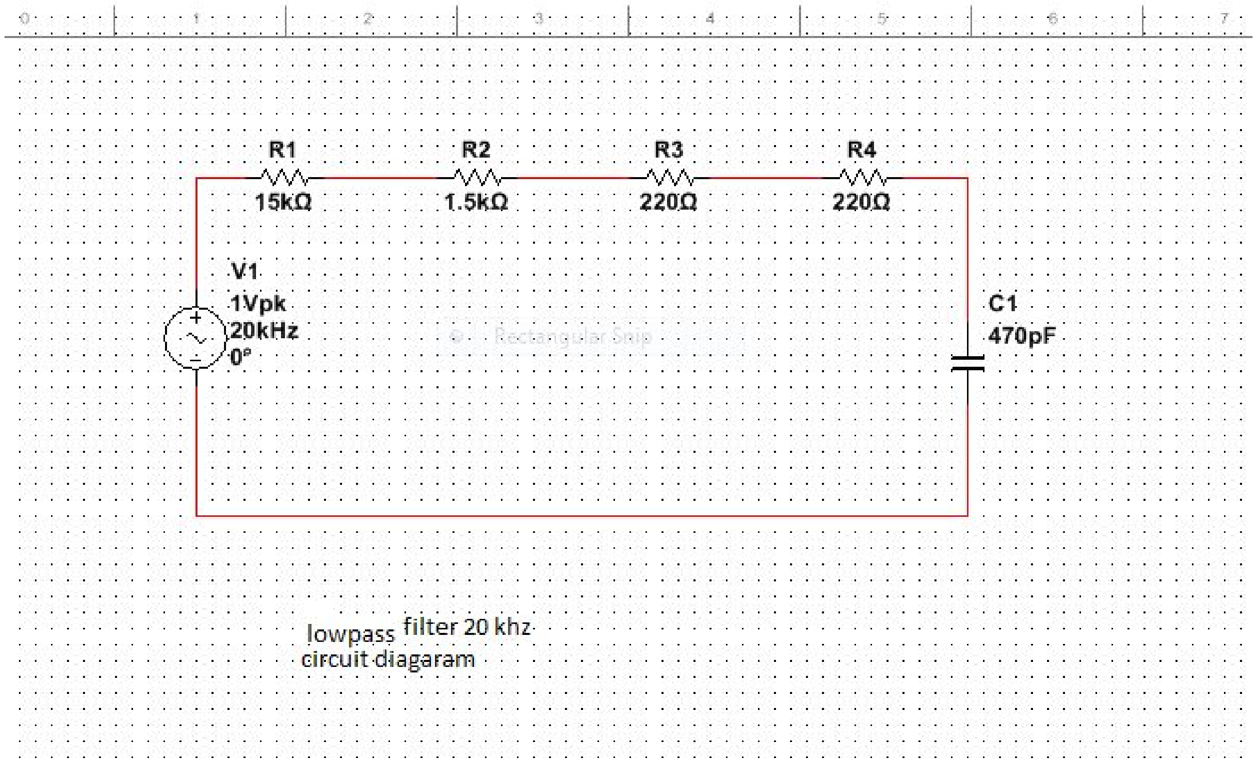
Again, ω_0 equals $1/(R \cdot C)$. It is the angular frequency at which the output voltage is reduced to 70.7%. The cutoff frequency of a high pass filter usually occurs at low frequency. The frequency response of low pass and high pass filters are shown in Fig. 2. There is a roll off at high frequency for the low pass filter and a roll off at low frequency for the high pass filters, respectively.

Data Analysis and Interpretation

Data, Waveforms, Curve Fitting, Analysis

Low Pass RC Filter -

Circuit diagram:



Note: Due to technical issue, we couldn't add ground sign between Voltage source and C1.

Using the function: f=1/(2piRC)

As f=20kHz we using C=10pf

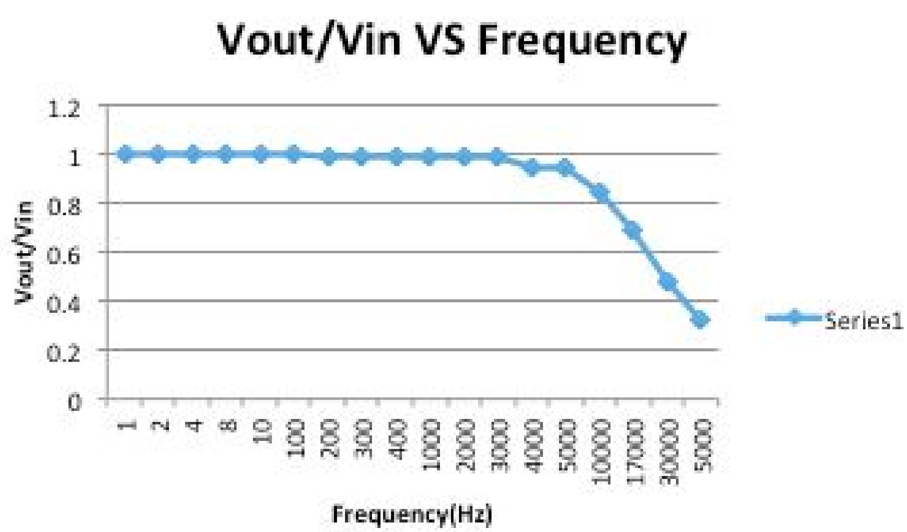
Ge te the R should be 16940 ohm

So using 15k ohm+1.5k ohm+220 ohm+220 ohm

Frequency response (Bode plot)

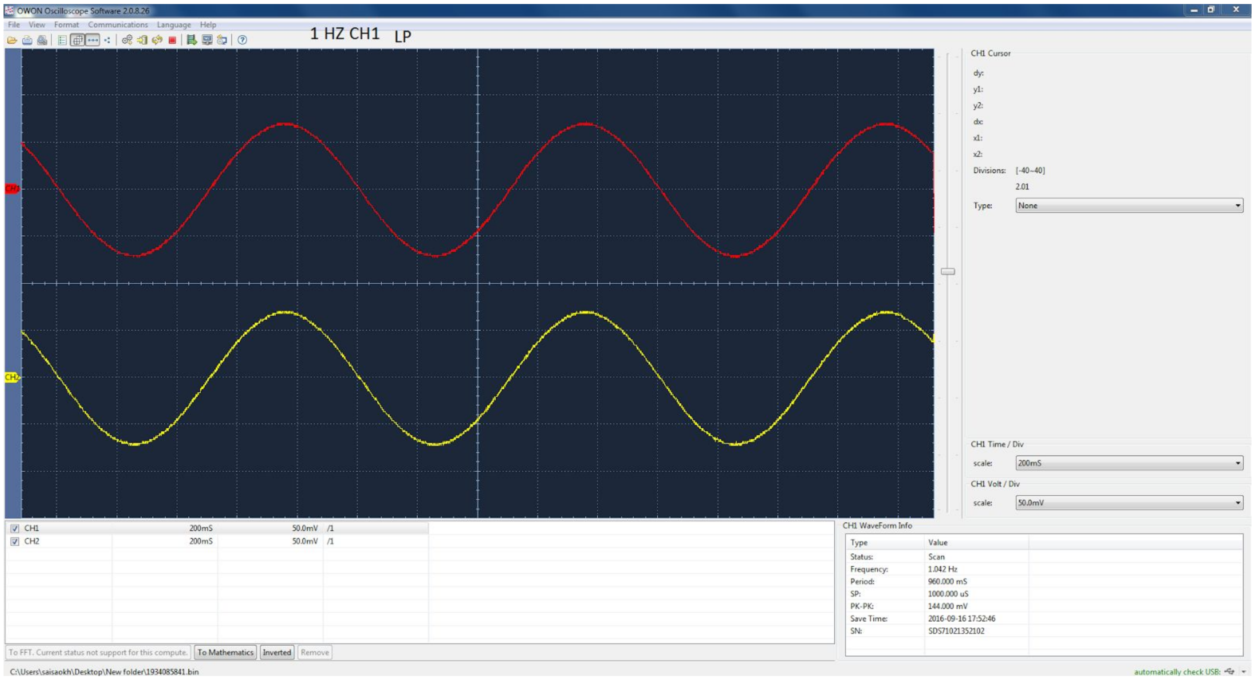
#(x,y) plot on excel goes here. (Bode Plot -Ouptput Voltage/input Voltage (V) vs Frequency (Hz)(Low Pass Filter) as in Example -Summary on UBLearn

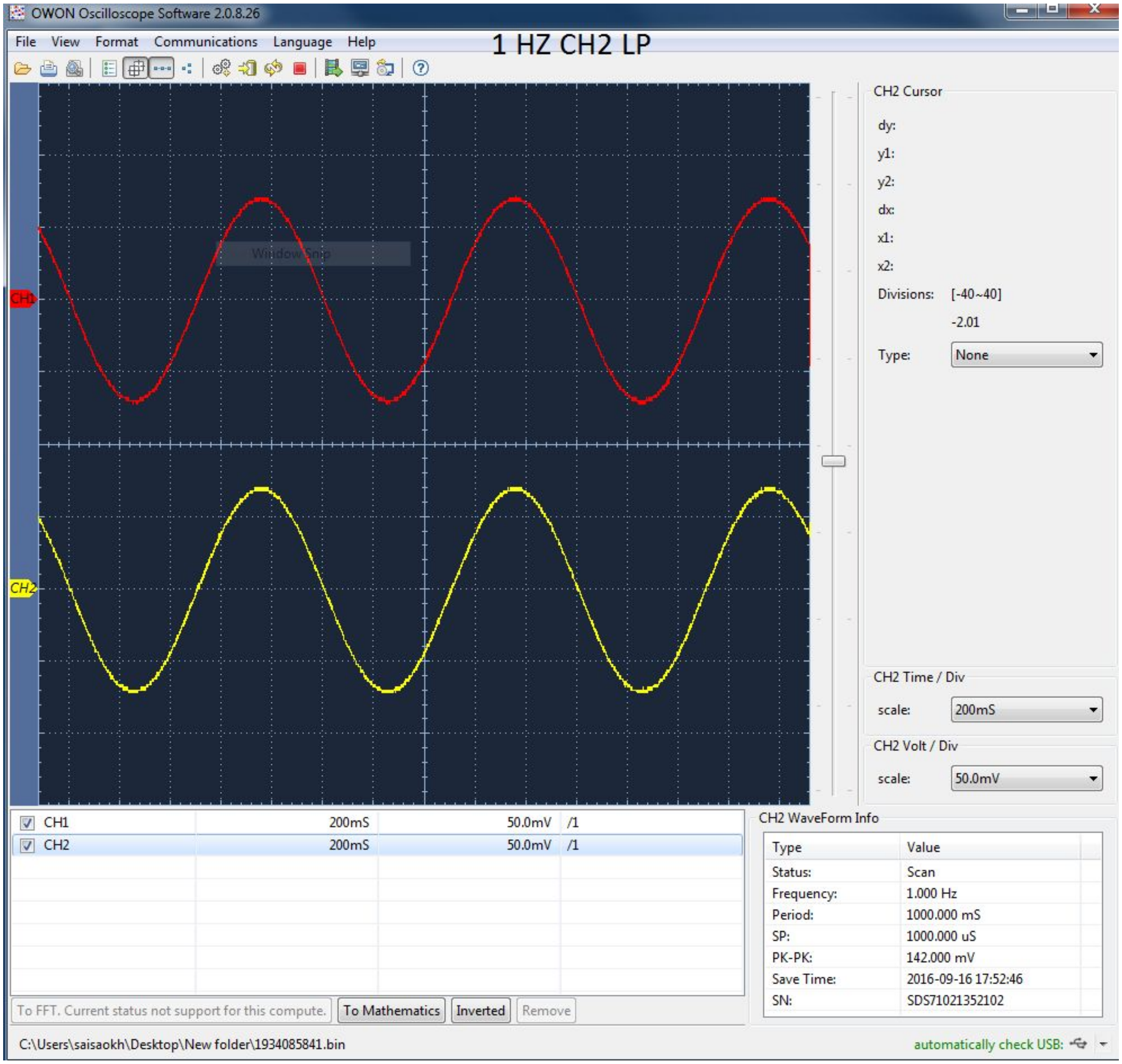
Frequency	Vout/Vin		vout	vin
1	1		0.142	0.142
2	1		0.272	0.272
4	1		0.4	0.4
8	1		0.51	0.51
10	1		0.51	0.51
100	1		1.02	1.02
200	0.981		1.02	1.04
300	0.981		1.02	1.04
400	0.981		1.02	1.04
1000	0.981		1.02	1.04
2000	0.981		1.02	1.04
3000	0.981		1.02	1.04
4000	0.942		0.98	1.04
5000	0.942		0.98	1.04
10000	0.846		0.88	1.04
17000	0.692		0.72	1.04
30000	0.48		0.5	1.04
5000	0.32		0.34	1.04

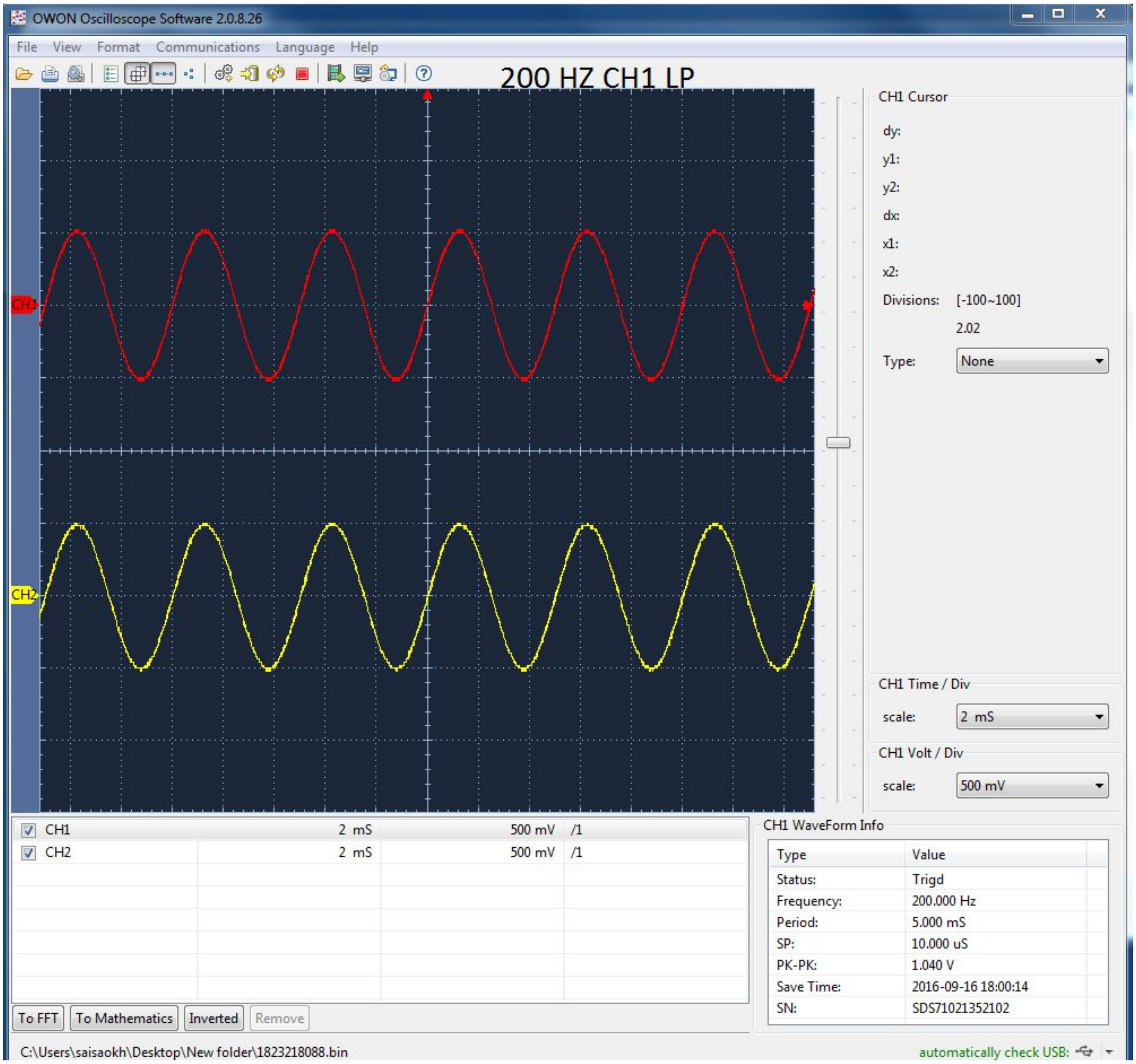


-3dB frequency**:** Designed 20 kHz; Measured waveforms of lowpass input and output i.e 1 Hz, 200 Hz, 2 khz, 5 khz, 17 kHz, 50 kHz, 5 kHz and square waveform as in step5 lab description.

Waveforms showing a phase shift of 45-degrees at -3dB frequency


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
1 HZ CH1 LP
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-40~40]
2.01
Type: None
CH1 Time / Div
scale: 200mS
CH1 Volt / Div
scale: 50.0mV
CH1 200mS 50.0mV /1
CH2 200mS 50.0mV /1
To FFT. Current status not support for this compute.
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Scan
Frequency: 1.042 Hz
Period: 960.000 mS
SP: 1000.000 uS
PK-PK: 144.000 mV
Save Time: 2016-09-16 17:52:46
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1934085841.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
1 HZ CH2 LP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-40~40]
-2.01
Type: None
CH2 Time / Div
scale: 200mS
CH2 Volt / Div
scale: 50.0mV
CH1 200mS 50.0mV /1
CH2 200mS 50.0mV /1
To FFT. Current status not support for this compute.
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Scan
Frequency: 1.000 Hz
Period: 1000.000 mS
SP: 1000.000 uS
PK-PK: 142.000 mV
Save Time: 2016-09-16 17:52:46
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1934085841.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
200 HZ CH1 LP
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 2 mS
CH1 Volt / Div
scale: 500 mV
CH1 2 mS 500 mV /1
CH2 2 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 200.000 Hz
Period: 5.000 mS
SP: 10.000 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 18:00:14
SN: SDS71021352102
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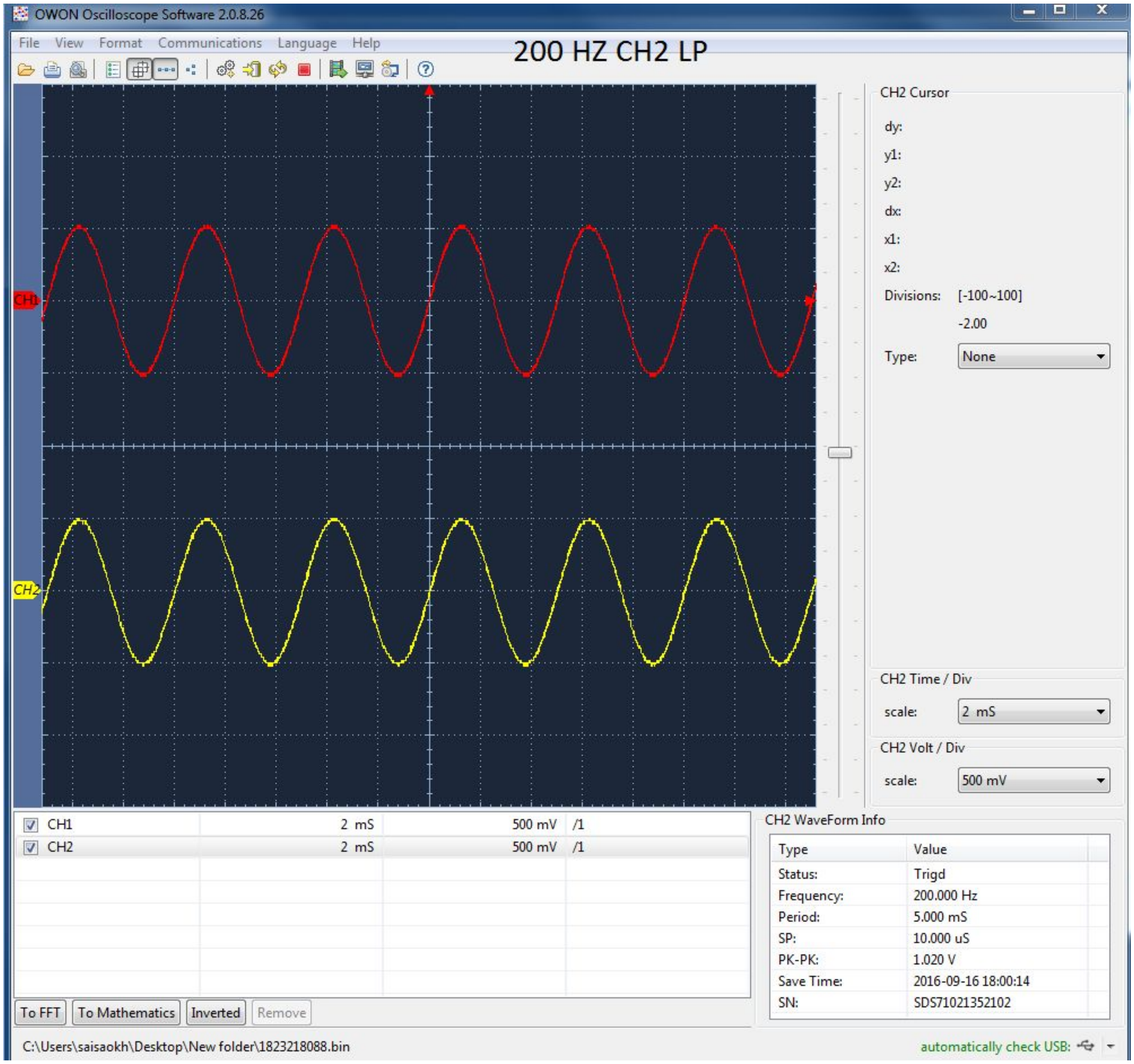
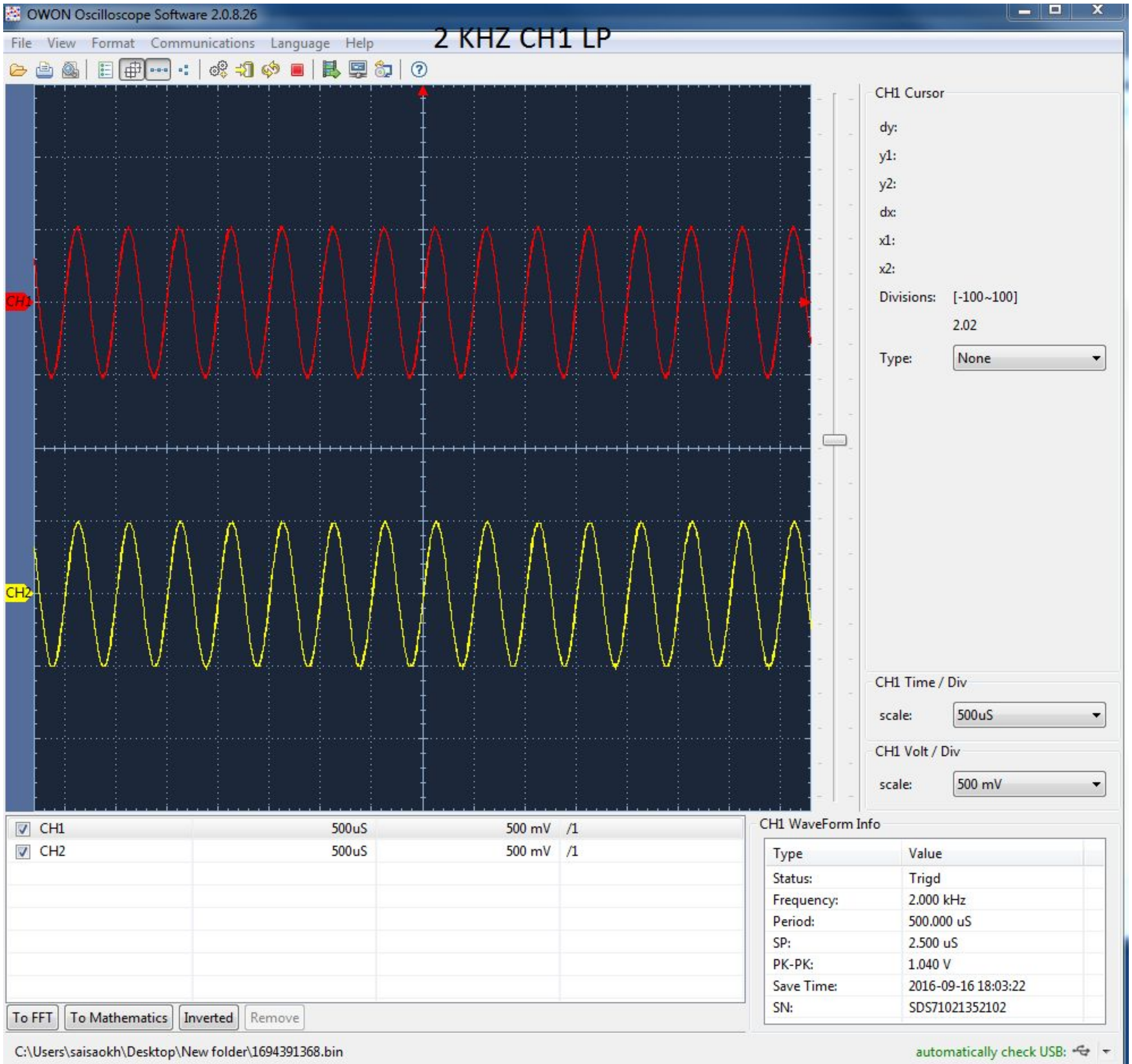
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
200 HZ CH2 LP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 2 mS
CH2 Volt / Div
scale: 500 mV
CH1 2 mS 500 mV /1
CH2 2 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 200.000 Hz
Period: 5.000 mS
SP: 10.000 uS
PK-PK: 1.020 V
Save Time: 2016-09-16 18:00:14
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1823218088.bin
automatically check USB:



OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
2 KHZ CH1 LP
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 500uS
CH1 Volt / Div
scale: 500 mV
CH1 500uS 500 mV /1
CH2 500uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 2.000 kHz
Period: 500.000 uS
SP: 2.500 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 18:03:22
SN: SDS71021352102
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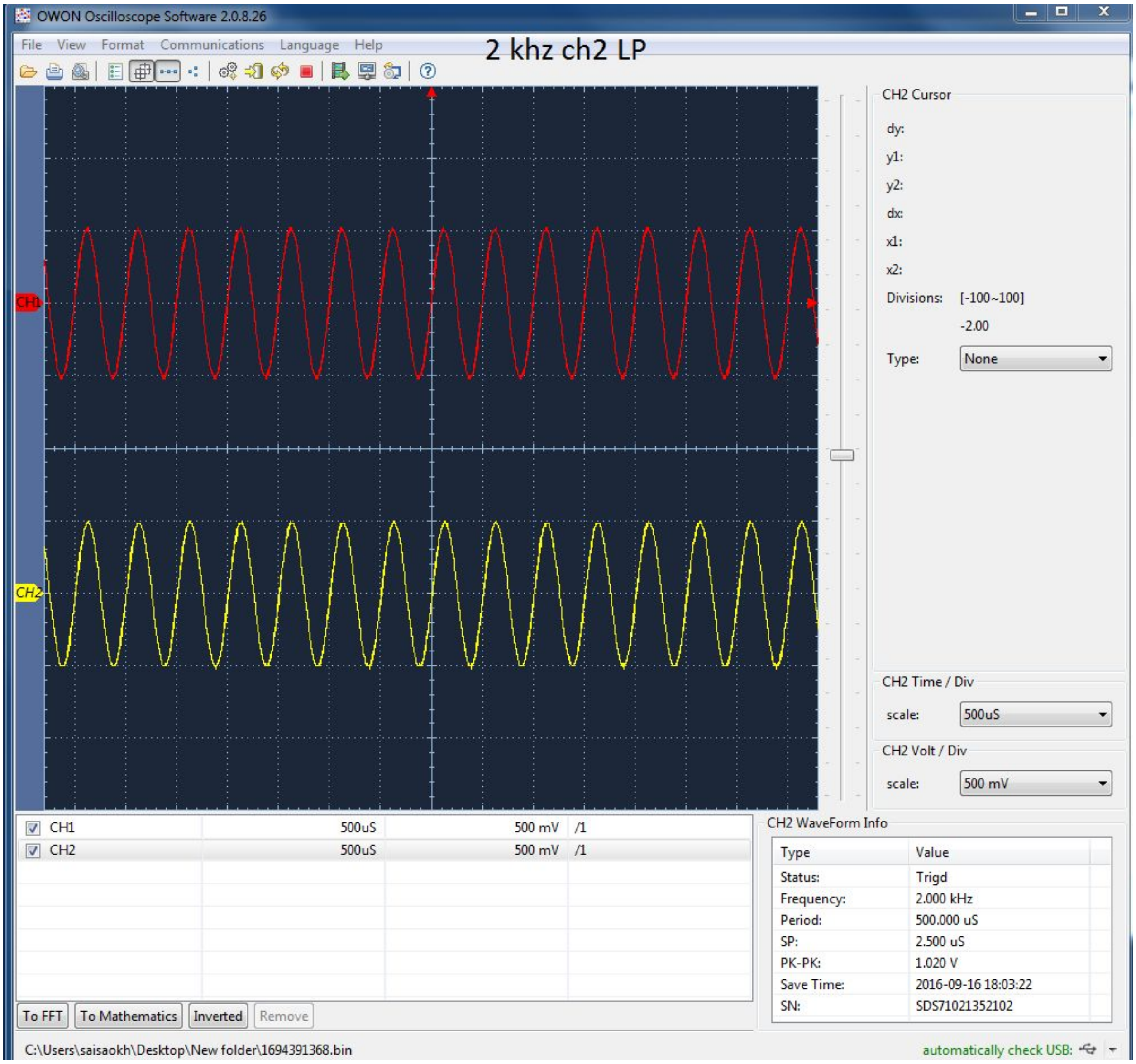
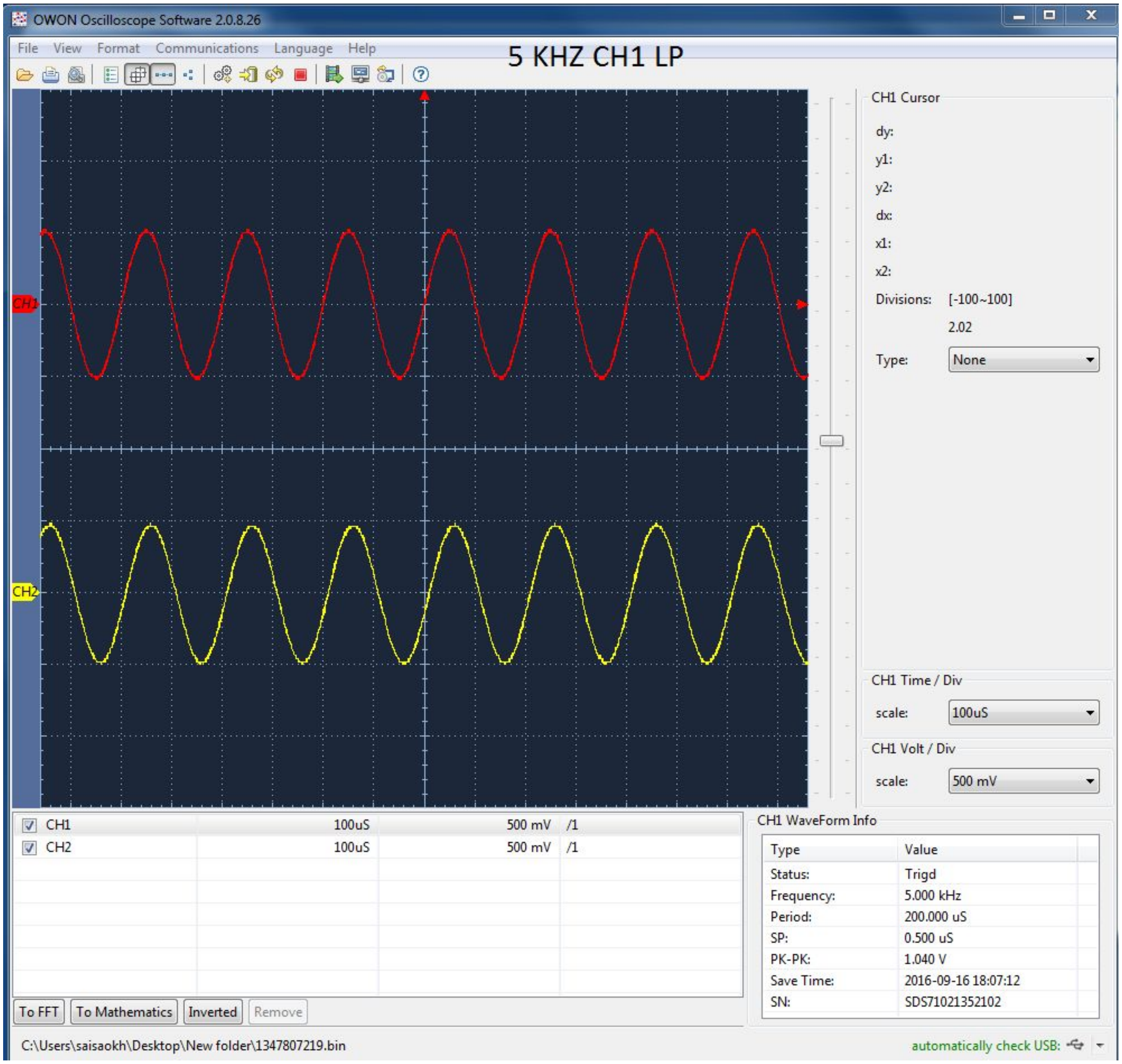
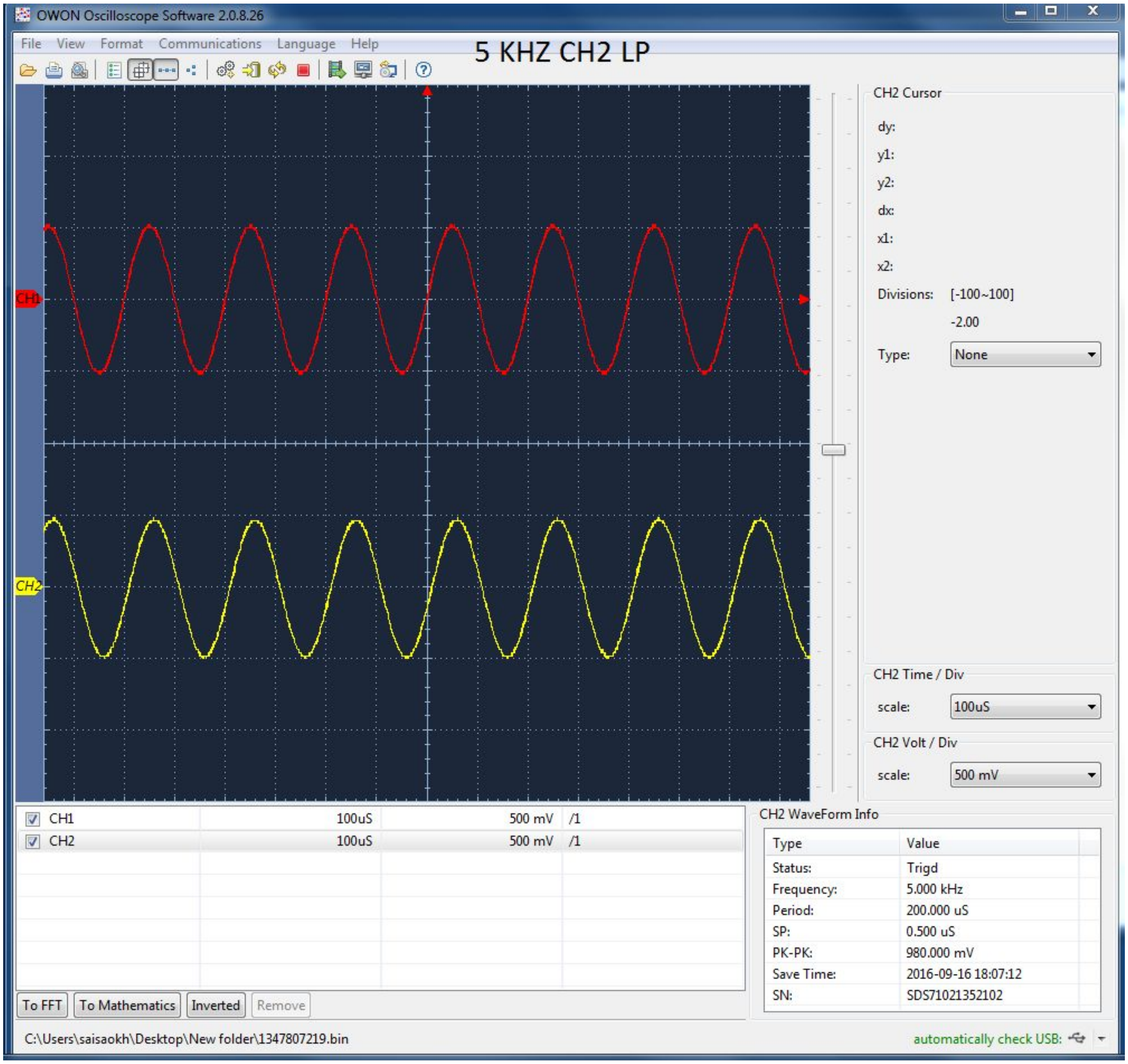
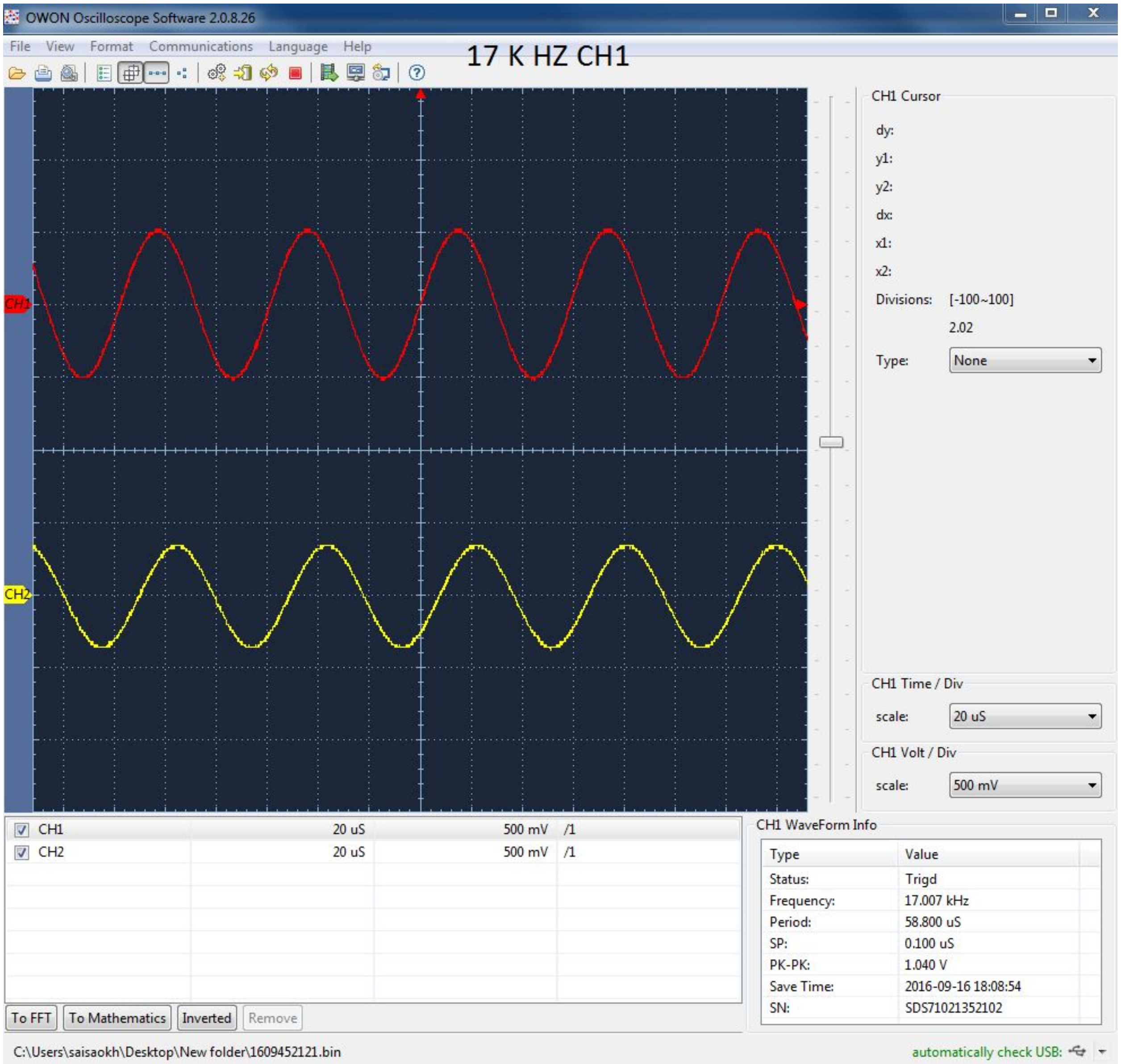
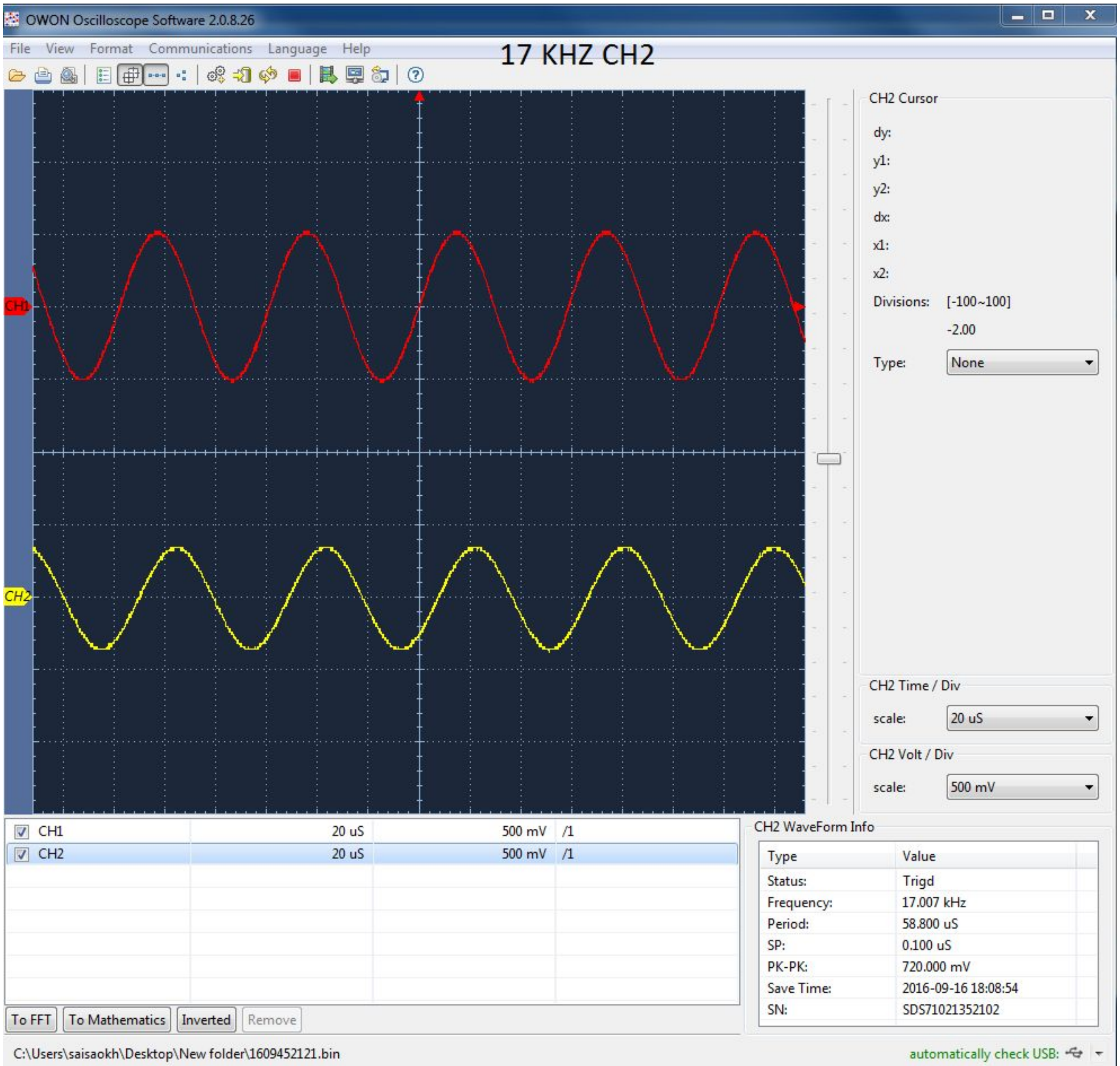
automatically check USB:

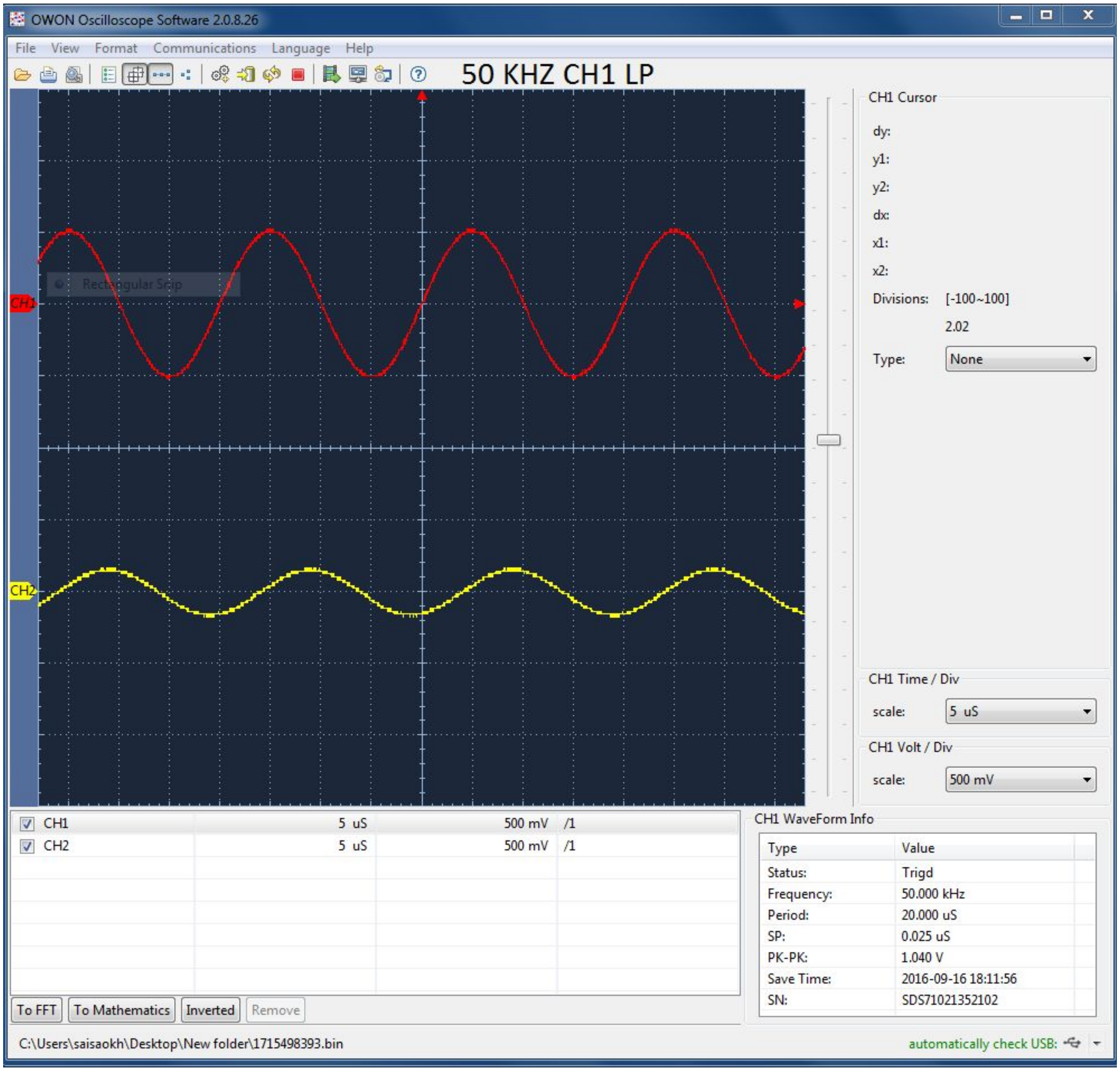

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
2 khz ch2 LP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 500uS
CH2 Volt / Div
scale: 500 mV
CH1 500uS 500 mV /1
CH2 500uS 500 mV /1
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 2.000 kHz
Period: 500.000 uS
SP: 2.500 uS
PK-PK: 1.020 V
Save Time: 2016-09-16 18:03:22
SN: SDS71021352102
To FFT
To Mathematics
Inverted
Remove
C:\Users\saisaokh\Desktop\New folder\1694391368.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
5 KHZ CH1 LP
CH1
CH2
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 100uS
CH1 Volt / Div
scale: 500 mV
CH1 100uS 500 mV /1
CH2 100uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 5.000 kHz
Period: 200.000 uS
SP: 0.500 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 18:07:12
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1347807219.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
5 KHZ CH2 LP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 100uS
CH2 Volt / Div
scale: 500 mV
CH1 100uS 500 mV /1
CH2 100uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 5.000 kHz
Period: 200.000 uS
SP: 0.500 uS
PK-PK: 980.000 mV
Save Time: 2016-09-16 18:07:12
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1347807219.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
17 K HZ CH1
CH1
CH2
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 20 uS
CH1 Volt / Div
scale: 500 mV
CH1 20 uS 500 mV /1
CH2 20 uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 17.007 kHz
Period: 58.800 uS
SP: 0.100 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 18:08:54
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1609452121.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
17 KHZ CH2
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 20 uS
CH2 Volt / Div
scale: 500 mV
CH1 20 uS 500 mV /1
CH2 20 uS 500 mV /1
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 17.007 kHz
Period: 58.800 uS
SP: 0.100 uS
PK-PK: 720.000 mV
Save Time: 2016-09-16 18:08:54
SN: SDS71021352102
To FFT
To Mathematics
Inverted
Remove
C:\Users\saisaokh\Desktop\New folder\1609452121.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
50 KHZ CH1 LP
CH1
CH2
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 5 uS
CH1 Volt / Div
scale: 500 mV
CH1 5 uS 500 mV /1
CH2 5 uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 50.000 kHz
Period: 20.000 uS
SP: 0.025 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 18:11:56
SN: SDS71021352102
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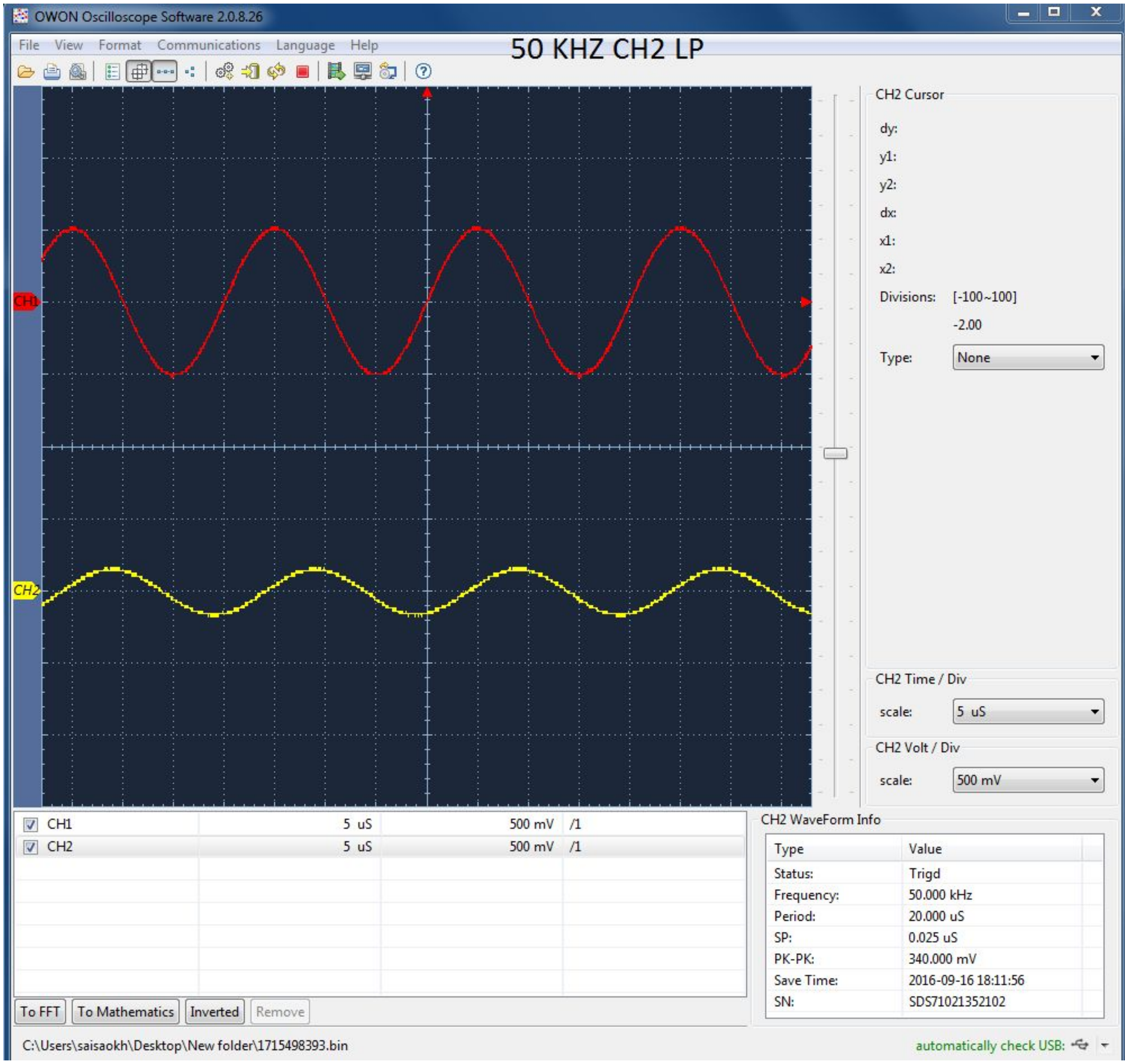
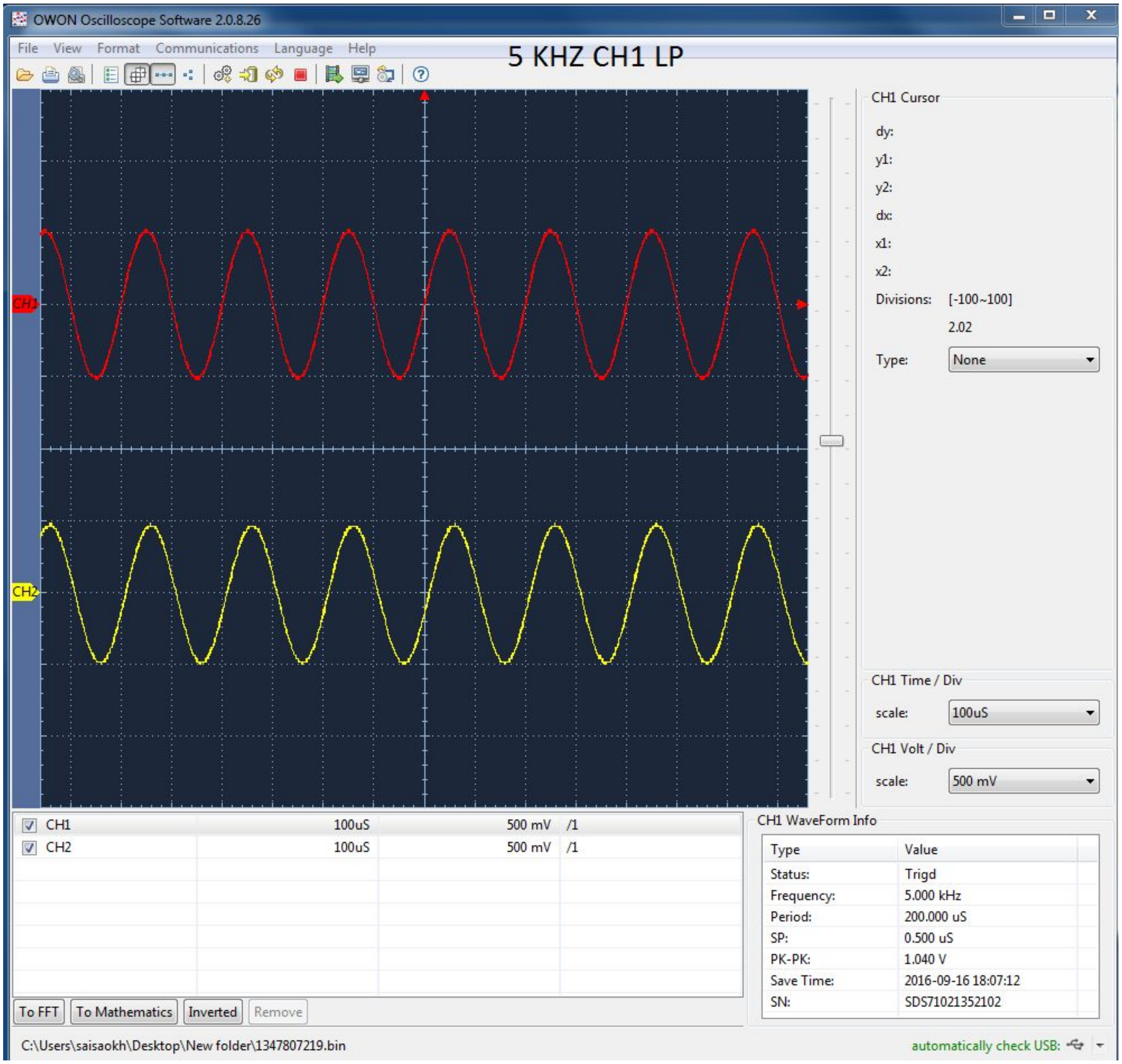
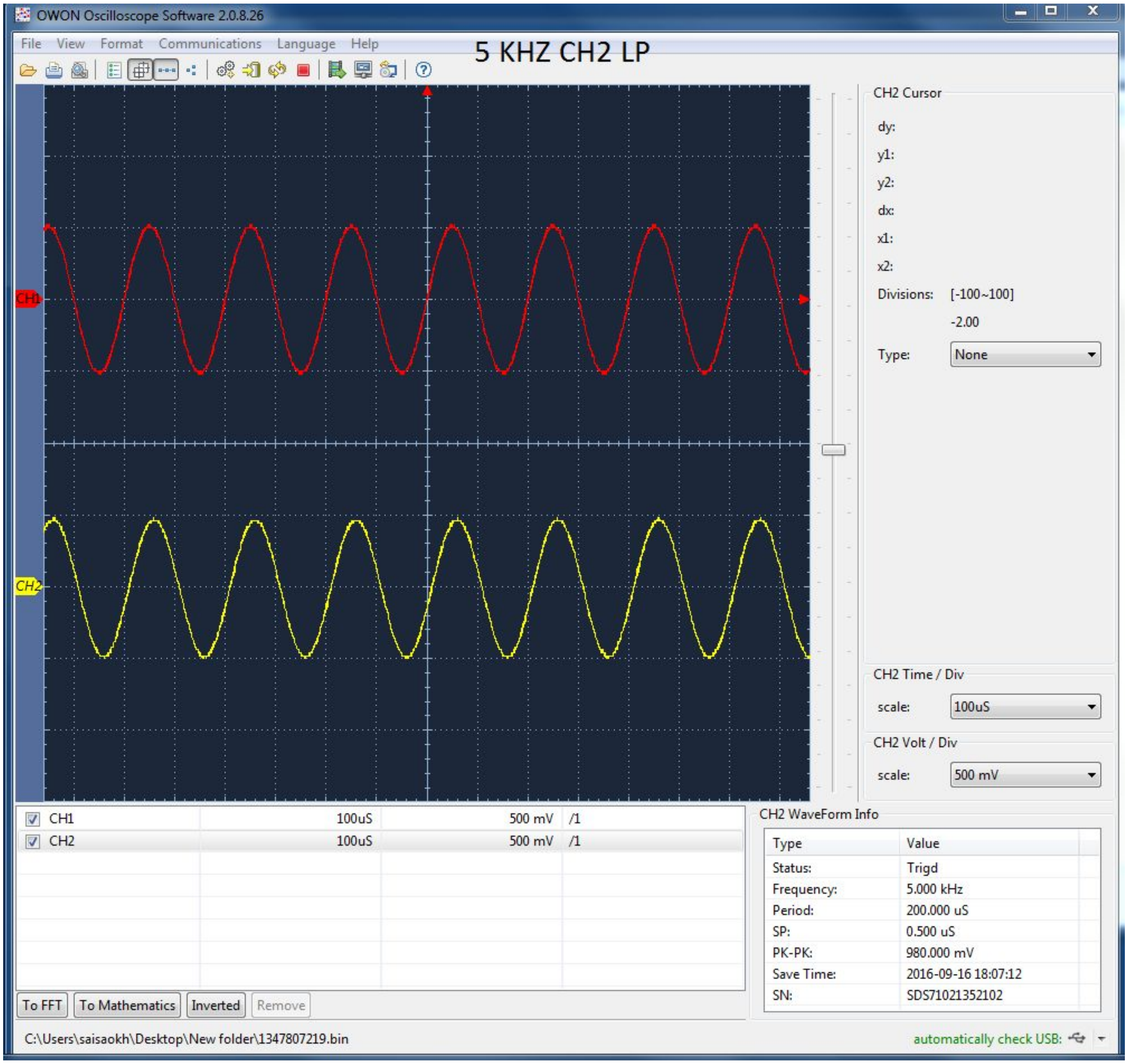
automatically check USB:

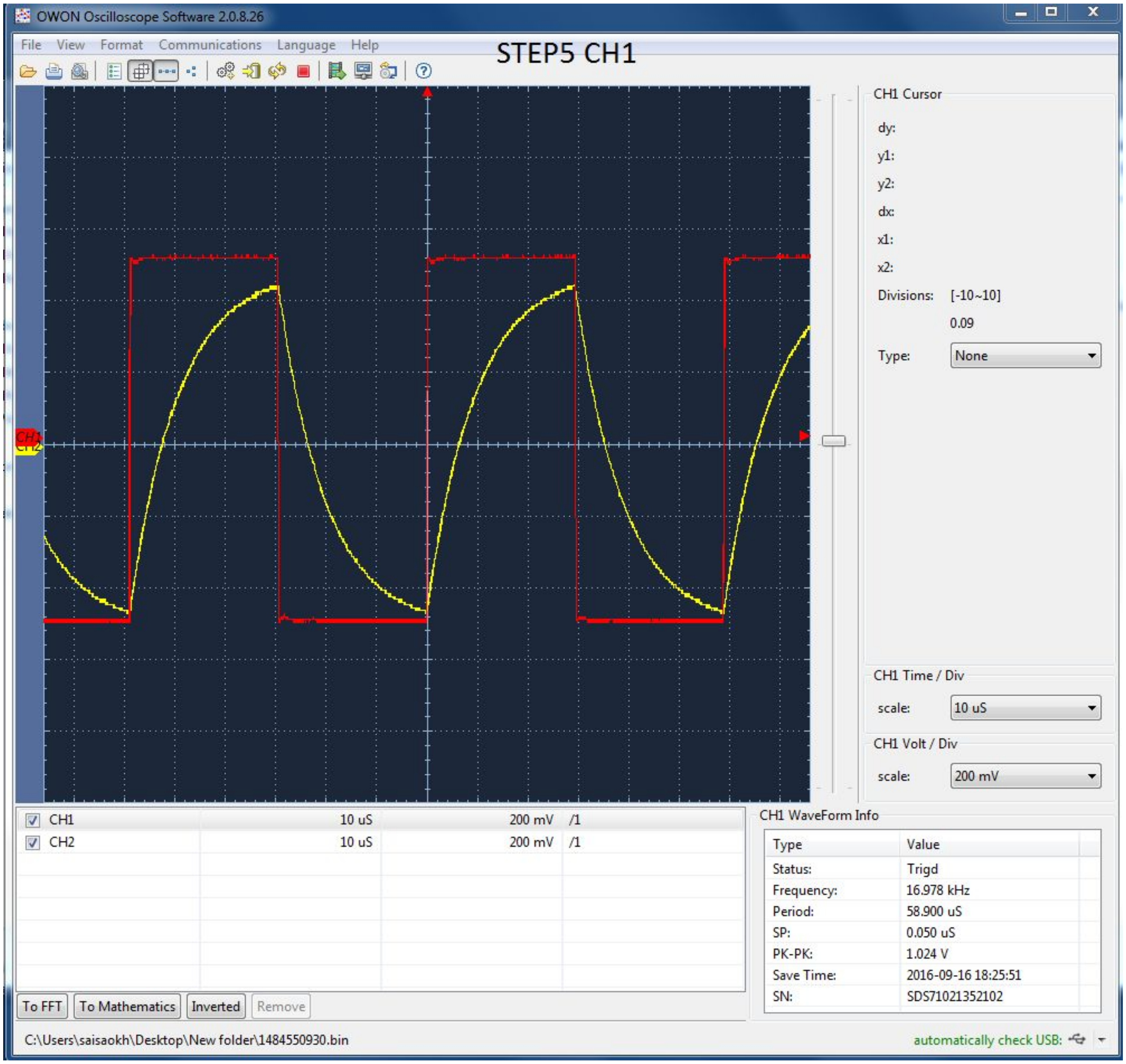

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
50 KHZ CH2 LP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 5 uS
CH2 Volt / Div
scale: 500 mV
CH1 5 uS 500 mV /1
CH2 5 uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 50.000 kHz
Period: 20.000 uS
SP: 0.025 uS
PK-PK: 340.000 mV
Save Time: 2016-09-16 18:11:56
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1715498393.bin
automatically check USB:

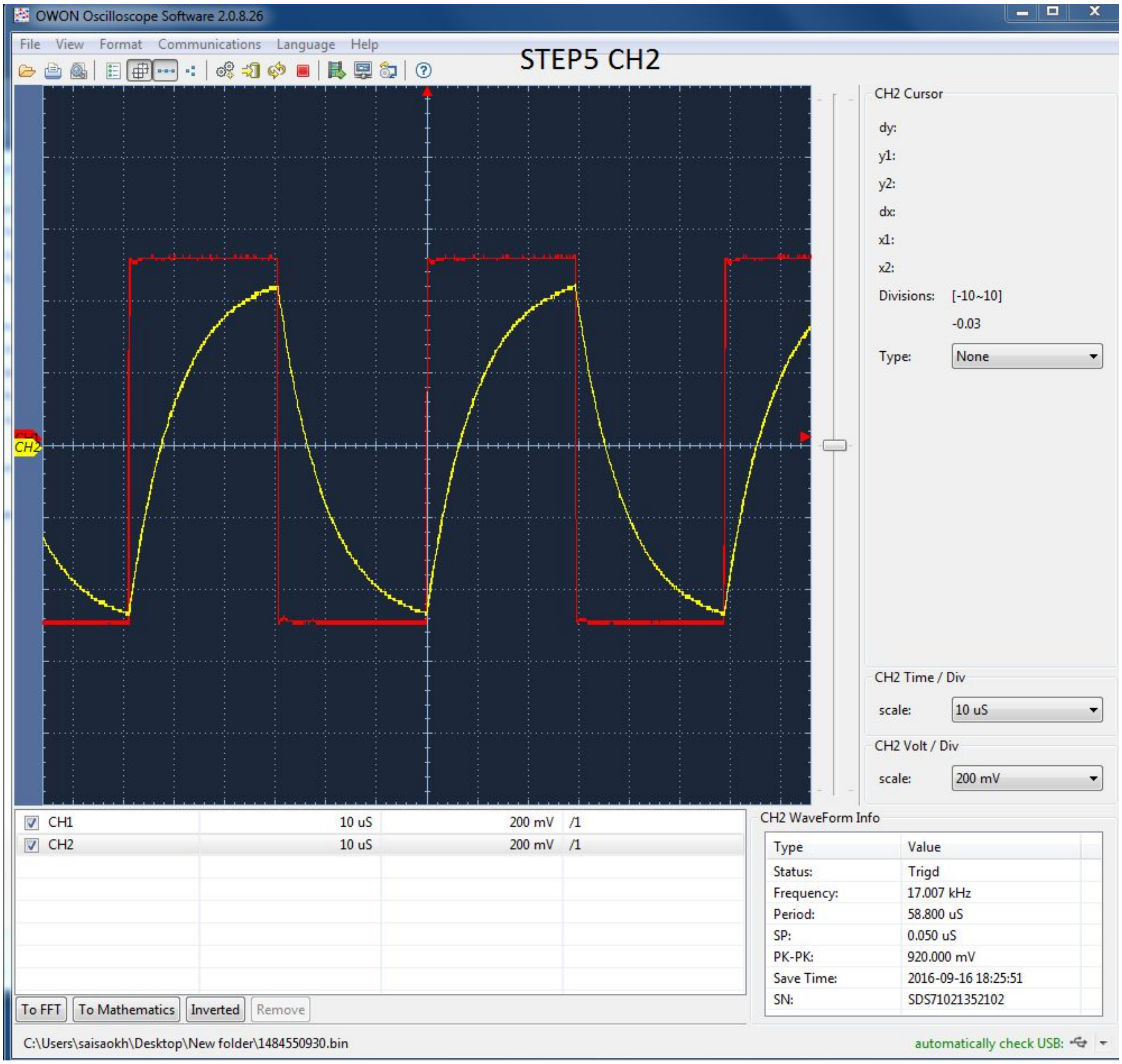

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
5 KHZ CH1 LP
CH1
CH2
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 100uS
CH1 Volt / Div
scale: 500 mV
CH1 100uS 500 mV /1
CH2 100uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 5.000 kHz
Period: 200.000 uS
SP: 0.500 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 18:07:12
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1347807219.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
5 KHZ CH2 LP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 100uS
CH2 Volt / Div
scale: 500 mV
CH1 100uS 500 mV /1
CH2 100uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 5.000 kHz
Period: 200.000 uS
SP: 0.500 uS
PK-PK: 980.000 mV
Save Time: 2016-09-16 18:07:12
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1347807219.bin
automatically check USB:

Square wave response:

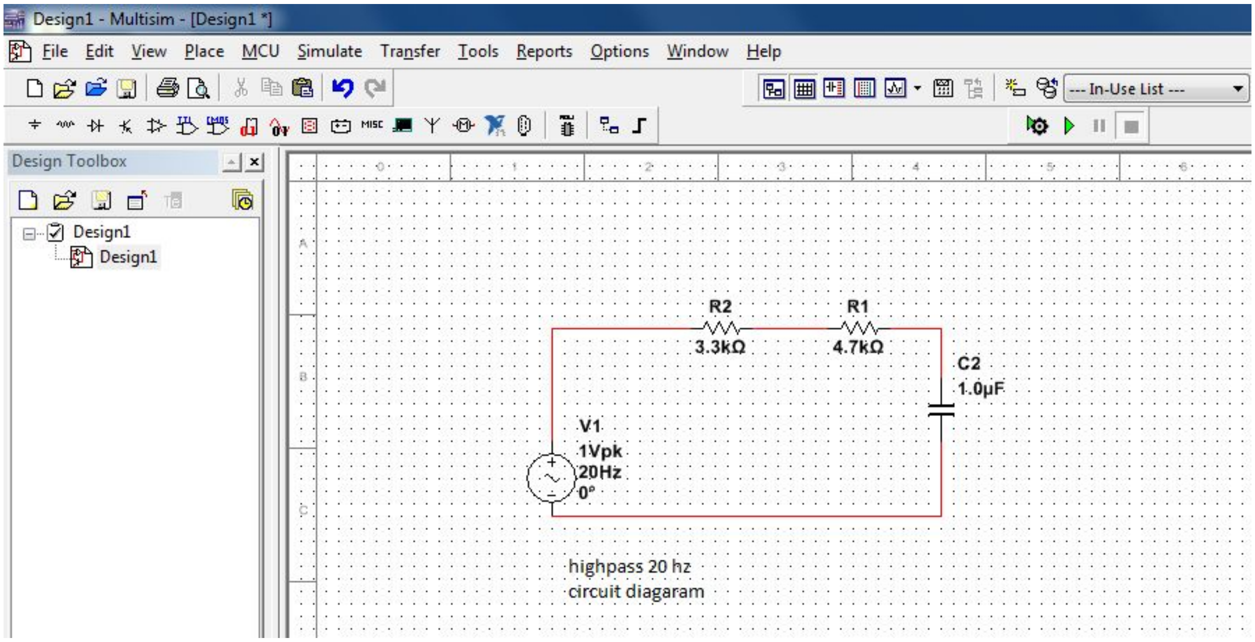
To study the transient response of the filter circuit, use the square wave as input. The waveforms should look similar to what are shown in Fig. 4. Digitize both the input and output waveforms at the –3dB frequency


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
STEP5 CH1
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-10~10]
0.09
Type: None
CH1 Time / Div
scale: 10 uS
CH1 Volt / Div
scale: 200 mV
CH1 10 uS 200 mV /1
CH2 10 uS 200 mV /1
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 16.978 kHz
Period: 58.900 uS
SP: 0.050 uS
PK-PK: 1.024 V
Save Time: 2016-09-16 18:25:51
SN: SDS71021352102
To FFT
To Mathematics
Inverted
Remove
C:\Users\saisaokh\Desktop\New folder\1484550930.bin
automatically check USB:



*********LP end
*********HP start

High Pass RC Filter –
Circuit diagram:



Note: Due to technical issue, we haven't add ground sign between voltage sourcse and C2 yet

Using the resistor in the 1k ohm - 100k ohm

Suing 8K ohm for the highpass RC filter circuit with 20K hz

f=1/(2piRC)

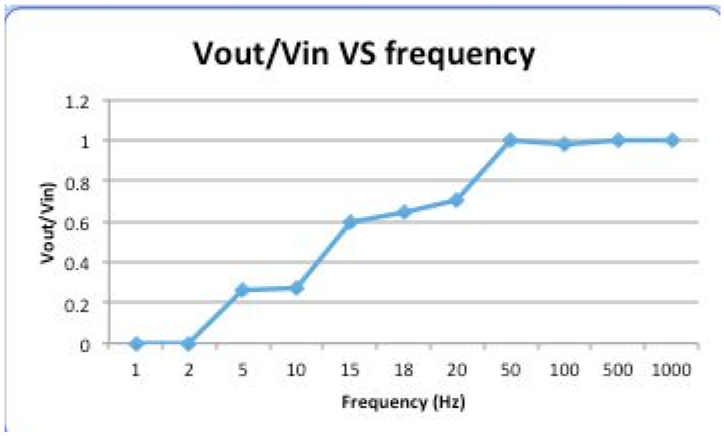
R=8K ohm

Get C=1 uf

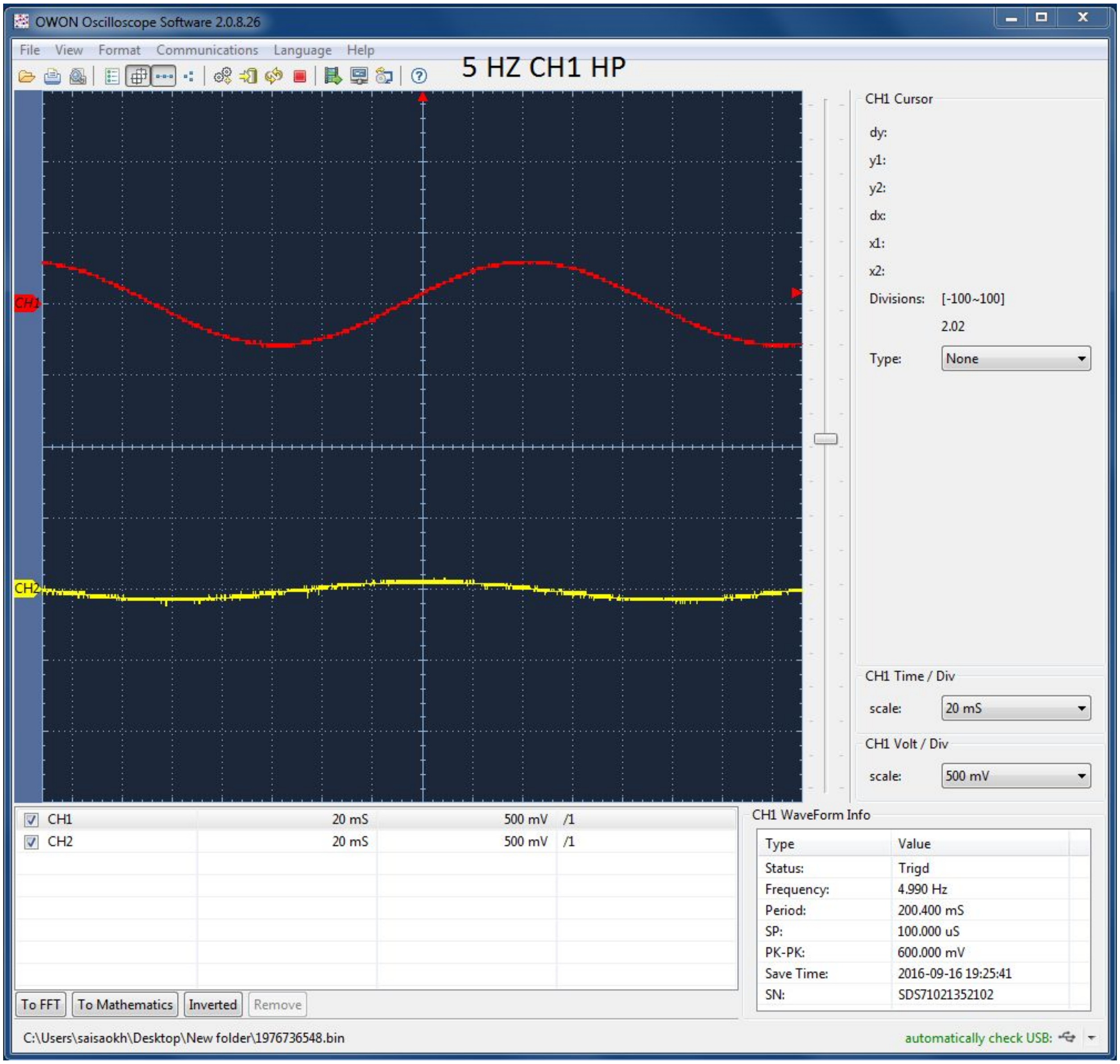
Frequency response (Bode plot):

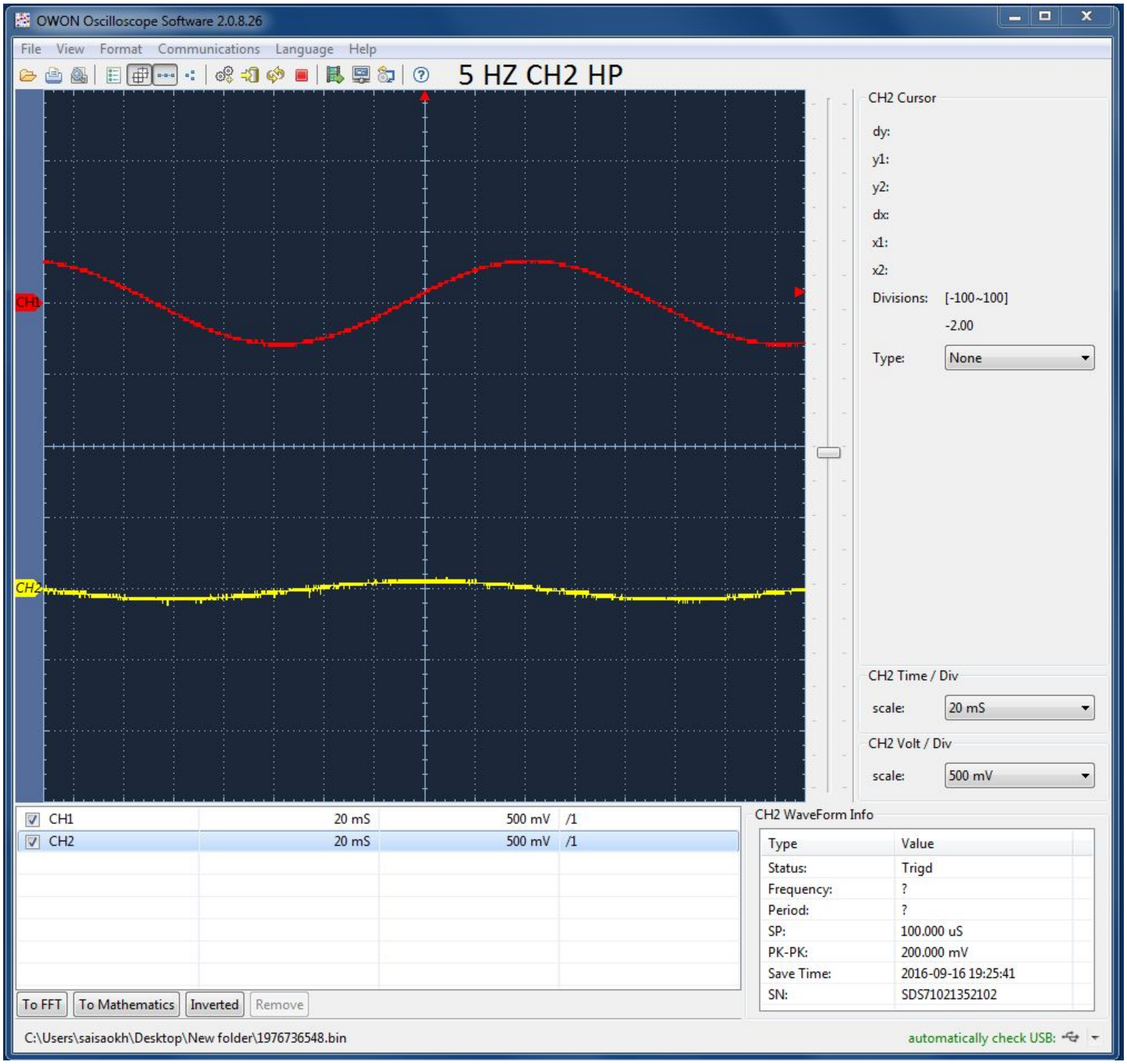
plot in excel as in eg

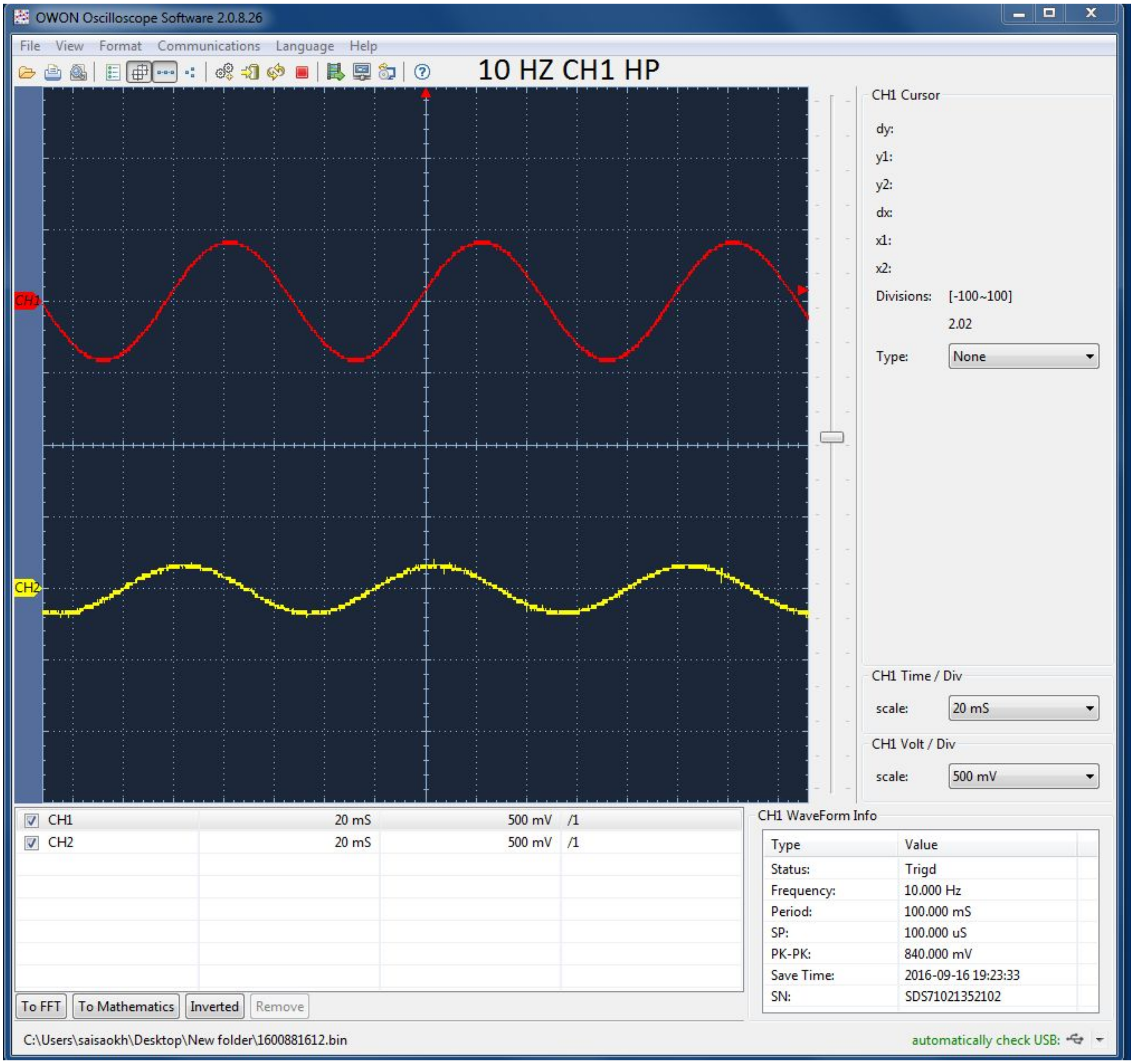
frequence	Vout/Vin		Vout	Vin
1	0		0	0.144
2	0		0	
5	0.266		0.16	0.6
10	0.2738		0.23	0.84
15	0.5957		0.56	0.94
18	0.645		0.62	0.96
20	0.7		0.7	1
50	1		1	1
100	0.981		1.02	1.04
500	1		1.04	1.04
1000	1		1.06	1.04

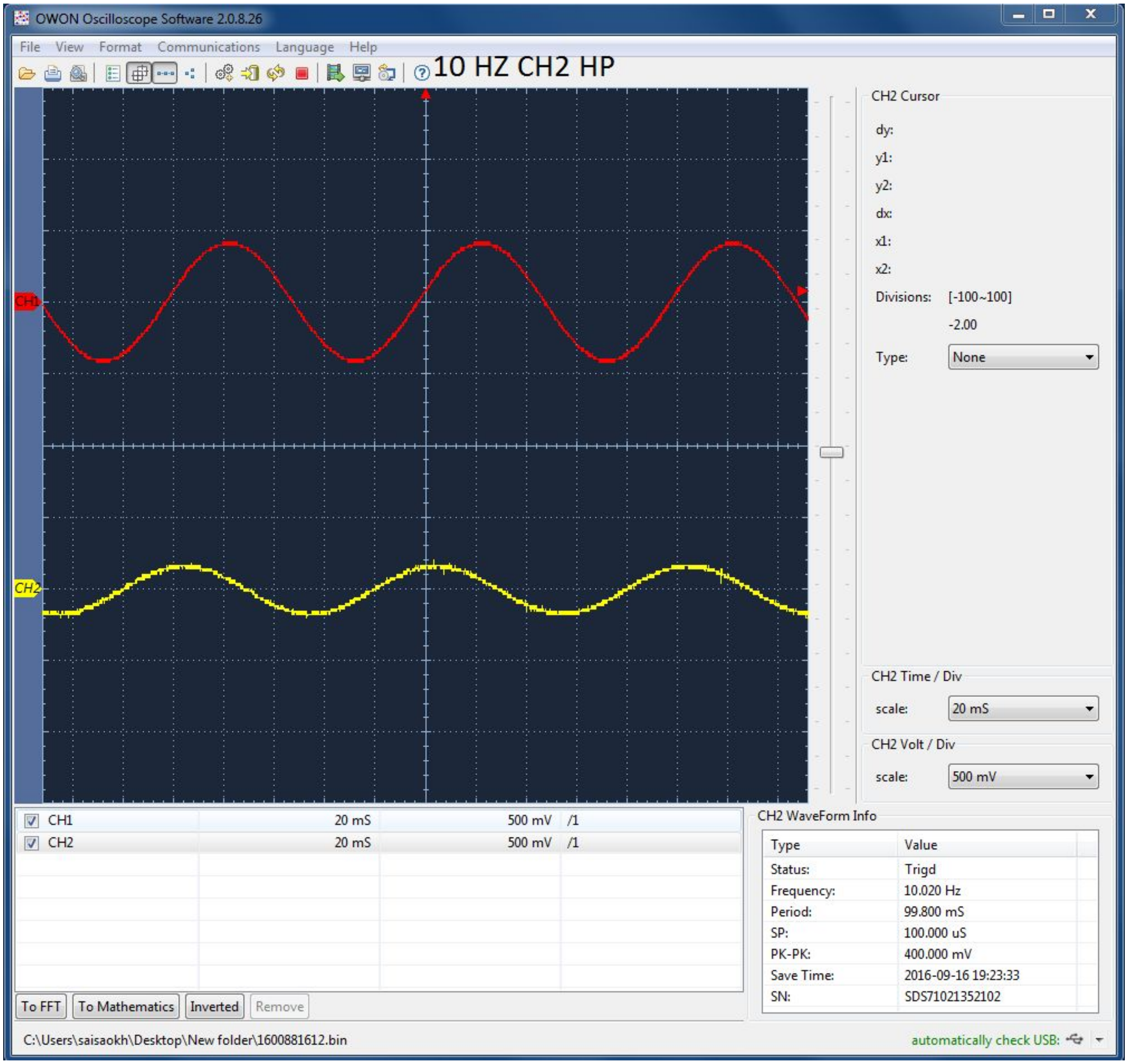


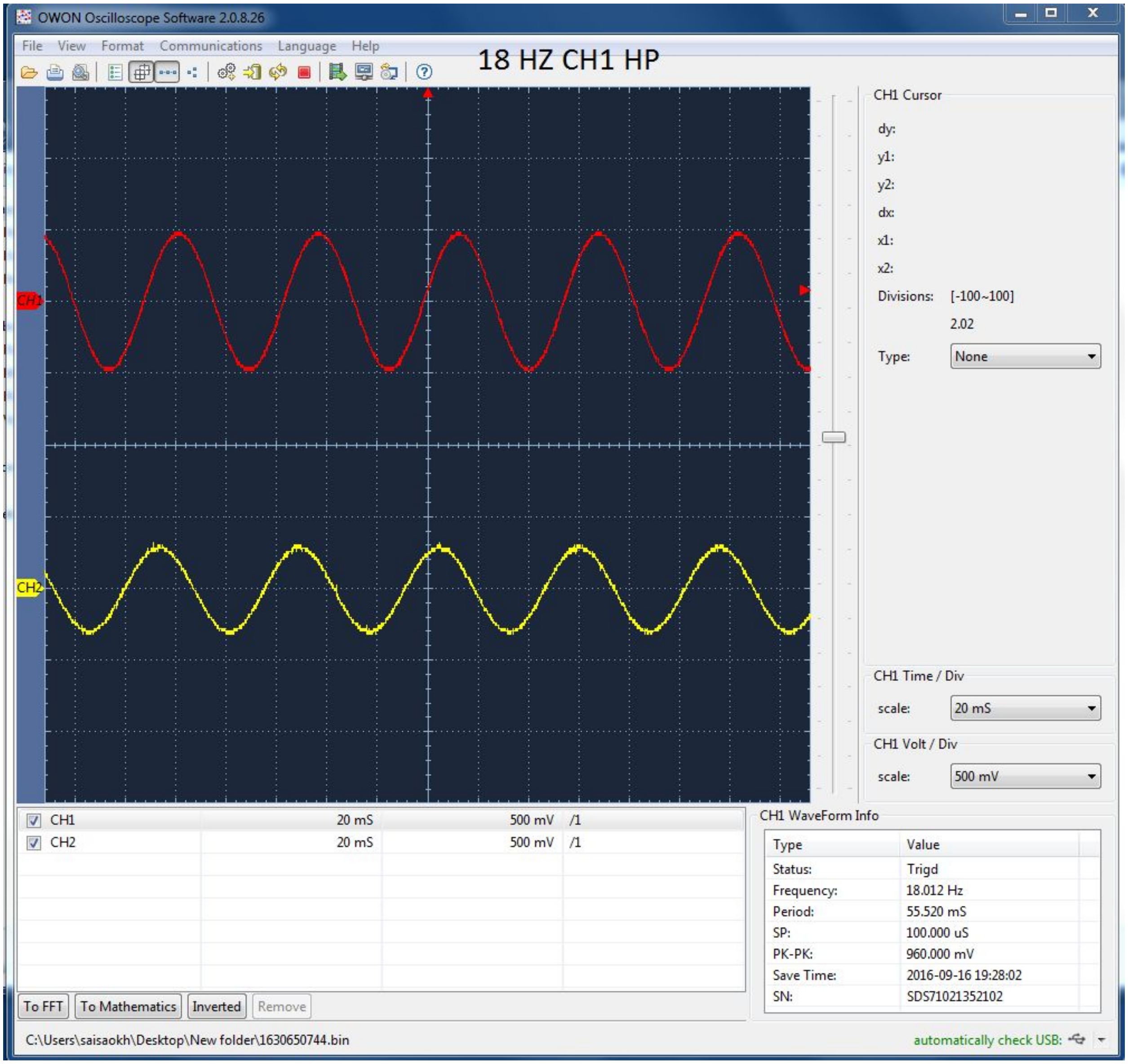
Waveforms showing phase shift of 45-degrees at -3dB frequency:
5 Hz, 10 Hz, 18 Hz, 20 Hz, 100 Hz, 1 k Hz, and square wave from.

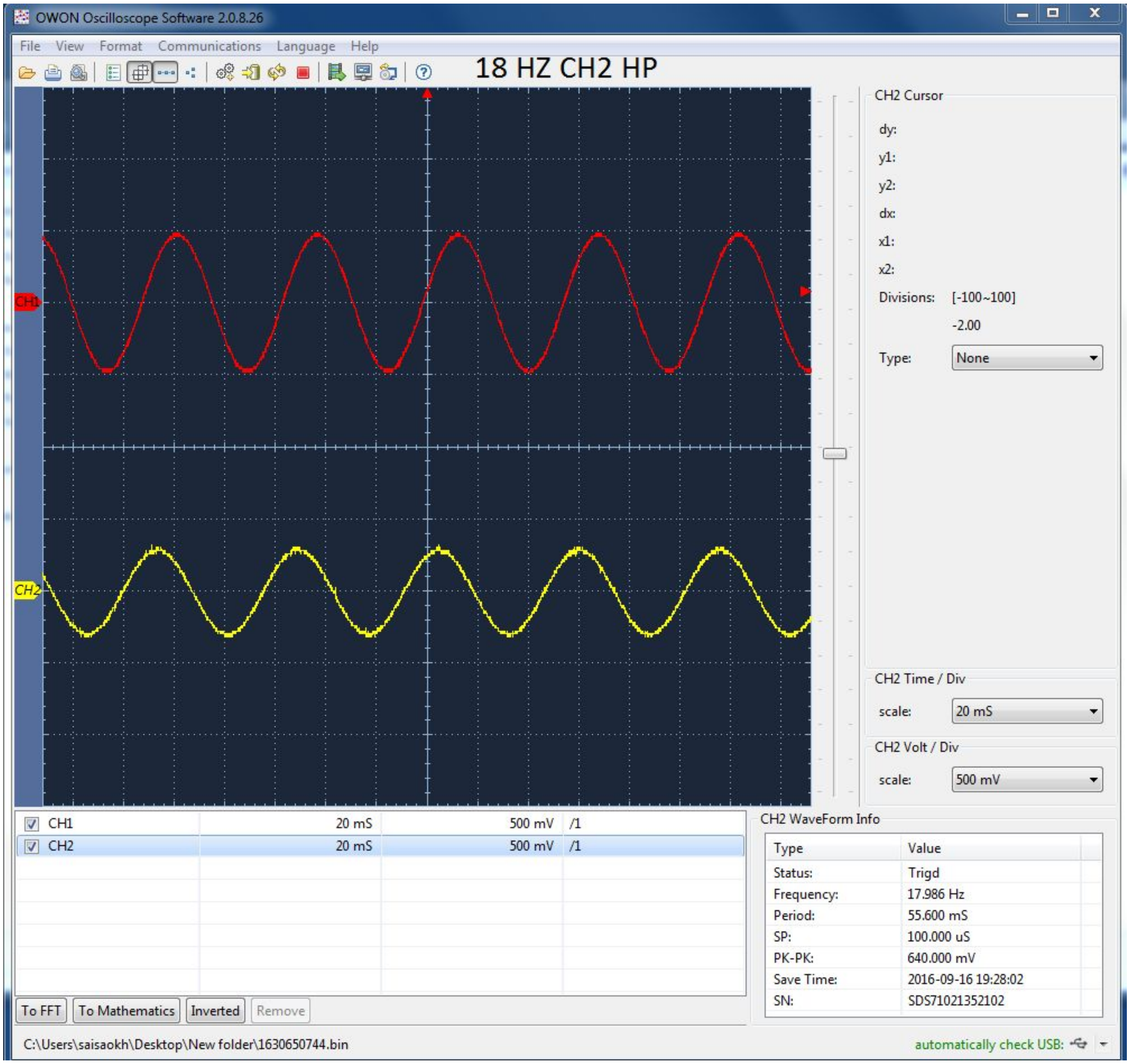

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
5 HZ CH1 HP
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 20 mS
CH1 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 4.990 Hz
Period: 200.400 mS
SP: 100.000 uS
PK-PK: 600.000 mV
Save Time: 2016-09-16 19:25:41
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1976736548.bin
automatically check USB:

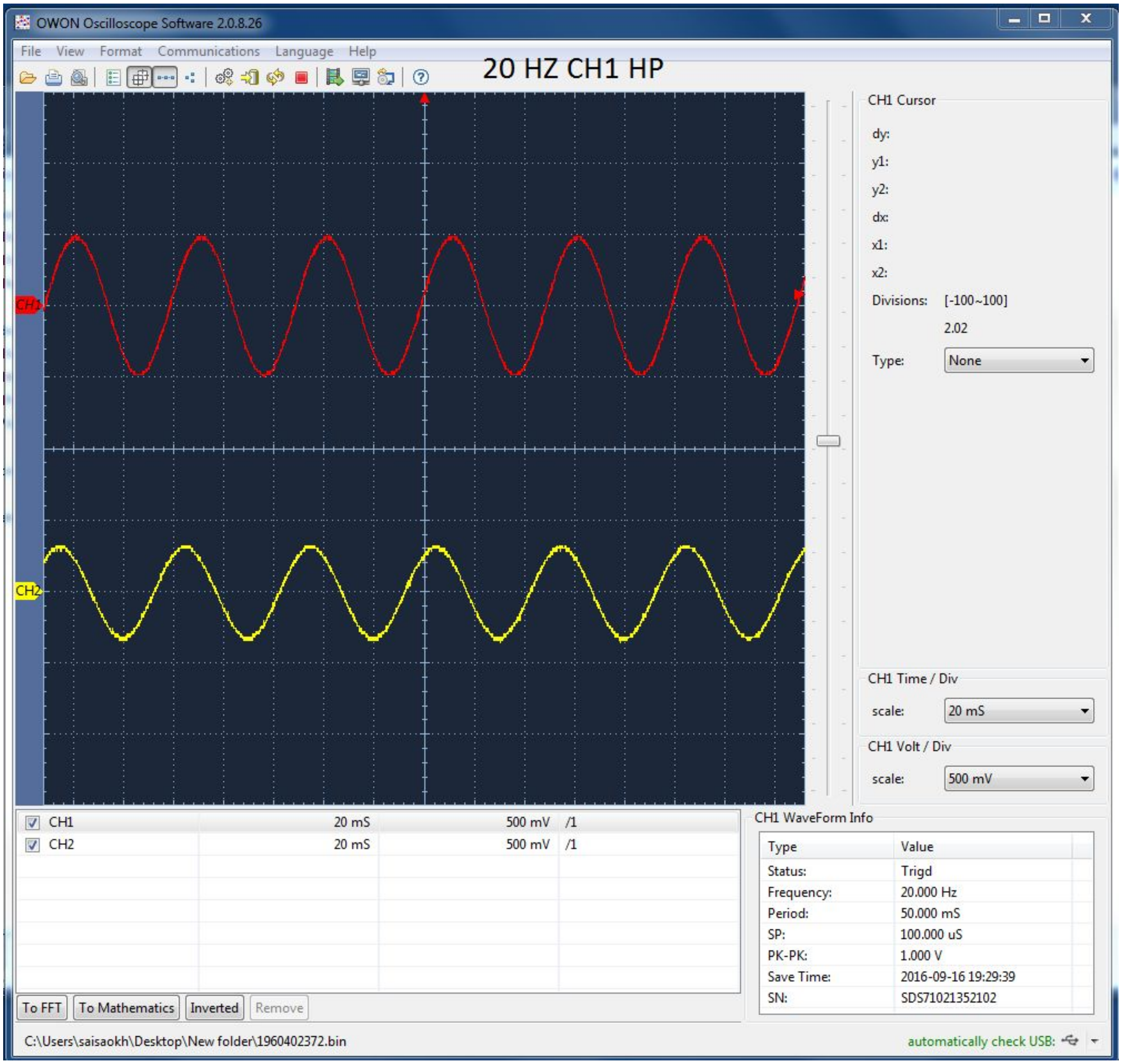

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
5 HZ CH2 HP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 20 mS
CH2 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: ?
Period: ?
SP: 100.000 uS
PK-PK: 200.000 mV
Save Time: 2016-09-16 19:25:41
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1976736548.bin
automatically check USB:

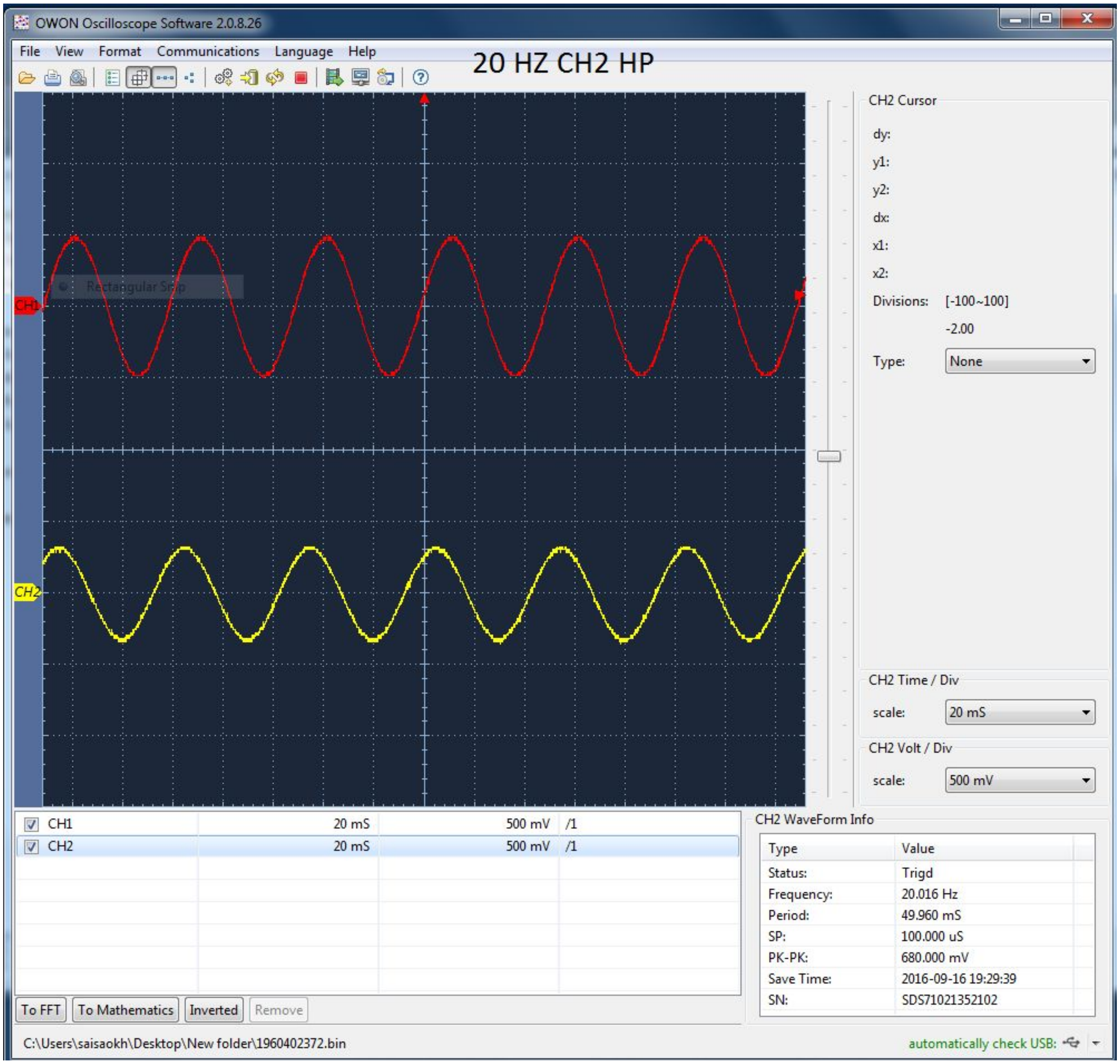

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
10 HZ CH1 HP
CH1
CH2
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 20 mS
CH1 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 10.000 Hz
Period: 100.000 mS
SP: 100.000 uS
PK-PK: 840.000 mV
Save Time: 2016-09-16 19:23:33
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1600881612.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
10 HZ CH2 HP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 20 mS
CH2 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 10.020 Hz
Period: 99.800 mS
SP: 100.000 uS
PK-PK: 400.000 mV
Save Time: 2016-09-16 19:23:33
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1600881612.bin
automatically check USB:

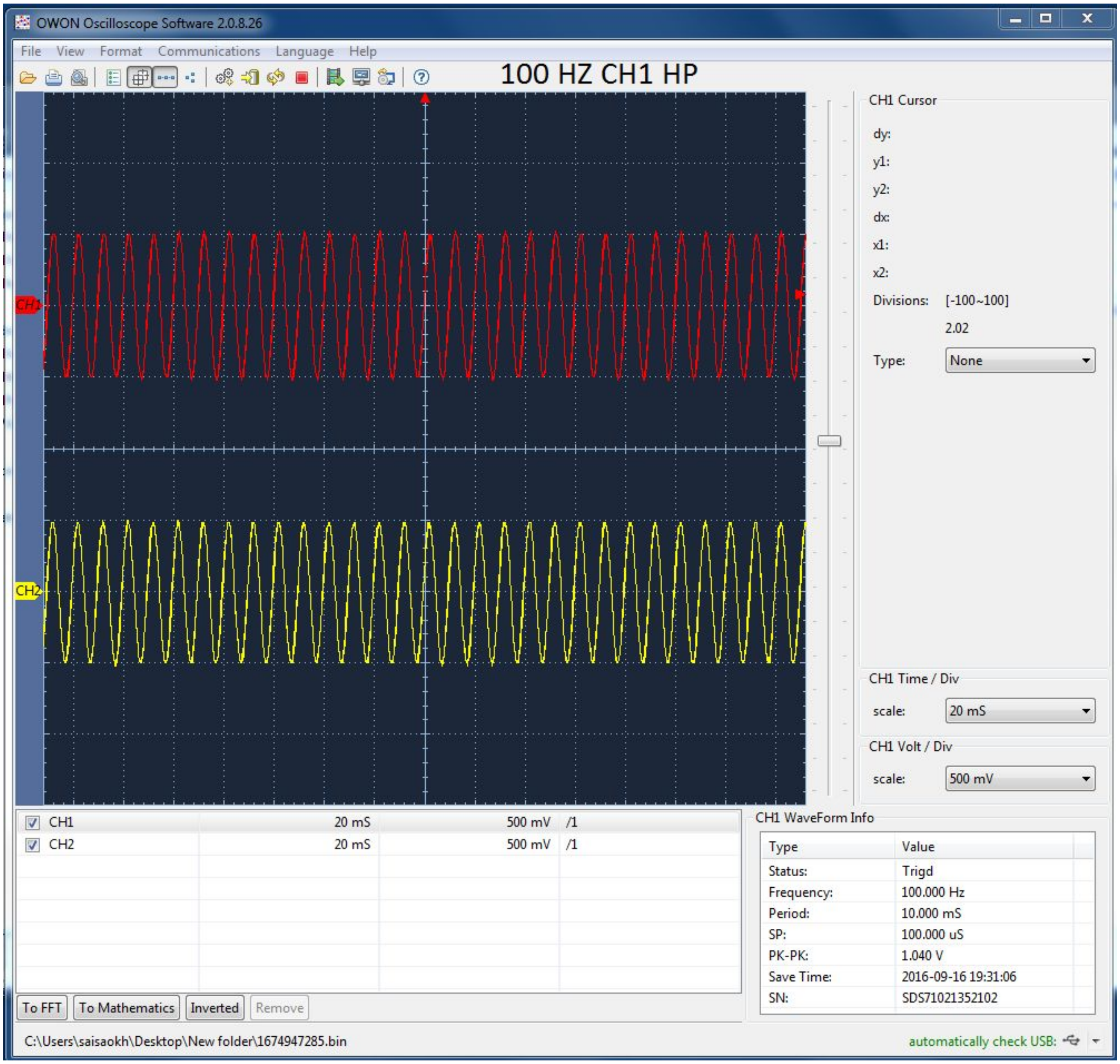

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
18 HZ CH1 HP
CH1
CH2
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 20 mS
CH1 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 18.012 Hz
Period: 55.520 mS
SP: 100.000 uS
PK-PK: 960.000 mV
Save Time: 2016-09-16 19:28:02
SN: SDS71021352102
To FFT
To Mathematics
Inverted
Remove
C:\Users\saisaokh\Desktop\New folder\1630650744.bin
automatically check USB:

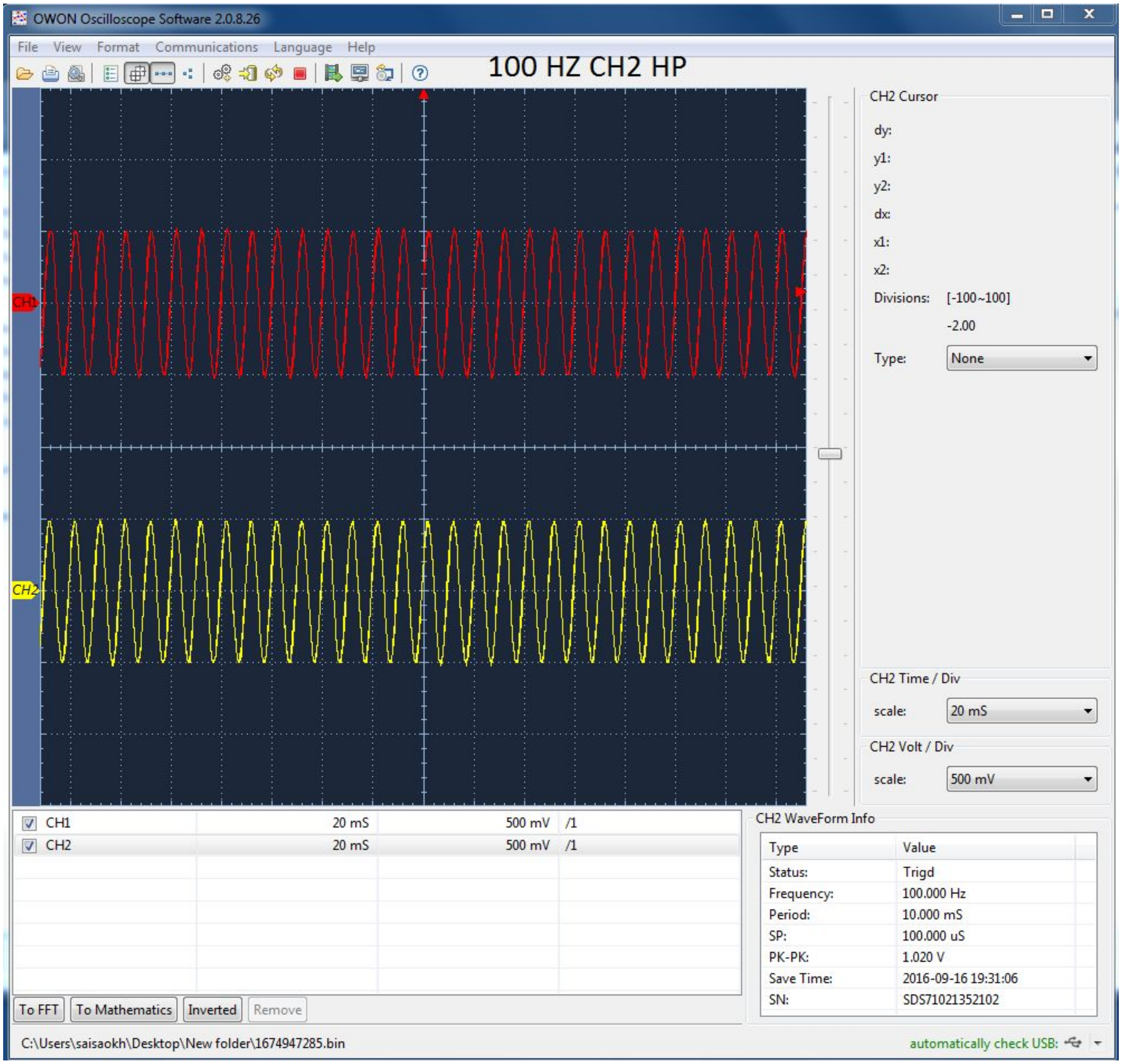

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
18 HZ CH2 HP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 20 mS
CH2 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 17.986 Hz
Period: 55.600 mS
SP: 100.000 uS
PK-PK: 640.000 mV
Save Time: 2016-09-16 19:28:02
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1630650744.bin
automatically check USB:

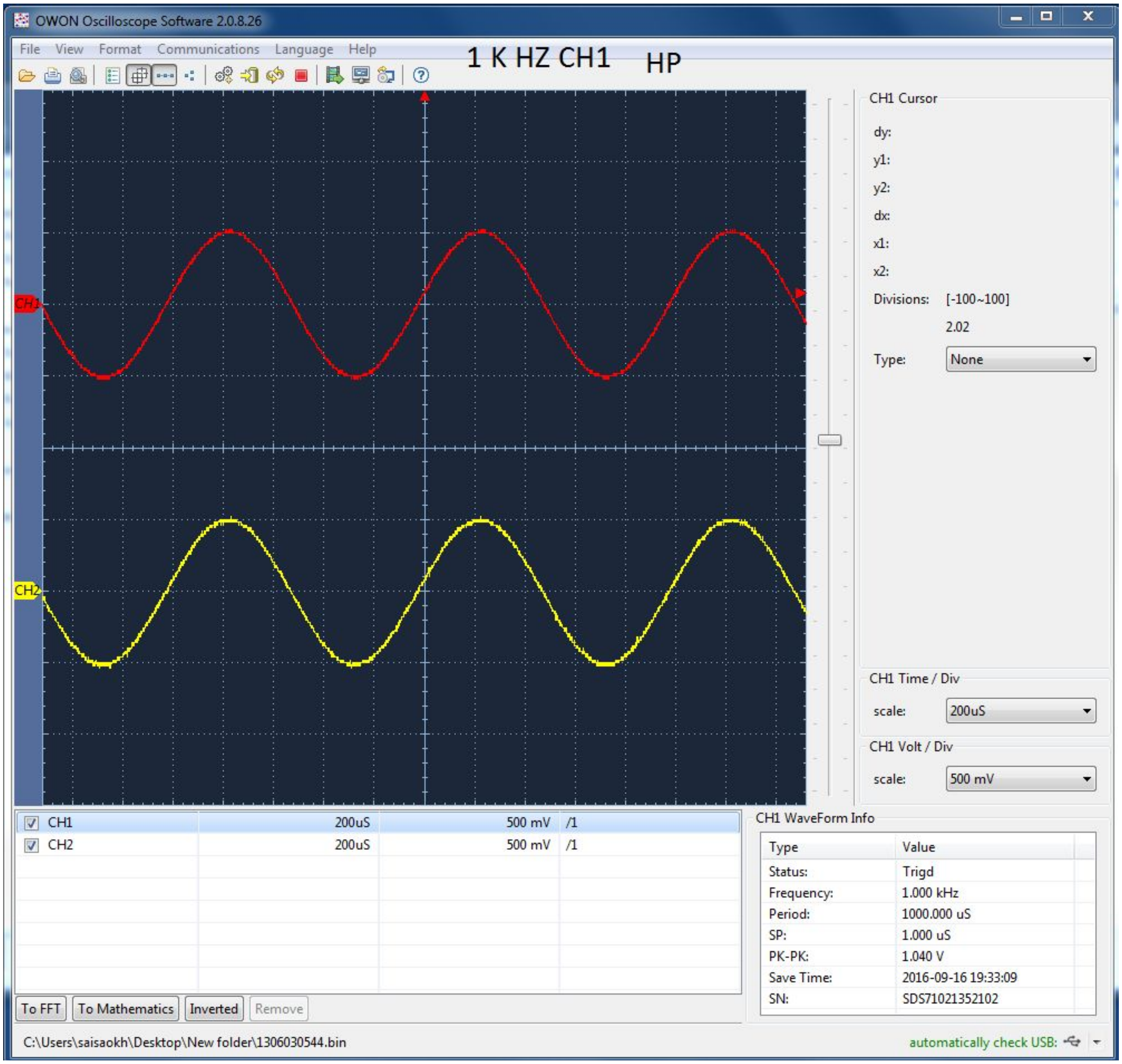

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
20 HZ CH1 HP
CH1
CH2
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 20 mS
CH1 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 20.000 Hz
Period: 50.000 mS
SP: 100.000 uS
PK-PK: 1.000 V
Save Time: 2016-09-16 19:29:39
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1960402372.bin
automatically check USB:

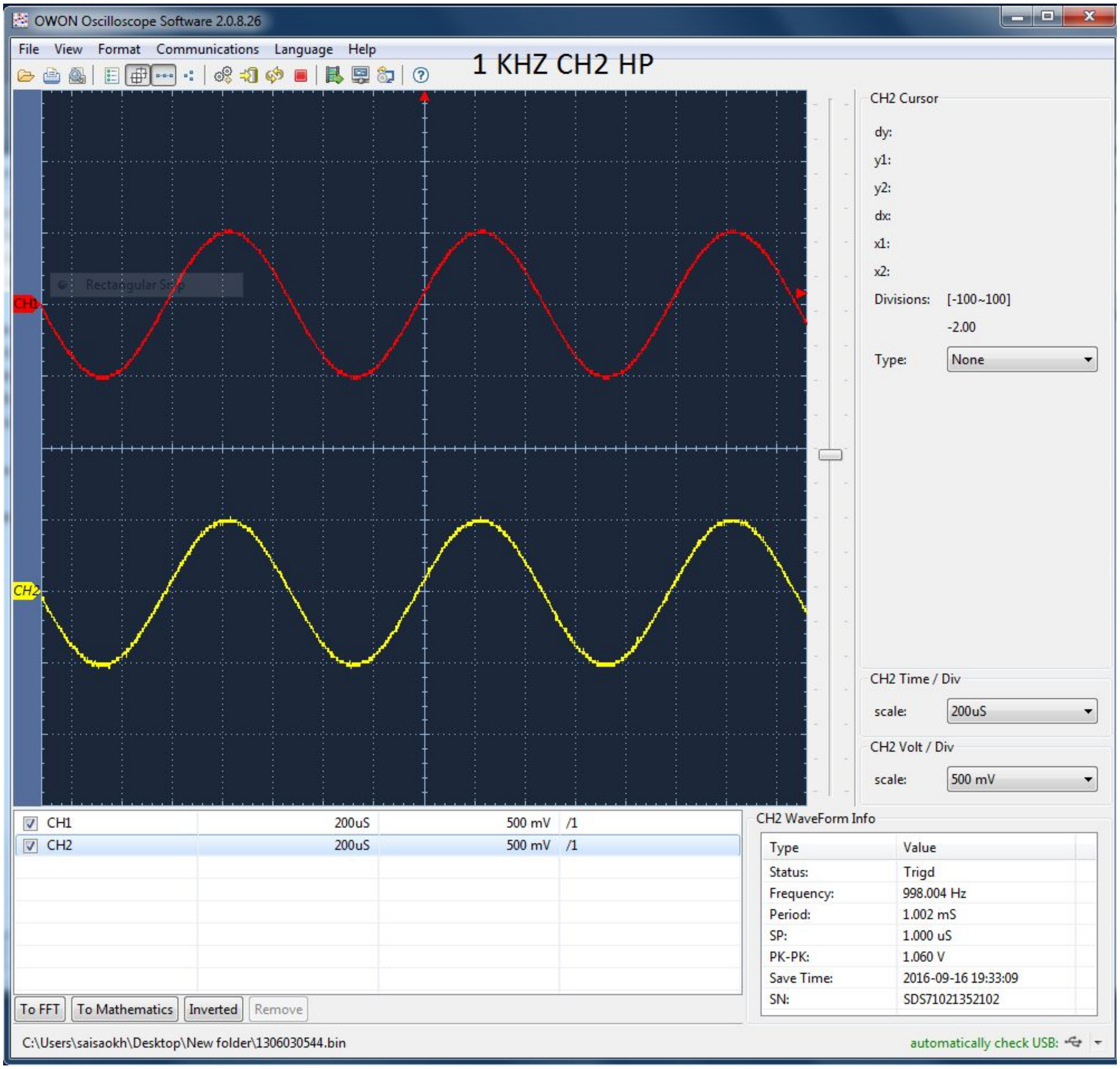


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
20 HZ CH2 HP
CH1
CH2
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 20 mS
CH2 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 20.016 Hz
Period: 49.960 mS
SP: 100.000 uS
PK-PK: 680.000 mV
Save Time: 2016-09-16 19:29:39
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1960402372.bin
automatically check USB:

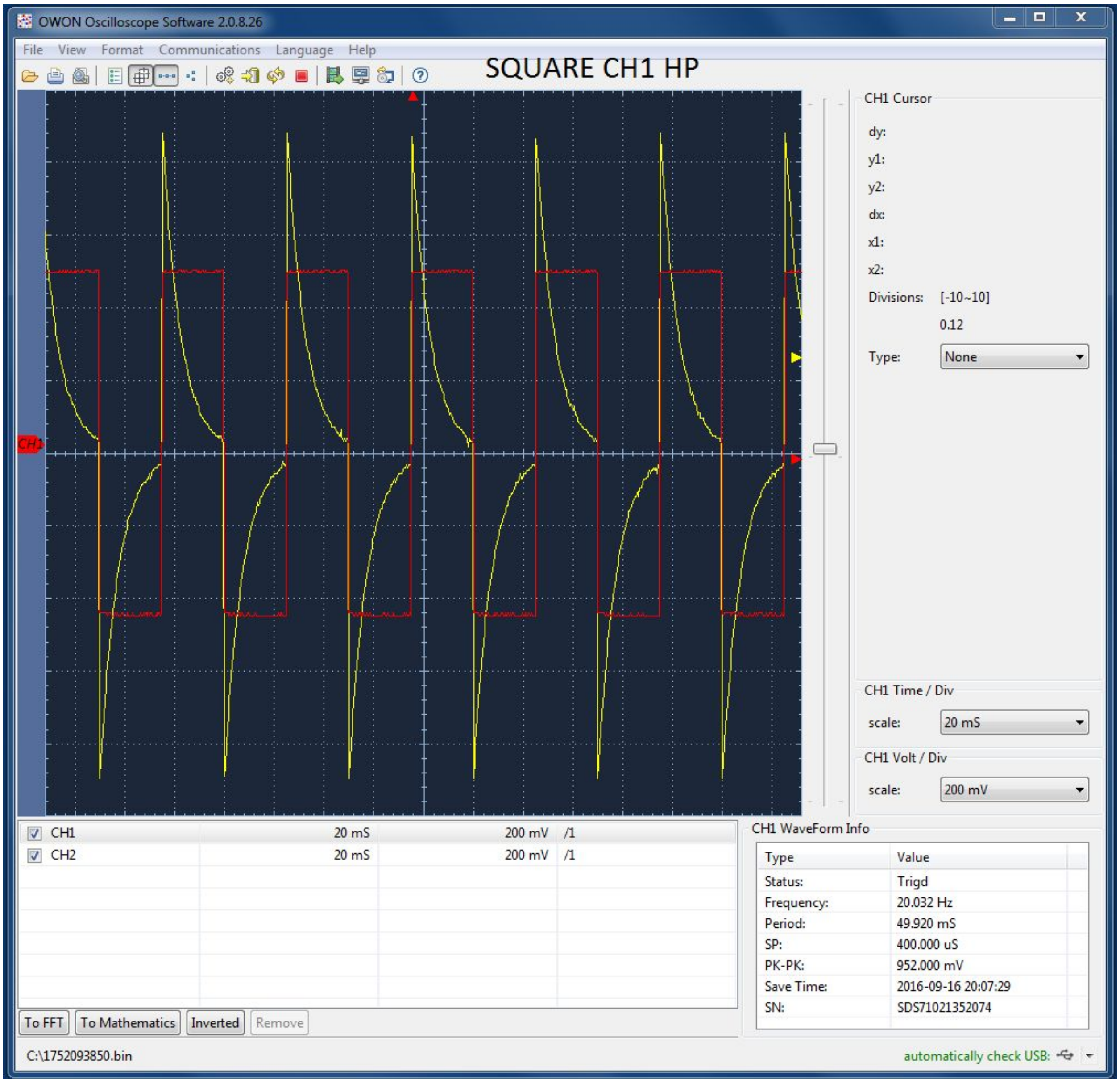

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
100 HZ CH1 HP
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 20 mS
CH1 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 100.000 Hz
Period: 10.000 mS
SP: 100.000 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 19:31:06
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1674947285.bin
automatically check USB:

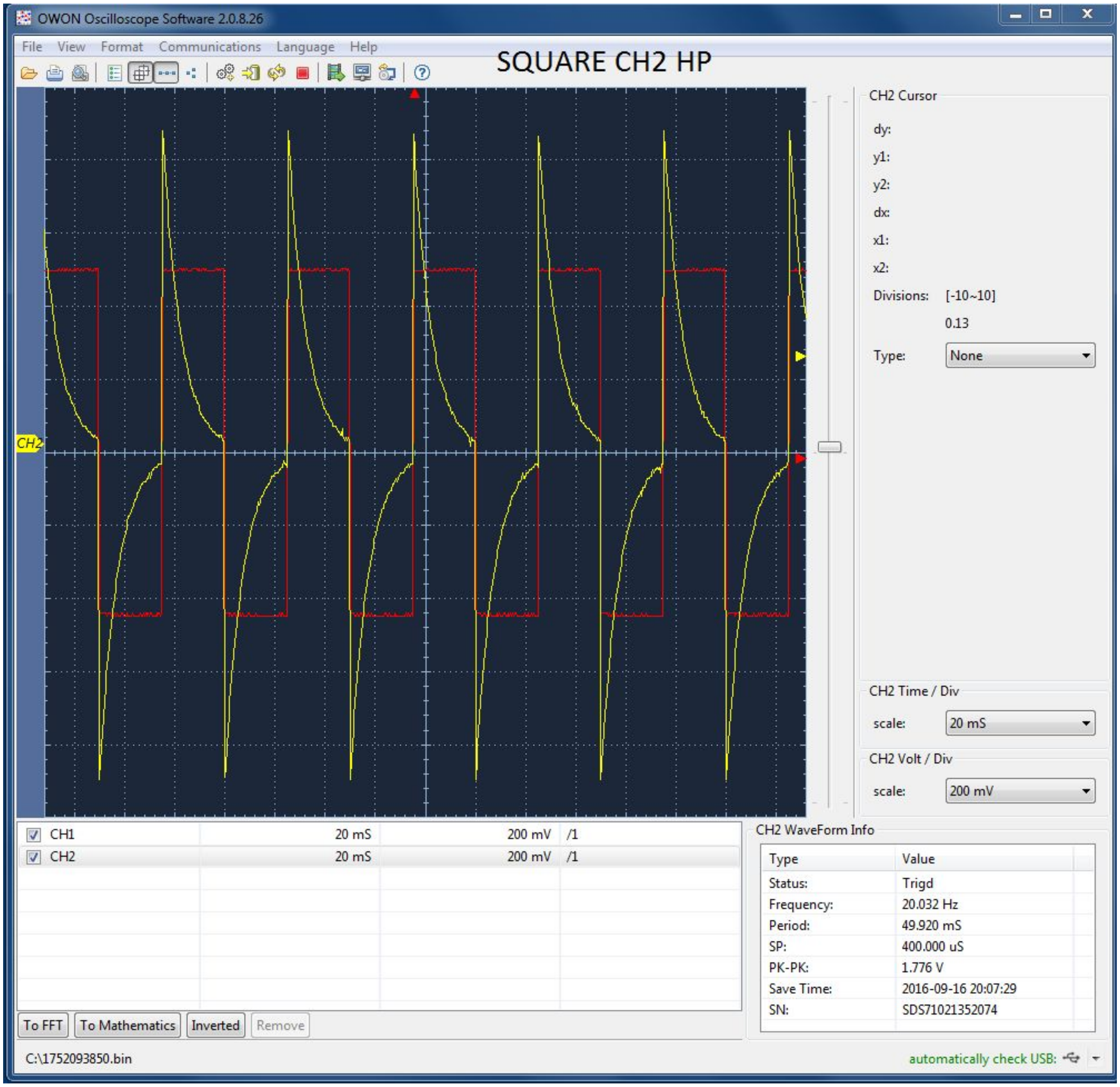

OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
100 HZ CH2 HP
CH2 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
-2.00
Type: None
CH2 Time / Div
scale: 20 mS
CH2 Volt / Div
scale: 500 mV
CH1 20 mS 500 mV /1
CH2 20 mS 500 mV /1
CH2 WaveForm Info
Type Value
Status: Trigd
Frequency: 100.000 Hz
Period: 10.000 mS
SP: 100.000 uS
PK-PK: 1.020 V
Save Time: 2016-09-16 19:31:06
SN: SDS71021352102
To FFT
To Mathematics
Inverted
Remove
C:\Users\saisaokh\Desktop\New folder\1674947285.bin
automatically check USB:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
1 K HZ CH1 HP
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-100~100]
2.02
Type: None
CH1 Time / Div
scale: 200uS
CH1 Volt / Div
scale: 500 mV
CH1 200uS 500 mV /1
CH2 200uS 500 mV /1
To FFT
To Mathematics
Inverted
Remove
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 1.000 kHz
Period: 1000.000 uS
SP: 1.000 uS
PK-PK: 1.040 V
Save Time: 2016-09-16 19:33:09
SN: SDS71021352102
C:\Users\saisaokh\Desktop\New folder\1306030544.bin
automatically check USB:



Response to square wave:


OWON Oscilloscope Software 2.0.8.26
File View Format Communications Language Help
SQUARE CH1 HP
CH1
CH1 Cursor
dy:
y1:
y2:
dx:
x1:
x2:
Divisions: [-10~10]
0.12
Type: None
CH1 Time / Div
scale: 20 mS
CH1 Volt / Div
scale: 200 mV
CH1 20 mS 200 mV /1
CH2 20 mS 200 mV /1
CH1 WaveForm Info
Type Value
Status: Trigd
Frequency: 20.032 Hz
Period: 49.920 mS
SP: 400.000 uS
PK-PK: 952.000 mV
Save Time: 2016-09-16 20:07:29
SN: SDS71021352074
To FFT
To Mathematics
Inverted
Remove
C:\1752093850.bin
automatically check USB:

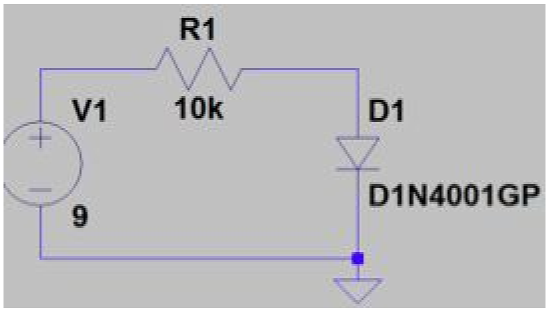


*********HP end

*********Diode start

Diode Characteristics -

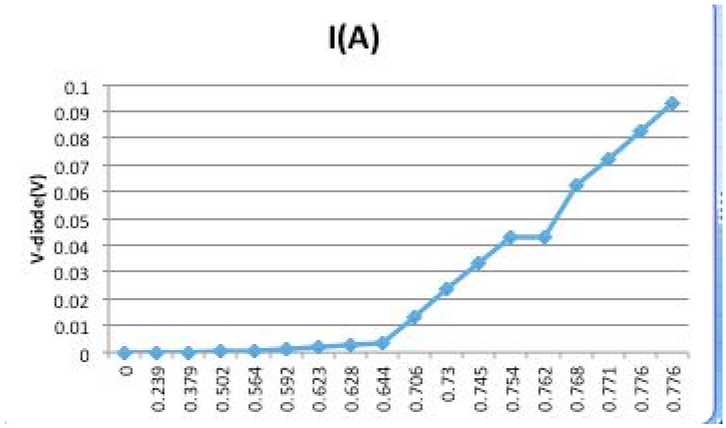
Fit with the following equation: *I* = *I* *e*(&) and assuming room temperature, I = 6nA and n = 1.82.



building the diode test circuit
Vary the voltage from 0V,0.2V,0.4V,0.5V,0.6V,0.7V,0.8V,0.9V: and 1V to 10V in 1-Vsteps.
Sine the current of diode =the current of the resistor= V-resistor/R-resistor

#plot value in excel

V(input)	V-resistor(100ohm)	V-diode (V)	I Current=V-resistor/R
0	0	0	0
0.2	0	0.239	0
0.4	0.00486	0.379	0.0000486
0.5	0.01316	0.502	0.0001316
0.6	0.07102	0.564	0.0007102
0.7	0.124	0.592	0.00124
0.8	0.23	0.623	0.0023
0.9	0.257	0.628	0.00257
1	0.356	0.644	0.00356
2	1.33	0.706	0.0133
3	2.343	0.73	0.02343
4	3.315	0.745	0.03315
5	4.28	0.754	0.0428
6	4.301	0.762	0.04301
7	6.266	0.768	0.06266
8	7.246	0.771	0.07246
9	8.264	0.776	0.08264
10	9.288	0.776	0.09288

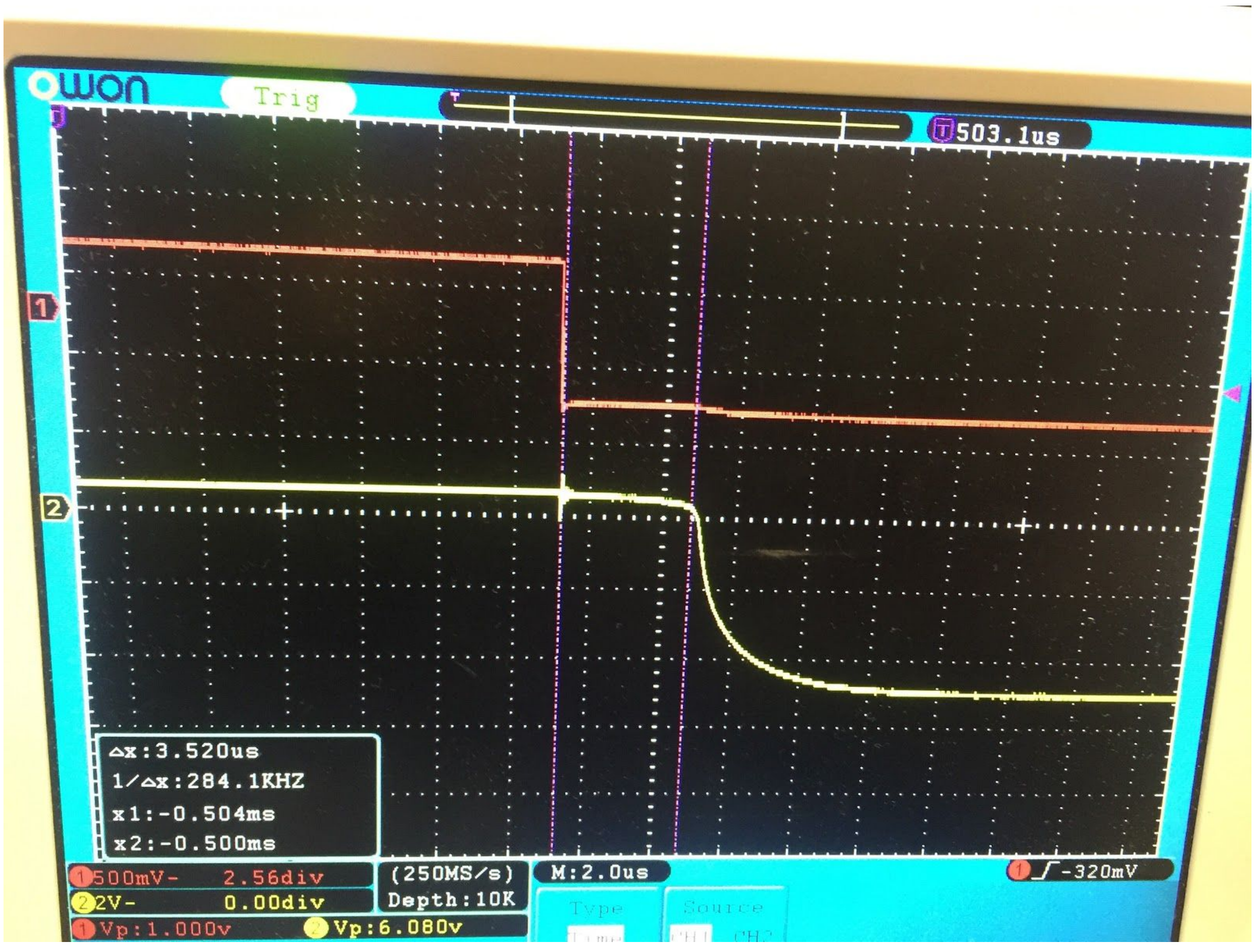


The resistance above the turn-on voltage (rd) can then be calculated with the following formula, *r*+ = ,-. which, assuming room temperature reduces to *r*+ = 1.1345

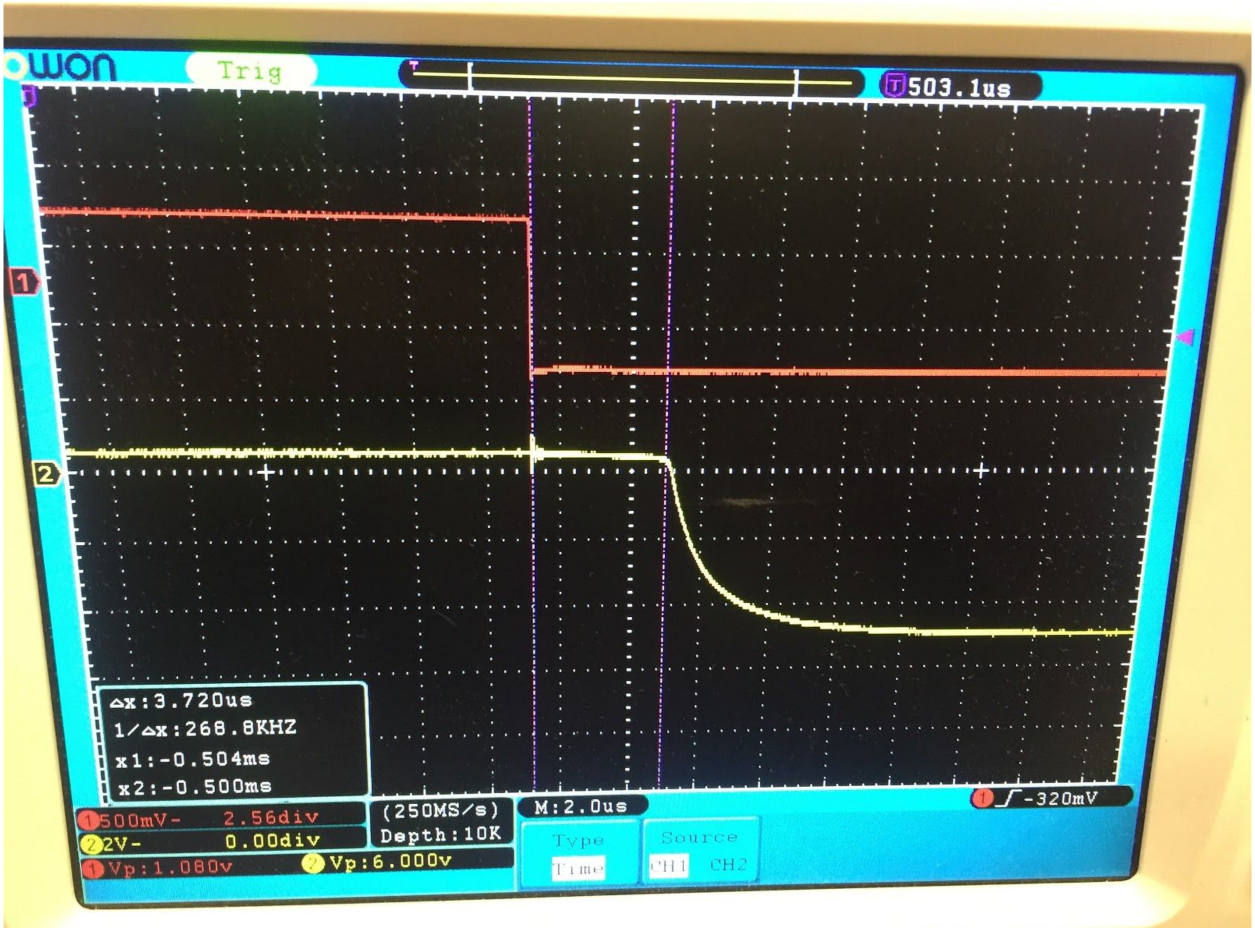
. Now, reverse the polarity of power supply and apply a negative voltage. Change the resistor to 100 kW. Record I and V for negative bias voltages from 0 to –10 V in 2-V steps.
#plot value in excel

Vin	V-diode	I
0	0	0
-2	-2.02	0
-4	-3.999	0
-6	-6.062	0
-8	-8.058	0
-10	-10.059	0

Use the diode test circuit with 470-W resistor. Instead of the dc power supply, drive the circuit with a 10-V square wave generated by the function generator



OWON
Trig
503.1us
△x:3.520us
1/△x:284.1KHZ
x1:-0.504ms
x2:-0.500ms
500mV- 2.56div
2V- 0.00div
(250MS/s)
Depth:10K
M:2.0us
-320mV
Vp:1.000v
Vp:6.080v
Type
Source



Δx increase to 3.720us from 3.520us

*********Diode end

Discussion

In this experiment we use learn RC circuit for both highpass and lowpass filter by using 2 components Resistor and Capacitor. If the output is across the Capacitor, RC circuit generate low pass due to AC voltage source. If the output is across the Resistor, RC circuit generate as high pass filter.

Conclusion

Both low pass and high pass filters can be constructed from R and C. In the case of high pass filter, C is in the front. The output is across R. For the low pass filter, it is the other way around. The frequency response is determined by RC time constant. One can easily design filters by properly choosing R and C values. By performing curve fitting, I can determine RC time constant, hence, capacitance accurately. The capacitors that I used are accurate within ±x% of labeled values.

IV characteristics of diode follow an exponential function. From measured data, I can determine the reverse saturation current, which is around 6 nA, and the ideality factor, which is 1.82.

References

Dr. Liu’s experiment 3 description.

A. S. Sedra and K. C. Smith, "Microelectronic Circuits," 7th ed. Oxford University Press,

2015. Chap.1 through Chap.7. (ISBN: 9780199339136)

*****************report end