User Manual

Channel Emulator
(SCE-C4202)



NOTICE TO USERS

This equipment has passed conformity assessment for use in a business (commercial) environment. Using it in a residential environment may cause radio interference.

Thank you for purchasing a product from Mantis Technology Co., Ltd. Please read this user manual carefully and use the product correctly. If any problem occurs during operation, refer to this manual. For anything not covered here, please contact your place of purchase or our company.

※ **Be sure to read this manual before using the product, and keep it in a safe place for future reference.**

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Section 1: Product Overview

1.1 Package Contents

- SCE-C4202 main unit (1 set)
- Power cable (1 set)
- Ethernet cable (1 set)
- User manual (1 set)

1.2 Specifications

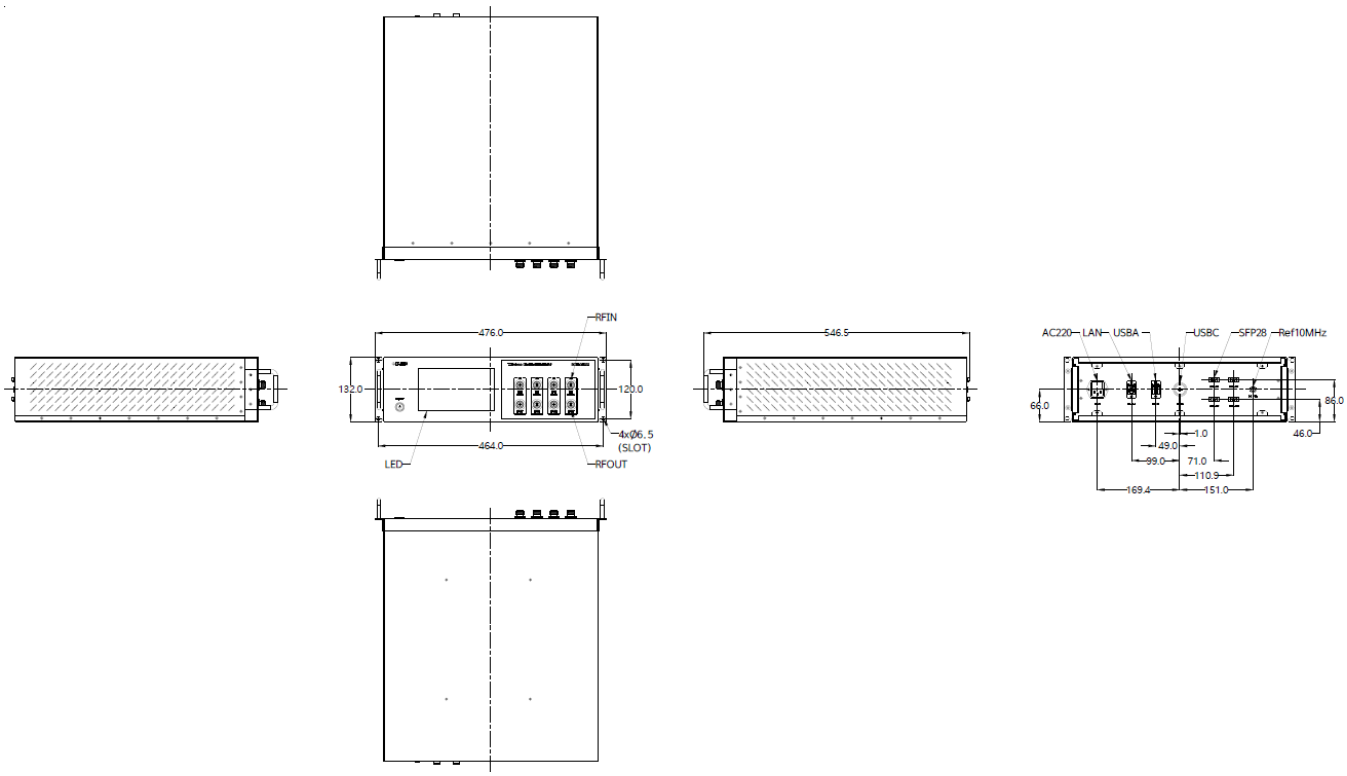
Item	Specification	Remarks
Input voltage	110/220VAC	
Power consumption	150W(Max)	
RF input frequency	200~2100MHz	BW = Up to 600MHz/CH
RF input level	0 dBm(Max)	
RF output frequency	200~2100MHz Up to 600MHz/CH	
RF output level	-10dBm (Max)	
System fixed gain adjustment	-20~20dB	
Dynamic Gain Control	-20~20dB	Supports dynamic gain simulation based on channel profiles.
Delay Emulator	16us~500ms	Supports dynamic delay simulation based on channel profiles.
Fixed Frequency Offset	0.5(Hz) ~ xx MHz)	
Worst-Case LEO Channel Modeling	Simulation of time- and frequency-domain Doppler effects based on satellite altitude.	
Fading Model	Supports Rician and Rayleigh fading models..	Provides example wireless channel profiles for mobile networks and supports user-defined custom channel profiles
Display	7-inch touchscreen	
IF input ports	2 channels (2 dummy channels for SCE-4202)	
IF output ports	2 channels (2 dummy channels for SCE-4202)	

Item	Specification	Remarks
Ethernet port	1	
USB port	1	
Weight	6.5Kg	
Dimensions	420 x 380 x 480 (mm)	
Dimensions	420 x 380 x 480 (mm)	

1.3 Technical Drawings & Dimensions

Drawings

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1.4 Product Warranty

Warranty Period

- A free warranty is provided for one year from the date of purchase.
- However, consumables (cables, etc.) may be subject to a separate warranty period.

Free Repair

Free repair is available within the warranty period in the following cases:

- Malfunction or failure of the product occurring during normal use
- Problems caused by manufacturing defects

Paid Repair

Repairs will be charged in the following cases, even within the warranty period:

- Failure caused by user negligence or unauthorized modification
- Damage caused by natural disasters (fire, lightning, flooding, etc.)
- When proof of purchase is not provided

Proof of Purchase

- Please keep the warranty card or purchase receipt to receive warranty service.

Customer Support

- For product inquiries and service requests, contact your place of purchase or the address below, also listed on our website:

- mantis@mantistech.co.kr

Section 2: Product Configuration and Installation

2.1 Product Layout



Component	Component
① Handle	⑦ Ethernet (※ administrator port)
② Power ON/OFF switch	⑧ USB A
③ Touch GUI: function selection / status display	⑨ USB C (※ administrator port)
④ Analog signal input/output ports	⑩ Optical port (※ administrator port)
⑤ Standard 19-inch rack mounting holes	⑪ Ref 10MHz Clock In
⑥ Power input: AC 115–230V, ON/OFF switch	

2.2 Installation and Power-Up

1. Connect 220VAC 60Hz power to the AC connector on the rear panel.

2. Turn ON the power switch at the lower left of the front panel.

3. Wait until the unit has finished booting.

4. Check the initial GUI screen.

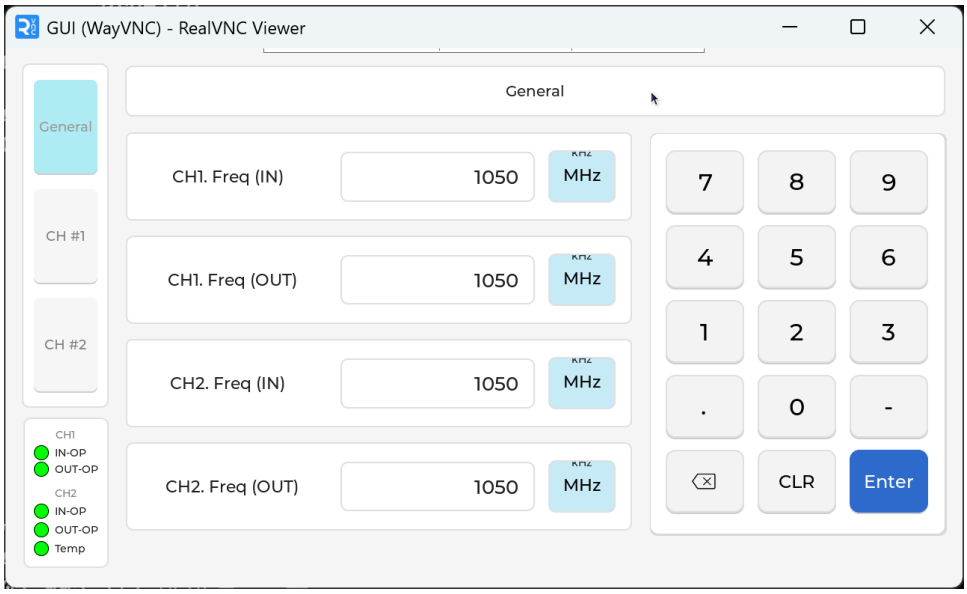


Figure 1. Initial screen

5. Touch the screen to confirm that it responds normally.

Section 3: Operation

3.1 Basic Operation

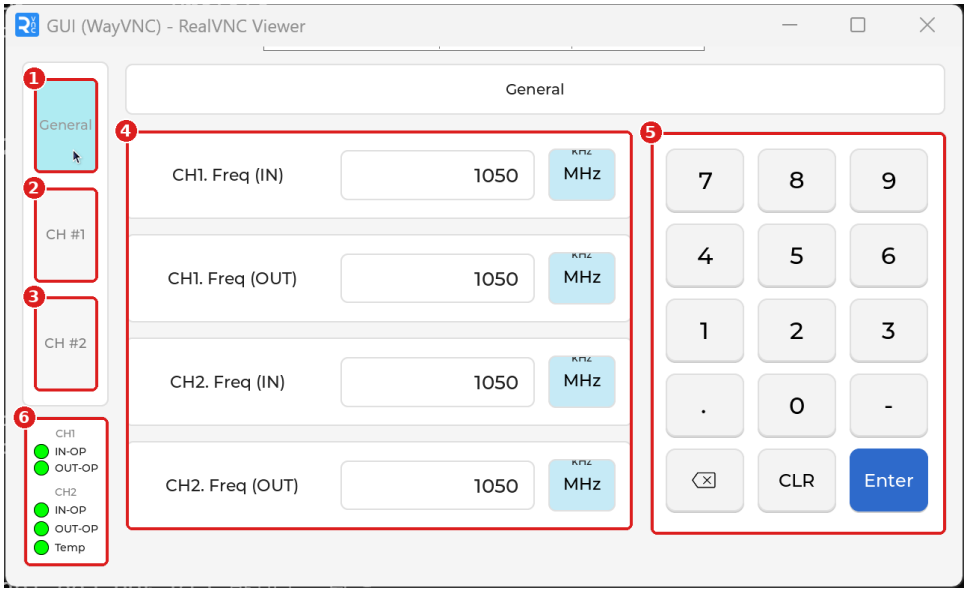


Figure 2. GUI screen layout (General tab)

The initial (General) screen is divided into six areas.

1. General tab (general settings, initial screen)

· Sets the CH1/CH2 input/output frequencies

2. CH #1 tab: CH1 channel emulation settings

3. CH #2 tab: CH2 channel emulation settings

4. Input/output frequency setting area

· Touch the value field for CH1. Freq (IN/OUT) or CH2. Freq (IN/OUT), enter a value with the keypad, and touch Enter. Use the slider button (MHz/kHz) to change the unit.

5. Input keypad (touch)

· Enters digits, the decimal point (.) and the minus sign (-). ⌫ deletes one character, CLR clears the entry, and Enter applies the value.

6. Channel status indicators

· Show the operating status of CH1 (IN-OP, OUT-OP) and CH2 (IN-OP, OUT-OP, Temp): green when normal, red when there is a fault (see Section 3.6).

3.2 Fixed Delay Setting (GEO and Fixed Base Station Emulation)

In this mode, the signal entering each channel is output with a fixed delay. The delay can be set independently for each channel from a minimum of 16us to a maximum of 500ms. The frequency offset and the level of the transmitted signal can also be changed.

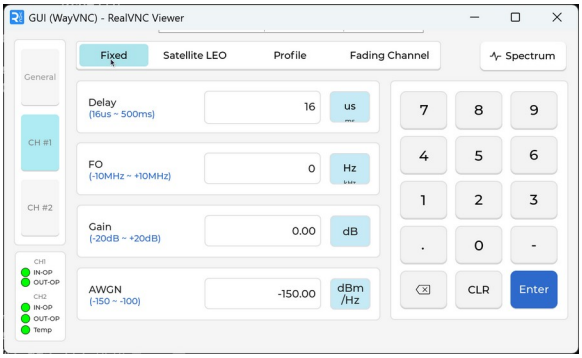


Figure 3. Fixed mode screen (CH #1)

1. Select (touch) the CH1 tab

· Touching the CH #1 tab shows four mode tabs at the top (Fixed, Satellite LEO, Profile, Fading Channel) and a Spectrum button. Touch the Fixed tab. (CH #2 is set independently in the same way.)

2. Set the fixed delay value

· Can be set from 16us to 500ms in 1ns steps. Touch the value field, enter a value with the keypad, and touch Enter to apply it. Use the unit button (us/ms) to switch units.

3. Set the frequency offset (FO)

· Can be set from -10MHz to +10MHz in 1Hz steps (unit switchable between Hz and kHz). Offsets larger than ±10MHz can be achieved by setting the input/output frequencies on the General tab.

4. Set the input signal gain

· Gain can be set from -20dB up to 20dB, within the maximum output level (-10dBm).

5. Set the noise emulation

· AWGN can be applied, with a noise density from -150dBm/Hz up to -100dBm/Hz.

The delay value can be entered in us or ms by switching with the unit button. Figure 4 shows a setting of 100us and Figure 5 a setting of 250ms.

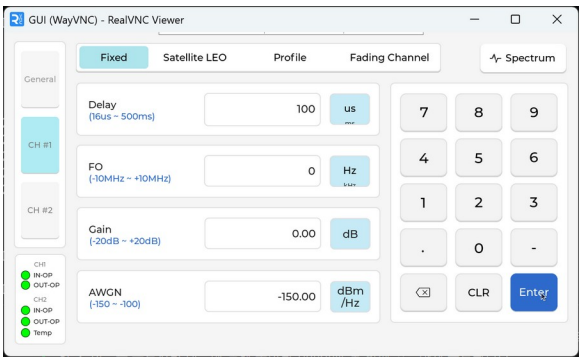


Figure 4. Example: delay set to 100us

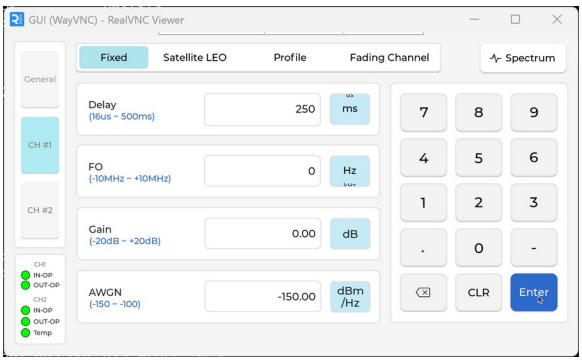


Figure 5. Example: delay set to 250ms (unit: ms)

Below are examples of actual signals measured with an oscilloscope (100us/div) for different delay settings. CH1 (yellow) is the input signal and CH2 (light blue) is the delayed output signal. With the delay set to 100us, the output appears about 100us after the input (Figure 6); with 200us, about 200us after (Figure 7).

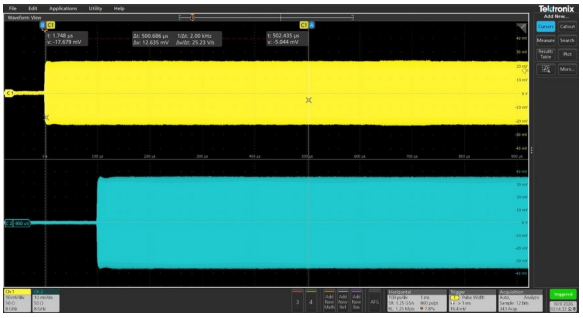


Figure 6. Oscilloscope measurement (delay 100us)

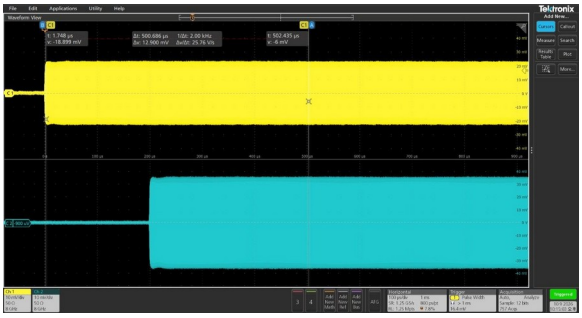


Figure 7. Oscilloscope measurement (delay 200us)

3.3 Frequency Setting and Spectrum Screen

Set the input (IN) and output (OUT) frequencies of CH1/CH2 on the General tab, and view the input/output signals on the Spectrum screen of each channel tab.

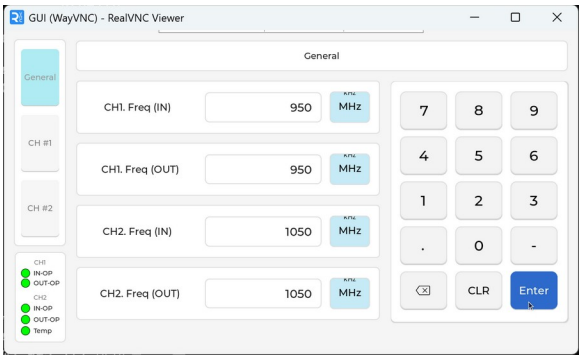


Figure 8. General tab: CH1 Freq set to 950MHz

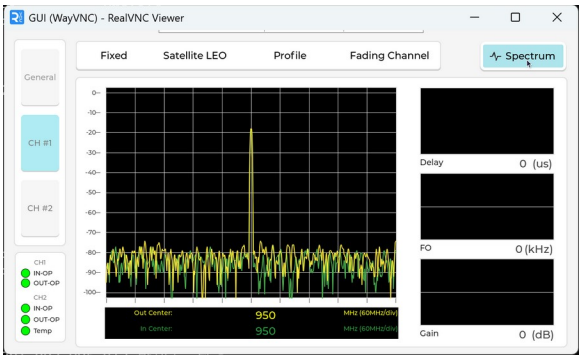


Figure 9. Spectrum screen (center frequency 950MHz)

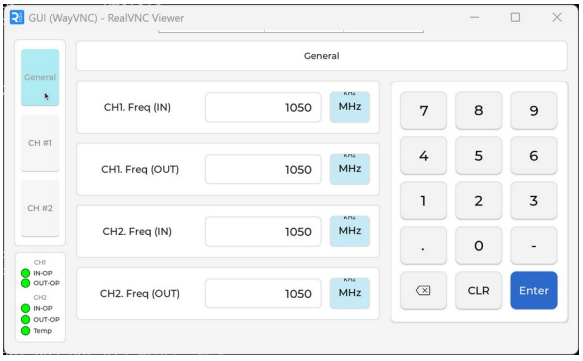


Figure 10. General tab: set to 1050MHz

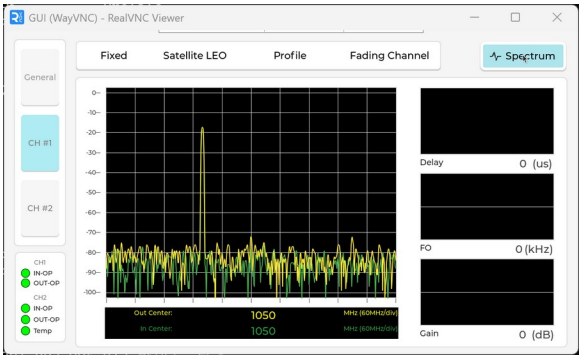


Figure 11. Spectrum screen (center frequency 1050MHz)

1. Frequency setting (General tab)

· Touch the value field of the item to set (CH1. Freq (IN), CH1. Freq (OUT), CH2. Freq (IN), CH2. Freq (OUT)), enter a value with the keypad, and touch Enter to apply it.

2. Spectrum screen

· Touch the Spectrum button on the CH #1 (or CH #2) tab. The yellow trace is the output (Out) signal and the green trace is the input (In) signal. Out Center / In Center at the bottom show the screen center frequency (MHz, 60MHz/div).

3. Delay / FO / Gain display

· The currently applied delay (us), frequency offset (kHz) and gain (dB) are shown on the right of the screen. In Fixed mode only the values are shown; in Satellite LEO mode, graphs of their change over time are also shown (Figure 22).

4. Measurement example

· With a 950MHz signal at the input and the frequency set to 950MHz, the signal appears at the center of the screen (Figure 9). Changing the center frequency to 1050MHz moves the screen center to 1050MHz, and the 950MHz signal appears 100MHz to the left of center (Figure 11).

3.4 Gain Setting and Measurement Example

The Gain item on the Fixed tab adjusts the level of the signal passing through the channel in the range -20dB to +20dB (within the maximum output level of -10dBm). Below are examples of the output signal (yellow) level relative to the input signal (green).

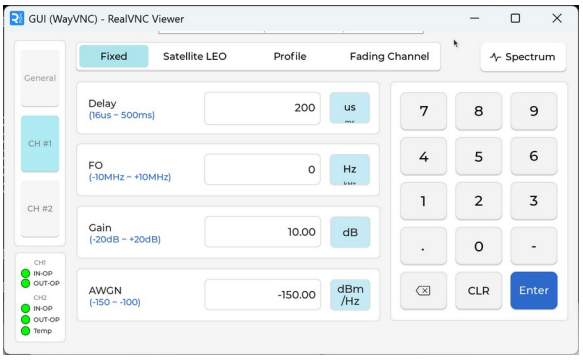


Figure 12. Gain set to +10dB

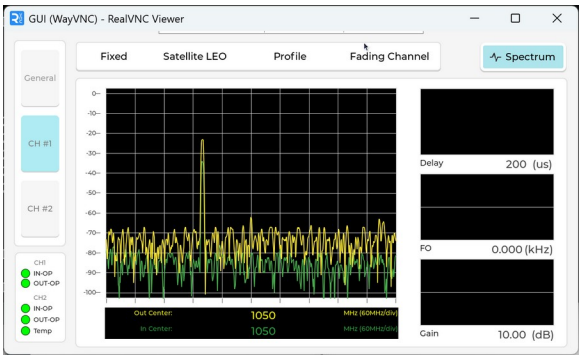


Figure 13. Spectrum screen (Gain +10dB)

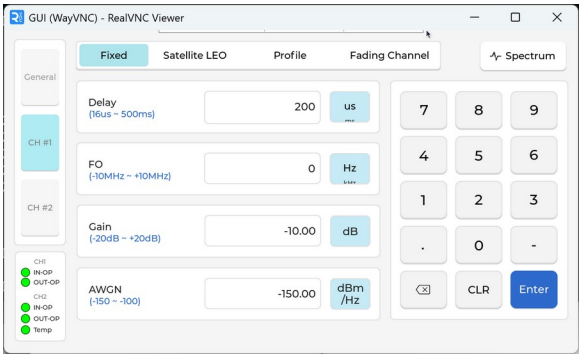


Figure 14. Gain set to -10dB

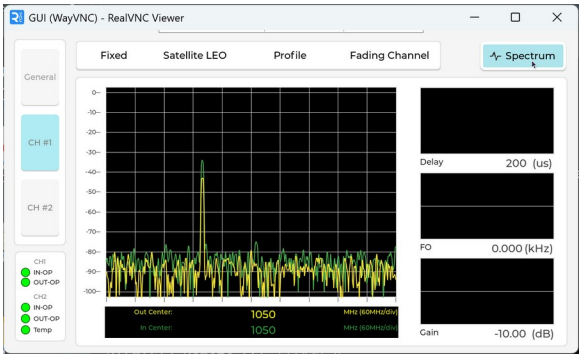


Figure 15. Spectrum screen (Gain -10dB)

1. Gain set to +10dB

· The output (yellow) signal peak appears about 10dB higher than the input (green) signal, and the Gain window on the right shows 10.00 (dB) (Figure 13).

2. Gain set to -10dB

· The output (yellow) signal peak appears about 10dB lower than the input (green) signal, and the Gain window on the right shows -10.00 (dB) (Figure 15).

3.5 Noise (AWGN) Setting and Measurement Example

The AWGN item on the Fixed tab adds noise to the output signal. It can be set from -150dBm/Hz (default) to -100dBm/Hz. Below is an example with AWGN set to -130dBm/Hz.

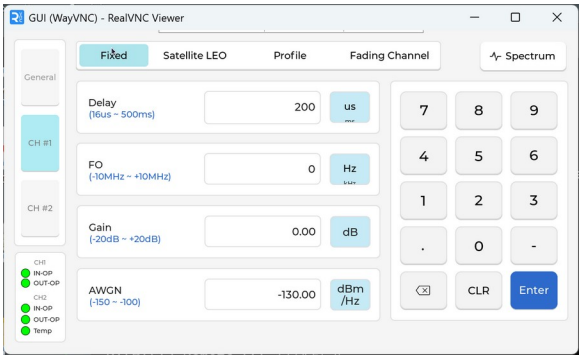


Figure 16. AWGN set to -130dBm/Hz

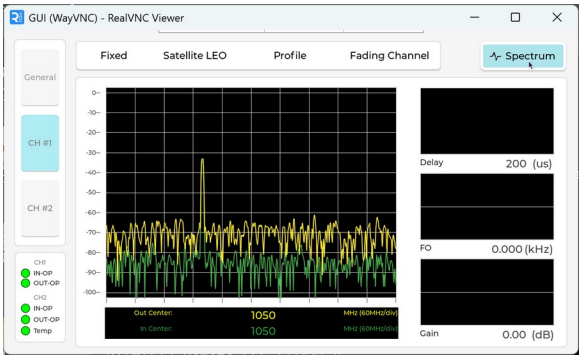


Figure 17. Spectrum screen (AWGN -130dBm/Hz)

1. AWGN setting

· Touch the AWGN value field, enter a value with the keypad, and touch Enter.

2. Checking the result

· On the Spectrum screen, the noise floor of the output (yellow) is higher than that of the input (green). The higher the setting (the closer to -100dBm/Hz), the more noise is added.

3.6 Status Indicators

The channel status indicators are green in normal operation. If there is a fault in the input (IN-OP) or output (OUT-OP) status, the corresponding indicator turns red. Figure 18 shows CH1 OUT-OP in red, and Figure 19 shows CH1 IN-OP in red. If an indicator is red, check the input signal level, the connections, and the Gain/AWGN settings.

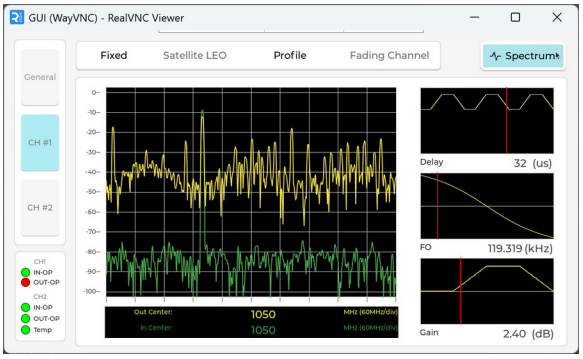


Figure 18. Example: CH1 OUT-OP shown in red

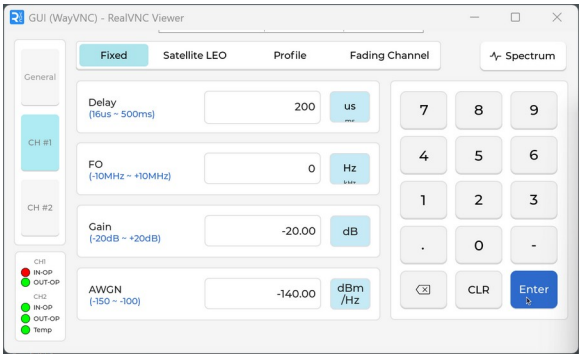


Figure 19. Example: CH1 IN-OP shown in red

Section 4: LEO (Low Earth Orbit Satellite) Channel Emulation

This mode emulates the channel of a low Earth orbit satellite (assuming a spherical Earth). CH1 and CH2 can be set independently; if needed, CH1 can emulate the UP-LINK and CH2 the DOWN-LINK.

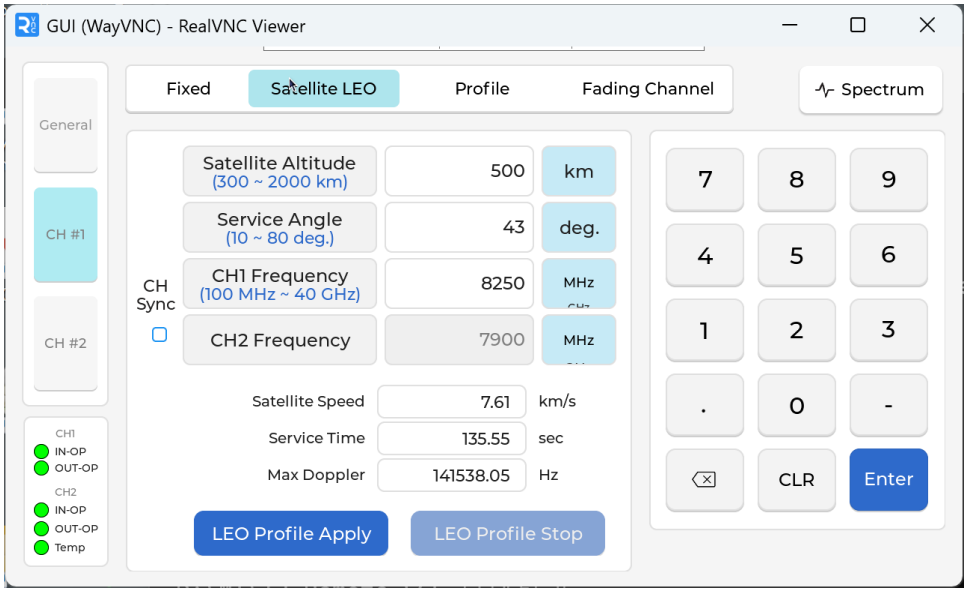


Figure 20. Satellite LEO tab parameter input screen

Touch the Satellite LEO tab on the CH #1 (or CH #2) tab to enter the satellite orbit information and emulate the satellite channel, as shown in Figure 20.

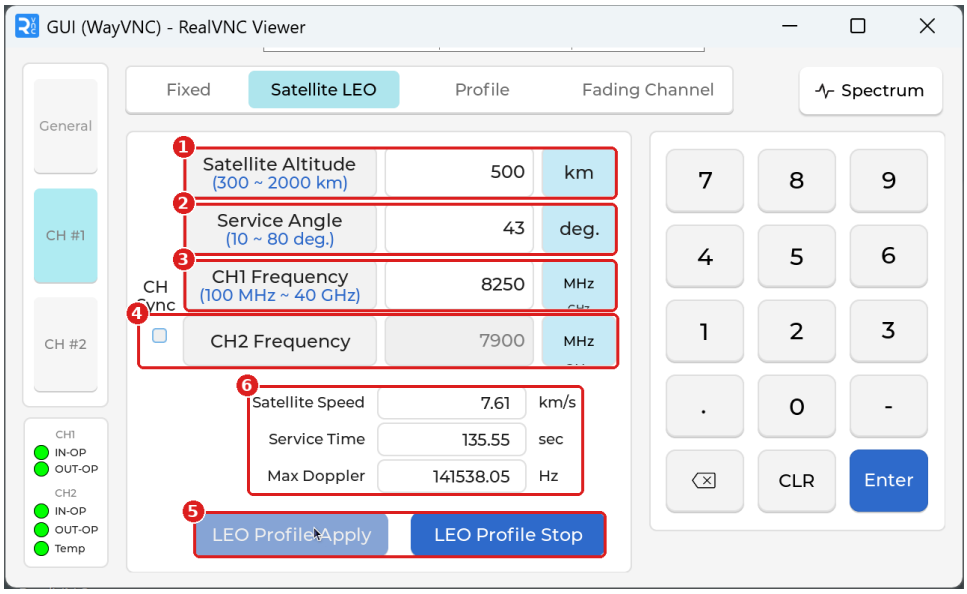


Figure 21. LEO channel emulation (LEO Profile Apply running)

1. Enter the Satellite Altitude

· Enter the height of the LEO satellite measured perpendicular to the Earth's surface. Most are 300–2000km; orbit data for a specific satellite can be found at www.n2yo.com.

2. Enter the Service Angle

· Sets the elevation above the horizon at which communication starts as the LEO satellite passes

overhead along its orbit. Enter an angle between 10 and 80 degrees.

3. Set the satellite signal frequency (CH1 Frequency)

· Can be set from 100MHz to 40GHz. The frequency Doppler is emulated based on this value.

4. Set the CH2 signal frequency (CH2 Frequency) and CH Sync

· Applies the same profile to CH2, using the same altitude and angle and the CH2 frequency. Checking CH Sync lets you enter the CH2 Frequency. This is useful when using the two channels as uplink and downlink.

5. Apply / stop the entered parameters

· Applies the entered parameters to the system and generates delay/Doppler/gain profiles for the LEO satellite. Touching LEO Profile Apply disables the Apply button and enables the LEO Profile Stop button (Figure 21); the other mode tabs are grayed out. Touch LEO Profile Stop to stop the emulation.

6. Calculated values

· Shows the satellite speed, service time and Doppler frequency calculated from the entered parameters. (Example: altitude 500km, angle 43deg., 8250MHz gives Satellite Speed 7.61km/s, Service Time 135.55sec, Max Doppler 141538.05Hz.)

After setup, touch the Spectrum button to monitor the progress of the LEO satellite channel emulation.

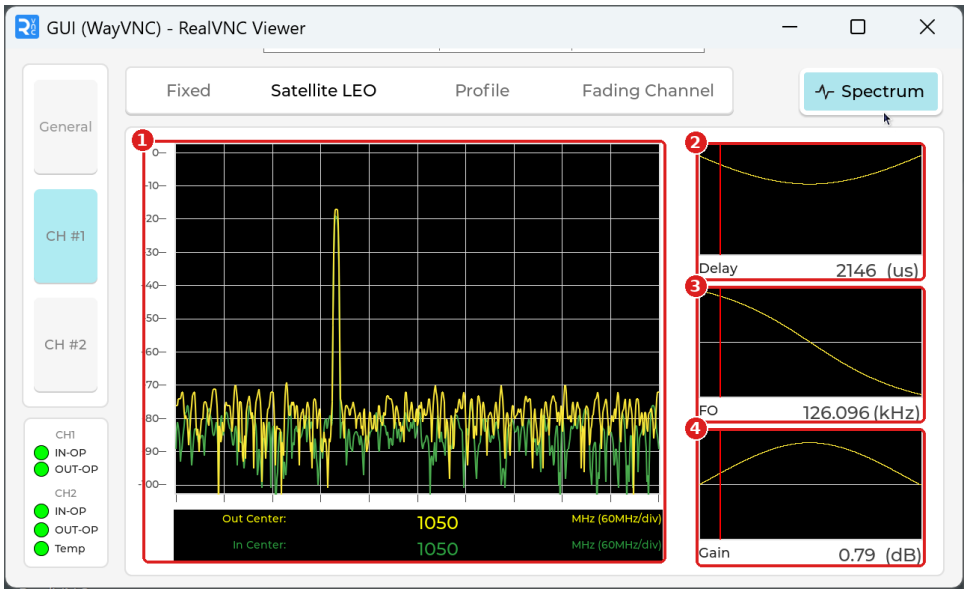


Figure 22. Monitoring LEO channel emulation progress

1. Input/output signals in the frequency domain

· Shows the spectrum of the signals entering and leaving the channel emulator.

2. Delay variation of the LEO emulation

· The current delay of the satellite channel emulation is shown by the Delay value.

3. Doppler frequency variation of the LEO emulation

· The current frequency offset of the satellite channel emulation is shown by the FO value.

4. Relative channel attenuation due to satellite distance

· The current attenuation of the satellite channel emulation is shown by the Gain value, relative to the shortest distance.

· The red vertical line on each graph marks the current position of the emulation. Figure 22 shows an example with Delay 2146us, FO 126.096kHz and Gain 0.79dB being applied.

Section 5: Profile (GEO/LEO/Fixed Station/Mobile Station) Channel Emulation

In this mode, you upload profiles for the specific channel environment you need, and the channel emulator runs according to them.

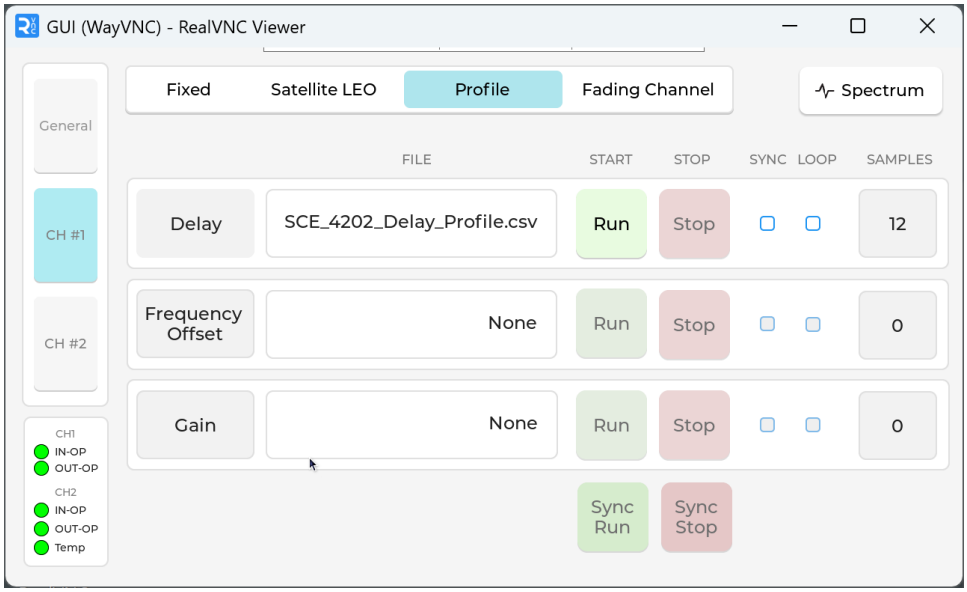


Figure 23. Profile tab screen (after selecting a Delay file)

Touch the Profile tab on CH1 or CH2, then touch Delay, Frequency Offset or Gain to load your own profiles, as shown in Figure 23.

Create the profiles on a PC, save them to a USB memory stick, insert it into the front of the unit, and select and load them as described below.

- For examples and instructions on writing profiles, see "Section 7: Creating Profiles (GEO/LEO/Fixed Station/Mobile Station)" in this manual.

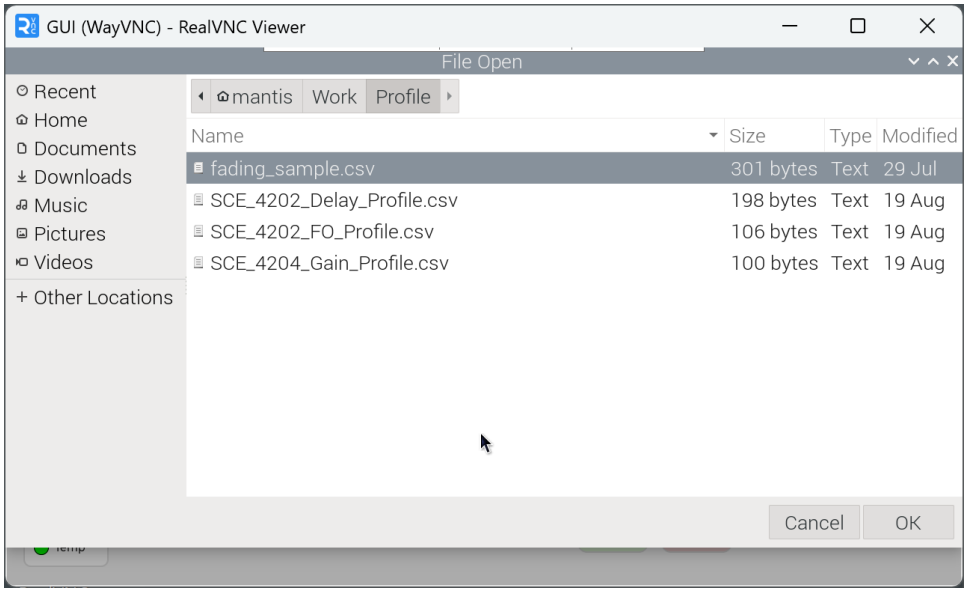


Figure 24. Selecting a profile file (File Open)

Profiles use the standard CSV file format for Delay (channel delay), Frequency Offset (frequency Doppler) and Gain (channel gain).

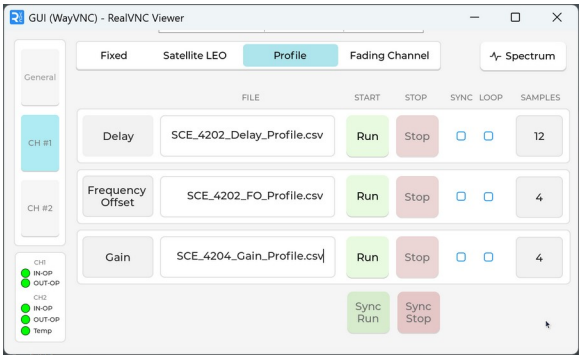


Figure 25. GUI after files are selected (Delay/FO/Gain)

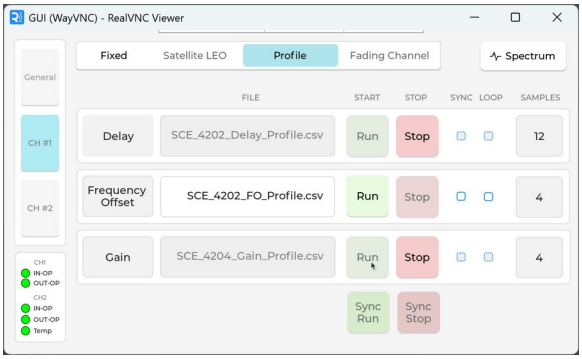


Figure 26. Delay and Gain profiles running individually

Each profile can be run independently by touching [RUN]. Once running, that item's Run button and file field are disabled and its Stop button is enabled; each item can be started and stopped independently (Figure 26).

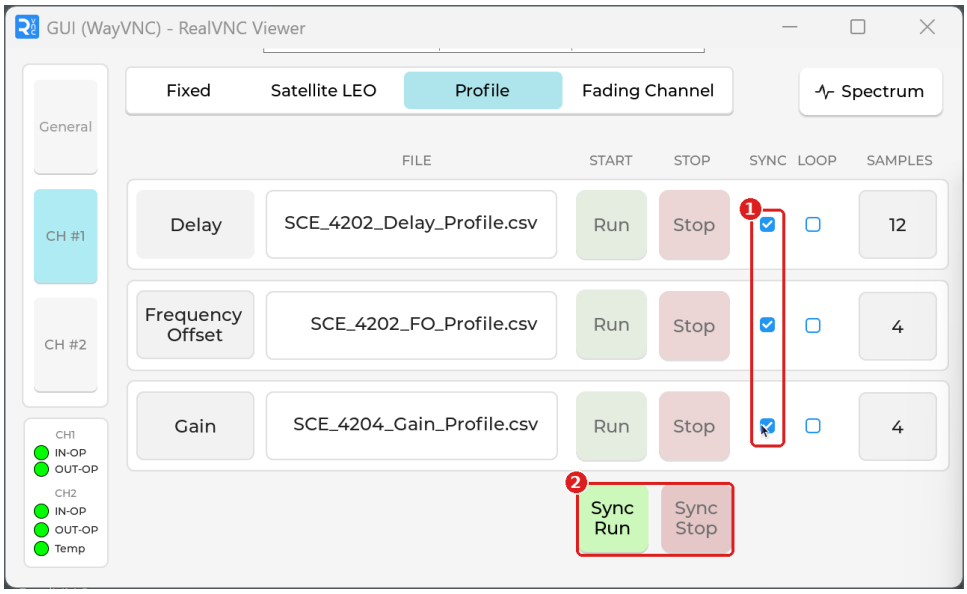


Figure 27. Running profiles together

Check [SYNC] and touch [SYNC RUN] to run different profiles simultaneously, synchronized to a single timing. While SYNC RUN is active, the Delay/FO/Gain changes can be viewed together on the Spectrum screen (Figure 28).

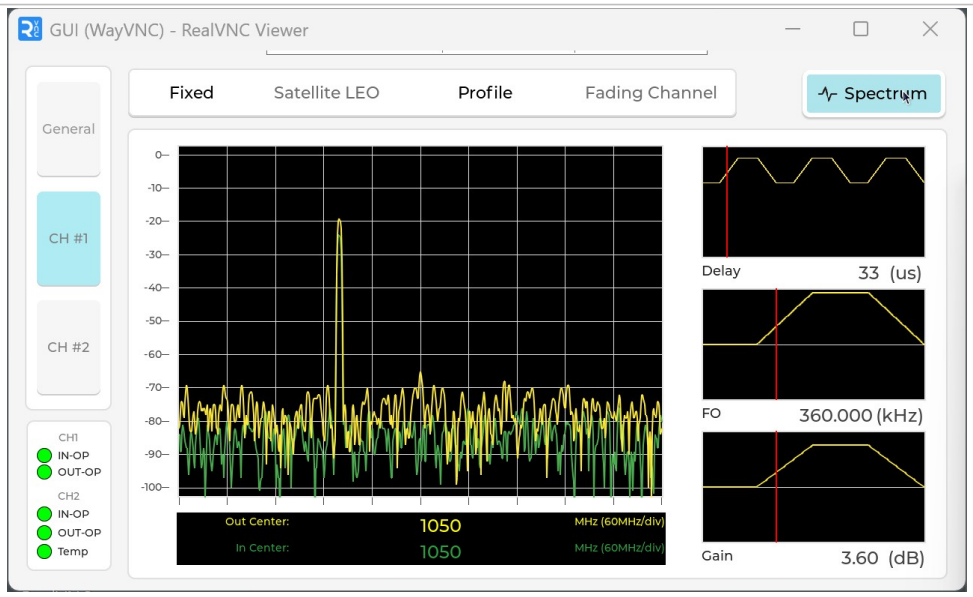


Figure 28. Spectrum screen during SYNC RUN

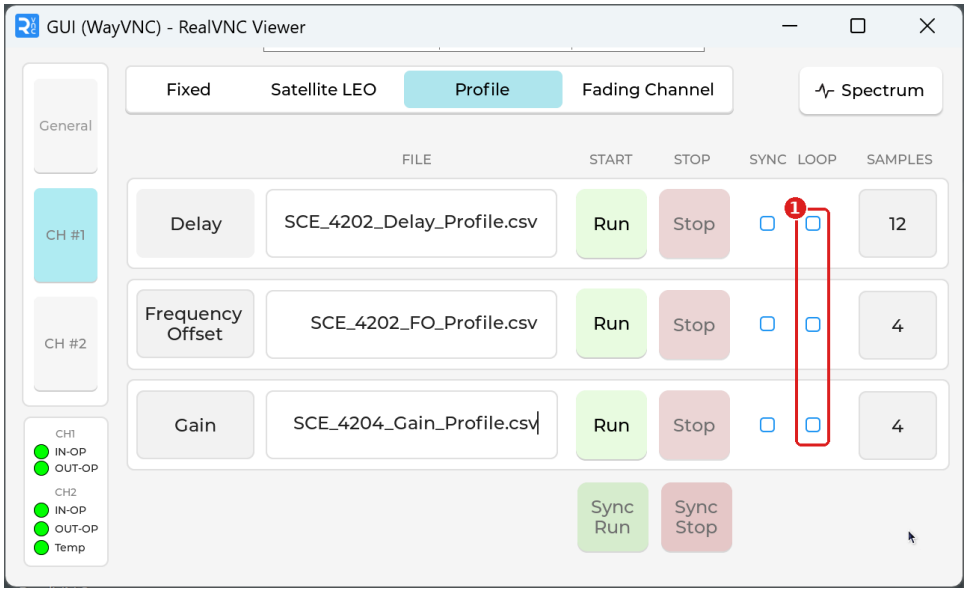


Figure 29. Running profiles in LOOP

Selecting LOOP in individual or SYNC mode runs the selected profiles repeatedly and continuously.

· Note for SYNC mode: the profiles must be the same length to repeat continuously with a consistent channel emulation state.

Each profile file must be in the format for its item (Delay/FO/Gain). If a file in the wrong format is selected (e.g. fading_sample.csv for Gain), Samples shows E-1 and the Run button is not enabled (Figure 30).

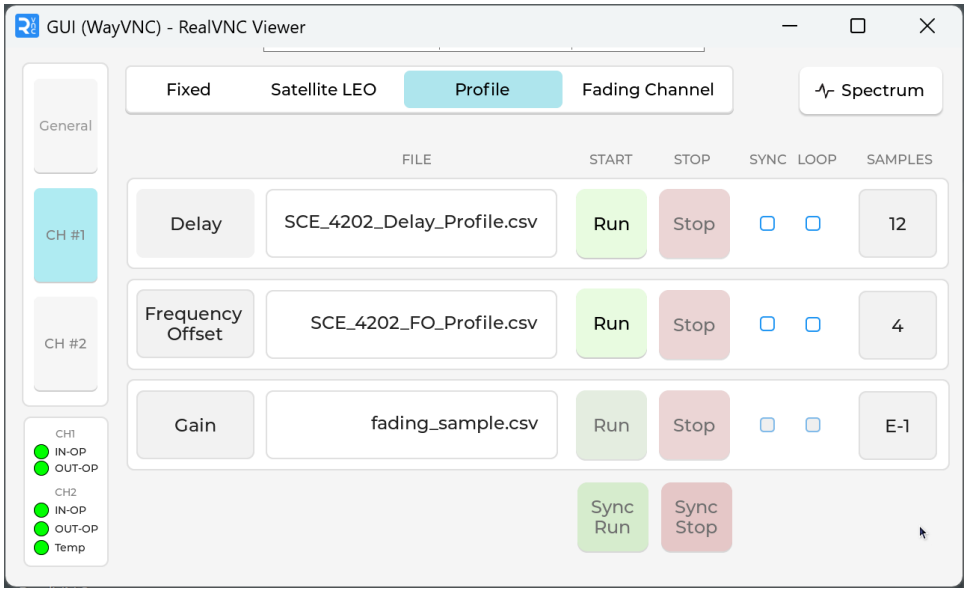


Figure 30. Profile file error example (Gain, Samples: E-1)

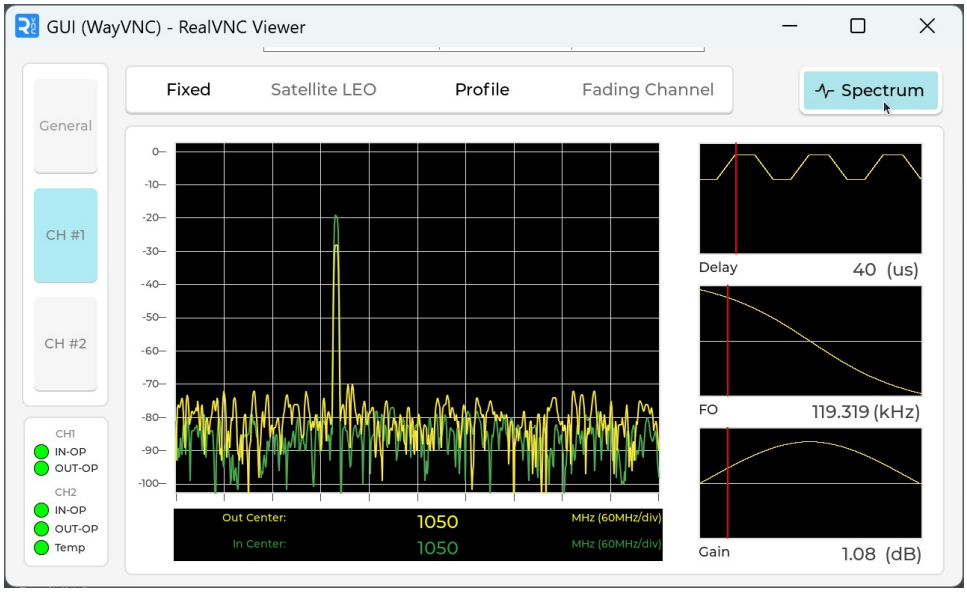


Figure 31. Spectrum screen while a profile is running

After starting Profile mode, touch the Spectrum button to view the channel currently being emulated. The Delay / FO / Gain windows show each profile graph, the current position (red vertical line) and the current value.

Section 6: Fading Channel Emulation

This mode emulates a fading channel in a multipath environment. A Rician or Rayleigh distribution is used, and a channel profile is applied with a delay, gain and maximum Doppler for each TAB (multipath). CH1 and CH2 can be set independently. Fading can be configured only through a profile; the details can be viewed on screen.

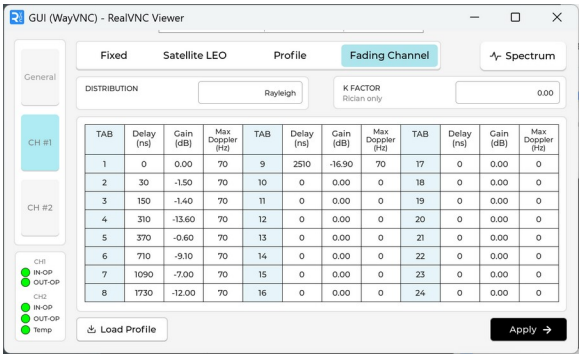


Figure 32. Fading Channel tab (Rayleigh, before applying)

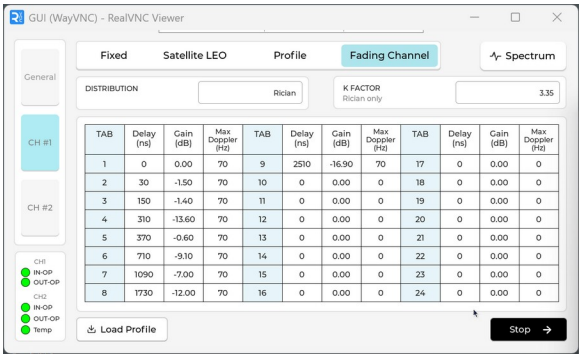


Figure 33. Fading Channel tab (Rician, applied)

1. Select the Fading Channel tab

· Touch the Fading Channel tab on the CH #1 (or CH #2) tab.

2. DISTRIBUTION

· Shows the applied distribution (Rician or Rayleigh). Figure 32 shows Rayleigh and Figure 33 shows Rician.

3. K FACTOR (dB)

· K FACTOR is used only with the Rician distribution (Rician only). It is 3.35 in Figure 33 and shows 0.00 for the Rayleigh distribution (Figure 32).

4. TAB table

· Shows the Delay (ns), Gain (dB) and Max Doppler (Hz) of up to 24 TABs. For example, TAB 2 is 30ns / -1.50dB / 70Hz and TAB 9 is 2510ns / -16.90dB / 70Hz; unused TABs show 0.

5. Load a fading profile

· Touch Load Profile to load a fading profile file (CSV, e.g. fading_sample.csv).

6. Apply / Stop

· Touch Apply to apply the configured fading channel; while it is applied the button changes to Stop (Figure 33). Touch Stop to stop the emulation.

7. Spectrum

· Touch the Spectrum button to view the spectrum of the input/output signals.

Section 7: Creating Profiles (GEO/LEO/Fixed Station/Mobile Station)

- Profiles for use in Profile mode are created as follows.
- A profile can have from 1 to 1024 lines and must follow the format of the Excel file provided.

The template can be downloaded from our website, http://www.mantistech.co.kr/.

- Delay / FO / Gain Profile

Line 1 holds the initial value of the profile. The allowed initial-value ranges are 16000–500000000 (ns) for Delay, -10–10000000 (Hz) for FO, and -20.00–20.00 (dB) for Gain. Taking line 3 as an example, it means a change of 0 ms, 0 Hz and 0 dB over 5000ms. The time unit of each change period is ms.

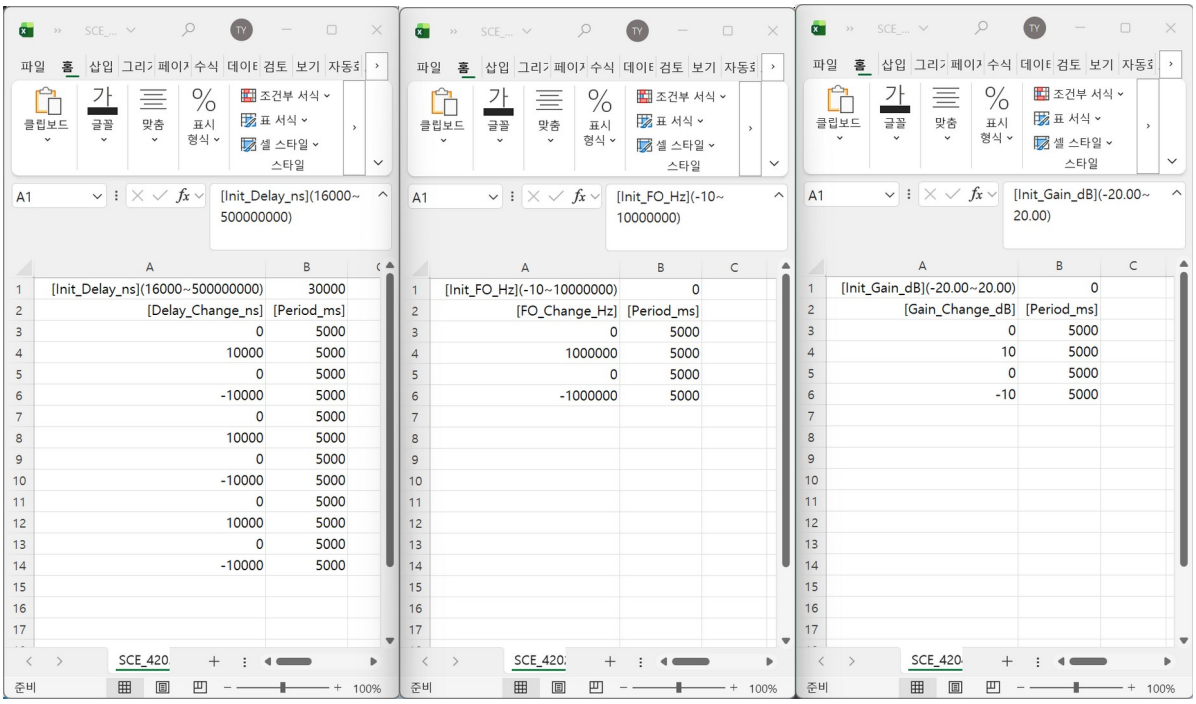
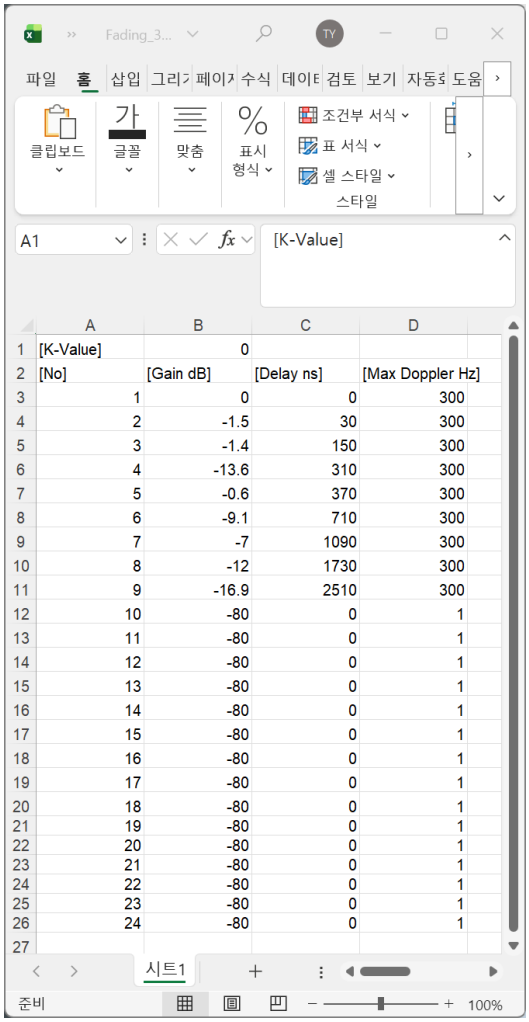


Figure 34. Delay/FO/Gain profile examples

- Fading Profile

Line 1 holds the K-Value. A K-Value of 0.0 means Rayleigh; any other value means Rician. No is the tap number, up to a total of 24. Taking line 3 as an example, it applies Gain 0 dB, Delay 0 ns and Max Doppler 300 Hz to Tap 1.



	A	B	C	D
1	[K-Value]	0		
2	[No]	[Gain dB]	[Delay ns]	[Max Doppler Hz]
3	1	0	0	300
4	2	-1.5	30	300
5	3	-1.4	150	300
6	4	-13.6	310	300
7	5	-0.6	370	300
8	6	-9.1	710	300
9	7	-7	1090	300
10	8	-12	1730	300
11	9	-16.9	2510	300
12	10	-80	0	1
13	11	-80	0	1
14	12	-80	0	1
15	13	-80	0	1
16	14	-80	0	1
17	15	-80	0	1
18	16	-80	0	1
19	17	-80	0	1
20	18	-80	0	1
21	19	-80	0	1
22	20	-80	0	1
23	21	-80	0	1
24	22	-80	0	1
25	23	-80	0	1
26	24	-80	0	1
27				

Figure 35. Fading profile example

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적합성 평가를 받은 자의 상호	주식회사 멘티스테크놀로지
기자재 명칭	Channel Emulator
모델명	SCE-C4202
인증번호	R-R-MNTS-SCE-C4202
제조년월	. .
제조자/제조국가	주식회사 멘티스테크놀로지/한국