Report Title: Exploring the demodulation features of FSW.
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Description: A signal with a binary pulse shifts keying (BPSK) modulation was generated from the signal generator (SMA) and demodulated using the signal and spectrum analyzer (FSW)'s I/Q analyzer.
Objective: - *Explore the features of generating modulated signal on the SMA and the demodulation features of the FSW.*

1. Procedure

This section discusses the procedure to produce a modulated signal on the SMA and to view the demodulated signal on the FSW.

[1]. Turning on the SMW shows the screen shown in figure 1. Begin by selecting the Baseband block.

From the list of options shown in figure 2, under the section "Misc", select "Custom Digital Mod…".

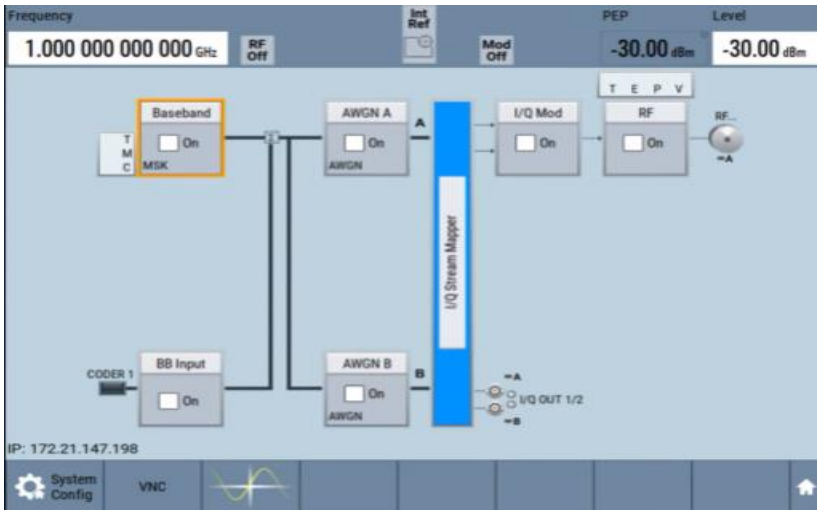

Figure 1. SMW display screen

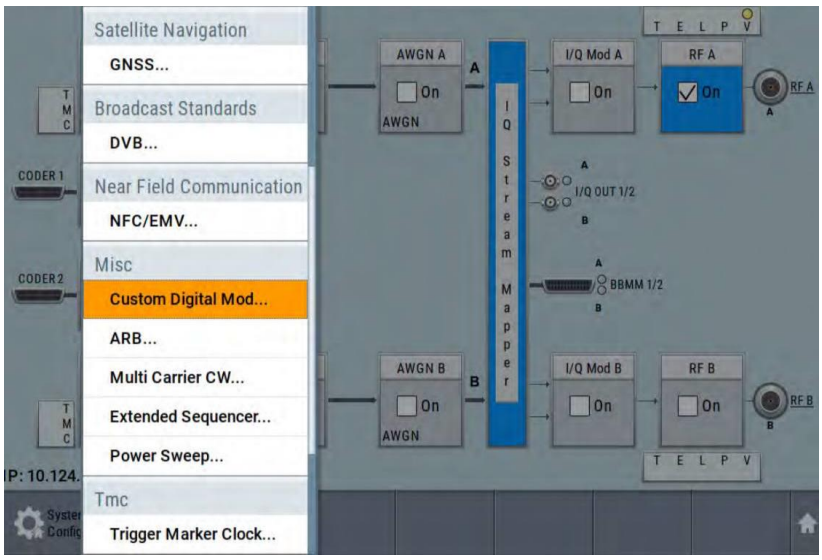

Figure 2. Directions of step 1.

[2]. On the "Custom Digital Modulation" dialog, shown in figure 3, change the "Symbol Rate" as needed. In this application, the symbol rate was set to 100 Ksym/s. Set the state to "On" to enable the baseband signal generation.

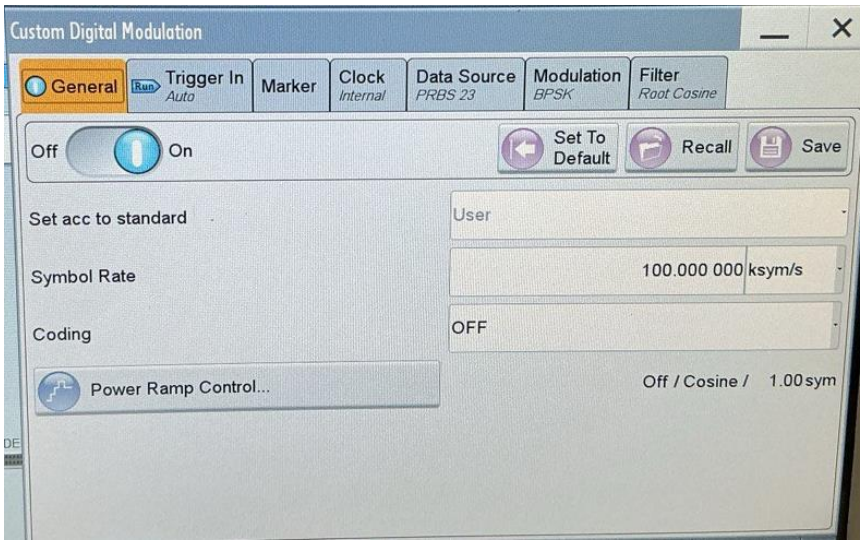

Figure 3. Custom digital modulation dialog, general tab.

[3]. Select the "Modulation" tab. In the modulation dialog, select the desired "Modulation type". Figure 4 shows the BSPK selected as the modulation type.

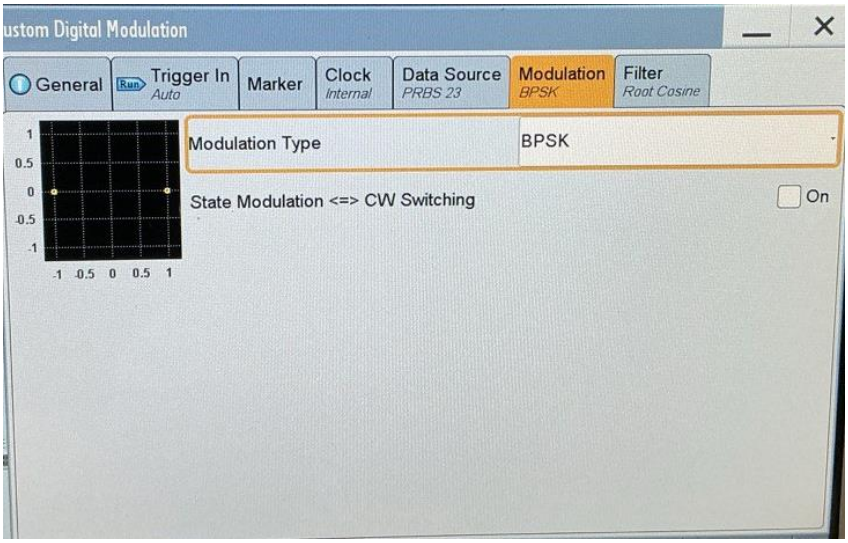

Figure 4. Custom digital modulation dialog, modulation tab.

[4]. Select the "Filter" tab. In the filter dialog, select the desired filter and roll off factor. Here, the filter "Root Cosine" was selected and the roll off factor was set to 0.35, as shown in figure 5, and close the dialog.

[5]. Next, in the block diagram, select the "I/Q Mod" block.

[6]. Navigate to the section "I/Q Mod In" and select the "Internal Baseband I/Q In" option, as illustrated in figure 6, and under the section "I/Q Settings", select, "I/Q Modulator…".

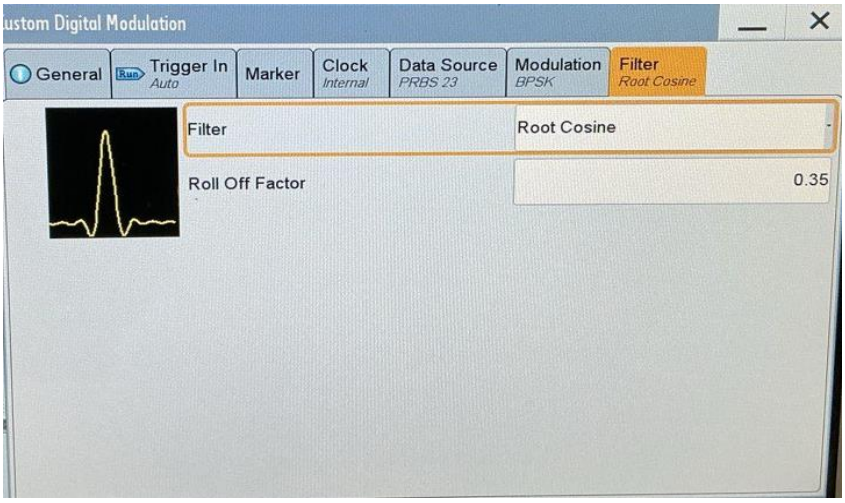

Figure 5. Custom digital modulation dialog, filter tab.

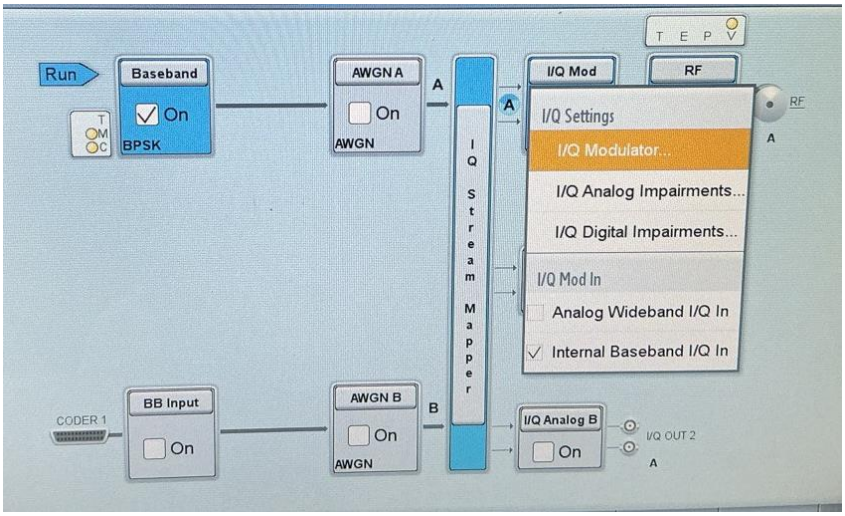

Figure 6. Direction of step 5.

[7]. Figure 7 shows the "I/Q Modulator" dialog. Set the "State" to "On". Select the "Source" as "Internal Baseband", as shown in figure 7, and close the dialog.

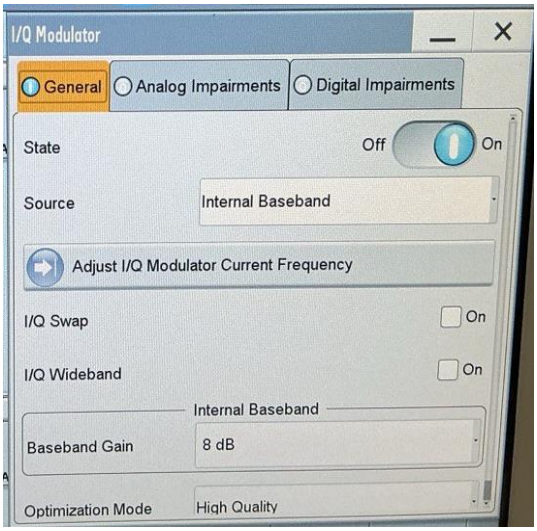

Figure 7. I/Q modulator dialog.

[8]. Next, set the frequency of the and power level of the RF signal, and turn the signal on. Here, the frequency was set to 2.4 GHz, and the power level was set to -10 dBm.

[6]. The generated baseband signal can be viewed, by selecting the sine wave option at the bottom, shown in figure 8, which opens the "Graphic Generator" dialog.

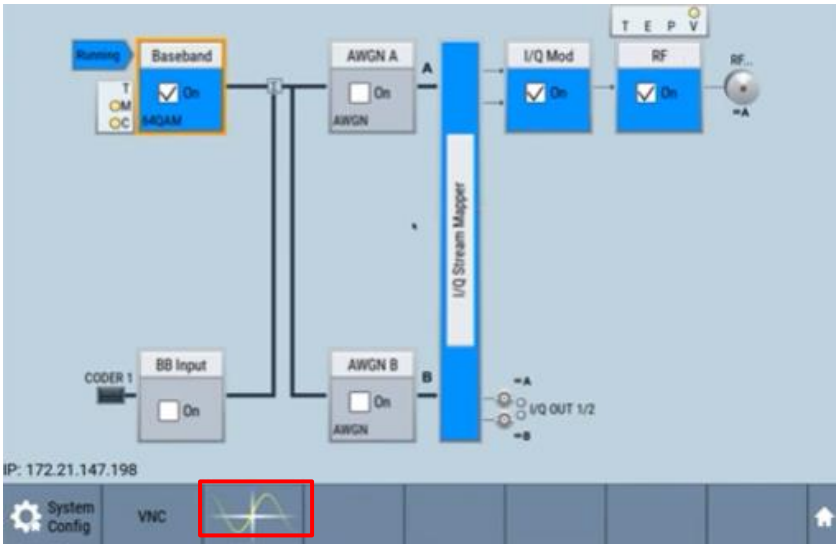

Figure 8. SMW screen, with red box at the sine graphic generator

[10]. In the " Graphic Generator" dialog, shown in figure 9, select "Mode ", from the list of options select the "Power Spectrum". Under the "Source", select "RF". Finally, select the "Add" shown at the bottom of the dialog. The generated baseband is shown in figure 10.

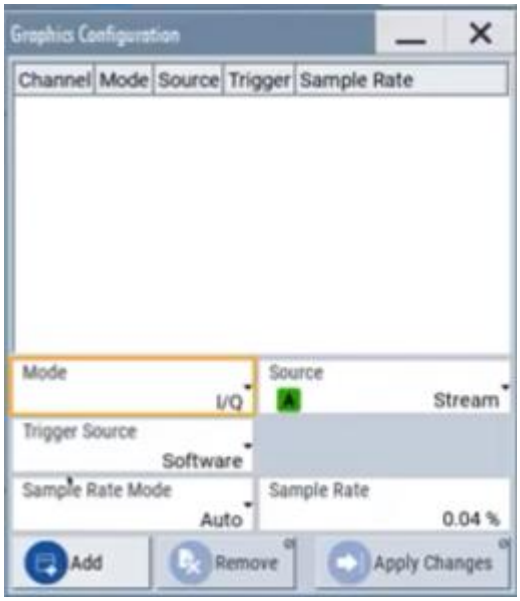

Figure 9. Graphic configuration dialog.

[11]. In the FSW, set the center frequency to generated RF frequency. Figure 10 shows the generated baseband signal to have a bandwidth of around 150 kHz, and hence the span can be set accordingly. Here the span was set to 250 kHz. Other parameters (RBW, VBW, reference level, etc.) can be set as required or desired. Figure 11 shows the FSW spectrum screen.

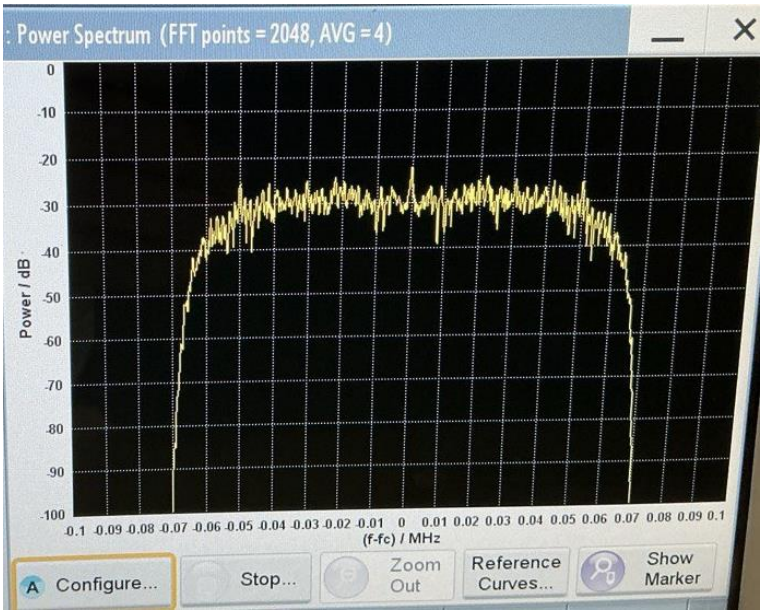

Figure 10. A preview of the generated baseband signal using the graphic generator

Figure 11. Baseband signal on the spectrum analyzer (FSW).

[12]. Next, to look at the signal's demodulation on the FSW, press the mode button, at the bottom of the FSW, then select the modes I/Q analyzer and VSA.

[13]. In the VSA tab, select the "Signal Description" option on the top right side of the screen. This opens the dialog box shown in figure 12. Under the "Modulation" section, set the parameters as those previously set on the SMW, and close the dialog.

[14]. The resulting VSA tab is shown in figure 13. The I/Q (Meas & Ref) graph should be two dots at the coordinates (1,0), and (-1,0). The marker table shows the EVM (error vector magnitude), and other error measurements to be approximately zero.

[15]. Figure 14 displays the I/Q analyzer tab.

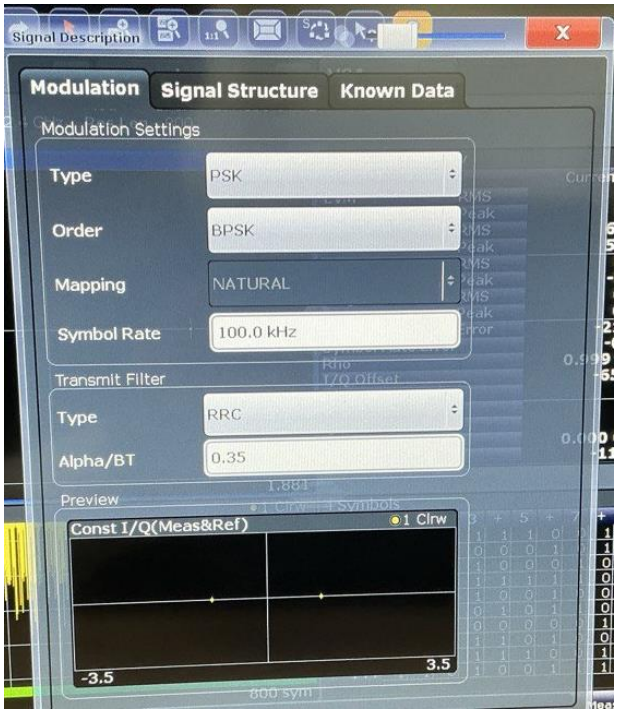

Figure 12. Signal description dialog on the VSA tab.

Figure 13. VSA tab.

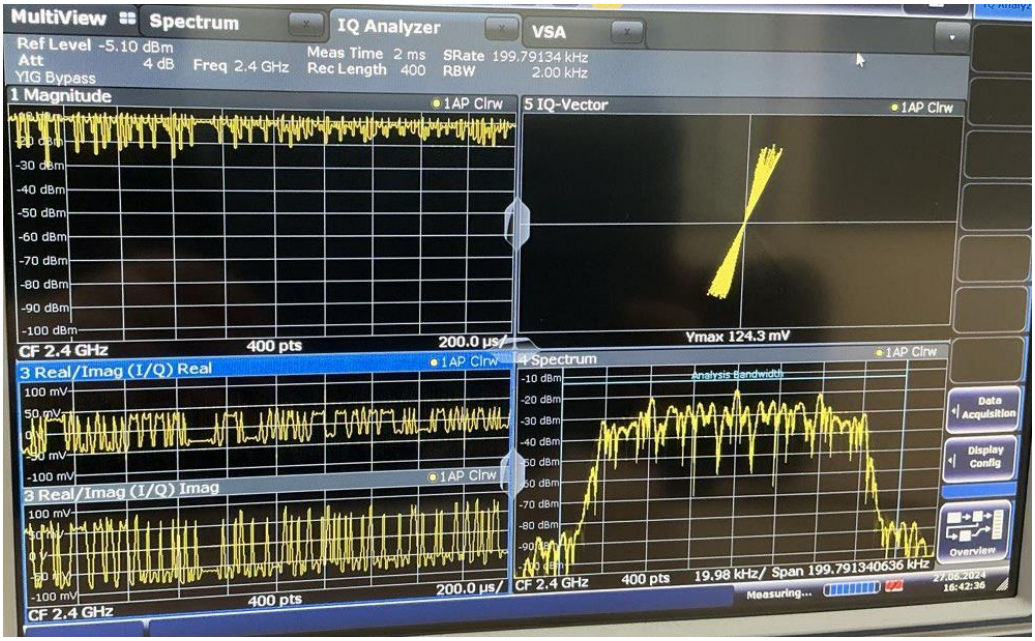

Figure 14. I/Q analyzer tab.

[16] The (Real/ Imaginary) I/Q screen, shown in figure 15, can be magnified by double pressing on it. In BPSK, the signal is modulated by setting the phase of the baseband signal to either 0 or 180 degrees. Hence, the I/Q vector is either ⟨-1×I, Q⟩ or ⟨1×I, -1×Q⟩. This can be seen as marked in figure 16. *(Note, this information may be checked for confirmation).*

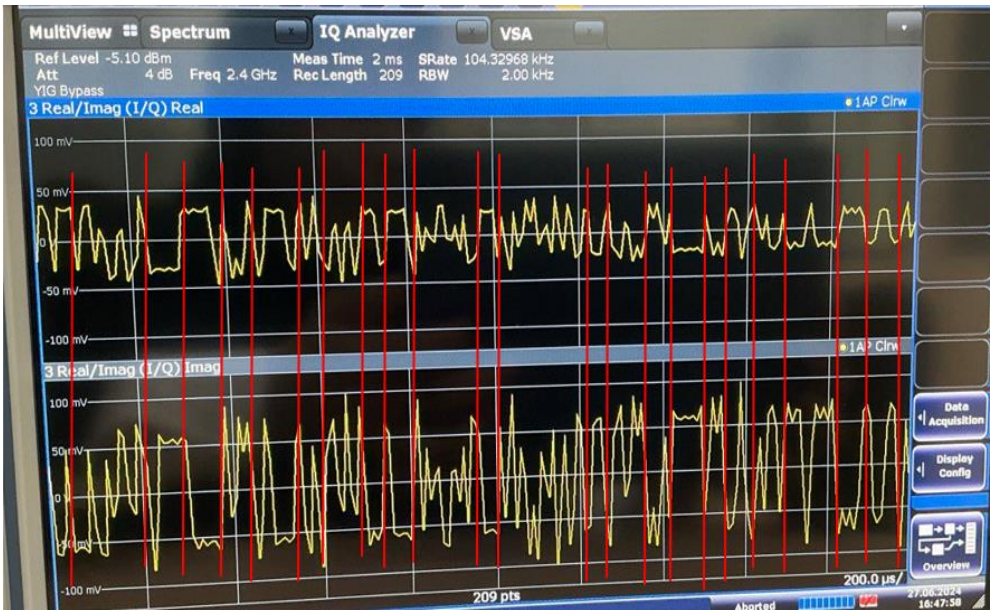

Figure 15. I/Q Real / Imaginary graph.

2. Schematic, Layout or Drawing

The SMW and FSW must be wired using SMA cables as shown in figure 16.

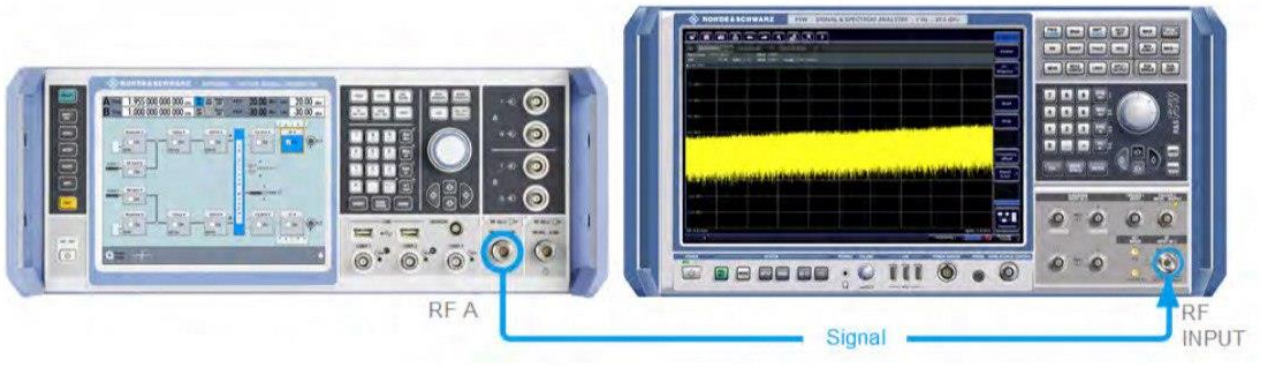

Figure 15. Ports connection between the FSW and SMW.

3. Future Steps

The future step is to experiment with more modulation types and analyze and study the demodulated signals on the FSW. As well as exploring the features of the FSW and SMW related to the passive radar project.