

Measurement of RF Splitter/Combiner with the help of RFME signal source and Power Detector:

This Application note gives a brief overview about the basic parameters of RF splitter and combiner and its measurement with RFME Signal Source and Power Detector.

As the name implies RF splitter is used to split a single RF input into multiple outputs while as a combiner is used to combine multiple inputs into a single output.

Both these passive devices have same circuits which can be used to combine as well as split RF power, the only difference being that in RF splitter the RF power is applied to one port and extracted from other, and in RF combiner, power is being applied in the opposite direction.

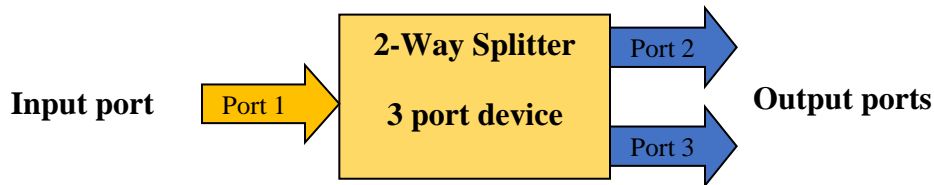


Figure 1: 2-Way Splitter

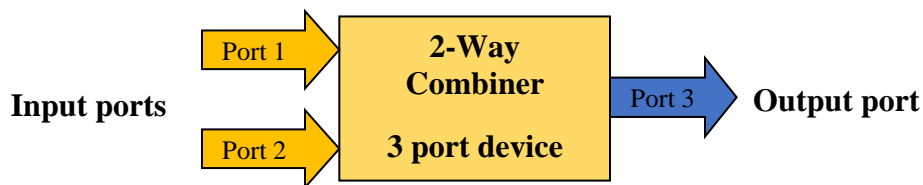


Figure 2: 2-Way Combiner

The output signals of RF splitter/combiner theoretically possess the following characteristics:

- Equal amplitude
- 0° phase relationship between any two output signals
- High isolation between each output signal
- Insertion loss depending upon the number of output ports

The reduction in the output signal level depends upon the number of outputs for which the signal is splitted. Thus the splitter division reduction loss table is as follows:

Number of Output Ports	Theoretical Insertion loss (dB)
2	3
3	4.8
4	6
5	7
6	7.8
8	9
10	10

For direct reading on RFME Signal Source, frequency is set to 2.25 GHz and signal level is -1dBm which is given as an input to the RFME Power Detector with the help of two coaxial cables and one adaptor in between as shown in the Figure: 1. You can easily measure the received signal at RFME Power Detector of -1.6dBm if there is a loss of -0.6dB in the coaxial cables and adaptor connected.

The setup below shows selection of Single mode with the switch position at 'S' on RFME Signal Source and on the RFME Power Detector the switch is selected for dBm. Thus on RFME Signal Source it will display "2.250" for 2.25GHz and on RFME Power Detector results will be displayed in dBm as "-01.6" for -1.6 dBm. In Figure: 1 direct reading with two 50 Ohms coaxial cable and an adaptor in between is shown. Results on RFME Power Detector are displayed in dBm.

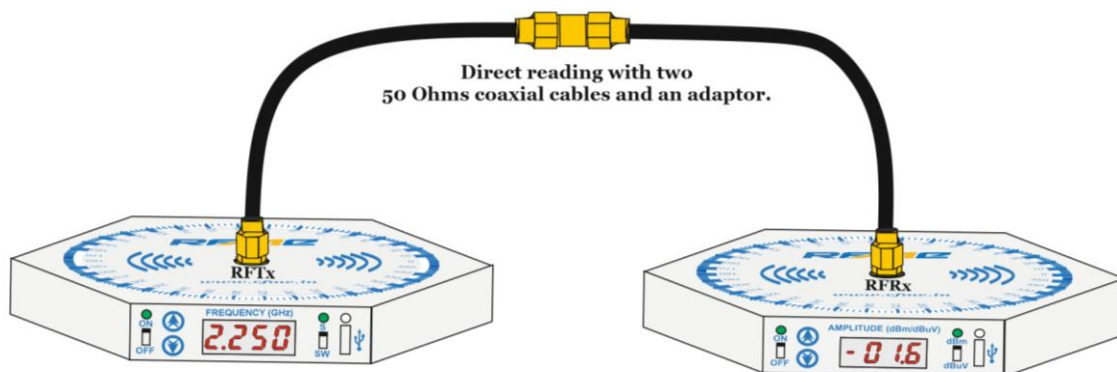


Figure: 1

Below, various setups for the 2-way splitter and 2-way combiner with RFME Signal Source and Power Detector which are used for measurements can be observed.

The direct reading at 2.25 GHz is “-01.6” dBm which is considered as an input to the 2-way splitter and 2-way combiner. *1

Thus in order to measure the insertion loss of Splitter/Combiner, the user first needs to test the 2-way splitter and connect it to the RFME Power Detector at port2 and terminate it with 50 Ohms at port3. The displayed output is “-04.7” dBm. This result shows that the 2-way splitter is under test at 2.25 GHz and has an insertion loss of -3.1dB at port2 since the direct reading is -1.6dBm. Now follow the same procedure for the port3 as well on the same signal input from RFME Signal Source than the displayed result on RFME POWER DETECTOR is “-04.8” dBm. This result interprets that the insertion loss on port3 is -3.2dB at 2.250 GHz. Here the RFME Power Detector is on the dBm selection. To check other frequencies which comes under the band of RFME Signal Source and 2-way splitter, similar procedures which are listed above can be used. *2

Note: *1) 1.6dB loss in the direct reading as measured.

*2) 2-way splitter/2-way combiner can be checked in single mode as well as on the scan mode according to the frequency band of the chosen Signal Source and Power Detector models.

In Figure: 2 setups to measure insertion loss at port2 is shown with results on RFME Power Detector in dBm. Here the adaptor is replaced by the 2-way splitter and port3 is terminated with 50 Ohms.

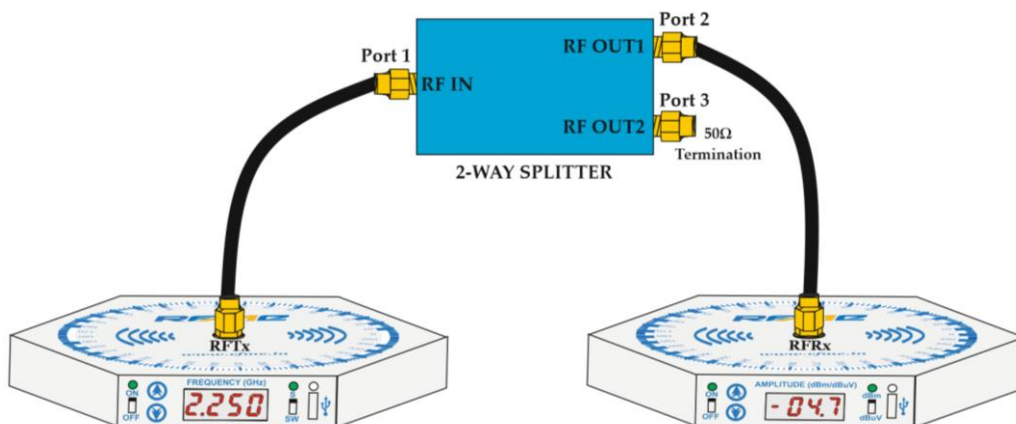


Figure: 2

In Figure: 3 a setup to measure insertion loss at port3 is shown with results on RFME Power Detector in dBm. Port2 is terminated with 50 Ohms at this time.

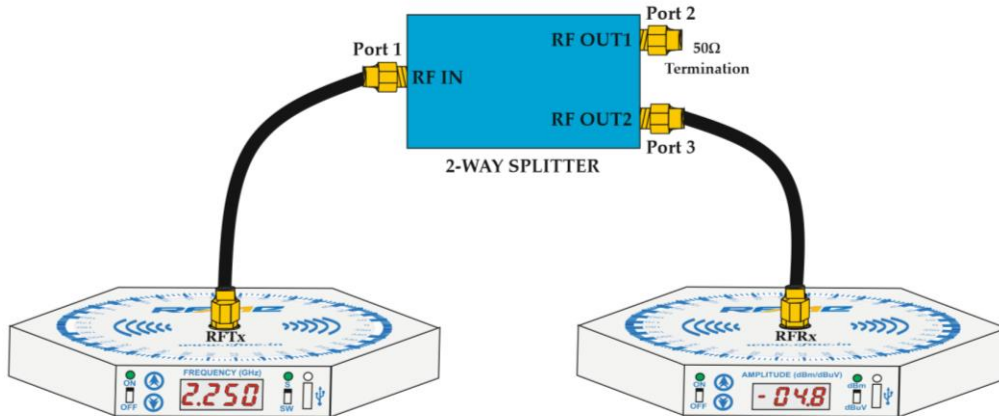


Figure: 3

Test setups for a 2-way combiner are shown in Figure: 4 and Figure: 5. The 2-way combiner has two inputs and one output at the opposite of the 2-way splitter. For doing measurement of the 2-way combiner, an input signal is given with the help of RFME Signal Source at 2.250 GHz of -1.6dBm (direct reading) to the port1 of 2-way combiner with port2 which is terminated with 50 ohms. RFME Power Detector is connected at port 3 which displays the result as “-04.8” dBm when port2 is terminated with 50 Ohms and shows the result as “-04.9” dBm when port1 terminated with 50 Ohms. Thus port3 of 2-way combiner has an insertion loss of -3.1dB when port2 is terminated and has an insertion loss of -3.2dB when port1 is terminated.

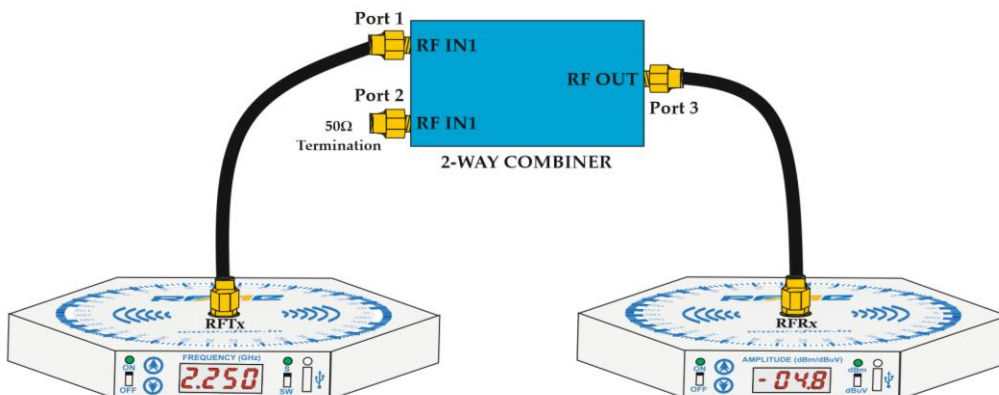


Figure: 4

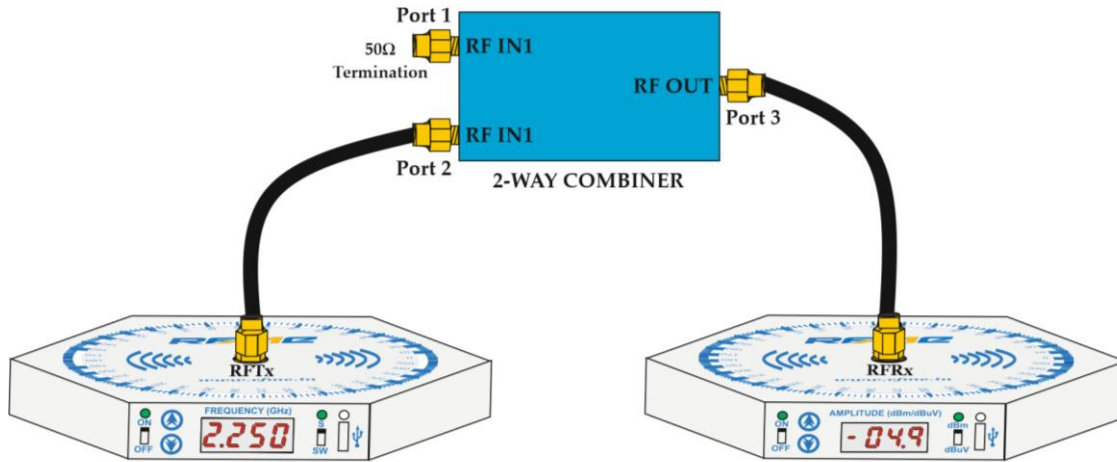


Figure: 5

Following is the table showing the 2-way RF Splitter/Combiner measurement parameters on Signal Source and Power Detector:

Sr.#	Frequency on Tx	Direct Reading on Rx	Reading on Rx for Port2(With Port 3 terminated) RF Splitter	Reading on Rx for Port3(With Port 2 terminated) RF Splitter	Reading on Rx for Port3(With Port 2 terminated) RF Combiner	Reading on Rx for Port3(With Port 1 terminated) RF Combiner
1	2.250 GHz	-01.6dBm	-04.7dBm	-04.8dBm	-04.8 dBm	-04.9dBm

Note: 1) The user can use any RFME Signal source which meets their frequency measurement requirements for the DUT.

2) The measured data on the RFME Power Detector can also be displayed in the dBuV when selected for dBuV with the help of the switch on the front panel.

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