Senior Design Project
T307
2 October 2020
Targets

Table of Contents

SECTION I

1: 2-Channel SDR

This target is moderately important because only one channel is necessary. Customers asked for at least one channel, but if two is possible, it is preferable. Without a channel, there is no signal to display. Channel input and output will be directed to the computer for display purposes. This will be tested by experiments using RF pulses and a computer display. Accomplished by using correct SDR and appropriate software.

2: Prototype can operate with no interruptions for a minimal period of two weeks

This target is important as the customer will be operating the experiments for an x_d (14), number of days. This target had been gathered after a hand-on virtual demonstration performed by one of the MAGLAB representatives over a Zoom call. It will be tested by leaving prototype ON for a different x_d. This target will be tested using a lower frequency source input and output signal analysis testbench and a camera to record the operation of a prototype and review it later.

3: Prototype plots a signal with a frequency in the range of 600 MHz to 800 MHz

This target is moderately important, because the customer operates on frequencies up to 1500MHz, but the requested prototype only needs to work for the specified range of (600 - 800) MHz. This was derived from the customer's needs. Using an oscilloscope, a circuit with the correct frequency range will be able to display the signal, which in return will give values to compare before use of the prototype. This gives information on how to tune the prototype to better the frequency range needed.

4: Sampling rate of SDR's ADC is at least 90ns or 11MSPS

This target is moderately important, due to the circuit running at half-power bandwidth and the accuracy of the results. Half-power bandwidth is a sampling time of about 90 ns or 11MSPS. This will be tested using an oscilloscope with a specific circuit to determine the nr, number of MSPS, before the circuit is hooked up to the prototype to test for similar results. This will be corrected in the coding syntax.

5: SDR must have an external trigger to receive a signal from the pulsed source to synchronize output digital data from SDR with the beginning of the pulse train

This target is very important, because without a trigger function on the SDR, the pulse will not be sent to the prototype. Trigger, T1, will be implemented into the SDR and the SDR will call on a pulsed source for the output signal. This can be tested by any circuit running while no signal is being mapped to the display, once requested by the user, T1 will be activated and send the signal to the SDR to then be displayed.

6: SDR has at least 8-bit ADC

This target is less important as it will be one of the easier objectives to tackle. 8-bit resolution on a computer screen should be fairly simple, but this is also the least n_b, number of bits, required for the project and therefore the aim is for 16-bit. Will be tested with the signal from SDR and display from the computer screen.

7: Attenuators lower the power of input/reverse signals to 2.5dBm

This target is important, if the attenuators let more than 2.5 dBm in, it can fry the SDR or throw off the desired signal. By examining the SDR's specifications, the proper attenuator needed was derived. This can be accomplished by determining the amount of power coming from the bi-directional coupler and buying the correct attenuator. The power from the circuit and attenuator are needed as well as the SDR's specifications are needed to validate this target.

8: Digital output data from SDR displays the entire envelope of pulse train

This target is very important due to it being the whole purpose of this project. This will be accomplished by applying all targets and functions listed, as well as, the team working together to find solutions to every obstacle or task. This will be accomplished by testing the customer's NMR RF signal on the prototype and oscilloscope, then comparing the results between the two. Will be fixed with troubleshooting all aspects between software and hardware on the project.

9: SDR is compatible with Linux

This target is not very important, it is more of a preference from the customer. Though there is equipment that runs on Windows, most equipment at the National High Magnetic Field

Laboratory runs off Linux. Good SDR and Linux compatibility will validate this target. Equipment and computers (running Linux) which the prototype will be tested on will be the tools used.

SECTION II

Table I: Targets

Metric Number	Need	Metric	Importance	Units	Marginal Value	Ideal Value
1	2-Channel SDR	Hardware	Moderate	N/A	1-2	2
2	Run for days	Duration	Impotant	Days	7-14	14
3	Frequency Range	Bandwidth	Moderate	MHz	600-800	800
4	Sampling Rate	Bandwidth	Moderate	ns or MSPS	11	11
5	External Trigger	Hardware	Very	N/A	1-2	2
6	Resolution	Quality	Least	bits	8	8
7	Attenuators	Resistance	Important	dBm	2.5	2.5
8	Display Envelope	Software	Very	Hz	1	1
9	Linux Compatibility	Software	Least	N/A	N/A	N/A

Table 1: Targets contained in this table

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