AUTOMATION OF PRE-TR, TR LIMITER

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Abstract— RF seekers have made life easier for launching missiles on desired targets by intercepting them, even when in motion, regardless of their surroundings, weather and other conditions. The proposed work focuses on the Pre-TR, TR Limiter, a receiver protector present in the Radar receiver portion of the RF seeker. This Pre-TR, TR Limiter, protects the receiver (particularly the LNAs) from high received echo power and unwanted high leakage powers. Here we make use of LabVIEW programming to generate from the STC law file which is applied to the diode limiter to achieve attenuation levels of up to 40dB. The generation of PROM files, which contain the attenuation values for the respective voltages, are fused into EPROMS and fed into the MSTC PCB, which then acts as an input to the Pre-TR, TR Limiter. The earlier method made the task usually tedious and time consuming, taking approximately about three dedicated days for a skilled employee. Our method reduces the whole process to a mere 7 minutes without the help of necessarily skilled labor. This method is helpful in the testing of each of the diode limiters individually in a short period of time.

Keywords: Pre-TR TR Limiter, Attenuation, STC

I. INTRODUCTION

The development of receiver protectors in modern radar technology has been booming off lately. They find use in varied military and commercial platforms, including air-borne fixed and rotary wing, missile seeker, sea and ground-based applications [1]. A receiver protector is usually made up of pre-T/R tubes, T/R tubes and other kinds of limiters and add ons depending on the requirement. The receiver protector used here as mentioned before, is the pre-TR, TR limiter, the most efficient type. For testing purposes and its general working, to know what voltage needs to be applied to attain the desired Attenuation range. The input needed in this is given through the MSTC PCB which contains the PROM files generated. The existing method of PROM file generation and testing makes the whole process very tedious and time consuming. Testing one pre-TR, TR limiter takes almost 3 days, there could be several limiters, in a single radar system, the time consumption and requirement of skilled labour would be unnecessarily high. There is no possibility for error detection. In our method, we combine different stages of the file generation which uses different executable programmes into one Lab VIEW program to directly obtain the PROM files from the .s2p files (files generated by the VNA). The process of PROM file generation reduces to a mere 7 minutes, with no requirement of skilled labour and error detection possibility using LabVIEW.

II. PROPOSED PROBLEM

The problem usually faced while using radar receiver systems is the constant need to input the required voltage to attain the desired attenuation according to the frequency range. This process is usually done when initializing the pre-TR, TR limiter, to get the PROM files, as mentioned before the earlier method took three days. Testing a single pre-TR, TR limiter takes at least 3 days again by the existing method and a single radar system comprises several pre-TR, TR limiters. This time consumption and requirement of skilled labour is difficult to find in the field at an hour of need.

The proposed work not only ensures, in reduced time consumption but a user-friendly GUI, which requires absolutely no skilled labour, for testing and PROM file generation. The receiver protectors like the pre-TR, TR limiter aid in protecting the low noise amplifier from high echo power and unnecessary high leakage powers. The MSTC PCB that is inserted in the limiter has the database (necessary PROM files) that provide proper attenuation. The process of generating the PROM files with the proper STC law specifications, goes through several stages of file conversions, starting from the .s2p files generated by the VNA. As mentioned this task is time consuming, no possibility for error detection, no possibility to get attenuation plots and no option for all kinds of instruments to be tested.

III. PROBLEM SOLUTION

Automation Testing of the pre-TR, TR limiter and PROM file generation, making use of LabVIEW programming, in order to reduce time consumption, error detection, and no requirement of skilled labour because of the introduction of a user-friendly GUI. Also helps in analysis by making provisions for attenuation plots.

IV. HARDWARE

The hardware setup, which comprises a pre-TR, TR limiter, which is connected to a VNA, the regulated power supply and the programmable power supply. The VNA acts as both a signal generator and an output device to the limiter. The programmable power supply tunes the voltage from 0-5V, with progressions of 20mV, for the individual .s2p file generation. The regulated power supply powers the limiter. Pre-TR, TR Limiter - Combination of Pre-TR tube, TR Tube, and Diode Limiter: Pre-TR-TR-Limiter is a receiver protector assembly, which protects the Radar receiver (particularly LNAs) from high received echo power and un-wanted high leakage powers. Sensitivity Time Control (STC) laws of 0 to 4V are applied to the diode limiter to achieve attenuation levels up to 40 dB. Pre-TR-TR-Limiter is radioactively primed and has limited life. It is a combination of Pre-TR tube, TR Tube, and Diode Limiter.

– The Pre-TR tube is additionally a gas plasma limiter and works on the equivalent rule as the TR tube. The thing that matters is that, in the

Pre- TR tube, the gas is encased in a quartz tube. This gives us two advantages: Quartz has a higher melting point than glass. In this way, a Pre-TR cylinder will deal with substantially more power than a TR tube. And enclosing the gas completely inside a quartz chamber takes into consideration the utilization of gases that can't be utilized in a body-filled TR tube. These gases have a lot quicker recovery time. Also, it exhibits very low insertion loss, less than 0.1dB.

– The TR tube is the most widely recognized receiver protector innovation being used today. The development of the TR tube incorporates one or increasingly full filter sections in a bit of waveguide which is fixed at the two closures with waveguide windows. Each filter section is a generally high Q equal L-C circuit. Shortened cones structure the capacitive component and irises or posts the inductive component. Practically all advanced TR tubes utilize radioactive priming. It is a very safe method which takes out the requirement for the large power supply, makes the unit totally passive, and significantly increases tube life. It additionally takes out the excess noise.

– Since its beginning in the late 1960's, the diode limiter has become a crucial part of virtually every modern receiver protector design. To a huge degree, this is on the grounds that, other than a functioning TR tube, it is the main receiver protector that is prepared to do sufficiently securing a cutting edge beneficiary.

Although composed of individual building blocks, the receiver protector assembly should always be treated as a single component. In other words, the building blocks should never be separated physically in the system design, particularly in this case of a pre-TR, TR limiter.

V. AUTOMATION

In the LabVIEW platform, in a control panel, using VIs and sub-VIs and other tools to efficiently run and generate the PROM file. These .S2P are generated by the VNA, as tracing parameters, to show how the pre- TR, TR limiter attenuates a stimulus signal generated by the VNA. The VNA does not necessarily give the area of interest but a whole range of raw data.
The LIMITER.exe is an executable program used to convert the.S2P files, the ones which contain raw data into files called attn.txt with the specific frequency that is desired. In the proposed LabVIEW program we incorporate the LIM-ITER.exe algorithm for the conversion.
PROM file is the final file which contains the necessary information regarding the attenuation and voltage values. The STC law file gives the specifications of the range of attenuation for a particular frequency. 16 spot frequencies are considered. The STC law file which is applied to the diode limiter to achieve attenuation levels of up to 40dB. The MSTCFLR.exe is another executable program file that is incorporated into the LabVIEW program. The STC law file is included in the program as a text block directly.

VI. RESULT

The whole purpose for this research was to enable on field testing in dire situations of need. The accomplished work reduced the total time consumed from 3 days to a mere 7 minutes. With the GUI introduced no skilled technician is necessary on the field to get. DUT tests done, no matter how large the number or whatever company the pre-TR, TR limiter is manufactured in. Error detection to test if the STC law files where correct can easily be verified. Stimulus signal attenuation behaviour can be plotted and analyzed. This ease in testing definitely helps utilize energy and time, in other places of need. LabVIEW being a graphical program is easy to debug. It affirms the statement that "Testing is not necessarily a lab job".

The front panel of the LabVIEW code opens into a user friendly GUI. The main reason for using LabVIEW is deploying the front panel as a GUI, which requires no skilled labour.

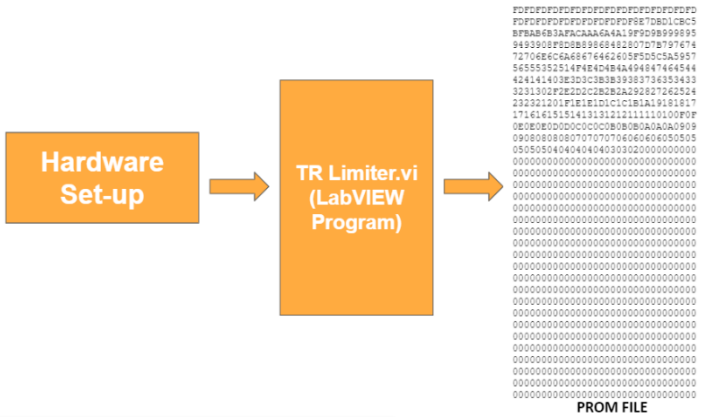

Figure 1: Process Flow Diagram

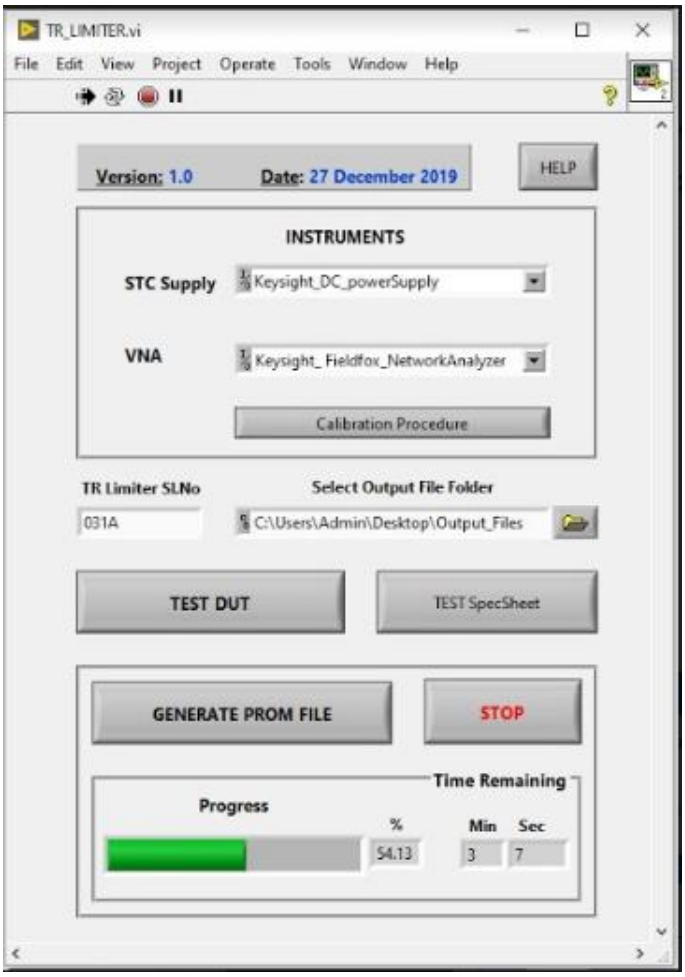

Figure 2: User Friendly GUI

VII. CONCLUSION

The proposed work was the first of its kind to make an automation improvement in testing of pre-TR, TR limiters after a decade or so of using the manual method. Its novel character comes about due to the use of the LabVIEW platform. This paper emphasizes the fact the smallest change can make the biggest impact. There are several ways that it could proceed to be changed in the future, but the proposed was a beginning step of that milestone. It not only equipped us with technical skills of programming in LabVIEW and using the VNA but also with problem solving and time management skills, which are necessary for the future.

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