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Mil-Std 1553 Cable Modeling for Fault Detection

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Abstract: *Amongst major industries, the aircraft industry has gained momentum not only in public transportation, but also in defence, business and space sectors. The electrical, mechanical and electronic systems of an aircraft are all interconnected by different types of cables like hook up wires, cables for high speed data transmission, cables for power transmission, fire resistant cables, co-axial cables etc , with each type of cable having its own specifications. Military Standard 1553 (Mil-Std 1553) is one such cable primarily used for on-board aircraft sub-system communication and monitoring. Mil-Std 1553 protocol defines the physical and electrical properties of the cable. Mil-Std 1553 is a dual redundant bus, that is, there are two channels for a single bus communication. Mil-Std 1553 is prone to faults like opens or shorts because of its continuous wear and tear in aircraft environment. If a faulty cable is operated, then it possesses a high risk to the aircraft system .As of now ,there is no automatic fault detection system employed on Mil-Std 1553. Hence there is a need for automatic fault detection system on Mil-Std 1553 cables before the entire system collapses. In this regard, modeling of Mil-Std 1553 is very important since the developed model can be used for testing of the fault detection algorithm and further prototype development. Here, the Mil-Std 1553 cable has been modeled using SIMULINK/MATLAB. The cable is modeled under two different scenarios: considering only the Test Signal , considering both Test Signal and Data Signal. The cable is modeled considering all its electrical characteristics for three conditions, namely, No Fault condition, Open circuit condition and Short circuit condition. PI section is used as an elemental block for modeling of Mil-Std 1553.*

Keywords: *Data Signal, Mil-Std 1553, Open Faults, Redundancy, Short Faults, Test Signal.*

I. INTRODUCTION

An aircraft is a complex system, wherein a number of sub-systems like avionics sub-system, flight control sub-system, hydraulics sub-system etc are integrated 1. All sub-systems are linked by using different types of cables, depending on the type of signal that it has to carry.

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Each type of cable has unique electrical and mechanical properties. MILITARY STANDARD 1553, from now onwards termed as "Mil-Std 1553 cable" is one of these special types of cables. It is a military standard data bus used for data communication between the sub-systems of an aircraft. Once the cable system is installed, it is very important to regularly oversee the healthiness of the cable since faults on the cable can hamper the functioning of the entire sub-system/system 2.

Mil-Std 1553 cable was created by the United States Department of Defense (DOD) for their avionics systems; however it was later considered by National Aeronautics and Space Administration (NASA) for the spacecraft and on-board data handling subsystems. Presently, it is maintained by the Society of Automotive Engineers. It has demonstrated such reliable and rugged performance that is now being exploited for international military and commercial applications. It maintains its efficacy even in the cases where there is high Electro Magnetic Induction(EMI) 3. Such significance motivates academia and industries to develop more efficient and robust online fault detection and localization system.

Fault detection on Mil-Std 1553 cables is a key factor since the reliability and life expectancy of the cable system greatly influences the performance of the entire system. The core conductor part of Mil-Std 1553 is protected by outer sheath which is usually an insulator. But in many cases, the insulator layer itself may be damaged after prolonged usage and also may be due to the impact of certain environmental conditions such as moisture, radiations, mechanical vibration, chemical corrosion, temperature, electric field etc1. This damage to the insulator may cause cables to rub over each other, leading to undesirable short circuits. These short circuits can spark off electrical discharges in aircraft sub-systems, leading to catastrophic failures. Hence fault detection has to be made ahead of system failure. This is possible only with the employment of progressive technologies since human intervention is not possible or minimal once the cable panel is embedded in the aircraft system 3.

The predominant focus of this research paper is to model the Mil-Std 1553 cable, considering all its physical and electrical characteristics using MATLAB/SIMULINK. This model developed in MATLAB/SIMULINK proves to be very useful for intermittent fault detection and localization on Mil-Std 1553 cable. Hence, a background study has been done to understand functional characteristics of the Mil-Std 1553 wire system.

Considering the critical safety as well as set-up complexity of the aircraft system, Mil-Std 1553 cable requires automated and highly precise wire fault detection system.

II. LITERATURE SURVEY

Mil-Std 1553 cable is chosen since it has numerous advantages over the other existing cables. Some of these advantages are: 6

- It facilitates a higher minimum bus voltage of 6V peak to peak for direct coupled and 6.36 peak to peak for transformer coupled.
- A maximum value of tolerable transmit jitter is specified which impacts distortion margin by increasing it.
- Interference between successive transmissions is avoided by putting a constraint of a tail-off voltage for 2.5 µs at the end of each transmission.
- High level of electrical ground isolation and common mode signal rejection is achieved from transformer isolation.
- It confines cross-talk among redundant buses.
- The receivers of this cable must provide a “dead zone” of 0.28V peak to peak, provisioning higher immunity to noise. This further improves the capability for a 1553 receiver to determine the end of a received signal transmission. Additionally its noise rejection test ensures the implementation of receiver filtering, thereby providing reliable operation in the presence of differential noise.

In the current scenario, many reflectometry methods have been applied on different types of aircraft cables for fault detection. Of the many reflectometry methods available, Spread Spectrum Time Domain Reflectometry (SSTDR) has proven its efficacy in detecting intermittent faults on aircraft wires that carry typical aircraft signals 7. The uniqueness of SSTDR lies in the fact that it can detect the reflected signal even when it is corrupted by noise. From the detailed literature survey, it can be inferred that SSTDR is the best reflectometry method for test signal generation on Mil-Std 1553 cable. This is because SSTDR test signal has the minimum interference with the Mil-Std 1553 digital data.

The characteristics of Mil-Std 1553 cable are given in Table I

TABLE- I: Specifications of Mil-Std 1553

Cable type	Twisted Shielded Pair
Minimum number of cable Twists	4 twists per feet
Capacitance	30pF per feet
Characteristic impedance	75Ω to 85Ω at 1MHz
Cable Attenuation	Maximum 1.5dB per 100 feet at 1MHz
Direct Coupled Stub Length	1 foot maximum
XFMR Coupled Stub Length	20 feet maximum
Data rate	1MHz
Word length	20 bits
Message length	Maximum of 32 data words
Transmission technique	Half duplex
Operation mode	Asynchronous
Encoding	Manchester II bi-phase
Fault tolerance	Typically dual redundant, the redundant bus will be in “Hot Backup” status
Communication Element	Mil_Std 1553 Physical Cable
Maximum Current	50A
Controlling Element	Bus Controller
Monitoring Element	Bus Monitor
Other Elements	Remote Terminals

III. REVIEW CRITERIA

The schematic of Mil-Std 1553 communication can be illustrated by a block diagram as shown in Fig.1.

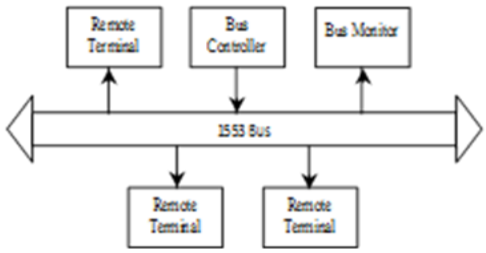

Fig. 1. Mil-Std 1553 Hardware Elements

The Mil-Std 1553 communication bus is actually a shielded twisted pair made up of a main bus and a number of tail ends which are called as “stubs”. A terminal gets connected to the main bus via a stub. The main bus is terminated with a resistance same as the cable’s characteristic impedance with plus or minus two percent tolerance at both the ends 9. Because of the terminating impedance, the communication bus acts like an infinite transmission line. Stubs act as local loads and are termed as “Remote Terminals”. In an aircraft system, each remote terminal can be a sub-system. Addition of stubs can result in impedance mismatches. Electrical reflections occur because of uncontrolled impedance mismatches which can deteriorate the efficiency of the main bus. Hence the standard specifies the characteristics of both main bus and stubs which have to considered during design phase of Mil-Std 1553 bus architecture. Bus Controller is the terminal which commences communication on the data bus. The BC issues commands to the remote terminals and the remote terminals have to respond to it. The BC is an important element of the Mil-Std 1553 cable system. The Bus Monitor (BM) keeps track of the bus traffic and extricates important information for usage at a later point of time. It is always suggested to model and test the bus to ensure its function and performance are satisfactory. The arrow shows the direction of communication from Bus Controller and Bus Monitors to remote terminals. There are two types of coupling methods by which terminals can be connected to the main bus as shown in Fig.2.

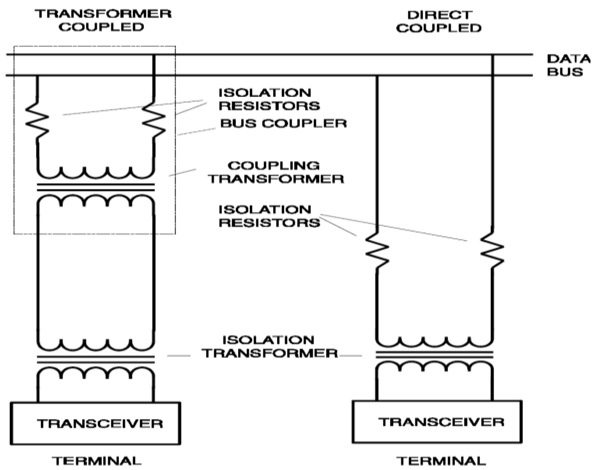

Fig. 2 . Terminal Connecting Methods for Mil-Std 1553

The two types of coupling methods are Direct Coupled and Transformer Coupled. In the transformer coupling method, the stub cable is connected to the main cable through an isolation transformer whereas in the direct coupling method, only isolation resistors are used for this purpose. The main idea of electrical isolation is to separate the electrical grounds of the main bus and stubs.

Isolation resistors can also placed in series with the data bus in transformer coupling also. But the main difference is that in the direct coupling method, the resistors are placed within the terminal whereas in the transformer coupling method, they are placed within the coupling transformer, in packages called data bus couplers. In this thesis, for modeling Mil-Std 1553 cable, transformer coupling is considered.

A. Mil-Std 1553 Data Format

Mil-Std 1553 data communication bus is in the form of messages which follow a format. Data communication messages on Mil-Std 1553 can be classified into two groups namely, Control message and Data message. Control message can be further classified into command word and status word 10. The order of transmission is Command Word followed by Data Word and at the last Status Word. Each word length is 16 bits. In addition to these 16 bits, 3 bits are for synchronization and 1 bit is for parity. Hence the total word length is 20 bits. Since the transmission speed of the bus is 1 Megabit per second, each bit will occupy 1µs of time.

The first communication sent from the Bus Controller to a remote terminal is the Command Word. The fields in the Command word are as follows:

- SYNC bits: Initial three bits are for synchronization which are called as SYNC bits. It is compulsory that the command and status bits are in synchronization with respect to their timing.
- Remote Terminal Address: Five bits are allocated for specifying the particular address of a remote terminal. Five bits can address 32 locations.
- Transmit/Receive Bit: This is to indicate the direction of transmission. For transmission, it is 1.
- Sub-address/Mode: If 00000 or 11111 is given as the sub-address field, it is an indication that the next field will contain the mode code number. Any other value of this field indicates it is the number of data words.
- Data Word Count/Mode Code: These 5 bits indicate the number of data words or the mode code. Mode code is an unique 5 bit code which indicates a pre-defined function.
- Parity Bit: Single bit used for odd parity.The Command Word is followed by a 20 bit Data Word. A data packet can accommodate maximum of 32 data words. Out of 20 bits, the inceptive three bits are for synchronization and odd parity is denoted by the last bit. Parity is calculated on sixteen bits of data and a parity bit. The polarity of initial synchronization data bits are opposite with respect to the synchronization bits of command and status words. The Data Word is followed by the Status Word. The destination remote terminal acknowledges the reception of a valid data message by transmitting a status word. The fields in the Status word are as follows:

- SYNC bits: Initial three bits for synchronization. It is compulsory that the command and status bits are in synchronization with respect to their polarity and timing.
- Remote Terminal Address: Address of the remote terminal or the bus controller to which the reply has to be sent.
- Message Error Bit: This message indicates whether the data received by the remote terminal is error free or error prone. If it is error prone, then it is set to 1.
- Instrumentation Bit: This is used to distinguish command word from the status word. In the status word, it is set as 0 and in the command word, it is set as 1.
- Service Request Bit: When this is high, it is an indication to the bus controller that a remote terminal is requesting a service.
- Broadcast Command Received: This is to indicate whether the earlier command was a broadcast command. It is set high if it is a broadcast command.
- Busy Bit: If it is high, it points out that the remote terminal is not able to handle the data.
- Sub-system flag: If this is set high, it is an indication to the bus controller that a sub-system fault exists and the request from the sub-system may be invalid.
- Dynamic Bus Control Acceptance: If this is high, it is an indication to the present bus controller as acceptance of its offer as the next bus controller.
- Terminal Flag: If it is set high, it is an indication of a fault within the remote terminal.
- Parity Bit: Single bit used for odd parity.

The Mil-Std 1553 data format is as shown in Fig.3.

IV. MATH

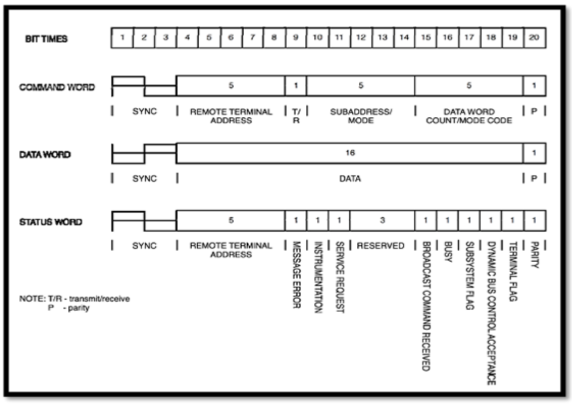

Fig. 3. Mil-Std 1553 Data Format

V. METHODOLOGY AND DESIGN

In this paper, two types of Mil-Std 1553 cable modeling is developed. The two types of models are:

- ➢ Mil-Std 1553 cable model with only the Test Signal (TS).
- ➢ Mil-Std 1553 cable model with Data Signal (DS) and Test Signal (TS).

A. Mil-Std 1553 Cable Model with only the Test Signal (TS)

Mil-Std 1553 cable system with SSTDR based fault detection is as shown in Fig.4.

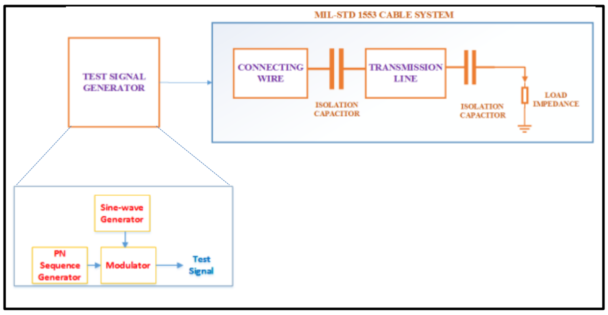

Fig.4. Block Diagram of Mil-Std 1553 Cable with Test Signal

Here, only the test signal propagates through the cable. The first block is the test signal generator block. The internal blocks of the test signal generator are sine wave generator, PN sequence generator and modulator. A sine-wave of 30 MHz is produced by the sine wave generator. A Pseudo- Noise (PN) sequence of 1024 bits is produced by the PN sequence generator. The sine wave output from the sine wave generator is modulated in accordance with the change in the logic levels in the PN sequence. Binary Phase Shift Keyed (BPSK) signal is the output of the modulator which is actually the test signal which will be transmitted onto the Mil-Std 1553 cable. This method of test signal generation is termed as SSTDR signal generation. The main recognition of SSTDR lies in the fact that it can be employed to locate faults even in noisy conditions and the accuracy is also high which also depends on the processing method. The series of ones and zeros in a PN sequence may appear very arbitrary but are absolutely designed, that is, it has a clear cut and perceptible pattern. High self-correlation and low correlation with other signals and codes and even with delayed versions of themselves is an important characteristic of PN code. The PN code is deterministic and a Recursive Linear Sequence (RLS) which is incident into the cable, already having an existing aircraft signal. The modulated PN code is transmitted onto the cable and it is reflected back from the point where there any open or short circuit faults or any other variation in impedance. Time delay of the reflected signal will be directly proportional to the distance to the fault. The Mil-Std 1553 cable system consists of connecting wire, transmission lines and isolation capacitors. The connecting wire models the signal delay from the point of signal generation to the starting point of the cable, through the connector. Isolation capacitors are placed before and after the transmission line connections. A standard load impedance is included at the line termination. The reflected signal from the transmission line is taken and further analyzed to determine fault detection and localization.

The specifications and the assumptions made for modeling of Mil-Std 1553 cable with the test signal only are as follows:

- Test Signal Amplitude is 20mV (Peak to Peak)
- Test Signal Frequency is 30 MHz
- Electrical isolation is achieved by capacitance effect and the value of the Isolation Capacitor is 30pF.
- Channel Attenuation is 1.5dB.

The SIMULINK model for Mil-std 1553 is as shown in the Fig. 5.

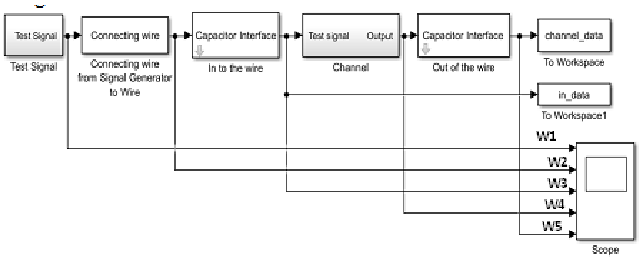

Fig.5. MATLAB/SIMULINK Model of Mil-Std 1553 Cable with only the Test Signal

B. Mil-Std 1553 cable model with Data Signal (DS) and Test Signal (TS)

Live Mil-Std 1553 cable system with both Data and Test signals is as shown in Fig.6.

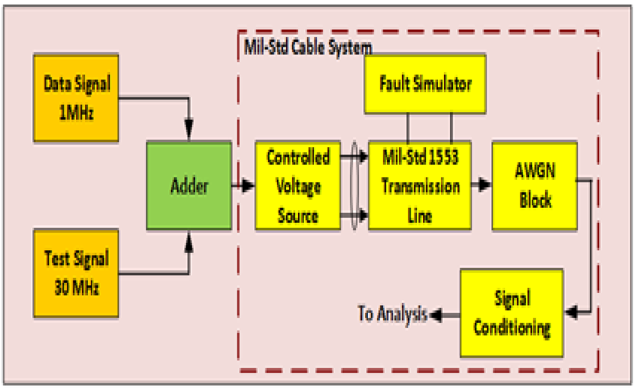

Fig. 6. Block Diagram of Mil-Std 1553 Cable with Test Signal and Data Signal

Mil-Std 1553 data signal is generated according to its standards at 1MHz and both Data Signal and Test Signal are superimposed in the Adder. The Controlled Voltage Source (CVS) converts the signal from the adder to differential physical voltage levels, before giving it to the actual transmission line. Additive White Gaussian Noise (AWGN) is added in the cable system. The signal conditioning block separates the DS and TS by using a filter. The addition of two signals might impose unwanted interference causing signal degradation and hence inaccurate fault analysis. But due to SSTDR concept, which is one of the most robust reflectometry types is applied here. SSTDR not only enables significant signal estimation but also avoids the issue of interference.

The specifications, assumptions and the design considerations made before modeling of Mil-Std 1553 cable with both Test Signal and Data Signal are as follows:

- Data Signal amplitude is ± **6V (Peak to Peak)**
- Data Signal Frequency is **1MHz**
- Repeating section of basic transmission line is **PI section**
- Parameter considered for fault induction is **current**
- Short circuit Impedance is **1Ω**
- Open circuit Impedance is **100MΩ**
- Normal Mil-Std cable Impedance is **75Ω**
- Mode of separation of Data Signal and Test Signal is **LCL filter**
- Test Signal Amplitude is **20mV (Peak to Peak)**

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- Test Signal Frequency is **30 MHz.**
- Electrical isolation is achieved by **Linear Transformer.**
- Channel Attenuation is **1.5dB.**

- Type of noise is **Additive White Gaussian Noise (0.1dB).**
- Maximum cable length is **30 meters.**

Design Considerations

- Cable length to time domain mapping is calculated as follows:

$$\lambda_{Required} = \frac{W_V}{f} \quad (1)$$

Where $\lambda_{Required}$ the wavelength in meters is, W_V is the wave-velocity in ms^{-1} and f is frequency in Hz.
Wave Velocity (W_V) is 0.66 times the speed of light in vaccum. Speed of light is $3*10^8$ ms^{-1}. Frequency of the Test Signal is 30MHz. Hence the required wavelength is calculated as shown below.

$$\lambda_{Required} = \frac{0.66*3*10^8}{30*10^6} \text{ [According to Equation (1)]} \quad (2)$$

$$\lambda_{Required} = 6.66 meters \quad (3)$$

Hence 6.66 meters of cable length is required for one wave cycle to pass through the cable. Hence the time taken for wave cycles to propagate till 30 meters is given by Equation 3.17.

$$\frac{30*3.33*10^{-8}}{6.66} = 1.5*e^{-7}S \quad (4)$$

- **PI section design**

Line length is 0.3048 Kilometers.
Resistance per unit kilometer is 1Ω.
Capacitance per unit kilometer is 9.84*10-8 F.
Inductance per unit kilometer is 10 *10 -12 H.
All these parameters are incorporated for the PI section used.
The developed SIMULINK model of Mil-Std 1553 model is as shown in Fig.7.

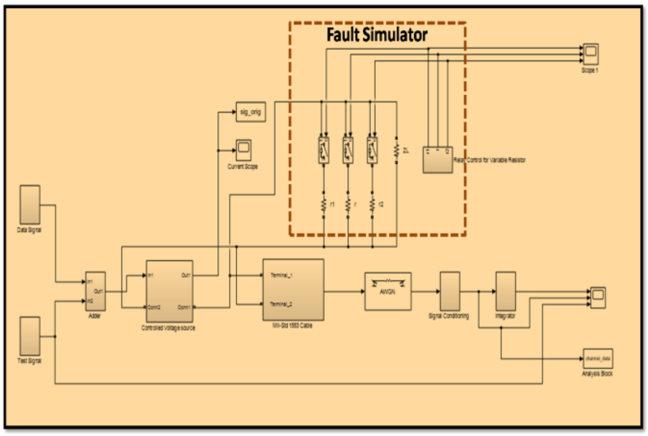

Fig.7 : MATLAB/SIMULINK Model of Mil-Std 1553 Cable with Test Signal and Data Signal

All the blocks designed in the model are explained as follows.
Data Signal Block: Mil-Std-1553 data signal is generated at 1MHz frequency and 6V peak-to-peak amplitude.
Test Signal Block: SSTDR Test Signal is generated at 30MHz frequency and 0.02V peak-to-peak amplitude.

Adder Block: Data Signal and Test Signal are combined in the adder. The test signal is superimposed on the data signal after combining.
Controlled Voltage Source Block: The Controlled Voltage Source block converts the output of the adder into differential physical voltage levels and places the differential signal onto the actual Mil-Std 1553 cable.
Mil-Std-1553 Cable: The Mil-Std-1553 cable is the core part of the entire system, which forms the actual transmission line.
Fault Simulator: The fault simulator is the fault induction circuit. It consists of three relays and three resistors.
Additive White Gaussian Noise (AWGN) block: AWGN block is for adding AWGN noise. AWGN of 0.1 variance is added in the transmission line.
Signal Conditioning block: Signal conditioning block separates Test Signal and data signals. Signal conditioning uses Inductance-Capacitance-Inductance (LCL) filter which is a band pass filter which separates the data signal and the Test_Signal. LCL filter also helps to avoid interference probability The Test Signal passes through the filter.
Integrator block: The Test Signal output of the signal conditioning block is followed by an integrator block that helps in achieving smoothened signal for further analysis.
Analysis block: Analysis block is added for automatic fault detection and localization. Here, only the reflected signal is captured for further processing since it is a good parameter for fault detection and localization.
The obtained output parameters after modeling of Mil-Std1553 cable are as shown in Table II.

Table- II: Output Parameters From Mil-Std 1553 Cable

Cable Condition	Line Impedance	Current Value
Normal	75Ω	6.02 A
Open Circuit	100MΩ	12:00 AM
Short Circuit	1Ω	30 A

VI. RESULTS AND DISCUSSION

A. Mil-Std 1553 Cable Model with only the Test Signal (TS)

Input to the model is the Test Signal amplitude of 20mV peak to peak and frequency 30MHz, which is generated based on SSTDR method. Fig.8 shows the waveform which is the output of the Test Signal generator block which is input to connecting wire.

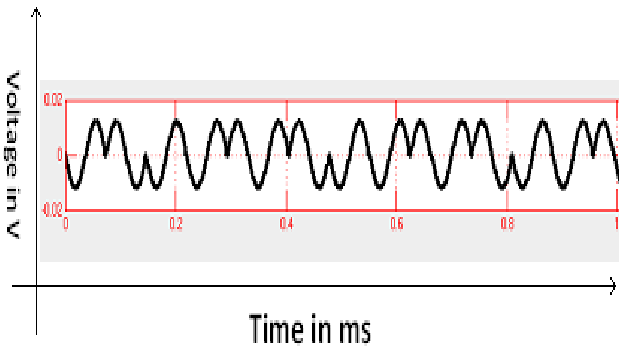

Fig.8.Output of Test Signal Generator Block

Fig.9 shows the waveform which is the output of the connecting wire with time delay of 55ps which is input to the isolation capacitor.

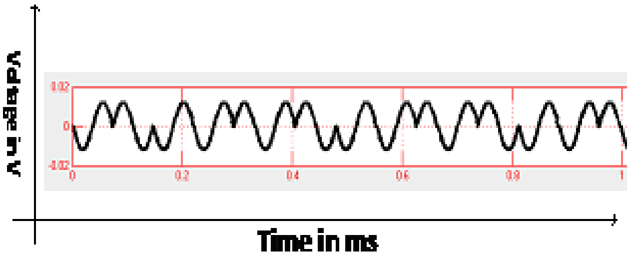

Fig.9. Output of Connecting Wire Block

Isolation capacitor is for separating input and output signals, hence avoiding reverse traversing of signal. Fig.10 shows the waveform which the output after the isolation capacitor which is input to the channel.

Fig.10.Output of First Isolation Capacitor Block

Fig.11 shows the waveform which is output of the channel. The channel is simulated for no fault case, open circuit case and short circuit case. If the channel is simulated for no fault case, then there is no reflection at the channel. If the channel is simulated for open and short circuit cases, reflected signal at the channel which is seen on the oscilloscope. This reflected signal forms input to the second isolation capacitor which isolates output to input.

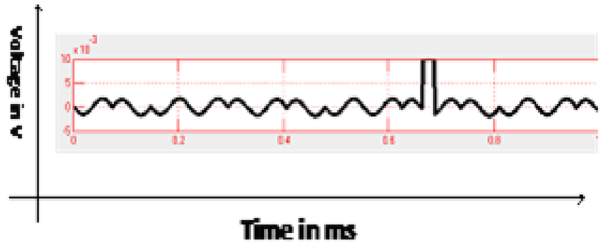

Fig.11. Output of Channel

Fig.12 shows the waveform which is the output of the second isolation capacitor.

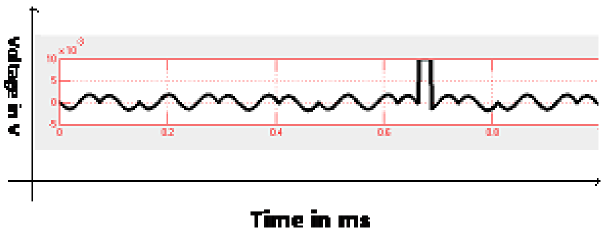

Fig.12. Output of Second Isolation Capacitor Block

B. Mil-Std 1553 cable model with Data Signal (DS) and Test Signal (TS)

Mil-Std 1553 Data Signal: Mil-Std 1553 Data Signal comprises of Command Word, Data Word and Status Word. Mil-Std 1553 complete word is as shown in Fig.13.

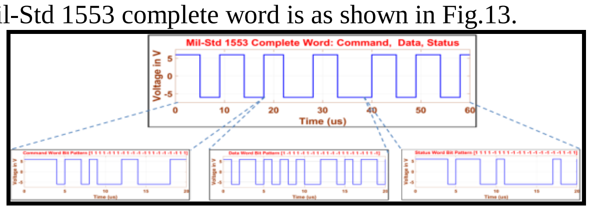

Fig.13. Mil-Std Complete Word

One cycle of complete Mil-Std 1553 word occupies 60µs. Command Word is of 20 bits and is shown in Fig.14.

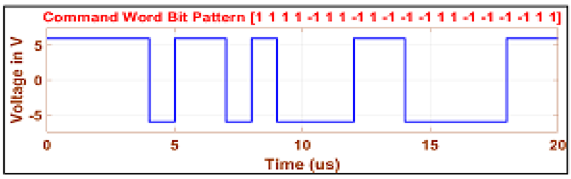

Fig.14. Mil-Std 1553 Command Word

Data Word is of 20 bits and is shown in Fig.15.

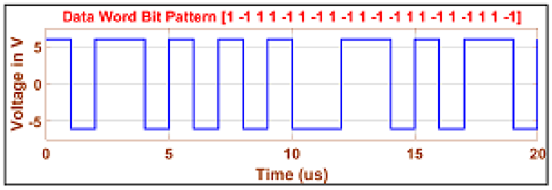

Fig.15. Mil-Std 1553 Data Word

Status Word is of 20 bits and is shown in Fig.16.

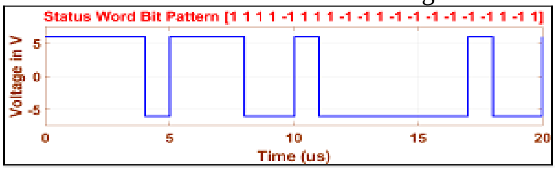

Fig.16. Mil-Std 1553 Status Word

Test Signal: The BPSK modulated signal is taken as Test Signal with frequency of 30MHz and amplitude of 20mV as shown in the Fig.17.

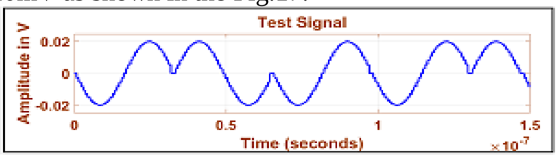

Fig.17. Test Signal

A sine wave of 30MHz modulates a PN sequence of length 1024 bits to give a BPSK output signal of 30MHz.

Test Cases:

Case 1: No_Fault case

Reflected signal during no fault or normal cable condition is as shown in Fig.18.

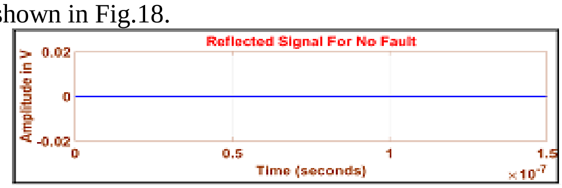

Fig.18. Reflected Signal for No_Fault case

In the No_Fault case, the reflected signal is zero since characteristic impedance of the cable is equal to the load impedance. Combined Signal: Test signal added with the data signal along the cable which is called as the combined signal is as shown in Fig.19.

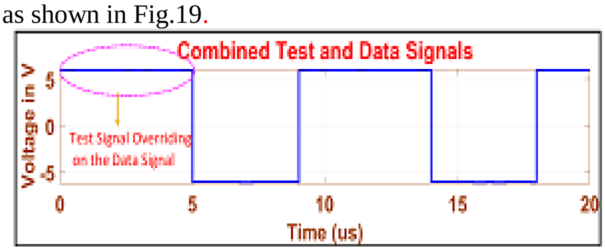

Fig.19: Combined Signal in No_Fault case

It can be inferred from the above figure that the variations of the Test Signal overrides on the data signal. The superposition of Test Signal is clearly shown in Fig 19 and this combined signal is received at the load end of the cable since the cable is without any faults. Current through the cable during No_fault is as shown in the Fig.20.

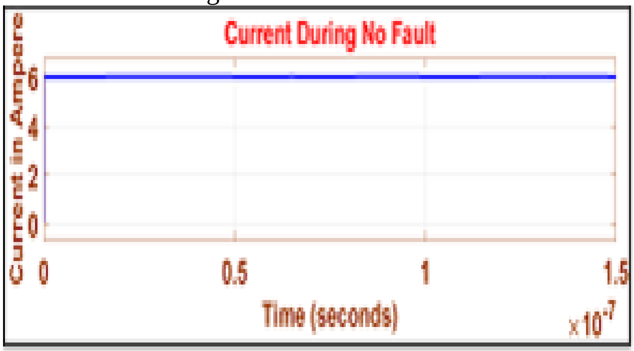

Fig.20: Current during No_Fault

Case 2: OPEN Fault case, Fault induced at 10 meters

Here, open circuit fault has to be induced at a distance of 10 meters. The distance of 10 meters is converted to a time series value and the switch in the relay corresponding to open circuit fault (Relay R1) is closed at that time value. This is similar to induction of fault at 10 meters on the cable. Because of the open circuit, there is signal reflection. Reflected signal and corresponding change of current at 10m open fault is as shown in Fig.21.

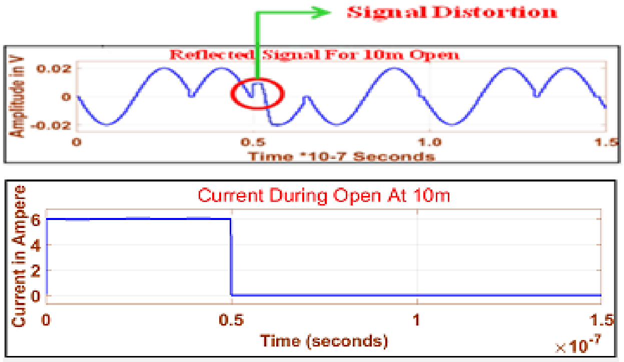

Fig.21. Reflected Test Signal and Corresponding Current at 10m Open Fault

It can be inferred from the above figure that for a time value of 0.5*10-7 seconds, signal distortion is observed which corresponds to 10 meters which is matching with the distance calculated using Equation C . At a timestamp of 0.5*10-7 seconds, which corresponds to 10 meters, the current drops to zero. Since the type of fault is assumed to be a hard open fault, the value of current will remain in the zero state.

Case 3: SHORT Fault case, Fault induced at 10 meters

Here, short circuit fault has to be induced at a distance of 10 meters. The distance of 10 meters is converted to a time series value and the switch in the relay corresponding to short circuit fault (Relay R2) is closed at that time value. This is similar to induction of fault at 10 meters on the cable. Because of the short circuit, there is signal reflection. Reflected signal and corresponding change of current at 10m short fault is as shown in Fig.22.

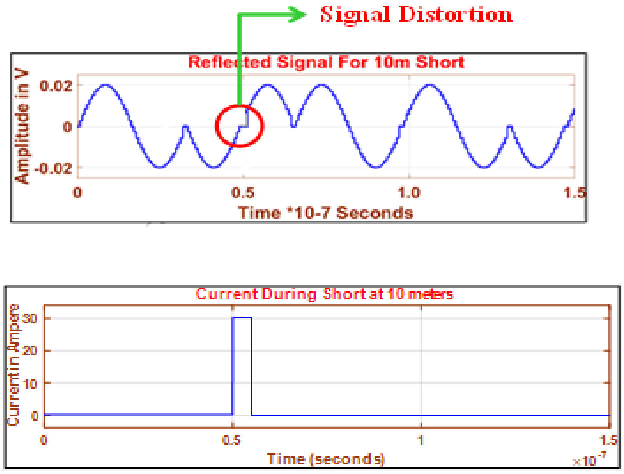

Fig.22. Reflected Test Signal and corresponding Current at 10m Short

It can be inferred from the above figure that for a time value of $0.5*10^{-7}$ seconds, signal distortion is observed which corresponds to 10 meters which is matching with the distance calculated using Equation C. At a timestamp of $0.5*10^{-7}$ seconds, which corresponds to 10 meters, there is a sudden increase of current to a very high value. Since the cable system will have inherently current protection circuits, the current will drop to zero and the line is cut-off.

VII. CONCLUSION

Mil-Std cable modeling is of prime importance in developing automatic fault detection system on it. First, the Mil-Std 1553 cable is modeled by taking only the Test Signal at a frequency of 30MHz. This is not a full fledged model, so even Mil-Std 1553 data signal is also generated at 1MHz and then the cable is modeled again. Command Word, Data Word and Status words are generated for a total time of 60µs and sent on the Mil-Std 1553 cable. A fault simulator block is designed for the conditions of No Fault, Open Circuit fault and Short Circuit fault. Current through the cable in each case is plotted. For the No Fault case, the value of current is 6A. For the Open circuit fault case, the current almost drops to 0. For the Short circuit fault case, there is a high current of almost 30A in the cable. There is always a reflected signal for Open and Short circuit conditions, which is captured for further processing of fault detection and localization.

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