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## Frequently Asked Questions about MIL-STD-1553

### How old is MIL-STD-1553?

The USAF developed and published MIL-STD-1553 in 1973. In 1975, revision A to the standard was published as a tri-service standard. A task group in the SAE was formed in 1976 to propose further changes resulting in the release of revision B to MIL-STD-1553 in September 1978 as a tri-service/NATO standard. USAF issued Notice 1 for the Standard in February 1980. The SAE worked with DoD tri-service group to generate 1553B Notice 2 in September 1986.

### What is Notice 2 and how important is it?

Notice 2 is a tri-service notice to MIL-STD-1553 and supersedes Notice 1 which was an US Air Force notice. Notice 2 clarifies some issues in the standard and adds some new requirements. The new requirements include setting the RT address from an external connector, required implementation of four mode codes (Transmit Status, Transmitter Shutdown, Override transmitter shutdown, and Reset Remote Terminal), maximum time for Initiate Self-Test and Reset Remote Terminal mode commands, Data Wrap-around, RT to RT receiver time-out, and maximum allowable output noise during power-up or power-down.

Notice 2 is very important and any new design should comply with its requirements.

### What is SEFAC testing?

Systems Engineering Avionics Facility known as SEAFAC was a facility at Wright-Patterson Air Force Base that provided the technical support for MIL-STD-1553. Starting in the late 70's they started providing a service of testing remote terminals to verify that they comply with the requirements of the Standard. In the early 90's they stopped testing remote terminals but continued testing components for MIL-STD-1553 and in 1993 they stopped providing the testing service altogether. There are two primary differences between the testing at SEAFAC and the testing that we provide here at Test Systems: first, we do more complete testing than the testing that was done at SEAFAC and second, we charge for our service (we try not to operate as a non-profit operation).

### What is the maximum length of the MIL-STD-1553 bus?

Revision A of MIL-STD-1553 specifies a maximum length of 300 feet. Revision B does not specify a maximum length. The length of the bus is part of the system design and is based on the number of stubs, the length of the stubs, and spacing between stubs.

### **What is the impact of degraded input impedance to my system?**

The MIL-STD-1553 data bus is a 70 - 85 Ohm terminated transmission line specified to minimize signal distortion with 'high' impedance terminals attached at various positions along the bus. If a terminal with 'low' impedance is present, excessive signal reflections may occur resulting in distortion. Distortion degrades the signals on the bus. As the signals become degraded, the system error rate increases resulting in reduced communication efficiency. All devices on the bus will suffer reduced margins.

### **What would be the results of directly interconnecting two 1553 terminals without using a bus terminator?**

First of all the standard specifies that the bus "...shall be terminated..." at both ends of the cable with a resistor equal to the cable characteristic impedance. The purpose of this is to minimize the effects of signal reflections causing waveform distortion.

If no termination is used the distortion could be severe enough to prevent communication on the bus, or the distortion could be insignificant allowing normal communication. A third and worse possibility would be that the signal may deteriorate just enough to cause intermittent communication. Don't bring upon yourself any more grief than necessary - terminate the bus!

### **What about stubs?**

A stub is an interconnection between the terminal and the data bus. Two methods for coupling to the bus are specified: transformer coupling and direct coupling. Transformer coupling, which requires a coupler near to the junction with the bus, is usually used when a longer interconnecting stub is required (1 to 20 ft); direct coupling is used when the stub length is one foot or less. Both coupling methods require fault isolation resistors in series with each connection to the bus. The length of a stub should be minimized and the use of long stubs is discouraged.

### **What if a system requires a stub longer than 20 feet?**

As stated above, long stubs are discouraged. Stub length should be minimized whenever possible. The Standard states "The length of a transformer coupled stub should not exceed 20 feet" and " ...if installation requirements dictate, stub lengths exceeding those lengths specified...are permissible". Thus, there is some latitude allowed in stub lengths. Longer stubs create signal reflections which in turn result in signal distortion so caution is in order.

### **Should unused stubs on the bus be terminated with 1000 Ohms?**

#### **What should be done with unused stubs?**

Studies show that unused stubs should not be terminated with a resistor but rather left open circuited. A dust cover over an unused connector is not a bad idea however.

### **Which type of stub is best?**

A transformer coupled stub is preferred in most cases. According to Notice 2 of the Standard, all terminals shall have transformer coupled stub connections. In US Air Force and US Army systems only transformer coupled stub connections may be used. In US Navy systems, either direct coupled or transformer coupled stubs may be used but each terminal must have both types of connections externally available.

From a technical standpoint, the direct coupled stub of less than approximately five feet in length, presents less disturbance to the matched transmission line than the transformer coupled stub of the same length. Above five feet the transformer coupled stub causes less loading. Other factors favoring transformer coupled stubs are; increased DC isolation, increased common mode rejection, and fault isolation for the entire stub and terminal.

The Standard states that "Direct coupled stubs ... should be avoided if at all possible."

### **What is the purpose of MIL-STD-1553 validation testing?**

The purpose of validation testing is to verify compliance of a terminal with MIL-STD-1553. The RT Validation Test Plan is the best tool for verifying compliance, characterizing a terminal, and defining its margins and limitations. The result of insufficient testing creates a twofold problem. First, the capabilities and margins of a terminal can not be properly determined without extensive testing. Secondly, any improper or marginal operation not found prior to production or system integration can be more costly to track down and correct.

If I use validated components in my design doesn't that eliminate the need for validation testing? While using validated or 'certified' parts in an RT does minimize potential problems it does not eliminate the need for thorough testing. It is important that the correct components be used together and that these components are used correctly. In addition, physical placement of the components and cable lengths can affect operation and thus testing of a fully integrated RT is the only way to be sure desired margins are not compromised.

### **Can I do my own validation testing?**

Certainly. In order to obtain accurate results you need to have the appropriate test equipment and trained personnel with experience in MIL-STD-1553. Familiarity with the MIL-STD-1553 and the Validation Test Plan is crucial. If several projects that require testing are anticipated, that may be justification for purchasing equipment and training personnel. If that is not the case, bringing in a MIL-STD-1553 specialist to perform the testing may be a better choice. A specialist can provide a wealth of experience and a knowledgeable interpretation of the standard to assist with on the spot problem solving.

### **Is validation testing required?**

Not always. It depends upon the requirements as specified by the development program. If full validation testing is not required, testing of a design during the development phase is important in order to verify operation with suitable margins and to prevent costly delays due to unexpected flaws. Delays can be much more expensive than the cost of an independent validation testing service.

### **How long should I expect it to take to complete testing of an RT?**

This depends upon several factors such as, how many problems are found, the experience of the person conducting the testing, and how much of the testing process is automated. An experienced person with proper equipment and a minimum of problems in the RT under test should be able to complete testing within 8 to 12 hours.

### **What characteristics of my RT should be tested?**

You only need to test those characteristics which you want to be sure meet the MIL-STD-1553 Standard. That's a tongue-in-cheek way of saying all of the RT characteristics should be tested to ascertain compliance with the Standard. The tests in the RT Validation Test Plan are divided into three broad categories; electrical characteristics (input and output), protocol tests (required and optional), and a noise rejection test.

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### **GENERAL INFORMATION:**

Specializing in MIL-STD-1553 since 1979, Test Systems provides test equipment, training seminars and validation testing. Test equipment provides for testing and simulating 1553A/B terminals and systems. Training seminars on MIL-STD-1553 provide a comprehensive discussion of the standard and includes hands-on lab sessions. Approved validation testing service tests remote terminals and components to the requirements of MIL-STD-1553.

For more information, contact:

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