Electronic Systems mbs

MIL-STD-1553
Fibre Optic Bus Extender

Features:

- Compliant to MIL-STD-1553A & B, MIL-STD-1760, ARINC 708A
- Two way MIL-STD-1553 communication over 62.5 µm/125 µm multimode fibre
- MIL-STD-1553 data bus extension upto 908m (subject to operational constraints)
- Autonomous Operation
- Class 1 FDA IEC60825-1 laser safety compliant

Description

The AE-1553-FOE, MIL-STD-1553 Fibre Optic Bus Extender, provides system designers the ability to extend MIL-STD-1553 signal transmissions to Remote Terminals, separated from the main data bus by distances of several hundred meters, using a (62.5 µm/125 µm) Multi-mode Optical Fibre cables, subject to the response time of the remote terminals and optical transmission delays.

Application

The AE-1553-FOE is designed to extend the range of a MIL-STD-1553 Data Bus beyond that which can be reliably sent over copper and this is achieved by converting MIL-STD-1553 signal transitions directly to symbols which are retransmitted over a fibre optic cable where it is captured by a second AE-1553-FOE device and then re-transmitted on to a second MIL-STD-1553 Data Bus for reception by a Remote Terminals.

The AE-1553-FOE requires 0.38 µs to convert MIL-STD-1553 signals to Fibre Optic and a further 0.17 µs to convert Fibre Optic signals back into MIL-STD-1553.
The range for which this data bus extension is possible, is further limited due to the finite speed (4.9 µs / km) at which signals can be transmitted over the optical link and the response time of the Remote Terminal. A pictorial representation of this process is shown in figure 1. Furthermore, the MIL-STD-1553 specification requires that a Remote Terminal (RT) must respond to a Bus Controller (BC) command within a time period of 4 to 12 µs although a BC must wait at least 14 µs before implimenting a no-response time-out and this does have a consequential influence on the practical range of the bus extender.That is, the practical range is not so much constrained by the overall Optical Fibre transmission range, but by operational constraints due to the finite propagation speed through the cables and the need to meet the strict requirements of MIL-STD-1553 specification.

Some MBS Customers

American Airlines · Delta · easyJet · British Airways · Jet2 · Condor · Eurowings · Luftwaffe · Icelandair · SAS · SunExpress · jetBlue Airways · Croatia Airlines · Tunisair · Jazeera · ITA · Titan Airways · Ameco Beijing · Corsair · Iberia · ASL Aviation Holdings · China Eastern · Avion Express · Sichuan Airlines · Aer Lingus · Bluebird Cargo · brussels airlines · AirAsia · novair · Aegean · China Airlines

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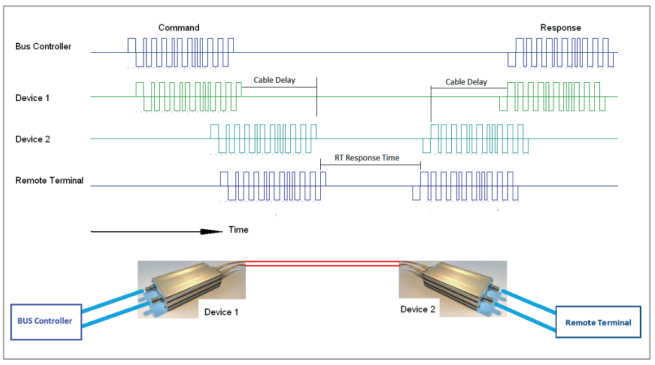

Figure 1: Pictorial representation of the communication process

The AE-1553-FOE has a total propagation delay of 0.38 + 0.17 µs = 0.55 µs and the Optical Fibre cable has a transmission delay of 4.9 µs / km. MIL-STD-1553 Remote Terminal (RT) must respond to a valid command within the time period of 4.0 to 12.0 µs. However, the specification also states that the BC must not impliment a time-out less than 14 µs. This implies that the range R that bus can be extended must satisfy the condition:

$$2 \times (RMAX \times 4.9 + 0.55) + RT\_Response\_Time < 14\ \mu s$$

So that the maximum bus extension range RMAX is given by:

$$RMAX = ((14-4)/2 - 0.55)/4.9\ Km = 0.908\ Km$$

In practice, the Remote Terminal response time will be larger than 4 µs but certainly less than 12 µs and one might assume an average response time of 8 µs which gives a range of 500 m.

The table below provides the maximum bus extension range with respect to the Remote Terminal response time.

Optical Fibre Cable Length	RT Response Time	Comment
No Bus Extension	14.0 µs	Normal MIL-STD-1553 bus without extension
0 m	12.9 µs	Bus Extenders fitted back-to-backt
100 m	11.92 µs	
200 m	10.94 µs	
300 m	9.96 µs	
500 m	8.00µs	
908 m	4.00 µs	MIL-STD-1553B standard requires that Remote Terminals must not respond faster than the minimum respond time of 4.00 µs

Specification

Item	Description
Standards	MIL-STD-1553B, MIL-STD-1760, ARINC 708A
MIL-STD-1553 Interface	Two Trumpeter BJ77 ConnectorsA
Fibre Optic Transceivers	Two Broadcom AFBR-57B4APZ DC-50 MBaud 850 nm Multimode LC Duplex SFP Transceivers
Power Supply	External power Adapter DC 5V/1A
Operating Temperature	-40˚C to +85˚C A

AE-1553-FOE Ordering Information

Part Number	Description
AE-1553-FOE	MIL-STD-1553 Fibre Optic Bus Extender

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