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Superseding AIR1189

Airborne Internal Interface Standards for Moderate Bit Rate* Digital Time Division-Multiplex Systems

CANCELLATION NOTICE

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1. INTRODUCTION

Electrical and electronic systems of modern aircraft are becoming increasingly more complex, requiring the interchange of more and more information within and among these systems and subsystems. At the present time, most of this information is exchanged by use of individual wires dedicated to the communication of each signal. However, many advantages are achievable by utilizing a common medium to communicate multiple signals. This concept is termed "multiplexing".

2. PURPOSE

It is the purpose of this AIR to define certain characteristics that should be incorporated in aircraft multiplexing systems. These characteristics represent those that have gained general acceptance by industry as being desirable for multiplexing systems. As others are defined, they will be included in revisions of this AIR.

3. SCOPE

All electrical and electronic signals within an aircraft are potential candidates for multiplexing, although the determination of whether or not they are multiplexed is a matter for individual system consideration. However, those signals that are selected for multiplexing preferably should conform to the characteristics included in this AIR.

4. GENERAL INFORMATION

This AIR provides guidelines for future developments in aircraft multiplexing systems. It is recognized that certain existing multiplexing systems do not comply with some of the characteristics included in this AIR. It is not the intent of this AIR to alter the characteristics of existing multiplexing systems but to guide the direction for future developments. This AIR includes specific characteristics of aircraft multiplexing systems on which there exists a general agreement within industry. As other characteristics are defined, they will be added to subsequent versions of this AIR. This AIR is intended for moderate data rate systems.

4.1 System Characteristics:

4.1.1 Balanced transmission lines (e.g., twisted shielded pair or dual conductor "twinax" cable) are preferred for use in multiplexed signal transmission within the aircraft.

4.1.2 For purposes of eliminating ground loops, it is recommended that there be no coupling of dc or low frequency ac signal voltages between units in the multiplexing system. This can be typically achieved by use of transformer coupling.

4.1.3 There are applications for digital and analog TDM (time-division multiplexing) and FDM (frequency-division multiplexing) systems or their combinations in aircraft interior multiplexing.

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* Nominally 1 megabit/sec or less

4.1.4 The multiplexing system should have a low susceptibility to EMI (electromagnetic interference) and should be low in emission of EMI. The requirements of MIL-STD-461, Class 1C or equivalent and the requirements of ARP 937 should be considered in defining the EMI susceptibility and emission characteristics of the multiplexing system.

4.1.5 The inherent redundancy capabilities of multiplex systems should be considered in both hardware and system design.

4.1.6 Time-diversity techniques should be considered in cases where sufficient immunity to transients is not otherwise achievable.

4.1.7 The inherent capabilities of multiplex systems for built-in-test (BIT) and system diagnostics should be considered in both hardware and system design.

4.2 Digital Transmission Standards:

4.2.1 The data stream used within digital TDM systems should be self-clocking.

4.2.2 A baseband data stream is preferred to a modulated-carrier system for digital TDM systems.

4.2.3 Biphase-level modulation (see MIL-STD-442) of the baseband signal is the preferred means of communicating digital TDM signals.

4.2.4 Digital TDM systems should preferably be capable of accepting synchronization from an external source. They should be capable of operating in the absence of the external synchronization signal.

4.2.5 In digital TDM systems, MODEM (modulator - demodulator) output voltages to transmission lines (as opposed to interconnections) should preferably be at a nominal five volts (peak-to-peak) level at transmission line impedances of 150 ohms or less. Deviations from this value may be made where required by considerations of MIL-STD-461 or of signal-to-noise ratio. This is applicable to both matched-line and lossy-line systems.

4.2.6 No more than two signal paths are required in a TDM system except for those cables used to provide redundant signal paths.

4.2.7 There are applications for both discrete-addressing and time-slot-addressing systems in aircraft multiplexing systems.

4.2.8 Discrete-addressing systems require message-synchronization and time-slot systems require frame-synchronization signals. Both frame-synchronization and message-synchronization signals should utilize a unique signal which is inherently different from the signals in the data stream (rather than bit patterns such as pseudorandom codes).

4.2.9 Frame- and message-synchronization signals for digital TDM systems preferably should extend over a minimum of a three-bit time period. If dead times between message words are utilized, they may be a part of the synchronization signal. The preferred synchronization signal is a three-bit invalid bi-phase level code followed by a "one" as shown in Figure 1(a). Optionally, a bit-synchronization field may precede the invalid code as shown in Figure 1(b). In this case, the bit following the invalid code may be a useful information bit.

4.2.10 Slot-synchronization signals are not required in time-slot-addressing systems. Slot-synchronization will be accomplished by use of frame-synchronization signals and the self-clocking data stream.

4.2.11 In a time-slot-addressing system, the data transmission interval (slot) preferably should be the same for all subscribers. Data rate and data sampling rate requirements are accommodated by assigning multiple slots to certain subscribers, as necessary.

4.2.12 Digital TDM systems may use either the matched-line or lossy-line approach, depending upon the design of the individual multiplexing system.

4.3 Analog Interface Characteristics:

4.3.1 Preferred input and output nominal signal voltage levels in analog TDM systems are:

Full scale positive	:	+5 VDC
Zero	:	0 VDC
Full scale negative	:	-5 VDC

4.3.2 Appropriate care should be given to system and hardware design to minimize aliasing effects and to provide adequate interpolation filtering.

5. REFERENCED DOCUMENTS

MIL-STD-442 - DoD - Aerospace Telemetry Standards
MIL-STD-461 - DoD - Electromagnetic Interference Characteristics Requirements
ARP 937 - SAE - Jet Engine Electromagnetic Interference Test Requirements and Test Methods

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