



AEROSPACE STANDARD

AS5652™**REV. A**

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Superseding AS5652

10 Megabit/sec Network Configuration Digital Time Division Command/Response Multiplex Data Bus

RATIONALE

Revision A corrects Figure numbers in the captions. There were no other changes to the content.

AS5652A has been reaffirmed to comply with the SAE Five-Year Review policy.

FOREWORD

This standard was developed in conjunction with the Miniature Munitions Interface Standard in order to support a distributed RT point-to-point network configuration.

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1. SCOPE

This SAE Aerospace Standard (AS) contains requirements for a digital time division command/response multiplex data bus, for use in systems integration that is functionally similar to MIL-STD-1553B with Notice 2 but with a star topology and some deleted functionality. Even with the use of this document, differences may exist between multiplex data buses in different system applications due to particular application requirements and the options allowed in this document. The system designer must recognize this fact and design the multiplex bus controller (BC) hardware and software to accommodate such differences. These designer selected options must exist to allow the necessary flexibility in the design of specific multiplex systems in order to provide for the control mechanism, architectural redundancy, degradation concept, and traffic patterns peculiar to the specific application requirements.

1.1 Purpose

This document establishes requirements for digital, command/response, time division multiplexing (Data bus) techniques. It encompasses the data bus line and its interface electronics illustrated on Figure 1, and also defines the concept of operation and information flow on the multiplex data bus and the electrical and functional formats to be employed.

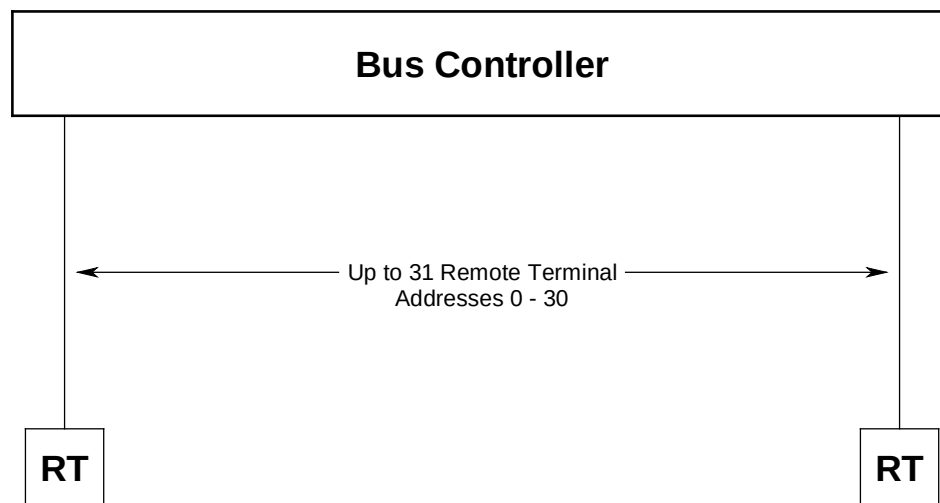


Figure 1 - Data bus network configuration

1.2 Field of Application

When invoked in a specification or statement of work, these requirements shall apply to the multiplex data bus and associated equipment which is developed either alone or as a portion of a Miniature Mission Store weapon system or subsystem development. The contractor is responsible for invoking all the applicable requirements of this standard on any and all subcontractors he may employ.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP4242 Electromagnetic Compatibility Control Requirements Systems

2.1.2 TIA Publications

Available from TIA, Standards and Technology Department, 2500 Wilson Boulevard, Arlington, VA 22201, www.tiaonline.org/standards/.

TIA/EIA-485-A 21 Electrical Characteristics of Generators and Receivers for
(ANSI/TIA/EIA-485-A-98) Use in Balanced Multipoint Systems

2.1.3 U.S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-STD-1553B Digital Time Division Command/Response Multiplex Data Bus

MIL-STD-464 Electromagnetic Environmental Effects, Requirements for Systems

2.2 Definitions

ASYNCHRONOUS OPERATION: For the purpose of this standard, asynchronous operation is the use of an independent clock source in each terminal for message transmission. Decoding is achieved in receiving terminals using clock information derived from the message.

BIT RATE: The number of bits transmitted per second.

BIT: Contraction of binary digit: may be either zero or one. In information theory a binary digit is equal to one binary decision or the designation of one of two possible values or states of anything used to store or convey information.

BROADCAST: Operation of a data bus system such that information transmitted by the bus is addressed to more than one of the remote terminals connected to the data bus.

Bus Controller (BC): The terminal assigned the task of initiating information transfers on the data bus.

BUS MONITOR (BM): The terminal assigned the task of listening to Logical Hub activity with ability to extract selected information, to be used at a later time. Bus Monitor may be stand alone or incorporated into another terminal.

COMMAND/RESPONSE: Operation of a data bus system such that remote terminals receive and transmit data only when commanded to do so by the bus controller.

COMPOSITE BUS MONITOR (cBM): The cBM provides a time correlated transmission of all activity entering and departing the Logical Hub, including all BC and RT valid, invalid, legal and illegal words.

DATA BUS: Whenever a data bus or bus is referred to in this document it shall imply all the hardware including twisted shielded pair cables, required to provide a single data path between the bus controller and each associated remote terminal resulting in a Star Topology, as seen in Figure 2.

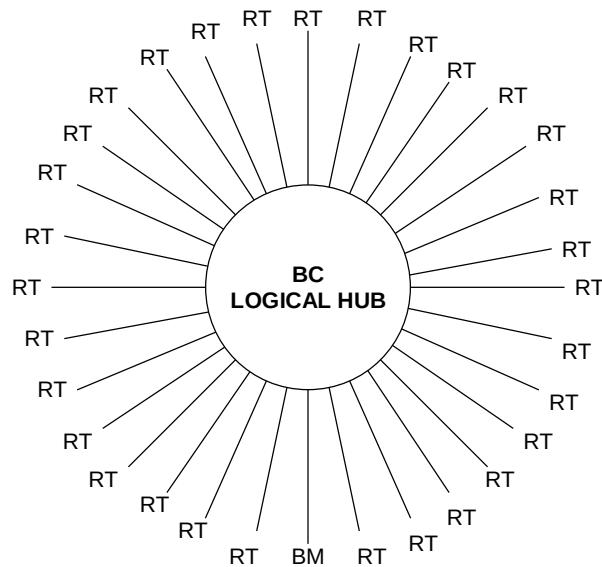


Figure 2 - BC logical hub - star architecture

HALF DUPLEX: Operation of a data transfer system in either direction over a single line, but not in both directions on that line simultaneously.

LOGICAL LEVEL HUB: In this document, the Logical Level Hub or just Logical Hub is a set of Hardware and/or software providing logical communications from the BC to and from each implemented RT, authorized by command word RT address bits, thru the RS-485 transceivers. The hub architecture is known as an Active Star Configuration; where the active function limits responses from the Remote Terminals so that the BC receives communications from only one RT at a time. The Logical Hub also supplies a composite Bus Monitoring traffic line out, to allow monitoring of all activity within the Logical Hub. See Figures 2 and 3.

MESSAGE: A single message is the transmission of a command word, status word, and data words if they are specified.

MODE CODE: A means by which the bus controller can communicate with the multiplex bus related hardware, in order to assist in the management of information flow.

MULTIPLEX DATA BUS: A communications pathway, based on a physical media, where Time Division Multiplexing is employed in order to manage the transfer of information to and from terminals located across the physical media.

PULSE CODE MODULATION (PCM): The form of modulation in which the modulation signal is sampled, quantized, and coded so that each element of information consists of different types or numbers of pulses and spaces.

REMOTE TERMINAL (RT): All terminals not operating as the bus controller or as a bus monitor.

RT LINK SHUTDOWN: The shutdown function contained within the BC/Logical Hub for inhibiting all transmissions to an RT link.

SUBSYSTEM: The device or functional unit receiving data transfer service from the data bus.

TERMINAL: The electronic module necessary to interface the data bus with the subsystem and the subsystem with the data bus. Terminals may exist as separate line replaceable units (LRUs) or be contained within the elements of the subsystem.

TERMINAL MONITOR (TM): The terminal assigned the task of listening to RT line traffic with ability to extract selected information, to be used at a later time. Terminal Monitor may be stand alone or incorporated into another terminal.

TIME DIVISION MULTIPLEXING (TDM): The transmission of information from several signal sources through one communication system with different signal samples staggered in time to form a composite pulse train.

WORD: In this document a word is a sequence of 16 bits plus sync and parity. There are three types of words: command, status and data.

2.3 Acronymns and Abbreviations

AIR	Aerospace Information Report
ARP	Aerospace Recommended Practice
BC to RT	Bus controller to remote terminal transfer
BC	Bus controller
BIT	Built-in-test
BM	Bus monitor
CS	Clear Status
dB	Decibels
DC	Direct current
EMC	Electromagnetic compatibility
ft	Feet
kHz	Kilohertz
LRU	Line replaceable unit
LSB	Least significant bit
MC	Mode code
MHz	Megahertz
MIL-STD	Military Standard
MSB	Most significant bit
ms	Milliseconds
mV	Millivolts
ns	Nanoseconds
PCM	Pulse code modulation
P	Parity
RMS	Root-mean-square
RT to BC	Remote terminal to bus controller transfer

RT	Remote terminal
T/R	Transmit/receive
TBD	To be determined
TDM	Time division multiplexing
TF	Terminal flag
V	Volt
Z_o	Nominal characteristic impedance

3. GENERAL REQUIREMENTS

3.1 Test and Operating Requirements

All requirements as specified herein shall be valid over the environmental conditions, which the multiplex data bus system shall be required to operate.

3.2 Data Bus Operation

The multiplex data bus system in its most elemental configuration shall be as shown on Figure 1, consisting of a Bus Controller with 1 to 31 individual lines, having one line to each respective Remote Terminal. An example of the data bus including subsystems and bus monitors can be seen in Figure 3. The multiplex data bus system shall function asynchronously in a command/response mode, and transmission shall occur in a half-duplex manner. Sole control of information transmission on the bus shall reside with the Bus Controller, which shall initiate all transmissions. The information flow on the data bus shall be comprised of messages, formed, by three types of words (command, data, and status) as defined in 3.3.3.5.

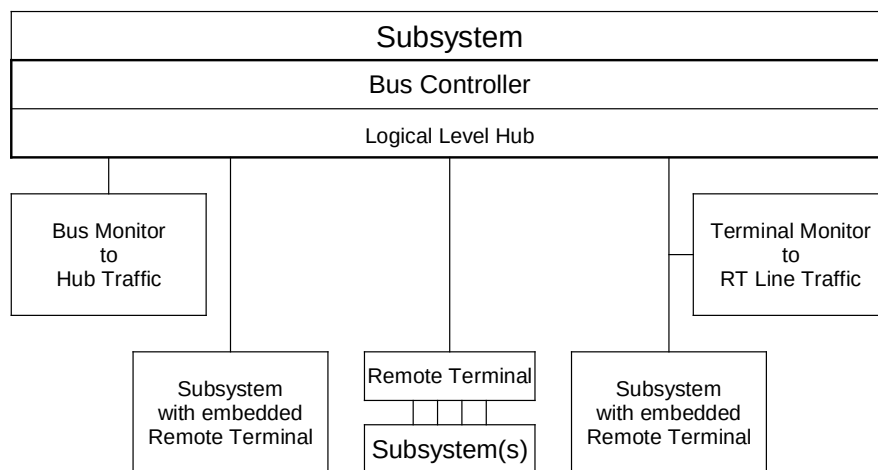


Figure 3 - Data bus with subsystems and monitors

3.3 Characteristics

3.3.1 Data Form

Digital data may be transmitted in any desired form, provided that the chosen form shall be compatible with the message and word formats defined in this standard. Any unused bit positions in a word shall be transmitted as logic zeros.

3.3.2 Bit Priority

The most significant bit (MSB) shall be transmitted first with the less significant bits following in descending order of value in the data word. The number of bits required to define a quantity shall be consistent with the resolution or accuracy required. In the event that multiple precision quantities (information accuracy or resolution requiring more than 16 bits) are transmitted, the most significant bits shall be transmitted first, followed by the word(s) containing the lesser significant bits in numerical descending order. Bit packing of multiple quantities in a single data word is permitted.

3.3.3 Transmission Method

3.3.3.1 Modulation

The signal shall be transferred over the data bus in serial digital pulse code modulation (PCM) form.

3.3.3.2 Data Code

The data code shall be Manchester II bi-phase level. A logic one shall be transmitted as a bipolar coded signal 1/0 (i.e., a positive pulse followed by a negative pulse). A logic zero shall be a bipolar coded signal 0/1 (i.e., a negative pulse followed by a positive pulse). A transition through zero occurs at the midpoint of each bit time (see Figure 4).

3.3.3.3 Transmission Bit Rate

The transmission bit rate on the bus shall be 10 megabit per second with a combined accuracy and long-term stability of $\pm 0.1\%$ (i.e., ± 10000 Hz). The short-term stability (i.e., stability over 1 second interval) shall be at least $\pm 0.01\%$ (i.e., ± 1000 Hz).

3.3.3.4 Word Size

The word size shall be 16 bits plus the sync waveform and the parity bit for a total of 20 bits times as shown on Figure 5.

3.3.3.5 Word Formats

The word format shall be as shown on Figure 5 for the command, data, and status words.

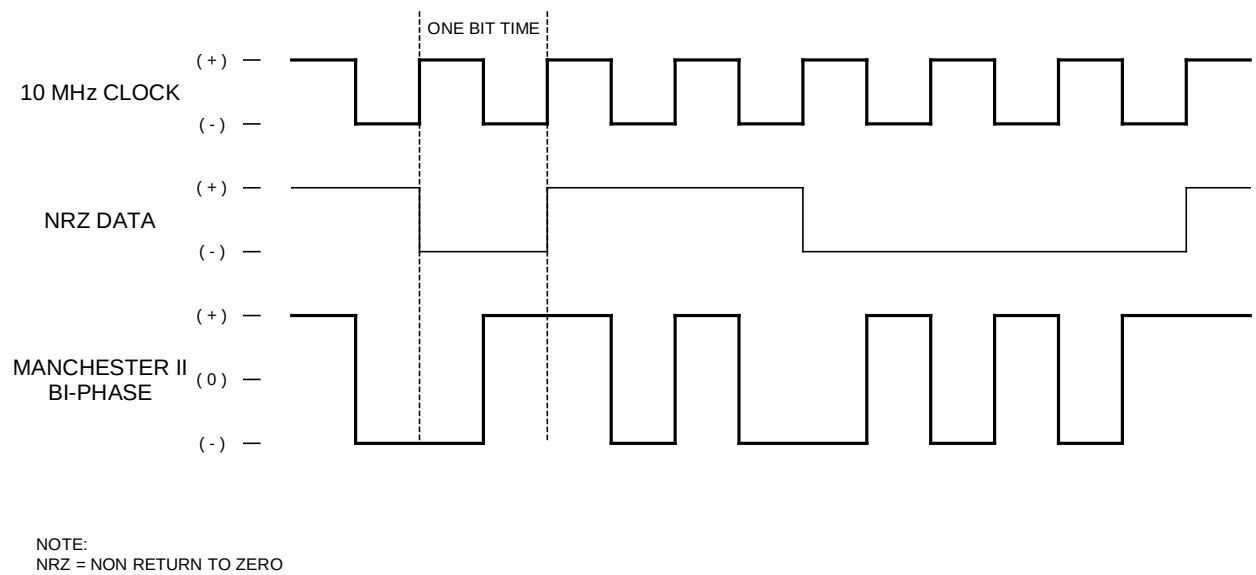


Figure 4 - Data encoding

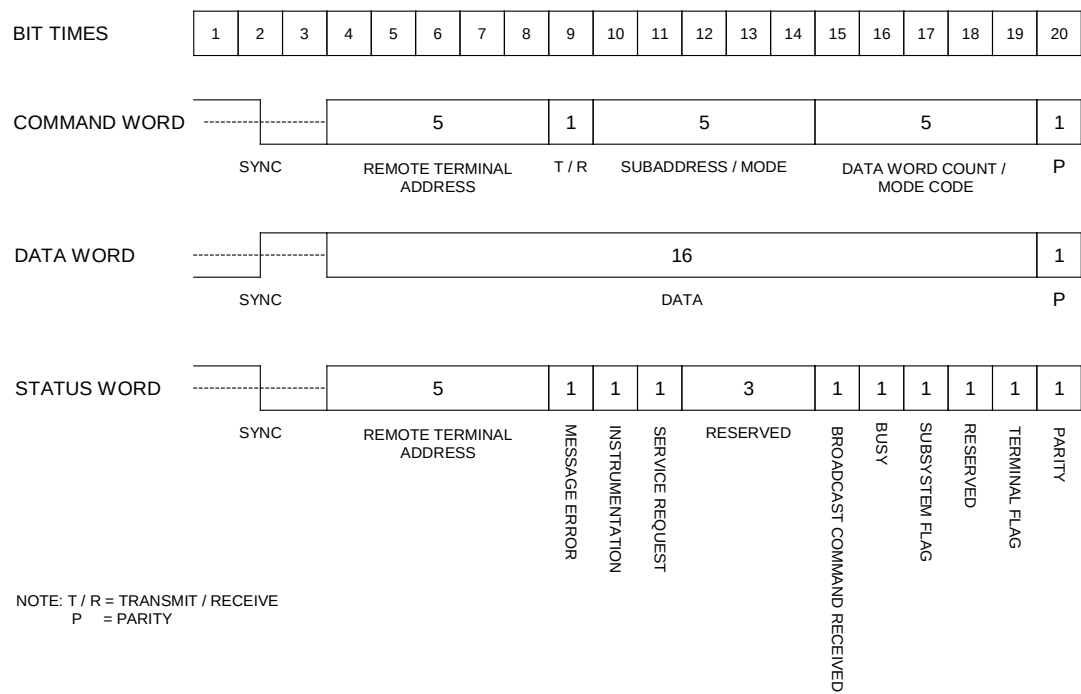


Figure 5 - Word formats