

# Aeroflex-Plainview

## MIL-STD-1553 Glossary

### A

#### 1553

Military standard that establishes requirements for digital, command/response timed mission multiplexing techniques. In this handbook, 1553 is used as a generic name for MIL-STD-1553(USAF), MIL-STD-1553A, and MIL-STD-1553B. Where a specific revision is referenced, the revision suffix is added, e.g., 1553B.

#### Address Programming

The method by which an RT is made unique from all others.

#### Analog Front End of a Terminal

The analog front-end portion of a 1553B terminal consists of one or more channels, each of which contains an interface to translate the 1553B bus signal into a digital signal with voltage levels appropriate for the remainder of the terminal. The fact that most terminals being designed today use purchased hybrid or VLSI IC parts has gone far toward simplifying terminal design.

#### Aperiodic

A treatment which renders nonconductive material receptive to electroless deposition

#### Applications Software

Electronic components, such as transistors, diodes, thyristors, etc., which can operate on an applied electrical signal so as to change its basic character; i.e., rectification, amplification, switching, etc.

#### Asynchronous Operation

An electrical element capable of modifying an input voltage in such a way as to achieve rectification, amplification, or switching action, e.g., transistors. Discrete devices such as diodes or transistors; or integrated devices, such as analog or digital circuits in monolithic or hybrid form.

#### Avionics

An element of a circuit in which an electrical input signal is converted into an output signal by the nonlinear voltage/current relationships of a semiconductor device (see Active Components).

#### Avionics Hot Bench

A network containing active and passive elements.

# B

## 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.

## Bit Rate

The number of bits transmitted per unit time, usually, per second.

## BLACK

The designation applied to all wirelines, components, equipment, and systems which handle only encrypted or unclassified signals, and areas in which no unencrypted or classified signals occur.

## Broadcast

Operation of a data bus system such that information transmitted by the bus controller using a unique broadcast address is addressed to all of the terminals connected to the data bus.

## Broadcast Command Received Bit

This bit is set by an RT that implements Broadcast Commands any time that a valid Broadcast Command has been received. Since there is no response to a Broadcast Command, the setting of this bit allows the Bus Controller to subsequently check that the command was received properly by issuing a ‘Transmit Status’ or ‘Transmit Last Command’ Mode Command.

## Built-in Test (BIT)

The capability of an LRU to perform some form of self-test.

## Bus

In this Glossary (unless noted in the text) bus refers to 1553 data bus, which is the part of the network which is terminated in its characteristic impedance, and to which stubs are attached. See Data Bus. Bus controller. The terminal assigned the task of initiating information transfers on the data bus. There is one (and only one) BC on a 1553B bus (at any given time), and this terminal totally controls the flow of information on the bus. No other terminal may transmit anything on the bus except as instructed by the BC.

## Bus Coupler

The circuit which is used to couple signals between the main bus cable and transformer coupled stub cables. A single stub bus coupler consists of a transformer, two isolation resistors, and a shielded enclosure. Multiple stub bus couplers are also commercially available.

## Bus Interface Unit (BIU) Function

This term is generally interchangeable with ‘terminal,’ as defined in 1553B: ‘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.’

### Bus Interface Unit (BIU) Hardware

This term describes a particular set of hardware that performs the interface between the data bus and the internal portion of an embedded or standalone remote terminal. As a minimum, it refers to the digital decode and encode logic that expands to the complete analog-to-digital interface between the data bus and the internal remote terminal electronics or the subsystem for embedded terminals..

### Bus Monitors

The terminal assigned the task of receiving bus traffic and extracting selected information to be used at a later time. A Bus Monitor does not transmit status words or anything else on the bus. It may have no terminal address, and in fact, can receive information addressed to any (or all) terminals on the bus. As defined in section 4.4.4 of 1553B, a Bus Monitor may have an assigned terminal address, in which case it will act just like an RT for commands to that address. The two most common applications of Bus Monitors are: 1. Instrumentation, for recording bus traffic from many or all terminals for off-line analysis. 2. Backup BC, to provide a terminal with enough information to become the BC on the bus if commanded to do so, either with a "Dynamic Bus Control" Mode Command or by some other method.

### Busy Bit

An RT that is functional but that cannot transfer data to or from the subsystem on command from the Bus Controller is busy. An RT that is busy should set the "Busy" bit in its Status Word responses on the bus.

## C

### Characteristic Impedance ( $Z_0$ )

The value of impedance which, if it terminates a transmission line, results in no reflection along the line.  $Z_0$  is usually specified at a certain frequency (1.0 MHz in 1553B, paragraph 4.5.1.2).  $Z_0$  is approximately equal to the square root of  $L/C$ , where  $L$  = inductance and  $C$  = capacitance per unit length of cable.

### Clock Rate

The signal from the 1553B bus is asynchronous with any clock in the terminal, since a Manchester code is by its nature self-clocking. That is, all Manchester-encoded bits have a zero-crossing in the middle, and it is to this zero-crossing time that the data is referenced.

### 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.

### Communications Protocol

See Protocol.

### Compool (global/local) (communication pool)

This is a JOVIAL language term used to declare or define data by name that will subsequently be set or used by program procedures. The JOVIAL compiler establishes locations in memory for compool data. As such, it is the means of data communications, and the scope of the declaration can be limited, hence the restriction "local."

### Configuration

The specific functional structure of a given integrated system consisting of physical interconnection (topology) and system control. See Architecture.

### Controller

See Bus Controller.

# D

## Data

This term is used in this handbook to denote the content (16 bits) of information transferred on the 1553 data bus in one data word.

## Data Bus

Whenever a data bus or bus is referenced in this handbook, it implies all the hardware, including twisted-shielded pair cables, isolation resistors, transformers, etc., required to provide a single data path between the bus controller and all the associated remote terminals.

## Data Bus Connectors

The two physically separate connectors provided on the RT interface to the data bus.

## Data Bus Interface

The part of the digital interface which is concerned with transferring data. See Digital Interface.

## Data Bus Loading

Data bus loading is the percent utilization of the total information transfer capacity of a multiplexed data bus.

## Data Latency

Data latency is the age of the data, or how long it has been since the data was measured or calculated to the point where it is used.

## Data Wrap-Around

Many RTs include a "data wrap-around" function, in which data words sent to the RT with a receive command are send back to the bus controller with a subsequent transmit command.

## Digital Interface

Embedded, high speed interface to the subsystem used to transfer control, status information and data to and from the subsystem.

## Digital Section

The remainder of the terminal other than the analog front end.

## Direct Coupled

A method of connecting terminals to the 1553 data bus using only a wire splice. Dispersion. Dispersion is transmission line effects on lossy transmission lines on propagating waveforms. It is a result of frequency-dependent velocity and frequency dependent attenuation which distorts the propagating wave.

## DMA Interface

DMA hardware and DMA-CPU protocol establish the means by which data may be transferred to and from memory without direct CPU intervention.

### Droop

The transient exponential decay of voltage across an inductor (typically a transformer winding) due to voltage drop across the output impedance of the source driving the inductor as the current in the winding increases (proportionally to the integral in time of the voltage).

### Dual-redundant

Use of two twisted, shielded cable pairs and interfaces for the purpose of greater reliability. Dynamic Bus Control. The operation of a data bus system in which designated terminals are offered control of the data bus, i.e., they become a BC when the terminal offering control relinquishes control.

# E

## Embedded Interface

1553 interface circuitry housed within a subsystem.

## Encryption Designs

Encryption techniques used by the data bus network and its associated terminals and processors to convert RED data into BLACK data and to isolate multiple classification levels and compartments of RED data. The specific encryption technique and system design must be approved by the government agency responsible for encryption certification.

## Equipment Specifications

See Specifications.

## Error Management

General term used to describe the detection of transient events that temporarily degrade bus timing or performance and the step-by-step sequence to branch to alternate functions, procedures, or equipment use.

## Event

A single occurrence at a precise time.

# F

## Fail-Safe Timer

MIL-STD-1553B requires (4.4.1.3 of 1553B) that every RT or BC contain a hardware timer to prevent any transmission on the bus longer than 800 us. Since no valid transmission is longer than 660 us, only a failure in the terminal could result in a transmission of 800 us or longer. The fail-safe timer is required to prevent such a failure from causing a continuous transmission on the bus and thus rendering it (the bus) unusable for other transmissions.

## Fault Management

General term used to describe the detection of intermittent or permanent events that require changes to system structure or operation and the step-by-step sequence to branch to alternate functions, procedures, or equipment use.

## Function

The special work done by a subsystem or a software task.

## Fundamental Impedance

See Characteristic Impedance.

## Fundamental Waveform

Defined in this glossary to be the original impinging waveform. The waveform that is transmitted.

# G

## Gateway

A unit that passes data between two data buses of similar bus type.

# H

## Half Duplex

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

## Hierarchical Control

A form of distributing all system control in a system, where one level of control is subordinate to a higher level of control.

## Hierarchical Network

A description of a physical topology that has both global and local levels of data buses.

## Illegal Commands

A valid command that is not implemented in the receiving RT.

## Input Threshold Adjustment

Some receivers allow the input voltage thresholds to be adjusted. It may be desirable to adjust the voltage thresholds to alter the noise performance for some special applications. Receivers are generally supplied with the input voltage threshold adjusted for optimum performance, and the range of acceptable threshold values is not wide.

## Input-Output (I/O)

This term is used to describe both the function of hardware and software to receive and transmit data and the physical hardware section that is the interface between a 1553 interface and subsystems of a remote terminal or bus controller.

## Instrumentation

The purpose of the “Instrumentation” bit is to enable the differentiation of Status Words and Command Words, which are otherwise differentiated only by their position in a message.

## Integration

In this handbook, integration refers to the cooperative need for shared information and the means for achieving that cooperation.

## Intersymbol Interference (ISI)

The effect seen as a pulse in a string of pulses distorting subsequent pulses as a result of being passed through a network that has less bandwidth than the spectrum of the pulses.

## ISI

Intersymbol interference (ISI) is the effect seen where a waveform is distorted by passing it through a network which either has less bandwidth than the signal, or is dispersive.

## Invalid Command

A command in which the command word fails to meet validation criteria.

## Isolation Resistors

Terminals for direct-coupled stubs require two isolation resistors between the terminal output and the bus connection. Their function is to isolate the bus from a terminal that has shorted (i.e., a terminal that, due to some failure, is presenting an abnormally low impedance to the bus).

# L

## Linked Lists

In linked list message processing, each message points to the next message to be transmitted. This method makes it easy to insert messages into the middle of a particular minor frame's message stream.

## Lossy

In the context of lossy transmission line, the term lossy acknowledges the fact that transmission lines do not have infinite, bandwidth and contribute to frequency shaping of a propagating pulse above and beyond ideal reflective effects.

# M

## Main Bus

See Bus.

## Major Cycle

A period of scheduled time during which all periodic transmissions and computations occur at least once. Major cycles are divided into subcycles called minor cycles.

## Manchester-coded Format Encoding and Decoding

Each channel of the digital section contains an encoder/decoder function that deals with the data on a bit and single-word level. Its purpose is to change the data from its Manchester-coded format into the proper digital data format (typically 16-bit parallel) needed by the rest of the terminal (and vice-versa), and to perform error detection for word-level 1553B errors (e.g., bit count errors, Manchester coding errors, etc.). There must be a separate decoder for each channel, but there may be only one encoder.

## Message

In 1553 terms, a message is a part of an information transfer format, such as 1 to 32 data words. A message may also refer to the entire transmission by both bus controller and responding remote terminal, which includes not only the data words but the overhead. This second usage is more correctly called an information transfer format. Definition from 1553: "A single message is the transmission of a command word, status word, and data words if they are specified. For the case of a remote terminal to remote terminal (RT to RT) transmission, the message shall include the two command words, the two status words and data words."

## Message Stacks

The stack method is the simplest to implement and allows for the implementation of minor and major frames by use of separate stacks for each minor frame. The subsystem processor simply reinitializes the stack pointer to the appropriate stack each time the particular minor frame is to begin.

## Minor Cycle

A period of scheduled time during which the most frequently occurring periodic transmission or computation will occur, or a period scheduled for a frequently occurring transmission or computation. Multiple minor cycles may be required to achieve a major cycle. See Major Cycle.

## 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 the information flow.

## Mode Command

An information transfer format with the subaddress/mode field in the command word set to indicate that the next following field is a mode code. An RT that implements Mode Commands is required to know that a Subaddress/Mode field in a Command Word equal to 00000 or 11111 defines a Mode Command, and that, in this case, the Word Count field is to be treated as the Mode Code rather than the number of words.

### Modem

Modulator/Demodulator. In this handbook, this term is used to mean the analog transceiver circuitry used to convert to digital form. It is also used (loosely) to denote a bus interface unit function.

### Modulation

The signaling method used to convey data on the data bus.

### Multiple-message Terminals

A multiple-message terminal is a processor or sequencer in its own right. This type of terminal only makes sense as a BC, although some multiple-message BCs are capable of being configured to act as RTs upon command from the subsystem or with a discrete signal. It is capable of chaining several messages together, maintaining a schedule of messages required on the bus, and initiating all transfers at the required times and in the required sequence. In system terms, the multiple-message BC would be programmed with a whole minor frame or even major frame at a time.

### Multiplex Protocol

See Protocol.

### Multiplex System Topology

Multiplex system topology is the network of the data bus terminals, the components that comprise the data bus, and the physical arrangement of redundant elements (whether terminals, bus controllers, or bus cables, coupler, or terminators). It includes all terminals and data buses involved in integrating the data buses into the vehicle.

### Multiplexing

The transmission of information from several signal sources through one communication system.

# N

## Network

Some devices are protected against short circuits applied to their outputs. This could be used to protect parts in debugging or breadboarding activities. Note that this is somewhat inherent in the design of a current-mode transmitter.

## Noise

Noise is mainly due to reflections from impedance discontinuities in the bus network. Another source of noise is electromagnetic interference (EMI) or coupling of signals into the cable from other parts of the system. Both of these types of noise are mostly higher in frequency than the 1553B fundamental frequency of 1 MHz. This noise and signal distortion can cause multiple zero-crossings to occur in a bit time (1 microsecond) and can also cause a large error in the time of a zero-crossing (a zero-crossing shift error). This could cause the word to be misinterpreted by the decoder. It is most likely that the decoder would detect a Manchester error, which is a bit that does not have opposite values in the two halves of the bit time. Also, if one bit is distorted sufficiently that it is decoded as valid but of the wrong value, the decoder detects this error with the parity bit. Experience has shown that there is little need for filtering of low-frequency noise. Good performance of the terminal in the presence of noise on the bus depends on input filtering and the proper setting of the input voltage thresholds.

# O

## Output Short Circuit Protection

Some devices are protected against short circuits applied to their outputs. This could be used to protect parts in debugging or breadboarding activities. Note that this is somewhat inherent in the design of a current-mode transmitter.

## Output Voltage Adjustment

Some transmitters offer adjustable output voltage. This feature could be very useful in the design of test equipment but is of limited usefulness otherwise. Over-temperature Shutdown. Some devices include a temperature sensor that shuts down the transmitter if it gets too hot. This is to protect the part from damage, so it is desirable. However, this feature increases the cost and may slightly decrease the device reliability.

# P

## Partitioning

The method used to divide a complex system or function into manageable size before allocating these smaller pieces to devices to perform the required job.

## Periodic

Event(s) recurring at specific time intervals. See Aperiodic.

## Polling

This is the method of communicating with multiple terminals within a system to determining information transfer priorities or servicing needs. RTs might be polled to determine whether they have aperiodic or high priority messages to transmit, state of health, or capability of accepting bus control.

## Protocol

The conventions imposed on serial data to ensure that the receiver correctly interprets the transmitted data; also, the procedures used for initiating messages and responding to them.

## 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.

# R

## Receiver Input Filtering

A method of electroplating in which the parts are affixed to a rigid rack.

## Receivers

Photographs made of the interior of a sealed package by use of X-rays to expose the film.

## RED

Random access memory; a type of memory which offers access to storage locations within it by means of X and Y coordinates.

## Redundancy

Circuit failures which occur randomly with the overall failure rate for the sample population being nearly constant.

## Redundant Data Bus

A network composed only of resistors and capacitors.

## RED/BLACK

Metals that readily form compounds.

## Reflection Coefficient

The surface area of an integrated circuit or of a hybrid or PCB substrate. The surface area required for a component or element.

## Remote Terminal (RT)

A second bonding attempt after a bond has been removed or failed to bond on the first attempt.

## Retrofitting

A second bond made on top of a removed or damaged bond or a second bond made immediately adjacent to the first bond.

# S

## Sample Consistency

Relates to the consistency of data in a message. Messages transmitted shall contain only mutually consistent samples of information, (i.e. all parameters shall be of the same sample set).

## Sensor

The hardware and software required to perform a specific system function, such as inertial measurement, radar detection.

## Service Request Bit

The purpose of this bit is to inform the Bus Controller that the RT wants the Bus Controller to request a particular message to be transmitted from the RT to the BC.

## Single-message Terminals

A single-message terminal has enough capability to construct or process a complete message without any action by the subsystem. Subsystem action is required only at the beginning or end of the message or in the event of an error. The subsystem is responsible for processing any errors and interpreting the status word contents, to decide what the next message should be, and then issuing it. This type of terminal is typically used with a microprocessor-based subsystem; the messages to be sent are all constructed by the subsystem processor and placed in defined memory locations (to be read by the terminal via direct memory access (DMA)) or written to registers in the terminal.

## Single-word Terminals

In a system with a single-word terminal, the subsystem must process each word in each message individually. That is, a single-word terminal requires subsystem intervention or action for every word. After all the words have been received, the subsystem processor must determine the validity of the message and construct the proper response. The response must then be transferred to the terminal and transmitted one word at a time.

## Specification

A document prepared specifically to support procurement that clearly and accurately describes the essential technical requirements for purchased material. Also included are procedures necessary to determine that the requirements have been met for the purchased material covered by the document.

## Standard

A military standard is a document that establishes engineering and technical requirements for processes, procedures, practices, and methods that have been adopted as standard.

## Status Flags

Specific one bit fields in the status word generated by the RT to indicate its status.

## Stub

The connection of a terminal to the main bus, usually kept as short as possible to minimize distortion. May be either director transformer coupled.

### Stub Coupling

The method of coupling an RT to the bus. These are generally transformer coupled, but some Navy applications require both transformer and direct coupled stubs (Notice 2).

### Subsystem

The subsystem is defined in 3.8 of 1553B as “The device or functional unit receiving data transfer service from the data bus.” The subsystem is considered to be the portion of the LRU (line replaceable unit—the entire item of electronics) other than the terminal. In other words, it is the hardware interfacing with the nonbus side of the terminal. See Sensor.

### System Flag Bit

A status word bit that indicates that there is some fault condition in the subsystem associated with the RT.

### Synchronous

Events occurring at specific time intervals. See Aperiodic.

### System

The interacting assembly of hardware, software, data, personnel, and facilities capable of performing a designated function with specified results.

### System Architecture

Includes the externally visible parts of a multiplex system, the internal partitioning of multiplex interfacing elements, and the hardware and software used for data transport and transport control. A multiplex system architecture consists of two major parts: system topology and system control.

### System Block Diagram

A graphic presentation of the partitions among functions. The blocks may represent actual parts or maybe schematic representations. In a real system functions may be partitioned among the parts used to implement the design.

### System Configuration

A 1553 bus system includes a BC (and possibly one or more backup BCs), one or more RTs (up to a maximum of 31), and zero or more bus monitors (typically not more than one, but could be any number). The BC has control of the system. It initiates messages that transfer data to or from an RT or control the operation of an RT. Each RT receives data sent to it by the BC, transmits to the BC or to another RT the data requested by the BC, or performs the commanded control function. A bus monitor listens to the traffic on the bus and extracts whatever information it has been programmed to extract.

### System Control

The part of the architecture that implements the dynamic functioning of the multiplex system. System control methodology is used to implement the protocol required for data transfers, the rules used in achieving media control and the procedures for initialization or startup, normal data bus transfer operations (such as, time synchronization, data security and data integrity), system error and fault management techniques, and bus control mechanization.

# T

## TEMPEST

An unclassified short name referring to investigations and studies or compromising emanations. It is sometimes used synonymously for the term “compromising emanations” (e.g. TEMPEST tests, TEMPEST inspections, TEMPEST control plan).

## 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 LRUs or be contained within the elements of the subsystem. The unit connects to the end of a stub which may be a transmitter or receiver. This definition allows a terminal to be a totally separate LRU, a circuit card, or a small portion of a circuit card; there is no restriction on the physical partitioning of the system. However, the current trend in technology is for smaller size and fewer parts. A terminal is either a Bus Controller (BC), a Remote Terminal (RT), or a Bus Monitor. Nothing in 1553B precludes a terminal from including the capability of performing the functions of more than one of these three types of terminals, but a terminal may perform only one function at anyone time.

## Terminal Flag Bit

This bit indicates that there is some fault condition in the RT. Remember that the RT is only that portion of the LRU necessary to communicate with the 1553 bus.

## Terminal Partitioning

Terminals may have various proportions of their design in hardware, firmware, and software. Typically, an older design, simple terminal would be almost all hardware, while a newer design, complex terminal would consist largely of software or firmware

## 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.

## Topology

The interconnectivity of the data bus(es) and their associated elements (terminals and controllers) to accomplish the desired data path required by the integration.

## Transceivers

Receivers and transmitters are generally packaged together as transceivers.

## Transformer

Another major analog component is the isolation transformer. It turns out that, to meet the terminal characteristics that are specified in 1553B, especially the common-mode rejection ratio (CMRR) requirement, an isolation transformer is the most appropriate design choice. As in the case of the transceiver, transformers are usually bought and not built. There are many available on the market that are specifically designed to work with available transceivers to meet the requirements of 1553B.

## Transformer Coupled

A method of connecting a stub to the 1553 data bus that uses a transformer and isolation resistors.

### Transmitters

The transmitter is the element in the terminal that outputs waveforms to the bus. It accepts as its input the digital signal from the encoder (typically differential TTL) and produces a signal on the 1553 bus that meets the requirements of 1553. It typically contains two drivers, one for each side of the differential 1553 bus. Each is designed to control the rise and fall times and the waveshape of the outputs. A transmitter also typically contains an inhibit input by which it maybe disabled.

### Twisted Shielded Pair

A twisted, shielded pair of wires is used to interconnect the elements of a network (transformers, resistors and connectors). It is the primary constituent of the network and is commonly referred to as cable.

### Transmission Coefficient

The ratio of the voltage wave transmitted beyond an impedance discontinuity over the incident voltage wave (referred to as CT in this document). It is the number between 0 and 2.

# W

## Waveform Quality

A phrase which addresses the amount of distortion with which a waveform arrives at its destination.

## Word

A 1553 word is a sequence of 20 bit times consisting of a 3 bit-time sync, 16 bits of data, and 1 parity bit. This is the word as it is transmitted on the bus; 1553 terminals add the sync and parity before transmission and remove them during reception. Therefore, the nominal word size is 16 bits; most significant bit first. There are three types of words: command, status, and data.