ASTRONICS BALLARD TECHNOLOGY:

Avionics Test & Simulation Terms and Definitions

By Astronics Corporation

Astronics

Astronics Ballard Technology develops and manufactures reliable test and simulation interface hardware and software for the aviation industry. These solutions are used to test, validate, and troubleshoot some of the world's most sophisticated commercial and military avionics systems. To better understand the Astronics Ballard Technology offerings, this white paper provides an explanation of the common terms used to define and describe these products.

Avionics Databus Protocols

A variety of communication protocols are used in avionics networks. Astronics Ballard Technology supports the following avionics protocols:

MIL-STD-1553

MIL-STD-1553 is a 1Mbps, Manchester encoded, multi-drop, half duplex, time multiplexed, command-response databus composed of a Bus Controller (BC) which initiates all commands, one or more Remote Terminals (RT) that accepts and/or responds to commands, and potentially a Bus Monitor (BM) which only listens to bus traffic. It is typically implemented in a Dual Redundant (A and B, or Primary and Secondary, or Primary and Backup) topology.

EBR-1553 (MMSI)

Enhanced Bit Rate 1553 (EBR-1553), also referred to as a Miniature Munition Serial Interface (MMSI) is a weapon interface which uses the MIL-STD-1553 protocol running at 10Mbps and wired point-to point from a hub using RS-485 communication.

ARINC 429

ARINC 429 defines a 32-bit word whereby the first eight bits, called the Label, define the interpretation of the remaining bits in the word. It is wired point-to-point from Transmitter to Receiver, or can be wired from a single Transmitter to multiple Receivers.

ARINC 708

ARINC 708 is a format for Weather Radar that is a 1Mbps, Manchester encoded bus that is electrically similar to MIL-STD-1553 and transmits up to 1865 bit frames (though typically 1600 bits) from Transmit to Receive channel. Buses are typically wired as a Direct Coupled bus as described by MIL-STD-1553.

Astronics Ballard Technology also supports the Honeywell Picture Bus (WXPD) which uses a unique 5-bit data format.

Astronics Ballard Technology pocket-sized USB adapters are an easy and portable way to interface computers to avionics databuses, including MIL-STD-1553, ARINC 429, ARINC 717, and ARINC 708.

ARINC 717

Flight data recorders typically use ARINC 717 data formatting. It represents 12-bit words composed into four one-second frames that are transmitted at different defined words per second (WPS) rates from Transmit to Receive channel.

ARINC 615-3

ARINC 615-3 is a Data Loading protocol and handshake using ARINC 429 as a data transfer bus. It is used for Operational Flight Program and Database loading for LRUs.

RS Serial

Many Astronics Ballard Technology products allow for RS-232, RS-422, and/or RS-485 serial data formats.

Discrete I/O

Most Astronics Ballard Technology products allow for avionics-level 28V compatible open/ground input or output Discrete I/O in various configurations and quantities.

Other ARINC Protocols

There are a host of other older ARINC protocols such as ARINC 419, 561, 568, 573, 575, and 582, to name a few. These protocols may be 12, 16, or 32-bit protocols and run at a variety of data rates. While Astronics Ballard Technology may not directly support these protocols, support can be available using the Advanced Parametric capabilities of our later generation products and treating data in a 'raw' mode, without predefined format.

Astronics Ballard Technology can analyze on a case-by-case basis, but can generally support any two-wire protocol.

ARINC 629

This was a protocol introduced by The Boeing Company for the 777 aircraft. Although Astronics Ballard Technology did support this protocol during the test and simulation design phase of the 777 aircraft, currently it is no longer supported.

ARINC 664

ARINC 664 is an Ethernet based data communications protocol used on some newer aircraft including A-380, B-787, and KC-46A. Astronics Ballard Technology does not currently support ARINC 664.

Avionics Protocol Terms and Definitions

MIL-STD-1553

The following Terms and Definitions are commonly used to describe characteristics of Astronics Ballard Technology MIL-STD-1553 Test and Simulation interfaces.

Channel	A Channel is defined as a Dual Redundant A – B (or Primary and Secondary) Bus Pair.
Single Function	A Single Function channel allows implementation of a Bus Controller (BC), OR up to 32 Remote Terminals (RTs), OR Bus Monitor (BM), but only one mode at a time under software selection.
Multi Function	A Multi Function channel allows implementation of Bus Controller (BC), up to 31 Remote Terminals (RTs), and Bus Monitor (BM) simultaneously. All three modes are not required to be implemented, but may be implemented, under software control.
Parametrics	Parametrics is a term used to define Protocol Error Injection capabilities for Astronics Ballard Technology MIL-STD-1553 Test and Simulation products. Most Multi-Function channels can support Protocol Error Injection with word, gap, and message errors as defined by the RT Production test plan.
Advanced Parametrics	Multi-function channels which implement Advanced Parametrics also include support for Variable Output Amplitude and Zero Crossing Distortion

ARINC 429

The following Terms and Definitions are commonly used to describe characteristics of Astronics Ballard Technology ARINC 429 Test and Simulation interfaces.

Transmit Channel	ARINC 429 is wired point-to-point from Transmit channel to Receive channel, or from Transmit channel to multiple Receive channels. For Astronics Ballard Technology products with fixed channel configurations, the total number of Transmit Channels required for a given test or simulation application is a critical parameter.
Receive Channel	ARINC 429 is wired point-to-point from Transmit channel to Receive channel, or from Transmit channel to multiple Receive channels. For Astronics Ballard Technology products with fixed channel configurations, the total number of Receive Channels required for a given test or simulation application is a critical parameter.
Programmable Channels	The latest generation of Astronics Ballard Technology ARINC 429 Test and Simulation products support Programmable Channels. Each channel can be individually programmed, under software application control, to be a Transmit or Receive channel. In this case, only the total number of channels required for a given test or simulation application is important.
Parametrics	Parametrics refers to the basic error injection capabilities for ARINC 429 Transmit channels and includes programmable bit rate, parity inversion, ± bit count (8-33 bits on certain products), and gap errors on a per channel basis.
Advanced Parametrics	Certain of Astronics Ballard Technology products support additional error conditions for Transmit channels. This includes the capabilities of standard Parametric modules, plus simulation of: • Leg open or leg short to ground; • Programmable output amplitude (0 to 200%); • Individually programmable rise and fall times; • Transmit NULL (DC offset) control (±5V).

Software

Astronics Ballard Technology products are supported by multiple levels of software.

BTIDriver API

Several generations of products ago, Astronics Ballard Technology created and unified on the BTIDriver interface. This is a set of C drivers for Windows or Linux that are included free of charge with products. The libraries are compatible across different form factors of a generational product line, and are forward compatible as new generations are introduced. This eliminates the need for software re-write as new generations of product are made available.

BTIDriver libraries are common across all current and legacy Astronics Ballard Technology products.

The BTIDriver supports C, C++, Visual Basic, .net, and LabVIEW environments.

BTITST32/BTITST64

The BTITST32 and BTITST64 applications (for 32 and 64 bit operating systems, respectively) are distributed along with the BTIDriver Libraries and offer a convenient method to validate driver installation and assign card numbers.

Compatibility Libraries

Astronics Ballard Technology products which were designed prior to the unification of a common BTIDriver library are not BTIDriver compatible and utilize a similar, but different, API. Many of these products are now in the Obsolete or End of Life stage of lifecycle management.

There may be instances when, due to drawings, configuration control, or other obsolescence matters (such as lost source code), a customer may need to purchase a newer BTIDriver compatible product, but may need to execute older, non-BTIDriver applications. In these cases, Astronics Ballard Technology has available, free of charge, a set of Compatibility DLLs (wrappers) which will allow the newer products to operate seamlessly with the older libraries in a Windows environment.

CoPilot Bus Analyzer Software

CoPilot is a very useful development, evaluation, and troubleshooting tool. It is a Graphical User Interface program running in a Windows environment that allows a user to set up and control various Avionics I/O interfaces without having to develop a custom application. One instance of the software running on a computer can control multiple Avionics I/O protocols. In the absence of actual hardware interfaces, CoPilot will default to a 'demo' mode, allowing users to evaluate the capabilities of the tool.

The CoPilot Bus Analyzer application is an add-on piece of software and is enabled at additional charge.

CoPilot Key

The CoPilot software is not licensed per copy or per computer. CoPilot is enabled to operate with a given piece of Astronics Ballard Technology hardware by purchasing a 'key' for the hardware. This can be thought of as a 'hardware upgrade' as opposed to purchasing the software.

CoPilot is an intuitive, graphical software program that allows you to easily monitor, record, replay, analyze, and simulate avionics bus data, and interact with data directly on multiple buses using interface hardware.

CoPilot software is available for download from the Astronics Ballard Technology Support web site or is shipped on CD with most Astronics Ballard Technology products. The CoPilot license allows users to install the application on as many computers as desired, and when enabled hardware is connected, the system will be completely operational. However, each piece of Astronics Ballard Technology hardware which is to operate with the CoPilot Bus Analyzer software application must have its own purchased enabling key.

Hardware products which have the CoPilot enabling key programmed are preceded by a CP- prefix in the part number.

Reliable Avionics Interface Products

Test and validate avionics equipment and systems with reliable test and simulation interfaces and software from Astronics Ballard Technology. For more information, visit astronics.com/BallardTechnology.

Astronics Corporation (NASDAQ: ATRO) serves the world's aerospace, defense and semiconductor industries with proven, innovative technology solutions. Astronics works side-by-side with customers, integrating its array of power, connectivity, lighting, structures, interiors, and test technologies to solve complex challenges. For 50 years, Astronics has delivered creative, customer-focused solutions with exceptional responsiveness. Today, global airframe manufacturers, airlines, military branches, completion centers and Fortune 500 manufacturing organizations rely on the collaborative spirit and innovation of Astronics.

To learn more about Astronics Ballard Technology avionics interface products, please visit **astronics.com/BallardTechnology**.

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