AceXtreme® 1553/429 USB Avionics Device

Hardware Manual

Model: BU-67X02/3U

BU-67X02U

BU-67103U

Compact, reliable, and easy-to-use, DDC's USB Avionics Device family provide a small, yet powerful solution for interfacing to MIL-STD-1553 and ARINC 429 data buses. The devices are ideal for users requiring portability, combined with the flexibility of a USB interface. DDC's common test/embedded software API increases productivity, allowing your test and embedded designs to be generated from a common source.

Applications

- Box Level Troubleshooting
- Simulation
- Portable Test Equipment
- Flight Line and Diagnostic Testing
- Software Development
- System Integration
- Automatic Test Applications (ATP)

Custom Design Capability - DDC can customize designs for all cards, ranging from simple modifications of standard products to fully customized solutions for commercial, military, aerospace, and industrial applications.

For more information: www.ddc-web.com/BU-67103U

DDC's Data Networking Solutions

MIL-STD-1553 | ARINC 429 | Fibre Channel

As the leading global supplier of data bus components, cards, and software solutions for the military, commercial, and aerospace markets, DDC's data bus networking solutions encompass the full range of data interface protocols from MIL-STD-1553 and ARINC 429 to USB, and Fibre Channel, for applications utilizing a spectrum of form-factors including PMC, PCI, Compact PCI, PC/104, ISA, and VME/VXI.

DDC has developed its line of high-speed Fibre Channel and Extended 1553 products to support the real-time processing of field-critical data networking netween sensors, compute notes, data storage displays, and weapons for air, sea, and ground military vehicles.

Whether employed in increased bandwidth, high-speed serial communications, or traditional avionics and ground support applications, DDC's data solutions fufill the expanse of military requirements including reliability, determinism, low CPU utilization, real-time performance, and ruggedness within harsh environments. Out use of in-house intellectual property ensures superior mutli-generational support, independent of the life cycles of commercial devices. Moreover, we maintain software compatibility between product generations to protect our customers' investments in software development, system testing, and end-product qualification.

MIL-STD-1553

DDC provides an assortment of quality MIL-STD-1553 commercial, military, and COTS grade cards and components to meet your data conversion and data interface needs. DDC supplies MIL-STD-1553 board level products in a variety of form factors including AMC, USB, PCI, cPCI, PCI-104, PCMCIA, PMC, PC/104, PC/104-Plus, VME/VXI, and ISAbus cards. Our 1553 data bus board solutions are integral elements of military, aerospace, and industrial applications. Our extensive line of military and space grade components provide MIL-STD-1553 interface solutions for microprocessors, PCI buses, and simple systems. Our 1553 data bus solutions are designed into a global network of aircraft, helicopter, and missle programs.

ARINC 429

DDC also has a wide assortment of quality ARINC-429 commercial, military, and COTS grade cards and components, which will meet your data conversion and data interface needs. DDC supplies ARINC-429 board level products in a variety of form factors including AMC, USB, PCI, PMC, PCI-104, PC/104 Plus, and PCMCIA boards. DDC's ARINC 429 components ensure the accurate and reliable transfer of flight-critical data. Our 429 interfaces support data bus development, validation, and the transfer of flight-critical data aboard commercial aerospace platforms.

Fibre Channel

DDC has developed its line of high-speed Fibre Channel network access controllers and switches to support the real-time processing demands of field-critical data networking between sensors, computer nodes, data storage, displays, and weapons, for air, sea, and ground military vehicles. Fibre Channel's architecture is optimized to meet the performance,reliability, and demanding environmental requirements of embedded, real time, military applications, and designed to endure the multi-decade life cycle demands of military/aerospace programs.

BU-67X02/3U AceXtreme®
1553/429 USB AVIONICS DEVICE
HARDWARE MANUAL

MN-67102UX-001

The information provided in this Manual is belived to be accurate; however, no responsibility is assumed by Data Device Corporation for its use, and no license or rights are granted by implication or otherwise connection therewith.

Specifications are subject to change without notice.
Please visit our Web site at http://www.ddc-web.com/ for the latest information.

105 Wilbur Place
Bohemia, New York 11716-2426
Tel: (631) 567-5600, Fax: (631) 567-7358
World Wide Web - http://www.ddc-web.com

For Technical Support - 1-800-DDC-5757 ext. 7771
United Kingdom - Tel: +44-(0)1635-811140, Fax: +44-(0)1635-32264
France - Tel: +33-(0)1-41-16-3424, Fax: +33-(0)1-41-16-3425
Germany Tel: +49-(0)89-15 00 12-11, Fax: +49-(0)89-15 00 12-22
Japan - Tel: +81-(0)3-3814-7688, Fax: +81-(0)3-3814-7689
Asia - Tel: +65-6489-4801

Revision	Date	Pages	Description
A	02/2009	All	Initial Release
B	06/2009	33 - 35	Added table 7. Inserted section 5.10. Minor edit to table 6.
C	10/2009	4, 33, 36	Modified accessory part numbers, updated Tables 7 & 8.
D	01/2010	6, 10, 13, 28	Environmental Qualification information entered. RT Address Selection section modified. Updated format. Order information added.
E	04/2010	All	Updates to missing source links
F	05/2010	26	Update to part number in Figures 8 & 9 title.
G	09/2010	34	changing the text to: The discrete I/O signals can be used for a variety of applications, including triggering software events, indicating status, or general-purpose use.
H	3/2011	22, 24, 30, 36	Updated Table 4 and Table 6. Updated section 4.2.2 and 5.4.4. Added Windows Vista/7
J	5/2011	32-39, 47, 48	Updates to tables 4 and 5, Windows notes. Update to table 6, pin 9. Update to Section 2: Overview. Added Appendix A. Added new part number option, BU-67202U, added new section 5.5.
K	6/2011	49	Update to Order information
L	5/2012	7, 28, 50	Update mounting bracket information, Update figure 9.
M	4/2013	7, 27	Updated power adapter part number
N	9/2013	49	Updated note for ordering information

1 PREFACE

This manual uses typographical conventions to assist the reader in understanding the content. This section will define the text formatting used in the rest of the manual

1.1 Text Usage

- **BOLD**–indicates important information and table, figure, and chapter references.
- ***BOLD ITALIC***–designates DDC Part Numbers.
- `Courier New`–indicates code examples.
- <…> - indicates user-entered text or commands.

1.2 Standard Definitions

USB	Universal Serial Bus

1.3 Trademarks

All trademarks are the property of their respective owners.

1.4 What is included in this manual?

This manual contains a complete description of hardware installation and use.

1.5 Technical Support

In the event that problems arise beyond the scope of this manual, you can contact DDC by the following:

US Toll Free Technical Support:
1-800-DDC-5757, ext. 7771

Outside of the US Technical Support:
1-631-567-5600, ext. 7771

Fax:
1-631-567-5758 to the attention of DATA BUS Applications

DDC Website:
www.ddc-web.com/ContactUs/TechSupport.aspx

Please note that the latest revisions of Software and Documentation are available for download at DDC's Web Site, www.ddc-web.com.

2 OVERVIEW

The ***BU-67X02/03U AceXtreme***® USB device provides an off-the-shelf interface to 1 or 2 dual-redundant MIL-STD-1553 channels, 4 ARINC 429 Receive channels, 2 ARINC 429 Transmit channels, 8 user programmable digital discrete I/O, IRIG-B Time Code input, and a 1 Pulse-per-Second (PPS) output. The device is available as 1553 only, 429 only, or the fully populated 1553/429 Multi-IO USB device and can be powered directly from the USB interface or from an external power source.

Each 1553 channel can operate in Bus Controller (BC) mode or Multiple Remote Terminal (Multi-RT) mode, that is, up to 31 RT addresses simultaneously. Each mode has the ability to run a concurrent Bus Monitor (MT), or the Bus Monitor can run by itself. The ***BU-67202U1*** model allows BC and Multi-RT modes to run simultaneously and also includes the Test and Simutlation toolkit.

The device includes the ***BU-69092S AceXtreme C Software Development Kit (SDK)*** and the ***DD-42992S ARINC 429 Multi-IO C SDK*** to support all modes of operation, including source code samples, and detailed documentation.

Optional graphical software packages include the MIL-STD-1553 BusTrACEr Analyzer/Simulator, ARINC 429 Data Bus Analyzer (DBA), ARINC 615 Data Loader, LabVIEW Multi-I/O support package, and dataSIMS Data Analysis Tool. The optional software packages allow users to easily generate or monitor avionic data for 1553 or 429 operation. For more information on included and optional software packages please visit the ***BU-67X02/03U AceXtreme*** USB product page on our web site.

2.1 Features

- MIL-STD-1553 and ARINC 429
  - USB 2.0 Interface Powered from USB
  - 6V auxiliary power supply included
  - 48-bit time tag, 100 ns programmable resolution
  - IRIG-B Time Code Input (Digital/Analog)
  - 1 Pulse per Second Output
  - 8 User-Programmable Digital Discrete I/O
  - DMA Engine for Low CPU Utilization for all 1553 modes

- MIL-STD-1553
  - Up to 2 Dual Redundant MIL-STD-1553 Channels
  - Transformer and Direct Coupled 1553 I/O
  - 1 MB RAM with Parity per 1553 Channel
  - MIL-STD-1553A/B Support
  - High Level C Software Development Kit
  - BC, Multi-RT, MT, BC/MT, Multi-RT/MT Operating Modes
  - ***BU-67202U1*** Supports BC/Multi-RT/MT concurrently
- 1553 Bus Controller
  - Multiple Methods of Message Scheduling
    - Major and Minor frames
    - High and Low Priority Asynchronous Messages
    - On Demand Streaming Interface
  - Modify Messages or Data while BC is running
  - Conditional Messages or Subroutines based on User Defined Conditions
  - Multiple BC retry programmable options
  - Detects and Reports 1553 Errors
  - Fully User-Definable Interrupts
    - Message and/or Frame completion
    - Message error
    - User Defined (Custom)
  - Optional Concurrent Bus Monitor
  - Flexible support for data streaming or bulk data transfer
- 1553 Remote Terminal
  - Emulate up to 31 addresses simultaneously
  - Software-Programmable RT Addresses
  - Choice of Buffering per Sub-address
    - Single Message
    - Double Buffering
    - Circular Buffering
  - Programmable Interrupt Conditions

        - Buffer servicing required
        - Illegal command received
        - Selective Message Complete
    - Stack with Descriptors for Individual Messages
    - Message Status, Time Tag, Command Word, Data Words
    - Programmable Command Illegalization based on:
        - RT address
        - Transmit/Receive
        - RT Sub-Address
        - Word Count/Mode Code
    - Programmable Busy by Sub-address
    - Optional Concurrent Bus Monitor
- 1553 Bus Monitor
    - Selective Message Monitor
    - Filter Based on RT Address, T/R bit, Sub-address
    - Message Status, Time Tag, Command Word, Data Words
    - Simultaneous RT/Message Monitor Option
    - Simultaneous BC/Message Monitor Option
    - Advanced Bus Error Detection to isolate bus failures
    - Messages formatted as per IRIG-106 Chapter 10 capability
    - Programmable Interrupt Conditions
        - Buffer servicing required
- 1553 Built-In Self-Test Capability
    - RAM Self Test
    - Register Self Test
    - Online Loopback Test
    - Capability to Test Transmitter Timeout Function
- Test and Simulation Features ***(BU-67202Ux*** Multi-Function only)
    - Each 1553 channel can run the BC, RTs, and MT concurrently
    - Programmable RT Response Times
    - Programmable Response Timeout
    - Intermessage Routines

  - Programmable Intermessage Gap
  - Advanced Error Monitor
  - Error Injection
  - Triggers
  - Dynamic Bus Control
  - Replay Function

- ARINC 429
  - High / low speed operation with automatic slew rate adjustment
  - Four receive channels, two transmit channels
  - FIFO or mailbox reception methods
  - FIFO and/or scheduled transmission methods
  - Message filtering
  - Supports ARINC 429/571/575/582/603/615/709/ 710/711/712/740/741/744

- Included Software
  - Complete C SDKs for MIL-STD-1553 and ARINC 429
    - Plug-n-Play Drivers for Windows and Linux
    - C SDK with high-level functions for all operating modes
    - Abstracts all low-level hardware memory/registers
    - Common Test/Embedded API for easy transition to other DDC hardware platforms.

- Optional Software
  - BusTrACEr 1553 Graphical Monitor/Generator
    - Provides an Easy-to-Use Graphical User Interface (GUI) for MIL-STD-1553
    - Simulates any operating mode (BC, Multi-RT, Monitor) of device
    - Provides 'C' Source Code Generation for custom stand-alone applications
  - Commercial Avionics Utilities Suite
    - Provides a Graphical User Interface for ARINC 429 bus analysis and simulation
    - Provides advanced filtering, message scheduling, triggers, and Engineering Units Conversion

        - ARINC 615 Data Loader provides a software interface to upload/download data to airborne computers
    - MIL-STD-1553 and ARINC 429 LabVIEW Support Package
        - High Level Vls to easily program the card
        - Detailed Sample Application Vls
        - Conforms to National Instrument's Driver Model
    - *dataSIMS* Real-Time Avionics Bus Analysis Tool
        - Locate Data Anomalies and Trends Using Real-Time Graphics
        - Store all or selected Real-Time Data of Multiple MIL-STD-1553 and Multiplex Channels
        - Trigger Storage based on Parameter Values, Timing, Bus Errors and Complex Expressions
        - Define a Complete User Database (ICD), with Message/Label and Parameter Definitions

- Included Accessories
  All USB device models include the following accessories:
    - 1 USB Cable (PN 5810-0020-0001)
    - 1 AC Power Adapter by CUI Inc, EMSA 060300-P5P-SZ (PN 5501-0159-0011)
    - 1 50 Pin D-Connector (3M PN 10150-3000PE)
    - 1 50 Pin D-Connector Shell (3M PN 10350-52F0-008)

  The ***BU-67X02U*** Rugged USB device additionally comes with the following accessories:
    - 5 Mounted Cable ties (PN 5501-0169-0001)
    - 1 Cable Tie Screw (PN 5465-1957-0015)
    - 1 Cable Tie Washer (PN 5471-5795-0804)

- Optional Accessories
  For the ***BU-67X02U*** Rugged USB device:
    - Mounting Bracket:
        - Short “U” bracket with mounting holes for screws (PN 5507-5606-0010)
        - Long “U” bracket with mounting holes for screws (PN 5507-5606-0020)

2.2 System Requirements

- USB 2.0 Port supporting 5 volts
  - Limited performance on USB 1.1
- Supported Operating System: Windows® 2000/XP/Vista/7 or Linux 2.6.x

Table 1. I/O Channel Count and Type Options

Channel Type	I/O Option 0 (*BU-67102/03U0*) Channel Count	I/O Option 1 (*BU-67X02/03U1*) Channel Count	I/O Option 2 (*BU-67102/03U2*) Channel Count
MIL-STD-1553	0	1	2
ARINC 429 RX	4	0	4
ARINC 429 TX	2	0	2
Discrete I/O	8	8	8

Figure 1. BU-67X02U Avionics Device for Rugged Applications

Figure 2. BU-67103U Avionics Device for Lab Applications

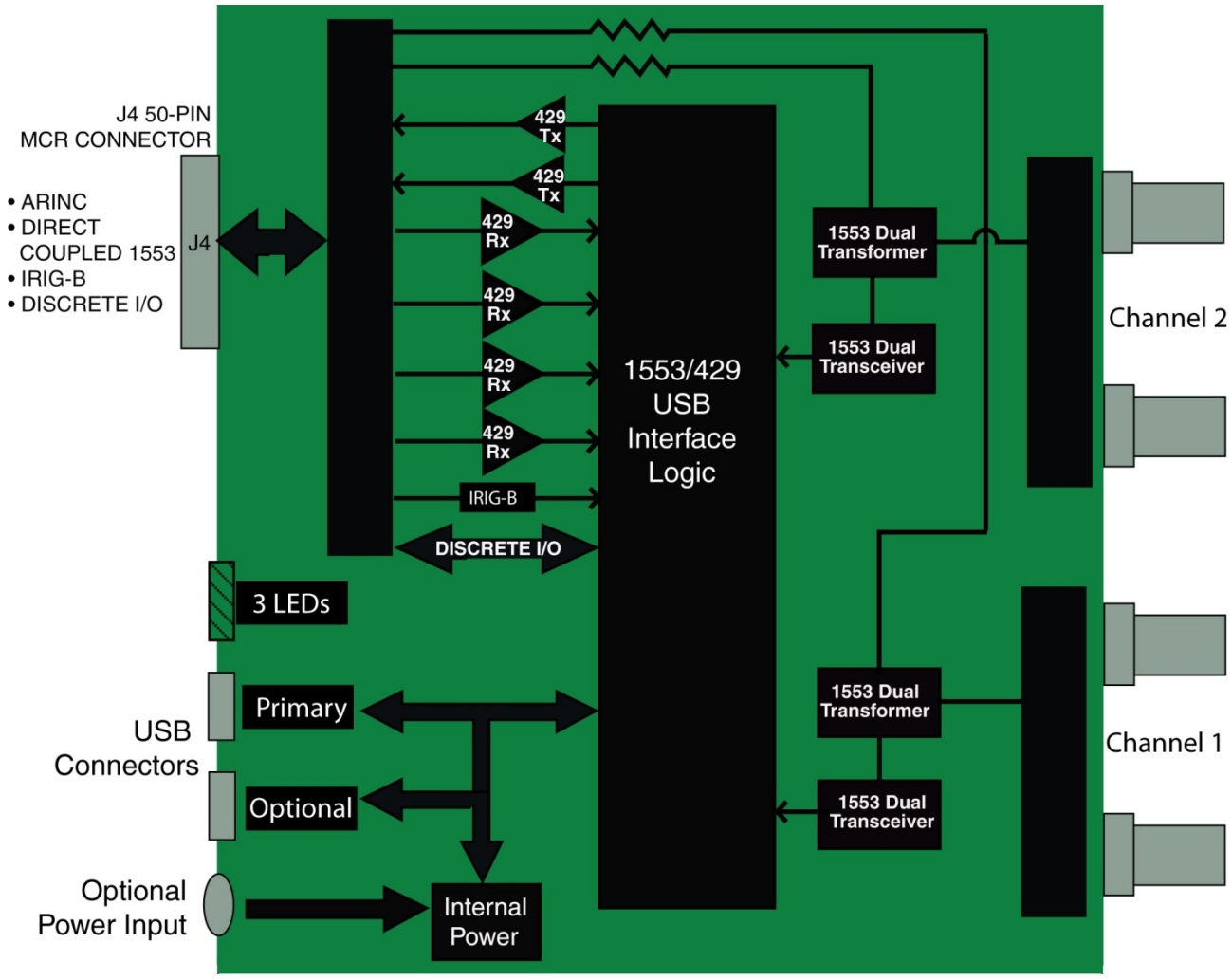


Figure 3. BU-67103U Block Diagram

2.3 Applications

The 1553/429 USB device is suited for a wide variety of applications including, but not limited to, box level testing, simulation, portable test equipment, flight line test and diagnostic, software development, system integration, and debugging. The device enhances the work of developers, integrators, testers, field personnel and flight test crew through advanced 1553 and 429 capabilities that are accessible in a portable form factor. The USB interface makes it suitable for use with desktop, laptop, or tablet computers.

2.4 Environmental Qualifications

The ***BU-67X02U*** has a rugged enclosure. Test specimens of the unit were subject to shock, sinusoidal, vibration, and temperature cycling. After these tests, the devices exhibited no evidence of physical damage and passed Acceptance Test Procedure (ATP) at their specified operating temperature extremes and 25°C. See the Environmental Qualifications section of Table 2 for more information about testing. The USB connector is Mini-B with strain relief.

2.5 BU-67X02UX Specifications

Table 2. BU-67X02U Specifications

PARAMETER	MIN	TYP	MAX	UNITS
ABSOLUTE MAXIMUM RATINGS				
USB Supply Voltage	-0.3		5.5	V
Optional 6V Power Input	-0.3		6.3	V
POWER SUPPLY REQUIREMENTS				
Operating Voltages				
USB Supply Voltage	4.75	5.0	5.5	V
Optional 6V Power Input	5.7	6.0	6.3	V
Current Drain (Using 5V source)				
• ***BU-67102U0***				
• ARINC 429				
• 0% Transmitter Duty Cycle		460	525	mA
• 50% Transmitter Duty Cycle		550	625	mA
• 100% Transmitter Duty Cycle		640	725	mA
• ***BU-67X02U1***				

Table 2. BU-67X02U Specifications				
PARAMETER	**MIN**	**TYP**	**MAX**	**UNITS**
• MIL-STD-1553				
• 0% Transmitter Duty Cycle		385	450	mA
• 50% Transmitter Duty Cycle		625	725	mA
• 75% Transmitter Duty Cycle		745	863	mA
• ***BU-67102U2***				
• MIL-STD-1553 & ARINC 429				
• 0% Transmitter Duty Cycle		510	580	mA
• MIL-STD-1553 (1 Channel)				
• 50% Transmitter Duty Cycle		750	855	mA
• 75% Transmitter Duty Cycle		870	993	mA
POWER SUPPLY REQUIREMENTS (Con't)				
• MIL-STD-1553 (2 Channel)				
• 50% Transmitter Duty Cycle		990	1130	mA
• 75% Transmitter Duty Cycle		1230	1410	mA
• ARINC 429				
• 50% Transmitter Duty Cycle		600	680	mA
• 75% Transmitter Duty Cycle		690	780	mA
POWER DISSIPATION				
• ***BU-67102U0***				
• ARINC 429 (Note 2)				
• 0% Transmitter Duty Cycle		2.30	2.63	W
• 50% Transmitter Duty Cycle		2.75	3.13	W
• 100% Transmitter Duty Cycle		3.20	3.63	W
• ***BU-67X02U1***				
• MIL-STD-1553				
• 0% Transmitter Duty Cycle		1.93	2.25	W
• 50% Transmitter Duty Cycle		2.43	2.93	W
• 100% Transmitter Duty Cycle		2.68	3.26	W
• ***BU-67102U2***				

Table 2. BU-67X02U Specifications				
PARAMETER	**MIN**	**TYP**	**MAX**	**UNITS**
• MIL-STD-1553 & ARINC 429				
• 0% Transmitter Duty Cycle		2.55	2.90	W
• MIL-STD-1553 (1 Channel)				
• 50% Transmitter Duty Cycle		3.05	3.58	W
• 75% Transmitter Duty Cycle		3.30	3.91	W
• MIL-STD-1553 (2 Channel)				
• 50% Transmitter Duty Cycle		3.55	4.25	W
• 75% Transmitter Duty Cycle		4.05	4.93	W
• ARINC 429				
• 50% Transmitter Duty Cycle		3.00	3.40	W
• 75% Transmitter Duty Cycle		3.45	3.90	W
THERMAL				
Operating Temperature				
• *BU-67X02UX00L-CL0*	-40		+71	°C
Storage Temperature				
• *BU-67X02UX00L-CL0*	-40		+85	°C
• External Power Supply Module	-10		+70	°C
HUMIDITY				
Operating Relative Humidity, non-condensing	5% - 95% operating relative humidity, non-condensing			
Environmental Qualification				
Shock	MIL-STD-202, TM213, Condition K, Sawtooth 30 G, 11 ms duration, 5.3 ft/sec velocity, ½ sine wave shock profile, 3 shocks in each direction of axes, 18 shocks total			
Vibration	0.7G from 5 to 15 Hz, 1.3G from 16 to 25 Hz, 3G from 26 to 55 Hz. 3 axis, 1 hour per axis			
Temperature Cycling	500 cycles, -40°C to +85°C			
PHYSICAL CHARACTERISTICS				
USB Box Dimensions	1.40 x 4.10 x 3.40			in
	35.6 x 104.1 x 86.4			mm

Table 2. BU-67X02U Specifications

PARAMETER	MIN	TYP	MAX	UNITS
Weight				
• *BU-67X02UX*		14 400		oz gm

NOTES:

1. Current drain and power dissipation specifications are preliminary and subject to change. MIL-STD-1553 Power dissipation specifications assume a transformer coupled configuration with external dissipation (while transmitting) of 1.4 Watts total:
   - 0.14 watts for the active isolation transformer
   - 0.08 watts for the active bus coupling transformer
   - 0.45 watts for each of the two bus isolation resistors and
   - 0.15 watts for each of the two bus termination resistors
2. ARINC 429 50% and 100% Transmitter Duty Cycle power estimate based on full load, 390 ohms.
3. All power supply and power dissipation values are based on the device being powered directly from the USB bus.
4. ARINC 429 and MIL-STD-1553 current and power data are for all channels available on the specified model.

2.6 BU-67103UX Specifications

Table 3. BU-67103U Specifications

PARAMETER	MIN	TYP	MAX	UNITS
ABSOLUTE MAXIMUM RATINGS				
USB Supply Voltage	-0.3		5.5	V
Optional 6V Power Input	-0.3		6.3	V
POWER SUPPLY REQUIREMENTS				
Operating Voltages				
USB Supply Voltage	4.75	5.0	5.5	V
Optional 6V Power Input	5.7	6.0	6.3	V
Current Drain (Using 5V source)				
• ***BU-67103U0***				
• ARINC 429				
• 0% Transmitter Duty Cycle		460	525	mA
• 50% Transmitter Duty Cycle		550	625	mA
• 100% Transmitter Duty Cycle		640	725	mA
• ***BU-67103U1***				
• MIL-STD-1553				
• 0% Transmitter Duty Cycle		525	600	mA
• 50% Transmitter Duty Cycle		875	1000	mA
• 75% Transmitter Duty Cycle		1050	1200	mA
• 100% Transmitter Duty Cycle		1230	1400	mA
• ***BU-67103U2***				
• MIL-STD-1553 & ARINC 429				
• 0% Transmitter Duty Cycle		560	635	mA
• MIL-STD-1553 (1 Channel)				
• 50% Transmitter Duty Cycle		910	1035	mA
• 75% Transmitter Duty Cycle		1090	1240	mA
• 100% Transmitter Duty Cycle		1260	1440	mA
• MIL-STD-1553 (2 Channel)				
• 50% Transmitter Duty Cycle		1260	1440	mA
• 75% Transmitter Duty Cycle		1610	1840	mA
• 100% Transmitter Duty Cycle		1960	2250	mA

Table 3. BU-67103U Specifications				
PARAMETER	**MIN**	**TYP**	**MAX**	**UNITS**
POWER SUPPLY REQUIREMENTS (Con't)				
• ARINC 429				
• 50% Transmitter Duty Cycle		650	735	mA
• 100% Transmitter Duty Cycle		740	835	mA
POWER DISSIPATION				
• ***BU-67103U0***				
• ARINC 429 (Note 2)				
• 0% Transmitter Duty Cycle		2.30	2.63	W
• 50% Transmitter Duty Cycle		2.75	3.13	W
• 100% Transmitter Duty Cycle		3.20	3.63	W
• ***BU-67103U1***				
• MIL-STD-1553				
• 0% Transmitter Duty Cycle		2.63	3.00	W
• 50% Transmitter Duty Cycle		3.68	4.30	W
• 75% Transmitter Duty Cycle		4.20	4.95	W
• 100% Transmitter Duty Cycle		4.73	5.60	W
• ***BU-67103U2***				
• MIL-STD-1553 & ARINC 429				
• 0% Transmitter Duty Cycle		2.80	3.18	W
• MIL-STD-1553 (1 Channel)				
• 50% Transmitter Duty Cycle		3.85	4.48	W
• 75% Transmitter Duty Cycle		4.38	5.13	W
• 100% Transmitter Duty Cycle		4.90	5.78	W
• MIL-STD-1553 (2 Channel)				
• 50% Transmitter Duty Cycle		4.90	5.80	W
• 75% Transmitter Duty Cycle		5.95	7.01	W
• 100% Transmitter Duty Cycle		7.00	8.43	W
• ARINC 429				
• 50% Transmitter Duty Cycle		3.25	3.68	W
• 75% Transmitter Duty Cycle		3.70	4.18	W

Table 3. BU-67103U Specifications				
PARAMETER	**MIN**	**TYP**	**MAX**	**UNITS**
THERMAL				
Operating Temperature				
• *BU-67103UX00L-JL0*	0		+55	°C
Storage Temperature				
• *BU-67103UX00L-JL0*	-40		+85	°C
• External Power Supply Module	-10		+70	°C
HUMIDITY				
Operating Relative Humidity, non-condensing	None			
ENVIRONMENTAL QUALTIFICATION				
Shock	None			
Vibration	None			
PHYSICAL CHARACTERISTICS				
USB Box Dimensions	1.50 x 5.20 x 5.00			in
	38.1 x 132.2 x 127			mm
Weight				
• *BU-67103UX*	15			oz
	425			gm

NOTES:

1. Current drain and power dissipation specifications are preliminary and subject to change. MIL-STD-1553 Power dissipation specifications assume a transformer coupled configuration with external dissipation (while transmitting) of 1.4 Watts total:
   - 0.14 watts for the active isolation transformer
   - 0.08 watts for the active bus coupling transformer
   - 0.45 watts for each of the two bus isolation resistors and
   - 0.15 watts for each of the two bus termination resistors
2. ARINC 429 50% and 100% Transmitter Duty Cycle power estimate based on full load, 390 ohms.
3. All power supply and power dissipation values are based on the device being powered directly from the USB bus.
4. ARINC 429 and MIL-STD-1553 current and power data are for all channels available on the specified model.

2.7 MIL-STD-1553 Channels

Each 1553 channel can emulate a Bus Controller (BC), multiple Remote Terminals (RTs), a Bus Monitor (MT), BC/MT, or Multi-RT/MT modes independently per 1553 channel. Standard features include 1 MB of RAM per 1553 channel, 48-bit message time tagging with a programmable resolution down to 100ns, IRIG-B time stamp input, 1 PPS output, transformer and direct coupling, triggers, extensive BC & RT frame structures, error detection, RT Status Bit and Mode Code responses, along with advanced BC functionality.

The advanced BC architecture provides a high degree of flexibility and autonomy by providing message schedule control, minimizing host overhead for asynchronous message insertion, facilitating bulk data transfers, double buffering, message retry, bus switching strategies, data logging, and fault reporting.

The RT architecture provides flexibility in meeting the MIL-STD-1553 protocol while emulating up to 31 RT addresses on each 1553 channel. The choices of Multi-RT buffering and interrupt options provide robust support for synchronous and asynchronous messaging, while ensuring data sample consistency and supporting bulk data transfers. The device includes a message monitor mode and a combined Multi-RT/MT mode where the MT will monitor all 1553 communications on the bus, including the 1553 channel's assigned RT addresses. The Bus Monitor mode provides complete error detection on 100% fully loaded buses, while providing features for advanced error detection to isolate faults at a particular word within a 1553 message.

2.8 Data Streaming Engine

The Data Streaming Engine, used in all modes, transfers all data between the host and the 1553 device. By using modern burst transfer technologies (DMA), CPU utilization and latency are drastically decreased when compared to older 1553 designs.

2.9 Digital Discrete I/Os

Eight Digital Discrete I/O’s pins are individually programmable to be either an output with wraparound or input-only digital discrete. Digital discrete inputs are +5V tolerant; outputs are +3.3V.

2.10 IRIG-B Time Code Support

The device includes an analog IRIG-B input and digital IRIG-B input, which operate as described in the IRIG-B Time Code section.

2.11 ARINC 429 Channels

Each ARINC 429 channel can support low and high speed communications with automatic slew rate adjustment while providing multiple reception and transmission methods for ARINC 429 data. A software programmable option allows the user to program the device to receive ARINC 575 data.

Each ARINC 429 channel provides message scheduling, label filtering, and full error detection. Received data can be stored in either FIFO buffers or system address label mailboxes. The ARINC 429 channels feature independent selection of data rate, parity choices for odd, even, or no parity checking, and automatic transmit channel slew rate adjustment. Transmitted data can be sent in FIFO mode or scheduled rate mode on each transmit channel. The device also provides the advanced capability to concurrently mix transmit FIFO mode messages with scheduled rate mode messages on the same channel.

2.12 Optional Software Tools

- The BusTrACEr MIL-STD-1553 Graphical Analyzer/Simulator software tool monitors a 1553 bus and stores the data for post analysis.
- The ARINC 429 Data Bus Analyzer software tool monitors and analyzes a 429 bus.
- The ARINC 615 Data Loader GUI provides all the functionality of a portable ARINC 615 Data Loader.
- The 1553/429 LabVIEW support package provides an interface with multiple high level VIs to easily program the card in the correct operating mode.
- The dataSIMs real-time data analysis software provides the user with visibility into and control over data in a system made of communication units, allowing for a complete environment of acquisition, display, and storage of real-time data.

3 HARDWARE INSTALLATION/REMOVAL

The ***BU-67X02/03U*** supports both the USB 2.0 and USB 1.1 specifications, however, performance may be limited when used with a USB 1.1 interface depending on 1553 and 429 bus load.

The device has been designed to source power from either 1 or 2 USB ports. In cases where the primary USB port cannot supply the necessary power, a second USB port may be plugged in for power only. In cases where two USB ports are insufficient, the included 6V AC adapter may be used to power the device.

This USB device does not contain any configuration jumpers or switches, providing a true Plug-and-Play interface.

3.1 BU-67X02U Module Installation

The four connectors at the top of the ***BU-67X02U*** module are the MIL-STD-1553 connectors (CH-1A, CH-1B, CH-2A, CH-2B) (Refer to Figure 4). To gain access to the ARINC 429 and other I/O pins (J5), and to the LEDs, power input, and USB ports (J6 and J7), the protective end-cap flaps need to be opened.

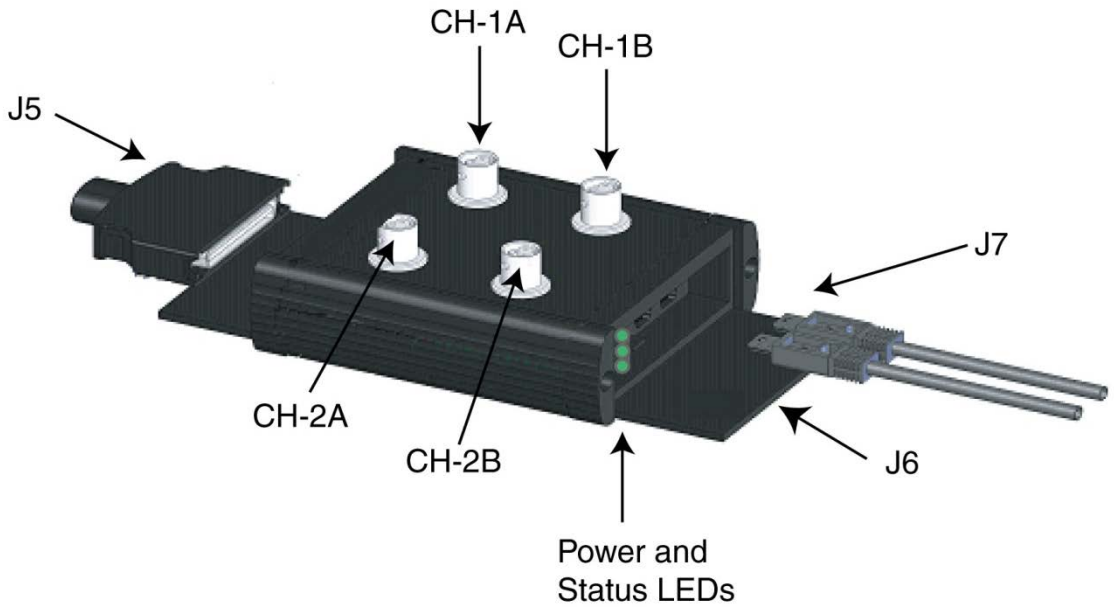


Figure 4. BU-67X02U Connector Locations

Follow Figure 5 to open the end-caps.

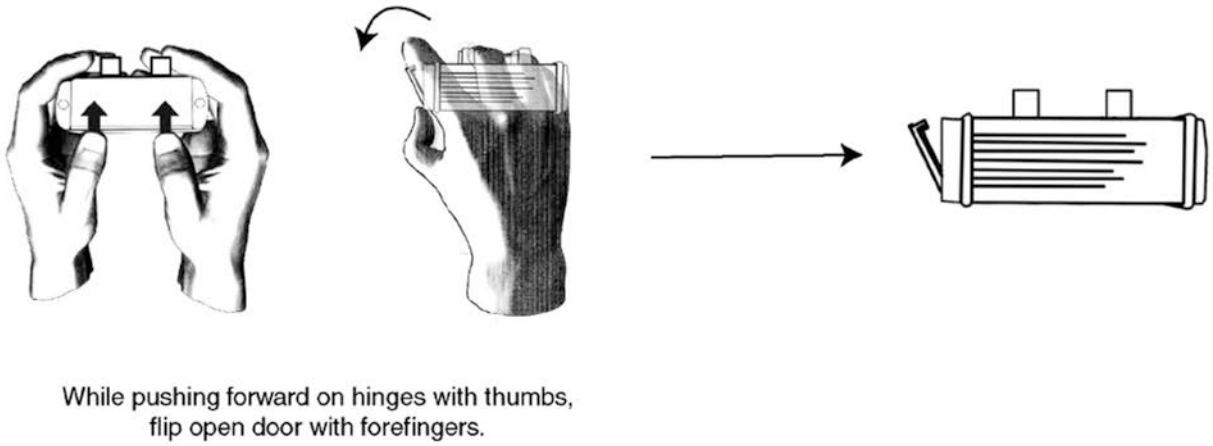


Figure 5. Opening the Case

Connect the USB cable's mini-B connector to the primary USB port of the ***BU-67X02U***. After this connection is made, connect the other end (Type A) of the USB cable to a USB 2.0 port in your computer.

If there is insufficient power to the device, either connect the secondary USB port and/or the supplied AC adapter.

3.1.1 Optional Strain Relief for USB Cable

Strain relief may be applied to the USB cable by using the supplied mounted cable tie, cable tie washer, and screw as detailed below (see Figure 6).

1. With the mini-B end of the USB cable plugged into the ***BU-67X02U*** device, attach and tighten the mounted cable tie to the USB cable as shown in Figure 6.

2. Put the washer onto the mounting post on the device.

3. Put the mounted cable tie onto the mounting post.

4. Insert the screw into the mounting post and tighten to secure.

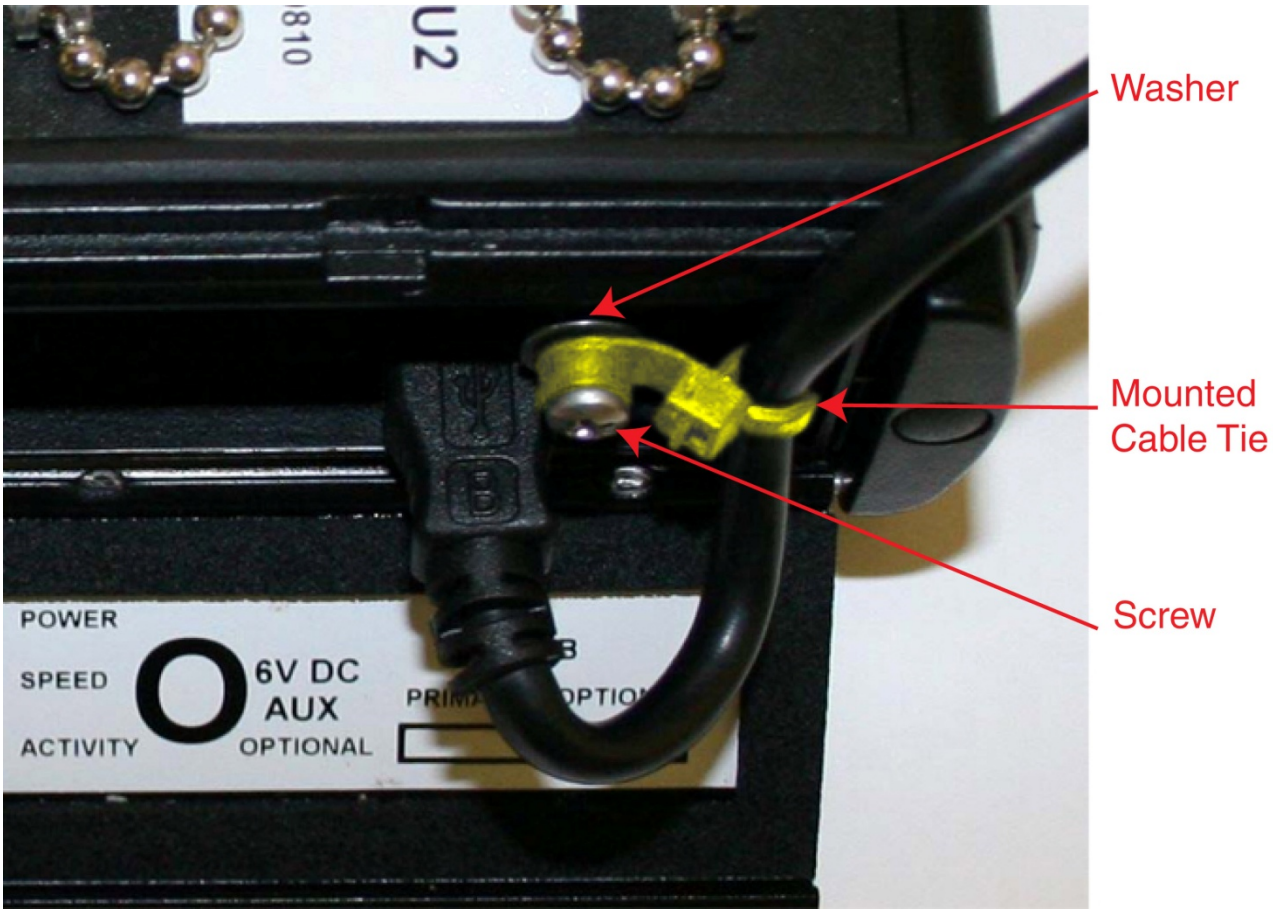


Figure 6. USB Cable Strain Relief

3.2 BU-67103U Module Installation

As shown in Figure 7, the 4 MIL-STD-1553 connectors (CH-1A, CH-1B, CH-2A, CH-2B) of the ***BU-67103U*** are located on the front of the device. The ARINC 429 and other I/O pins, LEDs, power input, and USB ports are located at the back of the device.

Figure 7. BU-67103U Connector Locations

Connect the USB cable's mini-B connector to the primary USB port of the ***BU-67103U***. After this connection is made, connect the other end (Type A) of the USB cable to the USB 2.0 port in your computer.

If there is insufficient power to the device, either connect the secondary USB port and/or the supplied AC adapter.

3.3 Module Removal

To remove the ***BU-67X02/03U*** device, unplug the USB cable from the device or the computer.

4 SOFTWARE INSTALLATION

Numerous software packages are available for the ***BU-67X02/03U***. The DDC software packages are developed to allow shorter design cycles while allowing all functionality to be accessed by user level code.

The supplied software packages include:

- MIL-STD-1553 ***AceXtreme***® Software Development Kit (SDK) (***BU-69092Sx***)
- ARINC 429 Multi I/O Software Development Kit (SDK) (***DD-42992Sx***)
- FLASH Update Utility
- Device Drivers (included in the MIL-STD-1553 and ARINC 429 API packages)

4.1 MIL-STD-1553 Software Overview

The card is supplied with the ***BU-69092Sx AceXtreme*** C Software Development Kit (SDK). This software development kit includes a runtime library that provides the user with a hardware abstraction layer for the DDC 1553 hardware. This software layer includes the routines that dramatically reduce software development time by providing high-level C functions for the application programmer to interface to the ***BU-67X02/03U***. Demonstration programs are included with the library to show the capabilities of the card in each mode. Table 4 shows a summary of the supported software.

Table 4. AceXtreme C SDK Part Number Descriptions

Part Number	Description	Requirements
BU-69092S0	32-Bit/64-Bit Library and Device Drivers for Windows	Windows® 2000/XP/Vista/7 (64-bit Windows only supported on Windows® Vista and Windows® 7)
BU-69092S1	32-Bit/64-Bit Library and Device Drivers for Linux	Linux® Kernel version 2.6.x

Please follow the detailed instructions in the ***BU-69092SX AceXtreme C SDK Software Manual*** (MN-69092SX-002), available on the DDC website on the BU-69092SX Product Page.

4.1.1 Windows 2000/XP/Vista/7 (BU-69092S0)

Software installation is performed by InstallShield®. This install script will make all necessary registry modifications and will create the required directory structures. A Windows 2000/XP/Vista/7 operating system specific driver is installed, along with the high-level C library functions.

4.1.2 Linux (BU-69092S1)

The SDK for Linux includes a Linux specific loadable module driver and source code so that the user can compile it against a specific version of the Linux kernel. The driver was developed and tested with Linux kernel version 2.6.x. Installation instructions are included in the BU-69092S1 software package.

4.2 ARINC 429 Software Overview

The ***DD-42992*** SDK provides the framework for developing applications for DDC's ARINC 429 Multi-IO series of devices with minimal development time.

This SDK is written so all low-level access to the Multi-IO device is performed through a set of driver modules. All Board Support Package specific functions and processor-specific issues are abstracted in a way that allows easy portability of the SDK to a variety of hardware and/or software platforms by modifying these low-level routines. This software library of functions is used to configure the card for receiving and transmitting data on the bus. The library allows users to develop software for the card without detailed knowledge of the card's architecture.

Table 5. ARINC 429 Software

Part Number	Description	Requirements
DD-42992S0	32-Bit/64-Bit Library and Device Drivers for Windows	Windows® 2000/XP/Vista/Windows 7 (64-bit Windows only supported on Windows® Vista and Windows® 7)
DD-42992S1	32-Bit/64-Bit Library and Device Drivers for Linux	Linux® Kernel version 2.6.x

Please follow the detailed instruction in the Software User's Manual For ARINC 429 Multi-IO Cards (MN-42992SX-001), available on the DDC website on the DD-42992SX Product Page.

4.2.1 Windows 2000/XP/Vista/7 (DD-42992S0)

Software installation is performed by InstallShield®. This install script will make all necessary registry modifications and will create the required directory structures.

A Windows 2000/XP/Vista/7 operating system specific driver is installed, along with the high-level C library functions.

4.2.2 Linux (BU-69092S1)

The SDK for Linux includes a Linux specific loadable module driver and source code so that the user can compile it against a specific version of the Linux kernel. The driver was developed and tested with Linux kernel version 2.6.x. Installation instructions are included in the ***BU-69092S1*** software package.

4.3 Testing the Installation

Once the hardware and software is installed, you can test the installation by running one of the sample programs that is shipped with the software. Follow the steps below to test the installation.

4.3.1 Testing the MIL-STD-1553 Software Installation

Run the *Tester.exe* program. This program requires a Logical Device Number (LDN) also referred to as the channel. A 0 indicates that channel is defined with the LDN of 0 in the 1553 Card Manager program. This parameter will be entered as required per the installation. If you have more than one channel installed in the system, then running Tester with the appropriate parameter, 0, 1, 2 or 3 should test each of the channels or cards individually.

If all elements of the test pass, the 1553 card/software is ready for use.

If one or more elements did not pass, refer to the section below on Troubleshooting the Installation.

4.3.2 Testing the ARINC 429 Software Installation

The ***DD-42992Sx*** software package comes with a loopback test that can be run to make sure the device is setup and communicating properly. The loopback test can be run internal so no external loopback connector is required.

4.3.3 Troubleshooting the Installation

Usually the installation will be successful, and the self-test will pass. There are, however, some situations that can cause problems during the installation. The most common are detailed below.

An error is returned when an attempt is made to run the SELFTEST or any of the other sample programs. This fault is almost always related to an incorrectly

assigned device number. Be sure that a device number was correctly assigned through the DDC Card Manager.

If an error is encountered and the device number appears to be correctly assigned, check the operating system resources to verify that the card has been given a valid memory region by the operating system. Errors have sometimes been observed in Windows operating systems. The BIOS setting for a PnP operating system is sometimes set to YES, which can cause a problem. This BIOS option was originally created by manufacturers to distinguish between Windows NT and Windows 9x based operating systems. Since Windows 2000 and Windows XP are extensions of the Windows NT kernel this BIOS option must be set for NO under these operating systems. The operating system, as well as all hardware on your system, will still maintain PnP compatibility; it will not be necessary to manually configure resources for PnP cards.

4.4 Updating the Flash Firmware

Detailed instructions regarding the flash firmware upgrade utility can be downloaded from the DDC web site. The document is located under the documentation tab on the ***BU-67X02/03U*** AceXtreme USB product page.

5 DETAILED DESIGN AND ARCHITECTURE

5.1 Hardware Configuration and Operation

The ***BU-67X02/03U*** device uses the USB interface, and as such does not require any jumpers or switches to configure. The job of configuration for Plug-and-Play USB is performed by the operating system.

The operating system will perform some simple tests on the resource registers in order to identify the memory sizes required, and then reload the registers with the actual resource address that has been reserved for the device. When the driver loads, it will access these registers and identify what configuration the operating system has been provided for the device. After identifying each of the installed modules, the Device driver will enumerate each of the channels and create a configuration structure that defines the allocated address.

5.2 Power Supply

The ***BU-67X02/03U*** device has been designed to source power from up to two USB ports. In cases where the primary USB port cannot supply the necessary power, a second USB port can be plugged in for power only. In cases where two USB ports are insufficient, the supplied 6V AC adapter may be used to power the device.

The ***BU-67X02/03U*** requires a minimum of 500 mA of current per USB port from the moment the USB connection is made. The device does not support a low power suspend mode.

The device contains a DC power jack for connection to an external 6V power source. Once connected, the USB device will stop drawing power from the USB port(s). The allowable range for this DC input is 6V ± 5% (5.7V to 6.3V). The DC jack is designed to interface with off-the-shelf AC adaptors such as the included CUI Inc. EMSA 060300-P5P-SZ switching power supply which is rated for an output of 6V±5%@3A.

5.3 Mechanical Outlines

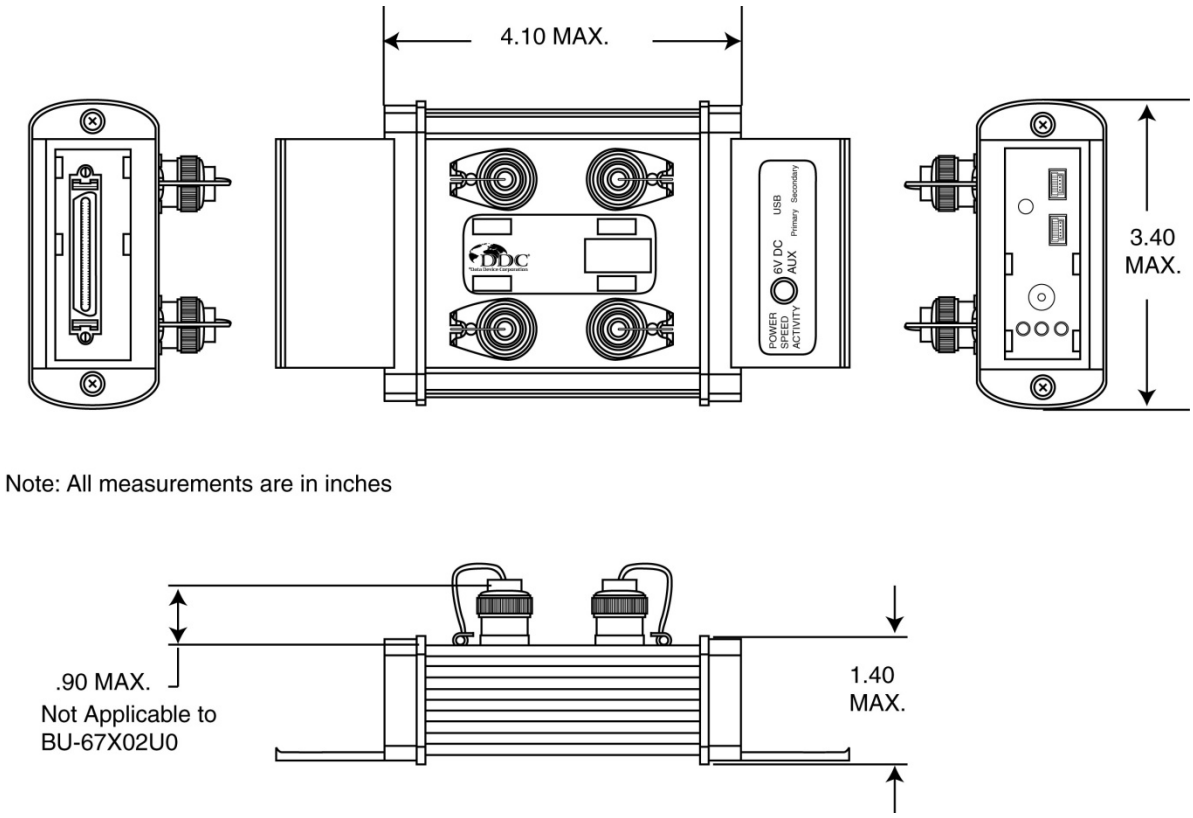
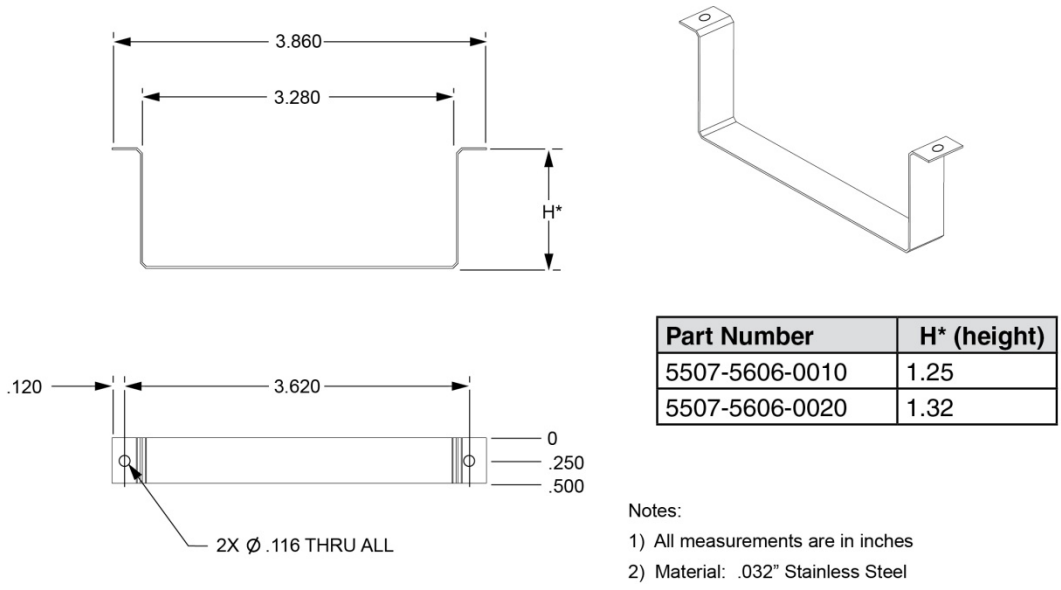


Figure 8. Mechanical Outline for the BU-67X02U



Part Number	H* (height)
5507-5606-0010	1.25
5507-5606-0020	1.32

Figure 9. Optional Mounting Bracket for the BU-67X02U

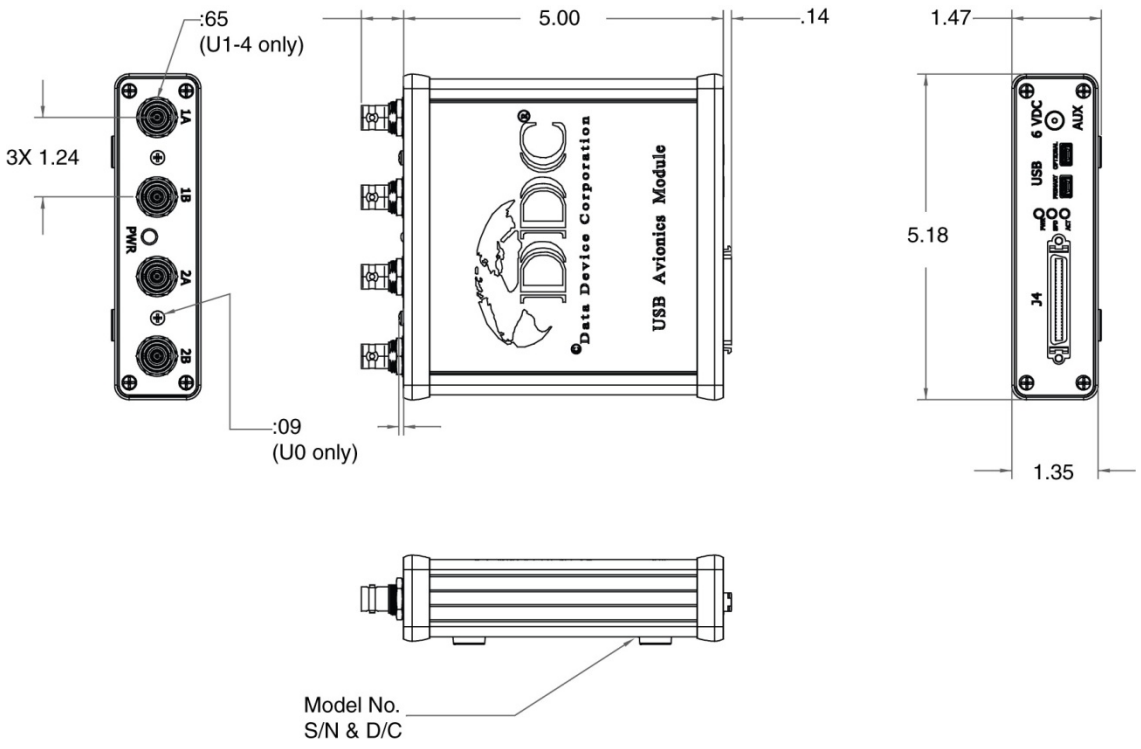


Figure 10. Mechanical Outline for the BU-67103U

5.4 1553 Architecture

5.4.1 Combination Modes

The ***BU-672102/3U*** Single-Function ***AceXtreme***® architecture has the ability to run the following concurrent modes:

(1) BC and MT-I

(2) RT and MT-I

(3) RT and MT

(4) Multi-RT and MT-I

The ***BU-67202U*** Multi-Function ***AceXtreme*** architecture has the ability to run the BC, Multi-RT, and MT-I modes concurrently on a single 1553 channel. Any combination of these modes is supported. By running more than one mode at one time, the user can have a variety of information and features readily available. Each channel's mode is configurable through software.

5.4.2 Bus Controller (BC) Architecture

The ***AceXtreme***® BC mode offers many powerful architectural features. This includes a highly autonomous BC message sequence control engine, which greatly serves to offload the operation of the host CPU. This can be a critical factor in embedded systems with real time requirements.

The Enhanced BC's message sequence control engine provides a high degree of flexibility for:

- Implementing major and minor frame scheduling
- Inserting asynchronous messages in the middle of a frame
- Separating 1553 message data from control/status data for the purpose of implementing double buffering and performing bulk data transfers
- Implementing message retry schemes, including the capability for automatic bus channel switchover for failed messages
- Reporting various conditions to the host processor by means of user defined interrupts and a general purpose queue
- The capability of transferring large blocks of data across the 1553 bus.

The BC performs all error checking required by MIL-STD-1553B. This includes validation of response time, sync type, sync encoding, Manchester II encoding, parity, bit count, word count, Status Word RT Address field, and various RT-to-RT transfer errors. The BC response timeout value is programmable with choices of 14, 18.5, 22.5, 50.5, and 130 ms via library functions. The longer response timeout values allow for operation over long buses and/or use of the repeaters. In the Enhanced BC mode, there is no explicit limit to the number of messages that may be processed in a frame.

The Multi-Function ***AceXtreme*** BC (***BU-67202U1*** option) provides additional features with the Test and Simulation Toolkit. See Section 5.5.

5.4.3 Multiple Remote Terminal (Multi-RT) Architecture

The ***AceXtreme*** provides the capability of implementing up to 31 RTs on a single channel of the ***BU-67X02/03U*** device. The Multi-RT architecture provides multi-protocol support, with full compliance to all of the commonly used data bus standards, including MIL-STD-1553A, MIL-STD-1553B (Notice 2), and MIL-STD-1760. Programmable flexibility enables the RT to be configured to fulfill any set of system requirements. This includes the capability to meet the MIL-STD-1553A

response time requirement of 2µs to 5µs, and multiple options for mode code subaddresses, mode codes, RT status word, and RT BIT word.

The ***AceXtreme***® RT protocol design implements all of the MIL-STD-1553B message formats and dual redundant mode codes. The design has passed validation testing for MIL-STD-1553B compliance. The ***AceXtreme*** RT performs comprehensive error checking, word and format validation, and checks for various RT-to-RT transfer errors. One of the main features of the ***AceXtreme*** RT is its choice of memory management options. These include single buffering by subaddress, double buffering for individual receive subaddresses, circular buffering by individual subaddresses, and global circular buffering for multiple (or all) subaddresses.

The ***AceXtreme*** RT provides an internal mechanism for RT Command Word illegalizing. The design of the ***BU-67X02/03U*** supports different options for specifying the RT addresses for the individual channels (See section 5.4.6). In all configurations, the RT address is readable by the host processor.

The Multi-Function ***AceXtreme*** RT (BU-67202U2 option) provides additional features with the Test and Simulation Toolkit. See Section 5.5.

5.4.4 Monitor (MT) Architecture

The ***AceXtreme*** MT can be run independently or concurrently with the BC or Multi-RT modes on any channel. The two main features are:

- Selective Message Monitor
- IRIG-106 Chapter 10 capability

5.4.4.1 Selective Message Monitor

The Selective Message Monitor provides a flexible interface that allows selective monitoring of 1553 messages based on RT Address, T/R, and Subaddress with very little host processor intervention. This mode recreates all command/response messages on the 1553 bus on channels A and B, and stores them on DDC hardware memory based on a user programmable filter (RT Address, T/R, and Subaddress). This monitor can be used as a monitor alone or in a combined RT/Monitor mode.

The MT hardware uses a command stack to store 1553 command information and a data stack to store 1553 data words.

5.4.4.2 IRIG-106 Chapter 10

The IRIG-106 Chapter 10 capability provides a definitive solution for systems requiring IRIG-106 Chapter 10 support. The MT adds DMA support, flexible event notification, and performance enhancements to maximize monitor data throughput.

IRIG-106 is a comprehensive telemetry standard developed to ensure interoperability in aeronautical telemetry applications. IRIG-106 is developed and maintained by the Telemetry Group of the Range Commanders Council. Chapter 10 addresses the Digital On-board Recorder Standard, which defines the operation and interfaces for digital flight data recorders. This new file format standard supports MIL-STD-1553, as well as other telemetry protocols such as PCM and ARINC 429.

The MT creates IRIG-106 Chapter 10 data packets, including a packet header and trailer, containing any monitored 1553 traffic (after filter is applied). The MT data packet is compliant to MIL-STD-1553, Format 1.

5.4.5 1553 Transceivers

Every ***AceXtreme***® 1553 channel provides complete multi-protocol support of MIL-STD-1553A/B and STANAG 3838 along with +5V, voltage source transceivers for improved line driving capability. The receiver sections of each 1553 channel are fully compliant with MIL-STD-1553B Notice 2 in terms of front-end overvoltage protection, threshold, common-mode rejection, and word error rate.

The BU-67X02/03U product contains both Transformer-Coupled (TC) and Direct-Coupled (DC) connections for the 1553 Channels. When using the 1 1553 channel configuration, both the TC and DC connections are accessible through the 1553 Trompeter connections. When using the 2 1553 channel configurations, the TC connections are routed through the Trompeter connections, and the DC connections are routed through the 50-Pin D-Type connector.

TC Connections: Should be connected directly through a 1553 cable to an appropriate 1553 Bus Coupler (supporting transformer coupled connections)

DC Connections: Contains internal 55 Ohm isolation resistors. Should be connected directly to an appropriate 1553 Bus Coupler (supporting direct coupled connections)

5.4.6 RT Address Selection

The RT address(es) for each 1553 channel are set via software only. However, these USB modules have an 8-bit digital discrete I/O port. This allows one RT address to be provided by the host CPU reading an externally applied value on six of the DDIO inputs and then writing this value to one of the ***AceXtreme***® channels via the appropriate API function.

Please reference the ***AceXtreme C SDK Software Manual (MN-69092SX-002)*** for detailed information regarding "setting the RT address" and, optionally, the Discrete I/O functions, if the DDIO port is used to supply and external RT address.

5.4.7 MIL-STD-1553 Time Tag

The architecture includes an internal MIL-STD-1553 read/write Time Tag Register. This register is a read/write 48-bit counter with a resolution as low as 100 nanoseconds. Another option allows software-controlled incrementing of the Time Tag Register. This supports self-test for the Time Tag Register. For each message processed, the value of the Time Tag Register is loaded into the second location of the respective descriptor stack entry ("TIME TAG 48-bit WORD") for both the BC and RT modes.

The functionality involving the Time Tag Register includes the capability to issue an interrupt request and set a bit in the Interrupt Status Register when the Time Tag Register rolls over from 0xFFFFFFFFFFFF to 0x000000000000; for RT mode, the capability to automatically clear the Time Tag Register following reception of a Synchronize (without data) mode command, or to load the Time Tag Register following a Synchronize (with data) mode command.

Additional time tag features supported by the card include the capability for the BC to transmit the contents of the Time Tag Register (lower 16-bits only) as the data word for a Synchronize (with data) mode command; the capability for the RT to "filter" the data word for the Synchronize with data mode command, by only loading the Time Tag Register if the LSB of the received data word is "0"; an instruction enabling the BC Message Sequence Control engine to autonomously load the Time Tag Register; and an instruction enabling the BC Message Sequence Control engine to write the value of the Time Tag Register to the General Purpose Queue.

5.4.8 MIL-STD-1553 Interrupt Handling

The ***AceXtreme***® SDK allows the user to implement custom Interrupt Service routines, which are operated on by the driver using a callback function. This allows for a high-level of scalability while maintaining the ease-of-use, which the API library affords.

The MIL-STD-1553 interfaces are capable of generating interrupts on numerous events. The specific conditions available to generate interrupts can be found in the ***AceXtreme*** C SDK software manual (***MN-69092SX-002***).

5.5 Test and Simulation ToolKit (Multi-Function Only)

5.5.1 BC Test and Sim Toolkit features

The Multi-Function ***AceXtreme*** BC (***BU-67202U*** option) provides for the following additional features:

- Programmable Response Timeout
- Intermessage Routines
- Programmable Intermessage Gap Time
- Error Injection (See section 5.5.4)
- Triggers (See section 5.5.5)

5.5.1.1 BC Programmable Response Timeout

The ***BU-67202U*** device supports a response timeout for the BC that is software programmable. The response timeout dictates how long the BC will wait for an RT status word. This allows the user control over when the BC will designate a particular message as a NO RESPONSE and move onto the next message. The longer response timeout values allow for operation over long buses and/or the use of repeaters. The BC supports a programmable timeout from 3.5 μseconds to 30 μseconds with a resolution of 0.5 μseconds.

5.5.1.2 BC Intermessage Routines (IMRs)

IMRs are events that occur upon completion of a BC message. The Multi-Function ***AceXtreme***® Architecture can allow the execution of up to 2 IMRs. The following is a list of the available IMRs:

- Set/Clear Discrete I/Os
- Automatic retries upon failed messages
- Skip next message
- Interrupt on End of Message
- Set/Clear status bits
- Increment data table
- Set/Clear triggers

Refer to Table 13 in the ***BU-69092SX ACEXTREME® C SDK* SOFTWARE MANUAL** (document #MN-69092SX-002) for a detailed summary of the ***BU-67202U***'s IMRs.

5.5.1.3 BC Inter-Message Gap Time

The intermessage gap time is defined as the time from the mid-parity bit crossing of the last word of one message to the time of the mid-sync crossing of the command word of the subsequent message (See Figure 11).

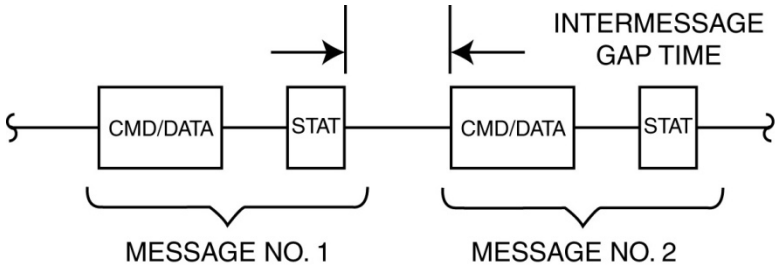


Figure 11. Intermessage Gap Time

To have a determinate time interval between messages, the new Multi-Function ***AceXtreme*** Architecture allows the user to define this gap time. The intermessage gap time is programmable between 3.5 µseconds and 32,000 µseconds with a resolution of 0.5 µseconds.

5.5.2 Multi-RT Test and Sim Toolkit features

The Multi-Function ***AceXtreme***® RT (***BU-67202U*** option) provides for the following additional features:

- Programmable Response Times
- Programmable Response Timeout
- Intermessage Routines
- Error Injection (See section 5.5.4)
- Triggers (See section 5.5.5)

5.5.2.1 Multi-RT Programmable Response Times

The ***BU-67202U*** device supports a response time for the RTs that is software programmable. The RT response time is defined as the time it takes an RT to send back a status word as shown in below. The programmable response time allows the user control over when the RT will respond to a MIL-STD-1553 command word. The RT supports a programmable response time from 3.5 µseconds to 30 µseconds with a resolution of 0.5 µseconds.

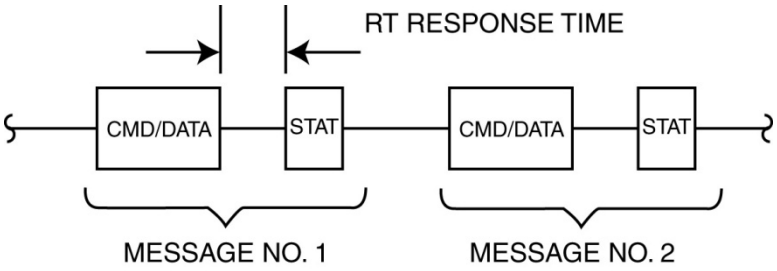


Figure 12. RT Response Time

5.5.2.2 Multi-RT Programmable Response Timeout

The ***BU-67202U*** device supports an RT response timeout that is software programmable. Setting the RT's response timeout value is used for RT to RT commands. The RT response timeout dictates how long the RT will wait for an RT status word. The programmable response timeout allows the user control over when the RT will designate a particular message as a NO RESPONSE and wait for the next message. The RT supports a programmable timeout from 3.5 µseconds to 30 µseconds with a resolution of 0.5 µseconds.

5.5.2.3 Multi-RT Intermessage Routines (IMRs)

IMRs are events that occur upon completion of an RT message. The Multi-Function ***AceXtreme***® Architecture can allow the execution of up to 2 IMRs. The following is a list of the available IMRs:

- Set/Clear Discrete I/Os
- Interrupt after mode code commands
- Store Time-Tag in a circular queue
- Set/Clear status bits
- Interrupt after accessing TX/RX data table
- Increment data table
- Set/Clear triggers

Refer to Table 57 in the ***BU-69092SX ACEXTREME® C SDK* SOFTWARE MANUAL** (document #MN-69092SX-002) for a detailed summary of the ***BU-67X02U***'s IMRs.

5.5.3 MT Advanced Error Sampling (AES)

The Monitor in the ***AceXtreme*** Multi-Function product provides the additional ability to capture Advanced Errors using a sampling mode. The types of errors captured in this mode include Manchester, Parity, and general glitch errors. These errors can then be emulated using the Replay feature (See Section 5.5.7). The AES mode generates the same packet header as MT-I but uses a slightly different packet trailer. The MT will determine if the message contains an error by using the error flag of the Block Status Word (BSW). If an error is detected, the MT will start sampling the bus at a 50 ns sample rate in order to capture this error.

5.5.4 Error Injection

Errors can be injected on either a BC Message or via an RT response on the ***BU-67202U***. The error types that can be injected by the BC and RTs are Length errors and Encoding errors. Refer to below for a list of available errors.

Length Errors include modifying data Word Count, or Bit Count Errors for a specific message.

Encoding Errors include Glitch or Inverse errors which can be anywhere in the message (command words, or datawords). The Glitch and Inverse errors allow

for error types such as invalid sync patterns, parity errors, and Manchester bi-phase errors.

Table 6. Error Injection			
Error	**Mode**	**Description**	**Value**
Word Count	BC/RT	Increasing or decreasing the number of data words in a message.	-32 to +32 Words
Bit Count	BC/RT	Adding or removing bits from a specific word for a given message.	-3 to +3 Bits
Glitch	BC/RT	Forces the output of the encoder to an idle bus connection for a specific time period.	50 to 3000 ns (50 ns steps)
Inverse	BC/RT	Invert the output of the encoder for a specific time period.	50 to 3000 ns (50 ns steps)

5.5.5 Triggers

The ***BU-67202U*** has a new Trigger component in each channel as a part of the Multi-Function ***AceXtreme*** Architecture.

Each channel can configure up to 18 different triggers. Each trigger configured can have up to twelve different available trigger events associated with it that would occur at the time the trigger condition is met. Refer to Table 5 in the ***BU-69092SX ACEXTREME® C SDK SOFTWARE MANUAL*** (document #MN-69092SX-002) for a detailed summary of the available trigger events.

Among the 18 triggers, two are Time-Message Triggers (TMT) and the other 16 are General Purpose Triggers (GPT).

The inputs to TMTs can be configured through software for either a time delay of x µs/ms or a specific number of messages processed. The inputs to the GPTs can be message patterns captured by the monitor. As a result, the use of GPTs requires an MT running concurrently in the same channel. These message patterns are user-defined through software.

Both TMTs and GPTs can be triggered by another trigger's output.

A block diagram of the Trigger component can be found in Figure 13.

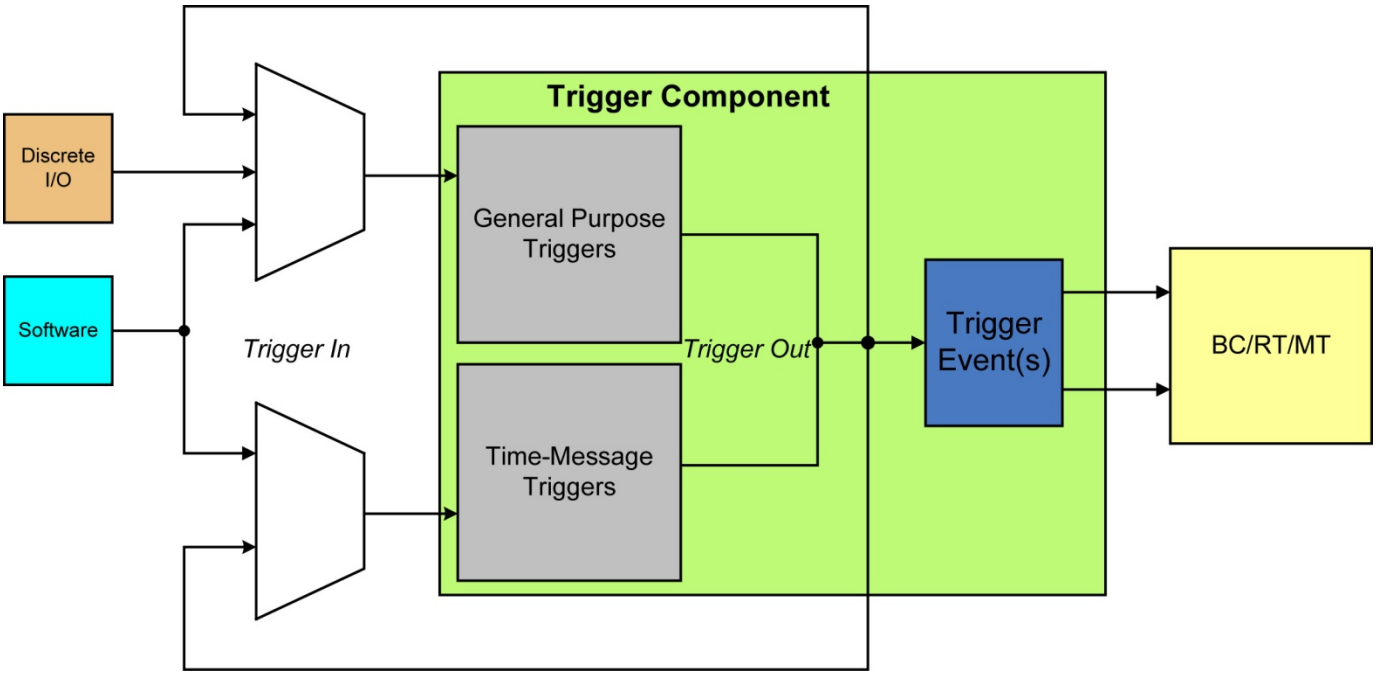


Figure 13. Trigger Component Block Diagram

5.5.6 Dynamic Bus Control

The Multi-Function ***AceXtreme***® BC has the option to enable a user-specified RT address after receiving the DBC acceptance RT status. The RT that is to be enabled does not need to be currently inactive.

The Multi-Function ***AceXtreme*** Multi-RT allows for multiple RTs to be configured to accept a DBC request. To enable an RT with DBC a hold-off time must be specified. The hold-off time is defined as the time that an RT must wait after accepting a DBC request before deactivating itself and then activating the BC in the same channel. The hold-off time is software programmable from 40 µs to 130,000 µs.

5.5.7 Replay Function

The ***BU-67202U*** Multi-Function ***AceXtreme*** Architecture provides the ability to replay bus traffic from captured MT-I/MT-R packets. The MT-I and MT-R modes have the capability to capture bus traffic data and store it into a file. The Replay function can use this file to replay the captured traffic data.

The Replay function has several configurable options and features such as the following:

- Start/Reset/Pause/Stop replay activity
- Emulate up to 31 RTs
- Loop replay a specific number of times
- Replay message errors

The Replay engine will replay captured 1553 streams stored in IRIG106 Chapter 10 packet formats (See Section 5.4.4.2). If the Advanced Error Sampling (AES) was enabled during the 1553 stream capture, the errors will be replayed. A software configurable option allows for the Replay engine to skip packets containing errors when AES was enabled. If AES was not enabled during the capture then all errors are automatically ignored during Replay.

In order to play back traffic, the user will need to configure the BC for replay mode and input a valid file containing a captured 1553 stream. See the **acexBCReplayStart()** function in the ***AceXtreme*® *C SDK*** software manual for detailed information.

5.6 ARINC Controller Architecture

The ARINC controllers are capable of operating in ARINC 429 or ARINC 575 mode. Each ARINC channel is independently programmable to operate in either mode of operation.

5.6.1 ARINC Mode Receive

The card allows the programmer access to the following card features in a simple, easy to understand format:

- “Mailbox” type reception
- FIFO type reception
- Filtering of received data
- Time stamping of received data

Each receive channel has a receive hardware FIFO that is 32 bits wide by 32 words long. When combined with the 32 bit, 32k word software FIFO for each channel, the ***BU-67102/03U*** provides excellent data transfer reliability. The transmission speed of the receive channels can be programmed in pairs. Receivers can be independently designated high or low speed. A 1024 word mailbox (software enhanced) on each channel stores the most recently received data value for any of the label/SDI (Source Destination Indicator) combinations. Data may be stored in the Mailbox only, FIFO only, or both the Mailbox and Receive FIFO.

The software API library supports two modes of reception: Mailbox and FIFO. Mailbox reception allows the user to retrieve the "latest" copy of data received on a particular label/SDI combination. This mode would be used when the user is only interested in the most recently received data. FIFO reception allows the user to dequeue words in the same sequence as they were received on the channel. This mode is useful when the user wants to see the exact order and timing of events on the data bus.

Data from each receive channel may by filtered prior to storing in the FIFO or Mailbox. A filter table, which is defined under program control, allows the user to specify which label/SDI combinations should be stored. This filtering allows the user to reduce the data being stored on the hard disk and displayed on the screen to only that data which is needed. A separate filter table is maintained for each receiver channel.

5.6.2 ARINC Mode Transmit

The card allows the programmer access to the following card features in a simple, easy to understand format:

- FIFO Queued transmissions
- Scheduled data transmissions

Each transmitter has a transmit hardware FIFO that is 32 bits wide by 32 words long. When combined with the 32 bit, 32k word software FIFO for each channel, the cards offer excellent data transfer reliability.

Each transmit FIFO allows the host PC to reliably transfer blocks of data to the card for transmission. Use of this FIFO prevents the host PC from becoming I/O bound, and allows for other activities to proceed in the PC when not transferring data to the card.

Data contained in the FIFO is transmitted on command from the host system. The transmit channels may be configured as either high or low speed, and are independent of the receiver speed settings. The library supports two modes of transmission: Scheduled and FIFO. Scheduled transmission allows the user to configure the host to automatically transmit labels at regular intervals (e.g. every 20 msec). Data values can be changed or updated without stopping the scheduled transmission once it has been started.

FIFO transmission allows the user to transmit a series of words in sequence. FIFO and Scheduled transmissions can be intermixed on the same transmit channel.

When a transmitter is set up for both FIFO and scheduled transmissions, the scheduled data will take priority over the FIFO data. The FIFO data will get transmitted on the first available gap between scheduled data transmissions without altering the schedule.

5.6.3 ARINC Time-Tag

The ARINC block has time stamping capability. Each received data word will be time stamped if the user specifies to do so in software. The time stamping of each data word has a resolution of 100 nanoseconds.

5.6.4 ARINC Interrupt Handling

The ***BU-67102/03U*** ARINC Controllers are capable of generating interrupts to the host computer. Using the supplied ARINC 429 Multi-IO C SDK, the host is capable of configuring the ARINC controllers to generate interrupts based on numerous events. Each channel may be configured independently of each other.

The per interface interrupt conditions are:

1. An ARINC Protocol word is received
2. A Fail warning is received
3. An ARINC Function test command is received
4. An ARINC solo command word is received
5. An ARINC transmit start command is issued
6. No data Received
7. End of transmission
8. Normal operation mode received
9. Data Pattern match
10. Word type match
11. Receiver buffer is full
12. Received FIFO rollover

5.7 Discrete Digital I/O

The ***BU-67X02/03U*** device includes 8 discrete digital signals (GPIO) that are individually programmable as inputs or outputs.

Discrete digital I/O channel 1 will be the least-significant bit and channel 8 will be the most-significant valid bit when using software registers to access to these signals.

The discrete digital I/O signals are totem-pole type with 3.3V-ground rails and a 12mA drive capability. The drivers and inputs are 5V tolerant with the following specifications:

V_{IL} max = 0.8V

V_{IH} min = 2.0V

V_{OL} max = 0.4V

The discrete I/O signals can be used for a variety of applications, including triggering software events, indicating status, or general-purpose use.

5.8 1 Pulse-per-Second (PPS) Output

This pin provides a 1 pulse per second output, synchronized to the SYNC signal of the IRIG-B time code.

5.9 IRIG-B Time Code

IRIG-B, B123 time code standardization allows equipment to be synchronized to a known reference time. The ***BU-67X02/03U*** device can accept an IRIG-B input via digital signal or amplitude modulated (AM) coding on an audio sine wave carrier signal. Digital or demodulated analog data is read once per second.

The IRIG Time can be fed to the ARINC 429 or MIL-STD-1553 channels to be used as the Time-Tag instead of the local timers included for each channel.

5.10 Backup Firmware

Should the need arise, for instance, if the normal firmware was corrupted during a firmware update, the backup firmware may be booted for recovery. This is done by tying the BOOT_SEL signal (see Table 7) to DGND. Then power down and power up. At this point, the user may attempt again to update the normal firmware.

Note: the backup firmware cannot be overwritten by the user.

5.11 USB Device Bus-Interface Connectors

This section delineates the MIL-STD-1553 and ARINC 429 bus-interface connectors for the ***BU-67X02/03U*** USB Device.

5.11.1 50-Pin D-Type Connector Pinout

The 50-pin D-type connector on the ***BU-67X02U*** (J5) and ***BU-67103U*** (J4) provides to the ARINC 429, discrete I/O's, IRIG-B time code input, 1 PPS output, and direct-coupled MIL-STD-1553 signals.

The device is supplied with a 50-pin D-type connector (3M PN 10150-3000PE) and a 50-pin D-type connector shell (3M PN 10350-52F0-008).

Table 7. 50-pin D-Type Connector Pinout for BU-*67X02U* and BU-67103U							
Pin	**Signal Name**	**I/O**	**Function**	**Pin**	**Signal Name**	**I/O**	**Function**
1*	CH1A-DIR-P	O	1553 Direct Coupled	26*	CH1B-DIR-P	O	1553 Direct Coupled
2*	CH1A-DIR-N	O	1553 Direct Coupled	27*	CH1B-DIR-N	O	1553 Direct Coupled
3*	Shield-1553		1553 Cable Shield (NC)	28*	Shield-1553		1553 Cable Shield (NC)
4*	CH2A-DIR-P	O	1553 Direct Coupled	29*	CH2B-DIR-P	O	1553 Direct Coupled
5*	CH2A-DIR-N	O	1553 Direct Coupled	30*	CH2B-DIR-N	O	1553 Direct Coupled
6	DGND		DGND	31	DGND		DGND
7	IRIG_MOD	I	IRIG Modulated Input	32	JTAG_CLK	I	JTAG Input
8	IRIG_DIG_A	I	IRIG Digital Input	33	JTAG_TRST_L	I	JTAG Input
9	FLASH_WR_DIS_L	I	Flash Write Disable	34	JTAG_TMS	I	JTAG Input
10	BOOT_SEL	I	Select Backup Boot	35	XILINX_TDO_R	O	JTAG Output
11	1 PPS Out	O	One Pulse per Second Output	36	JTAG_TDI	I	JTAG Input
12	DGND		DGND	37	DGND		DGND
13	Discrete (7)	I/O	Programmable I/O	38	Discrete (3)	I/O	Programmable I/O
14	Discrete (6)	I/O	Programmable I/O	39	Discrete (2)	I/O	Programmable I/O
15	Discrete (5)	I/O	Programmable I/O	40	Discrete (1)	I/O	Programmable I/O
16	Discrete (4)	I/O	Programmable I/O	41	Discrete (0)	I/O	Programmable I/O
17	DGND		DGND	42	DGND		DGND
18	A429-RXIN1A	I	ARINC Input-1A	43	A429-RXIN4B	I	ARINC Input 4B
19	A429-RXIN1B	I	ARINC Input-1B	44	A429-RXIN4A	I	ARINC Input 4A
20	DGND		DGND	45	DGND		DGND
21	A429-RXIN2A	I	ARINC Input-2A	46	A429-TXOUT2B	O	ARINC Output 2B
22	A429-RXIN2B	I	ARINC Input-2B	47	A429-TXOUT2A	O	ARINC Output 2A
23	+5V	O	Unregulated +5V Output	48	DGND		DGND
24	A429-RXIN3B	I	ARINC Input-3B	49	A429-TXOUT1B	O	ARINC Output 1B
25	A429-RXIN3A	I	ARINC Input-3A	50	A429-TXOUT1A	O	ARINC Output 1A

*** These connections are N/C's for the –U0 and –U1 options.**

Pin 23 of the 50-pin D-type connector provides an unregulated +5V output. The un-regulated +5V output will vary based on the input voltage source. If sourcing power from the USB connector, the 5V output will be approximately 4.65V or 0.35V less than the source. If using the 6V external supply (6.15V), the 5V output will be approximately 5.80V, again 0.35V less than the source. When this +5V output is being used, the power drawn from this pin will take away from usable power for the USB device. Caution must be taken to make sure that the power supplied from the USB port is adequate to use the +5V and the USB device at the same time. The USB specification allows 500mA to be drawn from one USB port.

5.11.2 MIL-STD-1553 Connectors

The 4 MIL-STD-1553 Connectors located on the top of the ***BU-67X02U*** (and the side of the ***BU-67103U***) are Trompeter Part Number 305-1635.

The suggested mating connector is Trompeter Part Number PL75-47.

RFI/Dust Caps are Trompeter Part Number RF175-2-D4.

5.12 LED Indicators

There are three status LEDs. The top LED indicates the Power status, and the middle and bottom LEDs are multifunctional, indicating the present status of the module.

5.12.1 Power Status (Top LED)

Table 8. Power LED Status Summary

Top LED	DESCRIPTION
Green	Power is being supplied from external AC adapter.
Orange	Power is being supplied from the USB port
Off	No power

5.12.2 Module Status (Middle and Bottom LEDs)

These LEDs are multifunctional and indicate the present status of the module. Refer to Table 9 for a summary of the various combinations and meanings for the Middle and Bottom LEDs.

Table 9. Middle and Bottom LED Status Summary		
LED		**DESCRIPTION**
Middle	**Bottom**	
OFF	OFF	Device is not configured (Contact Factory)
Blinking alternating colors, Orange – Green - Orange - Green	Blinking ***same*** color as Middle LED	Device is configured from the backup firmware
Blinking alternating colors, Orange - Green - Orange - Green	Blinking ***opposite*** color to Middle LED	Device configuration error (Contact Factory)
Blinking Green (temporarily)	Blinking Green (temporarily)	Device is not yet configured
Blinking Green	Blinking Green	Firmware Load passed
Any	Blinking Orange	Firmware Load failure
Steady Green	Any	A high-speed connection is established (480 Mbps)
Steady Orange	Any	A full speed connection is established (12 Mbps)
Any	Steady Orange	USB is in the suspend state
Any	Steady Green	USB Activity
Any	OFF	No USB Activity and device is not suspended

6 APPENDIX A – CE CERTIFICATION

DDC
*Data Device Corporation
105 Wilbur Place • Bohemia • New York • 11716-2482
Tel: (631) 567-5600 • Fax: (631) 244-8252
www.ddc-web.com

DECLARATION OF CONFORMITY

We Data Device Corporation
105 Wilbur Place
Bohemia, NY 11716-2482

declare under our sole responsibility that the product(s)

BU-67102U000L-CA0, BU-67102U100L-CA0, BU-67102U200L-CA0

to which this declaration relates is in conformity with the following standard(s) or other normative document(s):

EN 61326-1:2006; Clause 7.2:

CISPR 11 Edition 4:2003	Conducted Emissions Group 1, Class A (150KHz – 30Mhz)
CISPR 11 Edition 4:2003	Radiated Emissions Group 1, Class A (30MHz – 1GHz)
IEC 61000-3-2: 2000	Harmonics
IEC 61000-3-3: 2002	Flicker

EN 61326-1:2006; Table 1:

IEC 61000-4-2: 2001	Electrostatic Discharge
IEC 61000-4-3: 2002	Radiation Immunity
IEC 61000-4-4: 2004	EFT/Burst, Power Leads and I/O Cables
IEC 61000-4-5: 2001	Surge Immunity
IEC 61000-4-6: 2003	Conducted Immunity, Power Leads
IEC 61000-4-8: 1993, A1:2000	Power Frequency Magnetic Fields
IEC 61000-4-11: 2004	Voltage Dips and Interrupts

following the provisions of COUNCIL DIRECTIVE 2004/108/EC

Place Bohemia, NY USA

Date 12/15/09

(Signature)

Ron Kanaby
(Full Name)

Manager, Quality Assurance Engineering
(Position)

DDC-PAF-688A
12/14/2009

7 ORDERING INFORMATION

Model Number	1553 Ch.	429 Rx Ch.	429 Tx Ch.	Digital Discrete I/O
BU-67102U000L-CA0	0 SF	4	2	8
BU-67102U100L-CA0	1 SF	0	0	8
BU-67102U200L-CA0	2 SF	4	2	8
BU-67202U100L-CA0	1 MF	0	0	8

Temperature Range is -40°C to +71°C for all BU-67X02U models (note 1).

Model Number	1553 Ch.	429 Rx Ch.	429 Tx Ch.	Digital Discrete I/O
BU-67103U000L-JL0	0 SF	4	2	8
BU-67103U100L-JL0	1 SF	0	0	8
BU-67103U200L-JL0	2 SF	4	2	8

Temperature Range is 0°C to +55°C for all BU-67103U models.

Notes: *1. Component temperature: -40°C to +85°C*
2. All USBs include an IRIG-B Input and 1 pulse per second output
3. SF = BC or Multi-RT with concurrent Bus Monitor per 1553 channel
MF = BC and Multi-RT with concurrent Bus Monitor per 1553 channel

Included Accessories:

For the X02U and 103U versions:

- 1 USB Cable
- 1 AC Power Adapter
- 1 50-Pin D-Connector and Shell

For the X02U version only:

- 5 Mounted Cable Ties
- 1 Cable Tie Screw and Washer

Included Software:

BU-69092SX- AceXtreme C Software Development Kit (SDK

Operating System:

0 = Windows XP/Vista/7

1 = Linux 2.6.x

DD-42992SX- ARINC 429 Multi I/O Software Development Kit (SDK)

Operating System:

0 = Windows XP/Vista/7

1 = Linux 2.6.x

Optional Accessories:

For the X02U version only:

- Mounting Bracket:

  Short "U" Bracket with Mounting Holes P/N 5507-5606-0010

  Long "U" Bracket with Mounting Holes P/N 5507-5606-0020

Data Device Corporation

Leadership Built on Nearly 50 Years of Innovation

Military | Commercial Aerospace | Space | Industrial

Data Device Corporation (DDC) is the world leader in the design and manufacture of high-reliability data bus products, motion control, and solid-state power controllers for aerospace, defense, and industrial automation applications. For nearly 50 years, DDC has continuously advanced the state of high-reliability data communications and control technology for MIL-STD-1553, ARINC 429, AFDX®, Synchro/Resolver interface, and Solid-State Power Controllers with innovations that have minimized component size and weight while increasing performance. DDC offers a broad product line consisting of advanced data bus technology for Fibre Channel networks; MIL-STD-1553 and ARINC 429 Data Networking cards, components, and software; Synchro/Resolver interface components; and Solid-State Power Controllers and Motor Drives.

Product Families

Data Bus | Synchro/Resolver | Power Controllers | Motor Drives

DDC is a leader in the development, design, and manufacture of highly reliable and innovative military data bus solutions. DDC's Data Networking Solutions include MIL-STD-1553, ARINC 429, AFDX®, Ethernet and Fibre Channel. Each Interface is supported by a complete line of quality MIL-STD-1553 and ARINC 429 commercial, military, and COTS grade cards and components, as well as software that maintain compatibility between product generations. The Data Bus product line has been field proven for the military, commercial and aerospace markets.

DDC is also a global leader in Synchro/Resolver Solutions. We offer a broad line of Synchro/Resolver instrument-grade cards, including angle position indicators and simulators. Our Synchro/Resolver-to-Digital and Digital-to-Synchro/Resolver microelectronic components are the smallest, most accurate converters, and also serve as the building block for our card-level products. All of our Synchro/Resolver line is supported by software, designed to meet today's COTS/MOTS needs. The Synchro/Resolver line has been field proven for military and industrial applications, including radar, IR, and navigation systems, fire control, flight instrumentation/simulators, motor/motion feedback controls and drivers, and robotic systems.

As the world's largest supplier of Solid-State Power Controllers (SSPCs) and Remote Power Controllers (RPCs), DDC was the first to offer commercial and fully-qualified MIL-PRF-38534 and Class K Space-level screening for these products. DDC's complete line of SSPC and RPC boards and components support real-time digital status reporting and computer control, and are equipped with instant trip, and true I^2T wire protection. The SSPC and RPC product line has been field proven for military markets, and are used in the Bradley fighting vehicles and M1A2 tank.

DDC is the premier manufacturer of hybrid motor drives and controllers for brush, 3-phase brushless, and induction motors operating from 28 Vdc to 270 Vdc requiring up to 18 kilowatts of power. Applications range from aircraft actuators for primary and secondary flight controls, jet or rocket engine thrust vector control, missile flight controls, to pumps, fans, solar arrays and momentum wheel control for space and satellite systems.

Certifications

Data Device Corporation is ISO 9001: 2008 and AS 9100, Rev. C certified.

DDC has also been granted certification by the Defense Supply Center Columbus (DSCC) for manufacturing Class D, G, H, and K hybrid products in accordance with MIL-PRF-38534, as well as ESA and NASA approved.

Industry documents used to support DDC's certifications and Quality system are: AS9001 OEM Certification, MIL-STD-883, ANSI/NCSL Z540-1, IPC-A-610, MIL-STD-202, JESD-22, and J-STD-020.

DATA DEVICE CORPORATION
REGISTERED TO:
ISO 9001:2008, AS9100C:2009-01
EN9100:2009, JIS Q9100:2009
FILE NO. 10001296 ASH09

The first choice for more than 45 years—DDC

DDC is the world leader in the design and manufacture of high reliability data interface products, motion control, and solid-state power controllers for aerospace, defense, and industrial automation.

Inside the U.S. - Call Toll-Free 1-800-DDC-5757

Headquarters and Main Plant
105 Wilbur Place, Bohemia, NY 11716-2426
Tel: (631) 567-5600 Fax: (631) 567-7358
Toll-Free, Customer Service: 1-800-DDC-5757

Web site: www.ddc-web.com

Data Device Corporation

Outside the U.S. - Call 1-631-567-5700

United Kingdom: DDC U.K., LTD
Mill Reef House, 9-14 Cheap Street, Newbury,
Berkshire RG14 5DD, England
Tel: +44 1635 811140 Fax: +44 1635 32264

France: DDC Electronique
10 Rue Carle-Hebert
92400 Courbevoie France
Tel: +33-1-41-16-3424 Fax: +33-1-41-16-3425

Germany: DDC Elektronik GmbH
Triebstrasse 3, D-80993 München, Germany
Tel: +49 (0) 89-15 00 12-11
Fax: +49 (0) 89-15 00 12-22

Japan: DDC Electronics K.K.
Dai-ichi Magami Bldg, 8F, 1-5, Koraku 1-chome,
Bunkyo-ku, Tokyo 112-0004, Japan
Tel: 81-3-3814-7688 Fax: 81-3-3814-7689
Web site: www.ddcjapan.co.jp

Asia: Data Device Corporation - RO Registered in Singapore
Blk-327 Hougang Ave 5 #05-164
Singapore 530327
Tel: +65 6489 4801