LP1553-5 and LE1553-5
USER'S MANUAL

PCI/PCIe to MIL-STD-1553
INTERFACE BOARD

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Rev. A

11400 Airport Road, Suite 201
Everett, WA 98204 USA

Phone: (800) 829-1553 (425) 339-0281 Fax: (425) 339-0915
E-mail: *support@ballardtech.com*
Web: *www.ballardtech.com*

MA162-20090731

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1. INTRODUCTION

This manual is the user's guide for the LP1553-5 and the LE1553-5; hereafter, both products will be referred to generically as an Lx1553-5. This guide introduces the Lx1553-5, describes the installation process, references programming alternatives, and discusses special Lx1553-5 features.

1.1 Lx1553-5 Overview

The Lx1553-5 is either a PCI (LP1553-5) or PCI Express (LE1553-5) compliant interface card capable of communicating over MIL-STD-1553 avionics databuses. PCI and PCI Express (hereafter referred to as PCIe) are common buses available in desktop computers. In addition to the MIL-STD-1553 capability, the Lx1553-5 provides an IRIG timer and input/output avionics discrete I/O signals. The Lx1553-5 is available in different configurations to suit many diverse applications.

Figure 1.1—The LP1553-5 PCI card

Figure 1.2—The LE1553-5 PCIe card

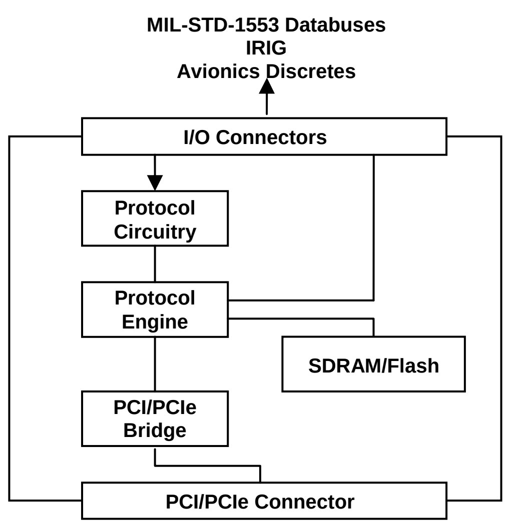

Figure 1.3—The Architecture of the Lx1553-5

1.2 Product Configurations

The Lx1553-5 offers many configurations with varying connectors, numbers of channels, and levels of functionality. Table 1.1 shows the Lx1553-5 models and their respective configurations.

Model No.	Description
LP1553-5/1ST	PCI, 1 MIL-STD-1553 Channel (Single-Function), Twinax Connectors
LP1553-5/1MT	PCI, 1 MIL-STD-1553 Channel (Multi-Function), Twinax Connectors
LP1553-5/1S	PCI, 1 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LP1553-5/1M	PCI, 1 MIL-STD-1553 Channel (Multi-Function), LFH Connectors
LP1553-5/2S	PCI, 2 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LP1553-5/2M	PCI, 2 MIL-STD-1553 Channel (Multi-Function), LFH Connectors
LP1553-5/3S	PCI, 3 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LP1553-5/3M	PCI, 3 MIL-STD-1553 Channel (Multi-Function), LFH Connectors
LP1553-5/4S	PCI, 4 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LP1553-5/4M	PCI, 4 MIL-STD-1553 Channel (Multi-Function), LFH Connectors
LE1553-5/1ST	PCI Express, 1 MIL-STD-1553 Channel (Single-Function), Twinax Connectors
LE1553-5/1MT	PCI Express, 1 MIL-STD-1553 Channel (Multi-Function), Twinax Connectors
LE1553-5/1S	PCI Express, 1 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LE1553-5/1M	PCI Express, 1 MIL-STD-1553 Channel (Multi-Function), LFH Connectors
LE1553-5/2S	PCI Express, 2 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LE1553-5/2M	PCI Express, 2 MIL-STD-1553 Channel (Multi-Function), LFH Connectors
LE1553-5/3S	PCI Express, 3 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LE1553-5/3M	PCI Express, 3 MIL-STD-1553 Channel (Multi-Function), LFH Connectors
LE1553-5/4S	PCI Express, 4 MIL-STD-1553 Channel (Single-Function), LFH Connectors
LE1553-5/4M	PCI Express, 4 MIL-STD-1553 Channel (Multi-Function), LFH Connectors

Table 1.1—Lx1553-5 Part Numbers

Each Lx1553-5 with LFH connectors provides an IRIG timer and sixteen avionics discrete I/O signals. The twinax configurations do not provide IRIG or discrete I/O signals.

The complete assembly part number is located on the product label.

For future reference, we encourage you to record the model number and serial number of your Lx1553-5. You may wish to use the space provided below:

Model No: ___________________

Serial No: ___________________

1.3 MIL-STD-1553 Protocol

MIL-STD-1553 is a standard defining a local area network (LAN) originally developed for and widely used on military aircraft. This digital, command-response, time-division multiplexing network protocol is also used in many other military and commercial applications where fast, positive control is required. The standard defines the handshaking, data formats, and timing requirements of the protocol as well as the electrical characteristics of the bus and the terminals' interface electronics. Familiarity with the MIL-STD-1553 databus protocol is essential to understanding the operation of the Lx1553-5, and it is assumed throughout this manual that the user is acquainted with this protocol.

1.4 Other Documentation

Besides this manual, Ballard Technology provides other documentation to facilitate the operation of the Lx1553-5. These include protocol manuals and information on the software distribution disk.

A BTIDriver API programming manual is available for MIL-STD-1553. This manual (*MIL-STD-1553 Programming Manual for BTIDriver-Compliant Devices*) provides information on the specific protocol and includes basic and advanced programming instructions for users who intend to write their own software. It also contains a comprehensive reference for each function.

The software distribution disk accompanying the Lx1553-5 device has example programs, drivers, and driver installation instructions for various operating systems, as well as other information, files, and resources.

1.5 Technical Support and Customer Service

Ballard Technology offers technical support before and after purchase. Our hours are 9:00 am to 5:00 pm Pacific Time, though support and sales engineers are often available outside those hours. We invite your questions and comments on any of our products. You may reach us by telephone at (800) 829-1553 or (425) 339-0281, by fax at (425) 339-0915, on the Web at www.ballardtech.com, or through e-mail at support@ballardtech.com.

1.6 Updates

At Ballard Technology, we take pride in high-quality, reliable products that meet the needs of our customers. Because we are continually improving our products, periodic updates to documentation and software may be issued. Please visit us at www.ballardtech.com and register your product(s) so that we can keep you informed of updates, customer services, and new product information.

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2. INSTALLATION

This Chapter explains the procedures for installing your Lx1553-5. There are five steps to installation:

Step 1: Set the Hardware Configuration
Step 2: Insert the Card into the Computer
Step 3: Install the Driver Software
Step 4: Set the Card Number and Test the Installation
Step 5: Connect to the MIL-STD-1553 Databus(es)

After the installation steps are completed, the Lx1553-5 device is ready to communicate on the MIL-STD-1553 databus(es).

WARNING

Static Discharge

As with most electronic devices, static discharge may damage or degrade components on a circuit card. When handling a circuit card, the user should be grounded (e.g., through a wrist strap). Each circuit card is shipped in an anti-static bag, and should be stored in a similar container when not installed in the computer.

2.1 Step 1: Set the Hardware Configuration

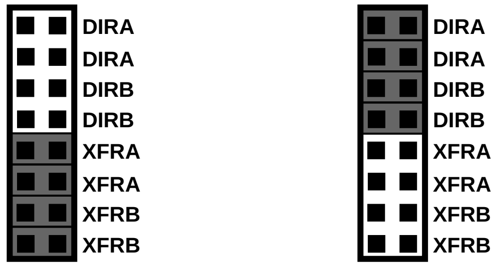
In an ESD safe environment, set the jumpers appropriately for your installation.

The Lx1553-5 contains on-board 75 ohm terminating resistors that may be used with direct coupling. A second bus terminator must still be used at the other end of the bus. By having the jumpers in place, the termination resistors are selected. Figure 2.1 shows the terminating resistor jumpers. The on-board terminating resistors should not be selected with transformer coupling. For more information, refer to Appendix A: Coupling and Termination.

Channel 1 Terminated *Channels 1 & 3 Terminated*

Figure 2.1—Termination resistor selection jumpers for direct coupling

The Lx1553-5/1ST and Lx1553-5/1MT models have twinax connectors which use the jumpers shown in Figure 2.2 to select the coupling method. Note: These jumpers should only be used on twinax connector models.



Transformer Coupled Twinax *Direct Coupled Twinax*

Figure 2.2—Coupling selection jumpers

2.2 Step 2: Insert the Card into the Computer

In an ESD safe environment, do the following:

- Shut down your computer.
- **For PCI cards:** Insert the card(s) into an empty PCI slot and secure it to the case of your computer with a screw.
- **For PCIe cards:** Insert the card(s) into an empty PCIe slot and secure it to the case of your computer with a screw. If there is a locking mechanism on the slot, make sure it is secured.
- Restart your computer.

2.3 Step 3: Install the Driver Software

Drivers allow programmatic control of the Lx1553-5 from a host computer.

The driver installation procedures vary, depending on your computer's operating system. These procedures are kept on disk so they can be easily updated as operating systems evolve. Before proceeding with the installation, find, print, and review the driver installation procedure for your operating system.

<u>To install the driver software:</u>

- Insert the driver disk in your drive and browse to the folder for your product
- Print the driver installation instructions located in a README file on the software distribution disk in a folder specific to your product
- Follow the instructions from the README file

The installation procedure differs for each operating system, but in most cases, several files are copied to the host computer system and either the system registry is modified or configuration files are created.

If you encounter problems, have installation questions, or cannot find instructions for your operating system, please contact Customer Service (see Section 1.5).

2.4 Step 4: Set the Card Number and Test the Installation

You must set a card number on the controlling computer for software to identify the Lx1553-5.

Since many Ballard BTIDriver™-compliant hardware devices (e.g., Lx1553-5) can be concurrently connected to the same computer, software running on a given computer uses a unique card number to designate which hardware device is being accessed. If you have only one BTIDriver-compliant device connected to the computer, it is recommended that you set it to card number 0 because the example programs included with the driver software assume a card number of 0. After the card number has been set, you can then test the Lx1553-5.

In Windows, the BTITST32.EXE test program can be used to assign and manage card numbers and to test the Lx1553-5 (and other BTIDriver-compliant devices). The test program discovers all connected BTIDriver-compliant devices and displays important information about each device such as card number, configuration, serial number, and assembly part number. Running the test sequence verifies both the device hardware and the interface between the device and the computer. If the program does not detect any faults, it displays a "passed test" message.

This program and a README file with instructions are found in the Windows Test subfolder (Lx1553-5→WINDOWS→TEST) on the software distribution disk.

> *Note: The Windows test program may be used at any time to determine or reassign the Lx1553-5 card number.*

In Linux, card numbers are automatically assigned as they are discovered by the kernel module on the PCI/PCIe bus. The card number is determined by the bus sequence.

In other operating systems, testing and card number management are handled differently. Example programs on the software distribution disk illustrate concepts for managing card numbers and testing hardware. In many cases, these example programs can be recompiled or easily modified for various operating systems. Instructions on assigning card numbers can be found on the README file found on the software distribution disk. If you need further assistance, contact Ballard Technology's Technical Support (see Section 1.5).

2.5 Step 5: Connect to the MIL-STD-1553 Databus(es)

The Lx1553-5 has either two 60-pin LFH connectors or two Twinax connectors. Connect the databuses according to the pin assignment tables in Chapter 6.

Connection of the ground pin(s) to the end system(s) is necessary for proper operation of MIL-STD-1553 and the discrete I/O. There is no need to terminate unused signals and do not connect the reserved pin(s).

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3. OPERATION

Now that you have installed the Lx1553-5 in your system, it is ready to be operated under the control of a software application. Ballard Technology's unified API library called BTIDriver, easily operates the Lx1553-5 and utilizes its powerful interfaces.

3.1 CoPilot

A PC with CoPilot® and Ballard's Lx1553-5 makes a powerful, low-cost databus analyzer/simulator. CoPilot interfaces directly with the Lx1553-5, eliminating the need to write custom software. CoPilot greatly simplifies such tasks as defining and scheduling bus messages and capturing and analyzing data. CoPilot is a Windows-based program that features a user-friendly GUI and many timesaving features. For example, bus messages can be automatically detected, posted in the hardware tree, and associated with the appropriate attributes from the database of equipment, message, and engineering unit specifications.

CoPilot users can quickly configure, run, and display the activity of multiple databuses in a unified view. Data can be observed and changed in engineering units while the bus is running. The Strip View graphically illustrates the history of the selected data values. Data can also be entered and viewed as virtual instruments (knobs, dials, gauges, etc.) that can be created by the user or automatically generated by dragging and dropping an item into the Control View window.

Because CoPilot can host multiple channels in the same project, it is the ideal tool for operating Lx1553-5 devices. CoPilot can be purchased separately or with an Lx1553-5 device. For more information or a free evaluation copy, call Ballard at (800) 829-1553. In addition, you can learn more about the latest version of CoPilot at www.ballardtech.com.

Figure 3.1—Sample CoPilot screen

3.2 User Developed Software

With only a few function calls, a program can operate the Lx1553-5 and process messages to and from the avionics databuses. Functions include routines for transmitting, receiving, scheduling, recording, data manipulation, and time-tagging bus messages. Although most tasks require only a few API calls, the comprehensive API library includes a broad range of functions for specialized needs.

Example programs are included with the API on the software distribution disk. Detailed information about API functions and instructions on programming for the Lx1553-5 are found in the *MIL-STD-1553 Programming Manual for BTIDriver-Compliant Devices*. You can use this manual to learn how to create custom applications for any of Ballard Technology's BTIDriver-compliant interface products.

4. TROUBLESHOOTING

4.1 LED Indicators

There are two LEDs on the front panel. The red LED and the green LED can be controlled via software using the API functions BTICard_ExtStatusLEDWr() and BTICard_ExtLEDWr() repectively. For more information on this function, consult the *MIL-STD-1553 Programming Manual for BTIDriver-compliant Devices* API programming manual.

4.2 Lx1553-5 Test Program

There are a few options available to verify that the Lx1553-5 is working correctly.

- Test Program: To test the device, run the test utility distributed on the driver disk for the particular host operating system. For example, on a Windows host computer run the BTITST32.EXE program included on the Windows Driver disk to verify the installation and hardware operation. These test utilities will display a passed or failed message and provide detailed information about the device hardware.
- API Test Function: The BTIDriver API includes the BTICard_CardTest() API function to verify operation of the hardware from a user developed application. It is advisable to include a call to this function at the beginning of an application. For more information on this function, consult the *MIL-STD-1553 Programming Manual for BTIDriver-compliant Devices* API programming manual.

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5. LX1553-5 FEATURES

This section describes the interfaces and features available on the Lx1553-5. If you need more information than what is presented here, please contact Customer Service at Ballard Technology for assistance (see Section 1.5).

5.1 PCI/PCIe Bus

The LP1553-5 uses the industry standard PLX Technology's PCI 9056 which interfaces the protocol circuitry to the PCI bus. The PCI 9056 provides the LP1553-5 with many features including:

- 32-bit wide host PCI data bus
- 33/66MHz PCI clock speed
- Universal signaling voltage on the PCI bus
- PCI bus mastering

The LE1553-5 uses the industry standard PLX Technology's PEX 8311 which interfaces the protocol circuitry to the PCIe bus. The PEX 8311 provides the LE1553-5 with many features including:

- PCI Express single-lane (x1) Endpoint
- Compatible with multi-lane PCIe devices
- Full 2.5 Gbps per direction
- PCIe bus mastering

5.2 MIL-STD-1553

Each MIL-STD-1553 channel is available in two levels of functionality (summarized in Table 5.1). Both levels provide at least Bus Controller, Remote Terminal, or Monitor operation. Advanced features include concurrent BC/RT/Monitor operation and protocol error injection (word, gap, and message errors).

Level Designator→	**S**	**M**
BC/RT/MON Operation	Single	Multi
BC or 32 RTs or MON	✓	✓
BC and 32 RTs and MON		✓
Protocol Error Injection		✓

Table 5.1—Ballard MIL-STD-1553 Functionality Levels

5.3 Avionics Discretes, Syncs, and Triggers

The Lx1553-5 has avionics shunt discretes which can be used to signal and detect events, determine status, and to drive loads. Discretes may also be used as general purpose digital I/O and have a wide range of avionics and general-purpose applications. Each avionics discrete I/O pin is configured as both a shunt input and a shunt output.

Note: Discrete I/O signals are not available on Lx1553-5/1xT models.

5.3.1 Shunt Inputs

A shunt input circuit pin is pulled up to a voltage source through a resistor. A load resistance applied between the pin and ground will shunt current from the source and generate a voltage at the pin. The pin voltage is compared with a reference voltage for input state detection. There are two defined states: the "Open" state in which a high impedance is applied to the pin, and the "Ground" state in which a low impedance is applied to the pin.

The Lx1553-5 discrete shunt input circuit, illustrated in Figure 5.1, has a 9 kΩ pull-up resistor to a 5 volt source. An isolation diode provides protection against over-voltage at the pin. A load resistance connected between the input pin and ground will shunt current from the 5 volt source, through the forward biased diode and the 9 kΩ resistor. A series resistor limits current as a voltage is generated across the load which is compared to a reference voltage produced by an identical configuration. This results in a 3.25 volt switching voltage.

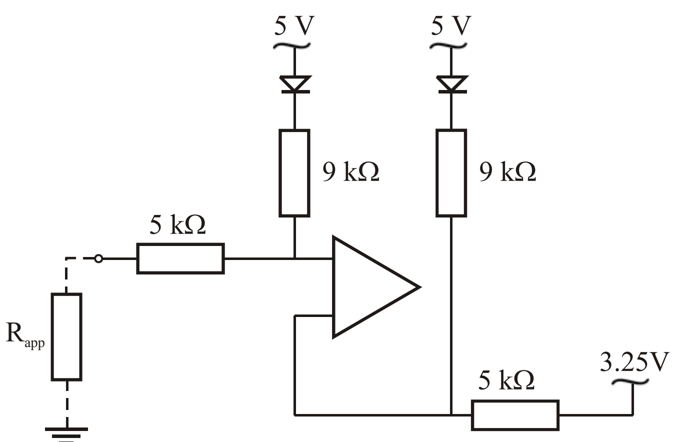

Figure 5.1—Lx1553-5 Discrete Shunt Input Circuit

5.3.2 Input Considerations

Limits: The Lx1553-5 discrete inputs can withstand up to 35 VDC applied to the pin. The discrete inputs are capable of interfacing with industry standard avionics discrete signals.

Usage: Some Lx1553-5 discrete inputs can be configured as input triggers using Ballard's BTIDriver API. Once the input has been configured as a trigger it may no longer be used as a discrete input. Refer to Section 5.3.5 for additional information.

5.3.3 Shunt Outputs

A shunt output is typically an open-collector circuit and is normally high impedance. When driven, the output sinks current to ground in a low impedance state. Shunt outputs can be used to communicate with an input discrete and/or to energize a load.

The Lx1553-5 discrete shunt output circuit, illustrated in Figure 5.2, is a low side switch capable of sinking up to 200 mA of current to ground through the external load (Z_{ext}). A diode protection circuit permits safe switching of inductive loads. Over-load detection limits the sink current and shuts the device down in an over-temperature condition. Each output circuit is wired in parallel with an input circuit (not shown) providing self monitor capabilities.

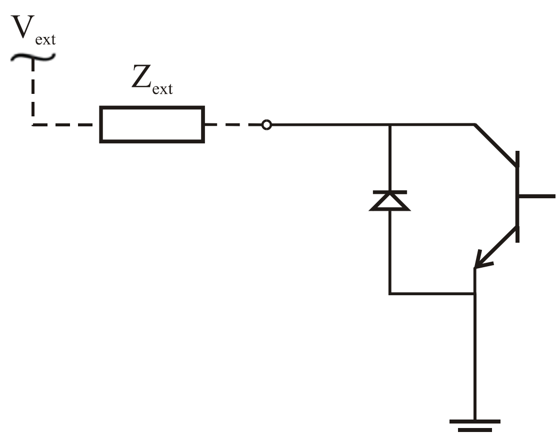

Figure 5.2—Lx1553-5 Discrete Shunt Output Circuit

5.3.4 Output Considerations

Limits: The Lx1553-5 discrete outputs are open-ground switches capable of sinking up to 200mA. The discrete outputs can withstand up to 35 VDC and are capable of interfacing with industry standard avionics discrete signals.

Usage: Some Lx1553-5 discrete outputs can be configured as output syncs using Ballard's BTIDriver API. Once the output has been configured as a sync it may no longer be used as a discrete output. Refer to Section 5.3.5 for additional information.

Self-Monitor: The Lx1553-5 discrete output circuits can be monitored by corresponding Lx1553-5 discrete input circuits. Writing to a discrete can drive an enabled output and reading from that discrete will report the current state of the input. Once the output is driven, there is a finite period of time before the change of state on the corresponding input is detected. This delay (approximately 30 µs) is due to the latency of the host system and the analog delay of the input and output circuitry.

Over-Load/Fault Reporting: The Lx1553-5 discrete shunt output circuits contain current limiting and thermal shutdown features. If a user attempts to sink too much current through an output discrete circuit, the output will begin current limiting. This is accomplished by increasing the resistance through the output, which causes the power dissipation and therefore the temperature to increase. The output continues to limit the current until the thermal limit is reached and then the output is automatically shut down. Once an output is shut down due to a fault, the output remains disabled until both the fault is cleared and the user drives the output again. For this reason, it is important that the user corrects fault conditions before attempting to drive the output.

High Current Drive: Each output is capable of sinking up to 200 mA of current. However, the user can wire multiple outputs in parallel to increase the maximum current sinking capability.

Power-On: After power-on, the discrete I/O is in its default state with outputs open (high impedance).

5.3.5 Discrete Input/Output Usage

The Lx1553-5 discrete inputs and outputs can be configured for additional uses as syncs and triggers. More than one discrete, each with an individually specified polarity, may be used in combination to define a sync or trigger state. For instance, a trigger may be defined as a particular state of only one input, or it may be defined as a particular combination of two or three inputs. Other triggers and syncs may use the same or different combinations of these lines.

Processes that are configured to be triggered by an external trigger can be triggered through software using the BTICard_CardTriggerEx function. This is useful for software testing and does not require external trigger equipment. Refer to the BTIDriver software manuals for more information on programming these discretes and their use as syncs and triggers.

Ballard Technology’s BTIDriver API provides functions to read and write the discretes. The parameter *dionum* in the API functions (BTICard_ExtDIORd and BTICard_ExtDIOWr) specifies which discrete to read or write. When DIO*n* (where *n* is a number) is described in other functions, it is synonymous with *dionum* (i.e., *n* = *dionum).*

Table 5.2 below shows the correlation between *dionum* and its hardware reference designator. The last column shows how these discretes are used as trigger inputs and sync outputs in the BTIDriver API functions.

Hardware Reference	**API *dionum***	**API usage**
DIO0	1	Trigger A
DIO1	2	Trigger B
DIO2	3	Trigger C
DIO3	4	-
DIO4	5	-
DIO5	6	-
DIO6	7	-
DIO7	8	-
DIO8	9	Sync A
DIO9	10	Sync B
DIO10	11	Sync C
DIO11	12	-
DIO12	13	-
DIO13	14	-
DIO14	15	-
DIO15	16	-

Table 5.2—Hardware Versus Software Designation of Discrete I/O

5.4 IRIG Timer

An IRIG time signal contains a human-readable binary coded decimal (BCD) time value in days, hours, minutes, seconds, etc. and can be used to synchronize many devices. This allows timing data from all compatible devices to be easily correlated.

Note: An IRIG signal is not available on Lx1553-5/1xT models.

The Lx1553-5 IRIG circuit can be configured as either a master or a slave. The IRIG timer pin is driven by the bidirectional buffer only when the IRIG timer is configured as a master. When the IRIG timer is configured as a slave, it will expect the IRIG signal to come from an external device.

The Lx1553-5 internally uses a binary system timer that is free running and keeps time until either set by software or synchronized to an IRIG signal when configured as a slave. This system timer is also the source for the IRIG interface when configured as a master. The system timer has a resolution down to one microsecond.

Note: The clocks in the master and slave can vary in accuracy. As a result, there can be a slight underflow or overflow in the least significant digits of the system timer each time the IRIG timer is resynchronized.

IRIG data can be encoded using Pulse Code Modulation (PCM), Modified Manchester Modulation, or Amplitude Modulation (AM). The Lx1553-5 supports PCM master, PCM slave, or AM slave modulation modes.

There are a number of formats for IRIG timing. The Lx1553-5 uses the IRIG formats indicated in Table 5.3 and Table 5.4. The characteristics of the external electrical interface to the IRIG pins are as shown in Table 5.5.

Format	A		1000 pps	
	B		100 pps	
Modulation Frequency	0	1	Pulse width coded	Amplitude modulated
Frequency/Resolution	0		No carrier/index count interval	
		2		1 kHz/1 ms (B only)
		3		10 kHz/.1 ms
		4		100 kHz/10 ms
		5		1 MHz/1 ms
Coded Expressions	0, 1, 2, 3		Slave: Uses only BCD field (input)	

Table 5.3—Input IRIG formats used by Lx1553-5

Format	A	1000 pps
	B	100 pps
Modulation Frequency	0	Pulse width coded
Frequency/Resolution	0	No carrier/index count interval
Coded Expressions	2	Master: BCD (output)

Table 5.4—Output IRIG formats used by Lx1553-5

Input impedance (min)	12 kΩ
Input level	-7.5V to 12.5V volts
Input level threshold	API Controlled (0V-5V)
Output level	0 to 3 volts
Output drive capability	20 mA

Table 5.5—Electrical characteristics of Lx1553-5 IRIG signals

For information on configuring and using the IRIG timer consult the BTIDriver API programming manuals.

6. CONNECTOR INFORMATION

The Lx1553-5 has two 60 pin LFH connectors or two Twinax connectors. This chapter provides the information needed to connect to the general-purpose (including triggers, syncs, and discretes) and protocol-specific signals.

6.1 Lx1553-5 Diagrams

The Lx1553-5 mechanical diagrams below show the relative positioning of the connectors and jumpers for the four model variations of the Lx1553-5 (they are not to scale).

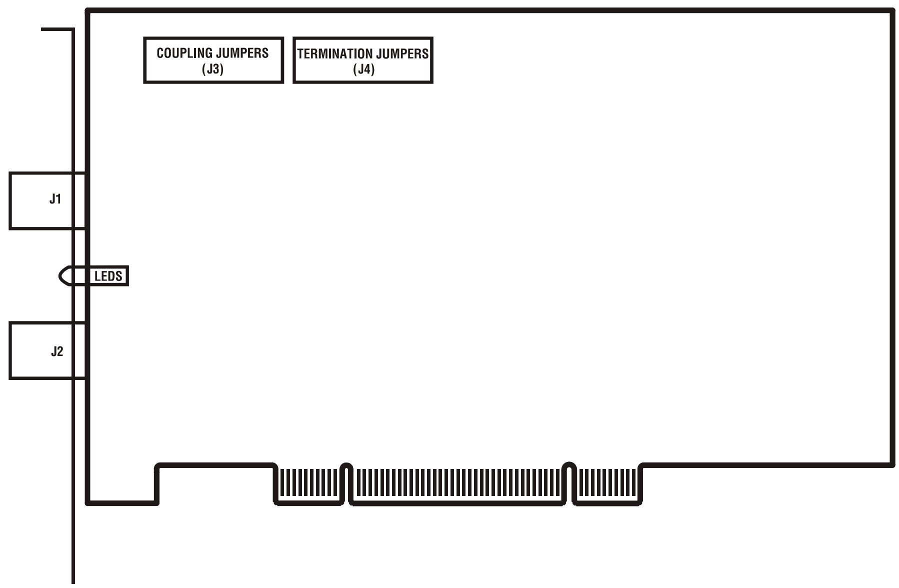

Figure 6.1—LP1553-5/1xT Mechanical Diagram

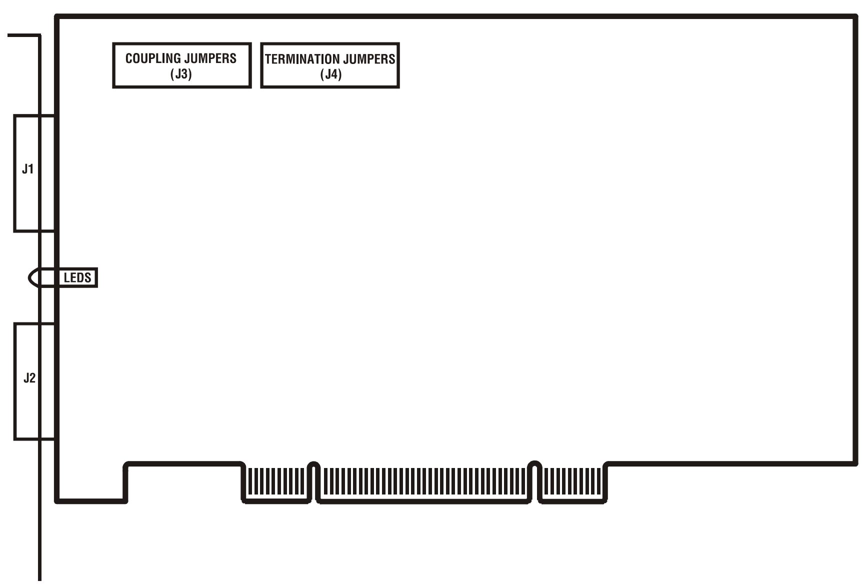

Figure 6.2—LP1553-5/xx Mechanical Diagram

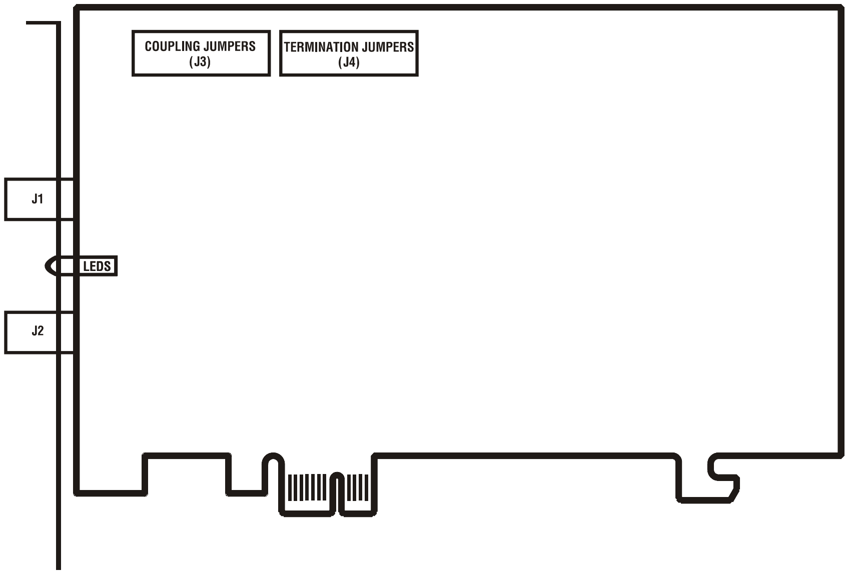

Figure 6.3—LE1553-5/1xT Mechanical Diagram

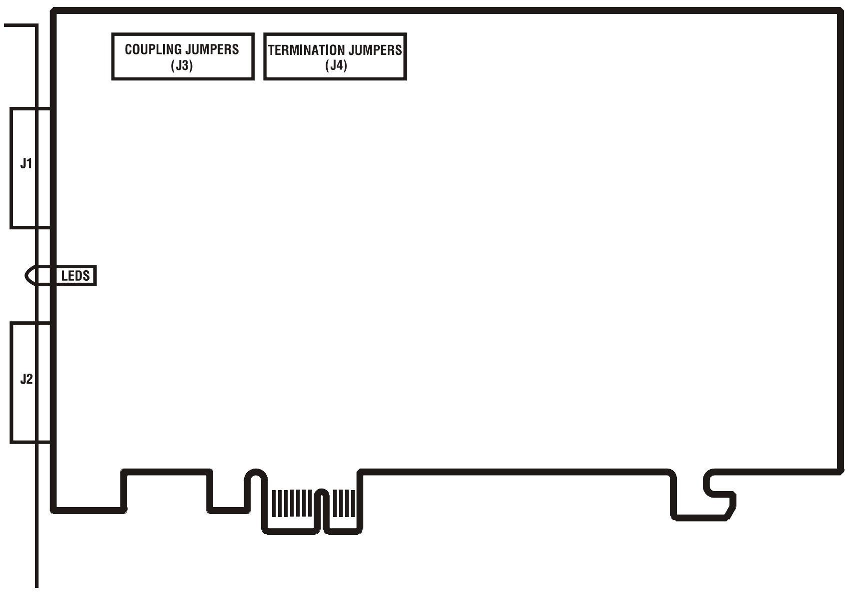

Figure 6.4—LE1553-5/xx Mechanical Diagram

6.2 Mating Connectors

6.2.1 Lx1553-5/xx Mating Connectors

Lx1553-5/xx models have two Molex 60-pin LFH receptacles for databus connections (Molex PN 70928-2000). The recommended mating connector is a cable plug assembly consisting of a frame subassembly (Molex PN 70929-2000) and four terminal strips (Molex PN 51-24-2022). For more information, consult *www.molex.com*. Appropriate shields, strain-reliefs, and backshells are also required. The LFH is a high-density connector about the size of a 15-pin D-subminiature connector. For proper clearance from adjacent connectors, the overall width of each LFH connector (including any backshell molding) must not exceed 1.64 inches.

6.2.2 Lx1553-5/1xT Mating Connectors

Lx1553-5/1xT models have two twinax connectors for databus connections (Trompeter PN BJ770). The recommended mating connector is a twinax plug connector (Trompeter PN PL75-29). Appropriate shields, strain-reliefs, and backshells are also required.

6.3 Standard Cables

Ballard Technology sells a number of different cables that are useful for wiring to Lx1553-5 products.

6.3.1 16035 cable assembly: LFH to LFH

This is a three-foot-long straight-through cable with 60-pin male LFH plugs on both ends. The 16035 is useful for connecting an Lx1553-5 product to a user-provided panel or other assembly.

6.3.2 16036 cable assembly: LFH to two 25 pin D-subs

This is a three-foot-long Y-cable that adapts a 60-pin male LFH plug (labeled P1) to two 25-pin male D-subminiature connectors (P2 and P3). Because of the size and popularity of D-sub connectors, some users may find it easier to interface to them than to the Lx1553-5 LFH connectors. On the 16036 cable assembly, the upper half of the LFH connector is wired to one D-sub and the lower half is wired to the other D-sub, thus giving similar signals on the corresponding pins of both D-subs. The wire pairs on the 16036 are different from those on the 16035. Wiring for the 16036 cable is shown for each model in the Connector Pinouts (Section 6.4).

6.3.3 MIL-STD-1553 cable assemblies

Ballard offers four standard LFH to Twinax cable assemblies for MIL-STD-1553 (see Table 6.1 below). The standard length is three feet.

Cable Assy. No.	No. of Twinax	No. of D-Sub
16037	4	1
16038	4	0
16039	2	1
16041	2	0

Table 6.1—MIL-STD-1553 cable assembly configurations

These four cables in Table 6.1 provide a combination of one or two channels of MIL-STD-1553 twinax connections with and without an auxiliary D-sub connector. The twinax connections are made with a PL-75 connector for each of the transformer coupled MIL-STD-1553 buses. All channels are dual redundant, so there are either two or four twinax cables with PL-75s on each assembly. Twinax cables are wired as shown in Table 6.2.

Cable Name	Wire Name	LFH Pin	PL-75
CH0 BUS A	CH0AX	3	Center
	CH0AXR	2	Outer
CH0 BUS B	CH0BX	26	Center
	CH0BXR	27	Outer
CH1 BUS A	CH1AX	33	Center
	CH1AXR	32	Outer
CH1 BUS B	CH1BX	56	Center
	CH1BXR	57	Outer

Braids connected between the LFH shell and the PL-75 shell

Table 6.2—Twinax wiring on MIL-STD-1553 cable assemblies

The 25-pin female D-sub connector provides IRIG and discrete I/O signals, as shown in Table 6.3. In order to use these signals the recommended cable assemblies are 16037 for dual-channel and 16039 for single-channel models.

Name (J1)	Name (J2)	LFH Pin	DB25S Pin
DIO00	DIO04	11	1
GND	GND	10	14
DIO01	DIO05	21	2
GND	GND	20	15
DIO02	DIO06	51	3
GND	GND	50	16
DIO03	DIO07	41	4
GND	GND	40	17
DIO11	DIO15	43	6
GND	GND	42	19
DIO08	DIO12	13	7
GND	GND	12	20
DIO09	DIO13	19	8
GND	GND	18	21
DIO10	DIO14	49	9
GND	GND	48	22
IRIG	IRIG	17	10
GND	GND	16	23
IRIG	IRIG	47	11
GND	GND	46	24
RSVD	RSVD	45	12
RSVD	RSVD	44	13

Braids connected shell to shell

Table 6.3—D-sub connector pinout for cable assemblies 16037 and 16039

6.4 Connector Pinouts

6.4.1 Pinout for the Lx1553-5/1ST & Lx1553-5/1MT (J1)

J1 Connector (Twinax)		
NAME	**DESCRIPTION**	**PIN**
CH0AX	CH0 BUS A (+)	Center
CH0AXR	CH0 BUS A (−)	Outer
GND	Ground	Shell

Table 6.4—Pinout for the Lx1553-5/1ST & Lx1553-5/1MT (J1)

6.4.2 Pinout for the Lx1553-5/1ST & Lx1553-5/1MT (J2)

J2 Connector (Twinax)		
NAME	**DESCRIPTION**	**PIN**
CH0BX	CH0 BUS B (+)	Center
CH0BXR	CH0 BUS B (−)	Outer
GND	Ground	Shell

Table 6.5—Pinout for the Lx1553-5/1ST & Lx1553-5/1MT (J2)

6.4.3 Pinout for the Lx1553-5/1S & Lx1553-5/1M (J1)

J1 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
CH0AX	CH0 BUS A transformer coupled (+)	3	P2-3
CH0AXR	CH0 BUS A transformer coupled (−)	2	P2-15
CH0BX	CH0 BUS B transformer coupled (+)	26	P2-5
CH0BXR	CH0 BUS B transformer coupled (−)	27	P2-17
CH0AD	CH0 BUS A direct coupled (+)	28	P2-2
CH0ADR	CH0 BUS A direct coupled (−)	29	P2-14
CH0BD	CH0 BUS B direct coupled (+)	5	P2-4
CH0BDR	CH0 BUS B direct coupled (−)	4	P2-16
DIO00	Discrete I/O 00	11	P2-11
DIO01	Discrete I/O 01	21	P2-22
DIO02	Discrete I/O 02	51	P3-22
DIO03	Discrete I/O 03	41	P3-11
DIO08	Discrete I/O 08	13	P2-13
DIO09	Discrete I/O 09	19	P2-24
DIO10	Discrete I/O 10	49	P3-24
DIO11	Discrete I/O 11	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	6,7,8, 9,14,15, 22,23,24, 25,32,33, 34,35,36, 45,52,53, 37,38,39, 44,54,55, 56,57,58, 59	P2-6,P2-7,P2-8, P2-9,P2-10,P2-11, P2-18,P2-19,P2-20, P2-25,P3-2,P3-3, P3-4,P3-5,P3-6, P3-7,P3-8,P3-9, P3-10,P3-11,P3-14, P3-15,P3-16,P3-17, P3-18,P3-19,P3-20, P3-25

Table 6.6—Pinout for the Lx1553-5/1S & Lx1553-5/1M (J1)

6.4.4 Pinout for the Lx1553-5/1S & Lx1553-5/1M (J2)

J2 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
DIO04	Discrete I/O 04	11	P2-11
DIO05	Discrete I/O 05	21	P2-22
DIO06	Discrete I/O 06	51	P3-22
DIO07	Discrete I/O 07	41	P3-11
DIO12	Discrete I/O 12	13	P2-13
DIO13	Discrete I/O 13	19	P2-24
DIO14	Discrete I/O 14	49	P3-24
DIO15	Discrete I/O 15	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	2,3,4, 5,6,7, 8,9,14, 15,22,23, 24,25,26, 27,28,29, 32,33,34, 35,36,45, 52,53,37, 38,39,44, 54,55,56, 57,58,59	P2-2,P2-3,P2-4, P2-5,P2-6,P2-7, P2-8,P2-9,P2-10, P2-11,P2-14,P2-15, P2-16,P2-17,P2-18, P2-19,P2-20,P2-25, P3-2,P3-3,P3-4, P3-5,P3-6,P3-7, P3-8,P3-9,P3-10, P3-11,P3-14,P3-15, P3-16,P3-17,P3-18, P3-19,P3-20,P3-25

Table 6.7—Pinout for the Lx1553-5/1S & Lx1553-5/1M (J2)

6.4.5 Pinout for the Lx1553-5/2S & Lx1553-5/2M (J1)

J1 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
CH0AX	CH0 BUS A transformer coupled (+)	3	P2-3
CH0AXR	CH0 BUS A transformer coupled (−)	2	P2-15
CH0BX	CH0 BUS B transformer coupled (+)	26	P2-5
CH0BXR	CH0 BUS B transformer coupled (−)	27	P2-17
CH0AD	CH0 BUS A direct coupled (+)	28	P2-2
CH0ADR	CH0 BUS A direct coupled (−)	29	P2-14
CH0BD	CH0 BUS B direct coupled (+)	5	P2-4
CH0BDR	CH0 BUS B direct coupled (−)	4	P2-16
CH1AX	CH1 BUS A transformer coupled (+)	33	P3-3
CH1AXR	CH1 BUS A transformer coupled (−)	32	P3-15
CH1BX	CH1 BUS B transformer coupled (+)	56	P3-5
CH1BXR	CH1 BUS B transformer coupled (−)	57	P3-17
CH1AD	CH1 BUS A direct coupled (+)	58	P3-2
CH1ADR	CH1 BUS A direct coupled (−)	59	P3-14
CH1BD	CH1 BUS B direct coupled (+)	35	P3-4
CH1BDR	CH1 BUS B direct coupled (−)	34	P3-16
DIO00	Discrete I/O 00	11	P2-11
DIO01	Discrete I/O 01	21	P2-22
DIO02	Discrete I/O 02	51	P3-22
DIO03	Discrete I/O 03	41	P3-11
DIO08	Discrete I/O 08	13	P2-13
DIO09	Discrete I/O 09	19	P2-24
DIO10	Discrete I/O 10	49	P3-24
DIO11	Discrete I/O 11	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	6,7,8, 9,14,15, 22,23,24, 25,36,37, 38,39,44, 45,52,53, 54,55	P2-6,P2-7,P2-8, P2-9,P2-10,P2-11, P2-18,P2-19,P2-20, P2-25,P3-6,P3-7, P3-8,P3-9,P3-10, P3-11,P3-18,P3-19, P3-20,P3-25

Table 6.8—Pinout for the Lx1553-5/2S & Lx1553-5/2M (J1)

6.4.6 Pinout for the Lx1553-5/2S & Lx1553-5/2M (J2)

J2 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
DIO04	Discrete I/O 04	11	P2-11
DIO05	Discrete I/O 05	21	P2-22
DIO06	Discrete I/O 06	51	P3-22
DIO07	Discrete I/O 07	41	P3-11
DIO12	Discrete I/O 12	13	P2-13
DIO13	Discrete I/O 13	19	P2-24
DIO14	Discrete I/O 14	49	P3-24
DIO15	Discrete I/O 15	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	2,3,4, 5,6,7, 8,9,14, 15,22,23, 24,25,26, 27,28,29, 32,33,34, 35,36,45, 52,53,37, 38,39,44, 54,55,56, 57,58,59	P2-2,P2-3,P2-4, P2-5,P2-6,P2-7, P2-8,P2-9,P2-10, P2-11,P2-14,P2-15, P2-16,P2-17,P2-18, P2-19,P2-20,P2-25, P3-2,P3-3,P3-4, P3-5,P3-6,P3-7, P3-8,P3-9,P3-10, P3-11,P3-14,P3-15, P3-16,P3-17,P3-18, P3-19,P3-20,P3-25

Table 6.9—Pinout for the Lx1553-5/2S & Lx1553-5/2M (J2)

6.4.7 Pinout for the Lx1553-5/3S & Lx1553-5/3M (J1)

J1 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
CH0AX	CH0 BUS A transformer coupled (+)	3	P2-3
CH0AXR	CH0 BUS A transformer coupled (−)	2	P2-15
CH0BX	CH0 BUS B transformer coupled (+)	26	P2-5
CH0BXR	CH0 BUS B transformer coupled (−)	27	P2-17
CH0AD	CH0 BUS A direct coupled (+)	28	P2-2
CH0ADR	CH0 BUS A direct coupled (−)	29	P2-14
CH0BD	CH0 BUS B direct coupled (+)	5	P2-4
CH0BDR	CH0 BUS B direct coupled (−)	4	P2-16
CH1AX	CH1 BUS A transformer coupled (+)	33	P3-3
CH1AXR	CH1 BUS A transformer coupled (−)	32	P3-15
CH1BX	CH1 BUS B transformer coupled (+)	56	P3-5
CH1BXR	CH1 BUS B transformer coupled (−)	57	P3-17
CH1AD	CH1 BUS A direct coupled (+)	58	P3-2
CH1ADR	CH1 BUS A direct coupled (−)	59	P3-14
CH1BD	CH1 BUS B direct coupled (+)	35	P3-4
CH1BDR	CH1 BUS B direct coupled (−)	34	P3-16
DIO00	Discrete I/O 00	11	P2-11
DIO01	Discrete I/O 01	21	P2-22
DIO02	Discrete I/O 02	51	P3-22
DIO03	Discrete I/O 03	41	P3-11
DIO08	Discrete I/O 08	13	P2-13
DIO09	Discrete I/O 09	19	P2-24
DIO10	Discrete I/O 10	49	P3-24
DIO11	Discrete I/O 11	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	6,7,8, 9,14,15, 22,23,24, 25,36,37, 38,39,44, 45,52,53, 54,55	P2-6,P2-7,P2-8, P2-9,P2-10,P2-11, P2-18,P2-19,P2-20, P2-25,P3-6,P3-7, P3-8,P3-9,P3-10, P3-11,P3-18,P3-19, P3-20,P3-25

Table 6.10—Pinout for the Lx1553-5/3S & Lx1553-5/3M (J1)

6.4.8 Pinout for the Lx1553-5/3S & Lx1553-5/3M (J2)

J2 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
CH2AX	CH2 BUS A transformer coupled (+)	3	P2-3
CH2AXR	CH2 BUS A transformer coupled (−)	2	P2-15
CH2BX	CH2 BUS B transformer coupled (+)	26	P2-5
CH2BXR	CH2 BUS B transformer coupled (−)	27	P2-17
CH2AD	CH2 BUS A direct coupled (+)	28	P2-2
CH2ADR	CH2 BUS A direct coupled (−)	29	P2-14
CH2BD	CH2 BUS B direct coupled (+)	5	P2-4
CH2BDR	CH2 BUS B direct coupled (−)	4	P2-16
DIO04	Discrete I/O 04	11	P2-11
DIO05	Discrete I/O 05	21	P2-22
DIO06	Discrete I/O 06	51	P3-22
DIO07	Discrete I/O 07	41	P3-11
DIO12	Discrete I/O 12	13	P2-13
DIO13	Discrete I/O 13	19	P2-24
DIO14	Discrete I/O 14	49	P3-24
DIO15	Discrete I/O 15	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	6,7,8, 9,14,15, 22,23,24, 25,32,33, 34,35,36, 45,52,53, 37,38,39, 44,54,55, 56,57,58, 59	P2-6,P2-7,P2-8, P2-9,P2-10,P2-11, P2-18,P2-19,P2-20, P2-25,P3-2,P3-3, P3-4,P3-5,P3-6, P3-7,P3-8,P3-9, P3-10,P3-11,P3-14, P3-15,P3-16,P3-17, P3-18,P3-19,P3-20, P3-25

Table 6.11—Pinout for the Lx1553-5/3S & Lx1553-5/3M (J2)

6.4.9 Pinout for the Lx1553-5/4S & Lx1553-5/4M (J1)

J1 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
CH0AX	CH0 BUS A transformer coupled (+)	3	P2-3
CH0AXR	CH0 BUS A transformer coupled (−)	2	P2-15
CH0BX	CH0 BUS B transformer coupled (+)	26	P2-5
CH0BXR	CH0 BUS B transformer coupled (−)	27	P2-17
CH0AD	CH0 BUS A direct coupled (+)	28	P2-2
CH0ADR	CH0 BUS A direct coupled (−)	29	P2-14
CH0BD	CH0 BUS B direct coupled (+)	5	P2-4
CH0BDR	CH0 BUS B direct coupled (−)	4	P2-16
CH1AX	CH1 BUS A transformer coupled (+)	33	P3-3
CH1AXR	CH1 BUS A transformer coupled (−)	32	P3-15
CH1BX	CH1 BUS B transformer coupled (+)	56	P3-5
CH1BXR	CH1 BUS B transformer coupled (−)	57	P3-17
CH1AD	CH1 BUS A direct coupled (+)	58	P3-2
CH1ADR	CH1 BUS A direct coupled (−)	59	P3-14
CH1BD	CH1 BUS B direct coupled (+)	35	P3-4
CH1BDR	CH1 BUS B direct coupled (−)	34	P3-16
DIO00	Discrete I/O 00	11	P2-11
DIO01	Discrete I/O 01	21	P2-22
DIO02	Discrete I/O 02	51	P3-22
DIO03	Discrete I/O 03	41	P3-11
DIO08	Discrete I/O 08	13	P2-13
DIO09	Discrete I/O 09	19	P2-24
DIO10	Discrete I/O 10	49	P3-24
DIO11	Discrete I/O 11	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	6,7,8, 9,14,15, 22,23,24, 25,36,37, 38,39,44, 45,52,53, 54,55	P2-6,P2-7,P2-8, P2-9,P2-10,P2-11, P2-18,P2-19,P2-20, P2-25,P3-6,P3-7, P3-8,P3-9,P3-10, P3-11,P3-18,P3-19, P3-20,P3-25

Table 6.12—Pinout for the Lx1553-5/4S & Lx1553-5/4M (J1)

6.4.10 Pinout for the Lx1553-5/4S & Lx1553-5/4M (J2)

J2 Connector (LFH)			16036
NAME	**DESCRIPTION**	**PIN**	**PIN**
CH2AX	CH2 BUS A transformer coupled (+)	3	P2-3
CH2AXR	CH2 BUS A transformer coupled (−)	2	P2-15
CH2BX	CH2 BUS B transformer coupled (+)	26	P2-5
CH2BXR	CH2 BUS B transformer coupled (−)	27	P2-17
CH2AD	CH2 BUS A direct coupled (+)	28	P2-2
CH2ADR	CH2 BUS A direct coupled (−)	29	P2-14
CH2BD	CH2 BUS B direct coupled (+)	5	P2-4
CH2BDR	CH2 BUS B direct coupled (−)	4	P2-16
CH3AX	CH3 BUS A transformer coupled (+)	33	P3-3
CH3AXR	CH3 BUS A transformer coupled (−)	32	P3-15
CH3BX	CH3 BUS B transformer coupled (+)	56	P3-5
CH3BXR	CH3 BUS B transformer coupled (−)	57	P3-17
CH3AD	CH3 BUS A direct coupled (+)	58	P3-2
CH3ADR	CH3 BUS A direct coupled (−)	59	P3-14
CH3BD	CH3 BUS B direct coupled (+)	35	P3-4
CH3BDR	CH3 BUS B direct coupled (−)	34	P3-16
DIO04	Discrete I/O 04	11	P2-11
DIO05	Discrete I/O 05	21	P2-22
DIO06	Discrete I/O 06	51	P3-22
DIO07	Discrete I/O 07	41	P3-11
DIO12	Discrete I/O 12	13	P2-13
DIO13	Discrete I/O 13	19	P2-24
DIO14	Discrete I/O 14	49	P3-24
DIO15	Discrete I/O 15	43	P3-13
IRIG	IRIG Signal	17,47	P2-12,P3-12
GND	Ground	1,10,12, 16,18,20, 30,31,40, 42,46,48, 50,60	P2-1,P2-23,P3-1, P3-23
RSVD	Reserved	6,7,8, 9,14,15, 22,23,24, 25,36,37, 38,39,44, 45,52,53, 54,55	P2-6,P2-7,P2-8, P2-9,P2-10,P2-11, P2-18,P2-19,P2-20, P2-25,P3-6,P3-7, P3-8,P3-9,P3-10, P3-11,P3-18,P3-19, P3-20,P3-25

Table 6.13—Pinout for the Lx1553-5/4S & Lx1553-5/4M (J2)

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APPENDIX A: COUPLING AND TERMINATION

Coupling and termination are important considerations for MIL-STD-1553 databuses. This appendix introduces concepts relating to coupling and termination. Actual interfaces, cabling, and part numbers will vary from product to product. All figures included in this appendix are used generically for illustration of these concepts.

A.1 Bus Termination

The main databus consists of a pair of twisted, shielded wires with a characteristic impedance in the range of 70 to 85 ohms. The databus must be terminated at both ends with a resistor to provide proper loading and to minimize signal reflection and degradation on the bus. The resistor value should be close to the characteristic impedance of the databus. The resulting total load on the databus is the two terminating resistors in parallel (about 39 ohms). Even with a very short databus, the load from the terminating resistors is still required. Notice how the resistors terminate the databuses in Figure A.1 and Figure A.2. Note that some Ballard products have on-board termination resistors that can be switched in manually or under software control.

> *Note: The most common problem in a new system is an improperly terminated databus.*

A.2 Transformer versus Direct Coupling

MIL-STD-1553 can be either direct or transformer coupled. Most military 1553 systems are transformer coupled.

Both coupling methods have a transformer as part of the terminal's interface, but transformer coupling has an additional external transformer coupler that isolates the stub from the main databus and reduces signal reflections. The signal level on the main bus is the same for both direct and transformer coupling. Though it is rarely done, systems can mix the use of direct and transformer coupling.

A terminal must be properly configured for either direct or transformer coupling. There is a difference between the terminal's internal interface circuit for direct and transformer coupling:

1. The transformer-coupled terminal has a lower turns ratio and no isolation resistors, but this is made up for in the external coupler, which has a step-up transformer and isolation resistors (see Figure A.1).
2. The direct-coupled terminal has a higher turns ratio and has isolation resistors that are connected directly to the main databus. Direct coupled stubs should be kept as short as possible (see Figure A.2).

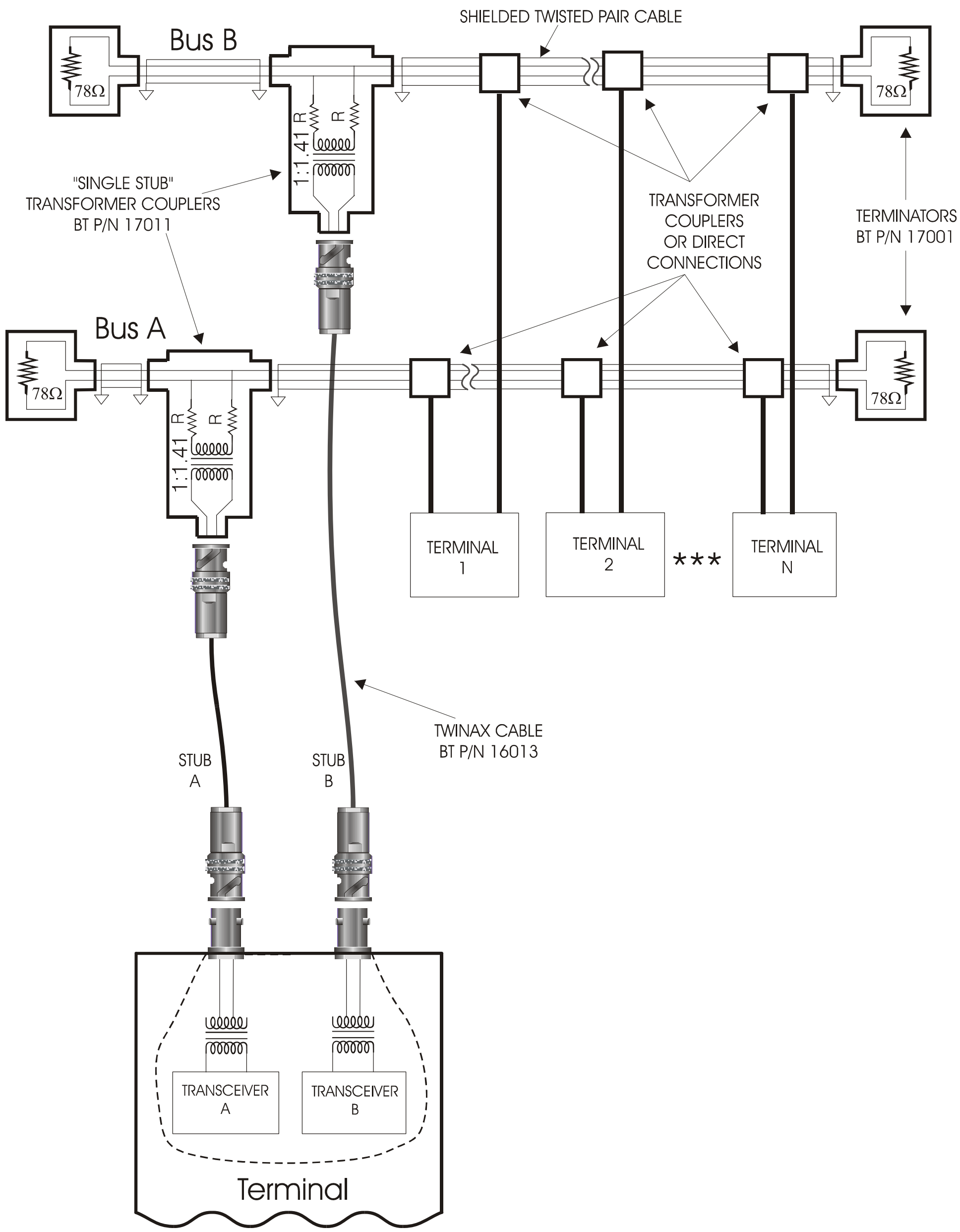

Figure A.1—Transformer Coupling to a Dual-Redundant Databus

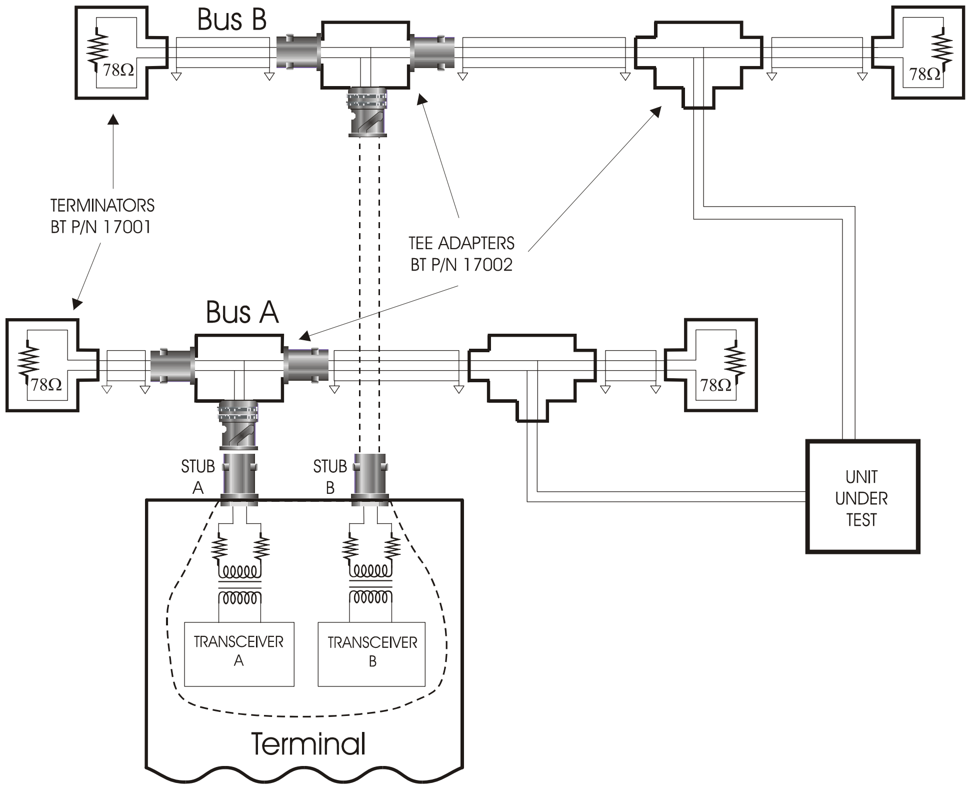

Figure A.2—Direct Connection to a Dual-Redundant Databus

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APPENDIX B: SPECIFICATIONS

General

- PCI/PCIe Compliant
- 32 MB SDRAM
- 4 MB Flash
- MTBF
    - LP1553-5 (PCI): 2,000,000+
    - LE1553-5 (PCIe): 2,500,000+

Interfaces

- MIL-STD-1553
    - BC/RT/MON (Single or Multi-Function)
    - Hardware controlled transmit scheduling
    - TA/SA message filtering
    - Sequential monitor
- Discrete I/O
    - Outputs: Open/GND
    - Inputs: Open/GND
- IRIG Input
    - IRIG A/B Format with Pulse Width Code Modulated TTL signal
    - IRIG A/B format with Amplitude Modulated signal
    - Pulse Per Second (PPS) TTL signal
- IRIG Output
    - IRIG A/B Format with Pulse Width Code Modulated TTL signal
    - Pulse Per Second (PPS) TTL signal

Environmental / Physical

- Industrial Temperature Range
    - Operating Temperature: -40ºC to +70ºC
    - Storage Temperature: -55ºC to +100ºC
- Mechanical
    - PCI/PCIe half card standard height
    - LP1553-5 (PCI) Weight: 4.45 ounces
    - LE1553-5 (PCIe) Weight: 4.55 ounces

Power

- LP1553-5 (PCI)
    - Typical

RAIL	1CH	2CH	3CH	4CH
+5V	620mA	935mA	1255mA	1570mA
+12V	2mA	2mA	2mA	2mA

    - Maximum

RAIL	1CH	2CH	3CH	4CH
+5V	1850mA	2350mA	2850mA	3350mA
+12V	60mA	60mA	60mA	60mA

- LE1553-5 (PCIe)
    - Typical

RAIL	1CH	2CH	3CH	4CH
+3.3V	1120mA	1630mA	1630mA	1630mA
+12V	65mA	65mA	190mA	315mA

    - Maximum

RAIL	1CH	2CH	3CH	4CH
+3.3V	1890mA	2450mA	2450mA	2450mA
+12V	80mA	80mA	250mA	400mA

Software

- BTIDriver™ API compatible

Technical specifications are subject to change without notice.

APPENDIX C: REVISION HISTORY

The following revisions have been made to this manual:

Rev. Preliminary *Date: March 11, 2009*

Preliminary release of this manual

Rev. A *Date: July 31, 2009*

Initial release of this manual

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