

BH32 Behavioral Cage Controller



Overview

The BH32 Behavioral Cage Controller integrates neural signals with behavioral inputs and outputs from standard behavioral cages; such as operant conditioning boxes. The device acts as a network appliance that can be used over a LAN to control several behavioral boxes or can be directly linked to a TDT RZ device for integration with neural recordings. The device provides the end user with 32 I/O lines in banks of eight. Each bank can be configured as inputs or outputs. End users can drive standard 5 Volt devices or power the device with an external supply to deliver up to 30 Volts, 3 A.

Features

Molex Pin and Socket Connectors

The BH32 uses 1.57 mm Diameter Standard Molex Pin and Socket connectors on the top panel. For pinouts, see “BH32 Technical Specifications” on page 17-30.

Power

The BH32 logic board is powered by either a 6-9V, 3A center-negative adapter connected to the power input on the back panel of the device or by Power over Ethernet (PoE) through the Ethernet Port (see “Ethernet Port” on page 17-20).

The BH32 Molex outputs can be driven by either the same power source as the logic board (5V) or by an external power source connected to the ‘External Power’ connectors on the top of the device. The ‘External Power’ connectors allow you to drive higher voltages/currents to external devices that require it, One connector can be used to input a 5-30V, 3A external power source that is shared among all Molex output connectors. A toggle switch on the back panel of the device determines which power source is used for the Molex outputs. The Molex connector outputs are always Active-Low.

Important! The two External Power Molex connectors on the top panel are shorted together; do not use more than one external power source. The second external power connector can be used to jumper the external power source to another BH32

Voltage Mode Toggle

This back panel switch toggles between 5 V and external power supply source for all Molex output banks. Use 5 V mode for connections to mains power or PoE. Use External Voltage mode for other external power sources up to 30 V.

Power Source	Mode	Max Total Output
Mains power	5 V	200 mA
PoE	5 V	100 mA
External power up to 30 V	External Voltage	3 A

Power Switch

The On/Off toggle switch turns the BH32 power off or on. The LED display will be illuminated when the power is on.

Status Display

The front panel display screen reports system status. The Mode button to the left toggles the display modes.

The display modes include:

1. Device Number – how the BH32 is recognized on the network by other devices
2. Bank Status – bank direction and current state of all bits in each bank
3. NetBIOS name and IP address:
4. IP address of paired RZ device (if paired). See “RZ Configuration” on page 17-22.

Push and hold the Mode button for two seconds then release to automatically cycle through all of the display items, displaying each for one second.

Push and hold the Mode button for 10 seconds to reset the Device Number.

I/O Control

The BH32 is a net appliance that was designed to be used under a variety of conditions, not all of which are available from vendors of behavioral control systems.

At the most basic the TDT BH32 system can replace existing devices such as the Med Associates, Colburn or Lafayette systems that interface to a standard operant or behavioral box with input and output lines, where the output lines drive feeders, lick meters and other devices that require more than a digital trigger. At the more complex level the TDT system can be used to send and receive complex signals to control multiple hardware devices.

Replicating an Existing Behavioral Control System

The TDT system provides a unifying interface for sending and receiving behavioral information from a behavioral control box without the need for the external devices from these other companies.

TDT provides a default set up that uses standard Molex pins, an External power source to drive high current and high voltage devices (such as feeders, water delivery systems, foot shock systems, etc) or to accept inputs from such devices. The hardware states of these particular interfacing devices are fixed and the BH32 bank directions and logic levels must be configured to match (see “Digital I/O ” on page 17-19).

More Complex Custom System Configuration

Information can be sent and received from the Molex interface in the following ways.

Note: Molex Banks A and B can be used as outputs and only outputs. Molex Bank D can be used as inputs and only inputs. The direction and logic level of each bank is configured through the BH32 web interface (See “Controller Configuration” on page 17-23).

Important!: Attempting to drive an input from both the digital input and Molex connectors will damage the device.

Controlling the Molex outputs with UDP/Serial (banks A & B only)

Configure the bank as an output. The Molex outputs are low when active. The digital output logic is the inverse of the Molex output logic.

Monitoring the Molex inputs with UDP/Serial and Digital I/O (bank D only)

Configure Bank D as an input. Active-Low means that when the Molex input is low, the value is 1. The digital output logic mirrors the Molex input logic.

Controlling the Molex outputs with Digital inputs (banks A & B only)

Configure the bank as an input, to bypasses the internal processor and control the Molex lines directly. Molex output logic is the inverse of the digital input.

Using Digital and UDP/Serial I/O only

If the Molex connectors are not being used, then all four banks of digital I/O can be used to send receive signals with the UDP/Serial interface with no restrictions on bank direction.

Digital I/O

The BH32 includes 32 bits of programmable I/O grouped in four 8-bit banks. Digital I/O lines are accessed via the Digital IO-1 and Digital IO-2 25-pin connectors on the back panel. Digital inputs accept +5V TTL inputs. Digital outputs are +5V. For pinouts, see “BH32 Technical Specifications” on page 17-30.

Status Lights

A row of 32 status lights on the front panel report the state of the individual input/output bits and are labeled to show banks A – D. When a bit is active, the corresponding bit light glows red.

Ethernet Port

The Ethernet port allows direct connections to a PC or network for communication over UDP. The BH32 supports Power over Ethernet (PoE) technology using the 802.3AF PD standard. Use of Cat 5 (or greater) Ethernet cable recommended. The BH32 can connect directly to a PC, an RZ device, or a network. If connecting directly to an RZ device, a crossover Ethernet cable is required. See “BH32 Circuit Design” on page 17-26, for more information on communicating with the BH32.

RS 232

The BH32 can communicate with other devices over a serial port. See “BH32 Circuit Design” on page 17-26, for more information.

DTE – E Switch

This toggle switch determines whether the BH32 serial port is in master or slave mode. This selects which wires on the BH32 serial port will be send and which will be receive.

BH32 Configuration

This section discusses configuring the BH32 networking communication and hardware interfaces. See “RZ-UDP Communications Interface” on page 1-49, for more information on the basics of networking and the various protocols.

Initialization

The BH32 will attempt to locate a DHCP server that will dynamically assign an IP address to the device.

If no DHCP server responds, the following static IP configuration is used:

IP Address:	10.1.0.101
IP Mask:	255.0.0.0
Gateway:	10.1.0.1

In either case, dynamic or static, the interface IP address is associated with a unique NetBIOS name set by TDT.

NetBIOS Name

All BH32 devices will use this standard NetBIOS Name structure:

TDT_BHC_32_XXXX

XXXX = last 4 digits of the BH32 device serial number.

For Example:

A BH32 with a serial number of 1234 uses a NetBIOS name of:
TDT_BHC_32_1234.

Although a default NetBIOS name is assigned, the name can be changed using the BH32 Web Interface. See below for more information.

Note: When connecting the BH32, be sure the network mask is set to a Class C or smaller network. A Class A network mask (255.0.0.0) will disable NetBIOS naming

on the PC Ethernet interface. In such cases, the IP address of the BH32 must be used instead.

Configuration through the Web Interface

Every BH32 contains a minimal web server which is used for configuration and monitoring. Options can be set here if no DHCP server is available. If a DHCP server exists, the NetBIOS name associated with the dynamically assigned IP address can be configured using the BH32 server.

To connect to the BH32 server:

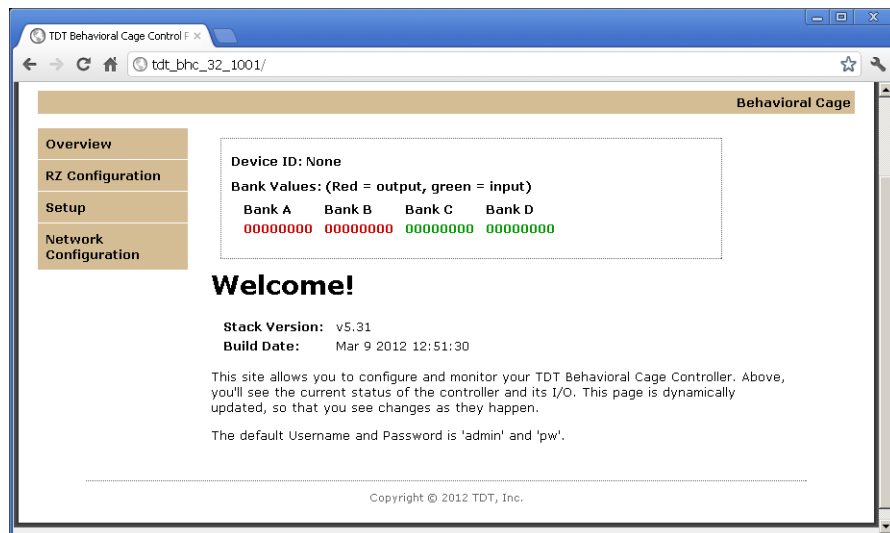
Make sure there is an active connection from the PC to the Ethernet port on the back of the BH32 then open an Internet browser such as Internet Explorer, Chrome or Firefox.

- Enter the device's IP address as the web address (e.g. `http://10.1.0.100`) and press **Enter**.
- or
- Enter the NetBIOS name as the web address (e.g. `TDT_BHC_32_1001`) and press **Enter**.

Once connected, navigation to the BH32 web interface loads the Welcome page. Clicking the links to the left of the web interface loads the corresponding page.

Welcome

The Welcome page provides basic information, allows real-time control of the BH32, and provides feedback on the status of each Bank.



Device Box

The status of individual bits is displayed for each bank. Clicking bits on an Output bank (red 0 or 1) will toggle that output bit and the corresponding LED on the front panel of the BH32. This can be used to manually control the output of the BH32 for testing a device connected to that output.

Firmware Version

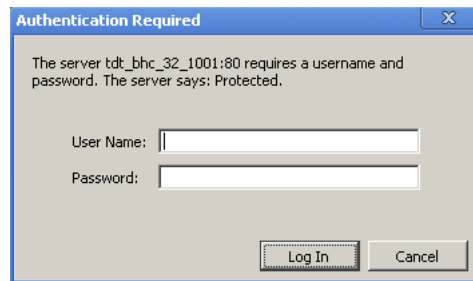
Stack Version and **Build Date** refer to the version of software running on the BH32.

Username and Password

Server pages that modify the device configuration, such as the Setup and Network Configuration pages, can only be accessed using a username and password. The default values are displayed in the Welcome message. This login information can be changed on the Network Configuration page.

To access a page that requires authentication:

1. Click the navigation link for the page.
2. When prompted, enter the username and password in the dialog box then click **Log In**.



The server tdt_bhc_32_1001:80 requires a username and password. The server says: Protected.

User Name:

Password:

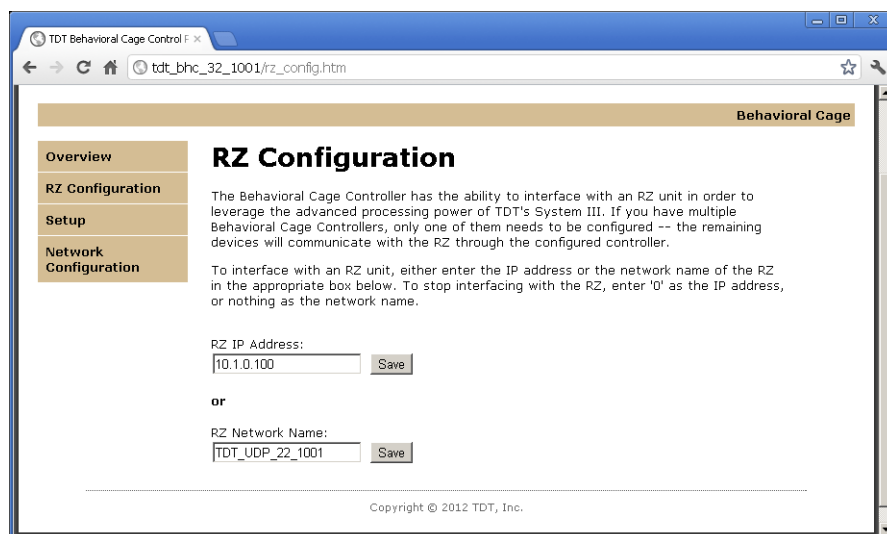
Log In Cancel

Default Username: **admin**

Default Password: **pw**

RZ Configuration

The BH32 can be paired with an RZ device that has a UDP interface. When any of the BH32's I/O bits changes state, a 32-bit integer (one bit per I/O) is sent via UDP packet to the RZ. Once this data is received on the RZ, it can be time stamped and/or processed to provide real-time feedback.



Behavioral Cage

Overview

RZ Configuration

Setup

Network Configuration

RZ Configuration

The Behavioral Cage Controller has the ability to interface with an RZ unit in order to leverage the advanced processing power of TDT's System III. If you have multiple Behavioral Cage Controllers, only one of them needs to be configured -- the remaining devices will communicate with the RZ through the configured controller.

To interface with an RZ unit, either enter the IP address or the network name of the RZ in the appropriate box below. To stop interfacing with the RZ, enter '0' as the IP address, or nothing as the network name.

RZ IP Address:
 Save

or

RZ Network Name:
 Save

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Controller Configuration

Note: This page may require authentication. See “Username and Password” above, for more information.

The Controller Configuration Page is used to configure properties of the BH32 hardware, including the Device Number, RS232 Baud Rate, and the behavior of individual banks when accessed via the DB25 connectors on the back panel.

Device Number

The Device Number is used to identify the BH32 among a network of BH32s. For single BH32 use, this value should be set to 1.

Direction

Each Bank can be configured as either Input or Output.

Logic Level

Each Bank can be configured to Active High (1 = True) or Active Low (0 = True).

Baud Rate

The desired rate can be entered in the RS232 Baud Rate box. The actual realizable rate will be displayed in the Real Baud Rate box after the configuration has been updated.

Saving or Resetting the Configuration

Changes to the configuration are not implemented until they are saved and can be reset to the default settings at any time.

To make changes to the configuration:

- Type or select the desired values then click the **Save Config** button. The Save Config button saves the current configuration settings and performs a soft reset of the BH32 interface to load the settings.

To restore the default values:

- Click the **Reset to Defaults** button.

Network Configuration Page

Note: This page may require authentication. See “Username and Password” on page 17-22, for more information.

The BH32’s IP Address, host name and web username and password can be changed on this page.

If the Enable DHCP check box is checked, the **IP Address**, **Gateway Address**, **Subnet Mask**, and **DNS** server address values are overridden and automatically configured by the DHCP server if available.

Note: These settings are reserved for connections that cannot locate a DHCP server. If no DHCP server can be detected, contact your network administrator for applicable settings.

To change the username and password:

1. Enter the desired new username and password in the **Web User Name** and **Web Password** boxes.
2. Click the **Save Config** button.

Note: Once changed, you may need to re-enter the new username and password to access pages that require authentication, such as the Network Configuration or Setup pages.

To Change the Host name (NetBIOS name):

- Type the desired host name in the **Host Name** box and click the **Save Config** button.

Note: The Host name can be no greater than 15 characters long and cannot contain spaces or the following characters: \ / : * ? " ; | -

Direct Connection to a PC

The BH32 interface can be connected directly to a PC or laptop; however, it is usually necessary to use an Ethernet crossover cable to connect the devices. Once connected, several steps are required for the PC to recognize the UDP interface connection. This method may be performed on any operating system which supports TCP/IP.

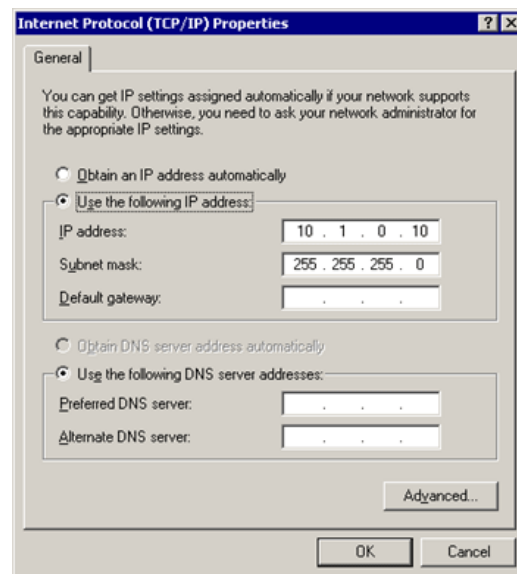
To initialize the PC for a direct connection in Windows XP:

1. Physically connect the BH32 Ethernet interface and the PC via an Ethernet crossover cable.
2. Click **Start | Control Panel** then double-click **Network Connections**.
3. Right-click the desired connection (this is usually a Local Area Connection) and select **Properties**.
4. Select **Internet Protocol (TCP/IP)** or if there are multiples, select **Internet Protocol (TCP/IPv4)**.
5. Click the **Properties** button.
6. Select **Use the following IP address** and enter these values:

IP address: **10.1.0.x**, where **x** can be any value from **1** to **254** except **100** or **101**

Subnet mask: **255.255.255.0**

Default gateway: **Leave empty**



7. Click **OK**.

The BH32 interface connection should now be recognized by the PC. Cycle power on the BH32 device, the IP address of the BH32 will be 10.1.0.101.

BH32 Circuit Design

To communicate with an RZ device, the BH32 must first be paired with the RZ device. See “RZ Configuration” on page 17–22, for more information. Once paired, there are several circuit macros available to access the BH32 using the UDP interface on an RZ device. If using one, two, three or four BH32s on the network, use the RZ_BH_Send_1-4Ch and RZ_BH_Rec_1-4Ch macros. If using more than four BH32s, use the RZ_BH_Send_MC and RZ_BH_Rec_MC macros. All macros can be configured to specify the number of BH32s, which corresponds to the size of the underlying UDP packets.

RZ_BH_Send Macros

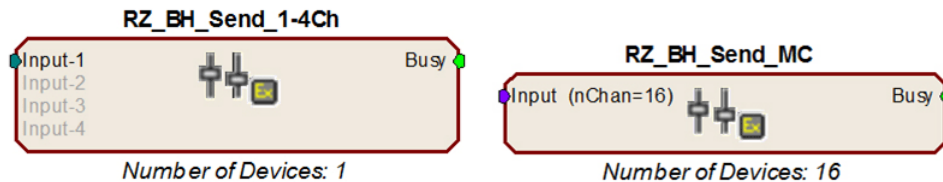
The RZ_BH_Send macros are used to send 32-bit words from the RZ over UDP to BH32 devices numbered from 1 to 4. The macro automatically sends a new packet if any of the Inputs change value. The 32-bit integer represents the current state of all I/O on the BH32 device. The ordering is as follows:

```

| Bit31 ..... Bit0 |
| A8 ... A1 | B8 ... B1 | C8 ... C1 | D8 ... D1 |
    
```

Example:

To change the state of D1 on BH32 Device Number 2, toggle the first bit of Input-2 of RZ_BH_Send_1-4Ch or channel two of RZ_BH_Send_MC’s Input.

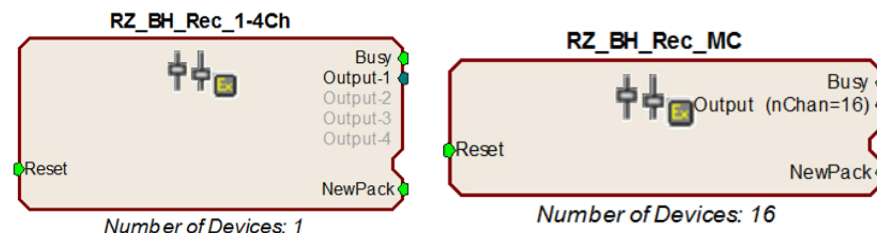


An output labeled “Busy” indicates if the macro is currently in the process of sending out a packet. The duration of the busy signal is dependent on the number of BH32 devices (it takes NumberOfDevices+2 samples to send a packet).

Note: Since the data packets are sent serially, it is recommended that the macro inputs are latched during transmission to ensure that the packet contains data from the same sample in time.

RZ_BH_Rec Macros

The RZ_BH_Rec macros are used to receive 32-bit words from networked BH32 devices through the RZ UDP port. The structure of each 32-bit word is described in the Packet Structure section below.



An incoming UDP packet is de-serialized and sent to the macro outputs. The “NewPack” output goes high (1) for one sample when a new packet header has been received. The “Busy” outputs are high (1) while the macro is de-serializing a packet. The length of this period depends on number of BH32 devices (it takes NumberOfDevices+1 sample to receive a packet). The macro outputs are latched until the next packet is received. The “Reset” input can be used to halt any data transfer and force the macro to wait for a new packet header.

Note: Since the channels are received serially, data in later channels occurred several samples before it is available on the macro Output.

The Packet Structure

This guide assumes the BH32 is communicating over UDP using the Ethernet port. BH32 devices listen on UDP port 22022 and all other UDP messages are disregarded. Communication over the RS232 serial port uses an identical packet structure and programming.

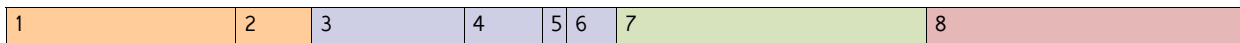
All data sent or received by the BH32 is in the form of a packet. Every packet has a standard structure which includes a header, target device and message.

The header consists of a 32-bit value; the first 24 bits are the protocol ID specific to the BH32/RZ interface and the next 8 bits are the protocol version (v1 as of this writing). This header is used by the BH32 and the RZ to identify packets that they should read and process.

The target device is identified with the next 24 bits of the packet. It consists of a 16-bit device number and an 8-bit group number in case you have more than 256 BH32 devices. This lets you target a single BH32 out of many on the network, or send batch commands to all BH32s on the network.

The message consists of a single toggle bit that identifies if the packet is to or from the device, a 7-bit message number (see “Messages” below) and a reserved 32-bit word for message parameters. Additional data can be appended to messages that require more than one parameter, such as the GET_SET_IO message that sets the output state or GET_SET_CONFIG that changes the device configuration.

The structure for the packet is shown below:



1. (24 bits) Unique protocol ID number – 0x55AB00.
2. (8 bits) Message protocol version number – this document covers protocol v. 1.
3. (16 bits) Device unit number.
 - a. Devices will only process messages:
 - b. Matching their unit number.
 - c. With a unit number of -1.
 - All devices numbered 0 are considered to be unnumbered.
4. (8 bits) Group – used in the GET_SET_IO message. Due to the maximum transmission unit constraints on most networks, each message can only contain ~256 data words. Offset provides a means of doing a bulk update in 256 device increments (e.g. update devices 256-511). This is typically set to 0.
5. (1 bit) Source – 1 means from device, 0 means device will process it.

6. (7 bit) Message number – See “Messages” below, for available commands.
7. (32 bits) Reserved word – See individual message details.
8. (0+ bits) Data word(s) – See individual message details.

Messages

Messages with a device number of -1 (0xFFFF) will be processed by all BH32s | 0x55AB00 | 0x11 precedes all of the following messages.

“N/A” indicates that those bits are not included in the packet.

All of the GET_SET_XXXX messages are always considered a GET – i.e. devices will always reply to these messages with the corresponding information. If the message includes Data words, then the message will also be considered a SET, updating the corresponding information on the device. In this case, the update happens before the GET so that the reply will show the updated information.

Name		Number			Description	
GET_VERSION		0			Retrieves BH32 firmware version number	
Message:	Device #	Group	0b0	0b0000000	N/A	N/A
Reply:	Device #	Group	0b1	0b0000000	0x00000000	Firmware version (32-bits)
SET_UNIT_NUM		1			Used for renumbering BH32s. Device number is set to 0, then BH32 enters PICK_UNIT_NUM mode. The starting device number is set to 1 (or the number sent in the data word). In PICK_UNIT_NUM mode, the BH32 display flashes a prompt for the user to press the input button to set the BH32 device number to the starting device number.	
Message:	Device #	Group	0b0	0b0000001	0x00000000	Starting Device # (optional)
Reply:	Device #	Group	0b1	0b0000001	N/A	N/A
PICK_UNIT_NUM		2			This message is broadcast by a device when it is in PICK_UNIT_NUM mode and the user presses the input button. After broadcasting this message, the device leaves PICK_UNIT_NUM mode and assumes the current starting device number as its own device number. If another device is in PICK_UNIT_NUM mode, then its current starting device # is set to the number sent in the data word plus 1.	
Message:	0xFFFF	Group	0b1	0b0000010	0x00000000	Device # (32-bits)
Reply:	None					
GET_SET_IO		3			Sets or receives I/O state on one or multiple BH32s Each number in the Reply IP Address corresponds to a byte, so 10.10.10.100 → 0x0A0A0A64. A Reply Address of 0x00000000 means reply to sender. A Reply Address of 0xFFFFFFFF means broadcast to all. If Device # is 0xFFFF and two 32-bit words are in the message, the first 32 bits are used by Device #0 and the rest by Device #1. The format of each 32-bit data word is as follows: A8-A1 B8-B1 C8-C1 D8-D1 Attempting to set a pin on an input bank is ignored.	
Message:	Device #	Group	0b0	0b0000011	Reply IP Address	Desired I/O state (32-bit words, optional)
Reply:	Device #	Group	0b1	0b0000011	Reply IP Address	I/O state (32-bits)

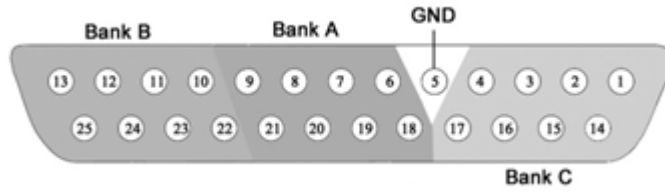
Name		Number			Description	
GET_SET_CONFIG		4			Used to set various device parameters. Can directly set Device number, RS232 baud rate, and the I/O configuration. Parameters are 16 bit values, but only one is sent per 32-bit data word. A parameter number of 0 will return all configuration parameters. Parameter number 1 =: get/set device number 2-3 =: set RS232 baud rate 4-5 =: read actual baud rate 6 =: read bank-wide settings 0b0101	
Message:	Device #	Group	0b0	0b0000100	Param #	Param mask(s)/val(s) (optional)
Reply:	Device #	Group	0b1	0b0000100	Param #	Param val(s)
GET_SET_TIMESTAMP		5			Used to set/read the device's internal clock. If a data word is sent, the clock is set to the value in the data words, interpreted as a single 64-bit value in microseconds.	
Message:	Device #	Group	0b0	0b0000101	0x00000000	64-bit timestamp (optional)
Reply:	Device #	Group	0b1	0b0000101	0x00000000	64-bit timestamp
GET_SET_TRACK		6			Sets which individual pins are in TRACK mode, meaning a 64-bit timestamp is recorded every time the pins value changes. The BH32 will reply with all recorded timestamps (if any) for that pin and flush the timestamp memory for that pin. Up to 256 timestamps total for all pins can be stored in memory.	
Message:	Device #	Group	0b0	0b0000110	Pin Number	Active? (0 or 1, 32-bits)
Reply:	Device #	Group	0b1	0b0000110	Pin Number	64-bit timestamp(s)
GET_SET_NETCONFIG		7			Currently for internal TDT use only.	
GET_SET_SERIAL		8			Currently for internal TDT use only.	
GET_SET_POLL		9			When period is non-zero, the BH32 will send a POLL_EVENT message to Reply IP Address at the specified period. Set period to 0 to stop sending POLL_EVENT messages.	
Message:	Device #	Group	0b0	0b0001001	Reply IP Address	32-bit period, in ms (optional)
Reply:	Device #	Group	0b1	0b0001001	Reply IP Address	32-bit period, in ms
POLL_EVENT		10			See GET_SET_POLL for information about configuring a device to send this message.	
Message:	Device #	Group	0b1	0b0001010	32-bit period, in ms	I/O state (32-bits)
Reply:	None					
GET_SET_TRIGGER		11			When the Trigger Mask is non-zero, the device will enter TRIGGER state. A TRIGGER_EVENT message is sent whenever a pin indicated in the Trigger Mask changes value.	
Message:	Device #	Group	0b0	0b0001011	Reply IP Address	Trigger Mask (optional)
Reply:	Device #	Group	0b1	0b0001011	Reply IP Address	Trigger Mask
TRIGGER_EVENT		12			See GET_SET_TRIGGER for information about configuring the BH32 to send this message.	
Message:	Device #	Group	0b1	0b0001010	Trigger Mask	I/O state (32-bits)
Reply:	None					

Name		Number		Description		
GET_SET_RZ_IP		13		<p>If the RZ IP Address is non-zero, the BH32 will enter RZ_CONTROLLER state. In this state, the BH32 will:</p> <ul style="list-style-type: none"> Multicast a GET_SET_TRIGGER message on the network to every BH32 device in its same group, with its own IP Address as the reply address and 0xFFFFFFFF as the Trigger Mask Send a SET_REMOTE_IP packet to the RZ IP Address Enter a special TRIGGER state <p>While in this mode, the device will respond to BH32 and RZ type packets. Whenever a GET_SET_IO, POLL_EVENT or TRIGGER_EVENT message is received, the BH32 will save the I/O state from the packet in an RZ message buffer. Every 1ms, the BH32 will check if new data has been received and transmit new data to the RZ as a DATA packet. Whenever a DATA packet is received from the RZ IP Address, the BH32 creates a GET_SET_IO message and multicasts it to the local network to its same group.</p> <p>If the RZ IP Address is set to 0, the BH32 will no longer be in RZ_CONTROLLER state and broadcast a GET_SET_TRIGGER message on the network with Trigger Mask 0.</p>		
Message:	Device #	Group	Ob0	0b0001101	0x00000000	RZ IP Address (optional)
Reply:	Device #	Group	Ob1	0b0001101	0x00000000	RZ IP Address
GET_SET_RZ_NBNAME		14		<p>Same as GET_SET_RZ_IP, but uses RZ's NetBIOS name as input (e.g. 'TDT_UDP_D3_2012'. If the name starts with a null character, the BH32 leaves RZ_CONTROLLER state.</p>		
Message:	Device #	Group	Ob0	0b0001110	0x00000000	Null-terminated string (up to 16 characters, optional)
Reply:	Device #	Group	Ob1	0b0001110	0x00000000	Null-terminated string (up to 16 characters)
RESET_TO_DEFAULTS		126		Clears the target IP and port, thereby stopping the flow of packets.		
Message:	Device #	Group	Ob0	0b1111110	N/A	N/A
Reply:	Device #	Group	Ob1	0b1111110	N/A	N/A
RESET		127		Performs a software reset of the BH32		
Message:	Device #	Group	Ob0	0b1111111	N/A	N/A

BH32 Technical Specifications

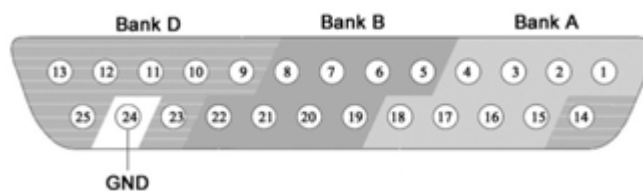
Power Input	Input for 6-9V, 3A center-negative adapter input.	
Timing Specs	Note that these timings depend on network latency.	
	UDP input to BH32 output	1 ms average
	UDP input to BH32 UDP response	4 ms average
	Digital Input to BH32 UDP response	<2 ms average

DB25 Digital IO Pinout



Pin	Name	Description	Pin	Name	Description
1	C1	Bank C Bits 1, 3, 5, and 7	14	C2	Bank C Bits 2, 4, 6, and 8
2	C3		15	C4	
3	C5		16	C6	
4	C7		17	C8	
5	GND	Digital I/O Ground	18	A1	Bank A Bits 1, 3, 5, and 7
6	A2	Bank A Bits 2, 4, 6, and 8	19	A3	
7	A4		20	A5	
8	A6		21	A7	
9	A8		22	B1	Bank B Bits 1, 3, 5, and 7
10	B2	Bank B Bits 2, 4, 6, and 8	23	B3	
11	B4		24	B5	
12	B6		25	B7	
13	B8				

DB25 Digital IO-2 Pinout



Pin	Name	Description	Pin	Name	Description
1	A1	Bank A Bits 1, 3, 5, and 7	14	D7	Bank D Bit 7
2	A3		15	A2	Bank A Bits 2, 4, 6, and 8
3	A5		16	A4	
4	A7		17	A6	
5	B1	Bank B Bits 1, 3, 5, and 7	18	A8	
6	B3		19	B2	Bank B Bits 2, 4, 6, and 8
7	B5		20	B4	
8	B7		21	B6	
9	D1	Bank D Bits 1, 2, 3, 4, and 6	22	B8	
10	D2		23	D8	Bank D Bit 8
11	D3		24	GND	Ground
12	D4		25	D5	Bank D Bit 5
13	D6				

Molex Pin and Socket Connectors

EXTERNAL POWER



V+ Positive Voltage

NC No Connection

G Ground

1.57mm Diameter Standard Molex Pin and Socket connectors on top panel.

Important! The external power connectors are shorted together; do not connect a second external power source.

I/O CONNECTORS



V+ Positive Voltage

S Signal

G Ground