LASER TECH

Measurably Superior®

LTI TruPulse i Series Bluetooth Communications

Document Control:

Version	Date	Name	Description
1	April 2024	LTI	Official released first draft

Contents

Introduction

This document describes the Bluetooth Low Energy (BLE) and Bluetooth Classic architecture used in TruPulse 200i & 360i rangefinder device by Laser Tech (LTI). The module is Bluetooth v4.0 - Dual Mode. A description of command structures are found in a separate document “TruPulse 200i & 360i User Interface Communication Protocols and Commands”.

Both Bluetooth Classic and BLE modes implement an ASCII command-response communication scheme described in the section *Data Format*. The master smart device can issue a command, and the slave LTI laser device will issue a response if the command is supported. In addition, upon acquisition of a range, the LTI laser device will report range data to the master smart device without the master’s request.

Bluetooth Low Energy (BLE)

The TruPulse 200i & 360i can operate in either *peripheral mode* or *central mode*.

Peripheral Mode

This section describes the operation of the TruPulse 200i & 360i when it is operating in the peripheral mode. The LTI Peripheral device will have available the LTI Data Exchange service.

Advertising

Upon power-on, the laser will begin advertising the Data Exchange service. The Laser will also accept scan requests. The complete list of UUIDs will be in the advertisement packet, and the advertised name will be in the scan response packet. The laser will advertise with a public address.

Connection

The laser will accept any connection request. Because of the potentially large messages transferred in the Data Exchange Service, the central device must support Bluetooth Version 4.2 or later to support larger packet sizes. This is to ensure that all messages can fit entirely within a single packet. The central device should also request an MTU of at least 200 bytes.

Central Mode

This section describes the operation of the Laser when it is in the central role.

Scanning

The laser will periodically scan for devices that contain the LTI Data Exchange service or other applicable service. Every device that contains applicable services will have its name added to a list. When the user selects a device in this list, the laser will save the address of this device and automatically connect to it when it is detected. When the Laser is connected to a peripheral with the Data Exchange service, the Laser will send vector information when it is obtained.

Advertising Requirements

- Peripherals must use Undirected Connectable Advertising.
- Peripherals must use a Public Device Address.
- The Laser will search for 128-bit UUIDs and Device Names.

Services

Device Information Service

This is a normative BLE service using UUID 180A.

Characteristics:

UUID 2A24	The ASCII value of the device's model number.
UUID: 2A25	The ASCII value of the device's serial number.
UUID: 2A26	The ASCII value of the firmware version of the device.

LTI Data Exchange Service

The service implements a simple full-duplex UART-style communication scheme. There is one characteristic for data being transferred from the central to the peripheral, and there is one characteristic for data being transferred from the peripheral to the central.

This service uses UUID 8621-0100-F831-4395-B29D-E70977D5BF94.

Characteristics:

POCI	Peripheral Out Central In	UUID: 8621-0102-F831-4395-B29D-E70977D5BF94
	POCI is used to transfer data from the peripheral to the central. The central should enable indication on the peripheral so this characteristic may transmit asynchronously.	
PICO	Peripheral In Central Out	UUID: 8621-0101-F831-4395-B29D-E70977D5BF94
	This characteristic is used to transfer data from the central to the peripheral. This characteristic must have the write property enabled for the peripheral to receive messages.	

LTI Device As Central

Some LTI devices can also connect to other peripheral devices. If the LTI Data Exchange Service cannot be implemented on the peripheral device, and the peripheral device has a preexisting BLE service, then the manufacturer of the desired peripheral must provide applicable service information to LTI so that the LTI device can properly interface with the peripheral.

Bluetooth Classic (BT)

All LTI devices that support Bluetooth Classic will use the Serial Port Profile (SPP), as defined by the Bluetooth Special Interest Group (SIG).

Bluetooth Classic-enabled LTI devices follow the guidelines of the NMEA 0183 Standard for Interfacing Marine Electronic Navigational Devices, Revision 2.0:

- NMEA 0183 provides for both standard and proprietary data formats. Since none of the standard formats are useful for the data transferred from the laser, special proprietary formats are used. Rules described in the NMEA standard governing general message structure, leading and trailing characters, numeric values, delimiting character, checksums, maximum line length, data rate, and bit format are followed exactly.
- As required by NMEA 0183, the LTI device will not respond to unrecognized header formats, malformed messages, or messages with invalid checksums.
- Bluetooth Classic can communicate/connect to Windows, Windows Mobile and Android devices. Classic mode cannot connect to iOS devices , must use BLE mode to connect to iOS devices.

TruPulse 200i & 360i Message Formats

Data is transferred via ASCII commands to the laser, which will then send an ASCII response (note: this was intended for use when the laser acts as the peripheral or slave device). The laser may also send messages asynchronously (e.g. if the user changes settings on the laser).

Here is an example command-response transaction between a master or central device (e.g. a phone or PC) and the laser.

The command `$GO` instructs the laser to take a measurement. Commands are delimited by <CR><LF> characters. Note that this data is written to the PICO characteristic when the communication path is BLE.

Byte	**0**	**1**	**2**	**3**	**4**
Contents	'$'	'I'	'D'	'\r'	'\n'

The laser will first respond to `$ID` with a version string. Note that when the communication path is BLE, these responses appear on the POCI characteristic via Indication by the peripheral.

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**…**	**n-1**	**n**
Contents	'$'	'P'	'L'	'T'	'I'	'T'	','	I	D	,	…	'\r'	'\n'

Some commands, like `$GO` will respond first with `$OK`, then begin the requested measurement, then return the result.

Responses

Responses to commands are formatted according to the NMEA 0183 Standard for Interfacing Marine Electronic Navigational Devices, Revision 2.0, implementing the CR400 message format.

Responses to commands may be *terse* or *parameterized* – responses containing one or more data fields separated by commas. Responses are terminated with <CR><LF> characters.

NMEA 0183 provides for both standard and proprietary data formats. Since none of the standard formats are useful for the data transferred from the TruPulse, special proprietary formats are used. Rules described in the NMEA standard governing general message structure, leading and trailing characters, numeric values, delimiting character, checksums, maximum line length, data rate, and bit format are followed exactly. As required by NMEA 0183, the CR400-format does not respond to unrecognized header formats, malformed messages, or messages with invalid checksums.

Terse Responses

Terse responses have no data fields.

`$OK`	acknowledges a request to begin a measurement.
E*nn*	Indicates that error *nn* occurred.

Parameterized Responses

Parameterized responses begin with the characters `$PLTIT, A` full response to the `$ID` command looks like this:

`$ID,`*`model,versionid, date, serial number*`*`csum`*<CR><LF>
`$ID,TP200i,0.9.37,20240122,000043*5d`

The first fields are comma delimited, and the last field begins after the last comma and is terminated by the '*' character. Fields have no character count requirement. An empty field would reside between two commas. The fields in the ID response are:

Field	Example Data	Description
0	$	Criterion 400 message identifier
1	ID	Message type identifier
2	TP200i	Laser model
3	V0.9.37	Firmware revision number
4	20240122	Date of Firmware release
5	000043	Serial Number
4	*5d	Checksum field
	<CR><LF>	Carriage return, Line feed

A two hex digit checksum follows the '*' character. This can be verified by XORing all the characters between the dollar sign and the '*' character.

TruPulse 200i & 360i Response and Commands

- For detailed parameterized responses and commands for the TruPulse 200i & 360i, refer to the "TruPulse i Series Communication Protocols and Commands" document.
    - Measurement Messages
        - Horizontal Vector Messages
        - Height Messages
        - Missing Line Messages
    - Commands

Bluetooth Connection

- Advertisement Name
    - TruPulse 200i: "TP200i-000000" where "000000" is the serial number of your TruPulse.
    - TruPulse 360i: "TP360i-000000" where "000000" is the serial number of your TruPulse.
- Refer to the TruPulse User's Manual to activate the Bluetooth.

Support

- Contact Laser Tech Support
    - 1.800.280.6113 or 1.303.649.1000
    - Info@lasertec.com, support@lasertech.com or servicecenter@lasertech.com