

# MapStar® TruAngle® II Bluetooth® Low Energy (BLE) Connectivity Protocols

## Revision Control:

Version	Date	Name	Description
1	August 2024	LTI	Official release of TA II BLE communications
2	October 2024	LTI	Updates to the UUID information

# Contents

Introduction .....	3
Bluetooth Low Energy.....	3
Advertising.....	3
Services .....	3
Device Information Service .....	3
Device Information Service Characteristics.....	3
LTI Data Exchange Service (DES).....	4
TruAngle II Message Formats.....	4
Instrument Status Messages .....	5
Instrument Control Messages .....	6
Level Assist Messages .....	7
Other Commands.....	<b>Error! Bookmark not defined.</b>
Error Messages.....	7

# Introduction

This document describes how to communicate with a TruAngle II using Bluetooth® Low Energy (BLE) protocol and associated commands. The underlying communication uses an ASCII command-response communication scheme described in the section TruAngle II Message Formats. The BLE protocol employs the LTI Data Exchange Service, which is described in the LTI BLE Specification. See this specification for information on how to implement this custom BLE service. Broadly, the master device can issue a command, and the slave device (i.e. TA II) will issue a response if the command is supported.

The TA II is an App controlled device utilizing BLE only. There is no serial or USB ports for connectivity.

The TruAngle II requires a smart device with a dedicated, custom designed App to connect, communicate and capture the angle measurements.

With this App, the Smart Device can intelligently detect BT devices and control connectivity to an LTI Laser and TA II individually.

Descriptions of the command structures are presented to jump-start new application development.

## Bluetooth Low Energy

The TA II Bluetooth module employs Bluetooth Low Energy (BLE), which is designed to create wireless low data rate networks using a minimum amount of power. BLE protocol is compatible with a multitude of data collection mobile devices (iOS and Android operating systems).

The TA II operates in peripheral mode only. This section describes expected operation as a peripheral.

### Advertising

Upon power-on, the TA II will begin advertising the Data Exchange service. The TA II 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 advertised name will be in the format “TA II-<sn>” where <sn> is the serial number of the device. The laser will advertise with a public address.

- Example: TAIL-000100 (Product Name Abbreviated and Serial Number of the unit)

### Services

#### Device Information Service

This is a normative BLE service using UUID 1800 and UUID 180A.

#### Device Information Service Characteristics

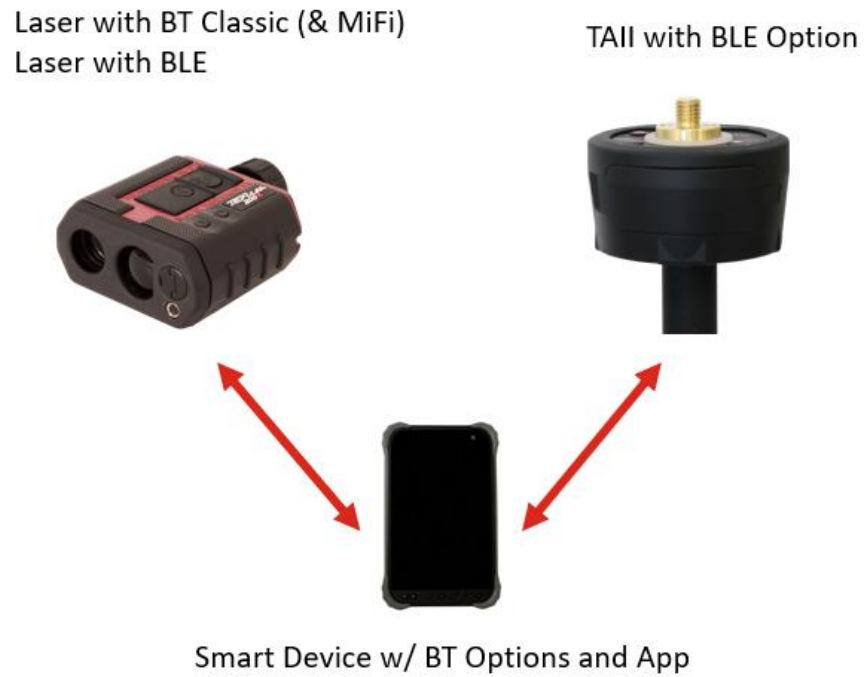
UUID 0X1800 UUID 0X2A00	The ASCII value of the device’s full serial number Test Sample: TAIL-000999
UUID 0X180A UUID 2A24	The ASCII value of the device’s model number. Text: TruAngleII
UUID 0X180A UUID: 2A25	The ASCII value of the device’s serial number. Text Sample: 00099
UUID 0X180A UUID: 2A26	The ASCII value of the firmware version of the device Text Sample: 1.0.1

## LTI Data Exchange Service (DES)

The TA II will communicate primarily over the LTI DES. The service itself is not described in this document. Please see the LTI BLE Specification for more information.

## TruAngle II Message Formats

When a TruPulse laser model (with Bluetooth) and TA II are connected to work together, the data collector/smart device app treats them as peripherals.



## Instrument Status Messages

All commands are preceded with # and should be terminated with a <CR><LF> (<CR>: Carriage return delimiter <LF> : Linefeed). The command interpreter will accept lower case letters as well as upper case.

Command Description	Send Command	Response	Example
Instrument Identification Request	#ID	#ID,TAII-n.nn,date,serial number*csum, <CR><LF>.  n.nn Firmware version date: Product manufacture date (format YYYYMMDD) serial number of the product *csum : An asterisk followed by a hexadecimal checksum (calculated by XORing all characters between the dollar sign and the asterisk) <CR> : Carriage return delimiter <LF> : Linefeed	#ID,TAII,1.0.0,20240508,000521*c4
Battery Condition	#BC	#BC,n	#BC,0 (Flashing LED) #BC,1 (One LED lit) #BC,2 (Two LEDs lit) #BC,3 (Three LEDs lit)
Battery Voltage Request	#BV	#BV,nnnn  nnnn = millivolts	#BV,3788  (voltage = 3.788V)
Serial Number Request	#SN	#SN,nnnnnn  nnnnnn = serial number, digits only	#SN,000292 Product Serial Number = 000292

## Instrument Control Messages

Command Description	Send Command	Response	Example
Current Angle Request (relative angle)	#AN	#AN,nnn.nn nnn.nn – Degrees Responds with #ER,3 when #LE is exceeded.	#AN,237.45  (Relative angle= 237.45 deg)
LED Brightness Set	#LB,n (range is 0 to 15) [Default = 13]	#OK	#LB,8 #OK (LED brightness set to 8)
LED Brightness Request	#LB	#LB,7	#LB,7 (LED brightness set to 7) [Default is 13]
Power Down TruAngle	#PD	#OK	Unit turns off, must be manually powered back up.
Timeout Interval Request (Auto Power Down Timer)	#TO	#TO,nnn nnn - Seconds	#TO,60  (Power off in 60 seconds)
Timeout Interval Set (To set value for #TO)	#TO,nnn nnn – Seconds (60 – 999) [0 = Never turns off]	#OK	#TO,60 (Will turn itself off after 60 seconds)
Set Zero Reference  (Sets zero reference point, same as manually pressing the Zero button)	#ZR	#OK	
Zero Reference Alert  (Output that notifies if zero reference panel button has been pressed)		#ZR	Message is sent after a long press of the FIRE/Zero button. Flash entire LED ring at highest brightness for three short bursts once zero is committed.
Set a Non-Zero Reference Angle	#ZR,ddd.dd ddd.dd = angle values (0-359.99)	#OK	#ZR,123.55 (Sets current angle to 123.55 degrees)

Fire button	(Short button press)	#FR, nnn.nn nnn.nn – Degrees Responds with #ER,3 when #LE is exceeded.	#FR, 268.54 #BC,3 (Current angle is 268.54 degrees) (Battery Condition: Three LEDs lit)
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## Level Assist Messages

Command Description	Send Command	Response/Behavior	Example
<b>Level Assist Mode Set</b>  (Turns On/Off and Level Assistance)	#LA,n  #LA,0 = Set to Off #LA,1 = Set to On	#OK	#LA,1 #OK
<b>Level Assist Mode Request</b>	#LA	#LA,n	#LA,0  (Level Assist Off)
<b>Level Assist Visual Limit Set</b>  (Sets when the visual LEDs begin to indicate plumb angle. If actual plumb angle < LV, LED's will flash at the four ordinate locations indicating the unit is within the LV limit)	#LV,nnn  nnn = Tenths of Degrees Minimum value = 4 Maximum value = 440	#OK	#LV,15 #OK  (Sets the threshold to 1.5 degrees) [DEFAULT =20 (2 degrees)]
<b>Level Assist Visual Limit Request</b>  (Requests the Sensitivity Value set)	#LV	#LV,nnn  nnn = Tenths of Degrees	#LV,15  (Visual limit threshold is set to 1.5 degrees)
<b>Level Assist Error Limit Set</b>  (Sets the value to send an #ER,3 warning message)	#LE,nnn  nnn= Tenths of Degrees Minimum value = 14 Maximum value = 450 LE-LV must always be ≥ 1 degree	#OK	#LE,50 #OK  (Will report ER,3 if level angle is >= 5 degrees as per the period set in #LS) [DEFAULT = 50 (5 degrees)]
<b>Level Assist Error Limit Request</b>  (Requests the value set for #LE)	#LE	#LE,nnn  nnn = Tenths of degrees  Actual plumb angle crossing over #LE will send out a single #ER,3 message. If the unit remains beyond this point, #AN, #LQ and #LS,n will only return a single #ER,3.	#LE #LE,50  (Error limit set to 5 degrees)

## Other Commands

Command Description	Send Command	Response/Behavior	Example
<b>Set to Factory Defaults</b>	#FD	#OK	<u>Defaults:</u> #T0,300 #LB,13 #LA,1 = Set to On #LV,20 #LE,50
<b>Perform User Rotation Calibration</b> Initiates the IMU Field Calibration routine	#LZ	#LZ,1	Unit is ready for the Field Calibration routine: Cal positions #LZ,1 #LZ,2 #LZ,3 #LZ,4 #LZ,0

## Error Messages

Command Description	Response	Example
Error Code	#ER,n 1 = Command Syntax Error 2 = Memory Checksum Error 3 = Level Assist Tilt Warning 51 – Temperature warning 52 = Under temperature shutdown imminent 53 = Over temperature shutdown imminent	#ER,1