



User Manual for

**TeraRanger Evo with:**

**USB and I2C/UART**

**backboard**

(Hardware revision 1.0, Firmware revision 1.0.0)

Technical support: [support@teraranger.com](mailto:support@teraranger.com)  
Sales and commercial support: [teraranger@terabee.com](mailto:teraranger@terabee.com)

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## Introduction

The purpose of this document is to give guidelines for use and integration of the TeraRanger Evo distance sensor with (a) UART/I2C backboard, and/or (b) USB backboard using these standard communication interfaces.

## Mechanical integration

The mechanical design of the main sensor module (black) allows easy assembly to its backboard (yellow) using a simple 'clip-in' technique. (When you clip the two together, ensure there is no visible gap between the black and yellow parts.) The yellow backboard has two mounting holes for final installation.



When choosing a place for mounting, please consider the following recommendations:

- Choose a place which is in accordance with the optical constraints listed in below
- Mounting close to sources of heat or strong electromagnetic fields can decrease the sensing performance
- Do not mount anything directly in front of the sensor or in a cone of approximately  $\pm 15^\circ$  around the central optical axis of the sensor
- Within the first metre of the sensor, avoid objects with high surface reflectivity in a cone of approximately  $\pm 45^\circ$  around the central optical axis of the sensor
- It is better to avoid having other sources of Continuous Wave or modulated IR light close to the sensor
- Please consider that dust, dirt and condensation can affect the sensor performance
- It is not advised to add an additional cover in front of the sensor
- Drone rotor blades, or other environments with flickering ('chopped') ambient light in the field of view can affect sensors' readings

## Sensor handling during system assembly

During assembly and integration, please observe all common ESD precautions. All optical surfaces (sensor front) should be kept clean and free from contact with chemicals.

## USB backboard use



The USB backboard comes with a standard Micro-USB connector.

## Connecting the TeraRanger Evo to a Host Computer

TeraRanger Evo can interact as a virtual COM port using the following configuration: 115200 bit/s, 8 data bits, no parity bit and one stop bit.

## Graphical User Interface

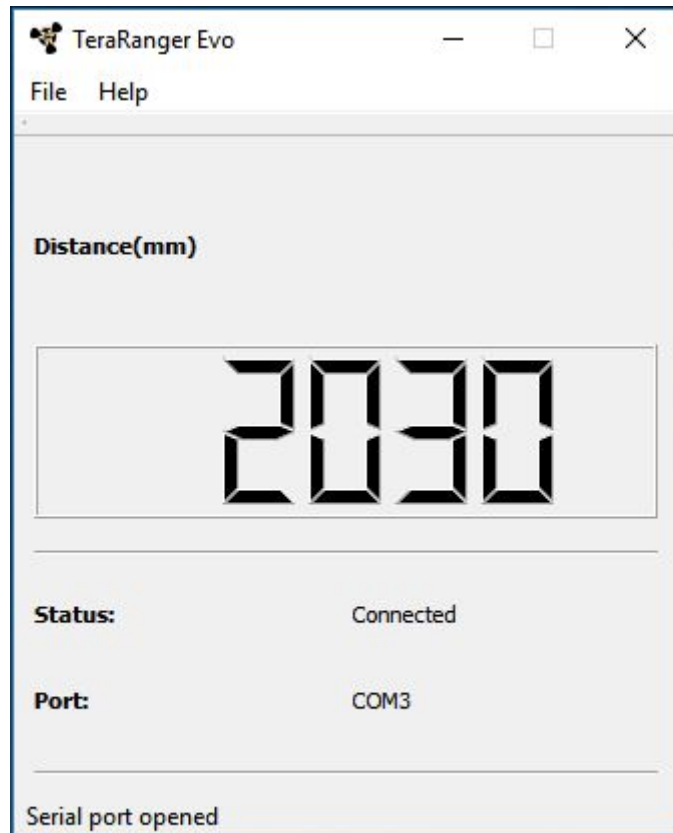
A free graphical user interface is available for Windows, providing an easy way to visualise the data from your TeraRanger Evo. This is useful for demonstration, testing purposes and checking some of the basic parameters of the sensor. It also provides a way to easily upgrade the firmware running on the device.

### Prerequisites

For usage on Windows (7, 8, 10) operating system, please download the driver from <http://www.st.com/en/development-tools/stsw-stm32102.html> and **follow the "ReadMe file" instructions given by the installer**. After successful installation, unplug the interface for a few seconds, and plug it back in. The virtual COM port should now be available on your PC.

### Basic Operation

Make sure your TeraRanger Evo is connected to a USB port on your computer. Select File > Connect. You should immediately see a distance reading in millimetres and the status should change to 'Connected'.



## Firmware Upgrade

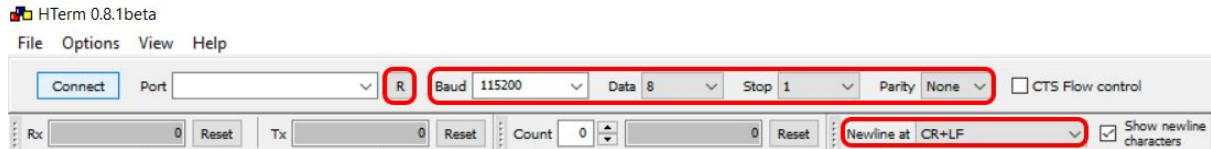
The current firmware version on your TeraRanger Evo can be found by selecting *Help > About* in the graphical user interface. It is possible to upgrade the firmware running on your device if a new firmware version is made available on the TeraRanger website.

Please note the Upgrade Firmware feature is only supported on Windows 7, 8 and 10. Please carefully follow the steps outlined below to avoid 'bricking' your device.

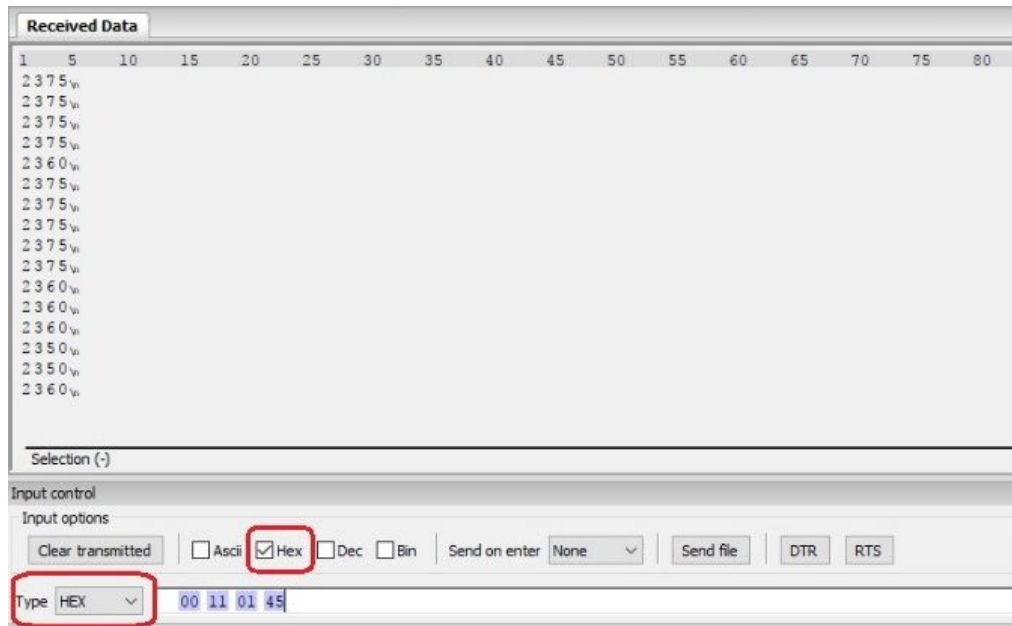
- Select *File > Upgrade Firmware*
- You will be presented with a dialog window asking you to confirm your choice  
Beyond this point, if you press 'Yes' it will not be possible to revert to the firmware currently running on your TeraRanger Evo. Press 'No' to cancel and keep the current firmware or 'Yes' to continue
- Read the instructions in the dialog window that opens
- Press 'Select FW' and select the new firmware file with Windows File Explorer
- Press 'Upgrade' and wait until the operation finishes
- Close the Upgrade dialog box

In Windows you can also use any terminal emulation software of your choosing, however we suggest you use HTerm (<http://www.der-hammer.info/terminal/>). Extract the downloaded zip file to the folder of your choice, open it and double click on the “HTerm.exe” document.

Connect the TeraRanger Evo to your computer and select the corresponding USB port (click “R” button to refresh the port list). Select values for the following fields: (1) Baudrate, (2) Data Bits, (3) Parity, (4) Stop Bits. For easier readings, select the “LF” option for “Newline at” tab. See Figure below for visual instructions.



Once you have selected the USB port and required values, click on the “Connect” button. The data will now appear in the “Received data” box (Figure below).



To communicate with the terminal emulation software, you need to send a command in hexadecimal via the “Type” box. First check the “Hex” checkbox and choose the “HEX” Type. The figure above shows an example of the command which allows data to be shown in TEXT mode.

## I2C/UART backboard use



### I2C/UART interface

The TeraRanger Evo can be controlled through I2C **or** UART interfaces. It uses a single 9 pin Hirose DF13 connector for interfacing to the host system. The mating connector is a Hirose DF13-9S-1.25C with crimping contacts DF13-2630SCF (tin) or DF13-2630SCFA (gold). Please consider the mechanical stability of the mated connectors and avoid any kind of excess force on the connector (during installation and once integrated) and follow the recommendations in the Hirose DF13 series datasheet (available here:

<https://www.hirose.com/product/en/products/DF13>) to ensure a reliable connection.

Table 1 provides an overview of the pin out of the DF13 connector:

***Pin out and description (According to DF13 datasheet)***

Pin	Designator	Description
1	Tx	UART transmit output. 3.3V logic
2	Rx	UART receive input. 3.3V logic
3	GND	Power supply and interface ground
4	SDA	I2C serial data line. 3.3V logic
5	SCL	I2C serial clock line. 3.3V logic
6	rfu	RESERVED FOR FUTURE USE
7	5V	+5V supply input
8	GND	Power supply and interface ground
9	rfu	RESERVED FOR FUTURE USE

## Backboard LEDs'

Five LEDs are mounted to give visual feedback on the sensor. Table 2 lists the functionality of each LED:

LED	Description
PWR (orange)	Power indicator, on when 5V connected
Rx/Tx (red/green)	UART receive and transmit indicators
LED 0 / LED 1	For internal use only

## Electrical characteristics

### *DC electrical characteristics*

<i>Parameter</i>	<i>Minimum</i>	<i>Typical</i>	<i>Maximum</i>
<b>Power supply</b>			
Voltage input (V)	4.8	5	5.2
Current consumption (mA)	25	*200	350
<b>Interface logic levels</b> (referenced to +3V3)			
LOW	-	-	1
HIGH	2.3	-	-

\* Depending on ambient conditions, distance and target reflectivity



## I2C protocol information

The communication parameters are:

**Frequency:** 400kHz

**Primary Address Length:** 7-bit

**Primary Slave Address:** 0x31

**Built-in pull-up resistors:** 10kOhms on SDA and SCL

The TeraRanger Evo is 'free running'. This means that it will restart a new measurement as soon as the last one is finished. The displayed data via I2C protocol is always updated at the end of a measurement. Nevertheless, it can always be read at any time.

Reading the distance is done by first writing a Trigger Reading command to the sensor - send 0x62 (this is the 7 bit address 0x31 followed by the write bit '0') and then reading from the sensor by sending 0x63 (the base address with the Read bit '1') followed by three byte read operations. The first two bytes you receive are a 16 bit word containing the latest measurement in mm\*\*, the third byte is the CRC8 checksum.

\*\*The TeraRanger Evo will output 01CRC (first distance byte set to zero and the second to one) as an error message **if the sensor is unable to measure a distance. If the target is too close** (below the minimum distance), the TeraRanger Evo will output 00CRC (both distance bytes set to zero). **If the target is too far away** (above the maximum distance), the TeraRanger Evo will output XXCRC with XX = FFFFhex (both distance bytes set to 0xFF)

Writing commands to the TeraRanger Evo:

1. Send the address byte consisting of a 7 bit base address and the last bit indicating write ('0'), e.g. 0x62 for base address 0x31. All commands listed in the table below are 'write operations'. The answer will be in the next read operation for which you have to send the 7 bit address with the read bit set
2. Send the desired command listed in the table below (see table below in the next paragraph)
3. In case the command creates an answer, read it back immediately

Reading data from the TeraRanger Evo:

1. Send the address byte consisting of 7 bit base address and the last bit indicating read ('1'), e.g. 0x63 for base address 0x31
2. Read back the the number of bytes imposed by the command, e.g. three bytes for a distance reading

## I2C commands

Command	Name	Description
0x00	TRIGGER READING	Write this command to the TeraRanger Evo and after a wait of approximately 500us read the 3 byte distance response
0x01	WHO_AM_I	Write this value to TeraRanger Evo via I2C and the device responds with 0xA1
0xA2	CHANGE_BASE_ADDR <sup>[1]</sup>	Write this value followed by the new address to set <sup>[2]</sup> , eg. send 0x42 if you want the Evo's base address to change to 0x42, ignore Read/Write bits.  Wait at least 1 second for the TeraRanger Evo to rejoin the I2C bus with the new address.

**[1]** This command assigns a base address that will be memorised by the TerRanger Evo ie. power cycling the Evo will not restore the default I2C address.

**[2]** Valid addresses accepted by the TeraRanger Evo are in the range 0x02 to 0x7F. Assignment of addresses within a local system is up to the system architect. For example, the I2C standard defines reserved addresses but if it is known that the reserved address is never going to be used for its intended purpose, a reserved address can be used as the Evo I2C Base Address.

## UART Communication

### UART protocol information

The UART communication for the TeraRanger Evo uses a simple Modbus-like protocol. The communication parameters are:

**Baud Rate:** 115 200

**Data Bits:** 8

**Stop Bit(s):** 1

**Parity:** None

**HW Flow Control:** None

## Commands

Address	Command	Data	CRC-8
0x00	PRINTOUT MODE 0x11	TEXT 0x01	0x45
0x00	PRINTOUT MODE 0x11	BINARY 0x02	0x4C

The default mode of TeraRanger Evo is Binary mode. For changing the output format to Text mode, please use the following command in hexadecimal: **00 11 01 45**. Accordingly, to switch back to Binary mode use the hexadecimal command: **00 11 02 4C**.


## UART output format

Two output formats are available:

<b>Text output</b>	<p>Data output in human readable form (5 to 7 bytes message):</p> <p>xxxxx\n</p> <ul style="list-style-type: none"> <li>- Distance reading in millimeters* (maximum 5 bytes per sensor): xxxxx</li> <li>- New line character: \n (10 decimal / 0x0A hex)</li> </ul> <p>*please be aware that there is no zero-padding for leading zeros!</p> <ul style="list-style-type: none"> <li>- If the TeraRanger Evo is unable to measure a distance, it will output -1\n as an error message</li> <li>- If the target is too close (below the minimum distance), the TeraRanger Evo will output -Inf\n</li> <li>- If the target is too far away (above the maximum distance), the TeraRanger Evo will output +Inf\n</li> </ul>
<b>Binary output</b>	<p>Data output (4 bytes message):</p> <p>TXXCRC8</p> <ul style="list-style-type: none"> <li>- Header (1 byte): T (84 decimal / 0x54 hex)</li> <li>- Distance reading in millimeters** (2 bytes): XX</li> <li>- Checksum (1 byte) of previous 3 bytes: CRC8</li> </ul>

	<p>**The TeraRanger Evo will output T01CRC (first distance byte set to zero and the second to one) as an error message if the sensor is unable to measure a distance:</p> <ul style="list-style-type: none"> <li>- If the target is too close (below the minimum distance), the TeraRanger Evo will output T00CRC (both distance bytes set to zero)</li> <li>- If the target is too far away (above the maximum distance), the TeraRanger Evo will output TXXCRC with XX = FFFFhex (both distance bytes set to 0xFF)</li> </ul>
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# Declaration of Conformity



## Declaration of Conformity

**Manufacturer:** Terabee  
**Product:** TeraRanger Evo

The undersigned hereby declares, on behalf of the Terabee, Technoparc, St Genis Pouilly, that the above-referenced product, to which this declaration relates, is in conformity with the provisions of the following European directives:

- Council Directive 2006/42/EC (May 17, 2006) on the Approximation of the Laws of the Member States Relating to Machinery;
- Council Directive 2014/30/EC (February 26, 2014) on Electromagnetic Compatibility;
- List European standards used
- Council Directive 2014/35/EC (February 26, 2014) on Low Voltage Equipment Safety;
- List European standards used
- Council Directive 2000/14/EEC amended by Directive 2005/88/EC (June 17, 2006) about noise limits and labeling requirements machines intended for use outdoors.
- Council Directive 2012/19/EC on Waste Electrical and Electronic Equipment (also known as WEEE II)
- Council Directive 2011/65/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.


Moreover the above referenced product is built in compliance with the following technical harmonized standards:

- IEC 62471:2006
- IEC 61000-6-1:2016
- IEC 61000-6-3:2006+AMD1:2010

This statement is based on information and data provided from third parties and may not have been verified through destructive testing methods or other chemical analysis.

The Technical Construction File required by this Directive is maintained at the corporate headquarters of Terabee, Technoparc - 90 rue Henri Fabre - 01630 Saint-Genis Pouilly, FRANCE.

Max Ruffo  
CEO, Terabee



**TERABEE S.A.S.**  
 Technoparc, 90 Rue Henri Fabre  
 01630 St Genis-Pouilly - France  
 TVA: FR 38 789459179

Dated 09/06/2017  
St. Genis-Pouilly

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Terabee, 90 Rue Henri Fabre, 01630, St. Genis-Pouilly, France  
 Tel: +33 7 50 1 5 16 64 - SIRET 78945917900022 - VAT FR 38 789459179

