TBR 700 Communication Protocol

Communication interfaces

TBR 700 RT: RS-485 (half duplex), Bluetooth and USB

TBR 700: Bluetooth and USB

Protocol

TBR 700 and TBR 700 RT prints real time tag data and receiver sensor readings (temperature and background noise) to all active communication interfaces. For real time applications, we recommend to use the RT-version with RS-485 for robust communication. Here is an overview of the data formats:

Tag detections

$000004,0946709086,287,S256,1,0,8,2329

- $ = Real time data
- 000004 = TBR serial number
- 0946709086 = UTC UNIX timestamp (automatically reset to 1. Jan. 2000 when power is off)
- 287 = millisecond timestamp (can be used for triangulation when codes are received on multiple receivers)
- S256 = code type (S256,R64k,R04k or R256)
  - S256 = 8 bits ID and 8 bits with data
  - R64K = 16 bits ID
  - R04K = 12 bits ID
  - R256 = 8 bits ID
- 1 = tag ID
- 0 = data (",," blank if other code set than S256)
- 8 = SNR (Signal to Noise Ratio)
- 2329 = code running entry number in flash memory

$$SNR[dB] = 10 \cdot log_{10}\left(\frac{Average\ peak\ signal\ power\ in\ pulse\ train}{Average\ noise\ power}\right) = 20 \cdot log_{10}\left(\frac{Average\ peak\ signal\ amplitude\ in\ pulse\ train}{\boldsymbol{Average\ noise\ amplitude}}\right)$$

Typical values for SNR will be from 7 to 55 depending on signal strength and noise conditions. Where 7 is very week signals and 30 and above is strong signals. The scale is logarithmic.

TBR sensor reading

$000004, 0946709700,TBR Sensor,309,1,69, 2330

- $ = Real time data
- 000004 = TBR serial number
- 0946709086 = UTC UNIX timestamp (automatically reset to 1. Jan. 2000 when power is off)

- TBR Sensor = receiver sensor readings (TBR 700 has a factory calibrated temperature chip inside the housing for water temperature documentation, and monitors background noise with the hydrophone)
- 309 = temperature ((data-50)/10 -> °C)
- 1 = Average noise amplitude, range = 1 to 63 (based on ADC samples logged during the last second if no signal is present)
- 69 = TBR listening frequency - kHz
- 2330 = code running entry number in flash memory

Commands

When TBR 700 is in listening mode (normal mode) it responds to the following commands:

1. Request: "?" -> The TBR responds with its serial number: "SN=000004 ><>" Can be used to test communication.
2. Clock sync. designed for very precise timestamps in positioning systems: (only supported by TBR 700 RT):
    a. When "(+)" is sent from connected sync. unit, the receivers' UTC UNIX timestamp is rounded to closest 10. The internal real time clock is also reset so that the timestamp is incremented after exactly 500 ms. The time is therefore in practice synced to XXXXXXXXX0.5. The receiver responds with "S1" if ok.
    b. "(+)123456789X" where X is Luhn's verification number. The 9 first digits is the new UTC UNIX timestamp and it's implied that the least significant digit is 0 (so the actual time given is 1234567890). If the verification number is correct, the timestamp is updated. When the time first is set, the clock should stay synchronized if "(+)" is given regularly. The receiver responds with "S2" if ok. Note: when (+) is received the action of point a. takes place also here.
3. Request: "TBR" -> if the response is "TBR", the receiver has successfully entered command mode. A timer forces the receiver back in listening mode if no command is received during 30 min. The command for reentering listening mode is "EX!". It is important that a connected device makes sure that the receiver is back in listening mode after communicating in command mode ("?" can be used to check if the receiver is in listening mode).

Important: To make sure the TBR has time to do all critical operations, there has to be **1 ms or more** delay between input characters in listing mode. After entering command mode, data can be received at full speed (baud 115200). After activating command mode with "TBR", you can use the following command set:

Get data and settings

Command	Response example	Description
HE?		Print help text
SN?	SN=000004	Serial number
FV?	FV=v1.3	Firmware version
UT?	UT=0946690444	Current UTC Unix timestamp

LM?	LM=00	Current listening mode (00 = 69 kHz normal mode, 01 = freq. can be configured in the range 60 to 80 kHz)
FC?	FC=69	TBR listing freq. in kHz
LI?	LI=01	Logging interval for temperature and noise (00 = never, 01 = once every 5 min. , 02 = 10 min, 03 = 30 min, 04 = 1 hour, 05 = 2 hours , 06 = 12 hours, 07 =24 hours)
TD?	TD=0000020	Total tag detections stored in flash
TS?	TS=0000035	Total TBR sensor logs stored in flash
TL?	TL=0000055	Total number of tag detections and TBR sensor logs stored in flash
MR?	MR=1572816	Max number of tag detections and TBR sensor logs the TBR can store in flash in total
PT?0000001 (use q to quit operation when running)		Print tag data from given code number in flash, same format as real time data but the lines starts with @
PS?0000001 (use q to quit operation when running)		Print TBR Sensor data from given code number in flash, same format as real time data but the lines starts with @
RD?0000001 (use q to quit operation when running)		Print binary data from given code number in flash (contact Thelma Biotel for more info. if this is of interest). The data is transferred in packets with header and checksum.

Set parameters

Command	Response	Description
LM=00	LM=00	Set listening mode (00 = 69 kHz normal mode, 01 = freq. can be configured in the range 60 to 80 kHz)
LI=00	LI=00	Set logging interval (00 = never, 01 = once every 5 min. , 02 = 10 min, 03 = 30 min, 04 = 1 hour, 05 = 2 hours , 06 = 12 hours, 07 =24 hours)
FC=69	FC=69	Set freq. channel (only possible if LM=01)
UT=0946690444	UT=0946690444	Set UTC Unix timestamp

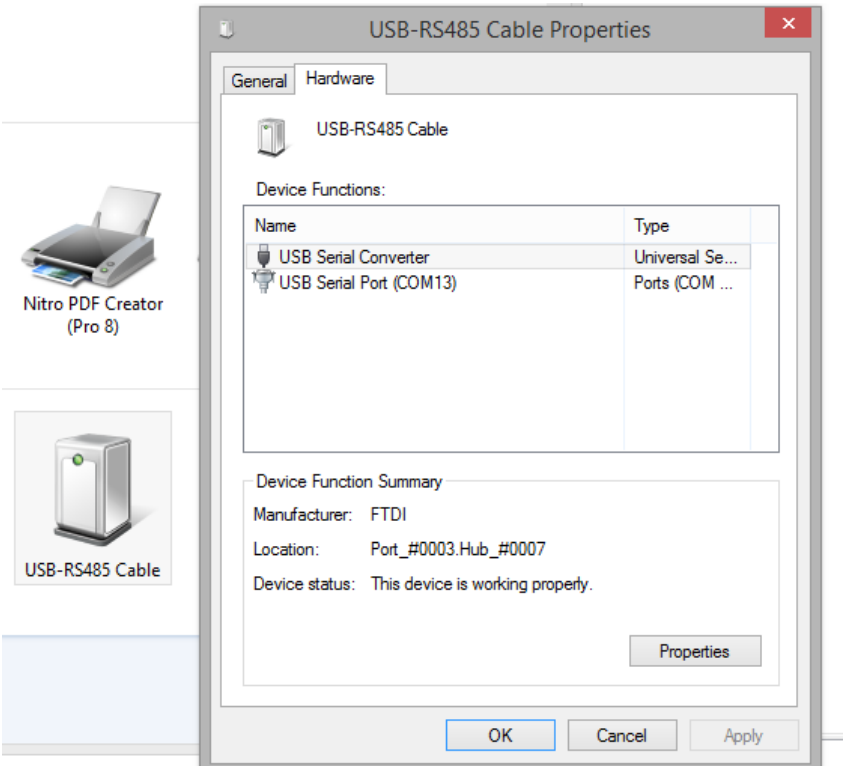
Actions

Command	Response	Description
RR!	RR!	Restart TBR
DD!	DD!	Warning: Deletes all tag detections and TBR sensor logs from flash memory
FS!	FS!	Warning: Restores factory settings and deletes all tag detections and TBR sensor logs from flash memory

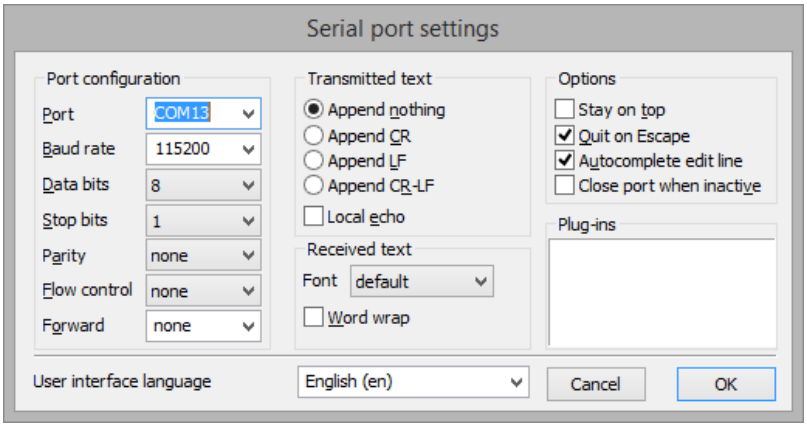
UF!	UF!	Warning: Puts TBR in bootloader mode. Firmware must be written after activating this action.
EX!	EX!	Exit command mode and start listing for signals

Connecting TBR-700 RT to a PC terminal

1. Plug in the USB to RS485 cable
2. Find the right COM port:
    a. Open Control Panel -> Hardware and Sound -> Devices and Printers
    b. Right click the device named “USB-RS485 Cable” and go to Hardware. For this example, the COM port will be 13.



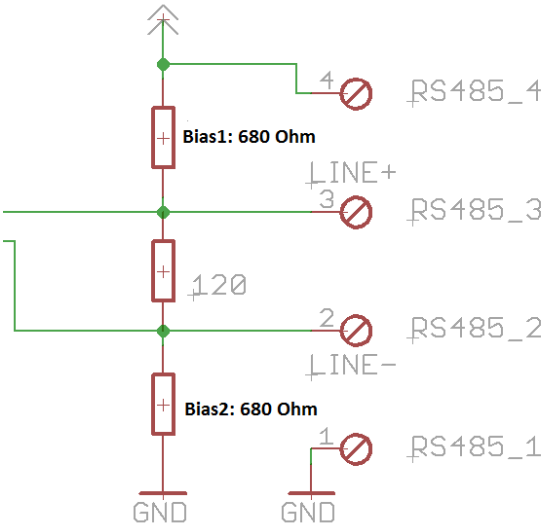
3. Run Termite (no installation needed) and open settings.
   Link: http://www.compuphase.com/software_termite.htm
4. Enter the right com port and the rest of the settings below:



To connect via USB use similar approach, but look for “FT232R USB UART” in devices instead of “USB-RS485 Cable”.

Bias Network – RS-485

To save power when TBR RT works as standalone, there is no bias network on the receiver side. To make sure the lines are in a defined state when no device transmits we recommend to use bias resistors on connected devices. The bias resistors should be chosen so that the offset voltage between Line+ and Line- is >200 mV. This also makes less noise on the transitions between transmit and receive mode:



Connectors – RS-485

Wet connector on receiver:

BH-4-MP Connector, Seacon, WetCon, Bulkhead, Male

1. Gnd
2. RS485+
3. Vcc
4. RS485-

Dry side of the cable:

AMPHENOL TUCHEL C016 30D006 110 10 Circular Connector, Ecomate C016 Series, Pins/male, 6, Socket, Solder, Cable

Pinout:

1. Vcc (5-12VDC), can be left unconnected, the receiver will in that case use the internal battery.
2. Not in use
3. Not in use
4. RS485+
5. RS485-
6. Not in use
7. Gnd