The Synchronization Experts.

MANUAL

TCR180USB-EL Setup Guide

Time Code Receiver

15th October 2020

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint

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2 Important Safety Information

2.1 Important Safety Instructions and Protective Measures

The following safety instructions must be respected in all operating and installation phases of the device. Non-observance of safety instructions, or rather special warnings and operating instructions in product manuals, violates safety standards, manufacturer instructions and proper usage of the device. Meinberg Funkuhren shall not be responsible for any damage arising due to non-observance of these regulations.

Depending on your device or the installed options some information is not valid for your device.

The device satisfies the requirements of the following EU regulations: EMC-Directive, RoHS Directive.

If a procedure is marked with the following signal words, you may only continue, if you have understood and fulfilled all requirements. In this documentation dangers and indications are classified and illustrated as follows:

DANGER!
The signal word indicates an imminently hazardous situation with a high risk level . This notice draws attention to an operating procedure or similar proceedings, of which a non-observance may result in serious personal injury or death .

WARNING!
The signal word indicates a hazard with a medium risk gradient . This notice draws attention to an operating procedure, a procedure or the like which, if not followed, can lead to serious injuries , possibly resulting in death .

CAUTION!
The signal word indicates a hazard with a low risk gradient . This notice draws attention to an operating procedure, a procedure or the like which, if not followed, can lead to minor injuries .

ATTENTION!
This notice draws attention to an operating procedure, a procedure or the like which, if not followed, can cause damage to the product or loss of important data .

2.2 Used Symbols

The following symbols and pictograms are used in this manual. To illustrate the source of danger, pictograms are used, which can occur in all hazard classes.

Symbol	Beschreibung / Description
	IEC 60417-5031 Gleichstrom / *Direct current*
	IEC 60417-5032 Wechselstrom / *Alternating current*
	IEC 60417-5017 Erdungsanschluss / *Earth (ground) terminal*
	IEC 60417-5019 Schutzleiteranschluss / *Protective earth (ground) terminal*
	ISO 7000-0434A Vorsicht / *Caution*
	IEC 60417-6042 Vorsicht, Risiko eines elektrischen Schlages / *Caution, risk of electric shock*
	IEC 60417-5041 Vorsicht, heiße Oberfläche / *Caution, hot surface*
	IEC 60417-6056 Vorsicht, Gefährlich sich bewegende Teile / *Caution, moving fan blades*
	IEC 60417-6172 Trennen Sie alle Netzstecker / *Disconnection, all power plugs*
	IEC 60417-5134 Elektrostatisch gefährdete Bauteile / *Electrostatic Sensitive Devices*
	IEC 60417-6222 Information generell / *Information general*
	2012/19/EU Dieses Produkt fällt unter die B2B Kategorie. Zur Entsorgung muss es an den Hersteller übergeben werden. *This product is handled as a B2B category product. In order to secure a WEEE compliant waste disposal it has to be returned to the manufacturer.*

The manuals for a product are included in the scope of delivery of the device on a USB stick. The manuals can also be obtained via the Internet. Enter www.meinbergglobal.com into your browser, then enter the corresponding device name in the search field at the top.

This manual contains important safety instructions for the installation and operation of the device. Please read this manual completely before using the unit.

This device may only be used for the purpose described in this manual. In particular, the given limits of the device must be observed. The safety of the installation in which the unit is integrated is the responsibility of the installer!

Non-observance of these instructions can lead to a reduction in the safety of this device!

Please keep this manual in a safe place.

This manual is intended exclusively for electricians or persons trained by an electrician who are familiar with the applicable national standards and safety rules. Installation, commissioning and operation of this device may only be carried out by qualified personnel.

2.3 Cleaning and Care

ATTENTION!

Do not wet clean the appliance! Penetrating water can cause considerable dangers to the user (e.g., electric shock).

Liquid can destroy the electronics of the device! Liquid penetrates into the housing of the device and can cause a short circuit of the electronics.

Only clean with a soft, dry cloth. Never use solvents or cleaners.

2.4 Return of Electrical and Electronic Equipment

ATTENTION!

WEEE Directive on Waste Electrical and Electronic Equipment 2012/19 / EU
(WEEE Waste Electrical and Electronic Equipment)

Separate Collection
Product Category: According to the device types listed in the WEEE Directive, Appendix 1, this product is classified as an IT and communication device.

This product meets the labeling requirements of the WEEE Directive. The product symbol on the left indicates that this electronic product must not be disposed of in domestic waste.

Return and Collection Systems
For returning your old equipment, please use the country-specific return and collection systems available to you or contact Meinberg.

The withdrawal may be refused in the case of waste equipment which presents a risk to human health or safety due to contamination during use.

Return of used Batteries
Batteries marked with one of the following symbols may not be disposed of together with the household waste according to the EU Directive.

3 Introduction

This Setup Guide is a systematically structured guide to support you during the initial setup of your Meinberg product. The individual chapters describe general functions, installation and essential technical data. The Setup Guide also describes the most important parameters which have to be configured in the respective management program for a quick startup of your product.

The TCR180USB-EL is a time code receiver for decoding modulated and unmodulated IRIG, AFNOR and IEEE time codes and is used for time synchronization of computers with no serial interface or no available PCI slot. It is also suitable for the verification of time code outputs. The board will be configured by the program MBGMON.

4 General information about time code

The transmission of coded timing signals began to take on widespread importance in the early 1950's. Especially the US missile and space programs were the forces behind the development of these time codes, which were used for the correlation of data. The definition of time code formats was completely arbitrary and left to the individual ideas of each design engineer. Hundreds of different time codes were formed, some of which were standardized by the "Inter Range Instrumentation Group" (IRIG) in the early 60's.

Except these "IRIG Time Codes" other formats, like NASA36, XR3 or 2137, are still in use. The board TCR180USB-EL however only decodes IRIG-A, IRIG-B, AFNOR NFS 87-500 or IEEE1344 formats.

The AFNOR code is a variant of the IRIG-B format. Within this code the complete date is transmitted instead of the "Control Functions" of the IRIG telegram.

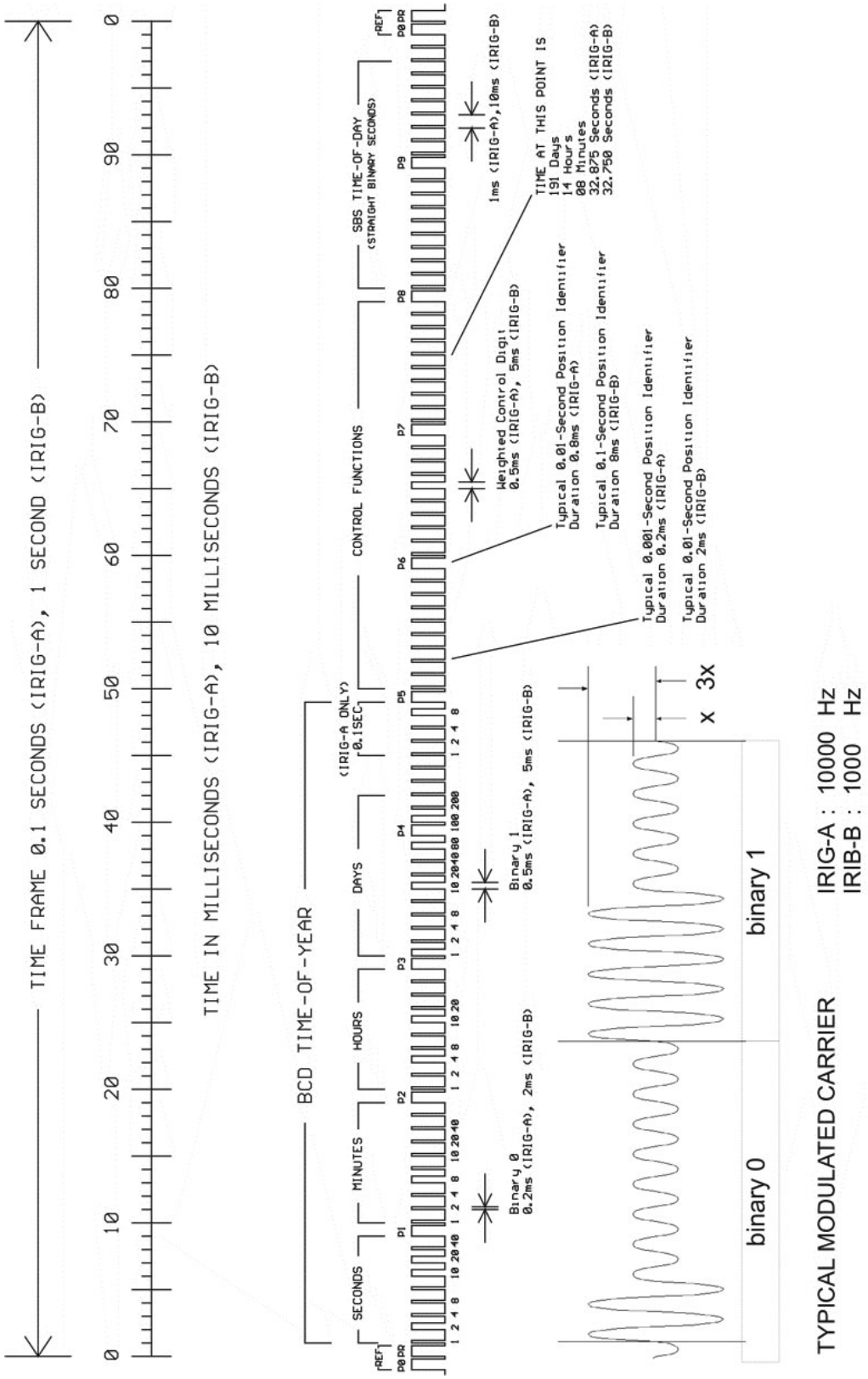
4.1 Description of IRIG-Codes

The specification of individual IRIG time code formats is defined in IRIG Standard 200-04. They are described by an alphabetical character followed by a three-digit number sequence. The following identification is taken from the IRIG Standard 200-98):

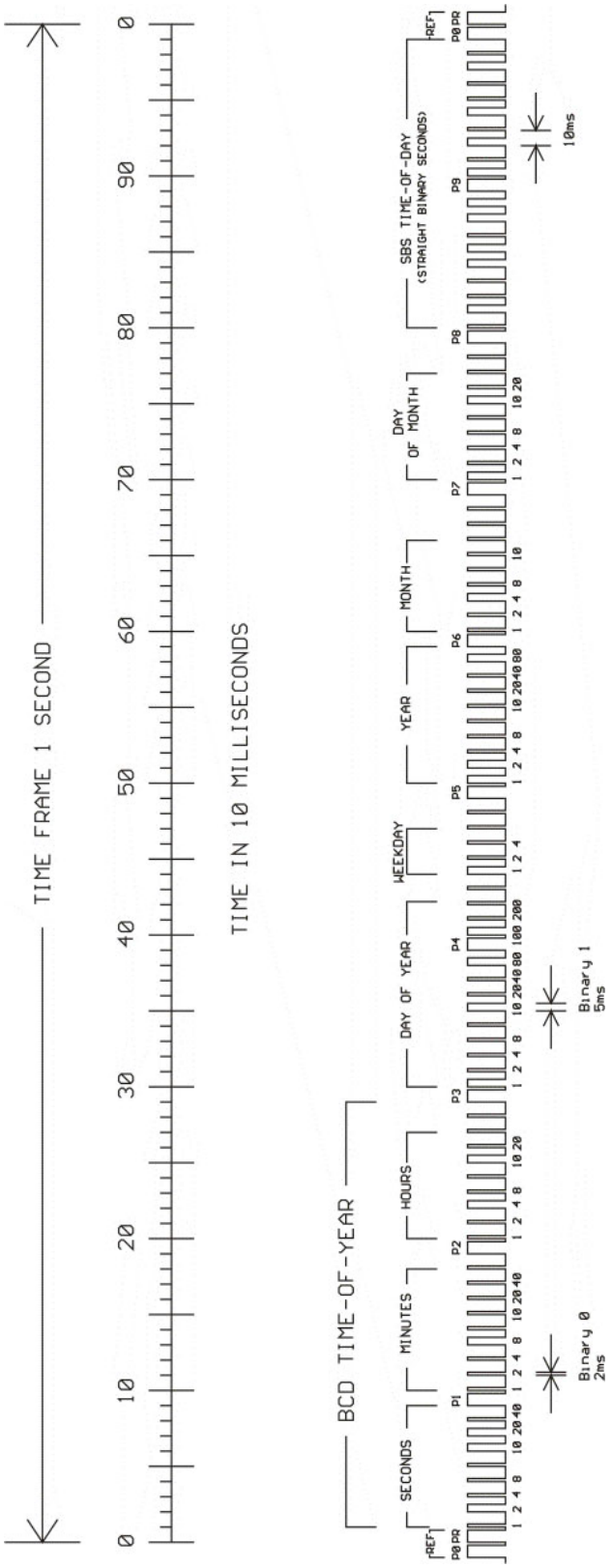
character	bit rate designation	A	1000 pps
		B	100 pps
1st digit	form designation	0	DC Level Shift pulse width modulated
	1	sine wave carrier amplitude modulated	
2nd digit	carrier resolution	0	no carrier (DC Level Shift)
	1	100 Hz, 10 msec resolution	
		2	1 kHz, 1 msec resolution
	3	10 kHz, 100 μsec resolution	
3rd digit	coded expressions	0	$BCD_{(TOY)}$, CF, SBS
		1	$BCD_{(TOY)}$, CF
		2	$BCD_{(TOY)}$
		3	$BCD_{(TOY)}$, SBS
		4	$BCD_{(TOY)}$, $BCD_{(YEAR)}$, CF, SBS
		5	$BCD_{(TOY)}$, $BCD_{(YEAR)}$, SBS
		6	$BCD_{(TOY)}$, $BCD_{(YEAR)}$
		7	$BCD_{(TOY)}$, $BCD_{(YEAR)}$, SBS

BCD:	time of year, BCD-coded
CF:	Control-Functions (user defined)
SBS:	seconds of day since midnight (binary)

4.2 IRIG Standard Format



4.3 AFNOR Standard Format



5 Technical Function TCR180USB-EL

The TCR180USB-EL is an IRIG receiver to be connected to the USB interface of a computer and is used to receive and decode modulated and unmodulated IRIG, AFNOR and IEEE time codes.

With modulated codes, the time information is transmitted by modulating the amplitude of a sine wave carrier. Unmodulated IRIG codes transmit the time information by variation of the width of pulses.

The automatic gain control of the receiver for modulated codes allows the decoding of IRIG signals with an amplitude of the sine carrier of 800 mV_{ss} to 8 V_{ss} . The potential-free signal input via SMB connectors has an impedance of 600 Ω.

The input for unmodulated or 'DC Level Shift' time codes also has an SMB connector. The receiver circuit of the TCR180USB-EL is insulated from the signal input via an integrated optocoupler.

5.1 Functional Description

The received IRIG codes are used to synchronize the internal clock as well as the capacitor-buffered real time clock (RTC) of the TCR180USB-EL, where each received telegram is subjected to a consistency check. If a telegram error is detected, the internal clock switches to free-running mode. In this case the drift of the time base is limited by an oscillator control to about 1 μs/sec.

The IRIG codes do not contain a complete date but only an day of year information, the complete date information is kept in the RTC and in the internal clock of the TCR180USB-EL.

The internal system clock is always set to the received IRIG time, which might have a local offset to UTC. Only if TCR180USB-EL is configured with this offset, Meinberg driver software is able to set the system time of the computer correctly.

IRIG telegrams don't include announcers for the change of time zone (daylight saving on/off) or for the insertion of a leap second. Hence the clock will switch into free running mode in case of such event, and resynchronize afterwards.

The board TCR180USB-EL decodes the following formats:

A133:	1000pps, amplitude modulated sine wave signal, 10 kHz carrier frequency BCD time of year, SBS time of day
A132:	1000pps, amplitude modulated sine wave signal, 10 kHz carrier frequency BCD time of year
A003:	1000pps, DC Level Shift pulse width coded, no carrier BCD time of year, SBS time of day
A002:	1000pps, DC Level Shift pulse width coded, no carrier BCD time of year
B123:	100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency BCD time of year, SBS time of day
B122:	100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency BCD time of year
B003:	100pps,DC Level Shift pulse width coded, no carrier BCD time of year, SBS time of day
B002:	100pps, DC Level Shift pulse width coded, no carrier BCD time of year

B126:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year, Year
B127:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year, Year, SBS time-of-day
B006:	100 pps, DC Level Shift, no carrier BCD time-of-year, Year
B007:	100 pps, DC Level Shift, no carrier BCD time-of-year, Year, SBS time-of-day
AFNOR NFS 87-500:	100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency BCD time of year, complete date, SBS time of day
IEEE 1344:	Code according to IEEE 1344-1995, 100 pps, AM sine wave signal, 1kHz carrier frequency, BCD time-of-year, SBS time-of-day, IEEE 1344 extensions for date, timezone, daylight saving and leap second in control functions (CF) segment. (also see table 'Assignment of CF segment in IEEE 1344 mode')
IEEE C37.118:	Like IEEE 1344 - with UTC offset to be applied reversely

Additional codes are available on request

5.2 Internal RTC

If the power supply of the TCR180USB-EL is interrupted the internal RTC continues to run on quartz basis. In this case the power supply of the clock will be provided by a built-in capacitor which has been charged via the USB power supply. This allows an independent power supply of the internal clock for about five days.

At restarting the TCR180USB-EL the time/date will be read once from the internal RTC and set as system time of the TCR180USB-EL. After five days the TCR180USB-EL cannot read out the correct time and date from the internal clock during the start procedure and consequently is not able to synchronize correctly to the received IRIG telegram. In this case it is necessary to set the date and time of the internal clock manually with the monitor program (see Configuration of the TCR180USB-EL).

5.3 Input signals

Amplitude modulated and Pulse width modulated signals IRIG-A/B (or AFNOR) codes must be connected to the SMB-jack connector in the housing of TCR180USB-EL. A shielded or a twisted pair cable should be used. The IRIG code used must be configured with the monitor software.

The board TCR180USB-EL can't be used to decode amplitude modulated and DC Level Shift signals simultaneously. Depending on the selected code, only the signal at the SMB-connector is decoded.

5.4 Input Impedance

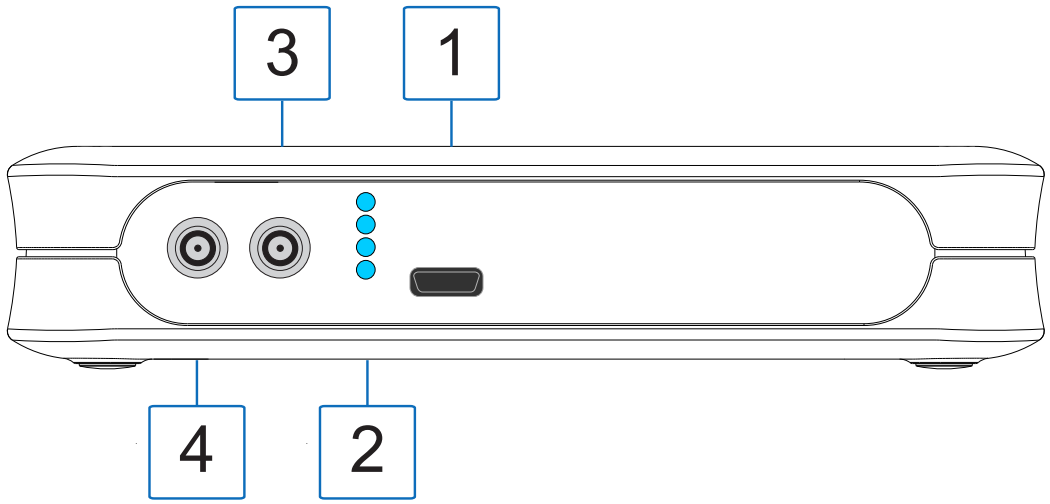
The IRIG specification does not define values for the output impedance of the transmitter or the input impedance of the receiver for modulated codes. As a result, the manufacturers of IRIG components have been free to choose these values, which means that not all devices are compatible with each other. For example, if the generator has a high output impedance and the IRIG reader has a low input impedance, the signal level at the receiver input may be too low for the evaluation. Please refer to chapter 6.3 or 6.4 for the input impedances of the respective signal input.

5.5 Optocoupler Input

Pulse width modulated (DC Level Shift) codes are insulated by an onboard photocoupler.

The internal series impedance allows direct operation with input signals that have a maximum high level of +12 V (e.g. TTL or RS-422). For higher signal voltages, an additional series resistor must be provided externally so that the maximum diode current of 50 mA is not exceeded. At the same time, the series resistor should be dimensioned in such a way that at least a current of 10 mA flows, so that a safe through-connection of the optocoupler is guaranteed.

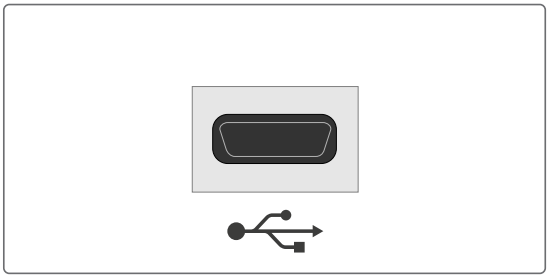
6 TCR180 USB Connectors



6.1 USB 2.0 high speed Interface

Power supply: 5 V DC via USB

Connection type: micro-USB type B



6.2 TCR180USB-EL Status LEDs

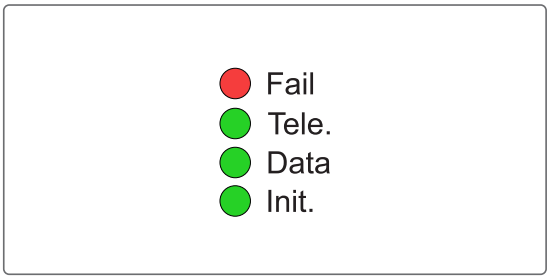
LED Indicators

Fail: red: Time Sync Error

Tele.: green: Time Code data consistent
red: Time Code data inconsistent

Data: green: IRIG data available
rot: IRIG data not available
yellow: Jitter to large

Init: blue: while the receiver passes through the initialization phase
green: the oscillator has warmed up



6.3 Time Code DCLS (unmodulated) Input

Input signal: Time Code DCLS, pulse-width modulated (e.g. IRIG-B00x)

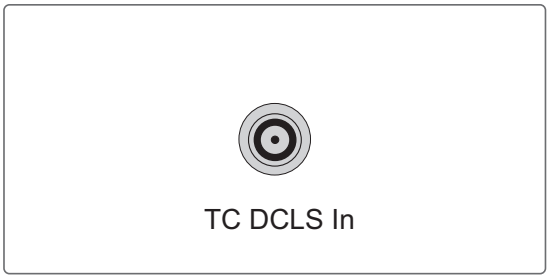
Isolation voltage: 3750 V_{rms}

internal resistance: 330 Ohm

max. input current: 25 mA

Connection type: SMB male

Cable: shielded coax line



6.4 Time Code AM (modulated) Input

Signal output: Time Code AM (amplitude modulated sine wave signal)

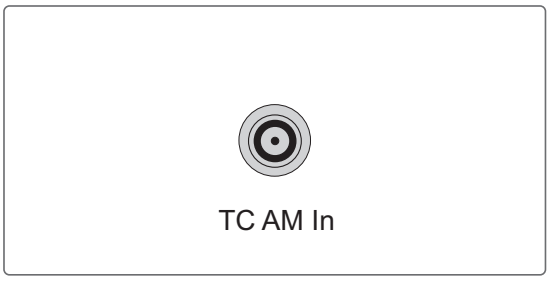
Signal level: 800 mV_{ss} / 8 V_{ss} (MARK/SPACE)

impedance: std. 600 Ohm
(optional 50 Ohm / 5 kOhm)

Isolation Voltage: 3000 V DC

Connection type: SMB male

Cable: shielded coax line



7 Before you start

7.1 Scope of delivery

Included in delivery of a TCR180USB-EL:

1. TCR180USB-EL
2. 1 x 1 m cable RG174 (SMB-female - BNC female)
3. 1 x 1.8 m USB interface cable (USB-A - micro USB-B)
4. 1 x USB stick (driver software)

Carefully unpack the product and all accessories and put them aside. Check the scope of delivery with the packing list to ensure that no parts are missing. If any of the listed contents are missing, please contact Meinberg Funkuhren.

Check the system for shipping damage. If the system is damaged or cannot be put into operation, contact Meinberg Funkuhren immediately. Only the recipient (the person or company receiving the system) can assert a claim against freight forwarder for shipping damage.

Meinberg recommends that you keep the original packaging materials for possible future transport.

7.2 Disposal of Packaging Materials

The packaging materials we use are fully recyclable:

Material	Use for	Disposal
Cardboard	shipping packaging, accessories packaging	Paper recycling
Foil	shipping packaging, accessories packaging	Household waste or recycling depot

7.3 Download MBGMON

The configuration as well as the status monitoring of the TCR180USB-EL is performed by the Meinberg Clock Monitor (MBGMON) program.

Windows:

You can download the MBGMON for free from the Meinberg homepage. Click on the following link to download the program.

Download: https://www.meinbergglobal.com/english/sw/#win

Linux operating system:

If you are using Linux as operating system, you can find the latest Linux driver under the following link.

https://www.meinbergglobal.com/english/sw/#linux

8 System Installation

8.1 Connecting the System

First connect the reference signals (TC AM or TC DCLS) and the management interface/power supply (USB connection) to the TCR180USB-EL. The initialisation phase starts automatically after the USB connection has been established (Init LED blue).

Application example:
The following schematic diagram shows a TCR180USB-EL whose synchronization is performed by using the time code outputs of an M300/GPS/TC-1-1.

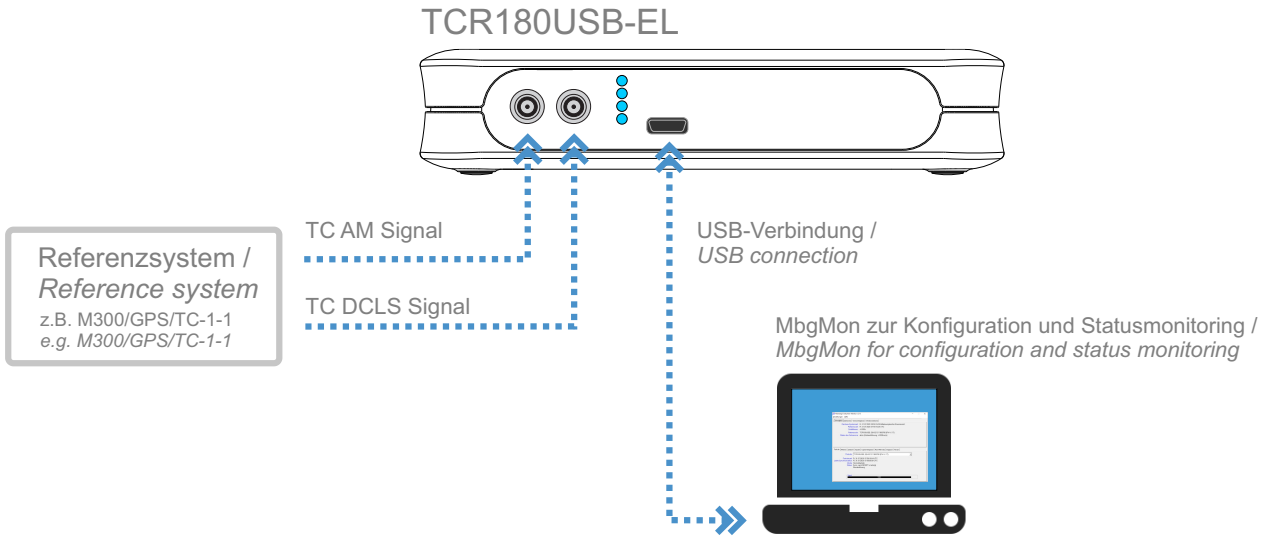
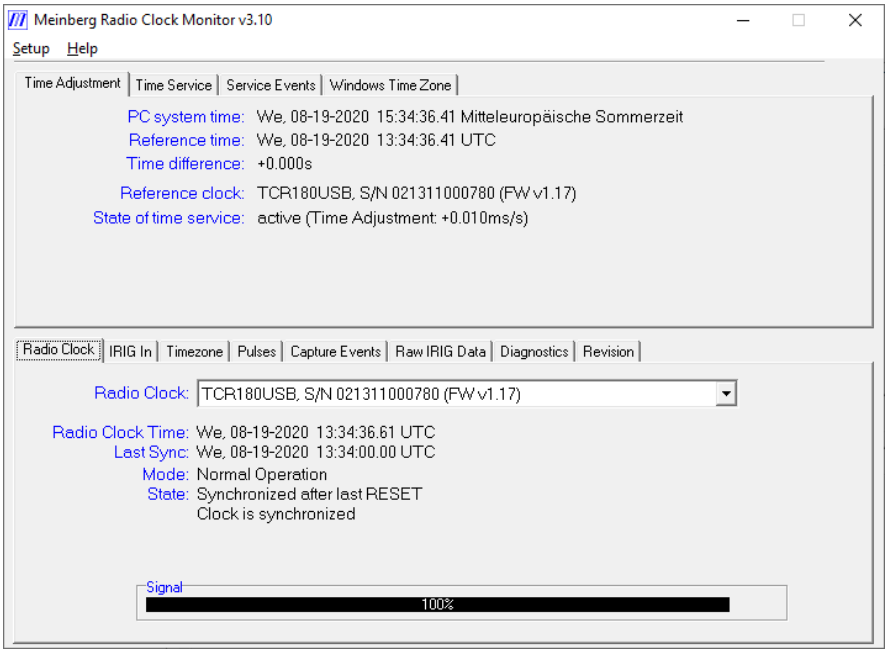


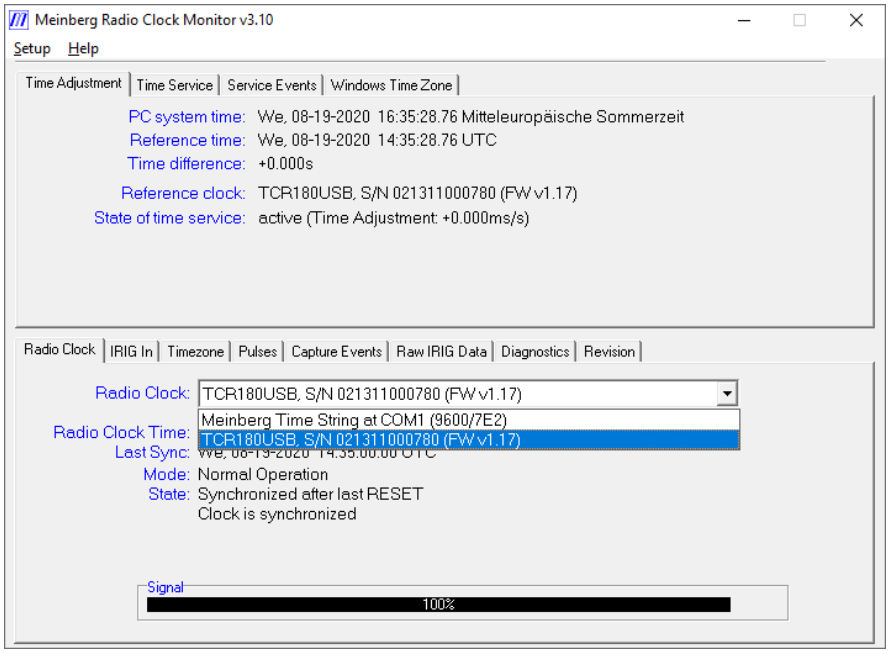
Figure: Synchronization of the TCR180USB-EL via an M300/GPS/TC-1-1 as reference system

9 Put the TCR180USB-EL into operation

This chapter explains how to put a TCR180USB-EL into operation via the management programm MBGMON. If your computer is running Windows 7 or later, the MBGMON program must be started as "Admin". Please right click on the program and select "Run as Administrator".



9.1 Configuration of TCR180USB-EL



The configuration of the TCR180USB-EL is done in the lower section of the MBGMON program.

First click on the tab "Radio Clock" and select the TCR180USB in the drop-down menu. Status information of the selected radio-controlled clock (e.g. TCR180USB, TCR180PEX) are displayed below.

Radio clock time:	The IRIG time currently received by the selected radio-controlled clock
Last sync:	Time of the last synchronization
Mode:	Current mode of the radio-controlled clock
Status:	Sync after RESET has occurred
Transmitter guidance Signal	Signal input receives valid IRIG signal
Radio clock runs quartz-based	Signal input does not receive a valid IRIG signal

1. Selection of the time code

Click the "IRIG IN" tab and select the time code format from the drop-down menu

To allow the TCR180USB-EL to use all time code telegram information received from the reference system, both the time code output of the generator and the corresponding time input of the TCR180USB-EL must be set identically.

Example:
TC-AM output of the reference system and TC-AM input of the TCR180USB-EL on AM code **B127**

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2. Set the offset

Enter the necessary IRIG offset.

It is recommended to transmit and receive the time code as UTC time. The operating system (e.g. Windows) itself has a time zone option to set the system time accordingly. If the reference system (e.g. LANTIME M300) sends the time code with a time zone offset, this offset must be entered in the MBGMON in IRIG Offset.

This is necessary if the time zone of the created IRIG or AFNOR code does not correspond to UTC time to ensure correct functioning of the driver software.

For example:
The time zone of the IRIG code is CET, the TCR180USB-EL must be set to the local offset '+60min' (CET = UTC + 1h).

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3. Manually setting the system time of the TCR180USB-EL

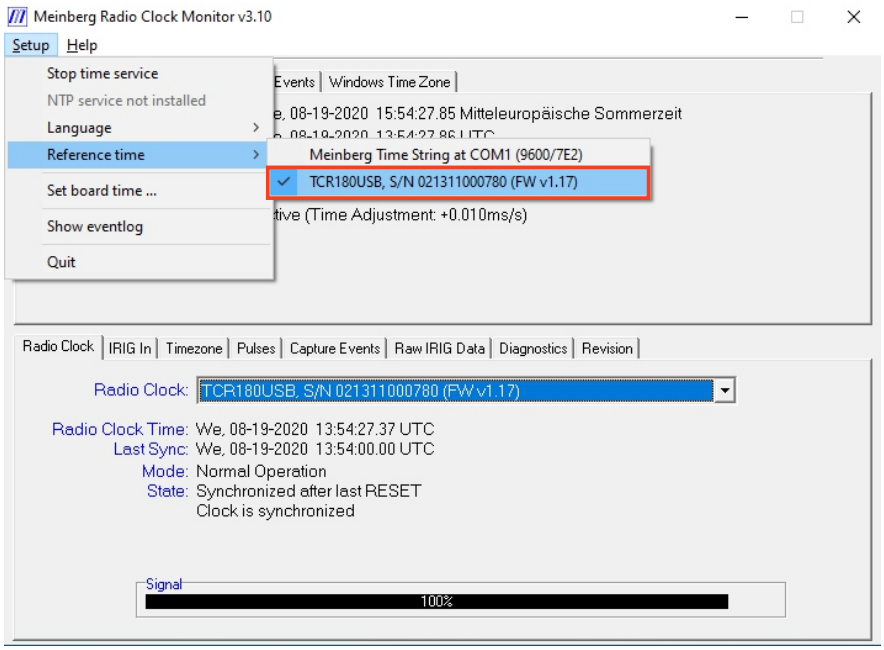
The date of the system clock must be set correctly when operating with an IRIG code, because IRIG codes, unlike AFNOR NFS 87-500 and IEEE1344, do not contain a complete Gregorian date but only the day number within the current year (1..366).

1. Click on "Settings" and then on "Set board Time"

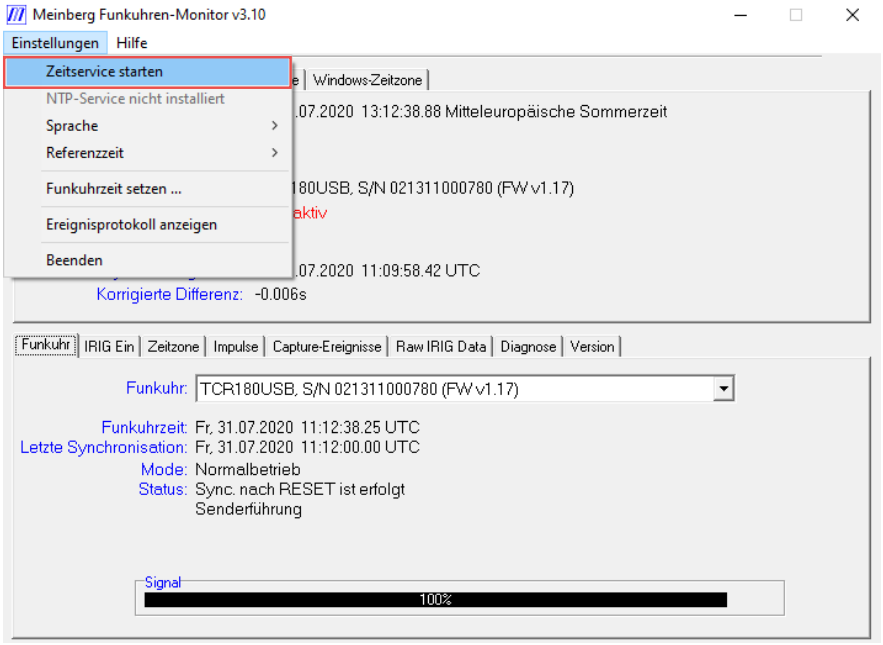
2. Set the date and time in the dialog box and confirm with "Set"

9.2 Set TCR180USB-EL as reference

After the configuration is completed, the TCR180USB-EL can be selected as reference source for the connected computer. Go to Settings –> Reference Time and select the TCR180USB-EL to use it for synchronizing the computer (see figure).



Start timeservie



After all necessary IRIG settings have been made, the time service can be started.

To do this, click on "Start time service". The previously selected reference clock is used for the synchronization of the computer time.

Status information:

The Tab "Time adjustment" gives a first overview of the computer system time and the time of the reference source (e.g., TCR180USB-EL), as well as its current time difference.

Reference clock:	Selected reference clock for computer synchronization
Status of time service:	
Active	Active The reference clock currently provides the time to the computer
disabled	Time service stopped
waiting for reference time...	Time service started but interrupted connection to clock
System time set:	Transmitted time information when setting the computer time by the TCR180USB-EL
Corrected offset	The corrected offset between computer time and reference time of the TCR180USB-EL

10 Technical Specifications TCR180USB-EL

Receiver Input:	AM-input:	
	Insulated by transformer	
	impedance:	600 Ω
	Input signal:	800 mV_{pp} to 8 V_{pp} (Mark)
		other ranges on request
	DC-Level Shift Input:	
	insulated by photocoupler	
	internal series resistance:	220 Ω
	maximum forward current:	50 mA
	diode forward voltage:	1.0 V...1.3 V
Decoding:	Decoding of the following codes possible : IRIG-A002/A003/A132/A133 IRIG-B002/B003/B006/B007/B122/B123/B126/B127 AFNOR NFS 87-500 IEEE 1344, IEEE C37.118	
Accuracy of Time Base:	± 1 μsec compared to IRIG reference marker	
Required Accuracy of Time Code Source:	± 100 ppm	
Holdover Mode:	Automatic switching to crystal time base, accuracy approximately 2E-9 if decoder has been synchronous for more than 1h	
Reliability of Operation:	Microprocessor supervisory circuit provides watch dog timer, power supply monitoring and backup-battery switchover software watchdog monitors correct program flow and generates a reset in case of error detection	
Power Requirements:	via USB: +5 V, approx. 80 mA	
Housing Dimensions:	73 mm x 117 mm x 24 mm (L X B X H)	
Ambient Temperature:	0...50 °C	
Humidity:	Max. 85 %	

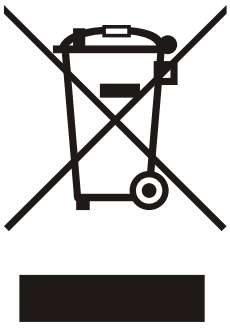
11 RoHS and WEEE

Compliance with EU Directive 2011/65/EU (RoHS)

We hereby declare that this product is conform to the European Directive 2011/65/EU and its delegated directive 2015/863/EU "Restrictions of Hazardous Substances in Electrical and Electronic Equipment". We ensure that electrical and electronic products sold in the EU do not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs), Bis (2-ethylhexyl)phthalat (DEHP), Benzylbutylphthalat (BBP), Dibutylphthalat (DBP), Diisobutylphthalat (DIBP), above the legal threshold.

WEEE status of the product

This product is handled as a B2B (Business to Business) category product. In order to secure a WEEE compliant waste disposal it has to be returned to the manufacturer. Any transportation expenses for returning this product (at its end of life) have to be incurred by the end user, whereas Meinberg will bear the costs for the waste disposal itself.



12 Declaration of Conformity

Declaration of Conformity

Doc ID: -2020-10-15

Hersteller *Manufacturer*	Meinberg Funkuhren GmbH & Co. KG Lange Wand 9, D-31812 Bad Pyrmont

erklärt in alleiniger Verantwortung, dass das Produkt,
declares under its sole responsibility, that the product

Produktbezeichnung *Product Designation*	**TCR180USB-EL**

auf das sich diese Erklärung bezieht, mit den folgenden Normen und Richtlinien übereinstimmt:
to which this declaration relates is in conformity with the following standards and provisions of the directives:

EMV – Richtlinie *EMC – Directive* 2014/30/EU	DIN EN 61000-6-2:2019 DIN EN 61000-6-3:2007 + A1:2011 DIN EN 55032:2015 DIN EN 55024:2010 + A1:2015
RoHS – Richtlinie *RoHS – Directive* 2011/65/EU + 2015/863/EU	DIN EN 50581:2012

Bad Pyrmont, 2020-10-15

S. Meinberg

Stephan Meinberg
Production Manager