MANUAL

TCR180USB

Time Code Receiver

April 23, 2024

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint

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You may also write to **techsupport@meinberg.de** to request an updated version at any time or provide feedback on errors or suggested improvements, which we are grateful to receive.

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3 Change Log

Version	Date	Revision Notes
1.00	3/3/2023	Initial Version

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5 Presentation Conventions in this Manual

5.1 Conventions for the Presentation of Critical Safety Warnings

Warnings are indicated with the following warning boxes, using the following signal words, colors, and symbols:

Caution!

This signal word indicates a hazard with a **low risk level**. Such a notice refers to a procedure or other action that may result in **minor injury** if not observed or if improperly performed.

Warning!

This signal word indicates a hazard with a **medium risk level**. Such a notice refers to a procedure or other action that may result in **serious injury** or even **death** if not observed or if improperly performed.

Danger!

This signal word indicates a hazard with a **high risk level**. Such a notice refers to a procedure or other action that will very likely result in **serious injury** or even **death** if not observed or if improperly performed.

5.2 Secondary Symbols Used in Safety Warnings

Some warning boxes may feature a secondary symbol that emphasizes the defining nature of a hazard or risk.

The presence of an "electrical hazard" symbol is indicative of a risk of electric shock or lightning strike.

The presence of a "fall hazard" symbol is indicative of a risk of falling when performing work at height.

This "laser hazard" symbol is indicative of a risk relating to laser radiation.

5.3 Conventions for the Presentation of Other Important Information

Beyond the above safety-related warning boxes, the following warning and information boxes are also used to indicate risks of product damage, data loss, and information security breaches, and also to provide general information for the sake of clarity, convenience, and optimum operation:

Important!

Warnings of risks of product damage, data loss, and also information security risks are indicated with this type of warning box.

Information:

Additional information that may be relevant for improving efficiency or avoiding confusion or misunderstandings is provided in this form.

5.4 Generally Applicable Symbols

The following symbols and pictograms are also used in a broader context in this manual and on the product.

The presence of the "ESD" symbol is indicative of a risk of product damage caused by electrostatic discharge.

Direct Current (DC) *(symbol definition IEC 60417-5031)*

Alternating Current (AC) *(symbol definition IEC 60417-5032)*

Grounding Terminal *(symbol definition IEC 60417-5017)*

Protective Earth Connection *(symbol definition IEC 60417-5019)*

Disconnect All Power Connectors *(symbol definition IEC 60417-6172)*

6 Important Safety Information

The safety information provided in this chapter as well as specific safety warnings provided at relevant points in this manual must be observed during every installation, set-up, and operation procedure of the device, as well as its removal from service.

Any safety information affixed to the product itself must also be observed.

Any failure to observe this safety information, these safety warnings, and other safety-critical operating instructions in the product documentation, or any other improper usage of the product may result in unpredictable behavior from the product, and may result in injury or death.

Depending on your specific device configuration and installed options, some safety information may not be applicable to your device.

Meinberg accepts no responsibility for injury or death arising from a failure to observe the safety information, warnings, and safety-critical instructions provided in the product documentation.

It is the responsibility of the operator to ensure that the product is safely and properly used.

Should you require additional assistance or advice on safety-related matters for your product, Meinberg's Technical Support team will be happy to assist you at any time. Simply send a mail to **techsupport@meinberg.de**.

6.1 Appropriate Usage

The device must only be used appropriately in accordance with the specifications of the product documentation! Appropriate usage is defined exclusively by this manual as well as any other relevant documentation provided directly by Meinberg.

Appropriate usage includes in particular compliance with specified limits! The device's operating parameters must never exceed or fall below these limits!

6.2 Product Documentation

The information in this manual is intended for readers with an appropriate degree of safety awareness.

The following are deemed to possess such an appropriate degree of safety awareness:

- **skilled personnel** with a familiarity with relevant national safety standards and regulations,
- **instructed personnel** having received suitable instruction from skilled personnel on relevant national safety standards and regulations

Read the product manual carefully and completely before you set the product up for use.

If any of the safety information in the product documentation is unclear for you, do **not** continue with the set-up or operation of the device!

Safety standards and regulations change on a regular basis and Meinberg updates the corresponding safety information and warnings to reflect these changes. It is therefore recommended to regularly visit the Meinberg website at **https://www.meinbergglobal.com** or the Meinberg Customer Portal at **https://meinberg.support** to download up-to-date manuals.

Please keep all product documentation, including this manual, in a safe place in a digital or printed format to ensure that it is always easily accessible.

Meinberg's Technical Support team is also always available at **techsupport@meinberg.de** if you require additional assistance or advice on safety aspects of your system.

6.3 Safety during Installation

This rack-mounted device has been designed and tested in accordance with the requirements of the standard IEC 62368-1 (*Audio/Video, Information and Communication Technology Equipment—Part 1: Safety Requirements*). Where the rack-mounted device is to be installed in a larger unit (such as an electrical enclosure), additional requirements in the IEC 62368-1 standard may apply that must be observed and complied with. General requirements regarding the safety of electrical equipment (such as IEC, VDE, DIN, ANSI) and applicable national standards must be observed in particular.

The device has been developed for use in industrial or commercial environments and may only be used in such environments. In environments at risk of high environmental conductivity ("high pollution degree" according to IEC 60664-1), additional measures such as installation of the device in an air-conditioned electrical enclosure may be necessary.

If the unit has been brought into the usage area from a cold environment, condensation may develop; in this case, wait until the unit has adjusted to the temperature and is completely dry before setting it up.

When unpacking & setting up the equipment, and before operating it, be sure to read the information on installing the hardware and the specifications of the device. These include in particular dimensions, electrical characteristics, and necessary environmental conditions.

Fire safety standards must be upheld with the device in its installed state—never block or obstruct ventilation openings and/or the intakes or openings of active cooling solutions.

The device with the highest mass should be installed at the lowest position in the rack in order to position the center of gravity of the rack as a whole as low as possible and minimize the risk of the rack tipping over. Further devices should be installed from the bottom, working your way up.

The device must be protected against mechanical & physical stresses such as vibration or shock.

Never drill holes into the device to mount it! If you are experiencing difficulties with rack installation, contact Meinberg's Technical Support team for assistance!

Inspect the device housing before installation. The device housing must be free of any damage when it is installed.

6.4 Electrical Safety

This Meinberg product is operated at a hazardous voltage.

This system may only be set up and connected by skilled personnel, or by instructed personnel who have received appropriate technical & safety training from skilled personnel.

Custom cables may only be assembled by a qualified electrician.

Never work on cables carrying a live current!

Never use cables or connectors that are visibly damaged or known to be defective! Faulty, defective, or improperly connected shielding, connectors, or cables present a risk of injury or death due to electric shock and may also constitute a fire hazard!

Before operating the device, check that all cables are in good order. Ensure in particular that the cables are undamaged (for example, kinks), that they are not wound too tightly around corners, and that no objects are placed on the cables.

Cables must be laid in such a way that they do not present a tripping hazard.

The power supply should be connected using a short, low-inductance cable. Avoid the use of power strips or extension cables if possible. If the use of such a device is unavoidable, ensure that it is expressly rated for the rated currents of all connected devices.

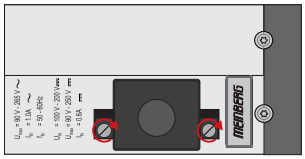
Never connect or disconnect power, data, or signal cables during a thunderstorm! Doing so presents a risk of injury or death, as cables and connectors may conduct very high voltages in the event of a lightning strike!

Device cables must be connected or disconnected in the order specified in the user documentation for the device. Connect all cables only while the device is de-energized before you connect the power supply.

Always pull cable connectors out at **both** ends before performing work on connectors! Improperly connecting or disconnecting this Meinberg system may result in electric shock, possibly resulting in injury or death!

When pulling out a connector, **never** pull on the cable itself! Pulling on the cable may cause the plug to become detached from the connector or cause damage to the connector itself. This presents a risk of direct contact with energized components.

5-Pin MSTB Connector



3-Pin MSTB Connector

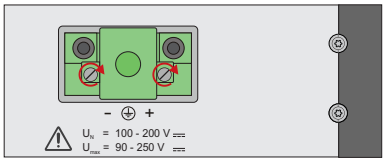


Illustration: Lock screws on an MSTB plug connector; in this case on a LANTIME M320

Ensure that all plug connections are secure. In particular, when using plug connectors with lock screws, ensure that the lock screws are securely tightened. This is especially important for power supply connectors where 3-pin or 5-pin MSTB connectors with lock screws are used (see illustration).

Before the device is connected to the power supply, the device housing must be grounded by connecting a grounding cable to the grounding terminal of the device.

When installing the device in an electrical enclosure, it must be ensured that adequate clearance is provided, minimum creepage distances to adjacent conductors are maintained, and that there is no risk of short circuits.

Protect the device from the ingress of objects or liquids!

If the device malfunctions or requires servicing (for example, due to damage to the housing, power supply cable, or the ingress of liquids or objects), the power supply may be cut off. In this case, the device must be isolated immediately and physically from all power supplies! The following procedure must be followed in order to correctly and reliably isolate the device:

- Pull the power supply plug from the power source.
- Loosen the locking screws of the MSTB power supply plug on the device and pull it out of the device.
- Contact the person responsible for your electrical infrastructure.
- If your device is connected to one or more uninterruptible power supplies (UPS), the direct power supply connection between the device and the UPS solution must be first be disconnected.

6.5 Safety when Maintaining and Cleaning the Device

Only use a soft, dry cloth to clean the device.

Never use liquids such as detergents or solvents to clean the device! The ingress of liquids into the device housing may cause short circuits in the electronic circuitry, which in turn can cause a fire or electric shock!

Neither the device nor its individual components may be opened. The device or its components may only be repaired by the manufacturer or by authorized personnel. Improperly performed repairs can put the user at significant risk!

In particular, **never** open a power supply unit or module, as hazardous voltages may be present within the power supply device even after it is isolated from the upstream voltage. If a power supply unit or module is no longer functional (for example due to a defect), it can be returned to Meinberg for repair.

Some components of the device may become very hot during operation. Do not touch these surfaces!

If maintenance work is to be performed on the device and the device housing is still hot, switch off the device beforehand and allow it to cool.

7 Important Product Information

7.1 CE Marking

This product bears the CE mark as is required to introduce the product into the EU Single Market.

The use of this mark is a declaration that the product is compliant with all requirements of the EU directives effective and applicable as at the time of manufacture of the product.

These directives are listed in the EU Declaration of Conformity, appended to this manual as Chapter 18.

7.2 UKCA Marking

This product bears the British UKCA mark as is required to introduce the product into the United Kingdom (excluding Northern Ireland, where the CE marking remains valid).

The use of this mark is a declaration that the product is in conformity with all requirements of the UK statutory instruments applicable and effective as at the time of manufacture of the product.

These statutory instruments are listed in the UK Declaration of Conformity, appended to this manual as Chapter 19.

7.3 Ensuring the Optimum Operation of Your Device

- Ensure that ventilation slots are not obscured or blocked by dust, or else heat may build up inside the device. While the system is designed to shut down safely and automatically in the event of temperature limits being exceeded, the risk of malfunctions and product damage following overheating cannot be entirely eliminated.
- The device is only deemed to be appropriately used and EMC limits (electromagnetic compatibility) are only deemed to be complied with while the device housing is fully assembled in order to ensure that requirements pertaining to cooling, fire safety, electrical shielding and (electro)magnetic shielding are upheld.

7.4 Maintenance and Modifications

Important!

Before performing any maintenance work on or authorized modification to your Meinberg system, we recommend making a backup of any stored configuration data (e.g., to a USB flash drive from the Web Interface).

7.5 Disposal

Disposal of Packaging Materials

The packaging materials that we use are fully recyclable:

Material	Use for	Disposal
Polystyrene	Packaging frame/filling material	Recycling Depot
PE-LD (Low-density polyethylene)	Accessories packaging, bubble wrap	Recycling Depot
Cardboard	Shipping packaging, accessories	Paper Recycling

For information on the proper disposal of packaging materials in your specific country, please inquire with your local waste disposal company or authority.

Disposal of the Device

This product falls under the labeling obligations of the Waste Electrical and Electronic Equipment Directive 2012/19/EU ("*WEEE Directive*") and thus bears this WEEE symbol. The presence of this symbol indicates that this electronic product may only be disposed of in accordance with the following provisions.

Important!

Do not dispose of the product via the household waste. Inquire with your local waste disposal company or authority on how to best dispose of the product if necessary.

This product is considered to be a "**B2B**" product for the purposes of the WEEE Directive and is also classified as "**IT and Telecommunications Equipment**" in accordance with Annex I of the Directive.

It can be returned to Meinberg for disposal. Any transportation expenses for returning this product (at end-of-life) must be covered by the end user, while Meinberg will bear the costs for the waste disposal itself. If you wish for Meinberg to handle disposal for you, please get in touch with us. Otherwise, please use the return and collection systems provided within your country to ensure that your device is disposed of in a compliant fashion to protect the environment and conserve valuable resources.

8 Introduction

This manual is a systematically structured guide designed to assist you with the set-up of your Meinberg product.

The TCR180USB is a **time code receiver** for decoding amplitude-modulated (AM) and pulse-width modulated DC Level Shift (DCLS) IRIG, AFNOR, and IEEE time codes. It is designed to be powered by and transmit data over USB interfaces and can be used to synchronize a directly connected PC, even if the PC has no dedicated RS-232 interface or available PCI slot. The module is powered via the USB interface and it is therefore not necessary to provide an external power source.

The basic TCR180USB-EL model operates exclusively as a time code receiver. A model of the TCR180USB is also available that is operable as a **time code generator**, allowing time code signals, programmable pulses, and other synchronization signals (based on TTL levels) to be output. The device is configured under Windows using the Meinberg Monitoring Tool **MbgMon**, which is included in the free driver package, or using the command-line tool **mbgtools**, which is available for both Linux and Windows.

This compact device features a plastic housing that hosts both the receiver and power supply unit. Four LEDs provide status information on time code reception, the synchronization state, and more.

Manual Revisions

Meinberg products are subject to ongoing development even after their market release, with new features and enhancements added on a regular basis via firmware and software updates. Meinberg also revises its product manuals to account for these feature updates.

This version of the manual has been prepared based on the feature set provided by **Firmware Version 2.21** of your TCR180USB as well as **MbgMon Version 3.15**. When using a different version of the software or firmware, there may be noticeable differences, for example in the presentation and availability of configuration and monitoring options as shown in Chapter 13 ("**Before You Start**").

9 Before You Start

9.1 Unpacking

A TCR180USB is shipped as standard with the following:

1 x 1 m RG174 Cable (SMB, Female – BNC, Female)
1 x 1.8 m USB Interface Cable (USB Type-A – Micro-USB-B)

Carefully unpack the product and all accessories and place them to one side. Compare the contents of the shipment with the enclosed packing list to ensure that nothing is missing. If anything in the packing list is missing, please contact Meinberg.

Check that the product has not been damaged in transit. If the product is damaged or fails to operate upon installation, please contact Meinberg immediately. Only the recipient (the person or company receiving the system) may file claims or complaints against the forwarder for damage caused in transit.

Meinberg recommends that you keep the original packaging materials in case the product needs to be shipped or transported again at a later date.

9.2 Downloading the Monitoring Utility (MbgMon)

The TCR180USB is configured and monitored using the Meinberg Monitoring Utility "MbgMon".

Windows:
The driver package can be downloaded free of charge from the Meinberg website:

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

Command-Line Tools

https://kb.meinbergglobal.com/kb/driver_software/driver_software_for_windows/mbgtools_for_windows

Users of Linux-Based Operating Systems:
When using a Linux-based operating system (a "Linux distribution"), you can download the most up-to-date Linux drivers from the link below:

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

10 TCR180USB Connectors

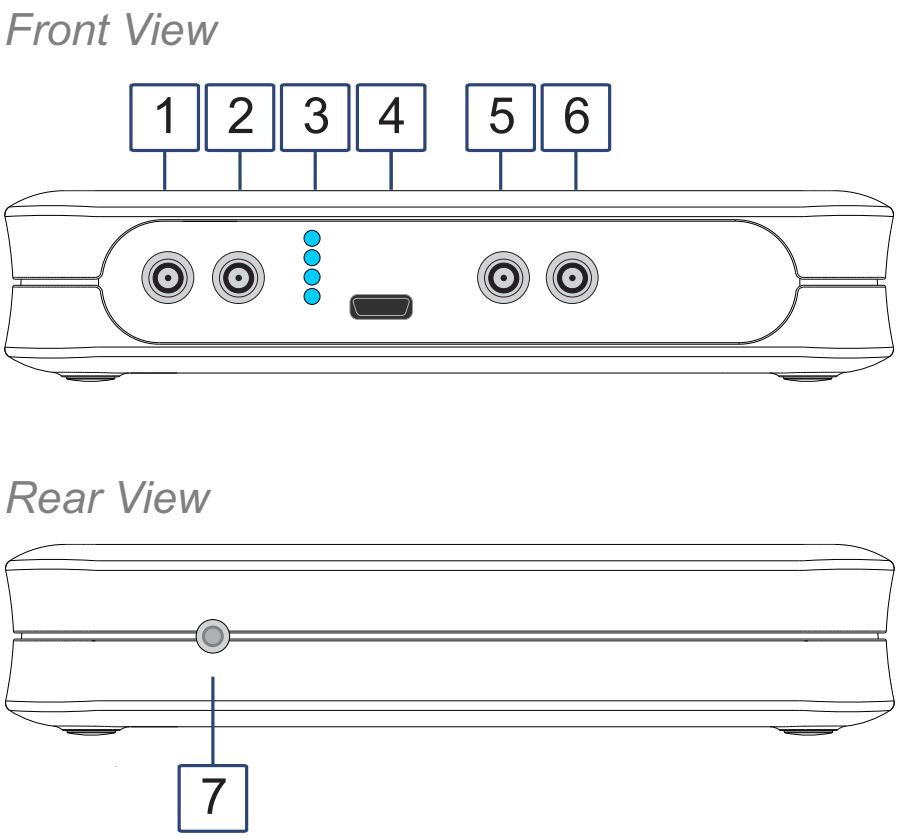
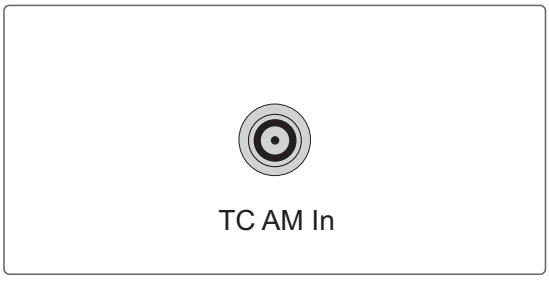


Illustration: A TCR180USB with 1x DCLS TC Input, 1x AM TC Input, 2x Outputs (Prog. Pulse Signals, AM Time Code).

10.1 Time Code AM Input

Input Signal:	AM Time Code (Amplitude-Modulated Sine-Wave Signal)
Signal Level:	800 mV_{pp} – 8 V_{pp}
Termination:	Default 600 Ohm (Optionally 50 Ohm / 5 kOhm)
Insulation Voltage:	3000 V DC
Connector Type:	SMB, Male
Cable Type:	Coaxial Cable, Shielded



10.2 Time Code DCLS Input

Input Signal: Time Code DCLS, Pulse-Width Modulated (e.g., IRIG-B00x)

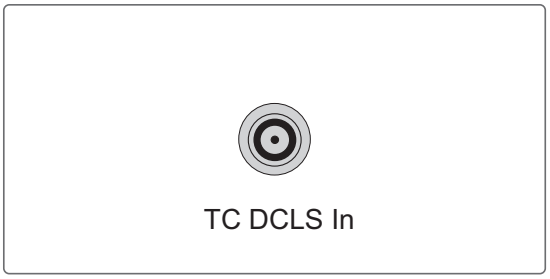
Insulation Voltage: 3750 V_{rms}

Internal Series Resistor: 330 Ω

Max. Input Current: 25 mA

Connector Type: SMB, Male

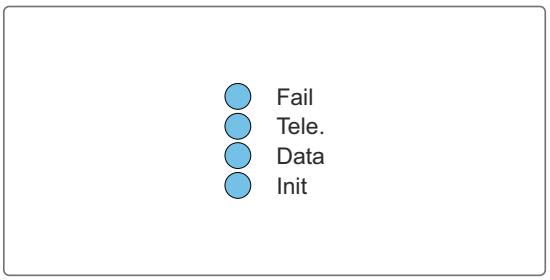
Cable Type: Coaxial Cable, Shielded



10.3 TCR180USB Status LEDs

LED Indicators

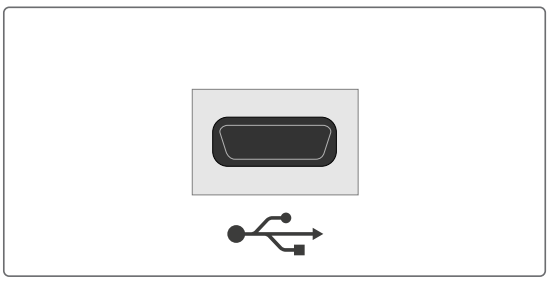
Fail:	Red:	Time sync error
Tele.:	Green:	Time code data consistent
	Red:	Time code data inconsistent
Data:	Green:	IRIG data available
	Red:	IRIG data not available
	Yellow:	Jitter too high
Init:	Blue:	Initialization in progress
	Green:	Oscillator is locked and settled



10.4 USB 2.0 High-Speed Interface

Power Supply: 5 V DC via USB

Connector Type: Micro-USB, Type B



10.5 Programmable Pulse Output

Output Signal: Programmable Pulses

Signal Level: TTL = 5 V (no load),
2.5 V (with 50 Ω load)

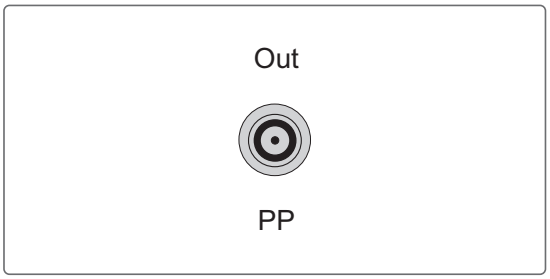
Rise Time: Typically 4 ns

Fall Time: Typically 4 ns

Connector Type: SMB, Male

Cable Type: Coaxial Cable, Shielded

Pulse Outputs:
Idle
Timer
Single Shot
Cyclic Pulse
Pulse Per Second
Pulse Per Min
Pulse Per Hour
DCF77 Marks
DCLS Time Code
10 MHz Frequency
Synthesizer Frequency
PTTI 1 PPS

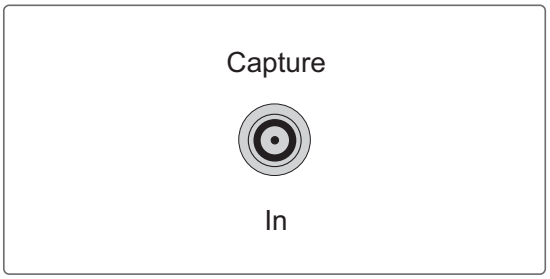


10.6 Capture Input

Input Signal: TTL Signal

Connector Type: SMB, Male

Cable Type: Coaxial Cable, Shielded



How It Works

The Capture Input (**Capture IN**) can be used to record the timing of any kind of event. Whenever the falling edge of a TTL pulse is detected at this input, the microprocessor logs the number of the input and the current time in a buffer capable of storing up to 500 entries.

This buffer allows a series of events occurring in rapid succession (intervals as low as 2 ms) to be recorded for a limited period of time. In the event that the buffer is full, the message ("** capture buffer full") will be output.

Please refer to our Knowledge Base for more information on Time Capture inputs:

https://kb.meinbergglobal.com/kb/driver_software/meinberg_sdks/meinberg_driver_and_api_concepts.

10.7 BSL Button

The TCR180USB features a **BSL** button on the rear (Bootstrap Loader). Holding down this button while the device is being powered on will activate a 'bootstrap loader' in the microprocessor that awaits commands (such as a firmware update) via the USB interface. This state can be used to upload the new firmware from the connected PC.

Important!

Only perform updates to the firmware of the TCR180USB under the expert guidance of one of our Technical Support team members. An improperly performed firmware update may render your product inoperable! You should only press the BSL right before you intend to transmit an update.

Once the BSL button has been pressed, the TCR180USB will be placed in Boot Mode and will no longer provide other functions.

Meinberg provides fast and expert assistance on updating the firmware of your TCR180USB. We provide free support for the lifetime of your Meinberg product.

Meinberg Technical Support Team

Phone: +49 (0) 5281 – 9309-888
Email: techsupport@meinberg.de

11 How the TCR180USB Operates

AM Time Code
With AM time codes, the time information is transmitted by modulating the amplitude of a sine-wave carrier. The automatic gain control of the receiver allows AM time code signals with a sine-wave carrier amplitude of between 800 mV_{pp} and 8 V_{pp} to be decoded.

DCLS Time Code
With DCLS time codes, the time information is transmitted by varying the pulse width of a TTL signal. Like the AM input, the DCLS time code input uses an SMB connector. The receiver circuit of the TCR180USB is galvanically isolated from the signal input by means of an optocoupler.

How Incoming Time Codes are Processed
Incoming time code is used to synchronize the internal clock as well as the capacitor-buffered real-time clock (RTC) of the TCR180USB. Each code received undergoes a consistency check. If an error is detected in a time code, the internal clock switches to free-run mode. The oscillator in this case limits the time base drift to around 1 microsecond per second.

Because most standard time codes (e.g., IRIG) lack a full date and only provide day-of-year information, the full date is maintained in the real-time clock and internal clock of the TCR180USB.

Information:

The internal clock is set by the incoming time code. If the time code has an offset relative to UTC, the receiver must be configured accordingly to allow the driver to correctly set the PC's system time. Chapter 13.1 ("**Configuring the TCR180USB**") describes in detail how to correctly configure the offset.

Warning!

Potential Problems for the PC's System Time

IRIG-A and IRIG-B time strings do not contain any announcement bits for the switch between summer-time (Daylight Saving Time, DST) and wintertime, nor do they accommodate the introduction of a leap second. Consequently, when switching between summertime and wintertime or adding a leap second, there will be a 'jump' in the resultant UTC time and, by extension, the PC's system time. This will cause the TCR180USB to switch to free-run mode and resynchronize. This time jump may cause severe disruption to applications dependent on accurate timing.

Meinberg recommends using IEEE time code to synchronize time code modules and systems in order to avoid this problem, as these time code formats contain information on UTC offsets, DST announcements, and leap second announcements from the outset.

11.1 Input Signals

Amplitude-modulated and pulse-width modulated IRIG-A/B, IEEE 1344, IEEE C37.118, and AFNOR NFS 87-500 time codes can be read by the receiver via the SMB connector. The transmission cable should be shielded.

The monitoring tool **MbgMon** must be used to configure the receiver to expect the appropriate time code.

Information:

The TCR180USB is not able to decode amplitude-modulated and pulse-width modulated time code signals simultaneously. The appropriate time code format must be selected in MbgMon. Only the signal received at the suitable SMB connector for the configured time code (**TC IN AM** or **TC IN DCLS**) will be processed.

11.1.1 Input Impedance

The IRIG specifications do not mandate any specific output impedance for the transmitter or input impedance for the receiver. As a result, manufacturers of IRIG readers and generators have applied their own values, resulting in devices not all being compatible with one another.

If the generator has a larger output impedance and the IRIG receiver has a lower impedance, for example, the signal level at the receiver input will be too low to process. Please refer to Chapter 15.1, "**Technical Specifications: TCR180USB**" for more information on the input impedance values of each of the signal inputs.

11.1.2 Optocoupler Input

The "**TC IN DC**" DCLS time code signal input is galvanically isolated from the other internal electronics by an internal optocoupler.

A typical DCLS input signal conforms to the established TTL level (5 V). The internal series resistor also allows the device to be operated directly with input signals with a maximum high-state voltage of +12 V, although this deviation from the standard TTL input levels can affect signal accuracy.

Important!

When using signal voltages that are higher than those specified above, an additional series resistor must be patched in to ensure that the maximum diode current of 50 mA is not exceeded. Likewise, the series resistance of the line must allow a current of at least 10 mA to flow in order to ensure that the optocoupler is reliably switched.

11.2 Internal Real-Time Clock

If the power supply to the TCR180USB is interrupted, the internal real-time clock will continue to run off the crystal oscillator. The clock in this case will be powered temporarily by an integrated capacitor, which is charged via the USB power supply, allowing the internal clock to run independently for around five days.

When the TCR180USB is restarted, the time & date are read once from the internal real-time clock and set as the system time of the TCR180USB. If more than five days have passed, the TCR180USB will no longer be able to acquire the correct time & date from the internal clock during startup, and will therefore be unable to synchronize properly against the incoming time code strings. In this case, the time & date of the internal clock will need to be set manually using the MbgMon monitoring software. For more information, please refer to Chapter ??, "??".

Information:

Meinberg generally recommends the use of IEEE time code as a reference source for the synchronization of time code modules and systems, as these signals provides full time and date information, eliminating the need to manually set the time of the internal real-time clock.

Please refer to the Meinberg Knowledge Base for more detailed information IRIG time code.

https://kb.meinbergglobal.com/kb/irig_time_code_basics#ieee_code_extensions.

11.3 Output Signals

The TCR180USB is available with the following signal output combinations:

- 1 x Programmable Signal Output + 1 x IRIG AM Output
- 2 x Programmable Signal Outputs
- 1 x Programmable Signal Output + 1 x Capture Input

The TCR180USB generator can generate time codes in IRIG-A/B, AFNOR NF S87-500, IEEE C37.118, and IEEE 1344 format. It is possible to generate these time code signals as amplitude-modulated (AM) signals via the dedicated AM output or as pulse-width modulated signals (DCLS) via the programmable signal outputs (PP).

The input and output elements of the device can be configured individually to process and generate different time codes with different UTC offsets. For example, this allows the TCR180USB to be used as a time code converter, whereby the TCR180USB would be synchronized to a DCLS time code input via the connector **TC IN DCLS**, and the accurate time is then output as an amplitude-modulated IRIG code via the **AM Output**.

The time codes to be used are configured using the Monitoring Tool **MbgMon** or the command-line tool **mbgtools**.

12 System Installation

12.1 Connecting the System

The reference signals and USB cable (serving both as the management interface and power supply) are first connected to the TCR180USB. Once the USB connection has been established, the initialization phase will start automatically (indicated by the Init LED turning blue).

Example Application:
The diagram below shows a TCR180USB that is synchronized against the time code output provided by a LANTIME time server with time code output.

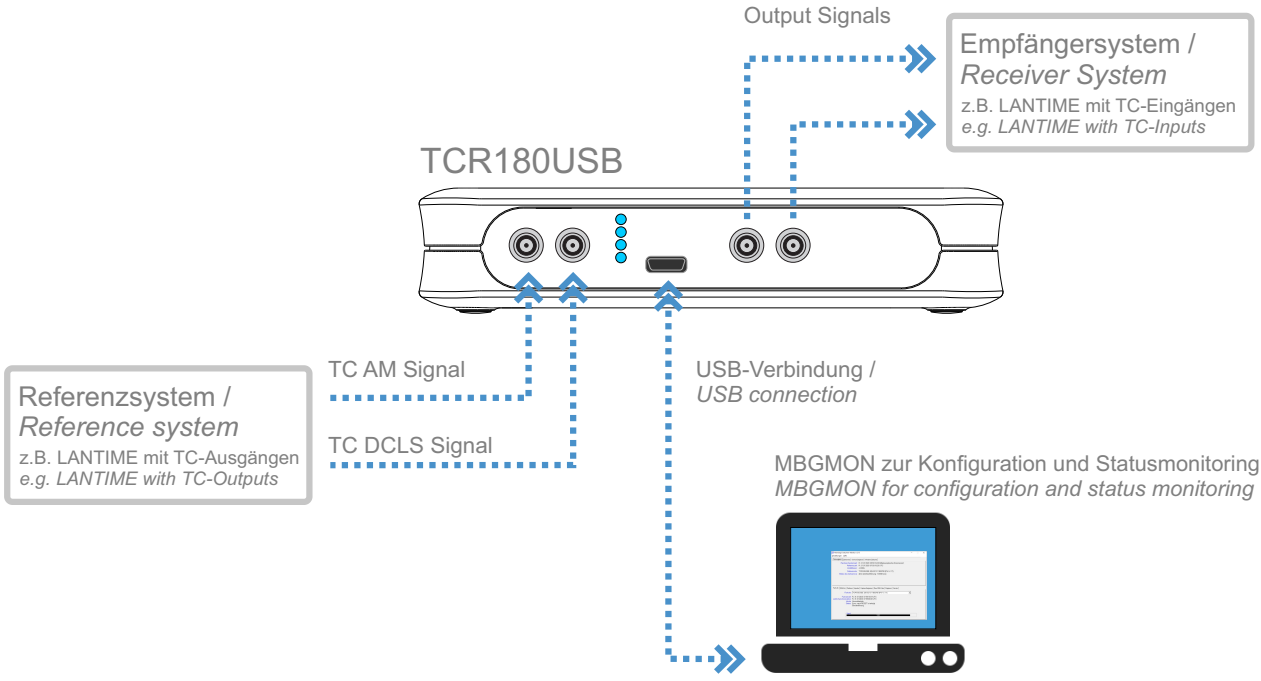


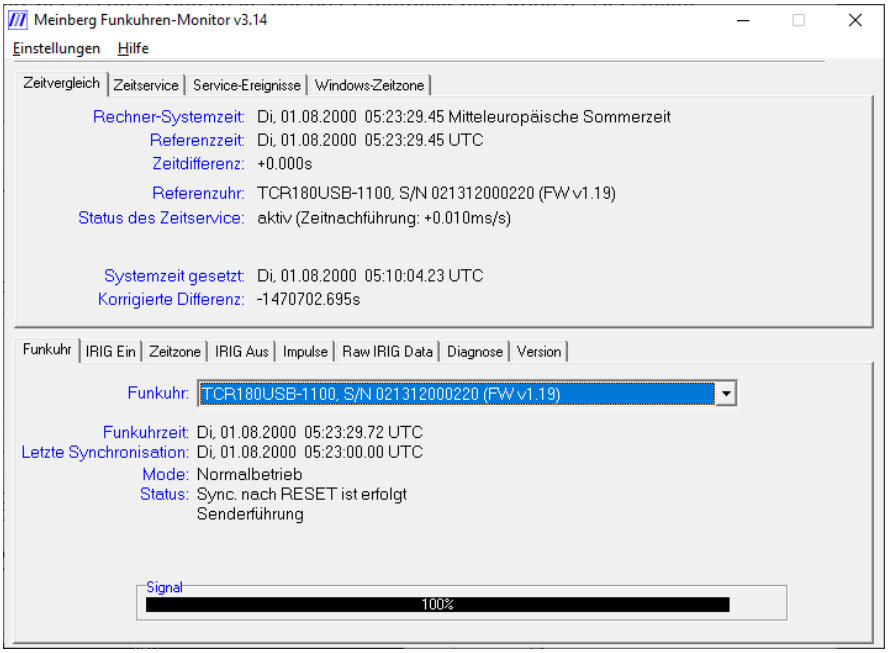
Illustration: Synchronization of the TCR180USB using a LANTIME time server as reference system

13 Before You Start

This chapter explains how to set up your TCR180USB using the Meinberg Monitoring Tool MbgMon. Each of this chapter's sub-chapters addresses basic and specific configuration processes in detail.

When Using Windows

When using MbgMon under Windows 7 or later, the software must be run as **Admin** in order to be able to change settings. This is done by right-clicking on the program and selecting "**Run as Administrator**".

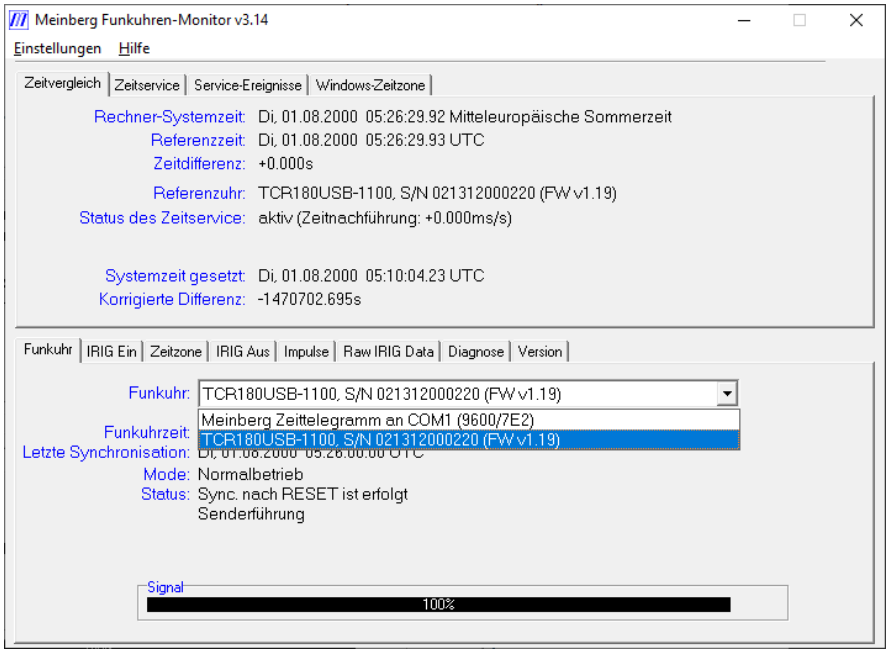


13.1 Configuring the TCR180USB

Information:

The TCR180USB is set to the factory default settings when shipped and is therefore not yet configured.

Some basic configuration is required when setting up the TCR180USB so that it can properly synchronize with a reference time code signal. The specific configuration of the inputs and outputs is addressed later in this chapter.



1. Selecting the Reference Clock

The software will usually automatically detect the connected TCR180USB and select it as the reference source. However, if there is also a Meinberg PCI card installed in the PC (for example), it may be necessary to manually select the appropriate clock.

First, click on the tab "**Radio Clock**" in the lower section of the MbgMon window and select the TCR180USB from the drop-down box.

The clock will start out in an "unsynchronized" state (**Mode:** *free running*), as the TCR180USB has not yet been able to decode the time data from the reference clock.

The status LEDs display the following pattern:

Fail	Red
Tele.	Green
Data	Green (data decoded)
Init	Off

Overview of Status Information

The status information that can be provided by the selected reference clock (e.g. TCR180USB) is described here in more detail.

Radio Clock Time:	The current IRIG time received by the selected reference clock.
Last Sync:	The time that the last synchronization was performed.

Mode:	The current operating mode (status) of the reference clock.
Normal Operation	The TCR180USB is synchronized to a valid IRIG signal.
No Input Signal	No valid IRIG signal detected.
Free Running	The TCR180USB is in free-run mode and is running solely off the local oscillator.

Status:	Synchronized since last RESET at least once.
Clock is Synchronized	A valid IRIG signal has been detected.
Clock running on Xtal Oscillator	No valid IRIG signal has been detected.

2. Selecting the Time Code Format

Select the "**IRIG In**" tab, then select the input IRIG signal received from the reference clock in the drop-down box.

Information:

Meinberg generally recommends the use of the IEEE 1344 reference signal for synchronizing time code modules and systems, as this format allows the UTC offset and leap second information to be incorporated into the time code signal.

Please refer to the Meinberg Knowledge Base for more detailed information on IRIG time code.

https://kb.meinbergglobal.com/kb/irig_time_code_basics#ieee_code_extensions.

To allow the TCR180USB to process all of the information contained within the string received from the reference system, both the IRIG code transmitted by the reference system and the corresponding IRIG input of the TCR180USB must be configured identically.

Example:
If the reference system is configured to output the DCLS time code format **IEEE 1344 (DCLS)**, the TCR180USB must be configured to process the IRIG time code **IEEE 1344** via the "**TC IN DC**" connector of the TCR180USB.

---

3. Configuring the Offset

The use of UTC as the time base for the reception and transmission of time code signals is recommended.

The IEEE 1344 time code format incorporates the time code offset relative to UTC into the transmitted data. When not using IEEE 1344 as a reference signal (see information box on previous page), a manual offset must be entered when using a time code such as IRIG B006/B007.

Setting the IRIG Offset to UTC

The time zone of the reference system and receiver (e.g., TCR180USB) is UTC.

Time Code	Offset
IEEE 1344	Automatic Transmission of Offset
B006/B007	00:00

However, if the reference system itself does not output UTC time code, and instead applies a local time zone offset such as CET, this offset needs to be accounted for to ensure that the TCR180USB is properly synchronized.

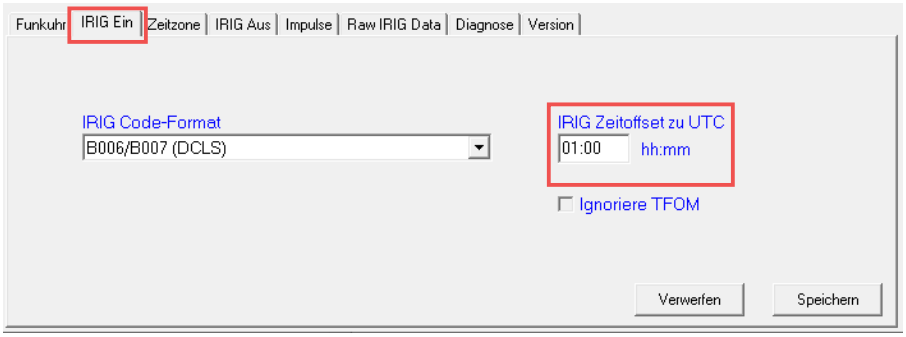
Caution!

If the start and end of Daylight Savings Time in a local time zone is reflected in the IRIG time, this will cause a 'jump' in the UTC time calculated from it, which will consequently feed down into the PC's system time.

For this reason, Meinberg recommends the use of IEEE 1344 code to synchronize time code modules and systems, as the code incorporates not only the UTC or local time zone information but also an announcement bit that is set 59 seconds before the DST change, allowing the device to prevent such a time jump.

In this example, the TCR180USB needs to be set to the local time zone "**+00:60 min**" (CET = UTC + 1 hour).

Time Code	Offset
IEEE 1344	Automatic Transmission of Offset
B006/B007	01:00 (hh:mm)



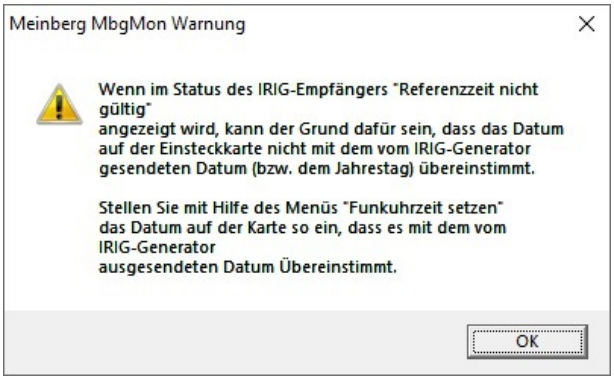
The status LEDs display the following pattern:

Fail	Off
Tele.	Green
Data	Green
Init	Off

4. Manually Setting the TCR180USB System Time

If the power supply to the TCR180USB is cut, the integrated real-time clock (RTC) used to store the date & time will be powered for around five days by the integrated capacitor. However, if the TCR180USB is left powered down for longer than this, the RTC will be set to the wrong date or time when it is powered back up (see screenshot). This can have severe consequences for dependent applications.

To correct this, it is necessary to manually set at least the date—or ideally, both the date & time—to the correct value.

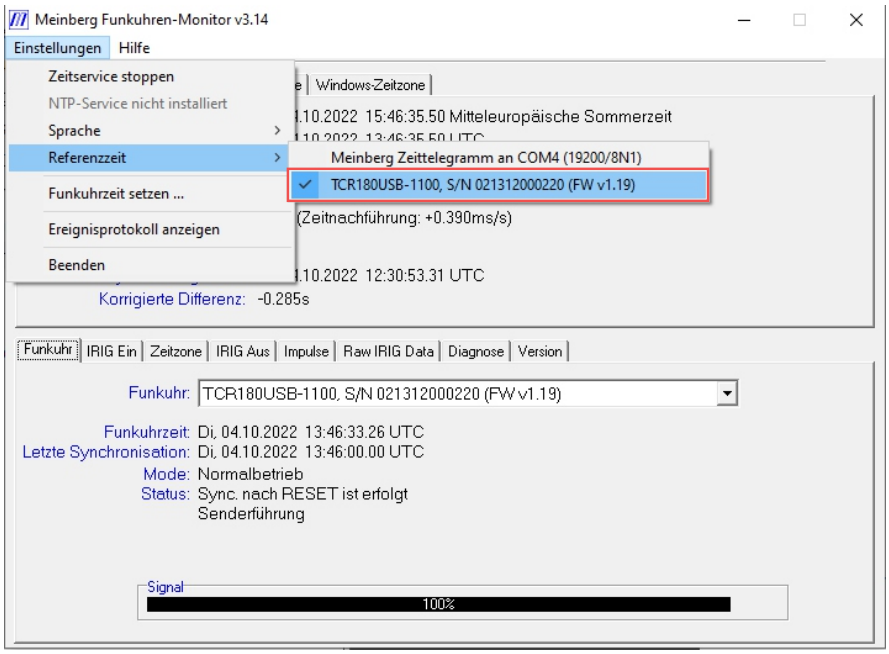


1. Click on "**Setup**" in the menu bar and then select "**Set Ref. Clock Time**".

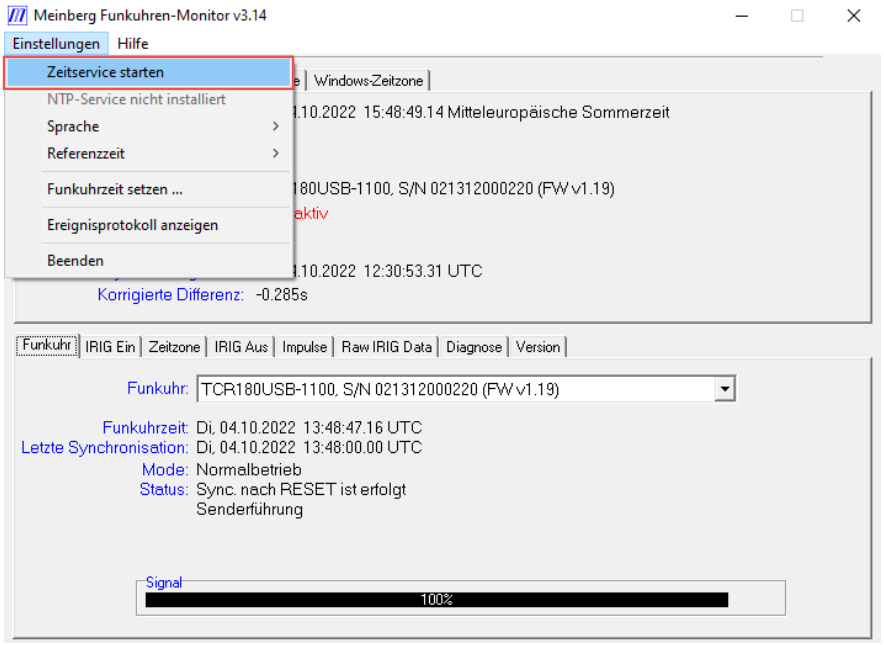
2. Set the current date & time by clicking on the button "**Transfer Current PC Time to Device**" in order to set the correct date & roughly correct time on the TCR180USB.

13.2 Using the TCR180USB as a Reference

Once the configuration is complete, the TCR180USB will usually be selected automatically as the reference source for the PC to which it is connected. If it is not, click on **Setup** → **Reference Time** from the menu bar and select the TCR180USB in order to use it to synchronize the PC (see illustration).



Starting the Time Service



Once all of the necessary IRIG settings have been performed, the time service can be started.

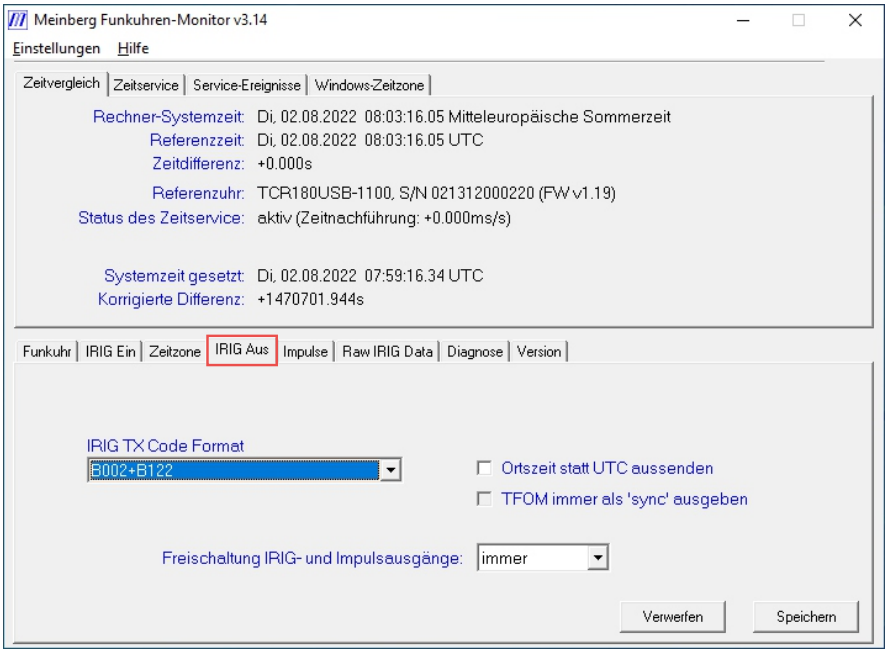
Do this by clicking on **Setup** → **Start Time Service** from the menu bar. The clock that you have just selected will now be used to synchronize the PC's time.

Status Information:

The tab "**Time Adjustment**" provides an overview of the PC's system time and the time of the reference source (e.g., the TCR180USB), as well as the current difference between these two.

Reference Clock:	The reference clock selected to synchronize the PC.
State of Time Service:	
Disabled	Time service is not currently running.
Active	Time service is currently running and is synchronizing the PC's system time.
Waiting Till Clock Has Synchronized	Time service is currently running but the clock is not yet synchronized.
Expecting Reference Time...	Time service is currently running but the connection with the clock has been disrupted.
System Time Set:	The time at which the PC's system time was last set by the time service (if necessary).
Corrected Offset:	The offset adjustment performed relative to the displayed time.

13.3 Configuring the Output Signals



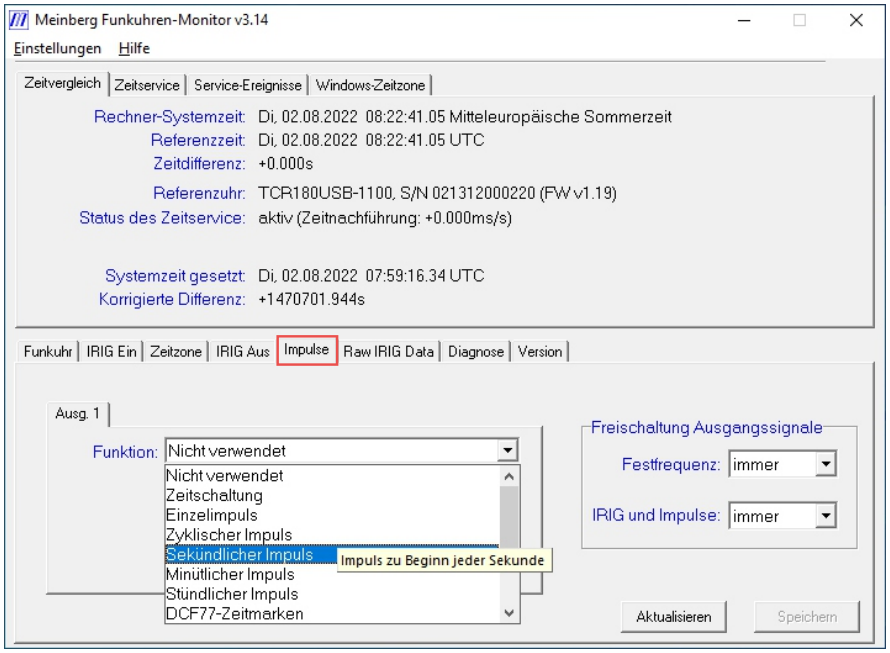
The output signals of a TCR180USB can be configured under the appropriate tab in the lower part of the MbgMon window.

The same time code signal format is always generated concurrently via both the DCLS and AM outputs. The DCLS signal can be optionally output via the programmable signal output (when configured accordingly), while the AM signal is only output via a TCR180USB with a TC AM output.

Time Code Output Signals
First select the tab "**IRIG Out**" and use the drop-down box to select the time code format to be generated.

Transmit Local Time Instead of UTC:	Select whether the time code to be output should follow UTC or local time. If *Local Time* is selected, the time is converted based on the settings under the tab "**Timezone**".
Output TFOM Always as 'Sync' :	If enabled, the TCR180USB will always output the time code with a *sync* flag (Value 0). (TFOM is only used with IEEE time codes)
Enable IRIG and Pulses Outputs:	
After Sync	Signals are only output once the receiver has successfully synchronized to one of the input signals for the first time.
Always	Signals are output immediately when the device is powered on.

Programmable Output Signals



On certain models of the TCR180USB, it is possible to configure one or two programmable signal outputs.

This is done by first clicking on the "**Pulses**" tab and selecting the signal to be output via the connector marked "**PP**" from the drop-down box.

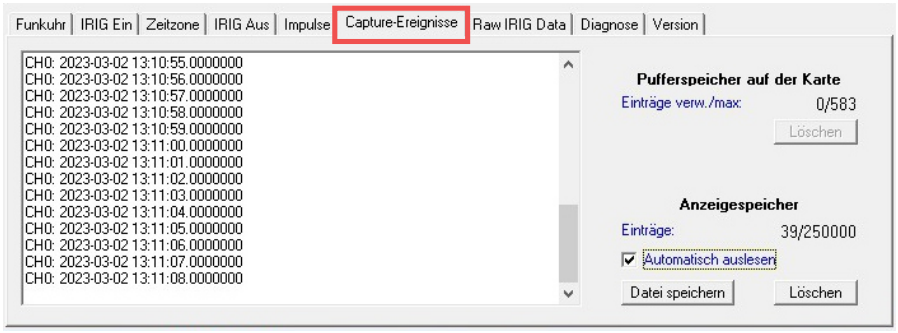
Enable Output Signals

After Sync	Signals are only output once the receiver has successfully synchronized to one of the input signals for the first time.
Always	Signals are output immediately when the device is powered on.
Timeout:	For DCF77 marks, see 15.3 . "Programmable Pulse Signal Types" .

13.4 Capture Input

Events recorded via the capture input can be viewed under the appropriate tab in the lower part of the MbgMon window.

This can be done by selecting the tab "**Capture Events**". All events are displayed in the Capture Log on the left with the associated date and time.



On-board FIFO Buffer: Shows the current (detected) and maximum number of entries in the on-board FIFO buffer (e.g. 20/583). If the option "**Read Out Automatically**" is **not** checked, the on-board FIFO buffer can be erased. This is done by clicking on the button "**Clear**".

Monitoring Buffer

Entries: Displays the number of entries shown in the Capture Log (e.g., 39/250000).

Read Out Automatically: If checked, the entries are automatically displayed in the Capture Log. If this option is not checked, the entries are written to the FIFO buffer.

Save File: Click on "**Save File**" to export the Capture Log entries to a `.log` file.

Clear: Click on "**Clear**" to erase the Capture Log entries.

14 Updating the Firmware

Important!

Only perform updates to the firmware of the TCR180USB under the expert guidance of one of our Technical Support team members. An improperly performed firmware update may render your product inoperable!

Meinberg provides fast and expert assistance on updating the firmware of your TCR180USB. We provide free support for the lifetime of your Meinberg product.

Meinberg Technical Support team

Phone: +49 (0) 5281 – 9309- 888
Email: techsupport@meinberg.de

15 Technical Appendix: TCR180USB

15.1 Technical Specifications: TCR180USB

Receiver Input:

AM Input:
Galvanically Isolated via Pulse Transformer
Impedance: 600 Ω
Input Signal: Approx. 800 mV_{pp} – 8 V_{pp} (Mark)
Other Ranges on Request

DC Level Shift Input:
Galvanically Isolated via Optocoupler
Internal Series Resistor: 330 Ω
Maximum Input Current: 50 mA
Diode Voltage: 1.0 V – 1.3 V

Decoding: The following input signals can be processed:
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 μs relative to IRIG Reference Marker

Required Accuracy of Reference Time Code: ± 100 ppm

Free-Run Mode: Clock switches automaticaly to oscillator free-run mode, accuracy approx. 2E-9 if decoder was synchronized for at least 1 hour beforehand.

Operational Reliability: A Hardware Watchdog generates a safe reset in the event of an undervoltage.

A Software Watchdog monitors the program execution and generates a reset in the event of a malfunction.

Power Supply: Via USB: +5 V, approx. 380 mA

Housing Dimensions: 73 mm x 117 mm x 24 mm (L x W x H)

Operating Temperature: 0 – 50 °C (32 – 122 °F)

Relative Humidity: Max. 85 %

15.2 General Information about Time Code

The need to transmit encoded time information became a topic of some importance as early as the 1950s. The U.S. space program in particular was a key driver of advancement in this field, using time code information to correlate different sets of measurements. However, the formats and usage of these signals were defined arbitrarily at the whims of the specific users, which resulted in the development of hundreds of different time code formats, some of which were standardized by the "Inter Range Instrumentation Group" (IRIG) in the early 1960s. These standardized time code formats are referred to as "IRIG Time Codes" today.

In addition to these general-purpose time signals, there are other codes in use designed for specific applications, among them NASA36, XR3, or 2137. The TCR180USB, however, limits itself to the output of IRIG-A, IRIG-B, AFNOR NF S87-500, and IEEE 1344 formats, as well as IEEE C37.118, the successor to IEEE 1344.

The AFNOR time code is a variant of the IRIG-B format that uses the available "control functions" segment of the IRIG time code to supply full date information.

Visit our website for more detailed information about IRIG and other time codes:
https://www.meinbergglobal.com/english/info/irig.htm

15.2.1 Description of IRIG Codes

Each IRIG time code format is denoted by an alphabetical character followed by a three-digit number sequence as specified in IRIG Standard 200-04. Each character in a time code format designation has the following meaning:

Character	Bit Rate	A	1000 pps
		B	100 pps
		E	10 pps
		G	10000 pps
1st Character	Pulse Wave	0	DC level shift (DCLS), pulse-width modulated
		1	Sine-wave carrier, amplitude-modulated
2nd Character	Carrier Frequency	0	No carrier (DC level shift)
		1	100 Hz, time resolution 10 ms
		2	1 kHz, time resolution 1 ms
		3	10 kHz, time resolution 100 μs
3rd Character	String Content	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 and day-of-year in BCD format
CF:	Control Functions (for unspecified use)
SBS:	Number of seconds in the day since midnight (binary)

In addition to the original IRIG standards, there are also other specifications issued by other bodies that define specific extensions.

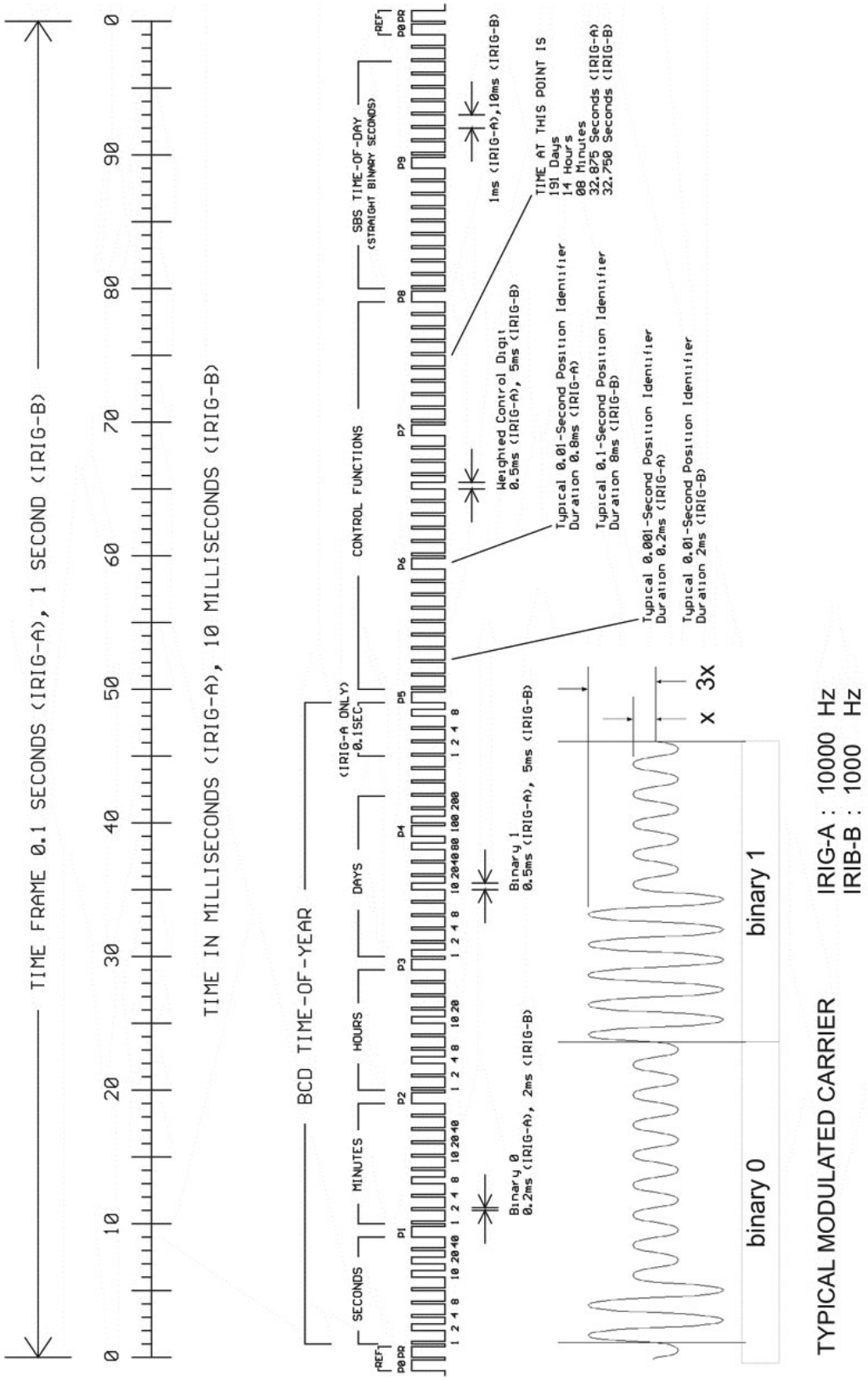
AFNOR: Code according to NF S87-500, 100 pps, AM sine-wave signal,
1 kHz carrier frequency, BCD time-of-year, complete date,
SBS time-of-day, signal level specified by standard.

IEEE 1344: Code according to IEEE 1344-1995, 100 pps, AM sine-wave signal, 1 kHz carrier frequency,
BCD time-of-year, SBS time-of-day, IEEE 1344 extensions for date,
time zone, Daylight Saving Time, and leap seconds in Control Functions (CF) segment.
(See also table "**Structure of CF Segment in IEEE 1344 Code**")

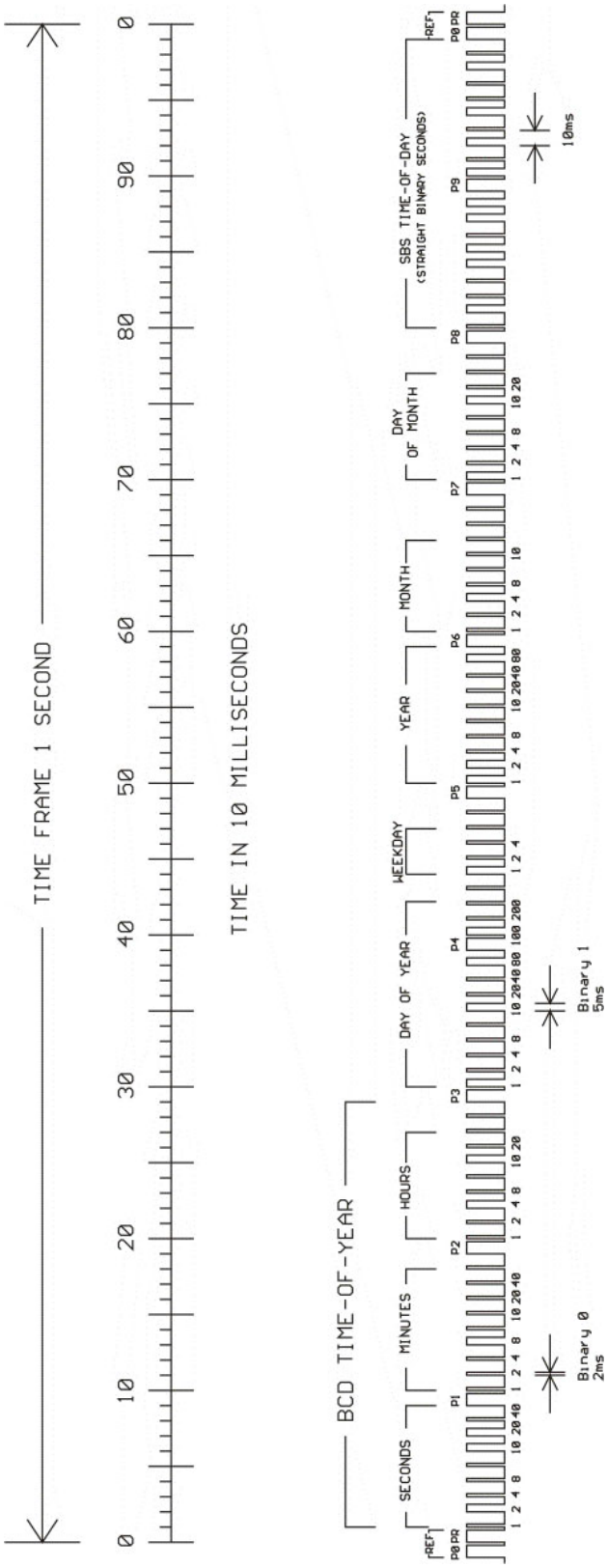
IEEE C37.118: Identical to IEEE 1344, but with UTC offset +/- sign bit reversed

NASA 36: 100 pps, AM sine-wave signal, 1 kHz carrier frequency,
Time Resolution: 10 ms (DCLS), 1 ms (AM carrier)
BCD time-of-year: 30 bits - seconds, minutes, hours, and days

15.2.2 Time Code Format According to IRIG Standard



15.2.3 Time Code Format According to AFNOR Standard



15.3 Programmable Pulse Signal Types

Meinberg systems with programmable pulse outputs provide the following signal options; the actual range of available signal options will vary from system to system:

Idle

Selecting "**Idle**" disables that specific output.

Timer

In "**Timer**" mode, the output simulates a timer with a fixed daily schedule. It is possible to configure three switch-on and three switch-off days for each day and each output. In order to set a timer, both the switch-on time ("**ON**") and the corresponding switch-off time ("**OFF**") must be set. If the switch-on time is later than the switch-off time, the switching scheduler will interpret this to mean that the switch-off time is on the next day, which will keep the signal enabled through midnight.

Thus, if a program was set with a switch-on time of *23:45:00* and a switch-off time of *0:30:00*, this would cause the output to be enabled on day *n* at 11:45 p.m., and then to be disabled on day *n+1* at 12:30 a.m. If any of these three programs are to be left disabled, simply enter the same times into the **ON** and **OFF** fields. The "**Signal**" selector specifies the active state for the timer periods. Selecting "*Normal*" will put the output in a low state outside of switch-on periods and in a high state during switch-on periods ("active high"). Conversely, selecting "*Inverted*" will place the output in a high state outside of switch-on periods and in a low state during switch-on periods ("active low").

Single Shot

"**Single Shot**" mode generates a single pulse of defined length once per day. The time of day when the pulse is to be generated can be set via the "**Time**" value. The value "**Length**" allows the pulse length to be set in 10 ms increments and may be any value in the range of *10 ms* to *10 s*. Entries that are not multiples of 10 ms will be rounded down.

Cyclic Pulse

"**Cyclic Pulse**" mode is used to generate cyclically repeating pulses. The time between two pulses is defined, and this value must always be provided in hours, minutes, and seconds. It is important to note that the pulse train is always synchronized with 0:00.00 local time, so that the first pulse on any given day will always be output at midnight, and is repeated at the specified cycle interval henceforth. Thus, if a cycle duration of *2 s* is specified, this will result in pulses being triggered at 0:00.00, 0:00.02, 0:00.04 and so on. While it is possible to set any cycle time between 0 and 24 hours, these repetitions are usually only useful if the time between pulses is always the same. For example, if a cycle time of *1:45.00* is set, this will output pulses at intervals of 6300 seconds. However, between the last pulse of any given day and the pulse at midnight on the following day, there will be an interval of just 4500 seconds.

Pulse Per Second, Per Min, Per Hour

These modes generate pulses of defined length once per second, once per minute, or once per hour. The configuration options for all three modes are the same. The value "**Pulse Length**" specifies the length of the pulse and can be between *10 ms* and *10 s*.

DCF77 Marks

In "**DCF77 Marks**" mode the selected output simulates the time string transmitted by the German DCF77 time code transmitter. The output pulses are the 100 ms and 200 ms pulses (logical 0/1) typical for the DCF77 code. The absence of the 59-second marker is used to signal the start of a new minute.

DCF77-like M59

Sends a 500 ms pulse at the 59-second mark.

The "**Timeout**" field can be used to enter how many minutes the system should wait while in free-run mode before DCF77 simulation is suspended. Entering *0* here will disable the timeout function, so that the DCF77 simulation will continue running perpetually until manually disabled.

Position OK, Time Sync, All Sync

There are three different modes available for outputting the synchronization status of the clock. The "**Position OK**" mode outputs a signal through the output whenever the GPS receiver is receiving enough satellites to determine its position.

In "**Time Sync**" mode, a signal is only passed through the output as long as the clock's internal timebase is synchronized to GPS Time. The "**All Sync**" mode requires both of the above states to be true—for a signal to be passed through the output, there must be sufficient satellites for positioning, and the internal timebase must be synchronized to GPS Time.

DCLS Time Code

DC level shift time code. The time code output here is configured in the "**Clock → IRIG Settings**" section of the Web Interface.

1 MHz Frequency, 5 MHz Frequency, 10 MHz Frequency

This mode is used to output a fixed frequency of 1, 5, or 10 MHz respectively, using a PPS signal as an absolute phase reference (i.e., the falling edge of the signal is synchronized with the rising edge of the PPS signal).

Synthesizer Frequency

This mode is used to output a custom frequency, which is defined using the "**Clock → Synthesizer**" section of the Web Interface.

PTTI 1PPS

This mode is used to pass a PPS signal of 20 μs length through the output.

16 Your Opinion Matters to Us

This user manual is intended to assist you in the preparation, use, and care of your Meinberg product, and provides important information for configuration and status monitoring.

Be a part of the ongoing improvement of the information contained in this manual. Please contact our Technical Support team if you have any suggestions for improvements or technical questions that are relevant to the manual.

Meinberg – Technical Support

Phone: +49 (0) 5281 – 9309- 888
Email: techsupport@meinberg.de

17 RoHS Conformity

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

We hereby declare that this product is compliant with the European Union Directive 2011/65/EU and its delegated directive 2015/863/EU "Restrictions of Hazardous Substances in Electrical and Electronic Equipment" and that no impermissible substances are present in our products pursuant to these Directives.

We warrant that our electrical and electronic products sold in the EU do not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs), bis(2-ethylhexyl)phthalat (DEHP), benzyl butyl phthalate (BBP), dibutyl phthalate (DBP), or diisobutyl phthalate (DIBP) above the legal limits.

18 Declaration of Conformity for Operation in the European Union

EU-Konformitätserklärung

Doc ID: -April 23, 2024

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**

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	EN 61000-6-2:2019 EN IEC 61000-6-3:2021 EN 55035:2017/A11:2020 EN 55032:2015 + AC:2016 + A11:2020 + A1:2020
Niederspannungsrichtlinie *Low-voltage Directive* 2014/35/EU	EN IEC 62368-1:2020 + A11:2020
RoHS – Richtlinie *RoHS Directive* 2011/65/EU + 2015/863/EU	EN IEC 63000:2018

EU-Declaration of Conformity

Doc ID: -April 23, 2024

Diese EU-Konformitätserklärung umfasst alle nachfolgend aufgeführten Gerätekonfigurationen:
This UKCA Declaration of Conformity further covers all the device configurations listed below:

CONFORMITYADDPRODUCTNAMES

Bad Pyrmont, den April 23, 2024

Aron Meinberg
Quality Management

Meinberg Funkuhren GmbH & Co. KG
Lange Wand 9
31812 Bad Pyrmont

19 Declaration of Conformity for Operation in the United Kingdom

UKCA Declaration of Conformity

Doc ID: -April 23, 2024

Manufacturer	Meinberg Funkuhren GmbH & Co. KG Lange Wand 9 31812 Bad Pyrmont Germany

declares that the product

Product Designation	**TCR180USB**

to which this declaration relates, is in conformity with the following standards and provisions of the following regulations under British law:

Electromagnetic Compatibility Regulations 2016 (as amended) *SI 2016/1091*	EN IEC 61000-6-2:2019 EN IEC 61000-6-3:2021 EN 55035:2017/A11:2020 EN 55032:2015 + AC:2016 + A11:2020 + A1:2020
Electrical Equipment (Safety) Regulations 2016 (as amended) *SI 2016/1101*	EN IEC 62368-1:2020/A11:2020
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (as amended) *SI 2012/3032*	EN IEC 63000:2018

UKCA Declaration of Conformity

Doc ID: -April 23, 2024

This UKCA Declaration of Conformity further covers all the device configurations listed below:

CONFORMITYADDPRODUCTNAMES

Bad Pyrmont, Germany, dated April 23, 2024

Aron Meinberg
Quality Management

Meinberg Funkuhren GmbH & Co. KG
Lange Wand 9
31812 Bad Pyrmont