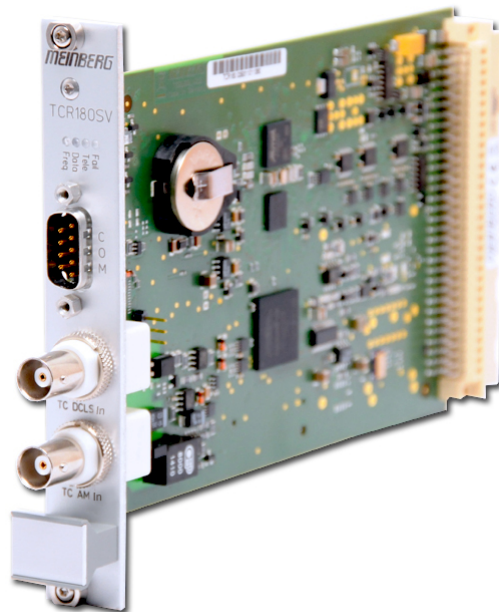MEINBERG

The Synchronization Experts.

MANUAL

TCR180

IRIG Code controlled Radio Clock

April 23, 2024

Meinberg Funkuhren GmbH & Co. KG

Table of Contents

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2 Imprint

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3 Safety instructions for Building-in Equipment

3.1 Important Safety Information and Safety Precautions

The following safety information must be observed whenever the device is being installed or operated. Failure to observe this safety information and other special warnings or operating instructions in the product manuals constitutes improper usage and may violate safety standards and the manufacturer's requirements.

Depending on the configuration of your device or installed options, some information may not specifically apply to your device.

The device satisfies the requirements of the following EU regulations: EMC Directive, Low Voltage Directive, RoHS Directive and—where applicable—the Radio Equipment Directive.

If a procedure is marked with the following signal words, you may only proceed with it if you have understood and fulfilled all requirements. Hazard notices and other relevant information are classified and indicated as such in this manual according to the following system:

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.

WARNING!
This signal 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.

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.

ATTENTION!
This signal word refers to a procedure or other action that may result in product damage or the loss of important data if not observed or if improperly performed.

3.2 Used Symbols

The following symbols and pictograms are used in this manual. Pictograms are used in particular to indicate potential hazards in all hazard categories.

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 parts*
⎗	IEC 60417-6172 Trennen Sie alle Netzstecker / *Disconnect all power connectors*
⚠	IEC 60417-5134 Elektrostatisch gefährdete Bauteile / *Electrostatic Discharge Sensitive Devices*
ⓘ	IEC 60417-6222 Information generell / *General information*
⌦	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. To ensure that the product is disposed of in a WEEE-compliant fashion, it must be returned to the manufacturer.*

3.3 Product Documentation

Extensive documentation for the product is provided on the Meinberg Customer Portal –
https://www.meinberg.support

The manuals can also be downloaded from the Meinberg website at https://www.meinbergglobal.com/english/docs/. On our website you can enter your system name into the search box at the top of the page to find the desired manual. If you have any questions or problems, our support team will be pleased to help you.

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

This device may only be used for the purpose described in this manual. In particular, the specified operating limits of the device must be heeded. The person setting up the device is responsible for safety matters in relation to any larger system in which the device is installed!

Failure to observe these instructions may have an adverse impact on device safety!

Please keep this manual in a safe place.

This manual is only intended to be used by qualified electricians, or by persons who have been appropriately instructed by a qualified electrician and who are familiar with applicable national standards and with safety rules & regulations. This device may only be installed, set up, and operated by qualified personnel.

3.4 Safety Hints TCR180

This building-in equipment has been designed and tested in accordance with the requirements of Standard DIN EN 62368-1 "Audio/video, information and communication technology equipment – Part 1: Safety requirements).

During installation of the building-in equipment in an end application (i.e. PC) additional requirements in accordance with Standard DIN EN 62368-1 have to be taken into account.

General Safety instructions

- The building-in equipment has been evaluated for use in office environment (pollution degree 2) and may be only used in this environment. For use in rooms with a higher pollution degree more stringent requirements are applicable.
- The equipment/building-in equipment was evaluated for use in a maximum ambient temperature of 50°C.
- Protection against fire must be assured in the end application.

3.5 Prevention of ESD Damage

ATTENTION!

An ESDS device (electrostatic discharge-sensitive device) is any device at risk of damage or malfunction due to electrostatic discharges (ESD) and thus requires special measures to prevent such damage or malfunction. Systems and modules with ESDS devices usually bear the following symbol:

Symbol Indicating Devices with ESDS Components

The following measures will help to protect ESDS components from damage and malfunction.

When preparing to dismantle or install devices:
Ground your body (for example, by touching a grounded object) before touching sensitive devices.

Ensure that you wear a grounding strap on your wrist when handling such devices. These straps must in turn be attached to an uncoated, non-conductive metal part of the system.

Use only tools and devices that are free of static electricity.

When transporting devices:
Devices must only be touched or held by the edges. Never touch any pins or conductors on the device.

When dismantling or installing devices:
Avoid coming into contact with persons who are not grounded. Such contact may compromise your connection with the earth conductor and thus also compromise the device's protection from any static charges you may be carrying.

When storing devices:
Always store devices in ESD-proof ("antistatic") bags. These bags must not be damaged in any way. ESD-proof bags that are crumpled or have holes cannot provide effective protection against electrostatic discharges.

ESD-proof bags must have a sufficient electrical resistance and must not be made of conductive metals if the device has a lithium battery fitted on it.

3.6 Cabling

WARNING!

Danger of death from electric shock! Never work on cables while the power is live!
Always disconnect the cables from the devices at **both** ends before working on
the plugs and terminals of connected cables!

3.7 Replacing the Lithium Battery

Skilled/Service-Personnel only: Replacing the Lithium Battery
The life time of the lithium battery on the receiver boards is at least 10 years. If the need arises to replace the battery, the following should be noted:

There is a Danger of explosion if the lithium battery is replaced incorrectly. Only identical batteries or batteries recommended by the manufacturer must be used for replacement.

The waste battery has to be disposed as proposed by the manufacturer of the battery.

4 Important Product Information

4.1 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.

4.2 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.

4.3 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 using Meinberg Device Manager).

4.3.1 Replacing the Battery

Your device's clock module is fitted with a lithium battery (type CR2032) that is used to locally storage almanac data and sustain operation of the real-time clock (RTC) in the reference clock.

This battery has a life of at least ten years. However, if the device exhibits the following unexpected behaviors, the voltage of the battery may have dropped below 3 V, and the battery will need to be replaced:

- The reference clock has the wrong date or wrong time when the system is started.
- The reference clock repeatedly starts in Cold Boot mode (i.e., upon starting, the system has no ephemeris data saved whatsoever, resulting in the synchronization process taking a very long time due to the need to rediscover all of the visible satellites).
- Some configuration options relating to the reference clock are lost every time the system is restarted.

In this case, you should not replace the battery on your own. Please contact the Meinberg Technical Support team, who will provide you with precise guidance on how to perform the replacement.

4.4 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 or batteries via the household waste. Inquire with your local waste disposal company or authority on how to best dispose of the product or battery 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.

Disposal of Batteries

Please consult your local waste disposal regulations for information on the correct disposal of batteries as hazardous waste.

5 TCR180 Features

The TCR180 card decodes and generates modulated (AM) and unmodulated (DC Level Shift, DCLS) IRIG–A/B, AFNOR NF S87–500, IEEE C37.118, or IEEE 1344 time codes. AM codes are transmitted by modulating the amplitude of a sine wave carrier, unmodulated codes by variation of the width of pulses.

The TCR180 is equipped with a high quality oscillator which is disciplined as log as an input signal is available, and provides accurate time in holdover mode if the input signal is disconnected.

Receiver:
Automatic gain control within the receive circuit for unmodulated codes allows decoding of IRIG–A/B, AFNOR NF S87–500, IEEE C37.118 or IEEE 1344 signals with a carrier amplitude of 600 mVpp to 8 Vpp. The input stage is electrically insulated and has an impedance of either 50 Ω, 600 Ω or 5 kΩ, selectable by a jumper.

Generator:
The time code output of the TCR180 can generate time codes in IRIG–A/B, AFNOR NF S87–500, IEEE C37.118, or IEEE 1344 format. The output signal is available as modulated (3 Vpp / 1 Vpp into 50 Ω) and unmodulated (DC Level Shift, DCLS) signal (TTL into 50 Ω and RS–422). A jumper on the board allows selection of active-high or active-low DCLS output.

Format and UTC offset of the incoming and outgoing time codes can be configured independently, so the TCR180 is well-suited for time code conversion.

The card provides four configurable serial interfaces (RS–232) COM. COM0 is available via the Sub-D connector, COM1 is accessible via an VG connector on the board.

TCR180 provides a synthesizer which can generate output frequencies from 1/8 Hz up to 10 MHz with TTL level into 50 Ω as a sine wave signal.

6 Block Diagram TCR180
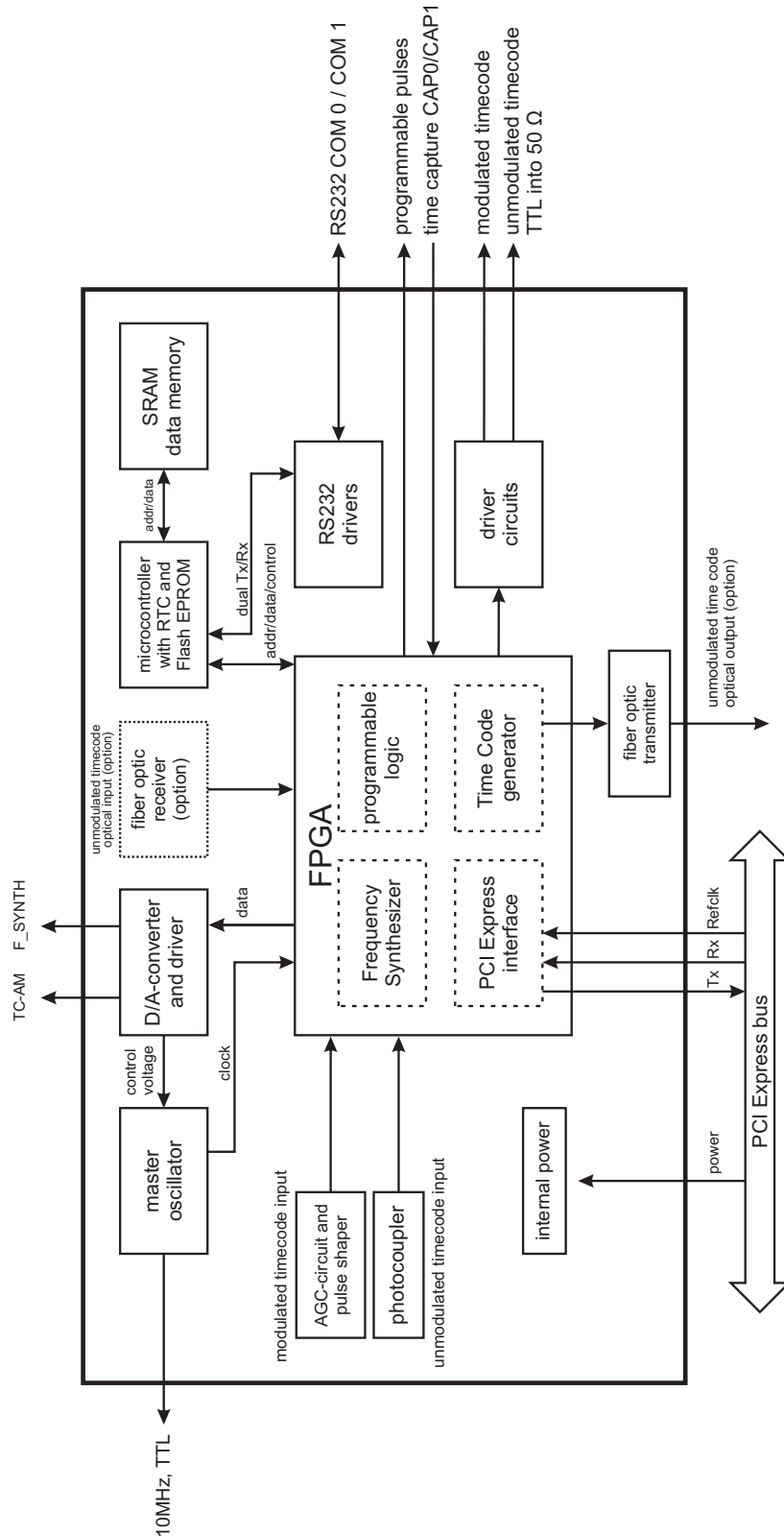
7 Master Oscillator

By default the TCR180 is equipped with a TCXO (Temperature Compensated Xtal Oscillator) as master oscillator to provide a good time accuracy and frequency stability. As long as an input signal is supplied the frequency of the oscillator is adjusted from the input signal, and if the input signal is disconnected afterwards the card can still provide accurate time for a certain holdover interval. Optionally the card can be ordered with an OCXO (Oven Controlled Xtal Oscillator) which provides even better frequency stability, and thus provides more accuracy over a longer holdover interval than the TCXO.

All internal timing as well as the output signals are derived from the oscillator. The last known good oscillator adjustment value is stored in non-volatile memory, and is used as default after power-up.

The oscillator's 10 MHz output frequency is also available with TTL level via at a ribbon cable connector.
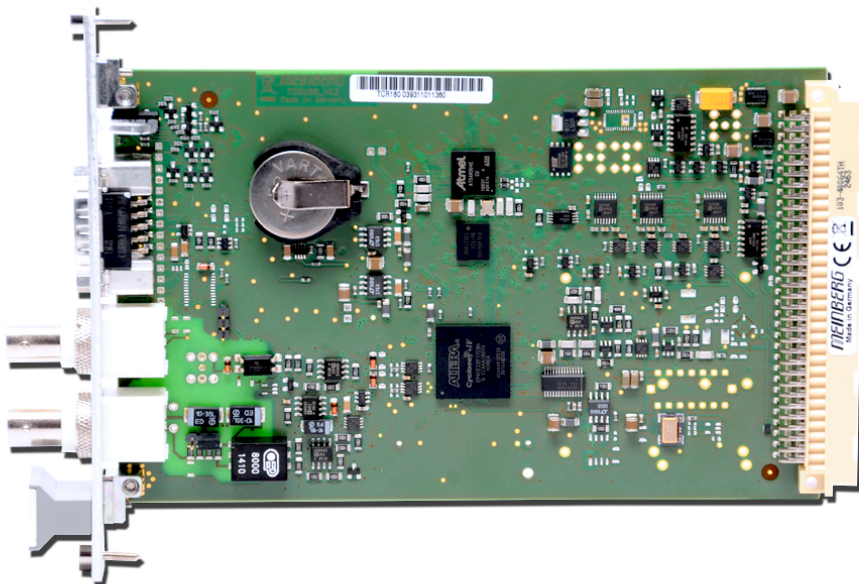
8 Functional Description of Receiver

After the received time code has passed a consistency check, the TCR180's on-board software clock and battery buffered real time clock are synchronized according to the external time reference. If an error or inconsistency is detected in subsequent time code frames, or the input signal is disconnected, the on-board clock switches to holdover mode, where the time is derived from the on-board high quality oscillator which has been disciplined before.

All IRIG and similar time codes provide the time-of-day, and a day-of-year number (1...365/366). When converting the day-of-year number from the incoming time code to a calendar date then the result is ambiguous unless the year number is not known: the day after February 28 can be March 1, but can also be February 29 in case the year is a leap year.

Unfortunately, most of the commonly used IRIG code formats don't include a year number, in which case the year number used for the computation of the calendar date is retrieved from the battery buffered on-board real time clock.

So care must be taken that the on-board clock has been set to the correct date. The on-board date and time can be adjusted by sending a Meinberg Standard Time string to the serial interface COM0, or via the PCI bus by using the utility programs included in the driver software package.

If the configured time code format does provide a year number (e.g. IEEE 1344, IEEE C37.118, IRIG-Bxx6/Bxx7) then the year number from the time code is used instead of the year number from the on-board real time clock, and the on-board date is set accordingly.

Most of the commonly used IRIG code formats also don't provide an indicator whether the transported time is UTC, or local time with some offset from UTC. However, the TCR180 always needs to derive UTC time from the incoming time code since the card's on-board time is expected to run on UTC.

If no UTC offset is provided by the time code then a UTC offset parameter on the card first needs to be configured, depending on the time provided by the input signal. When the TCR180 is shipped then the UTC parameter is set to "unconfigured", and as long as this is the case the card does not synchronize to the input signal. So the UTC offset has to be configured first when the card is put into operation. The tools that come with the driver software package given an appropriate hint if this is the case.

Only if the used time code format provides the UTC offset (e.g. IEEE 1344, IEEE C37.118) the card uses the UTC offset from the time code, and thus even synchronizes to the input signal if the card's UTC parameter is still set to "unconfigured".

Care must be taken, however, if one of the IEEE 1344 or IEEE C37.118 codes is used: The main difference between these formats is the way the UTC offset is to be applied: subtracted or added. Unfortunately there are 3rd party IRIG devices out there which claim to use a IEEE 1344 code, but in fact handle the UTC offset as specified in IEEE C37.118. This may result in a wrong UTC time derived from the time code if local time is transported. A simple fix is usually to switch the card from one of the IEEE codes to the other one.

The TCR180 can automatically convert its on–board UTC time to some local time, including automatic switching to and from DST year by year according to configurable rules. This is independent from the UTC offset of the incoming time code. The derived local time can be transmitted via the outgoing time code, the serial time strings, or can be read via the PCI interface.

The time zone is entered as offset of seconds from UTC, e.g. for Germany:
MEZ = UTC + 3600 sec, MESZ = UTC + 7200 sec

The specific date of beginning and end of daylight saving can be generated automatically for several years. The receiver calculates the switching times using a simple scheme, e.g. for Germany:

Beginning of daylight saving is the first sunday after March, 25th at two o'clock => MESZ
End of daylight saving is the first sunday after October, 25th at three o'clock => MEZ

The parameters for time zone and switching to/from daylight saving can be set by using the included monitor program. If the same values for beginning and end of daylight saving are entered then no switching to DST is made.

The associated settings can be changed using the configuration software shipped with the driver packages.

Most IRIG codes don't include an announcement flag for the DST change, or for the for the insertion of a leap second, so the TCR180 will switch into free wheeling mode on such event, and resynchronize a few seconds later.

The board TCR180 decodes the following formats:
Please note: all "A" Timecodes are only available **after** warmed up phase of the oscillator!

A002:   1000pps, DC Level Shift pulse width coded, no carrier
         BCD time of year

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

A133:   1000pps, amplitude modulated sine wave signal, 10 kHz carrier frequency
         BCD time of year, SBS time of day

B002:   100pps, DC Level Shift pulse width coded, no carrier
         BCD time of year

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

B123:   100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency
         BCD time of year, SBS time of day

B006:   100 pps, DC Level Shift, no carrier
         BCD time-of-year, Year

B126:   100 pps, AM sine wave signal, 1 kHz carrier frequency
                BCD time-of-year, Year

B007:   100 pps, DC Level Shift, no carrier
                BCD time-of-year, Year, SBS time-of-day

B127:   100 pps, AM sine wave signal, 1 kHz carrier frequency
                BCD time-of-year, Year, SBS time-of-day

AFNOR: Code according to NF S-87500, 100 pps, wave signal,
                1kHz carrier frequency, BCD time-of-year, complete date,
                SBS time-of-day, Signal level according to NF S-87500

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

8.1 Input Signals

Modulated and unmodulated IRIG or AFNOR-Codes are applied via the on board BNC connector. The lead should be shielded. The IRIG-Code to be used must be set by using a Monitorprogram (MBGMON, Meinberg Device Manager).

The IRIG-specification does not define values for the output impedance of generators or the input impedance of receivers. This fact led to incompatibility of some modules, because the manufacturers could choose the impedances freely. For example: if the output impedance of the generator is high and the input impedance of the receiver low, the signal level at the receiver input might be too low for correct decoding.

8.2 Input for unmodulated Codes

Unmodulated IRIG-Codes, often referred to as pulse with coded or DC-Level Shift Codes (DCLS), are fed into the board via BNC connector. Insulation of this input is done by a opto coupler device.

The internal series resistance allows direct connection of input signals with a maximum high level of +12 V (TTL or RS-422 for example). If signals with a higher amplitude are used, an additional external series resistance must be applied for not exceeding the limit of the forward current of the imput diode (60 mA). The forward current should not be limited to a value of less than 10 mA to ensure save switching of the photocoupler.

The input circuitry is shown below.
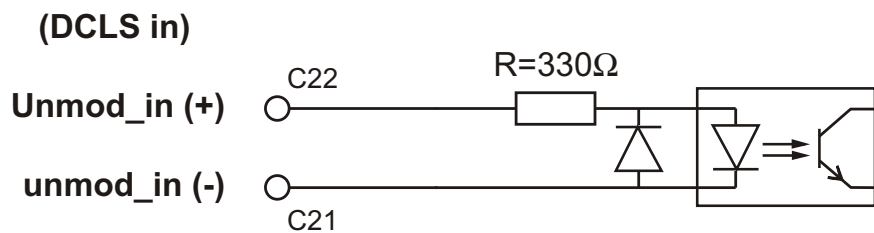
8.3 Input for modulated Codes

Modulated codes must be applied by BNC Connector. An automatic gain control allows decoding of codes within an amplitude range from abt. 600 mVpp up to 8 Vpp. To allow adaption of different time code generators, the boards input impedance can be selected by an on board jumper.

Therefore the board TCR180 provides a jumper to select the impedance (50O Ω, 600 Ω or 5 kΩ) of the input for modulated codes to comply with the requirements of several systems. Meinberg IRIG-generators have an output impedance of 50 Ω, to build a matched transmission system when using a coaxial cable. If such a generator is used to synchronize TCR180, the input impedance has to be set to 50 Ω. Default on delivery: 600 Ω.
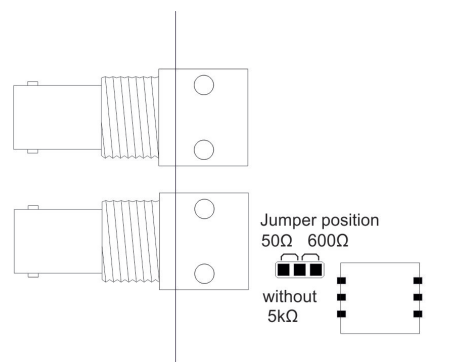
9 Functionality of the Generator

The time code generator of TCR180 is based on a DDS (Direct Digital Synthesis) frequency generator which derives the sine carrier of the modulated code from the reference clock of the master oscillator. The modulation of carrier amplitude (modulated codes) or pulse duration (unmodulated, DC level shift codes) is synchronized to the generated pulse-per-second (PPS) signalderived from the software clock.

The generated time code is independent from the settings for the received code. Thus it's possible to generate a output signal with a different format and UTC offset than the input signal.

9.1 Time Code Outputs

TCR180 provides modulated and unmodulated (DC level shift) outputs.

9.1.1 Modulated Outputs

The amplitude-modulated sine carrier is available by VG connector. The signal amplitude is 3Vpp (MARK) and 1Vpp (SPACE) into 50 Ohm. The encoding is made by the number of MARK-amplitudes during ten carrier waves. The following agreements are valid:

binary '0'   :   2 Mark - amplitudes, 8 SPACE-amplitudes
binary '1'   :   5 Mark - amplitudes, 5 SPACE-amplitudes
position-identifier :   8 Mark - amplitudes, 2 SPACE-amplitudes

9.1.2 Unmodulated Outputs

The pulse width modulated DC-signals are coexistent to the modulated output and are available with TTL level into 50 Ohm and as RS-422 signal.

9.2 Pulse Outputs

The pulse generator of the TCR180 generates pulses for the seconds change (P_SEC) and the minute change (P_MIN). In addition, fixed output frequencies of 10 MHz, 1 MHz and 100 kHz are derived from the OCXO. All these signals are carried out with TTL level on the back-side connector (VG96).

Three programmable pulses outputs are available (PPO0, PPO1, PPO2). The generator is capable of generating various pulses, which are configured via the monitor program. The pulse position is invertible for each channel, the pulse time can be adjusted in the 10 msec grid between 10 msec and 10 sec. By default, the pulse outputs remain inactive until the receiver has synchronized. The device can also be set in such a way that the outputs are activated immediately after switching on.

The following modes can be configured independently for each channel:

Timer mode:	Three "on" and "off" time pairs per day
Cyclic mode:	Periodically repeated pulses.
	A cycle time of two seconds would generate a pulse at
	0:00:00, 0:00:02, 0:00:04 etc.
DCF77-Simulation mode:	Outputs simulated DCF77-compüatible time marks,
	representing the local time configured on the device.
Single Shot Mode:	A single pulse of programmable length is generated once a day at a
	programmable point of time.
Per Sec.	
Per Min.	
Per Hr. modes:	Pulses once per second, minute, or hour aligned with second boundary
Synthesizer	Frequency output 1/8 Hz up to 10 MHz
Time Codes	Generation of Time Codes as described in chapter "Time Codes"
Idle-mode:	The output is inactive

The default configuration for the pulse outputs is:

PPO0:	Pulse each second (PPS), active HIGH, pulse duration 200 msec
PPO1:	Pulse each minute (PPM), active HIGH, pulse duration 200 msec
PPO2:	DCF77 Simulation

Frequency Outputs (optional)
The included synthesizer generates a frequency from 1/8 Hz up to 10 MHz synchronous to the internal timing frame. The phase of this output can be shifted from –360° to +360° for frequencies less than 10 kHz. Both frequency and phase can be setup from the front panel or using the serial port COM0. Synthesizer output is available at the rear connector as sine-wave output (F_SYNTH_SIN), with TTL level (F_SYNTH) and via an open drain output (F_SYNTH_OD). The open drain output can be used to drive an optocoupler when a low frequency is generated.

The synthesizer is turned off if a frequency of 0 Hz is configured.

If the output frequency is below 10 kHz the phase of the output signal can be set from –360° to +360° with a
resolution of 0.1°.

9.2.1 Enabling of Outputs

By default the time code output, the pulse outputs, the serial outputs, and the frequency synthesizer are disabled after power up until the receiver is synchronized. However, the monitor software can be used to configure each group of outputs so that they are always enabled immediately after power-up.

⚠️

Please note: Enabling of the time code output and the programmable pulses are controlled by the same setting.

9.2.2 Time Capture Inputs

Two time capture inputs called User Capture 0 and 1 are provided at the rear connector (CAP0 and CAP1) to measure asynchronous time events. A falling TTL slope at one of these inputs lets the microprocessor save the current real time in its capture buffer. From the buffer, capture events are transmitted via COM0 or COM1 and displayed on LCD. The capture buffer can hold more than 500 events, so either a burst of events with intervals down to less than 1.5 msec can be recorded or a continuous stream of events at a lower rate depending on the transmission speed of COM0 or COM1 can be measured.

The format of the output string is ASCII, see the technical specifications at the end of this document for details. If the capture buffer is full a message "** capture buffer full" is transmitted, if the interval between two captures is too short the warning "** capture overrun" is being sent.

9.2.3 Asynchronous Serial Ports (optional 4x COM)

Four asynchronous serial RS-232 interfaces (COM0 ... COM3) are available to the user. By default, automatic transmission of a time string via the serial ports is disabled until the receiver has synchronized. However, it is possible to change the device configuration so that serial time strings are always transmitted immediately after power-up.

Transmission speeds, framings and mode of operation can be configured separately using the setup menu. COM0 is compatible with other radio remote clocks made by Meinberg. It sends the time string either once per second, once per minute or on request with ASCII '?' only. Also the interfaces can be configured to transmit capture data either automatically when available or on request. The format of the output strings is ASCII, see the technical specifications at the end of this document for details.

9.2.4 DCF77 Emulation

The clock generates TTL level time marks (active HIGH) which are compatible with the time marks spread by the German long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany: time of day, date of month and day of week in BCD coded second pulses. Once every minute the complete time information is transmitted. However, the generates time marks representing its local time as configured by the user, including announcement of changes in daylight saving and announcement of leap seconds. The coding sheme is given below:
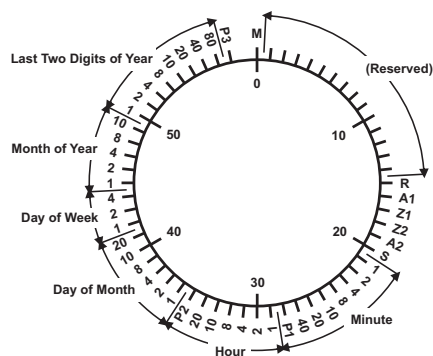
M	Start of Minute (0.1 s)	
R	RF Transmission via Secondary Antenna	
A1	Announcement of a Change in Daylight Saving Time	
Z1, Z2	Time Zone Identification	
	Z1, Z2 = 0, 1:	Daylight Saving Time Disabled
	Z1, Z2 = 1, 0:	Daylight Saving Time Enabled
A2	Announcement of a Leap Second	
S	Start of Time Code Information	
P1, P2, P3	Even Parity Bits	

Time marks start at the beginning of new second. If a binary "0" is to be transmitted, the length of the corresponding time mark is 100 msec, if a binary "1" is transmitted, the time mark has a length of 200 msec. The information on the current date and time as well as some parity and status bits can be decoded from the time marks of the 15th up to the 58th second every minute. The absence of any time mark at the 59th second of a minute signals that a new minute will begin with the next time mark. The DCF emulation output is enabled immediately after power-up.

10 Connectors and LEDs in the Frontpanel
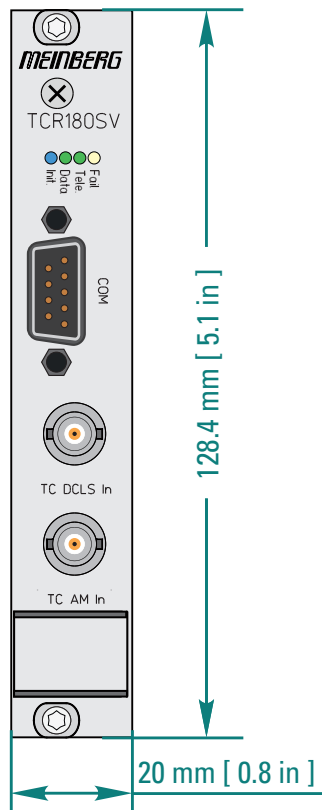
The frontpanel of the board includes the BNC connector for the amplitude modulated time codes, four LEDs and a 9 pin D–Sub-plug.

Pressing the hidden key BSL is required for activating the Bootstrap–Loader before updating the firmware.

The 9 pin D–Sub-connector is wired to the board's serial port. Pin assignment can be seen from the figure below. This port can not be used as serial port for the computer. Instead, the clock uses the port to send out Meinberg's standard time string in order to control an external display or some other external device. The string is sent out once per second, once per minute or if requested by an incoming ASCII "?".

It is also possible to change the board time by sending such a string towards the clock. Transmission speed, framing and mode of operation can be modified using the monitor software. The string format is described in the section 'Technical Specifications' at the end of this manual.

LED Indicators

1. blue: while the receiver passes the initialization phase
    off: Oscillator not warmed up
    green: the internal timing of TCR180 is synchronized to
                                      the received time code (Lock)

2. green: correct time code detected
    red: no correct time code detected
    yellow: TCR180 synchronized by Multi.Ref. source
    yellow/green (flashing):   Holdover mode (Multi.Ref.), IRIG Code available
    yellow/red (flashing):   Holdover mode (Multi.Ref.), IRIG Code not available

3. green: telegramm consistent
    red: telegramm inconsistent
    yellow (flashing):   Jitter too large

4. red: the internal timing of TCR180 is in holdover mode
    off: the internal timing of TCR180 is synchronized
                                      to the received time code (Lock)

11 Putting into Operation

To achieve correct operation of the board, the following points must be observed.

11.1 Configuration of TCR180

The selection of the time code, configuration of the serial interface and a possible offset of the received time to UTC must be set up by the monitor software. In contrast to AFNOR NF S87-500 the IRIG telegram containes only the day of year (1...366) instead of a complete date. To ensure correct function of TCR180, the date stored in the realtime clock of the board must be set when using IRIG codes therefore. This setting can be done by a terminal software also.

If the time zone of the received time code is not UTC, the local offset to UTC must be configured to ensure correct function of the driver software. If the local time zone is MEZ for example, the board must be set to a local offset of '+60min' (MEZ = UTC + 1 h).

The serial interface COM0 can be configured to send a time telegram with reference to UTC or to the received local time.

12 Firmware Update of the TCR180.

On slot cards, with flash program memory, the firmware update is being performed using the Meinberg flash program "mbgflash" via the serial port COM0 of the slot card.

The update requires a specific firmware image that matches the the slot card type. To install the "mbgflah" program download and execute the EXE file.

Download of mgbflash program:
https://www.meinbergglobal.com/download/utils/windows/mbgflash-1.13.exe

The update process can be performed as often as needed when faults occur, since it is independent from contents of the program memory. The current content of the program memory is kept until the update process sends the command to clear the program memory. In this case, the slot card is ready for operation after the computer is switched on again.

13 Meinberg Device Manager

The program serves the configuration of Meinberg Radio Clocks. The software can be run on the operating systems Windows 7 or higher. Supported Linux distributions include Ubuntu, Mint Linux, Debian, SUSE Linux, CentOS, and others.

Documentation:
https://www.meinbergglobal.com/download/docs/manuals/english/meinberg-device-manager.pdf

Download:
https://www.meinbergglobal.com/english/sw/mbg-devman.htm
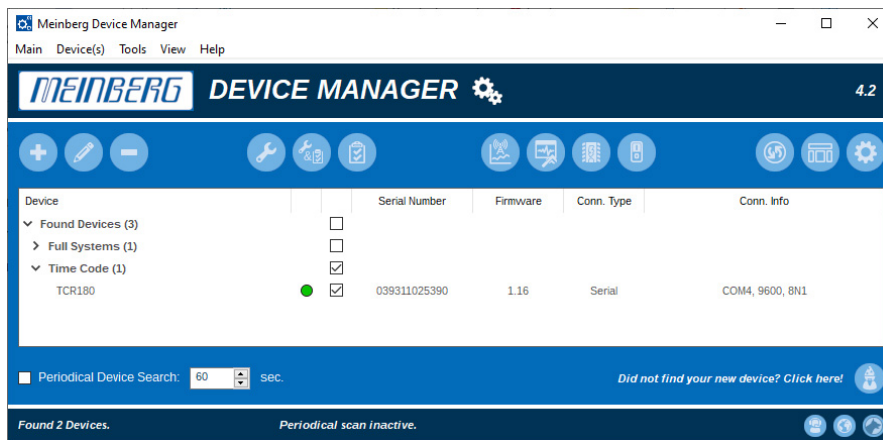
A connection between the module and the program can be established serially. Connect the serial interface of your PC (USB with USB → Serial - Adapter) with the COM 0 port of the TCR180.

The configurations are described in the Meinberg Device Manager documentation.

Connection
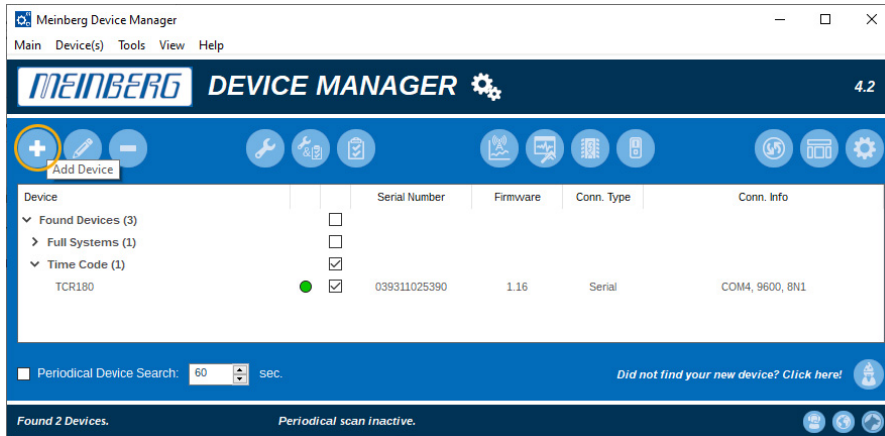
If your PC has not established an automatic connection to the time code receiver, select a manual connection with "Add Device". In this dialog you must now enter the port, the baud rate and the framing of the interface.

Device Type:	Other
Connection Type:	Serial
Serial Port:	Der COM-Port Ihres PC
Baudrate:	9600
Framing:	8N1
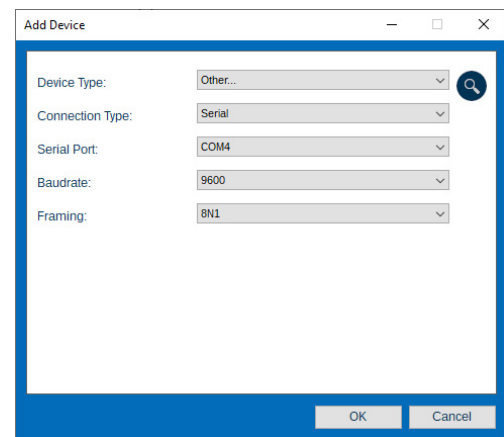
Configuration
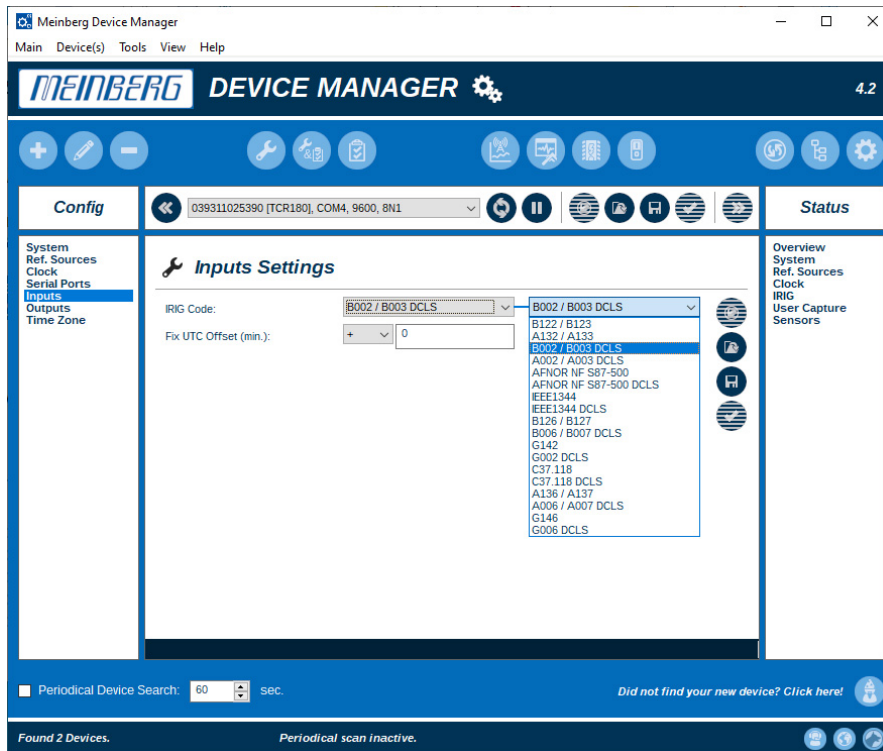
With "Configure Device(s) various configurations can be carried out on the system. Additionally many system status messages can be displayed. Please note that any changes you make in the settings must always be confirmed with the "Apply Configuration" button. Use the "Restore Configuration" button to reset all settings back to their default values. For more information, please refer to the Meinberg Device Manager manual.
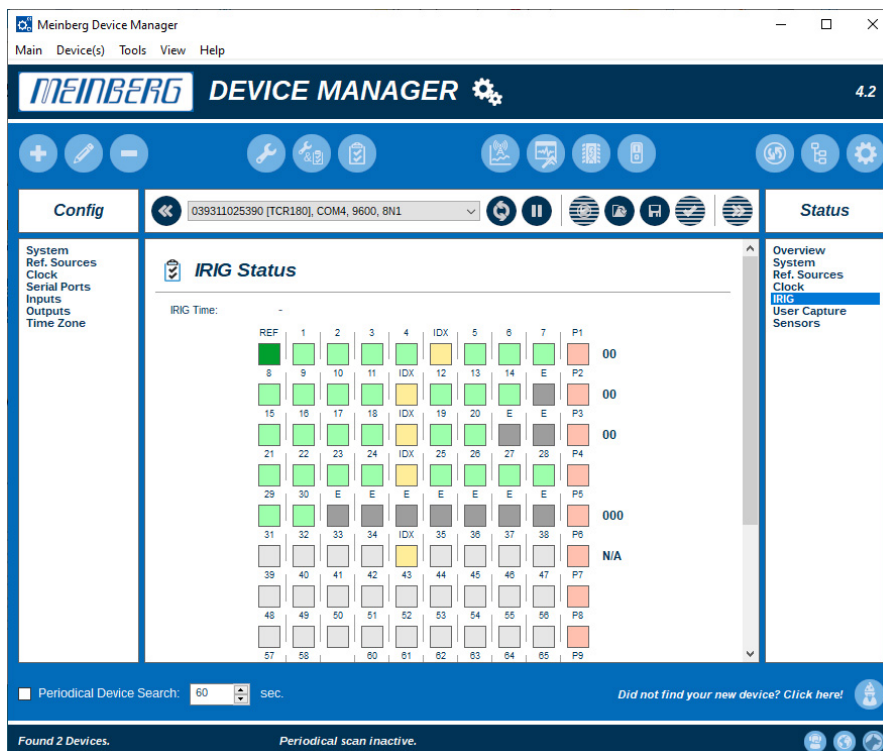
Figure: display of the IRIG status with "Meinberg Device Manager" Software.

14 Update of the System Software

If it is ever necessary to copy an updated version of the system firmware to the device, this can be done via the serial interface COM 0 without opening the housing of the device. The new firmware version can easily be loaded onto the system using the Meinberg monitoring software "Meinberg Device Manager".
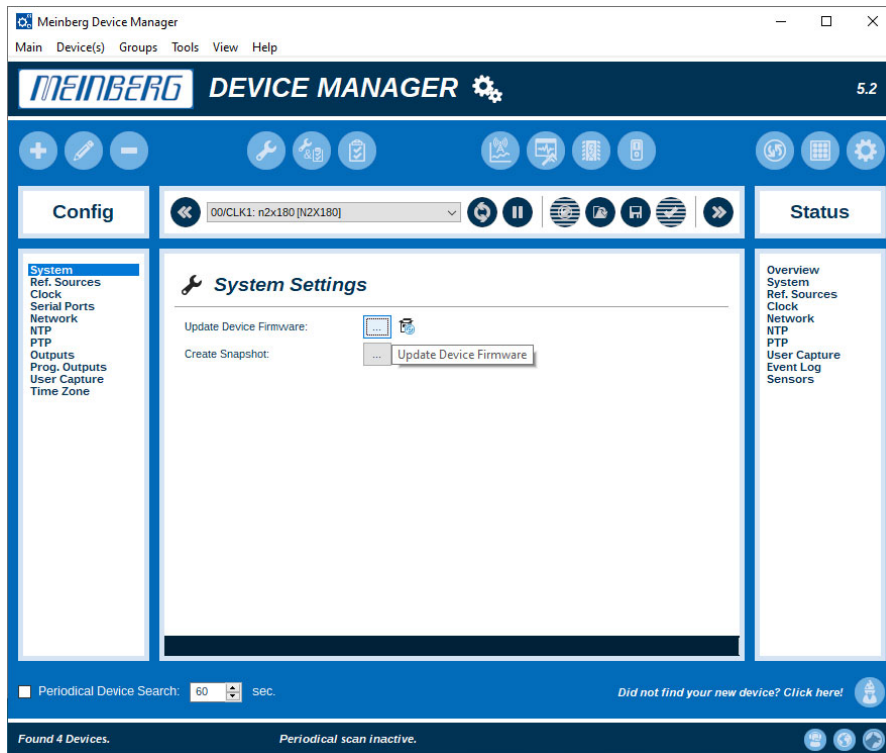
Figure: With the button **Update Device Firmware** *a current firmware version can be loaded on the TCR180 module.*

You can find the software and the "Meinberg Device Manager" documentation as download on our website:
https://www.meinbergglobal.com/english/sw/mbg–devman.htm

Create Snapshot
It is possible to save the current configuration of the TCR180 module as a text file (zip format). In case of operating problems you can send this file to the MEINBERG support team.

Note:
You may need a "Serial to USB Converter" to connect the system with your PC. This converter is not included in the scope of delivery.

15 Technical Specification TCR180

Receiver Input: AM-input (BNC-connector):
insulated by a transformer
impedance settable 50 Ω, 600 Ω, 5 kΩ
input signal: 600 mV$_{pp}$ to 8 V$_{pp}$ (Mark)
other ranges on request

DC Level Shift input (D-Sub-connector):
insulated by photocoupler

internal series resistance:	220 Ω
maximum forward current:	60 mA
diode vorward voltage:	1.0 V...1.3 V

Decoding: decoding of the following telegrams possible:
IRIG-A002 / A132 / A003 / A133 / A006 / A136 / A007 / A137
IRIG-B002 / B122 / B003 / B123 / B006 / B126 / B007 / B127
AFNOR NF S87-500
IEEE C37.118
IEEE 1344

Accuracy of Time Base: < 500 nsec compared to IRIG reference marker

**Required Accuracy of
Time Code Source:** +/- 100 ppm

Holdover Mode: automatic switching to crystal time base
accuracy approximately $1*10^{-8}$
if decoder has been synchronous for more than 1h

Backup Battery: if the power supply fails, an onboard realtime
clock keeps time and date information
important system parameters are stored in the
RAM of the system lifetime of the Lithium battery
at least 10 years

Generator Outputs: modulated output:
unbalanced sine carrier, 1 kHz
3V$_{pp}$(MARK), 1V$_{pp}$ (SPACE) into 50 Ω

unmodulated outputs(DCLS):
TTL into 50 Ω
RS-422
active high or low selectable by jumper

optical output (option):

optical power:	typ. 15μW
optical connector:	ST-connector

for GI 50/125μm
or GI 62,5/125μm
gradient fiber

Pulse Outputs:	three programmable outputs, TTL level	
	Default settings:	
	active only 'if sync'	
	PPO_0:	change of seconds (PPS)
		pulse duration 200 msec
		valid on rising edge
	PPO_1:	change of minute (PPM)
		pulse duration 200 msec
		valid on rising edge
	PPO_2:	DCF simulation

Accuracy of Pulses: better than +/- 1 μsec after synchronization
and 20 minutes of operation

Serial Ports:	four configurable RS-232 interface	
	baudrates:	300 Bd...115200 Bd
	framing:	7E2, 8N1, 8N2, 8E1
	7N2, 7E1, 801	
	mode of operation:	string per second
		string per minute
		string on request
	time telegram:	Meinberg Standard
		Uni Erlangen, SAT
	Meinberg Capture, ION	
	Computime, SPA, RACAL	

Capture Inputs:	triggered by falling TTL slope	
	pulse repetition time:	1.5 msec min.
	resolution:	800 nsec
	output of trigger event via PCI-bus or serial interface	

Master Oscillator:	TCXO	
	(Temperature Compensated Xtal Oscillator)	
	accuracy compared to IRIG-reference:	
	sync. and 20 min.	
	of operation:	+- $5(10^{-9})$
	first 20 min. after sync.:	+- $1(10^{-8})$
	accuracy of oscillator:	
	holdover, 1 day:	+- $1(10^{-7})$
	holdover, 1 year:	+- $1(10^{-6})$
	short term stability:	
	$\leq$ 10 sec, synchronized:	+- $2(10^{-9})$
	$\leq$ 10 sec, holdover:	+- $5(10^{-9})$
	temperature dependant drift:	
	holdover:	+- $1(10^{-6})$

Frequency Synthesizer:	1/8 Hz up to 10 MHz	
Accuracy of Synthesizer:	base accuracy depends on system accuracy	
	1/8 Hz to 10 kHz	Phase syncron with pulse output P_SEC
	10 kHz to 10 MHz	frequency deviation < 0.0047 Hz
Synthesizer Outputs:	F_SYNTH:	TTL into 50 Ω
	F_SYNTH_SIN:	sine-wave
		output voltage: 1.5 V eff.
		output impedance: 200 Ohm

Reliability of Operation: microprocessor supervisory circuit provides watchdog timer,
power supply monitoring and backupbattery
switchover software watchdog monitors correct program
flow and generates a reset in case of error detection

Initialisation: software and realtime clock can be set by a serial
Meinberg Standard Telegram via COM Port

Data Format: binary, byte serial

Outputs: pulse per second (PPS):
TTL- and RS-232 level
positive pulse, pulse duration 200 msec
pulse per minute (PPM): TTL level
positive pulse, pulse duration 200 msec

Ambient Temperature: 0 ... 50 °C

Humidity: max. 85 %

Current Consumption: 450 mA

Steckerbelegung / Pin Assignment   TCR180

		a	b	c
		a	b	c
1		**VCC in (+5 V)**	**VCC in (+5 V)**	**VCC in (+5 V)**
2		**VCC in (+12V) - do not connect**	**VCC in (+12V) - do not connect**	**VCC in (+12V) - do not connect**
3		**VDD in (TCXO/OCXO)** **optional, do not connect**	**VDD in (TCXO/OCXO)** **optional, do not connect**	**VDD in (TCXO/OCXO)** **optional, do not connect**
4		Reserved (FrequAdjust out)	PPS in IMS	PROG PULSE3 out
5		FIXED FREQUENCY out	GND	10 MHz IMS in
6		PPS IMS in		PPS out
7		TIME CODE DCLS IMS in	GND	PPS2 in
8		Reserved (10 MHz Osc in)		PPM out
9		10 MHz SINE out		
10		100 kHZ TTL out		PROG PULSE0 out
11		1 MHz TTL out		PROG PULSE1 out
12		10 MHz TTL out		PROG PULSE2 out
13		TIME CODE DCLS out		SCL
14		TIME CODE AM out	GND	COM4 RxD in
15		COM2 RxD in		SDA
16		COM2 TxD out		Reserved (P7.5)
17		COM3 RxD in		DCF MARK out
18		COM3 TxD out		Reserved (Vref/TxD2 TTL)
19		**GND**		TIMESYNC out
20		**GND**	GND	Reservd (P7.6)
21		**GND**		F_SYNTH TTL out
22		**GND**	GND	F_SYNTH_OD out
23		**GND**		F_SYNTH_SIN out
24		**GND**		COM1 TxD out
25		**GND**	Slot_ID0	COM4 TxD out
26		**GND**	Slot_ID1	COM0 TxD out
27		**GND**	Slot_ID2	CAP1 in
28		**GND**	Slot_ID3	CAP0 in
29		**GND**	+USB	COM1 RxD in
30		**GND**	-USB	COM0 RxD in
31		**GND**	**GND**	**GND**
32		**GND**	**GND**	**GND**

16 Technical Appendix TCR180

16.1 Abstract of 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.

The TCR180 supports decoding and generating of IRIG-A, IRIG-B, AFNOR NF S87-500, IEEE C37.118 and IEEE 1344.

16.1.1 Description of IRIG-Codes

Format:

Format A	1 k pps
Format B	100 pps
Format D	1 ppm
Format E	10 pps
Format G	10 k pps
Format H	1 pps

Modulation Frequency:

0	Pulse width code
1	Sine wave, amplitude modulated
2	Manchester modulated

Frequency/Resolution:

0	No carrier/index count interval
1	100 Hz/10 ms
2	1 kHz/1 ms
3	10 kHz/0.1 ms
4	100 kHz/10 ms
5	1 MHz/1ms

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}, CF
6	BCD_{TOY}, BCD_{YEAR}
7	BCD_{TOY}, BCD_{YEAR}, SBS

A 1 3 7

The signal designated as A137 is deciphered as follows: Format A, Sine wave (amplitude modulated), 10 kHz carrier/0.1 ms resolution, and Coded expressions BCD_{TOY}, BCD_{YEAR}, and SBS.

16.2 Time Code Format

16.2.1 Time Code Format According to IRIG Standard
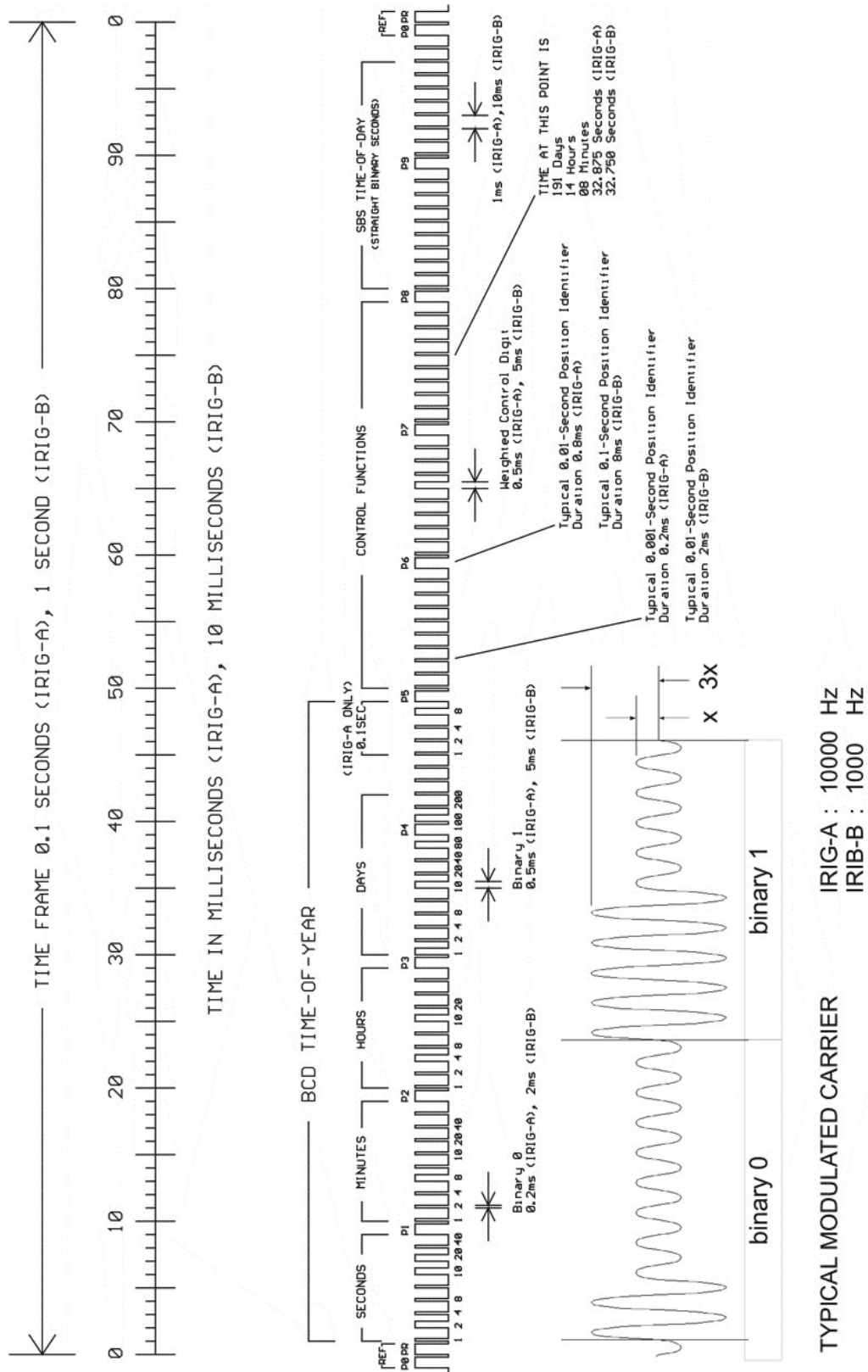
16.2.2 Time Code Format According to AFNOR Standard
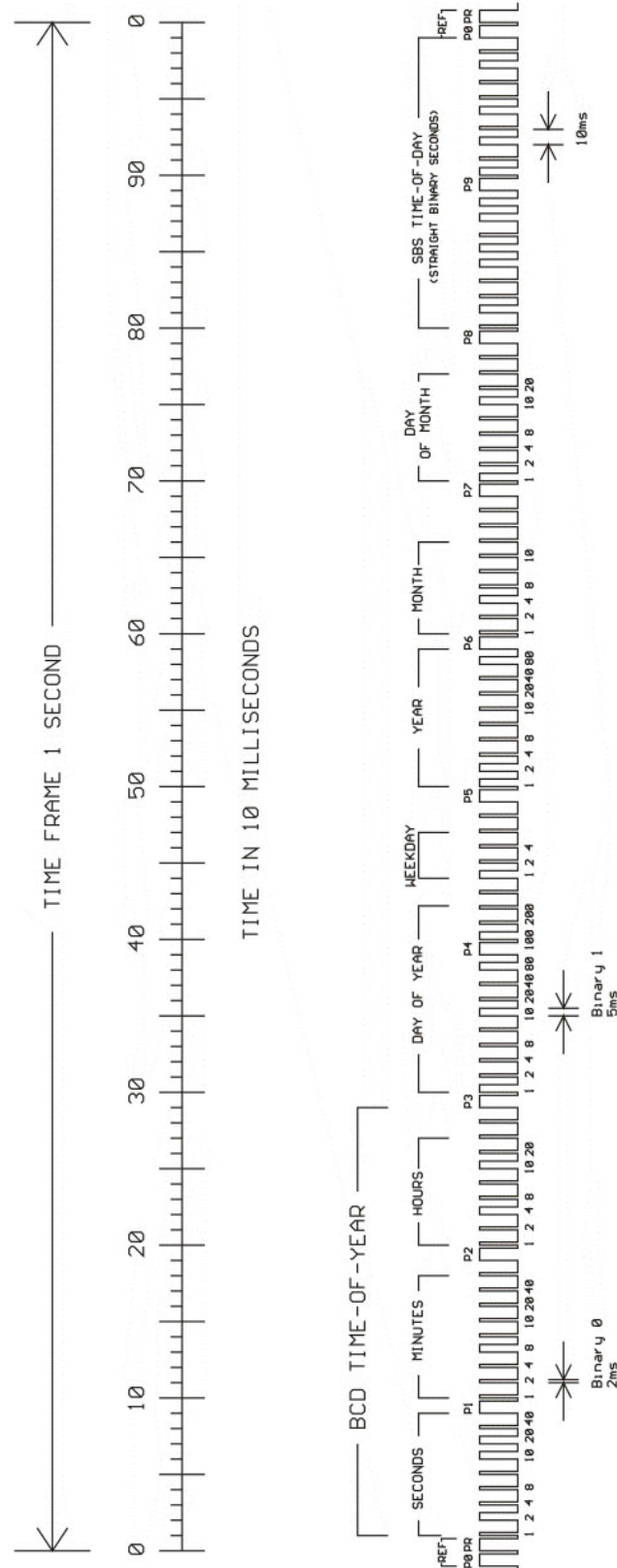
16.3 Time Strings

16.3.1 Meinberg Standard Time String

The Meinberg Standard Time String is a sequence of 32 ASCII characters starting with the <STX> (Start-of-Text) character and ending with the <ETX> (End-of-Text) character. The format is as follows:

<STX>D:*dd.mm.yy;T:w;U:hh.mm.ss;uvxy*<ETX>

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

<STX>	Start-of-Text, ASCII code 02h sent with one-bit accuracy at the change of each second

dd.mm.yy	The date:		
	dd	Day of Month	(01–31)
	mm	Month	(01–12)
	yy	Year of the Century	(00–99)

w	The day of the week	(1–7, 1 = Monday)

hh.mm.ss	The time:		
	hh	Hours	(00–23)
	mm	Minutes	(00–59)
	ss	Seconds	(00–59, or 60 during leap second)

uv	Clock status characters (depending on clock type):		
	u:	'#'	GPS: Clock is in free-run mode (no exact synchronization)
			PZF: Time frame not synchronized
			DCF77: Clock has not synchronized since last reset
		' '	(space, 20h)
			GPS: Clock is synchronized (base accuracy is reached)
			PZF: Time frame is synchronized
			DCF77: Clock has synchronized since last reset
	v:	'*'	
			GPS: Receiver has not checked its position
			PZF/DCF77: Clock currently running off XTAL
		' '	(space, 20h)
			GPS: Receiver has determined its position
			PZF/DCF77: Clock is synchronized with transmitter

x	Time zone indicator:		
	'U'	UTC	Universal Time Coordinated, formerly GMT
	' '	CET	European Standard Time, daylight saving disabled
	'S'	(CEST)	European Summertime, daylight saving enabled

y	Announcement of clock jump during last hour before jump enters effect:	
	'!'	Announcement of start or end of Daylight Saving Time
	'A'	Announcement of leap second insertion
	' '	(Space, 20h) nothing announced

<ETX>	End-of-Text, ASCII code 03h

16.3.2 Meinberg Capture String

The Meinberg Capture String is a sequence of 31 ASCII characters terminated by a `<CR><LF>` (Carriage Return/Line Feed) sequence. The format is as follows:

CH*x*`<SP>`*dd.mm.yy_hh:mm:ss.fffffff*`<CR><LF>`

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

x	0 or 1 corresponding on the number of the capture input
`<SP>`	Space, ASCII code 20h

`dd.mm.yy`   Capture date:

dd	Day of Month	(01–31)
mm	Month	(01–12)
yy	Year of the Century	(00–99)

`hh:mm:ss.fffffff`   Capture time:

hh	Hours	(00–23)
mm	Minutes	(00–59)
ss	Seconds	(00–59, or 60 during leap second)
fffffff	Fractions of second, 7 digits	

`<CR>`	Carriage Return, ASCII code 0Dh
`<LF>`	Line Feed, ASCII code 0Ah

16.3.3 Uni Erlangen String (NTP)

The Uni Erlangen String (NTP) of a GPS clock is a sequence of 66 ASCII characters starting with the `<STX>` (start-of-text) character and ending with the `<ETX>` (end-of-text) character. The format is as follows:

`<STX>`*dd.mm.yy; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.lllle hhhhm*`<ETX>`

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters are as defined below:

`<STX>`	Start-of-Text, ASCII code 02h sent with one-bit accuracy at the change of each second		
`dd.mm.yy`	The date:		
	dd	Day of Month	(01–31)
	mm	Month	(01–12)
	yy	Year of Century	(00–99)
`w`	Day of the week		(1–7, 1 = Monday)
`hh.mm.ss`	The time:		
	hh	Hours	(00–23)
	mm	Minutes	(00–59)
	ss	Seconds	(00–59, or 60 during leap second)
`v`	-/+ sign of the offset of local timezone relative to UTC		
`oo:oo`	Offset of local time zone relative to UTC in hours and minutes		

`ac` Clock status characters:
- a: '#'   Clock has not synchronized since reset
-      ' '   (Space, 20h) Clock has synchronized since reset
- c: '*'   GPS receiver has not checked its position
-      ' '   (Space, 20h) GPS receiver has determined its position

`d` Time zone indicator:
- 'S'   CEST   European Summertime, Daylight Saving Time enabled
- ' '   CET   European Standard Time, Daylight Saving Time disabled

`f` Announcement of clock jump during last hour before jump enters effect:
- '!'   Announcement of start or end of Daylight Saving Time
- ' '   (Space, 20h) nothing announced

`g` Announcement of clock jump during last hour before jump enters effect:
- 'A'   Announcement of leap second insertion
- ' '   (Space, 20h) nothing announced

`i` Leap second insertion
- 'L'   Leap second is currently to be inserted (only active in 60th second)
- ' '   (Space, 20h) No leap second to be inserted

`bbb.bbbb` Geographical latitude of receiver position in degrees
Leading characters padded by Space characters (20h)

n   Latitudinal hemisphere, with the following characters possible:
                'N'   North of Equator
                'S'   South of Equator

lll.llll Geographical longitude of receiver position in degrees
                Leading characters padded by Space characters (20h)

e   Longitudinal hemisphere, with the following characters possible:
                'E'   East of Greenwich Meridian
                'W'   West of Greenwich Meridian

hhhh   Altitude above WGS84 ellipsoid in meters
                Leading characters padded by Space characters (20h)

<ETX>   End-of-Text, ASCII code 03h

16.3.4 SAT Time String

The SAT Time String is a sequence of 29 ASCII characters starting with the `<STX>` (start-of-text) character and ending with the `<ETX>` (end-of-text) character. The format is as follows:

> `<STX>`*dd.mm.yy/w/hh:mm:ssxxxxuv*`<ETX>`

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters are as defined below:

`<STX>`   Start-of-Text, ASCII code 02h sent with one-bit
              accuracy at the change of each second

`dd.mm.yy`   The date:
dd	Day of Month	(01–31)
mm	Month	(01–12)
yy	Year of the Century	(00–99)

`w`   The day of the week, (1–7, 1 = Monday)

`hh:mm:ss`   The time:
hh	Hours	(00–23)
mm	Minutes	(00–59)
ss	Seconds	(00–59, or 60 during leap second)

`xxxx`   Time zone indicator:
'UTC'	Universal Time Coordinated, formerly GMT
'CET'	European Standard Time, daylight saving disabled
'CEST'	European Summertime, daylight saving enabled

`u`   Clock status characters:
'#'	Clock has not synchronized since last reset
' '	(Space, 20h) Clock has synchronized since last reset

`v`   Announcement of clock jump during last hour before jump enters effect:
'!'	Announcement of start or end of Daylight Saving Time
' '	(Space, 20h) nothing announced

`<CR>`   Carriage Return, ASCII code 0Dh

`<LF>`   Line Feed, ASCII code 0Ah

`<ETX>`   End-of-Text, ASCII code 03h

16.3.5 Computime Time String

The Computime time string is a sequence of 24 ASCII characters, starting with the character `T` and terminated with the character `<LF>` (Line Feed, ASCII code 0Ah). The format is as follows:

`T:`*`yy:mm:dd:ww:hh:mm:ss`*`<CR><LF>`

The letters printed in italics are replaced by ASCII numbers whereas the other characters
are unalterable parts of the time string. The groups of characters as defined below:

`T`	Start character Sent with 1-bit accuracy at the start of the second.

`yy:mm:dd`	The current date:		
	`yy`	Year without century	(00–99)
	`mm`	Month	(01–12)
	`dd`	Day of the month	(01–31)
	`ww`	Day of the week	(1–7, 1 = Monday)

`hh:mm:ss`	The current time:		
	`hh`	Hours	(00–23)
	`mm`	Minutes	(00–59)
	`ss`	Seconds	(00–59, or 60 during leap second)

`<CR>`	Carriage Return (ASCII code 0Dh)

`<LF>`	Line Feed (ASCII code 0Ah)

16.3.6 Format of the SPA Time String

The ABB SPA Time String is a sequence of 32 ASCII characters starting with the characters ">900WD" and ending with the <CR> (Carriage Return) character. The format is:

>900WD:*jj-mm-tt_hh.mm;ss.fff:cc*<CR>

The letters printed in italics are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

jj–mm–tt	the current date:		
	jj	year of the century	(00..99)
	mm	month	(01..12)
	tt	day of month	(01..31)
	_	Space	(ASCII–code 20h)

hh.mm;ss.fff	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	fff	milliseconds	(000..999)

cc	Checksum. EXCLUSIVE-OR result of the previous characters, displayed as a HEX byte (2 ASCII characters 0..9 or A..F)

<CR>	Carriage Return	ASCII Code 0Dh

16.3.7 RACAL Standard Time String

The RACAL Standard Time String is a sequence of 16 ASCII characters started by a `X` character and terminated by the `<CR>` (Carriage Return, ASCII code 0Dh) character. The format is as follows:

```
XGUyymmddhhmmss<CR>
```

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters are as defined below:

`X`	Start character, ASCII code 58h Sent with one-bit accuracy at the change of each second
`G`	Control character, ASCII code 47h
`U`	Control character, ASCII code 55h

`yymmdd`   Current date:

`yy`	Year of Century	(00–99)
`mm`	Month	(01–12)
`dd`	Day of Month	(01–31)

`hh:mm:ss`   Current time:

`hh`	Hours	(00–23)
`mm`	Minutes	(00–59)
`ss`	Seconds	(00–59, or 60 during leap second)

`<CR>`   Carriage Return, ASCII code 0Dh

16.3.8 ION Time String

The ION time string is a sequence of 16 ASCII characters starting with the `<SOH>` (Start of Header, ASCII code 01h) ASCII control character and ending with the `<LF>` (Line Feed, ASCII code 0Ah) character. The format is as follows:

> `<SOH>`*ddd:hh:mm:ssq*`<CR><LF>`

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

`<SOH>`   Start of Header (ASCII code 01h)
sent with one-bit accuracy at the change of each second

`ddd`   Day of Year   (001–366)

`hh:mm:ss`   Current time:

`hh`	Hours	(00–23)
`mm`	Minutes	(00–59)
`ss`	Seconds	(00–59, or 60 while leap second)
`q`	Quality	
	Indicator	Space (ASCII code 20h) Time Sync (GPS Lock)
		"?" (ASCII code 3Fh) No Time Sync (GPS Fail)

`<CR>`   Carriage Return (ASCII code 0Dh)

`<LF>`   Line Feed (ASCII code 0Ah)

16.4 RS-232 COMx Time String Output

Data Transfer Mode: Serial I/O

**RS-232 Baud Rates:** 19200 *(Default)*, 9600, 4800, 2400, 1200, 600, 300

Framing: 7N2, 7E1, 7E2, 8N1 *(Default)*, 8N2, 8E1, 8O1

Time String Formats: Meinberg Standard *(Default)*
Meinberg GPS
SAT
NMEA RMC
NMEA GGA
NMEA ZDA
NMEA RMC GGA *(RMC followed by GGA)*
Uni Erlangen
Computime
Sysplex 1
SPA
RACAL
ION
ION Blanked
IRIG-J-1
6021

Pin Assignment: Pin 2:   RxD *(Receive)*
Pin 3:   TxD *(Transmit)*
Pin 5:   GND *(Ground)*

Connector Type: D-Sub, Male, 9-Pin

Cable Type: Standard RS-232 Cable (Shielded)

COM x
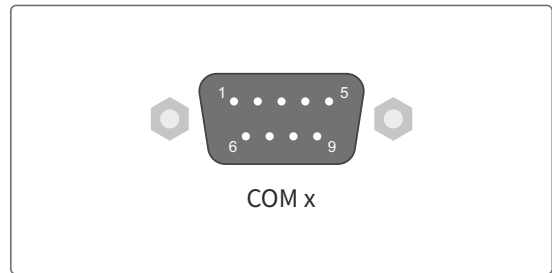
Information:

Please note that the pin layout of the device receiving the time string output will dictate whether you require a "straight-through" or a null modem cable to connect your system to a time string receiver. A null-modem cable has Pins 2 and 3 'crossed over', so that Pin 2 at one end leads to Pin 3 at the other, and vice versa.

If Pins 2 and 3 have identical assignments on both devices, you will require a null-modem cable. If they are opposite to one another, you will require a "straight-through" cable. Either way, it is important that the transmitter pin (TxD) of each device is connected to the receiver pin (RxD) of the other device.

16.5 Time Code AM Input

Isolation voltage:	3000 V DC
impedance (input):	std. 600 Ohm, (50 Ohm / 5 kOhm)
Signal range:	ca.600 mV – 8 V (Mark, peak–peak)
Connector:	BNC female, isolated
Cable:	shielded coax line

TC AM In

Danger!

This equipment is operated at a hazardous voltage.

Danger to life due to electrical shock!

- Never work with open terminals and plugs while the power is on!
- When working on the connectors, always remove both sides of the cable from the respective devices!
- The device is equipped with potential-free and isolated connections.
- In the event of a fault in a connected device, dangerous voltages can occur at the signal lines.

16.6 Time Code DCLS Input

Isolation voltage:	3750 Vrms
internal resistance:	330 Ohm
max. current (input):	25 mA
Cable:	shielded coax line

TC DCLS In
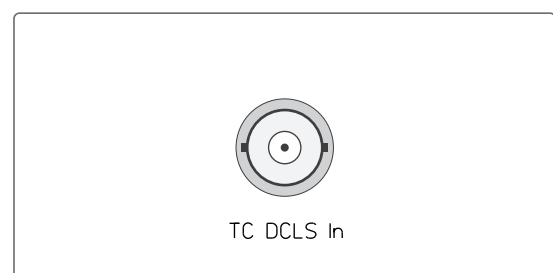
17 RoHS Conformity

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: TCR180–April 23, 2024

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

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

Produktbezeichnung   **TCR180**
Product Designation

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   EN 61000-6-2:2019
EMC Directive   EN IEC 61000-6-3:2021
                           EN 55035:2017/A11:2020
                           EN 55032:2015 + AC:2016 + A11:2020 + A1:2020

2014/30/EU
───
Niederspannungsrichtlinie EN IEC 62368-1:2020 + A11:2020
Low-voltage Directive

2014/35/EU
───
RoHS – Richtlinie   EN IEC 63000:2018
RoHS Directive

2011/65/EU + 2015/863/EU
───

EU-Declaration of Conformity
Doc ID: TCR180-April 23, 2024

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

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: TCR180-April 23, 2024

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

declares that the product

Product Designation   **TCR180**

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: TCR180-April 23, 2024

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

Bad Pyrmont, Germany, dated April 23, 2024

Aron Meinberg
Quality Management

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