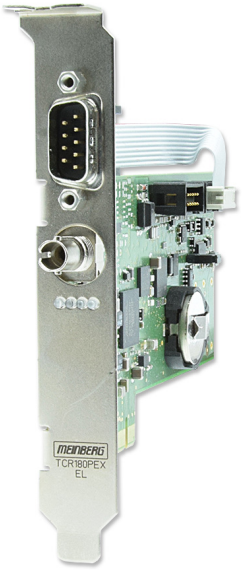
The Synchronization Experts.



MANUAL

TCR180PEX-EL

EL/FO-In

6th May 2021

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint

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2 Introduction

This manual is a systematically structured guide that comprehensively describes all functions of your Meinberg product. The individual chapters cover, the general functions of the TCR180PEX-EL, the correct installation, as well as essential technical data. The Setup Guide also describes the most important parameters that have to be configured for a quick start-up of your product in the respective management program.

The TCR180PEX-EL is used for synchronization of directly connected systems and can be equipped with a wide range of signal outputs for various applications. Possible output options of the TCR180PEX-EL are time code, frequency and pulse as well as relay outputs for status and TimeSync. It can be individually configured or its status can be monitored in the management program (MBGMON) by using a serial con-nection via RS-232 interface.

The software can be downloaded free of charge from our homepage:
https://www.meinberg.de/german/sw/

3 Safety instructions for building-in equipment

3.1 Important Safety Instructions and Protective Measures

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

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

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

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

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

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

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

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

3.2 Used Symbols

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

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

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

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

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

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

Please keep this manual in a safe place.

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

3.3 Safety Hints TCR180PEX-EL

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.

3.4 Prevention of ESD Damage

ATTENTION!

The designation ESD (Electrostatic Sensitive Devices) refers to measures which are used to protect electrostatically endangered components from electrostatic discharge and thus to prevent destruction. Systems and assemblies with electrostatically endangered components usually have the following characteristics:

Indicator for assemblies with electrostatic endangered components
The following measures protect electrostatically endangered components from destruction:

Prepare removal and installation of assemblies
Unload yourself (for example, by touching a grounded object) before touching assemblies.

Ensure that you wear a grounding strap on the wrist when working with such assemblies, which you attach to an unpainted, non-conductive metal part of the system.

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

Transporting Assemblies
Assemblies may only be touched at the edge. Do not touch any pins or conductors on assemblies.

Installing and Removing Assemblies
Do not touch persons who are not grounded while removing or installing components. This could result in a loss of grounding protection from your electrostatic discharge.

Storing Assemblies
Always keep assemblies in ESD protective covers. These protective covers must be undamaged. ESD protective covers, which are extremely wrinkled or even have holes, no longer protect against electrostatic discharge.

ESD protective covers must not be low-resistance and metallically conductive if a lithium battery is installed on the assembly.

3.5 Cabling

WARNING!
Danger to life through electric shock! Never work with voltage applied! When working on the plugs and terminals of connected cables, always disconnect both sides of the cables from the respective devices!

3.6 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 The System TCR180PEX-EL

4.1 TCR180PEX - Brand and Device Type

The TCR180PEX-EL belongs to the product series of computer plug-in cards and is used in the synchronization of the system clock of a computer system or as a highly accurate time base in own software applications.

The TCR180PEX-EL is designed as a "low profile" plug-in card for PCs with PCI Express interface and is equipped with a card holder in standard height at delivery, but can be converted for operation in "low profile" computers by a second bracket included in the scope of delivery.

4.2 Device Manufacturer

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

Phone: + 49 (0) 52 81 / 93 09 - 0
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Internet: https://www.meinbergglobal.com
Mail: info@meinberg.de

Date: 2021-05-06

Manual Version: 1.1

4.3 Target Audience

This manual is intended for professionals responsible for the installation, commissioning, maintenance, troubleshooting or operation of any of the equipment within the specified product range.

The structure and spelling of this manual assumes that the installation and commissioning technicians have knowledge of the use of electronical devices and network components.

4.4 Return of Equipment

All parts and components of your Meinberg system may only be repaired by Meinberg. In the event of a malfunction, the customer must contact our support service and never attempt to repair the device himself.

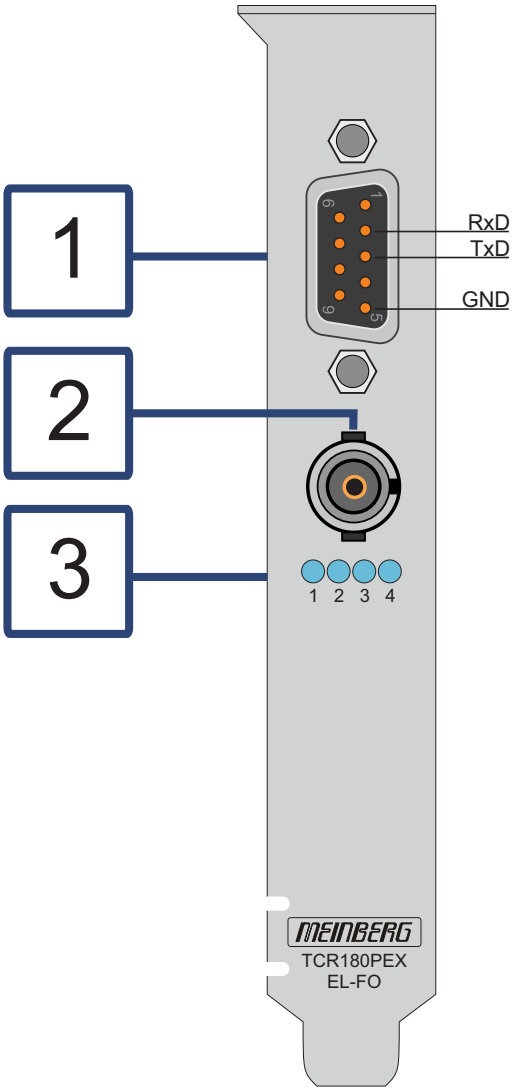
To request a device repair service, call Meinberg Technical Support to check shipping options and obtain the Return Material Authorization (RMA) number for shipping.

You can also request the RMA number from our website: https://www.meinbergglobal.com/english/support/rma.htm.

The device must be packed in its original packaging or suitable packaging to protect it from shock and moisture. Send your device to the manufacturer's address, including sender identification and RMA number.

What must be included with the shipment?
Please return the device complete with accessories such as antenna or cable if possible. This may be important for troubleshooting.

5 Front Connectors TCR180PEX-EL



5.1 COMx Timestring - RS-232

Data transfer: serial

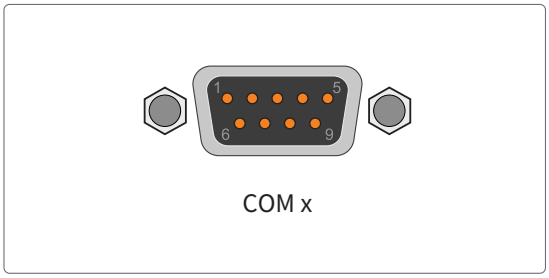
Baudrate/framing: 19200 / 8N1 (default)

Timestring: Meinberg Standard (default)

Assignment:
Pin 2: RxD (receive)
Pin 3: TxD (transmit)
Pin 5: GND (ground)

Connection type: D-SUB male 9pin.

Cable: data cable (shielded)
PC connector 1:1



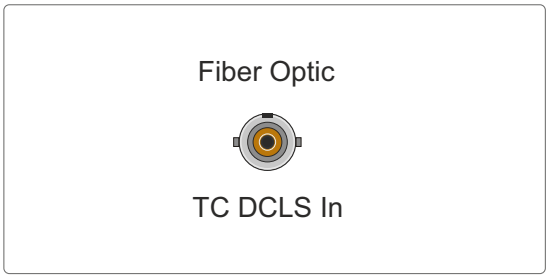
Signals like PPS, PPM, etc. can also be provided via this interface. Please refer to chapter Pre-setting - standard and multiref port for the pin assignment.

5.2 Time Code Fiber Optic Input

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

Input type: Fiber Optic (FO), Multimode

Time code signals: B002/003, B006/007
G002, G006
IEEE1344
C37.118
AFNOR NFS 87-500



Wave length: 850 nm

Min. input power: 3 μW

To ensure reliable signal detection, the input signal should not fall below the specified value.

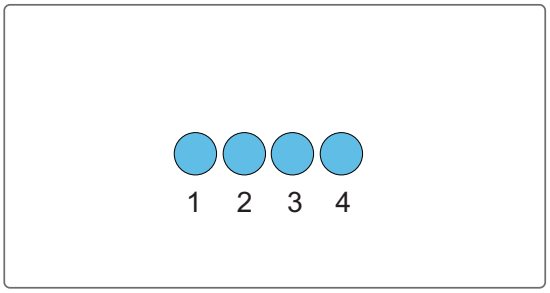
Connection type: ST connector.

Fiber type: GI 50/125 μm or
62.5/125 μm gradient fiber

5.3 TCR180PEX-EL - Status LEDs

Status indicator

LED 1:	Status of the TCR180PEX-EL
LED 2:	Status of the input signals
LED 3:	Telegram
LED 4:	Synchronization status



The status messages of the LED's are as follows:

LED 1:

blue:	During initialization.
off:	Oscillator has not yet reached operating temperature
green:	Oscillator has reached operating temperature

LED 2:

green:	TCR180PEX-EL receives a valid time code at the input
red:	TCR180PEX-EL does not receive a valid time code at the input
yellow:	TCR180PEX-EL is synchronized to a multi.ref. source
yellow/green (blinking):	Holdover mode (Multi.Ref.), time code available
yellow/red (blinking):	Holdover mode (Multi.Ref.), time code not available

LED 3:

green:	Telegram consistent
red:	Telegram not consistent
yellow (blinking):	Jitter too high

LED 4:

red:	Clock is running on quartz (holdover mode)
off:	Synchronized by the received time code

6 Functional description of receiver

After the received time code has passed a consistency check, the TCR180PEX-EL'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 TCR180PEX-EL 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 TCR180PEX-EL is shipped then the UTC parameter is set to "unconfigured", and as long as this is the case the card doesn't 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 TCR180PEX-EL 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 of a leap second, so the TCR180PEX-EL will switch into free running mode on such event, and resynchronize a few seconds later.

The board TCR180PEX-EL decodes the following formats:

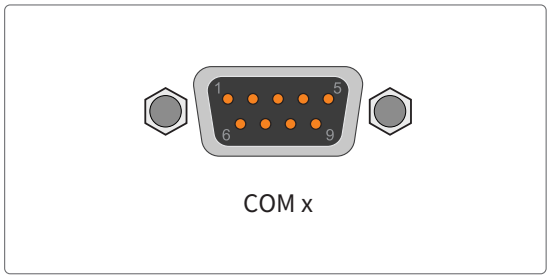
A002:	1000pps, DC Level Shift pulse width coded, no carrier BCD time of year
A003:	1000pps, DC Level Shift pulse width coded, no carrier BCD time of year, SBS time of day
B002:	100pps, DC Level Shift pulse width coded, no carrier BCD time of year
B003:	100pps,DC Level Shift pulse width coded, no carrier BCD time of year, SBS time of day
B006:	100 pps, DC Level Shift, no carrier BCD time-of-year, Year
B007:	100 pps, DC Level Shift, no carrier BCD time-of-year, Year, SBS time-of-day
G002:	10 k pps, DC Level Shift, no carrier BCD time-of-year
G006:	10 k pps, DC Level Shift, no carrier BCD time-of-year, Year
AFNOR NFS 87-500:	100 pps, DC Level Shift, no carrier, BCD time-of-year, complete date, SBS time-of-day, output level adjusted.
IEEE 1344:	Code according to IEEE 1344-1995, 100 pps, DC Level Shift, no carrier, 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

6.1 Fiber Optic FO Input

The TCR180PEX-EL synchronizes by using pulse width modulated (DC Level Shift) time codes, IRIG-A/B/G, AFNOR NF S-87500, IEEE C37.118 or IEEE 1344. These are transmitted to the ST connector (fiber optic input) via a fiber optic cable.

6.2 Signals of the D-SUB9 Inferface

The signals that can be transmitted via the D-SUB9 interface of the TCR180PEX-EL are described more detailed as follows.



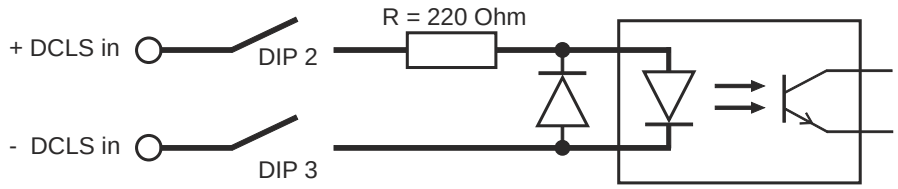
Enabling of outputs

By default the pulse outputs and the the serial outputs 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 refer to the chapter COMx Timestring - RS-232 for the specifications of the COM0 interface or to the chapter Pre-setting - standard and multiref port for the pin assignment.

6.2.1 Optocoupler input

Pulse width modulated (DC Level Shift) time codes are isolated by an integrated optocoupler and supplied to the TCR180PEX-EL. The connection diagram is as follows:



MultiRef-Port: Pin Assignment of the D-SUB 9 connecor (see chapter Pre-setting - standard and multiref port

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 has to be applied to not exceed the limit of the forward current of the input diode (60 mA). The forward current should not be limited to a value of less than 10 mA to ensure safe switching of the optocoupler.

6.2.2 Pulse outputs

PO0:	Pulse each second (PPS), active HIGH, pulse duration 200 msec
PO1:	Pulse each minute (PPM), active HIGH, pulse duration 200 msec

6.2.3 Asynchronous serial port

The TCR180PEX-EL has two serial interfaces COM0 (standard port) and COM1 (multi ref. port). At delivery the (COM0) is provided on the slot bracket. The interface (COM1) can optionally be used via a second D-SUB-9 connector.

By default, both interfaces remain inactive after the system is switched on, until the receiver is synchronized. By using the monitor program, however, the TCR180PEX-EL can be configured so that the interfaces are activated immediately after switch-on.

Transmission speed, framing and mode of operation can be configured individually for each port. Both of the ports can be configured to transmit either time strings (once per second, once per minute, or on request with

ASCII "?" only), or to transmit capture strings (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.

Please note:

If a serial interface sends capture events automatically, they can't be read via PCI-bus, because they are deleted from the buffer memory after transmission.

6.2.4 Time capture inputs

Capture 0 (CAP0) and Capture 1 (CAP1) of the standard port can be enabled by using the DIP switch for the D-SUB9 connector in the slot bracket. This allows any events to be recorded at any time. If a falling TTL edge is detected at one of these inputs, the microprocessor stores the number of the input and the current time in a buffer memory which can hold up to 500 entries. The capture events can be displayed using the monitor program or sent via the serial interface COM1.

The buffer memory can be used to record either a time-limited, fast sequence of events (interval down to 1.5 msec) or a continuous sequence of events with a lower repetition time (depending on the transmission rate of COM1). The output string consists of ASCII characters, a detailed description can be found in the back of this manual. If the buffer memory overflows, a message ("** capture buffer full" is output, if the time interval between two events at the same input is too short, the message "** capture overrun" is displayed and sent.

7 Before you start

7.1 Scope of Delivery

The delivery scope of the TCR180PEX-EL also includes:

Included with a TCR180PEX-EL are:

1. TCR180PEX-EL
2. low-profile card holder

Unpack the TCR180PEX-EL carefully and check the scope of delivery against the enclosed packing list to ensure that no parts are missing. If any of the listed items are missing, please contact our sales department: sales@meinberg.de

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

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

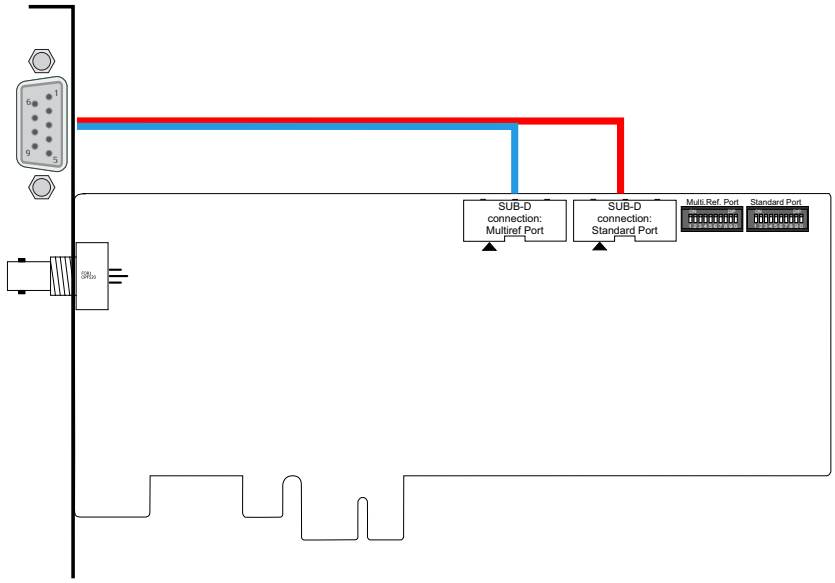
7.2 Disposal of Packaging Materials

The packaging materials we use are fully recyclable:

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

7.3 Pre-setting - standard and multiref port

Before installing the slot card, it is necessary to set the needed signals by means of the corresponding DIP switch and so make them available at the interface.

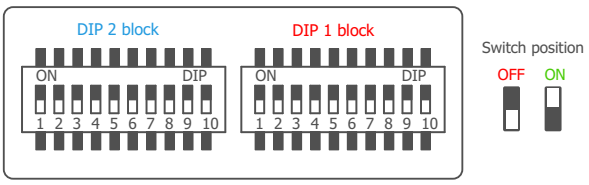


Standard Port

On delivery, the standard port is connected to the 9-pin connector on the front panel and the signals of the serial interface are led out. If another signal is to be led out, the corresponding switch of the **DIP 1 block** must be switched to ON before installing the TCR180PEX-EL. The table below shows the pin assignment of the connector and the assignment of the individual switches in the **DIP 1 block**.

At delivery of the TCR180PEX-EL only signals of the serial interface are transmitted via the connectors of the plug.

Please note that pin 1, pin 4 and pin 7 of the 9-pin connector can be used for two different signals, but only one of the respective DIP switches can be set to the ON position:



Pin 1: DIP 1 or DIP 8 ON
Pin 4: DIP 5 or DIP 10 ON
Pin 7: DIP 3 or DIP 7 ON

The graphic shows all DIP switches on position "OFF". Please use the DIP-Schalter 1 on the right.

Standard Ports:
Those signals which do not have a lever of the DIP switch assigned are always available at the connector:

Standard Port

9pin D-SUB	Signal	Signal Level	DIP-Switch ON	
1	VCC out	+5 V	**1**	*DIP 8 must be OFF*
1	PPO_0 (PPS) out	RS232	**8**	*DIP 1 must be OFF*
2	RxD 0 in	RS232	-	
3	TxD 0 out	RS232	-	
4	PPO_1 (PPM) out	TTL	**5**	*DIP 10 must be OFF*
4	10 MHz out	TTL	**10**	*DIP 5 must be OFF*
5	GND	-	-	
6	CAP 0 in	TTL	**2**	
7	CAP 1 in	TTL	**3**	*DIP 7 must be OFF*
7	/ DCLS out (B)	RS422	**7**	*DIP 3 must be OFF*
8	PPO_0 (PPS) out	TTL	**4**	
9	PPO_2 (DCF) out	TTL	**9**	*DIP 6 must be OFF*
9	DCLS out (A)	RS422	**6**	*DIP 9 must be OFF*

The default settings of the pulse outputs of the TCR180PEX-EL are set as follows:

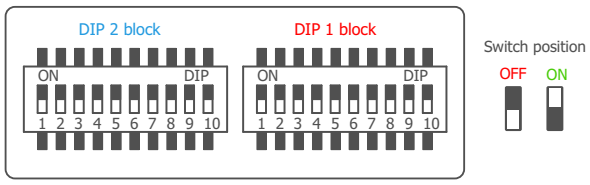
PO_0: PPS Out - Pulse Per Second
PO_1: PPM Out - Pulse Per Minute

Multi Ref. Port

Connection of ribbon cable
To route the signals of the "MultiRef" port out on the 9-pin connector, the assembled ribbon cable must be plugged into the MuliRef tub connector.

If another signal is to be led out, the corresponding switch of the **DIP 2 block** must be switched to ON. The table below shows the pin assignment of the connector and the assignment of the individual switches in the **DIP 2 block**.

Please note that pin 1 and pin 4 of the 9-pin connector can be used for two different signals, but only one of the respective DIP switches can be set to the ON position:



Pin 1: DIP 1 or DIP 7 ON
Pin 4: DIP 5 or DIP 10 ON

The graphic shows all DIP switches on position "OFF". Please use the DIP 2 block on the left.

D-SUB pin assignment

The following list shows the pin assignment and the necessary DIL-switch positions for the respective signals Some signals are only output when the specified DIL switch is set to "ON":

Multiref Port

9pin D-SUB	10-pol. Wannenst.	Signal	Signal Level	DIP-Switch	
1	9	VCC out	+5V	1	*DIP 7 must be OFF*
2	7	RxD1 in	RS232	-	
3	5	TxD1 out	RS232	-	
4	3	PO_1 (PPM) out	TTL	5	*DIP 10 must be OFF*
4	3	10MHz out	TTL	10	*DIP 5 must be OFF*
5	1	GND	-	-	
6	8	+ DCLS in	optocoupler	3	
7	6	- DCLS in	optocoupler		
8	4	PO_0 (PPS) out	TTL	4	
9	2	not used	-	-	*only PEX-EL Version*

7.4 Installing the TCR180PEX-EL

Power supply

All of the operating voltages required for the card are provided by the PCI (Express) bus.

Detection of the card

Every PCI Express board is a plug & play board. After power-up, the computer's BIOS assigns resources like I/O ports and interrupt numbers to the board, the user does not need to take care of the assignments. The programs shipped with the board retrieve the settings from the BIOS.

7.4.1 Installation of slotcards.

For protection of the TCR180PEX-EL, refer to the chapter Prevention of ESD Damage.

1. Pay attention to the safety instructions at the beginning of this manual!
2. The TCR180PEX-EL is not hot-pluggable. Please switch off the PC before installation.
3. Remove the bracket of the PCIx slot with a suitable tool and plug in the TCR180PEX-EL carefully.
4. Tighten the bracket of the card and close the computer case again
5. Connect all necessary cable connections.
6. Switch on the computer and put the inserted module into operation.

8 Configuration of TCR180PEX-EL

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 via the PCIExpress bus. 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 TCR180PEX-EL, 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.

9 Firmware Updates

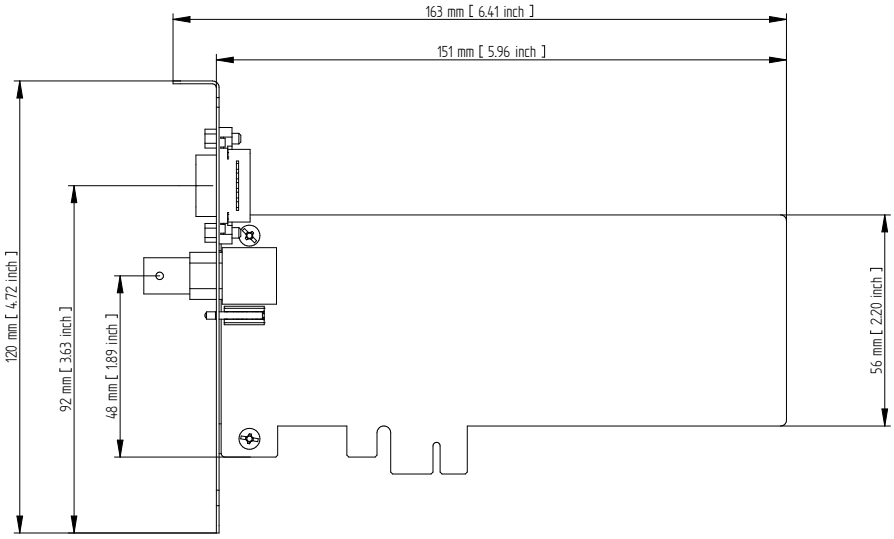
Whenever the on-board software must be upgraded or modified, the new firmware can be downloaded to the internal flash memory via the clock's serial port COM0. There is no need to open the computer case and insert a new EPROM.

A loader program shipped together with the file containing the image of the new firmware sends the new firmware from one of the computer's serial ports to the clock's serial port COM0. The bootstrap loader does not depend on the contents of the flash memory, so if the update procedure is interrupted, it can easily be repeated.

The contents of the program memory will not be modified until the loader program has sent the command to erase the flash memory. So if the button has been pressed accidentally, the system will be ready to operate again after the computer has been turned off and then on again.

10 Technical specification TCR180PEX-EL

Dimensions:



RECEIVER INPUT:	DC level shift input (fiber optic)	
	optical input power:	min.3μW
	optical connector:	ST connector for GI 50/125μm or GI 62.5/125μm, gradient fiber
	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 / A003 / A006 / A007 IRIG-B002 / B003 / B006 / B007 IRIG-G002 / G006 AFNOR NF S87-500 IEEE C37.118 IEEE 1344	
Accuracy of time base:	± 750 nsec compared to IRIG reference marker	
Required Accuracy of time code source:	± 100ppm	
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
Pulse outputs:	Active only 'if sync'
PO_0:	change of seconds (PPS) pulse duration 200 msec valid on rising edge
PO_1:	change of minute (PPM) pulse duration 200 msec valid on rising edge
Accuracy of pulses:	Better than $\pm$ 1 μsec after synchronization and 20 minutes of operation
Serial port:	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 Oszillator:	TCXO (Temperature Compensated Xtal Oscillator)
	Accuracy compared to IRIG-reference:
sync. and 20 min. of operation:	$\pm$ 5(10^{-9})
first 20 min. after sync.:	$\pm$ 1(10^{-8})
	Accuracy of oscillator:
holdover, 1 day:	$\pm$ 1(10^{-7})
holdover, 1 year:	$\pm$ 1(10^{-6})
	Short term stability:
$\leq$ 10 sec, synchronized:	$\pm$ 2(10^{-9})
$\leq$ 10 sec, holdover:	$\pm$ 5(10^{-9})
	Temperature dependant drift:
holdover:	$\pm$ 1(10^{-6})
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
Initialization:	Software and realtime clock can be set by a serial Meinberg Standard Telegram via COM0 or the PCI-Express bus

Bus-Interface:	Single lane (x1) PCI Express (PCIe) Interface compatible to PCI Express specification r1.0a
Data format:	binary, byte serial
Power supply:	+3.3 V DC, 250 mA +/- 10 mA Power supplies provided by PCI Express interface
Board dimension:	"low profile" slot card (69 mm x 150 mm)
Ambient temperature:	0 ... 50°C
Humidity:	max. 85 %

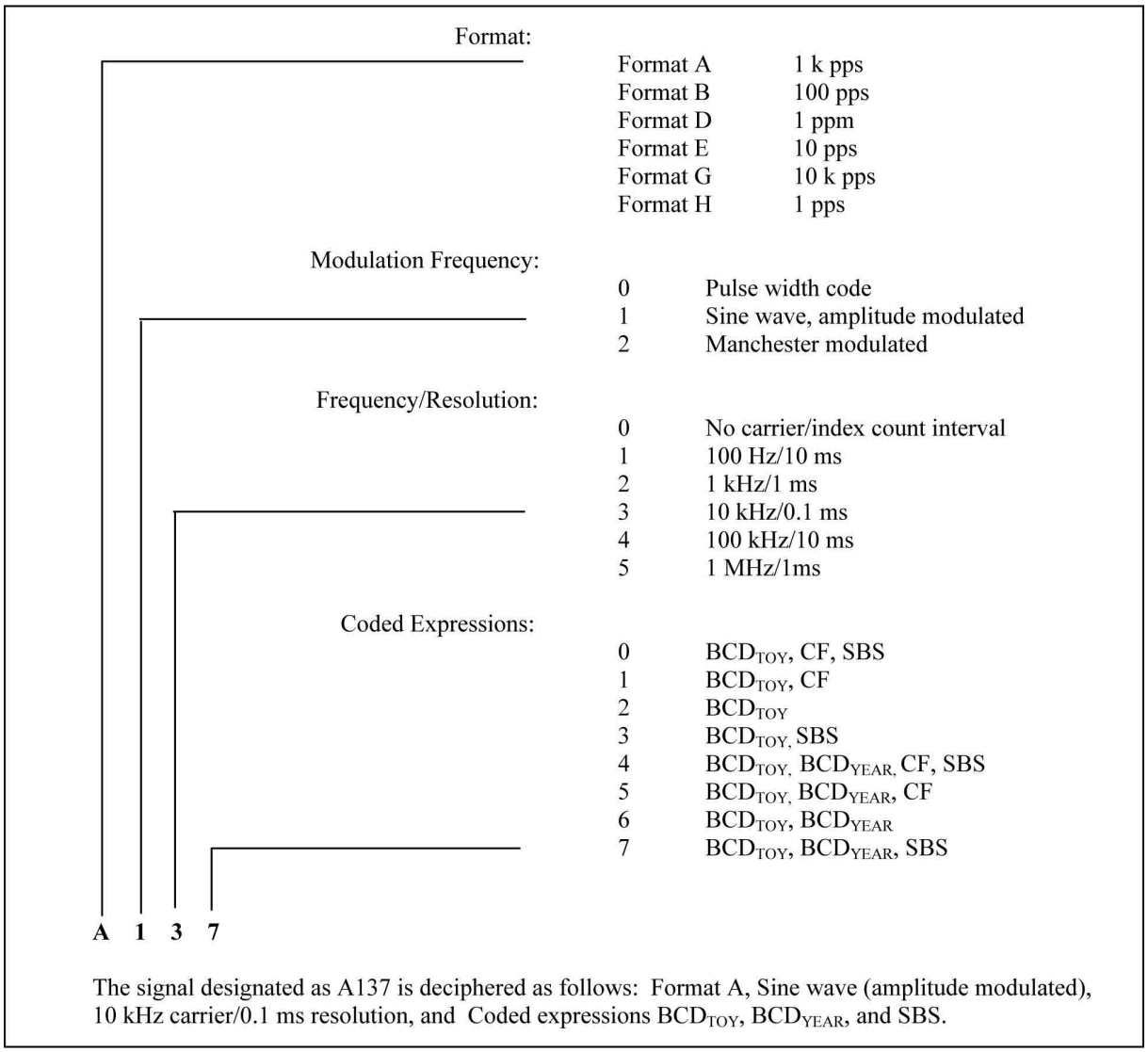
11 Technical appendix TCR180PEX-EL

11.1 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 TCR180PEX-EL supports decoding and generating of IRIG-A, IRIG-B, IRIG-G, AFNOR NF S87-500, IEEE C37.118 and IEEE 1344.

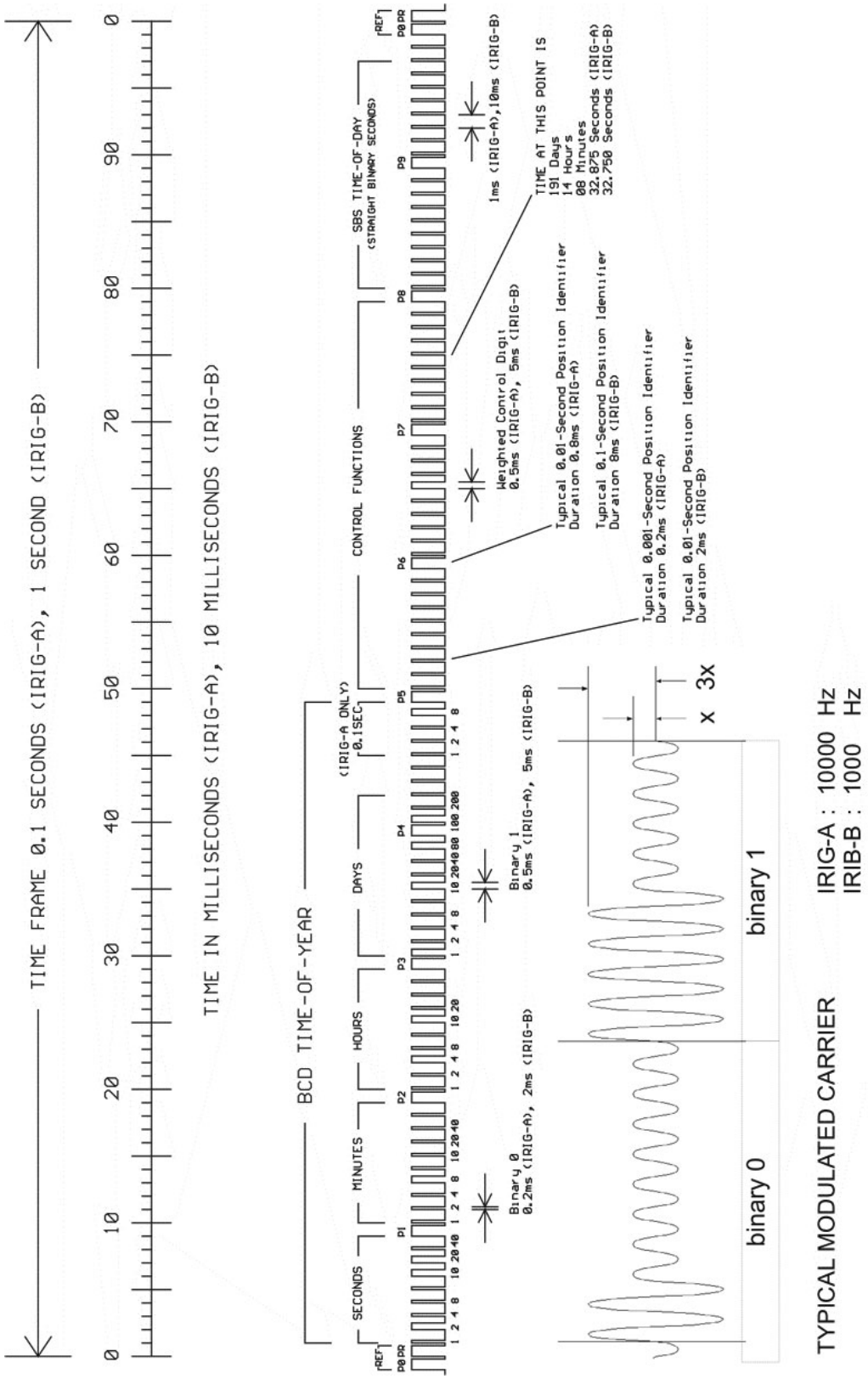
11.1.1 Description of IRIG-Codes



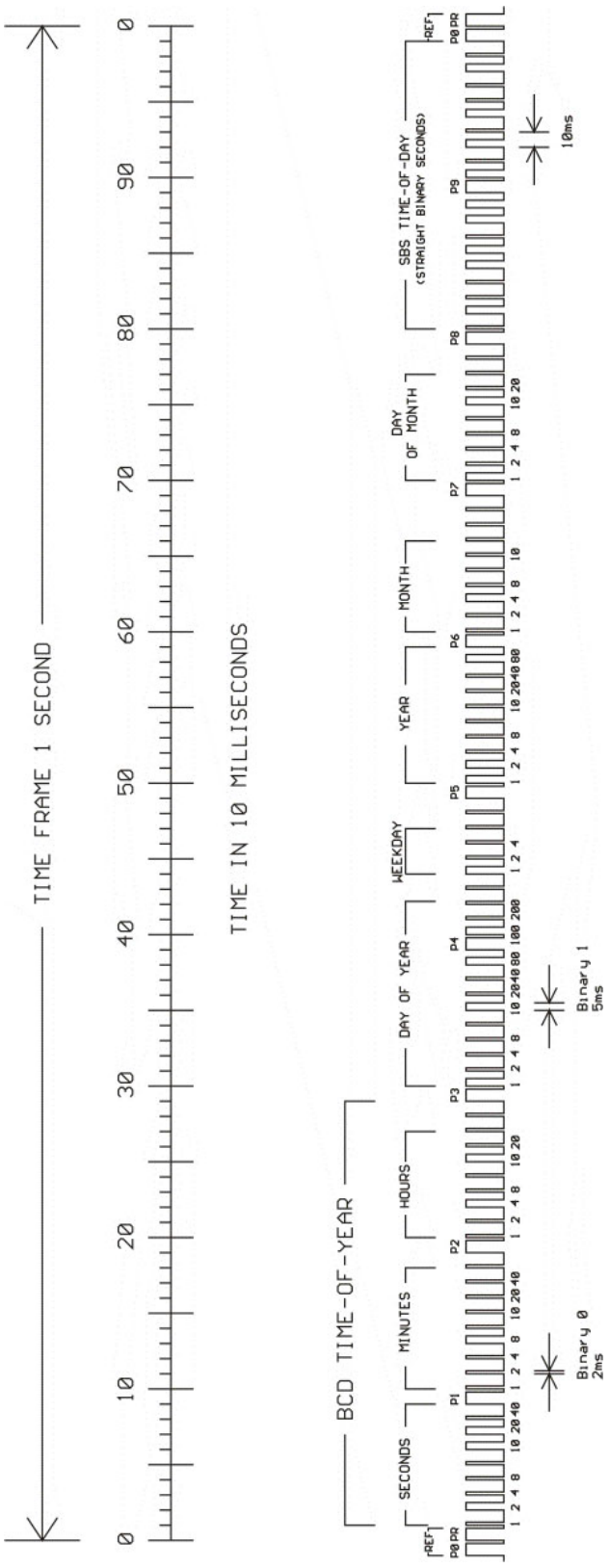
The signal designated as A137 is deciphered as follows: Format A, Sine wave (amplitude modulated), 10 kHz carrier/0.1 ms resolution, and Coded expressions BCD_{TOY}, BCD_{YEAR}, and SBS.

11.2 Time code Format

11.2.1 IRIG Standard Format



11.2.2 AFNOR Standard Format



11.3 Time Strings

11.3.1 Format of the 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:

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

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:

<STX>	Start-Of-Text, ASCII Code 02h		
	sending with one bit accuracy at change of second		
dd.mm.yy	the current 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 current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)

uv clock status characters (depending on clock type):

u:	'#'	GPS: clock is running free (without exact synchr.) PZF: time frame not synchronized DCF77: clock has not synchronized after reset
	' '	(space, 20h) GPS: clock is synchronous (base accuracy is reached) PZF: time frame is synchronized DCF77: clock has synchronized after reset
v:	'*'	GPS: receiver has not checked its position PZF/DCF77: clock currently runs on XTAL
	' '	(space, 20h) GPS: receiver has determined its position PZF/DCF77: clock is syncronized 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 anouncement of discontinuity of time, enabled during last hour before discontinuity comes in 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

11.3.2 Format of the Meinberg Capture String

The Meinberg Capture String is a sequence of 31 ASCII characters terminated by a CR/LF (Carriage Return/-Line Feed) combination. The format is:

CH*x_tt.mm.jj_hh:mm:ss.fffffff*<CR><LF>

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:

x	0 or 1 corresponding on the number of the capture input
_	ASCII space 20h

dd.mm.yy the capture date:

dd	day of month	(01..31)
mm	month	(01..12)
yy	year of the century	(00..99)

hh:mm:ss.fffffff the capture time:

hh	hours	(00..23)
mm	minutes	(00..59)
ss	seconds	(00..59, or 60 while leap second)
fffffff	fractions of second, 7 digits	

<CR> Carriage Return, ASCII Code 0Dh

<LF> Line Feed, ASCII Code 0Ah

11.3.3 Format of the Uni Erlangen String (NTP)

The time string Uni Erlangen (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:

<STX>*tt.mm.jj; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.llle hhhhm*<ETX>

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:

<STX> Start-Of-Text, ASCII Code 02h
sending with one bit occuracy at change of second

dd.mm.yy the current 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 current time:

hh	hours	(00..23)
mm	minutes	(00..59)
ss	seconds	(00..59, or 60 while leap second)

v sign of the offset of local timezone related to UTC

oo:oo offset of local timezone related to UTC in hours and minutes

ac clock status characters:

a:	'#'	clock has not synchronized after reset
	' '	(space, 20h) clock has synchronized after 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 enabled
' '	CET	European Standard Time, daylight saving disabled

f anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'!'	announcement of start or end of daylight saving time
' '	(space, 20h) nothing announced

g anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'A'	announcement of leap second insertion
' '	(space, 20h) nothing announced

i leap second insertion

'L'	leap second is actually inserted (active only in 60th sec.)
' '	(space, 20h) no leap second is inserted

bbb.bbbb latitude of receiver position in degrees
leading signs are replaced by a space character (20h)

n latitude, the following characters are possible:

'N'	north of equator

	'S'	south d. equator
lll.llll	longitude of receiver position in degrees leading signs are replaced by a space character (20h)	
e	longitude, the following characters are possible:	
	'E'	east of Greenwich
	'W'	west of Greenwich
hhhh	altitude above WGS84 ellipsoid in meters leading signs are replaced by a space character (20h)	
<ETX>	End-Of-Text, ASCII Code 03h	

11.3.4 Format of the 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:

<STX>*dd.mm.yy*/*w*/*hh:mm:ss*xxxxuv<ETX>

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:

<STX>	Start-Of-Text, ASCII Code 02h sending with one bit accuracy at change of second		
dd.mm.yy	the current 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 current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while 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 after reset	
	' '	(space, 20h) clock has synchronized after reset	
v	anouncement of discontinuity of time, enabled during last hour before discontinuity comes in 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		

11.3.5 Format of the Computime Time String

The Computime time string is a sequence of 24 ASCII characters starting with the T character and ending with the LF (line feed, ASCII Code 0Ah) character. The format is:

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 part of the time string. The groups of characters as defined below:

T	Start character sending with one bit accuracy at change of second		
yy:mm:dd	the current date:		
	yy	year of the century	(00..99)
	mm	month	(01..12)
	dd	day of month	(01..31)
	ww	the day of the week	(01..07, 01 = monday)
hh:mm:ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
<CR>	Carriage Return, ASCII Code 0Dh		
<LF>	Line Feed, ASCII Code 0Ah		

11.3.6 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

11.3.7 Format of the RACAL standard Time String

The RACAL standard Time String is a sequence of 16 ASCII characters terminated by a X (58h) character and ending with the CR (Carriage Return, ASCII Code 0Dh) character. The format is:

<X><G><U>*yymmddhhmmss*<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:

<X>	Control character sending with one bit accuracy at change of second		code 58h
<G>	Control character		code 47h
<U>	Control character		code 55h
yymmdd	the current date:		
	yy	year of the century	(00..99)
	mm	month	(01..12)
	dd	day of month	(01..31)
hh:mm:ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
<CR>	Carriage Return, ASCII code 0Dh		

11.3.8 Format of the ION Time String

The ION time string is a sequence of 16 ASCII characters starting with the SOH (Start of Header) ASCII controll character and ending with the LF (line feed, ASCII Code 0Ah) character. The format is:

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

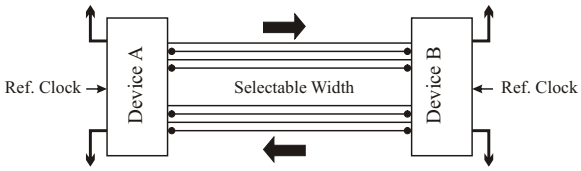
The letters printed in italics are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

<SOH>	Start of Header (ASCII control character) sending with one bit accuracy at change of second		
ddd	day of year		(001..366)
hh:mm:ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	q	Quality indicator	(space) Time Sync (GPS lock) (?) no Time Sync (GPS fail)
<CR>	Carriage-return (ASCII code 0Dh)		
<LF>	Line-Feed (ASCII code 0Ah)		

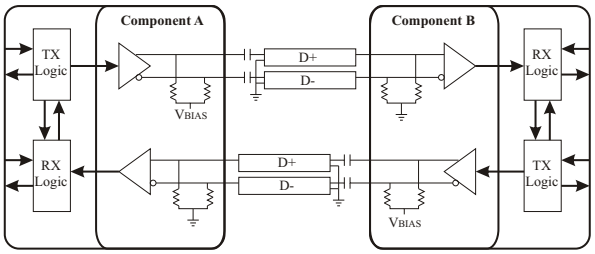
11.4 PCI Express (PCIe)

The main technical inovation of PCI Express is a serial data transmission compared to the parallel interfaces of other computer bus systems like ISA, PCI and PCI-X.

PCI Express defines a serial point-to-point connection, the so-called Link:



The data transfer within a Link is done via Lanes, representing one wire pair for sending and one wire pair for receiving data:



This design leads to a full duplex connection clocked with 2.5 GHz capable of transfering a data volume of 250 MB/s per lane in each direction. Higher bandwith is implemented by using multiple lanes silmutaneously. A PCI Express x16 slot for example uses sixteen lanes providing a data volume of 4 GB/s. For comparison: when using conventional PCI the maximum data transfer rate is 133 MB/s, PCI-X allows 1 GB/s but only in one direction respectively.

11.5 Content of the USB stick

Besides this manual, the provided USB stick includes a setup program for the monitor software MBGMON. This utility can be used to configure Meinberg receivers via their serial ports and to display status information of the module.

If the USB storage device is lost, the installation program can be downloaded free of charge from the Internet at: https://www.meinbergglobal.com/english/sw/

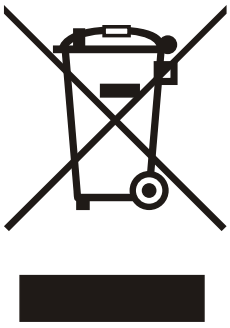
12 RoHS and WEEE

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

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

WEEE status of the product

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



13 Declaration of Conformity

Konformitätserklärung

Doc ID: TCR180PEX-EL/FO-In-2021-05-06

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*	**TCR180PEX-EL/FO-In**

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

EMV – Richtlinie *EMC Directive* 2014/30/EU	DIN EN 61000-6-2:2019 DIN EN 61000-6-3:2007 + A1:2011 DIN EN 55032:2015 DIN EN 55024:2010 + A1:2015
Niederspannungsrichtlinie *Low-voltage Directive* 2014/35/EU	DIN EN 62368-1:2014 + A11:2017
RoHS – Richtlinie *RoHS Directive* 2011/65/EU + 2015/863/EU	DIN EN IEC 63000:2018

Bad Pyrmont, 2021-05-06

S. Meinberg

Stephan Meinberg
Production Manager