The Synchronization Experts.

MANUAL

TCR167PCI

Time Code Receiver/Generator

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Meinberg Funkuhren GmbH & Co. KG

Table of Contents

1 Imprint

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Date: 25.08.2020

2 Content of the USB stick

The included USB stick contains a driver program that keeps the computer's system time synchronous to the received time. If the delivered stick doesn't include a driver program for the operating system used, it can be downloaded from:

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

On the USB stick there is a file called "readme.txt", which helps installing the driver correctly.

3 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.

Except these "IRIG Time Codes", other formats like NASA36, XR3 or 2137 are still in use. The TCR167PCI however generates the IRIG-B, AFNOR NFS 87-500 code as well as IEEE1344 code which is an IRIG coded extended by information for time zone, leap second and date.

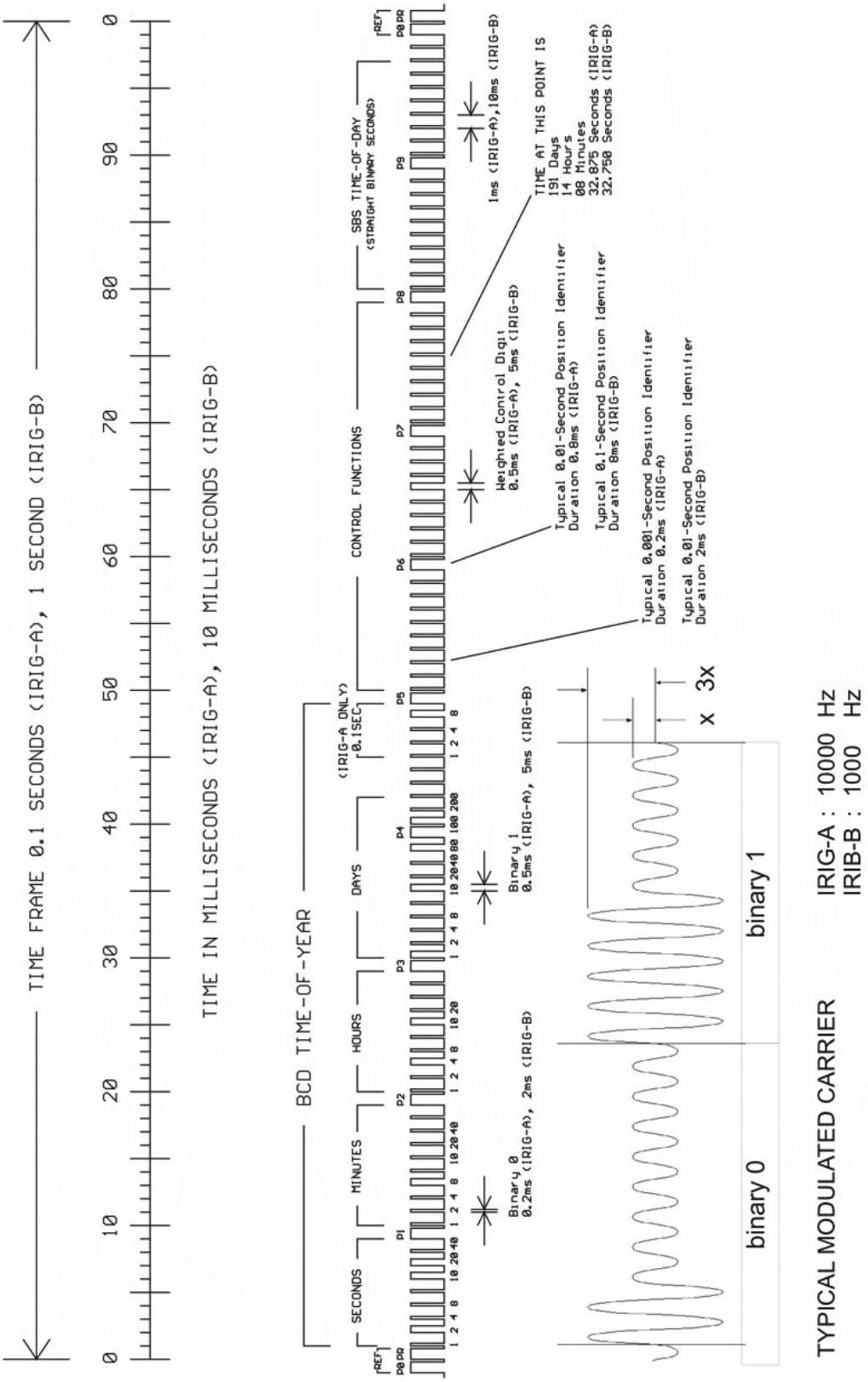
4 Description of IRIG-Codes

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

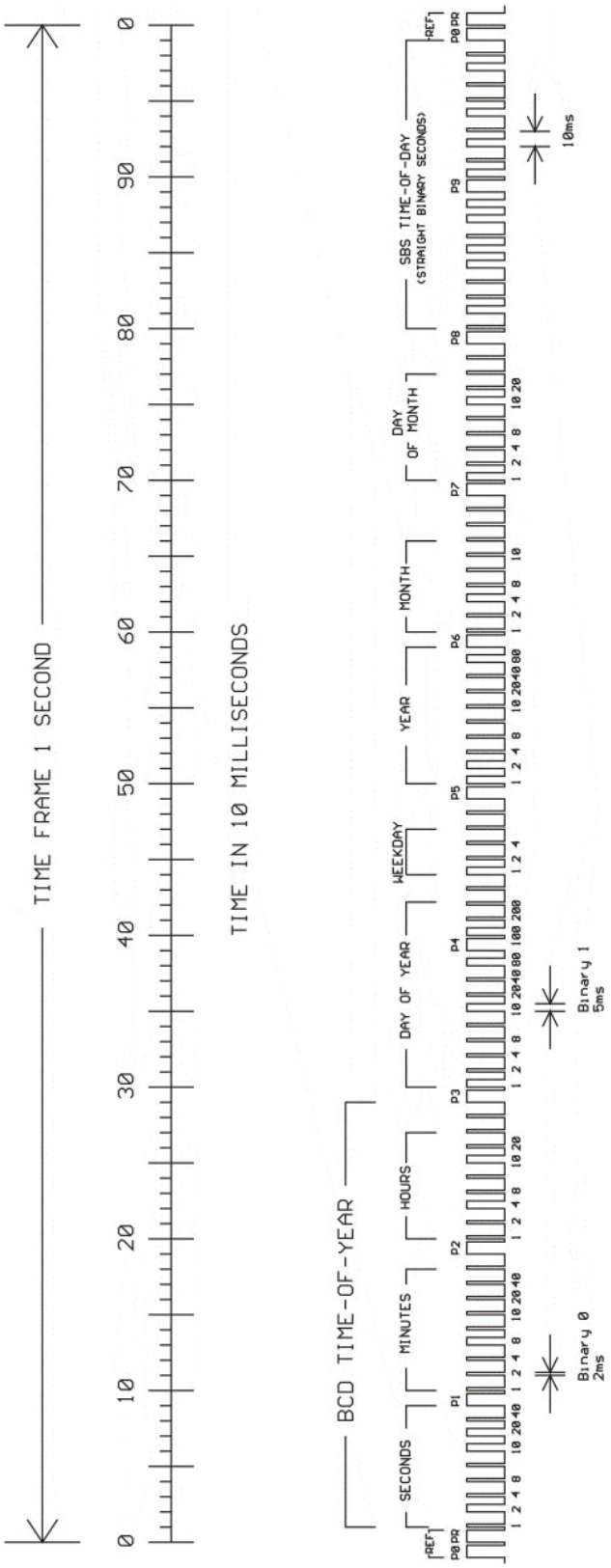
character	bit rate designation	A	1000 pps
		B	100 pps
1st digit	form designation	0	DC Level Shift pulse width modulated
	1	sine wave carrier amplitude modulated	
2nd digit	carrier resolution	0	no carrier (DC Level Shift)
	1	100 Hz, 10 msec resolution	
		2	1 kHz, 1 msec resolution
	3	10 kHz, 100 μsec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

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

5 IRIG Standard Format



6 AFNOR Standard Format



7 Features TCR167PCI

The board TCR167PCI was developed for computer systems with PCI-bus. It is designed as an universal board and can be used in systems with either 3.3 V or 5 V PCI slots therefore. The module supports clock speeds of 33 MHz and 66 MHz. TCR167PCI serves to decode and generate modulated (AM) and unmodulated (DC Level Shift) IRIG and AFNOR time codes. AM-codes are transmitted by modulating the amplitude of a sine wave carrier, unmodulated codes by variation of the width of pulses.

As standard the module TCR167PCI is equipped with a TCXO (Temperature Compensated Xtal Oscillator) as master oscillator to provide a high accuracy in holdover mode of +/- 1 * 10E-8. Optionally an OCXO (Oven Controlled Xtal Oscillator) is available for better accuracy.

Receiver:
Automatic gain control within the receive circuit for modulated codes allows decoding of IRIG or AFNOR signals with a carrier amplitude of 600 mVpp to 8 Vpp. The input stage is electrically insulated and has an impedance of either 50 Ohm, 600 Ohm or 5 Ohm, selectable by a jumper. The unmodulated input is accessible via a BNCconnector in the bracket of TCR167PCI.

Unmodulated or 'DC Level Shift' time codes must be connected to the D-Sub-plug of the module. The receive circuit is insulated by an onboard photocoupler which can be driven by TTL or RS-422 signals for example. In delivery state of TCR167PCI the contacts of the D-Sub-plug are not connected to the photocoupler. Two DIP-switches must be set to the 'ON' position for making this connection.

Generator:
The generator of TCR167PCI is capable of producing time codes in IRIG-B or AFNOR format. They are available as modulated (3 Vpp/1 Vpp into 50 O) and unmodulated (DC Level Shift) signals (TTL into 50 O and RS-422). A jumper on the board allows selection of active-high or active-low time codes.

Regarding time code and its offset to UTC, the receiver and the generator can be configured independantly. Thus TCR167PCI can be used for code conversion.

As an option the module can be delivered with optical inputs/outputs instead of the modulated signal paths.

The board TCR167PCI provides a configurable serial interface (RS-232), a pulse per second (PPS) with TTL and RS-232 level and a pulse per minute (PPM) with TTL level. Like the photocoupler, these signals are only connected to the D-Sub-plug after setting DIP-switches into the 'ON' position.

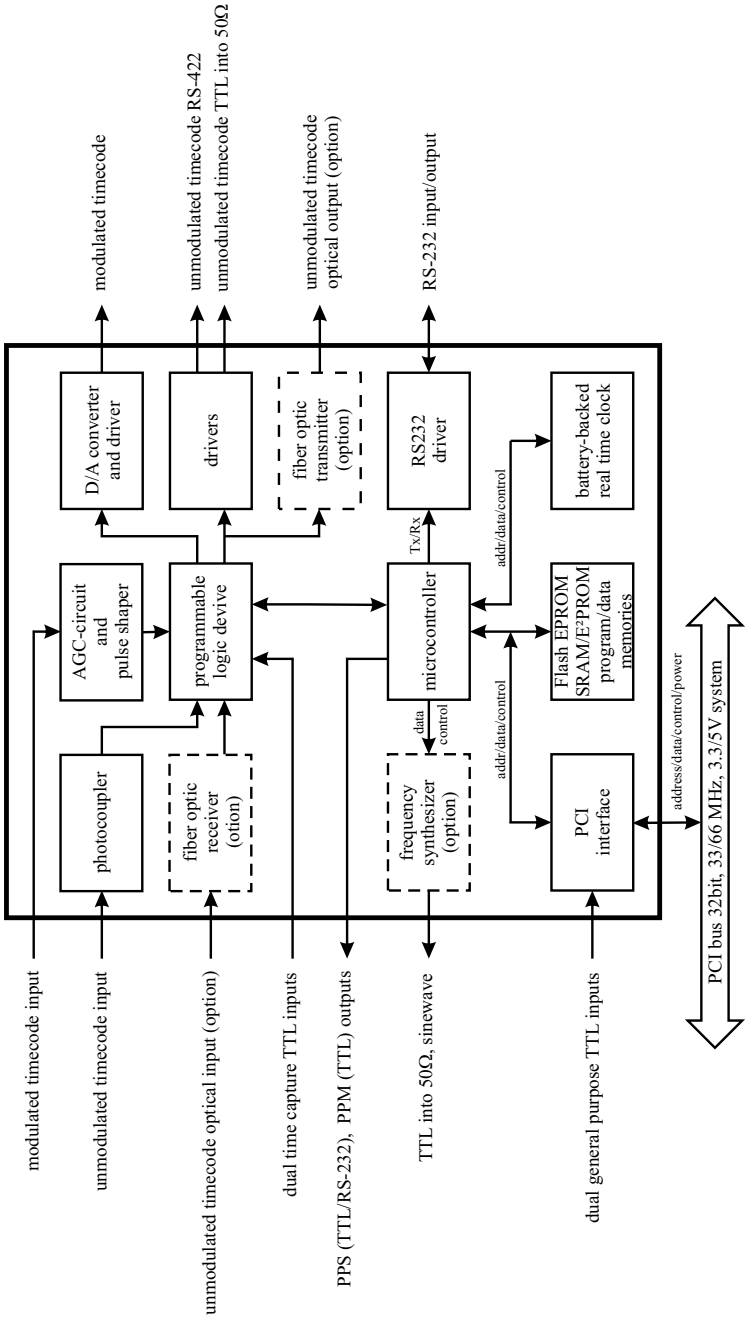
A contact strip on the board provides four TTL inputs. Two of those (CAP0 and CAP1) can be used to capture asynchronous time events. These time stamps are readable via the PCI-bus or the serial interface and can be evaluated by user software. The state of the other two inputs can be read via PCI-bus also. They can be driven by external status outputs for example.

As an option TCR167PCI provides a synthesizer which can generate output frequencies from 1/8 Hz up to 10 MHz with TTL level into 50 O and as a sine signal.

Software running on the computer can read out information regarding date, time and status of the IRIG receiver. Access to the board is made via writing to/reading from I/O ports. It is possible but not necessary to let the board generate periodic hardware interrupts on the computer bus. Driver software supplied with the board is keeping the computer's system time synchronous to the board time.

The microprocessor system of TCR167PCI is equiped with a Bootstrap-Loader and a Flash-EPROM. These features enable updating of the onboard software via the serial RS-232 interface COM0 by using the Meinberg program 'MBG Flash'.

7.1 Block Diagram TCR167PCI



7.2 Functional description

After the received IRIG code has passed a consistency check, the software clock and the battery backed realtime clock of TCR167PCI are synchronized to the external time reference. If an error in the IRIG telegram is detected, the system clock of the board switches to holdover mode. Drifting of the internal time base and the generated pulses (PPS/PPM) is limited to 1μsec/sec by regulating the onboard quartz of TCR167PCI. IRIG code includes day of year information only. The complete date is kept in the battery backed realtime clock and the software clock therefore. The received day of year is compared to this complete date once per minute. If the board detects a difference between received and stored date information, TCR167PCI switches to holdover mode but still synchronizes the internal time base to the received IRIG code.

Date and time kept in the realtime clock can be set by sending a Meinberg Standard Time Telegram to the serial interface COM0 or via the PCI-Express bus.

The internal system clock is always set to the received IRIG time, which might have a local offset to UTC. Only if TCR167PCI is configured with this offset, Meinberg driver software is able to set the system time of the computer correctly.

Conversion from UTC to local time including handling of daylight saving year by year can be done by the board's microprocessor if the corresponding parameters are set up with the help of the monitor software.

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' clocl =>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, no switching of time will be made.

The time code output (IRIG,AFNOR) of TCR167PCI can be generated by using these time zone settings or UTC as reference. This can be set up with by the monitor program.

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

The board TCR167PCI decodes the following formats:

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

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

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

AFNOR NFS 87-500: 100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency
BCD time of year, complete date, SBS time of day

7.2.1 Input signals

Amplitude modulated IRIG-A/B or AFNOR codes must be connected to the BNC-jack in the bracket of TCR511PEX. A shielded or twistet pair cable should be used.

Pulse width modulated (DC Level Shift) signals are applied by using the D-Sub-plug. Two DIP-switches must be set to the "ON" position for connecting the contacts of the D-Sub with the onboard photocoupler.

The IRIG code used must be configured with the monitor software.

The board TCR167PCI can't be used to decode amplitude modulated and DC Level Shift signals simultaneously. Depending on the selected code, only the signal at the BNC-jack or the D-Sub connector is decoded.

7.2.2 Input impedance for modulated signals

Except the AFNOR NF S87-500 standard there are no time code specifications for modulated signals which define the output impedance of a generator, or the input impedance of a receiver, so care must be taken that the specifications of this card meet the requirements of 3rd party devices.

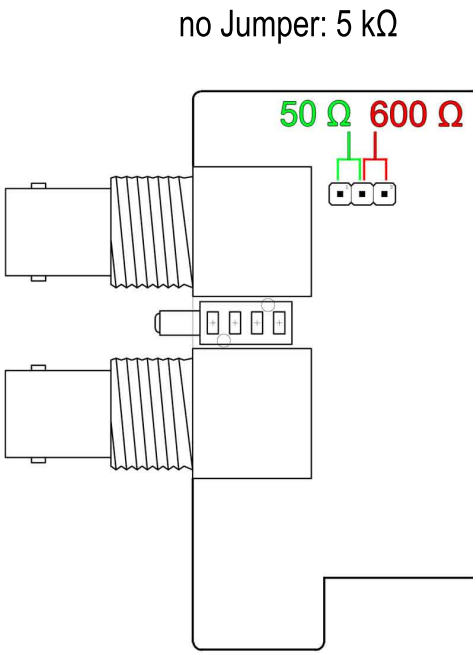
The TCR167PCI provides a jumper to set the input impedance for modulated codes to 50 Ω, 600 Ω, or 5 kΩ.

Time code outputs provided by Meinberg devices provide a 50 Ω output impedance to match the transmission requirements with coaxial cable, so the receiver should be set to 50 Ω input impedance if only a single receiver is connected to a generator.

If T-connectors are used to provide several receivers with a single output signal from a generator then the resulting load impedance for the generator may be too low if all receivers have a low input impedance, so it's more appropriate to set the input impedance of all receivers to 600 Ω. This also meets the requirement of the AFNOR standard, so this is the default setting when the TCR167PCI is shipped.

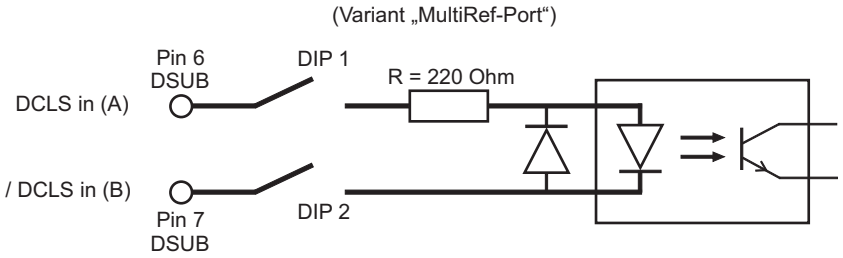
Only if the external time code generator has a high output impedance (see specifications of the external time code generator) it may be required to set the input impedance to 5 kΩ.

The driver software shows a bar chart for evaluation of the signal level at the receiver input. The following detail of the TCR167PCI's placeplan of shows the possible jumper settings and the associated input impedance:



7.2.3 Photocoupler input

Pulse width modulated (DC Level Shift) codes are insulated by an onboard photocoupler. The connection scheme is shown below:



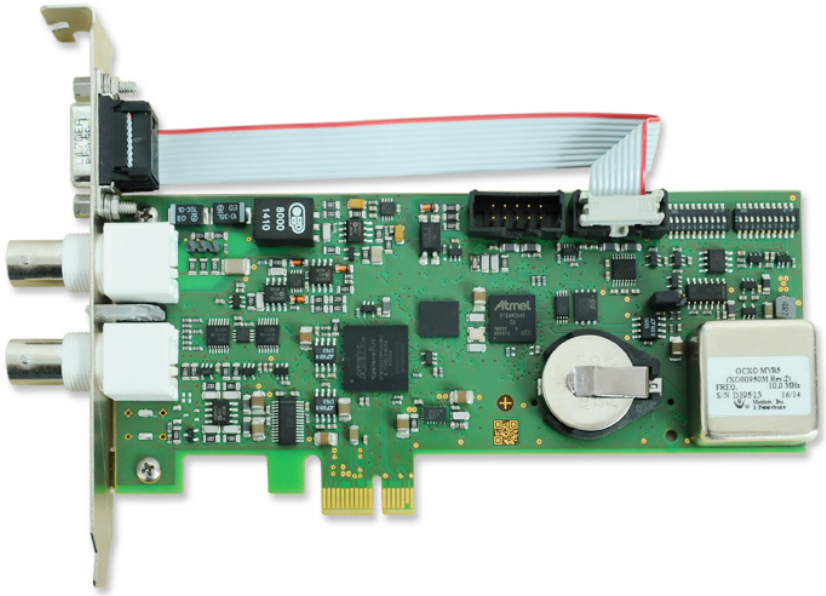
The internal series resistance allows direct connection of input signals with a maximum high level of +12 V (TTL or RS-422 for example). If signals with a higher amplitude are used, an additional external series resistance has to be applied to not exceed the limit of the forward current of the input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

7.3 Master oscillator

By default the TCR167PCI 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.



TCR180PEX with OCXO-HQ Oscillator

7.4 Functionality of the generator

The time code generator of TCR167PCI is baed on a DDS (Direct Digital Synthesis) freqzency 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 synchronizied to the pulse per second (PPS) of the system based on the software clock.

The generated time code is independant from the settings for the received code. It is possible to generated a different forma and offset from UTC therefore.

7.4.1 Time Code Outputs

TCR167PCI provides modulated and unmodulated (DC level shift) outputs. As an option, an optical output can be equipped instead of the modulated output. It is available as ST-connector for GI 50/125μm or GI 62,5/125μm gradient fiber.

7.4.1.1 Modulated Outputs

The amplitude-modulated sine carrier is available a BNC-coaxial-plug connector in the bracket. 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

7.4.1.2 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. After bringing DIP-switches into the 'ON' position, these outputs are available at the D-Sub connector. The active state of the unmodulated outputs can be set up by a jumper on the board TCR167PCI

7.5 Pulse outputs

The module TCR167PCI generates pulses at change of second (PPS) and change of minute (PPM). The PPS signal is available with TTL (0/+5V) and RS-232 (-3..12V/+3..12V) level, the PPM signal with TTL level only. If required, DIP-switches can be set up to direct the pulses to a corresponding pin of the D-Sub-connector in the bracket.

7.6 Asynchronous serial port

TCR167PCI provides an asynchronous serial interface (RS-232) called COM0. The serial port sends a time string in the format 'Standard Meinberg', 'Uni Erlangen', or 'SAT' either once per second, once per minute or on request with ASCII '?' only. Furthermore it can be set up to send telegrams containing time capture events automatically or on request. The format of these telegrams is described in the 'Technical Specificaions'. The transmission speed and the framing can be set via the PCI-bus by using the shipped monitor software. The serial interface COM0 is used for a potential firmware update also. The serial interface transmits the time zone set up in the appropriate menu. A potential offset to UTC must be set correctly.

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

7.7 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.

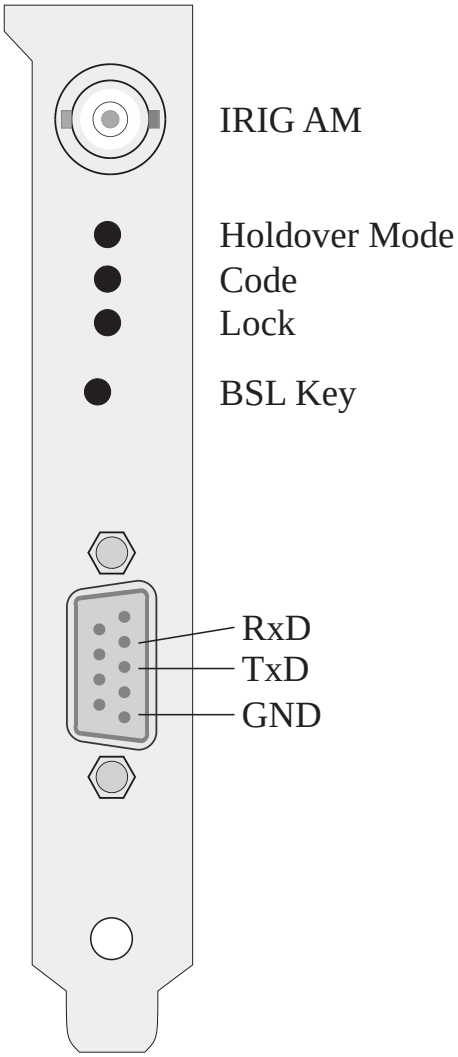
7.8 Time capture inputs

Two time capture inputs (CAP0 and CAP1) are provided at a contact strip of TCR170PEX 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 the PCI-bus or the serial interface COM0. 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 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.

7.9 Status inputs

TCR167PCI provides two general-purpose TTL inputs that are available at a contact strip. The state of these inputs can be read
via the PCI-bus.

8 Connectors and LEDs on the bracket



The bracket of the board includes the BNCconnector for the amplitude modulated time codes, three LEDs, a key for activating the Bootstrap- Loader and a 9 pin D-Sub-plug.

The LEDs signal the status of the IRIG receiver. The right, bicolor LED is switched to red wehnever the internal timing of TCR167PCI is in holdover mode. This state arises after power up and if an error in the IRIG telegram is detected. This LED changes state only an change of minute. This LED is switched to green (lock) if the internal timing of TCR167PCI is synchronized to the received IRIG code by a PPL (Phase Locked Loop). If the left, green LED (code) is switched on, the IRIG receiver detected a correct telegram at its input.

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 above. 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's 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.

8.1 Pin assignments of the D-Sub-connector

Only the signals of the serial interface are connected to the D-Sub-plug directly. If another signal shall be connected to a pin of the plug, a DIP-switch must be set to the 'ON' position.

Whenever an additional signal is connected to the rear panel, special care must be taken to the configuration of the cable used with the connector. If pins with TTL level and RS-232 levels are connected to each other, the circuits on the board may be damaged.

Only one of the switches 5 or 4 may be put in the 'ON' position to connect the pulse per second with TTL level or with RS-232 level to pin 8 of the plug. The table below shows the pin assignments for the connector and the DIP-switch assigned to each of the signals:

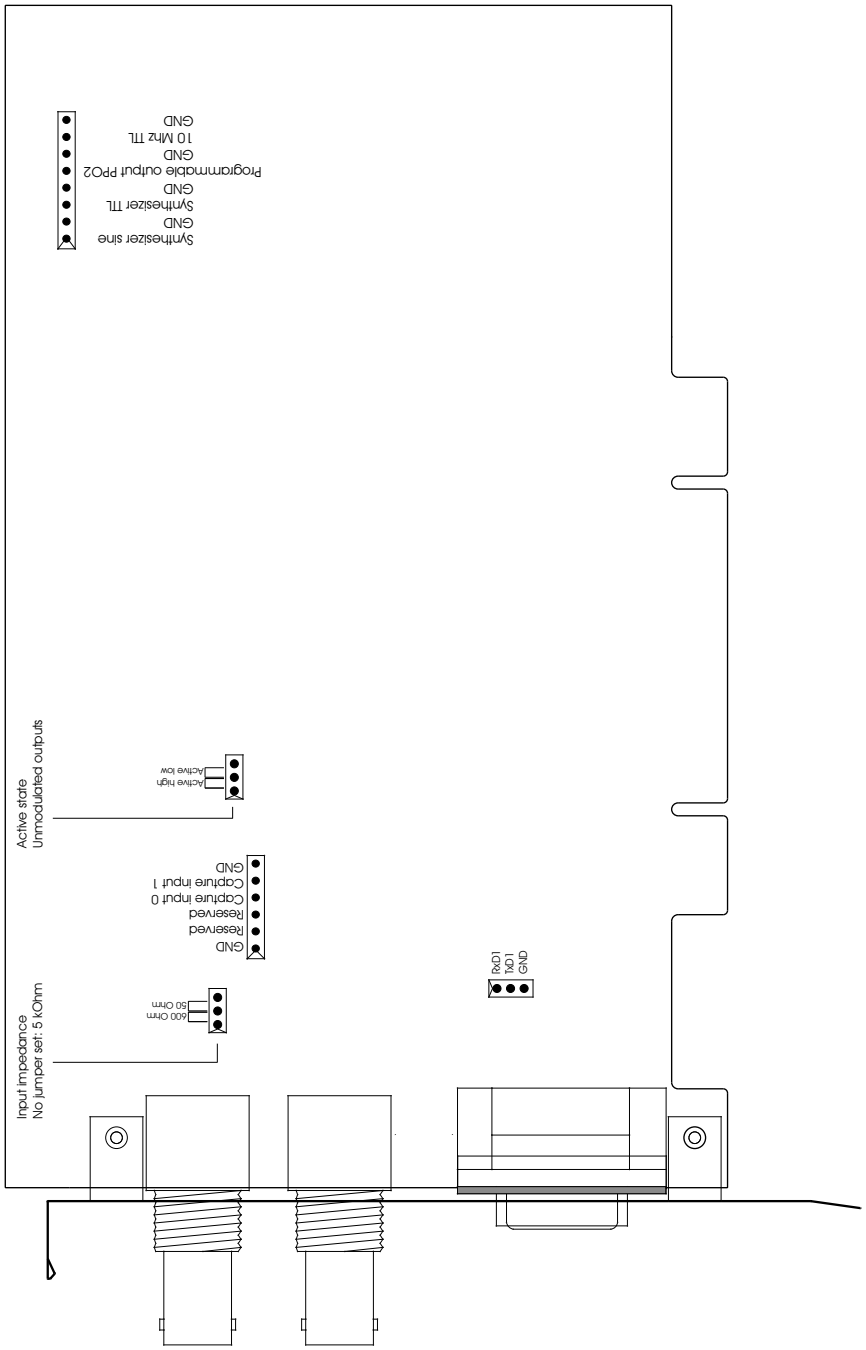
Pin	Signal	SWITCH
1	+ 5V / PPO0 out (RS-232)	3 / 4
2	RxD in (RS-232)	-
3	TxD out (RS-232)	-
4	PPO1 out (TTL) / - DCLS out (RS-422)	6 / 10
5	GND	-
6	+ DCLS in (photocoupler)	1
7	- DCLS in (photocoupler)	2
8	PPO0 out (TTL) / +DCLS out (RS-422)	5 / 9
9	DCLS out (TTL)	8
PPO0: programmable pulse output, default: pulse per second (PPS)		
PPO1: programmable pulse output, default: pulse per minute (PPM)		
DCLS: DC level shift, unmodulated timecode		

Those signals which do not have DIP-switch assigned are always available at the connector. All DIP-switches not assigned are reserved and should remain in the 'OFF' position.

Because TCR167PCI provides an additional time code generator, the assignment for the D-Sub couldn't be held compatible to the time code receiver (without generator) TCR510PCI for all contacts to provide the generated codes (DCLS TTL and RS-422) via this connector also.

8.2 Jumper and contact strips

The following diagram shows the possible jumper settings and the assignment of the contact strips of the board TCR170PEX:



8.3 Frequency synthesizer

The frequency synthesizer is capable to generate output frequencies of 1/8 Hz up to 10MHz as sine wave signal and with TTL-level into 50 Ohm. If a frequency smaller than 1 kHz has been selected, the following decimal places lead to real fractions of Hertz:

0.1	1/8 Hz
0.3	1/3 Hz
0.6	1/6 Hz

If a frequency of 0 Hz is selected, the synthesizer is turned off.

The phase position of the output frequency can be set from -360° to +360° with a resolution of 0.1°. If the phase angle is increased, the signal is more delayed. If the output frequency is bigger the 10kHz, than phase angle can't be set.

8.4 Putting into operation

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

8.4.1 Installing the TCR167PCI in your Computer

Every PCI-Express board is a plug & play board. After power-up, the computer's BIOS assigns resources like I/O ports and interrupt lines 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. The computer has to be turned off and its case must be opened. The board can be installed in any PCI-Express slot not used yet. The rear plane must be removed before the board can be plugged in carefully. The computer's case should be closed again before restarting the computer.

8.4.2 Power supply

All power supplies needed by TCR167PCI are delivered by the PCI-(Express) bus.

8.4.3 Configuration of TCR167PCI

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 TCR167PCI, 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 radio clock's serial port COM0. There is no need to open the computer case and insert a new EPROM.

If the button behind a hole in the rear slot cover is pressed for approximately 2 seconds, a bootstrap loader is activated and waits for instructions from the serial port COM0. 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 Skilled/Service-Personnel only: Replacing the Lithium Battery

The life time of the lithium battery on the board is at least 10 years. If the need arises to replace the battery, the following should be noted:

ATTENTION!

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.

CE marking
This device follows the provisions of the directives 93/68/EEC

CE

11 Technical specification TCR167PCI

RECEIVER INPUT:

AM-input (BNC-connector):
insulated by a transformer
impedance settable 50 Ohm, 600 Ohm, 5 kOhm
input signal: 600 mVpp to 8 Vpp (Mark)
other ranges on request

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

internal series resistance:	220 Ohm
maximum forward current:	50 mA
diode vorward voltage:	1.0 V...1.3 V

optional input(option):

optical receive power:	min. 3μW
optical connector:	ST-connector for GI 50/125μm or GI 62,5/125μm gradient fiber

DECODING:

decoding of the following telegrams possible:
IRIG-A133/A132/A003/A002
IRIG-B123/B122/B003/B002
AFNOR NFS 87-500

ACCURACY OF TIME BASE: +/-5 μsec compared to IRIG reference marker

REQUIRED ACCURACY OF TIME CODE SOURCE: +/- 100ppm

HOLDOVER MODE:

automatic switching to crystal time base
accuracy approximately 1E-6 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
3Vpp(MARK), 1Vpp(SPACE) into 50 Ohm

unmodulated outputs(DCLS):
TTL into 50 Ohm
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:
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

SERIAL PORT:
configurable RS-232 interface

baudrates:	300 Bd...38400 Bd
framing:	7E2, 8N1, 8N2, 8E1
mode of operation:	string per second string per minute string on request
time telegram:	Meinberg Standard Uni Erlangen, SAT

Capture Telegram

FREQUENCY-SYNTHESIZER (OPTION):

output frequency:	1/8 Hz up to 10MHz
accuracy:	like system accuracy
1/8 Hz to 10 kHz:	Phase synchronous to pulse per second
10 kHz to 10 MHz:	deviation of frequency < 0.0047 Hz
outputs:	TTL into 50 Ohm

sine wave 1.5Vrms
output impedance 200 Ohm

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 stbility:
+-2.10-9
+-5.10-9

temperature dependant drift:

holdover:	+-1.10-6

phase noise:

1 Hz besides carrier:	-60 dB/Hz
10 Hz besides carrier:	-90 dB/Hz
100 Hz besides carrier:	-120 dB/Hz
1 kHz besides carrier:	-130 dB/Hz

RELIABILITY OF OPERATION:
microprocessor supervisory circuit provides watch

	dog 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-bus
BUS-INTERFACE:	32 Bit, 33 MHz or 66 MHz PCI Bus compatible with PCI and PCI-X specifications
DATA FORMAT:	binary, byte serial
POWER REQUIREMENT:	+5V, @140 mA +12V, @15 mA -12V, @15 mA
BOARD DIMENSION:	short, universal board for 3.3 V or 5 V PCI slot
AMBIENT TEMPERATURE:	0 ... 70°C
HUMIDITY:	max. 85 %

11.1 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

11.2 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.lllle 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 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*xxxx*u*v<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		

11.4 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

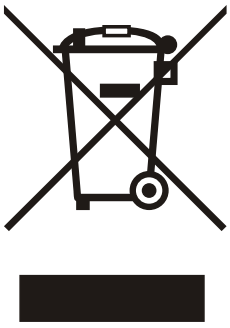
12 RoHS and WEEE

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.



EU Konformitätserklärung
EU Declaration of Conformity

CE

Doc ID: TCR167PCI-10012017

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 **TCR167PCI**
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 *EMC – Directive* 2014/30/EU	DIN EN 55032:2012 DIN EN 55024:2010
Niederspannungsrichtlinie *Low-voltage Directive* 2014/35/EU	DIN EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + AC:2011 + A2:2013
RoHS – Richtlinie *RoHS – Directive* 2011/65/EU	DIN EN 50581:2012

Bad Pyrmont, 10 January 2017

Günter Meinberg
Managing Director