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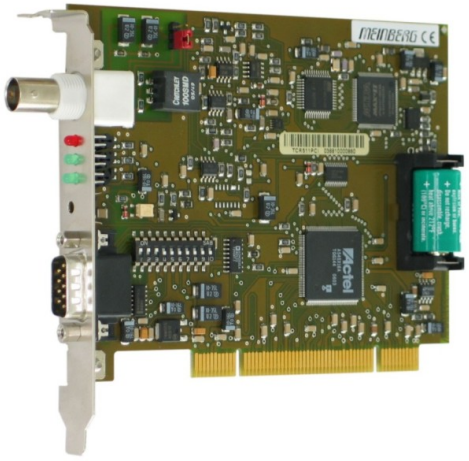
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MANUAL

TCR511PCI

IRIG Code controlled Radio Clock

2009-06-24

Meinberg Radio Clocks GmbH & Co. KG

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1 Impressum

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Date: 2009-06-24

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 IRIG-time. If the delivered stick doesn't include a driver program for the operating system used, it can be downloaded from:

http://www.meinberg.de/german/sw/



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

3 Introduction: 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 board &PRODUCT however only decodes IRIG-A, IRIG-B or AFNOR NFS 87-500 formats. The AFNOR code is a variant of the IRIG-B format. Within this code the complete date is transmitted instead of the "Control Functions" of the IRIG telegram.

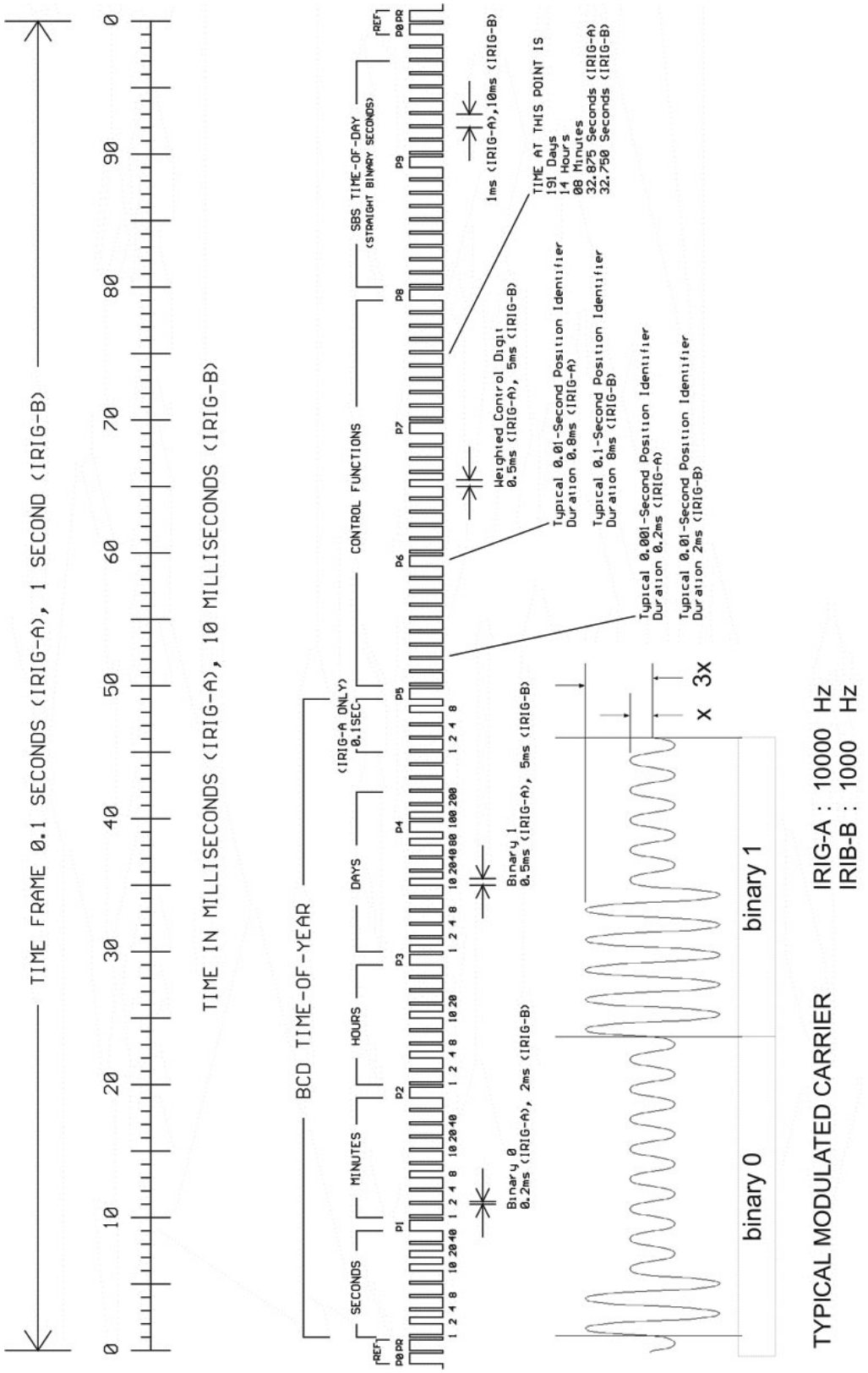
3.1 Description of IRIG-Codes

The specification of individual IRIG time code formats is defined in IRIG Standard 200-04. They are described by an alphabetical character followed by a three-digit number sequence. The following identification is taken from the IRIG Standard 200-98 (only the codes relevant to TCR5xx are listed):

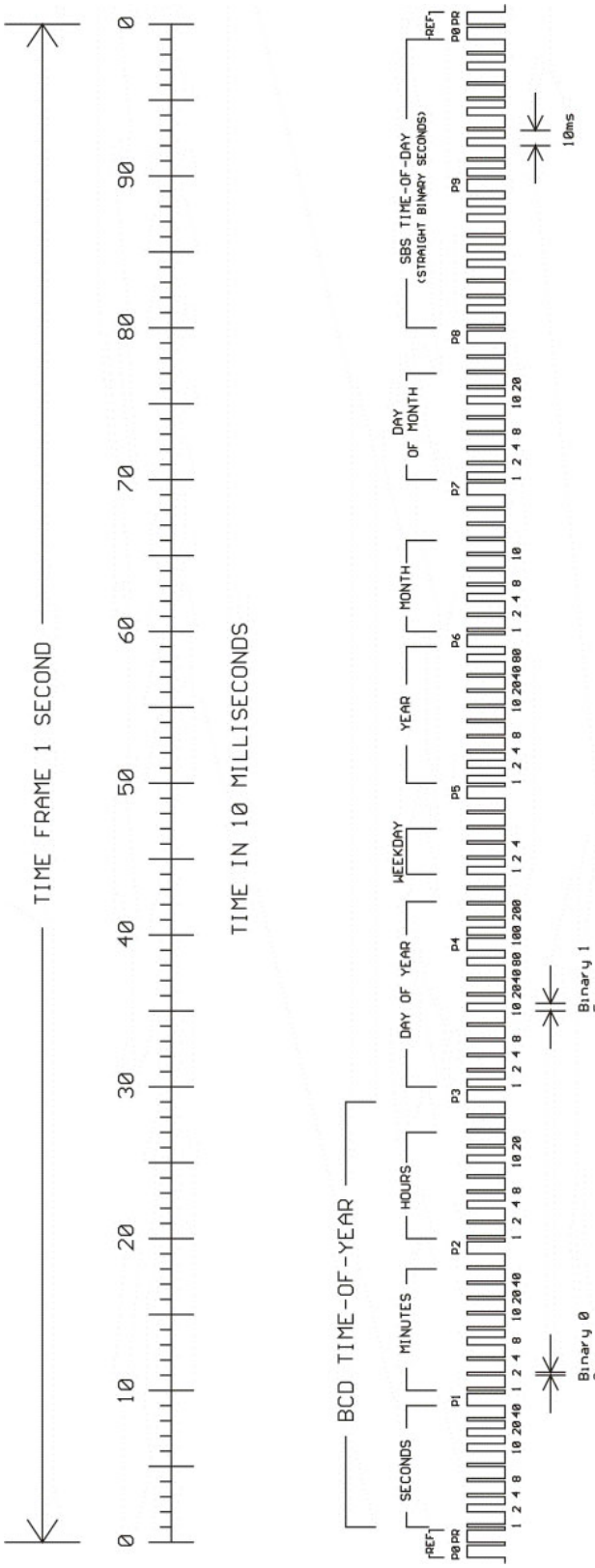
character	bit rate designation	A	1000 pps
		B	100 pps
1st digit	form designation	0	DC Level Shift width coded
		1	sine wave carrier amplitude modulated
2nd digit	carrier resolution	0	no carrier (DC Level Shift)
		1	100 Hz, 10 msec resolution
		2	1 kHz, 1 msec resolution
		3	10 kHz, 100 μsec resolution
3rd digit	coded expressions	0	BCD, CF, SBS
		1	BCD, CF
		2	BCD
		3	BCD, SBS

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

3.2 IRIG Standard Format



3.3 AFNOR Standard Format



4 Features TCR511PCI

The board TCR511PCI 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. TCR511PCI serves to receive and decode 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.

Automatic gain control within the receive circuit for modulated codes allows decoding of IRIG signals with a carrier amplitude of 600 mVpp to 8 Vpp. The input stage is elecctically insulated and has an impedance of 50Ω, it is accessible via the BNC connector in the bracket of TCR511PCI.

Unmodulated time codes must be connected to the D-Sub-plug of the module. An onboard photocoupler insulates the internal receive circuit. In delivery state of TCR511PCI 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.

The board TCR511PCI provides a configurable serial interface (RS-232), a pulse per second (PPS) with TTL or 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.

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. If the USB Flash Memory, delivered with TCR511PCI, doesn't include a driver for the used operating system, it can be downloaded free of charge at:

http://www.meinberg.de/english/sw/

Manuals for the drivers are available at this site also. The microprocessor system of TCR511PCI 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 a Flash Program.

4.1 Functional description

After the received IRIG code has passed a consistency check, the software clock and the battery backed realtime clock of TCR511PCI 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 TCR511PCI. 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, TCR511PCI 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 TCR511PEX is configured with this offset, Meinberg driver software is able to set the system time of the computer correctly. The serial interface COM0 can send the Standard Meinberg Timestring with UTC or local (IRIG) time.

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

The board TCR511PCI 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

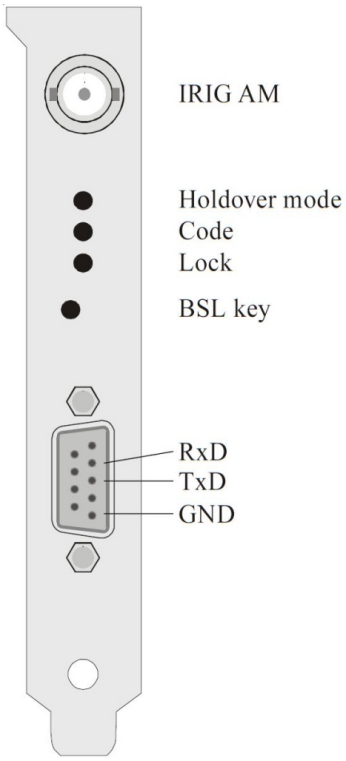
4.2 Pulse outputs

The module TCR511PCI generates pulses at change of second (PPS) and change of minute (PPM). The PPS signal is available with TTL (0/+5V) or 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.

4.3 Asynchronous serial port

TCR511PCI provides an asynchronous serial interface (RS-232) called COM0. The serial port sends a Standard Meinberg Time string either once per second, once per minute or on request with ASCII '?' only. The format of this telegram is described in the 'Technical Specifications'. The transmission speed and the framing can be set via the PCI-Express bus by using the shipped monitor software. Furthermore, the serial interface COM0 is used for a potential firmware update.

4.4 Connectors and LEDs in 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 upper, red LED is switched on whenever the internal timing of TCR511PCI 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 at change of minute.The central, green LED is switched on if the IRIG receiver detects a correct telegram at its input. If the below, green LED (Lock) is switched on, the internal timing of TCR511PEX is synchronized to the received IRIG code by a PLL (Phase Locked Loop).

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.

4.5 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	3
2	RxD in (RS-232)	-
3	TxD out (RS-232)	-
4	PPM out (TTL)	6
5	GND	-
6	+ PWM in	1
7	- PWM in	2
8	PPS out (TTL/RS232)	5/4
9	(reserverd)	8

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.

5 Putting into operation

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

5.1 Installing the TCR511PCI 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.

5.2 Power supply

All power supplies needed by TCR511PEX are delivered by the PCI-(Express) bus.

5.3 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.



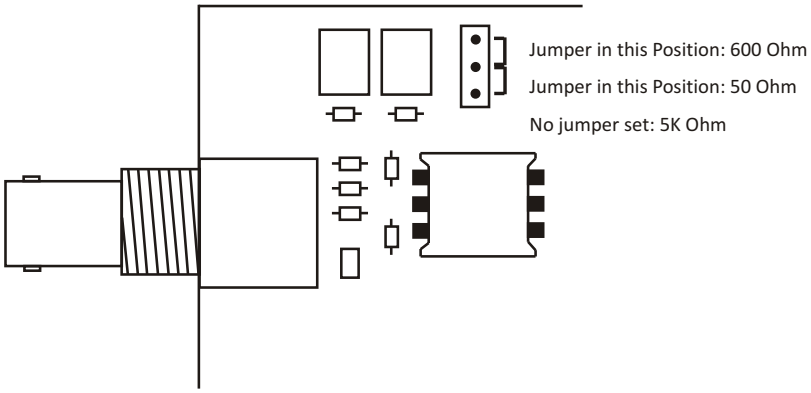
The board TCR511PCI can't be used to decode amplitude modulated and DC Level Shift signals simultaneously. Depending on the selected code, only the signal at the BNC-jack or the D-Sub connector is decoded.

5.4 Input impedance

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. Therefore the board TCR511PCI 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 TCR511PCI, the input impedance has to be set to 50 Ω accordingly (default on delivery).

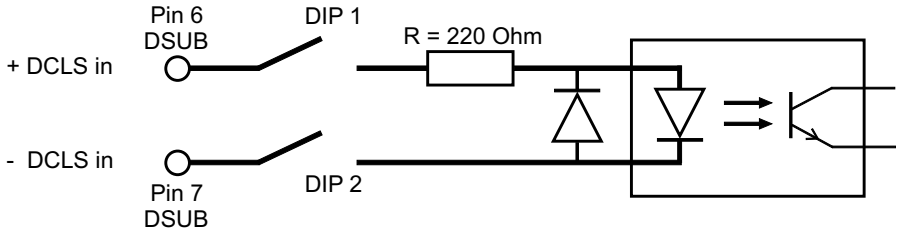
In addition to the telegram, the AFNOR-code defines the input/output impedances also. If TCR511PCI is synchronized by this code, an input impedance 600 Ω of must be set.

The setting „5 kΩ“ may be necessary if the generator has a high output impedance (see specifications of manufacturer). The driver software shows a bar chart for evaluation of the signal level at the receiver input. The following detail of the placeplan of TCR511PCI shows the possible jumper setting with the related input impedance:



5.5 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 must be applied for not exceeding the limit of the forward current of the imput diode (50 mA). The forward current should not be limited to a value of less than 10 mA to ensure save switching of the photocoupler.

5.6 Configuration of TCR511PCI

The selection of the IRIG code, configuration of the serial interface and a possible offset of the received IRIG time to UTC must be set up by the monitor software via the PCIExpress bus. In contrast to AFNOR NFS 87-500 the IRIG telegram containes only the day of year (1...366) instead of a complete date. To ensure correct function of TCR511PCI, 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 IRIG 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 IRIG time.

6 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.

7 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.

8 Technical specification TCR511PCI

RECEIVER INPUT:	AM-input (BNC-connector): insulated by a transformer impedance settable 50 Ω, 600 Ω, 5 kΩ 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: maximum forward current: diode vorward voltage:	 220 Ω 50 mA 1.0 V...1.3 V
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	
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-Express bus	
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: framing:	 300 Bd...38400 Bd 7E2, 8N1, 8N2, 8E1
	mode of operation:	string per second string per minute

		string on request
	time telegram:	Meinberg Standard Telegram
SYSTEM BUS INTERFACE:	32 Bit, 33 MHz or 66 MHz PCI Bus compatible with PCI and PCI-X specifications	
POWER REQUIREMENT:	+5 V:	140 mA
	+12 V :	15 mA
	-12 V :	15 mA
PHYSICAL DIMENSION:	shot, universal board for 3.3V or 5V PCI slot	
AMBIENT TEMPERATURE:	0 ... 50°C	
HUMIDITY:	max. 85 %	

8.1 CE-Label

Low-Voltage guideline	**EN 60950-1** Safety of Information Technology Equipment, including Electrical Business Equipment
Electromagnetic compatibility	**EN50081-1** Electromagnetic compatibility (EMC). Generic emission standard. Part 1: Residential, commercial and light industry
	EN50082-2 Electromagnetic compatibility (EMC). Generic immunity standard. Part 2: Industrial environment

CE

8.2 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 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)

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
' '	MEZ	European Standard Time, daylight saving disabled
	'S'	MESZ 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

Konformitätserklärung

Declaration of Conformity

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 Name	**IRIG Einsteckkarte**
Modell / Typ Model Designation	**TCR511PCI**

auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt
to which this declaration relates is in conformity with the following standards

EN55022:1998, Class B (+A1:2000 +A2:2003)	Grenzwerte und Meßverfahren für Funkstörungen von informationstechnischen Einrichtungen Limits and methods of measurement of radio interference characteristics of information technology equipment
EN55024:1998 (+A1:2001 +A2:2003)	Grenzwerte und Meßverfahren für Störfestigkeit von informationstechnischen Einrichtungen Limits and methods of measurement of Immunity characteristics of information technology equipment

gemäß den Richtlinien 89/336/EWG (Elektromagnetische Verträglichkeit), 73/23/EWG (Niederspannungsrichtlinie) und 93/68/EWG (CE Kennzeichnung) sowie deren Ergänzungen.
following the provisions of the directives 89/336/EEC (electromagnetic compatibility), 73/23/ECC (low voltage directive) and 93/68/EEC (CE marking) and its amendments.

Bad Pyrmont, den 02.05.2007



Authorized Signature

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