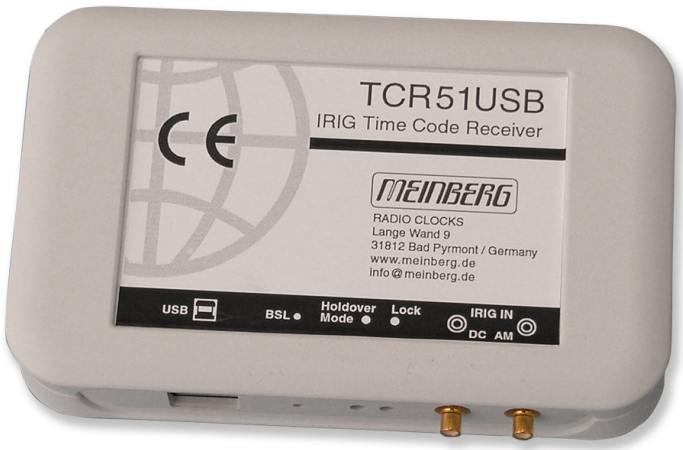

MANUAL

TCR51USB

USB Clock

10th July 2017

Meinberg Radio Clocks GmbH & Co. KG

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1 Imprint

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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:

http://www.meinbergglobal.com/english/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 TCR51USB 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.

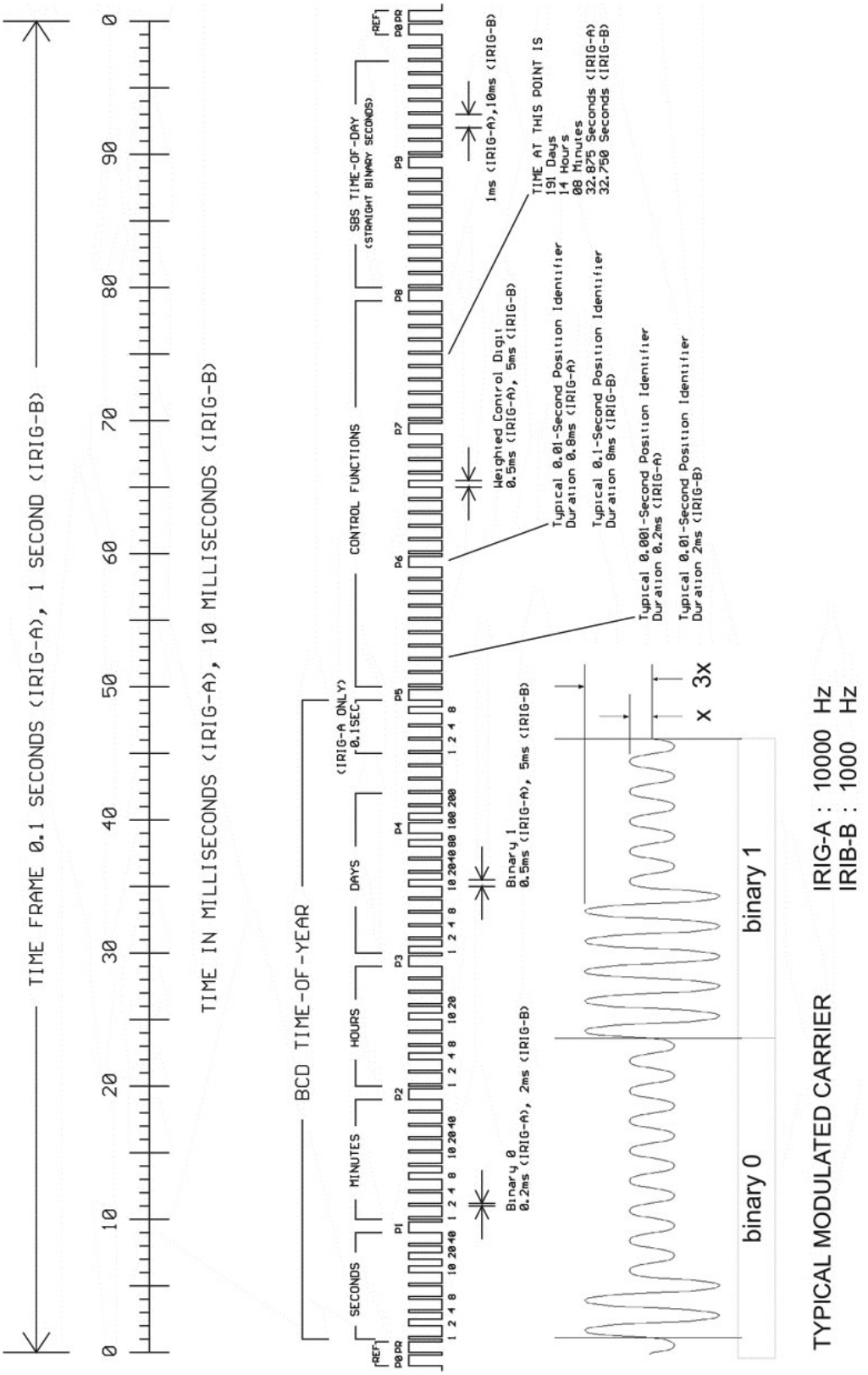
3.1 Description of IRIG-Codes

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):

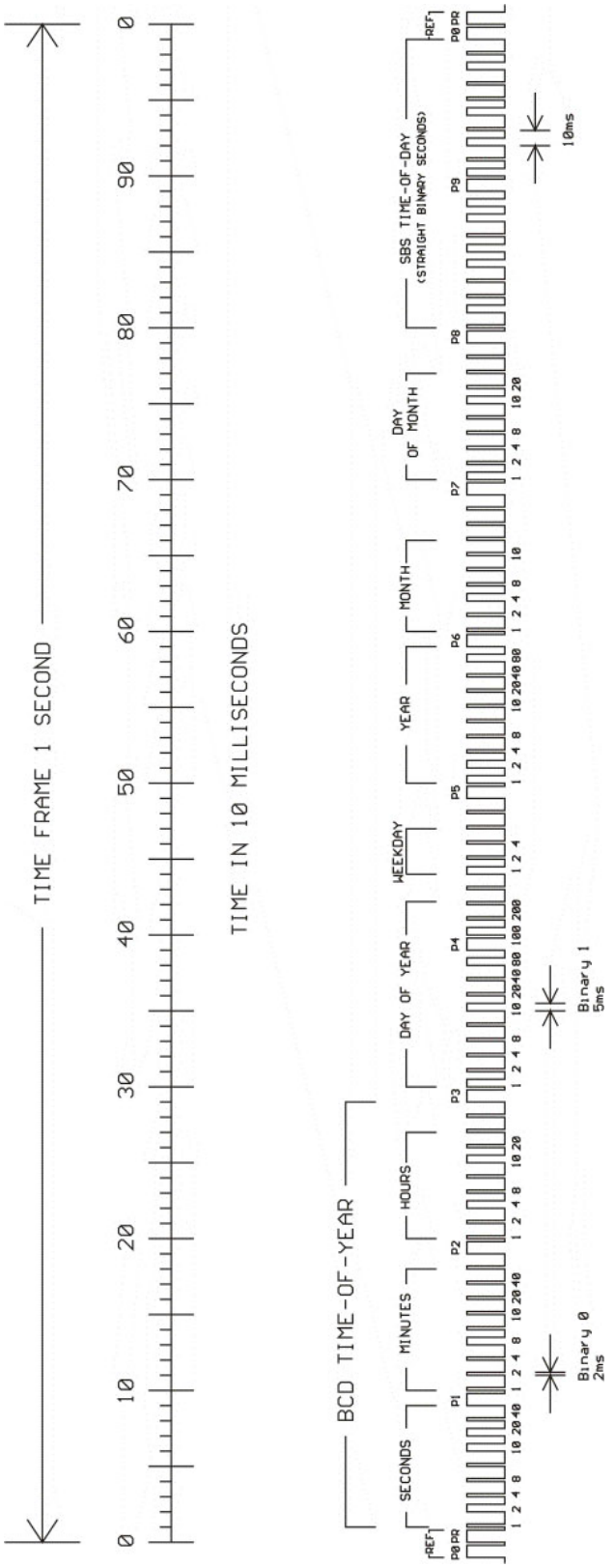
character	bit rate designation	A	1000 pps
		B	100 pps
1st digit	form designation	0	DC Level Shift pulse width modulated
		1	sine wave carrier amplitude modulated
2nd digit	carrier resolution	0	no carrier (DC Level Shift)
		1	100 Hz, 10 msec resolution
		2	1 kHz, 1 msec resolution
		3	10 kHz, 100 μsec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

3.2 IRIG Standard Format



3.3 AFNOR Standard Format



4 Features: TCR51USB

The TCR51USB was developed for computer systems with USB connection. TCR51USB 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 electrically insulated and has an impedance of 600 Ω, it is accessible via the SMB-jack connector in the housing of TCR51USB.

The unmodulated time codes must be connected to the second SMB jack connector. An onboard photocoupler insulates the internal receive circuit.

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 necessarry to let the board generate periodic hardware interrupts on the USB Bus.

The microprocessor system of TCR51USB is equiped with a Bootstrap-Loader and a Flash-EPROM. These features enable updating of the onboard software.

4.1 Functional Description

After the received IRIG code has passed a consistency check, the software clock and the battery backed realtime clock of TCR51USB 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 is limited to 1μsec/sec by regulating the onboard quartz of TCR51USB. 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, TCR51USB switches to holdover mode but still synchronizes the internal time base to the received IRIG code.

The internal system clock is always set to the received IRIG time, which might have a local offset to UTC. Only if TCR51USB is configured with this offset, Meinberg driver software is able to set the system time of the computer correctly.

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 TCR51USB 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

B126:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year, Year
B127:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year, 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
AFNOR NFS 87-500:	100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency BCD time of year, complete date, SBS time of day
IEEE 1344:	Code according to IEEE 1344-1995, 100 pps, AM sine wave signal, 1kHz carrier frequency, BCD time-of-year, SBS time-of-day, IEEE 1344 extensions for date, timezone, daylight saving and leap second in control functions (CF) segment. (also see table 'Assignment of CF segment in IEEE 1344 mode')
IEEE C37.118:	Like IEEE 1344 - with UTC offset to be applied reversely

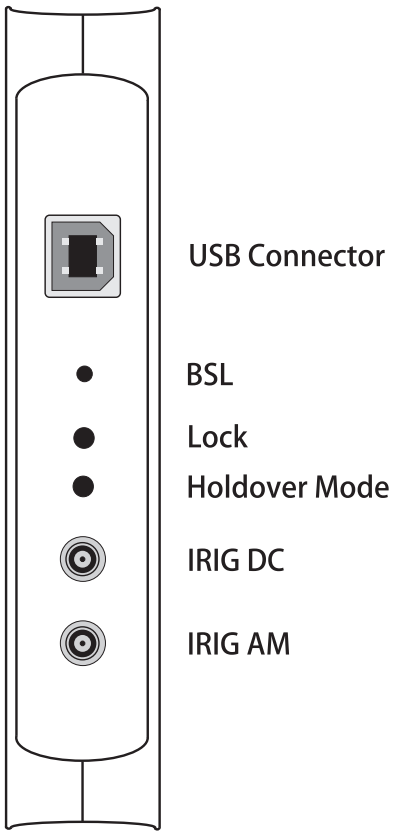
Additional codes are available on request

4.2 USB Interface

The TCR51USB contains a USB interface which is used for the communication and parameterization of the device with the Monitorprogramm.

4.3 Connectors and LEDs

The housing of the TCR51USB contains the connectors for the Timecode (IRIG AM/DC), two LED's, the key for the Bootstrap-Loader as soon as the the USB connector.



The LEDs signal the status of the IRIG receiver. The upper, red LED is switched on whenever the internal timing of TCR51USB is in holdover mode. This state arise after power up and if an error in the IRIG telegram is detected. This LED changes state only at change of minute.

The green LED (Lock) is switched on as soon as the internal timing of TCR51USB 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 USB connector is used for the communication of the Device with the PC.

Optional PPS output as TTL or RS232 level.

4.4 Buffering

If the power supply fails, an onboard realtime clock automatic switching to crystal time base. In this case the power requirement of this clock has been taken over by an internal capacitor which was load by the USB Powersupply. This enables a independent Voltagesupply for the internal realtime clock of ca. 5 Days.

After this this time the TCR51USB is not able to read, during the start activity, the correct time and date information from the realtime clock. Therefor the TCR51USB is not able to synchronize to the received IRIG signal. In this case it is necessary at first to set the correct date information to the TCR51USB. After the synchronization with the IRIG signal the correct Date and Time information were written to the realtime clock

4.5 Putting into operation

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

Installing the TCR51USB
After installing the software to the PC the TCR51USB was detected automaticly.

Power Supply
The power supplies needed by TCR51USB was delivered by the USB.

4.6 Input signals

Amplitude modulated and Pulse width modulated signals IRIG-A/B (or AFNOR) codes must be connected to the SMB-jack connector in the housing of TCR51USB. A shielded or a twisted pair cable should be used. The IRIG code used must be configured with the monitor software.

The board TCR51USB can't be used to decode amplitude modulated and DC Level Shift signals simultaneously. Depending on the selected code, only the signal at the SMB-connector is decoded.

4.7 Input Impedance

The IRIG-specification doesn't 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 TCR51USB contains a impedance of 600 Ω.

4.8 Optocoupler input

Pulse width modulated (DC Level Shift) codes are insulated by an onboard photocoupler.

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 input 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.

4.9 Configuration of TCR51USB

The selection of the IRIG code and a possible offset of the received IRIG time to UTC must be set up by the monitor software via the USB. 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 TCR51USB, 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).

5 Technical Specifications TCR51USB

Receiver Input:

AM-input (SMB-jack):
Insulated by transformer

impedance:	600 Ω
Input signal:	600 mV_{pp} to 8 V_{pp} (Mark)
	other ranges on request

DC-Level Shift Input (SMB-jack):
insulated by photocoupler

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

Decoding:

Decoding of the following codes possible :
IRIG-A133/A132/A003/A002
IRIG-B123/B122/B003/B002
AFNOR NFS 87-500 and IEEE1344

Optional Output Signal

PPS-Signal (as TTL-Level or RS232-Level)

Accuracy of Time Base:

± 5 µsec compared to IRIG reference marker

Required Accuracy of Time Code Source:

± 100 ppm

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. The realtime clock can work with the Backup Battery for approximately 5 days. Important system parameters are stored in the RAM of the system

Reliability of Operation:

Microprocessor supervisory circuit provides watch dog timer, power supply monitoring and backup-battery switchover software watchdog monitors correct program flow and generates a reset in case of error detection

Initialisation:

Software and realtime clock can be set by the USB monitor program

Interface:

USB V.1.1 connection

Power Requirements over USB:

TIME_SYN, TTL level, active high when clock is synchronuos

Housing Dimensions:

73mm x 117mm x 24mm (L X B X H)

Ambient Temperature:

0...50 °C

Humidity:

Max. 85 %

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 USB connection.

If the button behind a hole in the housing is pressed during the power up, a bootstrap loader is activated and waits for instructions from the USB. 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 USB interfaces. 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 an the on again.

7 Declaration of Conformity

Konformitätserklärung

Doc ID: TCR51USB-2017-07-06

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 **TCR51USB**
Product Designation

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

EN55032:2012, Class B	Limits and methods of measurement of radio interference characteristics of information technology equipment
EN55024:2010	Limits and methods of measurement of Immunity characteristics of information technology equipment
EN 60950-1:2006 (A11:2009 + A1:2010 + A12:2011 + AC:2011 + A2:2013)	Safety of information technology equipment
EN 50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

gemäß den Richtlinien 2014/30/EU (Elektromagnetische Verträglichkeit), 2014/35/EU (Niederspannungsrichtlinie), 2011/65/EU (Beschränkung der Verwendung bestimmter gefährlicher Stoffe) und 93/68/EWG (CE Kennzeichnung) sowie deren Ergänzungen.
following the provisions of the directives 2014/30/EU (electromagnetic compatibility), 2014/35/EU (low voltage directive), 2011/65/EU (restriction of the use of certain hazardous substances) and 93/68/EEC (CE marking) and its amendments.

Bad Pyrmont, 2017-07-06

Günter Meinberg
Managing Director