ClockBox V5 / ClockControl V3

Document-Version 1.0

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1   Preface

The *ClockBox* is a device for the synchronous triggering of up to five different measurement/data acquisition systems. Instead of sending just synchronous start and stop trigger, the *ClockBox* allows the user a frame-by-frame synchronal triggering by one master clock. The frequency, duty cycle and rising or falling edge for each single device or system can be adjusted by software. Thereby it is possible to synchronize even systems with different data acquisition frequencies (e.g. 10,000 Hz and 500 Hz) because after a common multiplier (20 for the given example) of clock pulses for the highest frequency there is always one synchronal frame of the low frequency device. This prevents the usually known jitter if all different systems are running free with their own frequency after a common start pulse.

2   Box Content

1 x ClockBox

1 x Driver and Software CD

1 x Wall plug power supply

1 x USB-cable (type A-B)

1 x Lemo-cable (FGG.0B.302:CLAD42 to FGB.0B.302.CLAD42)

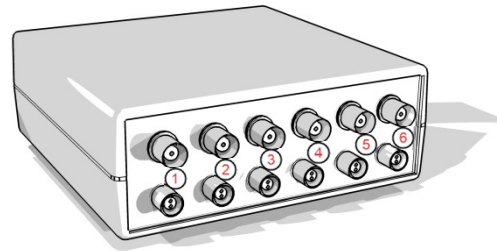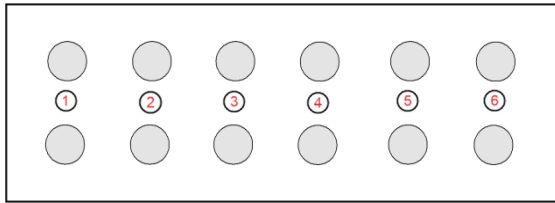# 3   Hardware Overview

3.1   Rear View
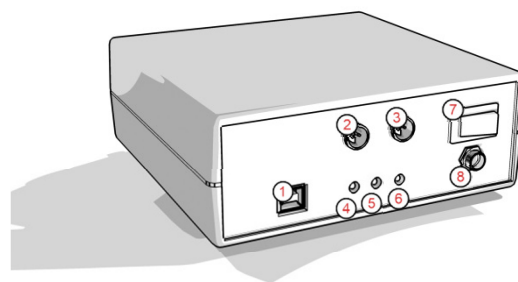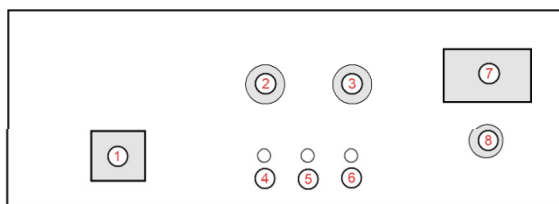
①   USB socket Typ-B

②   X7 Trigger/Enable IN (relay contact, galvanic isolation)

③   X8 Enable/Trigger OUT (relay contact, galvanic isolation)

④   Power – LED (green light if on)

⑤   Microcontroller – status – LED (green light if o.k.)

⑥   RS232-LED (flashes during communication)

⑦   ON-OFF-switch

⑧   Socket for power supply (9 V DC)

3.2 Front View

①   X1 Synchronization output [1)]

②   X2 Synchronization output [1)]

③   X3 Synchronization output [1)]

④   X4 Synchronization output [1)]

⑤   X5 Synchronization output - permanent sync. out! [1)]

⑥   X6 Enable OUT (Logic 1 as long as trigger on X1..X4 runs, otherwise Logic 0) [1)]

[1)] BNC = TTL (0..5 V DC) / Lemo = RS485 differential output

4   Installation Guide and Quick Start

1. Plug in the DC power supply into the matching socket at the *ClockBox*

2. Plug in the wall power supply to the AC power line

3. Connect the *ClockBox* to the data acquisition computer by means of the USB cable

4. Switch on the device

5. Install FTDI-driver from the CD (directory "Driver" follow the installation guide AN_119_FTDI_Drivers_Installation_Guide_for_Windows7.pdf)

6. Check the virtual COM-port in the device manager of the PC (Fig. 1 right)

7. Copy the *ClockControl* software "ClockControlV3.exe" from CD (software directory) to any directory of your PC

8. Start the software by double clicking the "ClockControlV3.exe"

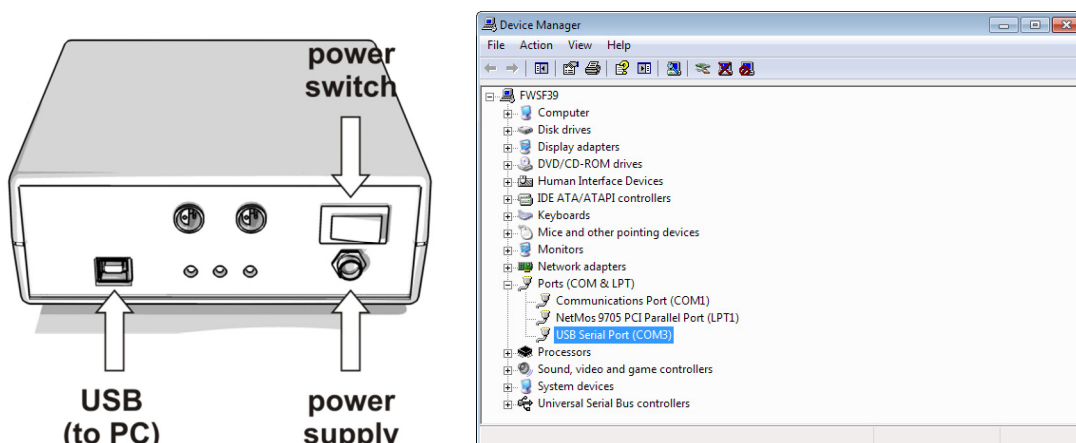9. Choose the right COM-port (cp. no. 6) and click "connect"

Fig. 1: Basic connection and setup of the *ClockBox*

5 Software ClockControl

The *ClockControl* software allows the setup and start of the *ClockBox* device via the virtual COM-port from a Widows® PC. This enables the adjustment of count rates (frequencies) and duty cycles, or pulse length, switching edges via PC-software. The settings can be stored to the device memory and read out from the device after restart. Additionally, there are three different triggering methods available:

1. Hardware trigger: The device is armed by switching on the hardware trigger mode. The *ClockBox* waits until the external trigger switches on the relay of the trigger IN port X7. *ClockBox* runs continuously until the trigger IN is switched OFF.

2. Continues Mode: The device runs with the previously set patterns for the user defined measurement duration. **ATTENTION** the measurement duration is based on Windows® system clock and is **NOT** hardware synchronal with the *ClockBox*, therefore a fixed value of frames cannot be determined with this mode!

3. Burst Mode: The Burst Mode allows a repetitive synchronal output of short bursts of pulses with a fixed burst interval over a user defined measurement duration. This is very useful for long term measurements e.g. for stability tests or transient experiments. For example: one can take measurements automatically every 15 minutes for just 30 seconds over a period of a couple of hours with very high frequencies without collecting terabytes of data, moreover many fast data acquisition devices like high speed cameras or wire mesh sensors have limited internal memory!

5.1 Setup Communication with PC

Fig. 2 shows the software after startup. The user can choose the right COM-port from the drop down list. Then click the connect button. If the software recognizes the *ClockBox* the button changes its appearances and hint to "disconnect" and you can continue with 5.2.

Fig. 2: *ClockControl* software after startup.
First step: setup PC communication by choosing the right COM-port.

If the chosen COM-port is wrong, the box is not connected or is switched OFF a message box appears.
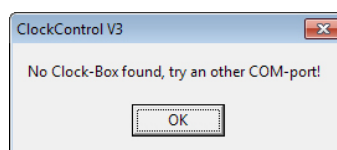

Fig. 3: Message box in case of non-successful connection.

Solutions:

- Check all connections (USB cable, power supply) as well as the power switch.
- Check if the power LED is glowing.
- Try another COM-port.
- Check if any other Windows® program blocks the COM-port (e.g. Microsoft ActiveSync).

5.2 Frequency Settings

In the register card "Frequency Settings" the user can define the synchronization pattern for five different output channels **X1**..**X5** (cp. Fig. 4). Please note that **X5** is a **permanent ON** output channel which is necessary for example for the synchronization of high speed camera systems. High speed cameras mostly need a permanent synchronization signal (external clock) to synchronize their internal clock – even if they are in standby or online mode! Therefore channel **X5** output is always ON with the last set frequency pattern while all other 4 channels are in OFF until software or hardware trigger starts the sequence.
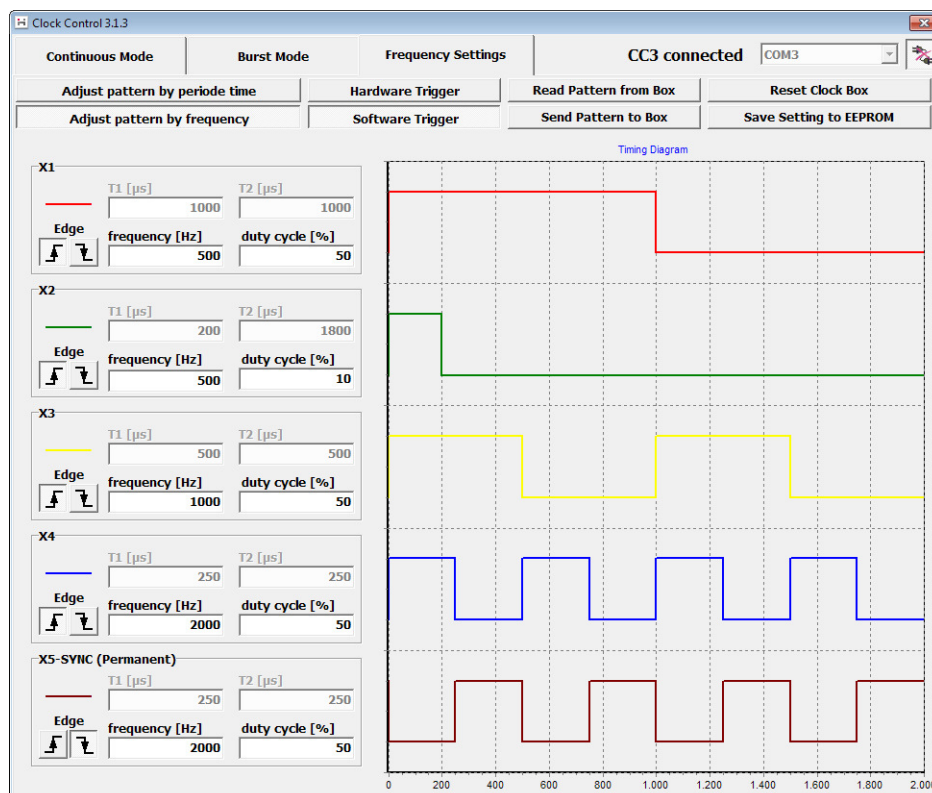

Fig. 4: The register card „Frequency Settings. Five different patterns can be adjusted and are displayed to prove the matching to each other.

In the lower part of the register card the user can change the behavior of the five channels separately. Either by typing the frequency and the duty cycle of the signals or by editing the period lengths T1 and T2 for each signal (e.g. a frequency of 1000 Hz and a duty cycle with

25% corresponds to T1 = 250 μs and T2 = 750 μs). The mode of input can be changed by the two buttons (top, left) "*Adjust pattern by Frequency*" rsp. "*Adjust pattern by period time*". Low active and high active logics or rising and falling edges respectively can be switched by the buttons on the left for each channel separately. By default the *ClockBox* is software controlled but it can also be triggered by a galvanically insulated relay input port **X7**. Therefore the user changes the trigger from "*Software Trigger*" to "*Hardware Trigger*" to arm the box.

The *ClockBox* device possesses an internal memory to store the settings. Previously saved pattern can be loaded to the software by clicking "*Read Pattern from Box*". Press the "*Send Pattern to Box*" button to send the actual settings to the device. Please note: this settings will be lost after power off or reset of the box! To save the sent pattern permanent, press the "*Save Setting to EEPROM*" button. A message window will show a security query to avoid unwanted changes to the permanent *ClockBox* settings (Fig. 6).
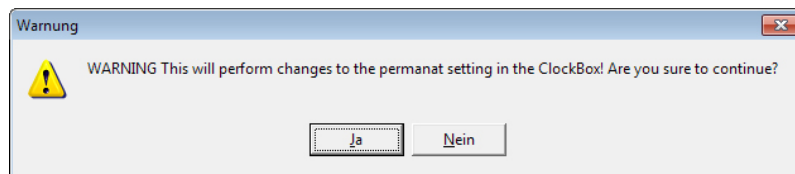

Fig. 5: Security query for overwriting settings in the internal EEPROM.

After a restart or reset of the box the data can be reloaded. The "*Reset Clock Box*" button allows the reset of the microcontroller in case of hang-up.
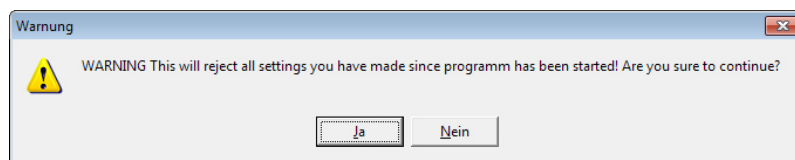

Fig. 6: Security query for reject all changes made in the actual session after last save to EEPROM.

5.3   Continuous Mode

In the register card "*Continuous Mode*" (Fig. 7) the user can define the "*Measurement Duration*" (in seconds) while trigger pulses should be created. **ATTENTION** the "*Measurement Duration*" is based on Windows® system clock and is **NOT** hardware synchronal with the *ClockBox*, therefore a fixed value of frames cannot be determined with this mode! The minimum measurement time is 3 seconds, smaller values will be changed automatically to "3". Clicking the "*START*" button starts the box. The progress bar shows the elapsed time in %. If the measurement should be stopped earlier just press the "*STOP*" button.
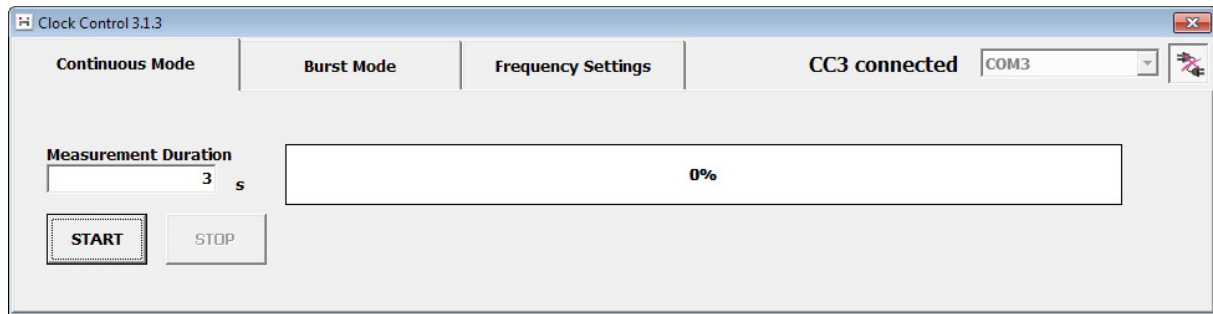
Fig. 7: ClockControl-Software in "*Continuous Mode*".

5.4 Burst Mode

The Burst Mode allows a repetitive synchronal output of short bursts of pulses with a fixed burst interval over a user defined measurement duration. This is very useful for long term measurements e.g. for stability tests or transient experiments. For example: one can take measurements automatically every 15 minutes for just 30 seconds over a period of a couple of hours with very high frequencies without collecting terabytes of data, moreover many fast data acquisition devices like high speed cameras or wire mesh sensors have limited internal memory!

At the register card "Burst Mode" the user has to define three parameters:
- "*Measurement Duration*": defines the overall measurement time
- "*Burst Interval*": defines the time gap between start of the single bursts
- "*Burst Length*": defines the exact period length of each burst. This value is hardware synchronized by the *ClockBox* and starts always with the edges defined in the pattern in register "*Frequency Settings*".

ATTENTION the "*Measurement Duration*" and the "*Burst Interval*" are based on Windows® system clock and are **NOT** hardware synchronal with the *ClockBox*!
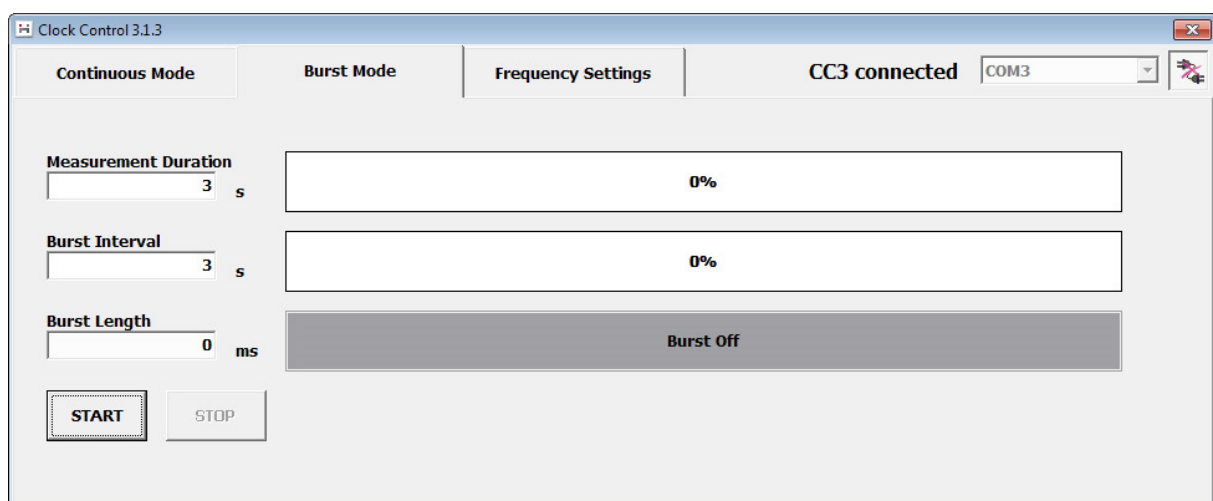

Fig. 8: ClockControl-software in *"Burst Mode".*

6   Technical Specifications

Port	Details
X1-X6 BNC	clock resolution = 50 µs T_{min} = 100 µs f_{max} = 10000 Hz (ti/tp = 50%)
X1-X6 BNC	I_{OH} = ± 10mA max I_{OL} = ± 45mA max U_{OUT} = 5V ± 0,1V
X1-X6 Lemo	Differential Bus Transceivers (EIA-422, EIA-485) I_{OUT}= ± 60mA max Lemo part number: EPG.0B.302.HLN (socket), FGG.0B.302.CLAD42 (plug)
X7 Lemo	DC 6,5 V < U in < 30 V, 30 mA Lemo part number: ERN.0S.302.CLL (socket), FFA.0S.302.CLAD42 (plug)
X8 Lemo	max DC 200 V; max 0,5 A; max 10 W Lemo part number: ERN.0S.302.CLL (socket), FFA.0S.302.CLAD42 (plug)
USB	High Speed 2.0, DC 5V, typ. 140 mA, min 500 mA
Power Supply	Primary side: 90..264 V AC, 50..60 Hz Secondary side: 9V DC, 1.33A (12W)
Power Consumption:	$I_{typ.}$ = 140 mA @ 9V DC I_{max} = 580 mA @ 9V DC

7   Versions

Version 1	Prototype 6-channel via RS232
Version 2	08-2009 FTDI-USB-Serial-Converter added
Version 3	10-2009 Bus-driver for BNC-TTL outputs Firmware update for Burst Mode Support
Version 4	02-2010 Relay input/output added, 24 V hardware trigger
Version 5	04-2013 Bug fixes

8 Minimum System Requirements

Architecture: x86

Processing power: 2000 MHz Single-Core (AMD Athlon XP, Pentium 4 or faster)

Memory: 5 MB RAM

Storage: 5 MB

Display adapter: 1440 x 900 screen resolution

Peripherals: USB 2.0

Platform: Windows OS (XP/7) 32bit

APIs and drivers: FTDI virtual COM port (VCP) driver

9 Contact

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The HZDRI Innovation GmbH is registered under the company registration number HRB 30595 at the Amtsgericht [chamber of commerce] in Dresden, Germany.

The system is designed for the specifications shown in the manual. For the usage of the system outside of this specification the HZDR Innovation GmbH assumes no liability.