

# 4 Channel Counter (Release 004 & 005)



## Manual



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4 Channel Counter (Release 004 & 005)  
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# 2 Introduction

## 2.1 General Information

This manual is intended to assist users in the installation, operation and maintenance of Release Version 004 & 005 of the 4 Channel Counter. It is divided into 8 chapters.

## 2.2 Safety Instructions



Please read this manual carefully before performing any electrical or electronic operations and strictly follow the safety rules given within this manual.

The following symbols appear throughout the manual:



The “note symbol” marks text passages, which contain important information/hints about the operation of the device. Follow this information to ensure a proper functioning of the device.



The “caution symbol” marks warnings, which are given to prevent an accidentally damaging of the device or the readout system. Do NOT ignore these warnings and follow them strictly. Otherwise no guarantee is given for arose damages.

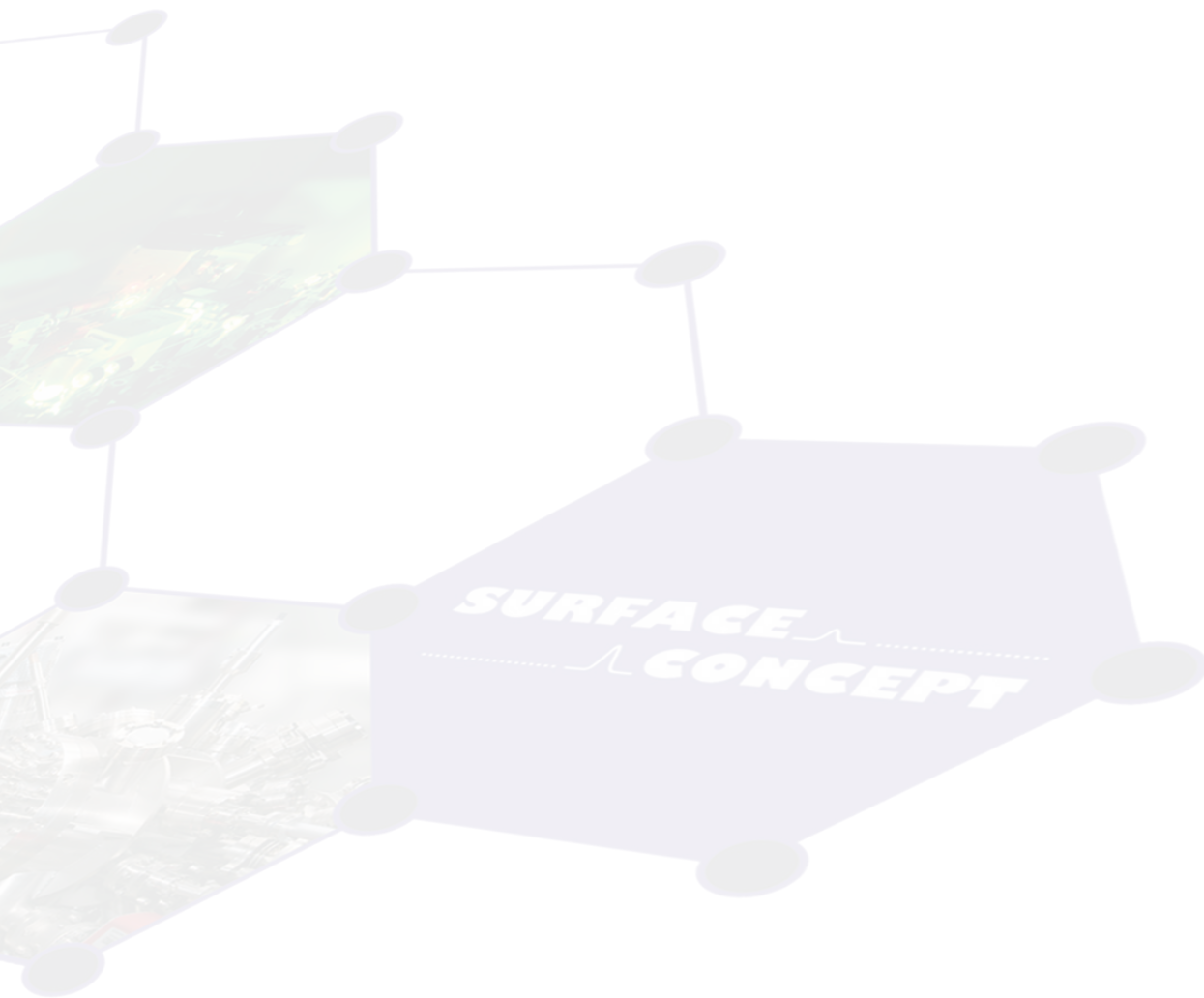


The “high voltage symbol” marks warnings, given in conjunction with the description of the operation/ use of high voltage supplies and/or high voltage conducting parts. Hazardous voltages are present, which can cause serious or fatal injuries. Therefore only persons with the appropriate training are allowed to carry out the installation, adjustment and repair work.

## 2.3 General Overview

The Surface Concept 4 Channel Counter R 004 is a stand alone 4 channel counter/timer device for standard low voltage TTL (LVTTTL) pulses. The R 005 comes in a 2/12 NIM housing and is layed out for standard NIM pulses. Device control and result display is realized by a touch screen display or by PC via Ethernet connection (WIN 7 or higher only) in both devices.

The counter includes an integrated basic logical processing unit which allows to detect input pulses under two different coincident definitions (AND and XOR) between any two of the four input channels.



# 3 Installation

## 3.1 Initial Inspection

Visual inspection of the system is required to ensure that no damage has occurred during shipping. Should there be any signs of damage, please contact SURFACE CONCEPT immediately. Please check the delivery according to the packing list (see [Table 1 & 2](#)) for completeness.

- 1x 4 Channel Counter
- 1x Wall Power Supply (5V/3A)
- CD with Software Package and Documentation
- 1x 4 Channel Counter
- CD with Software Package and Documentation

Table 1: Packing list for the 4 Channel Counter R 004.

Table 2: Packing list for the 4 Channel Counter R 005.

## 3.2 Installation

### 3.2.1 Power Connection

Connect the wall power supply to the 4 Channel Counter R 004. The counter has no additional switch for switching on and off. The counter is switched on as soon as power is provided by the wall power supply.

The power supply for the 4 Channel Counter R 005 is realized via the NIM crate. The device comes with an additional switch for switching on and off.

### 3.2.2 Initialization Process

After power up the device starts the primary initialization process which can take up to 1 minute. During this process all default settings are loaded into the counter. The change of settings in the display (as shown in [Figure 1](#)) indicate the end of the initialization process.



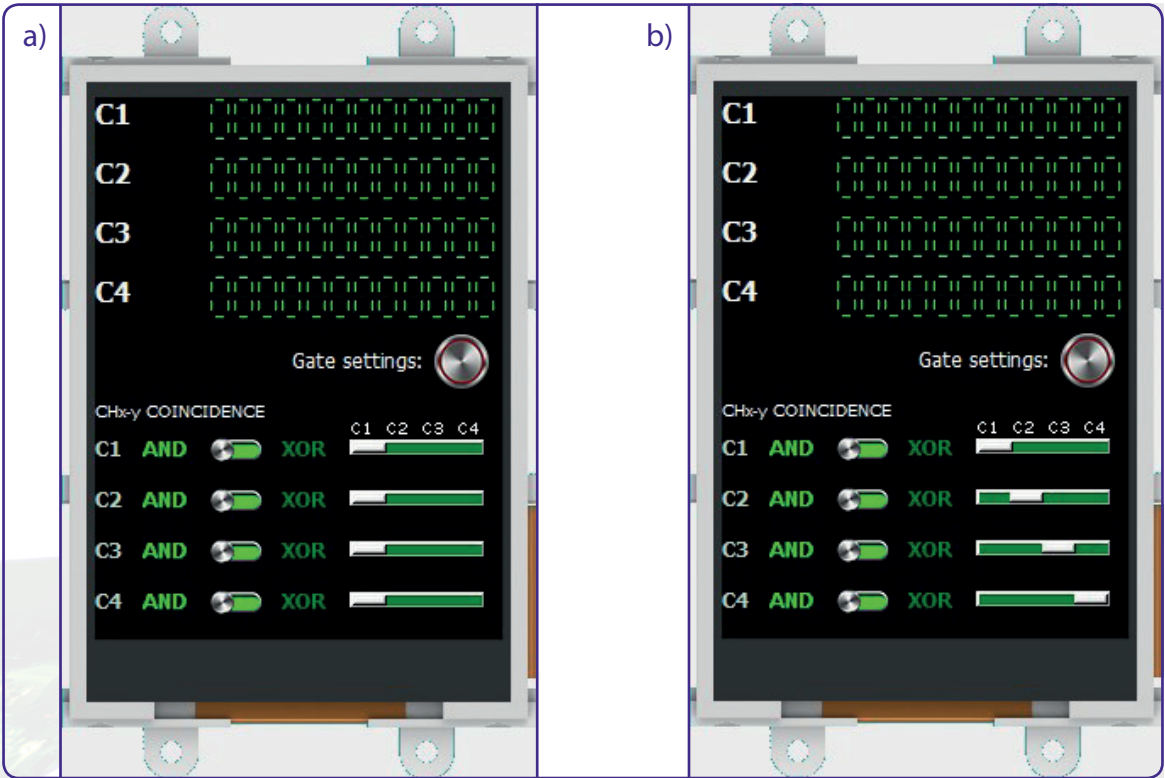


Figure 1: Display settings a) during the initialization process and b) after the initialization process has ended. Note the different settings for the coincident measurement.

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# 4 Device Layout

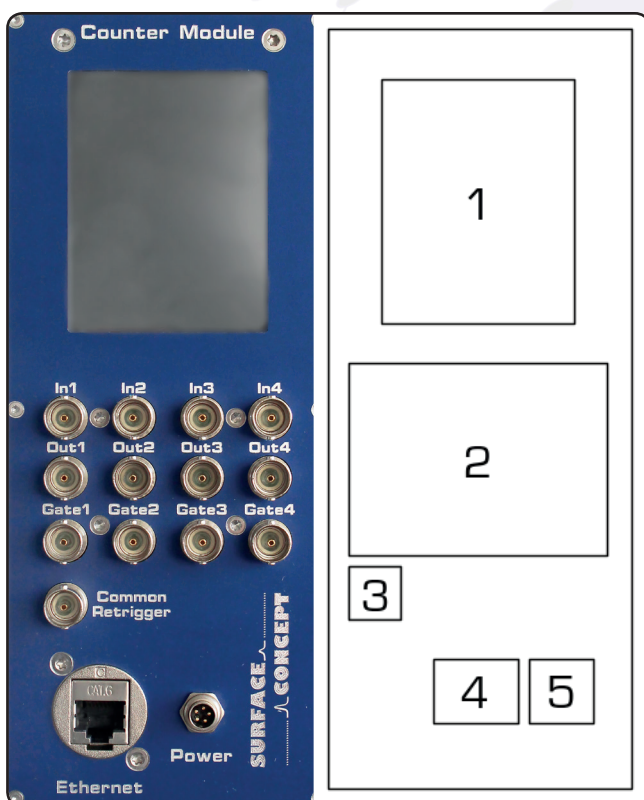
## 4.1 General Device Layout

The 4 Channel Counter consists of a display with touch screen functionality for direct device control. There are 3 sockets (BNC for R 004, LEMO for R 005) for signal input/output and for external gating (gate by wire) for each of the 4 channels. In addition the device holds a BNC/LEMO socket for a common retrigger signal. The signal level for the input signals must be standard low voltage TTL (TTL tolerant) for R 004 and respectively NIM for R 005. As well as the signal level for the external gate and the common retrigger.



All 4 signal input connectors are 50Ohm terminated. Please make sure that your input device can provide the necessary power.

The device holds an Ethernet connector for device communication via network. The electrical power is provided by a wall power supply (part of delivery) via a 5-pin socket or the NIM crate.



1. Display with touch screen functionality
2. BNC sockets for standard LVTTTL signal Input, low voltage TTL gate signal input and coincidence measurement pulse output for each of the 4 channels. The gate connector is also being used for the common gate input (see Chapter 5.1.2). The 4 signal inputs are 50 Ohm terminated. The gate signal inputs and outputs are MOhm terminated.
3. LVTTTL socket for common retrigger signal Input (low voltage TTL)
4. Ethernet connector for device communication via network
5. 5-pin socket for power supply

Figure 2a: General layout of the 4 Channel Counter R 004.



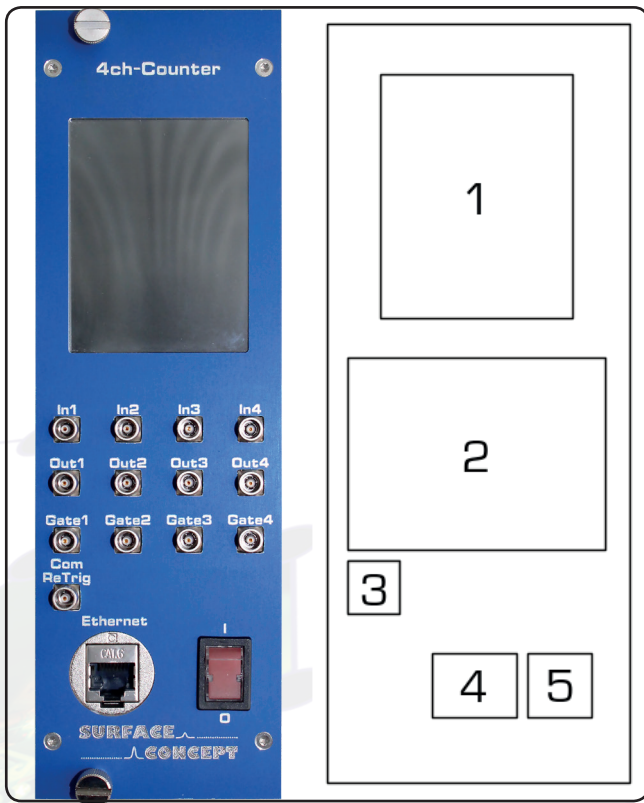


Figure 2b: General layout of the 4 Channel Counter R 005.

1. Display with touch screen functionality
2. LEMO sockets for NIM signal input, NIM gate signal input and coincidence measurement pulse output for each of the 4 channels. The gate connector is also being used for the common gate input (see [Chapter 5.1.2](#)). The 4 signal inputs are 50Ohm terminated. The gate signal inputs and outputs are MOhm terminated.
3. LEMO socket for common retrigger signal Input (NIM)
4. Ethernet connector for device communication via network
5. ON/OFF switch

## 4.2 Display Description

Setting and control of the 4 Channel Counter R 004 and R 005 is made via the touch screen functionality of the display. The description of the different display elements is given in Figure 3 and Figure 4.

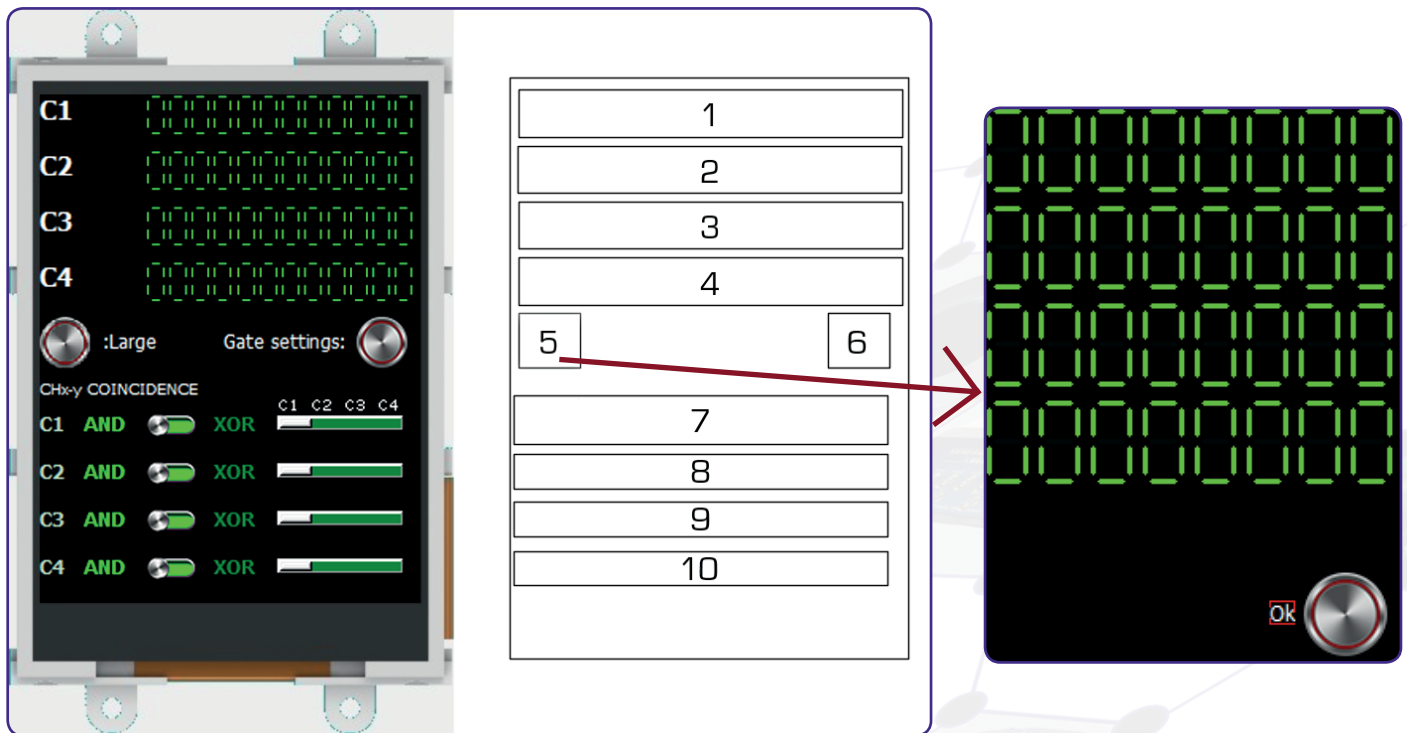


Figure 3: Display description of the 4 Channel Counter.

1. 12digit number to display counted events of channel 1 (C1)
2. 12digit number to display counted events of channel 2 (C2)
3. 12digit number to display counted events of channel 3 (C3)
4. 12digit number to display counted events of channel 4 (C4)
5. Large button: Increases the size of the 12 digit numbers for better visibility
6. Button to enter screen for gate setting options
7. Switch to select type of coincidence measurement (AND or XOR) between channel 1 and the channel selected with the corresponding slider.
8. Switch to select type of coincidence measurement (AND or XOR) between channel 2 and the channel selected with the corresponding slider.
9. Switch to select type of coincidence measurement (AND or XOR) between channel 3 and the channel selected with the corresponding slider.
10. Switch to select type of coincidence measurement (AND or XOR) between channel 4 and the channel selected with the corresponding slider.

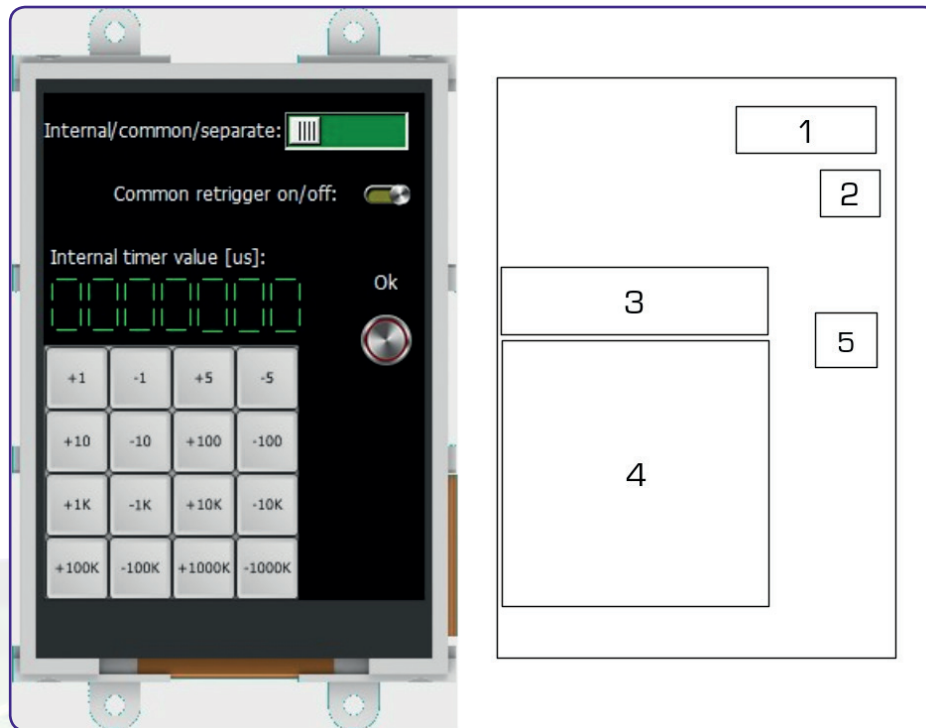


Figure 4: Display description of the gate setting screen.


1. Slider to select between internal/common and separate gate
2. Switch to set Common Retrigger on/off
3. 7digit number to display selected internal gate/timer value in  $\mu\text{s}$
4. keypad to enter internal gate/timer value in  $\mu\text{s}$
5. Button to switch back to main display

# 5 Device Operation

## 5.1 Standard Device Operation

The device is starting counting as soon and as long as a gate signal is applied. The gate signal can either be provided internally by the device itself or externally by wire.

### 5.1.1 Counting Operation with Internal Gate Signal

Internal/common/separate: 


The device can generate an internal gate signal for controlling the counting operation. The “gate” switch (No. 1 in Figure 4) must be set to “internal” to work with the internal gate signal. The length of the internal gate/timer signal is defined by the internal gate time which can be set in  $\mu\text{s}$  up to a maximum of 9,999,999  $\mu\text{s}$  by using the keypad on the display (No. 4 in Figure 4). The default value for the internal gate length is 1,000,000  $\mu\text{s}$ .



**Note**

The internal gate signal is generated anew each time when the device settings have been changed or when the internal gate time has elapsed. There is no indication for the elapsing of the internal gate time. With each new internal gate signal all 4 counters are reset.

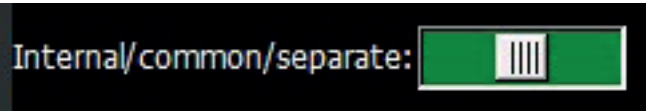
### 5.1.2 Counting Operation with External Gate Signal

Internal/common/separate: 

The counting operation can also be controlled via an external gate signal (gate by wire). The gate switch (No. 1 in Figure 4) must be set to “common” or “separate” to work with an external gate signal.

Each channel has its own gate signal input and the counting operation can be controlled individually for all 4 channels when setting the gate switch to “separate”.

It is also possible to use one common gate signal for all 4 channels. For this the gate switch must be set to "common".



The gate input socket of channel 1 is also used as signal input for the common gate signal. Gate signals on channel 2 – 4 are ignored when working with a common gate signal.

Each new gate signal resets the counters. The 4 counters are reset separately when working with separate external gate signals and they are reset together when working with one common external gate signal.

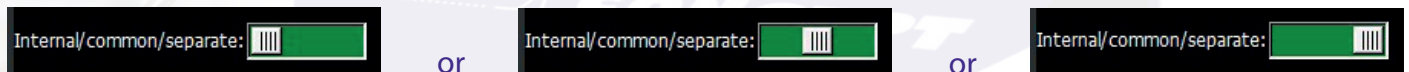
## 5.1.3 Common Retrigger or Trigger Gate Measurement

For applications where the start of a measurement with defined gate signals (internal/common/separate) should be triggered to an additional external signal, the 4 Channel Counter holds the possibility for an additional trigger input - the so called "Common Retrigger".

To use the common retrigger the "Common retrigger" switch (No. 2 in Figure 4) must be set to "on" (button lighted) and an external LVTTTL signal (R 004) or NIM signal (R 005) must be applied to the BNC/LEMO socket named "Common Retrigger" (No. 3 in Figure 2).

In this mode any internal or external gate signal is only accepted after receiving the common retrigger signal. The measurement is running for the duration of the gate signal. At the end of the gate signal, the device is stopping any measurement until the next common retrigger signal resets the counter.

The next gate signal which follows, defines the duration of the next measurement again. The counter results are kept and displayed until the next common retrigger signal appears.



## 5.2 Coincidence Measurements

The 4 Channel Counter holds an FPGA based integrated basic logical processing to allow different coincidence measurements. Coincidence measurements can be defined always between two input channels (e.g. between channel 1 and channel 3) and 4 separate coincidence measurements can be defined in total (one for each input channel). The conditions for the coincidence measurements can be set in the section "Chxy coincidence" on the device display (No. 7-10 in Figure 3)

There are two different types of coincidence measurements available: AND and XOR.

- AND: an event is counted only when a signal on channel x and channel y is registered. In all other combinations it is not.
- XOR: an event is counted only when a signal only on channel x or only on channel y is registered. In all other combinations it is not.

The default setting of the conditions of the coincidence measurements is CHX and CHX which corresponds to a coincidence measurement which is switched off.

Each time the device counts an event, which is respecting the selected coincidence condition, it provides an inverted LVTTTL/NIM signal on the "Out" socket of the corresponding channel, which is created internally within the FPGA.



The counter registers each incoming event up to the maximum input pulse frequency. But the pulse output frequency of the FPGA is limited to about 25 MHz. The exact pulse output frequency is given in the specification sheet.



## 6 Software Controlled Readout

The 4 Channel Counter can also be controlled and read out by PC. Therefore the device has an Ethernet connector and a simple stand alone monitor software is provided.

### 6.1 Network Connection

To connect the 4 Channel Counter to a PC simply connect it to your LAN network using the counters Ethernet connector. The counter is using the IPV4 Internet protocol which allows automatic identification of the device to the network and to the monitor software.



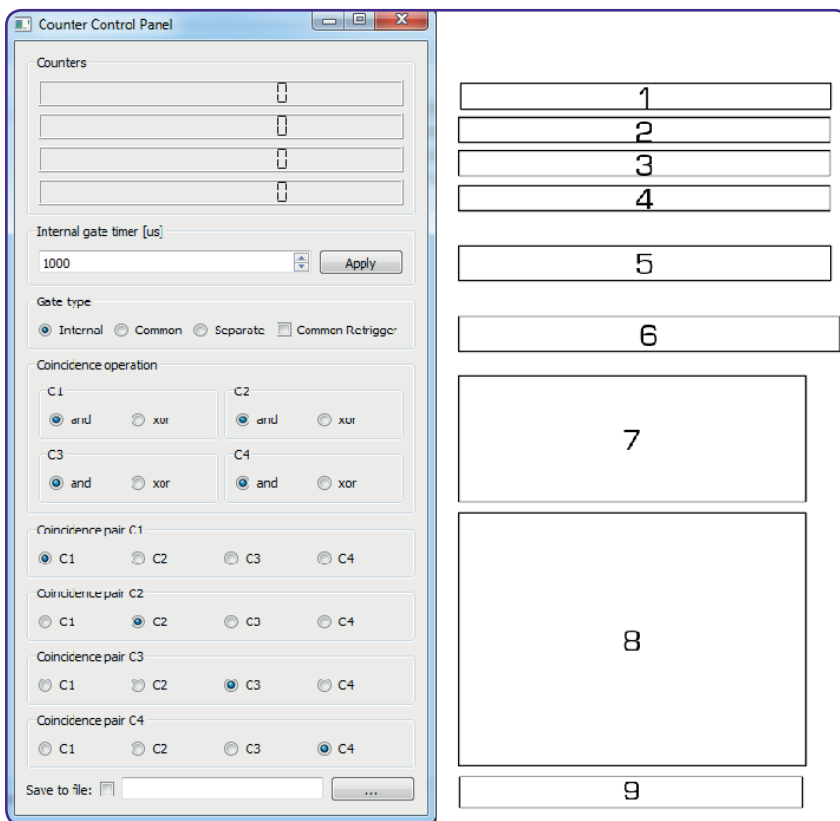
The device has to be connected to the network before it is powered up. The IP address will be determined by your DHCP server when booting up.

### 6.2 Monitor Software “Counter Control Panel”

There is a simple stand alone monitor software provided for control and readout of the 4 Channel Counter. The software can be found within the folder “software” on the CD which is part of the delivery. There is no installation procedure necessary. Simply copy the content of the software folder to a location of your choice on the hard drive of your PC and execute “counter.exe” to start the monitor software.

A dialog with a drop down menu will show the available counters which are connected to the network. Choose one and click “connect”. If no IP addresses are shown check the counters network connection and power the device off and on again.

The monitor software has the same possibilities for device adjustment as the device display itself. A screen shot of the monitor software is shown in [Figure 5](#).



1. Display field for measured counts of channel 1
2. Display field for measured counts of channel 2
3. Display field for measured counts of channel 3
4. Display field for measured counts of channel 4
5. Entry field to set the internal gate time in  $\mu\text{s}$ . Press apply after entering a gate time
6. Buttons to select different gate type options like the use of internal gate signal, external common and external separate gate signal. There is also a button to switch common retrigger on/off.

Figure 5: Description of the counter monitor software "Counter Control Panel".

7. Selection buttons for channel 1 to 4 to define the type of coincidence operation (AND or XOR)
8. Selection buttons for channel 1 to 4 to define the reference channel for the coincidence operation
9. Datasaving option: Choose a file to write to by pressing "...". and activate or deactivate datasaving by toggling the checkmark. The log files are ascii files with one measurement (gate) per line (timestamp, counter (0,1,2,3) and counts).

• File format of saved data files:

| Timestamp               | Counter Channel (0, 1, 2 or 3) corresponding to inputs 1, 2, 3 and 4 | Counts registered by Counter "q" |
|-------------------------|--|----------------------------------|
| yyyy.MM.dd.hh:mm:ss:zzz | ...q   | ...f                             |
| 2015.09.25.11:12:40:394 | 0  | 67269                            |

- The timestamp indicates the time the data was written to the file (according to the operating system clock), which is not necessarily the exact time the measurement was performed by the device. It is not intended to be used as a way to sync events; use an external trigger/gate in that case.
- The timestamp column always follows the format "year.month.day.hour:minute:second:millisecond".

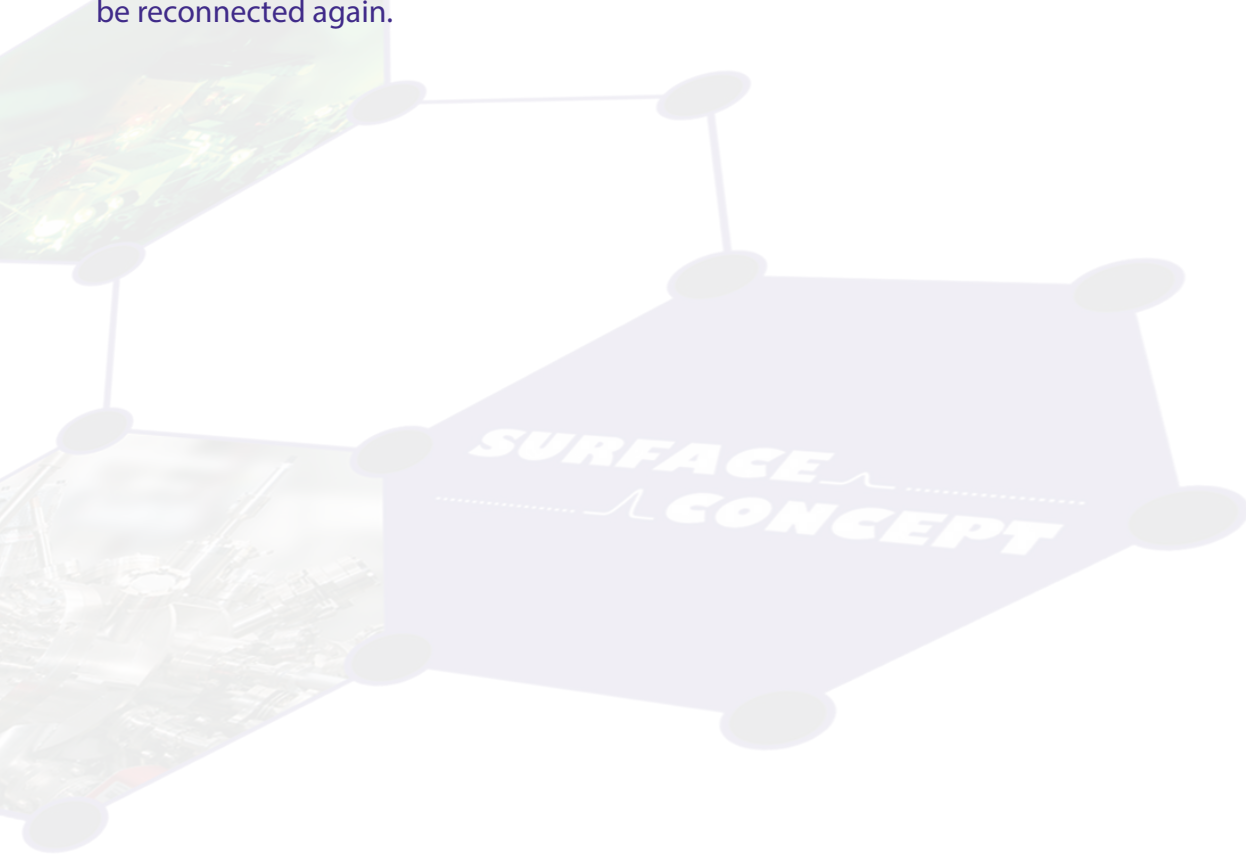
# 7 Trouble Shooting

## 7.1 Deadlock with Common Retrigger

Occasionally a deadlock of the common retrigger can occur. In this case the counter won't be reset and any new measurement started any more. This will be recognisable by a missing update of the last measurement results.

In case of a deadlock, please switch off the common retrigger functionality and disconnect the common retrigger signal. The counter should proceed performing measurements again.

Now the common retrigger functionality can be switched back on and the common retrigger signal can be reconnected again.



# 8 Technical Data

## Signal Input

|   | R 004                   | R 005                    |
|---|-------------------------|--------------------------|
| Input channels:                         | 4                       | 4                        |
| Level of input signal:                  | LVTTTL                  | NIM                      |
| Connector type of input signal:         | BNC (50 Ohm terminated) | LEMO (50 Ohm terminated) |
| Max. frequency (periodic input signal): | 200 MHz                 | 200 MHz                  |
| Double pulse resolution (typ.):         | 5ns                     | 5ns                      |
| Typ. frequency (random input)           | 20-50 MHz               | 20-50 MHz                |
|   | 2ns                     | 2ns                      |

## Signal Output

|  |                       |                        |
|--|-----------------------|------------------------|
| Output channels:                                     | 4                     | 4                      |
| Level of output signal:                              | Inverted LVTTTL       | NIM                    |
| Connector type of output signal:                     | BNC (MOhm terminated) | LEMO (MOhm terminated) |
| Width of output pulse (typ.):                        | 10ns                  | 10ns                   |
| Rise time of output pulse (typ.):                    | 1ns                   | 1ns                    |
| Inter. delay between input and output signal (typ.): | 80ns                  | 80ns                   |

## Gate Signal Input

|                                      |                               |                               |
|--------------------------------------|-------------------------------|-------------------------------|
| Gate input channels:                 | 4 (one for each signal input) | 4 (one for each signal input) |
| Level of input signal:               | LVTTTL                        | NIM                           |
| Connector type of gate input signal: | BNC (MOhm terminated)         | LEMO (MOhm terminated)        |
| Frequency of gate signal (max.):     | 10MHz                         | 10MHz                         |

## Common Retrigger Signal Input

|  |                       |                        |
|--|-----------------------|------------------------|
| Common retrigger input channels:                 | 1                     | 1                      |
| Level of input signal:                           | LVTTTL                | NIM                    |
| Connector type of common retrigger input signal: | BNC (MOhm terminated) | LEMO (MOhm terminated) |

## Common Retrigger Signal Input

|                   |                   |                 |
|-------------------|-------------------|-----------------|
| Electrical Input: | 100-240V, 50-60Hz | +6V             |
| Power:            | 15 Watt. (max.)   | 15 Watt. (max.) |

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Figure 1: Display settings a) during the initialization process and b) after the initialization process has ended. Note the different settings for the coincident measurement..... 7

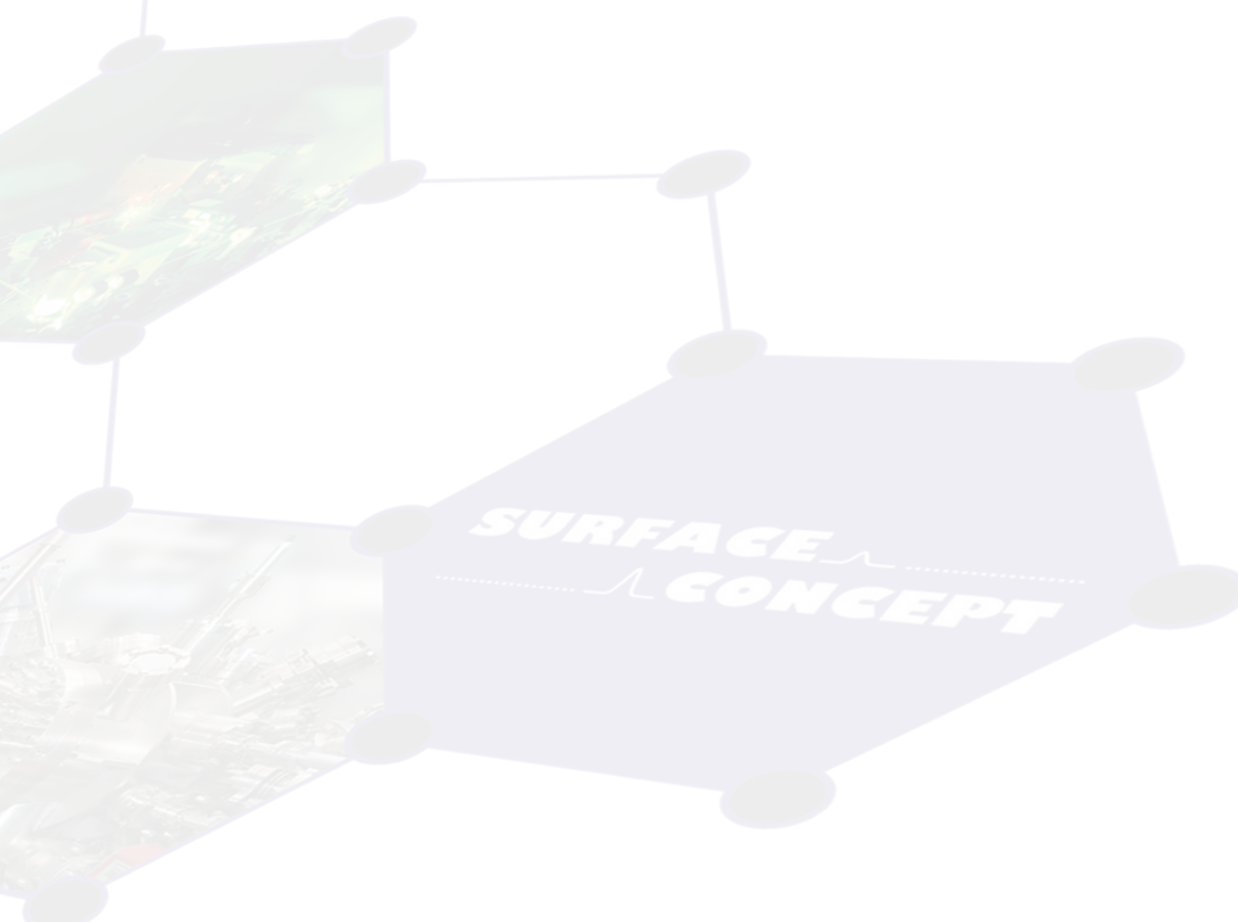
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# EC Declaration of Conformity

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## Product

Four Channel Counter

The above named products comply with the following European directive:

89/336/EEC

Electromagnetic Compatibility Directive, amended by 91/263/ EEC and 92/31/ EEC and 93/68/EEC

73/23/EEC

Low Voltage Equipment Directive, amended by 93/68/EEC

The compliance of the above named product to which this declaration relates is in conformity with the following standards or other normative documents where relevant:

EN 61000-6-2:2005+AC:2005

Electromagnetic compatibility (EMC):  
Generic standards - Immunity for industrial environments

EN 61000-6-4:2007+A1:2011

Electromagnetic compatibility (EMC):  
Generic standards - Emission standard for industrial environments

EN 61010-1: 2010

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

For and on behalf of Surface Concept GmbH

Mainz,.....01.08.2014.....  
(Date)

Legal Signature.....  
(Dr. Andreas Oelsner)

This declaration does not represent a commitment to features or capabilities of the instrument. The safety notes and regulations given in the product related documentation must be observed at all times.

