Countex specifications

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Product description

Countex is an FPGA-based scientific-grade counter of electronic pulses. It allows for high-speed pulse counting with temporal resolution down to few nanoseconds. It also features advanced functionality and connectivity. Countex is designed to be used with radiation or single-photon detectors, such as avalanche-photodiodes, superconducting nano-wires, photomultipliers, or Geiger-Mueller tubes.

Features

- 18 inputs with embedded comparators + window comparators
- 2 extra multi-channel analyzers with 8-levels
- *Optional 2-fold and 3-fold coincidence detection with coincidence window from 4 ns up.*
- Each comparator's threshold voltage is digitally tunable
- 4 inputs channels can be used for external gating
- Gate-end events are available, e.g. automatic readout
- Measurement of external gate interval
- Stable and tunable 10 MHz for both precision counting and synchronization of other devices
- Works also with external clock source
- Open protocol for virtual COM port communication over USB port
- Available python package (cross-platform support)
- 19'' rack package
- Plug-and-play operation – no installation of drivers needed
- Touch-screen interface and web interface

Application examples:

- characterization of single-photon sources
- single-photon detection
- laser excitation spectroscopy
- trapped ions fluorescence counting
- photon-number resolving detection
- linear quantum optics
- characterization of ionizing radiation detectors

Specifications

Input specification

There are 16 standard inputs, 2 extended voltage inputs, and 2 multi-channel analyzer (MCA) inputs. All inputs are 50-Ohm coupled to SMA connectors. Thresholds voltages can be tuned from -5V to 5V with 16-bit resolution, both from the touch-screen interface, web-interface or via USB from the computer.

Standard input

Accepts input voltage from -5V to +5V. Operates in standard or window-comparison modes. Standard mode: voltage pulse is counted only if the pulse height is greater than the threshold level U1. Window-comparation mode: the pulse is registered only when its height is within two threshold levels U_1 and U_2. Negative pulses are supported. Inputs 1, 9, HV1, and HV2 may be used as a gating signal.

Extended voltage input

The extended-voltage input is equipped with an attenuator which halves the voltage, increasing the accepted voltage range from -10V to +10V. Otherwise, the channel operates the same way as the standard input.

MCA input

The voltage is connected to 8 comparators. The threshold voltages U_1, …, U_8 form a monotonous series, e.g. $U_1<U_2<\ldots<U_8$. Then the height of the incoming pulse is assigned to one the formed voltage-bins and the counts in the bins are incremented. Negative pulses are also supported.

Coincidence unit

The optional version of Countex has *coincidence unit*. The unit counts the number of simultaneous pulses on different channels. Input 1, 2, 3 and 4 are connected to the coincidence unit. In this version, counted coincidences are routed to MCA channels 1 to 8, and MCA functionality on the corresponding input is not available. Coincidence windows if fixed and could be set as multiples of 4 ns. The actual coincidence window for each pair of channel is measured and issued in a testing list for each individual device. Following table shows the routing of coincidences.

Channel	Evaluated coincidence
MCA1_1	1 & 2
MCA1_2	1 &3
MCA1_3	1 & 4
MCA1_4	2 & 3
MCA1_5	2 & 4
MCA1_6	3 & 4
MCA1_7	(1 & 2) & 3
MCA1_8	1 & 2 & 3

Performance

Pulse-pair resolution

The performance of the device is characterized by pulse-pair resolution on a well-defined signal. Pulse-pair resolution is a time interval between two rising edges of two successive voltage pulses which can be recognized by the device as two pulses, not as a one. We define the time of rising edge as a time of voltage threshold crossing. The pulse-pair resolution is 4.26 ns for TTL pulses, e.g. maximal counting frequency is 230 MHz. The input pulse should be at least 1 ns rising-to-falling edge wide.

Counting depth

Counting depth is 32 bit for each counter, including windowing-counters and MCA counters.

Gate signal

The internal gate could be set from 1 us to 2^{32} us (1.2 hours). The duration of the external gating signal could be measured within the same range with the same resolution. Optionally, the counter can automatically read out counts on gate end and send them to a computer and optionally reset the counters.

Oscillator

The device is equipped with a stable 10 MHz clock oscillator. The stability is 5 ppb. This signal is coupled into 50-ohm SMA output, so it could be used to synchronize other devices. We provide a 50-Ohm coupled input for an external 10 MHz clock source.

Connectivity

USB virtual COM port

The device can be controlled from a computer via USB using a virtual COM port. Majority of platforms supports this type of communication. We provide an open protocol for communication with the device. Therefore Countex could be controlled from a wide range of programming languages on various platforms. Connection specifications are:

- Baudrate: 921600
- RTS/CTS: No
- Stop bit: 1
- Xon/Xoff: No
- Parity: None

Python package

We provide a python package for controlling the counter.

Web interface

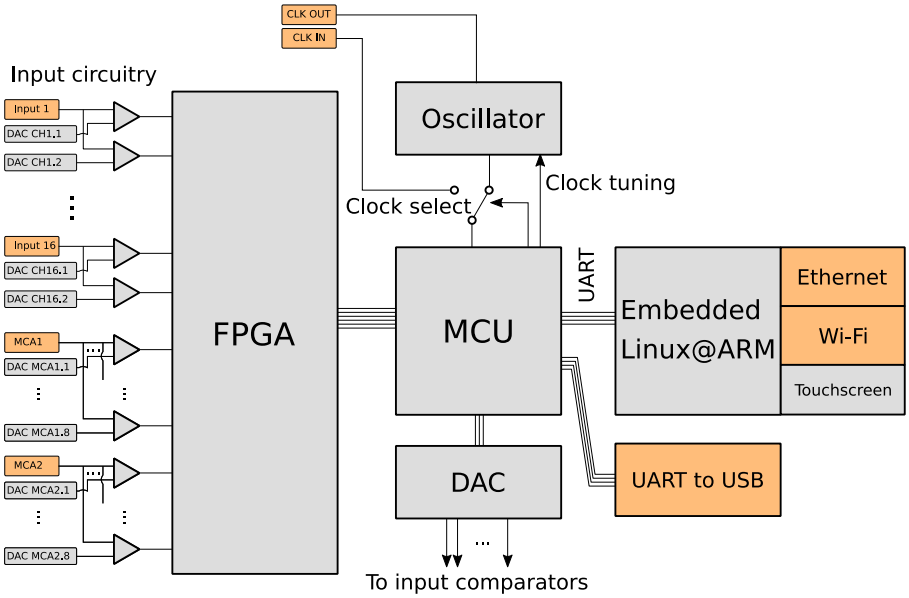
Countex could be connected into local area network using ethernet cable or Wi-Fi. Within the network, one can visit the control web application in the browser to remotely control Countex. No installations are required. The guest browser should support javascript and websocket technology.

Touchscreen interface

For easy operation, we provide a touch-screen interface. The device can be fully set up and used without any other computer. Settings might be saved into memory and recalled when needed. On

shutdown, the settings are saved and on boot are loaded again, therefore there is no need to set up device each time.

Block diagram



Application examples

- Fluorescence counting from trapped ions
- Laser excitation spectroscopy
- Confocal scanning microscopy
- Single-photon sources research
- Linear quantum optical experiments

For companies

Would you like to manufacture this product? We can offer you:

- VHDL source codes for FPGA
- C source codes for MCU
- CAD drawing of the chassis
- Design files for PCB manufacturing
- Design documentation
- Part list
- Manufacturing instructions
- Know how and participation on the product transfer