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Agilent U1050A

Acqiris Time-to-Digital Converter

TC840: 12 ch, 50 ps resolution
TC842: 12 ch, 5 ps resolution

Agilent Technologies





Main Features

- 12 channel, single stop, time-to-digital converter (TDC) with single start and multistart acquisition modes
- 5 ps or 50 ps timing resolution
- Ideal for measurements in large scale experiments including particle accelerator timing, nuclear fusion studies and sub-critical/explosive testing
- Wide range with up to 20 s between first and last events
- Internal memory buffer, with up to 512 events
- Low jitter (< 3 ps rms) high stability (±2 ppm) internal clock source
- External 10 MHz reference input
- FPGA based data processing
- Fast DMA readout for increased data throughput
- Overvoltage-protected inputs, with 50 Ω K-lock connectors
- Built-in self calibration
- Low power consumption (< 25 W)

Multichannel High-Resolution Time Measurement

The Agilent Acqiris U1050A time-to-digital converters (TDC) are designed specifically for use in large scale experiments including particle accelerator timing, nuclear fusion studies, and explosive testing. They are also well suited for use in commercial instrumentation including time-of-flight measurement in mass spectrometry and 3D geological mapping. While the TC840 is a good solution for timing measurements with accuracy requirements in the range of 100 ps, the TC842 is available for applications requiring higher precision.

The U1050A can be viewed as a free-running high-resolution (5 ps or 50 ps) counter with each individual channel capable of recording the time of arrival of trigger signals and storing this data in the local memory. The time base consists of a low phase noise PLL with very low jitter (< 3 ps rms) and a stable, high-accuracy 10 MHz reference. This time base can also be referenced to an external 10 MHz source through an auxiliary input.

The U1050A is a single- or multistart, single stop TDC. It has thirteen identical hardware channels, one common start channel and twelve independent stop channels. The timing information on the twelve independent channels is measured relative to the one common start channel.

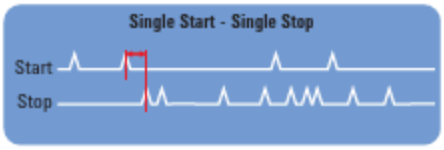


Figure 1. Single acquisition, common start, single stop



Figure 2. Multi acquisition, common start, single stop

On-Board Timing Calculation with Fast Data Readout

With the TC840, timing information for start and stop events on all channel inputs is obtained by combining a coarse-grain (5 ns), wide-range (32 bits), real-time count. This count has a finer grain interpolated result coming from the analysis of a ramp signal started by the event. The TC842, with its very high resolution of 5 ps, uses a sinewave signal that is generated, sampled, and precisely interpolated at the start of every hit on all the input channels.

Each channel consists of:
- A programmable comparator
- An XOR gate used to select the active slope
- A stable signal generator
- An analog-to-digital converter (ADC).

Once digitized, the data is fed to a Xilinx Virtex-2 Pro FPGA-based data processing unit for storage and readout. Data readout is achieved with fast direct memory access (DMA) at up to 100 MB/s.

Each channel is processed to determine the real time of each detected event, start and stop. The final relative time value is obtained by subtracting the start time from each stop time. The internal memory buffer on the card allows recording of 512 events for the TC840 and 128 events for the TC842. An auxiliary input for a common veto signal can be used to enable or disable all start and stop detection, as desired.

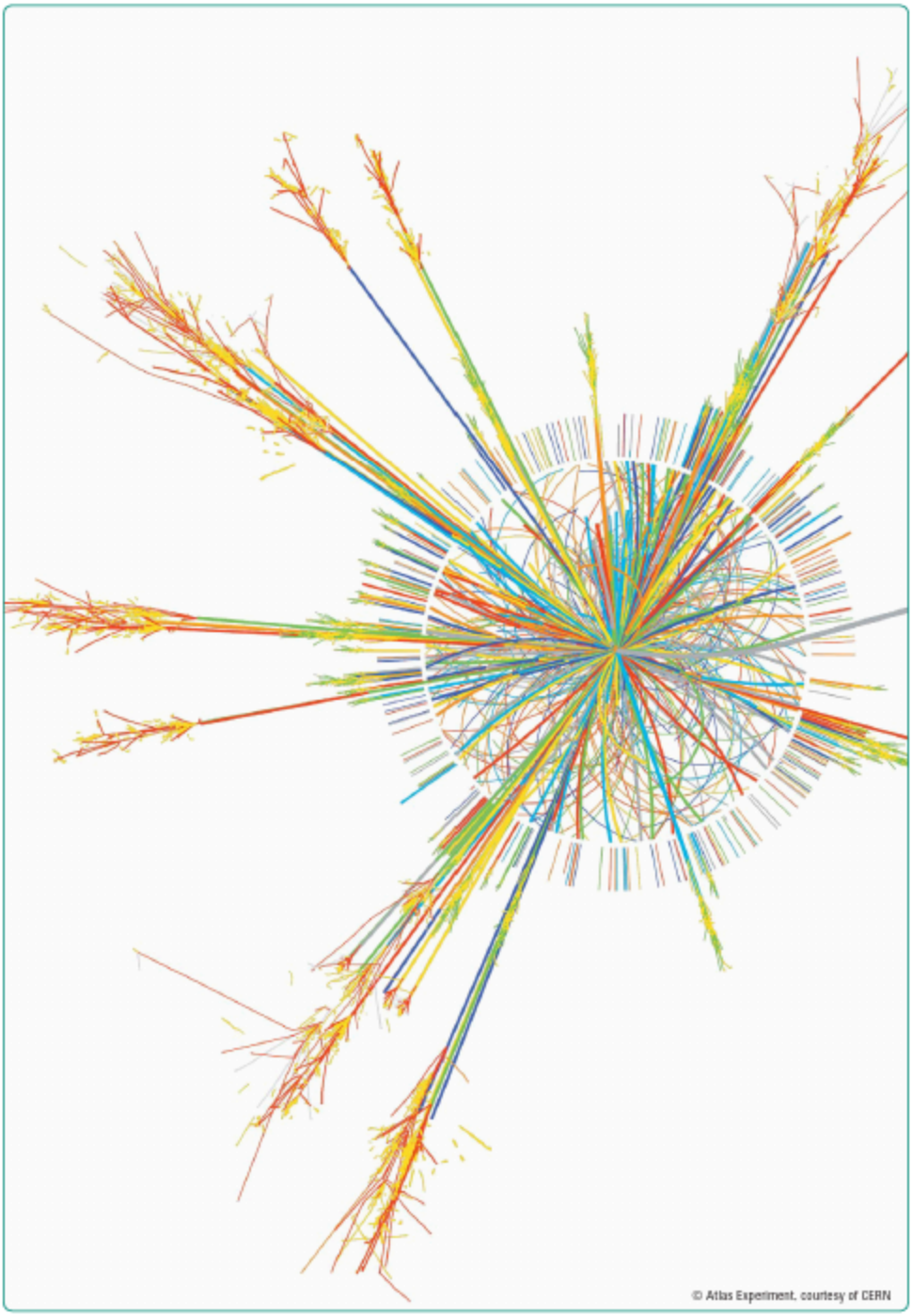
Self Calibration

To achieve the desired precision on all the input channels, the U1050A time-to-digital converter has a powerful self calibration routine. This self calibration is done simply through a software command available in the driver, so no extra programming is needed.

Easy Integration

Agilent Acqiris time-to-digital converters are supplied with software drivers for Windows® and Linux, and application code examples for MATLAB®, C/C++, Visual Basic, and LabVIEW. These code examples provide card set up and basic acquisition functionality, and are easily modified, so that the card can quickly be integrated into a measurement system. The flexibility of the driver means that, with minimum software adjustments, any Agilent Acqiris TDC can be swapped out, replaced, and upgraded over time, with the latest Agilent Acqiris time-to-digital converter.

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LabVIEW is a product of National Instruments



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Wide Range, Single and Multistart, Time-to-Digital Converter

Model TC840, 12 channel, 50 ps resolution
Model TC842, 12 channel, 5 ps resolution

Signal input

Connectors
50 Ω K-lock
Lemo 00.250
QLA 00
NIM/CAMAC Standard CD/N549

Impedance
50 Ω ±1%

Threshold
Programmable from -1.5 V to +1.5 V, in 0.732 mV steps (12-bit)

Sensitivity
100 mV over threshold for 350 ps (minimum pulse to trigger)
Hysteresis: 20 mV

Channels
One common start
Twelve inputs stop

Protection
Clamping diodes at ±2.5 V,
0.5 W max into 50 Ω

Propagation delay overdrive correction (typ.)
Δtpd = 40 ps for 100 mV to 2 V change

VSWR (typical)
< 1.5 from DC to 1 GHz

VETO IN
50 Ω input with programmable threshold

REF IN
50 Ω input for external high-precision 10 MHz source
0 to 3 V pkpk
Threshold at 1.5 V

Time resolution and range

Time resolution
TC840: 50 ps
TC842: 5 ps

Time range
Up to 20 s

Integral non-linearity
TC840: ±50 ps

Differential non-linearity
TC840: ±30 ps

Post-start dead time
10 ns

Clock accuracy
Better than ±2 ppm

Clock jitter
< 3 ps rms

Internal reference frequency
10 MHz

Acquisition and readout

Acquisition modes
Single start – single stop
Multistart – single stop

Readout modes
DMA – 100 MB/s

General

Host computer and operating system
PC compatible (x86) systems running Microsoft Windows Vista, Windows XP, Windows 2003 Server, Windows 2000 or National Instruments LabVIEW RT.
For more information on which specific processors and operating system versions are supported, please contact us.

Transfer speed
High-speed PCI bus transfers data at sustained rates to host computer:
Up to 100 Mbytes/s for 32-bit/33 MHz operation

Power consumption (typical)
< 25 W

Current requirements (typical)

12 V	0.1 A
5 V	4.1 A
3.3 V	0.8 A
-12 V	0.05 A

Warranty
1 year

Front-panel LEDs indicate module status

Environmental and physical

Operating temperature
0° to 40° C

Required airflow
> 2 m/s in situ

Relative humidity
5 to 95% (non-condensing)

Safety
Complies with EN61010-1

EMC immunity
Complies with EN61326-1
Industrial Environment

EMC emissions
Complies with EN61326-1 Class A for radiated emissions

Dimensions
6U CompactPCI standard (PXI compliant)
233 mm x 160 mm x 20 mm

Front panel complies with IEEE1101.10
CE Certification and Compliance

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