Agilent U1051A
Acqiris TC890 Time-to-Digital Converter
6 ch, 50 ps resolution
Main Features

- 6-channel multistop time-to-digital converter (TDC) with multistart acquisition mode
- 50 ps timing resolution
- Ideal for measurement in time-of-flight applications including mass spectrometry and LIDAR and for various pulse-timing measurements
- Large internal memory buffer, with up to 4 million events
- Low jitter (< 3 ps rms) stable (±2 ppm) internal clock source
- External 10 MHz reference input
- FPGA-based data processing unit
- Fast DMA readout mode for increased data throughput
- Data streaming mode allows continuous acquisition and readout
- Built-in self test and status monitoring
- Low power consumption (< 25 W)
Exceptional Performance for Precise Timing-Measurement Applications

The Agilent Acqiris U1051A (TC890) features six independent stopwatches for precise timing measurements from a common start event to multiple stop events at a high resolution.

The U1051A is ideal for time measurement applications including LIDAR for 3D mapping and navigation, fluorescence lifetime spectrometry and ion counting in time-of-flight mass spectrometry (TOFMS). Many pulse timing measurements, such as period, frequency and time interval analysis (TIA), also benefit from the new TDC’s precise measurement technology.

The U1051A CompactPCI module records multiple events or hits on each of its six input channels, with a timing resolution of 50 ps and a mean dead time between sequential pulses on the same input (double pulse resolution) of less than 15 ns. Running at full speed, the U1051A offers a massive 25 million events-per-second data-throughput rate. The U1051A enables event counting or histogram creation for easy data and spectra comparison.

Six of the seven identical input channels are independent stop inputs and the seventh is the common start. The module operates in a multistart, multistop acquisition mode with the timing information of stop events on all independent channels encoded relative to the most recent start event on the common channel.

In standard mode, the recording range is up to 10 ms. If one channel can be dedicated to a fiducial signal, the 10 ms recording time can be extended to a much wider range. The large internal buffer allows the recording of up to four million stop-events per module.

On-Board Timing Calculation with Fast Data Readout

The timing information of the start and hit events on all channel inputs is obtained by combining a coarse-grain (5 ns) wide-range (21 bit) real-time counter with a much finer-grained interpolated result coming from the analysis of a ramp signal started by the event.

Each channel consists of a programmable comparator, an XOR gate used to select the active slope, a stable signal generator, and an analog-to-digital converter (ADC). Once digitized, the data are fed to a Xilinx Virtex-2 Pro FPGA-based data processing unit for processing, storage, and readout. Data readout is achieved with a fast direct memory access (DMA) mode at up to 100 MB/s.

Each channel is processed to determine the time of each detected event, start and stop. The final relative time value is obtained by subtracting the start time from each stop time. An additional auxiliary input for a common veto signal can be used to enable/disable all start and stop detection, as desired.
**Self Calibration**

To achieve the desired precision on all of the input channels, the U1051A 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 application code examples for MATLAB®, C/C++ 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 Acqiris TDC can be swapped out, replaced, and upgraded over time, with the latest high-resolution Acqiris Time-to-Digital converter.

© Atlas Experiment, courtesy of CERN
High-Resolution Multistop Time-to-Digital Converter
Model TC890, 6 channel, 50 ps resolution

Signal input
Connectors
50 Ω K-lock
Lemo 00.250
QLA 00
NIM/CAMAC Standard CD/N549
50 Ω K-Lock (LEMO) type

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 15 mV

Channels
One common start
Six inputs stop

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

Propagation delay skew
\[ \Delta t_{pd} = 15 \text{ ps for } 10 \text{ mV to } 100 \text{ mV,} \]
\[ \Delta t_{pd} = 40 \text{ ps for } 100 \text{ mV to } 2 \text{ V} \]

VSWR (typ.)
< 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
50 ps

Time range
Up to 10.48 ms in standard operation.
Can be extended to a much wider range.

Double pulse resolution
< 15 ns

Integral nonlinearity
±50 ps

Differential nonlinearity
±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
 Multistart - Multistop

DMA
100 MB/s

General
Host computer and operating system:
PC compatible (x86) systems running
Microsoft Windows Vista, Windows XP,
or National Instruments LabVIEW RT.

For more information on which specific
processors and operating system ver-
sions 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 0.10 A
5 V 4.1 A
3.3 V 0.80 A
-12 V 0.05 A

Warranty
1 year

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 (TBC)

EMC emissions
Complies with EN61326-1 Class A for
radiated emissions (TBC)

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

Front panel complies with IEEE1101.10

Certification and Compliance
### Contacts

**Acqiris Product Information**

<table>
<thead>
<tr>
<th>Country</th>
<th>Phone Number</th>
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</thead>
<tbody>
<tr>
<td>USA</td>
<td>(800) 829-4444</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>61 3 9210 2890</td>
</tr>
<tr>
<td>Europe</td>
<td>41 (22) 884 32 90</td>
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<tr>
<td>Canada</td>
<td>(877) 894-4414</td>
</tr>
<tr>
<td>Latin America</td>
<td>(305) 269 7500</td>
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<td>United States</td>
<td>(800) 829-4444</td>
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<td>Australia</td>
<td>1 800 629 485</td>
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<td>China</td>
<td>800 810 0189</td>
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<tr>
<td>Hong Kong</td>
<td>800 938 693</td>
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<tr>
<td>India</td>
<td>1 800 112 929</td>
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<tr>
<td>Japan</td>
<td>0120 (421) 345</td>
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<tr>
<td>Korea</td>
<td>080 769 0800</td>
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<tr>
<td>Malaysia</td>
<td>1 800 888 848</td>
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<td>Singapore</td>
<td>1 800 375 8100</td>
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<td>Taiwan</td>
<td>0800 047 866</td>
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<td>Thailand</td>
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<td>Austria</td>
<td>0820 87 44 11</td>
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<td>Belgium</td>
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<td>Denmark</td>
<td>45 70 13 15 15</td>
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<td>Finland</td>
<td>358 (0) 10 855 2100</td>
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<td>France</td>
<td>0825 010 700*</td>
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<td>Germany</td>
<td>01805 24 6333</td>
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<td>Ireland</td>
<td>1890 924 204</td>
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<td>Israel</td>
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<tr>
<td>Italy</td>
<td>39 02 92 60 8484</td>
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<tr>
<td>Netherlands</td>
<td>31 (0) 20 547 2111</td>
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<tr>
<td>Spain</td>
<td>34 (91) 631 3300</td>
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<td>Sweden</td>
<td>0200-88 22 55</td>
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<td>Switzerland</td>
<td>0800 80 53 53</td>
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<td>United Kingdom</td>
<td>44 (0) 118 9276201</td>
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- Revised: March 27, 2008

### Ordering Information

**Model**

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<th>Model</th>
<th>Description</th>
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<td>U1051A</td>
<td>Six-channel high-resolution multistart, multistop cPCI time-to-digital converter, Acqiris TC890</td>
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<td>U1051A-UK6</td>
<td>Calibration certificate</td>
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**Accessories**

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<td>U1092A-CB7</td>
<td>BNC to Lemo, 1m cable</td>
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<tr>
<td>U1092A-CB8</td>
<td>BNC to Lemo, 2m cable</td>
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<td>U1092A-CB9</td>
<td>Lemo to BNC adapter</td>
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