



## Agilent U1064A

Acqiris High-Speed cPCI Digitizers

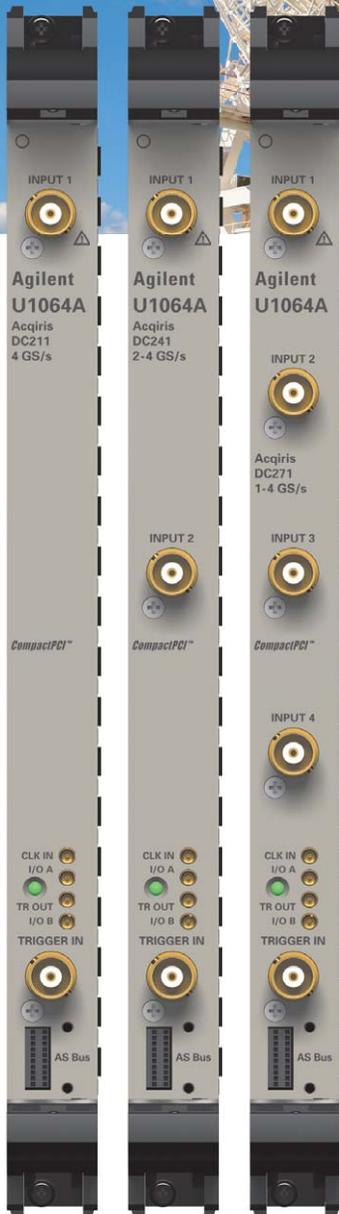
DC271: 8-bit, 4 ch, 1 GHz, 1-4 GS/s

DC241: 8-bit, 2 ch, 1 GHz, 2-4 GS/s

DC211: 8-bit, 1 ch, 1 GHz, 4 GS/s



Agilent Technologies



Ctrl I/O



AS bus



## Main Features

- Quad-, dual- and single-channel 8-bit digitizers with up to 4 GS/s sampling rate
- Choice of mezzanine front-ends with input protection and internal DC calibration
- 1 GHz bandwidth, 50  $\Omega$ , DC- or AC-coupled front-end
- 1 GHz/300 MHz bandwidth, 50  $\Omega$ / 1 M $\Omega$ , DC or AC-coupled front-end
- Large acquisition memory from 512 kSample up to 32 MSample (optional)
- Low dead-time sequential recording up to 8,000 segments with time stamps and high resolution trigger time interpolator for accurate timing measurements
- Multi-module synchronization with auto-synchronous bus system for distribution of trigger and clock signal
- High-speed PCI bus transfers data at sustained rates up to 100 Mbytes/s to host PC
- Device drivers for Windows®, VxWorks, LabVIEW RT, and Linux, with application code examples for MATLAB®, C/C++, Visual Basic, LabVIEW, and LabWindows/CVI

## Acqiris High-Speed Digitizers

The proprietary ADC chipsets in the Agilent Technologies Acqiris high-speed digitizers are designed for the specific purpose of optimizing high-speed ADC performance. The analog front-end technology provides the signal conditioning, amplification, and interleaving functions essential to achieving GS/s data acquisition rates. The digital data handling components provide vital clock and synchronization signals to capture and memorize acquired data with maximum data throughput. Together these ASICs make low power, high fidelity data acquisition much more accessible, and provide maximum data throughput to the host PC or processor to reduce the time and cost of measurement.

The Acqiris product line provides a range of 400 MS/s, 500 MS/s, 1 GS/s, 2 GS/s, 4 GS/s, and 8 GS/s high-speed digitizer cards with 8-, 10-, and 12-bit resolution, wide bandwidths, and large acquisition memories. These products, in PCI, PXI, cPCI, and VME formats, are used in research, ATE, and OEM applications in industries as wide spread as biotechnology, semiconductors, aerospace, physics, and astronomy.

| Current and previous part number | Memory option          |
|----------------------------------|------------------------|
| <b>U1064A-004</b> DC271          | 2-8 Mpts<br>8-32 Mpts  |
| <b>U1064A-002</b> DC241          | 4-8 Mpts<br>16-32 Mpts |
| <b>U1064A-001</b> DC211          | 8 Mpts<br>32 Mpts      |

| Front-end mezzanine selection | Input impedance           | Bandwidth                                       | Full scale range   |
|-------------------------------|---------------------------|---|--|
| <b>U1064A-F50</b>             | 50 $\Omega$               | 1 GHz   | 50 mV to 5 V   |
| <b>U1064A-FHZ</b>             | 50 $\Omega$ /1 M $\Omega$ | 1 GHz at 50 $\Omega$<br>300 MHz at 1 M $\Omega$ | 50 $\Omega$ and 1 M $\Omega$ :<br>50 mV to 5 V<br><br>1 M $\Omega$ only:<br>10 V to 50 V |

## High-Density Multi-Channel Waveform Recording

### More per module

Agilent Acqiris high-speed cPCI digitizers, with single, dual, and quad channels, set performance standards in single width 6U CompactPCI modules. The DC271 configuration has four channels that can synchronously sample signals at 1 GS/s rates.

The DC241 has two channels each with up to 2 GS/s sampling. Both modules use channel interleaving to achieve the same fast 4 GS/s single channel performance of the DC211. All the modules combine this ultra fast sampling rate with 1 GHz bandwidth and 512 kSample of storage memory (optional to 32 MSamples). Occupying just a single 6U slot, the digitizers set the standard in speed, density, and power consumption performance.

### Precision acquisition

The U1064A are ideal instruments for characterizing very fast signals. With over 1 GHz bandwidth and 4 GS/s sampling rate the digitizers allow precise measurements like jitter, rise time, fall time or overshoot with sub-nanosecond accuracy and resolution. Waveforms are stored directly into the digitizer's large acquisition memory so that complex signals can be stored as long as necessary. Large memory is essential for maintaining fast sampling rates and, therefore, timing resolution. For example, a model DC211 with 32 MSample of memory can record a signal over an 8 ms period with a sampling rate of 4 GS/s (250 ps per point). The fast sampling rate ensures that all high frequency signal components, up to the full 1 GHz bandwidth of the digitizer, are accurately recorded. Unlike most high-speed digitizers, the DC211, DC241, and DC271 all deliver high-speed performance without having to compromise on acquisition memory.

### Multiple channels in one crate

The high-density design of the digitizers allows them to be used in a variety of systems where the user needs from one to several hundred channels of high-speed data acquisition. For example, a single 8-slot 6 U cPCI crate can house up to 7 modules (plus a PC interface) to make a 28-channel bench-top, rack-mountable data acquisition system

(U1056A). The low power consumption of the digitizers results in a 28-channel system that uses less power than most comparable multi-channel systems. Furthermore, for high-density rack mounted applications, multiple crates can be linked together. This makes it possible to build systems containing hundreds of data acquisition channels controlled over a single bus!

### Auto-synchronous bus system

The U1064A also include a proprietary high bandwidth auto-synchronous bus system, the AS bus. In multi-channel applications, AS bus is a vital tool that takes care of the distribution of all necessary trigger and clock signals. The system improves trigger flexibility by allowing any module's input to be used as the trigger source for all the digitizers. For synchronous data acquisition, AS bus allows all the digitizers to be clocked at precisely the same time (to better than  $\pm 100$  ps). Synchronous digitizing improves the accuracy of cross-channel measurements and is essential for accurate time correlation. The AS bus can also be used to phase-synchronize all the digitizers to an external standard such as a 10 MHz reference.

### PC control and convenience

Acqiris software allows adjustment of the key acquisition settings such as time-base, trigger, and sensitivity while state-of-the-art front-end electronics allow high fidelity recording with full control over features such as input coupling, gain, and offset. Data recorded by the digitizers can be transferred directly to a host computer at rates up to 100 Mbytes/s. Combining the fast transfer rates with today's most powerful computer processors makes it possible to perform measurements and calculations significantly faster than with conventional instruments.

You can also store hundreds of waveforms directly on the computer's hard drive. Archiving important waveforms has never been easier. Furthermore, you can interface directly to your desktop PC and use the Internet or a local network to send important information to others anywhere and at anytime. The result is flexibility and performance that can dramatically reduce testing times, increase measurement throughput, and lower overall cost.

# Integrated Technology

## GHz mezzanine front-end

Using the latest SiGe BiCMOS technology, the U1064A digitizer family delivers outstanding high frequency performance. Each of the channel inputs for both 50  $\Omega$  and switchable 50  $\Omega$ /1 M $\Omega$  front-end options, provides a bandwidth of up to 1 GHz. Programmable front-end electronics are used to provide a complete set of input voltage ranges from 50 mV to 5 V full scale (-F50) in a 1, 2, 5 sequence with variable voltage offset. Amplifier response flatness, overshoot, and accuracy have been optimized to ensure that high frequency measurements can be made with the greatest precision and confidence. Furthermore, the inputs are fully protected against over-voltage signals. The front-end circuitry features internal calibration, switchable filtering, and very fast recovery from out-of-range signals. The entire front-end is mounted on a removable mezzanine card so, in the event of accidental damage or as components fatigue over time (e.g. relays in high duty cycle automated testing applications), replacement is fast and efficient.

## Front panel multi I/O ports



Ctrl I/O

The control over the trigger and time base is made even more flexible by the addition of high density, high-frequency front panel connectors. The four MMCX-type connectors enable the use of an external clock (up to 2 GHz) or reference signal (10 MHz), trigger output, and two additional I/O digital control lines. They can be used for monitoring or modifying the digitizer's status and configuration.

Example control include trigger gating, 10 MHz reference clock output, and acquisition states.

## Flexible trigger and low dead time



AS bus

The digitizers include a precision trigger system with pre- and post-trigger adjustment. User-selectable coupling is combined with internal or external trigger sources (positive or negative edges and windows) for maximum flexibility.

The digitizers also provide a sophisticated sequential trigger mode with less than 800 ns dead time between successive triggers. This extremely low dead time enables events, which may occur at very high repetition rates, to be captured and stored in the on-board memory. This trigger mode is perfect for "impulse response" type applications such as radar, sonar, LIDAR, time-of-flight, ultrasonic, and medical and biomedical research. The sequential trigger mode and very low dead time greatly extend the digitizers' timing range and resolution. Each event can be individually time stamped and relative time measurements between events can be made with less than 1 ns resolution.

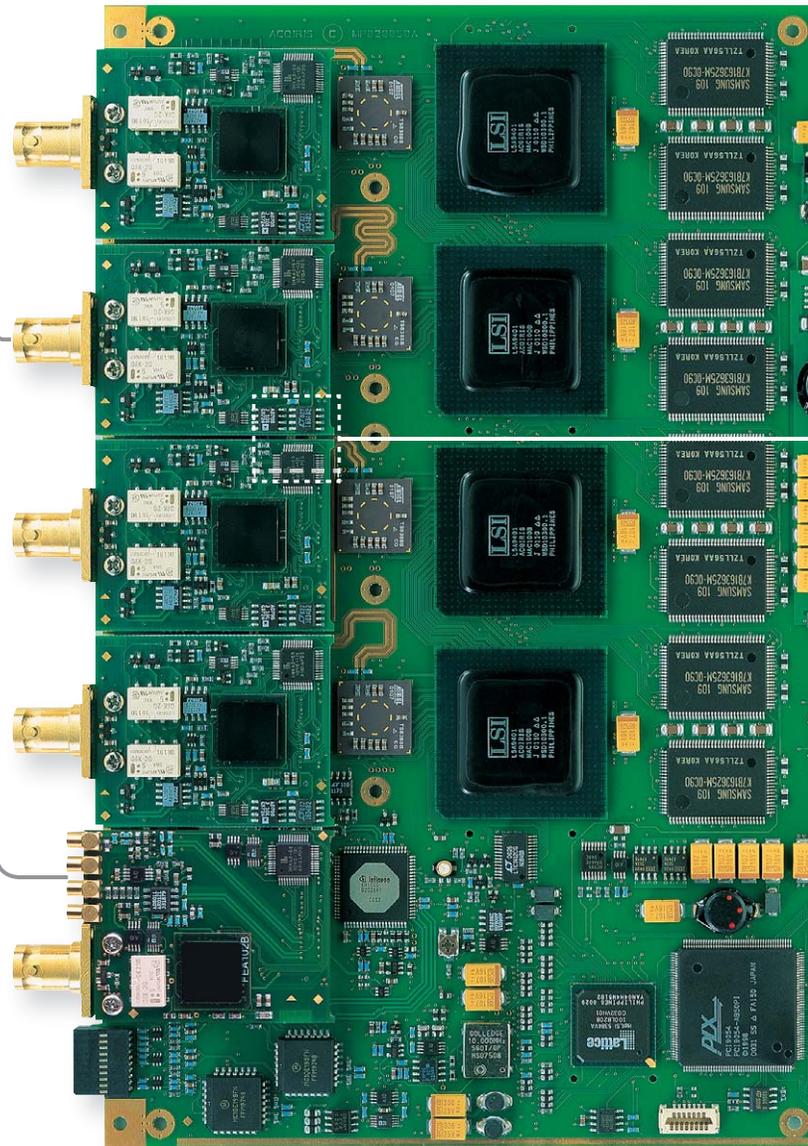


Figure 1: Agilent High-speed U1064A-004 quad channel digitizer.

## High reliability

### Low parts count and sophisticated cooling

A very high degree of integration is needed in order to achieve the level of performance obtained with the U1064A family of digitizers. By drastically reducing the number of components, the integration has clear benefits for reliability and lower total power consumption. To maintain quality measurements the digitizers also use a proprietary cooling scheme. This cooling method allows components to run at safe and stable operating temperatures. It helps to extend component life as well as minimize measurement errors caused by temperature variation.



## Precision time base

Each digitizer also has its own crystal-controlled precision time base and sample rates can be selected, in a 1, 2, 2.5, 4, 5 sequence, from 100 S/s to 1 GS/s plus 2 GS/s and 4 GS/s. An internal trigger time interpolator (TTI) with high timing resolution is used to assist with timing calibration and trigger positioning. The TTI permits accurate positioning of the trigger signal with respect to the internal clock (sampling time). The sample rate can also be generated externally, using the dedicated MMCX CLK IN connector, for applications where the sample rate must be synchronized with the signal to be acquired.

## Easy software integration

Agilent Technologies' high-speed Acqiris digitizers are supplied with software drivers for Windows®, Linux, LabVIEW RT and VxWorks, and application code examples for MATLAB®, C/C++, Visual Basic, LabVIEW, and LabWindows/CVI.

These code examples provide digitizer set up and basic acquisition functionality, and are easily modified, so that a card can quickly be integrated into a measurement system.

The flexibility of the driver means that, with minimum software adjustments, any Acqiris digitizer can be swapped out, replaced, and upgraded over time, with the latest high-speed Acqiris digitizer

Windows is a U.S. registered trademark of Microsoft Corporation.  
MATLAB is a U.S. registered trademark of The Math Works, Inc

## High-Fidelity Measurements

### Quality acquisitions

Agilent Acqiris digitizers are designed to provide superior measurement precision and accuracy. Key acquisition specifications such as SNR, DC accuracy, integral, and differential linearity are optimized to deliver maximum

measurement fidelity. Careful circuit layout, custom ICs, and special packaging techniques are all used to reduce overall system noise.

### FFT analysis

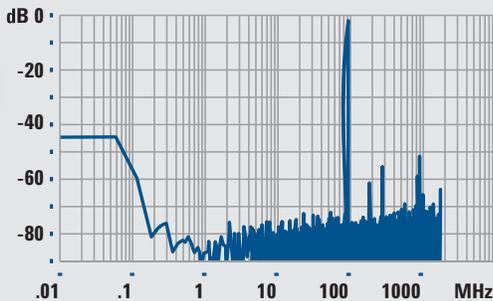


Figure 2: FFT analysis of a pure 100 MHz sinewave at 4 GS/s shows very low noise floor, high SFDR and little harmonic distortion.

### Step response

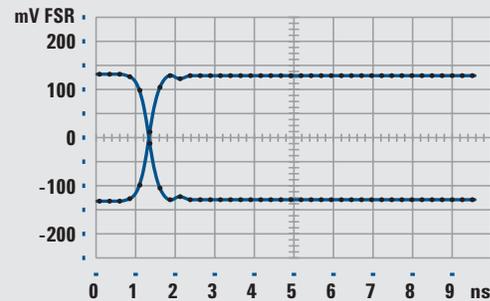


Figure 3: Positive and negative step responses with 700 MHz BWL show no overshoot and undershoot at 4 GS/s in single shot.

### Frequency response

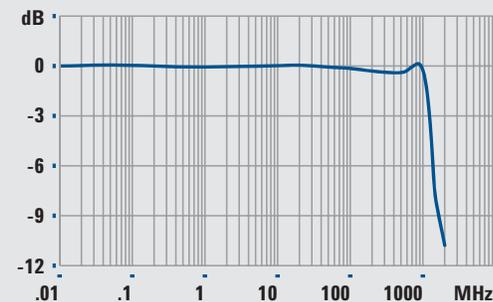


Figure 4: Frequency response is very flat and system bandwidth reaches well beyond the specified 1 GHz.

### Effective bits

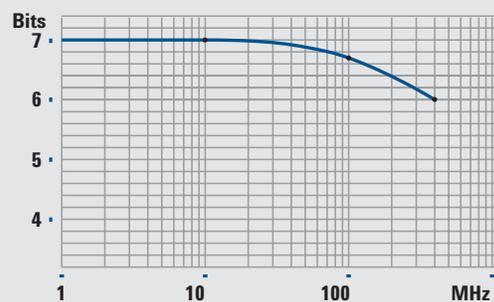


Figure 5: Effective bits at 4 GS/s are high.

# Acqiris High-Speed cPCI Digitizers

## Model DC271

Quad-channel, 8-bit, 1 to 4 GS/s, 128 to 512 kSample, 2 to 8 MSample or 8 to 32 MSample

## Model DC241

Dual-channel, 8-bit, 2 to 4 GS/s, 256 to 512 kSample, 4 to 8 MSample or 16 to 32 MSample

## Model DC211

Single-channel, 8-bit, 4 GS/s, 512 kSample, 8 MSample or 32 MSample

### Signal input

#### Channels

U1064A-001,-002,-004: Single at 4 GS/s  
U1064A-002, -004: Dual at 2 GS/s  
U1064A-004: Quad at 1 GS/s

#### Bandwidth (-3 dB)

-F50 front-end option:  
DC to 1 GHz  
-FHZ front-end option:  
50  $\Omega$ : DC to 950 MHz  
1 M $\Omega$ : DC to >300 MHz (typ.)

#### Bandwidth limit filters

-F50 front-end option:  
700 MHz, 200 MHz, 20 MHz  
-FHZ front-end option:  
50  $\Omega$ : 700 MHz, 200 MHz, 20 MHz  
1 M $\Omega$ : 20 MHz

#### Full scale (FS)

-F50 front-end option:  
50 mV to 5 V  
-FHZ front-end option:  
50  $\Omega$ : 50 mV to 5 V  
1 M $\Omega$ : 50 mV to 50 V

#### Offset range

-F50 front-end option:  
 $\pm 2$  V for 50 to 500 mV FS  
 $\pm 5$  V for 1 to 5 V FS  
-FHZ front-end option:  
50  $\Omega$ :  $\pm 2$  V for 50 to 500 mV FS  
50  $\Omega$ :  $\pm 5$  V for 1 to 5 V FS  
1 M $\Omega$ :  $\pm 2$  V for 50 to 500 mV FS  
1 M $\Omega$ :  $\pm 20$  V for 1 to 5 V FS  
1 M $\Omega$ :  $\pm 200$  V for 10 to 50 V FS

#### Maximum input voltage

-F50 front-end option:  
 $\pm 5$  V DC  
-FHZ front-end option:  
50  $\Omega$ :  $\pm 5$  V DC  
1 M $\Omega$ :  $\pm 300$  V DC

#### Coupling

-F50 front-end option:  
DC, AC (32 Hz LF limit, 50  $\Omega$ ), GND  
-FHZ front-end option:  
DC, AC (16 Hz LF limit, 50  $\Omega$ ), GND

#### Impedance

-F50 front-end option:  
50  $\Omega$   $\pm 1\%$  at DC  
-FHZ front-end option:  
1 M $\Omega$   $\pm 1\%$  at DC // 14  $\pm 2.5$  pF

#### VSWR

-F50 front-end option:  
< 1.25 DC to 1 GHz with 50  $\Omega$   
-FHZ front-end option:  
< 1.5 DC to 1 GHz with 50  $\Omega$

#### Connectors

BNC or SMA, gold plated

### Digital conversion

#### Sample rate

100 S/s to 1 GS/s  
in 1, 2, 2.5, 4, 5 sequence  
and 2 GS/s, 4 GS/s

#### Resolution

8 bits (1:256)

#### Differential nonlinearity (typ.)

$\pm 0.9$  LSB

#### Acquisition memory

-004: 128 kSamples/channel  
-002: 256 kSamples/channel  
-001: 512 kSamples

#### Maximum optional memory (M32M)

-004: 8 MSamples/channel  
-002: 16 MSamples/channel  
-001: 32 MSamples/channel

### Time base

#### Clock accuracy

Better than  $\pm 2$  ppm

#### Sampling jitter

< 1ps rms (typ.) for 10  $\mu$ s with internal clock and reference

#### Acquisition modes

Single shot  
Sequence: 1 to 200 segments with standard memory  
4'000 segments with M8M memory option  
8,000 segments with M32M memory option  
Dead time: < 800 ns at 1 GS/s

#### Trigger time interpolator

5 ps resolution

#### AS bus

Synchronized clock and trigger distribution for up to 7 adjacent modules of the same type in a crate

#### AS bus sampling skew

$\pm 100$  ps

## Internal and external trigger

### Internal trigger input

Threshold adjust range: same as vertical FSR

Sensitivity:

Frequency range:

DC to 500 MHz for positive, negative or window trigger

DC to 1 GHz for HF trigger

Amplitude range: >15% FS

### External trigger input

Threshold adjust range:

(-FS/2, FS/2) for FS = 0.5, 1, 2 and 5V

Impedance: 50  $\Omega$

Maximum input voltage:  $\pm 5$  V DC

Sensitivity:

Frequency range: DC to 1 GHz

Amplitude range: >15% FS

### Coupling

DC, AC (50 Hz LFRreject), HF Reject (50kHz)

### Modes

Positive, Negative, Window,

HF: divide by 4

### Pre-trigger

Adjustable to 100% of horizontal full scale

### Post-trigger

Adjustable up to 200 MSamples

## Control I/O (MMCX)

### Ctrl I/O A and B signals

TTL and CMOS compatible (3.3 V)

### Ctrl I/O A and B output

10 MHz reference clock out

Acquisition skipping to next segment

Acquisition active

Trigger ready

### Ctrl I/O A and B input

Trigger enable

### TRG OUT

Offset:  $\pm 2.5$  V (no load)

Amplitude:  $\pm 0.8$  V (no load),  $\pm 15$  mA max

Rise/fall time: 2.5 ns into 50  $\Omega$

Coupling: DC

Output impedance: 50  $\Omega$

### CLK IN ext. clock/ref

Amplitude: > 500 mV pk-pk into 50  $\Omega$

Threshold: variable between -2 V and +2 V

Maximum input voltage:  $\pm 2$  DC

### CLK IN ext. clock input

20 MHz to 2 GHz to allow up to 4 GS/s

### CLK IN ext. reference frequency

10 MHz (9 - 10.2 MHz)

## System performance

### DC accuracy

<  $\pm 2\%$   $\geq 100$  mV FS at 0 V offset

<  $\pm 2.5\%$  at 50 mV FS at 0 V offset

### Offset accuracy

<  $\pm 0.4\%$  offset range

### Effective bits

> 6.25 at 10.7 MHz with 1 M $\Omega$

> 6.5 at 10.7 MHz with 50  $\Omega$

> 6.0 at 99.5 MHz with 50  $\Omega$

> 5.0 at 410 MHz with 50  $\Omega$

### Integral linearity

<  $\pm 1\%$  FS

### SFDR (typ.)

> 55 dB at 10 MHz

> 40 dB at 400 MHz (only with 50  $\Omega$ )

### SNR (Full BW, 1 GS/s)

-FHZ front-end option:

> 32 dB at 50 mV FS

> 35 dB at 100 mV, 1 V

> 36 dB at 200 mV, 500 mV, 2 V, 5 V

-F50 front-end option:

> 37 dB at 50 mV FS

> 38 dB at 100 mV, 500 mV, 1 V, 5 V

> 39 dB at 200 mV, 2 V

## General

### Host computer and operating system

PC compatible (x86) systems

running Microsoft Windows Vista,

Windows XP, Windows 2003 Server,

Windows 2000, Wind River VxWorks,

National Instruments LabVIEW RT, or

Linux.

PowerPC systems running

Wind River VxWorks.

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

< 44 W with standard memory option

< 53 W with M32M memory option and AS bus

### Current requirements (max.)

+12 V 1.7 A (1.9 A with AS bus)

+5 V 2.9 A

+3.3 V 8.3 A (5.4 with M32M memory option)

-12V 0.05 A

### Battery backup (optional)

- 12 days retention without external power with standard memory

- 2 days retention without external power with M8M memory option

- 1 day retention without external power with M32M memory option

### Warranty

1 year

Front Panel LED indicates digitizer status

Green: ready for trigger

Yellow: module identification

Red: trigger

## Environmental and physical

### Operating temperature

0° to 40°C

### Relative humidity

5 to 95% (non-condensing)

### Dimensions

6U CompactPCI standard

233 mm x 160 mm x 20 mm

### Safety

Complies with EN61010-1

### EMC immunity

Complies with EN61326-1

Industrial Environment

### EMC emissions

Complies with EN61326-1

Class A for radiated emissions

### Required airflow

> 2 m/s in situ

Front panel complies with IEEE1101.10

CE Certification and Compliance



## Contacts

### Acqiris Product Information

|                     |                          |
|---------------------|--------------------------|
| <b>USA</b>          | <b>(800) 829-4444</b>    |
| <b>Asia-Pacific</b> | <b>61 3 9210 2890</b>    |
| <b>Europe</b>       | <b>41 (22) 884 32 90</b> |

### Agilent Americas

|               |                |
|---------------|----------------|
| Canada        | (877) 894-4414 |
| Latin America | 305 269 7500   |
| United States | (800) 829-4444 |

### Agilent Asia Pacific

|           |                |
|-----------|----------------|
| Australia | 1 800 629 485  |
| China     | 800 810 0189   |
| Hong Kong | 800 938 693    |
| India     | 1 800 112 929  |
| Japan     | 0120 (421) 345 |
| Korea     | 080 769 0800   |
| Malaysia  | 1 800 888 848  |
| Singapore | 1 800 375 8100 |
| Taiwan    | 0800 047 866   |
| Thailand  | 1 800 226 008  |

### Agilent Europe and Middle East

|                           |                     |
|---------------------------|---------------------|
| Austria                   | 0820 87 44 11       |
| Belgium                   | 32 (0) 2 404 93 40  |
| Denmark                   | 45 70 13 15 15      |
| Finland                   | 358 (0) 10 855 2100 |
| France                    | 0825 010 700*       |
|                           | *0.125 €/minute     |
| Germany                   | 01805 24 6333       |
| Ireland                   | 1890 924 204        |
| Israel                    | 972-3-9288-504/544  |
| Italy                     | 39 02 92 60 8484    |
| Netherlands               | 31 (0) 20 547 2111  |
| Spain                     | 34 (91) 631 3300    |
| Sweden                    | 0200-88 22 55       |
| Switzerland               | 0800 80 53 53       |
| United Kingdom            | 44 (0) 118 9276201  |
| Other European Countries: | 41 (22) 884 32 90   |

Revised: March 27, 2008

## Ordering Information

| Model       | Description  |
|-------------|--|
| U1064A      | Acqiris DC271, DC241 and DC211 8-bit high-speed cPCI digitizer     |
| U1064A-001  | Single-channel 1 GHz, 4 GS/s, 512 kSample cPCI digitizer, DC211    |
| U1064A-002  | Dual-channel 1 GHz, 2 - 4 GS/s, 256 kSample cPCI digitizer, DC241  |
| U1064A-004  | Quad-channel 1 GHz, 1 - 4 GS/s, 128 kSample cPCI digitizer, DC271  |
| U1064A-F50  | Standard front-end, 50 $\Omega$ , 1 GHz                            |
| U1064A-FHZ  | High-impedance front-end, 50 $\Omega$ /1 M $\Omega$ , 1 GHz/300MHz |
| U1064A-M8M  | 2 to 8 MSample acquisition memory option                           |
| U1064A-M32M | 8 to 32 MSample acquisition memory option                          |
| U1064A-UK6  | Calibration certificate  |
| U1064A-BB1  | Battery back-up  |
| U1064A-BNC  | BNC connectors   |
| U1064A-SMA  | SMA connectors   |

## Accessories

|            |                                      |
|------------|--------------------------------------|
| U1092A-CB1 | MMCX to BNC cable (1 m)              |
| U1093A-AS1 | AS bus connector, simple bridge      |
| U1093A-AS2 | AS bus connector, left termination   |
| U1093A-AS3 | AS bus connector, right termination  |
| U1093A-AS4 | AS bus connector, double termination |
| U1093A-AS7 | AS bus retainer                      |

[www.agilent.com](http://www.agilent.com)

For more information on Acqiris product line, sales or services, see our website at:

[www.agilent.com/find/acqiris](http://www.agilent.com/find/acqiris)

Product specifications and descriptions in this document subject to change without notice.

© Agilent Technologies, Inc. 2008  
 Printed in USA, October 31, 2008  
 5989-7444EN



**Agilent Technologies**