



Agilent U1065A

Acqiris High-Speed cPCI Digitizers

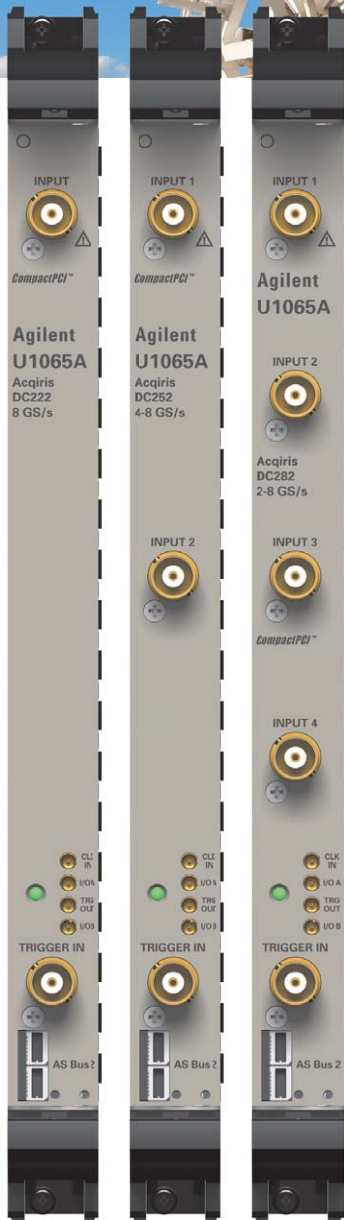
DC282: 10-bit, 4 ch, up to 2 GHz, 2-8 GS/s

DC252: 10-bit, 2 ch, up to 3 GHz, 4-8 GS/s

DC222: 10-bit, 1 ch, up to 3 GHz, 8 GS/s



Agilent Technologies



Ctrl I/O



AS bus 2



Main Features

- Quad-, dual- and single-channel 10-bit digitizers with up to 8 GS/s sampling rate
- Choice of mezzanine front-ends with input protection
- 2 GHz bandwidth, 50 Ω , DC or AC-coupled front-end with internal DC calibration
- 3 GHz bandwidth, 50 Ω , DC-coupled front-end with internal DC calibration
- 1 GHz bandwidth, 50 Ω / 1 M Ω , DC or AC-coupled front-end with internal DC calibration
- Large acquisition memory from 256 kSample to 1 GSample (optional)
- Multi-module synchronization with auto-synchronous bus system for distribution of trigger and clock signal
- High-speed 64-bit/66 MHz PCI bus transfers data at sustained rates up to 400 MB/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 high-speed data acquisition rates at GS/s. 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 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 bandwidth and large acquisition memory. 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.

High Resolution High Sample Rate Signal Acquisition

Agilent Acqiris DC282, DC252, and DC222 high-speed cPCI digitizers (U1065A) can each achieve a dazzling single channel sampling rate of 8 GS/s, and offer a choice of front-end input mezzanines including up to 3 GHz input bandwidth or switchable high impedance input coupling. This front-end flexibility, coupled with astounding data conversion performance, makes these digitizers ideal for implementation in applications such as high-resolution radar and lidar, as well as semiconductor test and large scale physics research experiments.

The interleaving of multiple analog-to-digital converters (ADCs) is essential for high-speed data conversion systems. The process increases the effective sample rate available in high-speed digitizer systems by acquiring the same signal on two or more high-speed ADCs, in parallel and out of phase. The Agilent Acqiris proprietary cross point switch (CPS) that allows to interleave up to four data acquisition channels can be described as a matrix of analog multiplexers. It includes a calibration input, essential for the accurate timing calibration of interleaved ADCs, and allows offset matching with four dedicated 8-bit DACs.

In a quad-channel DC282 configuration it's possible to achieve synchronous real-time sampling on all four channels at up to 2 GS/s, or interleaved dual- or single-channel sampling at up to 4 and 8 GS/s respectively. The dual- and single-channel configurations (DC252 and DC222 respectively) offer the same dual- and single-channel sampling performance.

These digitizers are fully compliant with both the PXI and CompactPCI standards, and combine ultra fast sampling rates with standard acquisition memories of 1 MSample (shared between input channels), and optional acquisition memories to 1 GSample.

Multiple Front-End Options

As with other Acqiris products, the entire analog front-end is mounted on a removable mezzanine card so in the event of accidental damage, or as relays fatigue over time, replacement is fast and efficient. The U1065A offers a choice of standard, high frequency and high-impedance front-end mezzanines, each with a choice of BNC or SMA connectors. Both, the 50- Ω and high-impedance front-ends of the digitizing channel are fully protected against over-voltage signals.

Programmable front-end electronics are used to provide a complete set of input voltage ranges, from 50 mV to 5 V (in a 1, 2, 5 sequence) with variable voltage offset. With a bandwidth of 2 GHz, amplifier response flatness, overshoot, and accuracy are optimized to ensure that high-frequency measurements can be made with the greatest precision and confidence. The front-end circuitry features switchable filtering, very fast recovery from out-of-range signals and internal calibration. Many applications can save time by only performing calibration for the configurations that will actually be used. Calibration can usually be performed with signals present at the channel, external, and clock inputs. However, if the calibration is found to be unreliable, as shown by a calibration failure status, it may be necessary to remove such signals.

The high-frequency input front-end provides direct access to the cross point switch (CPS) interleaving component. In order to benefit from the full bandwidth of the CPS and the 10-bit ADC, minimal signal conditioning is needed, and the full scale range is fixed at 1 V. The input channel has an over voltage protection to ± 2 V.

High voltage measurements are possible with the high-impedance front-end option. Programmable front-end electronics are used to provide a complete set of full scale input voltage ranges, from 50 mV to 5 V into 50 Ω , and up to 50 V into 1 M Ω impedance. With a bandwidth of 1 GHz (typical) into 50 Ω , and 300 MHz into 1 M Ω , the amplifier response is optimized. In addition, the front-end circuitry allows the same internal calibration as the standard 50 Ω front-end mezzanine, with switchable filtering and very fast recovery from out-of-range signals.

	Front-end mezzanine selection	Input impedance	Bandwidth	Full scale range	Memory option
U1065A-004 DC282	-F50	50 Ω	2 GHz	50 mV to 5 V	32-128 Mpts, 256-1014 Mpts
	-FHZ	50 Ω /1M Ω	1 GHz/300 MHz	50 Ω and 1 M Ω : 50 mV to 5 V 1 M Ω only: 10 V to 50 V	
U1065A-002 DC252	-F50	50 Ω	2 GHz	50 mV to 5 V	64-128 Mpts, 512-1024 Mpts
	-FHF	50 Ω	3 GHz	1 V	64-128 Mpts, 512-1024 Mpts
U1065A-001 DC222	-F50	50 Ω	2 GHz	50 mV to 5 V	128 Mpts, 1024 Mpts
	-FHF	50 Ω	3 GHz	1 V	128 Mpts, 1024 Mpts

Extended Functionality

Analog front-end with multi-GHz bandwidth

Both the standard and high-impedance front-end mezzanines include a proprietary front-end amplifier chip. This circuit includes a programmable gain amplifier (PGA) with on-chip filtering and trigger circuitry. It provides the pre-ADC signal conditioning and amplification, essential for high-performance high-speed data conversion systems.

The PGA provides five global gain settings: 1.0, 2.0, 5.0, and 10.0. The filter section, which is useful for signal noise reduction, allows 2-pole Bessel bandwidth limiting at 700 MHz and 200 MHz and a single-pole filter at 20 MHz.

Trigger mezzanine with I/O ports



Ctrl I/O

The trigger processing circuit embedded in the package includes

- Dual comparators for a window triggering mode
- On-chip DACs for threshold adjustment
- Additional filters for low frequency and high frequency reject trigger coupling
- A prescaler to allow a HF divide by 4 mode
- A pattern trigger to trigger on AND, NAND, OR, NOR combination of the trigger sources.

The trigger mezzanine external input uses standard 50 Ω terminated BNC or SMA connectors. The four front-panel Ctrl I/O MMCX connectors provide access for an external clock or 10 MHz reference signal, a trigger output, and two additional I/O digital control lines (I/O A & B) for monitoring or modifying the digitizer's status and configuration or to extract a 10 MHz clock signal.

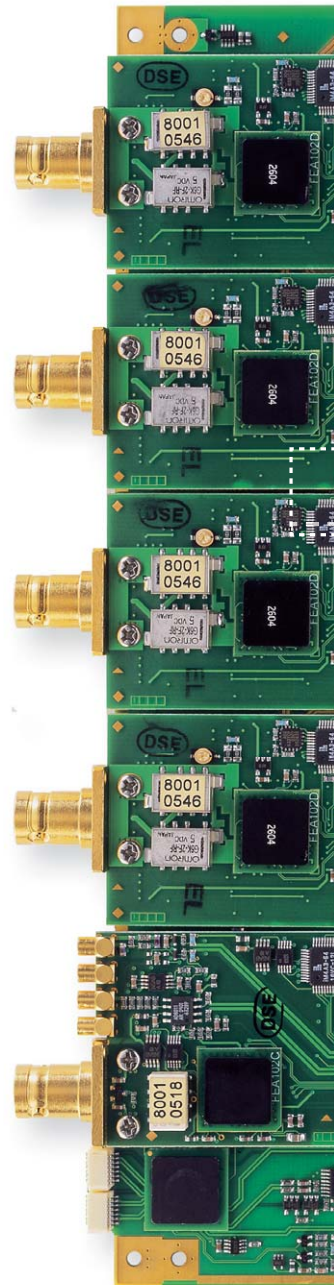
Multi-module synchronization



AS bus 2

If more than four synchronous data acquisition channels are required, multiple digitizers can be combined using the second generation Acqiris auto-synchronous bus system (AS bus 2).

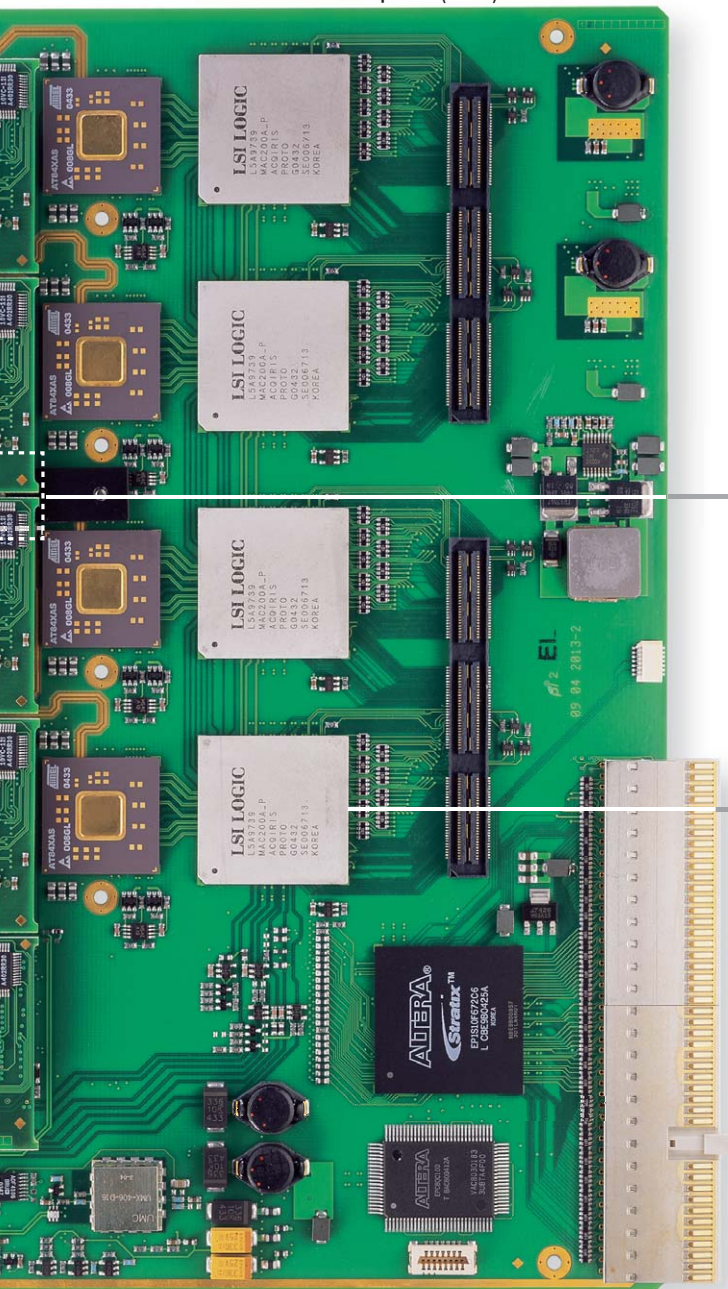
This proprietary high-bandwidth auto-synchronous bus system provides direct access to the digitizer's on-board clock distribution circuit. AS bus 2 connects up to 5 modules of the same type and synchronizes all of the sampling clock to a common master clock.



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 6U PXI crate can house up to 7 modules (plus a PC interface) to make a bench-top, multi-channel, rack-mountable data acquisition system (U1056A)¹.

Figure 1: High-speed U1065A cPCI digitizer with standard front-end option (-F50)



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++, VisualBasic, LabVIEW, and LabWindows/CVI.

These code examples provide digitizer 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 digitizer can be swapped out, replaced, and upgraded over time, with the latest high-speed Acqiris digitizer.

Precision time base

Each digitizer has a precision crystal-controlled time base. Sample rates can be selected, in a 1, 2, 2.5, 5 sequence, from 10 MS/s to 2 GS/s plus 4 GS/s and 8 GS/s. An internal trigger time interpolator (TTI) with high timing resolution is used to assist with trigger time measurements and positioning with respect to the internal clock (sampling time). The sampling clock 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.

The digitizers feature a sequence acquisition mode that allows the capture and storage of consecutive "single" waveforms. In sequence acquisition mode the acquisition memory is divided into segments. Waveforms are stored in successive memory segments as they arrive. The memory can be divided into any number of segments between 2 and 1000 (up to 16000 segments with the 128 M memory option, and 125000 segments with 1G memory option). Sequence acquisition mode is extremely useful in almost all impulse-response type applications such as radar, sonar, lidar, time-of-flight, ultrasonics, medical and biomedical research.

Fast data throughput

The memory and acquisition controller component is a digital CMOS integrated circuit. A high-speed data demultiplexer with on-board memory, it is designed to capture and memorize 10-bit digital data, at speeds of up to 2 GS/s. It has a large internal static RAM, high clock frequencies, and it is able to accept and generate low-voltage differential signal levels (LVDS) with a range of 100 mV to 600 mV for fast input/output signals.

The circuit allows storage of the input data stream to a self-addressed, 10-bit, 256 kSample internal memory. The DC282, DC252 and DC222 digitizers have provisions for external memory expansion of up to 1 GSample.

Reference clock and synchronization

The clock distribution circuit includes trigger functions to facilitate high performance triggering on specific signal waveforms. The chip is designed for use with the memory and acquisition controller component, for the interleaving up to 4 high-speed ADCs to achieve unmatched high-speed data acquisition performance.

1) System with 28-channels at 2 GS/s, 14 channels at 4 GS/s, or 7-channels at 8 GS/s using internal memory.

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Acqiris High-Speed cPCI Digitizers

Model DC282

Quad-channel, 10-bit, 2 to 8 GS/s, 256 to 1024 kSample, 32 to 128 MSample or 256 to 1024 MSample memory

Model DC252

Dual-channel, 10-bit, 4 to 8 GS/s, 512 to 1024 kSample, 64 to 128 MSample or 512 to 1024 MSample memory

Model DC222

Single-channel, 10-bit, 8 GS/s, 1024 kSample, 128 MSample or 1024 MSample memory

Standard input: 50 Ω (-F50 front-end option)

Bandwidth (-3 dB)
DC to 2 GHz

Full scale (FS)
50 mV to 5 V

Offset range
 ± 2 V for 50 to 500 mV FS
 ± 5 V for 1 to 5 V FS

Bandwidth limit filters
700 MHz, 200 MHz and 20 MHz

Maximum input voltage
 ± 5 V DC

Impedance
50 Ω $\pm 1\%$ at DC

Coupling
DC, AC (32 Hz LF limit, 50 Ω)

SFDR (typ.)
60 dB at 10.5 MHz
36 dB at 950 MHz

SNR (Full BW, 2 GS/s)
> 32 dB at 50 mV FS
> 36 dB at 100 mV FS
> 38 dB at 1 V FS
> 39 dB at 200 mV, 2 V, 5 V FS

DC accuracy
 $\pm 2.5\%$ FS at 50 mV FS
 $\pm 2\%$ FS at ≥ 100 mV FS

Effective bits (at 2 GS/s)
> 6.8 at 10.7 MHz, 200 MHz BWL
> 6.5 at 99.5 MHz, 700 MHz BWL
> 6.3 at 407 MHz, 700 MHz BWL
> 4.8 at 910 MHz, full BW (all sampling rates)

High-frequency input: 50 Ω (-FHF front-end option)

Bandwidth (-3 dB)
DC to 3 GHz

Full scale (FS)
1 V

Offset range
 ± 0.5 V

Maximum input voltage
 ± 2 V DC

Impedance
50 Ω $\pm 2\%$ at DC

Coupling
DC

SFDR (typ.)
52 dB at 10.5 MHz
42 dB at 950 MHz

SNR (Full BW, 2 GS/s)
> 45 dB

DC accuracy
 $\pm 2\%$ FS

Effective bits (at 2 GS/s)
> 6.8 at 10.7 MHz, 20 MHz BWL
> 6.5 at 99.5 MHz, 200 MHz BWL
> 6.3 at 410 MHz, 700 MHz BWL
> 5.0 at 910 MHz, full BW (all sampling rates)
> 4.5 at 1.8 GHz, full BW (all sampling rates)

High-impedance input: 50 Ω /1 M Ω (-HZ front-end option)

Bandwidth (-3 dB)

50 Ω : DC to 950 MHz

1 M Ω : DC to > 300 MHz (typ.)

Full scale (FS)

50 Ω : 50 mV to 5 V

1 M Ω : 50 mV to 50 V

Offset range

50 Ω : ± 2 V for 50 to 500 mV FS

50 Ω : ± 5 V for 1 to 5 V FS

1 M Ω : ± 2 V for 50 to 500 mV FS

1 M Ω : ± 20 V for 1 to 5 V FS

1 M Ω : ± 200 V for 10 to 50 V FS

Bandwidth limit filters

50 Ω : 700 MHz, 200 MHz, 20 MHz

1 M Ω : 20 MHz, 200 MHz at ≤ 5 V FS

1 M Ω : 20 MHz at > 5 V FS

Maximum input voltage

50 Ω : ± 5 V DC

1 M Ω : ± 300 V DC

Impedance

50 $\Omega \pm 1.0$ % at DC

1 M $\Omega \pm 1.0$ % at DC // 14 ± 2.5 pF

Coupling

DC, AC

SFDR (typ. at 2 GS/s, 50 Ω)

60 dB at 10.9 MHz

40 dB at 400 MHz

SNR (typ. 50 Ω)

50 Ω : > 33 dB at 50 mV FS

50 Ω : > 35 dB at 100 mV, 1 V FS

50 Ω : > 36 dB at other FS

1 M Ω : > 36 dB at 50 mV FS

1 M Ω : > 39 dB at 100 mV, 1 V FS

1 M Ω : > 40 dB at other FS

DC accuracy

± 2.5 % FS at 50 mV FS

± 2 % FS at ≥ 100 mV FS

Effective bits (at 2 GS/s)

50 Ω : > 6.5 at 10.7 MHz, 200 MHz BWL

1 M Ω : > 6.3 at 10.7 MHz, 200 MHz BWL

50 Ω : > 6.0 at 99.5 MHz, 700 MHz BWL

50 Ω : > 5.0 at 407 MHz, 700 MHz BWL

Digital conversion

Sample rate

10 MS/s to 2 GS/s

in 1, 2, 2.5, 5 sequence

and 4 GS/s, 8 GS/s

Resolution

10 bits (1:1024)

Integral nonlinearity (typ.)

$< \pm 0.3$ % FS (typ.) at 1.8 MHz

Differential nonlinearity (typ.)

< 2 LSB (typ.)

Acquisition memory

DC282: 256 kSample/channel

DC252: 512 kSample/channel

DC222: 1024 kSample

Maximum optional memory (M1G)

DC282-F50: 256 MSample/channel

DC282-FHZ: 256 kSample/channel

DC252-F50: 512 MSample/channel

DC252-FHF: 512 MSample/channel

DC222-F50: 1024 MSample

DC222-FHF: 1024 MSample

Time base

Clock accuracy

Better than ± 2 ppm

Sampling jitter

1.2 ps RMS (typ.) for 10 μ s with internal clock and reference

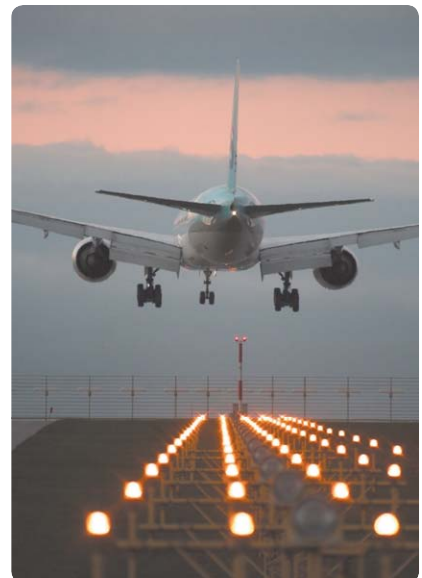
Acquisition modes

Single shot, Start-on-trigger, Sequence mode

(1 to 1000 segments with standard memory, dead time 350 ns at 2 GS/s, 16,000 segments with 32M-128M memory option, 1.8 μ s dead time at 2 GS/s, 125,000 segments with 256M-1024M memory option, 1.8 μ s dead time at 2 GS/s)

Trigger time interpolator

15 ps



Internal and external trigger

Internal trigger input (-F50, -FHZ)

Threshold adjust range: FS of channel

Sensitivity:

Frequency range:

-F50: DC to 1 GHz for positive, negative, window or pattern trigger, DC to 2 GHz in HF mode
-FHZ: 50 Ω ; DC to 950 MHz for positive, negative, window or pattern trigger
-FHZ: 1 M Ω ; DC to >300 MHz (typ.) for positive, negative, window or pattern trigger

Amplitude range: > 15% FS

External trigger input

Impedance: 50 $\Omega \pm 1\%$

Threshold Adjust Range: $\pm$ FS/2

Maximum input voltage: $\pm$ 5 V DC

Full Scale: 0.5, 1, 2, 5 V

Sensitivity:

Frequency range:

DC to 1 GHz for positive, negative, window or pattern trigger, DC to 2 GHz in HF mode

Amplitude range: >15% FS

Coupling

DC, AC LF reject (50 Hz),

HF reject (50 kHz)

Modes

Edge, positive and negative

HF: divide by 4

Spike Stretcher

Window In/Out

Pattern (-F50, -FHZ only)

Pre-trigger

Adjustable to 100% of horizontal full scale

Post-trigger

Adjustable up to $2^{35}-1$ points

Control I/O

I/O A and B signals

TTL and CMOS compatible (3.3 V)

Ctrl I/O A and B input

Trigger enable

Ctrl I/O A and B output

10 MHz reference clock

Acquisition skipping to next segment

Acquisition active

Trigger ready

CLK IN input

200 MHz to 2 GHz

> 500 mV pk-pk into 50 Ω

$\pm$ 5 DC max voltage

CLK IN ext. clock/ref threshold

Variable between -3 V and +3 V

CLK IN ext. reference frequency

10 MHz $\pm$ 0.3 %

TRG OUT output level

Adjustable in range $\pm$ 2.5 V (no load)

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

TRG OUT rise/fall time

2.5 ns into 50 Ω

General

Host computer and operating system

PC running Microsoft Windows 7, Windows Vista, Windows XP, Wind River VxWorks, National Instruments LabVIEW RT, or Linux.

The following 64 bits operating systems are also supported: XP64, Vista64, 7 64, 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 400 Mbytes/s for 64-bit/66 MHz operation

Up to 200 Mbytes/s for 64-bit/33 MHz operation

Up to 100 Mbytes/s for 32-bit/33 MHz operation

Power consumption

< 59 W for U1065A-F50, -FHF,

-FHZ without memory option

< 77 W for U1065A-F50, -FHF with memory option

Current requirements (max.)¹

Without memory option:

	-F50	-FHF	-FHZ
+12 V	100 mA	100 mA	100 mA
+5 V	6.7 A	5.7 A	6.7 A
+3.3 V	7.2 A	7.2 A	7.2 A
-12 V	30 mA	40 mA	30 mA

With memory option:

	-F50	-FHF
+12 V	100 mA	100 mA
+5 V	6.7 A	5.7 A
+3.3 V	12.5 A	12.5 A
-12 V	30 mA	40 mA

Battery backup (optional, without memory option only)

2 day retention without external power

Front-Panel LEDs indicate digitizer status Green: ready for trigger

Yellow: module identification

Red: trigger

Warranty

1 year

Environmental and physical

Operating temperature

0° to 40°C

Required airflow

> 2 m/s in situ

Relative humidity²

5 to 95% (non-condensing)

Shock²

30 G, half-sine pulse

Vibration²

5 – 500 Hz, random

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 PXI/CompactPCI standard

233 mm x 160 mm x 20 mm

CE Certification and Compliance

1) U1065A all ADCs sampling at 2 GS/s.

2) As defined by MIL-PRF-28800F Class 3. Front panel complies with IEEE1101.10



Contacts

Agilent Acqiris Product Information

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Additional Agilent Contact Information

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Hong Kong	800 938 693
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Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Thailand	1 800 226 008

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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	49 (0) 7031 464 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:

www.agilent.com/find/contactus

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Ordering Information

Model	Description
U1065A-001	DC222 base module for single-channel, 8 GS/s, 1024 kSample
U1065A-002	DC252 base module for dual-channel, 4 to 8 GS/s, 512 to 1024 kSample
U1065A-004	DC282 base module for quad-channel, 2 to 8 GS/s, 256 to 1024 kSample
U1065A-F50	Standard front-end for DC222, DC252 and DC282, 2 GHz
U1065A-FHZ	High-impedance front-end for DC282, (50 Ω /1 M Ω)
U1065A-FHF	High-frequency front-end for DC222 and DC252, 3 GHz
U1065A-128	32 to 128 MSample acquisition memory option for -F50 and -FHF front-end
U1065A-M1G	256 to 1024 MSample acquisition memory option for -F50 and -FHF front-end
U1065A-UK6	Calibration certificate
U1065A-BB1	Battery back-up for standard memory
U1065A-BNC	BNC connectors
U1065A-SMA	SMA connectors

Accessories

U1092A-CB1	MMCX to BNC cable (1 m)
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For more information on Acqiris product line, sales or services, see our website at:

www.agilent.com/find/acqiris

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