IDQ
FROM VISION TO TECHNOLOGY

NEW

CLEO/Laser Focus World
Innovation Award
2011 Honorable Mention

REDEFINING PRECISION

id210

ADVANCED SYSTEM FOR SINGLE PHOTON DETECTION

The id210 brings a major breakthrough for single photon detection at **telecom wavelengths**. Its performance in high-speed gating at internal or external **frequencies up to 100MHz** by far surpasses the performance of existing detectors and of its predecessor, the id200-id201, that has been used by researchers around the globe since first launched in 2002. Photons can be detected with probability up to 25% at 1550nm, while maintaining low dark count rate. A timing resolution lower than 200ps can be achieved. The id210 provides adjustable delays, adjustable gate duration from 0.5ns to 25ns and adjustable deadtime up to 100us. For applications requiring an asynchronous detection scheme, the id210 can operate in **free-running mode** with detection probability up to 10%. Beside performance, a particular effort has been made for providing a practical user interface, universal compatibility with scientific equipment, application-oriented functionalities including statistics and coincidence counting. Built around an advanced embedded-PC and FPGA, the id210 allows remote control, connection of external screen and keyboard, data export on USB key and setups saving.

KEY FEATURES

- Up to 100MHz external / internal gating frequency
- Asynchronous detection mode (free-running)
- Free gating mode
- Adjustable photon detection probability
- Adjustable delays, gate width and deadtime
- Universal Inputs/Outputs
- Two-channel auxiliary event counter
- Auxiliary coincidence counter
- Setup storage in internal memory
- Real time statistics, charts, sound alarms
- 5.7" VGA TFT-LED color display
- Data export through USB memory
- VGA HD15 output for external monitor / projector
- Ethernet remote control - VXI11 protocol (Option)
- SMF or MMF optical input
- USB remote control - USB-TMC (Option)

APPLICATIONS

- Quantum optics, quantum cryptography
- Fiber optics characterization
- Single-photon source characterization
- Failure analysis of electronic circuits
- Eye-safe Laser Ranging (LIDAR)
- Spectroscopy, Raman spectroscopy
- Photoluminescence
- Singlet oxygen measurement
- Fluorescence, fluorescence life time

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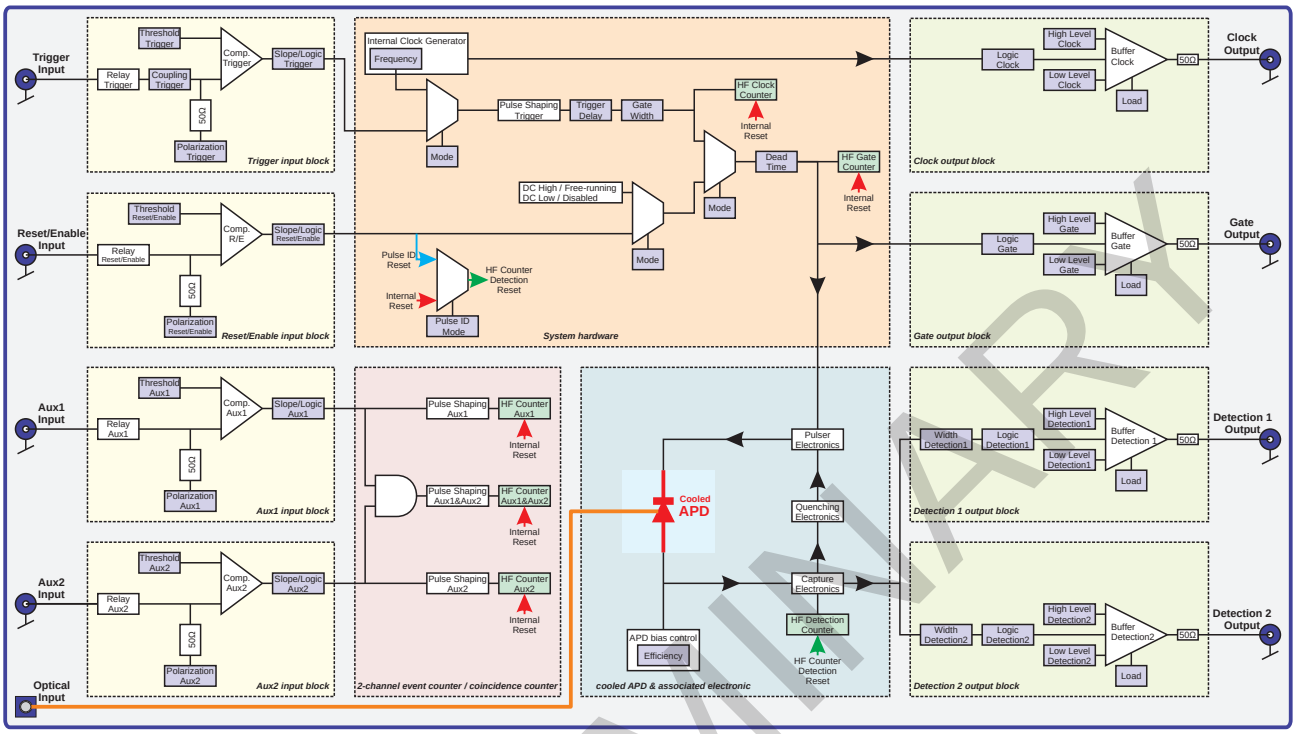
BLOCK DIAGRAM



PRINCIPLE OF OPERATION

The id210 Advanced System for Single Photon Detection is built around the following blocks:

■ **Trigger, Reset/Enable, Aux1 and Aux2 inputs blocks** with SMA connectors on the id210 front panel. Through the id210 user interface, each input can be set independently for receiving NIM, LVTTL-LVCMOS, NECL, PECL3.3V or PECL5V signals. A VAR mode is also provided with a large input voltage range, an adjustable threshold and slope/logic definition. AC/DC coupling selection is possible for the Trigger input. (see Inputs Specifications on page 6 for more details).

■ **Clock, Gate, Detection1 and Detection2 outputs blocks** with SMA connectors on the id210 front panel. Through the id210 user interface, each output can be set independently for providing NIM, LVTTL-LVCMOS, NECL, PECL3.3V or PECL5V signals. The user can also switch to VAR mode in which the pulse width, the logic definition, the high and low signal levels and the load can be adjusted. (see Outputs Specifications on page 6 for more details).

■ **an avalanche photodiode and associated electronics.** The key component at the heart of the id210 is a cooled InGaAs fiber-coupled avalanche photodiode (APD). The fiber (single mode or multi-mode) is connectorized to a FC/PC connector on the id210 front panel. The APD terminals are connected to:

- a DC high voltage controlled by the system to reach the efficiency set through the id210 interface,
- a Pulser Electronics that produces constant amplitude pulses for operation in single photon regime.

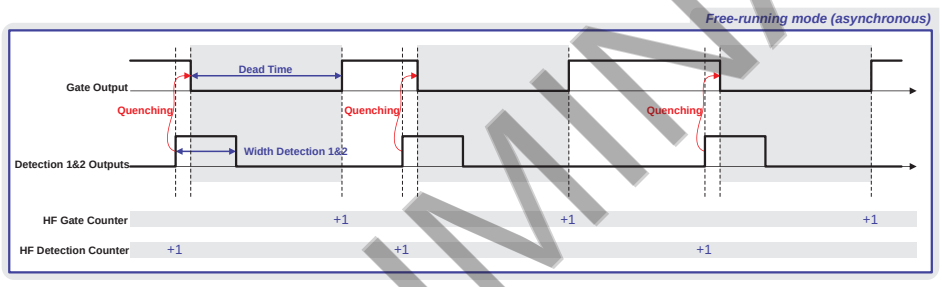
The Capture Electronics detects the avalanche events (resulting from photon absorption or dark generation) and feeds the Detection 1&2 outputs blocks and the HF (high frequency) detection counter. The Quenching Electronics inhibits the pulser until avalanche quenching.

- the System hardware

The system hardware allows the id210 operation in free-running, free-gating, internal gated or external gated modes.

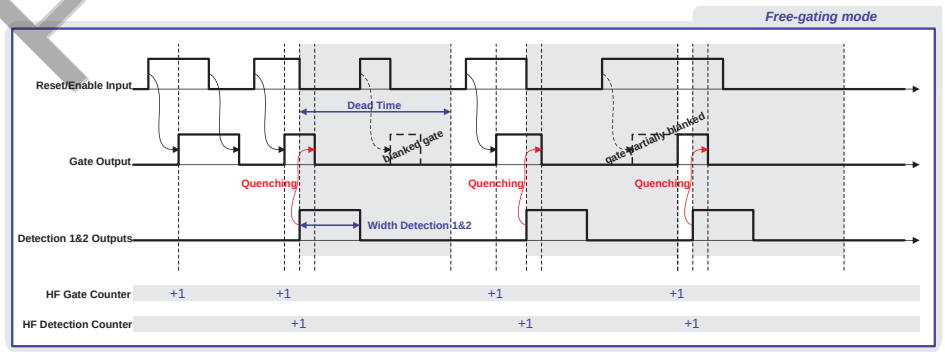
Free-running mode (asynchronous mode): NEW

A DC control signal travels through multiplexers and the Dead Time stage and sets the Pulser Electronics to High. Until photon absorption or dark count generation, the APD is biased above its breakdown voltage in Geiger mode. The Gate Output that reflects the APD state (i.e. On:photosensitive or Off:blind) is at high level. When an avalanche takes place in the APD, it is sensed by the Capture Electronics. A pulse of adjustable Width is produced on Detection1 and Detection2 outputs, the Detection HF Counter is incremented and the Quenching Electronics stops the avalanche. For limiting afterpulsing, the APD is maintained below breakdown until the end of the Dead Time. In this mode, the HF Gate Counter and HF Detection Counter rates are equal.



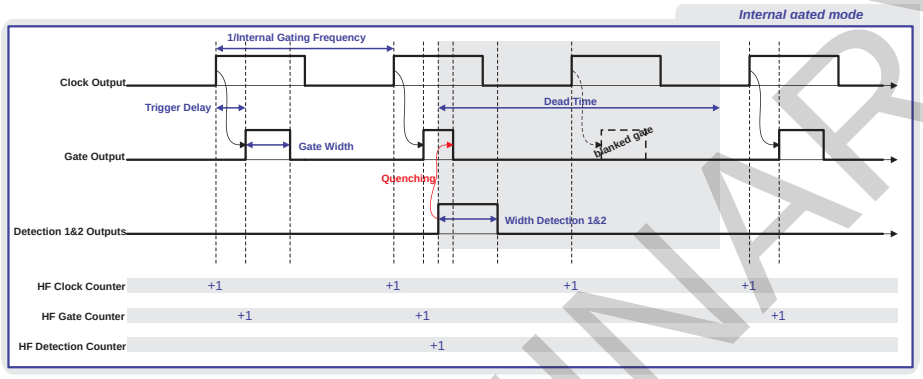
Free-gating mode: NEW

The user feeds an electrical signal at the Reset/Enable input. The signal, after transit in the input block, passes through multiplexers and the DeadTime stage. When no avalanche occurs, the Gate Output that reflects the APD state (On/Off) is identical to the Reset/Enable input signal. When an avalanche occurs during a gate, a pulse of adjustable Width is produced at Detection1 and Detection2 outputs, the Detection HF Counter is incremented and the Quenching Electronics stops the gate. When a Dead Time is applied for limiting the afterpulsing, the Gate signal remains at low level whatever the Reset/Enable state. This results in blanked gate(s) or partially blanked gates. The HF Gate Counter provides the effective gates rate applied to the APD.



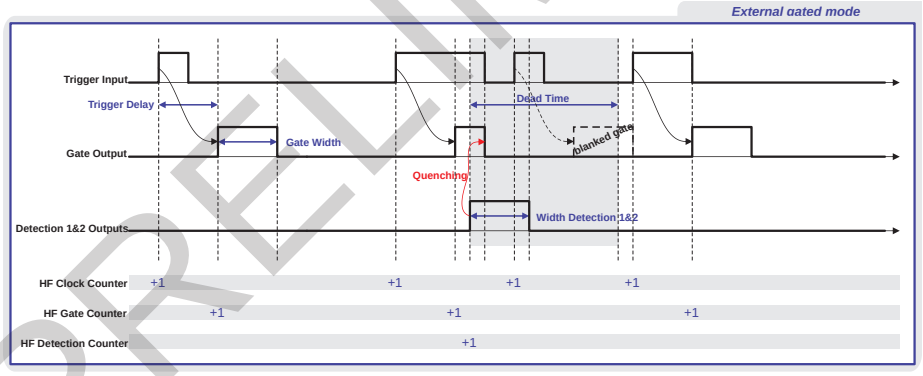
Internal-gating mode:

The APD is biased above breakdown during gates of adjustable Width and Frequency. Internal gating is a synchronous mode based on a clock provided by the internal clock generator. The 50% duty cycle clock signal is available at the Clock Output and counted by the HF Clock Counter. A user-adjustable Trigger Delay can be set between the Clock and the Gate signals. A gate of Width set by user is open on the rising edge of the delayed trigger. As consequence of an avalanche event within the gate, the HF Detection Counter is incremented and a pulse of adjustable Width is outputted at Detection1 and Detection2 connectors. The Quenching Electronics closes the gate and, if selected by the user, a Dead Time is applied resulting in one or several blanked pulses after a detection.



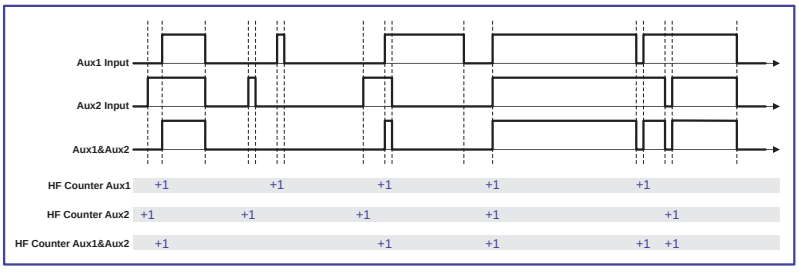
External-gating mode:

The operation in external gating mode is very similar to the internal gating mode except that the clock is provided by the user at the Trigger input.



- **A two-channel event counter and a coincidence counter** as an auxiliary independent block.

The signals outputted by Aux1 and Aux2 inputs blocks feed HF Counter Aux1 and HF Counter Aux2 after pulse shaping. The block also performs a logic AND of the two inputs that feeds a coincidence counter: HF Counter Aux1&Aux2.

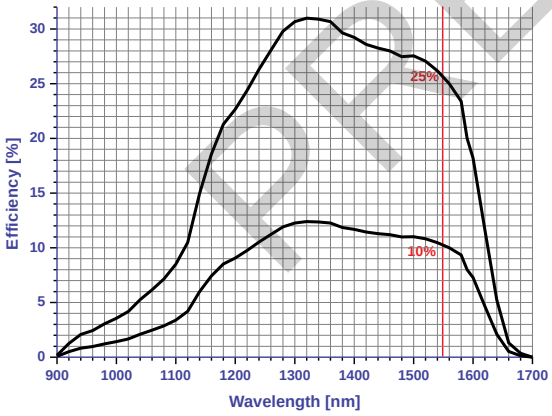


SPECIFICATIONS

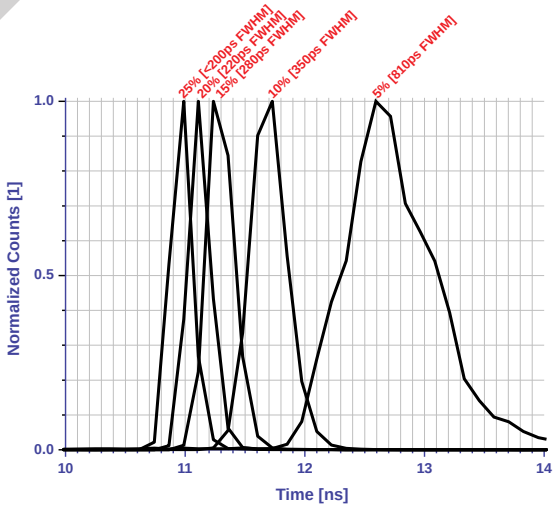
Parameter	Min	Typical	Max	Units
Wavelength range	900		1700	nm
Optical fiber type		SMF or MMF		
Efficiency range (except free-running mode) [1] [1]	5		25	%
Efficiency range in free-running mode	2.5		10	%
Efficiency resolution (all modes)		2.5		%
Intrinsic dark count rate (10% efficiency) [2]			$3x10^{-5}$	/ns
Intrinsic dark count rate (25% efficiency)			$2x10^{-4}$	/ns
Deadtime range	0.1		100	us
Deadtime step		10		ns
Timing resolution at max. efficiency [2]			200	ps
External trigger frequency			100	MHz
Internal trigger frequency	1,2,5,10,20,50,100,200,500 kHz		1,2,5,10,20,50,100	MHz
Effective gate width range	0.5		25	ns
Gate width resolution		10		ps
Trigger delay range			20	ns
Trigger delay resolution		10		ps
Operating temperature	+10		+30	°C
Dimensions LxWXH		400x250x150		mm
Weight			8	kg
Optical connector		FC/PC		
Power supply	110		230	VAC
Cooling time		5		min
InGaAs/InP APD		Telcordia GR-468-CORE		

1 Calibrated at λ=1.55 µm.

2 Please contact IDQ to inquire about the availability of ultra-low noise detectors.



1 Efficiency versus wavelength at 10% and 25% levels (λ=1550nm).



2 Typical FWHM timing resolution measured at 5%, 10%, 15%, 20% and 25%.

INPUTS SPECIFICATIONS

Parameter	Min	Typical	Max	Units
Frequency (Aux1, Aux2)			300	MHz
Frequency (Reset/Enable, Trigger)			100	MHz
Pulse duration	500			ps
Voltage range in VAR mode	-2.5		+2.5	V
Impedance		50		Ω
Pulse amplitude	+0.1		+5	V
Coupling (Trigger)		DC or AC		
Coupling (Aux1, Aux2, Reset/Enable)		DC		
Threshold voltage range in VAR mode	-2.5		+2.5	V
Threshold voltage resolution in VAR mode		+10		mV
Predefined standards 1 2		NIM - LVTTL/LVCMOS - NECL - PECL3.3V - PECL5V		
Connectors		SMA		
Protection		ESD		

1 For NECL, PECL3.3V and PECL5V, the id210 input provides standard termination scheme (NECL: 50Ω to -2V, PECL3.3V: 50Ω to +1.3V, PECL5V: 50Ω to +3V).

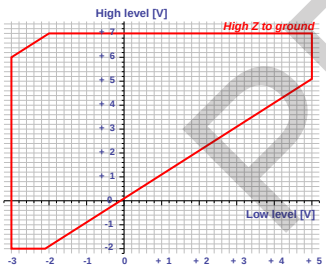
2 The Inputs parameters or Predefined Standards are included in setup files that can be saved on internal memory or on an external USB keys.

OUTPUTS SPECIFICATIONS

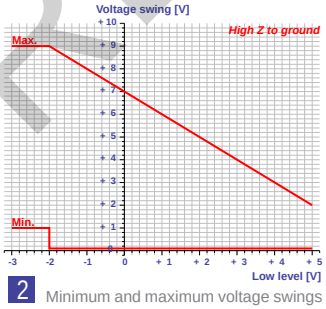
Parameter	Min	Typical	Max	Units
High level voltage range (high Z to ground) 1	-2.0		+7.0	V
High level voltage range (50Ω to ground) 3	-1.0		+3.5	V
Low level voltage range (high Z to ground) 1	-3.0		+5.0	V
Low level voltage range (50Ω to ground) 3	-1.5		+2.5	V
Voltage swing (high Z to ground) 2	+0.1		+7.0	V
Voltage swing (50Ω to ground) 4	+0.05		+3.5	V
Logic		+ or -		
Short pulse width (Detection1, Detection2)	4.5	5	5.5	ns
Large pulse width (Detection1, Detection2)	90	100	110	ns
Rise/fall times at 5V swing (10%-90%)		2.5		ns
Predefined standards 1 2		NIM - LVTTL/LVCMOS - NECL - PECL3.3V - PECL5V		
Connectors		SMA		
Protection		ESD		

1 Starting with a Predefined Standard, all the parameters can be modified by the user.

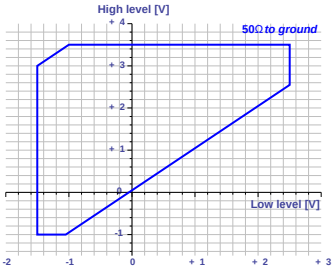
2 The Outputs parameters or Predefined Standards are included in setup files that can be saved on internal memory or on an external USB keys.



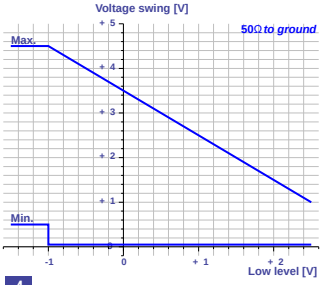
1 Low level and high level voltage ranges when the output is loaded at high impedance to ground.



2 Minimum and maximum voltage swings when the output is loaded at high impedance to ground.



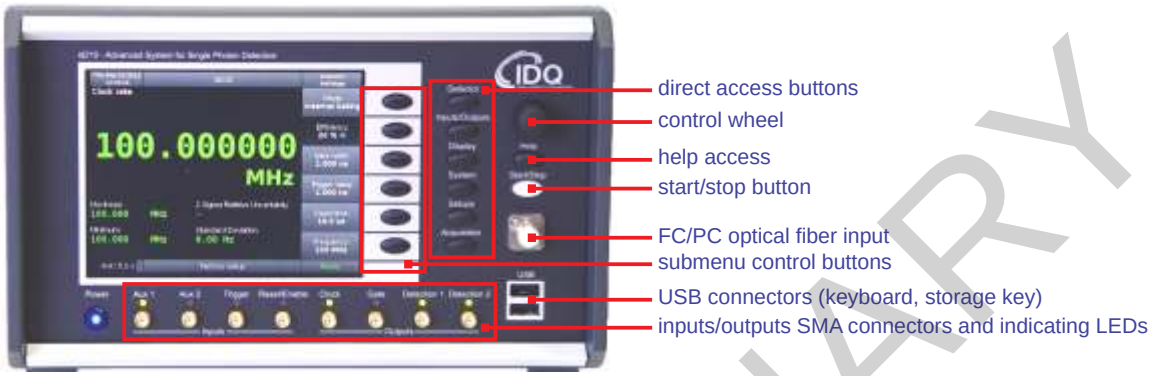
3 Low level and high level voltage ranges when the output is loaded at 50Ω to ground.



4 Minimum and maximum voltage swings when the output is loaded at 50Ω to ground.

USER INTERFACE - DATA & SETUP RECOVERY

All the user parameters are intuitively adjustable with direct access buttons (Detector, Inputs/Outputs, Display, System, Setups and Acquisition), submenus control buttons and the control wheel on the id210 front panel.



The bicolor indicating LEDs associated to SMA connectors inputs or outputs provide relevant informations such as valid triggers, pulses traffic at the outputs or unused inputs/outputs in the selected mode. Two USB connectors on the front panel can be used for connecting a keyboard or for data export on a storage key. The backlight intensity can be adjusted automatically or manually. The id210 is equipped with a buzzer that can be optionally used for indicating, for instance, the end of the cooling phase. On the rear panel, Ethernet and USB connectors can be used for remote control. A VGA HD-15 connector for external monitor/projector is accessible as well on the rear panel.

The id210 contains 6 HF counters providing the Detection, Clock, Gate, Aux1, Aux2 and Aux1&Aux2 coincidence rates. The id210 displays indicators associated to counters or any operation (+ - / x) between counters. Up to 5 different views can be set, saved and restored. A view defines the number of indicators displayed simultaneously (selected between 1 and 4) and the counter or operation between counters associated to each indicator.

The user can choose between three counting modes: Totalize, Frequency (Current) and Frequency (Last):

- In Totalize mode, the counters are reset upon pressure on the start/stop button. The numbers of counts since start are displayed until second pressure on the start/stop button. The user can then save the data on a USB storage key and/or restart the acquisition.

- In Frequency (Current) mode, the user selects the integration time between 0.2s and 100s (or infinite) by step of 0.2s. The id210 continuously computes and displays the mean value, the relative standard deviation, the minimum and maximum values taken during the 0.2s sampling period over the integration period, for the 6 HF counters. Upon pressure on the start/stop button, the user can save the data (integration period number, mean value, standard deviation, minimum and maximum values) for the 6 HF counters.

- In Frequency (Last) mode, the operation is similar to the Frequency (Current) mode except that the data display is delayed by the integration period.

The id210 allows the user to save up to 5 setups on internal memory. A setup includes all inputs/outputs parameters, view parameters and detector parameters (mode, efficiency, delay, width...).

IDQ
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OTHER SCIENTIFIC INSTRUMENTATION PRODUCTS

id100: Photon counter module in the VIS spectrum

> Spectral range: 350 to 900nm
> Best- in-class timing resolution of typically 40ps
> Very low dark count rate down to less than 2 Hz

id101: Photon counter in the VIS spectrum (OEM execution)

> World smallest photon counter

id150: Miniature 8-channel photon counter for OEM applications in the VIS spectrum

> The only multichannel solid-state single photon detector on the market

id400: Single photon detection module for 1064nm

> Spectral range: 900 to 1150nm
> Adjustable photon detection probability: 7.5%; 15% and 30%
> Gated and free-running modes of operation
> Internal or external gating modes

id300: Short-pulse laser source at 1310nm or 1550nm

> Externally triggered sub-nanosecond laser source
> DFB or Fabry-Perot lasers

These products are used in a wide range of applications, from medical and environmental instrumentation to quantum optics, aerospace and defence.

TRUE RANDOM NUMBER GENERATOR:

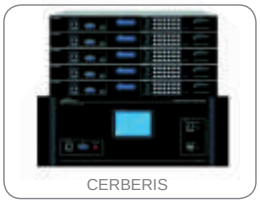
QUANTIS is a physical random number generator exploiting an elementary quantum optics process. Photons - light particles - are sent one by one onto a semi-transparent mirror and detected. The exclusive events (reflection - transmission) are associated to "0" - "1" bit values.

NETWORK ENCRYPTION:

Conventional Encryption

Centauris product line is a range of high performance layer 2 encryptors for the following protocols:. Ethernet, Fibre Channel, SONET/SDH and ATM.
The bandwith goes from 10Mbps up to 10Gbps.
They have been designed to integrate transparently and simply into existing networks. The products are certified according to International Security standards (Commmon Criteria EAL4+ and FIPS PUB 140-2 Level 3) to guarantee high-end security.


CENTAURIS


CERBERIS

Quantum key distribution

Cerberis combines the best of conventional encryption with quantum key distribution based on the laws of quantum physics to secure encryption key distribution.

ORDERING INFORMATION

id210-SMF	Detector module with singlemode fiber input (SMF28)
id210-MMF	Detector module with multimode fiber input (50/125µm)

SUPPLIED ACCESSORIES

- Power cable
- Optical fiber cleaner
- 1m FC/PC optic patch cord
- User guide on USB key

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