QICPIC | RODOS & Co. | Image Analysis
Particle Measurement | Laboratory
Size and Shape | 0.55 µm to 33,792 µm

SYMPA TEC

SUCELL

RODOS

QICPIC
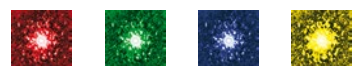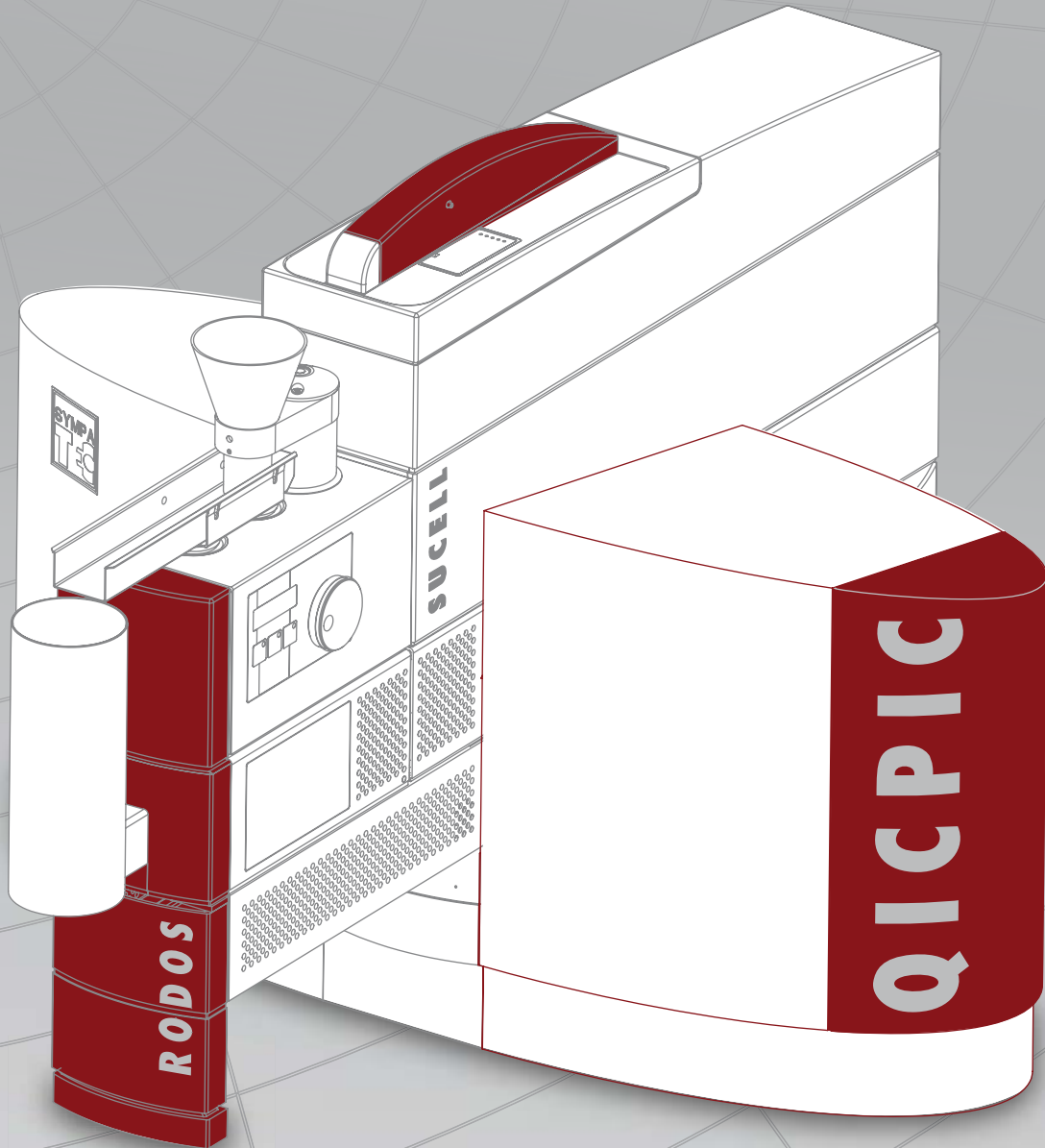
The Universal Shapefinder

High-Performance Image Analysis from Sub- to Megamicron with up to 500 fps
Unrivalled Resolution │ Greatest Accuracy │ Highest Statistical Confidence

The modular image analysis sensor **QICPIC** has proven its superior capabilities in size and shape analysis of disperse particle systems within a variety of demanding applications in research and industry. With adaptable dispersing units and feeders, the sensor is flexibly adjusted to powders, granules, fibres, suspensions and emulsions, which are to be characterized.

QICPIC offers an overall detection range from 0.55 µm to 33,792 µm. Seven of the overlapping optical modules will seamlessly capture the entire range. And the great dynamic measuring range of each respective module allows for the characterisation of wide distributed disperse systems.

A precise capturing of particle outlines is realized by transmitting 8 bit greyscale images even at highest frame rates. Powerful algorithms evaluate the particle projections at rates of up to 500 frames per second (fps). The accuracy of particle size and particle shape analysis has therefore reached a new dimension of quality.

High-resolution and high-speed CMOS cameras allow for optimal horizontal and vertical windowing. Even very large particle numbers (up to 100 million particles per measurement) are captured and evaluated at shortest measuring times. For the measurement results, a unique level of statistical confidence is achieved.*

Regarding image capturing, four sensor models are available:

❱ **QICPIC/R02** │ **L02**
   resolution up to 4.2 MP, frame rate up to 225 fps and data rate 5 GBit/s (1 x USB 3.0)

❱ **QICPIC/R06**
   resolution up to 4.2 MP, frame rate up to 500 fps and data rate 10 GBit/s (2 x CXP-5)

❱ **QICPIC/R16**
   resolution up to 4.0 MP, frame rate up to 500 fps and data rate 25 GBit/s (4 x CXP-6).

The network-ready control and evaluation software **PAQXOS** serves as a powerful tool for real-time capturing, storing and evaluation of the measuring data.

After every measuring operation the raw data will be stored in the database automatically to enable a subsequent evaluation with alternative modes.

QICPIC emphasises latest and future-oriented standard interfaces (such as TCP/IP, CoaXPress (CXP) and USB 3.0) for device control and system integration into the existing IT environment. This ensures the systems' upgrade capabilities as well as a high degree of compatibility.

Naturally, the proven modular system design delivers the highest degree of application flexibility. For an optimal adaptation to a wide variety of products many dispersing units are applicable:

❱ dry │ **RODOS**, **GRADIS**, **FIBROS**
❱ wet │ **LIXELL**, **FLOWCELL**, **MIXCEL**
❱ dry & wet │ **OASIS**.

Benefits at a glance

❱ **Reliable and fast determination of size, shape and quantity**
Dynamic image analysis with up to 500 fps ensuring a high number of captured particles for statistically sound results in seconds to just a few minutes.

❱ **Flexible adaptation to a wide range of applications**
Modular system design with a great selection of dispersing and dosing units for dry and wet applications. Best adaptation to your product(s).

❱ **Powerful dry dispersion with injection disperser RODOS**
Controlled dispersion forces generate a free aerosol jet from dry, even cohesive powders. With a sub-nanosecond exposure, accelerated and dispersed particles are captured as pin sharp images.

❱ **Wide measuring range │ < 1 µm to 34 mm**
A selection of four precision lenses covers the complete measuring range. Each optical module offers a unique dynamic range (1:2,000) for a perfect characterisation of even wider distributed samples.

❱ **Powerful evaluation modes │ Meaningful results**
Simultaneous determination of all relevant size and shape characteristics, including fibres. A particle gallery and user-defined screening criteria facilitate the creation of specific reports.

❱ **Adaptable, high resolution size and shape distributions**
Raw data recording allows for finest gradation of distribution diagrams. Result presentation adapted to your needs.

QICPIC/R & RODOS & VIBRI

* Typical relative standard deviation for accuracy $\sigma(Q_3) < 1\%$ │ for repeatability $\sigma(Q_3) < 0.1\%$.

QICPIC

High–Performance Image Analysis

Modular Image Analysis Sensor
for Particle Size and Shape Characterisation

Sensor			
Model	QICPIC/R02 │ L02	QICPIC/R06	QICPIC/R16
Detection range │ µm	0.55 - 33,792	0.55 - 33,792	0.70 - 24,192
Measuring range modules	7	7	6
Maximum frame rate │ fps	225 @ 1.5 MP	500 @ 1.5 MP	500 @ 4.0 MP

Measuring principle	
Dynamic image	Particle illumination in transmission
analysis	❯ Quasi-static image analysis by nanosecond exposure
	❯ Use of effective dry dispersion units that reliably separate particles
	❯ Double-telecentric optics for highest contrast of even transparent particles
	❯ Image size independent of object position
	❯ High confidence level by fastest image acquisition allowing for a high number of particles
	❯ In accordance with ISO 13322-1/2

Light source		
Model	QICPIC/R │ Laser	QICPIC/R │ LED
Pulsed laser	λ = 532.3 nm (green)	λ = 660 nm (red)
Pulse duration	< 1 ns	In nanoseconds range
Frequency	10 to 500 Hz	10 to 225 Hz
Classification	Class 1 laser product	not applicable
Beam diameter	Automatically adjustable	non-adjustable

Measuring ranges and optics					
	Magnification	$x_{min, phys}$ │ GSR[1]	–	$x_{max, ISO}$ │ phys	
Optical modules	M3 (10:1)	.55 │ 4.95	-	375 │	1,126 µm
R02 │ L02 │ R06	M4 (5:1)	1.1 │ 9.9	-	750 │	2,253 µm
	M5 (3:1)	1.8 │ 16	-	1,252 │	3,755 µm
	M6 (2:1)	2.8 │ 25	-	1,877 │	5,632 µm
	M7 (1.3:1)	4.2 │ 38	-	2,888 │	8,665 µm
	M8 (1:2)	11 │ 99	-	7,510 │	22,528 µm
	M9 (1:3)	17 │ 153	-	11,264 │	33,792 µm
Optical modules	M3 (10:1)	0.7 │ 6.3	-	403 │	1,210 µm
R16	M4 (5:1)	1.4 │ 12.6	-	806 │	2,419 µm
	M5 (3:1)	2.3 │ 21	-	1,344 │	4,032 µm
	M6 (2:1)	3.5 │ 32	-	2,016 │	6,048 µm
	M7 (1.5:1)	4.7 │ 42	-	2,688 │	8,046 µm
	M8 (1:2)	14 │ 126	-	8,064 │	24,192 µm

Discrete measuring ranges with highest precision and resolution. User-defined configuration of up to four precision lens modules per lens holding disk.[7]

Detector and data acquisition			
Camera performance	QICPIC/R02 │ L02	QICPIC/R06	QICPIC/R16
Detector resolution │ px	2,048 x 2,048	2,048 x 2,048	2,336 x 1,728
Pixel size │ µm^2	5.5 x 5.5	5.5 x 5.5	7.0 x 7.0
Frame rate │ fps	225 @ 1.5 MP	500 @ 1.5 MP	500 @ 4.0 MP
	170 @ 2.1 MP	355 @ 2.1 MP	—
	85 @ 4.2 MP	175 @ 4.2 MP	—
Data Rate	5 GBit/s	10 GBit/s	25 GBit/s
Interface	1 x USB 3.0	2 x CXP-5	4 x CXP-6
Measuring performance	Time[2]	Number of particles	Standard deviation[3]
Minimum	0.1 - 1 s	some hundred	5-10 %
Recommended	1 - 100 s	1 million	1 %
Maximum	100 - 1,000 s	> 30 millions	0.1 %

Evaluation modes	
Particle size	Equivalent sphere, equivalent perimeter, enclosing rectangle, Feret diameter, Chord length
Particle shape	Sphericity, aspect ratio, convexity, roundness
Fibre characterization	Fibre length, fibre diameter, volume-based fibre diameter, straightness, elongation
Volume models	Sphere, ellipsoid, cylinder
Class limits	Automatic generation depending on measuring range
	Intelligent, individual class limits generator
	ISO compliance by default

Quality of measuring results		
Accuracy	$\sigma < 1\ \%$	Mean relative standard deviation verified by standard target (USAF)
Repeatability[4]	$\sigma < 0.2\ \%$	Typical (narrow distribution)
	$\sigma < 1\ \%$	Typical (wide distribution)
Comparability[5]	$\sigma < 2\ \%$	Mean relative standard deviation of median (x_{50})
	$|\Delta x| < 5\ \%$	Maximum relative deviation[6]

FIBROS

GRADIS & VIBRI

RODOS | MIXCEL & Co.

Versatile Dry and Wet Dispersion

SYMPA TEC

Adaptable Dispersing Units
for Powders, Granules, Fibres, Suspensions and Emulsions

Dispersing Units and Feeders[7]

Dry

	Dispersing range	Sample amount per analysis[8]
RODOS/L	1.8 - 4,000 µm*	< 1 - 1,000 g
Injection disperser for finest, even cohesive powders		
	* with fibres up to 6,000 µm	
GRADIS/L	1.8 - 10,000 µm**	10 - 1,000 g
Gravity disperser for coarser, even fragile dry particulate systems		
	** with straight fibres up to 34 mm; with curled fibres up to 100 mm	
VIBRI/L[9]	up to 15,000 µm	< 1 - 1,000 g
Vibratory feeder for precise dosing and feeding of dry particulate systems		
ASPIROS/L[9]	up to 500 µm	< 1 g
Micro dosing system for feeding small amounts of precious or toxic dry substances in encapsulated sample vials		
**MULTISAMPLER	dry**[9]	up to 1,500 µm	39 ml vial
Sample handling system for automated feeding of dry powders in vials		70 vials per rack; up to 140 vials with rack extension
FIBROS[10]	500 - 30,000 µm	fibre length
Disperser for gentle separation and feeding of dry, even curly fibres	1.8 - 5,000 µm	fibre diameter

Dry and wet

		Dispersing range	Sample amount per analysis[8]
OASIS/L			
Combined	RODOS	dry[9]	1.8 - 4,000 µm	< 1 - 1,000 g
and	SUCELL	wet[11, 12]	0.55 - 2,000 µm	(50) 400 ml

Wet

|	Dispersing range	Analysis volume[8]
MIXCEL[12]	0.55 - 3,000 µm	up to 1,000 ml
Closed-loop flow-through cell with sonication (up to 72 W) temperature-controlled[13]		
**MULTISAMPLER	wet**	up to 1,000 µm	39 ml vials
Sample handling system for automated feeding of wet samples in vials		70 vials per rack; up to 140 vials with rack extension
LIXELL	0.55 - 2,000 µm	min. 20 ml
Flow-through cell for flexible application set-ups, adaptable cuvettes and application kits[13]		
**LIQXI	for LIXELL**	up to 500 µm	250 ml* or 400 ml**
Wet dosing system with stirrers, flow baffles and peristaltic pump for representative sample flow		* flow-optimized or ** standard glass beaker
FLOWCELL		
Large volume flow-through cell		
10 mm	11 - 5,000 µm*	> 10 l/min
20 mm	17 - 10,000 µm*	> 20 l/min
	* with soft disperse matter (e.g., pulp) up to 8 mm and 16 mm, respectively	

RODOS & VIBRI
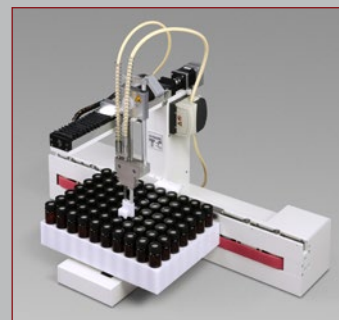
ASPIROS

MULTISAMPLER

LIXELL

the detector large-scale, higher optical concentrations may be accepted. 9) RODOS & GRADIS typically with dry feeding unit VIBRI. Feeding of RODOS with ASPIROS or MULTISAMPLER | dry, alternatively. 10) Applicable for feeding of fibres in combination with GRADIS. 11) Closed-loop flow-through cell for suspensions and emulsions, with sonication (0-60 W), small volume adapter (SVA) optional.

12) Automated sample feeding with MULTISAMPLER | wet optional 13) optional
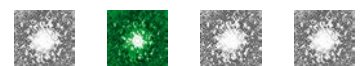
Systems for Particle Size and Shape Analysis
Sensor | Dispersers | Evaluation | Quality

Quality assurance system

Certification	Standardised test procedure
Reference material	SiC-P600 $(x_{50} \approx 26\ \mu m)$
	SiC-F230 $(x_{50} \approx 66\ \mu m)$
	SiC-P80 $(x_{50} \approx 260\ \mu m)$
	SiC-P50 $(x_{50} \approx 430\ \mu m)$
	SiC-P16 $(x_{50} \approx 1{,}600\ \mu m)$
Validation	According to FDA regulations

Software

PAQXOS	PC or remote control of application in terms of
Control and evaluation software for particle size	sensor, dispersing units and sample feeding
and shape analysis	Evaluation[14, 15]

- ❯ Particle size and size distribution, mean values and standard deviations
- ❯ Particle shape and shape distribution, mean values and standard deviations
- ❯ Fibre characterization
- ❯ Formation of individually specified fractions

Presentation of results based on user-defined reports and templates[15]

- ❯ Diagrams (distribution curves, trend graphs)
- ❯ Tables
- ❯ Characteristic values
- ❯ Shape factor diagrams | Scatter plots
- ❯ Particle gallery | Particle movie

Step-by-step wizard for quick and successful measurements
Intuitive SOP management
User-friendly, individual user interface

System specifications

Dimensions (L/W/H)	763 / 301.5 / 383 mm
Measuring zone	123 mm
Weight	45 kg	R-series and 36 kg	L-series
Supply voltages	90 - 250 V AC @ 50-60 Hz
Power consumption	Standby 0.1 W
	All on 38 W idle	360 W max.
Compressed air[16]	Supply min. 6 bar (Class 3)
	Consumption max. 300 l/min
Extraction[17]	Application dependent industrial extraction unit

Compliance

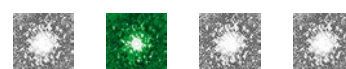|	
ISO 13322	The ISO standard requirements concerning "Particle size analysis - Image analysis methods - Part 2: Dynamic image analysis methods" are met and in parts outperformed.
FDA 21 CFR Part 11	The compliance to FDA rule standards concerning electronic records and electronic signatures is provided.

Computer specifications

	QICPIC/R02	L02	QICPIC/R06	QICPIC/R16
Operating system[18]	Microsoft® Windows® 10 Professional (64 Bit)		
Hardware specifications[19]	Up-to-date tower PC, e.g. Intel® Xeon® W processor min. 3.6 GHz, 16 GB RAM, nVidia® Quadro® P2000® 5 GB, 4x DisplayPort, sound and LAN onboard, DVD±RW		
CPU	Xeon® 6-Core W-2133	Xeon® 6-Core W-2133	Xeon® 8-Core W-2145
Hard disk	SSD 512 GB SATA, HDD 1 TB SATA		
Display	27" WQHD/QHD (2.560 x 1.440 px)		
Interfaces	1 x USB 3.0 (5 GBit/s)	2 x CXP-5 (10 GBit/s)	4 x CXP-6 (25 GBit/s)
			PCIe®-Gen 2	> 3.000 MByte/s

QICPIC/L & OASIS

Particle Measurement and Know-how from Pulverhaus

Several Thousand Installations
At Particle Professionals Worldwide

SYMPA TEC

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