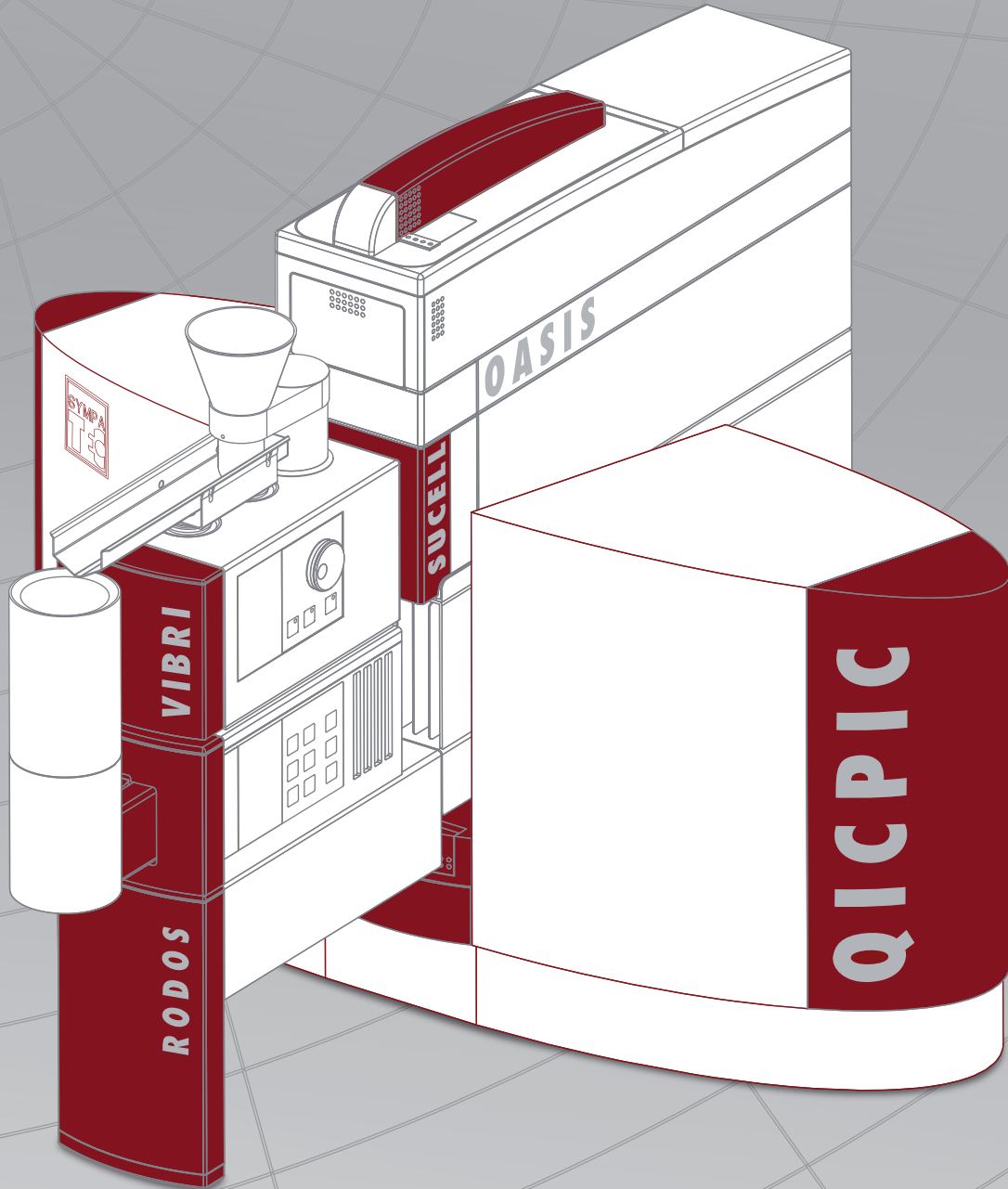


QICPIC | RODOS & Co. | Image Analysis
Particle Measurement | Laboratory
Size and Shape | 0.55 μm to 33,792 μm



Technical Specifications



Sympatec develops, manufactures, sells, services and supports a range of best instruments for particle size and shape analysis in laboratory and process applications for customers worldwide. With continuous innovations Sympatec makes a prominent contribution to **l**aser diffraction, **i**mage analysis, **u**ltrasonic extinction and **p**hoton cross-correlation spectroscopy.



The Universal Shapefinder

Technical Specifications

High-Performance Image Analysis from Submicron to Centimeter on 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, two sensor models are available:

- › **QICPIC/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/L06**
resolution up to 4.2 MP,
frame rate up to 500 fps and
data rate 10 GBit/s (2 x CXP-5)

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 complete 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, SUCELL**
- › 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 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 & RODOS & VIBRI

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

High-Performance Image Analysis

Modular Image Analysis Sensor for Particle Size and Shape Characterisation

Sensor		
Model	QICPIC/L02	QICPIC/L06
Detection range μm	0,55 - 33.792	0,55 - 33.792
Measuring range modules	7	7
Maximum frame rate fps	225 @ 1.5 MP	500 @ 1.5 MP

Measuring principle	
Dynamic image analysis	Particle illumination in transmission
	<ul style="list-style-type: none"> 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/L LED	
Pulsed LED	$\lambda = 660 \text{ nm}$ (red)	$\lambda = 450 \text{ nm}$ (blue)
Pulse duration	In nanoseconds range	
Frequency	10 to 500 fps	

Measuring ranges and optics			
Optical modules	Magnification	$x_{\text{min, phys}} \text{GSR}$ ¹	$x_{\text{max, ISO}} \text{phys}$
L02 L06	M3 (10:1)*	.55 4.95	- 375 1,126 μm
	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

* only for wet applications
M6 only for models with one fixed measuring range

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			
	QICPIC/L02	QICPIC/L06	
Camera performance			
Detector resolution px	2.048 x 2.048	2.048 x 2.048	
Pixel size μm^2	5,5 x 5,5	5,5 x 5,5	
Frame rate fps	225 @ 1,5 MP	500 @ 1,5 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	
Interface	1 x USB 3.0	2 x CXP-5	
Measuring performance	Duration ²	Number of particles	Standard deviation ³
Minimum	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

1) The second value (GSR) indicates the lower range limit which yields a good shape recognition. 2) Dependent on product under observation and - if wet dispersion is applied - dependent on dispersing media. 3) Related to particle size distributions of three consecutive measurements. Depending on the measuring task other criteria may be crucial in order to assess the quality of measurement when applying image analysis. 4) Repeated measurement

of a (riffled) sample with up to about 1 million particles with reference material SiC P600 (x_{50} -value). 5) System-to-system reproducibility. 6) Related to $x_{10}|x_{50}|x_{90}$ -values. 7) Stated size ranges are application and system configuration dependent. 8) With particles, that are just a fraction compared to the size of the detector, an optical concentration of $0.1 \% < c_{\text{opt}} < 0.3 \%$ is aspirable with regard to reproducibility of the particle size distribu-

Versatile Dry and Wet Dispersion

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

Dispersing Units and Feeders⁷

Dry

	Dispersing range	Sample amount per analysis ⁸
RODOS/L Injection disperser for finest, even cohesive powders	1.8 - 4,000 µm*	< 1 - 1,000 g
	* with fibres up to 6,000 µm	
GRADIS/L Gravity disperser for coarser, even fragile dry particulate systems	1.8 - 18,000 µm**	10 - 1,000 g
	** with straight fibres up to 34 mm; with curled fibres up to 100 mm	
VIBRI/L⁹ Vibratory feeder for precise dosing and feeding of dry particulate systems	up to 15,000 µm	< 1 - 1,000 g
ASPIROS/L⁹ Micro dosing system for feeding small amounts of precious or toxic dry substances in encapsulated sample vials ¹⁰	up to 500 µm	< 1 g
FIBROS¹¹ Disperser for gentle separation and feeding of dry, even curly fibres	500 - 30,000 µm 1.8 - 5,000 µm	fibre length fibre diameter



RODOS & VIBRI



ASPIROS

Dry and wet

	Dispersing range	Sample amount per analysis ⁸
OASIS/L Combined RODOS dry ⁹ and SUCELL wet ^{12, 13}	1.8 - 4,000 µm 0.55 - 2,000 µm	< 1 - 1,000 g (50) 500 ml

Wet

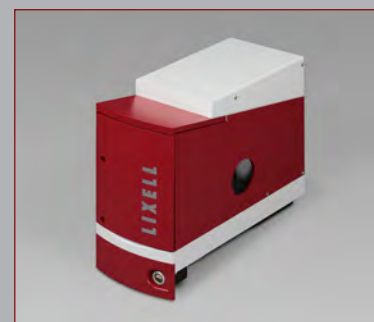
	Dispersing range	Analysis volume ⁸
SUCELL/L¹³ Closed loop flow-through cell for suspensions and emulsions; built-in sonication (0-72 W); small volume adapter (SVA) ¹⁴	0.55 - 2,000 µm	(50) 500 ml
MULTISAMPLER wet Sample handling system for automated feeding of wet samples in vials	up to 1,000 µm	39 ml vials 70 vials per rack up to 140 vials with rack extension
LIXELL Flow-through cell for flexible application set-ups, adaptable cuvettes and application kits ¹⁴	0.55 - 2,000 µm	min. 20 ml
LIQXI for LIXELL Wet dosing system with stirrers, flow baffles and peristaltic pump for representative sample flow	up to 500 µm	250 ml* or 400 ml** * 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



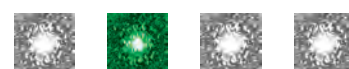
SUCELL/L



LIXELL

tion. With bigger sized particles, whose projections fill the detector large-scale, higher optical concentrations may be accepted. 9) RODOS & GRADIS typically with dry feeding unit VIBRI. Feeding of RODOS with ASPIROS, alternatively. 10) When using hazardous or toxic substances, additional safety measures must be taken by the operator at the installation site. 11) Applicable for feeding of fibres in combination with GRADIS. 12) Closed-loop

flow-through cell for suspensions and emulsions, with sonication (0-72 W), small volume adapter (SVA) optional. 13) Automated sample feeding with MULTISAMPLER | wet optional 14) optional





Interfaces

Systems for Particle Size and Shape Analysis
Sensor | Dispersers | Evaluation | Quality

Quality assurance system	
Certification	Standardised test procedure
Reference material	SiC-F800 ($x_{50} \approx 9 \mu\text{m}$)
	SiC-P600 ($x_{50} \approx 26 \mu\text{m}$)
	SiC-F230 ($x_{50} \approx 66 \mu\text{m}$)
	SiC-P80 ($x_{50} \approx 260 \mu\text{m}$)
	SiC-P50 ($x_{50} \approx 430 \mu\text{m}$)
	SiC-P16 ($x_{50} \approx 1,600 \mu\text{m}$)
Validation	According to FDA regulations

Software	
PAQXOS	PC or remote control of application in terms of sensor, dispersing units and sample feeding
Control and evaluation software for particle size and shape analysis	<ul style="list-style-type: none"> Evaluation^{15, 16} 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
	<ul style="list-style-type: none"> Presentation of results based on user-defined reports and templates¹⁶ Diagrams (distribution curves, trend graphs) Tables Characteristic values Shape descriptor diagrams Scatter plots Particle gallery Particle movie
	<ul style="list-style-type: none"> 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	36 kg
Supply voltages	90 - 250 V AC @ 50-60 Hz
Power consumption	Standby 0.1 W
	In operation 38 W idle 360 W max.
Compressed air ¹⁷	Supply min. 6 bar (Class 3)
	Consumption max. 300 l/min
Extraction ¹⁸	Application dependent industrial extraction unit

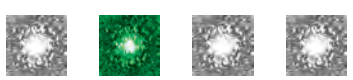
Compliance	
ISO 13322	The ISO standard requirements concerning "Particle size analysis - Image analysis methods" are met or even partially exceeded.
FDA 21 CFR Part 11	The compliance to FDA rule standards concerning electronic records and electronic signatures is supported.

Computer specifications		
Operating system ¹⁹	Microsoft® Windows® 10 Professional (64 Bit)	
	QICPIC/LO2	QICPIC/LO6
Hardware specifications ²⁰	Up-to-date desktop PC, e.g. Intel Core® i7, min. 2.9 GHz, 8 GB RAM,	Up-to-date tower PC, Intel Xeon® W-Prozessor, min. 3.6 GHz, 32 GB RAM,
	Sound and LAN onboard, DVD±RW	NVIDIA® Quadro® P2000® 5 GB,
CPU	Intel Core® 6-Core	Xeon® 8-Core
Hard disk	SSD 512 GB SATA	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)
		PCIe®-Gen 2 > 3.000 MByte/s



QICPIC & OASIS

15) A diversity of different size and shape factors is implemented. 16) Ex-post, recalculations and modifications of evaluation and presentation are possible. 17) In conjunction with injection disperser RODOS (resp. OASIS) and FIBROS. 18) In conjunction with dry dispersers RODOS (resp. OASIS), GRADIS and FIBROS. 19) Microsoft® Windows® 7 Professional (64 Bit) supported. 20) Sympatec reserves the right to supply equivalent or better specified personal computers.



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