RaySensor
Yichang RaySensor Optoelectronic Technology Co., Ltd.

RaySensing

Ultra-Weak FBG Sensor Arrays

English Product Brochure

Scalable fiber-optic sensing arrays for long-distance, multi-point strain, temperature, humidity and vibration monitoring.

UW-FBG Arrays | DAS Enhancement | FRP/CFRP Smart Reinforcement | Custom Spacing & Wavelengths

PRODUCT FAMILY	MODELS	VERSION	YEAR
RS-UWFBG	S1-S5 | D1-D2 | R1-R3	V2.0 English Layout	2025

ENGLISH TRANSLATION + PRODUCT BROCHURE

Ultra-Weak FBG Sensor Arrays

Translated and redesigned from the source Chinese product file for international technical communication.

TECHNOLOGY PLATFORM

Ultra-weak fiber Bragg grating arrays with low reflectivity, customizable grating spacing and low insertion loss for dense multi-point sensing.

MEASUREMENT TARGETS

Strain, temperature, humidity, distributed acoustic/vibration enhancement and FRP/CFRP-packaged structural sensing.

APPLICATION DOMAINS

Civil infrastructure, tunnels, bridges, pipelines, perimeter security, rail transit, oil logging, underwater acoustic sensing and special environments.

CUSTOMIZATION

Wavelength, spacing, reflectivity, coating, diameter, temperature rating and package form can be configured by project requirement.

INSTALLATION FLEXIBILITY

Bare fiber, tight-buffered fiber, GFRP/CFRP rods, strips and sensor cables support surface bonding, slot embedding and cable integration.

DOCUMENT SCOPE

This brochure includes English operating principles, typical applications, technical specifications and ordering-code structures for ten models.

DOCUMENT INFORMATION

Version	Change summary	Prepared by	Date
V1.0	Initial release	Luo Zhihui	2022.04.21
V2.0	Content update	Wang Huilan	2025.03.31

Company: Yichang RaySensor Optoelectronic Technology Co., Ltd.

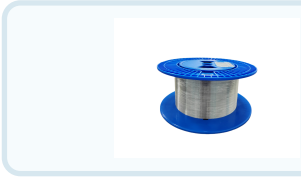
PORTFOLIO

Product Family Overview

A concise map of the RS-UWFBG product platform and application direction.

Model	English product name	Core sensing target	Package / diameter	Typical application focus
S1	Ø250 um Ultra-Weak FBG Array	Strain / temperature	Bare/coated fiber, 245 um +/- 5 um	Long-distance multi-point sensing
S2	High-Temperature Ultra-Weak FBG Array	High/low temperature strain	Ormocer-coated fiber, 195 um	Extreme-temperature sensing
S3	Humidity-Sensitive Ultra-Weak FBG Array	Humidity	Special polyimide, 165 um	Stay-cable and special-environment humidity
S4	Ø900 um Tight-Buffered UW-FBG Array	Surface strain	Hytrel tight buffer, 900 um	Direct bonding on structures
S5	Ø2.0 mm Tight-Buffered UW-FBG Array	Robust distributed strain	TPU tight buffer, 2.0 mm	Pre-tensioned bonding, slot embedding
D1	Ø250 um DAS UW-FBG Array	Distributed acoustic sensing	250 um fiber	DAS signal enhancement
D2	Ø165 um Fine-Diameter DAS UW-FBG Array	DAS / acoustic pressure	165 um G.657A2 fiber	Compact probes and underwater monitoring
R1	GFRP Smart Reinforcement Cable	Strain / temperature	1.0 mm / 2.0 mm GFRP	Embedded structural monitoring
R2	CFRP Smart Reinforcement Rod	Strain / tension / temperature	5.0 mm / 7.0 mm CFRP rod	Bridge cables, anchors, civil structures
R3	Ribbon-Type CFRP Sensor Strip	Strain / tension / temperature	30 mm x 1.2 mm CFRP strip	Bridge reinforcement and structural monitoring

PRODUCT VISUALS


Specifications are typical values. Custom configurations available upon request.

RS-UWFBG-S1

Ø250 um Ultra-Weak FBG Array

Strain / Temperature Array

OPERATING PRINCIPLE

RS-UWFBG-S1 is an ultra-low-reflectivity fiber Bragg grating array manufactured by automated draw-tower inscription. Multiple gratings with reflectivity from 0.01% to 0.1% are written into a single fiber using the phase-mask method. Grating wavelength and spacing can be customized. The complete array requires no coating stripping or serial splicing, offering strong mechanical integrity, low insertion loss, and suitability for long-distance, simultaneous multi-point measurements.

TYPICAL APPLICATIONS

- Distributed strain sensing
- Structural deformation monitoring and reconstruction
- High-precision chained temperature sensing

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Reflectivity	0.01% to 0.1% (customizable)
Bandwidth @ -3 dB	<= 0.30 nm
Side-mode suppression ratio	>= 15 dB
Fiber attenuation	<= 0.30 dB/km
Typical grating spacing	0.20 m, 0.5 m, 1 m, 2 m, 5 m (others customizable)
Fiber coating	Acrylate / Polyimide (customizable)
Fiber diameter	245 um +/- 5 um
Breaking tensile load	>= 20 N (corresponding to 2% strain)
Temperature sensitivity	10.02 pm/degC (typical)
Strain sensitivity	1.2 pm/microstrain
Operating temperature	-20 degC to 90 degC

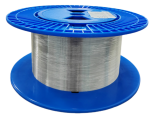
ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	S1	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 0.165 mm 2: 0.25 mm 3: 0.9 mm 4: Other	1: -20 to 90 degC 2: -40 to 120 degC	S: Single coating D: Dual coating O: Other

RS-UWFBG-S2

Ø165 um High-Temperature Ultra-Weak FBG Array

High-Temperature Strain Array



OPERATING PRINCIPLE

RS-UWFBG-S2 is a polyimide-coated low-reflectivity FBG array jointly developed with leading optical-fiber manufacturers. Multiple gratings with reflectivity from 0.01% to 0.1% are produced by femtosecond-laser inscription. The array provides excellent temperature endurance and environmental resistance, supports customized grating specifications and spacing, and requires no coating stripping or serial splicing across the full array.

TYPICAL APPLICATIONS

- Wide-range distributed strain sensing
- Extreme high-temperature measurement
- Extreme low-temperature measurement

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Grating length	4 mm
Reflectivity	0.01% (customizable)
Bandwidth @ -3 dB	<= 0.30 nm
Side-mode suppression ratio	>= 15 dB
Additional insertion loss	<= 0.3 dB/km
Typical grating spacing	0.20 m, 0.5 m, 1 m, 2 m
Fiber coating	Ormocer (modified organic ceramic)
Fiber diameter	195 um (900 um optional)
Breaking tensile load	>= 30 N (corresponding to 3% strain)
Temperature sensitivity	10.8 pm/degC
Strain sensitivity	1.21 pm/microstrain
Operating temperature	-200 degC to +300 degC

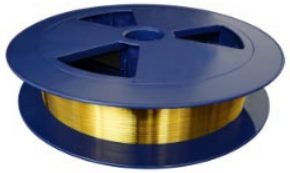
ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	S2	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 0.165 mm 2: Other	1: -200 to 300 degC 2: Other	O: Other

RS-UWFBG-S3

Ø165 um Humidity-Sensitive Ultra-Weak FBG Array

Humidity / Environmental Array



OPERATING PRINCIPLE

RS-UWFBG-S3 is a low-reflectivity humidity-sensitive grating array developed by RaySensor using automated draw-tower inscription. Multiple gratings with 0.01% to 0.1% reflectivity are written into a special polyimide-coated fiber. The coating absorbs moisture from the air and expands or contracts, driving wavelength shifts in the UW-FBG. Grating spacing and reflectivity can be customized. The array offers high humidity sensitivity and good consistency for large-area, multi-point humidity testing.

TYPICAL APPLICATIONS

- Humidity measurement inside bridge stay cables
- Humidity measurement in special environments

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Grating length	10 mm
Reflectivity	0.01% to 0.1% (customizable)
Bandwidth @ -3 dB	<= 0.30 nm
Side-mode suppression ratio	>= 15 dB
Additional insertion loss	<= 0.5 dB
Typical grating spacing	0.20 m, 0.5 m, 1 m, 2 m, 5 m (others customizable)
Fiber coating	Special Polyimide
Fiber diameter	165 um +/- 5 um
Breaking tensile load	>= 10 N (corresponding to 1% strain)
Temperature sensitivity	12.10 pm/degC @ 55% RH (typical)
Humidity sensitivity	4.6 pm/%RH @ 30 degC (typical)
Operating temperature	-20 degC to 60 degC

ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	S3	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 0.165 mm 2: Other	1: -40 to 120 degC	O: Other

RS-UWFBG-S4

Ø900 um Tight-Buffered Ultra-Weak FBG Array

Surface-Mount Strain Array

OPERATING PRINCIPLE

RS-UWFBG-S4 is a 900 um tight-buffered, low-reflectivity FBG array. An automated thermal-extrusion process applies a Hytrel jacket over a 250 um UW-FBG array, enabling dense bonding between the Hytrel material and the inner coating. The resulting specialty fiber provides low loss, strain capability greater than 20,000 microstrain, and excellent mechanical strength. It can be bonded directly to the surface of a measured object or further processed into customized optical cables.

TYPICAL APPLICATIONS

- Multi-point strain monitoring after slotting concrete structures
- Surface strain monitoring for metal structures and engineering test models
- Displacement monitoring of tunnel walls

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Grating length	10 mm
Reflectivity	0.01% to 0.1% (customizable)
Bandwidth @ -3 dB	<= 0.30 nm
Side-mode suppression ratio	>= 15 dB
Fiber loss	<= 0.30 dB/km
Typical grating spacing	0.20 m, 0.5 m, 1 m, 2 m, 5 m (others customizable)
Fiber coating	Acrylate / Hytrel
Fiber diameter	900 um
Breaking tensile load	>= 50 N
Strain sensitivity	1.2 pm/microstrain
Pigtail length	Customized
Operating temperature	-20 degC to 90 degC

ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	S4	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 0.9 mm 2: Other	1: -20 to 90 degC 2: -40 to 120 degC	S: Single coating D: Dual coating O: Other

RS-UWFBG-S5

Ø2.0 mm Tight-Buffered Ultra-Weak FBG Array

Robust Distributed Strain Array

OPERATING PRINCIPLE

RS-UWFBG-S5 is a 2.0 mm tight-buffered, low-reflectivity FBG array. A TPU layer is applied to a 250 um UW-FBG array through automated thermal extrusion, ensuring tight bonding between the TPU material and the inner coating. The resulting specialty fiber provides strain capacity above 20,000 microstrain and excellent mechanical strength. It can be pre-tensioned and bonded on structural surfaces, embedded in slots, or further processed into fixed-point distributed strain cables.

TYPICAL APPLICATIONS

- Multi-point strain monitoring after slotting concrete structures
- Surface strain monitoring for metal structures and engineering test models
- Secondary processing into distributed strain sensing cables

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Grating length	10 mm
Reflectivity	0.01% to 0.1% (customizable)
Bandwidth @ -3 dB	<= 0.30 nm
Side-mode suppression ratio	>= 15 dB
Fiber loss	<= 0.30 dB/km
Typical grating spacing	0.20 m, 0.5 m, 1 m, 2 m, 5 m (others customizable)
Fiber coating	Acrylate / Hytrel / TPU
Fiber diameter	2.0 mm
Breaking tensile load	>= 50 N
Strain sensitivity	1.2 pm/microstrain
Pigtail length	Customized
Operating temperature	-20 degC to 90 degC

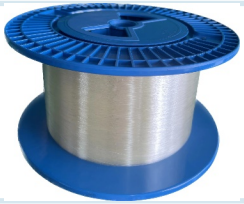
ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	S5	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 2.0 mm 2: 3.0 mm 3: Other	1: -20 to 90 degC 2: -40 to 120 degC 3: Other	S: Single coating D: Dual coating O: Other

RS-UWFBG-D1

Ø250 um DAS Ultra-Weak FBG Array

Distributed Acoustic Sensing Enhancement



OPERATING PRINCIPLE

RS-UWFBG-D1 is a distributed micro-vibration sensing (DAS) fiber grating array manufactured through automated draw-tower processing. Multiple chirped ultra-weak gratings with reflectivity around 0.01% and bandwidth greater than 5 nm @ 3 dB are written into a single fiber using the phase-mask method. The array provides fixed-point reflection and signal enhancement with excellent mechanical performance and low insertion loss, significantly improving the signal-to-noise ratio of DAS systems.

TYPICAL APPLICATIONS

- Distributed discrete scattering-enhanced DAS systems
- Acoustic sensing in oil well logging
- Pipeline leakage detection and perimeter security
- Smart highways and rail transit

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1550.12 nm
Grating length	10 mm
Reflectivity	0.01% to 0.05% (customizable)
Bandwidth @ -3 dB	>= 4.9 nm @ G.652D; >= 22 nm @ G.657A2
Side-mode suppression ratio	>= 15 dB
Fiber attenuation	<= 0.30 dB/km
Typical grating spacing	2 m, 5 m (1 m to 50 m customizable)
Fiber coating	Acrylate / Modified Acrylate
Fiber diameter	250 um +/- 5 um
Breaking tensile load	>= 30 N (corresponding to 3% strain)
Temperature sensitivity	10.02 pm/degC
Operating temperature	-20 degC to 90 degC; -40 degC to 120 degC

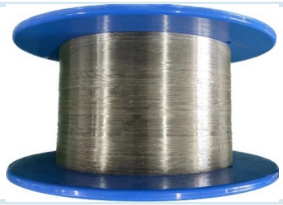
ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	D1	1: G.657A2 2: G.652D	1: 2 m 2: 5 m 3: Other	1: 1550.12 nm 2: Other	1: 0.16 mm 2: 0.25 mm 3: 0.9 mm 4: Other	1: -20 to 90 degC 2: -40 to 120 degC	S: Single coating D: Dual coating O: Other

RS-UWFBG-D2

Ø165 um Fine-Diameter DAS Ultra-Weak FBG Array

Compact DAS / Acoustic Array



OPERATING PRINCIPLE

RS-UWFBG-D2 is a fine-diameter DAS fiber grating array manufactured through automated draw-tower processing. Using a specialty drawing process and phase-mask inscription, multiple grating arrays with bandwidth greater than 5 nm @ 3 dB and reflectivity around 0.01% are written into a 165 um G.657A2 fiber. It provides high acoustic-pressure sensitivity and strong bend resistance, helping improve fiber sensitivity while reducing loss during sensor winding, cabling and installation.

TYPICAL APPLICATIONS

- Distributed DAS sensing systems
- Underwater vibration and sonar monitoring
- Small-size probes and VSP vibration sensors

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1550.12 nm
Grating length	10 mm
Reflectivity	0.01% (customizable)
Bandwidth @ -3 dB	>= 5 nm
Side-mode suppression ratio	>= 15 dB
Fiber attenuation	<= 0.30 dB/km
Typical grating spacing	2 m, 5 m (1 m to 50 m customizable)
Fiber coating	Acrylate / Modified Acrylate
Fiber diameter	165 um +/- 5 um
Breaking tensile load	>= 20 N (corresponding to 2% strain)
Temperature sensitivity	10.02 pm/degC
Operating temperature	-20 degC to 90 degC; -20 degC to 150 degC

ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	D2	1: G.657A2 2: G.652D	1: 2 m 2: 5 m 3: Other	1: 1550.12 nm 2: Other	1: 0.16 mm 2: 0.25 mm 3: 0.9 mm 4: Other	1: -20 to 90 degC 2: -40 to 120 degC	S: Single coating D: Dual coating O: Other

RS-UWFBG-R1

GFRP Smart Reinforcement Sensor Cable

FRP-Packaged Strain / Temperature Cable

OPERATING PRINCIPLE

RS-UWFBG-R1 is a glass-fiber-reinforced plastic (GFRP) ultra-weak grating sensing cable available in 1.0 mm and 2.0 mm specifications. The UW-FBG array is encapsulated into FRP through a specialty process to form a strain/temperature sensing cable. With high mechanical strength, it can be installed directly on structures or embedded in concrete.

TYPICAL APPLICATIONS

- Structural surface strain and deformation monitoring
- Deformation sensing experiments
- Temperature monitoring in special environments

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Grating length	10 mm
Reflectivity	0.01% to 0.1%
Bandwidth @ -3 dB	<= 0.50 nm
Side-mode suppression ratio	>= 15 dB
Fiber loss	<= 0.4 dB/km
Typical grating spacing	0.2 m, 0.5 m, 1 m, 2 m, 5 m (others customizable)
Cable weight	8 kg/km @ Ø1.0 mm; 16 kg/km @ Ø2.0 mm
Fiber/cable diameter	1.0 mm / 2.0 mm
Mechanical performance	Tensile >= 500 N @ 1.0 mm; tensile >= 1000 N @ 2.0 mm
Temperature sensitivity	17.86 pm/degC
Strain sensitivity	1.18 pm/microstrain
Operating temperature	-20 degC to 120 degC

ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	R1	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 1.0 mm 2: 2.0 mm 3: 5.0 mm 4: Other	1: -20 to 90 degC 2: Other	O: Other

RS-UWFBG-R2

CFRP Smart Reinforcement Sensor Rod

Carbon-Fiber Reinforced Sensor Rod

OPERATING PRINCIPLE

RS-UWFBG-R2 is a carbon-fiber-based ultra-weak grating reinforcement sensor. The UW-FBG array is encapsulated into a carbon-fiber resin material through thermal pultrusion to form a rod-shaped structure. Grating spacing can be customized. The sensor provides excellent mechanical strength, good thermal stability, corrosion resistance and long service life, making it suitable for bridge stay cables, anchors and civil structural monitoring.

TYPICAL APPLICATIONS

- Smart monitoring of bridge stay cables
- Strain sensing experiments
- Temperature sensing and tensile-force measurement in special environments

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Grating length	10 mm
Reflectivity	0.01% to 0.1%
Bandwidth @ -3 dB	<= 0.50 nm
Side-mode suppression ratio	>= 15 dB
Fiber loss	<= 0.4 dB/km
Typical grating spacing	0.2 m, 0.5 m, 1 m, 2 m, 5 m (others customizable)
Cable weight	16 kg/km @ Ø5.0 mm
Cable diameter	5.0 mm, 7.0 mm (others customizable)
Elastic modulus	>= 110 GPa
Elongation at break	>= 1.5%
Tensile strength	>= 2100 MPa
Temperature sensitivity	8.95 pm/degC
Strain sensitivity	1.21 pm/microstrain
Operating temperature	-20 degC to 150 degC

ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Diameter	Temp. rating	Notes
RS	UWFBG	R2	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 5.0 mm 2: 7.0 mm 3: Other	1: -20 to 90 degC 2: Other	O: Other

RS-UWFBG-R3

Ribbon-Type CFRP Sensor Strip

Carbon-Fiber Smart Strip

OPERATING PRINCIPLE

RS-UWFBG-R3 is a carbon-fiber-based ultra-weak grating plate sensor. The UW-FBG array is encapsulated into a carbon-fiber resin material through thermal pultrusion to form a ribbon-type smart carbon-fiber strip. It offers excellent mechanical strength, good thermal stability, corrosion resistance and long service life, and is suitable for bridge reinforcement and structural monitoring.

TYPICAL APPLICATIONS

- Bridge reinforcement, anchoring and related applications
- Deformation sensing experiments
- Temperature sensing and tensile-force measurement in special environments

TECHNICAL SPECIFICATIONS

Parameter	Typical specification
Center wavelength	1528 nm to 1568 nm
Center wavelength tolerance	+/- 0.5 nm
Reflectivity	0.01% to 0.1%
Bandwidth @ -3 dB	<= 0.50 nm
Side-mode suppression ratio	>= 15 dB
Fiber loss	<= 0.4 dB/km
Typical grating spacing	0.2 m, 0.5 m, 1 m, 2 m, 5 m (others customizable)
Cable weight	20 kg/km
Cable size	30 mm x 1.2 mm (others customizable)
Elastic modulus	>= 110 GPa
Elongation at break	>= 1.5%
Tensile strength	>= 2100 MPa
Temperature sensitivity	8.95 pm/degC
Strain sensitivity	1.21 pm/microstrain
Operating temperature	-20 degC to 150 degC

ORDERING INFORMATION

Company	Product family	Variant	Fiber type	Spacing	Wavelength	Width	Temp. rating	Notes
RS	UWFBG	R3	1: G.657A2 2: G.652D	1: 1 m 2: 2 m 3: 0.5 m 4: Other	1: 1536 2: 1536, 1548 3: 1530, 1542, 1554 4: Other	1: 30 mm 2: Other	1: -20 to 120 degC 2: Other	O: Other

Engineered for scalable structural sensing.

Ultra-weak grating arrays enable dense sensing points, low insertion loss, and application-specific packaging for civil infrastructure, energy, transportation and special-environment monitoring.

Product information, configuration and custom requirements

www.ray-sensor.com | sales@ray-sensor.com

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Specifications are subject to change without prior notice. Custom configurations are available upon request.