

WORLD-LEADING ULTRAFAST FBG (UFBG) DEVICES

- HIGH PERFORMANCE
- HIGH CONSISTENCY
- HIGH CUSTOMISABILITY



Product Catalog

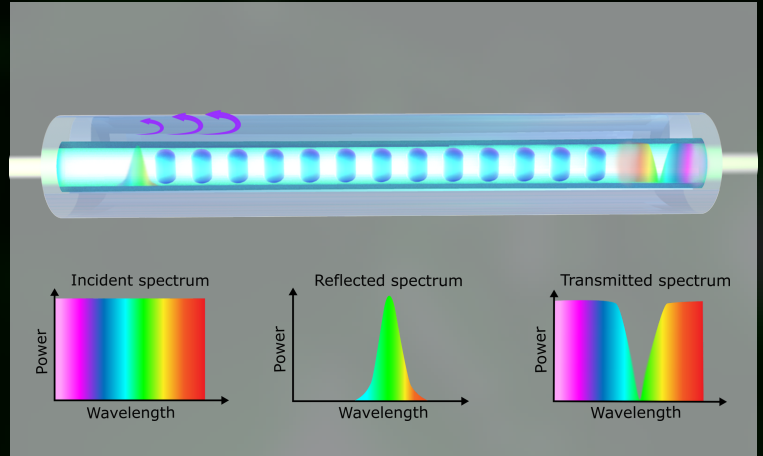
Oct 2023

innofocus

Innofocus Photonics Technology Pty Ltd

WHAT IS FIBRE BRAGG GRATING

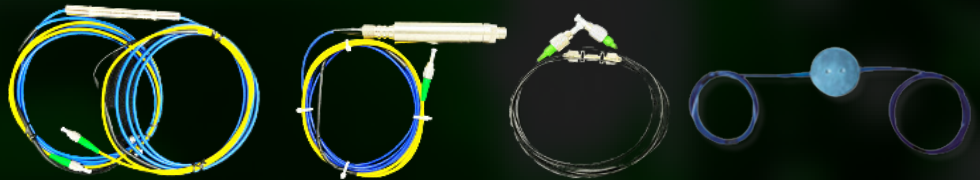
Fibre Bragg Grating (FBG) is a miniaturised optical reflector built in an optical fibre that reflects particular wavelength of light and transmits all others. FBGs can be used broadly in optical sensing systems and optical communication systems. In the meantime, the ultra-narrow bandwidth of FBGs making it extremely suitable for high-power ultra-narrow band fibre lasers.



FBGs



FBG Sensors



FBG HAVE VERSATILE APPLICATIONS IN ALMOST EVERY INDUSTRY



Oil & Gas



Mining



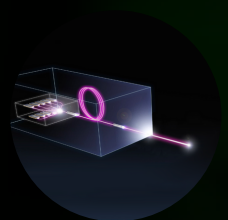
Power Plant



Transportation



Communication



Fibre Lasers

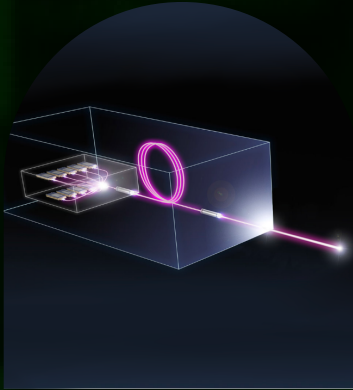
INDUSTRY CHALLENGES

Although FBGs are already widely used in a range of industries, achieving high performance, high consistency and high customisability are still challenges for FBGs to be applied to the following industries:



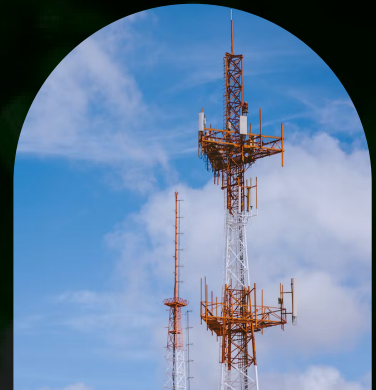
Extreme Environment Sensing

- Requires FBGs to have high temperature stability and high mechanical strength



High Power Fibre Lasers

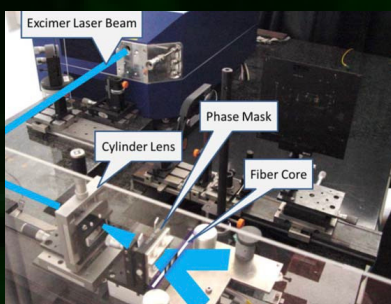
- Requires FBGs to have ultra-high reflectivity and high power stability



Optical Communication Systems

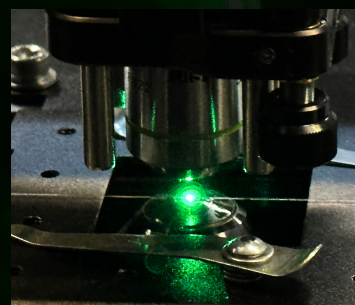
- Requires FBGs to have ultra-narrow bandwidth for WDM devices

INNOFOCUS SOLVED THESE CHALLENGES SUCCESSFULLY WITH FEMTOSECOND LASERS



Fabricated by UV and phase mask method

VS



Fabricated by femtosecond ultrafast laser pulses

Conventional FBGs	Innofocus's Ultrafast FBGs
✗ <i>Low Mechanical Strength</i>	✓ <i>High Mechanical Strength</i>
✗ <i>Low Temperature Stability</i>	✓ <i>High Temperature Stability</i>
✗ <i>Low Fabrication Flexibility</i>	✓ <i>Fully Customisable Fabrication</i>
✗ <i>Small Dynamic Range</i>	✓ <i>Large Dynamic Range</i>

WORLD-LEADING FBG MANUFACTURING COMPANY

In response to the industry challenges, Innofocus has invested heavily in technology, hardware and software, fully committed to supporting more advanced research and development together with our customers. We have been awarded ***“Best Intelligent Laser Manufacturing Specialist 2022”*** by APAC Insider, as a recognition of our cutting-edge nano-manufacturing capabilities. Innofocus is one of the few companies in the world who is capable of producing fully customisable Ultrafast FBG devices with high performance and high consistency using the world-leading ultrafast laser intelligent nano fabrication technology.

PRODUCT PORTFOLIO

Ultrafast FBG (UFBG)

UFBGs



UFBG_S

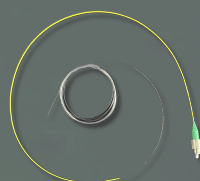


UFBG_W



Specialised UFBG

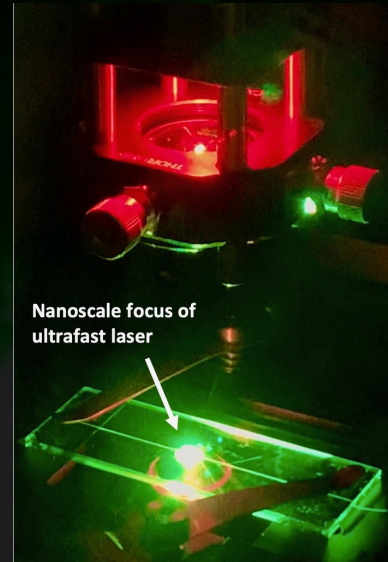
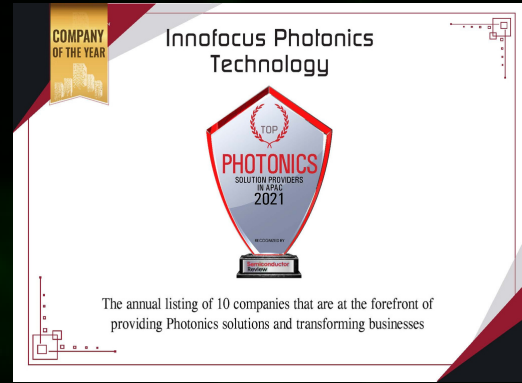
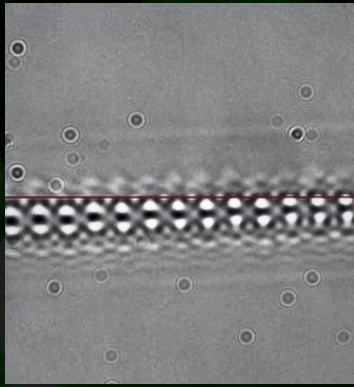
Connector Service



With fused FC/APC connector

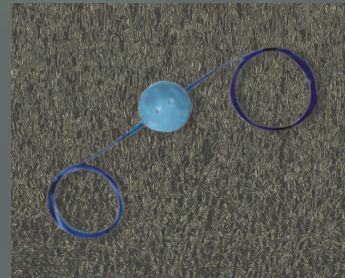
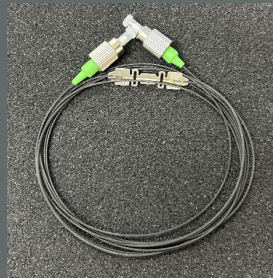
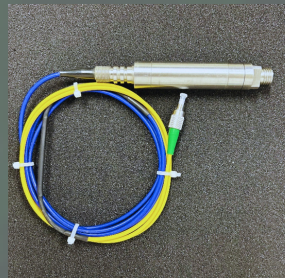


With fused FC/PC connector



Sensors and Demodulators

UFBG Sensors



UFBG Temperature Sensor UFBG Pressure Sensor UFBG Strain Sensor UFBG Soil Pressure Sensor

Demodulators



IF-GD-i6 Signal Demodulator

ULTRAFAST FBG

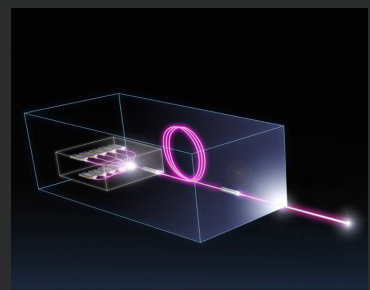
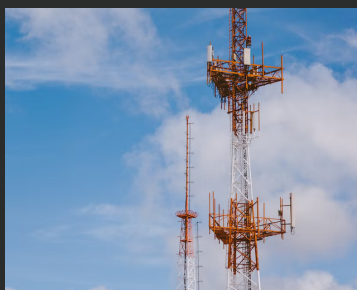
Femtosecond Laser Fabricated FBG

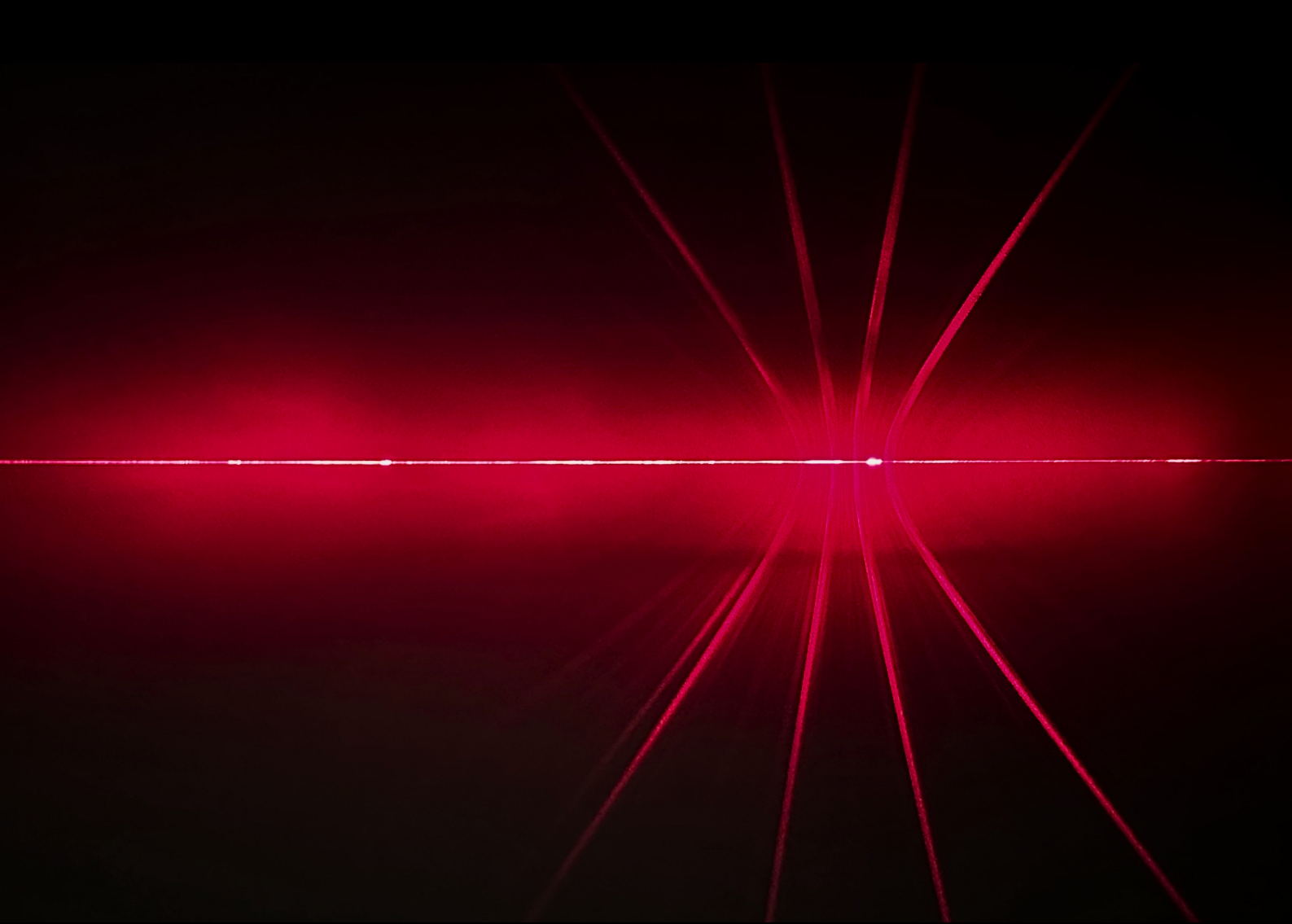




HIGH PERFORMANCE
HIGH CONSISTENCY
HIGH CUSTOMISIBILITY

Applicable to Extreme Environment Sensing Systems, Optical Communication Systems, High Power Fibre Lasers.





UFBG_S

*Femtosecond Laser Fabricated FBG
Standard Reflectivity*

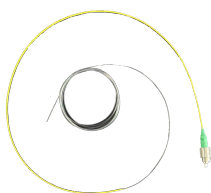
ULTRA-HIGH TEMPERATURE UFBG_S HIGH TEMPERATURE UFBG_S

- HIGH TEMPERATURE STABILITY
- HIGH PRESSURE STABILITY
- HIGH REFLECTIVITY
- HIGH CONSISTENCY
- BETTER CENTRAL WAVELENGTH CONTROL

Ultra-high Temperature UFBG_S



Without
fused FC/APC or
FC/PC connector



With
fused FC/APC or
FC/PC connector

UFBG_S_PI_80_0.25

Femtosecond laser fabricated single FBG

Standard reflectivity

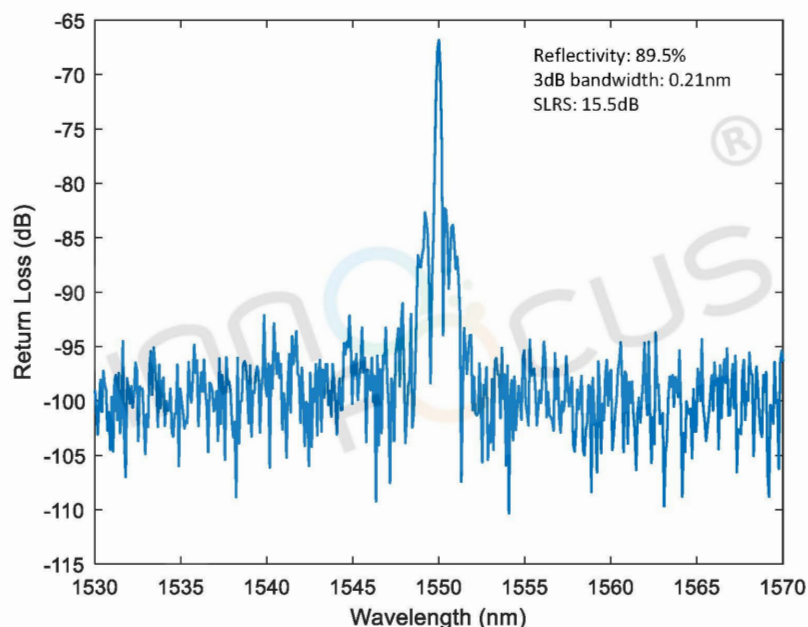
Fibre length 2m

Key Advantages

- Ultra-high temperature stability with PI coating

Reflectivity Spectrum

Device model: UFBG_S_PI_80_0.25



Key Parameters

Reflectivity	> 80%
3 dB Bandwidth	< 0.25 nm
Centre Wavelength	1460 nm - 1640 nm
Side Lobe Suppression Ratio	> 15 dB
Fibre Coating	Polyimide
Grating Length	9 mm

Ultra-high Temperature UFBG_S All Product Specifications

Item No.	Central Wavelength	Reflectivity	3dB Bandwidth	SLSR	Grating Length	Fibre Length	Fibre Coating
UFBG_S_PI_30_0.25	1460 nm – 1640 nm	> 30%	< 0.25 nm	> 15 dB	8.0 mm	2 m	Polyimide
UFBG_S_PI_30_0.40	1460 nm – 1640 nm	> 30%	< 0.40 nm	> 15 dB	5.0 mm	2 m	Polyimide
UFBG_S_PI_30_0.70	1460 nm – 1640 nm	> 30%	< 0.70 nm	> 15 dB	3.0 mm	2 m	Polyimide
UFBG_S_PI_60_0.25	1460 nm – 1640 nm	> 60%	< 0.25 nm	> 15 dB	8.0 mm	2 m	Polyimide
UFBG_S_PI_60_0.40	1460 nm – 1640 nm	> 60%	< 0.40 nm	> 15 dB	6.0 mm	2 m	Polyimide
UFBG_S_PI_60_0.70	1460 nm – 1640 nm	> 60%	< 0.70 nm	> 15 dB	3.0 mm	2 m	Polyimide
UFBG_S_PI_80_0.25	1460 nm – 1640 nm	> 80%	< 0.25 nm	> 15 dB	9.0 mm	2 m	Polyimide
UFBG_S_PI_80_0.40	1460 nm – 1640 nm	> 80%	< 0.40 nm	> 15 dB	7.0 mm	2 m	Polyimide

Customisable Configuration Table

Choose your own suitable parameters according to the following configuration table:

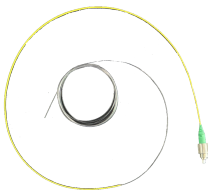
Key Parameters	
Reflectivity	From 5% to 80%
Reflectivity Consistency	Within 5% deviation of the designed reflectivity
3 dB Bandwidth	From 0.20 nm to 0.70 nm
Side Lobe Suppression Ratio	> 15 dB
Central Wavelength	From 1460 nm to 1640 nm
Central Wavelength Deviation	± 0.25 nm
Fibre Coating	Polyimide
Fibre Length	Upon request
Connector Service	With fused FC/APC or FC/PC connector upon request

- Detailed information can be provided upon request.

High Temperature UFBG_S



Without
fused FC/APC or
FC/PC connector



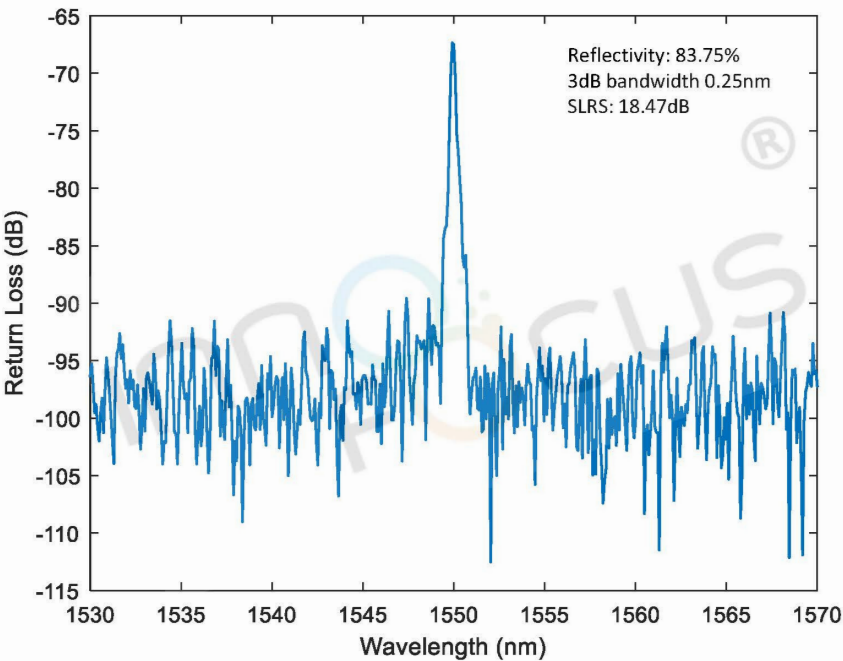
With
fused FC/APC or
FC/PC connector

UFBG_S_AC_80_0.25

Femtosecond laser fabricated single FBG
Standard reflectivity
Fibre length 2m

Reflectivity Spectrum

Reflectivity Spectrum
Device model: UFBG_S_AC_80_0.25



Key Parameters	
Reflectivity	> 80%
3 dB Bandwidth	< 0.25 nm
Central Wavelength	1460 nm - 1640 nm
Side Lobe Suppression Ratio	> 15 dB
Fibre Coating	Acrylate
Grating Length	9 mm

High Temperature UFBG_S All Products Specifications

Item No.	Central Wavelength	Reflectivity	3dB Bandwidth	SLSR	Grating Length	Fibre Length	Fibre Coating
UFBG_S_AC_30_0.25	1460 nm – 1640 nm	> 30%	< 0.25 nm	> 15 dB	8.0 mm	2 m	Acrylate
UFBG_S_AC_30_0.40	1460 nm – 1640 nm	> 30%	< 0.40 nm	> 15 dB	5.0 mm	2 m	Acrylate
UFBG_S_AC_30_0.70	1460 nm – 1640 nm	> 30%	< 0.70 nm	> 15 dB	3.0 mm	2 m	Acrylate
UFBG_S_AC_60_0.25	1460 nm – 1640 nm	> 60%	< 0.25 nm	> 15 dB	8.0 mm	2 m	Acrylate
UFBG_S_AC_60_0.40	1460 nm – 1640 nm	> 60%	< 0.40 nm	> 15 dB	6.0 mm	2 m	Acrylate
UFBG_S_AC_60_0.70	1460 nm – 1640 nm	> 60%	< 0.70 nm	> 15 dB	3.0 mm	2 m	Acrylate
UFBG_S_AC_80_0.25	1460 nm – 1640 nm	> 80%	< 0.25 nm	> 15 dB	9.0 mm	2 m	Acrylate
UFBG_S_AC_80_0.40	1460 nm – 1640 nm	> 80%	< 0.40 nm	> 15 dB	7.0 mm	2 m	Acrylate

Customisable Configuration Table

Choose your own suitable parameters according to the following configuration table:

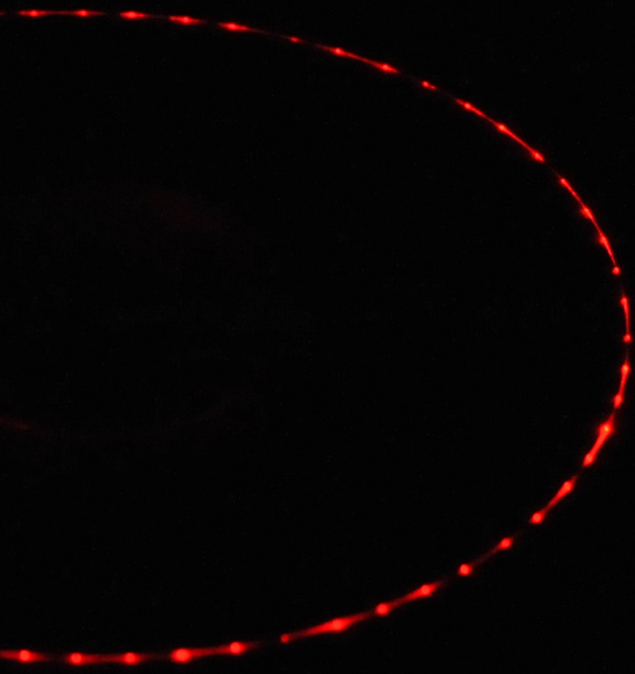
Key Parameters	Selectable Values
Reflectivity	From 5% to 80%
Reflectivity Consistency	Within 5% deviation of the designed reflectivity
3 dB Bandwidth	From 0.20 nm to 0.70 nm
Side Lobe Suppression Ratio	> 15 dB
Central Wavelength	From 1460 nm to 1640 nm
Central Wavelength Deviation	± 0.25 nm
Fibre Coating	Acrylate
Fibre Length	Upon request
Connector Service	With fused FC/APC or FC/PC connector upon request

- Detailed information can be provided upon request.

UFBG_W

*Femtosecond Laser Fabricated FBG Array
Low Reflectivity*





ULTRA-LOW REFLECTIVITY

Down to $< 0.001\%$, allowing for up to 100,000 FBG structures within one fibre

KILOMETRE-LENGTH SENSING

Able to continuously fabricate FBGs up to 5 km, extending the sensing range

HIGH SPATIAL RESOLUTION

Small grating spacing enabling higher sensing accuracy

FULLY CUSTOMISABLE

innofocus C I P C

CUSTOMER INNOVATION & PRACTICE CENTRE

service@innofocus.com.au

UFBG_W Array Example



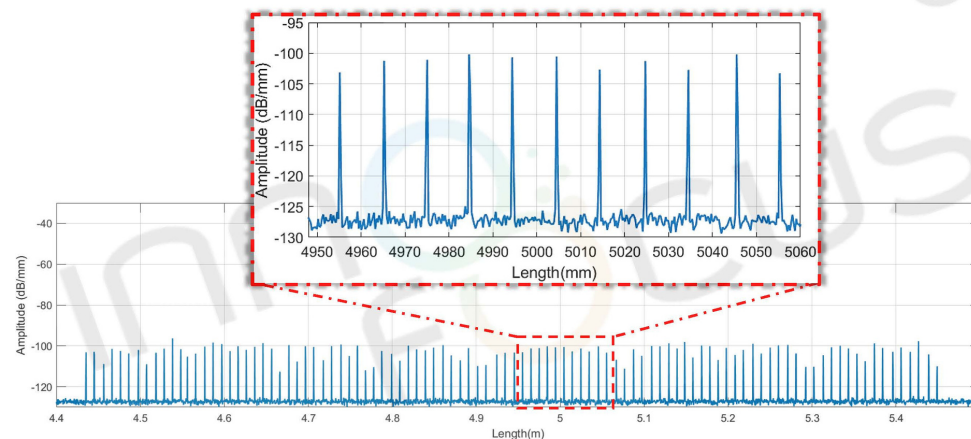
UFBG_W_PI_100_0.05

Femtosecond laser fabricated FBG Array
Weak reflectivity

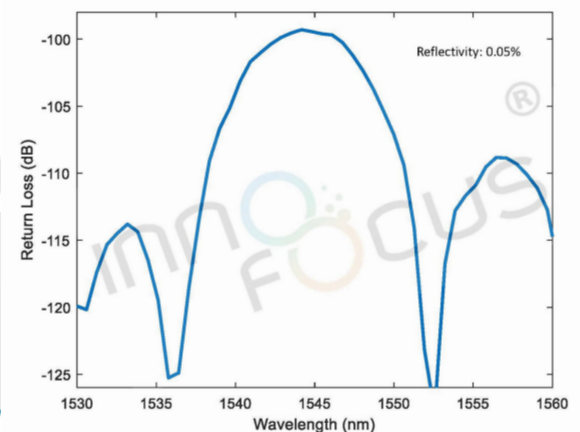
Key Advantages

- **Ultra-low reflectivity** allowing for more sensing points within one fibre
- **High spatial resolution** allowing for higher sensing accuracy

UFBG_W array spatial distribution
Device model: UFBG_W_PI_100_0.05



Reflectivity Spectrum
Device model: UFBG_W_PI_0.05



Key Parameters

Reflectivity	< 0.05%
Quantity	100
Central Wavelength	1460 nm - 1640 nm
Grating Spacing	10 mm
Fibre Coating	Polyimide

UFBG_W Customisable Configuration Table

Choose your own suitable parameters according to the following configuration table:

Key Parameters	Selectable Values
Reflectivity	From < 1% down to < 0.001% (Fully customisable)
Grating Spacing	Down to 500 µm
Grating Length	Down to 30 µm
Quantity	Up to 100,000
Continuous Processing Length	Up to 5 km
Central Wavelength	From 1460 nm to 1640 nm
Central Wavelength Deviation	± 0.25 nm
Fibre Coating	Acrylate / Polyimide
Connector Service	With fused FC/APC or FC/PC connector upon request

- All UFBG_W products are produced according to customer specifications upon request.

SPECIALISED UFBG

*Femtosecond Laser Fabricated FBG Devices
with Fully Customised Reflectivity,
Bandwidth & Central Wavelength*





HIGH PERFORMANCE
HIGH CONSISTENCY
HIGH CUSTOMISABILITY

MORE INNOVATIONS AT



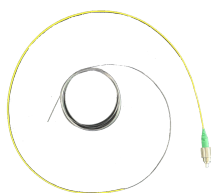
CUSTOMER INNOVATION & PRACTICE CENTRE

service@innofocus.com.au

Specialised UFBG Example 1



Without
fused FC/APC or
FC/PC connector



With
fused FC/APC or
FC/PC connector



Specialised_UFBG_AC_99.99%

Femtosecond laser fabricated Specialised UFBGs

Ultra-high reflectivity reaching 99.99%

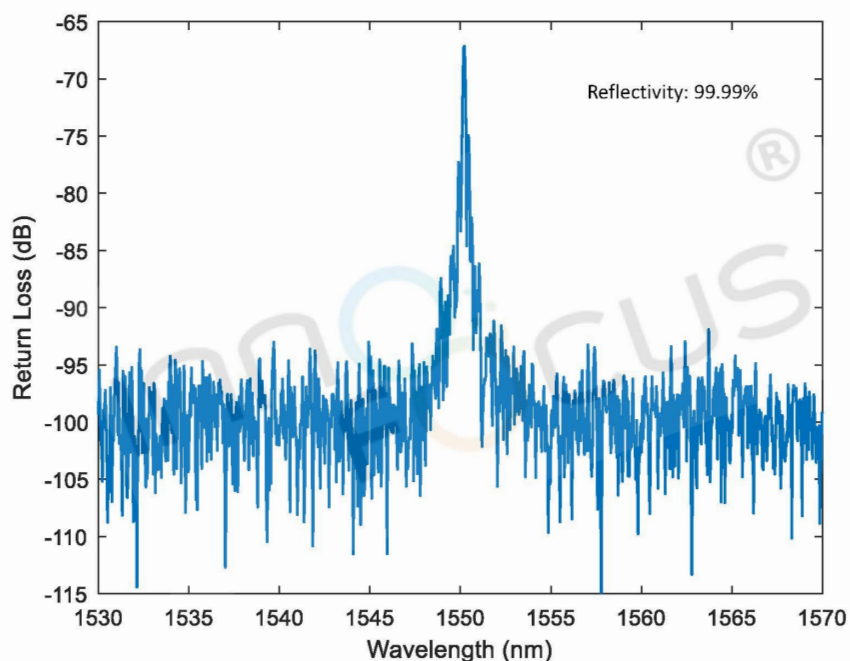
Featured product for high-power fibre lasers application

Key Advantages

- **Efficient Laser Cavity:** Achieving 99.99% reflectivity, perfect for fibre laser cavity reflectors.
- **High Power Handling & Long Lifetime:** They handle high power, ensuring stability and extended lifespan.
- **Industry Pioneer:** Our Specialised UFBG_AC_99.99% is the world's first commercial 99.99% reflectivity product designed for fibre lasers applications.

Reflectivity Spectrum

Device model: Specialised UFBG_AC_99.99%



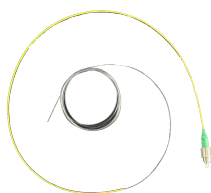
Key Parameters

Reflectivity	> 99.99%
3 dB Bandwidth	< 0.20 nm
Central Wavelength	1460 nm - 1640 nm
Fibre Coating	Acrylate

Specialised UFBG Example 2



Without
fused FC/APC or
FC/PC connector



With
fused FC/APC or
FC/PC connector

Specialised_UFBG_AC_0.05nm

Femtosecond laser fabricated FBG

Ultra-narrow bandwidth 0.05 nm

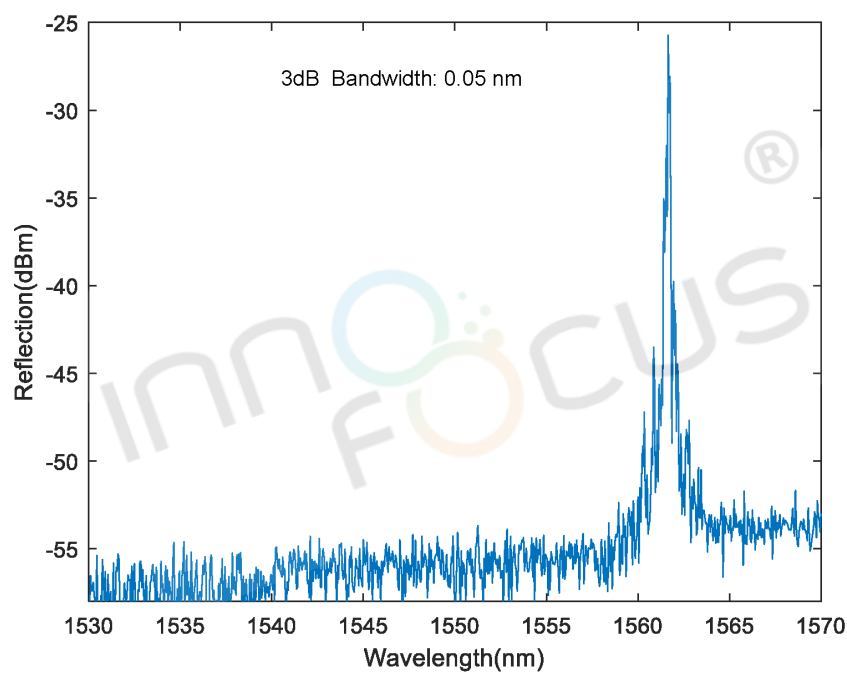
Featured product for optical communications & sensing

Key Advantages

- **Wavelength Division Multiplexing (WDM):** Enables channel spacing as small as 0.05 nm, allowing for densely packed channels and high data capacity.
- **High Sensitivity:** Maximises sensitivity in sensing applications, enabling the detection of minuscule changes with high precision.

Reflectivity Spectrum

Device model: Specialised UFBG_AC_0.05 nm



Key Parameters

Reflectivity	> 80%
3 dB Bandwidth	0.05 nm
Central Wavelength	1460 nm - 1640 nm
Fibre Coating	Acrylate

Specialised UFBG Customisable Configuration Table

Choose your own suitable parameters according to the following configuration table:

Key Parameters	Selectable Values
Reflectivity	Up to > 99.99%
3 dB Bandwidth	Down to 0.05 nm
Side Lobe Suppression Ratio	Up to 22 dB
Central Wavelength	From 1460 nm to 1640 nm
Fibre Coating	Acrylate / Polyimide
Connector Service	With fused FC/APC or FC/PC connector upon request

- Detailed information can be provided upon request.

Specialised UFBG

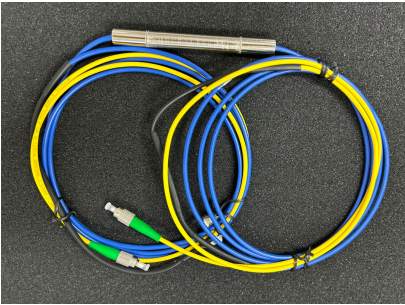
SENSORS AND DEMODULATORS



IMMUNE TO HUMIDITY, RADIOACTIVITY, CHEMICAL CORROSION,
HAVE BROAD APPLICATIONS IN ALMOST EVERY INDUSTRY

Applicable Temperature up to 800 °C, Applicable Pressure up to 60 MPa





UFBG Temperature Sensor

UFBG Temperature Sensor is featured for surface and internal temperature sensing and monitoring for various structures.

UFBG Temperature Sensors have extensive applications in constructions including factories, bridges, dams, tunnels and etc. They can also be broadly applied to industries such as oil and gas, power plant for fire protection purposes.

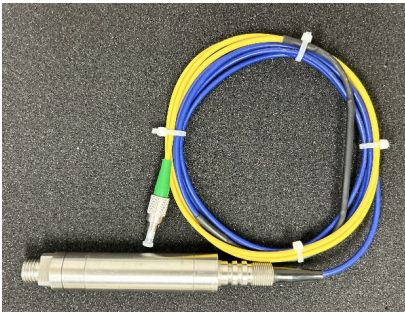
Key Parameters

Temperature Sensing Range	-50 °C ~ +350 °C
Accuracy	± 0.5 °C
Resolution	± 0.1 °C
Central Wavelength	1525 nm ~1565 nm
Dimension	Φ10*110 mm

- High temperature sensing range can be customised upon request.

Common Applications

- ✓ Oil & Gas Temperature Monitoring
- ✓ Mine Temperature Sensing
- ✓ Power Plant Temperature Monitoring



UFBG Pressure Sensor

UFBG Pressure Sensors is featured for pressure sensing and monitoring in various industrial automation environments.

UFBG Pressure Sensors can be used to monitor the water level, gas pipeline pressure, long-term monitoring of oil well and oil tank pressure. UFBG Pressure Sensors demonstrate their high performance for long-term pressure monitoring of oil well between 0.01 MPa ~ 60 MPa.

Key Parameters	
Pressure Sensing Range	0.01 Mpa ~ 60 Mpa
Accuracy	0.5% F·S
Resolution	0.1% F·S
Central Wavelength	1525 nm ~1565 nm
Reflectivity	≥ 90 %
Working Temperature Range	-50 °C ~ +120 °C
Dimension	Φ 14 ~ 40*60 mm

- Detailed information can be provided upon request.

Common Applications

- ✓ Oil Industry for Oil Well and Oil Tank Pressure Monitoring
- ✓ Gas Pipeline Pressure Monitoring
- ✓ Mine Pressure Monitoring



UFBG Strain Sensor

UFBG Strain Sensors with narrow 3dB Bandwidth and can be used to monitor structural deformations of aircrafts, electricity generators, oil and gas tank surfaces, wind turbines and etc.

Key Parameters

Strain Sensing Range	$\pm 2500 \mu\epsilon$
Strain Coefficient	$0.714 \mu\epsilon / \text{pm}$
3 dB Bandwidth	0.25 nm
Central Wavelength	1525 nm ~1565 nm
Reflectivity	90%
Side Lobe Suppression Ratio	> 20 dB
Working Temperature Range	-40 °C ~ +120 °C
Dimension	37*8*0.8 mm
Weight	2.6 g

- Detailed information can be provided upon request.

Common Applications

- ✓ Aircrafts
- ✓ Electricity Generators
- ✓ Wind Turbines



UFBG Soil Pressure Sensor

UFBG Soil Pressure Sensors are featured for monitoring soil pressure. They are consisted of two welded stainless stall plates, as the external pressure adding onto the sensor surface, the sensors will convert the pressure to an optical signal which will be transmitted to a signal demodulator to realise soil pressure monitoring.

UFBG Soil Pressure Sensors are suitable for long-term soil pressure management in soil, dams, embankments, slopes, roadbeds and etc.

Key Parameters	
Soil Pressure Sensing Range	50 kPa~ 34500 kPa
Accuracy	0.5% F·S
Central Wavelength	1525 nm ~1565 nm
Working Temperature Range	-50 °C ~ +120 °C

- Detailed information can be provided upon request.

Common Applications

- ✓ Soil
- ✓ Dams
- ✓ Slopes
- ✓ Roadbeds



Front



Rear

IF-GD-i6 Demodulator

IF-GD-i6 Demodulator obtains 8 channels and customisable scanning frequency (from 1 Hz up to 1000 Hz), demodulating signals from all UFBG sensors listed above. The demodulator builds in a calibration wavelength reference module, and it ensures a long-term accuracy of ± 2 pm when used between $-10^{\circ}\text{C} \sim 55^{\circ}\text{C}$.

Key Parameters

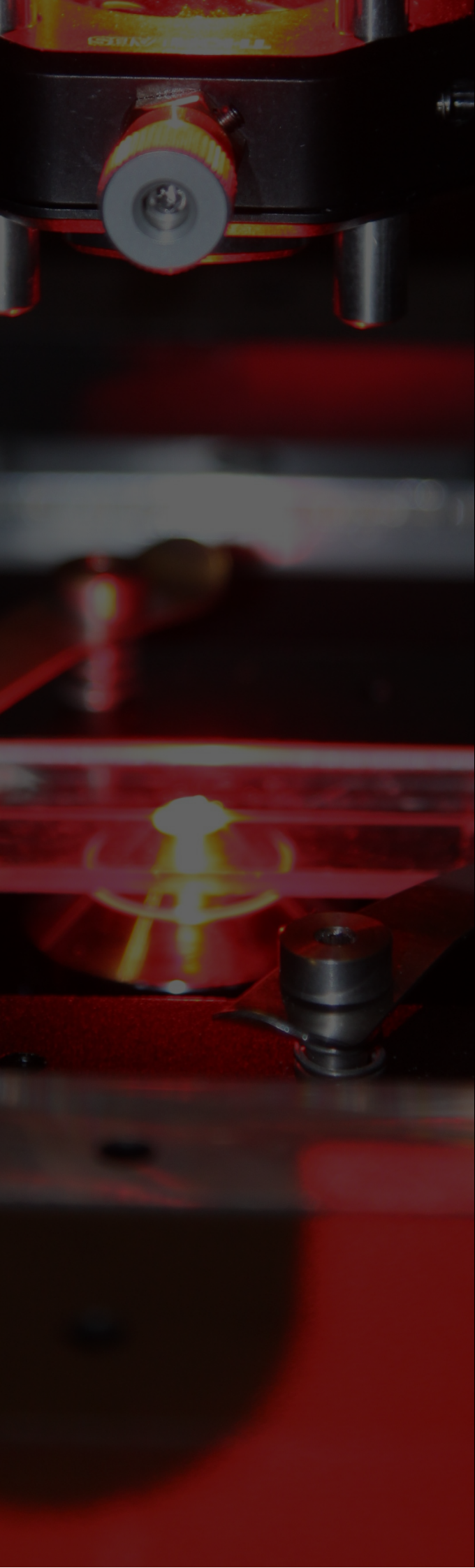
No. of Channels	8
Sampling Frequency	1 - 1000 Hz
Central Wavelength	1528 nm ~1568 nm
Resolution	0.1 pm
Accuracy	± 2 pm
Detecting Dynamic Range	≥ 40 dB

- Detailed information can be provided upon request.

Common Applications

IF-GD-i6 Demodulator can work with a various of sensors:

- ✓ Temperature Sensors
- ✓ Pressure Sensors
- ✓ Strain Sensors
- ✓ Soil Pressure Sensors
- ✓ Displacement Sensors



CONTACT US

Customer Innovation and Practice Centre:
service@innofocus.com.au

Products and Solutions Inquiry:
sales@innofocus.com.au