SPACE PHOTONICS

Mission-specific space optical amplifiers

Custom optical booster and low-noise amplifier configurations for orbital laser links.

Applications to discuss: Optical inter-satellite links; Satellite optical terminals.

Custom mission hardware; qualification to confirm

Selection points
1060 nm-band or 1550 nm-band options / PM and non-PM designs / Booster, preamplifier or combined functions

Configuration options

Optical band	Possible functions	Output-power limit
1060 nm band	Booster or low-noise amplification	Mission-specific; confirm
1550 nm band	Booster or low-noise amplification	Mission-specific; confirm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Orbit classes for design review	LEO, MEO or GEO requirements
Polarization	Polarization-maintaining or non-PM configurations
Control electronics	Radiation-tolerant electronics can be considered; grade and test evidence to confirm

Integration and delivery

Item	Configuration detail
Housing	Custom mission footprint, mass and thermal interface
Interface conformance	Agree the required optical-communications interface standard and revision

Conditions and configuration notes

• Mission acceptance requires a configuration-specific qualification plan and evidence for the delivered hardware. No blanket flight, radiation or standards qualification is asserted by this draft.

• Review thermal-vacuum, vibration, shock, radiation and electromagnetic requirements with the mission interfaces.

SPACE PHOTONICS

5 W space optical booster and preamplifier systems

Combined optical power amplification and receive preamplification in a compact mission enclosure.

Applications to discuss: LEO optical terminals; Spaceborne transmit and receive chains.

Platform specification; mission evidence required

Selection points
5 W listed booster output / Combined booster and preamplifier / 30 krad reported radiation rating

Configuration options

Platform reference	Listed booster output	Reported radiation rating
Combined space amplifier	5 W	Up to 30 krad; conditions to confirm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Reference orbit class	LEO design context
Signal wavelength	Confirm the exact passband of this platform
Receive amplifier gain and noise	Not numerically specified
Radiation conditions	Material reference, shielding, dose rate and particle environment not specified

Integration and delivery

Item	Configuration detail
Integration	Shared mission enclosure; dimensions, mass, power and thermal path to confirm

Conditions and configuration notes

• Mission acceptance requires a configuration-specific qualification plan and evidence for the delivered hardware. No blanket flight, radiation or standards qualification is asserted by this draft.

• Review thermal-vacuum, vibration, shock, radiation and electromagnetic requirements with the mission interfaces.

• The 30 krad figure is not a complete radiation qualification. Its test method, dose basis and applicability to the delivered configuration must be reviewed.

SPACE PHOTONICS

Optical ground-station power amplifiers

C-band high-power optical amplification for ground-to-space communication terminals.

Applications to discuss: Optical satellite uplinks; Ground-station terminals; Space-debris tracking.

Configuration-specific ground hardware

Selection points
50 W described amplifier configuration / C-band output / PPM, OOK or coherent-link review

Configuration options

Configuration	Optical band	Listed output power
Ground-station amplifier	C-band; exact range to confirm	Up to 50 W

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Beam quality	Near diffraction limited; numerical M^2 to confirm
Modulation formats for review	Pulse-position modulation, on-off keying or coherent signalling
Interface conformance	Required optical-communications standard and revision to be agreed

Integration and delivery

Item	Configuration detail
Integration	Custom optical, control and thermal interfaces

Conditions and configuration notes

• The detailed description gives up to 50 W; a separate headline mentions greater than 50 W. This draft adopts the described 50 W configuration and leaves higher output for confirmation.

• Modulation format, peak power, duty cycle and received waveform quality must be specified together.

SPACE PHOTONICS

589 nm sodium guide-star laser systems

High-power sodium-line sources for adaptive-optics telescope and optical ground-station systems.

Applications to discuss: Astronomical adaptive optics; Optical ground-station adaptive optics.

Reported platform performance; configuration to confirm

Selection points
>75 W reported at 589 nm / Atomic frequency reference / Remote pump delivery over >30 m reported

Configuration options

Output reference	Wavelength	Reported optical output
Guide-star system	589 nm	>75 W

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Beam propagation factor	M^2 = 1.04, reported
Beam asymmetry	<4%, reported
Astigmatism	<4%, reported
Wavefront error	<10 nm RMS, reported
Frequency control	Atomic wavelength reference; chirp-ready architecture
Repumping	Single-sideband repumping arrangement
Remote separation	>30 m between electronics and laser head, reported

Integration and delivery

Item	Configuration detail
Architecture	Raman fibre amplification and non-resonant frequency doubling
Telescope interface	Specify beam launch, cooling, locking and remote-pump interfaces

Conditions and configuration notes

- These figures are reported platform performance, not a guaranteed acceptance specification for every configuration.
- Confirm line shape, repumping offset, tuning and chirp capability, polarization and power at the telescope launch plane.
- Ground-based telescope use does not establish qualification for flight.

SPACE PHOTONICS

1178 nm narrowband guide-star fibre amplifiers

Narrowband infrared amplification for frequency-doubled sodium guide-star architectures.

Applications to discuss: Guide-star laser development; Adaptive-optics source integration.

Amplifier technology references; supply configuration to confirm

Selection points
1178 nm amplified seed / 130 W reported infrared scaling point / Separate frequency conversion to 589 nm

Configuration options

Reference operating point	Infrared wavelength	Reported infrared power
Earlier amplifier reference	1178 nm	40 W
Higher-power amplifier reference	1178 nm	130 W

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Architecture	Polarization-maintaining fibre amplification
Pump-chain reference	1064 nm and 1120 nm pump lasers
Conversion path	Second-harmonic generation from 1178 nm to 589 nm
Seed linewidth and amplifier gain	Numerical limits to confirm

Integration and delivery

Item	Configuration detail
System boundary	Seed, pump delivery, amplifier and visible conversion stage must be defined

Conditions and configuration notes

- The 130 W value is an infrared amplifier reference, not a 589 nm output-power claim.
- The historical 40 W and higher-power 130 W references are different configurations, not a continuously adjustable guaranteed range.
- Confirm whether an amplifier-only assembly is available and which ancillary stages are included.

SPACE DEVELOPMENT

High-power space-link amplifier development

Development targets for next-generation spaceborne and terrestrial optical amplifiers.

Applications to discuss: Future satellite optical networks; High-power ground terminals.

Development targets; not released specifications

Selection points
100 W spaceborne development target / 1000 W terrestrial development target / No released acceptance limits

Configuration options

Development direction	Target optical power	Status
Spaceborne amplifier	100 W	Development target
Terrestrial amplifier	1000 W	Development target

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Optical band, noise and gain	Not specified for these targets
Link capacity	System-level terabit communication objective; no guaranteed throughput assigned
Mission qualification	Development and qualification evidence required

Integration and delivery

Item	Configuration detail
Integration	Optical, electrical, mechanical and thermal interfaces under development

Conditions and configuration notes

- Do not interpret development targets as available output-power specifications.
- No delivered size, mass, electrical power, passband, reliability or radiation rating is assigned to these targets.

SPACE DEVELOPMENT

High-energy 1550 nm pulsed fibre amplifier prototype

A polarization-maintaining pulsed amplifier prototype with reported high-energy operating points.

Applications to discuss: Pulsed optical-communications research; Photoacoustic research; Scientific pulse experiments.

Functional prototype; released availability unconfirmed

Selection points
1545-1565 nm wavelength range / >20 W reported average output / Up to 80 µJ reported pulse energy

Configuration options

Wavelength	Pulse duration range	Repetition-rate range
1545-1565 nm	2-100 ns	0.05-50 MHz

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Average output power	>20 W, reported prototype
Peak power	Up to 4 kW, reported
Pulse energy	Up to 80 µJ, reported
Emission linewidth	≤50 pm at the 1/e² definition
Gain medium	Polarization-maintaining erbium-ytterbium-doped fibre
Delivery	Collimated pigtailed output; interface to confirm

Integration and delivery

Item	Configuration detail
Integration	Compact prototype; size, mass, electrical power and thermal interfaces to confirm

Conditions and configuration notes

- Pulse energy, peak power, average power and repetition-rate extremes are not one simultaneous operating point.
- A deep-space optical-communications standard is a design objective, not an established compliance claim in this draft.
- Hollow-core delivery is described as an investigation and is not assumed to be included.

SPACE DEVELOPMENT

Temperature-responsive spacecraft radiator films

A thin-film thermal-control concept that changes emissivity with temperature.

Applications to discuss: Passive spacecraft thermal control.

Development technology; numerical design data to confirm

Selection points
Tungsten-doped VO□ thin film / Temperature-dependent emissivity / Thermal-control development concept

Configuration options

Concept	Lower-temperature behaviour	Higher-temperature behaviour
Responsive radiator film	Lower-emissivity heat retention	Higher-emissivity heat rejection

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Transition temperature	Not numerically specified
Emissivity limits	Not numerically specified
Film thickness and area	Not numerically specified
Space qualification	Mission-specific evidence to confirm

Integration and delivery

Item	Configuration detail
Integration	Substrate, coating process and spacecraft thermal interface require review

Conditions and configuration notes

• No temperature setpoint, thermal capacity, emissivity range or flight acceptance limit is inferred.

• Ground-test statements do not establish flight qualification for a delivered coating.

CONTINUOUS WAVE

CW visible fibre laser modules

Visible CW light for instruments that need stable illumination and a well-defined beam.

Applications to discuss: Microscope excitation; Flow-cytometry illumination; Optical inspection.

Selection points
465-775 nm wavelength options / 200-1000 mW family power range / 20-100% power adjustment

Configuration options

Configuration	Wavelength options	Output power
Wavelength-selected system	465-775 nm	200-1000 mW; wavelength dependent

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Power adjustment	20-100%
Beam propagation factor	M^2 <1.1
Polarization extinction ratio	20 dB
Beam diameter	1 mm ±20%
Long-term wavelength stability	±0.1 nm
Intensity noise at nominal power	2% RMS, integrated over 5 Hz-100 kHz
Long-term power drift	2% peak-to-peak

Integration and delivery

Item	Configuration detail
Format	Integration module with separate frequency-conversion head
Delivery	Free-space output; optional fibre coupling
Control	Graphical interface; modulation option requires configuration review

Conditions and configuration notes

- Output power depends on wavelength and configuration. A family maximum is not available at every wavelength.
- Confirm the delivered power after any fibre coupling, isolation or added optics.
- Power adjustment is an intensity setting; it is not wavelength tuning. The drift averaging time is not stated.

CONTINUOUS WAVE

CW visible rack fibre lasers

Visible CW light for instruments that need stable illumination and a well-defined beam.

Applications to discuss: Microscope excitation; Flow-cytometry illumination; Optical inspection.

Selection points
465-775 nm wavelength options / 200-5000 mW family power range / 20-100% power adjustment

Configuration options

Configuration	Wavelength options	Output power
Wavelength-selected system	465-775 nm	200-5000 mW; wavelength dependent

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Power adjustment	20-100 %
Beam propagation factor	M^2 <1.1
Polarization extinction ratio	20 dB
Beam diameter	1 mm ±20%
Long-term wavelength stability	±0.1 nm
Intensity noise at nominal power	2% RMS, integrated over 5 Hz-100 kHz
Long-term power drift	2% peak-to-peak

Integration and delivery

Item	Configuration detail
Format	2U, 19-inch rack format with separate frequency-conversion head
Delivery	Free-space output; optional fibre coupling
Control	Graphical interface; modulation option requires configuration review

Conditions and configuration notes

- Output power depends on wavelength and configuration. A family maximum is not available at every wavelength.
- Confirm the delivered power after any fibre coupling, isolation or added optics.
- Power adjustment is an intensity setting; it is not wavelength tuning. The drift averaging time is not stated.

CONTINUOUS WAVE

Dual-wavelength CW fibre laser

Two visible channels in a shared rack platform for experiments using 488 nm and 514 nm excitation.

Applications to discuss: Two-colour microscopy; Flow-cytometry excitation.

Selection points
488 nm and 514 nm channels / 1000 mW and 1500 mW listed outputs / Simultaneous CW operation

Configuration options

Channel	Wavelength	Listed output
Blue channel	488 ± 0.5 nm	1000 mW
Green channel	514 ± 0.5 nm	1500 mW

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Power adjustment	40-100%
Emission linewidth	0.1 nm
Long-term wavelength stability	±0.1 nm
Beam propagation factor	M^2 <1.1
Power drift over 8 hours	2% peak-to-peak
Polarization	Linear
Transverse mode	TEM00

Integration and delivery

Item	Configuration detail
Format	2U, 19-inch rack platform; separate frequency-conversion head
Outputs	Two laser beams
Control	RS232 and USB graphical interface

Conditions and configuration notes

- The listed channel powers are not a guarantee of power after additional fibre coupling or isolation.
- Confirm how the two channels are delivered and whether any beam-combining optics are included.

CONTINUOUS WAVE

CW near-infrared fibre laser modules

Near-infrared CW output for spectroscopy, optical instrumentation and system integration.

Applications to discuss: Laser spectroscopy; Microscope and instrument integration.

Selection points
1030-2000 nm selected bands / ≤10 W family maximum / Air-cooled format

Configuration options

Configuration	Wavelength options	Output power
Wavelength-selected system	1030-1100 nm, 1530-1600 nm , 1730-2000 nm	≤10 W; wavelength dependent

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Beam propagation factor	M^2 <1.1
Polarization	20 dB polarization extinction ratio
Long-term wavelength stability	±0.1 nm
Long-term power drift	±1%
Intensity noise	<2% RMS, integrated over 5 Hz-100 kHz

Integration and delivery

Item	Configuration detail
Format and cooling	Air-cooled integration package
Controls	Graphical interface; detailed electrical interface to confirm
Output delivery	Confirm beam geometry and any fibre delivery

Conditions and configuration notes

• Output power depends on wavelength and configuration. A family maximum is not available at every wavelength.

• Confirm the delivered power after any fibre coupling, isolation or added optics.

• The wavelength groups are selectable configurations, not one continuously tunable laser. No single-frequency linewidth is assigned to this family.

CONTINUOUS WAVE

CW near-infrared rack lasers

Near-infrared CW output for spectroscopy, optical instrumentation and system integration.

Applications to discuss: Laser spectroscopy; Microscope and instrument integration.

Selection points
930-2000 nm selected bands / ≤50 W family maximum / Air-cooled format

Configuration options

Configuration	Wavelength options	Output power
Wavelength-selected system	930 nm, 976 nm, 1030-1100 nm, 1530-1600 nm , 1730-2000 nm	≤50 W; wavelength dependent

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Beam propagation factor	M^2 <1.1
Polarization	20 dB polarization extinction ratio
Long-term wavelength stability	±0.1 nm
Long-term power drift	±1%
Intensity noise	<2% RMS, integrated over 5 Hz-100 kHz

Integration and delivery

Item	Configuration detail
Format and cooling	Air-cooled 2U, 19-inch rack package
Controls	Graphical interface; detailed electrical interface to confirm
Output delivery	Confirm beam geometry and any fibre delivery

Conditions and configuration notes

• Output power depends on wavelength and configuration. A family maximum is not available at every wavelength.

• Confirm the delivered power after any fibre coupling, isolation or added optics.

• The wavelength groups are selectable configurations, not one continuously tunable laser. No single-frequency linewidth is assigned to this family.

CONTINUOUS WAVE

Water-cooled near-infrared fibre lasers

Near-infrared CW output for spectroscopy, optical instrumentation and system integration.

Applications to discuss: Laser spectroscopy; Quantum-optics experiments.

Selection points
930-2000 nm selected bands / Power limit awaiting clarification / Water-cooled format

Configuration options

Configuration	Wavelength options	Output power
Wavelength-selected system	930 nm, 976 nm, 1030-1100 nm, 1530-1600 nm, 1730-2000 nm	To be confirmed for the selected wavelength

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Beam propagation factor	M^2 <1.1
Polarization	99% degree of polarization
Long-term wavelength stability	±0.02 nm
Long-term power drift	±1%
Intensity noise	<2% RMS, integrated over 5 Hz-100 kHz

Integration and delivery

Item	Configuration detail
Format and cooling	Water-cooled 2U, 19-inch rack package
Controls	Graphical interface; detailed electrical interface to confirm
Output delivery	Confirm beam geometry and any fibre delivery

Conditions and configuration notes

• Output power depends on wavelength and configuration. A family maximum is not available at every wavelength.

• Confirm the delivered power after any fibre coupling, isolation or added optics.

• The published output-power notation is inconsistent. No numerical power limit is adopted in this draft; confirm an operating point before selection.

• The wavelength groups are selectable configurations, not one continuously tunable laser. No single-frequency linewidth is assigned to this family.

SINGLE FREQUENCY

Single-frequency fibre seed lasers

Low-power single-frequency seeds with thermal tuning and optional piezo frequency control.

Applications to discuss: Precision spectroscopy; Interferometry; Seeded amplifier systems.

Selection points
Four near-infrared wavelength bands / 5-50 mW nominal examples / 50 kHz maximum linewidth in listed tables

Configuration options

Wavelength band	Nominal example	Nominal output	Linewidth	Thermal tuning	Piezo tuning
910-930 nm options	922 nm nominal	5 mW nominal	50 kHz maximum	±0.1 nm about the centre	10 GHz minimum; optional piezo
1013-1110 nm options	1110 nm nominal	50 mW nominal	10 kHz nominal; 50 kHz maximum	±0.2 nm about the centre	10 GHz minimum; optional piezo
1530-1580 nm options	1550 nm nominal	5 mW nominal	50 kHz maximum	±0.2 nm about the centre	10 GHz maximum; optional piezo
1730-1950 nm options	1750 nm nominal	10 mW nominal	50 kHz maximum	±0.2 nm about the centre	10 GHz maximum; optional piezo

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Polarization extinction ratio	20 dB minimum
ASE suppression	50 dB minimum at 0.1 nm resolution bandwidth
Beam propagation factor	M^2 <1.1

Integration and delivery

Item	Configuration detail
Format	Benchtop controller with touchscreen and remote monitoring
Frequency control	Temperature control; optional piezo tuning and locking
Optical delivery	Polarization-maintaining fibre; connector to confirm

Conditions and configuration notes

• The 922, 1110, 1550 and 1750 nm figures are nominal examples, not all available centre wavelengths.

• Piezo limits are minima for the first two examples and maxima for the last two. The end-to-end tuning span and mode-hop behaviour need confirmation.

• No claim about final linewidth after an external amplifier or frequency converter is made.

SINGLE FREQUENCY

Single-frequency near-infrared fibre lasers

Integrated seed-and-amplifier systems for narrow-linewidth near-infrared experiments.

Applications to discuss: Atomic spectroscopy; Interferometry; Quantum-optics experiments.

Selection points
920-1900 nm selected bands / <50 kHz listed linewidth / Power limits vary by wavelength

Configuration options

Wavelength option	Output power	Emission linewidth
920-930 nm	≤6 W	<50 kHz
977 nm	≤4 W	<50 kHz
1018-1100 nm	≤30 W	<50 kHz
1535-1580 nm	≤8 W	<50 kHz
1730-1900 nm	≤10 W	<50 kHz

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Polarization extinction ratio	>20 dB
Beam propagation factor	M^2 <1.1
Polarization	Linear

Integration and delivery

Item	Configuration detail
Format	Air-cooled 2U, 19-inch rack enclosure
Controls	Constant-current or constant-power operation; power and temperature monitoring
Output	Polarized fibre output; confirm connector and isolation

Conditions and configuration notes

- Each wavelength band has its own power limit; the 30 W limit applies only to the 1018-1100 nm configuration.
- The linewidth measurement time and test method are not stated in the specification table.

SINGLE FREQUENCY

Single-frequency visible and near-infrared fibre lasers

Single-frequency systems combining a seed, fibre amplifier and single-pass frequency conversion.

Applications to discuss: Atomic physics; Holography; Laser spectroscopy.

Selection points
460-950 nm selected options / <100 kHz emission linewidth / Visible and near-infrared configurations

Configuration options

Output wavelength	Output power	Intensity noise, RMS
460-466 nm	500 mW	0.5%
514-550 nm	≤5 W	0.5%
633 nm	≤1 W	0.1%
767-790 nm	≤5 W	0.5%
865-950 nm	≤4 W	0.5%

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Emission linewidth	<100 kHz
Noise integration bandwidth	5 Hz-100 kHz
Polarization extinction ratio	>20 dB
Beam propagation factor	M^2 <1.2
Polarization	Linear

Integration and delivery

Item	Configuration detail
Format	Air-cooled 2U, 19-inch seed and amplifier enclosure
Conversion	Single-pass second-harmonic generation
Delivery and tuning	Collimated beam; fibre-output option and optional piezo tuning require configuration review

Conditions and configuration notes

- The intensity-noise entry at 633 nm is 0.1%; the other listed bands state 0.5%.
- Wavelength choices across the family do not imply a continuously tunable output across the full span.
- Linewidth measurement conditions and power after optional fibre delivery must be confirmed.

SINGLE FREQUENCY

High-power single-frequency visible laser systems

Visible single-frequency output using a seeded fibre amplifier and a stabilized resonant conversion cavity.

Applications to discuss: Atomic spectroscopy; Quantum-optics experiments.

Selection points
532-671 nm wavelength options / ≤10 W listed family limit / <100 kHz emission linewidth

Configuration options

Configuration	Output wavelength options	Output power
Resonant frequency conversion	532-671 nm	≤10 W; configuration dependent

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Emission linewidth	<100 kHz
Coarse frequency adjustment	50 GHz
Fine frequency adjustment	500 MHz
Beam propagation factor	M^2 <1.2
Collimated beam diameter	1 mm
Relative intensity noise	<0.5%; bandwidth to confirm
Wavelength stability	±0.1 pm; averaging time to confirm

Integration and delivery

Item	Configuration detail
System elements	Single-frequency seed, polarization-maintaining amplifier, resonant conversion cavity and cavity-control electronics
Cavity control	Pound-Drever-Hall stabilization; electrical interfaces to confirm

Conditions and configuration notes

- The frequency adjustment values are not a claim of tuning across the full 532-671 nm family range.
- Available power depends on output wavelength and the chosen conversion configuration.
- Noise bandwidth, wavelength-stability duration and included locking hardware require confirmation.

FIBRE AMPLIFICATION

Single-frequency amplifier systems with visible conversion

Seeded amplification and frequency conversion for narrowband visible experiments.

Applications to discuss: Narrowband spectroscopy; Atomic-physics light sources.

Selection points
461-765 nm selected output bands / 10-50 mW listed input range / External seed requirements to confirm

Configuration options

Output band	Listed output power
461 nm	0.5 W
488-560 nm	≤4 W
550-765 nm	≤4 W

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Input power range	10-50 mW; input wavelength and required seed quality to confirm
Polarization extinction ratio	20 dB
Beam propagation factor	M^2 <1.1

Integration and delivery

Item	Configuration detail
System format	Amplifier with optional or required frequency conversion, according to output wavelength
Seed	External single-frequency seed; included supply to confirm
Delivery	Fibre or collimated output, configuration dependent

Conditions and configuration notes

• These are seeded amplifier systems, not standalone laser sources. Confirm whether the external seed is supplied separately.

• Visible output can require a frequency-conversion stage. Specify the seed wavelength, target output wavelength and all included stages.

• Power figures apply to the selected configuration; they are not available across every wavelength in a band.

• Availability of short-wavelength configurations, including 461 nm and 488 nm, must be confirmed.

• No numerical final-output linewidth or gain is assigned without an agreed seed and operating point.

FIBRE AMPLIFICATION

Single-frequency near-infrared fibre amplifiers

Wavelength-specific fibre amplifier configurations for externally seeded narrowband systems.

Applications to discuss: Seeded laser systems; Quantum-optics experiments; Precision metrology.

Selection points
775-1950 nm selected output bands / Nine wavelength-specific configurations / Up to 20 W in one water-cooled band

Configuration options

Output band	Listed output power
775-800 nm	≤4 W
813 or 832 nm	≤4 W
1100-1280 nm	≤20 W
1290-1360 nm	≤15 W
1370-1400 nm	≤5 W
1410-1525 nm	≤8 W
1600-1720 nm	≤5 W
1530-1590 nm	≤10 W
1730-1950 nm	≤10 W

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Input power range	10-50 mW; input wavelength and required seed quality to confirm
Polarization extinction ratio	20 dB
Beam propagation factor	M^2 <1.1

Integration and delivery

Item	Configuration detail
Output delivery	Fibre or collimated delivery, depending on the wavelength configuration.

Conditions and configuration notes

• An external single-frequency seed is required. Confirm the input wavelength, seed power, seed linewidth and whether the seed is included.

• The 775-800 nm and 813/832 nm options may require conversion. Confirm the input wavelength and included stages.

• The 20 W limit requires water cooling and applies only to 1100-1280 nm. Confirm cooling for every other configuration.

• No common numerical gain, output linewidth or noise figure is specified across these bands.

PICOSECOND

Picosecond fibre seed lasers

Low-power picosecond sources for seeded amplifiers and time-resolved optical systems.

Applications to discuss: Time-resolved spectroscopy; Optical metrology.

Selection points
920-1570 nm selected bands / 3-100 ps listed options / Polarization-maintaining fibre delivery

Configuration options

Configuration	Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
920 nm seed	920 nm	3-5 ps	80 MHz	1-20 mW	<0.5 nm
Narrowband near-infrared seed	1020-1080 nm	6-60 ps	10-100 MHz	1-60 mW	Near transform limited
Broadband near-infrared seed	1020-1080 nm	3 ps	10-100 MHz	2 mW	Broadband pulses
Long-wavelength seed	1120-1240 nm	15-100 ps	30-100 MHz	1-60 mW	Near transform limited
Telecom-band seed	1550-1570 nm	3-100 ps	10-100 MHz	1-60 mW	Near transform limited

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output delivery	Polarization-maintaining fibre
Beam propagation factor	M^2 <1.1, stated feature

Integration and delivery

Item	Configuration detail
OEM	200 x 130 x 28.5 mm; supply: 5 V customer supplied; cooling: Thermal Plate customer supplied
Lab	227 x 170 x 37 mm; 227 x 170 x 63 mm with fans and feet; supply: 12 V customer supplied; cooling: Thermal Plate customer supplied/Air Cooled
Rack Mount	248 x 436 x 83 mm; supply: Built-in; cooling: Air Cooled

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

• Optional fibre-Bragg-grating stretchers need to be matched to the intended compressor.

• A near-transform-limited description is qualitative here; confirm the numerical spectral bandwidth for the chosen pulse.

PICOSECOND

Picosecond fibre laser systems

Amplified picosecond sources with wavelength-specific output and pulse settings.

Applications to discuss: Time-resolved spectroscopy; Optical metrology.

Selection points
1020-1570 nm selected bands / 6-100 ps listed options / 10-100 MHz configured repetition rate

Configuration options

Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
1020-1080 nm	6-60 ps	10-100 MHz	>1 W	Near transform limited
1120-1240 nm	15-100 ps	10-100 MHz	> 0.5 W	Near transform limited
1540-1570 nm	8-100 ps	10-100 MHz	>1 W	Near transform limited

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output format	Configured picosecond pulse train

Integration and delivery

Item	Configuration detail
Lab	287 x 196 x 71 mm; 287 x 196 x 99 mm with fans and feet; supply: 12 V customer supplied; cooling: Thermal Plate customer supplied/ Air Cooled
Rack Mount	248 x 436 x 83 mm; supply: Built-in; cooling: Air Cooled

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

• A near-transform-limited description is qualitative here; confirm the numerical spectral bandwidth for the chosen pulse.

PICOSECOND

Gigahertz picosecond fibre seed lasers

Picosecond seed pulses at a configured gigahertz repetition rate.

Applications to discuss: Time-resolved spectroscopy; Optical metrology.

Selection points
1.1-1.2 GHz configured repetition rate / 1020-1080 nm or 1550 nm options / Up to 60 mW in selected options

Configuration options

Configuration	Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
Near transform-limited seed	1020-1080 nm	3-60 ps	1.1-1.2 GHz	1-60 mW	Near transform limited
Broadband seed	1020-1080 nm	3 ps	1.1-1.2 GHz	2 mW	Broadband pulses
1550 nm seed	1550 nm	3-60 ps	1.1-1.2 GHz	1-60 mW	Not specified

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output delivery	Polarization-maintaining fibre
Beam propagation factor	M^2 <1.1, stated feature

Integration and delivery

Item	Configuration detail
OEM	200 x 130 x 28.5 mm; supply: 5 V customer supplied; cooling: Thermal Plate customer supplied
Lab	227 x 170 x 37 mm; 227 x 170 x 63 mm with fans and feet; supply: 12 V customer supplied; cooling: Thermal Plate customer supplied/Air Cooled
Rack Mount	248 x 436 x 83 mm; supply: Built-in; cooling: Air Cooled

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

• A near-transform-limited description is qualitative here; confirm the numerical spectral bandwidth for the chosen pulse.

PICOSECOND

Visible picosecond fibre lasers

Visible picosecond light with free-space delivery for time-resolved excitation.

Applications to discuss: Fluorescence-lifetime measurements; Time-resolved spectroscopy.

Selection points
514-595 nm wavelength options / 15-100 ps configured pulses / Up to 300 mW, repetition-rate dependent

Configuration options

Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
514-595 nm	15-100 ps	10-100 MHz	Up to 300 mW	Not numerically specified

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output delivery	Free space
Beam propagation factor	M^2 <1.1, typical
Polarization extinction ratio	>20 dB, typical

Integration and delivery

Item	Configuration detail
Laboratory unit	287 x 196 x 71 mm; 12 V supply and thermal plate customer supplied; air cooling option
Rack unit	248 x 436 x 83 mm; built-in supply; air cooled
Conversion head	132 x 50 x 30 mm; 2 m separation between units

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

PICOSECOND

Tunable picosecond fibre lasers

A tunable near-infrared centre wavelength with a configured picosecond pulse train.

Applications to discuss: Nonlinear-optics experiments; Time-resolved spectroscopy.

Selection points
1040-1080 nm tunable centre wavelength / 2-15 ps configured pulse duration / 1-60 mW listed average power

Configuration options

Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
1040 to 1080 nm	2-15 ps	10-100 MHz	1-60 mW	Near transform limited

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output delivery	Polarization-maintaining fibre

Integration and delivery

Item	Configuration detail
Benchtop	316 x 250 x 135 mm; supply: Built-in; cooling: Air Cooled

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

• A near-transform-limited description is qualitative here; confirm the numerical spectral bandwidth for the chosen pulse.

FEMTOSECOND

Femtosecond fibre seed lasers

Low-power femtosecond seeds with polarization-maintaining fibre delivery.

Applications to discuss: Seeded ultrafast amplifiers; Multiphoton research.

Selection points
1030 nm, 1560 nm and 1850-2100 nm options / 80-800 fs across selected configurations / 10-80 MHz configured repetition rate

Configuration options

Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
1030 nm	600-800 fs	10-80 MHz	3-10 mW	3 nm
1560 nm	80-800 fs	10-80 MHz	1-50 mW	>3 nm
1850-2100 nm	80-800 fs	10-80 MHz	1-50 mW	>15 nm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output delivery	Polarization-maintaining fibre

Integration and delivery

Item	Configuration detail
OEM	200 x 130 x 28.5 mm; supply: 5 V customer supplied; cooling: Thermal Plate customer supplied
Lab	227 x 170 x 37 mm; 227 x 170 x 63 mm with fans and feet; supply: 12 V customer supplied; cooling: Thermal Plate customer supplied/ Air Cooled
Rack Mount	248 x 436 x 83 mm; supply: Built-in; cooling: Air Cooled

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

• Optional fibre-Bragg-grating pulse stretching requires a matched compressor dispersion specification.

FEMTOSECOND

Femtosecond fibre laser systems

Amplified femtosecond systems with free-space output and optional dispersion control.

Applications to discuss: Multiphoton microscopy; Two-photon polymerization; Optical metrology.

Selection points
780-1560 nm selected options / <200 fs in listed standard configurations / Wavelength-specific average-power entries

Configuration options

Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
780 nm	<200 fs	10-80 MHz	>1 W	>3 nm
920 nm	<200 fs	10-80 MHz	>1 W	>10 nm
1030-1080 nm	<200 fs	10-100 MHz	>2 W	>10 nm
1100-1300 nm	Custom; confirm	Custom; confirm	Custom; confirm	Custom; confirm
1178 nm	<200 fs	30-100 MHz	>1.5 W	>10 nm
1560 nm	<200 fs	10-80 MHz	>1 W	>10 nm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output delivery	Free space
Beam propagation factor	M^2 <1.1, typical
Polarization extinction ratio	>20 dB, typical

Integration and delivery

Item	Configuration detail
Laser head	329 x 215 x 81.5 mm
Rack unit	248 x 436 x 83 mm; built-in supply; air cooled
Unit separation	2 m

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

• The 1100-1300 nm option has custom pulse, repetition-rate, bandwidth and power values; no standard numerical limits are assigned.

• Optional dispersion compensation and acousto-optic pulse picking must be specified separately.

FEMTOSECOND

Tunable femtosecond fibre lasers

Tunable long-wavelength femtosecond seeds with fibre delivery.

Applications to discuss: Long-wavelength spectroscopy; Nonlinear-optics experiments.

Selection points
1850-2100 nm tunable centre wavelength / <100 fs listed pulse duration / 1-60 mW listed average power

Configuration options

Centre wavelength	Pulse duration	Repetition rate	Average power	Spectral width
1850 to 2100 nm	<100 fs	10-80 MHz	1-60 mW	>15 nm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output delivery	Polarization-maintaining fibre

Integration and delivery

Item	Configuration detail
OEM	200 x 130 x 28.5 mm; supply: 5 V customer supplied; cooling: Thermal Plate customer supplied
Lab	227 x 170 x 37 mm; 227 x 170 x 63 mm with fans and feet; supply: 12 V customer supplied; cooling: Thermal Plate customer supplied/ Air Cooled
Benchtop	316 x 250 x 135 mm; supply: Built-in; cooling: Air Cooled
Rack Mount	248 x 436 x 83 mm; supply: Built-in; cooling: Air Cooled

Conditions and configuration notes

• The repetition rate and pulse duration are fixed choices within the stated intervals; those intervals are not a claim of user adjustment on every unit.

• Average power depends on wavelength, repetition rate and pulse settings. Maxima from different options must not be combined into one operating point.

SHORT PULSES

Sub-nanosecond fibre laser systems

Visible and near-infrared pulsed systems with an operating point to be specified.

Applications to discuss: Time-resolved spectroscopy; Super-resolution excitation research.

Selection points
514-1550 nm family coverage / Up to 10 W advertised, wavelength dependent / Timing specifications pending

Configuration options

Configuration	Output wavelength coverage	Listed output power
Wavelength-selected pulsed system	514-1550 nm; selected wavelengths	Up to 10 W; wavelength dependent; average/peak basis to confirm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Pulse-duration class	Sub-nanosecond; numerical duration and test method to confirm
Repetition rate	Not specified
Pulse energy	Not specified
Trigger and synchronization	Not specified
Beam and polarization limits	Not specified

Integration and delivery

Item	Configuration detail
Packaging and electrical interface	To be confirmed
Output delivery and cooling	To be confirmed

Conditions and configuration notes

• The power entry appears in the product summary, without a detailed optical table or an average/peak definition. Treat it as a family-level figure pending confirmation.

• The family wavelength span does not imply a continuously tunable source.

• No pulse energy is calculated without a matched repetition rate and average power.

NETWORK AMPLIFICATION

Rack DWDM optical power boosters

Gain-flattened launch amplifiers with separate C-band, extended-band and L-band operating points.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
Five launch configurations / 24-30 dBm maximum outputs / Wavelength-specific gain-flatness conditions

Configuration options

Configuration	Optical wavelength range	Maximum output power
C-band 24 dBm	1530-1565 nm	24 dBm
C-band 26 dBm	1530-1565 nm	26 dBm
Tilt-adjusted C-band 30 dBm	1529-1569 nm	30 dBm
Extended C-band 30 dBm	1524 - 1572 nm	30 dBm
L-band 30 dBm	1570-1608 nm	30 dBm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Output range for gain-flat operation	C-band 24 dBm: 18-24 dBm; C-band 26 dBm: 20-26 dBm
Input range for gain-flat operation	C-band 24 dBm: 3-9 dBm; C-band 26 dBm: 5-11 dBm; Tilt-adjusted C-band 30 dBm, Extended C-band 30 dBm, L-band 30 dBm: -13 to +7 dBm
Gain flatness, peak-to-peak at optimum gain	C-band 24 dBm: 1.0 dB; C-band 26 dBm: 1.5 dB
Supervisory-channel wavelength	C-band 24 dBm, C-band 26 dBm, Tilt-adjusted C-band 30 dBm: 1574 nm; Extended C-band 30 dBm: 1576 nm; L-band 30 dBm: 1610 nm
Supervisory-channel optical budget	C-band 24 dBm, C-band 26 dBm: 85 dB; Tilt-adjusted C-band 30 dBm, Extended C-band 30 dBm, L-band 30 dBm: 84 dB
Gain tilt at optimum gain and +30 dBm output	Tilt-adjusted C-band 30 dBm: 6-16 dB; L-band 30 dBm: -6 to +3 dB
Gain ripple, 27-30 dBm output, optimum gain, -11 dB tilt	Tilt-adjusted C-band 30 dBm: 1.5 dB max.
Gain ripple, 27-30 dBm output at optimum gain	Extended C-band 30 dBm: 1.5 dB max.
Gain ripple, 27-30 dBm output, optimum gain, zero tilt	L-band 30 dBm: 1 dB max.

Rack DWDM optical power boosters

Integration and delivery

Item	Configuration detail
Format	2U rack subsystem
Control	Ethernet, web interface and SNMP; command and management interfaces to confirm
Fibre integrity	Supervisory-channel monitoring with automatic shutdown/restart features

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

• The gain-flatness and ripple entries are stated at particular gain, tilt and output conditions; retain those conditions when specifying acceptance.

Configuration review

• Target wavelength or passband and input/output power

• Gain, noise, timing and polarization requirements

• Optical connections, control interface and installation conditions

NETWORK AMPLIFICATION

Rack Raman co-pump sources

Forward Raman pumping options for distributed post-amplification in long fibre spans.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
Up to 3 W in the third-order option / Up to 2 W combined in multiplexed options / Separate signal and pump paths

Configuration options

Configuration	Signal passband	Maximum output power
Third-order co-pump	1500-1568 nm	≤3 W
Multiplexed co-pump	1500-1568 nm	≤2 W combined
Supplemented co-pump	1500-1568 nm	≤2 W combined
Extended-band multiplexed pump	1524 - 1572 nm	up to 2 W combined
Extended-band supplemented pump	1524 - 1572 nm	up to 2 W combined

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Maximum degree of polarization	Third-order co-pump: <10%; Multiplexed co-pump, Supplemented co-pump: <4%
Maximum C-band insertion loss	Third-order co-pump: 3.2 dB; Multiplexed co-pump: 2 dB; Supplemented co-pump: 1 dB
Supervisory-channel wavelength	Third-order co-pump, Multiplexed co-pump, Supplemented co-pump: 1574 nm; Extended-band multiplexed pump, Extended-band supplemented pump: 1576 nm
Supervisory-channel optical budget, pump off	Third-order co-pump, Multiplexed co-pump, Supplemented co-pump: 86 dB
Degree of polarization	Extended-band multiplexed pump, Extended-band supplemented pump: < 4%
Maximum signal-band insertion loss	Extended-band multiplexed pump: 2 dB; Extended-band supplemented pump: 1 dB
Relative intensity-noise density	Extended-band multiplexed pump, Extended-band supplemented pump: -122 dB/Hz
Supervisory-channel optical budget	Extended-band multiplexed pump, Extended-band supplemented pump: 88 dB

Rack Raman co-pump sources

Integration and delivery

Item	Configuration detail
Format	2U rack subsystem
Control	Ethernet, web interface and SNMP; configuration-dependent management interfaces
Pump example	Third-order arrangement uses 1276 nm pump output; multiplexed arrangement uses 14xx nm pump wavelengths

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

• The two multiplexed entries share a combined-power specification; they are not independently rated at that combined total.

• The third-order arrangement targets signal channels at 1542-1568 nm. Exact pump lines and seed powers need confirmation.

Configuration review

• Target wavelength or passband and input/output power

• Gain, noise, timing and polarization requirements

• Optical connections, control interface and installation conditions

NETWORK AMPLIFICATION

Rack Raman counter-pump sources

Reverse-pumped Raman options with distinct conventional, second-order and third-order power limits.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
1.5-5 W pump limits by option / Distributed Raman pre-amplification / Extended-band option specified separately

Configuration options

Configuration	Maximum output power	Maximum signal-band insertion loss
Conventional counter-pump	≤1.5 W	3.8 dB
Second-order counter-pump	≤3 W	3.8 dB
Third-order counter-pump	≤5 W	4.0 dB
Extended-band counter-pump	up to 2 W	3.8 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Degree of polarization	Conventional counter-pump, Second-order counter-pump, Third-order counter-pump: <4%; Extended-band counter-pump: 4%
Signal-path polarization-dependent loss	0.3 dB
Supervisory-channel wavelength	Conventional counter-pump, Second-order counter-pump, Third-order counter-pump: 1574 nm; Extended-band counter-pump: 1576 nm
Supervisory-channel optical budget, pump off	Conventional counter-pump, Second-order counter-pump, Third-order counter-pump: 88 dB
Optical wavelength range	Extended-band counter-pump: 1524 - 1572 nm
Supervisory-channel optical budget	Extended-band counter-pump: 88 dB

Integration and delivery

Item	Configuration detail
Format	2U rack subsystem
Control	Ethernet, web interface and SNMP
Monitoring	Fibre-integrity monitoring and automatic shutdown/restart features

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

• The extended-band table states 1524-1572 nm. It does not assign that same operating range to every other pump option.

NETWORK AMPLIFICATION

Rack pump sources for remote optical amplifiers

Terminal pump arrangements for remotely energized in-line optical gain elements.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
Up to 5 W in selected pump arrangements / Remote in-line gain element required / Separate transmit and receive designs

Configuration options

Configuration	Main pump wavelength	Pump seed wavelength	Maximum output power
Single-wavelength pump	148x nm	Not specified	≤2 W
Dual-wavelength pump	142x nm	148x nm	≤5 W
Second-order pump	136x nm	142x + 148x nm	≤5 W
Cascaded third-order pump	127x nm	148x nm	≤5 W

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Signal-band insertion loss	Single-wavelength pump: 3.9 dB; Dual-wavelength pump, Second-order pump: 4.1 dB; Cascaded third-order pump: 4.4 dB
Degree of polarization	<10%
Supervisory-channel wavelength	1574/1610 nm

Integration and delivery

Item	Configuration detail
Format	2U terminal subsystem
Remote element	Passive optical gain assembly spliced into the span
Control	Power control, supervisory monitoring and SNMP interfaces

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

• The x in 148x, 142x, 136x and 127x nm denotes an unspecified last digit; exact pump and seed wavelengths require confirmation.

• A blank seed-wavelength entry is left unspecified rather than interpreted as proof that no seed is required.

NETWORK AMPLIFICATION

Compact network erbium optical amplifiers

Network-ready booster and preamplifier configurations in a compact rack format.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
Seven amplifier configurations / 10-21 dBm listed output limits / 1U network format

Configuration options

Configuration	Maximum output power	Input Power Range	Maximum noise figure
15 dBm booster	15 dBm	-5 to +10 dBm	5 dB
17 dBm booster	17 dBm	-5 to +10 dBm	5 dB
19 dBm booster	19 dBm	-5 to +10 dBm	5 dB
21 dBm booster	21 dBm	-5 to +10 dBm	5 dB
Single-channel preamplifier	10 dBm	-50 to -20 dBm	3.7 dB
Gain-flat booster	21 dBm	-8 to +7 dBm	6 dB
Gain-flat preamplifier	15 dBm	-50 to -15 dBm	4.3 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Optical wavelength range	15 dBm booster, 17 dBm booster, 19 dBm booster, 21 dBm booster: 1529 to 1563 nm; Single-channel preamplifier, Gain-flat booster, Gain-flat preamplifier: 1530-1565 nm
Optical connectors	LC/PC
Maximum gain flatness	Gain-flat booster, Gain-flat preamplifier: 1.5 dB

Integration and delivery

Item	Configuration detail
Format	1U single or combined-function enclosure
Management	Web interface, command interface and SNMP; exact management interfaces to confirm

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

NETWORK AMPLIFICATION

Compact Raman and remote-amplifier pump modules

Co-pump, counter-pump and remote-gain pumping options for long optical links.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
850 mW maximum pump output / 1500-1568 nm signal passband / 82 dB or 85 dB supervisory budgets

Configuration options

Configuration	Maximum output power	Supervisory-channel wavelength	Supervisory-channel optical budget
Raman co-pump	≤850 mW	1574 nm	82 dB
Raman counter-pump	≤850 mW	1574 nm	82 dB
Remote-amplifier pump	≤850 mW	1610 nm	85 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Signal passband	1500 - 1568 nm
C-band signal insertion loss	2.5 dB
Degree of polarization	4%
Pump-to-line interface	via Front Panel E-2000 PS High Power Connector
Other optical connectors	LC/PC

Integration and delivery

Item	Configuration detail
Control	Automatic power control, web interface and SNMP
Monitoring	Fibre-integrity monitoring with shutdown/restart features

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

NETWORK AMPLIFICATION

S-, C- and L-band Raman counter-pump modules

Multi-wavelength Raman pumping for gain and power-tilt control across extended signal bands.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
1390, 1405 and 1430 nm pump lines / 1460-1610 nm signal passband / Power limits apply per wavelength

Configuration options

Configuration	Pump wavelength	Maximum pump power per wavelength
1390 nm pump	1390 nm	500 mW
1405 nm pump	1405 nm	550 mW
1430 nm pump	1430 nm	300 mW

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Signal passband	1460 nm to 1610 nm
Signal-passband insertion loss	1.6 dB
Degree of polarization	4%
Supervisory-channel wavelength	1624.01 nm
Supervisory-channel optical budget at 1624 nm, pump off	40 dB
Inter-unit pump connection	via front panel E-2000 PS High Power Connectors
Pump-to-line interface	via front panel E-2000 PS High Power Connectors
Other optical connectors	LC/PC

Integration and delivery

Item	Configuration detail
Control	Web interface and SNMP; automatic fibre-integrity shutdown/restart
Connection	Front-panel high-power optical pump connections; other connectors as specified

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

• The 40 dB supervisory-channel budget is stated with the Raman pumps off and span loss evaluated at 1624 nm.

NETWORK AMPLIFICATION

Passive remotely pumped optical gain elements

In-span optical gain assemblies energized from terminal pump sources.

Applications to discuss: Long-span terrestrial links; Submarine optical links.

Selection points
No active electronics at the remote element / Transmit and receive configurations / Numerical gain specification to confirm

Configuration options

Configuration	Function	Numeric gain or noise limit
Transmit-side element	Remote optical gain	Not specified
Receive-side element	Remote optical gain	Not specified

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Electrical power at remote element	No local active electronics; energy is delivered optically
Gain and noise figure	Configuration-specific; no numerical values provided
Pump requirement	Terminal pump matched to the element and span

Integration and delivery

Item	Configuration detail
Installation	In-line fibre splice; splice-box integration depends on the selected assembly

Conditions and configuration notes

- Passive describes the absence of local electronics; this is still an optically pumped gain medium.
- No numerical gain, noise figure, environmental rating or fixed placement distance is inferred.

GAIN MODULES

Ultra-compact erbium fibre amplifier modules

Embedded erbium-doped gain modules with separately specified booster and preamplifier performance.

Applications to discuss: Optical instrument integration; Optical sensor amplification.

Selection points
70 x 45 x 12 mm package / 19 dBm standard; 15 dBm gain-flat limits / Booster and preamplifier configurations

Configuration options

Configuration	Optical wavelength range	Output power	Noise figure
Standard booster	1525 to 1590 nm	≤19 dBm	≤5.5 dB
Standard preamplifier	1525 to 1590 nm	≤19 dBm	≤3.7 dB
Gain-flat booster	1525 to 1575 nm	≤15 dBm	≤5.5 dB
Gain-flat preamplifier	1525 to 1575 nm	≤15 dBm	≤4.2 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Operating bandwidth	Standard booster, Standard preamplifier: Typ. 34 nm; Gain-flat booster, Gain-flat preamplifier: ≤34 nm
Small-signal gain	Standard preamplifier: >38 dB
Control modes	ACC, APC, AGC
Dimensions, length x width x height	70 mm x 45 mm x 12 mm
Per-channel gain at -25 dBm input	Gain-flat preamplifier: >35 dB
Gain flatness	Gain-flat booster, Gain-flat preamplifier: <1.5 dB

Integration and delivery

Item	Configuration detail
Integration	Embedded electronics; PM or non-PM optical options
Electrical and optical interfaces	RS232 or RS485 and connectors depend on the selected module; confirm pinout and optical delivery

Conditions and configuration notes

• The selected operating band is narrower than the overall family wavelength coverage; the bandwidth entry describes the individual configuration.

• ACC: automatic current control; APC: automatic power control; AGC: automatic gain control.

GAIN MODULES

Rugged erbium fibre amplifier modules

Embedded erbium-doped gain modules with separately specified booster and preamplifier performance.

Applications to discuss: Optical instrument integration; Optical sensor amplification.

Selection points
78 x 50 x 18 mm package / 19 dBm listed output limit / Booster and preamplifier configurations

Configuration options

Configuration	Optical wavelength range	Output power	Noise figure
Standard booster	1525 to 1590 nm	≤19 dBm	≤5.5 dB
Standard preamplifier	1525 to 1590 nm	≤19 dBm	≤3.7 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Operating bandwidth	Typ. 34 nm
Small-signal gain	Standard preamplifier: >38 dB
Control modes	ACC, APC, AGC
Dimensions, length x width x height	78 mm x 50 mm x 18 mm

Integration and delivery

Item	Configuration detail
Integration	Embedded electronics; PM or non-PM optical options
Electrical and optical interfaces	RS232 or RS485 and connectors depend on the selected module; confirm pinout and optical delivery

Conditions and configuration notes

• The selected operating band is narrower than the overall family wavelength coverage; the bandwidth entry describes the individual configuration.

• ACC: automatic current control; APC: automatic power control; AGC: automatic gain control.

• The rugged format does not establish a particular environmental qualification for a new installation. Review test reports and the required temperature range.

GAIN MODULES

Dual erbium fibre amplifier modules

Embedded erbium-doped gain modules with separately specified booster and preamplifier performance.

Applications to discuss: Optical instrument integration; Optical sensor amplification.

Selection points
90 x 70 x 15 mm package / 19 dBm limit per amplifier / Booster and preamplifier configurations

Configuration options

Configuration	Optical wavelength range	Output power	Noise figure
Standard booster	1525 to 1590 nm	≤19 dBm	≤5.5 dB
Standard preamplifier	1525 to 1590 nm	≤19 dBm	≤3.7 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Operating bandwidth	Typ. 34 nm
Small-signal gain	Standard preamplifier: >38 dB
Control modes	ACC, APC
Dimensions, length x width x height	90 mm x 70 mm x 15 mm

Integration and delivery

Item	Configuration detail
Integration	Embedded electronics; PM or non-PM optical options
Electrical and optical interfaces	RS232 or RS485 and connectors depend on the selected module; confirm pinout and optical delivery

Conditions and configuration notes

• The selected operating band is narrower than the overall family wavelength coverage; the bandwidth entry describes the individual configuration.

• ACC: automatic current control; APC: automatic power control; AGC: automatic gain control.

• Two independently controlled amplifiers share one package. The 19 dBm limit is per amplifier, not the sum of their powers.

GAIN MODULES

Compact erbium fibre amplifier modules

Embedded erbium-doped gain modules with separately specified booster and preamplifier performance.

Applications to discuss: Optical instrument integration; Optical sensor amplification.

Selection points
90 x 70 x 15 mm package / 24 dBm standard; 21 dBm gain-flat limits / Booster and preamplifier configurations

Configuration options

Configuration	Optical wavelength range	Output power	Noise figure
Standard booster	1525 to 1605 nm	≤24 dBm	≤5.5 dB
Standard preamplifier	1525 to 1605 nm	≤24 dBm	≤3.7 dB
Gain-flat booster	1524 to 1605 nm	≤21 dBm	≤5.5 dB
Gain-flat preamplifier	1524 to 1605 nm	≤21 dBm	≤4.2 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Operating bandwidth	Standard booster, Standard preamplifier: Typ. 34 nm; Gain-flat booster, Gain-flat preamplifier: ≤39 nm
Small-signal gain	Standard preamplifier: >50 dB
Control modes	Standard booster, Standard preamplifier: ACC, APC, AGC; Gain-flat booster, Gain-flat preamplifier: ACC, APC, APC with flat gain, AGC
Dimensions, length x width x height	90 mm x 70 mm x 15 mm
Per-channel gain at -25 dBm input	Gain-flat preamplifier: >35 dB
Gain flatness	Gain-flat booster, Gain-flat preamplifier: <1.5 dB

Integration and delivery

Item	Configuration detail
Integration	Embedded electronics; PM or non-PM optical options
Electrical and optical interfaces	RS232 or RS485 and connectors depend on the selected module; confirm pinout and optical delivery

Conditions and configuration notes

• The selected operating band is narrower than the overall family wavelength coverage; the bandwidth entry describes the individual configuration.

• ACC: automatic current control; APC: automatic power control; AGC: automatic gain control.

GAIN MODULES

High-output erbium fibre amplifier modules

Embedded erbium-doped gain modules with separately specified booster and preamplifier performance.

Applications to discuss: Optical instrument integration; Optical sensor amplification.

Selection points
200 x 130 x 28 mm package / 29 dBm standard; 27 dBm gain-flat limits / Booster and preamplifier configurations

Configuration options

Configuration	Optical wavelength range	Output power	Noise figure
Standard booster	1524 to 1625 nm	≤29 dBm	≤5.5 dB
Standard preamplifier	1524 to 1625 nm	≤29 dBm	≤3.5 dB
Gain-flat booster	1524 to 1605 nm	≤27 dBm	≤5.5 dB
Gain-flat preamplifier	1524 to 1605 nm	≤27 dBm	≤4.0 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Operating bandwidth	Standard booster, Standard preamplifier: Typ. 34 nm; Gain-flat booster, Gain-flat preamplifier: ≤47 nm
Small-signal gain	Standard preamplifier: >60 dB
Control modes	Standard booster, Standard preamplifier: ACC, APC, AGC; Gain-flat booster, Gain-flat preamplifier: ACC, APC, AGC with flat gain
Dimensions, length x width x height	200 mm x 130 mm x 28 mm
Per-channel gain at -25 dBm input	Gain-flat preamplifier: ≤50 dB
Gain flatness	Gain-flat booster, Gain-flat preamplifier: <1.5 dB

Integration and delivery

Item	Configuration detail
Integration	Embedded electronics; PM or non-PM optical options
Electrical and optical interfaces	RS232 or RS485 and connectors depend on the selected module; confirm pinout and optical delivery

Conditions and configuration notes

• The selected operating band is narrower than the overall family wavelength coverage; the bandwidth entry describes the individual configuration.

• ACC: automatic current control; APC: automatic power control; AGC: automatic gain control.

TEST INSTRUMENTS

Laboratory C-band and L-band optical amplifiers

Rack laboratory amplifiers with single-channel and gain-flattened booster or preamplifier options.

Applications to discuss: Optical component testing; Optical test benches.

Selection points
1524-1625 nm family coverage / 29 dBm or 27 dBm output limits / AC-powered laboratory rack format

Configuration options

Configuration	Optical wavelength range	Output power	Noise figure
Single-channel booster	1524 to 1625 nm	≤29 dBm	≥4.5 dB
Single-channel preamplifier	1524 to 1625 nm	≤29 dBm	≥3.5 dB
Gain-flat booster	1524 to 1625 nm	≤27 dBm	≥4.5 dB
Gain-flat preamplifier	1524 to 1625 nm	≤27 dBm	≥4.2 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Operating bandwidth	Single-channel booster, Single-channel preamplifier: Typ. 34 nm; Gain-flat booster, Gain-flat preamplifier: ≤47 nm
Small-signal gain	Single-channel booster: -; Single-channel preamplifier: ≤52 dB
Control modes	Single-channel booster, Single-channel preamplifier: ACC, APC, AGC; Gain-flat booster, Gain-flat preamplifier: ACC, APC, AGC with flat gain
Per-channel gain at -25 dBm input	Gain-flat preamplifier: ≤50 dB
Gain flatness	Gain-flat booster, Gain-flat preamplifier: <1.5 dB

Integration and delivery

Item	Configuration detail
Format	1U, AC-powered test instrument
Controls	RS232 graphical interface; optional Ethernet; key switch and remote interlock
Optical options	PM or non-PM, variable gain and mid-stage access require configuration review

Conditions and configuration notes

- The noise-figure inequalities are printed as lower bounds (≥), not guaranteed maxima. Their intended direction requires confirmation.
- The headline small-signal gain differs from the detailed table; the detailed table entries are retained pending confirmation.
- ACC: automatic current control; APC: automatic power control; AGC: automatic gain control.

TEST INSTRUMENTS

Rack broadband ASE light sources

Unpolarized broadband optical sources for spectral and component measurements.

Applications to discuss: Component characterization; Fibre sensing; Optical test benches.

Selection points
1524-1625 nm family coverage / Up to 42 nm spectral width / Up to 26 dBm listed output

Configuration options

Configuration	Family wavelength coverage	Spectral width	Output power
Broadband source	1524 nm to 1625 nm	Up to 42 nm	Up to 26 dBm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Spectral ripple	<1.5 dB
Polarization state	Unpolarized

Integration and delivery

Item	Configuration detail
Format	Rack instrument with integrated supply
Control	RS232 graphical interface; Ethernet optional
Interlock	Remote interlock and key switch

Conditions and configuration notes

• The selected source spectrum and measurement conditions must be agreed; the full family span is not a single 101 nm-wide specification.

• Confirm whether output-power and ripple limits apply over the complete chosen spectrum.

TEST INSTRUMENTS

Embedded broadband ASE source modules

Compact unpolarized broadband sources for integration into optical instruments.

Applications to discuss: Optical component testing; Fibre-sensing instrumentation.

Selection points
1525-1605 nm or 1525-1575 nm coverage / 21 dBm or 19 dBm output limits / Embedded source format

Configuration options

Configuration	Family wavelength coverage	Spectral width	Output power
Wider-range module	1525 nm to 1605 nm	≤36 nm	≤21 dBm
Compact-band module	1525 nm to 1575 nm	>36 nm	≤19 dBm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Spectral ripple	Wider-range module: <1.5 dB
Polarization state	Unpolarized

Integration and delivery

Item	Configuration detail
Integration	PCB or instrument integration; dimensions and pinout to confirm
Control	RS232 or RS485, according to configuration

Conditions and configuration notes

• One detailed table states >36 nm spectral width, while the general description states up to 36 nm. The inequality is preserved and needs confirmation.

• Do not apply the wider-range module ripple limit to the second module without confirmation.

TEST INSTRUMENTS

DWDM grid comb light sources

Spectrally sliced broadband light with selectable channel spacing on the ITU grid.

Applications to discuss: DWDM component testing; Optical network emulation.

Selection points
50 GHz or 100 GHz channel spacing / 22 dBm listed output / Unpolarized optical output

Configuration options

Configuration	Family wavelength coverage	Spectral width	Output power
Grid-sliced comb source	1524 to 1620 nm	≤42 nm	22 dBm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Spectral flatness, peak-to-peak	<2 dB
Channel spacing	50 GHz or 100 GHz
Extinction ratio	>44 dB
Deviation from the ITU grid	<0.02 nm
Polarization state	Unpolarized

Integration and delivery

Item	Configuration detail
Format	AC-powered rack instrument
Control	RS232 graphical interface; optional Ethernet; key switch and remote interlock

Conditions and configuration notes

• The description lists up to 100 channels at 50 GHz spacing. Confirm channel count, band edges and per-channel spectral density for the chosen unit.

• The 22 dBm entry is not assigned to each individual channel.

TEST INSTRUMENTS

O-band bismuth-doped fibre amplifiers

O-band optical gain for laboratory and production measurements around 1300 nm.

Applications to discuss: O-band component testing; Optical research.

Selection points
1270-1340 nm amplification range / 25 dB nominal gain at -20 dBm input / 16 dBm nominal output at 0 dBm input

Configuration options

Operating point	Input signal power	Nominal result
Gain measurement	-20 dBm	25 dB gain
Output-power measurement	0 dBm	16 dBm output

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Amplification bandwidth	1270-1340 nm
Noise figure	5 dB maximum at -20 dBm input
Polarization response	Polarization-insensitive gain; numerical dependence to confirm

Integration and delivery

Item	Configuration detail
Format	Compact laboratory package with touchscreen
Monitoring	Input and output optical-power monitoring

Conditions and configuration notes

- The gain and output-power entries are nominal results, not simultaneous guaranteed limits at one input condition.
- Confirm saturation behaviour, gain ripple, connector type and control interfaces for the selected band.

WAVELENGTH CONVERSION

Optical supervisory-channel wavelength converters

Bidirectional conversion between a client supervisory channel and a long-link optical channel.

Applications to discuss: Long-span supervisory links; Optical-network monitoring.

Selection points
155 Mb/s STM-1 / 1510 nm client channel / 1565.5 nm listed line channel

Configuration options

Configuration	Data rate	Line input/output wavelength	Client input/output wavelength
STM-1 supervisory converter	155 Mb/s STM-1	1565.5 nm	1510 nm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Line receiver sensitivity at BER 1e-10	-49 dBm
Optical connectors	LC/PC

Integration and delivery

Item	Configuration detail
Format	1U network unit
Adjustment	External variable-attenuator access for line-channel power adjustment
Management	Web interface, command interface and SNMP

Conditions and configuration notes

- Other line wavelengths require configuration review.
- The line sensitivity is -49 dBm at BER 1e-10; confirm the full optical budget and filter conditions.

WAVELENGTH CONVERSION

Network signal wavelength converters

Client-to-line optical wavelength conversion for multiple SDH and Ethernet rates.

Applications to discuss: Client-to-DWDM network interfaces; Long-span optical links.

Selection points
155 Mb/s to 11.1 Gb/s listed rate options / 1260-1620 nm client input coverage / LC/PC optical connections

Configuration options

Configuration	Data rate	Input receiver sensitivity
155 Mb/s STM-1	155 Mb/s STM-1	-49 dBm
622 Mb/s STM-4	622 Mb/s STM-4	-45 dBm
2.5 Gb/s STM-16	2.5 Gb/s STM-16	-39 dBm
1.25 Gb/s Ethernet	1.25 Gb/s	-42 dBm
10 Gb/s rate group	10.3 Gb/s 9.953 Gb/s	-34 dBm
10.7/11.1 Gb/s rate group	11.1 Gb/s 10.7 Gb/s	-22 dBm

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Line output wavelength	155 Mb/s STM-1, 622 Mb/s STM-4, 2.5 Gb/s STM-16, 1.25 Gb/s Ethernet: 1552.52 nm; 10 Gb/s rate group, 10.7/11.1 Gb/s rate group: 1530-1564 nm
Client input wavelength range	1260-1620 nm
Optical connectors	LC/PC

Integration and delivery

Item	Configuration detail
Format	Standalone converter or combined amplifier/converter enclosure
Management	Web interface, command interface and SNMP

Conditions and configuration notes

- The headline description rounds the upper rate to 10 Gb/s; the detailed table separately lists 10.3, 9.953, 11.1 and 10.7 Gb/s.
- Receiver-sensitivity bit-error ratios and protocol conditions are not stated for these entries.

WAVELENGTH CONVERSION

Integrated optical link terminal systems

Compact terminal systems combining conversion, amplification and optional dispersion management.

Applications to discuss: Optical network integration; Fibre-link engineering.

Selection points
155 Mb/s to 10 Gb/s terminal classes / 59-69 dB listed optical budgets / 1U multi-function format

Configuration options

Configuration	Listed optical link budget
STM-1 terminal	69 dB
STM-4 terminal	65 dB
STM-16 terminal	59 dB
1 GbE terminal	63 dB
STM-64/10 GbE terminal	59 dB

Each row is a separate configuration. Limits from different rows must not be combined.

Technical details

Parameter	Specification or condition
Line output wavelength	1552.52 nm
Client input wavelength	1270-1600 nm
Client output wavelength	1310 nm
Optical connectors	LC/PC

Integration and delivery

Item	Configuration detail
Functions	Wavelength conversion, optical amplification and configuration-dependent dispersion compensation
Management	Web interface, command interface and SNMP

Conditions and configuration notes

• A value in dBm describes optical power; a value in dB describes gain, loss or an optical budget. A link budget is not a distance in kilometres.

• Performance depends on channel loading, fibre losses and the selected operating point; family limits do not automatically apply together.

• Bit-error ratio, span fibre, dispersion and receiver conditions must be agreed before assigning a transmission distance.