



Benchtop Series of the Broadsweeper Wavelength-Swept Tunable Semiconductor Lasers

Applications

- Optical Coherent Tomography (OCT)
- Biomedical imaging
- Fiber-optic sensing
- Optical metrology
- Interferometric applications
- Optical components characterization

Features

- Wide selection of the tuning ranges
- Fast sweeping of emission wavelength
- High accuracy of wavelength setting
- k -linear wavelength tuning
- Precise electronic control of the output wavelength without a need of k -clock
- Computer control via RS-232 interface
- Superlum companion software for remote control
- Laser safety measures as per ICE 60825-1 Ed. 3 2014-5
- Product customization for a particular application

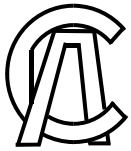
Description

This series of the Superlum Broadsweepers has sixteen standard models of the wavelength-swept tunable semiconductor laser; all of them are intended for laboratory use. The series covers wavelength region from 765 nm to 1090 nm and offers wide selection of tuning and sweeping rates from 1 to 10^5 nm/s. All devices are supplied as 220-VAC or 110-VAC power-supplied, standalone benchtop instruments. A wide range of optical accessories, including optical patch cables of different lengths and with different fiber types, is also available.

Design and Operation

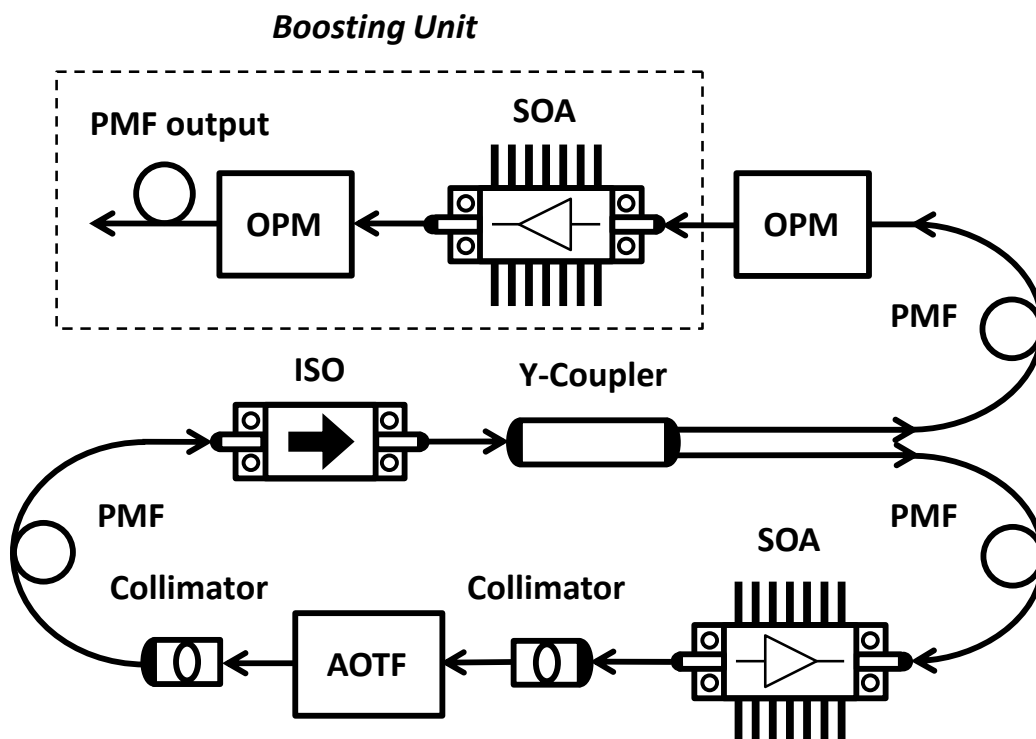
The optical scheme of any benchtop Broadsweeper (see the picture below) is based on a ring all-in-fiber external cavity configuration using a broadband semiconductor optical amplifier (SOA) working as a gain medium. An appropriate acousto-optic tunable filter (AOTF) acts as a fast wavelength-selective element. The AO-crystal is





mounted onto thermo-electric cooler. Its temperature is precisely stabilized by a feedback loop. The position of temperature sensor (thermistor) is carefully optimized for the most precise stabilization of AO-crystal inside the filter over operating temperature range of the device.

All other components comprising AOTF unit and laser cavity feature a unique customized design perfectly fitted for broadband spectral applications. Aberration-free aspherical lenses are used for maximizing the coupling efficiency to optical fiber and minimizing the insertion losses of the AOTF unit over the entire wavelength tuning range. The filter and its optics are all packaged into one monolithic metal housing, thereby ensuring reliable day-after-day operation without misalignment. In all versions with the **HP** abbreviation, additional boosting unit is added for increasing the output optical power up to 20 mW.



External Cavity of the Broadcaster benchtop laser with a boosting unit for output power increase, Simplified schematic (PMF – Polarization Maintaining Fiber)

The fiber used is a PANDA-type polarization maintaining (PM) fiber. It ensures a well-defined state of light polarization and its high stability in time and over the tuning range. Most of fiber-optic components are built by using of the fast-axis-blocking technology that also guarantees high values of the PER (> 18 dB) at the laser output. Non-boosted models are also characterized by extremely low spontaneous emission background (~ -50 dB).



The following operating modes are available with any standard Broadsweeper:

- CW operation at any wavelength within the full tuning range (FTR). In this mode of operation, the operating wavelength can be changed either from the front panel or from a computer. Under computer control, the instrument provides the wavelength switching with a time of approx. 100 ms and with a minimum spectral step of 0.05 nm.
- Continuous wavelength sweeping over the desired band of wavelengths (within the FTR) but not narrower than 5 nm. Both the internal triggering and the external triggering are available.
- Repetitive wavelength switching between two wavelengths (within the FTR) at a certain repetition frequency selectable by the operator. The range of the repetition frequencies includes 13 factory-set values.

Two BNC connectors for synchronization purposes are located on the back panel.

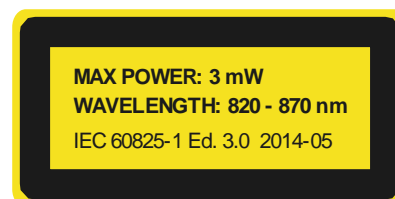
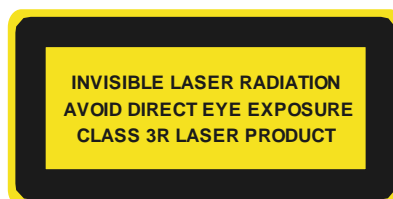
Optical output is a narrow key (2.0 mm) FC/APC mating sleeve on the front panel. Each device is supplied with a PM optical patch cable. The polarization is aligned to the slow axis of the fiber. An SM optical patch cable is also available on request.

Remote Control

All devices contain RS-232 interface for remote control from a computer using the Superlum companion software (supplied) which replicates the instrument's screen on your PC. The data communication protocol is also supplied with the instrument for the case of developing your own program.

Laser Safety Measures

To comply with the requirements of ICE 60825-1 Ed. 3 2014-05, the Broadsweeper benchtop tunable lasers are equipped with all laser safety measures required, including the master key control, remote interlock connection, visual/audible alarm, informational labeling etc. With these functions implemented, the instrument can be easily integrated into the end-user's local laser-safety-control system.



Informational labels about laser hazard meet the requirements of ICE 60825-1 Ed. 3 2014-05

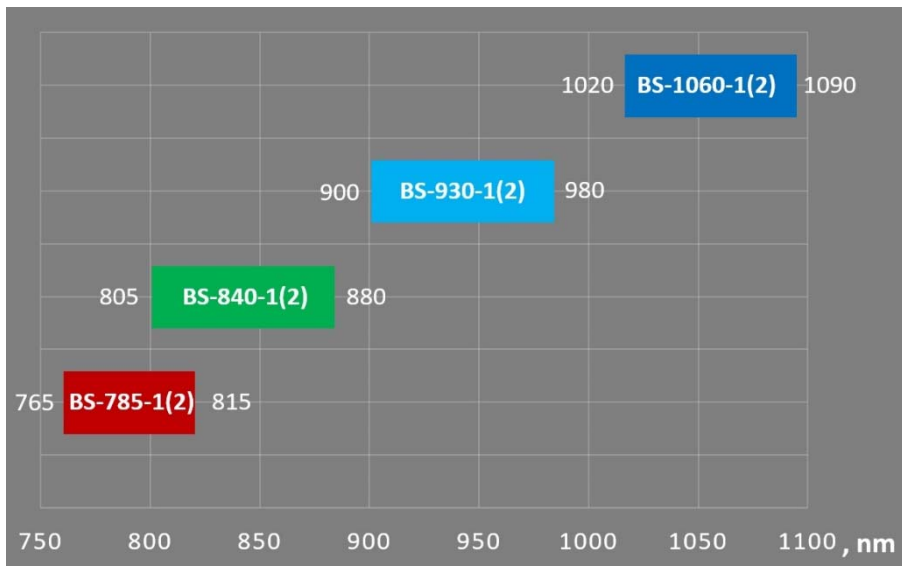


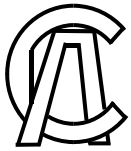
Product Customization

There are capabilities of product customization in terms of optical power, tuning range etc. Contact Superlum with your particular technical requirements.

Wavelengths Covered by Each Model

To make selection of the required spectral range as simple as possible, the models are spectrally arranged in the illustration below.





Specifications of the Broadsweeper benchtop series

Broadsweeper BS-785-1 / BS-785-1-HP	
Parameter	Value / Description
Center Wavelength	785±5 nm
Full Tuning Range (FTR)	50 nm (765 ± 2 nm to 815 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	10 nm/s @ 10-10000 nm/s 1 nm/s @ 2-10 nm/s
Output Optical Power (BS-785-1 / BS-785-1-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	2 nm/s to 10000 nm/s
Spectral Linewidth (FWHM)	≤ 0.06 nm
Signal-to-ASE Excess (BS-785-1 / BS-785-1-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 850
Fiber Working Axis	Slow axis, aligned with the connector key
Optical Output	Through FC/APC matting sleeve with narrow key
Operating Modes	Manual, Automatic, External, Modulation
Two-Wavelength Switching Frequency	0.1/0.2/0.5/1/2/5/10/20/50/100/200/500/1000 Hz
I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-785-1 / BS-785-1-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D) BS-785-1 / BS-785-1-HP	257 × 170 × 325 mm / 362 × 160 × 325 mm
Weight (BS-785-1 / BS-785-1-HP)	9 kg / 12 kg

* MALE CONNECTOR WITH DTE PIN FUNCTIONS

** THE REQUIRED POWER LINE VOLTAGE MUST BE SPECIFIED WHEN PLACING THE ORDER



Broadsweeper BS-840-1 / BS-840-1-HP	
Parameter	Value / Description
Center Wavelength	840±5 nm
Full Tuning Range (FTR)	75 nm (805 ± 2 nm to 880 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	10 nm/s @ 10-10000 nm/s 1 nm/s @ 2-10 nm/s
Output Optical Power (BS-840-1 / BS-840-1-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	2 nm/s to 10000 nm/s
Spectral Linewidth (FWHM)	≤ 0.06 nm
Signal-to-ASE Excess (BS-840-1 / BS-840-1-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 850
Fiber Working Axis	Slow axis, aligned with the connector key
Optical Output	Through FC/APC matting sleeve with narrow key
Operating Modes	Manual, Automatic, External, Modulation
Two-Wavelength Switching Frequency	0.1/0.2/0.5/1/2/5/10/20/50/100/200/500/1000 Hz
I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-840-1 / BS-840-1-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D) BS-840-1 / BS-840-1-HP	257 × 170 × 325 mm / 362 × 160 × 325 mm
Weight (BS-840-1 / BS-840-1-HP)	9 kg / 12 kg

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Broadsweeper BS-930-1 / BS-930-1-HP	
Parameter	Value / Description
Center Wavelength	935±5 nm
Full Tuning Range (FTR)	80 nm (900 ± 2 nm to 980 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	10 nm/s @ 10-10000 nm/s 1 nm/s @ 2-10 nm/s
Output Optical Power (BS-930-1 / BS-930-1-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	2 nm/s to 10000 nm/s
Spectral Linewidth (FWHM)	≤ 0.09 nm
Signal-to-ASE Excess (BS-930-1 / BS-930-1-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 850
Fiber Working Axis	Slow axis, aligned with the connector key
Optical Output	Through FC/APC matting sleeve with narrow key
Operating Modes	Manual, Automatic, External, Modulation
Two-Wavelength Switching Frequency	0.1/0.2/0.5/1/2/5/10/20/50/100/200/500/1000 Hz
I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-930-1 / BS-930-1-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D) BS-930-1 / BS-930-1-HP	257 × 170 × 325 mm / 362 × 160 × 325 mm
Weight (BS-930-1 / BS-930-1-HP)	9 kg / 12 kg

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Broadsweeper BS-1060-1 / BS-1060-1-HP	
Parameter	Value / Description
Center Wavelength	1060±5 nm
Full Tuning Range (FTR)	70 nm (1020 ± 2 nm to 1090 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	10 nm/s @ 10-10000 nm/s 1 nm/s @ 2-10 nm/s
Output Optical Power (BS-1060-1 / BS-1060-1-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	2 nm/s to 10000 nm/s
Spectral Linewidth (FWHM)	≤ 0.09 nm
Signal-to-ASE Excess (BS-1060-1 / BS-1060-1-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 980
Fiber Working Axis	Slow axis, aligned with the connector key
Optical Output	Through FC/APC matting sleeve with narrow key
Operating Modes	Manual, Automatic, External, Modulation
Two-Wavelength Switching Frequency	0.1/0.2/0.5/1/2/5/10/20/50/100/200/500/1000 Hz
I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-1060-1 / BS-1060-1-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D) BS-1060-1 / BS-1060-1-HP	257 × 170 × 325 mm / 362 × 160 × 325 mm
Weight (BS-1060-1 / BS-1060-1-HP)	9 kg / 12 kg

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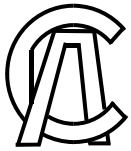
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Broadsweeper BS-785-2 / BS-785-2-HP	
Parameter	Value / Description
Center Wavelength	785±5 nm
Full Tuning Range (FTR)	50 nm (765 ± 2 nm to 815 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	100 nm/s
Output Optical Power (BS-785-2 / BS-785-2-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	100 nm/s to 100000 nm/s
Spectral Linewidth (FWHM)	≤ 0.12 nm
Signal-to-ASE Excess (BS-785-2 / BS-785-2-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 850
Fiber Working Axis	Slow axis, aligned with the connector key
Optical Output	Through FC/APC matting sleeve with narrow key
Operating Modes	Manual, Automatic, External, Modulation
Two-Wavelength Switching Frequency	1/2/5/10/20/50/100/200/500/1k/2k/5k/10k Hz
I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-785-2 / BS-785-2-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D) BS-785-2 / BS-785-2-HP	257 × 170 × 325 mm / 362 × 160 × 325 mm
Weight (BS-785-2 / BS-785-2-HP)	9 kg / 12 kg

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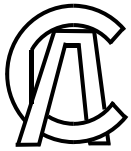
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Broadsweeper BS-840-2 / BS-840-2-HP	
Parameter	Value / Description
Center Wavelength	840±5 nm
Full Tuning Range (FTR)	75 nm (805 ± 2 nm to 880 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	100 nm/s
Output Optical Power (BS-840-2 / BS-840-2-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	100 nm/s to 100000 nm/s
Spectral Linewidth (FWHM)	≤ 0.12 nm
Signal-to-ASE Excess (BS-840-2 / BS-840-2-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 850
Fiber Working Axis	Slow axis, aligned with the connector key
Optical Output	Through FC/APC matting sleeve with narrow key
Operating Modes	Manual, Automatic, External, Modulation
Two-Wavelength Switching Frequency	1/2/5/10/20/50/100/200/500/1k/2k/5k/10k Hz
I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-840-2 / BS-840-2-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D) BS-840-2 / BS-840-2-HP	257 × 170 × 325 mm / 362 × 160 × 325 mm
Weight (BS-840-2 / BS-840-2-HP)	9 kg / 12 kg

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Broadsweeper BS-930-2 / BS-930-2-HP	
Parameter	Value / Description
Center Wavelength	935±5 nm
Full Tuning Range (FTR)	80 nm (900 ± 2 nm to 980 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	100 nm/s
Output Optical Power (BS-930-2 / BS-930-2-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	100 nm/s to 100000 nm/s
Spectral Linewidth (FWHM)	≤ 0.15 nm
Signal-to-ASE Excess (BS-930-2 / BS-930-2-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 850
Fiber Working Axis	Slow axis, aligned with the connector key
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I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-930-2 / BS-930-2-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D) BS-930-2 / BS-930-2-HP	257 × 170 × 325 mm / 362 × 160 × 325 mm
Weight (BS-930-2 / BS-930-2-HP)	9 kg / 12 kg

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Broadsweeper BS-1060-2 / BS-1060-2-HP	
Parameter	Value / Description
Center Wavelength	1060±5 nm
Full Tuning Range (FTR)	70 nm (1020 ± 2 nm to 1090 ± 2 nm)
Minimum Adjustable Tuning Range (within FTR)	5 nm
Wavelength Adjustment Step	0.05 nm
Output Wavelength Repeatability	±10 pm
Sweep Speed Adjustment Step	100 nm/s
Output Optical Power (BS-1060-2 / BS-1060-2-HP)	3 mW / 20 mW
Power Level Flatness (over FTR)	< 1.2 dB
Output Power Stability (for 3 hrs stability test)	< 0.5%
Sweep Speed Range	100 nm/s to 100000 nm/s
Spectral Linewidth (FWHM)	≤ 0.15 nm
Signal-to-ASE Excess (BS-1060-2 / BS-1060-2-HP)	> 50 dB / > 30 dB
Polarization Extinction Ratio	> 18 dB
Optical Fiber Type	PANDA PM 980
Fiber Working Axis	Slow axis, aligned with the connector key
Optical Output	Through FC/APC matting sleeve with narrow key
Operating Modes	Manual, Automatic, External, Modulation
Two-Wavelength Switching Frequency	1/2/5/10/20/50/100/200/500/1k/2k/5k/10k Hz
I/O Interface*	RS-232
Operating Temperature Range	+15 °C to + 30 °C
Storage Temperature Range	0 °C to +40 °C
Power Requirements**	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption (BS-1060-2 / BS-1060-2-HP)	20 W / 25 W
Warm-up Time	10 min
Physical Dimensions (W × H × D)	257 × 170 × 325 mm / 362 × 160 × 325 mm
BS-1060-2 / BS-1060-2-HP	
Weight (BS-1060-2 / BS-1060-2-HP)	9 kg / 12 kg

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