LT SERIES

Laser Triangulation Sensors

Datasheet

- Absolute distance and vibration measurements
- Working distance from 40 to 1000 mm
- Measuring range from 6 to 300 mm
- Fully-analog electronics: zero-time-delay output
- Ultrasound frequency range: from DC to 800 kHz
- Multi-channel modular instruments
- Ethernet interface
- Blue, Green, Red laser wavelength options
- High signal-to-noise ratio
- Customized Solutions available on request

Laser triangulation sensors are reliable and easy-to-use transducers for static and dynamic position measurements, that find application in many industrial processes and quality control systems.
The LT (Laser Triangulators) series produced by Julight is a family of more than 10 models, with working distance from 40 mm to 1000 mm, and measuring range from 6 mm to 300 mm.
The fully-analog electronics design ensures a very fast response time with a **zero-time-delay output signal**, which is an exact replica of the target displacement. This feature allows easy use in cases where minimum delay is required (e.g.: real-time control systems).
The standard bandwidth is **from DC to 20 kHz** (< 20 µs response time), **optional bandwidths are 100 kHz** (< 4 µs response time) **and the record 800 kHz** (< 0.5 µs response time).

The main control unit incorporates a low-noise linear power supply, an embedded system with an Ethernet interface. And can host **up to four multiple measuring channels** into a single larger main control unit. All the LT sensors can be controlled from the front panel keypads, or remotely using a dedicated PC software (for Microsoft Windows® 7, 8, 10 and 11 operating systems).

The optical heads of the LT sensors are in anodized aluminium and are realized with high-quality mechanical, electrical and optical components. Shielded cables (3 m standard length, optional up to 15 m) with high-quality IP54 push-pull connectors connect the optical head of the sensors to the main unit.Customized units allow to host larger number of measuring channels and the additional modules eventually required by the chosen sensors options.

Julight, a laser measurement Company

Julight is a privately held Company founded in 2011 and based in Italy. Julight owns a sound expertise in the development of sensors and measuring instruments based on laser and photonic technologies. The solid know-how of Julight's scientists and engineers in laser sources, photodetectors, electronic design, software, and opto-mechanical design has brought to the market innovative and unique Laser Triangulation Sensors and Laser Vibrometers, for the measurement without contact of physical quantities such as: vibration, distance, velocity. Julight represents the "*Italian Excellence for Vibrations*".

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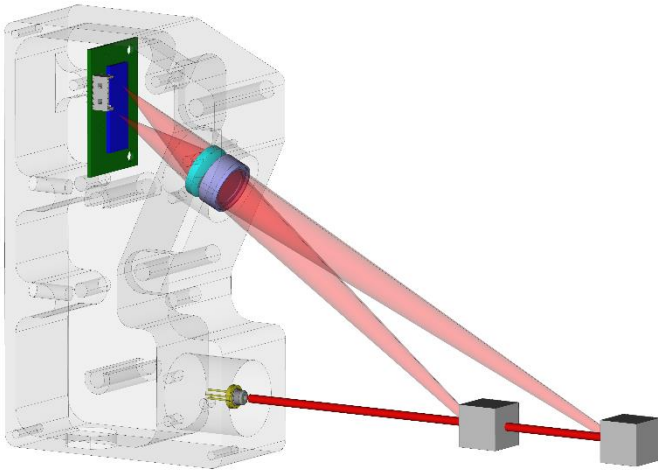
Principle of operation

Julight LT sensors are based on the well-known and reliable Laser Triangulation scheme: a light beam, generated by a semiconductor laser, is aimed at the target, and the back-scattered radiation is collected by a suitable optics, that projects the laser spot image onto an analog Position Sensitive Detector (PSD). When the target moves, the angle at which the laser spot is observed changes, resulting in a different position of its image onto the PSD.
A properly designed, low-noise analog electronics processes the PSD signals, and provides a voltage output signal that is an exact replica of the target displacement.
An optical bandpass filter, centered at the laser wavelength, suppresses unwanted effects due to ambient light and other illumination sources



Design philosophy: high Signal-to-Noise Ratio, preserving laser safety

Julight chooses to keep the electronic design of the LT sensors as simple as possible: fast, fully-analog electronics that avoids the complications and delayed response of digital sensors based on CCD/CMOS arrays.
Another strong design choice is aimed at providing the maximum possible signal-to-noise ratio – that allows to increase the resolution of position/displacement measurements – while keeping a reasonable small size for the receiving optics. This goal is achieved by increasing the optical power emitted by the laser up to 90 mW, which makes the Julight LT sensor series belong to laser safety class 3B (for some models, an optional reduced power version belonging to laser safety class 3R is also available). Considering the typical configuration of use, the LT sensors are highly safe.
Julight LT sensors operate in pure CW (Continuous Wave) mode instead of pulsed mode, meaning that the laser emits a constant power value instead of a sequence of pulses. This eliminates all the artifacts caused by pulsed operation, and reduces the spurious components on the output signal.
To further increase the safety of operators, a special SAFETY mode is automatically selected by the sensor (reducing the emitted power to laser safety class 3R) whenever the target is removed, or it is not present: in this way the alignment and set-up procedures can be carried out in full safety. The laser sensor brings the optical power level back to the operating value when the target is in position, within the measuring range.The high optical power ensures a reduced noise, and the ability to measure very small displacements with high accuracy (expressed by the parameters Noise Equivalent Displacement in the frequency domain, and Resolution in the time domain, see the specification table).
In Normal mode, the output optical power is automatically changed, by an adaptive-power control loop, according to the color/brightness of the surface under test. This ensures constant performance on different types of targets.The Fixed-power mode is recommended for targets that move transversally and have profile discontinuities (like fan blades, turbine blades, sliding objects, …); in this case the optical power is kept constant and measurements are performed properly, without artifacts produced by the automatic power control.

Integrating Laser Triangulation and Laser Vibrometer technologies

Julight is the only Company in the world that masters the two leading technologies for vibration and distance measurement: laser interferometry/vibrometry and laser triangulation. With the VSM-4000 series Julight offers the unique possibility of integrating laser triangulation sensors and laser vibrometers into the same instrument
Contact our sales team for more information and options.

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Use

Once the optical head is connected to the main board, the instrument can be operated directly via the keypad panel. For proper operation, each LT sensor head must be connected to its control module, for this reason the **unique Serial number** (S/N) is affixed on both the optical head and the keypad Panel.

The LASER **"ON/OFF"** push button, turns ON and OFF the laser sources of the optical head connected to the module and allows to select the operation modes: *SAFETY, NORMAL or FIXED POWER-modes* according to the measurement conditions. When the Laser is ON, the laser beam shall be aimed at the target, and, if this is within the measuring range, the signal is readily available at the **POSITION OUT** BNC connector.

The steady or blinking state of the LASER ON/OFF LED indicates right away the status (and, then, the operation mode) of the instrument.

The **"A/B"** push button changes the low-pass filter bandwidth of the sensor from value "A" HIGH to value "B" LOW, and vice versa. The corresponding LED is then enlightened. The **"IN-RANGE"** green and **"OUT-OF-RANGE"** red LED indicates weather the target surface is within the measuring range of the sensor head or not.

Remote-control software

All the LT sensors can be remotely controlled by a PC via the Julight *Laser Vibrometer Remote Control Software*.

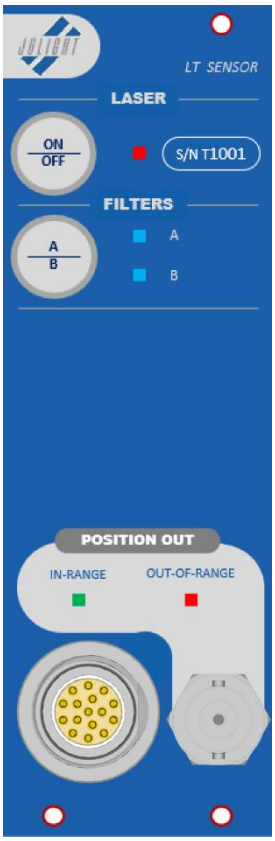
The application has been initially developed by Julight for controlling the laser vibrometers of the VSM-Series, and it has been upgraded for controlling the LT-series sensors. As soon as the software is launched, any Julight instrument directly connected to the Ethernet port of the PC or connected to the Local Area Network, if switched on, is automatically detected and identified (by its serial number).

The list of the on-line instruments is then shown on screen and the desired one can be selected.

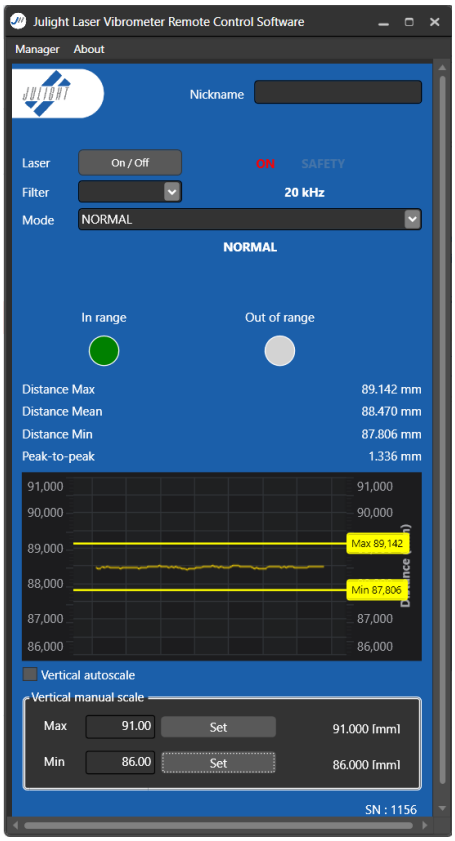
Each sensor module host by the selected instrument is recognized (be it laser vibrometer or triangulator), and its control panel pops-up on the PC screen. The sensor can then be controlled via both the software and the front panel keypad simultaneously.

The PC control panel allows to switch ON and OFF the laser source, as well as to set the operation mode and select the output bandwidth.

An oscilloscope-like display shows the average absolute position of the target and the peaK-to-peak vibrations amplitude.



Front panel keypad



Remote-console software panel

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Applications

The LT sensors are useful and recommended for many types of measurements: from quasi-static position/displacement to high-frequency mechanical vibrations, even with large in-plane displacement and velocity:

- static absolute position / distance
- relative displacements
- profile of moving objects
- thickness of slabs, sheets
- vibrations (from low frequency to ultrasound)
- high-speed transients (impact, explosions)
- surface roughness
- rotating machinery

Measurement with LT sensors can be performed on almost any kind of diffusive surfaces:

- unfinished or CNC-finished metals
- plastic
- wood
- rubber
- fabric
- paper

Targets with specular reflections require a specific optical design of the sensors. Measurements on those targets cannot be made by LT sensors in the standard configuration.

For adapting at best, the laser source wavelength of the LT sensors can be chosen among the classical **red (660 nm, R1 option, or 635 nm, R2 option), green (520 nm, G Option), and blue (450 nm, B option)**. Green and blue lasers are suitable for measurements on leather, rubber and some kind of plastics. On high-temperature surfaces (> 600 °C) the blue wavelength should be preferred, as it is far from the visible and infrared wavelengths radiated by the target. For multiple measurements on the same target, the use of sensors with different wavelengths avoids the crosstalk interference of the sensors pointed in close-proximity points of the target surface.

Process and product quality, vibration control, condition monitoring and predictive maintenance

INDUSTRY and MECHANICS

AUTOMOTIVE

Mechanical and electrical components testing, valve motion analysis

Structural analysis, turbine blades vibrations

AEROSPACE

ACOUSTICS

Musical instruments, loudspeakers, ultrasound tools

structural health monitoring
non-destructive testing
concrete detachment prevention

BUILDINGS, INFRASTRUCTURE

ELECTRONICS

Welding tools and process control
MEMS/MOEMS characterization

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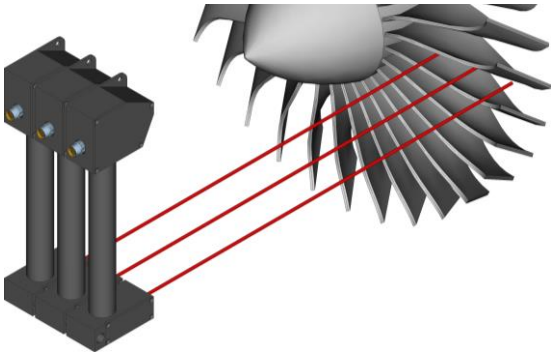
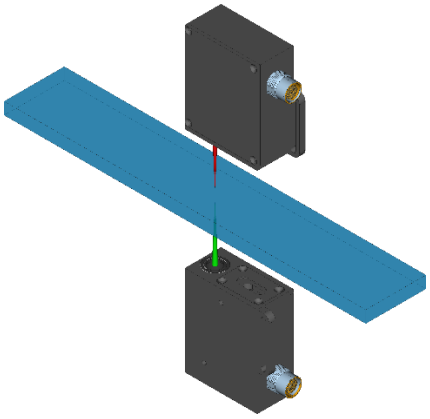
Application examples

- High speed transients (up to 240 km/s)
  - Impact experiments
  - Explosions
  - Rotating turbine blade vibrations

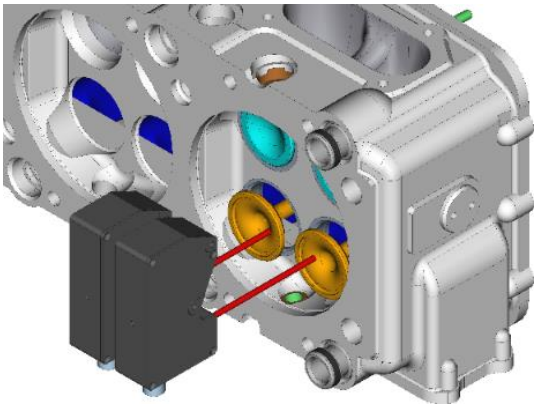


- Characterization of ultrasound actuators/systems:
  - *welding sonotrodes*
  - *dental surgery tools;*
  - *ultrasonic machining tools*
- Process & quality control
  - *Closed loop control of robotic and positioning systems*
  - *Verification of the position/profile/shape* of mechanical parts and extrusions
  - *Sheets thickness control*: two sensors are required with and an additional module for real-time difference of the two signals.
  - *Fabric and paper roughness*: "high-resolution" ("HR") option, with laser beam waist < 20 µm, is requested (available for the shortest working distance models only: LT4010, LT4506 and LT5020)

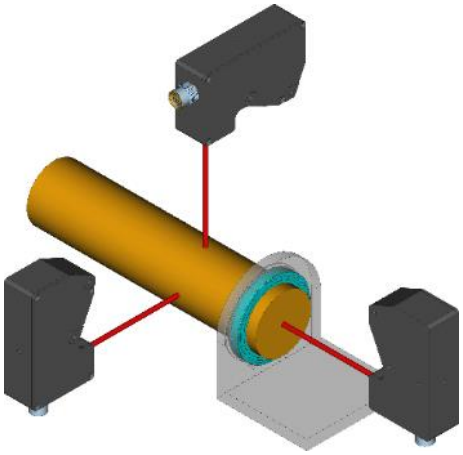


- Structural and material analysis
  - *Destructive and non-destructive tests*
  - *Buildings and big structures vibrations*
  - *concrete rib ceiling detachment prevention*
- Special customized solutions available on request
  - *Vacuum chambers*
  - *Low/High-temperature environments*
  - *Uderwater targets*

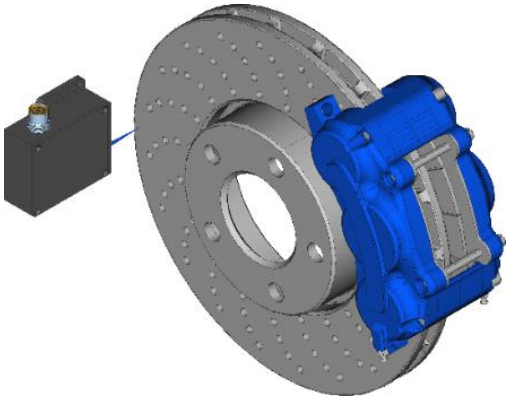
- Combustion engine valve motion
  - *Multiple valves lift simultaneous measurements*
  - *velocity and acceleration "real-time" analog outputs* ("VA" option, with additional electronic module)



- Rotating machinery
  - *Shafts and bearings: eccentricity, radial and axial vibration/displacements*



  - *Brakes disks rotor and caliper vibrations*
  - *Brakes disks rotor thikness*



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LT-Series LASER TRIANGULATION SENSORS
Physical and Electrical Characteristics

MODEL			4010	4506	5020	10030	14030	20050	300100	50020	500100	1000300
Stand-Off Distance (SOD ↔ 0 V output)		*mm*	40	45	50	100	140	200	300	500	500	1000
Measuring range (MR)		*mm*	10	6	20	30	30	50	100	20	100	300
Minimum measurable distance		*mm*	35	42	40	85	125	175	250	490	450	850
Maximum measurable distance		*mm*	45	48	60	115	155	225	350	510	550	1150
Analog output voltage range		*V*	±10	±7.5	±10	±7.5	±7.5	±10	±10	±10	±10	±7.5
Linearity Error/Accuracy[1]		*% MR*	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3	< 0.2	< 0.3	< 0.3
Noise equivalent displacement (NED)		*nm/√Hz*	< 20	< 20	< 40	< 30	< 50	< 70	< 140	< 100	< 140	< 390
Selectable Bandwidths (BW)			Standard (20K): Filter A: 0..20 kHz , Filter B: 0...2 kHz ***100K* Option:** Filter A: 0...100 kHz, Filter B: 0...10 kHz ***200K* Option:** Filter A: 0...200 kHz, Filter B: 0...20 kHz ***800K* Option:** Filter A: 0...800 kHz, Filter B: 0...100 kHz									
Resolution (time-domain) = NED * √BW	2 kHz	*µm (RMS)*	1	1	2	1	2	3	6	4	6	17
	10 kHz		2	2	4	3	5	7	14	10	14	39
	20 kHz		3	3	6	4	7	10	20	14	20	55
	100 kHz		6	6	13	9	16	22	44	32	44	123
	200 kHz		9	9	18	13	22	31	63	45	63	174
	800 kHz		18	18	36	27	45	63	125	89	125	349
Maximum Target Velocity	2 kHz	*m/s*	20	12	40	60	60	100	200	100	200	600
	10 kHz		100	60	200	300	300	500	1000	500	1000	3000
	20 kHz		200	120	400	600	600	1000	2000	1000	2000	6000
	100 kHz		1000	600	2000	3000	3000	5000	10000	5000	10000	30000
	200 kHz		2000	1200	4000	6000	6000	10000	20000	10000	20000	60000
	800 kHz		8000	4800	16000	24000	24000	40000	80000	40000	80000	240000
LASER spot diameter (transverse resolution @ SOD)		*mm*	< 2	< 2	< 2	< 5	< 5	< 5	< 10	< 10	< 10	< 10
			With -HR option: < 0.1			HR Option not available						
Typical/Maximum Optical Power [2]		*mW*	(5) 15/50	(5) 15/50	(5) 15/50	(5) 15/50	(5) 15/50	(5) 15/90	(5) 15/90	(5) 15/90	(5) 15/90	(5) 15/90
Laser classification (IEC 60825-1:2014)		*Safety Class*	(3R) 3B	(3R) 3B	(3R) 3B	(3R) 3B	(3R) 3B	(3R) 3B	(3R) 3B	(3R) 3B	(3R) 3B	(3R) 3B
Target surface			Diffusive, non-reflective/non-glossy									
LASER wavelength			Standard R1 (RED): 660 ± 10 nm **With *R2 (light RED)* option:** 635± 10 nm **With *G (GREEN)* option:** 520± 10 nm **With *B (BLUE)* option:** 450± 10 nm									
Optical Head Dimensions			See technical drawings									
Optical head connecting cables length			3 m [inutile mettere qui i codici] **Optional: 5 m, 10 m and 15 m**									
Temperature range			Storage: -20 °C ...85 °C, Operating: 5...70 °C **Extended-range option: T_{min} = -20 °C, T_{max} = +150 °C** **(special optical head enclosures with additional cooling/heating modules required)**									

[1] The reported linearity errors are valid for a diffusive target, from 100% reflectance down to 15% reflectance surfaces. For target reflectance < 15%, those values are not guaranteed.

[2] At start-up and when no target is detected within the measuring range (MR), the LT sensors automatically set the "Safety" low power mode (< 5 mW, Safety Class 3R). When a target is detected within the MR, the LT sensors can be operated the "Normal" (measuring) mode and the optical power emitted by the laser is automatically controlled according to the target color/reflectivity. When operating on bright diffusive targets, the laser power is typically < 15 mW, and it is increased to 50 or 90 mW on dark targets.

Main Unit Physical and Electrical Characteristics

Supply voltage	110 VAC/60 Hz or 220 VAC/50 Hz (manual selector)	
Power consumption	5 VA for each measuring channel	
Temperature range	0...50 °C	
Interface	Ethernet	
Remote control software	Microsoft Windows® 7, 8, 10 OS	
Laser Safety precaution	ON/OFF key and Interlock pins	
Dimensions (W x L x H)	Single channel	130 mm x 305 mm x 145 mm
	Multiple channel (up to 4)	251 mm x 305 mm x 145 mm

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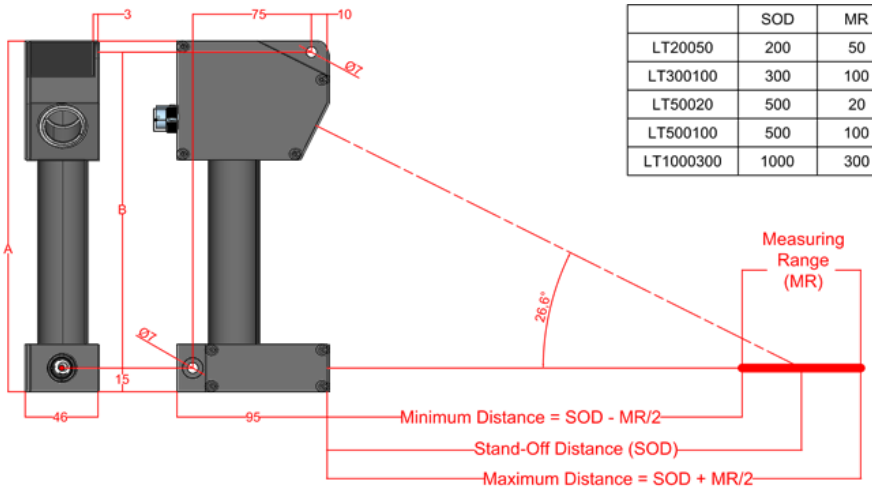
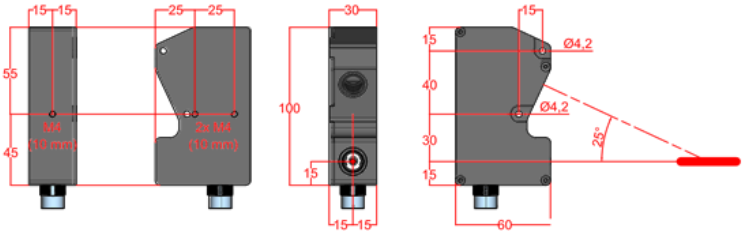
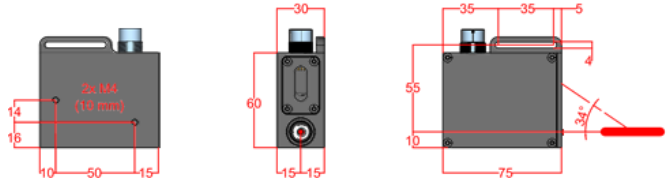
LT-Series LASER TRIANGULATION SENSOR
Optical heads drawings and dimensions



	SOD	MR	A	B
LT20050	200	50	172	150
LT300100	300	100	222	200
LT50020	500	20	322	300
LT500100	500	100	322	300
LT1000300	1000	300	572	500

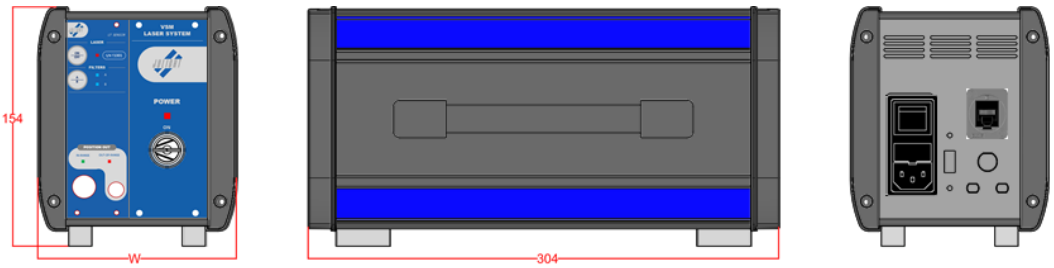


	SOD	MR
LT10030	100	30
LT14030	140	30

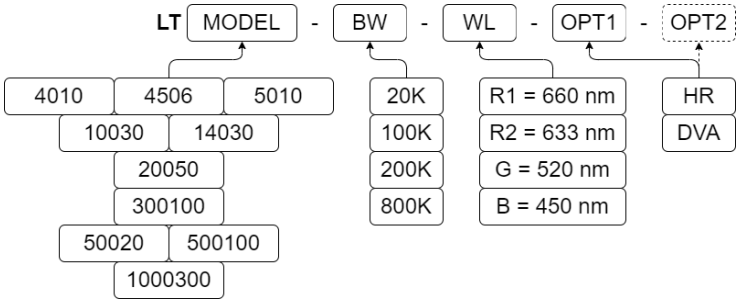


	SOD	MR
LT4010	40	10
LT4506	45	6
LT5020	50	20

Main unit drawings and dimensions



Ordering options



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