

Tunable Laser System

TLS

Operation Manual

Ver 1.0



*This device complies with part 18 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference received,
including interference that may cause undesired operation.*

SLI
SPECTROLIGHT

Tunable Laser System (TLS)

Fully tunable pico-second pulsed laser system by Spectrolight

Spectrolight's tunable laser system (TLS) is an innovative, continuously tunable laser that combines a super-continuum laser and a tunable bandpass filter in VISIBLE, IR, and SWIR ranges.

The **TLS-RED** offers a wide wavelength range of approximately 400 to 1700 nm and can allow for FWHM 2 to 15 nm (nominal). In contrast, the **TLS-BLUE** covers the same broad wavelength range but with a fixed FWHM of 10 or 20 nm. The TLS-RED is ideal for applications requiring precise scanning, while the TLS-BLUE is better suited for fields demanding high output. With Spectrolight's TLS systems, users can freely select the output power and wavelength ranges to meet their specific needs.

TLS is a pico-second tunable laser that can be applied to various fields, from fluorescence microscopy to time-resolved spectroscopy, such as TCSPC, Hyperspectral imaging, Machine vision, Semiconductors, Sensors, and other applications.

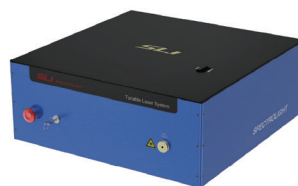
| Power Fluctuation Stability

RSD is < 1 % at 650/15 nm

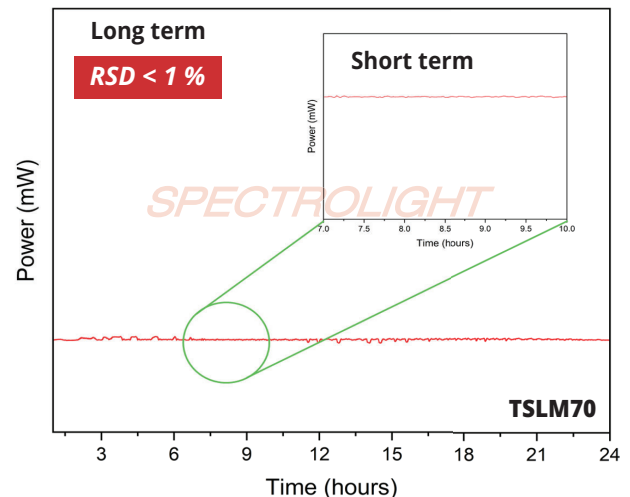
*RSD = Relative Standard Deviation



TLS-RED
(Tunable bandwidth)

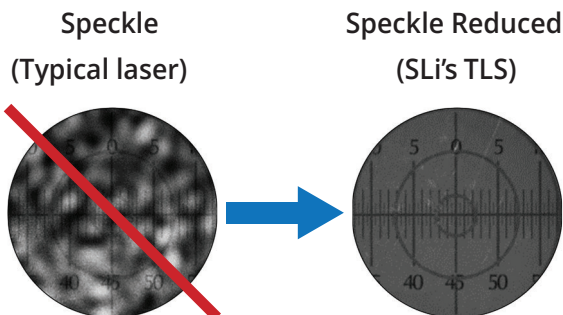


TLS-BLUE
(Fixed bandwidth)

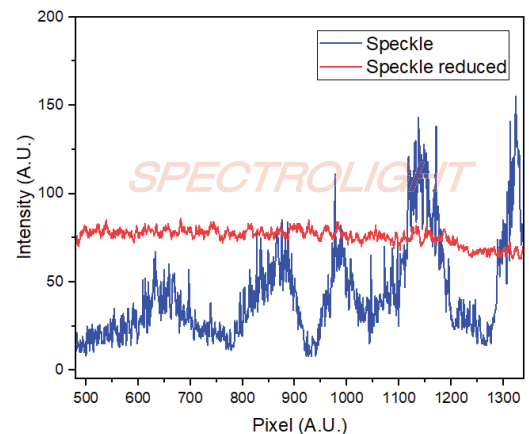


| Speckle Reduced Option for Imaging

TLS products feature an option to dramatically reduce laser speckle noise, a capability not typically found in conventional lasers. When this option is applied, TLS facilitates clear imaging. The image segmentation results on the right clearly show the significant difference in speckle noise across the entire image.



Low S/N ratio imaging with speckle noise using conventional laser (left), clear imaging with reduced speckle noise using TLS (right)



1. Introduction

1.1 TLS-RED



Each TLS-RED model covers distinct spectral ranges from 410 to 1700 nm. The bandwidth(FWHM) of TLS-RED is nominally tunable from 2 to 15 nm, with the exact tunable range dependent on the selected wavelength. Users can choose laser types and variable wavelength ranges to suit their specific applications. Please refer to the detailed specifications table below for more information.



TLS-RED (Tunable bandwidth)

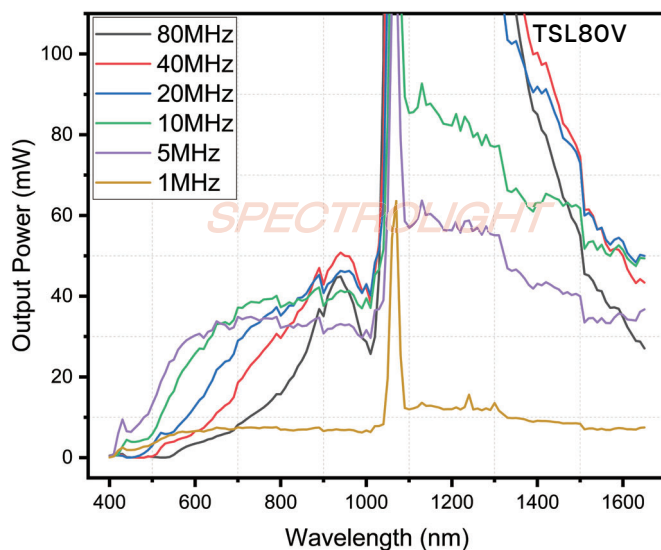
General Specifications

Tunable Laser System **TLS-RED** : Each TLS has VIS, IR, SWIR and Custom wavelength selection

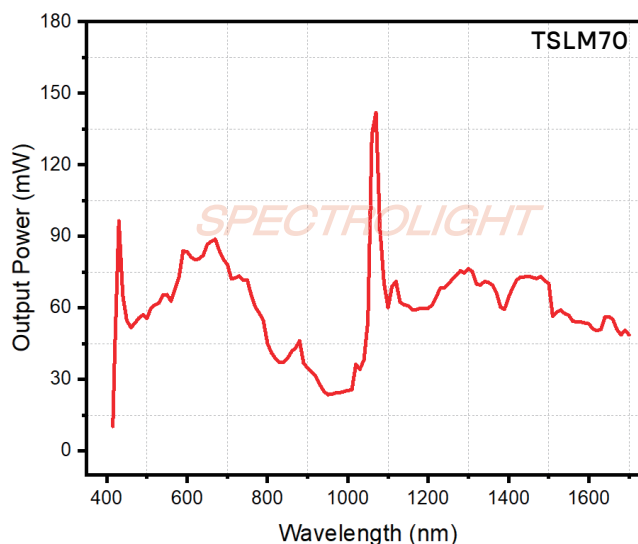
Model	Laser output power (mW, W)		Repetition Rate (MHz)	Output pulse width (ps)	CW Tuning Range (nm)	Bandwidth (FWHM) (nm)
	Visible	Total				
TSL10-RED	100 mW	1 W	5 MHz	< 300 ps	450 - 1700 nm	2 - 15 nm (nominal)
TSLM10-RED	250 mW	1 W	10 MHz	< 50 ps	410 - 1700 nm	
TSLM20-RED	500 mW	2 W	20 MHz	< 50 ps	410 - 1700 nm	
TSLM40-RED	1 W	4 W	40 MHz	< 50 ps	410 - 1700 nm	
TSLM35V-RED	1 W	3.5 W	0.01 to 40 MHz	< 50 ps	410 - 1700 nm	
TSL80V-RED	1 W	8 W	0.01 to 200 MHz	< 300 ps	430 - 1700 nm	
TSLM70-RED	2 W	7 W	80 MHz	< 50 ps	410 - 1700 nm	

The option for customizable repetition rates is available for an extra cost, allowing adjustment up to each product's maximum fixed rate.

Output Power of TLS-RED



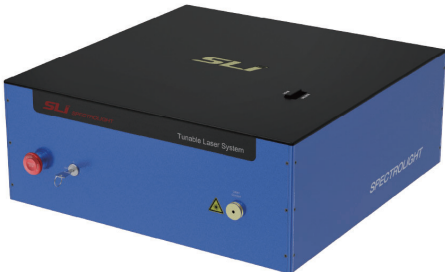
* Measured at 15 nm bandwidth (FWHM)





1.2 TLS-BLUE

Each TLS-BLUE model covers distinct spectral ranges from 410 to 1700 nm. The bandwidth(FWHM) of TLS-BLUE is fixed at either 10 or 20 nm. Users can choose laser types and variable wavelength ranges to suit their specific applications. Please refer to the detailed specifications table below for more information.



TLS-BLUE (Fixed bandwidth)

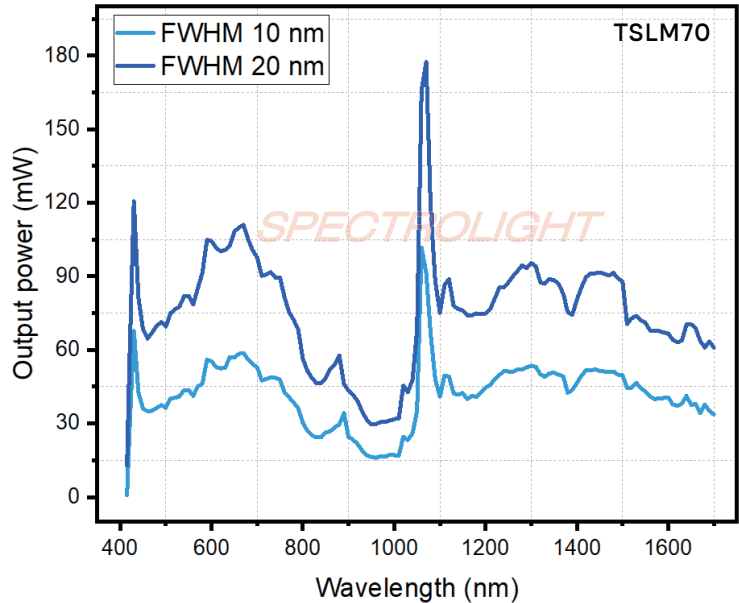
General Specifications

Tunable Laser System **TLS-BLUE** : Each TLS has VIS, IR, SWIR and Custom wavelength selection

Model	Laser output power (mW, W)		Repetition Rate (MHz)	Output pulse width (ps)	CW Tuning Range (nm)	Bandwidth (FWHM) (nm)
	Visible	Total				
TSL10-BLUE	100 mW	1 W	5 MHz	< 300 ps	450 - 1700 nm	10 or 20 nm fixed (nominal)
TSLM10-BLUE	250 mW	1 W	10 MHz	< 50 ps	410 - 1700 nm	
TSLM20-BLUE	500 mW	2 W	20 MHz	< 50 ps	410 - 1700 nm	
TSLM40-BLUE	1 W	4 W	40 MHz	< 50 ps	410 - 1700 nm	
TSLM35V-BLUE	1 W	3.5 W	0.01 to 40 MHz	< 50 ps	410 - 1700 nm	
TSL80V-BLUE	1 W	8 W	0.01 to 200 MHz	< 300 ps	430 - 1700 nm	
TSLM70-BLUE	2 W	7 W	80 MHz	< 50 ps	410 - 1700 nm	

The option for customizable repetition rates is available for an extra cost, allowing adjustment up to each product's maximum fixed rate.

Output Power of TLS-BLUE



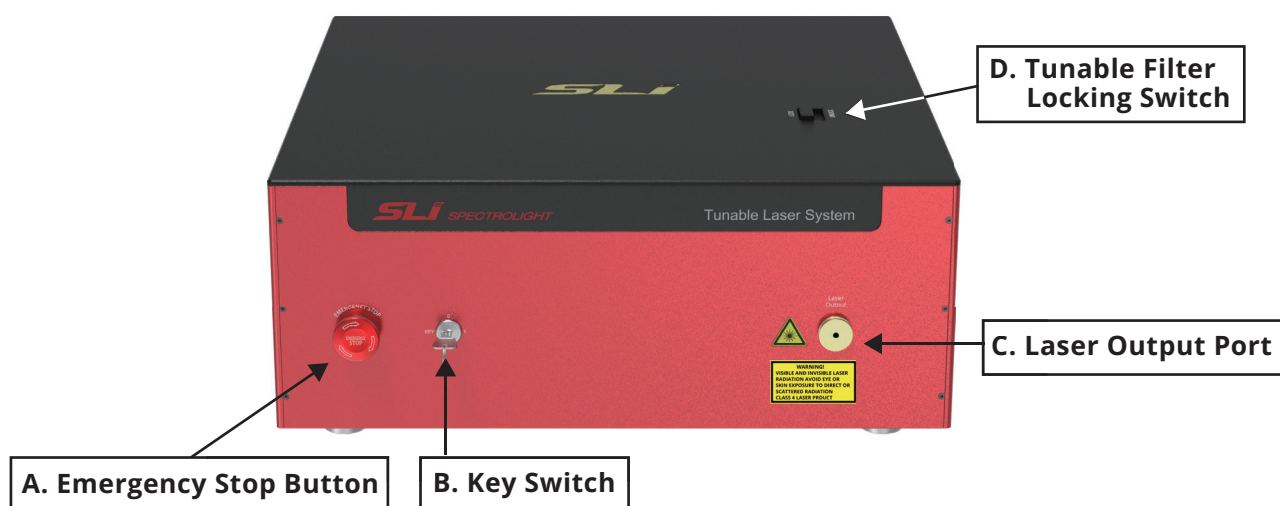
2. System Overview

2.1 System Main Components

1	TLS	Main body
2	Power cable	AC power cable (1 ea)
3	USB cable	USB A to B cable (1 ea)
4	Key switch	Key switch (2 ea)
5	Interlock plug	External safety device (1 ea)
6	Laptop	Product software, product user manual, etc.

2.2 Front Panel Functions

(Example: TLS-RED)



A. Emergency Stop Button : Press it in an emergency situation, and it can be restored by rotating it clockwise.

B. Key Switch : Rotate precisely 90 degrees clockwise to power on, and rotate 90 degrees counterclockwise to power off the laser.

C. Laser Output Port : The default output is free-space. To connect to optical fibers or fiber bundles, appropriate coupling accessories are required (e.g., fiber adapter)

D. Tunable Filter Locking Switch : When the equipment is not in use or being moved, the tunable filter must be locked.

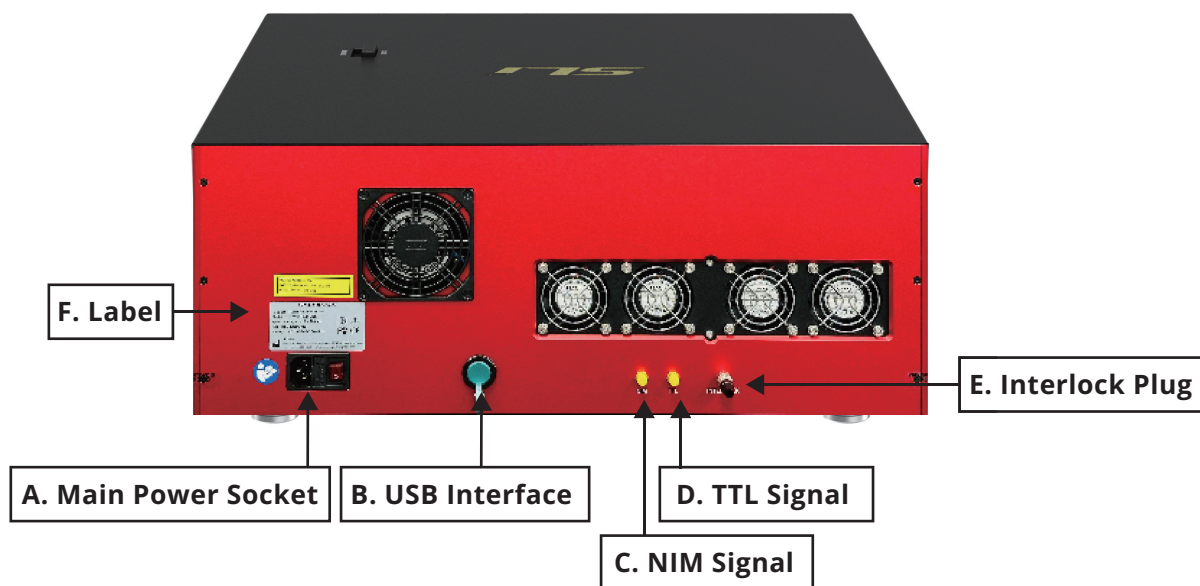
E. Labels : Laser safety



WARNING!
VISIBLE AND INVISIBLE LASER
RADIATION AVOID EYE OR
SKIN EXPOSURE TO DIRECT OR
SCATTERED RADIATION
CLASS 4 LASER PRODUCT

2. System Overview

2.3 Back Panel Functions (Example: TSL80V-RED-VIS)



A. Main Power Socket : Plug the power cord into the main socket.

B. USB Interface : Connect a USB cable to the computer to control the laser.

C. NIM Signal : The SMA interface will output a pulse square wave signal loaded 50 Ω with the same pulse and the same frequency; NIM Voltage: 0 to -1 V

D. TTL Signal : The SMA interface will output a pulse square wave signal loaded 50 Ω with the same pulse and the same frequency; TTL Voltage: 0 to 3.3 V

E. Interlock Plug : Connect the interlock plug when using the laser.

F. Label : Laser specifications

Product : Tunable Laser System

Model : TSL80V-RED-VIS

Spectral range : 430 - 790 nm

S/N : RT80VVIS0000

Ratings : AC 100 - 200V, 50/60 Hz



iiSM Inc.

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OUTPUT POWER : ≤ 8 W

WAVELENGTH RANGE : 430 - 2400 nm

REPETITION RATE : 0.01 to 200 MHz adjustable

2.4 Specifications



TLS-RED (Tunable bandwidth)

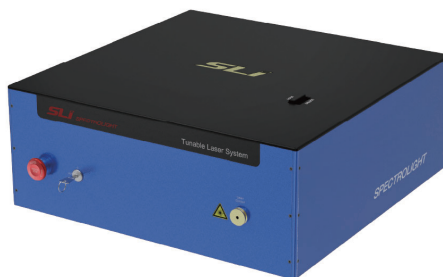
		TSL10-RED	TSLM10-RED	TSLM20-RED	TSLM40-RED	TSLM35V-RED	TSL80V-RED	TSLM70-RED
Output power	Visible	100 mW	250 mW	500 mW	1 W	1 W	1 W	2 W
	Total	1 W	1 W	2 W	4 W	3.5 W	8 W	7 W
Repetition rate		5 MHz	10 MHz	20 MHz	40 MHz	0.01 to 40 MHz adjustable	0.01 to 200 MHz adjustable	80 MHz
Output pulse width		< 300 ps	< 50 ps	< 50 ps	< 50 ps	< 50 ps	< 300 ps	< 50 ps
Fundamental pulse width		~ 100 ps	~ 6 ps	~ 6 ps	~ 6 ps	~ 6 ps	~ 100 ps	~ 6 ps
Tuning spectral range ¹⁾		450-1700 nm	410-1700 nm	410-1700 nm	410-1700 nm	410-1700 nm	430-1700 nm	410-1700 nm
Bandwidth(FWHM) ²⁾		2 - 15 nm(nominal)						
Power stability		< 1 %						
Intensity control		0 - 100						
Output type ³⁾		Free space						
Beam diameter & quality		~ 2 mm @ 633 nm; M2 < 1.1						
Beam divergence		< 1 mrad (half angle)						
State of polarization		Unpolarized						
Sync(trigger) output		NIM output 0 - (-1) V, TTL output 0 - 3.3 V						
Electric requirement		AC 100 - 240 V, 50/60 Hz						
Power consumption		< 280 W						
Software		TLS ver.2						
Data interface		USB 2.0						
Dimension (L x W x H)		584.3 mm x 583.6 mm x 246 mm						
Weight		< 37 kg						

1) Specified center wavelength(CWL) tolerance: ± 1 nm.

2) Specified full width at half maximum(FWHM) tolerance: ± 1 nm

3) Various output accessory configurations such as fiber and fiber bundle are available. Please contact us for custom options or detailed specifications.

2. System Overview



TLS-BLUE (Fixed bandwidth)

		TSL10-BLUE	TSLM10-BLUE	TSLM20-BLUE	TSLM40-BLUE	TSLM35V-BLUE	TSL80V-BLUE	TSLM70-BLUE
Output power	Visible	100 mW	250 mW	500 mW	1 W	1 W	1 W	2 W
	Total	1 W	1 W	2 W	4 W	3.5 W	8 W	7 W
Repetition rate		5 MHz	10 MHz	20 MHz	40 MHz	0.01 to 40 MHz adjustable	0.01 to 200 MHz adjustable	80 MHz
Output pulse width		< 300 ps	< 50 ps	< 50 ps	< 50 ps	< 50 ps	< 300 ps	< 50 ps
Fundamental pulse width		~ 100 ps	~ 6 ps	~ 6 ps	~ 6 ps	~ 6 ps	~ 100 ps	~ 6 ps
Tuning spectral range ¹⁾		450-1700 nm	410-1700 nm	410-1700 nm	410-1700 nm	410-1700 nm	430-1700 nm	410-1700 nm
Bandwidth(FWHM) ²⁾		10 nm or 20 nm (nominal)						
Power stability		< 1 %						
Intensity control		0 - 100						
Output type ³⁾		Free space						
Beam diameter & quality		~ 2 mm @ 633 nm; M2 < 1.1						
Beam divergence		< 1 mrad (half angle)						
State of polarization		Unpolarized						
Sync(trigger) output		NIM output 0 - (-1) V, TTL output 0 - 3.3 V						
Electric requirement		AC 100 - 240 V, 50/60 Hz						
Power consumption		< 280 W						
Software		TLS ver.2						
Data interface		USB 2.0						
Dimension (L x W x H)		584.3 mm x 583.6 mm x 246 mm						
Weight		< 37 kg						

1) Specified center wavelength(CWL) tolerance: ± 1 nm.

2) Specified full width at half maximum(FWHM) tolerance: ± 1 nm

3) Various output accessory configurations such as fiber and fiber bundle are available. Please contact us for custom options or detailed specifications.

7.1 TLS-RED Detailed Models

Model	Laser Specifications	Optical Specifications
TSL10-RED-VIS	Wavelength : 450 - 2400 nm Output power : 1 W VIS power : 0.1 W Repetition rate : 5 MHz	Tunable CWL : 450 - 790 nm FWHM : 2 - 15 nm (450 - 700 nm), 3 - 15 nm (701 - 790 nm)
TSL10-RED-IR		Tunable CWL : 775 - 1150 nm FWHM : 3 - 15 nm (775 - 890 nm), 5 - 15 nm (891 - 1150 nm)
TSL10-RED-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 5 - 15 nm (1140 - 1500 nm), 7 - 13 nm (1501 - 1700 nm)
TSL10-RED-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 450 - 1700 nm)
TSLM10-RED-VIS	Wavelength : 410 - 2400 nm Output power : 1 W VIS power : 0.25 W Repetition rate : 10 MHz	Tunable CWL : 410 - 790 nm FWHM : 2 - 15 nm (410 - 700 nm), 3 - 15 nm (701 - 790 nm)
TSLM10-RED-IR		Tunable CWL : 775 - 1150 nm FWHM : 3 - 15 nm (775 - 890 nm), 5 - 15 nm (891 - 1150 nm)
TSLM10-RED-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 5 - 15 nm (1140 - 1500 nm), 7 - 13 nm (1501 - 1700 nm)
TSLM10-RED-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm)
TSLM20-RED-VIS	Wavelength : 410 - 2400 nm Output power : 2 W VIS power : 0.5 W Repetition rate : 20 MHz	Tunable CWL : 410 - 790 nm FWHM : 2 - 15 nm (410 - 700 nm), 3 - 15 nm (701 - 790 nm)
TSLM20-RED-IR		Tunable CWL : 775 - 1150 nm FWHM : 3 - 15 nm (775 - 890 nm), 5 - 15 nm (891 - 1150 nm)
TSLM20-RED-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 5 - 15 nm (1140 - 1500 nm), 7 - 13 nm (1501 - 1700 nm)
TSLM20-RED-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm)
TSLM40-RED-VIS	Wavelength : 410 - 2400 nm Output power : 4 W VIS power : 1 W Repetition rate : 40 MHz	Tunable CWL : 410 - 790 nm FWHM : 2 - 15 nm (410 - 700 nm), 3 - 15 nm (701 - 790 nm)
TSLM40-RED-IR		Tunable CWL : 775 - 1150 nm FWHM : 3 - 15 nm (775 - 890 nm), 5 - 15 nm (891 - 1150 nm)
TSLM40-RED-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 5 - 15 nm (1140 - 1500 nm), 7 - 13 nm (1501 - 1700 nm)
TSLM40-RED-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm)
TSLM35V-RED-VIS	Wavelength : 410 - 2400 nm Output power : 3.5 W VIS power : 1 W Repetition rate : 0.01 - 40 MHz adjustable	Tunable CWL : 410 - 790 nm FWHM : 2 - 15 nm (410 - 700 nm), 3 - 15 nm (701 - 790 nm)
TSLM35V-RED-IR		Tunable CWL : 775 - 1150 nm FWHM : 3 - 15 nm (775 - 890 nm), 5 - 15 nm (891 - 1150 nm)
TSLM35V-RED-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 5 - 15 nm (1140 - 1500 nm), 7 - 13 nm (1501 - 1700 nm)
TSLM35V-RED-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm)
TSL80V-RED-VIS	Wavelength : 430 - 2400 nm Output power : 8 W VIS power : 1 W Repetition rate : 0.01 - 200 MHz adjustable	Tunable CWL : 430 - 790 nm FWHM : 2 - 15 nm (430 - 700 nm), 3 - 15 nm (701 - 790 nm)
TSL80V-RED-IR		Tunable CWL : 775 - 1150 nm FWHM : 3 - 15 nm (775 - 890 nm), 5 - 15 nm (891 - 1150 nm)
TSL80V-RED-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 5 - 15 nm (1140 - 1500 nm), 7 - 13 nm (1501 - 1700 nm)
TSL80V-RED-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 430 - 1700 nm)
TSLM70-RED-VIS	Wavelength : 410 - 2400 nm Output power : 7 W VIS power : 2 W Repetition rate : 80 MHz	Tunable CWL : 410 - 790 nm FWHM : 2 - 15 nm (410 - 700 nm), 3 - 15 nm (701 - 790 nm)
TSLM70-RED-IR		Tunable CWL : 775 - 1150 nm FWHM : 3 - 15 nm (775 - 890 nm), 5 - 15 nm (891 - 1150 nm)
TSLM70-RED-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 5 - 15 nm (1140 - 1500 nm), 7 - 13 nm (1501 - 1700 nm)
TSLM70-RED-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm)

7.2 TLS-BLUE Detailed Models

Model	Laser Specifications	Optical Specifications
TSL10-BLUE-VIS	Wavelength : 450 - 2400 nm Output power : 1 W VIS power : 0.1 W Repetition rate : 5 MHz	Tunable CWL : 450 - 790 nm FWHM : 10 or 20 nm (fixed)
TSL10-BLUE-IR		Tunable CWL : 775 - 1150 nm FWHM : 10 or 20 nm (fixed)
TSL10-BLUE-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 10 or 20 nm (fixed)
TSL10-BLUE-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 450 - 1700 nm) (FWHM : 10 or 20 nm (fixed))
TSLM10-BLUE-VIS	Wavelength : 410 - 2400 nm Output power : 1 W VIS power : 0.25 W Repetition rate : 10 MHz	Tunable CWL : 410 - 790 nm FWHM : 10 or 20 nm (fixed)
TSLM10-BLUE-IR		Tunable CWL : 775 - 1150 nm FWHM : 10 or 20 nm (fixed)
TSLM10-BLUE-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 10 or 20 nm (fixed)
TSLM10-BLUE-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm) (FWHM : 10 or 20 nm (fixed))
TSLM20-BLUE-VIS	Wavelength : 410 - 2400 nm Output power : 2 W VIS power : 0.5 W Repetition rate : 20 MHz	Tunable CWL : 410 - 790 nm FWHM : 10 or 20 nm (fixed)
TSLM20-BLUE-IR		Tunable CWL : 775 - 1150 nm FWHM : 10 or 20 nm (fixed)
TSLM20-BLUE-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 10 or 20 nm (fixed)
TSLM20-BLUE-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm) (FWHM : 10 or 20 nm (fixed))
TSLM40-BLUE-VIS	Wavelength : 410 - 2400 nm Output power : 4 W VIS power : 1 W Repetition rate : 40 MHz	Tunable CWL : 410 - 790 nm FWHM : 10 or 20 nm (fixed)
TSLM40-BLUE-IR		Tunable CWL : 775 - 1150 nm FWHM : 10 or 20 nm (fixed)
TSLM40-BLUE-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 10 or 20 nm (fixed)
TSLM40-BLUE-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm) (FWHM : 10 or 20 nm (fixed))
TSLM35V-BLUE-VIS	Wavelength : 410 - 2400 nm Output power : 3.5 W VIS power : 1 W Repetition rate : 0.01 - 40 MHz adjustable	Tunable CWL : 410 - 790 nm FWHM : 10 or 20 nm (fixed)
TSLM35V-BLUE-IR		Tunable CWL : 775 - 1150 nm FWHM : 10 or 20 nm (fixed)
TSLM35V-BLUE-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 10 or 20 nm (fixed)
TSLM35V-BLUE-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm) (FWHM : 10 or 20 nm (fixed))
TSL80V-BLUE-VIS	Wavelength : 430 - 2400 nm Output power : 8 W VIS power : 1 W Repetition rate : 0.01 - 200 MHz adjustable	Tunable CWL : 430 - 790 nm FWHM : 10 or 20 nm (fixed)
TSL80V-BLUE-IR		Tunable CWL : 775 - 1150 nm FWHM : 10 or 20 nm (fixed)
TSL80V-BLUE-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 10 or 20 nm (fixed)
TSL80V-BLUE-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 430 - 1700 nm) (FWHM : 10 or 20 nm (fixed))
TSLM70-BLUE-VIS	Wavelength : 410 - 2400 nm Output power : 7 W VIS power : 2 W Repetition rate : 80 MHz	Tunable CWL : 410 - 790 nm FWHM : 10 or 20 nm (fixed)
TSLM70-BLUE-IR		Tunable CWL : 775 - 1150 nm FWHM : 10 or 20 nm (fixed)
TSLM70-BLUE-SWIR		Tunable CWL : 1140 - 1700 nm FWHM : 10 or 20 nm (fixed)
TSLM70-BLUE-Custom		USER SPECIFIED CUSTOM RANGE (Range selectable from 410 - 1700 nm) (FWHM : 10 or 20 nm (fixed))