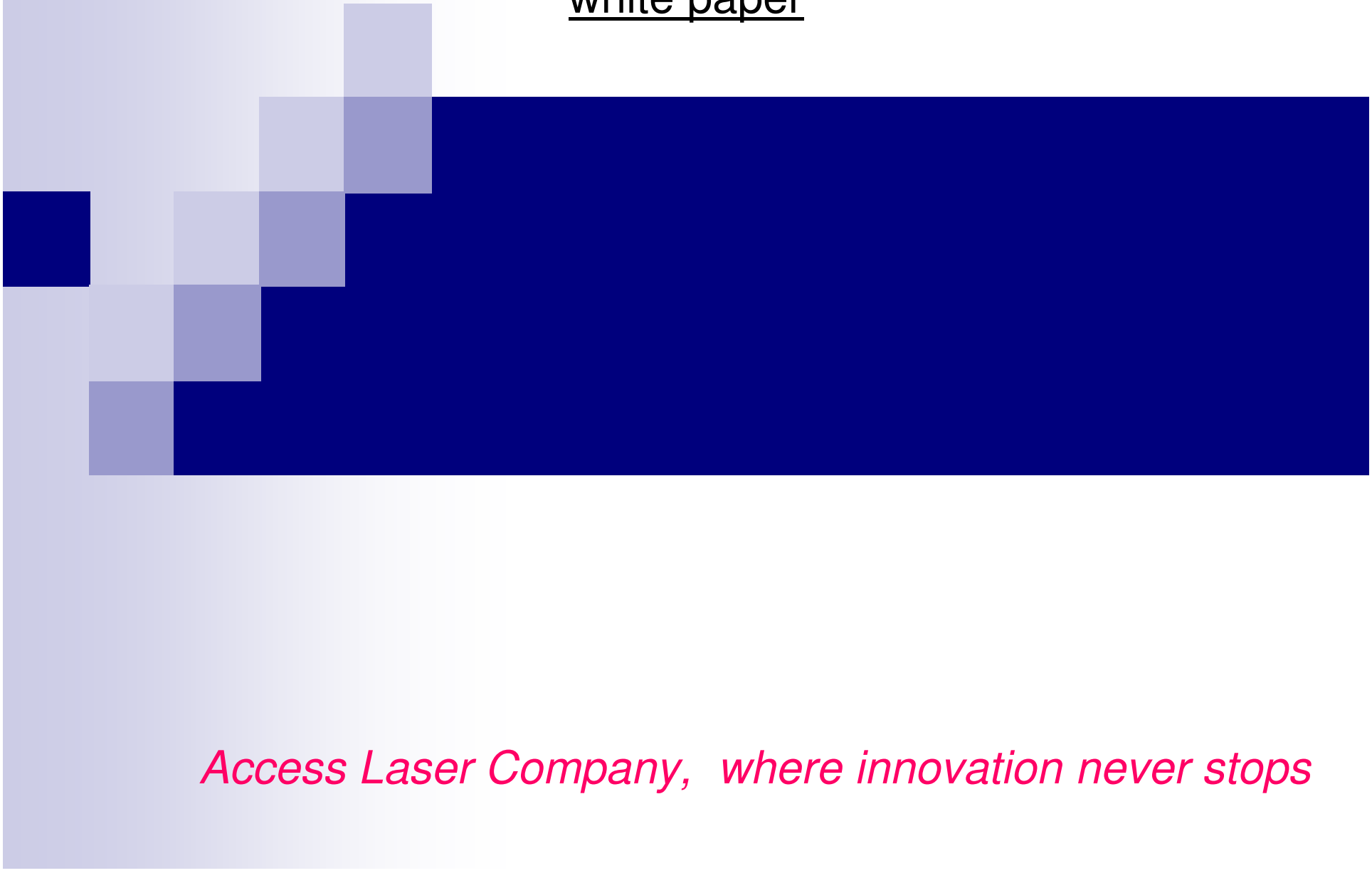
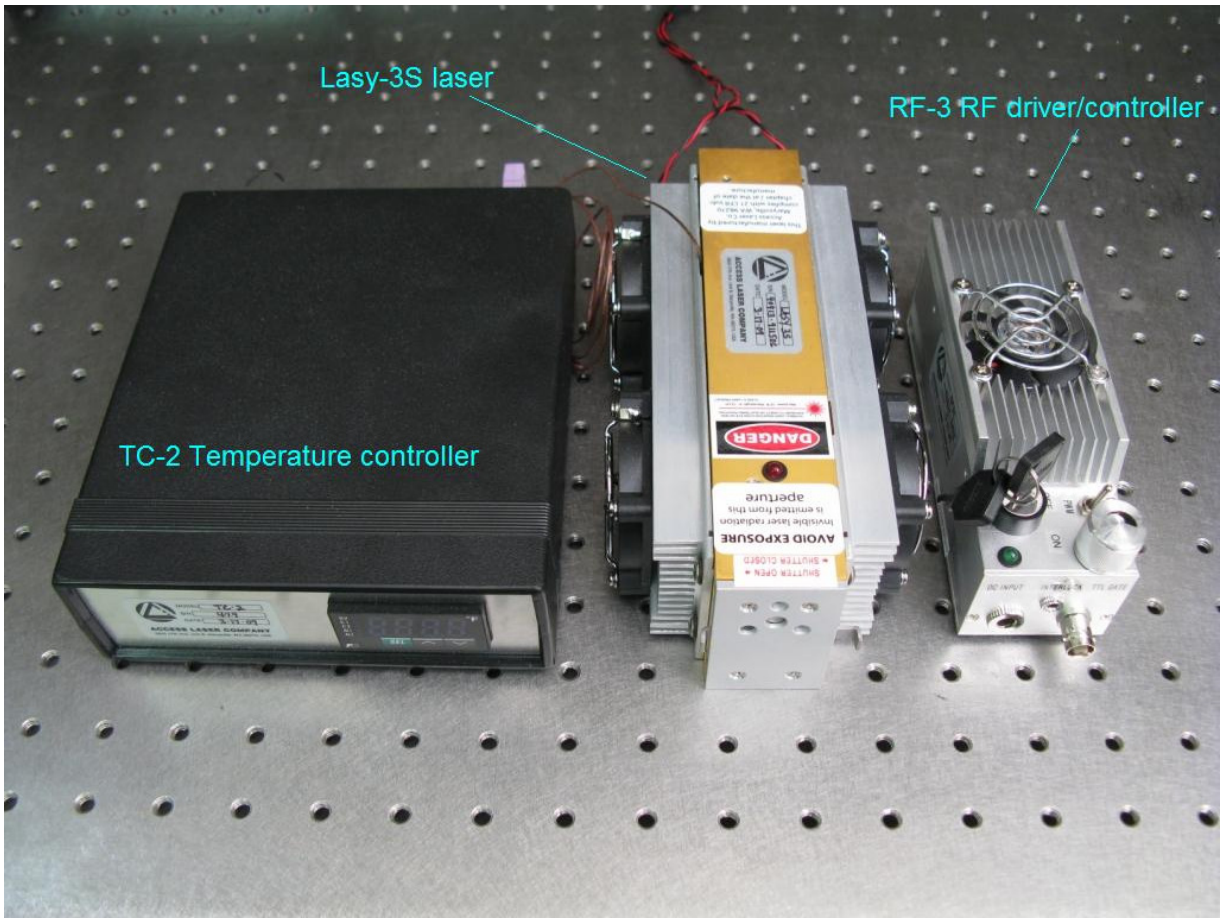
Stability and Tuning with -S models

white paper

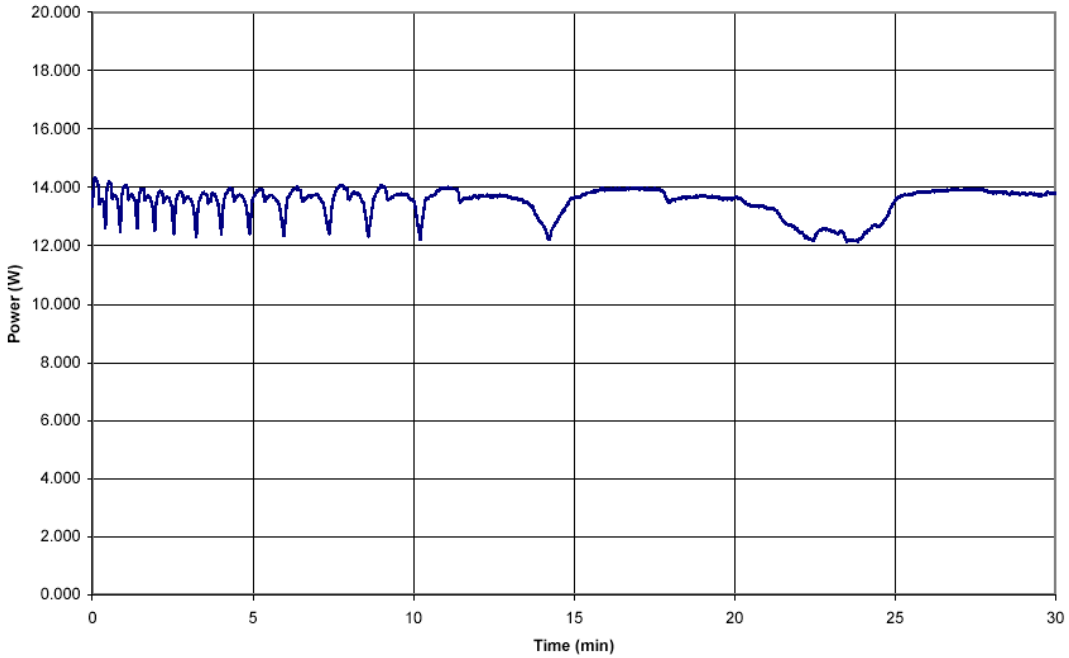


Access Laser Company, where innovation never stops

Stabilized lasers from Access Laser Company are made from Invar or other materials with high thermal mechanical stability. They also employ a feedback control system regulating the temperature of the laser resonator.



☹ Bad news becomes good news ☺



Typical CO2 lasers line hop, from one wavelength to another, causing instability in spectrum and power.

Reason: the length of the laser cavity drifts constantly under normal ambient conditions.

Solution: Control the drift and we will control wavelength and achieve power stability.

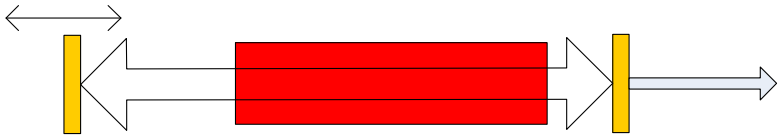
How it works: Gratingless tuned

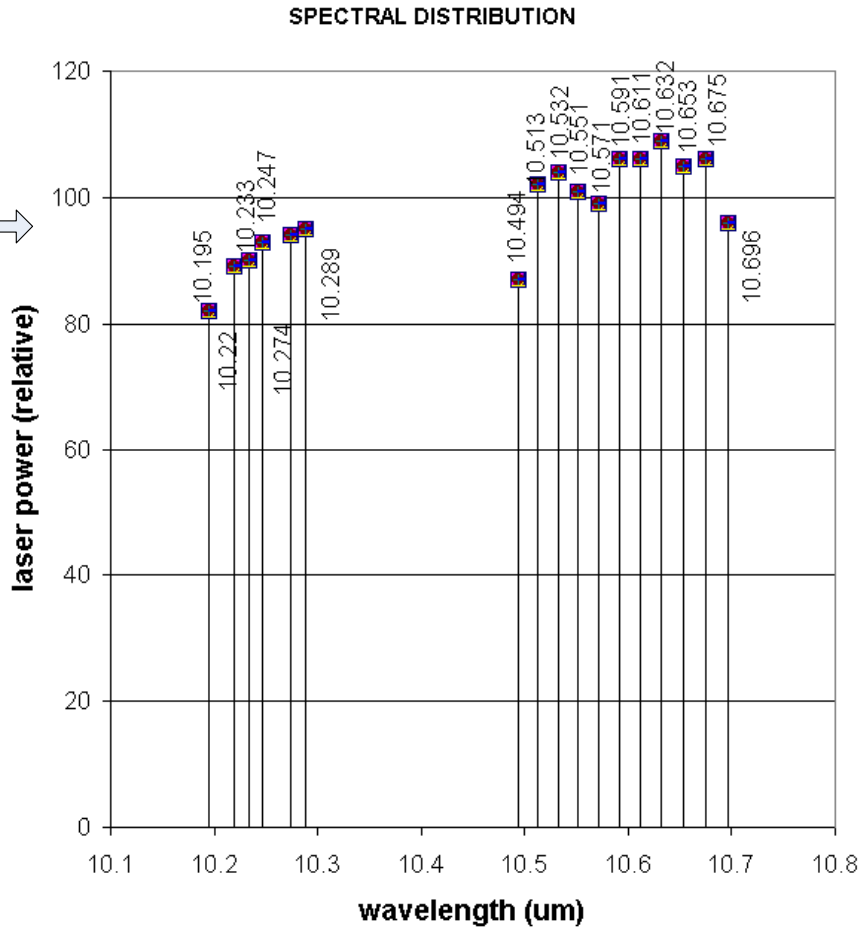
Taking advantage of the interaction between the molecular line spectrum and resonator modes by actively controlling the cavity length of the laser. Tuning into single wavelength and stay.

Method of tuning:

- Micrometer
- Temperature
- Piezo actuator

Spectral Distribution: Gratingless tunable



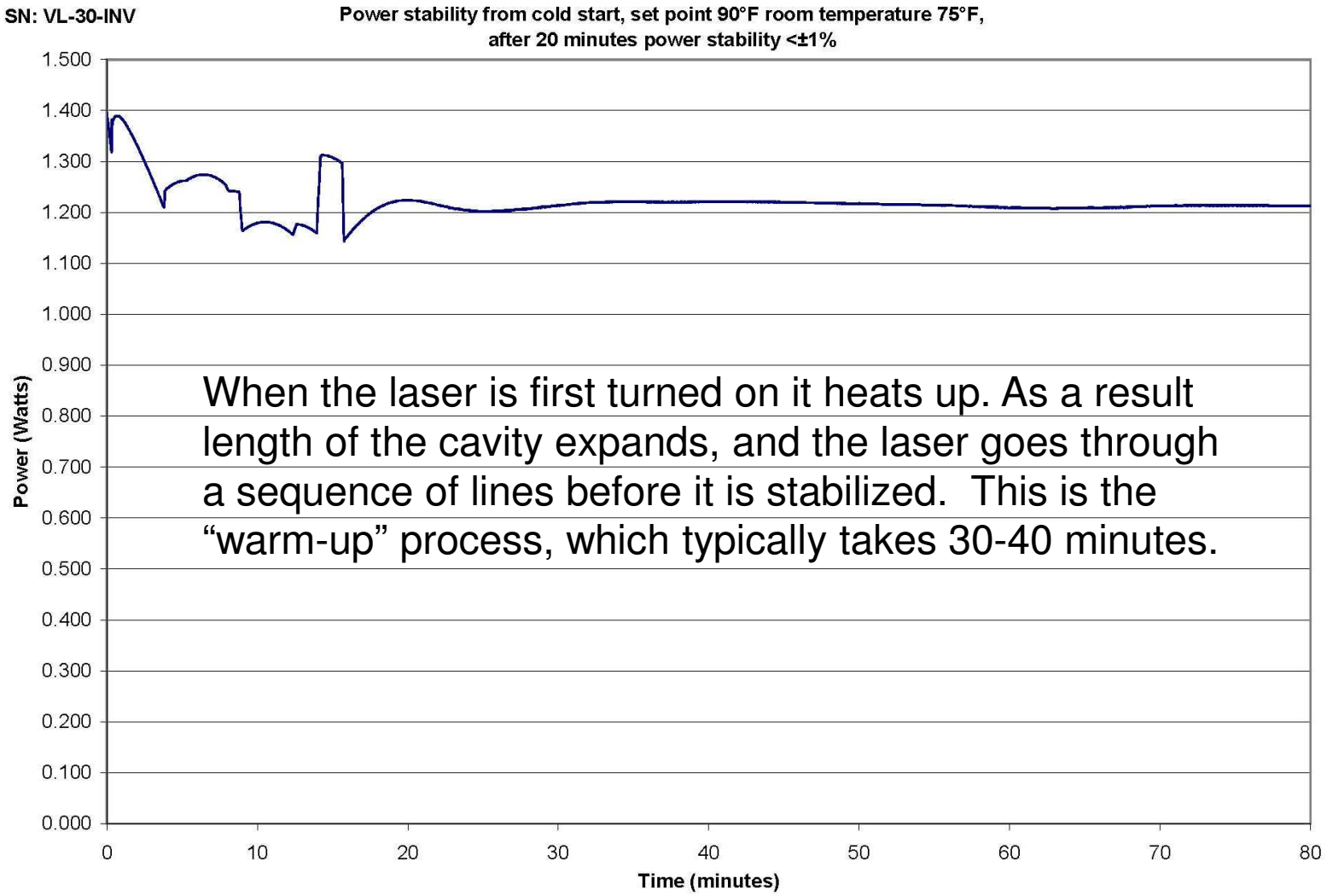


Laser resonators are tightly controlled to force the laser to stay in the desired wavelength

10.2-10.7 µm or

10.7-11.2 µm ($^{13}CO2$)

Warming Up To Stability



When the laser is first turned on it heats up. As a result length of the cavity expands, and the laser goes through a sequence of lines before it is stabilized. This is the "warm-up" process, which typically takes 30-40 minutes.

Power & Spectrum Considerations
in selecting the best model for you

- The smaller the laser the lower the power. Lasy-3S is the shortest with 400mw of output power. Lasy-20S is the biggest at 20 watts.
- The smaller the laser the more lines (you should notice this trend in the following pages). Lasy-3S has 15-17 lines typically, while Lasy-20S has 3-6.

Features Common to All –S Models

- All –S model lasers operate in single longitudinal mode and single transverse mode
- All –S model lasers operate in single line
- You can minimize wavelength and power instability by tuning to the middle of the temperature range for a specific line.
- The more lines an –S model laser can achieve the less temperature range each line has.
- Lines with wide range of temperature are easier to achieve and are more stable, and vise versa.

Wavelength vs. Temperature

As Laser Heats Up From A Cold State At CW

Laser Model : Lasy-3S		**Laser SN: 82835-83451C**	
Room Temperature 72.0 Deg F			
Wavelength	**Transition**	**Laser Temperature °F**	
(µm)	**00°1-10°0**		
10.513	10P12	75.3	75.4
10.675	10P28	75.4	75.7
10.494	10P10	75.7	75.9
10.260	10R18	75.9	76.2
10.591	10P20	76.2	78.5
10.632	10P24	78.5	80.2
10.274	10R16	80.2	80.8
10.611	10P22	80.8	82.6
10.220	10R24	82.6	82.7
10.532	10P14	82.7	84.9
10.571	10P18	84.9	87.0
10.551	10P16	87.0	89.4
10.653	10P26	89.4	91.2
10.653/10.303	10P26/10R12	91.2	91.3
10.303	10R12	91.3	91.5
10.207/10.513	10R26/10P12	91.5	91.6
10.513	10P12	91.6	93.8
10.494	10P10	93.8	94.8
10.675	10P28	94.8	95.0
10.260	10R18	95.0	95.7
10.591	10P20	95.7	#REF!

When using the temperature controller to tune the wavelengths the above temperatures may shift more than 1 °F as thermal equilibrium is achieved.

To tune to the desired wavelength, set temperature according to table and adjust setpoint as thermal equilibrium is achieved.

Setpoints Should Be Roughly 10 - 20 Degrees above room temperature, and within the limits of fan control.

Setpoints will vary based on room temperature and power settings but the wavelength cycle pattern should remain consistent.

Wavelength table of a typical model Lasy-3S, 400 mw laser, 14 lines.

Wavelength table of a typical model Lasy-4S, 1 W laser, 9 lines.

Wavelength vs. Temperature

As Laser Heats Up From Cold At CW

Laser Model : Lasy-4S		Laser SN: 029-RF2G-196	
Transition 00°1-10°0	Wavelength (µm)	Laser Temperature Range °F	
10P20	10.591	68.4	68.5
10R16	10.274	68.5	68.9
10P20/10R12	10.591/10.303	68.9	69.1
10P30	10.696	69.1	69.2
10P24	10.632	69.2	69.8
10P16	10.551	69.8	70.3
10P26	10.653	70.3	70.4
10P22	10.611	70.4	71.3
10P18	10.571	71.3	72.3
10P28	10.675	72.3	73.2
10P20	10.591	73.2	75.2
10R16	10.274	75.2	75.5
10P20/10R12	10.591/10.303	75.5	76.1
10R12	10.303	76.1	76.5
10P10	10.494	76.5	#REF!

When using the temperature controller to tune the wavelengths the above temperatures may shift approximately 1 °F as thermal equilibrium is achieved.

Set points will vary based on room temperature and power settings but the wavelength cycle pattern should remain consistent.

Temperature Set Points Should Be Roughly 8-15 Deg F Above Room Temperature

To tune to the desired wavelength, set temperature according to table and adjust set point as thermal equilibrium is achieved.

Maximum stability should be achieved at highest power for each wavelength, and on the wavelengths with the widest temperature range.

Wavelength vs. Temperature

As Laser Heats Up From Cold At CW

Room Temperature 67.0 Deg F

Laser Model : Merit-S		Laser SN: 85103-83905C	
Transition	Wavelength	Laser Temperature	
00°1-10°0	(µm)	Range °F	
10P24	10.632	68.5	69.5
10P28	10.675	69.5	73.2
10P26	10.653	73.2	78.7
10P22	10.611	78.7	82.3
10P20	10.591	82.3	87.5
10P20/10P30	10.591/10.696	87.5	88.6
10P30	10.696	88.6	89.3
10P24	10.632	89.3	92.8
10P28	10.675	92.8	93.8
10P26	10.653	93.8	96.9
10P22	10.611	96.9	99.3
10P20	10.591	99.3	104.0
10P20/10P30	10.591/10.696	104.0	104.9
10P30	10.696	104.9	105.2
10P24	10.632	105.2	0.0

Set points will vary based on room temperature and power settings but the wavelength cycle pattern should remain consistent.

Wavelength table of a typical model Merit-S, 8 W laser, 6 lines.

Wavelength table of a typical model Lasy20-S, 20 W laser, 4 lines

Wavelength vs. Temperature

As Laser Heats Up From Cold At CW

Laser Model : Lasy20SL-$C^{18}O_2$		Laser SN: 91402-91701C	
Room Temperature 22.0 °C			
Transition $00^01\text{-}02^00$	Wavelength (µm)	Laser Temperature Range °F	
9R18	9.125		22.2
9R16	9.134	22.2	23.1
9R20	9.115	23.1	24.6
9R22	9.105	24.6	26.0
9R18	9.125	26.0	27.8
9R16	9.134	27.8	28.6
9R20	9.115	28.6	

Temperatures may shift approximately 1°C as thermal equilibrium is achieved.

Set points will vary based on room temperature and power settings but the wavelength cycle pattern should remain consistent.

To tune to the desired wavelength, set temperature according to table and adjust set point as thermal equilibrium is achieved.

Maximum stability should be achieved at highest power for each wavelength, and on the wavelengths with the widest temperature range.

Other Considerations to Help You Make the Right Choice

- Do you need linear polarization? Lasy-20S is by default linearly polarized in the horizontal direction. Linearly polarization is not by default in other models, but can be added to Lasy-4S and Merit-S
- Do you want to achieve even better stability? Please read another white paper titled “cooling and stability”.
- Feel free to email us at info@accesslaserco.com, or call 425-582-8674.
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