



# Clean Jump Operation

Clean Light portfolio – Application Note

The Pure Photonics tunable laser is capable to operate at any desired frequency set-point within the tuning range. Every frequency & power set-point is defined by laser temperature, tuning element temperature (2x) and drive current.

In standard operation, the laser will disable itself when switching between channels. This is to ensure that the light emitted from the laser is always within 6GHz from the target frequency. Typical switching speed is 15 – 25 seconds.

Clean Jump allows for much faster switching between different set-points. This is achieved by changing the three temperature set-points only. During switching errant frequencies may be detected. The switching speed with Clean Jump is < 1 second for all frequency combinations and can be < 50ms for selected combinations.

In standard operation, the temperature of the tuning elements are known at every frequency (embedded in the processor), but drive current and laser temperature are optimized by the control loops of the laser. Without this information the Clean Jump would not be able to quickly reach a stable set-point. Hence, Clean Jump enabled products are calibrated over the frequency and power range to know both the set-points at the origin and the target frequency. This information is not stored in the module and needs to be provided by the user during operation (external data file is required).

The switching of the sled temperature and the temperature of the tuning elements determines the switching speed. Of these elements the sled temperature has the slowest response rate. Hence, the Clean Jump operation can be sped up by only changing the tuning element temperatures. When we freeze the sled temperature, only set-points on a 6GHz grid are accessible and hence the unit can switch fastest if the target frequency accuracy requirement is +/- 3 GHz.

Furthermore the fastest switch operations are between points that are close in temperature set-point. Thanks to the Vernier effect (the basic operating principle of the frequency selection mechanism) a small change in temperature can result in major frequency change. Favorable frequency jumps, for speed, are 275 – 550 GHz.

If specific operating points are known, then the device calibration can be optimized to make the switching between those points optimized.

Flowchart

		Register	Value	Comment
	Create table of set-points (frequency, sled temperature, current)			To be obtained from measurement or calculation
	↓			
	Activate the laser			
	↓			
	Set laser to starting frequency	0x35	e.g. 190	THz part
		0x36	e.g. 9000	10*GHz part (in this case 190.9THz)
	↓			
	Turn laser on	0x32	8	SENA bit 3 = 1
	↓			
	Monitor NOP until laser is locked	0x00		Pending flags in bit 9-16
	↓			
	Turn on Low-noise mode	0x90	1	Activate the Clean Mode 1
	↓			
	Set next frequency (THz part)	0xEA	e.g. 193	THz part
	↓			
	Set next frequency (GHz*10 part)	0xEB	e.g. 6785	10*GHz part (in this case 193.6785THz)
	↓			
	Set next sled temperature (C *100)	0xEC	e.g. 3134	to move the sled to 31.34C
	↓			
	Set next drive current (mA*10)	0xE9	1323	to move the current to 132.3mA
	↓			
	Hold laser for desired time			
	↓			
	Initiate Clean Jump (1)	0xED	1	transfer frequency, temperature and current to memory
	↓			
	Initiate Clean Jump (2)	0xED	1	calculate filter 1
	↓			
	Initiate Clean Jump (3)	0xED	1	calculate filter 2
	↓			
	Initiate Clean Jump (4)	0xED	1	Execute the jump
	↓			
	Monitor error until within range	0xE6		Coded as error = (value - 10000)/10 GHz
	↓			
Yes	Next setpoint ?			
	↓			
	No			
	↓			
	Stop Clean Jump	0xED	0	

## Graphical User Interface (GUI)

To facilitate operation and experimentation, Pure Photonics is making a GUI available that implemented the above flow-chart. The user can obtain this GUI through a download from the Pure Photonics website (download section).

The GUI is started by selecting the file 'PP GUI Clean Jump.exe'. Upon first execution this program will create a '\LogFiles' directory, which will store the log files that are generated during operation. It also should contain one or more '.map' files that contain the calibration data for the specific module (indicated by the .map file-name starting with the serial number). Each '.map' file contains the device data over the frequency range for a specific output power set-point. Upon delivery of the device and/or upon request Pure Photonics will provide these map-files.

Upon start of the program, several steps are shown. The user needs to connect to the module in STEP 1 (select the appropriate COM port).

In STEP 2 the user will select the power set-point and the starting frequency, as well as the frequency jump points. The user can either select a specific arbitrary sequence (on the left side) or jump to consecutive points (on the right side). The user can select how long the device remains at each set-point and what the criterion is for frequency lock. Finally, the user can select to optimize the points, which essentially means that the frequency set-point is modified by  $\pm 3$  GHz, so that the sled temperature does not have to change during a jump (see the discussion earlier or achieving faster switching).

In STEP 3 the user will activate the sequence and can monitor the progression of the Clean Jump. Note that data is saved in the log-file directory and can be accessed later.