Model No. FFC-100-100 and FFC-100-200 Document Last Updated on 2023/08/09 17:25

Please read Limited Warranty and General Warnings and Cautions prior to operating the FFC-100.





FFC-100 Fiber Frequency Comb

Useful Links

Click here for the Vescent manuals page. Click here for the FFC-100 API. Click here for the SLICE-FPGA-II Locking Manual Click here for the FFC-100 web page.

Please check back for added functionality. Contact sales [at] vescent [dot] com for questions and corrections, or to request added functionality.

Notice



Do not block the airflow vents on the side of the chassis or the fan inputs & outputs on either the FFC-100 or the SLICE-FPGA.

The mode-lock indicator on the GUI front panel cannot detect CW breakthrough. Keep the oscillator current within the range specified in your product's final test documentation or CoC.

Operating the FFC

This document provides instructions on how to operate the Vescent Photonics FFC-100 when controlled by the Vescent SLICE-FPGA or SLICE-FPGA-II.

Purchase Includes

- FFC-100 rack-mountable Fiber Frequency Comb
- Power cord for your country (if known)

Certificate of Conformance

Absolute Maximum Ratings and Power Input

Note: Reported specs are under laboratory conditions. Performance degradation can occur in deployed operation depending on the environment

Parameter	Rating
Environmental Temperature	15°C <t<30°c< td=""></t<30°c<>
Environmental Humidity	<60%
Environmental Dew Points	<15°C
Maximum AC Line Input Current	2 A
Tab. 1: Absolute Maximum Ratings	

The FFC-100 employs a proprietary design hybrid power supply that is both low noise and capable of accepting a range of AC input line voltages. It will accept input line voltages within the ranges shown in table 2.

Parameter	Value	Units		
Input Line Voltage	100-240	VAC		
Frequency	50-60	Hz		
Phase	1 phase			
User-serviceable fuse ¹⁾	T 2.0 A L 25	T 2.0 A L 250V		
Tab. 2: Input Voltage Specific	ations			

i ab. Z. iliput voltage specifications

Proper Usage



If this instrument is used in a manner not specified by the manufacturer in this manual or other relevant literature, protection provided by the instrument may be impaired.

Successful implementation of the FFC-100 depends critically on the design of the whole system: FFC-100, phase locking electronics, and any references to which the FFC is locked or vice versa.

Initial Set-up

- 1. Ensure all cables and fibers are connected according to the connection diagram figure 2.²⁾
- 2. Ensure the RF input amplitudes to the FPGA are between -30 dBm and -15 dBm. If power levels are higher than -15 dBm, utilize an appropriate RF attenuator.
- 3. Turn on the power to the Fiber Frequency Comb (FFC) and the FPGA, as well as the reference laser.
- 4. Ensure the optical input power to the fOPT input port is < 1.5 mW.



Fig. 2: FFC-100 electrical and optical connection diagram (Click for larger image)

Parameter	Rating
f _{opt} Power Input	<1.5 mW max
Tab. 3: Operating Parameters	

FFC-100 Operation

FFC Start Up GUI

 Touch the "System Off" button at the top of the front panel screen (figure 3) to bring up a dropdown menu. Select "Standby" (figure 4) to turn on temperature control of the pump diodes and oscillator cavity. Temperatures will appear yellow as they approach stability, and turn green when stabilized within a predefined temperature range around the setpoint.

	SYSTEM OFF	Slow Servo				
		OSC CAVITY				
	PZT Voltage [V]: -2.0 0.0		100.0	2		
5	DC Bias [V]		Target [°C] Actual [°C]			
A	PZT 0.00 T	emperature	25.000 -0.600			
Ľ	OSC Mod. [mA]: 0.0 -100	PUMP LASERS	100.0	-		
	Curr. [mA] Tem	o l°Cl	Curr. [mA] Temp [°C]			
0	OSC 0 -0.	200 AMP	0 -0.400			
				Fig. 3: 1	ne FFC-10	o Gui in oli state
		SYSTEM OF STANDBY LASER ON	F Slow Servo		100.0	
	5	DC Bias (\	4	Target [°C]	Actual [°C]	
	F	PZT 0.00	Temperature	25.000	-0.600	
			PUMP LASERS			
	<u>o:</u>	SC Mod. [mA]: 0	0.0 -100.0		100.0	
		Curr. [mA] DSC 0	-0.200	Curr. [mA] 0	Temp [°C] -0.400	

Fig. 4: Select Standby laser state

2. Once the temperature servos have stabilized and "Standby" has stopped blinking, touch the "Standby" drop-down menu (figure 5) and select "Laser On" (figure 6). The FFC should commence lasing and the Mode-locked indicator should turn green (figure 7).

2	STANDBY	Mode-locked
	OSC CAVITY PZT Voltage [V]: 0.00 0	100
5	DC Bias [V]	Setpoint [°C] Actual [°C]
6	PZT 0.00 Temperature	0.000 0.000
	PUMP LASERS	
	OSC Mod. [mA]: 0 -100	100
	Current [mA] Temp ["C]	Current [mA] Temp ['C]
0	OSC 0 0.000 AMF	0 0.000

Fig. 5: The FFC-100 GUI: in Standby

mode

2	SYSTEM OFF	Mode-locked
	STANDBY	CAVITY
	PZT	100
5	LASER ON	Setpoint ['C] Actual ['C]
	PZT 21.00 Temp	erature 25.000 0.000
	PUM	P LASERS
	OSC Mod. [mA]; 0 -100	100
	Current ImA] Temp I'Cl	Current [mA] Temp [°C]
	OSC 50 0.000	AMP 70 0.000
Fig. C. The FFC 100 CUIL (Stewallow to Guetawa Ora	
Fig. 6: The FFC-100 GUI: 5	standby to System On	
	LASER ON	Mode-locked
	LASER ON	Mode-locked
	LASER ON OSC	Mode-locked
	LASER ON OSC PZT Voltage [V]: 21.00 0 DC Bias [V]	Mode-locked CAVITY
	LASER ON VOIT VOITage [V]: 21.00 0 DC Bias [M] PZT 21.00 Temp	Mode-locked CAVITY 100 Setpoint ["C] Actual ["C] perature 25.000 0.000
	LASER ON LASER ON OSC PZT Voltage [V]: 21.00 0 DC Bias [V] PZT 21.00 Temp	Mode-locked CAVITY 100 Setpoint [°C] Actual [°C] Derature 25.000 0.000
Fig. 6: The FFC-100 GOI: S	LASER ON VOIT VOIT UN CONTRACT OF CONTRACT ON CONTRACT OF CONTRAC	Mode-locked CAVITY 100 Setpoint [°C] Actual [°C] Derature 25.000 0.000 P LASERS
Fig. 6: The FFC-100 GOI: S	LASER ON LASER ON PZT Voltage [V]: 21.00 0 DC Bias [V] PZT 21.00 Temp PUM OSC Mod. [mA]: 0 -100	Mode-locked CAVITY 100 Setpoint [°C] Actual [°C] perature 25.000 0.000 P LASERS 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100
Fig. 6: The FFC-100 GOI: S	LASER ON LASER ON PZT Voltage [V]: 21.00 0 DC Bias [V] PZT 21.00 Temp PUM OSC Mod. [mA]: 0 -100 Current [mA] Temp ["C]	Mode-locked CAVITY 100 Setpoint [°C] Actual [°C] Derature 25.000 0.000 P LASERS 100 Current [mA] Temp [°C]

Fig. 7: System On

3. Touch the "PZT" touch screen button (figure 8) to bring up a drop-down menu and select "Full Range x10" to enable the PZT servo.

2	SYSTEM OFF		Mode-lock	ced 🔿
	OFF		_	100
5			Setpoint [°C]	Actual [°C]
Ā	x1	Temperature	25.000	0.000
Ľ	Full Range x10	PUMP LASERS		
		00		100
	Current [mA] 1	[emp [°C]	Current [mA]	Temp [°C]
0	OSC 50	0.000 AMP	70	0.000



FPGA Control

The SLICE-FPGA dual-channel Offset Phase Lock Servo can be used to phase lock f_{ceo} to a reference (TBD) and f_{opt} to a reference laser such as the Rio Planex.

For locking the FFC-100 with the Vescent SLICE-FPGA-II Module, click here.

If using the SLICE-FPGA, click here.

Slow Loop Feedback

Slow servo functionality is designed to allow indefinite FOPT locking times despite long-term drifts in the reference laser's frequency outside the dynamic range of the FFC's PZT feedback. This is achieved by slow temperature feedback to the oscillator of the FFC, which locks the PZT output voltage to a setpoint voltage near the middle of its dynamic range. To enable the slow servo, first lock FOPT normally, with the DAC 1 slider as close to centered as possible. Next, navigate to the home screen of the FFC-100 and press the "Slow Servo" button at the top of the screen (figure 9 and figure 10).

	SYSTEM OFF Slow Servo	Mode-locked
	PZT Voltage [V]: -1.0 0.0	100.0
5	DC Bias [V]	Setpoint [°C] Actual [°C]
	PZT 0.00 Temperature	25.000 24.998
Ľ	PUMP LASERS	
	OSC Mod. [mA]: 0.0 -100.0	100.0
	Current [mA] Temp [°C]	Current [mA] Temp [°C]
0	OSC 0 0.000 AMP	0 0.000

Fig. 9: The slow servo button is located on the home screen to the right of the System Off/Laser On button.

This will activate the slow servo but does not turn on the feedback. You can tell that the slow servo has been activated by the blue background on the "Setpoint [°C]" button.

	LA	SER ON	Slow	v Servo	Mode-loc	ked
	PZT Volt	age [V]: 45.1	0.0			100.0
5		DC Bias [V]			Setpoint [°C]	Actual [°C]
Ā	x10	45.00	Tempe	rature	25.124	25.027
Ľ			PUMP	LASERS		
	OSC Mo	d. [mA]: 0.0	-100.0			100.0
		Current [mA]	Temp [°C]		Current [mA]	Temp [°C]
	OSC	300	25.000	AMP1	1200	25.000

Fig. 10: When the slow servo is activated, the slow servo button will turn green, and the temperature "Target [°C]" and "Actual [°C]" buttons will turn yellow or green according to the current state.

This will activate the slow servo. On the FPGA software under the "Optical Lock" tab, the "DAC 1" slider should be gradually pushed and eventually stabilize in the center of its dynamic range. The gain of the slow servo comes preconfigured for each unit but can be adjusted via a menu accessed by pressing and holding the "Slow Servo" button on the FFC GUI (figure 11) (We do not advise

changing the gain without input from the Vescent technical staff).



Fig. 11: The slow servo menu allows the user to change the setpoint, gain, and polarity of the servo, and also to turn it on or off.

While the slow servo is on, the color of the "Setpoint [°C]" button will change as the slow servo adjusts the temperature setpoint. A yellow color indicates that the PZT voltage is > 6V away from the setpoint (30V) and the temperature setpoint is being changed to compensate. This box will turn green when the PZT voltage is within the range of \pm 6V of the voltage setpoint. The color of the "Actual [°C]" box may also momentarily turn yellow as the temperature control servo corrects the cavity temperature when the temperature setpoint changes.

Remember to shut off the slow servo by pressing the On/Off button in the slow servo menu, when unlocking the FFC-100.

1)

Located in power receptacle on rear panel

Single frequency reference laser: for instance a RIO Planex[™] 1550 nm laser.

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