

# FFC-100 Frequency Comb

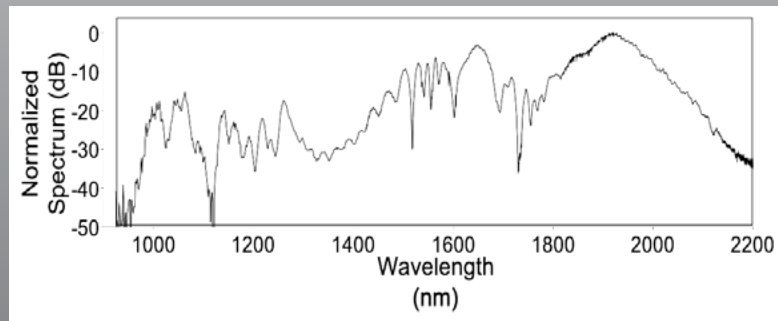
The FFC-100 from Vescent Photonics is a fully stabilized octave-spanning frequency comb with precise control over  $f_{rep}$ ,  $f_{opt}$ , and  $f_{CEO}$ . It is built around the Vescent MLL-100 Mode-Locked Laser, a stand-alone erbium-based femtosecond MOPA. A highly non-linear fiber broadens the spectrum and our unique  $f_{CEO}$  lock detection reduces the size, weight, and power of the system. The complete FFC-100 frequency comb is designed and built to ensure stable, low-phase noise operation with Allan Deviations supporting the next generation of optical atomic clocks.



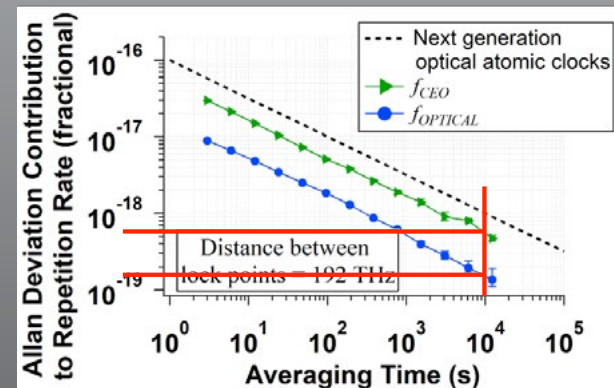
FFC-100 Frequency Comb

The FFC-100 was designed for low SWaP and turn-key, stable operation: A single 2U 19" rack mount chassis contains the oscillator, amplifier, pump lasers, supercontinuum generation module, and  $f_{CEO}$  detection and lock as well as the control electronics.

The simple oscillator mode locks at start up every time and the innovative passive SESAM mode-locker is specially designed for a robust, long life. Our unique oscillator design also makes it easy to precisely factory match the repetition rate of two (or more) FFC-100 combs for multi-comb spectroscopy experiments.



Full octave-spanning spectrum of the FFC-100



Rock-solid performance of the FFC-100 offers favorable stability with respect to the next generation of atomic clocks

## Features:

- Turn-key operation
- 1560 nm center wavelength
- >30 mW in supercontinuum
- Low phase & amplitude noise
- 2U 19" rack-mounted enclosure
- $f_{rep}$  monitoring, control, and matching
- Input port for  $f_{opt}$
- Repetition rates from 80 to 250 MHz
- Made in America

## Applications:

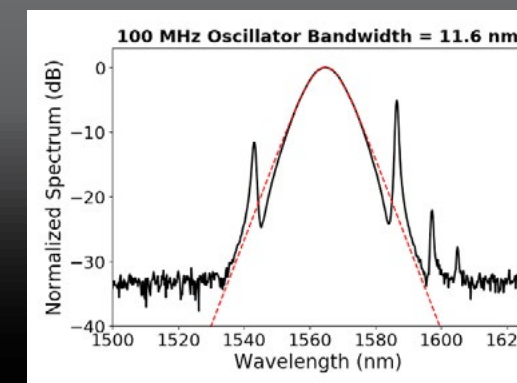
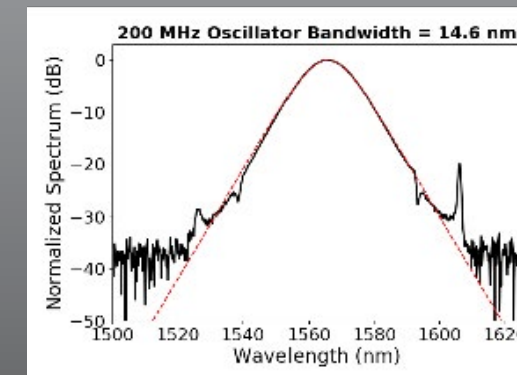
- Time & frequency readout & transfer
- Frequency ruler
- Dual- and multi-comb spectroscopy
- Quantum sensing, computing, & cryptography
- Low-phase noise rf generation



# FFC-100 Performance Specifications

Supercontinuum Performance	
Optical Bandwidth	>1,000 nm
Average Power	>30 mW
$f_{CEO}$ Performance	
Signal-to-noise	>35 dB
Linewidth	<200 kHz (typical:125 kHz)
In-Loop Allan Deviation	< $10^{-16}/\sqrt{\tau}$
Oscillator Performance	
Center Wavelength	1560 $\pm$ 10 nm
Oscillator Monitor Output Power	Monitor: 250 $\mu$ W $\times$ 5 mW
Bandwidth	$\geq$ 10 nm
Nominal Repetition Rate <sup>1</sup>	80, 100, 200, or 250 MHz
Electrical Pump Power Modulation Bandwidth <sup>2</sup>	1 MHz
Polarization Extinction Ratio	$\geq$ 20 dB
Optical Outputs	
Supercontinuum, Oscillator, and Amplifier	FC/APC PM1550 fiber (key aligned to slow axis)

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Broad bandwidth seed pulses are generated by the MLL-100 Mode-Locked Laser at repetition rates from 80 to 250 MHz



# FFC-100 Performance Specifications (con't)

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Repetition Rate Control	
Computer Control <sup>3</sup>	1-5 ppm
PZT Modulation Control Input Range <sup>3,4</sup>	0.3 - 1.0 ppm
PZT Control Transfer Function <sup>3</sup>	15 - 50 ppb/V
PZT Control Bandwidth <sup>5</sup>	>100 kHz
Temperature Control Range <sup>6</sup>	300 ppm
Temperature Control Transfer Function	10 ppm/°C
Temperature Set Point Resolution	<0.1 mK
Repetition Rate Stability <sup>7</sup>	<1 ppm/°C
Monitor Outputs	
$f_{rep}$	
RF Bandwidth	500 MHz
RF Power	>-10 dBm
$f_{opt}$	
RF Bandwidth	>50 MHz
RF Power	>-40 dBm
$f_{CEO}$	
RF Bandwidth	>50 MHz
RF Power	>-40 dBm
Optical Output	Oscillator and/or amplifier power
Physical Properties	
Power Input	100 - 240 VAC; 50 - 60 Hz
Power Consumption	<40 W
Dimensions <sup>8</sup>	19" rack mountable: 19" x 10" x 2U

All specifications subject to change without notice.

<sup>1</sup>Can be factory tuned to within 5 kHz

<sup>2</sup>Loop bandwidth limited by Er:fiber to ~30 kHz

<sup>3</sup>Depends on nominal repetition rate

<sup>4</sup>0-100 V input

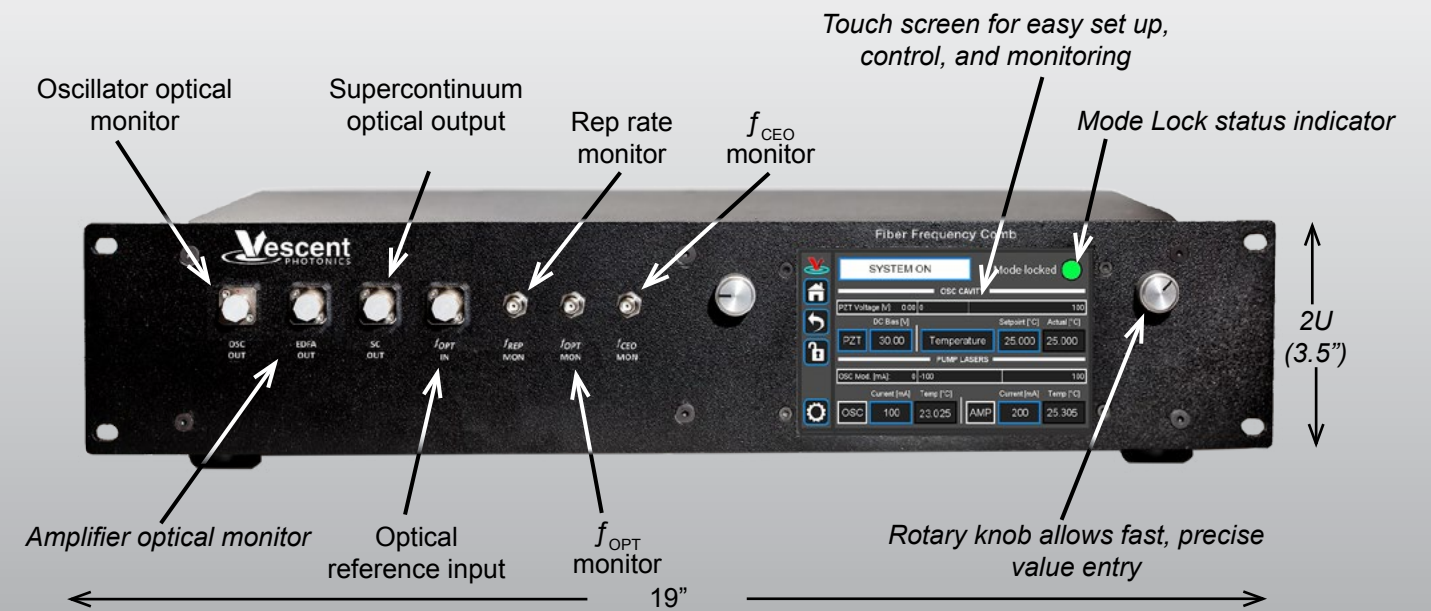
<sup>5</sup>Small signal ( $\pm 10$  V range centered at nominal set point)

<sup>6</sup>Assuming 40°C range

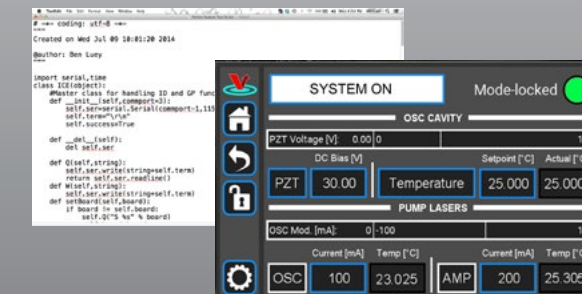
<sup>7</sup>With respect to room temperature

<sup>8</sup>Includes all electro-optical components & electronic drivers

# Meet the FFC-100



FFC-100 compact Frequency Comb



Control the FFC-100 via a touch screen or a serial command API



Made in America!



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