

USER GUIDE



OPTICAL FREQUENCY CORRELATOR

OFC



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I. INTRODUCTION

Thank you for ordering the OPTICAL FREQUENCY CORRELATOR (OFC) specially designed for you. The OFC system is comprised of a common 2-input optical frequency discriminator (OFD). This makes it possible to frequency-stabilize two wavelength-distant lasers onto the same optical reference to reduce their frequency fluctuations and to correlate them.

Based on this fact, the optical beat frequency between the two stabilized lasers generates a THz or GHz signal that reaches a very low frequency noise level and high frequency stability.

Moreover, as a standard OFD, it smartly delivers a voltage signal that is proportional to the frequency fluctuations of the input laser beam. This turn-key device is suitable for laser frequency noise characterization and/or for laser frequency stabilization to drastically reduce its optical full-width-at-half-maximum linewidth. The OFC features ultralow noise performances, achieving frequency noise levels as low as $0.01 \text{ Hz}^2/\text{Hz}$, in a compact and user-friendly package. It also includes external temperature control to act on the laser frequency once it is locked onto the OFC.

IMPORTANT: Read the operating instructions carefully and especially observe the safety information. If you do not follow the safety instructions and information on proper handling in this manual, we assume no liability for any resulting personal injury or damage to property. Such cases will invalidate the warranty/guarantee.

II. DELIVERY CONTENT

The OFC is delivered with a case for easy transportation and protection. Inside the case, you will find:

- OFC – Optical Frequency Correlator
- AC/DC switching power supply – XP-POWER ACM36US09
- User Guide (this document)
- Data Report

IMPORTANT: For up-to-date Operating Instructions, please contact us directly (see contact information at the end of this document).



III. SAFETY INSTRUCTIONS

- Consult an expert when in doubt about operation, safety or connection of the device.
- Maintenance, modifications and repairs are to be performed exclusively by SILENTSYS SAS.
- If you are not sure about the correct connection or use, or if questions arise which are not covered by these operating instructions, please do not hesitate to contact our technical support or another qualified specialist.
- The device is not a toy. Keep it out of the reach of children and pets.
- Protect the product from extreme temperatures, direct sunlight, strong jolts, high humidity, moisture, flammable gases, vapors and solvents.
- Do not place the product under any mechanical stress.
- If it is no longer possible to operate the product safely, take it out of operation and protect it from any accidental use. Safe operation can no longer be guaranteed if the product:
 - is visibly damaged,
 - is no longer working properly,
 - has been stored for extended periods in poor ambient conditions or
 - has been subjected to any serious transport-related stresses.
- Also observe the safety and operating instructions of any other devices which are connected to the product.
- Never open the device or insert objects into it through its holes. Such cases will void the warranty/guarantee.
- Always lay the cables so that nobody can trip over or become entangled in them. This poses a risk of injury.
- Check the product for damage(s) each time before use. If you discover any damages, do not use the product.
- Do not operate the product in interior places or rooms with unfavorable ambient conditions. This can damage the sensitive electronics found inside the product and can potentially pose life-threatening risks. Poor ambient conditions are:
 - High humidity (>80% relative, condensation)
 - Dust, flammable gases, solvent vapors, benzine
 - Electromagnetic fields (motors, transformers, audio systems for model building etc.) or electrostatic fields
- The maximum altitude allowed is 2000 m (6562 ft) above sea level.
- This device is powered down by removing the mains plug, which must remain accessible.

IV. DISPOSAL



Electronic devices are recyclable waste and must not be disposed of in the household waste. At the end of its service life, dispose of the product according to the relevant statutory regulations. You thus fulfill your statutory obligations and contribute to the protection of the environment.

V. CONNECTION INTERFACES

Your OFC contains 2 optical modules working at a given wavelength and “free spectral range” (see Data Report for details). Each optical module has an optical input with a narrow key (2.0 mm) FC/APC connector that is labeled “Input A” or “Input B” on the front panel of the device. The device converts the optical frequency fluctuations of the input laser into an electrical signal accessible on the corresponding SMA connector, “Output A” or “Output B”, on the front panel. Both SMA and FC/APC connectors are protected against dust with dedicated caps.

IMPORTANT: Connect the SMA “OUTPUT” to a high-impedance device (preferably not 50 Ω).

IMPORTANT: For optimal performance, ensure that the polarization of the input laser is aligned with the key of the PM FC/APC connection (commonly the slow axis).

On the left side of the front panel, a touchscreen is available to control the OFC and display important information. On the far-right side of the front panel, two SMA connectors are provided for external control of the optical module temperature. The top one is a 10 k Ω NTC element as a temperature sensor and the bottom one controls the Peltier element through a voltage-to-current converter. The “SERVO OUT” connector is not internally connected / not activated on this model.



On the back panel of the device, there is a P1J plug for the power supply and an illuminated power switch to enable or to disable the entire system. Also on this face are the product serial number and a 4 mm hole for grounding the device with a banana cable.



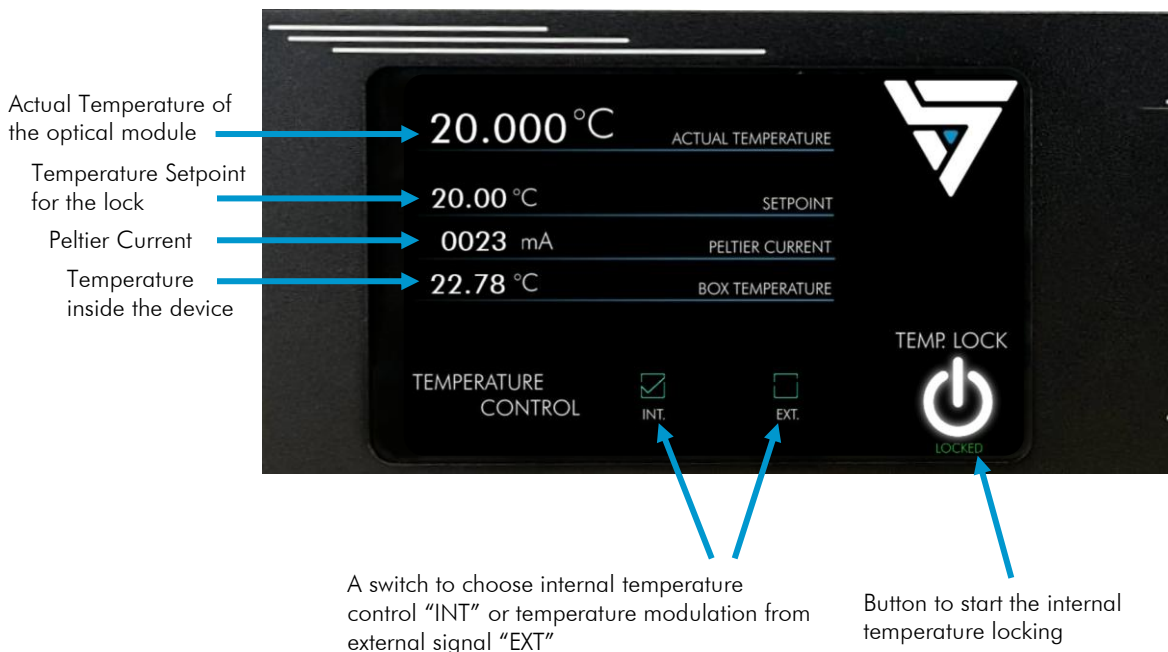
VI. QUICK START

1. Plug the provided power supply into an electrical socket.
2. Plug the P1J connector of the provided power supply into the POWER IN plug and connect a grounded banana plug to the 4 mm grounding hole on the rear face of the OFC.
3. Turn ON the OFC by pressing the ON/OFF button on the rear face. The button will illuminate when the OFC is powered on.
4. The OFC is ready to be used and can be connected to your devices. However, temperature stabilization is important to reach the best optical frequency stabilities (see next section).
5. To turn OFF the OFC, press the ON/OFF button on the rear face of the OFC and unplug the provided power supply from the OFC or the electrical socket. The socket must be accessible.

IMPORTANT: Place the OFC unit on a stable, level and robust surface. For the best results, place the OFC where the acoustic noise and mechanical vibrations are lowest and where the temperature stability is best.

VII. TOUCHSCREEN CONTROLS

When the OFC is powered on, you will be presented with the following screen.

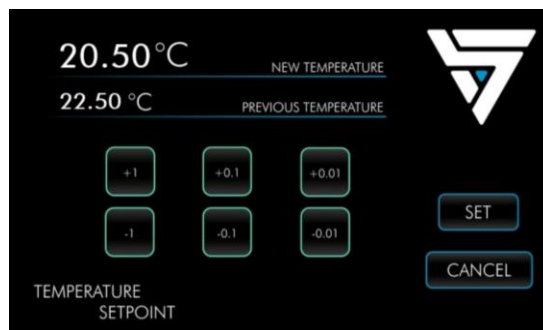


TEMPERATURE STABILIZATION:

1. Adjust the target temperature by clicking the Setpoint area on the touchscreen (red zone in the following image).

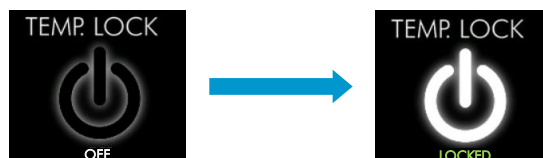


2. You will be presented with the following page. The adjustment of the setpoint is done by clicking on the +/– buttons. Press “SET” to make this new value the temperature setpoint or “CANCEL” to go back to the main page.



IMPORTANT: The value of the setpoint is saved in the internal memory of the system and recalled when the device is restarted.

3. Press the “TEMP. LOCK” button on the screen to launch the temperature stabilization of the optical module. The button will start blinking and the message “ON-GOING” will appear. When both of the following conditions are met, the button will display “LOCKED”:
 - The mean value of the temperature for 5 seconds is within 20 mK of the setpoint.
 - The standard deviation of the temperature for 5 seconds is less than 2 mK.



4. The setup is complete! Now plug in your continuous wave (CW) single-frequency lasers with cleaned FC/APC fiber connectors to stabilize and/or characterize them!

IMPORTANT: To reach the best performances, the temperature difference between the “Box Temperature” and the “Setpoint” should be as low as possible, meaning that the “Peltier Current” should be as low as possible.

IMPORTANT: A safety feature is present in the software such that if the temperature locking is too long, it will be automatically stopped to protect the device. If the absolute value of the Peltier current is greater than 700 mA for 4 minutes consecutively, the lock is automatically stopped.

VIII. TECHNICAL DATA

Specifications

- Number of optical inputs: 2
- Number of electrical outputs: 2
- Optical input connector: PM FC/APC with narrow key (2.0 mm)
- Electrical output connector: SMA
- Electrical output voltage range: ± 3 V max
- Laser type: Single-frequency continuous wave
- Optical input power: typ. 200 μ W at telecom wavelength 1.5 μ m before saturation, possible permanent damage beyond 10 mW
- Compatible wavelengths: *See Data Report*
- Free Spectral Range (FSR): *See Data Report*
- System sensitivity: *See Data Report*
- Frequency noise floor limit: *See Data Report*
- External temperature control
 - NTC resistance reading connector: SMA
 - Temperature control input connector: SMA
 - NTC characteristics: *See Data Report*
 - Temperature control input voltage range: ± 5 V, permanent damage beyond ± 9 V
- Power supply plug: P1J
- Provided power supply : 9 VDC / XP-POWER ACM36US09

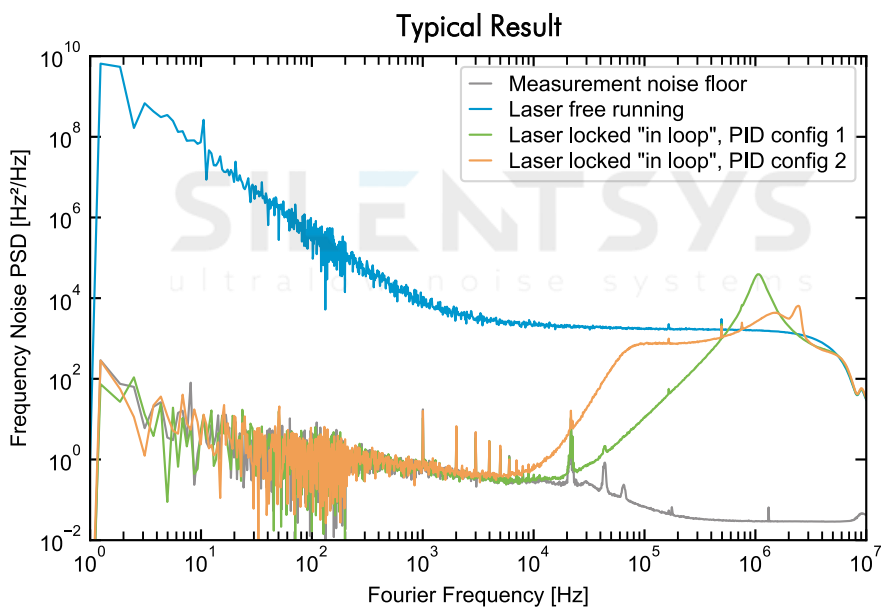
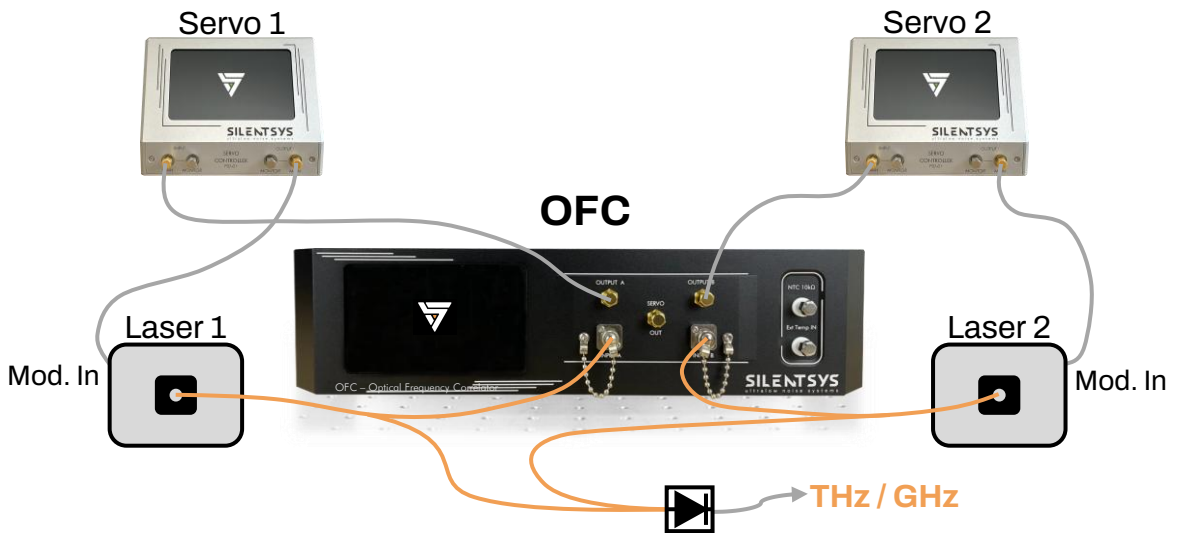
Mechanical characteristics

- Product dimensions: 360 mm x 360 mm x 88 mm
- Product weight: approx. 8.2 kg
- Aluminum case
- Temperature: +10 °C to +40 °C

IX. APPLICATION

The following illustration shows an example usage of the OFC for laser characterization and stabilization. The OFC outputs a voltage signal that is proportional to the frequency fluctuations of the laser. Therefore, connecting a digital oscilloscope or spectrum analyzer (denoted "Analysis" in the illustration) enables the characterization of the laser frequency/phase noise.

The OFC can also be used to stabilize the laser by acting on its modulation input. To achieve this, the output of the OFC must be connected to a PID controller like the SILENTSYS PID-01. Appropriate parameters for the feedback control loop are chosen to correct the frequency fluctuations of the laser.



ABOUT SILENTSYS

SILENTSYS SAS is a French company that develops, produces and commercializes innovative ultralow noise systems covering photonics, microwave/THz and electronic modules. Thanks to our well-established know-how and our patented designs, SILENTSYS offers high-performance systems that are compact, easy to use and affordable.

Our goal is to provide systems that are highly compatible with the needs of emerging industrial and laboratory applications such as those related to quantum technologies (Communications, Cryptography, Computing, Metrology, Sensing...).

CONTACT

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LOCATION



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