RESONANCE ACTUATION · FREQUENCY TRACKING

PHILL™



PHILL™ is a resonance actuation and tracking device, specifically designed for resonant sensors. It features a self-sustaining oscillator (SSO) and a frequency counter-based architecture. The enhanced wide-band-pass and digital low-pass filtering conditions the signal, converting sinusoidal input into precise rectangular waveforms and driving the resonator with accurate frequency data and stable operation, free of intermodulation noise.

FREQUENCY RANGE	FREQ. FLUCTUATION	SAMPLING RATE	WEIGHT
1 kHz–1 MHz	10^{-9} fractional	20 MSa/s	1.1 kg

FEATURES

- Resonance mode selection
- Frequency data acquisition
- Positive feedback oscillation driving and measurement in one system
- Stable oscillation frequency tracking and driving
- Integrated pre-amplifier
- OEM software
- Robust and easy to use

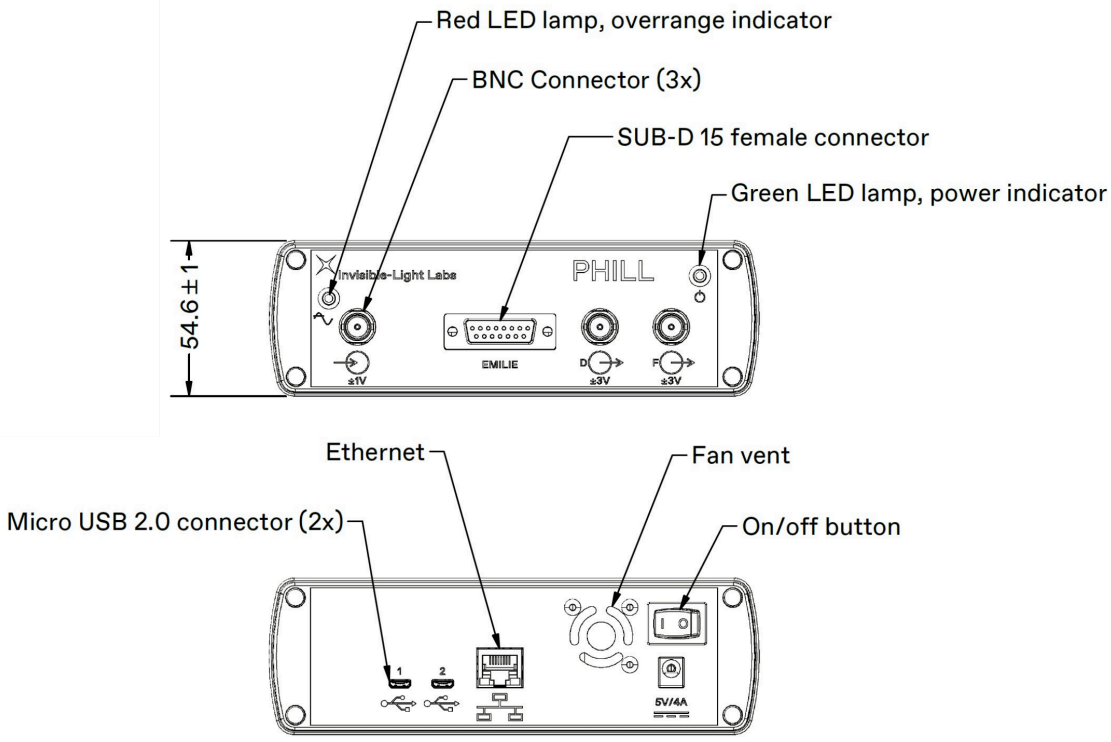
APPLICATIONS

- NEMS and MEMS chip sensor measurements
- Quartz crystal balance measurements
- Temperature control of resonators
- Calibration of the oscillation frequency of resonators

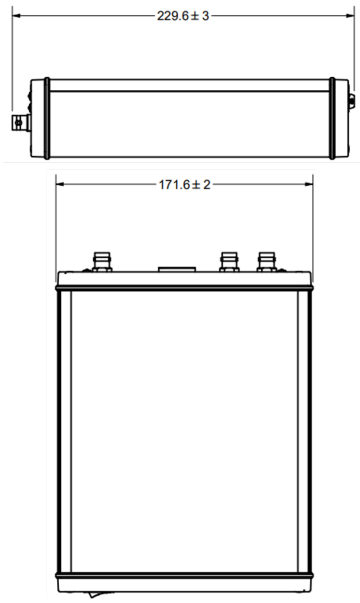
TABLE 1 GENERAL SPECIFICATIONS

Dimensions (L×W×H)	23×17×6 cm
Weight	1.1 kg
Enclosure material	3.3206, AlMgSi0.5 powder-coated; seals TPE
Supply voltage	5 V DC (SELV)
Power rating	6.25 W, max. 20 W
I/O	Sensor In (BNC), Drive (BNC), Frequency Out (BNC), EMILIE connector (Sub-D)
Host connection	Micro-USB 2.0, 480 Mbit/s; Ethernet 10/100/1000 Mbit/s
Operating environment	IEC 61010, indoor, installation category II, pollution degree 2
Storage temperature	5 °C to 35 °C
Operating temperature	5 °C to 35 °C

FRONT & REAR PANEL



DIMENSIONS



All dimensions in mm.

KEY CHARACTERISTICS

- Plug-and-play Micro-USB connection to PC
- Communicates between EMILIE™ and your spectrometer software
- Data visualization and processing for stand-alone systems

STABILITY WITHOUT LOCK LOSS

PHILL™ matches the frequency stability of Phase-Locked Loop systems, but never loses 'lock'. The oscillator bandwidth is freely selectable in the frequency counter, independent of circuit constraints. No PID parameters adjustment needed to track the resonator phase.

TABLE 2 ANALOG INPUT

Input frequency range	1 kHz to 1 MHz
Input impedance	10 kΩ
Input voltage	±1 V DC
A/D conversion	12 bit, 80 MSa/s

TABLE 4 PREAMPLIFICATION

Amplification stages	1, 3, 10 and 30
Bandwidth	1 MHz
Slew rate	30 V/µs

TABLE 6 FREQUENCY COUNTER

Resolution at 100 Hz with no averaging	1 Hz

TABLE 7 FREQUENCY OUTPUT FILTER

Cut-off	1 Hz to 10 kHz

TABLE 3 ANALOG OUTPUT

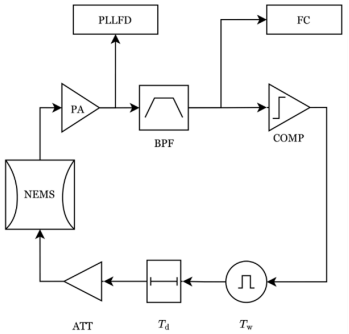
Frequency counter output frequency	3 kHz to 1 MHz
Resonator drive output frequency	1 kHz to 1 MHz
Frequency counter output voltage	±3 V DC
Resonator drive output voltage	±3 V DC
D/A conversion	14 bit, 200 MSa/s

TABLE 5 BAND-PASS FILTER

Center frequency range	1 kHz to 1 MHz
Maximum Q-factor	1000
Gain	1
Fractional frequency fluctuation	10^{-9} @ 100 kHz input signal, 1 s averaging

TABLE 8 SCOPE

Input channels	Signal input, band-pass out, drive
Trigger channels	Signal input, band-pass out
Trigger modes	Edge
Sampling rates	100 kSa/s to 20 MSa/s
Vertical resolution	14 bit
Bandwidth limit mode, vertical resolution increase	Sample decimation, averaging



SSO TRACKING SCHEME

Block representation of the self-sustaining oscillator loop: the NEMS resonator signal is pre-amplified (PA), band-pass filtered (BPF) and squared by a comparator (COMP) to feed the frequency counter (FC), then returned to the resonator through pulse shaping (T_w), delay (T_d) and attenuation (ATT).