

Zurich
Instruments

HF2PLL Phase-locked Loop

Dual PLL, 2 Input Channel, Quad PID,
50 MHz Lock-in Amplifier

Product Specification
Release date: August 2014



Key Features

- Dual 50 MHz phase-locked loop
- Dual 50 MHz lock-in amplifier
- Dual high performance signal outputs
- 50 kHz PLL bandwidth with full parameter control
- 4 configurable PID controllers
- Easy to use HF2PLL Advisor and PID Advisor tools with transfer function analysis
- Frequency response analyzer, FFT spectrum analyzer and oscilloscope
- Application pack (included): automatic gain control, tip protection, peak analyzer
- Application pack (optional): Kelvin probe force microscopy, Q-control, dual frequency resonance tracking (DFRT), side band analyzer
- PLL harmonic mode
- PID controller auto-tune
- Frequency deviation and dissipation outputs
- Graphical user interface and programming interfaces included

User Benefits

- Excellent PLL bandwidth enables highest speed measurements
- State-of-the-art software includes measurement tools enhancing productivity
- Demanding applications supported all in one box with application packs
- Many advanced measurements modes provide flexibility for research: higher oscillation modes, multi-frequency, KPFM, DFRT
- Multi-frequency supports simultaneous demodulation at several arbitrary frequencies
- All in one box solution simplifies any laboratory setup
- Legacy interfaces provide compatibility with most existing AFM/STM/MEMS setups
- The application know-how of Zurich Instruments customer support team

Description

The Zurich Instruments HF2PLL (high frequency, dual phase-locked loop) combines a dual digital lock-in amplifier covering the frequency range between 0.8 μ Hz and 50 MHz in combination with 2 high frequency PLLs. There are 2 physical input channels and 2 high frequency signal outputs, which enable the replacement of 2 conventional instruments in most laboratory setups. The 128-bit digital signal processing delivers superior precision thus improving both the noise performance and the dynamic reserve. With these unprecedented capabilities, the HF2PLL provides best in class closed loop performance and a new state of the art in phase sensitive detection.

This instrument relies on the host computer for the graphical user interface. This architecture has the advantage that excellent software integration with LabVIEW, MATLAB, C and Python are standard. Furthermore this way of working is suitable for both beginners and advanced users. The software permits the running of an unlimited number of clients accessing the HF2PLL at the same time, which is ideal for complex lab setups.

The world's fastest PLL

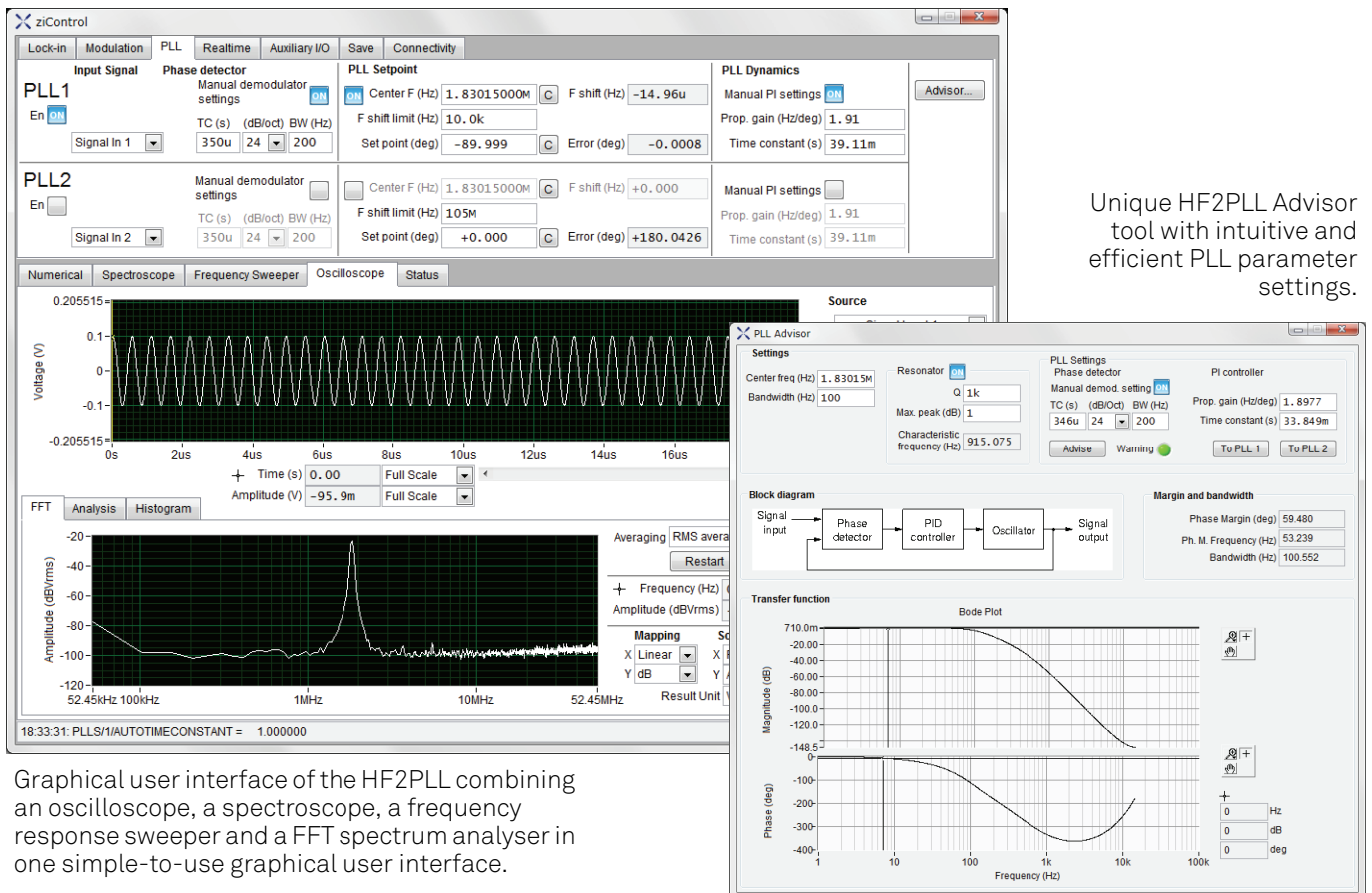
Two phase-locked loop circuits running up to 50 MHz with a bandwidth of up to 50 kHz constitutes the current world record. Users will profit by being able to produce measurements at speeds and precision not possible with other hardware.

High-Precision Inputs

The 2 input paths of the HF2PLL are optimized for very low noise operation. The sampling rate of 210 Msa/s is 4 times the analog bandwidth, ensuring full capture of the signal and reducing aliasing.

Quad PID Controller

Four fully configurable PID controllers with a wide selection of input and output units support the efficient implementation of control loops. The advisor and tuning tools greatly simplify the tedious optimization of control parameters. The maximum bandwidth depends on the chosen configuration, but is at least 5 kHz per PID controller for any application.



Unique HF2PLL Advisor tool with intuitive and efficient PLL parameter settings.

Graphical user interface of the HF2PLL combining an oscilloscope, a spectrogram, a frequency response sweeper and a FFT spectrum analyser in one simple-to-use graphical user interface.

Demodulators and Filters

The HF2PLL provides 6 dual-phase demodulators. Each demodulator can be configured with its own filter properties. The advantages of digital versus analog instruments include higher dynamic reserve, zero drift, precise phase shifts, and orthogonality.

Excellent Measurement and Configuration Tools

Integrated tooling provides a comprehensive set of analysis features making use of external equipment, such as an oscilloscope, obsolete. The internal oscilloscope with memory for 2048 samples provides immediate signal-vs-time plots. A sweeper can function as frequency response analyzer providing high-resolution signal-vs-frequency plots, as well as sweeper over other internally controlled quantities like voltages or time constants. An FFT spectrum analyzer provides very high resolution signal analysis on frequency spans of up to 200 kHz. Finally the HF2PLL Advisor and the PID Advisor ensure efficient closed-loop parameter settings.





Application Pack

A selection of product options enable many additional modes of operation and measurement. In particular the HF2LI-MF and the HF2LI-MOD option provide the multi-harmonic mode (MHM), dual frequency resonance tracking (DFRT), frequency modulated Kelvin probe force microscopy (FM-KPFM) and Q-Control. It is easy to extend the application support at any time as both mentioned options can be upgraded in the field.

Example Applications

- Atomic force microscopy (AFM)
- Scanning tunnelling microscopy (STM)
- Scanning near-field optical microscopy (SNOM)
- Micro electromechanical systems (MEMS)
- Magnetic resonance force microscopy (MRFM)
- Resonator characterization
- Sensors and actuators
- Frequency combs: time reference definition
- Semiconductor characterization and testing

Overview on available options

	<h4>HF2LI-MF Multi-frequency option</h4> <ul style="list-style-type: none"> ■ Simultaneous arbitrary frequency demodulation ■ 6 independent oscillators for arbitrary frequency generation ■ Individual demodulator filter settings ■ Enables FM-KPFM, Q-Control and DRFT
	<h4>HF2LI-MOD AM/FM Modulation option</h4> <ul style="list-style-type: none"> ■ Amplitude and frequency modulation and demodulation ■ Two-channel operation for input and output ■ Direct side-band demodulation instead of tandem demodulation ■ Supports FM-KPFM and other dual modulated setups
	<h4>HF2LI-UHS Ultra-high Stability option</h4> <ul style="list-style-type: none"> ■ Long term result reproducibility ■ Extreme temperature stability ■ Excellent short term stability ■ Reliable aging characteristics, Minimal phase noise
	<h4>HF2LI-RT Real-time option</h4> <ul style="list-style-type: none"> ■ User programmability for embedded processor ■ 32-bit processing unit at 64 MHz, 32-bit floating point unit, 64 MByte of RAM ■ Real-time system reaction time better than 10 µs ■ Access to all settings, input and output channels

