The Elettra Pilot-Tone RF front-end

A low-phase-noise PLL (7) generates the pilot tone (frequency and amplitude are programmable), which is split into four paths by a high-reverse-isolation splitter (6) that guarantees more than 52 dB of separation between the outputs. A coupler (2) sums the tone with the signal from the pick-ups, adding further 25 dB of noise, high-linearity amplifiers (5) (G=22 dB, F=0.5 dB, OIP3=+37 dBm, 1 MHz with a bandwidth of 15 MHz, and two variable-gain stages), composed of a bandpass filter (3), centered at 500 MHz with a bandwidth of 15 MHz, and two variable-gain stages, composed of low-noise, high-linearity amplifiers (5) (G=22 dB, F=0.5 dB, OIP3=+37 dBm, 1 MHz with a bandwidth of 15 MHz, and two variable-gain stages, composed of low-noise, high-linearity amplifiers (5) (G=22 dB, F=0.5 dB, OIP3=+37 dBm, 1 MHz with a bandwidth of 15 MHz, and two variable-gain stages), composed of low-noise, high-linearity amplifiers (5) (G=22 dB, F=0.5 dB, OIP3=+37 dBm, 1 MHz with a bandwidth of 15 MHz, and two variable-gain stages)

Measurement 1: at 25 °C stable temperature over 20 hours. All equipment, including the RF generator and splitter was placed inside the temperature chamber. Position data was taken every 1 second.

Measurement 2: Temperature was changed in the range from 20 °C to 30 °C in steps of 1 °C. Complete temperature profile is shown in Fig. 4. For this test, the RF generator and a 4-way splitter were put out of the temperature chamber and left at room temperature.

Libera Spark ERXR readout electronics

The Libera Spark ERXR [2] was modified to process both the carrier RF frequency at 499.654 MHz and the pilot tone frequency at 501.282 MHz. This was done through a new parallel digital-down-conversion (DDC) processing branch introduced in the FPGA of the Libera Spark.

The DDC chain for the RF signal was tuned to the 32.38 MHz component which is filtered and decimated in stages to provide the user with turn-by-turn data, fast data (10-30 kHz) and slow data (10-40 Hz) with narrower bandwidth. The additional chain for the pilot-tone is tuned to the 34.01 MHz component, for this test the four amplitudes (PFA, PFB, PTC, PTD) were highly averaged and provided to user space with slow update rate of 8.8 Hz. The compensation was done on-line in the upper software layer (EPICS).

Quality of the measure

The pilot tone is a constant-level signal and can give information whether the BPM system is working correctly. In Figure 6 the carrier signal is reduced by a factor of 10 while the RMS of the pilot-tone signal remains at the expected level.

Conclusions

The performed measurements show encouraging results, both in resolution and in long-term performances, compensating external effects, but must be proved with beam.

References