FELMI is a single-pass linac-based FEL user-facility covering the wavelength range from 100 nm (12 eV) to 4 nm (310 eV) and is located next to the third generation synchrotron radiation facility Elettra in Trieste, Italy. The first FEL line in operation (FEL-1) has been opened to users at the end of 2012, while the second FEL line (FEL-2) covering the shorter wavelength down to 4 nm is in commissioning. The 1.5 GeV S-band linac is composed of fifteen 3 GHz 45 MW peak RF power plants powering the gun, sixteen accelerating structures and the RF deflectors. The requirements on beam quality impose tight specifications on the stability of the electromagnetic fields, which can be achieved only installing high reliable and high performance state of the art LLRF systems.

This paper provides an overview of the performance of the system, discussing the achieved results, the strategies adopted to assure them and possible upgrade paths to increase the operability of the system.

**FELMI LLRF**
- Specification on amplitude and phase stability: 0.1% and 0.1° at 3 GHz.
- All-digital system, specifically developed for FELMI.
- System developed in the frame of a collaboration agreement between Elettra - Sincrotrone Trieste and Lawrence Berkeley National Lab.
- Loops in operation: amplitude, phase, cable calibration and phase locking loop.
- SLED: phase reversal and phase modulation.
- Intermediate system:
  - Commercial processing board (LLRF4).
- Installed from beginning.
- Requirements for machine operation met
- Final system:
  - Processing board specifically designed for FELMI
  - First two units in operation on the machine.
  - Firmware ported from LLRF4 board to the final board.
- It will allow further firmware developments of the system.

**Conclusion**
With the simple replacement of the LLRF4 board with the FELMI AD board, without any modification of the firmware, the performance of the entire system is improved by 20% in the achieved stability of both amplitude and phase. Long term acquisition (~15 days) comparing the results with the two boards.

**References**

**Next Steps**
- Replacement of the intermediate LLRF chassis with the final board is started.
- First two chassis in operation since August without problems.
- Plan to complete replacements by 2014.

**The new board will allow introducing new functionalities, such as:**
- Real time communication between LLRF units.
- Enlarging of average time of calibration and phase reference signals (increase in the Signal to noise ratio of the measurements);
- Intra pulse feedback (measure and apply correction in the same pulse in particular to correct jitter contributions);
- Investigate iterative learning (to remove periodical known errors).

**LLRF 2013**
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