# Current Status and Future Plans for the MicroTCA.4 compliant LO and CLK Generation Module

The 2nd MTCA/ATCA Workshop for Research and Industry

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HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

# Agenda

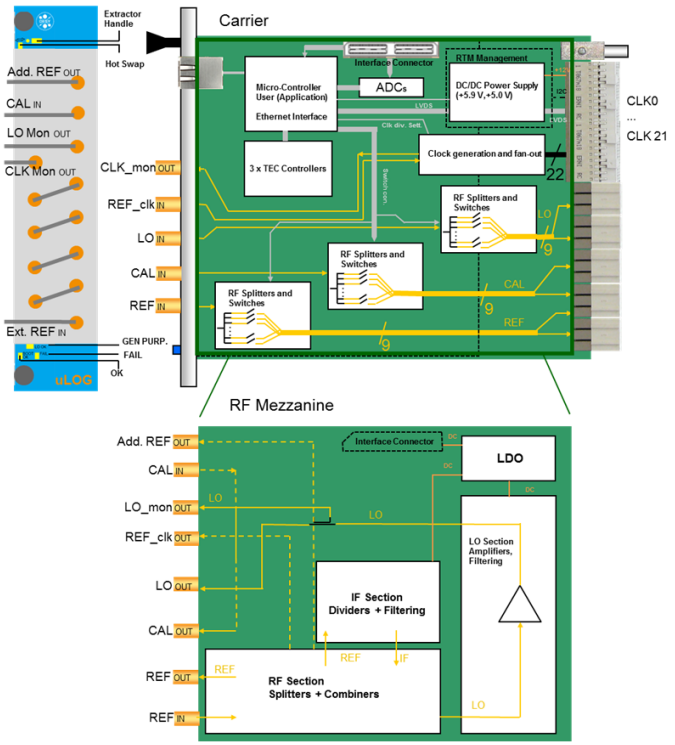
**Part 1: Introduction of DeRTM-LOG**

- DeRTM-LOG1300 – Technical Overview
- DeRTM-LOG1300 RF Performance
- DeRTM-LOG Test-Stand
- System Integration
- Future Developments
- Principles under Investigation
- Collaboration with KVG Quartz Crystal Technology GmbH

**Part 2: Introduction of KVG Quartz Crystal Technology GmbH**

# DeRTM-LOG1300 – Technical Overview

- Generation and splitting of:
  - 9 LO signals (can be turned on/off individualy)
  - 22 Diff. CLK signals (can be turned on/off individualy)
- Splitting of 9 reference signals and 9 pilot signals.
- MicroTCA.4 compatible , includes MMC1.0 and is compatible with the uRF-Backplane.
- Located in slot 15 and slot 14 in the rear.
- Application control over PCIe from CPU located in front.
- Includes on-board active temperature control over Peltier elements.
- Monitoring of: RF power, DC voltages, temperature, humidity, current.



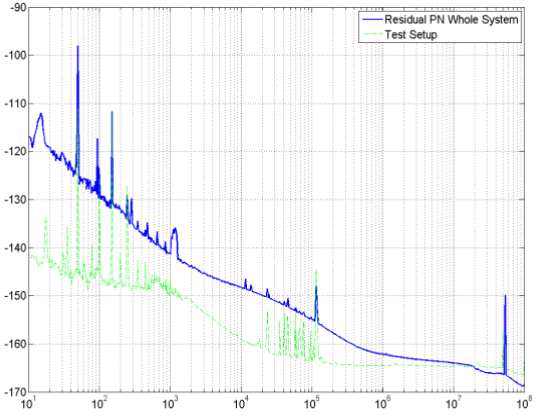

# DeRTM-LOG1300 RF Performance

- Challenging design points:
  - Limited DC power (30 W)
  - Limited cooling capability
  - Limited space
  - Demanding environment from EMI point
  - High density of output channels (~50 RF grade signals)

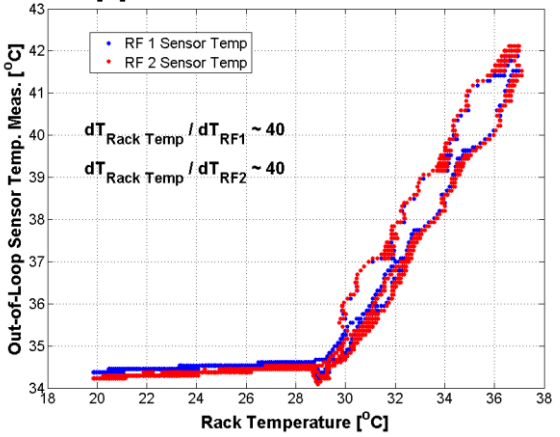
| RF Parameter | Measured Value (Worst Case) |
|---|---|
| Return Loss | >20 dB |
| LO Out Power | >29 dBm |
| Isolation | >80 dBc |
| Harmonics ($2^{nd}$, $3^{rd}$) | <-80 dBc |

**Typical CLK (81.25 MHz) Absolute Phase Noise**


**Measured Residual Phase Noise of the LO**
**4.3 fs [10 Hz-10 MHz]**

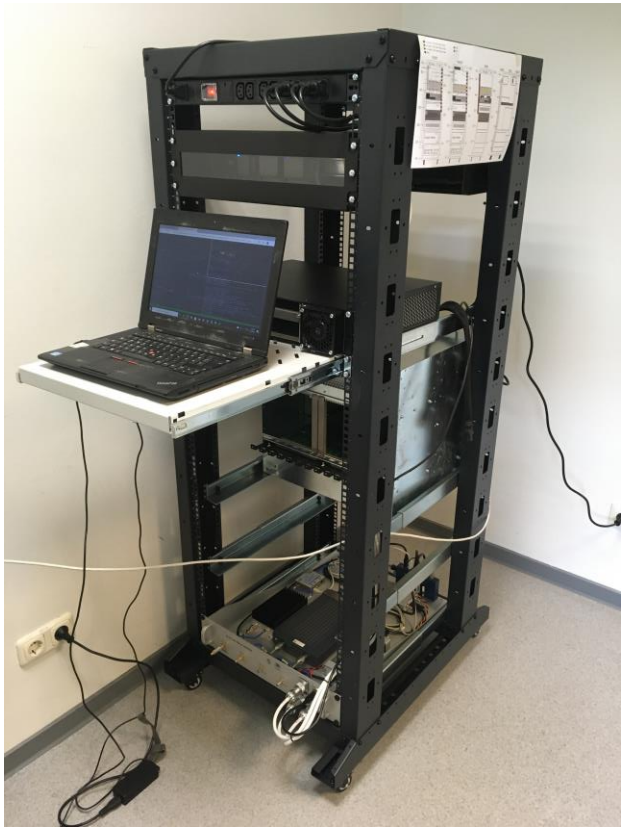



**Measured Temperature Regulation on the Board**
**Supp. Factor ~40**



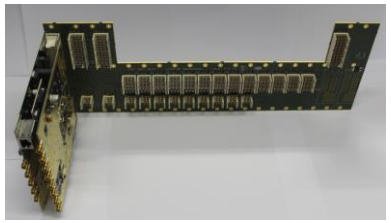
# DeRTM-LOG Test-Stand

- Development of a fully automated test stand to check possible production errors.
- Will measure:
  - individual mezzanines (DC/DC mezz., RF mezz.,..)
  - A fully assembled module
- Will cover testing of CLK frequencies from 1 MHz to 500 MHz and LO, REF and pilot from 1 MHz to 6 GHz.

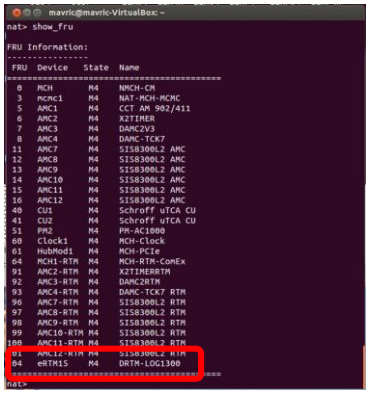


# System Integration


eRTM (e.g. DeRTM-LOG1300)



uRF Backplane

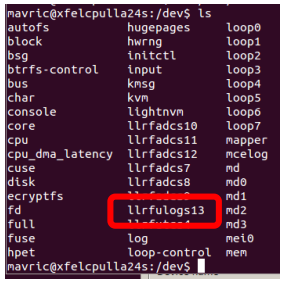




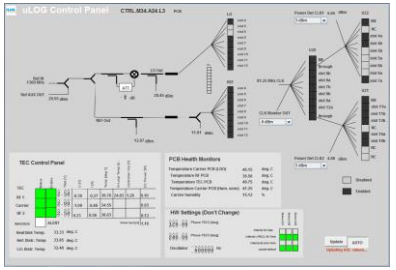


**Building Blocks**

- CPU
- NAT-MCH-PHYS80
- NAT-MCH-RTM-FPGA-BM
- DeRTM-LOG1300
- uRF Backplane




## Comissioned on EuXFEL (L3)



- There are 42 DeRTM-LOG1300 modules installed in the EuXFEL.
- The bERLinPro at HZB has 2 units in operation

**Thanks to N.A.T. GmbH for their support by integration.**

# Future Developments

## New Frequency Variants

- Because of modularity (plugabale mezzanine units) only the affacted modules have to be redesigned
- The current architecture doesn‘t allow to cover various LO and CLK generation scenarios (e.g. fractional ratios)
- The deisgn will cover reference  frequencies like 3 GHz, 500 MHz,..

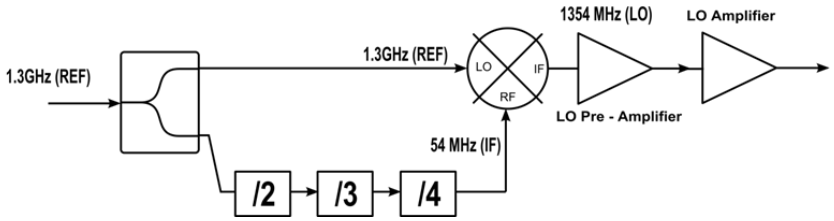
## Improvement of RF performance

- Improvement of residual phase noise of the LO and CLK generation
  - < - 165 dBc/Hz for white noise on LO
  - -165 dBc/Hz for white noise on CLK

# Principles under investigation

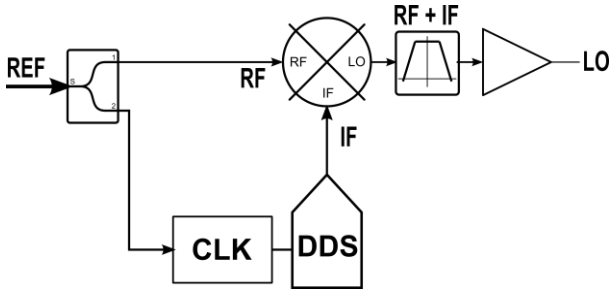
## Multipliers and dividers

- New low phase noise dividers on the market.
- Configurability is limited.



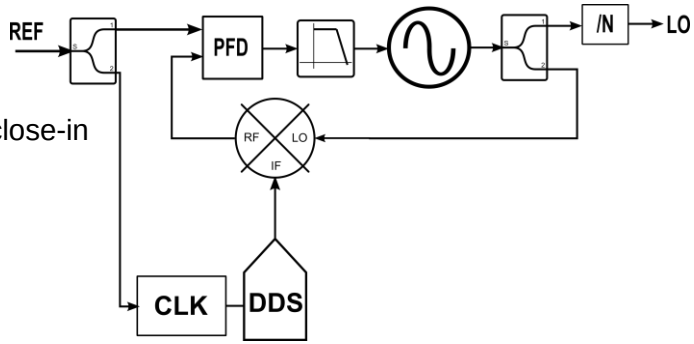

## Standard PLL

- New VCOs have very high Q – low phase noise.
- Configurability and overall phase noise is not the best (different frequency means a different VCO probably, phase detector limitations).




## Up-conversion of IF generated with a DDS

- Currently some very low phase-noise DDS solutions available on the market.
- One design can cover all the possible frequencies.
- Still need of an output bandpass filter (has to change with output frequency).




## Translation PLL

- Voids the problem of the divider in the feedback. A major improvement to the close-in phase noise.
- No sharp output bandpass filter needed.
- One design can cover all possible frequency generation scenarios.
- Higher complexity.

# Collaboration with KVG Quartz Crystal Technology GmbH

- The company KVG Quartz Crystal Technology GmbH is taking over the production of DeRTM-LOG1300 and LOG1500. The production phase has started this month.
- KVG has a licensing agreement  with DESY for all the future DeRTM-LOG variants.

**It is possible to order the DeRTM-LOG modules at KVG Quartz Crystal Technology GmbH.**

KVG Quartz Crystal Technology GmbH

DESY.

# Thank you

**Part 2:**
**Introduction of KVG Quartz Crystal Technology GmbH**
**by Jiaoni Bai**