# Design and Implementation of Automatic Cavity Resonance Frequency Measurement and Tuning Procedure for FLASH and European XFEL Cryogenic Modules

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Abstract

The superconducting cavities in FLASH and European XFEL should be tuned to the operating frequency after cool down and reversed to initial frequency before warm up by stepper motor tuners. The initial frequency deviates by 300 kHz from the operating frequency of 1.3 GHz to remove mechanical hysteresis of the tuner. The cavities should be relaxed to the initial frequency to avoid the plastic deformation. In framework of digital low level RF and DOOCS control systems we have developed a simple automatic procedure for the remote resonant frequency measurement and simultaneous remote tuning for all cavities which are driven from the single klystron. The basic idea is based on frequency sweeping, both for driving klystron and for generation of local oscillator frequency with constant RF frequency from master oscillator. The developed system has been used during FLASH commissioning in spring 2010, is in use for cryogenic module test stand CMTB at DESY and is planned for XFEL module test stand AMTF.

Measurement setup diagram

DOOCS control panels
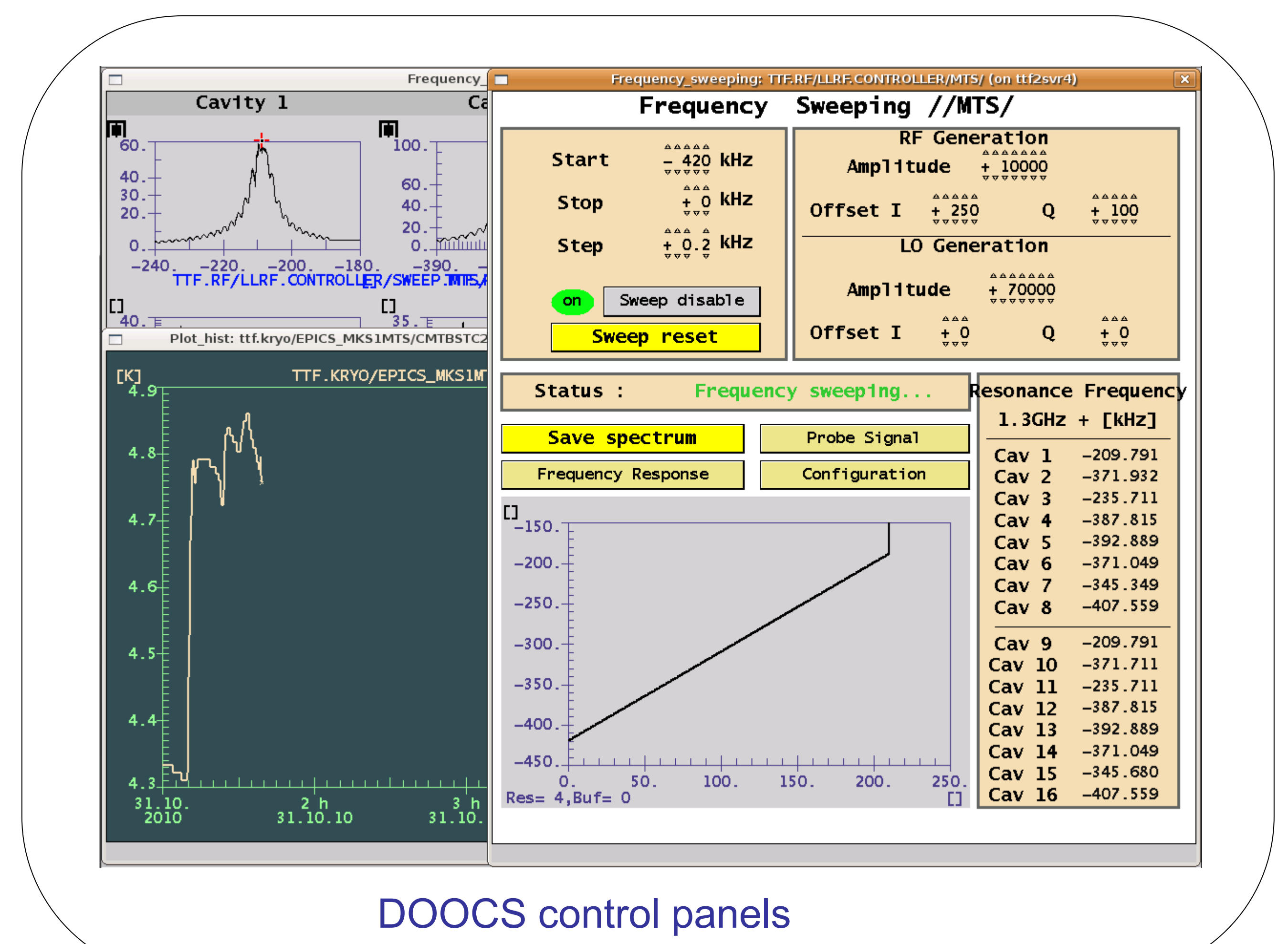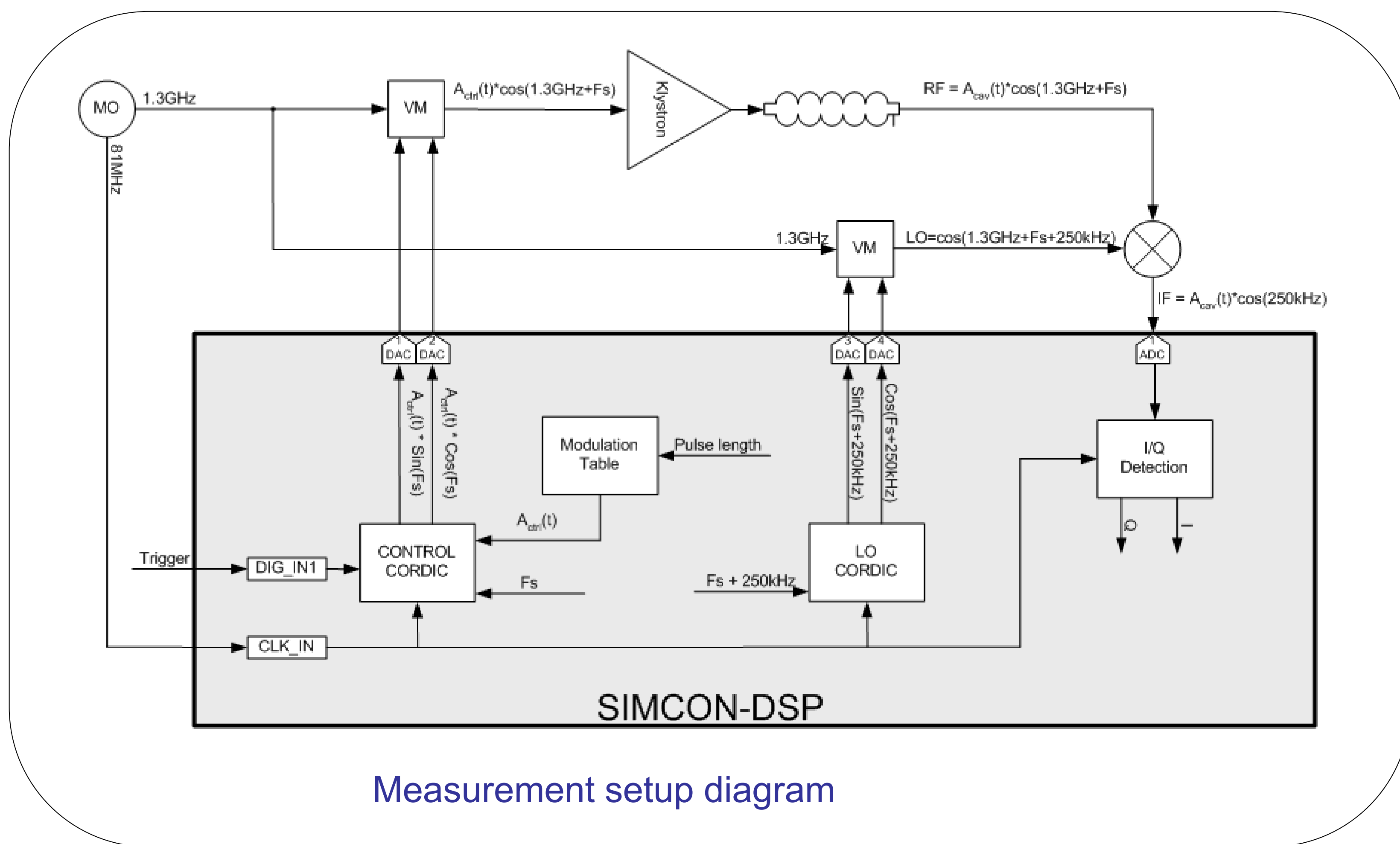
	Warm	Cold
Loaded quality factor	10^4	3×10^6
Frequency range [MHz]	1298.0 ± 0.4	1300.0 ± 0.4
Frequency deviation from pulse to pulse [kHz]	10	0.5
Measurement points (pulses)	80	1600
Frequency sensitivity [kHz]	25	1

Measurement conditions

Resonant frequency measurement before and after cavity tuning in accelerating module 6 in FLASH. Frequency f = 1300MHz + Δf, Δf[kHz]

CMTB superconducting RF accelerating module cavities' π-mode frequency vs. temperature

Resonant frequency measurement in the horizontal cryostat CHECHIA

Frequency sweep at CMTB: 8/9π and π modes. Temperature t = 300K(left), and t = 4.6K (right). Frequency f = 1300MHz + Δf, Δf [kHz]