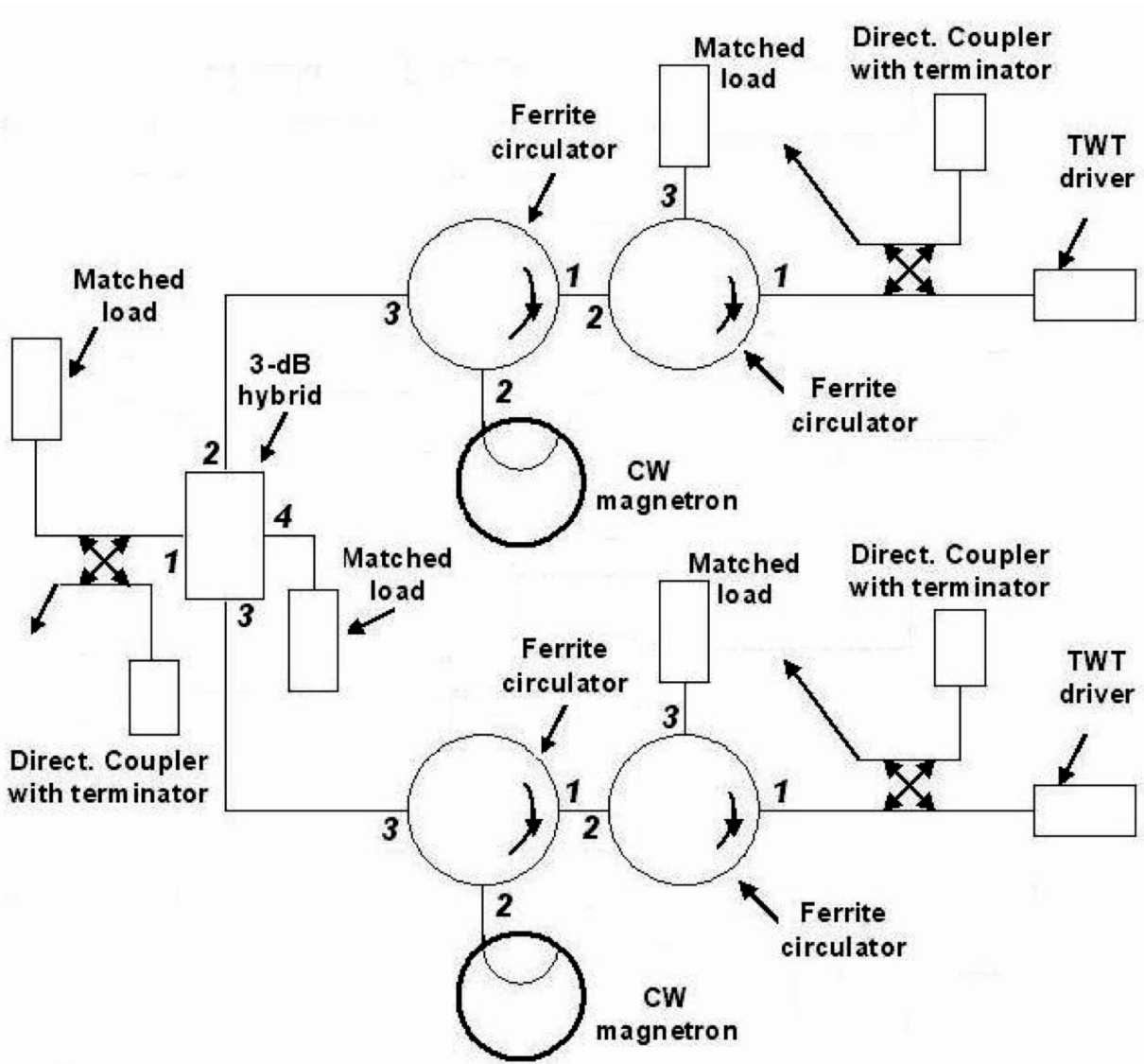


Injection locked CW Magnetron
RF Power Source
for
Project X

September 11, 2013

Schematic of Vector Summation of Injection Locked Magnetrons



GENERATORS

GET 2024 and GET 3000

**Ferrite's New Line of Generators
Provide the Longest Magnetron
Life in the Industry.**



75 kW@\$1/watt

Motivation for this technique is cost savings

650 MHz

Solid state 50 kW \$7/watt

IOT 50 kW \$5/watt

Magnetrons 50 kW \$2-\$3/watt

Project Summary Phase II-STTR 2011

(All information provided on this page is subject to release to the public.)

FIRM NAME: Muons, Inc. 552 N. Batavia Ave. Batavia, IL 60510	RESEARCH INSTITUTION: RESEARCH INSTITUTION: Fermi National Accelerator Laboratory Dr. Vyacheslav P. Yakovlev, subgrant PI P.O. Box 500, Batavia, IL 60510
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NAME of PRINCIPAL INVESTIGATOR: Micheal Neubauer

PHONE: XXXXXXXX

PROJECT TITLE: 60c Low-Cost Two-Stage Magnetron with Power Control For Project X

TECHNICAL ABSTRACT

Statement of the problem or situation that is being addressed - typically, one to three sentences.

State of the art high intensity proton accelerators require the development of an affordable cost, reliable RF sources with phase stability of less than 1 degree and amplitude control of +/- 15% (for identical cavities; in real situation the range can be wider). These power sources feed superconducting RF cavities for linacs capable of accelerating protons and ions up to several GeV.

General statement of how this problem is being addressed. This is the overall objective of the combined Phase I and Phase II projects

A two-stage frequency-locked magnetron RF source will be developed to feed individual superconducting cavities. The 30-40 db gain of the system will be obtained by cascade operation of the magnetron stages controlled by slowly-varying phase generated by a Low Level RF (LLRF) system to damp electronically instabilities caused by microphonics.



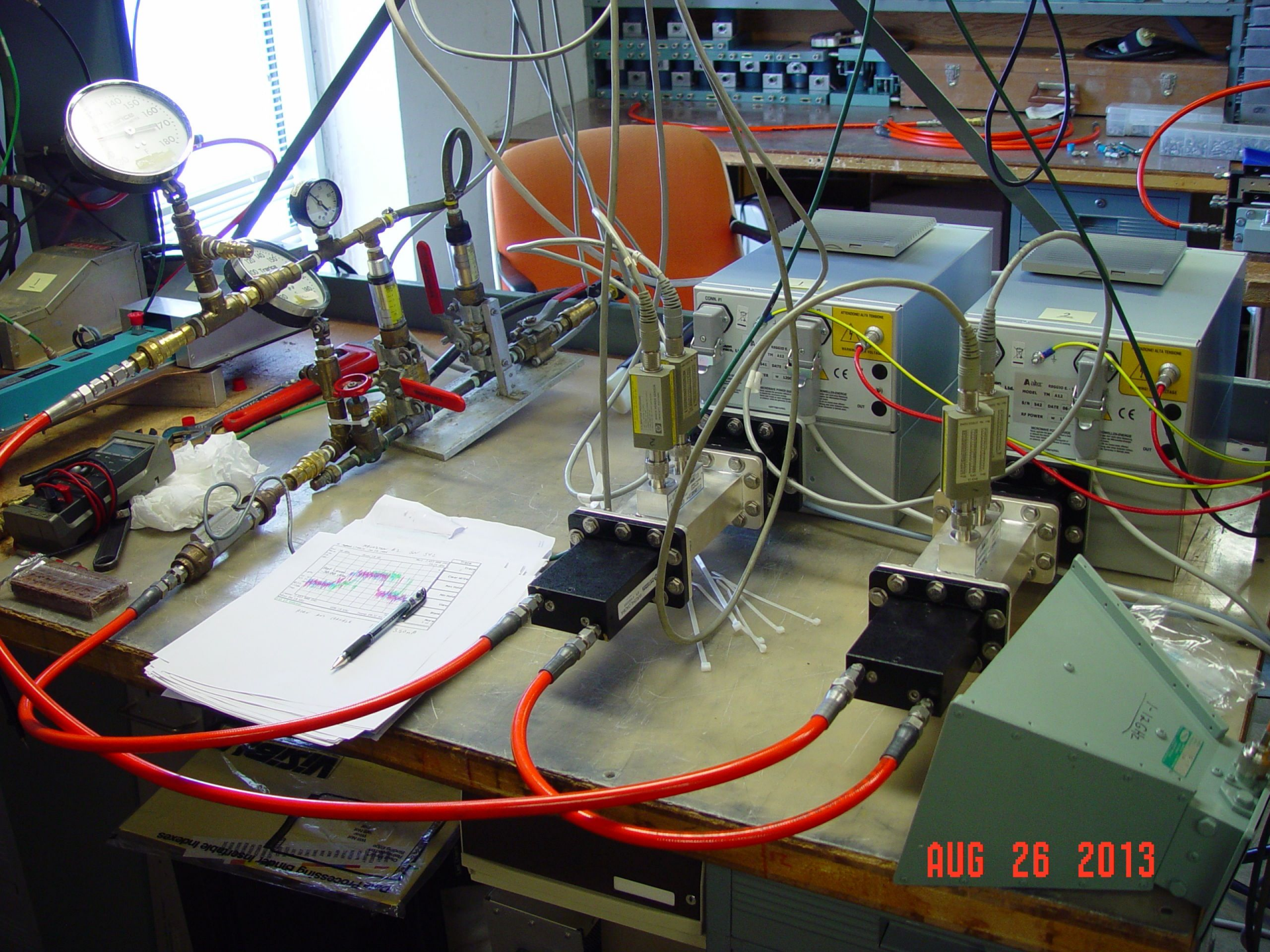
GA1.2 SM

2450 MHz

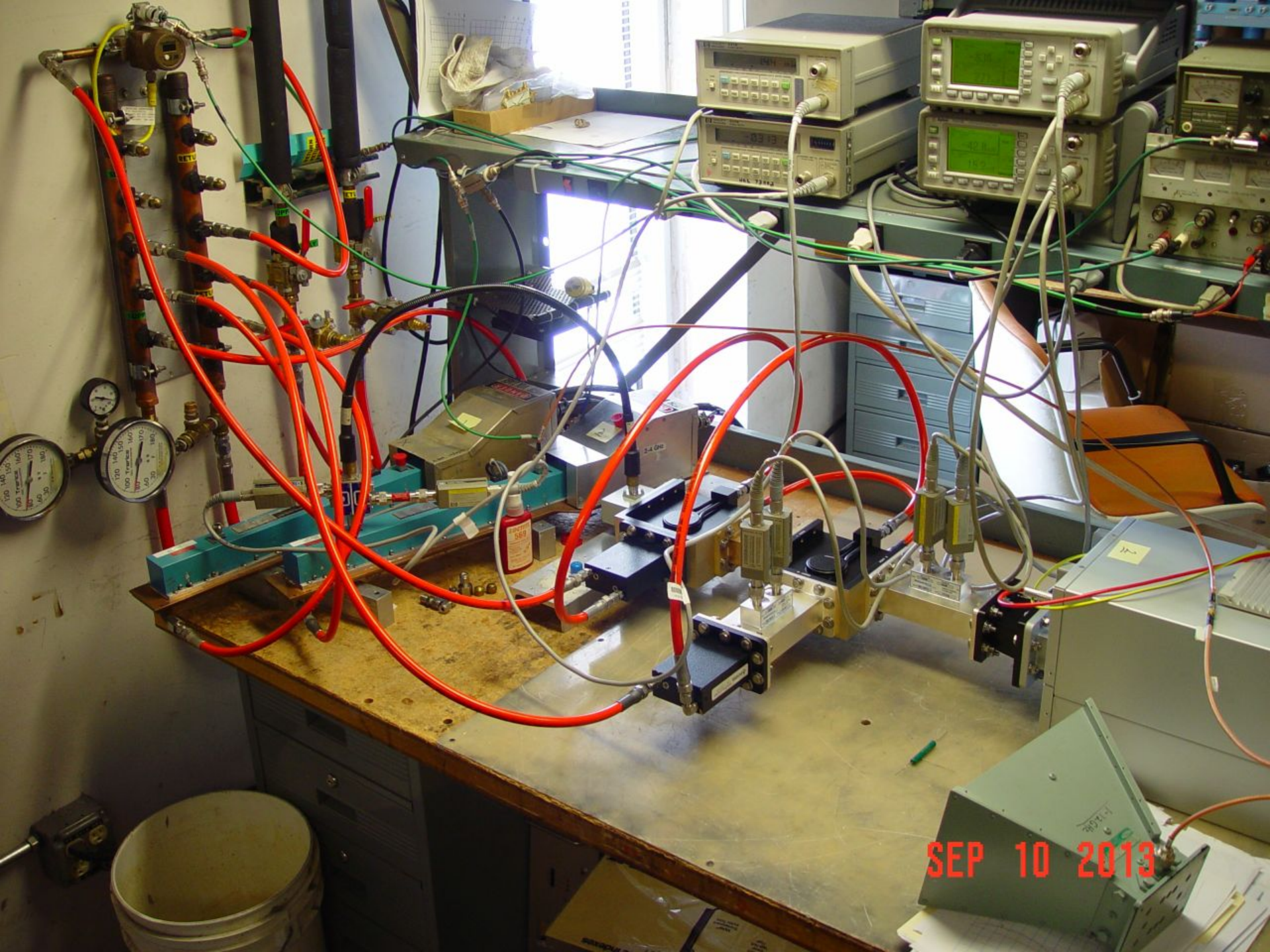
1.2kW

GA1.2SM20x10 - Series

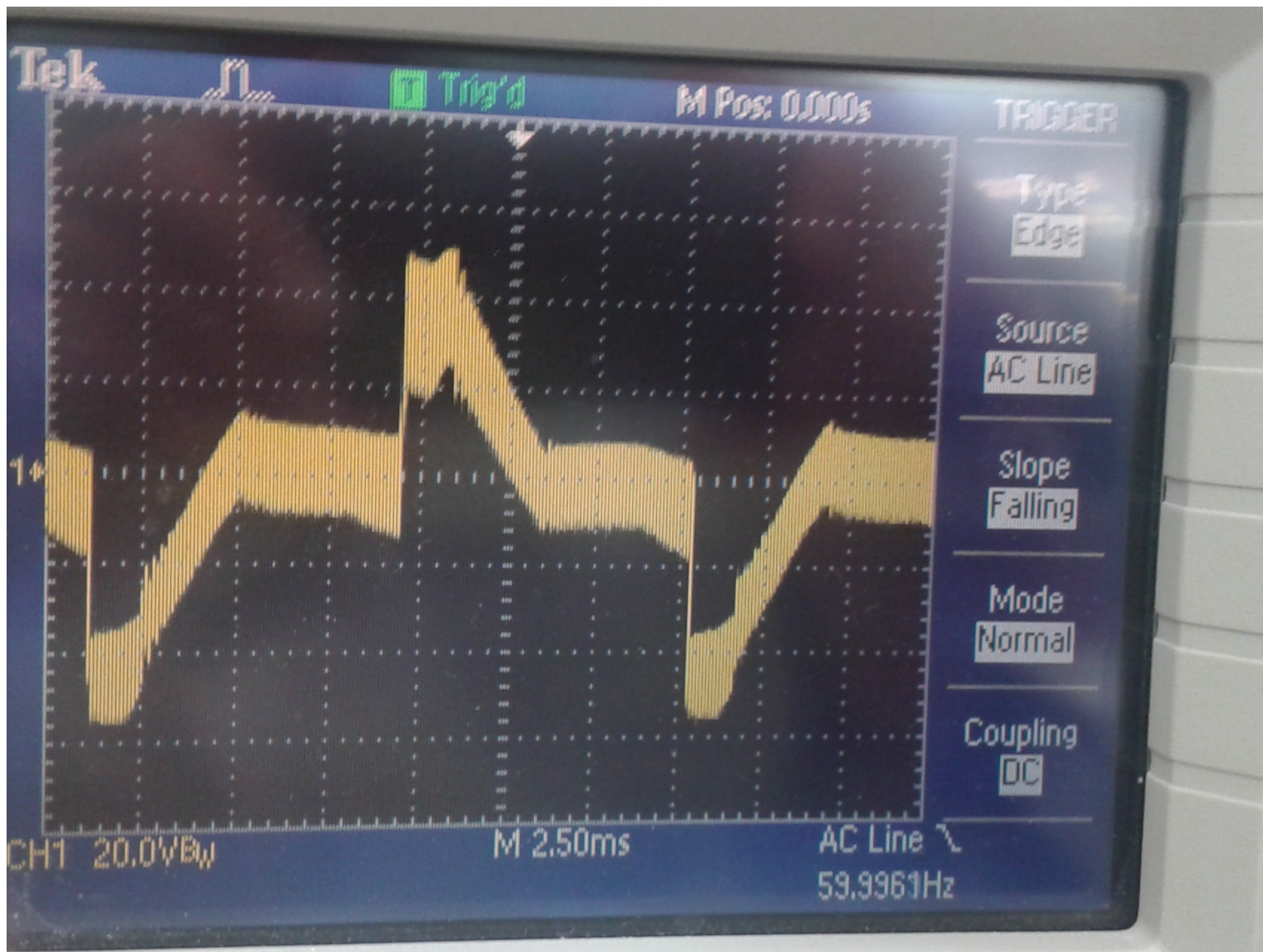




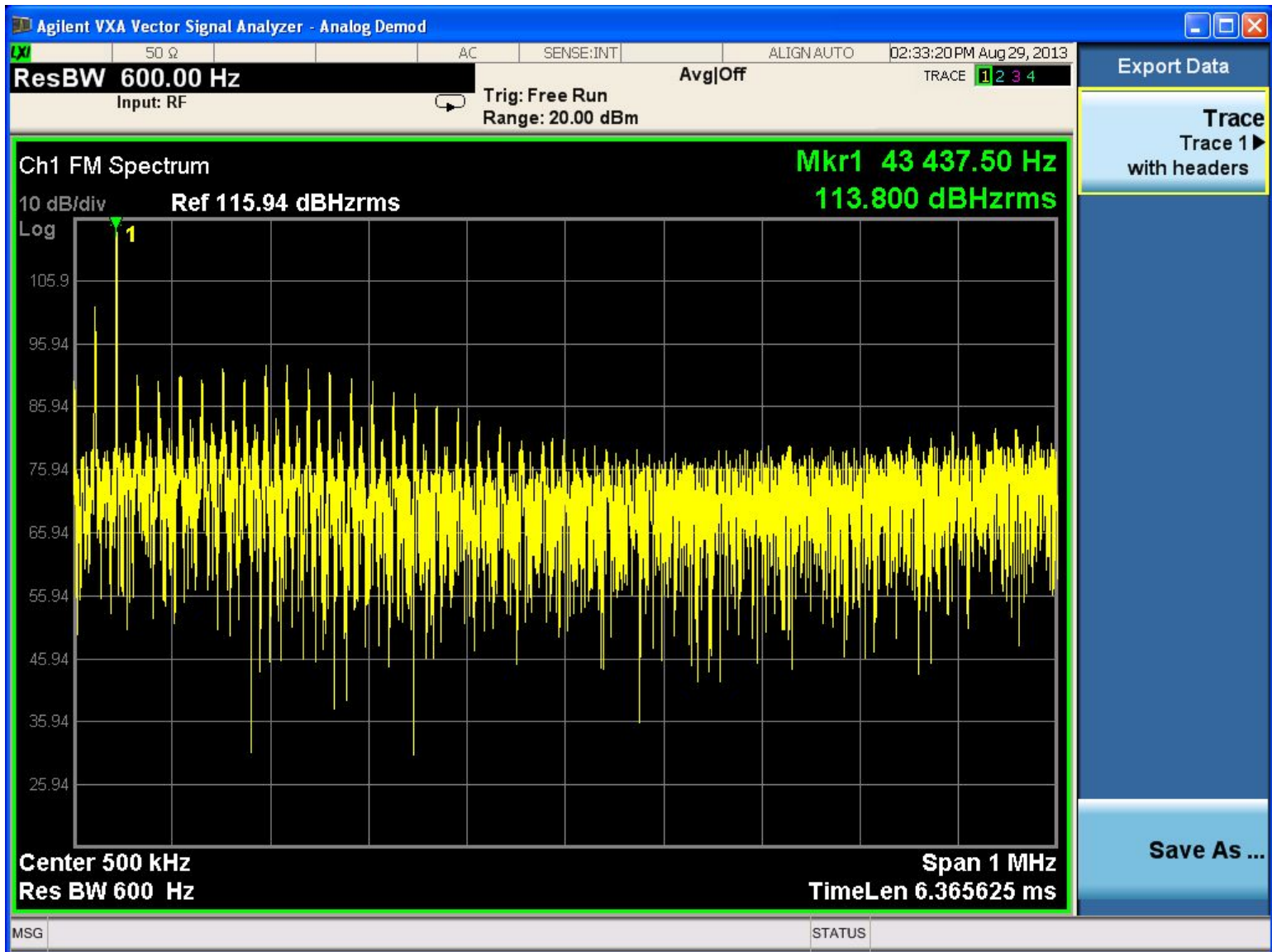
AUG 26 2013



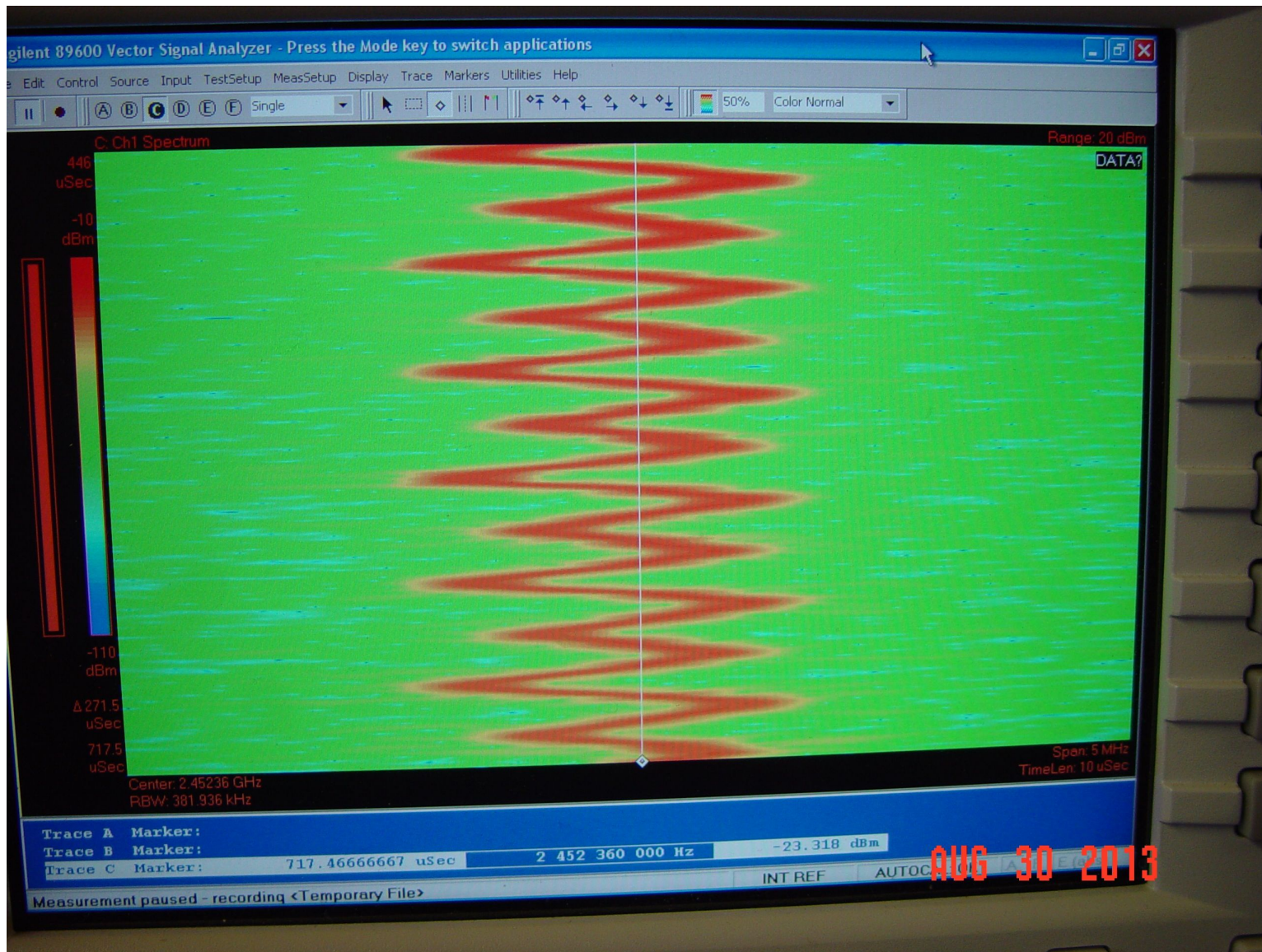
SEP 10 2013



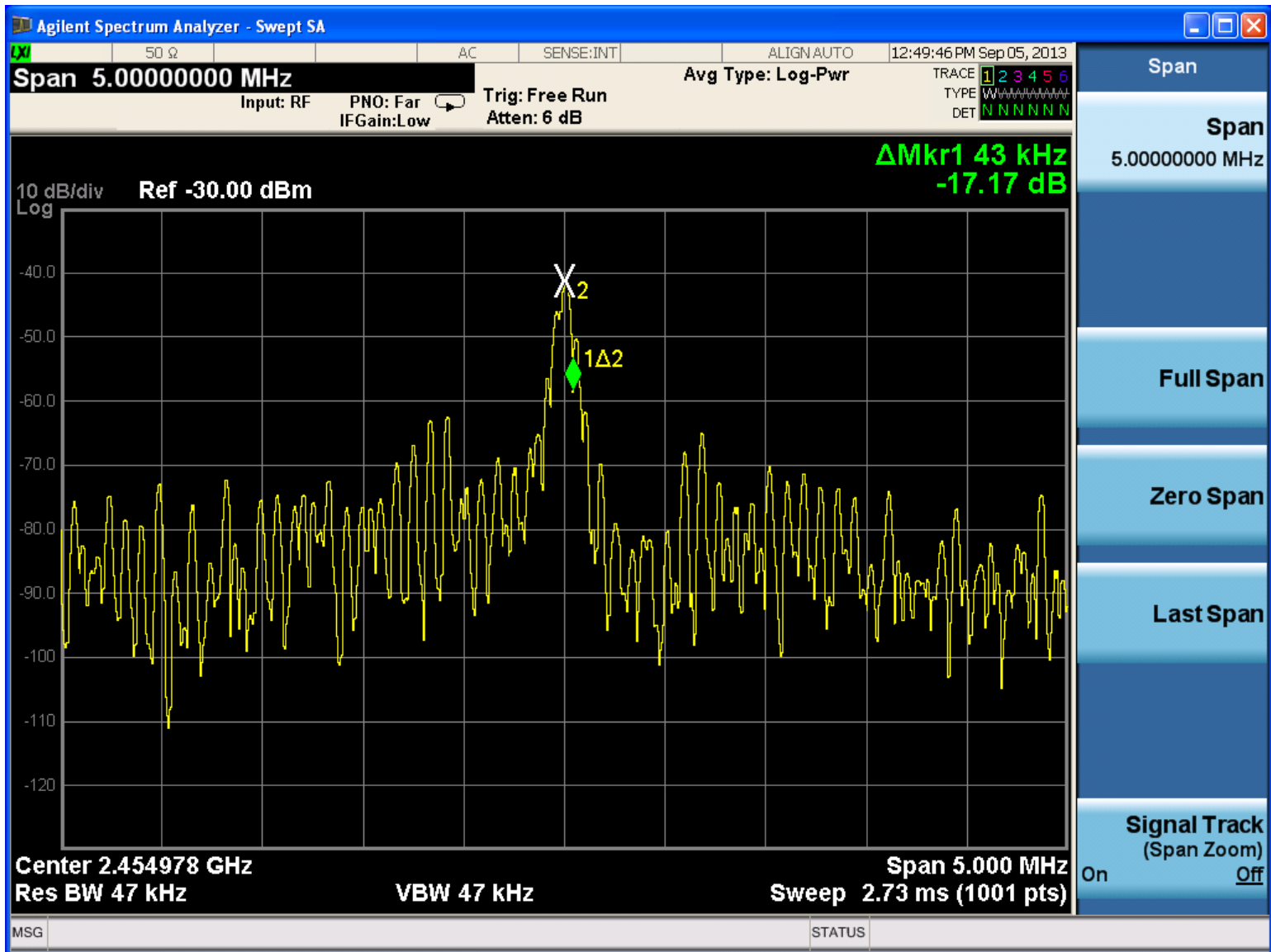
Magnetron power supply ripple, 60 Hz and 43 kHz



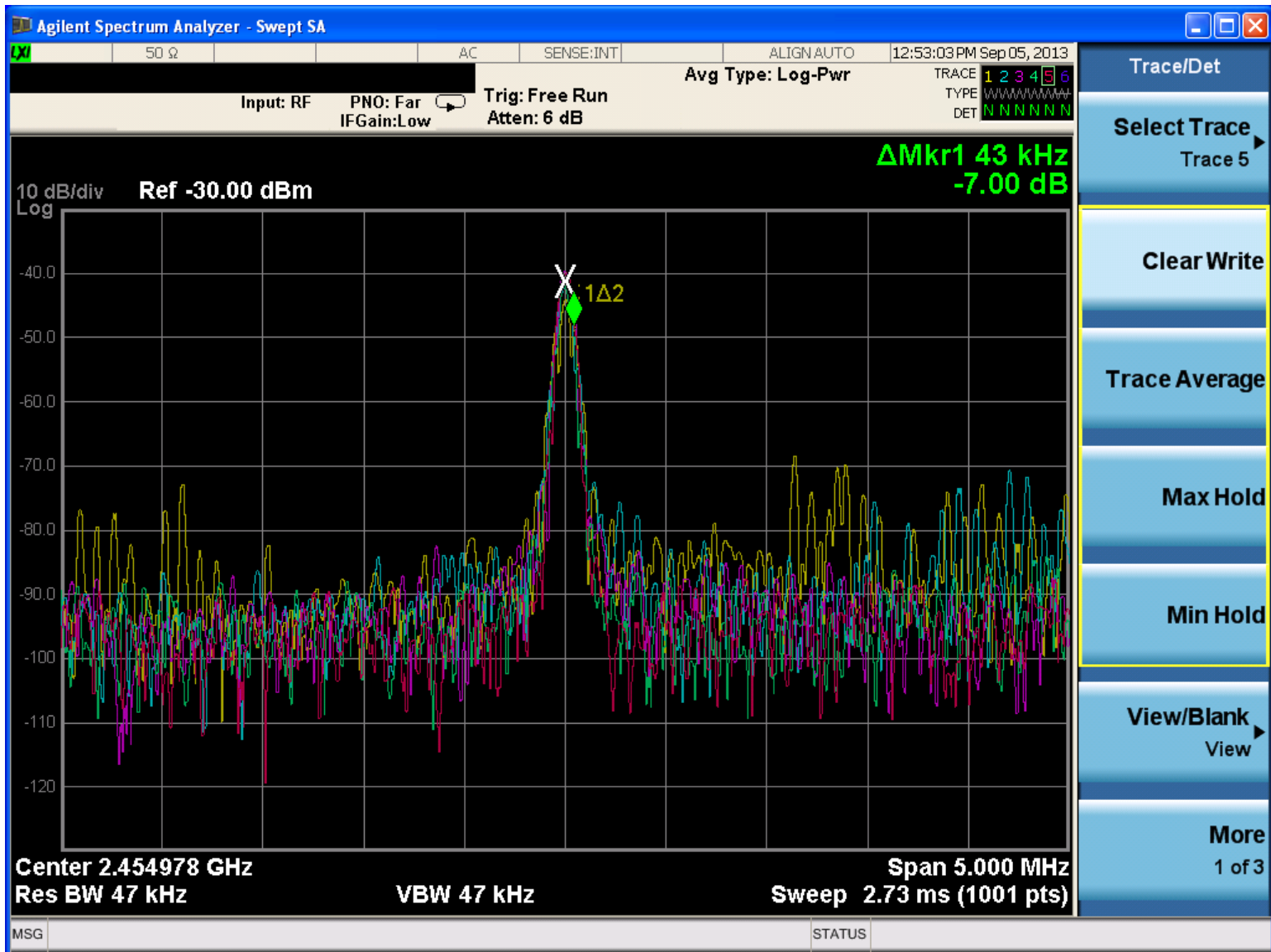
Spectrum of power supply noise



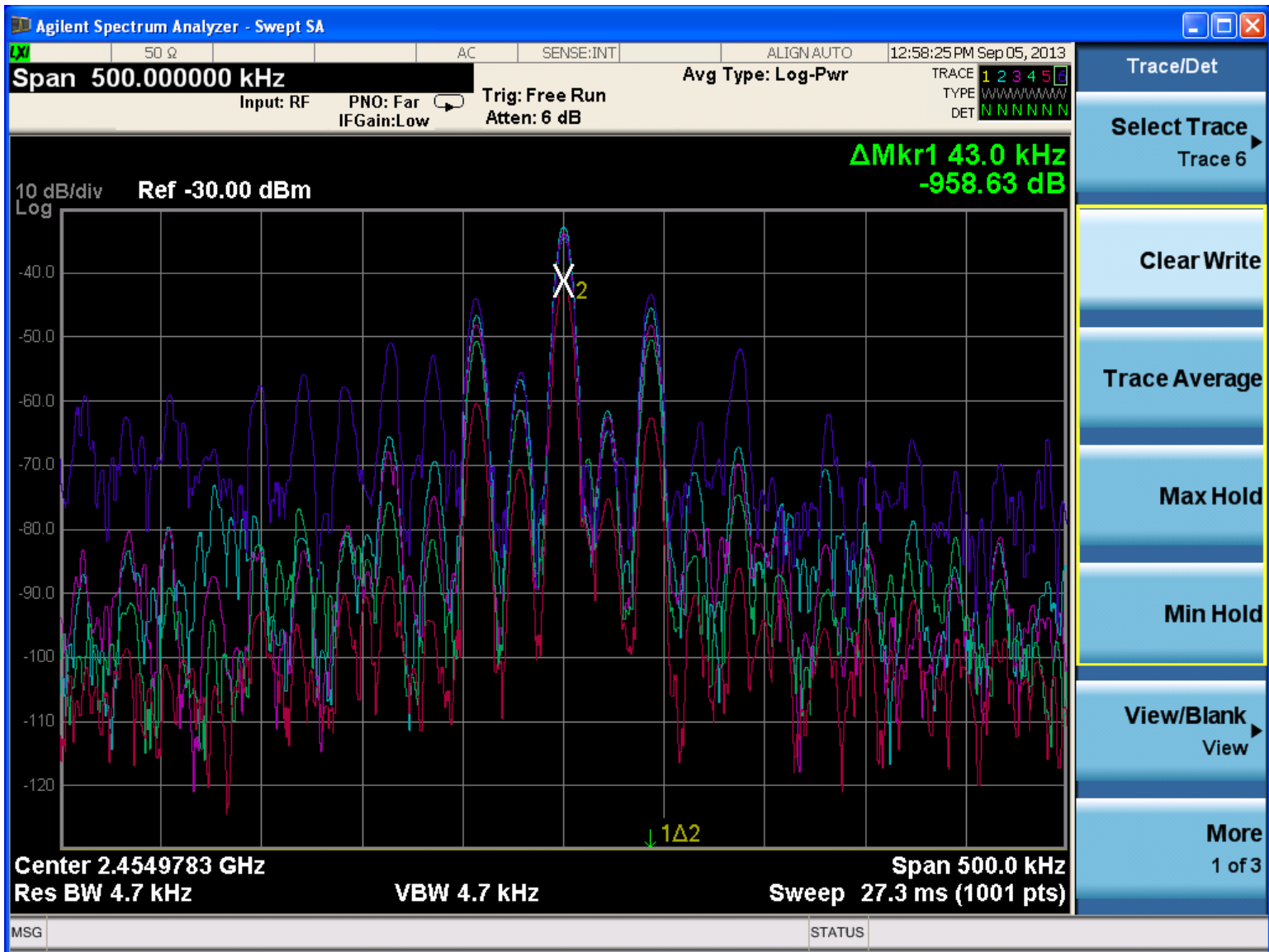
Vector Signal Analyzer real time spectrum unlocked magnetron



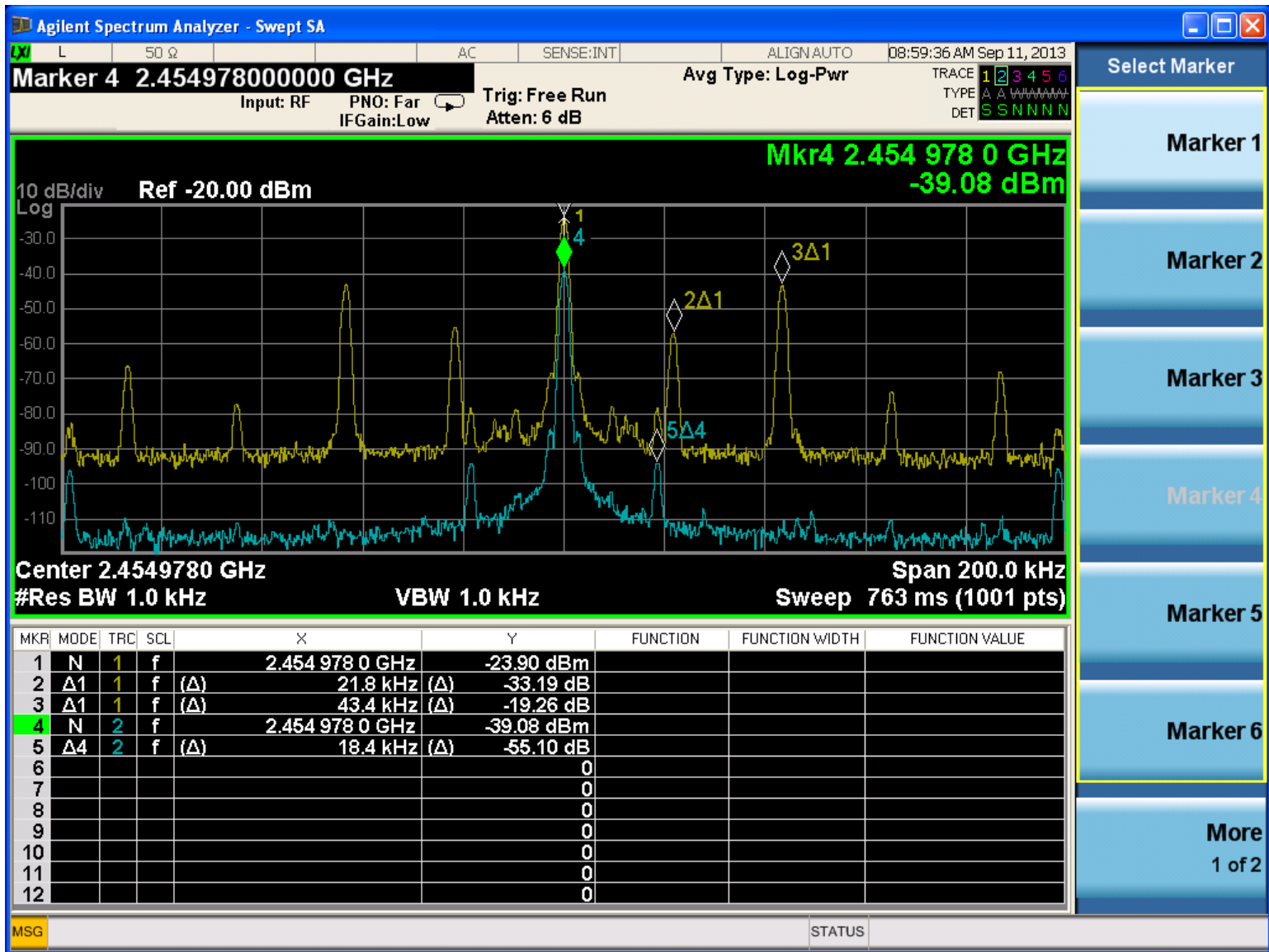
Harmonics with 3 watts injection drive, 1.14 kW mag out,
847 watts at out put 5 MHz span, 350 mA magnetron current



Wide spectra with 3,6,10,15,20 watts injection drive, 1.14 kW mag out, 847 watts at out put traces 1-5, 350 mA magnetron current



Harmonics with 1,3,6,10.15.20 watts injection drive, 1.14 kW mag out,
847 watts at out put, 350 mA magnetron current
Trace 6 is one watt, traces 1-5 are 3-20 watts



yellow Harmonics with 25 watts injection drive, 1.14 kW mag out,
blue magnetron off, TWT feed through, injection gain 15 dB

Next Steps:

Clean up power supply ripple with a filter

Characterize RF performance

Turn over to the LLRF group for vector control

Have vector modulation results by Spring of 2014