Update on Efforts to Develop New MI Phase Lock Controls

PIP Management Meeting

March 28, 2012

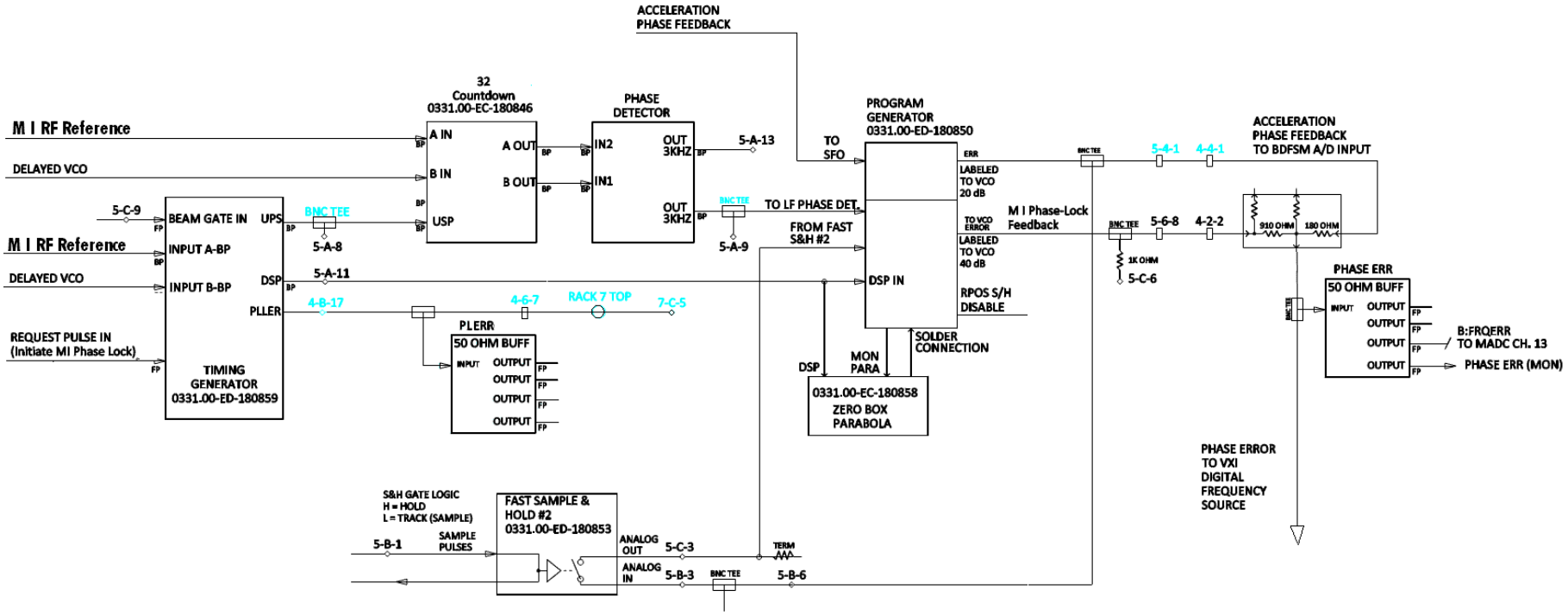
Craig Drennan

Current MIPL Controls

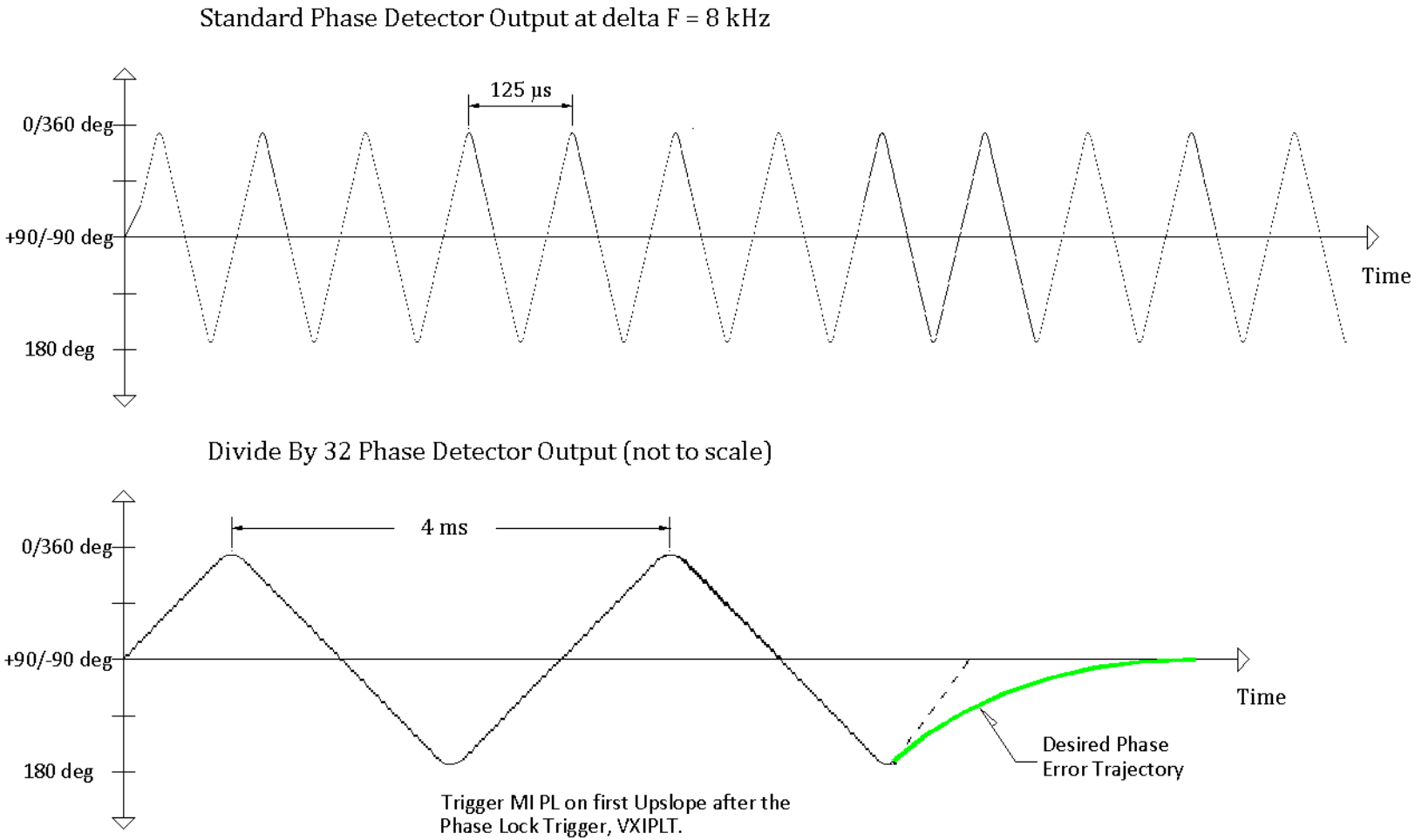
New Low-Level RF System for the Fermilab Booster Synchrotron

C. Kerns, J, Crisp, Q. Kerns and H. Miller
Fermi National Accelerator Laboratory

Submitted to the Partical Accel. Conf. March 16-19, 1987



Current MIPL Process

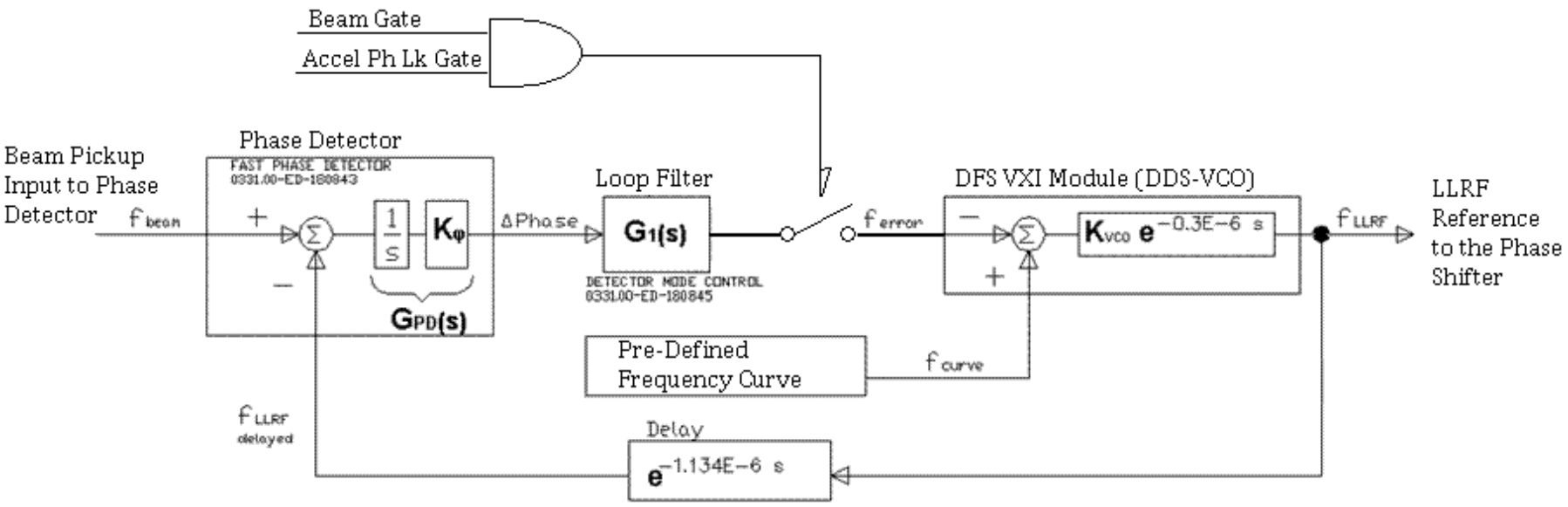


Goals for New MI Phase Lock Controls

- Less perturbation of the beam, reduction of synchrotron oscillations.
- Shorter locking interval.

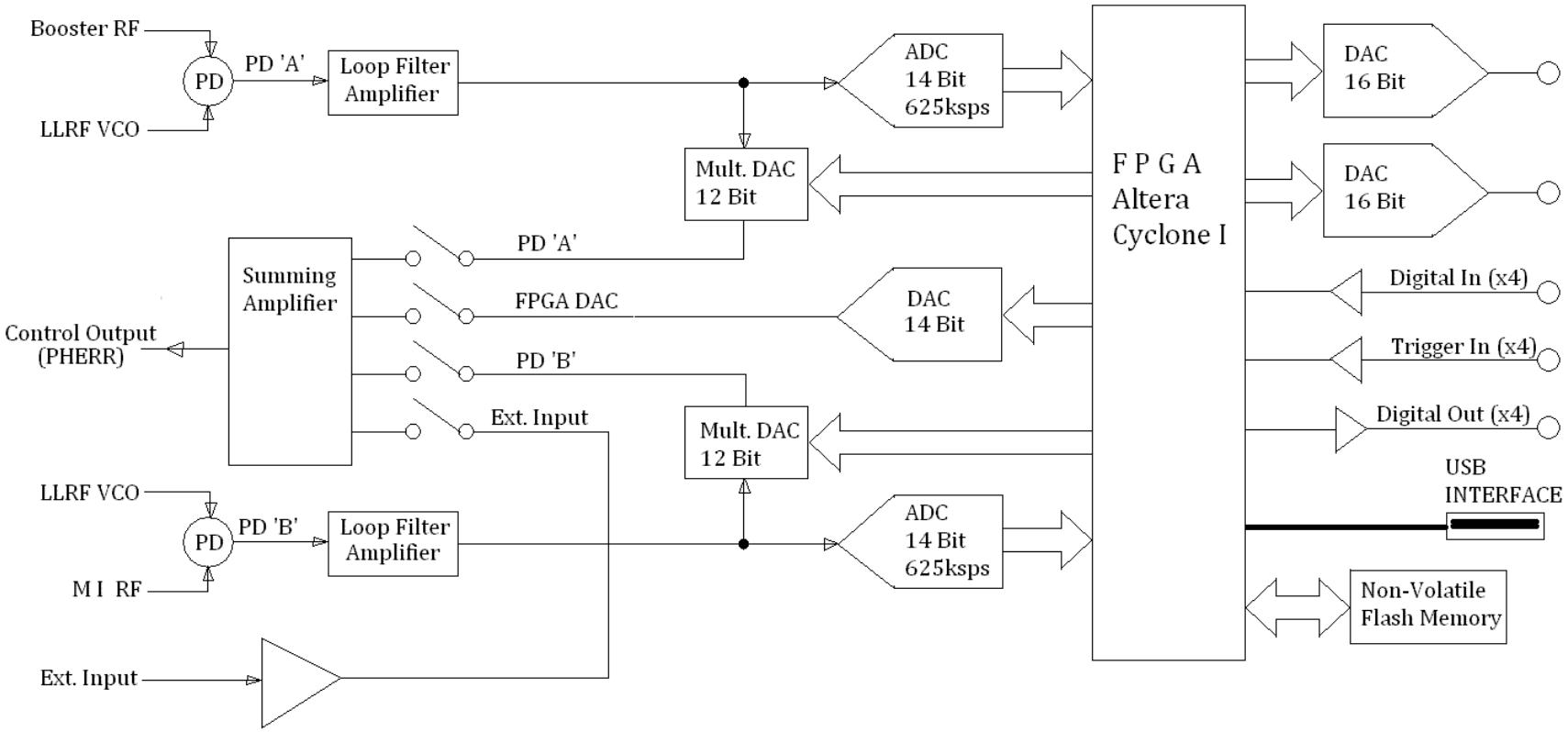
*Somewhat conflicting goals.

The Acceleration Phase Lock Loop

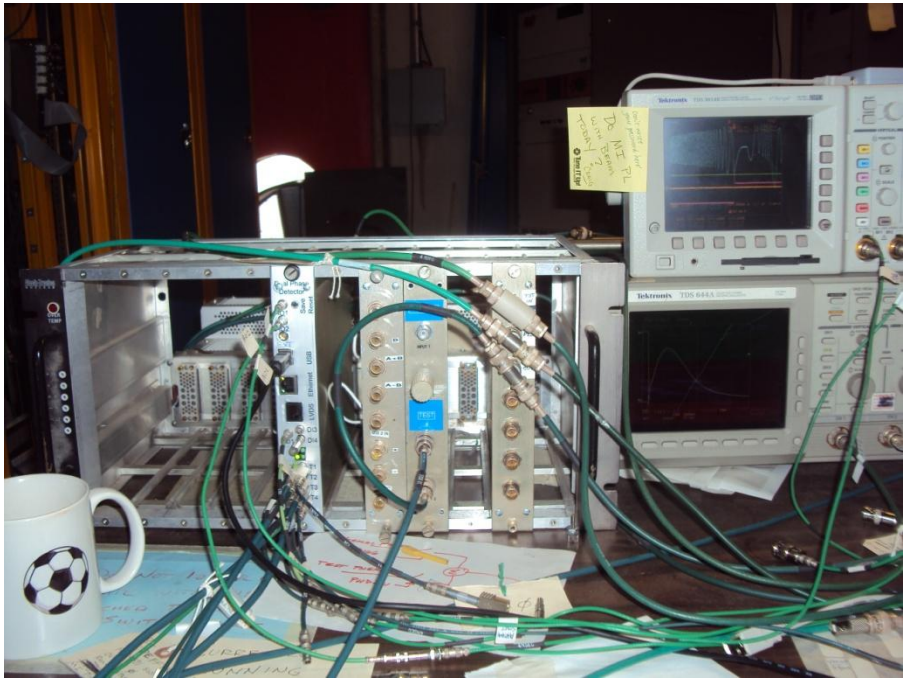


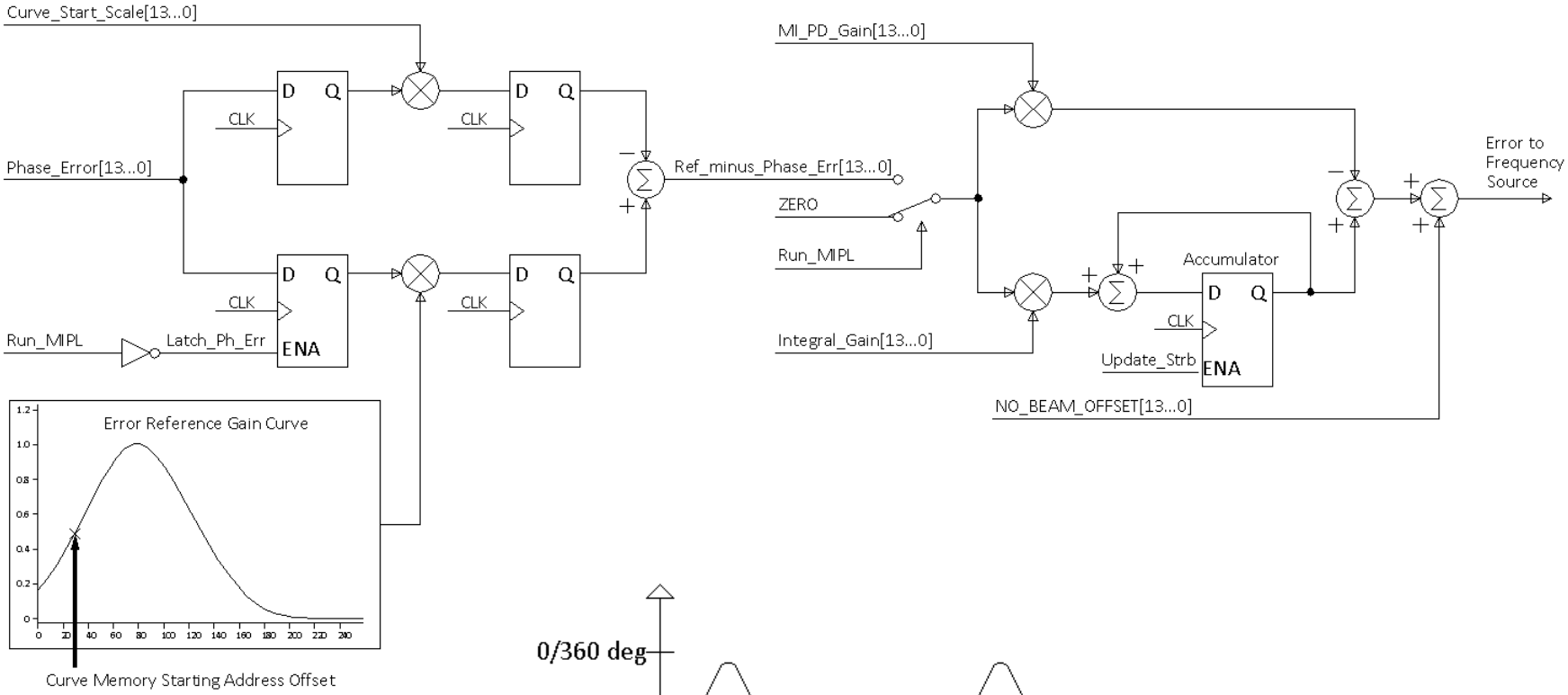
The first trick is to smoothly transition from Acceleration Phase Lock to MI Phase Lock

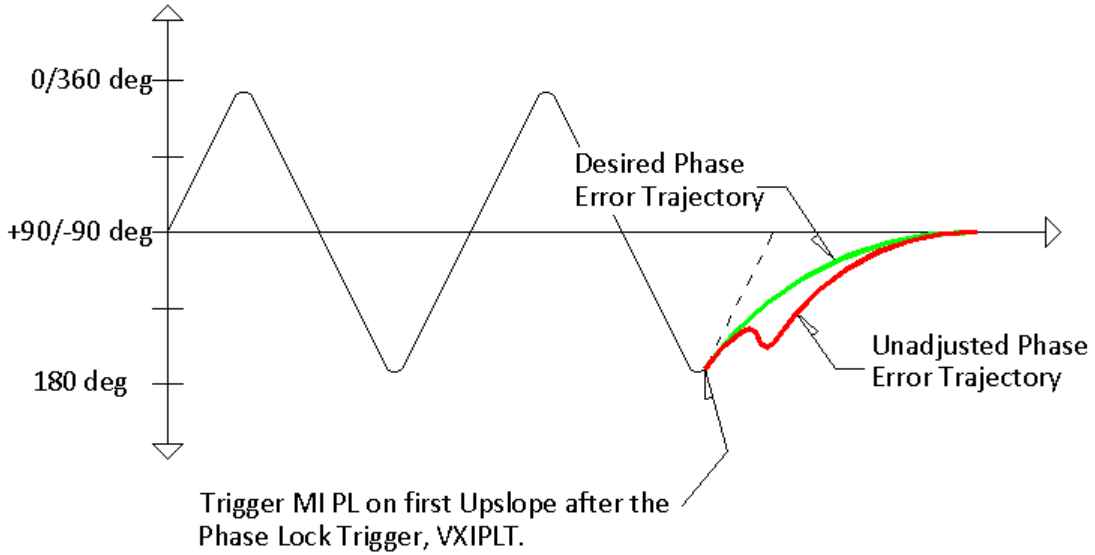
Platform for Developing New MIPL Controls




DUAL PHASE DETECTOR
DWG# 0000-ED-173632
AO1
AO2
AUX
USB
Ethernet
LVDS
DO1
L2
L1
L4
L3
DO2
DO3
DO4



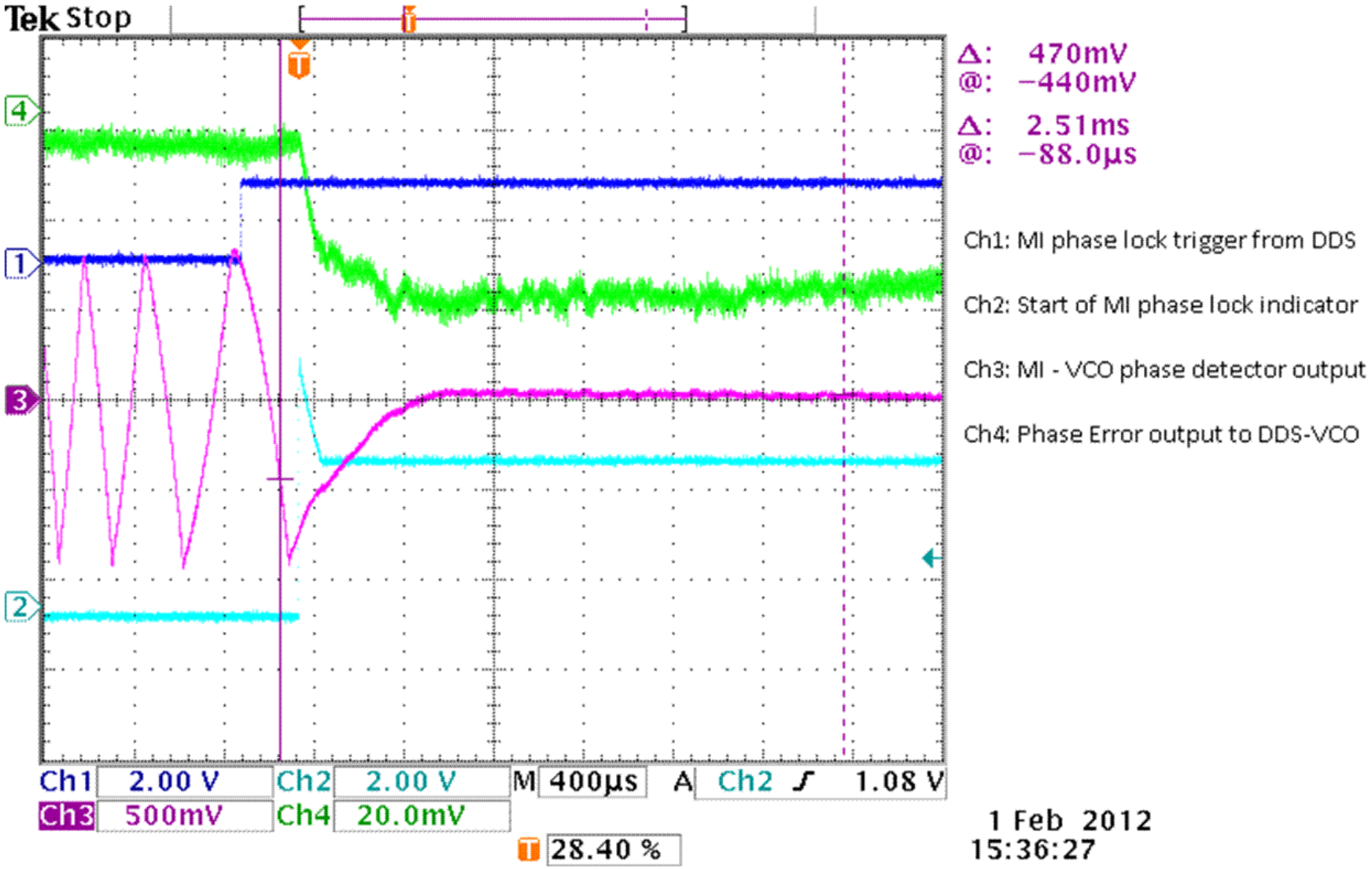

Curve_Start_Scale[13...0]
Phase_Error[13...0]
CLK
D
Q
Ref_minus_Phase_Err[13...0]
Run_MIPL
Latch_Ph_Err
ENA
MI_PD_Gain[13...0]
ZERO
Integral_Gain[13...0]
Accumulator
Update_Strb
NO_BEAM_OFFSET[13...0]
Error to Frequency Source
Error Reference Gain Curve
Curve Memory Starting Address Offset


0/360 deg
+90/-90 deg
180 deg
Desired Phase Error Trajectory
Unadjusted Phase Error Trajectory
Trigger MI PL on first Upslope after the Phase Lock Trigger, VXIPLT.

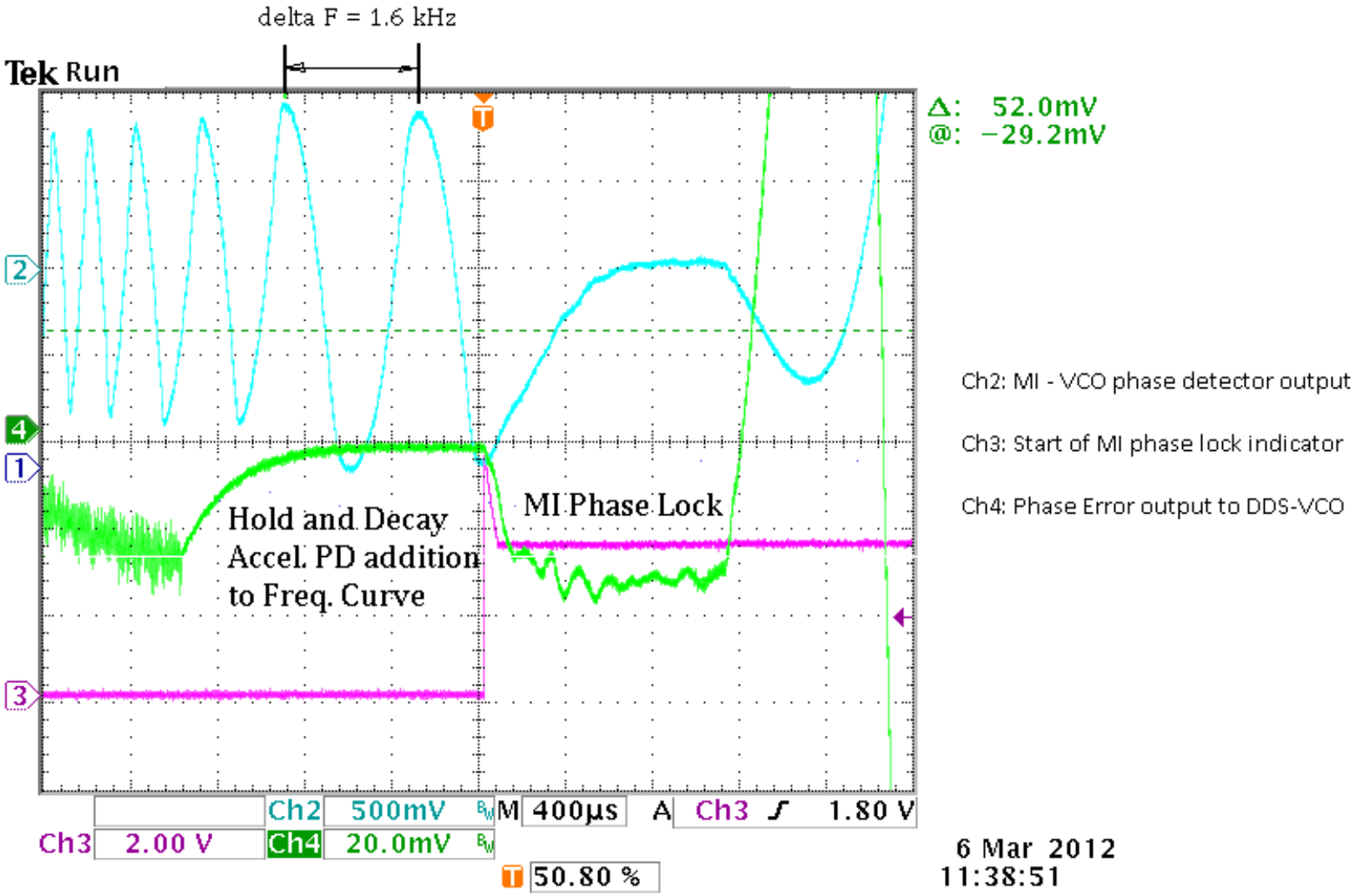
Booster Testing

- Acceleration PD gain and offset adjustments
- Online testing of new acceleration phase det.
  - Booster retuning typically required
- No Beam, MI phase lock testing
  - MIPL only locks DDS-VCO to MI RF, not to beam
  - Frequency curves changes were required
- Single turn beam MI phase lock testing

No Beam MIPL tests on February 1, 2012

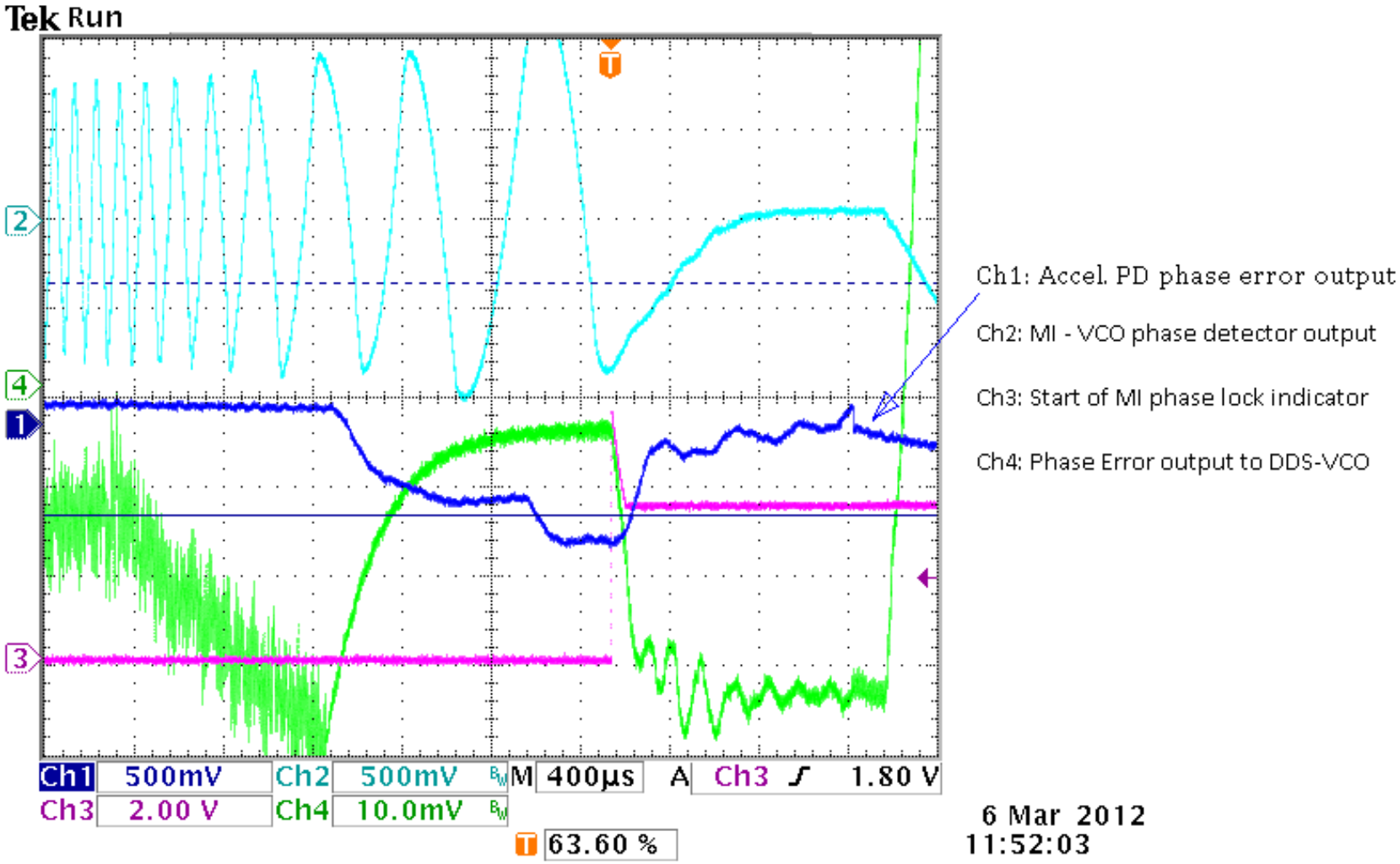


MIPL with Beam on March 6, 2012



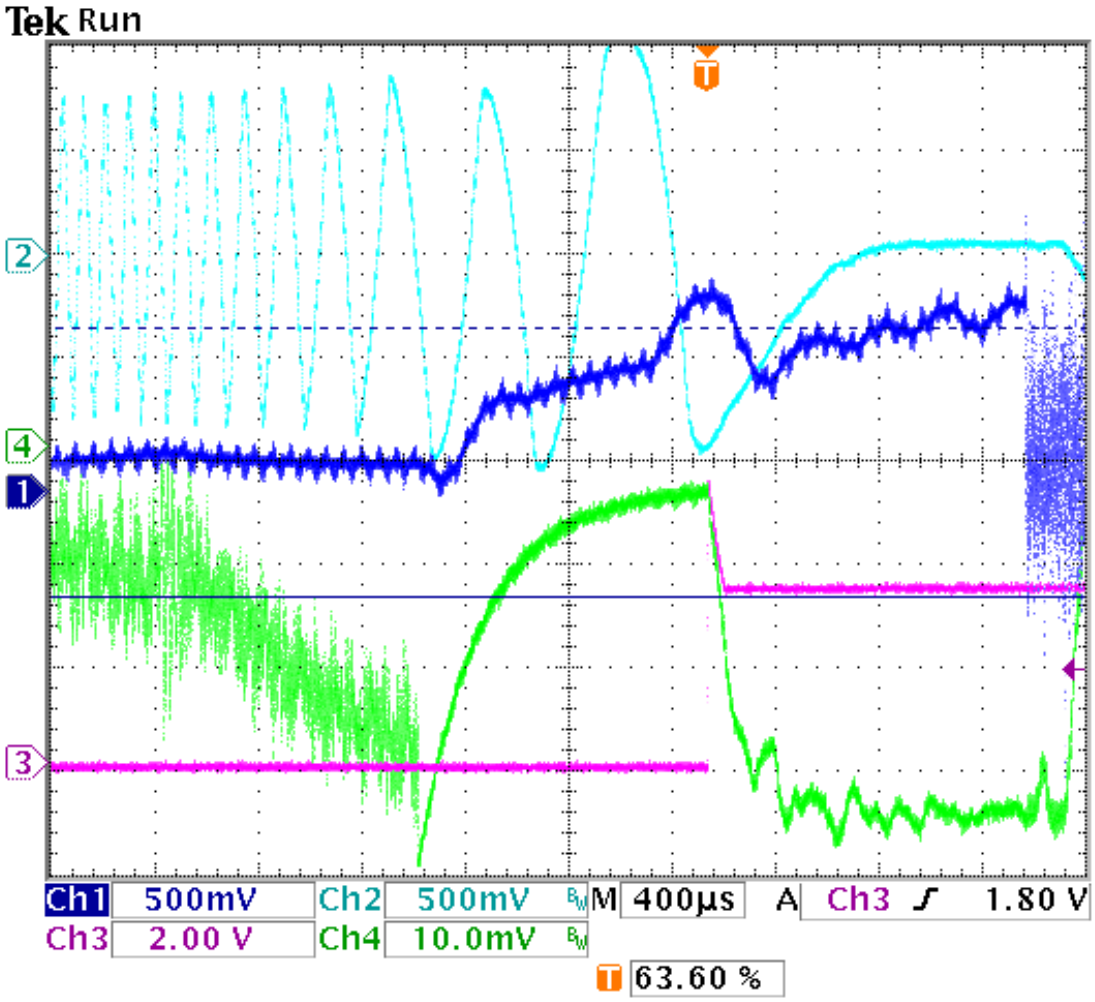
MIPL with Beam on March 6, 2012

Note changes in the Acceleration Phase Detector output.



MIPL with Beam on March 6, 2012

Note changes in the Radial Position of Beam



Ch1: Radial Position (RPOS)

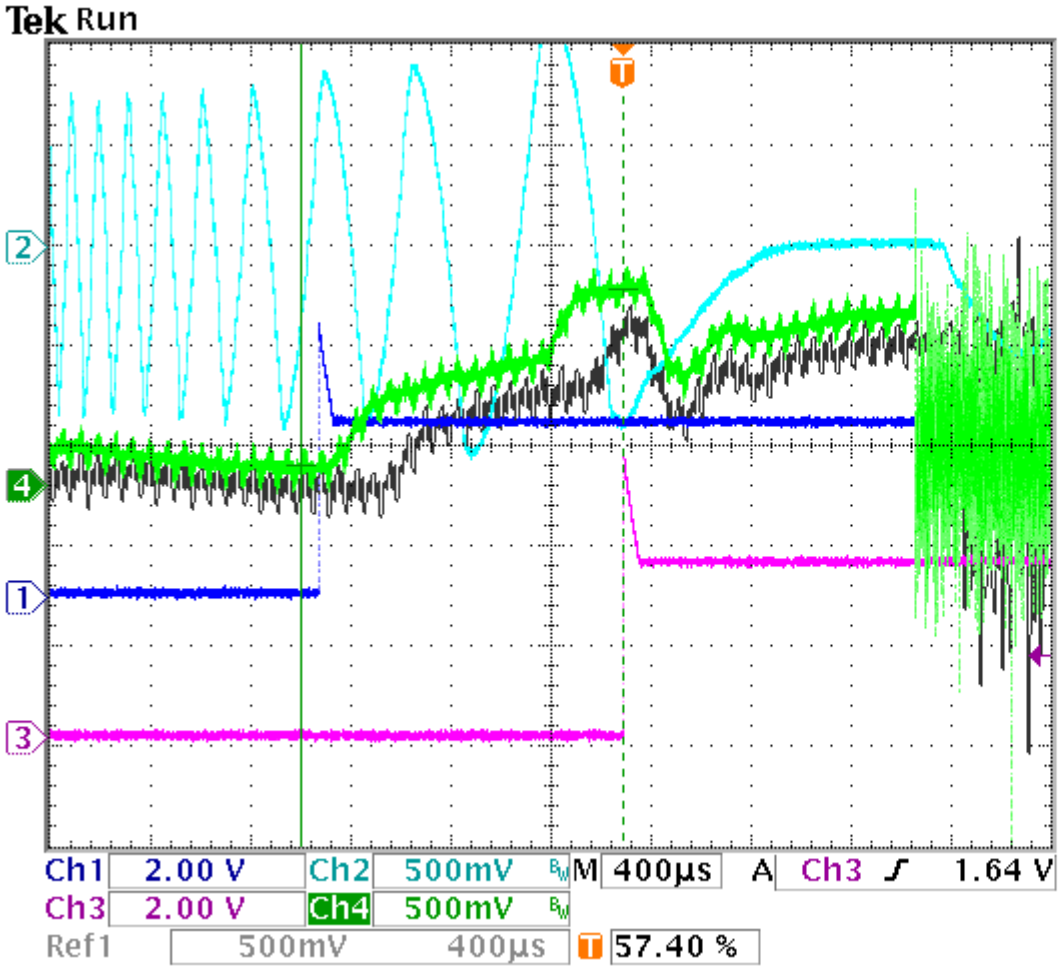
Ch2: MI - VCO phase detector output

Ch3: Start of MI phase lock indicator

Ch4: Phase Error output to DDS-VCO

MIPL with Beam on March 16, 2012

Note changes in the Radial Position of Beam



Ch1: Hold Accel PD trigger

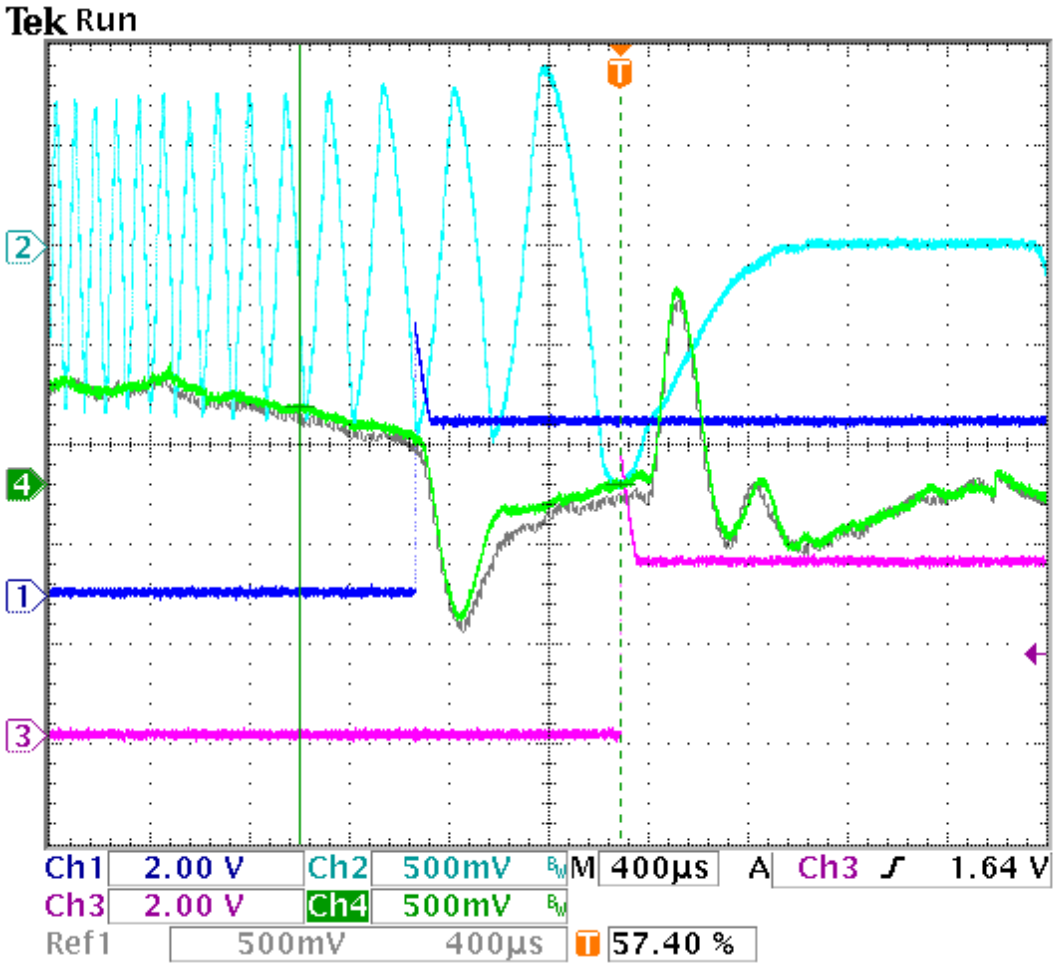
Ch2: MI - VCO phase detector output

Ch3: Start of MI phase lock indication

Ch4: Beam radial position, RPOS

MIPL with Beam on March 16, 2012

Note changes in the Phase Drive due to AC Dampers



Ch1: Hold Accel PD trigger

Ch2: MI - VCO phase detector output

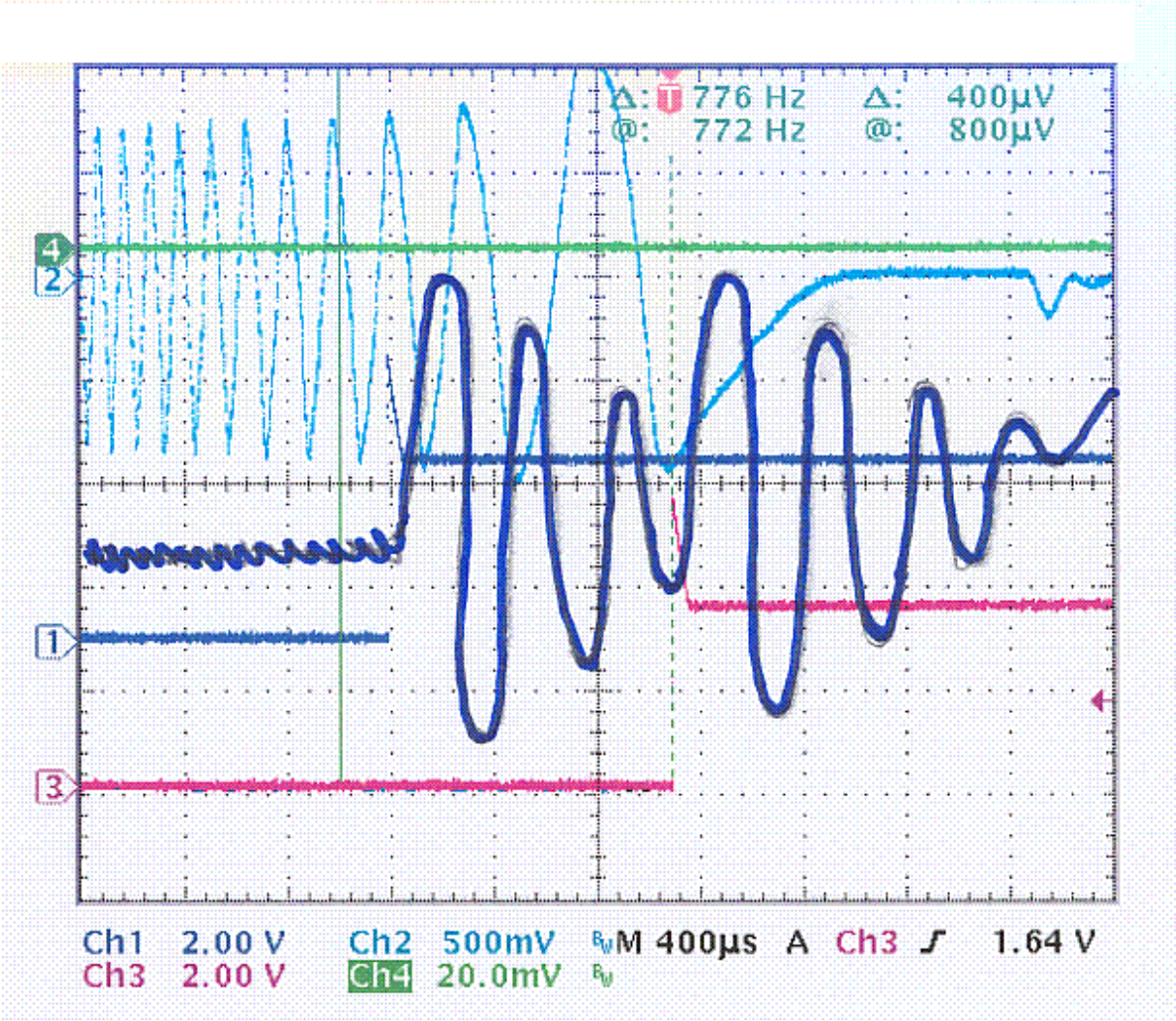
Ch3: Start of MI phase lock indication

Ch4: Phase Drive due to AC Dampers

16 Mar 2012
11:40:50

MIPL with Beam on March 16, 2012

AC Dampers Off



Going Forward

- Trials have been made to reduce the rate of rise of the phase error feedback, on the bench, using different curves for the reference trajectory.
  - No significant improvement with this yet.
- We will be looking to find a softer method for ensuring our initial conditions before MIPL.
- Trials on the bench have been made to implement a phase lock by starting with a smaller delta F.
- If nothing else, we can build a new divide by 32 module and replicate the current method in up to date, programmable hardware.

Extras

Running Frequency within 100 Hz of MI RF and locking.

http://www.youtube.com/watch?v=KpfD9K3_V0o&feature=email