SEE Lab Tests (Musson et al.)

Standard JLAB SEE

Goubau Line X-Y Scanner

Conditions

MATLAB used to integrate scan and EPICS readback functions

SEE employs 12-bit ADC ….. ENOB = 11 (2048 counts)

SEE AGC maintains a 4-wire sum of 1100 counts (boresight ~ 300 cts/electrode)

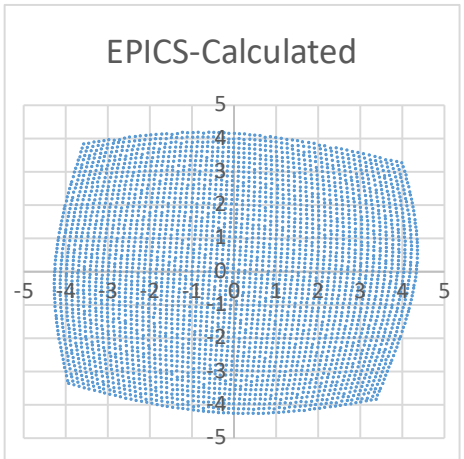
Scan range = 1.5 cm x 1.5 cm, 250 um step size

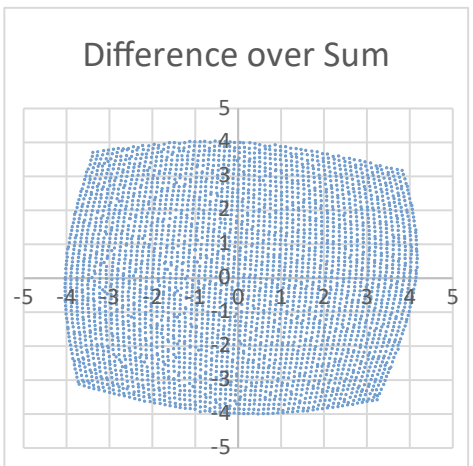
EPICS-calculated as well as raw electrode counts retained

- Difference-over-sum used, but EPICS auto-zeros low counts
- Fixed-gain mode also used, with hand optimization of dynamic range

Nominal RF level consistent with “1 uA” of beam current

SEE with M15 Sensor



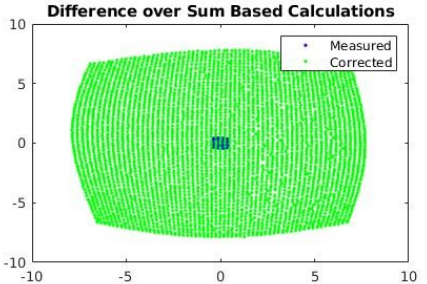


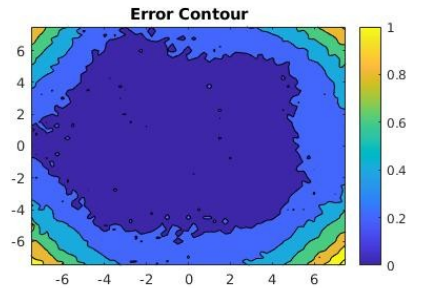
Raw Data

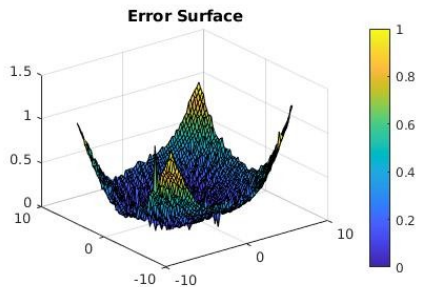
Regression Output:

```
Plots for SEE using M15 sensor.
Nominal beam current = 1uA
Scan range: +/- 0.75 cm
Scan resolution: 250 um
SEE ADCs simply cut out (read 0) when signal is low
SEE "minimum signal" is right at 100 nA.

M15:
Kx = 17.9
Ky = 18.4
D-theta = 0.4 degrees
RMS Error (1 cm) = 107.3 um
```

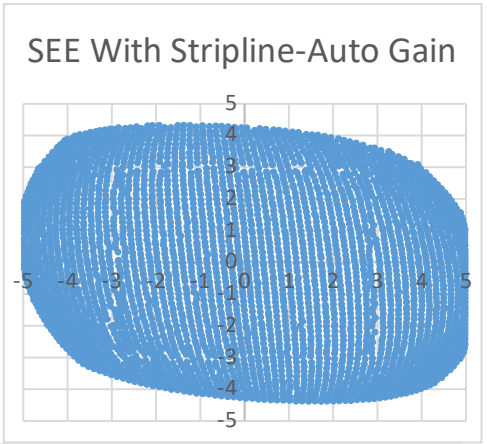


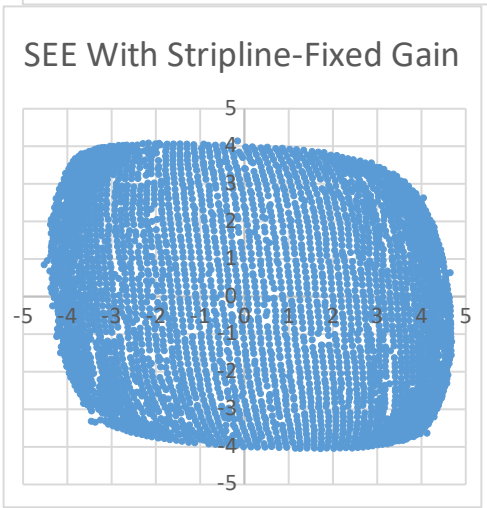




Regression applied

SEE with Stripline Sensor (#22)





Raw Data

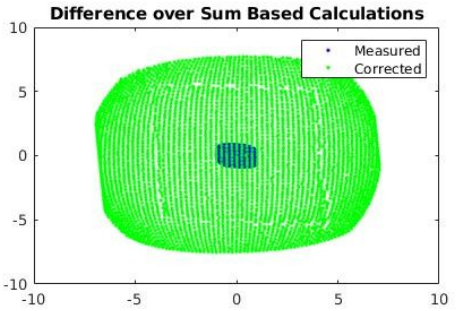
"Squelched" data piles up at edges and center in AG mode

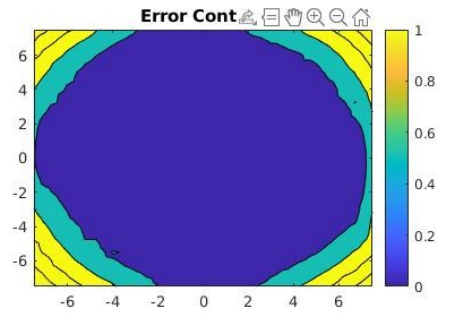
Regression Output:

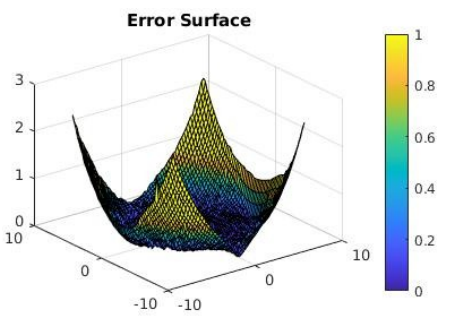
```
Plots for SEE using stripline (SPM).
Nominal beam current = 1uA
Scan range: +/- 0.75 cm
Scan resolution: 250 um
SEE ADCs simply cut out (read 0) when signal is low
SEE "minimum signal" is right at 100 nA.

SPM:
Kx = 6.9
Ky = 8.8
D-theta = 7.3 degrees
RMS error (1 cm) = 118.5 um
```

Accuracy maintained on-axis….







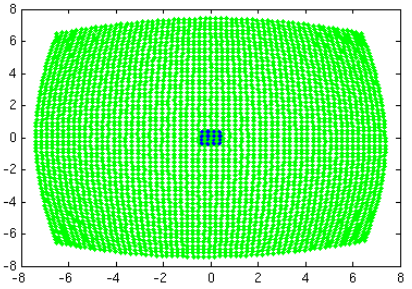
Regression applied

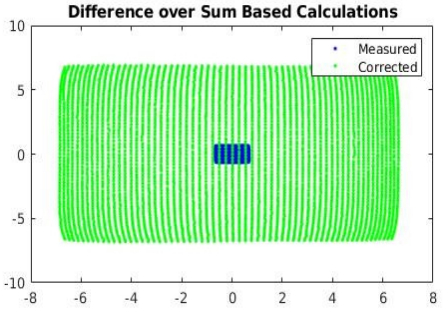
DR with M15 and Stripline Sensors

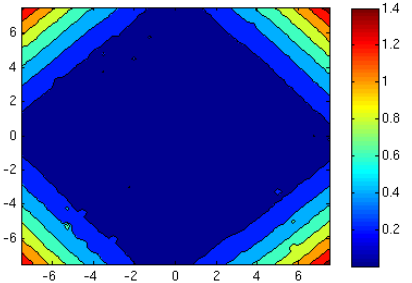
Accepted K values:

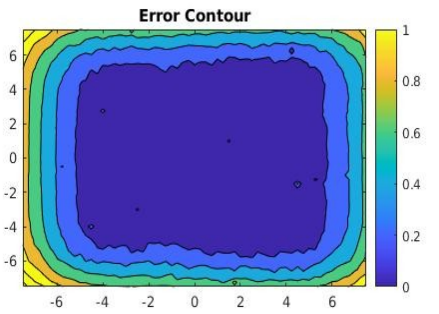
M15: 18.81

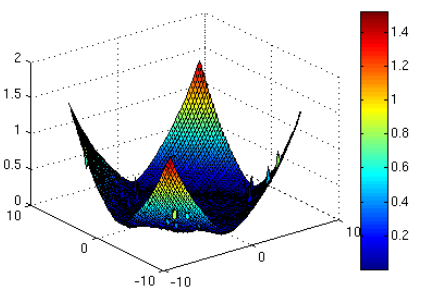
Stripline: 9.95

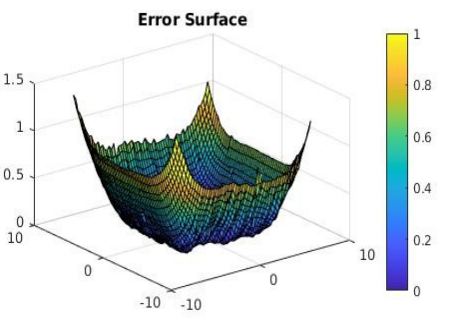












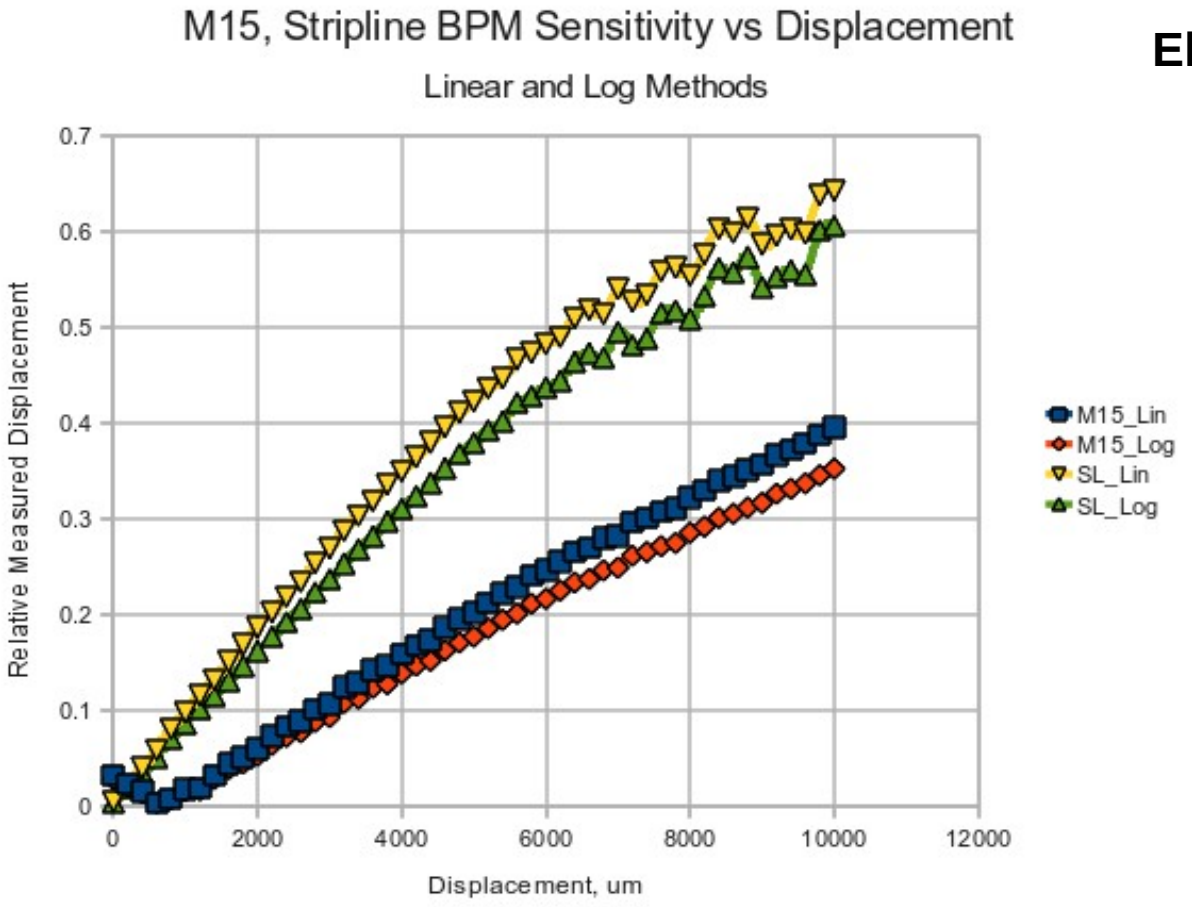
M15

Stripline #22

Electrical Sensitivities of M15 and Stripline Sensors

1100 counts are quickly eaten up.

Corners only have 550 cts.

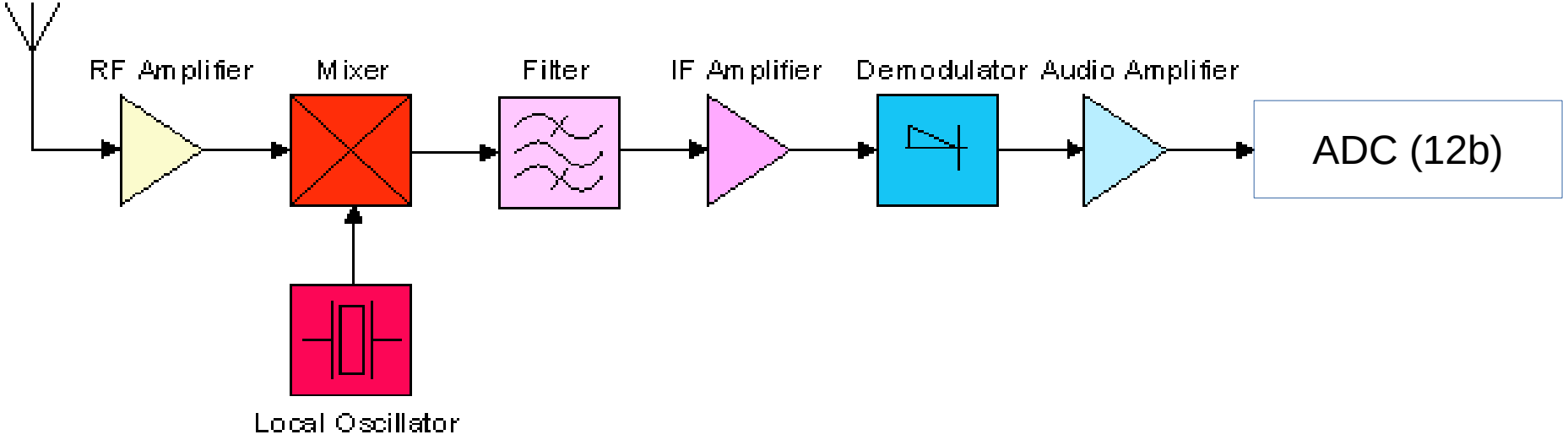


Electrode Delta:

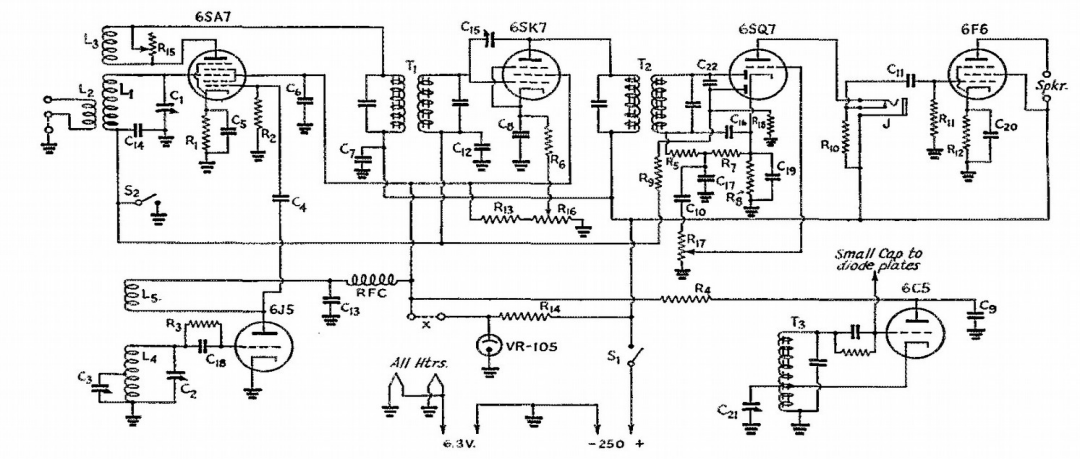
M15: 1 dB/mm

SL: 2 dB/mm

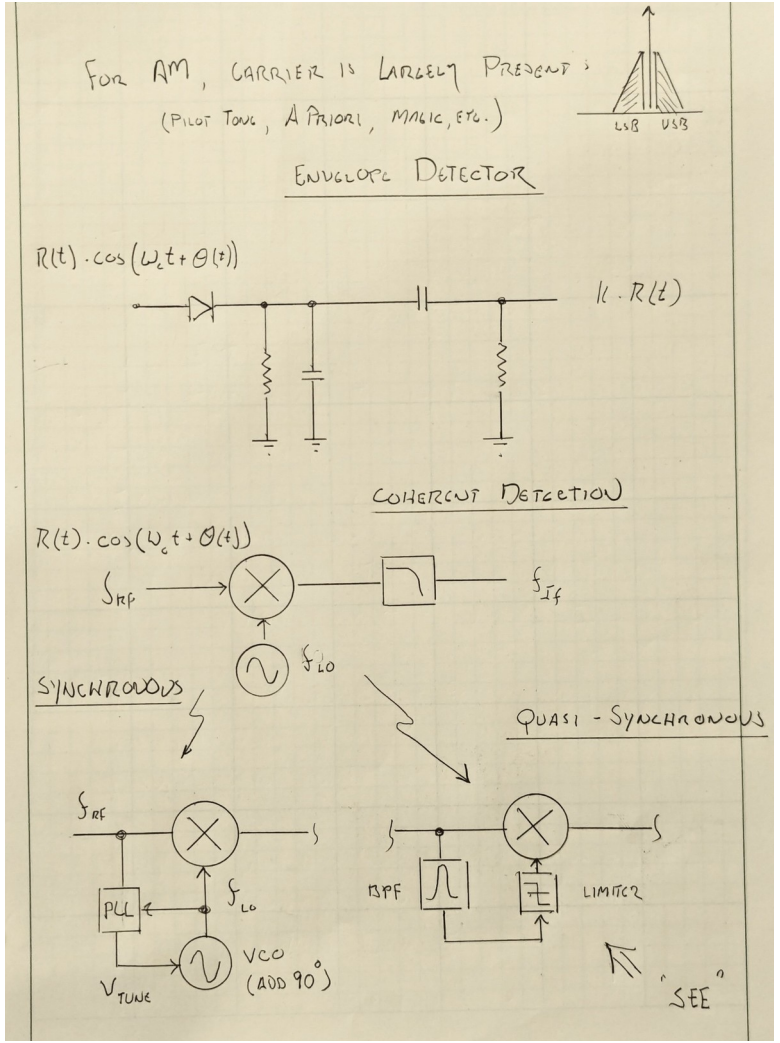
SEE vs DR Receiver Architecture



(ca. 1969)



Envelope Detection



Detection “locks in” the SNR…….

Some tricks remain, but…….

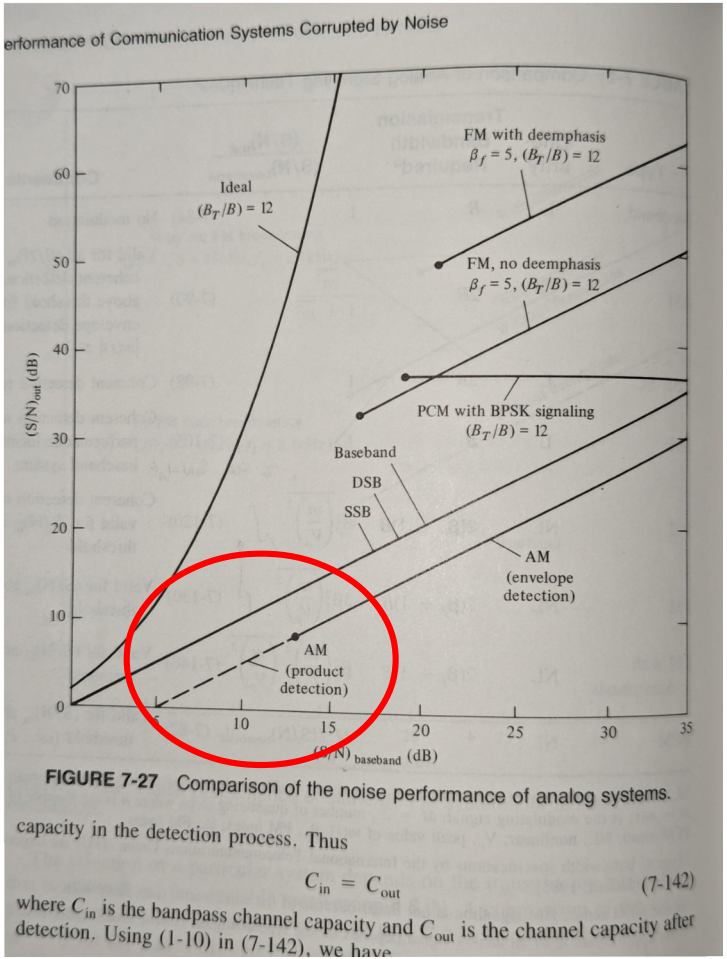


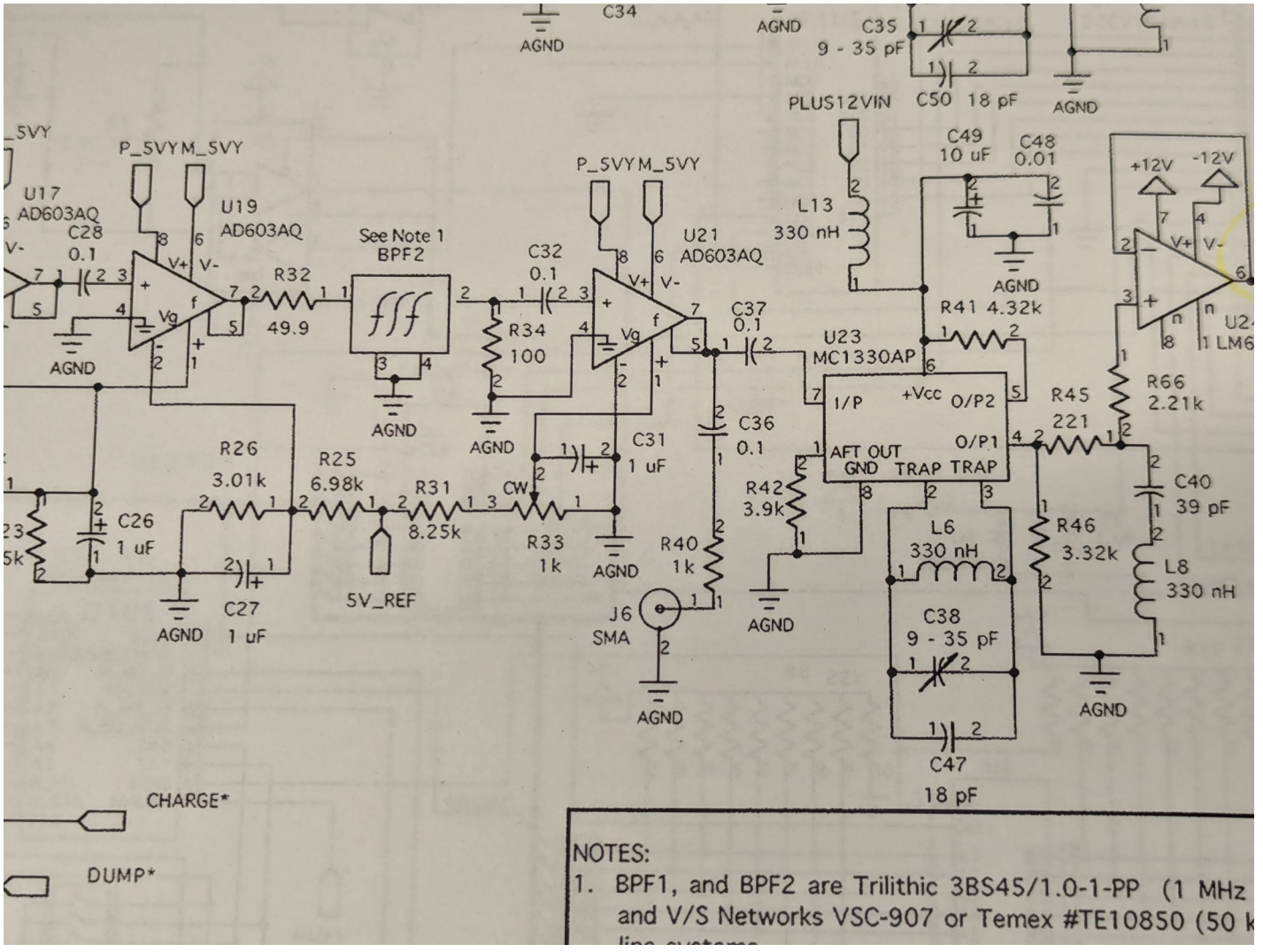
FIGURE 7-27 Comparison of the noise performance of analog systems.

capacity in the detection process. Thus

$$C_{in} = C_{out} \tag{7-142}$$

where C_{in} is the bandpass channel capacity and C_{out} is the channel capacity after detection. Using (1-10) in (7-142), we have

SEE IF


C34
AGND
C35
9 - 35 pF
C50 18 pF
PLUS12VIN
C49
10 uF
C48
0.01
L13
330 nH
+12V
-12V
P_5VYM_5VY
U17
AD603AQ
C28
0.1
U19
AD603AQ
R32
49.9
See Note 1
BPF2
C32
0.1
U21
AD603AQ
R34
100
C37
0.1
U23
MC1330AP
R41 4.32k
I/P
+Vcc
O/P2
AFT OUT
GND
TRAP
TRAP
O/P1
R45
221
R66
2.21k
R42
3.9k
R46
3.32k
C40
39 pF
L8
330 nH
L6
330 nH
C38
9 - 35 pF
C47
18 pF
R26
3.01k
R25
6.98k
R31
8.25k
CW
R33
1k
C31
1 uF
C36
0.1
R40
1k
C26
1 uF
C27
1 uF
5V_REF
J6
SMA
CHARGE*
DUMP*
NOTES:
1. BPF1, and BPF2 are Trilithic 3BS45/1.0-1-PP (1 MHz
and V/S Networks VSC-907 or Temex #TE10850 (50 k

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MC1330A

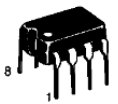
Low-Level Video Detector

LOW-LEVEL VIDEO DETECTOR

SILICON MONOLITHIC INTEGRATED CIRCUIT

The MC1330A is an integrated circuit featuring very linear video characteristics and wide bandwidth. Designed for color and monochrome television receivers, replacing the third IF, detector, video buffer and AFC buffer.

- Conversion Gain: 33 dB (Typ)
- Excellent Differential Phase and Gain
- High Rejection of IF Carrier Feedthrough
- High Video Output: 8.0 V(p-p)
- Fully Balanced Detector
- Output Temperature Compensated
- Improved Version of the MC1330



P SUFFIX
PLASTIC PACKAGE
CASE 626

MAXIMUM RATINGS

Rating	Value	Unit
Power Supply Voltage	24	Vdc
DC Video Output Current DC AFT Output Current	5.0 2.0	mAdc
Junction Temperature	150	°C
Operating Ambient Temperature Range	0 to 75	°C
Storage Temperature Range	–65 to +150	°C

Figure 7. Output Voltage Transfer Function

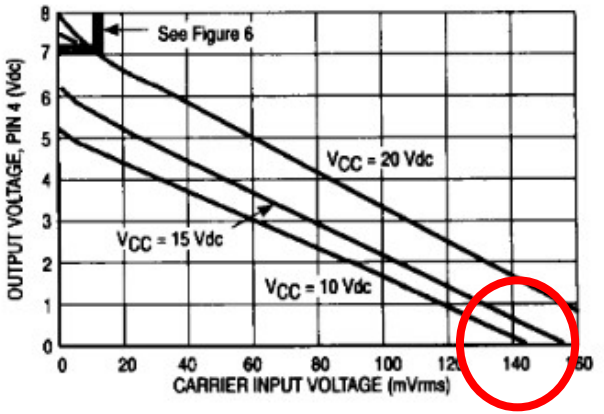
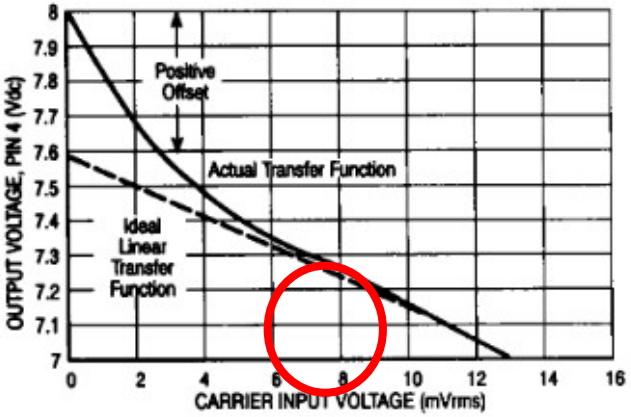


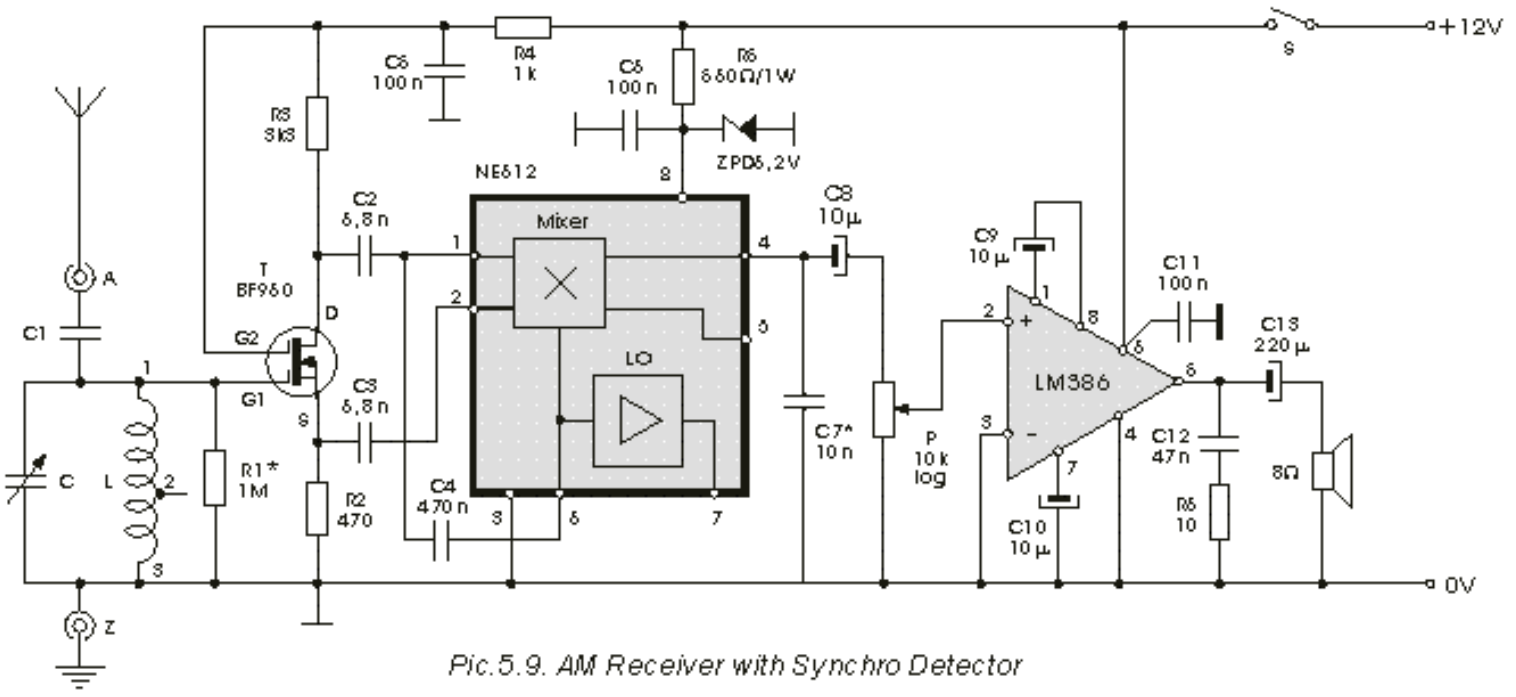
Figure 6. Output Voltage Transfer Function



Best-case DR = 25 dB

But, 1100 counts out of 2048 ==> 19 dB DR… Only 13 dB if in a corner.

...a Similar Example….



Pic.5.9. AM Receiver with Synchro Detector

….ultimately, pre-detection will limit the system performance

Post-ADC detection

Options for filtering AND detection methods. All numerical….

We use CORDIC at JLAB

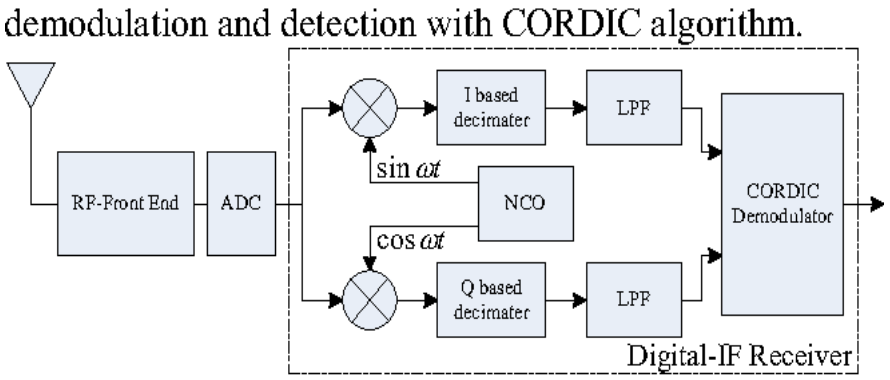
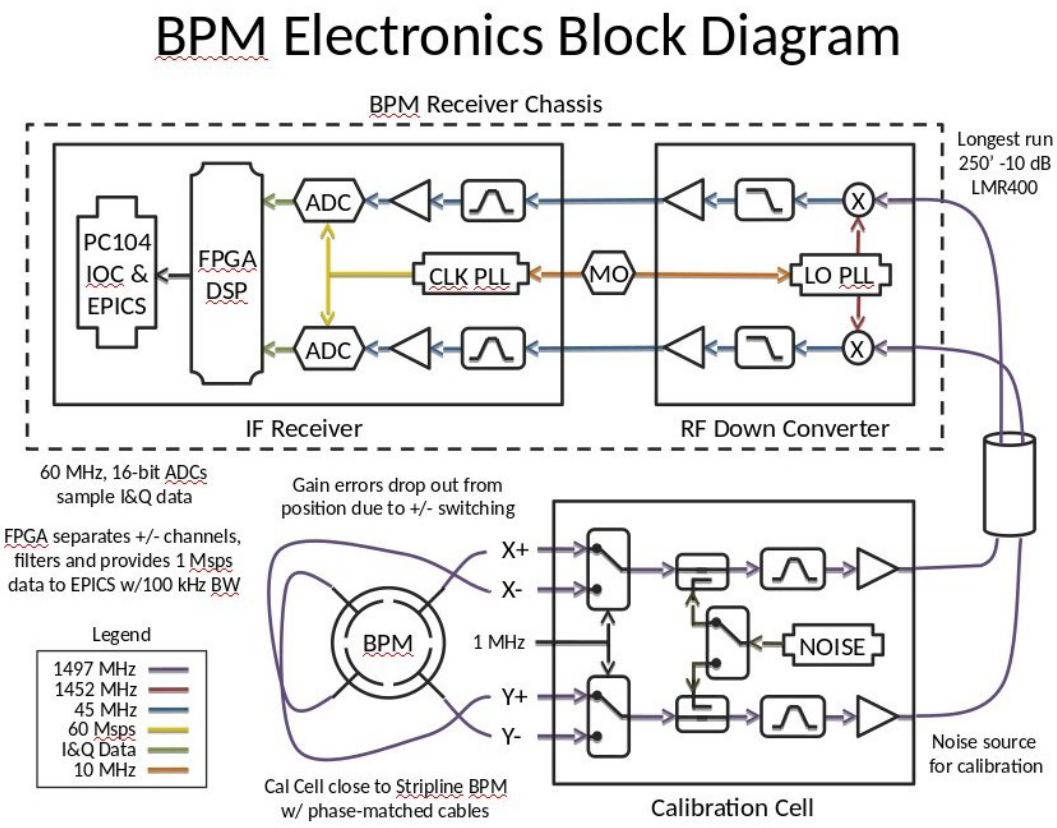


Figure 1. Platform for digital-IF receiver with CORDIC demodulator



Summary

SEE dynamic range is limited...Post-filtering might recover, but would be non-standard. Fixed-gain is advised.

For space constraints, might consider the JLAB “stubby” M15, which retains similar sensor electrical performance.

1 cm x 1cm is OK, with RMS accuracy error ~ 110 um. Careful steering (locks?) would be necessary.

“Stubby” JLAB M15 Scan

Kx = 15.46
Ky = 15.52

RMS(1cm) = 87.4 um
Delta Theta = 0.041 degrees