1) hit "start" button then wait

2) press "user preset button"

3) click on "all modes"

4) press "trace" button on the face
enables trace choice

5) to remove purple trace; select trace 3

6) select "view blank"

7) click on "blank". no traces left on screen

8) select trace 1. Then select the trace you want.

9) select "amplitude" to view active trace

10) adjust level with knob

11) hit trace again

12) "trace average" gives an average

13) to print this:
save it on the screen: view again

14) to save: press "save" among the buttons.

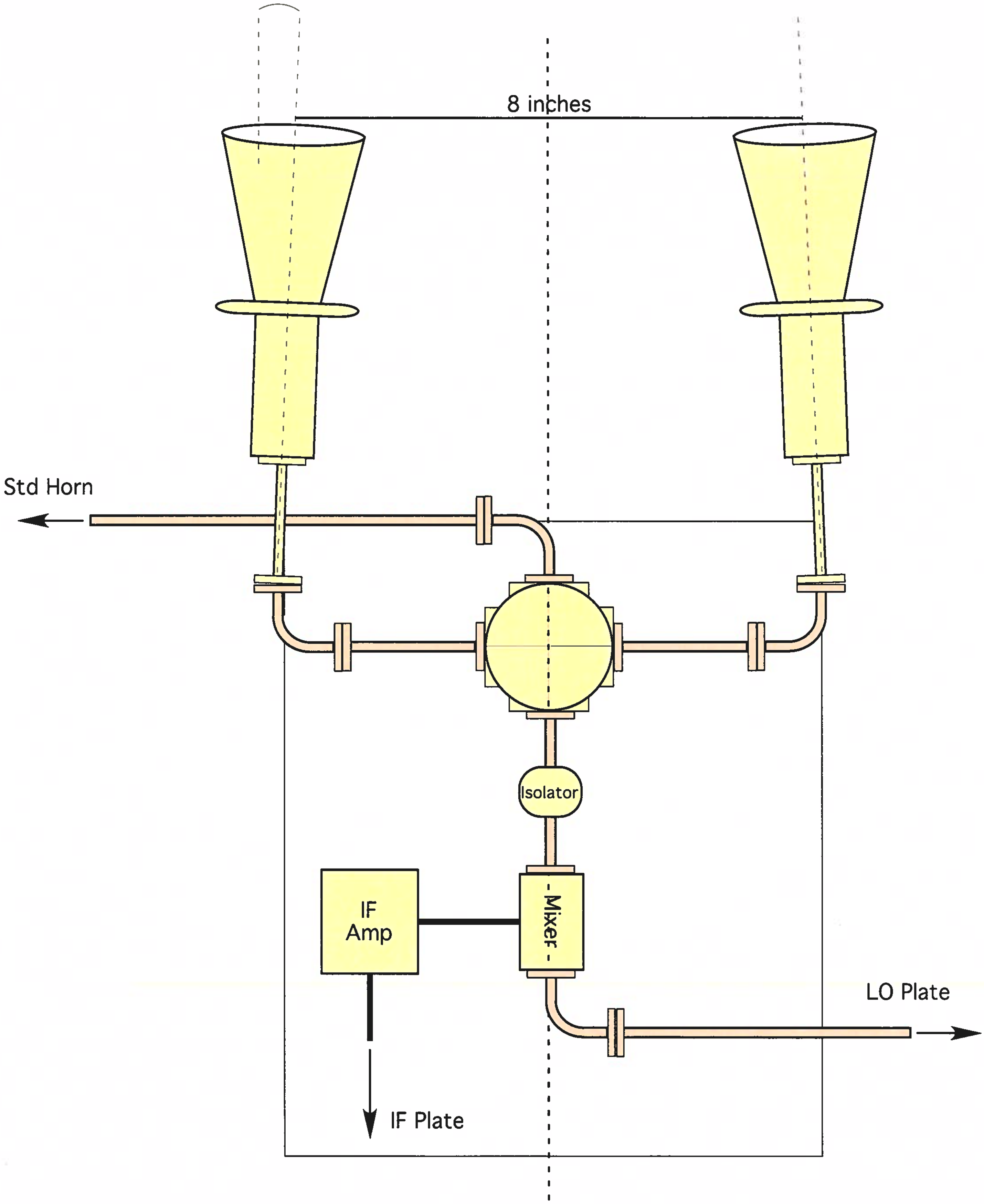
15) save as

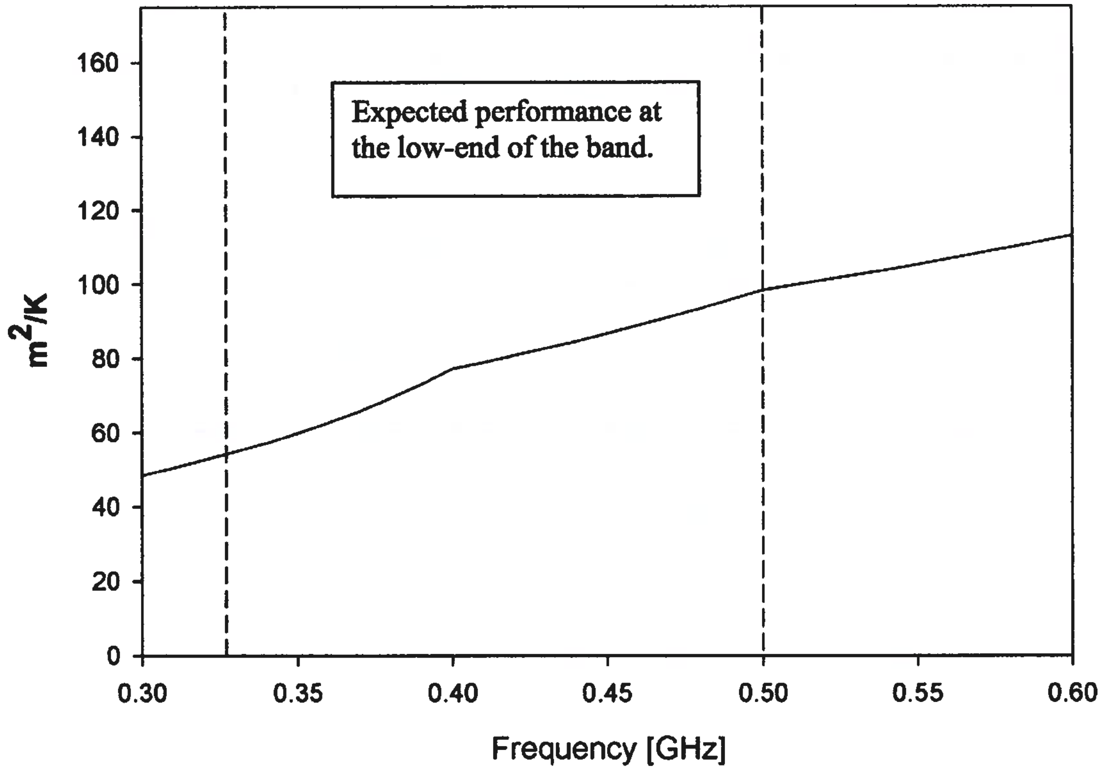
16) "Jack 2013" and the screen listing

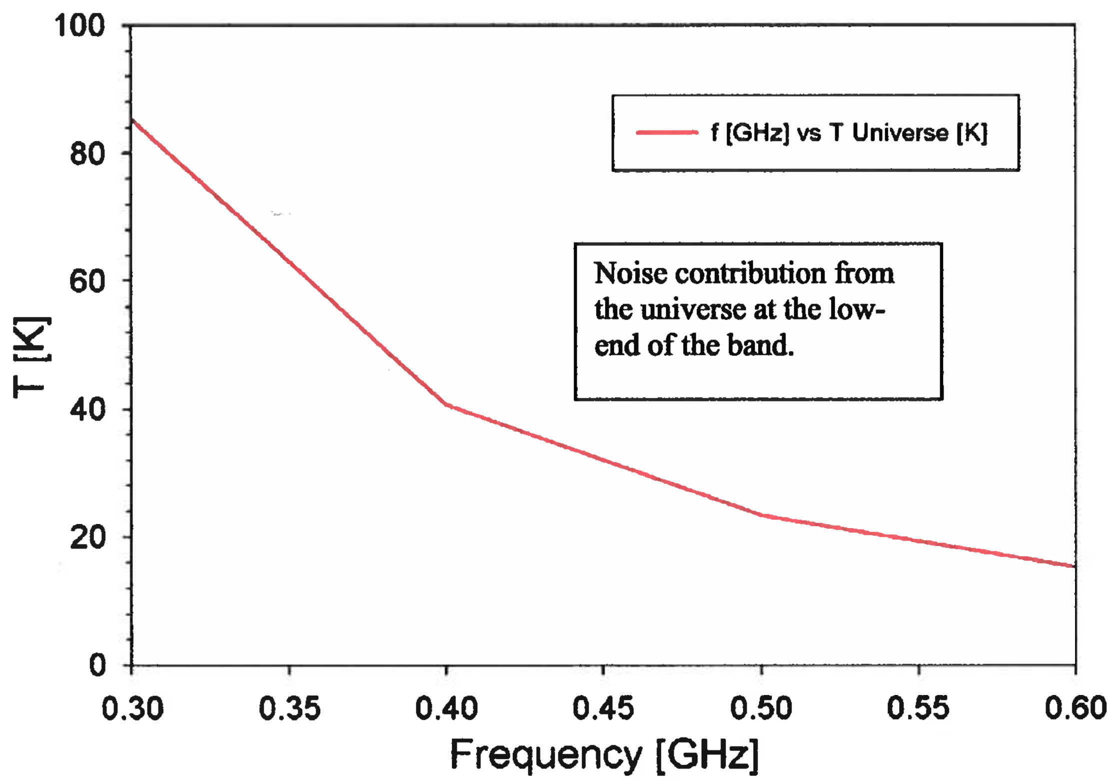
17) highlight that; type something in

18) cursor on given "file name"; left click; then
type in the name you want to give it.

19) to shut down


8 inches
Std Horn
Isolator
IF
Amp
Mixer
LO Plate
IF Plate



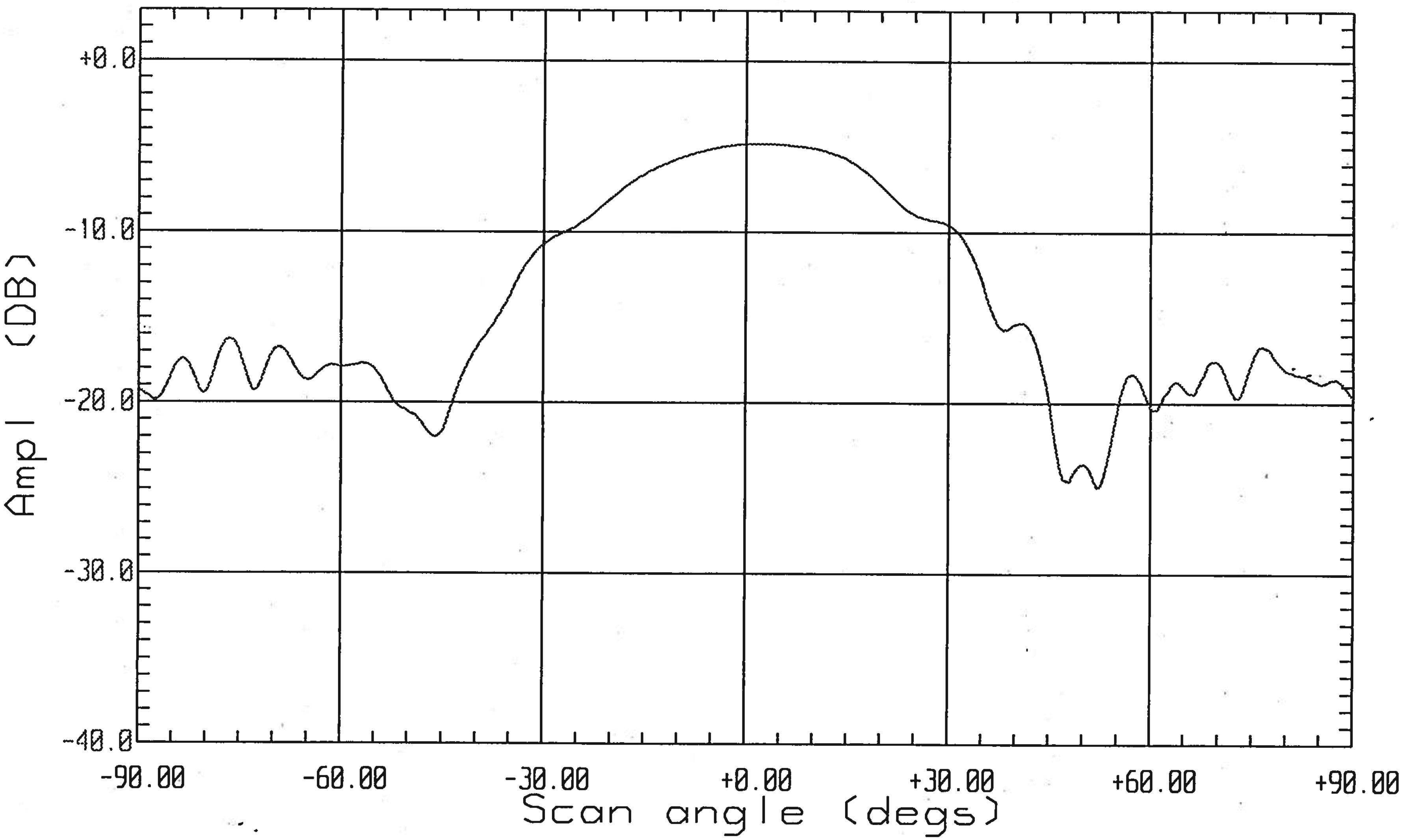


The performance roll-off evidenced in the top is partly components and filters, but predominantly the increased noise from the universe at lower frequencies (bottom figure).

ATA PROTOTYPE FEED II 12/20/01

File name: MesaAT No. samples: 361 Freq = 3.000 GHz

ATA1

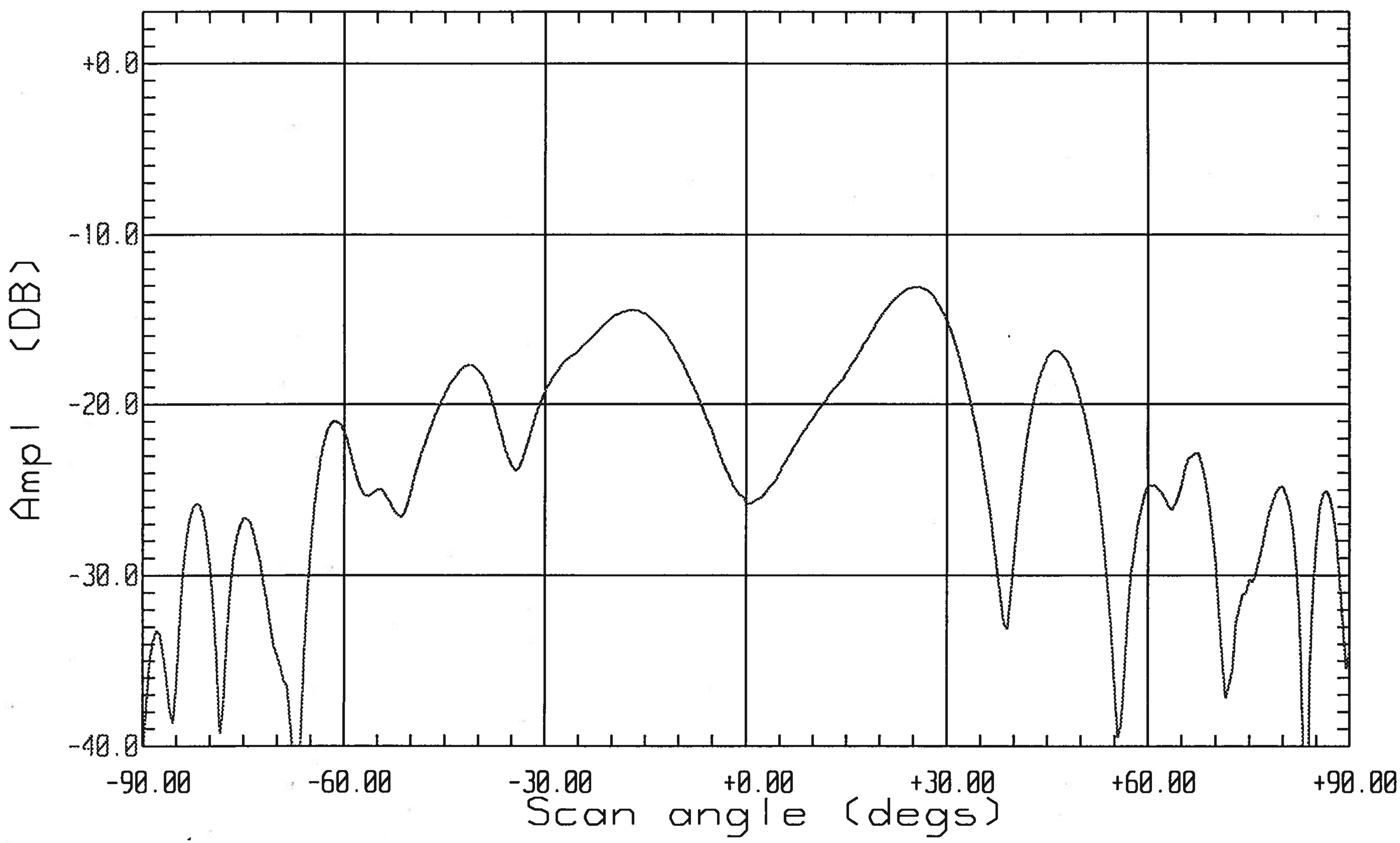


Max value of -4.81 Db at 3.00 degs 18 Dec 2001 13:34:27

Min value of -24.85 Db at 52.00 degs Pol angle .0295

File name: MesaAT No. samples: 361 Freq = 3.000 GHz

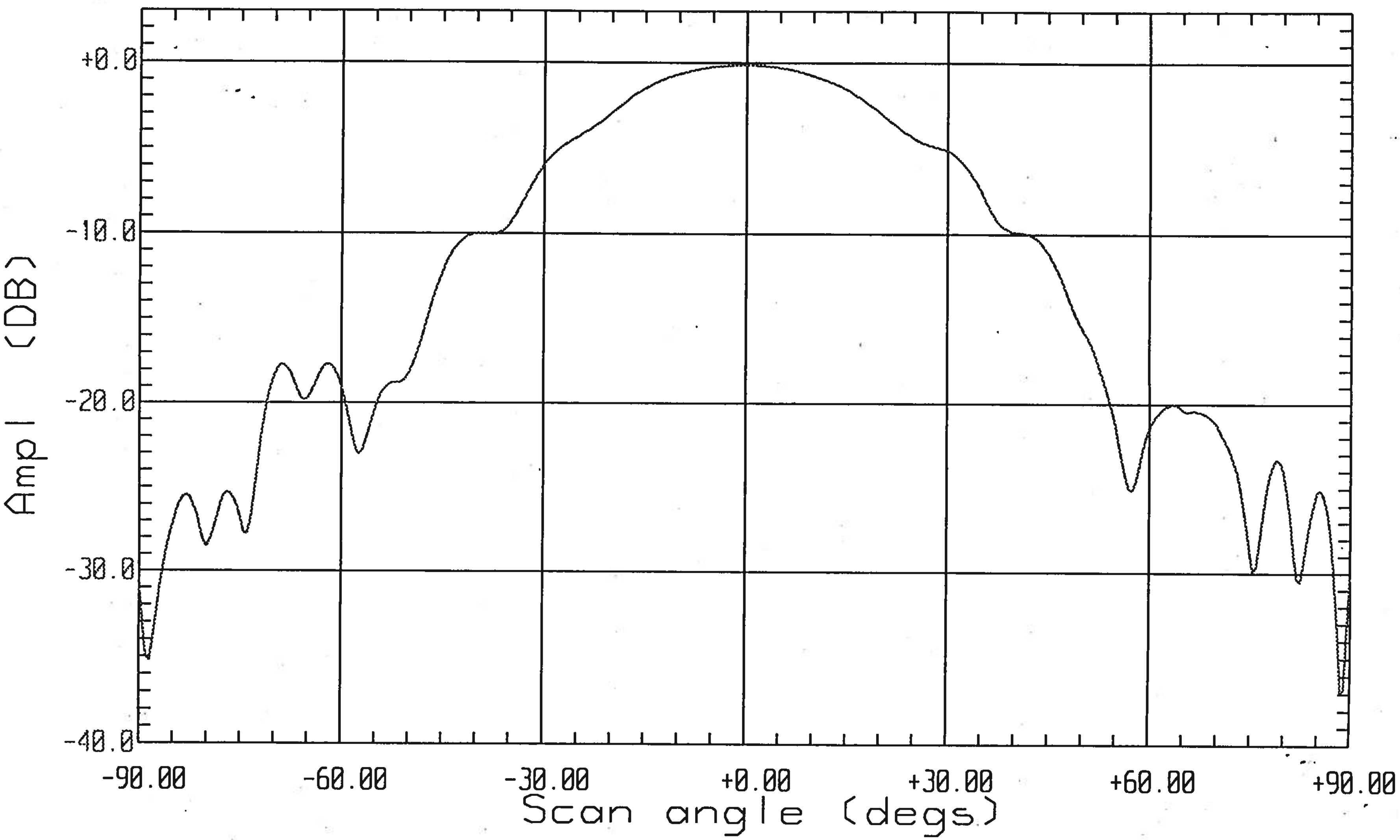
ATA1



Max value of -13.10 Db at 26.00 degs 18 Dec 2001 11:53:08

Min value of -51.43 Db at 83.50 degs Pol angle .0295

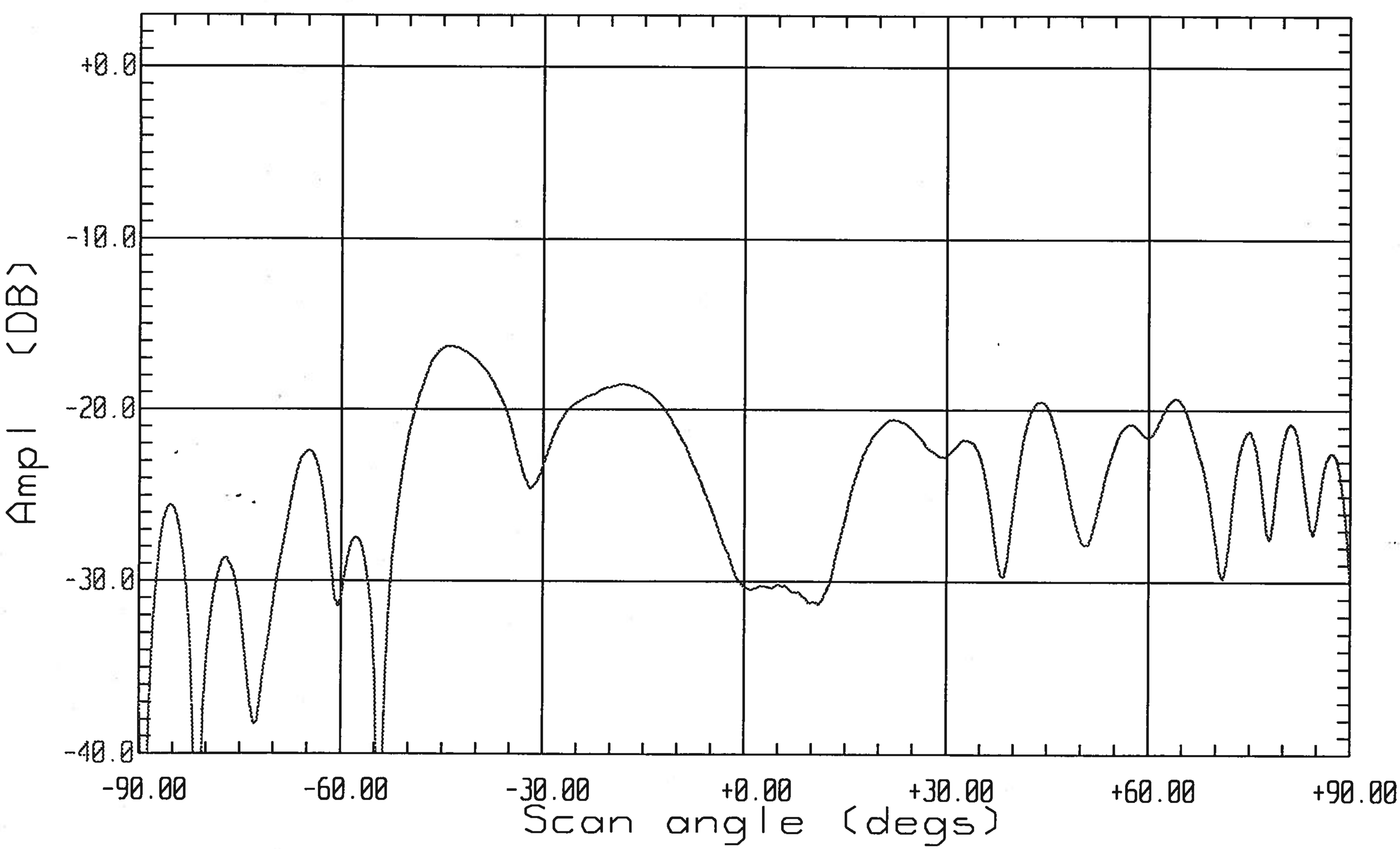
File name: MesaAT No. samples: 361 Freq = 3.000 GHz
ATA1



Max value of -.14 Db at -.50 degs
Min value of -36.92 Db at 88.50 degs

18 Dec 2001 11:50:26
Pol angle 89.9655

File name: MesaAT No. samples: 361 Freq = 3.000 GHz
ATA1

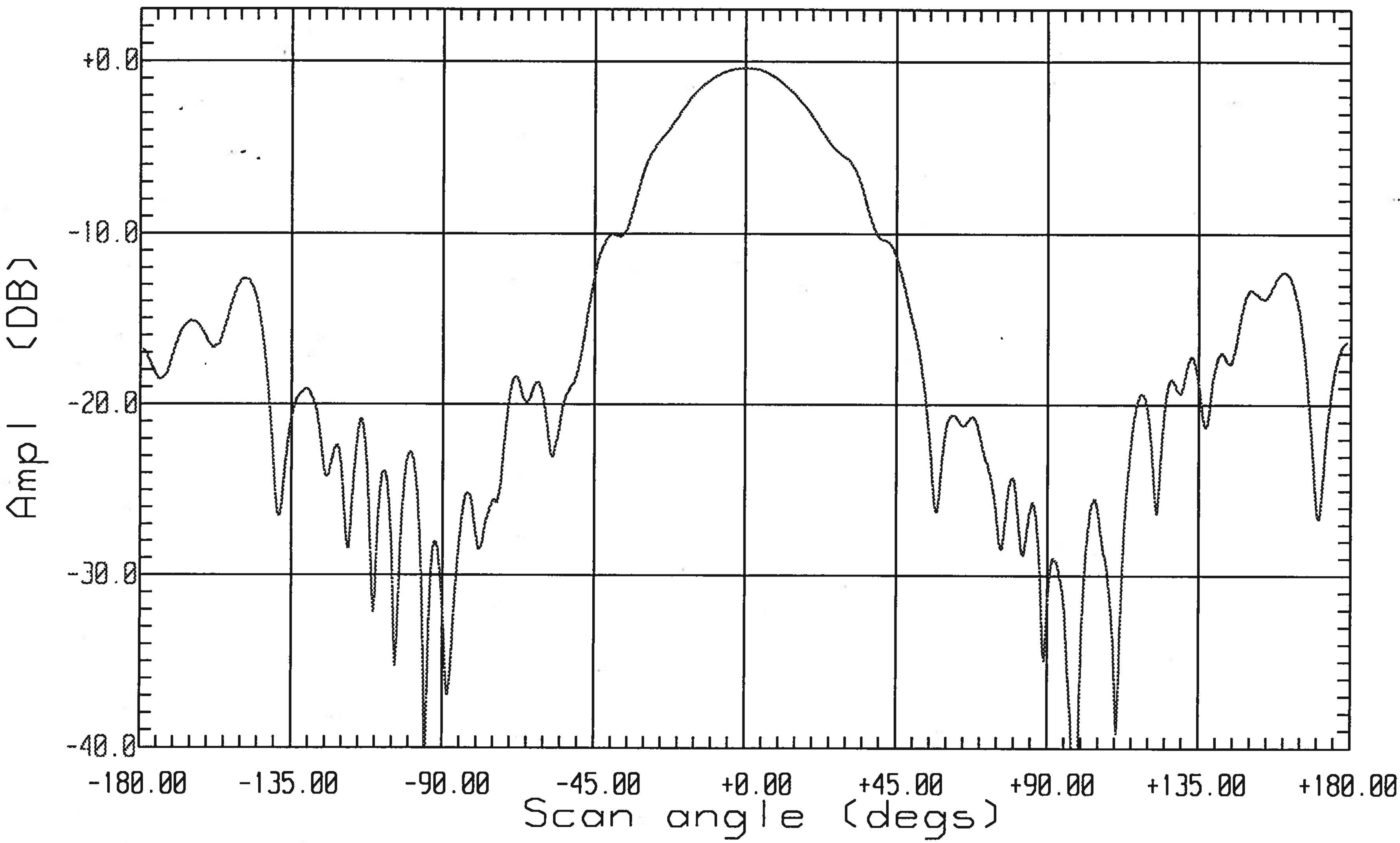


Max value of -16.29 Db at -44.50 degs
Min value of -52.71 Db at -81.50 degs

18 Dec 2001 11:45:22
Pol angle 89.9655

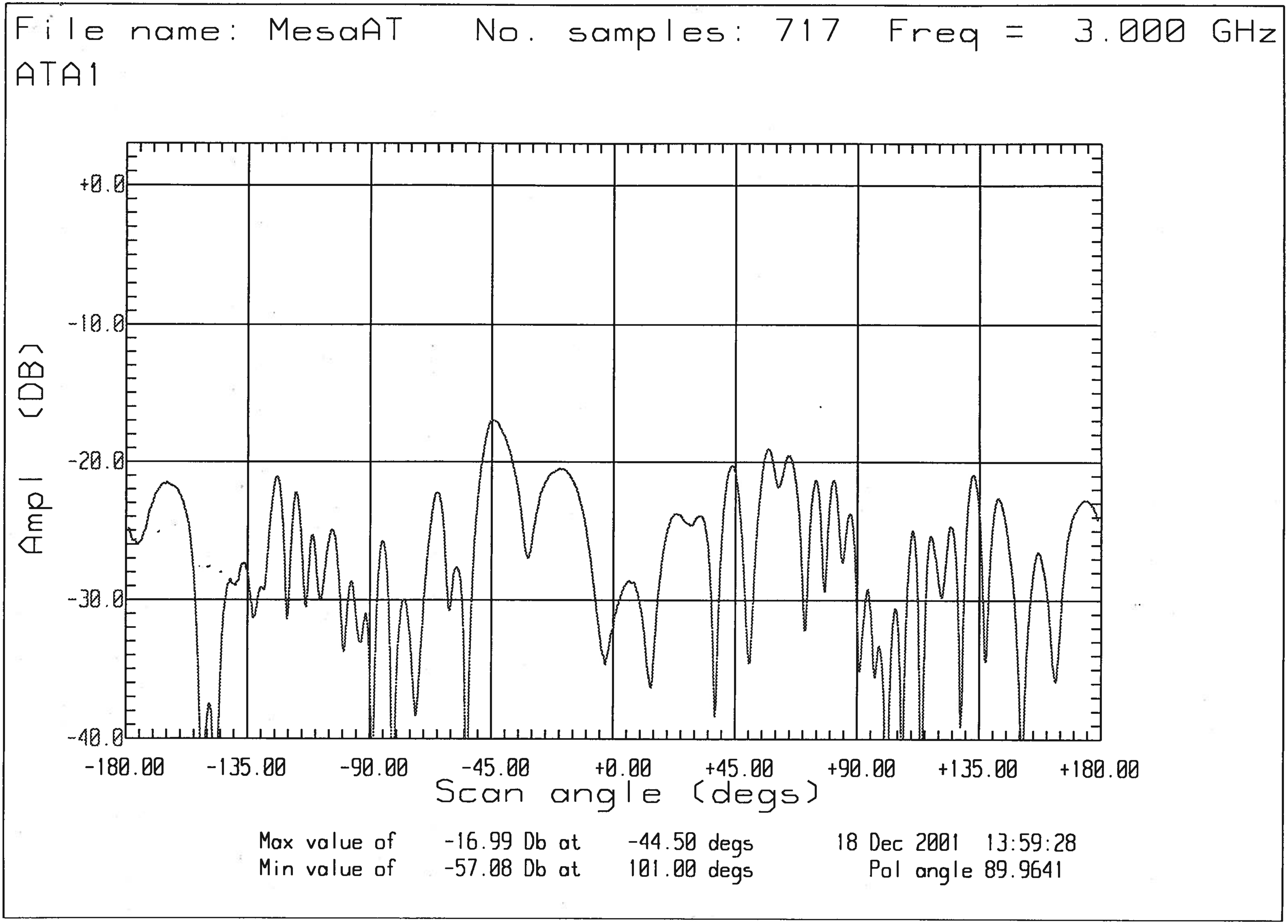
File name: MesaAT   No. samples: 717   Freq = 3.000 GHz

ATA1



Max value of -.38 Db at .50 degs   18 Dec 2001 14:03:24

Min value of -48.97 Db at 98.50 degs   Pol angle 89.9641



File name: MesaAT No. samples: 717 Freq = 3.000 GHz
ATA1
Ampl (DB)
+0.0
-10.0
-20.0
-30.0
-40.0
-180.00
-135.00
-90.00
-45.00
+0.00
+45.00
+90.00
+135.00
+180.00
Scan angle (degs)
Max value of -16.99 Db at -44.50 degs
Min value of -57.08 Db at 101.00 degs
18 Dec 2001 13:59:28
Pol angle 89.9641

JL

intransa.mcd jbl 28jun02

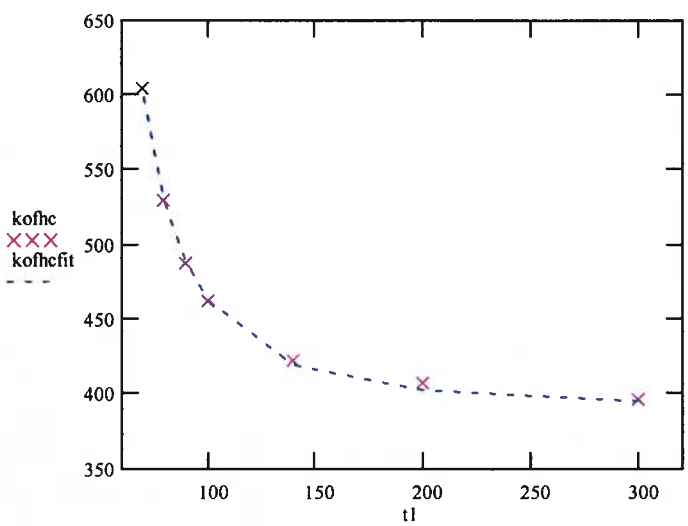
data from CIC database

$$t1 := \begin{bmatrix} 300 \\ 200 \\ 140 \\ 100 \\ 90 \\ 80 \\ 70 \end{bmatrix} \cdot K \qquad kofhcfit := \overrightarrow{\left[\left(\frac{520}{\frac{t1}{1 \cdot K} - 22}\right)^{2.25} + 391\right]} \cdot \frac{W}{m \cdot K}$$

$$kofhcf(t) := \left[\left(\frac{520}{\frac{t}{1 \cdot K} - 22}\right)^{2.25} + 391\right] \cdot \frac{W}{m \cdot K} \qquad t := 200 \cdot K \qquad kofhcf(t) = 402.157 \frac{W}{m \cdot K}$$

$$kofhc := \begin{bmatrix} 396 \\ 407 \\ 422 \\ 462 \\ 487 \\ 529 \\ 604 \end{bmatrix} \cdot \frac{W}{m \cdot K} \qquad kofhcfit = \begin{bmatrix} 395.092 \\ 402.157 \\ 419.137 \\ 462.416 \\ 488.244 \\ 530.09 \\ 603.919 \end{bmatrix} \frac{W}{m \cdot K}$$

kofhcfit is pretty good from 70 to 300 K

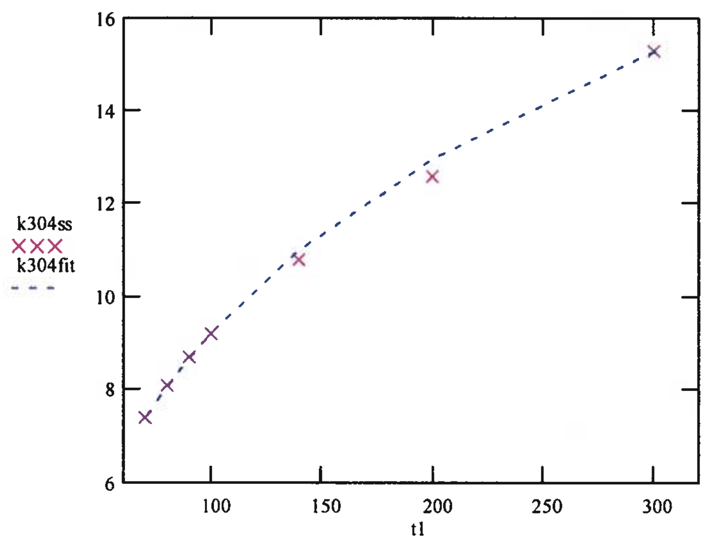


$$k304fit := \overrightarrow{\left[18. \cdot \left(\frac{t1}{1 \cdot K}\right)^{.15} - 0.0018 \cdot \frac{t1}{1 \cdot K} - 26.52\right]} \frac{W}{m \cdot K}$$

$$k304f(t) := \left[18. \cdot \left(\frac{t}{1 \cdot K}\right)^{.15} - 0.0018 \cdot \frac{t}{1 \cdot K} - 26.52\right] \cdot \frac{W}{m \cdot K} \qquad t := 100 \cdot K \qquad k304f(t) = 9.215 \frac{W}{m \cdot K}$$

$$k304ss := \begin{bmatrix} 15.3 \\ 12.6 \\ 10.8 \\ 9.2 \\ 8.7 \\ 8.1 \\ 7.4 \end{bmatrix} \cdot \frac{W}{m \cdot K} \qquad k304fit = \begin{bmatrix} 15.289 \\ 12.97 \\ 11.002 \\ 9.215 \\ 8.67 \\ 8.068 \\ 7.398 \end{bmatrix} \cdot \frac{W}{m \cdot K}$$

k304fit is pretty good from 70 to 300 K



$odss := 0.014 \cdot in$ $\qquad idss := .010 \cdot in$ $\qquad Ass := \frac{\pi}{4} \cdot (odss \cdot odss - idss \cdot idss)$ $\qquad Ass = 4.864 \cdot 10^{-8} \cdot m^2$

$tCu := 0.000150 \cdot in$ $\qquad ACu := \pi \cdot (odss + tCu) \cdot tCu$ $\qquad ACu = 4.302 \cdot 10^{-9} \cdot m^2$

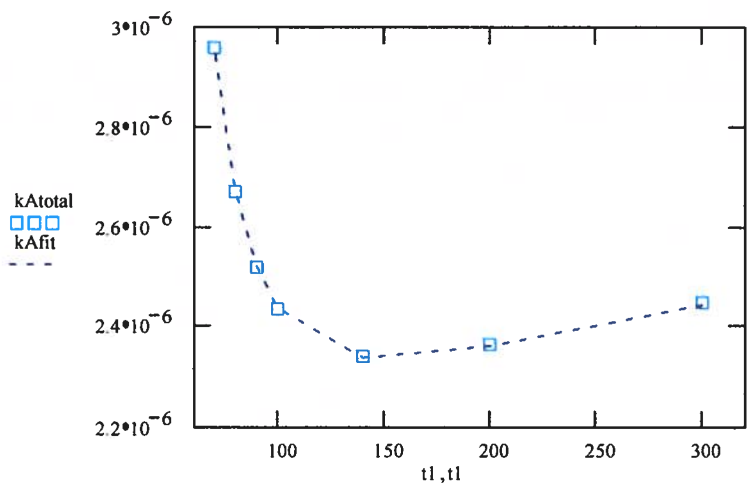
one wire

$kAtotal := kofhc \cdot ACu + k304ss \cdot Ass$

$kAfit := kofhcfit \cdot ACu + k304fit \cdot Ass$ $\qquad kAf(t) := kofhcf(t) \cdot ACu + k304f(t) \cdot Ass$

$$kAtotal = \begin{bmatrix} 2.448 \cdot 10^{-6} \\ 2.364 \cdot 10^{-6} \\ 2.341 \cdot 10^{-6} \\ 2.435 \cdot 10^{-6} \\ 2.518 \cdot 10^{-6} \\ 2.67 \cdot 10^{-6} \\ 2.958 \cdot 10^{-6} \end{bmatrix} \cdot W \cdot \frac{m}{K} \qquad kAfit = \begin{bmatrix} 2.443 \cdot 10^{-6} \\ 2.361 \cdot 10^{-6} \\ 2.338 \cdot 10^{-6} \\ 2.438 \cdot 10^{-6} \\ 2.522 \cdot 10^{-6} \\ 2.673 \cdot 10^{-6} \\ 2.958 \cdot 10^{-6} \end{bmatrix} \cdot \frac{W \cdot m}{K}$$

.00015 in = .00038 cm = 3.8 μm



$\mathrm{Thot} := 310 \cdot \mathrm{K}$ $\quad$ $\mathrm{Tmid} := 80 \cdot \mathrm{K}$ $\quad$ $\mathrm{Tcold} := 77 \cdot \mathrm{K}$

$\mathrm{lhot} := 2.6 \cdot \mathrm{in}$ $\quad$ $\mathrm{lhot} = 6.604 \cdot \mathrm{cm}$ $\quad$ $\mathrm{lcold} := 4.5 \cdot \mathrm{in}$ $\quad$ $\mathrm{lcold} = 11.43 \cdot \mathrm{cm}$

$$\mathrm{Qdot} := \int_{\mathrm{Tmid}}^{\mathrm{Thot}} \frac{\mathrm{kAf}(t)}{\mathrm{lhot}}\, dt$$?

$\mathrm{Qdot} = 8.34 \cdot 10^{-3} \cdot \mathrm{W}$

$\dot{q} = A k \frac{dT}{dx}$

Now estimate the required copper cross section on the balun ignoring substrate conductivity.

~~a little rough~~ (no)

$$I := \int_{\mathrm{Tcold}}^{\mathrm{Tmid}} \mathrm{kofhcf}(t)\, dt$$ $\quad$ $I = 1.616 \cdot 10^{3} \cdot \frac{\mathrm{W}}{\mathrm{m}}$

$$\mathrm{Acold} := \frac{\mathrm{Qdot} \cdot \mathrm{lcold}}{I}$$ $\quad$ $\mathrm{Acold} = 9.143 \cdot 10^{-4} \cdot \mathrm{in}^2$

$$\mathrm{dcold} := \sqrt{\frac{\mathrm{Acold} \cdot 4}{\pi}}$$ $\quad$ $\mathrm{dcold} = 0.0341 \cdot \mathrm{in}$ $\quad$ one wire? $\quad$ 4 wires?

For 209 Ω, D/d = 2.86; 2.86x .0341 = .0975, a big jump.

Look at balun substrate contribution. Conductivities from NBS Monograph 131, p508ff.

$$\mathrm{temp} := \begin{bmatrix} 60 \\ 70 \\ 80 \\ 90 \\ 100 \end{bmatrix} \cdot \mathrm{K} \qquad \mathrm{kalumina} := \begin{bmatrix} 155 \\ 162 \\ 155 \\ 135 \\ 122 \end{bmatrix} \cdot \frac{\mathrm{W}}{\mathrm{m} \cdot \mathrm{K}} \qquad \mathrm{ksapphire} := \begin{bmatrix} 2000 \\ 1300 \\ 850 \\ 580 \\ 380 \end{bmatrix} \cdot \frac{\mathrm{W}}{\mathrm{m} \cdot \mathrm{K}}$$

$$kqtzpar := \begin{bmatrix} 78 \\ 62 \\ 53 \\ 46 \\ 42 \end{bmatrix} \cdot \frac{W}{m \cdot K} \qquad kqtzperp := \begin{bmatrix} 40 \\ 32 \\ 27 \\ 25 \\ 24 \end{bmatrix} \cdot \frac{W}{m \cdot K} \qquad kqtzfused := \begin{bmatrix} 0.46 \\ 0.52 \\ 0.57 \\ 0.65 \\ 0.71 \end{bmatrix} \cdot \frac{W}{m \cdot K}$$

80 K
90
100

for a trapezoidal substrate shape:

$thk := 0.020 \cdot in$ $\qquad$ $wcold := 0.800 \cdot in$ $\qquad$ $wmid := 0.060 \cdot in$

$$area(z) := thk \cdot \left[wcold - (wcold - wmid) \cdot \frac{z}{lcold} \right]$$

$$areaint := \int_{0}^{lcold} \frac{1}{area(z)} dz \qquad areaint = 3.101 \cdot 10^{4} \cdot m^{-1}$$

for alumina take k = 150 w/m/K for whole temperature range

$$ksub := 150 \cdot \frac{W}{m \cdot K}$$

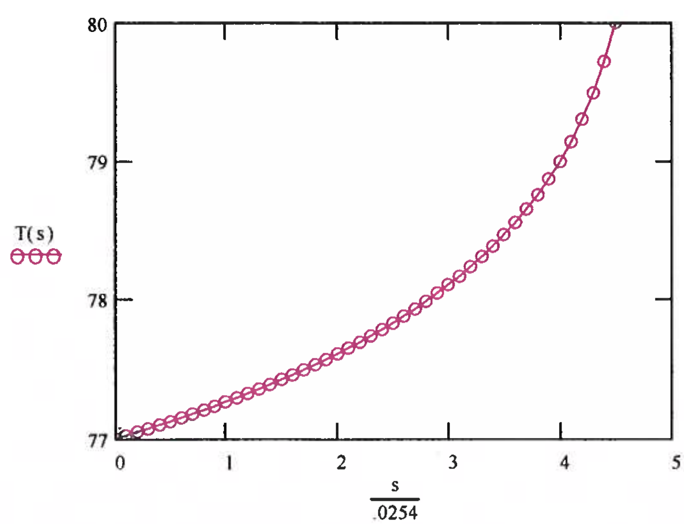
$$Qdotsub \tilde{:=} \frac{ksub \cdot (Tmid - Tcold)}{areaint} \qquad Qdotsub = 0.015 \cdot W$$

?

calculate the temperature profile

$s := 0 \cdot in, .1 \cdot in .. lcold$

$$T(s) \tilde{:=} \left[\int_{0}^{s} \frac{Qdotsub}{ksub \cdot area(z)} dz \right] + Tcold$$



Now look at electrical properties.
First check consistency between thermal and electrical conductivity.

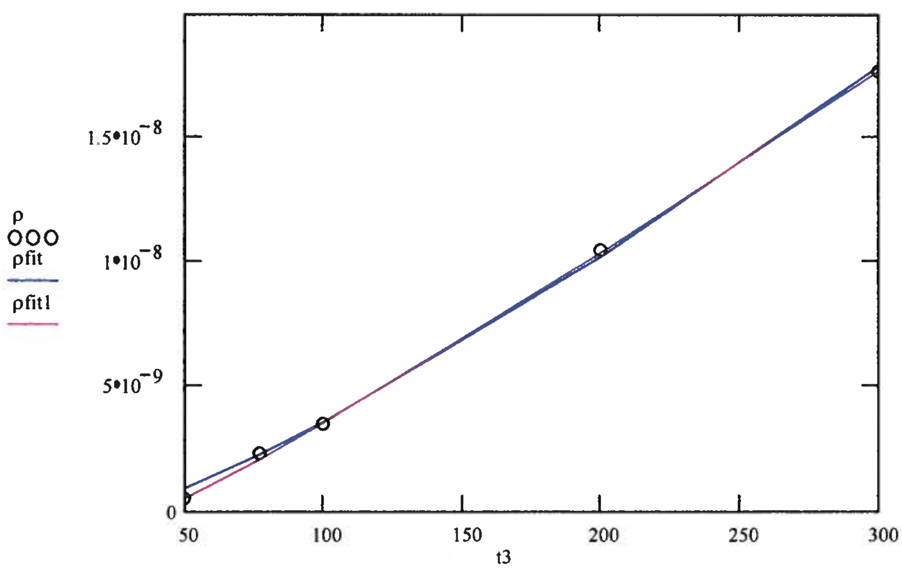
$$t3 := \begin{bmatrix} 300 \\ 200 \\ 100 \\ 77 \\ 50 \end{bmatrix}$$

$$\rho fit := \overrightarrow{\left[7.2 \cdot 10^{-9} \cdot \left[\frac{(t3 - 25)}{132} \right]^{1.24} \right]}$$

$$\rho fit1 := \overrightarrow{\left[8.4 \cdot 10^{-9} \cdot \left[\frac{(t3 - 40)}{132} \right]^{1.1} \right]}$$

$$\rho fit1a := \overrightarrow{\left[8.4 \cdot 10^{-9} \cdot \left[\frac{\left(\frac{t1}{1 \cdot K} - 40 \right)}{132} \right]^{1.1} \right]} \cdot ohm \cdot m$$

$$\rho := \begin{bmatrix} 1.771 \cdot 10^{-8} \\ 1.05 \cdot 10^{-8} \\ 3.5 \cdot 10^{-9} \\ 2.33 \cdot 10^{-9} \\ 5.1 \cdot 10^{-10} \end{bmatrix} \qquad \rho fit = \begin{bmatrix} 1.789 \cdot 10^{-8} \\ 1.021 \cdot 10^{-8} \\ 3.572 \cdot 10^{-9} \\ 2.268 \cdot 10^{-9} \\ 9.147 \cdot 10^{-10} \end{bmatrix} \qquad \rho fit1 = \begin{bmatrix} 1.771 \cdot 10^{-8} \\ 1.038 \cdot 10^{-8} \\ 3.529 \cdot 10^{-9} \\ 2.073 \cdot 10^{-9} \\ 4.916 \cdot 10^{-10} \end{bmatrix}$$



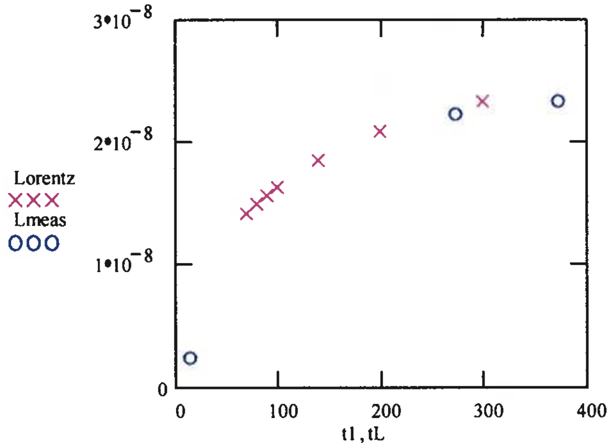
now check using Weideman-Franz law:

Kittel Solid State Physics gives L = 2.33e-8 at 373K, 2.23e-8 at 273K, and ~0.24e-8 at 15K.

$$Lorentz := \overrightarrow{\frac{kofhcfit \cdot \rho fit1a}{t1}}$$

$$Lmeas := \begin{bmatrix} 2.33 \cdot 10^{-8} \\ 2.23 \cdot 10^{-8} \\ 0.24 \cdot 10^{-8} \end{bmatrix} \qquad tL := \begin{bmatrix} 373 \\ 273 \\ 15 \end{bmatrix}$$

$$Lorentz = \begin{bmatrix} 2.332 \cdot 10^{-8} \\ 2.087 \cdot 10^{-8} \\ 1.853 \cdot 10^{-8} \\ 1.632 \cdot 10^{-8} \\ 1.566 \cdot 10^{-8} \\ 1.497 \cdot 10^{-8} \\ 1.42 \cdot 10^{-8} \end{bmatrix} \cdot \frac{W \cdot ohm}{K \cdot K}$$



Now calculate electrical loss in the copper plated stainless steel section at 10 GHz.

$Z0 := 204$

$sod := \cosh\left(\frac{Z0}{120}\right) \qquad sod = 2.828 \qquad s := sod \cdot (odss + 2 \cdot tCu) \qquad s = 0.0404 \cdot in$

$f := 10^{10}$ $\qquad lhot = 0.066 \cdot m$

$$Rs := \overrightarrow{\sqrt{\pi \cdot \pi \cdot 4 \cdot 10^{-7} \cdot f \cdot \rho}} \qquad Rs = \begin{bmatrix} 0.026 \\ 0.02 \\ 0.012 \\ 9.591 \cdot 10^{-3} \\ 4.487 \cdot 10^{-3} \end{bmatrix} \qquad odss + 2 \cdot tCu = 3.632 \cdot 10^{-4} \cdot m$$

$d := odss + 2 \cdot tCu \qquad d = 3.632 \cdot 10^{-4} \cdot m$

Now recall from page 3 that the thermal conductivity of this section of transmission line is nearly constant from 310 K down to 90K. Therefore assume a linear temperature profile. Use ρfit1.

$$T(z) := \frac{Thot}{1 \cdot K} - \left(\frac{Thot - Tmid}{1 \cdot K}\right) \cdot \frac{z}{lhot}$$

$$TB := \int_0^{lhot} \frac{2 \cdot sod}{\pi \cdot d \cdot Z0 \cdot \sqrt{sod^2 - 1}} \cdot \sqrt{\pi \cdot 4 \cdot \pi \cdot 10^{-7} \cdot f \cdot 8.4 \cdot 10^{-9} \cdot \left[\frac{(T(z) - 40)}{132}\right]^{1.1}} \cdot T(z) \cdot K \, dz$$

$TB = 2.49 \cdot K$

input transmission line calculations

summary

0.010 dia kovar pins with 0.000150 in thick Cu plate, 5 cm long

ave thermal cond. for 347 ss for 100-320K = 125 mW/cm/K
ave thermal cond. for constantan 100-320K = 230 mW/cm/K
ave thermal cond. for monel for 100-320K = 200 mW/cm/K
(all from my cryo notes; monel and constantan may be switched)

composition:	Fe	Ni	Cu	Co	Cr	K@20C (W/m.K)	rho (ohm.cm)
monel	.01	.655	.30				
inconel 718	.185	.525			.19	11.4	
constantan							
incoloy909	.42	.38	0	.13	0	14.8	
Kovar (Carpenter Technologies)	.53	.29		.17		17.3	4.9e-5
NILO alloy K (Inco Alloys International)	.53	.29		.17		16.7	4.3e-5
301 ss annealed	.75	.07			.17	~15.3	
302 ss annealed	.72	.09			.18	~15.3	
304 ss annealed	.71	.092			.19	~15.3	
347 ss annealed	.70	.11			.18	~15.3	

Cu plated Kovar for 5 cm:
take pin .010 inches OD, gives A = 5.07e-4 cm^2
take l = 5 cm
take deltaT = 320-100 = 220 K
take Kave = 150 mW/cm.K (167 - 10%)
Qdot = 3.35 mW
for copper plating thickness of 0.00015 inches, get A = 3.04e-5 cm^2;
the plating thickness is almost 2 skin depths at 1 GHz and 295 K,
increasing to 5 skin depths at 1 GHz and 77 K. see skindepth.xls
take l = 5 cm
take deltaT = 320-100 = 220 K
take Kave = 4400 mW/cm.K
Qdot = 5.89 mW
for 4 lines, get Qdot =37.0 mW
solid Cu for 23 cm:
take OD = 0.020, A = 2.03e-3 cm^2
l = 23 cm
Kave (90 K) = 5000 mW/cm.K
Qdot = 9.25 mW per wire
get deltaT = 21 K

input transmission line resonant frequency
from Mark's handbook: for simply supported ends f = (pi/2)*x/l/l
where x = sqrt(E*I*g/A/rho), l = length, g/rho = in^3/slug
for l = 2 in, get f = 215 Hz

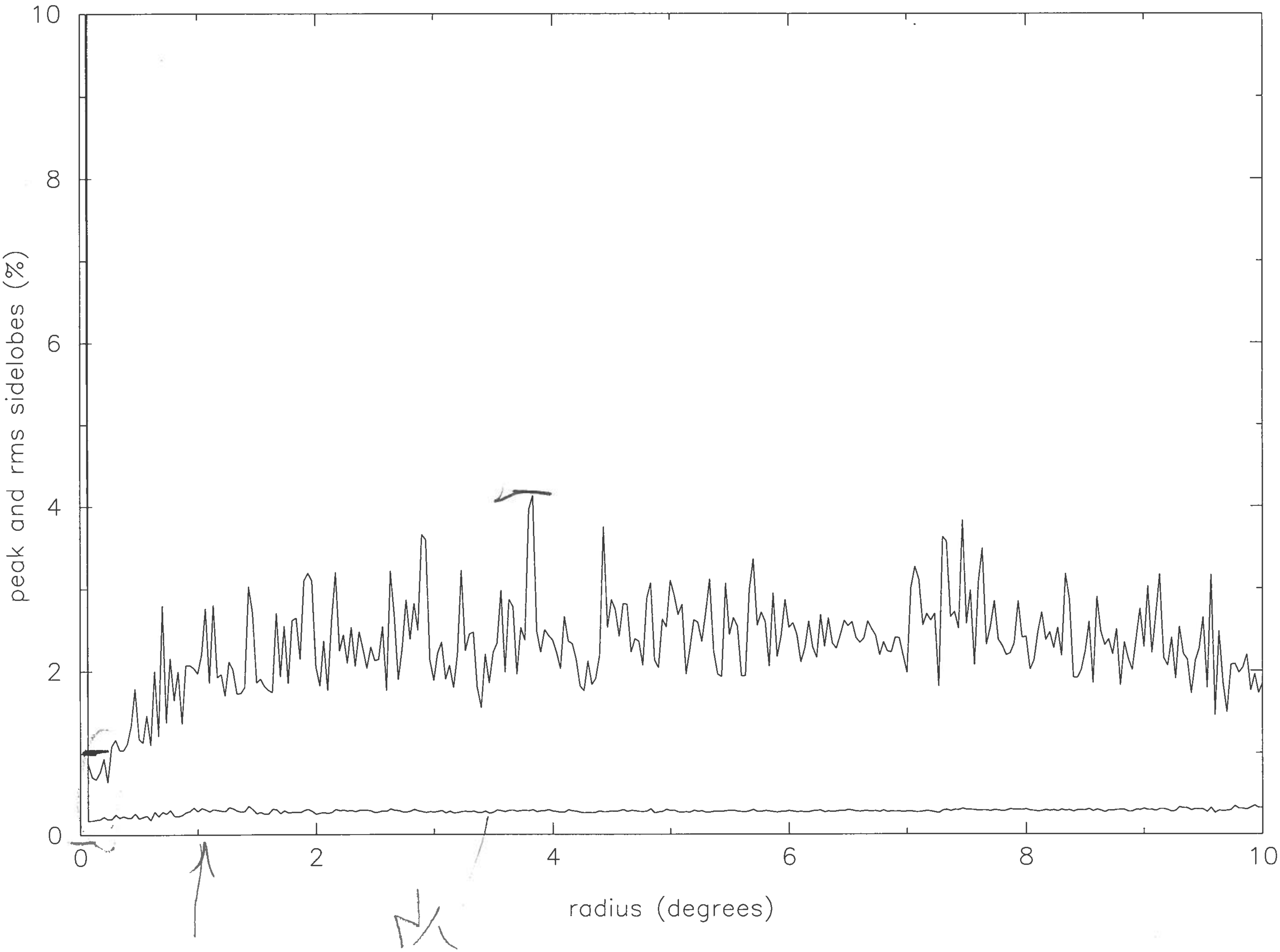
thermal expansion issues
deltaL/L = 2.9e-3 for 300K to 80K
deltaL/L = 3.0e-3 for 300K to 60K for 304 SS
so, roughly, for a linear temp gradient from 300 to 60, and L = 6 in
expect deltaL = 1.5e-3*6 = 0.009 in. this could be accomodated in
a diaphram dewar end as long as the diaphram is large enough.

heat sinking the Cu transmission lines to 70 K:

material	K@70K (mW/cm.K)	K@300K	epsilon (@ 1 MHz)
fused quartz, SiO	3.8	14.	3.75
alumina, Coors AD-998		300.	9.8

for fused quartz standoffs,

JBC (Amdel)



ATA Front-End Critical Design Review

Agenda

Wednesday, July 9, 2003

Campbell Hall 544

9:30	Assemble/Coffee	
10:00	Introductions	Tom Pierson/Leo Blitz
10:15	Overview	Dave DeBoer
10:45	PAX	Dave DeBoer
11:15	F/O Link/Cooler	Ed Ackerman
12:15	Lunch	Room 501
1:00	Executive committee	
1:00 1:30	Feed	Jack Welch
2:15	Coffee	
2:30	LNA	Sandy Weinreb/Niklas Wadefalk
3:00	Dewar Integration and Cryocooler	John Lugten
4:00	Feed Mechanicals	Matt Fleming
4:30	Lab Tour	
5:00	Executive Session	
7:00	Dinner for reviewers and presenters	

140K run gets 3000 WBA13 or 1400 WBAL2
Four wafers start out, expect 1/2 to work

any elevation effect?
cryo cost estimate ~ 3K

$\frac{5.02''}{5R}$ 1.5"?

ATA TAP Agenda
Dec 17-18 2002

Space Sciences Laboratory UCB

Tuesday, December 17 SSL Annex Conference Room

8:30 Welcome: Leo Blitz and Tom Pierson

8:45 Overview of ATA Status (Dave Deboer)

10:15 Coffee

10:30 The ATA Antenna (Matt Fleming)

11:15 The Pulse Tube Cooler/Compressor (John Lugten)

11:45 Executive Session

12:00 Lunch (catered in)

1:00 First Operation and Tests (Dave Deboer)

Pointing and tracking Tests (Geoff Bower)

2:00 Feed/Receiver Developments (Jack Welch)

2:30 ATA Control Software Archetecture (Gerry Harp/Rob Ackerman)

3:00 Coffee

3:15 Array Configuration (Douglas Bock)

3:45 Correlator Update (Leo Blitz)

4:00 Executive Session

7:00 Dinner at John Dreher's

Wednesday, December 18 Room 105 SSL (new building)

8:30 Hat Creek Permitting and site overview (Douglas Bock)

9:00 Report of the Antenna CDR (John Dreher)

9:30 ATA Schedule Recovery Plan (Mike Davis)

10:00 Coffee

10:15 Construction Plan and Budget (John Dreher)

11:30 Executive Committee

12:00 Lunch (catered in)

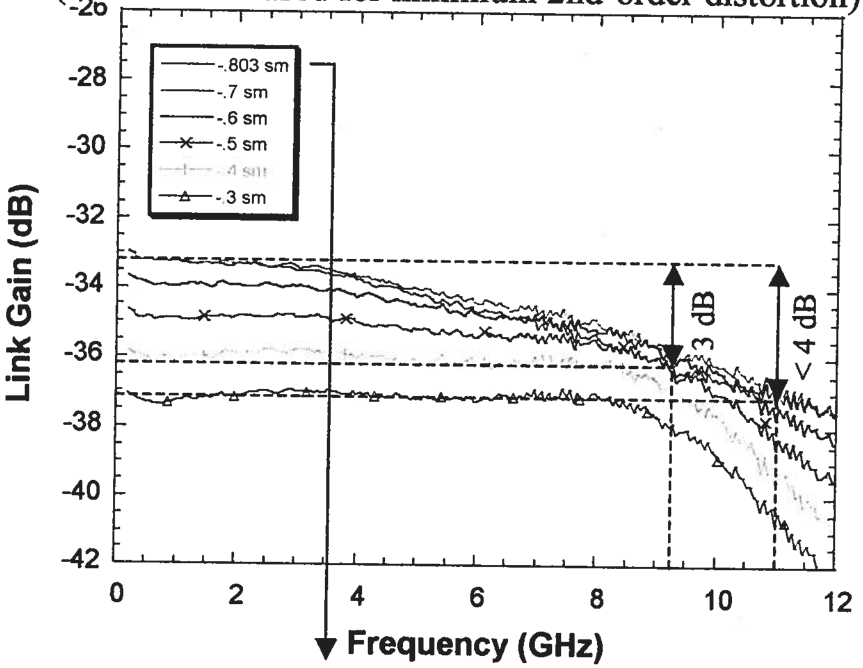
1:00 Executive Committee, Discussion and Report Drafting

Ψ Approach #3: Integrated Laser/EA Modulator

Measured Performance w/1 km SM fiber and Discovery Photodetector

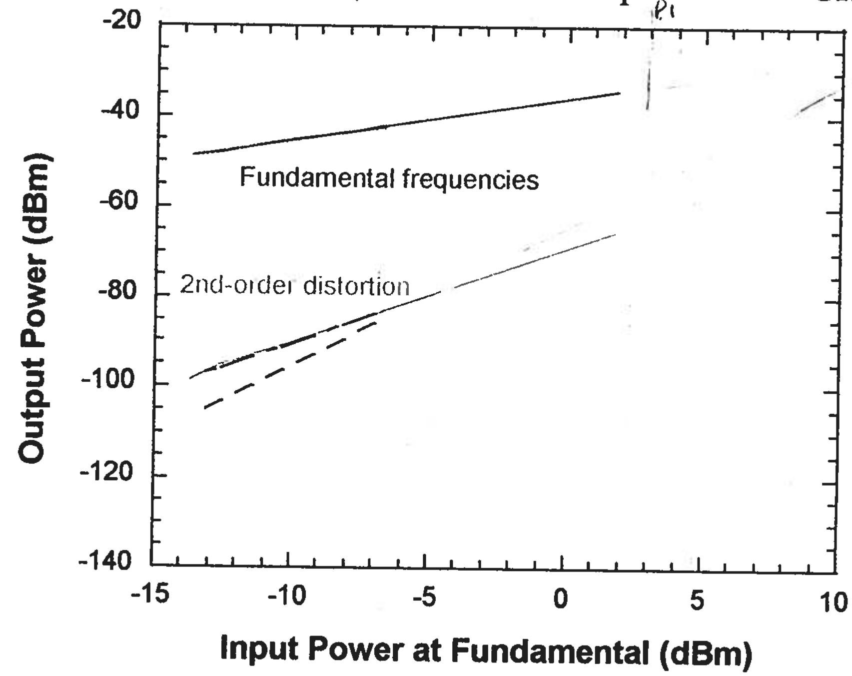
Measured Link Frequency Response vs. Modulator Bias Voltage

(Modulator biased for minimum 2nd-order distortion)



Measured Distortion Products

(Modulator biased for minimum 2nd-order distortion, detector bias = 6 V, fundamental frequencies ~ 5 GHz)



At bias for minimum 2nd-order distortion:

$G_{11\ GHz} \sim -37$ dB

$BW_{3dB} \sim 9.5$ GHz

$\Delta G_{0.5\text{-}11\ GHz} < 4$ dB

NF $\leq$ 42 dB

$SFDR_3 \geq 95$ dB·Hz$^{2/3}$; $SFDR_2 \geq 79$ dB·Hz$^{1/2}$

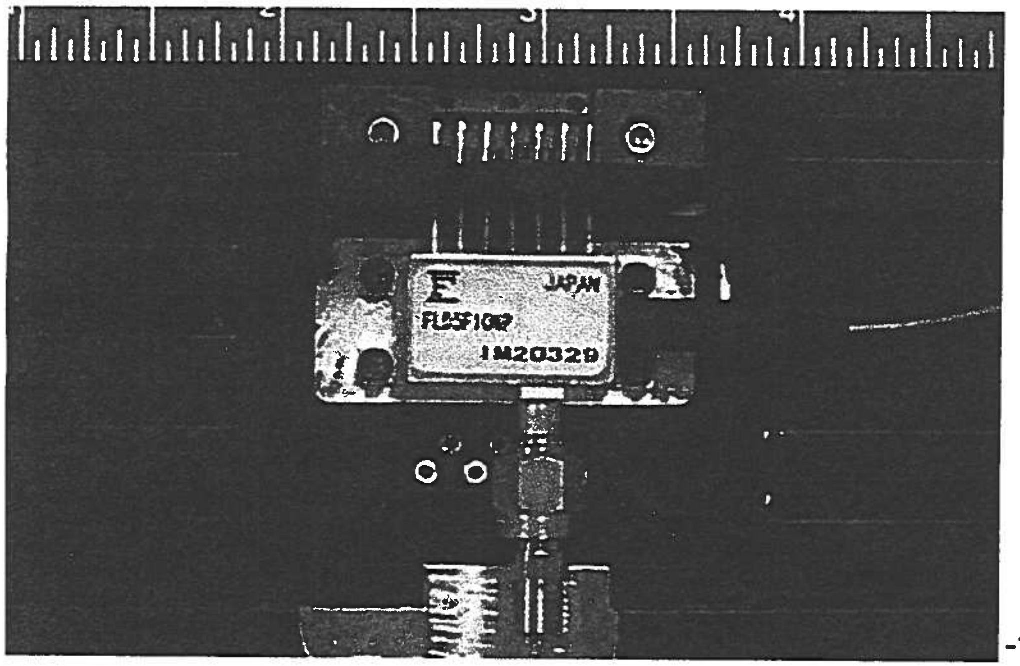
CDR $\geq$ 137 dB·Hz

Photonic Systems, Inc.

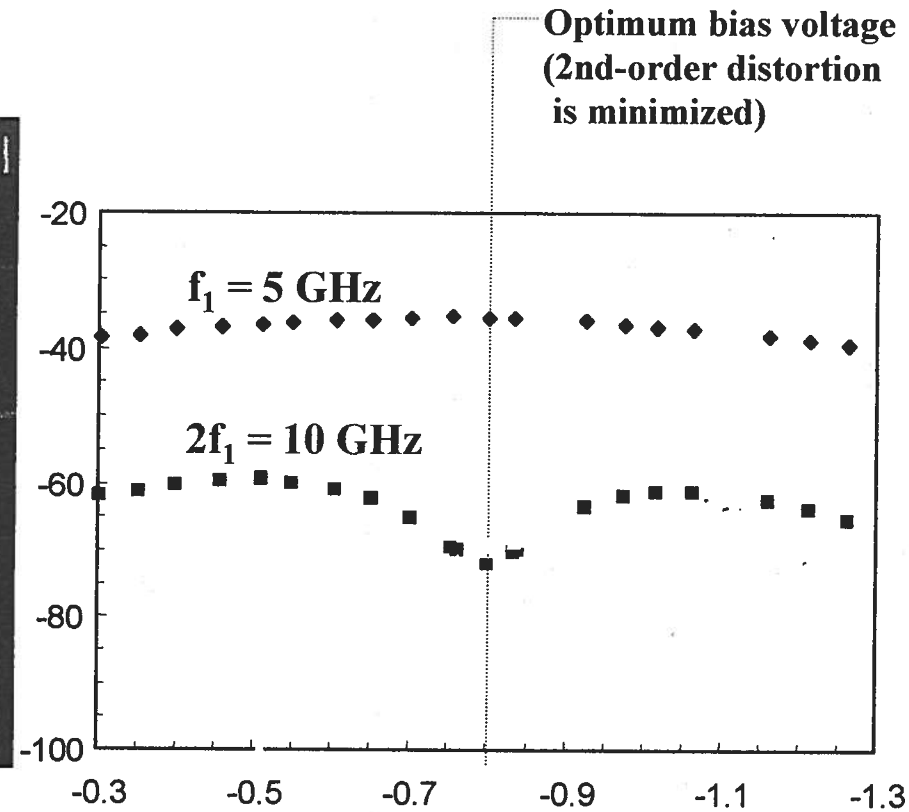
www.photonicsinc.com

Ψ Approach #3: Integrated Laser/EA Modulator

Measured Signal and Distortion Characteristics vs. DC Bias Voltage



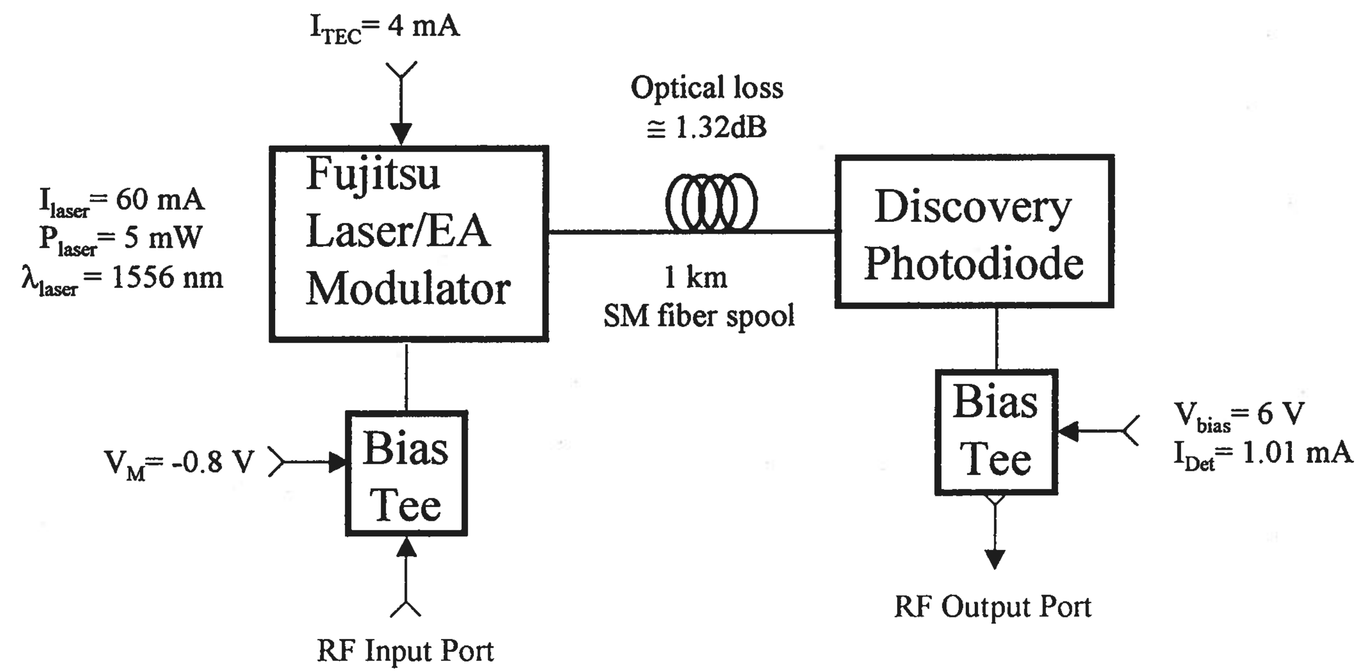
Integrated Laser/EA Modulator
(Fujitsu FLD5F10NP)



(Input signal: 0 dBm at $f_1 = 5$ GHz)

Approach #3: Integrated Laser/EA Modulator

Test Configuration (Room Temperature)



Single-mode fiber connection was achieved using FC/PC connectors.

PTA Single Dish Tests

0. Pedestal tests
    - Survival pull test ✔
    - GPS XYZ coordinates of upper flange and comparison to survey stake on ground (nice but not essential)
1. General Mechanical Inspection
    - Wiring, Power, and limits
    - Verify code compliance of antennas
    - Brakes
    - Weather proofing and radome (may be kludge at first)
    - Grounding checks
        - antenna to ground
        - intra-antenna grounds
    - Motion (under local control?)
        - Basic motion, slew rates, both hot (day) & cool (night)
        - Antenna hard-stop motion tests
    - cable wrap range and operation
    - safety items: E-stop, stow, power failure, wind stow, limits
    - azimuth back-drive
    - Measure alignment of optics with photogrammetry
    - Voice communications from antenna to control room
2. Dynamical/Mechanical Tests
    - Tiltmeter checks for AZ rotational stability
    - Resonant frequency measurements
    - Acceleration measurements, slew rate check
    - Motor current, power consumption, power factor
    - Determine basic antenna mount coordinates (zero points and tilt)
3. Tracking Tests (under computer control)
    - Optical (with BIMA camera)
        - check and optimize servo loop for smooth tracking
        - optical pointing model (optional)
        - determine non-reproducible errors (if we can)
    - Radio (with RT front end) at several TBD frequencies
        - focus curves
        - measure beam pattern using geostationary
        - determine radio pointing model with strong sources
        - verify smooth tracking with edge of sun or other strong source
        - Aeff/Tsys measurements
        - Cal source calibration (if available)
        - Tsys measurements with ambient absorber and cold sky
4. Other Tests
    - Measure antenna RFI/EMI characteristics
    - Mesure sound levels
    - Try both large and small stepper motors
    - Oil leak test

Here are some are the PTA "single-dish" tasks from the PTA Test Plan with some notes on suitable RF systems.

focus curves

Maybe OK with Spectrum Analyzer (SA), but if SNR requires use of a satellite, using a second antenna with fixed focus as a reference might be much better. That would require the RPA backend. Also requires a focus drive (possibly manual)

measure beam pattern using geostationary

For near in beam pattern, we can use a spectrum analyzer. But it would be very nice to be able to measure the voltage pattern over the whole sky like you did for the RPA dishes. I'd like to do that before and after the shroud is installed. Since the voltage method provides the phase information, it should be possible to do holography as well, which would provide a useful check on the photogrammetry and also demonstrate that we are providing the correct illumination of the primary.

determine radio pointing model with strong sources

The System Equivalent Flux Density for a single PTA dish with the room-temperature front end will be about 14,000 Jy. Since the strongest sources are of order 100-1000 Jy at L-band, we'll want BW*tau >> 1E4, which we can achieve much faster with the 10 MHz BW of the RPA system than with the SA -- in fact I have doubts that the SA can do this at all.

verify smooth tracking with edge of sun or other strong source

SA can do this

Aeff/Tsys measurements

The higher BW*tau of the RPA backend will be a big help with this.

Cal source calibration

Ditto

Tsys measurements with ambient absorber and cold sky

SA can do this.

Measure antenna RFI/EMI characteristics

SA can do this over full range, but RPA can go deeper, faster over it's RF range.