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31 July 1985

To: VLBA

From: Alan E.E. Rogers

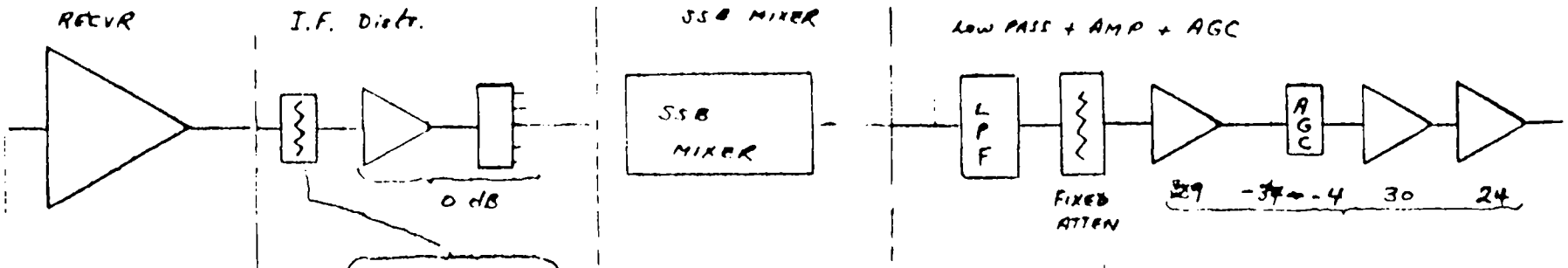
Subject: I.F. processing electronics - preliminary design

A preliminary design of the I.F. distributor and baseband converter is now ready for initial prototyping. Figure 1 shows the signal levels in the VLBA receiving system along with estimates of the internal noise and saturation levels. I have selected ultra-fast operational amplifiers as a means of providing the greatest stability of video gain (79 dB). The following are my estimates of expected performance.

Differential phase	<0.1 deg/deg C
Gain stability	<0.01 dB/deg C
L.O. phase	< 1 deg/deg C
Baseband delay	<100 ps/deg C at 8 MHz BW
Synthesized delay (500 MHz)	< 5 ps/deg C

I am starting to order enough parts to build and evaluate each sub-module. At this point, I show the low pass filters as being of a conventional LC passive design - but I am studying the possibility of using an active filter approach based upon the Signetics NE5539 ultra high frequency operational amplifiers. The attached circuit diagrams are preliminary sketches intended to give the flavor of the design as I now see it. Formal drawings will be made using AUTO CAD 2.

1 Atch. (9 pages)



GAIN (dB) = 57 (nominal incl. adj.) 0, −15, −30, −00 | 0 | 0 (62 KHz) | 49 → 79

−21 (8 MHz)

Normal Pwr levels (30°K input) or 30,000K | 30 dB atten setting "

AGC = −4 dB

−97 dBm/500 MHz | −40 dBm/500 MHz | −50 dBm/50 MHz | −79 dBm/BW | ϕ dBm/BW

30,000°K into 62.5 KHz channel

AGC = −34 dB

−97 dBm/500 MHz | −40 dBm/500 MHz | −47 dBm | −49 dBm | 0 dBm

1 dB gain compression levels | +12 dBm | +10 dBm | +13 dBm

Internal noise levels | −87 dBm (300°K) | −77 dBm/50 MHz (30,000°K)

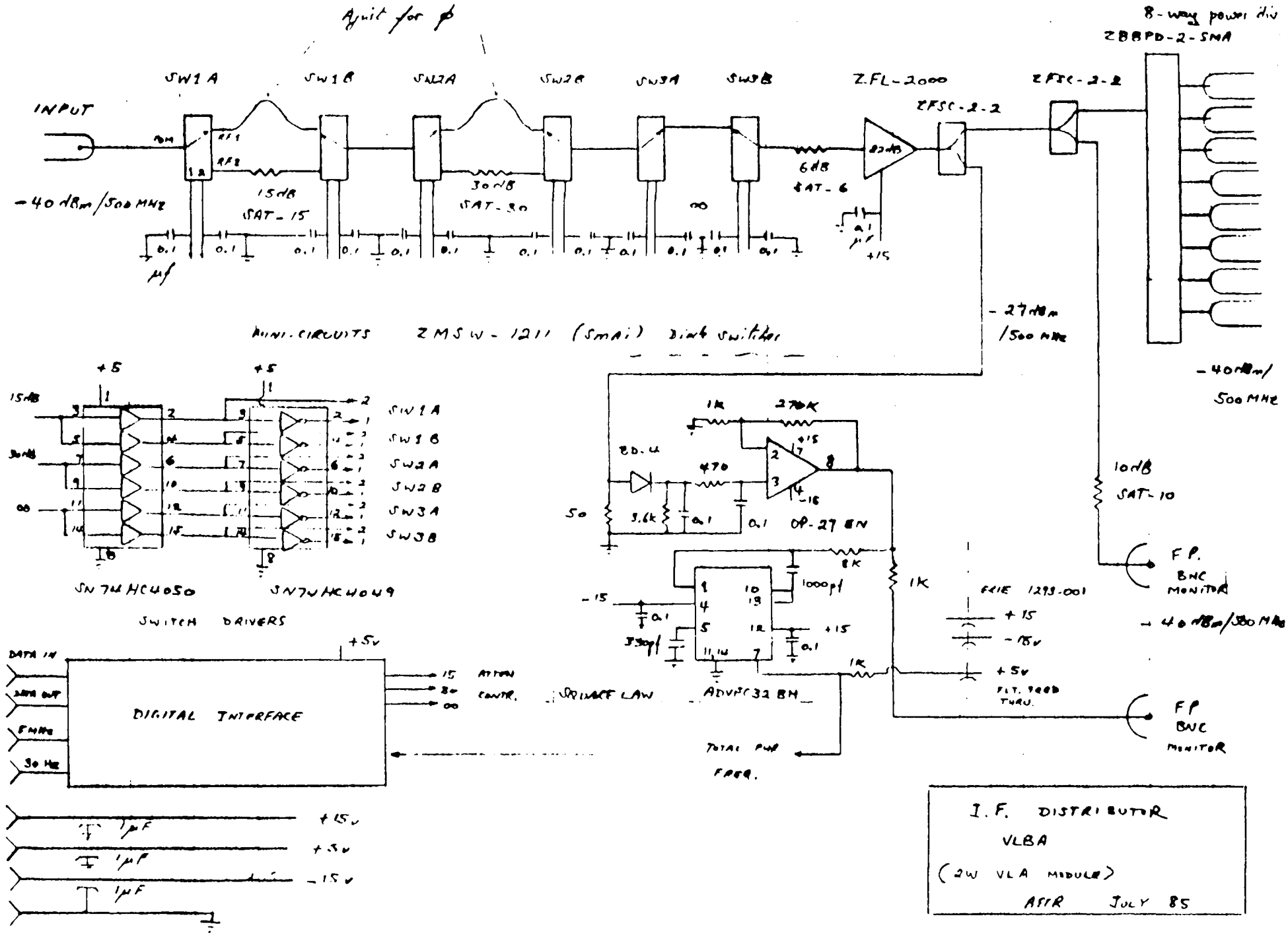
Derived from above:

Baseband SNR better than 27 dB

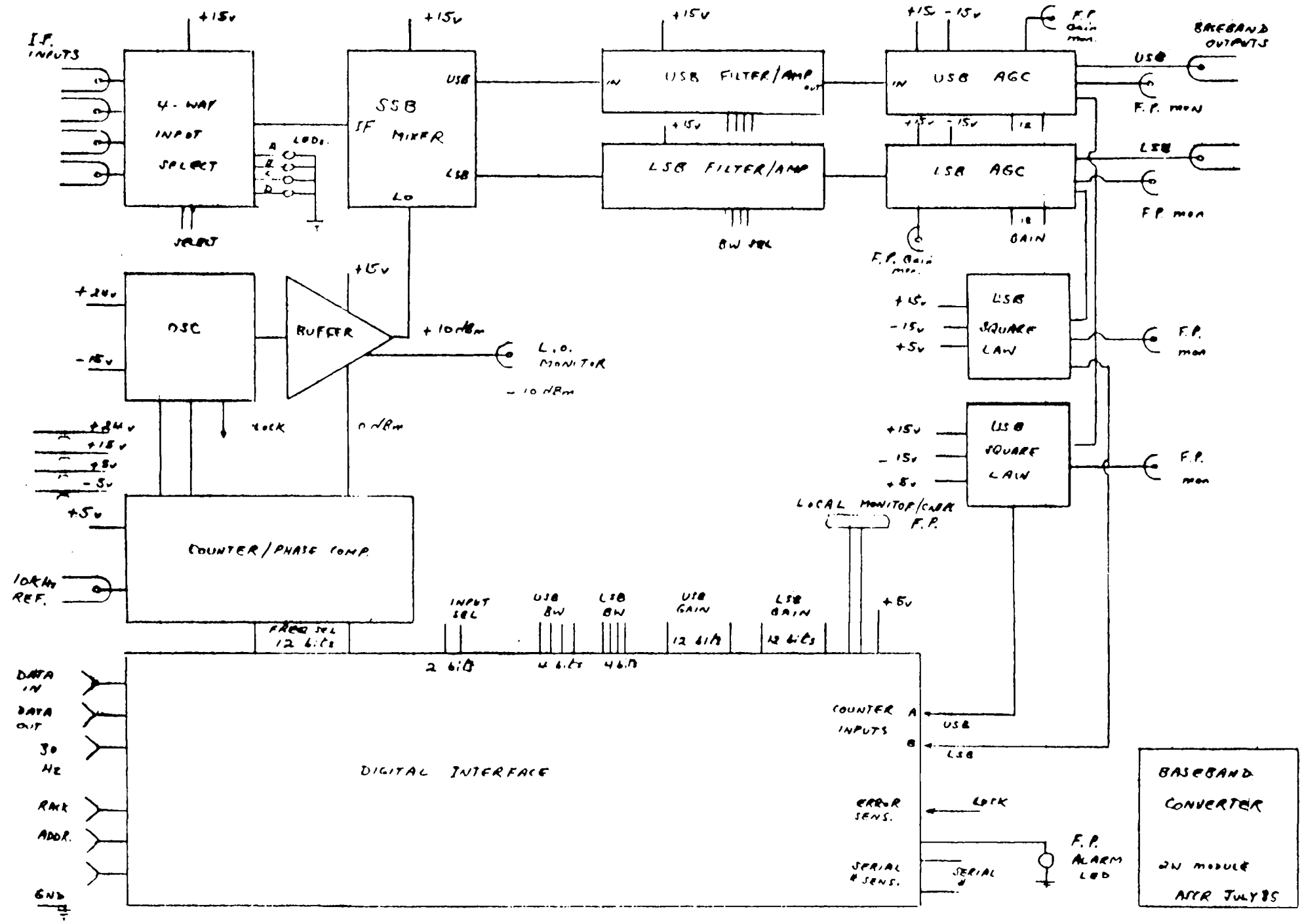
Worst case sensitivity to interference within I.F. but outside baseband channel −47 dBm at front-end input

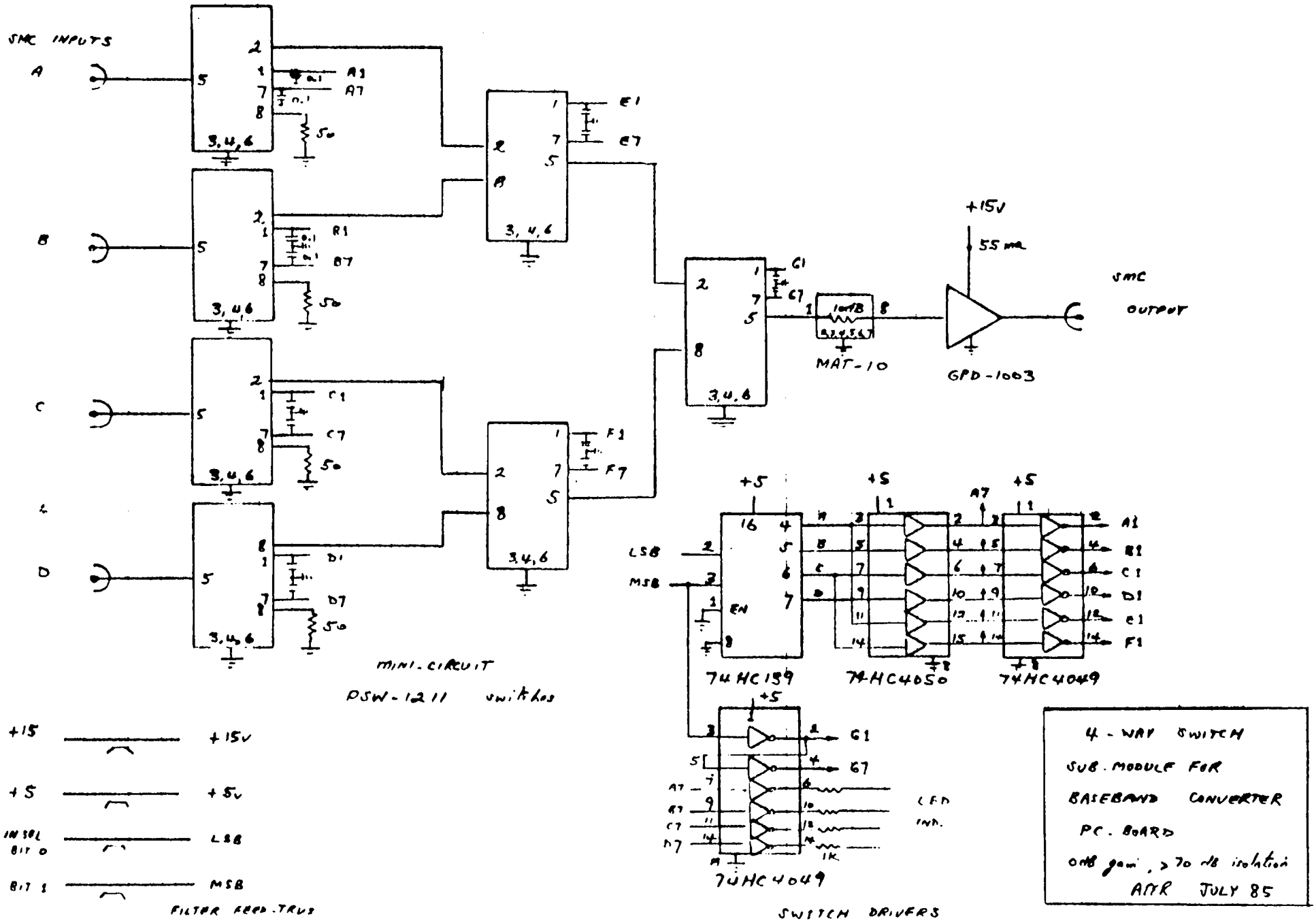
SIGNAL LEVELS IN VLBA RECEIVING SYSTEM

AETR July 85

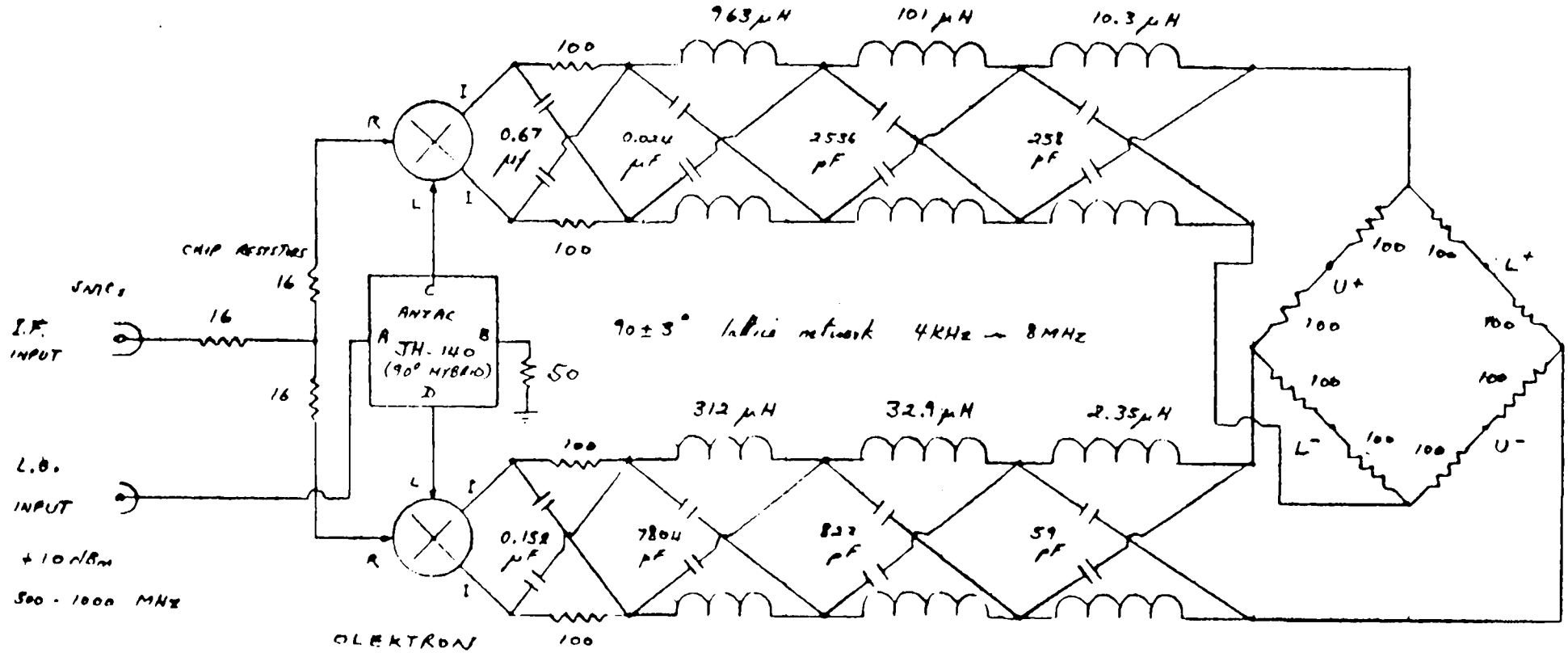


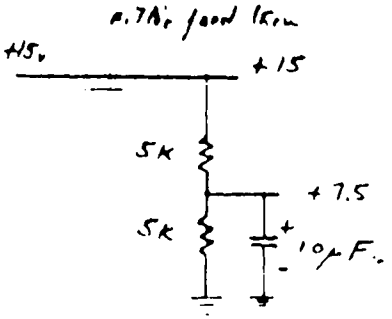
I.F. DISTRIBUTOR
VLBA
(2W VLA MODULE)
AFFR JULY 85

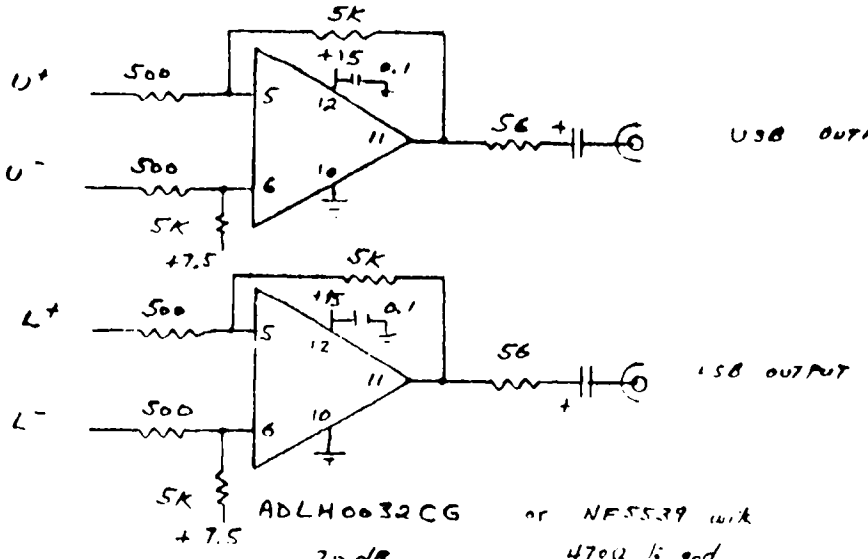

I.F. INPUTS
+15v
4 - WAY INPUT SELECT
SELECT
LEDs
A
B
C
D
SSB IF MIXER
USB
LSB
LO
+15v
USB FILTER/AMP
IN
OUT
+15v
LSB FILTER/AMP
BW SEL
+15v -15v
F.P. Gain mon.
USB AGC
LSB AGC
IN
+15v -15v
IR
GAIN
F.P. Gain mon.
BASEBAND OUTPUTS
USB
F.P. mon
LSB
F.P. mon
OSC
+24v
-15v
BUFFER
+15v
+10dBm
L.O. MONITOR
-10 dBm
LOCK
0 dBm
+8Mv
+15v
+8v
-5v
+5v
10MHz REF.
COUNTER/PHASE COMP.
FREQ SEL 12 bits
+15v
-15v
+5v
LSB SQUARE LAW
F.P. mon
+15v
-15v
+5v
USB SQUARE LAW
F.P. mon
LOCAL MONITOR/CABLE F.P.
+5v
INPUT SEL
2 bits
USB BW
4 bits
LSB BW
4 bits
USB GAIN
12 bits
LSB GAIN
12 bits
DIGITAL INTERFACE
DATA IN
DATA OUT
30 Hz
RMT ADDR.
GND
COUNTER INPUTS
A
B
USB
LSB
ERROR SENS.
LOCK
SERIAL # SENS.
SERIAL #
F.P. ALARM LED
BASEBAND CONVERTER
2W MODULE
AFTER JULY 85



4 - WAY SWITCH
SUB. MODULE FOR
BASEBAND CONVERTER
PC. BOARD
one gain, > 70 dB isolation
AMR JULY 85







SSB MIXER SUBMODULE FOR BASEBAND CONVERTER

PC BOARD

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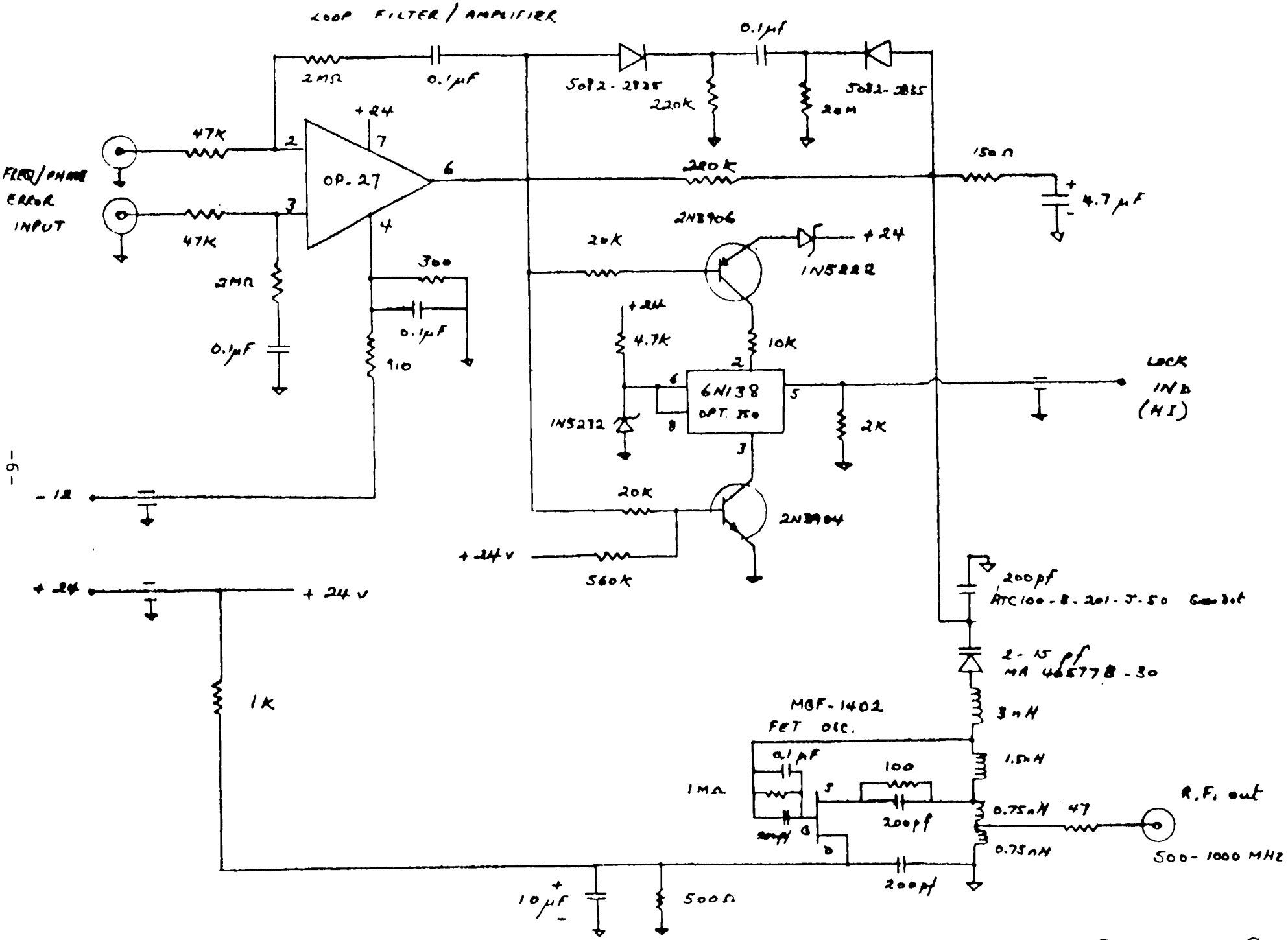
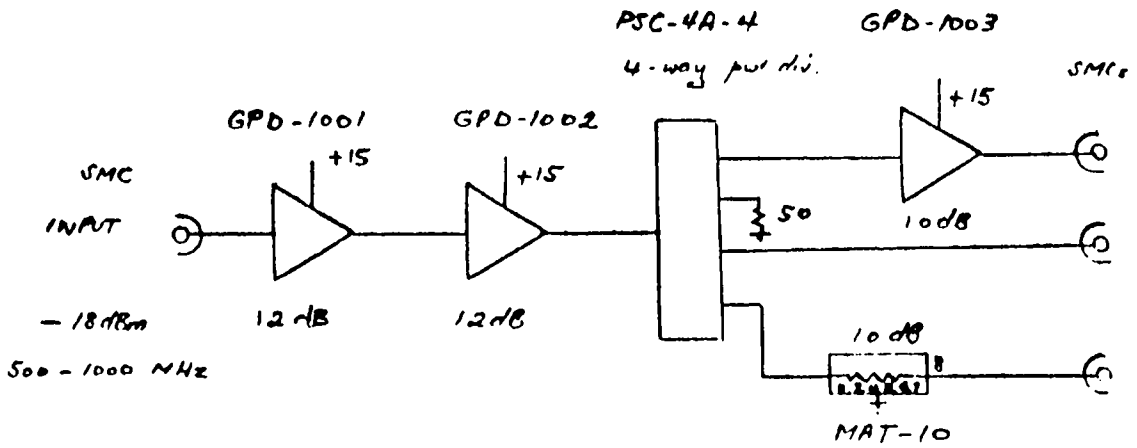

LOOP FILTER / AMPLIFIER
2MΩ
0.1μF
5082-2835
220K
0.1μF
5082-2835
20M
+24
47K
2
7
FREQ/PHASE ERROR INPUT
OP-27
6
220K
150Ω
4.7μF
47K
3
4
2MΩ
300
0.1μF
0.1μF
910
2N3906
20K
+24
IN5222
+24
4.7K
10K
2
6N138
OPT. 30
6
5
LOCK IND (HI)
IN5232
8
2K
3
-12
20K
2N3904
+24V
560K
+24
+24V
200pf
ATC100-B-201-J-50
2-15pf
MA 46577B-30
1K
MBF-1402
FET OSC.
3nH
0.1μF
1.5nH
100
1MΩ
S
0.75nH
47
R.F. out
200pf
G
0.75nH
D
200pf
10μF
500Ω
500-1000 MHz
SYNTHESIZER OSCILLATOR
(SUBMODULE FOR VLBA BASEBAND CONV.)



SSB MIXER + 10 dBm

DIVIDER 0 dB

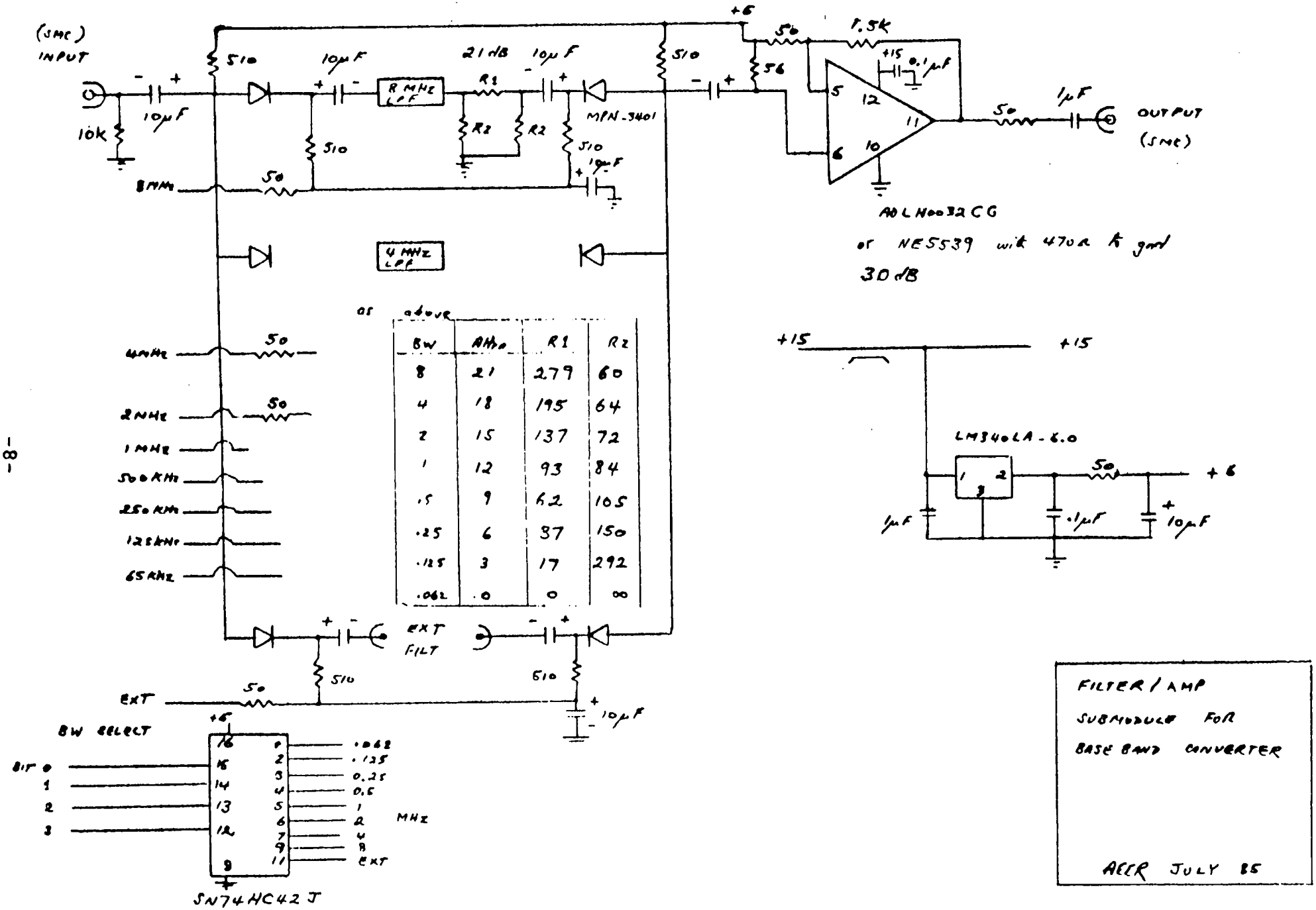
F.P. monitor - 10 dBm

+15(95ma) +15

FILTER FEED-THRU

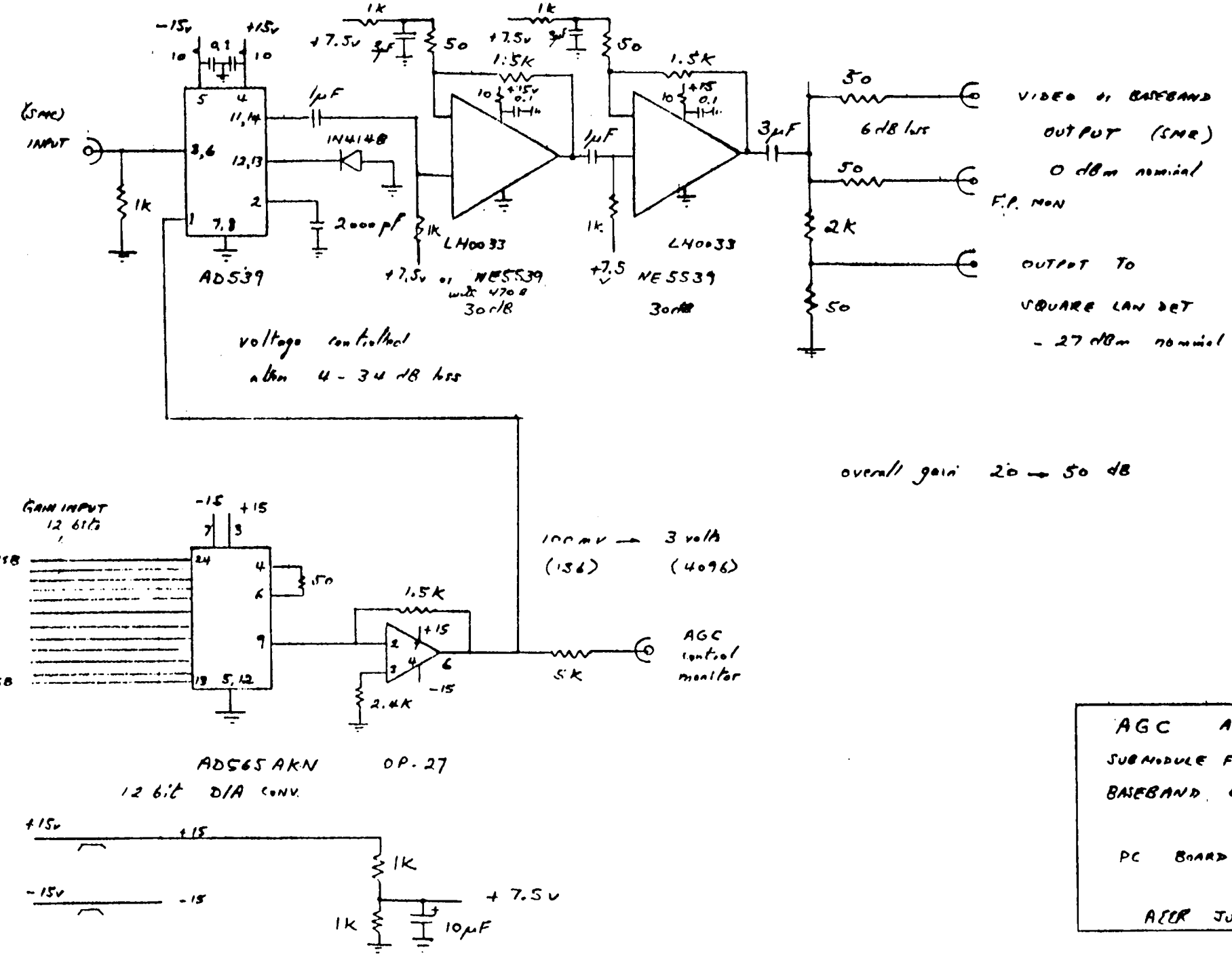
OSCILLATOR BUFFER
SUBMODULE FOR
BASEBAND CONVERTER

PC board
AFFR July 85



FILTER / AMP
SUBMODULE FOR
BASE BAND CONVERTER

AECR JULY 85


-15v
+15v
10
9.1
10
5
4
11,14
3,6
12,13
2
1
7,8
AD539
(SMR) INPUT
1k
1μF
IN4148
2000pf
1k
LH0033
+7.5v
NE5539
with 4700
30dB
1k
+7.5v
3μF
50
1.5k
+15v
0.1
1μF
1k
+7.5
LH0033
NE5539
30dB
3μF
50
6dB loss
50
2k
50
VIDEO or BASEBAND
OUTPUT (SMR)
0 dBm nominal
F.P. MON
OUTPUT TO
SQUARE LAW DET
-27 dBm nominal
voltage controlled
atten 4 - 34 dB loss
overall gain 20 → 50 dB
GAIN INPUT
12 bits
MSB
LSB
-15
+15
7
3
24
19
5, 12
4
6
9
50
1.5k
+15
2
3
4
6
-15
2.4k
100mv → 3 volts
(136) (4096)
5k
AGC
control
monitor
AD565AKN OP-27
12 bit D/A conv.
+15v
+15
-15v
-15
1k
+7.5v
1k
10μF
AGC AMP
SUBMODULE FOR
BASEBAND CONVERTER
PC BOARD
ACER JULY 85