I F (R e m o t e) S Y S T E M

Plug In Unit level test procedures for qualification of units
System integration and alignment procedures
Installation and commissioning of the IF(R) System
Brief Users' Guide

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Contents

C41 (First IF Conversion)

After the assembly of the PIU is complete, the checks have to be carried out in the sequence as indicated in the form titled, "Test Report cum Check Sheet for PIU code C-41".

This test will require the following apparatus:

- *Marconi 2031 signal generator at GPIB address 19.*
- *Marconi 2041 signal generator at GPIB address 20.*
- *HP 8508A vector voltmeter at GPIB address 12.*
- *RG 223 RF cable Type-N male to Type-N male (Two numbers).*
- *RG 223 RF cable TNC male to Type-N male.*
- *ABR power supply, with standard 5 pin male connector.*
- *PC with PCL748 GPIB card, and interconnecting HPIB cables.*
- *Digital Multimeter*

First note down the running serial number of the PIU at the appropriate space provided on the form and check the box. Next, the DC wiring, RF Cabling & Connectors and Mounting Screws have to be visually inspected and if found proper, the appropriate boxes have to be checked on the form. Any anomaly observed at this stage has to be rectified. before proceeding with the other functional tests.

Next, the PIU has to be powered on from a standard ABR power supply through a 5 pin connector wired for the purpose. Using a DMM, measure the DC voltages appearing on the front panel banana sockets, and note down the values on the form in the space provided. Now select 16dB, 8dB, 4dB and 2dB attenuation one by one and note that the corresponding LED lights up. Now repeat this for each of the three bandwidth settings. Next, select 16dB attenuation and 16MHz bandwidth and measure the voltages appearing on the banana sockets corresponding to these selections using a DMM. Note down these readings at the appropriate places on the form.

Now note down the serial number of the individual units used in the PIU in the space provided on the form for this purpose.

Connect the experimental setup as shown in Figure 1. Set the LO frequency to 395MHz@+12dBm and RF to 325MHz at -55dBm. Set the bandwidth to 16MHz and attenuation to 0dB. Now with the choose 2dB, 4dB, 8dB and 16dB attenuations one after the other, and ensure that the relative changes in power levels are as expected. After this restore the settings to 16MHz bandwidth and 16dB attenuation.

Now boot the PC and ensure that the program "GWBASIC.EXE" is located in the current directory or the PATH variable points to the location of this program. Additionally, ensure that the program "C41_TEST.BAS" is located in the current directory. Now type "GWBASIC C41_TEST" at the DOS prompt, and follow the instructions given by the program. The system will acquire and save test data for the PIU under test in a file.

To get a plot of the data, follow the following steps. Ensure that the following files are present in the working directory: oread(executable), bw6.hardcopy, bw16.hardcopy, bw32.hardcopy(setup files), mk_hardcopy(shell script) and plot1d3(executable). First ftp the file to UNIX, and remove the text comment lines in the file. Now type "oread <filename>" at the prompt. Now say "mk_hardcopy" at the prompt. This will create three postscript files bw6.ps, bw16.ps and bw32.ps which have the plots for all the various GMRT bands, for all the three bandwidths. The plots should resemble the test plots 1.2 and 3.

Test Report cum Check Sheet for PIU code C-41

Fill in the required information & check the proper boxes after the corresponding check has been executed.

☐ Unit Code & Serial Number: C41/

☐ DC Wiring

☐ RF Cabling & Connectors

☐ Mounting Screws

☐ DC Power Supply Test *(Note down the voltages on the front panel)*

•IMIX, +12B
•IMIX, +12A
•SAWS70, +12B
•SAWS70, +12A

☐ Control Circuitry Test *(Note down the voltages on the front panel)*

•IF ATTENUATION:	16dB	8dB	4dB	2dB
•IF BANDWIDTH:	32MHz	16MHz	6MHz	

☐ Note down below, the Unit codes and serial numbers of units mounted inside & tick if individual characterisation plot is available for the unit.

•IMIX,C61/
•PRATR,C62/
•100LPF,C63/
•SAWS70,C64/
•IFLED1,C75A/

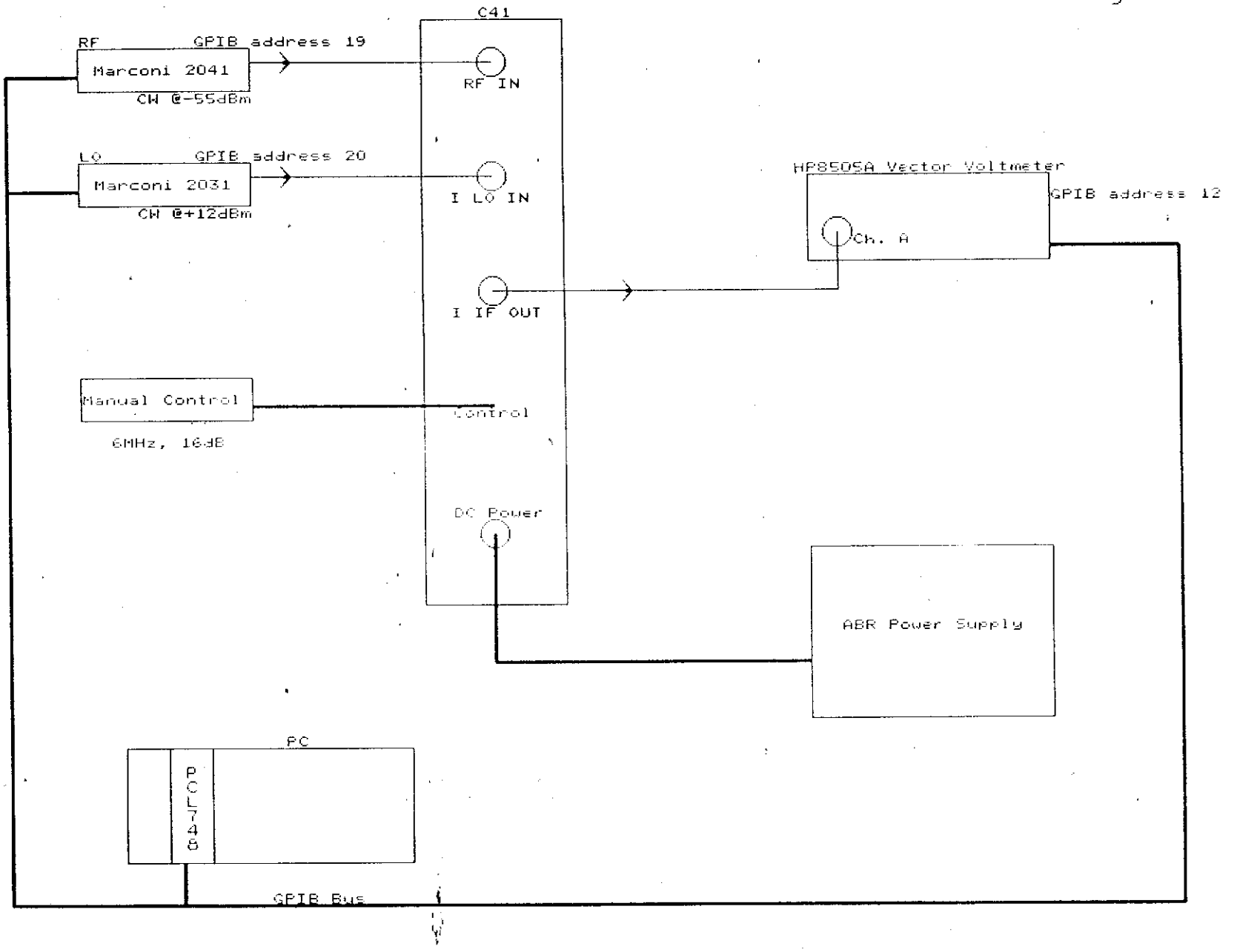
☐ Performance Checks *(Tick the item if test completed satisfactorily)*

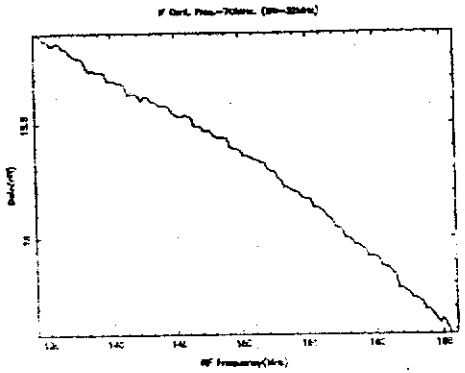
- Flatness over the band, Enter filename having the test data:

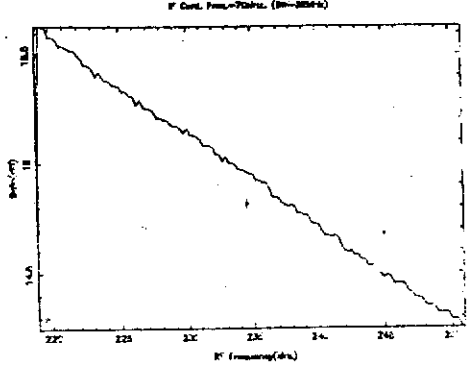
- IMD performance *(Attach additional sheets if required)*
- Final Perfromance plots taken. *(Attach the plots to this form)*

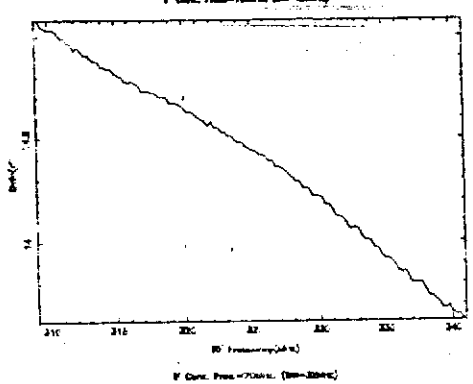
Check carried out by:
Dated:

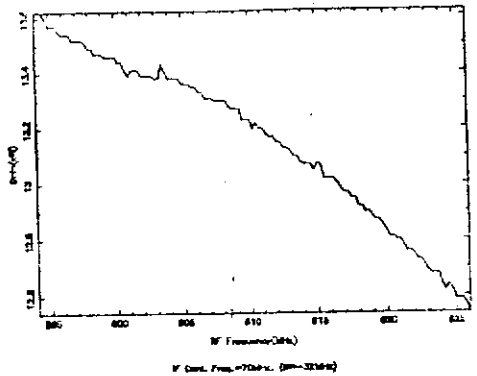
Figure 1.

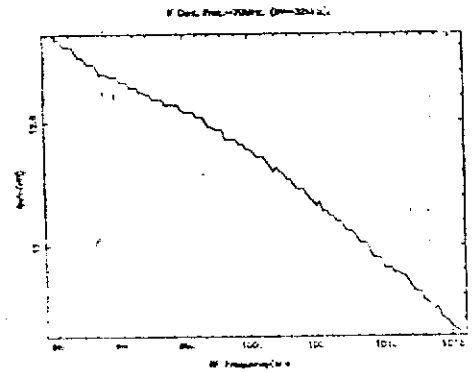

C41
RF
GPIB address 19
Marconi 2041
CW @-55dBm
RF IN
LO
GPIB address 20
Marconi 2031
CW @+12dBm
I LO IN
HP8505A Vector Voltmeter
GPIB address 12
Ch. A
I IF OUT
Manual Control
Control
6MHz, 18dB
DC Power
ABR Power Supply
PC
PCI-488
GPIB Bus

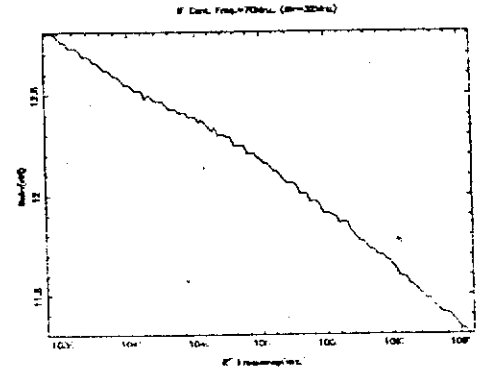


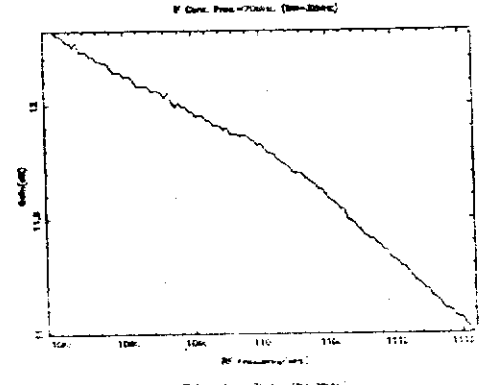


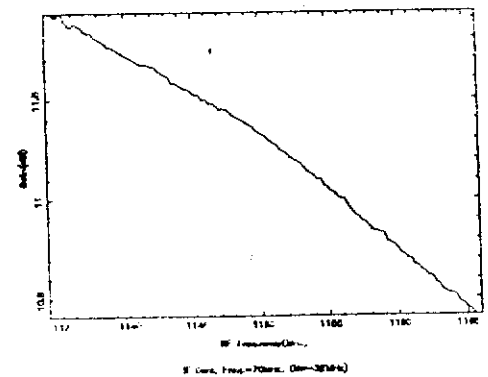


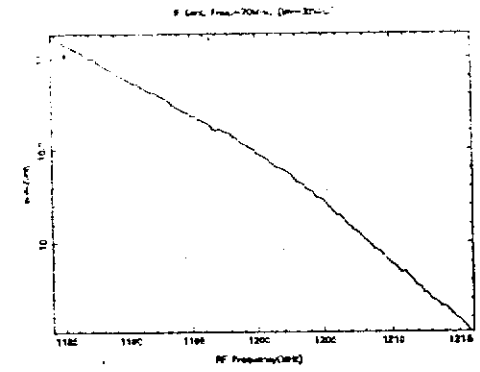


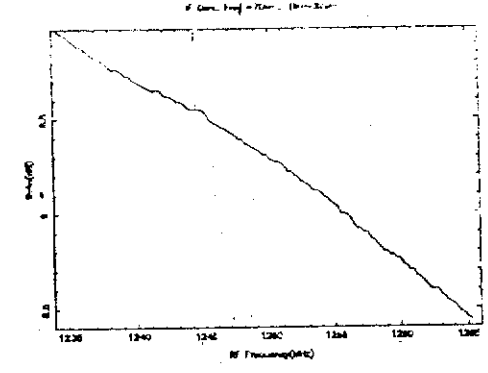


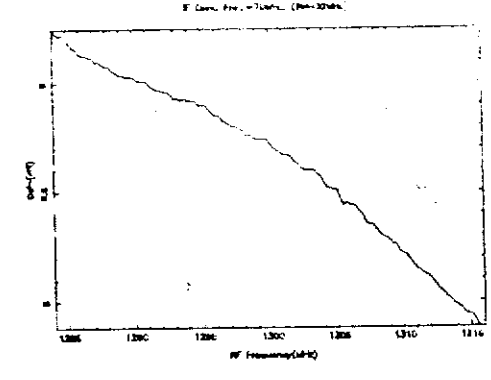


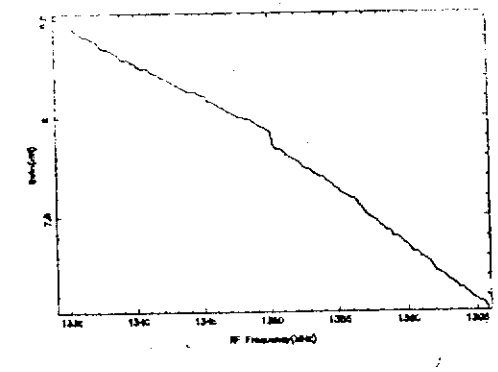


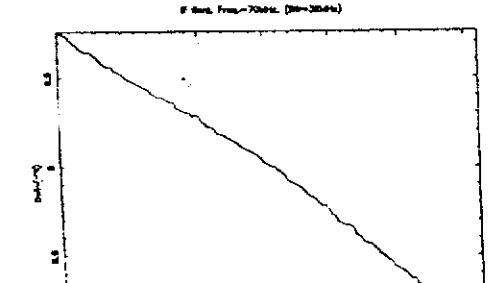


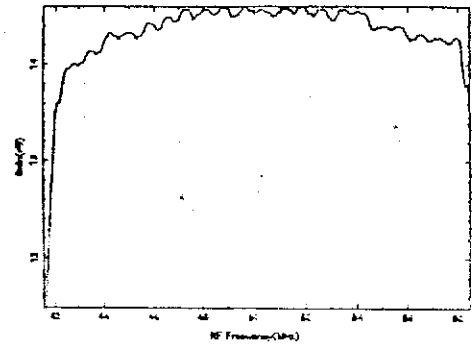


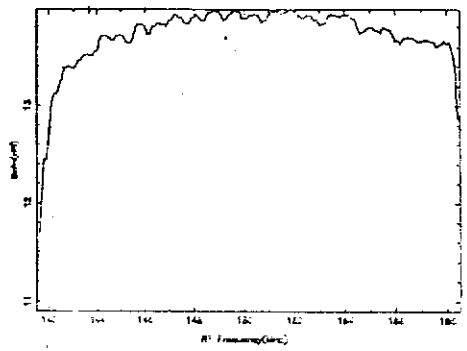


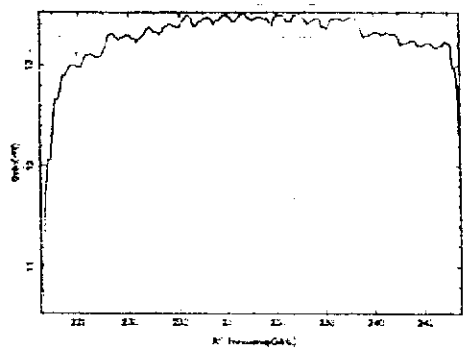


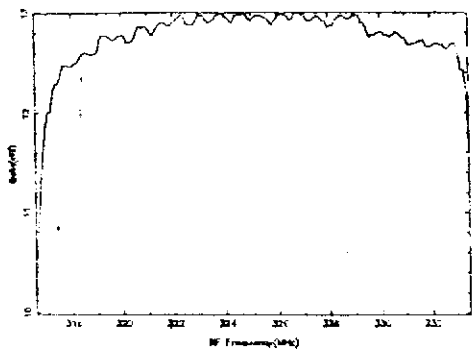


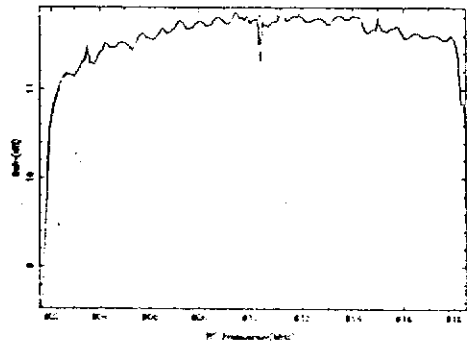


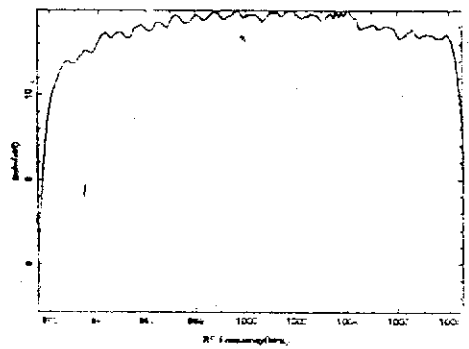


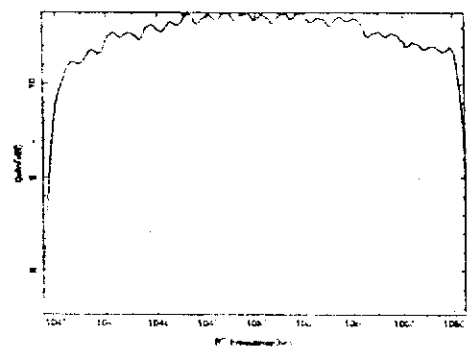


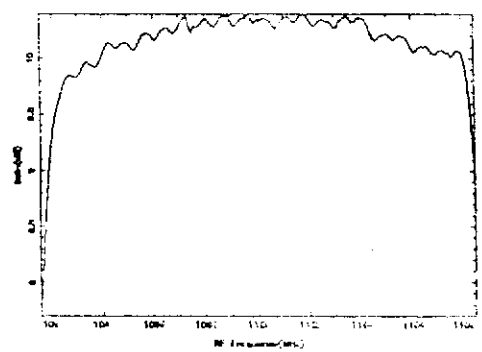


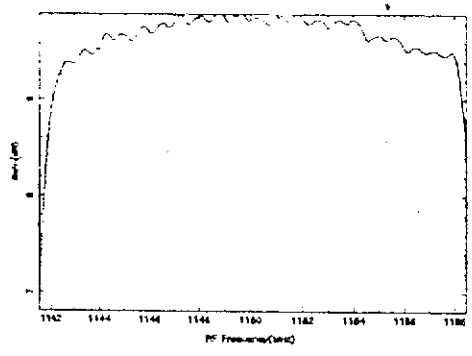


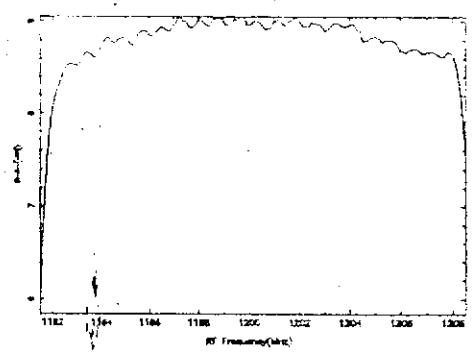


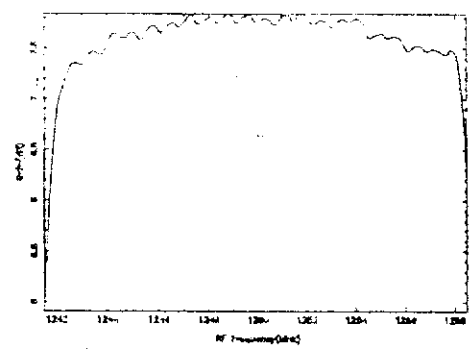


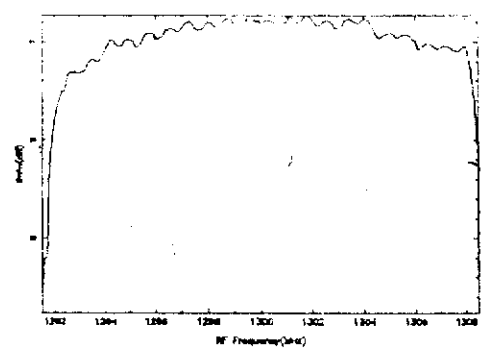


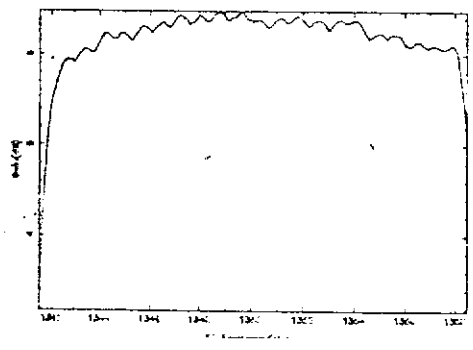


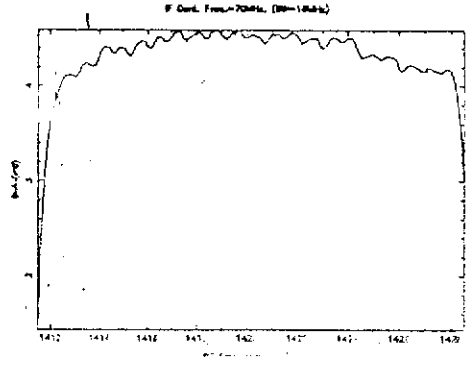




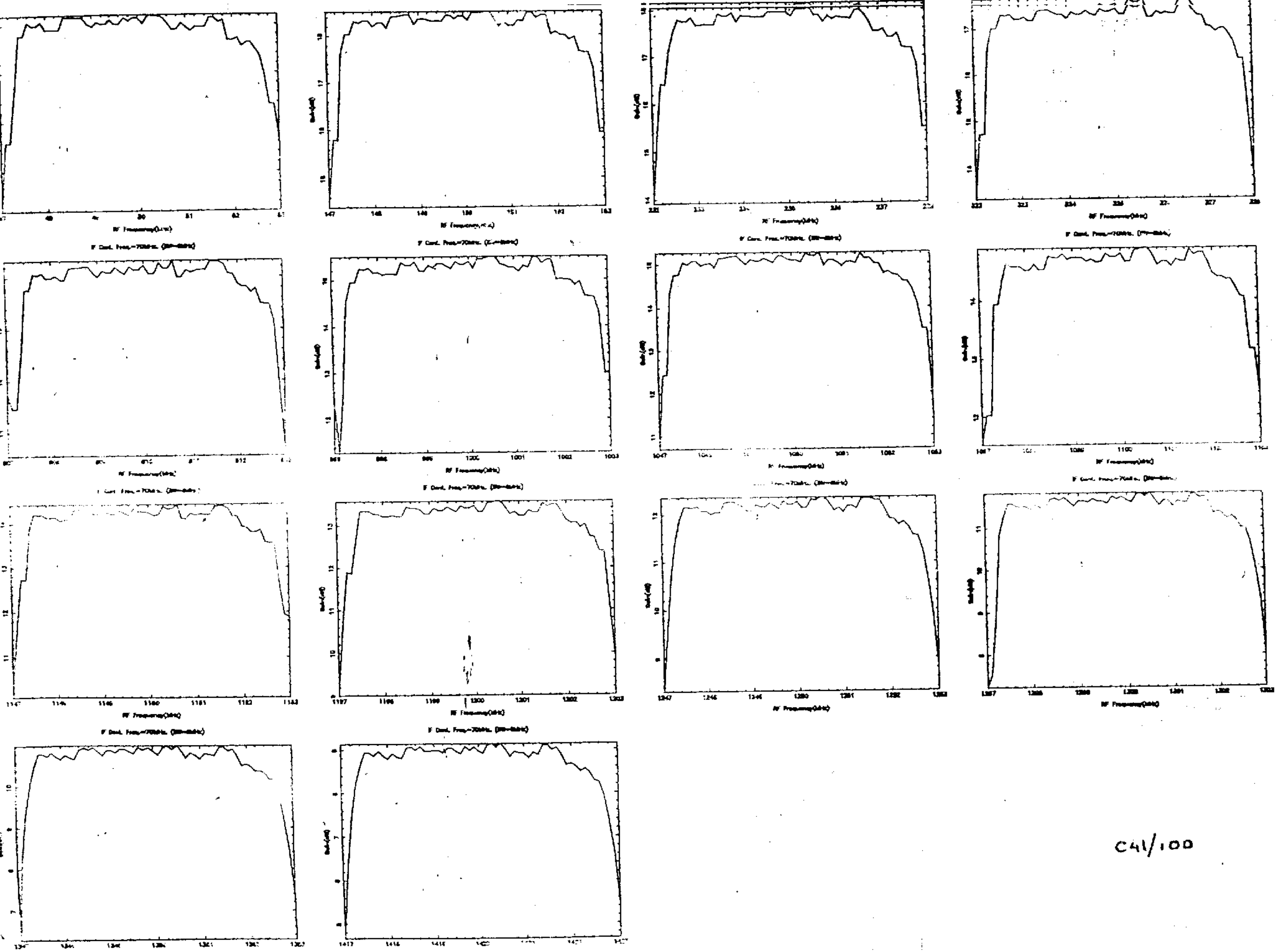








C41/100



C41/100

C42 (130 Conversion)

After the assembly of the PIU is complete, the checks have to be carried out in the sequence as indicated in the form titled, "Test Report and Check Sheet for PIU code C-42".

This test will require the following apparatus:

- *Marconi 2031 signal generator at GPIB address 20.*
- *Marconi 2041 signal generator, or LO(R) system delivering 200MHz@+12dBm.*
- *HP 8508A vector voltmeter at GPIB address 12.*
- *RG 223 RF cable TNC male to Type-N male (Three numbers).*
- *ABR power supply, with standard 5 pin male connector.*
- *PC with PCL748 GPIB card, and interconnecting HPIB cables.*
- *Digital Multimeter*

First note down the running serial number of the PIU at the appropriate space provided on the form and check the box. Next, the DC wiring, RF Cabling & Connectors and Mounting Screws have to be visually inspected and if found proper, the appropriate boxes have to be checked on the form. Any anomaly observed at this stage has to be rectified. before proceeding with the other functional tests.

Next, the PIU has to be powered on from a standard ABR power supply through a 5 pin connector wired for the purpose. Using a DMM, measure the DC voltages appearing on the front panel banana sockets, and note down the values on the form in the space provided. Now select 16dB, 8dB, 4dB and 2dB preattenuation one by one and note that the corresponding LED lights up. Now repeat this for AGC ON/OFF settings. Next, select 16dB attenuation and AGC OFF and measure the voltages appearing on the banana sockets corresponding to this selection using a DMM. Note down these readings at the appropriate places on the form.

Now note down the serial number of the individual units used in the PIU in the space provided on the form for this purpose.

Connect the experimental setup as shown in Figure 1. Set the LO frequency to 200MHz@+12dBm and RF to 70MHz at -50dBm. Now select 2dB, 4dB, 8dB and 16dB attenuations one after the other, and ensure that the relative changes in power levels are as expected. After this restore the settings to 16dB attenuation.

Now boot the PC and ensure that the program "GWBASIC.EXE" is located in the current directory or the PATH variable points to the location of this program. Additionally, ensure that the program "IIC_TEST.BAS" is located in the current directory. Now type "GWBASIC IIC_TEST" at the DOS prompt, and follow the instructions given by the program. The system will acquire and save test data for the PIU under test in a file.

The file will contain frequency versus conversion gain data points and a plot can be obtained using standard pgplot program on UNIX or any other convenient way and should resemble Plot 1.

Test Report cum Check Sheet for PIU code C-42

Fill in the required information & check the proper boxes after the corresponding check has been executed.

☐ Unit Code & Serial Number: C42/

☐ DC Wiring

☐ RF Cabling & Connectors

☐ Mounting Screws

☐ DC Power Supply Test *(Note down the voltages on the front panel)*

- IIMIX, +12B
- IIMIX, +12A
- IFSAW, +12B
- IFSAW, +12A
- AGC, +12B
- AGC, +12A
- AGC, -12B
- AGC, -12A
- AGC, +10B
- AGC, +5A

☐ Control Circuitry Test *(Note down the voltages on the front panel)*

- AGC PREATTENUATION: 16dB 8dB 4dB 2dB
- AGC OFF

☐ Note down below, the Unit codes and serial numbers of units mounted inside & tick if individual characterization plot is available for the unit

- IIMIX,C65/
- 130MHz SAW Filter,C66/
- 150LPF,C68/
- AGC Preattenuator cum Voltage Controlled Amplifier,C71A/
- AGC Controller,C71B/
- IFLED2,C75B/

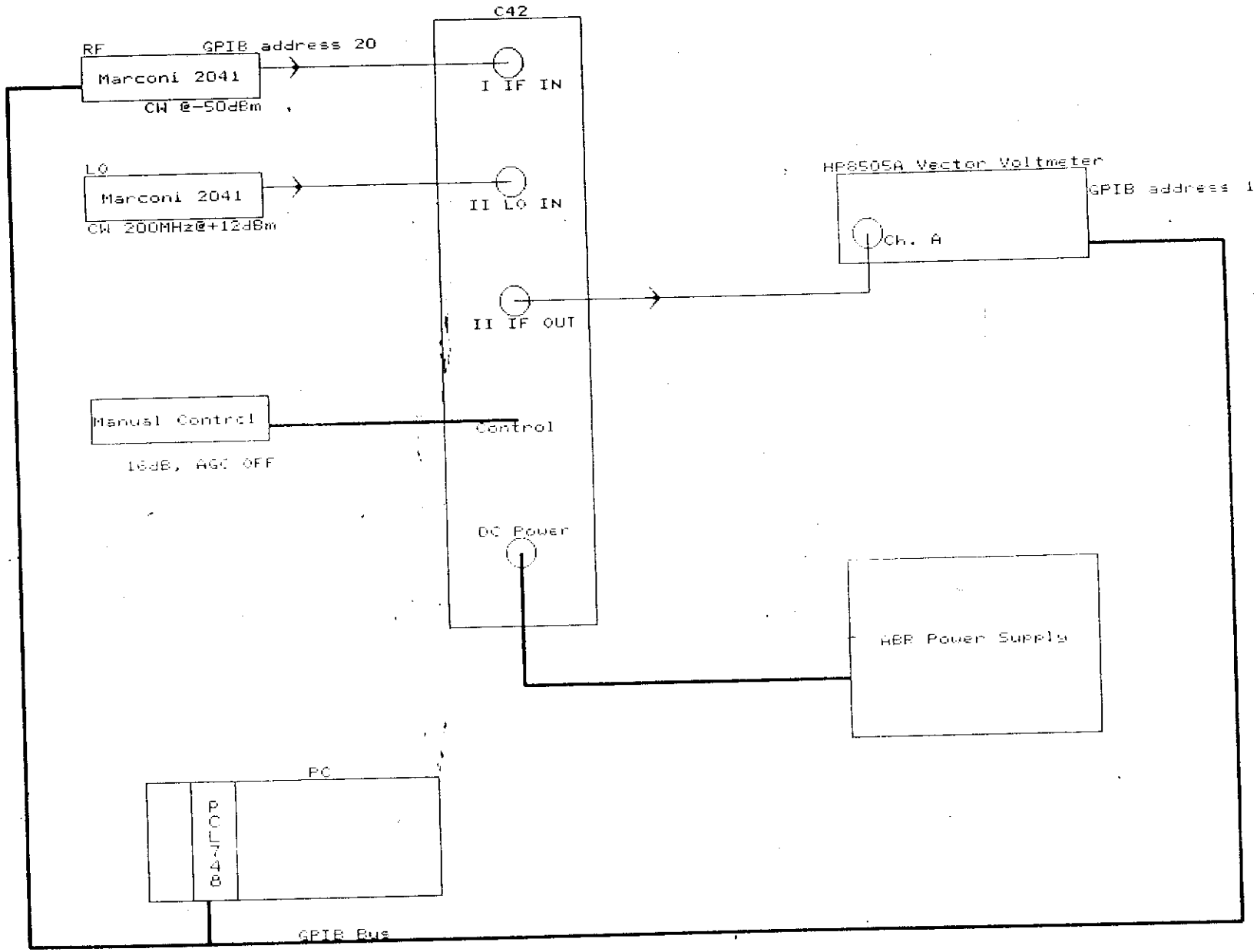
☐ Performance Checks *(Tick the item if test completed satisfactorily)*

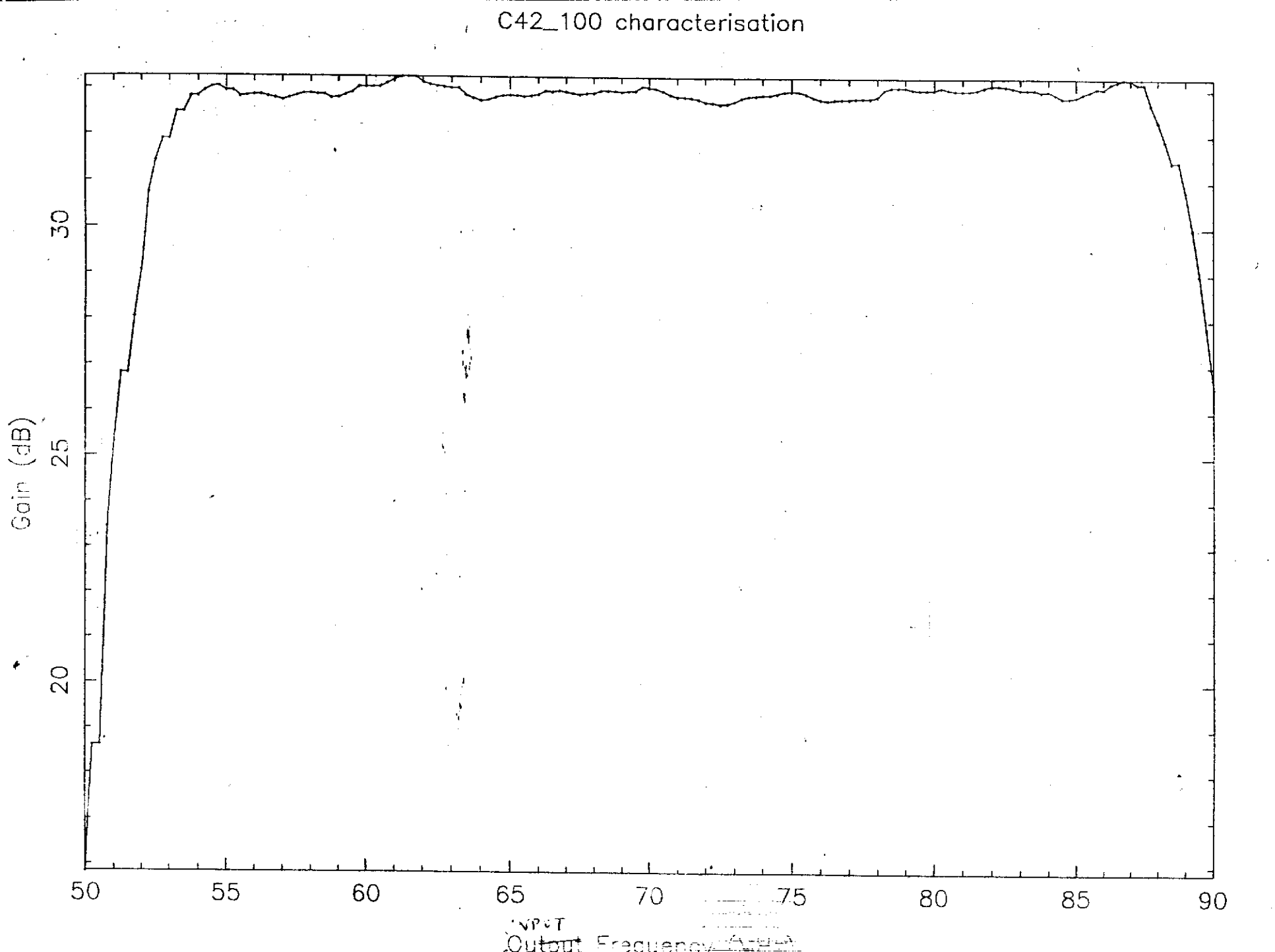
- Flatness over the band, Enter filename having the test data:

- IMD performance *(Attach additional sheets if required)*
- Final Performance plots taken. *(Attach the plots to this form)*

Check carried out by:
Dated:

Figure 1.


C42
RF
GPIB address 20
Marconi 2041
CW @-50dBm
I IF IN
LO
Marconi 2041
CW 200MHz@+12dBm
II LO IN
HP8505A Vector Voltmeter
GPIB address 12
Ch. A
II IF OUT
Msnusl Control
Control
16dB, AGC OFF
DC Power
ABR Power Supply
PC
PCL-748
GPIB Bus


C42_100 characterisation
Gain (dB)
20
25
30
50
55
60
65
70
75
80
85
90
INPUT
Output Frequency (GHz)

C43 (175 Conversion)

After the assembly of the PIU is complete, the checks have to be carried out in the sequence as indicated in the form titled, "Test Report cum Check Sheet for PIU code C-43".

This test will require the following apparatus:

- *Marconi 2031 signal generator at GPIB address 20.*
- *Marconi 2041 signal generator, or LO(R) system delivering 105MHz@+12dBm.*
- *HP 8508A vector voltmeter at GPIB address 12.*
- *RG 223 RF cable TNC male to Type-N male (Three numbers).*
- *ABR power supply, with standard 5 pin male connector.*
- *PC with PCL748 GPIB card, and interconnecting HPIB cables.*
- *Digital Multimeter*

First note down the running serial number of the PIU at the appropriate space provided on the form and check the box. Next, the DC wiring, RF Cabling & Connectors and Mounting Screws have to be visually inspected and if found proper, the appropriate boxes have to be checked on the form. Any anomaly observed at this stage has to be rectified. before proceeding with the other functional tests.

Next, the PIU has to be powered on from a standard ABR power supply through a 5 pin connector wired for the purpose. Using a DMM, measure the DC voltages appearing on the front panel banana sockets, and note down the values on the form in the space provided. Now select 16dB, 8dB, 4dB and 2dB preattenuation one by one and note that the corresponding LED lights up. Now repeat this for AGC ON/OFF settings. Next, select 16dB attenuation and AGC OFF and measure the voltages appearing on the banana sockets corresponding to this selection using a DMM. Note down these readings at the appropriate places on the form.

Now note down the serial number of the individual units used in the PIU in the space provided on the form for this purpose.

Connect the experimental setup as shown in Figure 1. Set the LO frequency to 105MHz@+12dBm and RF to 70MHz at -50dBm. Now select 2dB, 4dB, 8dB and 16dB attenuations one after the other, and ensure that the relative changes in power levels are as expected. After this restore the settings to 16dB attenuation.

Now boot the PC and ensure that the program "GWBASIC.EXE" is located in the current directory or the PATH variable points to the location of this program. Additionally, ensure that the program "IIC_TEST.BAS" is located in the current directory. Now type "GWBASIC IIC_TEST" at the DOS prompt, and follow the instructions given by the program. The system will acquire and save test data for the PIU under test in a file.

The file will contain frequency versus conversion gain data points and a plot can be obtained using standard pgplot program on UNIX or any other convenient way and should resemble Plot 1.

Test Report cum Check Sheet for PIU code C-43

Fill in the required information & check the proper box after the corresponding check has been executed.

☐ Unit Code & Serial Number: C43/

☐ DC Wiring

☐ RF Cabling & Connectors

☐ Mounting Screws

☐ DC Power Supply Test *(Note down the voltages on the front panel)*

•IIMIX, +12B
•IIMIX, +12A
•IFSAW, +12B
•IFSAW, +12A
•AGC, +12B
•AGC, +12A
•AGC, -12B
•AGC, -12A
•AGC, +10B
•AGC, +5A

☐ Control Circuitry Test *(Note down the voltages on the front panel)*

•AGC PREATTENUATION: 16dB 8dB 4dB 2dB
•AGC OFF

☐ Note down below, the Unit codes and serial numbers of units mounted inside & tick if individual characterization plot is available for the unit

•IIMIX,C65/
•175MHz SAW Filter,C67/
•200LPF,C69/
•AGC Preattenuator cum Voltage Controlled Amplifier,C71A/
•AGC Controller,C71B/
•IFLED2,C75B/

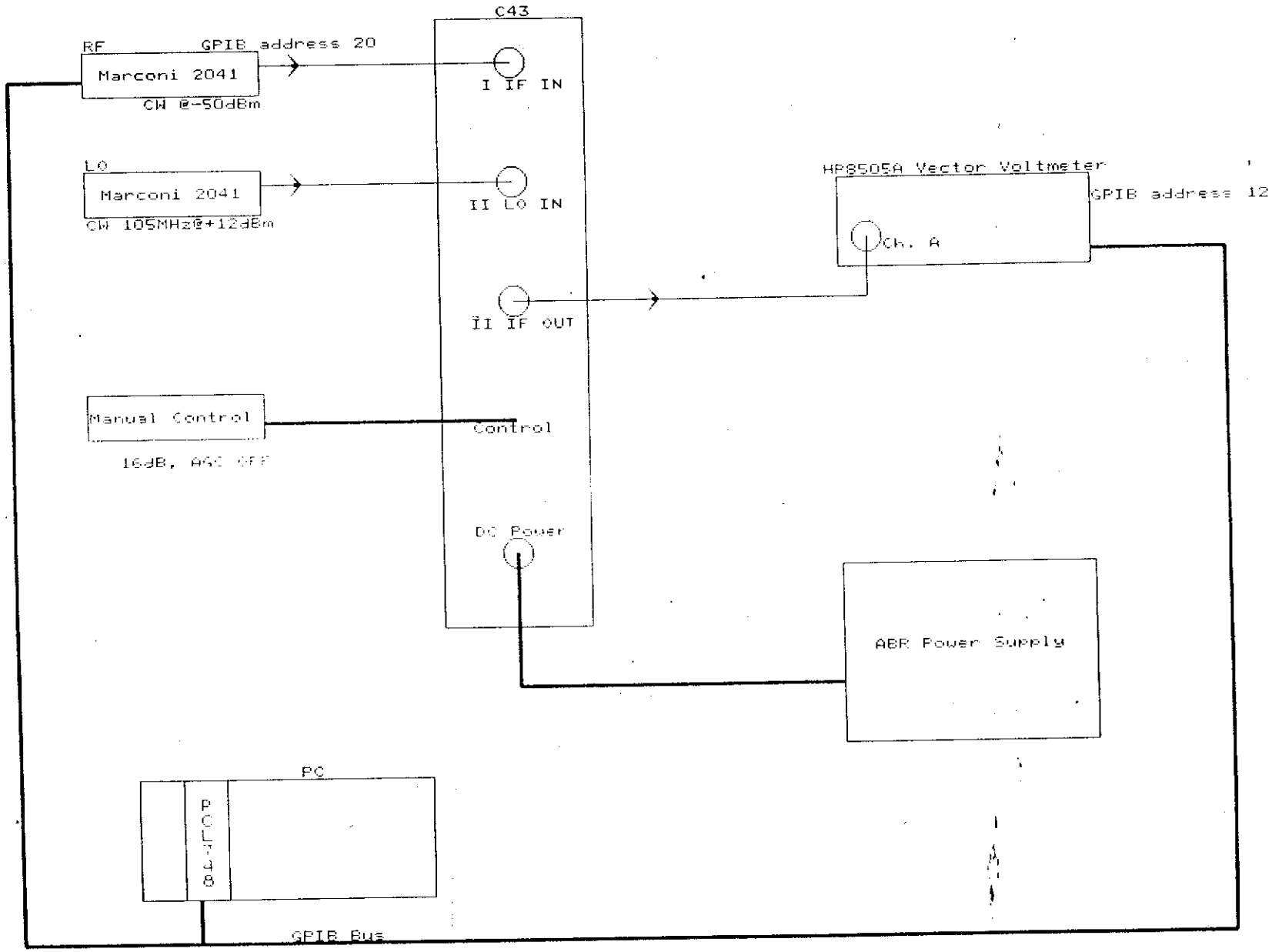
☐ Performance Checks *(Tick the item if test completed satisfactorily)*

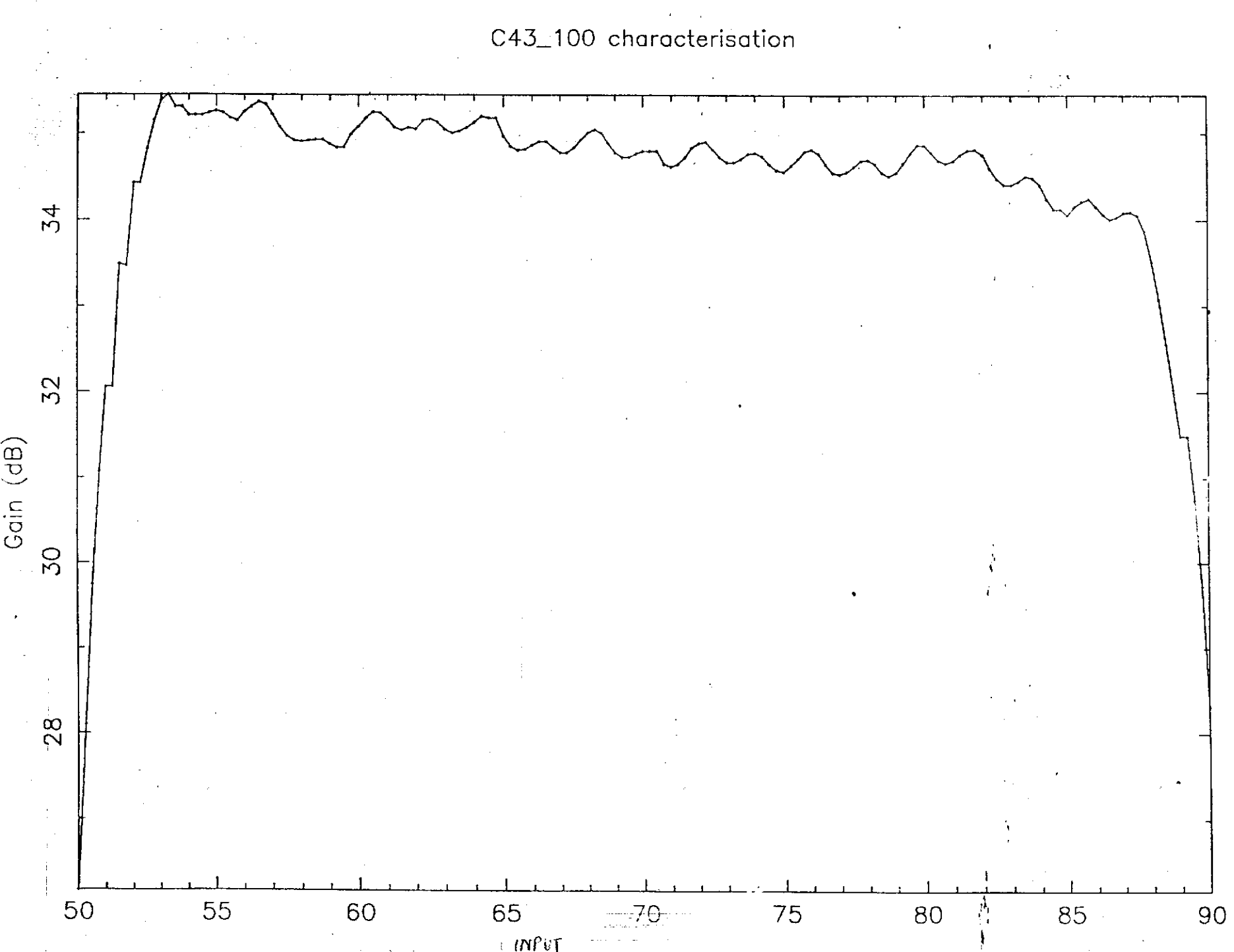
- Flatness over the band, Enter filename having the test data:

- IMD performance *(Attach additional sheets if required)*
- Final Performance plots taken. *(Attach the plots to this form)*

Check carried out by:
Dated:

Figure 1.


C43
RF
GPIB address 20
Marconi 2041
CW @-50dBm
I IF IN
LO
Marconi 2041
CW 105MHz@+12dBm
II LO IN
HP8505A Vector Voltmeter
GPIB address 12
Ch. A
II IF OUT
Manual Control
16dB, AGC OFF
Control
DC Power
ABR Power Supply
PC
PCI-488
GPIB Bus


C43_100 characterisation
Gain (dB)
28
30
32
34
50
55
60
65
70
75
80
85
90
INPUT

C45 (Control)

After the assembly of the PIU is complete, the checks have to be carried out in the sequence as indicated in the form titled, "Test Report cum Check Sheet for PIU code C-45".

This test will require the following apparatus:

- *PC with PCL203 digital IO card.*
- *±12V and +5V DC power supply.*
- *Digital multimeter.*

First note down the running serial number of the PIU at the appropriate space provided on the form and check the box. Next, the DC wiring & Connectors and Mounting Screws have to be visually inspected and if found proper, the appropriate boxes have to be checked on the form. Any anomaly observed at this stage has to be rectified. before proceeding with the other functional tests.

Next, the PIU has to be powered on from a standard ABR power supply through a 5 pin connector wired for the purpose. Using a DMM, measure the DC voltages appearing on the front panel banana sockets, and note down the values on the form in the space provided.

The experimental setup should be as shown in Figure 1. Boot the PC and make sure that the file IFCTL_R1.BAS is present in your current working directory. Additionally, your PATH variable should point to the location of GWBASIC.EXE (or optionally GWBASIC.EXE should be located in your current working directory.). Before proceeding, make sure that the data connections from the PCL203 card to the card under test, are connected exactly as specified in Figure 1. The connections are not one to one, though both connectors are 20pin FRC, and the test will be meaningless if these connections are incorrect. Also any mistake in making connections is liable to damage the PCL203 and/or the interface card under test.

Now run the program IFCTL_R1.BAS by typing "gwbasic iftcl_r1" at the DOS prompt. The program will start to reset the MCM-IF control interface card which is under test and various LEDs on the card will blink repeatedly. Wait till the reset is over, and then follow the instructions given by the program to go through the entire test. You will be required to note if the particular LED, as intimated by the program blinks, and check the voltage levels as required by the program at various IC and connector locations.

Test Report cum Check Sheet for PIU code C-44

Fill in the required information & check the proper boxes after the corresponding check has been executed.

☐ Unit Code & Serial Number: C44/

☐ DC Wiring

☐ Mounting Screws

☐ DC Power Supply Test *(Note down the voltages on the front panel)*

- +15
- +17
- -17
- -15
- +12
- +12, MCM
- -12, MCM
- -12
- +5, MCM

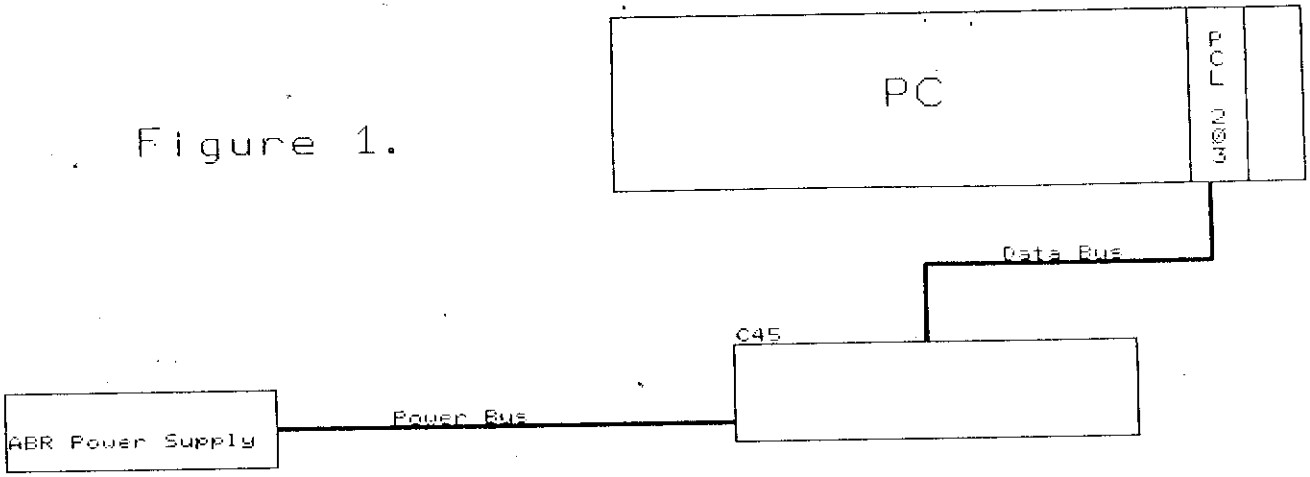
☐ Note down below, the Unit codes and serial numbers of units mounted inside & tick if individual characterization plot is available for the unit

- IFCTL,C72/
- IFDSPL,C76/
- IFLED3,C75C/
- PSSUP,C74A/
- PSSUP,C74B/

☐ Alignment Procedure carried out *(Tick the item if alignment completed satisfactorily)*

Check carried out by:
Dated:

Figure 1.



Data Bus connections.

Connector J0 on test card C72	Connector J8 on PCL 203
3	2
4	1
5	4
6	3
7	6
8	5
9	8
10	7
11	10
12	9
13	12
14	11
15	14
16	13
17	16
18	15
19	18
20	17
1 & 2 NC	19 & 20 NC

Note: These connections can be easily made by connecting two FRC female headers using a berg strip and offsetting one header in the proper direction.

Test Report cum Check Sheet for PIU code C-45

Fill in the required information & check the proper boxes after the corresponding check has been executed.

☐ Unit Code & Serial Number: C45/

☐ DC Wiring

☐ Cabling & Connectors

☐ Mounting Screws

☐ DC Power Supply Test: *(Note down the voltages on the front panel)*

- IFCTL, +17
- IFCTL, +12
- IFCTL, -17
- IFCTL, -12
- IFCTL, +10
- IFCTL, +5

☐ Control Circuitry Test :

Run the program "IFCTL_R1.BAS" after putting together the test setup and follow the instructions. All voltages should be as intimated by the program. Note down any discrepancies below:

Check the appropriate box below:

☐ Test completed satisfactorily ☐ Test failed

☐ Note down below, the Unit codes and serial numbers of units mounted inside:

- PSSUP,C74A/
- IFLED3,C75D/
- IFCTL,C72/

Check carried out by:

Dated:

Integrated System Testing of either/both channels.

Once the system has been integrated together, this test will require the following apparatus:

- *Marconi 2031 signal generator at GPIB address 19.*
- *Marconi 2041 signal generator at GPIB address 20.*
- *LO(R) system connected as required to the IF(R) system* under test.
- *HP 8508A vector voltmeter at GPIB address 12.*
- *RG 223 RF cable Type-N male to Type-N male.*
- *RG 223 RF cable TNC male to Type-N male.*
- *ABR power supply, connected as required to the IF(R) system under* test.
- *PC with PCL748 GPIB card, and interconnecting HPIB cables.*
- *Digital Multimeter*

Connect the experimental setup as shown in Figure 1. Now boot the PC and ensure that the program "GWBASIC.EXE" and "MCMPRN.EXE" are located in the current directory or the PATH variable points to the location of this program. Also ensure that the files "IF_INT.BAS" and "DFLT.DAT" are present in the current working directory. Run the program MCMPRN and use it to set the IF(R) system to a default state of 16dB IF attenuation, 10dB AGC Preattenuation, AGC OFF and 16MHz banswidth on both the channels by using the file "DFLT.DAT" as the runfile. Now say "GWBASIC IF_INT" at the DOS prompt, and follow the instructions given by the program. The system will acquire and save test data for the PIU under test in a file. The same procedure is to be repeated for the other polarisation channel.

To get a plot of the data, follow the following steps. Ensure that the following files are present in the working directory: oread(executable), bw6.hardcopy, bw16.hardcopy, bw32.hardcopy(setup files), mk_hardcopy(shell script) and plot1d3(executable). First ftp the file to UNIX, and remove the text comment lines in the file. Now type "oread <filename>" at the prompt. Now say "mk_hardcopy" at the prompt. This will create three postscript files bw6.ps, bw16.ps and bw32.ps which have the plots for all the various GMRT bands, for all the three bandwidths. The plots should resemble the test plots attached 1 through 6.

Integrated System Testing for the IF(R) System

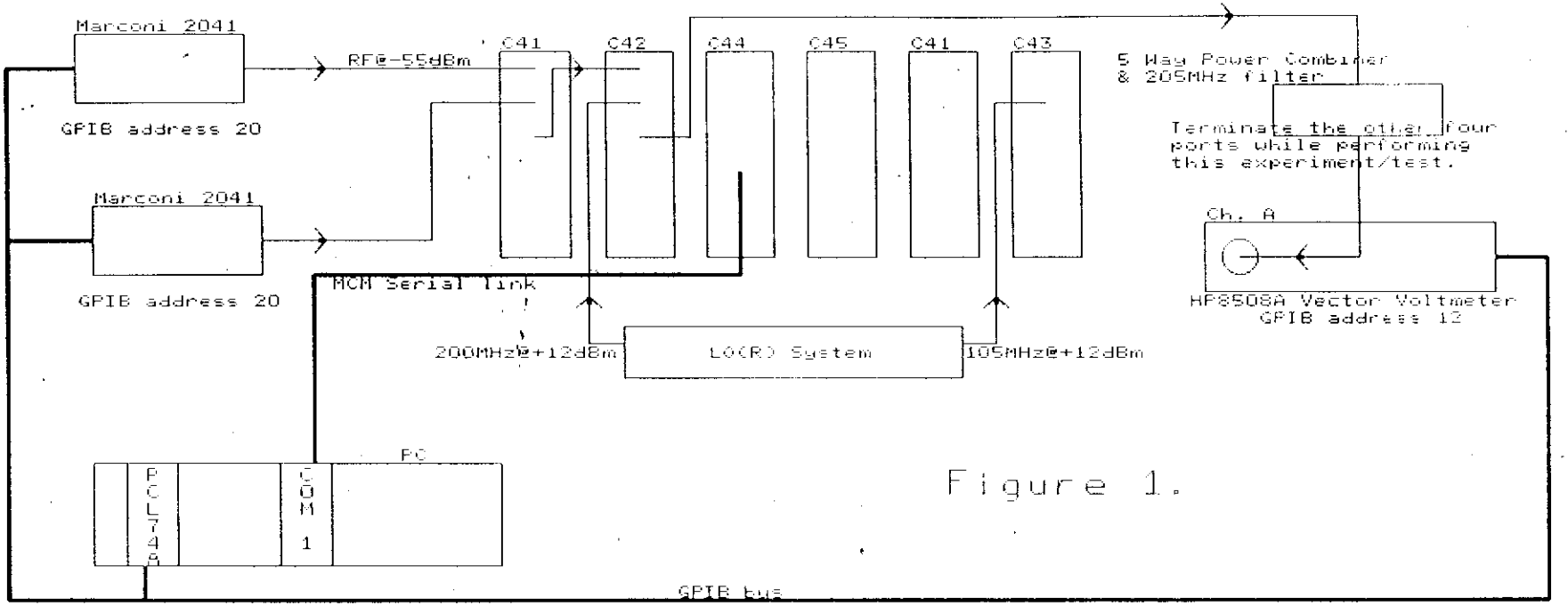
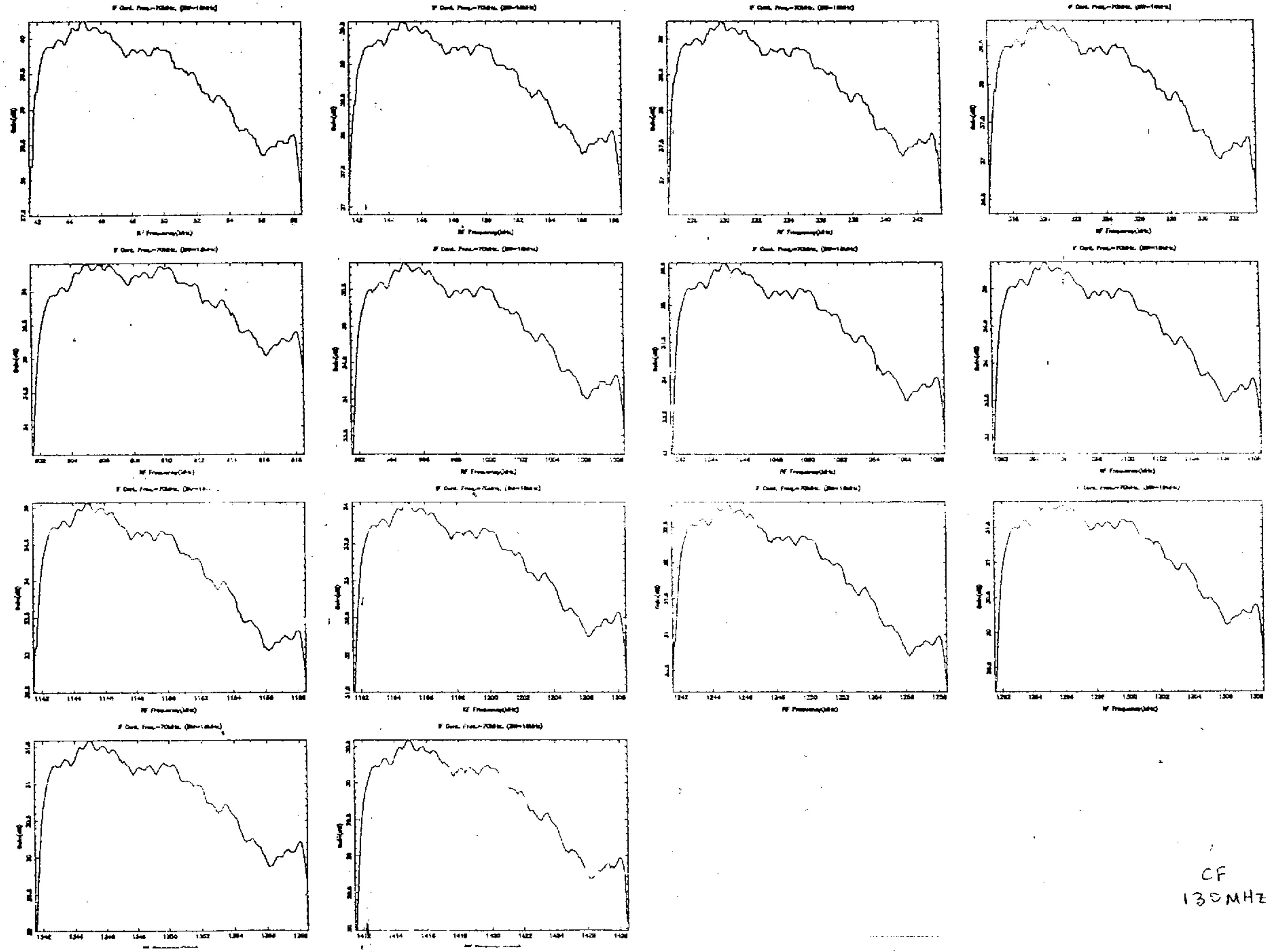


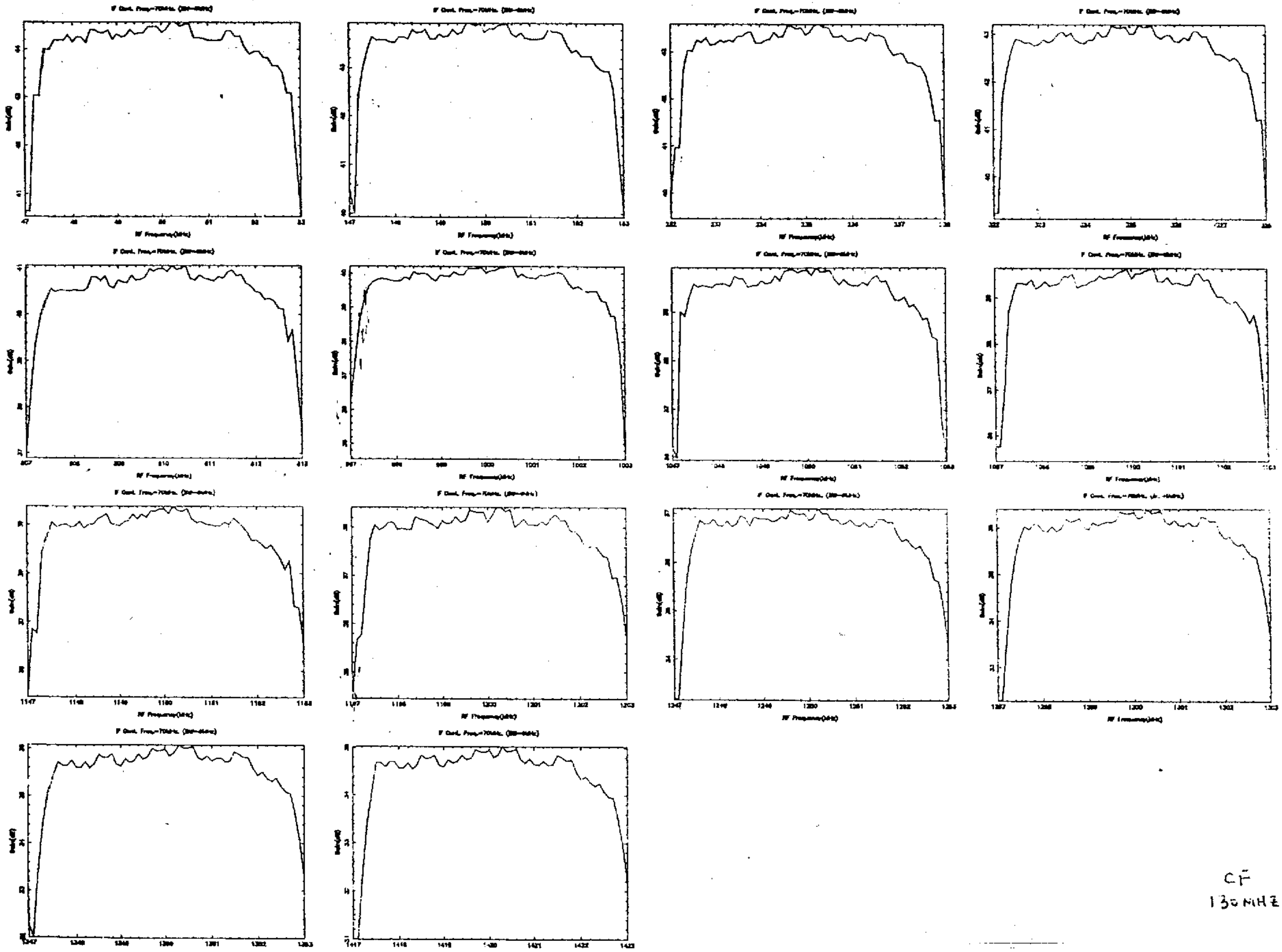
Figure 1.

Repeat similar setup and procedure for the other Polarisation Channel

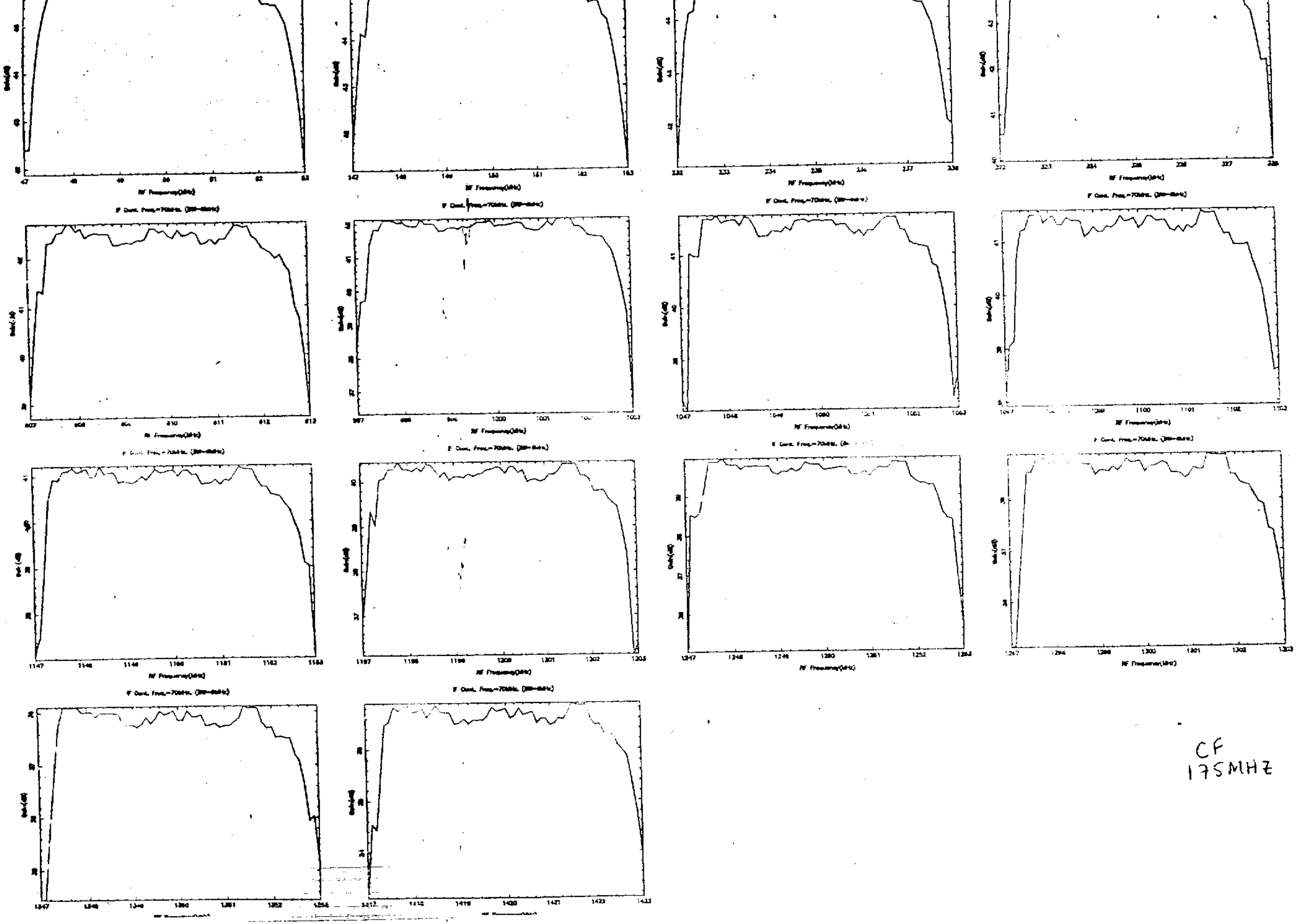
Data lines between C44,C45 and to C41,C42,C43 etc not shown here but required



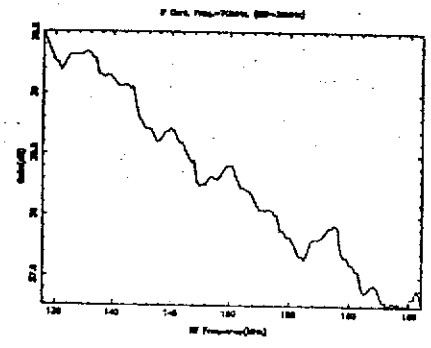
CF
130MHz

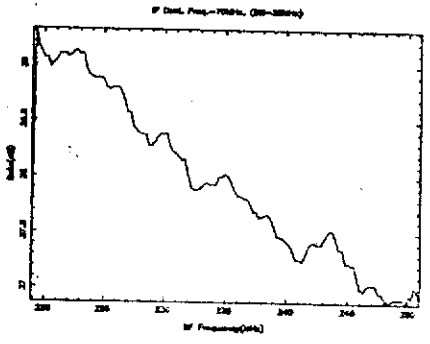


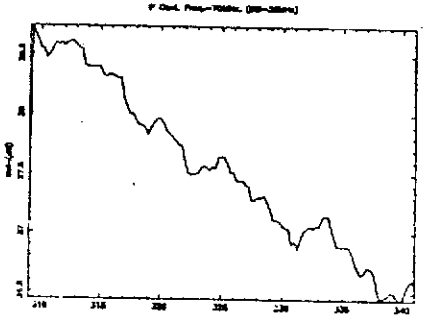
CF
130 MHZ

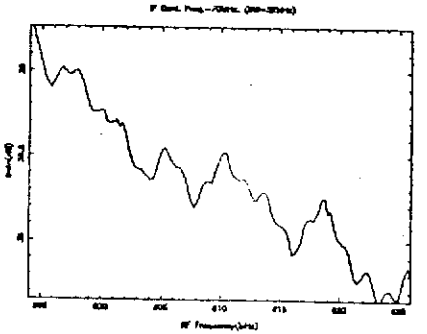


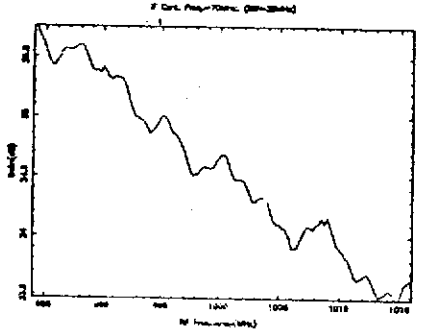
CF
175MHZ

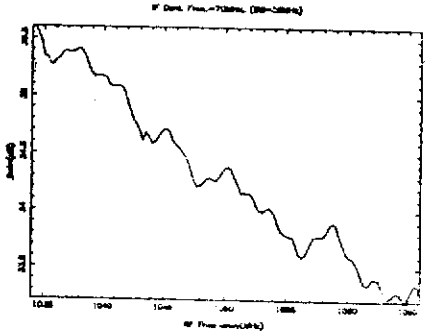


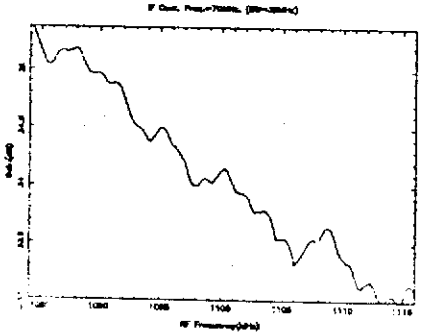


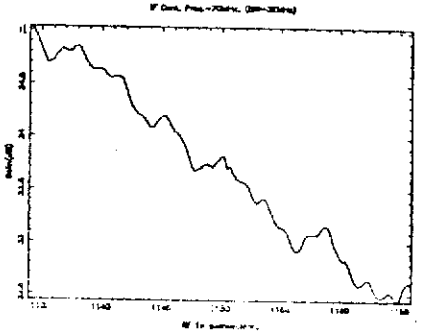


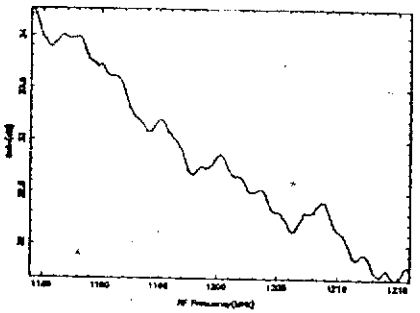


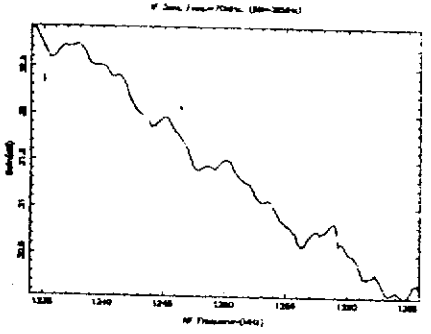


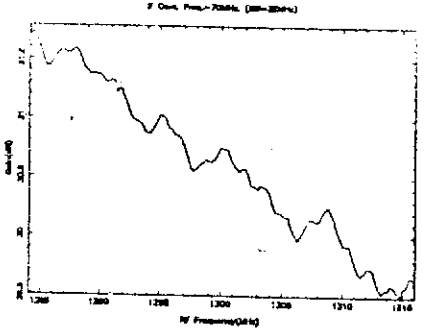


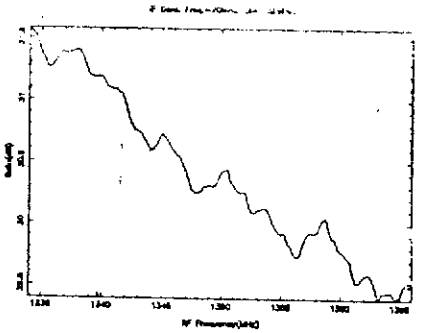


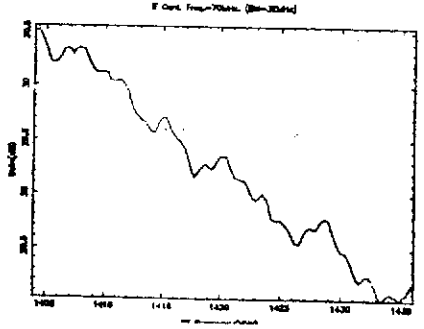




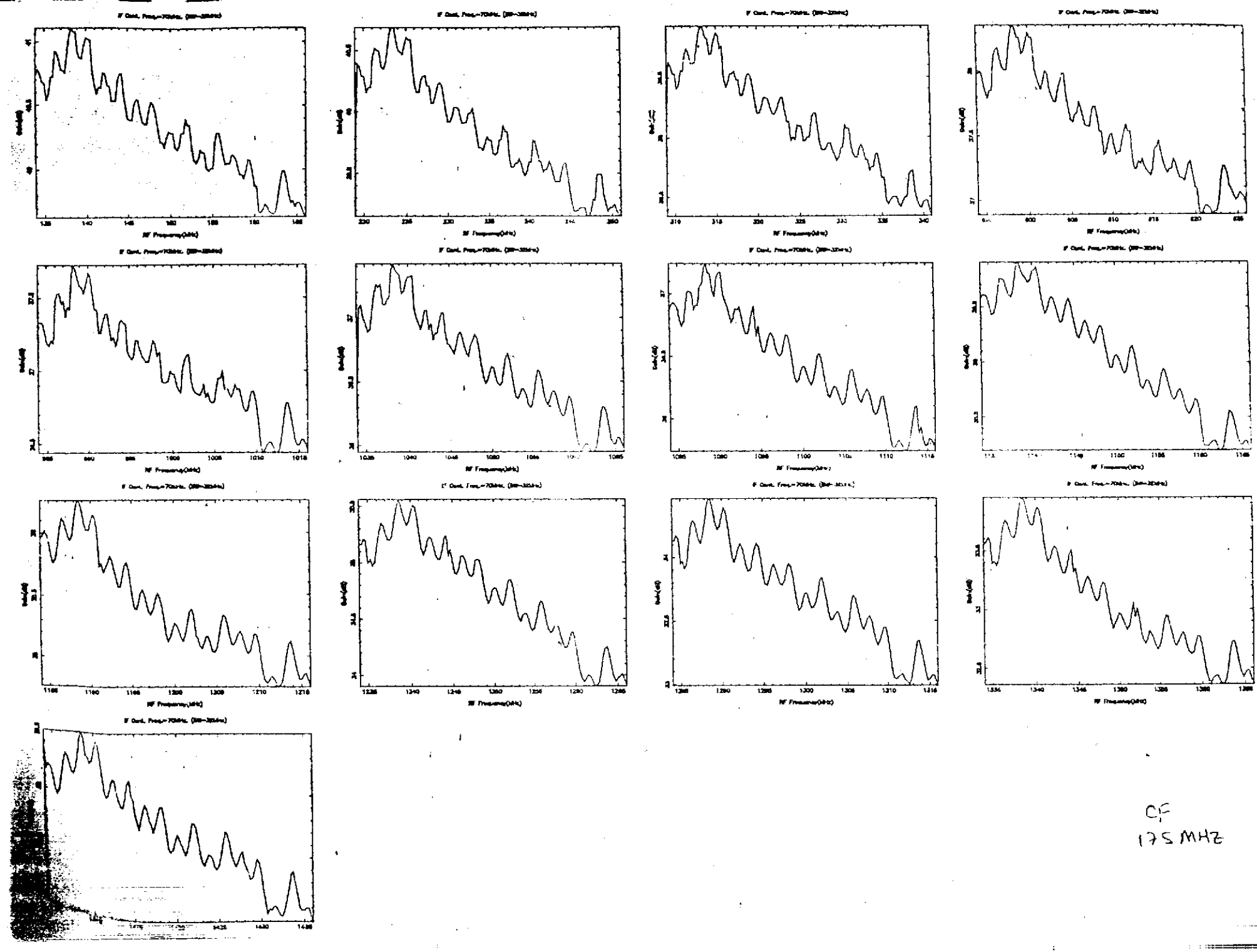




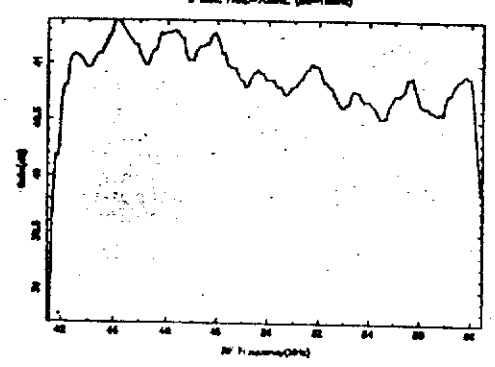


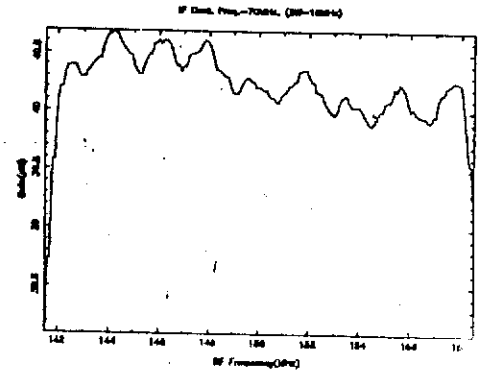


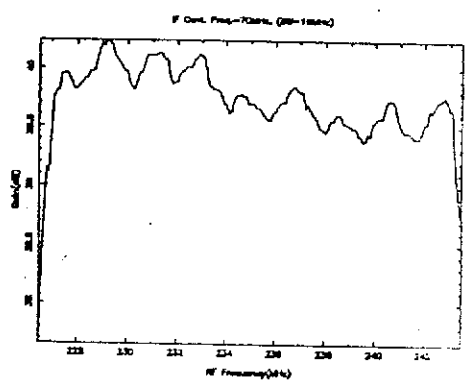
CF
130MHz

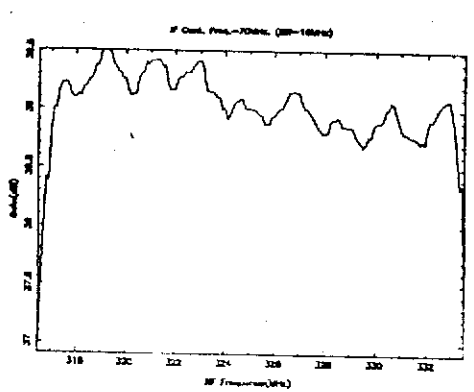


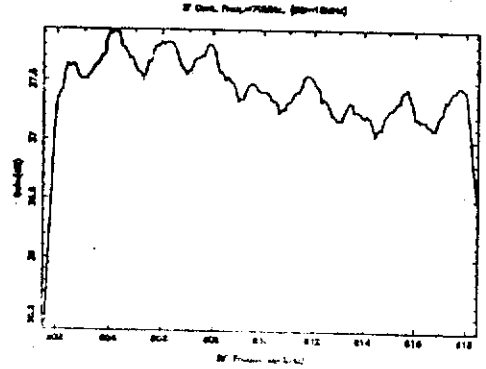
CF
175 MHz

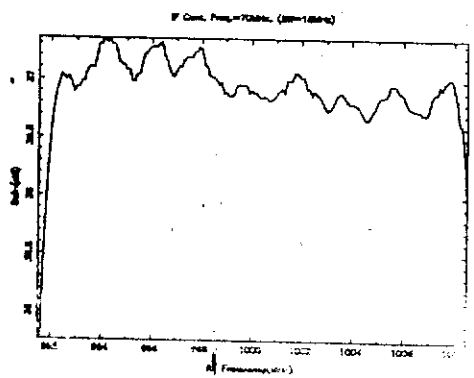


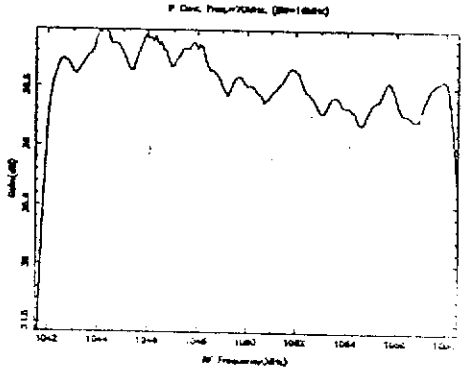


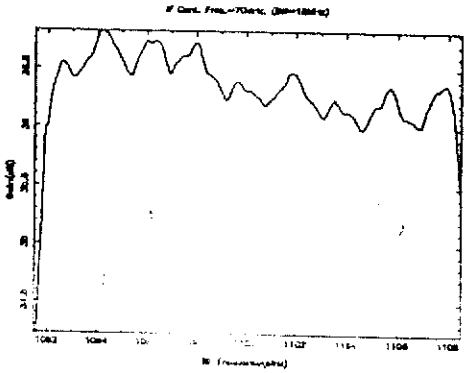


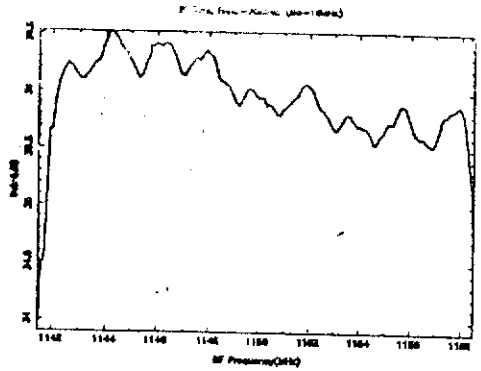


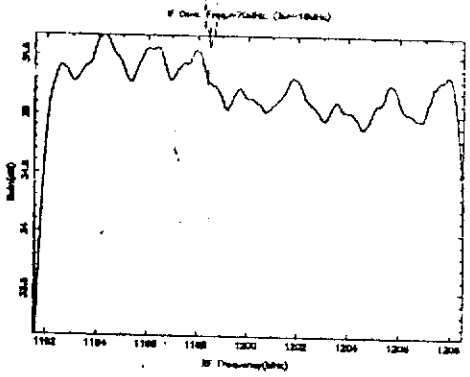


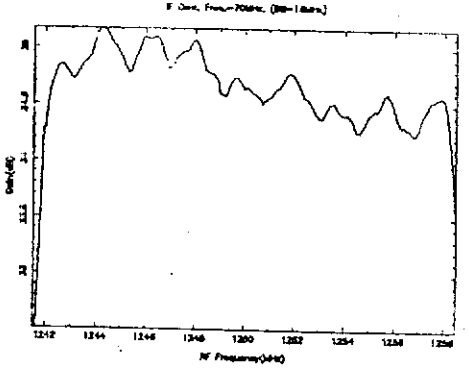


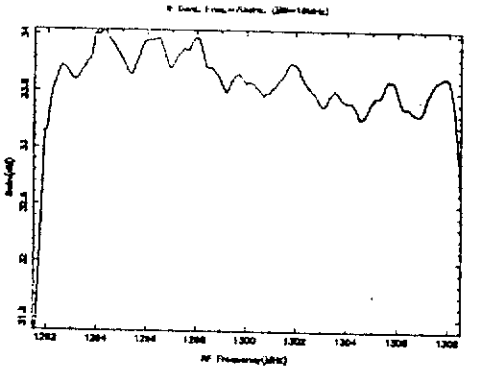


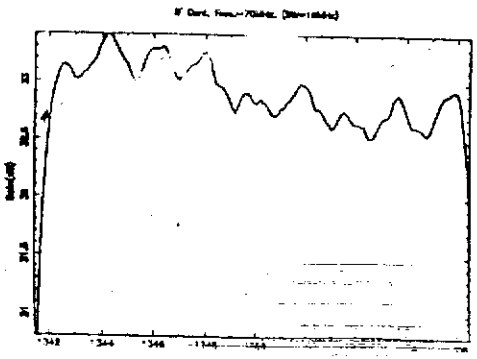


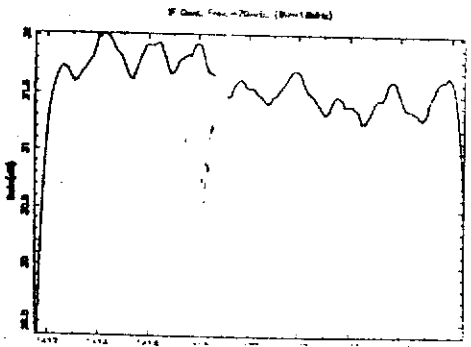












CF
175MHz

Table 1 (Readings with AGC turned ON)
Antenna C9, Channel 1

Default Settings: IF Attenuation=18dB, AGC Preattenuation=10dB, BW=16MHz.

Input CW @327MHz dBm	Output CW @130MHz dBm	AGC Control Voltage Count on Ch#4(front panel V)	Detector Output Count on Ch#6(front panel mV)
-57	-19.5	200(2.95)	28(-205)
-56	-18.7	205(2.96)	30(-233)
-55	-18	210(3.1)	32(-245)
-54†	-18	214(3.22)	32(-246)
-53	-18	214(3.3)	33(-248)
-52	-18	216(3.37)	33(-249)
-51	-18	216(3.42)	33(-250)
-50‡	-17.9	217(3.47)	33(-251)
-49	-17.9	219(3.52)	33(-252)
-48	-17.9	220(3.56)	33(-253)
-47	-17.9	220(3.59)	33(-254)
-46	-17.8	221(3.63)	33(-254)
-45	-17.8	221(3.66)	34(-255)
-44	-17.8	223(3.69)	34(-256)
-43	-17.7	225(3.72)	34(-256)
-42	-17.7	225(3.75)	34(-257)
-41	-17.7	225(3.77)	34(-258)
-40	-17.7	225(3.8)	34(-259)
-39	-17.7	225(3.82)	34(-260)
-38	-17.7	226(3.85)	34(-260)
-37	-17.7	227(3.87)	34(-261)
-36	-17.7	227(3.9)	34(-262)
-35	-17.7	228(3.92)	34(-263)
-34§	-17.7	228(3.94)	34(-263)
-33	-17.7	229(3.96)	34(-264)
-32	-17.7	230(3.98)	34(-265)
-31	-17.7	231(4.01)	34(-266)

Notes:
† AGC region begins.
‡ AGC_UNDER gets unasserted.
§ AGC_OVER gets asserted.

AGC_UNDER and AGC_OVER have been set conservatively. AGC_UNDER gets unasserted roughly 5dB after AGC region begins, while AGC_OVER get asserted a few dB before the usable AGC range ends. Hence, with proper precautions, system may be used even with these signals asserted.

Operating instructions for the new IF(R) system.

Kamaljee [illegible] Saini

Once all the PIUs of the system have been [illegible]ected, and RF, LO(S), LO(R), Optical fibre and telemetry connections made, the first step is to resort to default attenuation settings with AGC switched OFF (see Table 3.) and see if the total power output count is as listed therein (corresponding to about -17dBm output). If it is more, then keep stepping up the IF attenuator, two dB at a time, until the desired count is reached. If it is less, then keep stepping down the IF attenuator, two dB at a time, until the desired count is reached. If the IF attenuator reaches its limit (that is becomes 0dB or 30dB), then go over to the AGC preattenuator and carry out the same procedure. If power levels do not come anywhere near the listed value, then check the RF, LO(S) and LO(R) signals and their interconnection to the IF(R) system. This procedure is to be carried out for both the channels. After this, observations can be carried out in AGC OFF mode. If AGC is required to be ON, then after completing the above steps, resort to default [illegible] with AGC switched ON (see Tables 1 & 2.) Once this has been done, countercheck that AGC_LOW and AGC_HIGH signals for both the channels are not asserted. If any of these signals are asserted, then it means that the attenuation in the corresponding channel is too high (AGC_LOW) or it is too low (AGC_HIGH). This would normally happen if the above procedure has not been carried out properly, or if one or more of the inputs to the IF(R) systems has failed. (Check RF, LO(S) and LO(R) signals if such a condition persists.) Once it is ensured that both AGC_LOW and AGC_HIGH are not asserted on either channel, [illegible] to observe.§

Note: The monitor channels are mapped as listed below:

Signal name	Channel Number
AGC_UNDER (Ch. #1)	0
AGC_OVER (Ch. #1)	2
AGC Control Voltage (Ch. #1)	4
Detector Output (Ch. #1)	6
AGC_UNDER (Ch. #2)	8
AGC_OVER (Ch. #2)	10
AGC Control Voltage (Ch. #2)	12
Detector Output (Ch. #2)	14

The signals AGC_UNDER, AGC_OVER are TTL logic. Asserted means a count of around 230, while unasserted means a count of around 120 on the corresponding channel.

§ At present, the AGC_UNDER and AGC_OVER have been set conservatively. Therefore, system may be operated with caution even with these lines asserted. See the footnotes on Table 1 and 2 for more information in this respect.

Table 3 (Readings with AGC turned OFF)

Antenna C9.

Default Settings Ch. #1: IF Attenuation=18dB, AGC Preattenuation=10dB, BW=16MHz.

Default Settings Ch. #2: IF Attenuation=16dB, AGC Preattenuation=10dB, BW=16MHz.

Input CW	Output CW		Output CW	
@327MHz	@130MHz(Channel 1)		@175MHz(Channel 2)	
dBm	dBm	Count on Ch# 6(Det. Output in mV)	dBm	Count on Ch# 6(Det. Output in mV)
OFF	OFF	3(-18)	OFF	3(-22)
-57	-19.1	25(-193)	-19.1	23(-180)
-56	-18	27(-219)	-18.2	28(-205)
-55	-17	30(-247)	-17	33(-233)
-54†	-15.9	35(-282)	-16.1	35(-266)
-53	-14.9	40(-316)	-15.2	40(-300)
-52	-14.1	44(-353)	-14.2	45(-338)
-51	-13.1	49(-391)	-13.2	50(-379)
-50	-12.1	55(-431)	-12.2	55(-422)
-49	-11	62(-472)	-11.2	59(-467)
-48	-9.9	65(-517)	-10.2	67(-517)
-47	-9.1	72(-559)	-9.1	72(-563)
-46	-8	78(-604)	-8	78(-612)
-45	-7	82(-647)	-7.2	82(-661)
-44	-6.1	90(-691)	-6.2	90(-711)
-43	-5.4	94(-732)	-5.3	96(-762)
-42	-4.5	98(-773)	-4.5	104(-818)
-41	-3.9	100(-803)	-3.9	110(-868)
-40‡	-3.2	104(-826)	-3.2	115(-915)
-39	-3.2	105(-844)	-2.8	120(-957)
-36	-2.1	110(-890)	-1.8	130(-1049)

Notes:

† Minimum input level to output desired power to the optical fibre.

‡ Input corresponding to 1dB compression point of the IF(R) system.

Table 2 (Readings with AGC turned ON)
Antenna C9, Channel 2

Default Settings: IF Attenuation=16dB, AGC Preattenuation=10dB, BW=16MHz.

Input CW @327MHz dBm	Output CW @175MHz dBm	AGC Control Voltage Count on Ch#12(front panel V)	Detector Output Count on Ch#14(front panel mV)
-57	-19.5	211(3.24)	25(-212)
-56	-18.4	211(3.24)	31(-239)
-55†	-17.3	212(3.25)	34(-265)
-54	-17.3	213(3.3)	34(-272)
-53	-17.3	213(3.35)	34(-276)
-52	-17.3	214(3.4)	34(-276)
-51	-17.3	215(3.44)	34(-277)
-50‡	-17.3	216(3.48)	35(-278)
-49	-17.3	217(3.51)	35(-279)
-48	-17.3	218(3.54)	35(-281)
-47	-17.3	218(3.58)	36(-282)
-46	-17.3	219(3.6)	36(-283)
-45	-17.3	220(3.63)	36(-284)
-44	-17.3	221(3.66)	36(-285)
-43	-17.3	222(3.68)	36(-287)
-42	-17.3	223(3.71)	38(-288)
-41	-17.3	223(3.73)	38(-290)
-40	-17.3	224(3.76)	38(-291)
-39	-17.3	225(3.78)	38(-292)
-38	-17.3	225(3.8)	38(-294)
-37	-17.3	225(3.83)	38(-295)
-36	-17.3	226(3.85)	38(-297)
-35	-17.3	226(3.87)	39(-299)
-34	-17.3	227(3.89)	39(-301)
-33§	-17.3	229(3.92)	39(-303)
-32	-17.3	229(3.94)	39(-304)
-31	-17.3	230(3.96)	40(-307)

Notes:
† AGC region begins.
‡ AGC_UNDER gets unasserted.
§ AGC_OVER gets asserted.

AGC_UNDER and AGC_OVER have been set conservatively. AGC_UNDER gets unasserted roughly 5dB after AGC region begins, while AGC_OVER get asserted a few dB before the usable AGC range ends. Hence, with proper precautions, system may be used even with these signals asserted.

- Monitor Card.

This card was added to facilitate setting up proper attenuation values in the IF(R) system, so that optimum quiescent power levels are maintained. It will also serve to warn the user when the AGC input power level falls below a preset absolute minimum power level and AGC becomes linear in operation due to this reason. It also generates a warning when AGC input power level is higher than a preset absolute maximum level. The card also processes the voltage provided by the AGC output total power detector, and gives an indication of the output RF levels of the IF(R) channel.

□ Software Changes:

- The new runfiles are to be generated using the program "if_r_settings" whose C-source code is with me. It prompts for the settings required and generates a runfile based on the responses of the user.

- The MCM address assigned for the new IF(R) system is 9, instead of the usual 4. This has been done to ward off the confusion whether a particular station has the older or the newer version of the IF(R) system. All old version IF(R) systems shall have their MCM addresses as 4 while all the newer ones shall be assigned the address of 9. Thus even if the runfile of the older system is used for the newer system, it will not disturb the settings on the newer system and vice-versa. Simultaneously, a MCM time out error thus generated will serve to warn the user that something is wrong. This scheme will be retained for some time to come to avoid mistakes and confusion.

Upgrade manual for the IF(R) system. (Antenna number five onwards.)

Kamaljeet Singh Saini

The hardware as well as operational changes in the new systems over the previous systems are listed here.

☐ **Hardware changes:** The units which have undergone modification are: Programmable Attenuator (henceforth referred to as the IF attenuator), Automatic Level Controller / Automatic Gain Controller and the IF Control Card. Another Programmable Attenuator, similar in operation and characteristics to the IF attenuator has been included just before the AGC stage. Henceforth, this attenuator shall be referred to as AGC Preattenuator. A new monitor card facility has been added.

• Programmable Attenuator.

Unlike the older programmable attenuator, which had only 0dB, 4dB, 8dB and 12dB settings, this unit has 0dB through 30dB settings in 2dB resolution steps. This gives more flexibility to handle any variations in input power levels at different frequency bands.

• Automatic Level Controller / Automatic Gain Controller.

This unit is now built around the new HP device IVA05208, and not around the HP3188 pin diodes as was done earlier. This has enabled to enhance the AGC dynamic range to a value in excess of 20dB from the previous 7 or 8dB. The AGC unit now also incorporates a total power detector to permit monitoring of power levels being output by the IF(R) system. This can be used in conjunction with the IF attenuator and the AGC attenuator to set for the optimum quiescent level for the AGC operation as explained later on in this note. Also the new AGC unit is designed to attenuate frequencies above 200MHz unlike the old unit whose passband was flat upto one GHz or so. (Highest frequency that will ever be needed to pass through the AGC is the upper edge of the 175MHz polarisation, which is 191MHz when using full 32MHz bandwidth.)

• AGC Preattenuator.

This unit is identical in function to the IF Attenuator and provides additional fixed attenuation (programmable) of 0dB through 30dB in 2dB resolution steps. It further enhances the flexibility of the signal chain as far as handling of different power levels is concerned.

• IF Control Card.

The number of control lines required for the new system is much more than what was necessary in the old system. The control card was therefore modified to meet this increased requirement. The control architecture philosophy was totally changed to generate more control signals from the MCM. Consequently, the bit-pattern required to effect the desired control too has changed. This means that old runfiles existing for the old system are not usable for the new system. New runfiles can be created as detailed later. Using old runfiles to set up the new system will yield unexpected / undefined results.

A note on the optimum RF and IF(Remote) attenuator settings and calculation of the maximum signal handling capability of the receiver system.

Rakesh Malik & Kamaljeet Singh Saini

This note presents the signal levels at the RF-IF as well as the IF-Optical fiber interface. The calculations were performed to maximize the dynamic range of the system and to minimize the signal degradation down the link.

The calculations were performed for the optical system to determine the signal level that has to be provided at the IF output, so that the optical noise contribution is within 1%. The required signal power level was found to be -17dBm per 32MHz channel(See Fig. 1 & 5).

Calculations were then carried out for the optimum attenuator settings in the IF chain for different levels of input RF satisfying the following criteria:

- IF output power levels shall be -17dBm / 32MHz channel.
- Noise contribution from the IF shall be within 0.5% or 1.0%. (Results tabulated separately for the two cases)
- For any given level of input RF, the selected attenuator settings should provide the maximum possible instantaneous dynamic range.

The results of this optimization are presented in Fig.2(a) & 2(b).

Based on the numbers given in Fig.3 calculations were performed to obtain minimum and maximum solar attenuator settings for various input signal levels to the RF prime focus electronics. For a given incident signal level, the minimum and maximum solar attenuator settings provide an RF output which would be compatible with the IF input requirements as already listed in Fig.2. Calculations were made for the 150MHz, 233MHz, 327MHz, 610MHz and the 1420MHz RF signal chains and the results are as tabulated in Fig.4 (a) through (e).

Input temperatures gave been chosen to range from T_{sys} for cold sky to T_{sys} when the power at P2 is approximately 20dB below the 1 dB compression point.

Fig.4(a) Tabulation for the 150MHz band.

T_{inp} K	Equiv. Power (dBm)		Power at P2 (dBm)		Solar Attn. (dB)		Power at P4 (dBm) in 32MHz	
	BW=32MHz	BW=100MHz	BW=32MHz	BW=100MHz	Max.	Min.	Min.	Max.
580	-96	-91	-62	-57	14	0	-56	-42
10^3	-93	-88	-59	-54	14	0	-53	-39
10^4	-83	-78	-49	-44	30	14	-59	-43
10^5	-73	-68	-39	-34	44	14	-63	-33
10^6	-63	-58	-19	-24	44	30	-53	-39

Fig.4(b) Tabulation for the 233MHz band.

T_{inp} K	Equiv. Power (dBm)		Power at P2 (dBm)		Solar Attn. (dB)		Power at P4 (dBm) in 32MHz	
	BW=32MHz	BW=100MHz	BW=32MHz	BW=100MHz	Max.	Min.	Min.	Max.
250	-100	-95	-63	-58	14	0	-59	-45
10^3	-94	-89	-57	-52	30	0	-69	-39
10^4	-84	-79	-47	-42	30	14	-59	-43
10^5	-74	-69	-37	-32	44	14	-63	-33
10^6	-64	-59	-27	-22	44	30	-53	-39

Fig.4(c) Tabulation for the 327MHz band.

T_{inp} K	Equiv. Power (dBm)		Power at P2 (dBm)		Solar Attn. (dB)		Power at P4 (dBm) in 32MHz	
	BW=32MHz	BW=100MHz	BW=32MHz	BW=100MHz	Max.	Min.	Min.	Max.
100	-103	-98	-66	-61	14	0	-64	-50
10^3	-93	-88	-56	-51	30	0	-70	-40
10^4	-83	-78	-46	-41	30	14	-60	-44
10^5	-73	-68	-36	-31	44	30	-64	-50
10^6	-63	-58	-26	-21	44	30	-54	-40

Fig.4(d) Tabulation for the 610MHz band.

T_{inp} K	Equiv. Power (dBm)		Power at P2 (dBm)		Solar Attn. (dB)		Power at P4 (dBm) in 32MHz	
	BW=32MHz	BW=100MHz	BW=32MHz	BW=100MHz	Max.	Min.	Min.	Max.
100	-103	-98	-68	-63	0	0	-57	-57
10^3	-93	-88	-58	-53	14	0	-61	-47
10^4	-83	-78	-48	-43	30	0	-67	-37
10^5	-73	-68	-38	-33	30	14	-57	-41

Fig.4(e) Tabulation for the 1420MHz band.

T_{inp} K	Equiv. Power (dBm)		Power at P2 (dBm)		Solar Attn.(dB)		Power at P4 (dBm) in 32MHz	
	BW=32MHz	BW=100MHz	BW=32MHz	BW=100MHz	Max.	Min.	Min.	Max.
100	-103	-98	-63	-58	0	0	-65	-65
10^3	-93	-88	-53	-48	0	0	-55	-55
10^4	-83	-78	-43	-38	14	0	-59	-45
10^5	-73	-68	-33	-28	30	0	-65	-35
10^6	-63	-58	-23	-18	30	0	-55	-25

Note: Points P2 and P4 are as marked in Fig.3.

Conclusions/Comments:

☐ Instantaneous Dynamic range is limited to 14dB. However for slowly varying signals, dynamic range is 28dB with ALC-1 on.

☐ Since the dynamic range is limited by the ALC-1 amplifier, it would appear that dynamic range could improve if the IF output power level is brought down to a lower level either by inserting more gain at the IF output(after ALC-1) or at the optical fiber input. However, this is not true, since this would require reduction of the IF gain, which in turn would enhance the noise figure of the chain. As a result, for a given RF input level to the IF system, the noise contribution will exceed specified limits.

☐ According to Fig.4 (a) through (e) removal of the "post amplifier" stage in 150MHz, 233MHz, and 327MHz bands will not cause any signal level problems at the RF-IF interface. The "post amplifiers" at 610MHz & 1420MHz bands should be retained as in the present configuration.

Link calculations for the Optical System.

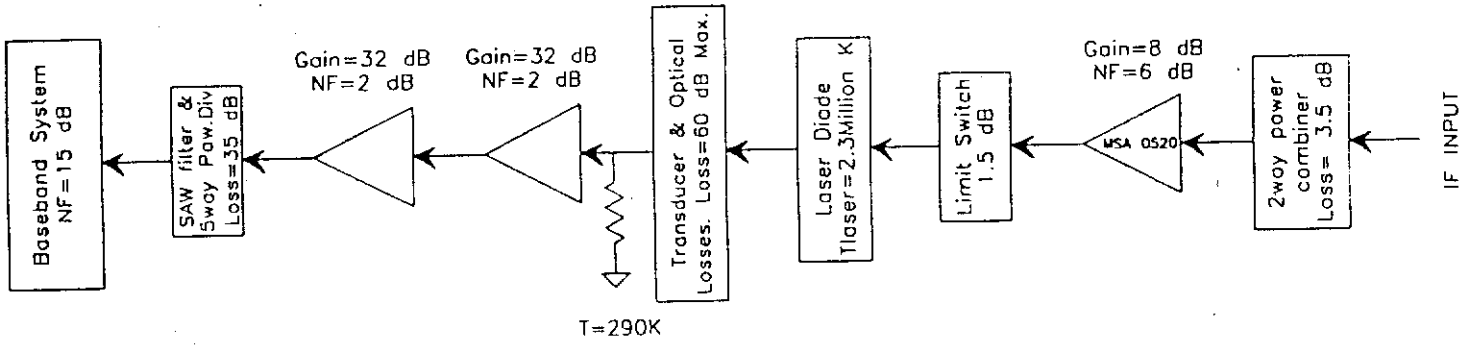


FIGURE - 1

Teq of the Optical System at IF output is 3.9E+08 K

This corresponds to a power level of −37dBm in a bandwidth of 32MHz. Hence to have a 1% noise contribution, the power fed to the optical system (which is the desired IF output level), should be −17dBm.

APK/SAINI

Quiescent RF Power Levels at IF-system and Optical system interface.

(A meeting was held to resolve the issue of Power Levels at the interface, on 10/02/1994. The following were present:)

- T.L.Venkatasubramani
- D.S.Sivaraj
- K.S.Saini

A rough sketch of the components present at the interface is given below. The RF Power levels present at various points are indicated in the diagram. The output of the 5 way combiner is the output of the Remote Receiver Rack which is fed to the Optical Rack. Currently the power level at this point is adjusted to −14dBm/IF channel. This works out at be −20dBm at the laser diode input which is less than the stipulated value of −14dBm.

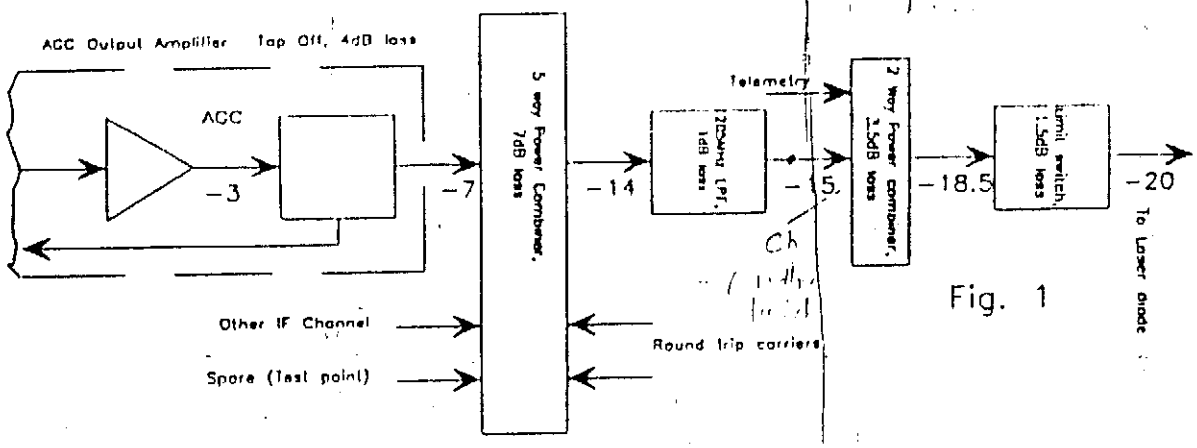


Fig. 1

With the current operating levels, the final output amplifier of the AGC in the IF system is operating at a level of −3dBm, which corresponds to an IMD performance of −46dBc. If IMD performance is not to be sacrificed, then the deficit of power at the laser diode cannot be made up by shifting the output level of the AGC by 6dB. It was therefore decided to add an 8dB modular amplifier MSA0520 of AVANTEK make (whose compression point is sufficiently high), and reduce the IF gain and the AGC operating level by 2dB. This gives the required operating levels as shown below.

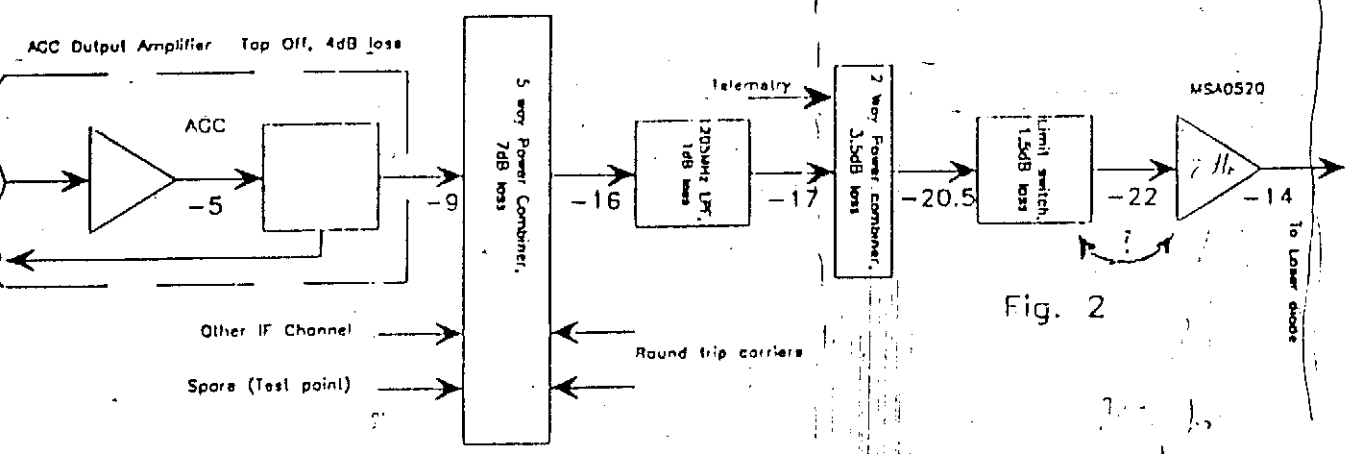
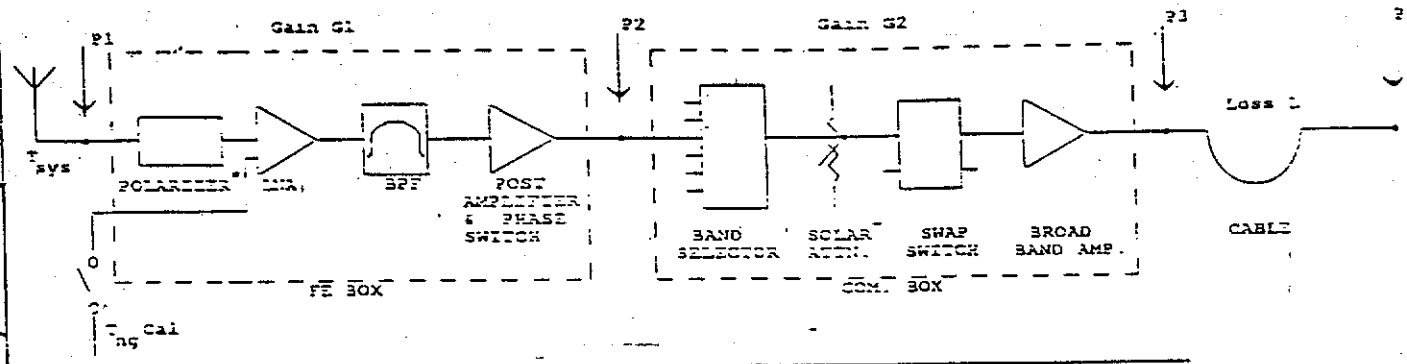


Fig. 2

Minuted by K.S.Saini

FIGURE - 5

LEVEL DIAGRAM [32-MHz BANDWIDTH]



FREQUENCY BAND [MHz]	T_{sys} [K]	P1 [dBm]	G1 [dB]	P2 [dBm]	G2* [dB]	P3 [dBm]	L [dB]	P4 [dBm]	
50	8170	-84	15	-69	29	-40	4	-44	±3
150	580	-96	34	-62	28	-34	9	-42	
233	234	-100	37	-63	27	-36	9	-45	
325	108	-103	38	-65	27	-38	11	-49	
610	101	-104	35	-69	26	-43	15	-58	-58
1420	72	-105	40	-65	21	-44	23	-67	-67

TYPICAL NOISE GENERATOR CALIBRATION LEVELS [T_{ng} Cal]

Freq. Band [MHz]	T_{ng} Cal. steps [K]			
	Extra Hi Cal	High Cal.	Medium Cal.	Low Cal.
1390	600	150	60	15
1290	640	160	64	16
1170	720	180	72	18
1060	760	190	76	19
610	400	100	40	10
327	400	100	40	10
233	800	200	80	20
150	800	400	80	40
50	10000	5000	1000	500

*) Solar attenuator setting: 0dB, 14dB, 30dB or 44dB.

**) For 0 dB solar attenuator setting.

***) The polarizer is incorporated after the LNA in the 1420 MHz receiver.

NCRA INDIA	GIANT METERWAVE RADIOTELESCOPE PROJECT	
	Title: FRONT END SYSTEM POWER LEVEL DIAGRAM	
Drwn: Srinivas M.	Size: A	Document Number:	REV: 5
Apprd: A.Praveen Kumar	Date: June 9, 1994	Sheet 25

BAND (MHz)	P2 1dB COMP	P4 1dB COMP 0dB SOLAR	P4 1dB COMP 14dB SOLAR	P4 1dB COMP 30dB SOLAR	P1 1dB COMP 44dB SOLAR
50		0			
150	-11	-1			
233	-14	-3			
325	-14	-1			
610	-12	-1	-15		
1420	0				

FIGURE - 3

Optimum IF attenuator settings upto 610MHz band for 0.5% noise contribution.

Available IF Dynamic Range (dB)	IF Attenuation (dB)	AGC Preattenuation (dB)	Min RF input to IF (dBm)	IF Gain (dB)
14.000	30	30	-32.000	15.000
14.000	28	30	-34.000	17.000
14.000	26	30	-36.000	19.000
14.000	24	30	-38.000	21.000
14.000	22	30	-40.000	23.000
14.000	20	30	-42.000	25.000
14.000	18	30	-44.000	27.000
14.000	16	30	-46.000	29.000
14.000	14	30	-48.000	31.000
14.000	12	30	-50.000	33.000
14.000	10	30	-52.000	35.000
14.000	08	30	-54.000	37.000
14.000	06	30	-56.000	39.000
14.000	04	30	-58.000	41.000
14.000	02	30	-60.000	43.000
14.000	00	30	-62.000	45.000
14.000	00	28	-64.000	47.000
14.000	00	26	-66.000	49.000

Optimum IF attenuator settings upto 610MHz band for 1.0% noise contribution.

Available IF Dynamic Range (dB)	IF Attenuation (dB)	AGC Preattenuation (dB)	Min RF input to IF (dBm)	IF Gain (dB)
14.000	30	30	-32.000	15.000
14.000	28	30	-34.000	17.000
14.000	26	30	-36.000	19.000
14.000	24	30	-38.000	21.000
14.000	22	30	-40.000	23.000
14.000	20	30	-42.000	25.000
14.000	18	30	-44.000	27.000
14.000	16	30	-46.000	29.000
14.000	14	30	-48.000	31.000
14.000	12	30	-50.000	33.000
14.000	10	30	-52.000	35.000
14.000	08	30	-54.000	37.000
14.000	06	30	-56.000	39.000
14.000	04	30	-58.000	41.000
14.000	02	30	-60.000	43.000
14.000	00	30	-62.000	45.000
14.000	00	28	-64.000	47.000
14.000	00	26	-66.000	49.000
14.000	00	24	-68.000	51.000
14.000	00	22	-70.000	53.000

Optimum IF attenuator settings for the 1420MHz band for 0.5% noise contribution.

Available IF Dynamic Range (dB)	IF Attenuation (dB)	AGC Preattenuation (dB)	Min RF input to IF (dBm)	IF Gain (dB)
14.000	30	30	-22.000	5.000
14.000	28	30	-24.000	7.000
14.000	26	30	-26.000	9.000
14.000	24	30	-28.000	11.000
14.000	22	30	-30.000	13.000
14.000	20	30	-32.000	15.000
14.000	18	30	-34.000	17.000
14.000	16	30	-36.000	19.000
14.000	14	30	-38.000	21.000
14.000	12	30	-40.000	23.000
14.000	10	30	-42.000	25.000
14.000	08	30	-44.000	27.000
14.000	06	30	-46.000	29.000
14.000	04	30	-48.000	31.000
14.000	02	30	-50.000	33.000
14.000	00	30	-52.000	35.000
14.000	00	28	-54.000	37.000
14.000	00	26	-56.000	39.000
14.000	00	24	-58.000	41.000
14.000	00	22	-60.000	43.000
14.000	00	20	-62.000	45.000
14.000	00	18	-64.000	47.000

Optimum IF attenuator settings for the 1420MHz band for 1.0% noise contribution.

Available IF Dynamic Range (dB)	IF Attenuation (dB)	AGC Preattenuation (dB)	Min RF input to IF (dBm)	IF Gain (dB)
14.000	30	30	-22.000	5.000
14.000	28	30	-24.000	7.000
14.000	26	30	-26.000	9.000
14.000	24	30	-28.000	11.000
14.000	22	30	-30.000	13.000
14.000	20	30	-32.000	15.000
14.000	18	30	-34.000	17.000
14.000	16	30	-36.000	19.000
14.000	14	30	-38.000	21.000
14.000	12	30	-40.000	23.000
14.000	10	30	-42.000	25.000
14.000	08	30	-44.000	27.000
14.000	06	30	-46.000	29.000
14.000	04	30	-48.000	31.000
14.000	02	30	-50.000	33.000
14.000	00	30	-52.000	35.000
14.000	00	28	-54.000	37.000
14.000	00	26	-56.000	39.000
14.000	00	24	-58.000	41.000
14.000	00	22	-60.000	43.000
14.000	00	20	-62.000	45.000
14.000	00	18	-64.000	47.000
14.000	00	16	-66.000	49.000
14.000	00	14	-68.000	51.000

FIGURE 2B