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G00174

Automated Testing of Frontend Subsystem

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STP – 2004 Project

Introduction

Frontend devices, which include Front End and Common Boxes, mounted on the top of GMRT antenna combining together forms an integral part of *Super Heterodyne Receiving System*. This whole system works as a nucleus for antenna because this is where a typical radio signal which has a power of only $2 \times 10^{-15} \text{W}$ is highly amplified and brought down to a lower frequency for further processing. (Block diagram 1)

This whole process of amplification and down conversion requires frontend devices to work with high precision and accuracy. For that all frontend as well common boxes (50, 150, 233, 327 and 1120) were used to be manually tested where one had to toil away for hours. My job was to automate this whole testing procedure using GPIB interface.

GPIB (IEEE-488) Interface:

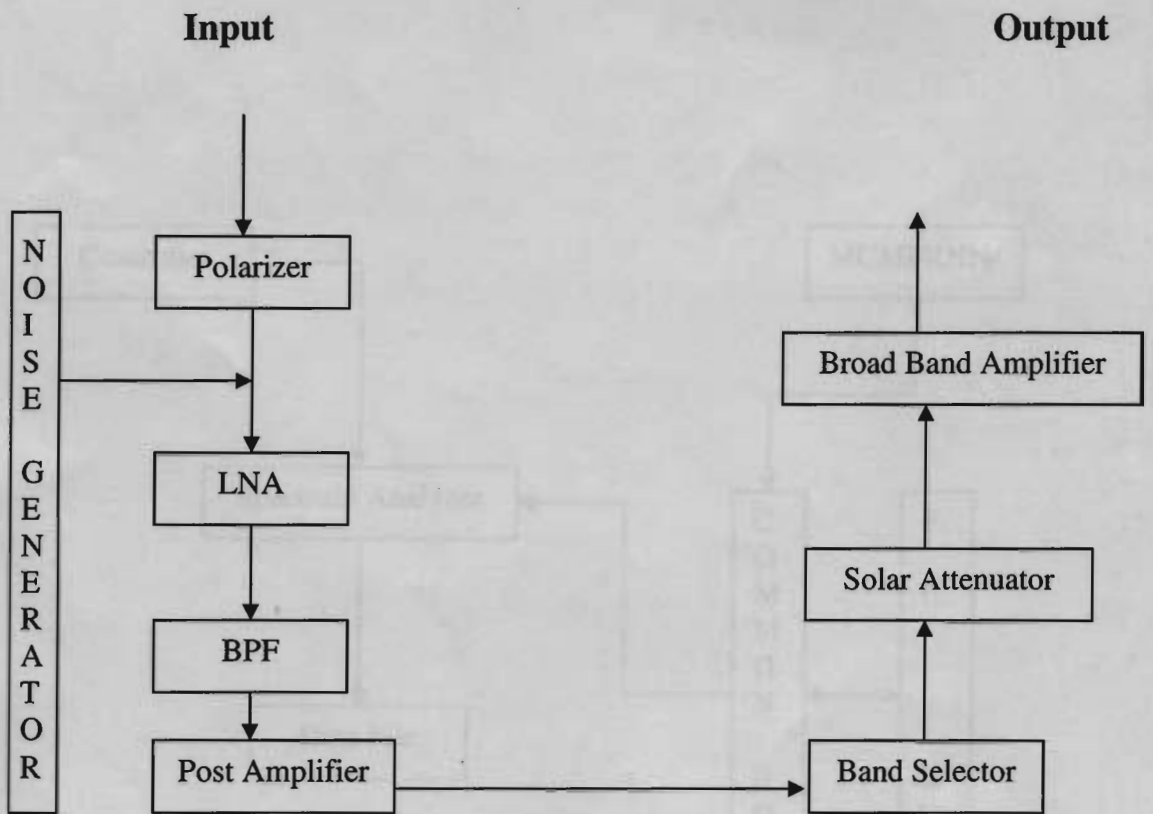
If the whole communication era is divided into 4 phases, It was in 3rd phase when serial port communication was embarked upon with introduction of RS-232. Just a little while later Hewlett –Packard launched HP-IB (Hewlett Packard Interface Bus), what is now known as GPIB (General Purpose Interface Bus, IEEE 488 standard), for parallel transfer of data (8-bits) as fast as 1Mbytes per second to connect their line of programmable instruments to their computers. Followings are the major features of PCI-GPIB card.

A digital 8-bit parallel communications interface.

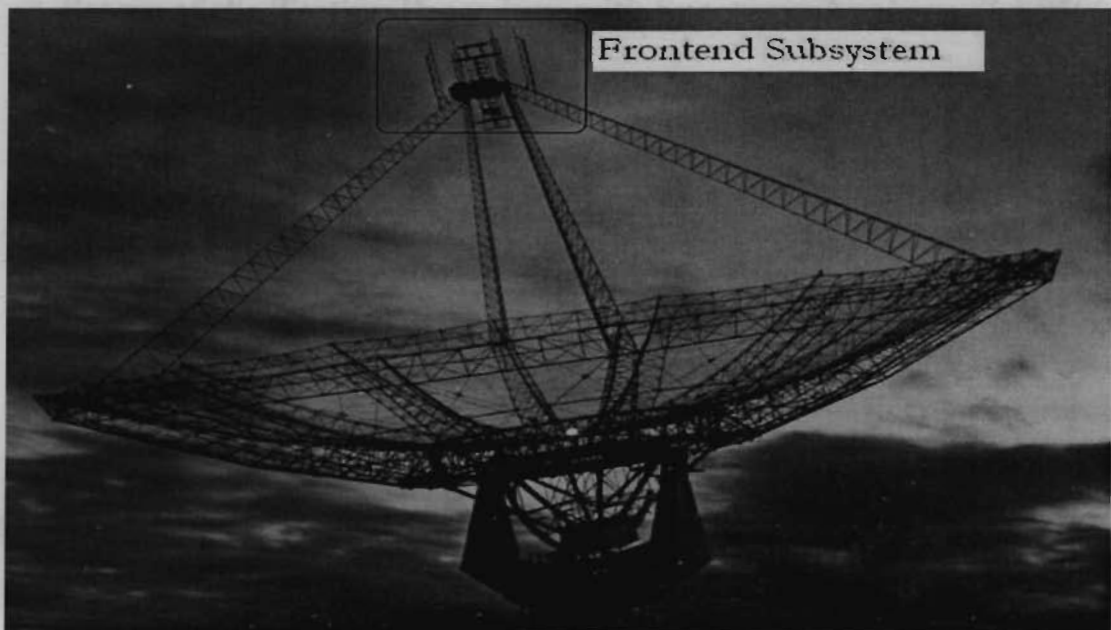
It allows up to 15 devices to be interconnected on one bus.

The system consists of 16 signal lines (8 data lines, 3 handshake lines, and 5 interface management lines) and 8 ground lines.

Data transfer rates up to 1 Mbyte/s.



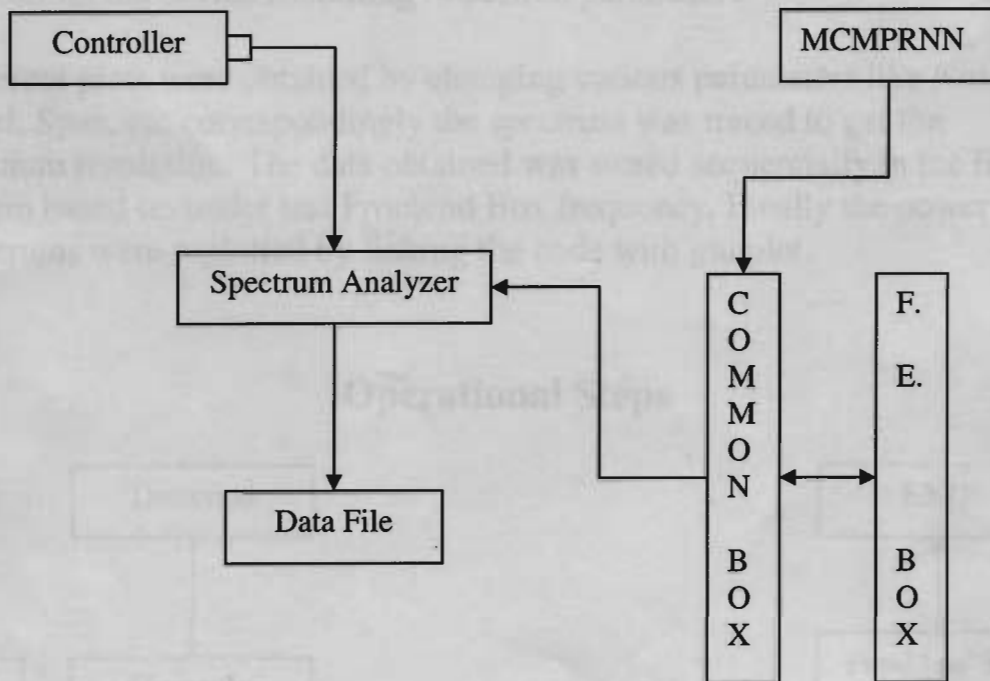
1. Block Diagram of the Front-end Subsystem



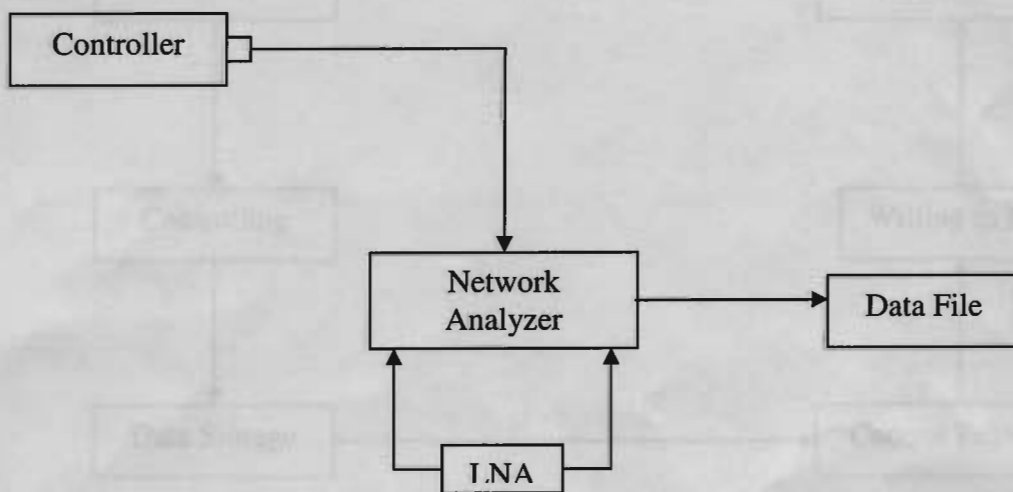
Pictorial view of GMRT antenna (FE Subsystem is encircled)

Steps Involved in Automated Testing

The first step was to set up the whole system as shown in the block diagram (2) & (3) above. Then a C program was written for controlling and controlling the device according to desired parameters.



2. Set up of the Testing Procedure with Spectrum Analyzer (hp 8590L)



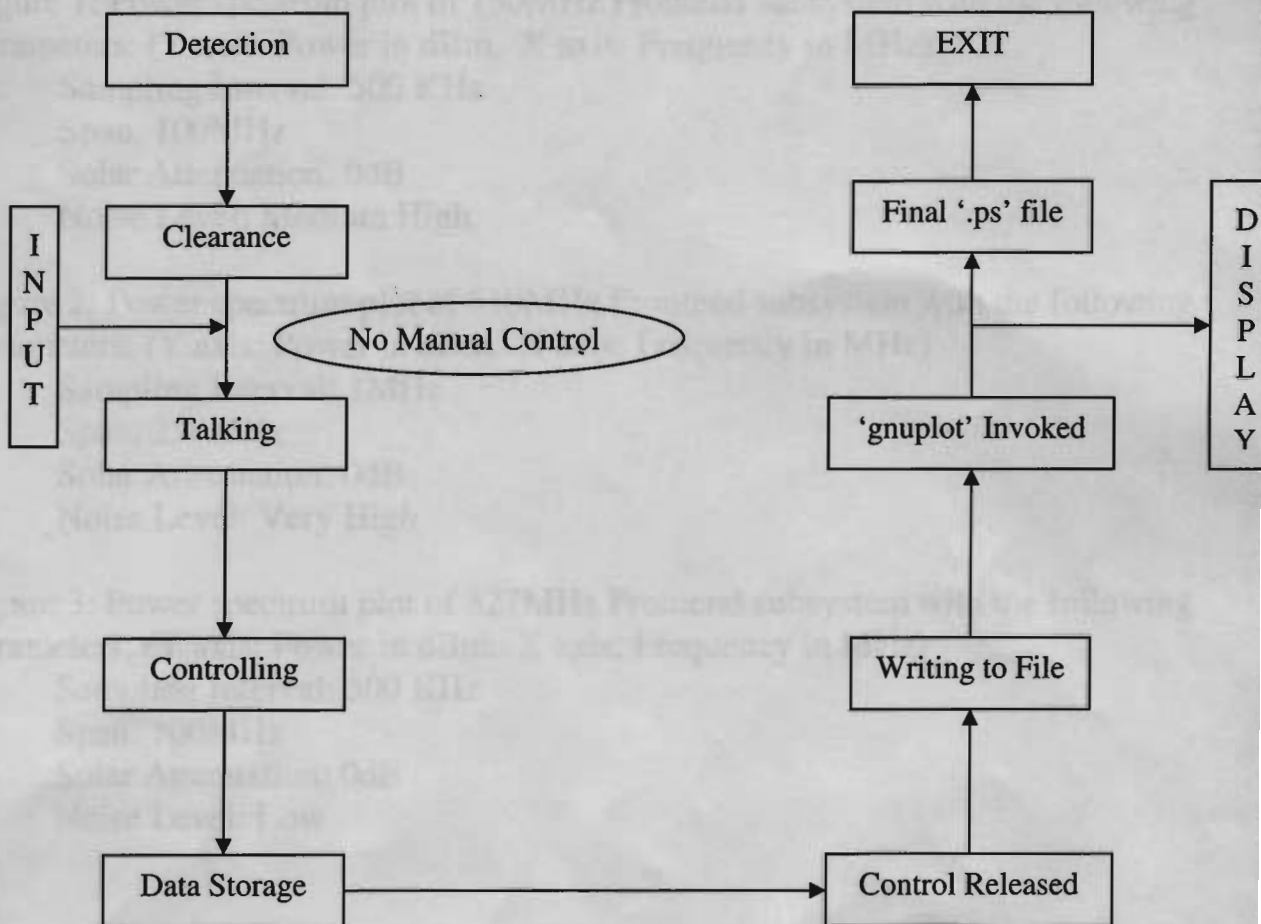
3. Set up of the Testing Procedure with Network Analyzer (hp 8753C)

Steps Involved in Automated Testing

The first step was to set up the whole system as shown in the block diagrams (2nd & 3rd) above. Then a C programme was written for communicating and controlling the device according to desired parameters.

Different plots were obtained by changing various parameters like Noise Level, Span, etc correspondingly the spectrum was traced to get the optimum resolution. The data obtained was stored sequentially in the file system based on under test Frontend Box frequency. Finally the power spectrums were replotted by linking the code with gnuplot.

Operational Steps



Data and Results

Followings are the typical examples of a data file and power spectrum plots after completion of testing procedure.

Captions to Table and Figures:

Table 1: Data File obtained after testing 150MHz Frontend subsystem with the following parameters:

Sampling Interval: 1MHz
Span: 100MHz
Solar Attenuation: 0dB
Noise Level: Medium High

Figure 1: Power spectrum plot of 150MHz Frontend subsystem with the following parameters: (Y axis: Power in dBm. X axis: Frequency in MHz)

Sampling Interval: 500 KHz
Span: 100MHz
Solar Attenuation: 0dB
Noise Level: Medium High

Figure 2: Power spectrum plot of 610MHz Frontend subsystem with the following parameters: (Y axis: Power in dBm. X axis: Frequency in MHz)

Sampling Interval: 1MHz
Span: 250MHz
Solar Attenuation: 0dB
Noise Level: Very High

Figure 3: Power spectrum plot of 327MHz Frontend subsystem with the following parameters: (Y axis: Power in dBm. X axis: Frequency in MHz)

Sampling Interval: 500 KHz
Span: 100MHz
Solar Attenuation: 0dB
Noise Level: Low

TEST Freq: 150MZ SPAN: 100MZ SAMPLING Freq: 1MZ

#Freq	#s11	#s12	#s21	#s22
100	-2.704015	-40.046322	-40.028091	-2.704015
101	-2.703556	-39.634159	-39.601460	-2.703556
102	-2.706266	-38.905560	-38.915852	-2.706266
103	-2.694415	-38.319172	-38.413620	-2.694415
104	-2.689455	-37.749279	-37.722359	-2.689455
105	-2.685826	-37.066299	-37.068039	-2.685826
106	-2.675812	-36.370998	-36.408760	-2.675812
107	-2.666350	-35.570011	-35.524220	-2.666350
108	-2.653534	-34.777519	-34.742470	-2.653534
109	-2.636907	-33.909470	-33.828121	-2.636907
110	-2.622162	-32.959148	-32.935490	-2.622162
111	-2.601997	-32.017101	-31.985720	-2.601997
112	-2.586334	-31.082121	-31.054331	-2.586334
113	-2.570900	-30.059910	-30.005529	-2.570900
114	-2.536266	-29.041340	-28.984570	-2.536266
115	-2.524186	-27.980040	-27.948860	-2.524186
116	-2.506547	-26.858669	-26.869141	-2.506547
117	-2.482018	-25.748409	-25.746670	-2.482018
118	-2.471087	-24.632820	-24.594971	-2.471087
119	-2.467963	-23.451870	-23.441080	-2.467963
120	-2.455836	-22.261921	-22.229759	-2.455836
121	-2.449498	-21.029659	-21.008711	-2.449498

Table 1.

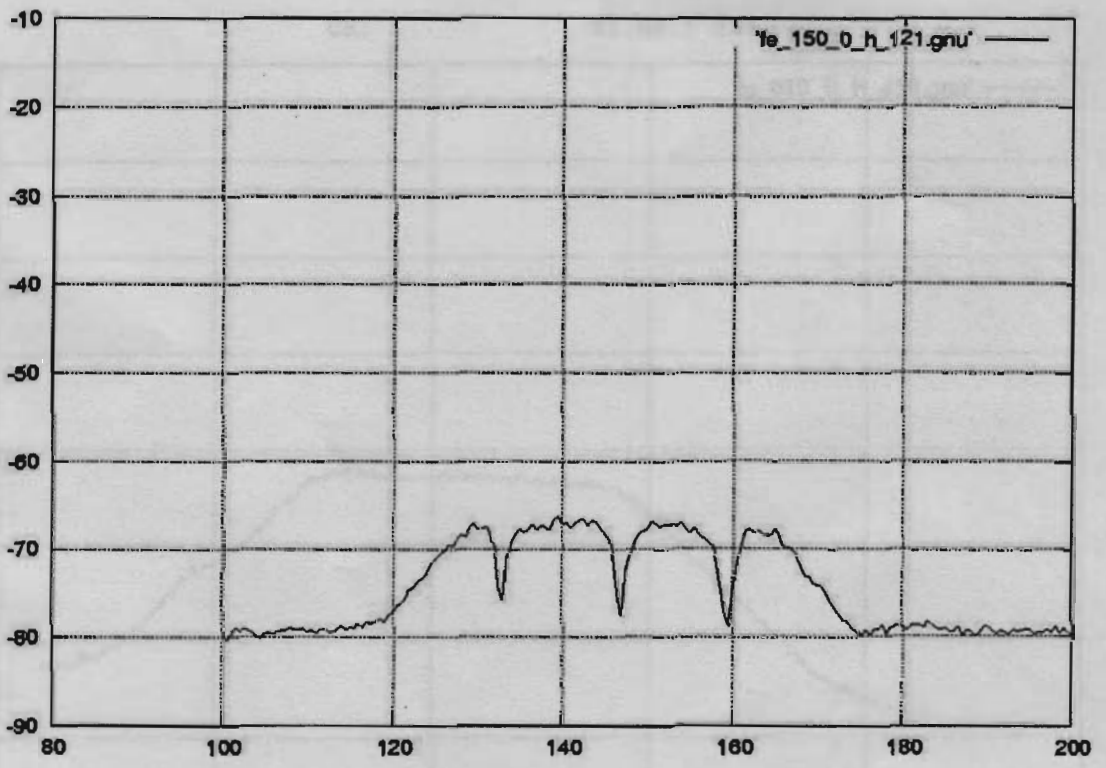


Figure 1. Power Spectrum (150MHz)

Figure 2. Power Spectrum (150MHz)

CH: 1

Sl.No.: 456

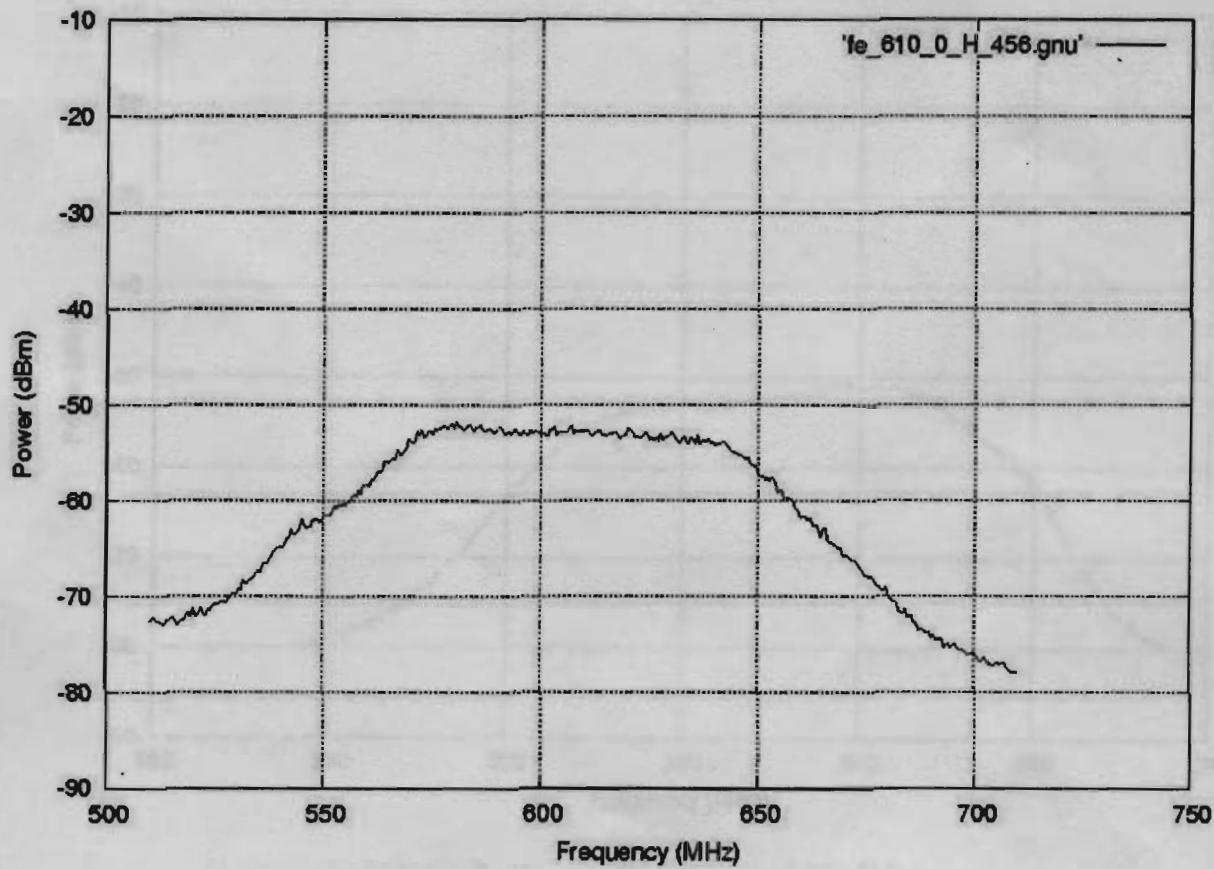


Figure 2. Power Spectrum (610MHz)

CH: 1

Sl.No.: 1234

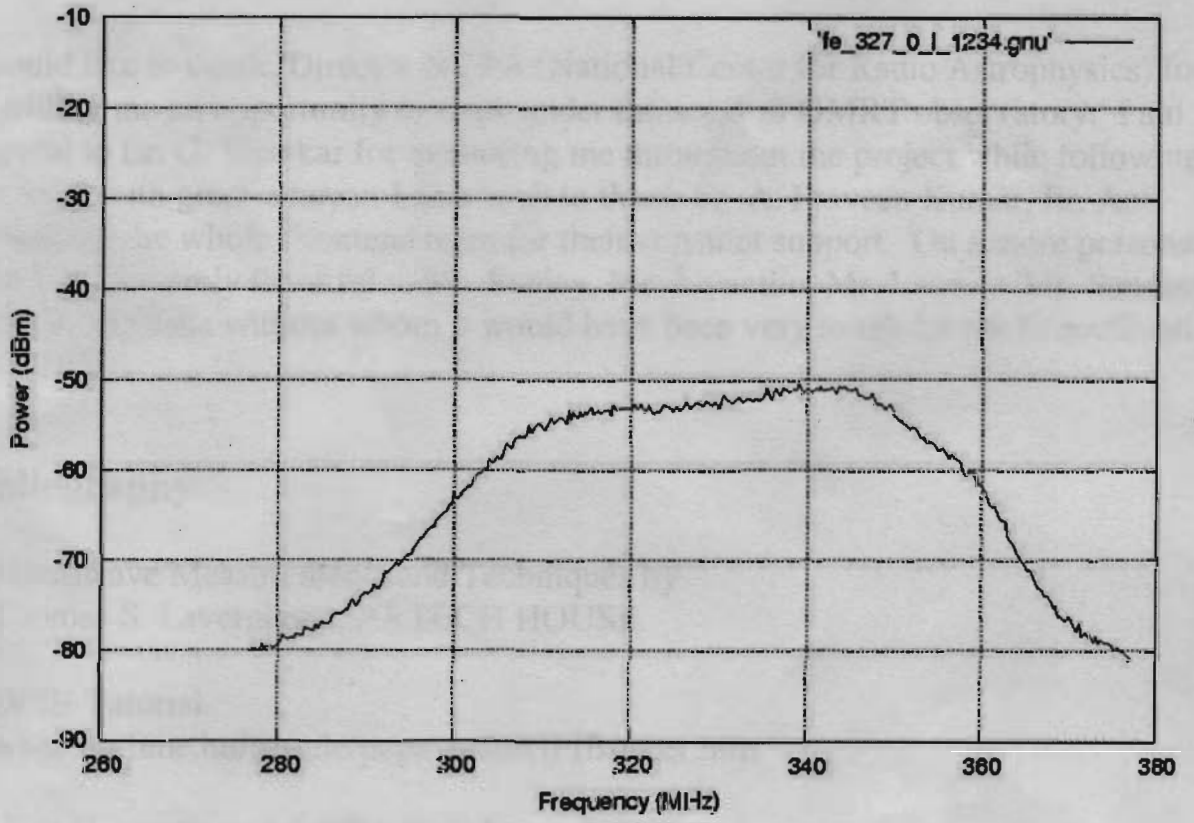


Figure 3. Power Spectrum (327MHz)

Acknowledgement:

I would like to thank, Director NCRA (National Center for Radio Astrophysics) for providing me an opportunity to work under the aegis of GMRT observatory. I am grateful to Er. G. Shankar for mentoring me throughout the project while following my work with great interest. I also wish to thank Er. A. Praveen Kumar, Er. Anil Rawat and the whole Frontend team for their constant support. On a more personal note I am sincerely thankful to Mr. Sanjay, Mr. Jayantho, Mr. Laurent, Mr. Sandeep and Ms. Manisha without whom it would have been very tough for me to acclimatize to GMRT.

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