

# TECHNICAL REPORT

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**TITLE** : Technical Report on RF PREAMPLIFIER for  
Phase Detector

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**CATEGORY** : Instrumentation

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## **RF PREAMPLIFIER for Phase Detector**

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**Abstract:** At IUAC, we have developed a compact, two stage front end RF preamplifier for RF phase detector of Linac. The noise figure of the amplifier is enhanced by reducing the bandwidth to near 48.5MHz with a double tuned bandpass filter. The present design overcomes the earlier designed bulky amplifiers.

### **Acknowledgment:**

I would like to thank Subhendu Ghosh, Linac group for specification of the preamplifier as well as for getting prepared the necessary hardware. I also thank Dr.Amit Roy, and Ajith Kumar. B.P, for their constant encouragement and providing the necessary infrastructure in order to complete this project successfully.

### Specifications

Input & Output Impedances	:	50 ohms
Gain	:	~ 60 dB
Bandwidth	:	~6 MHz
Centre Frequency (fc)	:	48.5 Mhz
Input limit	:	-30 dBm (50 ohms)
Harmonics	:	- 58dB (2nd)
Noise floor	:	- 64dB @ 48.5 MHz
Cabinet	:	G-106 Al. Diecast box
Connections	:	BNC (50 ohms)
DC Supply	:	+20-24V/0.8A. Through lemo Connector, Polarity reversal Protected
Environment	:	~25° C ventilated

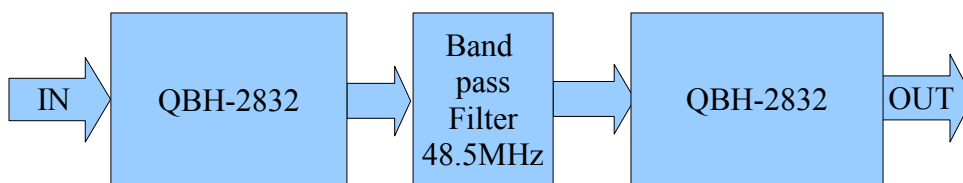
## Introduction:

At IUAC, we have developed a compact, two stage front end RF preamplifier for RF phase detector of Linac. The present design consists of high gain broadband CATV amplifier blocks and a double tuned bandpass filter peaked at frequency of interest ie. 48.5MHz. The present design overcomes the earlier designed bulky amplifiers. Three such amplifiers have been made and characterised.

## Theory of Operation:

In Linac of IUAC, the beam energy is stabilised and controlled accurately by phase locking of resonators with incoming beam phase. RF phase detectors placed at critical locations in beam line are used for deriving phase information of beam to be delivered. Thus picked up RF signals are suitably filtered, boosted and fed to closed loop control circuit.

In order to accomplish above requirement, a RF preamplifier circuit block consists of two identical CATV amplifiers in cascade, separated by a double tuned bandpass filter as shown here. The amplifiers used are QBH-2832 of M/s.REMEC, a replacement part of CA-2832 of M/s. Motorola. This block is opted for its typical gain of 35dB across frequency range of 1-250 MHz and its moderate price. These CATV blocks are also capable of delivering near 1Watt.



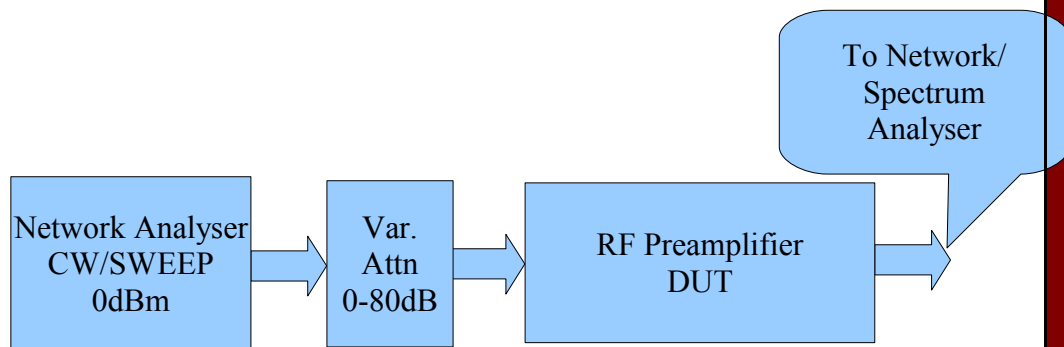
The double tuned bandpass filter (BPF) is chosen for simplicity and narrow bandwidth. The typical loss is 10dB. The BPF also helps in achieving a clean signal at frequency of interest.

BNC type connectors are used for input and output connections. The DC supply is given through Lemo type connectors. The amplifiers are protected from accidental polarity reversal of supply leads. The presence of supply is indicated with a LED on panel.

The CATV medium power amplifiers are biased in Class A configurations for linear operation. Thus generated heat is sunk by mounting these devices on a diecast aluminium cabinet. The cabinet is mounted on a large fin aluminium heat sink for reliable operation. High quality RF components are used to achieve desired results.

#### Test results:

The amplifiers assembled were characterised with test equipments as shown in the block diagram. The typical plots are shown.

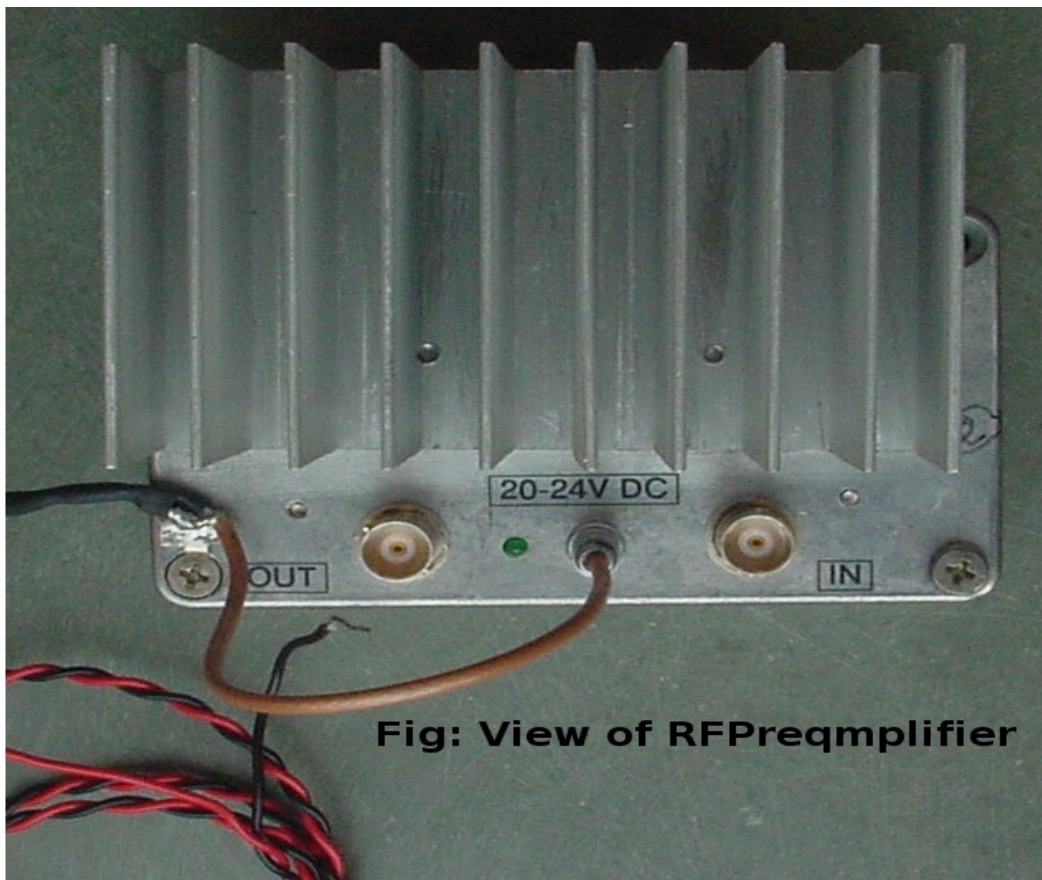


With fixed input power (0 dBm) from network analyser, the frequency was swept across 10MHz with centre frequency of 48.5MHz. The resulting plot is shown here. The peak output is measured to be 0dBm by adjusting the attenuator at the input in steps of 1dB. For spectrum analysis, the CW of 48.5MHz at 0dBm was fed to measure the harmonic content. In order to measure noise floor, the amplifier output was fed to spectrum analyser with 50 ohm termination at its input.

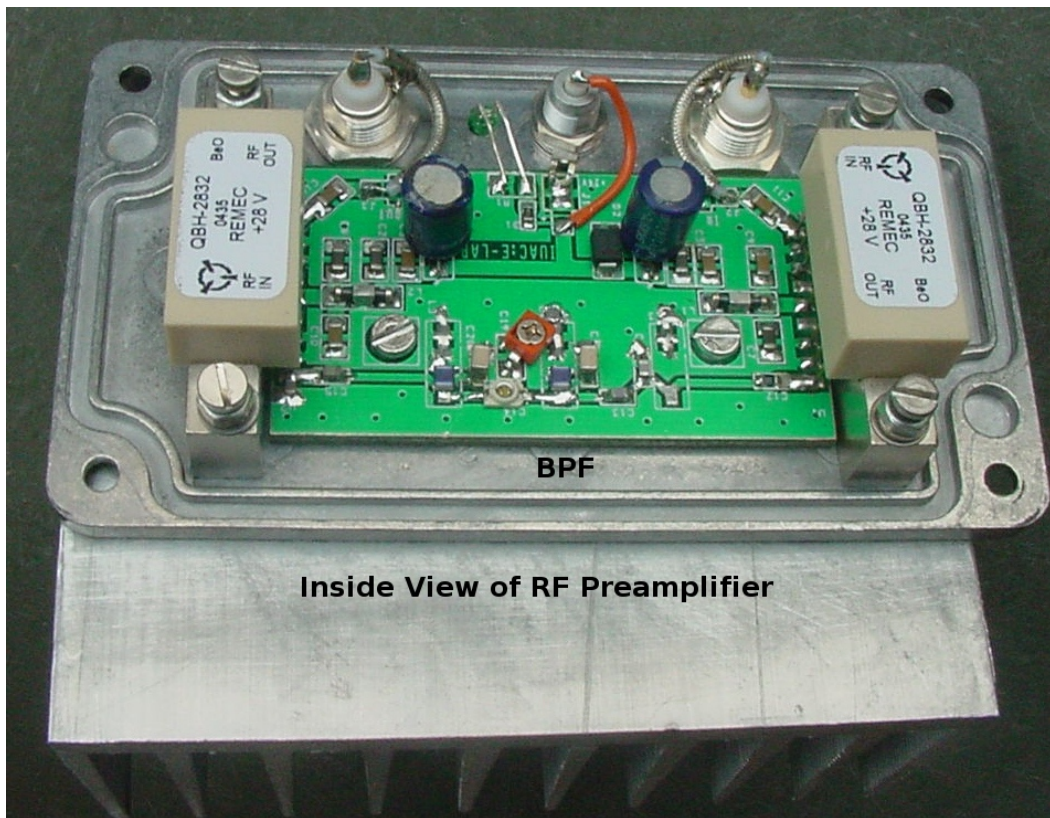
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2. W. Hayward, "[The Double Tuned Circuit: An Experimenter's Tutorial](#)", *QST*, December 1991, pp 29-34.
3. AN1022, Mechanical and thermal considerations in using RF linear hybrid amplifiers, M/s.Freescale semiconductors.

**Photos:**



**Fig: View of RF Preamplifier**



**Inside View of RF Preamplifier**