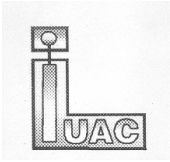

TECHNICAL REPORT
QUAD TIMING FILTER AMPLIFEIR MODULE

ELECTRONICS LABORATORY
Inter University Accelerator Centre (Formerly Nuclear Science Centre)
(An Autonomous Inter-University Centre of UGC)
Post Box No.: 10502, Aruna Asaf Ali Marg,
New Delhi 110067 (India)

TECHNICAL REPORT

TITLE : Technical Report on QUAD TIMING FILTER AMPLIFIER Module
AUTHORS : S.Venkataramanan, Arti Gupta, S.Muralithar
CATEGORY : Instrumentation
REFERENCE NO : IUAC/TR/SV/2007-2008/____01__

Inter University Accelerator Centre

(Formerly Nuclear Science Centre)

(An Autonomous Inter-University Centre of UGC)

Post Box No.: 10502, Aruna Asaf Ali Marg,

New Delhi 110067 (India) Phone: 2689 3955, 2689 2603, 2689 2601

Fax: 091-11-2689 3666 Email: info@iuac.ernet.in

Technical report on

QUAD TIMING FILTER AMPLIFIER

S.Venkataramanan*, Arti Gupta, S.Muralithar
Electronics Laboratory, Inter University Accelerator Centre,
P.B.10502,Aruna Asaf Ali Marg,
New Delhi 110067, India.
*email: venkat@iuac.ernet.in

Abstract: At IUAC, we have developed a compact, Quad Timing Filter Amplifier module for general dedicated functional Timing applications with nuclear radiation detectors. The single width NIM module contains Four independent channels of Timing Filter amplifiers with necessary signal amplification, shaping like Differentiation, Pole/Zero Cancellation, Integration along with voltage gain control and baseline restoration. High density of circuitry is achieved with SMD technology and all the important parameters are remote control compatible.

Acknowledgment:

Our sincere thanks to Dr.Amit Roy, and Ajith Kumar. B.P, for their constant encouragement and providing the necessary infrastructure in order to complete this project successfully. Sincere thanks to BARC, Electronics division and M/s.BEL, Bangalore for providing Hybrid microcircuit chips along with details.

Specifications:

Quad Timing Filter Amplifier

Input Impedance, Signal Range	: 50 ohms, ± 1V
Output Impedance, Signal Range	:<10 ohms, -2.5V, base Line corrected
Pole/Zero Adjustment	:on PCB, >40uS decay acceptable#.
Differentiation	: 200nS *, Programmable#
Integration	: 50nS /Open *, Programmable#
Gain	: Selectable and Adjustable on PCB,
Polarity	: Optional #.
Rise time	: <10nS, upto -2V @50 ohms
Noise.. input referred (50ohm)	: <10uV rms (1GHz-BW) 50 ohms
Coarse Gain Selection	: (X 10 / X 20 / Programmable#) X 10
Fine Gain	: X 0.1 to X 1.0
Input and Output	: LEMO_00 on Front Panel
Number of channels	: 4 Nos.
DC Power required	: +/- 6V, +/- 0.3A
Cabinet	: Single Width NIM Standard

*** Default settings**

 # Consult Electronics Lab, IUAC

Introduction:

Timing filter amplifiers (TFA) are used with nuclear radiation detectors in order to have optimum timing resolution in a typical timing spectroscopy applications. Such multiple channel commercially available TFA modules are based on patented power hungry Hybrid Microchip Circuits (HMC) along with general purpose front panel and PCB selection controls. Such high cost HMCs are known to fail due to poor thermal breakdown specifications, when powered for a continuous period. Availability of such HMCs from M/s.BEL, Bangalore which are low power consumption type, helped us to develop a multichannel TFA module indegenously without any compromise in performances.

The hybrid BMC 1513 [1] developed at BARC incorporates a twin transistor (Ft=5Ghz) complementary amplifier stage and an optional common emitter amplifier with voltage series feedback in order to stabilize gain. The optional buffer stage can drive 50 ohm coaxial cable load up to -2Volts. The additional components ensure the wide bandwidth and compensation at programmed gain ie. typically 10. The dc baseline correction is done with built in transconductance amplifier. Typical rise time measured is better than 2nS for the signal level mentioned.

Principle of Operation:

The TFA circuit consists of a HMC along with a ultra wide band, low noise operation amplifier (AD8099)[2] as front stage amplifiers in order to compensate signal loss in differentiator stage(R6,C6,C9). The input stage is protected against over voltage. The coarse gain as well as polarity reversal is done in second stage amplifier (AD8099)[2]. The operational amplifier provides excellent low noise as well as large gain bandwidth product of around 500 to 700MHz in order to preserve the rise time of the pulse. The gain range and adjustments are done on PCB, since any routing these parts carrying very fast rise time signals to panel through cable or wire would cause additional noise pickup or radiation that may cause inter channel coupling. The necessary shaping of nuclear pulses are done with front stage differentiator and Integrator components (R12,C12) on PCB through jumper (JP1). The fine gain adjustment is done through volume control potentiometer in order to simplify the design. In last stage, ultra fast Hybrid micro chip amplifier with baseline correction is wired with fixed gain of 10 (R4,R3). The DC lines of each active component stage

are bypassed with filter capacitors. is done in last stage HMC.

The performance of such amplifier chain is entirely depended on the parasitic components like Jumper, PCB track width etc. Therefore for an excellent timing characteristics, jumpers shall be avoided and components are wired directly as per typical experiment/detector requirements. When the jumpers and Gain control potentiometers are accessed through the front panel, the performances are compromised and inter channel pickup and oscillations may be noticed.

Assembly Procedure:

The PCB to be used is the latest version with Rev:1, 2006. This is a double sided, FR-4 type with solder mask and screen printed for easy assembly. The template for easy assembly is also available from Electronics Lab. of IUAC.

Check for any solder bridge with Magnifier lamp + magnifier eyepiece (x10/x12) as well as with multimeter. Known solder bridges in this PCB are listed in this maual. Apply thin flux for good solder connection (No clean solder flux recommanded). Assemble the resistors and capacitors 0805 foot print and SOT123 active parts like diodes, ICs. Capacitors (polarised) would be followed with RFCoils wound as per instructions given in schematic. Assemble the HMC insertion pins carefully flush mounted, with great care to avoid any solder bridges and excess solder

Check again with magnifier for any solder bridges and shorts with multimeter. Clean the PCB with good PCB cleaner/thinner and cotton for any excess Flux which attracts dust during long operation.

References:

1. Design and Development of Low power fast Pulse Amplifier Hybrid Microcircuit for Photon Counting Applications, V.B. Chandratre et al, Electronics Division, BARC, NSNI-200 Proceedings Pg 266-268.

2. AD8099 DATASHEET, M/s. Analog Devices Inc., USA.

Photos:

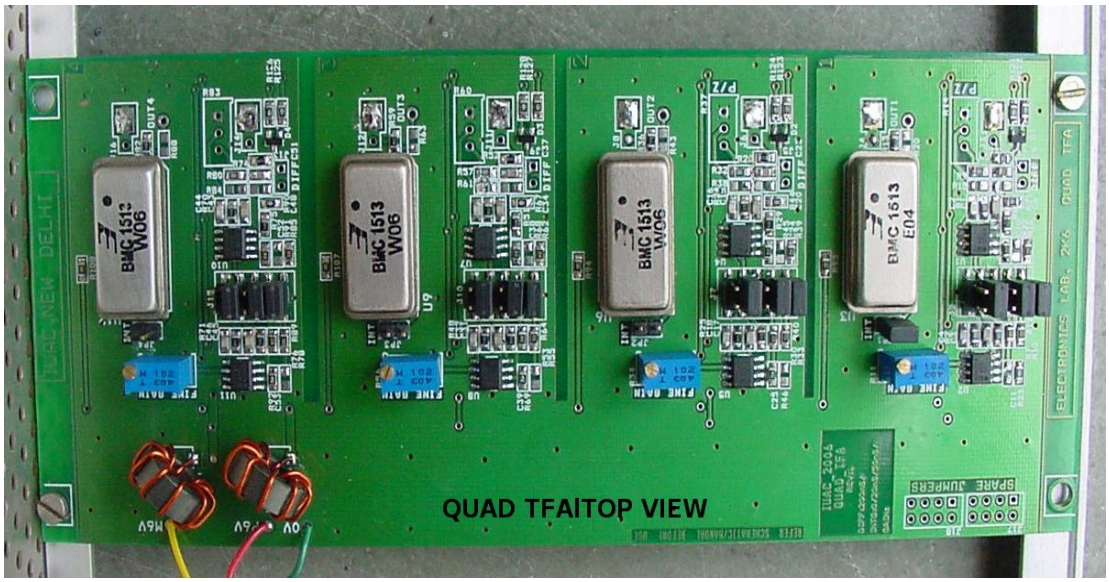

Fig: Quad TFA inside PCB Topview

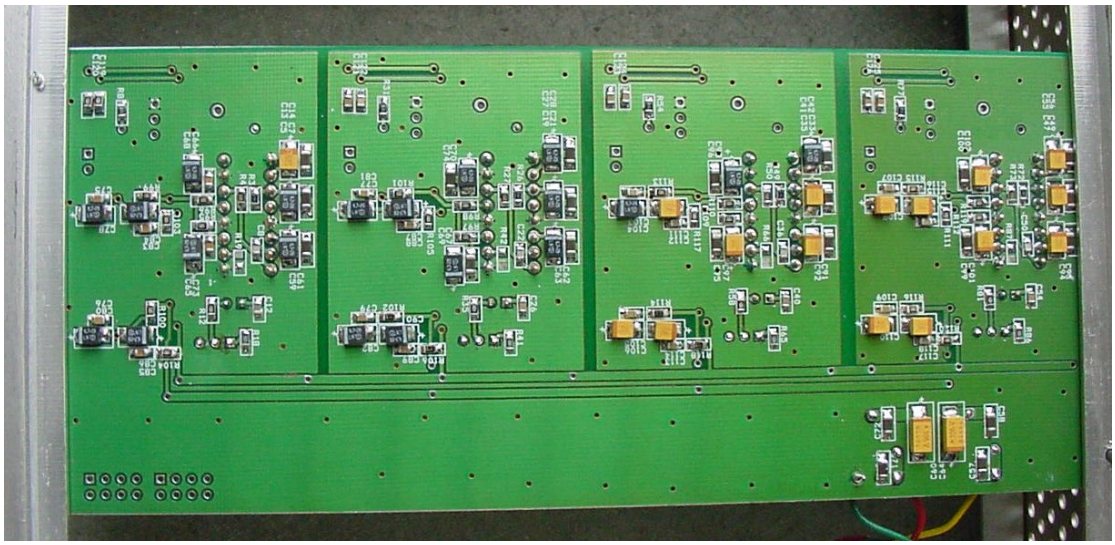

Fig: Quad TFA inside PCB Bottom view