TECHNICAL REPORT ON

TIME TO ANALOGUE CONVERTER

for Neutron Array at IUAC

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CATEGORY : **Instrumentation**

REFERENCE NO : **IUAC/TR/SV/2006-2007/_____**

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2006_April

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TIME TO ANALOGUE CONVERTER for Neutron Array at IUAC

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Abstract: At IUAC, we have succesfully developed and implemented a general purpose and compact TIME TO AMPLITUDE (TAC) converter for the ongoing Large Neutron Array[1] at IUAC. The TAC daughter card contains a TAC Hybrid Microchip BMC1522 alongwith level converters, power supply circuits and gain cum buffer circuit. Though recommanded for 500nS range, we have adopted the same for 100nS range and characterised its performances in this report.

Acknowledgment:

We would like to thank Dr. Swapan Kumar Dutta of Neutron Array at IUAC for specifying and evaluating overall timing functioning of the prototype and preproduction versions of the module. 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.

Specifications:

Time to Amplitude Converter

TAC Range	:100nS (Capacitor : 27pF / SM type)
Resolution	: better than 50pS [2]
Drift/Thermal stability*	: Short term (0-3 hours min) : 120 pS
	Long term (3 hours-24 hours) : 30 pS
DNL measured	:
Inputs	:START/RESET, STOP of Fast NIM type.
Output range & Width	: 0 10Volts, 2.5µS
DC Supply required	:±12Volts and -6V (750 mWatts)
Card Dimension	:44mm, x 70mm x 10mm

Note:

Refer the Data sheet for different TAC range.

Different Type Capacitors may be tried for best thermal stability or Drift Characteristics.

* : Tested with Pulser and other electronic modules at room temp: 25Deg. For 24 Hours duration.

Introduction:

Time to Amplitude (TAC) is a very essential circuit function utilised for various Nuclear experiments in a accelerator laboratory. The commercial Single/Multiple width TAC modules available are of general purpose in nature. They are also costly, bulky and require additional level converters, cables and connectors in a experimental setup.

In order to cater similar applications, we have successfully developed a compact TAC daughter card, which can be incorporated into any custom Nuclear Electronic modules. They are self contained, having required non standard power supplies, level converters, amplifier cum buffer to drive a low impedance coaxial cable.

Principle of Operations:

The detail working principle of TAC Hybrid Micro Chip BMC-1522, developed by BARC and produced by M/s.BEL and detail circuit implementation are made available within this report. Apart from the HMC, circuit board contains a non-standard biasing supply (VBB- 1.1V) required by this chip, derived from M6V supply line. The required level converters (FNIM ECL) are also implemented with a single transistor. The TAC range can be determined by Capacitor selection or Charging current (alter R2, R3) programming. The charging current is fixed and only Capacitor is changed to alter the TAC range. For example: 27pF is chosen for ~100 nS range in this design. High quality resistors (MFR, 1%, 25PPM) and Capacitor (Silver Mica) are used for best performance. The supply lines are filtered with LC type filters.

The TAC HMC is capable of 0-5V for the programmed TAC range. In order to make it identical to a commercial module, the output is amplified and buffered through composite amplifier containing LM6171 (WB Opamp) and BUF634 Buffer to obtain the dynamic output range 0- 10 Volts.

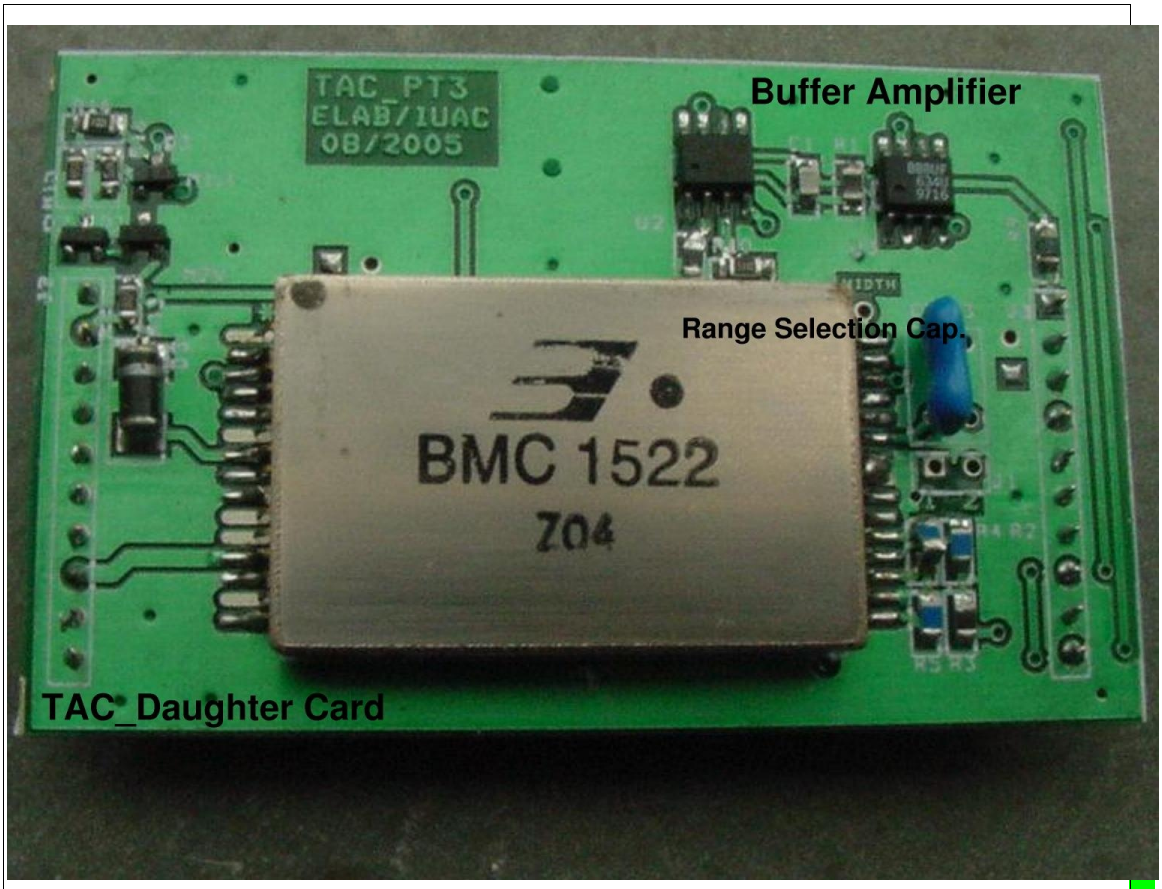


Fig: TAC Daughter Card

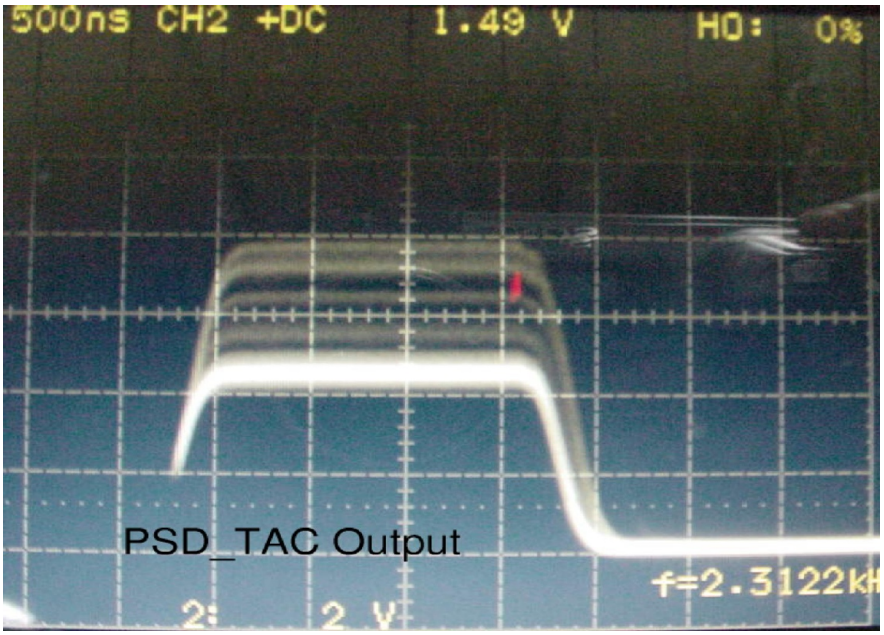
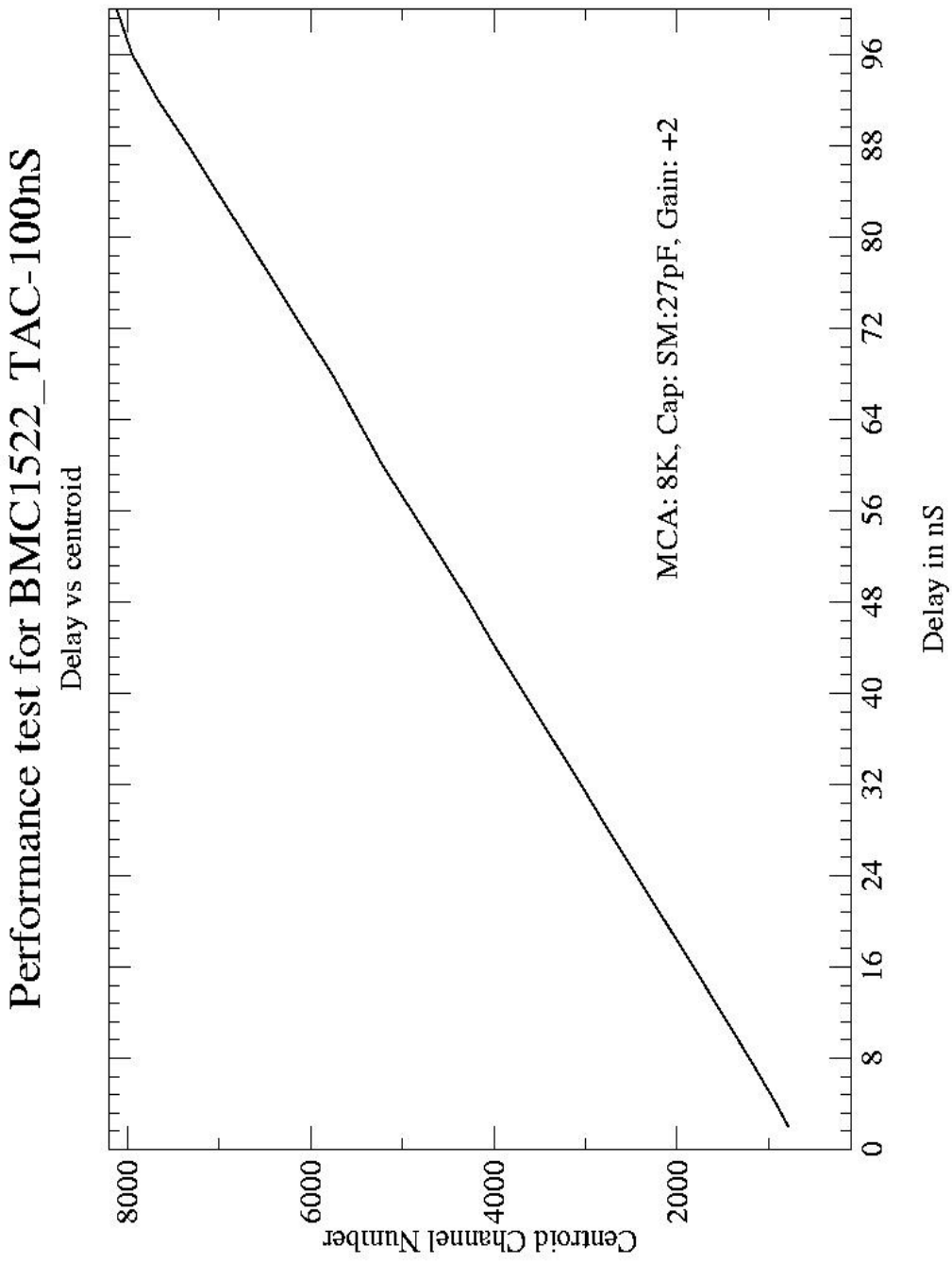
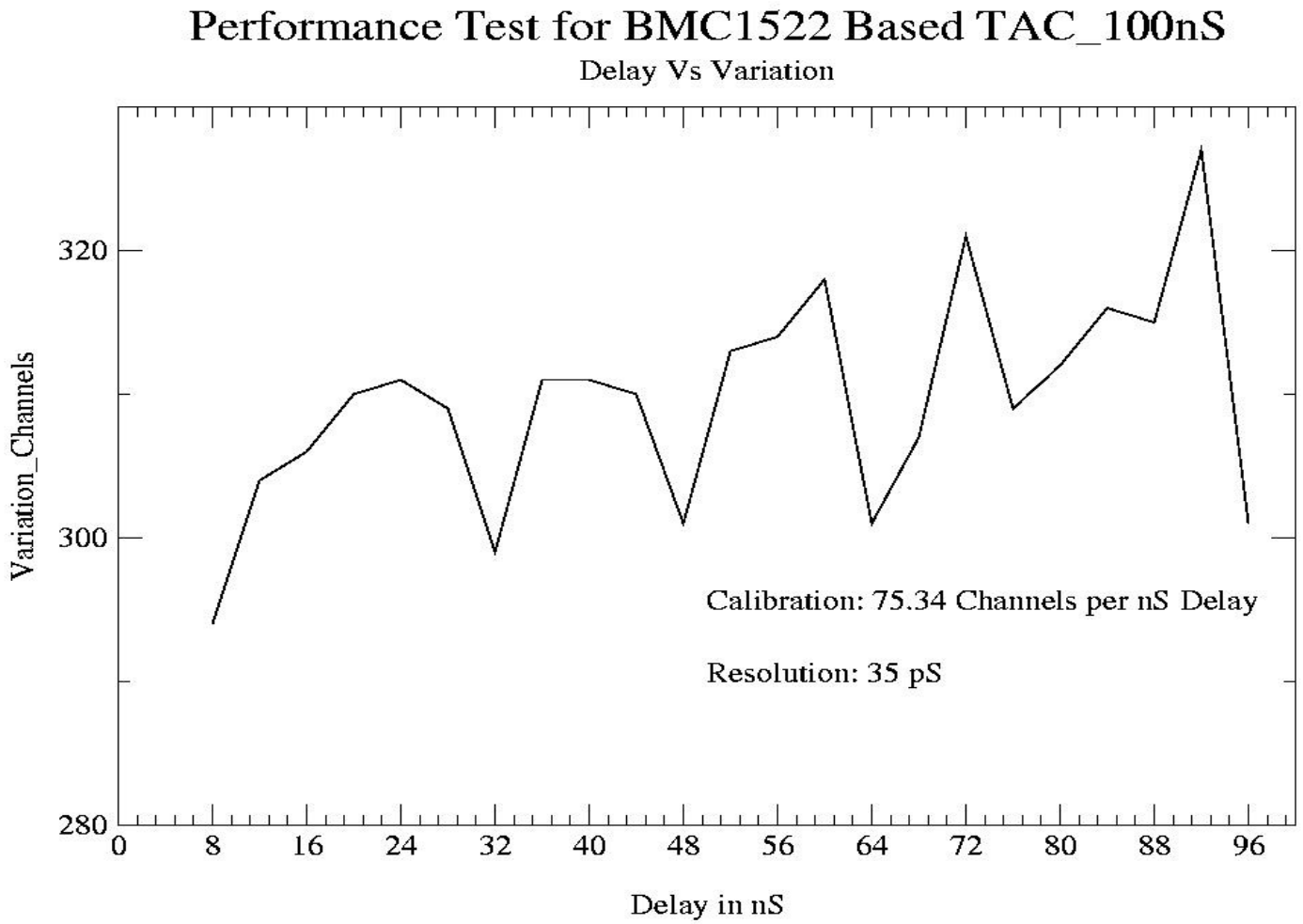


Fig: Typical TAC Output




Performance Test for BMC1522 Based TAC_100nS
Delay Vs Variation
Variation_Channels
320
300
280
0
8
16
24
32
40
48
56
64
72
80
88
96
Delay in nS
Calibration: 75.34 Channels per nS Delay
Resolution: 35 pS

Ref:

1. Development of TAC hybrid, V.B.Chandratre et al. NSNI 2004