TECHNICAL REPORT

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TECHNICAL REPORT ON
CLOVER ELECTRONICS MODULE

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TECHNICAL REPORT ON

CLOVER ELECTRONICS MODULE FOR INGA

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Abstract: ss

A prototype NIM module containing Shaping amplifiers, TFAs, CFDs and logic circuitry for processing signals from a Clover detector with Anti Compton Shield (ACS) has been developed. The circuits are realised in High density daughter card form using SMD components, while keeping the features and specifications at par with commercially available modules. After making 2 numbers of Pre-production version of this module, 12 such modules were produced at IUAC during year 2004 and 10 of them are being implemented with INGA setup at Kolkata for last 2 years. Another set of modules are being used with Super Clover (segmented) at GSI, Darmstad, Germany with certain modifications. **Version:**

Current version (2006) includes some added features like DELAY equaliser on PCB, LED BLINKER indicating the presence of GATE signals. The various control voltages required are generated with ultra high stable reference source, and measurement of temperature inside the module is provided through rear panel TEMP test point. This manual supercedes all previous versions.

Acknowledgment

We would like to thank Engineers and Scientists from GIP, Ganil, France for their constant support in simulating various circuit blocks and for fruitful discussions. Our sincere thanks to Dr.Amit Roy, Prof. G.K.Mehta for their constant encouragement and providing the necessary infrastructure in order to complete this project successfully. Special thanks to those provided valuable feedback in order to improve upon previous version(s). We also thank M/s.ANCOMP for their help in providing good quality PCBs. Our sincere thanks to TIFAC (DST) for initiating patent filing procedure in short time.

Note: Patent application is Pending with concerned authority, since 2004.

Introduction

The experimental facility like INGA consists of a large number of HPGe detectors. Each channel requires a Spectroscopy amplifier, Timing Filter Amplifier (TFA) and Constant Fraction Discriminator (CFD) and associated Logic circuits. Typical commercial electronic setup would require a large number of modules which occupy large area, interconnecting cables and connectors. The NIM module developed at IUAC contains five channels of electronics to accommodate one clover with accompanying anti-Compton shield. The content of this double width NIM module is shown in figure.

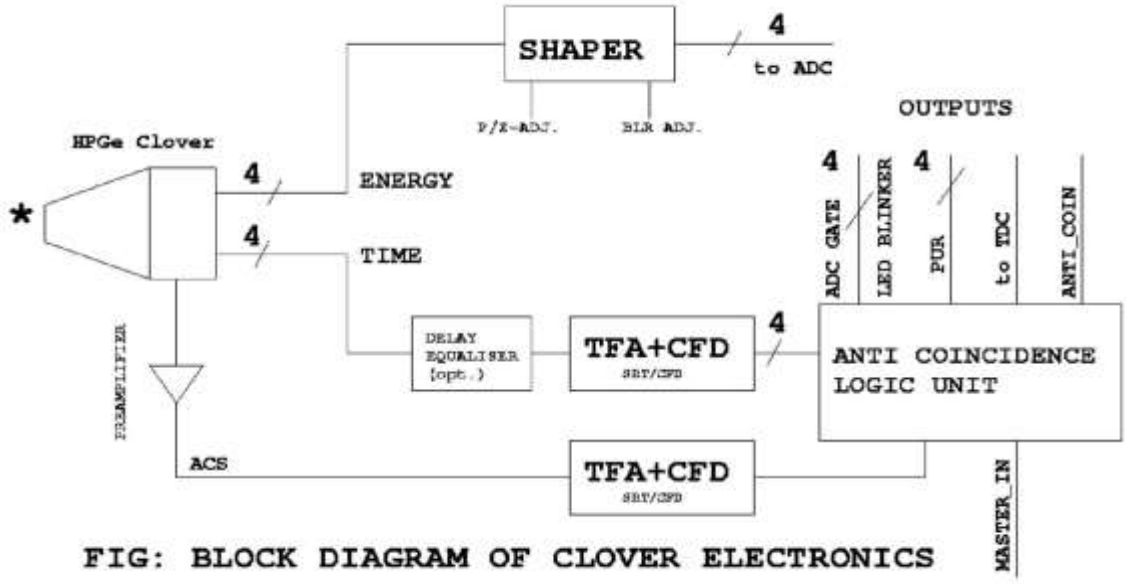

FIG: BLOCK DIAGRAM OF CLOVER ELECTRONICS

The high resolution spectroscopy amplifiers have fixed 3μs shaping constant and 3 fixed gain settings (2, 4 & 6 MeV) which are jumper selectable. The DC baseline is stabilized with Gated BLR, while P/Z and BLR (manual) threshold adjustments can be remotely voltage controlled. The unipolar output has the dynamic range of 8 volts across 50 ohms.

Four TFAs with fixed time constants and gain settings are provided for processing TIMING signals from Clover detector. The TFA is designed with single CFA gain stage and baseline is stabilized with twin diode restorer and high input impedance buffer. These amplifiers have rise time of better than 10 ns across their dynamic range of ±2.5 volts across 100 ohms. The CF Discriminator with amplitude & rise time compensation (ARC) is realized with fixed delay of 25 ns and fraction of 0.3. The Lower Level Threshold, WALK adjustment and Monitoring are possible on front panel. The CFD outputs from the individual Clover elements with width of 50 ns and dead time of 2 μs are set internally.

Anti-Compton shield signal received from ACS Preamplifier is processed with identical TFA + CFD as mentioned above but without dead time. The raw timing logic signals received from CFDs from Clover detector and ACS detector are further processed to affect Anti-coincidence. The TFA and CFD outputs from the ACS are available on the panel for ease of adjustment. The logic functions performed are Pileup Rejection, Individual ADC GATing, Anti-Coincidence output and Delayed STOP signal for TDC. All these logic outputs are buffered and available in standard logic levels on the panel.

Principle of Operations

The INGA Clover Electronics Module is essentially a double width NIM module contains a mother board where individual blocks in daughter card form are inserted. The DC supply lines are filtered with PI filter section, and a negative 2V zener regulated supply is generated. The rear panel receives the inputs like "ENERGY" and "TIME" signals from Preamplifier through Lemo (00 series) connectors. The Front panel provides the various monitoring points like P/Z Mon., BUSY, WALK_MON, Energy OUT, ADC GATE and other Logic related signals (TDC STOP, ACOIN..) through Lemo connectors and manual control of various adjustment like P/Z Adj., BLR Threshold adj., WALK adj., LLTH adj., through multi turn potentiometers. The TFA (ACS) and CFD (F_NIM) outputs corresponding to clover elements are provided for monitoring. The panel layout can be seen in attached photograph or drawing.

The high frequency signal layout techniques are widely used for reduction of ground loop related and pick-up problems in the motherboard. RG178C/U coaxial cable is used for interconnection along with ground cap with Lemo-00 series connectors. Typical cable lengths used for various interconnections inside the module are listed here. The Timing signals from TFA+CFD block are routed through 100 ohm differential ECLlines for further processing. The detailed operation principles of various blocks briefed here can be obtained from individual technical reports prepared by the Electronics Laboratory.

The technical specifications, photographs, representative signals seen on CRO of Shaping Amplifier, TFA+CFD, ACOIN LOGIC UNIT are attached for references.

Temperature Measurement:

The Temperature measurement inside the INGA module is accomplished by the Voltage reference chip **ADR03**, in order to measure the temperature inside the module and correlate the performances of various sub-circuits built in. This is required due to high density of electronic circuit, nearly dissipate 20Watts of DC power in quiescent state.

The pin readily available in this chip is accessed through a current protection resistor on the rear panel, and typical values measured with respect to analog ground of the NIM bin are as follows.

Temperature	***Cooling***	***Voltage measured***	***Observation***	***Observation***	***Time taken***
25 ºC	No	552mV	LLTH:-200mV	WALK_ADJ..	0 Sec
52ºC	No	605mV	LLTH:-200mV	Shifted UP (+)	50 Min.
36ºC	Yes	573mV	LLTH:-200mV	Original value	15min.

The instrument cooling fan is operated in order to maintain the near room temperature for a temperature stable operation. Where, the ADR03 along with amplifier circuits (LT1361) provides an excellent thermal stable reference supplies (dual polarity) for LLTH, WALK ADJ. Settings, and other voltage controlled parameters such as P/Z Adj., BLR reference settings.

Indication of ADC 'GATE':

In order to visualize the presence and rate of ADC 'GATE' signals, additional circuit has been incorporated on the motherboard. The ADC GATE signals generated by ACLogic card is utilised to trigger a monostable multi vibrator circuit to enable the LED on the front panel.

Alignment of TIME signals:

The TIME signals received from the Clover detector are TIME aligned (All CFD Prompt signals are aligned with Fast Pulser) in order to correct the misalignment caused due to poor Preamplifier compensation, different Propogation delays experienced by TIME signals on the mother board. The 10 tap delay line (Total 25nS) having discrete step of 2.5nS is jumper selected for this purpose. The TIME alignment is Detector specific and shall be carefully handled.

CLOVER ELECTRONICS MODULE FOR INGA SEPT 2K6

ENERGY	4 SHAPERS with 3mS Shaping constant and fixed gain for **2***

MeV/ 4 MeV/ 6 MeV.

*** Default** selection, Selected with 2 jumpers on PCB.

Input and Outputs are accessed through LEMO connectors on Rear and Front panel

respectively.

Controls for P/Z adjustment and BLR Threshold on Front panel.

Monitoring of **BUSY** and CLAMPED E_OUT (**P/Z MON**) possible through

Front panel LEMO connectors.

detectors and ACS respectively.

Timing Inputs are through Rear panel LEMO connectors.

on front panel.

TFA (attenuated) signal monitor for ACS is provided on front panel.

CFD outputs (F_NIM / 50nS & 500nS (ACS)) are available on rear panel.

PUR reject (TTL) available with 20uS moitoring period available on rear panel

Accepts all required timing informations in ECL complementary logic levels from

TFA+CFD units. The outputs and Monitors are provided on front panel through

LEMO connectors.

Presence of ADC '**GATE**' signal is indicated with LED on front panel.

The **ACL**ogic DELAY and WIDTH adjustments are possible on PCB.

MASTER GATE input (MGATE_IN) is TTL logic (positive) with "pull up"

resistor.

TEMPERATURE

Measurement of module inside temperature is possible through rear side

'**TEMP**' test point. Ref: @ **25˚C, 550mV** with Temp. coefficient of **~2mV**/˚**C**

CABINET Double width NIM module

RECOMMANDATION

To assemble 4 Nos. of this module in a standard **200 watts NIM Crate** with forced

air cooling from bottom of the NIM crate at ambient temperature of 25 deg.C

Power Consumption +/-6V, 0.7A/1.9A, +/-12V, 0.3A/0.3mA +24V, 0.03A

Input Impedance	~1000 ohm

Pole/Zero adj.	Input pulse having decay time about 50µSec ± 5%

can be corrected through potentiometer (FP) or

remote controlled through DAC. Input impedance: 1K

Control voltage not to exceed ± 1Volt.

Type	~3 µSec. Fixed, Active integration (4th order)

Quasi Gaussian having peaking time of 2.4τs.

Input signal*	-200mV/MeV is expected to generate +10 Volts at the

output for 3 gain settings. Not to exceed ±10V.

Gain	2MeV, 4MeV and 6 MeV for +10V output. Jumper

selection on board. Default is 2 MeV.

BLR threshold Manual baseline restorer threshold is set through

Potentiometer(FP) or remotely. Range is 0 to 600mV

when provided. Impedance is 1k. Control voltage not to

exceed ±10V

Output	Unipolar, Gated BLR DC restored.

Width :~20µSec. Impedance 50 ohm

BUSY	A TTL negative logic pulse for the duration of presence of

output pulse exceeds BLR threshold. Impedance: 10 ohm.

PUR (optional) Pile up reject signal is a TTL positive logic signal, with

pileup inspection interval of 20μSec. Impedance: 10 ohms.

Power required*	+/-6V, 0.04A/0.02A

+/-12V0.04A/0.03A

+24V	0.005A

Size & Weight	W x H x L : 1.75"x0.5"x 4", 30 grams.

Technology	Double sided PCB with PTH and SMD components are used.

PERFORMANCES:

The module has been subjected to various tests at IUAC with ^{60}Co and ^{152}Eu sources

and in beam, in parallel with commercial modules. The typical results obtained are :

Resolution: 1.3KeV (122KeV), 2.0 KeV (1408 KeV) of ^{152}Eu @ 9 Kcps.

Integral non-linearity: ± 80 eV for ^{60}Co spectrum .

Stability: With ^{60}Co, no significant shift observed at 6 kcps in 55 hours.

SPECIFICATIONS: **TIMING FILTER AMPLIFIER***

INPUT IMPEDANCE	50 ohms.

GAIN(fixed)*	~24(Ge)/15 (ACS)

OUTPUT AMPLITUDE 0 to ±2.5V into 50 ohm cable and load.

OUTPUT IMPEDANCE ~10 Ohm

RISE TIME	Better than 10nSec. With no additional integration

across dynamic range.

Baseline Correction	Twin diode restorer used.

POLE/ZERO ADJ.*	P/Z internally corrected for 50μS (±5%) decay

time internally.

DIFFERENTIATION 200nS (C1 X R12)

INTEGRATION	none.	(R4 X Cx)

• For ACS, the P/Z network is wired for 400nS internally to match the decay time of BGO

phosphor.

TIME ALIGNMENT For HPGe, Better than 3nS Possible with onboard Analog Delay Line

Jumpers.

SPECIFICATIONS: **CONSTANT FRACTION DISCRIMINATOR***

INPUT SIGNAL	Negative pulses accepted unto -5V

THRESHOLD RANGE	+60mV to -200mV

(LLTH)	Front panel adjustable.

LLTH MONitor	Measures x10 of actual LLTH set value.

DELAY	Internal, Zo: 100 0hm, 25nSec Fixed.

FRACTION RATIO~ 0.3

WALK ADJUST	Front panel control for exact zero-cross voltage.

WALK MONitor	Front panel LEMO connector for monitoring CF signal.

DEAD TIME	~2 µS. (Fixed)

WIDTH	~50nS.(Fixed)

OUTPUTS	ECL DIFFERENTIAL 2 µS internal.

FAST NIM (2 nos.) 50 nS. Rear panel (optional)

IMPEDANCE	100 ohm DIFFERENTIAL ECL

OTHERS	SRT/CFD(Default) selection (Jumper on board)

DIMENSION (WXHXL)	1.5" x 4" x 0.5", 50 grams

TECHNOLOGY	Both SMD and Through hole components used.

Masked PCB 1.6mm / 70µM Double sided with PTH.

Note: For ACS, the same CFD daughter card is used without any dead time and output having

width of 500 ηS.

SPECIFICATIONS: **ANTI_COINCIDENCE LOGIC UNIT***

INPUTS (Internal) ECL COMPLIMENTARY (Zo=100)

CHANNEL A CFD 2 µS DEAD TIME

CHANNEL B CFD 2 µS DEAD TIME

TTL (positive) internally pulled up input.

Must arrive within 1μS/2μS of individual CFD outputs.

OUTPUTS

ANTI-COINCIDENCE FAST NIM (Front panel LEMO)

(A_COIN) WIDTH 500 nS. (adjust on BOARD)

(500 nS) for Coincidence and output is generated.

START/STOP(**TDC**) FAST NIM (Front panel LEMO)

WIDTH 50 nS

Adjusted on BOARD) and output is generated.

MONITOR(**OR**) F_NIM (Front panel LEMO)

The CFD (50 nS) outputs are logic ORed and Level

converted and shaped (100nS).

ADC **GATE**s(GATE A-D) Positive TTL (Front panel LEMO) LED Indicated.

Zo: 10 ohms. WIDTH 10 µS.

Refer to Block diagram. Generated only when Master_Gate is

present within 1μS of the input signal.

PUR SUM(PUR A-D) POSITIVE TTL (Rear panel LEMO)

PUR inspection WIDTH 20 µS

Zo: 10 ohms. It is "OR" of four piled up channels.

DIMENSION	4 " x 0.5" x 3.75" 80 grams. W x H x L

Operational Procedures

Gain Selection Procedure:

The Shaper is designed to work with one of the three different GAIN settings 2MeV*/4MeV/6MeV as per user requirement. The GAIN can be selected on the SHAPER daughter card by the procedure given here.

Open the side panel of Clover Electronics Module

1. Locate the SHAPERS in TOP of Mother Board.
2. Identify JUMPER SOCKETS in extreme right corner facing top. (Ref. Photograph)
3. By plugging 'in' any on the jumper will select 4MeV.
4. By plugging 'in' both jumpers will select 6MeV.

* Default GAIN selection when jumpers are not used.

We suggest the user not to plug out the daughter card for GAIN change. Instead use fingers/sharp nose pliers to plug in/out jumper headers for gain change.

Pole_Zero Adjustment:

The Shaper is designed to work with Eurisys Measures Clover detectors with preamplifier s having 50μS (±5%) decay time constant. The Pole_Zero adjustment can be done with front panel PZ_Adj. Potentiometer while monitoring corresponding front panel PZ_ Mon. on a CRO. Any major deviation (above ±5%) in decay time can be corrected in Preamplifier card as suggested by the manufacturer.

BLR Adjustment:

The Shaper is designed to have stable zero reference at all specified working conditions. This is achieved by Gated BLR operation. The required threshold level above system noise is fed through front panel BLR adj. potentiometer. This is set while monitoring front panel BUSY (TTL) signal on a CRO for a minimum count rate when no radiation sources are used. It is essential to set proper Pole Zero adjustment for proper functioning of BLR. During above procedures, it is recommended to use corresponding BUSY signal to trigger CRO.

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Schematic Diagram

For easy references, a set of circuit diagrams are attached. The circuit diagram of

individual blocks can be obtained from Electronics laboratory, IUAC. The entire mother

board is mounted on side rails of a double width NIM module. The individual blocks are

assembled in daughter card form and plugged into low profile machine trimmed sockets. The

front panel trimmer potentiometers (3006P) are hood mounted. The series pass regulator

transistor is electrically isolated and mounted on rear panel for heat sinking.

The currently (MOTHERBRD, April 2006, Rev:3) available PCB is of glass epoxy,

double sided with 0.6mm drill PTH having dimension of 7.25" x 8.5". It is recommended to

have solder mask and silk screen printed on both sides for easy assembly as well to protect it

from solder bridges etc.,. Use of 0.2mm sharp solder tip, IC solder tips are recommended in

order to solder narrowly spaced SMT devices. SMT devices shall be picked only by fine

quality tweezers. While soldering a magnifier x5 (large) and x12 (eye piece) is used to assure

the soldering. It is essential to use solder cleaning liquid/thinner with cotton swab to remove

dust attracting solder paste.

The PCB shall be checked with magnifiers and multimeter for any unwanted

connections and PTHs. Then components shall be soldered in a orderly manner, to start with

all low profile chip resistors and capacitors. It is essential to check the impedance between

various nodes after soldering resistors, capacitors and inductors. Active components like

diodes, transistors and ICS are soldered thereafter. At last tantalum capacitors, connectors,

jumpers and any non-SMT devices. All PCBs shall be marked distinctly with unique number

for any future references. The Series pass transistor is mounted in conventional way with heat

sink kit.

Reference:

Assembly Procedure:

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 manual. Apply

thin flux for good solder connection (No clean solder flux recommended). Assemble the pins

first carefully flush mounted, with great care to avoid any solder bridges and excess solder.

Assemble the resistors and capacitors 0805 foot print and SOT123 active parts like diodes.

Capacitors (polarised) would be followed with RFCoils wound as per instructions given in

schematic.

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. Check the mother board with DC power supply and multimeter for

working of M2V supply line and power supply distribution to all daughter cards.

Preparation of Cabinet:

The double width cabinet of NIM standard is used as housing for this module. The

mother board Pcb shall be placed on the rails inside the cabinet for proper sizing before fixing

it. Excess projection of PCB shall be removed with "Rough File" before component assembly.

The front panel and back panel punch details are given in this manual and punching shall be

done with great to avoid wastage of cabinet assembly. The screen printing can be done after

punching of the panels. The sample screen print schematic is also attached here. The PCB is

secured on the side rails with four numbers of 4-40 size 1/4inch pan head screws on tapped

holes.

Wiring:

The standard length of 3 core flat wire and RG178C/U used for interconnections

inside the module are listed for easy assembly. Good hand tools and neat assembly procedure

shall be followed for any maintenance free operations. The connections involving coaxial

cables shall be done first and followed by potentiometer connections. Confirm the wiring also

with good quality continuity checker (multimeter). While mounting the LEMO connectors

and potentiometers, avoid any scratch to front and rear panels, and use standard tools for

quality finishing. The wiring orientations shall be checked while powering the unit with

daughter cards and necessary wiring correction shall be done in case of any reversal.

Fig: Inside view of the INGA_CLOVER Electronics Module

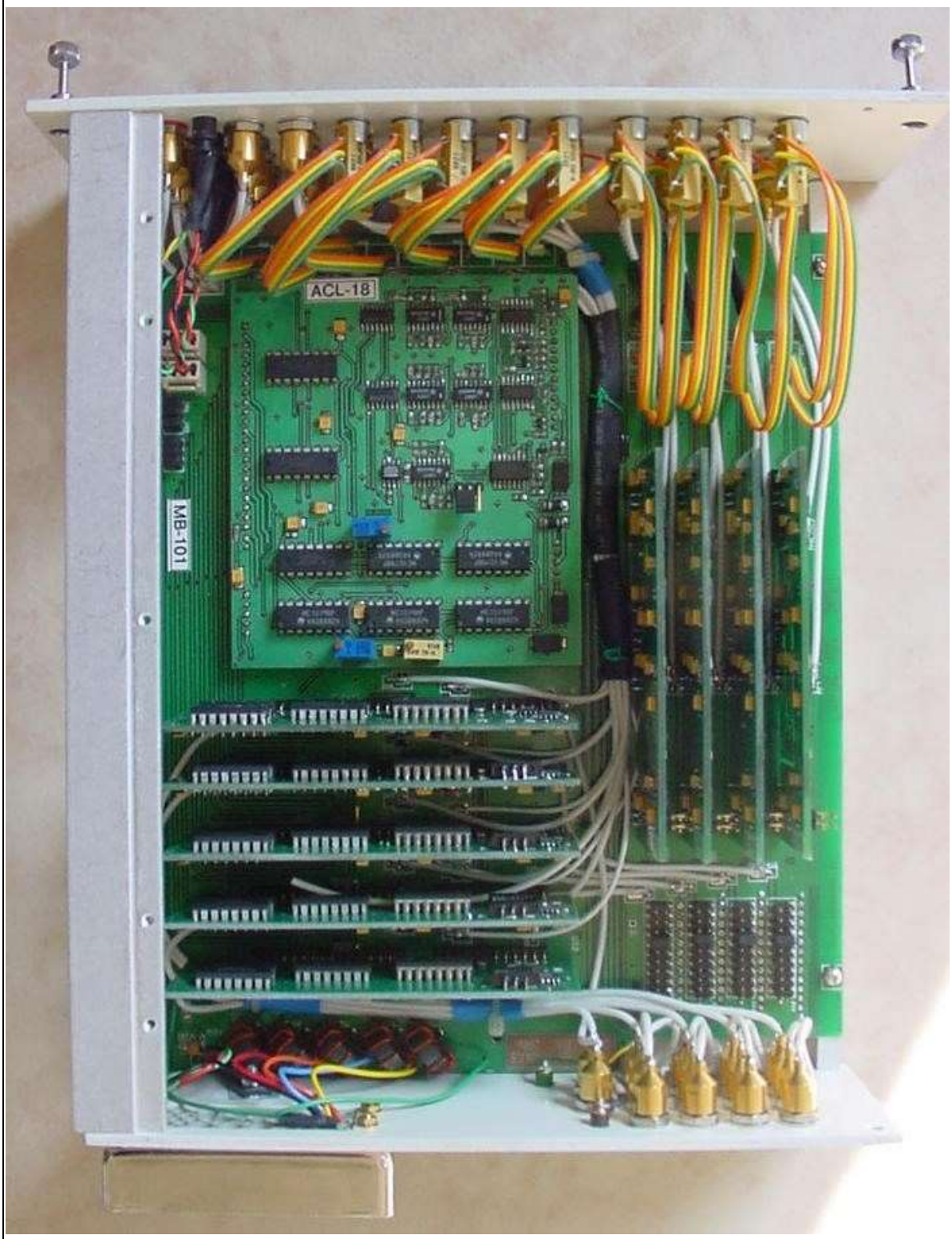


Fig: Front & Rear View of INGA_CLOVER Electronics Module

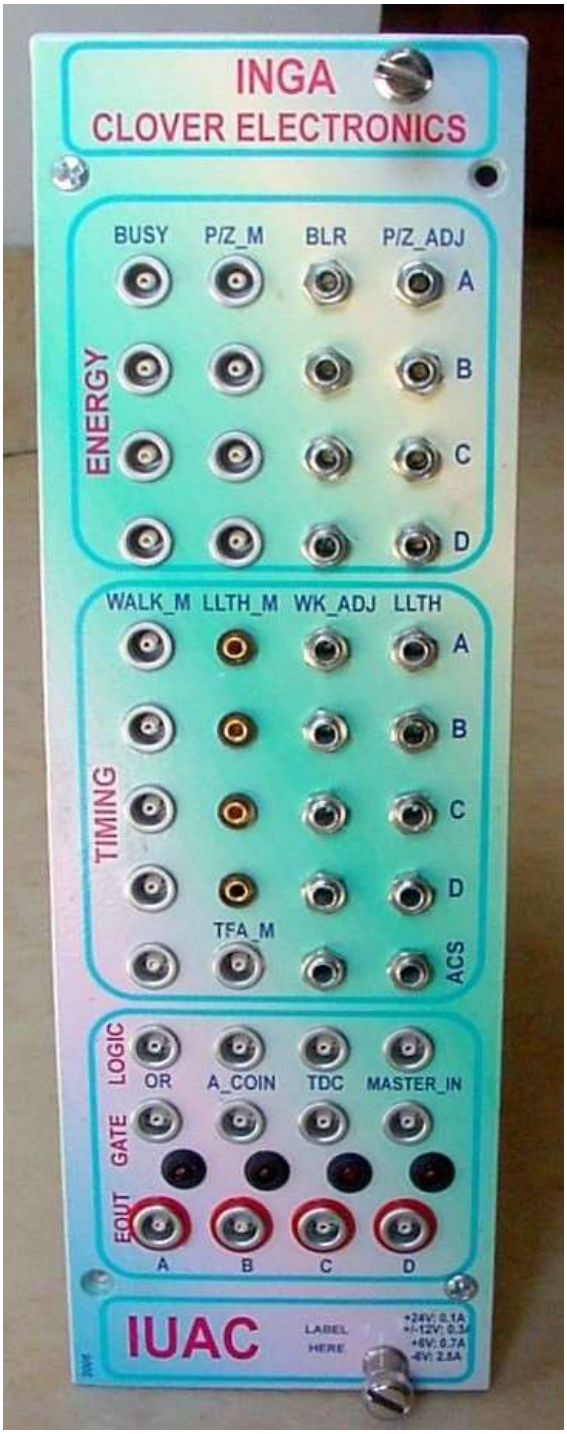
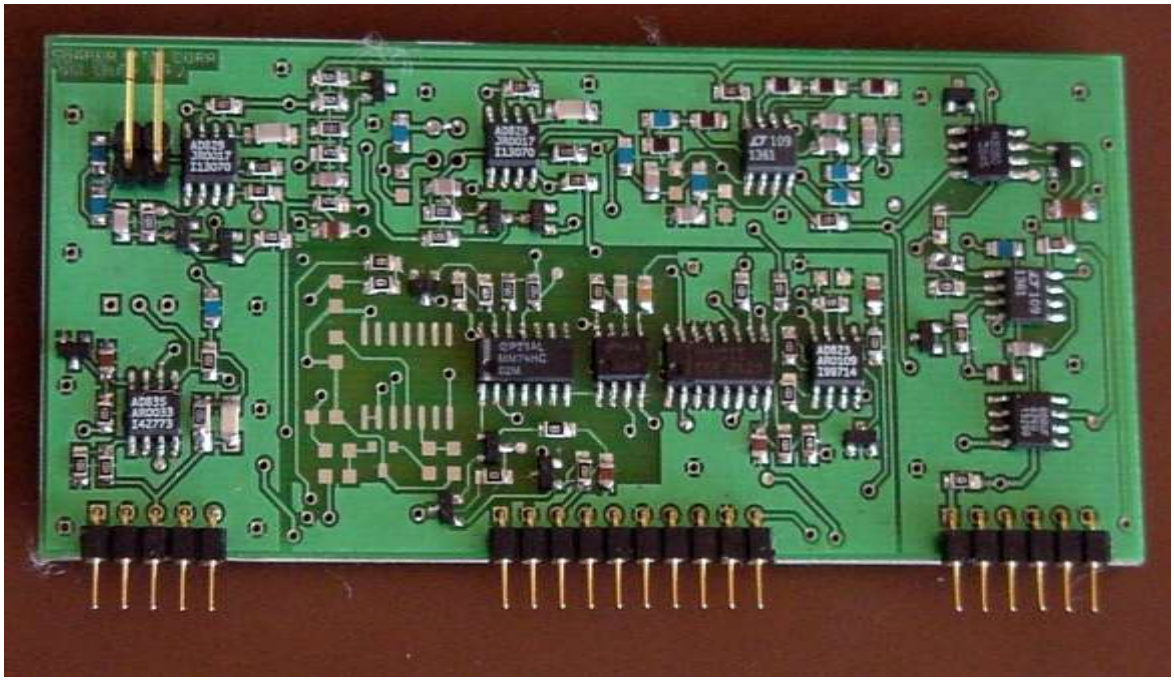


Fig: Shaper card with typical signals monitored



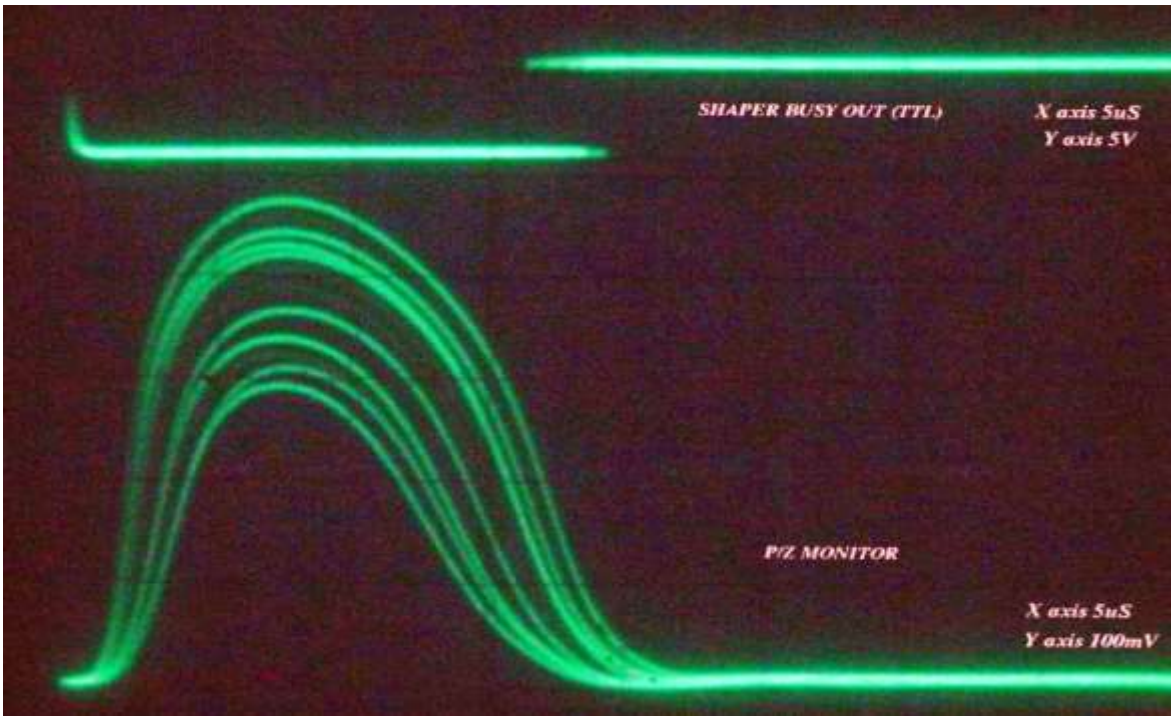


Fig: TFA+CFD card for Germanium an ACS detectors

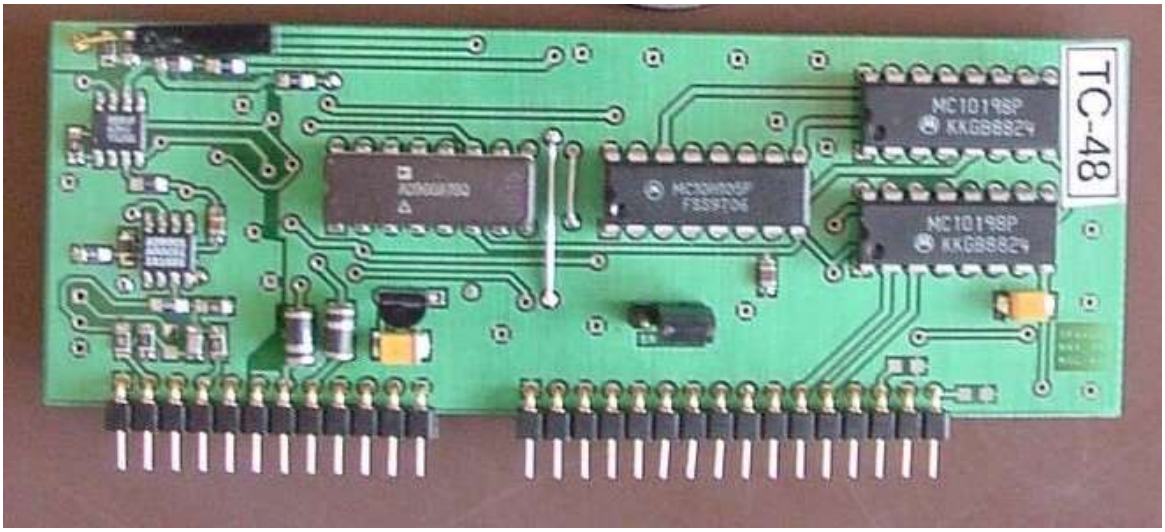
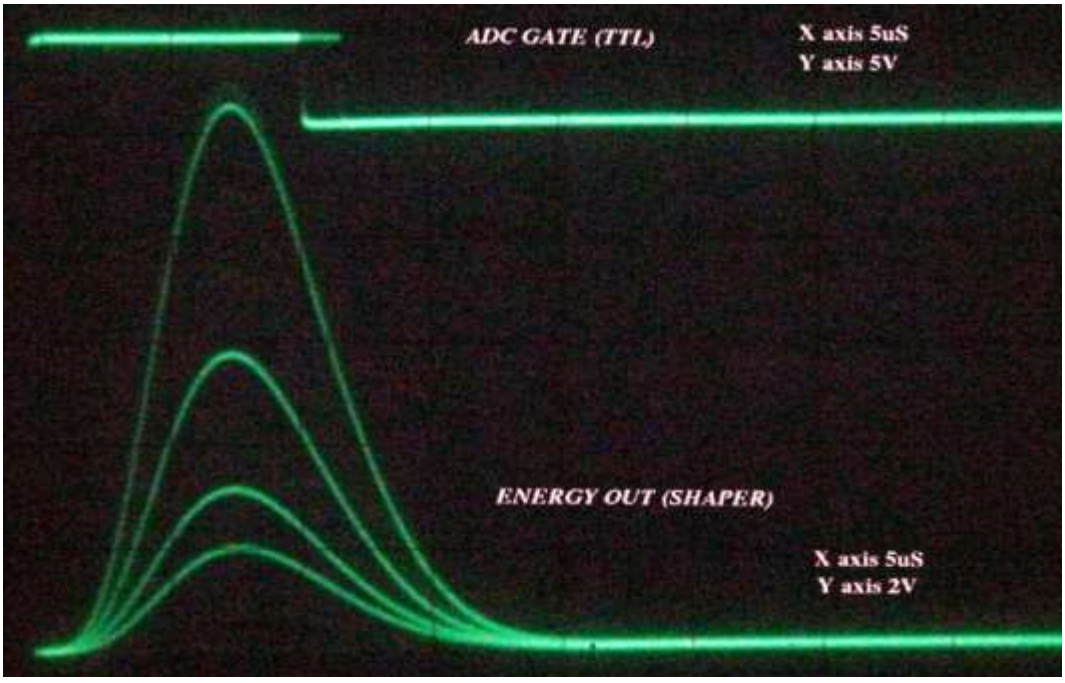


Fig: ACLogic card with typical signals monitored



List of Components required:

	Mother Board	1	per Module	
Sl.No	**Item Descriptions**	**Qty/PCB**	**Source**	**Source/Code No.**
1	PCB, FR-4, 1.6MM, 70uM,	1	Ancomp /Loca	Dry image process, Silk
	Model 2k6			Solder mask done with
	50PPM, 0805, MFR, 1% Resistor		IMPORT	
2	22	2	MERITEK	RN73-G-2A-TE-XXX-F
3	33.2	1	MERITEK	RN73-G-2A-TE-XXX-F
4	100	5	MERITEK	RN73-G-2A-TE-XXX-F
5	220	11	MERITEK	RN73-G-2A-TE-XXX-F
6	332	1	MERITEK	RN73-G-2A-TE-XXX-F
7	750	1	MERITEK	RN73-G-2A-TE-XXX-F
8	10k	5	MERITEK	RN73-G-2A-TE-XXX-F
9	220K	4	MERITEK	RN73-G-2A-TE-XXX-F
10	1K	1	MERITEK	RN73-G-2A-TE-XXX-F
11	1.2K	4	MERITEK	RN73-G-2A-TE-XXX-F
12	2K	4	MERITEK	RN73-G-2A-TE-XXX-F
13	0 OHMS	2	MERITEK	RN73-G-2A-TE-XXX-F
14	1.5K*	4	MERITEK	RN73-F-2A-TE-XXX-F
15	1K *	2	MERITEK	RN73-F-2A-TE-XXX-F
14	LED (1210)	1	Local	
15	TORROID T-12	5	Local	
16	SIP-5-255, Delayline	4	IMPORT	RHOMBUS
17	P9105-32-11-1 strip	4	Local	Protectron Electromech.
	0.1” pitch DOUBLE ROW, SMD) HEADER			
18	0.1” double row Headers strip	1	Local	Protectron Electromech.
19	0.1” Header Jumpers	10	Local	Protectron Electromech.
20	Cfu pins 4 pins set for LED	2	Local	
21	BD680A POWER TRANSISTOR	1	Local	SGS THOMSON
22	Heatsink kit for above	1	Local	
23	3mm LED RED	4	Local	
24	2N3904A Plastic thru hole	1	Local	PHILIPS/DIODE INC.
25	2N3906A Plastic thru hole	1	Local	PHILIPS/DIODE INC.
26	2N3906A SOT-23	1	Local	PHILIPS/DIODE INC.
27	BAT54S SOT-23	4	Local	PHILIPS/DIODE INC.
28	1N4003 SMD MINIMELF 1A Diode	1	Local	PHILIPS/DIODE INC.

29	ADR03BR SOIC	1	IMPORT	ANALOG DEVICES
30	LT1361CS8	1	IMPORT	LINEAR TECHNOLOGY
31	SN74AHCT123A SOIC-16	2	IMPORT	TEXAS INST
32	Potentiometer trimpot	18	IMPORT	SPECTROL/VISHAY
	M43P-103-K-B40-T602			
	10k, Panel type			
33	2MM Test point BS-3/RED..	6	Local	ELMECH INDIA
34	LED Holder 3mm Plastic	4	Local	
35	PTFE Hookup #26swg/x7	1M	Local	
36	0552-2-15-15-11-14-10-0	270	IMPORT	Mill-max

	Multilayer Ceramic chip capacitors			
37	0805-5-C-104-K-A-T-2-A	82	IMPORT	AVX
38	0805-5-C-103-K-A-T-2-A	~25	IMPORT	AVX
39	1nF/0805/50V/X7R	1	Local	
	TANTALUM CAPACITORS			
40	TAJC106K035R	13	IMPORT	AVX
41	TAJB106K035R	12	IMPORT	AVX
Ca binet and related Hardwares				
Sl.No	**Item Descriptions**	**Qty/PCB**	**Source**	**Source/Code No.**
1	ERA.00.250.CTL	44x	IMPORT	LEMO CONNECTOR NIM
2	GCD.00.020.LA	44x	IMPORT	Earth cap
3	GRA.00.269.GG (grey)	8X	IMPORT	GREY WASHER
4	DCG.91.149.OTN	1X	IMPORT	WRENCH
5	M17-093-RG178	100feet	IMPORT	Belden Cables-WHITE
6	CABINET_000102-00	1X	IMPORT	Mech-Tronics
7	CONNECTORS NIM_100-10	1X	IMPORT	Mech-Tronics
8	3CORE Flat plastic/PTFE.wire	20feet	Local	

9	Panel preparation Drawing attached	1X	Local	***On requirement***
10	PanelScrren printing attached	1X	Local	***On requirement***
	Shaping Amplifier card	**4**	**card per Mod**	**le**
Sl.No	**Item Descriptions**	**Qty/PCB**	**Source**	**Source/Code No.**
1	PCB, FR-4, 1.6MM, 70uM,	1X	Ancomp /Loca	Dry image process, Silk
	Model 2k6NSC-JULY 2K2			Solder mask done with
	SHAPER_PT5_CORR			
	25PPM, 0805, MFR, 1% Resistor			**MERITEK**
2	22	1X	IMPORT	RN73-F-2A-TE-XXX-F
3	6.8K	3X	IMPORT	RN73-F-2A-TE-XXX-F
4	680	1X	IMPORT	RN73-F-2A-TE-XXX-F
5	1.5K	4x	IMPORT	RN73-F-2A-TE-XXX-F
6	1.3K	1X	IMPORT	RN73-F-2A-TE-XXX-F
7	2K	1X	IMPORT	RN73-F-2A-TE-XXX-F
8	330	1X	IMPORT	RN73-F-2A-TE-XXX-F
9	100	1X	IMPORT	RN73-F-2A-TE-XXX-F
10	3.32K	1X	IMPORT	RN73-F-2A-TE-XXX-F
11	10K	1X	IMPORT	RN73-F-2A-TE-XXX-F
12	5.1K	1X	IMPORT	RN73-F-2A-TE-XXX-F
	50PPM, 0805, MFR, 1% Resistor			
13	22	8X	IMPORT	RN73-G-2A-TE-XXX-F
14	47.5	3X	IMPORT	RN73-G-2A-TE-XXX-F
15	100	3X	IMPORT	RN73-G-2A-TE-XXX-F
16	1K	12X	IMPORT	RN73-G-2A-TE-XXX-F
17	2K	1X	IMPORT	RN73-G-2A-TE-XXX-F
18	22K	1X	IMPORT	RN73-G-2A-TE-XXX-F
19	10K	5X	IMPORT	RN73-G-2A-TE-XXX-F

20	15K	2X	IMPORT	RN73-G-2A-TE-XXX-F
21	511	2X	IMPORT	RN73-G-2A-TE-XXX-F

CLOVER ELECTRONICS MODULE FOR INGA SEPT 2K6

	TFA + CFD CARD	***5 cards per ule Mod***		
Sl.No	**Item Descriptions**	**Qty/PCB**	**Source**	**Source/Code No.**
1	PCB, FR-4, 1.6MM, 70uM,	1 x	Ancomp /Loca	Dry image process, Silk
	Model MAY2K2			Solder mask done with
	TFA+CFD			
	50PPM, 0805, MFR, 1% Resistor			***XXX: FILL-IN***
2	22	3X	IMPORT	RN73-G-2A-TE-XXX-F
3	220	3X	IMPORT	RN73-G-2A-TE-XXX-F
4	332	2X	IMPORT	RN73-G-2A-TE-XXX-F
5	0	2X	IMPORT	RN73-G-2A-TE-XXX-F
6	1K	2X	IMPORT	RN73-G-2A-TE-XXX-F
7	10	1X	IMPORT	RN73-G-2A-TE-XXX-F
8	51	1X	IMPORT	RN73-G-2A-TE-XXX-F
9	22K	3X	IMPORT	RN73-G-2A-TE-XXX-F
10	4.75K	2X	IMPORT	RN73-G-2A-TE-XXX-F
11	47.5K	1X	IMPORT	RN73-G-2A-TE-XXX-F
12	1.2K	1X	IMPORT	RN73-G-2A-TE-XXX-F
13	750	1X	IMPORT	RN73-G-2A-TE-XXX-F
14	2K	7x	IMPORT	RN73-G-2A-TE-XXX-F
15	47.5	4x	IMPORT	RN73-G-2A-TE-XXX-F
16	3.32K	2X	IMPORT	RN73-G-2A-TE-XXX-F
17	511	11X	IMPORT	RN73-G-2A-TE-XXX-F
18	100	5X	IMPORT	RN73-G-2A-TE-XXX-F
19	110	5X	IMPORT	RN73-G-2A-TE-XXX-F
20	82 OHM, MFR, 1% THROUGH HOLE	1X	Local	
	Multilayer Ceramic chip capacitors			
21	0805-5-C-104-K-A-T-2-A	13X	Local	AVX
22	0805-5-C-103-K-A-T-2-A	2X	Local	AVX
	INDUCTORS SMD 1210			
23	47uH	3X	IMPORT	AVX
	TANTALUM CAPACITORS			
24	TAJB106K035R	10X	IMPORT	AVX
	COG/NPO Multilayer capacitors			

25	0805, 50V, 470PF	2X	IMPORT	AVX
26	0805, 50V, 4.7PF	1X	IMPORT	AVX
27	0805, 50V, 220PF	2X	IMPORT	AVX
28	0805, 50V, 10PF	1X	IMPORT	AVX
	SOIC-8 SMD PACKAGES			
29	AD96687BQ	1X	IMPORT	LINEAR TECHNOLOGY
30	AD8011AR	1X	IMPORT	ANALOG DEVICES
31	MC10198P	2X	IMPORT	ANALOG DEVICES
32	BUF634U	1X	IMPORT	Burr-Brown/TI
33	MC10H105P	1X	IMPORT	HARRIS
34	SP3-25-10	21X	IMPORT	RHOMBUS, 25nS, 100Zo

	SMD PACKAGES			
35	1N4003 SMD MINIMELF 1A Diode	2X	IMPORT	PHILIPS/DIODE INC.
36	BAV70/SOT-23	3X	IMPORT	PHILIPS/DIODE INC.
37	BAT54C /SOT-23	1X	IMPORT	PHILIPS/DIODE INC.
38	BRF92A/ SOT-23	2X	IMPORT	PHILIPS/DIODE INC.
	CONNECTORS			**Single row 32pins 10uM gold**
	Interconnects, Single Row,Rightangle Pin header			**0.1"Grid 0.018" LEAD Dia.**
39	*399-10-132-010-009*	1x	IMPORT	Mill-max
40	RIGHT ANGLE 0.1" Header , SINGLE ROW X3	1X	Local	Protectron Electromech.

NTICOINCIDENCE LOGIC CARD

1 PER INGA MODULE

Sl.No	Item Descriptions	Qty/PCB	Source	Source/Code No.
1	PCB, FR-4, 1.6MM, 70uM,	1X	Ancomp	Dry image process, Silk
	Model PT-4, 2003		/Local	Screen, Solder Mask
	ACLOGIC CARD			
	50PPM, 0805, MFR, 1% Resistor			***XXX: FILL-IN***
2	220	10X	IMPORT	RN73-G-2A-TE-XXX-F
3	4.7	1x	IMPORT	RN73-G-2A-TE-XXX-F
4	10	6X	IMPORT	RN73-G-2A-TE-XXX-F
5	1.3K	1X	IMPORT	RN73-G-2A-TE-XXX-F
6	475	8X	IMPORT	RN73-G-2A-TE-XXX-F
7	22K	4x	IMPORT	RN73-G-2A-TE-XXX-F
8	2K	3X	IMPORT	RN73-G-2A-TE-XXX-F
9	1.2K	1X	IMPORT	RN73-G-2A-TE-XXX-F
10	10K	4x	IMPORT	RN73-G-2A-TE-XXX-F
11	1.5K	5X	IMPORT	RN73-G-2A-TE-XXX-F
12	47.5	10X	IMPORT	RN73-G-2A-TE-XXX-F
13	3.32K	13X	IMPORT	RN73-G-2A-TE-XXX-F
14	511	8X	IMPORT	RN73-G-2A-TE-XXX-F
15	1.6K	1X	IMPORT	RN73-G-2A-TE-XXX-F
16	110	30X	IMPORT	RN73-G-2A-TE-XXX-F
17	1K	1x	IMPORT	RN73-G-2A-TE-XXX-F

	Multilayer Ceramic chip capacitors			
17	0805-5-C-104-K-A-T-2-A	10X	Local	AVX
18	0805-5-C-103-K-A-T-2-A	30X	Local	AVX
	POTENTIOMETER			
19	M64W-202-K-B40	3X	IMPORT	VISHAY
	TANTALUM CAPACITORS			
20	TAJB106K035R	4x	IMPORT	AVX
21	TAJB225K035R	5X	IMPORT	AVX
22	TAJC106K035R	3X	IMPORT	AVX

22	47.5K	5x	IMPORT	RN73-G-2A-TE-XXX-F
23	1.5K	1X	IMPORT	RN73-G-2A-TE-XXX-F
24	100K	1X	IMPORT	RN73-G-2A-TE-XXX-F
25	5.6K	1x	IMPORT	RN73-G-2A-TE-XXX-F
26	3.32K	2X	IMPORT	RN73-G-2A-TE-XXX-F
27	10	1X	IMPORT	RN73-G-2A-TE-XXX-F
	Multilayer Ceramic chip capacitors			
28	0805-5-C-104-K-A-T-2-A	30X	Local	AVX
29	1206-5-C-224-K-A-T-2-A	1X	Local	AVX
30	0805-5-C-223-K-A-T-2-A	2X	Local	AVX
	TANTALUM CAPACITORS			
31	TAJC106K035R	2X	IMPORT	AVX
32	TAJB106K035R	14X	IMPORT	AVX
33	TAJA155K025R	2X	IMPORT	AVX
	COG/NPO Multilayer capacitors			
34	1206, 50V, 1500PF	3X	IMPORT	AVX
35	0805, 50V, 1000PF	6X	IMPORT	AVX
36	0805, 50V, 22PF	2X	IMPORT	AVX
37	0805, 50V, 220PF	2X	IMPORT	AVX
38	0805, 50V, 330PF	2X	IMPORT	AVX
	SOIC-8 SMD PACKAGES			
39	LT1361CS8	2X	IMPORT	LINEAR TECHNOLOGY
40	AD829AR	2X	IMPORT	ANALOG DEVICES
41	AD835 AR	1X	IMPORT	ANALOG DEVICES
42	BUF634U	1X	IMPORT	Burr-Brown/TI
43	CA3080S	1X	IMPORT	HARRIS
44	MAX912CSE	1X	IMPORT	MAXIM
45	LM555CM	1X	IMPORT	National Semi.
46	MM74HC02M	1X	IMPORT	National Semi.
47	AD823AR	1X	IMPORT	ANALOG DEVICES
	SMD PACKAGES			
48	1N4003 SMD MINIMELF 1A Diode	2X	IMPORT	PHILIPS/DIODE INC.
49	BAV99/SOT-23	4x	IMPORT	PHILIPS/DIODE INC.
50	BAT54 SOT-23	2X	IMPORT	PHILIPS/DIODE INC.
51	BZX84C4V7 SOT-23	1X	IMPORT	PHILIPS/DIODE INC.
52	BZX84C8V2 SOT-23	1X	IMPORT	PHILIPS/DIODE INC.
53	BAT54A SOT-23	1X	IMPORT	PHILIPS/DIODE INC.
54	BAT54S SOT-23	1X	IMPORT	PHILIPS/DIODE INC.
55	MMBF4416L/SOT-23	1X	IMPORT	PHILIPS/DIODE INC.
56	PMBT3906/SOT-23	2X	IMPORT	PHILIPS/DIODE INC.
57	PMBT3904/SOT-23	1X	IMPORT	PHILIPS/DIODE INC.
	CONNECTORS			**Single row 32pins 10uM gold**
Interconnects, Single Row,Rightangle Pin header				**0.1"Grid 0.018" LEAD Dia.**
58	*399-10-132-010-009*	1x	IMPORT	Mill-max

List of Cables & Wires required for Interconnection inside Module

Standard lengths to be c	**ıt as per hi**	**s table.**				
NAME	***LENGTH***	***NAME***	***LENGTH***			
	Inches		***Inches***			
FRONT PANELONS CONNECTI						
A_COIN	6.5	BUSY_A	5			
OR_P	6	BUSY_B	5			
TDC	6.5	BUSY_C	5			
MASTER_GATE (M_GATE)	6	BUSY_D	5			
GATE_A	5	P/Z_MON_A	5.5			
GATE_B	5	P/Z_MON_B	5.5			
GATE_C	6	P/Z_MON_C	5.5			
GATE_D	6	P/Z_MON_D	5.5			
EOUT_A	11					
EOUT_B	10	WALK_MON_A	9			
EOUT_C	10	WALK_MON_B	10			
EOUT_D	9	WALK_MON_C	10			
		WALK_MON_D	11			
ACS TFA (TFA_M)	12	WALK_MON-ACS	10			
REAR PANELNS CONNECTIO						
EIN_A	4	ACS_CFD	9			
EIN_B	4	A_CFD	10			
EIN_C	4	B_CFD	9			

EIN_D	4	C_CFD	8			
TIME_IN A	3 & 3.25	D_CFD	6.5			
TIME_IN B	3 &3					
TIME_IN C	3&2	PUR	8			
TIME_IN D	3 & 2	PUR:Short 4bs innernd use Lem contacts a				
TIME_IN ACS	6	Lug for groundnnection. co				

CLOVER ELECTRONICS MODULE FOR INGA SEPT 2K6

CORE Splitted PTFE WIRE	**S**					
BLR_A	4.5	LLTH_A	3.5	**Use Low no**	**ise wire/GL**	**N-196A/U**
BLR_B	4.5	LLTH_B	3.5	LLTH_A	8	
BLR_C	4.5	LLTH_C	4	LLTH_B	9	
BLR_D	4.5	LLTH_D	4	LLTH_C	10	
		LLTH_ACS	4	LLTH_D	11	
				LLTH_ACS	10	
P/Z ADJ. A	4.5	WALK_ADJ. A	3.5	Temp	10	
P/Z ADJ. B	4.5	WALK_ADJ. B	3.5			

P/Z ADJ. C	4.5	WALK_ADJ. C	3.5			
P/Z ADJ. D	4.5	WALK_ADJ. D	4			
		WALK_ADJ. ACS	4			

Connections for Potentiometers are done through 3core Flat splitted PTFE wires, SWG26, multistrand.

Instructions

Cable : RG178B/U, Make: BELDEN or equ.
Use cautiously-sharp Industrial knife/sleeve remover to remove sleeve Use scissors/cutter to remove braid.
Use brush to clean braid bits which may cause short circuit.
Start the connection from connector ends with earth caps in case of Coaxial cable. Start the connections form PCB incase of teflon/plastic wire.

Remove only 2mm-3mm-5mm lenth for coax & low noise cables (inner-dielectric-braid)ie. 10mm.
Remove 10mm towards pot end and 6mm towrds PCB end of PTFE wires

The lengths given are always bit longer than required. Trim the length for neat assembly And secure them heat shrink tubes and or 10mm Cable ties where ever applicable.

Internet Web resources :

http://www.mech-tronics.com/
http://www.vishay.com/
http://www.avx.com/
http://www.lemosa.com/
http://www.rhombus-ind.com/
Http://www.analogdevices.com/
Http://www.linear.com/
Http://www.protectron-electromech.com/
http://www.mill-max.com/
http://www.meritekusa.com/ http://www.smd-in.com/