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INGRID - PREAMP BOARD -TECHNICAL DESCRIPTION

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INGRID HAWAII PREAMP BOARD TECHNICAL DESCRIPTION

This note gives a detailed technical description of the preamp board as used with the HAWAII array in ING's new infra red imager INGRID. This board allows independent control of each of the four quadrants of the HAWAII array.

Enclosure

The board is mounted in its own metal box enclosure. A 20-41 connector is mounted directly to the PCB and this protrudes through the metal enclosure to mate to the hermetic connector on the cryostat body. A lever arm is attached to the connector to allow it to be coupled and de-coupled when required. A 50 way D type connector socket also protrudes through the metal box enclosure to allow a 50 way D type cable to mate to it, which then connects to the SDSU controller front panel at the other end. The metal box enclosure is itself taken to AGND via a link from the board to a mounting screw on the enclosure.

PCB layout

The original intention was to use the PCB to route both the output signals via amplifiers and also all the clock signals. All signals were to pass via the one 20-41 connector. Due to the lack of time for testing and preliminary results showing cross talk from the clock lines to the bias supplies, it was decided to not use the clock feedthrough options on the board. The clock lines and digital supplies are now taken separately and directly from the SDSU controller front panel connector to a hermetic connector on the cryostat body, thus by-passing the preamp box completely.
The board is of four layer construction as follows:-

?? Layer 1 - Component Side
?? Layer 2 - Power Plane
?? Layer 3 - Ground Plane - subdivided between AGND and Clock DGND
?? Layer 4 - Solder Mask

Since the board is no longer used to route the clock lines the separated ground planes can be connected together with a link between TP41 and TP42. There have also been wire links added to the back of the board to reduce the impedance connections to the power supply lines to the op amps.

Some of the clock lines are now used to carry analogue signal lines. These are BIASGATE which goes from pin 50 to pin U and BIASPOWER which goes from Pin 17 to Pin 37.

Connector Designation

There are therefore two connectors associated with the preamplifier box, the 50 way D type which mates via a cable to the SDSU controller and the 20-41 connector which mates to the cryostat body mounted hermetic connector.

50 way D type pinout

Connector Pin Number	Signal Name
1	+15V preamp supply
2	OUT1 (OUT1+ after amplification)
3	OUT2 (OUT2+ after amplification)
4	OUT3 (OUT3+ after amplification)
5	OUT4 (OUT4+ after amplification)
6	
7	HIGH3
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	BIASPOWER
18	OFFSET1
19	AGND (Analogue ground)
20	AGND
21	AGND
22	AGND
23	HIGH3
24	HIGH4
25	DGND (not used)
26	
27	
28	
29	
30	
31	
32	
33	
34	-15V preamp supply
35	
36	OFFSET2
37	OFFSET3
38	OFFSET4

39	**HIGH1**
40	
41	**VRESET**
42	
43	
44	
45	
46	
47	
48	
49	
50	**BIASGATE**

20-41 Connector Pinout

Connector Pin Number	Signal Name
A	
B	
C	
D	
E	
F	
G	
H	DGND (linked to AGND plane at TP41)
J	DGND (DGND not used on this board)
K	
L	HIGH4
M	OUT4+
N	OUT3+
P	OUT2+
R	OUT1-
S	OUT1+
T	HIGH3
U	BIASGATE
V	
W	
X	
Y	
Z	
a	
b	
c	
d	
e	AGND
f	
g	
h	HIGH2
i	
j	BIASPOWER
k	
m	
n	
p	
q	VRESET
r	HIGH1
s	
t	

Circuit Description

The preamp board has been designed to give four independent d.c. coupled differential amplifier circuits each with its own separate d.c. offset adjust. This note will describe only one circuit in detail but the description of operation is identical for all four preamp circuits, only the circuit designators are different.

Each of the preamplifiers is a classic instrumentation amplifier design, d.c. coupled to the array outputs and with a d.c. offset adjust circuit. Each circuit has been designed for good low noise performance. The different parts to the circuit are described below.

d.c. offset adjust

Since the amplifier is d.c. coupled to the source follower circuit from the fanout board it then follows that a d.c. offset adjustment will be required to remove the d.c. level from the fanout signals as feed into the preamplifier circuit. this level is normally of the order of 3V. This d.c. level changes from Mux array to Science array, from warm arrays to cold arrays and from quadrant to quadrant on an array. The d.c. offset adjust circuit is supplied from a 4 channel DAC in the SDSU controller supplying four d.c. levels to the preamp board. Each of these levels is software controllable. Each level is fed into its own preamp circuit, using an OP400. This circuit has a gain of 2. The +15V and -15V supplies feed the op amps on the board. These supplies have been heavily filtered and current limited, the effect of which is to reduce these supplies from 15V levels to 12.5V levels. The d.c. offset circuit also relies on the power supply rejection of the op amps to keep the d.c. levels clean. The output of each d.c. offset circuit is also very heavily filtered. Each of these d.c. levels is then fed directly to its own differential preamplifier circuit to which the array outputs have been fed.

Differential Amplifier

The preamplifier stage takes the form of the classic instrumentation amplifier with modifications to allow a d.c. offset level to be subtracted from the incoming signal. The differential positive input is fed from the source follower circuit on the fanout board. The differential negative input is fed from the “resistor to ground” input from the fanout board. This configuration has been designed to have very high common mode rejection so that any common mode noise picked up by the signal lines as they travel from fanout board through the cryostat to the preamp circuit should be rejected. The circuit therefore has a common mode gain of only one but a differential gain of 5. The output from the amplifier after having been multiplied by a factor of 5 and having the d.c. level removed is then taken as a non differential signal via a cable to the SDSU controller where it connects to the Video Board.

Preamplifier Gain = [(1+(2*R4/R3)+R4/R2)*(OUT+ - OUT-)]-(R4/R2)*d.c. level

Video Board

The preamplified signals are then fed into the video board on the SDSU controller where they pass through another gain stage of 2 before being digitised by 16 bit ADCs.