



ENDCAP Alignment

CMS CCD OPTICAL POSITION SENSOR (COPS)

User's Manual

FNAL – PNPI
2003

1. Introduction

The CCD optical position sensor (COPS) is intended for using in the Straight Line Monitor (SLM) and Transfer line as two-dimensional sensor for cross hair laser beam. It receives two voltages and two clock signals from the DCOPS readout board through connector and a sensor cable. Output data arrives to the readout board by the same way. All signals in the sensor cable are single-ended.

The COPS contains four linear CCDs that **must** be modified before usage. They need absorbers glued to their surfaces. CCDs are inserted into the sockets on the printed circuit boards.

2. Construction

The CCD optical position sensor is an assembly of four printed circuit boards connected by means of short capton cables together with linear ILX551A CCDs inserted into sockets. Preliminary absorbers are glued to the CCDs. The following count is accepted for certainty: upper CCD has number 1, the next clockwise (right) is 2, lower is 3, and left is 4. The board containing CCD # 4 has a 20-pin connector J1 for control and readout. All boards have 14-contact zero-force connectors P1 – P6 for capton cables also.

3. Circuit Diagram

The CCD optical position sensor consists of four linear CCDs with bypass capacitors and clamp diodes and emitter followers with AC coupling capacitors at outputs of the CCDs (see circuit diagram).

The linear CCDs require two voltages: +9 V and +5 V that are taken from the readout board. The readout board produces two clock signals (0ROG and 0CLK) also to control the output of CCDs. These signals arrive to inputs of all CCDs providing four CCD output signals simultaneously.

4. Application Note

The CCD optical position sensor has six internal connectors and one external connector used for both signal transmitting and power connections. Therefore, it is very important to be sure that the power voltage is OFF before connecting or disconnecting any cable.

5. Functioning

The DCOPS readout board provides necessary voltages, clock signals, and timing for the CCD optical position sensor. For reference see ILX551A datasheet and “CMS CCD optical position sensor readout board. User's guide”.

Data readout is initiated by the 0ROG signal. Then sequence of 2087 periods of 0CLK causes a series of pixel output signals. The first 33 and last 6 pixels are dummy. A length of this sequence must be exact to provide a proper execution of the reading.

Warning: **First switch on +9V power supply voltage and then +5V.
Switch off power in the reverse order.**

6. Debugging and Testing

Necessary equipment:

- Computer running under Windows (9x, NT, 2000)
- RS-232/RS-422 adapter
- Interface board #1
- Readout board
- RS-232 serial link DB9/DB9 cable
- RS-422 serial link RJ11/RJ11 cable
- Power cable for RS-232/RS-422 adapter
- Power cable for the interface board
- Two 20-conductor ribbon cables for connection of the readout board to the interface board and to the sensor under test
- 10 – 15 V power supply
- Digital voltmeter

Software to be used:

- Hyper Terminal application

Properly manufactured readout boards do not require any adjustments. They should work at once after inserting of CCDs.

1. Check the assembled board visually. It must not have visible damages. All components and their values must be in accordance with documents.
2. Insert the CCDs following a key position
3. Connect printed circuit boards with flat flexible cables (FFC) as shown in Figure 1.

- Connect the readout board under test to the interface board as shown in Fig. 1 and turn on power.

Warning: All reconnections must be performed with power turned OFF

- Run Hyper Terminal application as described in the User's Guide for the readout board.

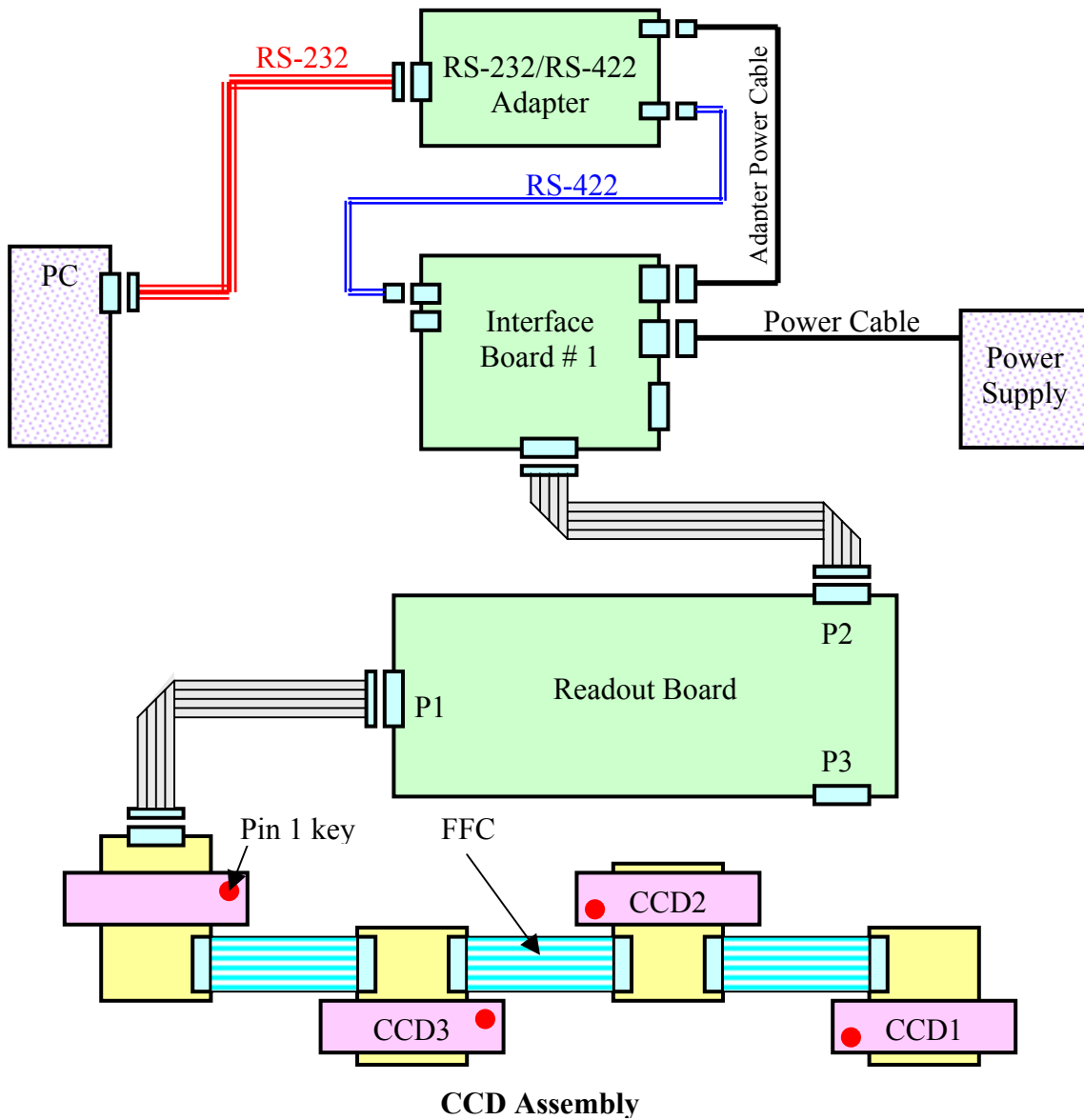


Fig. 1. Diagram of connections

6. Check presence of the data output for all CCDs using CC and CD commands for the readout board. By changing a light shield be sure that data changes also.
7. Complete test of the CCD optical position sensor must be performed after full mechanical assembly at the Fermilab alignment stand.

7. Troubleshooting and Maintenance

Due to simplicity of the sensor boards it is enough to check the following:

1. Input "AP 1" command. Check presence of +9V voltage at pin 20 of CCD and +5V at pin 22.
2. Input "CC 10 1" command. Check presence of 0ROG signal at pin 11 and 0CLK at pin 5 for all CCDs. Check output data at pin 1. Check the emitter follower.

Warning: All reconnections must be performed with power turned OFF

8. Specification

General

Dimensions of the boards:

CCD1 – CCD3	1.60" x 1.25"
CCD4	2.125" x 1.25"
Internal connectors P1 – P6	14 x 1 FFC header Molex 52207-1490
External connector J1	10 x 2 header 3M 3428-6002

Power characteristics

Input voltage 1	+9 V
Input voltage 2	+5 V
Power consumption	370 mW

There is no on board power protection.
Power protection is provided by the readout board.

Communication features

Signal levels	CMOS single-ended
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Specification of connectors

External connector J1:

Name	Pin	Pin	Name
+5V	1	2	+5V
GND	3	4	CCD1 input
GND	5	6	CCD2 input
GND	7	8	CCD3 input
GND	9	10	CCD4 input
GND	11	12	GND
0ROG5V output	13	14	GND
0CLK5V output	15	16	GND
<No used>	17	18	GND
+9V	19	20	+9V

Internal connectors P1 - P5:

Name	Pin
+5V	1
AGND	2
CCD1 output	3
AGND	4
CCD2 output*	5
AGND	6
CCD3 output**	7
AGND	8
GND	9
0ROG input	10
GND	11
0CLK input	12
GND	13
+9V	14

* Used in P3 – P6 connectors, connected to AGND in P1, P2

** Used in P5, P6 connectors, connected to AGND in P1 – P4

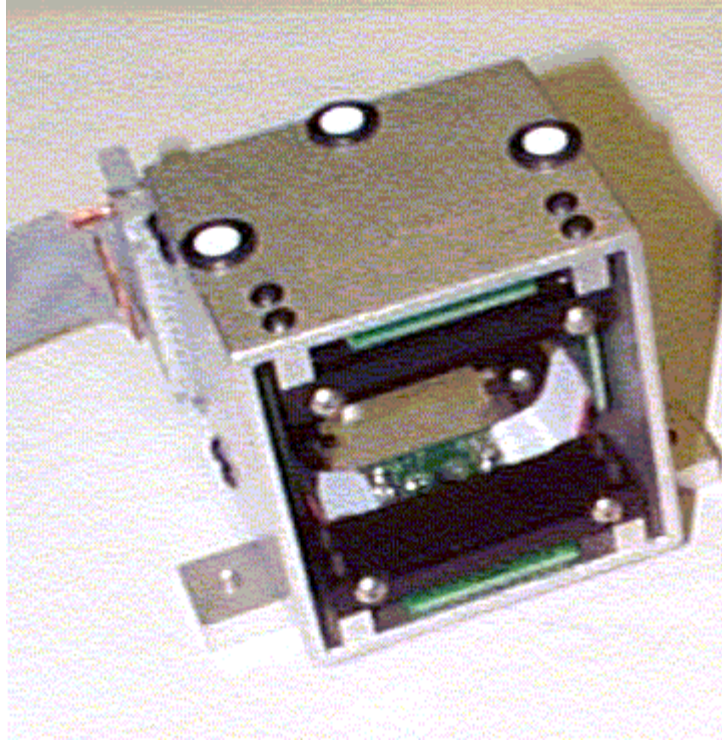


Fig. 1. The CCD optical position sensor