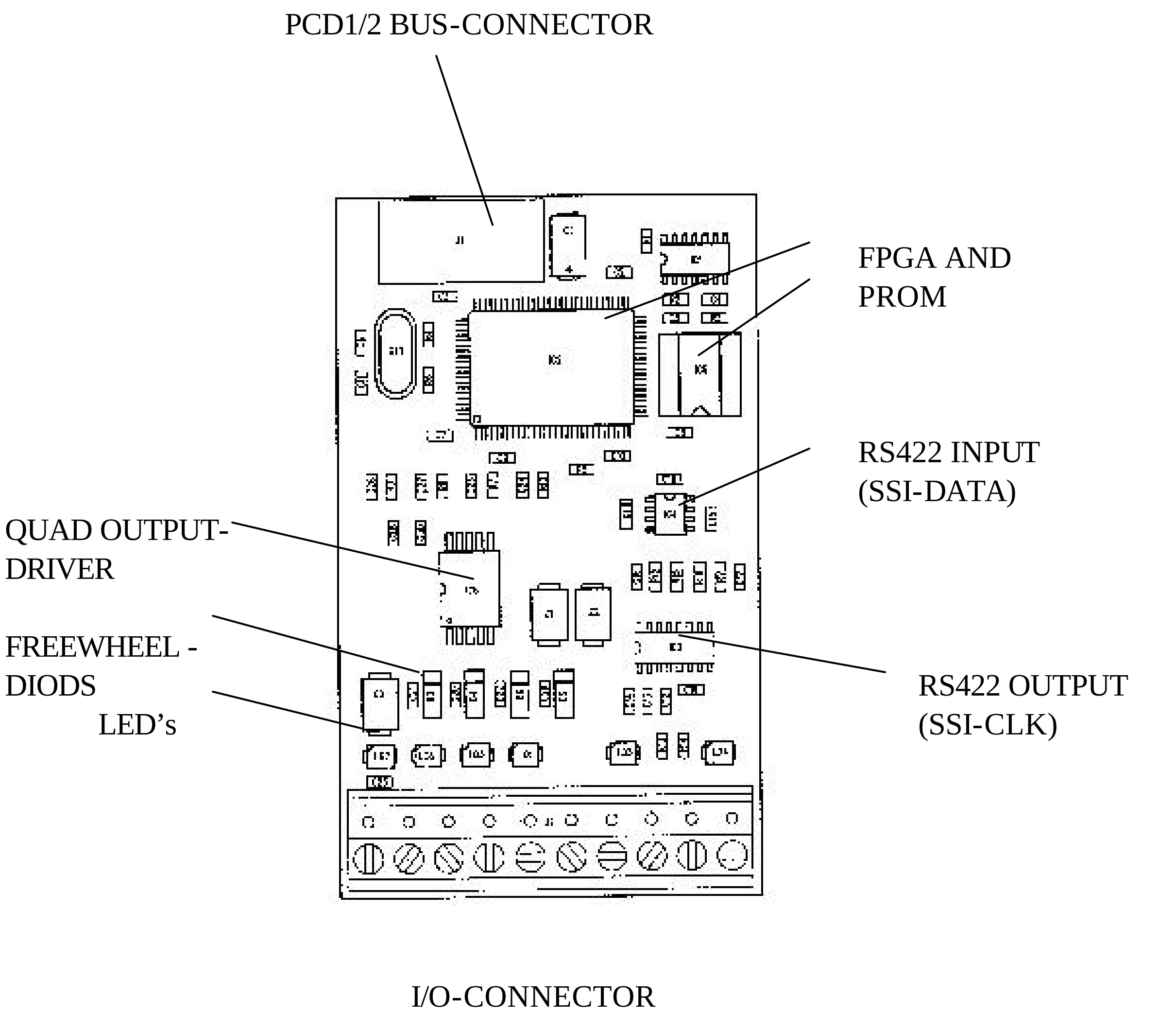
1. General

The PCD2.H150 module is an interface module for the SSI standard. The SSI interface is used on absolute encoders. Details on the SSI-specification can be read in the brochure: 'SSI Technische Information' from STEGMANN.

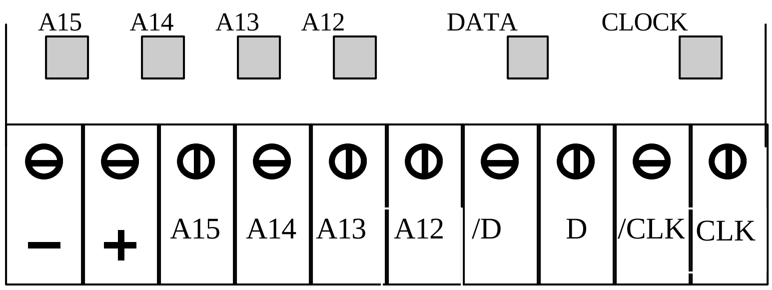
The HW consists of the RS422 channel for the SSI interface and 4 digital outputs that can be used independently. The intelligence is programmed in a FPGA.

2. Presentation



3. Connections

This picture shows the text on the print. The I/O connector is standard from 0...9 (from right to left).

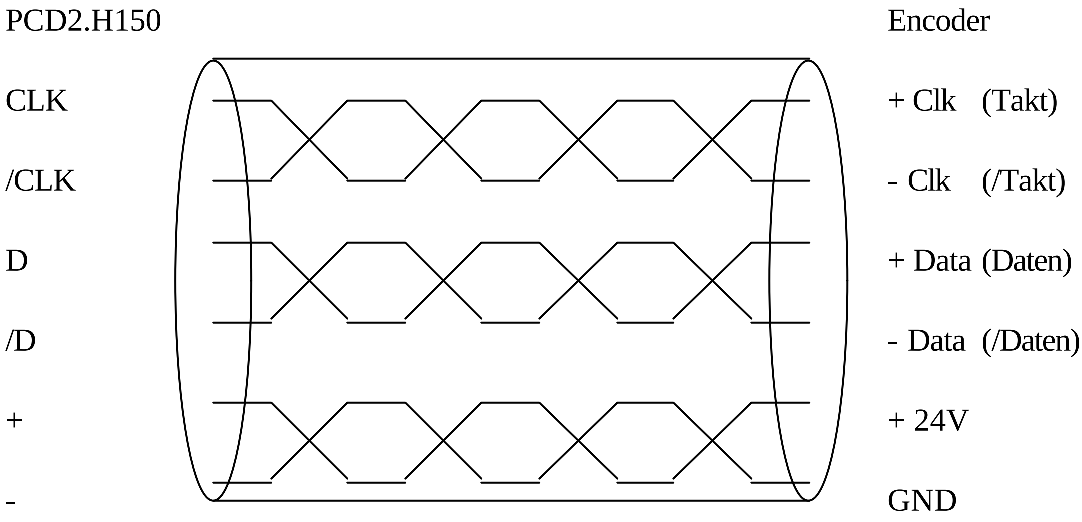


4. Descriptions of the LED's

There are 6 LED's equipped on the module:

- 1 LED for the SSI output CLOCK, which is flashing if a clock burst is sent to the absolute encoder
- 1 LED for the SSI input DATA, which is flashing if the absolute encoder is sending the position data. If the SSI interface works correctly, these two LED's are flashing when reading the position from the encoder.
  The LED pulse for CLOCK and DATA is extended to 5 ms so that it is visible. This makes that both LED's are constantly on, if the read period in the user program is shorter that 5 ms.
- 4 LED's shows the state of the 4 digital outputs A12…A15.
  If one output (ore more) is in a short circuit condition, the LED's of the outputs being H blink with a frequency of 6 Hz.

5. Connecting cables



To prevent perturbation problems a shielded and pair twisted cable should be used and the shield should be connected to ground on both sides.

6. Electrical specification

Internal power consumption

+5V:	20…45mA
Uext	0…10mA (without load current)

External power supply

Terminal + / -: 10...32 VDC smoothed, residual ripple max. 10%
TVS-diode 39V ±10%
max. 2A for outputs, not protected against wrong polarity!

SSI interface RS422-input with galvanic separation for SSI data D, /D.
RS422-output without galvanic separation for SSI clock CLK, /CLK (the clock is usually separated in the encoder).

Digital outputs 4 digital outputs (A12…A15) for universal use.
Addressing direct from the BUS.
Output current 5..500mA, short circuit protected (I_{short}=1.5A max.)

Voltage range	10…32V, DC smoothed
Voltage drop max.	0.3V at 0.5A
OUTPUT delay	typical 50 µs max. 100 µs (for resistive loads)

No galvanic separation on the outputs

Short circuit protection

The 4 outputs are protected against short circuits. If one output (ore more) is shorted, the current is internally limited to max 1.5A. If the chip temperature raises over 150°C (which is reached in about 1 to 2 sec), the output driver detects the over temperature, switches all the 4 outputs off and sets the diagnostic input. If the temperature drops below 150°C the driver tries to switch the outputs on again. The short circuit condition is visualised by the blinking output LED's

7. SSI functions

To handle all the known SSI interfaces, the H150 is configurable in several parameters:

Resolution: configurable 8 to 29 data bit
0 to 2 control bit

Clock frequency: configurable 100 kHz, 200 kHz, 300 kHz, 500 kHz
(Input filter designed for 500 kHz)
The frequency has to be selected depending on the cable length:

Cable length	Frequency
< 50 m	max. 500 kHz
< 100 m	max. 300 kHz
< 200 m	max. 200 kHz
< 400 m	max. 100 kHz

Data-Code: configurable gray or binary

Read Mode: normal mode (sing read)
Ringmode: double read and compare
(not all encoders support this function)

Execution time: Depending of the data length

Cable-break detection: detected and signaled in the diagnose.

Flags:
- Cable-break detection (if cable break, encoder defect, wrong addressing)
- Read error (if compare error in double read)
- Short cut on the Digital output.

8. Access to the module

All the functions are accessible throughout periphery addresses.
In the table 1, are listed all the address's offset.

Table 1

Addr	T PAB	T PAW	T PAD	L PEB	L PEW	L PED
0	A 12			A 12	Signature	Value
1	A 13			A 13	Diagnose	
2	A 14			A 14		
3	A 15			A 15		

Let's make some example to show how to use the module.

8.1 Digital output

There are 4 addresses to access to the 4 digital output. As this kind of module can't be set in the range of the process memory, there are also 4 addresses to read the real status of the 4 digital output.
Those access are done with byte. So the lowest bit is the value to be transfer at the output.

Example:
Let's say that the base address of the module is 300.

```
L     1          // load Value 1 in the accumulator
T     PAB 300    // transfer the value 1 to the digital output A12
                 // => set the output A12 to the high level

T     PAB 303    // transfer the value 1 to the digital output A15
                 // => set the output A15 to the high level

L     0          // load Value 0 in the accumulator
T     PAB 300    // transfer the value 0 to the digital output A12
                 // => set the output A12 to the low level

L     PEB303     // load the status of the output A15 in the accumulator
                 // if the accumulator is = 0 the output is a low level.
```

8.2 Diagnose

The diagnose word has the following meaning

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	D	R	B

- D Short circuit on the digital output

- R Read error in ring mode (compare in double read)

• B (Busy) communication with the encoder is not possible.

8.3 Value

The reading of the position value is done with a double WORD load.

L PED 300

This will load the value in the 32 bits of the accumulator 1. Most often the value read has to be converted and this for two reasons.

- In the x bits we read, there are some times parity bits, which are use to check the communication.
- The value (position) can be coded in ***Gray*** code or ***Binary*** .

There are no defined rules for that, this depending of the encoder.

8.4 Configure

The configuration of the H150 module is done on the DB1 (511,1023) .
The structure is the following.

```
Modul1       : STRUCT
    kenn        : WORD  := W#16#85;       // H150
    PANr        : INT   := 0;             // No process
image
    InCnt       : INT   := 4;
    OutCnt      : INT   := 4;
    InBase      : INT   := 300;           // PEB 300 - 303
    OutBase     : INT   := 300;           // PAB 300 - 303
    mask        : BYTE  := B#16#0;
    dummy_b     : BYTE  := B#16#0;
    Config      : WORD  := W#16#0318;     // 24 Date bits
                                          // 500kHz
                                          // Converting
                                             Gray -> Bin
                                          // Single mode
END_STRUCT;
```

We can see in Bold the important value.

- Module identification (kenn) : h85
- Input bytes needed (InCnt) : 4
- Output bytes needed (OutCnt): 4

And the last one (Config), we will see in details.

Config:
This parameter is a word value, which one is split in different setting.
Those setting are use to configure all the functionality of the H150 module. Let see the word figure.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	M	W	F1	F0	0	0	0	D4	D3	D2	D1	D0

- M: 0 → Singlemode; 1 → Ringmode
- W: 0 → Converting Graycode in Binary; 1 → not converting
- F1…F0: 0 → 100kHz; 1 → 200kHz; 2 → 300kHz; 3 → 500kHz
- D4…D0: Data bits length 1..31

Signification:

- Mode (M)

In Singlemode , the reading of the value from the encoder is done only when asked. In Ringmode the reading of the value is done continuously and each value is read twice, then a compare is done to check if any error occurred during transmission. If an erroc occurred the corresponding bit in the diagnose byte is set.

- Conversion (W)

If set to “0”, the value read from the module is already converted from Gray code to Binary value.

- F1…F0 (Transmission frequency)

This is the frequency of the clock use for the transmission between the Encoder and the module H150. This frequency depend from the encoder rate and the cables length.

- D4…D0 (Data bits length)

Number of data bits transmitted between encoder to H150 module.

8.5 Perturbation problems

In highly perturbed environments the SSI encoders can be desynchronised (by taking a perturbation spike as a clock edge) since the input filter of the encoders are very small (designed for clock frequencies up to 1 MHz).

A proper installation is very important:

- use shielded and pair twisted cables for the SSI (RS422) interface
- connect both sides of the shield to ground (if no potential differences are present)
- separate the SSI cable from power cables
- use the ringmode (if supported by the encoder)

If the encoder supports the ringmode, the perturbation immunity can be increased by much with this method:

In the ringmode is use, the H150 outs two times the specified number of clocks and the encoder sends two times the SSI value. The two positions are compared in the H150.

If they are equal, the position is supposed to be correct and is stored in the register.

If the two values are not equal, the diagnose byte is set. In this case either the transmission is seriously perturbed or the H150 is initialized with wrong encoder parameters. (ex. wrong number of data bits)

In the ringmode the diagnose word should be checked after each reading position to guarantee that the position is correct.