7.1 PCD2.H100   Simple counting module

Simple counting module with two inputs, "IN-A" and "IN-B", and one directly controlled output, "CCO".

Typical areas of application

- Counting revolutions or distances (impulses).

- Pre-setting a count value and switching off output CCO when counter = 0.

- Measurement by counting : measuring signals counted only when particular conditions are met, e.g. photoelectric barrier covered.

- Counting with recognition of count direction for incremental shaft encoders providing simple motion control.

Technical data

Number of systems	1
Counting range	0...65 535 (16 Bit) (series connection posible with CPU counters)
Counting frequency	max. 20 kHz (impulse/pause ratio 50 %)
Data protection	All data in this module are volatile. (non-volatile PCD registers are available).

Digital inputs

"IN-A" and "IN-B"	Signal voltages	
	rated voltage :	24 V
	"low" range :	- 30...+5 V
	"high" range :	+15...30 V
	for source operation	
Input current	typically 7.5 mA	
Input filter	25 kHz	

Process output

CCO (Counter Controlled Output)	counter output (switches when count is 0 or 65 535)

Current range

5...500 mA
(max. current leakage : 1 mA)
(min. load resistance : 48 Ω in
            voltage range 5 to 24 V)

Voltage range

5...32 V (external supply)

Circuit type

electrically coupled,
not short circuit protected,
positive switching.

Voltage drop

typically 2 V at 500 mA

Output delay

$< 10\,\mu s$
(longer for inductive load due
to protective diode)

Power supply

External (user)

5...32 VDC
(for supply of CCO output only)

Current consumption
from PCD1/2 bus

+ 5 V :   max. 90 mA
+24 V :   max. — mA

Interference immunity
according to EN 61000-4

1 kV with capacitive coupling for
unshielded cable at the 24 V I/O's

In a contaminated environment,
the use of shielded cables is rec-
ommended.

Programming

Based on direct peripheral in-
put/output access.

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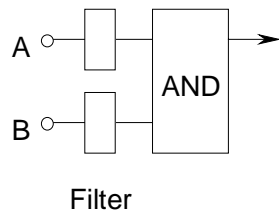**Count modes**   selectable by jumper

SC (Single Count)   Counting signals at input A.
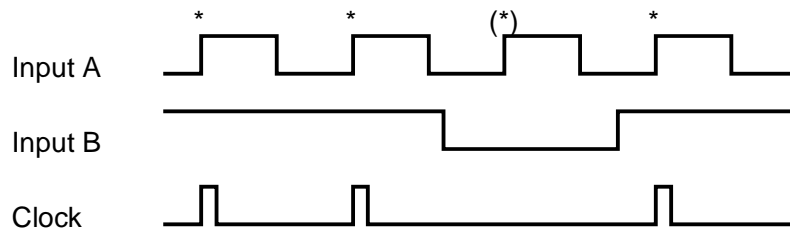   Up and down counting selectable by user
                                program.

A ○───   To enable signals at input A to reach the
                                counter, input B should be connected to
       AND   24 V (AND gate).
B ○───

Filter

Input A

Input B

Clock
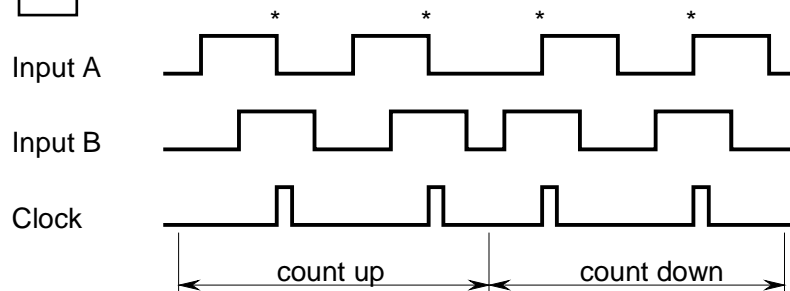
*   = active counting edge
Clock   = Signal which reaches the internal module counter

Modes x1, x2 :   Up/down counting mode for two-phase
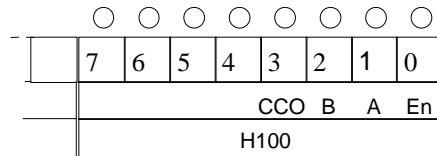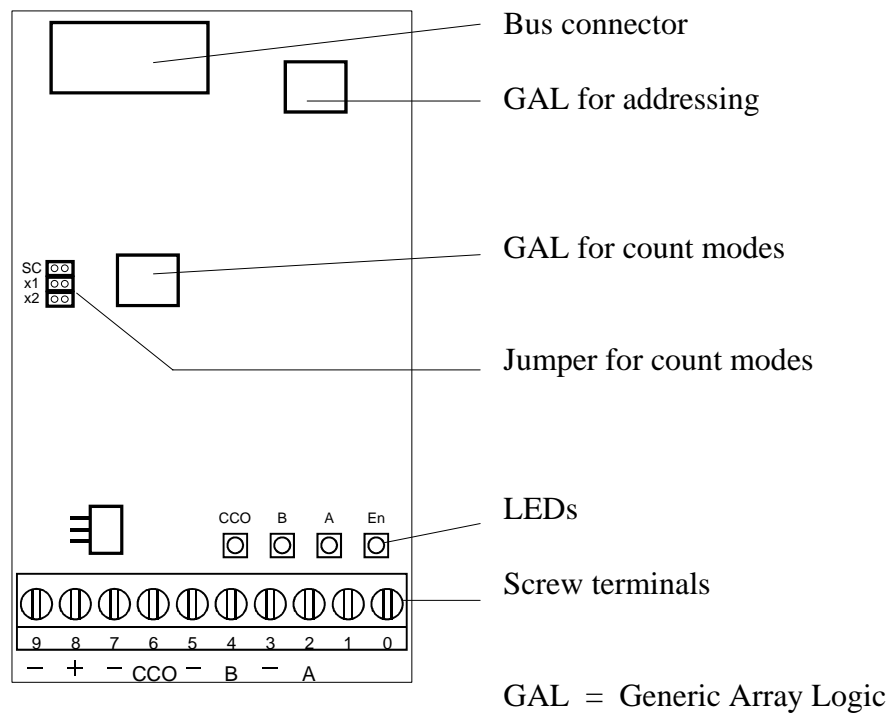   incremental shaft encoder at inputs A and B

x1

Input A

Input B

Clock

          count up   count down

x2

Input A

Input B

Clock

          count up   count down
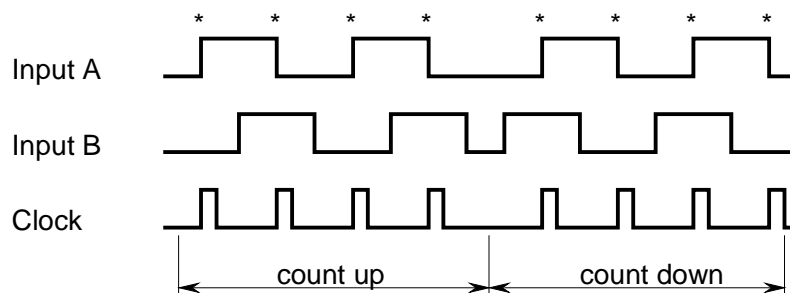
LED displays

LED "A"	input "A"
LED "B"	input "B"
LED "EN" (Enable)	counter active
LED "CCO"	output "CCO"

cover

```
  ○   ○   ○   ○   ○   ○   ○   ○
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
            CCO   B    A   En
        H100
```

Presentation

Bus connector

GAL for addressing

GAL for count modes

Jumper for count modes

LEDs

Screw terminals

GAL = Generic Array Logic
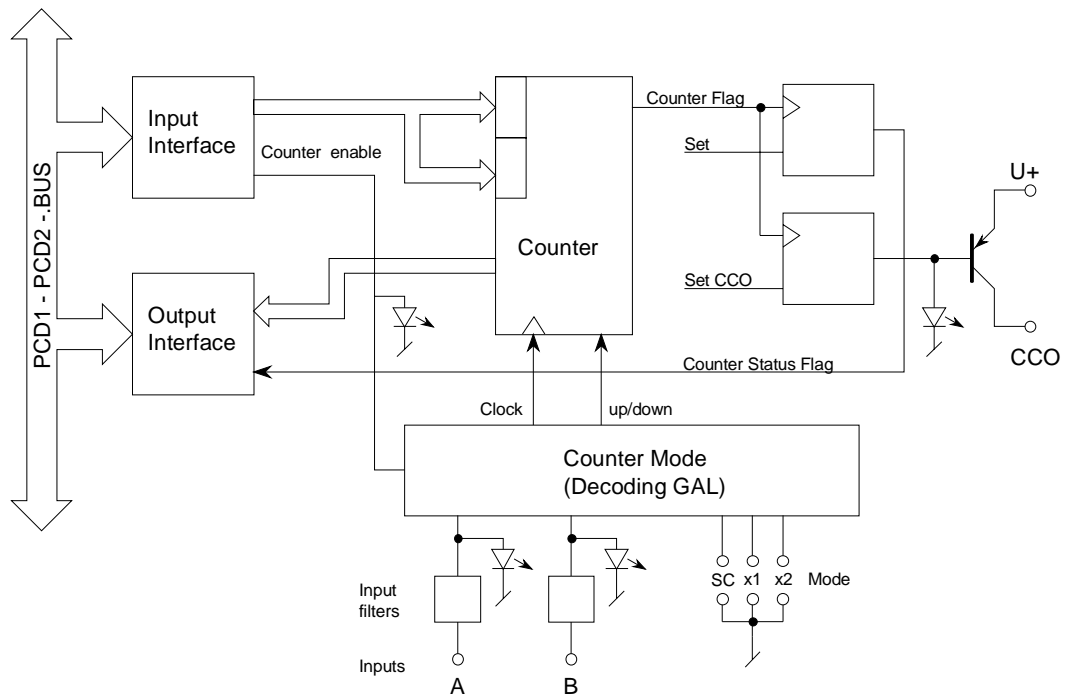
Changing the jumpers

Caution when changing :

Throughout the circuit board there are components which are sensitive to electrostatic discharges.

Logic diagram

Operating principle

This can be largely derived from the logic diagram. It is only necessary to add some explanation of the counter output circuit :

The output of the internal counter is identified as "Counter Flag". The user has no hardware access to it. This counter flag is set high whenever the counter is loaded or by means of a separate instruction.

The flag is low :

- in up-counting mode :   when counter value 65,535 is reached
- in down-counting mode :   when counter value 0 is reached

To reset a CCO hardware output which had previously been set high by the user program, it is necessary to differentiate between two cases :

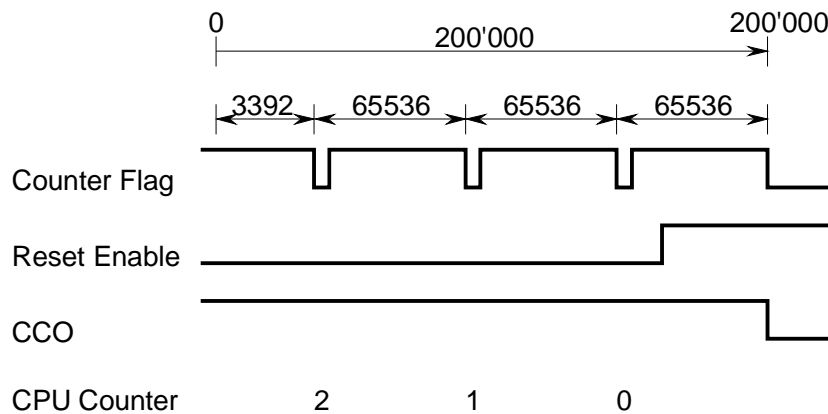a) count range between 0...65 535 (normal case)
b) count range exceeding 65 535

Case a)   Resetting the counter flag results in a simultaneous reset of
           the CCO output.

```
            0                              50'000
            |<──────────────────────────────>|

Counter Flag  ____|‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾|____

Reset Enable  ____|‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾

CCO           _____|‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾|____
```

The "Reset Enable" should be activated BEFORE the counter reaches
zero. See programming example.

Case b)   If the count range has to extend beyond the value 65 535,
           "Reset Enable" can be activated later, i.e. between the penul-
           timate and the last time the counter reaches zero. This means
           that the CCO output is only reset after several passes of the
           counter. The number of passes is counted by a CPU counter.

For example, output CCO must switch off after 200 000 count signals.

```
            0                  200'000              200'000
            |<──────────────────────────────────────>|
            |3392|  65536  |  65536  |  65536  |

Counter Flag  ‾‾‾|_|‾‾‾‾‾‾|_|‾‾‾‾‾‾|_|‾‾‾‾‾‾|____

Reset Enable  _____|‾‾‾‾‾‾‾‾‾

CCO           ‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾|____

CPU Counter         2         1         0
```

Definition (hardware configuration DB1,DB511 or DB1023)

Here is an example on how has to be made the hardware configuration of the module H100 inside the DB.

Name	Type	Initial value	Comment
Modul	WORD	80h	H100 module identifier
PANr :	INT	0	Not relevant (Process image)
InputCount	INT	3	Byte use in the input address range
OutputCount	INT	6	Byte use in the output address range
InputBase	INT	Xxx	Base address for the inputs. Has to be out of the process image area. Over 255.
OutputBase	INT	Yyy	Base address for the outputs. Has to be out of the process image area. Over 255.
mask	BYTE	0	Not relevant
not used:	BYTE	0	Not relevant
not used	WORD	0	Not relevant

Programming (user program)

The following functions are available :

Write commands :

- Select direction of count (SC mode only)
- Start/stop count
- Set CCO output
- Set counter flag
- Reset enable CCO output
- Load counter with a value between 0 and 65 535

Following table shows the meaning of the outputs and the S7 Instruction needed

Address Offset	S7-code	Meaning
+0	T PAW	Pre-set the counter with a value between 0 and 65535
+2	T PAB	Start/Stop counter (0 = stop, 1 = start)
+3	T PAB	Set counter flag
+4	T PAB	Select direction of the count (SC mode only)
+5	T PAB	Set CCO output (1) or Reset enable CCO (0)

Read commands :

- Poll counter flag
- Read current counter value

Following table shows the meaning of the inputs and the S7 Instruction needed

Address Offset	S7-Code	Meaning
+0	L PEW	Read actual Counter value
+2	L PEB	Read Counter flag status

Programming example

These small examples show how to use the command of the modules.
In the example the module will have the base address 256 for input and output.

Name	Type	Initial value	Comment
Modul	WORD	80h	H100 module identifier
PANr :	INT	0	Not relevant (Process image)
InputCount	INT	3	Byte use in the input address range
OutputCount	INT	6	Byte use in the output address range
InputBase	INT	256	Base address for the inputs is 256.
OutputBase	INT	256	Base address for the outputs is 256.
mask	BYTE	0	Not relevant
not used:	BYTE	0	Not relevant
not used	WORD	0	Not relevant

The functions are controlled by single PCD instructions (SET/RES) or by combinations of instructions. Instructions containing a hardware address in the operand should be offsets from the module's base address (BA).

- Select direction of count (jumper in position "SC")

```
L        1
T        PAB 260         ; down counting
L        0
T        PAB 260         ;  up-counting
```

- Start / stop count

```
        L       1               ; start counter
        T       PAB 258

        L       0               ; stop counter
        T       PAB258
```

- Set CCO output

```
        L       1               ; direct setting of CCO output
        T       PAB 261

        L       0               ; the CCO output will switch back
        T       PAB 261         ; at the next counter flag reset.
                                ; (Reset Enable).
```

- Pre-set the counter with a value between 0 and 65 535

```
        L       300             ; Load the value 300 in the ACCU 1
        T       PAW 256
```

When this load routine is executed, the counter flag is also automatically set high.

- Read counter flag Status

```
        L       PEB 258         ; Load the counter flag status in ACCU1
```

- Set counter flag

```
        L       1
        T       PAB 259
```

- Read current counter value

```
        L       PEW 256         ; Load the actual counter value in ACCU1
```

Notes :