Programmable Absolute Electro-Optical Encoders

Models CRF 58 - CRF 65 - CRF 66 - CRF 105

MULTI-TURN □ Parallel or Serial Interface *SSI* or *ASA*

CRF 10266 CE

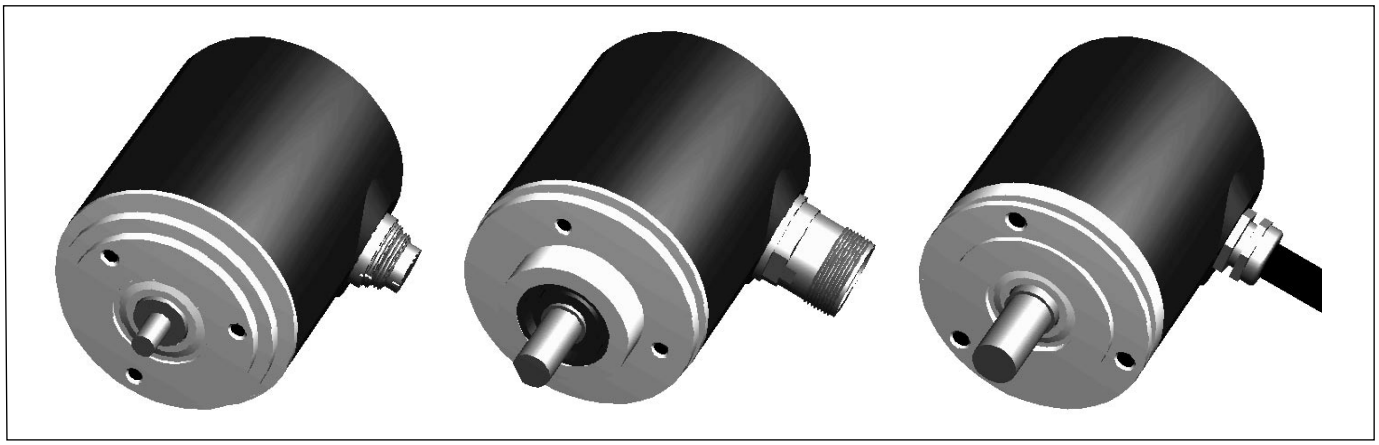
01 / 2010

- **For remote programming via PC**
- **Fourteen programmable parameters**
- **Total capacity 24 Bit**
- **Interfaces :** **Parallel**
  Synchronous-serial *SSI*
  Asynchronous-serial *ASA*
- **Optional:** **Additional functions**

Functional description

The encoders in the CRF series have been developed for the remote programming via PC of 14 different parameters as required by the user. This enables quick matching to the requirements of different mechanical and electrical applications.
The storage of the selected parameters takes place in an EEPROM within the encoder.

Software PROCOD is available for the programming of the encoder. It runs under Microsoft Windows®. A converter module for the connection of the RS 485 interface to the PC-compatible RS 232 entry is also available (ref. page 7).



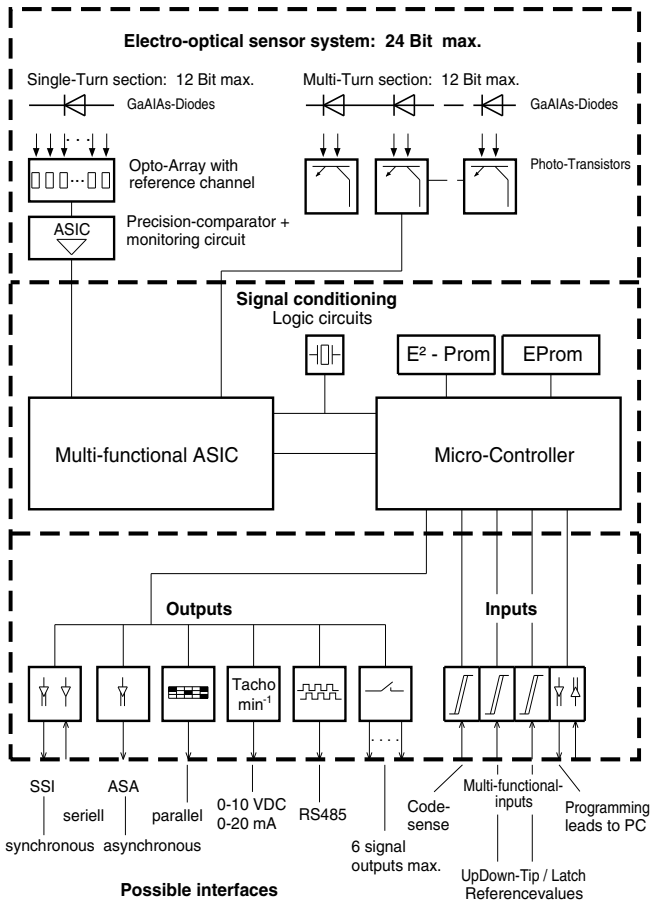
Construction

Flange and case in anodised aluminium - shaft in stainless steel 12 mm ball-bearings with Nilos ring or radial packing ring seal code disc in deformation resistant plastic -GaAlAs diodes photo-transistor array - gate array - customer specific microprocessor - multifunctional ASIC - SMD technology.

The Models CRF 58, CRF 65, CRF 66 and CRF 105 have different shaft, flange and case dimensions and different types of electrical connections (for details see page 6).

Programmable parameters

- Resolution: 0,0002 to 4096 positions per turn
- Measuring range: 1, 2, 4 ... 4096 turns for one pass through the code
- Output code: Gray, Gray-Tree, BCD, Natural Binary or Nat.Bin.-Tree
- Code sense: CW or CCW
- Logic polarity: Positive or negative (for parallel interface only)
- Parity bit: *ODD* or *EVEN*
- Adjustment modes: Preset or UpDown (see page 2)
- Reference value 1: 0 to total capacity
- Reference value 2: 0 to total capacity
- Offset value: - 32768 to + 32767
- Register length: 13, 16, 25 or 32 Bit (for *SSI*-interface only)
- Monoflop time: 1 to 682 µs (for *SSI*-interface only)
- Baud rate: 2,4 kBaud to 3 MBaud (for ASA-interface only)
- Identification-N°: 0 to 65535



Electrical data

(Valid for all versions unless otherwise stated)

- Sensor system: GaAlAs diode, photo-transistor array, precision comparator
- Parallel output circuits: A = Open collector Darlington; C = Open emitter Darlington; D = Push pull
- Serial outputs: *SSI* and *ASA*: Differential data output to RS 422,
- Clock input *SSI*: Differential (opto-coupler) for data driver to RS 422
- Parity bit: Check bit (not for *SSI* < 32 Bit)
- Error bit output: Data Bit (parallel and *SSI* / 32 Bit only)
- Enable circuit for bus operation: Active or inactive, Signal input E6 (for parallel interface only)
- Multifunctional inputs: (MFP) Depending on adjusting mode Signal input E6
- Memory circuit (latch): Through MFP
- Code sense: CW or CCW Signal input E6
- Supply voltage range: + 11 to + 26 VDC
- Supply current: 80 mA typ. / 120 mA max.
- Data rate: 1 to 3 kHz, depending on programming (parallel interface only)
- Measurement position deviation: ≤ ± 2' 38" (for 4096 pos. / 360°)
- Disc coding: Gray code
- Setting cycles EEPROM: ≤ 10^6

Mechanical data

- Operating speed: 3000 rpm max. (continuous) 4000 rpm max. (short period)
- Operating torque: ≤ 5 Ncm (8 Ncm - CRF 66) (at 1000 min^{-1})
- Wind-up torque: ≤ 1 Ncm (4 Ncm - CRF 66)
- Angular acceleration: 10^5 rad/s^2 max.
- Inertial mass of rotor: 50 gcm^2
- Permissible axial and radial shaft load: 250 N max.
- Bearing life expectancy : 10^9 turns

Environmental data

- Operating temperature range: - 20° C to + 60° C
  - ☐ optional (with connector): - 40° C to + 85° C
- Storage temperature range: - 25° C to + 70° C
- Permissible rel. humidity: 85% without condensation
- Resistance to shock: 200 m/s^2; 11 ms (DIN IEC 68)
- Resistance to vibration: 5 Hz ... 1000 Hz ; 100 m/s^2 (DIN IEC 68)
- Protection class (DIN 40 050)
  - CRP 58, 65 and 105: IP 65 (Nilos ring)
  - CRP 66: IP 66 (radial packing ring)
- Mass: CRF 58 = 0,6 kg CRF 66 = 0,7 kg CRF 65 = 0,7 kg CRF 105 = 1,3 kg

Timing - Diagrams

Fig. 1: Setting of reference point

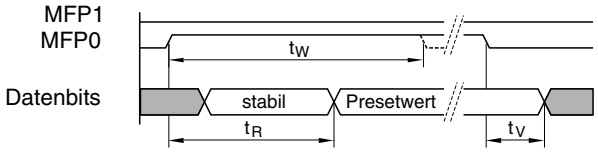


Fig. 2: Latch

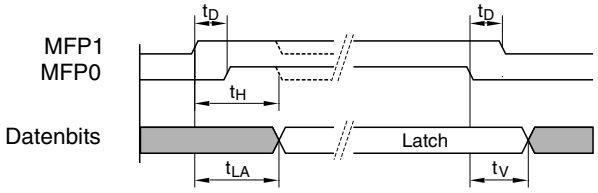
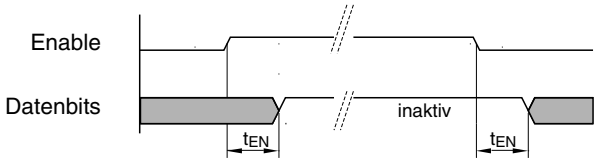


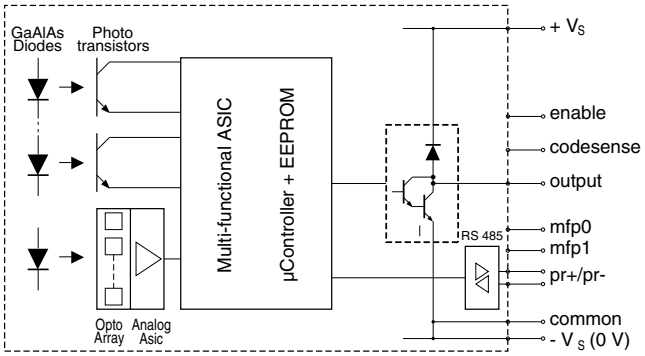
Fig. 3: Enable (for parallel interface only)



t_V : Delay period = 1,1 ms max.
t_H : Stop period = 750 µs min.
t_W : Waiting period = 70 ms min.
t_R : Reaction period = 60 ms max.
t_{LA} : Latch reaction period = 750 µs max.
t_D : Time difference between MFP`s = 100 µs max.
t_{EN} : Reaction period t_{EN} = 100 µs max.

The parallel interface

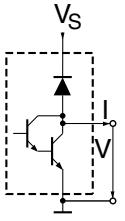
Block Diagram (Output A)



Output circuits

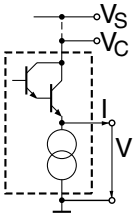
A

Vmax. = V_S
I max. = 50 mA
Log1 = V_S
Log0 = 1.1 V



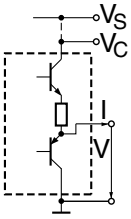
C

Vmax. = V_C
I max. = 20 mA
Log1 = V_C
Log0 = 0.5 V



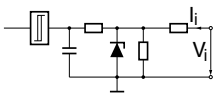
D

(not for bus mode)
Vmax. = V_C
I max. = 10 mA
Log1 = V_C - 3 V
Log0 = 2 V



Signal input

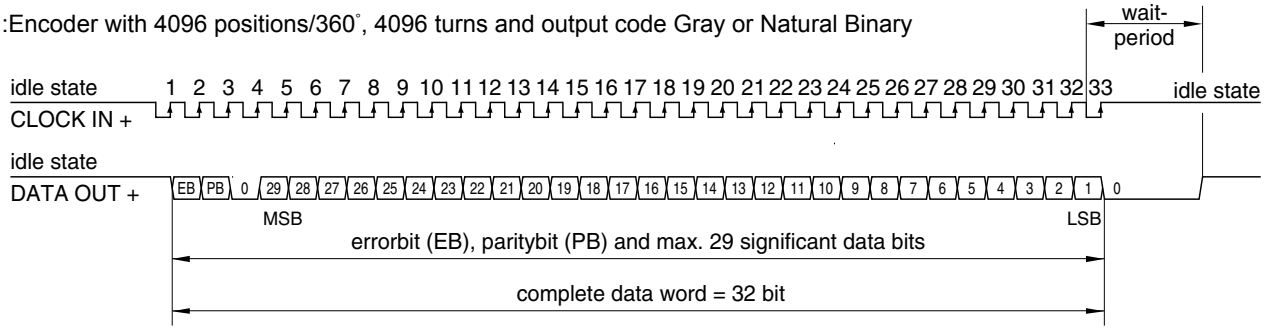
E6 active "high"



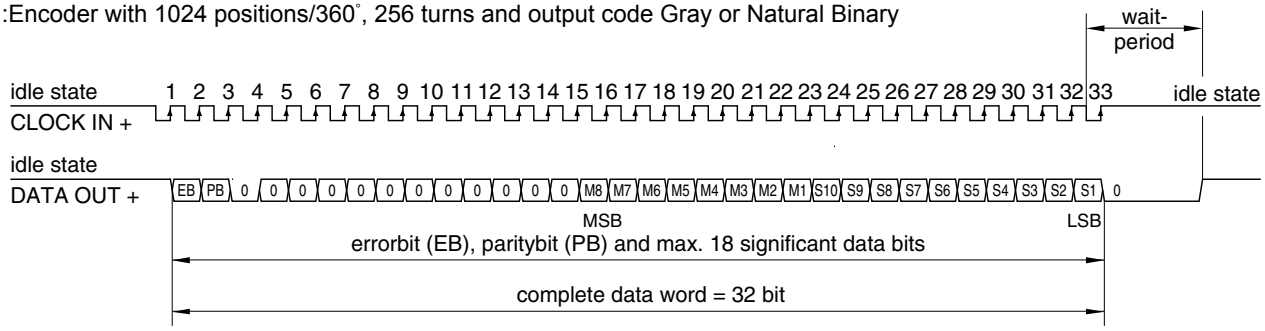
Log 0: Vi < 3.5 V or not connected
Log 1: Vi = 11 ... +V_S

Interface-profiles *SSI*-32 Bit

Exampel 1 :Encoder with 4096 positions/360°, 4096 turns and output code Gray or Natural Binary

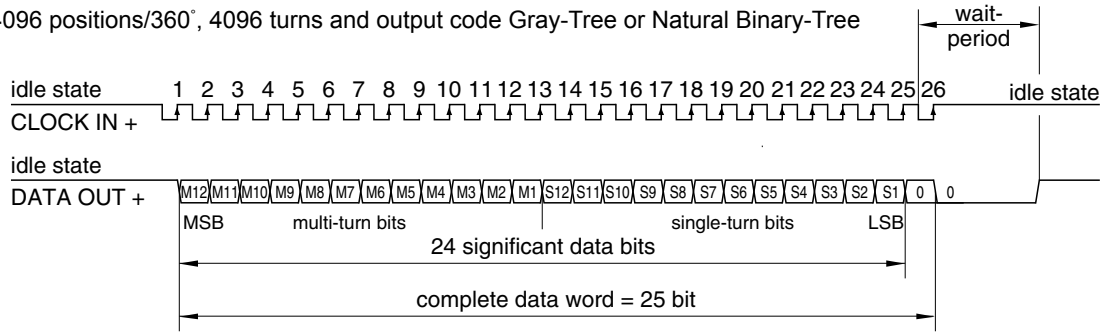


Exampel 2 :Encoder with 1024 positions/360°, 256 turns and output code Gray or Natural Binary

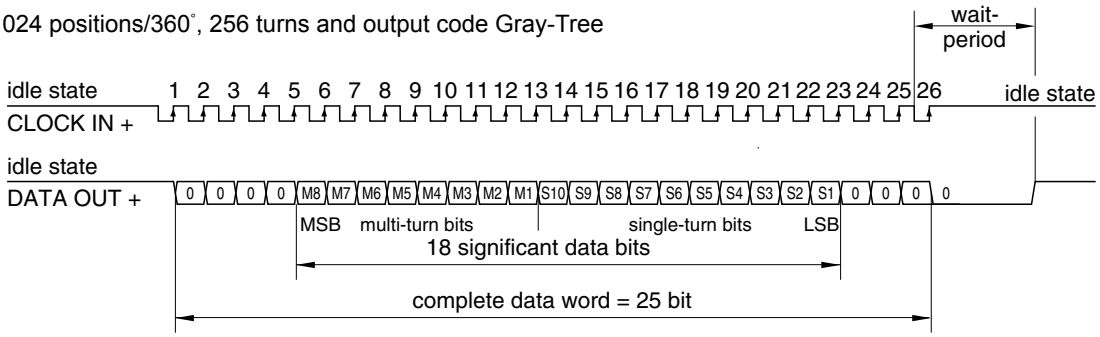


Interface-profiles *SSI*-25 Bit

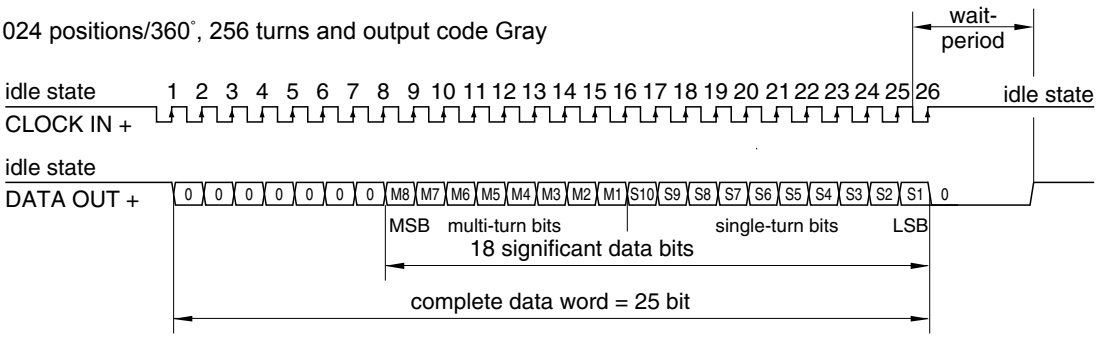
Exampel 3 :Encoder with 4096 positions/360°, 4096 turns and output code Gray-Tree or Natural Binary-Tree



Exampel 4 :Encoder with 1024 positions/360°, 256 turns and output code Gray-Tree

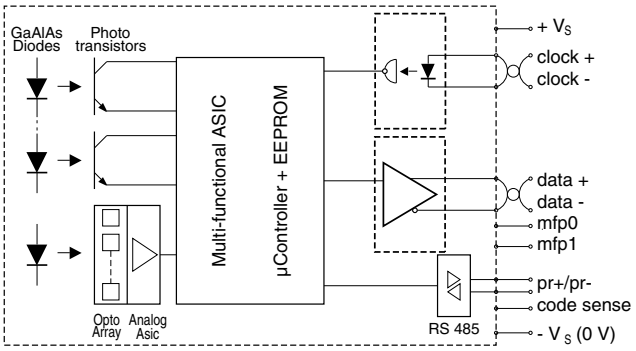


Exampel 5 :Encoder with 1024 positions/360°, 256 turns and output code Gray



The *SSI* synchronous serial interface

Block Diagram *SSI*



Interface profile 32 Bit *SSI*

The output shift register has a width of 32 bits and is updated by an internal microprocessor every 400 µs approximately, depending on the programming.

Along with the maximum 29 significant data bits, the error bit and the parity bit can be transmitted. The error bit is placed in the 1st location, the parity bit in the 2nd and a zero in the 3rd location (examples Nº 1 and 2 / page 5).

Depending on the programmed output code (Gray or Natural Binary)the significant data bits are positioned in a different way.

The LSB is always placed in the last location of the shift register when output code formats Gray (G), BCD (B) or Nat. Binary (R) are programmed (examples Nº 1 and 2 / page 5). When the output code formats Gray-tree (G-T) or Binary-tree (R-T) are used the MSB of the single-turn stage is placed in the thirteenth location before the last location.

Interface profile 25 Bit *SSI*

The output shift register has a width of 25 bits. Otherwise than the 32 Bit version it does not carry any error or parity bit.

Depending on the programmed output code the significant data bits are positioned in a different way. The LSB is always placed in the last location of the shift register when output code formats Gray (G), BCD (B) or Nat. Binary (R) are programmed (examples Nº 5 / page 5). When the output code formats Gray-tree (G-T) or Binary-tree (R-T) are used the MSB of the single-turn stage is placed in the thirteenth location before the last location (examples Nº 1 and 2 / page 5).

The above mode is identical to the **standard SSI protocol** for **multi-turn** encoders.

Interface profile 16 Bit *SSI*

The output shift register has a width of 16 bits. Depending on the programmed output code the significant data bits are positioned in a different way. The LSB is always placed in the last location of the shift register when output code formats Gray (G), BCD (B) or Nat. Binary (R) are programmed. When the output code formats Gray-tree (G-T) or Binary-tree (R-T) are used the MSB of the single-turn stage is placed in the thirteenth location before the last location.

Interface profile 13 Bit *SSI*

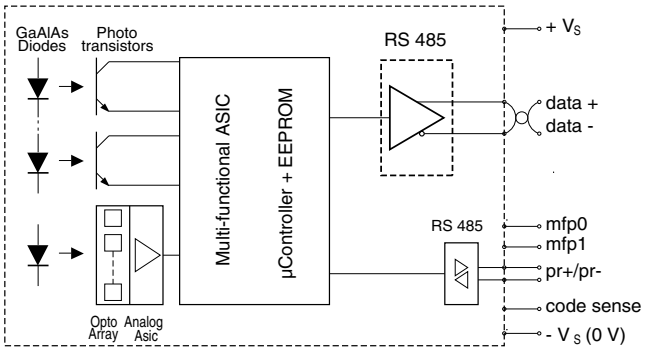
The output shift register has a width of 13 bits. Depending on the programmed output code the significant data bits are positioned in a different way.

The LSB is always placed in the last location of the shift register when output code formats Gray (G), BCD (B) or Nat. Binary (R) are programmed. When the output code formats Gray-tree (G-T) or Binary-tree (R-T) are used the MSB of the single-turn stage is placed in the first location.

The above mode is identical to the **standard SSI protocol** for **single-turn** encoders.

The *ASA* asynchronous serial interface

Block Diagram *ASA*



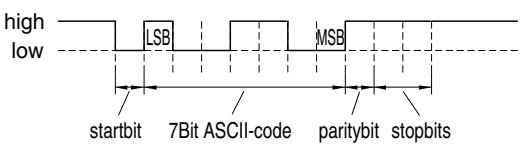
The data bits are transmitted in ASCII form as a block of 6 data characters + carriage return (CR). The 6 data characters represent 24 bits (Gray and Natural Binary) or 6 decades (BCD).

When using the BCD output code the characters are 0 to 9 (ASCII code 30h-39h). When using the Gray or Natural Binary output code the characters are 0 to F (ASCII code 30h-39h and 41h-46h).

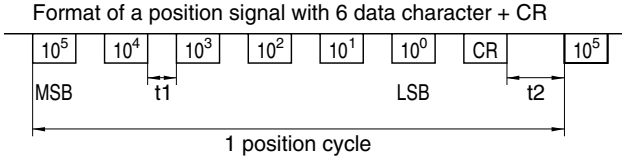
In the case of an error, '0' is output continuously but with the character 00h instead of the ASCII code 30h.

The baud rate and the parity bit are programmable.

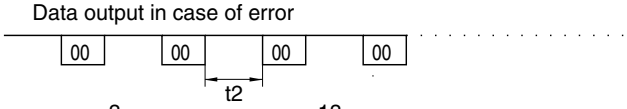
Character format



Format of a position signal with 6 data character + CR



Data output in case of error



$t1 = \frac{3}{\text{baud rate}}$ $t2 = \frac{13}{\text{baud rate}}$ ($\geq 400\mu s$)

Adjustment modes

The adjustment modes **Preset** and **UpDown** can be chosen via PC. They determine the function of the **multi-functional inputs** (MFP) . In both cases (Preset and Up-Down) the normal operation of the encoder and the memory circuit (latch) are controlled through these inputs.

MFP1	MFP0	**Adjustment mode: Preset**
0	0	Normal operation
0	1	Setting of reference point 1
1	0	Setting of reference point 2
1	1	Output value latched
MFP1	**MFP0**	**Adjustment mode: UpDown**
0	0	Normal operation
0	1	Decreasing output value and setting (down)
1	0	Increasing output value and setting (up)
1	1	Output value latched

The adjustment mode **Preset** is designed to set the reference points Nº 1 and Nº 2. The reference values can be programmed by the user within the total number of positions. It is also possible to change the values in the same manner. The reference point is the point at which the previously programmed reference value is applied to the data output (connector).

The adjustment mode **UpDown** is designed to increase or to decrease the output value through the MFP input circuits. When MFP 0 features Log 1 and MFP 1 features Log 0 the output value will increase and vice-versa. The adjusting speed increases depending on the time of application. When applying Log 0 for a short time the adjusting speed can be reduced.

Within 6 seconds approximately the output value will be stored. Afterwards the encoder starts its normal operation.

The **UpDown-mode** can be used to adjust the zero-point position of the encoder without any mechanical interference.

Ex-works programming and order code format

■ Basic programmierung

If not otherwise agreed the CRF encoders will be supplied with the basic ex-works programming as shown in the check list page 8.

CRF 65 - 4096 G 4096 A 01

- 01 — Electrical and mechanical variants
- A — Output circuits
  - A = Open collector Darlington
  - C = Open emitter Darlington
  - D = Push pull
  - E = *SSI*
  - K = *ASA*
  - N = bi-directional (RS 485)
- 4096 — Number of turns
- G — Output code G = Gray
- 4096 — Positions / turn
- 65 — Series 58 - 65 - 66 - 105
- CRF — Model CRF

■ Specific programming

If any specific ex-works programming is required the user should state all parameters with reference to the check list page 8.

Encoders featuring a specific programming will carry a short form ex-works code, e.g. CRF 65 * V11 * A01.

This code will be shown on an additional instrument label along with all programmed specific parameters which are covered by the * V-Nº *.

■ Customer programming

The customer programming is a programming performed by the customer wich are different from the delivered basic or specific programming (not the delivery standard).

■ Additional functionality

On principle following possibilities are given:

- ☐ Output of two by 90° shifted incremental signals ac cording RS 485 or an analogue output signal (0 to 10 VDC or (0)4 to 20 mA for a defined rpm-range.
- ☐ Maximal 6 signal outputs, e.g.:
  Limits for operating and safety area, cam switch, detection of rotating direction, limit switch, parity and strobe

The signal outputs can be executed optionally as Open Collector **(A)**, Open Emitter **(C)**, or Push pull **(D)**.

Electrical connections (standard versions)**:**

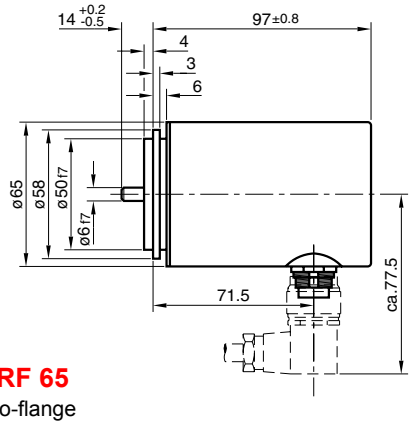
- CRP 58, 65 and 66 parallel: Lead with connector DC 37(IP 30)
- CRP 58, 65 and 66 serial: Round connector 12-way, (IP 65) on case
- CRP 105 parallel and serial: Connector DC 37 (IP 65) on case

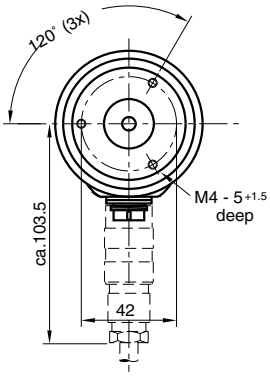
Mating connectors included in supplied items. Other types of connections on request.

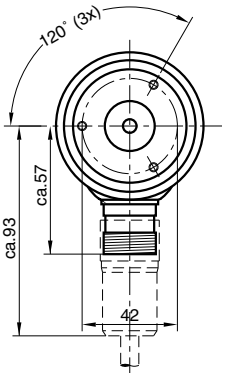
Dimensions in mm

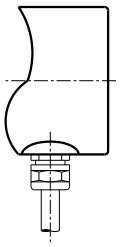
Model CRF 58

with synchro-flange





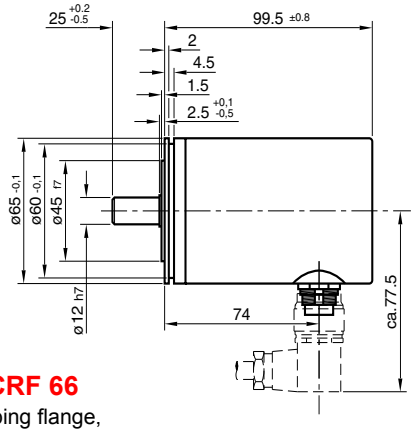


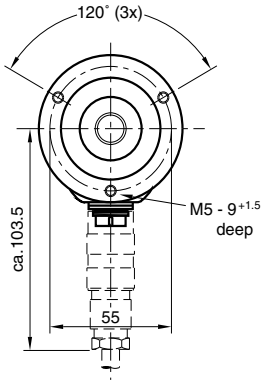


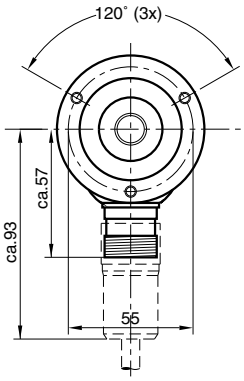
Standard:
Lead 300 mm long with connector DC 37 P + S

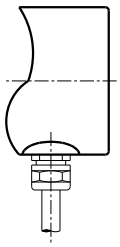
Model CRF 65

with synchro-flange





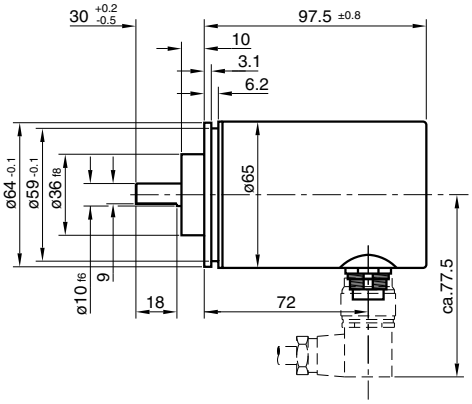


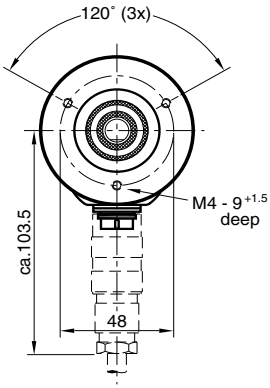


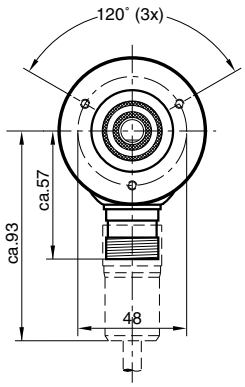
Standard:
Lead 300 mm long with connector DC 37 P + S

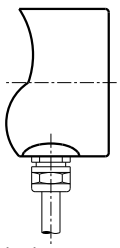
Model CRF 66

with clamping flange, shaft with flat







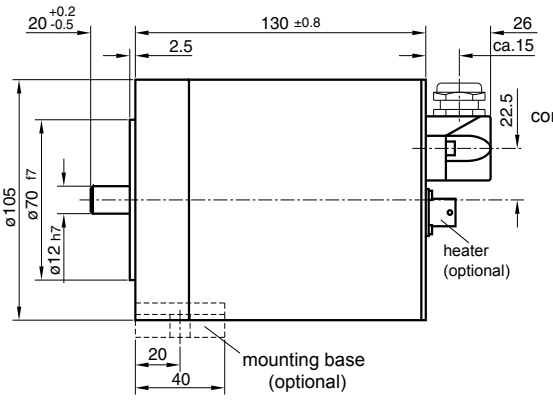


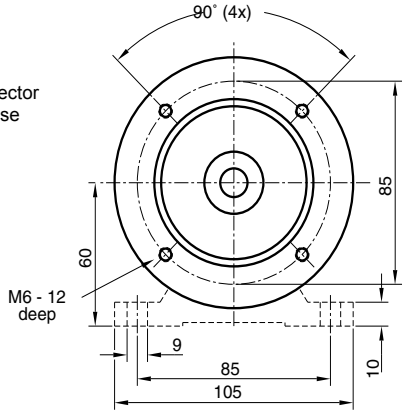
Standard:
Lead 300 mm long with connector DC 37 P + S

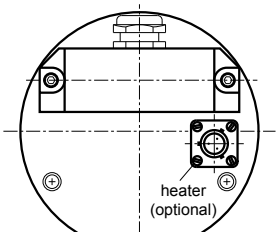
12 way connector Bi 423 — ***SSI* / ASA** — 12 way connector RS

Parallel
DC 37 / IP 30

Model CRF 105







Serial and parallel Interface
Connector DC 37 / IP 65

Converter Module for Programmable Encoder CRF 58, 65, 66 und 105

General description

This module has been designed for the programming of CRF and DAF encoders via a PC, by converting the RS 485 level to RS 232. The zero-modem cable PF-NM01 which is supplied with each module, connects the device to the serial input of the PC. To connect the encoder, a cable with an appropiate counter plug can be supplied upon request (refer to order code). Constructional and connecting details are shown below.

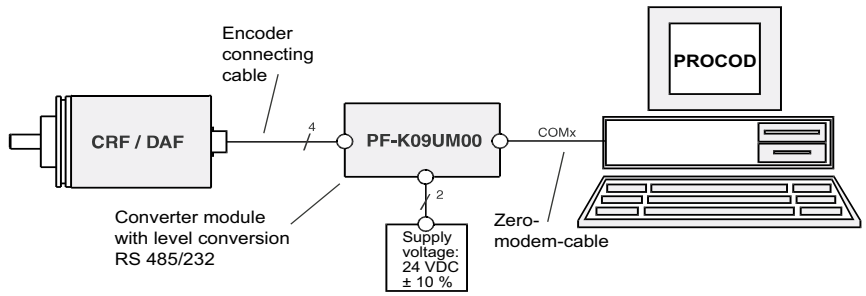
Note: The PF-K9UM00 module and the PF-NM01 cable replace the obsolete PF-M1UM01, PF-K9S01 and PF-VK items.

The PROCOD software supersedes the PROCRF software.

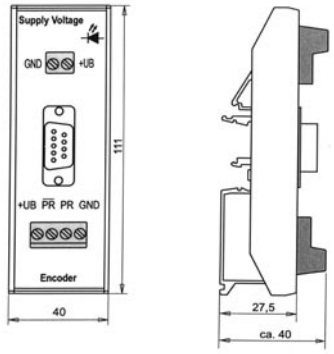
Technical Data

- Supply voltage UB: +24 VDC ± 10%
- Current: ≤ 150 mA (depending on communication)
- Temperature range: 0° C to + 50° C
- Mounting: EN-case for snap on (PHOENIX CONTACT)
- Contacts: 2.5 mm²
- Zero-modem cable: PF-NM01 — 2 m long (included in delivery)
- Connecting cable: 0.5 m long (refer to order code)

Block diagram



Dimensions in mm



Order code format

PF-K9UM00

- Basic module (without connecting cable)
- 01 = cable with counter plug Bi681
- 02 = cable with counter plug RS25
- 03 = cable with counter plug DC37
- 04 = cable with counter plug HAN 40
- 05 = cable with counter plug DC37/105*
- 06 = cable with counter plug Bi 723

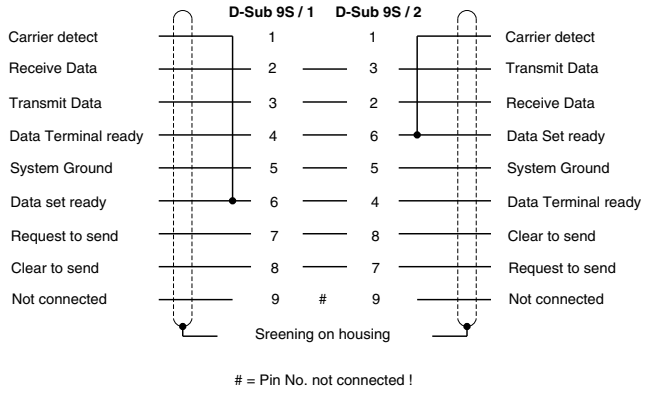
* with adapter to encoder CRF 105.
Other connecting cables upon request.

Contact configuration

COMBICON: (2 pins)	+ UB	= + 24 VDC ± 10%
	GND	= 0 VDC
COMBICON: (4 pins)	+ UB, GND	Supply voltage for encoder (if required)
	PR, $\overline{PR}$	Programming wire Differential-Data driver according to RS 485/422

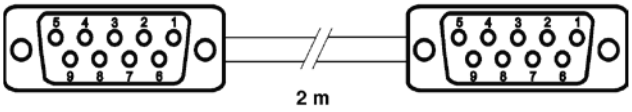
To connect the programming wires PR and $\overline{PR}$ a twisted pair cable is to be used.

Zero modem cable PF-NM01



= Pin No. not connected !

Socket contact configuration (mating side)



Attention: The supply voltages for CRF/DAF , for the converter module and for the encoder connecting cable must not be electrically separated (common ground for signals)!

CHECK LISTE : Programmable Encoders CRF 58, 65, 66 und 105

Bitte angeben / *please state*

Baureihe / *Series* (58, 65, 66 ,105) : .....

Ausgang / *Output circuit* (A, C, D, E, K, N) : .....

Elektrische und mechanische Varianten / *Electrical and mechanical variants* : .....

Kunde / *Customer*
(Anschrift und Bearbeiter)
(*Adress and Responsable*)

Zeichen / *References*

Datum / *Date*

			Parallele Schnittstelle Parallel interface		*SSI*-Schnittstelle *SSI*-interface		ASA-Schnittstelle ASA-interface	
	Parameter	**Werte-Bereich** **Range**	**Grund-Programmierung Basic programming**	**Vor-Programmierung Specific programming**	**Grund-Programmierung Basic programming**	**Vor-Programmierung Specific programming**	**Grund-Programmierung Basic programming**	**Vor-Programmierung Specific programming**
1	**Auflösung** **Resolution**	0,0002 bis 4096 Schritte / 360° 0,0002 to 4096 positions per 360° *	4096		4096		4096	
2	**Meßbereich** **Measuring range**	1, 2, 4 ... 4096 Umdrehungen 1, 2, 4 to 4096 turns	4096		4096		4096	
3	**Ausgabecode** **Output code**	Gray-, Binär oder BCD Gray-Tanne, Binär-Tanne Gray, Nat. Binary or BCD Gray-Tree,N.Binary-Tree	GRAY		GRAY		GRAY	
4	**Codeverlauf** **Code sense**	CW / CCW	CW		CW		CW	
5	**Logikpolarität** **Logic polarity**	positiv oder negativ positive or negative	positiv					
6	**Paritätsbit** **Parity bit**	ODD oder EVEN ODD or EVEN	EVEN		EVEN		EVEN	
7	**Justageart** **Adjustment mode**	Preset oder UpDown-Modus preset or UpDown-mode	Preset		Preset		Preset	
8	**Referenzwert 1** **Reference value 1**	0 bis Gesamt-schrittzahl 0 to total capacity	0		0		0	
9	**Referenzwert 2** **Reference value 2**	0 bis Gesamt-schrittzahl 0 to total capacity	0		0		0	
10	**Offsetwert** **Offset value**	-32768 bis +32767 -32768 to +32767	0		0		0	
11	**Registerlänge** **Register length**	13, 16, 25 oder 32 Bit 13, 16, 25 or 32 Bit			32			
12	**Monoflopzeit** **Monoflop time**	1 bis 682 µs 1 to 682 µs			20			
13	**Baudrate** **Baud rate**	2,4 kBaud bis 3 MBaud 2,4 kBaud to 3 MBaud					62.5 k	
14	**Identifikations-Nr.** **Identification-No.**	0 bis 65535 0 to 65535	0		0		0	

* (Tannenbaumformat: 1 ... 4096)

Diese Liste ermöglicht eine schnelle Übersicht über alle programmierbaren Parameter. Falls vom Anwender in der Spalte " **Vor**programmierung " nicht anders angegeben, werden die Winkelcodierer ab Werk mit der ausgedruckten " **Grund**programmierung " geliefert. Eine Änderung nach Lieferung durch den Anwender über PC ist in beiden Fällen möglich.

*The above check list allows a quick look to all programmable parameters. Unless otherwise stated by user in column " **Specific** programming " the encoders will be supplied as shown in the column " **Basic** programming ". In both cases the user can modify these parameters via PC after delivery.*