

- **Compact and robust design for mechanical engineering and industrial plant applications**
- **Certified SIL2 according to IEC 61508, certificate No. 44 799 08 554337-001**
- **With PROFI-safe Interface to PROFI-safe-Profile for Safety Technology, Version 1.30, No. 3.092/ Version 2.00, No.3.192 (PNO)**
- **DP-Slave Class 2 functionality in accordance with Profibus-Profile for Encoder, No. 3.060 (PNO)**
- **Total number of positions:  $2^{25}$  [25 (13 +12) bits] max.**
- **With Velocity signal depending on rotation sense**
- **With connecting cap: T-coupler functionality with integrated addressing facility as well as bus-termination resistors**

### General description

The PROFI-safe-Profile has been developed for safety relevant applications where human lives and environmental objects may be exposed to danger. In case of any unexpected event the device should revert to a fail-safe operation. To comply with this requirement the model CRS/S2 encoders feature additional surveillance functions which are described in the manual no. CRD 11948.

The encoder CRD/S2 certified SIL2 to IEC 61508 has been designed according to the PROFI-safe profile for safety technology to the PNO standards No. 3.092/ 3.192 (PNO). The protocol meets the DP slave class 2 functionality to PNO No. 3.060 and is described in the TWK user manual CRD 11948.

In addition to the angle position a velocity measurement signal is generated via the position data.

The SPC3 Siemens PROFIBUS controller has been implemented at the output interface. The maximum data transmission rate is 12 MBaud.

To guaranty a fail safe operation, a F-CPU master, e.g. Siemens S7 Distributed Safety (to version 5.4) must be used.

### Construction

Flange and housing of aluminium or stainless steel - shaft of stainless steel - 12 mm ball-bearings with Nilos ring seal or radial packing ring seal - code disk of glass or of deformation resistant plastic - GaAlAs diodes - photo-transistor array with comparator and trigger circuits for long-term stabilization of the sensor systems gate array - SMD technology - additional implementations for safety functions to comply with SIL2 to IEC 61508.



- **Diagnosis LEDs for supply voltage, SRD, Class 2 and Error**
- **Protection grade IP 65 or IP 66**

### Connecting cap

T-coupler functionality with integrated addressing code

Connection leads and functions:

- 1 cable for the supply voltage (+  $V_s = 24$  VDC, -  $V_s = 0$  VDC), M12 cable gland
- 1 cable for Bus in (A, B), M16 cable gland
- 1 cable for Bus out (A', B'), M16 cable gland
- The station address and bus-termination resistors are set with DIP switches in the connecting cap.

### Electrical data

- **Sensor system:** GaAlAs diodes, photo-transistor array
- **Resolution (max.):** 8192 positions per revolution
- **Measuring range:** 4096 revolutions
- **Total number of positions:**  $2^{25}$  (25 bits max.)
- **Graduation code:** Gray
- **Max. position variance:**  $\leq \pm 2' 38''$  at 4096 positions/rev.  
 $\leq \pm 1' 59''$  at 8192 positions/rev.
- **Output code:** Natural binary
- **Velocity signal:** depending on rotation sense  
2 Byte digits / 10ms  
(14,7 rpm (for 10 digits) to 1000 rpm (683 digits))
- **Code sense:** CW or CCW; (programmable)
- **Supply voltage range:** + 13,5 VDC to + 30 VDC
- **Power consumption:**  $P_D \leq 3,5$  W  
(Inrush current  $\leq 300$  mA)
- **Interface:** Line driver in acc. with RS 485; galvanic separation is achieved with an opto-coupler. Supply voltage galvanic separation is achieved with DC/DC-converter
- **Electromagnetic compatibility (EMC):** EN 61000-4-2 (ESD)  
EN 61000-4-4 (Burst)  
EN 61000-6-4 (Emission)

## Bus data

- Specification: PROFIsafe-Profile for Safety Technology (No. 3.092/ 3.192 - PNO)  
Profibus-Profile for Encoder (No. 3.060 - PNO)
  - Data transmission rate: 9,6 kBaud to 12 MBaud
  - Manufacturer code: 1962h
  - Stations address: 1 to 123  
Default value: 123  
adjustable via DIP switches  
in acc. with DIN 19245-3,  
PROFIBUS-DP
  - GSD File:
  - Diagnosis LED's\*: U<sub>B</sub> (green) - Supply voltage  
SRD (green) - SRD  
C (green) - Class  
Err (red) - Error
  - Freeze mode: not supported
  - Sync mode: not supported
  - Automatic baud rate search: being supported
  - Diagnosis bytes Class 2: 63 Diagnosis bytes
  - User-Parameterbytes Class 2: 22 Bytes
  - Configuration options: PROFIsafe, Class 2 -Encoder
- \* True table according to the connector arrangement will be supplied with each item.

## Safety Data (IEC61508)

- Measurement of angle position and angular velocity
  - Probability of dangerous failure per hour: PFH =  $5,26 \times 10^{-8}$  1/h
  - Safe failure fraction: SFF = 97,9 %
  - Hardware failure tolerance: HFT = 0
- Measurement of number of rotations
  - Probability of dangerous failure per hour: PFH =  $5,37 \times 10^{-8}$  1/h
  - Safe failure fraction: SFF = 98,2 %
  - Hardware failure tolerance: HFT = 0
- Maximum service life: 20 years

The PFH value of the entire position value (angle position + number of rotations) is therefore  $1.063 \times 10^{-7}$  1/h.

## Mechanical data

- Operating speed: 1000 min<sup>-1</sup> max
- Angular acceleration: 10<sup>5</sup> rad/s<sup>2</sup> max.
- Moment of inertia (rotor): 45 gcm<sup>2</sup>
- Operating torque: ≤ 5 Ncm (8 Ncm - CRD 66/S) (at 1000 rpm)
- Starting torque: ≤ 1 Ncm (4 Ncm - CRD 66/S)
- Permissible shaft load: 250 N max. (axial and radial)
- Bearing life expectancy: 10<sup>9</sup> revolutions \*
- Mass with connecting cap:
  - Aluminium: ca. 0.7 kg
  - Stainless steel: ca. 1,5 kg

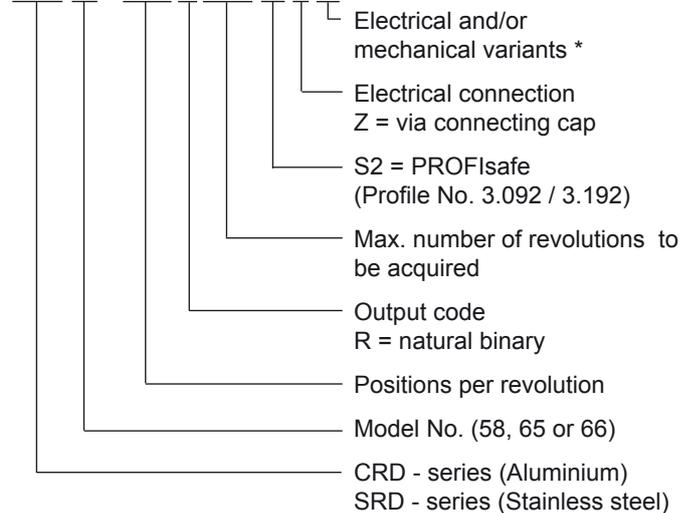
\* At max. shaft load and working temperature between - 20 °C and + 60 °C. Higher values are permissible with lower loads.

## Environmental data

- Operating temperature range: - 20 °C to + 60 °C
- Storage temperature range: - 20 °C to + 60 °C (dependant on packing materials)
- Permissible rel. humidity: 85 % without condensation
- Resistance to shock: 200 m/s<sup>2</sup>; 11 ms (DIN IEC 68)
- Resistance to vibration: 5 Hz to 1000 Hz; 100 m/s<sup>2</sup> (DIN IEC 68)
- Protection grade (DIN 40 050)
  - CRD 58 and 65: IP 65 (Nilos ring)
  - CRD 66: IP 66 (radial packing ring)
  - Connecting cap: IP 00 (when not mounted)

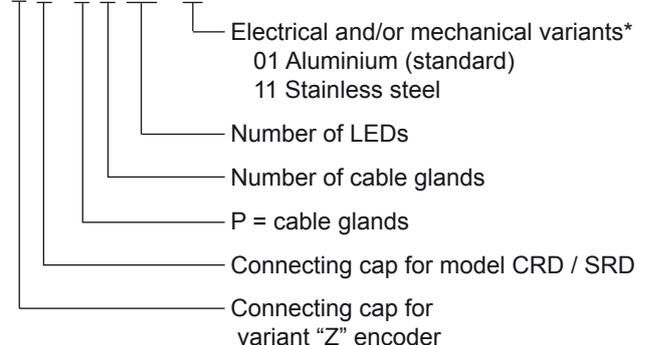
## Order code format encoder

### CRD 58 - 4096 R 4096 S2 Z 01



## Order code format for connecting cap

### Z D - P 3 L4 - 01



\* The basic versions in accordance with the data sheet bear the code number 01. Variations from the basic version are indicated with a consecutive number and are documented in our works.

- Mounting accessories and mounting clips can be supplied (ref. data sheet MZ 10111).
- The CRD encoders can also be supplied with a housing diameter of 105 mm, along with mounting bracket and additional internal heating to avoid condensation (please request dimensional drawing).

- Copies of Profibus-Profile for Encoders, No. 3.060 can be obtained from: PROFIBUS Nutzerorganisation e.V., Haid und Neu Str. 7, D-76131 Karlsruhe.
- The TWK user manual CRD 11948 as well as the GSD file are supplied with each item.

**Programming parameter: Encoder**

Parameter	Range of values	Parameter description
Code sense	CW, CCW	Direction of rotation when looking towards the shaft: CW (clockwise), CCW (counter clockwise)
Scaling function	enable	Enable for programming the parameters <i>Resolution and Total number of positions</i>
Resolution:Positions per revolution	2 to 8192 Positions/360°	Resolution (number of positions per revolution)
Total number of positions	2 to 33.554.432	Total number of positions which the encoder is physically capable of acquiring (25 - Bits)
Reference value (DDL:Data_Exchange)	0 to (Total number of positions -1)	Value displayed at the reference point

**Programming parameter: F-Parameter**

Parameter	Range of values	Default	Parameter description
<b>F_Check_SeqNr</b>	NO check 0 - The consecutive number are not included in the CRC2 signature. 1 - The consecutive number are included in the CRC2 signature.	No Check	This parameter defines whether or not the consecutive number shall be included in the CRC2 signature (see F-Data).
<b>F_Check_iPar</b>	0b 1b	0	0 - Individual parameter CRC3 are not included in the CRC2 1- Individual parameter CRC3 are included in the CRC2 CRC1-Checksum of F-Parameter CRC2-Checksum of Process data CRC3 -Checksum of Individual parameter
<b>F_SIL</b>	SIL1 - 00b SIL2 - 01b SIL3 - 10b NOSIL - 11b	SIL2 fix adjusted	SIL2 (Safety Integrity Level) to IEC 61508 (Functional safety of electrical/ electronic/programmable electronic safety-related systems)
<b>F_CRC_Length</b>	00b 3 Byte, V2 Mode 01b 2 Byte, V1 Mode 10b 4 Byte, (optional V1/ V2 Mode) 11b	2 Byte	CRC Test value (of F- useful data), V2 Mode ist not supported
<b>F_Block_ID</b>		F-Host/F-Slave relationship	fix adjusted
<b>F_Par_Version</b>	00b V1 Mode 01b V2 Mode 10b reserved 11b reserved		Parameter version, V2 Mode ist not supported
<b>F_Source_Add</b>	1-65534	2001	This parameter is allocated through the SIMATIC manager automatically.
<b>F_Dest_Add</b>	1-123	123	This parameter must agree with the address in the connecting cap.
<b>F_WD_Time</b>	1-65536 ms	2000	Watchdog time in the F-Device A valid current Safety telegram from the F-CPU must come inside the watchdog time (1 - 65536 ms).
<b>F_ParCRC (CRC1)</b>	0-65535		CRC-Sum of the F-Parameter from F_Prm_Flag1

## Data format

Output data: Host to slave

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
MSB * Preset value			LSB	MSB Dummy LSB		F-Data			

\* Preset control: Bit 31: 1/O

Input data: Slave to host

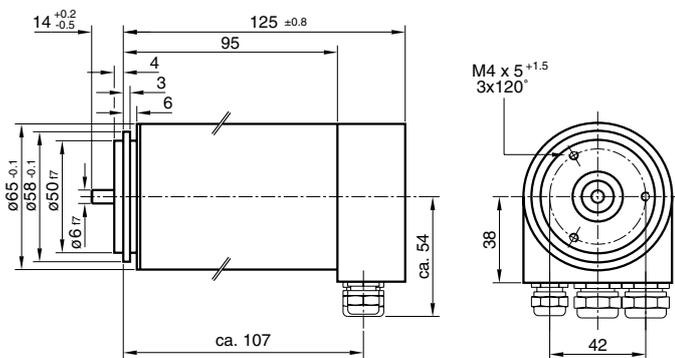
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
MSB Position value			LSB	MSB Velocity LSB		F-Data			

## Status/Control Byte - F-Data (V1-Mode)

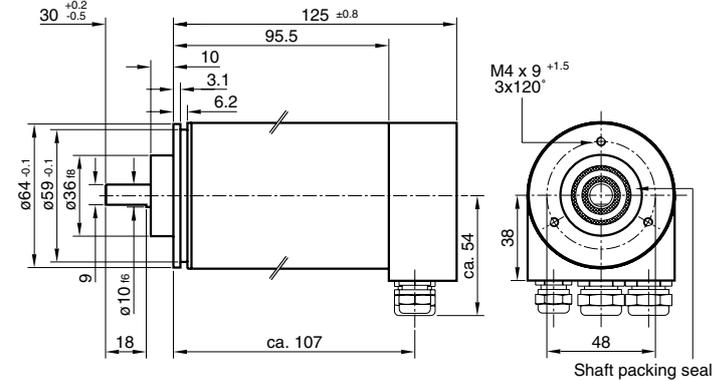
Status byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
user specific	reserved	reserved	Fail-safe values (FV) activated FV_activated	Communication failure WD_timeout	Communication failure CRC or Consecutive number CE-CRC	Encoder error Device_Fault	F-Slave has new i-parameter values assigned iPar_ok
Control byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
user specific	user specific	reserved	Fail-safe values (FV) to be activated Activate_FV	reserved	reserved	Operator acknowledge requested OA_Req	i-parameter assignment deblocked iPar_EN = 0

## Dimensions in mm

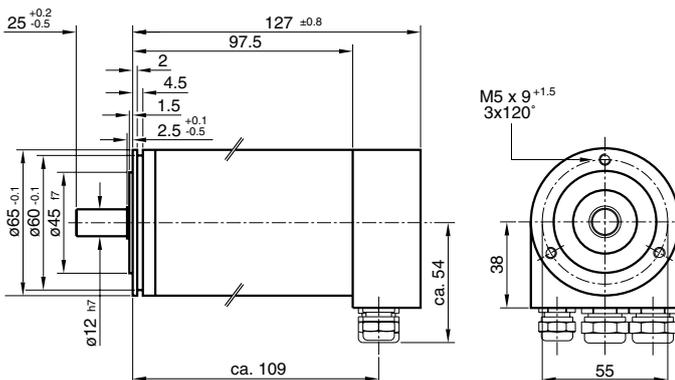
### Model No. 58 with synchro-flange



### Model No. 66 with clamping flange and shaft with flat



### Model No. 65 with synchro-flange



### Connecting cap ZD-P3L4-01 (Aluminium)

### Connecting cap ZD-P3L4-11 (Stainless steel)

The cap is listed as a separate item for ordering and delivery. The cap can be separated from the encoder for setting purposes by removing two screws.

