

# PLUTO Safety-PLC

Manual

Absolute Encoders

## Table of contents:

|       |   |    |
|-------|---|----|
| 1     | General .....                                       | 3  |
| 1.1   | Reaction time .....                                 | 3  |
| 1.2   | Safety parameters .....                             | 3  |
| 2     | Electrical.....                                     | 4  |
| 2.1   | Separation with Gateway in Bridge Mode .....        | 5  |
| 2.2   | CAN bus data .....                                  | 5  |
| 3     | Singleturn encoder RSA 597/RHA 597 .....            | 6  |
| 3.1   | Address setting.....                                | 6  |
| 3.2   | Software settings.....                              | 7  |
| 3.2.1 | Baudrate.....                                       | 7  |
| 3.2.2 | Scale .....   | 7  |
| 3.2.3 | Position adjustment .....                           | 8  |
| 3.3   | Speed limit .....                                   | 9  |
| 3.4   | Technical data .....                                | 9  |
| 3.4.1 | Electrical data.....                                | 9  |
| 3.4.2 | Mechanical data .....                               | 10 |
| 4     | Multiturn encoder RSA 698/RHA 698 .....             | 13 |
| 4.1   | Connectors.....                                     | 13 |
| 4.2   | Indicators.....                                     | 13 |
| 4.3   | Address setting.....                                | 14 |
| 4.4   | Baudrate.....                                       | 14 |
| 4.5   | Software settings.....                              | 14 |
| 4.5.1 | Scaling .....                                       | 15 |
| 4.5.2 | Position adjustment .....                           | 15 |
| 4.6   | Technical data .....                                | 16 |
| 4.6.1 | Electrical data.....                                | 16 |
| 4.6.2 | Mechanical data .....                               | 17 |
| 5     | PLC Software - Description of function blocks ..... | 20 |
| 5.1   | SafeEncoder .....                                   | 20 |
| 5.2   | SafeEncoderMult.....                                | 21 |
| 5.2.1 | SafeEncoderMult32.....                              | 22 |
| 5.3   | EncoderCam .....                                    | 23 |
| 5.3.1 | EncoderCam32 .....                                  | 23 |

# 1 General

Pluto can handle up to 16 absolute encoders connected to the CAN bus. However, the encoders themselves can only be addressed to one of 8 different addresses (for Multiturn encoders 9 addresses, but a safe solution requires that the encoders are mounted in pairs). This leads to that in practice a maximum of 8 encoders can be used.

One of the Pluto units on the bus must have software option for communication with the encoders. This special Pluto sends cyclically a sync telegram, which trigs all encoders on the bus to read the position and send a telegram with the position value back to the bus. The special Pluto can read the encoder telegrams and evaluate them. With block functions in the PLC code it is then possible to make a dual channel function with two encoders. Out of this the user gets failsafe values for position and speed including stand still monitoring and over speed detection.

The encoders are standard absolute encoders with modified software to meet the safety requirements.

## 1.1 Reaction time

The encoders are read every 10 ms. The system tolerates that a single reading of an encoder fails, but if two or more fails, it leads to failure alarm. This leads to the response times as below.

### Response time:

Normal conditions: 11 ms + program execution time  $\approx$  14 ms

By fault: 31 ms + program execution time  $\approx$  34 ms

## 1.2 Safety parameters

A system with two encoders connected to a Pluto with a PLC program which uses the block functions described in this manual (see 5) meets the safety levels below.

The values are the same as for the use of other input types, such as normal digital I/O:s or AS-i bus sensors. The values are including the encoders.

|  |                      |
|--|----------------------|
| SIL according to IEC 61508, EN 62061                   | SIL 3                |
| Charge pump outputs* (Q2, Q3)                          |                      |
| PFD <sub>AV</sub> (for proof test interval = 20 years) | $1.5 \times 10^{-4}$ |
| PFH <sub>D</sub> according to IEC 61508, EN 62061      | $1.5 \times 10^{-9}$ |
| Relay outputs* (Q0, Q1, Q4, Q5)                        |                      |
| PFD <sub>AV</sub> (for proof test interval = 20 years) | $1.5 \times 10^{-4}$ |
| PFH <sub>D</sub> according to IEC 61508, EN 62061      | $2.0 \times 10^{-9}$ |

|   |                 |
|---|-----------------|
| PL according to EN ISO 13849-1                | PL e            |
| Category according to EN ISO 13849-1          | 4               |
| MTTF <sub>d</sub> according to EN ISO 13849-1 | High/1500 years |
| DC <sub>avg</sub> according to EN ISO 13849-1 | High            |

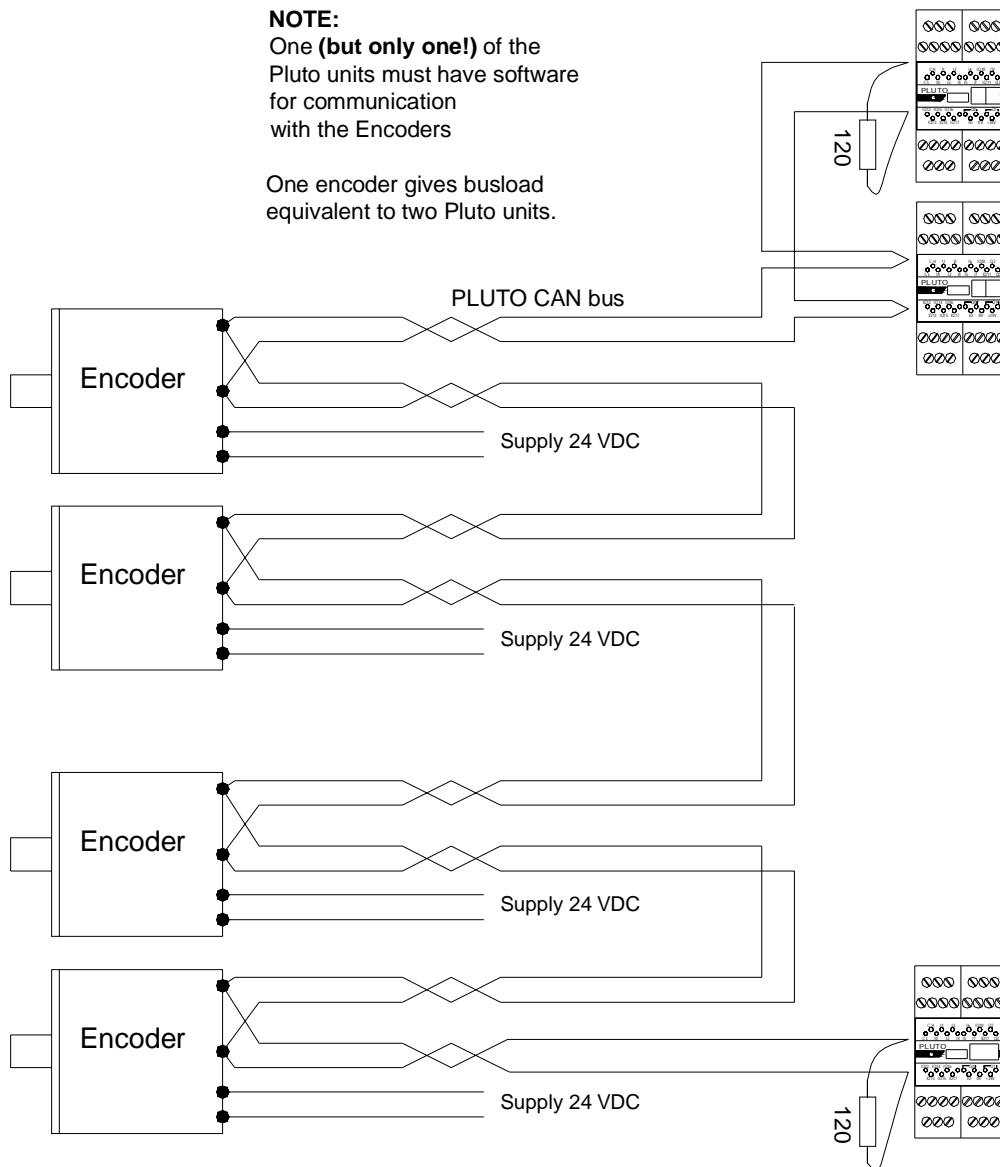
\*Encoder to output.

For more details see Pluto hardware manual.

## 2 Electrical

**NOTE:**  
One (**but only one!**) of the  
Pluto units must have software  
for communication  
with the Encoders

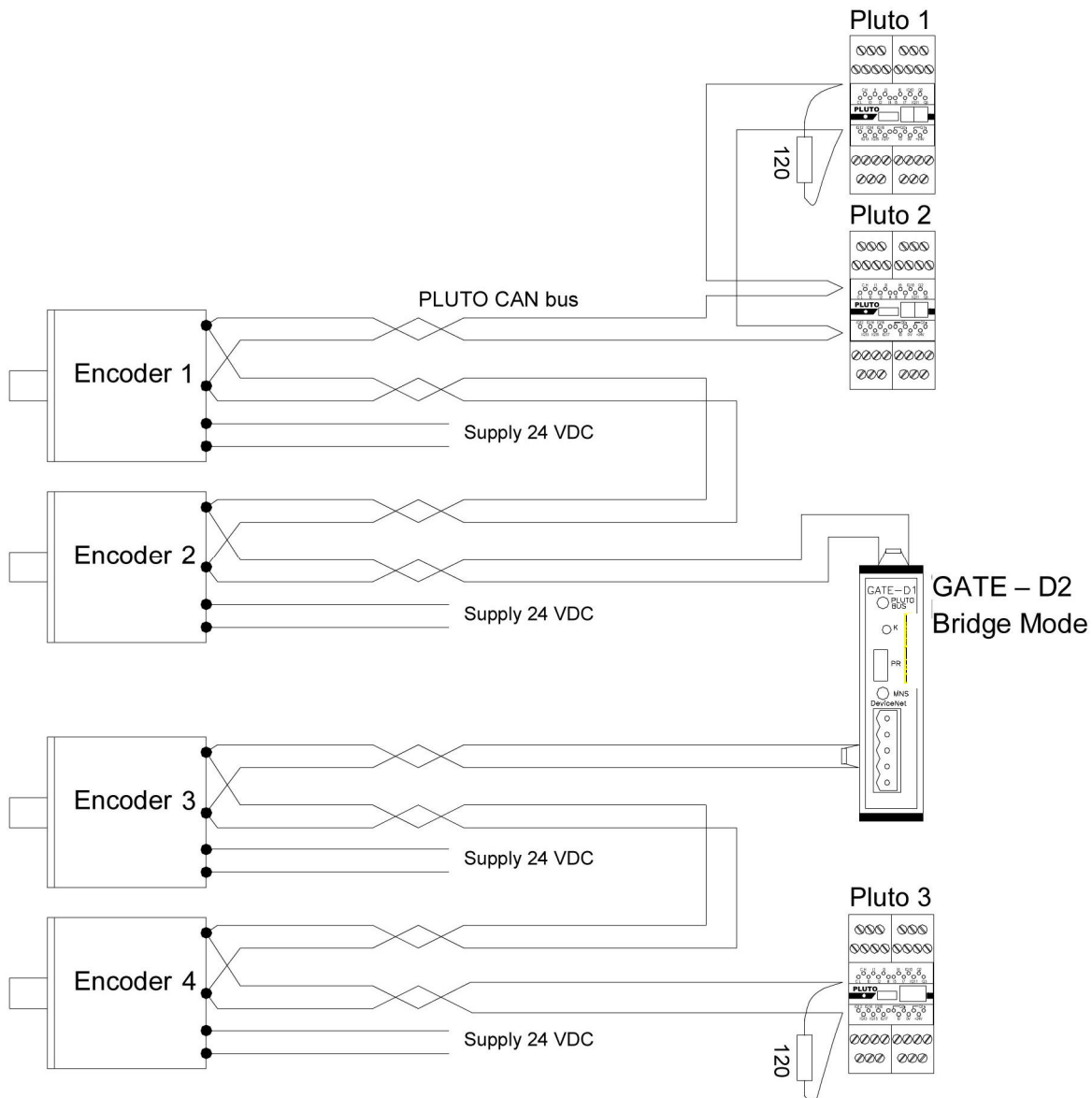
One encoder gives busload  
equivalent to two Pluto units.



*Connection of CAN bus*

## 2.1 Separation with Gateway in Bridge Mode

By using a Gateway GATE-C2 or GATE-D2 in bridge mode it is possible to separate the Encoders so that different Pluto units communicate with different Encoders. The Gateway will filter out the Encoder telegrams, but let the other telegrams pass through. (See 8.1 “Pluto filter” in the Pluto\_Gateway\_Manual.)



*In this example Pluto 1 communicates with Encoder 1 and 2, while Pluto 3 communicates with Encoder 3 and 4.*

## 2.2 CAN bus data

Each encoder gives bus load equivalent to two Pluto units. This leads to that with a certain CAN speed, the maximum amount of Pluto units will be reduced by two for each encoder. For example a Pluto-bus running with 250 kbit/s and 4 encoders can have 14-24 Pluto units instead of 22-32. For bus data as cable length / baudrate, amount of bus nodes, etc., see Pluto - Operating instructions - Hardware.

### 3 Singleturn encoder RSA 597/RHA 597



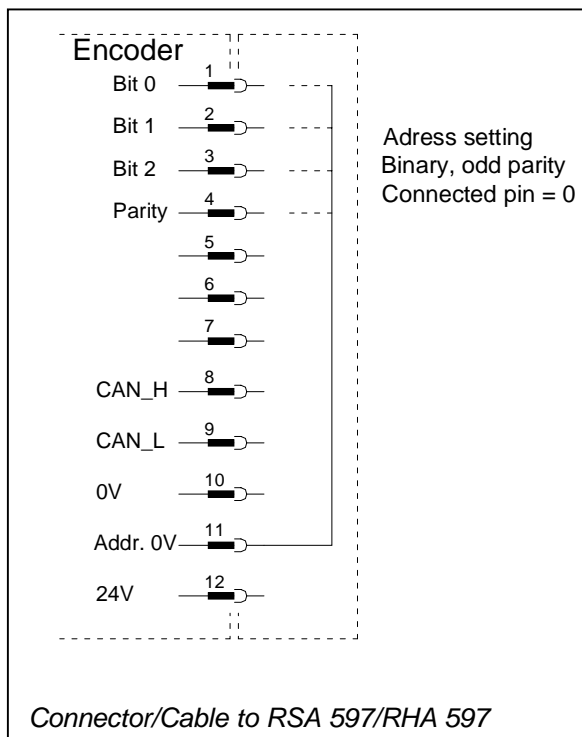
The singleturn encoder comes in four variants:

- RSA 597 with 12-pin connector.
- RSA 597 with 1.5 meter cable.
- RHA 597 with hollow shaft and 2 meter cable.
- RHA 597 with hollow shaft and 10 meter cable.

Besides connection of power supply and CAN bus the connector/cable is also used for setting the address with jumpers (see Address settings below).

#### 3.1 Address setting

The encoder must be addressed 1-8 by connecting pin 1...4 with pin 11 in the connector/cable. By exchange of encoder the addressing will automatically be made by fitting the connector.



| Connection type | Cable         |
|-----------------|---------------|
| <i>Function</i> | <i>Colour</i> |
| Address Bit 0   | White         |
| Address Bit 1   | Brown         |
| Address Bit 2   | Grey          |
| Parity          | Pink          |
| Address 0 Volt  | Blue/Red      |
| CAN_H           | Green         |
| CAN_L           | Yellow        |
| CAN_GND         | Grey/Pink     |
| +E Volt         | Red           |
| 0 Volt          | Blue          |
| Shield          | Housing       |

| Addr. | Pin 4<br>Parity | Pin 3<br>Bit 2 | Pin 2<br>Bit 1 | Pin 1<br>Bit 0 |
|-------|-----------------|----------------|----------------|----------------|
| 1     | 0               | 0              | 0              | 1              |
| 2     | 0               | 0              | 1              | 0              |
| 3     | 1               | 0              | 1              | 1              |
| 4     | 0               | 1              | 0              | 0              |
| 5     | 1               | 1              | 0              | 1              |
| 6     | 1               | 1              | 1              | 0              |
| 7     | 0               | 1              | 1              | 1              |
| 8     | 1               | 0              | 0              | 0              |

1 = Not connected  
0 = Connected to pin 11.

Example: Encoder address 3 – Pin 3 connected to Pin 11 and Pin 1, 2, 4 not connected.

## 3.2 Software settings

An encoder can be adjusted from Pluto by using Terminal Window in Pluto Manager.

By connection the prompt Pluto\_A> shall be visible.

Type “encoder” for entering the encoder menu where it is possible to change baudrate (B), set the current position (A) and rescale the encoder (I).

NOTE: If an encoder with wrong baud rate is connected to a running Pluto buss the CAN-bus communication fails.

```

PlutoManager Terminal Window
Send File Close Copy
Pluto_a>
Pluto_a>encoder
Safe encoder commands:

p   display Position
s   Status
v   Version info
b   Baudrate set
a   Position adjust
i   Scale encoder in Increment/rev
h   Help text
<Esc> Back to monitor

Encoder>

```

### 3.2.1 Baudrate

Baudrate: 125, 250, 500, 800 kbit/s or 1 Mbit/s. (Default Pluto setting 400kbit/s is not possible.) At delivery the encoders are set to 500 kbps. Note that the encoder must be powered off/on before the new setting is valid.

```

Encoder>
Encoder>baud rate set
Encoder node address? (1-16) 1
Desired baudrate ?(125/250/500/800/1000) 500
Command was successful - encoder must be powered on/off
Encoder>

```

### 3.2.2 Scale

Example of setting the scale to degrees.

```

Encoder>
Encoder>increment/rev scaling
Encoder node address? (1-16) 1
Wanted increments/rev? 360
Direction: ClockWise/AntiClockWise? (c/a)c
Encoder is singleturn
This will rescale the encoder - Are you sure? (y/n)y
Encoder rescaled!
Total resolution=          360 (ClockWise direction)
Encoder>

```

### 3.2.3 Position adjustment

The current position is set to 90.

```
Encoder>
Encoder>adjust encoder position
Encoder node address? (1-16) 1
Wanted encoder position 90
This will adjust the encoder position - Are you sure? (y/n)y
Encoder adjusted!
Encoder>
```



### 3.3 Speed limit

By use of single turn encoder for speed monitoring the maximum allowed rotating speed is limited to 50 rev/s = 3000 rpm. If the speed is exceeded the speed value will be negative.

**Note:** It must be secured by limitations in application that the maximum speed is not exceeded or that no dangerous situations can occur if it does.

Examples of such limitations are: An induction motor which speed is limited by the frequency or a hydraulic cylinder which is limited by a maximum pump capacity.

### 3.4 Technical data

| Type designation | Variant                        | Interface | Article number, ABB |
|------------------|--------------------------------|-----------|---------------------|
| RSA 597          | With 12-pole connector         | CAN04     | 2TLA020070R3600     |
| RSA 597          | With 1.5 m. cable              | CAN04     | 2TLA020070R3300     |
| RHA 597          | Hollow shaft, with 2 m. cable  | CAN04     | 2TLA020070R3400     |
| RHA 597          | Hollow shaft, with 10 m. cable | CAN04     | 2TLA020070R5900     |

| Encoder data             |   |
|--------------------------|---|
| Type                     | RSA 597, RHA 597                                    |
| Operating temperature    | -40°C .. +70°C                                      |
| Storage temperature      | -30°C .. +70°C                                      |
| Ingress protection class | IP-67 according to IEC 60529                        |
| At shaft inlet           | IP-66 according to IEC 60529                        |
| Vibration (55 to 2000Hz) | < 300 m/s <sup>2</sup> according to IEC 60068-2-6   |
| Shock (6ms)              | < 2000 m/s <sup>2</sup> according to IEC 60068-2-27 |
| Cover material           | Aluminium   |
| Cover surface treatment  | Coated and cromated or anodized                     |
| Weight                   | Approx. 300g  |
| Accuracy and resolution  |   |
| Resolution               | 13 Bit, 8192 positions per revolution               |
| Accuracy                 | ± ½ LSB   |

#### 3.4.1 Electrical data

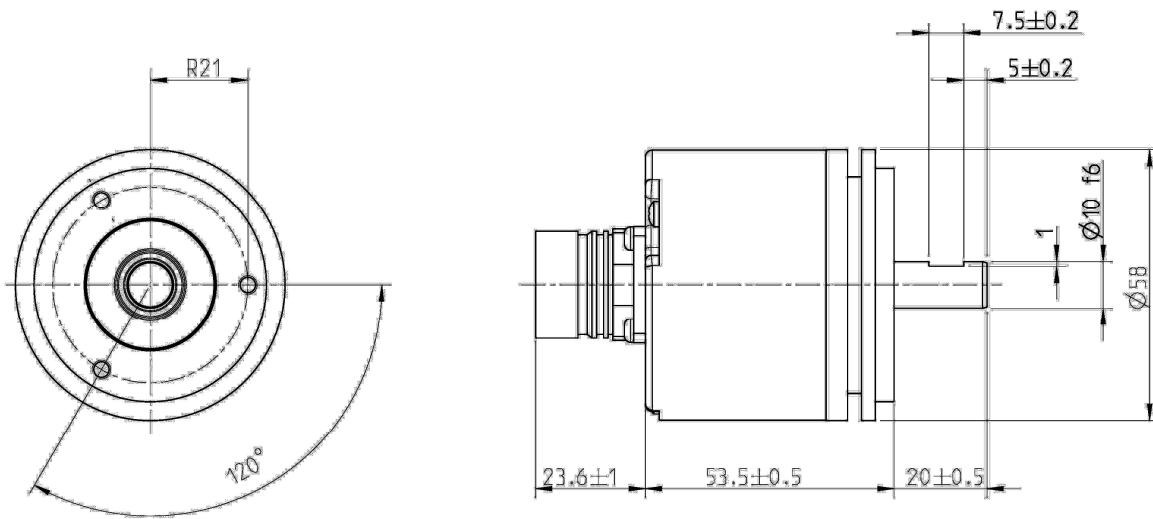
Default baud rate is 500kbit/s.

|                    |          |
|--------------------|----------|
| Power supply       | 9-36 Vdc |
| Polarity protected | Yes      |

|                         |                                     |
|-------------------------|-------------------------------------|
| Output interface        | CANPluto                            |
| Short circuit protected | Yes                                 |
| Interface               | CAN specifications 2.0 part A and B |
| Application layer       | Safe Encoder                        |
| Baud rate               | 5 kbit/s - 1 Mbit/s                 |
| CAN identifier          | 3 bit hardware adjustable           |
| Address input           | Active low                          |
| Code type               | Binary                              |
| Programmable functions  | Resolution, Preset                  |
|                         | Direction, Baud rate                |
|                         | Node ID                             |
| Current consumption     | 50mA @ 24Vdc                        |
| Max current consumption | 100mA                               |

### 3.4.2 Mechanical data

#### RSA 597 with 12-pin connector



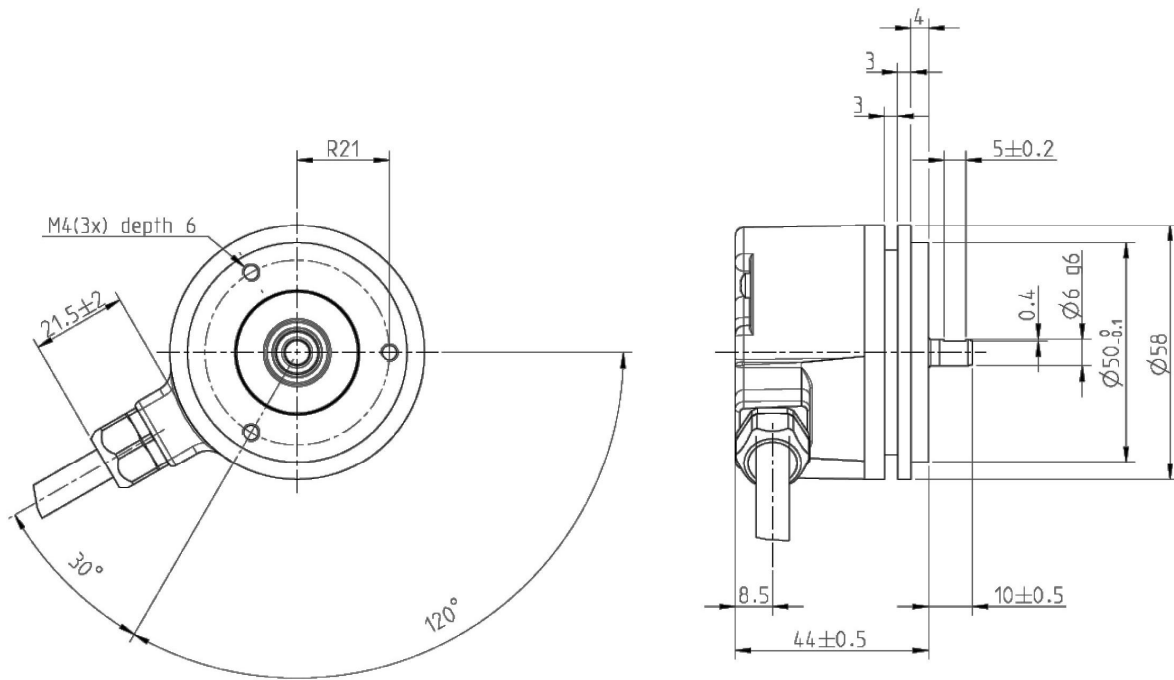
#### Shaft specification

| Shaft type              | Ø 10 with face                     |
|-------------------------|------------------------------------|
| Axial shaft load        | 50 N                               |
| Radial shaft load       | 60 N                               |
| Mech. permissible speed | 6000 rpm (12 000)                  |
| Shaft material          | Stainless steel                    |
| Moment of inertia       | $2,0 \times 10^{-6} \text{ kgm}^2$ |

#### Flange specification

| Flange type       | 63, Synchro |
|-------------------|-------------|
| Outer diameter    | ø58 mm      |
| Mounting holes    | 3 x M4      |
| Flange material   | Aluminium   |
| Surface treatment | Anodized    |

## RSA 597 with cable



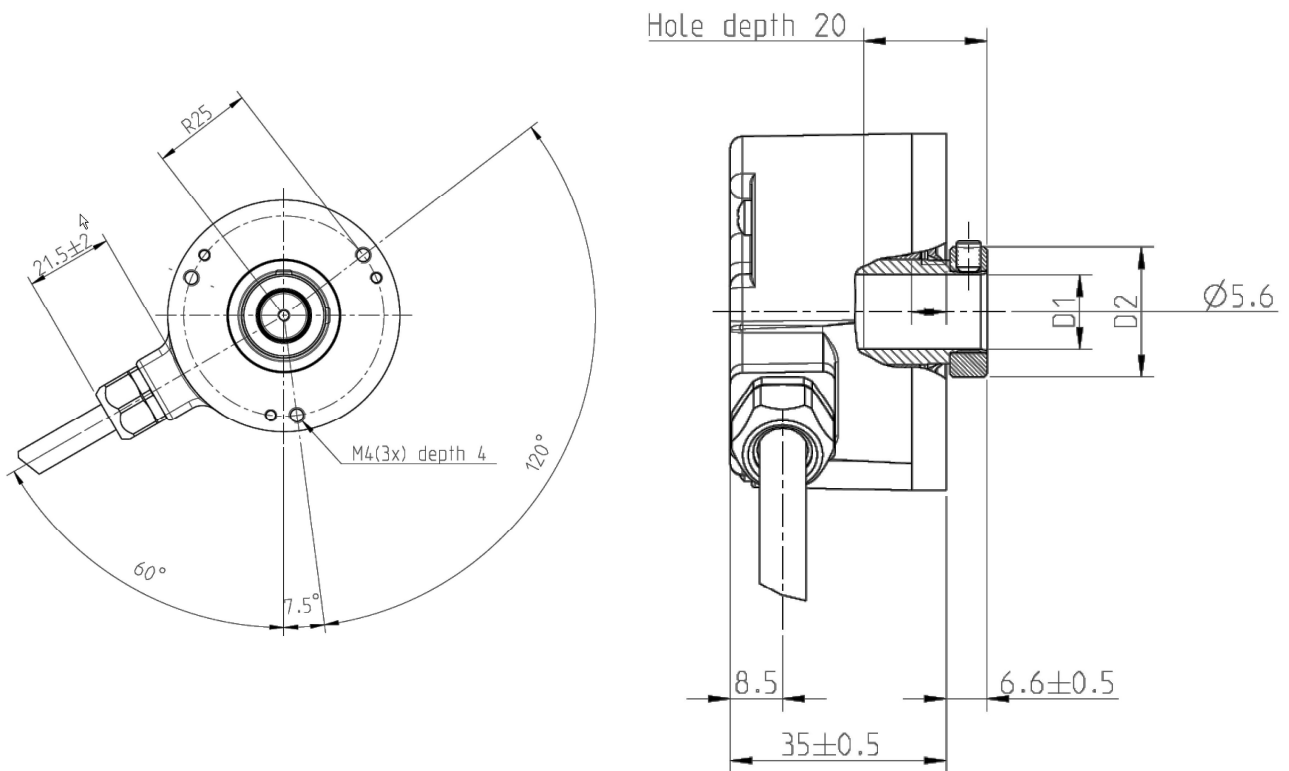
### Shaft specification

| Shaft type              | Ø 6 with face                      |
|-------------------------|------------------------------------|
| Axial shaft load        | 50 N                               |
| Radial shaft load       | 60 N                               |
| Mech. permissible speed | 6000 rpm (12 000)                  |
| Shaft material          | Stainless steel                    |
| Moment of inertia       | $1,9 \times 10^{-6} \text{ kgm}^2$ |

### Flange specification

| Flange type       | 63, Synchro |
|-------------------|-------------|
| Outer diameter    | Ø58 mm      |
| Mounting holes    | 3 x M4      |
| Flange material   | Aluminium   |
| Surface treatment | Anodized    |

## RHA 597 hollow shaft with cable



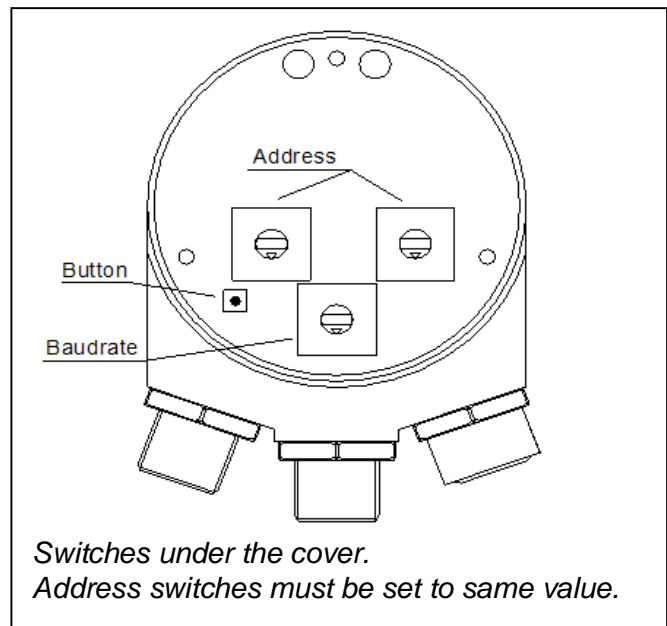
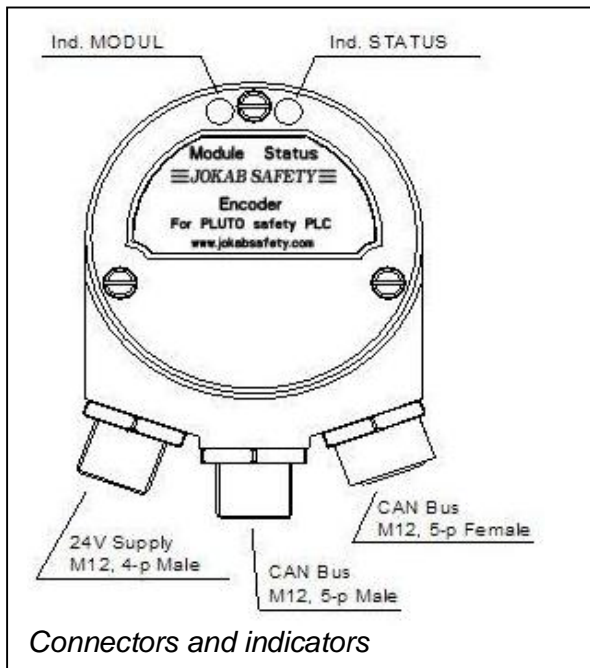
### Shaft specification

|                          |                                    |
|--------------------------|------------------------------------|
| <b>Hollow shaft type</b> | <b>Ø 12 hs</b>                     |
| Axial shaft load         | 10 N                               |
| Radial shaft load        | 20 N                               |
| Mech. permissible speed  | 6000 rpm                           |
| Shaft material           | Stainless steel                    |
| Moment of inertia        | $2,0 \times 10^{-6} \text{ kgm}^2$ |

### Flange specification

|                    |                         |
|--------------------|-------------------------|
| <b>Flange type</b> | <b>56, hollow shaft</b> |
| Diameter           | Ø58 mm                  |
| Flange material    | Aluminium               |
| Surface treatment  | Anodized                |
| Torque support     | Torque arm              |

## 4 Multiturn encoder RSA 698/RHA 698



### 4.1 Connectors

| Power supply<br>24 VDC | Pin |
|------------------------|-----|
| +24 Volt               | 1   |
| -                      | 2   |
| 0 Volt                 | 3   |
| -                      | 4   |

| CAN Bus    | Pin |
|------------|-----|
| CAN Shield | 1   |
| (CAN V+)*  | 2   |
| (CAN GND)* | 3   |
| CAN High   | 4   |
| CAN Low    | 5   |

\*Normally not used

### 4.2 Indicators

**STATUS:** Follows the CANopen standard.

| Green                    | OK   |
|--------------------------|--|
| Flashing red/green       | Fault<br>Example:<br>Wrong baudrate<br>Baudrate conflict |
| Flashing green/short red | No contact with bus                                      |

**MODULE:** Indicates sensor status.

| Green        | OK   |
|--------------|--|
| Flashing red | Fault<br>Example:<br>Address switches set to different values<br>Baudrate switch set to 9.<br>Sensor fault |

### 4.3 Address setting

The address is set by the two rotary switches under the cover. The two address switches shall be set to the same value.

**Note:** The encoder must be powered off/on before the new setting is valid.

| Address | Switch 1, 2 |
|---------|-------------|
| 1       | 1, 1        |
| 2       | 2, 2        |
| 3       | 3, 3        |
| 4       | 4, 4        |
| 5       | 5, 5        |
| 6       | 6, 6        |
| 7       | 7, 7        |
| 8       | 8, 8        |
| 9       | 9, 9        |

### 4.4 Baudrate

The baudrate is set by the switch under the cover.

**Note:** The encoder must be powered off/on before the new setting is valid.

| Baud rate | Baudrate switch |
|-----------|-----------------|
| 10 Kbit   | 0               |
| 20 Kbit   | 1               |
| 50 Kbit   | 2               |
| 125 Kbit  | 3               |
| 250 Kbit  | 4               |
| 500 Kbit  | 5               |
| 800 Kbit  | 6               |
| 1000 Kbit | 7               |
| 400 Kbit  | 8               |
| Error     | 9               |

### 4.5 Software settings

Via Terminal window in Pluto Manager it is possible to scale, set actual position and get information.

- Connect the computer to Pluto and start Pluto Manager. Start the terminal window.
- Start by typing `encoder` and `v` and `s` to see if the encoders are present on the bus:

```

PlutoManager Terminal Window
Send File Close Copy
Pluto_a>encoder
Safe encoder commands:

p  display Position
s  Status
v  Version info
b  Baudrate set
a  Position adjust
i  Scale encoder in Increment/rev
h  Help text
<Esc> Back to monitor

Encoder>ver:
ENC SERIAL-NO  OP-TIME NAM, HW_V, SW_V
05  99999999  44 60X, 1.00, 0.10
06  99999999  44 60X, 1.00, 0.10

Encoder>status:
ENC  POSITION ALARM  SCALED RES = INCR*TURNS DIR  HARDWARE RES = INCR*TURNS
05   2 298 0000    4 000 = 04000*00001 ACW  33 554 432 = 08192*04096
06   1 002 0000    4 000 = 04000*00001 CW   33 554 432 = 08192*04096

Encoder>
  
```

In this case encoder 5 and 6 are present on the bus.

The “v” command (version) shows serial number, version of hardware and software and operating time.

The status command “s” gives scaled and hardware resolution, position. Here the encoders are configured to emulate singleturn encoders (scaled res turns=1) with 4000 increments/rev.

The encoders must be scaled so that the total range is with 0 to 31999.

## 4.5.1 Scaling

The encoder is rescaled by the command “i”.

In below example the encoder is set to 100 increments/rev in multiturn mode. This means we can have up to 320 turns within the total range. Rotation direction is clockwise:

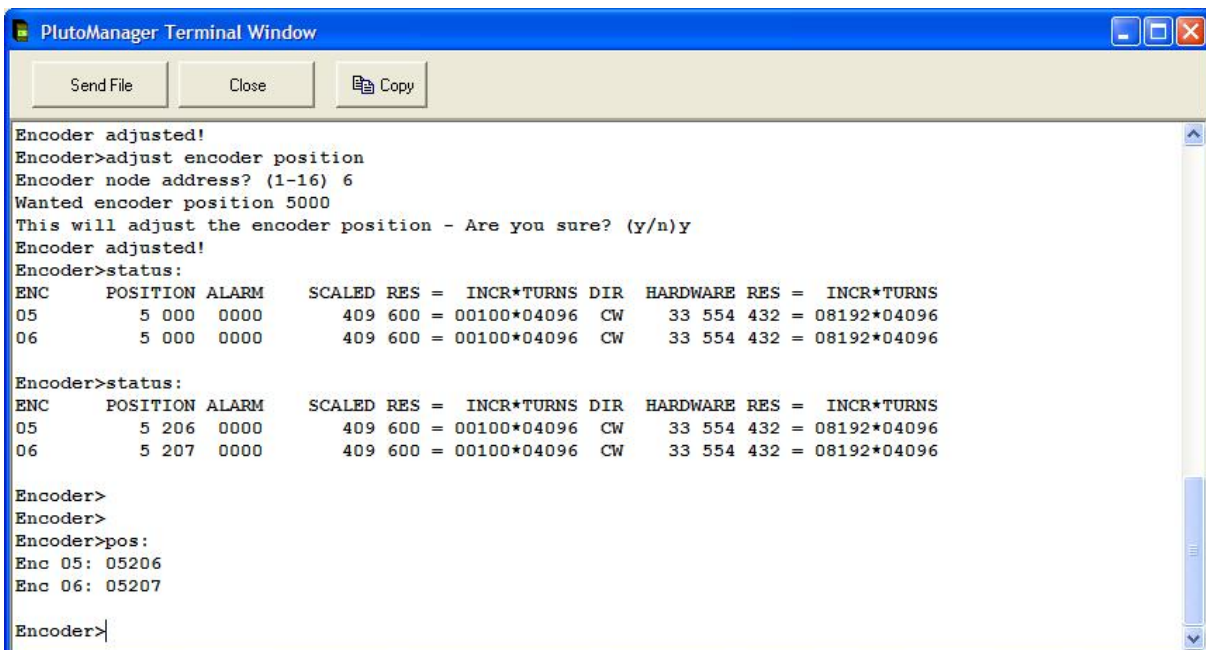
```
Encoder>increment/rev scaling
Encoder node address? (1-16) 5
Wanted increments/rev? 100
Direction: ClockWise/AntiClockWise? (a/c)c
Singleturn/Multiturn? (s/m)m
This will rescale the encoder - Are you sure? (y/n)y
Encoder rescaled!
Total resolution=      409 600 (ClockWise direction)
Encoder>increment/rev scaling
Encoder node address? (1-16) 6
Wanted increments/rev? 100
Direction: ClockWise/AntiClockWise? (a/c)c
Singleturn/Multiturn? (s/m)m
This will rescale the encoder - Are you sure? (y/n)y
Encoder rescaled!
Total resolution=      409 600 (ClockWise direction)
Encoder>status:
ENC    POSITION ALARM    SCALED RES = INCR*TURNS DIR  HARDWARE RES = INCR*TURNS
05     322 044 0000     409 600 = 00100*04096 CW   33 554 432 = 08192*04096
06     370 768 0000     409 600 = 00100*04096 CW   33 554 432 = 08192*04096

Encoder>
```

By typing “s” after the rescaling we can see that the total range is 409600, but since Pluto only has 16-bit arithmetic only the part between 0 and 31999 is usable.

## 4.5.2 Position adjustment

In below example the actual encoder position is adjusted to 5000.



```
PlutoManager Terminal Window
Send File Close Copy
Encoder adjusted!
Encoder>adjust encoder position
Encoder node address? (1-16) 6
Wanted encoder position 5000
This will adjust the encoder position - Are you sure? (y/n)y
Encoder adjusted!
Encoder>status:
ENC    POSITION ALARM    SCALED RES = INCR*TURNS DIR  HARDWARE RES = INCR*TURNS
05     5 000 0000     409 600 = 00100*04096 CW   33 554 432 = 08192*04096
06     5 000 0000     409 600 = 00100*04096 CW   33 554 432 = 08192*04096

Encoder>status:
ENC    POSITION ALARM    SCALED RES = INCR*TURNS DIR  HARDWARE RES = INCR*TURNS
05     5 206 0000     409 600 = 00100*04096 CW   33 554 432 = 08192*04096
06     5 207 0000     409 600 = 00100*04096 CW   33 554 432 = 08192*04096

Encoder>
Encoder>
Encoder>pos:
Enc 05: 05206
Enc 06: 05207

Encoder>
```

By typing “s” after the rescaling we can see that the position is changed to 5000.

If the encoder is turned and “s” is typed again we can see that the position is changed.

It is also possible to type “p” (position) to get the actual position. If position is displayed by the status command but not for the “p” command, probably the position is outside range 0-31999.

## 4.6 Technical data

| Type designation | Variant                 | Interface | Article number, ABB |
|------------------|-------------------------|-----------|---------------------|
| RSA 698          | Multiturn               | CAN04     | 2TLA020070R3700     |
| RSA 698          | Multiturn, 6mm shaft    | CAN04     | 2TLA020071R7800     |
| RHA 698          | Multiturn, Hollow shaft | CAN04     | 2TLA020071R7900     |

| Encoder data             |   |
|--------------------------|---|
| Type                     | RSA 698, RHA 698                                    |
| Operating temperature    | -40°C .. +70°C                                      |
| Storage temperature      | -30°C .. +70°C                                      |
| Ingress protection class | IP-67 according to IEC 60529                        |
| At shaft inlet           | IP-66 according to IEC 60529                        |
| Vibration (55 to 2000Hz) | < 100 m/s <sup>2</sup> according to IEC 60068-2-6   |
| Shock (6ms)              | < 2000 m/s <sup>2</sup> according to IEC 60068-2-27 |
| Cover material           | Aluminium   |
| Cover surface treatment  | Anodized  |
| Weight                   | Approx. 400g  |
| Accuracy and resolution  |   |
| Total Resolution         | 25 Bit  |
| Single turn resolution   | 13 Bit, 8192 positions per revolution               |
| Multiturn resolution     | 12 Bit, 4096 absolute number of revolutions         |
| Accuracy                 | ± ½ LSB   |

### 4.6.1 Electrical data

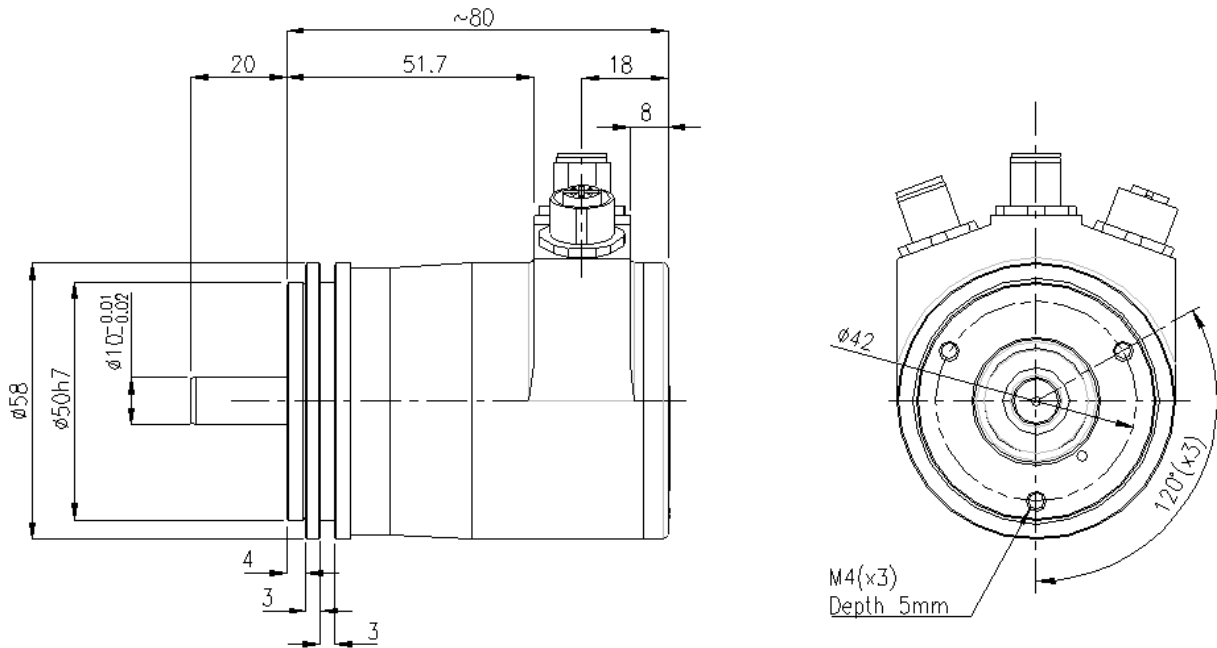
|                    |          |
|--------------------|----------|
| Power supply       | 9-36 Vdc |
| Polarity protected | Yes      |

|                         |                                  |
|-------------------------|----------------------------------|
| Output interface        | CANPluto                         |
| Node address            | Settable via DIP Switch          |
| Baud rate               | Settable via switch, Max 1MBit/s |
| Default Baud rate       | 125 kBit/s                       |
| Code type               | Binary                           |
| Programmable functions  | Scaling, Preset                  |
|                         | Code sequence                    |
| Current consumption     | 90 mA @ 24Vdc                    |
| Max current consumption | 150 mA @ 24Vdc                   |



## 4.6.2 Mechanical data

### RSA 698 Multiturn



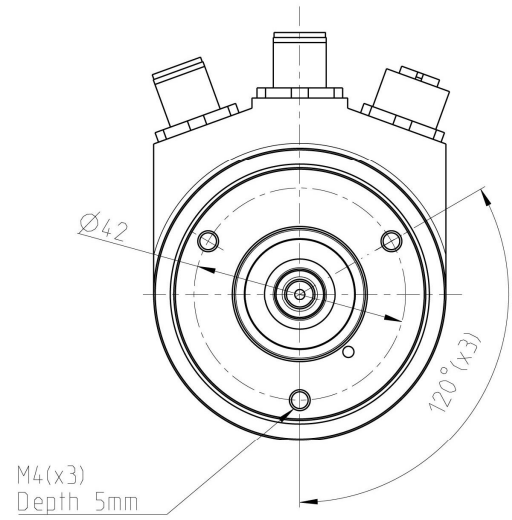
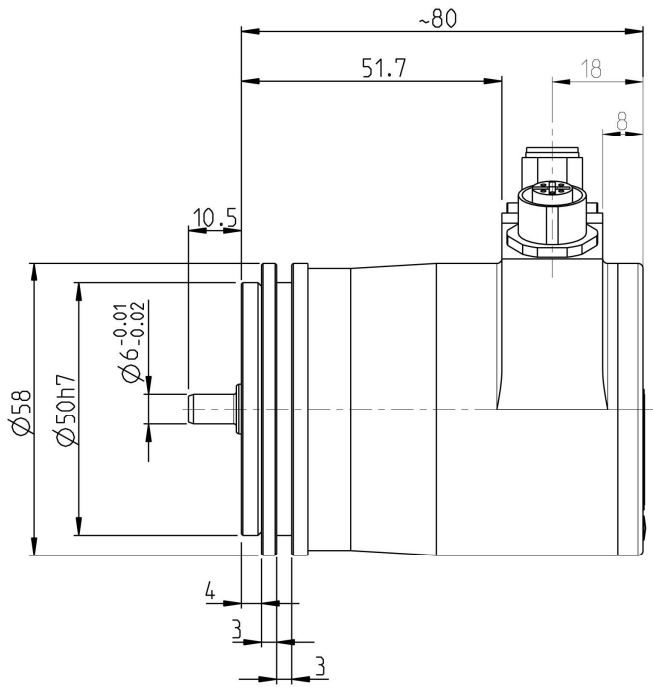
#### Shaft specification

| Shaft type              | Ø 10 round                         |
|-------------------------|------------------------------------|
| Axial shaft load        | 50 N                               |
| Radial shaft load       | 60 N                               |
| Mech. permissible speed | 12000 rpm                          |
| Shaft material          | Stainless steel                    |
| Moment of inertia       | $2,0 \times 10^{-6} \text{ kgm}^2$ |

#### Flange specification

| Flange type     | 63, Synchro |
|-----------------|-------------|
| Outer diameter  | Ø58 mm      |
| Mounting holes  | 3 x M4      |
| Flange material | Aluminium   |

## RSA 698 Multiturn, 6 mm shaft



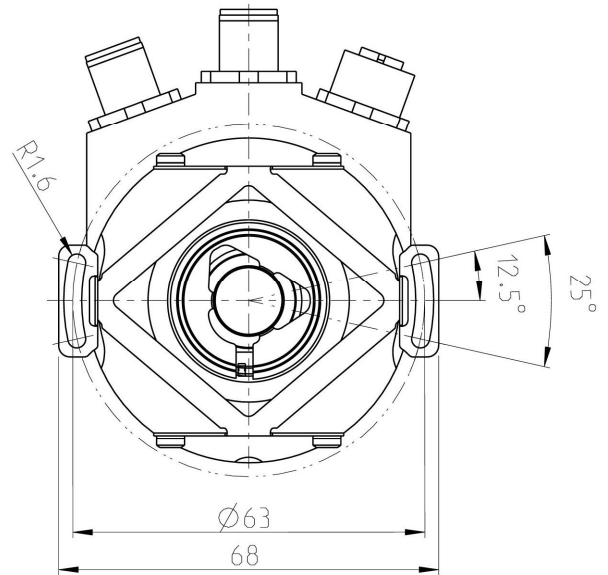
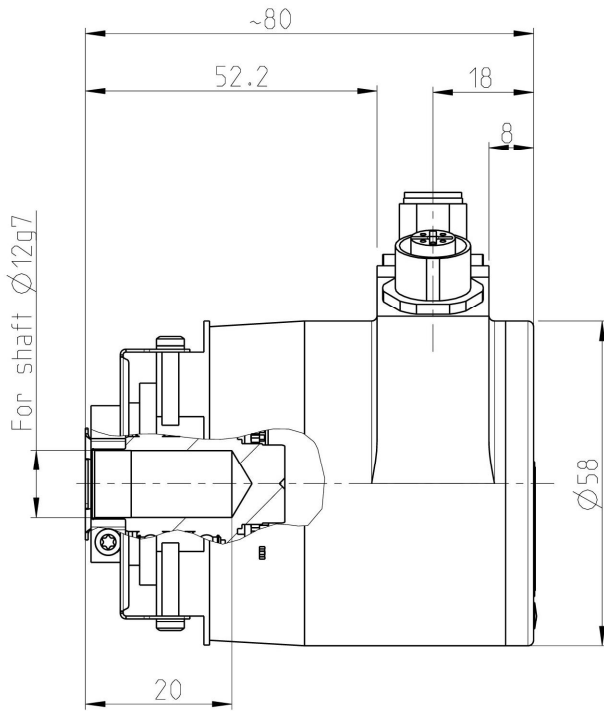
### Shaft specification

| Shaft type              | Ø 6 round                          |
|-------------------------|------------------------------------|
| Axial shaft load        | 50 N                               |
| Radial shaft load       | 60 N                               |
| Mech. permissible speed | 12000 rpm                          |
| Shaft material          | Stainless steel                    |
| Moment of inertia       | $1,9 \times 10^{-6} \text{ kgm}^2$ |

### Flange specification

| Flange type     | 63, Synchro |
|-----------------|-------------|
| Outer diameter  | Ø58 mm      |
| Mounting holes  | 3 x M4      |
| Flange material | Aluminium   |

## RHA 698 Multiturn, Hollow shaft



### Shaft specification

| Shaft type              | Ø 12 hs                            |
|-------------------------|------------------------------------|
| Axial shaft load        | 10 N                               |
| Radial shaft load       | 20 N                               |
| Mech. permissible speed | 6000 rpm                           |
| Shaft material          | Stainless steel                    |
| Moment of inertia       | $4,3 \times 10^{-6} \text{ kgm}^2$ |

### Flange specification

| Flange type     | 58, HS          |
|-----------------|-----------------|
| Outer diameter  | Ø58 mm          |
| Torque support  | Stator coupling |
| Flange material | Aluminium       |

## 5 PLC Software - Description of function blocks

The safety blocks for reading encoders are located in file "encoder01.fps".

### 5.1 SafeEncoder

Function block for singleturn encoders generating safe position and speed value out of two absolute encoders.

----- Function -----

The function block reads and evaluates two absolute encoders. The average of the two encoders is calculated and set to the output "Position". The output "Speed" is also an average value given in increments/10ms. It is also monitored that the two encoder values do not deviate more than the value set by the input "MaxDiff".

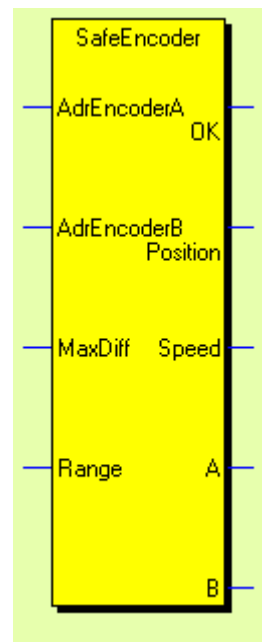
If something is wrong the output "OK" is set "0". In some application the values "Position" and 'Speed' must be used together with the "OK" output.

----- Description of in- and outputs -----

- AdrEncoderA: Encoder A node address
- AdrEncoderB: Encoder B node address
- MaxDiff: Max allowed deviation between the encoders (max 2% of Range)
- Range: Number of increments per revolution
- OK: Set when encoders are working OK and the position values are within the margin set by "MaxDiff"
- Position: Position value
- Speed: Speed value as increments/10ms
- A: Encoder A position. Must not be used in PLC program!
- B: Encoder B position. Must not be used in PLC program!

NOTE! Position values from single encoders are only available for adjustment purposes and must NOT be used for safety.

NOTE! When error occurs "Position" = -1, "Speed" = -32768 and the OK output will be reset.



## 5.2 SafeEncoderMult

Function block for multiturn encoders generating safe position and speed value out of two absolute encoders.

----- Function -----

The function block reads and evaluates two absolute multiturn encoders. The average of the two encoders is calculated and set to the output "Position".

The output "Speed" is also an average value given in increments/10ms.

It is also monitored so the two encoder values do not deviate more than the value set by the input "MaxDiff".

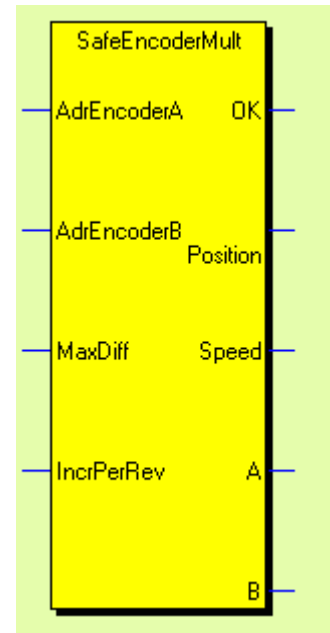
If something is wrong the output "OK" is set "0". In some application the values "Position" and "Speed" must be used together with the "OK" output.

----- Description of in- and outputs -----

- AdrEncoderA: Encoder A node address
- AdrEncoderB: Encoder B node address
- MaxDiff: Max allowed deviation between the encoders (max 2% of IncrPerRev)
- IncrPerRev: Number of increments per revolution
- OK: Set when encoders are working OK and the position values are within the margin set by "MaxDiff"
- Position: Position value
- Speed: Speed value as increments/10ms
- A: Encoder A position. Must not be used in PLC program!
- B: Encoder B position. Must not be used in PLC program!

NOTE! Position values from single encoders are only available for adjustment purposes and must NOT be used for safety.

NOTE! When error occurs "Position" = -1, "Speed" = -32768 and the OK output will be reset.



### 5.2.1 SafeEncoderMult32

Same as SafeEncoderMult but for Pluto with “Instruction set 3” (see Pluto Programming Manual). Can handle double registers.

#### ----- Function -----

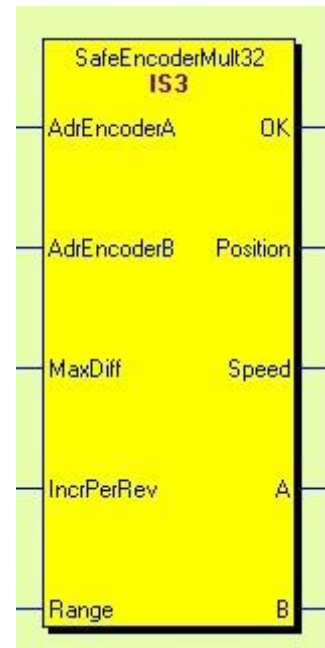
The function block reads and evaluates two absolute multiturn encoders. The average of the two encoders is calculated and set to the output “Position”.

The output “Speed” is also an average value given in increments/10ms. It is also monitored so the two encoder values do not deviate more than the value set by the input “MaxDiff”.

If something is wrong the output “OK” is set “0”. In some application the values “Position” and “Speed” must be used together with the “OK” output.

#### ----- Description of in- and outputs -----

- AdrEncoderA: Encoder A node address
- AdrEncoderB: Encoder B node address
- MaxDiff: Max allowed deviation between the encoders (max 2% of IncrPerRev)
- IncrPerRev: Number of increments per revolution
- Range: This value should be set to the total number of increments (IncrPerRev \* number of turns). \*See example below.
- OK: Set when encoders are working OK and the position values are within the margin set by “MaxDiff”
- Position: Position value
- Speed: Speed value as increments/10ms
- A: Encoder A position. Must not be used in PLC program!
- B: Encoder B position. Must not be used in PLC program!



\*Example: An encoder has a resolution of 1000 increments per revolution (IncrPerRev) and 4096 turns. In this case “Range” should be set to 4096000 and “IncrPerRev” to 1000. In terminal window this can be seen by typing “encoder”, followed by “s”.

```
Encoder>status:
ENC      POSITION ALARM      SCALED RES = INCR*TURNS DIR  HARDWARE RES = INCR*TURNS
01      4 095 900 0000      4 096 000 = 01000*04096 CW   33 554 432 = 08192*04096
03      4 095 900 0000      4 096 000 = 01000*04096 ACW  33 554 432 = 08192*04096
```

*Example: If IncrPerRev = 1000, Range shall be set to 4096000 (1000\*4096).*

NOTE! Position values from single encoders are only available for adjustment purposes and must NOT be used for safety.

NOTE! When error occurs “Position” = -1, “Speed” = -2147483648 and the OK output will be reset.

### 5.3 EncoderCam

Function block for electronic cam limit switch.

----- Function -----

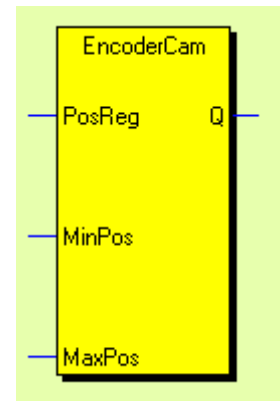
The output Q is set when the value in the input register PosReg is within the limits MinPos and MaxPos. The input value is normally Generated by the function block SafeEncoder.

NOTE! It is possible to specify a cam which passes through the zero position of an encoder. Position<0 is forbidden.

Example: If MinPos=3000 and MaxPos=200, Q is set when the position is greater than 2999 or less than 201.

----- Description of in- and outputs -----

- PosReg: Register where the position is stored
- MinPos: Min allowed value
- MaxPos: Max allowed value



#### 5.3.1 EncoderCam32

Same as SafeEncoderMult but for "Instruction set 3" (see Pluto Programming Manual). Can handle double registers.

----- Function -----

The output Q is set when the value in the input register PosReg is within the limits MinPos and MaxPos. The input value is normally Generated by the function block SafeEncoder.

NOTE! It is possible to specify a cam which passes through the zero position of an encoder. Position<0 is forbidden.

Example: If MinPos=3000 and MaxPos=200, Q is set when the position is greater than 2999 or less than 201.

----- Description of in- and outputs -----

- PosReg: Register where the position is stored
- MinPos: Min allowed value
- MaxPos: Max allowed value

