# SNC 021

## S-DIAS Safety Incremental Encoder

## Instruction Manual

## Translation of the Original Instruction

# S-DIAS Safety SNC Incremental Encoder          SNC 021

The S-DIAS Safety SNC incremental encoder module SNC 021 provides the values of two incremental encoders to the Safety CPU as well as the non-Safe CPU (standard PLC).

The two-channel safety function "monitors" the increments in the incremental encoder interfaces and processes the so-called Safety core in two micro controllers with cross-communication.

The incremental encoder function is monitored through a 2-channel analysis of the encoder signals, with 2-channel error detection of each data line, as well as via the measurement of the encoder supply voltages and currents.

Speed, position, direction and acceleration are monitored via the Safe application in the Safety CPU.

The module detects various error types, such as a cable break, cross-circuit and inverted input signals.

The safety functions of the module meet

- for **two**-channel application
  the requirements for **SIL 3** in accordance with EN / IEC 62061 and **PL e**, **Cat. 4** in accordance with EN ISO 13849.

as well as

- for **one**-channel application,
  the requirements for **SIL 3** in accordance with EN / IEC 62061 and **PL d**, **Cat. 2** in accordance with EN ISO 13849.
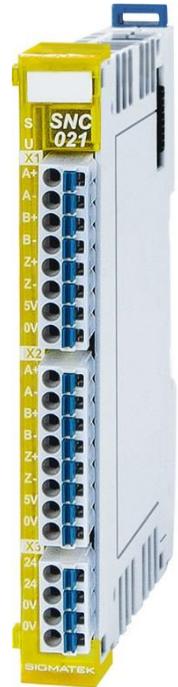
# Contents

# 1   Introduction

## 1.1   Target Group/Purpose of this Operating Manual

This operating manual contains all information required for the operation of the product.

This operating manual is intended for:

- Project planners
- Technicians
- Commissioning engineers
- Machine operators
- Maintenance/test technicians

General knowledge of automation technology is required.

Further help and training information, as well as the appropriate accessories can be found on our website www.sigmatek-automation.com.

Our support team is happily available to answer your questions.
Please see our website for our hotline number and business hours.

## 1.2   Important Reference Documentation

- Safety System Handbook

This and additional documents can be downloaded from our website or obtained through support.

## 1.3   Contents of Delivery

1x SNC 021

# 2  Basic Safety Guidelines

## 2.1   Symbols Used

The following symbols are used in the operator documentation for warning and danger messages, as well as informational notes:

### DANGER

**Danger** indicates that death or serious injury **will occur**, if the specified measures are not taken.

⇨   To avoid death or serious injuries, observe all guidelines.

**Danger** indique une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨   Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

### WARNING

**Warning** indicates that death or serious injury **can** occur, if the specified measures are not taken.

⇨   To avoid death or serious injuries, observe all guidelines.

**Avertissement** d'une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨   Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

### CAUTION

**Caution** indicates that moderate to slight injury **can** occur, if the specified measures are not taken.

⇨   To avoid moderate to slight injuries, observe all guidelines.

**Attention** indique une situation dangereuse qui, faute de prendre les mesures adéquates, **peut** entraîner des blessures assez graves ou légères.

⇨   Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

**CAUTION**

Danger for ESD-sensitive components.

Les signes de danger pour les composants sensibles aux décharges électrostatiques.

**INFORMATION**

**Information**

⇨ Provides important information on the product, handling or relevant sections of the documentation, which require attention.

## 2.2    Disclaimer

> **INFORMATION**
>
> The contents of this operating manual were prepared with the greatest care. However, deviations cannot be ruled out. This operating manual is regularly checked and required corrections are included in the subsequent versions. The machine manufacturer is responsible for the proper assembly, as well as device configuration. The machine operator is responsible for safe handling, as well as proper operation.
>
> The current operating manual can be found on our website. If necessary, contact our support.
>
> Subject to technical changes, which improve the performance of the devices. The following operating manual is purely a product description. It does not guarantee properties under the warranty.
>
> Please thoroughly read the corresponding documents and this operating manual before handling a product.
>
> **SIGMATEK GmbH & Co KG is not liable for damages caused through, non-compliance with these instructions or applicable regulations.**

## 2.3   General Safety Directives

The Safety Directives in the other sections of this operating manual must be observed. These instructions are visually emphasized by symbols.

> **INFORMATION**
>
> According to EU Directives, the operating manual is a component of a product.
>
> This operating manual must therefore be accessible in the vicinity of the machine since it contains important instructions.
>
> This operating manual should be included in the sale, rental or transfer of the product, or its online availability indicated.
>
> Regarding the requirements for Safety and health connected to the use of machines, the manufacturer must perform a risk assessment in accordance with machine directives 2006/42/EG before introducing a machine to the market.
>
> Operate the unit with devices and accessories approved by SIGMATEK only.

**CAUTION**

Handle the device with care and do not drop or let fall.

Prevent foreign bodies and fluids from entering the device.

The device must not be opened!

Manipulez l'appareil avec précaution et ne le laissez pas tomber.

Empêchez les corps étrangers et les liquides de pénétrer dans l'appareil.

L'appareil ne doit pas être ouvert!

If the device does not function as intended or has damage that could pose a danger, it must be replaced!

En cas de fonctionnement non conforme ou de dommages pouvant entraîner des risques, l'appareil doit être remplacé!

The module complies with EN 61131-2.

In combination with a facility, the system integrator must comply with EN 60204-1 standards.

For your own safety and that of others, compliance with the environmental conditions is essential.

Le module est conforme à la norme EN 61131-2.

En combinaison avec une équipement, l'intégrateur de système doit respecter la norme EN 60204-1.

Pour votre propre sécurité et celle des autres, le respect des conditions environnementales est essential.

## 2.4    Designated Use

The Safety functions implemented in the product are designed for use with safety applications in a SIGMATEK control and meet the required conditions for safe operation according to SIL 3, HFT 1 n compliance with EN 62061 and according to PL e, Kat. 4 in compliance with EN ISO 13849-1.

| | CAUTION |
|---|---|
| ⚠️ | The instructions contained in this operating manual must be followed. |

The instructions contained in this operating manual must be followed.

For error-free operation, proper transport and storage are essential.

Installation, mounting, programming, initial start-up, operation, maintenance and decommissioning can only be performed by qualified personnel.

Qualified personnel in this context are people, who have completed training or have trained under supervision of qualified personnel and have been authorized to operate and maintain safety-related equipment, systems and facilities in compliance with the strict directives and standards of safety technology (Functional Safety).

Les instructions contenues dans ce manuel technique doivent être suivies.

Pour un fonctionnement sans erreur, le transport et le stockage appropriés sont essentiels.

L'installation, le montage, la programmation, la mise en service initiale, l'exploitation, la maintenance et la mise hors service ne peuvent être effectués que par une personne qualifiée.

Dans ce contexte, on entend par personnel qualifié les personnes qui ont suivi une formation ou qui ont été formées sous la supervision d'un personnel qualifié et qui ont été autorisées à utiliser et à entretenir l'équipement, les systèmes et les installations de sécurité conformément aux directives et aux normes strictes de la technique de sécurité (Sécurité fonctionnelle).

For your own safety and that of others, the product should be used for their designated purpose only.

Correct EMC installation is also included under designated use.

Pour votre propre sécurité et celle des autres, le produit ne doivent être utilisés qu'à des fins prévues.

Une installation CEM correcte est également incluse dans l'utilisation prévue.

Non-designated use consists of:

- any changes made to the module or the use of damaged modules.

- use of the module inconsistent with the technical margins described in this operating manual or the specifications defined in the technical data.

L'utilisation non désignée consiste en:

- toute modification apportée au module ou l'utilisation des modules endommagés.

- utilisation du module non conforme aux marges techniques décrites dans ce manuel ou aux spécifications définies dans les données techniques.

Before delivering the module, the machine manufacturer must ensure that it is in "delivery condition". See chapter Transport/Storage for more information.

Avant de livrer le module, le constructeur de la machine doit s'assurer qu'il est en "état de livraison". Voir le chapitre Transport/Storage pour plus d'informations.

## 2.5   Software/Training

The application is created with the software LASAL CLASS 2 and LASAL SCREEN Editor, the Safety application is created using the SAFETYDesigner. Basic information on Safety (Functional Safety) can be found in the Safety System Handbook.

Training for the LASAL development environment, with which the product can be configured, is provided. Information on our training schedule can be found on our website.

# 3     Standards and Directives

## 3.1     Residual Risks

**CAUTION**

The following residual risks for the product must be included in the system integrator's risk assessment:

- Release of non-environmentally safe substances, emissions and unusual temperatures

- Possible effects of information technology devices

Les risques résiduels suivants pour le produit doivent être inclus dans l'évaluation des risques de l'intégrateur de système:

- Libération de substances non respectueuses de l'environnement, émissions et températures inhabituelles

- Effets possibles des dispositifs de technologie de l'information

## 3.2     Safety of the Machine or Equipment

**INFORMATION**

Observe all on-site rules and regulations for accident prevention and occupational safety.

## 3.3     Directives

The product was constructed in compliance with the following European Union directives and tested for conformity.

### 3.3.1    Functional Safety Standards

EN IEC 62061 - Safety of machinery - Functional safety of safety-related control systems
EN ISO 13849-1 - Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design
EN ISO 13849-2 - Safety of machinery — Safety-related parts of control systems — Part 2: Validation

### 3.3.2    EU Conformity Declaration

**EU Declaration of Conformity**

The product SNC 021 conforms to the following European directives:

- **2006/42/EG** Machine Directive

- **2014/30/EU** Electromagnetic Compatibility (EMC Directive)

- **2011/65/EU** "Restricted use of certain hazardous substances in electrical and electronic equipment" (RoHS Directive)

The EU Conformity Declarations are provided on the SIGMATEK website. See Products/Downloads or use the search function and the keyword "EU Declaration of Conformity".

## 3.4    Safety-Relevant Parameters

### 3.4.1    Mounting Position Horizontal 0-50 °C Ambient Temperature

| Input Module | Safety Parameters | Safety Levels |
|---|---|---|
| **SNC 021** including CPU module **SCP 011/SCP 111** | **1-channel application:**<br><br>$PFH_D$ = 3.4E-09 (1/h)<br><br>$MTTF_D$ = 806 years<br><br>DC = 97 %<br><br>SFF = 99 % | **1-channel application:**<br><br>PL d / Cat. 2<br><br>SIL 2 |
| | **2-channel application:**<br><br>$PFH_D$ = 3.5E-09 (1/h)<br><br>$MTTF_D$ = 581 years<br><br>DC = 99 %<br><br>SFF = 99 % | **2-channel application:**<br><br>PL e / Cat. 4<br><br>SIL 3 |

### INFORMATION

The system integrator must perform a separate verification according to EN ISO 13849-1 for the overall system consisting of SNC 021 and encoder. The safety characteristics of the encoder are to be requested from the manufacturer. The specified safety data refer only to the SNC 021 product.

## 3.4.2    Mounting Position Horizontal 0-60 °C Ambient Temperature

| Input Module | Safety Parameters | Safety Levels |
|---|---|---|
| **SNC 021** including CPU module **SCP 011/SCP 111** | **1-channel application:**<br><br>$PFH_D$ = 4.3E-09 (1/h)<br><br>$MTTF_D$ = 634 years<br><br>DC = 97 %<br><br>SFF = 99 % | **1-channel application:**<br><br>PL d / Cat. 2<br><br>SIL 2 |
| | **2-channel application:**<br><br>$PFH_D$ = 4.3E-09 (1/h)<br><br>$MTTF_D$ = 457 years<br><br>DC = 99 %<br><br>SFF = 99 % | **2-channel application:**<br><br>PL e / Cat. 4<br><br>SIL 3 |
| **SNC 021** including CPU module **SCP 211/SCP 111-S** | **1-channel application:**<br><br>$PFH_D$ = 5.1E-09 (1/h)<br><br>$MTTF_D$ = 503 years<br><br>DC = 97 %<br><br>SFF = 99 % | **1-channel application:**<br><br>PL d / Cat. 2<br><br>SIL 2 |
| | **2-channel application:**<br><br>$PFH_D$ = 5.1E-09 (1/h)<br><br>$MTTF_D$ = 401 years<br><br>DC = 99 %<br><br>SFF = 99 % | **2-channel application:**<br><br>PL e / Cat. 4<br><br>SIL 3 |

**INFORMATION**

The system integrator must perform a separate verification according to EN ISO 13849-1 for the overall system consisting of SNC 021 and encoder. The safety characteristics of the encoder are to be requested from the manufacturer. The specified safety data refer only to the SNC 021 product.

**1-channel and 2-channel Application**

The application for a specific PL, category or SIL requires a correct installation. Please note any normative requirements of the end application (machine) for installation and selection of encoders

The use of the specified parameters requires a risk analysis of the end application, by which whether 2 incremental encoders is sufficient must be determined.

For two-channel application, both incremental encoders must be monitored in the application (SCP 011/111/211/111-S).

## 3.5   Compatibility

**INFORMATION**

**Compatibility**

For compatibility of the S-DIAS Safety modules, see chapter "Compatibility of S-DIAS Safety Modules" in the system handbook.

# 4    Type Plate

HW: X.XX
SW: XX.XX.XXX
Safety Version: SXX.XX.XX

SIGMATEK GMBH & CO KG
Sigmatekstrasse 1  A-5112 LAMPRECHTSHAUSEN

Serial No.

Article Number    Product Name   Short Name

**Exemplary nameplate (symbol image)**

HW: 1.00
SW: 01.00.000
Safety Version: S01.00.00

SIGMATEK GMBH & CO KG
Sigmatekstrasse 1  A-5112 LAMPRECHTSHAUSEN

12345678

12-246-133-3    Handbediengerät Wireless HGW 1033-3

HW: Hardware version
SW: Software version

# 5   Technical Data

## 5.1   I-encoder Specifications

| Number of channels | 2 |
|---|---|
| Encoder | Incremental encoder with RS422 Interface with null position trace. |
| Input frequency | 0.75 MHz |
| Counter frequency | 3 MHz |
| Signal analysis | 4x |
| Encoder resolution | 12 bits (all versions up to FW V284, CPLD HW3.10 L1.9, S02.03.02)<br>28 bits (starting with version FW V286, CPLD HW3.20 L2.2, S03.04.03) |
| Encoder power supply | +5 V supply, short-circuit proof with monitoring function<br>and current measurement (+5 V is generated from +24 V at X3) |
| Status LED | yes |
| I-encoder current consumption | maximum 300 mA per encoder when installing the SNC 021 in ambient temperature up to 50 °C<br>maximum 200 mA per encoder with 60 °C ambient temperature |

## 5.2   Electrical Requirements

| Supply voltage for the encoder supply | +18-30 V[1]<br>(+5 V is generated from +24 V at X3) | |
|---|---|---|
| Current consumption of supply voltage for the encoder supply | typically 162 mA/24 V | maximum 200 mA/30 V |
| Voltage supply from Safety bus | +12 V | |
| Current consumption on the Safety bus (+12 V supply) | typically 75 mA | maximum 90 mA |
| Voltage supply from S-DIAS bus | +24 V | |
| Current consumption on the S-DIAS bus (+24 V supply) | typically 33 mA | maximum 40 mA |

**INFORMATION**

[1] With horizontal mounting position and increased ambient temperature >50 °C the maximum permissible supply voltage is reduced from 30 V to 28.8 V.

If this S-DIAS Safety module is connected to an SCP with several modules, the total current of the S-DIAS Safety modules used must be determined and checked.

The total current of the +24 V supply cannot exceed 800 mA.
The total current of the +12 V supply cannot exceed 800 mA.

The SNC 021 module can only be used in conjunction with an SCP 011/SCP 111 that has been configured as a master CPU.

The S-DIAS Safety module SNC 021 is supported from the following firmware versions of the S-DIAS Safety CPU modules:

S-DIAS Safety CPU module SCP 011: starting with FW version V370
S-DIAS safety CPU module SCP 111: starting with FW version V447

## 5.3   Miscellaneous

| Article number | 20-896-021 | |
|---|---|---|
| Standard | Two-channel application: | EN 62061SIL 3<br>EN ISO 13849-1 PL e/Cat. 4 |
| | One-channel application: | EN 62061 SIL 3<br>EN ISO 13849-1 PL d/Cat. 2 |
| | UL 508 (E247993) | |
| Approvals | CE, cUL<sub>US</sub>, TÜV Austria EG type-tested | |
| Mission time | 20 years | |
| Reaction time | see chapter "Reaction and Turn-off Time" in the Safety System Handbook | |

## 5.4   Environmental Conditions

| Storage temperature | -20 ... +85 °C | |
|---|---|---|
| Environmental temperature | 0 ... +50 °C (UL)<br>0 … +60 °C (CE) | |
| Humidity | 0-95 %, non-condensing | |
| Installation altitude above sea level | 0-2000 m without derating<br>> 2000 m with derating of the maximum environmental temperature by 0.5 °C per 100 m | |
| Operating conditions | Pollution degree 2 | |
| Noise emissions | ≤ 70 dB | |
| EMC resistance | in accordance with 61000-6-7:2015 (Generic standards - Immunity requirements for equipment intended to perform functions in safety-related systems (functional safety) at industrial locations)<br>in accordance with EN 61000-6-2:2007 (industrial area) (increased requirements in accordance with IEC 62061) | |
| EMC noise generation | in accordance with EN 61000-6-4:2007 (industrial area) | |
| Vibration resistance | EN 60068-2-6 | 3.5 mm from 5-8.4 Hz<br>1 g from 8.4-150 Hz |
| Shock resistance | EN 60068-2-27 | 15 g |
| Protection type | EN 60529 | IP20 |

# 6    Mechanical Dimensions

# 7   Connector Layout



| | |
|---|---|
| Bus Status (green) | |
| Safety-Used (yellow) | |
| Encoder Status (green) | A+  Track A+ |
| Safe DATA OK (green) | A-  Track A- |
| | B+  Track B+ |
| | B-  Track B- |
| X1 | Z+  Zero-pulse Z+   Encoder 1 |
| | Z-  Zero-pulse Z- |
| | 5V  +5 V |
| | 0V  GND |
| Encoder Status (green) | A+  Track A+ |
| Safe DATA OK (green) | A-  Track A- |
| | B+  Track B+ |
| | B-  Track B- |
| X2 | Z+  Zero-pulse Z+   Encoder 2 |
| | Z-  Zero-pulse Z- |
| | 5V  +5 V |
| | 0V  GND |
| DC OK (green) | 24  +24 V-supply |
| | 24  +24 V-supply |
| X3 | 0V  GND |
| | 0V  GND |
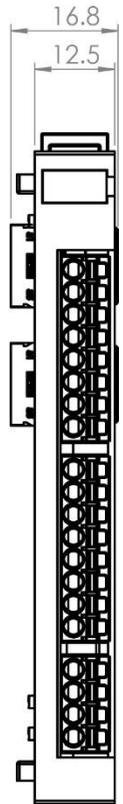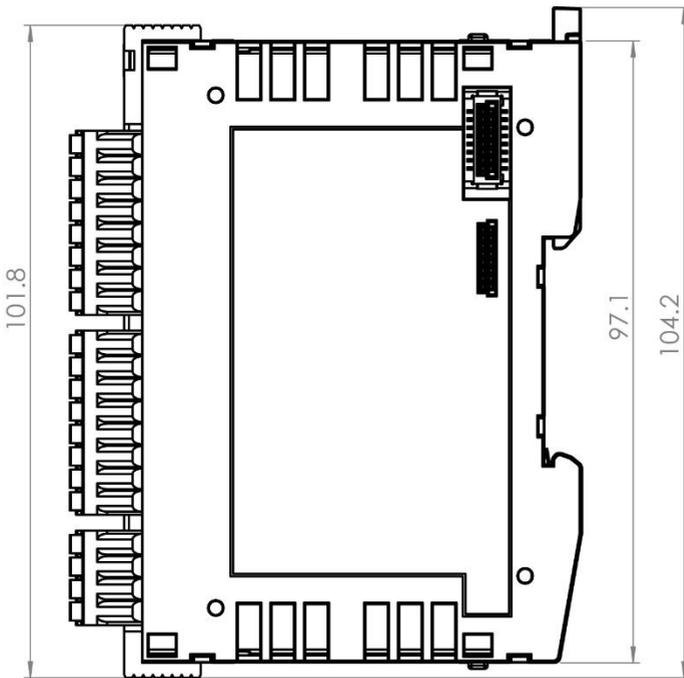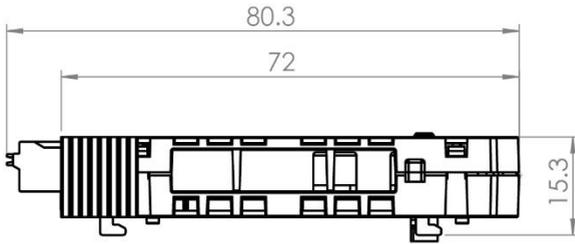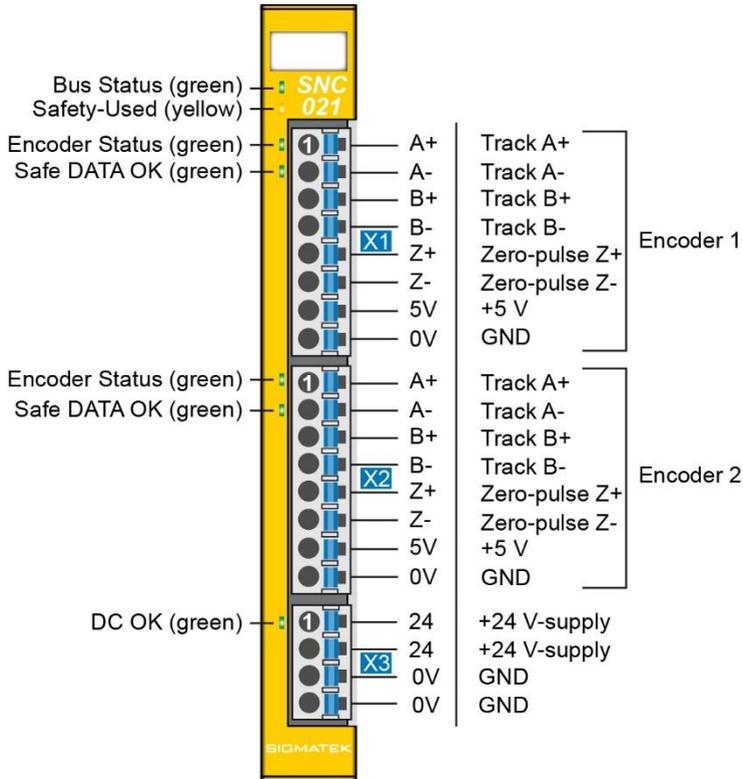
**INFORMATION**

The connections of the +24 V supply (X3: pin 1 and pin 2) or the GND supply (X3: pin 3 and pin 4) are internally bridged. To supply the module, only one connection to a +24 V pin (pin 1 or pin 2) and a GND pin (pin 3 or pin 4) is required. The bridged connections may be used for further looping of the +24 V supply and the GND supply. However, it must be taken into account that a total current of 6 A per connection is not exceeded by the forward looping!

## 7.1    Status LEDs

| Bus Status | green | ON | bus communication OK |
|---|---|---|---|
| | | OFF | no supply available |
| | | BLINKING (5 Hz) | no communication |
| Safety Used | yellow | ON | can be set from the application |
| | | OFF | (e.g. the module LED can be set to blinking through the visualization so that the module is easily found in the control cabinet) |
| | | BLINKING (2 Hz) | |
| | | BLINKING (4 Hz) | |
| Encoder Status | green | ON | encoder signal OK |
| | | OFF | encoder is not in use |
| | | BLINKS | signal error was detected |
| Safe Status | green | ON | Safety of the Safe CPU provides invalid encoder values |
| | | OFF | encoder is not in use or |
| | | | Safety provides invalid encoder values |
| DC OK | green | ON | +24 V input voltage for encoder supply OK |

## 7.2    Applicable Connectors

**Connectors:**
**X1-X3:** Connectors with spring terminals (included in delivery).
The spring terminals are suited for the connection of ultrasonically compacted (ultrasonically welded) wires.

**Connections:**

| | |
|---|---|
| Stripping length/sleeve length. | 10 mm |
| Mating direction: | parallel to the conductor axis or circuit board |
| Conductor cross section rigid: | 0.2-1.5 mm$^2$ |
| Conductor cross section flexible: | 0.2-1.5 mm$^2$ |
| conductor cross section strands ultrasonically compacted: | 0.2-1.5 mm$^2$ |
| Conductor cross section AWG/kcmil: | 24-16 |
| Conductor cross section flexible with ferrule without plastic sleeve: | 0.25-1.5 mm$^2$ |
| Conductor cross section flexible with ferrule with plastic sleeve: | 0.25-0.75 mm$^2$ (reason for reduction d2 of the ferrule) |



d2 = max. 2.8 mm

## 7.3    Label Field
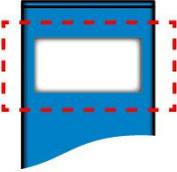


| Manufacturer: | Weidmüller |
|---|---|
| Type: | MF 10/5 CABUR MC NE WS |
| Article number Weidmüller | 1854510000 |
| | |
| Compatible printer | Weidmüller |
| Type: | Printjet Advanced 230V |
| Article number Weidmüller | 1324380000 |

# 8   Wiring

## 8.1   Wiring Example
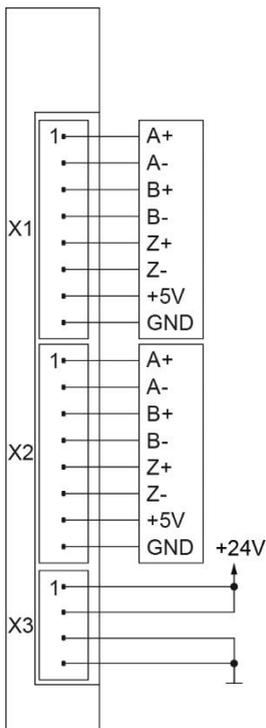
## 8.2    Note

The input filters, which suppress noise signals, allow operation in harsh environmental conditions. A careful wiring method is also recommended to ensure error-free function.

**The following installation guidelines should be observed:**

- Avoid parallel connections between input lines and load-bearing circuits.

- Protective circuits for all relays (RC networks or free-wheeling diodes)

- Correct wiring to ground

**INFORMATION**

The ground bus should be connected to the control cabinet when possible!

Wiring and mounting must be performed with no voltage applied!

The S-DIAS module CANNOT be connected/disconnected while voltage is applied!

# 9    RS422 Interface

The RS422 interface is internally connected in the component.

# 10  Encoder Configuration

The maximum encoder frequency is defined with 750 kHz (at 1x edge analysis). This corresponds to a maximum counter frequency or 1.5 MHz (at 4x edge analysis).

When selecting the encoder to install, this must be taken into consideration accordingly.

In the following table, the permissible speed in the rotary encoder for the respective resolution based on the maximum encoder frequency can be seen.

| Encoder Resolution (Increments/Conversion) | Speed Scaling | |
| --- | --- | --- |
| | Revolutions/Second | Revolutions/Minute |
| 60 | 12.500 | 750.000 |
| 80 | 9.375 | 562.500 |
| 100 | 7.500 | 450.000 |
| 128 | 5.859 | 351.563 |
| 150 | 5.000 | 300.000 |
| 200 | 3.750 | 225.000 |
| 256 | 2.930 | 175.781 |
| 512 | 1.465 | 87.891 |
| 1024 | 732 | 43.945 |
| 2048 | 366 | 21.973 |
| 4096 | 183 | 10.986 |

This is only a sample of possible encoder resolutions.

With the following formulas, the highest permissible rotation speed (revolutions/min) can be determined for an encoder with a resolution that is not listed in the table above.

Revolutions/sec:

$$n_{max} = \frac{f_{max}}{RES}$$

Revolutions/min:

$$n_{max} = \frac{f_{max} * 60}{RES}$$

**Legend:**

$n_{max}$ … highest permissible speed in revolutions/sec or revolutions/min.
$f_{max}$ … maximum encoder frequency of 750 kHz
$res$ … encoder resolution according to the manufacturer data sheet.

If linear encoders are used or for example, a translation ratio must be included, as well as the calculation for the maximum permissible speeds and the scaling parameters that must be defined in the Safety Designer for each encoder, taken into consideration.
The following formula is thereby generated:

$$v_{max} = (f_{max} * mul_{position} / div_{position}) * (mul_{speed} / div_{speed})$$

**Legend:**

$v_{max}$ … maximal possible, scaled speed
$f_{max}$ … maximum encoder frequency of 750 kHz
$mul_{position}$… factor for converting the position of length (units parameter)
$div_{position}$ … divisor for converting the position of length (units parameter)
$mul_{speed}$ … factor for converting the speed or time base (speed multiplier parameter)
$div_{speed}$ … divisor for converting the speed or time base (speed divisor parameter)

Due to the 32-bit data width, a maximum value of 2,147,483,647 is generated for the upper speed limit (the highest bit is used as the sign).
The following conditions result:

$$n_{max} \leq 2,147,483,647 \ and \ f \leq f_{max}$$
$$v_{max} \leq 2,147,483,647 \ and \ f \leq f_{max}$$

**Legend:**

$f$ … Encoder frequency (with simple edge analysis)

**Notes on position monitoring**

If the encoder is set for position monitoring, (linear, rotation encoder), it must be taken into consideration that the minimum and maximum value of the position must be monitored in the application. The maximum value is dependent on the scaling parameters for calculating the parameters and limited to 32 bits.

# 11  Installing the Encoder

Line and encoder errors are diagnosed using, among other things, the measurement of the encoder currents.
For this purpose, the preset values for measuring current must be defined in the system. The current limits are defined in the automatic system automatically, so the user does not have to predefine or configure any additional parameters.

In the unverified status of the system, the encoder currents are measured while starting the system and used as temporary reference values. Based on the determined reference values, the current limits are temporarily defined with ±25%. If a corresponding fluctuation in the encoder currents due to a wiring fault is detected during movement, the system switches to the Safe mode and the appropriate diagnostic codes are provided.

**CAUTION!**
Before the Safety system is labeled as verified, the wiring of the installed encoder must be checked manually to ensure that the system operates error-free (the encoder operates without fault).

During verification, which is run via the "Set Verified" button in the SafetyDesigner or the validation button on the Safe CPU, the actual current measurements are used to determine the permissible limit values for the encoder current and then stored in the Safe CPUs remnant data. These limit values are based on the measured value ±25 %.

After successful validation, the encoder currents are monitored using the current values stored in the Safe CPU. When in verified status, the upper or lower limits are exceeded, the system changes to safe mode and the appropriate diagnostic code for error analysis is again provided.

In the standard application, the actual and preset current values are provided via the hardware classes.

**CAUTION! Exchanging the encoder**
Basically, the Safety system cannot detect an encoder exchange when no power is applied. The parameters of the new encoder could be different from the replaced encoders with regard to the currents, whereby it is no longer possible guarantee the appropriate monitoring of the newly installed encoder.

In such a case, the system **must** be reverified. This means reconfiguring the Safe CPU via the SafetyDesigner or µSD card and verifying (see Safety System manual)

# 12  Important Notes for Two-channel Application

When using the SNC 021 module in compliance with **SIL 3** according to EN 62061 and **PL e**, **Cat. 4** according to EN ISO 13849-1, it must be taken into consideration that for 2-channel application, a part of the possible wiring errors can only be detected by comparing the measurement results of both encoders in the Safety application of the Safe CPU. The inversion of signal lines A+ with A- as well as B+ with B- are one of these errors. Mechanical errors, such as a detached coupling can also be detected only in the Safety application of the Safe CPU.

To meet the requirements of the diagnostic coverage ratio, both encoders must be synchronously monitored in the Safety application of the Safe CPU.

For synchronous monitoring, the functional Safety block SF_SkewMonitor (see chapter "Numerical Function Blocks" in the SafetyDesigner tool help) must be placed in the Safety project and used according to the documentation.

The inputs S_ChnValue1 and S_ChnValue2 of the functional Safety blocks must be wired with the input information _Chn1Value and S_Chn2Value (synchronous monitoring of the position) or alternatively, with S_Chn1Speed and S_Chn2Speed (synchronous monitoring of the speed) of the SNC 021 module.

The required tolerance must be defined by the user. During synchronous monitoring via the position, it must be taken into consideration that if there is the possibility of a position overflow, the scaling parameter can cause position jumps. In such a case, the scaling parameter for calculating the position should be left at the default settings (factor and divisor are 1), or synchronous monitoring performed using the speed.

**INFORMATION**

If the system is not in Safe mode, synchronous monitoring must be performed according to the previously mentioned criteria.

If all mechanical error sources can be excluded due to the coupling type and the type of encoder used (e.g. defective encoder mechanics), monitoring the direction of both encoders is then sufficient.

This can be run in the Safety application using the functional Safety block SF_DirectionMonitor (see chapter "Numeric Function Blocks" in the SafetyDesigner tools help) and in this case, performed for both encoders.

**INFORMATION**

If synchronous monitoring is not performed in the Safety application as described here, the machine manufacturer must then prove that the requirements of SIL 3 according to EN 62061 and PL e, Cat. 4 according to EN ISO 13849 are met if required for the machine.

# 13 Assembly/Installation

## 13.1 Check Contents of Delivery

Ensure that the contents of the delivery are complete and intact. See chapter Contents of Delivery.

> **INFORMATION**
>
> On receipt and before initial use, check the device for damage. If the device is damaged, contact our customer service and do not install the device in your system.
>
> Damaged components can disrupt or damage the system.

## 13.2  Mounting

The S-DIAS modules are designed for installation into the control cabinet. To mount the modules a DIN-rail is required. The DIN rail must establish a conductive connection with the back wall of the control cabinet. The individual S-DIAS modules are mounted on the DIN rail as a block and secured with latches. The functional ground connection from the module to the DIN rail is made via the grounding clamp on the back of the S-DIAS modules. The modules must be mounted horizontally (module label up) with sufficient clearance between the ventilation slots of the S-DIAS module blocks and nearby components and/or the control cabinet wall. This is necessary for optimal cooling and air circulation, so that proper function up to the maximum operating temperature is ensured.



HORIZONTAL Mounting
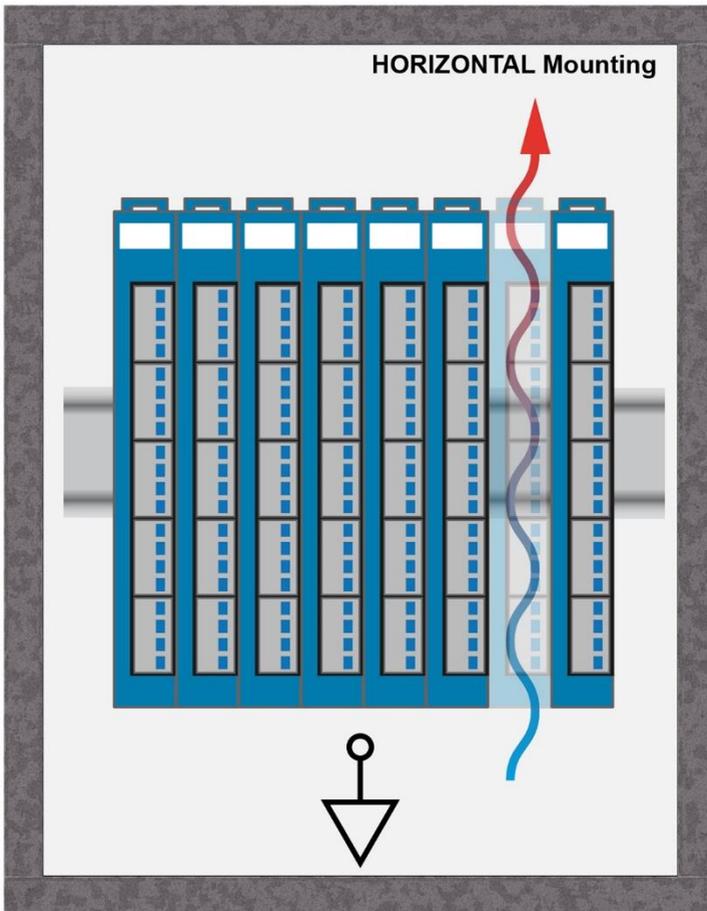
Recommended minimum distances of the S-DIAS modules to the surrounding components or control cabinet wall:
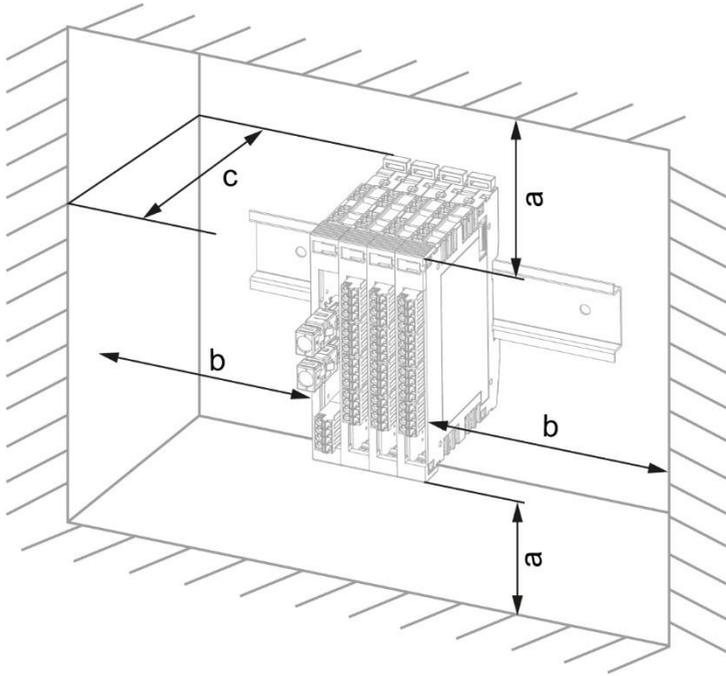


| a | b | c |
|---|---|---|
| **30 mm** (1.18˝) | **30 mm** (1.18˝) | **100 mm** (3.94˝) |

a, b, c … distances in mm (inches)

# 15 Transport/Storage

**INFORMATION**

This device contains sensitive electronics. During transport and storage, high mechanical stress must therefore be avoided.

For storage and transport, the same values for humidity and vibration as for operation must be maintained!

Temperature and humidity fluctuations may occur during transport. Ensure that no moisture condenses in or on the device, by allowing the device to acclimate to the room temperature while turned off.

When sent, the device should be transported in the original packaging if possible. Otherwise, packaging should be selected that sufficiently protects the product from external mechanical influences. Such as cardboard filled with air cushioning.

# 16 Storage

**INFORMATION**

When not in use, store the device according to the storage conditions. See chapter 15 Transport/Storage.

During storage, ensure that all protective covers (if available) are placed correctly, so that no contamination, foreign bodies or fluids enter the device.

# 17 Maintenance

**INFORMATION**

During maintenance as well as servicing, observe the safety instructions from chapter 2 Basic Safety Directives.

## 17.1 Service

This product was constructed for low-maintenance operation.

## 17.2 Repair

**INFORMATION**

In the event of a defect/repair, send the device with a detailed error description to the address listed at the beginning of this document.

For transport conditions, see chapter 15 Transport/Storage.

# 18 Disposal

**INFORMATION**

Should you need to dispose of the device, the national regulations for disposal must be followed.

The device appliance must not be disposed of as household waste.

# Documentation Changes

| Change date | Affected page(s) | Chapter | Note |
|---|---|---|---|
| 20.09.2018 | | 5 Connector Layout | Note added |
| 15.11.2018 | 15 | 3.3 Miscellaneous | UL instead of UL in preparation |
| 19.02.2019 | 28 | 11 Installing the Encoder | Tolerance changed from +25 % to ±25 % |
| 02.04.2019 | 12 | 2.3 Safety-Relevant Parameters | Correction of the safety-relevant parameters |
| | 16 | 3.4 Environmental Conditions | Corrections environmental conditions |
| | all | | Corrections due to CE |
| 08.08.2019 | | Entire document | "safety-related" replaced |
| 14.11.2019 | | 13 Supported Cycle Times | Chapter added |
| 02.12.2019 | | 2.3 Safety-Relevant Parameters | Values updated |
| 28.02.2020 | 31 | 13 Supported Cycle Times | Text adapted |
| 22.04.2020 | 14 | 3.1 I-encoder Specifications | Encoder resolution changed to 12 bits |
| 28.05.2020 | 31 | 13 Supported Cycle Times | Chapter removed |
| 20.07.2020 | all | | Up to +60 °C ambient temperature, derating I encoder power consumption and correction encoder resolution |
| 02.09.2020 | 1 | | Text correction |
| | 12 | 2.3.1 Mounting Position Horizontal 0-50 °C Ambient Temperature | $MTTF_D$ changed and text below corrected |
| | 13 | 2.3.2 Mounting Position Horizontal 0-60 °C Ambient Temperature | $MTTF_D$ changed and text below corrected |
| | 17 | 3.3 Miscellaneous | Text adapted for Standard |
| | 30 | 12 Important Notes for Two-channel Application | Text corrections |

| 04.11.2020 | 25 | 8 Mounting | Expansion functional ground connection |
|---|---|---|---|
| 05.03.2021 | | 3.4 Environmental Conditions | Standards added |
| 01.06.2021 | 16 | 3.2 Electrical Requirements | FW version SCPs added |
| 07.02.2022 | 13 | 2.3.2 Mounting Position Horizontal 0-60 °C Ambient Temperature | Parameters SCP 211/SCP 111-S added |
| 20.02.2023 | 15 | 3.2 Electrical Requirements | Info encoder supply added |
| 15.06.2023 | 15/16 | 3.4 Safety-Relevant Parameters | Specifications clarified |
| 05.12.2023 | 21 | 5.3 Miscellaneous | Mission time and Reaction time added |
| | 21 | 5.4 Environmental Conditions | Noise emissions added |
| | | 13 Hardware Class SNC021 | Chapter removed |