Safety Manual

safety - control - motion - interface

DS230 / DS240 Series

Safety Monitors for SinCos and Incremental Encoders / Sensors

Product features:

- Monitoring of underspeed, overspeed, standstill and direction of rotation
- SIL3 and PLe certification
- Safety functions equivalent to EN 61800-5-2
  (SS1, SS2, SOS, SLS, SDI, SSM, SLI, SBC, STO, SMS)
- Inputs for: 2 SinCos encoders
  2 RS422 incremental encoders
  2 HTL/PNP incremental encoders, proximity switches or
  2 - 4 control signals
- Outputs: 1 relay output 5 … 36 VDC (NO), (safety related)
  1 analog output 4 … 20 mA, (safety related)
  4 HTL control outputs, (safety related)
- Signal splitter: 1 SinCos Splitter Output, (safety related)
  1 RS422 Splitter Output, (safety related)
- Mounting to 35 mm top hat rail (according to EN 60715)
- USB interface for simple parametrization by the OS operator surface
- Optionally available: display and programming unit BG230 for parametrization and indication

Available Models:

- DS230: includes all inputs, all outputs and signal splitter
- DS236: includes all inputs, all outputs, but no signal splitter
- DS240: 1 SinCos input (SIL3/PLe), all control inputs, all outputs and signal splitter
- DS246: 1 SinCos input (SIL3/PLe), all control inputs, all outputs no signal splitter

motrona GmbH, Zeppelinstraße 16, DE - 78244 Gottmadingen, Tel. +49 (0) 7731 9332-0, Fax +49 (0) 7731 9332-30, info@motrona.com, www.motrona.com

Die deutsche Beschreibung ist verfügbar unter:
https://www.motrona.com/fileadmin/files/bedienungsanleitungen/Ds230_d.pdf

The English description is available at:
https://www.motrona.com/fileadmin/files/bedienungsanleitungen/Ds230_e.pdf

La description en français est disponible sur:
https://www.motrona.com/fileadmin/files/bedienungsanleitungen/Ds230_f.pdf

The operator software OS (freeware) is available at:
https://www.motrona.com/en/support/software.html

Version:	Description:
Ds23001a_oi/mb/07/14	First edition pre series
Ds23003a_oi/sn/ag/06/15	First edition series
Ds230_03b_oi/Oct-15/ag	Diverse adaptations and extensions
Ds230_04a_oi/Dez.-15/af-ag	Adaptations and extensions of parameters
Ds230_04b_oi/af-ag	Parameter description and list removed (separate manual). Extensive changes and extensions. New chapters added.
Ds230_04c_oi/af-ag	Chapter 11. Monitoring Functions supplemented Supplementation in chapters 6.4 / 6.6 / 6.7 / 6.11 New images : 1 x in chapter 8.2 and 2 x in 8.3
Ds230_04d_oi/af-ag	Changes in chapter "Runtime Test" Small corrections in chapter "Monitoring Functions" New chapter "Response times" added
Ds230_04e_oi/af/hk	Various adaptions and modifications Additional chapter for wiring of inputs, outputs, EDM function Extensions and amendments in chapter „Setup"
DS230_04f_oi/sn	Adaptations of safety characteristic data
Ds230_05a_oi/af	New parameters and functions
DS230_06coi/af-cn	New parameters and functions
Ds230_07a_oi/cf	New parameters and functions (Overlap, Delay, Switch Mode = 21, 22)
Ds230_07b_oi/mbo/05/21	Revised version

Important note about this document:

In addition to this manual, the separate parameter description **Ds230_07x_pd** must be used.

It contains a detailed description and a list of all parameters for setup and operation.

Further important manuals:

- OS Operating Manual
- OS User Installation Manual
- BG230 Operating Manual (optionally)

Table of Contents

1. Safety Instructions and Responsibility

1.1. General Safety Instructions

This operation manual is a significant component of the unit and includes important rules and hints about the installation, function and usage. Non-observance can result in damage and/or impairment of the functions to the unit or the machine or even in injury to persons using the equipment!

Please read the following instructions carefully before operating the device and observe all safety and warning instructions! Keep the manual for later use.

A pertinent qualification of the respective staff is a fundamental requirement in order to use these manual. The unit must be installed, configured, commissioned and serviced by a qualified electrician.

Liability exclusion: The manufacturer is not liable for personal injury and/or damage to property and for consequential damage, due to incorrect handling, installation, operation and maintaining. Further claims, due to errors in the operation manual as well as misinterpretations are excluded from liability.

In addition the manufacturer reserves the right to modify the hardware, software or operation manual at any time and without prior notice. Therefore, there might be minor differences between the unit and the descriptions in operation manual.

The raiser respectively positioner is exclusively responsible for the safety of the system and equipment where the unit will be integrated.

During installation, operation or maintenance all general and also all country- and application-specific safety rules and standards must be observed.

If the device is used in processes, where a failure or faulty operation could damage the system or injure persons, appropriate precautions to avoid such consequences must be taken.

1.2. Use according to the intended purpose

The unit is intended exclusively for use in industrial machines, constructions and systems. Non-conforming usage does not correspond to the provisions and lies within the sole responsibility of the user. The manufacturer is not liable for damages which are arisen through unsuitable and improper use. Please note that device may only be installed in proper form and used in a technically perfect condition in accordance to the technical Specifications. The device is not suitable for operation in explosion-proof areas or areas which are excluded by the EN 61010-1 standard.

1.3. Installation

The device is only allowed to be installed and operated within the permissible temperature range. Please ensure adequate ventilation and avoid all direct contact between the device and hot or aggressive gases and liquids.

Before installation or maintenance, the unit must be disconnected from all voltage-sources.
Further it must be ensured that no danger can arise by touching the disconnected voltage-sources.

Devices which are supplied by AC-voltages, must be connected exclusively by switches, respectively circuit-breakers with the low voltage network. The switch or circuit-breaker must be placed as near as possible to the device and further indicated as separator.

Incoming as well as outgoing wires and wires for extra low voltages (ELV) must be separated from dangerous electrical cables (SELV circuits) by using double resp. increased isolation.

All selected wires and isolations must be conforming to the provided voltage- and temperature-ranges. Further all country- and application-specific standards, which are relevant for structure, form and quality of the wires, must be ensured. Indications about the permissible wire cross-sections for wiring are described in the technical specifications.

Before first Start-up it must be ensured that all connections and wires are firmly seated and secured in the screw terminals. All (inclusively unused) terminals must be fastened by turning the relevant screws clockwise up to the stop.

Overvoltage at the connections must be limited to values in accordance to the overvoltage category II.

1.4. EMC Guidelines

All motrona devices are designed to provide high protection against electromagnetic interference. Nevertheless you must minimize the influence of electromagnetic noise to the device and all connected cables.

Therefore the following measures are mandatory for a successful installation and operation:

- Use shielded cables for all signal and control input and output lines.
- Cables for digital controls (digital I/O, relay outputs) must not exceed a length of 30 m and are allowed for in building operation only
- Use shield connection clamps to connect the cable shields properly to earth
- The wiring of the common ground lines must be star-shaped and common ground must be connected to earth at only one single point
- The device should be mounted in a metal enclosure with sufficient distance to sources of electromagnetic noise.
- Run signal and control cables apart from power lines and other cables emitting electromagnetic noise.

Please also refer to motrona manual "General Rules for Cabling, Grounding, Cabinet Assembly". You can download that manual by the link
https://www.motrona.com/en/support/general-certificates.html

1.5. Cleaning, Maintenance and Service Notes

To clean the front of the unit please use only a slightly damp (not wet!), soft cloth. For the rear no cleaning is necessary. For an unscheduled, individual cleaning of the rear the maintenance staff or assembler is self-responsible.

During normal operation no maintenance is necessary. In case of unexpected problems, failures or malfunctions the device must be shipped for back to the manufacturer for checking, adjustment or reparation. Unauthorized opening and repairing can have negative effects or failures to the protection-measures of the unit.

In case of continuous operation the DS unit must be switched on and off for at least 1 times a year.

2. Introduction

This series of speed monitors is suitable for safety-related monitoring tasks, e.g. over-speed, under-speed, standstill and direction of rotation. This SIL3/PLe certified generation of devices was developed to achieve functional safety by supporting a wide range of sensors and encoders in different combinations.

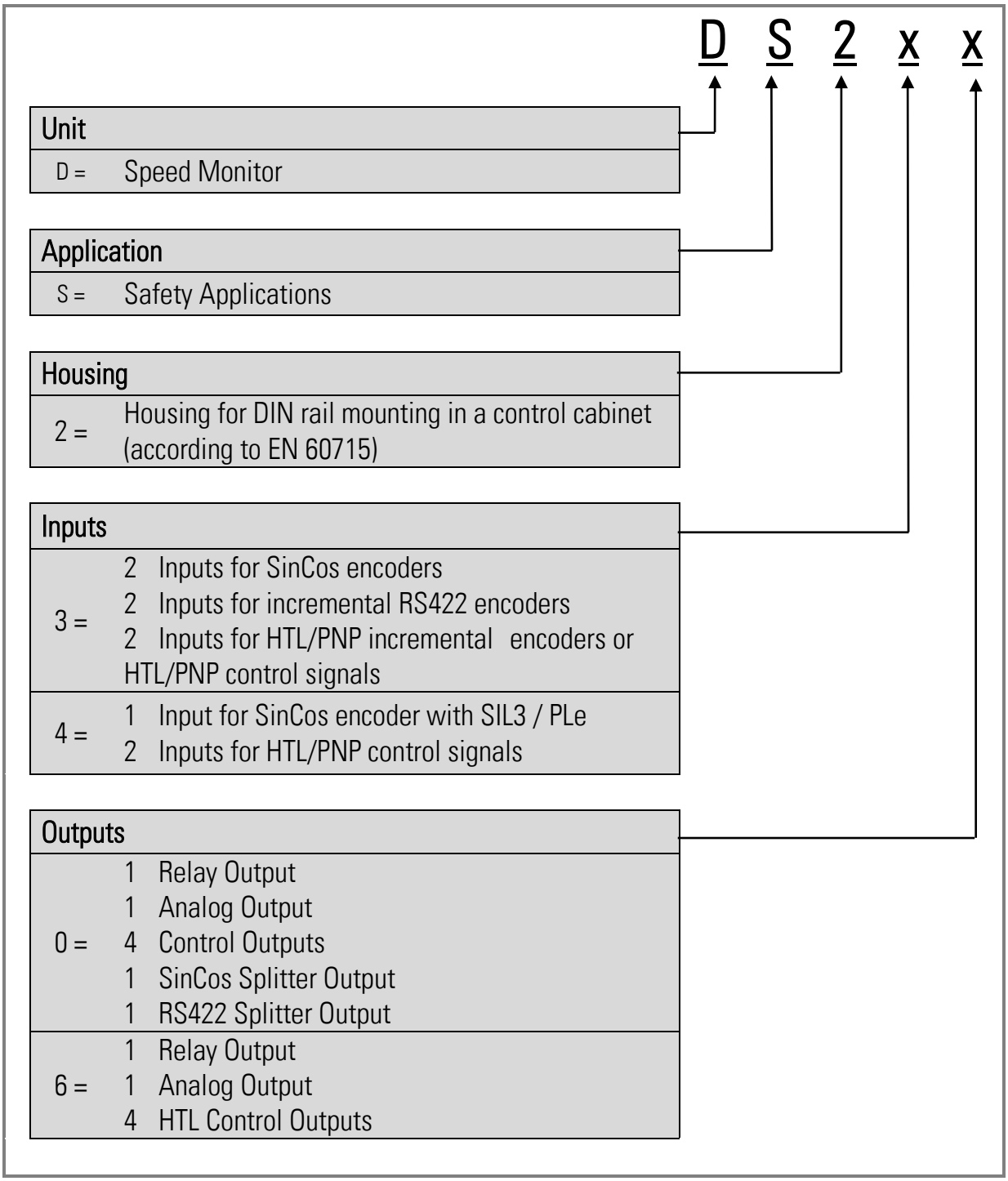
Due to parallel encoder inputs these devices are perfectly suitable for the retrofitting of existing plants and machines which are using "non-safe" sensors. This offers a great opportunity to save costs for expensive and certified sensors. Also the costs for new installations and adjustments can be reduced significantly by using the existing components and wiring.

Typical examples are centrifuges, cranes, wind power or hauling plants.

Special features:

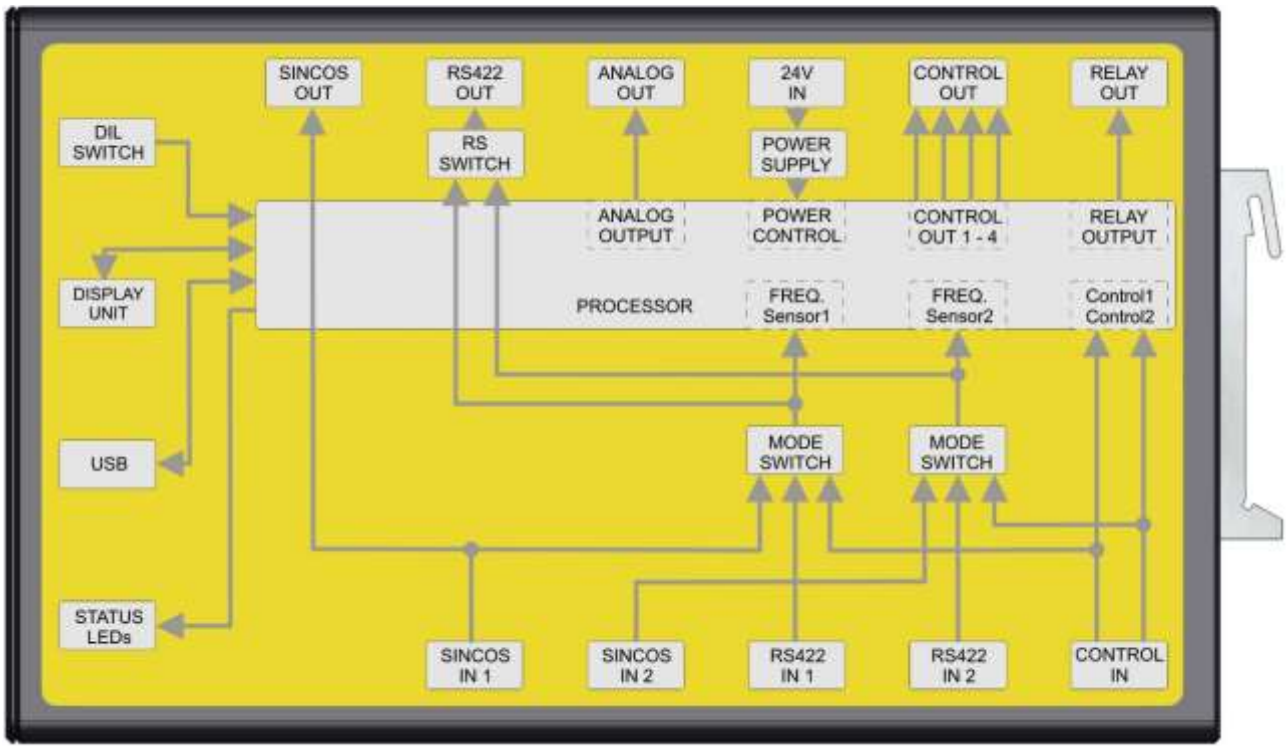
- Additionally suitable for use with setup operations,
  e. g. for manual settings in plants with open protection doors and reduced speed
- All models are safety-related and dually certified according to
  EN 61508, EN 62061 / SIL3 and EN ISO 13849-1 Cat. 3 / PLe,
  even when using "non-safety-related" standard sensors or encoders
- Generally, the use of 2 sensors / encoders is required because only then SIL3 / PLe can be achieved. The only exception is the use of a SIL3 PLe certified SinCos encoder.
- Wide input frequency range and fast response time
- Very versatile range of possible monitoring functions
- It is recommended to setup the DS unit via the front USB port by using a PC and the OS operator software.
- The final Safety Integration Level (SIL) results from the selected configuration and from external components connected to the unit.
- The additional display and operating unit BG230 (optional accessory, not included in the delivery) is used to display the encoder frequencies in converted operator units and further for visual monitoring of the DS unit. The BG230 can also be used for a simple configuration as well as for setup tasks.

3. Available Models



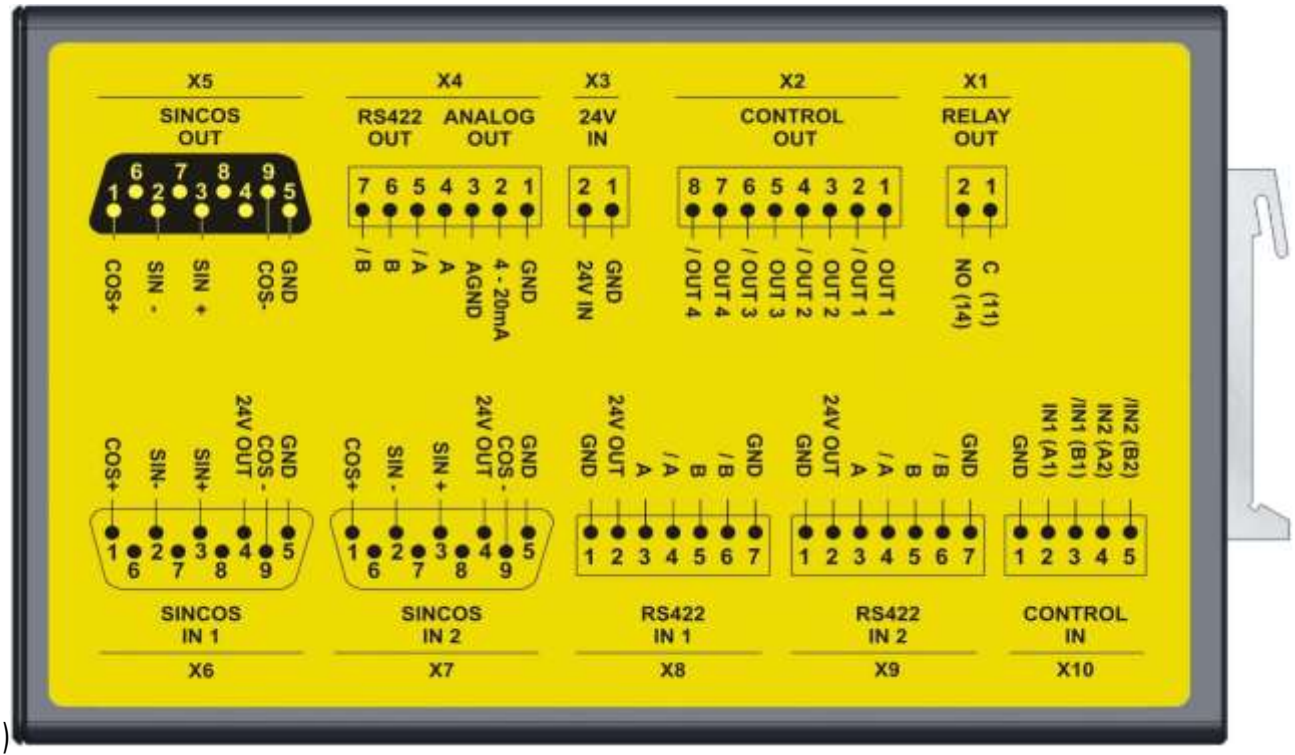
4. Block Diagrams and Connections

4.1. DS230 Block Diagram



4.2. DS230 Connections

(The figure shows the available ports)



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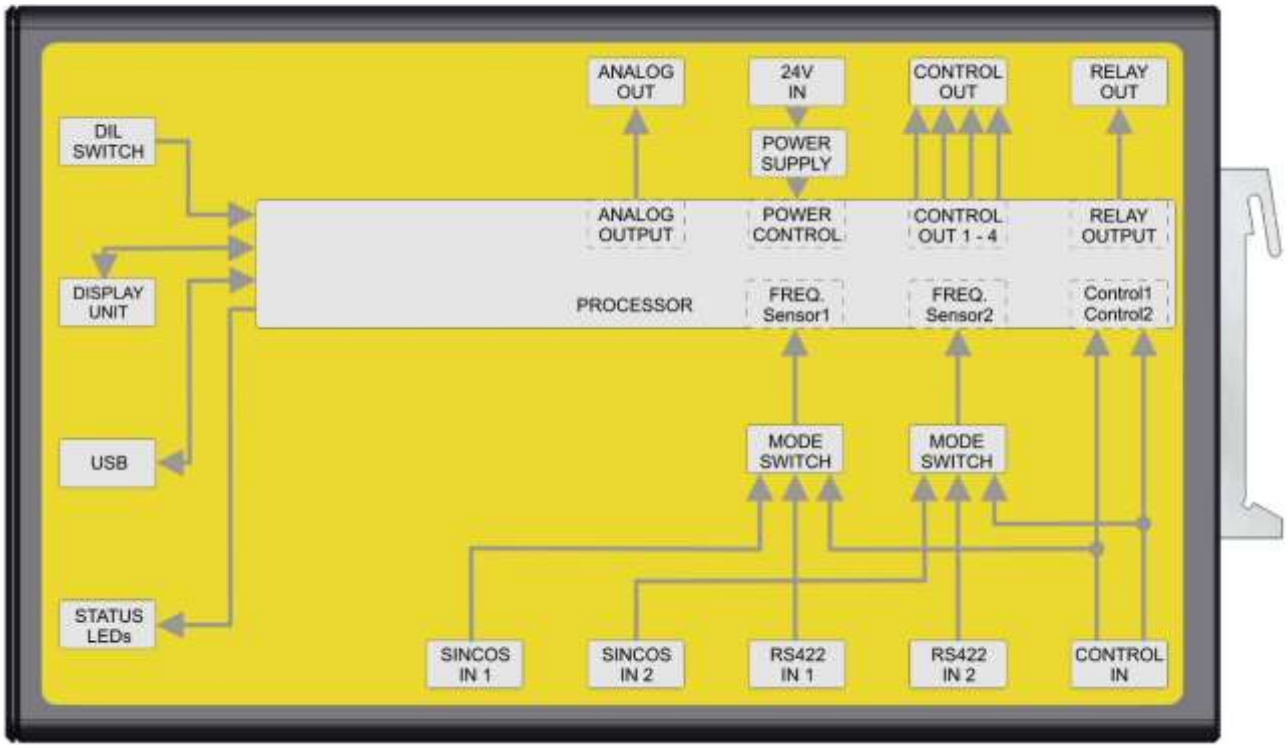
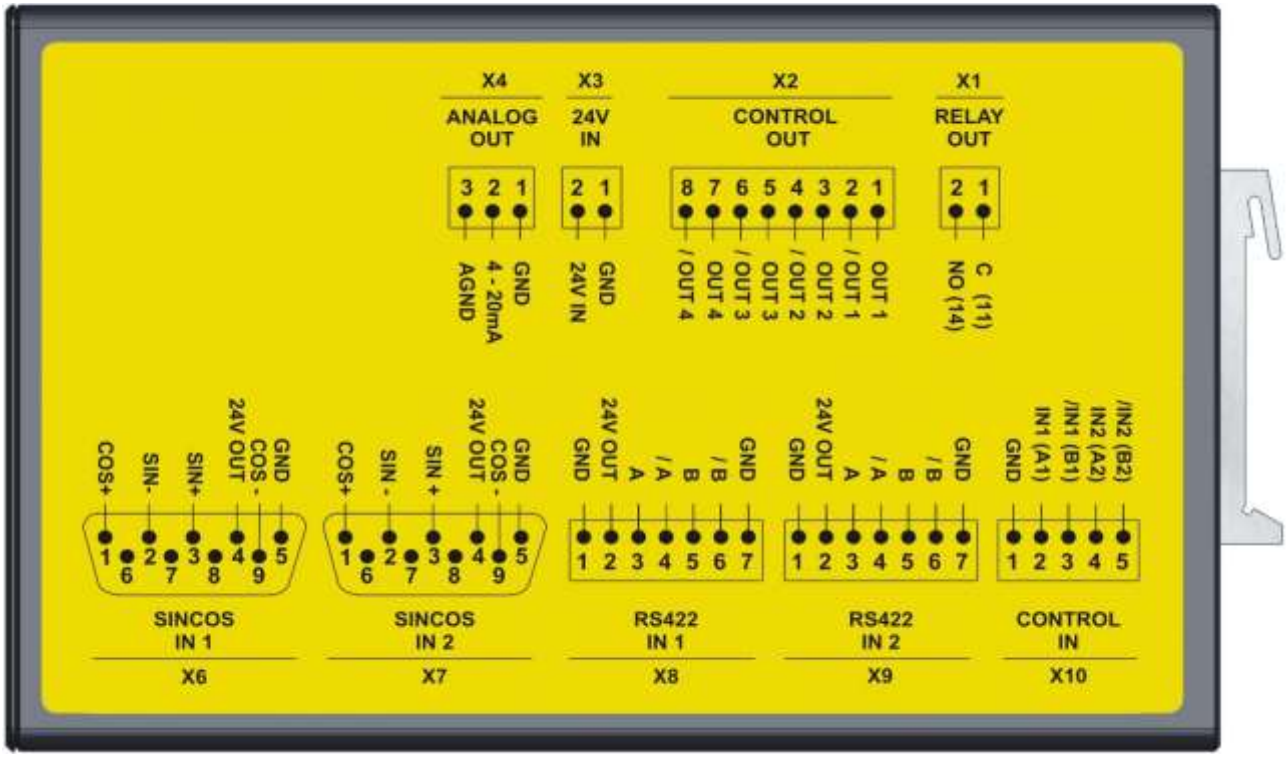
4.3. DS236 Block Diagram

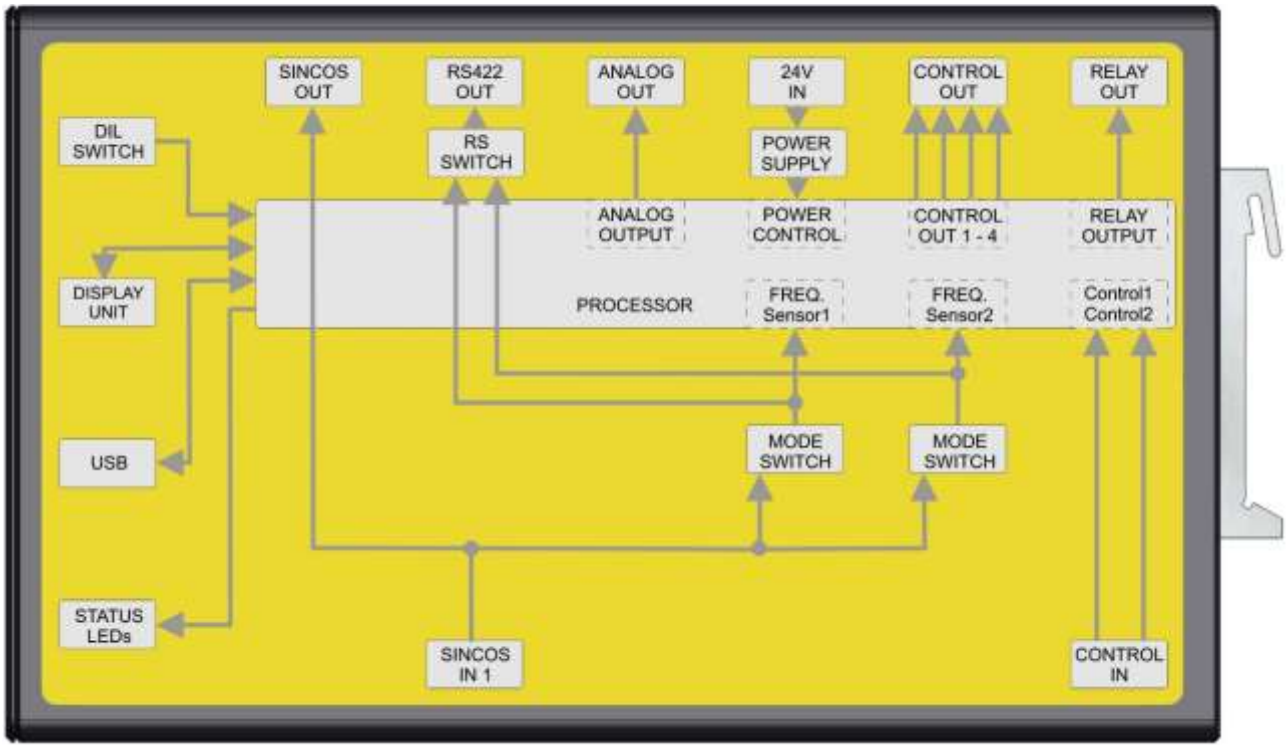


4.4. DS236 Connections

(The figure shows the available ports)

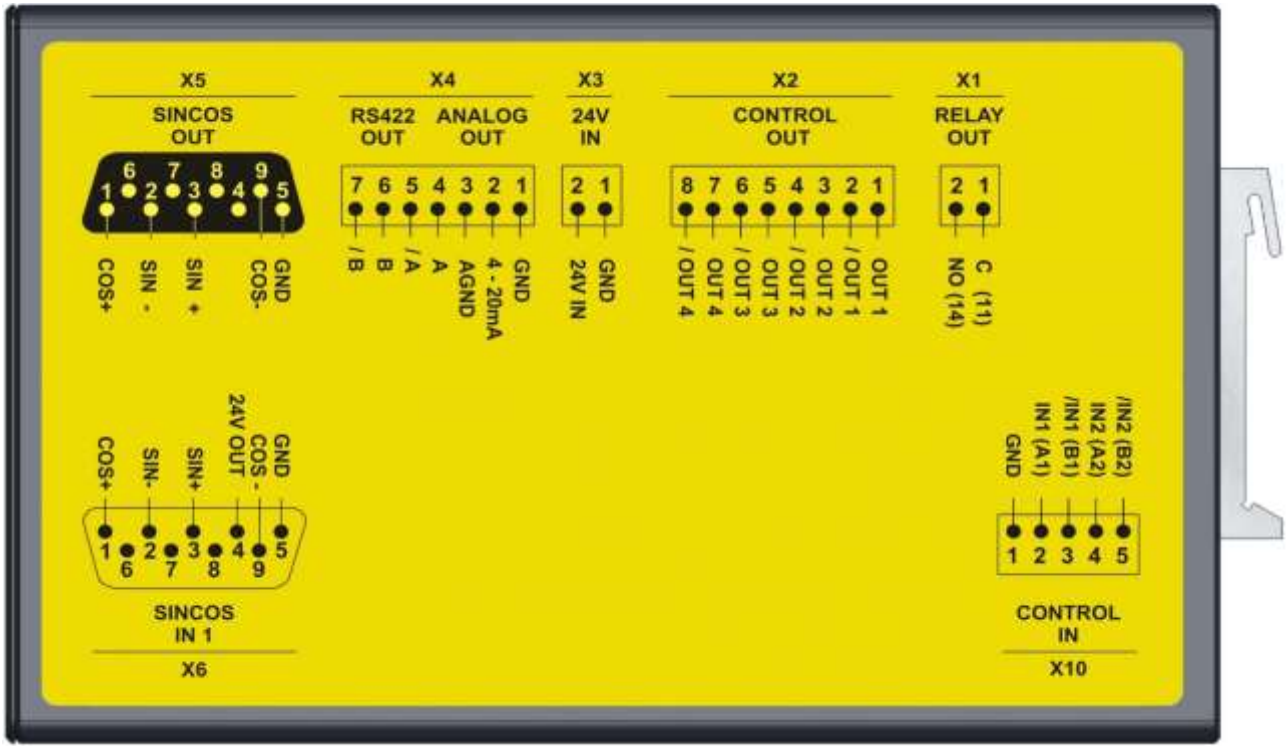


4.5. DS240 Block Diagram

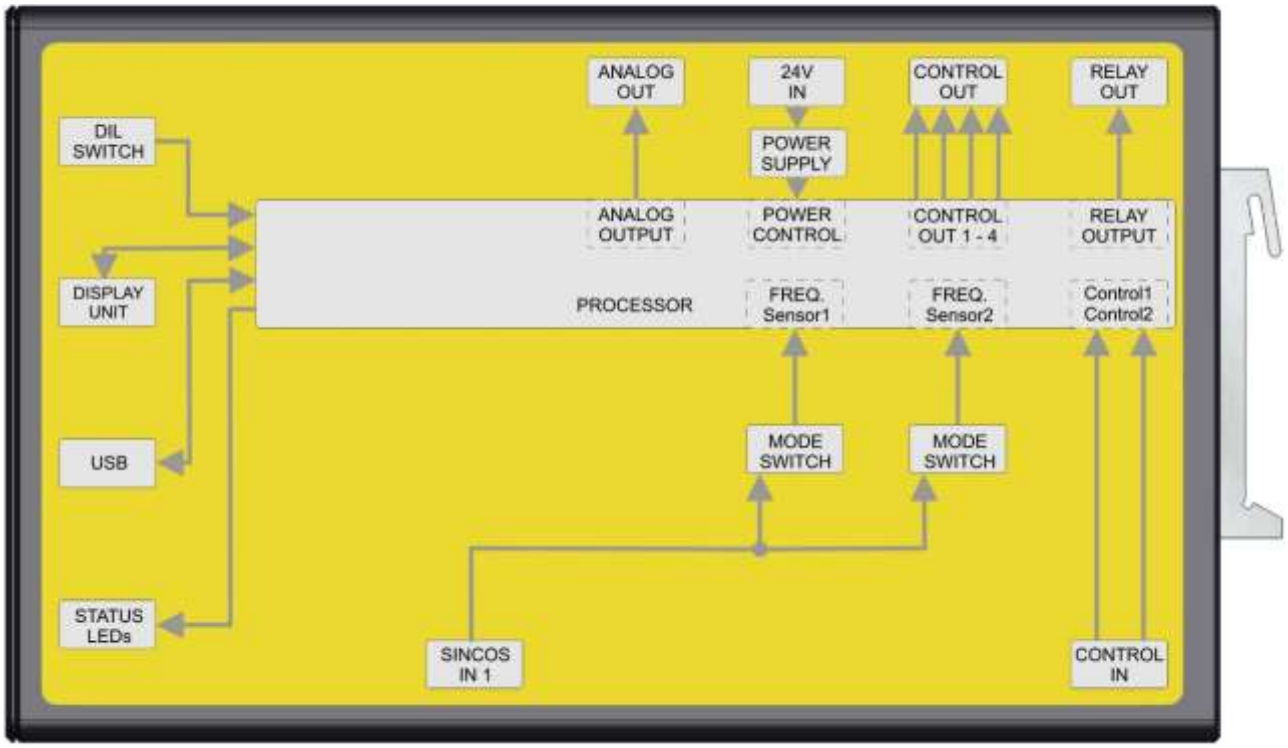


4.6. DS240 Connections

(The figure shows the available ports)

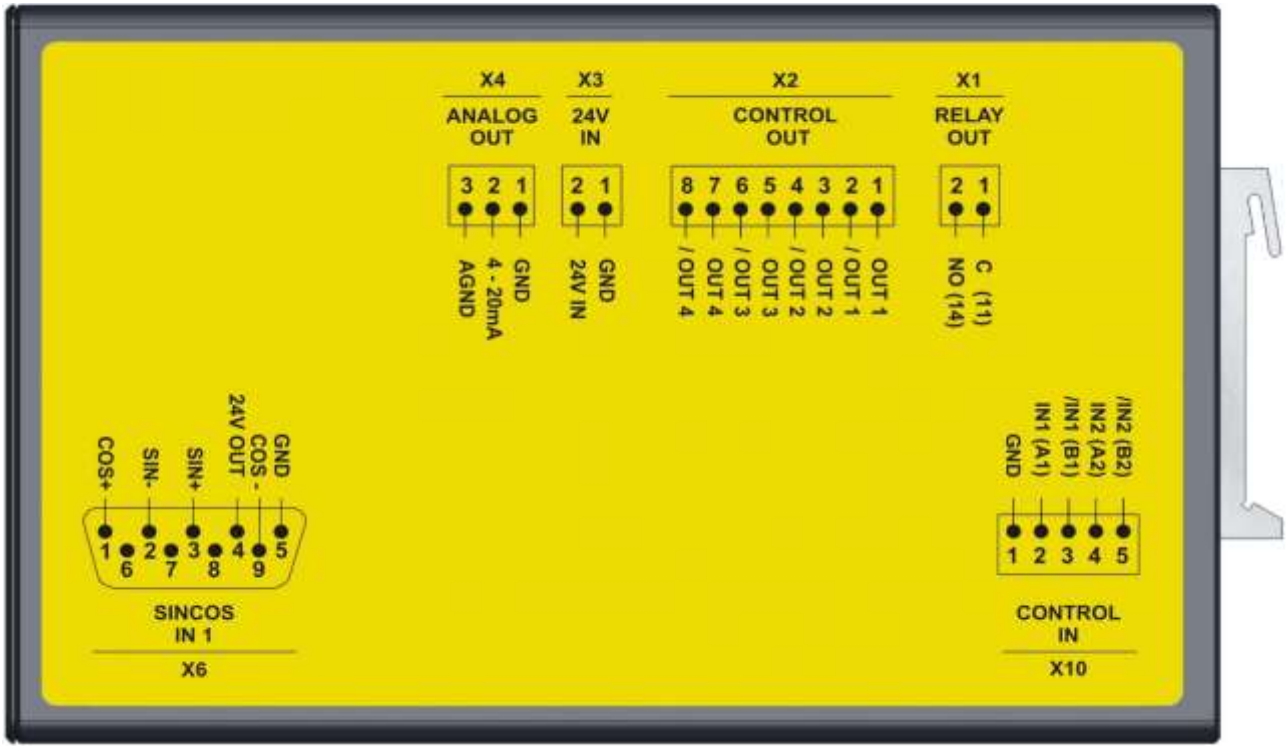


4.7. DS246 Block Diagram



4.8. DS246 Connections

(The figure shows the available ports)



5. Description of Connections

This chapter describes only the electrical connections and their general function.

Name	Description see chapter
X1 | RELAY OUT	0 Relay Output
X2 | CONTROL OUT	0 Control Outputs
X3 | 24V IN	0 Power Supply
X4 | ANALOG OUT	0 Analog-Output 4 to 20 mA
X4 | RS 422 OUT	0 RS422-Splitter-Output
X5 | SINCOS OUT	0 SinCos-Splitter-Output
X6 | SINCOS IN 1	0 SinCos Encoder Inputs
X7 | SINCOS IN 2	0 SinCos Encoder Inputs
X8 | RS422 IN 1	0 RS422 Encoder Inputs
X9 | RS422 IN 2	0 RS422 Encoder Inputs
X10 | CONTROL IN	5.5 HTL Encoder Inputs / Control Inputs
X11	0 BG230 Operator Interface
X12	5.13 USB Interface for the OS Operator Surface
S1	0 DIL Switch
ERROR - ON	0 LEDs / Status Indication

The connection to the outputs is only safe when the follower unit is able to detect the fault status of each output and when the outputs are configured accordingly.

In order to prevent simultaneous damages to the cables by external influences, the encoder resp. sensor lines must be kept physically apart from each other.

5.1. Power Supply

If the unit is connected to a DC power supply network which also supplies further devices or systems, it must be ensured that no voltages ≥ 60 V can occur at the terminals [X3:1] und [X3:2].

If this cannot be ensured, the unit must be supplied by a separate DC power pack, which must not be connected to further devices or systems.

The requirements for both kinds of power supplies are:

- Nominal voltage range from 18 … 30 VDC
- Ripple < 10% @ 24 V
- External fuse (2.5 A, medium time lag) required

A separate power pack must cover the following requirements:

- The switch-on current of the unit is not higher than 2.5 A
- The consumption of the unit is approx. 23 W (at permissible load and without short-circuit)

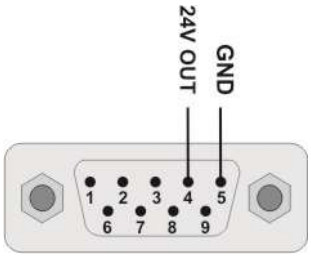
The 18 … 30 VDC power supply must be connected via the pluggable 2-position screw terminal strip [X3]. The power supply input is protected by an internal reverse polarity protection.

pluggable 2-position screw terminal [X3]

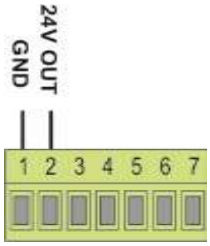
- The DC input must be protected by an external fuse (type and value see technical specifications).
- The DS unit has no internal galvanic isolation, thus all GNDs are interconnected. Please avoid any GND loops to the power supply input [X3].
- Even with use of a SIL3 certified power supply (U_{FAIL} < 60 V), an external fuse must be installed.

5.2. Encoder Supply

The unit offers an auxiliary voltage output for separate supply of the encoders or sensors in use. The encoder supply must be taken directly from the safety monitor, or via relay contact when using an indirect power supply.



Encoder supply: SinCos inputs [X6] [X7]



Encoder supply: RS422 inputs [X8] [X9]
HTL encoders or sensors must also be connected to the encoder supply terminals of the RS422 inputs

The maximum load of the encoder supply is 200 mA per channel (Sensor 1 and Sensor 2). The unit provides an auxiliary encoder supply for each sensor channel (HTL encoders will be supplied by the encoder supply of the RS422 inputs). The level of the supply voltage is approximately by 2 V lower than the 18 … 30 VDC power supply at terminal [X3].

Supply	SinCos inputs	RS422 inputs	HTL inputs
Sensor 1	[X6:4] [X6:5]	[X8:1] [X8:2]	[X8:1] [X8:2]
Sensor 2	[X7:4] [X7:5]	[X9:1] [X9:2]	[X9:1] [X9:2]

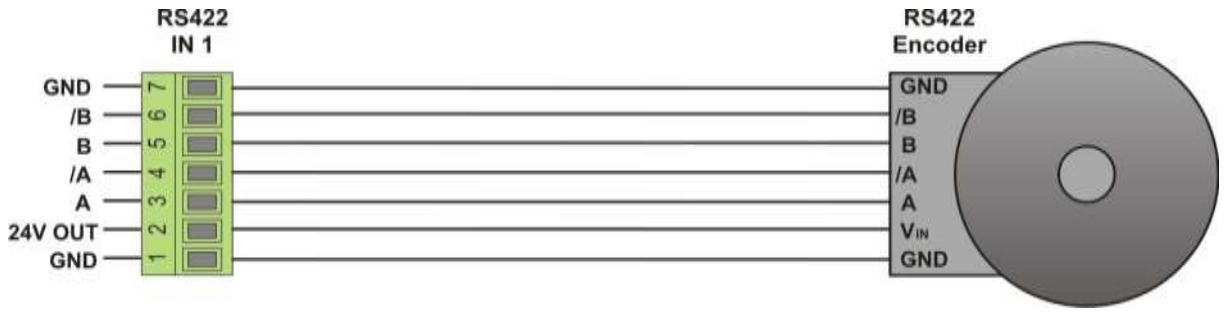
When powering up the encoder supply, the maximum input current of the safety unit could be exceeded, depending on the encoders in use. In this case, the encoder supply would not be enabled and an error appears.

In case of such problems, or if another voltage level is required, the encoder supply can be switched on from an external voltage source via remote relay. In this case, it is mandatory to energize the relay from the internal encoder supply of the DS unit.

- In case of a direct encoder supply it is mandatory to operate the encoders with the auxiliary voltage from the unit.
- Indirect encoder supply must in any case be carried out via relay, energized by the auxiliary voltage of the DS unit.

5.2.1. Direct Encoder Supply

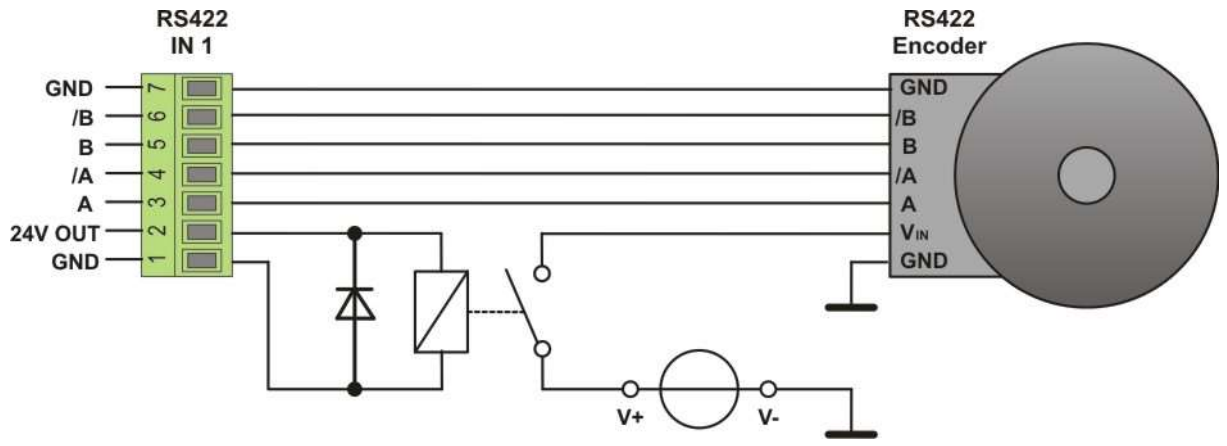
With direct encoder supply, the encoder must be connected as shown in the figure below:



Example of direct encoder supply

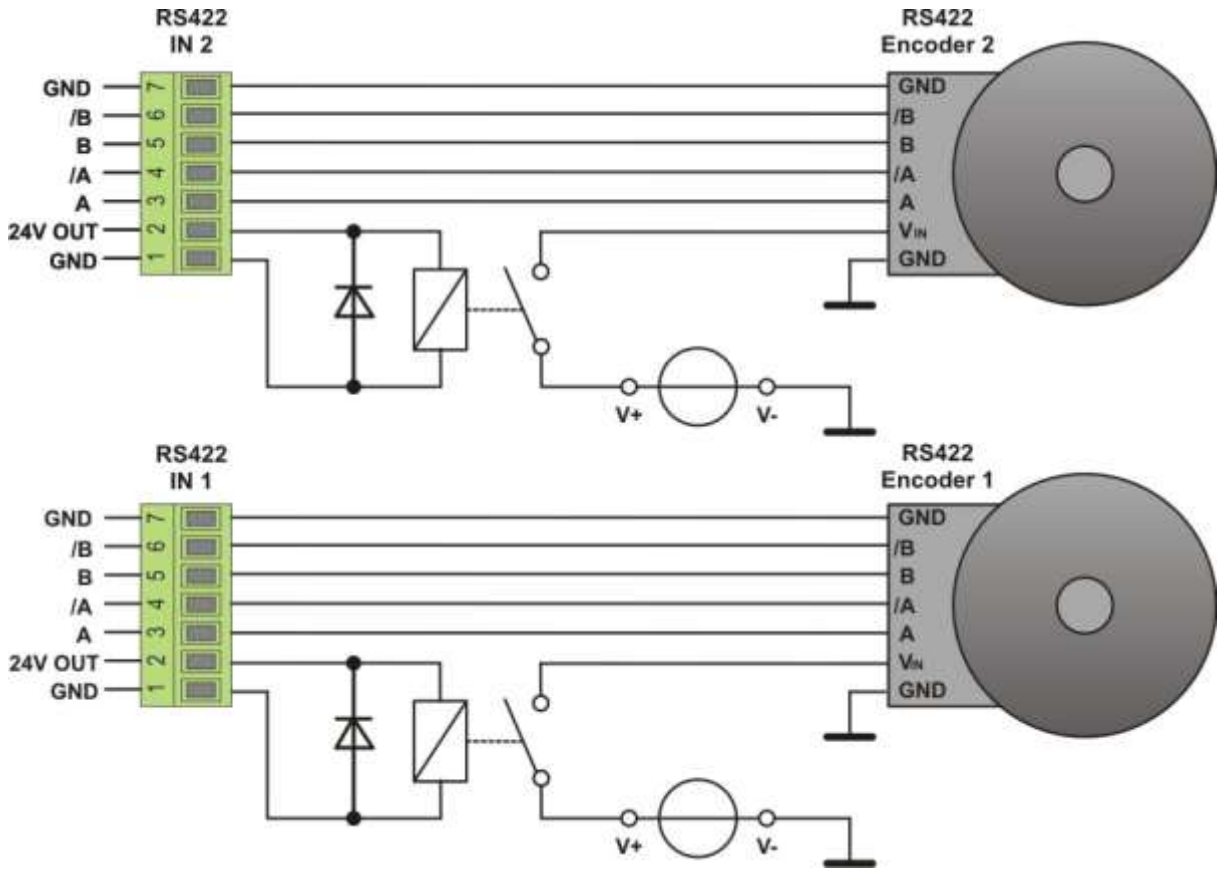
5.2.2. Indirect Encoder Supply

Indirect encoder supply must necessarily, and each separately, be switched on by use of a relay, energized with the auxiliary voltage of the unit. This is necessary, because no encoder signals must be applied to the safety monitor before the unit has successfully completed its initialization and self-test.



Example of indirect encoder supply (1 encoder is switched via 1 relay)

Continuation “External Encoder Supply”



Example of indirect encoder supply (2 encoders are switched via 2 relays)

- Indirect encoder supply must necessarily and each separately be switched on via relay, energized by the auxiliary voltage of the unit.
- In case of indirect supply of both encoders, two independent supply sources and two separate relays must be used.

5.3. SinCos Encoder Inputs

The unit is suitable for operation with SinCos sensors or encoders using differential sine-cosine signal outputs of 1 Vpp and 2.5 V DC offset.

- DS23x: Parameter "Operational Mode" must be set to 0, 1, 2 or 6. The SinCos encoder can be connected by one of the two or by both 9-pin SUB-D connectors [X6] and [X7].
- DS24x: Parameter "Operational Mode" must be set to 0.
  Connections use connector [X6] only.

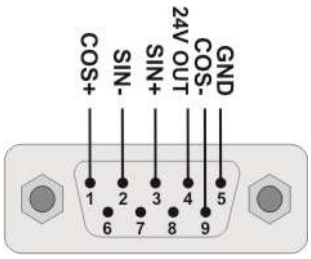
It is mandatory to wire all available signal lines (SIN+, SIN-, COS+ and COS-).

The internal SinCos signal monitor checks the offset range of the signals as well as the Lissajous figure resulting from the signals.

There is no option for evaluating any zero or index pulses.

All input lines are already terminated by internal 120 Ohm load resistors.

The SinCos encoder must use the corresponding encoder supply at pins 4 and 5 of the connector.



Male SUB-D connectors [X6], [X7]

Activating SinCos error is preferable to de-activating SinCos Error to avoid any subsequent errors. The parameter SIN Err TimeX can suppress SinCos error in 20 ms intervals. Disturbed SinCos signals can produce SinCos errors and frequency errors.

With models DS23x only:

In following cases you must switch off the SinCos error detection in order to avoid continuous SinCos error indications:

- with use of SinCos encoders providing a different DC offset than specified
- with use of encoders providing a sine output and a sine-reference-output instead of two sine and two cosine signals

In these cases the encoders are suitable for frequency evaluation only, but not for signal forwarding, i.e. the SinCos output cannot be used.

5.4. RS422 Encoder Inputs

(DS230 and DS236 only)

If parameter "Operational Mode" is set to 7, 8 or 9, the unit will accept signals from incremental encoders with complementary TTL or differential RS422 levels.

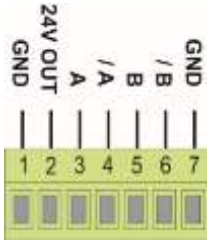
Incremental encoders must be connected by one or both of the pluggable 7-pin screw terminals [X8] and [X9].

The RS422 input channels (A and /A resp. B and /B) are internally terminated by a dynamic terminating circuit (220 pF / 120 Ohm).

It is mandatory to connect up all signal lines (A, /A, B and /B).

There is no option for evaluation of any existing zero pulses (Z / Z).

It is mandatory to supply the RS422 encoder from terminals 1 and 2 of the respective terminal strip.



Pluggable 7-position screw terminal [X8], [X9]

5.5. HTL Encoder Inputs / Control Inputs

Screw terminal strip [X10 | CONTROL IN] provides 2 - 4 inputs for signals with HTL level and PNP switching characteristics.

Depending on the setting of parameter "Operational Mode" the control inputs [X10 | CONTROL IN] can be configured as frequency inputs or as control inputs:

Frequency input for HTL encoders (A / B / 90°):

Sensor 1	[X10 | CONTROL IN]	incremental HTL encoder	[X10:2] [X10:3]	channel A channel B
Sensor 2	[X10 | CONTROL IN]	incremental HTL encoder	[X10:4] [X10:5]	channel A channel B

HTL encoders must be supplied by the encoder supply of the RS422 inputs.
Please observe the permissible frequency ranges (see Technical Specifications).

Frequency input for HTL encoders (A) or a proximity switch:

Sensor 1	[X10 | CONTROL IN]	incremental HTL encoder	[X10:2] [X10:3]	channel A unconnected / direction signal
Sensor 2	[X10 | CONTROL IN]	incremental HTL encoder	[X10:4] [X10:5]	channel A unconnected / direction signal

The inputs [X10:3] resp. [X10:5] may remain unconnected (internal pull-down) or can be used for a static direction signal. HTL encoders must be supplied by the encoder supply of the RS422 inputs. Please observe the permissible frequency ranges (see Technical Specifications).

Two inverse control inputs for HTL commands:

Signal pair 1	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:2] [X10:3]	control signal 1 inverse control signal 1
Signal pair 2	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:4] [X10:5]	control signal 2 inverse control signal 2

Strictly always the inverse signals must be applied to the inverted inputs. Any other signal conditions are illegal and will be detected as an error. Please use the separate parameter description to find more information about the control inputs. The configuration of the inputs will affect the Safety Integration Level (SIL).

Two homogenous control inputs for HTL commands:

Signal pair 1	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:2] [X10:3]	control signal 1 homogenous control signal 1
Signal pair 2	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:4] [X10:5]	control signal 2 homogenous control signal 2

Strictly the inverted input must always receive the same signal as the non-inverted input. Any other signal conditions are illegal and will be detected as an error. Please use the separate parameter description to find more information about the control inputs. The configuration of the inputs will affect the Safety Integration Level (SIL).

Four single control inputs HTL commands:

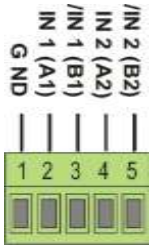
Signal 1	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:2]	control signal 1
Signal 2	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:3]	control signal 2
Signal 3	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:4]	control signal 3
Signal 4	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:5]	control signal 4

Please use the separate parameter description to find more information about the control inputs. The configuration of the inputs will affect the Safety Integration Level (SIL).

One homogenous/inverse control input and two single control inputs for HTL commands:

Signal pair 1	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:2] [X10:3]	control signal 1 homogenous/inverse signal 1
Signal 2	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:4]	control signal 2
Signal 3	[X10 | CONTROL IN]	HTL/PNP control signal	[X10:5]	control signal 3

Strictly always the homogenous or inverse signal must be applied to the inverted input. Any other signal conditions are illegal and will be detected as an error. Please use the separate parameter description to find more information about the control inputs. The configuration of the inputs will affect the Safety Integration Level (SIL).



Pluggable 5-pin screw terminal [X10]

- It does not make sense to configure the unit for connection of 2 HTL encoders simultaneously, since then no more inputs for external commands would be available.
- With DS24x units, all 4 channels can be used as control-inputs for external commands.
- When using a single-channel encoder, the associated second input is not suitable
- Transitionally, on some housing prints IN1… IN4 can be found as designation for the CONTROL IN signals of terminal X10.
  The correspondences of these terms are:
  IN1 = IN1, / IN1 = IN2, IN2 = IN3 and / IN2 = IN4.

5.6. SinCos-Splitter-Output

(DS230 and DS240 only)

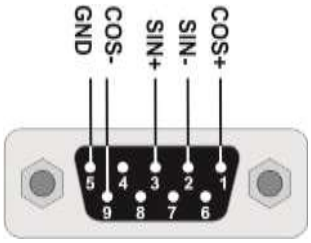
DS230 and DS240 units provide a safety-related SinCos-Splitter-Output. Depending on the setting of parameter "Operational Mode" (0, 1, 2 or 6), the integrated splitter function allows to reproduce the signal of input terminal [X6 | SINCOS IN1] to the female 9-pin SUB-D connector [X5 | SINCOS OUT]. Thus the encoder signal connected to [X6 | SINCOS IN1] can be processed by a further target device.

The signal delay time between SinCos input and SinCos output is approx. 200 ns.

The channels SIN+ and SIN- resp. COS+ and COS- must be terminated by 120 Ohm load resistors on site of the target device.

In case of errors, the DC-offset of the SinCos output will be shifted in order to signalize the error condition to the target device.

The connection to the SinCos splitter output is only safe, when the follower unit includes a SinCos monitoring system which can detect offset errors.



Female SUB-D Connector [X5]

- It is mandatory to terminate the SIN+ and SIN- resp. COS+ and COS- channels by a 120 Ohm resistor on the target device.
- SinCos input signals must consist of two sine-shaped and two cosine-shaped signal pairs.
- On the output site the DC offset value is typically 2.5 V, fully independent of the input offset.
- A SinCos error at the input can also produce an error at the SinCos output.

5.7. RS422-Splitter-Output

(DS230 and DS240 only)

DS230 and DS240 units provide a safety-related RS422-Splitter-Output.

The monitor evaluates two frequency channels (Sensor 1 and Sensor 2), which are determined by "Operational Mode".

The splitter-output allows reproducing the input frequency of Sensor 1 or Sensor 2.

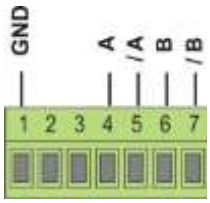
Regardless of the input signal (SinCos or HTL), the output [X4 | RS422 OUT] always delivers incremental RS422 square-wave signals.

The signal delay between the RS422 input and the RS422 output is approx. 600 ns.

In case of an error, no more incremental signals will be available at the RS422 output (Tri-State, internally with 1 kOhm pull-down resistors).

Connections to the RS422 Splitter output are only safe if the following device is capable to detect the error state of the monitor.

SinCos input signals are reproduced as 1:1 square wave output.



Pluggable 7-pin screw terminal [X4]

Screw terminal [X4] provides 7 connections:

[X4 | ANALOG OUT]	analog output	[X4:1-3]
[X4 | RS422 OUT]	RS422 output	[X4:4-7]

- When using the converted SinCos input as a RS422 output, a SinCos error at the input can also produce an error at the RS422 output.

5.8. Analog-Output 4 to 20 mA

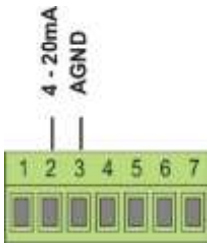
A safety-related analog output is available at terminal strip [X4]. The current output is freely scalable by setting parameters "Analog Start" and "Analog End". It delivers an output signal, which is proportional to one of the two input frequencies. Where the analog output is not used, terminals [X4:2] and [X4:3] must be bridged. An open analog output (e.g. wire fracture) will produce an error status.

During normal operation, the output moves in a proportional range between 4 and 20 mA.
In case of errors, the analog output delivers 0 mA.

The connection to the analog output is only safe if the follower unit is capable to detect the error state of the safety monitor.

With versions DS230 / DS240, screw terminal [X4] provides 7 connections:

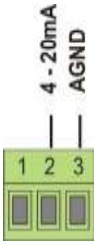
[X4 | ANALOG OUT]	analog output	[X4:2-3]
[X4 | RS422 OUT]	RS422 output	[X4:4-7]



Pluggable 7-position screw terminal [X4] at DS230/DS240

With unit versions DS236 / DS246, screw terminal [X4] provides only 3 connections:

[X4 | ANALOG OUT]	analog output	[X4:2-3]
[X4 | RS422 OUT]	not available!	



Pluggable 3-position screw terminal [X4] at DS236/DS246

- In case of an unused analog output [X4:2] and [X4:3] must be bridged.
- An open analog output (e.g. wire fracture) will produce an error status.

5.9. Control Outputs

Four inverse/homogeneous HTL control outputs are available at the screw terminal [X2 | CONTROL OUT].

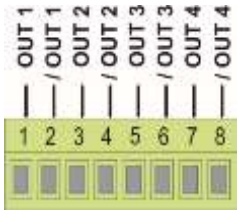
The switching points and switching conditions can be programmed by parameters.

In HIGH state, the output level is approximately 2 V lower than the supply voltage at terminal [X3 | 24V IN]. The outputs are short-circuit proof push-pull outputs. When switching inductive loads, additional external suppression measures are recommended.

In case of errors all outputs go to LOW state (no more inversion).

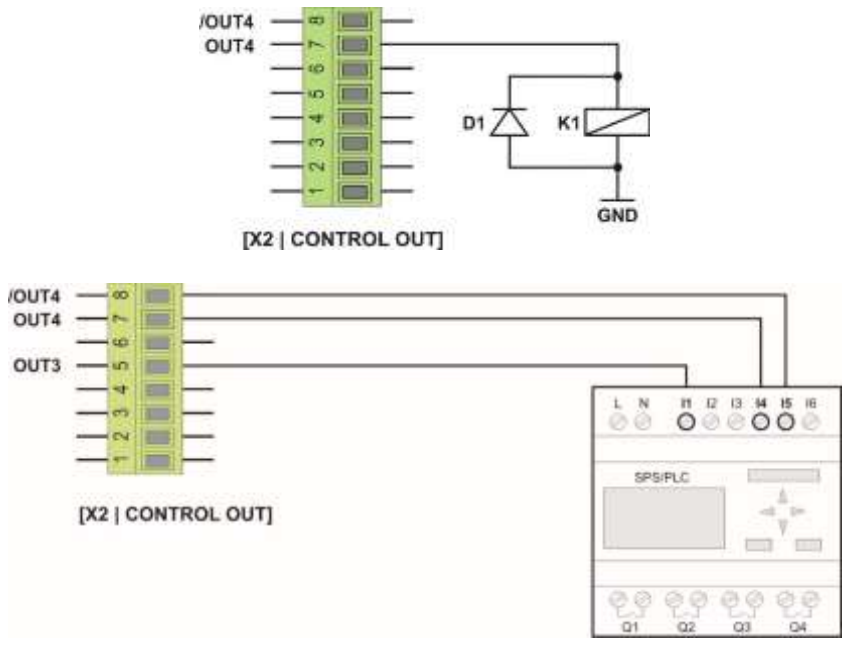
Connections to the analog output are only safe if the target device is able to detect the error state of the safety monitor.

The output configuration will affect the Safety Integrity Level (SIL).



Pluggable 8-position screw terminal [X2]

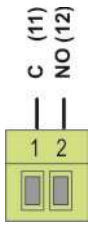
Wiring example:



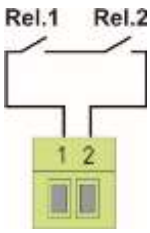
5.10. Relay Output

The safety-related relay output consists of two independent relays with forcibly guided contacts. The normally open contacts of the two relays (NO) are internally connected in series. This series-relay-contact is accessible by the 2-pin screw terminal [X1 | RELAY OUT], for integration into a Safety Circuit.

- The contacts are only closed during normal and disturbance-free operation. They will open to a safety state in case of errors or when the programmed switching condition occurs.
- In the de-energized state of the unit the contacts are also open.
- Switching points and switching conditions can be set by the corresponding parameters.
- An internal, forcibly guided opener of the relay is used to monitor the relay status by the unit itself.
- In case of an error the contact will change to the open and safe switching state.



Pluggable 2-position screw terminal [X1]



Internal connection [X1]

- The operator is responsible to ensure a safe state of all relevant parts and components of the equipment, whenever the relay contact is open.
- The target unit must be able to evaluate edges, in order to determine dynamical conditions of the relay output, too.
- With frequencies close to the switching point, relay bouncing may occur in consequence of variation of the frequency measurement. To prevent this, a hysteresis should be set.
- If also short overshoots of the switching point should be detected, a lock function should be set to the output.

5.11. DIL Switch

A 3-position DIL switch [S1] is located at the front of the unit
(only accessible when no display and programming unit BG230 is connected).

3-pos DIL switch [S1]

The DIL switch is used to set the operation state of the monitor:

DIL1	DIL3	Status	LED
ON	ON	Normal Operation	Off (lights up permanently at error state)
ON	OFF	Programming / Test - Mode	Flashes slowly (lights up permanently at error state)
OFF	ON	Factory Settings	Flashes slowly (lights up permanently at error state)
OFF	OFF	Factory Settings	Flashes slowly (lights up permanently at error state)

DIL2	Status	Operational readiness
ON	Normal Operation	Ready for operation approx. 2 s after power up
OFF	Self-Test Message	Ready for operation approx. 8 s after power up

- The Programming Mode (DIL switch) is used for Start-up and testing
- All DIL switch sliders must be set to „ON" after Start-up and testing
- After Start-up the DIL switch sliders should be protected against manipulation (e. g. by covering with an adhesive tape)
- Normal operation is only permitted when the yellow LED is permanently off
- The safety function of the unit cannot be guaranteed before the commissioning has been completed.

5.12. BG230 Operator Interface

On the front site the unit provides a serial interface for communication with BG230 operator units (optional accessory), allowing display and parameter setting.

8-pin female connector [X11]

The BG230 unit and the safety monitor are connected by plugging the BG230 directly onto the female 8-pin connector [X11] at the front.

This operator unit is intended for display of the encoder signals (in user units) and for visual monitoring of the DS unit. Although parameters can be set or changed by using the BG230, it is recommended to use the OS PC software for Start-up and commissioning purpose.

The female connector [X11] is reserved for exclusive use with a BG230 unit.

5.13. USB Interface for the OS Operator Surface

For communication between the unit and a PC or a superordinate controller, a virtual COM port is accessible at the USB connector. A standard USB-cable with a Type B connector is used for connection. This USB cable is available as an option. The USB port serves for PC setup of the DS monitors.

USB type B

A separate manual is available describing the installation procedure of the USB driver
(see page 2).

5.14. LEDs / Status Indication

Two status LEDs are located on the front of the unit.
The green one is marked as [ON] and the yellow one as [ERROR].

Status LEDs

The green status LED uses the following conditions:

Green LED	Status
OFF	Power off (no power supply voltage)
ON	Power on (power supply voltage ok)

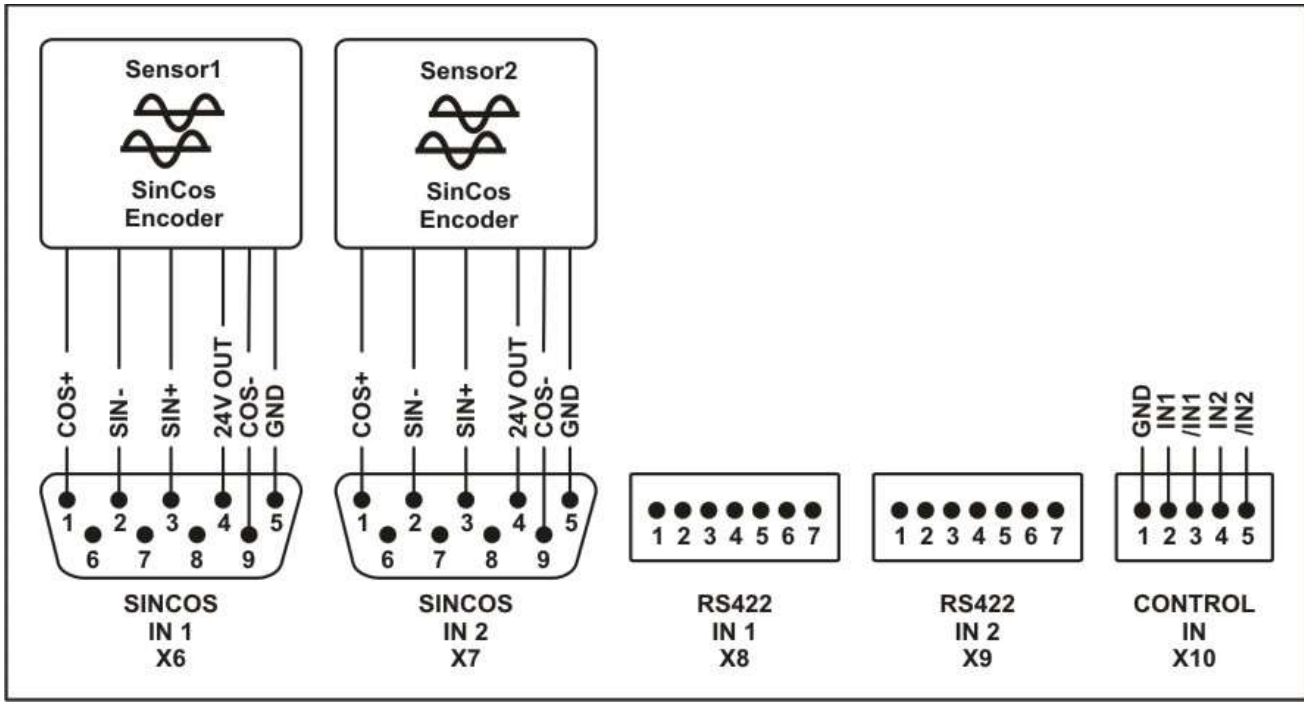
The yellow status LED uses the following conditions:

Yellow LED	Status
OFF	Normal operation, self-test successfully completed, no error messages
ON	During the self-test or with error state
Flashes slowly	Factory Settings or Programming / Test - Mode

6. Operational Modes

6.1. Application: 2 SinCos Encoders

Device	DS23x		
Operational Mode	0		
Sensor 1	[X6 | SINCOS IN 1]	SinCos encoder	SIN+, SIN-, COS+, COS-
Sensor 2	[X7 | SINCOS IN 2]	SinCos encoder	SIN+, SIN-, COS+, COS-
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	2 - 4 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe achievable (see below) Standstill → SIL3 / PLe achievable (see below)		



This mode is used to evaluate a dual channel system equipped with two SinCos sensors /encoders.

- With DS230 models this mode can be used to reproduce the input frequency of [X6 | SINCOS IN1] to the splitter output [X5 | SINCOS OUT].
- 2 - 4 inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.

6.2. Application: 1 SIL3 SinCos Encoder only

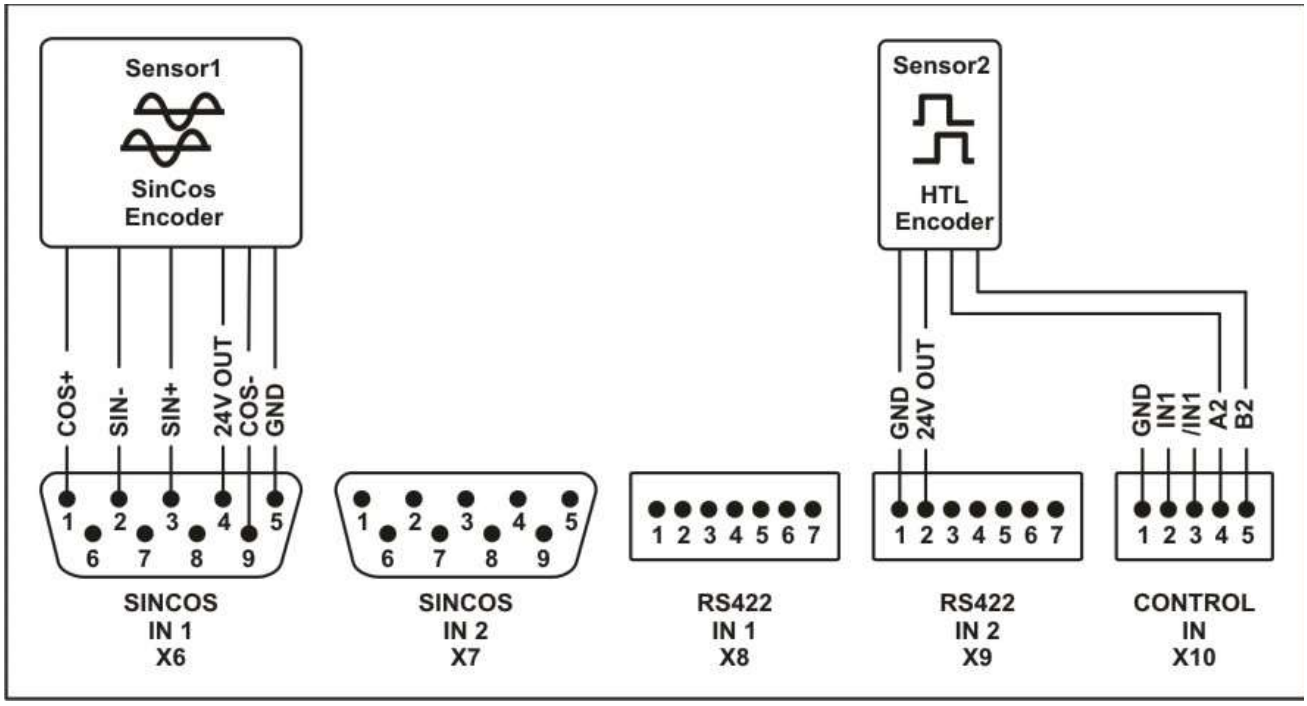
Device	DS24x		
Operational Mode	0		
Sensor 1	[X6 | SINCOS IN 1]	SIL3 SinCos encoder	SIN+, SIN-, COS+, COS-
Sensor 2	Sensor 1 and Sensor 2 are bridged internally		
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	2 - 4 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe achievable (see below) Standstill → SIL3 / PLe achievable (see below)		

This mode is exclusively used for connection of a SIL3-certified or a PLe-certified SinCos sensor / encoder.

- With DS230 models, this mode can be used to reproduce the input frequency of [X6 | SINCOS IN1] to the splitter output [X5 | SINCOS OUT].
- 2 - 4 inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.

6.3. Application: 1 SinCos Encoder and 1 HTL Encoder (quadrature)

Device	DS23x		
Operational Mode	1		
Sensor 1	[X6 | SINCOS IN 1]	SinCos encoder	SIN+, SIN-, COS+, COS-
Sensor 2	[X10 | CONTROL IN]	Incremental HTL encoder	A, B, 90°
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	1 - 2 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe achievable (see below) Standstill → SIL3 / PLe achievable (see below)		

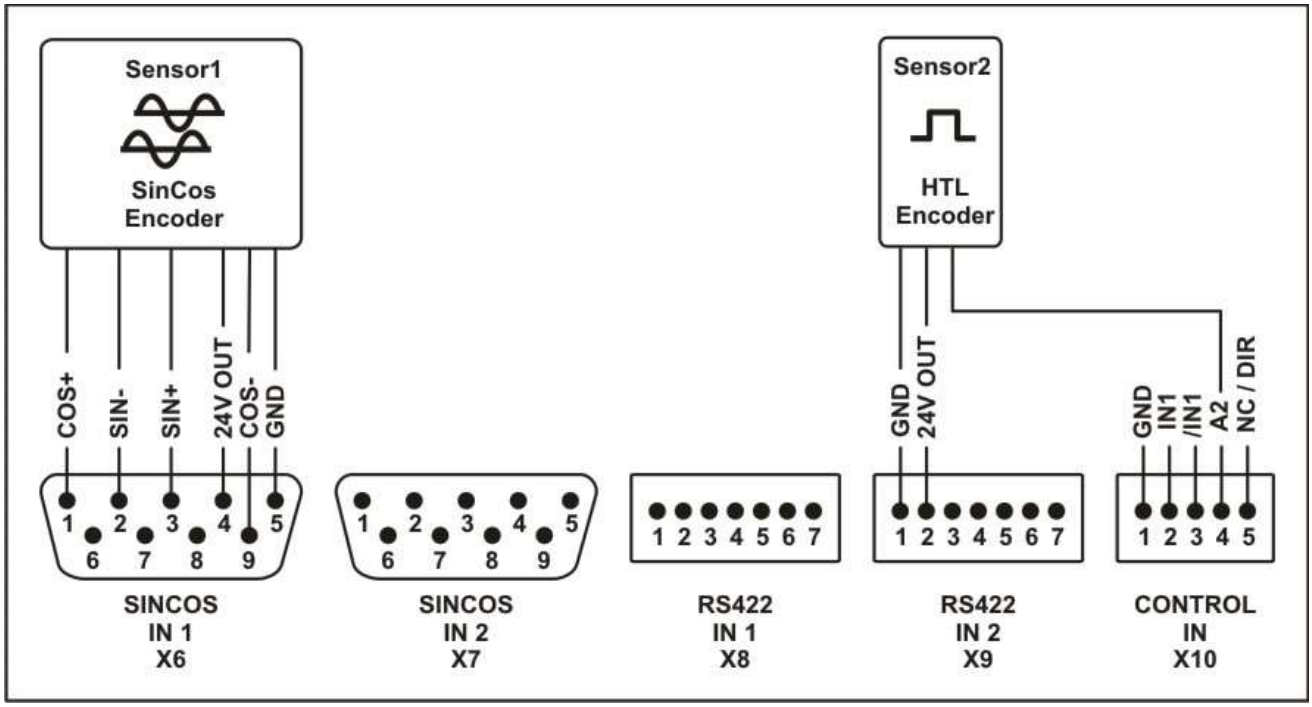


This mode allows evaluation of a dual channel system, equipped with a combination of one SinCos encoder and one incremental quadrature HTL encoder.

- With DS230 models this mode can be used to reproduce the input frequency of [X6 | SINCOS IN1] to the splitter output [X5 | SINCOS OUT].
- 1 - 2 inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.

6.4. Application: 1 SinCos Encoder and 1 HTL Encoder (single channel)

Device	DS23x		
Operational Mode	2		
Sensor 1	[X6 | SINCOS IN 1]	SinCos encoder	SIN+, SIN-, COS+, COS-
Sensor 2	[X10 | CONTROL IN]	Incremental HTL encoder	A, single channel
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	1 - 2 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe* achievable (see below) Standstill → SIL3 / PLe* achievable (see below). With single channel encoders, jitter around an edge can be misinterpreted as a frequency.		



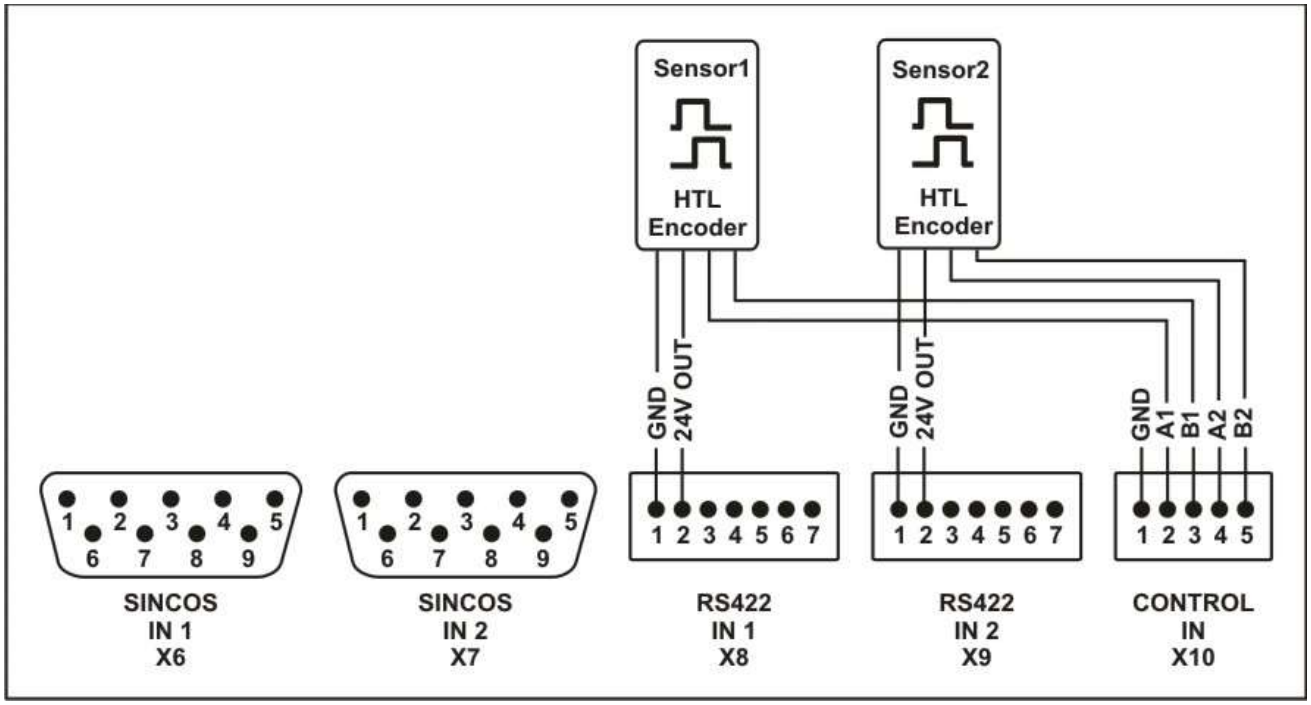
This mode allows evaluation of a dual channel system, equipped with a combination of one SinCos encoder and one incremental single channel HTL encoder.

- With DS230 models this mode can be used to reproduce the input frequency of [X6 | SINCOS IN1] to the splitter output [X5 | SINCOS OUT].
- 1 - 2 inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.
- For unbalanced single channel signals, the parameter A-Edge 2/1 must be set to 1, so that a stable frequency can be detected.

*) To achieve a safety level with this configuration, the user must be sure that the equipment will physically be able to rotate or move in one direction only (no reversals!). This could e.g. be ensured by use of a self-locking gearbox.

6.5. Application: 2 Quadrature HTL Encoders

Device	DS23x		
Operational Mode	3		
Sensor 1	[X10 | CONTROL IN]	Incremental HTL encoder	A, B, 90°
Sensor 2	[X10 | CONTROL IN]	Incremental HTL encoder	A, B, 90°
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signals	not available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe achievable (see below) Standstill → SIL3 / PLe achievable (see below)		

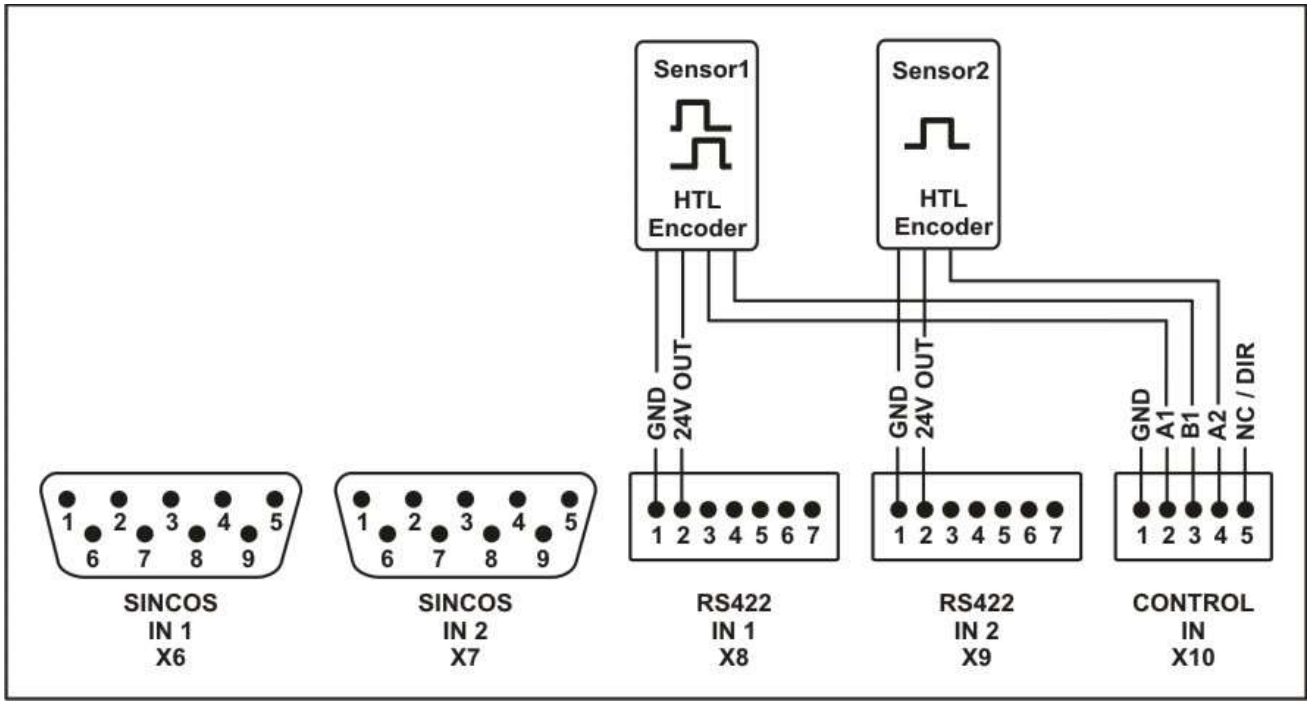


This mode allows evaluation of a dual channel system, equipped with two incremental dual channel HTL encoders.

- No inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.

6.6. Application: 1 Quadrature Encoder and 1 Single Channel HTL Encoder

Device	DS23x		
Operational Mode	4		
Sensor 1	[X10 | CONTROL IN]	Incremental HTL encoder	A, B, 90°
Sensor 2	[X10 | CONTROL IN]	Incremental HTL encoder	A, single channel
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	not available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe* achievable (see below) Standstill → SIL3 / PLe* achievable (see below). With single channel encoders, jitter around an edge can be misinterpreted as a frequency.		



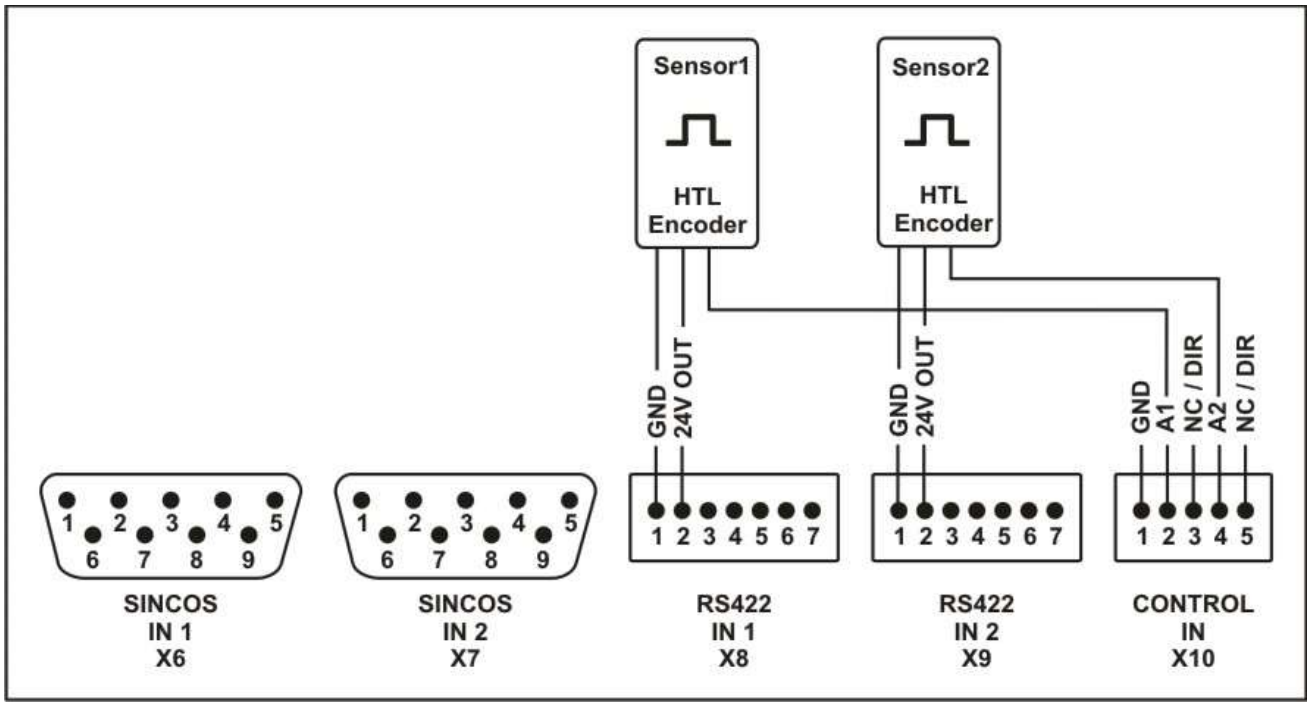
This mode allows evaluation of a dual channel system, equipped with a combination of one incremental quadrature HTL encoder and one single channel HTL encoder.

- No inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.
- For unbalanced single channel signals, the parameter A-Edge 2/1 must be set to 1, so that a stable frequency can be detected.

*) To achieve a safety level with this configuration, the user must be sure that the equipment will physically be able to rotate or move in one direction only (no reversals!). This could e.g. be ensured by use of a self-locking gearbox.

6.7. Application: 2 Single Channel HTL Encoders

Device	DS23x		
Operational Mode	5		
Sensor 1	[X10 | CONTROL IN]	Incremental HTL encoder	A, single channel
Sensor 2	[X10 | CONTROL IN]	Incremental HTL encoder	A, single channel
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	not available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe* achievable (see below) Standstill → SIL3 / PLe* achievable (see below). With single channel encoders, jitter around an edge can be misinterpreted as a frequency		



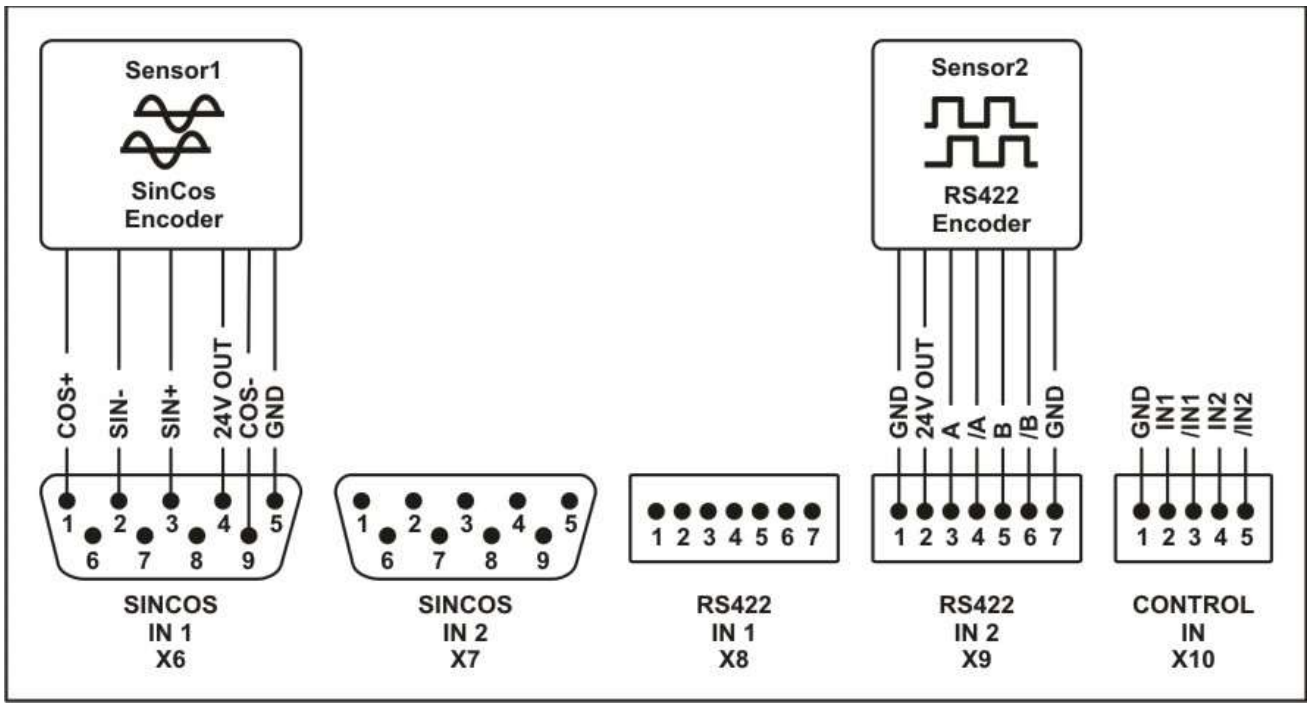
This mode allows evaluation of a dual channel system, equipped with two single-channel HTL encoders.

- No inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.
- For unbalanced single channel signals, the parameter A-Edge 2/1 must be set to 1, so that a stable frequency can be detected.

*) To achieve a safety level with this configuration, the user must be sure that the equipment will physically be able to rotate or move in one direction only (no reversals!). This could e.g. be ensured by use of a self-locking gearbox.

6.8. Application: 1 SinCos and 1 RS422 Encoder

Device	DS23x		
Operational Mode	6		
Sensor 1	[X6 | SINCOS IN 1]	Incremental HTL encoder	SIN+, SIN-, COS+, COS-
Sensor 2	[X9 | RS422 IN 2]	Incremental HTL encoder	A, /A, B, /B
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	2 - 4 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe achievable (see below) Standstill → SIL3 / PLe achievable (see below)		

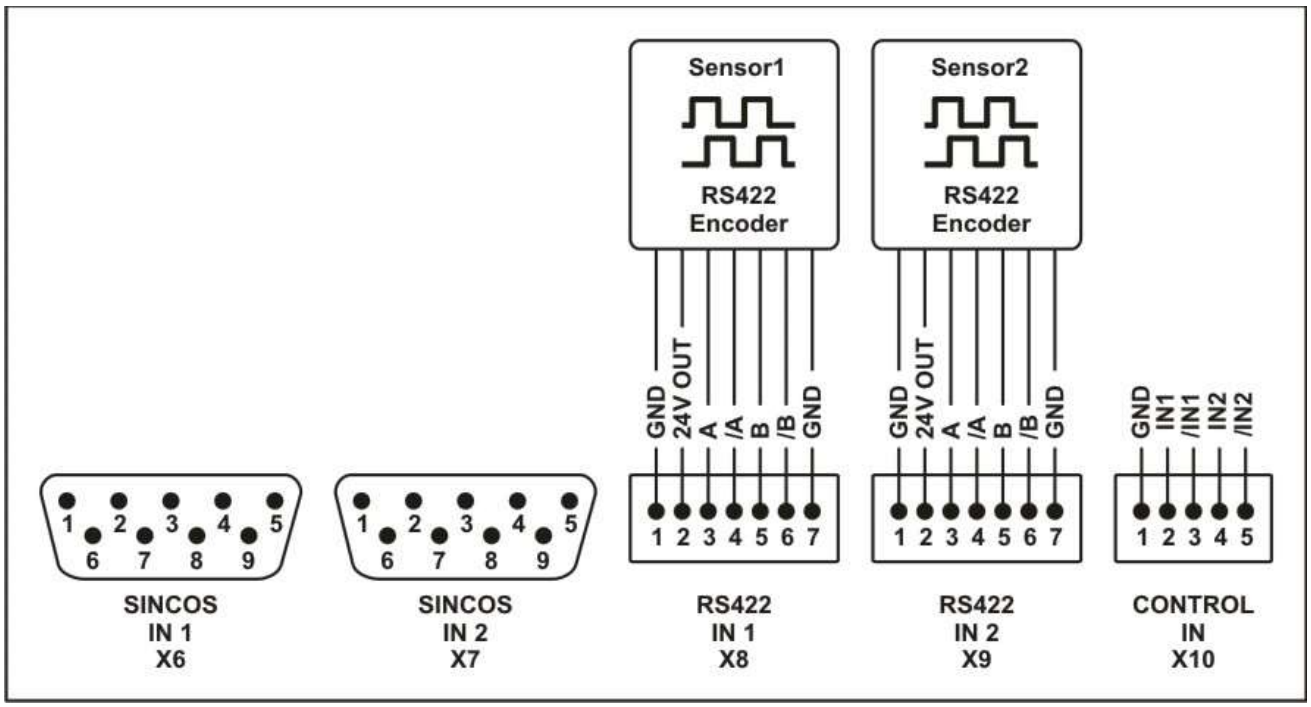


This mode allows evaluation of a dual channel system, equipped with a combination of one SinCos encoder and one RS422/TTL encoder.

- With a DS230 model this mode can be used to reproduce the input frequency of [X6 | SINCOS IN1] to the splitter output [X5 | SINCOS OUT].
- 2 - 4 inputs for control signals are available at terminal [X10 | CONTROL IN].
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.

6.9. Application: 2 RS422 Encoders

Device	DS23x		
Operational Mode	7		
Sensor 1	[X8 | RS422 IN 1]	Incremental HTL encoder	A, /A, B, /B
Sensor 2	[X9 | RS422 IN 2]	Incremental HTL encoder	A, /A, B, /B
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signals	2 - 4 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe achievable (see below) Standstill → SIL3 / PLe achievable (see below)		

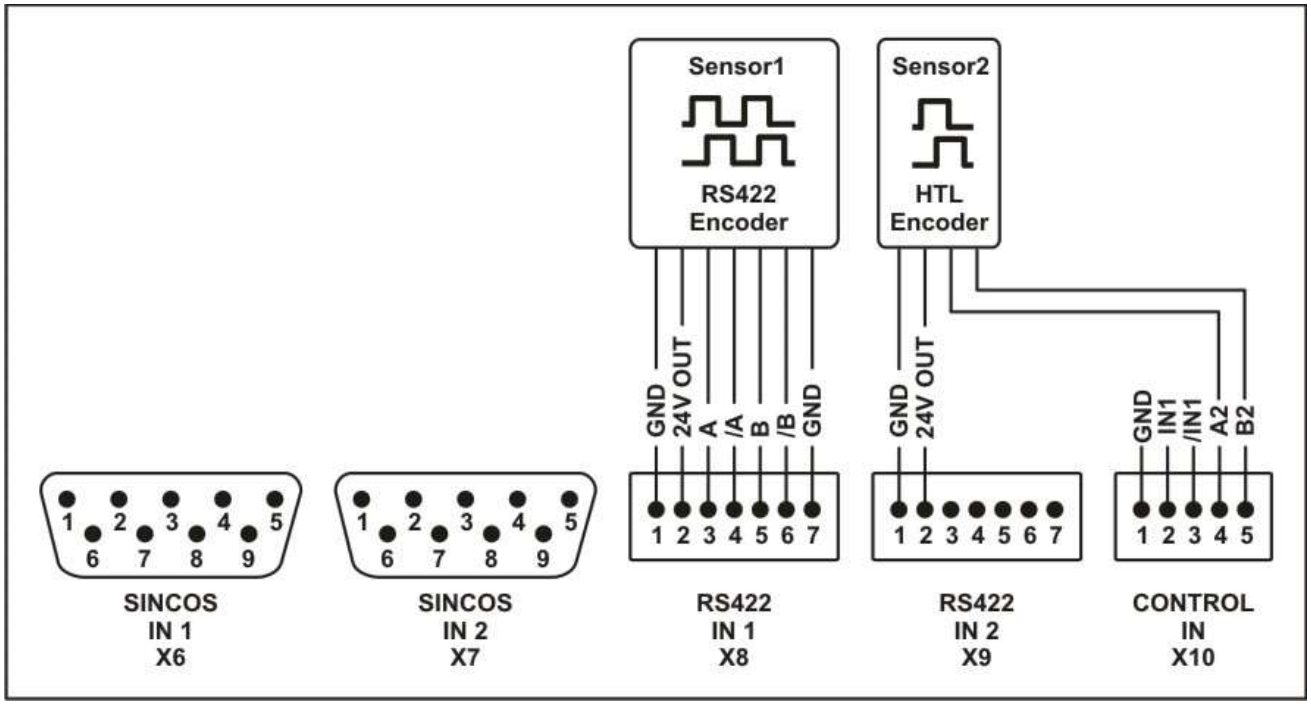


This mode (with DS23x models only) allows evaluation of a dual channel system, equipped with two identical RS422/TTL incremental encoders.

- 2 - 4 inputs for control signals are available at terminal block [X10 | (CONTROL IN).
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.

6.10. Application: 1 RS422 Encoder and 1 quadrature HTL Encoder

Device	DS23x		
Operational Mode	8		
Sensor 1	[X8 | RS422 IN 1]	Incremental RS422 / TTL encoder	A, /A, B, /B
Sensor 2	[X10 | CONTROL IN]	Incremental HTL encoder	A, B, 90°
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	1 - 2 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe achievable (see below) Standstill → SIL3 / PLe achievable (see below)		

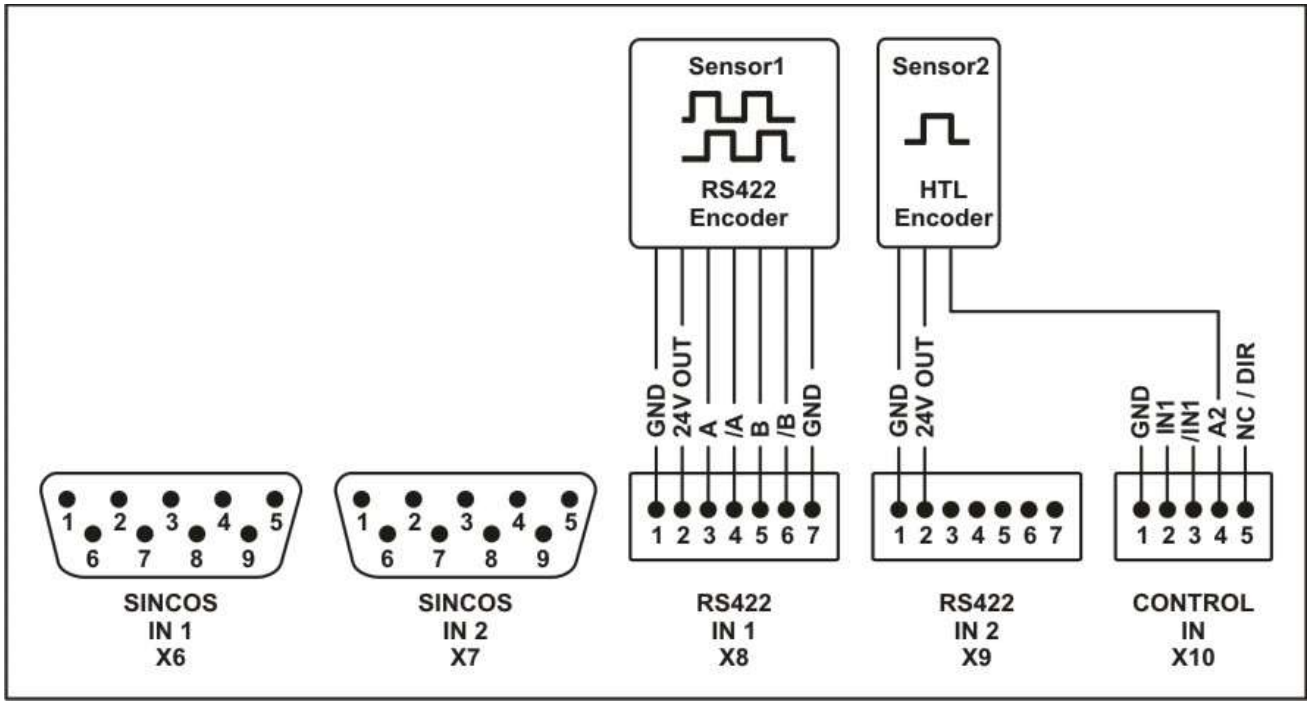


This mode is used for evaluation of a dual channel system, equipped with an incremental RS422/TTL encoder and a dual channel HTL encoder.

- 1 - 2 inputs for control signals are available at terminal block [X10 | (CONTROL IN).
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.

6.11. Application: 1 RS422 and 1 single channel HTL Encoder

Device	DS23x		
Operational Mode	9		
Sensor 1	[X8 | RS422 IN 1]	Incremental RS422 / TTL encoder	A, /A, B, /B
Sensor 2	[X10 | CONTROL IN]	Incremental HTL encoder	A, single channel
Control Inputs	[X10 | CONTROL IN]	HTL/PNP control signal	1 - 2 available
Safety Level	Speed → SIL3 / PLe achievable (see below) Direction → SIL3 / PLe* achievable (see below) Standstill → SIL3 / PLe* achievable (see below). With single channel encoders, jitter around an edge can be misinterpreted as a frequency		



This mode (applicable with DS23x models only) is used for evaluation of a dual channel system, equipped with an incremental RS422/TTL encoder and a single-channel HTL encoder.

- 1 - 2 inputs for control signals are available at terminal block [X10 | (CONTROL IN).
- The final Safety Integrity Level (SIL) depends on the selected configuration and on external components connected to the unit.
- For unbalanced single channel signals, the parameter A-Edge 2/1 must be set to 1, so that a stable frequency can be detected.

*) To achieve a safety level with this configuration, the user must be sure that the equipment will physically be able to rotate or move in one direction only (no reversals!). This could e.g. be ensured by use of a self-locking gearbox.

7. Commissioning

7.1. Cabinet installation

1. The unit must be in a mechanically and technically perfect condition.
2. The unit must be snapped onto a 35 mm DIN rail (according to EN 60715) by using the clip at the rear.
3. It must be ensured that the permissible environmental conditions of the specification are met accordingly.
4. All wirings must be executed in accordance with the general provisions for wiring (see www.motrona.com).
5. To choose and to connect the power supply unit, please refer to the section **Power Supply**.
6. To choose and to connect the encoders, please refer to sections **Encoder Supply**, **SinCos Encoder Inputs**, **RS422 Encoder Inputs** and **HTL Encoder Inputs**.
7. When control inputs, digital inputs or external relays are used, please note that the configuration will take part in the final Safety Integrity Level (SIL).
8. Analog output, digital outputs as well as the splitter output are only safe, if the follower unit is capable to detect and evaluate the error states of the monitor.
9. The relay contacts at terminal [X1] must be integrated into the safety circuit.

- In order to prevent simultaneous damages to the cables by external influences, the encoder lines or sensor lines must be kept physically separate from one another.
- Installation, commissioning and maintenance must only be performed by qualified personnel.
- In order to prevent manipulations, the machine as well as the equipment must be protected from unauthorized access.
- The machine must be securely mounted and be ready to operate.
- The safety function of the unit cannot be guaranteed before the commissioning resp. parametrization procedure has been fully completed.
- Before commissioning and parametrization, the risk situation of the system must be analyzed and all precautions must be taken accordingly.
  These are fundamental measures to protect persons and machinery.

7.2. Preparations for Setup and Testing

In order to put the DS monitor into operation or to change settings and Parameters, the following measures must be taken:

- Connect the unit to a power supply source
- Set the DIL switch sliders 1, 2 ON and 3 to OFF (Programming and Testing Mode)
- Install the OS operating software properly on a PC and start the program
- Connect the unit to the OS operator surface via the USB port
  (alternatively you are free to use a BG230 operator interface).
-

The parameterization and testing can be performed with the help of the OS. Parameters can be changed on-the-fly and their behaviour can be verified immediately after changing. The Programming and Test-Mode contains the complete functionality of the Normal or Safety Mode so that all tests in the Programming and Test-Mode are also valid in the Safety Mode.

The parameters Set Frequency X, Action Output, Action Polarity and the related commands Set Frequency and Freeze Frequency are an exeception, they are intended only for the Test Mode. During the test the switching of the DIL-switch is not necessary to activate the parameter changes. For an efficient and fast parameterization the use of the OS is to be preferred to the BG230.

7.3. Parameter Setting by PC

For parameterization of the safety monitor by PC, the operator software OS is used. This software is included in delivery on CD and is also available for download from www.motrona.com. After successful installation of the operator software of and the USB driver (see page 2) the PC can be connected to the safety monitor via USB cable.

When starting the software, the following screen appears:

Parametrization via PC

All functions of the operator software OS are described in a separate manual (see page 2).

7.4. Visualization by the BG230 Operator Unit

Visualization as well as configuration of the safety device also can be done with use of the Display- and Programming Module Type BG230. This optional operator unit is primarily used for visualization and diagnosis without PC, but can also be used for parameter setting. The module can be simply plugging onto the front of the DS unit.

However it is recommended to use preferably the OS PC software for the commissioning and parametrization procedure.

Operator Module BG230

All functions of the BG230 programming- and display module are described in a separate manual (see page 2).

8. Setup

In order to ensure proper functionality, the parameters must be set appropriate values. This section describes the most important parameters, which have to be set or checked in either case.

8.1. Operational Mode Settings

The setting of parameter "Operational Mode" is determined by the types of encoders in use, and by the respective connections. Encoder wirings and resulting mode settings are described in chapter **Operational Modes**.

No.	Parameter	Remark
000	Operational Mode	DS24x = 0, DS23x see chapter **Operational Modes**

With DS24x models, this parameter value must be left to default setting = 0.

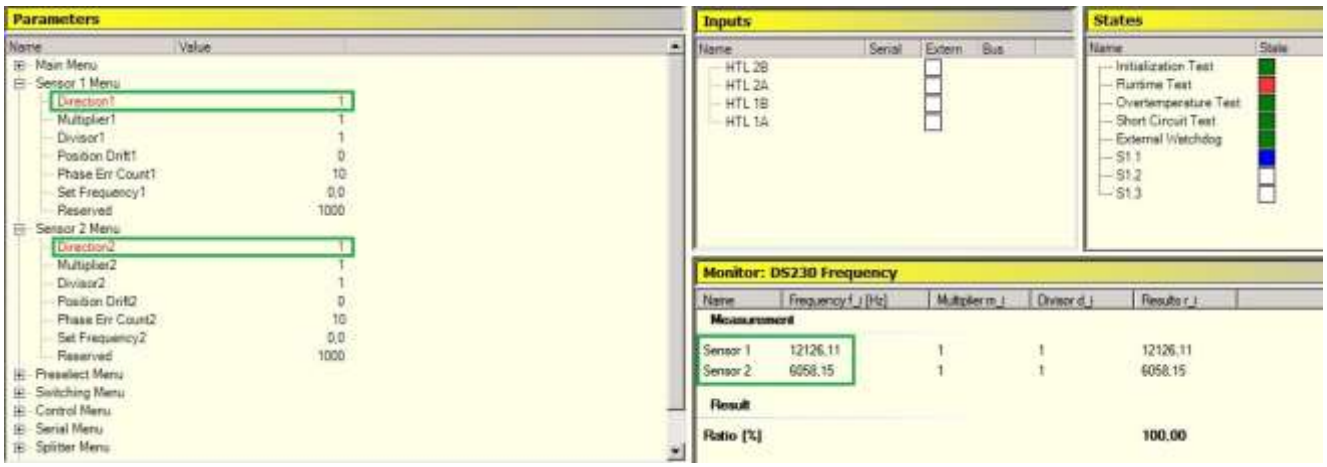
8.2. Direction Settings

In order to define the directions, the machine must move resp. turn in its working direction. As a first step, DS230: Frequency must be selected from the button bar of the operator screen.

The corresponding frequencies of Sensor 1 and Sensor 2 will then be indicated in the Monitor field. In case of negative frequency values, the direction must be changed by using the associated "Direction" register in the parameter field of the corresponding sensor menu.

No.	Parameter	Remark
017	Direction1	DS24x = 0 or 1, DS23x = X, positive frequency
024	Direction2	DS24x = 0 or 1, DS23x = X, positive frequency

With DS24x models, both parameter values must have equal setting (Direction1 = Direction2).

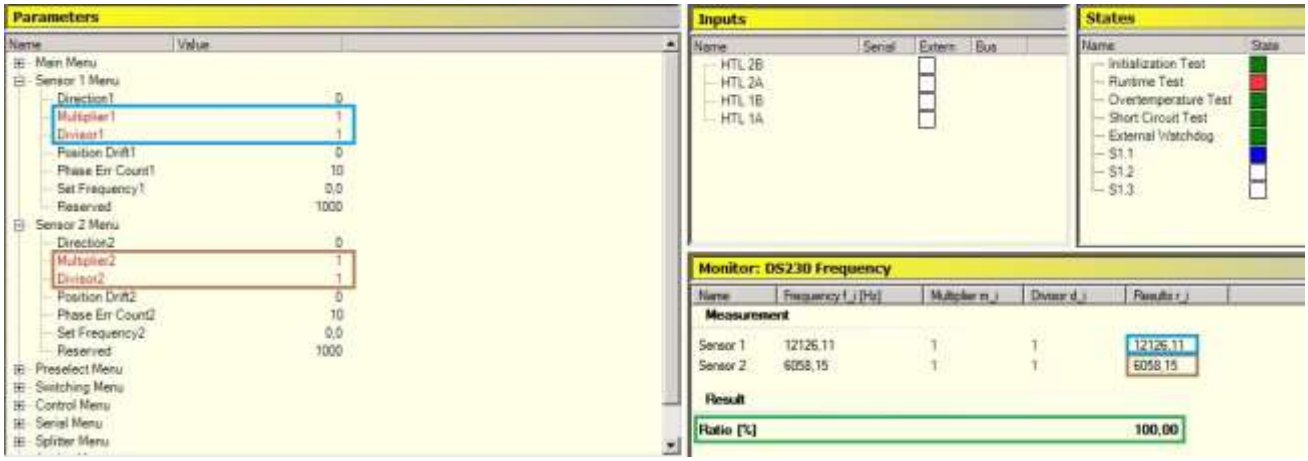


8.3. Frequency Ratio Settings

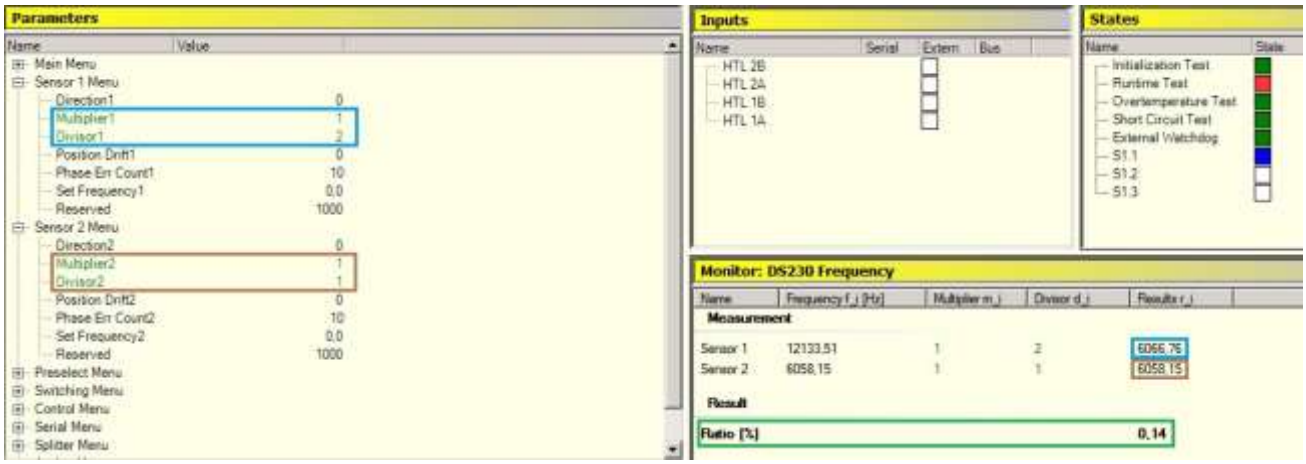
When using two sensors with different number of impulses, or in case of mechanical gear transmission ratio between both encoders, the higher one of the two frequencies must be adjusted to the lower one by corresponding setting of the scaling factors. Accurately calculated values are better than experimental results.

No.	Parameter	Remark
018	Multiplier1	DS24x = 1, DS23x Ratio = 0
019	Divisor1	DS24x = 1, DS23x Ratio = 0
025	Multiplier2	DS24x = 1, DS23x Ratio = 0
026	Divisor2	DS24x = 1, DS23x Ratio = 0

With DS24x models, both parameters must be left to default = 1.



In the example shown above, frequency 2 is by factor 0.0994 lower than frequency 1.
For alignment of both frequencies, “Multiplier1” can be set to 994 and “Divisor1” to 10.000.

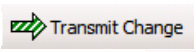


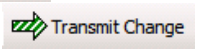
By this scaling procedure of frequency 1, internally both calculated frequencies are approximately equal and the calculated frequency ratio is close to 0.

8.4. Clear Errors

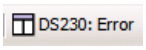
After parameter "Operational Mode" has been set correctly, the machine will move in working direction, with positive frequency indication of both, Sensor 1 and Sensor 2. Due to the frequency ratio setting, both frequencies are equal now, since the higher frequency has been scaled down to the lower frequency.

At this time, the indication boxes "Runtime Test" and "Initialization Test" in the **State** field can be set to green (green = no error, red = error). For this purpose, the following sequence of operations regarding parameter "Error Stimulation" must be observed:

- Set "Error Stimulation" to 2 and press 

- Set "Error Stimulation" back to 1 and press again 

Now, all **State** boxes, except the DIL switch States (S1.1, S1.2, S1.3) should light green.

In case a runtime error should be triggered again, please press 

of the button bar to find out more details about this error.

More information about errors can be found in the chapters **Runtime Test** and **Initialization Test**.

Error	Remark
GPI Error	If a GPI Error appears again after deleting without changing the input signal, check the setting of parameter "Input-Mode" and the signal status (High/Low) at the input. If a GPI Error appears, when changing the input signal, check the setting of parameter „GPI Err Time".
SIN/COS Channel X Error	If a SinCos error appears again after deleting at standstill, check the wiring. If a SinCos error sporadically appears at normal operation mode, first eliminate the disturbance source. With the parameter "SIN Error" and "SIN Err Time X" a SinCos error can be tolerated for a certain time.
Frequency Error	If a Frequency Error appears at normal rotation speed, check the rotation direction and the ratio of the two encoders (see chapter Direction Settings and Frequency Ratio Setting). If the Frequency Error still appears, the rotations speeds are too different for a temporary or longer period of time. In case of temporary deviations, change the parameter settings of "Sampling Time" and "Filter" for smoothing the frequency or set the parameter "Div.Filter" to a higher value. In case of continual deviations, the permissible deviation can be increased by the parameter "Div %-Value". In case of deviations in the low-frequency range, adjust the parameters „Div. f-Value" and„Div. Switch"%-f".
Position Error	If a Position error appears at normal rotation speed, check the rotation direction and the ratio of the encoders (see chapter Direction Settings and Frequency Ratio Setting). If the Position Error still appears, the encoder positions diverge. In this case, check the maximum permissible deviation of the encoder positons and adjust the parameter „Div. Inc-Value". Do not use the Position comparison, when the encoders slip or no comparison is possible.

8.5. Sampling Time Settings

All **State** boxes (except DIL switch States S1.x) light green at this time. Now please select DS230: Frequency in the button bar. We must determine the operating range of the unit, comprising the frequency range from the lowest switching point to the highest switching point:

1. Find out, which of the sensor frequencies shows the highest instability and fluctuation.
2. Move through the frequency range and find out the point of maximum fluctuating. In general this will be around the lowest switching point (underspeed or frequency band).
3. The frequency can be smoothed by use of parameter "Sampling Time" and parameter "Filter". Higher settings result in smoother running, but increase the response time and the fault detection time.
4. A combination of Sampling Time and Filter achieve the best result for smoothing the complete frequency range of input frequencies. Frequencies out of the Sampling Time, regarding to lower frequency range, are smoothed by the parameter Filter.
5. Only exceptionally you should set the Sampling Time to smoothen frequencies below the lower switch point setting (under speed or frequency band).
6. The Sampling Time and the Filter setting may also affect the signal variation on the analog output.
7. The settings can be verified at the Monitor DS230 Frequency.

No.	Parameter	Remark
001	Sampling Time	Control of frequency fluctuation
014	Filter	Control of frequency fluctuation

8.6. Wait Time Settings

The Wait Time parameter defines the frequency below which all frequencies will be taken as zero. Setting of e.g. 1.0 second will result in zeroizing all frequencies lower than 1 Hz. In this context it must be clarified whether the application requires a standstill- or drift-monitoring or not.

1. Where the application does not require any standstill or direction or drift control, you are free to set Standstill Time with regard of the expected minimum frequency and the required response time only.
2. Where the application uses standstill control, please observe also possible jitter during standstill and adjust Wait Time correspondingly.
3. Where the application uses forward/reverse direction control, also possible jitter should be considered while the system holds in closed loop position control.

No.	Parameter	Remark
002	Wait Time	Adjust the zero balancing window

8.7. Setting of F1 - F2 Selection

When the original frequency of sensor 1 is higher than the original frequency of sensor 2, please set parameter F1-F2-Selection to 0, otherwise please set to 1. In general the higher frequency should be the more stable one, and should therefore be used to set the switching points.

No.	Parameter	Remark
003	F1-F2 Selection	When F1 > F2, setting F1-F2 Selection = 0 (F1 selected). When F2 > F1, setting F1-F2 Selection = 1 (F2 selected).

8.8. Setting of the Divergence Parameters

The parameter "Div.Mode" defines the type of comparison: Frequency Comparison or Position Comparison. The setting of this parameter affects only on the error detection. The DS24x series use only one encoder, controlling the positions should be favored.

If the frequency ratio setting can not be set precisely, do not use the Position Comparison caused by cumulative position increments. If the encoders slip, Frequency Comparison has to be preferred.

Frequency comparison:

These parameters defines the maximum permissible frequency deviation between sensor 1 and sensor 2, based on percentaged values of Div Calculation. Parameter Div. Switch %-f defines the frequency threshold below which deviations are taken as absolute values, and above which deviations are taken as percentage. When the absolute difference of frequencies exceeds the setting of Div. f-Value below the threshold setting, a frequency error will be triggered. When the percentaged difference exceeds the setting of Div. %-Value above the threshold setting, also a frequency error will be triggered. Parameter Div. Filter provides an option for suppression of short-duration errors.

1. The facility of setting a frequency threshold provides suppression of possible frequency errors caused by jerking in the startup phase.
2. The threshold setting must be below the lower switchpoint setting (underspeed or frequency band).
3. It is an individual issue of the actual application to fix the deviation values under normal operating speed and under startup conditions that should trigger a frequency error signal.
4. Where no standstill nor drift nor direction control is needed, the frequency threshold can also serve as trigger threshold for error activation, by increasing the setting of Div. f-Value correspondingly (see 3.)
5. Where the application uses standstill control, possible jitter during closed-loop standstill should be observed to adjust Div. f-Value correspondingly.
6. Where forward/reverse direction control is used, please also observe possible jitter during standstill for best setting of Div. f-Value.

Sensor Position Comparison:

This parameter defines the maximum permissible position deviations between sensor 1 and sensor 2. Parameter DIV. Inc Value defines the position threshold. If deviation exceeds this threshold a frequency error will be triggered. This position threshold is implemented independent of the direction of rotation. If parameter DIV.Inc Value is set to zero, no error massage will be applied.

No.	Parameter	Remarks
004	Div. Switch %-f	Frequency threshold
005	Div. %-Value	Percentage of frequency deviation above the Div.Switch %.
006	Div. f-Value	Absolute frequency deviation (Hz) below the Div. Switch %-f threshold
007	Div. Calculation	0
008	Div. Filter	Filter (OFF = 0, MEDIUM = 5, HIGH = 10)
012	Div. Mode	Type of comparison of encoder inputs
013	Div. Inc-Value	Max. incremental deviation

Divergence parameters are relevant even with the DS24xx models, since also with only one SIL3 encoder frequency or position is splitted into two channels, where asynchronism during changes of the frequency may cause frequency divergence. Using DS24x position deviation has to be preffered.

8.9. Setting of Power-up Delay

After initialization, Power-up Delay defines a retardation time before the unit takes the normal control state.

1. During this delay time, the unit will not take care of any errors
2. The delay is important to allow the encoder signals to stabilize after power up.
3. In case of indirect encoder connection, the retardation must also include the switching time of the relays.
4. In case of different power-up times of the parts and components of the installation, adaption to the DS2xx unit can be achieved by the retardation time settings.

No.	Parameter	Remarks
010	Power-up Delay	delay time

8.10. Setting of the SinCos Output

There are no settings available for the SinCos output. At any time the signals of SinCos Input 1 [X6] will be routed to the output.
With models DS2x6, no SinCos output is available.

8.11. Setting of the RS422 Output

The output delivers the signals from Sensor 1 or Sensor 2 (regardless of the input configuration). Depending on the Operational Mode setting, the converted signals of a SinCos or of a HTL encoder will be forwarded.

No.	Parameter	Remark
107	RS Selector	Sensor 1 to output = 0, Sensor 2 to output = 1

With models DS2x6, no RS422 output is available.

8.12. Analog Output Settings

In case of an unused analog output the output terminals must be bridged. The parameters "Analog Start" and "Analog End" are related to the frequency which is selected by the "F1-F2 Selection" register. The "Analog Gain" setting should be changed only in exceptional cases (e.g. for limitation of the upper current value). The "Analog Offset" parameter serves for fine adjustment.

1. Fluctuation of the analog output signal can be reduced by corresponding setting of Sampling Time and Filter.
2. With very small span (between Analog Start and Analog End) the analog output signal can become stepped due to the low frequency resolution.
3. Analog Start and Analog End operate under control of F1-F2 Selection.

Nr.	Parameter	Remark
108	Analog Start	Input frequency to produce output of 4 mA
109	Analog End	Input frequency to produce output of 20 mA
110	Analog Gain	100 : fixed setting, change only in exceptional cases
111	Analog Offset	0 : fine astment

8.13. Digital Output Settings

The configuration of the outputs will affect the Safety Integrity Level (SIL).

1. Switching points are affected by the F1-F2 Selection setting
2. Output flattering caused by unstable frequencies must be eliminated by corresponding setting of a hysteresis.
3. No hysteresis setting is required with self-sustaining outputs.

No.	Parameter	Remark
031 - 046	Preselect Menu	Setting of the tripping points
047 - 084	Switching Menu	Configuration of the outputs

8.14. Relay Output Settings

The relay contacts must be embedded into the safety circuit.

1. Switching points are affected by the F1-F2 Selection setting
2. Output flattering caused by unstable frequencies must be eliminated by corresponding setting of a hysteresis.
3. No hysteresis setting is required with self-sustaining outputs.
4. It is mandatory to assign the most important and essential of all safety functions to the relay output.

No.	Parameter	Remark
031 - 046	Preselect Menu	Setting of the tripping points
047 - 084	Switching Menu	Configuration of the outputs

8.15. Digital Input Settings

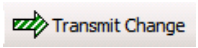
The configuration of the inputs will affect the Safety Integrity Level (SIL).

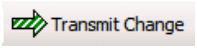
1. With 2-pole inputs please observe possible difference with regard of the transition times. Parameter "GPI Err Time" defines the permissible delay time during illegal conditions.
2. With 1-pole clocked inputs the static triggering characteristics (low/high) should be adapted to the dedicated command according to safety requirements.

No.	Parameter	Remark
090 - 100	Control Menu	Configuration if the inputs

8.16. Producing an Error

After setting of all relevant parameters an error can be produced for testing purpose. This conduces to force the DS2xx outputs into the error state and to check function and behavior of the follower units.

- Set parameter „Error Stimulation" to 0 and activate 

- The error state is set now.
- Set parameter „Error Stimulation" to 2 and activate 

- Set parameter „Error Stimulation" to 1 again and activate 

- The error state is released again

While in Error State, the safety monitor acts as follows:

- The analog output signal is set to 0 mA
- The relay contact is open
- Both channels of the digital outputs are in LOW state
- The offset of the SinCos output is displaced
- All channels of the RS422 output are in LOW state.

It is important to check for proper detection of these error indications on site of the target units connected to the monitor.

9. Completion of the Setup Procedure

Finally, all application-specific parameters should once more be reviewed for correctness and plausibility. The safety-relevant relay output falls back to its open state when an error occurs or when the programmed switching condition occurs. Of course the contact is also open in powerless state of the unit. It is mandatory to check the safety behavior of the monitor and all connected follower units carefully.

The following items must be verified:

- plausibility and correctness of encoder signals
- sense of rotation and proper scaling of the encoder frequencies
- plausibility of the frequencies themselves
- correct settings of all necessary parameters
- plausibility of the parameter settings
- SinCos output signals with regard to frequency and error behavior
- RS422 output signals with regard to frequency and error behavior
- analog output signal under operation and error conditions
- scaling of the analog output with respect to the frequency range
- digital outputs and relay output as for error comportment
- switching points with regard to correct comportment
- response times and related parameter settings
- inputs regarding proper function and comportment

It is on the responsibility of the operator to ensure that all relevant parts of the whole installation pass over to a safe state as soon as the relay contact of the safety monitor opens.

After commissioning (parameterization and testing), the Programming Mode of the unit must be left by setting slider 3 of the DIL switch back to its ON position. Please observe that for normal operation of the monitor always all
3 sliders of the DIL switch must be set to ON.

- Programming Mode (DIL switch setting) must only be used for Start-up (parameterization and testing)
- Set all DIL switch positions to ON after Start-up
- Protect the DIL switch against later manipulation after conclusion of the Start-up procedure (e. g. by covering with adhesive tape)
- Normal operation is only permitted while the yellow LED is permanently OFF

10. Error Detection

In order to ensure a maximum of operational safety and reliability, the Safety Monitors are equipped with several and profound monitoring-functions. This monitoring allows immediate recognition and messaging of possible failures and malfunctions.

In case of errors:

- the relay contact switches to its open (safety) condition (interruption of the safety circuit)
- the analog output (with DS236 and DS246 units) sets to 0 mA (which is out of the regular operating range of 4 … 20 mA)
- all digital outputs are set to LOW. No more inversion between OUTx and /OUTx (Attention in case of homogenous configuration!)
- no more incremental signals are available at the RS422 output (Tri-State with pulldown cut off)
- the DC-offset of the SinCos output will be shifted (which signals an error to the target unit)

The following types of error recognition are distinguished:

- Initialization Test Error
- Runtime Test Error

Both error types are described in detail on the following pages.

10.1. Error Representation

Error Representation	Reference
Front LED's	Yellow LED lights continuously
BG230 Operator Unit	The bottom line displays the error when the BG230 is not in the programming mode
Operator surface OS	Initialization Test = red (State field) Runtime Test = red (State field)

10.2. Initialization Test

These self-monitoring tests are processed automatically when switching the unit on.

Error code BG230	Error OS operator software	Instruction
H' 0000 0001	ADC Error	Internal error
H' 0000 0002	I2C Error	Internal error
H' 0000 0004	OTH Error	Check the BG230 power supply or the encoder supply (or internal error)
H' 0000 0008	SCI Error	Internal error
H' 0000 0010	DIO Error	Check the digital outputs for short circuit resp. other errors (or internal error)
H' 0000 0020	GPI Error	Check the connections of the digital inputs and the input configuration (or internal error)
H' 0000 0040	CAP Error	Internal error
H' 0000 0080	SPI Error	Check the connections of the analog output (or internal error)
H' 0000 0100	QEP Error	Check the separation or disconnection of the encoder supply at Self-Test (or internal error)
H' 0000 0200	SCO Error	Check the connections of the SinCos output (or internal error)
H' 0000 0400	CPU Error	Internal error
H' 0000 0800	RAM Error	Internal error
H' 0000 1000	WDO Error	Internal error
H' 0000 2000	EDM Error	Error in EDM test, check external relay
H' 0000 4000	FLA Error	Internal error

For all error messages, the following applies:
Switch the unit OFF and ON again.
If the error message continues, please contact the manufacturer of the unit.

10.3. Runtime Test

These internal monitoring procedures run automatically and continuously in the background:

From software version 5 the following error codes applies:

Error code BG230	Error Message on PC (Operator Software OS)	Instruction
H' 0000 0001	SIN/COS Channel 1 Error	SinCos Encoder 1 signals at [X6] incorrect (Offset/Phase)
H' 0000 0002	SIN/COS Channel 2 Error	SinCos Encoder 2 signals at [X7] incorrect (Offset/Phase)
H' 0000 0004	Encoder Supply Error	Encoder Supply 1/2 at [X6-X9, X11]: short circuit resp. faulty circuit
H' 0000 0008	Position Error	Position error detected Parameter Div. Mode = 1, 2
H' 0000 0010	-	-
H' 0000 0020	-	-
H' 0000 0040	-	-
H' 0000 0080	Overlap Error	Faulty sensor overlap
H' 0000 0100	Temperature Error	Impermissible high temperature
H' 0000 0200	Readback Digital Output Error	Digital outputs [X2]: short circuit resp. faulty circuit
H' 0000 0400	Analog Error	Open analog output (
H' 0000 0800	Readback Relay Output Error	Relay control error, contact readback error
H' 0000 1000	-	-
H' 0000 2000	GPI Error	Illegal transition state at the inputs
H' 0000 4000	-	-
H' 0000 8000	-	-
H' 0001 0000	Phase Channel 1 Error	Illegal signal change at Encoder 1
H' 0002 0000	Phase Channel 2 Error	Illegal signal change at Encoder 2
H' 0004 0000	Frequency Error	Frequency error F1 ≠ F2 Parameter Div. Mode = 0, 2
H' 0008 0000	Drift Error 1	Drift error at Encoder 1
H' 0010 0000	Drift Error 2	Drift error at Encoder 2
H' 0020 0000	ESM Error	Internal error

Continuation „Runtime Test“:

Error code BG230	Error Message on PC (Operator Software OS)	Instruction
H‘ 0040 0000	External RB Error	Setting or resetting of the external relay faulty
H‘ 0080 0000	Wrong Parameter Error Simulation	Parameter “Error Simulation“≠ 1 while DIL-switch setting „Normal Operation“
H‘ 0100 0000	Register Error	Internal error
H‘ 0200 0000	RTI/QEP Cycle Error	
H‘ 0400 0000	External Clock Error	
H‘ 0800 0000	Wrong Parameter Setting	Frequency too high with regard to “Sampling Time” setting (Overflow)
H‘ 1000 0000	ADC Error	Internal error
H‘ 2000 0000	I2C Error	
H‘ 4000 0000	Initialization Test Error	An initialization test error has been detected (see chapter **Initialization Test**)

Up to software version 4 the following error codes applies:

Error code BG230	Error Message on PC (Operator Software OS)	Instruction
H‘ 0000 0001	SIN/COS Channel 1 Error	SinCos Encoder 1 signals at [X6] incorrect (Offset/Phase) or internal error
H‘ 0000 0002	SIN/COS Channel 2 Error	SinCos Encoder 2 signals at [X7] incorrect (Offset/Phase) or internal error
H‘ 0000 0004	External Supply Channel 1 Error	Encoder Supply 1: short circuit resp. faulty circuit at [X6] or [X8] or internal error
H‘ 0000 0008	External Supply Channel 2 Error	Encoder Supply 2: short circuit resp. faulty circuit at [X7] or [X9] or internal error
H‘ 0000 0010	External Supply BG Error	BG230 Power Supply: short circuit resp. faulty circuit at [X11] or internal error
H‘ 0000 0020	External Supply BG Status Error	BG230 Power Supply: short circuit resp. faulty circuit at [X11] or internal error
H‘ 0000 0040	External Supply GV Status Error	Encoder Supply: short circuit resp. faulty circuit or internal error
H‘ 0000 0080	External Supply Short Circuit Error	Encoder Supply: short circuit resp. faulty circuit internal error
H‘ 0000 0100	Temperature Error	Impermissible high temperature or internal error
H‘ 0000 0200	Readback Digital Output Error	Digital outputs [X2]: short circuit resp. faulty circuit or internal error
H‘ 0000 0400	Sequence Analog Output Error	Open analog output (mA) or internal error
H‘ 0000 0800	Readback Relay Output Error	Relay control error, contact readback error or internal error
H‘ 0000 1000	Readback Analog Output Error	Open analog output (mA), overheating or internal error
H‘ 0000 2000	GPI Error	Illegal transition state at the inputs

Continuation „Runtime Test“:

Error code BG230	Error Message on PC (Operator Software OS)	Instruction
H‘ 0000 4000	Sequence DAC Output Error	Open analog output (mA), overheating or internal error
H‘ 0000 8000	DAC Output Error	Open analog output (mA), overheating or internal error
H‘ 0001 0000	Phase Channel 1 Error	Illegal signal change at Encoder 1
H‘ 0002 0000	Phase Channel 2 Error	Illegal signal change at Encoder 2
H‘ 0004 0000	Frequency Error	Frequency error F1 ≠ F2
H‘ 0008 0000	Drift Error 1	Drift error at Encoder 1
H‘ 0010 0000	Drift Error 2	Drift error at Encoder 2
H‘ 0020 0000	ESM Error	Internal error
H‘ 0040 0000	External RB Error	Setting or resetting of the external relay faulty or internal error
H‘ 0080 0000	Wrong Parameter Error Simulation	Parameter “Error Simulation“≠ 1 while DIL-switch setting „Normal Operation“
H‘ 0100 0000	Register Error	Internal error
H‘ 0200 0000	RTI/QEP Cycle Error	
H‘ 0400 0000	External Clock Error	
H‘ 0800 0000	Wrong Parameter Setting	Frequency too high with regard to “Sampling Time” setting (Overflow)
H‘ 1000 0000	ADC Error	Internal error
H‘ 2000 0000	I2C Error	
H‘ 4000 0000	Initialization Test Error	An initialization test error has been detected (see chapter Initialization Test)

With all error messages, the following applies:

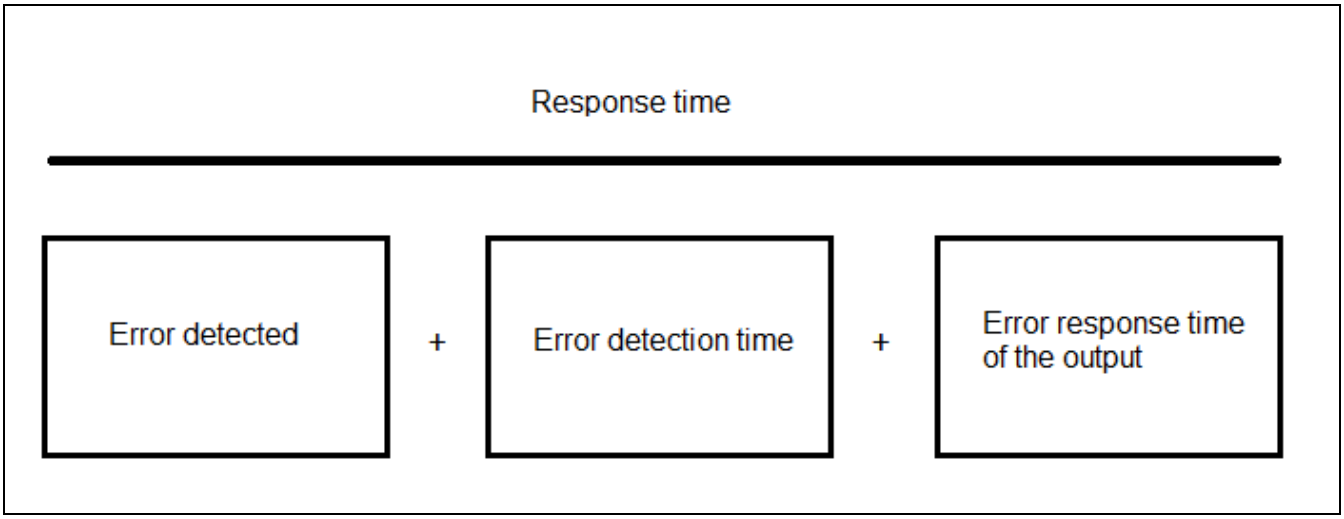
Switch the unit OFF and ON again. If the error message continues, please contact the manufacturer of the unit.

10.4. Error Clearing

Error states can generally be cleared by switching power off and on again (after the cause of the error has been removed). During commissioning only, errors can also be cleared as described under chapter Setup / Clearing Errors.

10.5. Error Detection Time

Basically it is not possible to specify an accurate error detection time, since times depend on many factors and error reasons. For example it makes a difference in time to detect either a SinCos error or an analog error. For simplification however we can assume that errors are recognized after a time of 85 ms plus the tripping time. As an exception of this, detection of frequency errors could also take longer, since these times are related to the input frequency and to parameter settings.
Typical respond times for various outputs and for frequency errors can be found in chapter Response Times.



The error detection time depends (amongst others) on the following factors:

- type of error
- parameter settings
- external events and actions
- internal events and actions
- respond time of the output

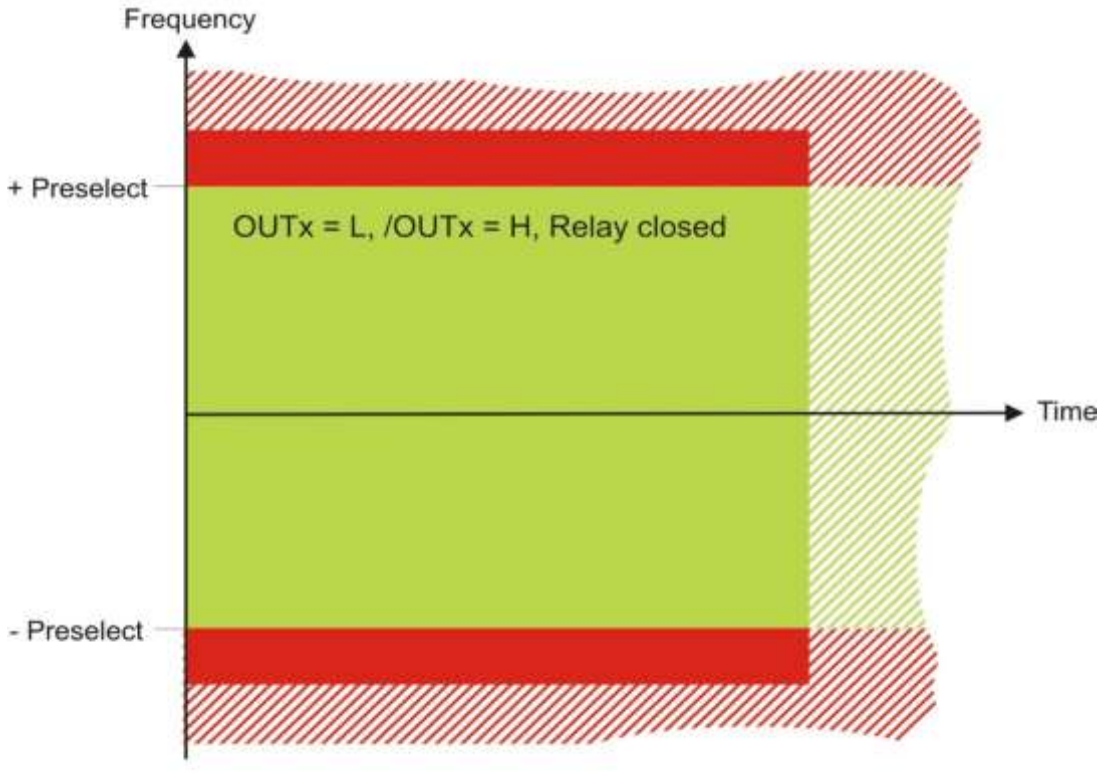
11. Monitoring Functions

The monitoring functions are used to set the properties of digital outputs and relay output.

11.1. Overspeed (Switch Mode = 0)

With parameter setting "Switch Mode" = 0, the frequency is monitored for overspeed.
The function is always active and independent of the direction of rotation. The switching point for overspeed is always at Frequency = Preselect (no matter if with or without hysteresis).

Relevant Parameters	Remark
Switch Mode XXXX	= 0
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Hysteresis XXXX	hysteresis
Lock Output	lock function
Output Mode	homogenous or inverse output configuration (affects the Safety Integrity Level SIL)
Delay XXXX	shutter delay
Preselect XXX.L/H	switching point
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



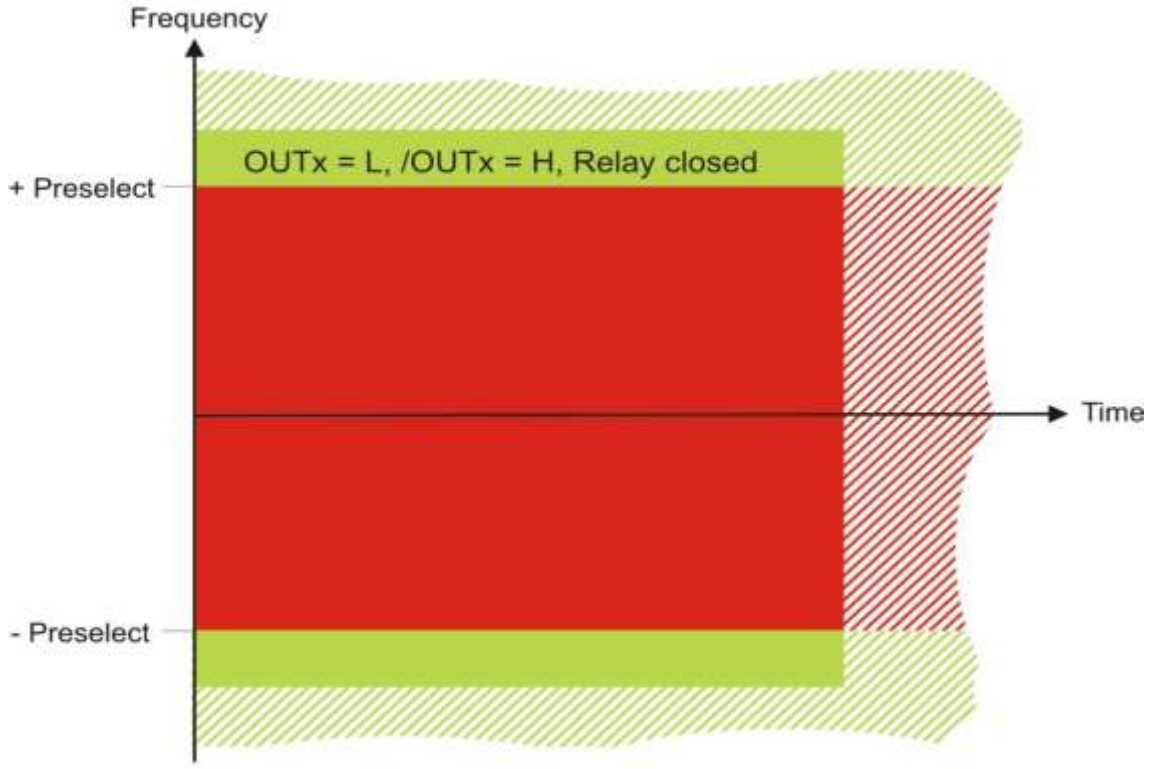
Relevant input functions	Remark
Selfhold function (function: 1-6)	Only if selfhold function is activated
Toggle switching points (function: 13)	Only if commutation function is activated

Example:
With Preselect = 1000.0 Hz and Hysteresis = 10 %, frequencies $|f| \geq 1000$ Hz are detected as overspeed. The overspeed output will be cleared with frequencies $|f| < 900$ Hz.

11.2. Underspeed (Switch Mode = 1)

With parameter setting "Switch Mode" = 1, the frequency is monitored for underspeed.
The function is always active and independent of the direction of rotation. The switching point for underspeed is always at Frequency = Preselect (no matter if with or without hysteresis).

Relevant Parameters	Remark
Switch Mode XXXX	= 1
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Hysteresis XXXX	hysteresis
Startup Mode	type of start-up-delay
Startup Output	assignment of the outputs for start-up delay
Lock Output	lock function
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	switching point
IN function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



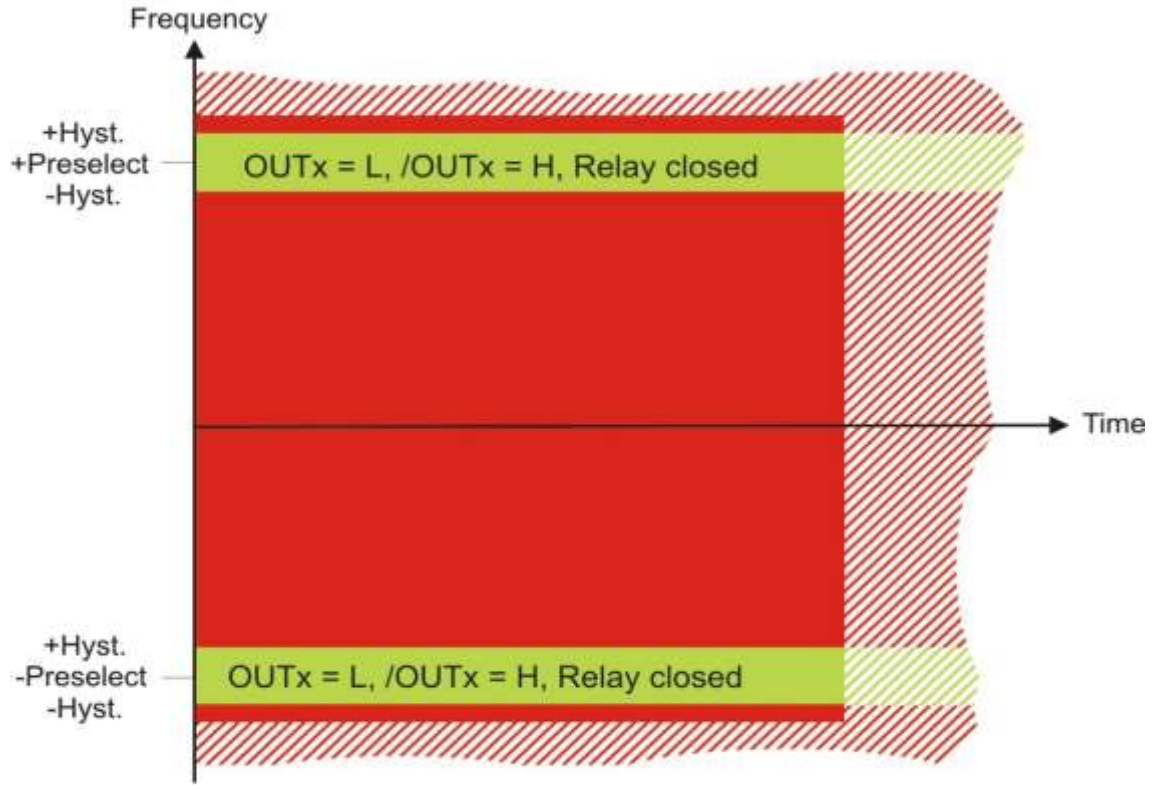
Relevant input functions	Remark
Selfhold function (function: 1-6)	Only if selfhold function is activated
Toggle switching points (function: 13)	Only commutation function is activated

Example:
With Preselect = 1000.0 Hz and Hysteresis = 10 %, frequencies |f| < 1000 Hz are detected as underspeed. The underspeed output will be cleared with frequencies |f| > 1100 Hz.

11.3. Frequency Band (Switch Mode = 2)

With parameter setting "Switch Mode" = 2, the frequency is monitored within a frequency band. The function is always active and independent of the direction of rotation. The switching points of the band are located at Preselect +/- Hysteresis.

Relevant Parameters	Remark
Switch Mode XXXX	= 2
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Hysteresis XXXX	+/- range (center)
Startup Mode	type of start-up delay
Startup Output	output assignment for start-up delai
Lock Output	lock function
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	center
IN function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



Relevant input functions	Remark
Selfhold function (function: 1-6)	Only if selfhold function is activated
Toggle switching points (function: 13)	Only if commutation function is activated

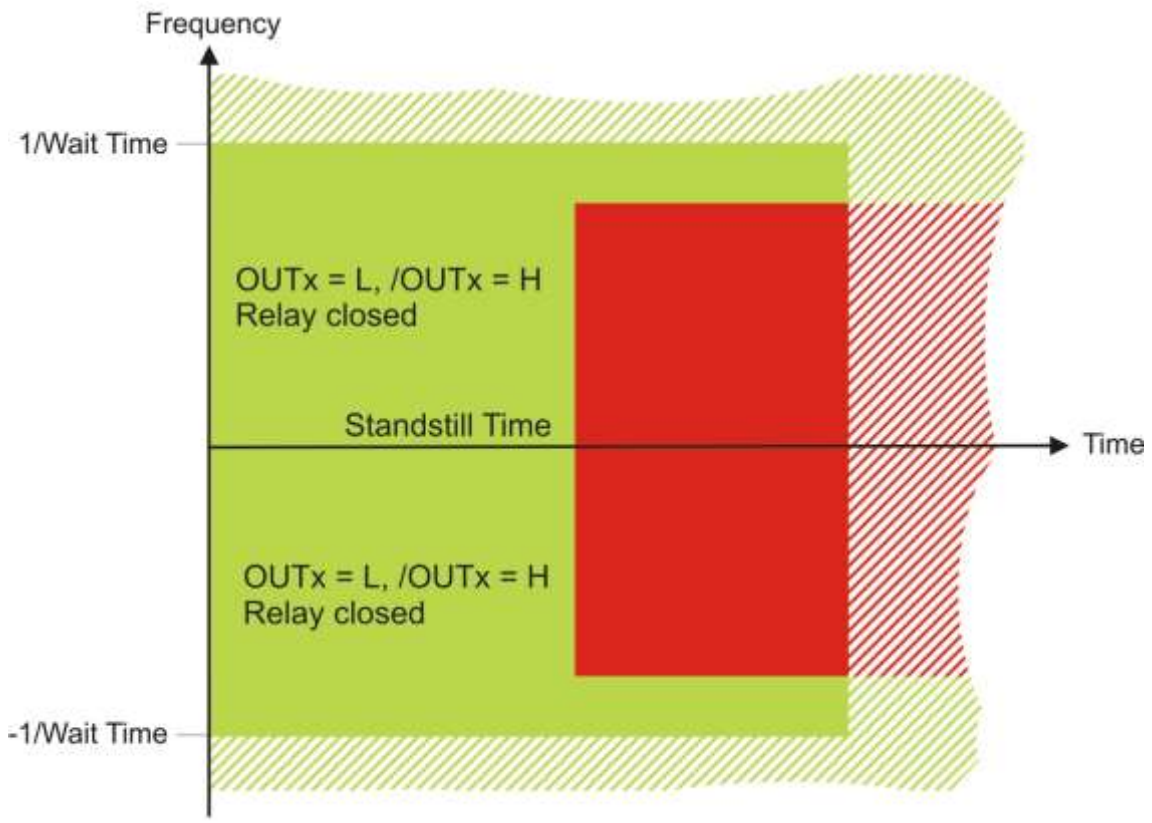
Example:

With Preselect = 1000.0 Hz and Hysteresis = 10 %, frequencies |f| < 900 Hz are detected as underspeed and frequencies |f| > 1100 Hz as overspeed.

11.4. Standstill (Switch Mode = 3)

With parameter setting "Switch Mode" = 3, the frequency is monitored for standstill. The function is always active. The output is set after detection of frequency 0 Hz and expiration of the standstill time. When a frequency different from zero is detected, the output will be reset. Parameter "Wait Time" determines the threshold under which a frequency is taken as zero.

Relevant Parameters	Remark
Switch Mode XXXX	= 3
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Standstill Time	standstill time in x seconds
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)



Relevant input functions	Remark
none	none

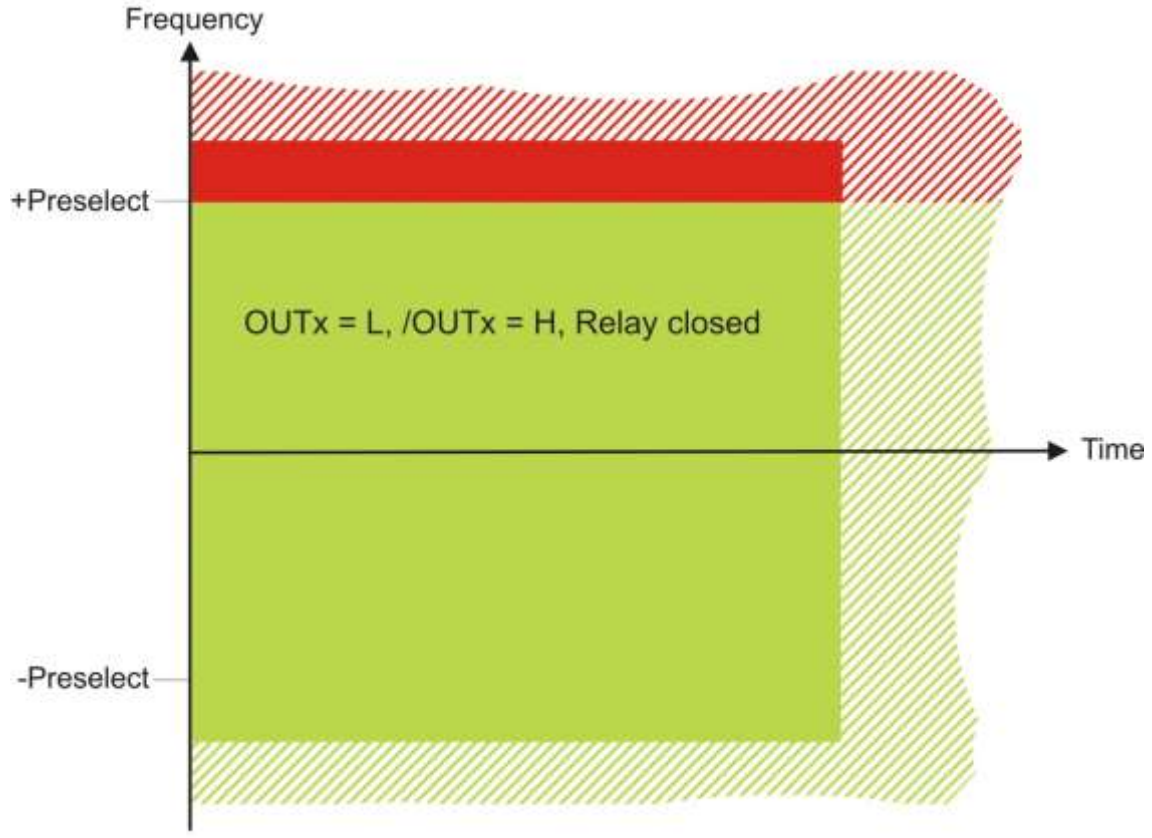
Example:

With a Wait Time setting of 0.01 seconds, all frequencies < 100 Hz will be taken as zero (f = 0).
The expiration of Standstill Time starts as soon both channels report 0 Hz. When this time has expired and both frequencies are still 0 Hz, the standstill output will be set. As soon one of the two frequencies becomes different from zero again, the standstill output will be reset.

11.5. Overspeed (Switch Mode = 4)

With parameter setting "Switch Mode" = 4, the frequency is monitored for overspeed.
The function is always active and considers the direction of rotation. The switching point for overspeed is always at Frequency = Preselect (no matter if with or without hysteresis).

Relevant Parameters	Remark
Switch Mode XXXX	= 4
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Hysteresis XXXX	hysteresis
Lock Output	lock function
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	switching point
IN function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



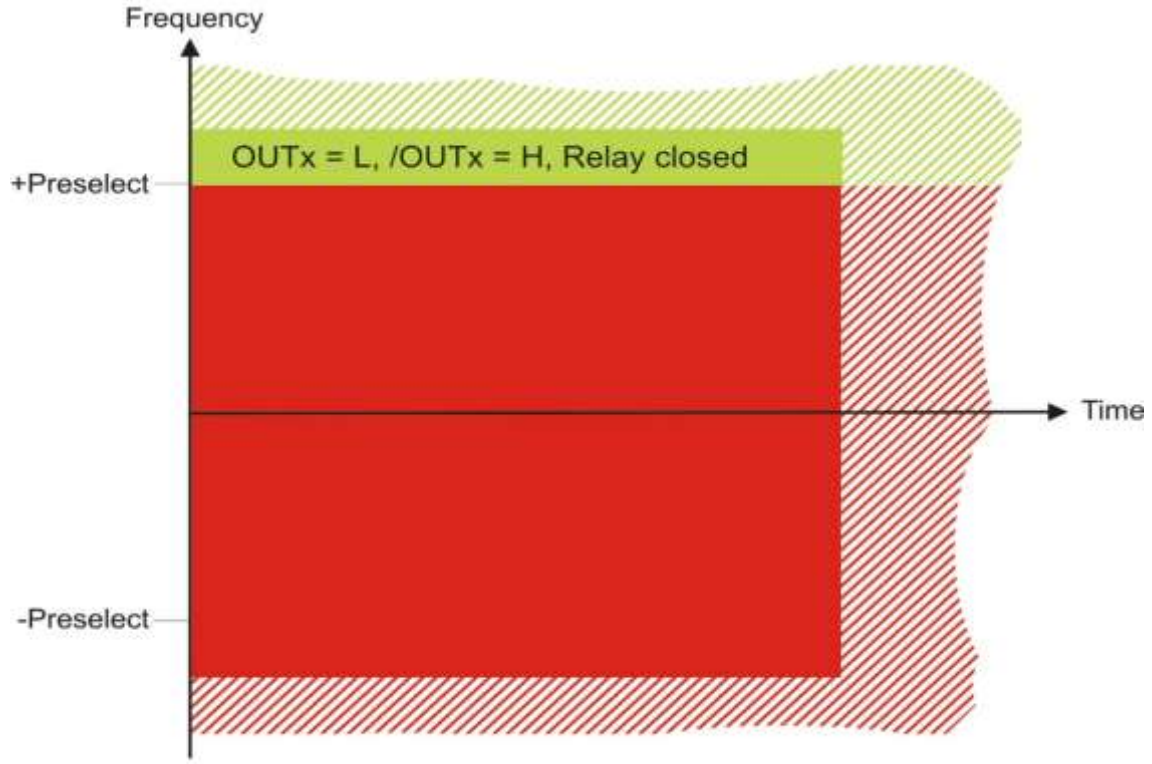
Relevant input functions	Remark
Selfhold function (function: 1-6)	Only if selfhold function is activated
Toggle switching points (function: 13)	Only if commutation function is activated

Example:
With Preselect = 1000.0 Hz and Hysteresis = 10 %, Frequencies f ≥ 1000 Hz are declared as overspeed.
The overspeed output will be cleared with frequencies f < 900 Hz.

11.6. Underspeed (Switch Mode = 5)

With parameter setting "Switch Mode" = 5, the frequency is monitored for underspeed.
The function is always active and considers the direction of rotation. The switching point for underspeed is always at Frequency = Preselect (no matter if with or without hysteresis).

Relevant Parameters	Remark
Switch Mode XXXX	= 5
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Hysteresis XXXX	hysteresis
Startup Mode	type of start-up delay
Startup Output	output assignment for start-up delay
Lock Output	lock function
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	switching point
IN function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



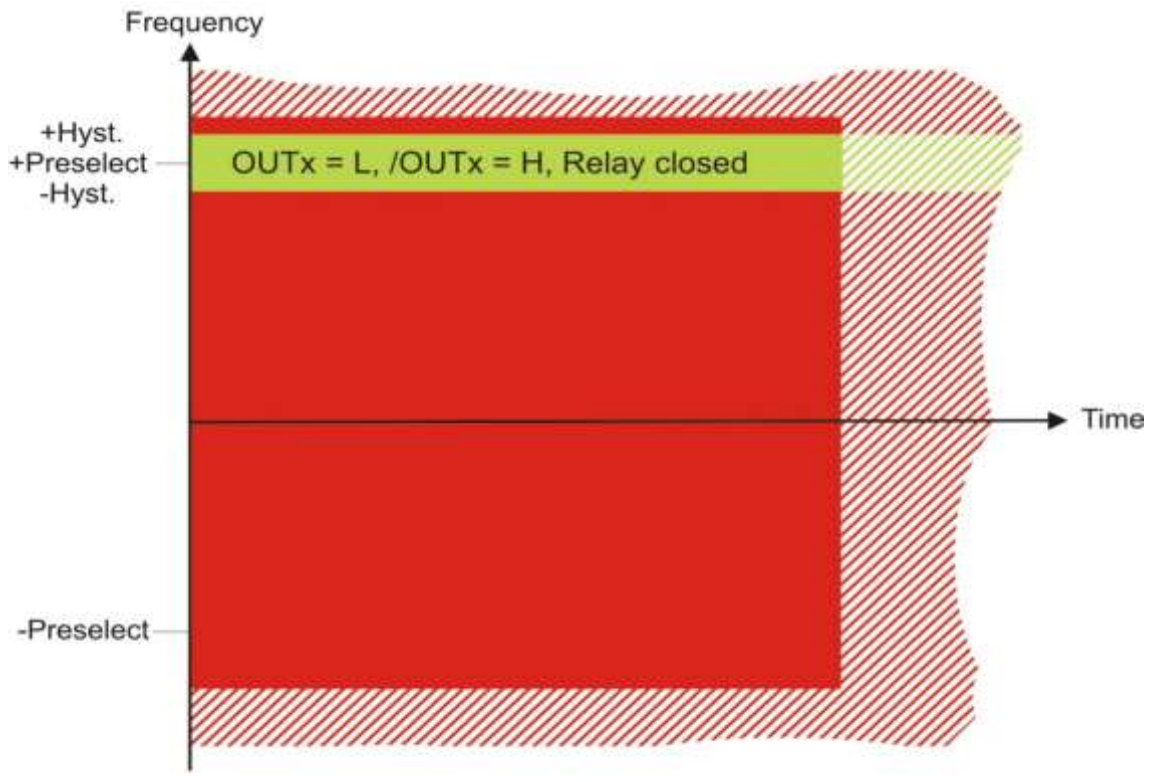
Relevant input functions	Remark
Selfhold function (function: 1-6)	Only if selfhold function is activated
Toggle switching points (function: 13)	Only if commutation function is activated

Example:
With Preselect = 1000.0 Hz and Hysteresis = 10 %, frequencies f < 1000 Hz are declared as underspeed.
The underspeed output will be cleared with frequencies f > 1100 Hz.

11.7. Frequency Band (Switch Mode = 6)

With parameter setting "Switch Mode" = 6, the frequency is monitored within a frequency band. The function is always active. The switching positions inside the frequency band are at Preselect +/- Hysteresis.

Relevant Parameters	Remark
Switch Mode XXXX	= 6
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Hysteresis XXXX	+/- range (center)
Startup Mode	type of start-up delay
Startup Output	output assignment for start-up delay
Lock Output	lock function
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	center
IN function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



Relevant input functions	Remark
Selfhold function (function: 1-6)	Only if selfhold function is activated
Toggle switching points (function: 13)	Only if commutation function is activated

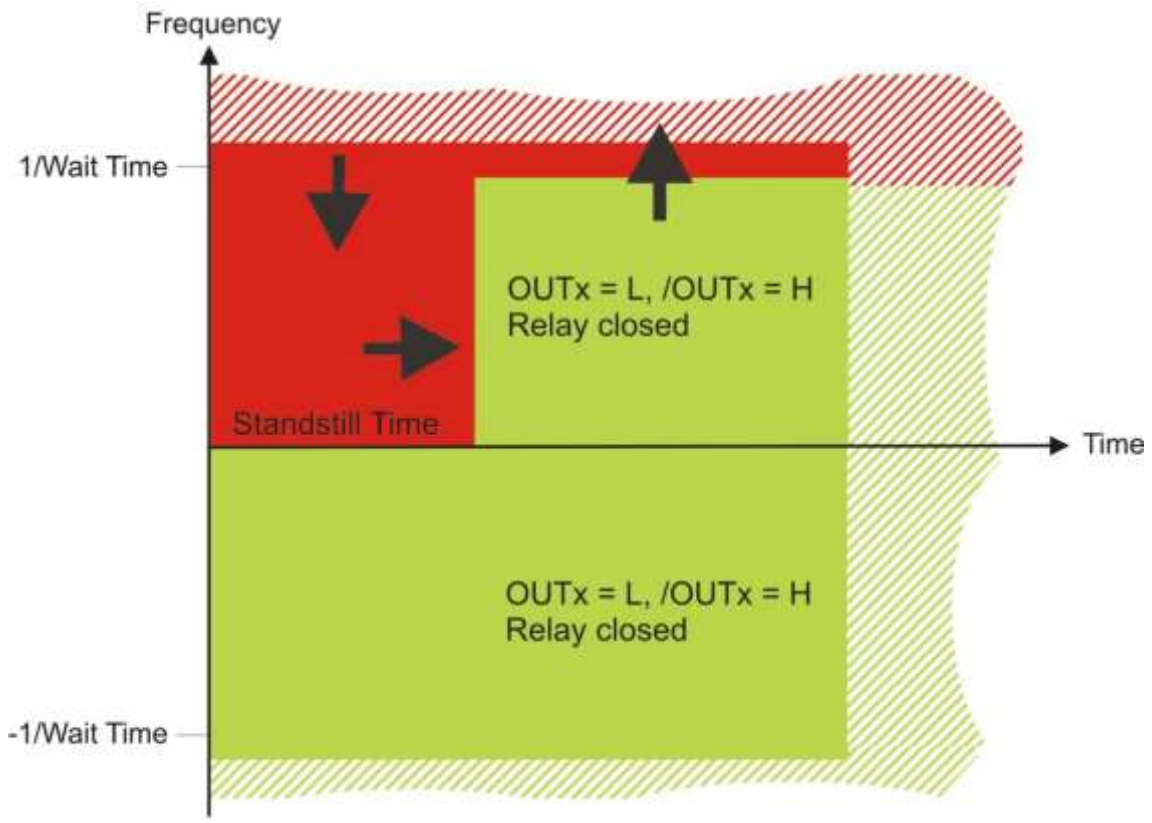
Example:

With Preselect = 1000.0 Hz and Hysteresis = 10 %, frequencies f < 900 Hz are declared as underspeed and frequencies f > 1100 Hz as overspeed.

11.8. Frequency > 0 Hz (Switch Mode = 7)

With parameter setting "Switch Mode" = 7, the direction of the frequency is monitored. The function is always active. With positive frequencies (f > 0 Hz), the output is set to ON. The output will reset with negative frequencies (f < 0 Hz) or with standstill (f = 0 Hz) after expiration of the Standstill Time.

Relevant Parameters	Remark
Switch Mode XXXX	= 7
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Standstill Time	standstill time in seconds
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)



Relevant input functions	Remark
none	none

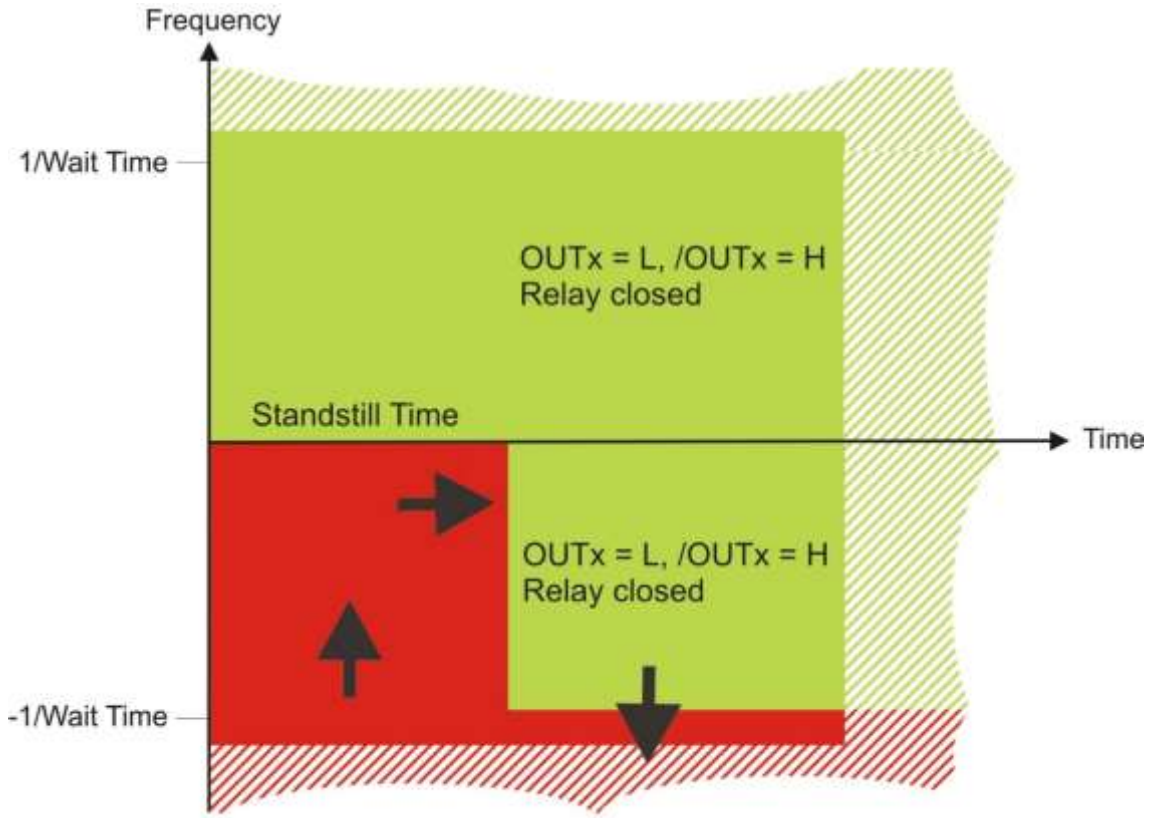
Example:

The transition from a negative to a positive frequency will cause an immediate change of the output state. Only in case of a transition from a positive frequency to zero, the output will not change before Standstill Time has elapsed.

11.9. Frequency < 0 Hz (Switch Mode = 8)

With parameter setting "Switch Mode" = 8, the direction of the frequency is monitored. The function is always active. With negative frequencies (f < 0 Hz), the output is set to ON. The output will reset with positive frequencies (f > 0 Hz) or with standstill (f = 0 Hz) after expiration of the Standstill Time.

Relevant Parameters	Remark
Switch Mode XXXX	= 8
Pulse Time XXXX	statically = 0 or pulse duration in x seconds
Standstill Time	standstill time in seconds
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)



Relevant input functions	Remark
none	none

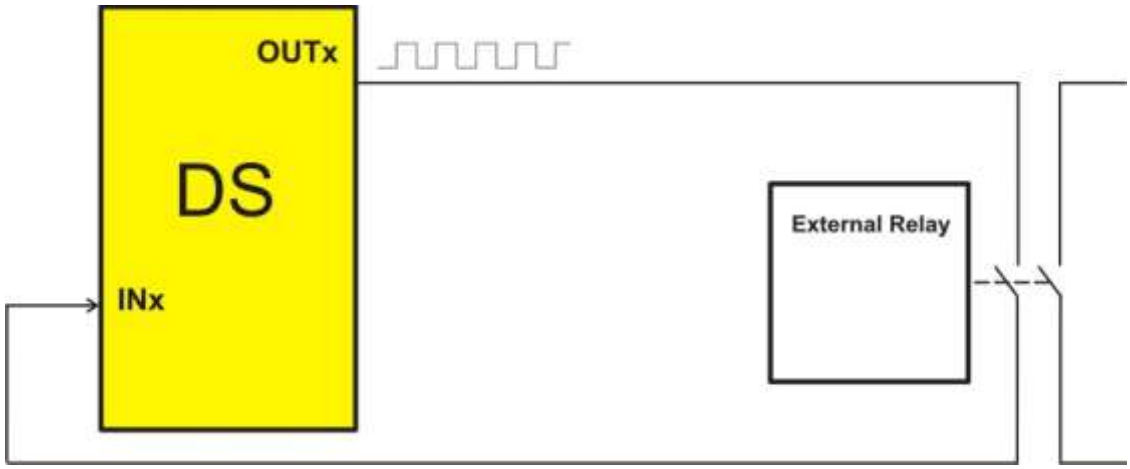
Example:

The transition from a positive to a negative frequency will cause an immediate change of the output state. Only in case of a transition from a negative frequency to zero, the output will not change before Standstill Time has elapsed.

11.10. Clock Generation for Pulsed Readback (Switch Mode = 9)

With parameter setting "Switch Mode" = 9, the output supplies a clock or an inverted clock with a specific frequency. The Output Mode of the output in use must be set to zero. Clock outputs provide different output frequencies. This function is used to monitor the readback contacts of an external relay (see EDM function).

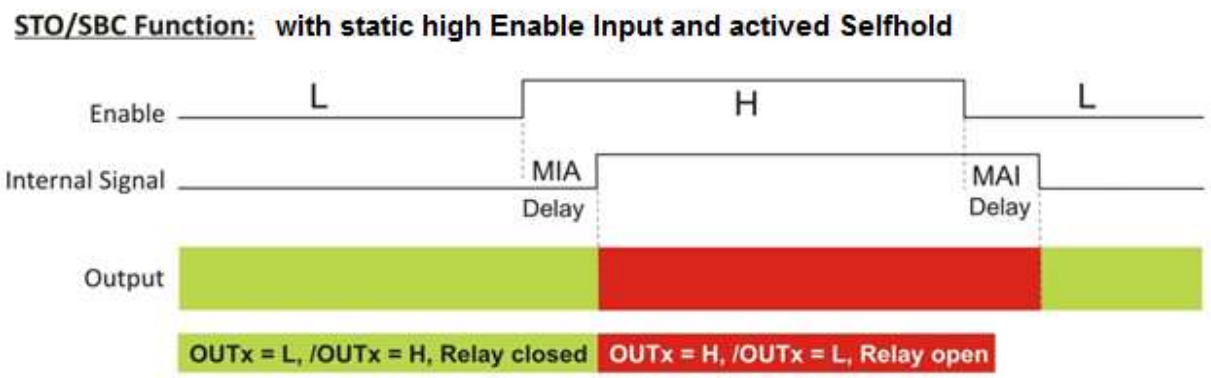
Relevant Parameters	Remark
Switch Mode XXXX	= 9
Output Mode	= 0 for this output (inverse configuration)



11.11. STO/SBC/SS1 by Input (Switch Mode = 10)

With parameter setting "Switch Mode" = 10, an STO, SBC or SS1 function is assigned to the output. The function requires an enable input signal which is assigned by the Matrix parameter. Parameter "Lock Output" can be used to activate a lock function, which can be acknowledged by a further input. Acknowledgement is only possible with deactivated enable signal. There is no frequency or ramp monitoring.

Relevant Parameters	Remark
Switch Mode XXXX	= 10
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0
MAI-Delay XXXX	= 0
Lock Output	for lock function use only range 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
IN Function	Input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if selfhold function is activated

Important: A safety function will not be achieved before the DS230 monitor has been combined with a corresponding actuator unit.

11.12. STO/SBC Produced by Situation (Switch Mode = 10)

If an STO should e.g. be triggered by overspeed, a second feedback output, configured as overspeed can be used as enable input (parameter "Matrix XXXX"). One of the two functions requires a lock function.

Relevant Parameters	Remark
Switch Mode XXXX	= 10
Matrix XXXX	feedback output
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	for lock function use only range 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if selfhold function is activated

11.13. SS1 Produced by Input (Switch Mode = 10)

An SS1 function can be achieved when the STO function is provided with a MIA Delay. After this safe delay time an STO will be triggered. In this case a lock function must be activated. In case the Enable signal should be reset during the delay period, the output will not trigger. There is no frequency or ramp monitoring.

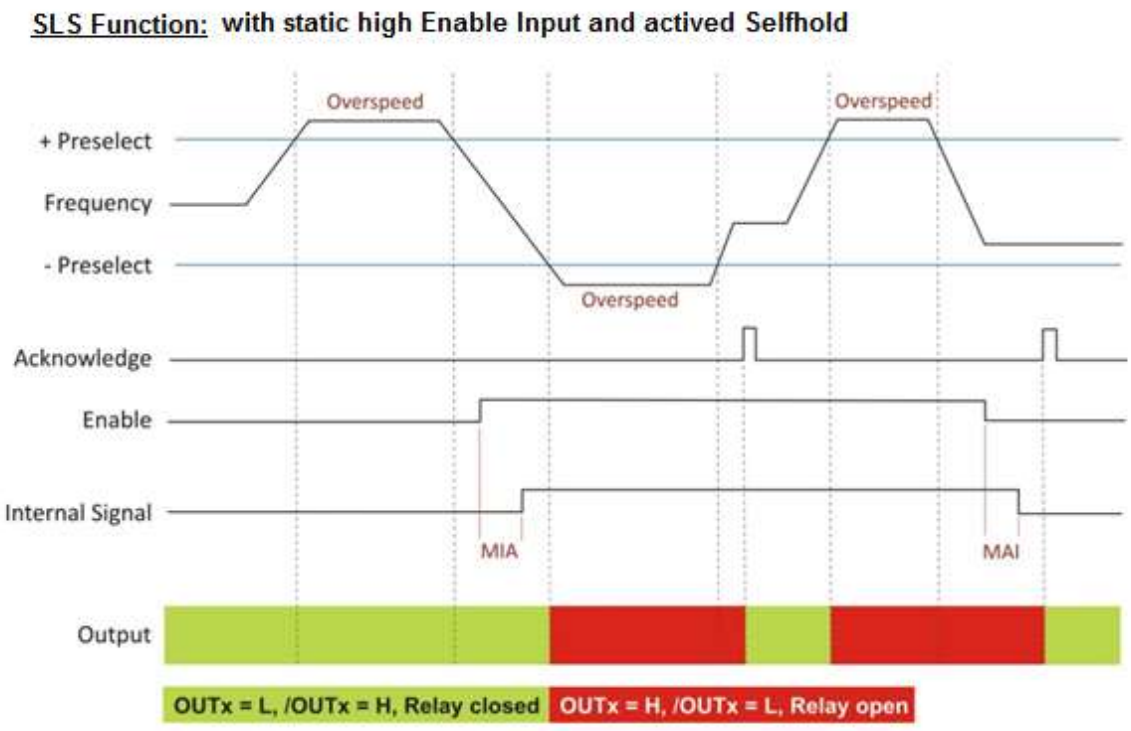
Relevant Parameters	Remark
Switch Mode XXXX	= 10
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	delay time
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	for lock function use only range 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if selfhold function is activated

11.14. SLS Produced by Input (Switch Mode = 11)

With parameter setting “Switch Mode” = 11, an SLS function is assigned to the output. The function is triggered, independent of the direction of rotation, at overspeed. The function requires an enable input signal which must be assigned by parameter Matrix.
Selfhold function can be realized with the parameter "Lock Output". The lock function can be acknowledged by a further input. Acknowledgement is only possible with frequencies below overspeed, or with the enable signal deactivated. No ramp monitoring is available.

Relevant Parameters	Remark
Switch Mode XXXX	= 11
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	Selfhold function, use only range from 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	switching point
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

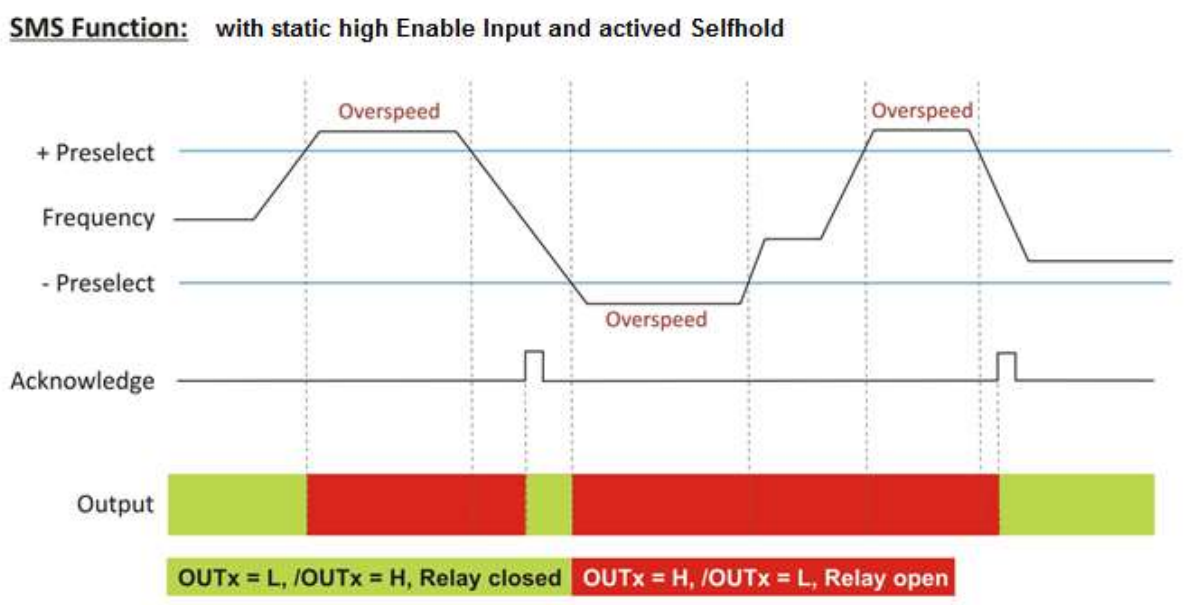


Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if Selfhold function is activated

11.15. SMS (Switch Mode = 12)

With parameter setting “Switch Mode” = 12, an SMS function is assigned to the output. The function is triggered, independent of the direction of rotation, at overspeed. Selfhold function can be realized with the parameter "Lock Output". The lock function can be acknowledged by a further input. Acknowledgement is only possible with frequencies below overspeed. No ramp monitoring is available.

Relevant Parameters	Remark
Switch Mode XXXX	= 12
Lock Output	Selfhold function, use only range from 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	switching point
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

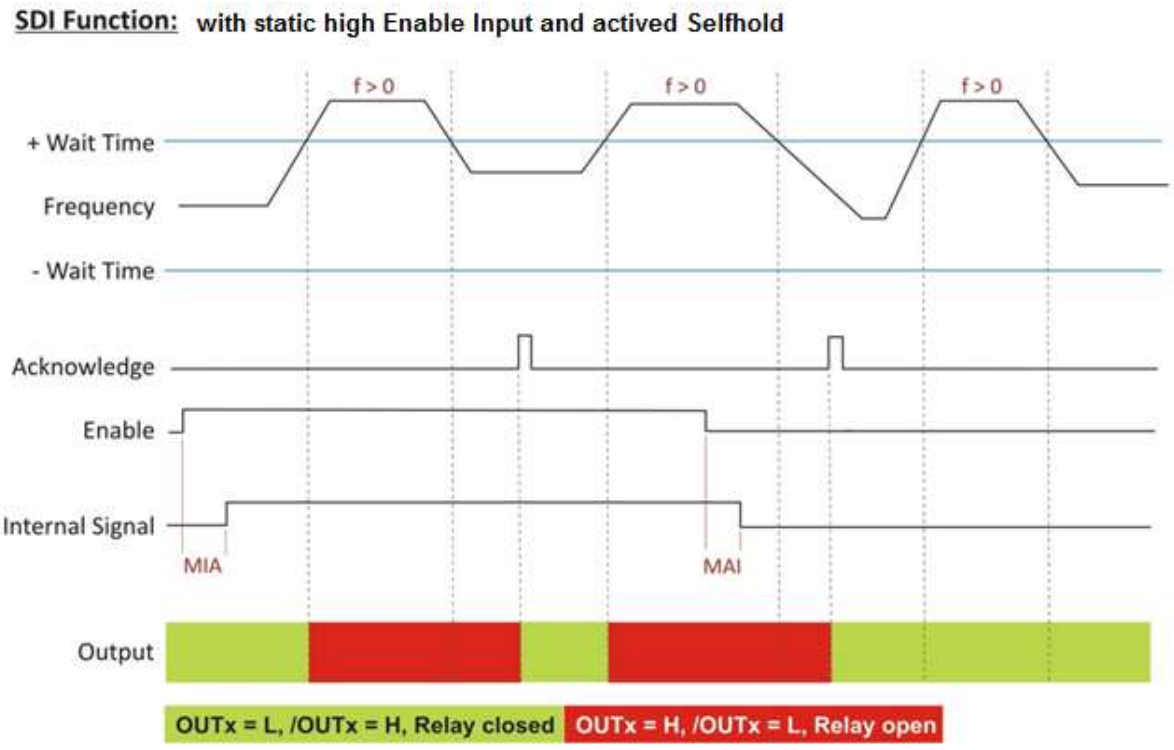


Relevant input functions	Remark
Selfhold function (function: 1-6)	Only if selfhold function is activated

11.16. SDI Produced by Input (f > 0 Hz), (Switch Mode = 13)

With parameter setting “Switch Mode” = 13, an SDI function is assigned to the output. The function is triggered with positive frequency. Selfhold function can be realized with the parameter "Lock Output". The lock function can be acknowledged by a further input. An Acknowledgement is only possible with frequencies lower than or equal to 0 Hz (f ≤ 0 Hz) or with the Enable signal deactivated. The SDI function refers to evaluation of frequency, but not of the position.

Relevant Parameters	Remark
Switch Mode XXXX	= 13
Wait Time	reset time
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	Selfhold function, use only range from 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

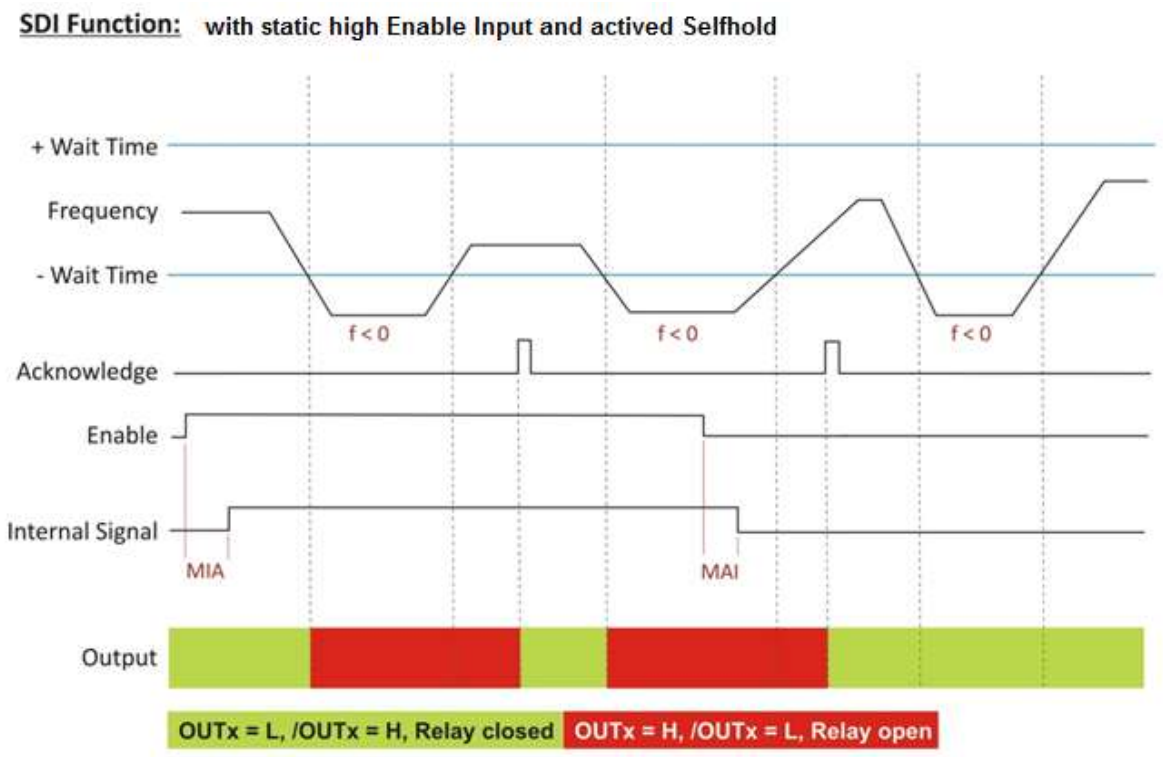


Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if selfhold function is activated

11.17. SDI Produced by Input (f < 0 Hz) (Switch Mode = 14)

With parameter setting “Switch Mode” = 14, an SDI function is assigned to the output. The function is triggered with negative frequency. Selfhold function can be realized with the parameter "Lock Output". The lock function can be acknowledged by a further input. An Acknowledgement is only possible with frequencies higher than or equal to 0 Hz (f ≥ 0 Hz), or with the Enable signal deactivated. The SDI function refers to evaluation of frequency, but not of the position.

Relevant Parameters	Remark
Switch Mode XXXX	= 14
Wait Time	reset time
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	Selfhold function, use only range from 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

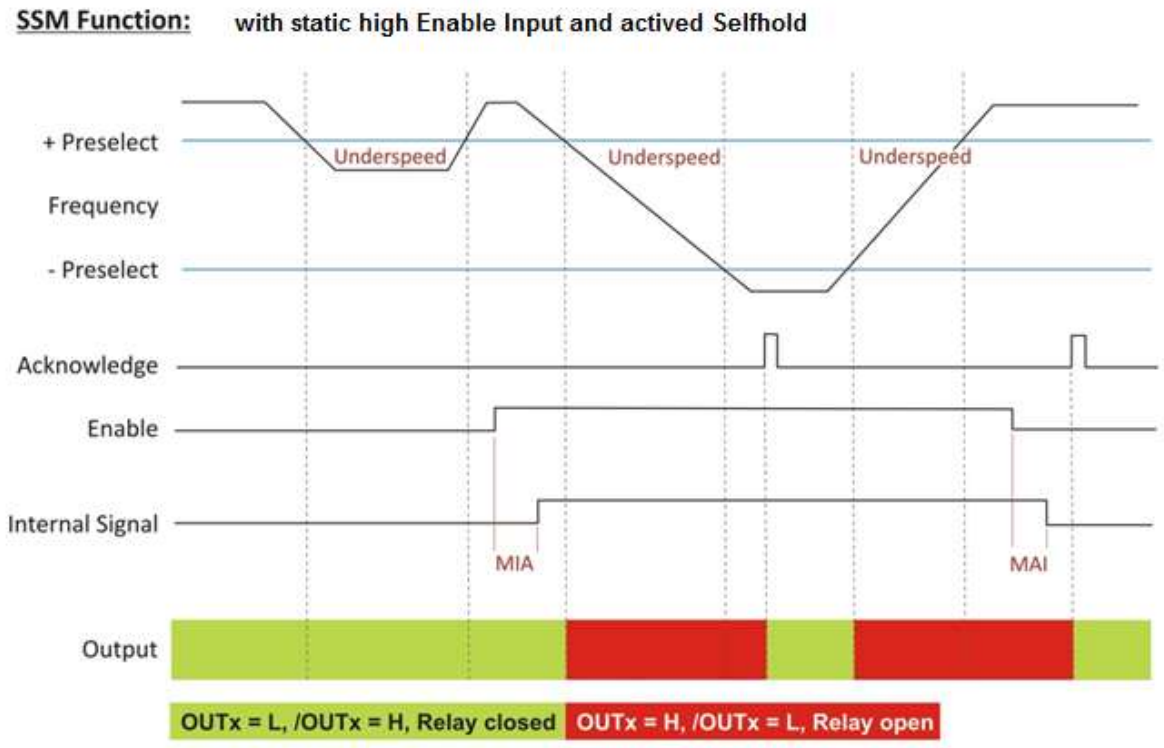


Relevant input functions	Remark
Enable (Function: 21)	Activates the function
unlock lock function (function: 1-6)	Only if selfhold function is activated

11.18. SSM via Input (Switch Mode = 15)

With parameter setting "Switch Mode" = 15, an SSM function is assigned to the output. The function is triggered by underspeed, independent of the direction of rotation. The function requires an enable input signal which must be assigned by parameter Matrix.
A lock function can be set separately, which can be acknowledged by a further input.
Acknowledgement is only possible with frequencies higher than underspeed, or with the enable signal deactivated.

Relevant Parameters	Remark
Switch Mode XXXX	= 15
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	for lock function use only range 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	switching point
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

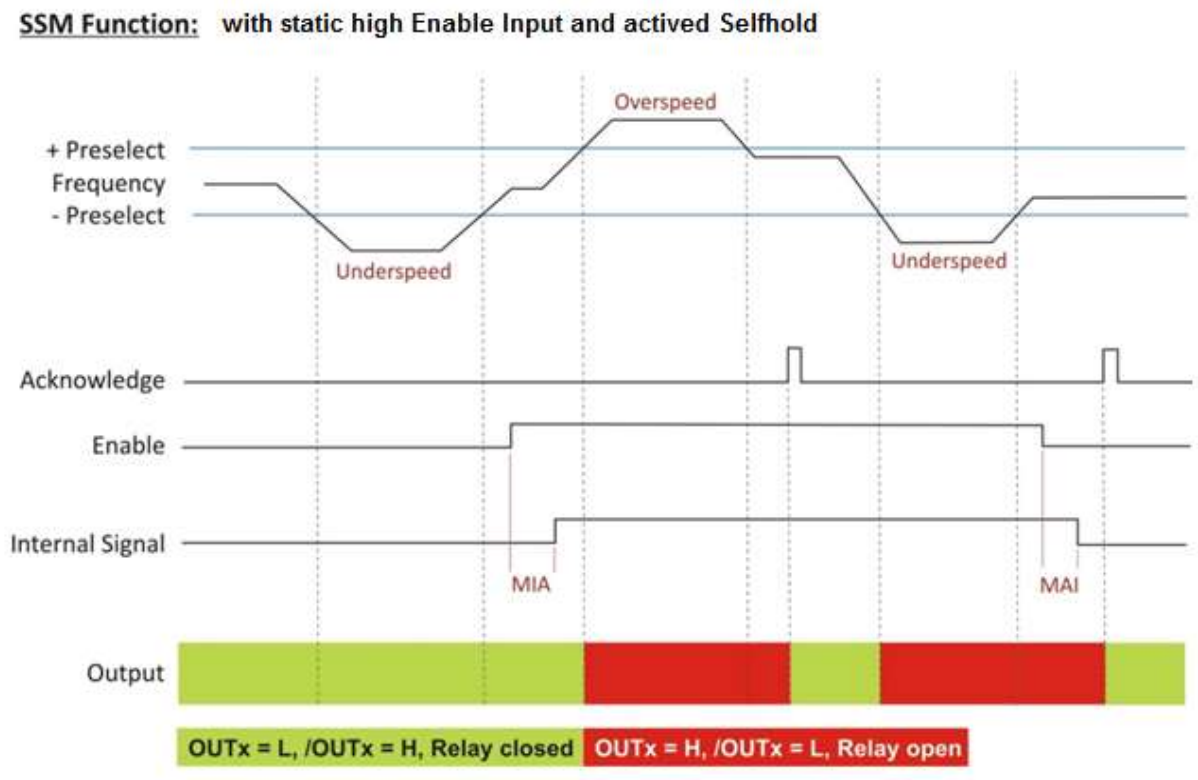


Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if selfhold function is activated

11.19. SSM via Input (Switch Mode = 16)

With parameter setting "Switch Mode" = 16, an SSM function is assigned to the output. The function is triggered when the frequency leaves the frequency band, independent of the direction of rotation. The function requires an enable input signal which must be assigned by parameter Matrix. A lock function can be set separately, which can be acknowledged by a further input. Acknowledgement is only possible with frequencies inside the frequency band, or with the enable signal deactivated.

Relevant Parameters	Remark
Switch Mode XXXX	= 16
Hysteresis XXXX	+/- range (center)
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	for lock function use only range 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. L/H	center
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

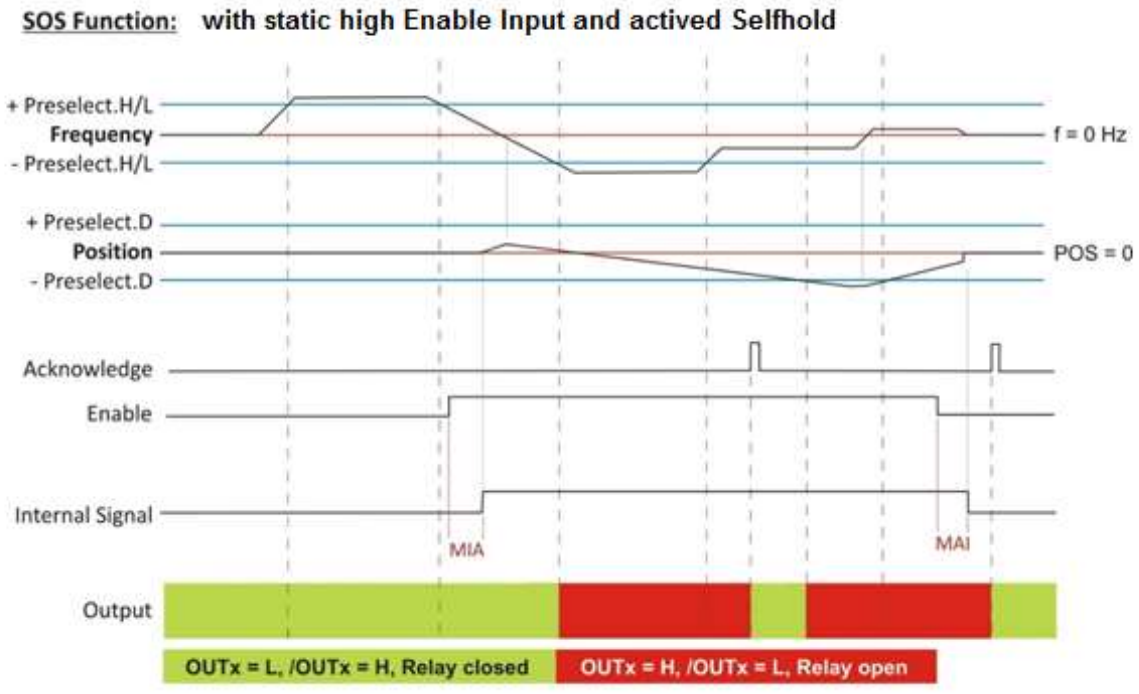


Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if selfhold function is activated

11.20. SOS/SLI/SS2 via Input (Switch Mode = 17)

With parameter setting "Switch Mode" = 17, an SOS/SLI/SS2 function is assigned to the output. This function will be triggered by overspeed or by position error, with no regard of the direction of rotation. An enable input signal is required, which can be assigned by the Matrix parameter. Selfhold function can be switched on. The lock function can be acknowledged by a further input. Acknowledgement is only possible with frequencies lower than overspeed, or with the enable signal deactivated. By switching the enable signal from inactive to active, the current position is adopted for error evaluation. SLI and SOS are different with regard to the level of the switching points only. While SLI corresponds to a monitored Jog operation, SOS provides standstill monitoring. A position error can be acknowledged only by disabling the Enable signal. Any SOS function with MIA Delay unequal to zero will turn to an SS2 function.

Relevant Parameters	Remark
Switch Mode XXXX	= 17
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need, SS2)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	Selfhold function, use only range from 0-31
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Delay XXXX	Shutter delay
Preselect XXX. D	switching point for position
Preselect XXX. L/H	switching point for overspeed
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions

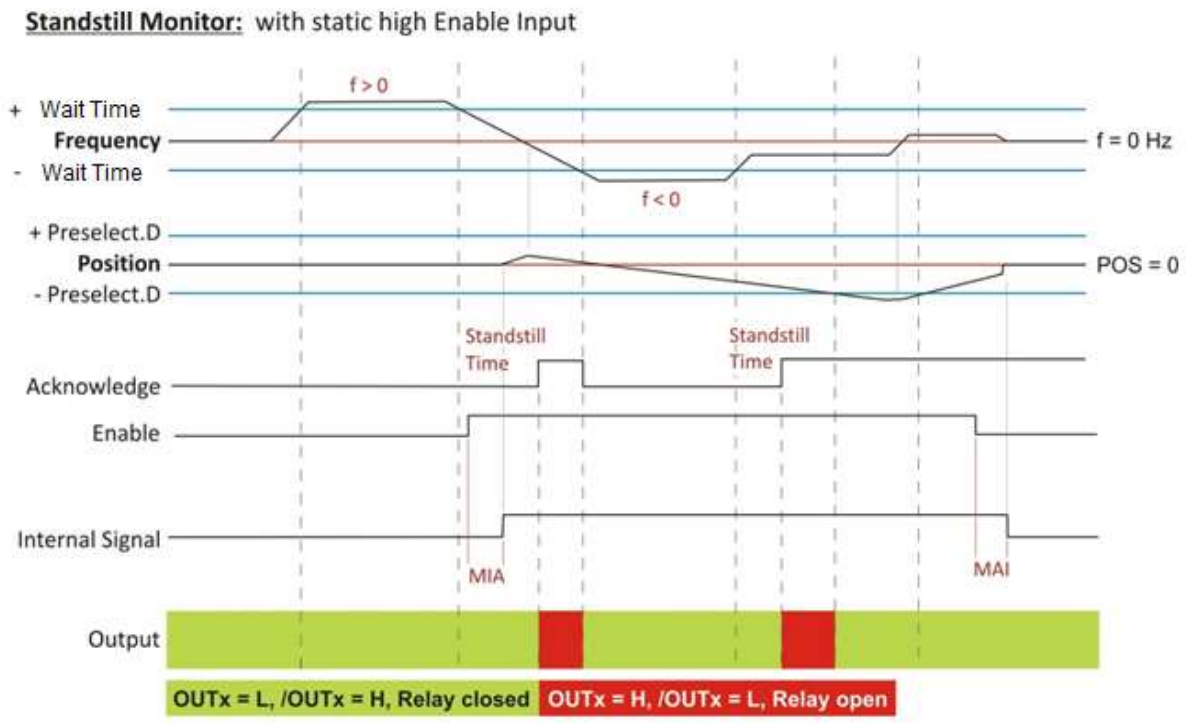


Relevant input functions	Remark
Enable (Function: 21)	Activates the function
Selfhold function (function: 1-6)	Only if selfhold function is activated

11.21. Standstill via Input (Switch Mode = 18)

With parameter setting "Switch Mode" = 18, a standstill function is assigned to the output. The function is triggered at standstill. The function requires an enable input signal which can be assigned by parameter Matrix. There is no lock function implemented. By switching the enable signal from inactive to active, the current position will be adopted for error evaluation. The output is set after Standstill Time has elapsed. In case of a position error, or with a frequency unequal to zero, the output will reset. Position errors can be cleared only by deactivation of the Enable signal.

Relevant Parameters	Remark
Switch Mode XXXX	= 18
Wait Time	reset time
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Output Mode	homogenous or inverse (affects the Safety Integrity Level SIL)
Preselect XXX. D	switching point for position
Standstill Time	time (sec.)
IN Function	input function
IN Config	switching behavior (dynamically, statically)
Input Mode	input configuration (affects the Safety Integrity Level SIL)
GPI Err Time	Max. permissible delay time during illegal conditions



Relevant input functions	Remark
Enable (Function: 21)	Activates the function

11.22. Reserved (Switch Mode = 19)

This Switch Mode is reseved for factory tests.

11.23. No Standstill (Switch Mode = 20)

If the parameter „Switch Mode“ is set to 20, the functionality corresponds to the inverted Switch Mode = 3. The function is always active as in the Switch Mode = 3, but the output can only be set up statically.
With this function, the relay output is invertedly controlled to the Switch Mode=3, the relay is closed at standstill and opened for frequencies different to zero. The Standstill Time defines a delay before standstill is detected.

Relevant Parameters	Remark
Switch Mode XXXX	= 20
Pulse Time XXXX	Only statically = 0
Standstill Time	Standstill time in x seconds
Output Mode	homogenous or inverse output configuration (affects the Safety Integrity Level SIL)

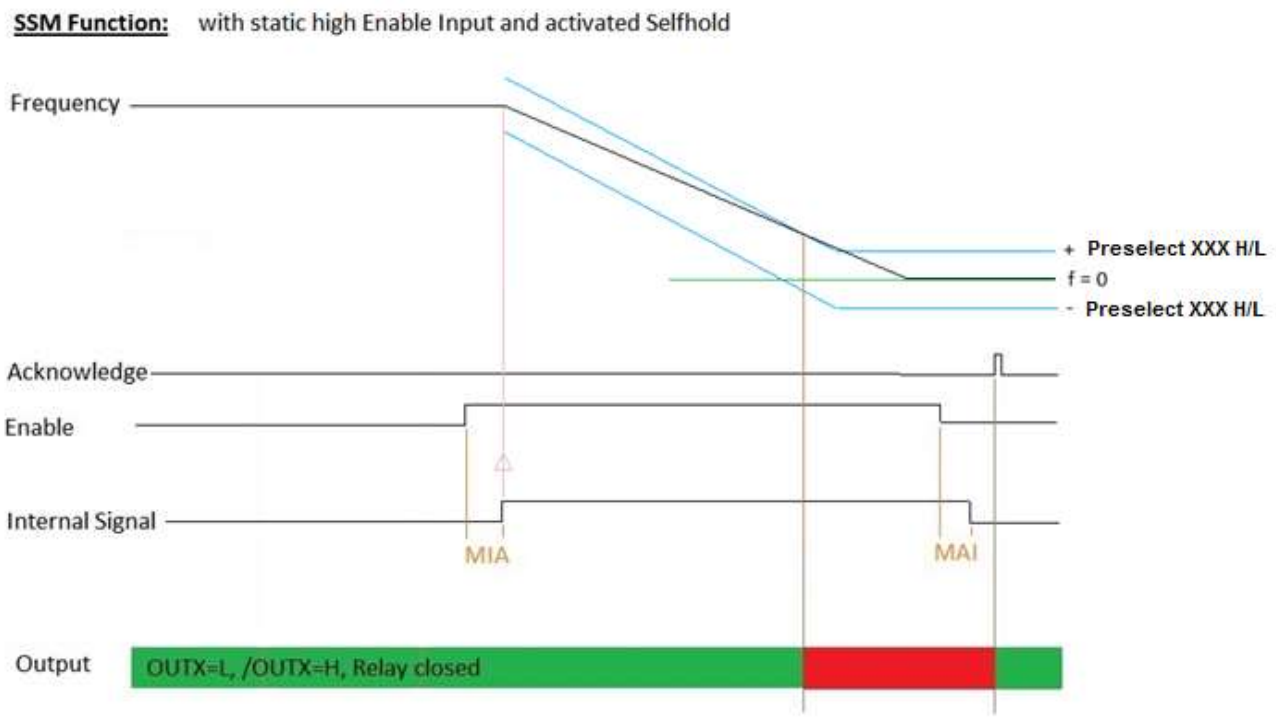
Relevant Input function	Remark
no	no

11.24. Ramp monitoring (Switch Mode = 21)

With parameter setting “Switch Mode” = 21, a ramp monitoring function is assigned to the output. The requirement for ramp monitoring is that the braking behavior follows a linear function of frequency and time. During the transition from inactive to active enable flank, the current frequency is cached in the device and the expected frequency can be determined by the pre-programmed ramp parameter "Presel XXXX .F". If the current frequency deviates so that the precalculated window "Presel. XXXX.H/L " is left, the output is set. An enable input signal is required for the function, which is assigned by the parameter "Matrix XXXX" ". A lock function can be attributed. The lock function can be acknowledged by a further input. A confirmation is only possible if the enable signal is disabled.

Continuation **„ramp monitoring (Switch Mode = 21)“**:

Relevant Parameters	Remark
Switch Mode XXXX	= 21
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	Selfhold function, use only range 0-31
Output Mode	homogenous or inverse output configuration (affects the Safety Integrity Level SIL/PL)
Delay XXXX	shutter release delay
Preselect XXXX.H/L	+/-range from the cached center point
Preselect XXXX.F	Entering the brake ramp
IN Function	configuration of the control inputs (affects the safety level SIL/PL)
IN Config	function of the control input
Input Mode	switching behaviour (single-channel, two-channel, inverse, homogeneous, dynamic, static)
GPI Err Time	max. permissible delay time during illegal conditions



Relevant Input function	Remark
Enable, e.g. Parameter „IN1 Function“ = 21	Activates the function
Clear lock function, e.g. parameter „IN2 Function“ = 1 … 6	Only when lock function is active

Continuation „ramp monitoring (Switch Mode = 21)“:

The window is determined by the "Presel XXXX.H/L " and is entered directly in 0.00 Hz values. An input of 100.00 Hz generates a window of +/-100.00 Hz by the calculated frequency. The parameter "Presel XXXX.F " indicates the braking ramp.
If lock function has been activated, the Delay parameter must also be activated. It must be set at least to the smallest value of 2ms.

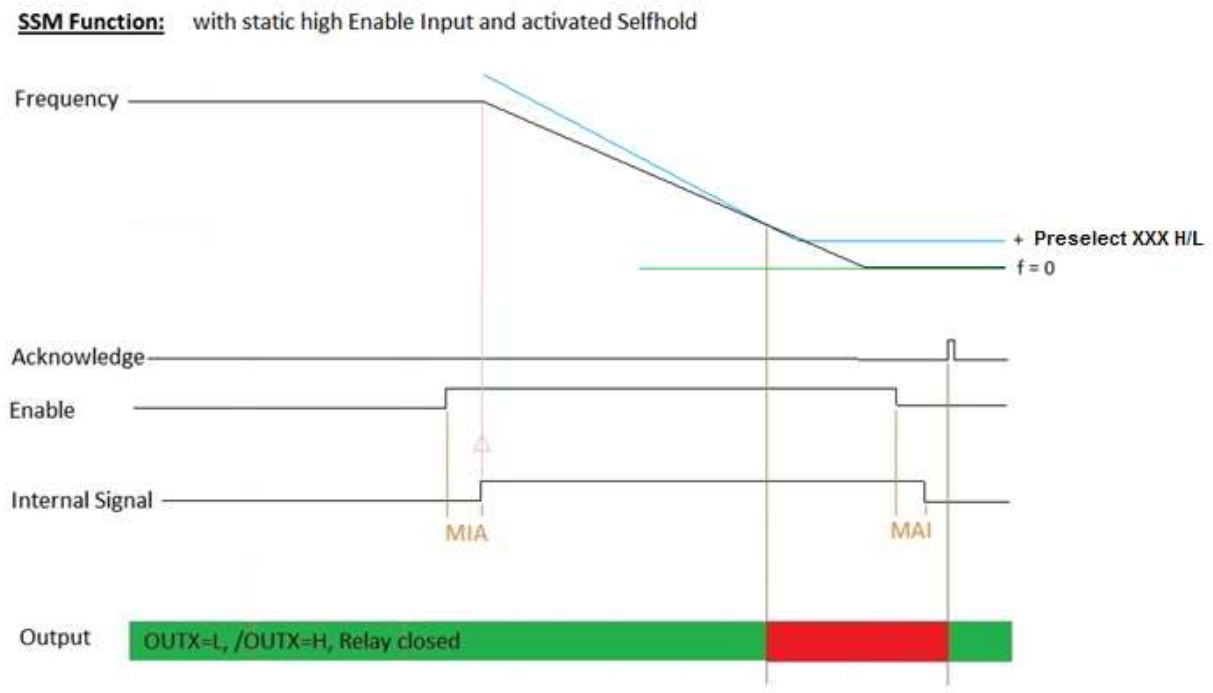
Example:
If a braking ramp is triggered from 0.01 Hz/ms at 1353 Hz, the time to 0 Hz is reached: 1353 Hz/(0.01 Hz/ms) = 135.3 s = 2min 15,3s
To determine the ramp, the drive should be braked at e.g. 1kHz and the time duration measured. The parameter value follows by calculation.

11.25. Ramp monitoring (Switch Mode = 22)

With parameter setting “Switch Mode” = 22, a ramp monitoring function is assigned to the output. The requirement for ramp monitoring is that the braking behavior follows a linear function of frequency and time. During the transition from inactive to active enable flank, the current frequency is cached in the device and the expected frequency can be determined by the pre-programmed ramp parameter "Presel. XXXX.F ". In contrast to switch mode = 21, only one monitoring of the ramp is carried out.
If the current frequency is greater, so that the precalculated window "Presel. XXXX.H/L " is left, the output is set. If the current frequency is smaller, so that the calculated window is left, the output is not set. An enable input signal is required for the function, which is assigned by the parameter "Matrix XXXX ". A lock function can be attributed. The lock function can be acknowledged by a further input. A confirmation is only possible if the enable signal is disabled.

Relevant Parameters	Remark
Switch Mode XXXX	= 22
Matrix XXXX	use only inputs, but no feedback outputs
MIA-Delay XXXX	= 0 (can also be set according to need)
MAI-Delay XXXX	= 0 (can also be set according to need)
Lock Output	for lock function use only range 0-31
Output Mode	homogenous or inverse output configuration (affects the Safety Integrity Level SIL/PL)
Delay XXXX	shutter release delay
Preselect XXXX.H/L	+/-range from the cached center point
Preselect XXXX.F	Entering the brake ramp
IN Function	configuration of the control inputs (affects the safety level SIL/PL)
IN Config	function of the control input
Input Mode	switching behaviour (single-channel, two-channel, inverse, homogeneous, dynamic, static)
GPI Err Time	max. permissible delay time during illegal conditions

Continuation „ramp monitoring (Switch Mode = 22)“:



Relevant Input function	Remark
Enable, e.g. Parameter „IN1 Function“ = 21	Activates the function
Selfhold function, e.g. parameter „IN2 Function“ = 1 … 6	Only when selfhold function is active

The window is determined by the "Presel. XXXX.H/L " and is entered directly in 0.00 Hz values. An input of 100.00 Hz generates a range of + 100.00 Hz by the calculated frequency. The parameter "Presel. XXXX.F F" indicates the braking ramp.

If lock function has been activated, the Delay parameter must also be activated. It must be set at least to the smallest value of 2ms.

Example:
If a braking ramp is triggered from 0.01 Hz/ms at 1353 Hz, the time to 0 Hz is reached: 1353 Hz/(0.01 Hz/ms) = 135.3 s = 2min 15,3s
To determine the ramp, the drive should be braked at e.g. 1kHz and the time duration measured. The parameter value follows by calculation.

12. Response times

12.1. Response Time of the Relay Output

Hardware delay of the relay itself: 50 ms (max.)

With normal monitoring of overspeed, underspeed or frequency band: (with frequency band please choose the lower frequency, since this produces more delay)	
2 x Sampling Time + 25 ms	for frequencies > 1 / Sampling Time
e.g. f = 10 kHz, Sampling Time = 1 ms	10 kHz > 1 kHz -> delay = 27 ms
2 x 1/frequency + 25 ms	for frequencies < 1 / Sampling Time
e.g.. f = 100 Hz, Sampling Time = 1 ms	100 Hz < 1 kHz -> delay = 45 ms

With normal monitoring of standstill:	
2 x Wait Time + Standstill Time + 25 ms	for frequency = 0
e. g. Standstill Time = 0 ms, Wait Time = 100 ms	delay = 225 ms

These response times are based on a step function.
For this times, the parameter "Filter" is not regarded. If Filter is activated, Sampling Time or 1/frequency has to be multiplied by the factor x 5. (5 = a final value about 100% is reached, 3= a final value about 95% is reached).
With a system error (critical internal error) the response time will be
85 ms + 25 ms =110 ms (valid for versions 3B or higher)

12.2. Response Time of the Analog Output

Hardware delay of the analog output itself: 1 ms

With normal monitoring of overspeed, underspeed or frequency band: (with frequency band please choose the lower frequency, since this produces more delay)	
2 x Sampling Time + 1 ms e.g. f = 10 kHz, Sampling Time = 1 ms	for frequencies > 1 / Sampling Time 10 kHz > 1 kHz -> delay = 3 ms
2 x 1/frequency + 1 ms e.g. f = 100 Hz, Sampling Time = 1 ms	for frequencies < 1 / Sampling Time 100Hz < 1 kHz -> delay = 21 ms

With normal monitoring of standstill:	
2 x Wait Time + Standstill Time + 1 ms e.g. Standstill Time = 0, Wait Time = 100 m s	for frequency = 0 delay = 201 ms

These response times are based on a step function.
For this times, the parameter "Filter" is not regarded. If Filter is activated, Sampling Time or 1/frequency has to be multiplied by the factor x 5. (5 = a final value about 100% is reached, 3= a final value about 95% is reached).
With a system error (critical internal error) the response time will be
85 ms + 1 ms =86 ms (valid for versions 3B or higher)

12.3. Response Time of the Digital Outputs

Hardware delay of the digital output itself: 1 ms

With normal monitoring of overspeed, underspeed or frequency band: (with frequency band please choose the lower frequency, since this produces more delay)	
2 x Sampling Time + 1 ms	for frequencies > 1 / Sampling Time
e.g. f = 10 kHz, Sampling Time = 1 ms	10 kHz > 1 kHz -> delay = 3 ms
2 x 1/frequency + 1 ms	for frequencies < 1 / Sampling Time
e.g. f = 100 Hz, Sampling Time = 1 ms	100Hz < 1 kHz -> delay = 21 ms

With normal monitoring of standstill:	
2 x Wait Time + Standstill Time + 1 ms	for frequency = 0
e.g. Standstill Time = 0, Wait Time = 100 ms	delay = 201 ms

These response times are based on a step function.
For this times, the parameter "Filter" is not regarded. If Filter is abled, Sampling Time or 1/frequency has to multiplied by the factor x 5. (5 = a final value about 100% is reached, 3= a final value about 95% is reached).
With a system error (critical internal error) the response time will be
85 ms + 1 ms =86 ms (valid for versions 3B or higher)

12.4. Response Time of the Splitter Output:

Hardware delay of the splitter output itself: 1 ms

These response times are based on a step function.
With a system error (critical internal error) the response time will be
85 ms + 1 ms = 86 ms (valid for versions 3B or higher)

12.5. Response Time of the Frequency Error Evaluation

Response time with a sudden frequency drop:

Time calculations in the subsequent tables assume the following settings:
Sampling Time = 10 ms, Wait Time = 100 ms

Valid for versions 3B or higher:

- Use Sampling Time for the calculation when f > 1/Sampling Time
- Use reciprocal frequency 1/f when f < 1/Sampling Time

In addition to the delay times shown in the tables below, please add also the hardware delay time of the corresponding output
(relay = 25 ms, analog output = 1 ms, digital output = 1 ms). The parameter Filter is excluded.

***) Calculated values for response times assume that "Sampling Time" would be greater than the reciprocal frequency 1/f.**

Div. Filter = 10	
With „Div. %-Value" = 10:	11 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 210 ms*)
With „Div. %-Value" = 20:	21 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 310 ms*)
With „Div. %-Value" = 30:	31 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 410 ms*)
With „Div. %-Value" = 40:	41 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 510 ms*)

Div. Filter = 5	
With „Div. %-Value" = 10:	5 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 150 ms*)
With „Div. %-Value" = 20:	10 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 200 ms*)
With „Div. %-Value" = 30:	15 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 250 ms*)
With „Div. %-Value" = 40:	21 x (Sampling Time or (1/f)) + 1x Wait Time -> delay = 310 ms*)

Div. Filter = 3	
With „Div. %-Value" = 10:	1 x (Sampling Time or (1/f)) + 1x Wait Time -> delay 110 ms*)
With „Div. %-Value" = 20:	2 x (Sampling Time or (1/f)) + 1x Wait Time -> delay 120 ms*)
With „Div. %-Value" = 30:	3 x (Sampling Time or (1/f)) + 1x Wait Time -> delay 130 ms*)
With „Div. %-Value" = 40:	5 x (Sampling Time or (1/f)) + 1x Wait Time -> delay 150 ms*)

Filtering effect with a frequency drop of 10 %	
Div. Filter = 3 and Div. %-Value = 10:	tripping after 9 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 10:	tripping after 10 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 10:	tripping after 10 x (Sampling Time or 1/f)

Filtering effect with a frequency drop of 20 %	
Div. Filter = 3 and Div. %-Value = 20:	tripping after 13 x (Sampling Time or 1/f)
Div. Filter = 3 and Div. %-Value = 10:	tripping after 4 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 20:	tripping after 20 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 10:	tripping after 10 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 20:	tripping after 20 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 10:	tripping after 10 x (Sampling Time or 1/f)

Filtering effect with a frequency drop of 30 %	
Div. Filter = 3 and Div. %-Value = 30:	tripping after 16 x (Sampling Time or 1/f)
Div. Filter = 3 and Div. %-Value = 20:	tripping after 7 x (Sampling Time or 1/f)
Div. Filter = 3 and Div. %-Value = 10:	tripping after 3 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 30:	tripping after 30 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 20:	tripping after 20 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 10:	tripping after 10 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 30:	tripping after 30 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 20:	tripping after 20 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 10:	tripping after 10 x (Sampling Time or 1/f)

Filtering effect at a frequency drop of 40 %	
Div. Filter = 3 and Div. %-Value = 40:	tripping after 18 x (Sampling Time or 1/f)
Div. Filter = 3 and Div. %-Value = 30:	tripping after 9 x (Sampling Time or 1/f)
Div. Filter = 3 and Div. %-Value = 20:	tripping after 5 x (Sampling Time or 1/f)
Div. Filter = 3 and Div. %-Value = 10:	tripping after 2 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 40:	tripping after 36 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 30:	tripping after 26 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 20:	tripping after 16 x (Sampling Time or 1/f)
Div. Filter = 5 and Div. %-Value = 10:	tripping after 6 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 40:	tripping after 40 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 30:	tripping after 30 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 20:	tripping after 20 x (Sampling Time or 1/f)
Div. Filter = 10 and Div. %-Value = 10:	tripping after 10 x (Sampling Time or 1/f)

13. Connection of the Inputs

There are different ways to connect the inputs. The DS2xx monitors offer HTL inputs with SIL3 capability, provided that their configuration is set to two-pole-inverse operation. The finally resulting Safety Integration Level (SIL) however also depends on the remote circuit and on the configuration.

Relevant Parameters	Remark
xINx Config	Input characteristics (bipolar, unipolar, clocked)
Input Mode	Configuration of inputs (individual input, signal pair, mixed)
Switch Mode XXXX	=9, when an output is used for clock generation with clocked input
Output Mode	Clock output must be set to "inverse"
GPI Err Time	Max. permissible delay time during illegal conditions

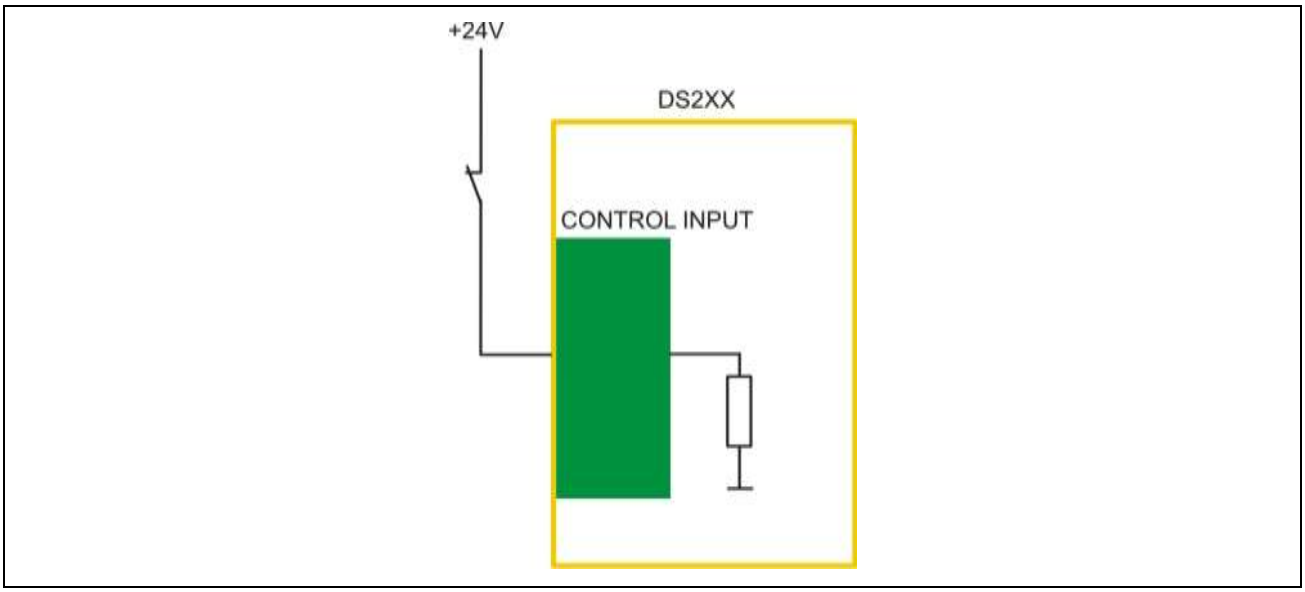
- Unipolar, un-clocked inputs provide SIL = 1 only
- Unipolar, clocked inputs can reach SIL = 1 - 2
- Bipolar, un-clocked inputs can reach SIL = 2 - 3

Where you utilize clocked inputs, for the clock generation you should use OUT1, OUT2 and OUT3 first, and lastly OUT4. The clock outputs are different regarding the output frequency, and OUT1 is able to emit the highest frequency.

Both output tracks can be used due to the 180° phase displacement (please observe parameter „Output Mode")

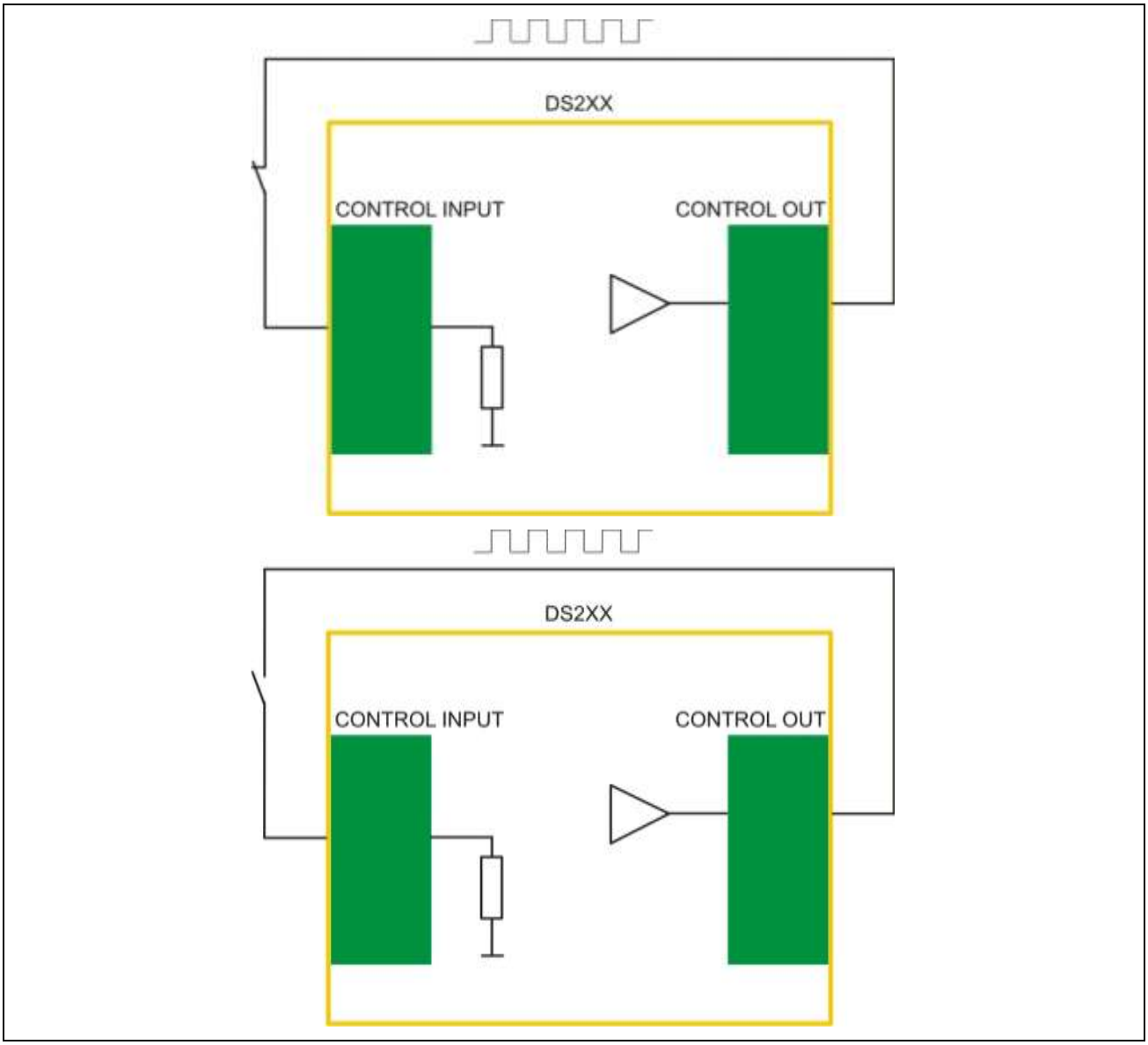
13.1. Connection of Unipolar, Un-Clocked Inputs

Unipolar, un-clocked inputs are connected as shown below. Alternatively a change-over contact can be used, toggling between GND and +24 V. Unipolar, un-clocked inputs provide Safety Integrity Level (SIL) = 1. Parameter "xINx Config" must be set to a value between 8 and 11. Parameter "Input Mode" must be set to 1 or 2. No errors can be detected, so there is no influence on the response time.



13.2. Connection of Unipolar, Clocked Inputs

Unipolar, clocked inputs are connected as shown below. This type of input reaches a Safety Integrity Level (SIL) = 1 - 2. Parameter "xINx Config" must be set to a value between 20 and 35. Parameter "Input Mode" must be set to 1 or 2. For clock generation, one of the outputs must be available. In case of incorrect or missing clock signal, the tripping function (static high/low) must be chosen in a way that no safety risk can come up (line interruption and switching failure cannot be detected). In case of error, a Runtime Readback Digital Output Error will result and the response time will be approx. 20 ms.

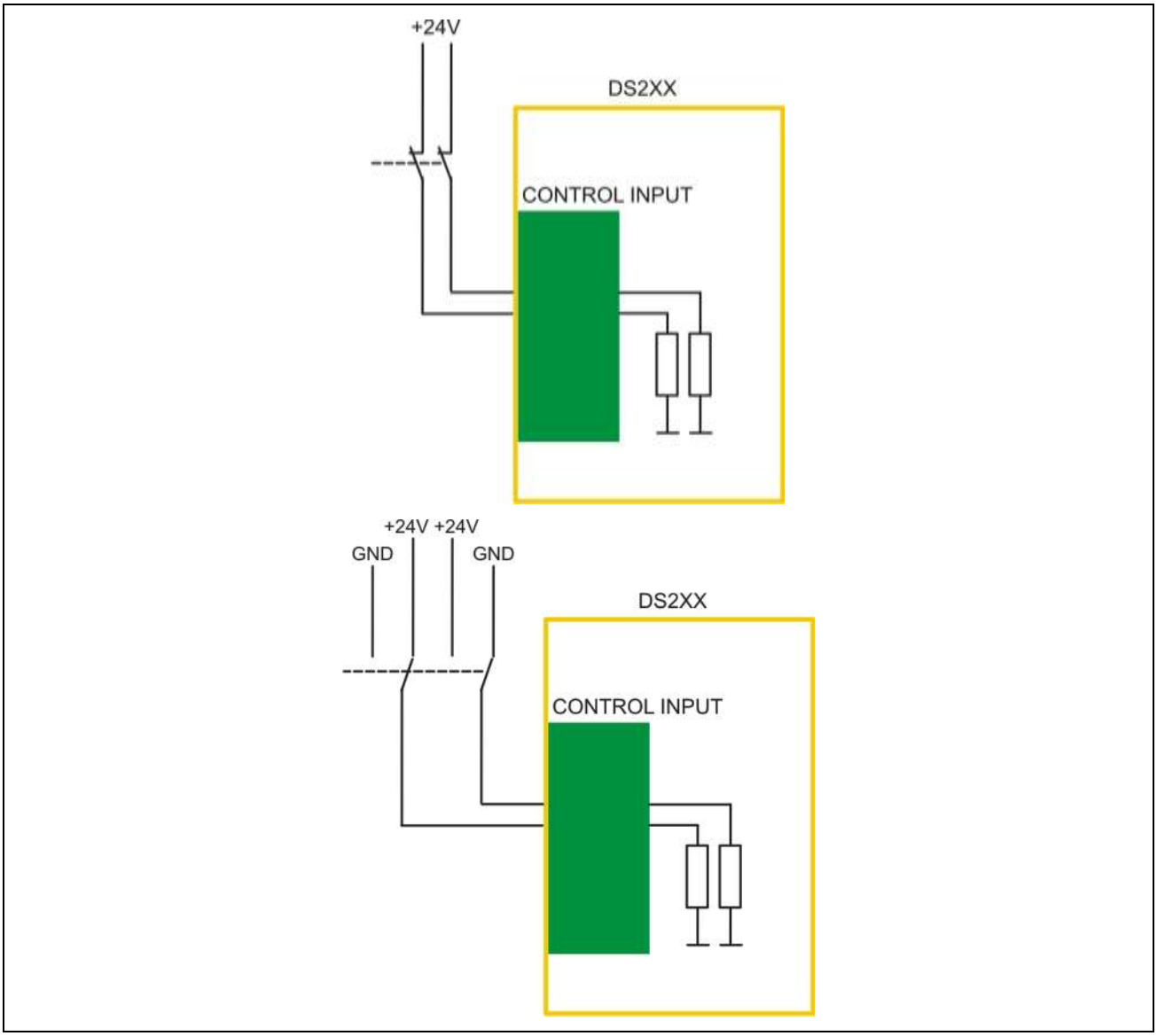


Impacts to the final Safety Integrity Level (SIL):

- Separate areas for cable leads of switch cables
- Forcibly guided and redundant series contacts
- Protected switch terminals to avoid short circuits and shunt faults
- MTTFd specification if the switch

13.3. Connection of Bipolar, Un-Clocked Inputs

Bipolar, un-clocked inputs can be connected as shown below. This type of input reaches a Safety Integrity Level (SIL) = 2 - 3. (homogenous = 2 - 3, inverse = 3). Parameter "xINx Config" must be set to a value between 0 and 7. Parameter "Input Mode" must be set to 0 or 1. In case of error, a Runtime GPI Error will result and the response time will be approx. 20ms. Parameter GPI Err Time defines the max. permissible delay time during illegal conditons (1 equals approx. 1 ms).



Impacts to the final Safety Integrity Level (SIL):

- Separate areas for cable leads of switch cables
- Forcibly guided and redundant series contacts
- Protected switch terminals to avoid short circuits and shunt faults
- MTTFd specification if the switch

14. Connection of the Outputs

There are different ways to connect the outputs. The DS2xx monitors offers HTL outputs with SIL3 capability, provided that their configuration is set to two-pole-inverse operation. The finally resulting Safety Integration Level (SIL) also depends on the remote circuit and on the configuration.

Relevant Parameters	Remarks
Output Mode	Output configuration (homogenous / inverse)

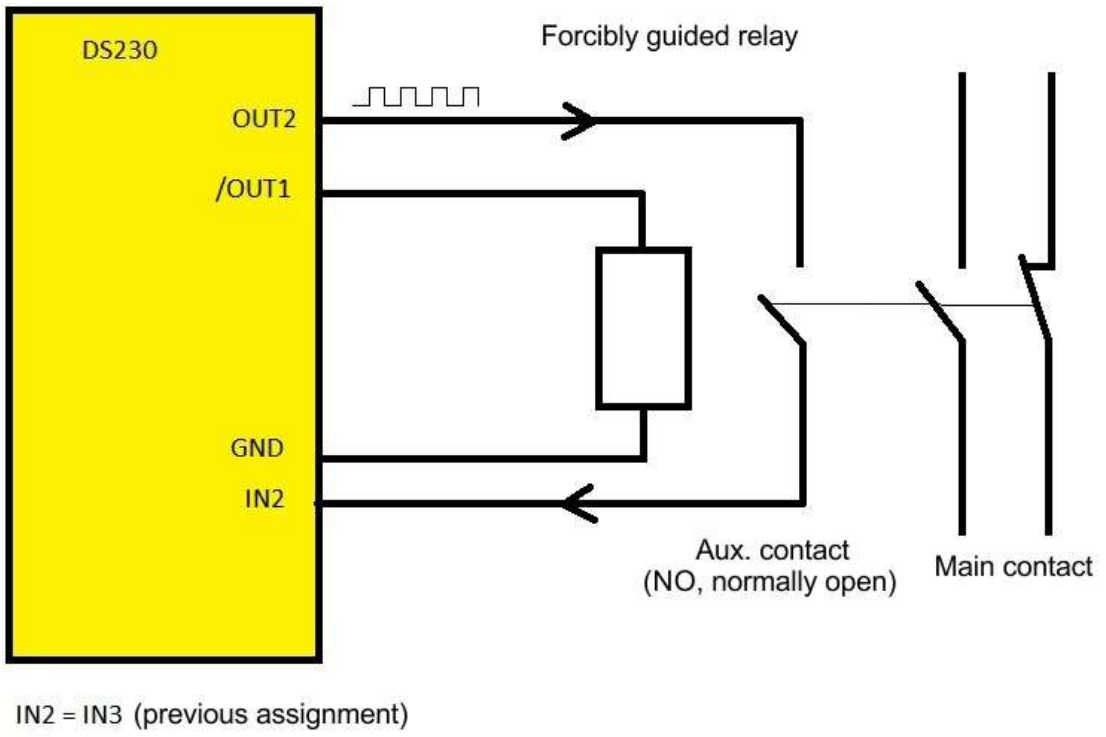
- Unipolar outputs provide SIL = 1
- Bipolar homogenous outputs can reach SIL = 2 - 3
- Bipolar inverse outputs can reach SIL = 3

15. EDM Function

The EDM function (External Device Monitoring) provides special surveillance of faulty operation of remote relay or contactors by means of a separate feedback circuit. For feedback a clocked output signal is used, which is lead back to an input by a positively driven relay contact. This means that the DS2xx monitor has to allocate one output to drive the relay coil, another output to generate the clock signal, and an input for reading back of the clock signal.
Parameter *IN* Function appoints the output to be used for control of the relay. Possible settings are from 17 – 20 and 22. Parameter *IN* Config appoints the output to be used for clock generation. Possible settings are from 12 to 19.
The finally resulting Safety Integration Level (SIL) also depends on the remote circuit and on the configuration. In case of error, a Runtime External RB Error signal will be produced.

Relevant Parameters	Remarks
Read Back OUT	Possible inversion of the relay control
Switch Mode	Output to control the relay coil (setting: „inverse“)
Switch Mode	Clock output (setting: „inverse“)
IN Function	Specification of the relay feedback
IN Config	Specification of the clock feedback
Input Mode	Configuration of the read-back input (single input for read-back)
Read Back Delay	Delay time to ensure that the relay has quite certainly energized (common parameter valid for all relays in use)

15.1. EDM: 1 Relay, 1 Output, 1 Input (NO)



Parameter	Setting	Description
Switch Mode OUT1	0	OUT1 to detect overspeed
Switch Mode OUT2	9	OUT2 to generate clock signal
Read Back OUT	**1**	**Inversion (connection to /OUT1 via NO contact)**
IN2 Function	17	Adaption to OUT1 (overspeed)
IN2 Config	14	Adaption to clock output OUT2 **[X10/4]**
Input Mode	2	4 single inputs for free use
Read Back Delay	0,050	Delay 50 ms to obviate contact bouncing
Output Mode	0	Inverse configuration

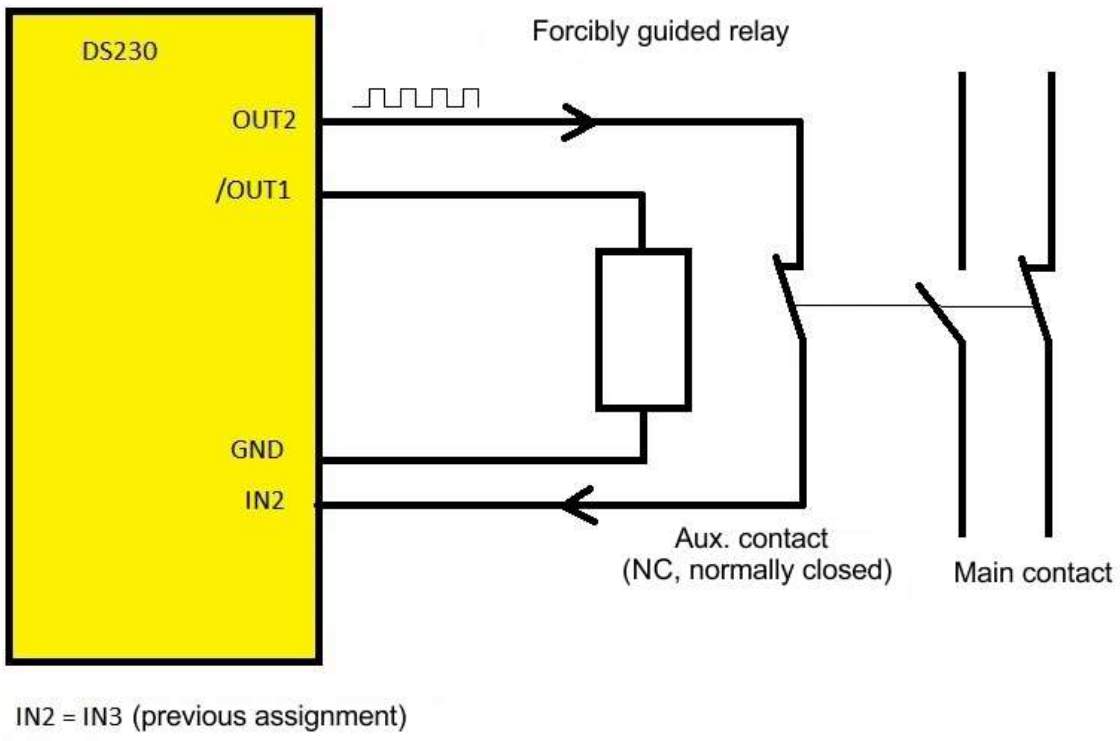
Function:

With normal operation speed the inverted output /OUT1 is in HIGH state and the relay is energized. The forcibly guided aux. contact therefore is closed and the clock signal is conducted to the input. Upon overspeed output /OUT1 will descend to LOW and the remote relay will drop.

Errors in the clock circuit can only be detected while the relay is energized. Under error condition the DS2xx monitor will set all digital outputs to LOW, i.e. the remote relay will be de-energized, which will signal "overspeed". With errors occurring under normal operating speed, the unit will take an error state which signals "overspeed" again (Safety Integrity Level = 1).

The main contacts can be used as opener or closer depending on the application.

15.2. EDM: 1 Relay, 1 Output, 1 Input (NC)



Parameter	Setting	Description
Switch Mode OUT1	0	OUT1 to detect overspeed
Switch Mode OUT2	9	OUT2 to generate clock signal
Read Back OUT	**0**	**No inversion (connection to /OUT1 via NC contact)**
IN2 Function	17	Adaption to OUT1 (overspeed)
IN2 Config	14	Adaption to clock output OUT2 **[X10/4]**
Input Mode	2	4 single inputs for free use
Read Back Delay	0,050	Delay 50 ms to obviate contact bouncing
Output Mode	0	Inverse configuration

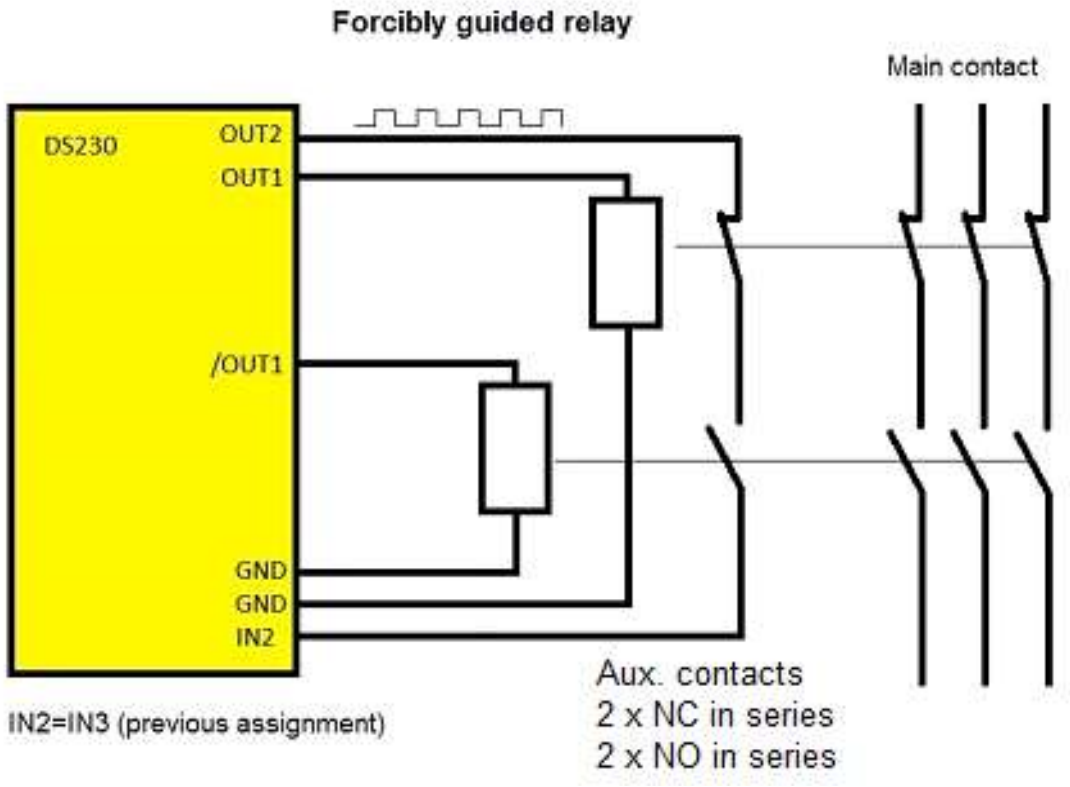
Function:

With normal operation speed the inverted output /OUT1 is in HIGH state and the relay is energized. The forcibly guided aux. contact therefore is open and the clock signal is disconnected from to the input. Upon overspeed output /OUT1 will descend to LOW and the remote relay will drop.

Errors in the clock circuit can only be detected while the relay is de-energized. Under error condition the DS2xx monitor will set all digital outputs to LOW, i.e. the remote relay will be de-energized, which will signal "overspeed". With errors occurring under overspeed conditions, the unit will take an error state which signals "overspeed" again (Safety Integrity Level = 1).

The main contacts can be used as opener or closer depending on the application.

15.3. EDM: 2 Relays, 1 Output, 1 Input (NC, NO)

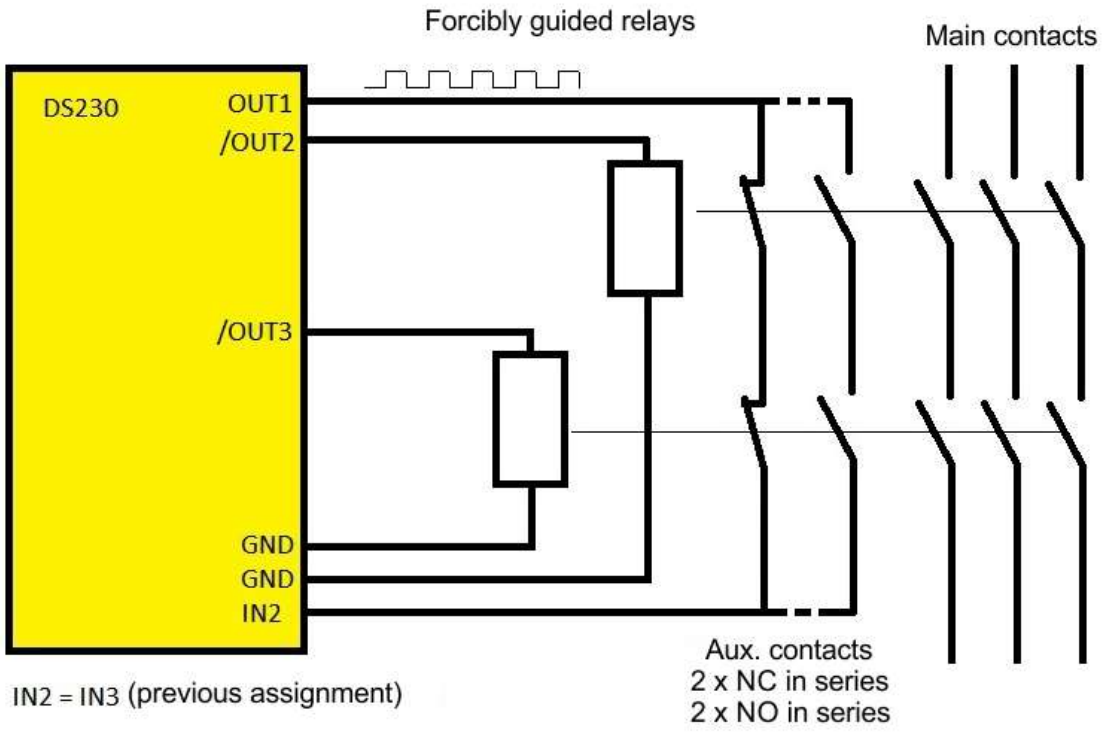


Parameter	Setting	Description
Switch Mode OUT1	0	OUT1 to detect overspeed
Switch Mode OUT2	9	OUT2 to generate clock signal
Read Back OUT	**1**	**Inversion**
IN2 Function	17	Adaption to OUT1 (overspeed)
IN2 Config	14	Adaption to clock output OUT2 **[X10/4]**
Input Mode	2	4 single inputs for free use
Read Back Delay	0,050	Delay 50 ms to obviate contact bouncing
Output Mode	0	Inverse configuration

Function:
With normal operation speed, output /OUT1 is in HIGH state and output OUT1 is in LOW state. With overspeed, output /OUT1 is in LOW state and output OUT1 is in HIGH state. Therefore, at any time one of the relays is energized while the other one is de-energized.

The clock loop is closed with normal speed and interrupted with overspeed.
The GND lines of the two relays must be independent one from each other.
Errors in the clock circuit can only be detected with the clock loop closed. In case of errors the DS2xx monitor will set all digital outputs to LOW, i.e. both relays will drop and overspeed will be indicated. In case of errors in the clock loop during overspeed, an error signal will be produced and overspeed will be indicated. (Safety Integrity Level = 2).
The main contacts can be used as opener or closer depending on the application.

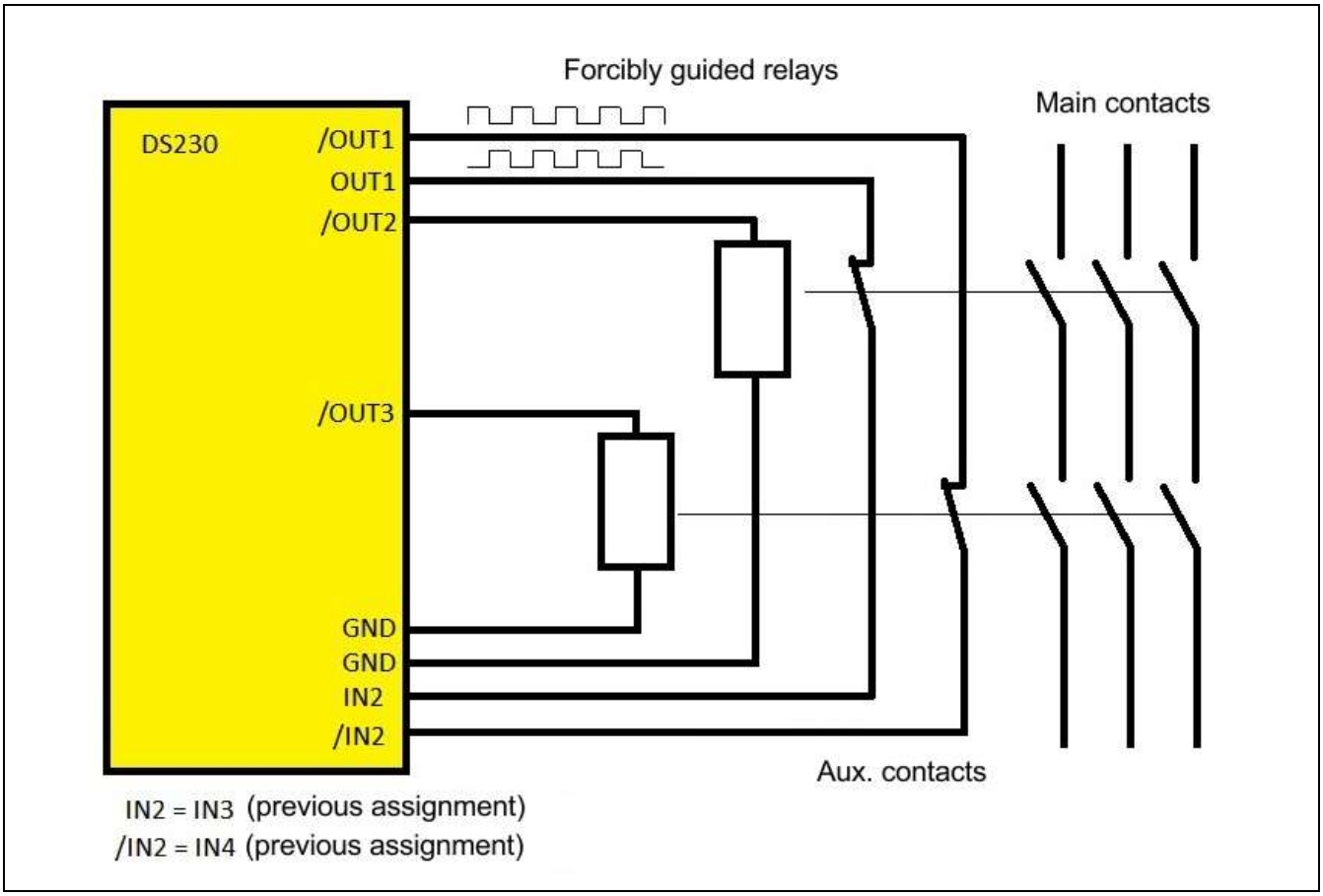
15.4. EDM: 2 Relays, 2 Outputs, 1 Input (NC, NO)



Parameter	Setting	Description
Switch Mode OUT1	9	OUT1 to generate clock signal
Switch Mode OUT2	0	OUT2 to signal overspeed
Switch Mode OUT3	0	OUT3 to detect overspeed
Read Back OUT	**0/6**	**Inversion yes or no, depending on type of aux. contact**
IN2 Function	18/19	Adaption to OUT2 or OUT3 (overspeed)
IN2 Config	12	Adaption to clock output OUT1 [**X10/4**]
Input Mode	2	4 single inputs for free use
Read Back Delay	0,050	Delay 50 ms to obviate contact bouncing
Output Mode	0	Inverse operation

Function:
This application uses two independent outputs /OUT2 and /OUT3 with fully identical configuration concerning their switching characteristics. The basic function is similar to the application with one relay. The auxiliary contacts of both relays are connected in series to conduct the clock signal to an input. Parameter *IN2 Function* can be set to 18 or 19, since the switching behavior of both outputs must be identical. The GND lines of the two relays must be independent one from each other (Safety Integrity Level = 2).
The main contacts can be used as opener or closer depending on the application.

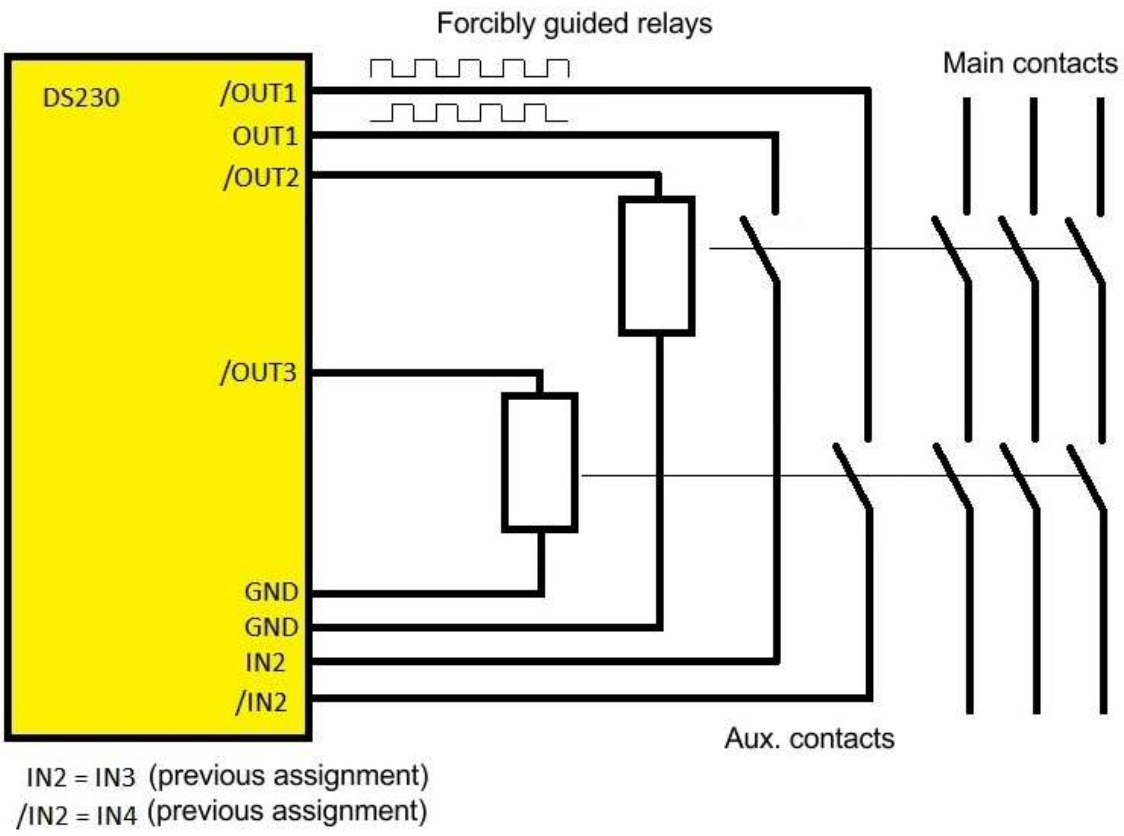
15.5. EDM: 2 Relays, 2 Outputs, 2 Inputs (NC)



Parameter	Setting	Description
Switch Mode OUT1	9	OUT1 to generate clock signal
Switch Mode OUT2	0	OUT2 to signal overspeed
Switch Mode OUT3	0	OUT3 to detect overspeed
Read Back OUT	**0**	**No inversion (connection via NC contact)**
IN2 Function	18	Adaption to OUT2 (overspeed)
IN2 Config	12	Adaption to clock output OUT1 [**X10/4**]
/IN2 Function	19	Adaption to OUT3 (overspeed)
/IN2 Config	13	Adaption to clock output /OUT1 [**X10/5**]
Input Mode	2	4 single inputs for free use
Read Back Delay	0,050	Delay 50 ms to obviate contact bouncing
Output Mode	0	Inverse operation

Function:
This application uses two independent outputs /OUT2 and /OUT3 with fully identical configuration concerning their switching characteristics. The basic function is similar to the application with one relay. The auxiliary contacts of both relays are individually connected to a separate input each. The GND lines of the two relays must be independent one from each other (Safety Integrity Level = 3).
The main contacts can be used as opener or closer depending on the application.

15.6. EDM: 2 Relays, 2 Outputs, 2 Inputs (NO)



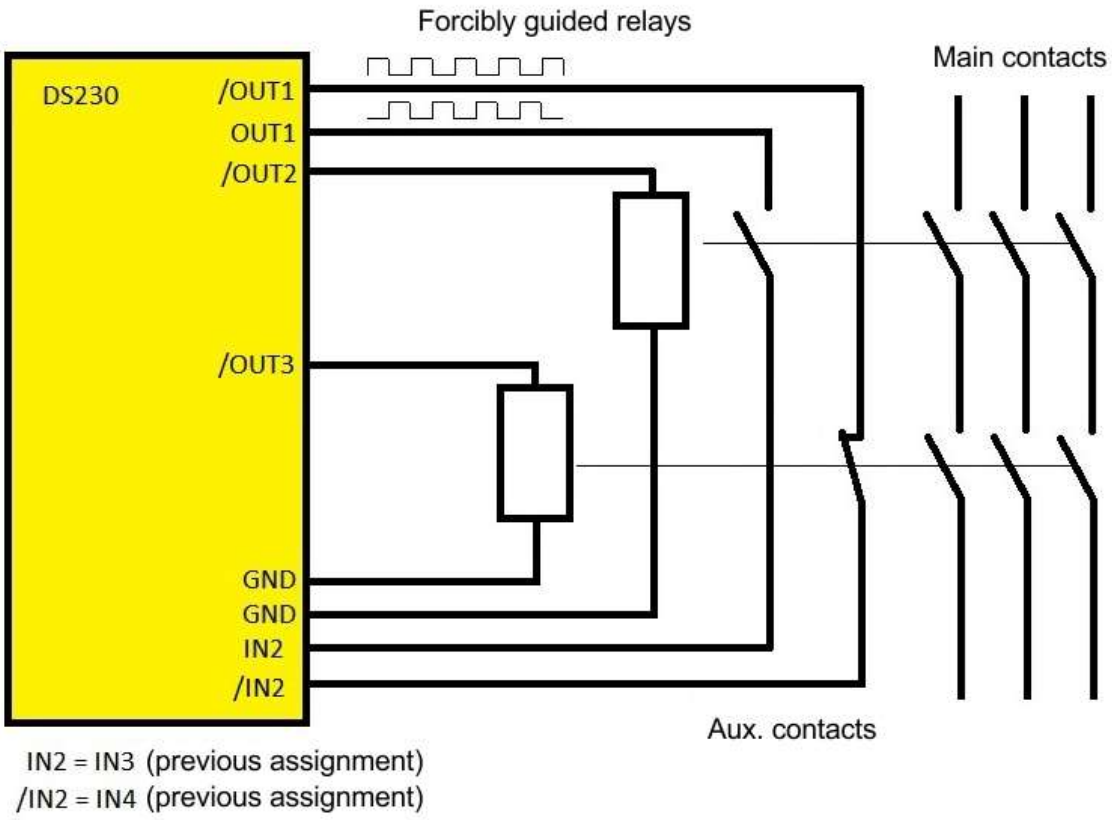
Parameter	Setting	Description
Switch Mode OUT1	9	OUT1 to generate clock signal
Switch Mode OUT2	0	OUT2 to signal overspeed
Switch Mode OUT3	0	OUT3 to detect overspeed
Read Back OUT	**6**	**Inversion (connection via NO contact)**
IN2 Function	18	Adaption to OUT2 (overspeed)
IN2 Config	12	Adaption to clock output OUT1 **[X10/4]**
/IN2 Function	19	Adaption to OUT3 (overspeed)
/IN2 Config	13	Adaption to clock output /OUT1 **[X10/5]**
Input Mode	2	4 single inputs for free use
Read Back Delay	0,050	Delay 50 ms to obviate contact bouncing
Output Mode	0	Inverse operation

Function:

This application uses two independent outputs /OUT2 and /OUT3 with fully identical configuration concerning their switching characteristics. The basic function is similar to the application with one relay. The auxiliary contacts of both relays are individually connected to a separate input each. The GND lines of the two relays must be independent one from each other (Safety Integrity Level = 3).

The main contacts can be used as opener or closer depending on the application.

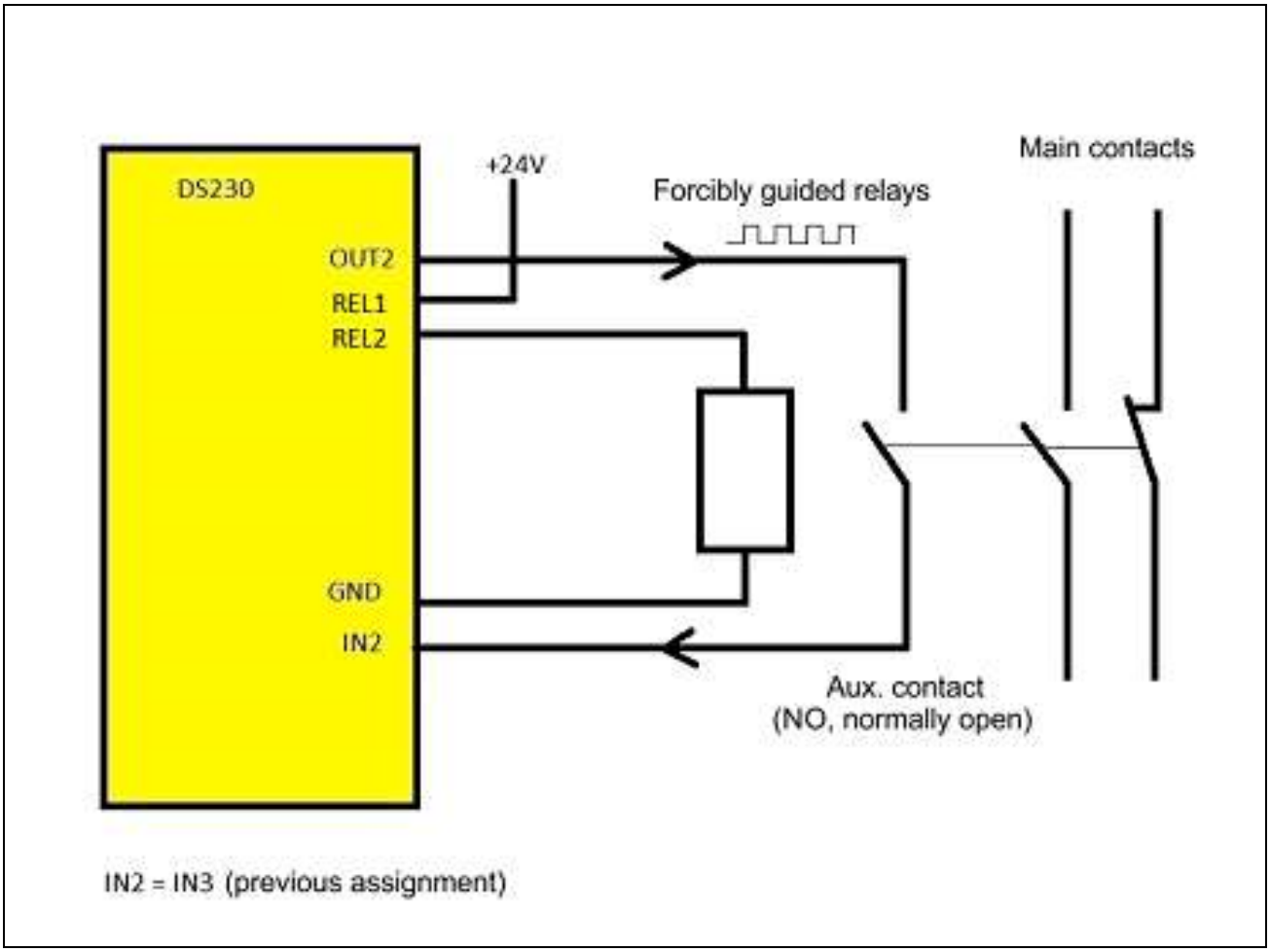
15.7. EDM: 2 Relays, 2 Outputs, 2 Inputs (NO, NC)



Parameter	Setting	Description
Switch Mode OUT1	9	OUT1 to generate clock signal
Switch Mode OUT2	0	OUT2 to signal overspeed
Switch Mode OUT3	0	OUT3 to detect overspeed
Read Back OUT	**2**	**Inversion (connection via NO, NC contact)**
IN2 Function	18	Adaption to OUT2 (overspeed)
IN2 Config	12	Adaption to clock output OUT1 **[X10/4]**
/IN2 Function	19	Adaption to OUT3 (overspeed)
/IN2 Config	13	Adaption to clock output /OUT1 **[X10/5]**
Input Mode	2	4 single inputs for free use
Read Back Delay	0,050	Delay 50 ms to obviate contact bouncing
Output Mode	0	Inverse operation

Function:
This application uses two independent outputs /OUT2 and /OUT3 with fully identical configuration concerning their switching characteristics. The basic function is similar to the application with one relay. The auxiliary contacts of both relays are individually connected to a separate input each. The GND lines of the two relays must be independent one from each other (Safety Integrity Level = 3).
The main contacts can be used as opener or closer depending on the application.

15.8. EDM: Configuration of Relay Out X1



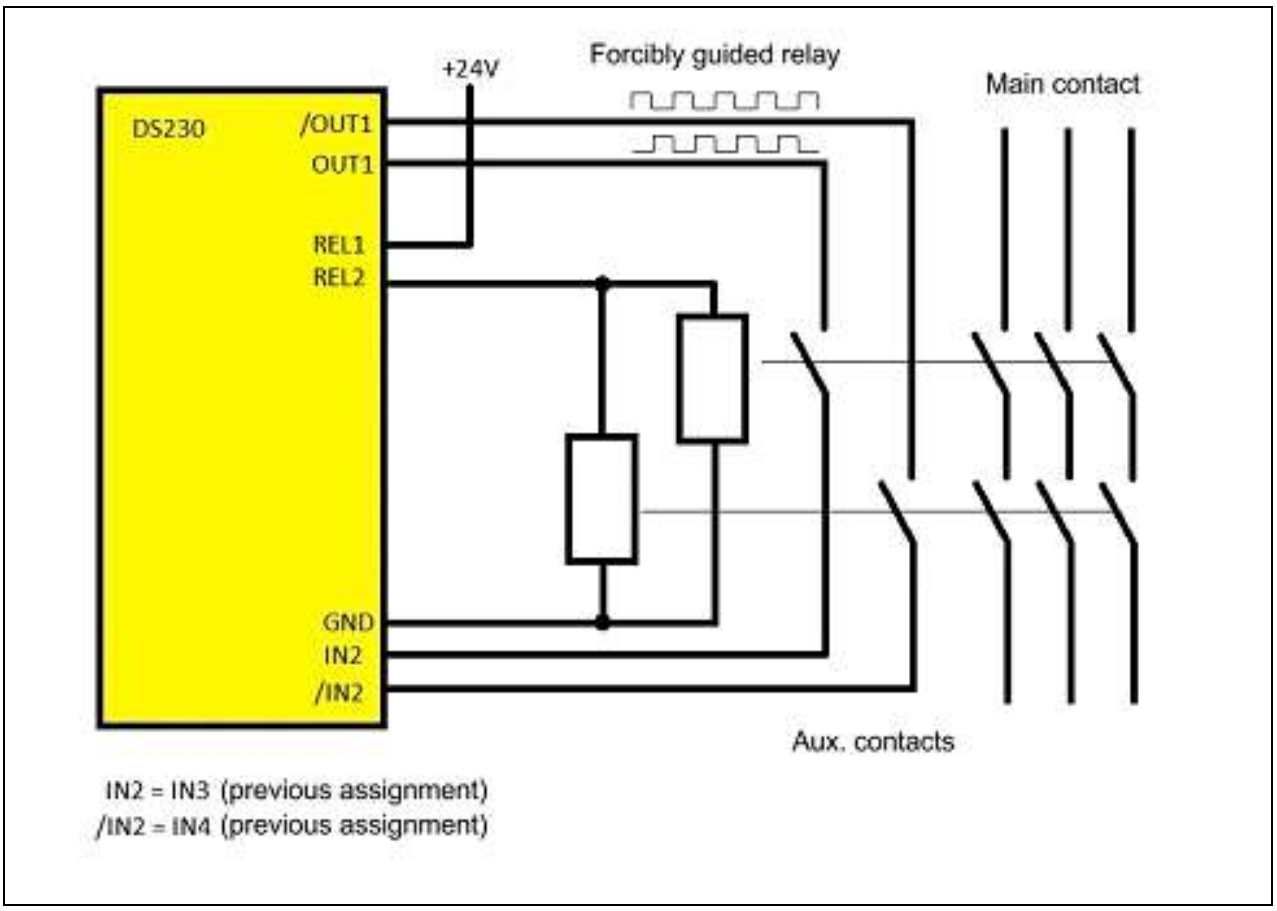
Parameter	Setting	Description
Switch Mode REL1	0	REL1 to detect overspeed
Switch Mode OUT2	9	OUT2 to generate clock signal
Read Back OUT	**16**	**Inversion (connection to REL2 via NO contact)**
IN2 Function	22	Adaption to REL1 (overspeed)
IN2 Config	14	Adaption to clock output OUT2 **[X10/4]**
Input Mode	2	4 single inputs for free use
Read Back Delay	0,100	Delay 100 ms to obviate double contact bouncing
Output Mode	0	Inverse configuration

Function:

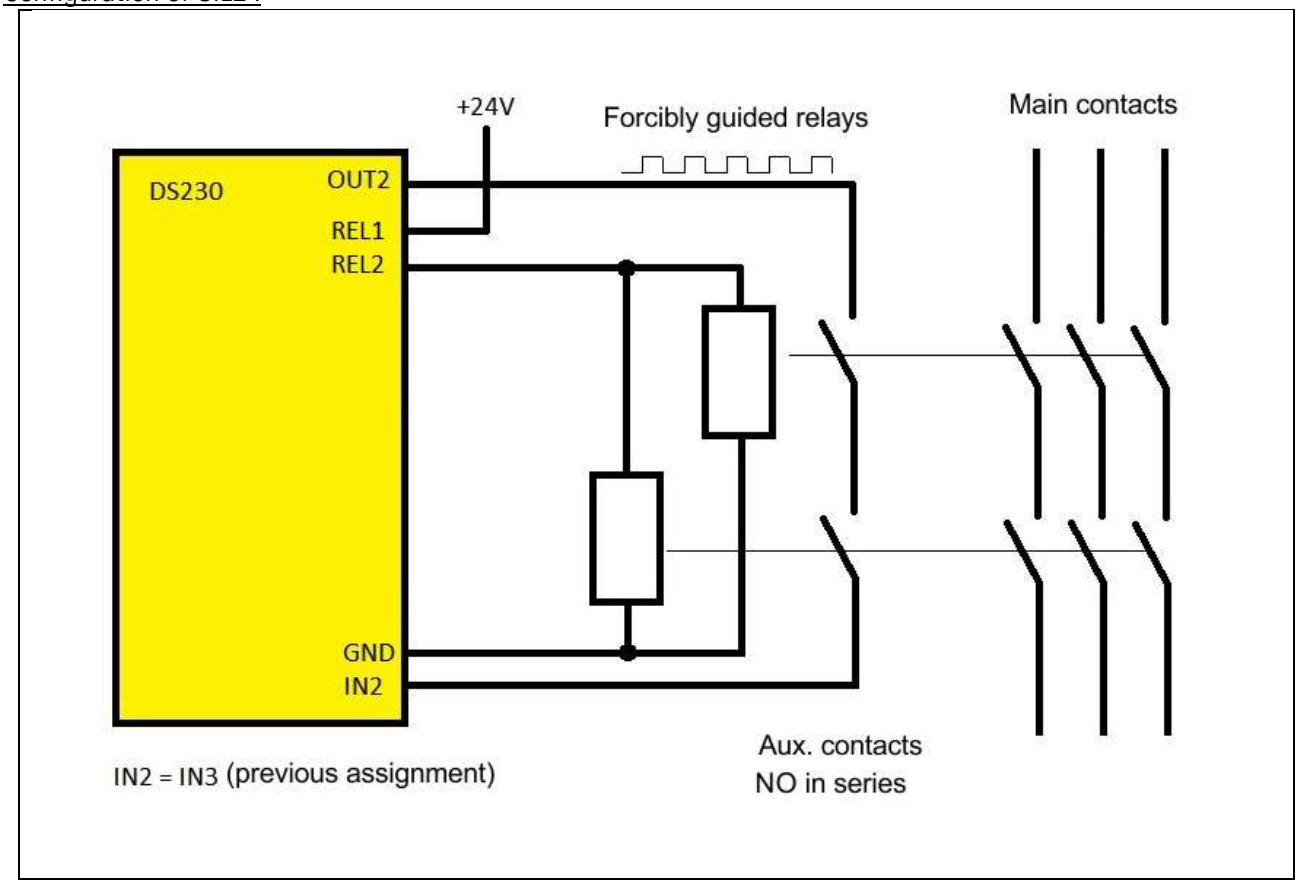
With normal operation speed the relay output X1 is closed, the external relay therefore is energized. Upon overspeed the relay output X1 is open and the remote relay will drop. The forcibly guided aux. contact is closed, when the relay output X1 is energized and the clock signal is conducted to the input.

Under error condition the DS2xx monitor will open the relay output X1, the remote relay will be de-energized, which will signal "overspeed". With errors occurring under normal operating speed, the unit will take an error state which signals "overspeed" again (Safety Integrity Level = 1). The main contacts can be used as opener or closer depending on the application.

Configuration of SIL3 :

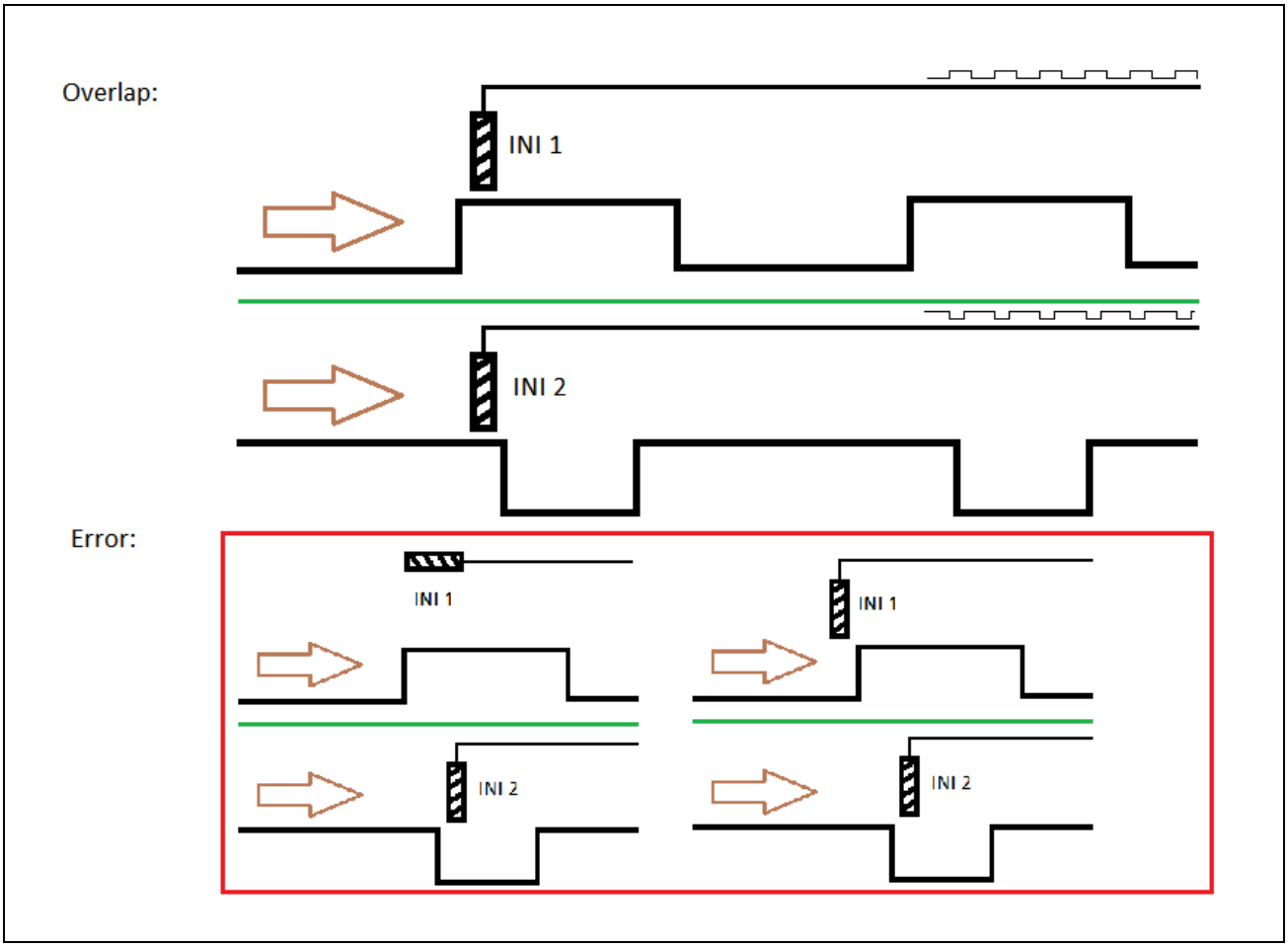


Configuration of SIL2 :



16. Overlap

Using the sensor parameter „Sensor Overlap“, Overlap monitoring can be activated. The Overlap function can only be performed if the “Operational Mode“ = 5 3 is activated, i.e. both sensors work with a HTL signals.
If the sensors are proximity switch, the recesses of both sensors must be installed in such a way that only three of the four possible output states occur during the run-off.
The picture below shows that there is never a condition where both proximity switch are uncovered. If a sensor fails, an error can be triggered in the uncovered phase of the other sensor, because both sensors display the state uncovered. Removing both sensors or a cable break can also cause an error.
The type of recess can cause an error while at the same time covered or at the same time uncovered state. By choosing the proximity switch PNP opener or PNP closer, the polarity can be adjusted to the input of the DS. (DS input open corresponds to low).



17. Technical Specifications

Power supply:	Input voltage:	18 ... 30 VDC
	Protective circuit:	reverse polarity protection
	Ripple:	max. 10 % at 24 VDC
	Power consumption:	approx. 150 mA (unloaded)
	Protection:	external fuse (2.5 A, medium time lag) necessary
	Connections:	X3, screw terminal, 2-pin, 1.5 mm² / AWG 14
Encor supply:	Number:	2
	Output voltage:	approx. 2 VDC lower than input voltage
	Output current:	max. 200 mA per encoder
	Protection:	short circuit proof
SinCos inputs:	Number of inputs:	2
	Signal tracks:	SIN+, SIN-, COS+, COS-
	Amplitude:	0.8 ... 1.2 Vpp
	DC offset:	2.4 … 2.6 VDC
	Frequency:	max. 500 kHz
	Connections:	(with Lissajous figure monitoring max. 100 kHz) X6 and X7, SUB-D (male), 9-pin
Incremental inputs:	Number of inputs:	2
	Format:	RS422 standard (differential signal A, /A, B, /B)
	Frequency:	max. 500 kHz
	Connections:	X8 and X9, screw terminal, 7-pin, 1.5 mm² / AWG14
Control-/ incremental inputs:	Number of inputs:	2 (complementary format)
	Application:	HTL encoder, proximity switch, control command
	Signal level:	HTL / PNP (10 ... 30 V)
	Load:	max. 15 mA
	Frequency (control):	max. 1 kHz
	Frequency incremental):	max. 250 kHz
	Connections:	X10, screw terminal, 5-pin, 1.5 mm² / AWG 14
SinCos output: (safety related)	Splitter output:	Source: input SinCos 1
	Signal tracks:	SIN+, SIN-, COS+, COS-
	Amplitude:	0.8 ... 1.2 Vpp
	DC offset:	2.4 … 2.6 VDC
	Frequency:	max. 500 kHz
	Connection:	X5, SUB-D (female), 9-pin
Incremental output: (safety related)	Splitter output:	Source: input SinCos 1, SinCos 2, RS422 1, RS422 2 HTL1 or HTL2
	Format:	RS422 (differential signals A, /A, B, /B)
	Frequency:	max. 500 kHz
	Signal delay:	approx. 600 ns
	Connections:	X4, screw terminal, 7-pin, 1.5 mm² / AWG 14
Analog output: (safety related)	Current output:	4 ... 20 mA (load max. 270 Ohm)
	Resolution:	14 bit
	Accuracy:	± 0.1 %
	Connection:	X4, screw terminal, 7-pin, 1.5 mm² / AWG 14
Control outputs: (safety related)	Number of outputs:	4 (complementary format)
	Output voltage:	HTL (approx. 2 VDC lower than input voltage)
	Output current:	max. 30 mA per output
	Switching characteristic:	Push-Pull
	Protective circuit:	short-circuit-proof
	Connection:	X2, screw terminal, 8-pin, 1.5 mm² / AWG 14
Relay output: (safety related)	Number of relays:	two relays in series with forced-guided contacts (NO)
	Switching capability:	5 ... 36 VDC
	Switching capacity:	5 mA ... 5 A
	Connection:	X1, screw terminal, 2-pin, 1.5 mm² / AWG 14

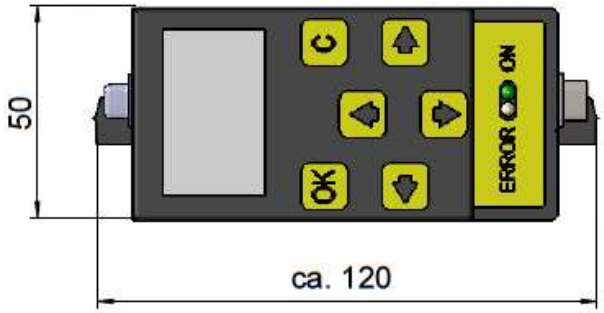
Continuation „Technical Specifications“:

USB interface:	Version:	USB 1.0
	Connection:	X12, USB-B (female)
	Operating System:	Software DS2xx from version 4c for WIN7 /8 / 10 (tested with (1511 build 10586.104), otherwise only for WIN7 / 8
Display:	Green LED:	„ON“
	Yellow LED:	„ERROR“
Switches:	DIL switch:	1 x 3-pin
	Marking:	S1
Conformity and standards:	MD2006/42EC	EN ISO 13849-1
		EN 61508
		EN 62061
		EN 60947-5-1
	EMC 2014/30/EU:	EN 61000-6-2
		EN 61000-6-3
		EN 61000-6-4
		EN 61326-3-1
		EN 61326-3-2
	Vibration resistance:	EN 60068-2-6 (sine, 7 g, 10 – 200 Hz, 20 cycles)
	Shock resistance:	EN 60068-2-27 (half sine, 30 g, 11 ms, 3 shocks)
		EN 60068-2-27 (half sine, 17 g, 6 ms, 4000 shocks)
	RoHS (II) 2011/65/EU	
	RoHS (III) 2015/863:	EN IEC 63000
Safety characteristic data:	Classification:	SIL3/PLe (depends on encoders in use)
	Approved Safety function:	Certification No.: 44 207 14018601
	System structure:	dual-channel
	System architecture:	Cat. 3 / HFT = 1
	DC_{avg}:	97,95 %
	SFF:	98,77 %
	$MTTF_D$:	38,1 Jahre
	PFH:	$3{,}76 * 10^{-8}\ h^{-1}$
	λ_{SD}:	$1{,}93 * 10^{-6}\ h^{-1}$
	λ_{SU}:	$4{,}64 * 10^{-8}\ h^{-1}$
	λ_{DD}:	$2{,}94 * 10^{-6}\ h^{-1}$
	λ_{DU}:	$6{,}14 * 10^{-8}\ h^{-1}$
	Safety functions:	equivalent to EN 61800-5-2 for SS1, SS2, SOS, SLS, SDI, SSM, SLI, SBC, STO, SMS (depending on the used encoder input signals)
Housing:	Material:	Plastic
	Mounting:	to 35 mm top hat rail (according to EN 60715)
	Dimensions:	50 x 100 x 165 mm (B x H x T)
	Protection class:	IP20
	Weight:	approx. 390 g
Ambient temperature:	Operation:	-20 °C ... +55 °C (without condensation)
	Storage:	-25 °C ... +70 °C (without condensation)
Maintenance:	Interval:	Switch on/off for at least 1 times a year (at continuous operation)
Programming module BG230 (optional):	Display:	OLED-Display
	Operation:	Touch screen

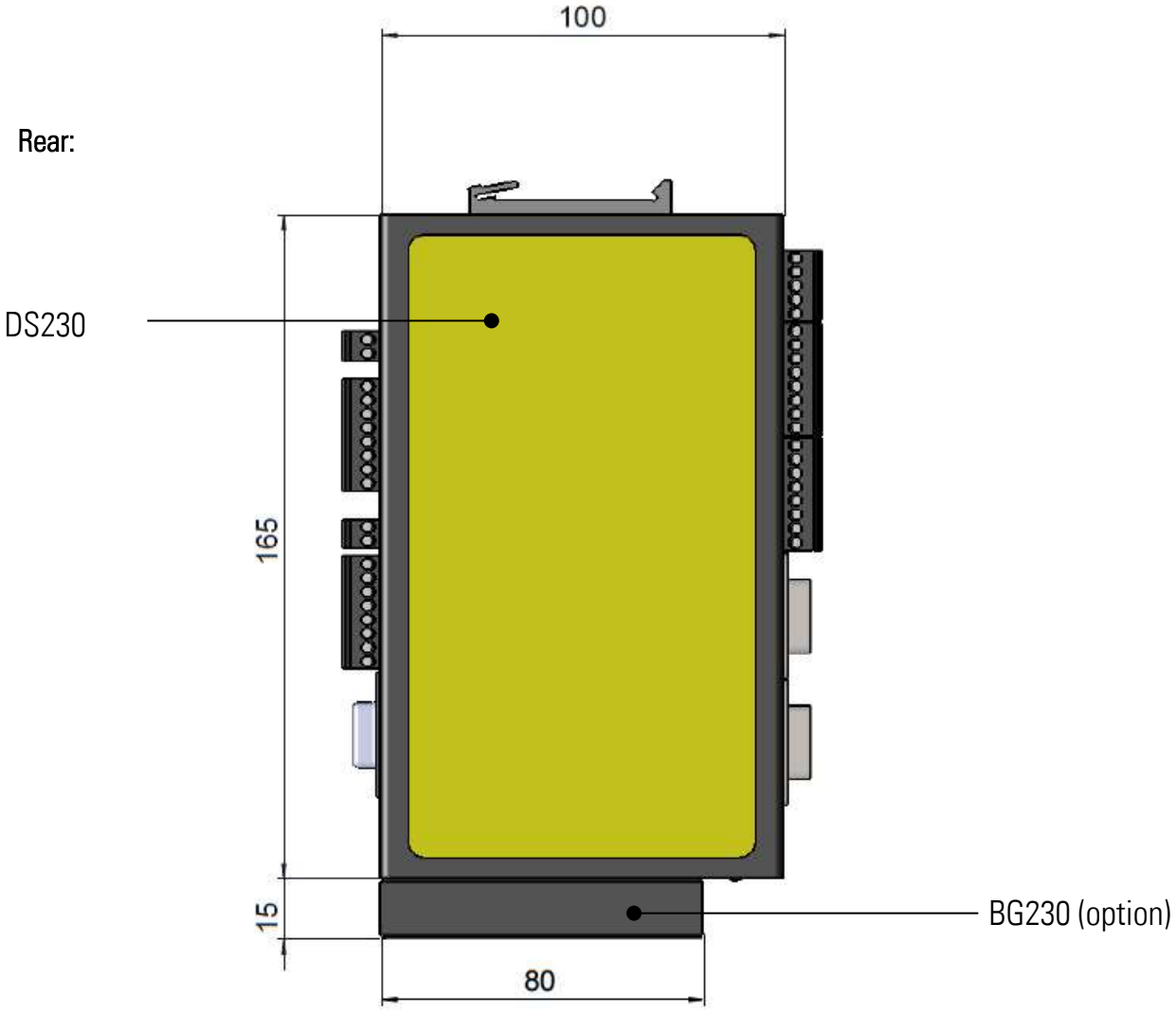
17.1. Dimensions

(incl. BG230 on front)

Front:



Rear:



18. Certificate

TÜV NORD

ZERTIFIKAT
CERTIFICATE

Hiermit wird bescheinigt, dass die Firma / *This is to certify, that the company*

motrona GmbH
Zeppelinstraße 16
78244 Gottmadingen
Deutschland

berechtigt ist, das unten genannte Produkt mit dem abgebildeten Zeichen zu kennzeichnen.
is authorized to provide the product described below with the mark as illustrated.

Fertigungsstätte: *Manufacturing plant:*	**motrona GmbH** **Zeppelinstraße 16** **78244 Gottmadingen** **Deutschland**
Beschreibung des Produktes: (Details s. Anlage 1) *Description of product:* *(Details see Annex 1)*	**Ds2xx Wächterserie zur sicherheitsgerichteten Überwachung von Drehzahl, Stillstand und Drehrichtung** *DS2xx monitor series for safety-related monitoring of speed, standstill and direction of rotation*
Geprüft nach: *Tested in accordance with:*	**EN ISO 13849-1:2015 – Kat. 3 PL e** **EN 61508:2010 – SIL 3** **EN 62061:2005 + Cor. 2010 + A1:2013 + A2:2015 – SILCL 3**

TÜV NORD CERT GmbH – Approved Safety Function
EN ISO 13849-1
EN 61508
EN 62061
PL 'e'
SIL 3
SIL_{CL} 3

Registrier-Nr. / *Registered No.* 44 207 14018601
Prüfbericht Nr. / *Test Report No.* 3527 1535
Aktenzeichen / *File reference* 8003019827

Gültigkeit / Validity
von / *from* 2020-06-11
bis / *until* 2025-06-10

Zertifizierungsstelle der TÜV NORD CERT GmbH
Certification body of TÜV NORD CERT GmbH

Essen, 2020-06-11

TÜV NORD CERT GmbH Langemarckstraße 20 45141 Essen www.tuev-nord-cert.de machinery@tuev-nord.de

Bitte beachten Sie auch die umseitigen Hinweise
Please also pay attention to the information stated overleaf

Hinweise zum TÜV NORD- Zertifikat	Hints to the TÜV NORD - Certificate
Dieses TÜV NORD - Zertifikat gilt nur für die umseitig bezeichnete Firma und das angegebene Produkt. Es kann nur von der Zertifizierungsstelle auf Dritte übertragen werden.	This TÜV NORD - certificate only applies to the firm stated overleaf and the specified product. It may only be transferred to third parties by the certification body.
Notwendige Bedienungs- und Montageanweisungen müssen jedem Produkt beigefügt werden.	Each product must be accompanied by the instructions which are necessary for its operation and installation.
Jedes Produkt muss deutlich einen Hinweis auf den Hersteller oder Importeur und eine Typenbezeichnung tragen, damit die Identität des geprüften Baumusters mit den serienmäßig in den Verkehr gebrachten Produkten festgestellt werden kann.	Each product must bear a distinct indication of the manufacturer or importer and a type designation so that the identity of the tested sample maybe determined with the product launched on the market as a standard.
Der Inhaber des TÜV NORD - Zertifikates ist verpflichtet, die Fertigung der Produkte laufend auf Übereinstimmung mit den Prüfbestimmungen zu überwachen und insbesondere die in den Prüfbestimmungen festgelegten oder von der Zertifizierungsstelle geforderten Kontrollprüfungen ordnungsgemäß durchzuführen.	The bearer of the TÜV NORD - Certificate undertakes to regularly supervise the manufacturing of products for compliance with the test specifications and in particular properly carry out the checks which are stated in the specifications or required by the test laboratory.
Bei Änderungen am geprüften Produkt ist die Zertifizierungsstelle umgehend zu verständigen.	In case of modifications of the tested product the certification body must be informed immediately.
Bei Änderungen und bei befristeten Zertifikaten ist das Zertifikat nach Ablauf der Gültigkeit urschriftlich an die Zertifizierungsstelle zurückzugeben. Die Zertifizierungsstelle entscheidet, ob das Zertifikat ergänzt werden kann oder ob eine erneute Zertifizierung erforderlich ist.	In case of modifications and expiration of validity the original certificate must be returned to the certification body immediately. The certification body decides if the certificate can be supplemented or whether a new certification is required.
Für das TÜV NORD - Zertifikat gelten außer den vorgenannten Bedingungen auch alle übrigen Bestimmungen des allgemeinen Vertrages. Es hat solange Gültigkeit, wie die Regeln der Technik gelten, die der Prüfung zu Grunde gelegt worden sind, sofern es nicht auf Grund der Bedingungen des allgemeinen Vertrages früher zurückgezogen wird.	In addition to the conditions stated above, all other provisions of the General Agreement are applicable to the TÜV NORD - Certificate. It will be valid as long as the rules of technology on which the test was based are valid, unless revoked previously pursuant to the provisions of the General Agreement.
Dieses TÜV NORD - Zertifikat verliert seine Gültigkeit und muss unverzüglich der Zertifizierungsstelle zurückgegeben werden, falls es ungültig wird oder für ungültig erklärt wird.	This TÜV NORD - Certificate will become invalid and shall be returned to the certification body immediately in the event that it shall expire without delay when it has expired or revoked.

ANLAGE
ANNEX

zum Zertifikat Registrier-Nr. / *to Certificate Registration No.* 44 207 14018601

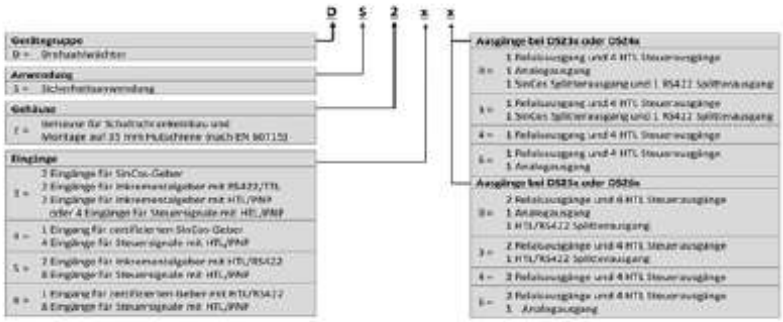
Produktbeschreibung:
Product description:

Redundante Auswerteeinheit zum Erfassen, Verarbeiten und Weiterleiten von sicherheitsgerichteten Ein- und Ausgangsgrößen in sicherheitsgerichteten Applikationen bezogen auf Drehzahl, Stillstand und Drehrichtung
Redundant safety monitor for measuring, processing and forwarding safety-related input and output values on safety related applications with regards to speed, standstill and direction of rotation

Typbezeichnung:
Type designation:

DS23x, DS24x, DS25x oder DS26x

Technische Daten:
Technical data:



Weitere Technische Daten sind dem zugehörigen Safety-Manual zu entnehmen
Further technical data can be found in the corresponding Safety Manual
Zur Realisierung einer SIL 3 / SILCL 3 / PL e bzw. SIL 2 / SILCL 2 / PL d Sicherheitsfunktion ist bei der Variante DS24x und DS26x ein gleichermaßen zertifizierter Sensor zu verwenden
To implement a SIL 3 / SILCL 3 / PL e or SIL 2 / SILCL 2 / PL d safety function, an equally certified sensor must be used with the DS24x and DS26x versions.

F. Hegenfeld

Zertifizierungsstellenleiter TÜV NORD CERT GmbH — Essen, 2020-06-11
Certification body of TÜV NORD CERT GmbH

TÜV NORD CERT GmbH Langemarckstraße 20 45141 Essen www.tuev-nord-cert.de machinery@tuev-nord.de

For the DS230 / DS240 safety units

- Supplement to the DS operating manual
- Describes the DS parameter functions
- incl. Parameter list as short overview
- For setup and commissioning procedure
- Overview of all registers

Version:	Description:
Ds230_04b_pd_e.doc/Jan-16/ag	First separated version as parameter description
Ds230_05a_pd_e.doc/af	Page 27 line 19… / OUT5 replaced with …/OUT4 Capter 2.2: Parameter 090, Default = 0,000 - 1,000 (instead of 0000 – 1000) New parameter, major modifications
Ds230_06a_pd_e.doc/af	New Parameter A-Edge 2/1 Frequency range from 0.1Hz to 0.01Hz was enlarged
Ds230_07a_pd_e.docx/cf	New parameters, major adjustments
Ds230_07b_pd_e.docx/cf	Minor adjustments
Ds230_07c_pd_docx/mbo	Revised version

General

This parameter description was created as a separate document for an optimum overview.
It contains information about the entire DS230 / DS240 registers as well as a parameter list at the end of the document.

Table of Contents

1. Parameter / Menu Overview

The parameterization of the device is realized via USB interface with a PC and the operating software OS. The link to the free download can be found on page 2 of the operating manual Ds230. This section provides an overview of the menus and their assignments to the different unit functions. The menu names are printed bold and associated Parameters are arrayed directly under the menu names.

No.	Menu / Parameter
	Main Menu
000	Operational Mode
001	Sampling Time
002	Wait Time
003	F1-F2 Selection
004	Div. Switch %-f
005	Div. %-Value
006	Div. f-Value
007	Div. Calculation
008	Div. Filter
009	Error Simulation
010	Power-up Delay
011	SIN Error
012	Div. Mode
013	Div. Inc-Value
014	Filter
015	A-Edge 2/1
016	Sensor Overlap
	Sensor1 Menu
017	Direction1
018	Multiplier1
019	Divisor1
020	Position Drift1
021	Phase Err Count1
022	Set Frequency1
023	SIN Err Time1
	Sensor2 Menu
024	Direction2
025	Multiplier2
026	Divisor2
027	Position Drift2
028	Phase Err Count2
029	Set Frequency2
030	SIN Err Time2

Nr.	Menu / Parameter
	Preselect Menu
031	Preselect OUT1.H
032	Preselect OUT1.L
033	Preselect OUT1.D
034	Preselect OUT2.H
035	Preselect OUT2.L
036	Preselect OUT2.D
037	Preselect OUT3.H
038	Preselect OUT3.L
039	Preselect OUT3.D
040	Preselect REL4.H
041	Preselect REL4.L
042	Preselect REL4.D
043	Preselect REL1.H
044	Preselect REL1.L
045	Preselect REL1.D
046	Preselect OUT1.F
047	Preselect OUT2.F
048	Preselect OUT3.F
049	Preselect OUT4.F
050	Preselect REL1.F
051	*Reserved*

Nr.	Menu / Parameter
	Switching Menu
052	Switch Mode OUT1
053	Switch Mode OUT2
054	Switch Mode OUT3
055	Switch Mode OUT4
056	Switch Mode REL1
057	Pulse Time OUT1
058	Pulse Time OUT2
059	Pulse Time OUT3
060	Pulse Time OUT4
061	Pulse Time REL1
062	Hysteresis OUT1
063	Hysteresis OUT2
064	Hysteresis OUT3
065	Hysteresis OUT4
066	Hysteresis REL1
067	Matrix OUT1
068	Matrix OUT2
069	Matrix OUT3
070	Matrix OUT4
071	Matrix REL1
072	MIA-Delay OUT1
073	MIA-Delay OUT2
074	MIA-Delay OUT3
075	MIA-Delay OUT4
076	MIA-Delay REL1
077	MAI-Delay OUT1
078	MAI-Delay OUT2
079	MAI-Delay OUT3
080	MAI-Delay OUT4
081	MAI-Delay REL1
082	Delay OUT1
083	Delay OUT2
084	Delay OUT3
085	Delay OUT4
086	Delay REL1
087	Startup Mode
088	Startup Output
089	Standstill Time
090	Lock Output
091	Action Output
092	Action Polarity
093	Read Back OUT
094	Output Mode

Nr.	Menu / Parameter
095	*Reserved*
096	*Reserved*
097	*Reserved*
098	*Reserved*
099	*Reserved*
	Control Menu
100	IN1 Function
101	IN1 Config
102	/IN1 Function
103	/IN1 Config
104	IN2 Function
105	IN2 Config
106	/IN2 Function
107	/IN2 Config
108	Input Mode
109	Read Back Delay
110	GPI Err Time
	Serial Menu
111	Serial Unit Nr.
112	Serial Baud Rate
113	Serial Format
114	Serial Page
115	Serial Init
116	*Reserved*
	Splitter Menu
117	RS Selector
	Analog Menu
118	Analog Start
119	Analog End
120	Analog Gain
121	Analog Offset
122	*Reserved*
	OPU Menu
123	X Factor 1
124	/ Factor 1
125	+/- Value 1
126	Units 1
127	Decimal Point 1
128	X Factor 2
129	/ Factor 2
130	+/- Value 2
131	Units 2
132	Decimal Point 2
133	*Reserved*

2. Parameter Description

2.1. Important notes for DS240 / DS246

When using a DS240 resp. DS246 variant, the following hints must be observed:

Nr.	Parameter	Hints for DS240 /. DS246
000	Operational Mode	Exclusively „Mode = 0“ may be used
003	F1-F2 Selection	Both settings have the same effect
017	Direction1	Direction1 and Direction2 must be equal
018	Multiplier1	The setting must be „1“
019	Divisor1	The setting must be „1“
020	Position Drift1	Position Drift1 and Position Drift2 must be equal
021	Phase Err Count1	Phase Err Count1 and Phase Err Count2 must be equal
023	Direction2	Direction1 and Direction2 must be equal
024	Multiplier2	The setting must be „1“
025	Divisor2	The setting must be „1“
026	Position Drift2	Position Drift1 and Position Drift2 must be equal
027	Phase Err Count2	Phase Err Count1 and Phase Err Count2 must be equal
028	*IN* Function	To clear drift errors, Clear Drift 1&2 must be used
030	RS Selector	Both settings have the same effect
100 - 107	*IN* Function	To erase drift errors, Drift 1 & 2 must be used
117	RS Selector	Both settings deliver the same result

2.2. Main Menu

No.	Parameter	Range	Default
000	Operational Mode:	0 - 9	0

This parameter determines which frequency input is assigned to Sensor1 and Sensor2. Depending on the assignment, up to 4 control inputs for external commands are available.

Notes and examples for wiring the encoders, control inputs etc. can be found in the operating manual of the DS unit.

Operational Mode of DS23x:

To ensure the safety function, two independent sensors / encoders are required.

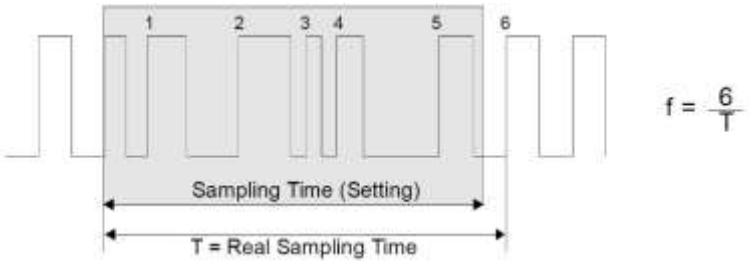
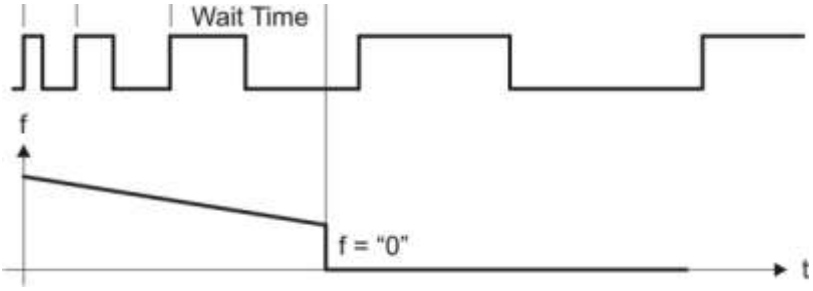
Mode	Sensor1	Sensor2	[X10: 2 and 3]	[X10: 4 and 5]
0	SinCos encoder to [X6 | SINCOS IN 1]	SinCos encoder to [X7 | SINCOS IN 2]	Available for control signals	Available for control signals
1	SinCos encoder to [X6 | SINCOS IN 1]	HTL encoder (A, B, 90°) to [X10 | CONTROL IN]	Available for control signals	Not available for control signals!
2	SinCos encoder to [X6 | SINCOS IN 1]	HTL encoder (A) to [X10 | CONTROL IN]	Available for control signals	Not available for control signals!
3	HTL encoder (A, B, 90°) to [X10 | CONTROL IN]	HTL encoder (A, B, 90°) to [X10 | CONTROL IN]	Not available for control signals!	Not available for control signals!
4	HTL encoder (A, B, 90°) to [X10 | CONTROL IN]	HTL encoder (A) to [X10 | CONTROL IN]	Not available for control signals!	Not available for control signals!
5	HTL encoder (A) to [X10 | CONTROL IN]	HTL encoder (A) to [X10 | CONTROL IN]	Not available for control signals!	Not available for control signals!
6	SinCos encoder to [X6 | SINCOS IN 1]	RS422 encoder to [X9 | RS422 IN 2]	Available for control signals	Available for control signals
7	RS422 encoder to [X8 | RS422 IN 1]	RS422 encoder to [X9 | RS422 IN 2]	Available for control signals	Available for control signals
8	RS422 encoder to [X8 | RS422 IN 1]	HTL encoder (A, B, 90°) to [X10 | CONTROL IN]	Available for control signals	Not available for control signals!
9	RS422 encoder to [X8 | RS422 IN 1]	HTL encoder (A) to [X10 | CONTROL IN]	Available for control signals	Not available for control signals!

Operational Mode of DS24x:

To ensure the safety function, a SIL3/PLe certified SinCos sensor resp. encoder is required.

Mode	Sensor1	Sensor2	[X10: 2 and 3]	[X10: 4 and 5]
0	SIL3/PLe SinCos encoder to [X6 | SINCOS IN 1]	Sensor1 and Sensor2 are internally bridged	available for control signals	available for control signals

Continuation **"Main Menu":**

No.	Parameter	Range	Default
001	**Sampling Time:** The configured value corresponds to the minimum measurement time. The Parameter is used as a filter in case of irregular frequencies. This parameter directly affects the response time of the unit. The setting is valid for both inputs channels. 	0.001 - 9.999 (sec.)	0.001
002	**Wait Time** (Zeroing)**:** Defines the period time of the lowest frequency resp. the waiting time between 2 rising edges, which is detected as frequency = 0 Hz by the unit.  All frequencies with a period longer than the Wait Time value will be interpreted as frequency = 0 Hz. 0.010 — Frequency = 0 Hz with frequencies smaller than 100 Hz … — 9.999 — Frequency = 0 Hz with frequencies smaller than 0.1 Hz The setting is valid for both inputs channels.	0.010 - 9.999 (sec.)	0.100
003	**F1-F2 Selection** (Basic Frequency Selection)**:** This Parameter determines, which of both input frequencies of Sensor1 or Sensor2 (parameter „Operational Mode") will be monitored and processed as basic frequency. The basic frequency selection affects the following outputs: - Analog output - Control outputs - Relay outputs 0 — Frequency of Sensor1 serves as basic frequency 1 — Frequency of Sensor2 serves as basic frequency	0 - 1	0

Continuation **"Main Menu"**:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>004</td><td>Div. Switch %-f (Divergence switching point %-Hz):
The DS unit constantly compares the frequencies of Sensor1 and Sensor2 to the adjusted maximum allowed divergence. Application-specific a percentage comparison can be problematic with lower frequencies, so that a direct monitoring of the difference frequency in Hz can deliver better results.
This Parameter allows to define a limit. When undershooting the adjusted value the comparison will proceed no more percentages, but absolute in Hz.</td><td>0 - 999.99
(Hz)</td><td>100.00</td></tr>
<tr><td>005</td><td>Div. %-Value (maximum Divergence %):
Defines the maximum allowed percentage divergence between the frequencies of Sensor1 and Sensor2. If this value is exceeded, the unit switches to an error state. The calculation is specified by parameter "Div. Calculation ".</td><td>0 - 100
(%)</td><td>10</td></tr>
<tr><td>006</td><td>Div. f-Value (maximum Divergence Hz):
Defines the maximum allowed absolute divergence in Hz between the frequencies of Sensor1 and Sensor2. If the adjusted value is exceeded, the unit switches to an error status.</td><td>0 - 99.99
(Hz)</td><td>30.00</td></tr>
<tr><td>007</td><td>Div. Calculation (Divergence Calculation Mode):
This parameter will calculate the percentage divergence.
<table><tr><td>0</td><td>Reference value is the frequency of Sensor1:
△(%) = (Sensor1 - Sensor2) : Sensor1 x 100 %</td></tr><tr><td>1</td><td>Reference value is the frequency of Sensor2:
△(%) = (Sensor2 - Sensor1) : Sensor2 x 100 %</td></tr></table></td><td>0 - 1</td><td>0</td></tr>
<tr><td>008</td><td>Div. Filter:
This digital filter parameter evaluates the divergence between Sensor1 and Sensor2.
<table><tr><td>0</td><td>The filter is not active:
The unit reacts immediately to each frequency deviation</td></tr><tr><td>5</td><td>Medium filter effect:
The unit tolerates temporary deviations and fluctuations e. g. caused from torsion or mechanical vibrations and reacts delayed to deviations between both input frequencies</td></tr><tr><td>10</td><td>Higher filter effect:
The unit tolerates temporary deviations and fluctuations e. g. caused from torsion or mechanical vibrations and reacts with a very long delay to prolonged deviations between both input frequencies</td></tr></table></td><td>0 - 20</td><td>1</td></tr>
</table>

Continuation **"Main Menu":**

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>009</td><td><u>Error Simulation</u>:

This Parameter is only allowed in Programming Mode and serves exclusively for test purposes during the commissioning procedure. It allows to simulate and suppress error messages as follows:

<table>
<tr><td>0</td><td>Error state:
Sets the unit into error status. By using this parameter it is possible to check, if the entire follow-up system reacts correctly in case of errors.</td></tr>
<tr><td>1</td><td>Normal state:
Before exiting the Programming Mode,
this parameter always must be set to 1.</td></tr>
<tr><td>2</td><td>Error clearing:
All errors reported by the unit will be reset.</td></tr>
</table>
A direct changeover between 0 and 2 should be avoided.

After the test, this parameter must be reset to default (=1).</td><td>0 - 2</td><td>1</td></tr>
<tr><td>010</td><td><u>Power-up Delay</u>:

A delay time setting is recommended to ensure a safely power up and enough time for stabilization after switching the encoder supply for all connected encoders. The evaluation of the encoder signals will start after the selected delay time has been elapsed. This parameter can also be used to compensate different start-up times at power up.</td><td>0.001 - 9.999
(sec.)</td><td>0.100</td></tr>
<tr><td>011</td><td><u>SIN Error</u> <u>(activating or de-activating SIN/COS error)</u>:

This parameter allows activating or de-activating SIN/COS errors. SIN Err TimeX defines a permitted time limit for each sensor. With setting 1, all SIN/COS errors are suppressed.
<table>
<tr><td>0</td><td>SIN/COS errors are evaluated.</td></tr>
<tr><td>1</td><td>All SIN/COS errors are suppressed .</td></tr>
</table></td><td>0 - 1</td><td>0</td></tr>
</table>

Continuation **"Main Menu":**

<table>
<tr>
<td>012</td>
<td><u>Div. Mode</u> (Type of comparison):

This parameter defines the type of comparison for sensor evaluation. Frequency comparison compares the two sensor frequencies. Parameters 004 - 008 are relevant. Sensor Position Comparison compares the two sensor positions. Parameter 013 is relevant.

<table>
<tr><td>0</td><td>Frequency Comparison:
Differences between the two sensor frequencies results in a Run Time error.</td></tr>
<tr><td>1</td><td>Sensor Position Comparison:
Differences between the two sensor positons results in a Run Time error.</td></tr>
<tr><td>2</td><td>Frequency und Sensor Position Comparison:
Differences between the two sensor frequencies and the sensor positions results in a Run Time error.</td></tr>
</table>

Strongly fluctuating frequencies caused by step motors or elastic connections between the encoders, Sensor Position Comparison could be more stable.
Relationship between the encoders which are not adjusted by the parameter Multiplier and Divisor could cause cumulative errors. In this case Frequency comparison is more stable.
The DS24x is normally used with Position Comparison.</td>
<td>0 - 2</td>
<td>0</td>
</tr>
<tr>
<td>013</td>
<td><u>Div. Inc-Value</u> (absolute deviation in increments):

This parameter defines the maximum acceptable deviation in increments by Sensor Position Comparison.
If value 1000 is set, a position deviation higher than 1000 or lower than -1000 increments results in a Run-Time error.
This parameter is only used by Sensor Position Comparison.

If the parameter is set to 0, no error is recognized.</td>
<td>0 - 9999999</td>
<td>0</td>
</tr>
</table>

Continuation **"Main Menu":**

014	Filter (filtering the input frequencies): If value is set to 0, smoothing and filtering of the input frequencies will not be executed. The higher the value setting, the stronger the smoothing of the input frequencies, the lower the dynamic within frequency chances. A combination of Sampling Time and filtering is the best for smoothed input frequencies The Sampling Time affects more on high-frequency range (period time shorter than the Sampling Time). Filtering affects the frequency value determined after the Sampling Time resp. frequencies with period times longer than the Sampling Time. Frequencies > 1/Sampling Time: For Sampling Time = 1ms and Filter = 10, a value approx. 65 % is reached after 10 ms, 95 % after 30 ms and the final value is reached after 50 ms. A tenfold of the Sampling Time occurs a tenfold of the filtering time. Same for a tenfold of Parameter Filter and filtering time. The min. filter time is approx. 100 µs, up to two sampling periods. T (63 %) = Sampling Time x Filter T (95 %) = 3 x Sampling Time x Filter T (100 %) = 5 x Sampling Time x Filter Frequencies < 1/Sampling Time: In this case, you have to look at the period time = 1/f. For Filter = 10, after 10 periods a final value approx. 63 %, and after 30 periods a final value approx. 95 % is reached. T (63 %) = 1/f x Filter T (95 %) = 3 x 1/f x Filter T (100 %) = 5 x 1/f x Filter	0 - 999	0
015	A-Edge 2/1 (edge evaluation with A Single): This parameter is only active, if the operation mode is set to 2, 4, 5 or 9. The parameter refers to the A Single signal processing. Here every edge (A Edge 2/1=0) or every second edge (A Edge 2/1 = 1) can be evaluated. For signals with different pulse/pause times, the parameter must be set to 1 in order to detect a clear frequency. A faster reaction time is achieved by the setting of = 0	0 - 1	0

Continuation **"Main Menu":**

<table>
<tr>
<td>016</td>
<td><u>Sensor Overlap</u>:
The overlap of the two sensors can be defined with this parameter in Op.-Mode = 5.

<table>
<tr><td>0</td><td>Off:
The overlap is disabled. No error evaluation occurs.</td></tr>
<tr><td>1</td><td>Error at low:
The overlap for both signals of the encoder is active. An error is triggered when both sensors are controlled with low.</td></tr>
<tr><td>2</td><td>Error at high:
The overlap for both signals of the encoder is active. An error is triggered when both sensors are controlled with high.</td></tr>
</table>
</td>
<td>0 - 2</td>
<td>0</td>
</tr>
</table>

2.3. Sensor1 Menu

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>017</td><td><u>Direction1</u>:

With DS240 / DS246 versions: Direction1 = Direction2

Parameter to assign the direction of Sensor1

<table><tr><td>0</td><td>No changes</td></tr><tr><td>1</td><td>Changes the sign of the direction</td></tr></table>
This allows to reverse direction of Sensor1 in order to adapt Sensor1 to direction of Sensor2.</td><td>0 - 1</td><td>0</td></tr>
<tr><td>018</td><td><u>Multiplier1</u> (proportional pulse scaling factor):

With DS240 / DS246 versions: Multiplier1 = 1, Multiplier2 = 1

Is used to modulate the frequencies of Sensor 1 and Sensor2.
This scaling affects only the calculation of the divergence.</td><td>1 - 10 000</td><td>1</td></tr>
<tr><td>019</td><td><u>Divisor1</u> (reciprocal pulse scaling factor):

With DS240 / DS246 versions: Divisor1 = 1, Divisor = 1

To adjust the frequencies of Sensor1 and Sensor2.
This scaling affects only the calculation of the divergence.</td><td>1 - 10 000</td><td>1</td></tr>
<tr><td>020</td><td><u>Position Drift1</u> (drift monitoring at standstill):

With DS240 / DS246 versions: PositionDrift1 = PositionDrift2

This parameter handles drift movements at standstill. If the period time of the input frequency exceeds the adjusted „Wait-Time" parameter, the sensor is assigned to frequency = 0 Hz, even if a slow drift movement is present.

In case of an illegal drift, this parameter allows to preset an error threshold (symmetrical position window +/- xxx pulses). An error status is triggered if the adjusted value is exceeded.

The monitoring is only performed at standstill and begins at position 0, immediately when frequency = 0 Hz is detected.

<table><tr><td>0</td><td>Drift monitoring is not active</td></tr><tr><td>xxx</td><td>An error message appears, if the position is drifting out of the adjusted window of +/- xxx pulses (single edge evaluation).</td></tr></table></td><td>0 - 100 000</td><td>0</td></tr>
</table>

When using two encoders with differing pulse rates or in case of a mechanical reduction between both encoders, the higher frequency must be converted to the lower frequency by using the scaling factors.

Continuation "Sensor1 Menu":

No.	Parameter	Range	Default
021	Phase Err Count1 (faulty pulse counting limit): The DS unit is able to detect incorrect pulse sequences as well as faulty phase positions. Normally, the parameter should remain set to 10. A different setting is useful only in special cases. The error status will be released if the adjusted number of faulty pulses is exceeded. Incorrect pulses can be caused by faulty wirings, EMC-problems, incorrect mode settings, when turn up the encoder supply or when reverse the direction Parameter.	1 - 1 000	10
022	Set Frequency1 (simulation of a fixed encoder frequency): This Parameter is used for test purposes and allows to substitute the real encoder frequency by a fixed frequency. The parameter is only effective, while the unit is in the Programming Mode and if the input is assigned to this function.	-500 000,00 - 500 000,00 (Hz)	0,00
023	SIN Err Time1 (time until SIN/COS error will appear): This parameter defines the time in 20 ms intervals, appearing a SIN/COS error. If the parameter is 1, every SIN/COS error longer than 20ms, results in a RUN Time error. If the parameter is 0, every SIN/COS error results in a RUN Time error. If SIN Error is 1, this parameter is disabled, no SIN/COS error will appear.	0 - 99	0

2.4. Sensor2 Menu

No.	Parameter		Range	Default
024	Direction2:	The functions of the Sensor2 parameters are identical to Sensor1 menu, but all settings are related to Sensor2 which is specified by the parameter „Operation Mode".	0 - 1	0
025	Multiplier2:		1- 10 000	1
026	Divisor2:		1 - 10 000	1
027	Position Drift2:		0 - 100 000	0
028	Phase Err Count2:		1 - 1 000	10
029	Set Frequency2:		-500 000,00 - 500 000,00 (Hz)	0,00
030	SIN Err Time2 :		0 - 99	0

When using 2 encoders with differing pulse rates or in case of a mechanical reduction between both encoders, the higher frequency must be converted to the lower frequency by using the scaling factors.

2.5. Preselect Menu

This menu is used to set the switching points of the following outputs:

- 1 x relay output [X1 | RELAY OUT]
- 4 x control output [X2 | CONTROL OUT]

All limit values are related to the selected basic frequency (parameter “F1-F2 Selection”). The pulse-scaling does not influence the switching points.

Two separate switching points for each output are available, which allows e. g. to define the limit values for the setup mode and production mode. For this purpose, the function "Preselection Change" must be assigned to an unused control input (parameter “*IN* Function”).

A switchover between the switching points HIGH and LOW can only be released by an external command via control input at terminal [X10 | CONTROL IN]. The change will affect all outputs.

A switchover is only possible, if the control input is available by setting the parameter „Operational Mode”.

- Index .H means HIGH and requires definition of the higher limit value.
- Index .L means LOW and requires definition of the lower limit value.

Continuation „Preselect Menu"

No.	Parameter	Range	Default
031	Preselect OUT1.H: Upper switching point of output OUT1 [X2:1-2]	-500 000,00 - 500 000,00 (Hz) (defined by the „F1-F2 Selection" parameter)	2 000,00
032	Preselect OUT1.L: Lower switching point of output OUT1 [X2:1-2]		1 000,00
033	Preselect OUT1.D: Maximum drift if parameter Switch Mode OUT1 = 17 or 18 Drift values are indicated in ¼ increments		0
034	Preselect OUT2.H: Upper switching point of output OUT2 [X2:3-4]		4 000,00
035	Preselect OUT2.L: Lower switching point of output OUT2 [X2:3-4]		3 000,00
036	Preselect OUT2.D: Maximum drift if parameter Switch Mode OUT2 = 17 or 18 Drift values are indicated in ¼ increments		0
037	Preselect OUT3.H: Upper switching point of output OUT3 [X2:5-6]		6 000,00
038	Preselect OUT3.L: Lower switching point of output OUT3 [X2:5-6]		5 000,00
039	Preselect OUT3.D: Maximum drift if parameter Switch Mode OUT3 = 17 or 18 Drift values are indicated in ¼ increments		0
040	Preselect OUT4.H: Upper switching point of output OUT4 [X2:7-8]		8 000,00
041	Preselect OUT4.L: Lower switching point of output OUT4 [X2:7-8]		7 000,00
042	Preselect OUT4.D: Maximum drift if parameter Switch Mode OUT4 = 17 or 18 Drift values are indicated in ¼ increments		0
043	Preselect REL1.H: Upper switching point of the relay output [X1:1-2]		200,00
044	Preselect REL1.L: Lower switching point of the relay output [X1:1-2]		100,00
045	Preselect REL1.D: Maximum drift if parameter Switch Mode REL1 = 17 or 18 Drift values are indicated in ¼ increments		0

<table>
<tr><td>046</td><td><u>Preselect OUT1.F</u>:
This parameter is for setting the frequency difference per unit of time for "Switch Mode OUT1" = 21 and 22.

Time = frequency [Hz] / setting [Hz/ms]

It follows: 1000 Hz / 0,1 [Hz/ms] = 10 000ms = 10s

<table>
<tr><th>Frequency</th><th>Setting</th><th>Time</th></tr>
<tr><td>10Hz</td><td>00,0010</td><td>10s</td></tr>
<tr><td>100Hz</td><td>00,0100</td><td>10s</td></tr>
<tr><td>1kHz</td><td>00,1000</td><td>10s</td></tr>
<tr><td>10kHz</td><td>01,0000</td><td>10s</td></tr>
<tr><td>100kHz</td><td>10,0000</td><td>10s</td></tr>
</table>
<table>
<tr><th>Frequency</th><th>Setting</th><th>Time</th></tr>
<tr><td>1kHz</td><td>1,0000</td><td>1s</td></tr>
<tr><td>1kHz</td><td>0,1000</td><td>10s</td></tr>
<tr><td>1kHz</td><td>0,0100</td><td>100s</td></tr>
</table>
</td><td>1 – 5000,0000</td><td>046</td></tr>
<tr><td>047</td><td><u>Preselect OUT2.F</u>:
This parameter is for setting the frequency difference per unit of time for "Switch Mode OUT2" = 21 and 22.
(see parameter Preselect OUT1.F)</td><td>1 – 5000,0000</td><td>1000,0000</td></tr>
<tr><td>048</td><td><u>Preselect OUT3.F</u>:
This parameter is for setting the frequency difference per unit of time for "Switch Mode OUT3" = 21 and 22.
(see parameter Preselect OUT1.F)</td><td>1 – 5000,0000</td><td>1000,0000</td></tr>
<tr><td>049</td><td><u>Preselect OUT4.F</u>:
This parameter is for setting the frequency difference per unit of time for "Switch Mode OUT4" = 21 and 22.
(see parameter Preselect OUT1.F)</td><td>1 – 5000,0000</td><td>1000,0000</td></tr>
<tr><td>050</td><td><u>Preselect REL1.F</u>:
This parameter is for setting the frequency difference per unit of time for "Switch Mode REL1 = 21 and 22.
(see parameter Preselect OUT1.F)</td><td>1 – 5000,0000</td><td>1000,0000</td></tr>
<tr><td>051</td><td>Reserved</td><td></td><td></td></tr>
</table>

- The upper switching points (index .H) are only active, if no error can be detected and if the function Preselection Change is assigned to the control input.
- The operator has to assign the values to the switch-points correctly.
  The HIGH value must always be higher than the LOW value.
- The drift depends on the parameter "F1-F2 Selection" and thus refers to the selected encoder channel. Depending on the setting a drift error can set the output, but does not produce an error state.

2.6. Switching Menu

This menu is used to set the switching conditions of the following outputs:

- 1 x relay output [X1 | RELAY OUT]
- 4 x control output [X2 | CONTROL OUT]

The following form of writing is used:

|f| = absolute value of the basic frequency
|Preselection| = absolute value of the switching point
f = direction dependent, direction signed basic frequency
Preselection = direction dependent, direction signed switching point

Additional output features:

{S} = self-locking function
{H} = switching hysteresis
{A} = start up delay

- With an active self-locking function no hysteresis setting is necessary, because no bouncing is possible.
- With an inactive self-locking function a hysteresis setting is always useful.
- When using Switch Mode 7 or 8, the specified standstill-time must be higher than the adjusted wipe period. This is helpful to prevent a breakdown of the wipe signal before the wipe period has been elapsed.
- With Switch Mode 2, 6 and 16, the parameter "Hysteresis" is used for determining the frequency band.

Fortsetzung „Switching Menu“:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>052</td><td><u>Switch Mode OUT1</u> (switching conditions for OUT1):
<table>
<tr><td>0</td><td>|f| >= |Preselection|
Output switches in event of overspeed.</td><td>{S, H}</td></tr>
<tr><td>1</td><td>|f| <= |Preselection|
Output switches in event of underspeed.</td><td>{S, H, A}</td></tr>
<tr><td>2</td><td>|f| == |Preselection|
Output switches in event of leaving the frequency band (Preselection +/- Hysteresis).</td><td>{S, A}</td></tr>
<tr><td>3</td><td>Standstill
Output switches in event of standstill.</td><td></td></tr>
<tr><td>4</td><td>f >= Preselection
Output switches in event of overspeed.</td><td>{S, H}</td></tr>
<tr><td>5</td><td>f <= Preselection
Output switches in event of underspeed.</td><td>{S, H, A}</td></tr>
<tr><td>6</td><td>f == Preselection
Output switches in event of leaving the frequency band (Preselection +/- Hysteresis).</td><td>{S, A}</td></tr>
<tr><td>7</td><td>f > 0
Output switches, if a positive frequency (e.g. clockwise direction) is detected. The directional information will be deleted immediately when „Standstill“ is detected.</td><td></td></tr>
<tr><td>8</td><td>f < 0
Output switches, if a negative frequency (e.g. anticlockwise direction) is detected. The directional information will be deleted immediately when „Standstill“ is detected.</td><td></td></tr>
<tr><td>9</td><td>Clock generation for pulsed readback
EDM and pulse monitored inputs</td><td></td></tr>
<tr><td>10</td><td>STO/SBC/SS1
Enable + external self-locking,
without ramp monitoring</td><td>{S}</td></tr>
<tr><td>11</td><td>SLS |f| >= |Preselection|
Overspeed + enable + external self-locking,
without ramp monitoring</td><td>{S}</td></tr>
<tr><td>12</td><td>SMS |f| >= |Preselection|
Overspeed without enable + external self-locking</td><td>{S}</td></tr>
</table></td><td>0 - 22</td><td>0</td></tr>
</table>

Continuation „Switching Menu“:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>052</td><td>
<table>
<tr><td>13</td><td>SDI1 f > 0
Enable + external self-locking, frequency monitoring, no position monitoring</td><td>{S}</td></tr>
<tr><td>14</td><td>SDI2 f < 0
Enable + external self-locking, frequency monitoring, no position monitoring</td><td>{S}</td></tr>
<tr><td>15</td><td>SSM1 |f| <= |Preselection|
Underspeed + enable + external self-locking</td><td>{S}</td></tr>
<tr><td>16</td><td>SSM2 |f| within |Preselection +/- Hysteresis|
Underspeed + overspeed + enable + external self-locking</td><td>{S}</td></tr>
<tr><td>17</td><td>SOS/SLI/SS2 |f| > |Preselection| or Position Error
Overspeed + position + enable + self-locking</td><td>{S}</td></tr>
<tr><td>18</td><td>Standstill (at Standstill and no Position Error)
Standstill + position + enable + self-locking</td><td></td></tr>
<tr><td>19</td><td>Reserved</td><td></td></tr>
<tr><td>20</td><td>No standstill
This Mode operates like Mode 3, but only statically and the output is inverted. Here the inverted relay control is important.
Output switches if f is not equal to Zero (no standstill)</td><td></td></tr>
<tr><td>21</td><td>Ramp monitoring 1
Under Speed + Overspeed + Enable + External self-locking
The condition is that the braking behaviour is linear. The parameter " Preselect XXXX.H/L" describes the slope. The parameter " Preselect XXXX.D“ in Hz describes the +/- deviation.</td><td>{S}</td></tr>
<tr><td>22</td><td>Ramp monitoring 2
Under Speed + Overspeed + Enable + External self-locking
The condition is that the braking behaviour is linear. The parameter " Preselect XXXX.H/L" describes the slope. The parameter " Preselect XXXX.D“ describes the +/- deviation.</td><td>{S}</td></tr>
</table>
</td><td>0 - 22</td><td>0</td></tr>
<tr><td>053</td><td><u>Switch Mode OUT2</u> (switching condition for OUT2):
Settings are analogous to parameter „Switch Mode OUT1“</td><td>0 - 20</td><td>0</td></tr>
<tr><td>054</td><td><u>Switch Mode OUT3</u> (switching condition for OUT3):
Settings are analogous to parameter „Switch Mode OUT1“</td><td>0 - 20</td><td>0</td></tr>
<tr><td>055</td><td><u>Switch Mode OUT4</u> (switching condition for OUT4):
Settings are analogous to parameter „Switch Mode OUT1“</td><td>0 - 20</td><td>0</td></tr>
<tr><td>056</td><td><u>Switch Mode REL1</u> (switching condition for the relay output):
Settings are analogous to parameter „Switch Mode OUT1“</td><td>0 - 20</td><td>0</td></tr>
</table>

Continuation „Switching Menu“:

- With an active self-locking function no hysteresis setting is necessary, because no bouncing is possible.
- With an inactive self-locking function a hysteresis setting is always useful.
- When using Switch Mode 7 or 8, the specified standstill-time must be higher than the adjusted wipe period. This is helpful to prevent a breakdown of the wipe signal before the wipe period has been elapsed.
- With Switch Mode 2, 6 and 16, the parameter “Hysteresis” is used for determining the frequency band.

No.	Parameter	Range	Default
057	Pulse Time OUT1 (Wipe Signal Period of OUT1): 0: static wipe signal ≠0: wipe signal period in seconds	0 - 9.999 (sec.)	0,000
058	Pulse Time OUT2 (Wipe Signal Period of OUT2): Settings are analogous to parameter „Pulse Time OUT1“		
059	Pulse Time OUT3 (Wipe Signal Period of OUT3): Settings are analogous to parameter „Pulse Time OUT1“		
060	Pulse Time OUT4 (Wipe Signal Period of OUT4): Settings are analogous to parameter „Pulse Time OUT1“		
061	Pulse Time REL1 (Wipe Signal Period of the relay): Settings are analogous to parameter „Pulse Time OUT1“(min. 25 ms)		
	• The minimum wipe period of the control outputs is 1 msec. The minimum wipe period of the relay is 25 msec. • If a wipe signal is adjusted, no self-locking function can be assigned to the corresponding output.		
062	Hysteresis OUT1: Percental hysteresis of the adjusted switching point of parameter „Preselect OUT1“	0 - 100.0 (%)	0,0
063	Hysteresis OUT2: Percental hysteresis of the adjusted switching point of parameter „Preselect OUT2“		
064	Hysteresis OUT3: Percental hysteresis of the adjusted switching point of parameter „Preselect OUT3“		
065	Hysteresis OUT4: Percental hysteresis of the adjusted switching point of parameter „Preselect OUT4“		
066	Hysteresis REL1: Percental hysteresis of the adjusted switching point of parameter „Preselect REL1“		

Continuation „Switching Menu“:

- Due to the variance of the frequency measurement an output-bouncing around the limit value can occur. This behavior can be prevented by setting a hysteresis. A reasonable hysteresis value is approximately 1%.
- The setting of a hysteresis is only possible when the parameter "Switch Mode" is set to 0, 6 or 16.

No.	Parameter	Range	Default
067	Matrix OUT1 (enable matrix for output OUT1): Defines the enable signal (for Switch Mode 10 … 18) of output OUT1 by input selection at terminal X10 as well as the remaining feedback outputs (see table below). An input as well as a feedback output can be used as enable signal (OR operation in case of several signals). Bit 0: Input 1 [X10: 2] Bit 1: Input 2 [X10: 3] Bit 2: Input 3 [X10: 4] Bit 3: Input 4 [X10: 5] Bit 4: Output OUT1, not available here Bit 5: Output OUT2 Bit 6: Output OUT3 Bit 7: Output OUT4 Bit 8: Output REL1	0 - 511	0
068	Matrix OUT2 (enable matrix for output OUT2): Bit 0: Input 1 [X10: 2] Bit 1: Input 2 [X10: 3] Bit 2: Input 3 [X10: 4] Bit 3: Input 4 [X10: 5] Bit 4: Output OUT1 Bit 5: Output OUT2, not available here Bit 6: Output OUT3 Bit 7: Output OUT4 Bit 8: Output REL1	0 - 511	0
069	Matrix OUT3 (enable matrix for output OUT3): Bit 0: Input 1 [X10: 2] Bit 1: Input 2 [X10: 3] Bit 2: Input 3 [X10: 4] Bit 3: Input 4 [X10: 5] Bit 4: Output OUT1 Bit 5: Output OUT2 Bit 6: Output OUT3, not available here Bit 7: Output OUT4 Bit 8: Output REL1	0 - 511	0

Continuation „Switching Menu“:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>070</td><td><u>Matrix OUT4</u> (enable matrix for output OUT4)<u>:</u>
<table>
<tr><td>Bit 0</td><td>Input 1 [X10: 2]</td></tr>
<tr><td>Bit 1</td><td>Input 2 [X10: 3]</td></tr>
<tr><td>Bit 2</td><td>Input 3 [X10: 4]</td></tr>
<tr><td>Bit 3</td><td>Input 4 [X10: 5]</td></tr>
<tr><td>Bit 4</td><td>Output OUT1</td></tr>
<tr><td>Bit 5</td><td>Output OUT2</td></tr>
<tr><td>Bit 6</td><td>Output OUT3</td></tr>
<tr><td>Bit 7</td><td>Output OUT4, not available here</td></tr>
<tr><td>Bit 8</td><td>Output REL1</td></tr>
</table></td><td>0 - 511</td><td>0</td></tr>
<tr><td>071</td><td><u>Matrix REL1</u> (enable matrix for output REL1)<u>:</u>
<table>
<tr><td>Bit 0</td><td>Input 1 [X10: 2]</td></tr>
<tr><td>Bit 1</td><td>Input 2 [X10: 3]</td></tr>
<tr><td>Bit 2</td><td>Input 3 [X10: 4]</td></tr>
<tr><td>Bit 3</td><td>Input 4 [X10: 5]</td></tr>
<tr><td>Bit 4</td><td>Output OUT1</td></tr>
<tr><td>Bit 5</td><td>Output OUT2</td></tr>
<tr><td>Bit 6</td><td>Output OUT3</td></tr>
<tr><td>Bit 7</td><td>Output OUT4</td></tr>
<tr><td>Bit 8</td><td>Output REL1, not available here</td></tr>
</table></td><td>0 - 511</td><td>0</td></tr>
<tr><td>072</td><td><u>MIA-Delay OUT1</u> (delay for transition inactive to active)<u>:</u>
Matrix delay inactive to active for output OUT1 (in seconds).
This setting will delay the enable function, if the enable input or the feedback output changes from inactive to active.</td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>073</td><td><u>MIA-Delay OUT2</u> (delay for transition inactive to active)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>074</td><td><u>MIA-Delay OUT3</u> (delay for transition inactive to active)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>075</td><td><u>MIA-Delay OUT4</u> (delay for transition inactive to active)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>076</td><td><u>MIA-Delay REL1</u> (delay for transition inactive to active)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>077</td><td><u>MAI-Delay OUT1:</u> (delay for transition active to inactive)<u>:</u>
Matrix delay active to inactive for output OUT1 (in seconds).
This setting will delay the enable function, if the enable input or the feedback output changes from active to inactive.</td><td>0 - 99.999
(sec.)</td><td>0,000</td></tr>
<tr><td>078</td><td><u>MAI-Delay OUT2</u> (delay for transition active to inactive)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>079</td><td><u>MAI-Delay OUT3</u> (delay for transition active to inactive)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>080</td><td><u>MAI-Delay OUT4</u> (delay for transition active to inactive)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
<tr><td>081</td><td><u>MAI-Delay REL1</u> (delay for transition active to inactive)<u>:</u></td><td>0 - 99.999(sec.)</td><td>0,000</td></tr>
</table>

Continuation „Switching Menu“:

No.	Parameter	Range	Default
082	Delay OUT1 (Delay of the tripping for OUT1): Trip delay for the output OUT1 in seconds. This delay delays the tripping of OUT1. If the output has been reset before the delay time has expired, no change of state takes place at OUT1. The return takes place without delay. Oscillating releases and their recall ensure that the delay time restarts. If a wiping time is activated, a new wiping impulse can be issued only after recall and after the expiry of the delay time. Does not apply to Switch Mode = 3, 9,1 0 and 20	0 - 9,999 (sec.)	0,000
083	Delay OUT2 (Delay of the tripping for OUT2):	0 - 9,999 (sec.)	0,000
084	Delay OUT3 (Delay of the tripping for OUT3):	0 - 9,999 (sec.)	0,000
085	Delay OUT4 (Delay of the tripping for OUT4):	0 - 9,999 (sec.)	0,000
086	Delay REL1 (Delay of the tripping for REL1):	0 - 9,999 (sec.)	0,000

Continuation „Switching Menu“:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>087</td><td><u>Start-up Mode</u> (start-up delay time window):

Window for delay time until the monitoring function is activated.
Only useful in combination with parameter setting
„Switch Mode“ = 1, 2, 5 oder 6.

To use the start-up delay, it must be assigned to an output.

The start-up delay will be activated:
- with next power-up
- always when after standstill a frequency is detected again

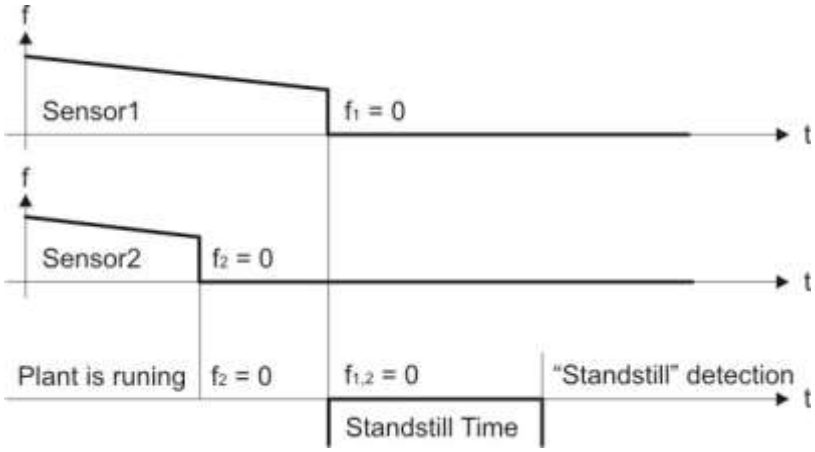
<table>
<tr><td>0</td><td>no start-up delay</td></tr>
<tr><td>1</td><td>start-up delay 1 second</td></tr>
<tr><td>2</td><td>start-up delay 2 seconds</td></tr>
<tr><td>3</td><td>start-up delay 4 seconds</td></tr>
<tr><td>4</td><td>start-up delay 8 seconds</td></tr>
<tr><td>5</td><td>start-up delay 16 seconds</td></tr>
<tr><td>6</td><td>start-up delay 32 seconds</td></tr>
<tr><td>7</td><td>start-up delay 64 seconds</td></tr>
<tr><td>8</td><td>start-up delay 128 seconds</td></tr>
<tr><td>9</td><td>automatically, until the value has been exceeded
for the first time</td></tr>
</table>
The defined delay time window is valid for all outputs.</td><td>0 - 9</td><td>0</td></tr>
<tr><td>088</td><td><u>Startup Output</u> (assignment of a start-up delay to outputs):

By using a 5 bit binary code the start-up delay function can be assigned to an output. Settings see below:

<table>
<tr><td>Output:</td><td>RELAY</td><td>OUT4</td><td>OUT3</td><td>OUT2</td><td>OUT1</td></tr>
<tr><td>Bit:</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>Binary:</td><td>10000</td><td>01000</td><td>00100</td><td>00010</td><td>00001</td></tr>
<tr><td>Value:</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr>
</table>
Example: A setting of Startup Output = 17 (binary 10001) means that a start-up delay is assigned to OUT1 and to the RELAY output.</td><td>0 - 31</td><td>0</td></tr>
</table>

Continuation **"Switching Menu"**:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>089</td><td><u>Standstill Time</u> (delay time for standstill detection):

This parameter defines the delay time until the unit detects a standstill after detecting frequency = 0 Hz.
 

Prior condition is that both input frequencies are detected as „Zero" ($f_{1,2}$ = 0 Hz). From that moment, the standstill period runs off and indicates a standstill when elapsed.</td><td>0 - 9.999
(sec.)</td><td>0,000</td></tr>
<tr><td>090</td><td><u>Lock Output</u> (assignment of a lock-function to an output):

The assignment of a self-locking-function to an output can be adjusted by using a 6 bit binary code as follows:
<table><tr><td>Output:</td><td>*</td><td>RELAY</td><td>OUT4</td><td>OUT3</td><td>OUT2</td><td>OUT1</td></tr><tr><td>Bit</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>Binary:</td><td>100000</td><td>010000</td><td>001000</td><td>000100</td><td>000010</td><td>000001</td></tr><tr><td>Value:</td><td>32</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr></table>Bits 1 to 5 are used to assign the lock function to the respective outputs.
*) The highest valued bit 6 determines if a locked output can be released exclusively by an external input signal via parameter "*IN* Function" (bit 6 = 0) or additionally by an automatic reset when standstill is indicated (bit 6 = 1).

Example:
An adjustment of Lock Output = 17 (binary 10001) means that a lock is assigned to output OUT1 and to the relay, which can be deactivated exclusively by an external input signal.

Further the adjustment Lock Output = 49 (binary 110001) means that the lock-functions of OUT1 and the relay are deleted additionally when standstill is detected.

Please note: With an active wipe time setting, no self-locking function can be assigned to the corresponding output.</td><td>0 - 63</td><td>0</td></tr>
</table>

Continuation **"Switching Menu"**:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>091</td><td>
<u>Action Output</u> (output selection for overwriting):

The function to set fixed output conditions for OUT1 to OUT4 is only effective in the Programming Mode. It is used for test purposes and allows to force each output to a defined switching condition.

The „Action Output“ parameter selects the outputs to be tested.
The next Parameter „Action Polarity“ is used to assign the desired switching conditions to the selected outputs.

The outputs are selectable by using a 5 bit binary code:
<table>
<tr><td>Output:</td><td>RELAY</td><td>OUT4</td><td>OUT3</td><td>OUT2</td><td>OUT1</td></tr>
<tr><td>Bit</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>Binary:</td><td>10000</td><td>01000</td><td>00100</td><td>00010</td><td>00001</td></tr>
<tr><td>Value:</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr>
</table>

Example: A setting of Action Output = 14 (binary 01110) means that the outputs OUT2, OUT3 and OUT4 are selected for overwriting.
<table>
<tr><td>REL</td><td>0</td><td>No overwriting</td></tr>
<tr><td>OUT4</td><td>1</td><td>Status see parameter “Action Polarity”</td></tr>
<tr><td>OUT3</td><td>1</td><td>Status see parameter “Action Polarity”</td></tr>
<tr><td>OUT2</td><td>1</td><td>Status see parameter “Action Polarity“</td></tr>
<tr><td>OUT1</td><td>0</td><td>No overwriting</td></tr>
</table>

After the test this parameter must be reset to default (= 0).
</td><td>0 - 31</td><td>0</td></tr>
</table>

Continuation **"Switching Menu"**:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>092</td><td>
<u>Action Polarity</u> (setting the output conditions):

This setting-function is only effective in the Programming Mode and requires a selection of the corresponding outputs by the parameter "Action Output".

The output-conditions are assignable by a 9 bit binary code:
<table>
<tr><td>OUT:</td><td>REL</td><td>4</td><td>/4</td><td>3</td><td>/3</td><td>2</td><td>/2</td><td>1</td><td>/1</td></tr>
<tr><td>Bit:</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>Binary:</td><td>1 0000 0000</td><td>0 1000 0000</td><td>0 0100 0000</td><td>0 0010 0000</td><td>0 0001 0000</td><td>0 0000 1000</td><td>0 0000 0100</td><td>0 0000 0010</td><td>0 0000 0001</td></tr>
<tr><td>Value:</td><td>256</td><td>128</td><td>64</td><td>32</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr>
</table>
Example: A setting of Action Output = 275 (binary 1 0001 0011) causes the following output conditions:
<table>
<tr><td>REL</td><td>1</td><td>Contact closed</td></tr>
<tr><td>OUT4</td><td>0</td><td>LOW</td></tr>
<tr><td>/OUT4</td><td>0</td><td>LOW</td></tr>
<tr><td>OUT3</td><td>0</td><td>LOW</td></tr>
<tr><td>/OUT3</td><td>1</td><td>HIGH</td></tr>
<tr><td>OUT2</td><td>0</td><td>LOW</td></tr>
<tr><td>/OUT2</td><td>0</td><td>LOW</td></tr>
<tr><td>OUT1</td><td>1</td><td>HIGH</td></tr>
<tr><td>/OUT1</td><td>1</td><td>HIGH</td></tr>
</table>
After the test, this parameter must be reset to default (= 0).
</td><td>0 - 511</td><td>0</td></tr>
<tr><td>093</td><td>
<u>Read Back OUT</u> (output for the EDM function):

Defines the read back output for the EDM function - with respect to inverting or non-inverting.
<table>
<tr><td>Bit 0</td><td>= 0 EDM function of OUT1
= 1 EDM function of /OUT1</td></tr>
<tr><td>Bit 1</td><td>= 0 EDM function of OUT2
= 1 EDM function of /OUT2</td></tr>
<tr><td>Bit 2</td><td>= 0 EDM function of OUT3
= 1 EDM function of /OUT3</td></tr>
<tr><td>Bit 3</td><td>= 0 EDM function of OUT4
= 1 EDM function of /OUT4</td></tr>
<tr><td>Bit 4</td><td>= 0 EDM function of REL1
= 1 EDM function of REL1 (inverted)</td></tr>
</table>
</td><td>0 - 31</td><td>0</td></tr>
</table>

Continuation „Switching Menu“:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>094</td><td><u>Output Mode</u> (output configuration)<u>:</u>
Defines the configuration of the outputs:<table><tr><td>Bit 0</td><td>= 0 OUT1 and /OUT1 are inverse
= 1 OUT1 and /OUT1 are homogeneously</td></tr><tr><td>Bit 1</td><td>= 0 OUT2 and /OUT2 are inverse
= 1 OUT2 and /OUT2 are homogeneously</td></tr><tr><td>Bit 2</td><td>= 0 OUT3 and /OUT3 are inverse
= 1 OUT3 and /OUT3 are homogeneously</td></tr><tr><td>Bit 3</td><td>= 0 OUT3 and /OUT4 are inverse
= 1 OUT3 and /OUT4 are homogeneously</td></tr></table></td><td>0 - 15</td><td>0</td></tr>
<tr><td>095</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>096</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>097</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>098</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>099</td><td>Reserved</td><td></td><td></td></tr>
</table>

- With homogeneous outputs, all inputs will be pulled down to GND in case of power or hardware failure. Thereby an error state cannot be clearly transmitted to another device by these outputs.
- Using homogeneous outputs will reduce the Safety Integrity Level (SIL).

2.7. Control Menu

This chapter describes the features and configuration options of the control inputs. Depending on the mode (parameter "Operational Mode") two up to four HTL/PNP control inputs are available at the terminal [X10 | CONTROL IN].

Three different input configurations can be set by the parameter „Input Mode":

- Two 2-pole inputs (IN1, /IN1 + IN2, /IN2)
  The control inputs are either homogeneous or inversely. In this case each input requires a dual signal.

Signal pair 1	[X10: 2] LOW	[X10: 3] LOW	Error if inverse	Configuration by parameter „IN1 Function" and „IN1 Config"
	[X10: 2] LOW	[X10: 3] HIGH	Error if homogeneously	
	[X10: 2] HIGH	[X10: 3] LOW	Error if homogeneously	
	[X10: 2] HIGH	[X10: 3] HIGH	Error if inverse	
Signal pair 2	[X10: 4] LOW	[X10: 5] LOW	Error if inverse	Configuration by parameter „IN2 Function" and „IN2 Config"
	[X10: 4] LOW	[X10: 5] HIGH	Error if homogeneously	
	[X10: 4] HIGH	[X10: 5] LOW	Error if homogeneously	
	[X10: 4] HIGH	[X10: 5] HIGH	Error if inverse	

- One 2-pole input (IN1, /IN1) and two 1-pole inputs (IN2 + /IN2)
  The 2-pole input is either homogeneous or inversely. The 2-pole control input requires a dual signal, while the 1-pole inputs only require a single signal. Thus three independent inputs are available.

Signal pair 1	[X10: 2] LOW	[X10: 3] LOW	Error if inverse	Configuration by parameter „IN1 Function" and „IN1 Config"
	[X10: 2] LOW	[X10: 3] HIGH	Error if homogeneously	
	[X10: 2] HIGH	[X10: 3] LOW	Error if homogeneously	
	[X10: 2] HIGH	[X10: 3] HIGH	Error if inverse	
Signal 2	[X10: 4] LOW		Configuration by parameter „IN2 Function" and „IN2 Config"	
	[X10: 4] HIGH			
Signal 3	[X10: 5] LOW		Configuration by parameter „/IN2 Function" and „/IN2 Config"	
	[X10: 5] HIGH			

- Four 1-pole inputs (IN1 + /IN1 + IN2 + /IN2)
  The 1-pole inputs require only a single signal. Thus four independent inputs are available.

Signal 1	[X10: 2] LOW	Configuration by parameter „IN1 Function" and „IN1 Config"
	[X10: 2] HIGH	
Signal 2	[X10: 3] LOW	Configuration by parameter „/IN1 Function" and „/IN1 Config"
	[X10: 3] HIGH	
Signal 3	[X10: 4] LOW	Configuration by parameter „IN2 Function" and „IN2 Config"
	[X10: 4] HIGH	
Signal 4	[X10: 5] LOW	Configuration by parameter „/IN2 Function" and „/IN2 Config"
	[X10: 5] HIGH	

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>100</td><td>
<u>IN1 Function</u> (assigns a function to input [X10 : 2]):
This parameter defines the input function. The respective switching behavior can be specified by using the “IN1 Config” parameter.
<table>
<tr><td>0</td><td>No function assigned</td><td></td></tr>
<tr><td>1</td><td>Release lock of output OUT1</td><td>[dyn]</td></tr>
<tr><td>2</td><td>Release lock of output OUT2</td><td>[dyn]</td></tr>
<tr><td>3</td><td>Release lock of output OUT3</td><td>[dyn]</td></tr>
<tr><td>4</td><td>Release lock of output OUT4</td><td>[dyn]</td></tr>
<tr><td>5</td><td>Release lock of output REL1</td><td>[dyn]</td></tr>
<tr><td>6</td><td>Release all output locks together</td><td>[dyn]</td></tr>
<tr><td>7</td><td>Set Frequency1
Frequency simulation of Sensor1</td><td>[stat]
[PRG]</td></tr>
<tr><td>8</td><td>Set Frequency2
Frequency simulation of Sensor2</td><td>[stat]
[PRG]</td></tr>
<tr><td>9</td><td>Set Frequency12
Frequency simulation of Sensor1 und Sensor2</td><td>[stat]
[PRG]</td></tr>
<tr><td>10</td><td>Freeze Frequency1
Freezes the actual encoder frequency of Sensor1</td><td>[stat]
[PRG]</td></tr>
<tr><td>11</td><td>Freeze Frequency2
Freezes the actual encoder frequency of Sensor2</td><td>[stat]
[PRG]</td></tr>
<tr><td>12</td><td>Freeze Frequency12
Freezes the encoder frequency of Sensor1 and Sensor2</td><td>[stat]
[PRG]</td></tr>
<tr><td>13</td><td>Preselection Change
Switchover between the upper and lower switching point. The changeover takes effect to all outputs.</td><td>[stat]</td></tr>
<tr><td>14</td><td>Clear Drift1
Clears the counter of position drift 1.</td><td>[dyn]</td></tr>
<tr><td>15</td><td>Clear Drift2
Clears the counter of position drift 2</td><td>[dyn]</td></tr>
<tr><td>16</td><td>Clear Drift12
Clears both counters (position drift 1 and 2)</td><td>[dyn]</td></tr>
<tr><td>17</td><td>EDM function of OUT1 or /OUT1</td><td></td></tr>
<tr><td>18</td><td>EDM function of OUT2 or /OUT2</td><td></td></tr>
<tr><td>19</td><td>EDM function of OUT3 or /OUT3</td><td></td></tr>
<tr><td>20</td><td>EDM function of OUT4 or /OUT4</td><td></td></tr>
<tr><td>21</td><td>Enable input for the output function of parameter „Switch Mode“ = 10 - 18</td><td>[stat]</td></tr>
<tr><td>22</td><td>EDM function for REL1</td><td></td></tr>
</table>
[dyn] = dynamic function if a rising edge appears at the input
[stat] = static permanent function
[PRG] = function only in the “Programming Mode” active
</td><td>0 - 22</td><td>0</td></tr>
</table>

In case of simultaneous commands "Set Frequency" and "Frequency freeze" via both control inputs, the function "Set Frequency" has priority.

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>101</td><td><u>IN1 Config</u> (switching behavior of input [X10 : 2]):
This parameter defines the switching behavior of the input. The respective function assignment can be specified by using the “IN1 Function” parameter.

<table>
<tr><td>0</td><td>Inverse dual channel input (statically, LOW)</td></tr>
<tr><td>1</td><td>Inverse dual channel input (statically, HIGH)</td></tr>
<tr><td>2</td><td>Inverse dual channel input (dynamically, LOW)</td></tr>
<tr><td>3</td><td>Inverse dual channel input (dynamically, HIGH)</td></tr>
<tr><td>4</td><td>Homogeneous dual channel input (statically, LOW)</td></tr>
<tr><td>5</td><td>Homogeneous dual channel input (statically, HIGH)</td></tr>
<tr><td>6</td><td>Homogeneous dual channel input (dynamically, LOW)</td></tr>
<tr><td>7</td><td>Homogeneous dual channel input (dynamically, HIGH)</td></tr>
<tr><td>8</td><td>Single channel input (statically, LOW)</td></tr>
<tr><td>9</td><td>Single channel input (statically, HIGH)</td></tr>
<tr><td>10</td><td>Single channel input (dynamically, LOW)</td></tr>
<tr><td>11</td><td>Single channel input (dynamically, HIGH)</td></tr>
<tr><td>12</td><td>Single channel input EDM clock of OUT1</td></tr>
<tr><td>13</td><td>Single channel input EDM clock of /OUT1</td></tr>
<tr><td>14</td><td>Single channel input EDM clock of OUT2</td></tr>
<tr><td>15</td><td>Single channel input EDM clock of /OUT2</td></tr>
<tr><td>16</td><td>Single channel input EDM clock of OUT3</td></tr>
<tr><td>17</td><td>Single channel input EDM clock of /OUT3</td></tr>
<tr><td>18</td><td>Single channel input EDM clock of OUT4</td></tr>
<tr><td>19</td><td>Single channel input EDM clock of /OUT4</td></tr>
<tr><td>20</td><td>Pulsed single channel input of OUT1 (statically, HIGH)</td></tr>
<tr><td>21</td><td>Pulsed single channel input of /OUT1 (statically, HIGH)</td></tr>
<tr><td>22</td><td>Pulsed single channel input of OUT2 (statically, HIGH)</td></tr>
<tr><td>23</td><td>Pulsed single channel input of /OUT2 (statically, HIGH)</td></tr>
<tr><td>24</td><td>Pulsed single channel input of OUT3 (statically, HIGH)</td></tr>
<tr><td>25</td><td>Pulsed single channel input of /OUT3 (statically, HIGH)</td></tr>
<tr><td>26</td><td>Pulsed single channel input of OUT4 (statically, HIGH)</td></tr>
<tr><td>27</td><td>Pulsed single channel input of /OUT4 (statically, HIGH)</td></tr>
<tr><td>28</td><td>Pulsed single channel input of OUT1 (statically, LOW)</td></tr>
<tr><td>29</td><td>Pulsed single channel input of /OUT1 (statically, LOW))</td></tr>
<tr><td>30</td><td>Pulsed single channel input of OUT2 (statically, LOW)</td></tr>
<tr><td>31</td><td>Pulsed single channel input of /OUT2 (statically, LOW)</td></tr>
<tr><td>32</td><td>Pulsed single channel input of OUT3 (statically, LOW)</td></tr>
<tr><td>33</td><td>Pulsed single channel input of /OUT3 (statically, LOW)</td></tr>
<tr><td>34</td><td>Pulsed single channel input of OUT4 (statically, LOW)</td></tr>
<tr><td>35</td><td>Pulsed single channel input of /OUT4 (statically, LOW)</td></tr>
</table>
</td><td>0 - 35</td><td>0</td></tr>
</table>

Continuation „Control Menu“

No.	Parameter	Range	Default
102	/IN1 Config (switching behavior of input [X10 : 3]): The functions are identical to the parameter "IN1 Function"	0 - 22	0
103	/IN1 Config (switching behavior of input [X10 : 3]): The functions are identical to the parameter "IN1 Config"	0 - 35	0
104	IN2 Config (switching behavior of input [X10 : 4]): The functions are identical to the parameter "IN1 Function"	0 - 22	0
105	IN2 Config (switching behavior of input [X10 : 4]): The functions are identical to the parameter "IN1 Config"	0 - 35	0
106	/IN2 Config (switching behavior of input [X10 : 5]): The functions are identical to the parameter "IN1 Function"	0 - 22	0
107	/IN2 Config (switching behavior of input [X10 : 5]): The functions are identical to the parameter "IN1 Config"	0 - 35	0
108	Input Mode (input configuration): Defines the input types: 0 Two dual-channel input pairs 1 One dual-channel input pair and two single inputs 2 Four single-ended inputs	0 - 2	0
109	Read Back Delay (time until the read back is active again): Bounce time delay for an external relay of the EDM function	0,000 - 1,000 (sec.)	0,000
110	GPI Err Time (value 1 corresponds to an error time of approx. 1 ms): After this time, illegal conditions at the GPI Input results in an error. A default value of 10 corresponds to an error time of approx. 10 ms.	1 - 999	10

2.8. Serial Menu

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>111</td><td><u>Serial Unit No.</u> (assigns a serial unit number):

The devices can be assigned by unit numbers between 11 and 99 (default = 11).

Please note: Unit numbers must not contain a 0 because these numbers are reserved for group- or bulk-addressing.</td><td>11 - 99</td><td>11</td></tr>
<tr><td>112</td><td><u>Serial Baud Rate</u> (serial transmission speed):

<table>
<tr><td>0</td><td>9 600 Baud</td></tr>
<tr><td>1</td><td>4 800 Baud</td></tr>
<tr><td>2</td><td>2 400 Baud</td></tr>
<tr><td>3</td><td>1 200 Baud</td></tr>
<tr><td>4</td><td>600 Baud</td></tr>
<tr><td>5</td><td>19 200 Baud</td></tr>
<tr><td>6</td><td>38 400 Baud</td></tr>
<tr><td>7</td><td>56 000 Baud</td></tr>
<tr><td>8</td><td>57 600 Baud</td></tr>
<tr><td>9</td><td>76 800 Baud</td></tr>
<tr><td>10</td><td>115 200 Baud</td></tr>
</table></td><td>0 - 10</td><td>0</td></tr>
<tr><td>113</td><td><u>Serial Format</u> (format of the serial data):

<table>
<tr><td>0:</td><td>7 data bits, parity even, 1 stop bit</td></tr>
<tr><td>1:</td><td>7 data bits, parity even, 2 stop bits</td></tr>
<tr><td>2:</td><td>7 data bits, parity odd, 1 stop bit</td></tr>
<tr><td>3:</td><td>7 data bits, parity odd, 2 stop bits</td></tr>
<tr><td>4:</td><td>7 data bits, no parity*, 1 stop bit</td></tr>
<tr><td>5:</td><td>7 data bits, no parity*, 2 stop bits</td></tr>
<tr><td>6:</td><td>8 data bits, parity even, 1 stop bit</td></tr>
<tr><td>7:</td><td>8 data bits, parity odd, 1 stop bit</td></tr>
<tr><td>8:</td><td>8 data bits, no parity*, 1 stop bit</td></tr>
<tr><td>9:</td><td>8 data bits, no parity*, 2 stop bits</td></tr>
</table></td><td>0 - 9</td><td>0</td></tr>
</table>

*) With setting „no parity“ no secure data transmission guaranteed.
For a secure data transmission „Parity even“ or „Parity odd“ must be selected.

Continuation „Serial Menu“:

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>114</td><td><u>Serial Page</u> (serial page number of a variable):

The Parameter serves only for diagnosis purposes by the manufacturer.</td><td>0 - 16</td><td>0</td></tr>
<tr><td>115</td><td><u>Serial Init:</u>

This parameter determines the baud rate for the transmission of the initialization values to the operator surface OS respectively to the BG230 programming and display unit.

<table><tr><td>0</td><td>The initialization values will be transmitted with 9600 baud. After that, the unit returns back to the baud rate set by the user.</td></tr><tr><td>1</td><td>The initialization values will be transmitted with the user setting. After that, the unit continues with this baud rate.</td></tr></table>
With settings higher than 9600 baud the duration of the initialization can be shortened.</td><td>0 - 1</td><td>0</td></tr>
<tr><td>116</td><td>Reserved</td><td></td><td></td></tr>
</table>

2.9. Splitter Menu

(Looping of Sensor Signals for further Target Units)

The Splitter function is only integrated in DS230 and DS240.

<table>
<tr><th>No.</th><th>Parameter</th><th>Range</th><th>Default</th></tr>
<tr><td>117</td><td><u>RS Selector</u> (determination of the RS422 output source):

This parameter defines which input frequency (Sensor1 or Sensor2) is exported at terminal [X4 | RS422 OUT].

The assignment of channels for sensor1 and sensor 2 is specified by the parameter „Operational Mode“.

<table>
<tr><td>0</td><td>Sensor1
A copy of the Sensor1 frequency appears at terminal [X4 | RS422 OUT]</td></tr>
<tr><td>1</td><td>Sensor2
A copy of the Sensor2 frequency appears at terminal [X4 | RS422 OUT]</td></tr>
</table>

Independent from the input signal, always incremental RS422 square-wave pulses are generated.

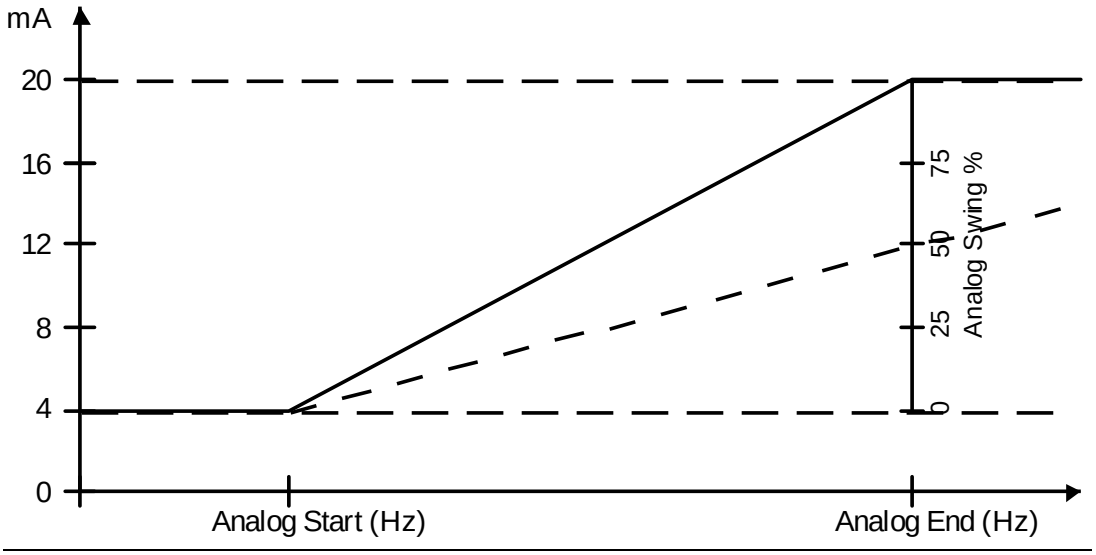
SinCos signals are converted to incremental signals with 1 pulse / period (without an interpolation).</td><td>0 - 1</td><td>0</td></tr>
</table>

2.10. Analog Menu

(Analog Output Configuration)

The setting of parameter "F1-F2-Selection" determines whether the frequency of Sensor1 or Sensor2 is used to generate the analog output signal.

No.	Parameter	Range	Default
118	**Analog Start** (initial value of the conversion range in Hz): Defines the initial frequency, at which the analog output should set its initial value of 4 mA.	-500 000,00 - 500 000,00 (Hz)	0
119	**Analog End** (final value of the conversion range in Hz): Defines the final frequency, at which the analog output should set its final value of 20 mA.		1 000,00
120	**Analog Gain** (gain of the D/A converter): With a setting of 100, the frequency curve between the parameters „Analog Start" and „Analog End" corresponds to the whole stroke of 16 mA (20 mA – 4 mA). With a setting of e. g. 50 the stroke would be only 8 mA and the analog output supplies a value of 4 + 8 = 12 mA when reaching the end frequency of parameter „Analog End".	1 - 1 000	100
121	**Analog Offset** (fine adjustment of the zero point in µA): Accurate adjustment of the analog offset within a fine range.	-25 … +25 (µA)	0
122	*Reserved*		



2.11. OPU Menu

(Operational Unit Menu in case of a connected BG230)

No	Parameter	Range	Default
123	X Factor 1 (no function for DS, internal BG parameter)	1 - 999 999	1
124	/ Factor 1 (no function for DS, internal BG parameter)	1 - 999 999	1
125	+/- Value 1 (no function for DS, internal BG parameter)	-999 999 - 999 999	0
126	Units 1 (no function for DS, internal BG parameter)	0 - 12	0
127	Decimal Point 1 (no function for DS, internal BG parameter)	0 - 5	0
128	X Factor 2 (no function for DS, internal BG parameter)	1 - 999 999	1
129	/ Factor 2 (no function for DS, internal BG parameter)	1 - 999 999	1
130	+/- Value 2 (no function for DS, internal BG parameter)	-999 999 - 999 999	0
131	Units 2 (no function for DS, internal BG parameter)	0 - 12	0
132	Decimal Point 2 (no function for DS, internal BG parameter)	0 - 5	0
133	*Reserved*		

Hint: The actual BG230 operating manual describes further details about these parameters.

3. Parameter List

No.	Parameter	Min. Value	Max. Value	Default	Characters	Decimal Places	Serial Code
000	Operational Mode	0	9	0	1	0	A0
001	Sampling Time	1	9999	1	4	3	A1
002	Wait Time	10	9999	100	4	3	A2
003	F1-F2 Selection	0	1	0	1	0	A3
004	Div. Switch %-f	0	99999	10000	5	2	A4
005	Div. %-Value	1	100	10	3	0	A5
006	Div. f-Value	0	9999	3000	4	2	A6
007	Div. Calculation	0	1	0	1	0	A7
008	Div. Filter	0	20	1	2	0	A8
009	Error Simulation	0	2	1	1	0	A9
010	Power-up Delay	1	9999	100	4	3	B0
011	SIN Error	0	1	0	1	0	B1
012	Div. Mode	0	2	0	1	0	B2
013	Div. Inc-Value	0	9999999	0	7	0	J2
014	Filter	0	999	0	3	0	J3
015	A-Edge 2/1	0	1	0	1	0	J4
016	Sensor Overlap	0	2	0	1	0	J5
017	Direction1	0	1	0	1	0	B3
018	Multiplier1	1	10000	1	5	0	B4
019	Divisor1	1	10000	1	5	0	B5
020	Position Drift1	0	100000	0	6	0	B6
021	Phase Err Count1	1	1000	10	4	0	B7
022	Set Frequency1	-50000000	50000000	0	88	2	B8
023	SIN Err Time1	0	99	0	2	0	B9
024	Direction2	0	1	0	1	0	C0
025	Multiplier2	1	10000	1	5	0	C1
026	Divisor2	1	10000	1	5	0	C2
027	Position Drift2	0	100000	0	6	0	C3
028	Phase Err Count2	1	1000	10	4	0	C4
029	Set Frequency2	-50000000	50000000	0	88	2	C5
030	SIN Err Time2	0	99	0	2	0	C6
031	Preselect OUT1.H	-50000000	50000000	100000	88	2	C7
032	Preselect OUT1.L	-50000000	50000000	200000	88	2	C8
033	Preselect OUT1.D	0	9999999	0	7	0	M0
034	Preselect OUT2.H	-50000000	50000000	300000	88	2	C9
035	Preselect OUT2.L	-50000000	50000000	400000	88	2	D0
036	Preselect OUT2.D	0	9999999	0	7	0	M1
037	Preselect OUT3.H	-50000000	50000000	500000	88	2	D1
038	Preselect OUT3.L	-50000000	50000000	600000	88	2	D2
039	Preselect OUT3.D	0	9999999	0	7	0	M2
040	Preselect OUT4.H	-50000000	50000000	700000	88	2	D3
041	Preselect OUT4.L	-50000000	50000000	800000	88	2	D4
042	Preselect OUT4.D	0	9999999	0	7	0	M3
043	Preselect REL1.H	-50000000	50000000	10000	88	2	D5

Continuation „Parameter List“:

N°	Paramètre	Valeur min.	Valeur max.	Défaut	Chiffres	Décimales	Serial Code
044	Preselect REL1.L	-50000000	50000000	20000	88	2	D6
045	Preselect REL1.D	0	9999999	0	7	0	M4
046	Preselect OUT1.F	1	50000000	10000000	8	4	N0
047	Preselect OUT2.F	1	50000000	10000000	8	4	N1
048	Preselect OUT3.F	1	50000000	10000000	8	4	N2
049	Preselect OUT4.F	1	50000000	10000000	8	4	N3
050	Preselect REL1.F	1	50000000	10000000	8	4	N4
051	*Reserved*	0	10000	1000	5	0	D8
052	Switch Mode OUT1	0	22	0	1	0	D9
053	Switch Mode OUT2	0	22	0	1	0	E0
054	Switch Mode OUT3	0	22	0	1	0	E1
055	Switch Mode OUT4	0	22	0	1	0	E2
056	Switch Mode REL1	0	22	0	1	0	E3
057	Pulse Time OUT1	0	9999	0	4	3	E4
058	Pulse Time OUT2	0	9999	0	4	3	E5
059	Pulse Time OUT3	0	9999	0	4	3	E6
060	Pulse Time OUT4	0	9999	0	4	3	E7
061	Pulse Time REL1	0	9999	0	4	3	E8
062	Hysteresis OUT1	0	1000	0	4	1	E9
063	Hysteresis OUT2	0	1000	0	4	1	F0
064	Hysteresis OUT3	0	1000	0	4	1	F1
065	Hysteresis OUT4	0	1000	0	4	1	F2
066	Hysteresis REL1	0	1000	0	4	1	F3
067	Matrix OUT 1	0	511	0	3	0	K0
068	Matrix OUT 2	0	511	0	3	0	K1
069	Matrix OUT 3	0	511	0	3	0	K2
070	Matrix OUT 4	0	511	0	3	0	K3
071	Matrix REL1	0	511	0	3	0	K4
072	MIA-Delay OUT1	0	99999	0	5	0	K5
073	MIA-Delay OUT 2	0	99999	0	5	0	K6
074	MIA-Delay OUT 3	0	99999	0	5	0	K7
075	MIA-Delay OUT 4	0	99999	0	5	0	K8
076	MIA-Delay REL1	0	99999	0	5	0	K9
077	MAI-Delay OUT 1	0	99999	0	5	0	L0
078	MAI-Delay OUT 2	0	99999	0	5	0	L1
079	MAI-Delay OUT 3	0	99999	0	5	0	L2
080	MAI-Delay OUT 4	0	99999	0	5	0	L3
081	MAI-Delay REL1	0	99999	0	5	0	L4
082	Delay OUT1	0	9999	0	4	3	N5
083	Delay OUT2	0	9999	0	4	3	N6
084	Delay OUT3	0	9999	0	4	3	N7
085	Delay OUT4	0	9999	0	4	3	N8
086	Delay REL1	0	9999	0	4	3	N9
087	Startup Mode	0	9	0	1	0	F4
088	Startup Output	0	31	0	2	0	F5

Continuation „Parameter List“:

C	Parameter	Min - Wert	Max - Wert	Default	Stellen	Nachkommastellen	Serial Code
089	Standstill Time	0	9999	0	4	3	F6
090	Lock Output	0	63	0	2	0	F7
091	Action Output	0	31	0	2	0	F8
092	Action Polarity	0	511	0	3	0	F9
093	Read Back OUT	0	31	0	2	0	G0
094	Output Mode	0	15	0	2	0	G1
095	*Reserved*	0	10000	1000	5	0	H2
096	*Reserved*	0	10000	1000	5	0	H3
097	*Reserved*	0	10000	1000	5	0	H4
098	*Reserved*	0	10000	1000	5	0	J0
099	*Reserved*	0	10000	1000	5	0	J1
100	IN1 Function	0	22	0	2	0	G2
101	IN1 Config	0	35	0	2	0	G3
102	/IN1 Function	0	22	0	2	0	I0
103	/IN1Config	0	35	0	2	0	I1
104	IN2 Function	0	22	0	2	0	G4
105	IN2 Config	0	35	0	2	0	G5
106	/IN2 Function	0	22	0	2	0	I2
107	/IN2 Config	0	35	0	2	0	I3
108	Input Mode	0	2	0	1	0	I4
109	Read Back Delay	0	1000	0	4	3	G6
110	GPI Err Time	1	999	10	3	0	G7
111	Serial Unit Nr.	11	99	11	2	0	90
112	Serial Baud Rate	0	10	0	2	0	91
113	Serial Format	0	9	0	1	0	92
114	Serial Page	0	16	0	2	0	~0
115	Serial Init	0	1	0	1	0	9~
116	*Reserved*	0	10000	1000	5	0	H0
117	RS Selector	0	1	0	1	0	H1
118	Analog Start	-50000000	50000000	0	88	2	H5
119	Analog End	-50000000	50000000	1000000	88	2	H6
120	Analog Gain	1	1000	100	4	0	H7
121	Analog Offset	-25	25	0	83	0	H8
122	*Reserved*	0	10000	1000	5	0	H9
123	X Factor 1	1	999999	1	6	0	z0
124	/ Factor 1	1	999999	1	6	0	z1
125	+/- Value 1	-999999	999999	0	86	0	z2
126	Units 1	0	12	0	2	0	z3
127	Decimal Point 1	0	5	0	1	0	z4
128	X Factor 2	1	999999	1	6	0	z5
129	/ Factor 2	1	999999	1	6	0	z6
130	+/- Value 2	-999999	999999	0	86	0	z7
131	Units 2	0	12	0	2	0	z8
132	Decimal Point 2	0	5	0	1	0	z9
133	*Reserved*	0	10000	1000	5	0	00