Operating Manual

FM210
Frequency Multiplier, Frequency Divider

Product features:

- Adjustable Multiplier / divider (F1/F2)
- Input format RS-422, HTL single ended, HTL differential or TTL
- Multiplication / division without cumulative residual error
- Additional functions like Jog, Trim, Offset and Reference
- Input frequency up to 1MHz, depending on input format
- Output frequency max. 1MHz
- Two HTL outputs to display different states
- Supply 9 to 30 VDC

Die deutsche Beschreibung ist verfügbar unter:
https://www.motrona.com/fileadmin/files/bedienungsanleitungen/Fm210_d.pdf

The English description is available at:
https://www.motrona.com/fileadmin/files/bedienungsanleitungen/Fm210_e.pdf

La description en français est disponible sur:
https://www.motrona.com/fileadmin/files/bedienungsanleitungen/Fm210_f.pdf

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

Version:	Description:
FM210_01b/AF/ Jul 2020	Version 1
FM210_02a/AF/MBO/Apr.2021	Version 2, Extension by Offset Edge +/-

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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 unit 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 this manual. The unit must be installed, connected and put into operation 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 and operation. 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 or maintenance all general and also all country- and application-specific safety rules and standards must be observed.

If the unit 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 has arisen through unsuitable and improper use.

Please note that unit may only be installed in proper form and used in a technically perfect condition (in accordance to the Technical Specifications, see chapter 16). The unit is not suitable for operation in explosion-proof areas or areas which are excluded by the EN 61010-1 standard.

1.3.   Installation

The unit is only allowed to be installed and operated within the permissible temperature range. Please ensure an adequate ventilation and avoid all direct contact between the unit 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.

Units 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 unit 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 a double resp. increased isolation.

All selected wires and isolations must be conformed 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 (see chapter 16).

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.

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

1.4.   EMC Guidelines

All motrona units are designed to provide high protection against electromagnetic interference. Nevertheless, you must minimize the influence of electromagnetic noise to the unit 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 unit 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 unit must be shipped for back to the manufacturer for checking, adjustment and reparation (if necessary). Unauthorized opening and repairing can have negative effects or failures to the protection-measures of the unit.

2. Introduction

The FM210 is an intelligent unit for proportional conversion of an input frequency fin into an output frequency fout.

$$f_{out} = \frac{F1}{F2} \times f_{in}$$

The ratio results from setting two variable factors F1 (Parameter Factor 1) and F2 (Parameter Factor 2). Applications are mainly in the field of digital, frequency-controlled drives in the realization of electronic shafts or electronically adjustable gears.

Since the pulse conversion works without errors, the unit can also be used for positioning tasks or angular synchronous operation. Useful additional functions such as "Jog", "Reference", "Trim" and "Offset" allow the slave drive to be moved independently of the master drive.

All settings are made at the DIL switches on the housing and by programming. The unit is housed in a compact housing with screw terminals and can be plugged onto a top-hat rail.

3. Block Diagram
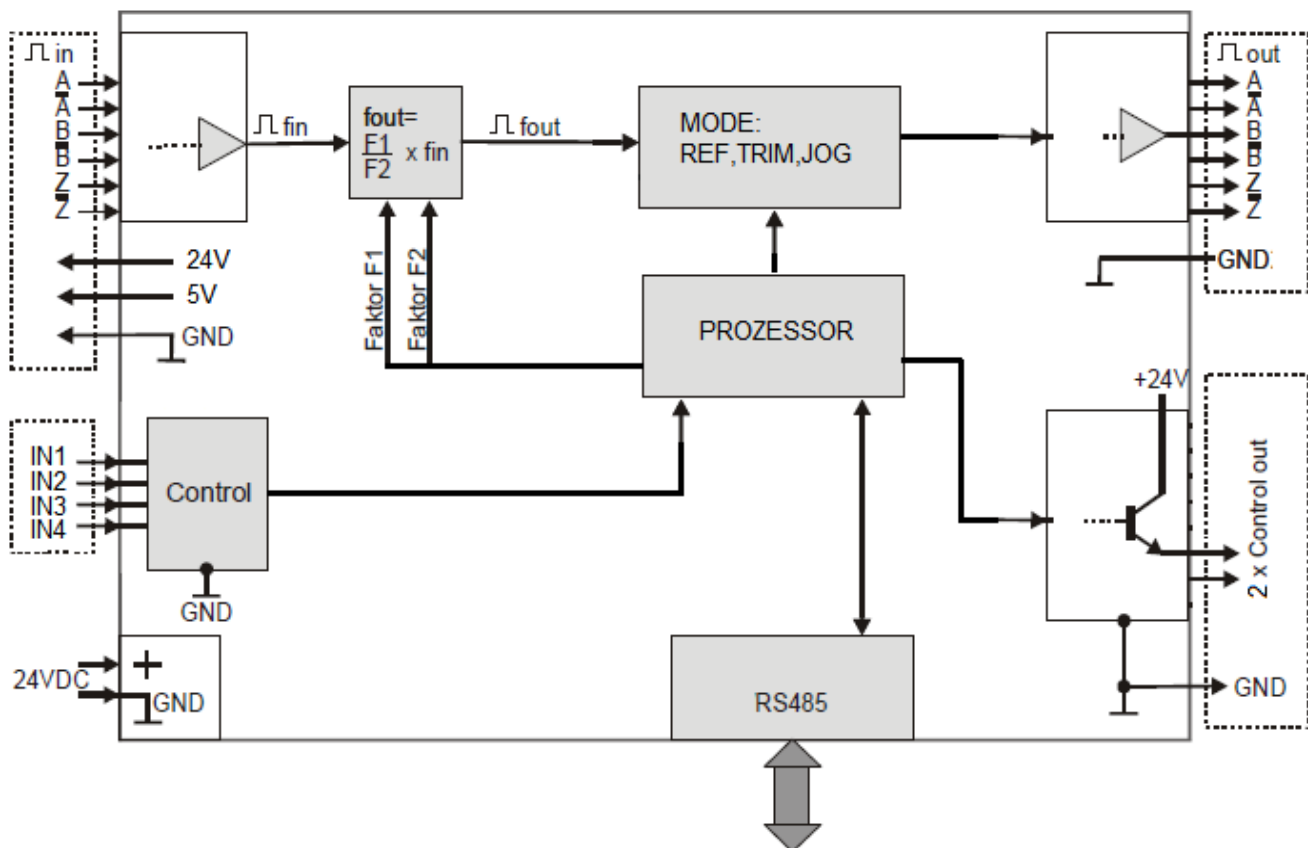
4. Electrical Connections

The clamps should be tightened with a slotted screwdriver (blade width 2mm).
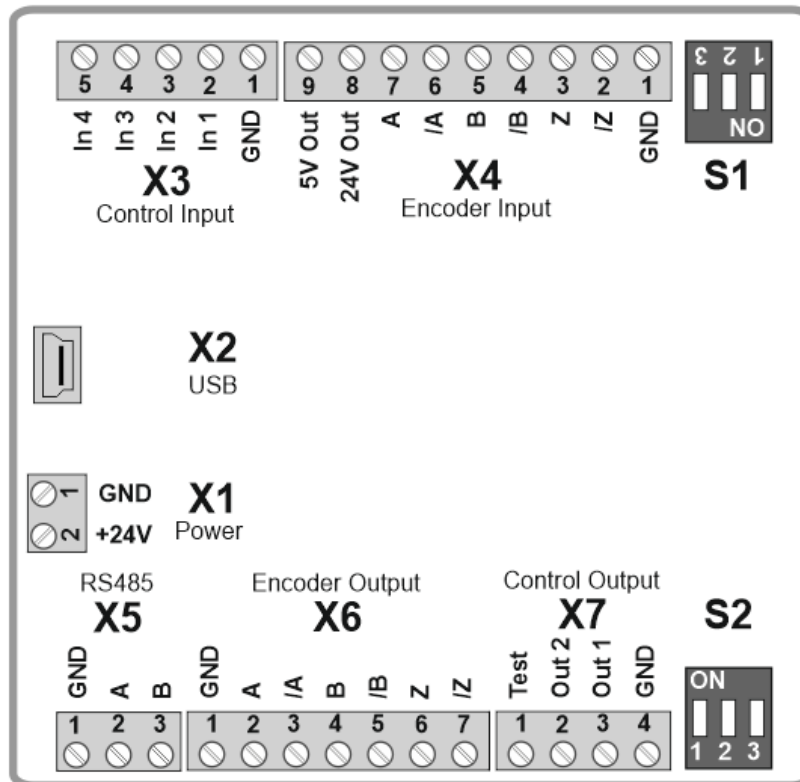
Please note that all inputs and outputs refer to the same ground potential GND (except USB), which is also the negative pole of the unit supply.
In any case, it must be ensured that the signal quality of the entire arrangement including the encoder, any external circuitry and cable capacitance ensure a perfect pulse pattern at the unit input (pulse level, pulse shape, phase offset A/B).

4.1.   DC Input Voltage Supply

The unit is supplied with a DC voltage between 9 - 30 VDC via terminals 1 and 2 of X1.
The current consumption depends among others on the level of the supply voltage and the settings and is approx. 45 mA at 24VDC without load from the encoder supply and outputs. All GND connections are internally connected.

4.2.   Output for encoder supply 5V/24V Out

At terminal 1 and 9 of X4, the auxiliary voltage for the encoder supply is +5.5 VDC and can be loaded with max. 250mA. At terminals 1 and 8 of X4, the auxiliary voltage for the encoder supply corresponds approximately to the voltage supply of the unit (at 24V supply at X1 approx. 23V) and can be loaded with max. 250mA.

4.3. Encoder Inputs A, /A, B, /B, Z, /Z

An encoder input A/B 90° for HTL/TTL/RS-422 signals is available at terminals 2 - 7 of X4. The unused inputs must either remain open (HTL Single Ended as opposed to HTL Differential), or possibly be terminated (unused Z-lines in RS-422 or HTL Differential Format).

Connection of the encoder inputs:
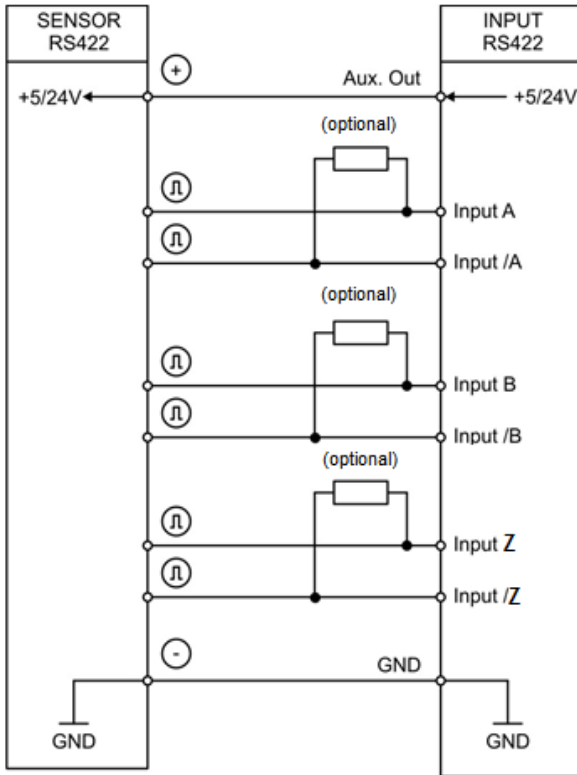
RS-422   HTL Differential
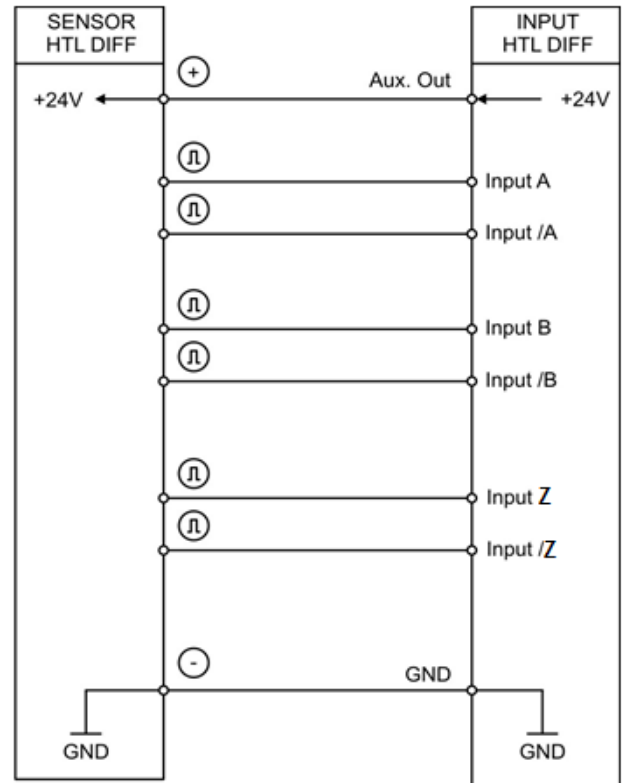
Other circuits (HTL-TTL single ended):
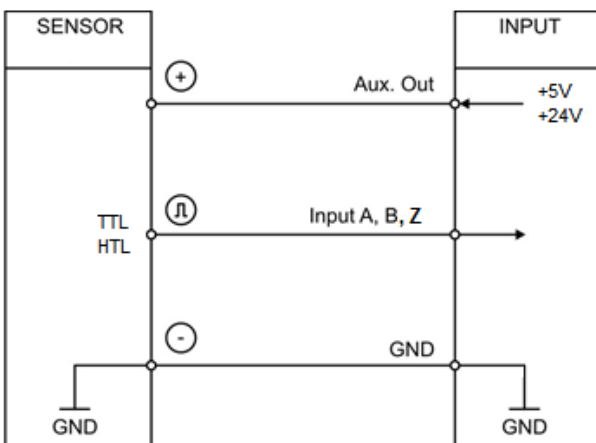
4.4. Control-Inputs INx

4 control inputs with HTL PNP characteristics are available on terminal 2 – 5 of X3.
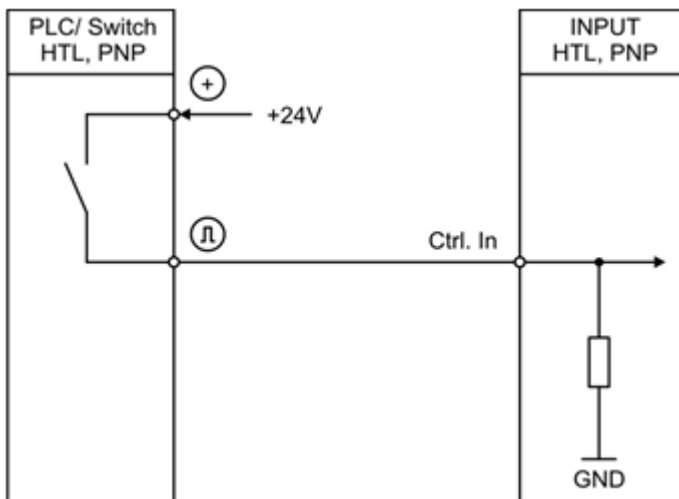
Open control inputs are "low active". The inputs could be used for control purposes. They could be used for different functions regarding the parameterization.

4.5. Encoder Output A, /A, B, /B, Z, /Z

At the outputs of terminal X6, the encoder signals are available either in HTL or RS-422 format, depending on the DIL switch S2/1 setting.
The output level corresponds in the HTL setting approximately to the supply voltage at X1.
(S2(1) = OFF, encoder output RS-422; S2(1) = ON, encoder output HTL)

⚠️	Attention: If the DIL switch is set incorrectly, the following circuit may be damaged.

4.6. Control Outputs OUTx

Two HTL (24V) signals are available at terminal 2 and 3 of X7. They can show different states according to the parameterization.
At terminal 1 of X7, there is an analog test output which shows the status of the differential counter. Here approx. 1.65V correspond to the counter value 0, the voltage range is max. 1.65V in both directions and corresponds to approx. +/-128 increments. This output may only be connected to an oscilloscope or a multimeter to record the timing behavior of the differential counter.

4.7.   LEDs

The green LED shows that the unit is ready (power supply switched on).
The yellow LED shows an input error in case of a static illumination. (only with RS-422 or HTL differential), otherwise it flashes.

4.8.   DIL Switch

The DIL switch S1 is used to detect an input error with HTL differential or RS-422 format. The A line can be monitored via DIL1/1. If the DIL switch DIL1/1 is set to ON, the A line can give out an error. The same applies to DIL switch DIL1/2 and the B line, as well as DIL1/3 and the Z line.
The DIL switch 2/1 is used to switch the voltage level of the encoder output at X6 from 5V (OFF) to 24V (ON). The DIL switch 2/3 is used for loading the factory parameters when the supply voltage is switched on. In the ON position, the factory parameters will be loaded at the next power up and the programmed values will be overwritten.

4.9.   USB

The USB port can be used to connect to a PC. With the help of OS this interface can be used as a programming interface. The ground isolated interface is configured as a virtual port and works with the LECOM protocol with 115,2 kBaud, 8N1.

4.10.   RS-485

An RS-485 (2-wire) interface is available at X5. Terminal 2 of X5 provides the non-inverted driver output or input (A/Y), whereas terminal 3 provides the inverted driver output or input (B/Z).
This interface works with the LECOM protocol by default and can be switched to the MODBUS protocol by parameter setting using the USB port and OS.

5.Parameter

5.1. Factor Menu

Nr.	Parameter	Adjustment range	Default
000	**Factor 1:** Proportional factor of the pulse ratio. f out = (F1 x f in) / F2	0,0001 - 9,9999	1,0000
001	**Factor 2:** Reciprocal factor of the pulse ratio. f out = (F1 x f in) / F2	0,0001 - 9,9999	1,0000
002	Reserved		

5.2. Command Menu

Nr.	Parameter	Adjustment range	Default
003	**Ref. Speed High:** This parameter is only valid in Reference mode. It indicates the frequency in Hz at high speed.	1 – 1 000 000	4 000
004	**Ref. Speed Low:** This parameter is only valid in Reference mode. It indicates the frequency in Hz at low speed.	1 – 1 000 000	2 000
005	**Ref. Ramp:** This parameter is only valid in Reference mode. It indicates the ramp time in seconds. (0 = ramp off).	0 - 99	10
006	**Jog Speed:** This parameter is only valid in Jog mode. It indicates the Jog frequency in Hz.	1 – 1 000 000	1 000
007	**Jog Ramp:** This parameter is only valid in Jog mode. It indicates the ramp time in seconds. (0 = ramp off).	0 - 99	10
008	**Trim Speed:** This parameter is only valid in Trim mode. It indicates the duration in seconds for the inserted Trim pulses.	0,000 – 5,000	0,020
009	**Offset:** This parameter is only valid in Offset mode. It indicates the number of increments to be added.	-99 999 – 99 999	200
010	**Special Mode:** This parameter has different properties depending on the parameter setting and extends the functionality.	0 - 5	0
011	Reserved		

012	Reserved		

5.3.   General Menu

Nr.	Parameter	Adjustment range	Default
013	<u>Encoder Mode:</u> This parameter sets the input format of the encoder. 0 : Differential HTL 1 : RS-422 2 : HTL1 (Low 0…5V, High 9…30 V) 3 : HTL2 (Low 0…10V, High 14…30 V) 4 : TTL	0 – 4	0
014	<u>Z Pulse:</u> This parameter indicates the number of Z pulses at the output	0 – 60 000	10
015	<u>Sampling Time:</u> This parameter reflects the measuring time of the input frequency in ms. The longer the measuring time, the more difference increments are received during dynamic changes of the input frequency, since the reaction time increases.	0,001 – 1,000	1
016	<u>Overshoot:</u> This parameter reflects the maximum frequency change in percent at the output. This limitation does not apply at an input frequency of 0Hz	0 – 100	10
017	Calculation Freq: This parameter reflects different ways of calculating the output frequency. 0 : faster, but less accurate 1 : slower, but more accurate	0 - 1	0
018	<u>Direction:</u> This parameter changes the direction at output.	0 – 1	0
019	<u>Correction Basis:</u> This parameter reflects the closed loop control factor. Small values can produce larger phase errors at higher frequencies. Larger values can cause oscillations 0 : Regulation switched off	0 – 10 000	25
020	Correction Freq: This parameter in kHz corrects the phase error together with parameter Correction Value. 0 : switched off	0 – 1 000	0
021	Correction Value: This parameter in kHz corrects the phase error together with parameter Correction Freq. 0 : switched off	0 – 10 000	0
022	<u>Test:</u> This parameter activates the internal voltage measurements. 0 : Test off, faster 1 : Test on, slower	0 - 1	1
023	Reserved		
024	Reserved		

5.4. Input Menu

Nr.	Parameter	Adjustment range	Default
025	**Input 1 Config:** Defines the input behavior 0: Static Low, Function triggering at a "low" state 1: Static High, Function triggering at a "high" state	0 - 1	0
026	**Input 1 Function:** 0: No Function 1: Reset Edge 2: Inhibit 3: Direction 4: Jog 5: Offset Edge + 6: Reference 7: Trim+ 8: Trim- 9: Prestop Mark 10: Edge Prestop 11: Reset Static 12: Z Reference 13: Offset Edge -	0 - 13	0
027	**Input 2 Config:** see Input 1 Config	0 - 1	0
028	**Input 2 Function:** see Input 1 Function	0 - 13	0
029	**Input 3 Config:** see Input 1 Config	0 - 1	0
030	**Input 3 Function:** see Input 1 Function	0 - 13	0
031	**Input 4 Config:** see Input 1 Config	0 - 1	0
032	**Input 4 Function:** see Input 1 Function	0 - 13	0

5.5. Output Menu

Nr.	Parameter	Adjustment range	Default
033	**Output 1 Function:** 0: No function 1: Encoder input error (only with input format RS-422 or HTL differential) 2: Phase error (parameter Diff Error exceeded) 3: Fout > 0 (Direction recognition) 4: Reset activated 5: Reference activated 6: Jog activated 7: Encoder input error and phase error (parameter Diff Error exceeded)	0 - 7	1
034	**Output 2 Function:** see Output 1 Function	0 - 7	1
035	**Output Polarity:** Switching the output polarity (binary) 0: no inversion of the outputs 1: OUT1 inverted, OUT2 not inverted 2: OUT1 not inverted, OU2 inverted 3: both outputs are inverted	0 - 3	0
036	**Diff Error:** Number of differential counter increments at which the phase error is activated for the outputs. With a setting of 50, a phase error is triggered when the differential counter increments rise above 50 or falls below -50.	0 - 99999	64
037	Reserved		

5.6. Modbus Menu

Nr.	Parameter	Adjustment range	Default
038	**Modbus Address:** Modbus address	1 - 247	1
039	**Modbus CRC Reset:** Modbus CRC Calculator Reset Additional tool, serves to calculate the CRC value	0 - 1	0
040	**Modbus CRC Byte:** Modbus CRC Calculator Byte Additional tool, serves to calculate the CRC value	0 - 255	0
041	Reserved		

5.7.   Serial Menu

Nr.	Parameter	Adjustment range	Default
042	**USB Unit No.:** USB unit number for the virtual port is fixed to 11.	11	11
043	**USB Baud Rate:** USB baud rate for the virtual port is fixed at 115.2 kBaud.	0	0
044	**USB Baud Rate:** USB format for the virtual port is fixed to 8N1.	0	0
045	**Serial Page:** Selection of a specific variable page for internal diagnostics	0 - 7	0
046	**Serial Mode:** Switching the RS-485 interface to different protocols, baud rates and formats 0 : Lecom protocol with RS Unit No., Baud rate and format 1 : Modbus protocol with RS baud rate and 8E1 2 : Modbus protocol with RS baud rate and 8O1 3 : Modbus protocol with RS baud rate and 8N2	0 - 3	0
047	**RS Unit No.:** Unit No. for the RS-485 interface (only for Lecom protocol)	11 - 99	11
043	**RS Baud Rate:** RS Baud rate for the RS-485 interface 0 : 9600 Baud 1: 4800 Baud 2: 2400 Baud 3: 1200 Baud 4: 600 Baud 5: 19200 Baud 6: 38400 Baud 7: 56000 Baud 8: 57600 Baud 9: 76800 Baud 10: 115200 Baud	0 - 10	10
044	**RS Format:** Format for the RS-485 interface 0 : 8N1 (8 data bit, non-parity, 1 stop bit) 1 : 8E1 (8 data bit, even parity, 1 stop bit) 2 : 8O1 (8 data bits, odd parity, 1 stop bit)	0 - 2	0
045	Reserved		
046	Reserved		

6. Commissioning

6.1. Setting the Encoder Mode

First the parameter Encoder Mode must be selected for the connected encoder. For connection or wiring see chapter Encoder Inputs. Depending on the selection of the encoder mode, an input error can be detected on the input lines A, /A, B, /B or Z, /Z. (short circuit or possible line break depending on termination).

The lines where an error should be detected can be selected by the DIL switch 1. An error can only be detected in RS-422 or HTL differential format, all other formats do not trigger an error. If a Z line in RS-422 format is not connected, the error triggering for the Z line must be deactivated by the DIL switch S1. The error can be optionally shown by an output. The error is also indicated in the OS by the output field Enc. Error (blue = error, white = no error).

6.2. Setting the Encoder Output

The encoder output can be changed from RS-422 (5V signals) to HTL (24 signals) using the DIL switch S2. (S2(1) = OFF, encoder output RS-422; S2(1) = ON, encoder output HTL)

Attention: Wrong setting will destroy the following unit!

6.3. Setting the Factor Ratio

If the basic setting for both factors is 1:1, the parameter factor 1 is set to 1.0000, also the parameter factor 2. The transmission behavior is best when both factors are approximately symmetrical to 1,0000. An example of a 10:1 ratio: F1 = 3.0000, F2 = 0.3000. It can thus be multiplied or divided.
If factor 1 decreases, the frequency at the output decreases.
If factor 1 increases, the frequency increases.
If factor 2 decreases, the frequency at the output increases.
If factor 2 increases, the frequency decreases.

6.4. Setting the Output Direction

The Direction parameter can be used to change the direction of the output signals A/B 90°.
The direction can also be switched by an input or by a serial command.
The direction information can be get out by an output.

6.5.   Additional Optional Settings

6.5.1. Setting the Z Output Pulses

The number of the Z output signals can be defined by the parameter Z Pulse. The Z output is set in the high phase of the A and B signal.
The Z output pulses can be referenced by an input or by a command with the input Z pulses.
As long as the input or command is active, the internal Z counter is reset with every Z pulse and thus referenced. If there are more Z input pulses than Z output pulses per time unit, then no Z pulse appears as long as the command or input is active at the output. If there are more Z output pulses than Z input pulses per time unit, then an asymmetrical Z pulse output image appears as long as the command or input is active at the output.

6.5.2. Setting the Serial RS-485 Interface

The protocol of the RS-485 interface can be defined by the Serial Mode parameter. With the setting Serial Mode = 0 the interface works with the Lecom protocol and with the parameter setting options RS Unit No., RS Baud rate and RS Format. If the parameter Serial Mode is set to 1, 2 or 3 the Modbus protocol is used, the baud rate remains adjustable via the parameter RS Baudrate, whereby the format is set to 8 data bits, Parity Even (=1), Parity Odd (=2) or Parity None (=3) with 1 stop bit. Various commands can be sent via Modbus or Lecom. The Modbus address can be set via the parameter Modbus address. Furthermore, a Modbus CRC Calculator is available. (Parameter CRC Reset and Byte).

7. Input Functions

7.1. Reset Static

The Reset Static function sets the frequency output to 0Hz independent of the frequency input.
This function also resets the commands for Reference and Jog.

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 11	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 54 (dec)	Release: 04 31 31 02 35 34 30 03 32 Set: 04 31 31 02 35 34 31 03 33 (Unit no. 11, command in hex)	If a 1 is written at code 54, the command is set.
Modbus	FF02 (hex)	Release: 07 06 FF 02 00 00 18 78 Set: 07 06 FF 02 00 01 D9 B8 (Modbus address = 7, command in hex)	If a 1 is written to FF02, the command is set.

If the Output X Function parameter is set to 4, the output reflects the command status.
(command set, output high without inversion)

7.2. Direction

The Direction function changes the direction of the frequency output.

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 3	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 58 (dec)	Release: 04 31 31 02 35 38 30 03 3E Set: 04 31 31 02 35 38 31 03 3F (Unit no. 11, command in hex)	If a 1 is written at code 58, the command is set.
Modbus	FF00 (hex)	Release: 07 06 FF 00 00 00 B9 B8 Set: 07 06 FF 00 00 01 78 78 (Modbus address = 7, command in hex)	If a 1 is written to FF00, the command is set.

If the Output X Function parameter is set to 3, the output reflects the direction.
(frequency > 0, output high without inversion)
This command can be used together with other commands.

7.3.   Trim+/-

The Trim+/- function continuously adds or subtracts increments into the differential counter and thus ensures that the output runs away, for example for a position shifting to the master drive. The time per added or subtracted pulse is indicated by the Trim Speed parameter. A setting of zero executes this in minimum time (loop time). This command is similar to Offset Edge.
Trim pulses are saved in an internal Trim Counter Register and can be read out. (code position :4). The internal Trim Counter Register can be reset by using the Reset Edge command (setting Special Mode = 1).

Trim+:

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 7	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 65 (dec)	Release: 04 31 31 02 36 35 30 03 30 Set: 04 31 31 02 36 35 31 03 31 (Unit no. 11, command in hex)	If a 1 is written at code 65, the command is set.
Modbus	FF0C (hex)	Release: 07 06 FF 0C 00 00 79 BB Set: 07 06 FF 0C 00 01 B8 7B (Modbus address = 7, command in hex)	If a 1 is written to FF0C, the command is set.

Trim-:

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 8	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 66 (dec)	Release: 04 31 31 02 36 36 30 03 33 Set: 04 31 31 02 36 36 31 03 32 (Unit no. 11, command in hex)	If a 1 is written at code 66, the command is set.
Modbus	FF0E (hex)	Release: 07 06 FF 0E 00 00 D8 7B Set: 07 06 FF 0E 00 01 19 BB (Modbus address = 7, command in hex)	If a 1 is written to FF0E, the command is set.

	Attention: If too many increments per time are added or subtracted and the closed loop control is not able to follow, the differential counter may run away. The closed loop control or the affected parameters have to be adjusted in a way that this does not happen. Alternatively, the differential counter must be reset afterwards (Reset Edge) Also note the settings for the output phase error, because the differential counter is modified during trim operation.

7.4. Offset Edge

The Offset Edge +/- function adds or subtracts once with the falling command edge increments into the differential counter and thus ensures that the output runs away, for example for a position shifting to the master drive. The Offset parameter is used to indicate the number of added or subtracted pulses. This command is similar to the Trim command.

Offset Edge + :

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 5	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 61 (dec)	Release: 04 31 31 02 36 31 30 03 34 Set: 04 31 31 02 36 31 31 03 35 (Unit no. 11, command in hex)	If a 1 is written at code 61, the command is set.
Modbus	FF0A (hex)	Release: 07 06 FF 0A 00 00 99 BA Set: 07 06 FF 0A 00 01 58 7A (Modbus address = 7, command in hex)	If a 1 is written to FF0A, the command is set.

Offset Edge - :

Tiggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 13	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 56 (dec)	Release : 04 31 31 02 35 36 30 03 30 Set : 04 31 31 02 35 36 31 03 31 (Unit Nr. 11, command in hex)	If a 1 is written at code 56, the command is set.
Modbus	FF18 (hex)	Release : 07 06 FF 18 00 00 39 BF Set : 07 06 FF 18 00 01 F8 7B (Modbus address = 7, command in hex)	If a 1 is written to FF18, the command is set.

	Attention: If too many increments per time are added or subtracted and the closed loop control is not able to follow, the differential counter may run away. The closed loop control or the affected parameters have to be adjusted in a way that this does not happen. Alternatively, the differential counter must be reset afterwards (Reset Edge) Also note the settings for the output phase error, because the differential counter is modified during trim operation.

7.5.   Reset Edge

The Reset Edge function resets the differential counter with the command edge.

Tiggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 1	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 60 (dec)	Release: 04 31 31 02 36 30 30 03 35 Set: 04 31 31 02 36 30 31 03 34 (Unit no. 11, command in hex)	If a 1 is written at code 60, the command is set.
Modbus	FF04 (hex)	Release: 07 06 FF 04 00 00 F8 79 Set: 07 06 FF 04 00 01 39 B9 (Modbus address = 7, command in hex)	If a 1 is written to FF04, the command is set.

If the Special Mode parameter is set to 1, the internal Trim Counter is also reset. (code: 4)

7.6.   Z Reference

The Z Reference function references the Z Pulse input to the output. If the command is activated, a Z Pulse at the input resets the internal Z counter. This allows the output Z Pulse to be brought into a certain position to the input.

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 12	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 69 (dec)	Release: 04 31 31 02 36 39 30 03 3C Set: 04 31 31 02 36 39 31 03 3D (Unit no. 11, command in hex)	If a 1 is written at code 69, the command is set.
Modbus	FF16 (hex)	Release: 07 06 FF 16 00 00 58 7C Set: 07 06 FF 16 00 01 99 BC (Modbus address = 7, command in hex)	If a 1 is written to FF16, the command is set.

If a static signal is connected to the Z input, the output Z pulse can be disabled (permanent zeroing) or enabled with the command.

7.7.   Inhibit

The inhibit function switches off the closed loop control (input to output relation) and sets the lowest possible frequency at the output. (approx. 0.1Hz) This command is used together with Jog and Reference.

Tiggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 2	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 55 (dec)	Release: 04 31 31 02 35 35 30 03 33 Set: 04 31 31 02 35 35 31 03 32 (Unit no. 11, command in hex)	If a 1 is written at code 55, the command is set.
Modbus	FF06 (hex)	Release: 07 06 FF 06 00 00 59 B9 Set: 07 06 FF 06 00 01 98 79 (Modbus address = 7, command in hex)	If a 1 is written to FF06, the command is set.

7.8.   Jog

The Jog function performs a manual movement. First the Inhibit command must be set to decouple the frequency output from the input. After setting the Jog command the frequency is started to ramp up to the end point. The parameters Jog Ramp and Jog Speed determine the ramp time in seconds and the end point of the ramp in Hz. After reaching the end point, the frequency remains until the Jog command is reset. Afterwards the frequency is reduced to zero with the same ramp time. (start, drive, stop).

If the Jog Ramp parameter is set to zero, a jump to the end frequency is performed after the Jog command is set. The same happens when the Jog command is reset. A negative ramp end point (forward / reverse drive) can be reached by using the Direction command.

The Direction command should be occurred before setting the Jog command.

If the jog command is reset within the rising time of the ramp, the frequency is changed from the current point and falls to zero. If a new jog command is set during the downward ramp, a jump to zero is executed and then the new rising ramp is started. If the Special Mode parameter is set unequal to zero, no jump to zero is executed but the new ramp rises at the current value.

The Jog Speed parameter can also be changed while motion. But this change manifests itself abruptly.

This command is used together with Inhibit.

Tiggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 4	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 59 (dec)	Release: 04 31 31 02 35 39 30 03 3F Set: 04 31 31 02 35 39 31 03 3E (Unit no. 11, command in hex)	If a 1 is written at code 59, the command is set.
Modbus	FF08 (hex)	Release: 07 06 FF 08 00 00 38 7A Set: 07 06 FF 08 00 01 F9 BA (Modbus address = 7, command in hex)	If a 1 is written to FF08, the command is set.

If the Output X Function parameter is set to 3, the output reflects the direction.
If the parameter Output X Function is set to 6, the output reflects the complete movement. (Frequency > 0 or run, Output High without inversion)

Process Jog: Normal motion
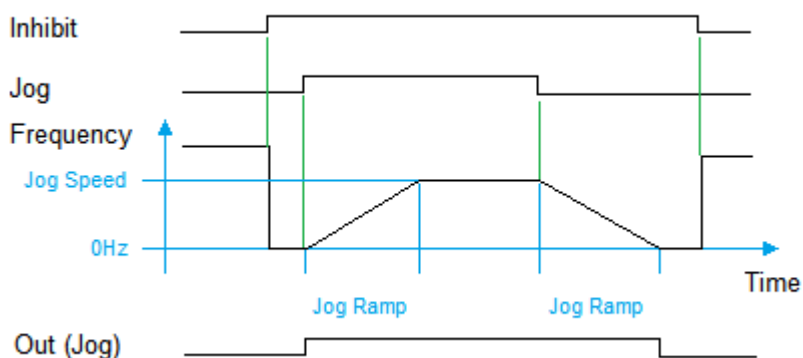
Process Jog: Reset before Jog Speed is reached
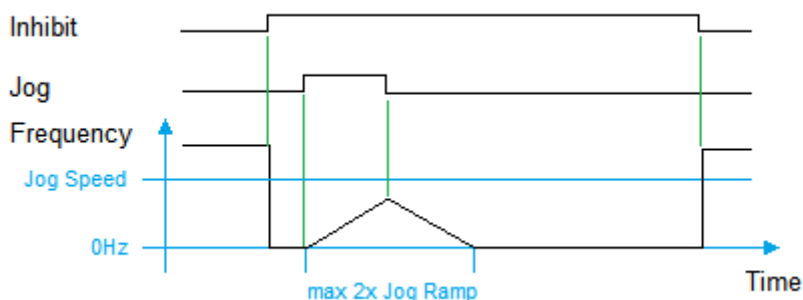
Process Jog: New setting of Jog before 0Hz are reached (Special Mode = 0)

Process Jog: New setting of Jog before 0Hz are reached (Special Mode not equal to zero)
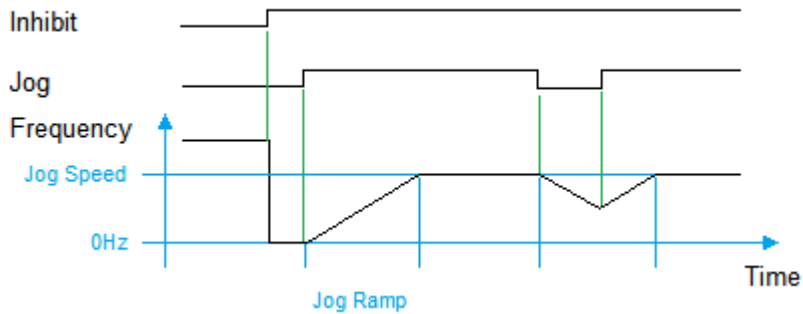
7.9.   Prestop Mark

The Prestop Mark function corresponds to the pre-stop signal. This command is used with Reference and Prestop Edge.

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 9	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 57 (dec)	Release: 04 31 31 02 35 37 30 03 31 Set: 04 31 31 02 35 37 31 03 30 (Unit no. 11, command in hex)	If a 1 is written at code 57, the command is set.
Modbus	FF12 (hex)	Release: 07 06 FF 12 00 00 19 BD Set: 07 06 FF 12 00 01 D8 7D (Modbus address = 7, command in hex)	If a 1 is written to FF12, the command is set.

7.10. Edge Prestop

The Edge Prestop function corresponds to the edge of the pre-stop signal. This command is used with Reference and Prestop Mark.

Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 10	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 63 (dec)	Release: 04 31 31 02 36 33 30 03 36 Set: 04 31 31 02 36 33 31 03 37 (Unit no. 11, command in hex)	If a 1 is written at code 63, the command is set.
Modbus	FF14 (hex)	Release: 07 06 FF 14 00 00 F9 BC Set: 07 06 FF 14 00 01 38 7C (Modbus address = 7, command in hex)	If a 1 is written to FF14, the command is set.

7.11. Reference

The reference function is used to bring the drive into a defined reference position. This command is used together with Edge Prestop and Prestop Mark.

First the Inhibit command must be set to decouple the frequency output from the input. After setting the Reference command the frequency is started to ramp up to the end point. The parameters Ref Ramp and Ref Speed High determine the ramp time in seconds and the end point of the ramp in Hz. After reaching the end point, the frequency remains until the limit switch (Prestop Mark command) is passed.

After the limit switch has been passed, the frequency is reduced to zero with the same ramp time. (start, drive, stop)

After zeroing, the drive changes the direction and frequency ramps up to a lower end point. The parameters Ref Ramp and Ref Speed Low determine the ramp time in seconds and end point of the ramp in Hz.

If the limit switch is passed again, the drive stops abruptly.

The Edge Prestop parameter defines the edge. If Edge Prestop is not set, a rising edge at the limit switch triggers starts ramping down. During backward motion, a falling edge at the limit switch triggers the stop at low frequency.

| Triggering	Parameter	Comment	Addition
Input	Input X Config = 0/1 Input X Function = 6	If Input X Config = 0 is set, the command is triggered in case of a "low" state at input X.	The status of the input can be read in the OS Input field
Lecom	Code 64 (dec)	Release: 04 31 31 02 36 34 30 03 31 Set: 04 31 31 02 36 34 31 03 30 (Unit no. 11, command in hex)	If a 1 is written at code 64, the command is set.
Modbus	FF10 (hex)	Release: 07 06 FF 10 00 00 B8 7D Set: 07 06 FF 10 00 01 79 BD (Modbus address = 7, command in hex)	If a 1 is written to FF10, the command is set.

If the Output X Function parameter is set to 3, the output reflects the direction.

If the parameter Output X Function is set to 6, the output reflects the complete movement. (Frequency > 0 or run to stop, Output High without inversion)
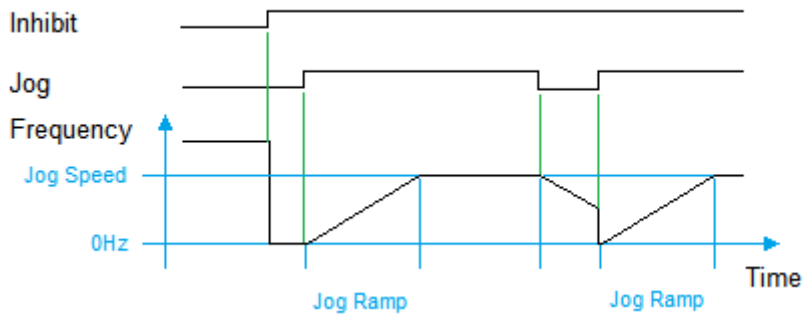
Note:
The parameter Ref Speed High must always be larger than Ref Speed Low. If the parameter Ref Ramp is set to zero, a jump is executed. A negative ramp end point can be achieved with the Direction command. The Direction command should be executed before the Reference command is set. The direction may only be changed once per complete cycle.

The Reference command can be reset earlier. If the Special Mode is set to 2, reset the Reference command means an abort. In this case, the sequence would have to correspond the image below to complete the cycle.

Process Reference: Edge Prestop = 0

Inhibit
Reference
Prestop
Frequency
Ref Speed High
0Hz
Ref Speed Low
Ref Ramp   Ref Ramp   Ref Ramp
Time
Out (Ref)
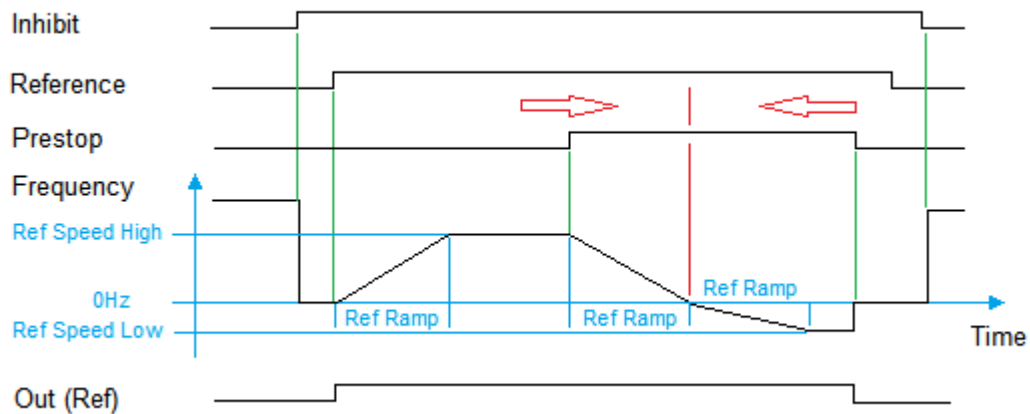
If Edge Prestop = 1, an inversion of Prestop produces the same course

Process Reference: Edge Prestop = 0

Inhibit
Reference
Prestop
Frequency
Ref Speed High
0Hz
Ref Speed Low
Time
Out (Ref)
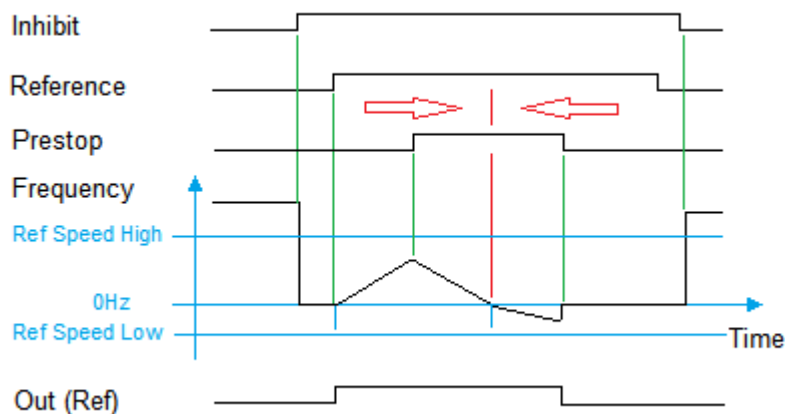
If the limit switch already appears during the ascending ramp, the frequency is then ramped down at the current position. If the limit switch already appears during the reverse ramp, the ramp is stopped at the current position.

8. Output Functions

All output functions can be inverted by the Output Polarity parameter.

8.1. Encoder Error

If RS-422 or HTL differential is selected as encoder mode, an input error can be detected with the DIL switch. This error can then be shown via an output. The output field of the OS can also be used to display this error (Enc. Error = blue = track error)

8.2. Phase Error

If the differential counter becomes larger than the value set in the Diff Error parameter, a phase error is triggered, which can then be shown via an output.

8.3. Direction (f > 0)

If the output frequency f > 0, the output will be set. This output can be used in all modes.

8.4. Condition Reset Static

If the Reset Static command is set, the output will be set.

8.5. Command Process Reference

If the Reference command is set, the output is set until two pre-stop edges are passed. The Reference cycle can thus be monitored.

8.6. Command Process Jog

If the Jog command is set, the output is set until the frequency decreases back to zero. This allows the Jog cycle to be monitored.

9. Lecom Protocol

If you communicate with the unit by the Lecom protocol, you have full read and write access to all internal parameters, states and actual values.
The unit uses the Lecom protocol according to DIN ISO 1745. The serial access codes for all parameters of the unit are specified in the parameter list.

9.1. Lecom Read

To request data from the unit, the following request string must be sent:

EOT		AD1	AD2	C1	C2	ENQ
EOT = control character (Hex 04)						
AD1 = unit address, High Byte						
AD2 = unit address, Low Byte						
C1 = code, High Byte						
C2 = code, Low Byte						
ENQ = control character (Hex 05)						

If the current differential counter for example should be read (code: 1), with the unit address 11 (parameter RS Unit No.), then the detailed request string is:

ASCII-Code:	EOT	1	1	:	1	ENQ
Hexadecimal:	04	31	31	3A	31	05
Binary:	0000 0100	0011 0001	0011 0001	0011 1010	0011 0001	0000 0101

If the request is correct the answer of the unit is:

STX	C1	C2	x x x x x x x	ETX	BCC
STX = control character (Hex 02)					
C1 = code, High Byte					
C2 = code, Low Byte					
xxxxx =data to be read					
ETX = control character (Hex 03)					
BCC = block check character					

Leading zeros are <u>not</u> transferred. The Block Check Character (BCC) is formed by an EXCLUSIVE-OR function of all characters from C1 to ETX (each inclusive).

9.2.   Lecom Write

To write data to the unit the following string must be sent:

EOT	AD1	AD2	STX	C1	C2	x x x x x x x	ETX	BCC

EOT = control character (Hex 04)
AD1 = unit address, High Byte
AD2 = unit address, Low Byte
STX = control character (Hex 02)
C1   = code, High Byte
C2   = code, Low Byte
xxxxx = written data
ETX = control character (Hex 03)
BCC = block check character

The Block Check Character (BCC) is formed by an EXCLUSIVE-OR function of all characters from C1 to ETX (each inclusive). If the reception is correct, the unit responds with the control character ACK, otherwise with NAK or no message. A newly sent parameter is first stored temporarily in the unit without influencing the function. Thus, it is possible to prepare several new parameters in the background while the unit is running.

If the transferred parameters are to be activated, the value "1" must be sent to the "Activate Data" register. This will activate all changed parameters simultaneously.
If the new parameters are to remain permanently stored even after the power supply has been switched off, additionally the value "1" must be sent to the "Store EEProm" register. Thus, all new data are also stored in the unit. Otherwise, the unit will return to the original parameter set after power up.

Function	Code
Command Activate Data	67
Command Store EEProm	68

Both commands react dynamically, i.e. it is sufficient to send the value "1" to the corresponding code. After execution, the command is automatically reset.

Activate Data on unit 11:

ASCII	EOT	1	1	STX	6	7	1	ETX	BCC
Hex	04	31	31	02	36	37	31	03	33

Store EEProm on unit 11:

ASCII	EOT	1	1	STX	6	7	1	ETX	BCC
Hex	04	31	31	02	36	38	31	03	3C

10. Modbus Protocol

If you communicate with the unit by the Modbus protocol, you have full read and write access to all internal parameters, states and actual values. The FM210 uses the Modbus RTU protocol. The serial access codes for all parameters of the unit are listed in the parameter list. With the help of USB access the parameter Serial Mode can be changed from Lecom to Modbus. The parameter Serial Baud Rate refers to both protocols. With the parameter Modbus Address the Modbus unit address can be set. Allowed here are the settings 1… 247.

Attention: The Modbus checksum sequence L/H is just reversed to the data.

The FM210 supports the function Reading Holding Register (R, FCT = 03), the function Report Slave ID (R, FCT = 11) and the function Preset Single Register (W, FCT = 06).

10.1. Modbus Read

To request data from the unit, the following request string must be sent:

ADR	FCT	STH	STL	CRH	CRL	CRCL	CRCH
ADR = MB address (Parameter)							
FCT = function (Hex 03)							
STH = start Address, High Byte							
STL = start Address, Low Byte							
CRH = number of registers High Byte							
CRL = number of registers, Low Byte							
CRCL = checksum CRC16, Low Byte							
CRCH = checksum CRC16, High Byte							

For example, if the parameter Ref Speed High (Modbus ST = 00 0C (hex), 32 Bit = 2 Word -> Modbus CR = 00 02) is to be read from the unit with address 07, the detailed request string is:

Designation:	ADR	FCT	STH	STL	CRH	CRL	CRCL	CRCH
Hexadecimal:	07	03	00	0C	00	02	04	6E
Binary:	0000 0111	0000 0011	0000 0000	0000 1100	0000 0000	0000 0010	0000 0100	0110 1110

The unit will answer if the request is correct:

ADR	FCT	CB	DATA	CRCL	CRCH

ADR = MB address (Parameter)
FCT = function (Hex 03)
CB = number of bytes, here 4 bytes
DATA = data, 4 bytes (32 Bit)
CRCx = checksum CRC16

Designation:	ADR	FCT	CB	DATA	CRCL	CRCH
Hexadecimal:	07	03	04	00 00 0F A0	99	BB
Binary:	0000 0111	0000 0011	0000 0100		1001 1001	1011 1011

The data above corresponds to a read out of the parameter Ref Speed High of 4000.
-The function Reading Holding Registers supports 2 Word (32-bit) accesses to the direct parameter addresses (0x0, 0x4, 0x8, 0xC ..)
- The function Reading Holding Register also supports more than 2 Word accesses to the direct parameter addresses (0x0, 0x4, 0x8, 0xC ..) for area readout

10.2.   Modbus Write

To write data to the unit, the following string must be sent:

ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH

ADR = MB address (parameter)
FCT = function (hex 06)
REH = register address, high byte
REL = register address, low byte
DAH = data high byte
DAL = data low byte
CRCL = checksum CRC16, low byte
CRCH = checksum CRC16, high byte

If for example the unit shall be written with the parameter Ref Speed High (Modbus ST = 00 0E, 000C (hex), Modbus DA = 00 01, 00 01), then the detailed request string for the High Word Register is:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	00	0E	00	01	29	AF
Binary:	0000 0111	0000 0011	0000 0000	0000 1110	0000 0000	0000 0001	0010 1001	1010 1111

The unit will answer if the request is correct:

ADR	FCT	REG	DATA	CRCL	CRCH

ADR = MB address (parameter)
FCT = function (Hex 06)
REG = register address
DATA = data
CRCx = checksum CRC16

Designation:	ADR	FCT	REG	DATA	CRCL	CRCH
Hexadecimal:	07	06	00 0E	00 01	29	AF
Binary:	0000 0111	0000 0110			0010 1001	1010 1111

String for writing the Low Word Register:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	00	0C	00	01	88	6F
Binary:	0000 0111	0000 0011	0000 0000	0000 0110	0000 0000	0000 0001	1000 1000	0110 1111

The data corresponds to a written value of the parameter Ref Speed High of 65537.
(00 01 00 01 hex). The newly sent parameter is first stored temporarily in the unit, without influencing the function. Thus, it is possible to prepare several new parameters in the background while the unit is running.

If the transferred parameters are to be activated, an "Activate Data" must be sent to the unit. This will activate all changed parameters simultaneously.

To execute an "Activate Data", the following string must be sent:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	FF	FE	00	01	19	88
Binary:	0000 0111	0000 0011	1111 1111	1111 1110	0000 0000	0000 0001	0001 1001	1000 1000

It must be ensured that a range violation of the parameter does not cause it to be transferred to the buffer. The permissible parameter ranges can be taken from the parameter description and are defined for the parameter Ref Speed High from 1 to 1 000 000.

If the new parameters are to remain permanently stored even after the power supply is switched off, an additional "Store EEProm" must be sent to the unit. This means that all new data is also stored in the unit. Otherwise, the unit will return to the original parameter set after power up.

To execute a "Store EEProm" the following string must be sent:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	FF	FE	00	02	34	49
Binär:	0000 0111	0000 0011	1111 1111	1111 1110	0000 0000	0000 0010	0011 0100	0100 1001

With negative parameter values such as -10000, the value must be divided into two 16-bit values and transmitted with two write accesses. (-10000 dec = FFFF D8F0 hex)

An ID can be requested to identify the unit:

To request an ID, the following string must be sent:

Designation:	ADR	FCT	CRCL	CRCH
Hexadecimal:	07	11	C3	8C
Binary:	0000 0111	0001 0001	1100 0011	1000 1100

The answer of the unit is if the request is correct:

Designation:	ADR	FCT	BYTE	RUN	DATA	CRCL	CRCH
Hexadecimal:	07	11	12	FF	46 4D 32 31 30 20 20 20 46 4D 32 31 30 30 31 42	C9	00
Binary:	0000 0111	0001 0000	0001 0020	1111 1111		1100 1001	0000 0000

46 4D 32 31 30 30 31 42 corresponds in ASCII format: FM21001B
Here the unit header, which is also visible in the OS, is displayed. It identifies the unit
 (FM210) with software version (01B) and, if available, the special number.

Splitting of the memory area

Memory address (dec)	MODBUS-FCT	R-access	Read / Write	Note
0…207 0…204 (32 Bit)	03 (R) 06 (W)	2-124 Words 1 Word	R/W	Parameter area
1000..1127 1000..1124 (32 Bit)	03 (R)	2-64 Words	Read only	variable area
FF00 – FF16 FFFE (hex, 16 Bit)	06 (W) 06 (W)	1 Word 1 Word	Write only Write only	Command area

11. Modbus CRC Calculation

The Modbus CRC Reset parameter is used to reset the CRC Calulator. If Modbus CRC Reset = 0, the CRC Calculator is set to FFFF in the monitor field (Page 1; Variable <4). If Modbus CRC Reset = 1, the CRC value can be calculated with every Modbus byte.
The parameter Modbus CRC Byte is used to enter the bytes for the CRC calculation.
Into this memory address the Modbus bytes can be transferred one after the other and then the CRC checksum can be read out in the monitor field (Page 1, variable <4).

<u>Using the OS</u>

For the Modbus command 0x07 0x11 the checksum shall be determined. First the Serial Page parameter should be set to 1 to select Page 1.
- Modbus CRC Reset = 0,   Modbus Byte = 7dec   (Press OS Transmit change)
-> Variable <4 = 0x0000 FFFF (reset)
- Modbus CRC Reset = 1,   Modbus Byte = 7dec   (Press OS Transmit change)
-> Variable <4 = 0x0000 82FE
- Modbus CRC Reset = 1,   Modbus Byte = 17dec(Press OS Transmit change)
-> Variable <4 = 0x0000 8CC3

Now the command can be set together
-> 07 11 C3 8C
Note that with Modbus the CRC sends first the LByte and then the HByte, therefore byte swapping is necessary.

12. Correction of the difference increments

The correction of the difference increments can be done by the parameters Correction Basis, Correction Freq and Correction Value. If Correction Freq and Correction Value are set to zero, then the extended correction is switched off.
A simple correction can be done by using the Correction Basis parameter. If all Correction parameters are set to zero, the correction is deactivated and the output frequency is not corrected, so that a slight deviation of the position in time is noticeable. Here, the differential counter slowly rises or falls to the maximum value (approx. +/- 244 000) and then stops. An Out of Sync event is also triggered.

If you now set the Correction Base parameter at a certain frequency, you can see that with higher parameter values, the differential counter runs around zero. With lower parameter values a differential counter value is generated, which results in a constant position shift. Too high settings can make the system unstable, resulting in an oscillation. If you now change the frequency, you can see that the position shift increases or decreases.

To obtain an optimal correction over a wide frequency range, the Base Correction value must first be set at low frequency (approx. 10 kHz). Here the other two parameters (Correction Freq and Correction Value) are set to zero. Now start with values at 25 and check the deviation of the differential counter. Then increase the frequency to the maximum value. The differential counter will show a higher deviation. These two values can now be transferred to the two parameter values.

Here the parameter Correction Freq is overwritten with the value 500 for 500kHz, for the parameter Correction Value the value 1500 is entered. After these settings, the differential counter decreases to a value between -40 and -20. (see example below)

Example:

10kHz   Difference counter moves around zero at Correction Basis = 25
500kHzDifference counter moves around -1590

Now the Correction Freq is set to 500 and Correction Value to 1500.
500kHzDifference counter now moves around -40 to -20

If the frequency is now reduced to 250kHz, the differential counter moves by -20 to -10.
The position shift has approximately halved.

13. Overshoot

With the overshoot parameter the maximum allowed frequency change at the output can be set. With a setting of 10, the output frequency is changed by +/-10% to reduce the differential counter deviation. This prevents that any occurring difference increments are reduced too quickly and with excessive acceleration. For the Trim and Offset commands, the settings must be made in such a way that not more increments are entered into the differential counter than can be reduced. If this is not done, the drive may run longer even when the Trim command is reset, because there are still increments in the differential counter and these cause a further shift.
But the overshoot also acts as a frequency limit or compensation limit, so that for example the output frequency does not exceed a certain value at constant input frequency.

14. Parameter List

Nr.	Parameter	Min – value	Max – value	Default	Places	Decimal places	Lecom Code	Modbus Code
000	Factor 1	1	99999	10000	5	4	00	L00/H02
001	Factor 2	1	99999	10000	5	4	01	L04/H06
002	Reserved	0	10000	1000	5	0	A0	L08/H0A
003	Ref. Speed High	1	1000000	4000	7	0	02	L0C/H0E
004	Ref. Speed Low	1	1000000	2000	7	0	03	L10/H12
005	Ref. Ramp	0	99	10	2	0	04	L14/H16
006	Jog Speed	1	1000000	1000	7	0	05	L18/H1A
007	Jog Ramp	0	99	10	2	0	06	L1C/H1E
008	Trim Speed	0	5000	10	4	3	07	L20/H22
009	Offset	-99999	+99999	200	85	0	09	L24/H26
010	Special Mode	0	5	0	1	0	A1	L28/H2A
011	Reserved	0	10000	1000	5	0	A2	L2C/H2E
012	Reserved	0	10000	1000	5	0	A3	L30/H32
013	Encoder Mode	0	4	0	1	0	A4	L34/H36
014	Z Pulse	1	60000	10	5	0	11	L38/H3A
015	Sampling Time	1	1000	1	4	3	12	L3C/H3E
016	Overshoot	0	100	10	3	0	13	L40/H42
017	Calculation Freq	0	1	0	1	0	14	L44/H46
018	Direction	0	1	0	1	0	15	L48/H4A
019	Correction Basis	0	10000	25	5	0	16	L4C/H4E
020	Correction Freq	0	1000	0	4	0	17	L50/H52
021	Correction Value	0	10000	0	5	0	18	L54/H56
022	Test	0	1	1	1	0	19	L58/H5A
023	Reserved	0	10000	1000	5	0	A5	L5C/H5E
024	Reserved	0	10000	1000	5	0	A6	L60/H62
025	Input 1 Config	0	12	0	2	0	A7	L64/H66
026	Input 1 Function	0	13	0	2	0	A8	L68/H6A
027	Input 2 Config	0	12	0	2	0	A9	L6C/H6E
028	Input 2 Function	0	13	0	2	0	B0	L70/H72
029	Input 3 Config	0	12	0	2	0	B1	L74/H76
030	Input 3 Function	0	13	0	2	0	B2	L78/H7A
031	Input 4 Config	0	12	0	2	0	B3	L7C/H7E
032	Input 4 Function	0	13	0	2	0	B4	L80/H82
033	Output 1 Config	0	7	1	1	0	B5	L84/H86
034	Output 2 Config	0	7	1	1	0	B6	L88/H8A
035	Output Polarity	0	3	0	1	0	B7	L8C/H8E
036	Diff Error	0	99999	64	5	0	B8	L90/H92
037	Reserved	0	10000	1000	5	0	B9	L94/H96

Nr.	Parameter	Min – value	Max – value	Default	Places	Decimal places	Lecom Code	Modbus Code
038	Modbus Address	1	247	1	3	0	C0	L98/H9A
039	Modbus CRC Reset	0	1	0	1	0	C1	L9C/H9E
040	Modbus CRC Byte	0	255	0	3	0	C2	LA0/HA2
041	Reserved	0	10000	1000	5	0	C3	LA4/HA6
042	USB Unit Nr.	11	11	11	2	0	90	LA8/HAA
043	USB Baud Rate	0	0	0	1	0	91	LAC/HAE
044	USB Format	0	0	0	1	0	92	LB0/HB2
045	Serial Page	0	7	0	1	0	~0	LB4/HB6
046	Serial Mode	0	3	0	1	0	C4	LB8/HBA
047	RS Unit Nr.	11	99	11	2	0	C5	LBC/HBE
048	RS Baud Rate	0	10	10	2	0	C6	LC0/HC2
049	RS Format	0	2	0	1	0	C7	LC4/HC6
050	Reserved	0	10000	1000	5	0	C8	LC8/HCA
051	Reserved	0	10000	1000	5	0	C9	LCC/HCE

15. Dimensions

subview

side view

front view
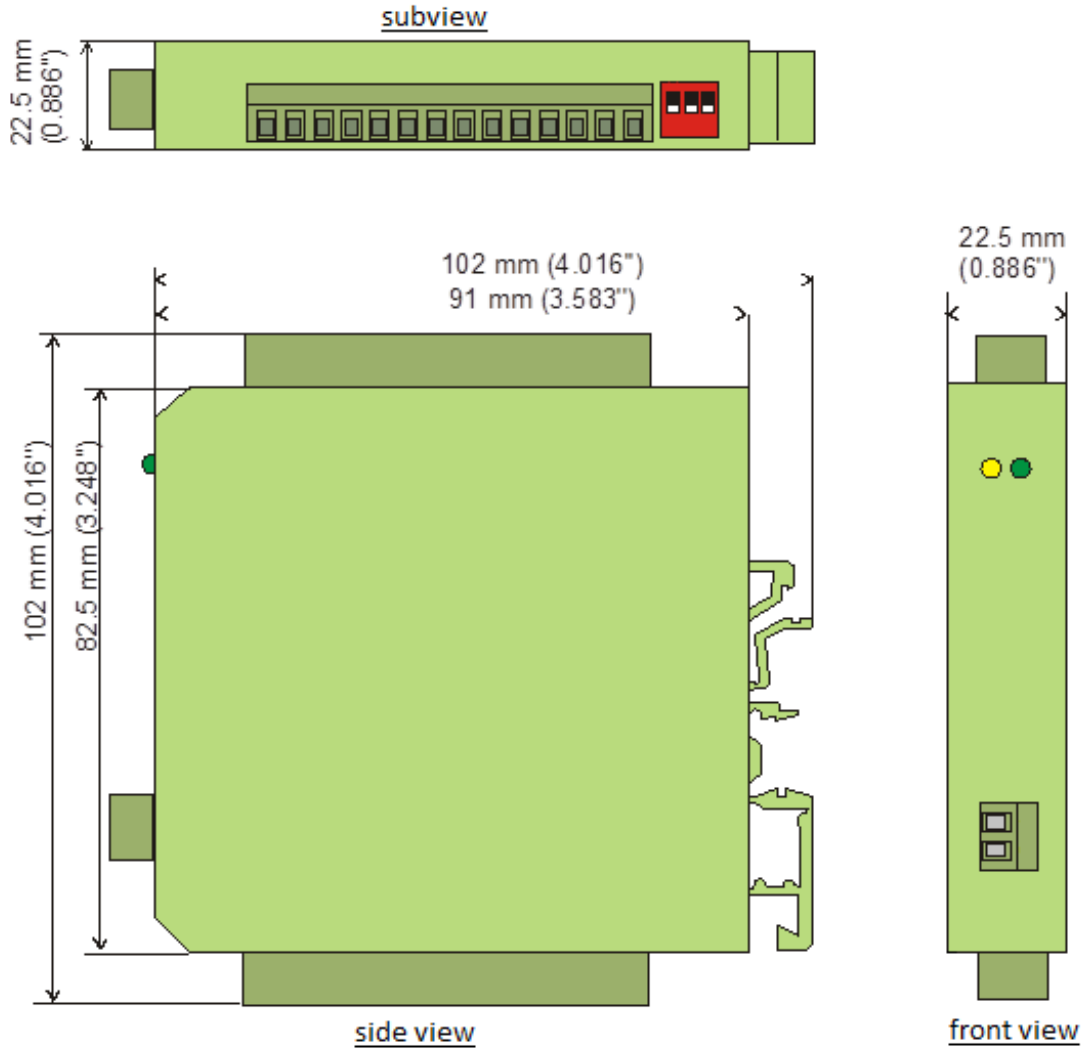
16. Technical Specifications

Technical specifications:		
Connections:	Connector type:	screw terminal, 1,5 mm² / AWG 16
Power supply:	Input voltage:	9 … 30 VDC
	Protection circuit:	reverse polarity protection
	Ripple:	≤ 10 %
	Consumption:	approx. 70 mA (at 9 V unloaded)
		approx. 47 mA (at 30 V, unloaded)
Encoder supply:	Output voltage:	5,5 VDC
		24VDC (depending on supply voltage)
	Output current:	max. 250 mA
Incremental inputs:	Number of inputs:	3
	Channels:	A, B, Z (HTL Single Ended, TTL Single Ended)
		A, /A, B, /B, Z, /Z (RS422, HTL Differential)
	Configuration:	RS-422, HTL Differential, HTL Single Ended, TTL
	RS422:	max. 1 MHz (RS-422 Differential signal > 0.5 V)
	HTL Differential:	max. 1 MHz (HTL Differential signal > 1 V)
	HTL Single Ended:	max. 350kHz, Level 1: Low 0…10V, High 14…30 V
		Level 2: Low 0 … 5V, High 9 … 30 V
	TTL:	max. 350kHz, Low 0 … 0.6V, High 2.2 … 5V
Control inputs:	Number of inputs:	4
	Format:	HTL, PNP (Low 0 … 4 V, High 10 … 30 V)
	Frequency:	max. 1 kHz
	Reaction time:	1 ms
	Load:	max. 5mA at 24VDC
Incremental outputs:	Number of outputs:	3
	Channels:	A, /A, B, /B, Z, /Z
	Format / level:	HTL: 8 … 29 V (depend on supply voltage)
		RS-422: 5 V
	Output current:	max. 30 mA / Push-Pull
Housing:	Material:	Plastic
	Mounting:	35 mm top hat rail (according to EN 60715)
	Dimensions (B x H x T):	22,5 x 102 x 102 mm
	Protection class:	IP20
	Weight:	approx. 100 g
Temperature range:	Operation:	0 °C … +60 °C / 32 … 140 °F (not condensing)
	Storage:	-25 °C … +70 °C / -13 … 158 °F (not condensing)
Failure rate:	MTBF in years:	66,1 (long-term usage at 60 °C / 140 °F)
Conformity and standards:	EMC 2014/30/EU:	EN 61326-1: 2013 for industrial location
		EN 55011: 2017 / CISPR11: 2017 Class A
	RoHS (II) 2011/65/EU	
	RoHS (III) 2015/863:	EN IEC 63000: 2018