Bonfiglioli
Vectron

ACTIVE CUBE

Application manual - Electronic gear
Position control and index control

Bonfiglioli
power, control and green solutions

General Information about the Documentation

This manual complements the configurations described in the operating instructions and the Quick Start Guide of the ACU 201 and ACU 401 frequency inverters. Configurations 115, 215, 415 and 515 additionally include the functions of an electronic gear with position controller. Configurations 116, 216 and 516 extend the functionality by the electronic gear with index controller.

For better clarity, the documentation is structured according to the customer-specific requirements made on the frequency inverter.

Quick Start Guide
The Quick Start Guide describes the basic steps required for mechanical and electrical installation of the frequency inverter. The guided commissioning supports you in the selection of necessary parameters and the software configuration of the frequency inverter.

Operating Instructions
The Operating Instructions describe and document all functions of the frequency inverter. The parameters required for adapting the frequency inverter to specific applications as well as the wide range of additional functions are described in detail.

Application Manual
The Application Manual contains additional information facilitating the installation and commissioning of the frequency inverter, i.e. information on the different issues relating to the specific application realized by the frequency inverter.

Installation Instructions
Complementing the Quick Start Guide and the Operating Instructions, the Installation Instructions provide information on how to install and use the additional/optional components.

If you need a copy of the documentation or additional information, contact your local representative of BONFIGLIOLI.

The following pictograms and signal words are used in the documentation:

Danger!
Danger refers to an immediate threat. Non-compliance with the precaution described will result in death, serious injury or material damage.

Warning!
Warning refers to a possible threat. Non-compliance with the warning may result in death, serious injury or material damage.

Caution!
Caution refers to an immediate hazard. Damage to people or property can be the result.

Attention!
Attention and the related text refer to a possible behavior or an undesired condition which can occur during operation.

Note
Note marks information which facilitates handling for you and supplements the corresponding part of the documentation.

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1 General Safety Instructions and Information on Use

The present documentation was prepared with great care and it was subjected to extensive and repeated reviews. For reasons of clarity, it was not possible to include all details of all the different types of the product in the documentation. Neither was it possible to consider all conceivable installation, operation or maintenance situations. If you require further information or if you meet with specific problems which are not dealt with in sufficient detail in the documentation, contact your local BONFIGLIOLI agent.
We would also like to point out that the contents of this documentation do not form part of any previous or existing agreement, assurance or legal relationship. Neither are they intended to supplement or replace such agreements, assurances or legal relationships. The manufacturer's obligations are exclusively specified in the relevant purchase contract. This contract also contains all and any warranty regulations which may apply to the relevant scope of supply. These contractual warranty provisions are neither extended nor limited by the specifications contained in this documentation.
The manufacturer reserves the right to correct or amend the specifications, product information and omissions in these operating instructions without notice. The manufacturer shall not be liable for any damage, injuries or costs which may be caused by the aforementioned reasons.

Warning! The specifications and instructions contained in the documentation must be complied with strictly during installation and commissioning. Only qualified staff who has read and understood the documentation is allowed to carry out installation or commissioning work or to operate the devices. The safety instructions must be complied with strictly. The term „Qualified Staff" refers to anybody who is familiar with the installation, assembly, commissioning and operation of the frequency inverter and has the proper qualification for the job.

1.1 General Information

Warning! The DC-link circuit of the BONFIGLIOLI VECTRON frequency inverter is charged during operation, i.e. there is always the risk of contact with high voltage. Frequency inverters are used for driving moving parts and they may become hot at the surface during operation.
Any unauthorized removal of the necessary covers, improper use, wrong installation or operation may result in serious injuries or material damage.
In order to avoid such injuries or damage, only qualified staff may carry out the transport, installation, setup or maintenance work required. The standards EN 50178, IEC 60364 (Cenelec HD 384 or DIN VDE 0100), IEC 60664-1 (Cenelec HD 625 or VDE 0110-1), BGV A2 (VBG 4) as well as the applicable national regulations must be complied with. The term „Qualified Staff" refers to anybody who is familiar with the installation, assembly, commissioning and operation of the frequency inverter as well as the possible hazards and has the proper qualification for the job.

1.2 Purpose of the Frequency Inverters

Warning! The frequency inverters are electrical drive components intended for installation in industrial plants or machines. Commissioning and start of operation is not allowed until it has been verified that the machine meets the requirements of the EC Machinery Directive 98/37/EEC and EN 60204. In accordance with the CE marking requirements, the frequency inverters also comply with the Low Voltage Directive 2006/95/EC as well as EN 50178/DIN VDE 0160 and EN 61800-2. The user shall be responsible for making sure that the requirements of the EMC Directive 89/336/EEC are met. Frequency inverters are only available at specialized dealers and are exclusively intended for professional use as per EN 61000-3-2. The frequency inverters are also marked with the UL label according to UL508c, which proves that they also meet the requirements of the CSA Standard C22.2-No. 14-95. The technical data, connection specifications and information on ambient conditions are indicated on the name plate and in the documentation and must be complied with in any case. Anyone involved in any kind of work at the device must have read the instructions carefully and understood them before starting the work.

1.3 Transport and Storage

The frequency inverters must be transported and stored in an appropriate way. During transport and storage the devices must remain in their original packaging. The units may only be stored in dry rooms which are protected against dust and moisture and are exposed to little temperature deviations only. Observe the climatic conditions according to EN 50178 and the marking on the packaging. The frequency inverters must not be stored for more than one year without connecting them to nominal voltage.

1.4 Handling and Installation

Warning! Damaged or destroyed components must not be put into operation because they may be a health hazard.

The frequency inverters are to be used in accordance with the documentation as well as the applicable directives and standards. They must be handled carefully and protected against mechanical stress. Do not bend any components or change the isolating distances. Do not touch any electronic components or contacts. The devices are equipped with components which are sensitive to electrostatic energy and can easily be damaged if handled improperly. Any use of damaged or destroyed components shall be considered as a non-compliance with the applicable standards. Do not remove any warning signs from the device.

1.5 Electrical Connection

Warning! Before any assembly or connection work, discharge the frequency inverter. Verify that the frequency inverter is discharged.
Do not touch the terminals because the capacitors may still be charged.
Comply with the information given in the operating instructions and on the frequency inverter label.

When working at the frequency inverters, comply with the applicable standards BGV A2 (VBG 4), VDE 0100 and other national directives. Comply with the electrical installation instructions given in the documentation as well as the relevant directives. The manufacturer of the industrial machine or plant is responsible for making sure that the limit values specified in the EMC product standard EN 61800-3 for electrical variable-speed drives are complied with.
The documentation contains information on EMC-conforming installation. The cables connected to the frequency inverters may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.

1.6 Information on Use

Warning! The frequency inverter may be connected to power supply every 60 s. Consider this for a jog operation of a mains contactor. For commissioning or after an emergency stop, a non-recurrent, direct restart is permissible.
After a failure and restoration of the power supply, the motor may start unexpectedly if the AutoStart function is activated. Install protective equipment if personal injury or material damage is possible.
Before commissioning and the start of the operation fix all covers and check the terminals. Check the additional monitoring and protective devices according to EN 60204 and applicable the safety directives (e.g. Working Machines Act, Accident Prevention Directives etc.).
No connection work may be performed, while the system is in operation.

1.7 Maintenance and Service

Warning! Unauthorized opening and improper interventions can lead to personal injury or material damage. Repairs on the frequency inverters may only be carried out by the manufacturer or persons authorized by the manufacturer. Check protective equipment regularly.

2 Control Inputs and Outputs

The modular structure of the frequency inverters enables a wide spectrum of applications on the basis of the available hardware and software functionality. The functionality of the control inputs and outputs described in the brief instructions and operating instructions is extended in the described configurations.

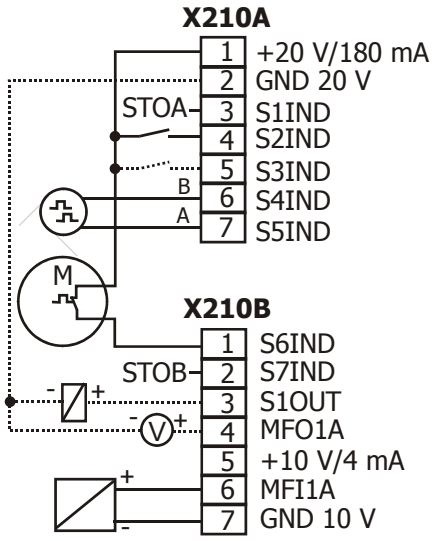
Caution! Switch off power supply before connecting or disconnecting the control inputs and outputs. Otherwise, components may be damaged.

- The unit may only be connected with the power supply switched off.
- Make sure that the frequency inverter is discharged.

2.1 Control Terminals

The connection diagrams describe the default assignment of control terminals and functions in the different configurations. According to the requirements of the application, the other functions can be assigned to the control terminals.

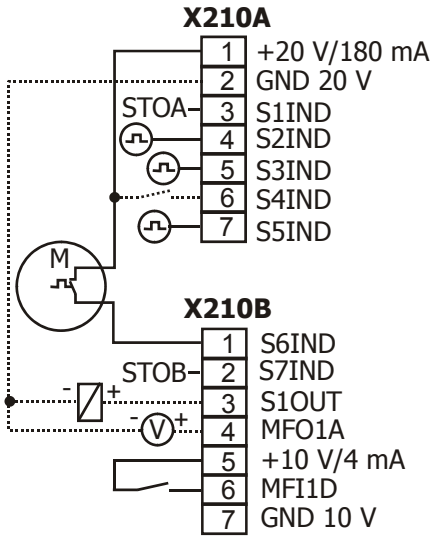
Configuration 115 – sensorless control with electronic gear and position control



Control terminal X210A	
X210A.1	Supply voltage +20V
X210A.2	Ground 20 V
X210A.3	Safety function, digital input STOA
X210A.4	Start of clockwise operation
X210A.5	Start of anticlockwise operation
X210A.6	Reference value electronic gear at speed sensor 1 input, track B
X210A.7	Reference value electronic gear at speed sensor 1 input, track A

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	Safety function, digital input STOB
X210B.3	Operating message
X210B.4	Analog signal of actual frequency
X210B.5	Supply voltage +10V
X210B.6	Analog signal reference gear factor
X210B.7	Ground 10 V

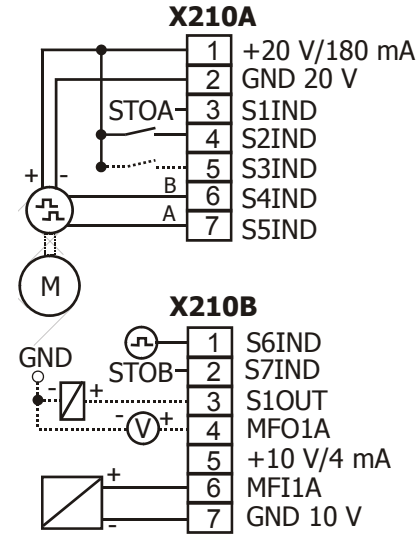
Configuration 116– sensorless control with electronic gear and index control



Control terminal X210A	
X210A.1	Supply voltage +20V
X210A.2	Ground 20 V
X210A.3	Safety function, digital input STOA
X210A.4	Index signal Master
X210A.5	Index signal Slave
X210A.6	Start of clockwise operation
X210A.7	Reference value electronic gear at speed sensor 1 input, track A

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	Safety function, digital input STOB
X210B.3	Operating message
X210B.4	Analog signal of actual frequency
X210B.5	Supply voltage +10V
X210B.6	Index controller release
X210B.7	Ground 10 V

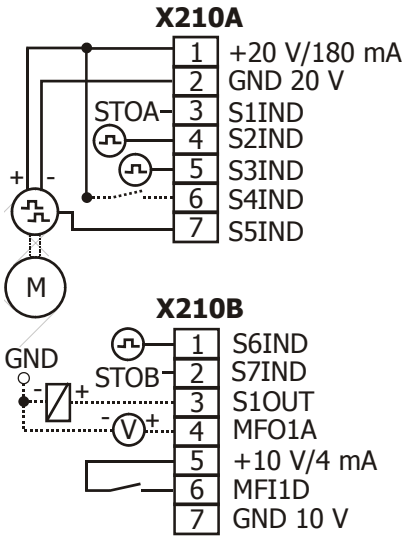
Configuration 215– field-oriented control with electronic gear and position control



Control terminal X210A	
X210A.1	Supply voltage +20V
X210A.2	Ground 20 V
X210A.3	Safety function, digital input STOA
X210A.4	Start of clockwise operation
X210A.5	Start of anticlockwise operation
X210A.6	Speed sensor track B
X210A.7	Speed sensor track A

Control terminal X210B	
X210B.1	Repetition frequency input (reference value electronic gear)
X210B.2	Safety function, digital input STOB
X210B.3	Operating message
X210B.4	Analog signal of actual frequency
X210B.5	Supply voltage +10V
X210B.6	Analog signal reference gear factor
X210B.7	Ground 10 V

Configuration 216 – field-oriented control with electronic gear and index control

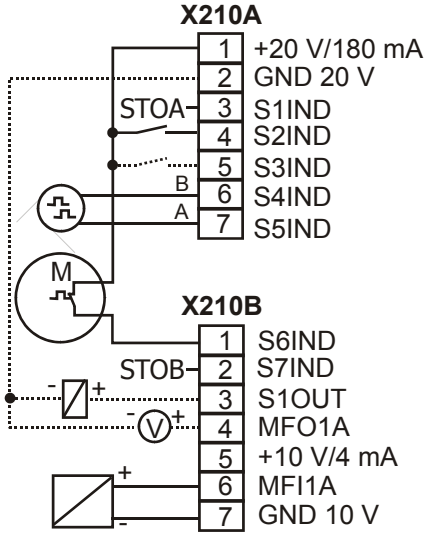


Control terminal X210A	
X210A.1	Supply voltage +20V
X210A.2	Ground 20 V
X210A.3	Safety function, digital input STOA
X210A.4	Index signal Master
X210A.5	Index signal Slave
X210A.6	Start of clockwise operation
X210A.7	Speed sensor track A

Control terminal X210B	
X210B.1	Repetition frequency input (reference value electronic gear)
X210B.2	Safety function, digital input STOB
X210B.3	Operating message
X210B.4	Analog signal of actual frequency
X210B.5	Supply voltage +10V
X210B.6	Index controller release
X210B.7	Ground 10 V

Note: In this configuration, generally only the simple or double evaluation of a track of a speed sensor is performed. This is to be considered during the parameterization.

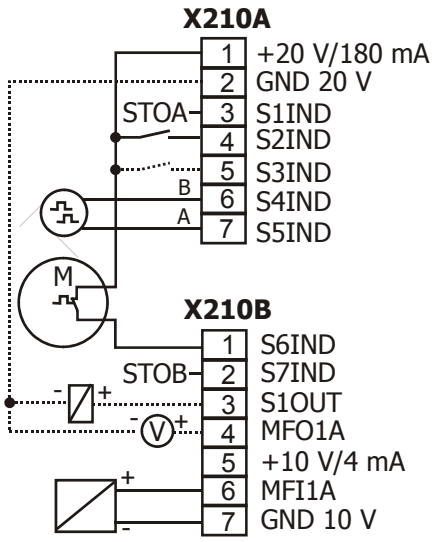
Configuration 415 – sensorless field-oriented control with electronic gear and position control



Control terminal X210A	
X210A.1	Supply voltage +20V
X210A.2	Ground 20 V
X210A.3	Safety function, digital input STOA
X210A.4	Start of clockwise operation
X210A.5	Start of anticlockwise operation
X210A.6	Reference value electronic gear at speed sensor 1 input, track B
X210A.7	Reference value electronic gear at speed sensor 1 input, track A

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	Safety function, digital input STOB
X210B.3	Operating message
X210B.4	Analog signal of actual frequency
X210B.5	Supply voltage +10V
X210B.6	Analog signal reference gear factor
X210B.7	Ground 10 V

Configuration 515 – field-oriented control of a synchronous machine with electronic gear and position control

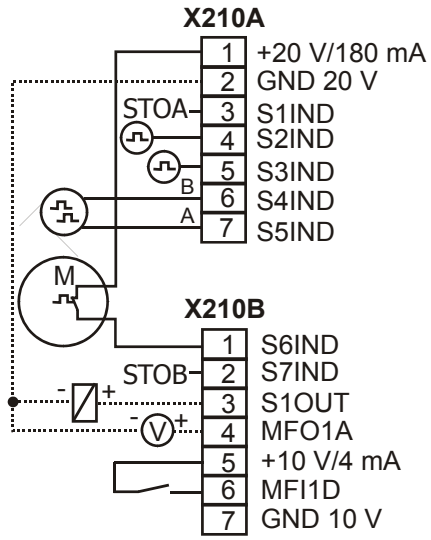


Control terminal X210A	
X210A.1	Supply voltage +20V
X210A.2	Ground 20 V
X210A.3	Safety function, digital input STOA
X210A.4	Start of clockwise operation
X210A.5	Start of anticlockwise operation
X210A.6	Reference value electronic gear at speed sensor 1 input, track B
X210A.7	Reference value electronic gear at speed sensor 1 input, track A

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	Safety function, digital input STOB
X210B.3	Operating message
X210B.4	Analog signal of actual frequency
X210B.5	Supply voltage +10V
X210B.6	Analog signal reference gear factor
X210B.7	Ground 10 V

Note: For the operation of a synchronous machine, an expansion module for evaluating a resolver is required. This functionality is available with the modules of the EM-RES series.

Configuration 516 – field-oriented control of a synchronous machine with electronic gear and index control



Control terminal X210A	
X210A.1	Supply voltage +20V
X210A.2	Ground 20 V
X210A.3	Safety function, digital input STOA
X210A.4	Index signal Master
X210A.5	Index signal Slave
X210A.6	Reference value electronic gear at speed sensor 1 input, track B
X210A.7	Reference value electronic gear at speed sensor 1 input, track A

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	Safety function, digital input STOB
X210B.3	Operating message
X210B.4	Analog signal of actual frequency
X210B.5	Supply voltage +10V
X210B.6	Index controller release
X210B.7	Ground 10 V

Note: For the operation of a synchronous machine, an expansion module for evaluating a resolver is required. This functionality is available with the modules of the EM-RES series.

3 Commissioning of the Frequency Inverter

3.1 Switching on Mains Voltage

After completion of the installation work, make sure to check all control and power connections again before switching on the mains voltage. If all electrical connections are correct, make sure that the frequency inverter is not enabled (control input S1IND open). After power-up, the frequency inverter carries out a self-test and the relay output (X10) reports "Fault".

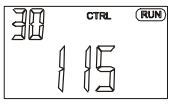
After a few seconds, the self-test is complete, the relay (X10) picks up and signals "no fault ".
If the unit is in "as-delivered" condition or after resetting the unit to the factory settings, the guided commissioning procedure is started automatically. On the control unit, the "SetUP" menu from the menu branch CTRL is displayed.

3.2 Setup Using the Control Unit

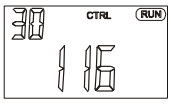
Caution! During the guided commissioning, comply with the safety instructions in chapter "General Safety Instructions and Information on Use" and in the Operating Instructions or the Brief Instructions.

Carry out the guided commissioning procedure of the frequency inverter for one of the configurations listed below. These contain the function of the electronic gear with position control or with index control.

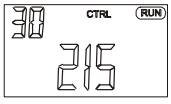
Note: The guided commissioning contains the function for parameter identification. The parameters are determined by way of measurement and set accordingly. In the case of higher requirements as regards the accuracy of the speed/torque control, you should carry out the guided commissioning procedure once again **under operating conditions** because part of the machine data depends on the operating temperature.



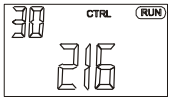
Configuration 115, sensorless control with electronic gear and position control
Configuration 115 extends the sensorless control of Configuration 110 by the functions of the electronic gear and a position controller.



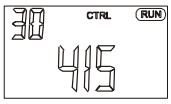
Configuration 116, sensorless control with electronic gear and index control
Configuration 116 extends the sensorless control of Configuration 110 by the functions of the electronic gear and an index controller.



Configuration 215, field-oriented control with electronic gear and position control
Configuration 215 extends the field-oriented control of Configuration 210 by the functions of the electronic gear and a position controller.

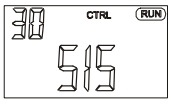


Configuration 216, field-oriented control with electronic gear and index control
Configuration 216 extends the field-oriented control of Configuration 210 by the functions of the electronic gear and an index controller.



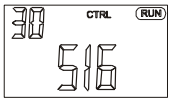
Configuration 415, sensorless field-oriented control with electronic gear and position control

Configuration 415 extends the sensorless field-oriented control of Configuration 410 by the functions of the electronic gear and a position controller.



Configuration 515, field-oriented control of a synchronous machine with electronic gear and position control

Configuration 515 includes the sensorless field-oriented control of a synchronous machine and the functions of the electronic gear and a position controller.



Configuration 516, field-oriented control of a synchronous machine with electronic gear and index control

Configuration 516 includes the sensorless field-oriented control of a synchronous machine and the functions of the electronic gear and an index controller.

4 Electronic Gear

The electronic gear enables the synchronization of drives without mechanical transmission elements such as shafts or clutches. The reference value for the Slave is the repetition frequency determined by the Master. This value can be multiplied by a gear factor. The transmission from the Master to the Slave is done via a repetition frequency signal or via System Bus.
The gear factor can be set permanently or varied during operation via freely configurable digital and analog signal sources through the percentage reference channel.

4.1 Scope of Functions

- Electronic gear
- Reference value via repetition frequency input, speed sensor 1 input, speed sensor 2 input of an expansion module EM-ENC/EM-IO or via System Bus
- Gear factor, numerator and denominator can be set separately
- Gear factor can be scaled during the operation
- Offset frequencies can be added depending on digital signals
- Position control, relative angle ratio of the drives adjustable
- Index control for exact control of synchronization of drives

Note: For the transmission of the repetition frequency value from the Master to the Slave via System Bus, an optional expansion module with System Bus interface is required.

4.2 Operation Modes of Electronic Gear

Via parameter *Operation Mode* **689** for the electronic gear, you can determine if the gear factor is to be set permanently or to be scaled via a signal source, e.g. an analog input signal at the Slave. The repetition frequency of the Master is multiplied by the gear factor. Via parameter *Operation Mode* **689** you can activate a position controlling in configurations 115, 215, 415 and 515.

Operation mode **689**	Function
0 - Frequency Reference Channel	Reference value specification for the Slave is done via the *Reference Frequency Source* **475** of the frequency reference channel. The electronic gearbox is deactivated.
1 - Fixed	The repetition frequency value specified via the repetition frequency input is multiplied by the gear factor and is the reference frequency for the Slave. The gear factor is calculated from the values of parameters *Gear Factor Numerator* **685** and *Gear Factor Denominator* **686**.
2 - Numerator Analog Numerator	Like operation mode 1, but the numerator of the gear factor is scaled via the *Reference Percentage Source* **476**.
3 - Denominator Analog Denominator	Like operation mode 1, but the denominator of the gear factor is scaled via the *Reference Percentage Source* **476**.
11 - Fixed with position controller	Like operation mode 1. Additionally, the relative angle position which the Slave drive is to have in relation to the Master is controlled. The gear factor is taken into account.

4.3 Gear Factor

The gear factor can be set permanently or scaled via the *Reference Percentage Source* **476** during operation. In the factory settings, the gear factor can be set during operation, in configurations 115, 215, 415 and 515, via an analog voltage signal at multifunction input MFI1A. This enable the realization of applications which require an adjustment of the transmission ratio during operations, e.g. winding machines or applications with tension control.

4.3.1 Setting a Fixed Gear Factor

Via parameters *Gear Factor Numerator* **685** and *Gear Factor Denominator* **686**, the gear factor is set permanently at the frequency inverter of the Slave drive.

$$\text{Gear Factor} = \frac{\textit{Gear Faktor Numerator}\ \mathbf{685}}{\textit{Gear Faktor Denominator}\ \mathbf{686}}$$

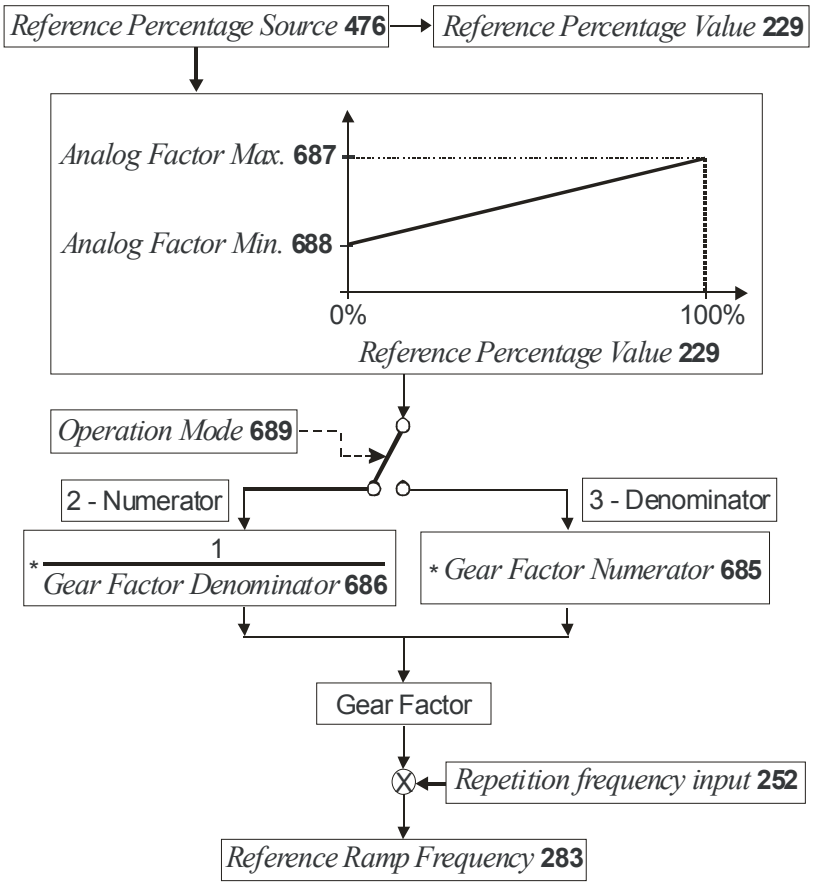
Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
685	Gear Factor Numerator	-300.00	300.00	1.00
686	Gear Factor Denominator	0.01	300.00	1.00

4.3.2 Setting a Variable Gear Factor

Via parameters *Analog Factor Max.* **687** and *Analog Factor Min.* **688** the gear factor range is scaled if operation mode 2 or 3 is selected for parameter *Operation Mode* **689**. The scaling is done via the *Reference Percentage Source* **476** via which the signal sources for determining the reference value are selected. With the signal source selected, e.g. an analog signal at the multifunction input MFI1A, the gear factor can be changed during operation.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
687	Analog Factor Max.	0.00	3.00	1.20
688	Analog Factor Min.	0.00	3.00	0.80

Signal flow diagram for scaling the gear factor via the reference percentage source:



Example:

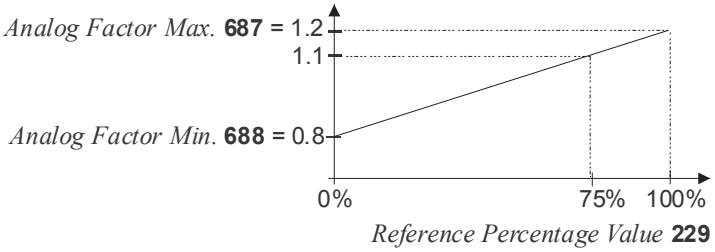
In an application, a Slave drive is to follow a Master drive, with the speed of the Slave having to be increased continuously without changing the speed specified by the master. The gear factor control is to be done using an analog voltage signal (0...10 V).

Suggested parameterization:

- Via parameter *Operation Mode* **689**, set operation mode "2 – Numerator Analog" for the electronic gear for a change of the gear factor by the numerator.
- Set the minimum and maximum limit for the numerator value via parameters *Analog Factor Max.* **687** and *Analog Factor Min.* **688**.

- Set the *Gear Factor Denominator* **686** to the required value.
- Set multifunction input MFI as an analog voltage input by adjusting *Operation Mode* **452** to "1 – voltage Input".
- For the *Reference Percentage Source* **476**, select an operation mode which contains MFI1A as a reference value source, e.g. operation mode "11 – +/- MFI1A + FP".

In this example, the default settings for *Analog Factor Max.* **687** and *Analog Factor Min.* **688**, an adjusted gear factor denominator of 2 and a reference percentage of 75% will result in a gear factor numerator of 1.1 and a reference frequency for the Slave of 10 Hz ∗ 1.1 / 2 = 5.5 Hz.



4.4 Offset Switches

Via the parameters *Offset Switch 1* **132** and *Offset Switch 2* **133**, you can select additional fixed frequencies which are added to the reference frequency. Digital signals at the control inputs or internal logic signals can be assigned to the parameters. The function is activated by these signals.

Note: While one of the offset switches is activated in operation mode "11 – fixed with position control" for parameter *Operation Mode* **689** and thus the fixed frequency is switched on, the position controller is switched off.

Via the logic statuses of *Offset Switch 1* **132** and *Offset Switch 2* **133**, you can select *Fixed Frequency 5* **485** and *Fixed Frequency 6* **486**.

Fixed Frequency Control		
Offset Switch 1 **132**	*Offset Switch 2* **133**	Function/active fixed value
0	0	no additional fixed frequencies active
1	0	*Fixed Frequency 5* **485**
0	1	*Fixed Frequency 6* **486**
1	1	*Fixed Frequency 5* **485** +*Fixed Frequency 6* **486**

0 = contact open, 1 = contact closed

4.5 Reference value and actual value input

The following inputs of the slave frequency inverter can be used for reference frequency transmission from master to slave. The actual value input receives the actual speed from the slave speed sensor.

Frequency inverter without expansion module [3]		
Configuration	**Reference value input**	**Actual value input**
115 116	Speed sensor 1[1] or Repetition frequency input	-
215 216	Repetition frequency input [1]	Speed sensor 1[1]
415	Speed sensor 1[1] or Repetition frequency input	-
Frequency inverter with expansion module EM-ENC or EM-IO		
Configuration	**Reference value input**	**Actual value input**
115 116	Speed sensor 1[1] or Speed sensor 2 or Repetition frequency input	-
215 216	Repetition frequency input[1, 2] or Speed sensor 1 or Speed sensor 2	Speed sensor 1[1] or Speed sensor 2
415	Speed sensor 1[1] or Speed sensor 2 or Repetition frequency input	-
Frequency inverter with expansion module EM-RES		
Configuration	**Reference value input**	**Actual value input**
515 516	Speed sensor 1[1] or Repetition frequency input	Resolver input[1]

[1] Factory setting.
Additional Note for Configuration 116 and 216: The factory setting "Speed sensor 1" is only set to track A.
[2] Parameterisation of the repetition frequency input is not possible, if an expansion module EM-ENC-01 is connected. Use speed sensor 1 input or speed sensor 2 input.
[3] Communication modules CM are not taken into consideration by this distinction.

Parameterisation of the inputs:

Speed sensor 1 input:
Parameter *Operation Mode* **490**
Parameter *Division Marks* **491**

Speed sensor 2 input [1]:
Parameter *Operation Mode* **493**
Parameter *Division Marks* **494**
Parameter *Level* **495**

Repetition frequency input:
Parameter *Operation Mode* **496**
Parameter *Divider* **497**

[1] Parameterisation is possible, if an expansion module EM-ENC or EM-IO is connected.

The factory settings of electronic gear configurations provide reference value inputs. If other inputs are required , for example speed sensor 2 input of an expansion module, loading of XPI files to the **software VPlus** is necessary. These files include additional parameters. For instance file swc215.xpi must be loaded, if configuration 215 is adjusted.

If the XPI file is loaded the parameter *El. Gear Reference Frequency* **125** can be adjusted for the reference value input of the electronic gear. Practical settings for operation without optional System bus are:

Operation mode	Function
80 - Freq. Speed Sensor 1	Reference value source is the speed sensor 1 frequency signal.
81 - Freq. Speed Sensor 2	Reference value source is the speed sensor 2 frequency signal.
288 - Repetition Frequency Input	Reference value source is the frequency signal at the repetition frequency input.

Note: It is possible to use Systembus values as reference value. Change the parameter *El. Gear Reference Frequency* **125** accordingly to the Systembus PDO, which receives the reference value.

4.6 Position Control

Activation of the overriding position control for the electronic gear is particularly useful if a synchronization without drift between the Master and the Slave is required for longer periods of time. Inaccuracies which result from rounding errors in the calculation of the gear factor are eliminated. Additionally, an offset angle relative to the master drive can be set at the slave drive.
The reference value for the position controller is specified via the repetition frequency input or the speed sensor input of the slave or via the System Bus.
To enable position control, operation mode "11 – fixed with position control" must be selected for parameter *Operation Mode* **689**.

If an XPI file x15 is loaded to the **software VPlus**, e.g. swc215.xpi for the configuration 215, you can adjust parameter *Position Reference Value* **147** to the reference value source for the position control. Practical settings for operation without optional System bus are:

Operation mode	Function
82 - Position Speed Sensor 1	Reference value source is the speed sensor 1 input.
83 - Position Speed Sensor 2	Reference value source is the speed sensor 2 input.

Via parameter *Position Actual Value* **148**, you can adjust the actual value source for the position control. Practical settings for operation without optional System bus are:

Operation mode	Function
82 - Position Speed Sensor 1	Actual value source is the speed sensor 1 input.
83 - Position Speed Sensor 2	Actual value source is the speed sensor 2 input.

Example for parameterisation:

Reference frequency value at speed sensor 1 input
Speed sensor feedback at speed sensor 2 input (expansion module required)

Parameter *Operation mode* **689** = 11 - Fixed with position controller
Parameter *El. Gear Reference Frequency* **125** = 80 - Freq. Speed Sensor 1
Parameter *Position Reference Value* **147** = 82 - Position Speed Sensor 1
Parameter *Position Actual Value* **148** = 83 - Position Speed Sensor 2

Via parameter *Amplification Position Controller* **696**, the dynamism of the position controller is adjusted and the position error is assessed.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
696	Amplification Position Controller	0.00%	200.00%	10.00%

Via parameter *Lim. Position Deviation* **697**, you can adjust the maximum angle on which the Slave drive is yet to catch up during the compensation of a position error. The Slave drive cannot follow large jumps of the reference value directly due to the startup time. The startup time depends on the moment of inertia of the drive and the adjusted ramp gradients (acceleration and deceleration). If, for example, the drive has a deviation of 36 000° (i.e. 100 revolutions) from the reference value, the limitation of the position error must be set to values greater than or equal to 36 000° if the drive is to catch up on this deviation from the reference value again. However, the Slave does not try to catch up on values exceeding the *Lim. position deviation* **697.**

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
697	Lim. Position Deviation	0°	99 999°	99 999°

Via parameter *Lim. Position Controller* **698**, you can adjust the maximum output frequency of the position controller.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
698	Lim. Position Controller	0.00 Hz	1000.00 Hz	1.00Hz

Via parameter *Position Correction* **699**, you can adjust an offset angle of the Slave relative to the Master. This parameter can be written while the frequency inverter is in operation.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
699	Position Correction	-3200.0°	3200.0°	-

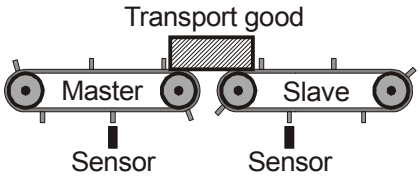
4.7 Index Control

The electronic gearbox with index control is available in configurations 116, 216 and 516. Via index control, deviations from synchronous running which are due to process changes can be detected directly in the process by sensors and compensated by the index controller. The sensors detect reference points of the Master drive and the Slave drive and produce the index signals from these reference points. The time difference between the index signals resulting from the different position of the drives is compensated, thus the drives are synchronized.

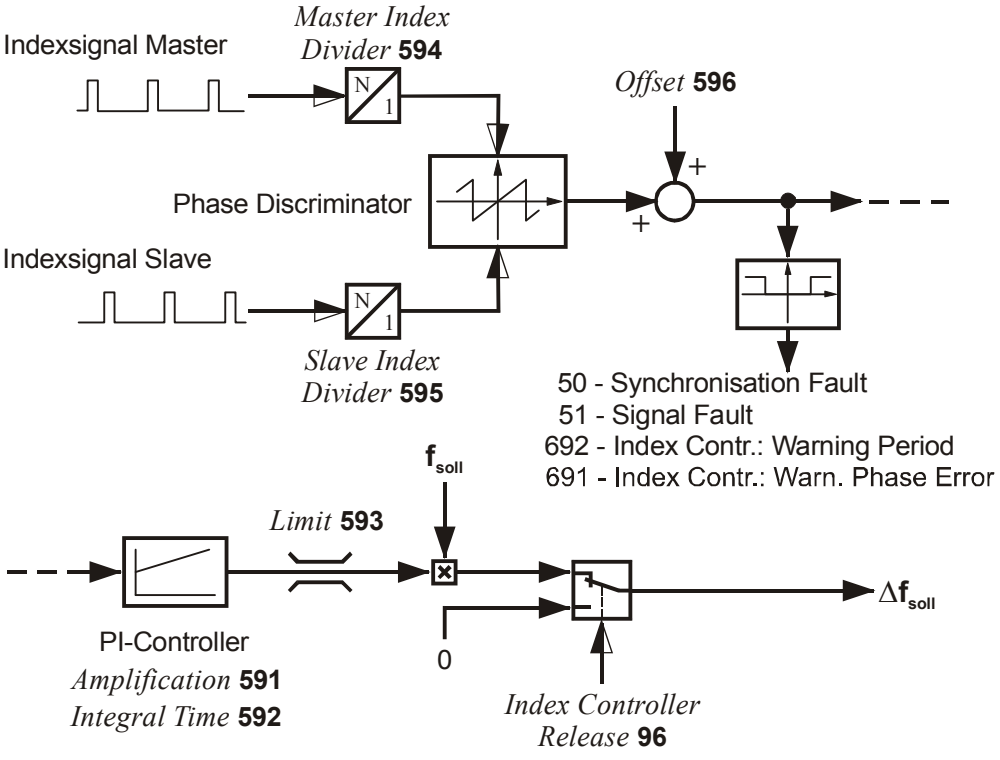
Note: The connection of the index signals is described in chapter 2.1"Control Terminals".

Example: Synchronous running of transport conveyors

The transported material is conveyed from one conveyor to the next and taken along by cams which serve as reference marks. The position of the reference marks is detected by sensors which supply the index signals for controlling the synchronous operation. The Slave drive is accelerated or decelerated depending on the time difference between the index signals from the Master and the Slave. Synchronous operation is restored as soon as the time difference is compensated, i.e. the reference marks of the Master and the Slave are detected by the sensors at the same time.



Index Control Principle:



Via parameter *Operation Mode* **598**, the index controller is switched on or off permanently depending on the signal state at a digital input.

Operation mode 598	Function
0 - Off	The index controller is switched off permanently.
1 - On	The index controller is switched on permanently.
2 - Controlled by Contact	The index control is switched on or off via a digital input.

For contact control, a digital input can be selected and assigned to parameter *Index Controller Release* **96**. By default, multifunction input MFI1D which is configured as a digital input is assigned to this parameter in configurations 116, 216 and 516.

A PI controller supplies the percentage value which acts on the reference value of the electronic gear. Via parameters *Amplification* **591** and *Integral Time* **592**, you can adjust the proportional and the integrating part of the index controller.
The maximum percentage value of the output signal of the controller can be adjusted via parameter *Limit* **593**, thus the dynamism of the controller can be influenced.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
591	Amplification	0.0	100.0	1.0
592	Integral Time	0.0 ms	60.000 ms	1000 ms
593	Limit	0.00%	200.00%	10.00%

Parameters *Master Index Divider* **594** and *Slave Index Divider* **595** enable index control at different numbers of reference marks and thus different frequencies of the index signals for the Master and the Slave. The parameters can be adjusted according to the number of Master reference marks / number of Slave reference marks ratio.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
594	Master Index Divider	1	65 535	1
595	Slave Index Divider	1	65 535	1

Attention! When setting parameters *Master Index Divider* **594** and *Slave Index Divider* **595**, note that the period of the divided index signals must at least be 16 ms since this is the response time of the digital inputs.

Via parameter *Offset* **596**, you can correct the position of the Slave relative to the Master.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
596	Offset	-50.00%	50.00%	0.00%

Via parameter *Warning Limit* **597**, you can monitor the phase displacement of the index signals from the Master and the Slave. A setting of e.g. 50% means that a warning is issued if the displacement between the index signals exceeds 50% of the period.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
597	Warning Limit	0.00%	50.00%	0.00%

Note: The parameter *Warning Limit* **597** should be set if an early warning of asynchronous behavior of the Master drive and the Slave drive is to be issued.

The warning messages due to a phase error or if the index signal period is too short can be assigned to a digital output.

Operation mode	Function
50 - Synchronization Fault	The phase error exceeded the *Warning Limit* **597**.
51 - Signal Fault	Index signal period too short
150 and 151	Operation modes inverted

The following operation modes are available as signal sources for further linking to digital inputs.

Operation mode	Function
691 - Index Contr.: Warn. Phase Error	The phase error exceeded the *Warning Limit* **597**.
692 - Index Contr.: Warning Period	Index signal period too short.

4.7.1 Scope sources

For the VPlus Scope function two dedicated sources are available.
693 – Master Index
694 – Slave Index
These sources will display the inputs at the two corresponding digital inputs "Index Signal Master" (S2IND) and "Index Signal Slave" (S3IND).

4.8 Actual Values

Via parameter *Repetition Frequency Input* **252**, you can display the actual value of the repetition frequency input.

Via parameter *Freq. Speed Sensor 1* **217**, you can display the frequency reference value or the actual frequency value of the speed sensor 1 input, dependent on the use as reference value input or input for speed sensor feedback.

Via parameter *Freq. Speed Sensor 2* **219**, you can display the frequency reference value or the actual frequency value of the speed sensor 2 input, dependent on the use as reference value input or input for speed sensor feedback. Speed sensor 2 input is available if an expansion module EM-ENC or EM-IO is connected.

Via parameter *Reference Ramp Frequency* **283**, the actual value of the frequency after multiplication by the gear factor and addition of the optionally selectable repetition frequencies can be displayed. This parameter is available if a communication module CM-232/485 or CM-CAN is connected.

4.9 Adjustment Options

The following instructions describe options for setting the electronic gear and the position controller. The settings must be adjusted to the application. For further information on the parameterization of the repetition frequency inputs and outputs, refer to the operating instructions. For information on the parameterization of the System Bus, refer to the instructions of the expansion modules with System Bus.

Attention! The control functions listed in the following table may affect the synchronous operation of the drives. It should be checked if these additional control functions are switched on and if they are required.

Parameter		Function
573	Operation Mode	Intelligent current limits
610	Operation Mode	Current limit value controller
660	Operation Mode	Slip compensation
670	Operation Mode	Voltage controller
720	Operation Mode	Speed controller

Via parameter *Controller Status* **275** you can display if a controller is active.

The function of the electronic gear is realized by configuring a digital input of the Slave frequency inverter as a repetition frequency input. If a frequency inverter is the Master, the repetition frequency output of the Master frequency inverter or of an expansion module is used.

Note: Connect the inverter according to the instructions and connection diagrams in chapter "Control Inputs and Output".

4.9.1 Frequency Inverter as Master

If a frequency inverter is configured as Master of the electronic gear, the following settings (examples) can be made for the transmission of the repetition frequency.

- If not yet done after commissioning, select a configuration for parameter *Configuration* **30**, e.g. Configuration "210 – speed-controlled field-oriented control" for speed control of the Master drive with speed sensor feedback. Depending on the application, another configuration can be selected, too.
- If a configuration with speed sensor feedback is selected you should check if the speed sensor monitoring is switched on. In this way, faulty speed sensor signals can be detected. Speed sensor monitoring is activated by default. By selecting operation mode "2 **–** Error" for parameter *Operation Mode* **760**, you can switch on the speed sensor monitoring.
- Select operation mode "3 **–** Repetition Frequency" for parameter *Operation Mode* **550** of the multifunction output MFO1. As a result, the multifunction output is used as a repetition frequency output.

- Select an operation mode for parameter *Repetition frequency Mode* **555**, e.g. Operation Mode "3 – Frequency Speed Sensor 1", for the Master drive with speed sensor feedback. In this operation mode, the speed of the Slave drive follows the speed of the Master drive at the highest accuracy. Depending on the application, you can also choose another operation mode for *Repetition Frequency Mode* **555**.

Note: Parameter *Repetition Frequency Mode* **555** is not available for the expansion modules with resolver interface EM-RES. The number of division marks is set permanently to 1024.
The expansion module is equipped with a two-channel repetition frequency output for push-pull operation (TTL).

- Set the value for parameter *Division Marks* **556** according to the required frequency at the repetition frequency output. This is the number of pulses per motor revolution for the repetition frequency. The pulse duration depends on the motor speed. By default, this parameter is set to 1024. When making the settings, take the frequency limit of the frequency output of 150 kHz into account. The maximum value S_{max} which can be set for parameter *Division Marks* **556** is:

$$S_{max} = \frac{150\,000\,\text{Hz}}{\text{absolute frequency}}; \qquad \textit{Division Marks}\,\mathbf{556} * \frac{\text{motor speed}}{\text{Gear Factor}} \leq 150\,\text{kHz}$$

4.9.2 Frequency Inverter as Slave

For the function of the electronic gear via the repetition frequency, the following settings (examples) can be made at the frequency inverter of the Slave drive.

- If not done yet after the commissioning, select one of the configurations with electronic gear for parameter *Configuration* **30**, e.g. Configuration "215 – speed-controlled field-oriented control with electronic gear". Depending on the application, another configuration with electronic gear can be selected, too.

- For parameter *Operation Mode* **496**, select the digital input for the repetition frequency and the type of evaluation, e.g. "62 – S6IND Double Evaluation pos.".

- Since the rated speed decreases when the number of pole pairs is higher (n~1/p), different speeds may result if the Master and Slave have the same reference frequencies. Adjust the values for parameters *Divider* **497** of the repetition frequency input of the Slave and *Division Marks* **556** of the repetition frequency output of the Master according to the number of pole pairs of the motors in order to obtain the same speeds for the Master drive and the Slave drive. Different speeds can be realized by setting the gear factor, as described in chapters "Setting a Fixed Gear Factor" and "Setting a Variable Gear Factor".

Different values for parameters *Divider* **497** of the repetition frequency input of the Slave and *Division Marks* **556** of the repetition frequency output of the Master result in different speeds of the Master drive and the Slave drive if the number of pole pairs of the motors is the same.

- If a configuration with speed sensor feedback is selected, check if the speed sensor monitoring is switched on. In this way, faulty speed sensor signals can be detected. Speed sensor monitoring is activated by default. By selecting operation mode "2 – Error" for parameter *Operation Mode* **760**, you can switch on the speed sensor monitoring.

- Set parameters *Acceleration* (*Clockwise*) **420** and *Deceleration* (*Clockwise*) **421** or *Acceleration Anticlockwise* **422** and *Deceleration Anticlockwise* **423** to the required values. For synchronous acceleration and deceleration of the drives, set the values of the Slave slightly higher than the values of the Master. These increased values are to ensure that the Slave drive can follow the Master drive in dynamic operation cases.

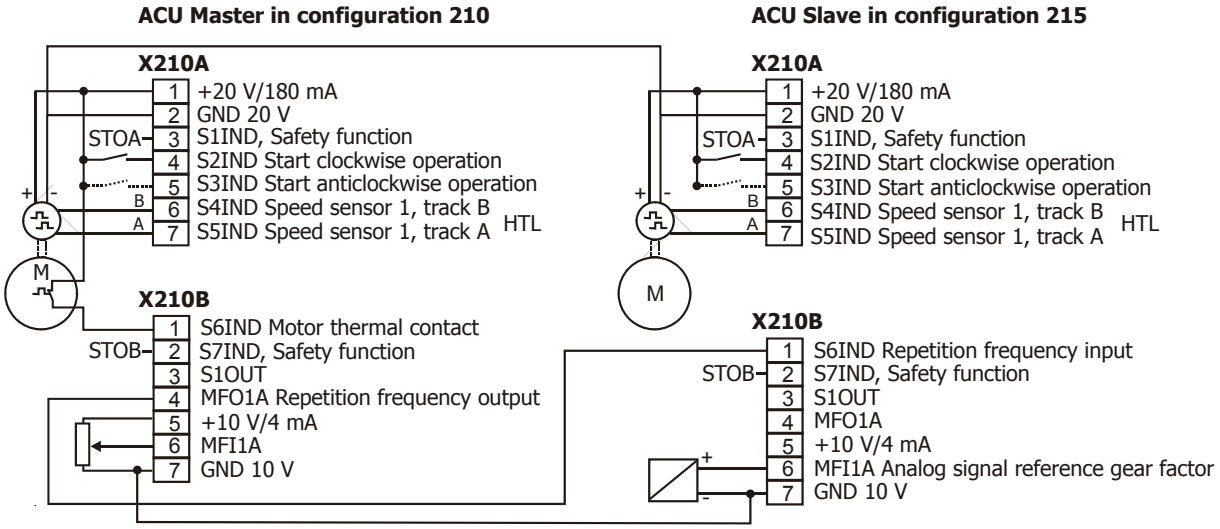
- For a synchronous start of the Master drive and the Slave drive, set the *Minimum Frequency* **418** of the Slave to 0 in order to prevent a premature start of the Slave drive if the controller release signal is present at S1IND.

- Select an *Operation Mode* **689** and adjust the required transmission ratio via parameters *Gear Factor Numerator* **685** and *Gear Factor Denominator* **686**.

Attention! In order to avoid time delays during the processing of the repetition frequency, the Slave frequency inverter should be released before the Master frequency inverter.

4.10 Examples of wiring

Example 1: Transmission of the reference frequency value without information about direction of rotation



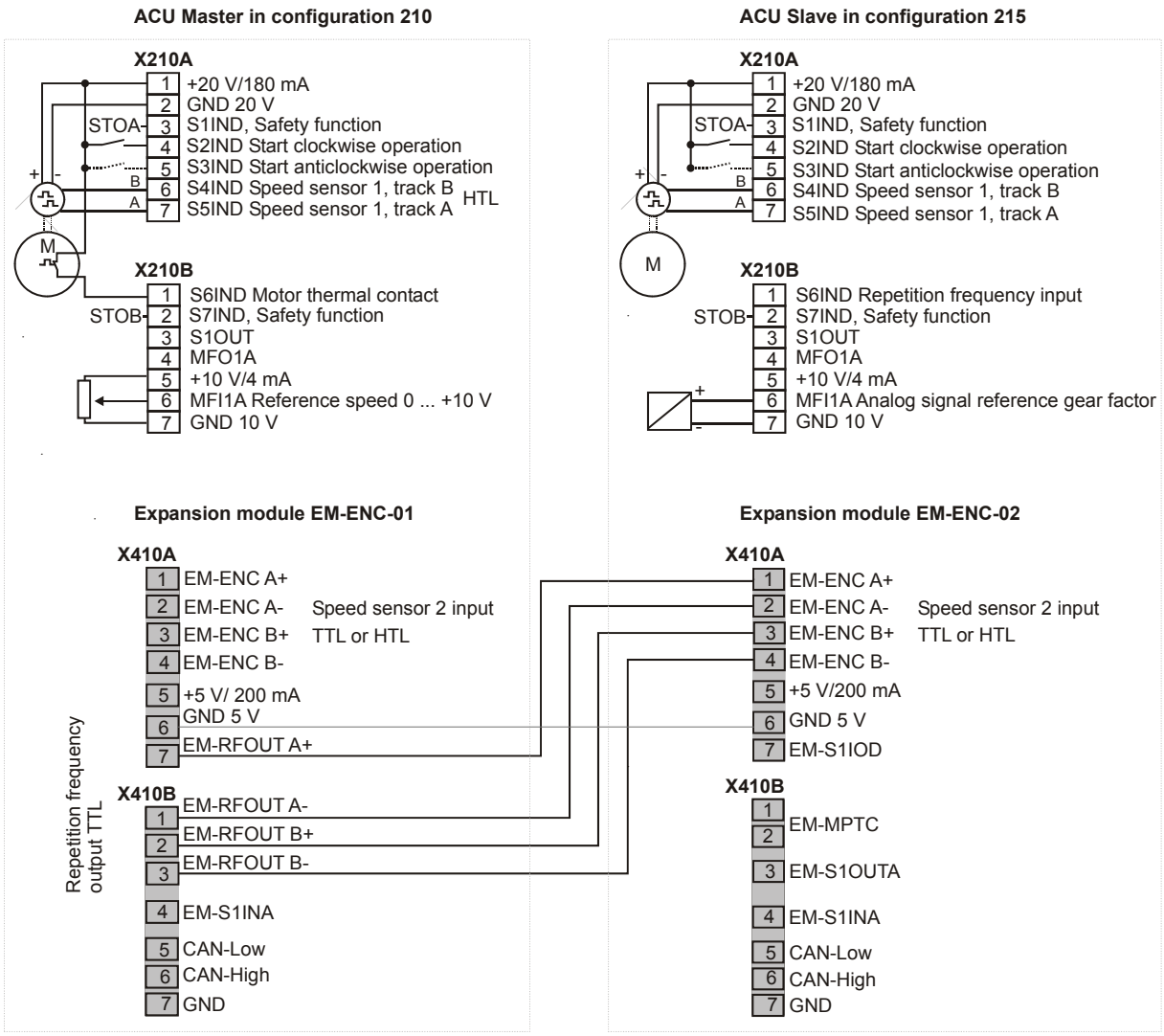
To ensure correct operation, connect the GND terminals between the frequency inverters.

Overview of Parameter Setting Examples:

Parameter		Setting/Selection
Master Settings		
30	Configuration	210 – speed-controlled field oriented control
420	Acceleration (Clockwise)	5 Hz/s
421	Deceleration (Clockwise)	5 Hz/s
490	Operation Mode (of speed sensor 1)	4 – Quadruple Evaluation
491	Division marks (of speed sensor 1)	Division marks of the master speed sensor
550	Operation Mode	3 – Repetition Frequency
555	Repetition Freq. Operation	3 – Freq. Speed Sensor 1
556	Division Marks (of Multifunctional output 1)	1024
760	Operation Mode (of speed sensor monitoring)	2 – Error
766	Actual speed source	1 – Speed sensor 1
Slave Settings		
30	Configuration	215 – speed-controlled field-oriented control with electronic gear
420	Acceleration (Clockwise)	10 Hz/s
421	Deceleration (Clockwise)	10 Hz/s
490	Operation Mode (of speed sensor 1)	4 – Quadruple Evaluation
491	Division marks (of speed sensor 1)	Division marks of the slave speed sensor
496	Operation Mode (of repetition frequency input)	62 – S6IND Double Evaluation pos.
497	Divider (of repetition frequency input)	1024
685	Gear Factor Numerator	1
686	Gear Factor Denominator	1
689	Operation Mode (of electronic gear)	1 – Fixed
760	Operation Mode	2 – Error
766	Actual speed source	1 – Speed sensor 1

Note: The repetition frequency input receives the reference frequency value in single-channel mode. The reference frequency value is transmitted, but not the direction of rotation. In this case the direction of rotation must be set via the control terminals S2IND and S3IND at the slave.

Example 2: Transmission of the reference frequency value with information about direction of rotation, frequency inverter with expansion modules



The digital inputs of the frequency inverter or the speed sensor inputs EM-ENC (extended speed sensor evaluation) can be used alternatively as speed sensor inputs.

Speed sensor input of frequency inverter basic unit:
HTL, 12 to 30 VDC

Speed sensor input EM-ENC of the expansion module:
TTL according to RS-422A/RS-485 or
HTL, 5 to 30 VDC

Overview of Parameter Setting Examples:

	Parameter		Setting/Selection
Master Settings			
	30	Configuration	210 – speed-controlled field oriented control
	420	Acceleration (Clockwise)	5 Hz/s
	421	Deceleration (Clockwise)	5 Hz/s
	490	Operation Mode (of speed sensor 1)	4 – Quadruple Evaluation
	491	Division marks (of speed sensor 1)	Division marks of the master speed sensor
	546	Operation Mode Repetition Frequency	101 – Frequency speed sensor 1 wo. corr.
	760	Operation Mode (of speed sensor monitoring)	2 – Error
	766	Actual speed source	1 – Speed sensor 1
Slave Settings			
	30	Configuration	215 – speed-controlled field-oriented control with electronic gear
☞	125	El. Gear Reference Frequency	81 – Freq. Speed Sensor 2
☞	147	Position Reference Value	83 – Position Speed Sensor 2
☞	148	Position Actual Value	82 – Position Speed Sensor 1
	420	Acceleration (Clockwise)	10 Hz/s
	421	Deceleration (Clockwise)	10 Hz/s
	490	Operation Mode (of speed sensor 1)	4 – Quadruple Evaluation
	491	Division marks (of speed sensor 1)	Division marks of the slave speed sensor
	493	Operation Mode (of speed sensor 2)	4 – Quadruple Evaluation
	494	Division marks (of speed sensor 2)	Division marks of the master speed sensor
	495	Operation Mode Level (of speed sensor 2)	0 – push-pull
	685	Gear Factor Numerator	1
	686	Gear Factor Denominator	1
	689	Operation Mode (of electronic gear)	11 – Fixed with position controller
	696	Amplification Position Controller	10.00%
	697	Lim. Position Deviation	99 999°
	698	Lim. Position Controller	3.00 Hz
	766	Actual speed source	1 – Speed sensor 1

☞ This parameter is available after loading of a configuration file, e.g. swc215.xpi.

5 Electronic gear via System bus

5.1 Speed Sensor Simulation

If the electronic gear is realized by means of the System Bus, the transmitted position data must be converted in a pulse-width modulated repetition frequency signal. This is done via the speed sensor simulation (remote encoder) which works as an internal speed sensor. The type of evaluation is adjusted via parameter *Operation Mode* **498**.

Operation mode	Function
0 - Off	Speed measurement not active
1 - Single Evaluation	Two-channel speed sensor with recognition of direction of rotation via track signals A and B. One signal edge is evaluated per division mark.
2 - Double Evaluation	Two-channel speed sensor with recognition of direction of rotation via track signals A and B. Two signal edges are evaluated per division mark.
4 - Quadruple Evaluation	Two-channel speed sensor with recognition of direction of rotation via track signals A and B. Four signal edges are evaluated per division mark.

Via parameter *Division Marks* **499**, the number of division marks per revolution for generation of the signal for the speed sensor simulation is defined.

Parameter		Settings		
No.	**Description**	**Min.**	**Max.**	**Fact. sett.**
499	Division Marks	1	8192	1024

Note: For the speed sensor simulation (remote encoder), the settings for *Operation Mode* **490** and *Division Marks* **491** of the Master frequency inverter must be taken over.

5.2 Adjustment Options

The repetition frequency is transmitted via the System Bus.

Note: Only the parameterization required for realizing the electronic gear are described here. For operation of the System Bus, further settings are required. These are described in the operating instructions of the expansion modules with System Bus.

5.2.1 Frequency Inverter as Master

If a frequency inverter is configured as Master of the electronic gear, the following settings can be made for the transmission of the repetition frequency via the System Bus.

- If not yet done after commissioning, select a configuration for parameter *Configuration* **30**, e.g. Configuration "210 – speed-controlled field-oriented control" for speed control of the Master drive with speed sensor feedback. Depending on the application, another configuration can be selected, too.
- If a configuration with speed sensor feedback is selected, check if the speed sensor monitoring is switched on. Speed sensor monitoring is activated by default. By selecting operation mode "2 **–** Error" for parameter *Operation Mode* **760**, you can switch on the speed sensor monitoring.
- Select a source for a Transmit-PDO of data type long, e.g. select signal source "80 - Speed Sensor 1" via parameter *TxPDO1 Long1* **954** for transmission of the repetition frequency to the Slave.

Note: The parameters of the System Bus (e.g. TxPDO's for transmission of the data) are only available if the file sysbus.xpi is loaded in the software VPlus.

5.2.2 Slave Settings

For the function of the electronic gear via System Bus, the following settings (examples) can be made.

- If not done yet after the commissioning, select one of the configurations with electronic gear for parameter *Configuration* **30**, e.g. Configuration "215 – speed-controlled field-oriented control with electronic gear". Depending on the application, another configuration with electronic gear can be selected, too.
- If a configuration with speed sensor feedback is selected, check if the speed sensor monitoring is switched on. Speed sensor monitoring is activated by default. By selecting operation mode "2 **–** Error" for parameter *Operation Mode* **760**, you can switch on the speed sensor monitoring.
- Set parameters *Acceleration* (*Clockwise*) **420** and *Deceleration* (*Clockwise*) **421** or *Acceleration Anticlockwise* **422** and *Deceleration Anticlockwise* **423** to the required values. For synchronous acceleration and deceleration of the drives, set the values of the Slave slightly higher than the values of the Master. These increased values are to ensure that the Slave drive can follow the Master drive in dynamic operation cases.
- Assign a RxPDO source for the repetition frequency received to parameter *El. Gear Reference Frequency* **125**, e.g. source "708 **–** RxPDO1 Long1".

Note: The parameter *El. Gear Reference Frequency* **125** is only available if the file for a configuration with electronic gear is loaded in the software VPlus, e.g. swc215.xpi.

- Select an *Operation Mode* **689** and adjust the required transmission ratio via parameters *Gear Factor Numerator* **685** and *Gear Factor Denominator* **686**.

Overview of Parameter Setting Examples:

Parameter		Setting/Selection
Master Settings		
30	Configuration	210 – speed-controlled field oriented control
420	Acceleration (Clockwise)	5 Hz/s
421	Deceleration (Clockwise)	5 Hz/s
954	TxPDO1 Long1	80 – Speed Sensor 1
Slave Settings		
30	Configuration	215 – speed-controlled field-oriented control with electronic gear
125	El. Gear Reference Frequency	708 – RxPDO1 Long1
420	Acceleration Clockwise	10 Hz/s
421	Deceleration Clockwise	10 Hz/s
498	Operation Mode	4 – Quadruple Evaluation
499	Division marks	1024
689	Operation Mode	1 – Fixed
685	Gear Factor Numerator	1
686	Gear Factor Denominator	1
760	Operation Mode	2 – Error

5.3 Position Control via System Bus

Example of Position Control Settings via System Bus:

Master:

- Select a source for a Transmit-PDO of data type long, e.g. select signal source "80 – Speed Sensor 1 via parameter *TxPDO1 Long1* **954** for transmission of the repetition frequency to the Slave.
- Select a source for a Transmit-PDO of data type Word, e.g. via parameter *TxPDO2 Word1* **960,** select the signal source "82 - Position Speed Sensor 1" or "289 - Position Rep. Frequency Input" for transmission of the position to the Slave.

Note: The parameters of the TxPDO's for transmission of the data is only available if the file sysbus.xpi is loaded in the software VPlus. Parameters 125, 147 and 149 which are described in the following are contained in the configuration files to be loaded, e.g. swc215.xpi.

Slave:

- Select operation mode "11 – fixed with position control" for parameter *Operation Mode* **689**.
- Assign a RxPDO source for the repetition frequency received to parameter *El. Gear Reference Frequency* **125**, e.g. source "708 – RxPDO1 Long1".
- Assign a RxPDO source for the position value received to parameter *Position Reference Value* **147**, e.g. source "714 – RxPDO2 Word2". The position value received is thus specified as the reference value for the Slave.
- Select a signal source (signal at digital input or internal logic signal) for parameter *Start Position Controller* **149** or select "6 – On" if the position controller is to be switched on permanently.
- Select an operation mode for the speed sensor simulation for parameter *Operation Mode* **498**. Via this function, the function of an incremental speed sensor is simulated.
- Via parameter *Division Marks* **499**, you can adjust the output frequency of the speed sensor simulation.
- Adjust parameters 696 to 699 of the position controller.

6 Parameter List

The parameter list is structured according to the menu branches of the control unit. For better clarity, the parameters have been marked with pictograms:

The parameter is available in the four data sets.

This parameter cannot be written in the operation of the frequency inverter.

This parameter is available after loading of a configuration file, e.g. swc215.xpi.

6.1 Actual Value Menu (VAL)

Actual Values of the Frequency Inverter				
No.	**Description**	**Unit**	**Display range**	**Chapter**
217	Freq. Speed Sensor 1	Hz	0.00 ... 999.99	4.8
219	Freq. Speed Sensor 2	Hz	0.00 ... 999.99	4.8
252	Repetition Frequency Input	Hz	0.00 ... 999.99	4.8
283	Reference Ramp Frequency	Hz	0.00 ... 999.99	4.8

6.2 Parameter Menu (PARA)

No.	Description	Unit	Setting range	Chapter
	Digital Inputs			
96	Index Controller Release	-	Selection	4.7
	Electronic Gear			
125	El. Gear Reference Frequency	-	Selection	4.5
	Digital Inputs			
132	Offset Switch 1	-	Selection	4.4
133	Offset Switch 2	-	Selection	4.4
	Position Controller			
147	Position Reference Value	-	Selection	4.6
148	Position Actual Value	-	Selection	4.6
	Digital Inputs			
149	Start Position Controller	-	Selection	4.6
	Fixed Frequencies			
485	Fixed Frequency 5	Hz	-999.99 ... 999.99	4.4
486	Fixed Frequency 6	Hz	-999.99 ... 999.99	4.4
	Speed Sensor Simulation			
498	Operation mode	-	Selection	5.1
499	Division marks	-	1 ... 8192	5.1
	Index controller			
591	Amplification	-	0.0 ... 100.0	4.7
592	Integral Time	ms	0.0 ... 60 000	4.7
593	Limit	%	0.00 ... 200.00	4.7
594	Master Index Divider	-	1 ... 65 535	4.7
595	Slave Index Divider	-	1 ... 65 535	4.7
596	Offset	%	-50.00 ... 50.00	4.7
597	Warning Level	%	0.00 ... 50.00	4.7
598	Operation Mode	-	Selection	4.7
	Electronic Gear			
685	Gear Factor Numerator	-	-300.00 ... 300.00	4.3.1
686	Gear Factor Denominator	-	0.01 ... 300.00	4.3.1
687	Analog Factor Max.	-	0.00 ... 3.00	4.3.2
688	Analog Factor Min.	-	0.00 ... 3.00	4.3.2
689	Operation Mode	-	Selection	4.2
	Position Controller			
696	Amplification Position Controller	%	0.00 ... 200.00	4.6
697	Lim. Position Deviation	°	0 ... 99 999	4.6
698	Lim. Position Controller	Hz	0.00 ... 1000.00	4.6
699	Position Adjustment	°	-3200.0 ... 3200.0	4.6

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