Baumer

Passion for Sensors

Manual

Positioning Motor *FlexiDrive* MSIA with Profibus-DP

Firmware version 2.05.xx

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1 Introduction

1.1 Product assignment

Table 1: Product assignment

Product family	Product	Product code	GSD file	Interface
FlexiDrive	MSIA 53 PBAx-N53 xxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP
FlexiDrive	MSIA 68 PBAx-N68 xxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP
FlexiDrive	MSIA 83 PBAx-N83 xxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP
FlexiDrive	MSIA 95 PBAx-N95 xxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP

Product family	Product	Product code	GSD file	Interface
FlexiDrive	MSIA 42P2xxxx-xxxxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP
FlexiDrive	MSIA 53P2xxxx-xxxxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP
FlexiDrive	MSIA 68P2xxxx-xxxxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP
FlexiDrive	MSIA 83P2xxxx-xxxxx xxxx	28	BEAG0793.GSD	PROFIBUS-DP

1.2 Function overview

Intelligent positioning motor as decentralized bus participant on PROFIBUS-DP

Large variety of planetary, spur or worm gears available

Absolute multi-turn position encoder

Voltage supply for motor and electronics
- via single cable
- via separate cables (see connector assignment)

4 digital inputs for Jogging, traversing blocks, hardware limit switch or referencing
- triggered by standard position sensor
- various functions programmable (P31)

1 digital output for control of external devices (optional up to 4 digital outputs, P32)

Operating modes (P700):
- position control
- external target values
- speed control

Additional functions
- software limit switches to limit moving path (P6)
- hardware limit switches (P31)
- set target value (P39)
- position/speed controller
- backlash compensation against gear or spindle play (P200)
- torque / current limit (P20)
- linear- or rotational axis (P1)
- direction of rotation can be reversed (P204)
- stand-alone / jogging operation without bus and programming (P215)
- referencing
- status and error diagnosis via bus (P968 and P947)
- temperature monitoring with warning message and drive shut-down in case of error (P47)
- traversing blocks programmable
- on-the-fly positioning task parameter modification

Communication via PROFIBUS-DP
- Parameter area (PPO1 or PPO2 for read / write parameters)
- Process data area (control word / status word for drive control and status information)

Quick start-up
- adaptation of only little number of parameters
- connectors to loop through fieldbus connection
- pre-molded cables for power supply and PROFIBUS-DP available as accessories
- software function blocks for SIMATIC® S7
- PC software PROFImaster for programming and start-up (see CD-ROM Art. Nr. 10147362 or download from the internet)

Non-volatile memory (EEPROM) for default data (P971)

Removable cover on drive backside for access to
- integrated switch for selecting node address (P918)
- duo LED light as drive status indicator

1.3 Safety and operating instructions

Supplementary information

- This manual is intended as a supplement to already existing documentation (catalogue, product information and assembly instructions).
- Please read this manual carefully before initial appliance of the device.

Intended purpose of the device

- This motor is a precision measurement and actuator device. It is intended to adjust angular positions of axles and spindles, and to prepare and supply measured position values as electrical output signals for follow-on device systems. The motor may be used for this purpose only.

Commissioning

- The motor may be installed by suitably qualified experts only.
- Observe all operating instructions of the machine manufacturer.

Safety remarks

- Prior to commissioning of the equipment, check all electrical connections.
- If installation, electrical connection or any other work performed at the motor or at the equipment is not correctly executed, this can result in a malfunction or failure of the motor.
- Steps must be taken to exclude any risk of personal injury, damage to the plant or to the operating equipment as a result of motor failure or malfunction by providing suitable safety precautions.
- Motor must not be operated outside the specified limited values (see detailed product documentation).

Failure to comply with the safety remarks can result in malfunctions, personal injury or damage to property.

Transport and storage

- Transport or store motor in original packaging only.
- Never drop motor or expose it to strong vibrations.

Assembly

- Avoid impacts or shocks on housing or shaft.
- Avoid any twist or torsion on the housing.
- Do not open the motor or perform any mechanical changes.

Failure to comply with the safety remarks can result in malfunctions, personal injury or damage to property.

Electrical Commissioning

- Do not perform any electrical changes at the motor.
- Do not carry out any wiring work when the motor is connected to supply voltage.
- Never plug or unplug the electrical connection when the motor is connected to supply voltage.
- Ensure that the entire plant is installed in line with EMC requirements. The installation environment and wiring affects the electromagnetic compatibility of the motor. Install the motor and supply cables separately or at a long distance from cables with high interference emissions (frequency converters, contactors, etc.)
- Where working with devices having high interference emissions, make available a separate power supply for the motor.
- Completely shield the motor housing and connecting cable.
- Connect the motor to the protective earth (PE) conductor by using shielded cable. The braided shield must be connected to the cable gland or plug. Ideally, aim at bilateral connection to protective earth (PE), the housing via the mechanical assembly, and the cable shield via the downstream connected devices. In case of earth loop problems, earth on one side only as a minimum requirement.

Failure to observe these instructions can result in malfunctions, material damage or personal injury.

2 Communication via PROFIBUS-DP

2.1 General information

PROFIBUS-DP is an international, open fieldbus standard and is defined in the following regulations:

- European fieldbus EN 50170 Part 2
- DIN 19245 Part 1 and 3
- IEC 61158

PROFIBUS-DP is optimized for fast data transfer on field level with critical timing. PROFIBUS-DP is used for cyclic and non–cyclic data transfer between a master and the slaves on the bus.

Master devices (active bus nodes) define the data transfer along the bus, and are therefore also designated as active bus nodes. For the masters, a differentiation is made between 2 Classes:

- DP master, Class 1: This designates central master devices which exchange information with the slaves in a defined telegram cycle. Examples: SIMATIC S7, etc.
- DP master, Class 2: These are devices to configure, commission, control and visualize with the bus operational. Examples: Programmers, operator control/ visualization devices.

Slaves are passive bus nodes and may only be used to receive and acknowledge messages, and to transfer messages on master request. The positioning Motor *FlexiDrive* MSIA is a slave on the PROFIBUS-DP.

Automatic baud rate detection
When powered up, the slave *FlexiDrive* MSIA automatically detects the actual fieldbus baud rate. When commissioning the bus, the baud rate is set identical for all devices starting from the master. The maximum cable length corresponding to the actual baud rate is indicated in Table 2. By using repeaters, the cable length can be increased.

Table 2: Maximum cable length depending on baud rate

Baud rate (kbaud)	9,6	19,2	45,45	93,75	187,5	500	1’500	3’000	6’000	12’000
Cable length (m)	1’200	1’200	1’200	1’200	1’000	400	200	200	100	100

Slave node address
The slave *FlexiDrive* MSIA has the default address 3. This address can be changed via software (see parameter P918) or via DIP-switches on the drive backside (see chapter 4.1.2).

2.2 Parameter process data objects (PPO)

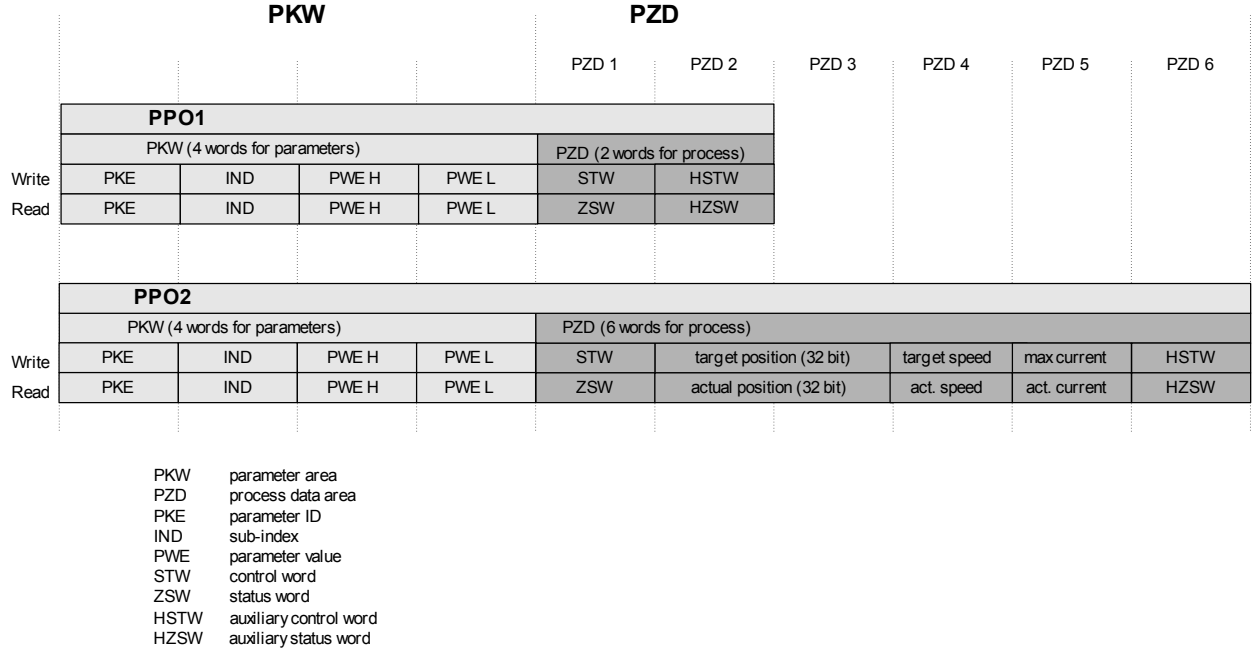
The data structure for cyclic data transfer is designated as Parameter Process Data Object (PPO) in the profile for variable speed drives. This profile is a guideline published by the PROFIBUS user organization PNO. The data structure for cyclic data transfer combines two areas, which are transferred in each telegram:

- Parameter area (PKW):
  This telegram part is used to read and/or write parameters and to read out errors.
- Process data area (PZD):
  This area contains the control words and setpoints (tasks: master to drive),
  status information and actual values (responses: drive to master).

In the PROFIBUS profile, 5 defined PPO types (PPO1 to PPO5) exist. *FlexiDrive* MSIA supports PPO type 1 (PPO1) and PPO type 2 (PPO2).
PPO1 is structured as follows:

- 4 words for the parameter area (PKW area)
- 2 words for the process data area (PZD area)

Using PPO1, a new target position can be set only after finishing or stop of a positioning task. Using PPO2, the setting of e.g. a new target position or a new maximum motor current is possible while the drive carries out a positioning task. The structure of the mentioned PPO types is shown in Figure **1**.



PKW	parameter area
PZD	process data area
PKE	parameter ID
IND	sub-index
PWE	parameter value
STW	control word
ZSW	status word
HSTW	auxiliary control word
HZSW	auxiliary status word

Figure 1: Structure of parameter process data objects PPO1 and PPO2 supported by *FlexiDrive* MSIA

2.3 Parameter area (PKW)

The PKW area comprises of the parameter ID (PKE), the sub–index (IND) and the parameter value (PWE).

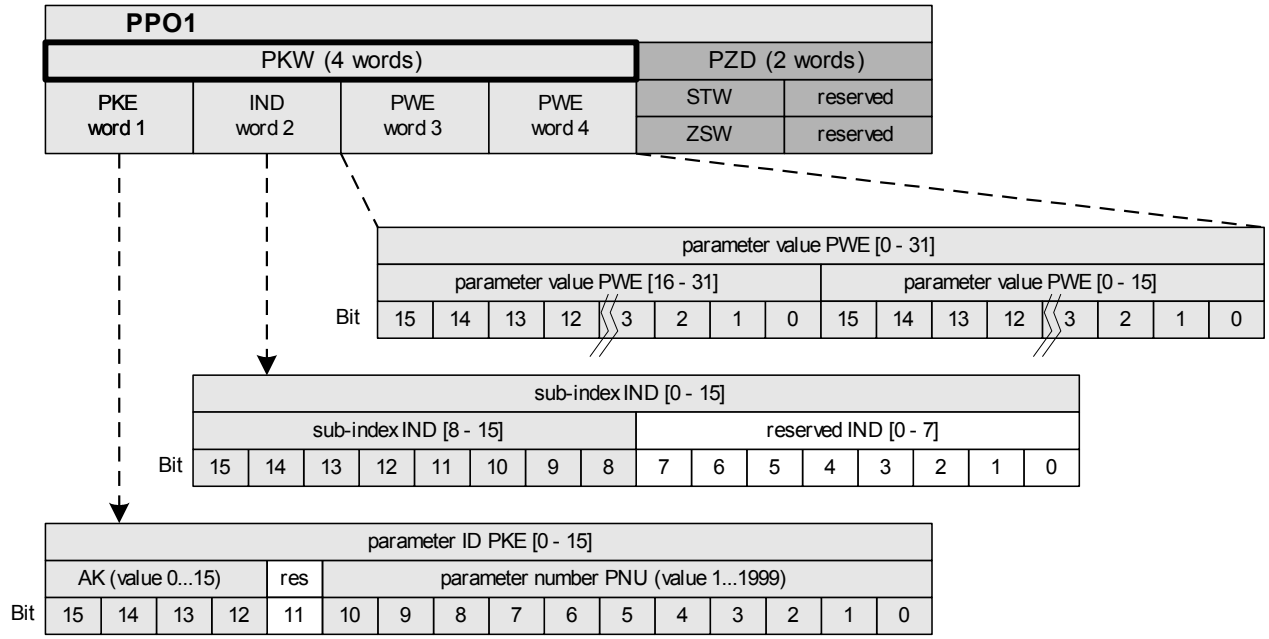


Figure 2: Structure of parameter area (PKW)

The parameter-ID PKE consists of the task or response-ID AK which has a value range from 0 … 15 (see Table 3 and Table 4). Furthermore, the parameter-ID PKE consists of the parameter number PNU, which has a value range from 1...1999. Bit 11 of the PKE is a reserved toggle bit for spontaneous messages. The task IDs for master-to-slave telegrams can be found in Table 3. The response ID's for slave-to-master telegrams are compiled in Table 4.

Table 3: Task telegram IDs (master-to-slave)

Task ID	Function	Response ID (positive)
0	No task	0
1	Request parameter value	1,2
2	Change parameter value(I/U16 or I/U8)	1
3	Change parameter value (I/U32)	2
4, 5	Not supported	-
6	Request parameter value (array)	4,5
7	Change parameter value (ARR I/U16 or I/U8)	4
8	Change parameter value (ARR I/U32)	5
9	Request number of array elements	not supported

Table 4: Response telegram IDs (slave-to-master)

Response ID	Function
0	No response
1	Transfer parameter value (I/U16 or I/U8)
2	Transfer parameter value (I/U32)
3	Not supported
4	Transfer parameter value (ARR I/U16 or I/U8)
5	Transfer parameter value (ARR I/U32)
6	Transfer number of array elements
7	Task cannot be executed (with error ID, see Table 5)
8, 9 and 10	Not supported

The master transfers a task to the slave and repeats this task until the corresponding response is received from the slave. The slave provides this response until the master has formulated a new task. For responses, which contain parameter values, the slave always responds with an updated value to these cyclic repeats. This involves all of the responses to the tasks ”request parameter value” and ”request parameter array”.

If a task cannot be executed, the slave responds as follows:

- the slave response with ID= 7
- the corresponding error number will be found in the parameter area (word 4) of PPO1, refer to Table 5 for the error ID’s

Table 5: Error ID

Error ID	Cause
0	Illegal parameter (the parameter does not exist)
1	Parameter value cannot be changed (read only or protected)
2	Lower or upper value exceeded
3	Incorrect sub-index
4	No array (parameter has no sub-index)
5	Incorrect data type
6	No set allowed
7	Descriptive element cannot be changed
8	Required PPO write is missing
9	Descriptive elements not available
10	Incorrect access group
11	No permission
12	Incorrect password
13	Text in cyclic data transfer not readable
14	Name in cyclic data transfer not readable
15	No text array available
16	PPO write is missing
17	Task cannot be executed due to operating status
18	Other error
19	Date in cyclic data transfer not readable
20	Parameter value out of range

The data type, which is assigned to the parameter, must be written into the parameter values via the PKW mechanism. The following are valid for the format designations (according to the recommended PROFIBUS guideline):

Table 6: Data types and parameter formats

Format	Length (byte)	Description
ARR		Array as described
U8	1	8-bit unsigned integer number
U16	2	16-bit unsigned integer number
U32	4	32-bit unsigned integer number
I16	2	16-bit signed integer number
I32	4	32-bit signed integer number
N16	2	Linear normalized value ±200 %: 100 % corresponds to 0x4000 (16'384)
C32	4	Fixed-point value, 32 bit with four decimal places Example: P3 = 22'200 corresponds to 22'200/10'000 = 2,22)
V16	2	Bit sequence: 16 Boolean quantities combined in 2 octets

2.4 Process data area (PZD)

For PPO type 1, the process data area PZD comprises of 2 words (PZD1 and PZD 2). Depending on the direction of communication, these 2 words either form a control word or a status word:

- Control word (STW) is used for master-to-slave communication
- Status word (ZSW) is used for slave-to-master communication.

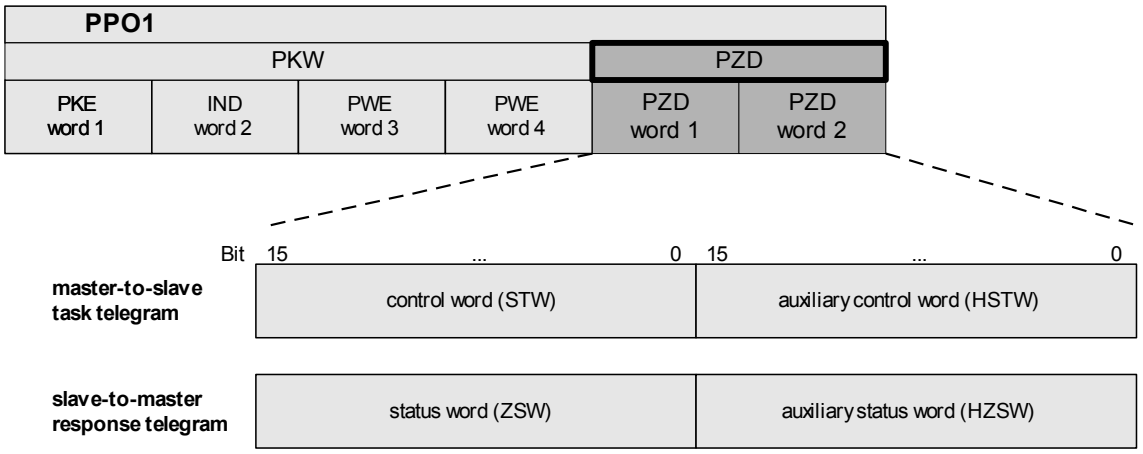


Figure 3: Structure of the process data

2.4.1 Description of control word (data to drive)

The master sends commands to the slave via the control word (STW).

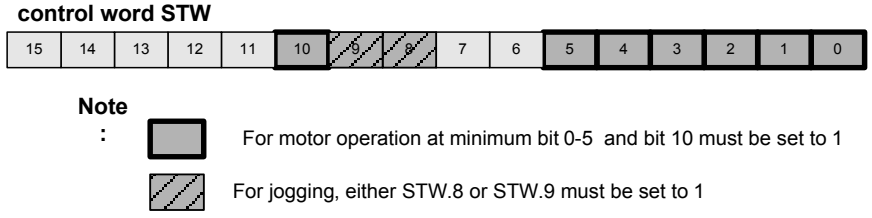


Figure 4: Structure of control word (see Table 7 for details)

Table 7: Description of the individual signals in the control word (STW). Operating condition bits for drive movement are marked in column Value

Bit	Signal name	Value	Signal status and description
0	OFF 1	1	Operating condition for program. Prerequisite for READY state
		1-0-1	Toggle bit to switch from POWER-ON INHIBIT state to READY state
1	Operating condition/OFF 2	1	Operating condition for program Prerequisite for state change from NOT READY to READY
		0	OFF 2 Power disconnected from the motor, 4Q regulator is not active, motor coasts down, POWER-ON INHIBIT state
2	Operating condition/OFF 3	1	Operation condition for program Prerequisite for state change from NOT READY to READY
		0	OFF 3 4Q regulator is active, deceleration along the current limit, POWER-ON INHIBIT state
3	Enable operation	1	Enable operation ON Prerequisite for state change from NOT READY to READY
		0	Enable operation OFF Power disconnected from the motor, motor coasts down
4	Operating condition/stop	1	Operating condition for program (positioning) The signal must be continuously present in order to execute a positioning task. Prerequisite for state change from NOT READY to READY
		0	Stop ON Deceleration along the current limit. The motor remains stationary with the holding torque. The current positioning task is rejected.
5	Operating condition/intermediate stop	1	Operating condition for program (positioning) The signal must be continuously present in order to execute a positioning task. Prerequisite for state change from NOT READY to READY
		0	Intermediate stop ON The drive brakes from an active positioning task along the current limit to standstill and then remains stationary with the holding torque. The positioning task is not rejected. For a change to bit 5 = 1, the positioning task is continued.
6	Activate positioning task (edge)	1-0	Each edge enables a positioning task or a new target position (toggle bit). An edge change may only be realized if bit 12 of the status word is used to acknowledge that the previous positioning task was accepted. A program start is valid as a positioning task.
		0-1	
7	Reset error	0-1	Acknowledge error and reset error memory (edge, see P947 and P952)
		0	-
8	Jogging+	1	Jogging+ ON If operation is enabled and positioning is not active, the drive moves in closed–loop speed control within software limit switches (as long as control word STW.8 HIGH). Acceleration in P20-6 Amax, Deceleration in P20-7 Amin.
		0	Jogging+ OFF, normal operation
9	Jogging-	1	Jogging- ON If operation is enabled and positioning is not active, the drive moves in closed–loop speed control within software limit switches (as long as control word STW.9 HIGH). Acceleration in P20-6 Amax, Deceleration in P20-7 Amin.
		0	Jogging- OFF, normal operation
10	Control request	1	Prerequisite for state change from NOT READY to READY No further function supported
		0	Not supported

Bit	Signal name	Value	Signal status and description
11	Referencing	1	Referencing ON, switch drive from READY state to REFERENCING state. 4Q regulator is not active. Absolute position parameter P40 can be overwritten.
		0	Referencing OFF, normal operation
12-14	Not in use	-	
15	Open holding brake	1	Open holding brake (only, if holding brake is activated in P60-1 = 0)
		0	Close holding brake (only, if holding brake is activated in P60-1 = 0)

Table 8: Description of the individual signals in the auxiliary control word (HSTW)

Bit	Signal name	Signal status and description
0	Control bit 0	Indirect switching of output 1 (only valid, if P32-1, bit 15 = 1)
1	Control bit 1	Indirect switching of output 2 (only valid, if P32-2, bit 15 = 1)
2	Control bit 2	Indirect switching of output 3 (only valid, if P32-3, bit 15 = 1)
3	Control bit 3	Indirect switching of output 4 (only valid, if P32-4, bit 15 = 1)
4-7	Not in use	
8-13	Traversing block line	The master selects the traversing block to be started by entering the required block number into this control byte, binary coded decimal value where LSB = Bit 8
14-15	Not in use	

Table 9: Description of the program control word (PSW), P20-4

Bit	Signal name	Signal status and description
0-1	Mode control	0 = speed control 1 = position control absolute 2 = position control relative
4	Timer control	0 = If target is reached, timer starts 1 = If activate traversing task, timer starts
5	Sequence control	0 = go to next block number 1 = end of control, hold the last target value

2.4.2 Description of status word (data from drive)

The slave signals its current status to the master using the status word (ZSW) which has a 15-bit structure equivalent to the control word.

Table 10: Description of the individual signals in the status word (ZSW)

ZSW.Bit	Signal name	Value	Signal status and description
0	Ready to power up / not ready to power up	1	ZSW.0 is set always in combination with ZSW.1 and ZSW.2
		0	Drive is in NOT READY state (or OFF 2 or OFF 3)
1	Ready	1	ZSW.1 is set always in combination with ZSW.0 and ZSW.2
		0	Drive is in NOT READY state (or OFF 2 or OFF 3)
2	Operation enabled	1	Drive operation is enabled
		0	Drive is in NOT READY state (or OFF 2 or OFF 3)
3	Error present	1	Error present, drive is not operational. The drive enters power–on inhibit state after the error was removed and acknowledged. For further information about errors or warnings, refer to P947 and P953.
		0	No error present
4	No OFF 2	1	No OFF 2 present
		0	Drive is in OFF 2 active state
5	No OFF 3	1	No OFF 3 present
		0	Drive is in OFF 3 active state
6	Power-on inhibit	1	Drive is in POWER-ON INHIBIT state. The drive can be brought into READY state by Signal OFF 1 (set control word STW.0 from 1 to 0 and then back to 1)
		0	No POWER-ON INHIBIT present
7	Warning present	1	Warning present. Drive remains operational. Acknowledgement is not required. For further information about errors or warnings, refer to P947 and P953.
		0	No warning present
8	No following error	1	Bit is permanently set to 1
		0	Not supported
9	Control request	1	Bit is permanently set to 1
		0	Not supported
10	Target reached	1	Target position is reached within position target range (P11) at end of positioning task or target speed is reached within speed target range (P12) during Jogging+/- or during speed control e.g. by using traversing block
		0	Target position or speed is not reached
11	Referencing	1	Drive is in REFERENCING state. Absolute position parameter P40 can be overwritten.
		0	Drive is in not REFERENCING state. Normal operation
12	Acknowledge positioning task (edge)	0/1	The drive acknowledges by an edge that a new positioning task or target position was accepted. Signal level such as control word STW.6 (toggle bit).
		1/0	
13	Drive active	1	Drive is in TASK ACTIVE or JOGGING state. Drive axis might be moving. 4-quandrant controller of drive is active
		0	Drive is not in TASK ACTIVE or JOGGING state (no driving job active). 4-quandrant controller of drive can be active or not
14	Motor under voltage	1	Voltage supply motor +VsM < 11.5 V (from Firmware version 2.04.04)
		0	Voltage supply motor +VsM ≥ 11.5 V
15	Internal holding brake open	1	Internal holding brake is open
		0	Internal holding brake is closed

Table 11: Description of the individual signals in the auxiliary status word (HZSW)

Bit	Signal name	Signal status and description
0	Checkback signal 0	Factory default is hardware input 1
1	Checkback signal 1	Factory default is hardware input 2
2	Checkback signal 2	Factory default is hardware input 3
3	Checkback signal 3	Factory default is hardware input 4
4-7	Checkback signal 4-7	Number of state according to state machine (see Table 12), binary coded decimal value where LSB = Bit 4
8-13	Actual traversing block line	Actual traversing block line of traversing block array, binary coded decimal value where LSB = Bit 8
14-15	Not in use	

Table 12: Description of the drive state within the drive state machine

Value Bit 4-7	Drive state [HZSW]
1	NOT READY
2	READY
3	TASK ACTIVE
4	INTERMEDIATE STOP
5	JOGGING
6	REFERENCING
7	OFF 1 ACTIVE
8	OFF 2 ACTIVE
9	OFF 3 ACTIVE
10	ERROR
11	POWER-ON INHIBIT

See Figure **5**: State machine of *FlexiDrive* MSIA

2.5 State machine

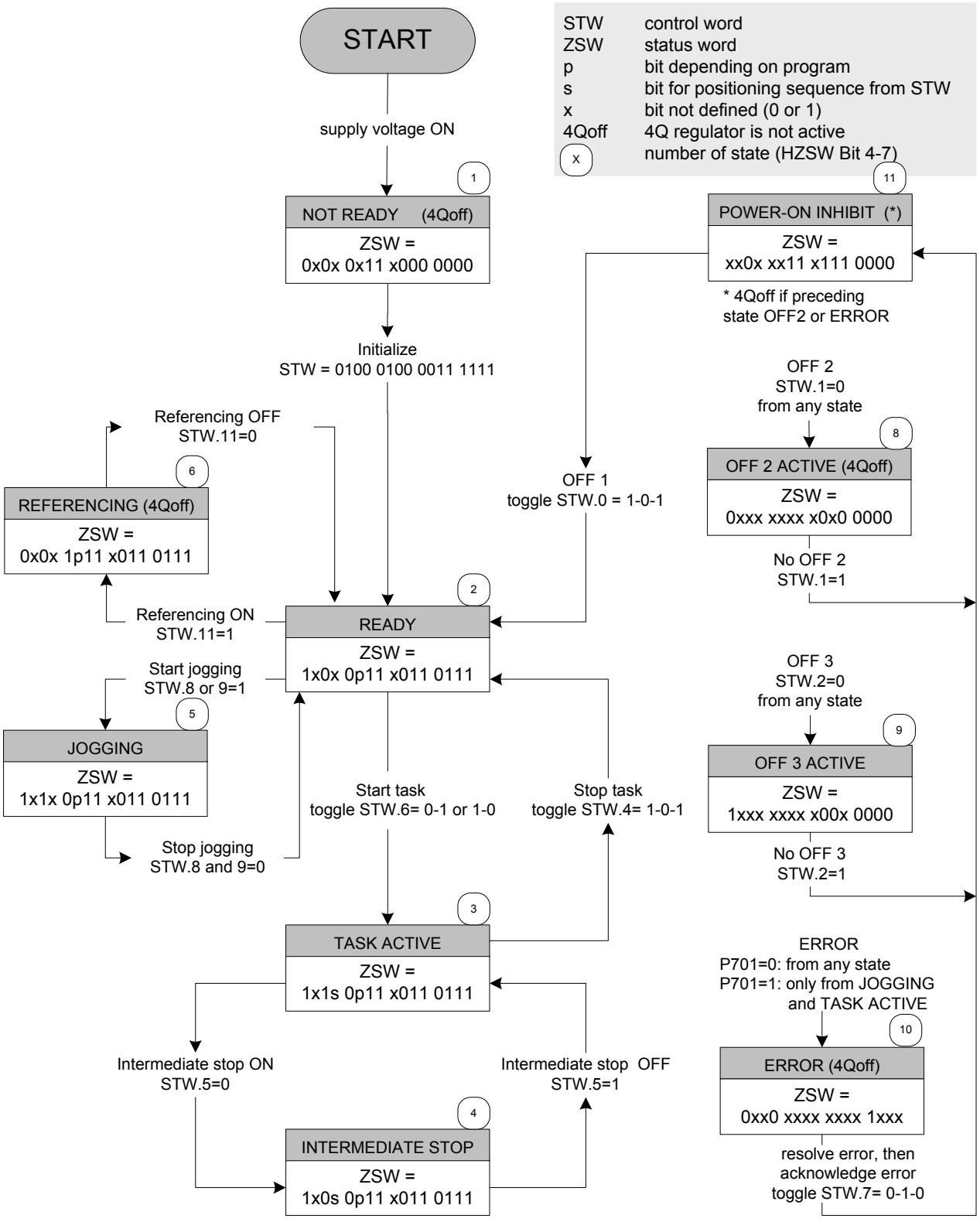


Figure 5: State machine of *FlexiDrive* MSIA

3 Parameter description

All parameters for motor operation are described in Table 13. This includes the parameters from P900 to P999. These parameters are defined according to the PNO guideline profile for variable speed drives. If the PROFIBUS master sends an invalid command to the drive, an error message is activated according to the profile. Changes of parameters with write access can be stored non-volatile in an EEPROM. After drive power-up, all parameters are loaded from this EEPROM.

3.1 Save and load parameters (non-volatile memory)

Non-volatile save of all actual parameters into EEPROM: Toggle P971 from 0 to 1. Then, drive acknowledges the successful execution by toggling P971 from 1 to 0.
Load default parameters (this resets all parameters to the condition as supplied to customer, see default column in Table 13): Toggle P970 from 1 to 0. Then, drive acknowledges the successful execution with toggling P970 from 0 to 1.

3.2 Parameter list

Explanation of the parameter representation

Example:

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
1	Axis type	1	1	12	rw	U16	Axis type depending on application 1: linear movement 12: rotational movement

Para. nr.	Parameter number. Each parameter has a unique parameter number.
Name	Parameter name. The parameter name uniquely identifies a parameter.
Value	Parameter value. Extremes and default value. factory: Factory settings when the product is shipped
Access	Indicates read and/or write values. rw: read / write ro: read only rp: read, write password protected wo: write only
Format	Data type of the parameter according to Table 6: Data types und parameter formats
Description	Description of the parameters and its settings

Table 13: List of DP slave parameters. Parameter number and sub-index are given in decimal values (e.g. P32 1)

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
1	Axis type	1	1	12	rw	U16	Axis type depending on application 1: linear movement 12: rotational movement
2	Distance per gearbox revolution	1	10'000	2^{31}-1	rw	C32	Conversion factor in unit 1/10'000 to calculate movement on user side from revolution of motor or gearbox output shaft. For linear movement with spindle, this factor is mm / revolution. For rotary movement, this factor is degree / revolution.
3	Gearbox step-down ratio	1	factory	2^{31}-1	rw	C32	Step-down ratio of gearbox in unit 1/10'000. Factory setting is actual gearbox specification. Gear ratio of e.g. i=45,56 corresponds to P3 = 455'600.
4	Dimension unit	-9	-6	255	rw	I16	User defined position unit P1=1 (linear movement): -1 = increment (0) (from Firmware version 2.04.04); 3 = kilometer (km); 0 = meter (m); -3 = millimeter (mm); -6 = micrometer (µm); -9 = nanometer (nm) P1=12 (rotational movement): -1 = increment (0); 0 = radian (rad); 79 = second (“); 78 = minute (’); 80 = degree (°); 81 = centesimal degr. (gon) Remark: From Firmware version 2.03.01, the parameter format is I16, however the old parameter format I8 is still accepted and will be handled correctly. Example: I8: -1 = 0xFF I16: -1 = 0xFFFF
5	Time unit	0	0	72	rw	I16	User defined time unit. 0 = second (s) 67 = minute (min) 72 = hour (h) NOTE: Speed unit is defined as P4 / P5, e.g. µm / s. Acceleration unit is defined as P4 / P5², e.g. µm / s².

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
6	Minimum software position limit	$-2^{31}+1$	0	$2^{31}-1$	rw	I32	Minimum value of software limit switch for position in dimension unit P4. active: P6 < P7 non-active: P6 = P7 NOTE: Position of software limit switch can not be passed, not by Jogging and not by positioning task. In speed mode the software limit switches can be passed; a warning message appears (see Table 19).
7	Maximum software position limit	$-2^{31}+1$	0	$2^{31}-1$	rw	I32	Maximum value of software limit switch for position in dimension unit P4. active: P6 < P7 non-active: P6 = P7 NOTE: Position of software limit switch can not be passed, not by Jogging and not by positioning task. In speed mode the software limit switches can be passed; a warning message appears (see Table 19).
8	Nominal target speed	0	factory	$2^{31}-1$	rw	U32	Nominal system target speed in speed unit P4 / P5. For relative target speed, see P41. P41 multiplied with P8 gives the speed which is achieved during active tasks in operating mode P700 = 1 or 3. This speed cannot exceed Maximum absolute target speed P10. See chapter 4.5 for examples.
10	Maximum target speed	0	$2^{31}-1$	$2^{31}-1$ *	rw	U32	Maximum absolute system target speed in speed unit P4 / P5. Can be used to limit speed in application. P10 cannot be exceeded by the product of P8 and P41. * The maximum value can be smaller, depending on other parameters. If higher values are written, this parameter will be automatically set back to maximum.
11	Position target range	1	factory	32'767	rw	I16	Position target range in encoder steps. If actual position is within target position ± P11 then ZSW.10=1.
12	Speed target range	1	factory	32'767	rw	I16	Speed target range in encoder steps / millisecond. If actual speed is within target speed ± P12 then ZSW.10=1.
17	Speed controller parameters					ARR	
17-1	P factor	1	factory	2'000	rw	U32	Gain of speed controller. Recommended parameter range is 1…100. If value is 0, no drive movement.
17-2	I factor	1	factory	2'000	rw	U32	Integration time of speed controller. Recommended parameter range is 1…100. If value is 0, no drive movement.
18	Position controller parameters					ARR	

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
18-1	P factor	1	factory	2'000	rw	U32	Gain of position controller. Recommended parameter range is 1…100. If value is 0, no drive movement.
18-2	I factor	0	0	2'000	rw	U32	Integration time of position controller. Recommended parameter value is 0. Drive oscillations can occur, if parameter value is increased.
20	Traversing block array					ARR	Two-dimensional traversing block array (TBA) with 20 traversing block lines and 8 sub-parameters per line. For detailed overview, see Table 14. For use of traversing blocks, drive must be in state TASK ACTIVE (see Figure 5). Control is done via control word STW and auxiliary control word HSTW (see Table 7and Table 8). Only active when operating mode P700 = 1 or P700 = 3 and only for line number 5…20 in P20-1
20-1	Traversing block line	1	-	20	rw	I32	Number of actual traversing block line Block line number 1 = Jogging- Block line number 2 = Jogging+ Block line number 3 = Backlash compensation Block line number 4 = Target position Block line number 5...20 = Traversing block lines NOTE: Do not change pre-defined traversing block lines 1 – 4.
20-2	Target position TBA	$-2^{31}+1$ *	-	$2^{31}-1$ *	rw	I32	Target position in traversing block array in dimension unit P4. Values which do not lie between min and max are not possible and result in an Error ID 20 in the response telegram (see Table 5). * The max value can be smaller, depending on P6 and P7.
20-3	Time	$-2^{31}+1$	-	$2^{31}-1$	rw	I32	Waiting time in timer for control of positioning task. Time unit is 0.5 ms. Timer properties are defined by P20-4 Bit [4] Loop programming: Loop start Time = –1. Loop termination Time = n = number of loop cycles. Time = –1…–32'767. Endless loop with Time = –32'768 Any positioning task between loop start and end.

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
20-4	PSW	0	-	63	rw	I32	Program control word for traversing block control (see Table 9) Bit [0:1] Controller property: 0 = speed controller 1 = position controller absolute 2 = position control relative Bit [4] Timer property (time defined in P20-3): 0 = time waiting after positioning task, until next task (next traversing block line) 1 = total available time for positioning task (speed and acceleration are adapted automatically) Bit [5] Behavior after traversing block line: 0 = go to next traversing block line 1 = end of control, hold last target position
20-5	Vmax	$-2^{31}+1$	factory	$2^{31}-1$	rw	I32	System target speed in speed unit P4 / P5. Values higher than P10 are not possible and result in an Error ID 20 in the response telegram (see Table 5).
20-6	Amax	0	factory	$2^{31}-1$	rw	U32	Maximum system acceleration in acceleration unit P4 / P5². Values which do not lie between min and max are not possible and result in an Error ID 20 in the response telegram (see Table 5).
20-7	Amin	0	factory	$2^{31}-1$	rw	U32	Maximum system deceleration in acceleration unit P4 / P5². Values which do not lie between min and max are not possible and result in an Error ID 20 in the response telegram (see Table 5).
20-8	Imax	0	factory	P28	rw	U32	User motor current limit in mA (peak value). NOTE: Imax can be edited by user according to application in order to limit torque. Maximum value for Imax is Maximum current P28. Higher values result in Error ID 20 in the response telegram (see Table 5).
28	Maximum current	0	factory	20'000	ro	U16	Maximum motor current in mA (peak value) for drive protection depending on specific drive configuration (motor, electronics, gear, etc.). NOTE: Maximum current cannot be changed by user.
29	Actual current	-20'000	-	20'000	ro	I16	Actual motor current in mA (effective value) for monitoring of drive or application status. Actual current is an unfiltered internally measured value and can exhibit noise. Actual current corresponds to the actual drive torque. NOTE: Actual current is given as effective value. Imax is given as peak value. Therefore, Actual current never can reach more than 1 / √2 * Imax = 70.7% of Imax.
31	External inputs 1-4					ARR	
31-1	Input 1	0	0	150	rw	U16	Hardware input for control word STW control. HIGH active, inverting by addition of 128.

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			NOTE: If value >0, hardware input directly controls STW. In this case, PROFIBUS master looses control. Parameter value / description: 0 Set STW by PROFIBUS master 1 Set STW.0: OFF 1 2 Set STW.1: Operating condition/OFF 2 3 Set STW.2: Operating condition/OFF 3 4 Set STW.3: Enable operation 5 Set STW.4: Operating condition/stop 6 Set STW.5: Operating condition/interm. stop 7 Set STW.6: Activate positioning task 8 Set STW.7: Reset error 9 Set STW.8: Jogging+ 10 Set STW.9: Jogging- 11 Set STW.10: Control request 12 Set STW.11: Referencing 13…15 Set STW.12…14: not in use 16 Set STW.15: Open holding brake 17 External sensor for reference position (see chapter 4.2). 18 Minimum software position limit. Set actual position to minimum software limit switch 19 Maximum software position limit. Set actual position to maximum software limit switch 20 Override minimum hardware limit switch. If positioning task is active, then motor is stopped and warning is activated. If JOGGING state, only warning is activated. 21 Override maximum hardware limit switch. If positioning task is active, then motor is stopped and warning is activated. If JOGGING state, only warning is activated. 22 Set ZSW.14 23 bit-oriented release of inputs to control traversing block lines. With digital input 1..4 a 4-Bit-adressing is possible. Addressing of traversing block line 5 with 0001 (input 1 active, inputs 2..4 inactive). Stopping the actuator with 0000 (inputs 1..4 inactive). Addressing will only become active after change. Definition of time delay on inputs with parameters 31-5 (Input Filter Time). If an Input for a different parameter value than 23 is used, the remaining 3 inputs build the bit-addressing. Example:

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
							Input 1 used for referencing (P31-1=12). Input 2 assigns Bit 1, Input 3 assigns Bit 2, Input 4 assigns Bit 3).
31-2	Input 2	0	0	150	rw	U16	See Input 1 description
31-3	Input 3	0	0	150	rw	U16	See Input 1 description
31-4	Input 4	0	0	150	rw	U16	See Input 1 description
31-5	Input filter time	0	0	255	rw	U16	Filter time for input 1-4 in ms
32	External outputs 1...4					ARR	For drives equipped with external output (see chapter 6.2 Connector assignment and data sheet)
32-1	Output 1	0	0	2^{32}-1	rw	U32	Hardware output of status word ZSW (bit oriented, individual bits are combined with OR-relation). Output HIGH active: Bit 0: Ready to power up Bit 1: Ready Bit 2: Operation enabled Bit 3: No OFF 2 Bit 4: No OFF 3 Bit 5: Power-on inhibit Bit 6: Warning present Bit 7: No following error Bit 8: Control request Bit 9: Target reached Bit 10: Referencing Bit 11: Acknowledge positioning task Bit 12: Drive active Bit 13: Open holding brake Bit 14: Actual position larger than CAM position Bit 15: Output 1 is controlled through HSTW.0 Output LOW active: Bit 16: corresponds to bit 0, but LOW active Bit 17: corresponds to bit 1 but LOW active Bit 18-30: correspond to bit 2-14 but LOW active Bit 31: Mirror of respective input (e.g. output 1 mirrors input 1)
32-2	Output 2	0	0	2^{32}-1	rw	U32	See Output 1 description
32-3	Output 3	0	0	2^{32}-1	rw	U32	See Output 1 description
32-4	Output 4	0	0	2^{32}-1	rw	U32	See Output 1 description
33	CAM					ARR	Simple CAM function. Allows to set a digital external output at a certain shaft position. Activation in Bit 14 of P32
33-1	CAM position 1	-2^{31}-1	0	2^{31}-1	rw	I32	Position for CAM in user defined position unit P4. If actual position (P40) larger than CAM position 1, then Output 1 is active.
33-2	CAM position 2	-2^{31}-1	0	2^{31}-1	rw	I32	See CAM position 1 description (Output 2)
33-3	CAM position 3	-2^{31}-1	0	2^{31}-1	rw	I32	See CAM position 1 description (Output 3)
33-4	CAM position 4	-2^{31}-1	0	2^{31}-1	rw	I32	See CAM position 1 description (Output 4)
34	Referencing					ARR	See also 4.23 Referencing to a reference switch

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
34-1	Free referencing distance	$-2^{31}-1$	-	$2^{31}-1$	rw	I32	Driven way while referencing, in user defined position unit.
34-2	Actual referencing position	$-2^{31}-1$	-	$2^{31}-1$	rw	I32	Absolute reference position in user defined position unit P4.
34-3	Referencing speed fast	-32768	4096	32767	rw	I32	Relative target speed to search the reference switch in percent of the nominal target speed P8. 100% is equivalent to 0x4000 (16'384).
34-4	Referencing speed slow	-32768	256	32767	rw	I32	Relative target speed to reference the reference switch in percent of the nominal target speed P8. 100% is equivalent to 0x4000 (16'384).
39	Target position	$-2^{31}+1$	-	$2^{31}-1$	rw	I32	Target position for positioning task in dimension unit P4. If backlash compensation is active, all intermediate positions are defined by drive automatically. If actual position is outside software limits, an error message with error ID 2 is activated (see Table 4 and Table 5).
40	Actual position	$-2^{31}+1$	-	$2^{31}-1$	rw	I32	Actual absolute position in dimension unit P4. NOTE: For referencing, overwrite P40 with desired position. This is possible in REFERENCING state only. P40 must be saved to EEPROM by P971 in order to be stored non-volatile.
41	Relative target speed	-32'768	16'384	32'767	rw	N16	Relative target speed with respect to nominal target speed P8. 100 % corresponds to 0x4000 (16'384) See examples in chapter 4.5.
42	Relative actual speed	-32'768	-	32'767	ro	N16	Relative actual system speed. 100 % corresponds to 0x4000 (16'384)
44	Absolute actual speed	$-2^{31}+1$	-	$2^{31}-1$	ro	I32	Absolute actual system speed in speed unit P4 / P5.
45	Jogging speed	-32'768	factory	32'767	rw	N16	Relative jogging speed with respect to nominal target speed P8. 100 % corresponds to 0x4000 (16'384) NOTE: P45 will be overwritten if $V_{Jogging+}$ is changed in traversing block line 2.
47	Electronics temperature					ARR	
47-1	Actual temperature	0	-	128	ro	U16	Actual temperature in °C measured at electronics
47-2	Maximum temperature	0	-	128	ro	U16	Maximum temperature in °C which occurred over drive lifetime
47-3	Warning temperature	0	97	128	rw	U16	Temperature in °C at which a warning becomes active
47-4	Error temperature	0	128	128	rp	U16	Temperature in °C at which an error becomes active
47-5	Temperature time tolerance	0	0	65'535	rw	U16	Time in seconds, after which a temperature warning is transferred into a temperature error 0 = temperature time tolerance non-active

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
60	Holding brake					ARR	
60-1	Brake activation	0	500	65'535	rw	U16	0 = brake is controlled by control word STW Bit 15 (Bit 15=1: brake opens; Bit 15=0: brake closes). Brake also closes if the 4Q regulator turns out (see all states with 4Q regulator off in Figure 5 state machine, e.g. in case of under voltage of motor < 11.5 V or high temperature) > 0 = Time in milliseconds from brake opening to switching the drive into READY state Brake also closes if the 4Q regulator turns out (see all states with 4Q regulator off in Figure 5 state machine e.g. in case of under voltage of motor < 11.5 V or high temperature)
200	Backlash compensation	0	0	2	rw	U8	In order to rule out backlash effects from spindle play, the direction of target position approach can be defined. This functionality is only available in Operating mode P700 = 3. In case of indirect approach, target position is always approached from the predefined direction. If necessary, target position is exceeded by backlash delta (see P201) followed by a subsequent direct approach. 0 = direct approach (backlash compensation inactive) 1 = approach from positive direction 2 = approach from negative direction
201	Backlash delta	$-2^{31}+1$	0	$2^{31}-1$	rw	I32	Parameter in dimension unit P4, which defines how far a target position is exceeded during a positioning task (only if backlash compensation in P200 is active)
202	Jogging delta	-	-	-	ro	I32	Not used
204	Polarity	-1	1	1	rw	I16	Direction of rotation if position values increase (view to gear/motor shaft) 1 = counter-clockwise -1 = clockwise NOTE: Software limit switches (P6, P7) must be mirrored, if polarity is changed (exchange the position value of the upper and lower software limit switch and change the prefix of both). Changing the polarity changes the sign of the actual position value.
205	Encoder resolution	1	16'384	16'384	ro	U16	Single-turn resolution of absolute position encoder in steps per revolution (14 bits). The multi-turn resolution is 18 bits (262'144 revolutions).
207	Drive operating time	0	-	$2^{32}-1$	ro	U32	Total drive power-ON time in seconds. Value is saved to EEPROM every 10 minutes.

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
208	Motor operating time	0	-	2^{32}-1	ro	U32	Total motor moving time in seconds. A warning is given, if 20'000 h are reached. Value is saved to EEPROM every 10 minutes.
209	Number of positioning tasks	0	-	2^{32}-1	ro	U32	Total number of performed positioning tasks Value is saved to EEPROM every 10 minutes.
211	Offset	-2^{31}+1	0	2^{31}-1	rw	I32	Offset is a parameter in dimension unit P4, which can be used to shift drive coordinate system. NOTE: All position values such as actual position, target position and position of software limits are shifted by Offset.
213	Positioning timeout	0	0	65'535	rw	U16	0 = no timeout >0 = timeout in seconds If a positioning task requires more time than positioning timeout, it is aborted and an error is indicated.
214	Abort bus communication	0	0	3	rw	I16	Error handling in case of PROFIBUS communication loss 0 = no action (warning is activated) 1 = soft stop (error is activated) – Motor control stopped immediately (see statemachine state Off 2) 2 = quick stop (error is activated) - Motor decelerated with max. braking current (see statemachine state Off 3) 3 = simulation of control word (warning is activated, see parameter P215)
215	Simulation of control word	0x0000	0x443F	0xFFFF	rw	I16	Control word (STW, bit oriented) which is used if PROFIBUS communication lost (for stand-alone operation of drive). Default is the control word to initialize, i.e. switch from NOT READY state to READY state. NOTE: Function only available, if error handling is defined correctly (parameter P214 = 3).

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
700	Operating mode	-50	2	131	rw	I16	1 = Closed-loop speed control (Target speed P41) 2 = External target values, excl. ramps (PZD, PPO2) 3 = Closed-loop position control (Target position P39) 4 = External target values (PZD, PPO2) ACHTUNG: In Operating mode P700 = 1, 3 and 4 acceleration and deceleration is performed according the settings in Traversing Block (P20) Line 4. In operating mode external target values (P700=2), all target values are given directly via process data (PZD area, Figure 1) and immediately transformed by the drive. System position and speed are given in user defined units P4 and P4 / P5. Current is given in milliamps. Parameters P39, P41 and P20 are not valid in this operating mode. Start of a positioning task is necessary only one time at the task beginning according to drive state machine (Figure 5). Operating mode external target values requires PPO2 telegram (P922=2). Additional modes for moving tasks (speed defined in P41, acceleration, deceleration and current defined in P20-6...8 line 4): -20 = Moving to lower software limit switch -21 = Moving to upper software limit switch -22 = Moving to zero position Referencing methods, see chapter 4.2 (speed defined in P34-3 and -4, acceleration, deceleration and current defined in P20-6...8 line 4): -30 = Referencing to lower reference switch -31 = Referencing to upper reference switch
701	Customer mode	0x0000	0x0000	0xffffffff	rw	U32	Bit [0]: Handling in case of motor under voltage Bit [0] = 0: Standard handling: If +VsM < 11.5 V the drive goes to state error (see Figure 5), Bit 3 of Status word ZSW = 1) Bit [0] = 1: Special handling: If +VsM < 11.5 V the drive goes only to state error after a start command has been given (control word STW Bit 6, 8 or 9).

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
918	Node address	3	3	126	rw	U8	Node address of slave on PROFIBUS-DP network, which can be set via P918, via DIP-switch or via STEP 7. For details, see following chapters. NOTE: DIP-switch setting is dominant. P918 applies only for DIP-switch set to zero. In order to adjust address via P918, set DIP-switch to zero and set P918 to desired value. Then, save to EEPROM (P971) and reset drive (power supply OFF / ON).
922	Telegram	1	2	2	rw	U8	Available cyclic data telegram when transferring data using PROFIBUS-DP and the profile for variable speed drives are the parameter process data objects (PPO): 1 = PPO1 2 = PPO2
947	Error buffer					ARR	Register with actual error. Last occurred error is stored in highest error entry. For number of error entries, see P952. For troubleshooting procedure, see chapter 5.2.
947-1	Error entry 1	0x----	0x----	0x----	ro	U16	Error (bit oriented) word containing actual error (see Table 19)
...	...		...		...	...	...
947-8	Error entry 8	0x----	0x----	0x----	ro	U16	Error (bit oriented) word containing actual error (see Table 19)
952	Number of errors	0	0	8	rw	U8	Total number of actual error messages. Parameter can be erased by overwriting with zero
953	Warnings	0x----	0x----	0x----	ro	U16	Warning (bit oriented) word containing actual warning messages (see Table 20)
964	Drive ID					ARR	
964-1	Vendor ID	-	0x0793	-	rp	U16	PNO vendor ID Baumer Electric AG (0x0793)
964-2	Drive Type	-	28	-	rp	U16	Drive type, e.g. 28 = MSIA PROFIBUS-DP
964-3	-	-	factory	-	rp	U16	not assigned
964-4	Final inspection year	-	factory	-	rp	U16	Year of final inspection in format YYYY, e.g. 0x07D6 = 2006
964-5	Final inspection date	-	factory	-	rp	U16	Date of final inspection in format DD.MM, e.g. 0x1A06 = 26.06
964-6	Axis number	1	1	1	rp	U16	Axis number (always 1)
964-7	Gear ratio code	1	factory	65’535	rp	U16	Gear ratio code (rounded to whole number)
964-8	Serial number	1	factory	65’535	rp	U16	Unique serial number for drive identification. This serial number is printed on the drive label.

Para. nr.	Name	Value			Access	Format	Description
		min	default	max			
964-9	Firmware drive	-	factory	-	ro	U16	Firmware version number of drive (overall firmware version). 0xsfbb (s: Specification, f: Function, b: Bug). Example: Firmware version 0x2202 = 2.02.02. Main number and sub-index refer to drive functions (2.02.xx). Last index (xx) refers to bug fix only. This firmware version must be identical with manual version and with version number printed on drive label.
967	Control word	0x----	0x----	0x----	rw	V16	Parameter corresponding to control word STW
968	Status word	0x----	0x----	0x----	ro	V16	Parameter corresponding to status word ZSW
970	Load default parameters	0	-	4	rw	U16	Load default parameters (column “default” in this table) by toggle bit: for factory setting, write 1 then 0 (factory setting: condition as supplied to customer, parameters with value “factory” in column “default” will be loaded with the condition as supplied) for general setting, write 4 then 0. (general setting: no customer specific modifications such as gear and serial number, parameters with value “factory” in column “default” will be overwritten with a general value which does not respect the customer modifications. For experienced users only) ATTENTION: Successful load is acknowledged by a change from 0 to 1 or from 0 to 4.
971	Save to EEPROM	0	-	1	rw	U16	Save actual parameters by toggle bit: write 0 and wait for acknowledge 1, then write 1 Successful save is acknowledged by 0. This allows to load the actual parameters after drive is switched on.

3.3 Traversing block array

In order to write a value, first the block number must be set in P20 sub-index 1.

The following table shows the traversing block array TBA containing 20 traversing block lines. Table values are shown according to default settings. Traversing block lines nr. 1...4 are pre-defined. Traversing block lines 5...20 can be freely programmed. For details, see parameter P20 definition.

Black frame = freely programmable
Parameters outside of the black frame are programmable but default values will be reloaded when the Mode of operation is changed.

Table 14: Traversing block array containing 20 traversing block lines

Traversing block array parameter			20-2	20-3	20-4	20-5	20-6	20-7	20-8
	line number	comment	Target position TBA	Time	PSW	Vmax	Amax	Amin	Imax
Traversing block line 20-1	1	Jogging-	0x00	1	0x20	$V_{Jogging-}$	factory	factory	factory
	2	Jogging+	0x00	1	0x20	$V_{Jogging+}$	factory	factory	factory
	3	Backlash compensation	P39	1	0x01	P41	factory	factory	factory
	4	Target position	P39	1	0x21	P41	factory	factory	factory
	5	Traversing block line 5	0	0	0	0	0	0	0
	6	Traversing block line 6	0	0	0	0	0	0	0
	...								
	20	Traversing block line 20	0	0	0	0	0	0	0

NOTE: Factory settings in traversing block line 1...4 can be modified. However, they will be reset to factory setting when loading default setting.

Two variants exist for setting of speed Vmax of Jogging- and Jogging+:

- Identical speed for Jogging- and Jogging+:
  Setting of speed is done by setting of parameter P45. In this case, $V_{Jogging-}$ and $V_{Jogging+}$ are automatically adapted according the relations
  $V_{Jogging-}$ = -1 * P45 / 16'384 * P8
  $V_{Jogging+}$ = P45 / 16'384 * P8
  Example: For P45 = 16'384 (100%) and P8 = 50'000, the result is $V_{Jogging+}$ = 50'000.
- Different speeds for Jogging- and Jogging+:
  Here, the different system speed values for $V_{Jogging-}$ and $V_{Jogging+}$ are set directly in the traversing block array in user defined speed unit P4 / P5, e.g. µm / s. Selection of the corresponding traversing block entry is done via parameters P20-1 and P20-5. After setting of $V_{Jogging+}$, P45 is adapted accordingly. After setting of $V_{Jogging-}$, P45 remains unchanged.

NOTE: A change of speed sign corresponds to a change of movement direction.

Table 15: Presetting and command to start a traversing block line

<table>
<tr><th>Way of control</th><th>Controlable traversing block lines</th><th>Presetting</th><th colspan="5">Activation of a positioning task</th></tr>
<tr><td>Via fieldbus</td><td>1...20</td><td>P700 = 1 or 3
Select a traversing block line with auxiliary control word HSTW (see Table 8)</td><td colspan="5">By toggling bit 6 in control word STW (see Table 7)</td></tr>
<tr><td rowspan="6">Via digital hardware inputs</td><td rowspan="6">5...19</td><td rowspan="6">Hardware inputs must be configured: P31-1 ...4 = 23</td><td colspan="4">Hardware Input*</td><td>Starts line:</td></tr>
<tr><td>4</td><td>3</td><td>2</td><td>1</td><td></td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>5</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>6</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>...</td><td>...</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>19</td></tr>
</table>

* positioning task starting after change

3.4 Operating mode selection

Table 16: Guideline table to assist selection of drive operating mode

Parameter process data object				PPO1	PPO2	
					Possibility 1	Possibility 2
Operating mode	P700	1	Speed control	Drive control via parameters (P41 etc.) and control word STW.6	Drive control via traversing block (P20), auxiliary control word HSTW.8-13 and control word STW.6	like PP01
		2	External target value, excl. ramps	Not possible		Drive control via PZD and control word STW.6 (only once for state change from READY to TASK ACTIVE), immediate reaction of drive on PZD changes. Acceleration and deceleration at maximum (according to max. current in PZD). Recommended for dynamic operation
		3	Position control	Drive control via parameters (P39 etc.) and control word STW.6		like PP01
		4	External target value	Not possible		Drive control via PZD and control word STW.6 (only once for state change from READY to TASK ACTIVE), immediate reaction of drive on PZD changes. Acceleration and deceleration according to settings in traversing block (P20) line 4 Recommended for dynamic operation.

For further details about parameter process data objects, see chapter 2.2.
For further details about drive state machine, see chapter 2.5.

3.5 On-the-fly positioning task parameter modification

Positioning task parameters like target position, speed, max. current can be changed during an active positioning task and even while drive is moving. In this case, the drive responds according to target values. If an actual parameter value exceeds the actual parameter limit, a warning is activated.

Precondition:
Telegram-Type PPO2 for cyclic data exchange selected (P922 = 2). See chapter 2.2 Parameter process data objects (PPO) for details concerning PPO2.

Setting:

1. Bring the drive into READY state (see Figure 5: State machine of *FlexiDrive* MSIA)
2. Set operating mode to external target values (P700 = 2)
3. Enable positioning task by toggling Bit 6 of control word (STW) once: For details of STW see chapter 2.4.1 Description of control word (data to drive)

After performing above settings the drive is acting according the target values in PPO2.

4 Quick start-up

4.1 Start-up using SIMATIC S7

GSD file and software function blocks are available on CD-ROM.

4.1.1 Install GSD file

Install new master device file (GSD) as shown in Figure 6 by using command

- Extras: install new GSD file.

Now, a selection window appears, where the new GSD file has to be selected for import. Use command

- open

to import and install GSD file. The drive now becomes visible in the STEP 7 library and can be connected to PROFIBUS-DP by drag-and-drop as shown in Figure 7. Now select the drive and use the command „properties“ to adapt drive node address parameter to the desired value. New node address applies immediately after change. For further information on how to proceed, please refer to STEP 7 manual.

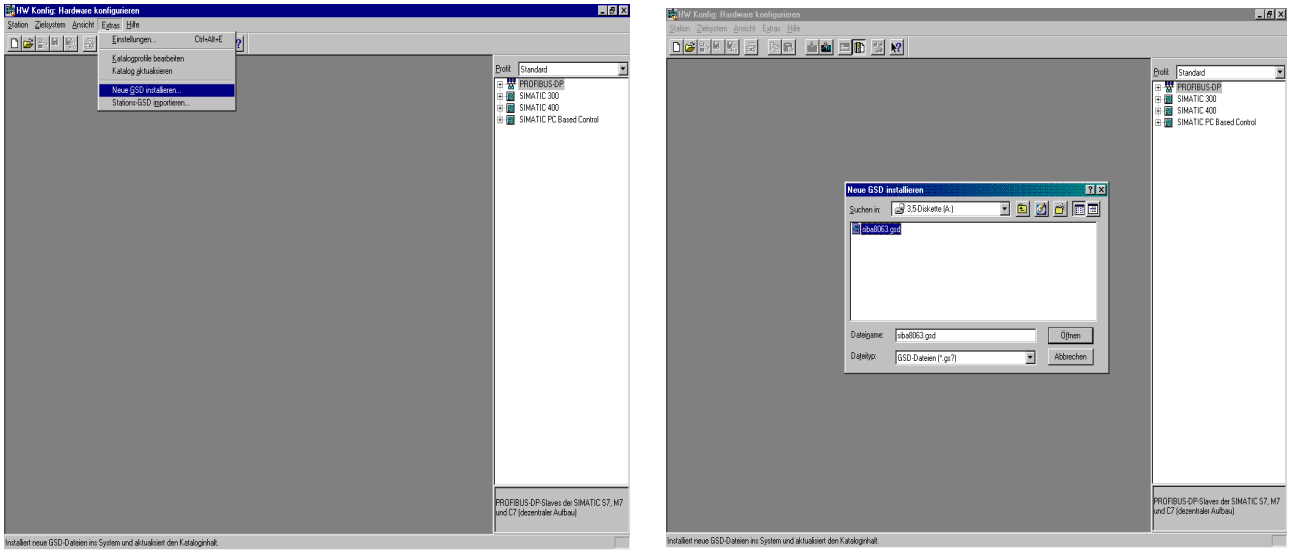


Figure 6: Installation of new GSD file by import

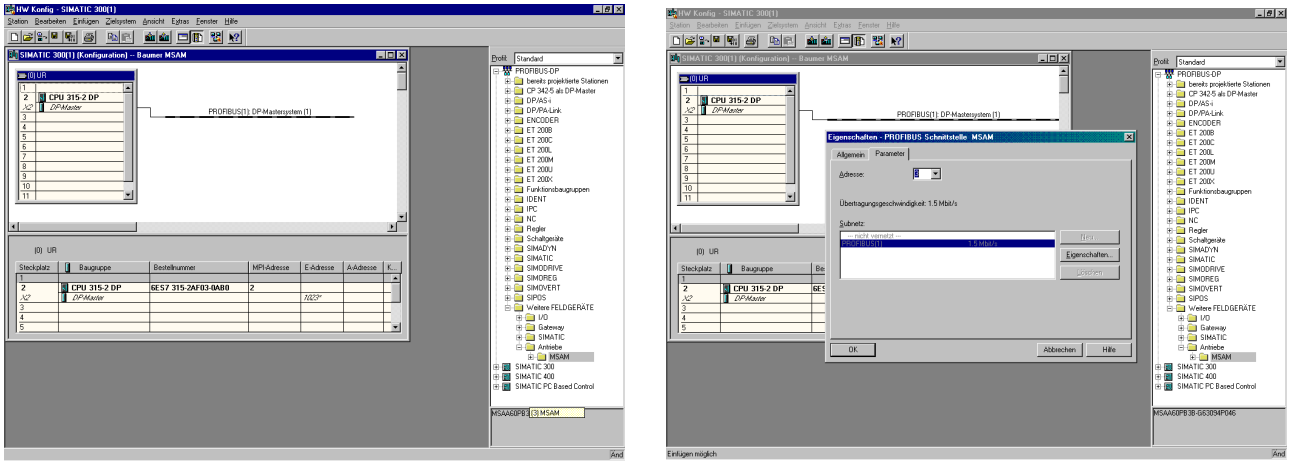


Figure 7: Connection of *FlexiDrive* MSIA to PROFIBUS and selection of node address

The slave node I/O addresses are automatically assigned by HW Config as shown in Figure 8. For correct operation of the software function blocks, the I/O addresses defined in these blocks must be identical to the slave I/O dresses as defined in the HW Config environment (see I_O_Address).

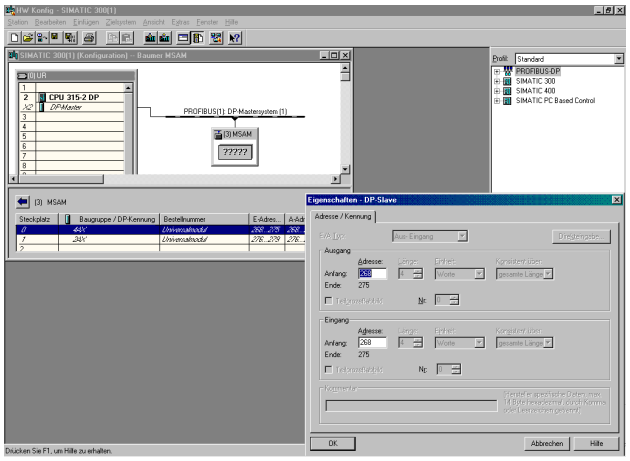


Figure 8: Definition of drive PROFIBUS I/O node addresses in hardware and software environment for identical values

4.1.2 Setting of PROFIBUS node address

Two ways exist for setting of PROFIBUS slave address:

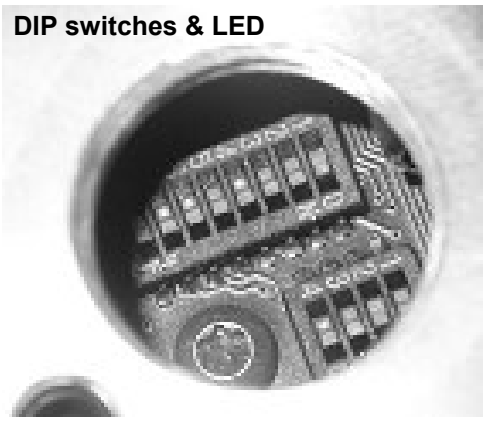
- Manual setting of node address by switches. There are three different kinds of switches:
  - DIP switches
  - Dec rotary switches
  - Hex rotary switches

  The selected PROFIBUS node address is indicated via parameter P918. New address applies after new power-up. Default setting of all switches is 0.

- Setting of node address by parameter P918 via PROFIBUS.
  Please note: All switches must be set to 0 in this case. New address applies after new power-up. Default setting of P918 is node address 3. For details, see P918 description.

Set PROFIBUS node address by DIP switches

Default setting of DIP switch is 0 (see Figure 9). Valid PROFIBUS node addresses range from 3 to 125.





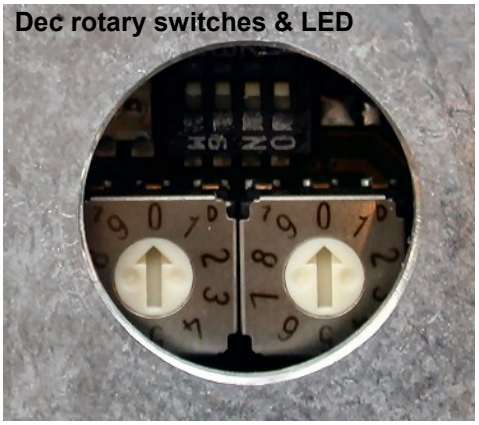
Example

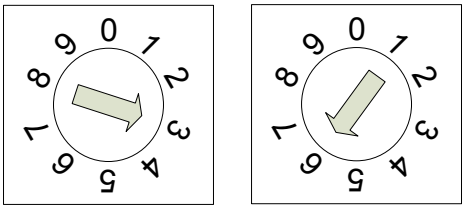
$2^0 = 1$	S1:	ON	= 1
$2^1 = 2$	S2:	OFF	= 0
$2^2 = 4$	S3:	ON	= 4
$2^3 = 8$	S4:	OFF	= 0
$2^4 = 16$	S5:	ON	= 16
$2^5 = 32$	S6:	OFF	= 0
$2^6 = 64$	S7:	ON	= 64

Node address = 85

Figure 9: Manual setting of PROFIBUS node address by adjusting DIP switches. The LED light status indicator is located next to the switches

Set PROFIBUS-DP node address by Dec rotary switches
Default setting of Dec rotary switches is 0 (see Figure 10). Possible PROFIBUS node addresses range from 3 to 99.

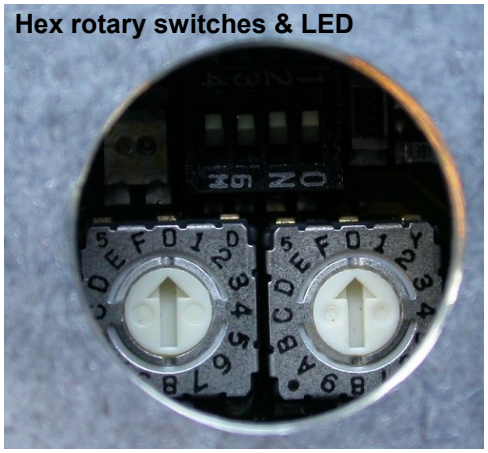


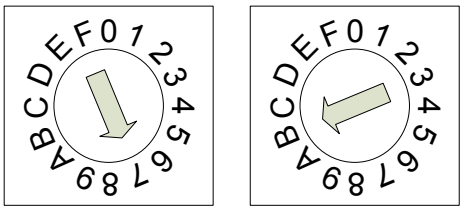


Example: Node address = 36

Figure 10: Manual setting of PROFIBUS node address by adjusting Dec rotary switches. The LED light status indicator is located next to the switches

Set PROFIBUS node address by Hex rotary switches
Default setting of Hex rotary switches is 0 (see Figure 11). Possible PROFIBUS node addresses range from 3 to 125.





Example: Node address = 123 (7B)

Figure 11: Manual setting of PROFIBUS node address by adjusting Hex rotary switches. The LED light status indicator is located next to the switches

Table 17: Conversion between decimal and hexadecimal numbers

Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex
01	01	26	1A	51	33	76	4C	101	65
02	02	27	1B	52	34	77	4D	102	66
03	03	28	1C	53	35	78	4E	103	67
04	04	29	1D	54	36	79	4F	104	68
05	05	30	1E	55	37	80	50	105	69
06	06	31	1F	56	38	81	51	106	6A
07	07	32	20	57	39	82	52	107	6B
08	08	33	21	58	3A	83	53	108	6C
09	09	34	22	59	3B	84	54	109	6D
10	0A	35	23	60	3C	85	55	110	6E
11	0B	36	24	61	3D	86	56	111	6F
12	0C	37	25	62	3E	87	57	112	70
13	0D	38	26	63	3F	88	58	113	71
14	0E	39	27	64	40	89	59	114	72
15	0F	40	28	65	41	90	5A	115	73
16	10	41	29	66	42	91	5B	116	74
17	11	42	2A	67	43	92	5C	117	75
18	12	43	2B	68	44	93	5D	118	76
19	13	44	2C	69	45	94	5E	119	77
20	14	45	2D	70	46	95	5F	120	78
21	15	46	2E	71	47	96	60	121	79
22	16	47	2F	72	48	97	61	122	7A
23	17	48	30	73	49	98	62	123	7B
24	18	49	31	74	4A	99	63	124	7C
25	19	50	32	75	4B	100	64	125	7D

4.1.3 Activate internal terminating resistor

All MSIA 42 and all MSIA with Dec or Hex switches are equipped with terminating resistor. To activate or deactivate the internal terminating resistor, use DIP switch S1 and S2:



The terminating resistor is activated, if:
S1 = ON
S2 = ON

4.1.4 Function blocks for SIMATIC S7

For easy access and control of the positioning motor *FlexiDrive* MSIA from a SIMATIC S7 program, example software function blocks are available which support the following operations:

- Jogging
- Positioning
- Referencing
- Traversing blocks
- Parameter read/write
- Save to EEPROM
- Load default parameters

These function blocks are available free of charge. For details, see corresponding manual.

4.2 Referencing of drive position

After assembling the drive into a mechanical system, the absolute position value usually has no relevance. The motor needs a reference point to the mechanics of the system or application. Therefore the motor usually has to be referenced once. The following referencing methods can be used:

- Direct referencing (overwrite the actual position value)
- Referencing with point of reference (move to a reference point and overwrite the actual position value.
- Referencing to a reference switch (install a digital switch at the reference position and use the built-in automatic referencing function to overwrite the position)

The following methods and functions can be used for referencing:

Table 18: Overview of referencing methods and additional moving functions (parameter P700)

Parameter P700		Description
-20	ECh	Moving to lower software limit switch
-21	EBh	Moving to upper software limit switch
-22	EAh	Moving to zero position
-30	E2h	Referencing to lower reference switch
-31	E1h	Referencing to upper reference switch

Out of state READY the positioning task for referencing is activated by toggling STW.6.

4.2.1 Direct referencing

After switching-on, the motor is in READY state. The referencing occurs in the REFERENCING state with the parameter P40.

Procedure:

1. Changing of the state: control word STW.11 = 1: drive goes to REFERENCING state
2. Overwrite parameter P40 actual position with the requested value
3. Store with parameter P971

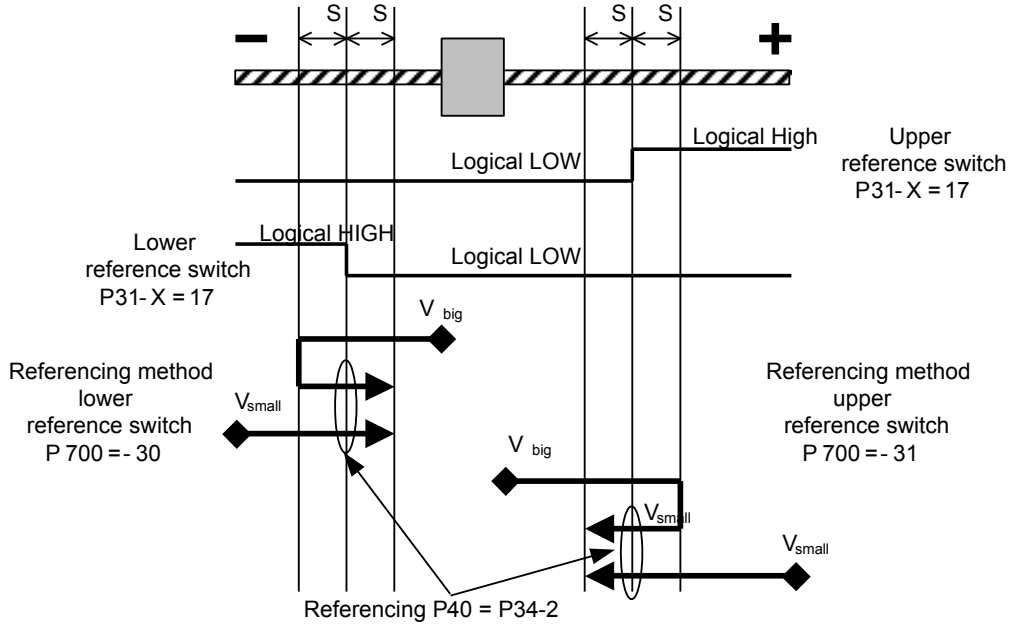
4.2.2 Referencing with point of reference

First the drive is moved to a point of reference where the position is known. Afterwards the actual position is overwritten with the requested value which corresponds to the reference position.
Procedure:

1. There are several ways to move to a reference position:
   a) Approaching the point of reference by jogging e.g. triggering of the digital hardware-inputs
      Define the hardware inputs as jogging-switch +/- (in parameter P31)
   b) Approaching the point of reference by definition of the target position via Profibus
      Set the target position in user defined unit (see parameter P39)
2. Overwrite actual value (see above in 4.2.1 Direct referencing).

4.2.3 Referencing to a reference switch

This method uses an external sensor on input as a reference. It must be defined as external hardware input. When starting this reference procedure, the drive moves with P34-3 [Relative target speed] in direction of the reference switch. After the change of the level from LOW to HIGH, the motor brakes within the distance (s) and searches the reference switch with slow speed. After the change of the reference switch from HIGH to LOW the reference position (parameter P34-2) will be assigned to the actual position (parameter P40). As soon as Bit11 of the ZSW is being reset, the referencing is finished. The motor continues in regulation. To store the reference position non-volatile save parameters to EEPROM (P971)



S: free referencing distance] P34-1
V_{big} search reference switch with velocity P34-3
V_{small} search reference switch with velocity P34-4

Figure 12: Referencing on lower or upper reference switch

Procedure:

1. Install the external referencing switch at reference position
2. Define the external hardware-input (in parameter P31-X), set reference position (see P34-2) Bit will be deactivated automatically after every referencing and must be set again for the next referencing
3. Use parameter P700, value 30 or 31 to start referencing
4. Check ZSW.11 for completion of referencing
5. To store the reference position non-volatile save parameters to EEPROM (P971)

4.3 Setting of current and torque limit

The motor current limits can be used to define the drive torque limit. The motor current limit depends on the used Operating mode P700.
For drive operation in mode closed-loop speed control (P700=1) and closed-loop position control (P700=3), set Imax P20-8 to the desired value. The maximum value for current and therewith torque is limited as indicated in the parameter description P28.
For drive operation in mode external target values (P700=2) in PPO2 communication, the drive is permanently controlled by process data PZD and continuously carries out any PZD changes. Torque limit is done by limiting max. current in PZD 5.

4.4 Flow diagram for quick start-up

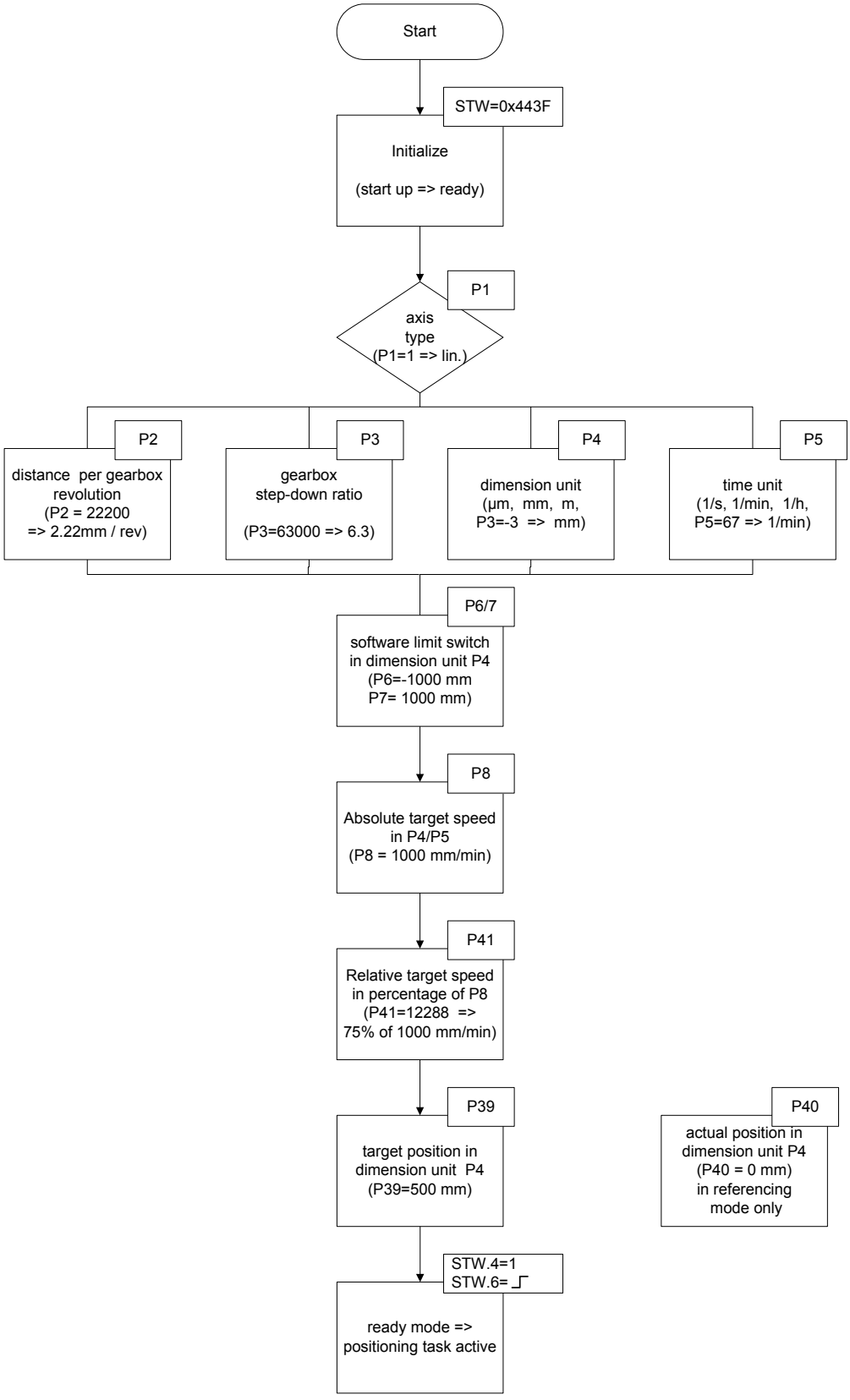


Figure 13: Flow diagram for quick start-up

4.5 Example: Rotational & linear axis positioning

Before using the drive, check parameters and adapt to application, if required. For details, see following examples and parameter description.

Example 1:
The system consists of motor (nominal speed = 3'500 rpm) with rotational gear (I = 45.56).
Parameters:

P1	Axis type	P1 = 12 (rotational movement)
P2	Distance per gearbox revolution	P2 = 10'000 (no practical meaning for rotational movement)
P3	Gearbox step-down ratio	P3 = 455'600 (i = 1 : 45.56)
P4	Dimension unit	P4 = 80 (°)
P5	Time unit	P5 = 0 (1/s)
P8	Nominal target speed	P8 = 360 (°/s)
P10	Maximum target speed	P10 = 461 (°/s)
P41	Relative target speed	P41 = 0x4000 (100% of P8)

Resulting speed during tasks:	System rotational speed	= 360 °/s
		= 60 rpm
	Motor rotational speed	= 2'734 rpm

Example 2:
The system consists of a motor (nominal speed = 3'000 rpm) with gear (i = 6.3) and spindle (2.2 mm/rev).
Parameters:

P1	Axis type	P1 = 1 (linear movement)
P2	Distance per gearbox revolution	P2 = 22'000 (2.2 mm/rev)
P3	Gearbox step-down ratio	P3 = 63'000 (i = 1 : 6.3)
P4	Dimension unit	P4 = -3 (mm)
P5	Time unit	P5 = 67 (1/min)
P6	Minimum software position limit	P6 = -1'000 (mm)
P7	Maximum software position limit	P7 = +1'000 (mm)
P8	Nominal target speed	P8 = 1'000 (mm/min)
P10	Maximum absolute target speed	P10 = 1'200 (mm/min)
P39	Target position	P39 = +500 (mm)
P40	Actual position	P40 = 0 (mm)
P41	Relative target speed	P41 = 0x3000 (75% of P8)

Resulting speed during tasks:	System movement speed	= 750.00 mm/min
	Spindle rotational speed	= 340.90 rpm
	Motor rotational speed	= 2'147.72 rpm

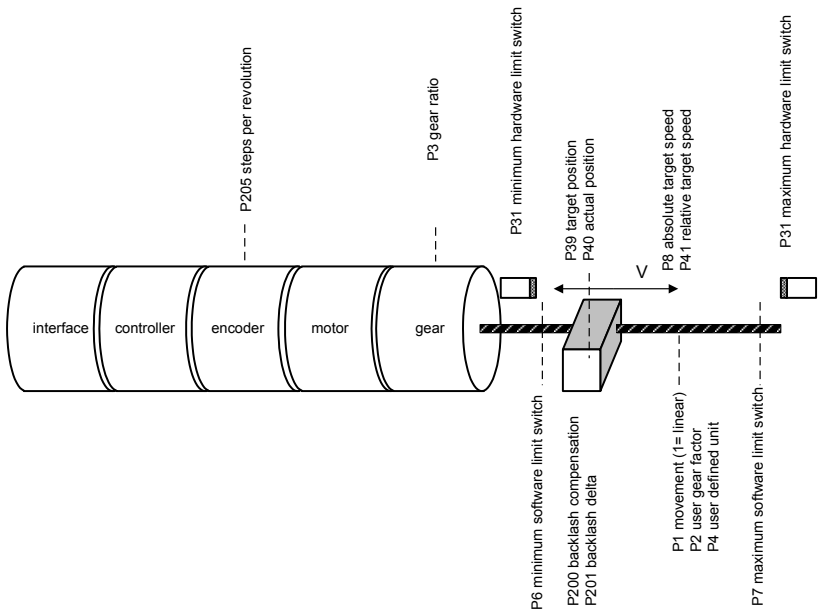


Figure 14: Example for spindle application

4.6 Example: Timing during a positioning task

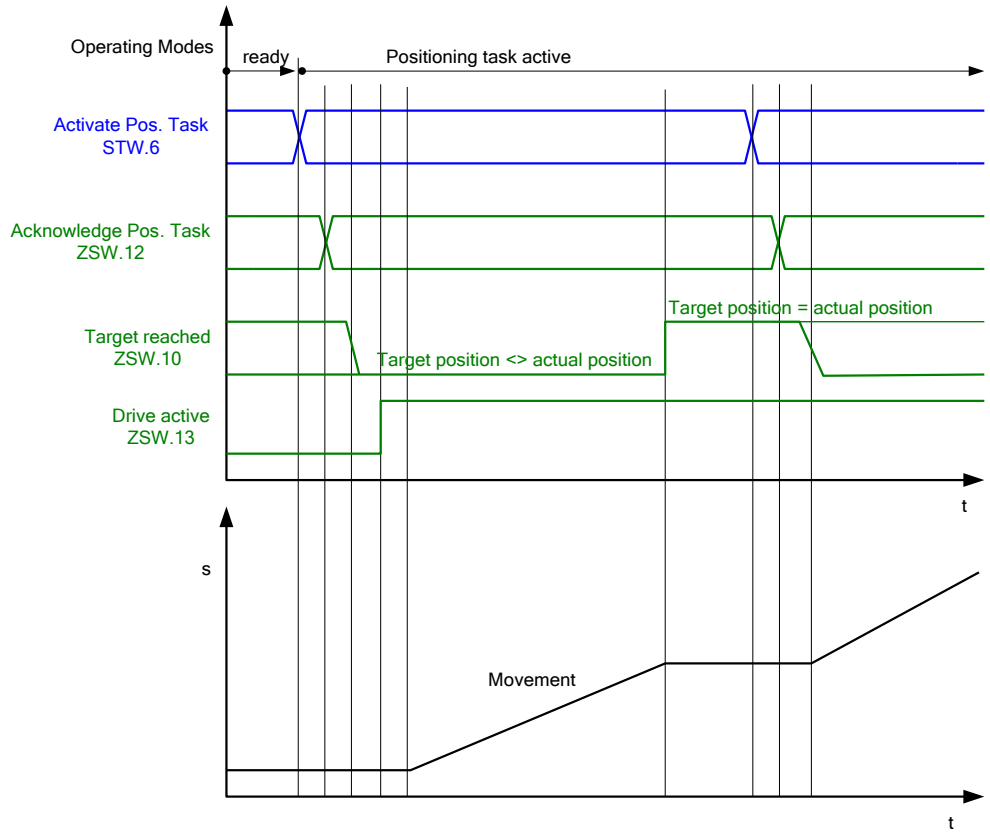


Figure 15: Timing during a positioning task

5 Error diagnostic

5.1 LED light status indicator

For indication of drive status, a duo LED light is located behind a removable cover on the drive backside (see Figure 9 - Figure 11).

- Permanent green light indicates correct drive operation without warning or error.
- Green flashing indicates an active warning message.
- Red flashing indicates an active error message.
- The number of an error or warning is coded in the flashing sequence. The number of flashes corresponds to the number of the error or warning bit plus one (see Table 19 and Table 20). If bit[1] is set, the LED flashes two times with a break of about one second.
- If several errors are active at the same time, the number of flashes is added, i.e. if error bit[0] and bit[1] are set, the LED flashes three times with subsequent long break. The flashing indication is not unambiguous in this case. The description is true for warnings as well.
- If errors and warnings are active at the same time, the red and the green LED is flashing independent of the other.

For detailed evaluation of active errors and warnings, it is strongly recommended to read out P947, P952 and P953.

5.2 Error messages (P947)

- If an error occurs, the motor power is disconnected and the motor coasts down
- Errors are displayed in ZSW.3 and via flashing of a red LED
- Up to 8 error messages are stored in error buffer P947. The total number of occurred errors is stored in P952. For detailed evaluation of active errors, it is strongly recommended to read out P947 and P952.
- To clear the error, first remove error cause (see Table 19)
- After removal of error cause, acknowledge error with the following sequence:
  Toggle control word STW.7 from 0-1-0. Then, the drive changes from ERROR state to POWER-ON INHIBIT state (see Figure 5) and the error memory P947 and P952 are automatically deleted. After that, toggle control word STW.0 from 1 to 0 to 1. Then, the drive changes from POWER-ON INHIBIT to READY state.

Table 19: List of DP slave error messages

P947	Red LED flashes	Error	Description
0x000z	1x	Temperature	
Bit[0]=1		Reason Action	The electronics temperature was above 85 °C (P47-3) for a time longer than time defined in P47-5. Reduce output power.
0x000z	2x	Temperature	
Bit[1]=1		Reason Action	The electronics temperature was above 112 °C. Wait for drive cooling and reduce output power.
0x000z	3x	Undervoltage	
Bit[2]=1		Reason Action	The supply voltage was lower than 11.5 VDC. The load power supply is overloaded. Increase load power supply rating. Eventually decrease motor current limit value (P20-8). Acknowledgement: Remove cause, toggle control word STW.7 = 1/0 and control word STW.0 = 0/1.

P947	Red LED flashes	Error	Description
0x000z	4x	Overvoltage	
Bit[3]=1		Reason Action	The supply voltage was higher than 31 VDC. When braking, the braking energy might be excessive which can cause an inadmissible increase in the load voltage. Provide regenerative feedback protection. Acknowledgement: Remove cause, toggle control word STW.7 = 1/0 and control word STW.0 = 0/1.
0x00z0	5x	Bus communication	
Bit[4]=1		Reason Action	Communication between PROFIBUS master and slave was lost (and error handling P214 = 1 or 2). Check bus connections and other possible reasons.
0x00z0	6x	Internal communication	
Bit[5]=1		Reason Action	Internal communication error. Take next opportunity for service at manufacturer.
0x00z0	7x	Timeout	
Bit[6]=1		Reason Action	Time required for positioning task was larger than defined in parameter P213. Check for reason. Eventually increase timeout value (P213).
0x00z0	8x	Calculation	
Bit[7]=1		Reason Action	A numerical calculation error occurred (parameters P1, P2, P3, P4, P205). Check and change parameter values.

5.3 Warning messages (P953)

- Warnings have no influence on drive operation.
- Warnings automatically disappear after removal of reason.
- Warnings are displayed in ZSW.7. Bit coded readout is possible from P953

Table 20: List of DP slave warning messages

P953	Green LED flashes	Warning	Description
0x000z	1x	Temperature	
Bit[0]=1		Reason Action	The actual power electronics temperature lies above 85°C (P47-3) for shorter than time limit (defined in P47-5). If this warning is present for a time interval longer than time limit, an error occurs. Reduce output power.
0x00z0	5x	Minimum hardware limit switch	
Bit[4]=1		Reason Action	Limit switch was activated. Actual position is outside of allowed range. Passing of hardware limit switch possible (P31). Move drive position back to allowed range (positive direction). Check position of switch.
0x00z0	6x	Maximum hardware limit switch	
Bit[5]=1		Reason Action	Hardware limit switch was activated. Actual position is outside of allowed range. Passing of hardware limit switch possible (P31). Move drive position

P953	Green LED flashes	Warning	Description
			back to allowed range (negative direction). Check position of switch.
0x00z0	7x	Minimum software limit switch	Message occurs in JOGGING state only
Bit[6]=1		Reason Action	Software limit switch was activated. Actual position is outside of allowed range. Passing of software limit switch not possible. Move drive position back to allowed range (positive direction). Check position of switch.
0x00z0	8x	Maximum software limit switch	Message occurs in JOGGING state only
Bit[7]=1		Reason Action	Software limit switch was activated. Actual position is outside of allowed range. Passing of software limit switch not possible. Move drive position back to allowed range (negative direction). Check position of switch.
0x0z00	10x	Revolution counter	
Bit[9]=1		Reason Action	Difference between redundant multi-turn counters. The absolute encoder observes permanently the correct functioning of the power-off-multi-turn counter (is used in the status without supply only). A warning indicates that the multi-turn counter might not work in the power-off status. Check reference position. Take next opportunity for drive service at manufacturer.
0x0z00	11x	Tolerance revolution counter	
Bit[10]=1		Reason Action	Difference between revolution from multi-turn counter and single-turn system. Use of drive no longer recommended. Take next opportunity for service at manufacturer.
0x0z00	12x	DVMT (data valid multi-turn)	
Bit[11]=1		Reason Action	Battery voltage below voltage limit. Absolute position storage no longer guaranteed. Further use of drive possible for days or weeks. Afterwards take next opportunity for service at manufacturer. Check reference position after power-down.
0xz000	13x	Service	
Bit[12]=1		Reason Action	Total drive operating time (in movement) larger than 20'000 h. Further use of drive possible. Further action depends on application.
0xz000	14x	Bus communication	
Bit[13]=1		Reason Action	Communication between PROFIBUS master and slave was lost (and error handling P214 = 0 or 3). Check bus connections and other possible reasons.
0xz000	15x	Undervoltage	
Bit[14]=1		Reason Action	The operating voltage of the motor is below 11.5 V. Increase the voltage or current from power supply. A reduction of the motor current limitation (P28) may solve the problem.

5.4 Wiring for optimum EMC

Note PROFIBUS-DP cable specifications

Table 21: Specification of Profibus-DP cable type A according to EN 50170 standard

Parameter	Specification
Impedance	135...165 Ω at frequency 3…20 MHz
Capacity	< 30 pF / m
Resistance	≤ 110 Ω/ km
Wire diameter	> 0,64 mm
Wire cross section	> 0,34 mm^2

Note maximum bus and stub cable length

Maximum length of Profibus-DP (RS 485) network segments is 1'200 m. This maximum length is valid only for small baud rates. For baud rates larger than 100 kbits/s, the maximum segment length must be reduced according to the following table:

Table 22: Maximum Profibus-DP (RS 485) segment length (copper wires)

Baud rate	Max. segment length
9,6 kbit/s	1'200 m
19,2 kbit/s	1'200 m
45,45 kbit/s	1'200 m
93,75 kbit/s	1'200 m
187,5 kbit/s	1'000 m
500 kbit/s	400 m
1,5 Mbit/s	200 m
3 Mbit/s	100 m
6 Mbit/s	100 m
12 Mbit/s	100 m

Stub lines e.g. with T-connectors are branch lines from main segment. For baud rates larger than 1,5 Mbit/s, no stub lines are allowed. According to standard, there is no exception to this rule. For baud rates up to 1,5 Mbit/s, stub lines can be used as long as the sum of all stub lines in the network does not exceed the maximum length as defined in the following table.

Table 23: Maximum length of stub lines (T-lines) calculated for PROFIBUS cable type A (30pF/m)

Baud rate	Capacity	Sum of stub line length
>1,5 Mbit/s	no	no
1,5 Mbit/s	0,2 nF	6,7 m
500,0 kbit/s	0,6 nF	20 m
187,5 kbit/s	1,0 nF	33 m
93,75 kbit/s	3,0 nF	100 m
19,2 kbit/s	15 nF	500 m

NOTE:

- Do not use terminating resistors on stub lines.
- Avoid stub lines, whenever possible.
- Use repeaters for stub lines.

Requirements for baud rates larger than 1.5 Mbit/s:

- For baud rates larger than 1.5 Mbit/s, use specially dedicated connectors. Eventually, these connectors incorporate serial inductivities to compensate for connector capacities.
- Stub lines are not allowed for stub lines larger than 1.5 Mbit/s.
- The maximum segment length is restricted to 100 m.
- A minimum cable length of 1 m between two slaves is strongly recommended. This allows to compensate incorrect connections and the complete installation is less critical.

Connect terminating resistors

A terminating resistor is required at physical beginning and at physical end of the bus system.

Ensure correct shielding of bus and motor cable

- Connect shield of bus cable on both ends.
- Use mounting bracket, to ensure large area connection between shield and PE.
- Remove bus and motor cable isolation to ensure large area connection to mounting bracket.
- Fix mounting brackets of bus cable and motor cable with a minimum distance of 50 mm from each other.

If a proper earth connection over the drive housing can not be ensured, connect cable shield to earth as shown in Figure **16**. If a cable is connected to earth on both ends, guarantee potential equalization by a separate potential equalization cable with sufficient cross section to avoid a ground loop.

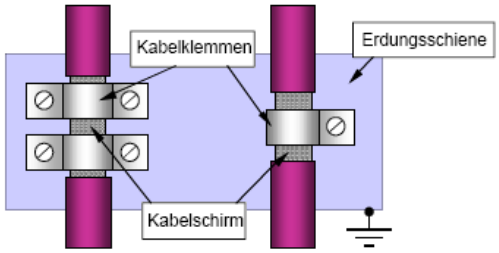


Figure 16: EMC optimum wiring by correctly connecting cable shield

Avoid potential difference between network nodes

Potential differences (reference to PE) between nodes of network can cause communication disturbance or can damage bus participants.

Avoid potential differences by

- Connecting each bus participant on the shortest and minimum resistance path to the same earth potential (PE) of the machine/system.
- Using a potential compensation cable between bus communication participants.
- realizing low resistance contact between overall earth and earth contact of machine/system.

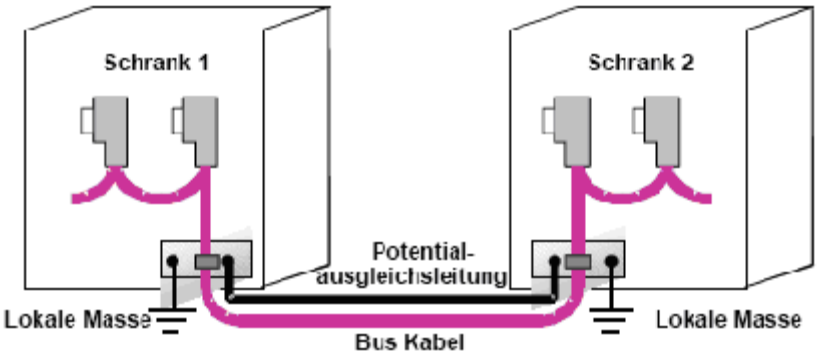


Figure 17: Installation of a potential compensation line

6 Technical data

6.1 Electrical and mechanical data

See corresponding datasheet.

6.2 Connector assignment

See corresponding datasheet or product label.

6.3 Voltage supply

The voltage supply to the drive must be 24 VDC ±10 %. Motor and bus electronics have separate supply lines. Check polarity during initial commissioning (see **Fehler! Verweisquelle konnte nicht gefunden werden.** and data sheets).

Reverse polarity:
Motor electronics are not reverse polarity protected. The drive can be damaged if the polarity is reversed. Bus electronics are reverse polarity protected.

Over voltage:
Motor and bus electronics are not protected against supply voltage exceeding 24 V ±10 %.
The conditions for over voltage peaks due to generator duty are described in chapter 6.5.

6.4 Block diagram and external inputs

The drive offers two ways to connect the voltage supply. (Figure **18**). If the voltage supply is connected to +VsM, the drive is fully working. If the supply voltage connected to +VsM is switched off due to an emergency-stop, the positioning control and fieldbus interface still work, if the voltage supply is additionally connected to +VsE. Drive movement is excluded by hardware in this case.

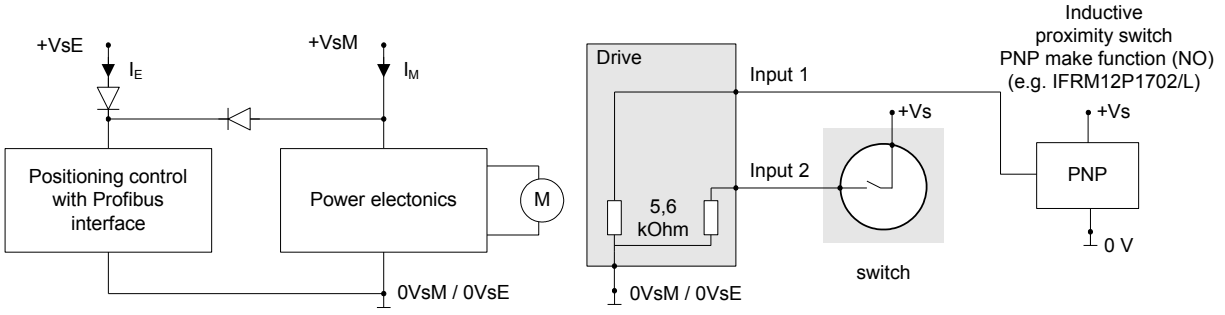


Figure 18: Block diagram of drive and example for connecting a sensor or switch to external inputs

In addition, the drive offers four programmable digital inputs (P031) to connect standard position sensors. Programming function examples are:

- Activate Jogging (Jogging+, Jogging-)
- Hardware limit switch or referencing switch
- Control of control word for e.g. access to traversing blocks (P020)

6.5 Power feedback during motor deceleration

During drive deceleration, especially in dynamic applications with low wear, the resulting electrical deceleration energy can influence the power supply and can lead to an increase of supply voltage above the maximum voltage level of about 28 VDC. In this case, the use of a power feedback protection must be taken into account to handle the deceleration energy. This deceleration energy depends on the following factors:

- Moments of inertia in application (drive and load)
- Wear and efficiency of mechanics
- Number of simultaneously decelerated drives connected to the same power supply (e.g. due to operation conditions such as emergency stop or simultaneous movement)

The deceleration energy of a drive without loss effects is calculated according to:

$$W = \frac{1}{2} \cdot J \cdot \omega^2 = \frac{\pi^2}{1800} \cdot J \cdot n^2$$

W : brake energy $[Ws = kgm^2/s^2]$

J : momentof inertia $[kgm^2]$

ω : angularfrequency$= (2 \cdot \pi \cdot n)/60$ [1/s] withn [rpm]

The typical deceleration energy is about 0,5 Ws for MSIA 42 and 2 Ws for MSIA 83 (deceleration from nominal speed in S3 operation, only motor moment of inertia, typical loss effects).
Moment of inertia and deceleration energy are directly proportional to each other, i.e. double moment of inertia means double deceleration energy.
For conversion of deceleration energy, the following is possible:

- Power feedback protection with diode and capacitor (see Figure **19**). In this case, the deceleration energy is stored in the capacitor.
- Use of a power supply with power feedback capability or use of a power management module (e.g. Siemens DC-PMM/24V)

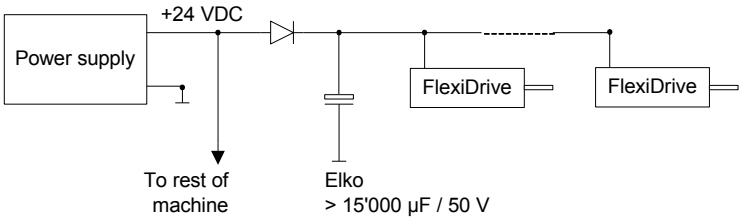


Figure 19: Example: Power feedback protection with diode and capacitor

6.6 Reduction of motor current at elevated ambient temperature

The motor current depends on ambient temperature. Drive operation according to nominal specifications is possible for ambient temperature up to +40°C. However, the drive can be operated at elevated ambient temperature up to +65°C with reduced motor current (see Figure **20**).

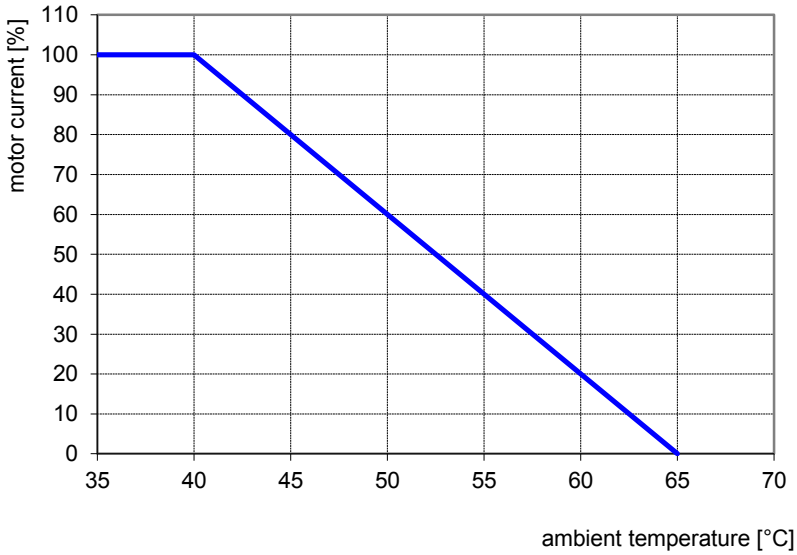


Figure 20: Motor current reduction at elevated ambient temperature in percent of nominal current at +40°C

6.7 Dimensions

See corresponding datasheet.