BAUMÜLLER

TECHNOLOGY FUNCTION POSITIONING

Technical description and operation manual

E | 5.94021.11

Edition March 1996

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This operation manual is intended as a complement to the technical description and the operation manual of the apparatus.

READ AND COMPLY WITH THE OPERATION MANUAL AND THE SAFETY NOTES BEFORE COMMISSIONING

This manual contains the necessary information for normal opteration of the products described therein. The drives may only be used, maintained and repaired by personnel familiar with the operation manual and the applicable regulations on working safety and accident prevention. The devices are manufactured to a high technical specification and are operationally safe. Provided that all safety instructions habe been adhered to, there will be no personal danger during the installation and commissioning stages.

The commisioning is prohibited until it has been positively determined that the machine, into which these components are to be incorporated, complies with EC machine regulations.

This technical description replaces and nullifies all provious description. In order to provide the best possible service, we reserve the right to alter information without notice.

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Ostendstr. 80
90482 Nürnberg
Germany
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Country of origin: Made in Germany

Date of manufacture: Determined from the serial number on the machine/motor.

TABLE OF CONTENTS

ABBREVIATIONS

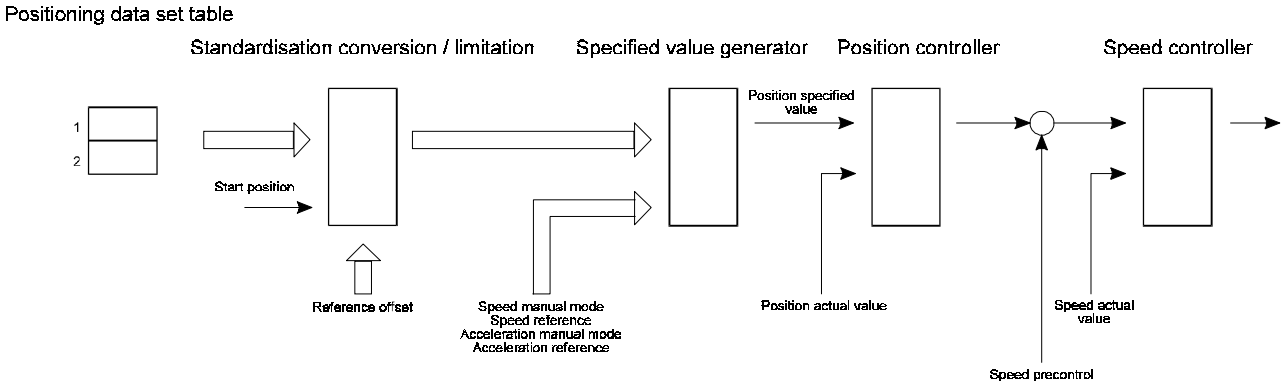
AI	Function module analog inputs
UU	User Unit
DE	Function module digital inputs
H	Level HIGH
HLG	Function module ramp-up generator
I	Internal unit of position
ID no.	Identification number
L	Function module position controller
L	Level LOW
M	Function module drive manager
N	Function module speed controller
POS	Function module positioning
SH	Quick stop
SW	Software
SWG	Function module set value generator
t	Time
v1	Speed, if position set 1 is operated
v2	Speed, if position set 2 is operated

1 GENERAL

The distance positioning is set out as single axis positioning. Distance positioning mode is possible in the same way as round table positioning, which is driven with direct positioning data set specification via a superordinated controller.

A selection can be made from 2 different positioning data sets.

The following diagram shows the structure of the positioning.



2 INSTALLATION

For recording the drive position, either the resolver built into the drive or an incremental encoder can be used. The various encoder systems are selected via the parameter POS *Position actual value recording*.

As both encoder systems supply relative position information (that of the resolver only absolutely refers to one revolution), a reference run is necessary to refer the position of the drive absolutely to the process distance. Currently, a reference run with the resolver is the only one implemented.

Corresponding reference run traverses are possible for the various encoder systems. These are set via the parameter POS r*eference run mode*.

3 COMMISSIONING

To install positioning the external options as well as the optimisation of the unit must be effected via the operation software. This settings can be stored in the controller.

3.1 Optimisation

The parameters should be set in the following way.

1. Optimisation of **ramp-function generator**:
   - *RFG input selection* = 1 ID no. 13
   - *RFG ramp-up time 2* = 0.001s ID no. 5
   - *RFG ramp-down time 2* = 0.001s ID no. 11
   - *RFG rounding* = 0 ms ID no. 16
2. Optimisation of **positional controller**:
   - *P Kv-Faktor* e.g. 15 ID no. 202
   - *P N-interpolation* ID no. 207

     In reference run mode this parameter must be 100 % optimised !
3. Optimisation of remaining function moduls:
   - *N actual value smoothing* = 0 ms ID no. 62
   - *SVG targed ID no.* = 0 ID no. 140
   - *AI 1 targed ID no.* to *AI 1 targed ID no.* must not be programmed on 4 ID no. 280, 287, 294, 301
4. Optimisation of **drive manager**:
   - *M control word* = 0 = 0000_{hex} (command inhibit voltage) ID no. 120
   - *M desired mode* e.g. 1 = locating positon
     5 = manual operation
     6 = reference run mode ID no. 122
   - *M control word* = 6 = 0006_{hex} (command shutdown) ID no. 120
   - *M control word* = 15 = $000F_{hex}$ (command enable operating) ID no. 120

NOTE

Before the external pulse enabling can be switched on the positioning mode must be activated. The optimising of the positioning mode is described in the following chapters.

3.2 Control/status words

To acivate the operation modes target position mode, reference run and manual mode, the explained sequence in chapter 3.1 has to be executed. Moreover the external pulse enabling must be given. Each module synchronises itself to the set position value (ID no. 208) of the position controller on start-up.

The meaning of the individual bits in the status and control words of the drive manager are, to some extent, mode-dependant. In the following text the status and control words for the various modes will thus be listed.

Only bits relevant to the positioning are listed, i.e. only these have an effect on positioning modules or are controlled by them. A more detailed description of the control and status words can be found in the description of the drive manager.

NOTE

The internal control sets back the positioning parameters to the initialising values, if the positioning is switched off (e.g. through a rapid halt). After switching on once more in the operation modes manual mode and reference run is started with the setting of position actual values to parameter ID no. 208. as soon as a start bit is set. If the start bit is already 1 the mode is started immediatly. In the operation mode target position specification a position set has to be calculated before starting.

Start bits:	Bit no. 11	in operation mode target position specification
	Bit no. 4	in operation mode reference run
	Bit no. 11 and 12	in manual mode

3.2.1 Target position specification mode

M desired operation mode (ID no. 122) = 1.

Bit no.	M control word (ID no.120)	M status wort (ID no.121)
0		
1		
2	Rapid halt	
3		
4	New set value	
5		
6		
7		
8		
9		
10		Target position reached
11	Start positioning	
12		Set value acknowledgement
13		
14		
15		

3.2.2 Reference run mode

M desired operation mode (ID no. 122) = 6.

Bit no.	M control word (ID no.120)	M status wort (ID no.121)
0		
1		
2	Rapid halt	
3		
4	Start reference run	
5		
6		
7		
8		
9		
10		Speed set value reached
11		
12		Reference reached
13		Reference error
14		
15		

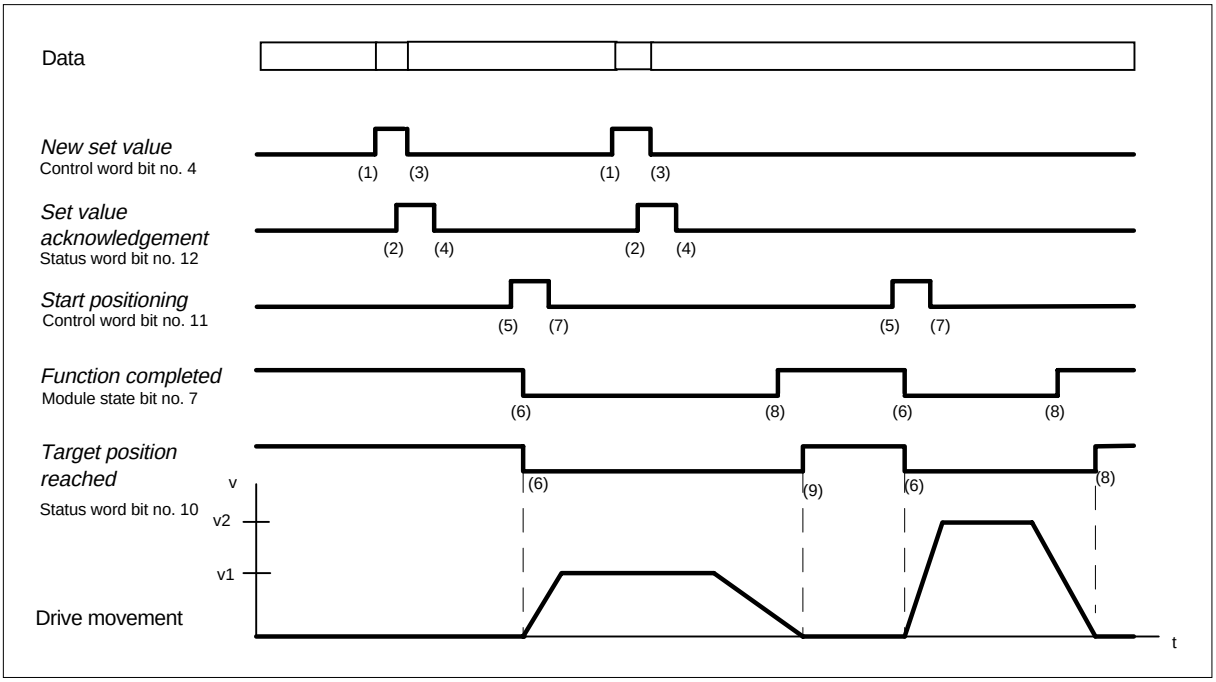
3.2.3 Manual mode (inching operation)

M desired operation mode(ID no. 122) = 5.

Bit no.	M control word (ID no.120)	M status wort (ID no.121)
0		
1		
2	Rapid halt	
3		
4		
5		
6		
7		
8		
9		
10		
11	Inch forwards	
12	Inch backwards	
13		
14		
15		

3.3 Positioning with data set specification

At the start of the positioning traverse, a position data set is selected or transmitted. Calculation of the positioning characteristic data is started by the command *New set value*.



Transfer description

Transfer	Meaning		Condition(s)
1	New set value	L → H	Set value acknowledgement = L Positioning data valid
2	Set value acknowledgement	L → H	New set value = H Positioning data calculated
3	New set value	H → L	Set value acknowledgement = H
4	Set value acknowledgement H → L		Set value acknowledgement = H Function completed = H Target position reached = H
5	Start positioning	L → H	Function completed = H Target position reached = H No position data calculation active, i.e. New set value ≠ H and Set value acknowledgement ≠ L
6	Function completed Target position reached	H → L H → L	Start positioning = H
7	Start positioning	H → L	Function completed = L
8	Function completed	L → H	Target position at set value input reached (last set value
9	Target position reached	L → H	Drive has reached positioning range

Description of actions

Transfer (1): After transferring the data of a new traversing set, the controller signals the validity of the data to the drive regulator via *New set value* = 1 (control bit 4).

Transfer (2): As a result of *New set value* = 1 the drive regulator takes over the data, calculated the positioning characteristics and additionally sets Set value acknowledgement = 1 (status bit 12). It lasts 30 ms to calculate the data.

Transfer (3): After setting *Set value acknoledgement* the bit *New set value* is set to 0

Transfer (4): The drive controller displays, by retrieval of bit *Set value quit* that it is ready once again for reception. The retrieval is effected as soon as the control is set to *New set value* = 0.

Transfer (5): The controller starts the positioning with *Start positioning* = 1 (control bit 11).
Transfer (3) and (5) is allowed at the same time!

Transfer (6): If the start command is taken over by the drive regulator, the drive commences positioning, and *Target position reached* (status bit no. 10) and *Function completed* change to 0.
If the controller recognises that the function has been ended, it can set *Start positioning* to 0. If the positioning recognises a rapid halt request this results in the drive braking to a standstill in compliance with parameter M RAPID HALT code (ID no. 131) and the positioning is switched off. If the drive is re-enabled, *New set value* = 1 set and a new start requested, the drive repositions itself via **absolute** positioning on the original target position.

Transfer(7): As soon as the drive manager has recognised the start command the bit *start positioning* can be set back. The setting back of the bit start positioning completes a cycle.

Transfer(8): If the last set position transfered to the controller the bit *Function completed* is set to 1 (parameter module state).

Transfer(9): *Position* reached is set to 1 as soon as the drive has not leaved the positioning tolerance range in a set time.

3.4 Reference run

Exact knowledge of the absolute position of the drive is generally required for operation with positioning drives. If an incremental encoder is applied for position actual value recording, or if more than one revolution is required for the entire traversing range for position actual value recording with a resolver, a reference run is required. The reference position and the starting direction, and thus also the exact traverse of the reference run, are set via the parameter *Reference run mode* (ID no. 414*)*.

The reference runs 1 - 6 (resolver) and 101 - 106 (incremental encoder, without stage 4) are divided into following stages.

- Stage 1
  In stage 1 the reference speed is used, as defined in parameter ID no. 412.
- Stage 2
  After reaching the reference initiator (end switch or zero point transfer switch), the drive is braked to zero speed via the *Rapid halt deceleration* (ID no. 442) and is driven in the opposite direction at an eighth of the reference speed. The acceleration value is set in the parameter *POS Reference acceleration* (ID no. 413).
- Stage 3
  The next switching transition of the switch causes braking to a fixed speed of 50 inc/ms (= 45 rpm). As soon as the reference module specifies this speed, the resolver angle is recorded.

  If the resolver´s zero angle * respectively the incremental encoder´s zero impulse is recorded no further position set values are set and the drive remains stationary. The current resolver angle and the position value of the reference point (ID no. 432) are then copied to the position actual/set values (ID no. 209, 208), as soon as the *POS actual value* (ID no. 437) stays the set time in the position window (ID no. 429).
- Stage 4
  In stage 4 positioning takes place according to the reference point value. In repeated running of the reference point a deviation up to 0.3° should be allowed for.

  To deliver identical reference points, following conditions must be satisfied:
  - The parameter *L N pre-control* (ID no. 207) must be set to 100 % in order to reach to afore mentioned accurancy!
  - Referencing speed-acceleration, -deceleration as well as encoder offset may not be altered once set.
  - The refencing speed must be reached in stage 1.

* At resolver zero angle the parameter Mot phi (ID no. 30) is 180°.

Reference runs -4 and -5 :

These modes only use end switches for reference.

-4 = go to the negative end switch

-5 = go to the positive end switch

The reference runs -4 and -5 are divided into following stages.

- Stage 1
  In stage 1 the reference speed is used, as defined in parameter ID no. 412.
- Stage 2
  After reaching the end switch, the drive is braked to zero speed via the *Rapid halt deceleration* (ID no. 442) and is accelerated in the opposite direction at an eighth of the reference speed. The acceleration value is set in the parameter *POS Reference acceleration* (ID no. 413).
- Stage 3
  The next switching transition of the end switch causes braking and a movement in the opposite direction with a fixed speed of 10 inc/ms.
- Stage 4
  As soon as the end switch is reached the drive is stoped. The actual position represents the reference point. The current position value of the reference point (ID no. 432) are then copied to the position actual/set values (ID no. 209, 208), as soon as the *POS actual value* (ID no. 437) stays the set time in the position window (ID no. 429).

NOTE

The reference runs -4 and -5 are not as accurate as the reference runs 1 - 6 (101 - 106) because of the switching tolerance of the end switches. However a setting of the encoder offset is not necessary (ID no. 435).

Reference runs -1, -2 and -6 (resolver) or -101, -102 (incremental encoder):

The nearest resolver zero angle is referenced during these modes. At -1 or -101 the drive mover to the right and at -2 or -102 the drive moves to the left to the resover zero angle respectively the zero impulse. At -6 the drive takes the shortest way to the resolver zero angle. The speed during this is unalterable and programmed to 10 I/ms. No reference initiator (end switch or zero point transfer switch) is necessary.

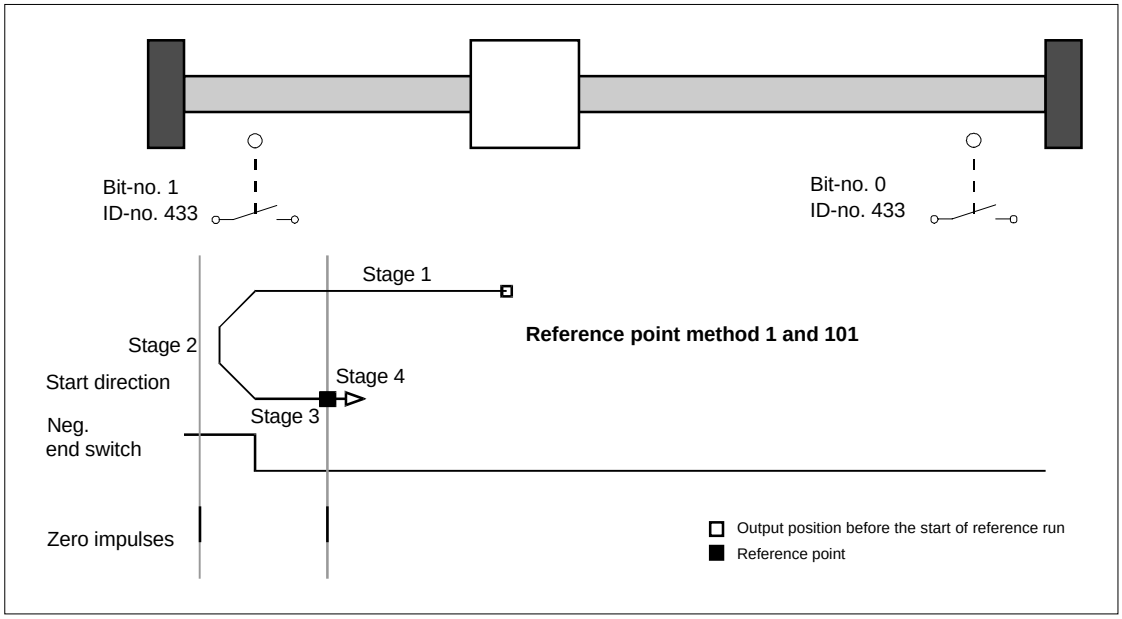
Reference run -3 :

In this mode the position value of the reference point is copied immediatly to the position actual/ set value (ID no. 209 and 208) without movement of the drive!

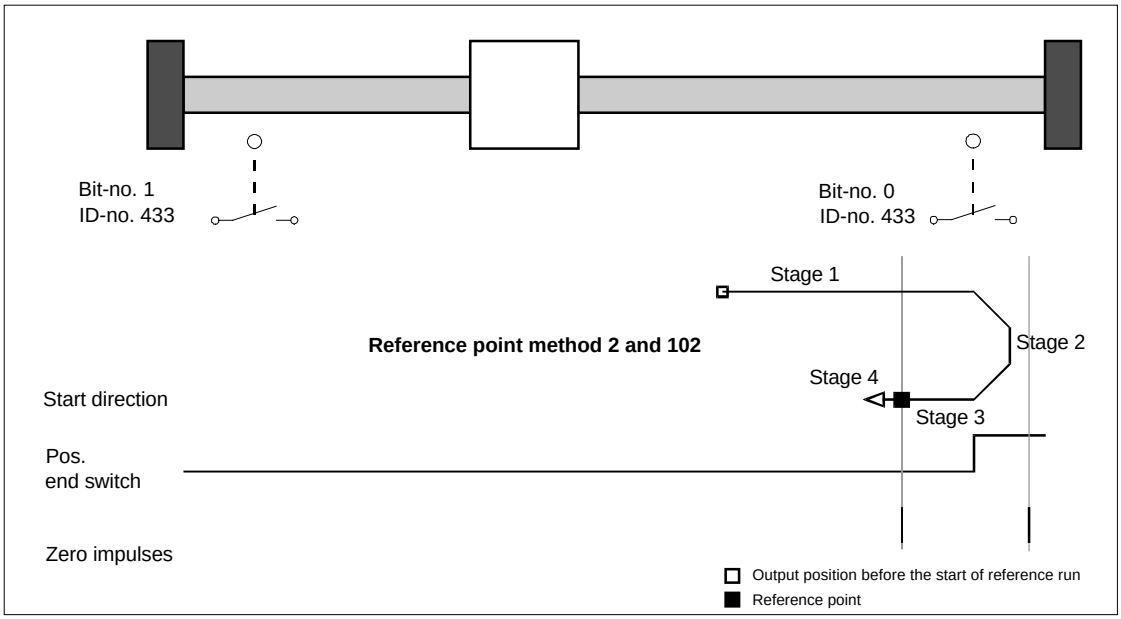
NOTE

- The reference runs -101, -102 and 101 - 106 need an incremental encoder
- If the bit no. 12 in M status word (ID no. 121) is not set after reference run, the value of the parameter POS position range (ID no. 429) must be enlarged.
- If the position of the tool slide does not require a return at reference initiator, phase 1 does not apply and it is accelerated to an eighth of the reference speed (phase 2).
- The zero angle of the resolver for internal calculation can be moved via the parameter *Encoder offset* (ID no. 435) so that it lies outside the tolerances of the switches. The resolver zero angle at *Encoder offset* of 0 increments corresponds to an actual resolver angle of 180°.
- Should the limit switch be exceeded, it is necessary to maintain the condition until the switch is re-activated after a reversal of direction.

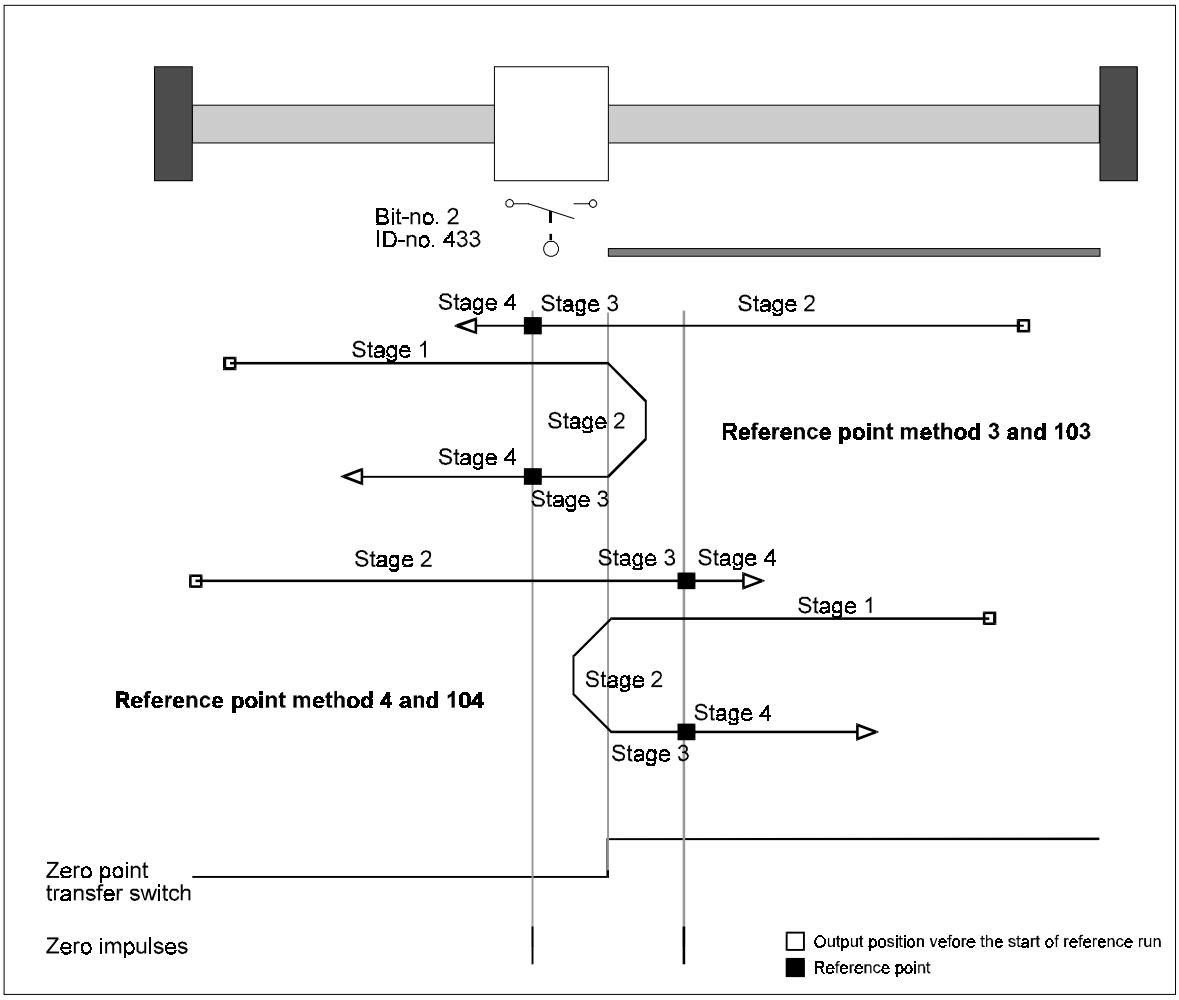
Starting the negative end switch



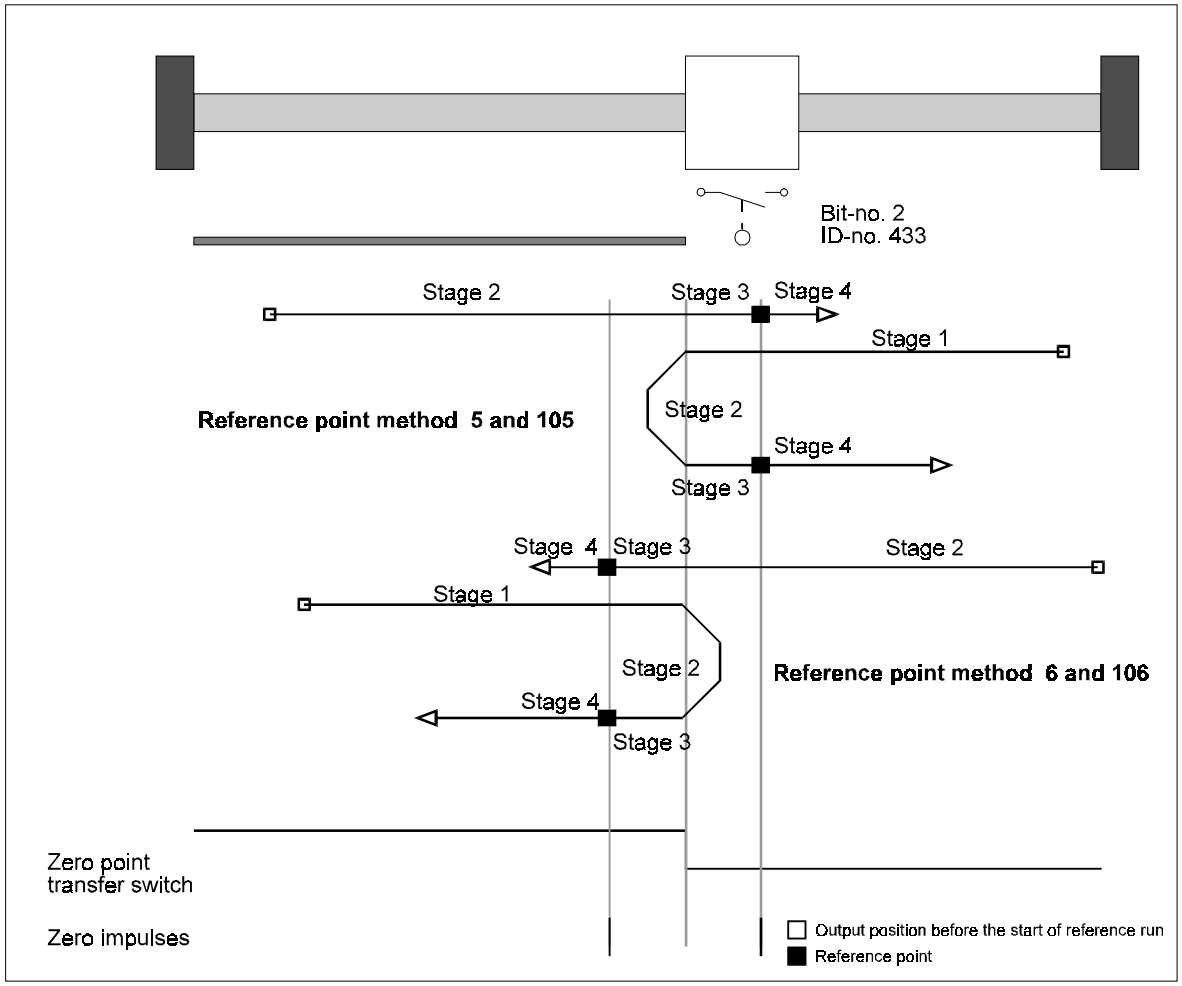
Starting the positive end switch



Starting the positive zero point transfer switch



Starting the negative zero point transfer switch



4 PARAMETERS

With parameters relevant for positioning, differentiation is drawn between global parameters i.e. those applicable to both traversing sets, and position-set related parameters.

4.1 Global parameters

Parameterübersicht

ID no.	Name	Range min. ... max.	Unit	Standard value	Only display
400	POS **module state**	0000 ... FFFF			5
401	POS **current set number**	1 ... 2		1	
402	POS **norm position Z**	1 ... 65535	I	1	
403	POS **norm position N**	1 ... 65535	BE	1	
406	POS **mode**	0000 ... FFFF		0001	
407	POS **rapid halt terminal velocity**	0	I / ms	0	
408	POS **rapid halt deceleration**	0.25 ... 150.00	I / ms^2	5.00	
409	POS **inching speed**	1 ... 4400	I / ms	500	
410	POS **inching acceleration**	0.25 ... 150.00	I / ms^2	2.00	
411	POS **inching deceleration**	0.25 ... 150.00	I / ms^2	2.00	
412	POS **reference speed**	50 ... 4400	I / ms	500	
413	POS **reference acceleration**	0.25 ... 150.00	I / ms^2	5.00	
414	POS **reference run mode**	-102 ... 106		1	
429	POS **positioning tolerance range**	0 ... FFFF FFFF	BE	0000000F	
430	POS **positioning tolerance range time**	1 ... FFFF	ms	8	
431	POS **loose offset**	0 ... FFFF FFFF	BE	00000000	
432	POS **reference point**	0 ... FFFF FFFF	BE	00000000	
433	POS **switch state**	0 ... FFFF			5
434	POS **switch mode**	0 ... FFFF		0000	
435	POS **encoder offset**	0 ... FFFF	I	0	
436	POS **position set value**	0 ... FFFF FFFF	BE		5
437	POS **position actual value**	0 ... FFFF FFFF	BE		5
438	POS **set speed**	-4400 ... +4400	I / ms		5
439	POS **SW end switch 1**	0 ... FFFF FFFF	BE	0	
440	POS **SW end switch 2**	0 ... FFFF FFFF	BE	FFFFFFFF	
441	POS **deviation**	0 ... 8191	ms	0	
442	POS **reference delay.**	0.25 ... 150.00	I / ms^2	5.00	

I = Increments
BE = User units

Standardisation of speeds and acceleration:

1 revolution Û 65536 Increments

$$1000\frac{I}{ms} = 1000 * \frac{60 * 1000}{65536}\ \text{rpm} = 915\ \text{rpm}$$

Parameter description

400 POS **modul state**

This parameter shows the status of the positioning module. The bits are not used from all operation modes.

Bit no.	Meaning	Target postion specification mode	Manual mode	Reference run
0	0: STOP 1: RUN	5	5	5
4	1: SW end switch 1 active	5	5	
5	1: SW end switch 2 active	5	5	
6	1: Initialisation error	5	5	5
7	1: Function completed	5		
8	1: Set position reached ¹ set target	5		
9	1: Error in characteristic data calculation	5		
10	1: Norm position Z < norm position N	5	5	5
11	1: Traversing range will be exceeded	5	5	
12	1: Set value reached	5		5

Note:
- Bit no. 11 is set when the traversing range will be exceeded
- If a rapid halt is ended, all bits are reset and positioning is switched of
- Bit no. 12 „Set value reached“ means in the operational mode „Positional target reached“ and in the reference run „Reference speed reached“.

401 POS **current set number**

The current positioning set is selected via this parameter.

Value	Meaning
1	Positioning data set 1 active
2	Positioning data set 2 active

402 POS **norm position Z**
403 POS **norm position N**

These parameters are used for the conversion of the application-specific position parameters into the internal number standardisation (1 motor revolution ⇔ 65536 increments).

Application-specific position parameters are all global parameters and all positioning set parameters which contain the abbreviation BE (user unit) in their unit.

Conversion to standardisation, using a position input parameter by way of example:

$$\text{Input parameter}[\text{I}] = \text{input parameter}[\text{BE}] \bullet \frac{\text{POS position norm Z } [\text{Inc}]}{\text{POS position normN } [\text{BE}]}$$

NOTE

- Condition 1: POS norm position Z ³ POS norm position N
  If this condition is not met, the last-described standardisation parameter remains set to its old value and bit no. 10 in module state is set.
  The bit is only reset and the new standardisation accepted when one of the two parameters is altered so that the condition is met.
- Condition 2:
  The permitted limits of the application-specific position input parameters are reduced by factor $\frac{\text{POS position norm N}}{\text{POS position norm Z}}$. Monitoring does not take place on exceeding these limits and is the responsibility of the user.
- On conversion to standardisation of the application-specific input parameters, all values are rounded off. Positioning takes place corresponding to the possible calculation accuracy. However, no position values are lost in the event of repeated relative positioning, if the ramp is calculated newly before start, the calibration factors are set to 1 or the factor $\frac{\text{POS position norm N}}{\text{POS position norm Z}}$ is an integer.

406 POS **mode**

This parameter switches functions on respectively off.

Bit no.	Meaning
0	1: Software end switches active
1 - 15	Reserved

Note: The function of the software end switches has to be fixed before first positioning.

407 POS **rapid halt terminal speed**

Not implemented.

408 POS **rapid halt terminal speed**

The deceleration in the case of a rapid halt is entered via this parameter. If the rapid halt is to take place corresponding to this slope, the parameter M rapid halt code (ID no. 131) must be set to 1 or 2. Positioning is only switched off after completion of the rapid halt. Otherwise, positioning is immediately switched off and the rapid halt is carried out according to the selection code.

NOTE

In the operation mode target position specification the switching off effects in delete the positioning data. After switching on the ramp has to be calculated newly.

409 POS **inching speed**

The inching speed corresponds to the drive´s traversing speed in manual mode.

410 POS **inching acceleration**

The inching acceleration describes the maximum acceleration of the drive in manual mode.

411 POS **inching deceleration**

The inching deceleration corresponds to the maximum deceleration of the drive in manual mode.

412 POS **reference speed**

The reference run speed corresponds to the total maximum traversing speed of the drive in reference run mode.

413 POS **reference acceleration**

The reference run acceleration corresponds to the maximum acceleration of the drive in reference run mode. The rapid halt deceleration value (ID no. 408) applies for braking the drive in reference run mode.

414 POS **reference run mode**

This parameter describes the reference run procedure. The starting direction of the reference point and the evaluation of the reference initiator are set by the various modes.

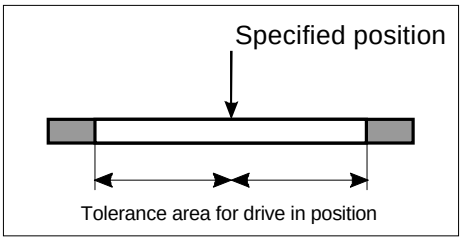
Value	Meaning
-102	Start-up of encoder zero impulse with left turn (method -102)
-101	Start-up of encoder zero impulse with right turn (method -101)
-6	Start-up of next resolver-zero-angle (method -6)
-5	Start-up of the positive end switch (method -5)
-4	Start-up of the negative end switch (method -4)
-3	Set reference point (method -3)
-2	Start-up of next resolver-zero-angle with left turn (method -2)
-1	Start-up of next resolver-zero-angle with right turn (method -1)
1	Start-up of the negative end switch with resolver reference run (method 1)
2	Start-up of the positive end switch with resolver reference run(method 2)
3	Start-up of the positive zero point transfer switch with resolver reference run (method 3)
4	Start-up of the positive zero point transfer switch with resolver reference run (method 4)
5	Start-up of the negative zero point transfer switch with resolver reference run (method 5)
6	Start-up of the negative zero point transfer switch with resolver reference run (method 6)
101	Start-up of the negative end switch with zero impulse reference run (method 101)
102	Start-up of the positive end switch with zero impulse reference run(method 102)
103	Start-up of the positive zero point transfer switch with zero impulse reference run (method 103)
104	Start-up of the positive zero point transfer switch with zero impulse reference run (method 104)
105	Start-up of the negative zero point transfer switch with zero impulse reference run (method 105)
106	Start-up of the negative zero point transfer switch with zero impulse reference run (method 106)

NOTE

For the reference runs -101, -102 and 101 - 106 a incremental encoder is necessary.

429 POS **position tolerance range**

If the drive reaches a tolerance range around the new target position, the bit "Target position reached" is set in the status word. The target position is in the centre of this range. Its size is set by the parameter "Position tolerance range".



430 POS **position talerance range time**

In order to prevent the bit "Drive in position" being set in the event of the positioning range being temporarily entered, a time can be set, via this parameter, during which the drive must be in the positioning range before correct positioning is announced.

431 POS **loose offset**

Not implemented.

432 POS **reference point**

The position value POS reference point is the absolute position of the drive at the reference point. This value must be set before reference run is started. Has the drive reached the reference point after the reference run this position value is copied to position set value and position actual value. The value of the reference point must be within the permitted positioning range, i.e. between the software end switches (ID no. 439 and 440).

433 POS **status switch**

The status of the end switch, the reference initiator and the rapid halt switch are represented by this parameter.
If the bit which corresponds to the switch is bit 1, the switch is operated.

Bit no.	Meaning
0	End switch positive
1	End switch negative
2	Reference initiator status
3 - 15	Unassigned

Examples: Programming of digital Input 0 for postitive end switch.
(method 2)

DI ID no. input 0 = 433	ID no. 370
DI bit selction 0 = 1 = 0001 $_{hex}$	ID no. 371
DI LOW-format 0 = 0 = 0000 $_{hex}$	ID no. 372
DI HIGH-format 0 = 1 = 0001 $_{hex}$	ID no. 373

Programming of digital input 0 for negative end switch.
(method 1)

DI ID no. input 0 = 433	ID no. 370
DI bit selction 0 = 2 = 0002 $_{hex}$	ID no. 371
DI LOW-format 0 = 0 = 0000 $_{hex}$	ID no. 372
DI HIGH-format 0 = 2 = 0002 $_{hex}$	ID no. 373

Programming of digital input 0 for zero point transfer switch
(method 3 .. 6)

DI ID no. input 0 = 433	ID no. 370
DI bit selction 0 = 4 = 0004 $_{hex}$	ID no. 371
DI LOW-format 0 = 0 = 0000 $_{hex}$	ID no. 372
DI HIGH-format 0 = 4 = 0004 $_{hex}$	ID no. 373

434 POS **mode switch**

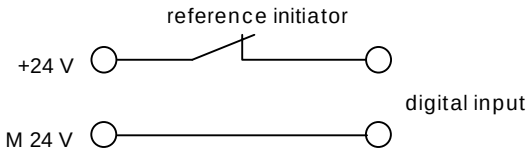
Each end switch, the reference initiator and the rapid halt can all be set individually as a make or a break contact via this parameter.

Bit no.	Meaning
0	End switch mode positive
1	End switch mode negative
2	Reference initiator mode
3 - 14	Reserved
15	Rapid halt mode

Bit = 0: Switch is a make contact

Bit = 1: Switch is a break contact

Connection of the digital inputs (prefer because of wire break):



435 POS **encoder offset**

The encoder offset is added to the current resolver angle during the reference run and thus permits movement of the zero angle signal. The zero angle signal can hence be set outside the switching tolerance of the end switch or reference initiator.

436 POS **postion set value**

The position set value created on positioning is displayed in BE (see ID no. 208 Position set value in increments).

437 POS **postion actual value**

The current position actual value is displayed in BE (see ID no. 209 Position set value in increments).

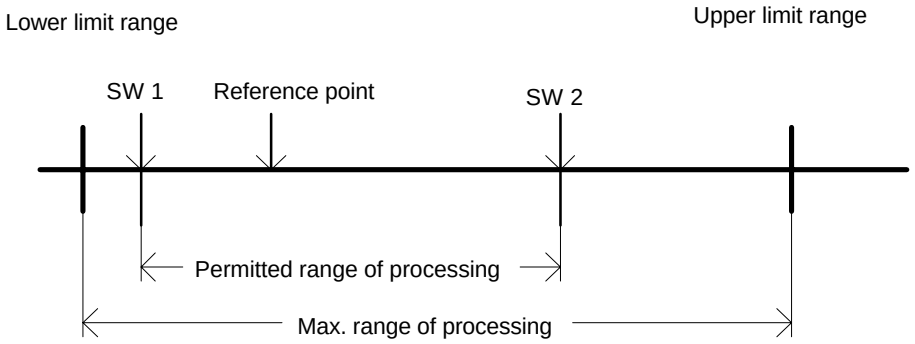
438 POS **set speed**

The current set speed set on positioning is displayed in $\frac{I}{ms}$.

439 POS **SW end switch 1**

440 POS **SW end switch 2**

The 2 parameters limit the permitted range of processing in the operational mode target postion and manual mode.



Lower limit range = 0000 0000 $_{hex}$;

Upper limit range = $FFFFFFFF_{hex} \bullet \frac{\text{POS position norm N (ID no. 403)}}{\text{POS position norm Z (ID no. 402)}}$;

The limit switch 1 contains the value for the permitted processing range start, the limit switch 2 contains the permitted processing range end.

Following requirements must be satisfied for the correct functioning of the software end switches:

- Bit no. 0 must be set in parameter POS mode (ID no. 406)
- A reference run must be carried out before switching over to the target position specification mode or manual mode. SW limit switches are not active in reference run!
- 0 < SW end switch 1 < reference point < SW end switch 2 < upper limit range.
- The maximum range must not be exceeded (apart from the reference run).

Function of the software end switches:

- In the target postion specification mode (ID no. 122 = 1)
  By means of *New set value = 1* a new position set is accepted. Thus, the target postion ist outside the permitted processing range, is checked by calculation the positioning data. Is this the case a process ramp is calculated to the SW end switch whose value should be exceeded. Additionally either the bit no. 4 for the limit switch 1 or the bit no. 5 for SW end switch 2 is set in the module state (ID no. 400).
  The drive can stand outside the newly permitted process range if the value of a SW end switch is altered after the reference run. The activation of the display in *POS module state* as well as the validity of the new value are effected by the next transfer of data. Should the pre-set target position lie outside, it will, independent of the target reading, be positioned according to the SW end switch.
- In the manual mode (ID no. 122 = 5):
  As soon as a SW end switch is reached, the drive will slow down according the *set POS rapid halt deceleration* (ID-no. 408) and the corresponding bit at the *POS module state* will be activated. A Movement is only possible in the opposite direction of travel.
  Should the value of a SW end switch altered after the reference run the drive position could lie outside the newly permitted process range. The display is activated in the *POS module state* as soon as an inching is carried out.

It is only after a complete optimisation and commissioning of the positioning the drive will possess 2 SW end switches in the operation modes target position specification and manual mode, so that no mechnical end switches are required in this operating modes. However, to systematically reduce the enormous energy produced by an moving drive, limit switches are unalterably connected to the power module or influence the pulse enabling setting of the controller.

441 POS **rounding**

To round the edges of the ramps a PT_1 term is implemented. This parameter sets the integration time. The rounding is not active if the setting is 0 ms.

442 POS **reference decelaration**

The reference run deceleration indicates the maximum drive deceleration during the reference run.

4.2 Positioning data set parameters

A selection can be made between 2 positioning data sets. If the *Set value acknowledgement* is set in the status (ID no. 121) switching can be undertaken via parameter *POS current data set number* (ID no. 401) and/or the same positioning data set can be overwritten with new data. If, however, relative positioning is to be newly undertaken around the same position difference, this is not necessary.

Parameterübersicht

ID no.	Name	Range min. ... max.	Unit	Standard value	Only display
415	POS **target position 1**	0 ... FFFF FFFF	BE	00000000	
416	POS **target input 1**	-1 ... +1		0	
417	POS **positioning speed 1**	1 ... 4400	I / ms	100	
418	POS **terminal velocity 1**	0	I / ms	0	
419	POS **positioning acceleration 1**	0.25 ... 150.00	I / ms^2	5.00	
420	POS **positioning deceleration 1**	0.25 ... 150.00	I / ms^2	1.00	
421	POS **dwell 1**	0 ... 65535	ms	1	
422	POS **target position 2**	0 ... FFFF FFFF	BE	00000000	
423	POS **target input 2**	-1 ... +1		0	
424	POS **positioning speed 2**	1 ... 4400	I / ms	100	
425	POS **terminal velocity 2**	0	I / ms	0	
426	POS **positioning acceleration 2**	0.25 ... 150.00	I / ms^2	5.00	
427	POS **positioning deceleration 2**	0.25 ... 150.00	I / ms^2	1.00	
428	POS **dwell 2**	0 ... 65535	ms	1	

415 **POS target position 1**
422 **POS target position 2**

The target position is the position at which the drive has reached terminal velocity.

416 **POS target input 1**
423 **POS target input 2**

The "target input" describes whether the target position is entered absolutely or is to be started relatively to the last set position.

Value	Meaning
-1	relative, rotating anticlockwise
0	absolute
+ 1	relative, rotating clockwise

Multiple starting of the identical ramp without fresh calculation of the positioning data via relative positioning:

- With standarisation factors ≠ 1 a cumulative error can occur via the revolution of BE when no new calculation take place.
- Should the positioning function identify during a multiple start that a SW limit switch has been overrun, the corresponding bit will be triggered an the actual set position will be re-instated (POS window and POS window time are considered).
- Once the controller is switched on, the positioning data will possess their initialised values, that means no process ramp available.
- Should the operating mode target position specification be switched off (impulse blocked, rapid stop, operation mode change) then the process set previously calculated will be deleted. The data must be newly calculated, after switching-on again, before repeat starting.

417 **POS positioning speed 1**
424 **POS positioning speed 2**

The positioning speed refers to the maximum traversing speed of the drive in positioning mode.

418 **POS terminal velocity 1**
425 **POS terminal velocity 2**

Not implemented.

419 **POS positioning acceleration 1**
426 **POS positioning acceleration 2**

The maximum acceleration of the drive in positioning mode is set via this parameter.

420 **POS positioning deceleration 1**
427 **POS positioning deceleration 2**

As with maximum acceleration, the positioning deceleration shows the maximum deceleration of the drive in positioning mode.

421 POS **dwell 1**
428 POS **dwell 2**

Not implemented.

5 TESTING OPERATION MODE

The procedure for testing the operation modes reference run, target position specification und manual mode are described in the following chapters.

NOTE
The drive must be optimised before tested!

5.1 Testing operation mode reference run

- **Optimising relevant parameters**

  Setting of mode form external user units (BE) to internal increments (I)

POS norm position Z	e.g. 1	ID no. 402
POS norm position N	e.g. 1	ID no. 403

  If both parameters are set to one, then 1 increment (I) = 1 user unit (BE).

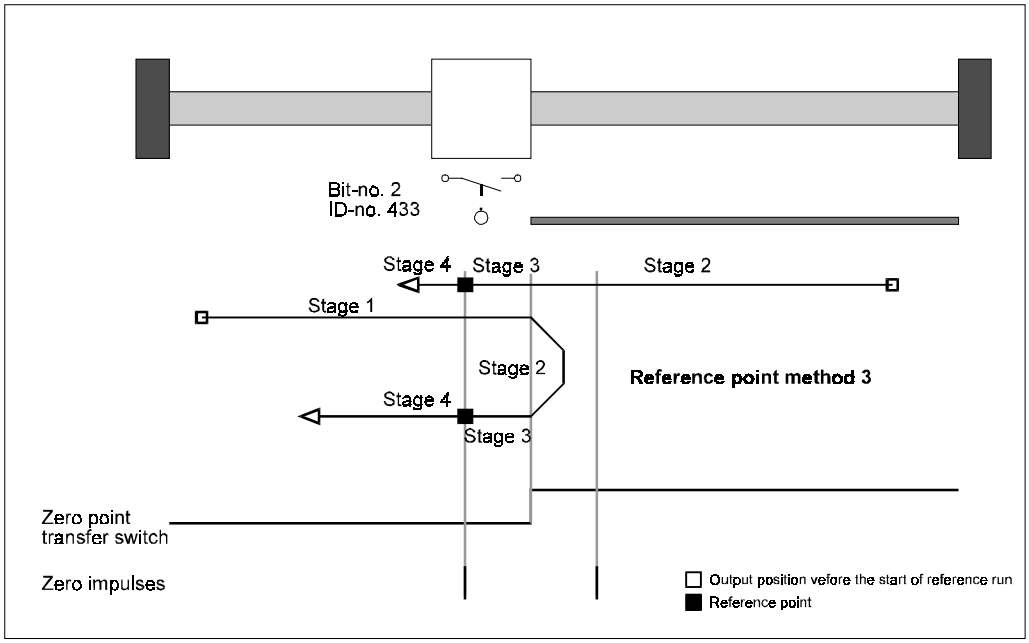
  The definition of the motor direction is set in the parameter *RFG polarity* (ID no. 17).
  If the parameter ID no. 17 is 0 the motor will turn, with progressively greater positional values, to the right. If RFG polarity is 1, it will turn to the left.
  In the example the RFG polarity shoult be set to 0.

  Setting of the speed profile during reference run

POS reference speed	e.g. 500 l/ms	ID no. 412
POS reference acceleration	e.g. 5.00 l/ms^2	ID no. 413
POS reference delay	e.g. 10.00 l/ms^2	ID no. 442

  The positional value which the absolute position of the drive at the reference point indicates must be input into parameter POS reference point (ID no. 432), e.g. 655360 BE.

  The position of the reference point and the start direction, i.e. the exact cycle of the reference run is set via parameter *POS reference run mode* (ID no. 414).



In this example method 3 (starting the positive zero point transfer switch) must be used. This means that the zero point transfer switch left of the zero point must be always un-activated and the zero point transfer switch right of the zero point must be always activated. The reference point lies right of the zero!
⇒ *POS reference run mode* z.B. 3 (ID no. 414)

In the *POS mode switch* (ID no. 434) each reference initiator can be set separatly, whether it is a normally open or normally closed contact.
Because of the set *POS reference run mode* in the example the zero point transfer switch is only evaluated during the reference. The zero point transfer switch used is a normally closed contact.
⇒ *POS mode switch :* 0004_{hex} (Bit no. 2 = 1)
The bit no. 0 und 1 are not relevant for *POS reference run mode*.

The parameter *POS encoder offset* (ID no. 435) is set to 0.

NOTE

In this operating mode the parameter *P N pre-control* (ID no. 207) must be 100 %.!

- **Programming of the digital input for the reference run**
  In the example the digital input 0 is programmed at bit no. 2 parameter POS switch state (ID no. 433).
  DI ID no. input 0 = 433 ID no. 370
  DI bit selection 0 = 0004_{hex} ID no. 371
  DI LOW pattern 0 = 0000_{hex} ID no. 372
  DI HIGH pattern 0 = 0004_{hex} ID no. 373

NOTE

The Eingabe of 0000_{hex} is required! In parameter DI state (ID no. 382) bits 0 to 3 must be set to ensure that the digital input is switched relative to the software.

For testing the reference initiator it can be activated manually. A verification is required that in parameter POS state switch (ID no. 433) is set the corresponding bit. In the example bit no. 2 must be set if the reference initiator is activated.
Care should be taken in optimising that selected bit (via the digital input) of the POS state switch (ID no. 433) corresponds to the POS reference run mode (ID no. 414). (See description parameter ID no. 433)

- **Setting of operation mode**
  Parameter M set operation mode (ID no. 122) must be set on 6 for reference run mode.

- **Drive manager override**
  For override of drive manager following input sequence is required.:
  M control word = 6 = 0006_{hex} (command stand still) ID no. 120
  M control word = 15 = $000F_{hex}$ (command operation override) ID no. 120

- **Setting external impulse release**
  Please use operation manual in the event of questions relating to plug pin assignment.

- **Starting reference run**
  Set bit no. 4 in parameter *M control word* (ID no. 120).
  ⇒ Reference run is being executed;
  ⇒ Reference run is terminated if *M status word* (ID no. 121) bit no. 12 is set.

  Behaviour of drive in example:
  - The drive rests right of zero point:
    After starting signal the drive moves at *POS reference speed* (ID no. 412) in direction of zero point, turns around at zero point and stands still at reference point.
    (Stages 1 to 4; see chapter 3.4).
  - The drive rests left of zero point:
    After starting signal the drive moves at one eight of the set speed in ID no. 412 toward the zero point, overruns zero point and stands still at reference point (stages 2 to 4, see chapter 3.4).

- **Check list for avoiding faults:**
  - Drive doesn´t start
    ⇒ Is the drive released and the external impuls release set?
    ⇒ Is M actual operating mode = 6 (ID no. 123) ?
    ⇒ Is positioning activated, bit no. 0 = 1 at *POS module state* (ID no. 400) ?
    ⇒ Is RFG input selection = 1 (ID no. 13) ?
    ⇒ Is start bit set in *M control word* (bit no. 4, ID no. 120)?
    ⇒ Is bit no. 12 set in *M status word* (ID no. 121)? If yes then the drive rests probably near the reference initiator. Because of the short displacement the movement is rot recognised.
  - Drive doesn´t respond to reference initiator signal
    ⇒ Is M actual operating mode = 6 (ID no. 123)?
    ⇒ Is positioning activated, bit no. 0 =1 at *POS module state* (ID no. 400) ?
    ⇒ Is RFG input selection = 1 (ID no. 13) ?
    ⇒ Check programming of digital input (see 5.1.2)
  - Bit no. 12 in M status word (ID no. 121) is not set after reference run is carried out.
    ⇒ Enlarge POS position tolerance range (ID no. 429) until bit is set.
    ⇒ Enlarge POS position tolerance range time (ID no. 430) until bit is set.

- Drive is moving at lower speed than set in *POS reference speed* (ID no. 412)
  ⇒ Is M actual operating mode = 6 (ID no. 123)?
  ⇒ Is positioning activated, bit no.0 =1 at *POS module state* (ID no. 400) ?
  ⇒ Is RFG input selection = 1 (ID no. 13) ?
  ⇒ State of reference initiator is activated hence the drive is only moving one eight of the reference speed.
  ⇒ Check programming of digital input, in the event the drive movement being incorrect (see 5.1.2)
  ⇒ Check *POS mode switch* (ID no. 434)!
- After start drive is moving in wrong direction
  ⇒ Is M actual operating mode = 6 (ID no. 123)?
  ⇒ Is positioning activated, bit no.0 =1 at *POS module state* (ID no. 400) ?
  ⇒ Is RFG input selection = 1 (ID no. 13) ?
  ⇒ State of reference initiator is activated hence the drive is only moving one eight of the reference speed.
  ⇒ Check parameter RFG polarity (ID no. 17) !
  ⇒ Check programming of digital input, in the event the drive movement being incorrect (see 5.1.2)
  ⇒ Check *POS mode switch* (ID no. 434)!
  ⇒ Check *POS reference run mode* (ID no. 414)!
- After starting multiple reference runs there are two reference points.
  ⇒ change encoder zero angle with *POS encoder offset* (ID no. 435), e.g 32768 increments.
- The input at parameter *POS norm position Z* (ID no. 402) or *POS norm position N* (ID no. 403) is not accepted.
  ⇒ Following condition must be realised: *POS norm positionZ* ³ POS norm position N!
- The input at parameter *POS reference point* (ID no. 432), *POS SW end switch 1* (ID no. 439) or *POS SW end switch 2* (ID no. 440) is not accepted.
  ⇒ Following condition must be realised:
  POS SW end switch 1 < *POS reference point* < *POS SW end switch 2*

5.2 Testing operating mode target position specification

Before this operation mode a reference run (see chapter 5.1) must have executed.
For the following example the parameter values in chapter 5.1 are valid for the parameters *POS norm position Z* (ID no. 402), *POS norm position N* (ID no. 403), *POS reference point* (ID no.432) und *RFG polarity* (ID no. 17).

- **Optimising of relevant global parameters**
  In parameter *POS modus* (ID no. 406) it is possible to enable and disable the software end switch monitoring. For testing the software end switch must be set on 0001_{hex}. Next the values of the software end switches must be set.
  Pay attention to the following condition:

  POS SW end switch 1 < *POS reference point* < *POS SW end switch 2*

  In the example the value of für *POS reference point* (ID no. 432) is set to 655360 BE. The calibration is defined to 1 BE = 1 Increment (see 5.1.1).
  The permitted traversing range must for example be restricted to 5 motor revolutions to the left and 10 to the right.
  ⇒ *POS SW end switch 1* = (655360 - 5 * 65536) BE = 327680 BE ID no. 439
  ⇒ *POS SW end switch 2* = (655360 + 10 * 65536 BE = 1310720 BE ID no. 440

  The deceleration during rapid halt are set parameter *POS rapid halt deceleration* (ID no. 408) (see 4.1). In the example the value is set to 20.00 I/ms^2.

  Select by *POS current set number* (ID no. 401) the next valid position data for the following calculation of the positioning characteristics, e.g. position data set 1.

  The following 3 parameters are described in detail in chapter 4.1.
  POS position window z.B. 64 BE ID no. 429
  POS position window time z.B. 8 ms ID no. 430
  POS deviation z.B. 0 ms (no deviation) ID no. 441

- **Optimising the position data set parameters**
  The parameters of the first position data set range from ID no. 415 to 421, the parameter of the second position data set from ID no. 422 to 428.
  Example:
  The drive rests after the reference run exactly at reference point.
  (= 655360 BE). Er soll sich nun um sechs Motorumdrehungen nach rechts drehen. In the example position data set 1 was selected, the parameter of which has now to be set.

  1. Possibility: absolute positioning
  POS target position 1 = (655360 + 6 * 65536)BE = 1048576 BE ID no. 415
  POS target input 1 = 0 ID no. 416

  2. Possibility: relative positioning
  POS target position 1 = 6 * 65536 BE = 393216 BE ID no. 415
  POS target input 1 = 1 ID no. 416

The setting of the remaining position data set parameters is independent *POS target input 1.*
The following 3 parameters set out the speed profile when positioning, e.g.

POS positioning speed 1 = 500 l/ms	ID no. 417
POS positioning acceleration 1 = 5.00 l/ms^2	ID no. 419
POS postioning deceleration. 1 = 1.00 l/ms^2	ID no. 420

The parameters *POS end speed.1* (ID no. 418) und *POS dwell 1* (ID no. 421) not yet implemented and therefore it is not necessary to set them!

- **Setting of operation mode**
  Parameter M set operation mode (ID no. 122) must be set on 1.

- **Drive manager override**
  For override of drive manager following input sequence is required.:

M control word = 6 = 0006$_{hex}$ (command stand still)	ID no. 120
M control word = 15 = 000F$_{hex}$ (command operation override)	ID no. 120

- **Setting external impulse release**
  Please use operation manual in the event of questions relating to plug pin assignment.

- **Starting calculation of positioning data**
  Additionally bit no. 4 in *M control word* (ID no. 120) must be set on 1. The calculation is finished if bit no. 12 is set in M status word (ID no. 121). Now it is possible resetting bit no. (ID no. 120) to 0.

- **Starting target position specification**
  Additionally bit no. 11 in *M control word* (ID no. 120) must be set.
  The drive has reached the target postion if bit no. 10 is set on 1 in *M status word* (ID no. 121). In the example parameter *POS position set value* (ID no. 436) displays after finishing the positioning 1048576 BE.

- **Check list for avoiding faults:**
  - Drive doesn´t start
    ⇒ Is the drive released and the external impuls release set?
    ⇒ Is M actual operating mode = 1 (ID no. 123) ?
    ⇒ Is positioning activated, bit no.0 =1 at *POS module state* (ID no. 400) ?
    ⇒ Is RFG input selection = 1 (ID no. 13) ?
    ⇒ Is positioning data calculated?
    ⇒ Is start bit (bit no. 11) in M control word (ID no. 120) set ?
    ⇒ Bit no. 10 „target position reached“ in *M status word* (ID no 121) wasn´t set in the last positioning. Increase value of *POS postion window* (ID no. 429) and/or decrease *POS position window time* (ID no. 430) until the bit is set.
    ⇒ The parameters ID no. 416 respectively 423 (*POS target input 1* bzw. *POS target input 2*) display 0, i.e. absolute positioning is activated. The actual POS position specfied value (ID no. 436) is identical with *POS target input 1* (ID no. 415) respectively *POS target postion 2* (ID no. 422).
    ⇒ Is the software end switch control activated; *POS modus* = 1 (ID no. 406) ?

⇒ Is bit no. 4 and 5 in *POS module state* (ID no. 400) set to 1 ?
If yes then one of the two software end switches had been activated. For further information look at description of parameter *POS SW end switch 1* und *POS SW end switch 2* (ID no. 439 and 440) in chapter 4.1.

- Drive is moving a shorter distance than set
  ⇒ Is the software end switch control activated; *POS modus* = 1 (ID no. 406) ?
  ⇒ Is bit no. 4 and 5 in *POS module state* (ID no. 400) set to 1 ?
  If yes then one of the two software end switches had been activated. For further information look at description of parameter *POS SW end switch 1* und *POS SW end switch 2* (ID no. 439 and 440) in chapter 4.1.
  ⇒ Is the bit no. 9 „Error in characterstic data calculation“ in parameter *POS modul state* (ID no. 400) set to 1 ?
  If yes, please contact hotline.
- Drive positioned a few increments beside the calculated target position.
  ⇒ Was it positioned relatively ? (ID no. 416 or 423 not equal 0)
  ⇒ Was after the last positioning or reference run the state „Operation enabled“ left (impulses not enabled) ?
  If yes, the deviation was caused by a renewed release of the controller.
- The programming of a value on parameter *POS SW end switch 1* (ID no. 439) or *POS SW end switch 2* (ID no. 440) wasn´t possible.
  ⇒ Following condition must be realised:

POS SW end switch 1 < *POS reference point* < *POS SW end switch 2*

5.3 Testing the manual mode

In the following exampe the identical settings are valid für the parameters *RFG polarity* (ID no. 17), *POS norm position Z* (ID no. 402), *POS norm position N* (ID no. 403), *POS mode* (ID no. 406), *POS rapid halt deceleration* (ID no. 408), *POS reference point* (ID no. 432), *POS SW end switch 1* (ID no. 439) und *POS SW end switch 2* (ID no. 440) as in chapter 5.1 and 5.2.

- **Optimising of relevant global parameters**
  The setting of the speed profile during the manual mode is effected by following parameters:

POS inching speed. e.g. 300 l/ms	ID no. 409
POS inching acceleration. e.g. 4.00 l/ms^2	ID no. 410
POS inching deceleration e.g. 6.00 l/ms^2	ID no. 411

- **Setting of operation mode**
  Parameter M set operation mode (ID no. 122) must be set on 5 for reference run mode.

- **Programming of the digital inputs**
  One digital input must programmed on bit no.11 (inching forward) and another on bit no. 12 (inching backward) of *M control word* (ID no. 120).
  e.g.:

  Digital input 1 for inching forward (hier Rechtsdrehung)

DI ID no. input 1 = 120	ID no. 374
DI bit selection 1 = 0800$_{hex}$	ID no. 375
DI LOW pattern 1 = 0000$_{hex}$	ID no. 376
DI HIGH pattern 1 = 0800$_{hex}$	ID no. 377

  Digital input 2 for inching backward (hier Linksdrehung)

DI ID no. input 2 = 120	ID no. 378
DI bit selection 2 = 1000$_{hex}$	ID no. 379
DI LOW pattern 2 = 0000$_{hex}$	ID no. 380
DI HIGH pattern 2 = 1000$_{hex}$	ID no. 381

  NOTE
  The setting of 0000$_{hex}$ is required! In parameter DI state (ID no. 382) bit 4 to 11 must be set to ensure that the digital inputs 1 and 2 are switched relative to the software.

- **Drive manager override**
  For override of drive manager following input sequence is required.:

M control word = 6 = 0006$_{hex}$ (command stand still)	ID no. 120
M control word = 15 = 000F$_{hex}$ (command operation override)	ID no. 120

- **Setting external pulse enabling**
  Please use operation manual in the event of questions relating to plug pin assignment.

- **Starting inching forward**
  Digital input 1 (inching forward) must set bit no. 11 of *M control word*.
  ⇒ The drive turns right until the bit is set to 1 and software end switch 2 isn´t reached.

- **Starting inching backward**
  Digital input 2 (inching backward) must set bit no. 12 of *M control word*.
  ⇒ The drive turns left until the bit is set to 1 and software end switch 1 isn´t reached.

  NOTE

  The drive slows down to speed 0 if bit no. 11 and 12 set in *M control*!

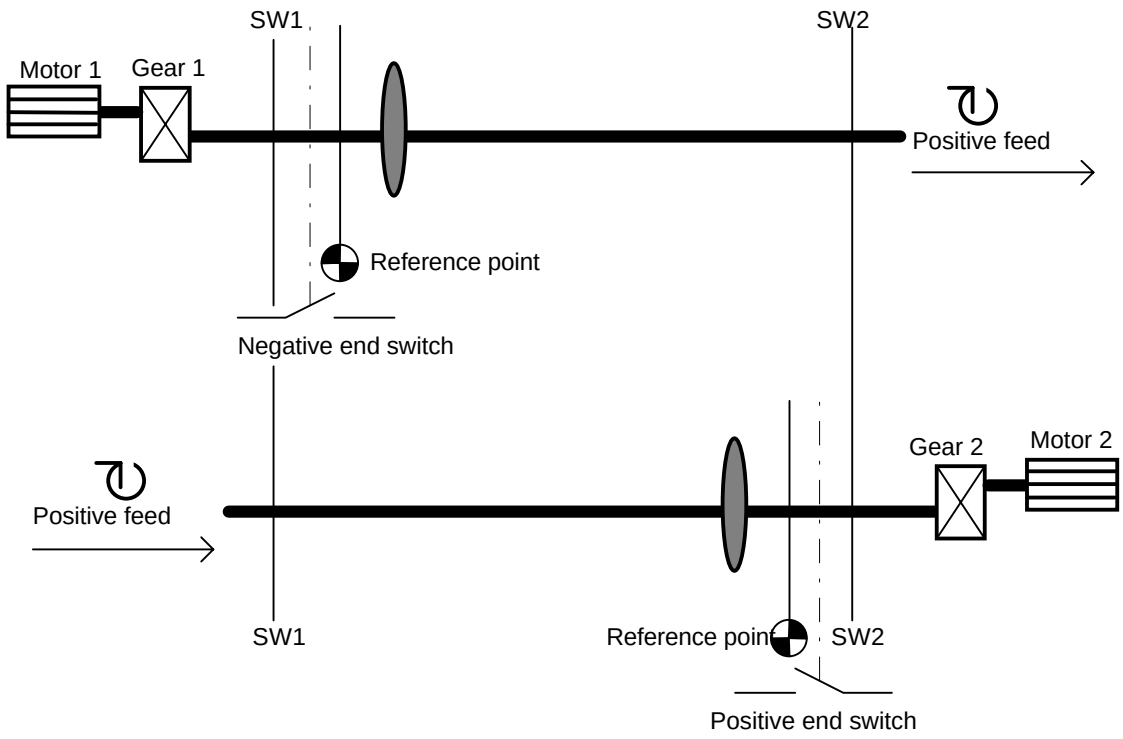
- **Check list for avoiding faults:**
  - Drive doesn´t start
    ⇒ Is the drive released and the external impuls release set?
    ⇒ Is M actual operating mode = 5 (ID no. 123) ?
    ⇒ Is positioning activated, bit no.0 =1 at *POS module state* (ID no. 400) ?
    ⇒ Is RFG input selection = 1 (ID no. 13) ?
    ⇒ Is start bit (bit no. 11) in M control word (ID no. 120) set ?
    ⇒ Are both bit no. 11 and 12 set in M control word (ID no. 120)?
    ⇒ Is the software end switch control activated; *POS modus* = 1 (ID no. 406) ?
    ⇒ Is bit no. 4 and 5 in *POS module state* (ID no. 400) set to 1 ?
    If yes then one of the two software end switches had been activated. For further information look at description of parameter *POS SW end switch 1* und *POS SW end switch 2* (ID no. 439 and 440) in chapter 4.1.
  - The programming of a value on parameter *POS SW end switch 1* (ID no. 439) or *POS SW end switch 2* (ID no. 440) wasn´t possible.
    ⇒ Following condition must be realised:
    POS SW end switch 1 < *POS reference point* < *POS SW end switch 2*

6 APPLICATION EXAMPLE SPINDLE POSITIONING

In the following example the procedure for optimising outlines a type of spindle positioning.

The assembly is depicted below. A spindle-driven slide is to be positioned between both *software end switches* SW1 and SW2. The position of the slide must be indentical for both drive units. The following data is valid for both drive units.

Motor:	n_n = 3000 rpm 1 motor revolution ⇔ 65536 increments ⇒ n_n = 3000rpm * 65536 increments / (60*1000 ms/min) ⇒ n_n = 3000rpm * 1.092 increments*ms/min ⇒ n_n = 3276 increments/ms
Gearbox ratio:	1 : 2,5
Spindle pitch:	6,4 mm
Permissible tranversing rang:	3000 mm (distance SW1 - SW2)



Following calibration must be applied: 1 BE ⇔ $^1/_{100}$ mm

Calculation of calibration parameters:
1 motor ⇔ 65536 I
1 motor revolution ⇔ 2.5 * 6.4 mm = 16 mm
$^1/_{100}$ mm ⇔ 65536 I * $^1/_{100}$ mm / 16 mm
$^1/_{100}$ mm ⇔ 1 BE Û 40.96 I
⇒ *POS norm position Z* = 4096 (ID no. 402)
⇒ *POS norm position N* = 100 (ID no. 403)

It is possible to change the sign of the set value in the module ramp function generator. Both drive units can be set identically after the reference run, if parameter RFG polarity is set followise:

RFG polarity = 0 for drive 1 (ID no. 17)
= 1 for drive 2

Rapid halt:

POS rapid halt deceleration e.g. 20.00 I/ms^2 (ID no. 408)

The rapid halt should be carried out by a digital input.
Programming digital input 0 on *M control word* (ID no. 120):

DI ID no. input 1 = 120 (ID no. 370)
DI bit selection 1 = 4 = 8004 $_{hex}$ (ID no. 371)
DI LOW pattern 1 = 32768 = 8000 $_{hex}$ (ID no. 372)
DI HIGH pattern 1 = 32772 = 8004 $_{hex}$ (ID no. 373)

NOTE

The bit no. 15 in *M control* word is the write protection bit. The setting of this bit prevents the *M control* word to be written over through another communication source before it is processed. The write protection bit is set back automatically.

Settings for the **reference run**:

M control word = 15 = 000F$_{hex}$ = operation enabled	(ID no. 120)	
M desired operation mode = 6	(ID no. 122)	
POS reference speed. e.g. 500 l/ms	(ID no. 412)	
POS reference acceleration. e.g. 5.00 l/ms^2	(ID no. 413) ⇒	results in an acceleration time of 100 ms
POS reference deceleration. e.g. 10.00 l/ms^2	(ID no. 442) ⇒	results in a deceleration time of 50 ms

Set POS reference run mode (ID no. 414):

Drive 1: Movement toward negative end switch ⇒ *POS reference run mode* = 1
POS switch mode = 0 = 0000$_{hex}$ (ID no. 434), becaus of end switch is normally open (*POS switch mode* = 2 = 0002$_{hex}$, if end switch is normally closed)
Programming of digital input 1 for end switch on *POS switch state* (ID no. 433):

DI ID no. input 1 = 433	(ID no. 374)
DI bit selection 1 = 2 = 0002$_{hex}$	(ID no. 375)
DI LOW pattern 1 = 0 = 0000$_{hex}$	(ID no. 376)
DI HIGH pattern 1 = 2 = 0002$_{hex}$	(ID no. 377)

Drive 2: Movement toward positive end switch ⇒ *POS reference run mode* = 2
POS switch mode = 0 = 0000$_{hex}$ (ID no. 434), becaus of end switch is normally open (*POS switch mode* = 2 = 0002$_{hex}$, if end switch is normally closed)
Programming of digital input 1 for end switch on *POS switch state* (ID no. 433):

DI ID no. input 1 = 433	(ID no. 374)
DI bit selection 1 = 2 = 0002$_{hex}$	(ID no. 375)
DI LOW pattern 1 = 0 = 0000$_{hex}$	(ID no. 376)
DI HIGH pattern 1 = 2 = 0002$_{hex}$	(ID no. 377)

The position values of the reference points must be determined. In this example the distance between the reference points must be measured additionally to reach at identical position set values identical spindle positions.
e.g. distance between reference points 2800 mm ⇔ 280 000 BE

⇒ Drive 1:	*POS reference point* = 110 000 BE	(ID no. 432)
⇒ Drive 2:	*POS reference point* = 390 000 BE	(ID no. 432)

Starting reference run: *M control word* bit no.4 is additionally set to 1 ⇒ 31 = 001F$_{hex}$
If bit no. 12 is set in *M status word* the reference run is finished ⇒ 1037$_{hex}$

NOTE

Shift the reference point with the *encoder offset* (ID no. 435) if several reference runs effect in two reference points.

Optimise **software end switches**:

Permitted traversing range 3000 mm ⇔ 300 000 BE
⇒ *POS SW end switch 1* = 100 000 BE (ID no. 439)
⇒ *POS SW end switch 2* = 400 000 BE (ID no. 440)

Optimisation for **manual mode**:

M control word = 15 = 000F $_{hex}$ = operation enabled (ID no. 120)
M desired operation mode = 5 (ID no. 122)
POS inching speed e.g. 200 l/ms (ID no. 409)
POS inching acceleration e.g. 5.00 l/ms^2 (ID no. 410) ⇒ results in a acceleration time of 40ms
POS inching deceleration e.g. 10.00 l/ms^2 (ID no. 411) ⇒ results in a deceleration time of 20 ms
Starting inching forward: Additionally set bit no. 11 in *M control word* ⇒ 2063 = 080F $_{hex}$
Starting inching backward: Additionally set bit no. 12 in *M control word* ⇒ 4111 = 100F $_{hex}$

Optimisation for **target specification mode**:

M control word = 15 = 000F $_{hex}$ = operation enabled (ID no. 120)
M desired operation mode = 1 (ID no. 122)
POS position window e.g. 4 BE (ID no. 429)
POS position window time e.g. 2ms (ID no. 430)
POS current set number e.g. 1 (ID no. 401)

Example for optimisation of **positioning characteristic data**:
The drive 1 has reached after reference run an actual position set value (110000BE). The drive should be positioned (absolute positioning) at 250000 BE. The positioning time must be minimized.

⇒ *POS target position 1* = 250000 BE (ID no. 415)
⇒ *POS target input 1* = 0 (absolute positioning) (ID no. 416)
⇒ *POS position speed 1* = 3276 l/ms ⇔ 3000 rpm (ID no. 417)

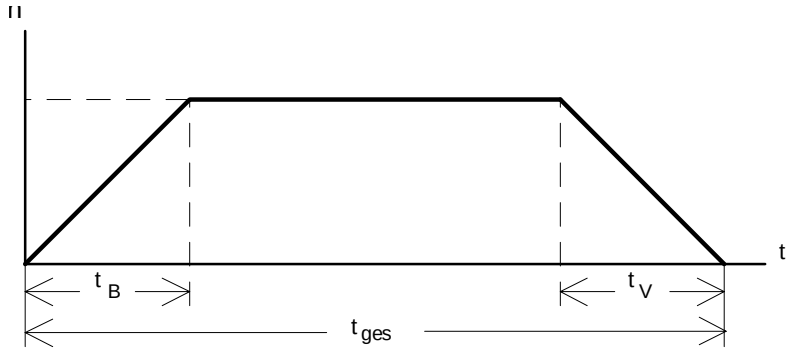
The motor allows following acceleration values:

⇒ *POS position acceleration. 1* = 20.00 l/ms^2 (ID no. 419)
⇒ *POS position deceleration. 1* = 24.00 l/ms^2 (ID no. 420)

Calculate ramp: Additionally set bit no. 4 in *M control word* ⇒ 31 = 001F $_{hex}$
Starting positioning: Additionally set bit no. 11 in *M control word* ⇒ 2063 = 080F $_{hex}$

The positioning is finished if bit no. 7 is set in *POS module state* ⇒ 0081 $_{hex}$
The target position is reached, if bit no. 10 is set in *M status word* ⇒ 0437 $_{hex}$

Acceleration time t_B in ms
Deceleration time t_V in ms
Time in which maximale speed is traveled - t_K in ms
Total traverse time t_{ges} in ms
Maximale speed v in I/ms
Total displacement s in BE
Displacement in acceleration stage s_B in BE
Displacement in deceleration stage s_V in BE
Displacement with maximale speed s_K in BE
Acceleration a_B in I/ms^2
Deceleration a_V in I/ms^2



speed/time curve

$$t_B = \frac{v}{a_B} = \frac{3276\,\frac{I}{ms}}{20\,\frac{I}{ms^2}} \approx 164 \text{ ms}; \quad t_V = \frac{v}{a_V} = \frac{3276\,\frac{I}{ms}}{24\,\frac{I}{ms^2}} \approx 137 \text{ ms};$$

$$s = 250000 \text{ BE} - 110500 \text{ BE} = 139500 \text{ BE}$$

$$s_B = 0.5 \cdot a_B \cdot t_B^{\,2} = 0.5 \cdot 20\,\frac{I}{ms^2} \cdot (164 \text{ ms})^2 = 268960 \text{ I} = 268960 \text{ I} \cdot \frac{100 \text{ BE}}{4096 \text{ I}} \approx 6566 \text{ BE};$$

$$s_V = 0.5 \cdot a_V \cdot t_V^{\,2} = 0.5 \cdot 24\,\frac{I}{ms^2} \cdot (137 \text{ms})^2 = 225228 \text{ I} = 225228 \text{ I} \cdot \frac{100 \text{ BE}}{4096 \text{ I}} \approx 5498 \text{ BE};$$

$$s_K = s - s_V - s_B = (139500 - 5498 - 6566) \text{ BE} \approx 127436 \text{ BE};$$

$$t_K = \frac{s_K}{v} = \frac{127436 \text{ BE} \cdot \frac{4096 \text{ I}}{100 \text{ BE}}}{3276\,\frac{I}{ms}} \approx 1594 \text{ ms};$$

$$t_{ges} = t_B + t_V + t_K = (164 + 137 + 1594) \text{ ms} = 1895 \text{ ms};$$

The aforementioned calculations are valid for a continous position set pre-set. The results correspond, however, with sufficient accurance, to those for discrete set pre-set.