Mocontronic **O**peration **S**ystem - **C**ontrol **L**anguage

an extension to TMCL™

Reference

Table of contents

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

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ISO 9001:2015

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

1 General introduction to MocOS-CL

MocOS-CL (Mocontronic Operation System - Control Language) enables the control of Mocontronic devices via a higher-level computer. MocOS-CL is based on the syntax of TMCL™ (Trinamic Motion Control Language) from Trinamic and offers Mocontronic-specific extensions, that only Mocontronic modules can use.

It also offers an emulation mode to use Mocontronic modules with Master-Software, that is designed to be used with TMCL™ modules from Trinamic/ADI.

With Mocontronic modules, the controller software consists of two main components: a bootloader and the application firmware. The bootloader is installed during production and testing at Mocontronic and remains unchanged for the entire service life of the module. The firmware, on the other hand, can be updated by the user and new versions can be downloaded free of charge from the Mocontronic website.

All Mocontronic modules support MocOS-CL direct mode (binary commands) and independent MocOS-CL programme execution. This makes it possible to write MocOS-CL programmes and save them in the module's memory.

In direct mode, MocOS-CL communication takes place via RS-232, RS-485, CAN and USB in a master/slave architecture. A host computer (e.g. PC or PLC) acts as the bus master and sends commands to the Mocontronic controller. The MocOS-CL interpreter on the module interprets the commands and performs operations such as initialising the motion controller, reading inputs and writing outputs. Once this operation has been completed, the module sends a response back to the bus master. Only then should the master transmit the next command.

The module only switches to transmit to give a response and otherwise remains in receive mode. It does not send any data via the interface without first receiving a command, which prevents bus collisions if several nodes are connected to a single bus.

There are also some extensions that enables the modules to exchange data, if you have more than one module connected. Since MocOS-CL is modularized it is easy for us to extend the base system by customer specific functions to meet your requirements.

MocOS-CL provides a series of structured motion control commands. Each command can be given by a host computer or stored in the memory of the Mocontronic module to create stand-alone running programmes. In addition to motion control commands, there are also commands to control the programme structure, such as conditional jumps, comparisons, and calculations.

Each command has a binary representation that is used for the transmission of commands. In addition, there are configuration variables for the axes and global parameters that allow customisation of almost every function of a module. This manual provides a detailed description of all MocOS-CL commands and their use.

1.1 Supported module and MocDrive series

IKS-12 (only basics), IKS-24, IKS-32, IKS-34, IKS42-14, IKS60-14, IKS-61, MD28, MD42, MD60

The IKS-16 series has its own command set explained in the IKS-16 manual !

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1.2 Binary Command Format

Each command has a binary representation. A core command consists of the following seven bytes: a 1-byte command field, a 1-byte type field, a 1-byte command motor/bank field and a 4-byte value field.

If a command is to be sent via RS-232, RS-485 or USB, it must also contain an address byte at the beginning and a checksum byte at the end. In this case, the total length of the command is nine bytes.

The binary command format for RS-232, RS-485 and USB is as follows:

Table 1 – MocOS-CL Command Format

Position	Number of bytes	Meaning
1	1	Module address
2	1	Command number
3	1	Type number
4	1	Motor or Bank number
5	4	Value (MSB first)
6	1	Checksum

1.3 Reply Format

Each time a command is sent to a module, the module sends a response. The response format for RS-232, RS-485 and USB is as follows:

Table 2 – MocOS-CL Reply Format

Position	Number of bytes	Meaning
1	1	Reply address
2	1	Modul address
3	1	Status
4	1	Command number
5	4	Value (MSB first)
6	1	Checksum

1.4 Notes, remarks

1.4.1 Checksum Calculation

The checksum is calculated by summing all bytes, starting with the module address, using 8-bit addition.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
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1.4.2 Using CAN

When using the CAN interface, the response does not contain an address byte and a checksum byte. With CAN, the CAN ID is used as the response address and the checksum is not required as the CAN bus uses a hardware CRC check.

1.4.3 Status Codes

Each response contains a status code. An overview can be found in Table 3.

Table 3 – MocOS-CL Status Codes

Status Code	Meaning
100	Successfully executed, no error
101	Command loaded into Modul Memory
1	Wrong checksum
2	Invalid command
3	Wrong type
4	Invalid value
5	Configuration EEPROM locked
6	Command not available

1.5 Standalone Applications

The module has a memory in which MocOS-CL applications can be stored. This enables autonomous operation without a higher-level controller.

1.6 MocOS-CL Command Overview

Table 4 – MocOS-CL Command Overview

Command	Number	Parameter	Description
ROR	1	<motor number>, <velocity>	The motor is instructed to rotate with a specified velocity in right direction (decreasing the position counter). The velocity is given in microsteps per second (pulse per second [pps]).
ROL	2	<motor number>, <velocity>	The motor is instructed to rotate with a specified velocity in left direction (increasing the position counter). The velocity is given in microsteps per second (pulse per second [pps]).
MST	3	<motor number>	The MST command stops the motor using a soft stop.
MVP	4	ABS|REL<motor number>, <position|offset>	With this command the motor will be instructed to move to a specified relative or absolute position. It will use the acceleration/deceleration ramp and the positioning speed programmed into the unit. This command is non-blocking - that is, a reply will be sent immediately after command interpretation and initialization of the motion controller. Further commands may follow without

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
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Command	Number	Parameter	Description
			waiting for the motor reaching its end position. The maximum velocity and acceleration as well as other ramp parameters are defined by the appropriate axis parameters. The range of the MVP command is 32 bit signed (-2147483648... 2147483647). Positioning can be interrupted using MST, ROL or ROR commands. Three operation types are available: - Moving to an absolute position in the range from -2147483648... 2147483647 (-2^31...2^31-1). - Starting a relative movement by means of an offset to the actual position. In this case, the new resulting position value must not exceed the above-mentioned limits, too.
SAP	5	<parameter>, <motor number>, <value>	With this command most of the motion control parameters of the module can be specified. The settings will be stored in SRAM and therefore are volatile. That is, information will be lost after power off.
GAP	6	<parameter>, <motor number>	Most motion / driver related parameters of the module can be adjusted using e.g. the SAP command. With the GAP parameter they can be read out. In standalone mode the requested value is also transferred to the accumulator register for further processing purposes (such as conditional jumps). In direct mode the value read is only output in the value field of the reply, without affecting the accumulator.
STAP	7	<parameter>, <motor number> <value>	stores the parameter value permanently in the non-volatile memory of the device, value: don't care
SGP	9	<parameter>, <motor number>, <value>	With this command most of the module specific parameters not directly related to motion control can be specified and the user variables can be changed. Global parameters are related to the host interface, peripherals, or application specific variables. The different groups of these parameters are organized in banks to allow a larger total number for future products. Currently, bank 0 is used for global parameters, and bank 2 is used for user variables. Bank 3 is used for interrupt configuration. All module settings in bank 0 will automatically be stored in non-volatile memory (EEPROM).
GGP	10	<parameter>, <bank number>	All global parameters can be read with this function. Global parameters are related to the host interface, peripherals, or application specic variables. The different groups of these parameters are organized in banks to allow a larger total number for future products. Currently, bank 0 is used for global parameters, and

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Command	Number	Parameter	Description
			bank 2 is used for user variables. Bank 3 is used for interrupt conguration.
STGP	11	<parameter>, <bank number>	This command is used to store global parameters permanently in the EEPROM of the module. This command is mainly needed to store the user variables (located in bank 2) in the EEPROM of the module, as most other global parameters (located in bank 0) are stored automatically when being modied. The contents of the user variables can either be automatically or manually restored at power on.
RSGP	12	<parameter>, <bank number>	With this command the contents of a user variable can be restored from the EEPROM. By default, all user variables are automatically restored after power up. A user variable that has been changed before can be reset to the stored value by this instruction.
RFS	13	<START|STOP|STATUS>, <motor number>	The modules have a built-in reference search algorithm. The reference search algorithm provides different refrence search modes. This command starts or stops the built-in reference search algorithm. The status of the reference search can also be queried to see if it already has nished. (In a program it Mostly is better to use the WAIT RFS command to wait for the end of a reference search.) Please see the appropriate parameters in the axis parameter table to congure the reference search algorithm to meet your needs
SIO	14	<port number>, <bank number>, <value>	This command sets the states of the general-purpose digital outputs. Please not module specific IO functions according to the modules hardware manual.
GIO	15	<port number>, <bank number>	With this command the status of the available general-purpose outputs of the module can be read. The function reads a digital or an analog input port. Digital lines will read as 0 or 1, while the ADC channels deliver their 12-bit result in the range of 0. . . 4095. In standalone mode the requested value is copied to the accumulator registers for further processing purposes such as conditional jumps. In direct mode the value is only output in the value field of the reply, without affecting the accumulator. The actual status of a digital output line can also be read. Setting “Motor” to 0 reads the inputs as digital, Setting “Motor” to 1 reads the inputs as analog. Please not module specific IO functions according to the modules hardware manual.
CALC	19	<operation>, <value>	A value in the accumulator variable, previously read by a function such as GAP (get axis parameter) can be modied with this instruction. Nine different

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
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Command	Number	Parameter	Description
			arithmetic functions can be chosen and one constant operand value must be specied. The result is written back to the accumulator, for further processing like comparisons or data transfer. This command is mainly intended for use in standalone mode.
COMP	20	<value>	The specied number is compared to the value in the accumulator register. The result of the comparison can for example be used by the conditional jump (JC) instruction. This command is intended for use in standalone operation only.
JC	21	<condition>, <jump address>	The JC instruction enables a conditional jump to a fixed address in the program memory, if the specified condition is met. The conditions refer to the result of a preceding comparison. Please refer to COMP instruction for examples. This command is intended for standalone operation only.
JA	22	<jump address>	Jump to a fixed address in the program memory. This command is intended for standalone operation only.
CSUB	23	<subroutine address>	This function calls a subroutine in the program memory. It is intended for standalone operation only.
RSUB	24		Return from a subroutine to the command after the CSUB command. This command is intended for use in standalone mode only.
EI	25	<interrupt number>	The EI command enables an interrupt. It needs the interrupt number as parameter. Interrupt number 255 globally enables interrupt processing. This command is mainly intended for use in standalone mode
DI	26	<interrupt number>	The DI command disables an interrupt. It needs the interrupt number as parameter. Interrupt number 255 globally disables interrupt processing. This command is mainly intended for use in standalone mode.
WAIT	27	<condition>, <motor number>, <ticks>	This instruction interrupts the execution of the program until the specified condition is met. This command is intended for standalone operation only. There are five different wait conditions that can be used: • TICKS: Wait until the number of timer ticks specified by the <ticks> parameter has been reached. • POS: Wait until the target position of the motor specified by the <motor> parameter has been reached. An optional timeout value (0 for no timeout) must be specified by the <ticks> parameter. • REFSW: Wait until the reference switch of the motor specified by the <motor> parameter has been

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
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Command	Number	Parameter	Description
			triggered. An optional timeout value (0 for no timeout) must be specified by the <ticks> parameter. • LIMSW: Wait until a limit switch of the motor specified by the <motor> parameter has been triggered. An optional timeout value (0 for no timeout) must be specified by the <ticks> parameter. • RFS: Wait until the reference search of the motor specified by the <motor> field has been reached. An optional timeout value (0 for no timeout) must be specified by the <ticks> parameter. Special case for the <ticks> parameter: When this parameter is set to -1 the contents of the accumulator register will be taken for this value. So, for example WAIT TICKS, 0, -1 will wait as long as specified by the value store in the accumulator. The accumulator must not contain a negative value when using this option. The timeout flag (ETO) will be set after a timeout limit has been reached. You can then use a JC ETO command to check for such errors or clear the error using the CLE command.
STOP	28		This command stops the execution of a program. It is intended for use in standalone operation only.
SCO	30	<coordinate number>, <motor number>, <position>	Up to 20 position values (coordinates) can be stored for every axis for use with the MVP COORD command. This command sets a coordinate to a specified value. Depending on the global parameter 84, the coordinates are only stored in RAM or also stored in the EEPROM and copied back on startup (with the default setting the coordinates are stored in RAM only).
GCO	31	<coordinate number>, <motor number>, <position>	Using this command previously stored coordinate can be read back. In standalone mode the requested value is copied to the accumulator register for further processing purposes such as conditional jumps. In direct mode, the value is only output in the value eld of the reply, without affecting the accumulator. Depending on the global parameter 84, the coordinates are only stored in RAM or also stored in the EEPROM and copied back on startup (with the default setting the coordinates are stored in RAM only).
CCO	32	<coordinate number>, <motor number>, <position>	This command copies the actual position of the axis to the selected coordinate variable. Depending on the global parameter 84, the coordinates are only stored in RAM or also stored in the EEPROM and copied back on startup (with the default setting the coordinates are stored in RAM only). Please see the SCO and GCO commands on how to copy coordinates between RAM and EEPROM.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
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Command	Number	Parameter	Description
CALCX	33	<operation>	This instruction is very similar to CALC, but the second operand comes from the X register. The X register can be loaded with the LOAD or the SWAP type of this instruction. The result is written back to the accumulator for further processing like comparisons or data transfer. This command is mainly intended for use in standalone mode.
AAP	34	<parameter>, <motor number>	The content of the accumulator register is transferred to the specified axis parameter. For practical usage, the accumulator must be loaded e.g. by a preceding GAP instruction. The accumulator may have been modified by the CALC or CALCX (calculate) instruction. This command is mainly intended for use in standalone mode.
AGP	35	<parameter>, <bank number>	The content of the accumulator register is transferred to the specied global parameter. For practical usage, the accumulator must be loaded e.g. by a preceding GAP instruction. The accumulator may have been modified by the CALC or CALCX (calculate) instruction. This command is mainly intended for use in standalone mode.
CLE	36	<flag>	This command clears the internal error ags. It is mainly intended for use in standalone mode. The following error flags can be cleared by this command (determined by the <flag> parameter):
VECT	37	<interrupt number>, <address>	The VECT command defines an interrupt vector. It takes an interrupt number and a label (just like with JA, JC and CSUB commands) as parameters. The label must be the entry point of the interrupt handling routine for this interrupt. Interrupt vectors can also be re-defined. This command is intended for use in standalone mode only.
RETI	38		This command terminates an interrupt handling routine. Normal program flow will be continued then. This command is intended for use in standalone mode only.
ACO	39	<coordinate number>, <motor number>	With the ACO command the actual value of the accumulator is copied to a selected coordinate of the motor. Depending on the global parameter 84, the coordinates are only stored in RAM or also stored in the EEPROM and copied back on startup (with the default setting the coordinates are stored in RAM only).
CALCVV	40	<operation>, <user variable 1>, <user variable 2>	The CALCVV instruction directly uses the contents of two user variables for an arithmetic operation, storing the result in the first user variable. This eliminates the need for using the accumulator register and/or X register for such purposes. The parameters of this

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
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Command	Number	Parameter	Description
			command are the arithmetic function, the index of the first user variable (0. . . 255) and the index of the second user variable (0. . . 255). This command is mainly intended for use in standalone mode.
CALCVA	41	<operation>, <user variable>	The CALCVA instruction directly modifies a user variable using an arithmetical operation and the contents of the accumulator register. The parameters of this command are the arithmetic function and the index of a user variable (0. . . 255). This command is mainly intended for use in standalone mode.
CALCAV	42	<operation>, <user variable>	The CALCAV instruction modifies the accumulator register using an arithmetical operation and the contents of a user variable. The parameters of this command are the arithmetic function and the index of a user variable (0. . . 255). This command is mainly intended for use in standalone mode.
CALCVX	43	<operation>, <user variable>	The CALCVX instruction directly modifies a user variable using an arithmetical operation and the contents of the X register. The parameters of this command are the arithmetic function and the index of a user variable (0. . . 255). This command is mainly intended for use in standalone mode.
CALCXV	44	<operation>, <user variable>	The CALCXV instruction modifies the X register using an arithmetical operation and the contents of a user variable. The parameters of this command are the arithmetic function and the index of a user variable (0. . . 255). This command is mainly intended for use in standalone mode.
CALCV	45	<operation>, <value>	The CALCV directly modifies a user variable using an arithmetical operation and a direct value. This eliminates the need of using the accumulator register for such a purpose and thus can make the program shorter and faster. The parameters of this command are the arithmetic function, the index of a user variable (0. . . 255) and a direct value. This command is mainly intended for use in standalone mode.
MVPA	46	ABS|REL|COORD, <motor number> Note: The possibility to drive on a COORD is not implemented yet!	With this command the motor will be instructed to move to a specified relative or absolute position. The contents of the accumulator register will be used as the target position. This command is non-blocking which means that a reply will be sent immediately after command interpretation and initialization of the motion controller. Further commands may follow

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
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Command	Number	Parameter	Description
			without waiting for the motor reaching its end position. The maximum velocity and acceleration as well as other ramp parameters are defined by the appropriate axis parameters. Positioning can be interrupted using MST, ROL, or ROR commands. Three operation types are available: • Moving to an absolute position specified by the accumulator register contents. • Starting a relative movement by means of an offset to the actual position. • Moving the motor to a (previously stored) coordinate (refer to SCO for details).
RST	48	<jump address>	Stop the program, reset the interpreter and then re-start the program at the given label. This command can be used to re-start the program from anywhere in the program, also out of subroutines or interrupt routines. This command is intended for standalone operation only.
DJNZ	49	<user variable>, <jump address>	Decrement a given user variable and jump to the given address if the user variable is greater than zero. This command can for example be used to easily program a counting loop, using any user variable as the loop counter. This command is intended for standalone operation only.
ROLA	50	<motor number>	Rotate in left direction (decreasing the position counter) using the velocity specified by the contents of the accumulator register. The velocity is given in microsteps per second (pulse per second [pps]).
RORA	51	<motor number>	Rotate in right direction (increasing the position counter) using the velocity specified by the contents of the accumulator register. The velocity is given in microsteps per second (pulse per second [pps]).
SIV	55	<value>	This command copies a direct value to a user variable. The index of the user variable (0. . . 255) is specified by the content of the X register. Therefore, the value in the X register must not be lower than zero or greater than 255. Otherwise, this command will be ignored. This command is mainly intended for use in standalone mode.
GIV	56		This command reads a user variable and copies its content to the accumulator register. The index of the user variable (0. . . 255) is specified by the X register. Therefore, the content of the X register must not be lower than zero or greater than 255. Otherwise, this command will be ignored. This command is mainly intended for use in standalone mode.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
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Command	Number	Parameter	Description
AIV	57	<value>	This command copies the content of the accumulator to a user variable. The index of the user variable (0. . . 255) is specified by the content of the X register. Therefore, the value in the X register must not be lower than zero or greater than 255. Otherwise, this command will be ignored. This command is mainly intended for use in standalone mode.
CALL	80	<condition>, <label>	The CALL command calls a subroutine in the program, but only if the specified condition is met. Otherwise the program execution will be continued with the next command following the CALL command. The conditions refer to the result of a preceding comparison or assignment. This command is intended for standalone operation only.

2 Axis Parameters

Most of the module's motor control functions are controlled via axis parameters. The axis parameters can be changed or read using the SAP, GAP and AAP commands. This chapter describes all axis parameters that can be used on the Mocontronic modules. There are different types of parameter access, such as read only or read/write.

The large number of axis parameters is identical for all modules. However, specific axis parameters may vary from module to module. A detailed overview of the specific axis parameters can be found in the module-specific documentation.

Please note: even in emulation mode some parameters may differ from the on of the emulated TMCM module !

Table 5 shows the different parameter access types used in the axis parameter Table 6 tables.

Table 5 – Axis Parameter access

Access type	Command	Description
R	GAP	Parameter readable
W	SAP, AAP	Parameter writable
F	STAP, RSAP	Parameter can be stored in Flash or the EEPROM

Table 6 – Axis Parameters

Number	Parameter	Parmeter description	Value range / unit	Access
0	Target position	The desired target position in position mode.	-2^31... +(2^31)-1 -2.147.483.648 ... 2.147.483.647 [microsteps]	RW

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Number	Parameter	Parmeter description	Value range / unit	Access
1	Actual position	The actual position of the motor. Stop the motor before overwriting it. Should normally only be overwritten for reference position setting.	-2^31... +(2^31)-1 -2.147.483.648 ... 2.147.483.647 [microsteps]	RW
2	Target speed	The desired speed in velocity mode. Not valid in position mode.	-2047 ... 2047 [int]	RW
3	Actual speed	The actual speed of the motor.	-2047 ... 2047 [int]	R
4	Maximum positioning speed	The maximum speed used for positioning ramps.	1 ... 2047 [int]	RWF
5	Maximum acceleration	Maximum acceleration in positioning ramps. Acceleration and deceleration value in velocity mode.	1 ... 2047 [int]	RWF
6	Maximum current	Motor current used when motor is running. The maximum value is 255 which means 100% of the maximum current of the module. The current can be adjusted in 32 steps: Important note! Later in this Chapter you will find the module-specific setting options for axis parameters 6 and 7. Axis parameters 6 and 7 are very important parameters, too high values can damage the motor!	1 ... 255 [int]	RWF
7	Standby current	Motor current used when motor is running. The maximum value is 255 which means 100% of the maximum current of the module. The current can be adjusted in 32 steps: This value should be as low as possible so that the motor can cool down when it is not moving. Important note! Later in this Chapter you will find the module-specific setting options for axis parameters 6 and 7. Axis parameters 6 and 7 are very important parameters, too high values can damage the motor!	1 ... 255 [int]	RWF
8	Position reached flag	This flag is always set when target position and actual position are equal.	0/1	R
9	Home switch state	The logical state of the home switch input.	0/1	R
10	Right limit switch state	The logical state of the right limit switch input.	0/1	R

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Number	Parameter	Parmeter description	Value range / unit	Access
11	Left limit switch state	The logical state of the left limit switch input.	0/1	R
12	Right limit switch enable	Enables the stop function of the right limit switch if set to 1.	0/1	RWF
13	Left limit switch enable	Enables the stop function of the left limit switch if set to 1.	0/1	RWF
130	Minimum speed	This is the stop speed (the start speed is always 1). Default value is 1. Can be set higher to reach the target position faster. Never set lower than 1, as in this case the target position cannot be reached.	1 ... 2047 [int]	RWF
135	Actual acceleration	The current acceleration.	-2047 ... 2047 [int]	R
138	Ramp mode	Automatically set when using ROR, ROL, MST and MVP. **0**: Position mode. Steps are generated when the parameters actual position and target position differ. Trapezoidal speed ramps are provided. **2**: Velocity mode. The motor will run continuously, and the speed will be changed using the maximum acceleration parameter when the target speed gets changed. 1: For special purposes, the soft mode (value 1) with exponential decrease of speed can be selected.	0/1/2	RW
140	Microstep resolution	Microstep resolutions per full step: Table 7 – Microstep resolution **Value** / **microsteps**: 0 fullstep; 1 2 -halfstep; 2 4; 3 8; 4 16; 5 32; 6 34; 7 128; 8 256 It is strongly recommended to use at least 8 microsteps.	0...8	RWF

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
149	Soft stop flag	0: Hard stop when a stop switch is hit. 1: Soft stop (using deceleration ramp) when a stop switch is hit.	0/1	RWF
150	End switch power down mode	0: Stay at run current when stopped by end switch. 1: Use stand by current when stopped by end switch.	0/1	RWF
153	Ramp devisor	The exponent of the scaling factor for the ramp generator. Change this parameter carefully (in steps of one) and only while the motor is not moving. Lower values lead to higher accelerations. This parameter specifies the relation between internal and real world acceleration units.	0...13	RWF
154	Pulse divisor	The exponent of the scaling factor for the pulse (step) generator. Change this parameter carefully (in steps of one) and only while the motor is not moving. Lower values lead to higher speeds. This parameter specifies the relation between internal and real world velocity units	0...13	RWF
160	Step interpolation enable	Step interpolation is supported with 16 microstep setting only. With this option activated, each microstep will internally be executed as 16 1/256 microsteps. This causes the motor to run as smooth as with 256 microsteps resolution. 0: step interpolation off 1: step interpolation on	0/1	RW
161	Double step enable	With this option turned on, each microstep will be executed twice. Normally, use this option only together with the step/direction input. Every edge of the step signal then causes a microstep to be executed. 0: double step off 1: double step on	0/1	RW

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
162	Chopper blank time	Selects the comparator blank time. This time needs to safely cover the switching event and the duration of the ringing on the sense resistor. Normally leave at the default value.	0...3	RW
163	Constant TOff mode	Selection of the chopper mode: 0: spread cycle 1: classic constant off time	0/1	RW
164	Disable fast decay comparator	See parameter 163. For “classic const. off time” setting this parameter to “1” will disable current comparator usage for termination of fast decay cycle.	0/1	RW
165	Chopper hysteresis end / fast decay time	See parameter 163. For “spread cycle” chopper mode this parameter will set / return the hysteresis end setting (hysteresis end value after a number of decrements). For “classic const. off time” chopper mode this parameter will set / return the fast decay time.	0...15	RW
166	Chopper hysteresis start / sine wave offset	See parameter 163. For “spread cycle” chopper mode this parameter will set / return the hysteresis start setting (please note that this value is an offset to the hysteresis end value). For “classic const. off time” chopper mode this parameter will set / return the sine wave offset.	0...8	RW
167	Chopper off time (TOff)	The off-time setting controls the minimum chopper frequency. An off time within the range of 5 microseconds to 20 microseconds will fit. Off time setting for constant t Off chopper: N_CLK = 12 + 32 * tOFF (Minimum is 64 clocks) Setting this parameter to zero completely disables all driver transistors and the motor can free wheel.	0...15	RW
168	SmartEnergy current minimum (SEIMIN)	Sets the lower motor current limit for CoolStep operation by scaling the maximum current (see axis parameter 6) value. Minimum motor current: 0 - 1/2 of CS 1- 1/4 of CS	0/1	RW

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
169	SmartEnergy current down step	Sets the number of StallGuard2 readings above the upper threshold necessary for each current decrement of the motor current. Number of StallGuard2 measurements per decrement: Scaling: 0...3: 32, 8, 2, 1 0: slow decrement 3: fast decrement	0...3	RW
170	SmartEnergy hysteresis	Sets the distance between the lower and upper threshold for StallGuard2 reading. Above the upper threshold the motor current becomes decreased. Hysteresis: ([AP172] + 1) * 32 Upper StallGuard threshold: ([AP172] + [AP170] + 1) * 32	0...15	RW
171	SmartEnergy current up step	Sets the current increment step. The current becomes incremented for each measured StallGuard2 value (see SmartEnergy hysteresis start). Current increment step size: Scaling: 0...3: 1, 2, 4, 8 0: slow increment 3: fast increment / fast reaction to rising load	0...3	RW
172	SmartEnergy hysteresis start	The lower threshold for the StallGuard2 value (see SmartEnergy current up step). Setting this to 0 (default) turns off CoolStep.	0...15	RW
173	StallGuard2 filter enable	Enables the StallGuard2 filter for more precision of the measurement. If set, reduces the measurement frequency to one measurement per four fullsteps. In most cases it is expedient to set the filtered mode before using CoolStep. Use the standard mode for step loss detection. 0 - standard mode 1 - filtered mode	0/1	RW
174	StallGuard2 threshold	This signed value controls StallGuard2 threshold for stall output and sets the optimum measurement range for readout. A lower value gives a higher sensitivity. Zero is the starting value. A higher value makes StallGuard2 less sensitive and requires more torque to indicate a stall.	-64...63	RW

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
175	Slope control high side	Determines the slope of the motor driver outputs. Leave at default value unless differently recommended by customer support. **0**: lowest slope ... **3**: fastest slope	0...3	RW
176	Slope control low side	Determines the slope of the motor driver outputs. Leave at default value unless differently recommended by customer support. **0**: lowest slope ... **3**: fastest slope	0...3	RW
177	Short protection disable	witches short to ground protection of the motor driver on or off. Leave at default value unless differently recommended by customer support. 0: Short to GND protection on 1: Short to GND protection of	0/1	RW
178	Short detection timer	Timer value for short circuit protection of the motor driver. Leave at default value unless differently recommended by customer support. 0: 3.2µs 1: 1.6µs 2: 1.2µs 3: 0.8µs	0...3	RW
179	Vsense	Sense resistor voltage based current scaling. 0: Full scale sense resistor voltage is 1/18 VDD 1: Full scale sense resistor voltage is 1/36 VDD Leave at default value. Do not change!	0/1	RW
180	SmartEnergy actual current	This status value provides the actual motor current setting as controlled by CoolStep. The value goes up to the CS value and down to the portion of the CS as specified by SEIMIN. Actual motor current scaling factor: 0...31: 1/32, 2/32, ...32/32	0...31	R

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

<table>
<tr><th>Number</th><th>Parameter</th><th>Parmeter description</th><th>Value range / unit</th><th>Access</th></tr>
<tr><td>181</td><td>Stop on stall</td><td>Below this speed motor will not be stopped. Above this speed motor will stop in case StallGuard2 load value reaches zero.</td><td>0... 2047 [int]</td><td>RW</td></tr>
<tr><td>182</td><td>smartEnergy threshold speed</td><td>Above this speed CoolStep becomes enabled.</td><td>0... 2047 [int]</td><td>RW</td></tr>
<tr><td>183</td><td>SmartEnergy slow run current</td><td>Sets the motor current which is used below the threshold speed. A value of 255 means 100% of the maximum current of the module.</td><td>0... 255 [int]</td><td>RW</td></tr>
<tr><td>184</td><td>Random TOff mode</td><td>0 - Chopper off time is fixed
1 - Chopper off time is random</td><td>0/1</td><td>RW</td></tr>
<tr><td>193</td><td>Reference search mode</td><td>Table 8 – Reference search mode<table><tr><th>Value</th><th>Reference search mode</th></tr><tr><td>1</td><td>Search left stop switch only.</td></tr><tr><td>2</td><td>Search right stop switch, then search left stop switch.</td></tr><tr><td>3</td><td>Search right stop switch, then search left stop switch from both sides.</td></tr><tr><td>4</td><td>Search left stop switch from both sides.</td></tr><tr><td>5</td><td>Search home switch in negative direction, reverse the direction when left stop switch reached.</td></tr><tr><td>6</td><td>Search home switch in positive direction, reverse the direction when right stop switch reached.</td></tr><tr><td>7</td><td>Search home switch in positive direction, ignore end switches.</td></tr><tr><td>8</td><td>Search home switch in negative direction, ignore end switches.</td></tr></table>Additional functions:

- Add 128 to a mode value for inverting the home switch (can be used with mode 5... 8).

- Add 64 to a mode for searching the right instead of the left reference switch (can be used with mode 1... 4).</td><td>1...8</td><td>RW</td></tr>
<tr><td>194</td><td>Reference search speed</td><td>This value specifies the speed for roughly searching the reference switch.</td><td>0... 2047 [int]</td><td>RW</td></tr>
</table>

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
195	Reference switch speed	This parameter specifies the speed for searching the switching point. It should be slower than parameter 194.	0... 2047 [int]	RW
196	End switch distance	This parameter provides the distance between the end switches after executing the RFS command (with reference search mode 2 or 3).	-2147483648 ... 2147483647 [µsteps]	R
197	Last reference position	This parameter contains the last position value before the position counter is set to zero during reference search.	-2147483648 ... 2147483647 [µsteps]	R
200	Boost current	Current used for acceleration and deceleration phases. If set to 0 the same current as set by axis parameter 6 will be used. Same scaling as with axis parameter 6. Important note! In this Chapter 0 you will find the module-specific setting options for axis parameters 6 and 7. Axis parameters 6 and 7 are very important parameters, too high values can damage the motor!	0...255	RW
204	Freewheeling mode	Time after which the power to the motor will be cut when its velocity has reached zero (a value of 0 (default setting) means never).	0... 65535 [10ms]	RWF
206	Actual load value	Readout the actual load value used for stall direction (StallGuard2).	0...1023	R
207	Extended error flags	A combination of the following values: *Table 9 – Reference search mode* Value: 1 = StallGuard error; 2 = deviation error These error fags are cleared automatically when this parameter has been read out or when a motion command has been executed.	0...3	R

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

<table>
<tr><th>Number</th><th>Parameter</th><th>Parmeter description</th><th>Value range / unit</th><th>Access</th></tr>
<tr><td>208</td><td>Motor driver Error Flags</td><td>Table 10 – Motor Error driver Flags<table><tr><th>Bit</th><th>Description</th></tr><tr><td>BIT0</td><td>StallGuard2 status
(1: threshold reached)</td></tr><tr><td>BIT1</td><td>Overtemperature
(1: driver is shut down due to overtemperature)</td></tr><tr><td>BIT2</td><td>Overtemperature pre-warning
(1: temperature threshold is exceeded)</td></tr><tr><td>BIT3</td><td>Short to ground A
(1: short condition detected; driver currently
shut down)</td></tr><tr><td>BIT4</td><td>Short to ground B
(1: short condition detected; driver currently shut down)</td></tr><tr><td>BIT5</td><td>Open load A
(1: no chopper event has happened during the last period with constant coil polarity)</td></tr><tr><td>BIT6</td><td>Open load B
(1: no chopper event has happened during the last period with constant coil polarity)</td></tr><tr><td>BIT7</td><td>Stand still
(1: no step pulse occurred during the last 220 clock cycles)</td></tr></table>Please also refer to the TMC262 Datasheet for more information.</td><td>0...255</td><td>R</td></tr>
<tr><td>209</td><td>Encoder position</td><td>Encoder counter value of the built-in SensOstep encoder.</td><td>-2^31... +(2^31)-1
-2.147.483.648 ...
2.147.483.647
[microsteps]</td><td>RW</td></tr>
<tr><td>210</td><td>Encoder prescaler</td><td>Prescaler for the encoder. Please see section 2.1.1.</td><td>See section 2.1.1.</td><td>RW</td></tr>
<tr><td>212</td><td>Maximum encoder deviation</td><td>When the actual position (parameter #1) and the encoder position (parameter #209) differs more than set here the motor will be stopped.

If you set this parameter to zero, this function is deactivated and the encoder deviation flag, if present, is reset at the same time.</td><td>0...(2^20)
0... 2147483647
[encoder
steps]</td><td>RW</td></tr>
<tr><td>214</td><td>Power down delay</td><td>Standstill period before the motor current will be switched to standby current. The default value is 200 which means 2000ms.</td><td>1...65535 [10ms]</td><td>RWF</td></tr>
</table>

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
215	Absolute resolver value	Absolute position of the internal SensOstep encoder. The absolute position is within one motor rotation.	0...1023	R
216	External encoder position	External encoder counter value. Note. This axis parameter is only available if the module supports an external encoder.	-2147483648 . . .2147483647 [microsteps]	RW
217	External encoder prescaler	Prescaler for the encoder. Please see section 2.1.1. Note. This axis parameter is only available if the module supports an external encoder.	See section 2.1.1.	RW
218	Maximum external encoder deviation	When the actual position (parameter #1) and the external encoder position (parameter #216) differ more than set here the motor will be stopped. If you set this parameter to zero, this function is deactivated and the encoder deviation flag, if present, is reset at the same time.	0...(2^20) 0... 2147483647 [encoder steps]	RW

2.1 Hints

2.1.1 Matching Encoder Resolution and Motor Resolution

If you select a different microstep resolution than the factory default setting, the encoder prescaler must be adjusted accordingly so that functions that use the built-in encoder continue to work properly. Table 11 shows the appropriate prescaler settings for different microstep resolutions. The factory setting is 256 microsteps and a prescaler value of 50.

Table 11 – Matching Encoder Resolution and Motor Resolution

Internal Encoder Settings			
Microstep		Encoder	
Resolution	SAP Command	Prescaler	SAP Command
256	SAP 140, 0, 8	50	SAP 210, 0, 25600
128	SAP 140, 0, 7	25	SAP 210, 0, 12800
64	SAP 140, 0, 6	12,5	SAP 210, 0, 6400
32	SAP 140, 0, 5	6,25	SAP 210, 0, 3200
16	SAP 140, 0, 4	3,125	SAP 210, 0, 1600
8	SAP 140, 0, 3	1,5625	SAP 210, 0, 800
4	SAP 140, 0, 2	0,78125	SAP 210, 0, 400
2	SAP 140, 0, 1	0,390625	SAP 210, 0, 200

Encoder prescalers other than those shown in Table 11 can also be used but are usually not intended for the internal encoder. The formula for setting the prescaler is:

$$p = prescaler \times 512$$

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Here is p the value that is transferred to the axis parameter #210. A setting of SAP 210, 0, 512 would therefore correspond to a prescaler of 1, for example.

The lower four bits of the p value must not be used to set the prescaler, as they are reserved for activating special encoder functions.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

2.2 Module-specific axes parameters

2.2.1 IKS-24S

2.2.1.1 Axis parameters 6 and 7, running and standstill current

Table 12 – IKS-24S – Axis parameters 6 and 7, running and standstill current

Level	Irms[A]	IPeak[A]	Values for AP 6 and 7		Note
			Min	Max	
0	0,101	0,142	0	8	
1	0,201	0,285	8	16	
2	0,302	0,427	16	24	
3	0,403	0,570	24	32	
4	0,504	0,712	32	40	
5	0,604	0,855	40	48	
6	0,705	0,997	48	56	
7	0,806	1,140	56	64	
8	0,907	1,282	64	72	
9	1,007	1,425	72	80	
10	1,108	1,567	80	88	
11	1,209	1,710	88	96	
12	1,310	1,852	96	104	
13	1,410	1,994	104	112	
14	1,511	2,137	112	120	
15	1,612	2,279	120	128	
16	1,713	2,422	128	136	
17	1,813	2,564	136	144	
18	1,914	2,707	144	152	
19	2,015	2,849	152	160	
20	2,115	2,992	160	168	
21	2,216	3,134	168	176	
22	2,317	3,277	176	184	Only permitted with heat sink!
23	2,418	3,419	184	192	Only permitted with heat sink!
24	2,518	3,562	192	200	Only permitted with heat sink!
25	2,619	3,704	200	208	Only permitted with heat sink!
26	2,720	3,847	208	216	Only permitted with heat sink!
27	2,821	3,989	216	224	Not permitted!
28	2,921	4,131	224	232	Not permitted!
29	3,022	4,274	232	240	Not permitted!
30	3,123	4,416	240	248	Not permitted!
31	3,224	4,559	248	254	Not permitted!

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

2.2.2 IKS-34S

2.2.2.1 Axis parameters 6 and 7, running and standstill current

Table 13 – IKS-34S – Axis parameters 6 and 7, running and standstill current

Level	Irms[A]	IPeak[A]	Values for AP 6 and 7		Note
			Min	Max	
0	0,101	0,142	0	8	
1	0,201	0,285	8	16	
2	0,302	0,427	16	24	
3	0,403	0,570	24	32	
4	0,504	0,712	32	40	
5	0,604	0,855	40	48	
6	0,705	0,997	48	56	
7	0,806	1,140	56	64	
8	0,907	1,282	64	72	
9	1,007	1,425	72	80	
10	1,108	1,567	80	88	
11	1,209	1,710	88	96	
12	1,310	1,852	96	104	
13	1,410	1,994	104	112	
14	1,511	2,137	112	120	
15	1,612	2,279	120	128	
16	1,713	2,422	128	136	
17	1,813	2,564	136	144	
18	1,914	2,707	144	152	
19	2,015	2,849	152	160	
20	2,115	2,992	160	168	
21	2,216	3,134	168	176	
22	2,317	3,277	176	184	Only permitted with heat sink!
23	2,418	3,419	184	192	Only permitted with heat sink!
24	2,518	3,562	192	200	Only permitted with heat sink!
25	2,619	3,704	200	208	Only permitted with heat sink!
26	2,720	3,847	208	216	Only permitted with heat sink!
27	2,821	3,989	216	224	Not permitted!
28	2,921	4,131	224	232	Not permitted!
29	3,022	4,274	232	240	Not permitted!
30	3,123	4,416	240	248	Not permitted!
31	3,224	4,559	248	254	Not permitted!

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

2.2.3 IKS-32

2.2.3.1 Axis parameters 6 and 7, running and standstill current

The table shows the possible current settings for standstill and moving.

Table 14 – IKS-32 – Axis parameters 6, 7 and 179, running and standstill current

SAP 6/7		CS	V FS [V] 0,165	SAP 179 1	V FS [V] 0,31	SAP 179 0
von	bis		I RMS [A]	I Peak [A]	I RMS [A]	I Peak [A]
0	7	0	0,024	0,034	0,046	0,065
8	15	1	0,049	0,069	0,091	0,129
16	23	2	0,073	0,103	0,137	0,194
24	31	3	0,097	0,138	0,183	0,258
32	39	4	0,122	0,172	0,228	0,323
40	47	5	0,146	0,206	0,274	0,388
48	55	6	0,170	0,241	0,320	0,452
56	63	7	0,194	0,275	0,365	0,517
64	71	8	0,219	0,309	0,411	0,581
72	79	9	0,243	0,344	0,457	0,646
80	87	10	0,267	0,378	0,502	0,710
88	95	11	0,292	0,413	0,548	0,775
96	103	12	0,316	0,447	0,594	0,840
104	111	13	0,340	0,481	0,639	0,904
112	119	14	0,365	0,516	0,685	0,969
120	127	15	0,389	0,550	0,731	1,033
128	135	16	0,413	0,584	0,776	1,098
136	143	17	0,438	0,619	0,822	1,163
144	151	18	0,462	0,653	0,868	1,227
152	159	19	0,486	0,688	0,913	1,292
160	167	20	0,510	0,722	0,959	1,356
168	175	21	0,535	0,756	1,005	1,421
176	183	22	0,559	0,791	1,050	1,485
184	191	23	0,583	0,825	1,096	1,550
192	199	24	0,608	0,859	1,142	1,615
200	207	25	0,632	0,894	1,187	1,679
208	215	26	0,656	0,928	1,233	1,744
216	223	27	0,681	0,963	1,279	1,808
224	231	28	0,705	0,997	1,324	1,873
232	239	29	0,729	1,031	1,370	1,938
240	247	30	0,754	1,066	1,416	2,002
248	255	31	0,778	1,100	1,461	2,067

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

2.2.4 IKS42-14 and MocDrive MD42

2.2.4.1 Axis parameters 6 and 7, running and standstill current

Table 15 – IKS42-14 – Axis parameters 6 and 7, running and standstill current

Level	SAP 6/7		I RMS	I Peak
	from	to	[A]	[A]
1	0	7	0,101	0,142
2	8	15	0,201	0,285
3	16	23	0,302	0,427
4	24	31	0,403	0,570
5	32	39	0,504	0,712
6	40	47	0,604	0,855
7	48	55	0,705	0,997
8	56	63	0,806	1,140
9	64	71	0,907	1,282
10	72	79	1,007	1,425
11	80	87	1,108	1,567
12	88	95	1,209	1,710
13	96	103	1,310	1,852
14	104	111	1,410	1,994
15	112	119	1,511	2,137
16	120	127	1,612	2,279
17	128	135	1,713	2,422
18	136	143	1,813	2,564
19	144	151	1,914	2,707

2.2.4.2 Axis parameters for the simple closed-loop solution

The simple closed-loop position control enables step losses to be corrected.

If the target position has been reached, it is checked whether the encoder value is within the position window (AP 80) around the target position. If this is the case, the position approached is assumed to be correct.

If the encoder value is outside the position window, we will try to move to the target position again with the configurable closed-loop speed (AP 81). The process is repeated until the encoder position is within the position window around the target position.

In order for the closed-loop control to function correctly, the magnetic encoder must be correctly parameterized (AP 140 – microstep resolution, AP 210 – encoder prescaler). It is also important that the basic positioning parameters (AP 4 - positioning speed, AP 5 - acceleration, AP 153 - ramp divisor, AP 154 - pulse divisor) are set correctly.

Table 5 shows the different parameter access types used in the simple closed loop parameters Table 16.

Table 16 – IKS42-14 – simple closed loop parameters

Number	Parameter	Parmeter description	Value range / unit	Access
80	Closed Loop Activate	Activate the closed-loop control. 0: Disable 1: Activate	0... 1	RW

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
81	Closed Loop Position Window	The position window is an area around the target position where the deviation from the target position is considered acceptable. If the encoder value is within the position window, no readjustment is carried out. However, if the encoder value is outside the position window, the position is readjusted.	0... +(2^31) -1 0... 2.147.483.647 [microsteps]	RW
82	Closed Loop Velocity	The position is corrected at this speed if readjustment is required.	0... +(2^31) -1 0... 2.147.483.647 [microsteps]	RW

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

2.2.5 IKS-61

2.2.5.1 Axis parameters 6 and 7, running and standstill current

The table shows the possible current settings for standstill and moving.

Table 17 – IKS-61 – Axis parameters 6, 7 and 179, running and standstill current

SAP 6/7		CS	V FS [V] 0,165	SAP 179 1	V FS [V] 0,31	SAP 179 0
von	bis		I RMS [A]	I Peak [A]	I RMS [A]	I Peak [A]
0	7	0	0,024	0,034	0,046	0,065
8	15	1	0,049	0,069	0,091	0,129
16	23	2	0,073	0,103	0,137	0,194
24	31	3	0,097	0,138	0,183	0,258
32	39	4	0,122	0,172	0,228	0,323
40	47	5	0,146	0,206	0,274	0,388
48	55	6	0,170	0,241	0,320	0,452
56	63	7	0,194	0,275	0,365	0,517
64	71	8	0,219	0,309	0,411	0,581
72	79	9	0,243	0,344	0,457	0,646
80	87	10	0,267	0,378	0,502	0,710
88	95	11	0,292	0,413	0,548	0,775
96	103	12	0,316	0,447	0,594	0,840
104	111	13	0,340	0,481	0,639	0,904
112	119	14	0,365	0,516	0,685	0,969
120	127	15	0,389	0,550	0,731	1,033
128	135	16	0,413	0,584	0,776	1,098
136	143	17	0,438	0,619	0,822	1,163
144	151	18	0,462	0,653	0,868	1,227
152	159	19	0,486	0,688	0,913	1,292
160	167	20	0,510	0,722	0,959	1,356
168	175	21	0,535	0,756	1,005	1,421
176	183	22	0,559	0,791	1,050	1,485
184	191	23	0,583	0,825	1,096	1,550
192	199	24	0,608	0,859	1,142	1,615
200	207	25	0,632	0,894	1,187	1,679
208	215	26	0,656	0,928	1,233	1,744
216	223	27	0,681	0,963	1,279	1,808
224	231	28	0,705	0,997	1,324	1,873
232	239	29	0,729	1,031	1,370	1,938
240	247	30	0,754	1,066	1,416	2,002
248	255	31	0,778	1,100	1,461	2,067

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

3 Global Parameters

The following sections describe all global parameters that can be used with the SGP, GGP, AGP, STGP and RSGP commands. Global parameters are grouped into banks:

Table 18 – Global Parameters bank description

Bank	Description
0	Global conguration of the module.
1	Not used.
2	user variables.
3	interrupt conguration.

3.1 Bank 0

Parameters with numbers 64 and above set all parameters that influence the overall behaviour of a module. This includes things like the serial address, the RS485 baud rate or the CAN bit rate (if applicable). Change these parameters according to your requirements. Parameters with numbers between 64 and 128 are automatically saved in the Flash or the EEPROM.

Hint

- An SGP command on such a parameter will always store it permanently and no extra STGP command is needed.
- Some configurations of the interface (e.g. baud rates that are not supported by the PC) can lead to the module no longer being can no longer be reached.
- Some settings (the interface bit rate settings) do not take effect immediately. For these settings, you must switch off the module after making the changes to allow the changes to take effect.

There are different parameter access types, like read only or read/write. Table 19 shows the different parameter access types used in the global parameter tables.

Table 19 – Global parameter access

Access type	Command	Description
R	GAP	Parameter readable
W	SAP, AAP	Parameter writable
F	STAP, RSAP	Parameter can be stored in Flash or the EEPROM
A	SGP	Automatically stored in Flash or the EEPROM

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Table 20 – Global Parameters Bank 1

<table>
<tr><th>Number</th><th>Parameter</th><th>Parmeter description</th><th>Value range / unit</th><th>Access</th></tr>
<tr><td>65</td><td>Baud rate for serial connections such as RS232, RS485 & USB</td><td>Table 21 – Serial Baus rate<table><tr><th>Value</th><th>Baud rate</th></tr><tr><td>1</td><td>9600</td></tr><tr><td>2</td><td>14000</td></tr><tr><td>3</td><td>19200</td></tr><tr><td>4</td><td>28800</td></tr><tr><td>5</td><td>38400</td></tr><tr><td>6</td><td>57600</td></tr><tr><td>7</td><td>76800</td></tr><tr><td>8</td><td>115200</td></tr><tr><td>9</td><td>230400</td></tr></table></td><td>0...8</td><td>RWA</td></tr>
<tr><td>66</td><td>Serial address</td><td>Module (target) address for RS485.</td><td>1...255</td><td>RWA</td></tr>
<tr><td>67</td><td>ASCII Mode</td><td>Table 22 – ASCII Mode<table><tr><th>Bit</th><th>Description</th></tr><tr><td>0</td><td>0 - start up in binary (normal) mode
1 - start up in ASCII mode</td></tr><tr><td>4&5</td><td>00 - Echo back each character
01 - Echo back complete command
10 - Do not send echo, only send command reply</td></tr></table></td><td>0...63</td><td>RWA</td></tr>
<tr><td>68</td><td>Serial heartbeat</td><td>Serial heartbeat for RS485 interface and USB interface. If this time limit is up and no further command is received by the module the motor will be stopped. Setting this parameter to 0 (default) turns off the serial heartbeat function.</td><td>0...65535</td><td>RWA</td></tr>
<tr><td>69</td><td>CAN bit rate</td><td>Table 23 – CAN Bit rate<table><tr><th>Value</th><th>Bit rate</th></tr><tr><td>2</td><td>20 kBit/s</td></tr><tr><td>3</td><td>50 kBit/s</td></tr><tr><td>4</td><td>100 kBit/s</td></tr><tr><td>5</td><td>125 kBit/s</td></tr><tr><td>6</td><td>250 kBit/s</td></tr><tr><td>7</td><td>500 kBit/s</td></tr><tr><td>8</td><td>1000 kBit/s (default)</td></tr></table></td><td>1 ...8</td><td>RWA</td></tr>
<tr><td>70</td><td>CAN reply ID</td><td>The CAN ID for replies from the board (default:2).</td><td>1...2047 [int]</td><td>RWA</td></tr>
<tr><td>71</td><td>CAN ID</td><td>The module (target) address for CAN (default: 1).</td><td>1...2047 [int]</td><td>RWA</td></tr>
</table>

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
75	Telegram pause time	Pause time before the reply via RS485 is sent. For use with older RS485 interfaces it is often necessary to set this parameter to 15 or more (e.g. RS485 adapters controlled by the RTS pin). For CAN interface this parameter has no effect!	0...255 [ms]	RWA
76	Serial host address	Host address used in the reply telegrams sent back via RS485.	0...255	RWA
77	Auto start mode	0: Do not start application after power up (default). 1: Start application automatically after power up.	0/1	RWA
79	End switch polarity	0: normal polarity 1: reverse polarity	0/1	RWA
81	code protection	Protects a program against disassembling or overwriting. 0: no protection 1: protection against disassembling 2: protection against overwriting 3: protection against disassembling and overwriting Hint: When switching off the protection against disassembling (changing this parameter from 1 or 3 to 0 or 2, the program will be erased first!	0/1/2/3	RWA
82	CAN heartbeat	Heartbeat for CAN interface. If this time limit is up and no further command is received the motor will be stopped. Setting this parameter to 0 (default) turns off the CAN heartbeat function.	0...65535	RWA
83	CAN secondary address	Second CAN ID for the module. Switched off when set to zero.	0...2047	RWA
84	Coordinate storage	0: coordinates are stored in RAM only (but can be copied explicitly between RAM and EEPROM) 1: coordinates are always also stored in the EEPROM and restored on startup	0/1	RWA
85	Do not restore user variables	Determines if user variables are to be restored from the EEPROM automatically on startup. 0: user variables are restored (default) 1: user variables are not restored	0/1	RWA

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

Number	Parameter	Parmeter description	Value range / unit	Access
87	Serial secondary address	Second module (target) address for RS485. Setting this parameter to 0 switches off the secondary address.	0..255	RWA
90	Reverse shaft	Reverse motor and encoder direction. 0: normal direction (default) 1: reverse direction Reversing the motor direction only works for normal mode, not for step/direction mode.	0/1	RWA
128	MocOS-CL application status	0: stop 1: run 2: step 3: reset	0..3	R
129	Download mode	0: normal mode 1: download mode	0/1	R
130	MocOS-CL program counter	Contains the address of the currently executed command.		R
132	tick timer	A 32-bit counter that gets incremented by one every millisecond. It can also be reset to any start value.	0...2147483647	RW
133	Random number	Returns a random number. The seed value can be set by writing to this parameter.	0...2147483647	RW
255	Suppress reply	The reply in direct mode will be suppressed when this parameter is set to 1. This parameter cannot be stored to EEPROM and will be reset to 0 on startup. The reply will not be suppressed for GAP, GGP and GIO commands.	0/1	RW

3.2 Bank 2

Bank 2 contains 32-bit variables for general purposes, which are intended for use in MocOS applications. The first 56 variables can typically also be stored permanently in the flash or EEPROM memory. The number of variables permanently stored on the module depends on the respective module. After booting, their values are automatically restored in RAM. Up to 256 user variables are available. Table 17 provides an explanation of the different types of parameter access.

Table 24 – Global Parameters Bank 2

Number	Parameter	Parmeter description	Value range / unit	Access
0...55	user variables #0...#55	user variables	-2147483648... 2147483647	RWF
56...255	user variables #56...#255	volatile user variables	-2147483648... 2147483647	RW

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

3.3 Bank 3

Bank 3 contains interrupt parameters. Some interrupts must be configured (e.g. the timer interval of a timer interrupt). This can be achieved by using the SGP commands with parameter bank 3 (SGP <type>, 3, <value>). The priority of an interrupt depends on its number. Interrupts with a lower number have a higher priority. Table 25 lists all interrupt parameters that can be set. An explanation of the parameter access types can be found in Table 17.

Table 25 – Global Parameters Bank 3

Number	Parameter	Parmeter description	Value range / unit	Access
0	Timer 0 period (ms)	Time between two interrupts	0...4294967295 [ms]	RW
1	Timer 1 period (ms)	Time between two interrupts	0...4294967295 [ms]	RW
2	Timer 2 period (ms)	Time between two interrupts	0...4294967295 [ms]	RW
27	Stop left 0 trigger transition	0=off, 1=low-high, 2=high-low, 3=both	0...3	RW
28	Stop right 0 trigger transition	0=off, 1=low-high, 2=high-low, 3=both	0...3	RW
29	Input 0 trigger transition	0=off, 1=low-high, 2=high-low, 3=both	0...3	RW
39	Input 1 trigger transition	0=off, 1=low-high, 2=high-low, 3=both	0...3	RW
41	Input 2 trigger transition	0=off, 1=low-high, 2=high-low, 3=both	0...3	RW
42	Input 2 trigger transition	0=off, 1=low-high, 2=high-low, 3=both	0...3	RW

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

4 Notes, Comments and Assistance

4.1 Reference Search

The modules can perform a reference search by their own.

For using this feature, it is necessary to have at least one stop switch (normally the left one) installed to your system.

Axis parameters 193 to 197 are relevant to configure the reference search with can be started, stopped and observed by the command RFS.

Explanation of the modes (parameter 193):

1:
There is only one switch on the left side of the system, the motor starts running left an searches this switch and stops

2:
There are two stop switches installed, the motor starts running right, finds the right switch, than turning around and searching for the left switch and stops

3:
There are two stop switches installed, the motor starts running right, finds the right switch, than turning around and searching for the left switch but drives on until the switch gets released, turning around and stops when switch gets hit again

4:
Starts searching the left switch by moving left but drives on until the switch gets released, turning around and stops when switch gets hit again

5:
There are now three switches installed one left, one right and one home switch somewhere between them. The systems starts searching the home switch by moving left, if the left stop switch is hit, it turns around and searching the home switch by driving right. It only stops when hitting the home switch.

6:
There are now three switches installed one left, one right and one home switch somewhere between them. The systems starts searching the home switch by moving right, if the right stop switch is hit, it turns around and searching the home switch by driving left. It only stops when hitting the home switch.

7:
The stop switches are unimportant in this scenario. The motor drives right to search for the home switch. It only stops when hitting the home switch.

8:
The stop switches are unimportant in this scenario. The motor drives left to search for the home switch. It only stops when hitting the home switch.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

4.2 StallGuard2™ – a short introduction

The Mocontronic Modules of the IKS-series use motion control chips of Trinamics' TMC-series, which have the StallGuard2™ technology.

StallGuard2™ offers load and stall detection in particular to control the current consumption and to omitting reference switches by detecting stall.

For this the chips measures the energy return and compares the difference between input and output; if almost all energy comes back (the difference is 0) the motor is in overload and stalls.

The important axis parameters for the StallGuard configuration are 173,174 and 181. It is important that the motor reaches some speed before using StallGuard otherwise the detection will not work properly.

For stall detection you have to disable coolStep and disable the filtered mode.

A short sample:

Detection stall for reference:

SAP 4,0,1800	→ maximum speed of the motor
SAP 173,0,0	→ Disable the filter
SAP 174,0,4	→ Threshold (in normal this should be between -10 and 10), you have to try
SAP 181,0,1000	→ stallGuard gets active if speed is above 1000
MVP REL,0,150000	→ now start moving in the direction of your block

If your motor does not stop when it gets blocked try to modify axis parameter 174 to find a value matching your system.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

4.3 Using coolStep™

The coolStep™ technology is used to operate the motor with the optimal, minimum necessary power consumption.

It uses the load values of StallGuard and is able to increase the efficiency, protect components trough lower heat generation and reduce motor noise.

The smartEnergy parameters 168 to 172 are essential to control coolStep.

168 → lower limit of scaling down the maximum current (½ or ¼ of parameter 6)

169 → how many StallGuard reading are necessary to activate current decremention

170 → distance between lower and upper threshold

171 → number of increments of each StallGuard reading if StallGuard Value below value of 172

172 → lower threshold (StallGuard value) to start coolStep operation (setting this to 0 turns off)

182 → above this speed coolStep gets active

Summary:

Axis parameter 6 is the maximum current that is consumed at high load and can be reduced by ½ or ¼ according to parameter 168 if the load value configured in parameter 169 and 171. It is only active if the speed of the motor is above the value of parameter 182 and if the StallGuard value is once above the value of parameter 172. Setting parameter 172 to 0 turns of coolStep.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

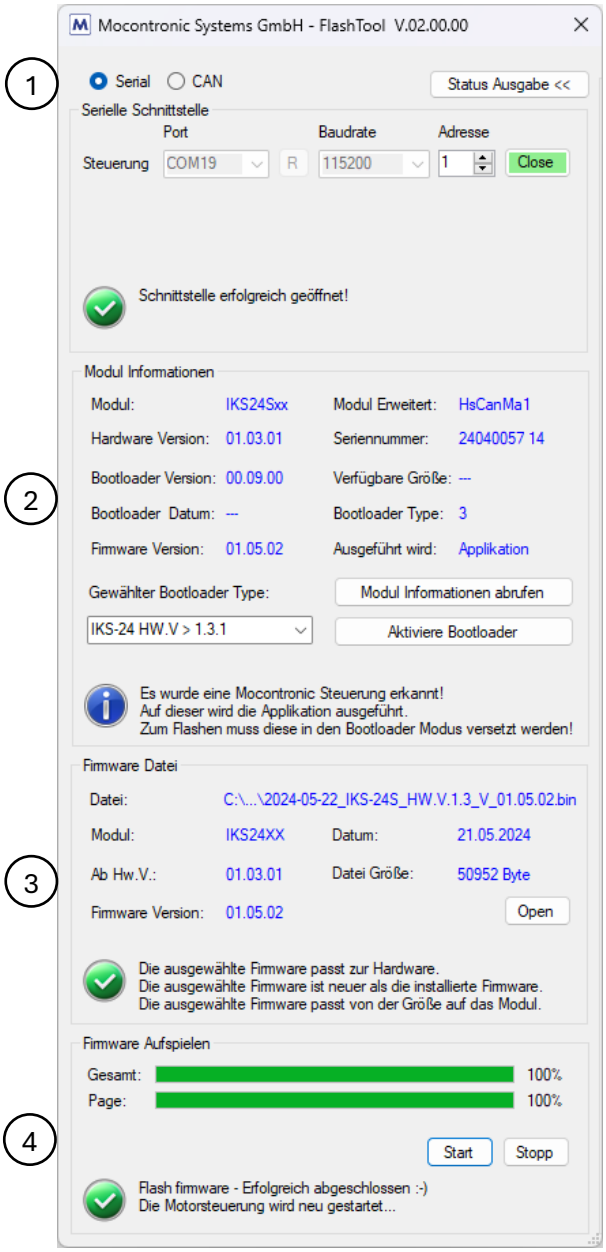
Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

4.4 Firmware update of the modules

All Mocontronic modules are equipped with a bootloader that facilitates the updating of the application software. Mocontronic offers user-friendly PC software “FlashTool” for this purpose, which enables the firmware to be updated in a timely and efficient manner.

4.4.1 FlashTool – Overview of the control elements

Figure 1 – Mocontronic FlashTool



4.4.2 FlashTool – A brief guide to the installation of firmware

The following short quick start guide is structured in such a way that the numbered steps correspond to the numbered areas of the software user interface. See also Figure 1.

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

(1) Once the control unit has been connected to the PC, it is necessary to select an interface and configure the interface parameters.
(2) The software automatically attempts to recognise the connected module and make the necessary configurations. If necessary, manual selection is also possible.
(3) Select the desired firmware from the file browser. The software then analyses whether the selected firmware is suitable for the connected module. If this is the case, the module is set to bootloader mode.
(4) The firmware can then be loaded onto the module using the Start button.

At each stage, the software verifies that the prerequisites for uploading the desired firmware to the selected module have been met. The user is guided to the desired destination by instructions.

4.4.3 FlashTool – FAQ

- Check interface parameters. Is the baud rate correct? Is the module address, correct?
- If the interface parameters of the function firmware and the bootloader differ. And the module cannot put into bootloader mode with the MOC Flash Tool, the following procedure can follow:

  (1) Select the interface for the bootloader.
  (2) Selecting the Firmware File
  (3) Shortly disconnect the module from the power supply and reconnect it. The module is now in bootloader mode. The LED flashes faster.
  (4) Then start the firmware installation.

5 Directories

5.1 List of Tables

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410

5.2 List of Figures

6 Revision history

6.1 Document revision history

Version	Date	Description
00.00.01	2024 05 28	CR First version.
1.00.00	2024 05 29	AW Final Release
1.01.00	2024 08 08	AW MocDrives added

Mocontronic System GmbH
Warmensteinacher Str. 59 | 12349 Berlin
Tel.: +49 30 / 4432 75-32 | Fax: +49 30 / 4432 75-33
info@mocontronic.de | www.mocontronic.de

Geschäftsführer: Andreas Wendt
Sitz und Regierungsgericht: Berlin-Charlottenburg HRB 106228
UST.-IDNr.: DE 252810410