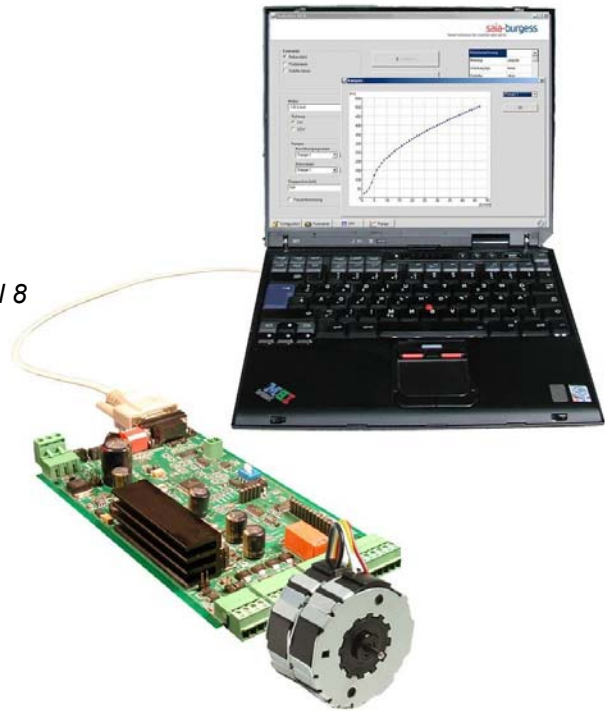


Evaluation-Kit2 stepper motor controller

operating instructions

Contents

1. Introduction
2. Hardware
 - 2.1. Start up procedure
 - 2.2. Functional modules
 - 2.3. Terminals and control elements
 - 2.4. Safety instructions
3. Operation modes
4. Software
 - 4.1. Operating system
 - 4.2. PC–software environment *StepControl 8*
 - 4.2.1. System requirements
 - 4.2.2. Installation
 - 4.2.3. Structure of PC–software environment
 - 4.2.4. Configuration window
 - 4.2.5. Command window
 - 4.2.6. PLC window
 - 4.2.7. Ramp generation window
 - 4.3. In-system programming
 - 4.4. File management and support
5. Troubleshooting
6. Technical specification
7. Contact



1. Introduction

The Evaluation-Kit2 for stepper and stepper driver is a universal development and test tool. This allows fast prototype development as well as flexible application support.

Following main tasks are supported:

- stepper motor and gearbox selection
- setting and optimization of drive parameters
- assembly and installation of test systems with sequence tables
- drive test in customer applications via process inputs/outputs

The Evaluation-Kit2 is a PCB where all important driver circuits and drive modes are implemented. In addition, software tools were developed to perform miscellaneous drive sequences and functions. They can be commanded, evaluated, visualized and documented by a windows-based computer very conveniently and without special expert knowledge. Our PCB in combination with the software environment enables the design engineer to test, to modify and to optimize any stepper motor drive application within short time and at low development costs.

Read this manual carefully to avoid injury and prevent damages!

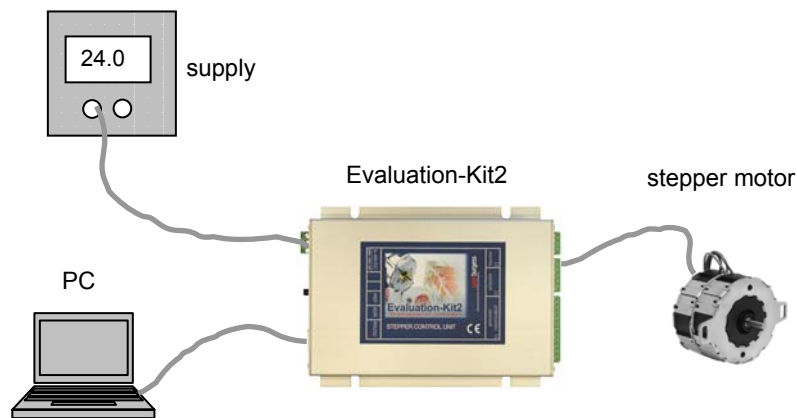
2. Hardware

2.1. Start up procedure

This chapter describes a quick start up procedure for the hardware of the Evaluation-Kit2. After installing all modules, you can continue with the installation of the software for your PC. Please read the section PC-software environment *StepControl 8* for further details. To use the whole capability of this evaluation tool you should read the whole manual carefully. For the start up procedure, please follow the guidelines below.

Quick start up for Evaluation-Kit2

- (1) Please unpack the Evaluation-Kit2 package and verify if you have all components of the packing list.
- (2) Install the metal case with the Evaluation-Kit2 board at your workbench about one meter away to your personal computer.



- (3) Connect the null modem cable (9-pin female to 9-pin female) with the RS232-interface of the Evaluation-Kit2 and on the other side to a free COM-port of your PC. If your PC/notebook has not a free RS232-port you can use a free USB-port. Please connect in this case the USB-RS232-adapter between the Kit and the PC.
 - (4) Choose a unit address via DIP-switch beside the RS232-port connector of the metal box. Mark this device number for the later setup of the PC-communication.
 - (5) Connect a unipolar or bipolar stepper motor from Saia-Burgess to the screw terminals of the Kit. Check the rated voltage and current of the motor. Look at the Saia-Burgess Actuators Catalogue for technical details or ask your local Saia-Burgess representative.
 - (6) Choose a laboratory power supply unit according the required input power of the stepper motor for both phases. Do not apply a voltage to a terminal that is outside the range specified in the chapter 5. Watch on the polarity and connect the wires to terminal J100 of the Kit. For a motor supply voltage over 8V there is only need for connecting pin 1 and pin 2 (see section terminals and control elements).
- | Pin | Label | Name |
|-----|-------|------|
| 1 | - | GND |
| 2 | + | U55 |
| 3 | | U8 |
- (7) Now complete your installation with the software package. Follow the instructions of the install wizard. For using the USB-RS232-adapter please install also this driver and find the right COM-port for the communication in the Windows Device Manager.
 - (8) Launch the software environment StepControl 8, choose the COM-port and check the first communication by clicking the button **upload**. Wait for the response okay.



2.2. Functional modules

The Evaluation-Kit2 board is a complete electronic controller for unipolar and bipolar stepper motors. The core contains an efficient 8-Bit-microcontroller MC68HC908GP32 with 32 kByte Flash-EPROM as program memory. Thus it is ensured that in the test phase program modifications and new parameter settings can be done easily. The microcontroller is equipped with the modules ADC (analog-digital converter), UART (universal serial interface), SPI-interface, two timers for step generation/process control and many I/O-ports. On the board, integrated stepper motor drivers permit both the direct porting of 4-coil unipolar stepper motors and 2-coil bipolar stepper motors. Bipolar stepper motors can be used in the constant current mode, the height of chopper current can be adjusted. Likewise, it is possible to control the bipolar stepper motors by microstepping. Digital inputs and outputs as well as an analog input permit the integration of the Evaluation-Kit2 into complex drives or customer applications. Light emitting diodes indicate the operating conditions. The board has different serial interfaces for programming and operation. The address of a unit can be set by DIP switches.

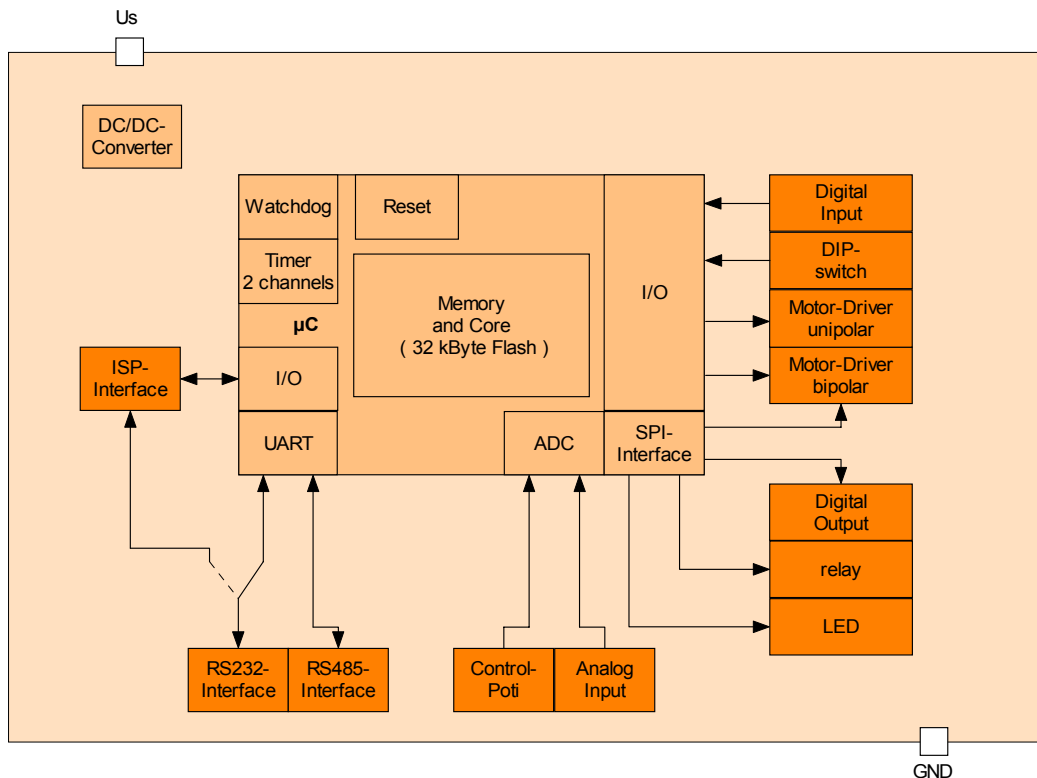


Fig. 2.1 functional modules of the Evaluation-Kit2

The functional modules represented in fig. 2.1 have the following functionality:

Microcontroller

- with 32kByte Flash-EPROM and internal periphery
- Flash-EPROM serve as program and table memory
- using special Flash programming routines to change parts of the Flash during operating mode of the Evaluation-Kit2 (e.g. ramp tables, SPS sequences)

DC/DC-converter

- supply of regulated supply voltage for logic components

Motor driver bipolar

- stepper motor driver with power output stages (2 two separate H-bridges)
- control of 2 coils of a bipolar stepper motor
- chopper current adjustable

Motor driver unipolar

- 4 power transistors
- selectable Zener diodes for fast decay of motor current

DIP-switch

- 4-pole DIP-switch for setup of the device address

RS232-Interface

- serial RS232-Interface for programming and operation control of the Evaluation-Kit2 via a personal computer

RS485-Interface

- serial RS485-Interface for programming and operation control of the Evaluation-Kit2 in a network

Reference potentiometer

- potentiometer for position control in the 0..10V-mode
- for presentations

Analog input

- external analog input for position control in the 0..10V-mode
- in other modes available as additional digital input (0/10V)

Digital input

- 2 digital control signals used in the PLC mode

Digital output

- 4 open-collector-outputs for control functions and indication
- 1 free of potential relay contact

LED

- 3 LED to indicate operating conditions, available in PLC mode

Reset button

- restart the Evaluation-Kit2 with the saved configuration

Dependent on Evaluation-Kit2 mode of operation, motion control can be done via RS-232 or RS-485 Interface, internal potentiometer or external control voltage. Furthermore, the Evaluation-Kit2 can be used in the PLC mode. In this mode instruction sequences are processed, which are filled as a table in the Flash-EEPROM. The system is equipped with an ISP interface and thus offers the possibility of reprogramming and testing the microcontroller via RS232-Interface. Special software for this procedure is described later.

2.3. Terminals and control elements

The Evaluation-Kit2 has a standard 160mm x 100 mm board size and the following user interfaces. For fast and easy connection, special terminal plug connectors are used.

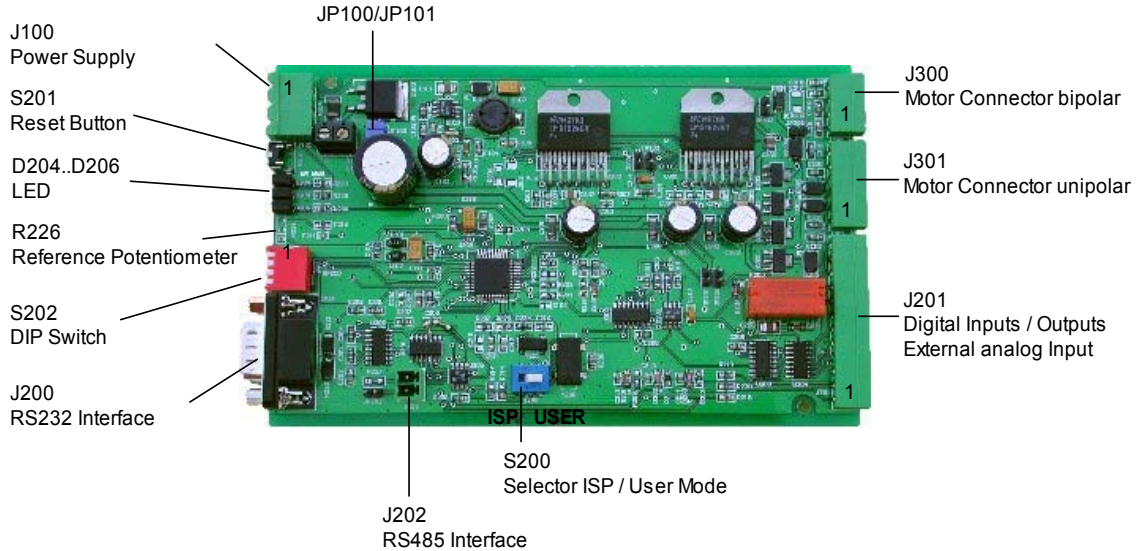


Fig. 2.2 Evaluation-Kit2

Power Supply J100

Power supply for the Evaluation-Kit2 and connected stepper motors

Pin	Label	Name	Description
1	-	GND	Power supply ground
2	+	U55	Power supply for motor and electronics
3		U8	Power supply for motor *

* For motor supply voltages smaller than 8 VDC separate supplies for motor and electronic are required. In this case the jumpers JP100 and JP101 have to be removed (see Technical Specifications).

Attention: Both jumpers have to be removed!

Reset Switch S201

Hardware reset if button is pushed.

LED D204..D206

Display

LED	Colour
D204	red
D205	yellow
D206	green

Reference potentiometer R226

Adjust the target position of the drive within the range of 0 to 100% of the working range. The working range is specified in the configuration window.

DIP Switch S202

Address of module for communication with different boards (network)

Address range: 0..15

Address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DIP 1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

RS232 Interface J200

PC communication via serial link cable

Pin	1	2	3	4	5	6	7	8	9
Signal	not used	RxD	TxD	not used	GND	not used	not used	not used	not used

RS485 Interface J202

Network interface

Pin	1	2
Signal	A	B
	T+	T-
	R+	R-

Motor connector bipolar J300

Pin	1	2	3	4
Signal	Phase 1A	Phase 1B	Phase 2A	Phase 2B

Motor connector unipolar J301

Pin	1	2	3	4	5	6
Signal	Phase 1A	Umot	Phase 1B	Phase 2A	Umot	Phase 2B

Digital inputs/outputs/external analog input J201

Pin	1	2	3	4	5	6
Signal	DIGIN1	DIGIN2	DIGIN3 / AIN *	GND	DIGOUT1	DIGOUT2
Des.	dig. input 1	dig. input 2	dig. input 3 / analog input	Ground	dig. output 1 (open Collector)	dig. output 2 (open Collector)

* in operation mode **standalone analog extern.** This input is an external analog input (0...10V), in all other modes the input can be used as a digital (0/10V) input

Pin	7	8	8	10	11	12
Signal	DIGOUT 3	DIGOUT4	REL1	REL1	free wheel	+5V
Des.	dig. output 3 (open Collector)	dig. output 4 (open Collector)	relay contact 1	relay contact 2	free wheeling diode	Supply voltage

Attention: The digital inputs need an active signal (high-active)!

2.4. Safety instructions

Intended operation

The unit Evaluation-Kit2 is a complete development system for evaluation and testing stepper motor drives. The appliance may be used only for its intended purpose. This product is intended for use by qualified personnel like electrical engineers or specially trained operators. The product is developed and proved under environmental conditions of laboratories and offices. The metal case protects the board against harsh conditions in the daily work of a laboratory. Even this metal cover does not install the unit as an industrial motion controller. Never operate this product with removed cover. The Evaluation-Kit2 was designed and successfully proved in combination with personal computers and notebooks of brand label companies.



EMC requirements

The product Evaluation-Kit2 covers all the rules according to the EMC-directive 89/336/EEC for use as **electrical equipment for measurement, control and laboratory**.

The product Evaluation-Kit2 is in accordance with:

emission	EN61326:1997+A1:1998+A2:2001
immunity	EN61326:1997+A1:1998+A2:2001

The CE marking on the product and our EC declaration of conformity are related only to the EMC-directive. Saia-Burgess did not test the Evaluation-Kit2 under the special electromagnetic disturbance of an industrial environment. The maximal length for all signal wires are limited to 3 meters. Saia-Burgess tested the EMC requirements under typical working conditions like maximum voltage and maximum phase current. Saia-Burgess has not tested all possible working conditions of the specific customer applications. Therefore you should take care of the following hints. Keep the cable length as short as possible. Keep a sufficient distance to your personal computer, monitor and communication devices.

To check the right hardware setting or to change jumpers/switches directly on the printed circuit board, please open the metal case after removing the power supply connector. Use only the upper four screws and take apart the upper metal part. Electrostatic discharge (ESD) can damage components in the Evaluation-Kit2. Avoid ESD and wear a grounded antistatic wrist strap to discharge the static voltage from your body or at least ground yourself by making contact with the bottom metal.

Power supply

The Evaluation-Kit2 is designed for use with laboratory power packs. Please compare the voltage output of your power source with the rated voltage for the Evaluation-Kit2 and the motor. Keep in mind that the current for the motor are supplied on the same connecting line. Do not use wires providing an invalid cross-sectional area for these motor currents. Also the laboratory power pack has to be valid for the required currents. To avoid fire hazard do not use power sources with an output power capability over the specified limit in chapter 5 like an automotive cell. Furthermore, do never use power supplies with reference to power line. **This could cause a fatal electric shock!**

Danger of burns

Stepper motor operation can cause in strong temperature rising of the electronic power stages and the motor parts. **There is danger of burns.** Do not leave your working place with unwilling energized motor coils. Check also the box "break with current" and calculate the power dissipation of the motor. Remove the power supply connector after finish your work with the Evaluation-Kit2.

3. Operation modes

The Evaluation-Kit2 was designed in such a way that it can be operated online on a PC (**remote**) or standalone without a PC. Controlled via a PC the Evaluation-Kit2 must be connected by a serial link cable to the PC. The parameter setup and operation are made by the control software which is installed on the PC. In the standalone mode the Evaluation-Kit2 works without connection to a personal computer. Prerequisite for this mode is that the Evaluation-Kit2 was configured in the last remote session correctly as standalone mode. It is possible to choose one of the following **standalone** modes.

- control with reference potentiometer → **standalone analog intern**
- control with external reference voltage → **standalone analog extern**
- programmable logic control mode → **standalone PLC**

The standalone mode is valid after a power on reset.

4. Software

4.1. Operating System

The operating system contains all necessary software modules for the complex functionality of the Evaluation-Kit2. It controls the system initialisation, selects the current operation mode and handles the interfaces as well as inputs, outputs and analog control signals.

This is essentially performed by the following software modules with the specified main functions. (see Fig. 4.1).

Main Program

- system initialisation
- evaluation of the DIP switches
- main loop with
 - evaluation of the digital inputs
 - handler for communication protocol
 - mode of operation control
 - operation of the active mode of operation
 - execution of the control commands
 - processing of the PLC sequences
 - evaluation of the reference voltage and positioning

Timer Interrupt Service Routine

- calculation of step times
- execution of steps according to current drive mode

SCI Receiver Interrupt Service Routine

- receipt of communication protocol
- data flow control
- check sum computation and error recognition
- error handling
- timeout monitoring
- acknowledgement

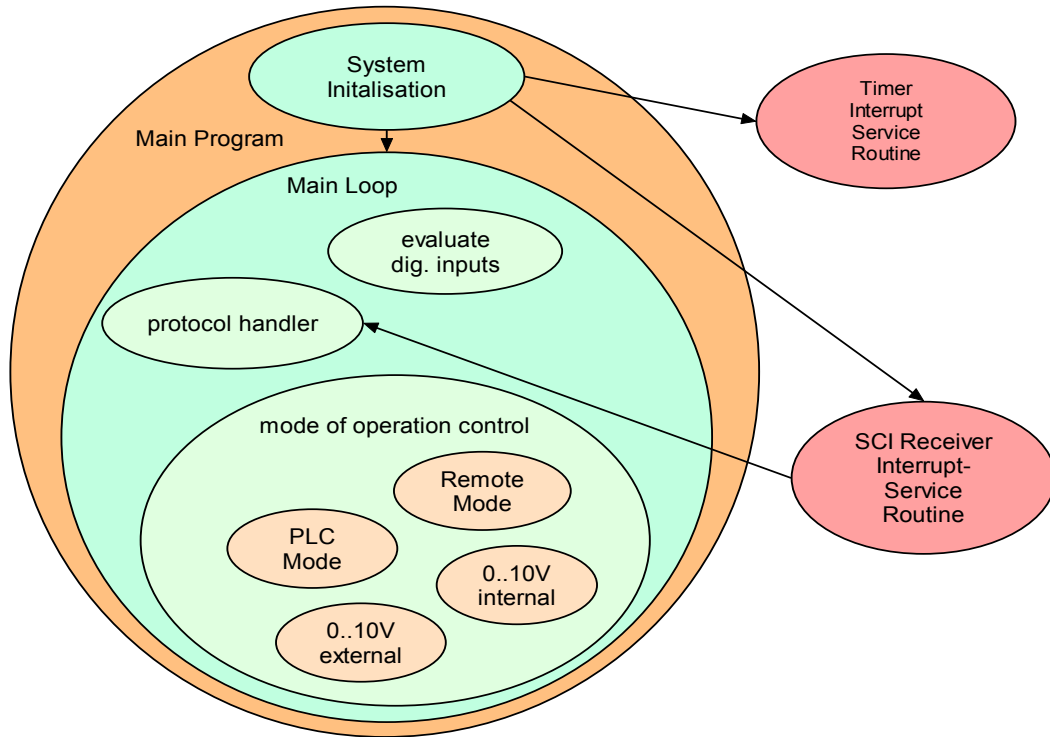


Fig. 4.1 Software module

4.2. PC-software environment *StepControl 8*

4.2.1. System requirements

- IBM compatible PC
- operating system Microsoft Windows (95, 98, NT, 2000 or XP)
- 128 MB RAM (512MB recommended, depends on the operating system)
- graphic controller and monitor:
min. 65536 colours,
resolution 1024x768 or higher
- free HDD memory: ca. 10 MB
- RS232 interface for communication between PC and evaluation board. Using of USB interface is possible with an additional USB to RS232 converter.

4.2.2. Installation

Installation under WINDOWS is done by using an Setup Wizard. Start the assistant by execution of the program „stepcon_8x.exe“. The software environment can be installed in english or in german language. Software can be loaded as FREEWARE from Internet under <http://www.saia-burgess.com>. Figure 4.2 shows the startup window of the installation assistant.



Fig. 4.2 Startup window of Setup Wizard for installation of the PC-software environment

A Setup Wizard navigates step by step through the installation. The installation is executed in the following order:

- Select the destination directory
- Choose language version
- Select the Start Menu folder
- Select additional tasks.

During the installation it is possible to create own settings or take the default environment. If you have done all settings, the Setup Wizard shows a summary of installation parameters. The installation will be executed by pushing the soft button **Install**.

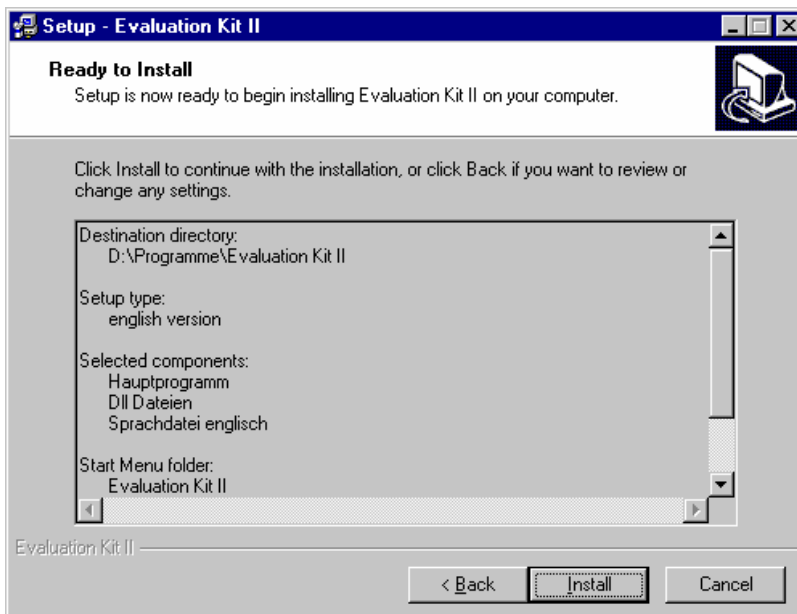


Fig. 4.3 Summary of installation parameters

4.2.3. Structure of the PC-software environment

The PC user interface based on a software environment is structured in four main windows

- configuration window
- command window
- PLC window
- ramp window

Unrestricted change between the windows is possible using the buttons at the bottom of the screen – the window selector.



Fig. 4.4 Buttons

Attention: Pushing the soft button Reset causes the termination of all stand-alone modes.

4.2.4. Configuration

After the start of *StepControl 8* the configuration window is opened, because at first a parametrisation is necessary. This can be done in different ways

- (1) Manually parameter setup in the parameter fields
- (2) Parameter upload from evaluation board
After pushing the **Upload** button the parameters are loaded from the Flash-EEPROM and inserted into the parameter fields.
- (3) Load an existing parameter configuration from a file

We recommend to save the parameters after setting the configuration window on evaluation board by executing the **Download** function or in a configuration file. So it is possible to continue later with the fixed setup. In this window you can configure parameters of the drive and other variables like COM port and device address. A parameter transfer between evaluation board and PC user interface can be done. If parameters are used in the other windows a synchronisation takes place.

Parameters are arranged in the following groups:

parameters

parameters, which depends on motor type and gearbox construction

settings

free adjustable parameters, which affect the working behavior of the drive

interface settings

parameters for communication between Personal Computer and evaluation board

For each parameter group a frame exists in the configuration window with control elements and input fields.

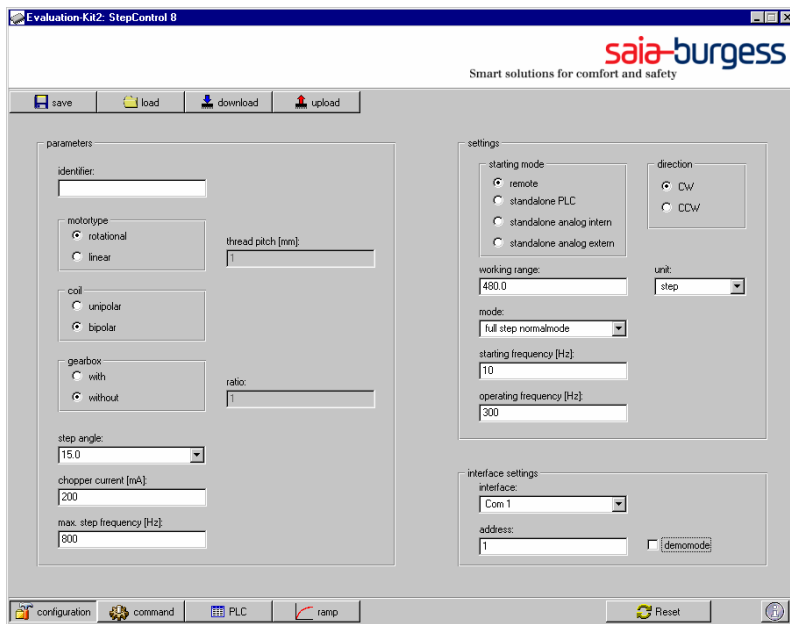


Fig. 4.5 configuration window

The following overview describes the adjustable parameters and the value range. Several parameters can be influenced or changed by others.

Hint: The configuration window can be used as a drive calculator based on the parameter relationships. As an example it is easy to switch between travel range in mm for linear motors and internal steps for this motor.

parameters

identifier:

description: This string is optional and can be used to identify a configured drive. So the configuration can be assigned to an application.

range of values: unrestricted alphanumerical string
It is recommended to use the motor description of the manufacturer.

motortype:

description: type of the stepper motor

range of values: linear or rotational

influences: The field **thread pitch** is been activated depending on the motor type. The dropdown list **unit** is also influenced by motor type. In case the motor type is **linear**, the dropdown list **unit** includes the entries **step** and **path**. Otherwise the list includes **step**, **angle** and **revolution**.

coil:

description: type of the motor coils

range of values: bipolar or unipolar

influences: dropdown list **mode**

gearbox:

description: marks if the drive includes a gearbox or not

range of values: without or with

influences: Depending on this selector the field **ratio** is activated or deactivated

step angle:

description: set step angle of the motor

It is possible to select values from the dropdown list or insert a new value.

range of values: 1..25 degrees

influences: The calculation of the working range in different units is influenced by the value of the step angle. If the unit is changed, a recalculation occurs..

chopper current:

description: max. phase current in constant current mode

range of values: see Technical specifications for hardware

max. step frequency:

description: max. step frequency for the drive as advance fitting for an application

range of values: 10...10000 Hz

influences: The starting frequency and the operating frequency are limited by this max. step frequency

thread pitch:

description: thread pitch of the spindle at linear stepper motors

range of values: 0.1...10 mm

influences: The calculation of the working range in different units is influenced by the value of the thread pitch. If the value is changed, a recalculation occurs.

ratio:

description: gear ratio if a gear box is used

range of values: 1...10 000 000

influences: The calculation of the working range in different units is influenced by the value of the ratio. If the value is changed, a recalculation is executed.

settings

starting mode:

description: The Evaluation-Kit2 can work in 4 different modes of operation. Closed to the remote mode, where the evaluation board ist controlled from PC, there are also 3 different standalone modes. For activation of a stand-alone mode the steps below have to be done:

- the remote mode is current [initial,]
- select the starting mode
- configure the drive
- **download** the configuration to board.

If you have done all these steps, the board will start in the new mode after a reset.

Attention: The selected standalone mode is active only after a power on reset (Push „Reset“ button or switch off/on power supply).

range of values: **remote:** drive is controlled by commands from PC

standalone PLC: drive executes PLC sequences which are saved in the program memory of the evaluation board (PLC table)

standalone analog intern: position of the drive is controlled by a potentiometer on board

standalone analog extern: position of the drive is controlled by an external reference voltage (0-10 V)

Attention: The mode „standalone PLC“ is aborted by pushing the soft button „Reset“ !

direction:

description: direction of movement

range of values: CW clockwise
CCW counter clockwise

Attention: The direction of rotation depends on the wiring sequence of the motor coils!

working range:

description: max. range of movement, can be defined in different units

range of values: 0...65535 [step]
0...100 [mm] (path)
0...360 [grad] (angle)
0...3000 [revolution]

influences: If the unit was changed, a recalculation of working range occurs.

Attention: Please notice the format of steps!

XXXX:YY

XXXX Number of full steps

YY Number of divided steps (depends on mode)

Example: In the ¼-step-mode YY may be 0,1,2 or 3.

So 15:1 means 15 and ¼ (full-) steps

unit:

description: sets the unit of the working range

range of values: step, mm, angle[°], revolution

influences: If the unit was changed, a recalculation of working range is executed.

mode:

description: selection of the driver mode

range of values: for **bipolar motors**: full step normal mode, full step wave mode, half step, half step compensated, 1/4 step, 1/8 step, 1/16 step, special
for **unipolar motors**: full step normal mode, full step wave mode, half step, special

influences: the selectable modes depends on the motor type

starting frequency:

description: value of stepper frequency when the drive executes the first step

range of values: 10 [Hz]...working frequency [Hz]

influences: the max. value of working frequency

operating frequency:

description: value of nominal stepper frequency in pull out operation

range of values: starting frequency [Hz]...max. step frequency [Hz].

influences: parameter is limited by starting frequency and max. step frequency

interface settings

interface:

description: used PC COM port

range of values: COM1...COM9

address:

description: hardware address of evaluation board,
is necessary if the board is used in a RS485 network

range of values: 0...15

demomode:

description: If the demomode is active, all communication functions are disabled.

range of values: activated or deactivated

Hint: The user interface StepControl 8 includes a demomode. So you can test the functionality partly without the Evaluation-Kit2 hardware.

If all settings were done, the configuration should be saved in a file. So it is possible to re-configure the drive later. A configuration file has the extension **sbk**. The file handling is possible by using the functions **load** or **save**.

The parameter synchronisation between user interface and Flash-EEPROM of the evaluation board can be done by **upload** or **download** in the configuration window.

A synchronisation is possible at the first change from configuration window to another windows. On the screen you see the following message.

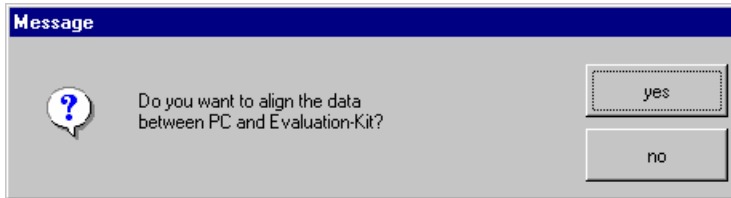


Fig. 4.6 message for parameter synchronisation

Confirmation with **yes** causes a download of the settings in the configuration window to the Flash-EPROM. Otherwise no synchronisation takes place. An upload of ramp tables is always performed. Changing to the configuration window is allowed everytime.

4.2.5. command window

Figure 4.7 shows a screenshot of the command window. This window permits the generation and execution of single drive commands. Thereby it is possible to send a new command before the last command is finished.

- **reference run**

Executes a drive command with the max. number of steps (working range) +20% in the chosen direction. The position reached is the home position for position control.

Attention: To ensure the drive reaching the mechanical reference point, movement with the fixed number of steps +20% was defined !

- **reference run to switch**

Execute a drive command up to the switch is reached. The execution is aborted, when the signal on J201-1 is HIGH-active (+5VDC).

- **position control**

movement to an absolute position based on the home position

Attention: Before position control can be used a reference run is required!

- **execute steps**

executes the defined number of steps in the selected direction

Execution of a command:

First select a command in the menu **command** and adjust all parameters. As support for parametrisation you have the information table on the right site of the window. Then push the button **Run** and the command will be executed. With the button **Stop** you can abort the execution.

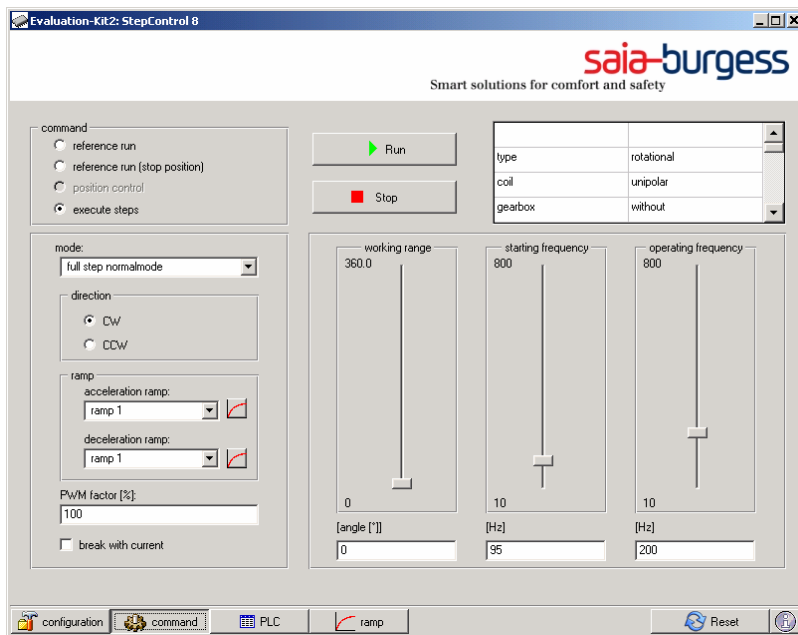


Fig. 4.7 command window

command parametrisation:

Before execution of a command the following settings have to be done.

mode

Here you can choose a driver mode for the next commands. A lot of modes based on chopper current control capability exist for bipolar motors. 1/16 microstepping enables the highest resolution and provides an increased step resolution, and reduces torque variations and resonance problems at low speed.

Entries of the dropdown list depends on the motor type:

unipolar	bipolar
full step normal mode	full step normal mode
full step wave mode	full step wave mode
half step	full step low current
special (on request)	half step
	half step compensated
	1/4 step
	1/8 step
	1/16 step
	special (on request)

chopper current or PWM-factor

A chopper current can be adjusted if the motortype is bipolar. The value is the upper threshold of the phase current. The true RMS value of phase current depends on the current step frequency, selected mode, supply voltage and the motor parameters like coil resistance.

The unipolar drivers don't support a chopper current control. Therefore PWM-factors can be used to adjust the current. Such a factor means the ON-time as part of the step-time. Range of values: see Technical specifications

working range

The working range is showed with the unit, which was selected in the configuration window. The upper limit is the value **working range** in configuration window.

Adjustment of the working range as absolute position (position control) or as relative movement (execute steps) are available.

range of values: 0 bis 65536 (steps)

starting frequency

value of stepper frequency when the drive executes the first step

range of values: 10...10 000 (Hz)

operating frequency

value of nominal stepper frequency

range of values: 10...10 000 (Hz)

Attention: The max. value for the starting frequency and the operating frequency is the value of the parameter max. step frequency in the configuration window!

acceleration ramp / deceleration ramp

selection of acceleration and deceleration ramp for the current command

range of values: ramp 1, ramp 2, ramp 3, none

direction

selection of moving direction

left/right at rotational drives

forward/backward at linear drives

range of values: CW, CCW

break with current

If this selector is set the motor stops with energized coils to get a high holding torque.

range of values: activated or deactivated

Attention: This setting is very important for drives with spring return!

Break with current results in strong temperature rising!

The synchronisation between configuration window and command window takes place with the following parameters:

- mode
- direction
- starting frequency
- operating frequency
- chopper current

4.2.6. PLC window

In PLC-mode the Evaluation-Kit2 can be used as a programmable logic control unit. So the unit is able to execute complex motion sequences. The sequence table can be generated by an offline editor. After generation the table has to be **downloaded** to the Flash-EPROM of the evaluation board. The execution of sequences is activated with the command **PLC Start**. The command **PLC Stop** aborts the execution. In the PLC standalone mode the sequence starts after a hardware restart or reset.

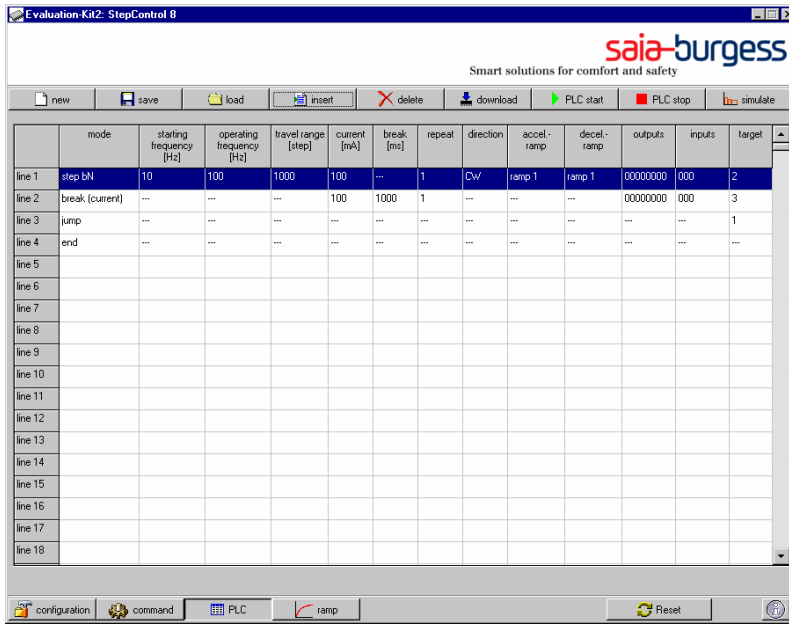


Fig. 4.8 PLC window

Structure of a row in the PLC table:

mode	starting frequency	operating frequency	travel range	current	break	repeat
direction	acceleration ramp	deceleration ramp	outputs	inputs	target line	

The sequence input takes place with a special mask.

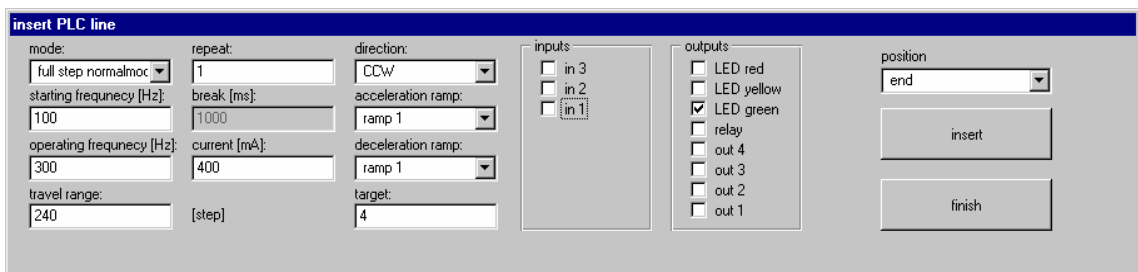


Fig. 4.9 input mask

Fields, which are not necessary for the current mode, are disabled.

generation of a PLC table:

- (1) Open the PLC window
- (2) Push the button **new** to erase the table
- (3) Push button **insert** to edit new PLC sequences
- (4) Specify parameters regarding point 4.2.3
Please take notice of additional functions.
 - **mode** (dropdown list)
 - **break** and **break with current**
break time in ms
range of values: 10 to 65535 (ms)
 - **jump**
jump without condition to defined target
 - **end**
end of sequence (not required)
 - **inputs**
setting of branch conditions
If the condition is true, the sequence will be aborted and the sequence goes to the next line. If the condition is false the PLC continues with the line specified in **target**.
 - **outputs**
output of 4 digital signals (open collector), 3 LED, relays control
 - **repeat**
number how often the line should be repeated before execution the next line
range of values: 1 to 65535

Attention: Repeat “n” means jump (back) n-1 times to target and go to next line after n repeats.

 - **target**
execution pointer if conditions are false, a jump occurs or the number of repeats is higher than 1.
In all other cases the process continues with the next line.
range of values: 0 to 255

Attention: Without an activated condition bit (all off) no jump to target is possible. With one or more bits a true condition leads to the next line.

- (5) If the configuration of the PLC line is completed, insert the sequence into the table by pushing the button **insert**. The setting of the field **position** defines the insertion position in the table.
- (6) Further lines can be inserted in the same way. Pushing the button **finish** closes the procedure.

The complete PLC table must be transferred to the evaluation board with **download**.

Change of parameters in a existing PLC line

At first double click in the line which shall be changed. The input mask opens. Now you can modify the parameters of the selected sequence. With pressing the button **confirm** the changed sequence will be updated.

Displacement of lines

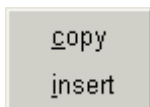
Click with the mouse cursor in the line, which shall be displaced and move the clicked mouse cursor to the target position. Then release the mouse cursor and the sequence is at the new position.

Delete a line

Mark this line and press button **delete** and this line will be deleted.

Copy of lines

At first move the cursor to the first line which you like to copy, click the left mouse button and move the cursor to the last line which should be copied. Now click the right mouse button and the following menu opens.



Execute **copy** with the left mouse button and move the cursor to the target line. Now press the right mouse button again and **insert** the copied lines at target position.

Transmission to Evaluation-Kit2

The PLC-Table is downloaded to the Flash-EEPROM of the Evaluation-Kit2 after pushing the button **Download**.

Attention: Before you can start the PLC-sequences you have to download the PLC-table!

4.2.7. Ramp generation window

The maximum frequencies with defined loads at which the motor can start/stop instantaneously, without loss of synchronism, is the Pull-In curve. Outside the Pull-In area the motor must be ramped (**acceleration and deceleration**) into the **Pull-Out area**. Using ramps results in higher possible torques and higher frequencies. These functions are performed with ramp tables in the Evaluation-Kit2 firmware. Ramp characteristics can be changed with the user interface StepControl 8. After ramp table generation the tables have to be downloaded into the Flash-EPROM of the Evaluation-Kit2. It is possible to implement 3 different ramp characteristics in the firmware. An operation without ramp is possible too.

The generation or modification of ramps can be done by different ways. It is possible to calculate the ramp according to a mathematical function, edit the ramp with the integrated table editor or to load an external created ramp with a file. The new ramps can be saved in a file. When the ramps have been downloaded to the evaluation board, they can be used by the motion commands and sequences. Figure 4.10 shows the ramp window.

In the Evaluation-Kit2 firmware there isn't a difference between acceleration and deceleration ramp. The ramps can be used upward for acceleration and downward for deceleration.

Attention: With different ramp characteristics for acceleration and deceleration, be sure that the number of steps for the drive command is higher than the sum of ramp steps!

Before the first change from configuration window to another window, the ramps must be uploaded from evaluation board to the PC user interface (PC-software environment).

The selection of ramps in the ramp window is possible by dropdown list **ramp**.

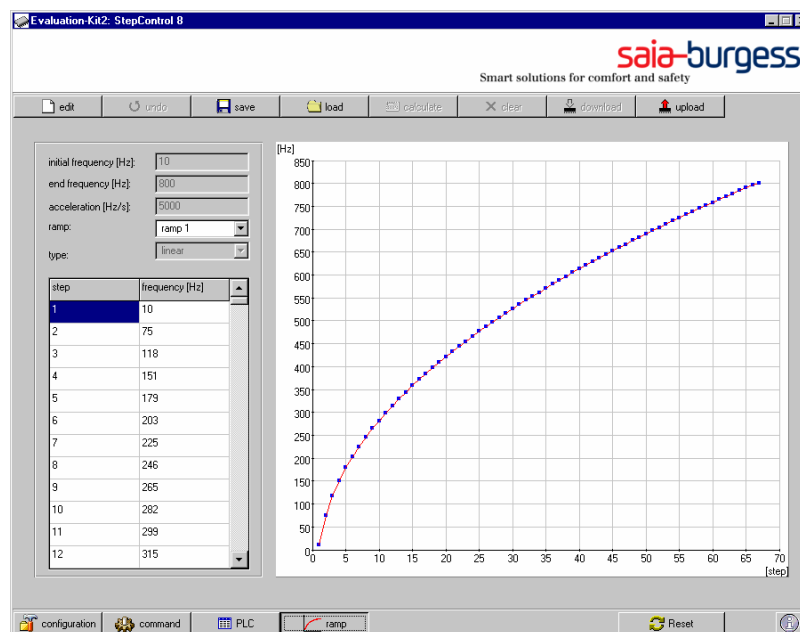


Fig 4.10 ramp window

The next sequence describes the procedures to create or change a ramp.

- (1) Select the ramp, which should be handled
- (2) Push button **edit**
- (3) Select the **type** (linear or special)
- (4) If the type **linear** was chosen, specify parameters initial frequency, end frequency and acceleration.

Press button **calculate** to get the new linear ramp. →(7)

- (5) If the type **special** is selected, the table can be edited or can be filled with new values after click **clear**
- (6) Insert the values into the table
- (7) the graphic is updated
- (8) By pushing the button **Download**, the new ramp is transferred to evaluation board.
- (9) If the new ramp should not be transferred press the button **undo** and the old ramp is reconstructed.

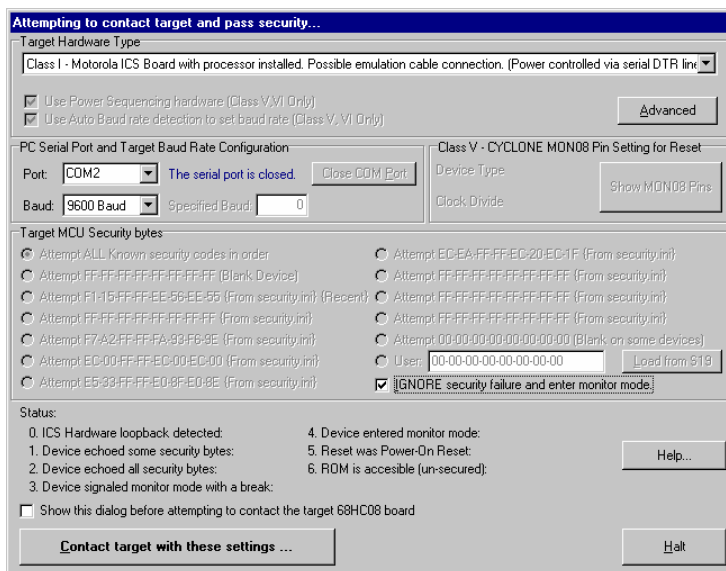
4.3. In-system programming

A special mode supports the In-System Programming (ISP) of the Evaluation-Kit2 firmware. The RS232 interface is used for communication between PC and evaluation board. To set the board in the ISP mode, switch **S200** in Position **ISP**.

Attention: This mode is only for programming or reprogramming of the Evaluation-Kit2 firmware (operating system).

Evaluation board and PC must be linked by a serial modem cable (female-female crossover cable). Software tool for programming is the freeware PROG08SZ of PEMICRO. The programmer software you find on the Evaluation-Kit2 CD. Please copy the folder to your PC and set all files to not write protected. Now you can start the programmer.

The programming software starts with the following screen.

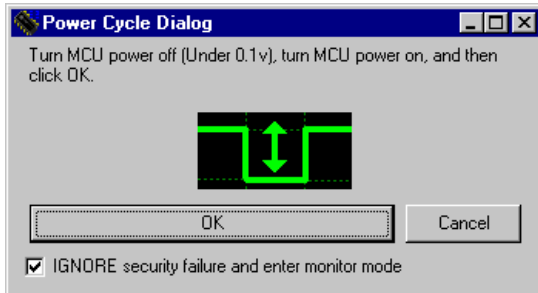


Choose the following settings:

- Target Hardware Type: Class III
- Port: a free COM-port for the Evaluation-Kit2
- Baud: 9600
- Target MCU Security bytes: Attempt FF FF FF FF FF FF FF FF (Blank Device)
- Choose IGNORE security failure and enter monitor mode

Press Button **Contact target with these settings**.

Next you see the following window.

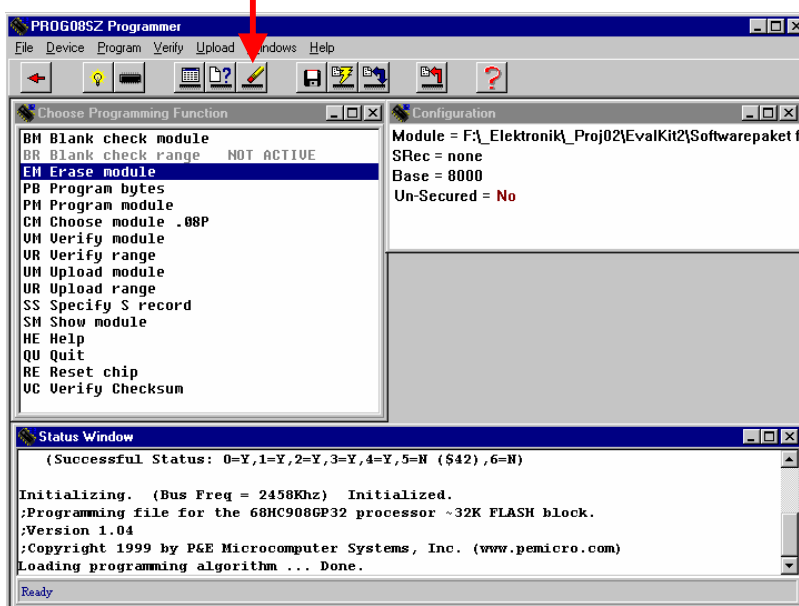


- Switch off power supply
- Wait approximately 2 sec
- Switch on power supply
- Press button **OK**

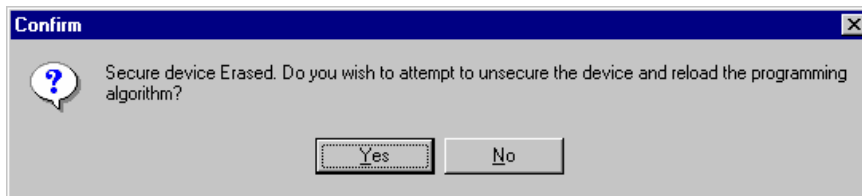
In the next window you have to choose the MCU module file. Please change into the directory with the file **908_gp32.08p** and open this file.



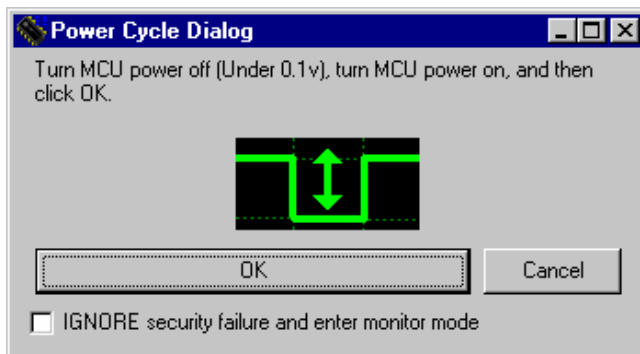
- **Execute Erase module**



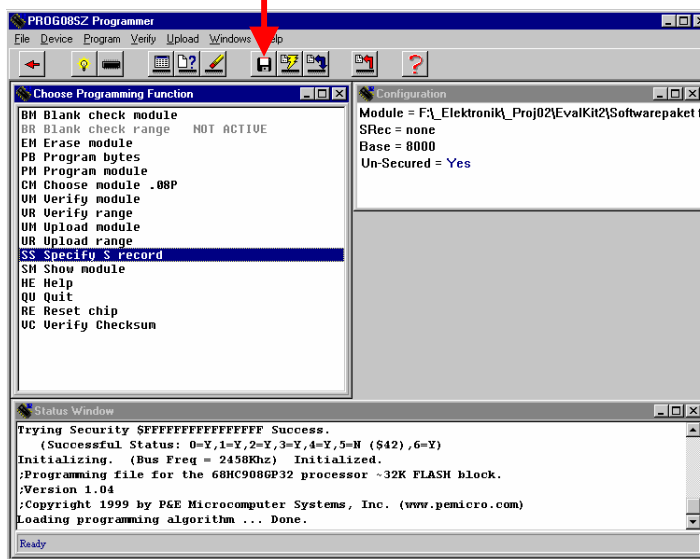
- Confirm the following message with **Yes**



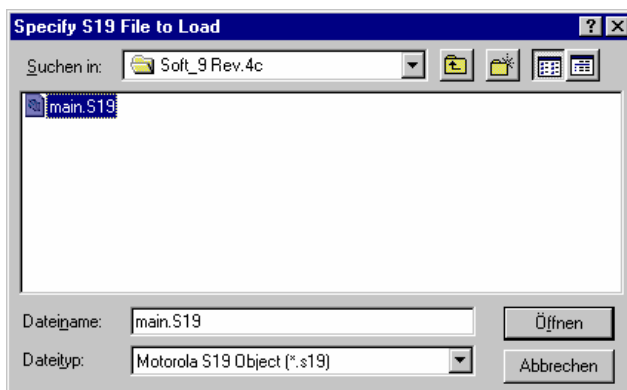
- switch off, wait 2 seconds, switch on and press **OK**



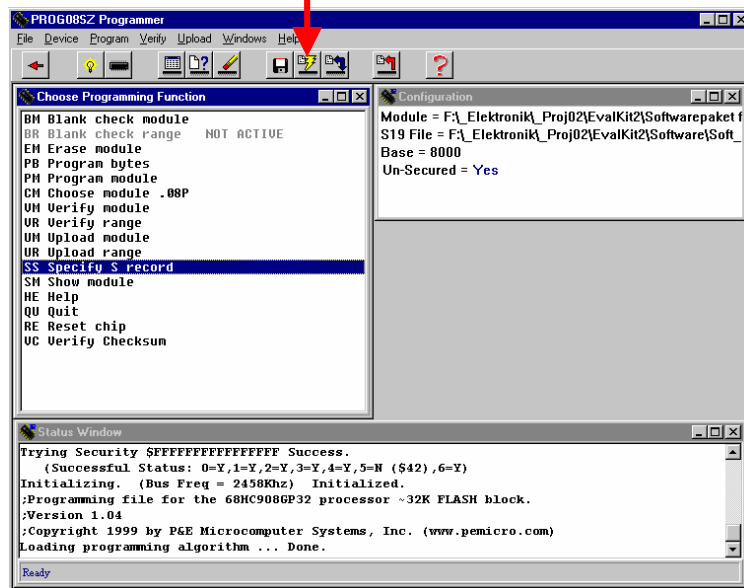
- Choose the firmware file with **Specify SRecord**



- open the new S19 File (which you got from Saia-Burgess Dresden)



- Execute Program module



When you get the confirmation **programmed** the programming was successful. Now you can close the programmer software. Set the board into User-mode (**Switch S200 in position USER**) and reset the Evaluation-Kit2 hardware.

Attention: Only after a hardware reset the Evaluation-Kit2 is ready to work with the new firmware!

4.4. File management und support

The Evaluation-Kit2 and the software environment are a huge development tool for stepper drives. There is need for a flexible file management system. This helps you to change the drive setup and the current configuration for your investigations and tests quickly. Figure 4.11 shows all types of files which you can use. Further information about the files you find in the related chapters.

Based on the innovative file system we are able to help you by using the Evaluation-Kit2. At your request, we support you with predefined configuration files for special motor/gearbox combinations for your application.

One of the main tasks of the PLC-mode is control motion sequences. Examples are lifetime test for Saia-Burgess motors under customer specific conditions. We offer you help to create such PLC-tables for the test of Saia-Burgess motors in your application.

Please send us your email address to get available updates of Firmware or further information like special tutorials about design and optimization of stepper drives.

From time to time you should look at our homepage for new versions for the manual and for new downloads of the software package.

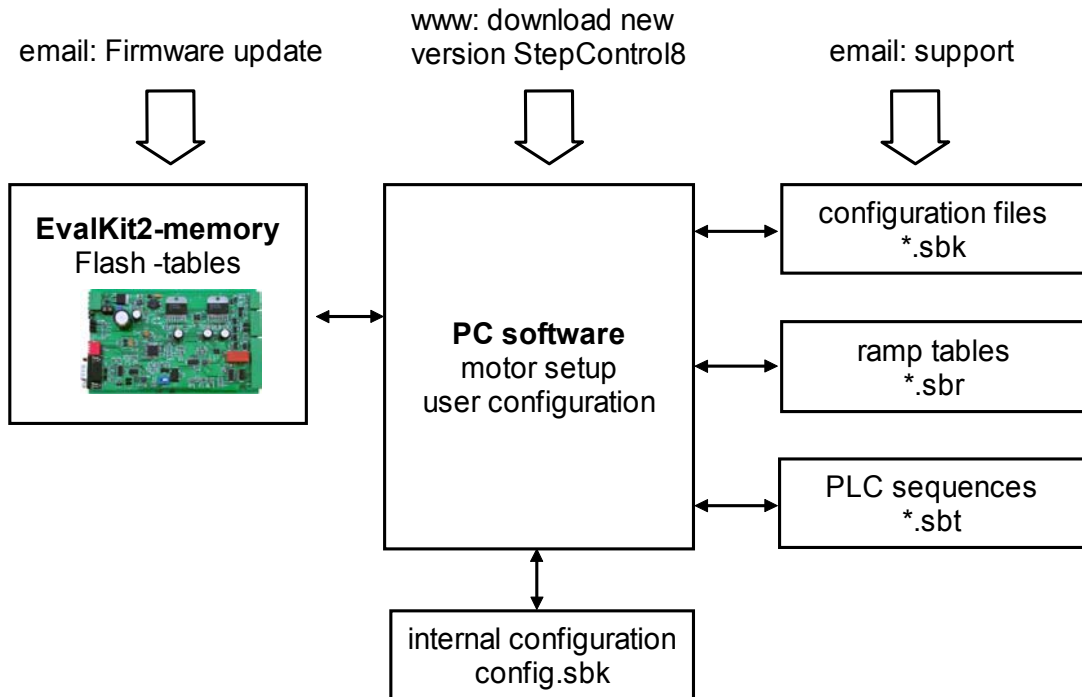


Fig. 4.11 Overview file system Evaluation-Kit2

5. Troubleshooting

If the Evaluation-Kit2 doesn't work correctly, please check if von of the following reason for errors are valid.
 Otherwise please contact our support line.

Error	possible reasons
no communication between PC and Evaluation-Kit2	power supply not connected
	crossover cable between PC and Evaluation-Kit2 is not connected, RS232-Port is not correct
	hardware address and selected address on user interface are not identical
	switch ISP/USER in position ISP
	user interface in demomode
Commands are not executed	motors not correct connected, unipolar and bipolar interchanged
	user interface in demomode
Command position control is not possible	reference run was not executed
PLC sequences are not executed	download of the table was not performed
motor doesn't work	no motor voltage or jumpers J100/J101 are removed

6. Technical specifications (Hardware version 2)

Power supply

Supply voltage for logic:	8 to 48 VDC or 24 VAC \pm 20 %
Supply voltage for motor:	3 to 48 VDC unipolar, 8 to 48 VDC bipolar or 24 VAC \pm 20%
Max. input power:	100Watt
Operating temperature:	0 to 55 °C

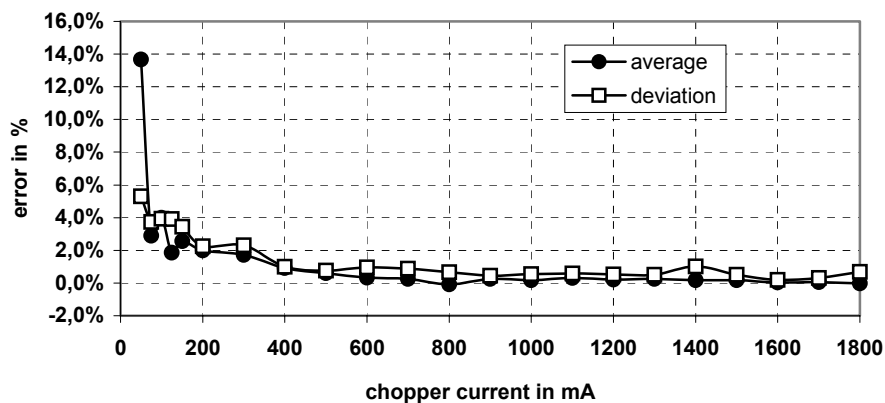
Motor management / μ C MC68HC908GP32

ROM-size:	32 kByte
RAM-size:	512 Byte
Internal clock frequency:	2,46 MHz
Max. stepper frequency:	10000 steps/s
Driver modes:	wave step, full step, half step, microstep

Bipolar driver LMD18245

RDS(ON):	
Low side	0,28 Ω (typical)
High side	0,25 Ω (typical)
Max. chopper current:	2,25 A / phase
Min. chopper current:	100 mA / phase (full step) 20 mA / phase (low current full step)
Resolution chopper current:	12 bit
Relative error of chopper current:	\pm 5 %, see diagram

measured error of chopper current



Chopper frequency:	16 ... 50 kHz (depends on motor type, speed, voltage)
J304/305 open:	toff=30 μ s
J304/305 closed:	toff=17 μ s

Unipolar driver NTD3055L

RDS(ON):	0,07 Ω (typical)
Output current:	2,6 A / phase
Zener voltage:	
J302/303 open	10 V
J302 closed:	5,6 V
J303 closed:	0 V
PWM-factors:	only 100% ON-time, not supported!

Miscellaneous

Signal inputs and outputs (length > 3m):

J201-1	Input digital	0 / 5 VDC +/-10 %	
J201-2	Input digital	0 / 5 VDC +/-10 %	
J201-3	Input analog or digital	0 ... 10 VDC or 0/10 VDC	0,5 mA
J201-4	Ground	-	
J201-5	Output – open collector	5 ... 24 VDC	0,25 A
J201-6	Output – open collector	5 ... 24 VDC	0,25 A
J201-7	Output – open collector	5 ... 24 VDC	0,25 A
J201-8	Output – open collector	5 ... 24 VDC	0,25 A
J201-9	Relay contact 1	5 ... 24 VDC/AC	6 A
J201-10	Relay contact 2	-	(closing contact)
J201-11	Output – free wheeling diodes	-	(for open collector)
J201-12	Output for logic voltage	5V DC –10 %	0,25 A

RS232 interface: 9600 baud, 8 bit, no parity, 1 stop bit

RS485 interface: max. 250 kbps possible, **not supported!**

Mechanical Parameters

PCB dimensions: 160 x 100 x 30mm (assembled Euro-PCB)

Metal case dimension: 164 x 130 x 45mm (Fischer Elektronik KOH2+KOL2)

Terminal plug system:

			order number Phoenix Contact:
J100	supply voltage	MSTB 2,5/3-ST-5,08	17 57 02 2 V0
J201	signal inputs and outputs	MC 1,5/12-ST-3,81	18 03 67 5 V0
J202	RS485 interface	MCVR 1,5/2-ST-3,81	18 27 12 7 V0
J300	motor connector bipolar	MC 1,5/4-ST-3,81	18 03 59 4 V0
J301	motor connector unipolar	MC 1,5/6-ST-3,81	18 03 61 7 V0

7. Contact

Saia-Burgess Dresden GmbH
Wilhelm-Liebnecht-Str. 6
D-01257 Dresden
Telefon ++49 351 20 78 6-370
Telefax ++49 351 20 78 6-361
Internet: <http://www.saia-burgess.com>
email: DE01-Electronic@saia-burgess.com

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Saia-Burgess makes no guarantee for any particular usage other than described in this manual, nor can we accept any liability in case a connected device or appliance will be damaged.

Kit2-Manual Rev.1.1

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