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Instruction manual EDA

Interface card for amplifier system ENV

☐ EDA 2
☐ EDA 3
☐ EDA 4
☐ EDA 5

Please read the instructions carefully before switching on the device !

This instruction manual includes CD-ROM:
Interface Board EDA

Serial no.:

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Instructions for using piezoelectrical elements and power supplies

- Piezoelectric actuators from ***piezosystem jena*** are controlled by voltages up to 150V. These values can be quite hazardous. Therefore read the installation instructions carefully and only authorized personal should handle the power supply.
- After transportation, piezoelectric actuators should be allowed to adapt for approximately 2 hours to the room temperature before being switched on
- Piezoelectric actuators are made from ceramic materials with and without metallic casings. The piezo-ceramic is a relatively brittle material. This should be noted when handling piezoelectrical actuators. All piezo-elements are sensitive to bending or shock forces.
- Due to the piezoelectric effect piezo-actuators can generate electrical charges by changing the mechanical load or the temperature or such actions described above
- Piezoelectric actuators are able to work under high compressive forces, only actuators with pre-load can be used under tensile loads (these tensile forces must be less then the pre-load, given in the data sheet)
- Please note, that the acceleration of the ceramic material (e.g., caused by fall down, discharging or high dynamic application) will occur.
- After excitation of the actuators by a voltage in the upper control range, the ceramic will move and generate an opposite high voltage after disconnection.
- Heating of the ceramic material will occur during dynamic operation and is caused by structure conditional loss processes. This may cause failure if the temperature exceeds specified values cited below.
- With increasing temperature, up to the Curie temperature (usual values approx. 140°C - 250°C), the piezoelectric effect disappears.
- Piezoelectric actuators such stacks or various tables work electrically as a capacitance. These elements are able to store electrical energy over a long period (up to some days) and the stored energy may be dangerous.
- If the actuator remains connected to the drive electronics, it is unloaded within a second after shutdown and quickly reaches harmless voltage values.
- Piezo-actuators can generate voltages by warming or cooling only (caused by the longitudinal change). The discharge potential should not be ignored due to the inner capacitance. This effect is insignificant at usual room temperature.
- Piezo-actuators from ***piezosystem jena*** are adjusted and glued. Any opening of the unit will cause misalignment or possible malfunction and the guarantee will be lost.
- Please contact ***piezosystem jena*** or your local representative, if there are any problems with your actuator or power supply.
-

Caution!
Shock forces may damage the built-in ceramic element. Please avoid such forces, and handle the units with care, otherwise the guarantee will be lost.

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Safety Instruction

- Do not open the units! There are no user serviceable parts inside and opening or removing covers may expose you to dangerous shock hazards or other risks. Refer all servicing to qualified service personnel.
- Allow adequate ventilation around the units so that heat can properly dissipate. Do not block ventilated openings or place the units near a radiator, oven or other heat sources. Do not put anything on top of the units except those that are designed for that purpose (e.g. actuators).
- Do not spill any liquids into the cabinet or use the units near water.
- Do not insert objects of any kind into the cabinet slots, as they may touch dangerous voltage points, which can be harmful or fatal or may cause electric shock, fire or equipment failure.
- Do not place any heavy objects on any cables (e.g. power cords, sensor cables, actuator cables, optical cables). Damage may cause malfunction or shock or fire!
- Do not place the units on a sloping or unstable cart, stand or table as they may fall or not work accurately.
- Work with the units only in a clean and dry environment! Only specially prepared units (e.g. actuators) can work under other conditions!
- Please use only original parts from ***piezosystem jena***. ***piezosystem jena*** does not give any warranty for damages or malfunction caused by additional parts not supplied by ***piezosystem jena***. Additional cables or connectors will change the calibration and other specified data. This can change the specified properties of the units and cause them to malfunction.
- Piezoelements are sensitive systems capable of the highest positioning accuracy. They will demonstrate their excellent properties only if they are handled correctly! Please mount them properly only at the special mounting points.

Immediately unplug your unit from the wall outlet and refer servicing to qualified service personnel under the following conditions:

- When the power supply cord or plug is damaged
- If liquid has been spilled or objects have fallen into the unit.
- If the unit has been exposed to rain or water.
- If the unit has been dropped or the housing is damaged.

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Contents

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1. Introduction

The purpose of the interface card is the intelligent in-and output of digital aswell as analogue signals. It was optimised for controlling piezo actuator amplifier. The interface card can store user written makros and work independent of a personal computer. The **EDA** interface card is available in the following versions:

- as 12-bit version:

- with RS232 - EDA 2
- with RS232 and IEEE 488 - EDA 3

- as 16-bit Version:

- with RS232 - EDA 4
- with RS232 and IEEE 488 - EDA 5

The EDA consists of the the modules computer interface and analogue electronic. In addition there are 8 digital in- and outputs. The modules are controlled by CPU SAB-C515A with 128KByte FLASH-EPROM and 128KByte RAM. The micro controller works at 11.059 MHz clock frequenzy. The EDA was build on a Europe card (MLL 100x160 mm²). PC-interfaces and control elements are on the front panel of the EDA, whereas inputs and outputs aswell as the working current are delivered via a 64-pin connector at the back side of the card.

The EDA is delivered with user manual and CD-ROM EDA. The CD contains the demo-software demoeda.EXE, some programing tools for the EDA and the source code of the demosoftware.

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2. Technical Data

circuit board:	100x160 mm^2
working voltage:	+5V (140mA), +/-15V (15mA)
CPU:	SAB-C515A (SIEMENS)
data memory:	128 kByte
code memory:	128 kByte FLASH 256 Byte EEPROM
digital outputs:	8
digital inputs:	8
display:	4 x LED (front panel)

variant of EDA			**2**	**3**	**4**	**5**
RS232 (front panel)			**x**	**x**	**x**	**x**
IEEE 488 (front panel)				**x**		**x**
analogue outputs (0..10V)						
	resolution: 4 x 12 Bit		**x**	**x**		
	resolution: 4 x 16 Bit				**x**	**x**
analogue inputs						
	resulution: input voltage:	8 x 12 bit +/-10V,+/-5V,0..10V,0..5V	**x**	**x**		
	resulution: input voltage:	4 x 16 bit 0..10V			**x**	**x**

3. Pin Connection X3 (C64)

A			C	
pin	**signal**	**description**	**signal**	**description**
1	GND	digital ground	GND	digital ground
2	GND	digital ground	GND	digital ground
3	eo7	digital output 7	eo6	digital output 6
4	VCC	+5V digital	VCC	+5V digital
5	eo5	digital output 5	eo4	digital output 4
6	+15V	analogue Ub	+15V	analogue Ub
7	eo3	digital output 3	AI5	analogue input 5
8	AGND	analogue ground	AGND	analogue ground
9	AGND	analogue ground	AGND	analogue ground
10	AI6	analogue Eingang 6	AI7	analogue input 7
11	-15V	analogue Ub	-15V	analogue Ub
12	AI1	analogue input 1	AI0	analogue input 0
13	AI2	analogue input 2	AO0	analogue output 0
14	AO2	analogue output 2	AO1	analogue output 1
15	eo0	digital output 0	eo2	digital output 2
16	eo1	digital output 1	AO3	analogue output 3
17	AI3	analogue input 3	AI4	analogue input 4
18	-	NC	-	NC
19	-	NC	-	NC
20	-	NC	-	NC
21	-	NC	-	NC
22	-	NC	-	NC
23	-	NC	-	NC
24	-	NC	-	NC
25	-	NC	-	NC
26	AGND	analogue ground	AGND	analogue ground
27	ei4	input 4 (0...5V)	ei3	input 3 (0...5V)
28	ei5	input 5 (0...5V)	ei2	input 2 (0...5V)
29	ei6	input 6 (0...5V)	ei1	input 1 (0...5V)
30	-	NC	-	NC
31	ei7	input 7 (0...5V)	ei0	input 0 (0...5V)
32	-	NC	-	NC

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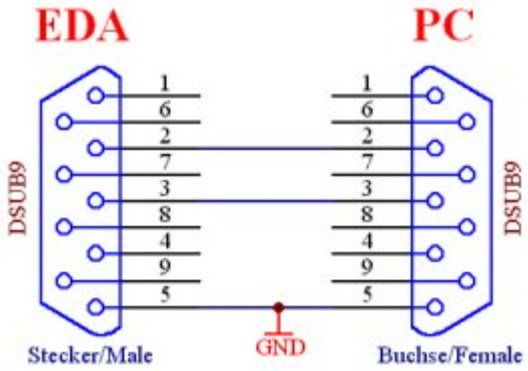
4. Pin Connection X4 (DSUB9)

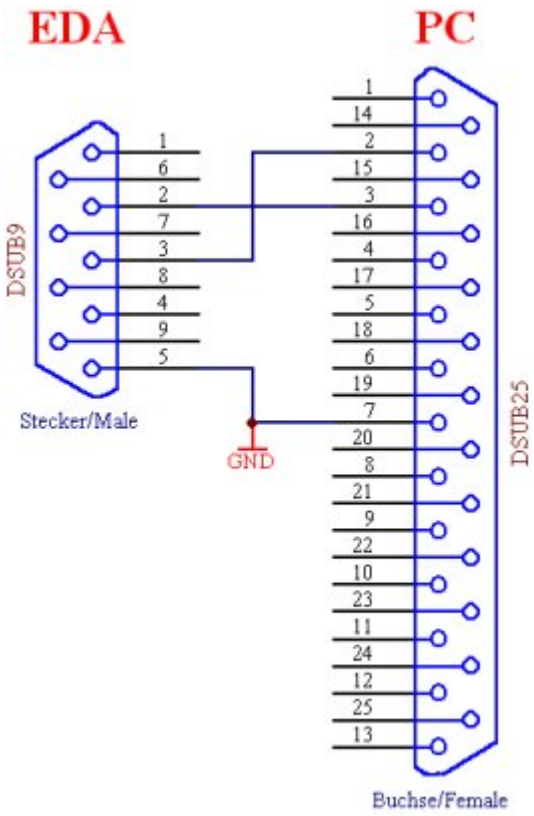
pin	signal
1	NC
2	TxD
3	RxD
4	connected with pin 6
5	GND
6	connected with pin 4
7	connected with pin 8
8	connected with pin 7
9	NC

5. RS232-cable

- **9-pol --> 9-pol cable**



- **9-pol ⇒ 25-pol cable**



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6. Demosoftware
6.1. Installation

System Requirements:

- PC running Windows 3.11, 95/98 oder NTx
- 8 MB free memory on hard disc

Software:

- Microsoft Windows 3.11 capable of 32-Bit prozessing, 95/98 or NTx

ACROREAD:
ACROBAT-READER

DATASHEETS:
datasheets for EDA

DOC:
Documentation

SOURCE:
C51-source for Urlader and actual EDA-program
EDA2_5.HEX – program stored on interface card, download with included terminal software possible
URLADER.HEX – simple download program for page 1, download with included terminal software possible

WWW.PIEZOSYSTEM.COM:
Website of ***piezosystem jena GmbH***

- copy DEMOEDA.EXE and Help-Files onto hard disc and execute
- press F1 or use with '?' for Help

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6.2. Getting started

After starting the demo program for the first time parameters and possible settings are set by default. The language setting adjusts to the language of the operating system. In case of a system language different from German or English the program language is set to English. The subroutine **Voltage/Way** is activated. The interface is specified as RS232 on COM1 with 9600 Baud. If COM 1 is not accessible an error is prompted and the menu **Settings** opens. The settings have to been adjusted. After changing to the subroutine **Terminal** the EDA should use it prompt:

EDAx Vn.nnn S0>

In case of reply:

URL Vn.nnn S1>

the function switch S1 is in position 2 and has to be switched to position 1. Reset the interface card afterwards.
If the terminal shows no response the following points should be checked:

- is the EDA (the ENV-System) switched on ?
- is the RS232-Connection between PC and interface card established ?
- is the configuration of the RS232-Connection ok ?
- were the appropriate COM-parameter choosen ?

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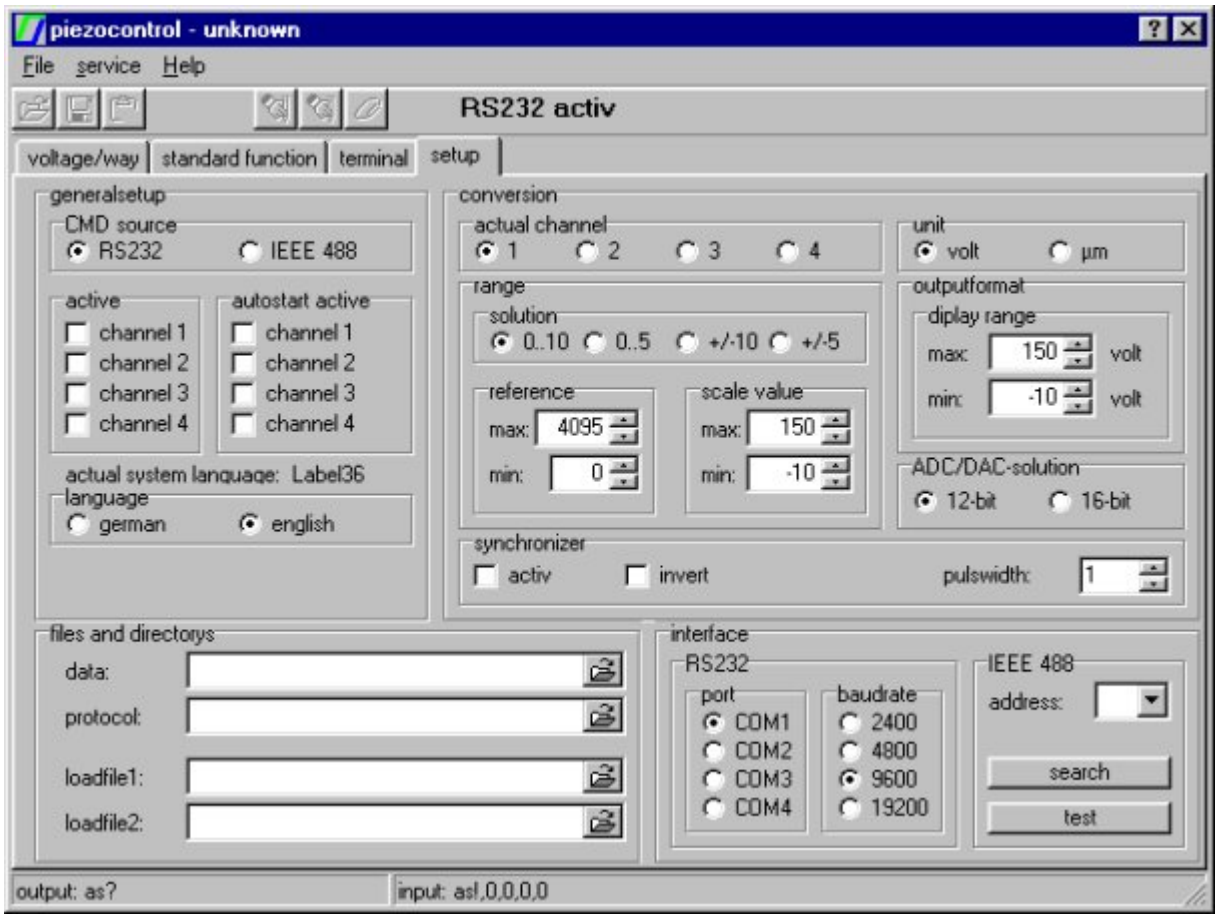
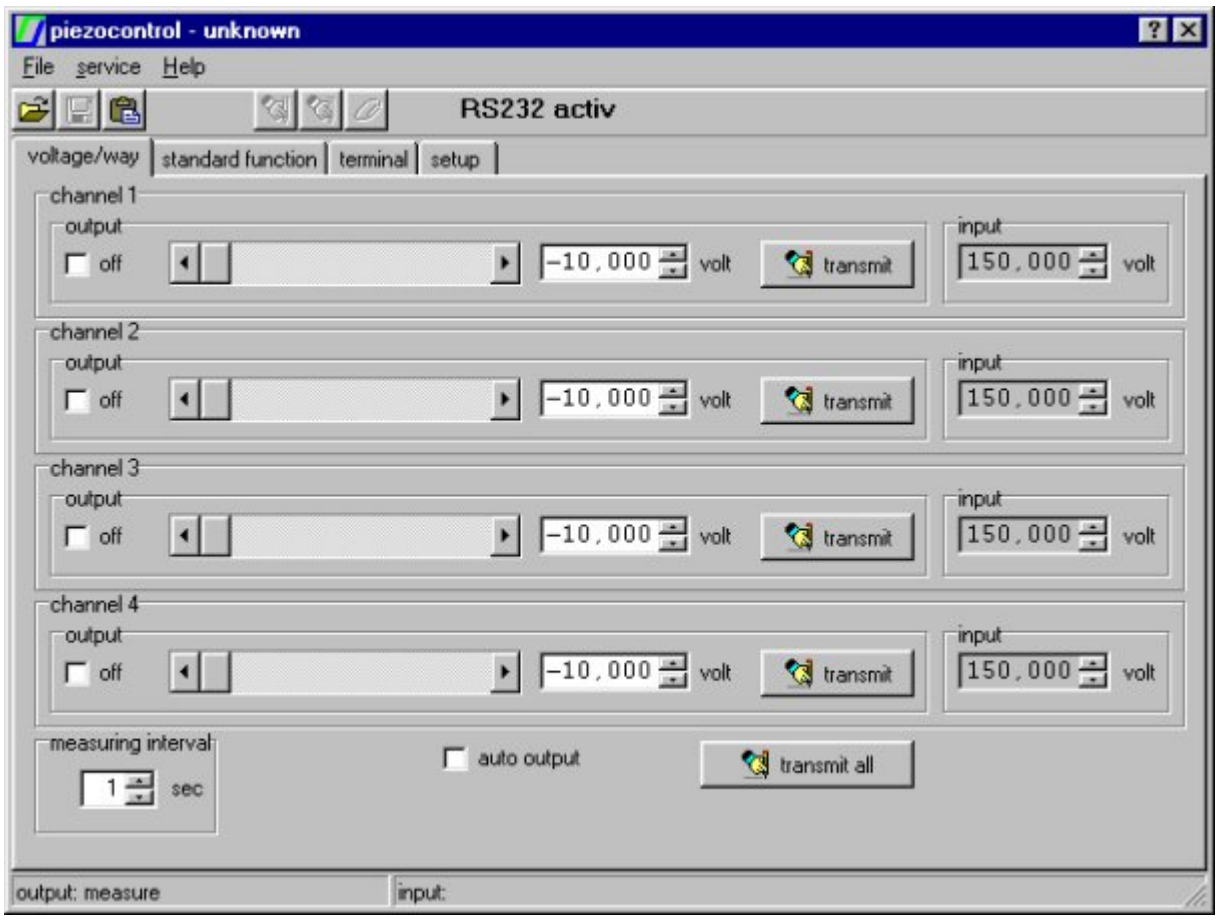
6.3. Default setting



6.4. Voltage/Position

6.4.1. Overview

In this register every accessible channel can be supplied with a different voltage and the corresponding position of the piezo actuator is displayed. Changes in driving voltage or position of piezo can be made by altering the settings via sliding control or edit field. For accessing control elements of a channel, the channel has to be activated first.



As long as this register is activated the 8 (**EDA2/3**) or 4 (**EDA3/4**) channel of the AD-converter are read out and the measured values are send to the demo program using the command '**aw**'. The procedure is repeated at an intervall specified by measuring interval.

By changing to or leaving from this register all channels are switched off.

6.4.2. Switch Channels

The marked channel is activated.This is only possible if the corresponding channel was activated in the setup register.

6.4.3. Sliding Controls

The output voltage can be specified. If the box **auto output** is marked, changes will be transmitted to the EDA immediatly.

6.4.4. Voltage Setting

The output voltage can be changed directly or by means of the arrow keys. If the box **auto output** is marked, changes will be transmitted to the EDA immediatly.

6.4.5. Set Voltage

The specified voltage of the selected channel is send by **set,nr,Usoll**.

6.4.6. Voltage Display

If the register **Voltage/Distance** is activated, a cyclic voltage measurement of all activated ADC-Channels is performed by using the command **measure**. The periodicity of measurements can be changed in the sub menu **measuring interval**. The EDA answers with the command 'aw,wert0,wert1,...,wert7'. This voltage values are scaled and displayed according to the rules defined in the register **Setup/Scaling/Measurement Range**.

6.4.7. Button Transmit All

All four specified voltages are transmitted using the command **setall**.

6.4.8. Pick Up Auto Output

By marking this option changes are transmitted automaticly.

6.4.9. Measuring Interval

The periodtime for voltage measurements can be set here. Possible intervals range from 0 to 25 seconds. If 0 seconds is selected no voltage measurement is performed.

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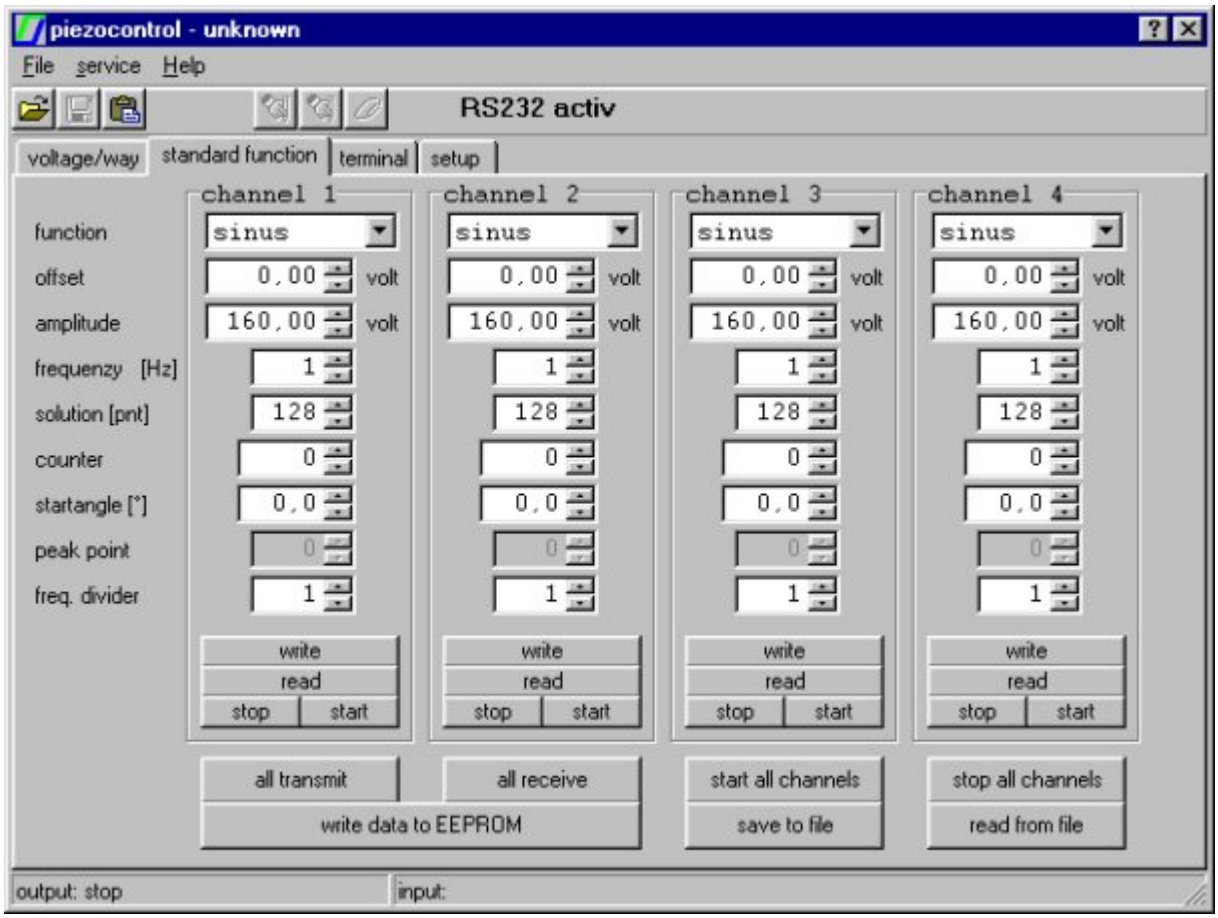
6.5. Standard Function

6.5.1. Overview

The register page enables setting and output of standard functions. The parameters of the function can be set up easily and send to the EDA. Moreover actual parameters can be stored permanently (EEPROM). Different parameter profiles can be stored onto PC. Standard function contain **sinus**, **triangle** und **jump**. The channels can be started and stopped seperatly or synchroneously.



6.5.2. Functions

6.5.2.1. Sinus

A sinus function specified by the parameters in the same groupbox is modulating the piezo actuator. The current parameters are transmitted to the EDA by pressing **write**. The corresponding system command is **setsi**. The parameter **vertex** is not defined for this function.

6.5.2.2. Triangle

A triangle function specified by the parameters in the same groupbox is modulating the diezo actuator. The current parameter are transmitted to the EDA by pressing **write**. The corresponding system command is **setdr**.

6.5.2.3. Jump

A jump function specified by the parameters in the same groupbox is modulating the diezo actuator. The current parameter are transmitted to the EDA by pressing **write**. The corresponding system command is **setsp**. The parameter **vertex** and **resolution** are not defined for this function.

6.5.3. Parameter of Standard Function

Offset

Offset can be altered within the limits set in register **setup**.

Amplitude

Amplitude can be altered within the limits set in register **setup**. If offset is set to zero the entire voltage range is used for modulation.

Frequency

The parameter defines the frequency of the output signal. For each standard function the frequency has to be specified. The maximum frequency is depended on the specified standard function and the resolution.

Resolution

The parameter specifies the number of points used within a peride of the specified function. For **sinus-** and **triangle function** the possible values range from 4..128 points in steps of 2. As higher the resolution as lower the **maximum frequency**. The resolution of the standard function **jump** is set to 2.

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Number of periods

Limits the number of periodes of the standard function. By selecting the value 0, the output is permanently.

Initial angle

The inital angle enables to start the output at any phase angle. By working with several channels the phase difference between them can be easily manipulated.

Vertex

This parameter is valid for the function **triangle** only. The vertex can be set to any position within the period enabling sawtooth function like output.

Frequency divider

The frequency is divided by the value specified here. Maximum value depends on function and parameters choosen.

6.5.4. Keys

write

The parameter of the corresponding channel are send to the EDA via **setsi**, **setdr** or **setsp**. They are stored until the next reset. To store parameter permanently they have to be saved onto EEPROM by pushing WRITE DATA TO EEPROM button.

Read

Parameter of the selcted channels are read and displayed.

stop

Channel is stopped by command **stop,ch**.

start

Channel is started by command **start,ch**.

write all channels

All parameter of all channels are send to the EDA.

read all channels

Parameter of every channel are read and displayed.

start all channels

Every activated channel is started WITHOUT PARAMETER by sending the command **start**. Parameters are set by sending the command **cset,...** before.

stop all channels

The program sends the command **stop** without parameter to the EDA. This stops all channels.

write data to EEPROM

By sending the command **save** all parameters are stored permanently to EEPROM

save to file

The selected parameters are saved as file..

read from file

A previously saved data file can be reloaded..

6.5.5. Limits

Limits of frequency and resolution for sinus and triangle function are:

active Channels	f_{max}/Hz	Resulution/Pnt	
1	65	-->	128
1	2083	-->	4
2	36	-->	128
2	1166	-->	4
3	23	-->	128
3	750	-->	4
4	10	-->	128
4	333	-->	4

jumpfunction:

active Channels	f_{max}/Hz
1	4166
2	2333
3	1500
4	666

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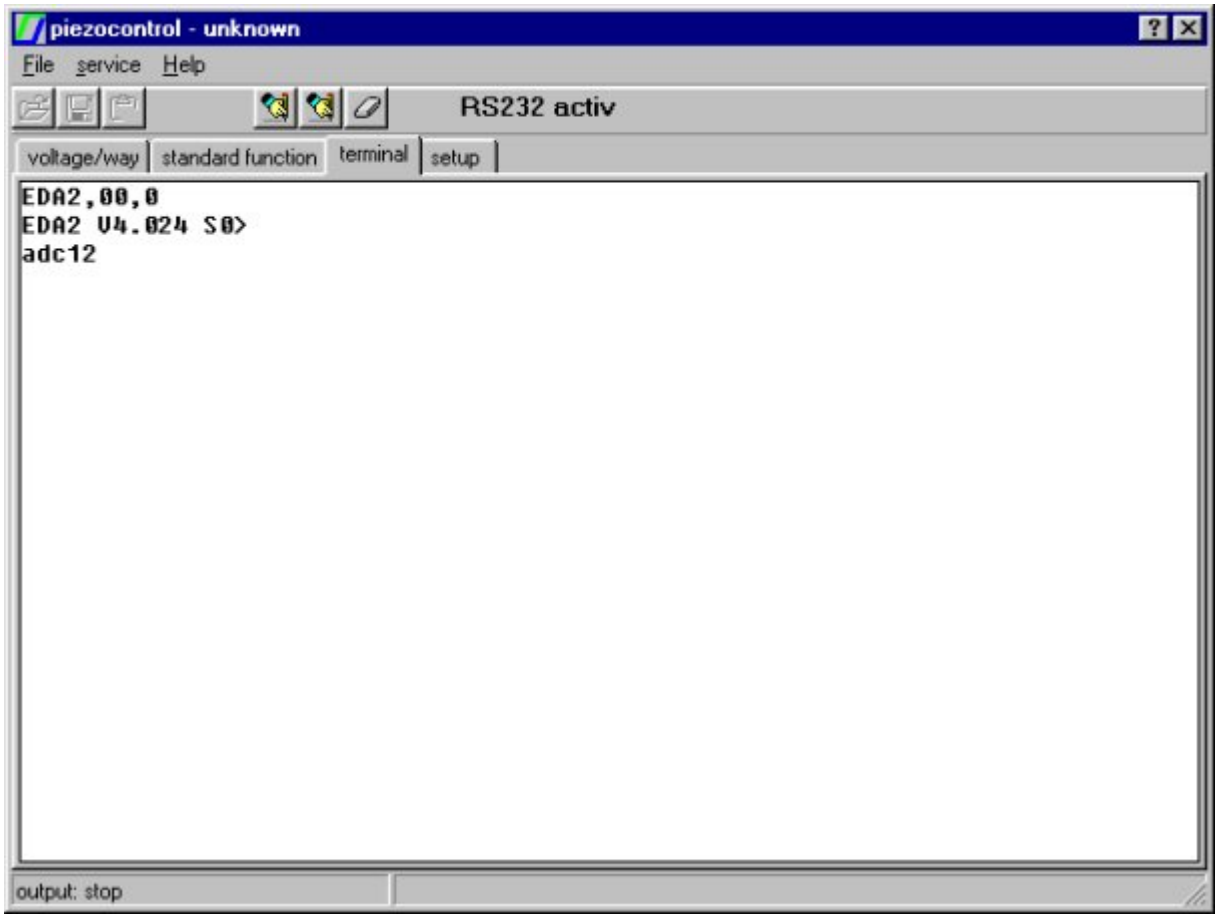
6.6. Terminal

6.6.1. Overview

The register "TERMINAL" contains a small terminal program. Command strings can be typed in here and send directly to the EDA. It can be used to communicate with the EDA, to test command seqencies or to load user defined programs. The terminal works for the RS232 interface only.



6.6.2. Buttons

 **file 1, file 2**

Each button can be used for a HEX-file. By pushing a button the corresponding file is downloaded.

 **delete**

By pushing this button the memory is deleted by sending '**fdel**' to the EDA. The command has to be confirmed before it applies.

6.6.3. Loading Programms

Since the EDA contains of a memory, it is possible user defined programs to load into memory and start from there. The programs have to be written in INTEL-HEX-format.
Before loading the FLASH-memory page has to be deleted and the **opposite** page has to be selected.

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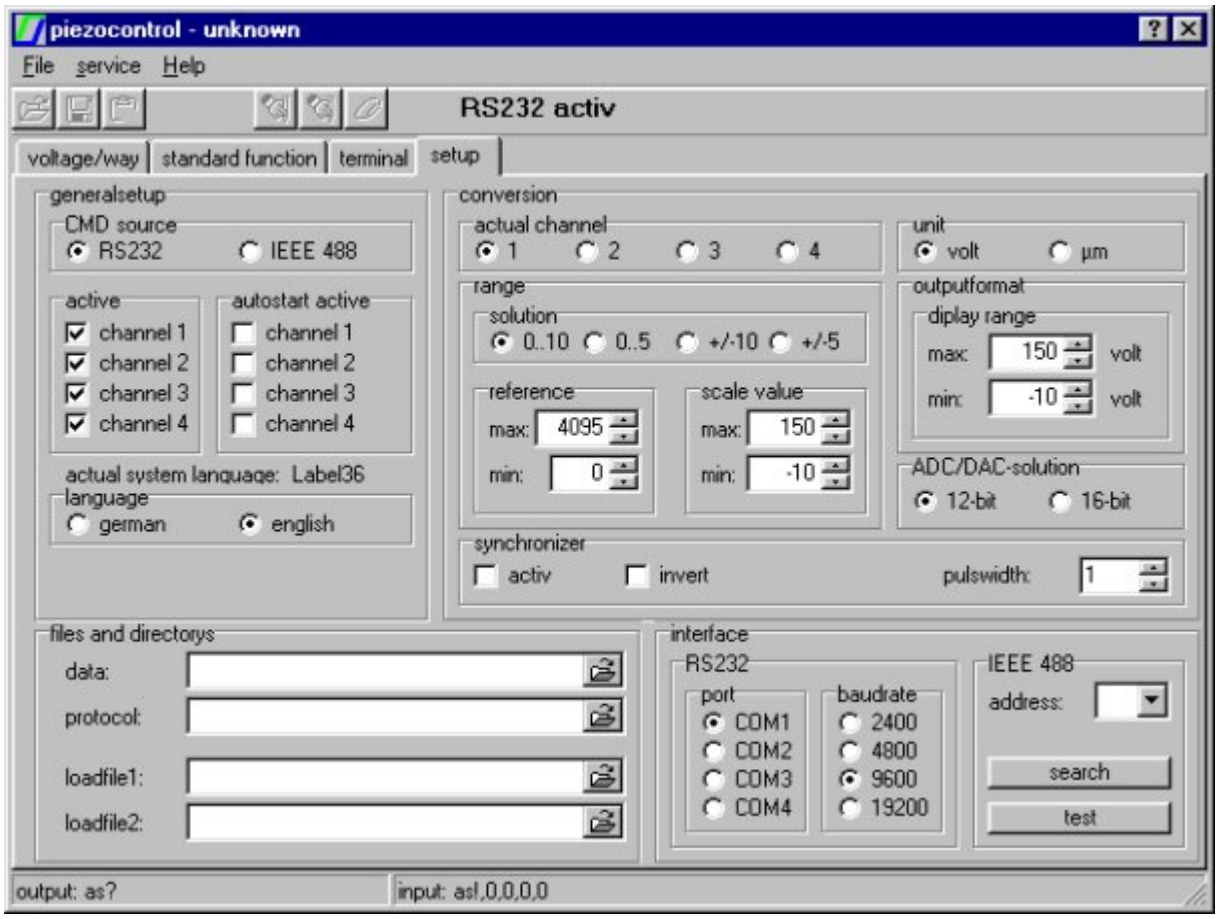
6.7. Settings

6.7.1. Overview

The register enables to completly setup the EDA interface card. All settings are saved before leaving the program and restored when starting the program again. If there is no connection to the IEEE interface the interface option will be deactivated. It may have to be activated by using the "test" button. Starting the program for the first time the **default settings** are choosen to garantee a functioning of the EDA. If problems should be encounterd there is additional help at **getting started**.



6.7.2. General Setup

active

The channels later to be worked with (at the register **Voltage/ Way** and **standard functions**) are activated here.

autostart active

By choosing this option a program saved on **EEPROM** will be started after RESET and applied to the channel selected. Switch S1 has to be in position 1 !!

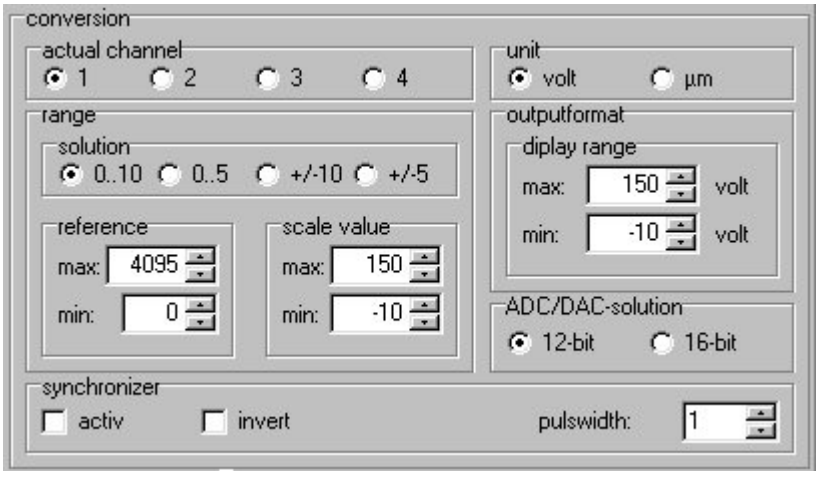
language

The prefered program and helpfile language can be selected.

command source

As command source a RS232 or for the EDA a IEEE 488 too can be choosen. The setting defines the channel of transmission from PC to interface card. The EDA implements both interfaces. Commands for interfaces differ slightly (List of Commands: System Commands).

6.7.3. Conversion



channel

The channel is choosen influenced by the range and output format settings.

units

The setting has no influence on scaling and output format. Piezo actuators can be driven controled or uncontroled. Depending on mode of operation the feedback signal to the EDA corresponds to the driving voltage (in volts) or the actuator position (in microns).

range

The measurement range of the ADC correponding to the channel (1 - 4) choosen can be set up here.

reference dimension and scale value

The value measured by the ADC is converted into a value displayed to the user in the register volatage/way. Conversion is made between the measured ADC-minimum/maximum and the minimum/maximum of the voltage or position.

displayed value

Linear interpolation between the limits set in output format

display range

Range of values displayed in the register **voltage/way**.

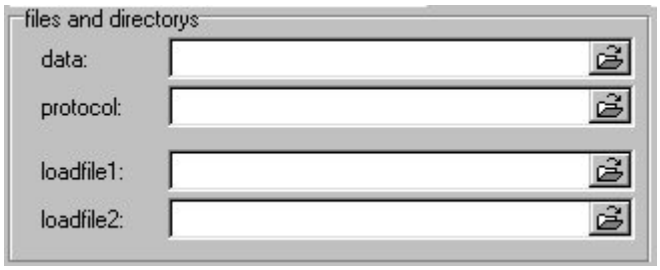
ADC/DAC solution

Setup range of converter solution (EDA2/3 - 12-Bit, EDA4/5 - 16-Bit). If EDA active, the demoprogram converter solution recognice independent.

synchronize extern

If **activ** is checked then set digital output to **1** and reset after interval (**pulswidth**). If **invert** checked outputlevel is inverted.

6.7.4. Data/Folder



data

The selected folder contains datafiles saved during operation.

Protocol

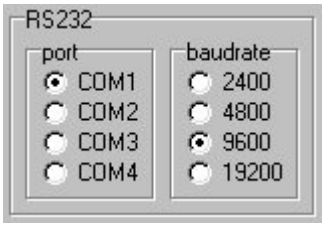
Protocol files are saved into this folder. Names are generated automaticlyl starting with 00000000.pro.

loadfile1/2

Path for 2 files available for terminal download.

6.7.5. Interface

6.7.5.1. RS232



COM

The serial interface is specified here.

baud rate

Setup of the baud rate of transmission over serial interface (default setting 9600 bit/sec).

6.7.5.2. IEEE 488

address

Selection of GPIB-Adresse of EDA.

search

The demoprogram looks for IEEE-listener addresses. Addresses found are displayed in a list box and may be choosen with **ADDRESS**.

test

By pressing the button **Test** a connection to an GBIP-Interface (gpib-32.dll) is tried to establish. If the IEEE-DLL is not found, there is no interaction with the interface possible. In this case either there is no IEEE-interface card connected to the pc or the IEEE-driver are not installed. It is important to point out that the EDA3/5 is only able to work with the 32-Bit IEEE driver. If an error occurs during communication over IEEE-bus the communication is switched to the command source **RS232**.

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7. Hardware

7.1. Introduction

The interface card consists of two parts - computer interface and analogue electronics. In addition, 8 digital outputs and 8 digital inputs exist. The main circuit of this card is the micro controller SAB-C515A with 128k Flash-EPROM and 128k RAM. This controller works at a clock frequency of 11,059 MHz. The interface card is realised as a simple Europe board (100x160 mm²).
Buttons, displays and interface connector are placed on the front panel. The power supply and the digital and analogue inputs and outputs are connected via a basic 64-pin connector.

7.2. Microcontroller

7.2.1. Description

The microcontroller used is a SAB-C515A with 8-bit MCU, 128k Flash-EPROM and 128k RAM working at a clock frequency of 11,059 MHz. It is only able to directly address 64 kByte code and data memory. Therefore the code memory was split into two memory pages. Only one of this pages is active after reset.
A monitoring program is saved on the active page 0 ($A16_{FLASH}$ = 0) after resetting the microcontroller. This monitoring program includes functions to communicate with the host, to operate the ADC and DAC and to write and delete the contents of memory page 1. Switching between the two pages is initiated by software and the necessary logic for this is realised by a GAL.
The shared data memory can be changed by software as well (P4.4). After RESET the RAM page 1 ($A16_{RAM}$ = 1) is activated.
The periphery units of the interface card are addressed in memory space 0xff60 – 0xffff.
Basic values for the operation of the interface card are saved in address space 0x0080 to 0x00ff of code memory on page 1. These basic values cannot be deleted but remain on a EEPROM with a capacity of 256 Byte.

7.2.2. Behaviour of Interface Card after RESET

After **RESET** all analogue outputs are set to 0V, all digital outputs are set to 'HIGH' and the RS232-Interface sends the message:

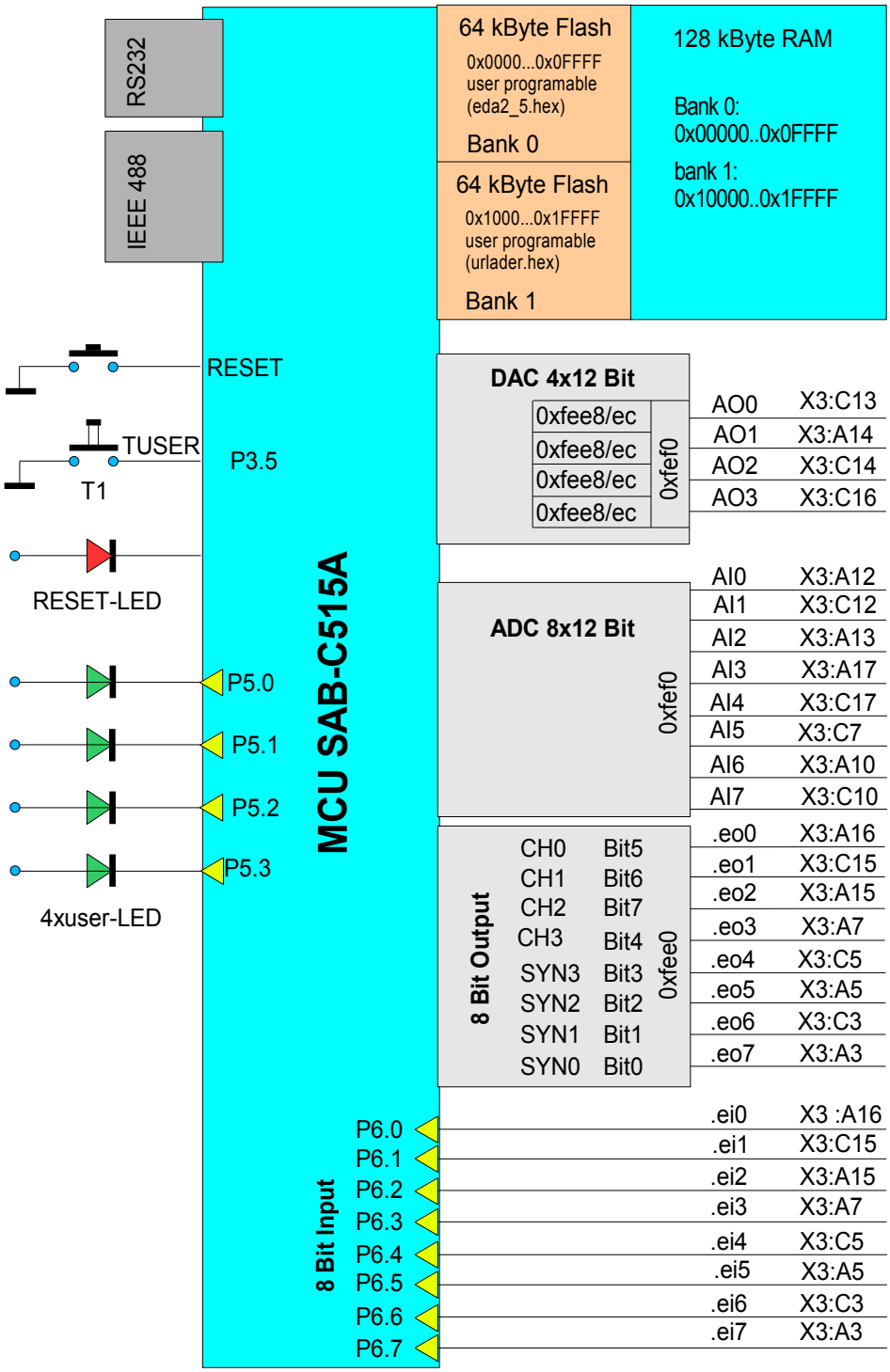
"EDA2,00,n(CR/LF)" and
"EDAx Vn.nn S0>(CR/LF)"

All LEDs on front panel are switched off (unlit), the baud rate is set to 9600 (default) and the function switch status is checked. If the switch is in position 1, the controller will stay in the monitor program loop and will wait for user inputs. If the switch is in position 2, the controller will check if an executable program is saved at code memory page 1. If so the controller will run this program. Otherwise the controller checks if sensible parameters are saved. If it finds executable parameters, it will activate the appropriate channels and start the output function.
If the controller finds no sensible commands on code page 1, it returns to the monitor program.

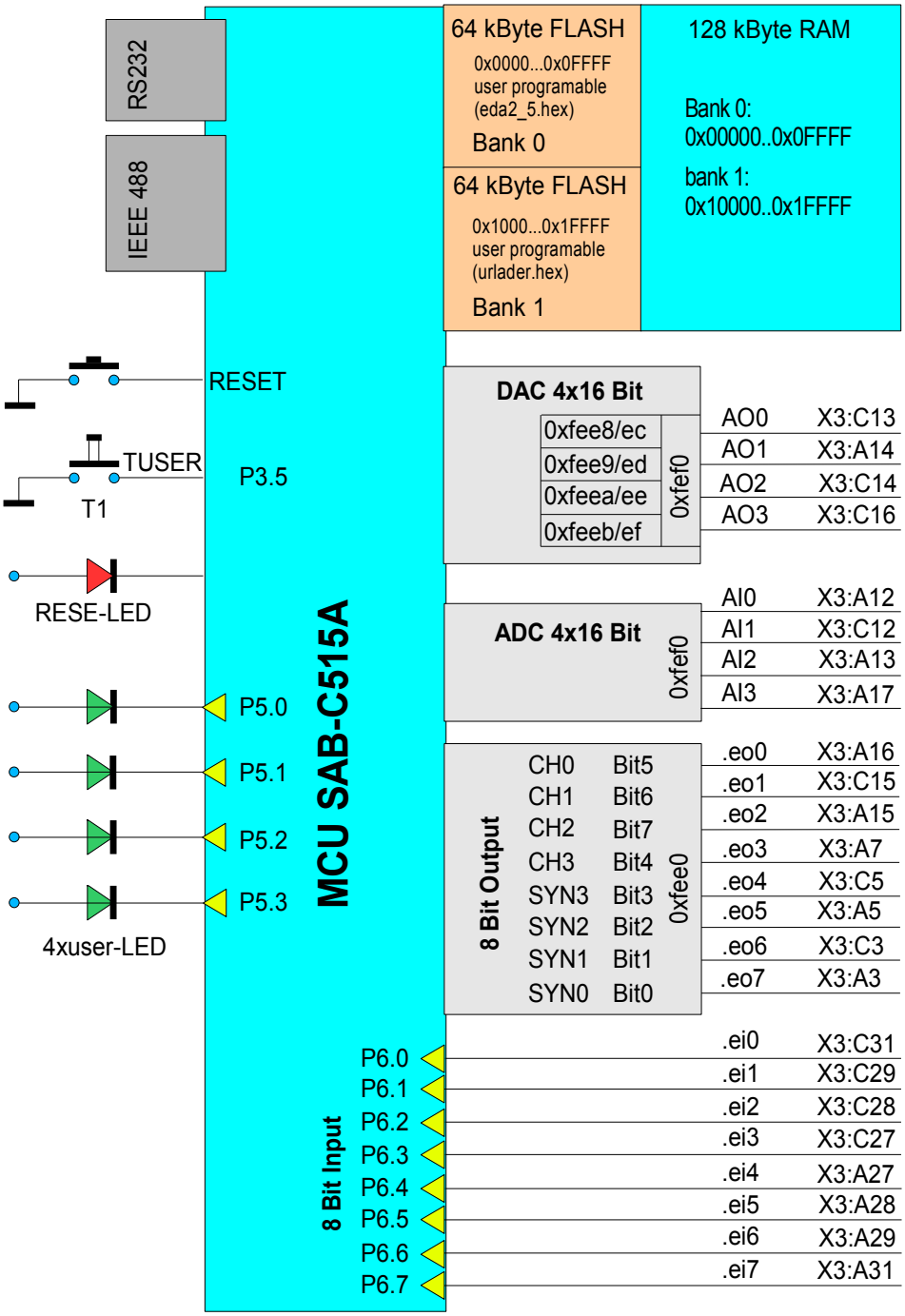
7.2.3. Memory EEPROM

Adr(HEX)	Symbol	Contents
0x00	xxx	- used for internal checking
0x01	IEEE_EOS	- Label for EOS
0x02	IEEE_ADR	- Adress IEEE
0x03	IEEE_SRQ	- SRQ-Register
0x04	IEEE_PPR	- Parallel-Register
0x81	LPNUMMER	- Number of circuit board
0x83	DATUM	- Date of delivery control
0x87	PRUEFER	- Name of controller
0x8d	PROGANZ	- Number of programs
0x8f	F_BAUD	- Baudrate, 0-2400,1-4800,2-9600,3-19200
0xa0	F_MODE	- Mode:0(SINUS),1(DREIECK),2(JUMP)
0xa4	F_AMPLITUDE	- Parameter Amplitude
0xac	F_OFFSET	- Parameter Offset
0xb4	F_FREQUENZ	- Parameter Frequency
0xbc	F_ANZAHL	- Parameter Number of periods
0xc4	F_SCHRITTWEITE	- Parameter Resolution
0xcc	F_WOFFSET	- Parameter Initial angle
0xd4	F_SCHEITEL	- Parameter Vertex
0xdc	F_DIVISOR	- Parameter Frequency division
0xe4	F_IMPULS	- Parameter synchronisation
0xf0	F_MESSBEREICH	- Measurement range ADC
0xf8	F_AUTOSTART	- active channel for Autostart

7.2.4. Blockscheet EDA 2/3



7.2.5. Blockscheet EDA 4/5



7.3. Computer Interface

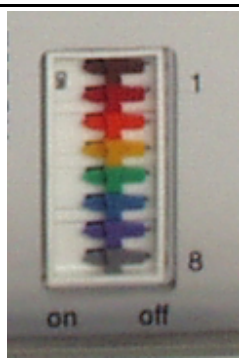
7.3.1. RS232

The computer interface is realised by an serial interface RS232. The baud rate can be set by software to the values 2400, 4800, 9600 (default value) and 19200. The transfer protocol is set to 8 data bits, 1 stop bit, with neither parity nor flow control. The communication between computer and interface card is realised by transfer of strings in ASCII-Code. The strings are terminated by **CR** (0x0d). The receiving software ignores values less than 0x20 **(SPACE)** and greater than 0x7f (**DEL).** Input errors can be corrected by **BACKSPACE** (0x08). Parameters are comma-separated e.g, **help,start(CR)**.

7.3.2. IEEE 488

The IEEE 488 Interface is based on a modul by CompuBoards. All pin connections are according to the IEEE standard. Data transfer is performed in 7-bit mode. Every writing operation is followed by an EOI (end of instruction). Switch 2 handels the Interface address. By default the GBIP address is set to 8. It can by changed by means of switches S2.1 to S2.5. Switch S2.1 corresponds to binary adress bit '0'. Switches S2.6 to S2.8 are without meaning.

Switch S2	8	7	6	5	4	3	2	1
Bit 0	x	x	x	0	0	0	0	1
Bit 1	x	x	x	0	0	0	1	0
Bit 2	x	x	x	0	0	1	0	0
Bit 3	x	x	x	0	1	0	0	0
Bit 4	x	x	x	1	0	0	0	0
Default setting:	0	0	0	0	1	0	0	0



Attention: A change in the address setting applies after '**RESET**' only!

7.4. Inputs/Outputs

7.4.1. analogue Outputs

- Channels: 4
- Resolution EDA2/3: 12 Bit
- Resulution EDA4/5: 16 Bit
- Output voltage range: 0...10V

Channel	Adress	Function
CSLSB0	- 0xfee8	write LOW-Byte Channel 0
CSMSB0	- 0xfeec	write HIGH-Byte Channel 0
CSLSB1	- 0xfeea	write LOW-Byte Channel 1
CSMSB1	- 0xfeee	write HIGH-Byte Channel 1
CSLSB2	- 0xfee9	write LOW-Byte Channel 2
CSMSB2	- 0xfeed	write HIGH-Byte Channel 2
CSLSB3	- 0xfeeb	write LOW-Byte Channel 3
CSMSB3	- 0xfeef	write HIGH-Byte Channel 3
LDAC1	- 0xfef0	transfer all DAC-Register

7.4.2. analogue Inputs

	EDA2/3	EDA4/5
• Channels:	8	4
• Resolution:	12 Bit	16 Bit
• Measurement range EDA2/3:	+/-10V,+/-5V,0..10V,0..5V	0..10V
• Hardware address:	0xfee4	0xfee4

7.4.3. digital Outputs

- IC: 74HCT573
- Hardware address: 0xfee0

7.4.4. digital Inputs

The controller's ADC-input pins are used for digital input. Due to this arrangement TTL-signals can be read and in addition analogue signals in the range 0..5V can be measured.

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8. Firmware

8.1. Overview

Before delivery two programs are installed at the EDA: an operating system on page 0 and an data transfer program on page 1. The operating system enables driving external hardware (ENV). The demo program makes substantial use of subroutines from the operating system. The data transfer program (URLADER.hex) enables loading of user defined programs. Source code of both programs is contained in the delivered software.
The communication between PC and EDA is enabled by RS232 or IEEE488 interface and performed with help of ASCII strings. Using a RS232 interface, the endsign of every string has to be 'CR'; using the IEEE interface, the endsign has to be 'LF'.
A string for the EDA is according to the following scheme:

command[,parameter 1[,parameter 2[,...,parameter x]]]

If a command is known to the EDA it will be carried out. In case the command is not known to the EDA either the EDA prompt is send back (in case of sending strings by RS232 interface) or the commond is ignored (in case of using the IEEE interface). Commands for the EDA can be divided into **monitor commands** und **system commands**. Monitor commands partly ask for their parameters interactivly whereas system commands all parameters include.

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8.2. List of Commands

8.2.1. Monitor Commands

8.2.1.1. Overview

CMD		short description
dc*)	-	display code memory
de*)	-	display extended data memory
di*)	-	display internal data memory
dx*)	-	display external data memory
df*)	-	display FLASH-EPROM memory
dm*)	-	display EEPROM memory
ei*)	-	edit internal data memory
ex*)	-	edit external data memory
ee*)	-	edit extended data memory
fi*)	-	fill internal data memory
fx*)	-	fill external data memory
wf*)	-	write FLASH-EPROM
s*)	-	display available EDA commands
co*)	-	compare FLASH-EPROM
mtst*)	-	memory test
baud*)	-	set baud rate
ver	-	display version
sh*)	-	HEX-file output
q*)	-	quit
fdel*)	-	delete FLASH-EPROM
go*)	-	start program
help*)	-	display help on command

*) This commands are available for RS232 only!

8.2.1.2. Command 'dc'

Command string: dc,xxxx,nnnn (RS232)

Answer: memory listing

Lists **nnnn** bytes starting from code memory address **xxxx** as a hex dump. Parameters have to be hexadecimal.

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8.2.1.3. Command 'de'

Command string: de,xxxx,nnnn (RS232)

Answer: memory listing

Lists **nnnn** bytes starting from extended data memory address **xxxx** as a hex dump. Parameters have to be hexadecimal.

8.2.1.4. Command 'di'

Command string: di,xxxx,nnnn (RS232)

Answer: memory listing

Lists **nnnn** bytes starting from internal data memory address **xxxx** as a hex dump. Parameters have to be hexadecimal.

8.2.1.5. Command 'dx'

Command string: dx,xxxx,nnnn (RS232)

Answer: memory listing

Lists **nnnn** bytes starting from external code memory address **xxxx** as a hex dump. Parameters have to be hexadecimal.

8.2.1.6. Command 'df'

Command string: df,xxxx,nnnn (RS232)

Answer: memory listing

Lists **nnnn** bytes starting from the opposite side of FLASH-EPROM memory address **xxxx** as a hex dump. Parameters have to be hexadecimal.

8.2.1.7. Command 'dm'

Command string: dm,xx,nn (RS232)

Answer: momory listing

Lists nn bytes starting from EEPROM address **xx** as a hex dump. Parameters have to be hexadecimal.

8.2.1.8. Command 'ei'

Command string: ei (RS232)

Answer: dialog

Enables editing of internal data memory. Necessary parameters are questioned interactiv.

8.2.1.9. Command 'ex'

Command string: ex (RS232)

Answer: dialog

Enables editing of external data memory. Necessary parameters are questioned interactiv.

8.2.1.10. Command 'ee'

Command string: ee (RS232)

Answer: dialog

Enables editing of extended data memory. Memory can be adressed by setting Pin 77 (P4.4) during reading to low.This memory is not used by the demoprogram.

8.2.1.11. Command 'fi'

Command string: fi (RS232)

Answer: dialog

Fills the internal data memory with a byte. Necessary parameters are questioned interactivly..

8.2.1.12. Command 'fx'

Command string: fx (RS232)

Answer: dialog

Fills the external data memory with a byte. Necessary parameters are questioned interactivly..

8.2.1.13. Command 'wf'

Command string: wf (RS232)

Answer: dialog

Writes a byte to the opposite side of the FLASH-EPROM. Necessary parameters are questioned interactivly.

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8.2.1.14. Command 's'

Command string: s (RS232)

Answer: List of Commands

Lists every command of the EDA

8.2.1.15. Command 'co'

Command string: co (RS232)

Answer: Differences

Entire code memory is compared with the opposite side of FLASH-EPROM. Any differences are listed with memory address.

8.2.1.16. Command 'mtst'

Command string: mtst (RS232)

Answer: none

Through a part of external code memory is for a specified byte. Any different byte will be displayed.

8.2.1.17. Command 'baud'

Command string: baud,n (RS232)

Answer: none

Switches the EDA to a different transmission rate. Changings are valid immediatly and permantly (changes are saved to EEPROM.)

n = 0 - 2400
= 1 - 4800
= 2 - 9600
= 3 - 19200

8.2.1.18. Command 'ver'

Command string: ver (RS232,IEEE)

Answer: version,vnumber,createdate,createtime

Answer string contains software version of demo program.

8.2.1.19. Command 'sh'

Command string: sh (RS232)

Answer: Hexfile

Entire memory of opposite FLASH-Side is send over RS232 as Intel-Hexfile.

8.2.1.20. Command 'q'

Command string: q (RS232)

Answer: none

Switches from current side of FLASH EPROM to the opposite side and starts program from address 0x0000. If there is none, the command is ignored.

8.2.1.21. Command 'fdel'

Command string: fdel (RS232)

Answer: dialog

The command deletes the opposite side of FLASH-EPROM.

8.2.1.22. Command 'go'

Command string: go (RS232)

Answer: none

Starts program from address 0x0000. If there is none, the command is ignored.

8.2.1.23. Command 'help'

Command string: help,cmd (RS232)

Answer: helptext

Displays short helptext on the command. By sending the string 'help' without further parameter, a listing of all commands with short helptext will be displayed.

8.2.2. System Commands

8.2.2.1. Overview

CMD		short description
start	-	starts user selected function
stop	-	stops user selected function
M	-	status
cset	-	activates / deactivates channel
ke	-	switches on every activated channel
ka	-	switches off every activated channel
set	-	sets selected DAC-channel to the specified value
rk	-	voltage measurement
rkz*)	-	cyclic voltage measurement
setall	-	sets all DAC-channel to the specified value
save	-	saves parameter to EEPROM
setdr	-	sets parameter for function 'triangle'
setsp	-	sets parameter for function 'jump'
setsi	-	sets parameter for function 'sinus'
cl	-	delets selected function from selected channel
amt*)	-	sets up measurement range
setk	-	switches on / off the desired channel
setc	-	sets measurement range of selected ADC-channel
setcc	-	sets measurement range of all ADC-channel
dp	-	writes the digital outputs directly
rch	-	reads parameter of one channel
rcha*)	-	reads parameter of every channel
sp	-	reads measurement range of ADC-converter
measure	-	reading of every ADC-channel
ERR?	-	reads error occured at last
as	-	writes active autostart channels to EDA
as?	-	reads active autostart channels

*) Ths commands are available for RS232 only!

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8.2.2.2. Command 'start'

Command string: start[,ch] (RS232,IEEE)

Answer: none

Startes defined function on channel **ch** with parameters saved onto the EDA or parameters sended before. By sending the command without further parameter all channel will be started.

8.2.2.3. Command 'stop'

Command string: stop[,ch] (RS232,IEEE)

Answer: none

The function output on channel **ch** is stopped and in case of using without parameter all channels will be stopped.

8.2.2.4. Command 'M'

Command string: M (RS232,IEEE)

Answer: EDA2,xx,sh

This command asks for an identification of the current interface It enables to determine the presence of the EDA. The parameter **xx** send back by the EDA includes status information:

bit 0 = 1 atleast onto one channel parameter are send to

The parameter **sh** contains the position of switch S1

0 - position 1
1 - position 2

8.2.2.5. Command 'cset'

Command string: cset,ch,ea (RS232,IEEE)

Answer: none

The channel specified with **nr** is activated or inactivated.

Ea = 0 - on
1 - off

To activate the changes made the command **ke** has to be send too. The activation is only meant to switch the digital outputs.

8.2.2.6. Command 'ke'

Command string: ke (RS232,IEEE)

Answer: none

Switches all channels on which previously were switched off **ka**.

8.2.2.7. Command 'ka'

Command string: ka (RS232,IEEE)

Answer: none

Switches all channels off

8.2.2.8. Command 'set'

Command string: set,ch,wert (RS232,IEEE)

Answer: none

Sets the DAC-channel specified by **ch** to **wert**. Values which exceed the range limits are corrected automaticly (ch=3,wert=0).

8.2.2.9. Command 'rk'

Command string : rk,ch,br (RS232,IEEE)

Answer: rk,ch,wert

Sends back the value measured by ADC-channels **ch**. The second parameter describes the measurement range:

br	**=**	**0 - 0..10V**
	=	**1 - 0..5V**
	=	**2 - +/-10V**
	=	**3 - +/-5V**

If the values exceed the measurement range the command is not executed. Sending the command **ERR?** the last error can be traced back.

8.2.2.10. Command 'rkz'

Command string: rkz,ch,br (RS232)

Answer: rk,ch,wert

Similar to **rk**, but cyclic. The measurement range can be specified by sending the command **amt**. This command can only be interrupted by pushing a key or reset. Sending the command **ERR?** the last error can be traced back.

8.2.2.11. Command 'setall'

Command string: setall,k0,k1,k2,k3 (RS232,IEEE)

Answer: none

All DAC-channels are set to the specified values. There is no check for valid inputs.

8.2.2.12. Command 'save'

Command string: save (RS232,IEEE)

Answer: saveok

Saves the parameter of standard function to EEPROM.

8.2.2.13. Command 'setdr'

Command string: setdr,ch,off,amp,fre,pkt,anz,sangle,apex, divider,syn (RS232,IEEE)

Answer: none

Sends to channel **ch** the function TRIANGLE with parameters:

off	-	offset
amp	-	amplitude
fre	-	frequency
pkt	-	points/periode
anz	-	Number of periodes, 0 = infinity
sangle	-	initial angle
apex	-	vertex
divider	-	frequency divider
syn	-	syncronisation

The function can be started by sending **start[,ch]**.

8.2.2.14. Command 'setsp'

Command string:
setsp,ch,off,amp,fre,pkt,anz,sangle,apex,divider,syn (RS232,IEEE)

Answer: none

Sends to channel chanal **ch** the function JUMP with parameters:

off	-	offset
amp	-	amplitude
fre	-	frequency
pkt	-	2
anz	-	Number of periodes, 0 = infinity
sangle	-	initial angle
apex	-	**not used**
divider	-	frequency divider
syn	-	syncronisation

The function can be started by sending **start[,ch]**.

8.2.2.15. Command 'setsi'

Command string:
setsi,ch,off,amp,fre,pkt,anz,sangle,apex,divider,syn (RS232,IEEE)

Answer: none

Sends to channel chanal **ch** the function SINUS with parameters:

off	-	offset
amp	-	amplitude
fre	-	frequency
pkt	-	points/periode
anz	-	Number of periodes, 0 = infinity
sangle	-	initial angle
apex	-	**not used**
divider	-	frequency divider
syn	-	syncronisation

The function can be started by sending **start[,ch]**.

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8.2.2.16. Command 'cl'

Command string: cl,ch (RS232,IEEE)

Answer: none

Deletes the function specified on channel ch.

8.2.2.17. Command 'amt'

Command string: amt,time (RS232)

Answer: none

This command set the measurement interval of command **rkz**, range: 0..255 (corresponding 0..25s)..

8.2.2.18. Command 'setk'

Command string: setk,ch,ea (RS232,IEEE)

Answer: none

Switches the channel **ch** on (1) or off (0). Only the digital outputs and the corresponding LED are affected. In case of **ch** > 7 all channels and LED are switched off.

8.2.2.19. Command 'setc'

Command string: setc,ch,range (RS232,IEEE) !!! only EDA2/3 !!!

Answer: none

Set measurement range of channel **ch**.

Range = 0 - 0...10V
= 1 - 0...5V
= 2 - ± 10V
= 3 - ± 5V

8.2.2.20. Command 'setcc'

Command string: setcc,rng0,rng1... (RS232,IEEE) !!! only EDA2/3 !!!

Answer: none

Sets measurement range of every ADC-channel (rng definition **setc**).

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8.2.2.21. Command 'dp'

Command string: dp,xx (RS232,IEEE)

Answer: none

Sets the digital outputs to (0x00..0xff). LEDs are not affected.

8.2.2.22. Command 'rch'

Command string: rch,ch (RS232,IEEE)

Answer: rch,ch,off,amp, fre,pkt,anz,sangle,apex,divider,syn

Reads parameter of channel **ch** using the RS232 interface. The order of the parameters agrees with **setsi**, **setdr**, **setsp**.

8.2.2.23. Command 'rcha'

Command string: rcha (RS232)

Answer: rch,0..3,...

Reads out parameter of all channel using the RS232 interface.

8.2.2.24. Command 'sp'

Command string: sp (RS232) !!! only EDA2/3 !!!

Answer: sc,s0,s1,..,s7

Reads out previously specified measurement range of AD-converter.

8.2.2.25. Command 'measure'

Command string: measure (RS232,IEEE)

Answer: aw,wert0,wert1,...,wert7

Reads out measurements of all ADC-channel.

8.2.2.26. Command 'ERR?'

Command string : ERR? (RS232,IEEE)

Answer: ERROR,"last error"

Sends back the last error encountered. The error buffer is deleted afterwards.

8.2.2.27. Command 'as'

Command string : as,ch,e/a (RS232,IEEE)

Answer: none

The autostart channel are send to the EDA. Each channel has to be activated/deactivated. The command:

as,1,1

activates channel 2 of the EDA for autostart

as,1,0

deactivates channel 2 of the EDA for autostart

8.2.2.28. Command 'as?'

Command string : as? (RS232,IEEE)

Answer: as!,ach1,...,ach4

This command reads out the autostart channels activated. An active channel is specified by parameter "1".

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Index