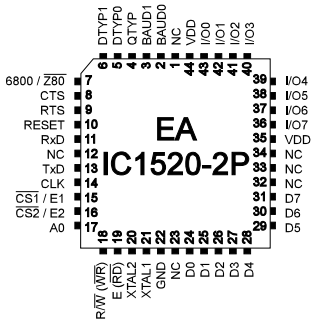
EA IC1520

HIGH-LEVEL GRAPHICS CONTROLLER FOR DISPLAYS WITH SED 1520



PLCC44J

FEATURES

* FOR LC-GRAPHICS DISPLAYS WITH SED 1520 i.E. 122x32, 120x32, 98x32
* NO TIMING PROBLEMS WITH FAST BUS SYSTEMS
* PROGRAMMING BY MEANS OF COMMANDS SIMILAR TO HIGH-LEVEL LANGUAGE:
* STRAIGHT LINE, POINT, AREA, AND/OR/EXOR, BAR GRAPH...
* 3 DIFFERENT FONTS BUILT IN
* ZOOM FUNCTION FOR ALL FONTS (2X, 3X AND 4X)
* 8 FREELY DEFINABLE CHARACTERS
* MIXING TEXT AND GRAPHICS
* INPUT ON RS-232 / CMOS-LEVEL
* DIRECT CONNECTION TO MAX232 OR EQUIVALENT
* BAUDRATES 1200, 2400, 9600 OR 19200 BAUD
* DOES NOT SLOW DOWN CPU PERFORMANCE
* NEEDS ONLY MAX. 4 EXTERNAL COMPONENTS
* 8 DIGITAL I/O-PORTS FREELY AVAILABLE FOR CUSTOM DESIGNS

ORDERING INFORMATION

LOW-COST HIGH-LEVEL GRAPHCONTR. FOR SED1520	**EA IC1520-1PGH**
HIGH-LEVEL GRAPHICS CONTROLLER FOR SED1520	**EA IC1520-2PGH**
MATCHING GRAPHICS DISPLAY WITH 120x32 DOTS	**EA P120-5NLED**
CERAMIC RESONATOR SMD 7,37 MHZ, 3 PIN INCL. C´S	**EA KERS7M37-C**
COMPLETE GRAPHICS UNIT 120x32 WITH IC1520-1PGH	**EA GE120-5NV24**

ELECTRONIC ASSEMBLY GMBH
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GENERAL

The EA IC1520 High-Level Graphics Controller bonds your system processor to your graphic display. Inputs accept a serial asynchronous RS-232 interface. The graphic controller includes complete graph routines to display and various character sizes.

Programming is made by high level programming language graph commands; time consuming programming of character sets and graph routines is not necessary anymore. Expenditure for developing of your product is reduced significant and several features are gained on top of it:

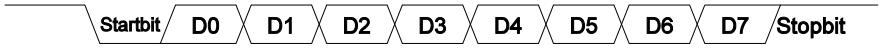
- no timing problems with fast processor bus
- enough memory space (operating memory and characterset memory especially for µC)
- no time consuming graphic calculations which would slow down processor speed

Connecting to hardware is very simple. Display and main processor are connected directly. Drivers, decoders or port modules are not required. A simple display input need 1 wire (RxD) only. 2 up to maximum 4 external components will complete the circuit: a quartz with 2 capacitors and a reset-capacitor. **No external components** are needed when you operate with 8051-compatible systems. Clock and reset signal can be taken from main processor.
We have two different versions available. Graphics Controller EA IC1520-1 represents the base model. Version EA IC1520-2 features an additional big sized font (page 7) and additional commands like Bargraph 'B', Hardcopy 'H' and more (see page 8).

HARDWARE

Supply voltage of system is +5 Volts. Data transfer is asynchronous serial in RS-232 format at CMOS level. Data format is 8 data bits, 1 stop bit and no parity. Baud rate can be selected on 3 pins from 150 Baud on up to 115200 Baud. Handshake lines RTS and CTS on board too.

Data format:



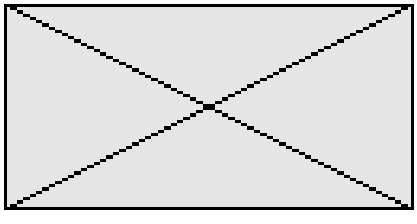
Additional 8 I/O-ports are available for freely usage. This may be wired as inputs or outputs*) on individual desire. Possible applications are switching of backpanel illumination or reading in several keys.

SOFTWARE

Programming of this High-Level Graphics Controller is performed by commands like i.e. "plot a rectangular box from (0,0) to (64,15) which origins in top left hand corner of display". Therefore the serial interface has to transmit this sequence of bytes: $52 $00 $00 $40 $0F. Character strings can be placed exactly to the pixel. Mixing of graphic images with text elements is possible anytime. Three different character sets are available where each of them can be zoomed 2x, 3x and 4x. The biggest character set 8x16 allows when using 2x zoom (=16x32) a totally filled display with letters and numbers.

TESTMODE *)

As long as pin 9 (RTS) is after Power-On or after Reset connected with GND, the graphics controller is in test mode. Display shows now a marked flashing box. When connection Pin 9 (RTS) to GND is removed, the graphics controller returns to normal operation mode.



**) This function is available only with High-Level-Graphics Controller EA IC1520-2.*

TECHNICAL DESCRIPTION

Symbol	Parameter	Valid for	Condition	Min	Max	Units
VDD	Power Supply	VDD	11,059 MHz	4	6	V
ICC	Power Supply Current	VDD, Controller is busy	11,059 MHz		25	mA
ICC	Power Supply Current	VDD, Controller is ready	11,059 MHz		6.5	mA
ICPS	Power Supply Current Power-Save-Mode	VDD	VDD=6V		100	µA
			VDD=3V		40	µA
VIL	Input Low Voltage	RESET, I/O0..7, Baud0..1, Dtyp0..1, Qtyp, RxD, CTS		-0.5	0.2*VDD-0.1	V
VIH	Input High Voltage	I/O0..7, Baud0..1, Dtyp0..1, Qtyp, RxD, CTS		0.2*VDD+	VDD+0.5	V
VIHR	Input High Voltage Reset	RESET		0.7*VDD	VDD+0.5	V
VOL	Output Low Voltage	Out0..7; I/O0..7	IOL=3.2mA		0.45V	V
IIL	Logical 0 Input Current	Baud0..1, Dtyp0..1, Qtyp RxD, CTS	VIN=0.45V		-50	µA
ITL	Logical 1 to 0 Transition Current	Baud0..1, Dtyp0..1, Qtyp RxD, CTS	VIN=2V		-650	µA
ILI	Input Leakage Current	I/O0..7	0.45<VIN<VD		±10	µA
CIO	Pin Capacitance	RESET, I/O0..7, Baud0..1, Dtyp0..1, Qtyp, RxD, CTS	1 MHz, 25°C		10	pF
IOL	Output Low Current	Out0..7, I/O0..7	per line		10	mA
IOP	Output Low Current	Out, I/O	port		26	mA
TRSTH	RESET Pulse Width	RESET		10		ms
RRST	RESET Pull Down Resistor	RESET		50	300	kOhm
TOP	Operating Temperature			0	+70	°C
FOSC	Oscillator Frequency	XTAL1, XTAL2		0	20	MHz

Datas are valid for T_a = 0..+70°C and VDD= 5,0V ±20% if not noted otherwise.

POWER-SAVE FUNCTION*)

Default settings			
Register	**Command**	**after Power-On**	**after Power-Save-Mode**
Display Control	C	Display on	Display on
Text Mode	T	set	set
Grafik Mode	V	set	set
Font	F	6x8	6x8
Font Factor width/height	F	1/1	1/1
Last xy	W	(0;0)	(0;0)
Self Defined Characters	E	undefinied	unchanged
Bar Graph 1..8	B	undefinied	unchanged
High Level Graphics Controller	K	selected	selected
Input/Output I/O0..7	Y	H-Level	H-Level

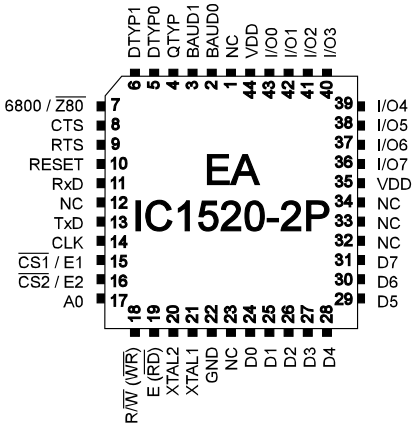
Power-Save function allows use in battery powered devices. Command "Q $01" puts the High-Level-Graph-controller from Normal operation into Power-Save mode. The current consumption (without display) is reduced to about 100µA. Because the display is connected to supply voltage, still some mA current are drawn depending on type of display. Total content of display, i.e. all by your own created characters and bargraph-definitions remain preserved. In this Power-Save-mode no commands will be accepted and executed (RTS at H-level).

Command "Q $02" sets controller to Power Save Mode and a transistor driven display to "Static Drive Mode". Also this mode will not accept and execute commands (RTS on H-level).

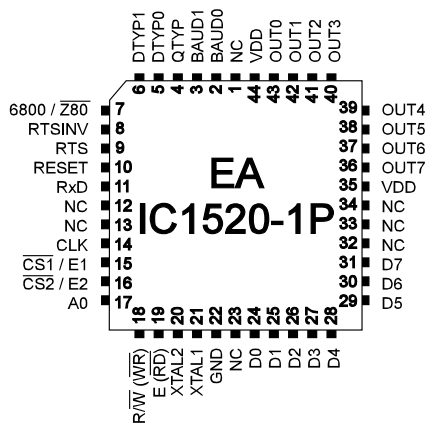
An at least 10ms wide reset puls (H-level) turns the graph controller back to normal operation. The internal registers will be resetted as listed in above table.

**) This function is available only with High-Level-Graphics Controller EA IC1520-2.*

PINNING



EA IC1520-1PGH



EA IC1520-2PGH

Pin Description				
Pin	**Symbol**	**In/Out**	**Level**	**Description**
1	NC			do not connect
2,3	BAUD0..1	In	lo	Baud Rates
4	QTYP	IN	lo	Quarz type 11,0592MHz / 7,37MHz
5,6	DTYP0, DTYP1	In	lo	Display type
7	M68/Z80	In	lo	lo: Z80 Mode (RD, WR); hi:M6800 Mode (E, R/W)
8	RTSINV (1520-1) CTS (IC1520-2)	Out In	lo lo	RTS Signal inverse (IC1520-1 only) CTS Handshake (IC1520-2 only)
9	RTS	Out	lo	lo: data receve enable hi: data receive disable
10	RESET	In	hi	default controller settings
11	RxD	In	lo	RS-232 receive
12	NC			do not connect
13	NC (IC1520-1) TxD (IC1520-2)	Out	lo	do not connect (IC1520-1) RS-232 transmit (IC1520-2 only)
14	CLK	Out	lo	2kHz clock (at 7,37MHz) for displays with externenal clock also usable for charge pump with negative voltage
15,16	CS1(E1), CS2(E1)	Out	hi	Display: left (CS1) or right (CS2) display half
17	A0	Out		Display: hi: data; lo: command
18	WR (R/W)	Out		Display: data/command write (Read/Write)
19	RD (E)	Out	hi	Display: data/command read (Enable)
20	XTAL2	Out		System clock
21	XTAL1	In		System clock (ext. input)
22	GND	GND	lo	Power supply 0V
23	NC			do not connect
24,25,26,27, 28,29,30,31	D0..7	I/O		Display: 8 Data lines
32,33,34	NC			do not connect
35	VDD	VDD	hi	Power supply +5V
36,37,38,39, 40,41,42,43	Out7..0 (IC1520-1) IO7..0 (IC1520-2)	I/O		8 Opendrain output (IC1520-1) 8 In- or output (IC1520-2 only)
44	VDD	VDD	hi	Power supply +5V

BAUD RATES

Various baud rates can be selected depending on System Clock (Quartz, Ceramic Resonator) for RS-232 data transfer. Its done by connecting pins BAUD 0..2 and QTYP to VDD or to GND-level. Programmable baud rates are shown in this table (0: GND, 1: VDD).

Baud rates					
Baud 1	Baud 0	QTYP = 1	QTYP = 0		
		11.0592 MHz	3.6864 MHz	7.3728 MHz	14.7456 MHz
0	0	1200	600	1200	2400
0	1	2400	1200	2400	4800
1	0	9600	4800	9600	19200
1	1	19200	9600	19200	38400

TYPES OF DISPLAYS

Four standard display types can be preset by connecting pins DTYP0..1 with VDD or GND-level (0: GND, 1: VDD). Setting of our ELECTRONIC ASSEMBLY displays is shown in table aside. Other displays with 32 pixel in height can be preset with command "!" "Set display type" (see page 8 and page 15).

DTYP 1	DTYP 0	Resolution	Organisation	Display
0	0	70 x 32	70 + 0	EA 8070-5LED
0	1	98 x 32	61 + 37	EA P098-5NLED
1	0	122 x 32	61 + 61	EA P122-5NLED
1	1	120 x 32	60 + 60	EA P120-5N

M68/Z80 = 0		
Pin	Symbol	Description
15	CS1	low aktive, left half of display
16	CS2	low aktive, right half of display
18	WR	low aktive, data/command write
19	RD	low aktive, data/command read

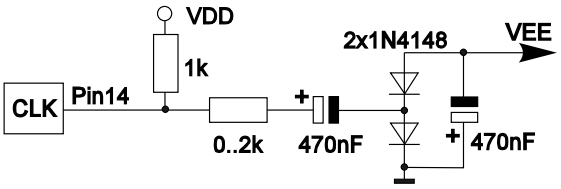
Pin 7 presets M68/Z80 displays with Motorola Interface (E, R/W) as well as displays with Z80 Interface (RD, WR). Connecting pin 19 RD (E) to GND performes a third drive mode which is available for displays with 2 Enables, one for left half of display and one for right half of display.

M68/Z80 = 1		
Pin	Symbol	Description
15	CS1	low aktive, left half of display
16	CS2	low aktive, right half of display
18	R/W	H: read, L: write
19	E	enable

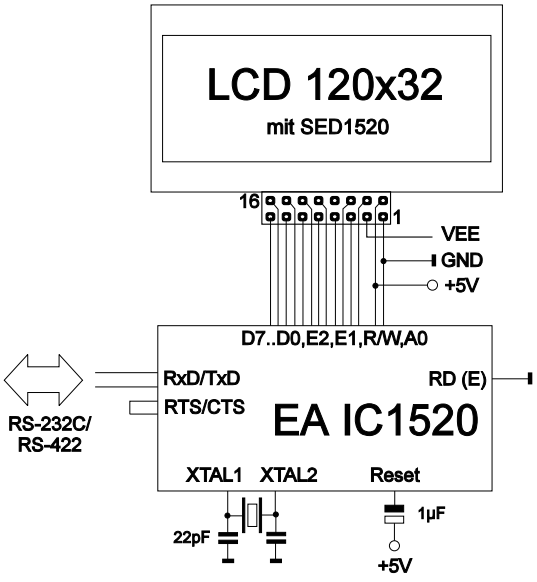
RD (E) = 0		
Pin	Symbol	Description
15	E1	enable, left half of display
16	E2	enable, right half of display
18	R/W	H: read, L: write

GENERATING A NEGATIVE DISPLAY VOLTAGE

Pin 14 CLK may drive a negative voltage booster to generate display voltages up to -4V. Command adjust display contrast 'K' adjusts the display voltage level. Choose a serial resistor between 0..2 kOhms. Low value of serial resistor increases on one hand the display voltage VEE, but reduces on the other hand the range for adjustments by command 'K' .



APPLICATION EXAMPLE



APPLICATION HINTS

In order to ensure trouble free operation, you should be aware of basic construction rules in digital electronic applications already during development of your circuit layout:

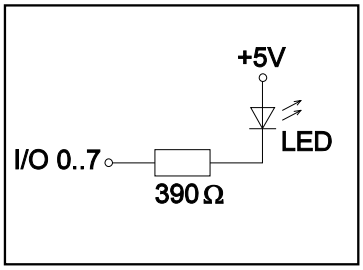
- Watch for straight ground routing in your layout (no ground loops)
- Supply voltage distribution is best performed star shaped by widend conductor tracks, preferably by multilayer boards, decoupled with seperate power supply layers.
- Components resp. cuircits with big or highly variable current consumption needs seperate supply cables. Remaining circuits must be decoupled and filtered on demand. Also power for LED-illumination of display should be supplied seperate.
- Use blocking capacitors on all active components.
- Keep tracks carrying high frequency signals resp. high rising slopes as short as possible (XTAL1 and XTAL2 !)

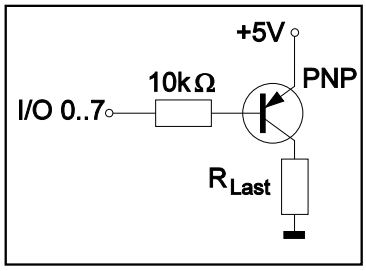
DIGITAL INPUTS AND OUTPUTS IO 0..7

8 pins of this High-Level Graph-controller may be used as freely available programmable inputs and outputs. Also mixed operation of i.e. 3 outputs and 5 inputs is possible.

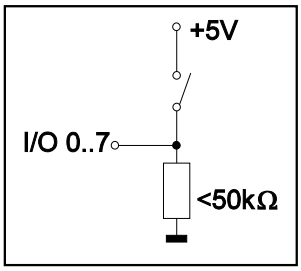
Output circuit

Command "Y n1 n2"[1)] sets any selected pin IO 0..7 to H- or to L-level; it can be compared with an Open-Drain output without pull-up resistor. Current flows only when L-level is applied. A single pin may be loaded with max. 10mA, all pins together may be loaded with 26mA in all (i.e. 2 pins @ 10mA plus 1pin @ 6mA). Its practicable i.e. to connect and switch a LED directly. Bigger currents can be provided by an external transistor circuit. Note that after Power-On-mode resp. in Power-Save-mode all outputs will be at H-level.

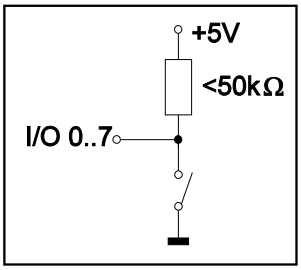




Input circuit[*)]



Input pins accept voltage levels between -0,5V and +0,2V*VDD -0,1V. Leakage current is max. ±10µA. Trigger levels are listed in table of technical description on page 3. Command "X n1" [1)] allows read in of datas on each individual pin IO 0..7. Voltage level must be stable all over the read in procedure. There is no built in filter circuit to surpress contact jitter.



[1)] *see page 13 for description of commands*

**) This function is available only with High-Level-Graphics Controller EA IC1520-2.*

BUILT IN FONTS

EA IC1520-1 High Level Graphics Controller incorporates two character sets; EA IC1520-2 incorporates three character sets. Each character set may be used in 1-, 2-, 3- or 4-fold height. Independant of that the width may be multiplied by 2x, 3x or 4x. Furthermore you also can define up to 8 own designed character sets which are available as long as the supply voltage is on. (see command 'E').

Upper \ + Lower	$0 (0)	$1 (1)	$2 (2)	$3 (3)	$4 (4)	$5 (5)	$6 (6)	$7 (7)	$8 (8)	$9 (9)	$A (10)	$B (11)	$C (12)	$D (13)	$E (14)	$F (15)
$20 (dez: 32)		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
$40 (dez: 64)	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
$50 (dez: 80)	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_

Font 1: 4x6

Upper \ + Lower	$0 (0)	$1 (1)	$2 (2)	$3 (3)	$4 (4)	$5 (5)	$6 (6)	$7 (7)	$8 (8)	$9 (9)	$A (10)	$B (11)	$C (12)	$D (13)	$E (14)	$F (15)
$20 (dez: 32)		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
$40 (dez: 64)	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
$50 (dez: 80)	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
$60 (dez: 96)	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
$70 (dez: 112)	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	⌂
$80 (dez: 128)	Ç	ü	é	â	ä	à	å	ç	ê	ë	è	ï	î	ì	Ä	Å
$90 (dez: 144)	É	æ	Æ	ô	ö	ò	û	ù	ÿ	Ö	Ü	¢	£	¥	ß	ƒ
$A0 (dez: 160)	á	í	ó	ú	ñ	Ñ	ª	º	¿	⌐	¬	½	¼	¡	«	»
$B0 (dez: 176)	░	▒	▓	│	┤	╡	╢	╖	╕	╣	║	╗	╝	╜	╛	┐
$C0 (dez: 192)	└	┴	┬	├	─	┼	╞	╟	╚	╔	╩	╦	╠	═	╬	╧
$D0 (dez: 208)	╨	╤	╥	╙	╘	╒	╓	╫	╪	┘	┌	▀	▄	▌	▐	▪
$E0 (dez: 224)	α	ß	Γ	π	Σ	σ	µ	τ	Φ	Θ	Ω	δ	∞	φ	ε	∩
$F0 (dez: 240)	≡	±	≥	≤	⌠	⌡	÷	≈	°	∙	·	√	ⁿ	²	■	

Font 2: 6x8

Each individual character can be placed precisely to the pixel. You may mix text with graphics in any way at your desire. Several different character sizes can be displayed together.

Font No.	usable ASCII character	
	EA IC1520-1	EA IC1520-2
1: 4x6	32..95	32..95
2: 6x8	32..158	32..255
3: 8x16	-	32..158

Upper \ + Lower	$0 (0)	$1 (1)	$2 (2)	$3 (3)	$4 (4)	$5 (5)	$6 (6)	$7 (7)	$8 (8)	$9 (9)	$A (10)	$B (11)	$C (12)	$D (13)	$E (14)	$F (15)
$20 (dez: 32)		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
$40 (dez: 64)	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
$50 (dez: 80)	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
$60 (dez: 96)	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
$70 (dez: 112)	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	⌂
$80 (dez: 128)	Ç	ü	é	â	ä	à	å	ç	ê	ë	è	ï	î	ì	Ä	Å
$90 (dez: 144)	É	æ	Æ	ô	ö	ò	û	ù	ÿ	Ö	Ü	¢	£	¥	ß	

Font 3: 8x16
only EA IC1520-2

SUMMARY OF ALL GRAPHICS FUNCTIONS

Command table EA IC1520-1 and -2												
Command												**Remarks**
Functions for outputting text												
Text mode	T	R	n1	ptn								Write character string; n1: overlay combination mode for text output 1=set; 2=delete; 3=inverse; 4=replace; 5=inverse repl.; ptn: use pattern no. 0..7;
Set font	F	n1	n2	n3								Set font no. n1; n1=1:4x6 font; n1=2:6x8 font; n1=8x16 font; n2+n3=zoom factor (1..4); n2=X factor; n3=Y factor;
Set ASCII characters	A	x1	y1	n1								The character n1 will be set at coordinate x1,y1. (Reference top left)
Set character string	Z	x1	y1	...	NUL							Output character string (...) to x1,y1; character ´NUL´ ($00)=end
Define character	E	n1	data ...									n1=character no.; data =number of bytes dep. on current font
Graphics commands with overlay mode												
Graphics mode	V	n1										n1: 1=set; 2=delete; 3=inverse; 4=replace; 5=inverse replace;
Set point	P	x1	y1									Set one pixel at coordinates x1, y1
Draw straight line	G	x1	y1	x2	y2							Draw straight line from x1,y1 to x2,y2
Continue straight line	W	x1	y1									Draw a straight line from last end point to x1, y1
Draw rectangle	R	x1	y1	x2	y2							Draw a rectangle; x1,y1,x2,y2 = opposite corner points
Area with fill pattern	M	x1	y1	x2	y2	ptn						Draw area with pattern ptn (0..7); x1,y1,x2,y2 = corner points
Other graphics commands												
Delete display	D	L										Delete entire contents of display (set to white);
Invert display	D	I										Invert entire contents of display;
Fill display	D	S										Fill entire contents of display; (set to black);
Delete area	L	x1	y1	x2	y2							Delete an area; x1,y1,x2,y2 = opposite corner points
Invert area	I	x1	y1	x2	y2							Invert an area; x1,y1,x2,y2 = opposite corner points
Fill area	S	x1	y1	x2	y2							Fill an area; x1,y1,x2,y2 = opposite corner points
Draw box	O	x1	y1	x2	y2	ptn						Draw a rectangle with fill pattern ptn (0..7); (always replace)
Upload picture area	U	x1	y1	data ...								Load a picture area to x1,y1; see picture structure for picture data
Control / definition commands												
Adjust display contrast	K	n1										n1=0..20 Contrast adustment; 0= low, 20 high
Write I/O port	Y	n1	n2									n1=0..7: reset I/O port n1 (n2=0); set (n2=1); invert (n2=2) n1=8: Set all 8 I/O ports in accordance with n2 (=8 bit binary value)
Set display type	!	n1	n2									Another display can be set: n1=X resolution, n2=Resolution of left half of display

Additional commands for EA IC1520-2 only												
Command												**Remarks**
Functions for outputting text												
Text-Mode	T	R L O U	n1	ptn								R/L/O/U: Write character string (R)ight, (L)eft, (O)ben (up), (U)nten (down) n1: Overlay combination mode for text output 1=set; 2=delete; 3=invers; 4=Replace; 5=Invers Replace; ptn: Pattern no. 0..7;
Graphic commands with overlay mode												
Draw round corner	N	x1	y1	x2	y2							Draw a rectangle with round corners; x1,y1,x2,y2 = corner points
Other graphics commands												
Draw round box	J	x1	y1	x2	y2	ptn						Draw a round corner with fill pattern ptn (0..7); (always replace)
Draw bar graph	B	no	valu									Set the bar graph with the ´nr´ (1..8) to the new user ´value'
Control / definition commands												
Define bar graph	B	R L O U	no	x1	y1	x2	y2	aw	ew	ptn		Define bar graph to L(eft), R(ight), O(up), U(down) with the ´nr´ (1..8). x1,y1,x2,y2 form the rectangle enclosing the bar graph. aw, ew are the values for 0% and 100%. ptn=pattern (0..7).
Display Control	C	n1										n1=0:Display off entire unchanged; n1=1:Display on
Power Save Mode	Q	n1										n1=1: Power save for graphics controller; RTS->HIGH; n1=2: Power save graphics controller RTS->HIGH; display sleep mode
Send commands												
Hardcopy	H	x1	y1	x2	y2							An area is requested as a picture. The width and height are sent in pixels first of all, followed by the actual picture data, via RS232.
Read I/O port	X	n1										n1=0..7: load I/O port <n1> (1=H level=5V, 0=L level=0V) n1=8: load all 8 I/O ports I/O0..I/O7 as 8-bit binary value
Query display type	?											This command is used to query the display type. 3 bytes are sent back: X resolution, Y resol., 'H' (e.g. 240, 64 (pixels), horizontal picture)

PARAMETERS

Various built in commands can be used to program this High-Level Graphics Controller. Each command starts with a command letter which is followed by a number of parameters. All commands with parameters, coordinates and other hand over datas are expected in form of Bytes. No space characters are allowed, i.e. no space bars, no commas. End of command **does not need a closing byte** such as a Carrige Return.

A...Z, L/R/O/U ..... All commands are transmitted as ASCII code.
Example: G = 71 (dec.) = $47 initiates the straight line drawing command.

x1, x2, y1, y2 ..... Coordinates are transmitted with one byte. True values are from 0..122 for x- resp. 0..31 for y- coordinates.
Example: x1= 10 (dec.) = $0A

n1,n2,nr,aw,ew,value,ptn,data ..... Parameters with numbers are transmitted with one byte.
Example: n1= 15 (dec.) = $0F

EXAMPLE OF PROGRAMMING

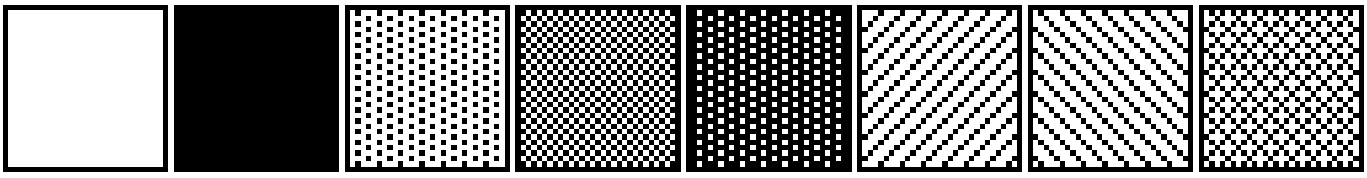
Below table shows the character string "Test" which is displayed at coordinates 7,3.

Example	**Codes**							
ASCII	Z	BEL	ETX	T	e	s	t	NUL
Hex	$5A	$07	$03	$54	$65	$73	$74	$00
Decimal	90	7	3	84	101	115	116	0
Turbo-Pascal	write(aux, 'Z', chr(7), chr(3), 'Test', chr(0));							
´C´	fprintf(stdaux, "%c%c%c%s%c", 'Z', 7, 3, "Test", 0);							
Q-Basic	OPEN "COM1:1200,N,8,2,BIN" FOR RANDOM AS #1 PRINT #1,"Z"+CHR$(7)+CHR$(3)+"Test"+CHR$(0)							

PATTERN

Several commands allow setting of pattern type parameters (ptn = 0..7). They will link and display rectangular areas, bargraphs and even text lines with various pattern.

This pattern are available:



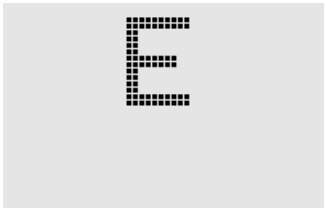
ptn=0 white	ptn=1 black	ptn=2 25% black	ptn=3 50% black	ptn=4 75% black	ptn=5 45° right	ptn=6 45° left	ptn=7 45° cross hatch

DESCRIPTION OF INDIVIDUAL GRAPHICS FUNCTIONS

Coming pages show detailed descriptions in alphabetical order for each individual function. Examples are shown as hardcopy in an enlarged window of 50 x 32 pixel once the command has been executed. Examples show transfered Bytes all in Hex codes.

A x1 y1 n1 — Set ASCII-Character

A character **n1** will be displayed on coordinates **x1**,**y1** with preset font 'F' and text mode 'T' (set / delete / invert / replace / invers replace / pattern). Origin is (0,0) at top left hand corner of display. Datas for coordinates apply also to top left hand corner of a given character.
Note: Font No.1 shows capital letters only.



Example: $41 $13 $02 $45

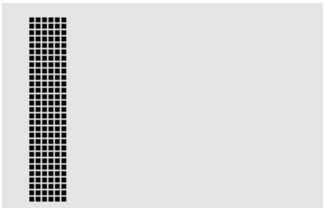
Character 'E' will be displayed at coordinates 19,2

Preset font: 6x8, with double width and double height

Text mode: Replace and black pattern

B L/R/O/U nr x1 y1 x2 y2 aw ew ptn — Define Bargraph*)

Up to 8 bargraphs (**nr**=1..8) can be defined, which may oscillate to **L**=left, **R**=right, **O**=top or **U**=bottom direction. Bargraph full level range coordinates are described from **x1**,**y1** to **x2**,**y2**. Scaling of bargraph is performed by starting zero position **aw** (=0..254) and max. ending position (full size) **ew** (=0..254). Bargraph always is displayed in inverse-mode using the **ptn-**pattern type: the background remains preserved in any case. (Note: executing this command only the bargraph range is defined but nothing is visible on display).

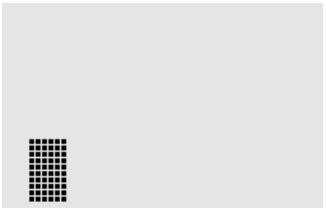


Example: $42 $4F $01 $04 $02 $09 $1E $04 $14 $01

Defines bargraph no. 1 which oscillates vertical up to top. At full level its coordinates ranges from 4,2 to 9,30. Displayed start- and end- values represent a current value of 4..20 mA. (Hardcopy shows bargraph at its full level operating at $42 $01 $14)

B nr value — Draw Bargraph*)

Bargraph number **n1** (1..8) will be adjusted to a new value (aw <= **value** <= ew).



If **wert** > ew, than final value will be displayed. Bargraph must be defined before, see above example.

Example: $42 $01 $0A

Above defined bargraph no. 1 is set now to value 10.

C n1 — Display Control*)

Switches display On (**n1**=1) or Off (**n1**=0); all display datas remains preserved and commands can be executed furthermore.

Example: $43 $00

Content of display becomes invisible, but remains preserved.

**) This function is available only with High-Level-Graphics Controller EAIC1520-2.*

D L/I/S — Display Command

Total content of display will be: **L**=deleted (white), **I**=inverted or **S**=filled (black)

Example: $44 $49

inverts total content of display.

E n1 daten — Define Characters

Up to 8 characters can be defined by yourself. This characters have ASCII codes from 1 to 8 and remain stored until the supply voltage is switched off. Attention! For a given ASCII-Code-No. only one font size can be defined.

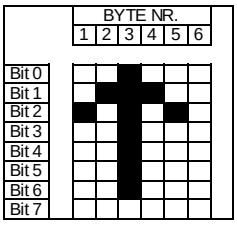
Example 1:

Command

$45 $03

$04 $02 $7F $02 $04 $00

defines a top pointing arrow with ASCII-No. 3 and with a preset 6x8 character set.



Example 2:

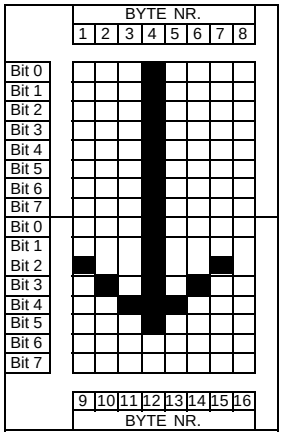
Command

$45 $02

$00 $00 $00 $FF $00 $00 $00 $00

$04 $08 $10 $3F $10 $08 $04 $00

defines a down pointing arrow with ASCII-No. 2 and with a preset 8x16 character set.



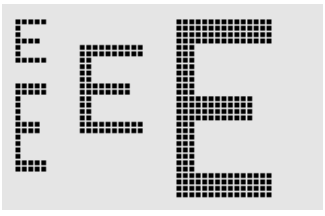
F n1 n2 n3 — Set Font

Font No. **n1** (1=4x6 capital letters only; 2=6x8; 3=8x16*)) is choosed.
Different zoom factors (1..4x) for width **n2** and for height **n3** are selected.

Example: $46 $02 $03 $04

6x8- font is now set to 3-x width and to 4-x height.

Beside hardcopy shows letter 'E' from font 6x8 in different sizes.

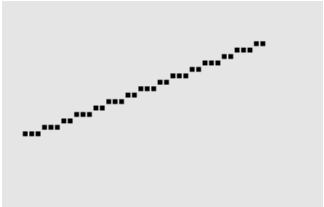


G x1 y1 x2 y2 — Draw straight line

Straight line is drawn from coordinates **x1,y1** to **x2,y2** taking into account the preset graph mode 'V' (set / clear / invert).

Example: $47 $03 $14 $28 $06

Draws a straight line from 3,20 to 50,6.



**) This function is available only with High-Level-Graphics Controller EAIC1520-2.*

H x1 y1 x2 y2 — Get Hardcopy from Display*)

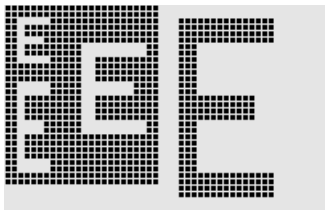
Range from top left hand corner **x1,y1** to right hand bottom corner **x2,y2** is requested. Graphic chip transmits first width and height of requested display-section and afterwards the datas of display-content. See command Image Upload 'U' for building up display datas.

Example: $48 $00 $00 $1F $0F

top left hand section of display-content (size 32 x 16 pixel) will be sent via RS-232 immediately.

I x1 y1 x2 y2 — Invert Range

The area from top left hand corner **x1,y1** to right hand bottom corner **x2,y2** will be inverted (black pixel turns to white and vice versa).

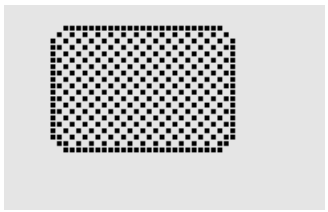


Example: $49 $00 $00 $17 $1B

inverts display-content of example "Set Font" in range from 0,0 to 23,27.

J x1 y1 x2 y2 ptn — Draw a rounded corner box*)

A rectangular box with rounded corners is drawn from top left hand corner **x1,y1** to right hand bottom corner **x2,y2** and filled with pattern **ptn** and delete background. See also 'N' draw rectangular with rounded corner.



Example: $4A $07 $03 $23 $16 $03

draws a rounded corner box from 7,3 to 35,22 filled with pattern 3=50% black.

K n1 — Adjust contrast of display

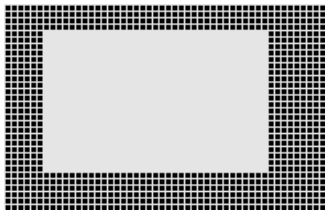
A charging pump can be built up by using the clock signal CLK (Pin 14). Varying the pulse ratio **n1** (0..20) will change the negative contrast voltage within certain limits.

Example: $4B $14

Sets contrast to maximum value = 20 (clock signal on CLK pin is set to 50% ratio).

L x1 y1 x2 y2 — Clear a specific display area

Area from top left hand corner **x1,y1** up to bottom right hand corner **x2,y2** will be cleared.



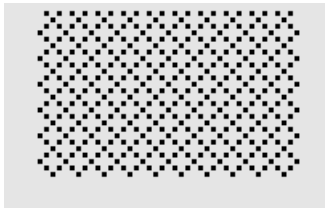
Example:

$44 $53
$4C $06 $04 $28 $19

Display is filled first with 'D', 'S' followed by clearing the area from 6,4 to 40,25.

M x1 y1 x2 y2 ptn — Fill an area with pattern

A rectangular area starting from top left hand corner **x1,y1** up to bottom right hand corner **x2,y2** is filled with pattern **ptn** according to preset graphic mode 'V' (set / clear / inverse / replace / inverse replace).

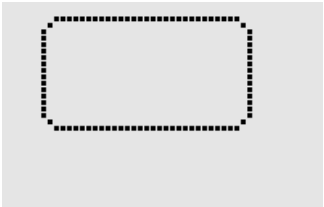


Example: $4D $05 $01 $2D $1A $07

draws a cross hatch pattern 7=45° from 5,1 to 45,26.

**) This function is available only with High-Level-Graphics Controller EAIC1520-2.*

N x1 y1 x2 y2 Draw rectangular with rounded corners*)

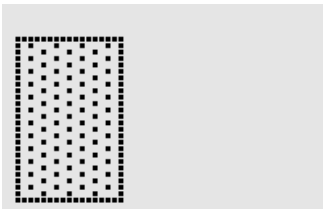


Draw a rectangular with rounded corners from top left hand corner **x1,y1** up to bottom right hand corner **x2,y2** honoring preset graphic mode 'V' (set / clear / inverse). Content of box remains unchanged. See also drawing box with rounded corners 'J' .

Example: $4E $06 $02 $26 $13

draws a box with rounded corners from coordinates 6,2 up to coordinates 38,19.

O x1 y1 x2 y2 ptn Draw Box



A rectangular box is drawn from top left hand corner **x1,y1** up to bottom right hand corner **x2,y2** filled with pattern **ptn.** Background of box will be cleared.
Consult also 'R' = draw rectangular.

Example: $4F $02 $05 $12 $1E $02

draws a box from coordinates 2,5 up to coordinates 18,30 with pattern 2= 25% black.

P x1 y1 Place a Dot

A single dot will be placed at coordinates x1, y1 honoring preset graphic mode 'V' (set / clear / inverse).

Example: $50 $0D $11

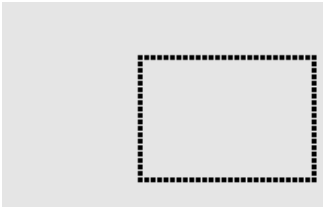
places a single Pixel at coordinates 17,13.

Q n1 Power Save Mode*)

Example: $51 $01

switches our High-Level Graphic Controller into Power-Save-Mode. Handshake line RTS shows H- level which means that no more commands will be accepted. Supply voltage may be reduced now down to 2 Volts. Applying a wide pulse of >10 msec onto reset pin will awake the controller. Contents of registers remains unchanged, see table on page 3.

R x1 y1 x2 y2 Draw Rectangular

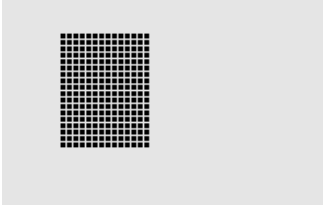


A rectangular is drawn from top left hand corner **x1,y1** up to right hand bottom corner **x2,y2** honoring the preset graphic mode 'V' (set / clear / inverse). Contents of rectangular box remains unchanged.
See also 'O' = draw box.

Example: $52 $15 $08 $30 $25

draws a rectangular from coordinates 21,8 up to coordinates 48,37.

S x1 y1 x2 y2 Fill an area



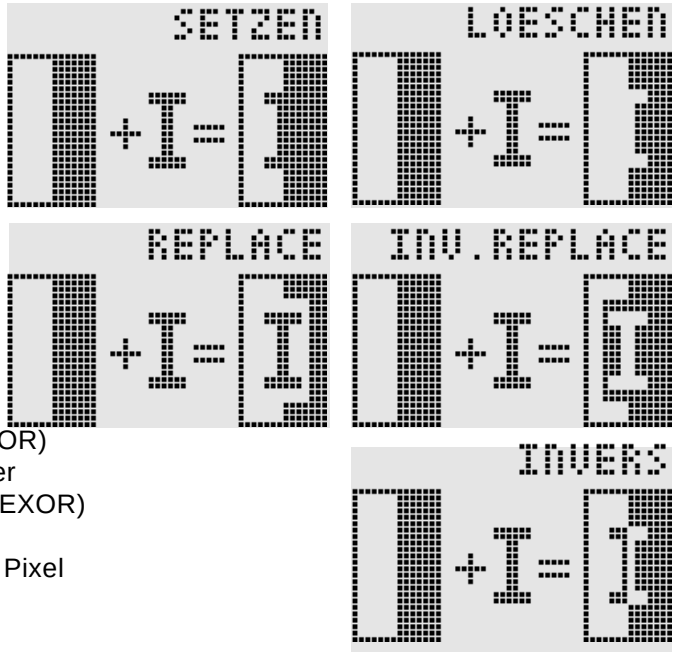
An area from top left hand corner **x1,y1** up to right hand bottom corner **x2,y2** will be filled with black pixels.

Example: $53 $09 $05 $16 $16

fills an area from coordinates 9,5 to coordinates 22,22 with black pixels.

**) This function is available only with High-Level-Graphics Controller EAIC1520-2.*

T L/R/O/U n1 ptn — Set Text-Mode



Sets the overlay combination mode **n1** and pattern **ptn** for the commands 'A' and character string 'Z'. For display a character chain (command 'Z') the typing-direction *) must be set by: **L**=to left, **R**=to right, **O**=to top and **U**=to bottom.

Example: $54 $52 $03 $03

Initiates the overlay combination mode for text functions with grey characters (pattern 3 = 50% black), inverts the background and writes character chains from left to right.

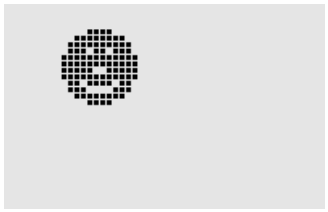
Overlay combination mode n1:

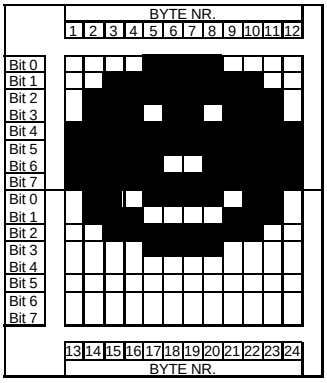
1 = set: black Pixel without regarding previous parameter (OR)
2 = delete: white Pixel without regarding previous parameter
3 = invert: black Pixel turns to white Pixel and vice versa (EXOR)
4 = replace: clear background and set black colored Pixel
5 = invers replace: fill background and place white colored Pixel

U x1 y1 data — Image Upload

An image will be loaded at coordinates **x1,y1**

data: - 1 Byte for width of image in Pixel
- 1 Byte for height of image in Pixel
- Image datas: Qty = ((height+7) / 8) * width Bytes.
  1 Byte equals 8 vertical Pixel on screen;
  0=white, 1=black; LSB: top, MSB: bottom;
  Image builts up from left hand to right hand.
  Programme BMP2BLV.EXE generates out of monochrome Windows-Bitmap-Graphics the datas for our Image inclusively width- and height informations.



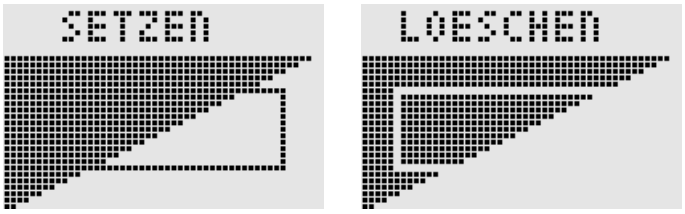


Example: $55 $09 $04 $0C $0C
$F0 $FC $FE $FE $F7 $BF $BF $F7 $FE $FE $FC $F0
$00 $03 $07 $06 $0D $0D $0D $0D $06 $07 $03 $00

loads beside shown image at coordinates 9,4.

V n1 — Set Graphics-Mode

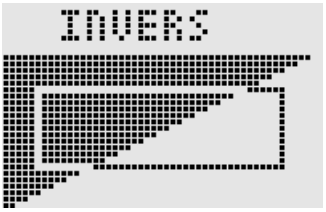
Set overlay combination mode **n1** i.e. for following graph-functions: set dot 'P', draw straight line 'G', continue drawing straight line 'W', draw rectangular 'R', draw rectangular with rounded corners 'N', fill area with pattern 'M'.



Example: $56 $03

sets overlay combination mode to inverse.

Beside example illustrates drawing of a rectangular in overlay combination modes set, clear and inverse on existing background.



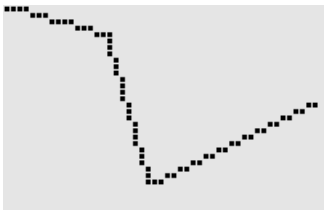
Link-mode n1:

1 = set: black Pixel without considering previous parameter (OR)
2 = delete: white Pixel without regarding previous parameter
3 = invert: black Pixel turns to white Pixel and vice versa (EXOR)
4 = replace: clear background and set Pixels inside area of filling pattern 'M'
5 = invers replace: fill background, delete Pixels from area with filling pattern 'M'.

**) This function is available only with High-Level-Graphics Controller EAIC1520-2.*

W x1 y1 — Continue a straight line

Draws a straight line from last drawn line end resp. (see page 3: Last xy) to **x1,y1** under considering the Graphic Mode 'V' (set / clear / inverse).



Example:

$47 $00 $00 $10 $04
$57 $16 $1B
$57 $30 $0F

Draws first a straight line from 0,0 to 16,4; then continuing from 22,27 to 48,15.

X n1 — Read I/O Port*)

Reads in Port (**n1**: 0..7 = I/O: 0..7).
When **n1** = 8, all I/O 0..7 are read in binary; I/O 0: LSB, I/O 7: MSB. See application on page 6.

Example: $58 $02

reads in signal at I/O 2 and transmits L-level a $00 resp. H-level a $01 via RS-232

Y n1 n2 — Set I/O Port

Changes port value (**n1**: 0..7 = I/O: 0..7) into value **n2** (0=L-level; 1=H-level; 2=invert port level). When **n1=8,** all I/O 0..7 will be transfered as binary value **n2**; I/O 0: LSB, I/O 7: MSB. See application on page 6.

Example: $59 $02 $01

sets port I/O 2 to H-level

Z x1 y1 ASCII... NUL — Write a character string

Writes a character string **ASCII....** beginning from coordinate **x1,y1** honoring preset mode 'T' (set / clear / inverse / replace / inverse replace / fill/ direction). Character strings must be terminated with **NUL** ($00). Origin (0,0) starts in top left hand corner of display. Datas of coordinates refer to top left hand corner of character. Note: Font Nr. 1 has capital letters only.

Example: $5A $06 $0B $54 $65 $73 $74 $00

writes character string "Test" starting at coordinate 6,11, Font: 8x16 with normal height and width.
Text mode: Writing direction is from right hand, Overlay combination mode is replace with pattern black.

! n1 n2 — Set Display

This command allows setting of display- width which is not programmable by DTYP0/1 (see page 5).
Width of left half of display is set with **n2**. Height of display is fixed programmed with 32 pixel.

Example: $21 $64 $32
sets display 100 pixel wide divided into two logical halfs with a resolution of 50 pixel each.

? — Show Type of Display*)

Resolution of display and type of image structure is sent via RS-232.

Example: $3F

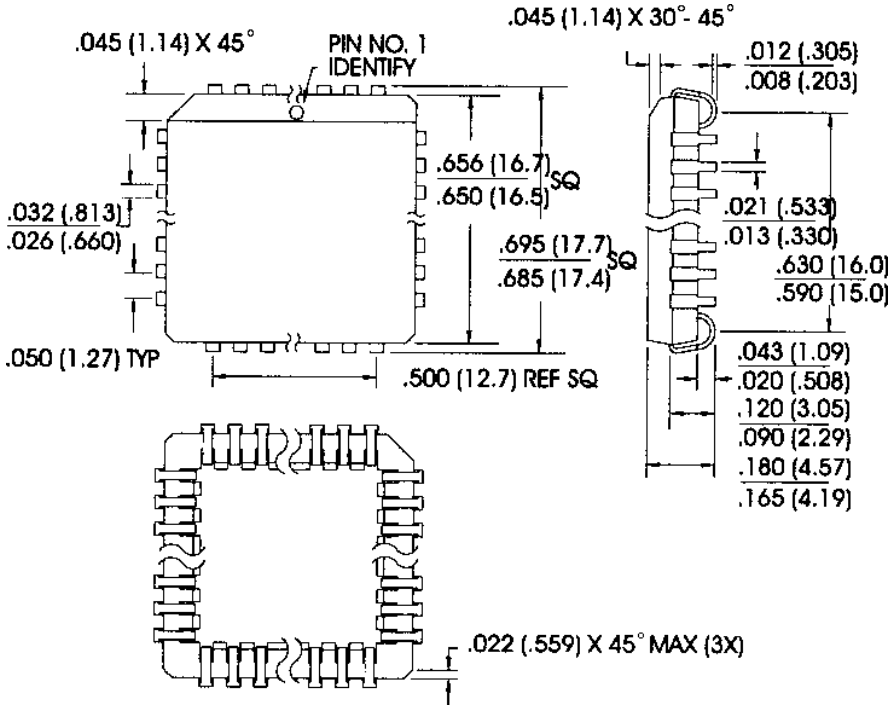
This command transmits first the x- and y-resolution and then follows the type of image structure ('V' for vertical organization) via RS-232 interface.

**) This function is available only with High-Level-Graphics Controller EAIC1520-2.*

EA IC1520

DIMENSIONS OF EA IC1520-xxx

Housing: PLCC44J; sizes in Inches (mm)



ATTENTION

handling precautions!

EA GE120-5NV24 GRAPHICS UNIT 120x32, 2 FONTS, RS-232

Graphics unit EA GE120-5NV24 is based on High-Level-Graphics-Controller EA IC1520-1PGH. This graphics unit operates either on true RS-232C level (±10V) or on CMOS-level.

Dimensions	68 x 39 x 11 mm
Display	120x32, Supertwist, LED-Backlight
Supply Voltage	+5V / 100 mA
Terminals	10 Pins, Grid 2,54 mm
Operating Temperature	0 ... +70°C
Storage Temperature	-20 ... +70°C

- 120x32 dots SUPERTWIST-LCD WITH GREENLED-ILLUMINATION
- 2 FONTS from 3,2mm (5x30 characters) to 4,6mm (4x20) up to 18,2 mm (1x5)
- DRAW STRAIGHT LINES, INVERT OR CLEAR AREAS
- SUPPLY VOLTAGE: +5V / typ. 100mA
- BAUDRATES 1200, 2400, 4800, 9600, 19200BD

Ordering Information

Graphics unit 120x32 with LED-backlight	**EA GE120-5NV24**
Cable with 9-pin D-SUB plug (female)	**EA KV24-9B**

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