

ICs for Consumer Electronics MEGATEXT

Display Functions

MEGATEXT[®] Display Functions	
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Page	Subjects (changes since last revision)

Data Classification

Maximum Ratings

Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

Characteristics

The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at $T_A = 25\text{ °C}$ and the given supply voltage.

Operating Range

In the operating range the functions given in the circuit description are fulfilled.

For detailed technical information about “**Processing Guidelines**” and “**Quality Assurance**” for ICs, see our “**Short Form Catalog**”.

Edition 10.94

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1 How to Use this Manual

1.1 Address Structure

The internal memory of the MEGATEXT® is organized in four blocks.

Each of them has 26 rows and 40 columns (= 1 Kbyte).

This structure is the same as used for the transmission of teletext pages.

Each address (block / row / column) points to a 48-bit long data word.

The addresses as used in this manual have the following formats:

0 / 02 / 03

is the address of a complete register with 48 bits:

Block	0
Row	02
Column	03

0 / 02 / 03 / 12

is the address of one bit of a register:

Block	0
Row	02
Column	03
Bit position	12

0 / 02 / 03 / 27:29

is the address of a sequence of bits in a register (here: 3 bits):

Block	0
Row	02
Column	03
Bit position	27 to 29.

Bit 27 is the LSB of this 3-bit word.

1.2 Bit Position

The 48-bit-long registers are a combination of 6 bytes.

The following table shows the relation of the bit position (as used in this manual) and byte position (format for the user software).

Byte position	5	4	3	2	1	0
Bit position	44444444 76543210	33333333 98765432	33222222 10987654	22221111 32109876	11111100 54321098	00000000 76543210

1.3 Glossary

PCS	Programmable Character Set: defined by the user and stored in the internal RAM.
DRCS	Dynamically Redefinable Character Set: transmitted PCS characters from the video signal.
Line	TV line, height of one pixel
Row	Text or graphics display row. The standard height is 10 pixels, but this depends on several parameters.
Page	A teletext page with 25 rows and 40 columns.
Inner Screen (Display) Area	An area of 25 rows and 40 characters. It is required for the display of one teletext page in normal size.
Outer Screen (Display) Area	Rest of the TV screen outside the inner screen area.
User Software	Assembler software for the external micro controller, which controls the MEGATEXT chip via I ² C or M3L Bus.
PU Software	Executed by the on-chip controller (PU = Processor Unit).
PU ROM	Memory for the program code of the PU software.
PU RAM	Memory for the use of the PU software.

2 Display Format

The display generator of MEGATEXT is able to print on the complete TV screen.

The number and format of the pixels is defined by the TV and teletext standards.

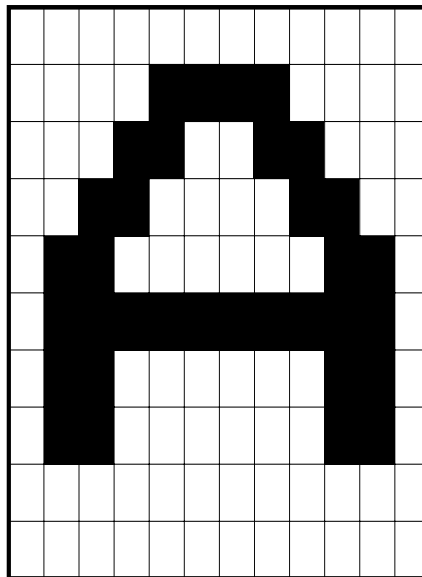
2.1 Pixel Size

The horizontal pixel size is defined by the display generator. The rate is limited by the video amplifier.

The pixel size in vertical direction is fixed by the line distance.

In teletext applications the horizontal pixel width is only $\frac{2}{3}$ of the line distance.

So the pixels for the standard display mode have an aspect ratio of 2:3 (width:height).



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2.2 Display Size

The number of displayable pixels depends on the screen format.

Using the standard PAL 4:3 format, 290 by 624 pixels (1508 normal sized characters) may be displayed on the screen. The total number is 180,960 pixels.

Only with a 16:9 screen the complete display area of 1984 normal sized characters (= 238,080 pixels) will be visible.

Format	Vertical			Horizontal				
	Frequency	Lines	Characters	Frequency	Length	Rate	Pixel	Characters
4:3	50 Hz	310	31	15.625 kHz	52 μ s	12 MHz	624	52
16:9	50 Hz	310	31	15.625 kHz	52 μ s	16 MHz	768	64

Note: The number of generated lines is higher than the number of lines in the visible area of a TV screen. The times and frequencies refer to a normal scan display.

3 CLUT (Color Look-Up Table)

3.1 What is a CLUT?

Color Look-Up Tables are used to reduce data. As the three basic colors may be displayed in 16 intensity steps, 4096 different combinations are possible.

If a character and its background were displayed in 4096 different colors, two times 12 bits would be necessary.

As it is not necessary to display all possible colors within one screen page, 64 different color combinations may be defined in the CLUTs.

The CLUTs are devised in two sets. They are called Norm CLUT and User CLUT. Foreground and background colors of each character must be from the same set.

After all these simplifications, only 11 bits are necessary to define the foreground and background colors of each character.

3.2 How is a CLUT Modified?

The color information of the CLUTs are defined by:

- Hardwire (CLUT 0 and 1). These CLUTs are fixed. They may not be modified.
- TTX transmitter (CLUT 2 and 3). Special control codes of the transmitter are used to modify these CLUTs.
Transmitted CLUT control codes in the extension packets can be modified by user software down-loaded to CLUTs 2 and 3.
- User software (CLUTs 2 to 7). The modification is made by the microcontroller, which is connected to the interface bus lines.

3.3 Structure of CLUT

The 64 different color combinations are stored in eight CLUTs.

Each CLUT has eight vectors, which point to 12-bit-long color information.

Each of the three basic colors red, green and blue may have 16 intensity steps (4 bits).

The norm set (CLUT 0 to 3) is necessary for WST (World System Text).

The CLUT set 4 to 7 may be reserved by the user for OSD (On-Screen Display) functions.

3.4 CLUT Map

Norm Clut (UC = '0')

Color	CLUT	Defined by	Used for	Vector	Colors
0 1 2 3 4 5 6 7	0	Hardwired	WST level 1	0 1 2 3 4 5 6 7	Black Red Green Yellow Blue Magenta Cyan White
8 9 10 11 12 13 14 15	1		WST level 2	0 1 2 3 4 5 6 7	Reduced intensity black Reduced intensity red Reduced intensity green Reduced intensity yellow Reduced intensity blue Reduced intensity magenta Reduced intensity cyan Reduced intensity white
16 17 18 19 20 21 22 23	2	Redefined by	WST level 3	0 1 2 3 4 5 6 7	Default: black
24 25 26 27 28 29 30 31	3	TTX transmitter + user software	PCS with 16 colors	0 1 2 3 4 5 6 7	Default: black

User Clut (UC = '1')

Color	CLUT	Defined by	Used for	Vector	Colors
32	4	Redefined by user software	UC = '0' PCS with 4 colors UC = '1'	0	Default: black
33				1	
34				2	
35				3	
36				4	
37				5	
38				6	
39				7	
40	5	Redefined by user software	Pixel graphics with 2 colors	0	Default: black
41				1	
42				2	
43				3	
44			Pixel graphics with 4 colors	4	
45				5	
46				6	
47				7	
48	6	Redefined by user software	PCS and pixel graphics with 16 colors	0	Default: black
49				1	
50				2	
51				3	
52				4	
53				5	
54				6	
55				7	
56	7	Redefined by user software	PCS and pixel graphics with 16 colors	0	Default: black
57				1	
58				2	
59				3	
60				4	
61				5	
62				6	
63				7	

3.5 Color Word Format

Each color word contains the information for the intensity of the three components red, green and blue.

As they have 16 intensity steps each, three times 4 bits are required.

Color Word											
MSB											LSB
b3	b2	b1	b0	g3	g2	g1	g0	r3	r2	r1	r0
Blue				Green				Red			

3.6 Position of CLUTs in Memory

The 64 different color combinations are stored in 16 addresses.

Each color is defined by a color word.

Four color words (Word A to Word D) with 12-bit length are always linked together to form a 48-bit word.

Conditioned by the hardware design in the chip, the sequence is not homogeneous.

Address			Color Number			
			Bit 47:36	Bit 35:24	Bit 23:12	Bit 11:0
Block	Row	Col	Word A	Word B	Word C	Word D
0	3	20	18	19	20	21
		21	22	23	24	25
		22	26	27	28	29
		23	30	31	16	17
		24	34	35	36	37
		25	38	39	40	41
		26	42	43	44	45
		27	46	47	32	33
		28	50	51	52	53
		29	54	55	56	57
		30	58	59	60	61
		31	62	63	48	49

3.7 Loading New CLUTs

The CLUTs can be edited in the memory without changing the appearance of the display. The information for the color generator is stored in a latch.

The display changes only after the LNCL bit in the DPW is set to '1'.

See: 'Load New CLUT', page 20.

4 **Display Area**

The display area includes the complete screen area of a TV set in the format 16:9.

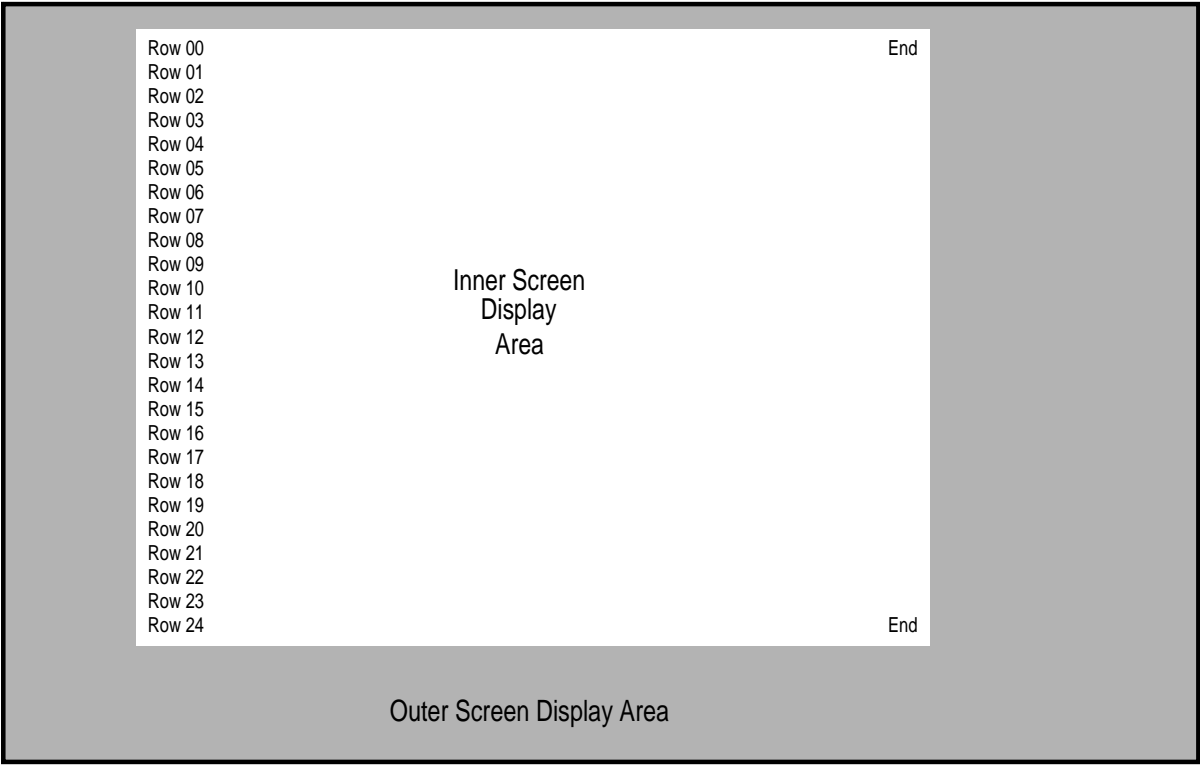
Each normal sized character has a height of 10 pixels and a width of 12 pixels.

In this case 1984 characters may be displayed at the same time instead of 1000 characters as in former teletext applications.

The complete size is:

horizontal: 64 columns (characters)
vertical: 31 rows (text lines)

If the TV set has the old format 4:3, part of the display area is not visible.



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4.1 Display Position Word (DPW)

The DPW defines the characteristics of the whole screen area.

Note: The DPW does not affect the graphics position.

Register Word	Address
DPW	0/03/01

4.1.1 Position of ISDA

The position of the ISDA inside the display area is defined in the DPW (Display Position Word).

The values indicate the start preset of the counters for column, line and row after the sync pulses.

Example: If the DPWR is set to '20', the upmost row of the display is row 20.

The DPW also influences the pixel cursor.

Note: The DPW does not affect the graphics position.

Bit	Function	Values	Address
DPWC	Column	0 – 63	0/03/01/9:14
DPWL	Line (offset)	0 – 9	0/03/01/15:18
DPWR	Row	0 – 30	0/03/01/19:23

– Display Position Word –

The picture in chapter 4 has the following position values:

Column:	55
Line:	00
Row:	30

4.1.2 Width Control

The DWD (Double Width Display) bit influences the horizontal pixel generation for the complete screen area.

If the DWD bit is set to '1', each pixel is displayed twice.

DWD 0/03/01/24	Function
0	Normal width
1	Double width

– Display Position Word –

4.1.3 Pixel Speed Control

The DSC (Display Speed Control) bit influences the pixel frequency in horizontal direction.

It is used for the adaptation of the pixel frequency to the horizontal frequency of TV sets (50 Hz/ 100 Hz).

If the DSC bit is set to '1' in a 50-Hz TV, the display is compressed to half size in horizontal direction.

Note: In this mode the bandwidth of the RGB output stage of the TV set may not be high enough.

DSC 0/03/01/25	Function
0	Half pixel frequency (50/60-Hz TV)
1	Normal pixel frequency (100/120-Hz TV)
– Display Position Word –	

4.1.4 Height Control

The DHD (Double Height Display) bit influences the vertical pixel generation.

If the DHD bit is set to '1', everything appears in double height.

Unlike the character DH attribute, no upper half is required.

DHD 0/03/01/26	Function
0	Normal height
1	Double height
– Display Position Word –	

4.1.5 Screen Attribute Select

The SAS (Screen Attribute Select) bit points to the mask registers, which influence the ISDA or the boxed characters.

The SAS allows the fast switch between two different preset display designs.

See: 'Mask Functions', page 91.

SAS 0/03/01/29	Registers Used
0	BOXDW 0 BOXMR 0 ISDW 0 ISMR 0
1	BOXDW 1 BOXMR 1 ISDW 1 ISMR 1
– Display Position Word –	

4.1.6 Load New CLUT

The LNCL (Load New CLUT) controls the update of the color generator out of the memory.

This function allows the simultaneous change of many colors.

Note: The LNCL bit has to be set to '1' for at least one TV frame.

LNCL 0/03/01/27	Function
0	Color information is latched in hardware
1	Color generator is connected to memory
– Display Position Word –	

4.1.7 Load New Screen Attributes

The LNSA (Load New Screen Attributes) bit controls the update of the screen attributes of the display hardware out of the memory.

LNSA 0/03/01/28	Function
0	Only SDW is loaded
1	All screen attributes are loaded
– Display Position Word –	

4.2 Inner Screen Display Area

The area which is necessary to display the standard teletext pages is called the ISDA (Inner Screen Display Area).

It may be placed anywhere in the display area (complete screen).

If all characters are displayed in normal dimensions, the size is:

horizontal: 40 columns (characters)

vertical: 25 rows (text lines)

4.3 Page Position Word

The characteristics of the ISDA are defined in the PPW (Page Position Word).

Register Word	Address
PPW	0/03/02

4.3.1 Character Size

Both width and height may be increased for all characters together in the ISDA.

Unlike the DH and DW attributes for single characters, each character has to be edited only one time.

If the USF (User Screen Format) for a row is set to '0', this row is not influenced by the DHP and DWP bits.

If characters are increased in size, the total size of the ISDA is not changed.

This means that only one half or one quarter of the contents of the standard ISDA is visible.

The relevant bits are DHP and DWP:

Bit	Function	Address
DHP	Double Height Page	0/03/02/33
DWP	Double Width Page	0/03/02/38
– Page Position Word –		

4.3.2 Holding Rows

It is possible to hold the rows 0, 1, 23 and 24. The hold row bits are placed in the PPW (Page Position Word) and may be set individually.

This feature makes it possible to keep the page header (row 0) and the status line (row 24) on their original position and size for example, while the rest of the teletext page is displayed in double height.

Quality of a held row:

- The absolute position within the ISDA is fixed.
- The row attributes are defined in the default RATT register (0/02/31).
- The bits LSC (1:0), DWP, CHC (1:0), LCC (1:0) and DHP are not regarded.

Bit	Function	Address
HR0	Hold Row 0	0/03/02/29
HR1	Hold Row 1	0/03/02/30
HR23	Hold Row 23	0/03/02/31
HR24	Hold Row 24	0/03/02/32

– Page Position Word –

Tip: If a row is held, it will be displayed a second time, if the ISDA is scrolled. To prevent this, it should be made invisible using its original RATT register. This can be realized by masking the CO bit and setting it to '1'.

(The held row is defined in RATT register 31).

4.3.3 Scroll Out Functions

The bits SOH (Scroll Out Horizontal) and SOV (Scroll Out Vertical) define the area in the ISDA which is visible when one of the corners of the page is shifted inside the ISDA.

The position of the page inside the ISDA is defined in the PPW.

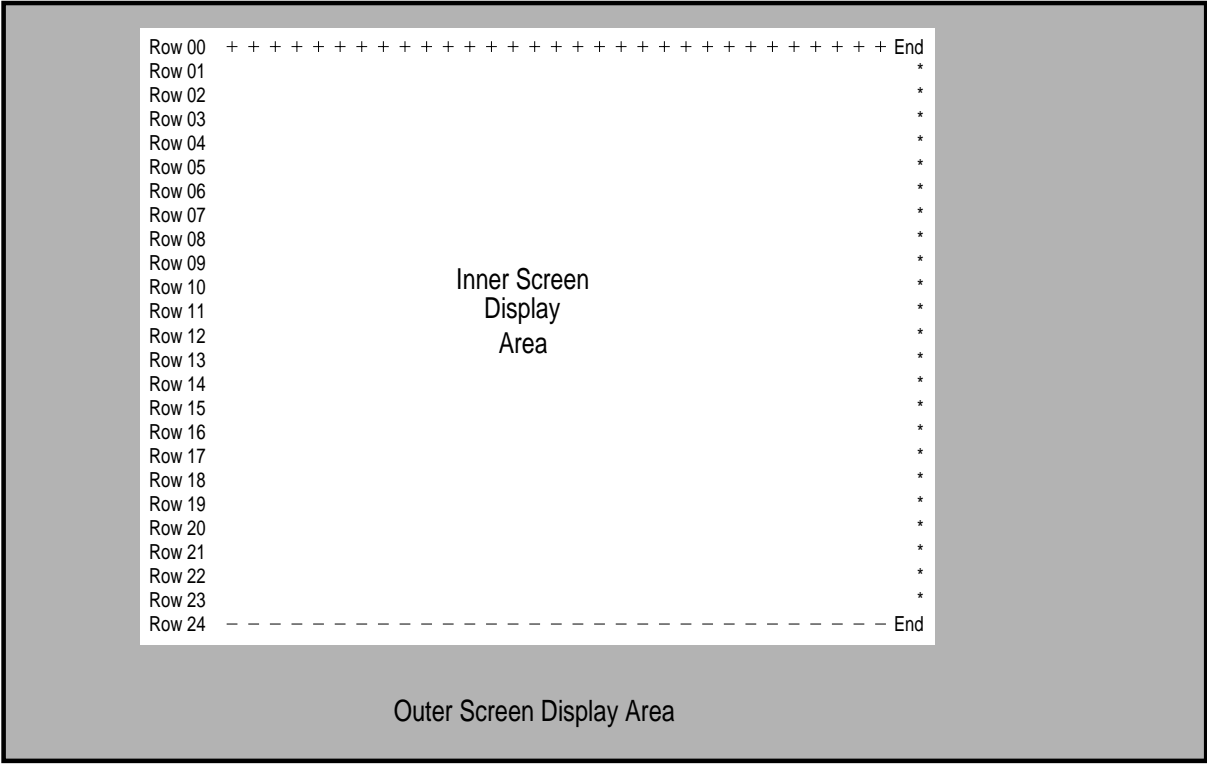
See: ‘Positioning of Inner Screen Area’, page 27.

Bit	Function	Address
SOH	Scroll Out Horizontal	0/03/02/24
SOV	Scroll Out Vertical	0/03/02/25

– Page Position Word –

Both bits may be set independently of each other. So the scroll behavior may be different in both directions.

The following page in original position will be scrolled and manipulated using the scroll out bits:




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The examples show the influence of these bits. If they are ‘0’, the area before or behind a line or row is defined by the TDW.

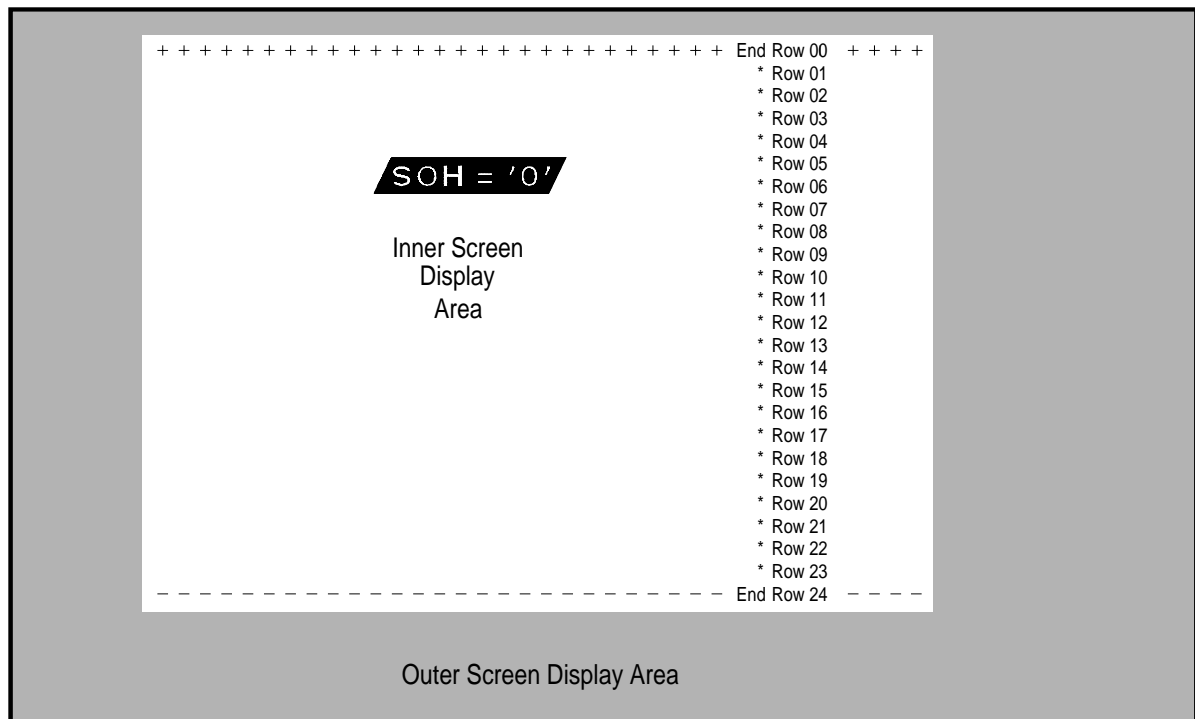
The TDW has the same format as a character in the CDW.

Word	Function	Address
TDW	Termination Display Word	0/03/05

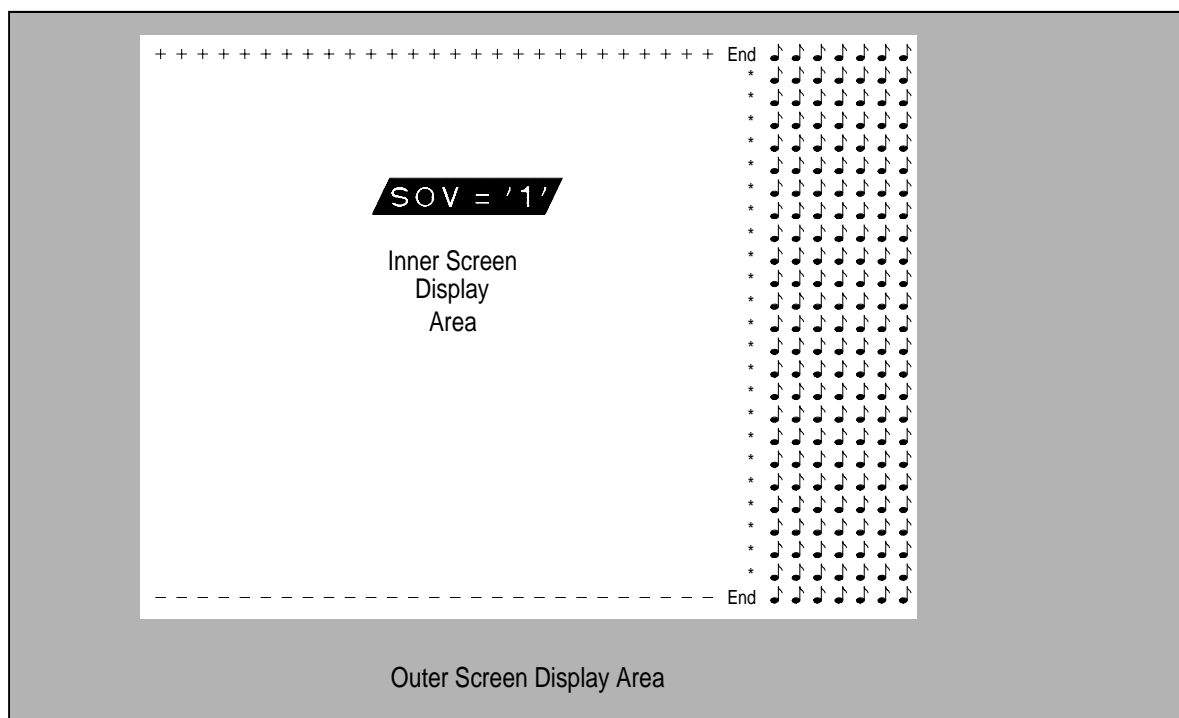
The TDW of the following examples contains a PCS character which shows a musical note.

TDW = 

Example 1: The origin of the page (upper left corner) is shifted 10 characters to the right. The position is set to PPWC = 30:

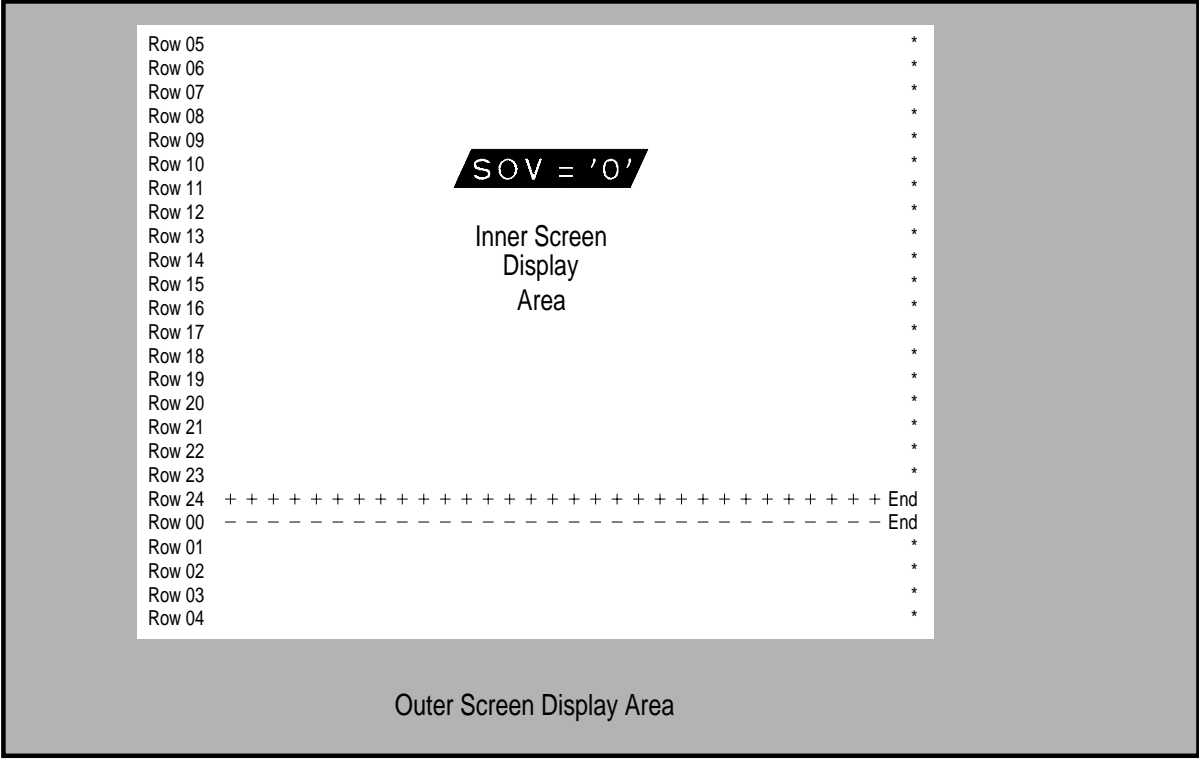


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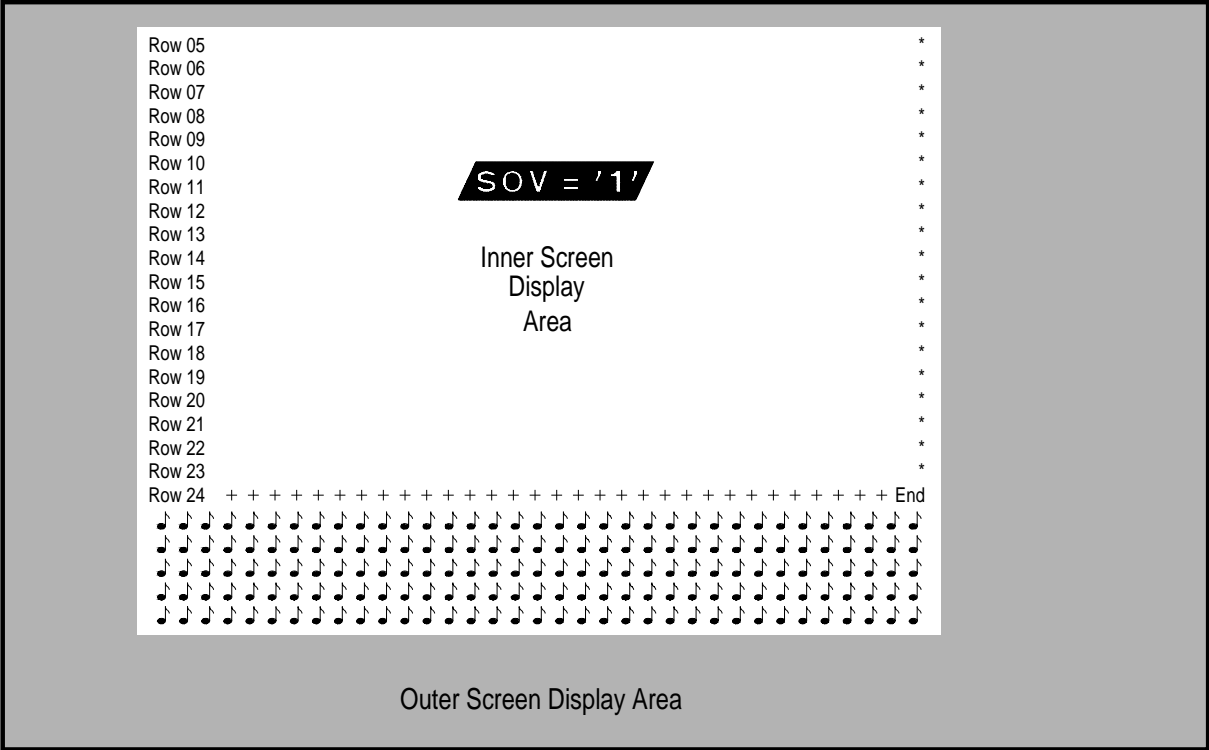


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Example 2: The origin of the page (upper left corner) is shifted 5 characters down.
The position is set to PPWR = 20, PPWL = 0:



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4.3.4 Page Screen Resolution Mode

It is possible to display two text pages together in the ISDA. These pages are stored in block 2 and block 3.

Their dimensions may be compressed in horizontal or vertical direction. So they are displayed side by side (80×25 mode) or one upon the other (40×50 mode).

The arrangement of the pages in the ISDA is defined in the BES bit.

More information: 'Basic or Extended Memory', page 28.

Note: The 80×25 mode is not possible in 100-Hz TV applications. In this case the double speed mode is already used to set the pixel rate to 24 MHz.

The relevant bits are SRM 1 and SRM 0.

SRM1 0/03/02/27	SRM0 0/03/02/26	Function	Mode
0	0	40 columns 25 rows	Standard mode
0	1	80 columns 25 rows	Extended mode 1
1	0	40 columns 50 rows	Extended mode 2
1	1	Not allowed	

– Page Position Word –

If the 80×25 mode is selected, the RLSC bit (Row Line Speed Control) of all row attributes has to be set to 'double speed'.

RLSC1 0/02/#/01	RLSC0 0/02/#/00	Function
0	0	Normal speed
1	0	Double speed

= Row number

4.3.5 Positioning of Inner Screen Area

The page, which represents a transmitted teletext page may be positioned everywhere in the inner screen display area.

The position values point to the character which is displayed in the upper left corner.

Example: If the PPWC has the value '20', the rows in the ISDA start with the characters in column 20.

Bit	Function	Values	Address
PPWC	Column	0 – 39	0/03/02/9:14
PPWL	Line (offset)	0 – 9	0/03/02/15:18
PPWR	Row	0 – 24	0/03/02/19:23
– Page Position Word –			

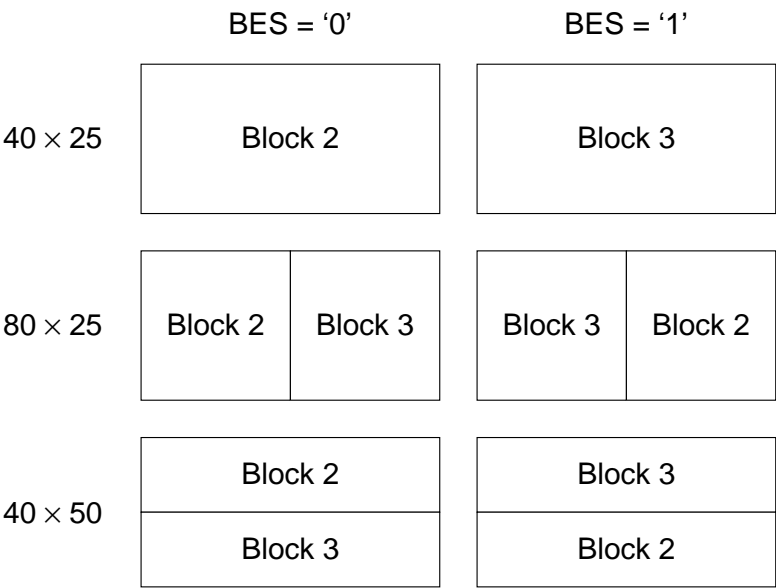
4.3.6 Basic or Extended Memory

The BES bit (Basic or Extended Memory Select) in the PPW defines the memory block, which is displayed in the ISDA.

If a mode with smaller characters (80×25 or 50×40) is selected, two blocks are displayed together on the screen.

The BES bit defines the blocks which are displayed in the inner screen area.

Bit	Address
BES	0/03/02/28
– Page Position Word –	



More information: 'Page Screen Resolution Mode', page 26.

4.3.7 Character Height Control

The PCHC bits (Page Character Height Control) enable to display of the ISDA with double height.

The bits are only taken in those rows where the USF bit is set to '1'.

PCHC1 0/03/02/37	PCHC0 0/03/02/36	Function
0	0	Normal display
0	1	Repeat each character line
1	0	Not implemented up to now
1	1	

– Page Position Word –

4.3.8 Line Count Control

The characters in the ISDA may be displayed with three different vertical resolutions.

Instead of the normal height of 10 lines (= pixel), the vertical size may also be 9 or 8 lines.

So the number of displayed rows in the ISDA may be increased. This function is helpful for 60-Hz TV sets.

Even with less lines in vertical direction, the same information may be displayed.

If the height is reduced in this way, the bottom pixel rows are suppressed.

PLCC1 0/03/02/35	PLCC0 0/03/02/34	Displayed Lines
0	0	10 (0:9)
0	1	9 (0:8)
1	0	8 (0:7)
1	1	Not allowed

– Page Position Word –

Definition: Line 0 is the topmost line of the complete 12 × 10 pixel matrix.

4.3.9 Line Speed Control

The PLSC (Page Line Speed Control) bits influence the pixel rate in horizontal direction.

The normal rate for 50-Hz TV sets is 12 MHz.

The double speed mode (24 MHz) has to be used in 100-Hz TV sets.

PLSC1 0/03/02/40	PLSC0 0/03/02/39	Function
0	0	Normal speed
0	1	Half speed
1	0	Double speed
1	1	Not allowed

– Page Position Word –

4.4 Outer Screen Display Area

The possibility displaying something in the OSDA (Outer Screen Display Area) is a new feature of MEGATEXT.

Using former teletext circuits, the area outside the page could not be written on.

The screen in this part was either black or the video picture was visible.

The outer screen display area may e. g. used in teletext mode for the display of

- Menus
- Help functions
- List of received pages.

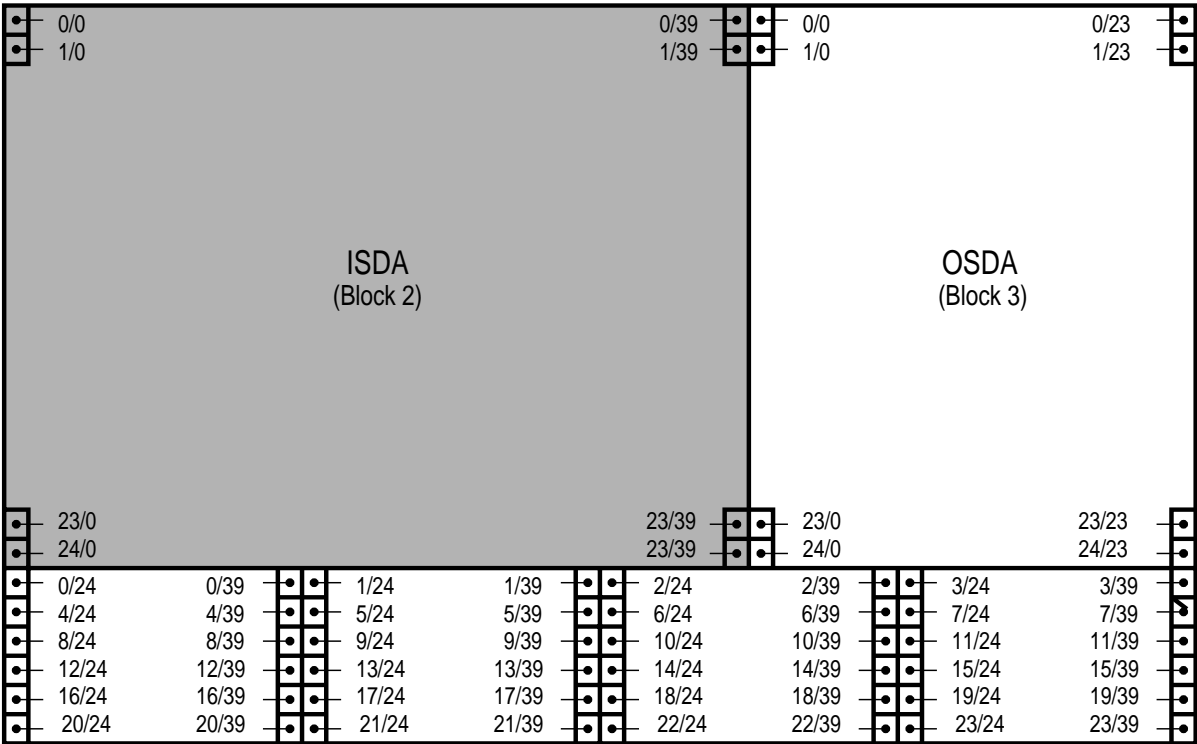
The size of the OSDA is designed for 16:9 screen formats. If the screen format is 4:3, only part of the OSDA is visible.

4.4.1 Address Mapping

The position of the addresses in the OSDA is shown in the following diagram. The position values of the DPW are set to '0'.

If other values are set, the complete combination will be scrolled.

Example: If the DPWC is set to '63', the characters of the right border are displayed on the left side.
If the DPWR is set to '30', the characters of the lower border are displayed on the top side.



UED04989

5 Character Display Word

Each character of the display is defined by a 40 bit long word.

In teletext mode, the text information is transmitted with serial attributes.

The SPC (Serial to Parallel Conversion) software in the PU (Processor Unit) transforms them to parallel attributes for the display generator.

Characters which have been attributed information are replaced by spaces.

This display word may be also entered via I²C or M3L Bus.

5.1 Bits of Character Display Word

Byte Pos.	Bit	Name	Function	Remark
0	0	B0	ROM character select	Each character is defined by 12 × 10 pixel matrix
	1	B1		
	2	B2		
	3	B3		
	4	B4		
	5	B5		
	6	B6		
	7	B7		
1	8	B8		
	9	US	Underline/Separate graphic	Function depends on special character
	10	UH	Upper Half double height	
	11	DH	Double Height	
	12	DW	Double Width	Marks left half of character
	13	CO	Conceal/Reveal	
	14	TRB	Transparent Background	Video picture visible
	15	TRF	Transparent Foreground	See: 'Transparency', page 39.
2	16	BX	Box Mode	
	17	BC0	Selection of 8 Background Colors	Color vector
	18	BC1		
	19	BC2		
	20	FC0	Selection of 8 Foreground Colors	Color vector
	21	FC1		
	22	FC2		
3	23	F0	Control of Flash modes	See: 'Flash', page 40.
	24	F1		
	25	F2		
	26	F3		
	27	IC	Inverse Colors	May be used as cursor
	28	BC3	CLUT Select for Background Color	
	29	BC4		
	30	FC3	CLUT Select for Foreground Color	
	31	FC4		
4	32	DD0	Multimode bits – Addressing of Accents – Addressing of PCS memory – Selection of the DRCS mode	
	33	DD1		
	34	DD2		
	35	DD3		
	36	DD4		
	37	DM0	Display Mode selection	
	38	DM1		
	39	UC	User CLUT select	Selects CLUT 0:3 or CLUT 4:7

5.2 Character Set

The following tables show the complete ROM-based character set. It contains more than the characters which are defined in the WST sets G 0 to G 3.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Hex	Character Set
00	ö	ő	ŕ	ř	š	ś	š	ť	ẗ	ú	û	ü	ü	ü	ü	ÿ	000	MEGATEXT
01	ž	ž	ž	Ɛ	G	I	U	()	?	?	?	?	?	?	?	01F	
02		!	"	#	¤	%	&	'	()	*	+	,	-	.	/	020	WST G0
03	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?	to	
04	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O		
05	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_		
06	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o		
07	p	q	r	s	t	u	v	w	x	y	z	{		}	~	■	07F	
08	À	Á	Â	Ã	Ä	Å	Ä	Å	Ç	Ç	Ç	Đ	È	È	È	È	080	
09	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	Ě	09F	
UED04842																	.	
0A																	0A0	WST G1
0B																		
0C																	to	
0D																		
0E																	0FF	
0F																		
UED04843																		

[illegible]

UED04844

100 to 11F	MEGATEXT
120 to 17F	WST G2
180 to 19F	MEGATEXT

UED04845

1A0	
to	WST G3
1FF	

Each character is defined by a 12×10 pixel matrix.


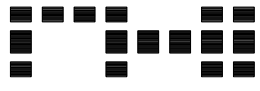
The ROM based characters can be addressed using the bits B0 to B8 of the CDW.

5.3 Underline / Separate

The influence of the US bit depends on the type of character:

- Alphanumeric characters are underlined.
- Graphic characters are displayed with separated elements.

Only the G1 characters (block graphics) are separated. All other characters (include G3 graphics characters) are displayed with an underline.

US	Alpha	G1 Graphics
0	Text	
1	<u>Text</u>	
- Character Display Word -		




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5.4 Upper Half and Double Height

The UH (Upper Half double height) bit marks the upper part of a double height character.

It is only active, if the DH (Double Height) bit is set to '1'.

The following table shows the influence of the DH bit and the UH bit on the character 'A':

DH	UH	Display
0	x	
1	1	
1	0	
- Character Display Word -		

UED04847

5.5 Double Width

The DW bit (Double Width) marks the left half of a character with double width.

The character to its right will be overwritten by the right half.

If the DW bit of the following character (here the 'X') is also set to '1', the right half of the 'A' is overwritten by the left half of the 'X'.

The attributes of the character which is overwritten by the right half of the 'A' are not influenced.

They are now used for this half.

So it is possible to display each half with different color attributes or flash modes for example.

Note: If a PCS character is set to 'Double Width', the right character must have the same attributes (DM bits, D bits) as the left one (except DW bit).

DW Bit		Display
Left Character	Right Character	
0	0	A X
1	0	A
1	1	AX
- Character Display Word -		

UED04848

5.6 Conceal

The conceal function was not yet implemented in WST level 1.

All characters whose CO bit is set to '1' are normally hidden. Their foreground color is the same as the background color.

To make the concealed information visible, the CO bit has to be masked and set to '0'.

The mask function of the RATT registers influence only one row.

The complete ISDA may be influenced in the ISDW.

See: 'Mask Functions', page 91.

The original idea was the transmission of riddle pages. The question is always displayed. The answer is made invisible with the conceal attribute. It can be seen when the CO bit is masked.

In TV-program preview pages, VPS labels are often concealed.

5.7 Transparency

The TF bit (Transparent Foreground) or the TB bit (Transparent Background) disable the blanking output signal.

So the video picture is visible instead of background or foreground.

If both bits are masked (set to '1') in the ISDW and the OSDW (for the OSDA), the screen is set to normal TV mode.

If only the TB bit is masked to '1', the characters are displayed without background on the TV pictures. This function was called 'Mixed Mode' in existing TV sets.

5.8 Box Bit

The BX (BoX) bit has three different functions:

- Selection of mask registers

If the BX bit is set to '1', this character may be influenced by one of the box mask registers. Otherwise one of the ISDW registers is used.

See: 'Mask Functions', page 91.

Note: The selection of the mask registers is only regarded if the character is placed in the ISDA.

- Control of contrast reduction

The contrast reduction pin is active if the BX bit and the RCOR bit are set to '1'.

See: 'Contrast Reduction', page 96.

- Handling of RIB

The BX bit influences the processing of characters whose foreground or background color is set 'RIB' (Reduced Intensity Black).

BX	Display if Color = RIB
0	SBC (Screen Background Color)
1	Video picture
– Character Display Word –	

5.9 Flash

The bits F0 to F3 are part of the character display word.

They define the flash quality of the characters.

The flash timing can be set individually for each character on the screen.

So it is possible to use the eight different types of flash at the same time.

5.9.1 Flash Mode Control

These bits enable the flash. Two opposite phases may be selected.

If both bits are '1', the foreground color toggles between the one color which is defined in the CDW (Character Display Word) and the color of the next CLUT.

Technical background: Bit FC3 is toggled.

F1	F0	Function
0	0	Steady (flash disabled)
0	1	Normal flash
1	0	Inverted phase
1	1	Flash foreground to next CLUT <div> <div>0 > 1</div> <div>1 > 0</div> <div>2 > 3</div> <div>3 > 2</div> <div>4 > 5</div> <div>5 > 4</div> <div>6 > 7</div> <div>7 > 6</div> </div>
– Character Display Word –		

5.9.2 Flash Clock Control

Two different flash frequencies are possible.

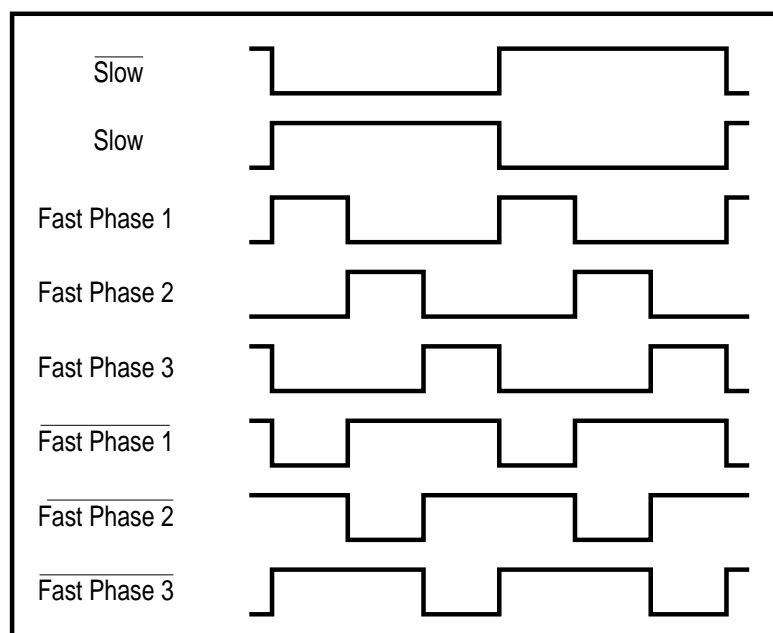
The slow rate changes the foreground to the background color with a frequency of about 1 Hz with a duty cycle of 50 %.

The fast rate has a frequency of about 2 Hz with a duty cycle of 33 %.

F3	F2	Function
0	0	Slow rate flash (app. 1 Hz)
0	1	Fast rate flash (app. 2 Hz) phase 1
1	0	Fast rate flash (app. 2 Hz) phase 2
1	1	Fast rate flash (app. 2 Hz) phase 3
– Character Display Word –		

If the fast rate is used, it is possible to simulate a repeated movement without changing the characters permanently.

Time relation of the different flash modes and phases:



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5.10 Inverted Colors

If the IC (Inverted Colors) bit is set to '1', foreground and background colors are exchanged.

This function can be used as a cursor. It is very effective when the IC bit is set using row attributes. So it is possible to highlight a row of a menu for example.

IC	Display
0	ABC
1	ABC
- Character Display Word -	

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5.11 Multimode Bits (DD)

The function of the multimode bits depends on the DM (Display Mode) bits.

More information: 'Display Mode', page 43.

'PCS Characters', page 44.

5.12 Display Mode

The DM bits (Display Mode) control the combination of ROM characters and PCS characters.

Mode	DM1	DM0	Function	PCS Resolution	Number of PCS Characters	Address of ROM Character	Address of PCS Character
1	0	0	Combination of ROM character and ROM accents			B (8:0)	None
2	0	1	PCS character Resolution defined with DD bits	Depends on DD (4:0)		None	B (8:0)
3	1	0	The foreground pixels of the ROM character overprint the PCS character. 'PCS background'	12 × 10 pixels 16 colors	32	B (8:0)	DD (4:0)
4	1	1	ROM characters ORed with PCS characters	12 × 10 pixels 2 colors	32	B (8:0)	DD (4:0)

– Character Display Word –

5.13 User CLUT Select

The UC bit (User CLUT) selects the CLUT set (0 to 3) or (4 to 7).

Foreground and background color are both influenced by the UC bit.

So it is not possible, for example, to use CLUT 2 for the foreground and CLUT 7 for the background color within one character.

UC	Selected CLUTs			
0	0	1	2	3
1	4	5	6	7

– Character Display Word –

6 PCS Characters

In addition to the hardwired character set, PCS (Programmable Character Set) characters can be used. They may be defined by the user software or transmitted.

The following examples show the presentation of PCS characters together with ROM characters on the TV screen.



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The transmission is only defined in WST level 3. In this case they are called 'DRCS' characters (Dynamically Redefinable Character Set).

Depending on the PCS mode, the characters are addressed using the B (8:0) or the DD (4:0) bits.

6.1 Partially Transparent PCS Characters

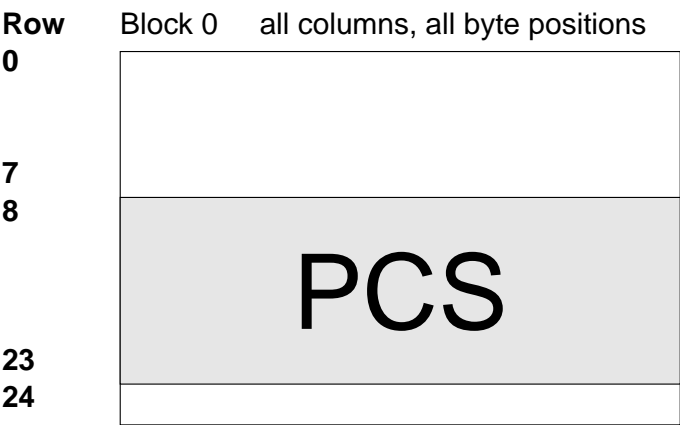
The TF (Transparent Foreground) and TB (Transparent Background) bits may also be used for PCS characters.

The pixels with color vector 0 are defined as 'background'.

Number of Colors	BG Vector	FG Vectors
2	0	1
4	00	01, 10, 11
16	000	001 to 111

6.2 Memory Location of PCS

The PCS characters are stored in a special memory area (in block 0) with a size of 3840 bytes.



6.3 PCS Resolution Modes (for Display Mode 2)

Display mode 2 is selected when the DM bits are set in the following way:

DM1	DM0
0	1

Depending on the DD bits (DD2, DD1 and DD0), eight different resolution modes are possible. As the memory size is constant, the quantity of different PCS characters depends on the resolution.

12 × 10 × 2 means:

12 pixels horizontal
 10 pixels vertical
 2 bits (color planes) for 4 different colors in 1 character

Res. Mode	DD2	DD1	DD0	PCS Resolution	Quantity of different PCS Characters
0	0	0	0	12 × 10 × 1	256
1	0	0	1	12 × 10 × 2	128
2	0	1	0	12 × 10 × 4	64
3	0	1	1	6 × 10 × 1	512
4	1	0	0	6 × 10 × 2	256
5	1	0	1	6 × 10 × 4	128
6	1	1	0	6 × 5 × 2	512
7	1	1	1	6 × 5 × 4	256

– Character Display Word –

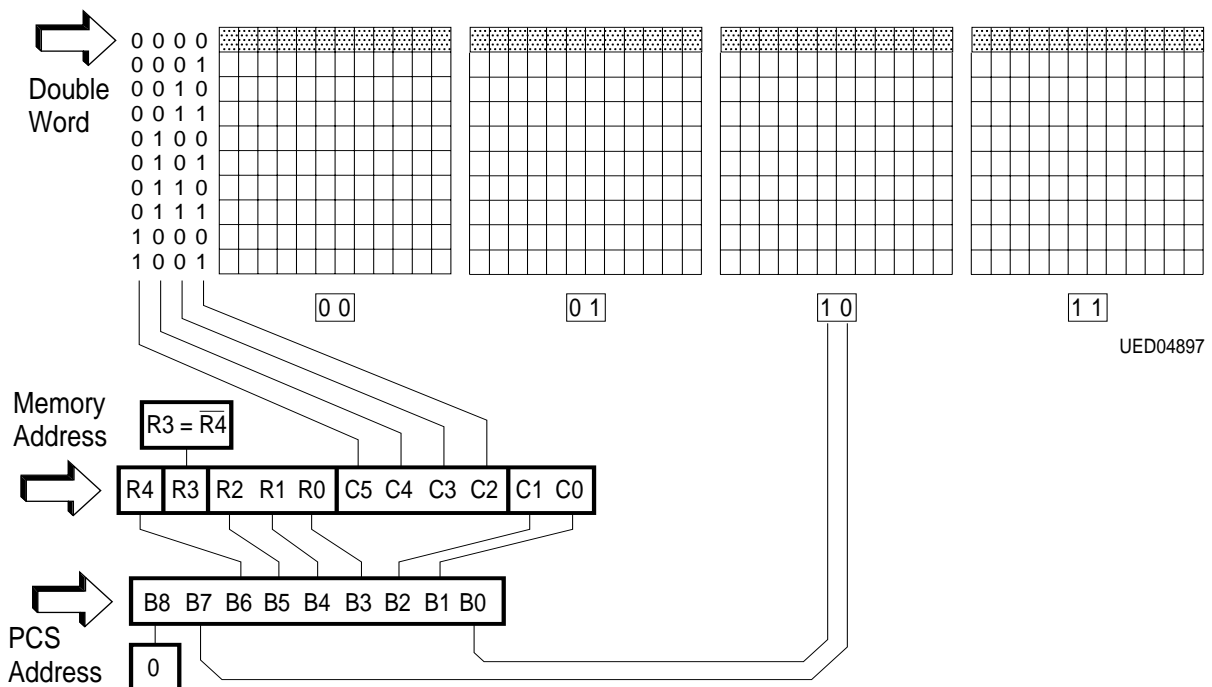
6.3.1 Format 12 × 10 × 1

One pixel line of four PCS characters is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

Pixel Bit	Used Color
0	Background
1	Foreground



6.3.2 Format $12 \times 10 \times 2$

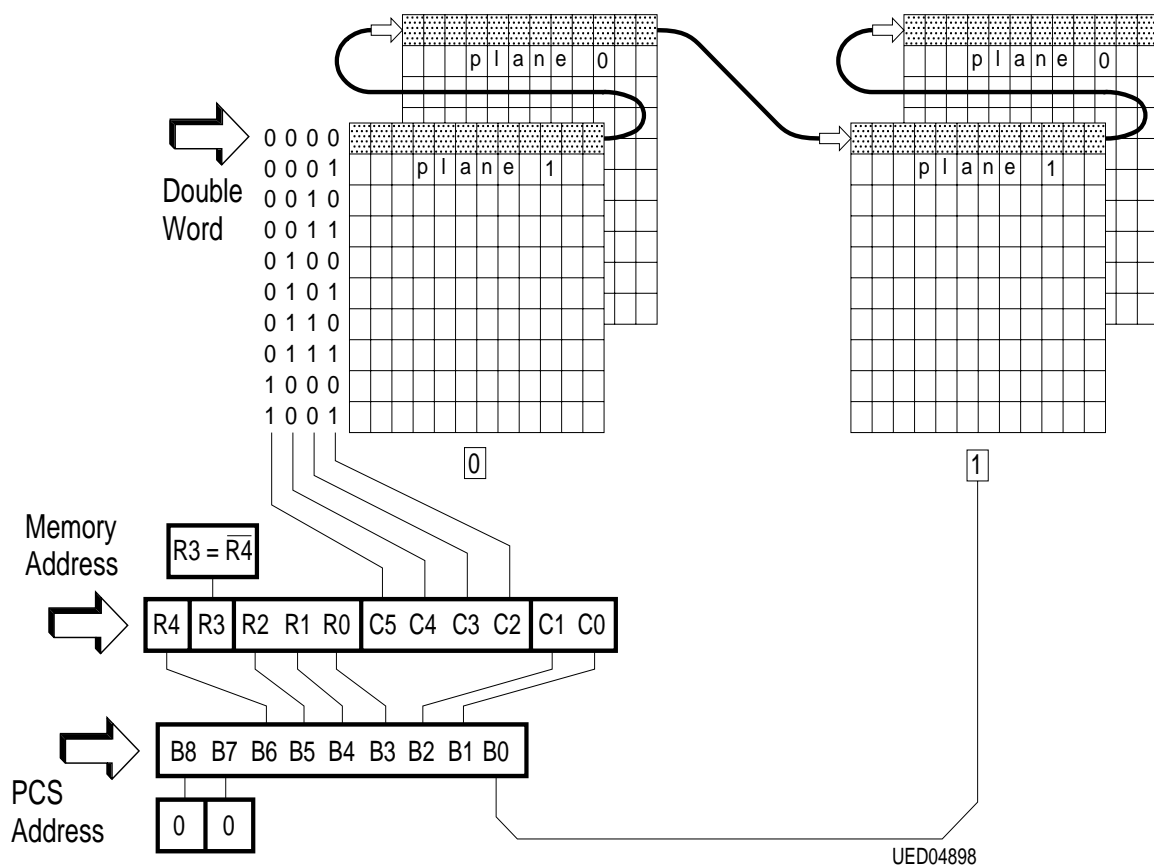
Each pixel has 2 bits (planes) for color information.

One pixel line of two PCS characters is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

UC	CLUT	Vector
0	4	0:3
1	4	4:7



6.3.3 Format $12 \times 10 \times 4$

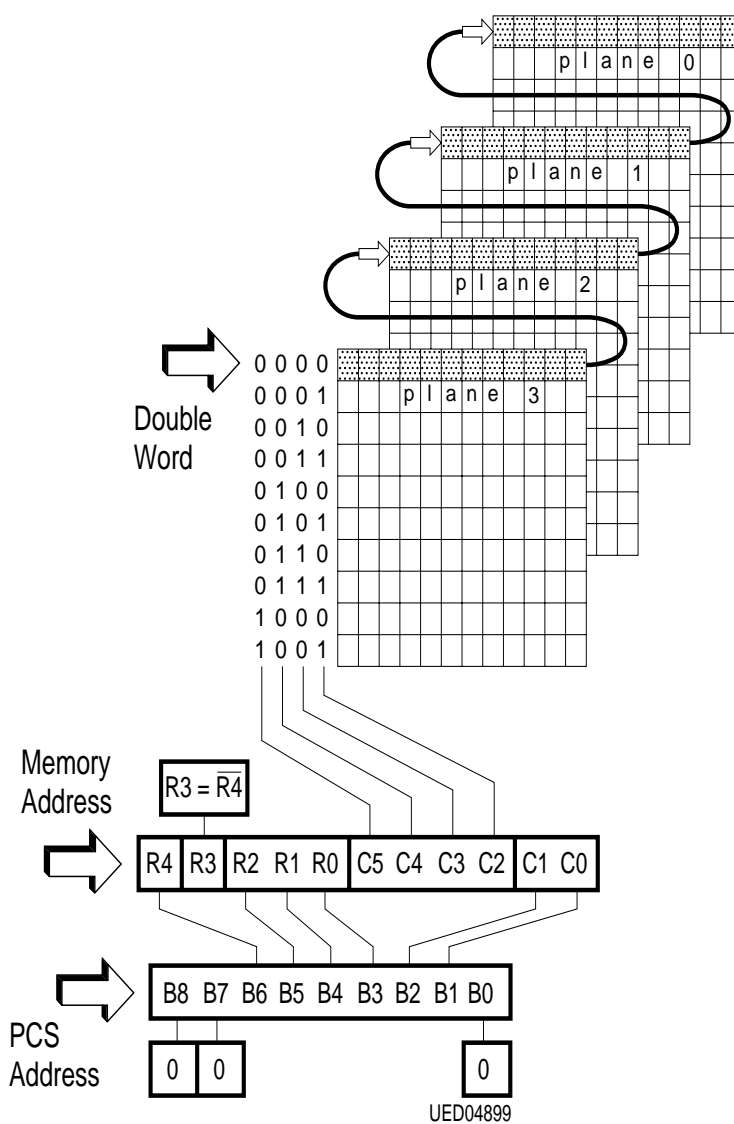
Each pixel has 4 bits (planes) for color information.

One pixel line of a PCS character is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

UC	CLUT	Vector
0	2 and 3	All
1	6 and 7	All



6.3.4 Format $6 \times 10 \times 1$

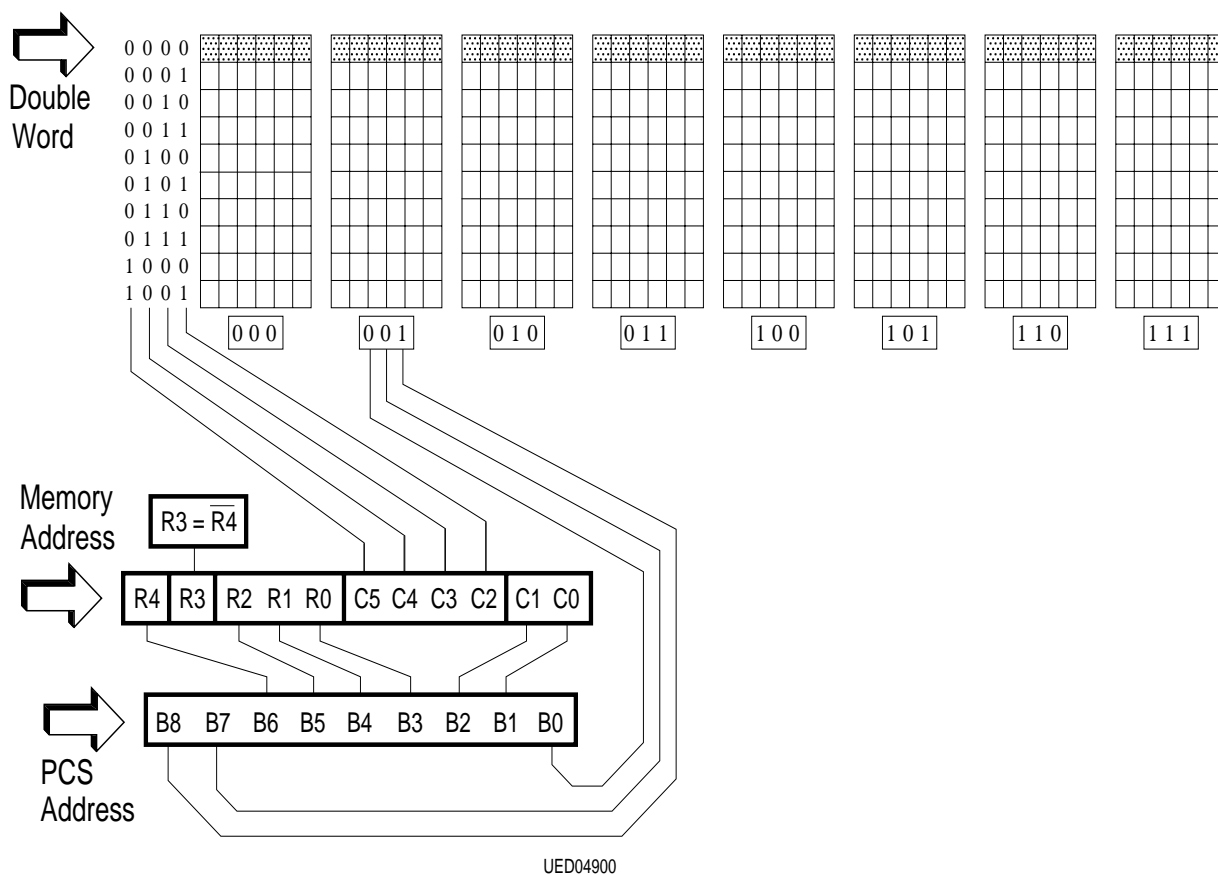
The pixels are displayed with double width.

One pixel line of eight PCS characters is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

Pixel Bit	Used Color
0	Background
1	Foreground



6.3.5 Format $6 \times 10 \times 2$

The pixels are displayed with double width.

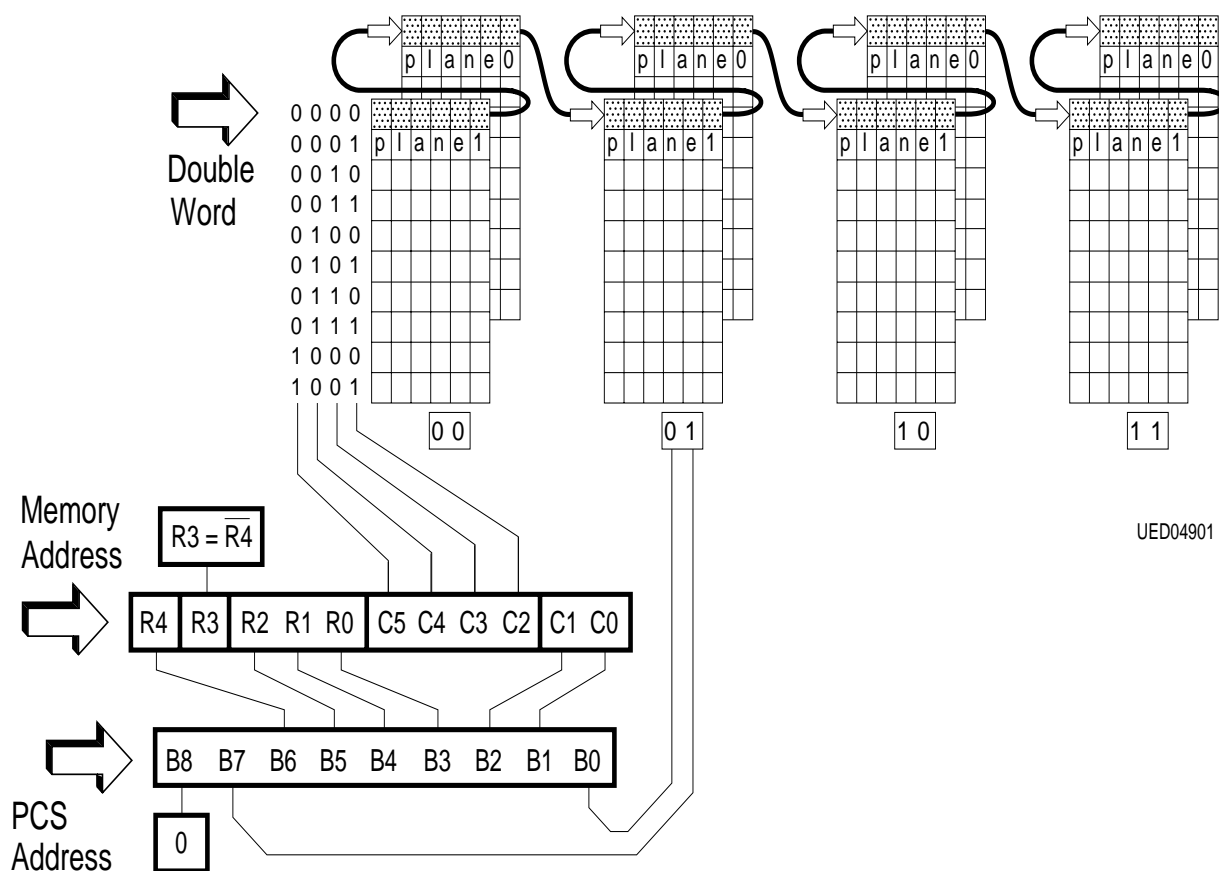
Each pixel has 2 bits (planes) for color information.

One pixel line of four PCS characters is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

UC	CLUT	Vector
0	4	0:3
1	4	4:7



6.3.6 Format $6 \times 10 \times 4$

The pixels are displayed with double width.

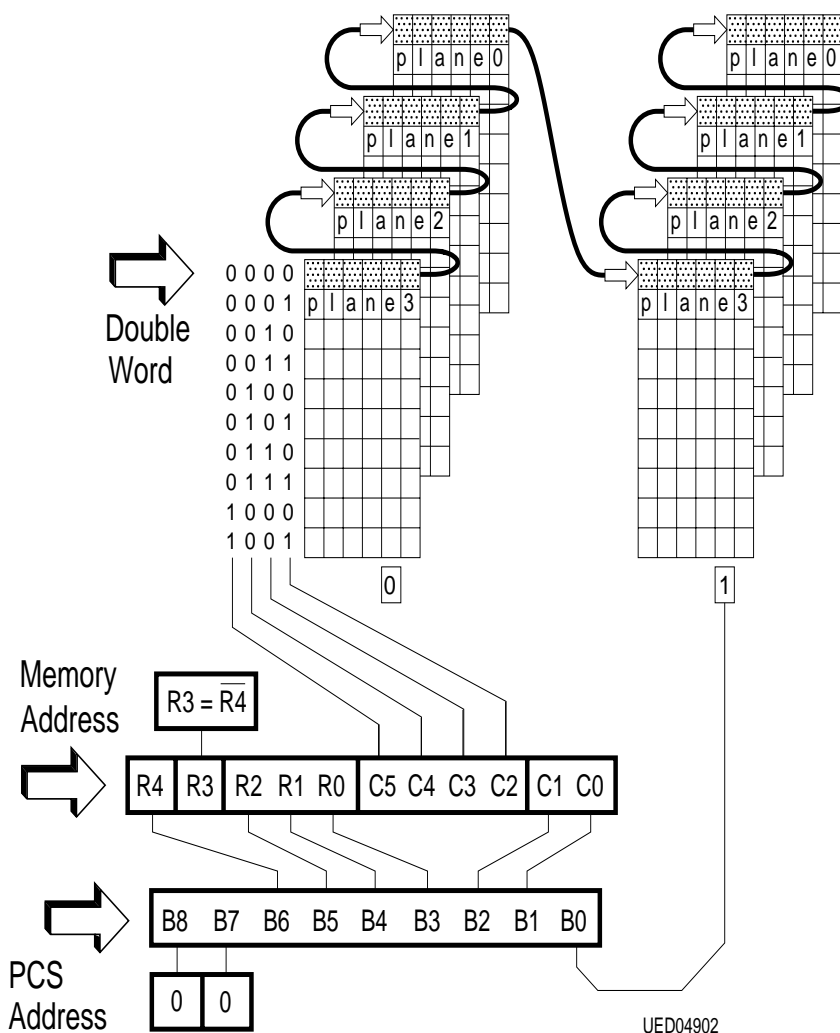
Each pixel has 4 bits (planes) for color information.

One pixel line of two PCS characters is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

UC	CLUT	Vector
0	2 and 3	All
1	6 and 7	All



6.3.7 Format $6 \times 5 \times 2$

The pixels are displayed with double width and double height.

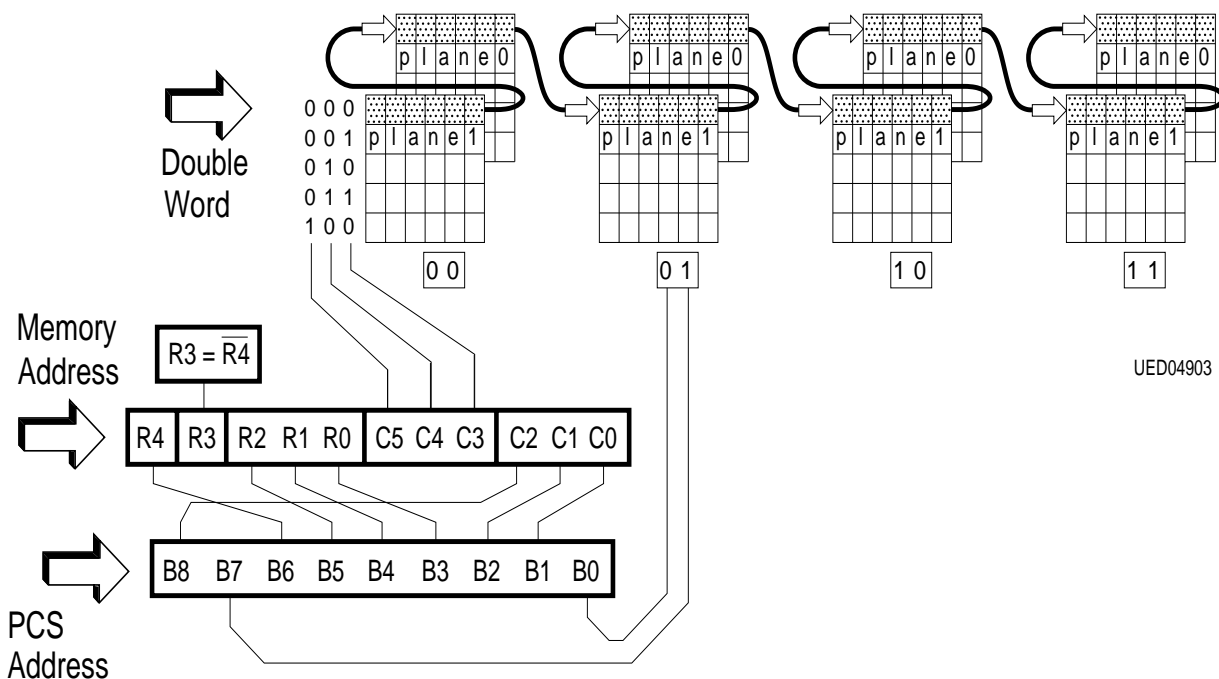
Each pixel has 2 bits (planes) for color information.

One pixel line of four PCS characters is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

UC	CLUT	Vector
0	4	0:3
1	4	4:7



6.3.8 Format $6 \times 5 \times 4$

The pixels are displayed with double width and double height.

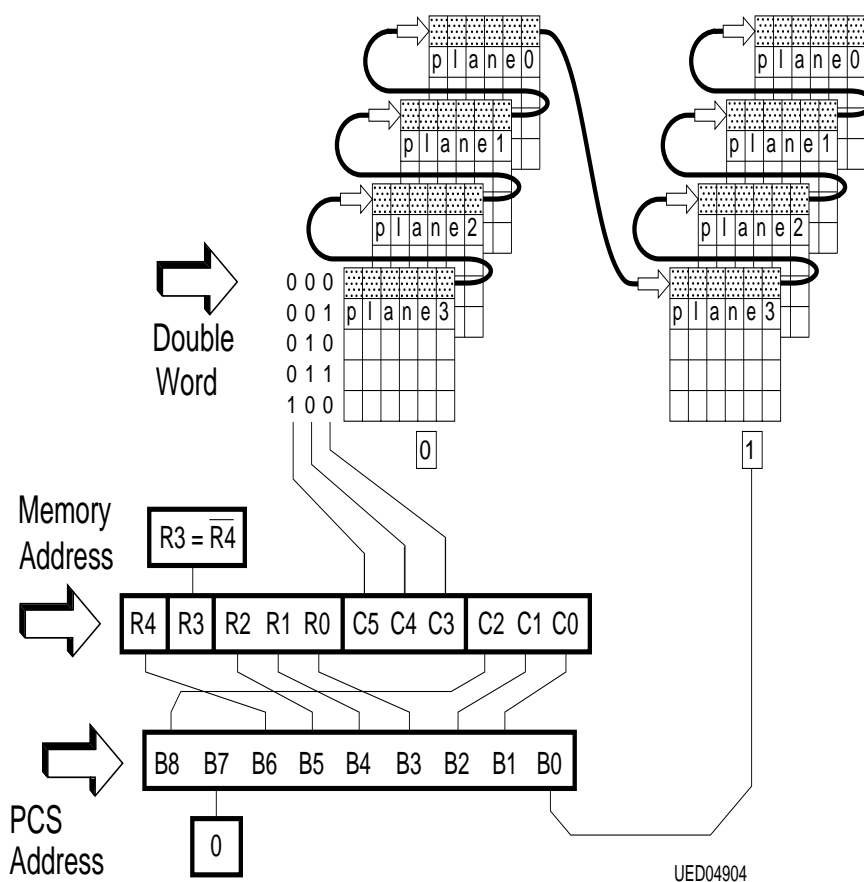
Each pixel has 4 bits (planes) for color information.

One pixel line of two PCS characters is linked to a double word.

See: 'Example of Address Calculation', page 58.

Color processing:

UC	CLUT	Vector
0	2 and 3	All
1	6 and 7	All



6.4 PCS for Display Mode 3 and 4

In the display modes 3 and 4, the PCS characters are combined with ROM characters.

They are addressed by the B bits.

As the DD bits are used for addressing the PCS characters, only 32 of the PCS characters may be used.

The PCS characters have the same organization as in mode 2.

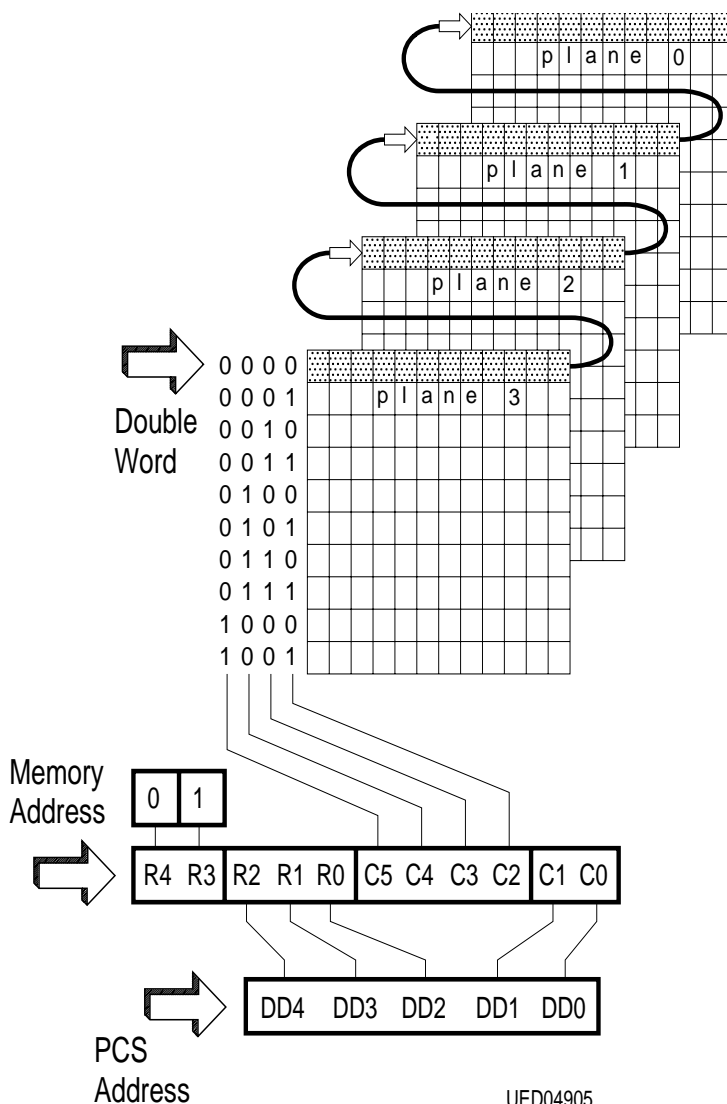
6.4.1 Display Mode 3

Display mode 3 is selected, when the DM bits are set in the following way:

DM1	DM0
1	0

The foreground pixels of the ROM character overprint the PCS character.

So the PCS character is displayed instead of the background.



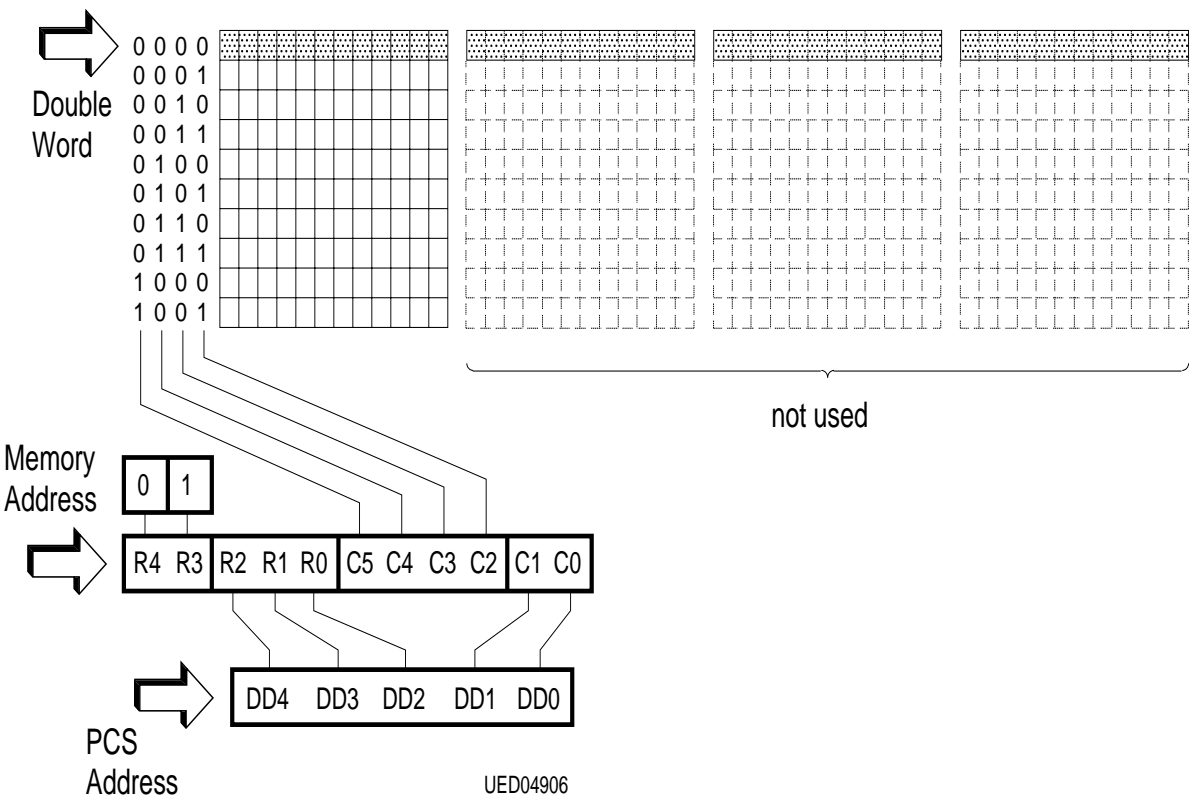
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6.4.2 Display Mode 4

Display mode 4 is selected when the DM bits are set in the following way:

DM1	DM0
1	1

The ROM characters are ORed with the PCS characters.



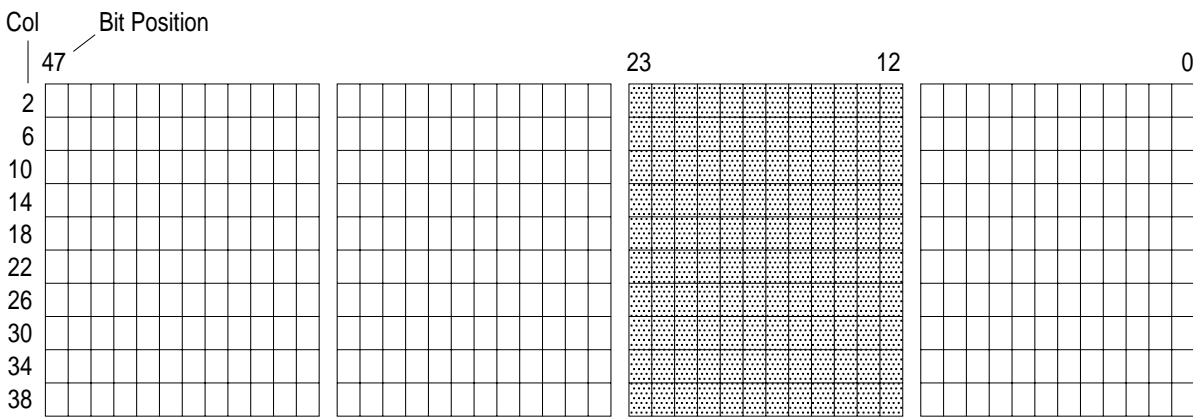
6.5 Example of Address Calculation

How to calculate the memory address of the following PCS character (see , 48).

Resolution: 12 × 10 × 1 Number: 45 (dez)

B8	B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	1	0	1	1	0	1

- Block: ‘0’
All PCS characters are stored in block 0.
- Row: 13
R0 = B3 = 1 R1 = B4 = 0 R2 = B5 = 1
R3 = $\overline{R4}$ = 1 R4 = B6 = 0
- Columns: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38
Each pixel row (12 pixels) is stored under one column value.
As the bits C2 – C5 are used to address them, the ten values are stored in steps of four columns.
The first column value is ‘2’.
It is defined by C0 = B1 = 1; C1 = B2 = 0
- Bit Position: 23 – 12
As B0 = 1 and B7 = 0, the third 12 × 10 pixel field is addressed.
The pixels are stored in the upper 4 bits of byte position 1 and the complete byte position 2.



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7 Pixel Graphics

The pixel graphics function is a new feature of MEGATEXT.

It allows to display of colored pixel drawings in addition to the normal text information.

The pixel graphics information is stored in a special memory and may be placed anywhere in the screen area.

It may easily be shifted by changing the coordinates of the start point (origin).

The maximum size is

384×320 pixels

(without using the zoom function)

The attributes for pixel graphics are defined in the GPW (Graphic Position Word).

They define the size, the resolution, the location on the screen, and the way characters behind the pixel graphics area are handled.



UED04873

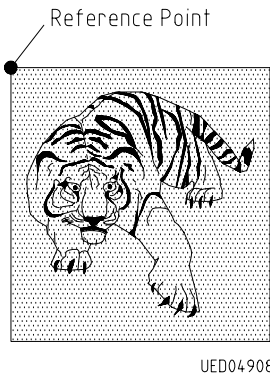
7.1 Placement of Pixel Graphics

Pixel graphics can be placed everywhere on the screen.
The position is related to the screen area.
The coordinates define the upper left corner of the picture (reference point).
The position of the origin can be defined with the following accuracy:

horizontal: 1 column (12-pixel-wide steps)
vertical: 1 line (1-pixel steps)

Bit	Function	Values	Address
GPWC	Column	0 – 63	0/03/03/9:14
GPWL	Line	6 – 15	0/03/03/15:18
GPWR	Row	0 – 31	0/03/03/19:23
– Graphic Position Word –			

Note: The value of GWPL has an offset of '6'.
(Example: Should the start point be in line 5, the GWPL has to be set to '11'.)



7.2 Graphic Modes

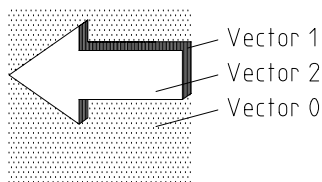
The graphics may be displayed on the screen in three different ways.

The GRM bits (GGraphical Mode) define the priorities of graphics and characters below the graphics area.

The following table gives an overview of the different modes.

The examples show graphic pictures with three colors:

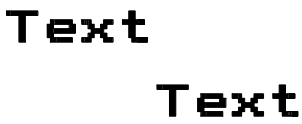
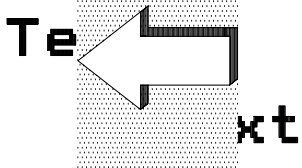
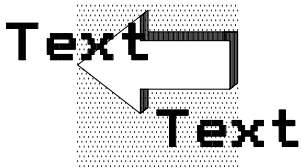
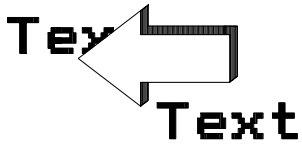
- Grey (vector 0)
- White (vector 1)
- Black (vector 2)



UED04909

7.2.1 Overview

Depending on the GRM bits (GGraphic Mode), three different modes for the graphic display are defined.

GRM1 0/03/03/36	GRM0 0/03/03/35	Function	Display	
0	0	No Graphics	 UED04910	
0	1	Graphics Mode 1	 UED04911	<p>Only the graphics are visible.</p> <p>They have the highest priority in the graphics area.</p>
1	0	Graphics Mode 2	 UED04912	<p>Characters under the graphic area are visible.</p> <p>Their foreground has higher priority than the graphics pixels.</p>
1	1	Graphics Mode 3	 UED04913	<p>Pixels with color vector 0 are transparent.</p> <p>Pixels with color vector $\neq 0$ have the highest priority.</p>

– Graphic Position Word –

7.2.2 Graphics Mode 3

Transparent Pixels

In many applications the graphic picture area does not have a rectangular form.

The graphics mode 3 allows display of only a part of the pixels of the graphics area. The colors with color vector 0 are not displayed. They are transparent.

So they can be used for the 'background' of the graphics.

CLUT Vector	Graphics Mode 3
≠ 0	Graphics are visible
0	Graphics area transparent

Restrictions for Mode 3

If PCS characters are placed under the graphics area, they are not displayed correctly. The address in the CDW will be interpreted as the address of a ROM character. The display under the transparent graphics area will be wrong.

Tip: (for PCS with 4 or 16 colors):

If the FC and the BC bits of the CDW point to the same color, a blank character field will be displayed instead of the PCS.

7.3 Colors for Pixel Graphics

From the 64 different colors which may be displayed together on the screen, only up to 16 may be used for the graphics area.

7.3.1 Number of Colors

The GRSZ bits define the number of colors which can be used together in the graphics field.

Each single pixel has one of the supported colors.

GRSZ1 0/03/03/34	GRSZ0 0/03/03/33	Z Resolution	
		Bit Planes	Colors
0	0	1	2
0	1	2	4
1	0	4	16
1	1	Not allowed	

– Graphic Position Word –

7.3.2 Color Processing

Depending on the number of bit planes, the color information is taken from different CLUTs:

GRSZ	00	01	10
CLUT	5	5	6 and 7
Vector	0:1	4:7	Each 0:7

7.4 Resolution of Pixel Graphics

The size of the pixel graphics area is variable.

Without using the zoom function, the horizontal length may have three different values, the vertical height even six.

Together with the zoom factors, 162 different configurations for the pixel graphics size are possible:

horizontal: 3 different numbers of pixels
 3 different zoom factors

vertical: 6 different numbers of lines
 3 different zoom factors

7.4.1 Horizontal Size

The GRSX bits define the horizontal length of the pixel graphics field.

Three different values are possible:

96 pixels (8 characters)

192 pixels (16 characters)

384 pixels (32 characters)

GRSX1 0/03/03/29	GRSX0 0/03/03/28	X Resolution per Line
0	0	384 pixels
0	1	192 pixels
1	0	96 pixels
1	1	Not allowed
– Graphic Position Word –		

7.4.2 Vertical Size

The GRSY bits define the vertical height of the pixel graphics field (in TV lines).

Six different values are possible:

10 lines (1 character)

20 lines (2 characters)

40 lines (4 characters)

80 lines (8 characters)

160 lines (16 characters)

320 lines (32 characters)

GRSY2 0/03/03/32	GRSY1 0/03/03/31	GRSY0 0/03/03/30	Y Resolution
0	0	0	10 lines
0	0	1	20 lines
0	1	0	40 lines
0	1	1	80 lines
1	0	0	160 lines
1	0	1	320 lines
1	1	0	Not allowed
1	1	1	Not allowed

– Graphic Position Word –

7.5 Memory Models

Depending on the graphics modes, MEGATEXT requires different sizes of memory to store the pixel graphics information.

Four different memory models are defined.

Their relation to the different resolution modes are shown in the following tables.

Memory models for 1 bit plane (2 colors):

Resolution	96 Pixels	192 Pixels	384 Pixels
10 lines	0	0	0
20 lines	0	0	0
40 lines	0	0	0
80 lines	0	0	1
160 lines	0	1	2
320 lines	1	2	3

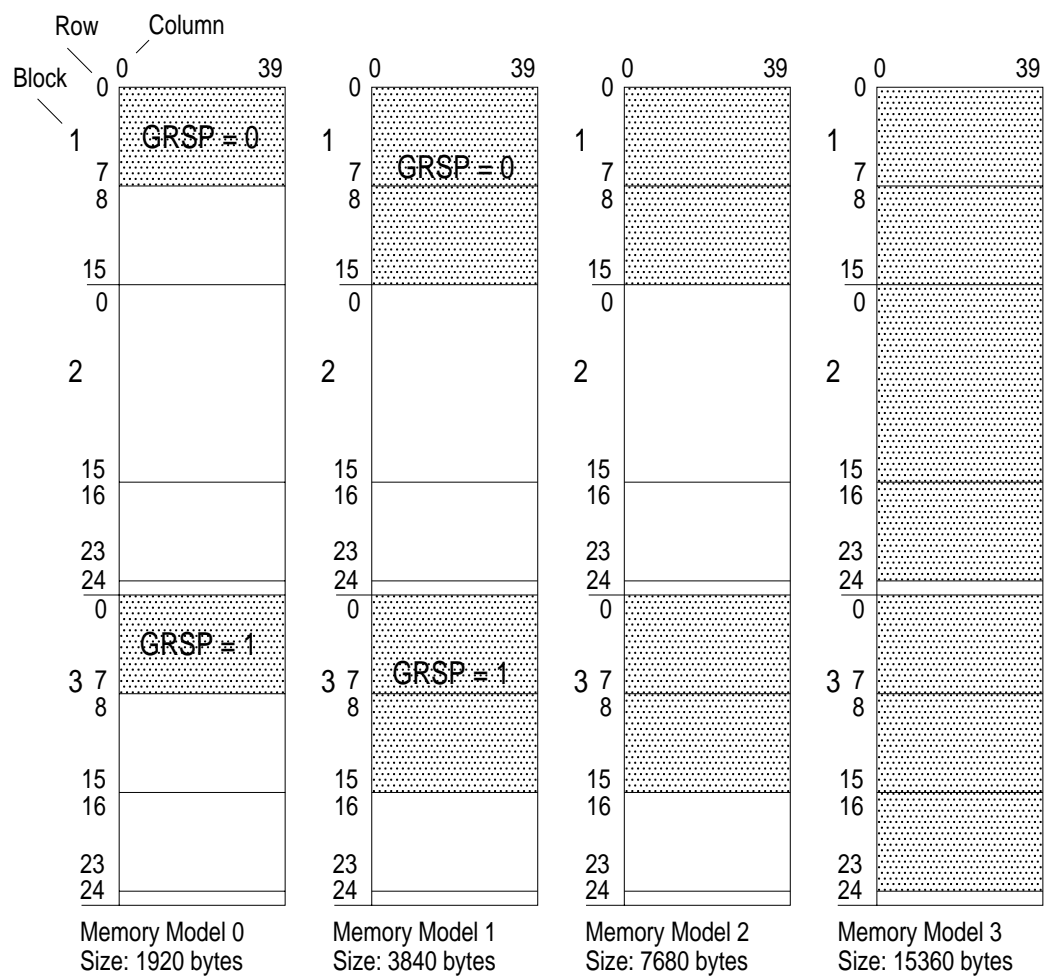
Memory models for 2 bit planes (4 colors):

Resolution	96 Pixels	192 Pixels	384 Pixels
10 lines	0	0	0
20 lines	0	0	0
40 lines	0	0	1
80 lines	0	1	2
160 lines	1	2	3
320 lines	2	3	

Memory models for 4 bit planes (16 colors):

Resolution	96 Pixels	192 Pixels	384 Pixels
10 lines	0	0	0
20 lines	0	0	1
40 lines	0	1	2
80 lines	1	2	3
160 lines	2	3	
320 lines	3		

The memory mapping for the different memory models of the graphics mode are shown in the following table:



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Note: If you use memory model 3, the whole memory is necessary for storing the graphics information. In block 2 and block 3 only row 24 may be used for text display.

7.6 Memory Location of Pixel Graphics

7.6.1 Graphic Start Point

The GRSP (GRAphic Start Point) defines the beginning of the graphics memory.

This memory may be located in block 1 or block 3.

If the graphics are stored in block 1, block 3 can be used as page memory for received teletext pages.

GRSP 0/03/03/37	Function
0	Graphics memory begins at address 1/00/00
1	Graphics memory begins at address 3/00/00
– Graphic Position Word –	

7.6.2 Memory Organization

The order of the pixels is similar to the PCS mode.

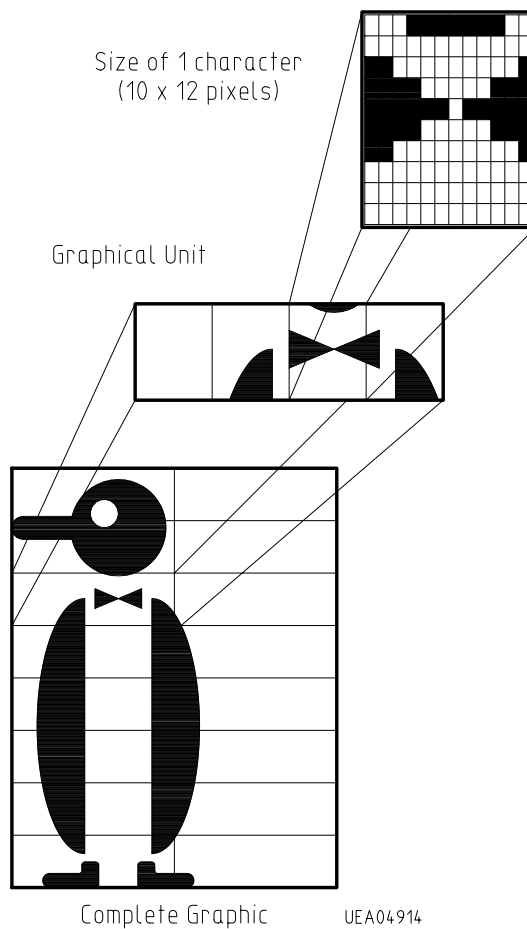
The graphic area is composed of graphic units.

They have the size of one, two or four PCS characters.

The graphic units are explained under 'Graphic Units', page 70.

The following example shows a pixel graphic with the parameters:

- Width: 96 pixels
- Height: 80 pixels
- 2 colors



Graphic Units

The graphic area is composed of graphic units.

The units have the height of one character (ten lines). The width depends on the number of colors.

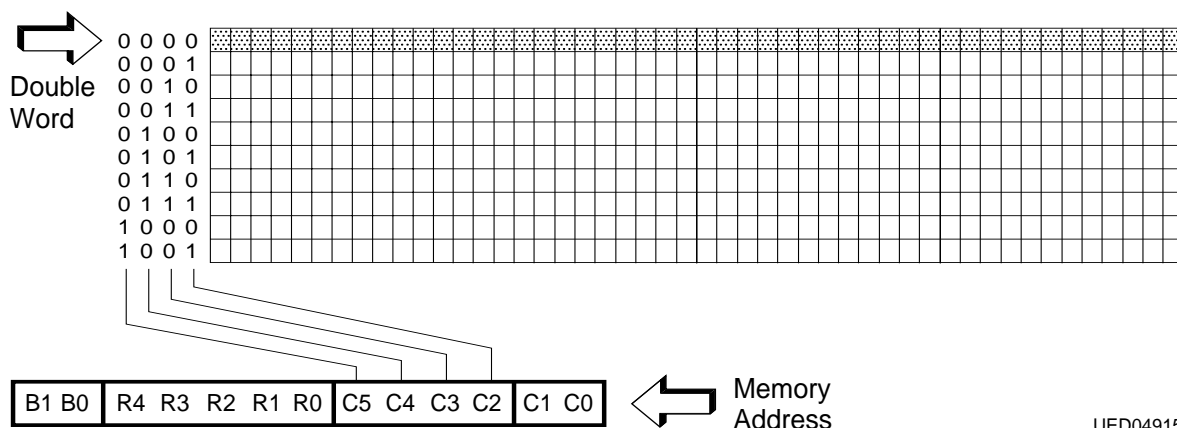
Each unit is stored in ten double words.

The column address bits C2 to C5 are used to select a graphic line.

Units with two colors:

Each double word contains the complete information of 48 pixels.

The units have the width of four characters.



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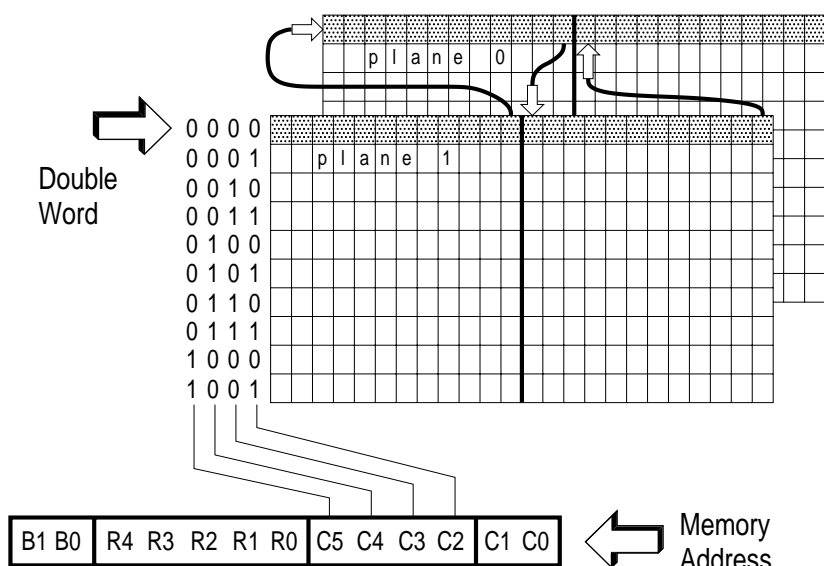
Units with four colors:

Each double word contains the complete information of 24 pixels.

The units have the width of two characters.

The sequence is:

- ⇒ Plane 1 of the left half (12 pixels)
- ⇒ Plane 0 of the left half
- ⇒ Plane 1 of the right half
- ⇒ Plane 0 of the right half.

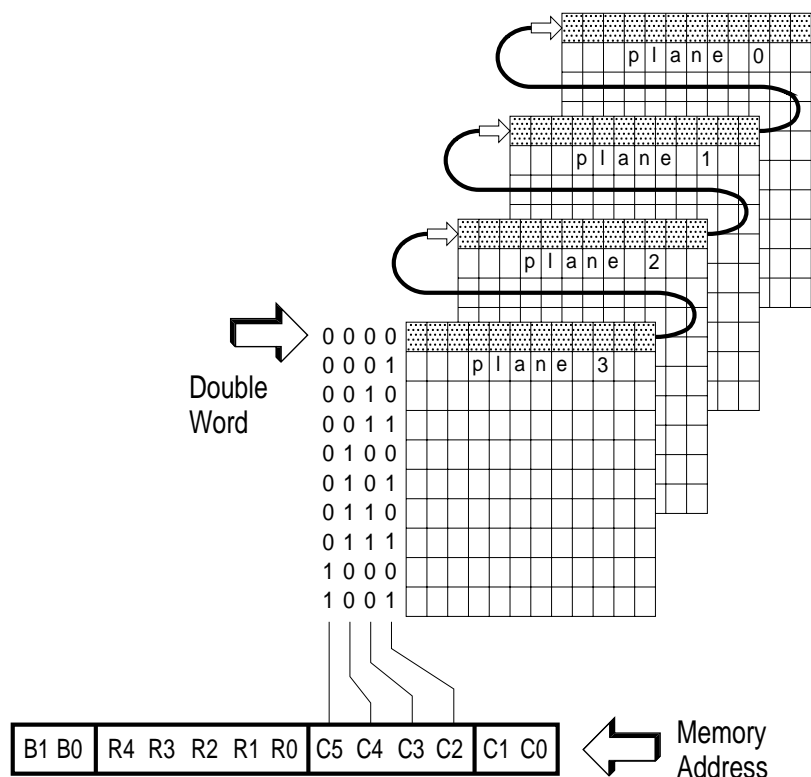


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Units with 16 colors:

Each double word contains the complete information of 12 pixels.

The units have the width of one character.



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Graphics with Two Colors

Mode: 384 pixels (horiz.) 2 colors

This mode allows the largest graphic area.

It has the width of 32 characters.

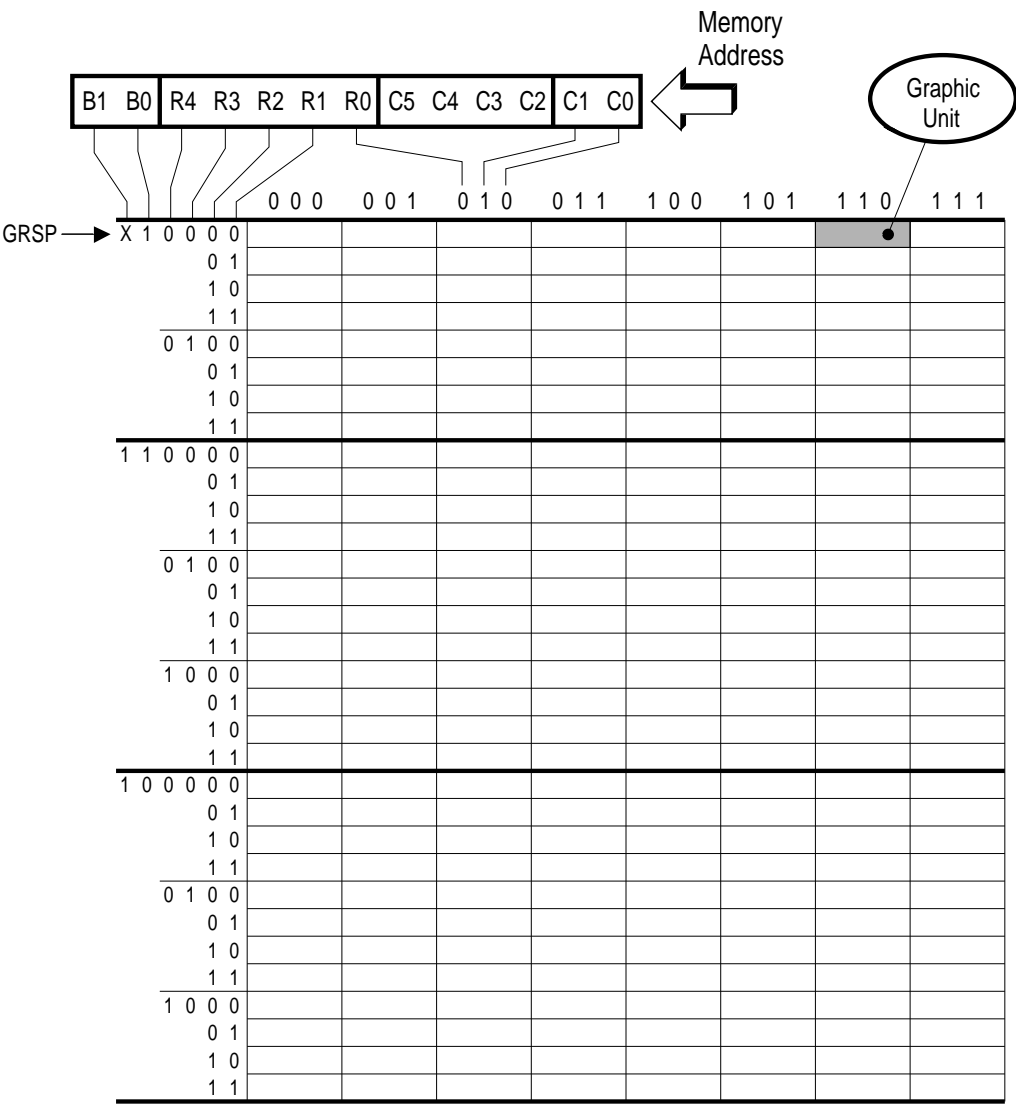
The maximum height is 320 lines (= 32 characters).

GRSP bit (Graphic Start Point) = '0'

Block 1 is displayed in the upper eight rows (80 lines).

GRSP bit (Graphic Start Point) = '1'

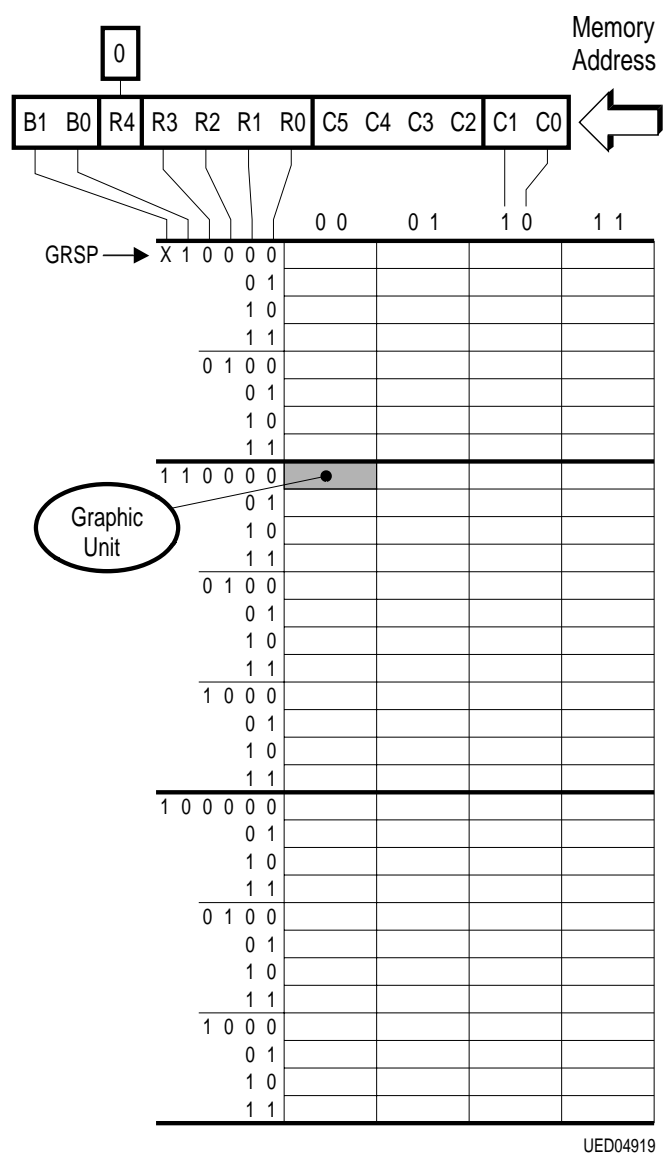
This version may only be used if the height of the graphic area is not more than 80 lines. Otherwise the contents of block 3 are displayed twice.



UED04918

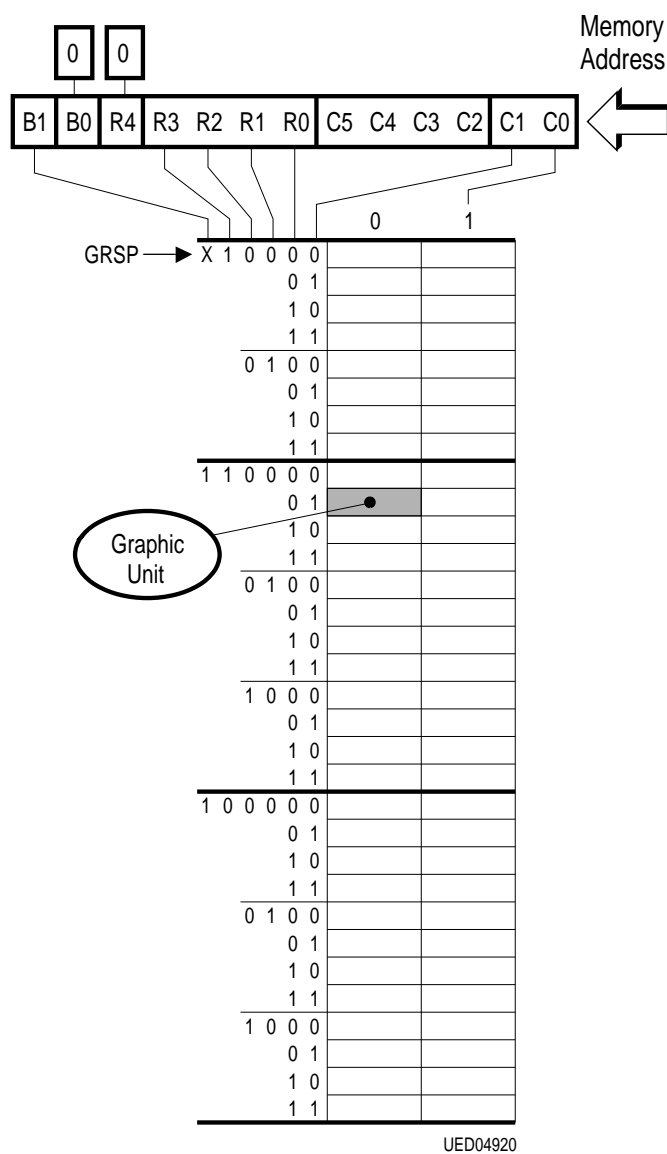
Mode: 192 pixels (horiz.) 2 colors

The width has the size of 16 characters.



Mode: 92 pixels (horiz.) 2 colors

The width has the size of eight characters.



Graphics with Four Colors

Mode: 384 pixels (horiz.) 4 colors

It has the width of 32 characters.

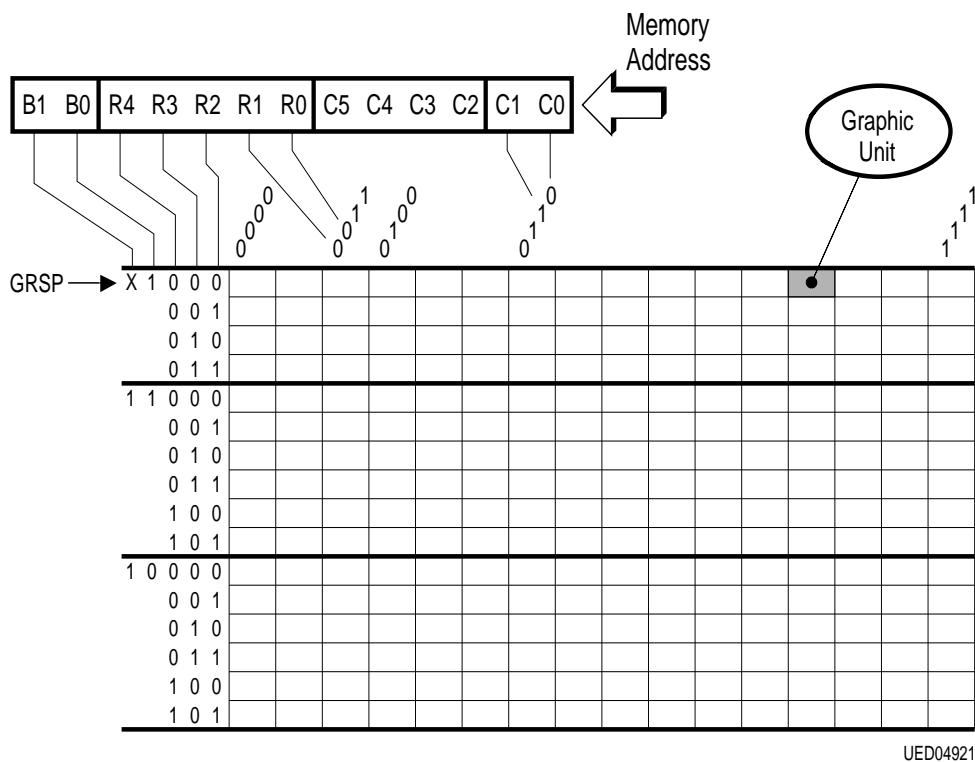
The maximum height is 160 lines (= 16 characters).

GRSP bit (Graphic Start Point) = '0'

Block 1 is displayed in the upper four rows (40 lines).

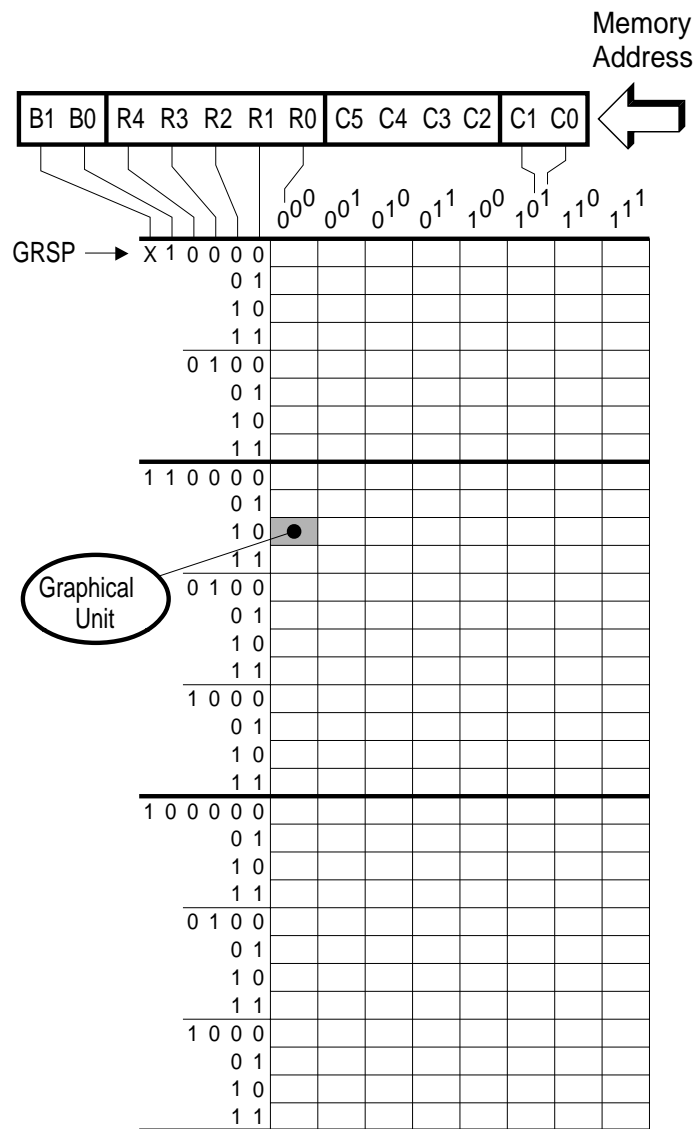
GRSP bit (Graphic Start Point) = '1'

This version may only be used if the height of the graphic area is not more than 40 lines. Otherwise the contents of block 3 are displayed twice.



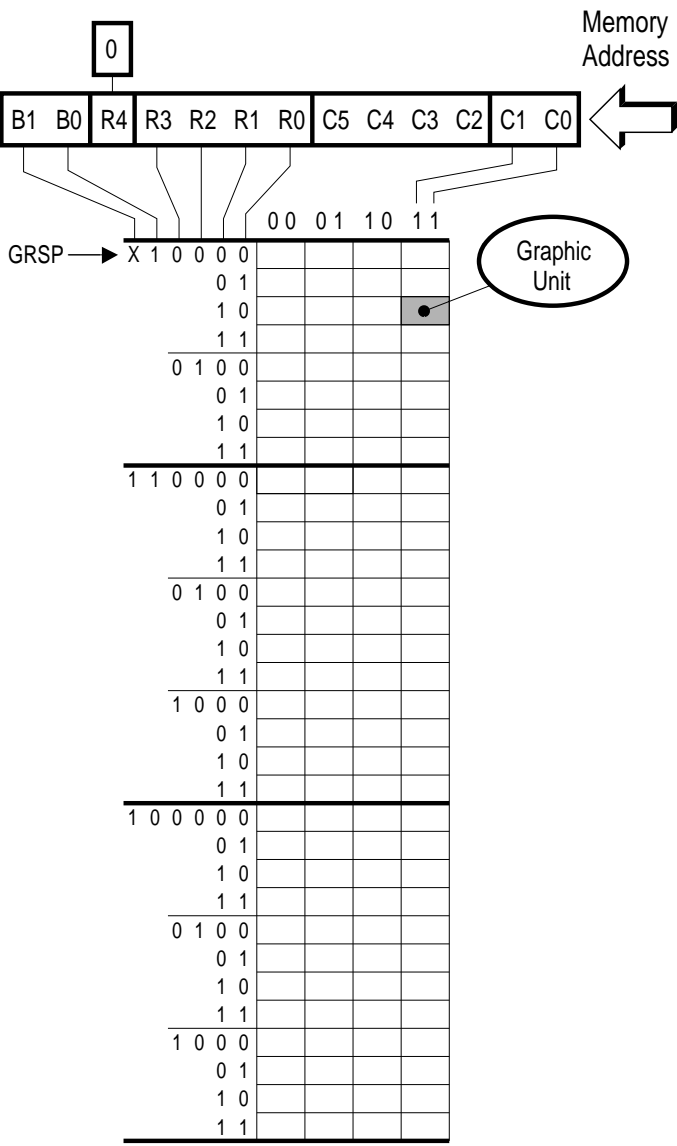
Mode: 192 pixels (horiz.) 4 colors

The width has the size of 16 characters.



Mode: 92 pixels (horiz.) 4 colors

The width has the size of eight characters.



UED04923

Graphics with 16 Colors

Mode: 384 pixels (horiz.) 16 colors

It has the width of 32 characters.

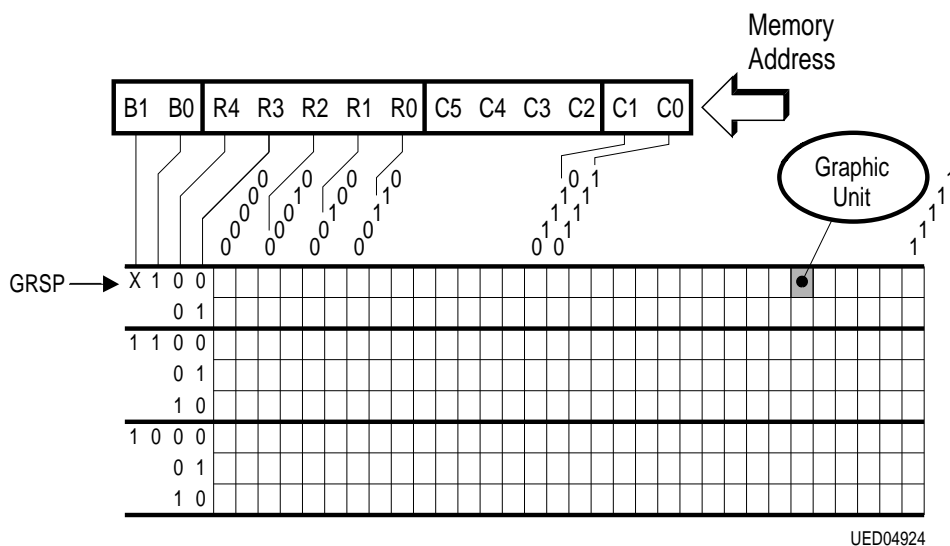
The maximum height is 80 lines (= eight characters).

GRSP bit (Graphic Start Point) = '0'

Block 1 is displayed in the upper two rows (20 lines).

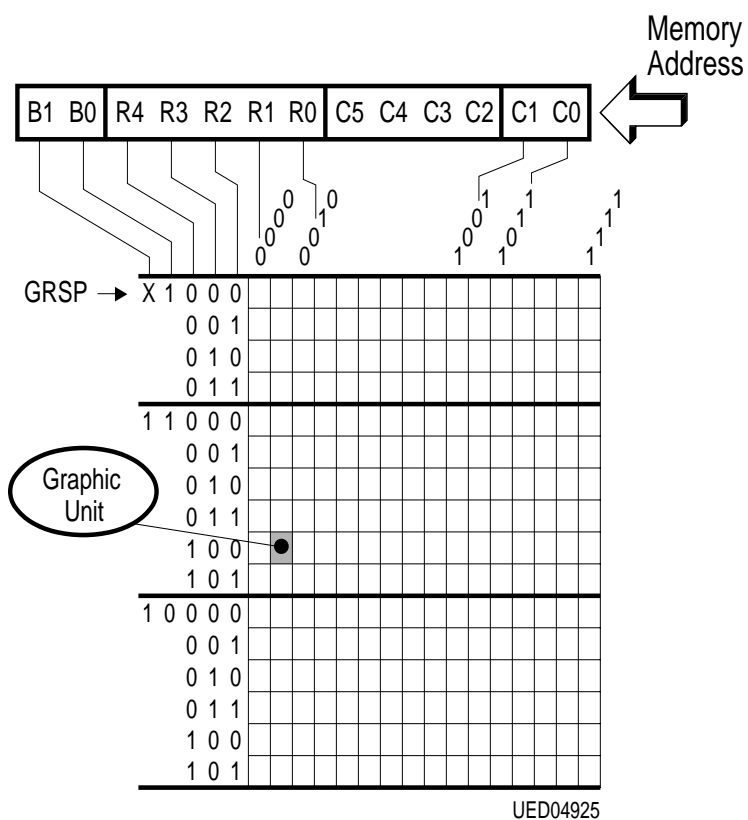
GRSP bit (Graphic Start Point) = '1'

This version may only be used if the height of the graphic area is not more than 20 lines. Otherwise the contents of block 3 are displayed twice.



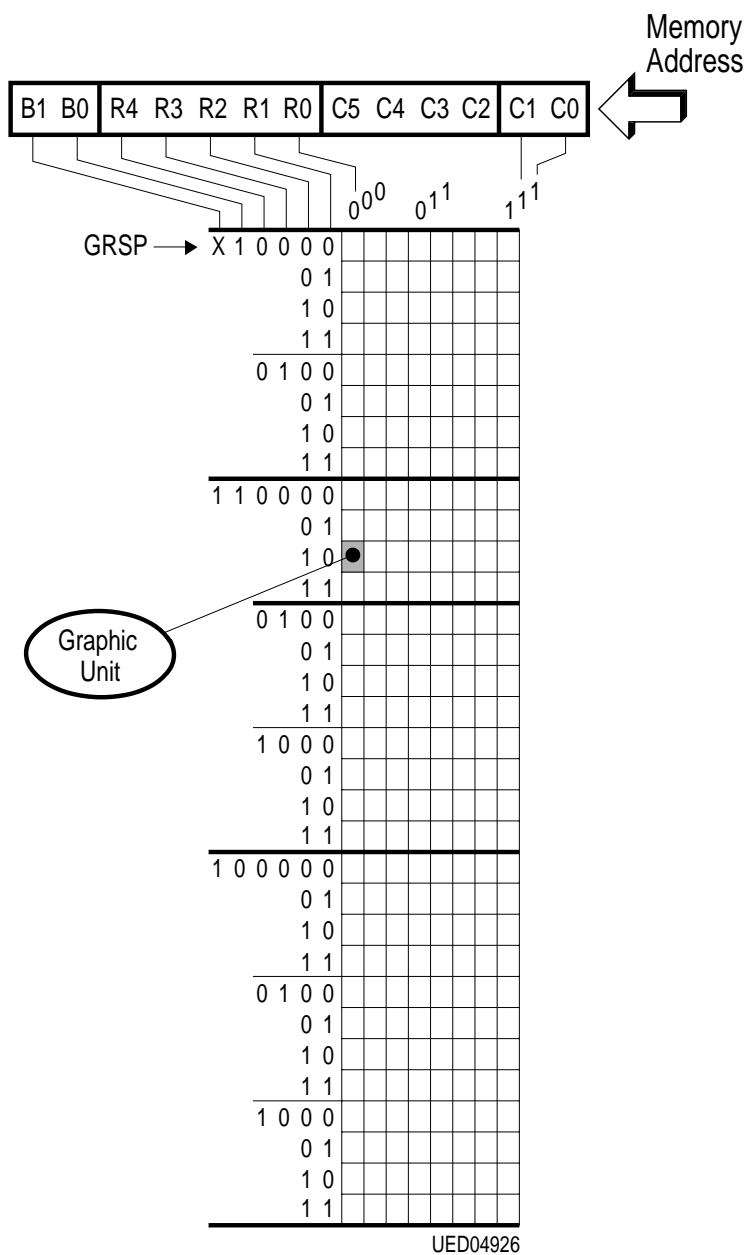
Mode: 192 pixels (horiz.) 16 colors

The width has the size of 16 characters.



Mode: 92 pixels (horiz.) 16 colors

The width has the size of eight characters.

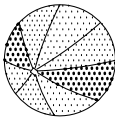
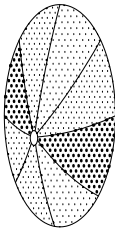
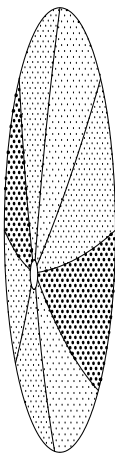


7.7 Zooming a Graphic

The four GRZF (G_Raphic Z_oom F_actor) bits define the zoom factor in X and Y direction.
The factors may be 1, 2, and 4.
They are independent of each other.

7.7.1 Vertical Zoom

The GRZF bits 2 and 3 define the zoom factor in vertical direction.
If the zoom factor is 2, the pixels are duplicated. If it is 4, the same pixel is displayed four times.

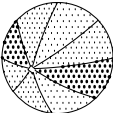
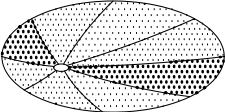
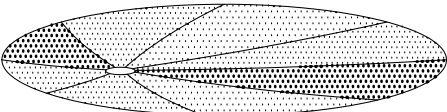
GRZF3 0/03/03/27	GRZF2 0/03/03/26	Y-Zoom Factor	Display
0	0	1	 UED04927
0	1	2	 UED04928
1	0	4	 UED04929
1	1	Not allowed	
– Graphic Position Word –			

7.7.2 Horizontal Zoom

The GRZF bits 0 and 1 define the zoom factor in horizontal direction.

If the zoom factor is 2, the pixels are duplicated.

If it is 4, the same pixel is displayed four times.

GRZF1 0/03/03/25	GRZF0 0/03/03/24	X-Zoom Factor	Display
0	0	1	 UED04930
0	1	2	 UED04931
1	0	4	 UED04932
1	1	Not allowed	

– Graphic Position Word –

8 Cursor

For applications like menus or VPT (Video recorder Programming by Text), it is necessary to display a cursor. The MEGATEXT has multiple options to chose the individual cursor form.



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8.1 Cursor Types

Three different types of cursor are available:

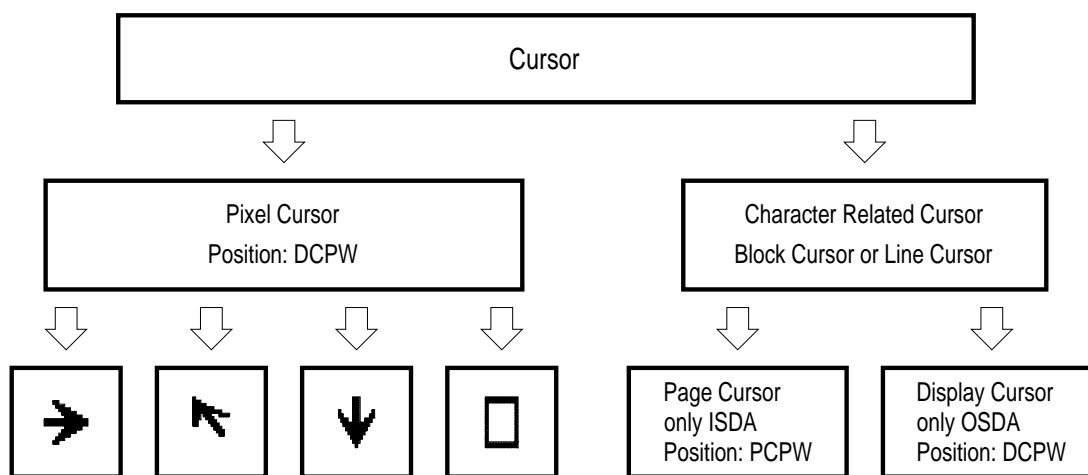
- Pixel Cursor
- Block Cursor
- Line Cursor

The pixel cursors have a resolution of 16×16 .

The line and the block cursor have the same resolution as a character (12×10). Their position is related to a single character.

Two independent character related cursors may be used.

The page cursor is placed in the ISDA, the display cursor in the OSDA.



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8.2 Pixel Cursor

The four different pixel cursors have a resolution of 16 × 16 pixels.

It is not possible to set any blink mode for the pixel cursors. If they are to blink, the corresponding PCF bit has to be toggled.

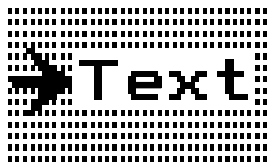
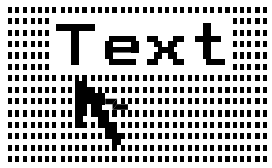

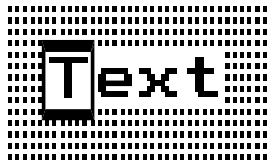
8.2.1 Pixel Cursor Form

Each of the four different types is enabled by one of the 4 PCF bits in the DCPW (Display Cursor Position Word).

Only one of these bits may be set. Otherwise the cursors would overlap.

As the position marks the upper left corner, the optimal position depends on the cursor type, if the cursor should point to a character (the 'T' in the example).

If the cursors are to point to the 'e', only the column value has to be incremented.

Displayed Cursor	PCF0 0/03/ 04/31	PCF1 0/03/ 04/32	PCF2 0/03/ 04/33	PCF3 0/03/ 04/34	Position values of the examples			
					Row	Line	Col.	Pixel
	1	0	0	0	r-1	7	c-2	6
	0	1	0	0	r+1	0	c	6
	0	0	1	0	r-2	4	c-1	10
	0	0	0	1	r-1	7	c-1	10
- Display Cursor Position Word -								

Note: 'r' and 'c' are the Row and Column position of the 'T' in the above examples.

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8.2.2 Cursor Color

The color of the pixel cursor is defined in the RATT (Row ATtribute) register.

Only one of the eight pure colors of CLUT 0 can be used.

If the cursor covers more rows with different cursor colors, the parts of the cursor are displayed in different colors.

See: 'Cursor Color', page 97.

8.2.3 Placement

The pixel cursors may be placed anywhere in the screen area with a resolution of 1 pixel.

The coordinates mark the upper left corner of the 16×16 field.

The position of the pixel cursor is defined in the DCPW (Display Cursor Position Word) in the bits 5:23.

The cursor position is related to the screen area. So its location is influenced by the display position word.

The horizontal position is defined by the column position (0 to 63) and an additional pixel offset (0 to 11).

The vertical position is defined by the row position (0 to 31) and a line offset (0 to 9).

Function	Bits	Address
X pixel (horizontal offset)	DCPWP	0/03/04/5:8
Column	DCPWC	0/03/04/9:14
Y line (vertical offset)	DCPWL	0/03/04/15:18
Row	DCPWR	0/03/04/19:23

– Display Cursor Position Word –

Note: As the LSB of the X pixel word (bit 5) is not regarded by the hardware, the horizontal offset may only be set in steps of 2 pixels.

8.2.4 Pixel Cursor Size

The normal size of the pixel cursors is 16×16 pixels.

Its size may only be influenced by the DSC bit.

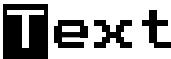

More information: 'Pixel Speed Control', page 19.

8.3 Character-Related Cursors

The Block Cursor affects the whole character area of 12 × 10 pixels.

The Line Cursor affects the lower two pixel rows of a character.

The CF bits (Cursor Form) select one of the two different possible forms of the Cursor:

CF0 0/03/04/26	Function	Display
0	Block Curser	
1	Line Cursor	
- Display Cursor Position Word -		

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Note: The CF1 bit (0/03/04/27) is currently not used and must be set to '0'.

8.3.1 Cursor Mode

The cursor may appear in three different modes. They are defined in the CM bits (Cursor Mode).

Note: If the mode 'Change Foreground to Background' is selected, the cursor should be displayed with the blinking mode. Otherwise the character would only disappear and the cursor may not be detected.

CM1 0/03/04/25	CM0 0/03/04/24	Function
0	0	Change foreground to background
0	1	Change foreground to next CLUT (inversion of color bit 3)
1	0	Exchange foreground and background
1	1	Not allowed
– Display Cursor Position Word –		

8.3.2 Cursor Speed

The CS bit (Cursor Speed) defines the blink frequency of the cursor.

Note: The CS bit does not affect the pixel cursors.

CS 0/03/04/28	Function
0	Steady cursor
1	Cursor is blinking with app. 0.5 Hz
– Display Cursor Position Word –	

8.3.3 Selection of Display and Page Cursor

As the control bits for the cursor only exist in the DCPW register, they have to be associated dynamically to the page cursor and the display cursor.

If both cursors are active, the control bits are related to the display cursor.

The page cursor has following default attributes:

- Block cursor
- Exchange foreground and background

DCON 0/03/04/30	PCON 0/03/04/29	CS, CM, CF Bits are Related to	Active Cursor
0	0	–	No cursor
0	1	Page cursor	Page cursor
1	1	Display cursor	Display cursor
1	1	Display cursor	Both
– Display Cursor Position Word –			

8.3.4 Handling of Bigger Characters

Double width: Block cursor and line cursor are supported.

Double height: Both cursors are related to the lower part. So only the line cursor can be used.

8.3.5 Page Cursor

The PCPW (Page Cursor Position Word) defines the position of the page cursor inside the page area (inner screen area).

The page cursor is related to a character.

The page cursor is enabled by setting the PCON (Page Cursor On) bit of the DCPW.

In the PCPW only column and row are defined.

It is the address pointer of the data port 0.

So it is automatically moved, if text is written into the ISDA on port 0.

The position of the page cursor is defined in the PCPW.

Bit	Function	Address	M3L Register
PCPWC	Page Cursor Column	0/00/06/24:29	R49
PCPWR	Page Cursor Row	0/00/06/30:34	R49/50
– Page Cursor Position Word –			

8.3.6 Display Cursor

The display cursor may be placed anywhere in the OSDA.

The position (row and column) of the display cursor is defined in the DCPW (Display Cursor Position Word).

The pixel cursor uses the same bits for its placement.

If the DCON and one of the PCF bits are set together, both cursors are related to the same character.

The pixel cursor may be shifted for short distances using the pixel and line offset bits.

The CS, CM and CF bits are used for the display cursor and the page cursor.

If both are active, these bits are only used for the display cursor.

The display cursor has following default attributes:

- Block cursor
- Exchange foreground and background.

9 Mask Functions

The advantage of the mask functions is, that many spots on the screen may be changed by setting only some few bits.

This may be e.g. the marking of a complete text line or a change of all colours of the page.

See: 'Resulting Display Word', page 101.

9.1 Mask Registers for the Inner Screen Display Area

The complete ISDA may be influenced by following registers:

- The 2 ISMR with their corresponding ISDW's
- The 2 BOXMR with their corresponding BOXDW's

They have the same format as a CDW (Character Display Word).

If the Box bit in the CDW (Character Display Word) is set to '1', the character attributes may be influenced by one of the two Box Registers.

They are called BOXDW 0 and BOXDW 1 (BOX Display Word).

The SAS (Screen Attribute Select) bit in the DPW (Display Position Word) selects one of the two box registers.

BX (CDW)	SAS 0/03/01/29	Mask Register	Data Register
1	0	BOXMR 0 0/03/08	BOXDW 0 0/03/09
1	1	BOXMR 1 0/03/12	BOXDW 1 0/03/13
0	0	ISMR 0 0/03/10	ISDW 0 0/03/11
0	1	ISMR 1 0/03/14	ISDW 1 0/03/15

9.2 Mask Registers for the Outer Screen Display Area

The OSDA may only be masked using the OSMR (Outer Screen Mask Register) and the OSDW (Outer Screen Display Word).

The handling is the same as for ISDW and ISMR.

Word	Function	Address
OSMR	Outer Screen Mask Register	0/03/06
OSDW	Outer Screen Display Word	0/03/07

9.3 Row Attributes

The RATT (Row ATtributes) influence the character attributes of one row in the ISDA.

They are a powerful instrument to modify one complete row by changing only some bits.

25 RATT registers (0 to 24) correspond to the 25 Text lines in the ISDA.

They have the addresses 0/02/00 to 0/02/24.

The RATT registers 25 to 30 are currently not used. They must be set to '0'.

RATT register 31 is used for Rows 0, 1, 23 or 24, if their HR bits (Hold Row) are set.

See: 'Holding Rows', page 22.

The RATT registers contain following information (sub registers):

Sub Register	Bit Position
Row Format Register	0 : 7
Row Data Register	8 : 23
Row Mask Register	24 : 39
Screen Background Colour	40 : 44
Cursor Colour	45 : 47

9.3.1 Row Format Register

The row format registers influence the display generator for one row in the ISDA.

Row Line Speed Control

The RLSC (Row Line Speed Control) bits influence the pixel rate.

The normal rate for 50-Hz TV sets is 12 MHz.

The double speed mode (24 MHz) has to be used for

- 100-Hz TV sets
- 80-character mode.

See: 'Page Screen Resolution Mode', page 26.

RLSC1 0/02/#/01	RLSC0 0/02/#/00	Function
0	0	Normal speed
0	1	Half speed
1	0	Double speed
1	1	Not allowed

= Row number

Lines per Character

The characters in the row may be displayed with three different vertical resolutions.

Instead of the normal height of ten lines (= pixel), the vertical size may also be nine or eight lines.

If the height is reduced in this way, the bottom pixel rows are suppressed.

So the number of displayed rows in the ISDA may be increased. This function is helpful for 60-Hz TV sets. Even with less lines in vertical direction, the same information may be displayed.

Definition: Line 0 is the topmost line of the complete 12×10 pixel matrix.

RLCC1 0/02/#/03	RLCC0 0/02/#/02	Displayed Lines
0	0	10 (0:9)
0	1	9 (0:8)
1	0	8 (0:7)
1	1	Not allowed

= Row number

Row Character Height Control

The RCHC bits (Row Character Height Control) may be disabled for each row individually by setting the USF bit to '0'.

RCHC1 0/02/#/05	RCHC0 0/02/#/04	Function
0	0	Normal display
0	1	Repeat each character line
1	0	Not implemented up to now
1	1	

= Row number

Use Screen Format

If the USF bit is set to '0', the CHC bits (Character Height Control) and LSC bits (Line Speed Control) functions in the PPW (Page Position Word) are not regarded in this row.

USF 0/02/#/07	CHC and LSC Used from
0	Row Attribute Register
1	Page Position Word

= Row number

9.3.2 Row Data Register

The information in the row data register is only displayed, when the corresponding bits in the row mask register are set to '1'.

Data Bit	Function	Address
RUS	Underline / Separate	0/02/#/08
RCO	Conceal	0/02/#/09
RTRB	Transparent Background	0/02/#/10
RTRF	Transparent Foreground	0/02/#/11
RBX	Box	0/02/#/12
RIC	Inverted Color	0/02/#/13
RFL0 : RFL3	Flash	0/02/#/14 : 0/02/#/17
RBC0 : RBC4		0/02/#/18 : 0/02/#/22

= Row number

9.3.3 Row Mask Register

The row mask register defines the attributes which are influenced by the row data register or one of the inner screen display registers.

Note: The abbreviations in the following table define row mask bits (e. g. RCHM is the abbreviation of Row CHaracter Mask).

Mask Bit	Function	Address
RCHM	Character	0/02/#/24
RUSM	Underline / Separate	0/02/#/25
RUHM	Upper Half	0/02/#/26
RDHM	Double Height	0/02/#/27
RDWM	Double Width	0/02/#/28
RCOM	Conceal	0/02/#/29
RTRBM	Transparent Background	0/02/#/30
RTRFM	Transparent Foreground	0/02/#/31
RBXM	Box	0/02/#/32
RICM	Inverted Color	0/02/#/33
RFLM	Flash	0/02/#/34
RBCM	Background Color	0/02/#/35
RBCCM	Background CLUT	0/02/#/36
RFCM	Foreground Color	0/02/#/37
RFCCM	Foreground CLUT	0/02/#/38
RPMM	PCS Mode	0/02/#/39

= Row number

– RATT –

If a bit in the row mask register is set to '1', the corresponding attributes of the original CDW (Character Display Word) are not longer relevant.

This information is now taken out of the row data register (RATT) or the selected Display Word (ISDW 0, ISDW 1, BOXDW 0 or BOXDW 1).

See: 'Register Selection', page 91.

The following table shows which attributes may be influenced by which register.

Attribute Bit	RATT	DW
B0 : B8		*
US	*	
UH		*
DH		*
DW		*
CO	*	
TRB	*	
TRF	*	
BX	*	
FC0 : FC2		*
BC0 : BC2	*	
F0 : F3		*
IC	*	
BC3 : BC4	*	
FC3 : FC4		*
DD0 : DD4		*
DM0 : DM1		*
UC		*

9.3.4 Contrast Reduction

The contrast reduction pin is controlled by:

- Row attributes enable the function for each row individually
- The BX bit (box) in the resulting character display word

The contrast reduction is only active if the RCOR and BX bits are both set to '1'.

RCOR 0/02/#/23	BX	Contrast Reduction Pin
0	0	High impedance (inactive)
	1	
1	0	Grounded (active)
	1	

= Row number – RATT –

9.3.5 Screen Background Color

The color may be selected out of the norm CLUT set (CLUT 0 to 3).

The screen background color is visible when a character foreground or background color is RIB (Reduced Intensity Black) and the BX bit is set to '0'.

So the SBC defines the background of non-boxed characters.

Bit	Function	Address
SBC0	Screen	0/02/#/40
:	Background	:
SBC4	Color	0/02/#/44

= Row number – RATT –

Note: This function is only active when the box bit is '0' in the resulting display word.
If the box bit is '1', the video picture is visible instead of the SBC.

9.3.6 Cursor Color

The color of the pixel cursor may be defined for each row individually.

Only the pure colors (in CLUT 0) can be used.

If the cursor is placed over two rows with different cursor colors, the cursor is displayed in two parts with different colors.

Bit	Function	Address
CC0	Cursor Color	0/02/#/45
CC1		0/02/#/46
CC2		0/02/#/47

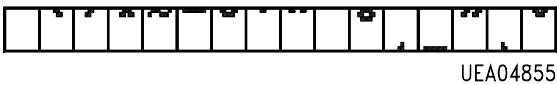
= Row number – RATT –

10 Combine

Many national character sets have characters with accents.
This function allows the combination of a normal character with an accent.

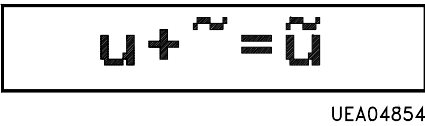
10.1 ROM-Based Accents

In the WST (World System Text) specification for level 2, all Latin based languages may be displayed by combining a G0 character and an accent.



The DM1 and DM0 bits of the character display word have to be '0'.

Mode	DM1	DM0	Function
1	0	0	Combine ROM character with ROM accent
– Character Display Word –			



The bits DD3 to DD0 address one of the 15 possible accents.

Note: The hardware always combines a character with an accent. If no accent is to be displayed, the DD bits have to be '0'. In this case a blank accent is shown.

It only makes sense to combine accents with characters of the G0 character set table. But in principle, all characters may be combined with an accent.

10.2 Combination with PCS Characters

There are two possible modes to combine ROM characters and PCS characters.

Mode 3: This feature makes it possible to beautify the background.

Mode 4: This mode is used when a special national character requires an accent which is not in the ROM accent set.

More information: 'Display Mode', page 43.

Mode	DM1	DM0	Function
3	1	0	The foreground pixels of the ROM character overprint the PCS character. 'PCS background'
4	1	1	ROM characters ORed with PCS characters

– Character Display Word –

Tip: If the IC bit of the CDW is set to '1', the combination with PCS (mode 3) may be used to beautify the foreground area.

11 Sync Delay Word

The SDW (Sync Delay Word) defines the time delay between the H-sync pulse to the MEGATEXT and the start of displaying one line.

The SDW setting of delay times in steps of 500 ns.

The SDW influences the

- ☺ Display Position
- ☺ Graphics Position
- ☺ Display Cursor Position.

Bit	Function	Address
0:5	Lower bits	0/03/00/9:14
6	MSB	0/03/00/24
– Sync Delay Word –		

The delay time may be calculated by the following formula:

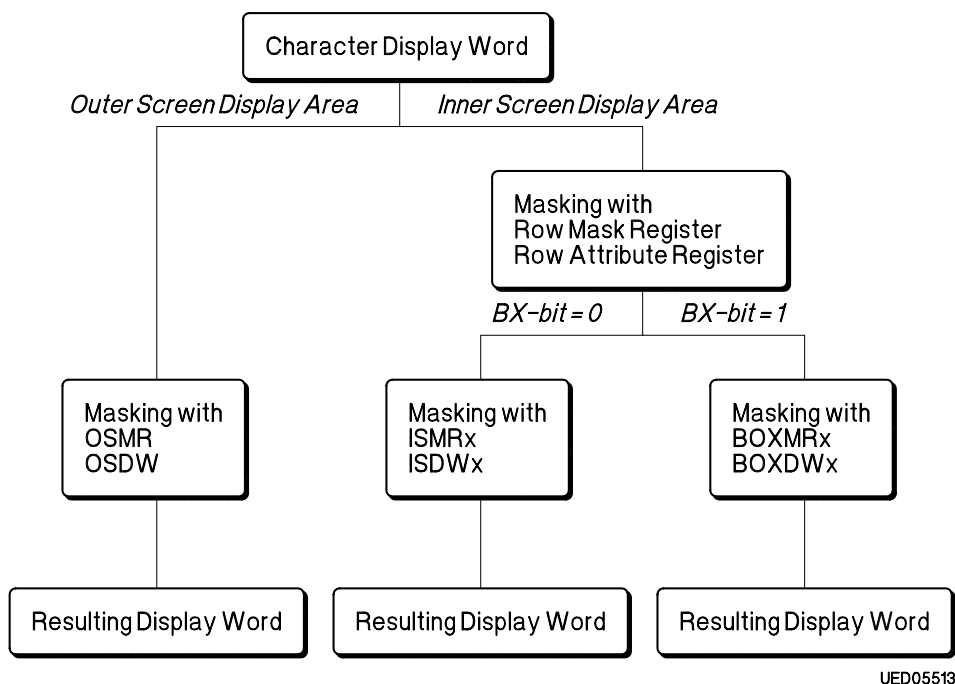
$$t_{sd} = SDWC \times 500 \text{ ns.}$$

Note:

The MSB must be '0', if the horizontal display frequency is 32 kHz (e.g. in 100 Hz TV sets).

12 Resulting Display Word

The character which is displayed on the screen may be quite different than its original character display word. In the inner screen area it may be influenced in the following succession:



The box attributes are used instead of the inner screen attributes, if the BX bit is set to '1'.

In the outer screen area the attributes may only be modified by the outer screen row attributes (RATT register 31).

12.1 Box Bit

The box bit has two different functions:

- Selection of the mask register (Box or ISDW)
- Control of the blanking output

The box mask register is selected if the BX bit is set in the CDW or influenced by the row attributes register.

The blanking output is influenced by the BX bit in the resulting character display word.

So it may even be set in the ISDW.

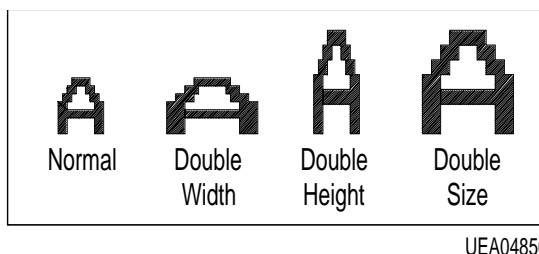
BX	Display if Color = RIB
0	SBC (Screen Background Color)
1	Video picture

13 Bigger Characters

There are three different ways are possible to increase the character size:

- Double height
- Double width
- Double size (height and width)

The pixel structure of the increased characters remains. The pixels are only doubled in one or both directions.



It is possible to increase the whole screen (inner and outer display area together), parts of the inner screen display area or each single character.

13.1 Increasing the Whole Screen

The information about the character size is placed in the DPW (Display Position Word). These bits affect the whole screen (ISDA and OSDA).

If any characters are already increased by setting the DH or DW bits in the character display word, their dimensions appear now four times bigger than normal.

The relevant bits are:

Bit	Function	Address
DHD	Double Height Display	0/03/01/26
DWD	Double Width Display	0/03/01/24

– Display Position Word –

Note: The DHD and DWD bits do not affect the graphics and the pixel cursors.

13.2 Increasing Inner Screen

The character size of the ISDA is defined in the PPW register (Page Position Word).
The relevant bits are DHP, CHC0, CHC1, DWP, LSC0 and LSC1.

Bit	Function	Address
DHP	Double Height Page	0/03/02/33
CHC0	Character Height Control	0/03/02/36
CHC1		0/03/02/37
DWP	Double Width Page	0/03/02/38
LSC0	Line Speed Control	0/03/02/39
LSC1		0/03/02/40
– Page Position Word –		

More information: ‘Inner Screen Display Area’, page 21.

Note: It is unfavorable to use the mask functions for the DH or DW bits of the character display word. If they were set to ‘1’ using the row attributes or the ISDW, only one half of the increased character would be displayed.

13.3 Increasing Single Characters

The following modifications are done in the CDW (Character Display Word).
They influence only a single character.

Double Height

If the DH bit is ‘1’ and the DW bit is ‘0’, only one half of the character is displayed in the 12 × 10 character field. If the UH bit is set, the upper half is selected.

Example of double height character ‘A’:

Row n	B8:B0: ‘A’ DH: 1 UH: 1
Row n + 1	B8:B0: ‘A’ DH: 1 UH: 0



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Double Width

This mode splits a character into two following 12 × 10 fields. If the DW bit is set, the left half is displayed.

From the character placed on the right position, only the attributes are used.

So the character parts may be displayed in different ways (e. g. colors, flash modes).

Example of double width character 'A':

Col n	Col n + 1
B8:B0: 'A'	B8:B0: 'Space'
DW: 1	DW: 0



Double Size

If height and width of a character are increased, it is divided into four parts. Each quarter is displayed in a 12 × 10 pixels character field.

A double sized character requires the space of four characters.

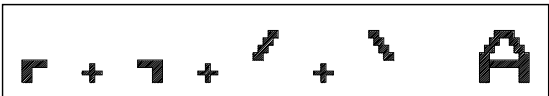
The two upper segments are marked with the UH bit (= '1'). The DW bit has only to be set in the left two segments. The character following the one with a set DW bit is not displayed.

As its attributes are active, it is possible to display both parts with different colors or flash modes.

Note: If a PCS character is set to 'Double Width', the right character must have the same attributes (DM bits, D bits) as the left one (except DW bit).

Example of double size character 'A':

	Col n	Col n + 1
Row n	B8:B0: 'A' DH: 1 UH: 1 DW: 1	B8:B0: 'A' DH: 1 UH: 1 DW: 0
Row n + 1	B8:B0: 'A' DH: 1 UH: 0 DW: 1	B8:B0: 'A' DH: 1 UH: 0 DW: 0



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