

## SCB2673 Video Attributes Controller (VAC)

### Product Specification

#### Microprocessor Products

#### DESCRIPTION

The Signetics 2673A and 2673B Video Attributes Controllers (VAC) are bipolar LSI devices designed for CRT terminals and display systems that employ raster scan techniques. Each contains a high-speed video shift register, field and character attributes logic, attribute latch, cursor format logic and half-dot shift control.

The VAC provides control of visual attributes on a field or character-by-character. Internal logic preserves field attribute data from character row to character row so that an attribute byte is not required at the beginning of each row. The 2673B provides for reverse video, blank (non-display), blink, underline and highlight attributes and a graphics mode attribute to work in conjunction with the Signetics 2670 Display Character and Graphics Generator (DCGG). The 2673A substitutes a light pen (strike-through) attribute for the graphics attribute.

The horizontal dot frequency is the basic timing input to the VAC. Internally, this clock is divided down to provide a character clock output for system synchronization. Up to ten bits of video dot data are parallel loaded into the video shift register on each character boundary. The video data is shifted out on three outputs at the dot frequency. On the VIDEO output, the data is presented as a three level signal representing low, medium and high intensities. The three intensities are also encoded on two TTL compatible video outputs. Light or dark screen background can be selected.

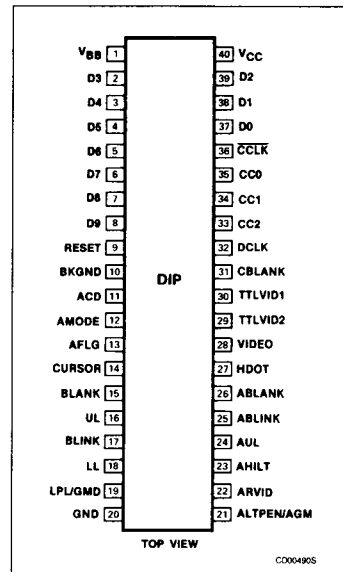
#### FEATURES

- 18 and 25MHz video dot rates
- Three-level current-driven video output
- Three level-encoded TTL video outputs
- Character/field attribute logic:
  - Reverse video
  - Character blank
  - Character blink
  - Underline
  - Highlight
  - Light pen strike-through or graphics control
- Field attributes extend from row to row
- Light or dark field
- Cursor reverse video logic
- Up to 10 dots per character
- Composite blanking for light field retrace
- Optional field graphics control output
- High-speed bipolar design
- TTL compatible
- Compatible with Signetics' 2672 PVTC and 2670 DCGG

#### APPLICATIONS

- CRT terminals
- Word processing systems
- Small business computers

#### PIN CONFIGURATION



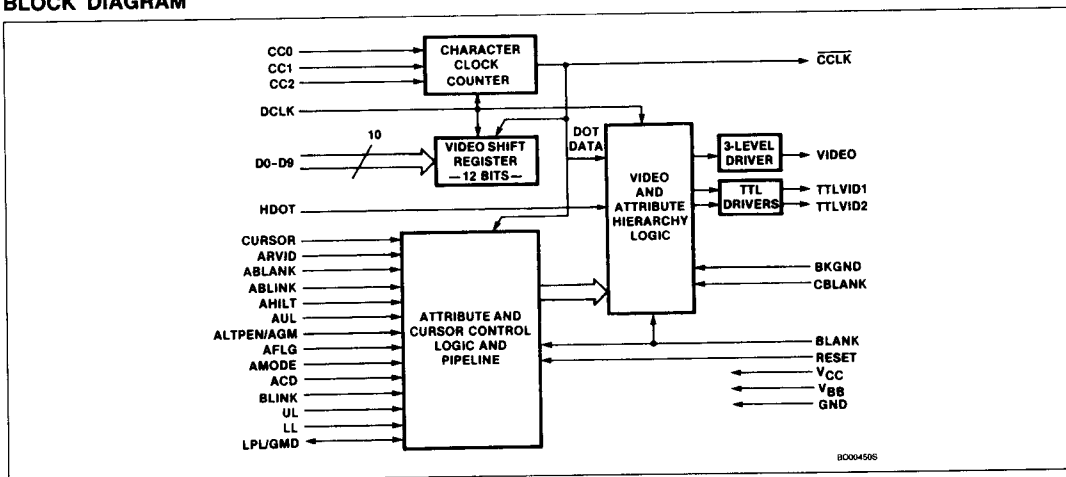
## Video Attributes Controller (VAC)

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## ORDERING INFORMATION

PACKAGES	$V_{CC} = +5V \pm 5\%$ , $T_A = 0^\circ\text{C to } +70^\circ\text{C}$			
	Graphics Attribute		Light Pen Attribute	
	25MHz	18MHz	25MHz	18MHz
Ceramic DIP	SCB2673BC5140	SCB2673BC8140	SCB2673AC5140	SCB2673AC8140
Plastic DIP	SCB2673BC5N40	SCB2673BC8N40	SCB2673AC5N40	SCB2673AC8N40

## BLOCK DIAGRAM



## PIN DESCRIPTION

MNEMONIC	PIN NO.	TYPE	NAME AND FUNCTION
	DIP		
DCLK	32	I	<b>Dot Clock:</b> Dot frequency input. Video shift output rate.
CCLK	36	O	<b>Character Clock:</b> A submultiple of DCLK. The frequency ranges from one sixth to one twelfth of DCLK, as determined by the state of the CC0 - CC2 inputs.
CC2 - CC0	33 - 35	I	<b>Character Clock Control:</b> The logic state on these three static inputs determine the internal divide factor for the CCLK output rate. Character clock rates of 6 through 12 dots per character may be specified.
D0 - D9	37 - 39, 2 - 8	I	<b>Dot Data Input:</b> These are parallel inputs corresponding to the character graphic symbol dot data for a given scan line. These inputs are strobed into the video shift register on the falling edge of each character clock.
HDOT	27	I	<b>Half-Dot Shift:</b> When this input is high, the serial video output is delayed by one half-dot time. This input is latched on the falling edge of each character clock.
CURSOR	14	I	<b>Cursor Timing:</b> This input provides the timing for the cursor video. When high, effectively reverses the intensities of the video and attributes. Cursor position, shape, and blink rate are controlled by this input.
BKGND	10	I	<b>Background Intensity:</b> Specifies light or dark video during BLANK and character fields. Affects the intensities of all attributes.
BLANK	15	I	<b>Screen Blank:</b> When high, this input forces the video outputs to the level specified by the BKGND input (either high or low intensity). Not effective when CBLANK is high.

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## PIN DESCRIPTION (Continued)

MNEMONIC	PIN NO.	TYPE	NAME AND FUNCTION
	DIP		
CBLANK	31	I	<b>Composite Blank:</b> Used with the TTL video outputs only. When high, this input forces the video outputs to a low intensity state for retrace blanking. When BKGND input is low, or when using video outputs, this input may be tied low.
ARVID	22	I	<b>Reverse Video Attribute:</b> The intensity of the associated character or field video is reversed. All other attributes are effectively reversed.
AHILT	23	I	<b>Highlight Attribute:</b> All dot video (including underline) of the associated character or field is highlighted with respect to the BKGND input and the reverse video attribute.
ABLANK	26	I	<b>Blank Attribute:</b> Generates a blank space in the associated character or field. The blank space intensity is determined by the BKGND input, the reverse video attribute, and the CURSOR input.
ABLINK	25	I	<b>Blink Attribute:</b> The associated character or field video is driven to the intensity determined by BKGND and the reverse video attribute when the BLINK input is high.
AUL	24	I	<b>Underline Attribute:</b> Specifies a line to be displayed on the character or field. The line is specified by the UL input. All other attributes apply to the underline video.
ALTPEN/ AGM	21	I	<b>Light Pen Attribute (2673A):</b> Specifies a highlighted line to be displayed on the character or field. The line is specified by the LPL input.
		I	<b>Attribute Graphics Mode (2673B):</b> This input is latched and synchronized to provide a field GMD output for the 2670 DCGG.
AMODE	12	I	<b>Attribute Mode:</b> Specifies character (AMODE = 0) or field (AMODE = 1) attributes mode.
AFLG	13	I	<b>Attributes Flag:</b> The VAC samples and latches the attributes inputs when this input is high. If field attributes are specified (AMODE = 1), the attributes are double buffered on a row basis. Thus, each scan line of every character row will start with the attributes that were valid at the end of the previous row.
ACD	11	I	<b>Attributes Control Display:</b> In field attributes mode (AMODE = 1), if ACD = 0, the first character in each new attribute field (the attribute control character) will be suppressed and only the attributes will be displayed. If ACD = 1, the first character and the attributes are displayed. This input has no effect in character mode (AMODE = 0).
BLINK	17	I	<b>Blink:</b> This input is sampled on the falling edge of BLANK to provide the blink rate for the character blink attribute. It should be a submultiple of the frame rate.
UL	16	I	<b>Underline:</b> Indicates the scan line(s) for the underline attribute. Latched on the falling edge of BLANK.
LPL/GMD	19	I	<b>Light Pen Line (2673A):</b> Indicates the scan line(s) for the light pen strike-through attribute. Latched on the falling edge of BLANK.
		O	<b>Graphics Mode (2673B):</b> This output provides a synchronized, latched, field graphics mode corresponding to the AGM input. This output can be used to control the GM input on the 2670 DCGG.
LL	18	I	<b>Last Line:</b> Indicates the last scan line of each character row. Used internally to extend field attributes across row boundaries. Latched on the falling edge of BLANK. This input has no effect in character mode (AMODE = 0).
VIDEO	28	O	<b>Video:</b> A three-level serial video output which corresponds to the composite dot pattern of characters, attributes and cursor.
TTLVID1	30	O	<b>TTL Video 1:</b> This output corresponds to the serial, non-highlighted video dot pattern.
TTLVID2	29	O	<b>TTL Video 2:</b> This output corresponds to the highlighted serial video dot pattern. Should be used with TTLVID1 to decode a composite video of three intensities.
RESET	9	I	<b>Manual Reset:</b> This active high input initializes the internal logic and resets the attribute latches.
V <sub>CC</sub>	40	I	<b>Power Supply:</b> +5V ±5%
V <sub>BB</sub>	1	I	<b>Bias Supply:</b> See Figure 13.
GND	20	I	<b>Ground:</b> 0V reference

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**FUNCTIONAL DESCRIPTION**

The VAC consists of four major sections (see block diagram). The high-speed dot clock input is divided internally to provide a character clock for system timing. The parallel dot data is loaded into the video shift register on each character boundary and shifted into the video logic block at the dot rate. The six attribute inputs are latched internally and combined with the serial dot data to provide a three level video source for the monitor.

A separate BLANK input defines the active screen area. When BLANK = 0, the video levels are derived internally by the combinations of dot data, attributes, cursor, and the state of the BKGND input. Either black or white background can be selected. Symbols (dot data) are normally gray and can be highlighted to white or black as shown in Figure 1.

During the inactive screen area (BLANK = 1), the video level produced by the TTL outputs is either white (BKGND = 1) or black (BKGND = 0). A separate composite blank (CBLANK) input is provided to suppress raster retrace video when white background is specified. During the inactive screen area (BLANK = 1), the video level produced by the VIDEO output is either black (BKGND = 1) or white (BKGND = 0).

For the latter case, raster retrace video suppression is accomplished by raising the BKGND input during horizontal and vertical retrace intervals. For black background, tie BKGND high. Tie CBLANK input low for both cases.

Since BLANK is delayed by 3 CCLKs internally, CBLANK must be sync'ed with the internal BLANK signal to avoid active scan data from being suppressed. A CBLANK transition must occur at least 15ns before the rising edge of DCLK in order to be latched into the 2673 (see Figure 8).

**Table 1. Clock Control Inputs**

CC2	CC1	CC0	CCLK	
			Dots/Character	Duty Cycle*
0	0	0	6	3/3
0	0	1	6	3/3
0	1	0	7	4/3
0	1	1	8	4/4
1	0	0	9	5/4
1	0	1	10	5/5
1	1	0	11	6/5
1	1	1	12	6/6

**NOTE:**

\* High/low

**Character Clock Counter**

The character clock counter divides the frequency on the DCLK input to generate the character clock (CCLK). The divide factor is specified by the clock control inputs (CC0 - CC2) as shown in Table 1.

**Video Shift Register**

On each character boundary, the parallel data (D0 - D9) is loaded into the video shift register. The data is shifted out least significant bit first (D0) by the DCLK. If 11 or 12 dots/character are specified (CC2 - CC0 = 110 or 111), a 0 (blank dot) is always shifted out before D0. For 12 dots/character, a 0 is also shifted out after D9. The serial dot data is shifted into the video logic where it is combined with the cursor and attributes to encode three levels of video.

**Attribute and Cursor Control**

The VAC visual attributes capabilities include: reverse video, character blank, blink, underline, highlight, and light pen strike-through. The six attributes and the three attribute control inputs (AMODE, AFLG, and ACD) are clocked into the VAC on the falling edge of CCLK. If AFLG is high, the attributes are latched internally and are effective for either one character time (AMODE = 0) or until another set of attributes is latched (AMODE = 1). The attributes set is double

buffered on a row-by-row basis internally. Using this technique, field attributes can extend across character row boundaries, thereby eliminating the necessity of starting each row with an attribute set.

When field attribute mode is selected, (AMODE = 1), the VAC will accommodate two attribute storage configurations. In one configuration, the attribute control data is stored in the refresh RAM, taking the place of the first character code in the field to be affected. For this mode, the ACD input is tied low and blank characters will be displayed in the screen positions occupied by the attribute data (see Figure 11). In the second configuration, (ACD = 1), the character codes and attribute data are presented to the VAC in parallel. In this mode, dot data is displayed at each character position (see Figure 12).

The CURSOR and the attribute input signals are pipelined internally to allow for system propagations (one CCLK for refresh RAM, one CCLK for dot generator). The attribute timing signals BLINK, UL, LPL and LL are clocked into the VAC at the beginning of each scan line by the falling edge of the BLANK input. Thus, these signals must be in their proper state at the falling edge of BLANK preceding the scan line at which they are to be active (see Figure 4).

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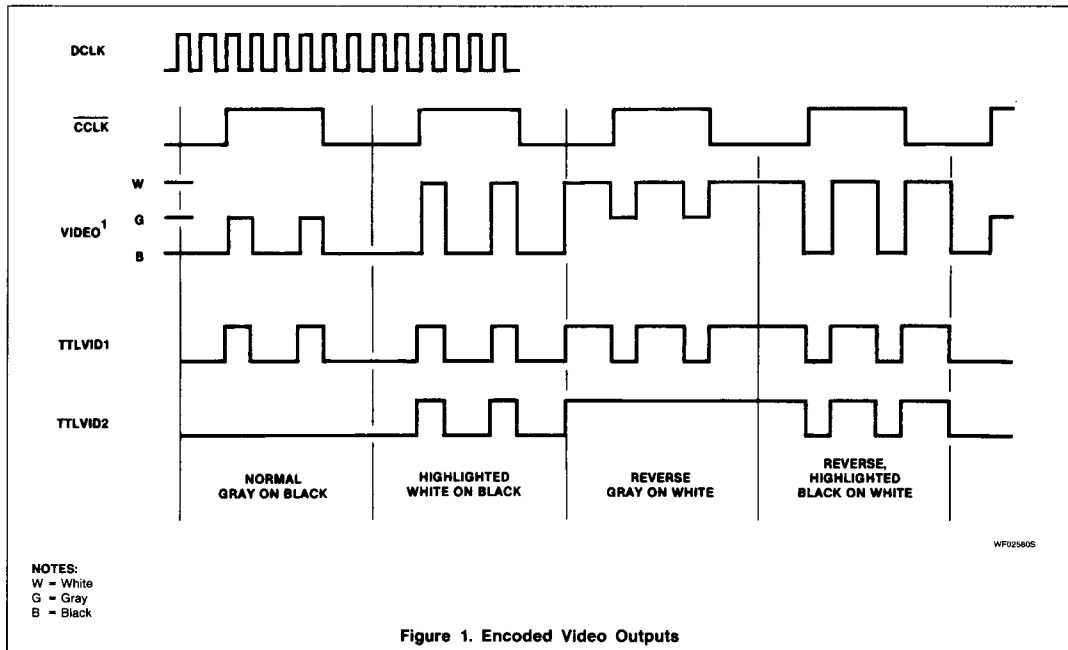


Figure 1. Encoded Video Outputs

## Video Logic

The serial dot data and the pipelined cursor and attributes are combined to generate the three level current source on the VIDEO output. The three levels (white, gray, and black) are also encoded on the two TTL compatible outputs TTLVID1 and TTLVID2. The three levels are encoded as shown in Table 2.

The video is normally shifted out on the leading edge of the DCLK. When the HDOT input is asserted, the corresponding dot data is delayed by one-half DCLK. This half-dot shifting, when used on selected lines of character video, can be used to effect character rounding as shown in Figure 2.

## Attribute Hierarchy

The video of each character block consists of four components as shown in Figure 3.

Table 2. Video Output

TTLVID2	TTLVID1	INTENSITY
0	0	Black (or CBLANK)
0	1	Gray (on black surround)
1	0	Gray (on white surround)
1	1	White

**NOTE:**

The TTLVID1 output can be used independently to generate a two-level non-highlighted video.

Symbol video is generated from the dot data inputs D0 – D9.

Underline video is enabled by the AUL attribute and is generated when the UL timing input is active. Underline and symbol video are always the same intensity.

Strike-through video is enabled by the ALTPEN attribute and is generated when the LPL timing input is active. This video is always highlighted and takes precedence over the

symbol and underline video. This feature applies to the 2673A only.

Surround video is the absence of symbol, underline and strike-through video or the presence of the non-display attributes (ABLANK or ABLINK • BLINK).

The relative intensities of the four video components are determined by the remaining attributes (AHILT, ABLANK, ABLINK, ARVID) and the BKGND and CURSOR inputs as illustrated in Table 3.

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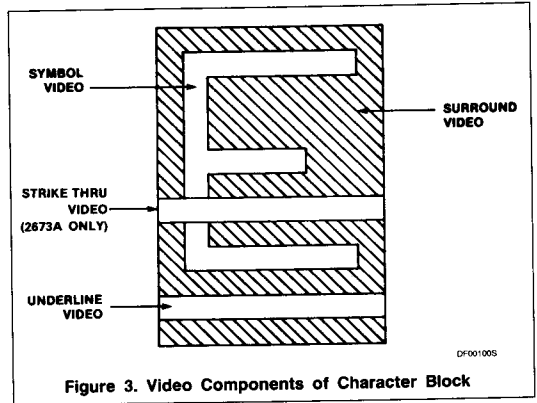
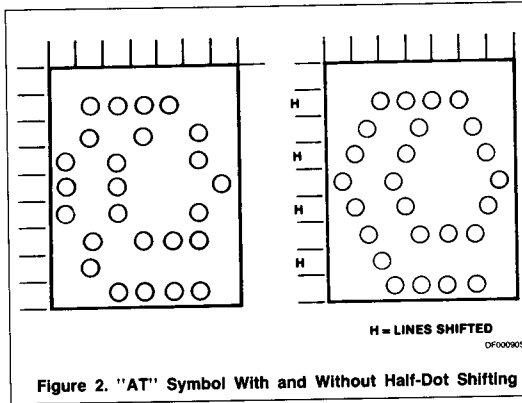


Table 3. Attributes Hierarchy

ATTRIBUTES AND CONTROL INPUTS d = Don't Care				RELATIVE VIDEO INTENSITIES W = White, B = Black, G = Gray		
BKGND <sup>5</sup>	Reverse <sup>1</sup>	Non-Display <sup>2</sup>	AHILT	Strike-Through Video <sup>3</sup>	Symbol Or Underline Video <sup>3, 4</sup>	Surround Video <sup>3</sup>
0	0	0	0	W	G	B
0	0	0	1	W	W	B
0	0	1	d	B	B	B
0	1	0	0	B	G	W
0	1	0	1	B	B	W
0	1	1	d	W	W	W
1	0	0	0	B	G	W
1	0	0	1	B	B	W
1	0	1	d	W	W	W
1	1	0	0	W	G	B
1	1	0	1	W	W	B
1	1	1	d	B	B	B

**NOTES:**

1. Reverse = ARVID • CURSOR + ARVID • CURSOR
2. Non-display = ABLANK + ABLINK • BLINK
3. See Figure 3.
4. Symbol and underline video are always the same intensity.
5. Reverse sense for VIDEO output.

## Video Attributes Controller (VAC)

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ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

SYMBOL	PARAMETER	RATING	UNIT
T <sub>A</sub>	Operating ambient temperature <sup>2</sup> range	0 to +70	°C
T <sub>STG</sub>	Storage temperature range	-65 to +150	°C
	All voltages with respect to ground	-0.5 to +6.0	V

DC ELECTRICAL CHARACTERISTICS T<sub>A</sub> = 0°C to +70°C, V<sub>CC</sub> = +5V ±5%, V<sub>BB</sub> = see Figure 14<sup>3, 4, 5</sup>

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			Min	Typ	Max	
V <sub>IL</sub> V <sub>IH</sub>	Input low voltage Input high voltage		2		0.8	V V
V <sub>OL</sub> V <sub>OH</sub>	Output low voltage (except VIDEO) Output high voltage (except VIDEO)	I <sub>OL</sub> = 4mA  I <sub>OH</sub> = -400μA	2.4		0.4	V V
V <sub>B</sub> V <sub>G</sub> V <sub>W</sub>	VIDEO black level VIDEO gray level VIDEO white level	R <sub>L</sub> = 150Ω to GND R <sub>L</sub> = 150Ω to GND R <sub>L</sub> = 150Ω to GND		0 0.45 0.90		V V V
I <sub>IL</sub> I <sub>IH</sub>	Input low current Input high current	V <sub>IN</sub> = 0.4V  V <sub>IN</sub> = 2.4V			-400/ -800 <sup>6</sup> 20/40 <sup>6</sup>	μA μA
I <sub>CC</sub> I <sub>BB</sub>	V <sub>CC</sub> supply current V <sub>BB</sub> supply current	V <sub>IN</sub> = 0V, V <sub>CC</sub> = Max V <sub>BB</sub> = Max			80 120	mA mA

## NOTES:

- Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or at any other condition above those indicated in the operation section of this specification is not implied.
- For operating at elevated temperatures, the device must be derated based on +150°C maximum junction temperature.
- Parameters are valid over operating temperature range unless otherwise specified.
- All voltage measurements are referenced to ground (V<sub>SS</sub>). All input signals swing between 0.4V and 2.4V. All time measurements are referenced at input voltages of 0.8V, 2V and at output voltages of 0.8V, 2V as appropriate.
- Typical values are at +25°C, typical supply voltages and typical processing parameters.
- For DCLK input.
- C<sub>L</sub> less than 150pF minimum could be faster.

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AC ELECTRICAL CHARACTERISTICS  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = +5V \pm 5\%$ ,  $V_{BB} =$  see Figure 14<sup>3</sup>, 4, 5

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS				UNIT
			25MHz Version		18MHz Version		
			Min	Max	Min	Max	
<b>Dot clock (see Figure 10)</b>							
$f_d$	Frequency (HDOT = 0) (HDOT = 1)			25 18		18 18	MHz ns
$t_{DH}$	High		15		22		ns
$t_{DL}$	Low		15		22		ns
<b>Setup times to CCLK (see Figures 4, 5, 6 and 10)</b>							
$t_{BS}$	BLANK		50		50		ns
$t_{SC}$	BLINK, UL, LPL, LL (ref to BLANK)		20		20		ns
$t_{SA}$	Attributes		45		55		ns
$t_{SD}$	Dot data D0 - D9		70		70		ns
$t_{SK}$	CURSOR		50		50		ns
$t_{FS}$	AFLG, AMODE		50		65		ns
$t_{SH}$	HDOT		45		55		ns
<b>Hold times from CCLK (see Figures 4, 5, 6 and 10)</b>							
$t_{HC}$	BLINK, UL, LPL, LL (ref to BLANK)		20		20		ns
$t_{HA}$	Attributes		20		20		ns
$t_{HD}$	Dot data D0 - D9		30		30		ns
$t_{HK}$	CURSOR		20		20		ns
$t_{FH}$	AFLG, AMODE		30		30		ns
$t_{HH}$	HDOT		20		20		ns
<b>Setup times to DCLK (see Figure 9)</b>							
$t_{SG}$	BKGND		15		15		ns
$t_{SB}$	CBLANK		15		15		ns
$t_{CS}$	CC0 - CC2		30		35		ns
<b>Hold times from DCLK (see Figure 9)</b>							
$t_{HG}$	BKGND		15		15		ns
$t_{HB}$	CBLANK		15		15		ns
$t_{CH}$	CC0 - CC2		20		20		ns
<b>Delay times (see Figures 6 and 7)</b>							
$t_{DGM}$	GMD from DCLK			65		65	ns
$t_{DC}$	CCLK from DCLK			65		65	ns
$t_{DV7}$	TTLVID1 and TTLVID2 from DCLK	$C_L = 150\text{pF}$		75		80	ns
$t_{DV}$	VIDEO from DCLK			240		240	ns



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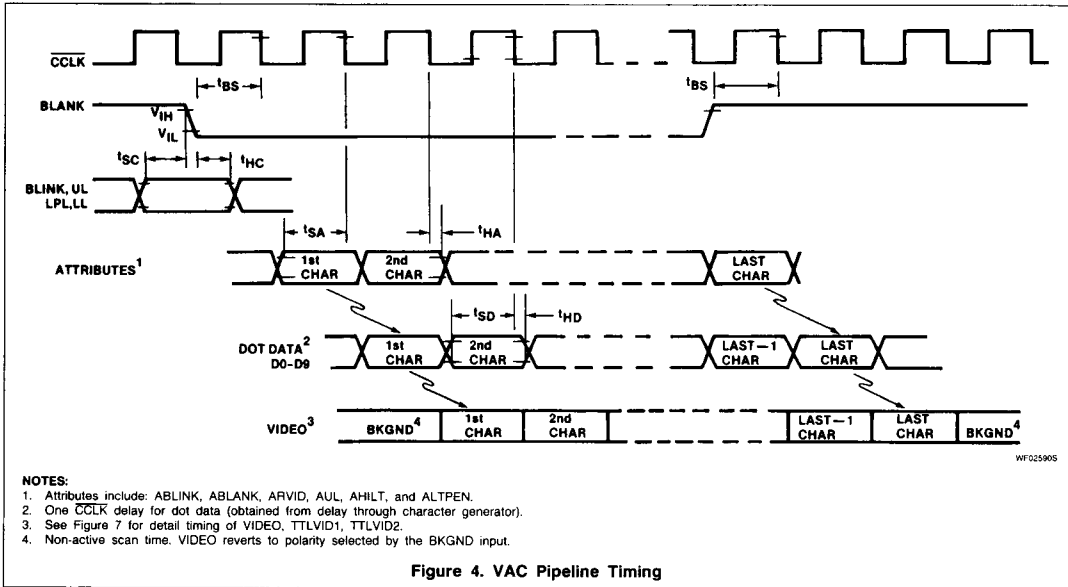


Figure 4. VAC Pipeline Timing

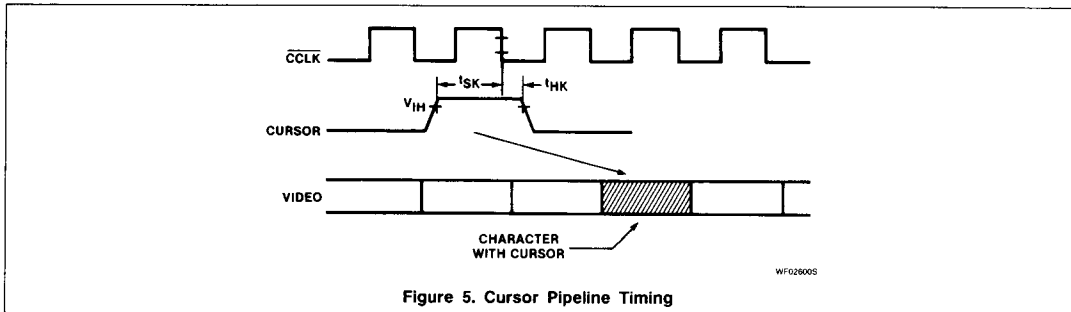
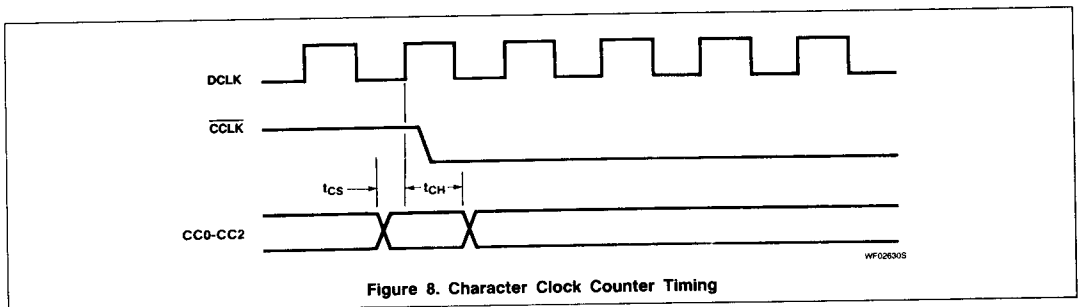
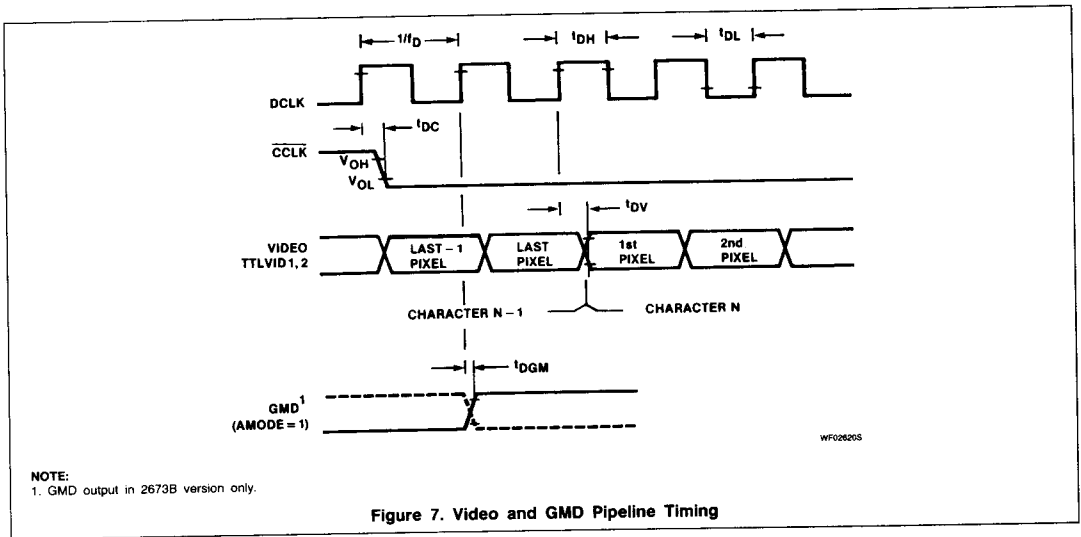
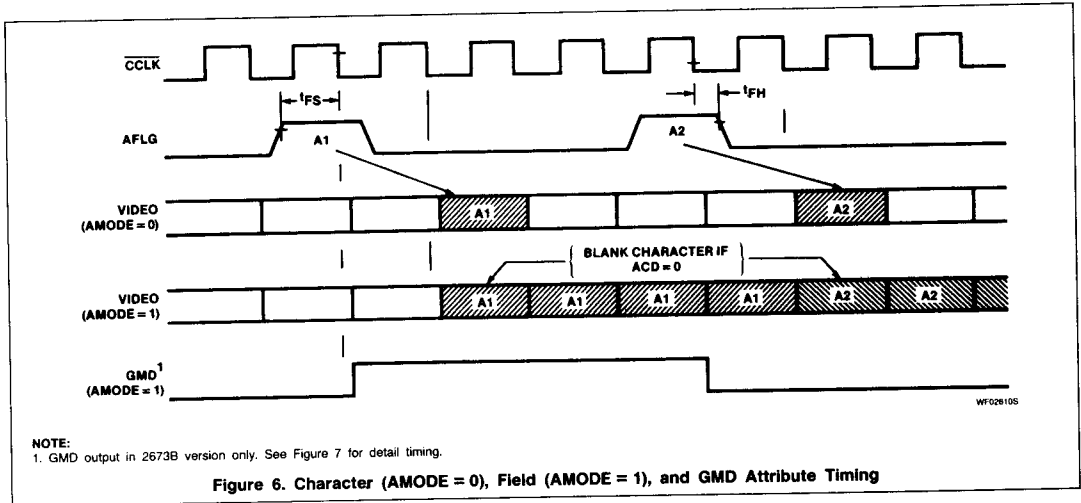


Figure 5. Cursor Pipeline Timing

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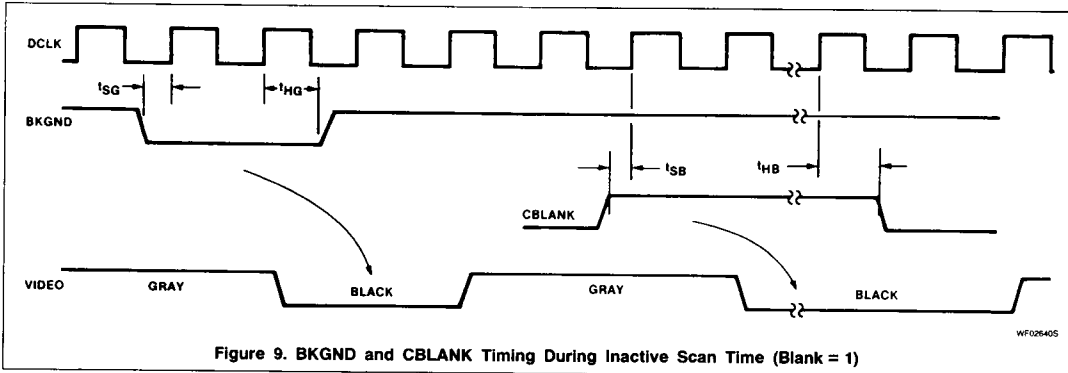


Figure 9. BKGND and CBLANK Timing During Inactive Scan Time (Blank = 1)

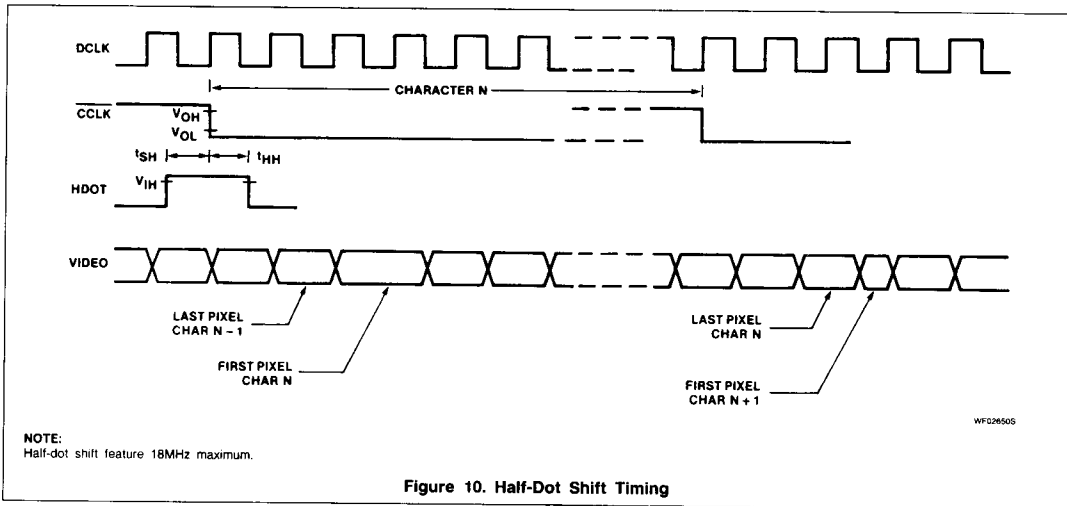
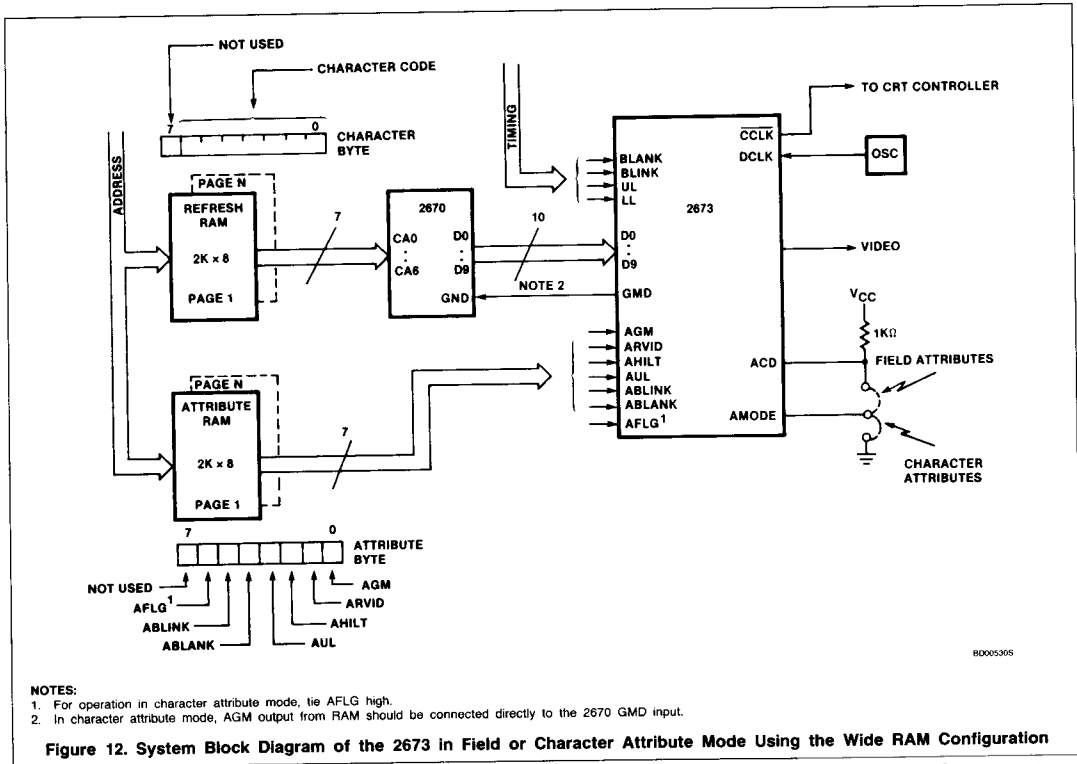
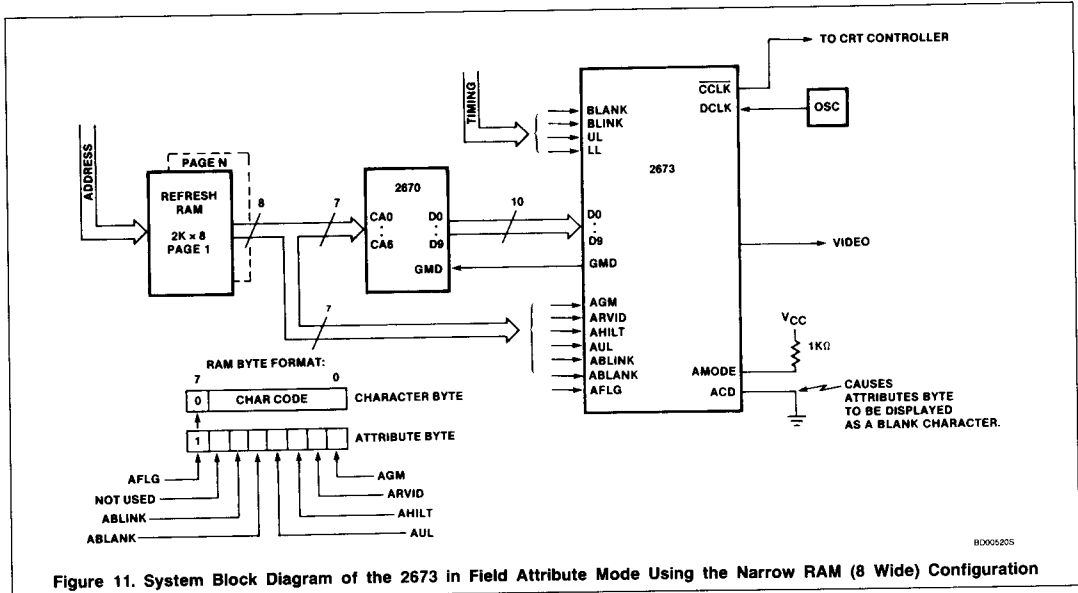


Figure 10. Half-Dot Shift Timing

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