Video

CSEE W4840

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The Model 181 is a high console model which provides television sight and sound entertainment with a selection of four (4) television channels. The black and white picture of pleasing contrast is reproduced on the screen of the 14 inch teleron, and measures 8 inches by 10 inches. The beautifully grained walnut cabinet of pleasing modern design measures $48\frac{3}{4}$ inches high, 23 inches wide and 26 inches deep. It is completely A.C., operated from standard 110 volt 60 cycle power lines. Twenty-two (22) tubes including the Du Mont Teletron are employed in the superheterodyne circuit. A dynamic speaker is used for perfect sound reproduction. In addition, a three-band superhetrodyne all wave radio is provided for standard radio reception. This receiver employs 8 tubes, is completely A.C. operated from 110 volt 60 cycle power lines. Push button and manual tuning are provided. An individual dynamic speaker is used for broadcast sound reproduction.
Vector Displays

SCORE  0000
HIGH SCORE  5000

GAME OVER

INSERT COIN

© ATARI 1980
Raster Scanning
Raster Scanning
Raster Scanning

Diagram showing the process of raster scanning with arrows indicating the movement of the scanning mechanism.
Raster Scanning
Raster Scanning
NTSC or RS-170

Originally black-and-white
60 Hz vertical scan frequency
15.75 kHz horizontal frequency

\[
\frac{15.75 \text{ kHz}}{60 \text{ Hz}} = 262.5 \text{ lines per field}
\]

White \quad 1 \text{ V}
Black \quad 0.075 \text{ V}
Blank \quad 0 \text{ V}
Sync \quad -0.4 \text{ V}
A Line of B&W Video

- White
- Black
- Blank
- Sync

Front Porch: 0.02H
Sync: 0.08H
Back Porch: 0.06H
Blanking: 0.16H
Interlaced Scanning
Interlaced Scanning
Interlaced Scanning
Interlaced Scanning
Interlaced Scanning
Interlaced Scanning
Color added later: had to be backwards compatible.
Solution: continue to transmit a “black-and-white” signal and modulate two color signals on top of it.
RGB vs. YIQ colorspaces

\[
\begin{bmatrix}
0.30 & 0.59 & 0.11 \\
0.60 & -0.28 & -0.32 \\
0.21 & -0.52 & 0.31 \\
\end{bmatrix}
\begin{bmatrix}
R \\
G \\
B \\
\end{bmatrix}
= 
\begin{bmatrix}
Y \\
I \\
Q \\
\end{bmatrix}
\]

Y baseband 4 MHz “black-and-white” signal
I as 1.5 MHz, Q as 0.5 MHz at 90°:
modulated at 3.58 MHz
# International Standards

<table>
<thead>
<tr>
<th></th>
<th>lines</th>
<th>active lines</th>
<th>vertical lines</th>
<th>aspect ratio</th>
<th>horiz. res.</th>
<th>frame rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTSC</td>
<td>525</td>
<td>484</td>
<td>242</td>
<td>4:3</td>
<td>427</td>
<td>29.94 Hz</td>
</tr>
<tr>
<td>PAL</td>
<td>625</td>
<td>575</td>
<td>290</td>
<td>4:3</td>
<td>425</td>
<td>25 Hz</td>
</tr>
<tr>
<td>SECAM</td>
<td>625</td>
<td>575</td>
<td>290</td>
<td>4:3</td>
<td>465</td>
<td>25 Hz</td>
</tr>
</tbody>
</table>

**PAL:** Uses YUV instead of YIQ, flips phase of V every other line

**SECAM:** Transmits the two chrominance signals on alternate lines; no quadrature modulation
## Computer Video: VGA

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Red</td>
<td>2</td>
<td>Green</td>
<td>3</td>
<td>Blue</td>
</tr>
<tr>
<td>6</td>
<td>RGND</td>
<td>7</td>
<td>GGND</td>
<td>8</td>
<td>BGND</td>
</tr>
<tr>
<td>11</td>
<td>ID0</td>
<td>12</td>
<td>ID1</td>
<td>13</td>
<td>hsync</td>
</tr>
<tr>
<td>14</td>
<td>id2</td>
<td>15</td>
<td>id3</td>
<td>9</td>
<td>ID2</td>
</tr>
<tr>
<td>10</td>
<td>GND</td>
<td>10</td>
<td>GND</td>
<td>10</td>
<td>GND</td>
</tr>
</tbody>
</table>

### ID2 ID0 ID1

- - GND Monochrome, \( < 1024 \times 768 \)
- GND - Color, \( < 1024 \times 768 \)
GND GND - Color, \( \geq 1024 \times 768 \)

### DDC1

ID2 Data from display
vsync also data clock

### DDC2

ID1 \( \text{I}^2\text{C} \) SDA
ID3 \( \text{I}^2\text{C} \) SLC
## VGA Timing

<table>
<thead>
<tr>
<th>Mode</th>
<th>Resolution</th>
<th>Vertical</th>
<th>Horizontal</th>
<th>Pixel Clock</th>
</tr>
</thead>
<tbody>
<tr>
<td>VGA</td>
<td>640×350</td>
<td>70 Hz</td>
<td>31.5 kHz</td>
<td>25.175 MHz</td>
</tr>
<tr>
<td>VGA</td>
<td>640×400</td>
<td>70 Hz</td>
<td>31.5 kHz</td>
<td>25.175 MHz</td>
</tr>
<tr>
<td>VGA</td>
<td>640×480</td>
<td>59.94 Hz</td>
<td>31.469 kHz</td>
<td>25.175 MHz</td>
</tr>
<tr>
<td>SVGA</td>
<td>800×600</td>
<td>56 Hz</td>
<td>35.2 kHz</td>
<td>36 MHz</td>
</tr>
<tr>
<td>SVGA</td>
<td>800×600</td>
<td>60 Hz</td>
<td>37.8 kHz</td>
<td>40 MHz</td>
</tr>
<tr>
<td>SVGA</td>
<td>800×600</td>
<td>72 Hz</td>
<td>48.0 kHz</td>
<td>50 MHz</td>
</tr>
<tr>
<td>XGA</td>
<td>1024×768</td>
<td>60 Hz</td>
<td>48.5 kHz</td>
<td>65 MHz</td>
</tr>
<tr>
<td>SXGA</td>
<td>1280×1024</td>
<td>61 Hz</td>
<td>64.2 kHz</td>
<td>110 MHz</td>
</tr>
<tr>
<td>HDTV</td>
<td>1920×1080i</td>
<td>60 Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UXGA</td>
<td>1600×1200</td>
<td>60 Hz</td>
<td>75 kHz</td>
<td>162 MHz</td>
</tr>
<tr>
<td>UXGA</td>
<td>1600×1200</td>
<td>85 Hz</td>
<td>105.77 kHz</td>
<td>220 MHz</td>
</tr>
<tr>
<td>WUXGA</td>
<td>1920×1200</td>
<td>70 Hz</td>
<td>87.5 kHz</td>
<td>230 MHz</td>
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</tbody>
</table>
**Detailed VGA Timing**

640 × 480, “60 Hz”

- 25.175 MHz Dot Clock
- 31.469 kHz Line Frequency
- 59.94 Hz Field Frequency

<table>
<thead>
<tr>
<th>pixels</th>
<th>role</th>
<th>lines</th>
<th>role</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Front Porch</td>
<td>2</td>
<td>Front Porch</td>
</tr>
<tr>
<td>96</td>
<td>Horizontal Sync</td>
<td>2</td>
<td>Vertical Sync</td>
</tr>
<tr>
<td>40</td>
<td>Back Porch</td>
<td>25</td>
<td>Back Porch</td>
</tr>
<tr>
<td>8</td>
<td>Left border</td>
<td>8</td>
<td>Top Border</td>
</tr>
<tr>
<td>640</td>
<td>Active</td>
<td>480</td>
<td>Active</td>
</tr>
<tr>
<td>8</td>
<td>Right border</td>
<td>8</td>
<td>Bottom Border</td>
</tr>
<tr>
<td>800</td>
<td>total per line</td>
<td>525</td>
<td>total per field</td>
</tr>
</tbody>
</table>

Active-low Horizontal and Vertical sync signals.