Ordering number : EN4453A

CMOS IC

LC74760, 74760M

On-Screen Display IC

Overview

The LC74760 and LC74760M are on-screen display CMOS ICs that superimpose text and low-level graphics onto a TV screen (video signal) under microprocessor control. The display characters have a 12 by 18 dot structure, and 128 characters are provided. The display area consists of 12 lines of 24 characters each.

Features

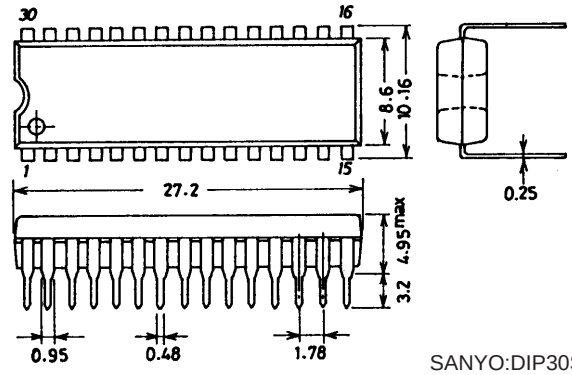
- Display structure: 12 lines by 24 characters (up to 288 characters)
- Number of displayed characters: Up to 288 characters
- Character configuration: 12 (W) by 18 (H) dot structure
- Character sizes: Three sizes (normal, double, and triple sizes)
- Display starting positions: 64 horizontal and 64 vertical locations
- Reverse video function: Characters can be inverted on a per character basis.
- Flashing types: Two types with periods of 0.5 and 1.0 second on a per character basis (duty fixed at 50%)
- Background color: One of eight colors (when internal synchronization used)
- External control input: Serial data input in 8-bit units
- Built-in horizontal/vertical sync separation circuit, AFC circuit, and synchronization detector
- Video output: Composite video signal output in NTSC, PAL, PAL-M, PAL-N, PAL60, NTSC4.43, or SECAM format

Package Dimensions

unit: mm

3061-DIP30S

[LC74760]

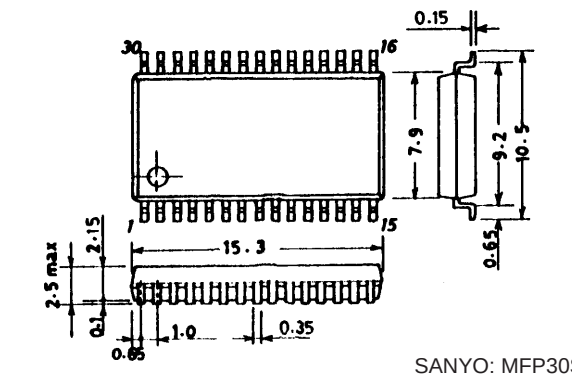


SANYO:DIP30S

unit: mm

3073A-MFP30S

[LC74760M]



SANYO: MFP30S

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Condition	Rating	Unit
Maximum supply voltage	V_{DD} max	V_{DD1}, V_{DD2} pins	V_{SS} – 0.3 to V_{SS} + 7.0	V
Maximum input voltage	V_{IN} max	All input pins	V_{SS} – 0.3 to V_{DD} + 0.3	V
Maximum output voltage	V_{OUT} max	$HSYNC_{OUT}$, $VSYNC_{OUT}$, $SYNC_{DET}$ pins	V_{SS} – 0.3 to V_{DD} + 0.3	V
Allowable power dissipation	Pd max		300	mW
Operating temperature	Topr		–30 to +70	°C
Storage temperature	Tstg		–40 to +125	°C

Allowable Operating Ranges at Ta = –30 to +70°C

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply voltage	V_{DD1}	V_{DD1} pin	4.5	5.0	5.5	V
	V_{DD2}	V_{DD2} pin	4.5	5.0	1.27 V_{DD1}	V
Input high level voltage	V_{IH1}	$\overline{RST}$, CS, SIN, SCLK pins	0.8 V_{DD1}		V_{DD1} + 0.3	V
	V_{IH2}	SECAM, $\overline{525}$/625, $\overline{NTSC}$/PAL, $\overline{3.58}$/4.43 pins	0.7 V_{DD1}		V_{DD1} + 0.3	V
Input low level voltage	V_{IL1}	$\overline{RST}$, $\overline{CS}$, SIN, SCLK	V_{SS} – 0.3		0.2 V_{DD1}	V
	V_{IL2}	SECAM, $\overline{525}$/625, $\overline{NTSC}$/PAL, $\overline{3.58}$/4.43 pins	V_{SS} – 0.3		0.3 V_{DD1}	V
Input voltage	V_{IN}	FC, AMP_{IN} pins	V_{SS} – 0.3		V_{DD1} + 0.3	V
Composite video signal input voltage	V_{IN1}	CVIN pins		2 V_{PP}		V
	V_{IN2}	CV_{CR} pins		2 V_{PP}		V
	V_{IN3}	$SYNC_{IN}$ pins		2 V_{PP}	2.5 V_{PP}	V
Oscillator frequency	F_{OSC1}	$Xtal_{IN1}$, $Xtal_{OUT1}$ pins; 4fsc: NTSC		14.318		MHz
	F_{OSC2}	$Xtal_{IN2}$, $Xtal_{OUT2}$ pins; 4fsc: PAL		17.734		MHz
		$Xtal_{IN2}$, $Xtal_{OUT2}$ pins; 4fsc: PAL-M		14.302		MHz
		$Xtal_{IN2}$, $Xtal_{OUT2}$ pins; 4fsc: PAL-N		14.328		MHz

Electrical Characteristics at Ta = –30 to +70°C, with V_{DD1} = V_{DD2} = 5 V unless otherwise specified

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Output off leakage current	I_{leak1}	CV_{OUT} pin			10	µA
Input off leakage current	I_{leak2}	CV_{IN}, CV_{CR} pins			10	µA
Output high level voltage	V_{OH}	$HSYNC_{OUT}$, $VSYNC_{OUT}$, $SYNC_{DET}$, SECAM, $\overline{525}$/625, $\overline{NTSC}$/PAL, $\overline{3.58}$/4.43, AMP_{OUT}, PD_{OUT} pins; V_{DD1} = 4.5 V, I_{OH} = –1.0 mA	3.5			V
Output low level voltage	V_{OL}	$HSYNC_{OUT}$, $VSYNC_{OUT}$, $SYNC_{DET}$, SECAM, $\overline{525}$/625, NTSC/PAL, $\overline{3.58}$/4.43, AMP_{OUT}, PD_{OUT} pins; V_{DD1} = 4.5 V, I_{OL} = 1.0 mA			1.0	V
Input current	I_{IH}	$\overline{RST}$, $\overline{CS}$, SIN, SCLK, SECAM, $\overline{525}$/625, NTSC/PAL, $\overline{3.58}$/4.43 pins; V_{IN} = V_{DD1}			1	µA
	I_{IL}	SECAM, $\overline{525}$/625, $\overline{NTSC}$/PAL, $\overline{3.58}$/4.43 pin; V_{IN} = V_{SS1}	–1			µA
Oscillator frequency	F_{OSC3}	VCO_{IN}, VCO_{OUT} pins; FC = 1/2 V_{DD1}		14.12		MHz
Operating current dissipation	I_{DD1}	V_{DD1} pin; All outputs open, Xtal: 4fsc			15	mA
	I_{DD2}	V_{DD2} pin; V_{DD2} = 5.0 V			20	mA

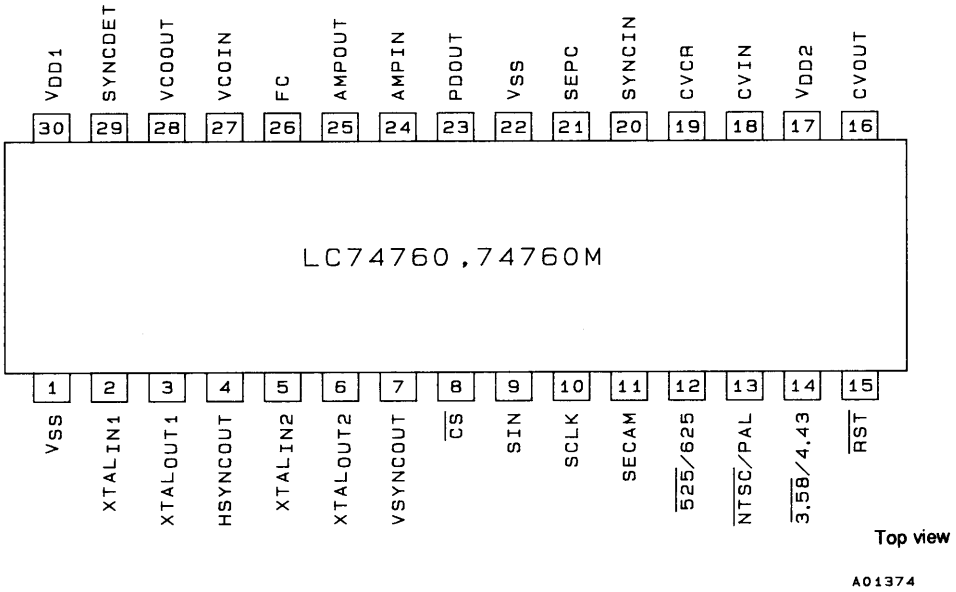
Timing Characteristics at Ta = –30 to +70°C, V_{DD} = 5 ±0.5 V

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Minimum input pulse width	$t_{W(SCLK)}$	SCLK pin	200			ns
	$t_{W(CS)}$	$\overline{CS}$ pin (during periods when $\overline{CS}$ is high)	1			µs
Data setup time	$t_{SU(CS)}$	$\overline{CS}$ pin	200			ns
	$t_{SU(SIN)}$	SIN pin	200			ns
Data hold time	$t_{h(CS)}$	$\overline{CS}$ pin	2			µs
	$t_{h(SIN)}$	SIN pin	200			ns
One word write time	t_{word}	Write time for 8 bits of data	4.2			µs
	t_{wt}	RAM data write time	1			µs

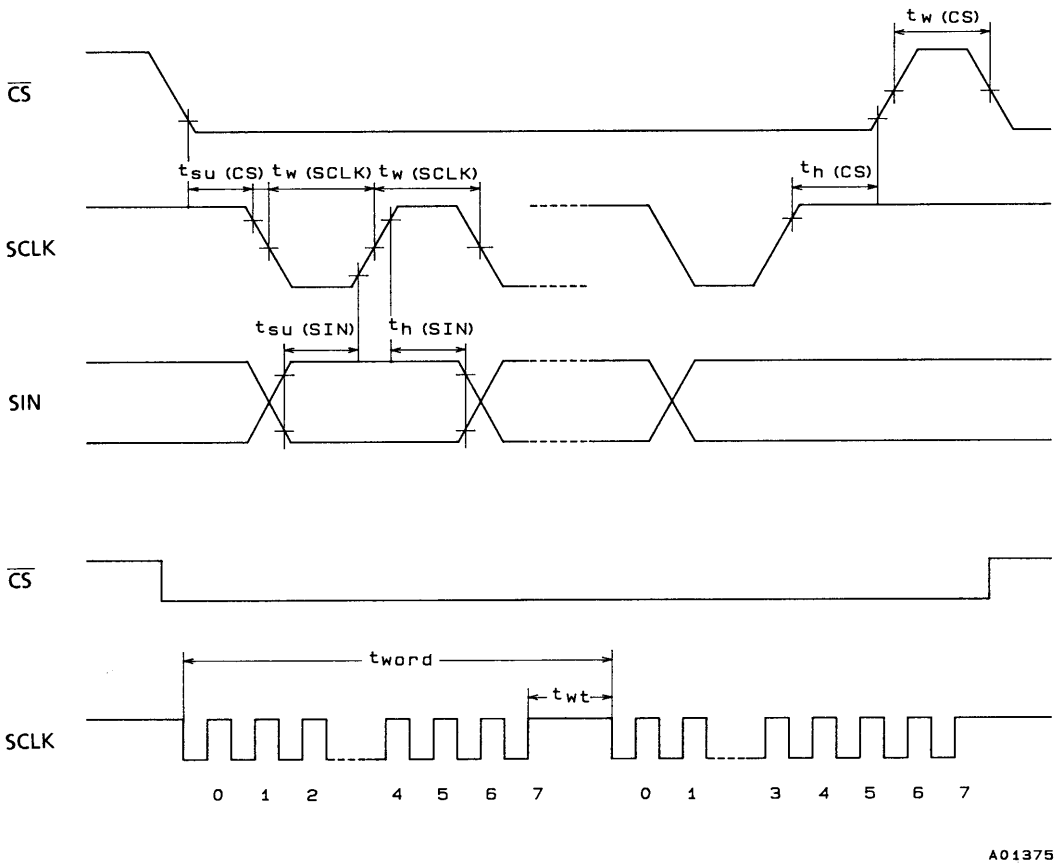
Pin Functions

Pin No.	Symbol	Function	Description
1	V_{SS}	Ground	Ground connection
2	$Xtal_{IN1}$	Crystal oscillator connection	Connection for the crystal and capacitor used to form the crystal oscillator that generates the internal synchronization signal. (For an NTSC crystal oscillator 4fsc = 14.318 MHz.)
3	$Xtal_{OUT1}$		
4	$HSYNC_{OUT}$	Horizontal synchronization output	Outputs the horizontal synchronization signal (AFC). The polarity can be selected with a metal switch.
5	$Xtal_{IN2}$	Crystal oscillator connection	Connection for the crystal and capacitor used to form the crystal oscillator that generates the internal synchronization signal. (For a PAL crystal oscillator 4fsc = 17.734 MHz.)
6	$Xtal_{OUT2}$		
7	$VSYNC_{OUT}$	Vertical synchronization output	Outputs the vertical synchronization signal. The polarity can be selected with a metal switch.
8	$\overline{CS}$	Enable input	Enables/disables serial data input. Serial data is enabled when this pin is low. Pull-up resistor built in (hysteresis input).
9	SIN	Data input	Serial data input. Pull-up resistor built in (hysteresis input).
10	SCLK	Clock input	Clock input for serial data input. Pull-up resistor built in (hysteresis input).
11	SECAM	SECAM mode switch input	Switches between SECAM and other modes. Low = other modes, high = SECAM mode
12	$\overline{525}$/625	525/625 switch input	Switches between 525 scan lines and 625 scan lines. Low = 525 lines, high = 625 lines
13	$\overline{NTSC}$/PAL	NTSC/PAL switch input	Switches the color mode between NTSC and PAL. Low = NTSC, high = PAL
14	$\overline{3.58}$/4.43	3.58/4.43 switch input	Switch FSC between 3.58 MHz and 4.43 MHz. Low = 3.58, high = 4.43
15	$\overline{RST}$	Reset input	System reset input pin, low is active (reset). Pull-up resistor built in (hysteresis input).
16	CV_{OUT}	Video signal output	Composite video output
17	V_{DD2}	Power supply connection	Power supply connection for composite video signal level generation
18	CV_{IN}	Video signal input	Composite video input
19	CV_{CR}	Video signal input	SECAM chroma signal input
20	$SYNC_{IN}$	Sync separator circuit input	Built-in sync separator circuit video signal input
21	SEP_{C}	Sync separator circuit	Built-in sync separator circuit (AMP out)
22	V_{SS}	Ground	Ground connection
23	PD_{OUT}	Control voltage output	AFC control voltage output
24	AMP_{IN}	AFC filter connection	Filter connection
25	AMP_{OUT}		
26	FC	Control voltage input	AFC control voltage input
27	VCO_{IN}	LC oscillator connection	VCO LC oscillator circuit coil and capacitor connection
28	VCO_{OUT}		
29	$SYNC_{DET}$	External synchronization signal detection output	Outputs the exclusive NOR of the horizontal synchronization signal (AFC) and CSYNC (sync separator).
30	V_{DD1}	Power supply connection	Power supply connection (+5 V: digital system power supply)

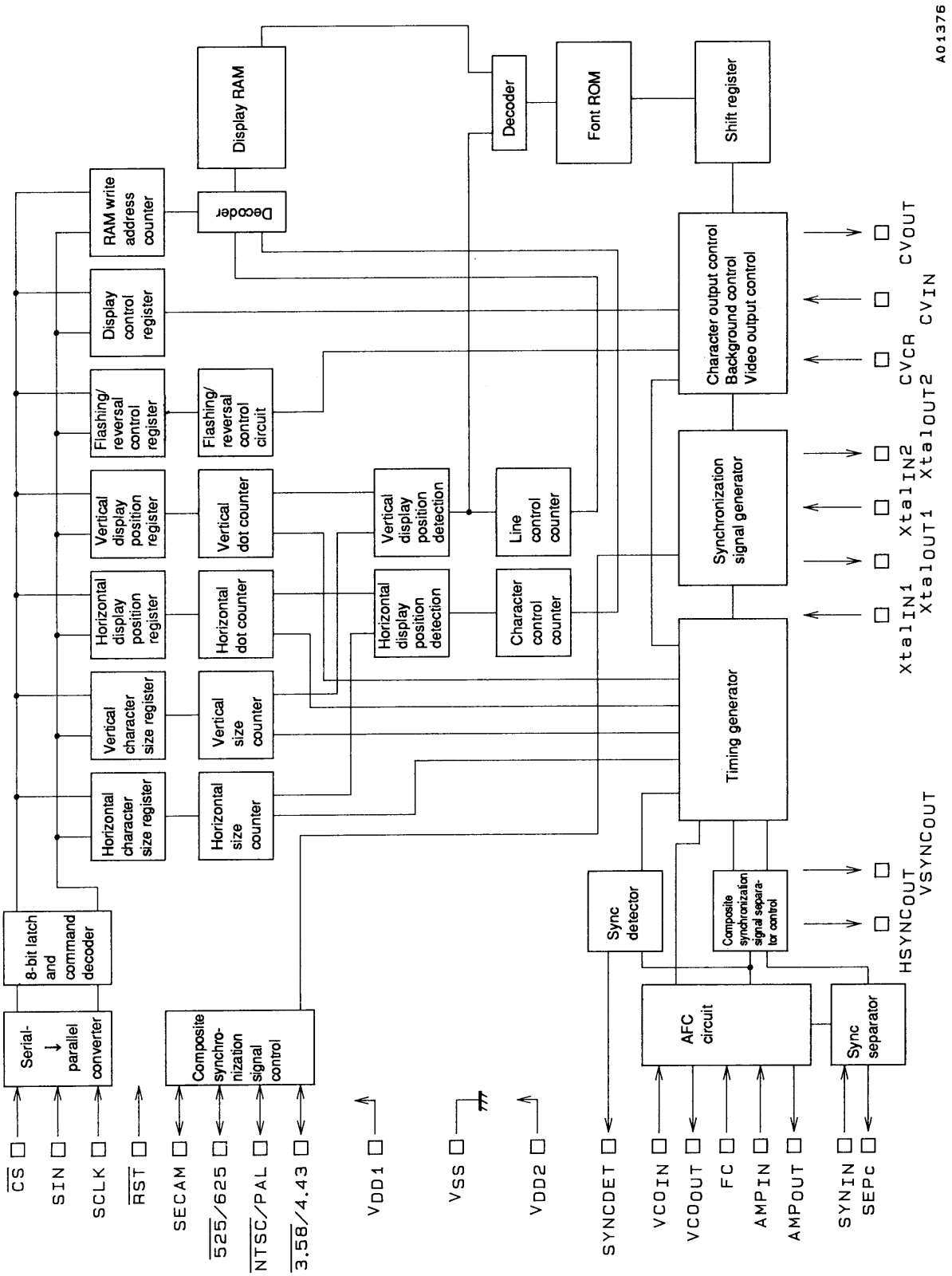
Pin Assignment



Serial Data Input Timing



System Block Diagram



Display Control Commands

Display control commands are input in an 8-bit serial format. Commands consist of a command identification code in the first byte and data in the second and following bytes. The following commands are supported.

1 COMMAND0: Display memory (VRAM) write address setting command
2 COMMAND1: Display character data write command
3 COMMAND2: Vertical display start position and character size (lines 1 and 2) setting command
4 COMMAND3: Horizontal display start position and character size (lines 9 and 11) setting command
5 COMMAND4: Display control setting command 1
6 COMMAND5: Display control setting command 2
7 COMMAND6: Display control setting command 3
8 COMMAND7: Display control setting command 4

Display Control Command Table

Command	First byte								Second byte							
	Command identification code				Data				Data							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
COMMAND0 Write address	1	0	0	0	V3	V2	V1	V0	0	0	0	H4	H3	H2	H1	H0
COMMAND1 Character write	1	0	0	1	0	0	at2	at1	0	c6	c5	c4	c3	c2	c1	c0
COMMAND2 Vertical display start position	1	0	1	0	SZ 21	SZ 20	SZ 11	SZ 10	0	0	VP 5	VP 4	VP 3	VP 2	VP 1	VP 0
COMMAND3 Horizontal display start position	1	0	1	1	SZ B1	SZ B0	SZ 91	SZ 90	0	0	HP 5	HP 4	HP 3	HP 2	HP 1	HP 0
COMMAND4 Display control 1	1	1	0	0	RST	RAM	OSC	RND	0	I/N	BLK 1	BLK 0	BK 1	ATS	0	DSP
COMMAND5 Display control 2	1	1	0	1	PH 2	PH 1	PH 0	I/E	0	TST	CHAL	BLK	RSL 1	RSL 0	0	0
COMMAND6 Display control 3	1	1	1	0	MOD 3	MOD 2	MOD 1	MOD 0	0	0	0	0	IOS	BCL 1	BCL 0	CB
COMMAND7 Display control 4	1	1	1	1	0	0	0	LINS	0	0	LIN 5	LIN 4	LIN 3	LIN 2	LIN 1	LIN 0

Once the command identification code in the first bite is written, it is stored internally until the first byte of the following command is written. However, when the display character data write command (COMMAND1) is written, the system becomes locked in display character data write mode, and the first byte cannot be overwritten.

When the $\overline{CS}$ pin is set high the command state is set to COMMAND0, i.e., display memory write address setting mode.

1 COMMAND0: Display Memory Write Address Setting Mode

First data byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	The command 0 identification code: sets the display memory write address.	
6	—	0		
5	—	0		
4	—	0		
3	V3	0	Display memory line address (from 0 to B (hexadecimal))	
		1		
2	V2	0		
		1		
1	V1	0		
		1		
0	V0	0		
		1		

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification code	
6	—	0		
5	—	0		
4	H4	0	Display memory character address (from 0 to 17 (hexadecimal))	
		1		
3	H3	0		
		1		
2	H2	0		
		1		
1	H1	0		
		1		
0	H0	0		
		1		

Note: When the chip is reset by the $\overline{\text{RST}}$ pin, the register states (bits) are all cleared to 0.

2 COMMAND1: Display Character Data Write Command

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	The command 1 identification code: sets the display memory write address.	When this command is entered, the chip locks in display character write mode until the $\overline{\text{CS}}$ pin is set high.
6	—	0		
5	—	0		
4	—	1		
3	—	0		
2	—	0		
1	at2	0	Turns character attribute 2 off.	Specifies highlight or flashing.
		1	Turns character attribute 2 on.	
0	at1	0	Turns character attribute 1 off.	Specifies reverse video.
		1	Turns character attribute 1 on.	

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Character code (from 00 to 7F (hexadecimal))	
6	c6	0		
		1		
5	c5	0		
		1		
4	c4	0		
		1		
3	c3	0		
		1		
2	c2	0		
		1		
1	c1	0		
		1		
0	c0	0		
		1		

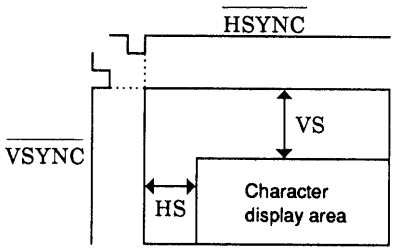
Note: When the chip is reset by the $\overline{\text{RST}}$ pin, the register states (bits) are all cleared to 0.

3 COMMAND2: Vertical Display Position Setting Command

First byte

<table>
<tr><th rowspan="2">DA0 to DA7</th><th rowspan="2">Register name</th><th colspan="2">Register content</th><th rowspan="2">Note</th></tr>
<tr><th>State</th><th>Function</th></tr>
<tr><td>7</td><td>—</td><td>1</td><td rowspan="4">The command 2 identification code:
sets the vertical display position.</td><td rowspan="4"></td></tr>
<tr><td>6</td><td>—</td><td>0</td></tr>
<tr><td>5</td><td>—</td><td>1</td></tr>
<tr><td>4</td><td>—</td><td>0</td></tr>
<tr><td>3</td><td>SZ21</td><td>0
1</td><td rowspan="3"><table><tr><th>SZ21 \ SZ20</th><th>0</th><th>1</th></tr><tr><td>0</td><td>Normal size</td><td>Double size</td></tr><tr><td>1</td><td>Triple size</td><td>Normal size</td></tr></table></td><td rowspan="3">Character size for the second line</td></tr>
<tr><td>2</td><td>SZ20</td><td>0
1</td></tr>
<tr><td>1</td><td>SZ11</td><td>0
1</td></tr>
<tr><td>0</td><td>SZ10</td><td>0
1</td><td><table><tr><th>SZ11 \ SZ10</th><th>0</th><th>1</th></tr><tr><td>0</td><td>Normal size</td><td>Double size</td></tr><tr><td>1</td><td>Triple size</td><td>Normal size</td></tr></table></td><td>Character size for the first line</td></tr>
</table>

Second byte

<table>
<tr><th rowspan="2">DA0 to DA7</th><th rowspan="2">Register name</th><th colspan="2">Register content</th><th rowspan="2">Note</th></tr>
<tr><th>State</th><th>Function</th></tr>
<tr><td>7</td><td>—</td><td>0</td><td>Second byte identification code</td><td></td></tr>
<tr><td>6</td><td>—</td><td>0</td><td></td><td></td></tr>
<tr><td>5</td><td>VP5
(MSB)</td><td>0
1</td><td rowspan="8">The vertical display start position is given by
$VS = H \times (\sum_{n=0}^{5} 2^n VPn)$
where H is the horizontal synchronization pulse period.
  </td><td rowspan="8">The six bits VP0 to VP5 specify the vertical display start position.
The weight of the lsb is 1 × H.</td></tr>
<tr><td>4</td><td>VP4</td><td>0
1</td></tr>
<tr><td>3</td><td>VP3</td><td>0
1</td></tr>
<tr><td>2</td><td>VP2</td><td>0
1</td></tr>
<tr><td>1</td><td>VP1</td><td>0
1</td></tr>
<tr><td>0</td><td>VP0
(LSB)</td><td>0
1</td></tr>
</table>

Note: When the chip is reset by the $\overline{RST}$ pin, the register states (bits) are all cleared to 0.

4 COMMAND3: Horizontal Display Position Setting Command

First byte

<table>
<tr><th rowspan="2">DA0 to DA7</th><th rowspan="2">Register name</th><th colspan="2">Register content</th><th rowspan="2">Note</th></tr>
<tr><th>State</th><th>Function</th></tr>
<tr><td>7</td><td>—</td><td>1</td><td rowspan="4">The command 3 identification code:
sets the horizontal display position.</td><td rowspan="4"></td></tr>
<tr><td>6</td><td>—</td><td>0</td></tr>
<tr><td>5</td><td>—</td><td>1</td></tr>
<tr><td>4</td><td>—</td><td>1</td></tr>
<tr><td>3</td><td>SZB1</td><td>0
1</td><td rowspan="3"><table><tr><th>SZB1 \ SZB0</th><th>0</th><th>1</th></tr><tr><td>0</td><td>Normal size</td><td>Double size</td></tr><tr><td>1</td><td>Triple size</td><td>Normal size</td></tr></table></td><td rowspan="3">The character size for the eleventh line.</td></tr>
<tr><td>2</td><td>SZB0</td><td>0
1</td></tr>
<tr><td>1</td><td>SZ91</td><td>0
1</td></tr>
<tr><td>0</td><td>SZ90</td><td>0
1</td><td><table><tr><th>SZ91 \ SZ90</th><th>0</th><th>1</th></tr><tr><td>0</td><td>Normal size</td><td>Double size</td></tr><tr><td>1</td><td>Triple size</td><td>Normal size</td></tr></table></td><td>The character size for the ninth line.</td></tr>
</table>

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification code	
6	—	0		
5	HP5 (MSB)	0	The horizontal display start position is given by $HS = Tc \times (\sum_{n=0}^{5} 2^n HPn)$ where Tc is the period of the OSCIN and OSCOUT oscillator in operating mode.	The six bits HP0 to HP5 specify the vertical display start position. The weight of the lsb is 1 x Tc.
		1		
4	HP4	0		
		1		
3	HP3	0		
		1		
2	HP2	0		
		1		
1	HP1	0		
		1		
0	HP0 (LSB)	0		
		1		

Note: When the chip is reset by the $\overline{RST}$ pin, the register states (bits) are all cleared to 0.

5 COMMAND4: Display Control Setting Command 1

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	The command 4 identification code: sets display control parameters.	
6	—	1		
5	—	0		
4	—	0		
3	RST_{SYS}	0		This reset occurs when the $\overline{CS}$ pin goes low, and the reset state cleared when the $\overline{CS}$ pin goes high.
		1	Resets all registers. (Clears all registers to 0.)	
2	RAM_{ERS}	0		The RAM erase function requires at least 500 µs. It is executed on DSPOFF.
		1	Erases display RAM. (Sets display RAM to 7F (hexadecimal).)	
1	OSC_{STP}	0	Continues crystal oscillator operation.	Only valid with character display off if external synchronization is used.
		1	Stops the crystal oscillator.	
0	RND_{SEL}	0	Turns off rounding.	Only valid for double and triple size characters.
		1	Turns on rounding.	

Second byte

<table>
<tr><th rowspan="2">DA0 to DA7</th><th rowspan="2">Register name</th><th colspan="2">Register content</th><th rowspan="2">Note</th></tr>
<tr><th>State</th><th>Function</th></tr>
<tr><td>7</td><td>—</td><td>0</td><td colspan="2">Second byte identification code</td><td></td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">INT/NON</td><td>0</td><td colspan="2">Interlaced</td><td rowspan="2">Switches between interlaced and non-interlaced display.</td></tr>
<tr><td>1</td><td colspan="2">Non-interlaced</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">BLK1</td><td>0</td><td rowspan="4" colspan="2"><table><tr><th>BLK1 \ BLK0</th><th>0</th><th>1</th></tr><tr><td>0</td><td>Blanking off</td><td>Character size blanking</td></tr><tr><td>1</td><td>Frame size blanking</td><td>Total area blanking</td></tr></table></td><td rowspan="4">Changes the blanking size.</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">BLK0</td><td>0</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">BK1</td><td>0</td><td colspan="2">Flashing period about 0.5 s</td><td rowspan="2">Sets the flashing period.</td></tr>
<tr><td>1</td><td colspan="2">Flashing period about 1 s</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">ATS</td><td>0</td><td colspan="2">Highlight function</td><td rowspan="2">Selects at2.</td></tr>
<tr><td>1</td><td colspan="2">Flashing function</td></tr>
<tr><td>1</td><td>—</td><td>0</td><td colspan="2"></td><td></td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">DSPON</td><td>0</td><td colspan="2">Character display off</td><td rowspan="2">Turns character output on and off.</td></tr>
<tr><td>1</td><td colspan="2">Character display on</td></tr>
</table>

Note: When the chip is reset by the $\overline{\text{RST}}$ pin, the register states (bits) are all cleared to 0.

6 COMMAND5: Display Control Setting Command 2

First byte

<table>
<tr><th rowspan="2">DA0 to DA7</th><th rowspan="2">Register name</th><th colspan="2">Register content</th><th rowspan="2">Note</th></tr>
<tr><th>State</th><th>Function</th></tr>
<tr><td>7</td><td>—</td><td>1</td><td colspan="2" rowspan="4">The command 5 identification code:
sets display control parameters.</td><td rowspan="4"></td></tr>
<tr><td>6</td><td>—</td><td>1</td></tr>
<tr><td>5</td><td>—</td><td>0</td></tr>
<tr><td>4</td><td>—</td><td>1</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">PH2</td><td>0</td><td rowspan="10" colspan="2"><table><tr><th rowspan="2">PHASE 2</th><th rowspan="2">PHASE 1</th><th rowspan="2">PHASE 0</th><th colspan="2">Background color (phase)</th></tr><tr><th>NTSC</th><th>PAL</th></tr><tr><td>0</td><td>0</td><td>0</td><td>π/2</td><td>±π/2</td></tr><tr><td>0</td><td>0</td><td>1</td><td>In phase</td><td>In phase</td></tr><tr><td>0</td><td>1</td><td>0</td><td>3 π/2</td><td>∓π/2</td></tr><tr><td>0</td><td>1</td><td>1</td><td>π</td><td>±π</td></tr><tr><td>1</td><td>0</td><td>0</td><td>3 π/4</td><td>±3 π/4</td></tr><tr><td>1</td><td>0</td><td>1</td><td>π/4</td><td>±π/4</td></tr><tr><td>1</td><td>1</td><td>0</td><td>7 π/4</td><td>∓π/4</td></tr><tr><td>1</td><td>1</td><td>1</td><td>5 π/4</td><td>∓3 π/4</td></tr></table></td><td rowspan="10">Sets the phase of the background color for color burst.sz</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">PH1</td><td>0</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">PH0</td><td>0</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">INT/EXT</td><td>0</td><td colspan="2">External synchronization mode</td><td rowspan="2">Switches between internal and external synchronization.</td></tr>
<tr><td>1</td><td colspan="2">Internal synchronization mode</td></tr>
</table>

Second byte

<table>
<tr><th rowspan="2">DA0 to DA7</th><th rowspan="2">Register name</th><th colspan="2">Register content</th><th rowspan="2">Note</th></tr>
<tr><th>State</th><th>Function</th></tr>
<tr><td>7</td><td>—</td><td>0</td><td colspan="2">Second byte identification code</td><td></td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">TST</td><td>0</td><td colspan="2">Normal operation</td><td rowspan="2">Test mode should not be used. This bit should always be zero.</td></tr>
<tr><td>1</td><td colspan="2">Test mode</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">CHAL</td><td>0</td><td colspan="2">Sets the character intensity level to about 95 IRE (bright white).</td><td rowspan="2">Switches the character intensity level.</td></tr>
<tr><td>1</td><td colspan="2">Sets the character intensity level to about 75 IRE (white with a touch of grey).</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">BKL</td><td>0</td><td colspan="2">Sets the blanking intensity level to about 5 IRE (a deep black as a frame level).</td><td rowspan="2">Switches the blanking intensity level.</td></tr>
<tr><td>1</td><td colspan="2">Sets the blanking intensity level to about 15 IRE (a dark grey as a frame level).</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">RSL1
RSL0</td><td rowspan="4">0
1
0
1</td><td colspan="2" rowspan="4">
<table>
<tr><th>RSL1</th><th>RSL0</th><th>Intensity level</th><th>Amplitude</th></tr>
<tr><td>0</td><td>0</td><td>About 15 IRE</td><td>About 60 IRE</td></tr>
<tr><td>0</td><td>1</td><td>About 30 IRE</td><td>About 60 IRE</td></tr>
<tr><td>1</td><td>0</td><td>About 45 IRE</td><td>About 60 IRE</td></tr>
<tr><td>1</td><td>1</td><td>About 60 IRE</td><td>About 69 IRE</td></tr>
</table>
</td><td rowspan="4">Switches the background intensity level.</td></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr><td>1</td><td>—</td><td>0</td><td colspan="2"></td><td></td></tr>
<tr><td>0</td><td>—</td><td>0</td><td colspan="2"></td><td></td></tr>
</table>

Note: When the chip is reset by the $\overline{\text{RST}}$ pin, the register states (bits) are all cleared to 0.

7 COMMAND6: Display Control Setting Command 3

First byte

<table>
<tr><th rowspan="2">DA0 to DA7</th><th rowspan="2">Register name</th><th colspan="2">Register content</th><th rowspan="2">Note</th></tr>
<tr><th>State</th><th>Function</th></tr>
<tr><td>7</td><td>—</td><td>1</td><td colspan="2" rowspan="4">The command 6 identification code:
sets display control parameters.</td><td rowspan="4"></td></tr>
<tr><td>6</td><td>—</td><td>1</td></tr>
<tr><td>5</td><td>—</td><td>1</td></tr>
<tr><td>4</td><td>—</td><td>0</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">MOD3</td><td>0</td><td colspan="2">Sets Fsc to 3.58 MHz.</td><td rowspan="2">The logical or of this bit and the Fsc switching input pin (pin 14) is used.</td></tr>
<tr><td>1</td><td colspan="2">Sets Fsc to 4.43 MHz.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MOD2</td><td>0</td><td colspan="2">Sets the color mode to NTSC.</td><td rowspan="2">The logical or of this bit and the color mode switching input pin (pin 13) is used.</td></tr>
<tr><td>1</td><td colspan="2">Sets the color mode to PAL.</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">MOD1</td><td>0</td><td colspan="2">Sets the number of scan lines to 525 lines.</td><td rowspan="2">The logical or of this bit and the scan line count switching input pin (pin 12) is used.</td></tr>
<tr><td>1</td><td colspan="2">Sets the number of scan lines to 625 lines.</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">MOD0</td><td>0</td><td colspan="2">Sets the mode to a mode other than SECAM.</td><td rowspan="2">The logical or of this bit and the mode switching input pin (pin 11) is used.</td></tr>
<tr><td>1</td><td colspan="2">Sets the mode to SECAM mode.</td></tr>
</table>

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification code	
6	—	0		
5	—	0		
4	—	0		
3	IOS	0	Sets the mode setting pin to be an input pin.	Switches the input/output direction of the mode setting pins. (11 pin to 14 pin)
		1	Sets the mode setting pin to be an output pin.	
2	BCOL1	0	BCOL1 / BCOL0 / Background color 0 / 0 / Background color displayed 0 / 1 / No background color (about 15 IRE) 1 / 0 / No background color (about 25 IRE) 1 / 1 / Illegal value	Determines whether a background color is displayed. (Only valid in internal synchronization mode.)
		1		
1	BCOL0	0		
		1		
0	CBOFF	0	Outputs a color burst signal.	Only valid when either BCOL0 is 1 or BCOL1 is 1.
		1	Stops the output of color burst signals.	

Note: When the chip is reset by the $\overline{\text{RST}}$ pin, the register states (bits) are all cleared to 0.

8 COMMAND7: Display Control Setting Command 4

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	The command 7 identification code: sets display control parameters.	
6	—	1		
5	—	1		
4	—	1		
3	—	0		
2	—	0		
1	—	0		
0	LINS	0	Selects the lower 6 bits (bits 0 to 5)	Selects the upper or lower six bits when halftone output line mode is specified.
		1	Selects the upper 6 bits (bits 6 to B)	

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification code	
6	—	0		
5	LIN5	0	Turns off (low) sixth line halftone output.	Used for the line 12 setting when LINS is high.
		1	Turns on (high) sixth line halftone output.	
4	LIN4	0	Turns off (low) fifth line halftone output.	Used for the line 11 setting when LINS is high.
		1	Turns on (high) fifth line halftone output.	
3	LIN3	0	Turns off (low) fourth line halftone output.	Used for the line 10 setting when LINS is high.
		1	Turns on (high) fourth line halftone output.	
2	LIN2	0	Turns off (low) third line halftone output.	Used for the line 9 setting when LINS is high.
		1	Turns on (high) third line halftone output.	
1	LIN1	0	Turns off (low) second line halftone output.	Used for the line 8 setting when LINS is high.
		1	Turns on (high) second line halftone output.	
0	LIN0	0	Turns off (low) first line halftone output.	Used for the line 7 setting when LINS is high.
		1	Turns on (high) first line halftone output.	

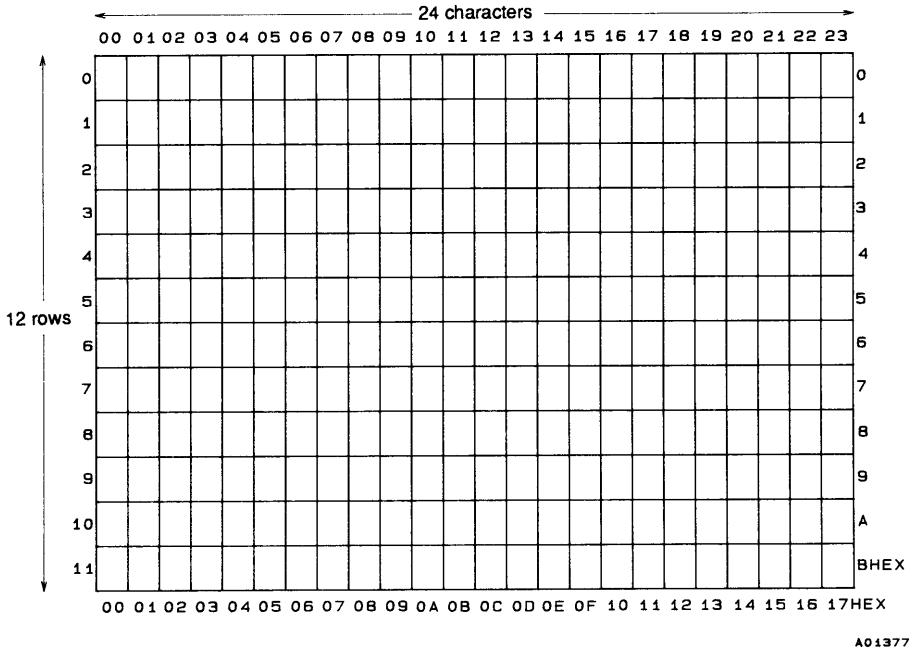
Note: When the chip is reset by the $\overline{\text{RST}}$ pin, the register states (bits) are all cleared to 0.

Display Configuration

The display consists of 12 rows of 24 characters each. Up to 288 characters can be displayed unless enlarged characters are displayed. Display memory addresses are expressed as a row address in the range 0 to B (hexadecimal) and a column address in the range 0 to 17 (hexadecimal).

Display Configuration and Display Memory Addresses

24 characters by 12 rows



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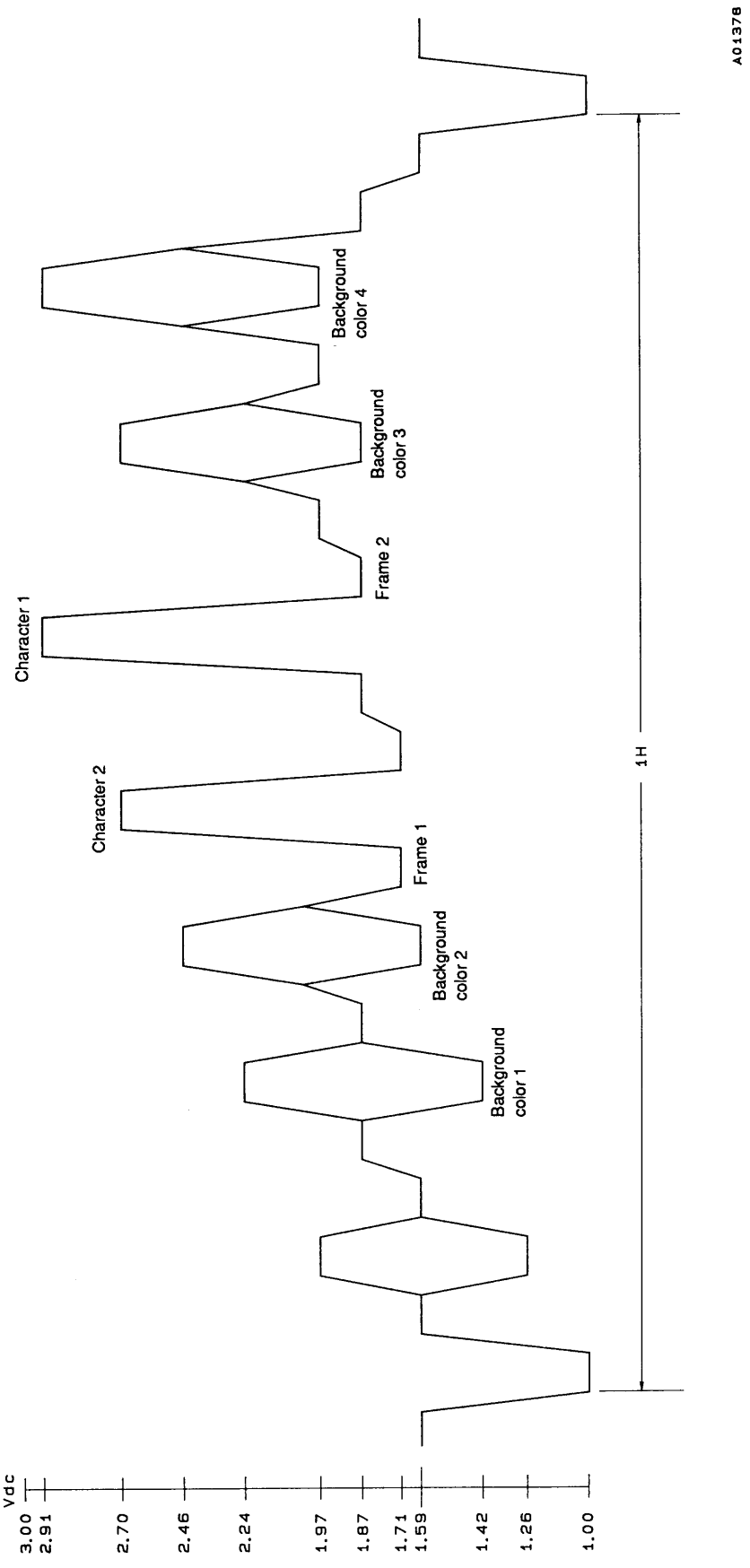
Composite Video Signal Output Levels (internally generated levels)



Output level	Output voltage (VDC)
Character level 1	2.914
Character level 2	2.702
Background high level 2	2.460
Background high level 1	2.244
Burst high level	1.971
Frame level 2	1.873

Output level	Output voltage (VDC)
Frame level 1	1.713
Pedestal level	1.597
Background low level 1	1.428
Burst low level	1.263
Sync level	1.000