Ordering number:ENN*4088

CMOS IC

LC7471

On-Screen Display Controller for NTSC-Format Video

Preliminary

Overview

The LC7471 is a video display controller for superimposing text and low-level graphics onto an NTSC-format television receiver. The LC7471 incorporates a 64 character internal character generator ROM, a 24-character × 64-line display ROM and a 176-character display RAM. Up to 288, 12 × 18-pixel characters can be displayed under microprocessor control on a 24-character by 12-line display.

The LC7471 features selectable pixel width and pixel height, and 64 vertical and 64 horizontal display start positions. It also features a flashing enable bit for each character position.

The LC7471 operates from a 5 V supply and is available in 22-pin shrink DIPs.

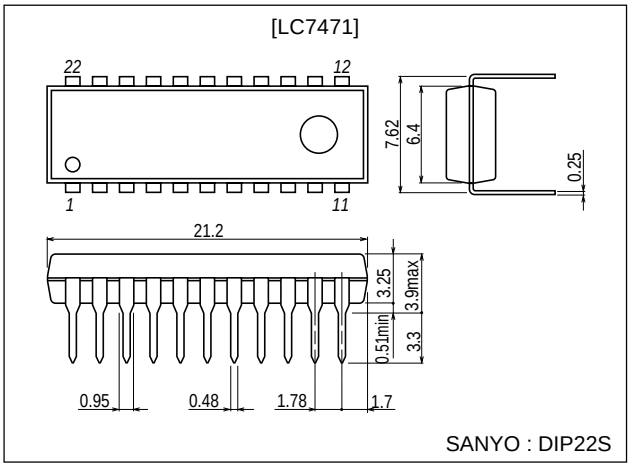
Features

- Complete text and graphics video overlay circuitry.
- 64-character internal character generator ROM.
- 24-character × 64-line display ROM.
- 176-character display RAM.
- 288-character display capability.
- 12 × 18-pixel characters.
- Four pixel widths.
- Four pixel heights.
- Selectable background color.
- Approximately 0.5 or 1 s period character flashing option.
- 25, 50 or 75% flashing duty cycle.
- Internal or external synchronization.
- Serial data control.
- 5 V supply.
- 22-pin shrink DIP.

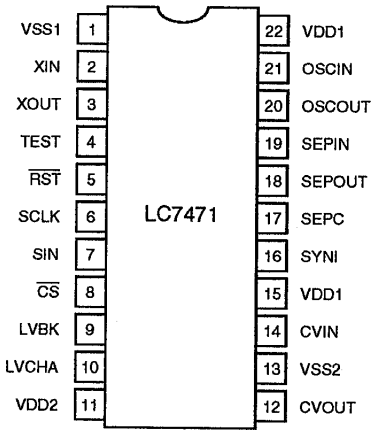
Package Dimensions

unit:mm

3059-DIP22S



Pin Assignment



Top view

SANYO Electric Co.,Ltd. Semiconductor Company

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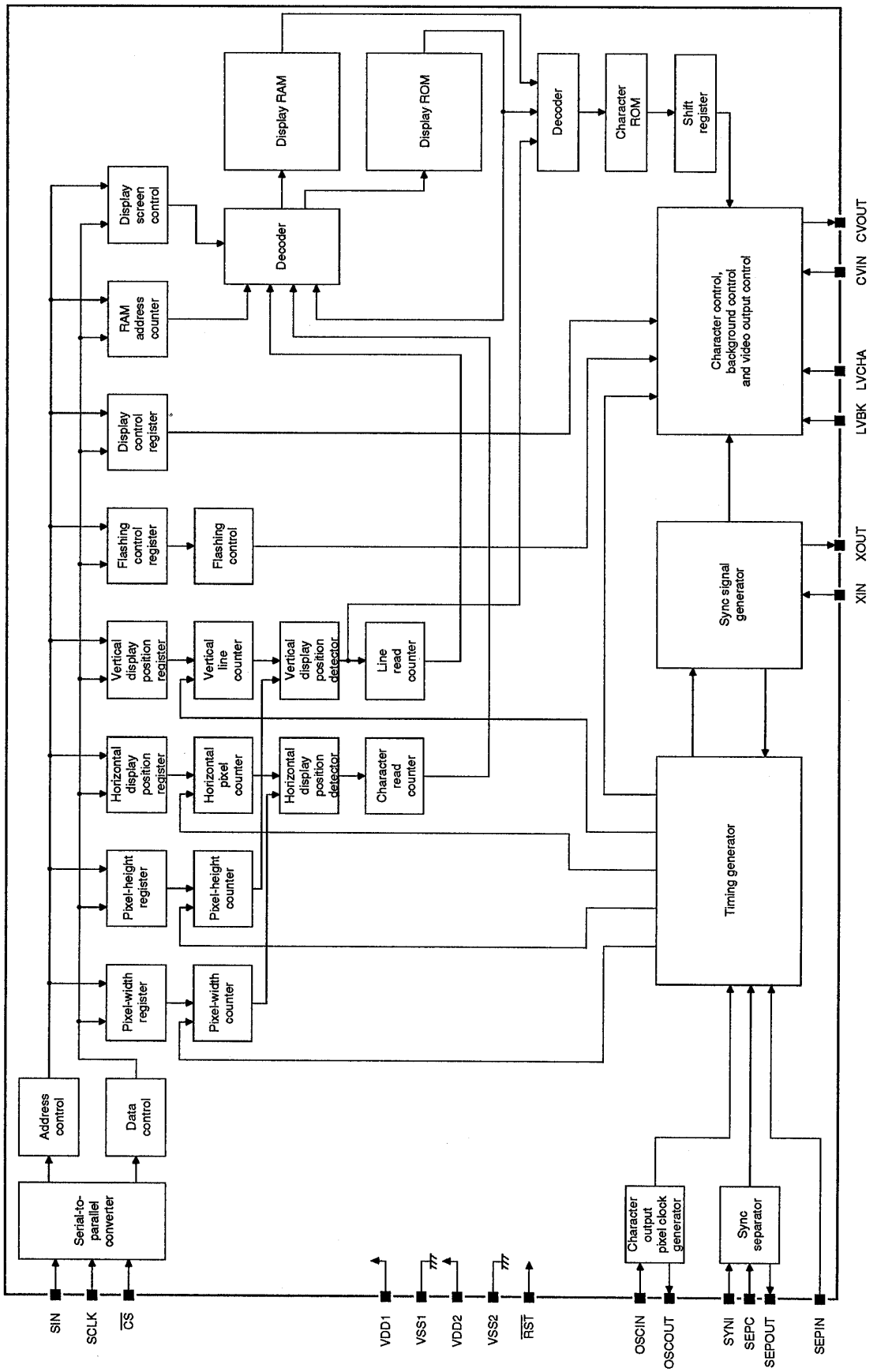
Block Diagram



Pin Description

Number	Name	Description
1	V_{SS1}	Digital circuit ground
2	XIN	Crystal oscillator input
3	XOUT	Crystal oscillator output
4	TEST	Test output
5	$\overline{RST}$	Active-LOW reset input with hysteresis
6	SCLK	Serial data clock input with hysteresis
7	SIN	Serial data input with hysteresis
8	$\overline{CS}$	Active-LOW chip select input with hysteresis
9	LVBK	Blanking-level adjustment input
10	LVCHA	Character-level adjustment input
11	V_{DD2}	Analog circuit supply
12	CVOUT	Composite video output
13	V_{SS2}	Analog circuit ground
14	CVIN	Composite video input
15	V_{DD1}	5V logic supply
16	SYNI	Sync separator input
17	SEPC	Sync separator capacitor connection
18	SEPOUT	Sync separator output
19	SEPIN	Vertical sync input
20	OSCOUT	Pixel-clock LC oscillator network connections
21	OSCIN	
22	V_{DD1}	5V logic supply

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{DD}		$V_{SS}-0.3$ to $V_{SS}+7.0$	V
Input voltage	V_I		$V_{SS}-0.3$ to $V_{DD}+0.3$	V
Output voltage	V_O		$V_{SS}-0.3$ to $V_{DD}+0.3$	V
Allowable power dissipation	Pd max	Ta = 25˚C	300	mW
Operating temperature	Topr		–30 to +70	˚C
Storage temperature	Tstg		–40 to +125	˚C

Reommended Operating Conditions at Ta = 25˚C

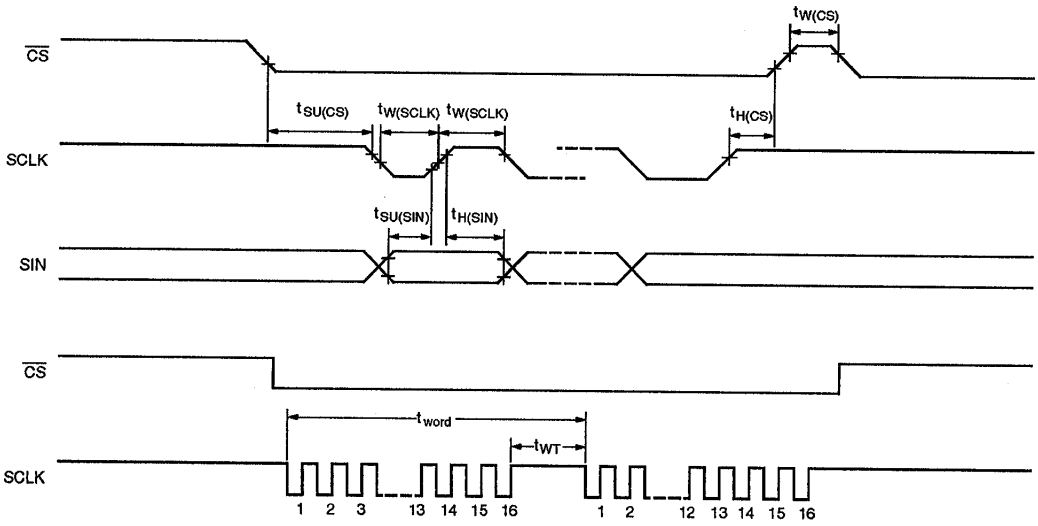
Parameter	Symbol	Conditions	Ratings	Unit
Logic supply voltage	V_{DD1}		5	V
Analog supply voltage	V_{DD2}		5	V
Logic supply voltage range	V_{DD1}		4.5 to 5.5	V
Analog supply voltage range	V_{DD2}		4.5 to $1.27V_{DD1}$	V

Electrical Characteristics at Ta = –30 to +70˚C, V_{DD1} = 5V, unless otherwise noted

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current	I_{DD}	$V_{\overline{RST}}=V_{DD1}$, f_{XTAL}=14.31MHz, f_{LC}=7MHz, V_{DD2} and all outputs are open			15	mA
$\overline{CS}$, SIN, $\overline{RST}$ and SCLK LOW-level input voltage	V_{IL}		$V_{SS}-0.3$		$0.2V_{DD1}$	V
$\overline{CS}$, SIN, $\overline{RST}$ and SCLK HIGH-level input voltage	V_{IH}		$0.8V_{DD1}$		$V_{DD1}+0.3$	V
SYNI composite video input voltage	V_{IN1}			2.0	2.5	V_{P-P}
CVIN composite video input voltage	V_{IN2}			2		V_{P-P}
$\overline{OSCIN}$ LOW-level input current	V_{IL}	$V_I=V_{SS}$	–1			µA
$\overline{CS}$, SIN, $\overline{RST}$, SCLK and SEPIN HIGH-level input current	V_{IH}	$V_I=V_{DD}$			1	µA
SEPOUT LOW-level output voltage	V_{OL}	V_{DD1}=4.5V, I_{OL}=1mA			1.0	V
SEPOUT HIGH-level output voltage	V_{OH}	V_{DD1}=4.5V, I_{OH}=1mA	3.5			V
Oscillator frequency	f_{OSC}	$f_{XTAL}=4f_{SC}$		14.318		MHz
		$f_{XTAL}=2f_{SC}$		7.159		
		LC oscillator	5	7	10	
CVOUT leakage current	I_L				10	µA

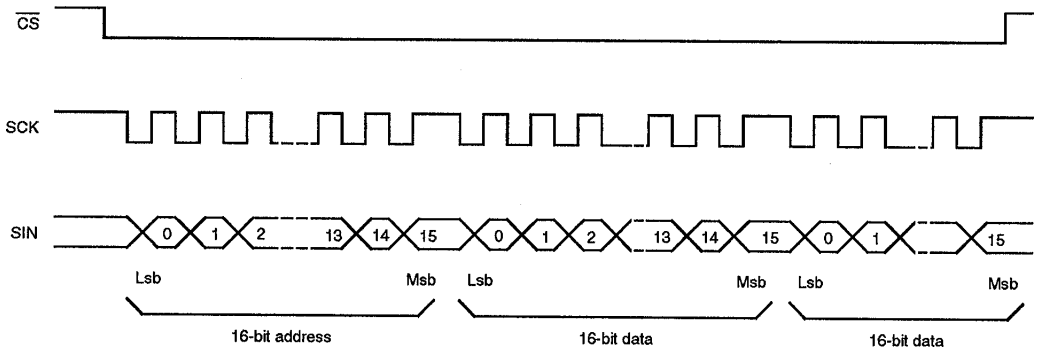
Timing Characteristics at Ta = –30 to +75˚C, V_{DD1} = 5±0.5V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
SCLK input pulsewidth	$t_{W(SCLK)}$		200			ns
$\overline{CS}$ HIGH-level input pulsewidth	$t_{W(CS)}$		1			µs
$\overline{CS}$ data enable input setup time	$t_{SU(CS)}$		200			ns
SIN data input setup time	$t_{SU(SIN)}$		200			ns
$\overline{CS}$ data enable input hold time	$t_{H(CS)}$		2			µs
SIN data input hold time	$t_{H(SIN)}$		200			ns
16-bit data word write time	t_{word}		10			µs
RAM data write time	t_{WT}		1			µs



Input Timing

Data and address words are input in serial format on SIN. A 16-bit address word followed by 16-bit data words is input after the falling edge of $\overline{CS}$. The address automatically increments after each data word. The data input timing is shown in the following figure.



Only the lower eight bits of the address word are significant. Only the lower eight bits of data words at addresses 000H to 0AFH, the lower 11 bits of data words at addresses 0B0H to 0BBH and the lower 12 bits of data words at addresses 0BCH to 0BFH are significant. All non-significant bits should be set to 0.

RAM Memory Configuration

RAM memory is organized as 16-bit words as shown in the following table. Locations 000H to 0AFH are display RAM, locations 0B0H through to 0BBH are display line address registers, locations 0BCH to 0BDH are display control registers, location 0BEH is the video signal control register and location 0BFH is the general control register.

Address	Memory contents																Description
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	
000H to 0AFH	0	0	0	0	0	0	0	0	FL	0	C_5	C_4	C_3	C_2	C1	C_0	Display RAM with 6-bit character code and flashing enable bit
0B0H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 1
0B1H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 2
0B2H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 3
0B3H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 4
0B4H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 5
0B5H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 6
0B6H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 7
0B7H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 8
0B8H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 9
0B9H	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 10
0BAH	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 11
0BBH	0	0	0	0	0	ADRA	ADR9	ADR8	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address in display ROM of first character of line 12
0BCH	0	0	0	0	HSZ31	HSZ30	HSZ21	HSZ20	HSZ11	HSZ10	HP5	HP4	HP3	HP2	HP1	HP0	Hrizontal display start position and pixel width
0BDH	0	0	0	0	VSZ31	VSZ30	VSZ21	VSZ20	VSZ11	VSZ10	VP5	VP4	VP3	VP2	VP1	VP0	Vertivcal display start position and pixel height
0BEH	0	0	0	0	$\overline{\text{INT}}$/ NON	×	×	OSC STP	DSP ON	×	SYS RST	×	×	×	PH1	PH0	Video signal phase, display blanking, oscillator control and system reset selection
0BFH	0	0	0	0	TST MOD	×	×	BLK1	BLK0	×	FL2	FL1	FL0	EXT	×	BCOL	Character blanking, flashing, and test mode selection

Note

× = don't care

Horizontal Display Control Register (0BCH)

The function of each bit in the horizontal display control register is shown in the following table. Note that a LOW-level pulse on $\overline{\text{RST}}$ resets all bits to 0.

Data bit	Name	Function
0	HP0	Selects the horizontal start position of the display on the screen, HS, as given by the following equation $HS = T_C \times \left(4 \times \sum_{n=0}^{5} 2^n HPn\right)$ where T_C is the period of the dot clock oscillator. Note that HS increments in multiples of $4T_C$.
1	HP1	
2	HP2	
3	HP3	
4	HP4	
5	HP5	
6	HSZ10	Selects line 1 pixel width as shown in table 1.
7	HSZ11	
8	HSZ20	Selects line 2 pixel width as shown in table 2.
9	HSZ21	
A	HSZ30	Selects line 3 to line 12 pixel width as shown in table 3.
B	HSZ31	
C	–	No function

Table 1. Line 1 pixel width

HSZ11	HSZ10	Width
0	0	$1T_C$/pixel
0	1	$2T_C$/pixel
1	0	$3T_C$/pixel
1	1	$4T_C$/pixel

Table 2. Line 2 pixel width

HSZ21	HSZ20	Width
0	0	$1T_C$/pixel
0	1	$2T_C$/pixel
1	0	$3T_C$/pixel
1	1	$4T_C$/pixel

Table 3. Line 3 to line 12 pixel width

HSZ31	HSZ30	Width
0	0	$1T_C$/pixel
0	1	$2T_C$/pixel
1	0	$3T_C$/pixel
1	1	$4T_C$/pixel

Vertical Display Control Register (0BDH)

The function of each bit in the vertical display control register is shown in the following table. Note that a LOW-level pulse on $\overline{RST}$ resets all bits to 0.

Data bit	Name	Function
0	VP0	Selects the vertical start position of the display on the screen, VS, as given by the following equation $VS = H \times \left(4 \times \sum_{n=0}^{5} 2^n VPn\right)$ where H is the horizontal sync pulsewidth. Note that VS increments in multiples of 4 lines from line 0 to line 64.
1	VP1	
2	VP2	
3	VP3	
4	VP4	
5	VP5	
6	VSZ10	Selects line 1 pixel height as shown in table 4.
7	VSZ11	
8	VSZ20	Selects line 2 pixel height as shown in table 5.
9	VSZ21	
A	VSZ30	Selects line 3 to line 12 pixel height as shown in table 6.
B	VSZ31	
C	–	No function

Table 4. Line 1 pixel height

HSZ11	HSZ10	Height
0	0	1H/pixel
0	1	2H/pixel
1	0	3H/pixel
1	1	4H/pixel

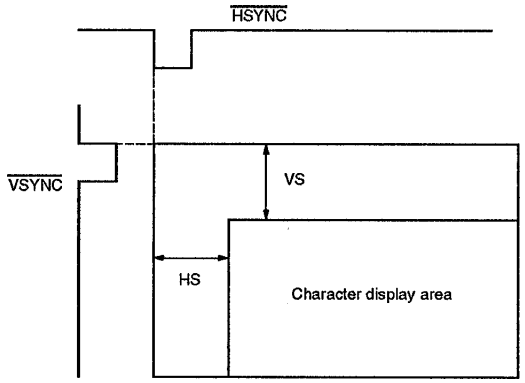
Table 5. Line 2 pixel height

HSZ21	HSZ20	Height
0	0	1H/pixel
0	1	2H/pixel
1	0	3H/pixel
1	1	4H/pixel

Table 6. Line 3 to line 12 pixel height

VSZ31	VSZ30	Height
0	0	1H/pixel
0	1	2H/pixel
1	0	3H/pixel
1	1	4H/pixel

The relationships between the vertical sync and horizontal sync pulses and between the horizontal and vertical display start positions are shown in the following figure.



Video Signal Control Register (0BEH)

The function of each bit in the video signal control register is shown in the following table. Note that a LOW-level pulse on $\overline{RST}$ resets all bits to 0.

Data bit	Name	Function
0	PH0	Selects the phase, and hence the background color, in the color burst as shown in table 7.
1	PH1	
2	–	No function
3	–	No function
4	–	No function
5	SYS RST	Resets all registers and turns the display OFF when 1. Note that the device remains reset until $\overline{CS}$ goes HIGH again.
6	–	No function
7	DSP ON	Selects character display OFF when 0, and ON, when 1.
8	OSC STP	Turns the crystal oscillator and LC oscillator ON when 0, and OFF, when 1. Note that the oscillators can be turned OFF only when external synchronization is selected and the character display is OFF.
9	–	No function
A	–	No function
B	$\overline{INT}$/NON	Selects 262.5 lines/field, interlaced display when 0, and 263 ines/field, non-interlaced display, when 1.
C	–	No function

Table 7. Phase selection

PH1	PH0	Phase
0	0	π/2
0	1	π
1	0	3π/2
1	1	In phase

General Control Register (0BFH)

The function of each bit in the general control register is shown in the following table. Note that a LOW-level pulse on $\overline{RST}$ resets all bits to 0.

Data bit	Name	Function
0	BCOL	Selects background color ON when 0 (valid for internal synchronization only), and 0FF, when 1.
1	–	No function
2	EXT	Selects external horizontal and vertical synchronization when 0, and internal, when 1.
3	FL0	Selects the display flashing duty cycle as shown in table 8.
4	FL1	
5	FL2	Selects a flashing period of approximately 1 s when 0, and of approximately 0.5 s, when 1.
6	–	No function
7	BLK0	Selects the blanking area of the display as shown in table 9.
8	BLK1	
9	–	No function
A	–	No function
B	TST MOD	Selects normal operation when 0, and test mode, when 1. Note that test mode should not be selected during normal operation.
C	–	No function

Table 8. Flashing duty cycle selection

FL1	FL0	Duty cycle
0	0	Flashing OFF
0	1	25%
1	0	50%
1	1	75%

Table 9. Blanking area selection

BLK1	BLK0	Blanking area
0	0	Blanking OFF
0	1	Character size
1	0	Frame size
1	1	Total area

Display ROM Configuration

The display ROM is configured as 1,536 words from address 000H to 5FFH as shown in the following table. Each 16-bit word contains a 7-bit character code and a single control bit. When the control bit is 0, the 7-bit character code is significant and is used to address the character generator ROM, and when 1, the 7-bit character code in ROM is ignored and the character code is read from display RAM. The display RAM address automatically increments by one each time a character code is read from RAM. Note that your local SANYO representative can offer advice on how to specify the generator character ROM.

Address	Video signal control bits																Description
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	
000H	0	0	0	0	0	0	0	0	$\overline{\text{ROM}}$/RAM	0	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address of first character of line 1
to																	
017H	0	0	0	0	0	0	0	0	$\overline{\text{ROM}}$/RAM	0	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address of twenty-fourth character of line 1
018H	0	0	0	0	0	0	0	0	$\overline{\text{ROM}}$/RAM	0	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address of first character of line 2
to																	
5FFH	0	0	0	0	0	0	0	0	$\overline{\text{ROM}}$/RAM	0	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address of twenty-fourth character of line 64

The function of each significant bit in a display ROM word is shown in the following table.

Data bit	Name	Description
0	ADR0	Specifies the character generator ROM address. ADR0 to ADR5 should be set to 0 when bit 7 is 1.
1	ADR1	
2	ADR2	
3	ADR3	
4	ADR4	
5	ADR5	
6	ADR6	Should be set to 0.
7	$\overline{\text{ROM}}$/RAM	Selects direct ROM addressing.
		Selects indirect ROM addressing from RAM.

The line addresses in display ROM are shown in the following table.

Line	Address(hex)	Line	Address(hex)
1	00	17	180
2	18	18	198
3	30	19	1B0
4	48	20	1C8
5	60	21	1E0
6	78	22	1F8
7	90	23	210
8	A8	24	228
9	C0	25	240
10	D8	26	258
11	F0	27	270
12	108	28	288
13	120	29	2A0
14	138	30	2B8
15	150	31	2D0
16	168	32	2E8

Line	Address(hex)	Line	Address(hex)
33	300	49	480
34	318	50	498
35	330	51	4B0
36	348	52	4C8
37	360	53	4E0
38	378	54	4F8
39	390	55	510
40	3A8	56	528
41	3C0	57	540
42	3D8	58	558
43	3F0	59	570
44	408	60	588
45	420	61	5A0
46	438	62	5B8
47	450	63	5D0
48	468	64	5E8

Screen Configuration

The character screen display is configured as 12 lines × 24 characters, making a maximum number of 288 characters when the smallest character size is used. The number of characters that can be displayed reduces as character size is increased. The character screen configuration is shown in the following table.

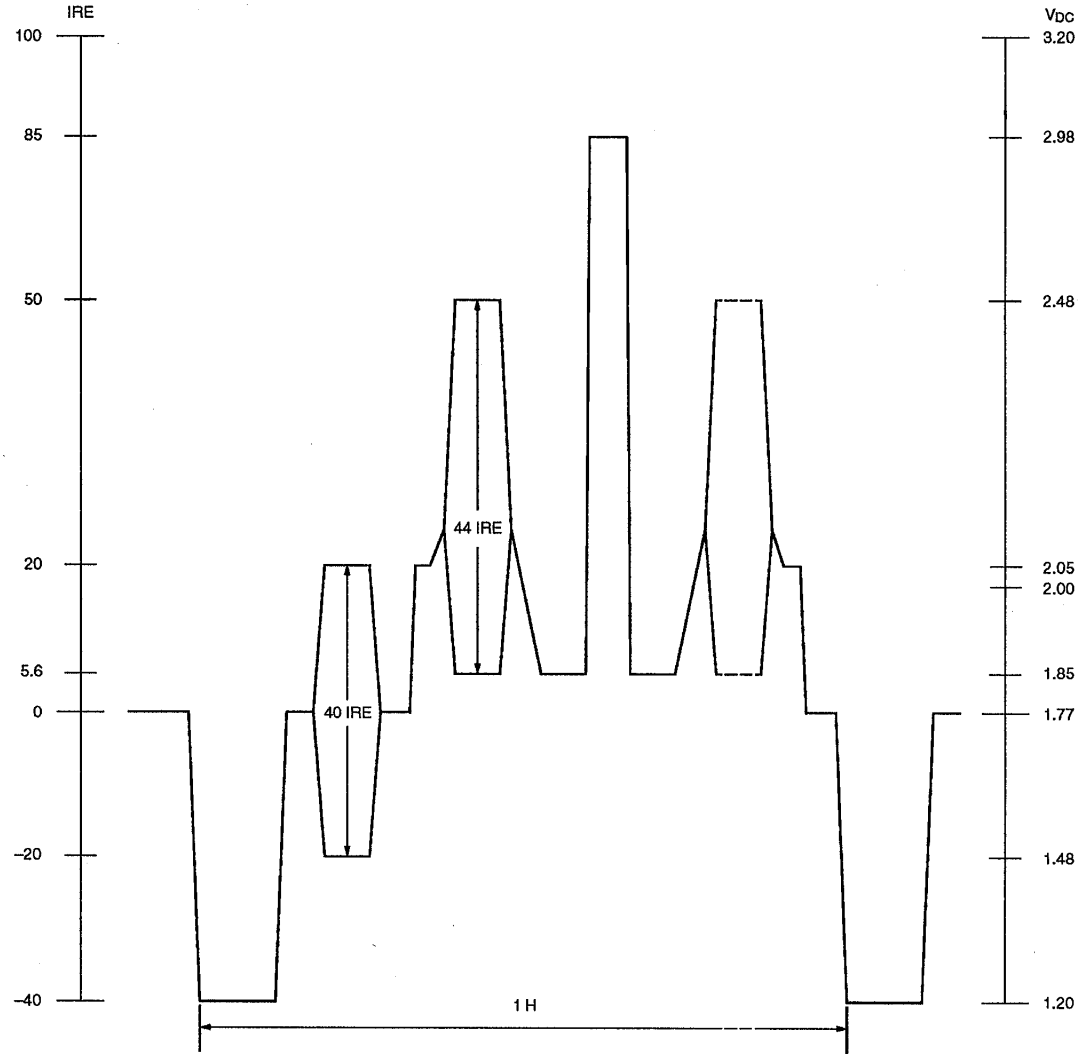
Line	Character number																							
1	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
3	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
4	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
5	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
6	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
7	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167
8	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
9	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215
10	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
11	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263
12	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287

The start address for each of the twelve display lines is specified in the display line address registers in RAM. An example arrangement of ROM and RAM addresses is shown in the following table. Note how both the RAM and ROM addresses increment.

Line	Character RAM and ROM configuration (hex)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	ROM 00	ROM 01	ROM 02	ROM 03	ROM 04	ROM 05	ROM 06	ROM 07	ROM 08	ROM 09	ROM 0A	ROM 0B	ROM 0C	ROM 0D	ROM 0E	ROM 0F	RAM 00	RAM 01	RAM 02	RAM 03	RAM 04	RAM 05	ROM 16	ROM 17
2	ROM 18	RAM 06	RAM 07	RAM 08	RAM 09	ROM 1D	ROM 1E	ROM 1F	ROM 20	ROM 21	RAM 0A	RAM 0B	RAM 0C	RAM 0D	RAM 0E	RAM 0F	ROM 28	ROM 29	ROM 2A	ROM 2B	ROM 2C	ROM 2D	ROM 2E	ROM 2F
3	ROM 30	RAM 10	RAM 11	RAM 12	RAM 13	RAM 14	ROM 36	ROM 37	ROM 38	ROM 39	RAM 15	RAM 16	RAM 17	RAM 18	RAM 19	RAM 1A	RAM 1B	RAM 1C	RAM 1D	RAM 1E	ROM 44	ROM 45	ROM 46	ROM 47
4	ROM 48	ROM 49	ROM 4A	ROM 4B	ROM 4C	RAM 1F	RAM 20	RAM 21	RAM 22	ROM 51	RAM 23	RAM 24	ROM 54	RAM 25	RAM 26	ROM 57	RAM 27	RAM 28	ROM 5A	ROM 5B	ROM 5C	ROM 5D	ROM 5E	ROM 5F
5	ROM 60	RAM 29	RAM 2A	RAM 2B	RAM 2C	RAM 2D	RAM 2E	RAM 2F	RAM 30	ROM 69	RAM 31	RAM 32	ROM 6C	RAM 33	RAM 34	ROM 6F	RAM 35	RAM 36	ROM 72	ROM 73	ROM 74	ROM 75	ROM 76	ROM 77
6	ROM 78	RAM 37	RAM 38	RAM 39	RAM 3A	RAM 3B	RAM 3C	RAM 3D	ROM 80	RAM 3E	RAM 3F	RAM 40	RAM 41	ROM 85	RAM 42	RAM 43	RAM 44	RAM 45	RAM 46	ROM 8B	RAM 47	RAM 48	ROM 8E	ROM 8F
7	RAM 49	RAM 4A	RAM 4B	RAM 4C	RAM 4D	RAM 4E	RAM 4F	RAM 50	RAM 51	RAM 52	RAM 53	RAM 54	ROM 9C	ROM 9D	ROM 9E	ROM 9F	ROM A0	ROM A1	ROM A2	ROM A3	ROM A4	ROM A5	ROM A6	ROM A7
8	RAM 55	RAM 56	RAM 57	RAM 58	RAM 59	RAM 5A	RAM 5B	RAM 5C	RAM 5D	RAM 5E	RAM 5F	RAM 60	ROM B4	ROM B5	ROM B6	ROM B7	ROM B8	ROM B9	ROM BA	ROM BB	ROM BC	ROM BD	ROM BE	ROM BF
9	ROM C0	ROM C1	ROM C2	ROM C3	ROM C4	ROM C5	ROM C6	ROM C7	ROM C8	ROM C9	ROM CA	ROM CB	RAM 61	RAM 62	RAM 63	RAM 64	RAM 65	RAM 66	RAM 67	RAM 68	RAM 69	RAM 6A	RAM 6B	RAM 6C
10	ROM D8	ROM D9	ROM DA	ROM DB	ROM DC	RAM 6D	RAM 6E	RAM 6F	RAM 70	RAM 71	RAM 72	RAM 73	RAM 74	RAM 75	RAM 76	RAM 77	RAM 78	RAM 79	RAM 7A	ROM EB	ROM EC	ROM ED	ROM EE	ROM EF
11	ROM F0	ROM F1	ROM F2	ROM F3	ROM F4	ROM F5	ROM F6	ROM F7	ROM F8	ROM F9	ROM FA	ROM FB	ROM FC	ROM FD	ROM FE	RAM 7B	RAM 7C	ROM 101	RAM 7D	RAM 7E	ROM 104	RAM 7F	RAM 80	ROM 107
12	RAM 81	RAM 82	RAM 83	RAM 84	RAM 85	RAM 86	RAM 87	RAM 88	RAM 89	RAM 8A	RAM 8B	RAM 8C	RAM 8D	RAM 8E	RAM 8F	RAM 90	RAM 91	RAM 92	RAM 93	RAM 94	RAM 95	RAM 96	RAM 97	ROM 11F

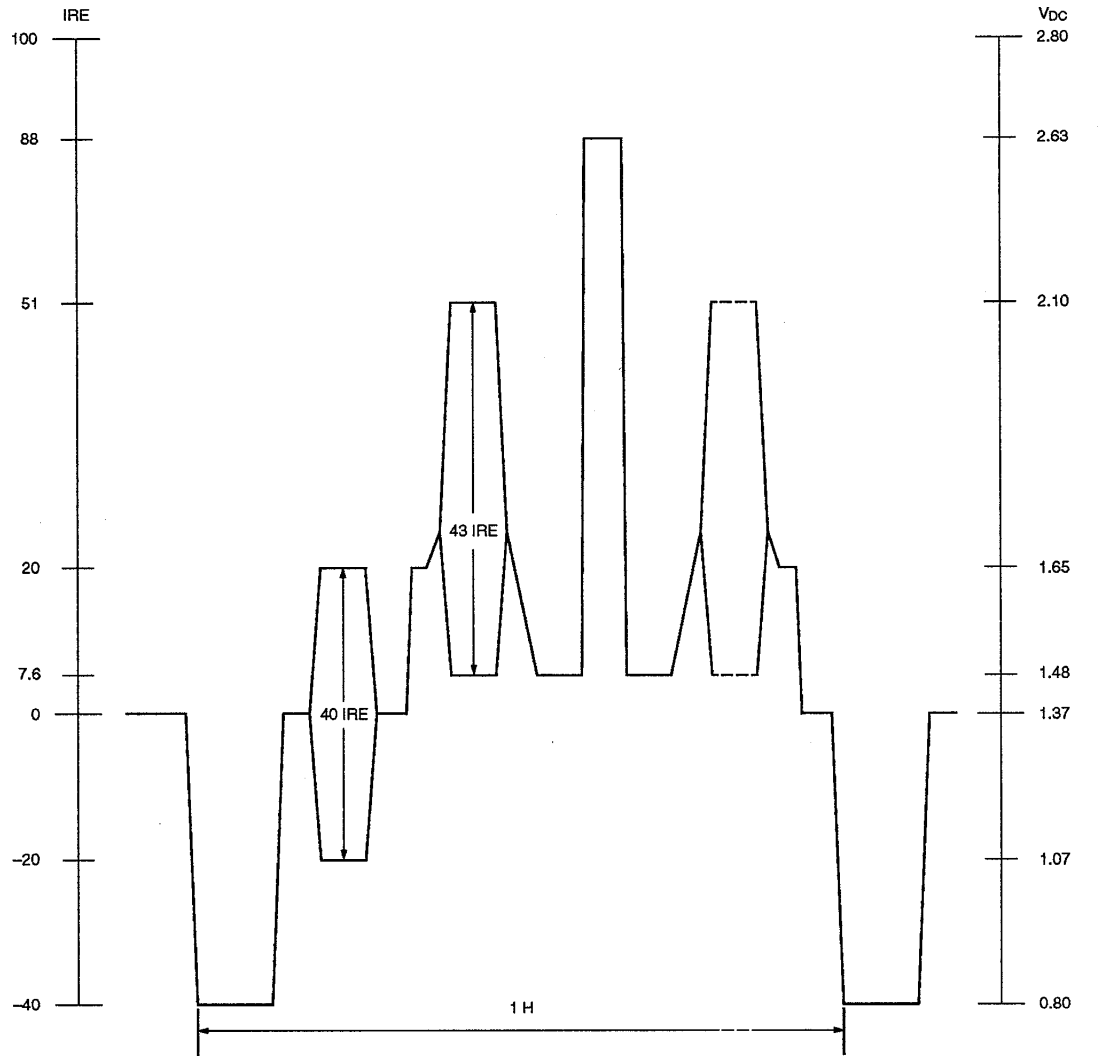
Composite Video Output

The character and background images are superimposed onto the composite video signal.
The composite video signal output levels when the sync pulse level is 1.2V and V_{DD}=5.000V are shown in the following figure and the voltages corresponding to the relative carrier amplitudes in the following table.



Relative carrier amplitude (IRE)	Output voltage amplitude (V)
100	3.200
85	2.986
50	2.485
20	2.057
5.6	1.851
0	1.771
–20	1.486
–40	1.200

The composite video signal output levels when the sync pulse level is 1.2V and V_{DD}=5.000V are shown in the following figure, and the voltages corresponding to the relative carrier amplitudes in the following table.



Relative carrier amplitude (IRE)	Output voltage amplitude (V)
100	2.800
88	2.628
51	2.100
20	1.657
7.6	1.480
0	1.375
–20	1.075
–40	0.800