

Ordering number: EN✕4088

CMOS LSI

SANYO

No. ✕4088

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 an 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.

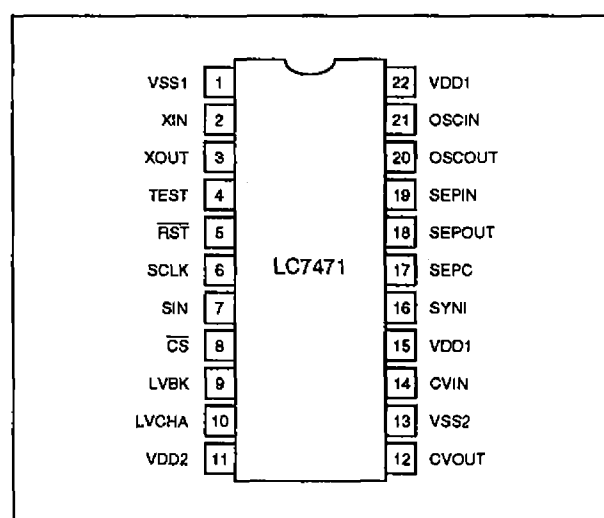
The LC7471 features selectable pixel width and pixel height, and 64 vertical and 64 horizontal display start positions. It also features a flashing enable bit for each character position.

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

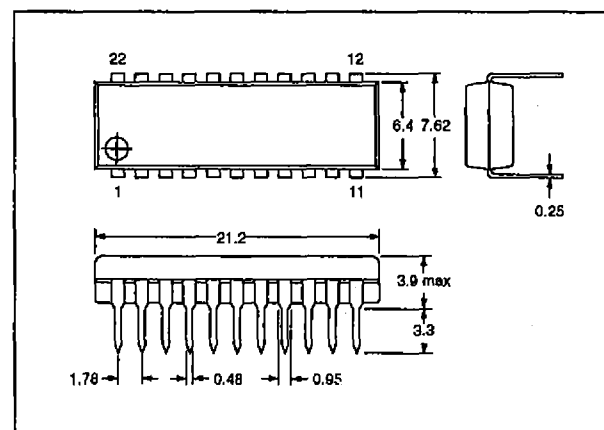
PINOUT



PACKAGE DIMENSIONS

Unit: mm

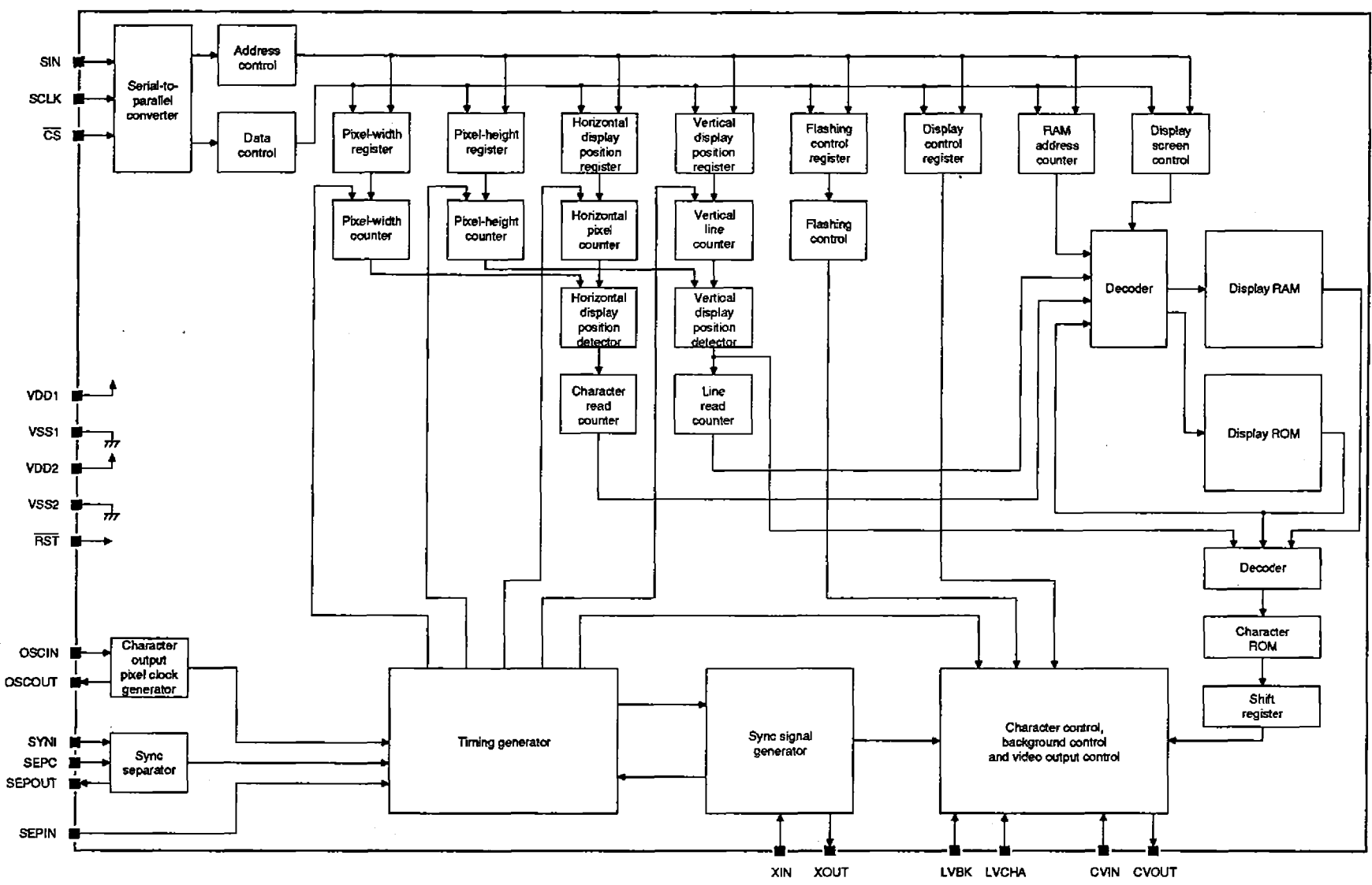
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SANYO Electric Co., Ltd. Semiconductor Business Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

5182JN(US) No. 4088-1/13

BLOCK DIAGRAM



LC7471

PIN DESCRIPTION

Number	Name	Description
1	VSS1	Digital circuit ground
2	XIN	Crystal oscillator input
3	XOUT	Crystal oscillator output
4	TEST	Test output
5	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	VDD2	Analog circuit supply
12	CVOUT	Composite video output
13	VSS2	Analog circuit ground
14	CVIN	Composite video input
15	VDD1	5 V 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	VDD1	5 V logic supply

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage range	V_{DD}	$V_{SS} - 0.3$ to $V_{SS} + 7.0$	V
Input voltage range	V_I	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Output voltage range	V_O	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Power dissipation	P_D	300 ($T_A = 25\text{ }^{\circ}\text{C}$)	mW
Operating temperature range	T_{opr}	-30 to 70	$^{\circ}\text{C}$
Storage temperature range	T_{stg}	-40 to 125	$^{\circ}\text{C}$

Recommended Operating Conditions

$T_A = 25\text{ }^{\circ}\text{C}$

Parameter	Symbol	Rating	Unit
Logic supply voltage	V_{DD1}	5	V
Analog supply voltage	V_{DD2}	5	V

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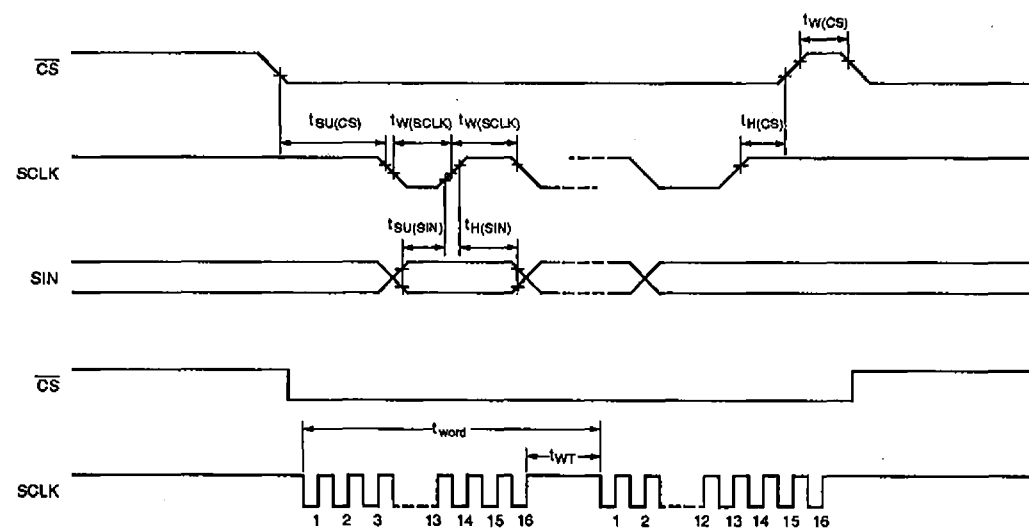
Parameter	Symbol	Rating	Unit
Logic supply voltage range	V_{DD1}	4.5 to 5.5	V
Analog supply voltage range	V_{DD2}	4.5 to $1.27V_{DD1}$	V

Electrical Characteristics

$V_{DD1} = 5\text{ V}$, $T_a = -30\text{ to }70\text{ }^{\circ}\text{C}$ unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply current	I_{DD}	$V_{RST} = V_{DD1}$, $f_{XTAL} = 14.31\text{ MHz}$, $f_{LC} = 7\text{ MHz}$, 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
$SINI$ composite video input voltage	V_{IN1}		—	2.0	2.5	V_{pp}
$CVIN$ composite video input voltage	V_{IN2}		—	2	—	V_{pp}
$OSCIN$ LOW-level input current	I_{IL}	$V_I = V_{SS}$	—1	—	—	μA
$\overline{CS}$, SIN , $\overline{RST}$, $SCLK$ and $SEPIN$ HIGH-level input current	I_{IH}	$V_I = V_{DD}$	—	—	1	μA
$SEPOUT$ LOW-level output voltage	V_{OL}	$V_{DD1} = 4.5\text{ V}$, $I_{OL} = 1\text{ mA}$	—	—	1.0	V
$SEPOUT$ HIGH-level output voltage	V_{OH}	$V_{DD1} = 4.5\text{ V}$, $I_{OH} = 1\text{ mA}$	3.5	—	—	V
Oscillator frequency	f_{osc}	$f_{XTAL} = 4f_{SC}$	—	14.318	—	MHz
		$f_{XTAL} = 2f_{SC}$	—	7.159	—	
		LC oscillator	6	7	10	
$CVOUT$ leakage current	I_L		—	—	10	μA

Timing Characteristics



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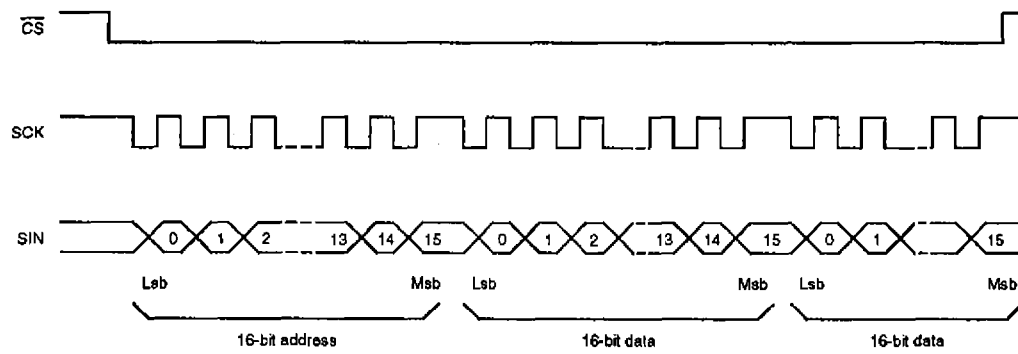
$V_{DD1} = 5 \pm 0.5 \text{ V}$, $T_a = -30 \text{ to } 75 \text{ }^\circ\text{C}$

Parameter	Symbol	Rating			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	C ₁	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

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Address	Memory contents																Description
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	
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	Horizontal display start position and pixel width
0BDH	0	0	0	0	VSZ31	VSZ30	VSZ21	VSZ20	VSZ11	VSZ10	VP5	VP4	VP3	VP2	VP1	VP0	Vertical display start position and pixel height
0BEH	0	0	0	0	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 $\text{HS} = T_C \times \left(4 \times \sum_{n=0}^5 2^n \text{HP}_n \right)$ 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 _{Cl} /pixel
0	1	2T _{Cl} /pixel
1	0	3T _{Cl} /pixel
1	1	4T _{Cl} /pixel

Table 2. Line 2 pixel width

HSZ21	HSZ20	Width
0	0	1T _{Cl} /pixel
0	1	2T _{Cl} /pixel
1	0	3T _{Cl} /pixel
1	1	4T _{Cl} /pixel

Table 3. Line 3 to line 12 pixel width

HSZ31	HSZ30	Width
0	0	1T _{Cl} /pixel
0	1	2T _{Cl} /pixel
1	0	3T _{Cl} /pixel
1	1	4T _{Cl} /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 $\overline{\text{RST}}$ 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 $\text{VS} = \text{H} \times \left(4 \times \sum_{n=0}^5 2^n \text{VP}_n \right)$ 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

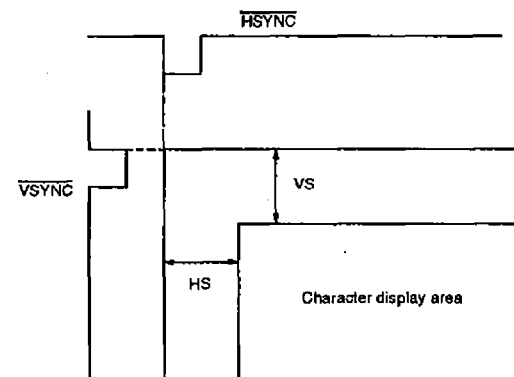
Table 5. Line 2 pixel height

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 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 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	INT/NON	Selects 262.5 lines/field, interlaced display when 0, and 263 lines/field, non-interlaced display, when 1.
C	—	No function

Table 7. Phase selection

PH1	PH0	Phase
0	0	$\pi/2$
0	1	π
1	0	$3\pi/2$
1	1	In phase

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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 $\overline{\text{RST}}$ resets all bits to 0.

Data bit	Name	Function
0	BCOL	Selects background color ON when 0 (valid for internal synchronization only), and OFF, 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 charac-

ter 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	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	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	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	ROM/RAM	0	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	Address of twenty-fourth character of line 64

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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	ROM/AM	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)	Line	Address (hex)	Line	Address (hex)
1	00	33	300	17	180	49	480
2	18	34	318	18	198	50	498
3	30	35	330	19	1B0	51	4B0
4	48	36	348	20	1C8	52	4C8
5	60	37	360	21	1E0	53	4E0
6	78	38	378	22	1F8	54	4F8
7	90	39	390	23	210	55	510
8	A8	40	3A8	24	228	56	528
9	C0	41	3C0	25	240	57	540
10	D8	42	3D8	26	258	58	558
11	F0	43	3F0	27	270	59	570
12	108	44	408	28	288	60	588
13	120	45	420	29	2A0	61	5A0
14	138	46	438	30	2B8	62	5B8
15	150	47	450	31	2D0	63	5D0
16	168	48	468	32	2E8	64	5E8

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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.

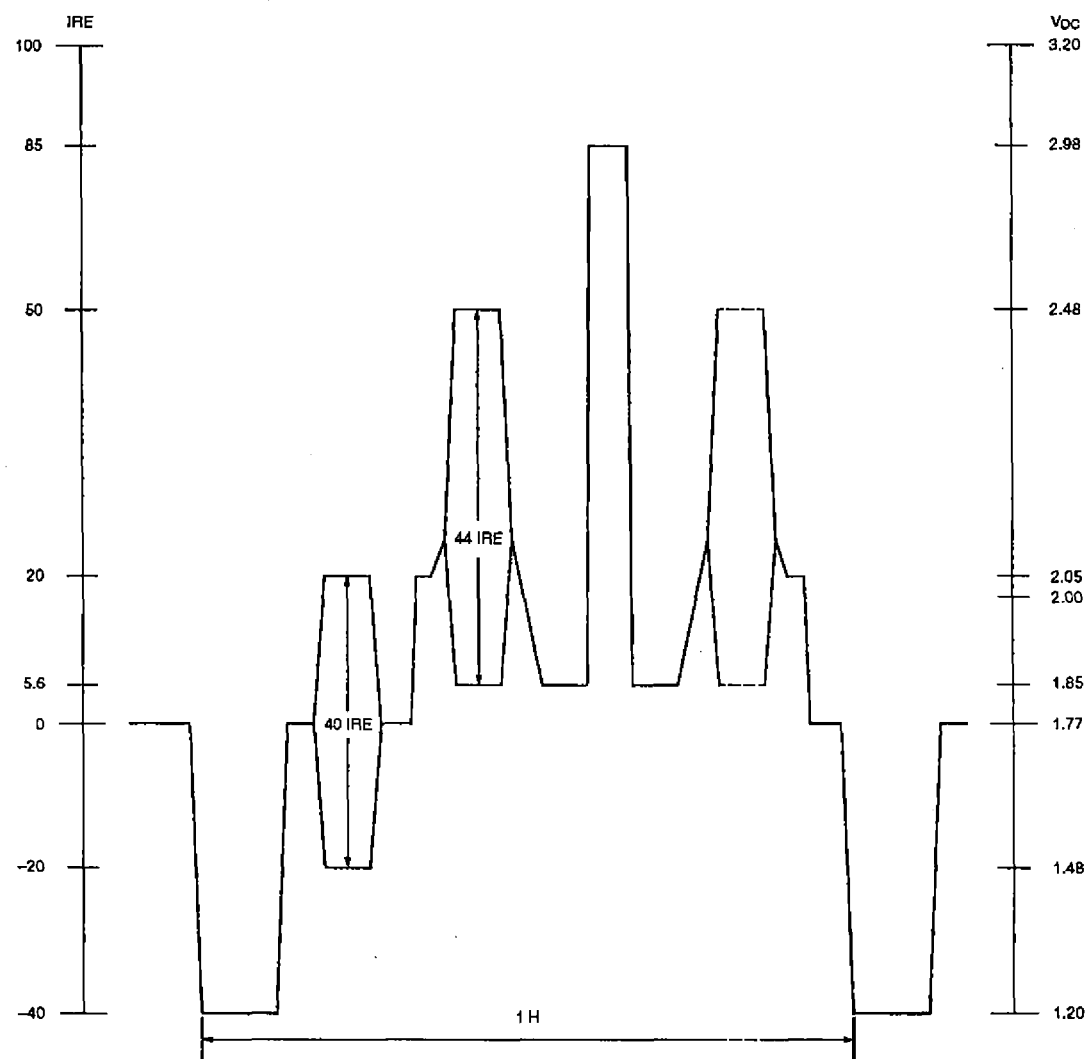
Line	Character RAM and ROM configuration (hex)																							
1	ROM 00	ROM 01	ROM 02	ROM 03	ROM 04	ROM 05	ROM 06	ROM 07	ROM 08	ROM 09	ROM 0A	ROM 0B	ROM 0C	ROM 0D	ROM 0E	ROM 0F	RAM 00	RAM 01	RAM 02	RAM 03	RAM 04	RAM 05	RAM 06	RAM 07
2	ROM 18	ROM 19	ROM 1A	ROM 1B	ROM 1C	ROM 1D	ROM 1E	ROM 1F	ROM 20	ROM 21	ROM 22	ROM 23	ROM 24	ROM 25	ROM 26	ROM 27	RAM 28	RAM 29	RAM 2A	RAM 2B	RAM 2C	RAM 2D	RAM 2E	RAM 2F
3	ROM 30	ROM 31	ROM 32	ROM 33	ROM 34	ROM 35	ROM 36	ROM 37	ROM 38	ROM 39	ROM 3A	ROM 3B	ROM 3C	ROM 3D	ROM 3E	ROM 3F	RAM 40	RAM 41	RAM 42	RAM 43	RAM 44	RAM 45	RAM 46	RAM 47
4	ROM 48	ROM 49	ROM 4A	ROM 4B	ROM 4C	ROM 4D	ROM 4E	ROM 4F	ROM 50	ROM 51	ROM 52	ROM 53	ROM 54	ROM 55	ROM 56	ROM 57	RAM 58	RAM 59	RAM 5A	RAM 5B	RAM 5C	RAM 5D	RAM 5E	RAM 5F
5	ROM 60	ROM 61	ROM 62	ROM 63	ROM 64	ROM 65	ROM 66	ROM 67	ROM 68	ROM 69	ROM 6A	ROM 6B	ROM 6C	ROM 6D	ROM 6E	ROM 6F	RAM 70	RAM 71	RAM 72	RAM 73	RAM 74	RAM 75	RAM 76	RAM 77
6	ROM 78	ROM 79	ROM 7A	ROM 7B	ROM 7C	ROM 7D	ROM 7E	ROM 7F	ROM 80	ROM 81	ROM 82	ROM 83	ROM 84	ROM 85	ROM 86	ROM 87	RAM 88	RAM 89	RAM 8A	RAM 8B	RAM 8C	RAM 8D	RAM 8E	RAM 8F
7	RAM 90	RAM 91	RAM 92	RAM 93	RAM 94	RAM 95	RAM 96	RAM 97	RAM 98	RAM 99	RAM 9A	RAM 9B	RAM 9C	RAM 9D	RAM 9E	RAM 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	RAM 61	RAM 62	RAM 63	RAM 64	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	ROM CC	ROM CD	ROM CE	ROM CF	RAM D0	RAM D1	RAM D2	RAM D3	RAM D4	RAM D5	RAM D6	RAM D7
10	ROM D8	ROM D9	ROM DA	ROM DB	ROM DC	ROM DD	ROM DE	ROM DF	ROM E0	ROM E1	ROM E2	ROM E3	ROM E4	ROM E5	ROM E6	ROM E7	RAM E8	RAM E9	RAM EA	RAM EB	RAM EC	RAM ED	RAM EE	RAM 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	ROM FF	RAM 100	RAM 101	RAM 102	RAM 103	RAM 104	RAM 105	RAM 106	RAM 107
12	RAM B1	RAM B2	RAM B3	RAM B4	RAM B5	RAM B6	RAM B7	RAM B8	RAM B9	RAM BA	RAM BB	RAM BC	RAM BD	RAM BE	RAM BF	RAM C0	RAM C1	RAM C2	RAM C3	RAM C4	RAM C5	RAM C6	RAM C7	RAM C8

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 1.2 V and $V_{DD} = 5.000$ V are shown in the

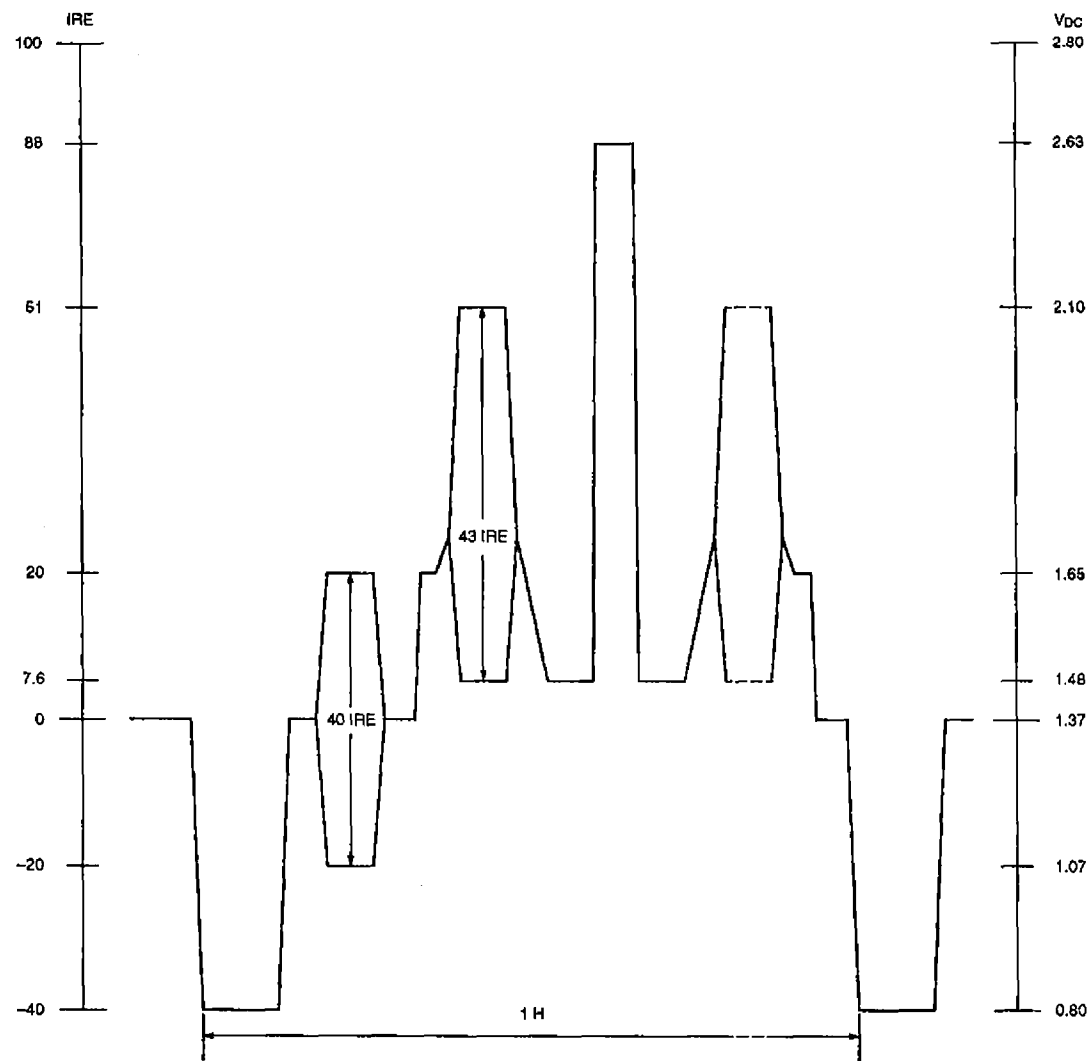
following figure and the voltages corresponding to the relative carrier amplitudes in the following table.



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

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The composite video signal output levels when the sync pulse level is 1.2 V and $V_{DD} = 5.000$ V 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 amplified (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