

**SANYO****LC7874E****CD Graphics Decoder****Overview**

The LC7874E is a CMOS LSI that provides the signal processing needed for compact disc graphics (CD-G) on a single chip. The LC7874E accepts subcode R to W signals output from a CD player DSP LC786X Series, LC7862XE Series, or LC7863XE Series device, and performs de-interleaving, error detection and correction, graphic instruction processing, and image processing.

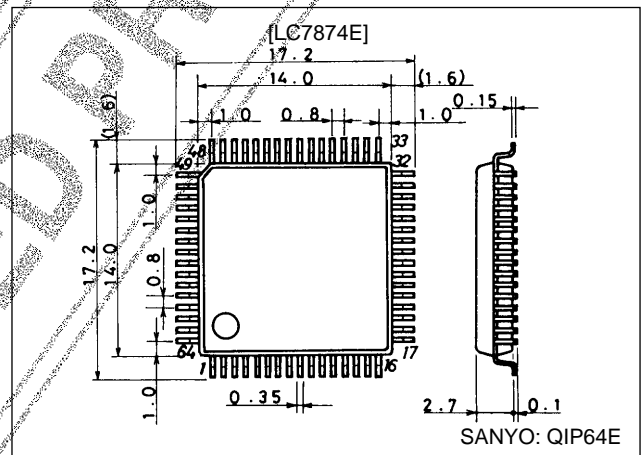
**Features**

- A CD-G decoder can be configured using a three-chip combination of this LSI—the LC7874E—with external RAM (64K × 4 bits) and an LC78010E digital RGB encoder.
- Performs insertion and protection of CD subcode R to W sync signals and detection of R to W signal de-interleave error signals.
- Has two crystal oscillators, for NTSC and PAL, with simple switchover by means of a control pin. Connecting a crystal resonator of 14.31818 MHz for NTSC and 17.734476 MHz for PAL enables the standard clock and other necessary timings to be generated internally.
- Performs CD graphics instruction processing and drawing functions, and controls image display.

- Has microcomputer interface functions, allowing set upgrading.
- Provides superimposition support.
- Has a color bar signal output function.
- DRAM interface and RGB output and sync signal output are 3-state outputs.

**Package Dimensions**

unit: mm

**3159-QFP64E**

- CCB is a trademark of SANYO ELECTRIC CO., LTD.
- CCB is SANYO's original bus format and all the bus addresses are controlled by SANYO.

**Specifications****Electrical Characteristics at Ta = -30°C to +85°C**

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	$V_{DD}$	$V_{DD}$	$V_{SS} - 0.3$ to $V_{SS} + 7.0$	V
Input voltage	$V_{IN}$	S1, S2, SFSY, PW, SBSY, CE, DI, CL, MUTE, DB0 to 3, CB, CE1, CE2, CE3, LINE, HRESET, VRESET, INIT, RESET, N/P, SON, XIN1, XIN2	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Output voltage	$V_{OUT}$	SBCK, DO, CDGM, WE, RAS, A0 to 7, DB0 to 3, CAS, OE, ROUT0 to 3, GOUT0 to 3, BOUT0 to 3, HSYNC, CSYNC, BLANK, YS, 4FSCO, EFLG, FSCO, XOUT1, XOUT2	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Allowable power dissipation	$Pd_{max}$	Ta = 25°C	500	mW
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-40 to +125	°C

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## LC7874E

### Allowable Operating Ranges at Ta = -30°C to +85°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply voltage	V <sub>DD</sub>	V <sub>DD</sub>	3.0	5.0	5.5	V
Input high-level voltage	V <sub>IH1</sub>	S1, S2, CB LINE, N/P, SON	0.7 V <sub>DD</sub>		V <sub>DD</sub> + 0.3	V
	V <sub>IH2</sub>	INIT, RESET	0.8 V <sub>DD</sub>		V <sub>DD</sub> + 0.3	V
	V <sub>IH3</sub>	CL	0.8 V <sub>DD</sub>		5.8	V
	V <sub>IH4</sub>	DB0 to DB3, HRESET, VRESET	2.2		V <sub>DD</sub> + 0.3	V
	V <sub>IH5</sub>	SFSY, PW, SBSY, CE, DI, MUTE, CE1 to CE3	2.2		5.8	V
Input low-level voltage	V <sub>IL1</sub>	S1, S2, CB, LINE, N/P, SON	V <sub>SS</sub> - 0.3		0.3 V <sub>DD</sub>	V
	V <sub>IL2</sub>	CL, INIT, RESET	V <sub>SS</sub> - 0.3		0.2 V <sub>DD</sub>	V
	V <sub>IL3</sub>	SFSY, PW, SBSY, CE, DI, MUTE, DB0 to DB3, CE1 to CE3, HRESET, VRESET	V <sub>SS</sub> - 0.3		0.8	V
Input frequency	F <sub>SCIN1</sub>	XIN1		14.31818		MHz
	F <sub>SCIN2</sub>	XIN2		17.734476		MHz
Input amplitude	V <sub>IN</sub>	XIN1, XIN2	0.5		V <sub>DD</sub>	Vp-p

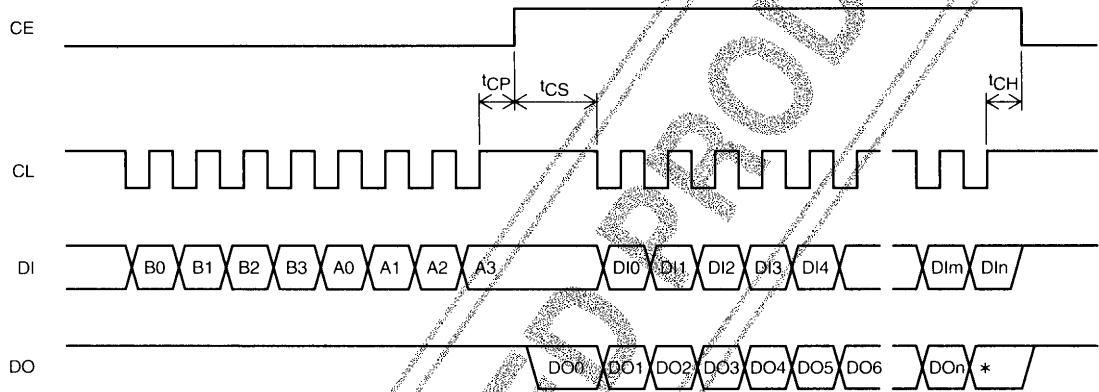
### Electrical Characteristics at Ta = -30 to +85°C, V<sub>DD</sub> = 5 V unless otherwise specified

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Input high-level current	I <sub>IH1</sub>	S1, S2, SFSY, PW, SBSY, CE, DI, CL, MUTE, DB0 to DB3, LINE, HRESET, VRESET, CE1 to 3, INIT, RESET, N/P, SON: V <sub>IN</sub> = V <sub>DD</sub>			5	μA
	I <sub>IH2</sub>	CB: V <sub>IN</sub> = V <sub>DD</sub>	30	100	200	μA
Input low-level current	I <sub>IL1</sub>	S1, S2, SFSY, PW, SBSY, CE, DI, CL, MUTE, DB0 to DB3, CB, LINE, HRESET, VRESET, CE1 to 3, INIT, RESET, N/P, SON: V <sub>IN</sub> = V <sub>SS</sub>	-5			μA
Output high-level voltage	V <sub>OH</sub>	SBCK, WE, RAS, A0 to 7, CAS, OE, DB0 to 3, CDGM, ROUT0 to 3, GOUT0 to 3, BOUT0 to 3, FSCO, 4FSCO, HSYNC, YS, CSYNC, BLANK, EFLG: I <sub>OH</sub> = -0.5 mA	V <sub>DD</sub> - 1		V <sub>DD</sub>	V
Output low-level voltage	V <sub>OL</sub>	SBCK, WE, RAS, A0 to 7, CAS, OE, DB0 to 3, CDGM, ROUT0 to 3, GOUT0 to 3, BOUT0 to 3, FSCO, 4FSCO, HSYNC, YS, CSYNC, BLANK, EFLG: I <sub>OL</sub> = 2.0 mA	V <sub>SS</sub>		0.4	V
Output off leakage current	I <sub>OFF</sub>	A0 to A7, RAS, CAS, OE, WE, DB0 to DB3, HSYNC, ROUT0 to 3, GOUT0 to 3, BOUT0 to 3, CSYNC, BLANK, FSCO, 4FSCO	-5		+5	μA
Built-in feedback resistance	R <sub>X</sub>	XIN1, XIN2		1		MΩ
Clock frequency	f <sub>o</sub>	SBCK		220		kHz
Operating current drain	I <sub>DD</sub>	V <sub>DD</sub>		26	40	mA

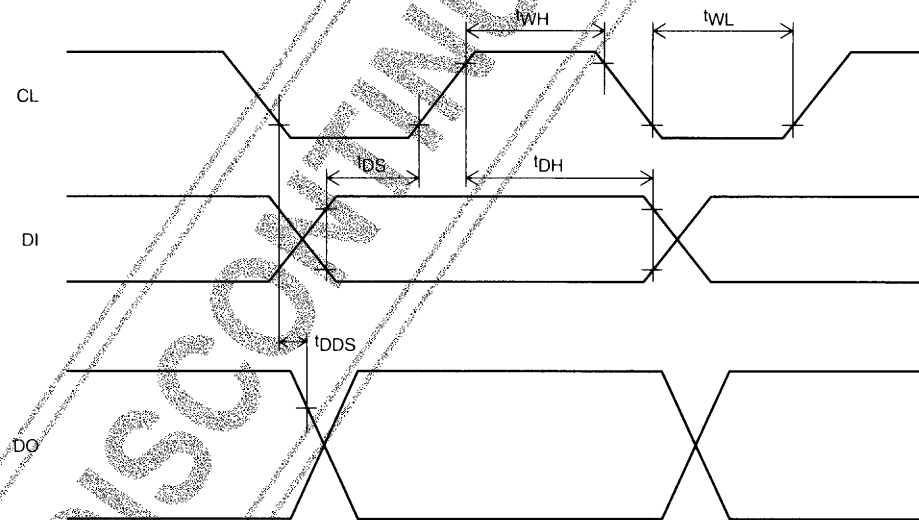
## LC7874E

### Timing Characteristics (Microcontroller Interface Timing) at $T_a = 25^\circ\text{C}$ , $V_{DD} = 5\text{ V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Input minimum pulse width	$t_{WH}$	CL, high pulse width	400			ns
	$t_{WL}$	CL, low pulse width	400			ns
Data setup time	$t_{DS}$	DI, CL	200			ns
Data hold time	$t_{DH}$	DI, CL	200			ns
Data hold time	$t_{DOH}$	DO, CL	130		300	ns
CE wait time	$t_{CP}$	CE, CL	400			ns
CE setup time	$t_{CS}$	CE, CL	400			ns
CE hold time	$t_{CH}$	CE, CL	400			ns



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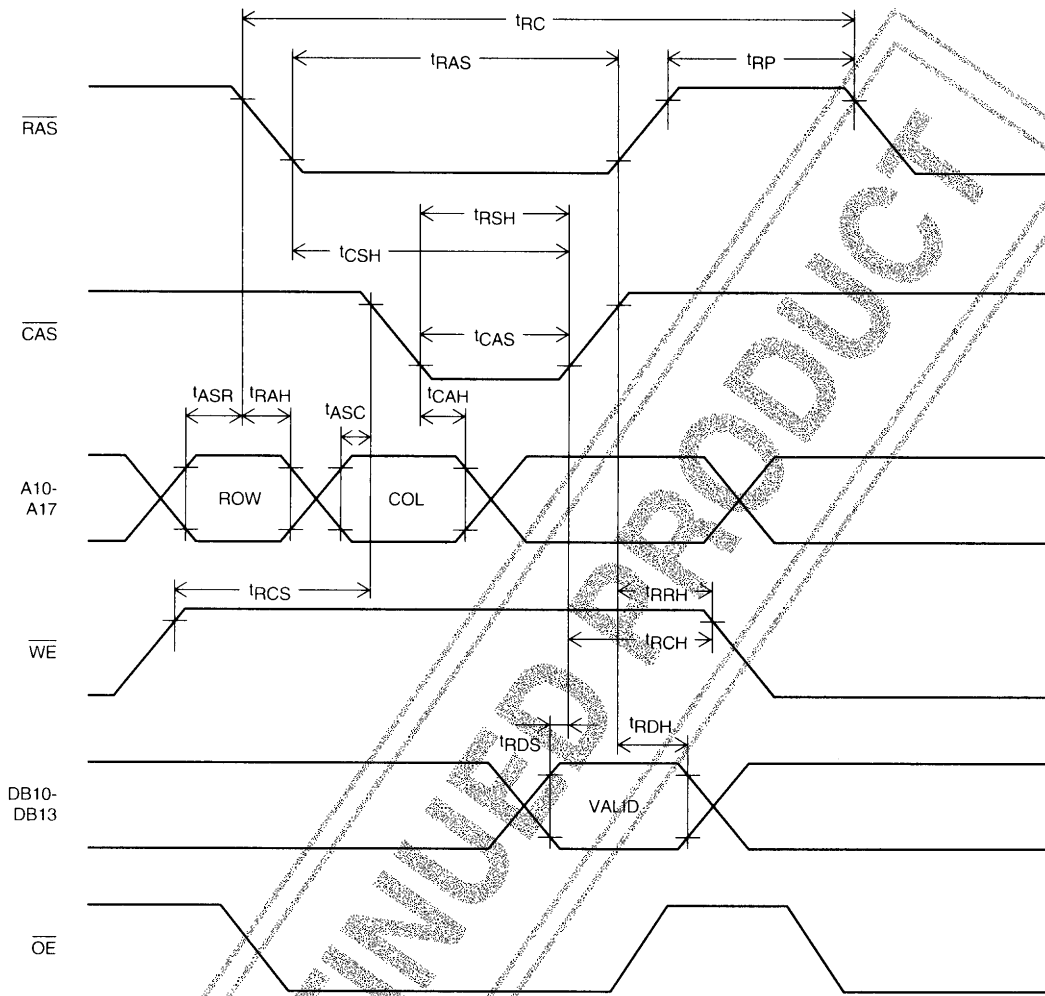
LC7874E

Timing Characteristics (DRAM Access Timing) at Ta = 25°C, V<sub>DD</sub> = 5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Random read/write cycle time	t <sub>RC</sub>		250			ns
Page mode cycle time	t <sub>PC</sub>		130			ns
RAS precharge time	t <sub>RP</sub>		100			ns
RAS pulse width	t <sub>RAS</sub>		120			ns
RAS pulse width (page mode)	t <sub>RASP</sub>				18000	ns
RAS hold time	t <sub>RSH</sub>		60			ns
CAS hold time	t <sub>CSH</sub>		120			ns
CAS pulse width	t <sub>CAS</sub>		60			ns
CAS precharge time	t <sub>CPN</sub>		50			ns
CAS precharge time	t <sub>CP</sub>	(In page mode)	50			ns
Row address setup time	t <sub>ASR</sub>		100			ns
Row address hold time	t <sub>RAH</sub>		50			ns
Column address setup time	t <sub>ASC</sub>		0			ns
Column address hold time	t <sub>CAH</sub>		50			ns
Read command setup time	t <sub>RCS</sub>		150			ns
Read command hold time	t <sub>RCH</sub>	(Referenced to CAS)	120			ns
Read command hold time	t <sub>RRH</sub>	(Referenced to RAS)	120			ns
Write command setup time	t <sub>WCS</sub>		100			ns
Write command hold time	t <sub>WCH</sub>		50			ns
Write command pulse width	t <sub>WP</sub>		150			ns
Write data setup time	t <sub>DS</sub>		100			ns
Write data hold time	t <sub>DH</sub>		100			ns
CAS setup time	t <sub>CSR</sub>	(CAS before RAS)	50			ns
CAS hold time	t <sub>CHR</sub>	(CAS before RAS)	50			ns
RAS precharge CAS active time	t <sub>RPC</sub>		50			ns
Read data setup time	t <sub>RDS</sub>		20			ns
Read data hold time	t <sub>RDH</sub>		10			ns
Refresh time	t <sub>REF</sub>				3.5	ms

DISCONTINUED PRODUCT

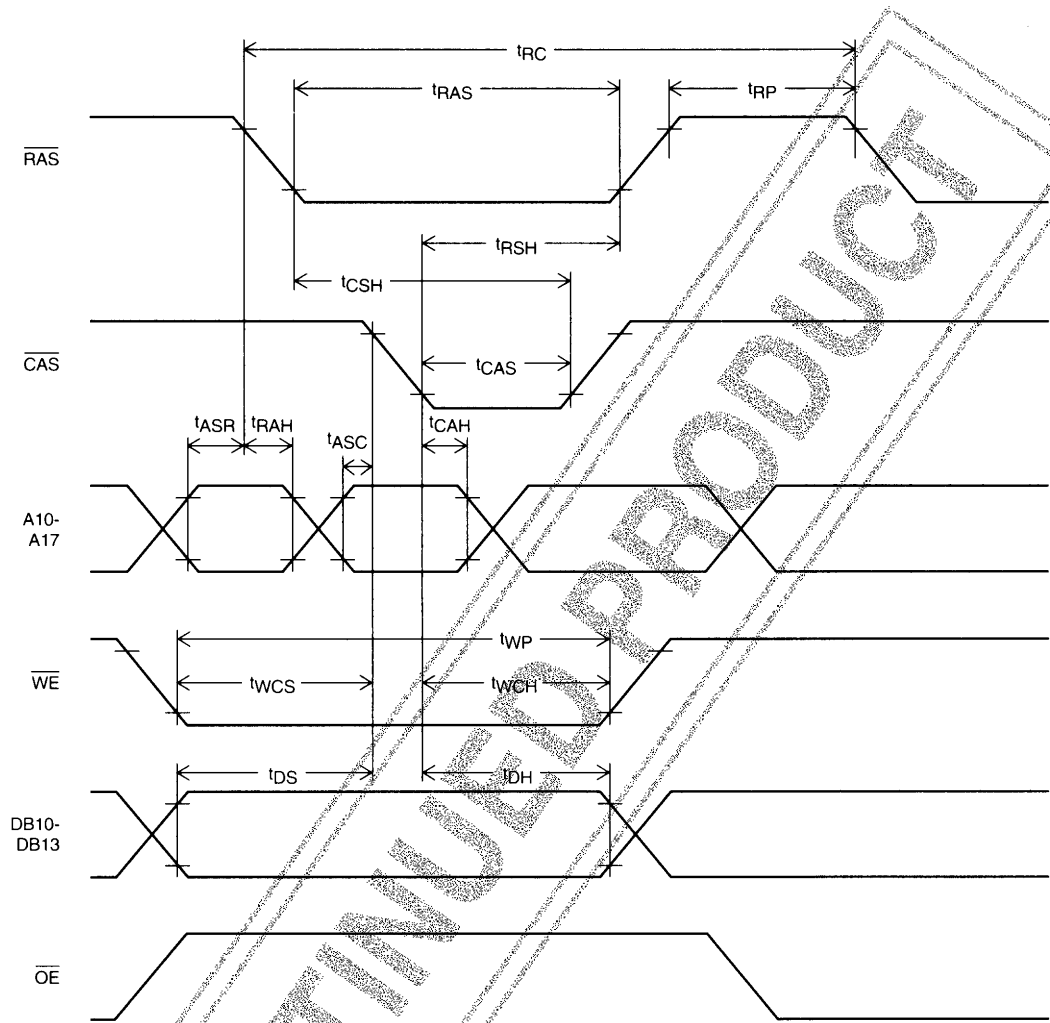
DRAM Read Cycle



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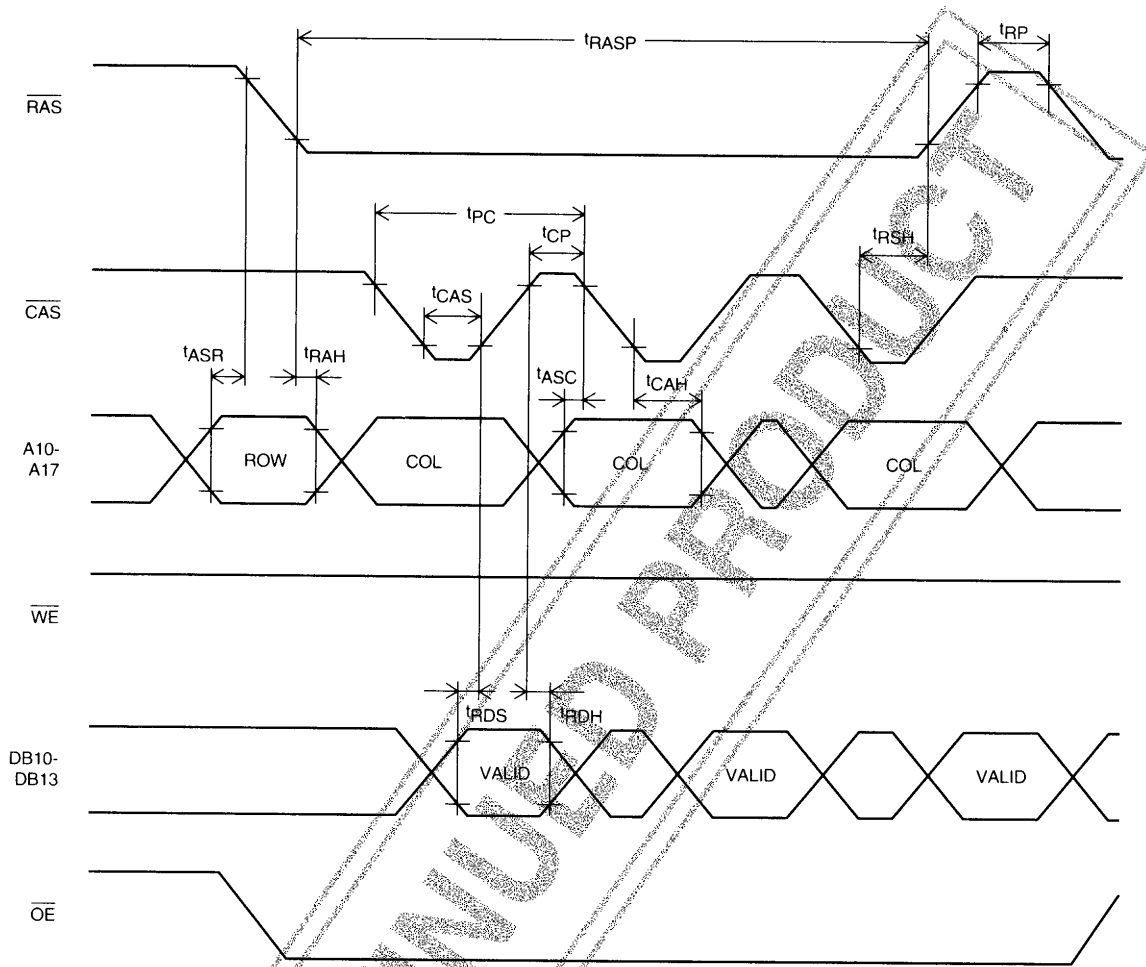
DRAM Early Write Cycle



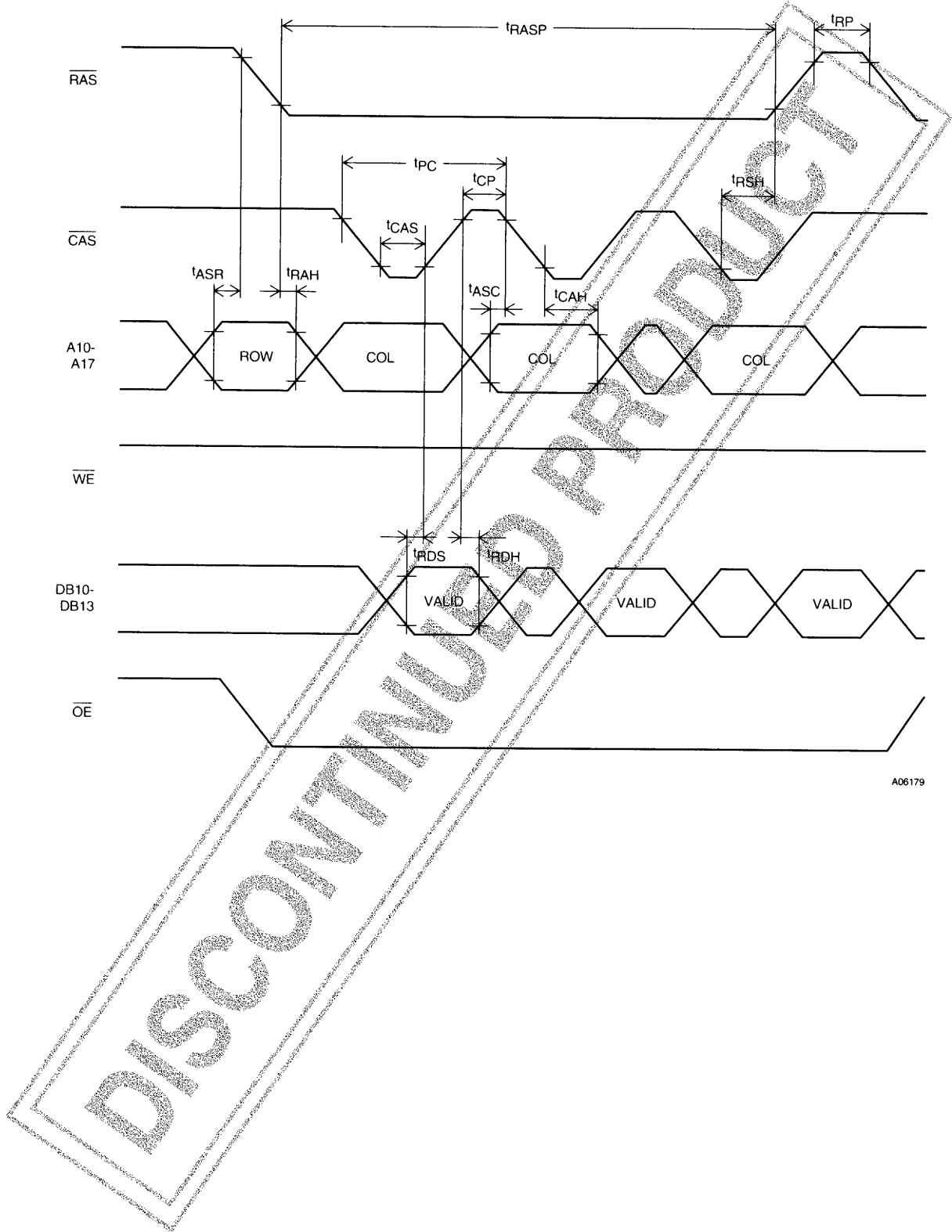
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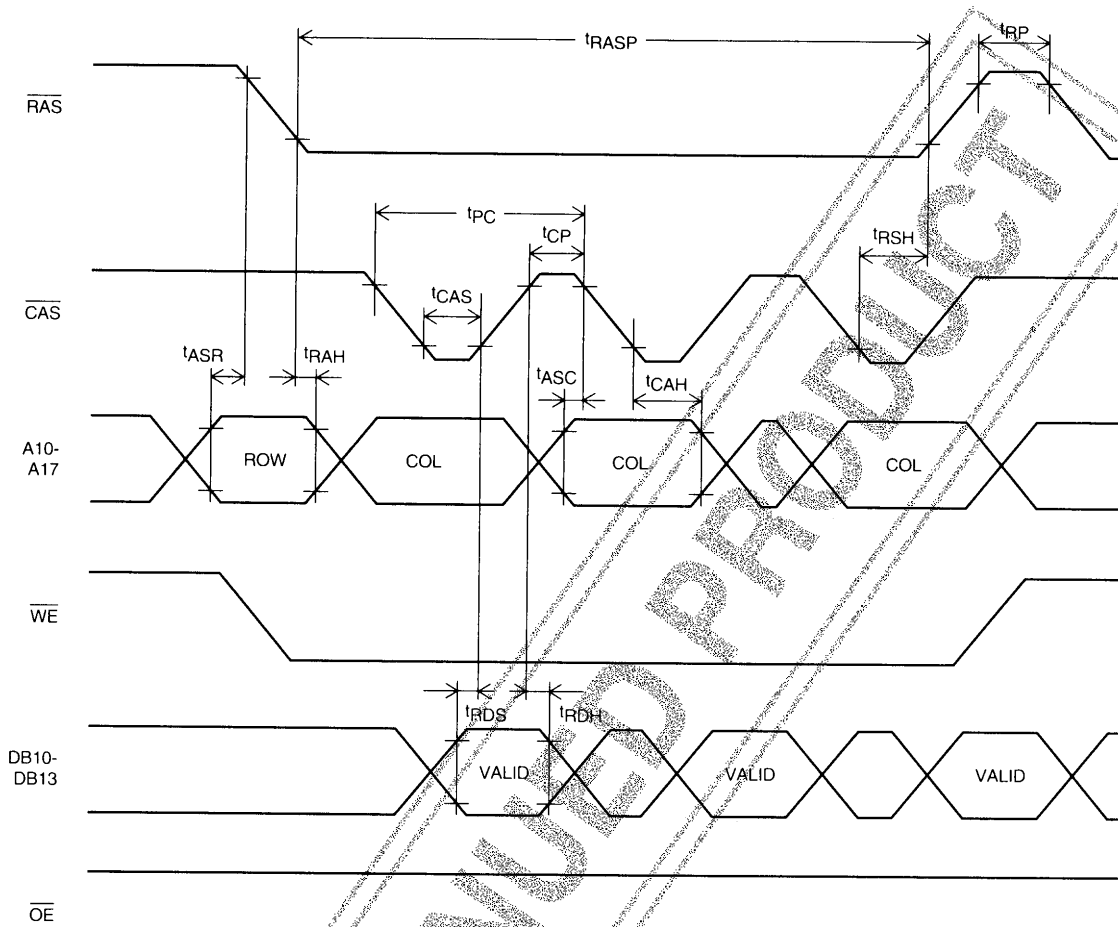
DRAM Page Mode Read Cycle



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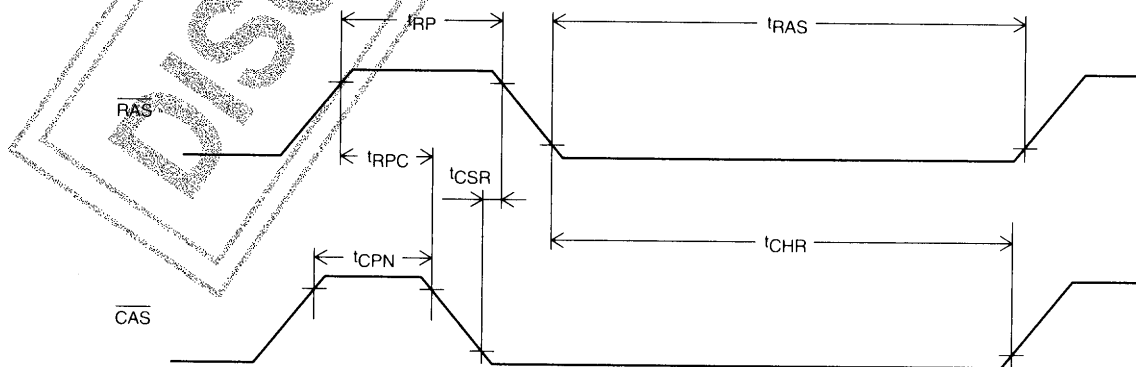


DRAM Page Mode Write Cycle



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DRAM CAS-Before-RAS Refresh Cycle

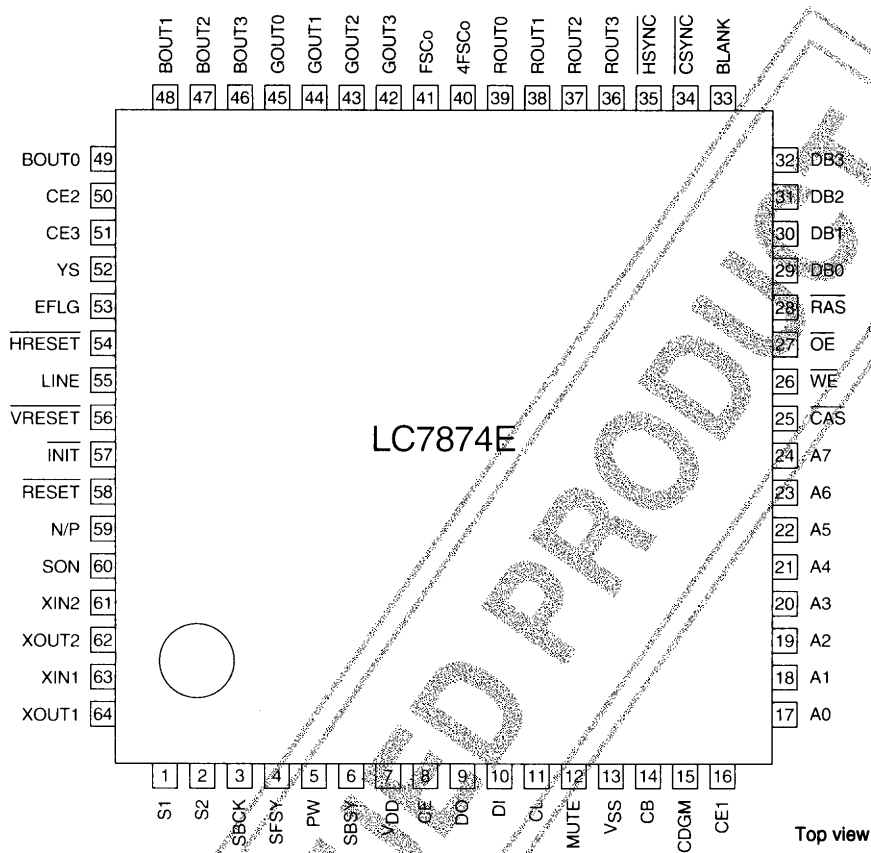


A06181



LC7874E

Pin Assignment



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## LC7874E

### Pin Functions

Pin	Pin Symbol	Pin Name	I/O	Polarity	Function															
1	S1	CD DSP selection pins	In	Positive	<table border="1"> <thead> <tr> <th>S1</th> <th>S2</th> <th>Selected CD DSP</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>LC7861N/67</td> </tr> <tr> <td>1</td> <td>0</td> <td>LC7860K/63</td> </tr> <tr> <td>0</td> <td>1</td> <td>Setting prohibited</td> </tr> <tr> <td>1</td> <td>1</td> <td>LC7868/62X/63X</td> </tr> </tbody> </table>	S1	S2	Selected CD DSP	0	0	LC7861N/67	1	0	LC7860K/63	0	1	Setting prohibited	1	1	LC7868/62X/63X
S1	S2				Selected CD DSP															
0	0				LC7861N/67															
1	0				LC7860K/63															
0	1	Setting prohibited																		
1	1	LC7868/62X/63X																		
2	S2																			
3	SBCK	Clock output pin	Out	—	Subcode R to W read clock output															
4	SFSY	Sync signal input pin	In	Positive	Subcode frame sync signal input (MORE+ input)															
5	PW	Data input pin	In	Positive	Subcode R to W data input (MORE+ input)															
6	SBSY	Sync signal input pin	In	Positive	Subcode block sync signal input (MORE+ input)															
7	V <sub>DD</sub>	Power supply pin (+5 v)	—	—	Digital power supply															
8	CE	Enable input pin	In	Positive	Serial input/output data control input (MORE+ input)															
9	DO	Data output pin	Out	Positive	Serial data output (Not open-drain)															
10	DI	Data input pin	In	Positive	Serial data input (MORE+ input)															
11	CL	Clock input pin	In	Positive	Serial data input/output clock input (MORE+ input)															
12	MUTE	Data input pin	In	Positive	Control signal input invalidating subcode data (MORE+ input)															
13	V <sub>SS</sub>	Ground pin (GND)	—	—	GND															
14	CB	Color bar selection pin	In	Positive	L: Normal mode, H: Color bar output (built-in pull-down resistor)															
15	CDGM	Graphic data discrimination output pin	Out	Positive	Goes high when graphics data is input (can be reset low by command control).															
16	CE1	DRAM control input pin	In	Positive	Signal input setting DRAM connection pin to high impedance (MORE+ input)															
17	A0	DRAM output pin	I/O	Positive	DRAM address (A0) output															
18	A1	DRAM output pin	I/O	Positive	DRAM address (A1) output															
19	A2	DRAM output pin	I/O	Positive	DRAM address (A2) output															
20	A3	DRAM output pin	I/O	Positive	DRAM address (A3) output															
21	A4	DRAM output pin	I/O	Positive	DRAM address (A4) output															
22	A5	DRAM output pin	I/O	Positive	DRAM address (A5) output															
23	A6	DRAM output pin	I/O	Positive	DRAM address (A6) output															
24	A7	DRAM output pin	I/O	Positive	DRAM address (A7) output															
25	$\overline{\text{CAS}}$	DRAM output pin	3ST	Negative	DRAM column address strobe signal output															
26	$\overline{\text{WE}}$	DRAM output pin	3ST	Negative	DRAM data write enable signal output															
27	$\overline{\text{OE}}$	DRAM output pin	3ST	Negative	DRAM data read enable signal output															
28	$\overline{\text{RAS}}$	DRAM output pin	3ST	Negative	DRAM row address strobe signal output															
29	DB0	DRAM input/output pin	I/O	Positive	DRAM data (D0) input/output															
30	DB1	DRAM input/output pin	I/O	Positive	DRAM data (D1) input/output															
31	DB2	DRAM input/output pin	I/O	Positive	DRAM data (D2) input/output															
32	DB3	DRAM input/output pin	I/O	Positive	DRAM data (D3) input/output															
33	BLANK	Blank signal output pin	3ST	Positive	Video signal blanking period output															
34	$\overline{\text{CSYNC}}$	Composite sync output pin	3ST	Negative	Composite sync signal output															

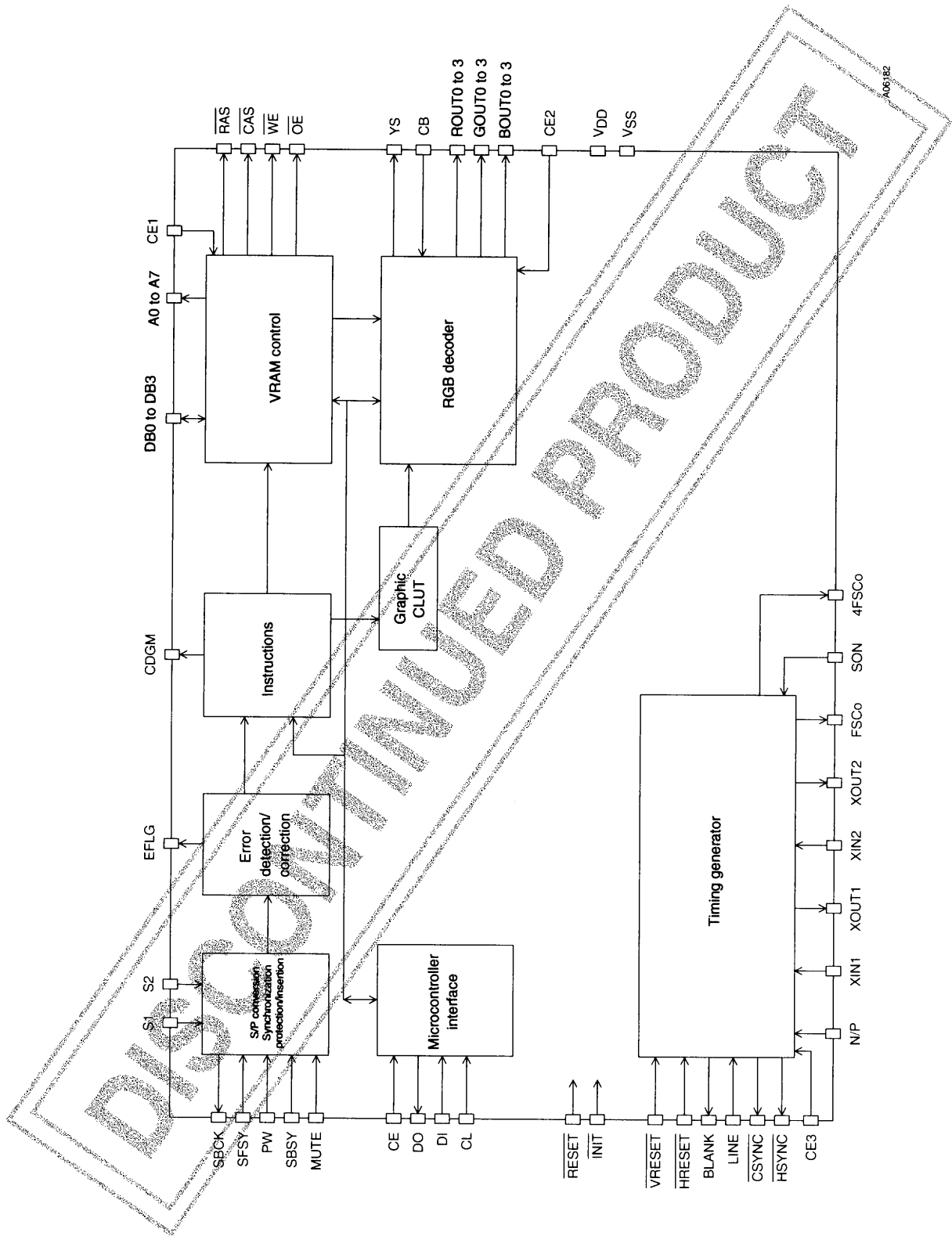
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## LC7874E

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Pin	Pin Symbol	Pin Name	I/O	Polarity	Function
35	$\overline{\text{HSYNC}}$	Horizontal synchronization output pin	3ST	Negative	Horizontal sync signal output
36	ROUT3	R data output pin	I/O	Positive	Video signal R3 data output
37	ROUT2	R data output pin	I/O	Positive	Video signal R2 data output
38	ROUT1	R data output pin	I/O	Positive	Video signal R1 data output
39	ROUT0	R data output pin	I/O	Positive	Video signal R0 data output
40	4FSC <sub>0</sub>	Clock output pin	3ST	Positive	4 × FSC clock output NTSC: 14.31818 MHz PAL: 17.734476 MHz
41	FSC <sub>0</sub>	Clock output pin	3ST	Positive	Subcarrier clock output NTSC: 3.579545 MHz PAL: 4.433619 MHz
42	GOUT3	G data output pin	I/O	Positive	Video signal G3 data output
43	GOUT2	G data output pin	I/O	Positive	Video signal G2 data output
44	GOUT1	G data output pin	I/O	Positive	Video signal G1 data output
45	GOUT0	G data output pin	I/O	Positive	Video signal G0 data output
46	BOUT3	B data output pin	I/O	Positive	Video signal B3 data output
47	BOUT2	B data output pin	I/O	Positive	Video signal B2 data output
48	BOUT1	B data output pin	I/O	Positive	Video signal B1 data output
49	BOUT0	B data output pin	I/O	Positive	Video signal B0 data output
50	CE2	Video output control input pin	In	Positive	Signal input setting video output pin to high impedance (MORE+ input)
51	CE3	Sync signal control input pin	In	Positive	Signal input setting sync signal output pin to high impedance (MORE+ input)
52	YS	Superimposition output pin	Out	Positive	Superimposition control output
53	EFLG	Error status monitor output pin	Out	Positive	Error status monitor signal output
54	$\overline{\text{HRESET}}$	External horizontal synchronization input pin	In	Negative	External horizontal synchronization timing control pin
55	LINE	Line number selection pin	In	—	Line number selection input NTSC : L = 263H, H = 262H PAL : H = 312H, L = 314H
56	$\overline{\text{VRESET}}$	External vertical synchronization input pin	In	Negative	External vertical synchronization timing control pin
57	$\overline{\text{INIT}}$	Initial input pin	In	Negative	System initial signal input
58	$\overline{\text{RESET}}$	Reset input pin	In	Negative	System reset signal input
59	N/P	NTSC/PAL selection input pin	In	Positive	NTSC/PAL selection input L: NTSC, H: PAL
60	SON	Superimposition control pin	In	Positive	Superimposition ON/OFF control input H: Superimposition ON
61	XIN2	Crystal oscillator connection pins	In	—	PAL crystal oscillator connection pin (4Fsc = 17.734476 MHz)
62	XOUT2		Out	—	
63	XIN1	Crystal oscillator connection pins	In	—	NTSC crystal oscillator connection pin (4Fsc = 14.31818 MHz)
64	XOUT1		Out	—	

Block Diagram



A06182

**CD-G Instructions**

The contents of instructions in the CD Red Book which are supported by the LC7874E are as follows.

ZERO mode (MODE = 0, ITEM = 0)

LINE GRAPHICS mode (MODE = 1, ITEM = 0)

- ① INSTRUCTION (4): Write FONT
- ② INSTRUCTION (12): Write Scroll SCREEN

TV GRAPHICS mode (MODE = 1, ITEM = 1)

- ① INSTRUCTION (1): Preset MEMORY
- ② INSTRUCTION (2): Preset BORDER
- ③ INSTRUCTION (6): Write FONT FOREGROUND/BACKGROUND
- ④ INSTRUCTION (20): scroll SCREEN with preset
- ⑤ INSTRUCTION (24): scroll SCREEN with copy
- ⑥ INSTRUCTION (30): Load CLUT color-0 color-7
- ⑦ INSTRUCTION (31): Load CLUT color-8 color-15
- ⑧ INSTRUCTION (38): EXCLUSIVE-OR FONT

**Outline of Functions**

1. Crystal clock oscillation: XIN1, XOUT1, XIN2, XOUT2, N/P, 4FSCO, FSCO

XIN1 and XOUT1 are 14.31818 MHz (NTSC) crystal oscillator connection pins, and XIN2 and XOUT2 are 17.734476 MHz (PAL) crystal oscillator connection pins. Both modes can be supported by switching the N/P pin. The 4FSCO pin outputs the Xtal OSC clock, and the FSCO pin outputs this clock divided by 4. The pin functions in each mode are shown below.

XIN1, XOUT1	XIN2, XOUT2	N/P	TV system	4FSCO	FSCO
14.31818 MHz	*	L	NTSC/M	14.31818 MHz	3.579545 MHz
*	17.734476 MHz	H	PAL/GBIH	17.734476 MHz	4.433619 MHz

2. Subcode interface: S1, S2, SBCK, SFSY, PW, SBSY

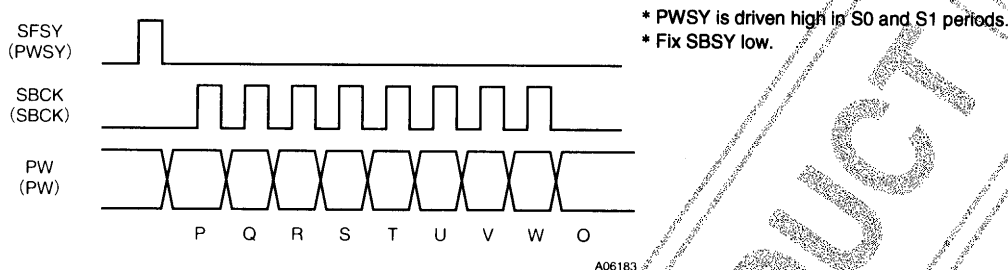
Control of the S1 and S2 pins provides interfacing with the following three modes. Driving the mute pin high disables SBSY and PW input and SBCK output.

S1	S2	Mode
L	L	LC7861N/67 interface
H	L	LC7860K/63 interface
H	H	LC78661/62X/63X interface

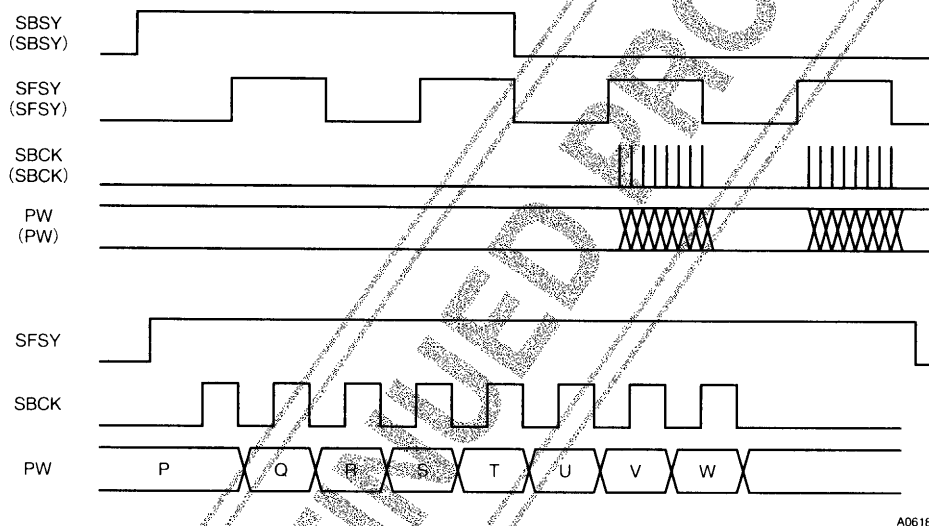
## LC7874E

With the LC7860K/63 interface, SBCK is transmitted when SFSY is confirmed to be low approximately 2.2  $\mu$ s after a falling edge of SFSY is detected. With other interfaces, SBCK is transmitted when SFSY is confirmed to be high and SBSY to be low approximately 2.2  $\mu$ s after a rising edge of SFSY is detected.

### (1) LC7860 interface [DSP pin names shown in parentheses]



### (2) LC7861N/67 interface [DSP pin names shown in parentheses]



### (3) LC78681/62X/63X Series interface

Same as (2), except that the SBCK polarity is shifted inversely (shifted on rise of SBCK).

### 3. DRAM interface.

Interface pins: A0 to A7, DB0 to DB3,  $\overline{\text{RAS}}$ ,  $\overline{\text{CAS}}$ ,  $\overline{\text{WE}}$ ,  $\overline{\text{OE}}$

64K  $\times$  4-bit DRAM is connected externally. The interface pins are set to high impedance by driving the CE1 pin high. MPEG DRAM sharing is possible.

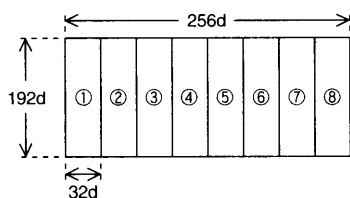
### 4. CD graphic monitor pin: CDGM

CDGM goes high once the LC7874E accepts any CD-G instruction. In the power-on state, once CDGM goes high it remains high. It can be driven low by driving the INIT pin low or transferring an INIT command from the microcontroller.



8. Color bar output: CB

When the CB pin is driven high, color bars are output from the video output pins. Details of the color bars are shown below.



A06187

	R	G	B
① White	F	F	F
② Gray	B	B	B
③ Yellow	F	F	O
④ Cyan	O	F	F
⑤ Green	O	F	O
⑥ Magenta	F	O	F
⑦ Red	F	O	O
⑧ Blue	O	O	F
BORDER (BLACK)	O	O	O

**Drawing Functions (Graphic Functions)**

1. Operating modes (scan operation, display operation)

NTSC mode

- Non-interlace 60 Hz (262 or 263 lines)
- Dot clock 2fsc: 7.15909 MHz (T = 139.67 ns)
- System clock 4fsc: 14.31818 MHz

PAL mode

- Non-interlace 50 Hz (312 or 314 lines)
- Dot clock 4fsc × 2/5: 7.09379 MHz (T = 140.97 ns)
- System clock 4fsc: 17.734476 MHz

PAL60 mode

- Non-interlace 60 Hz (262 or 263 lines)
- Dot clock 4fsc × 2/5: 7.09379 MHz (T = 140.97 ns)
- System clock 4fsc: 17.734476 MHz

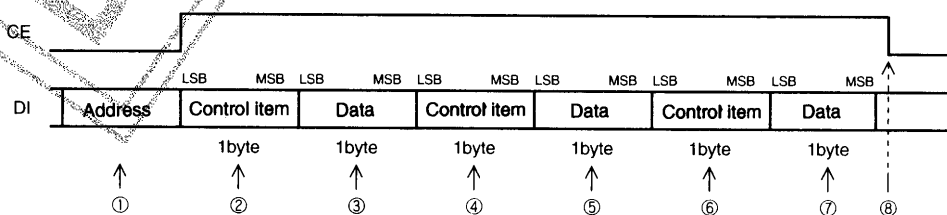
2. Display functions

- Display resolution 288 dots × 192H
- Image data area 300 dots × 216H
- 16-color display Selection of 16 colors from 4096

**Microcontroller Interface (CCB)**

1. Transfer format (for command transfer)

Transfer format (example)



- ① Address: F4<sub>HEX</sub>
- ② ④ ⑥ Command identification code (control item)
- ③ ⑤ ⑦ Command register setting data
- ⑧ End of serial transfer

A06188



Display Control Command Table

Command	First byte								Second byte							
	MSB Command identification code LSB								MSB Data LSB							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Register 00HEX (Various mode settings)	0	0	0	0	0	0	0	0	INIT	SCP <sub>2</sub>	SCP <sub>1</sub>	SCP <sub>0</sub>	CB	DISK /GPH	TV/ LINE	VRAM /BG
Register 10HEX (Fine adjustment of screen position)	0	0	0	1	0	0	0	0	VP <sub>3</sub>	VP <sub>2</sub>	VP <sub>1</sub>	VP <sub>0</sub>	HP <sub>3</sub>	HP <sub>2</sub>	HP <sub>1</sub>	HP <sub>0</sub>
Register 20HEX (Channel 0 to 7 ON/OFF)	0	0	1	0	0	0	0	0	CH <sub>7</sub>	CH <sub>6</sub>	CH <sub>5</sub>	CH <sub>4</sub>	CH <sub>3</sub>	CH <sub>2</sub>	CH <sub>1</sub>	CH <sub>0</sub>
Register 30HEX (Channel 8 to 15 ON/OFF)	0	0	1	1	0	0	0	0	CH <sub>15</sub>	CH <sub>14</sub>	CH <sub>13</sub>	CH <sub>12</sub>	CH <sub>11</sub>	CH <sub>10</sub>	CH <sub>9</sub>	CH <sub>8</sub>
Register 40HEX (BGC R, G settings)	0	1	0	0	0	0	0	0	BGG <sub>3</sub>	BGG <sub>2</sub>	BGG <sub>1</sub>	BGG <sub>0</sub>	BGR <sub>3</sub>	BGR <sub>2</sub>	BGR <sub>1</sub>	BGR <sub>0</sub>
Register 50HEX (BGC B setting)	0	1	0	1	0	0	0	0	0	0	0	0	BGB <sub>3</sub>	BGB <sub>2</sub>	BGB <sub>1</sub>	BGB <sub>0</sub>
Register 60HEX (Chroma key color R, G settings)	0	1	1	0	0	0	0	0	CKG <sub>3</sub>	CKG <sub>2</sub>	CKG <sub>1</sub>	CKG <sub>0</sub>	CKR <sub>3</sub>	CKR <sub>2</sub>	CKR <sub>1</sub>	CKR <sub>0</sub>
Register 70HEX (Chroma key color B setting)	0	1	1	1	0	0	0	0	0	0	0	0	CKB <sub>3</sub>	CKB <sub>2</sub>	CKB <sub>1</sub>	CKB <sub>0</sub>
Register 80HEX (YS output phase adjustment)	1	0	0	0	0	0	0	0	CSY SEL	PAL 60	0	YT <sub>4</sub>	YT <sub>3</sub>	YT <sub>2</sub>	YT <sub>1</sub>	YT <sub>0</sub>
Register 90HEX (External synchronization mode, test mode)	1	0	0	1	0	0	0	0	CV SEL	MVMD	EXSN	HVMK	0	TST <sub>2</sub>	TST <sub>1</sub>	TST <sub>0</sub>
Register A0HEX (Subtitle scroll: vertical)	1	0	1	0	0	0	0	0	0	0	0	SCV <sub>4</sub>	SCV <sub>3</sub>	SCV <sub>2</sub>	SCV <sub>1</sub>	SCV <sub>0</sub>
Register B0HEX (Subtitle scroll: horizontal)	1	0	1	1	0	0	0	0	0	0	SCH <sub>5</sub>	SCH <sub>4</sub>	SCH <sub>3</sub>	SCH <sub>2</sub>	SCH <sub>1</sub>	SCH <sub>0</sub>
Register 01HEX (19-byte command input)	0	0	0	0	0	0	0	1	R	S	T	U	V	W	0	0

DISCONTINUED

**Description of Commands**

Command transmission should be performed LSB-first.

- 1. Control item code 00<sub>HEX</sub>: Various mode settings  
Default: MSB [01100000] LSB

Data 0: VRAM/BG Display screen switchover setting  
0: VRAM contents displayed  
1: Background color displayed

Data 1: TV/LINE Graphic display mode setting  
0: TV graphic mode  
1: LINE graphic mode

Data 2: DISK/GPH Disk command acceptance control  
0: DISK command only accepted  
1: DISK command acceptance ignored, MGC (Micro graphic command) only accepted

Data 3: CB Color bar screen output setting  
0: Graphic signal output  
1: Color bar signal output

Data 4: SCP0 YS output (pin 52) control

Data 5: SCP1 Superimposition compare condition (valid only when SON = 1: pin 60)

SCP1	SCP0	Compare condition
0	0	Comparison not performed
1	0	When border color is black, YS is high (display) in the parts whose color does not match the border color, and low (transparent) otherwise
1	1	High in parts whose color does not match the chroma key color; low otherwise

Data 6: SCP2 YS output (pin 52) control  
0: When SCP0, SCP1 = 0, 0; 0, 1, and compare condition is not satisfied, setting is full-screen low (transparent)  
1: L: When SCP0, SCP1 = 0, 0; 0, 1, and compare condition is not satisfied, setting is full-screen high (display)

Data 7: INIT Software reset setting  
0: Internal reset not executed (normal)  
1: Internal reset executed (display screen becomes blue background screen)

- 2. Control item code 10<sub>HEX</sub>: Fine adjustment of screen position  
Default: MSB [00000000] LSB

Data 0: HP0 Horizontal fine adjustment of screen position  
Data 1: HP1 Specified as two's complement with left as positive direction  
Data 2: HP2 (variable by -16 to +14 dots from center in 2-dot units)  
Data 3: HP3  
Data 4: VP0 Vertical fine adjustment of screen position  
Data 5: VP1 Specified as two's complement with up as positive direction  
Data 6: VP2 (variable by -16 to +14 dots from center in 2-dot units)  
Data 7: VP3

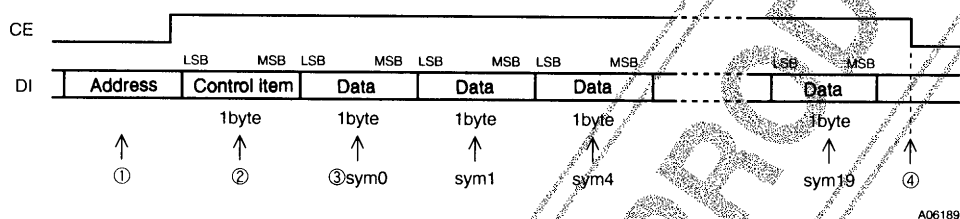
3. Control item code 20<sub>HEX</sub>: Channel on/off setting  
Default: MSB [00000011] LSB  
Data 0: CH0 CH0 to CH7 on/off setting  
Data 1: CH1  
Data 2: CH2 0: Channel off  
Data 3: CH3 1: Channel on  
Data 4: CH4  
Data 5: CH5  
Data 6: CH6  
Data 7: CH7
  
4. Control item code 30<sub>HEX</sub>: Channel on/off setting  
Default: MSB [00000000] LSB  
Data 0: CH8 CH8 to CH15 on/off setting  
Data 1: CH9  
Data 2: CH10 0: Channel off  
Data 3: CH11 1: Channel on  
Data 4: CH12  
Data 5: CH13  
Data 6: CH14  
Data 7: CH15
  
5. Control item code 40<sub>HEX</sub>: BGC color (R, G) settings  
Default: MSB [00000000] LSB  
Data 0: BCR0 BGC color: R setting = 16 kinds  
Data 1: BCR1  
Data 2: BCR2  
Data 3: BCR3  
Data 4: BCG0 BGC color: G setting = 16 kinds  
Data 5: BCG1  
Data 6: BCG2  
Data 7: BCG3
  
6. Control item code 50<sub>HEX</sub>: BGC color (B) setting  
Default: MSB [00001010] LSB  
Data 0: BCB0 BGC color: B setting = 16 kinds  
Data 1: BCB1  
Data 2: BCB2  
Data 3: BCB3 \* R, G, B, 16 kinds each; selection of 1 color from 4096  
Data 4 to data 8: Fixed at 0
  
7. Control item code 60<sub>HEX</sub>: Chroma key color (R, G) settings  
Default: MSB [00000000] LSB  
Data 0: CKR0 Chroma key color: R setting = 16 kinds  
Data 1: CKR1  
Data 2: CKR2  
Data 3: CKR3  
Data 4: CKG0 Chroma key color: G setting = 16 kinds  
Data 5: CKG1  
Data 6: CKG2  
Data 7: CKG3

8. Control item code 70<sub>HEX</sub>: Chroma key color (B) setting  
 Default: MSB [00000000] LSB  
 Data 0: CKB0 Chroma key color: B setting = 16 kinds  
 Data 1: CKB1  
 Data 3: CKB3 \* R, G, B, 16 kinds each; selection of 1 color from 4096  
 Data 4 to data 8: Fixed at 0
9. Control item code 80<sub>HEX</sub>: YS signal output/video signal output phase adjustment data setting  
 Default: MSB [00000000] LSB  
 Data 0: YT0 YS signal output/video signal output phase adjustment data  
 Data 1: YT1  
 Data 2: YT2  
 Data 3: YT3  
 Data 4: YT4  
 Data 5: Fixed at 0  
 Data 6: PAL60 PAL/PAL60 setting (valid only when N/P = 1)  
 0: PAL  
 1: PAL60  
 Data 7: CSYSEL CSYNC output addressing (autonomous mode only)  
 0: Equalization pulses used  
 1: No equalization pulses
10. Control item code 90<sub>HEX</sub>: External synchronization control, test mode setting  
 Default: MSB [00000000] LSB  
 Data 0: TST0 Test mode addressing (normally fixed low)  
 Data 1: TST1  
 Data 2: TST2  
 Data 3: Fixed at 0  
 Data 4: HVMK  $\overline{\text{HRESET}}$ ,  $\overline{\text{VRESET}}$  mask  
 0: Mask used  
 1: No mask  
 Data 5: EXSN Sync signal rest control setting when using external clock (when SON = 1)  
 0: Reset executed with  $\overline{\text{HRESET}}$  (pin 54) and  $\overline{\text{VRESET}}$  (pin 56) signals  
 0: Reset executed with  $\overline{\text{VRESET}}$  (pin 56) signal ( $\overline{\text{HRESET}}$  signal unnecessary)  
 Data 6: MVMD Moving display area setting  
 0: Movement of display area only  
 1: Border area included in movement (only horizontal movement possible)  
 Data 7: CVSEL  $\overline{\text{CSYNC}}$  output pin setting  
 0:  $\overline{\text{CSYNC}}$  output  
 1:  $\overline{\text{VSYNC}}$  output
11. Control item code A0<sub>HEX</sub>: Superimposed text scroll amount, vertical setting  
 Default: MSB [00000000] LSB  
 Data 0: SCV0 Upward scroll amount (font unit) setting (scroll amount: 0 to 17 font units)  
 Data 1: SCV1 Screen display position scrolled vertically by 1 font unit  
 Data 2: SCV2 (1 font unit: 12 vertical dots (12H))  
 Data 3: SCV3  
 Data 4: SCV4  
 Data 5 to data 7: Fixed at 0

12. Control item code C0<sub>HEX</sub>: Superimposed text scroll amount, horizontal setting  
 Default: MSB [00000000] LSB  
 Data 0: SCH0 Left scroll amount (font unit) setting (scroll amount: 0 to 49-font units)  
 Data 1: SCH1 Screen display position scrolled horizontally in 1-font unit  
 Data 2: SCH2 (1-font unit: 6 horizontal dots)  
 Data 3: SCH3  
 Data 4: SCH4  
 Data 5: SCH5  
 Data 6, data 7: Fixed at 0

13. Control item code 01<sub>HEX</sub>: 19-byte command input (MGC write)

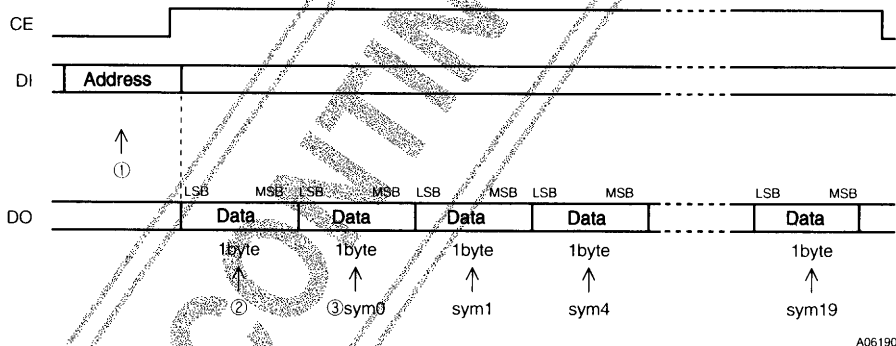
Transfer format



- ① Address: F4<sub>HEX</sub>
- ② Control item: 01<sub>HEX</sub>
- ③ sym0 to sym19: R to W = subcode input
- ④ Executed on fall

14. Control item code 11<sub>HEX</sub>: 19-byte command input (pack data read)

Transfer format



- ① Address: F5<sub>HEX</sub>
- ② Data (check flags)  
 MSB [PF1, PF0, OF1, OF0, DKMD, VBLK, EXEC, OE] :LSB
- Data 0: OE = 1 when the next 18 bytes are guaranteed and are the first data to be read.  
 \* Note: Reading must be completed within 1.1 ms after OE output setting.
- Data 1: EXEC Command status  
 0: Command executing  
 1: Command wait state
- Data 2: VBLK = 1 output during vertical blanking (vertical retrace line) period  
 Vertical retrace line period NTSC: 19H  
 PAL: 25H
- Data 3: DKMD Disk identification flag  
 0: CD  
 1: CD-G

