Ordering number : EN5800

CMOS LSI

LC75874E, 75874W

1/4-Duty General-Purpose LCD Display Driver

Overview

The LC75874E and LC75874W are 1/4-duty general-purpose microprocessor-controlled LCD driver that can be used in applications such as frequency display in products with electronic tuning. In addition to being able to drive up to 264 segments directly, the LC75874E and LC75874W can also control up to 8 general-purpose output ports.

Since the LC75874E and LC75874W use separate power supply systems for the LCD drive block and the logic block, the LCD driver block power-supply voltage can be set to any voltage in the range 2.7 to 6.0 V, regardless of the logic block power-supply voltage.

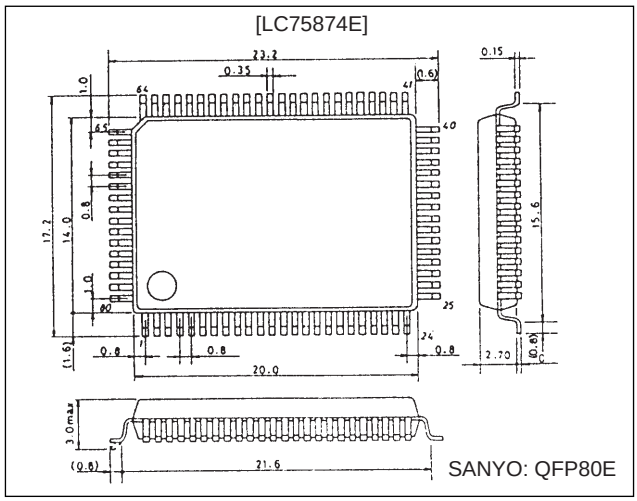
Features

- Support for 1/4-duty 1/2-bias or 1/4-duty 1/3-bias drive techniques under serial data control (up to 264 segments)
- Serial data input supports CCB format communication with the system controller.
- Serial data control of the power-saving mode based backup function and the all segments forced off function.
- Serial data control of switching between the segment output port and general-purpose output port functions.
- High generality, since display data is displayed directly without the intervention of a decoder circuit.
- Independent V_{LCD} for the LCD driver block (V_{LCD} can be set to any voltage in the range 2.7 to 6.0 V, regardless of the logic block power-supply voltage.)
- The $\overline{INH}$ pin allows the display to be forced to the off state.
- RC oscillator circuit

Package Dimensions

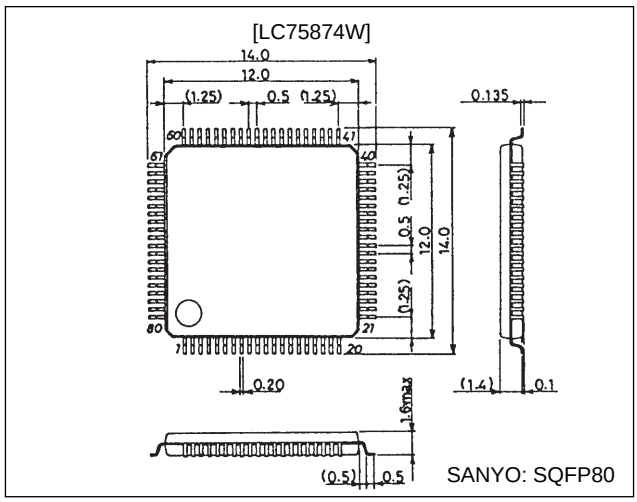
unit: mm

3174-QFP80E



unit: mm

3220-SQFP80



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- **CCB is SANYO's original bus format and all the bus addresses are controlled by SANYO.**

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Specifications

Absolute Maximum Ratings at Ta = 25°C, V_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max	V_{DD}	–0.3 to +7.0	V
	V_{LCD} max	V_{LCD}	–0.3 to +7.0	
Input voltage	$V_{IN}1$	CE, CL, DI, $\overline{INH}$	–0.3 to +7.0	V
	$V_{IN}2$	OSC	–0.3 to V_{DD} + 0.3	
	$V_{IN}3$	$V_{LCD}1$, $V_{LCD}2$	–0.3 to V_{LCD} + 0.3	
Output voltage	$V_{OUT}1$	OSC	–0.3 to V_{DD} + 0.3	V
	$V_{OUT}2$	S1 to S66, COM1 to COM4, P1 to P8	–0.3 to V_{LCD} + 0.3	
Output current	$I_{OUT}1$	S1 to S66	300	µA
	$I_{OUT}2$	COM1 to COM4	3	mA
	$I_{OUT}3$	P1 to P8	5	
Allowable power dissipation	Pd max	Ta = 85°C	200	mW
Operating temperature	Topr		–40 to +85	°C
Storage temperature	Tstg		–55 to +125	°C

Allowable Operating Ranges at Ta = –40 to +85°C, V_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{DD}	V_{DD}	2.7		6.0	V
	V_{LCD}	V_{LCD}	2.7		6.0	
Input voltage	$V_{LCD}1$	$V_{LCD}1$		2/3 V_{LCD}	V_{LCD}	V
	$V_{LCD}2$	$V_{LCD}2$		1/3 V_{LCD}	V_{LCD}	
Input high-level voltage	V_{IH}	CE, CL, DI, $\overline{INH}$	0.8 V_{DD}		6.0	V
Input low-level voltage	V_{IL}	CE, CL, DI, $\overline{INH}$	0		0.2 V_{DD}	V
Recommended external resistance	R_{OSC}	OSC		43		kΩ
Recommended external capacitance	C_{OSC}	OSC		680		pF
Guaranteed oscillation range	f_{OSC}	OSC	25	50	100	kHz
Data setup time	t_{ds}	CL, DI: Figure 2	160			ns
Data hold time	t_{dh}	CL, DI: Figure 2	160			ns
CE wait time	t_{cp}	CE, CL: Figure 2	160			ns
CE setup time	t_{cs}	CE, CL: Figure 2	160			ns
CE hold time	t_{ch}	CE, CL: Figure 2	160			ns
High-level clock pulse width	$t_{øH}$	CL: Figure 2	160			ns
Low-level clock pulse width	$t_{øL}$	CL: Figure 2	160			ns
Rise time	t_r	CE, CL, DI: Figure 2		160		ns
Fall time	t_f	CE, CL, DI: Figure 2		160		ns
$\overline{INH}$ switching time	t_c	$\overline{INH}$, CE: Figure 3	10			µs

Electrical Characteristics for the Allowable Operating Ranges

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Hysteresis	V_H	CE, CL, DI, $\overline{INH}$		0.1 V_{DD}		V
Input high-level current	I_{IH}	CE, CL, DI, $\overline{INH}$: V_I = 6.0 V			5.0	µA
Input low-level current	I_{IL}	CE, CL, DI, $\overline{INH}$: V_I = 0 V	–5.0			µA
Output high-level voltage	$V_{OH}1$	S1 to S66: I_O = –20 µA	V_{LCD} – 0.9			V
	$V_{OH}2$	COM1 to COM4: I_O = –100 µA	V_{LCD} – 0.9			
	$V_{OH}3$	P1 to P8: I_O = –1 mA	V_{LCD} – 0.9			
Output low-level voltage	$V_{OL}1$	S1 to S66: I_O = 20 µA			0.9	V
	$V_{OL}2$	COM1 to COM4: I_O = 100 µA			0.9	
	$V_{OL}3$	P1 to P8: I_O = 1 mA			0.9	
Output middle-level voltage*1	$V_{MID}1$	COM1 to COM4: 1/2 bias, I_O = ±100 µA	1/2 V_{LCD} – 0.9		1/2 V_{LCD} + 0.9	V
	$V_{MID}2$	S1 to S66: 1/3 bias, I_O = ±20 µA	2/3 V_{LCD} – 0.9		2/3 V_{LCD} + 0.9	
	$V_{MID}3$	S1 to S66: 1/3 bias, I_O = ±20 µA	1/3 V_{LCD} – 0.9		1/3 V_{LCD} + 0.9	
	$V_{MID}4$	COM1 to COM4: 1/3 bias, I_O = ±100 µA	2/3 V_{LCD} – 0.9		2/3 V_{LCD} + 0.9	
	$V_{MID}5$	COM1 to COM4: 1/3 bias, I_O = ±100 µA	1/3 V_{LCD} – 0.9		1/3 V_{LCD} + 0.9	
Oscillator frequency	f_{OSC}	OSC: R_{OSC} = 43 kΩ, C_{OSC} = 680 pF	40	50	60	kHz
Current drain	$I_{DD}1$	V_{DD}: Power-saving mode			5	µA
	$I_{DD}2$	V_{DD}: V_{DD} = 6.0 V, outputs open, f_{OSC} = 50 kHz		230	460	
	$I_{LCD}1$	V_{LCD}: Power-saving mode			5	
	$I_{LCD}2$	V_{LCD}: V_{LCD} = 6.0 V, outputs open, 1/2 bias, f_{OSC} = 50 kHz		200	400	
	$I_{LCD}3$	V_{LCD}: V_{LCD} = 6.0 V, outputs open, 1/3 bias, f_{OSC} = 50 kHz		120	240	

Note: *1 Excluding the bias voltage generation divider resistors built in the $V_{LCD}1$ and $V_{LCD}2$. (See Figure 1.)

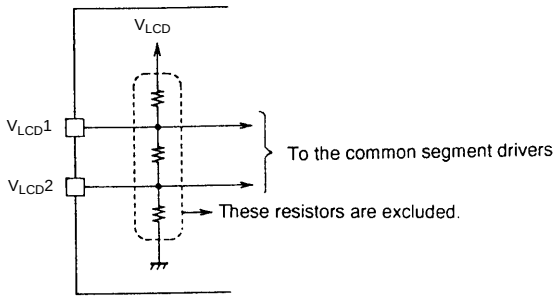
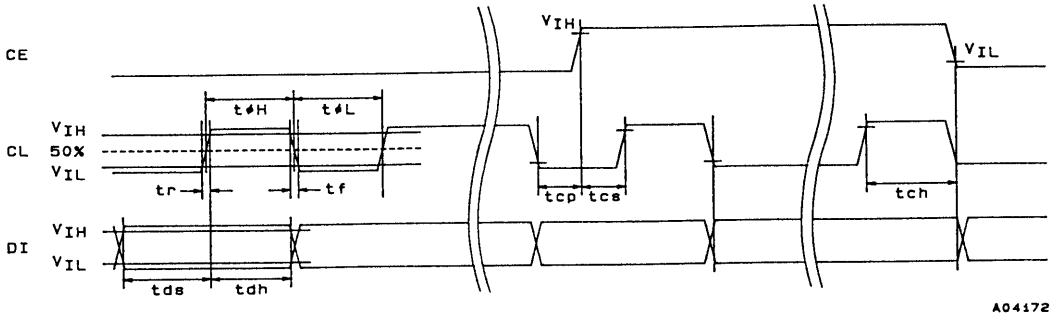


Figure 1

1. When CL is stopped at the low level



2. When CL is stopped at the high level

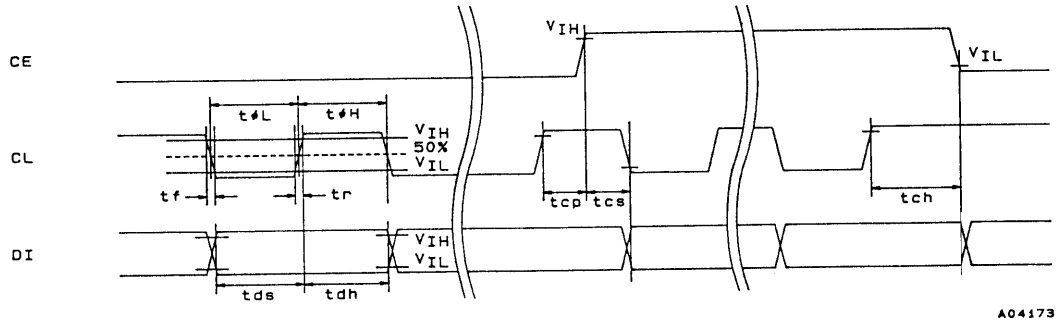
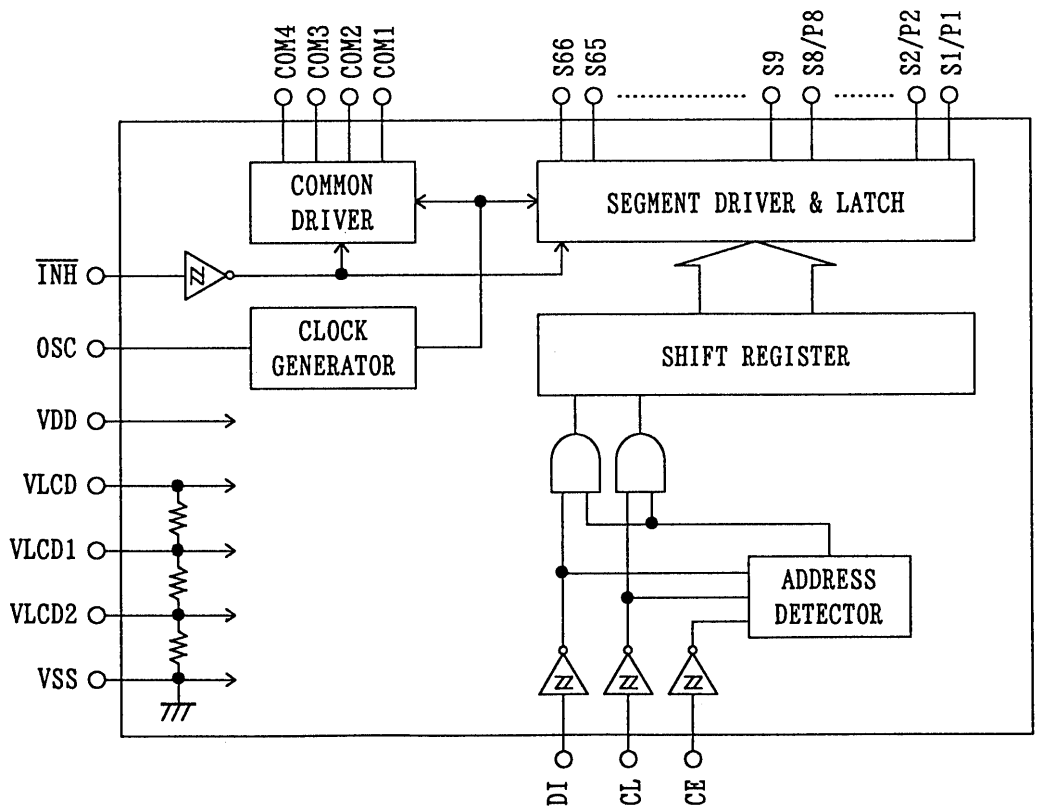


Figure 2

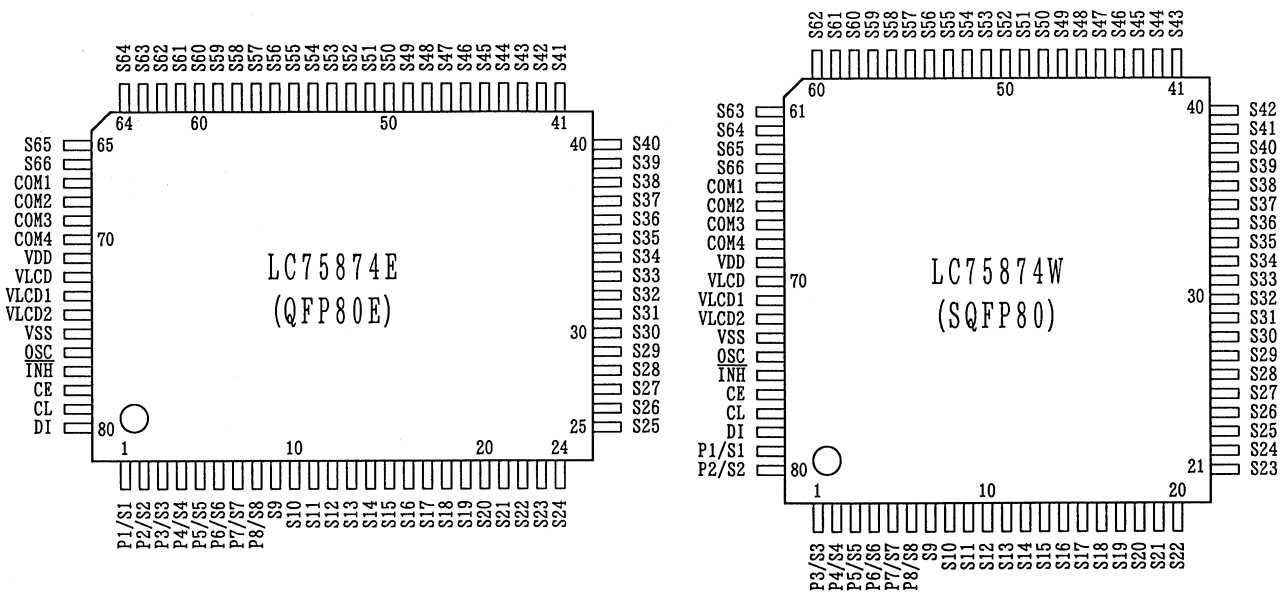
Block Diagram



Pin Functions

Symbol	Pin No.		Function	Active	I/O	Handling when unused
	LC75874E	LC75874W				
S1/P1 to S8/P8 S9 to S66	1 to 8 9 to 66	79, 80, 1 to 6 7 to 64	Segments outputs for displaying the display data transferred by serial data input. The S1/P1 to S8/P8 pins can be used as general-purpose output ports under serial data control.	—	O	Open
COM1 COM2 COM3 COM4	67 68 69 70	65 66 67 68	Common driver outputs. The frame frequency fo is f_{OSC}/512 Hz.	—	O	Open
OSC	76	74	Oscillator connection. An oscillator circuit can be formed by connecting an external resistor and capacitor at this pin.	—	I/O	V_{DD}
CE CL DI	78 79 80	76 77 78	Serial data transfer inputs. Connected to the controller. CE: Chip enable CL: Synchronization clock DI: Transfer data	H ↑ —	I I I	GND
$\overline{INH}$	77	75	Display off control input $\overline{INH}$ = low (V_{SS}) .....Display forced off S1/P1 to S8/P8 = low (V_{SS}) (These pins are forcibly set to the segment output port function and held at the V_{SS} level.) S9 to S66 = low (V_{SS}) COM1 to COM4 = low (V_{SS}) $\overline{INH}$ = high (V_{DD}).....Display on However, serial data transfer is possible when the display is forced off by this pin.	L	I	GND
$V_{LCD}1$	73	71	Used to apply the LCD drive 2/3 bias voltage externally. Connect this pin to $V_{LCD}2$ when using a 1/2-bias drive scheme.	—	I	Open
$V_{LCD}2$	74	72	Used to apply the LCD drive 1/3 bias voltage externally. Connect this pin to $V_{LCD}1$ when using a 1/2-bias drive scheme.	—	I	Open
V_{DD}	71	69	Logic block power supply. In the range 2.7 to 6.0 V.	—	—	—
V_{LCD}	72	70	LCD driver block power supply. In the range 2.7 to 6.0 V.	—	—	—
V_{SS}	75	73	Ground pin. Connect to ground.	—	—	—

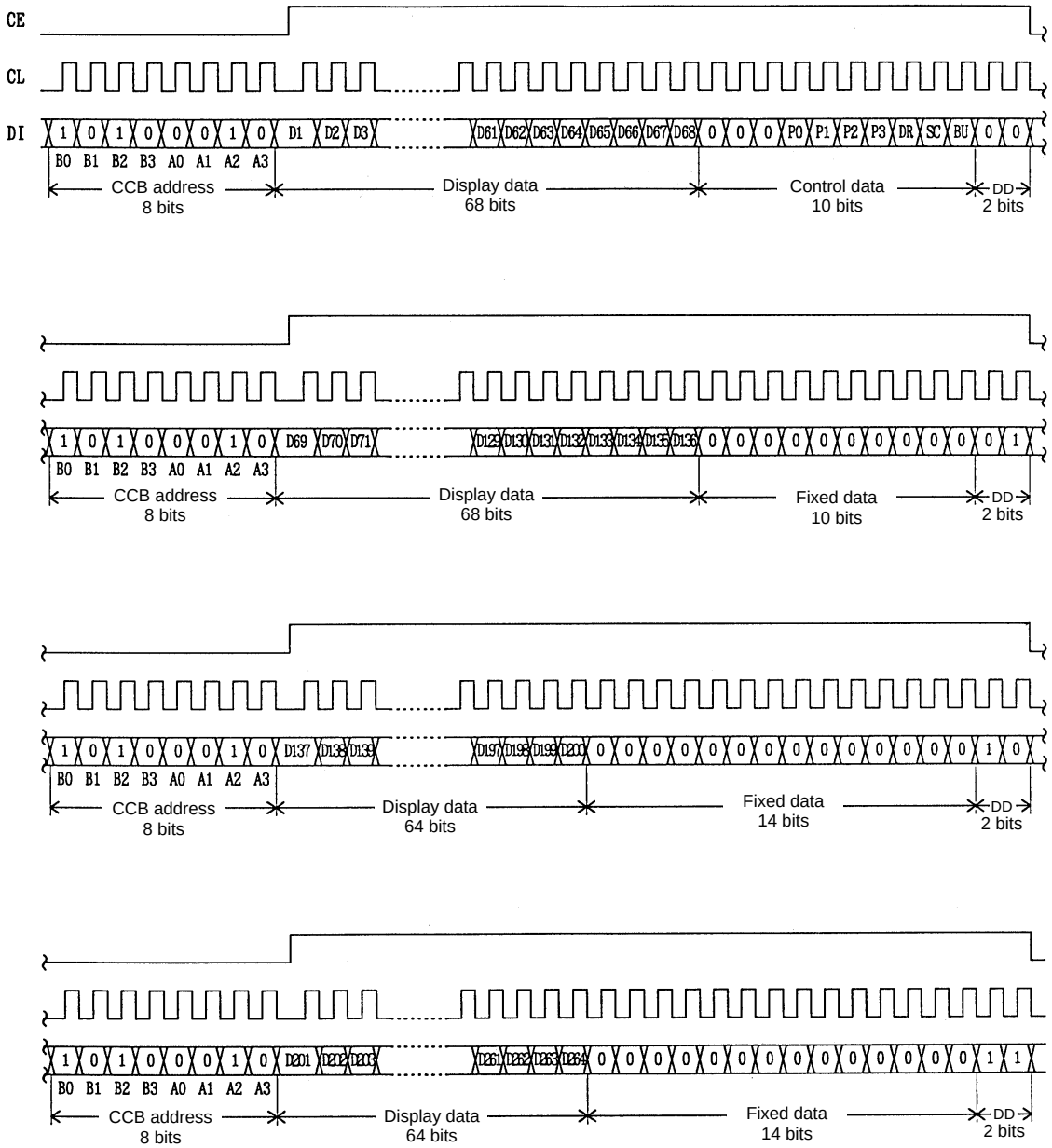
Pin Assignments



Top view

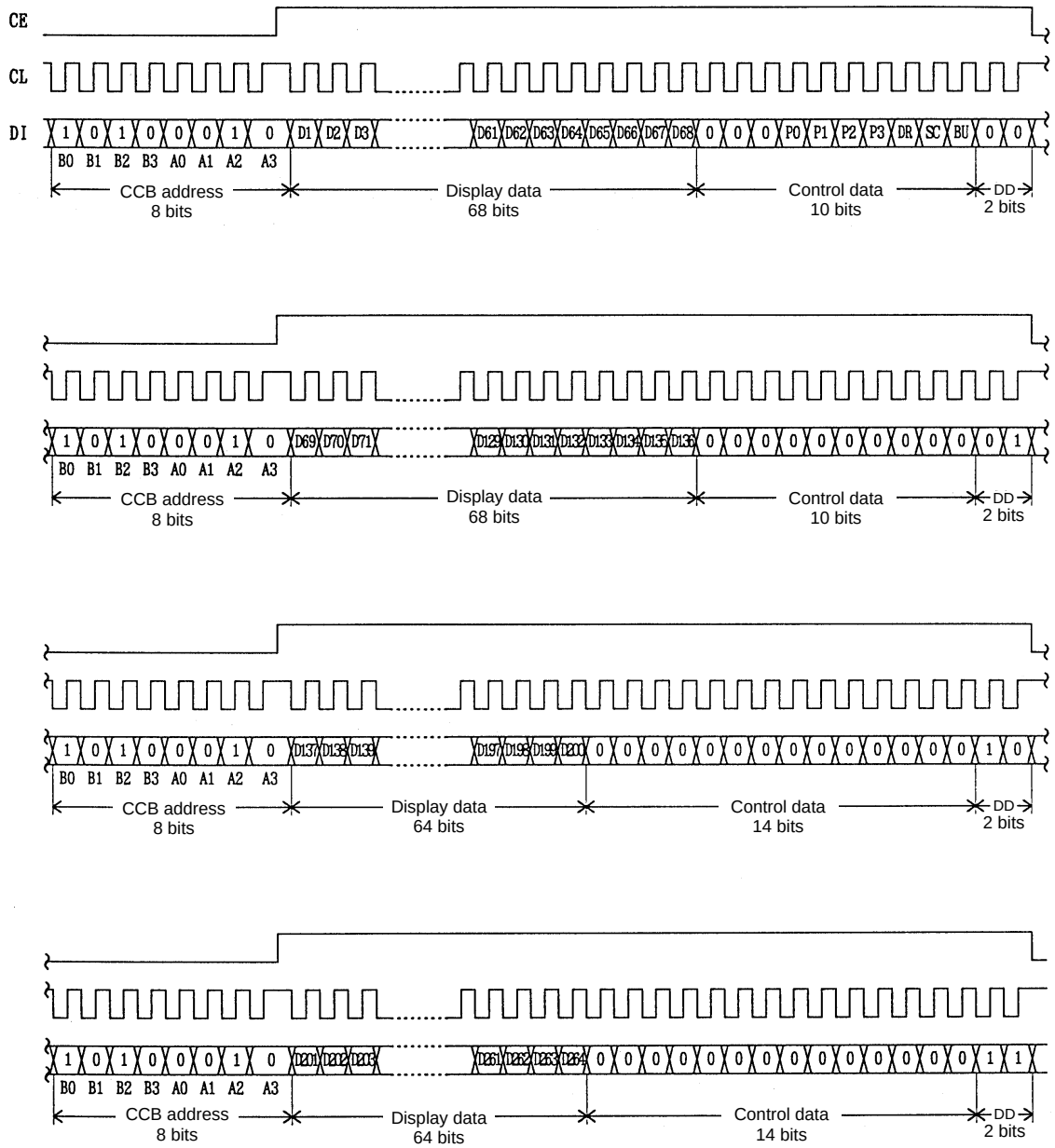
Serial Data Transfer Format

1. When CL is stopped at the low level



Note: DD is the direction data.

2. When CL is stopped at the high level

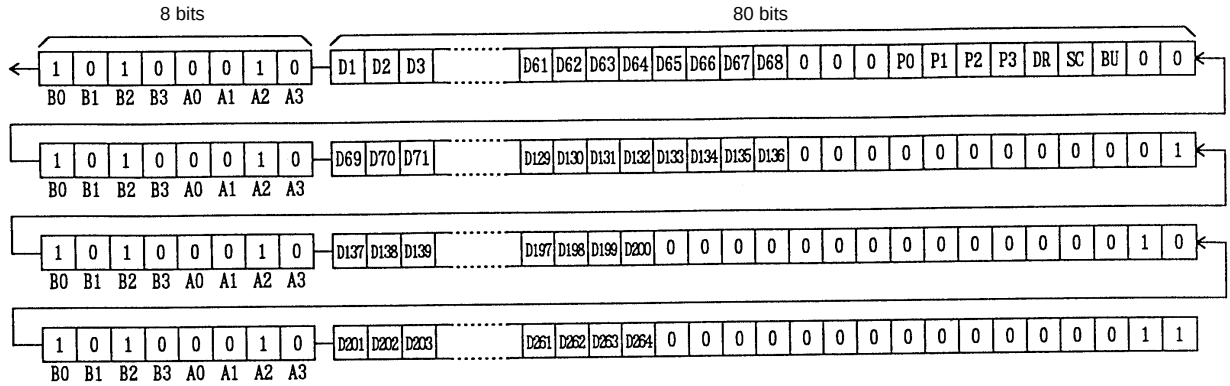


Note: DD is the direction data.

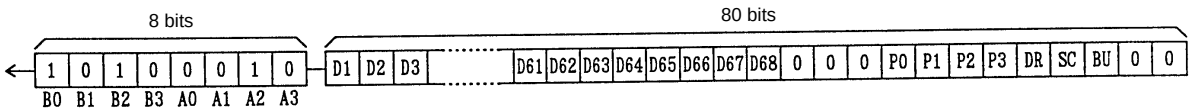
- CCB address.....45H
- D1 to D264.....Display data
- P0 to P3.....Segment output port/general-purpose output port switching control data
- DR.....1/2-bias drive or 1/3-bias drive switching control data
- SC.....Segments on/off control data
- BU.....Normal mode/power-saving mode control data

Serial Data Transfer Example

1. When 201 or more segments are used
   All 320 bits of serial data must be sent.



2. When fewer than 201 segments are used
   Either 80, 160 or 240 bits of serial data may be sent, depending on the number of segments used. However, the serial data shown below (the D1 to D68 display data and the control data) must be sent.



Control Data Functions

1. P0 to P3: Segment output port/general-purpose output port switching control data
   These control data bits switch the segment output port/general-purpose output port functions of the S1/P1 to S8/P8 output pins.

Control data				Output pin state							
P0	P1	P2	P3	S1/P1	S2/P2	S3/P3	S4/P4	S5/P5	S6/P6	S7/P7	S8/P8
0	0	0	0	S1	S2	S3	S4	S5	S6	S7	S8
0	0	0	1	P1	S2	S3	S4	S5	S6	S7	S8
0	0	1	0	P1	P2	S3	S4	S5	S6	S7	S8
0	0	1	1	P1	P2	P3	S4	S5	S6	S7	S8
0	1	0	0	P1	P2	P3	P4	S5	S6	S7	S8
0	1	0	1	P1	P2	P3	P4	P5	S6	S7	S8
0	1	1	0	P1	P2	P3	P4	P5	P6	S7	S8
0	1	1	1	P1	P2	P3	P4	P5	P6	P7	S8
1	0	0	0	P1	P2	P3	P4	P5	P6	P7	P8

Note: Sn (n = 1 to 8): Segment output port function
Pn (n = 1 to 8): General-purpose output port function

Note that when the general-purpose output port function is selected, the correspondence between the output pins and the display data will be that shown in the table.

Output pin	Corresponding display data
S1/P1	D1
S2/P2	D5
S3/P3	D9
S4/P4	D13

Output pin	Corresponding display data
S5/P5	D17
S6/P6	D21
S7/P7	D25
S8/P8	D29

For example, if the general-purpose output port function is selected for the S4/P4 output pin, that output pin will output a high level (V_{LCD}) when the display data D13 is 1, and a low level (V_{SS}) when the D13 is 0.

2. DR: 1/2-bias drive or 1/3-bias drive switching control data
   This control data bit selects either 1/2-bias drive or 1/3-bias drive.

DR	Drive scheme
0	1/3-bias drive
1	1/2-bias drive

3. SC: Segment on/off control data
   This control data controls the on/off state of the segments.

SC	Display state
0	On
1	Off

   Note that when the segments are turned off by setting SC to 1, the segments are turned off by outputting segment off waveforms from the segment output pins.

4. BU: Normal mode/power-saving mode control data
   This control data bit selects either normal mode or power-saving mode.

BU	Mode
0	Normal mode
1	Power saving mode. In this mode, the OSC pin oscillator is stopped and the common and segment output pins go to the V_{SS} level. However, the S1/P1 to S8/P8 output pins can be used as general-purpose output ports under the control of the data bits P0 to P3.

Display Data and Output Pin Correspondence

Output pin	COM1	COM2	COM3	COM4
S1/P1	D1	D2	D3	D4
S2/P2	D5	D6	D7	D8
S3/P3	D9	D10	D11	D12
S4/P4	D13	D14	D15	D16
S5/P5	D17	D18	D19	D20
S6/P6	D21	D22	D23	D24
S7/P7	D25	D26	D27	D28
S8/P8	D29	D30	D31	D32
S9	D33	D34	D35	D36
S10	D37	D38	D39	D40
S11	D41	D42	D43	D44
S12	D45	D46	D47	D48
S13	D49	D50	D51	D52
S14	D53	D54	D55	D56
S15	D57	D58	D59	D60
S16	D61	D62	D63	D64
S17	D65	D66	D67	D68
S18	D69	D70	D71	D72
S19	D73	D74	D75	D76
S20	D77	D78	D79	D80
S21	D81	D82	D83	D84
S22	D85	D86	D87	D88
S23	D89	D90	D91	D92
S24	D93	D94	D95	D96
S25	D97	D98	D99	D100
S26	D101	D102	D103	D104
S27	D105	D106	D107	D108
S28	D109	D110	D111	D112
S29	D113	D114	D115	D116
S30	D117	D118	D119	D120
S31	D121	D122	D123	D124
S32	D125	D126	D127	D128
S33	D129	D130	D131	D132

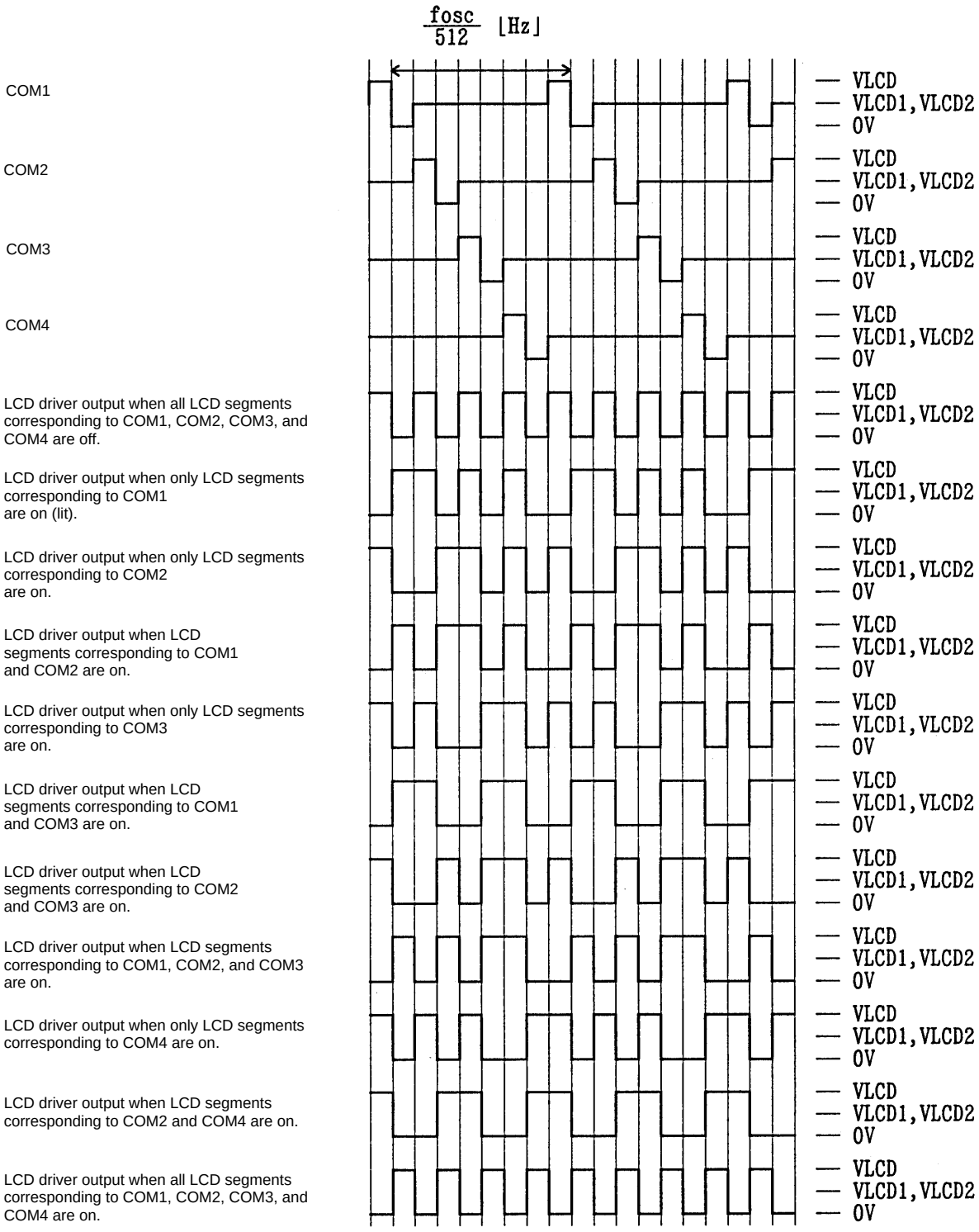
Output pin	COM1	COM2	COM3	COM4
S34	D133	D134	D135	D136
S35	D137	D138	D139	D140
S36	D141	D142	D143	D144
S37	D145	D146	D147	D148
S38	D149	D150	D151	D152
S39	D153	D154	D155	D156
S40	D157	D158	D159	D160
S41	D161	D162	D163	D164
S42	D165	D166	D167	D168
S43	D169	D170	D171	D172
S44	D173	D174	D175	D176
S45	D177	D178	D179	D180
S46	D181	D182	D183	D184
S47	D185	D186	D187	D188
S48	D189	D190	D191	D192
S49	D193	D194	D195	D196
S50	D197	D198	D199	D200
S51	D201	D202	D203	D204
S52	D205	D206	D207	D208
S53	D209	D210	D211	D212
S54	D213	D214	D215	D216
S55	D217	D218	D219	D220
S56	D221	D222	D223	D224
S57	D225	D226	D227	D228
S58	D229	D230	D231	D232
S59	D233	D234	D235	D236
S60	D237	D238	D239	D240
S61	D241	D242	D243	D244
S62	D245	D246	D247	D248
S63	D249	D250	D251	D252
S64	D253	D254	D255	D256
S65	D257	D258	D259	D260
S66	D261	D262	D263	D264

Note: This table assumes that the segment output port function is selected for the S1/P1 to S8/P8 output pins.

For example, the table below lists the output states for the S11 output pin.

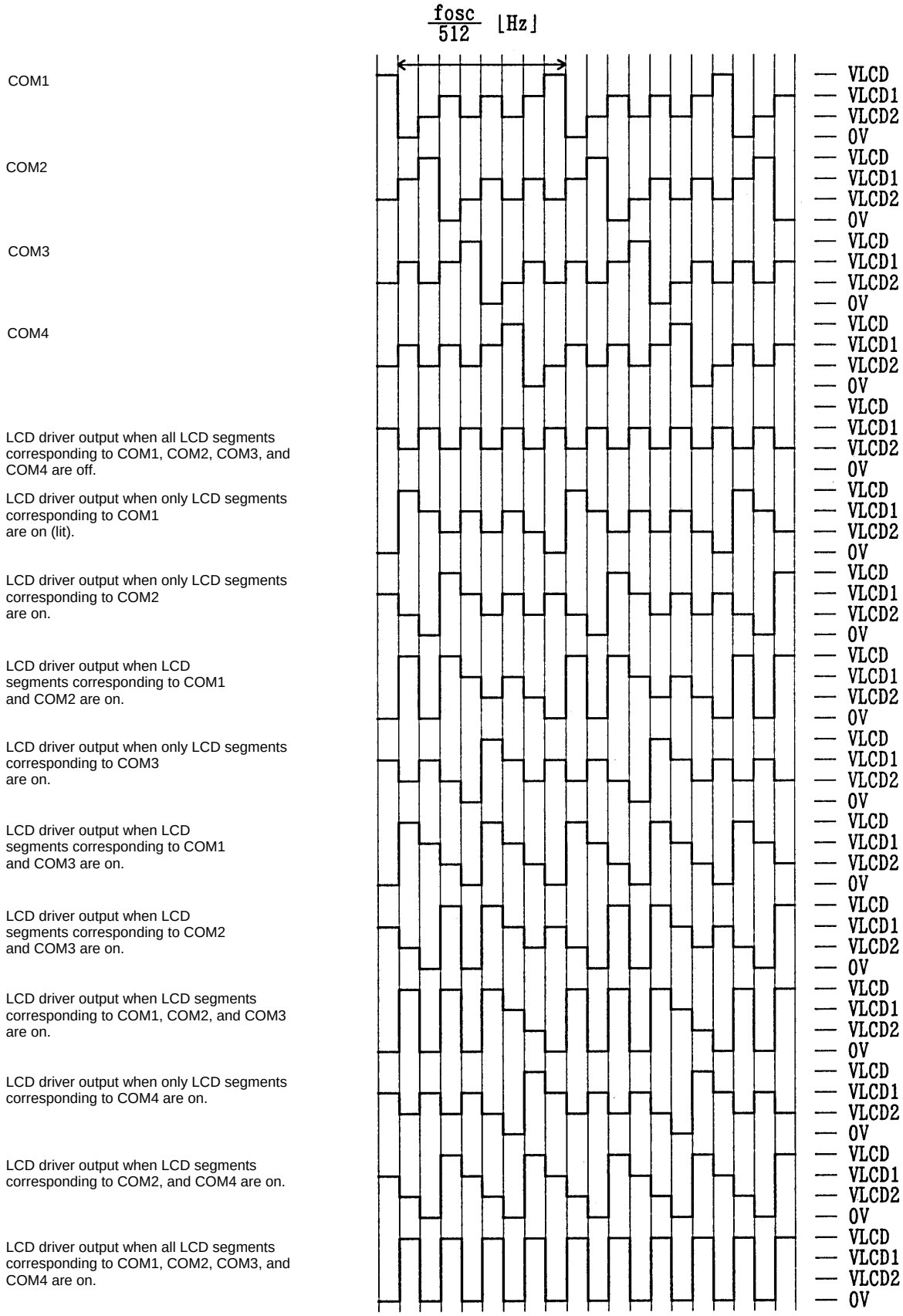
Display data				Output pin (S11) state
D41	D42	D43	D44	
0	0	0	0	The LCD segments corresponding to COM1, COM2, COM3, and COM4 are off.
0	0	0	1	The LCD segments corresponding to COM4 are on.
0	0	1	0	The LCD segments corresponding to COM3 are on.
0	0	1	1	The LCD segments corresponding to COM3 and COM4 are on.
0	1	0	0	The LCD segments corresponding to COM2 are on.
0	1	0	1	The LCD segments corresponding to COM2 and COM4 are on.
0	1	1	0	The LCD segments corresponding to COM2 and COM3 are on.
0	1	1	1	The LCD segments corresponding to COM2, COM3, and COM4 are on.
1	0	0	0	The LCD segments corresponding to COM1 are on.
1	0	0	1	The LCD segments corresponding to COM1 and COM4 are on.
1	0	1	0	The LCD segments corresponding to COM1 and COM3 are on.
1	0	1	1	The LCD segments corresponding to COM1, COM3, and COM4 are on.
1	1	0	0	The LCD segments corresponding to COM1 and COM2 are on.
1	1	0	1	The LCD segments corresponding to COM1, COM2, and COM4 are on.
1	1	1	0	The LCD segments corresponding to COM1, COM2, and COM3 are on.
1	1	1	1	The LCD segments corresponding to COM1, COM2, COM3, and COM4 are on.

1/4-Duty 1/2-Bias Drive Scheme



1/4-Duty 1/2-Bias Waveforms

1/4-Duty 1/3-Bias Drive Scheme



1/4-Duty 1/3-Bias Waveforms

Display Control and the $\overline{\text{INH}}$ Pin

Since the LSI internal data (the display data D1 to D264 and the control data) is undefined when power is first applied, applications should prevent meaningless displays with the following procedure. First, set the $\overline{\text{INH}}$ pin low at the same time as power is applied to turn off the display. This will set the S1/P1 to S8/P8, S9 to S66, and COM1 to COM4 pins low. While the $\overline{\text{INH}}$ pin is held low, the control microprocessor should send the serial data. Finally, the application can set the $\overline{\text{INH}}$ pin to high. (See Figure 3.)

Notes on Power Supply Sequences

Applications must observe the following sequences when power is turned on or off.

- Power on: Turn on the logic power supply (V_{DD}) first → then turn on the LCD driver power supply (V_{LCD}).
- Power off: Turn off the LCD driver power supply (V_{LCD}) first → then turn off the logic power supply (V_{DD}).

However, if the logic and LCD driver block use a shared power supply, then the power supplies can be turned on and off at the same time.

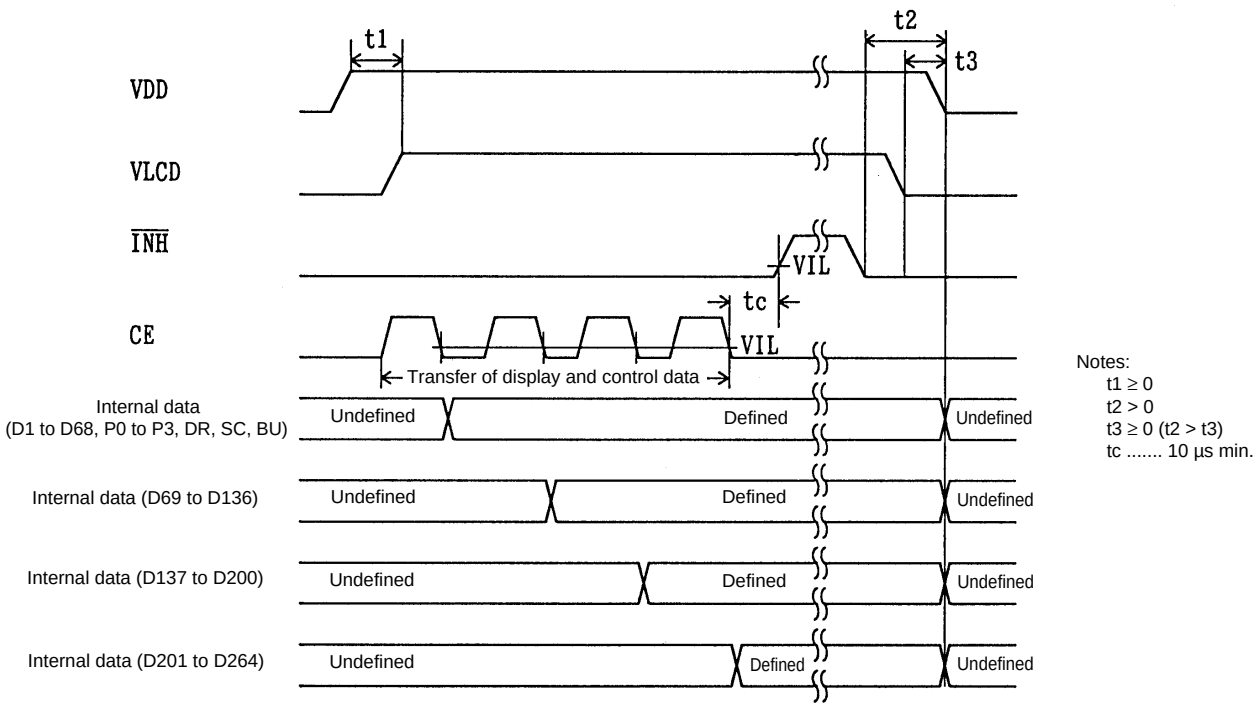


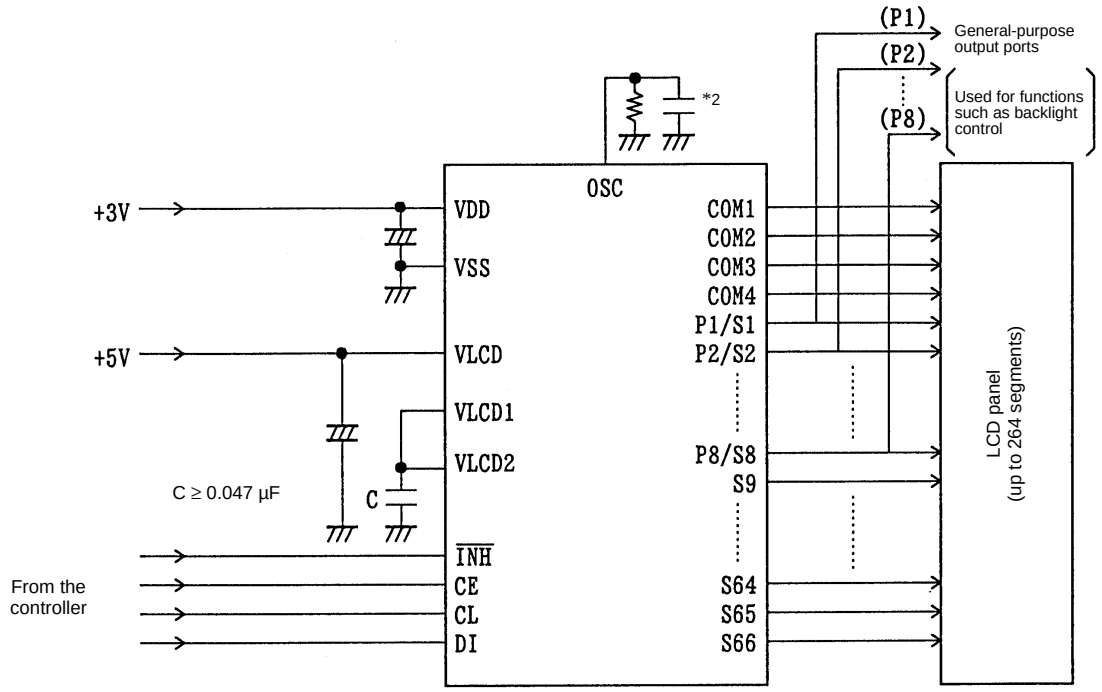
Figure 3

Notes on Controller Transfer of Display Data

Since the LC75874E and LC75874W accept the display data (D1 to D264) divided into four separate transfer operations, we recommend that applications make a point of completing all four data transfers within a period of less than 30 ms to prevent observable degradation of display quality.

Sample Application Circuit 1

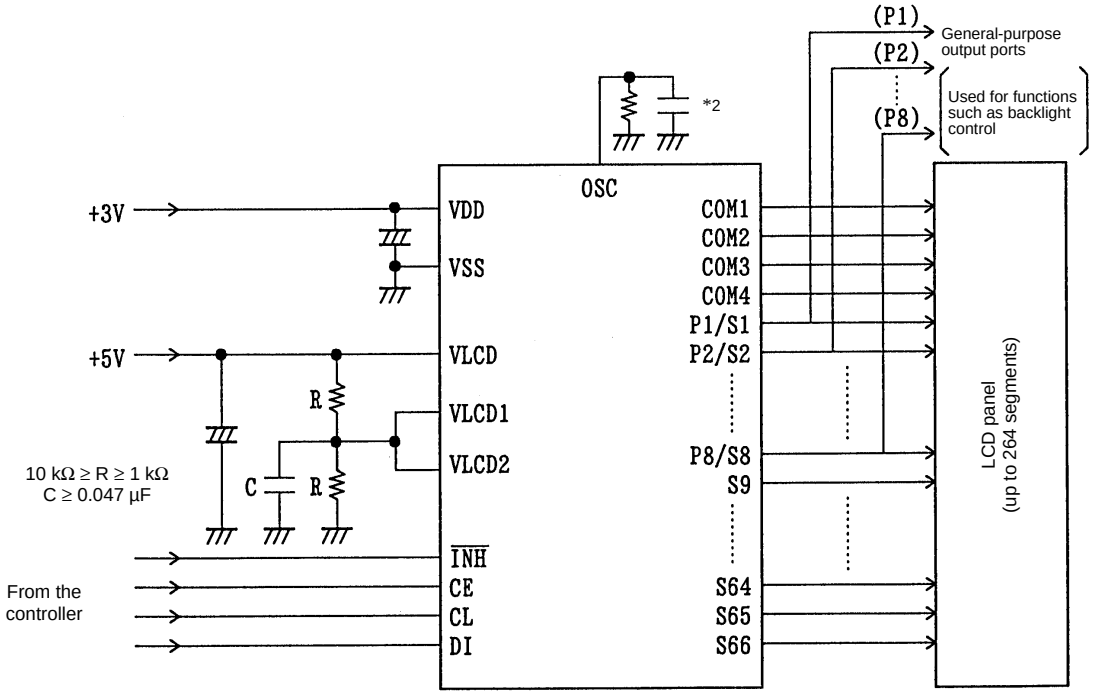
1/2 Bias (for normal LCD panels)



Note: *2 When a capacitor except the recommended external capacitance (Cosc = 680 pF) is connected the OSC pin, we recommend that applications connect the OSC pin with a capacitor in the range 220 to 2200 pF.

Sample Application Circuit 2

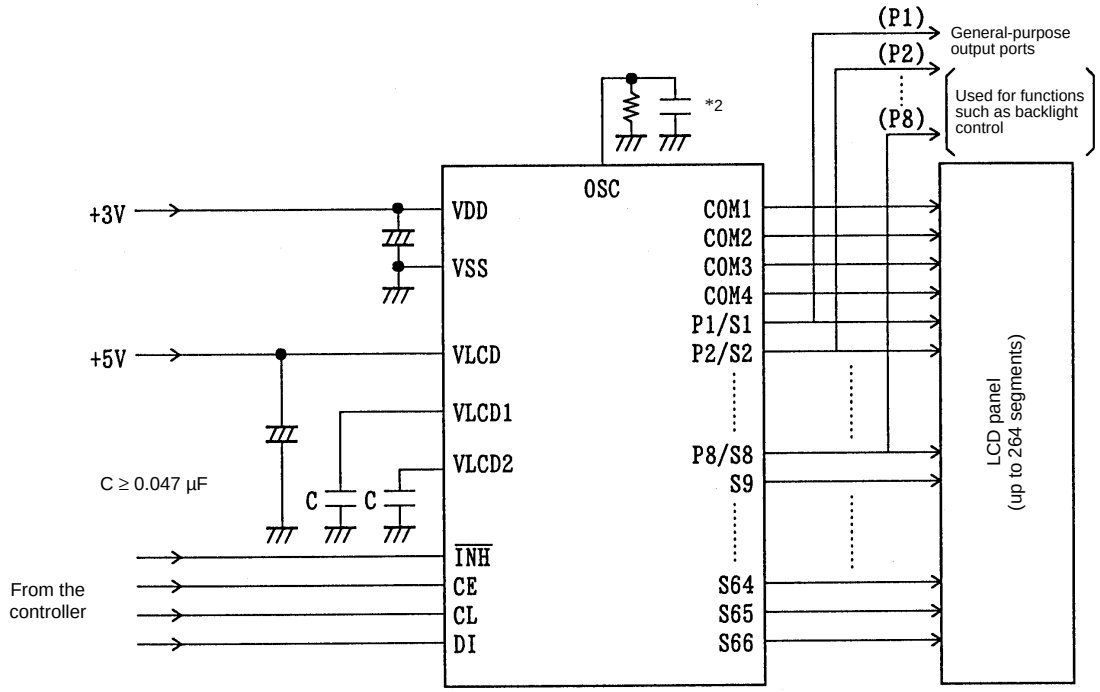
1/2 Bias (for large LCD panels)



Note: *2 When a capacitor except the recommended external capacitance (Cosc = 680 pF) is connected the OSC pin, we recommend that applications connect the OSC pin with a capacitor in the range 220 to 2200 pF.

Sample Application Circuit 3

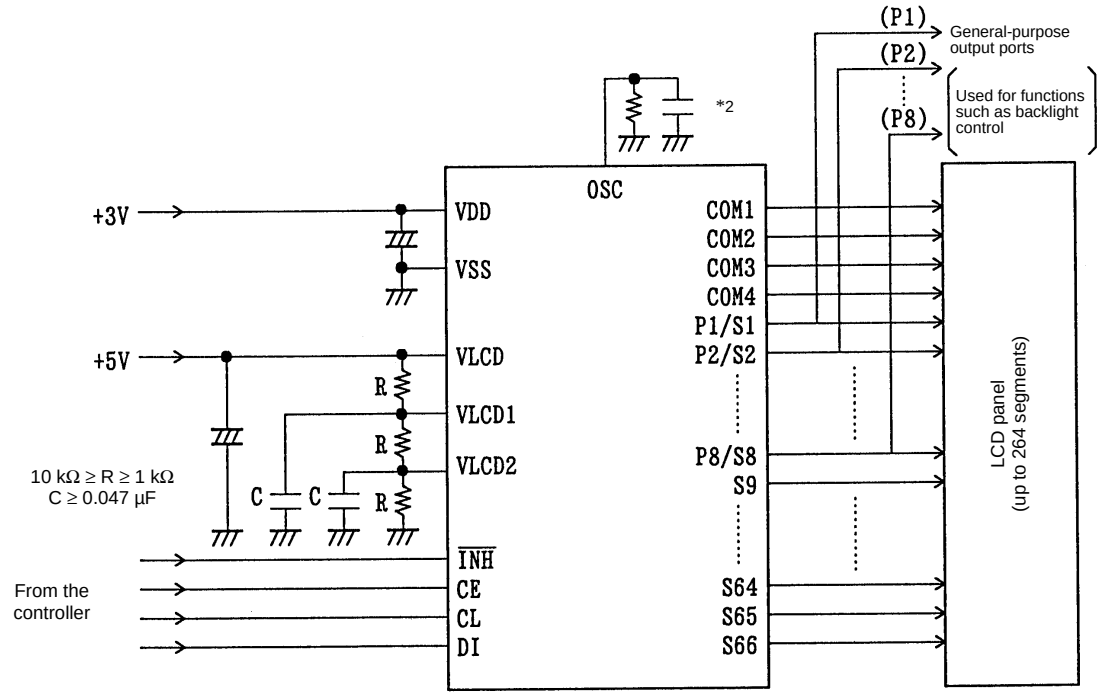
1/3 Bias (for nornal LCD panels)



Note: *2 When a capacitor except the recommended external capacitance (Cosc = 680 pF) is connected the OSC pin, we recommend that applications connect the OSC pin with a capacitor in the range 220 to 2200 pF.

Sample Application Circuit 4

1/3 Bias (for large LCD panels)



Note: *2 When a capacitor except the recommended external capacitance (Cosc = 680 pF) is connected the OSC pin, we recommend that applications connect the OSC pin with a capacitor in the range 220 to 2200 pF.