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LC75832E, LC75832W

## Static Drive, 1/2-Duty Drive General-Purpose LCD Driver
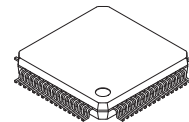
ON Semiconductor®

Overview

The LC75832E and 75832W are static drive or 1/2-duty drive, microcontroller-controlled general-purpose LCD drivers that can be used in applications such as frequency display in products with electronic tuning. In addition to being capable to drive up to 108 segments directly, they can control up to 4 general-purpose output ports. Since the LC75832E and LC75832W 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 volts, regardless of the logic block power-supply voltage.

Features

- Serial data control of switching between static drive mode and 1/2 duty drive mode.
- Up to 54 segments can be displayed in static drive (1/1 duty) mode and up to 108 segments can be displayed in 1/2 duty drive mode.
- 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 (up to 4 general-purpose output ports).
- Serial data control of the frame frequency of the common and segment output waveforms.
- Either RC oscillator operating or external clock operating mode can be selected with the serial control data.
- 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 of 2.7 to 6.0 volts.)
  regardless of the logic block supply-voltage.
- The $\overline{INH}$ pin allows the display to be forced to the off state.
- Allows compatible operation with the LC75822 (822 mode transfer function).
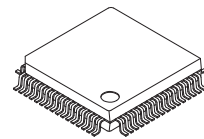
PQFP64 14x14 / QIP64E
[LC75832E]

SPQFP64 10x10 / SQFP64
[LC75832W]

* Computer Control Bus (CCB) is an ON Semiconductor's original bus format and the bus addresses are controlled by ON Semiconductor.

ORDERING INFORMATION
See detailed ordering and shipping information on page 24 of this data sheet.

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	
Output voltage	$V_{OUT}1$	OSC	−0.3 to V_{DD}+0.3	V
	$V_{OUT}2$	S1 to S54, COM1, COM2, P1 to P4	−0.3 to V_{LCD}+0.3	
Output current	$I_{OUT}1$	S1 to S54	300	μA
	$I_{OUT}2$	COM1, COM2	3	mA
	$I_{OUT}3$	P1 to P4	5	
Allowable power dissipation	Pd max	Ta = 105°C	100	mW
Operating temperature	Topr		−40 to +105	°C
Storage temperature	Tstg		−55 to +125	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Allowable Operating Ranges at Ta = −40 to +105°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 high-level voltage	$V_{IH}1$	CE, CL, DI, $\overline{INH}$	$0.8V_{DD}$		6.0	V
	$V_{IH}2$	OSC external clock operating mode	$0.7V_{DD}$		V_{DD}	
Input low-level voltage	$V_{IL}1$	CE, CL, DI, $\overline{INH}$	0		$0.2V_{DD}$	V
	$V_{IL}2$	OSC external clock operating mode	0		$0.3V_{DD}$	
Recommended external resistor for RC oscillation	Rosc	OSC RC oscillator operating mode		39		kΩ
Recommended external capacitor for RC oscillation	Cosc	OSC RC oscillator operating mode		1000		pF
Guaranteed range of RC oscillation	fosc	OSC RC oscillator operating mode	19	38	76	kHz
External clock operating frequency	f_{CK}	OSC external clock operating mode [Figure 3]	19	38	76	kHz
External clock duty cycle	D_{CK}	OSC external clock operating mode [Figure 3]	30	50	70	%
Data setup time	tds	CL, DI [Figure 1] [Figure 2]	160			ns
Data hold time	tdh	CL, DI [Figure 1] [Figure 2]	160			ns
CE wait time	tcp	CE, CL [Figure 1] [Figure 2]	160			ns
CE setup time	tcs	CE, CL [Figure 1] [Figure 2]	160			ns
CE hold time	tch	CE, CL [Figure 1] [Figure 2]	160			ns
High-level clock pulse width	tφH	CL [Figure 1] [Figure 2]	160			ns
Low-level clock pulse width	tφL	CL [Figure 1] [Figure 2]	160			ns
Rise time	tr	CE, CL, DI [Figure 1] [Figure 2]		160		ns
Fall time	tf	CE, CL, DI [Figure 1] [Figure 2]		160		ns
$\overline{INH}$ switching time	tc	$\overline{INH}$, CE [Figure 4] to [Figure 7]	10			μs

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

LC75832E, LC75832W

Electrical Characteristics for the Allowable Operating Ranges

Parameter	Symbol	Pin	Conditions	Ratings			unit
				min	typ	max	
Hysteresis	V_H	CE, CL, DI, $\overline{INH}$			$0.1V_{DD}$		V
Input high-level current	$I_{IH}1$	CE, CL, DI, $\overline{INH}$	$V_I = 6.0$ V			5.0	μA
	$I_{IH}2$	OSC	$V_I = V_{DD}$ external clock operating mode			5.0	
Input low-level current	$I_{IL}1$	CE, CL, DI, $\overline{INH}$	$V_I = 0$ V	−5.0			μA
	$I_{IL}2$	OSC	$V_I = 0$ V external clock operating mode	−5.0			
Output high-level voltage	$V_{OH}1$	S1 to S54	$I_O = -20$ μA	$V_{LCD} -0.9$			V
	$V_{OH}2$	COM1, COM2	$I_O = -100$ μA	$V_{LCD} -0.9$			
	$V_{OH}3$	P1 to P4	$I_O = -1$ mA	$V_{LCD} -0.9$			
Output low-level voltage	$V_{OL}1$	S1 to S54	$I_O = 20$ μA			0.9	V
	$V_{OL}2$	COM1, COM2	$I_O = 100$ μA			0.9	
	$V_{OL}3$	P1 to P4	$I_O = 1$ mA			0.9	
Output middle-level voltage	V_{MID}	COM1, COM2	1/2 bias $I_O = \pm100$ μA	$1/2V_{LCD} -0.9$		$1/2V_{LCD} +0.9$	V
Oscillator frequency	fosc	OSC	RC oscillator operating mode Rosc = 39kΩ, Cosc = 1000 pF	30.4	38	45.6	kHz
Current drain	$I_{DD}1$	V_{DD}	Power-saving mode			10	μA
	$I_{DD}2$	V_{DD}	$V_{DD} = 6.0$ V output open fosc = 38 kHz		250	500	
	$I_{LCD}1$	V_{LCD}	Power-saving mode			15	
	$I_{LCD}2$	V_{LCD}	$V_{LCD} = 6.0$ V output open Static fosc = 38 kHz		100	200	
	$I_{LCD}3$	V_{LCD}	$V_{LCD} = 6.0$ V output open 1/2 duty fosc = 38 kHz		1300	2600	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
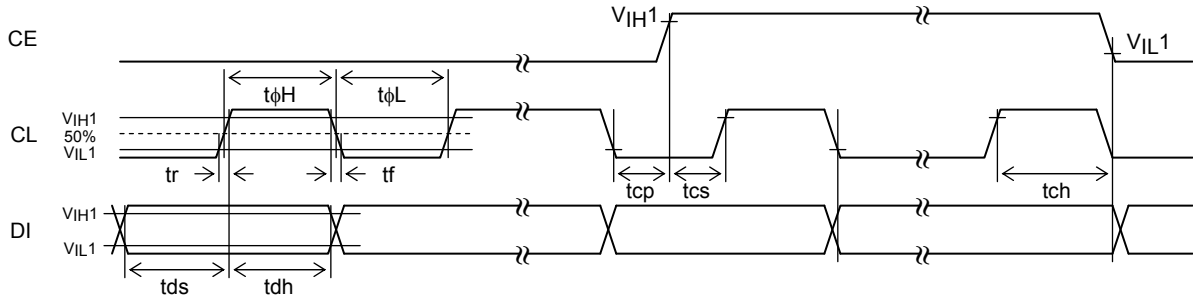
1. When CL is stopped at the low level

Figure 1

2. When CL is stopped at the high level

Figure 2

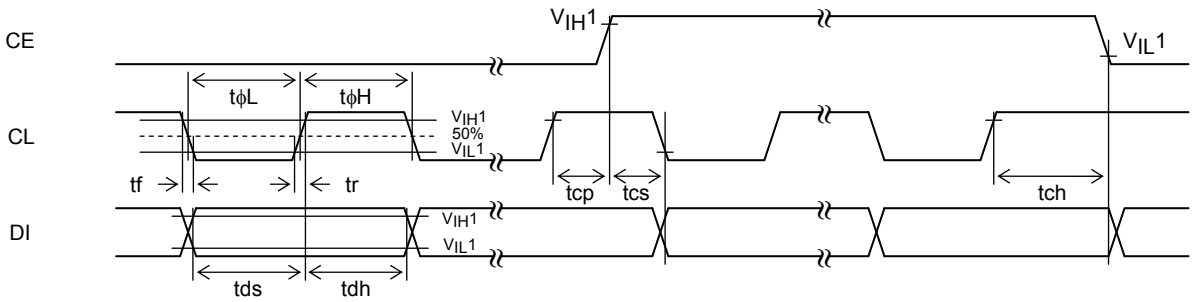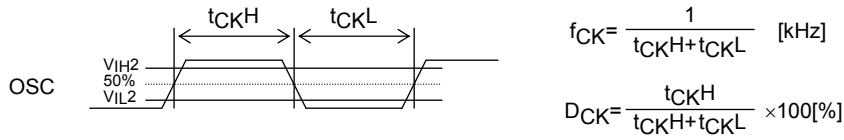3. OSC pin clock timing in external clock operating mode

$$f_{CK} = \frac{1}{t_{CK}H + t_{CK}L} \quad [kHz]$$

$$D_{CK} = \frac{t_{CK}H}{t_{CK}H + t_{CK}L} \times 100[\%]$$

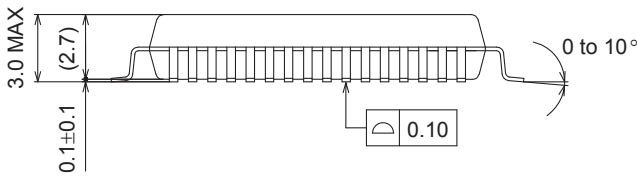Figure 3

LC75832E, LC75832W

Package Dimensions

unit : mm

[LC75832E]

PQFP64 14x14 / QIP64E
CASE 122BP
ISSUE A
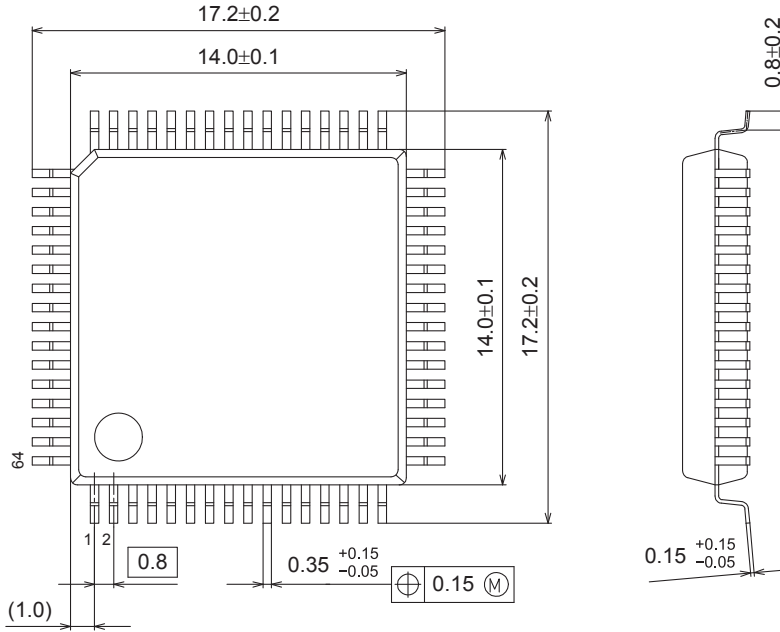
17.2±0.2

14.0±0.1

0.8±0.2

14.0±0.1

17.2±0.2

64

1 2

0.8
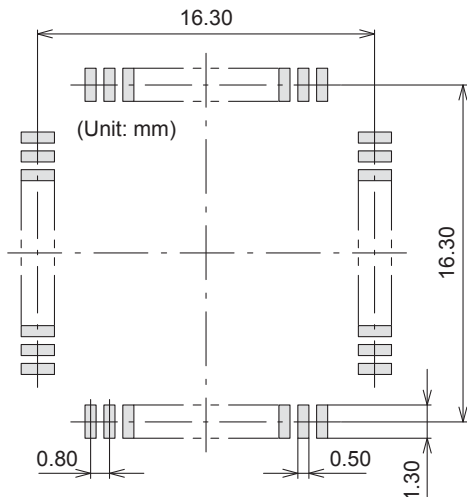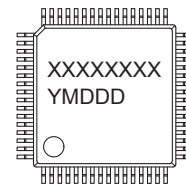
0.35 +0.15 −0.05

⊕ 0.15 Ⓜ

(1.0)

0.15 +0.15 −0.05

3.0 MAX

(2.7)

0.1±0.1

0 to 10°

△ 0.10

SOLDERING FOOTPRINT*

16.30

(Unit: mm)

16.30

0.80

0.50

1.30

GENERIC MARKING DIAGRAM*

XXXXXXXX
YMDDD

XXXXX = Specific Device Code
Y = Year
M = Month
DDD = Additional Traceability Data

*This information is generic. Please refer to
device data sheet for actual part marking.
Pb-Free indicator, "G" or microdot "∎",
may or may not be present.

NOTE: The measurements are not to guarantee but for reference only.

*For additional information on our Pb-Free strategy and soldering
details, please download the ON Semiconductor Soldering and
Mounting Techniques Reference Manual, SOLDERRM/D.
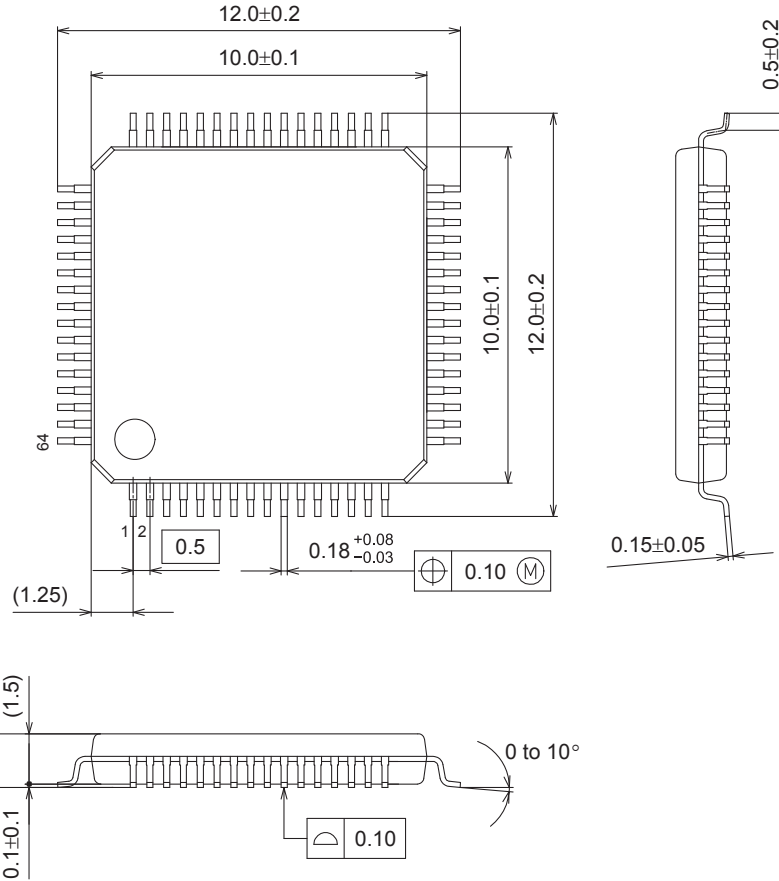
LC75832E, LC75832W
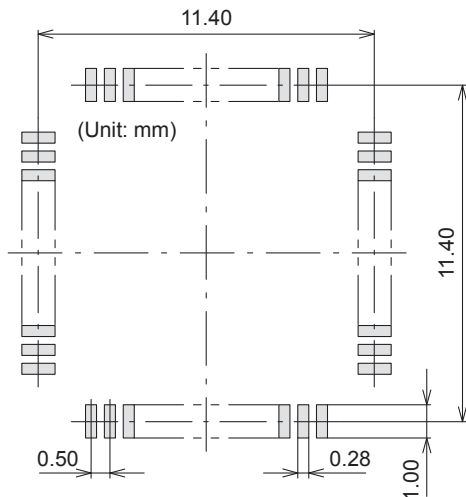
Package Dimensions

unit : mm
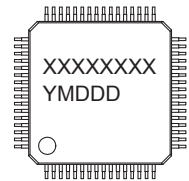
[LC75832W]

SPQFP64 10x10 / SQFP64
CASE 131AK
ISSUE A

12.0±0.2

10.0±0.1

10.0±0.1

12.0±0.2

0.5±0.2

64

1 2

0.5

(1.25)

$0.18^{+0.08}_{-0.03}$

⊕ 0.10 Ⓜ

0.15±0.05

1.7 MAX

(1.5)

0.1±0.1

0 to 10°

⌒ 0.10

SOLDERING FOOTPRINT*

11.40

(Unit: mm)

11.40

0.50

0.28

1.00

GENERIC MARKING DIAGRAM*

XXXXXXXX
YDD
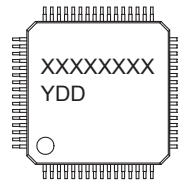
XXXXXXXX
YMDDD

XXXXX = Specific Device Code
Y = Year
DD = Additional Traceability Data

XXXXX = Specific Device Code
Y = Year
M = Month
DDD = Additional Traceability Data

*This information is generic. Please refer to
device data sheet for actual part marking.
Pb-Free indicator, "G" or microdot "▪",
may or may not be present.

NOTE: The measurements are not to guarantee but for reference only.

*For additional information on our Pb-Free strategy and soldering
details, please download the ON Semiconductor Soldering and
Mounting Techniques Reference Manual, SOLDERRM/D.

LC75832E, LC75832W

Pin Assignment

Top view
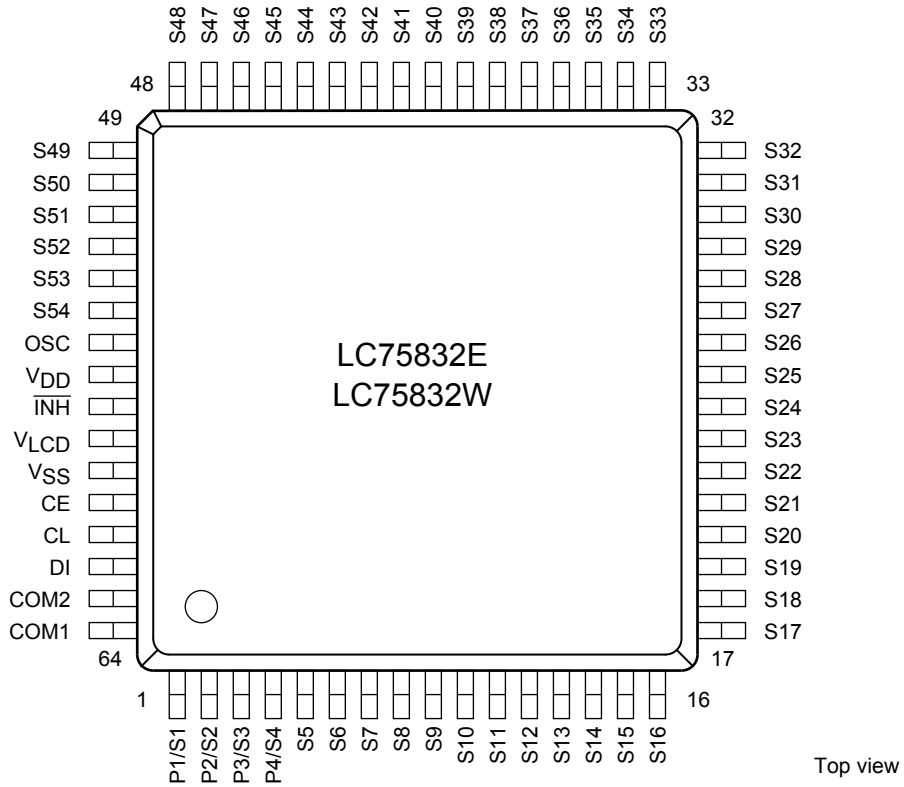
LC75832E : QIP64E(14×14)
LC75832W : SQFP64(10×10)

Block Diagram

LC75832E, LC75832W

Pin Functions

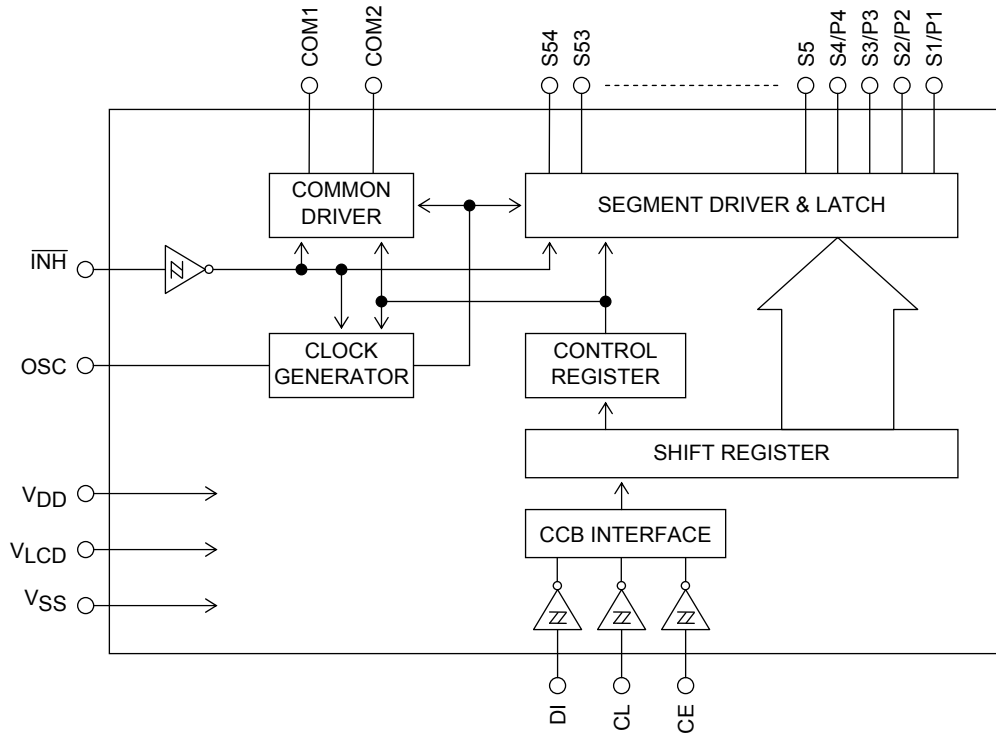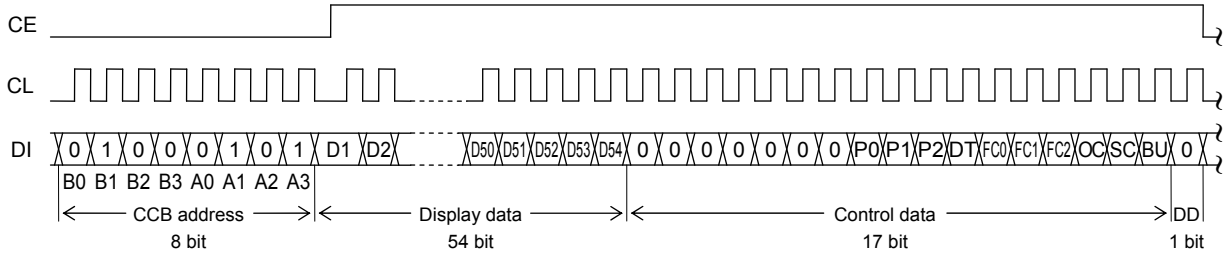| Symbol	Pin No.	Function	Active	I/O	Handling when unused
S1/P1 to S4/P4 S5 to S54	1 to 4 5 to 54	Segment outputs for displaying the display data transferred by serial data input. The S1/P1 to S4/P4 pins can be used as general-purpose output ports when so set up by the control data.	-	O	OPEN
COM1 COM2	64 63	Common driver outputs. The frame frequency is fo [Hz].	-	O	OPEN
OSC	55	Oscillator connection. An oscillator circuit is formed by connecting an external resistor and capacitor to this pin. This pin can be used as the external clock input pin if external clock operating mode is selected with the control data.	-	I/O	V_{DD}

CE
CL
DI
	60
	61
	62
		Serial data transfer inputs. Must be connected to the controller.
		    CE: Chip enable
		    CL: Synchronization clock
		    DI: Transfer data
			H
			
			-
				I
				I
				I
					GND

$\overline{INH}$	57	Display off control input
		• $\overline{INH}$ = low (V_{SS}) ...Display forced off
		        S1/P1 to S4/P4 = low (V_{SS})
		        (These pins are forcibly set to the segment output port function and held at the V_{SS} level.)
		        S5 to S54 = low (V_{SS})
		        COM1, COM2 = low (V_{SS})
		        OSC = Z (high impedance)
		        RC oscillation stopped
		        Inhibits external clock input.
		• $\overline{INH}$ = high (V_{DD})...Display on
		        RC oscillation enabled (RC oscillator operating mode)
		        Enables external clock input (external clock operating mode).
		However, serial data transfer is possible when the display is forced off.
			L	I	GND

V_{DD}	56	Logic block power supply. Provide a voltage in the range 2.7 to 6.0 V.	-	-	-
V_{LCD}	58	LCD driver block power supply. Provide a voltage in the range 2.7 to 6.0 V.	-	-	-
V_{SS}	59	Ground pin. Must be connected to ground.	-	-	-

Serial Data Transfer Formats

(1) Static drive mode

1. When CL is stopped at the low level

CE

CL

DI 0 1 0 0 0 1 0 1 D1 D2 D50 D51 D52 D53 D54 0 0 0 0 0 0 0 0 P0 P1 P2 DT FC0 FC1 FC2 OC SC BU 0

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Control data →|DD|

8 bit / 54 bit / 17 bit / 1 bit

2. When CL is stopped at the high level

CE

CL

DI 0 1 0 0 0 1 0 1 D1 D2 D50 D51 D52 D53 D54 0 0 0 0 0 0 0 0 P0 P1 P2 DT FC0 FC1 FC2 OC SC BU 0

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Control data →|DD|

8 bit / 54 bit / 17 bit / 1 bit

Note: DD is the direction data.
- CCB address .... "A2H"
- D1 to D54 .... Display data
- P0 to P2 .... Segment output port/general-purpose output port switching control data
- DT .... Static drive or 1/2 duty drive switching control data
- FC0 to FC2 .... Common/segment output waveform frame frequency control data
- OC .... RC oscillator operating mode/external clock operating mode switching control data
- SC .... Segments on/off control data
- BU .... Normal mode/power-saving mode control data

LC75832E, LC75832W

(2) 1/2 duty drive mode

1. When CL is stopped at the low level

CE

CL

DI `0 1 0 0 0 1 0 1` D1 D2 ... D47 D48 D49 D50 D51 D52 D53 D54 `0 0 0 0 0 0 0` P0 P1 P2 DT FC0 FC1 FC2 OC SC BU `0`

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Control data →|DD|

8 bit — 54 bit — 17 bit — 1 bit

DI `0 1 0 0 0 1 0 1` D55 D56 ... D101 D102 D103 D104 D105 D106 D107 D108 `0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0` `1`

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Fixed data →|DD|

8 bit — 54 bit — 17 bit — 1 bit

2. When CL is stopped at the high level

CE

CL

DI `0 1 0 0 0 1 0 1` D1 D2 ... D47 D48 D49 D50 D51 D52 D53 D54 `0 0 0 0 0 0 0` P0 P1 P2 DT FC0 FC1 FC2 OC SC BU `0`

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Control data →|DD|

8 bit — 54 bit — 17 bit — 1 bit

DI `0 1 0 0 0 1 0 1` D55 D56 ... D101 D102 D103 D104 D105 D106 D107 D108 `0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0` `1`

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Fixed data →|DD|

8 bit — 54 bit — 17 bit — 1 bit

Note: DD is the direction data.
- CCB address .... "A2H"
- D1 to D108 .... Display data
- P0 to P2 .... Segment output port/general-purpose output port switching control data
- DT .... Static drive or 1/2 duty drive switching control data
- FC0 to FC2 .... Common/segment output waveform frame frequency control data
- OC .... RC oscillator operating mode/external clock operating mode switching control data
- SC .... Segments on/off control data
- BU .... Normal mode/power-saving mode control data

Serial Data Transfer Formats (When in 822 mode data transfer)

(1) Static drive mode (When in 822 mode data transfer)
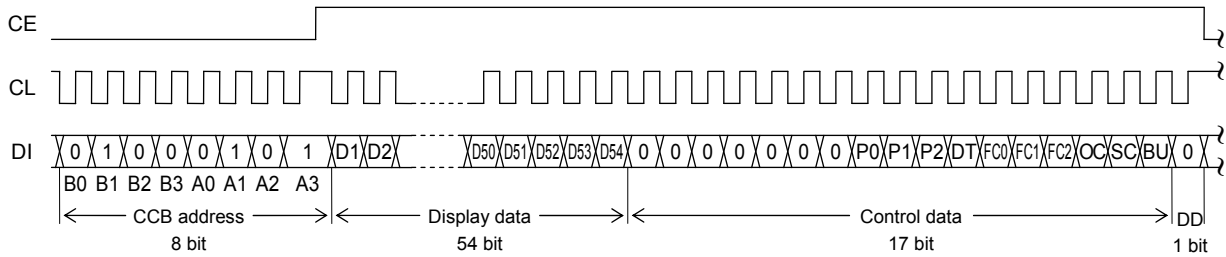
1. When CL is stopped at the low level

2. When CL is stopped at the high level

Note: DD is the direction data.
- CCB address …………….. "A2H"
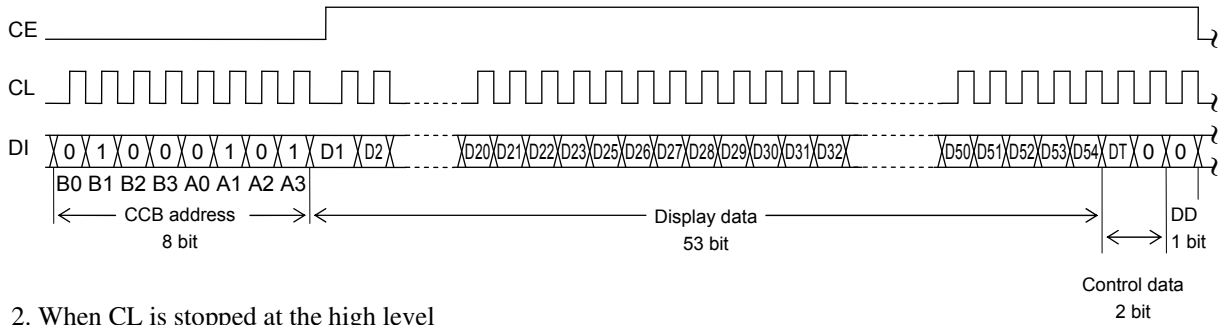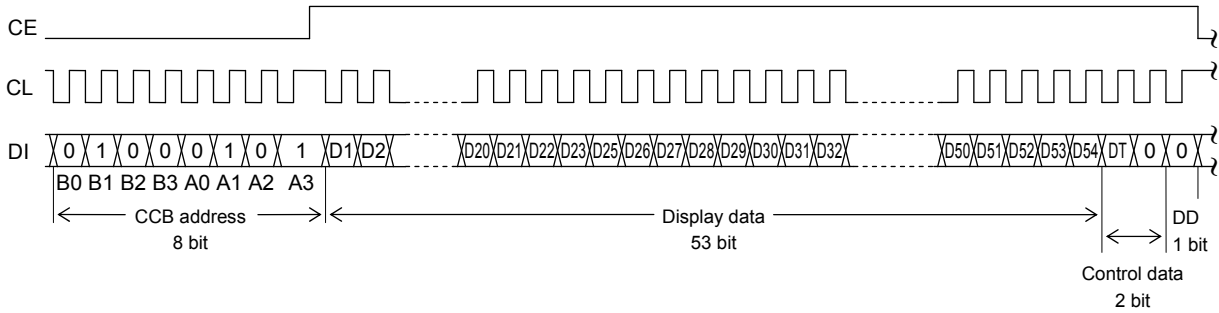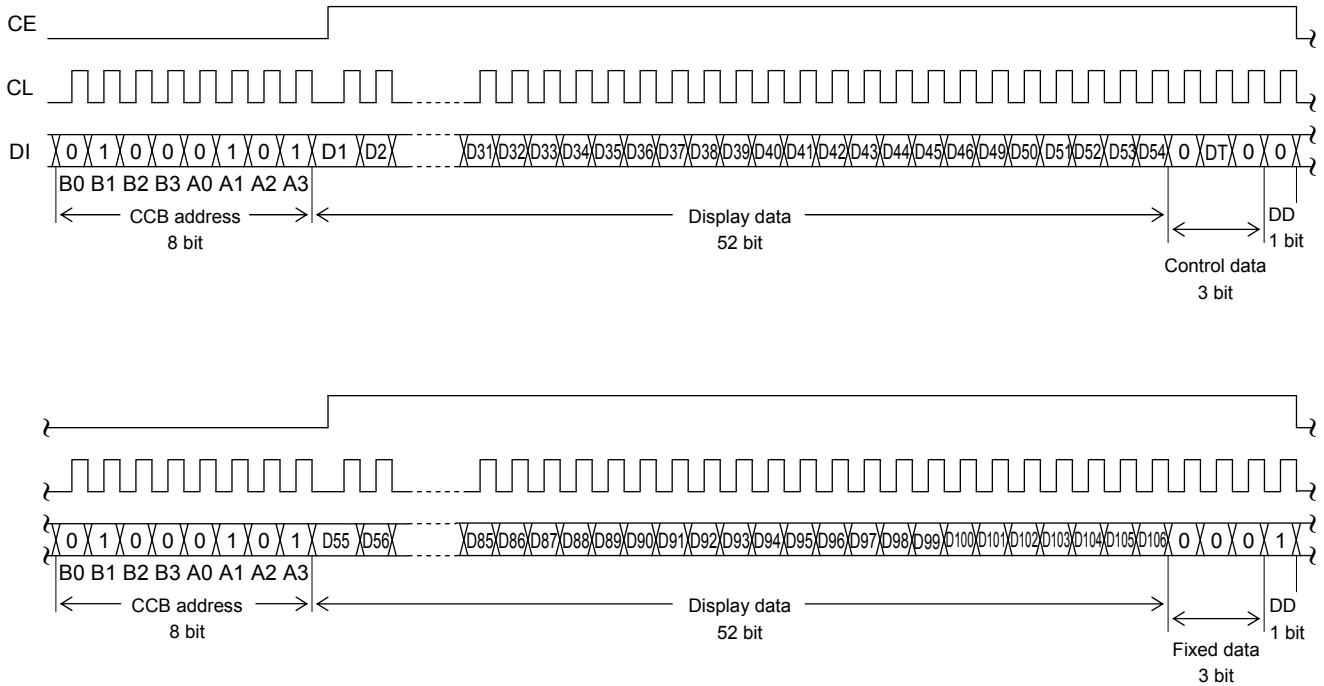- D1 to D23, D25 to D54 …. Display data
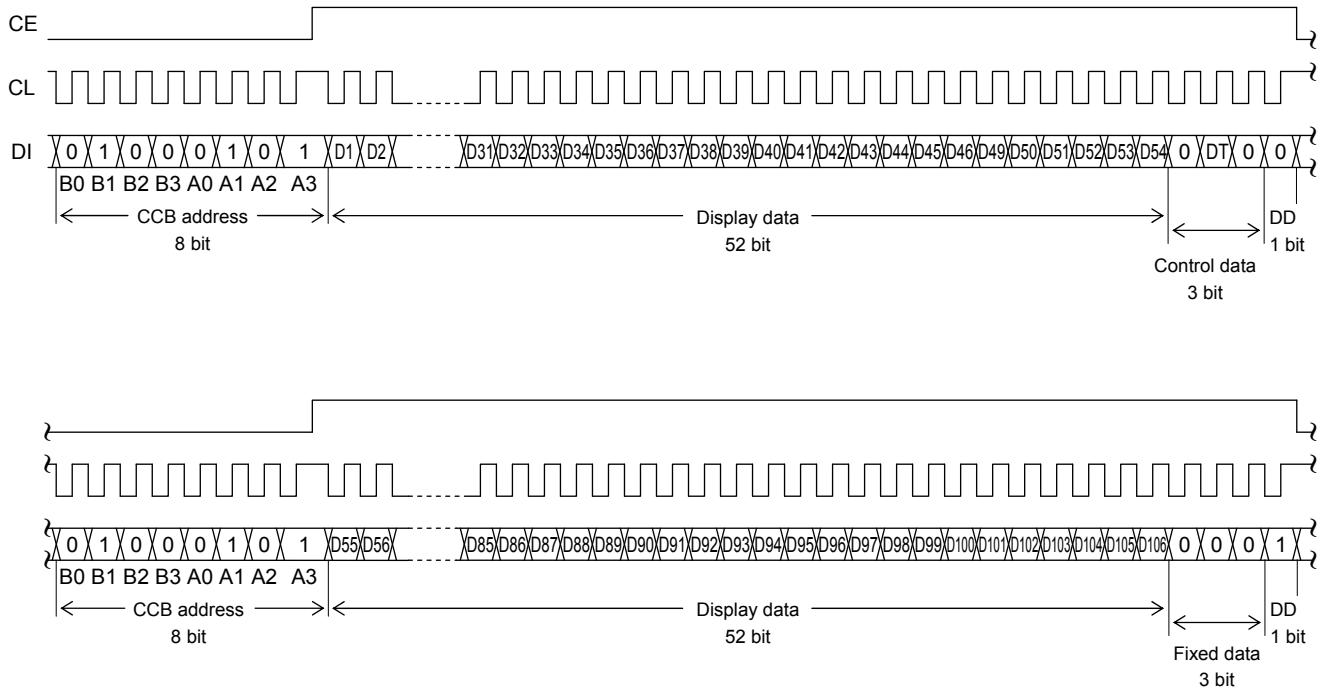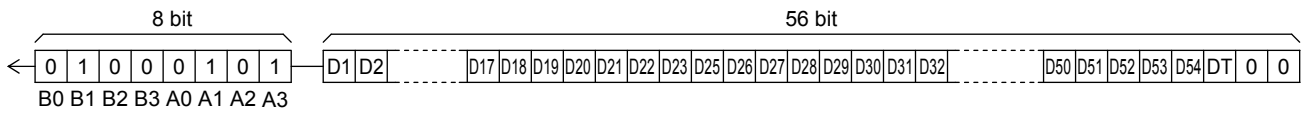- DT ……………………….. Static drive or 1/2 duty drive switching control data

LC75832E, LC75832W

(2) 1/2 duty drive mode (When in 822 mode data transfer)

1. When CL is stopped at the low level

CE

CL

DI 0 1 0 0 0 1 0 1 D1 D2 ... D31 D32 D33 D34 D35 D36 D37 D38 D39 D40 D41 D42 D43 D44 D45 D46 D49 D50 D51 D52 D53 D54 0 DT 0 0

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Control data →| DD

8 bit   52 bit   3 bit   1 bit

CE

CL

DI 0 1 0 0 0 1 0 1 D55 D56 ... D85 D86 D87 D88 D89 D90 D91 D92 D93 D94 D95 D96 D97 D98 D99 D100 D101 D102 D103 D104 D105 D106 0 0 0 1

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Fixed data →| DD

8 bit   52 bit   3 bit   1 bit

2. When CL is stopped at the high level

CE

CL

DI 0 1 0 0 0 1 0 1 D1 D2 ... D31 D32 D33 D34 D35 D36 D37 D38 D39 D40 D41 D42 D43 D44 D45 D46 D49 D50 D51 D52 D53 D54 0 DT 0 0

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Control data →| DD

8 bit   52 bit   3 bit   1 bit

CE

CL

DI 0 1 0 0 0 1 0 1 D55 D56 ... D85 D86 D87 D88 D89 D90 D91 D92 D93 D94 D95 D96 D97 D98 D99 D100 D101 D102 D103 D104 D105 D106 0 0 0 1

B0 B1 B2 B3 A0 A1 A2 A3

|← CCB address →|← Display data →|← Fixed data →| DD

8 bit   52 bit   3 bit   1 bit

Note: DD is the direction data.
- CCB address …………….... "A2H"
- D1 to D46, D49 to D106 …. Display data
- DT ……………………..... Static drive or 1/2 duty drive switching control data

Serial Data Transfer Examples

(1) Static drive mode

The serial data shown in the figure below must be sent.

8 bit	72 bit

← | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |—| D1 | D2 | ---- | D47 | D48 | D49 | D50 | D51 | D52 | D53 | D54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | P0 | P1 | P2 | DT | FC0 | FC1 | FC2 | 0C | SC | BU | 0 |

B0 B1 B2 B3 A0 A1 A2 A3

(2) 1/2 duty drive mode

• When 55 or more segments are used

160 bits of serial data (including CCB address bits) must be sent.

8 bit	72 bit

← | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |—| D1 | D2 | ---- | D47 | D48 | D49 | D50 | D51 | D52 | D53 | D54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | P0 | P1 | P2 | DT | FC0 | FC1 | FC2 | 0C | SC | BU | 0 | ←

B0 B1 B2 B3 A0 A1 A2 A3

| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |—| D55 | D56 | ---- | D101 | D102 | D103 | D104 | D105 | D106 | D107 | D108 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

B0 B1 B2 B3 A0 A1 A2 A3

• When fewer than 55 segments are used

The serial data shown below (the D1 to D54 display data and the control data) must always be sent.

8 bit	72 bit

← | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |—| D1 | D2 | ---- | D47 | D48 | D49 | D50 | D51 | D52 | D53 | D54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | P0 | P1 | P2 | DT | FC0 | FC1 | FC2 | 0C | SC | BU | 0 |

B0 B1 B2 B3 A0 A1 A2 A3

Serial Data Transfer Example (When in 822 mode data transfer)

(1) Static drive mode

The serial data shown in the figure below must be sent.

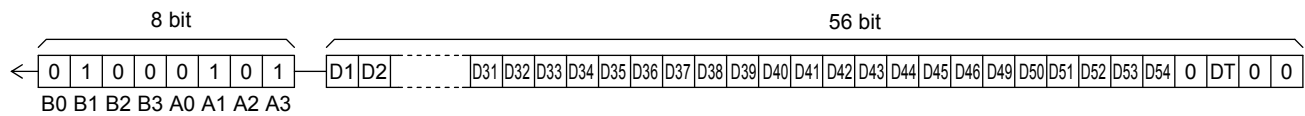| 8 bit								56 bit

← | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | D1 | D2 | D17 | D18 | D19 | D20 | D21 | D22 | D23 | D25 | D26 | D27 | D28 | D29 | D30 | D31 | D32 | D50 | D51 | D52 | D53 | D54 | DT | 0 | 0

B0 B1 B2 B3 A0 A1 A2 A3

(2) 1/2 duty drive mode

• When 53 or more segments are used

128 bits of serial data (including CCB address bits) must be sent.

8 bit								56 bit

← | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | D1 | D2 | D31 | D32 | D33 | D34 | D35 | D36 | D37 | D38 | D39 | D40 | D41 | D42 | D43 | D44 | D45 | D46 | D49 | D50 | D51 | D52 | D53 | D54 | 0 | DT | 0 | 0 | ←

B0 B1 B2 B3 A0 A1 A2 A3

| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | D55 | D56 | D85 | D86 | D87 | D88 | D89 | D90 | D91 | D92 | D93 | D94 | D95 | D96 | D97 | D98 | D99 | D100 | D101 | D102 | D103 | D104 | D105 | D106 | 0 | 0 | 0 | 1

B0 B1 B2 B3 A0 A1 A2 A3

• When fewer than 53 segments are used

The serial data shown in the figure below (the D1 to D46 and D49 to D54 display data, and the control data) must be sent.

8 bit								56 bit

← | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | D1 | D2 | D31 | D32 | D33 | D34 | D35 | D36 | D37 | D38 | D39 | D40 | D41 | D42 | D43 | D44 | D45 | D46 | D49 | D50 | D51 | D52 | D53 | D54 | 0 | DT | 0 | 0

B0 B1 B2 B3 A0 A1 A2 A3

Control Data Functions

1. P0 to P2: 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 S4/P4 output pins.

   However, segment output port is forcibly selected when in 822 mode data transfer.

Control data			Output pin state			
P0	P1	P2	S1/P1	S2/P2	S3/P3	S4/P4
0	0	0	S1	S2	S3	S4
0	0	1	P1	S2	S3	S4
0	1	0	P1	P2	S3	S4
0	1	1	P1	P2	P3	S4
1	0	0	P1	P2	P3	P4

Note: Sn (n = 1 to 4): Segment output ports

Pn (n = 1 to 4): General-purpose output ports

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	
	Static drive mode	1/2 duty drive mode
S1/P1	D1	D1
S2/P2	D2	D3
S3/P3	D3	D5
S4/P4	D4	D7

For example, if the general-purpose output port function is selected for the S4/P4 output pin in 1/2 duty drive mode, it will output a high level (V_{LCD}) when display data D7 is 1, and a low level (V_{SS}) when D7 is 0.

2. DT: Static drive mode/1/2 duty drive mode switching control data

   This control data bit selects either static drive mode or 1/2 duty drive mode.

DT	Duty drive mode	Output pin state (COM2)
0	Static drive mode	V_{SS} level
1	1/2 duty drive mode	COM2

3. FC0 to FC2: Common/segment output waveform frame frequency control data

   These control data bits set the frame frequency of the common and segment output waveforms.

   However, fo=fosc/384 is forcibly selected when in 822 mode data transfer.

Control data			Frame frequency fo [Hz]
FC0	FC1	FC2	
1	1	0	fosc/768, f_{CK}/768
1	1	1	fosc/576, f_{CK}/576
0	0	0	fosc/384, f_{CK}/384
0	0	1	fosc/288, f_{CK}/288
0	1	0	fosc/192, f_{CK}/192

4. OC: RC oscillator operating mode/external clock operating mode switching control data.

   This control data bit switches the OSC pin function

   (either RC oscillator operating mode or external clock operating mode).

   However RC oscillator operating mode is forcibly selected when in 822 mode data transfer.

OC	OSC pin function
0	RC oscillator operating mode
1	External clock operating mode

Note: An external resistor, Rosc, and an external capacitor, Cosc, must be connected to the OSC pin if RC oscillator operating mode is selected.

5. SC: Segment on/off control data

This control data bit controls the on/off state of the segments.

However, the segment on state is forcibly selected when in 822 mode data transfer.

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.

6. BU: Normal mode/power-saving mode control data

This control data bit selects either normal mode or power-saving mode.

However, the normal mode is forcibly selected when in 822 mode data transfer.

BU	Mode
0	Normal mode
1	Power-saving mode. In RC oscillator operating mode (OC = 0), the OSC pin oscillator is stopped, and in external clock operating mode (OC = 1), acceptance of the external clock is stopped. In this mode the common and segment output pins go to the V_{SS} levels. However, S1/P1 to S4/P4 output pins that are set to be general-purpose output ports by the control data P0 to P2 can be used as general-purpose output ports.

Display Data and Output Pin Correspondence

(1) Static drive mode

Output pin	COM1		Output pin	COM1		Output pin	COM1
S1/P1	D1		S21	D21		S41	D41
S2/P2	D2		S22	D22		S42	D42
S3/P3	D3		S23	D23		S43	D43
S4/P4	D4		S24	D24		S44	D44
S5	D5		S25	D25		S45	D45
S6	D6		S26	D26		S46	D46
S7	D7		S27	D27		S47	D47
S8	D8		S28	D28		S48	D48
S9	D9		S29	D29		S49	D49
S10	D10		S30	D30		S50	D50
S11	D11		S31	D31		S51	D51
S12	D12		S32	D32		S52	D52
S13	D13		S33	D33		S53	D53
S14	D14		S34	D34		S54	D54
S15	D15		S35	D35			
S16	D16		S36	D36			
S17	D17		S37	D37			
S18	D18		S38	D38			
S19	D19		S39	D39			
S20	D20		S40	D40			

Note 1: This applies to the case where the S1/P1 to S4/P4 output pins are set to be segment output ports.

Note 2: The S24 output pin outputs a low level (V_{SS} level) when in 822 mode data transfer.

For example, the table below lists the output states for the S21 output pin.

Display data	Output pin (S21) state
D21	
0	The LCD segment corresponding to COM1 is off
1	The LCD segment corresponding to COM1 is on

(2)1/2 duty drive mode

Output pin	COM1	COM2
S1/P1	D1	D2
S2/P2	D3	D4
S3/P3	D5	D6
S4/P4	D7	D8
S5	D9	D10
S6	D11	D12
S7	D13	D14
S8	D15	D16
S9	D17	D18
S10	D19	D20
S11	D21	D22
S12	D23	D24
S13	D25	D26
S14	D27	D28
S15	D29	D30
S16	D31	D32
S17	D33	D34
S18	D35	D36
S19	D37	D38
S20	D39	D40

Output pin	COM1	COM2
S21	D41	D42
S22	D43	D44
S23	D45	D46
S24	D47	D48
S25	D49	D50
S26	D51	D52
S27	D53	D54
S28	D55	D56
S29	D57	D58
S30	D59	D60
S31	D61	D62
S32	D63	D64
S33	D65	D66
S34	D67	D68
S35	D69	D70
S36	D71	D72
S37	D73	D74
S38	D75	D76
S39	D77	D78
S40	D79	D80

Output pin	COM1	COM2
S41	D81	D82
S42	D83	D84
S43	D85	D86
S44	D87	D88
S45	D89	D90
S46	D91	D92
S47	D93	D94
S48	D95	D96
S49	D97	D98
S50	D99	D100
S51	D101	D102
S52	D103	D104
S53	D105	D106
S54	D107	D108

Note 1: Applies when the S1/P1 to S4/P4 output pins are to their segment output function.

Note 2: The S24 output pin outputs a low level (V_{SS} level) when in 822 mode data transfer.

Note 3: The S54 output pin outputs an all-segment-on waveform when in 822 mode data transfer.

For example, the table below lists the output states for the S21 output pin.

Display data		Output pin (S21) state
D41	D42	
0	0	The LCD segments corresponding to COM1 and COM2 are off
0	1	The LCD segment corresponding to COM2 is on
1	0	The LCD segment corresponding to COM1 is on
1	1	The LCD segments corresponding to COM1 and COM2 are on

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Output Waveforms (Static drive mode)

fo[Hz]

COM1 — V$_{LCD}$ / 0V

LCD driver output when off — V$_{LCD}$ / 0V

LCD driver output when on — V$_{LCD}$ / 0V
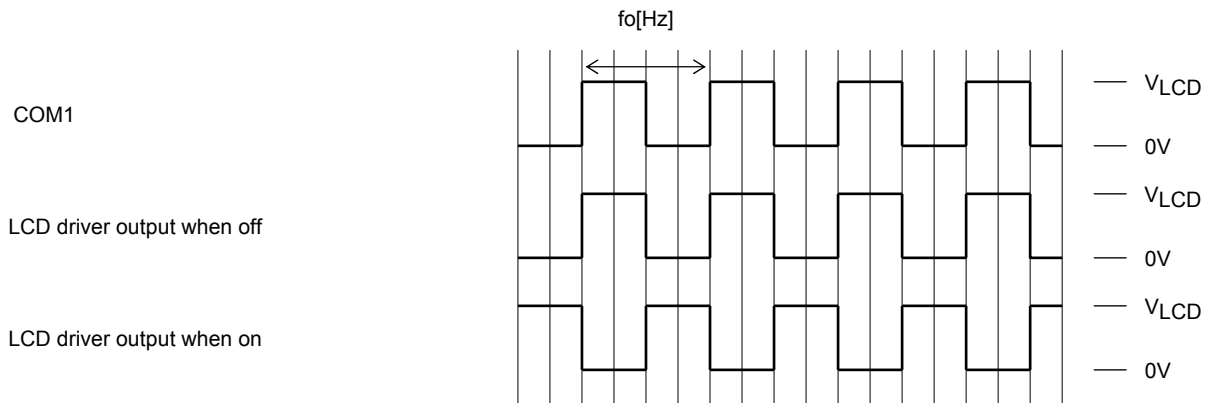
Output Waveforms (1/2 duty, 1/2 bias drive mode)
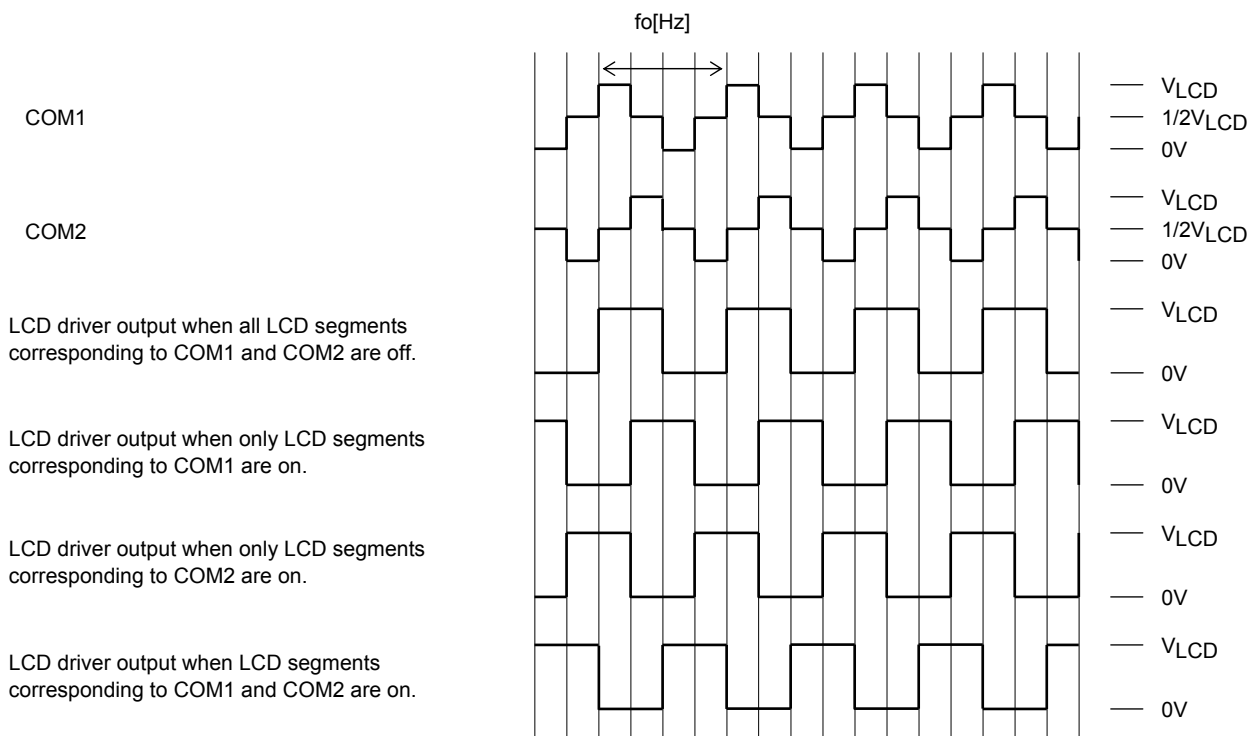
fo[Hz]

COM1 — V$_{LCD}$ / 1/2V$_{LCD}$ / 0V

COM2 — V$_{LCD}$ / 1/2V$_{LCD}$ / 0V

LCD driver output when all LCD segments corresponding to COM1 and COM2 are off. — V$_{LCD}$ / 0V

LCD driver output when only LCD segments corresponding to COM1 are on. — V$_{LCD}$ / 0V

LCD driver output when only LCD segments corresponding to COM2 are on. — V$_{LCD}$ / 0V

LCD driver output when LCD segments corresponding to COM1 and COM2 are on. — V$_{LCD}$ / 0V

Control data			Frame frequency fo [Hz]
FC0	FC1	FC2	
1	1	0	fosc/768, f$_{CK}$/768
1	1	1	fosc/576, f$_{CK}$/576
0	0	0	fosc/384, f$_{CK}$/384
0	0	1	fosc/288, f$_{CK}$/288
0	1	0	fosc/192, f$_{CK}$/192

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

Since the IC's internal data (the display data D1 to D54 and the control data when in static drive mode, and the display data D1 to D108 and the control data when in 1/2 duty drive mode) is undefined when power is first applied, applications should set the $\overline{\text{INH}}$ pin low at the same time as power is applied to turn off the display (setting S1/P1 to S4/P4 and S5 to S54, COM1, and COM2 to the V_{SS} level) and during this period send serial data from the controller. The controller should then set the $\overline{\text{INH}}$ pin high after the data transfer has completed. This procedure prevents unnecessary display at power on (See Figures 4 to 7).

Notes on the Power On/Off Sequences

Applications should observe the following sequence when turning the LC75832E and LC75832W power on and off. (See Figures 4 to 7):
• At power on: Logic block power supply (V_{DD}) on → LCD driver block power supply (V_{LCD}) on
• At power off: LCD driver block power supply (V_{LCD}) off → Logic block power supply (V_{DD}) off

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

• Static drive mode

Notes: t1≥0
t2>0
t3≥0 (t2>t3)
tc ⋯ 10μs min
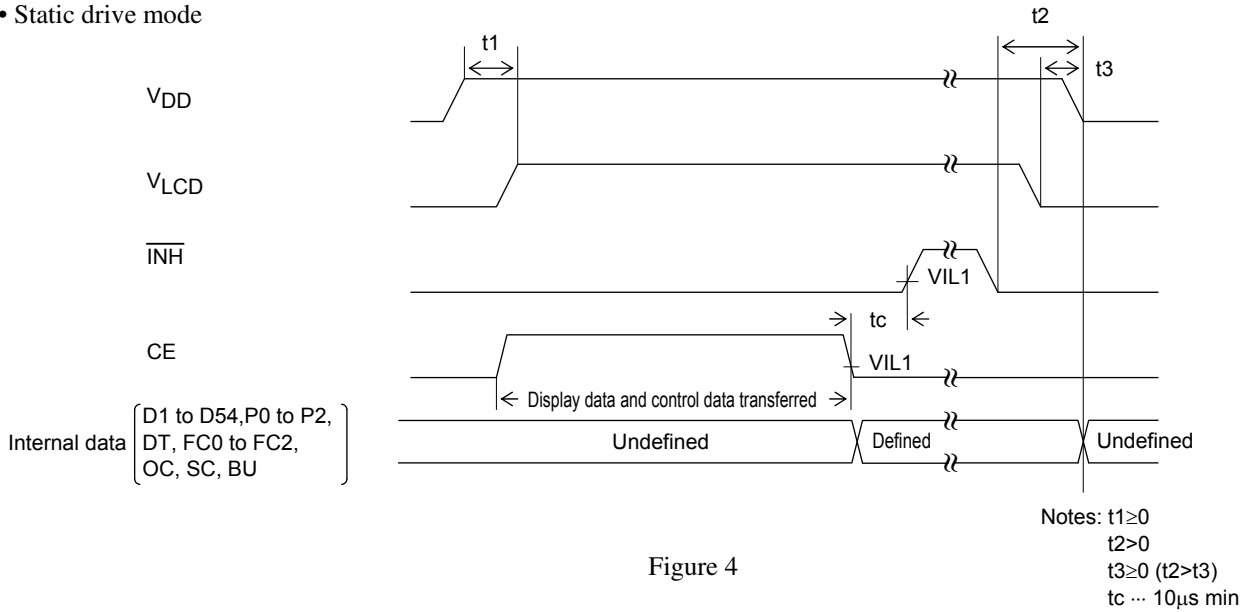
Figure 4

• Static drive mode (when in 822 mode data transfer)
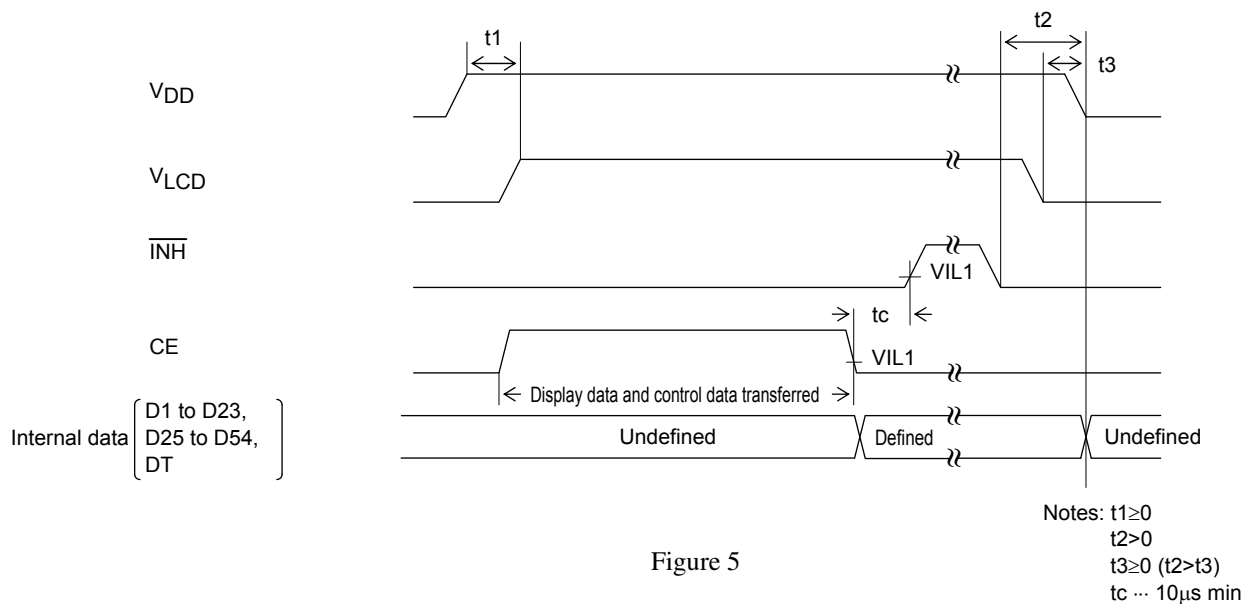
Notes: t1≥0
t2>0
t3≥0 (t2>t3)
tc ⋯ 10μs min

Figure 5
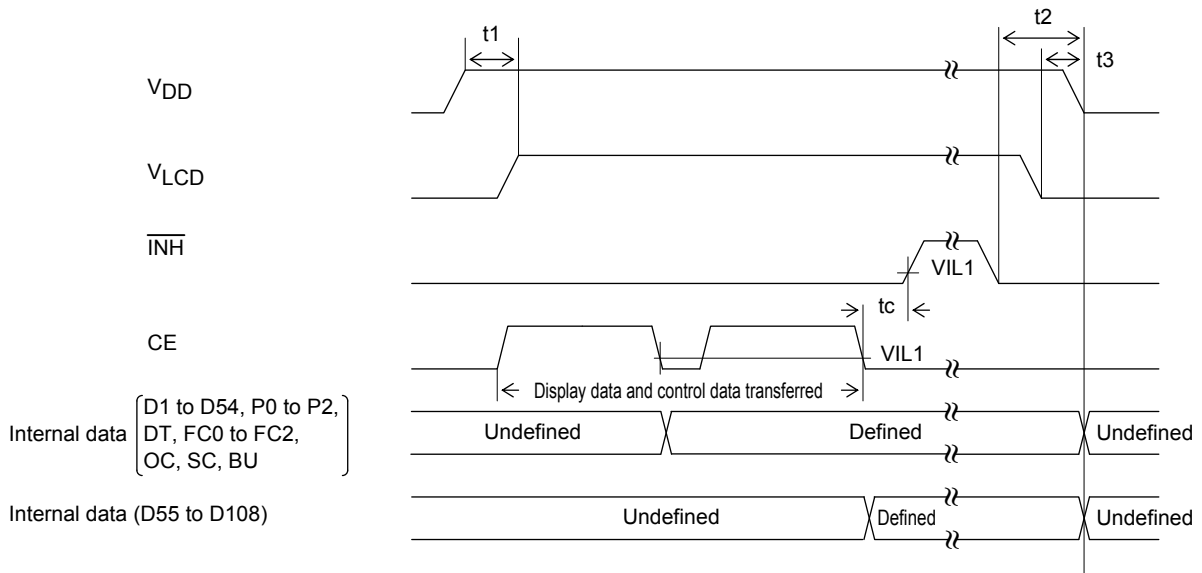
• 1/2 duty drive mode

Figure 6

Notes: t1≥0
t2>0
t3≥0 (t2>t3)
tc ⋯ 10µs min

1/2 duty drive mode (when in 822 mode data transfer)
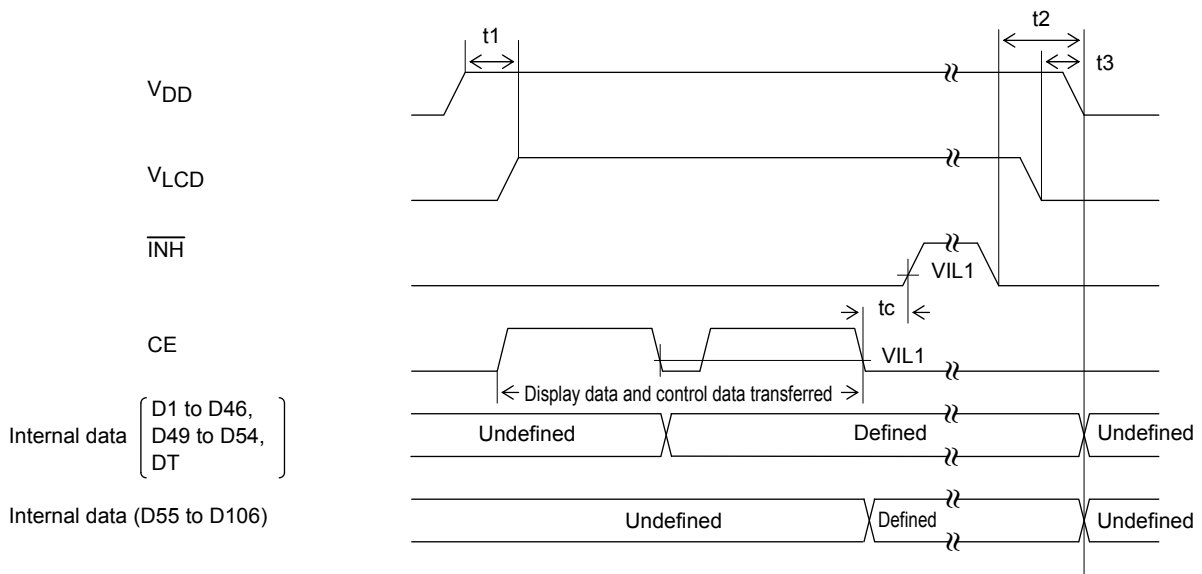
Figure 7

Notes: t1≥0
t2>0
t3≥0 (t2>t3)
tc ⋯ 10µs min

Notes on Controller Transfer of Display Data

Since the LC75832E/W transfer the display data (D1 to D108) in two separate transfer operations in 1/2 duty drive mode, we recommend that applications make a point of completing all of the display data transfer within a period of less than 30 ms to prevent observable degradation of display quality.

OSC Pin Peripheral Circuit

(1) RC oscillator operating mode (control data OC = 0)
An external resistor, Rosc, and an external capacitor, Cosc, must be connected between the OSC pin and GND if RC oscillator operating mode is selected.
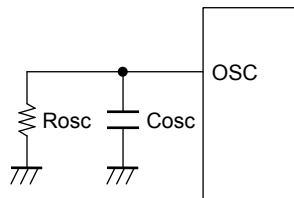
(2) External clock operating mode (control data OC = 1)
When the external clock operating mode is selected, insert a current protection resistor Rg (4.7 to 47 kΩ) between the OSC pin and external clock output pin (external oscillator). Determine the value of the resistance according to the allowable current value at the external clock output pin. Also make sure that the waveform of the external clock is not heavily distorted.
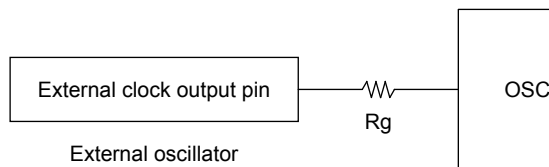
Note: Allowable current value at external clock output pin $> \dfrac{V_{DD}}{Rg}$

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Sample Application Circuit 1

Static drive mode
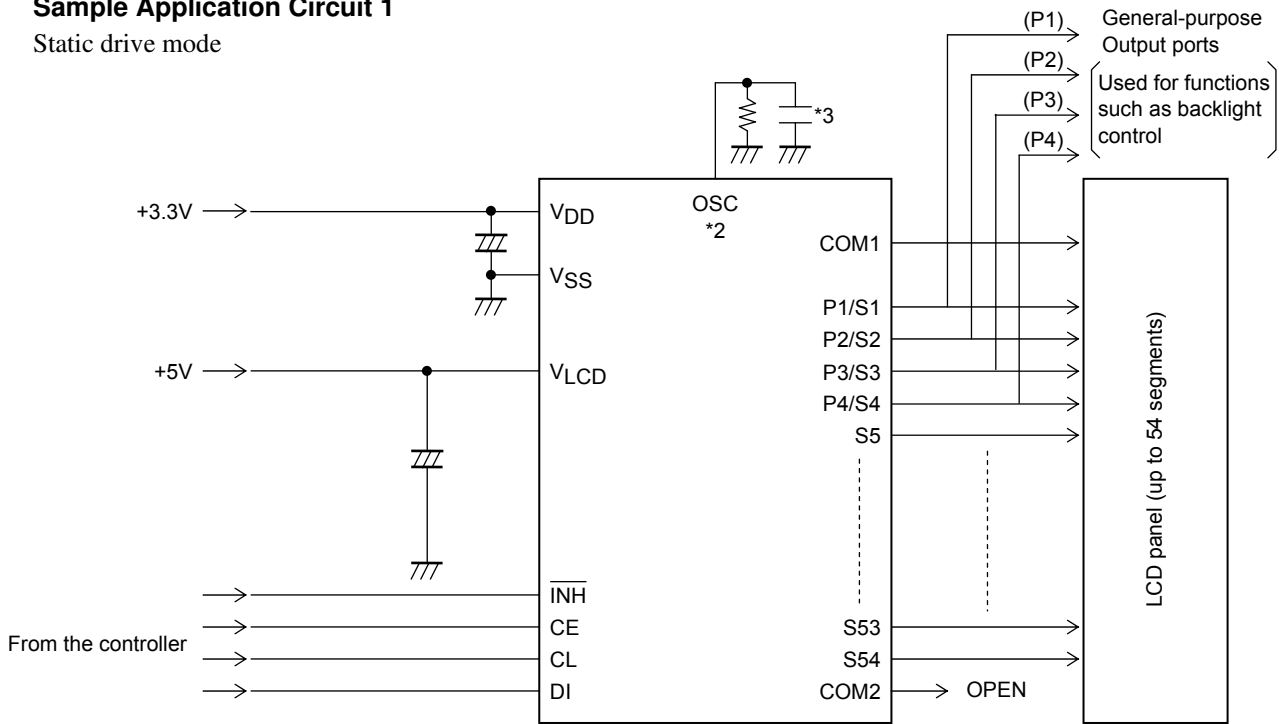
*2: In RC oscillator operating mode, an external resistor, Rosc, and an external capacitor, Cosc, must be connected between the OSC pin and ground. If external clock operating mode is selected, a current protection resistor, Rg (4.7 to 47 kΩ), must be inserted between the external clock output pin (on the external oscillator) and the OSC pin. (See the "OSC Pin Peripheral Circuit" section.)

*3: When a capacitor except the recommended external capacitance (Cosc = 1000 pF) is connected to the OSC pin, it should be in the range 220 to 2200 pF.

Sample Application Circuit 2

1/2 duty drive mode
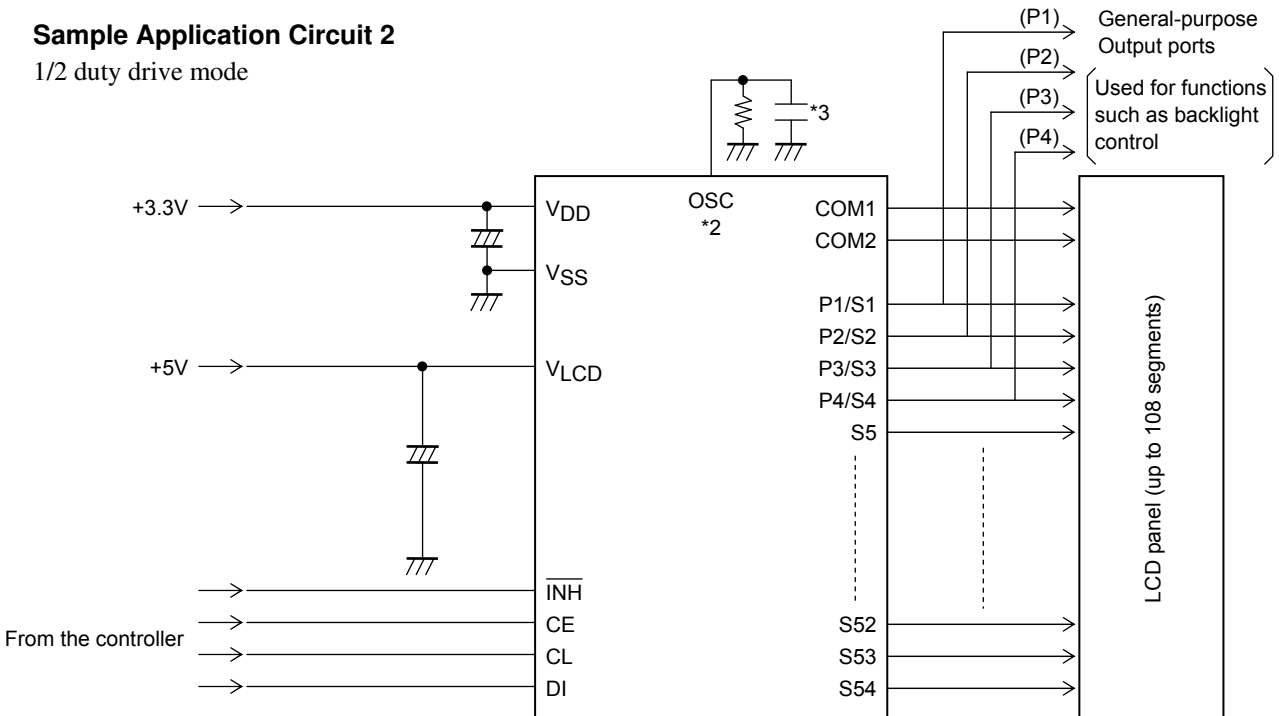
*2: In RC oscillator operating mode, an external resistor, Rosc, and an external capacitor, Cosc, must be connected between the OSC pin and ground. If external clock operating mode is selected, a current protection resistor, Rg (4.7 to 47 kΩ), must be inserted between the external clock output pin (on the external oscillator) and the OSC pin. (See the "OSC Pin Peripheral Circuit" section.)

*3: When a capacitor except the recommended external capacitance (Cosc = 1000 pF) is connected to the OSC pin, it should be in the range 220 to 2200 pF.

ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
LC75832E-E	PQFP64 14x14 / QIP64E (Pb-Free)	300 / Tray Foam
LC75832EH-E	PQFP64 14x14 / QIP64E (Pb-Free)	300 / Tray Foam
LC75832ES-E	PQFP64 14x14 / QIP64E (Pb-Free)	300 / Tray Foam
LC75832W-E	SPQFP64 10x10 / SQFP64 (Pb-Free)	800 / Tray JEDEC
LC75832W-TBM-E	SPQFP64 10x10 / SQFP64 (Pb-Free)	1000 / Tape & Reel
LC75832WH-E	SPQFP64 10x10 / SQFP64 (Pb-Free)	800 / Tray JEDEC
LC75832WS-E	SPQFP64 10x10 / SQFP64 (Pb-Free)	800 / Tray JEDEC
LC75832WS-TBM-E	SPQFP64 10x10 / SQFP64 (Pb-Free)	1000 / Tape & Reel

† For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D. http://www.onsemi.com/pub_link/Collateral/BRD8011-D.PDF