

CCB LC75847T



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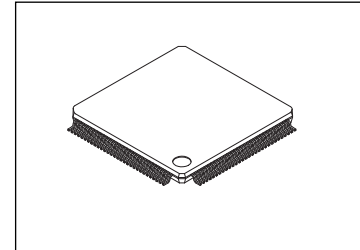
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CMOS LSI

1/3, 1/4 Duty General-Purpose LCD Driver

Overview

The LC75847T is 1/3 duty and 1/4 duty general-purpose LCD driver that can be used for frequency display in electronic tuners under the control of a microcontroller. The LC75847T can drive an LCD with up to 420 segments directly. The LC75847T can also control up to 8 general-purpose output ports.



TQFP120 14x14

Features

- Switching between 1/3 duty and 1/4 duty drive techniques under serial data control.
- Switching between 1/2 bias and 1/3 bias drive techniques under serial data control.
- Up to 318 segments for 1/3 duty drive and 420 segments for 1/4 duty drive can be displayed.
- Serial data input supports CCB format communication with the system controller.
- Serial data control of the power-saving mode based backup function and all the segments forced off function.
- Serial data control of switching between the segment output port and the general-purpose output port functions.
- Serial data control of frame frequency for common and segment output waveforms.
- High generality, since display data is displayed directly without decoder intervention.
- Built-in display contrast adjustment circuit
- Independent VLCD for the LCD driver block
- The $\overline{\text{INH}}$ pin can force the display to the off state.
- RC oscillator circuit

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$, $V_{SS} = 0\text{V}$

| Parameter | Symbol | Conditions | Ratings | unit |
|-----------------------------|-----------------------|---|-------------------------|------------------|
| Maximum supply voltage | $V_{DD \text{ max}}$ | V_{DD} | -0.3 to +7.0 | V |
| | $V_{LCD \text{ max}}$ | V_{LCD} | -0.3 to +7.0 | |
| Input voltage | V_{IN1} | CE, CL, DI, $\overline{\text{INH}}$ | -0.3 to +7.0 | V |
| | V_{IN2} | OSC | -0.3 to $V_{DD} + 0.3$ | |
| | V_{IN3} | V_{LCD1} , V_{LCD2} | -0.3 to $V_{LCD} + 0.3$ | |
| Output voltage | V_{OUT1} | OSC | -0.3 to $V_{DD} + 0.3$ | V |
| | V_{OUT2} | VLCD0, S1 to S106, COM1 to COM4, P1 to P8 | -0.3 to $V_{LCD} + 0.3$ | |
| Output current | I_{OUT1} | S1 to S106 | 300 | μA |
| | I_{OUT2} | COM1 to COM4 | 3 | mA |
| | I_{OUT3} | P1 to P8 | 5 | mA |
| Allowable power dissipation | $P_d \text{ max}$ | $T_a = 85^\circ\text{C}$ | 200 | mW |
| Operating temperature | T_{opr} | | -40 to +85 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -55 to +125 | $^\circ\text{C}$ |

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.

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ORDERING INFORMATION

See detailed ordering and shipping information on page 28 of this data sheet.

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Allowable Operating Ranges at $T_a = -40$ to $+85^\circ\text{C}$, $V_{SS} = 0$ V

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|----------------------------------|--------------|---|--------------|----------------|--------------|---------------|
| | | | min | typ | max | |
| Supply voltage | V_{DD} | V_{DD} | 2.7 | | 6.0 | V |
| | V_{LCD} | $V_{LCD}, V_{LCD0} = 0.70 V_{LCD}$ to $0.95 V_{LCD}$ $V_{LCD}, V_{LCD0} = V_{LCD}$ | 4.0 | | 6.0 | |
| Output voltage | V_{LCD0} | V_{LCD0} | 2.7 | | V_{LCD} | V |
| Input voltage | V_{LCD1} | V_{LCD1} | | $2/3 V_{LCD0}$ | V_{LCD0} | V |
| | V_{LCD2} | V_{LCD2} | | $1/3 V_{LCD0}$ | V_{LCD0} | |
| 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 | | 39 | | k Ω |
| Recommended external capacitance | C_{OSC} | OSC | | 1000 | | pF |
| Guaranteed oscillation range | f_{OSC} | OSC | 19 | 38 | 76 | 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 | $t_{\phi H}$ | CL: Figure 2 | 160 | | | ns |
| Low level clock pulse width | $t_{\phi L}$ | 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, Figure 4 | 10 | | | μs |

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Electrical Characteristics for the allowable operating ranges

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|-------------------------------|------------|---|----------------------|--------------|----------------------|---------------|
| | | | min | typ | max | |
| Hysteresis | V_H | CE, CL, DI, $\overline{\text{INH}}$ | | 0.1 V_{DD} | | V |
| Input high level current | I_{IH} | CE, CL, DI, $\overline{\text{INH}}$: $V_I = 6.0$ V | | | 5.0 | μA |
| Input low level current | I_{IL} | CE, CL, DI, $\overline{\text{INH}}$: $V_I = 0$ V | -5.0 | | | μA |
| Output high level voltage | V_{OH1} | S1 to S106: $I_O = -20$ μA | $V_{LCD0} - 0.9$ | | | V |
| | V_{OH2} | COM1 to COM4: $I_O = -100$ μA | $V_{LCD0} - 0.9$ | | | |
| | V_{OH3} | P1 to P8: $I_O = -1$ mA | $V_{LCD} - 0.9$ | | | |
| Output low level voltage | V_{OL1} | S1 to S106: $I_O = 20$ μA | | | 0.9 | V |
| | V_{OL2} | COM1 to COM4: $I_O = 100$ μA | | | 0.9 | |
| | V_{OL3} | P1 to P8: $I_O = 1$ mA | | | 0.9 | |
| Output middle level voltage*1 | V_{MID1} | COM1 to COM4: 1/2 bias, $I_O = \pm 100$ μA | $1/2 V_{LCD0} - 0.9$ | | $1/2 V_{LCD0} + 0.9$ | V |
| | V_{MID2} | S1 to S106: 1/3 bias, $I_O = \pm 20$ μA | $2/3 V_{LCD0} - 0.9$ | | $2/3 V_{LCD0} + 0.9$ | |
| | V_{MID3} | S1 to S106: 1/3 bias, $I_O = \pm 20$ μA | $1/3 V_{LCD0} - 0.9$ | | $1/3 V_{LCD0} + 0.9$ | |
| | V_{MID4} | COM1 to COM4: 1/3 bias, $I_O = \pm 100$ μA | $2/3 V_{LCD0} - 0.9$ | | $2/3 V_{LCD0} + 0.9$ | |
| | V_{MID5} | COM1 to COM4: 1/3 bias, $I_O = \pm 100$ μA | $1/3 V_{LCD0} - 0.9$ | | $1/3 V_{LCD0} + 0.9$ | |
| Oscillator frequency | f_{OSC} | OSC: $R_{OSC} = 39$ k Ω , $C_{OSC} = 1000$ pF | 30.4 | 38 | 45.6 | kHz |
| Current drain | I_{DD1} | V_{DD} : Power-saving mode | | | 5 | μA |
| | I_{DD2} | V_{DD} : $V_{DD} = 6.0$ V, output open, $f_{OSC} = 38$ kHz | | 250 | 500 | |
| | I_{LCD1} | V_{LCD} : Power-saving mode | | | 5 | |
| | I_{LCD2} | V_{LCD} : $V_{LCD} = 6.0$ V, output open, 1/2 bias, $f_{OSC} = 38$ kHz, $V_{LCD0} = 0.70 V_{LCD}$ to $0.95 V_{LCD}$ | | 400 | 800 | |
| | I_{LCD3} | V_{LCD} : $V_{LCD} = 6.0$ V, output open, 1/2 bias, $f_{OSC} = 38$ kHz, $V_{LCD0} = V_{LCD}$ | | 350 | 700 | |
| | I_{LCD4} | V_{LCD} : $V_{LCD} = 6.0$ V, output open, 1/3 bias, $f_{OSC} = 38$ kHz, $V_{LCD0} = 0.70 V_{LCD}$ to $0.95 V_{LCD}$ | | 300 | 600 | |
| | I_{LCD5} | V_{LCD} : $V_{LCD} = 6.0$ V, output open, 1/3 bias, $f_{OSC} = 38$ kHz, $V_{LCD0} = V_{LCD}$ | | 250 | 500 | |

Note: *1 Excluding the bias voltage generation divider resistors built in the V_{LCD0} , V_{LCD1} , V_{LCD2} , and V_{SS} . (See Figure 1.)

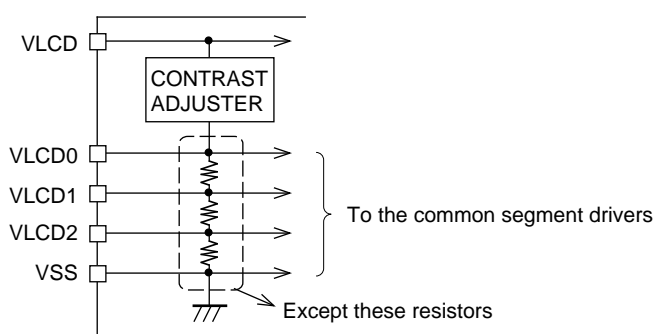
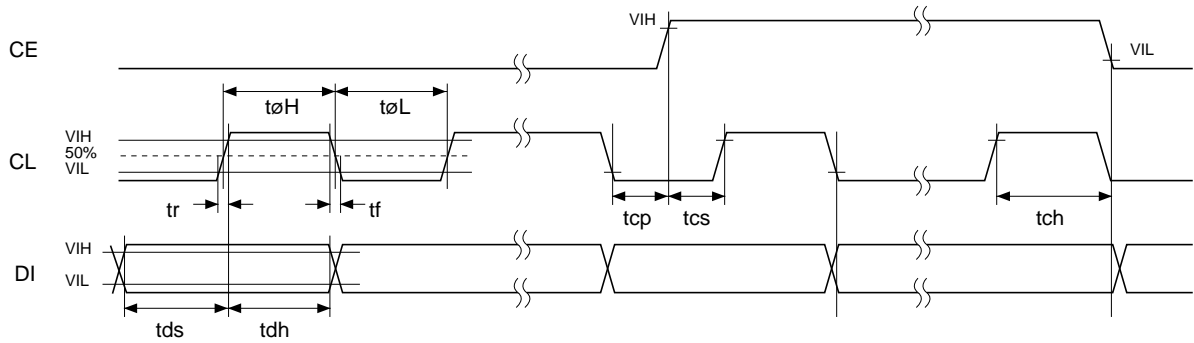


Figure 1

1. When CL is stopped at the low level



2. When CL is stopped at the high level

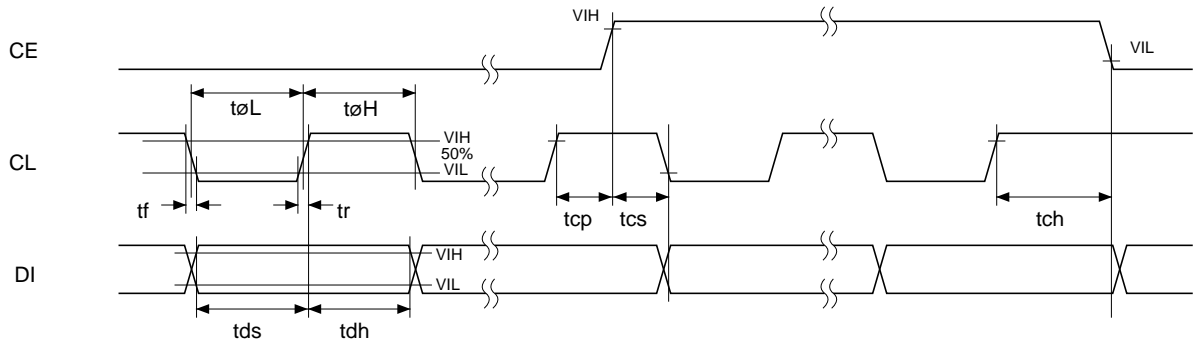
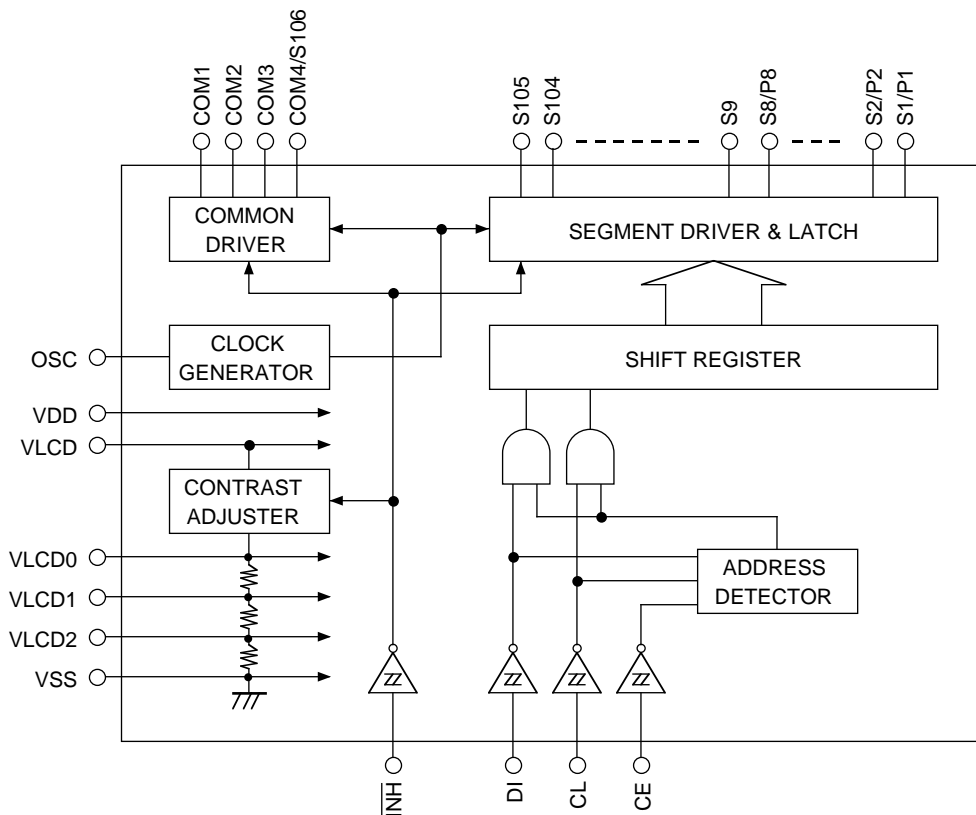



Figure 2

Block Diagram



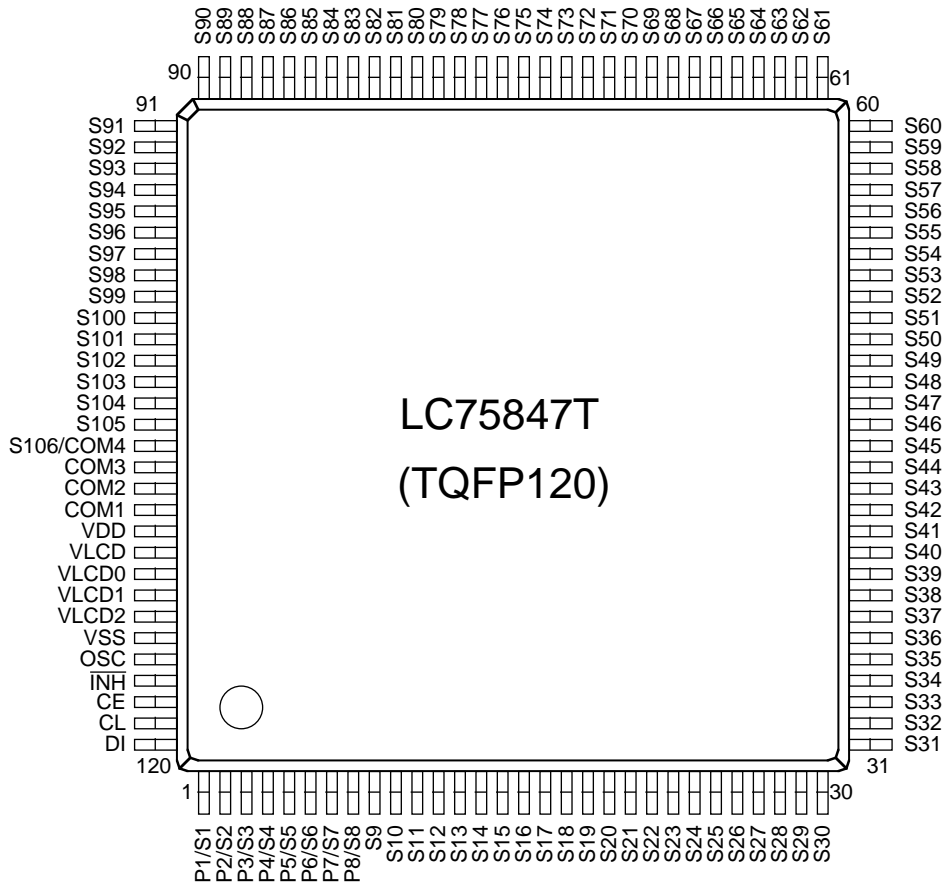
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Pin Functions

| Symbol | Pin No. | Function | Active | I/O | Handling when unused |
|------------------------------|--------------------|--|---|-------------|----------------------|
| S1/P1 to S8/P8 S9 to S105 | 1 to 8 9 to 105 | Segment outputs for displaying the display data transferred by serial data input. The pins S1/P1 to S8/P8 can be used as general-purpose output ports when so set up by the control data. | — | O | Open |
| COM1 to COM3 COM4/S106 | 109 to 107 106 | Common driver outputs. The frame frequency is f_O Hz. The COM4/S106 pin can be used as a segment output in 1/3 duty. | — | O | Open |
| OSC | 116 | Oscillator connection. An oscillator circuit is formed by connecting an external resistor and capacitor to this pin. | — | I/O | V_{DD} |
| CE CL DI | 118 119 120 | Serial data transfer inputs. These pins are connected to the control microprocessor. CE: Chip enable CL: Synchronization clock DI: Transfer data | H  — | I I I | GND |
| $\overline{\text{INH}}$ | 117 | Display off control input • $\overline{\text{INH}} = \text{low } (V_{SS}) \dots \text{Off}$ S1/P1 to S8/P8 = low (V_{SS}) (These pins are forcibly set to the segment output port function and fixed at the V_{SS} level.) S9 to S105 = low (V_{SS}) COM1 to COM3 = low (V_{SS}) COM4/S106 = low (V_{SS}) • $\overline{\text{INH}} = \text{high } (V_{DD}) \dots \text{On}$ Note that serial data transfers can be performed when the display is forced off by this pin. | L | I | GND |
| V_{LCD0} | 112 | LCD drive 3/3 bias voltage (high level) supply. This level can be modified using the display contrast adjustment circuit. However, note that V_{LCD0} must be greater than or equal to 2.7 V. Also, since this IC provides the built-in display contrast adjustment circuit, applications must not attempt to provide this level from external circuits. | — | O | Open |
| V_{LCD1} | 113 | LCD drive 2/3 bias voltage (middle level) supply. It is possible to supply the 2/3 V_{LCD0} voltage to this pin externally. This pin must be shorted to V_{LCD2} if 1/2 bias is used. | — | I | Open |
| V_{LCD2} | 114 | LCD drive 1/3 bias voltage (middle level) supply. It is possible to supply the 1/3 V_{LCD0} voltage to this pin externally. This pin must be shorted to V_{LCD1} if 1/2 bias is used. | — | I | Open |
| V_{DD} | 110 | Logic block power supply. Provide a voltage in the range 2.7 to 6.0 V. | — | — | — |
| V_{LCD} | 111 | LCD driver block power supply. When V_{LCD0} is between 0.70 V_{LCD} and 0.95 V_{LCD} , supply a voltage in the range 4.0 to 6.0 V. When V_{LCD0} and V_{LCD} will be equal, supply a voltage in the range 2.7 to 6.0 V. | — | — | — |
| V_{SS} | 115 | Ground pin. Connect to ground. | — | — | — |

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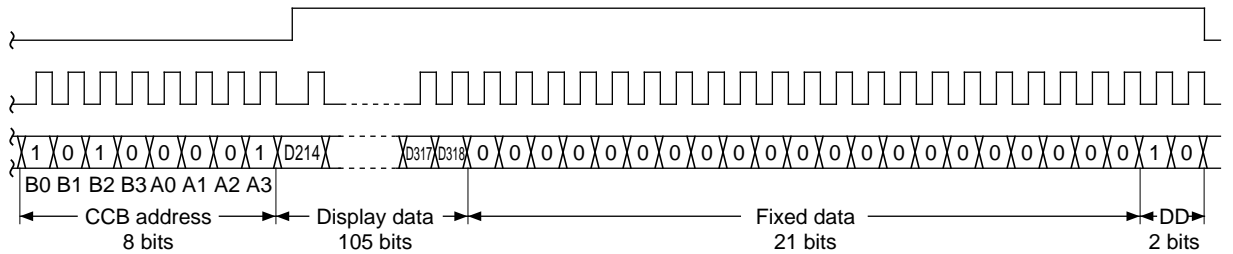
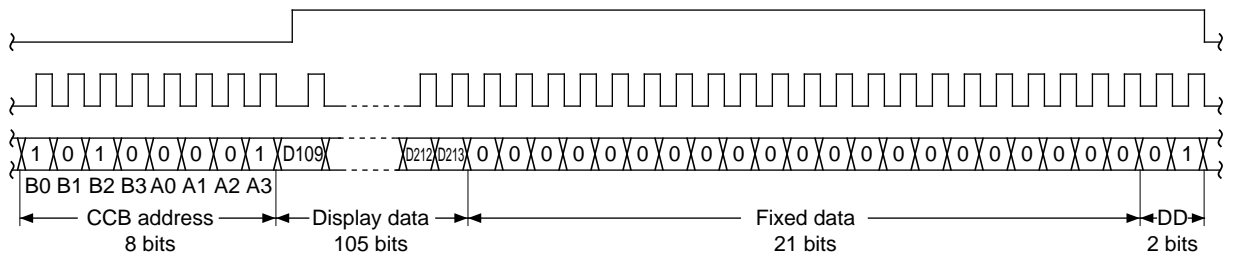
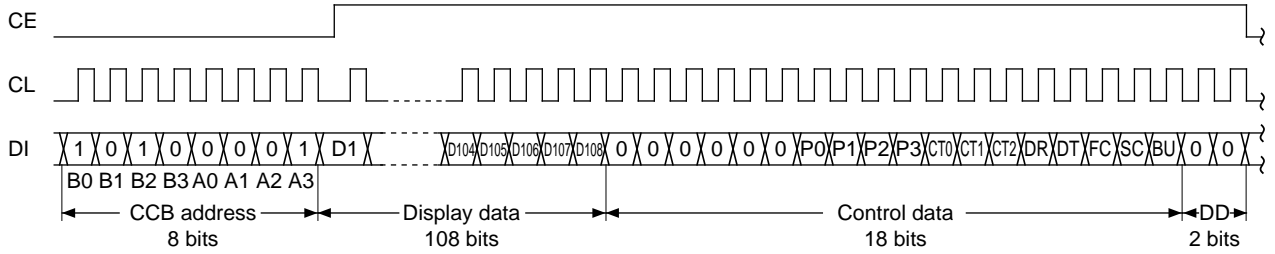
Pin Assignment



Serial Data Transfer Format

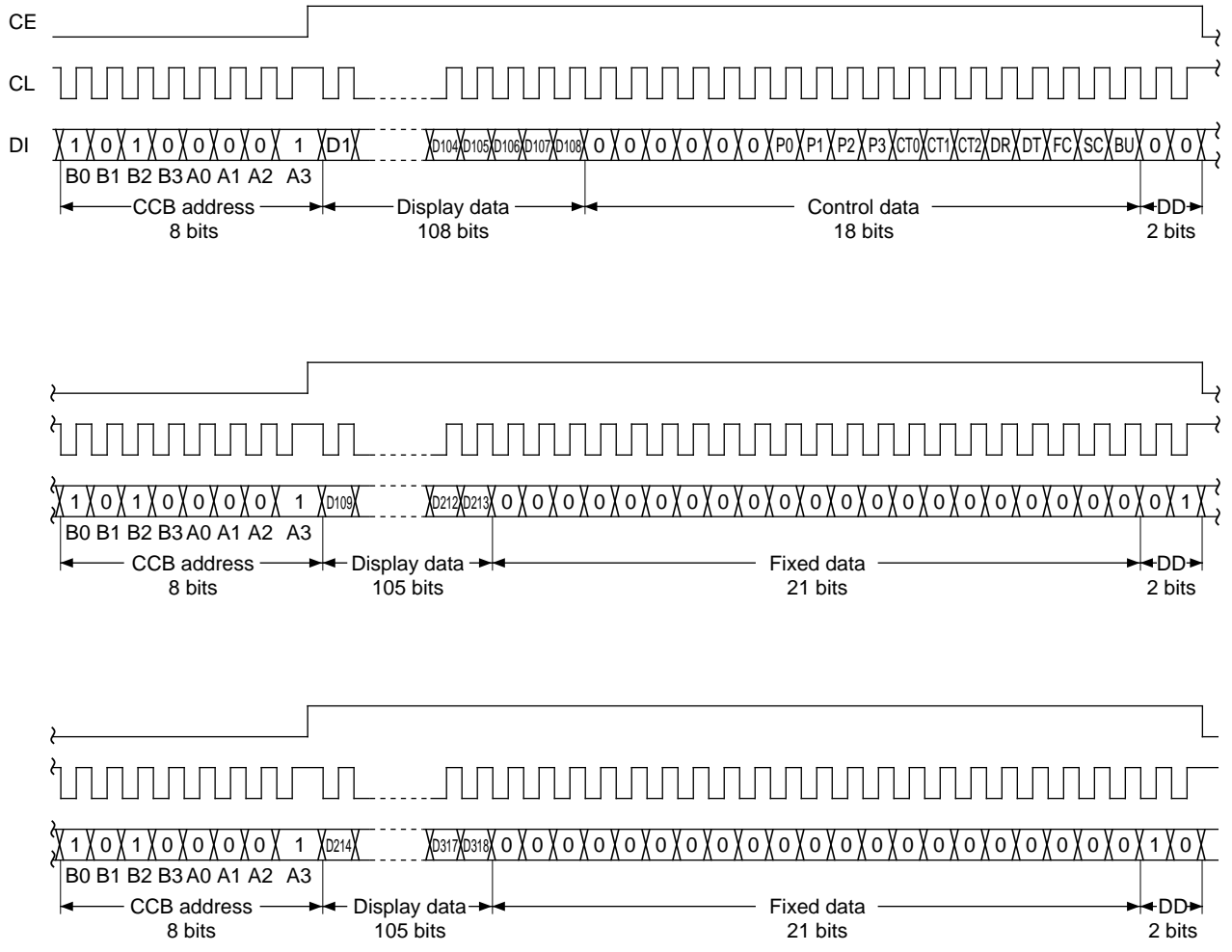
1. 1/3 duty

① When CL is stopped at the low level



Note: DD---Direction data.

② When CL is stopped at the high level



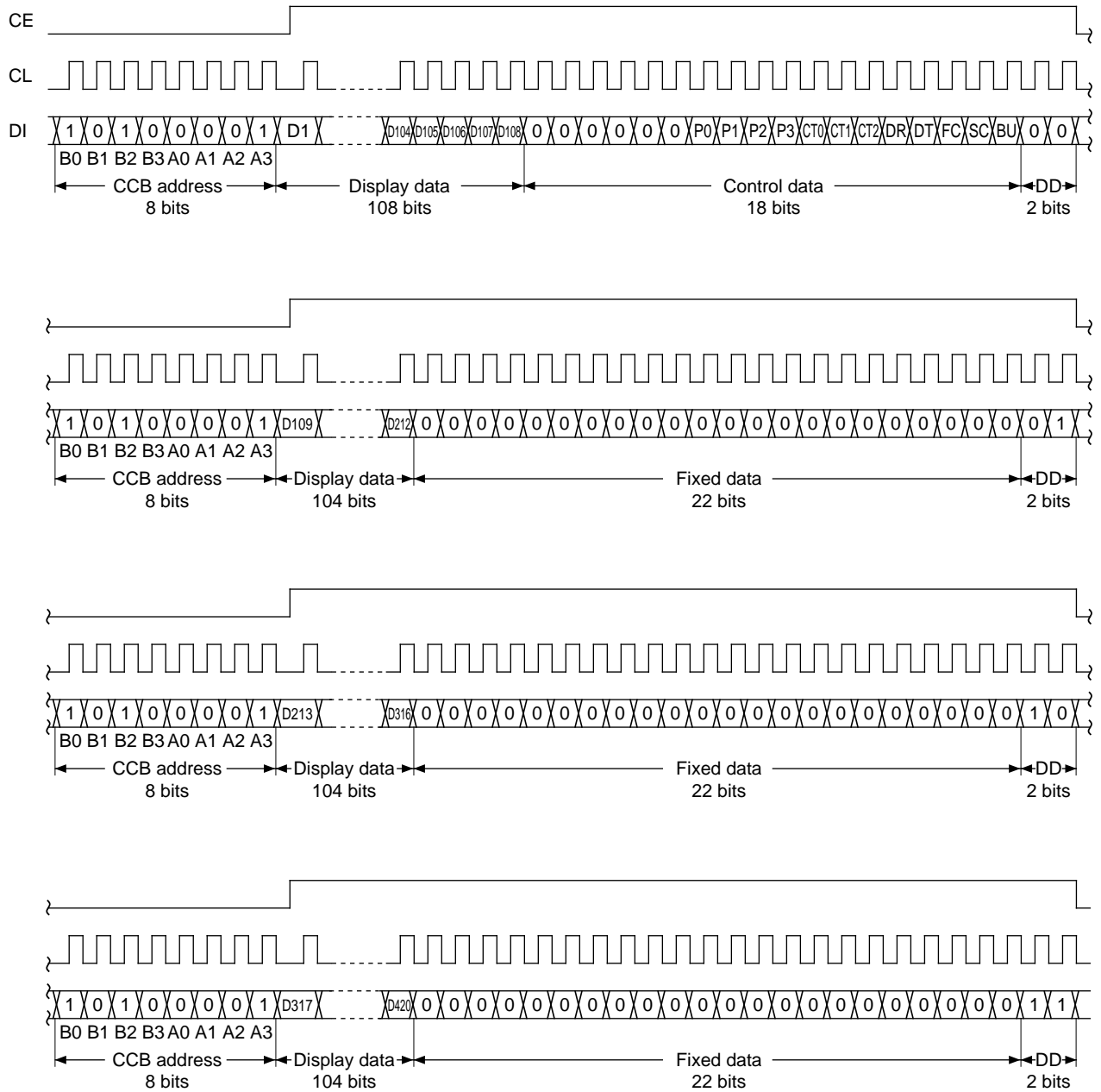
Note: DD...Direction data.

- CCB address.....85H
- D1 to D318.....Display data
- P0 to P3Segment output port/general-purpose output port switching control data
- CT0 to CT2Control data that sets the display contrast
- DR1/2 bias drive or 1/3 bias drive switching control data
- DT1/3 duty drive or 1/4 duty drive switching control data
- FC.....Common and segment output waveforms frame frequency setting control data
- SC.....Segments on/off control data
- BUNormal mode/power-saving mode control data

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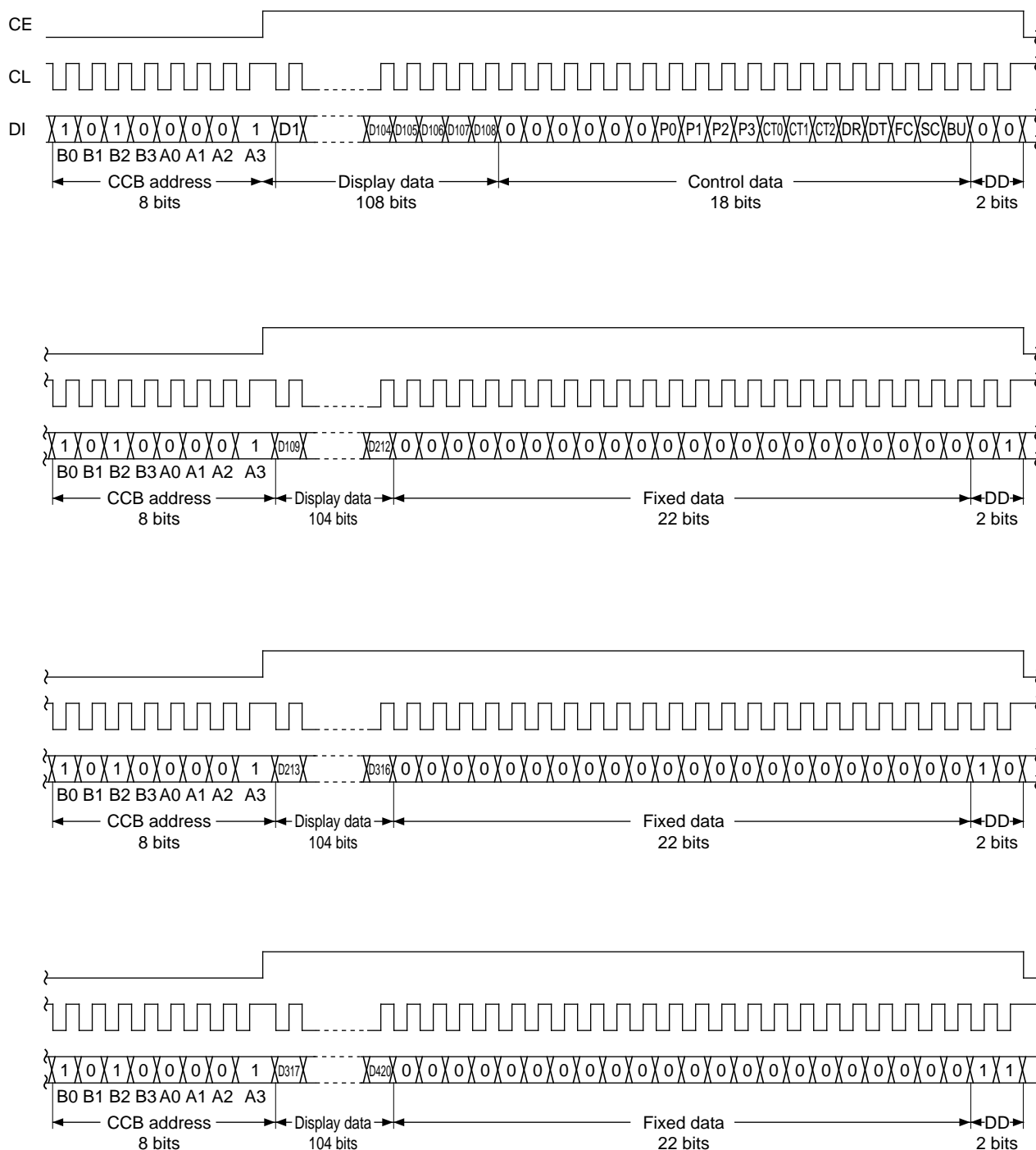
2. 1/4 duty

① When CL is stopped at the low level



Note: DD---Direction data.

② When CL is stopped at the high level



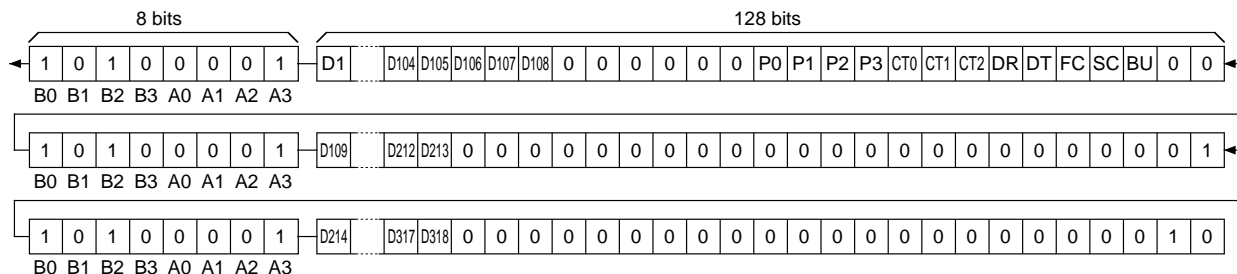
Note: DD...Direction data.

- CCB address.....85H
- D1 to D420.....Display data
- P0 to P3Segment output port/general-purpose output port switching control data
- CT0 to CT2Control data that sets the display contrast
- DR1/2 bias drive or 1/3 bias drive switching control data
- DT1/3 duty drive or 1/4 duty drive switching control data
- FC.....Common and segment output waveforms frame frequency setting control data
- SC.....Segments on/off control data
- BUNormal mode/power-saving mode control data

Serial Data Transfer Example

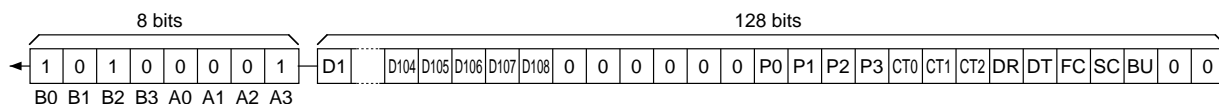
1. 1/3 duty

- ① When 214 or more segments are used
All 384 bits of serial data must be sent.



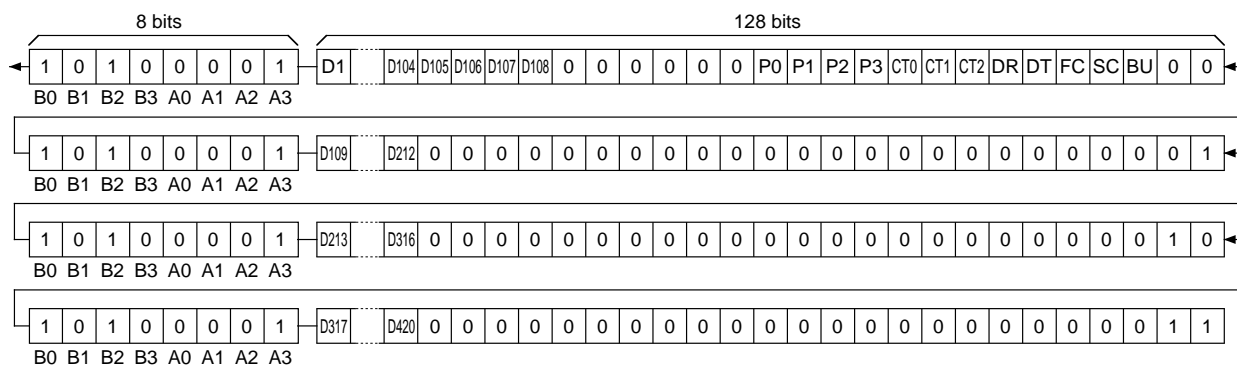
- ② When fewer than 214 segments are used

Either 128 or 256 bits of serial data may be sent, depending on the number of segments used. However, the serial data shown below (the D1 to D108 display data and the control data) must be sent.



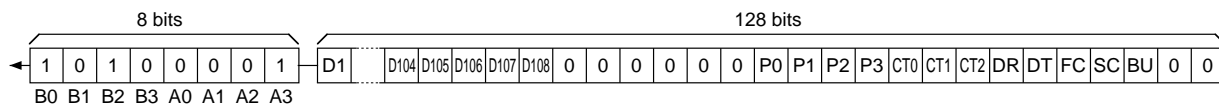
2. 1/4 duty

- ① When 317 or more segments are used
All 512 bits of serial data must be sent.



- ② When fewer than 317 segments are used

Either 128, 256 or 384 bits of serial data may be sent, depending on the number of segments used. However, the serial data shown below (the D1 to D108 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 S1/P1 to S8/P8 output pins between their segment output port and general-purpose output port functions.

| 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 ports
Pn (n = 1 to 8): General-purpose output ports

Also note that when the general-purpose output port function is selected, the output pins and the display data will have the correspondences listed in the tables below.

| Output pin | Corresponding display data | |
|------------|----------------------------|----------|
| | 1/3 duty | 1/4 duty |
| S1/P1 | D1 | D1 |
| S2/P2 | D4 | D5 |
| S3/P3 | D7 | D9 |
| S4/P4 | D10 | D13 |
| S5/P5 | D13 | D17 |
| S6/P6 | D16 | D21 |
| S7/P7 | D19 | D25 |
| S8/P8 | D22 | D29 |

For example, when 1/4 duty drive scheme is used, 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. CT0 to CT2: Control data that sets the display contrast

This control data is used to set the display contrast.

CT0 to CT2: Display contrast setting (7 steps)

| CT0 | CT1 | CT2 | LCD drive 3/3 bias voltage power supply (V_{LCD0}) level |
|-----|-----|-----|--|
| 0 | 0 | 0 | $1.00 V_{LCD} = V_{LCD} - (0.05 V_{LCD} \times 0)$ |
| 1 | 0 | 0 | $0.95 V_{LCD} = V_{LCD} - (0.05 V_{LCD} \times 1)$ |
| 0 | 1 | 0 | $0.90 V_{LCD} = V_{LCD} - (0.05 V_{LCD} \times 2)$ |
| 1 | 1 | 0 | $0.85 V_{LCD} = V_{LCD} - (0.05 V_{LCD} \times 3)$ |
| 0 | 0 | 1 | $0.80 V_{LCD} = V_{LCD} - (0.05 V_{LCD} \times 4)$ |
| 1 | 0 | 1 | $0.75 V_{LCD} = V_{LCD} - (0.05 V_{LCD} \times 5)$ |
| 0 | 1 | 1 | $0.70 V_{LCD} = V_{LCD} - (0.05 V_{LCD} \times 6)$ |

Note that although the display contrast can be adjusted by operating the built-in display contrast adjustment circuit, it is also possible to adjust the contrast by varying the voltage level on the LCD drive block power supply V_{LCD} pin. However, V_{LCD0} must always be greater than or equal to 2.7 V.

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3. 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 | Bias drive scheme |
|----|-------------------|
| 0 | 1/3 bias drive |
| 1 | 1/2 bias drive |

4. DT: 1/3 duty drive or 1/4 duty drive switching control data

This control data bit selects either 1/3 duty drive or 1/4 duty drive.

| DT | Duty drive scheme | Output pin state (COM4/S106) |
|----|-------------------|------------------------------|
| 0 | 1/4 duty drive | COM4 |
| 1 | 1/3 duty drive | S106 |

Note: COM4: Common output
S106: Segment output

5. FC: Common and segment output waveforms frame frequency setting control data

This control data bit sets the frame frequency for common and segment output waveforms.

| FC | Frame frequency f_0 [Hz] |
|----|----------------------------|
| 0 | $\frac{f_{osc}}{384}$ |
| 1 | $\frac{f_{osc}}{192}$ |

6. SC: Segments on/off control data

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

| SC | Display state |
|----|---------------|
| 0 | On |
| 1 | Off |

However, 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.

7. 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 (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 that are set to be general-purpose output ports by the control data P0 to P3 can be used as general-purpose output ports.) |

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Display Data to Segment Output Pin Correspondence

1. 1/3 duty

| Segment Output pin | COM1 | COM2 | COM3 | Segment Output pin | COM1 | COM2 | COM3 | Segment Output pin | COM1 | COM2 | COM3 |
|--------------------|------|------|------|--------------------|------|------|------|--------------------|------|------|------|
| S1/P1 | D1 | D2 | D3 | S37 | D109 | D110 | D111 | S73 | D217 | D218 | D219 |
| S2/P2 | D4 | D5 | D6 | S38 | D112 | D113 | D114 | S74 | D220 | D221 | D222 |
| S3/P3 | D7 | D8 | D9 | S39 | D115 | D116 | D117 | S75 | D223 | D224 | D225 |
| S4/P4 | D10 | D11 | D12 | S40 | D118 | D119 | D120 | S76 | D226 | D227 | D228 |
| S5/P5 | D13 | D14 | D15 | S41 | D121 | D122 | D123 | S77 | D229 | D230 | D231 |
| S6/P6 | D16 | D17 | D18 | S42 | D124 | D125 | D126 | S78 | D232 | D233 | D234 |
| S7/P7 | D19 | D20 | D21 | S43 | D127 | D128 | D129 | S79 | D235 | D236 | D237 |
| S8/P8 | D22 | D23 | D24 | S44 | D130 | D131 | D132 | S80 | D238 | D239 | D240 |
| S9 | D25 | D26 | D27 | S45 | D133 | D134 | D135 | S81 | D241 | D242 | D243 |
| S10 | D28 | D29 | D30 | S46 | D136 | D137 | D138 | S82 | D244 | D245 | D246 |
| S11 | D31 | D32 | D33 | S47 | D139 | D140 | D141 | S83 | D247 | D248 | D249 |
| S12 | D34 | D35 | D36 | S48 | D142 | D143 | D144 | S84 | D250 | D251 | D252 |
| S13 | D37 | D38 | D39 | S49 | D145 | D146 | D147 | S85 | D253 | D254 | D255 |
| S14 | D40 | D41 | D42 | S50 | D148 | D149 | D150 | S86 | D256 | D257 | D258 |
| S15 | D43 | D44 | D45 | S51 | D151 | D152 | D153 | S87 | D259 | D260 | D261 |
| S16 | D46 | D47 | D48 | S52 | D154 | D155 | D156 | S88 | D262 | D263 | D264 |
| S17 | D49 | D50 | D51 | S53 | D157 | D158 | D159 | S89 | D265 | D266 | D267 |
| S18 | D52 | D53 | D54 | S54 | D160 | D161 | D162 | S90 | D268 | D269 | D270 |
| S19 | D55 | D56 | D57 | S55 | D163 | D164 | D165 | S91 | D271 | D272 | D273 |
| S20 | D58 | D59 | D60 | S56 | D166 | D167 | D168 | S92 | D274 | D275 | D276 |
| S21 | D61 | D62 | D63 | S57 | D169 | D170 | D171 | S93 | D277 | D278 | D279 |
| S22 | D64 | D65 | D66 | S58 | D172 | D173 | D174 | S94 | D280 | D281 | D282 |
| S23 | D67 | D68 | D69 | S59 | D175 | D176 | D177 | S95 | D283 | D284 | D285 |
| S24 | D70 | D71 | D72 | S60 | D178 | D179 | D180 | S96 | D286 | D287 | D288 |
| S25 | D73 | D74 | D75 | S61 | D181 | D182 | D183 | S97 | D289 | D290 | D291 |
| S26 | D76 | D77 | D78 | S62 | D184 | D185 | D186 | S98 | D292 | D293 | D294 |
| S27 | D79 | D80 | D81 | S63 | D187 | D188 | D189 | S99 | D295 | D296 | D297 |
| S28 | D82 | D83 | D84 | S64 | D190 | D191 | D192 | S100 | D298 | D299 | D300 |
| S29 | D85 | D86 | D87 | S65 | D193 | D194 | D195 | S101 | D301 | D302 | D303 |
| S30 | D88 | D89 | D90 | S66 | D196 | D197 | D198 | S102 | D304 | D305 | D306 |
| S31 | D91 | D92 | D93 | S67 | D199 | D200 | D201 | S103 | D307 | D308 | D309 |
| S32 | D94 | D95 | D96 | S68 | D202 | D203 | D204 | S104 | D310 | D311 | D312 |
| S33 | D97 | D98 | D99 | S69 | D205 | D206 | D207 | S105 | D313 | D314 | D315 |
| S34 | D100 | D101 | D102 | S70 | D208 | D209 | D210 | COM4/S106 | D316 | D317 | D318 |
| S35 | D103 | D104 | D105 | S71 | D211 | D212 | D213 | | | | |
| S36 | D106 | D107 | D108 | S72 | D214 | D215 | D216 | | | | |

Note: This applies to the case where the S1/P1 to S8/P8, and COM4/S106 output pins are set to be segment output ports.

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

| Display data | | | Segment output pin (S11) state |
|--------------|-----|-----|---|
| D31 | D32 | D33 | |
| 0 | 0 | 0 | The LCD segments corresponding to COM1, COM2, and COM3 are off. |
| 0 | 0 | 1 | The LCD segment corresponding to COM3 is on. |
| 0 | 1 | 0 | The LCD segment corresponding to COM2 is on. |
| 0 | 1 | 1 | The LCD segments corresponding to COM2 and COM3 are on. |
| 1 | 0 | 0 | The LCD segment corresponding to COM1 is on. |
| 1 | 0 | 1 | The LCD segments corresponding to COM1 and COM3 are on. |
| 1 | 1 | 0 | The LCD segments corresponding to COM1 and COM2 are on. |
| 1 | 1 | 1 | The LCD segments corresponding to COM1, COM2, and COM3 are on. |

LC75847T

2. 1/4 duty

| Segment 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 |
| 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 |

| Segment Output pin | COM1 | COM2 | COM3 | COM4 |
|--------------------|------|------|------|------|
| 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 |
| S67 | D265 | D266 | D267 | D268 |
| S68 | D269 | D270 | D271 | D272 |
| S69 | D273 | D274 | D275 | D276 |
| S70 | D277 | D278 | D279 | D280 |
| S71 | D281 | D282 | D283 | D284 |
| S72 | D285 | D286 | D287 | D288 |
| S73 | D289 | D290 | D291 | D292 |
| S74 | D293 | D294 | D295 | D296 |
| S75 | D297 | D298 | D299 | D300 |
| S76 | D301 | D302 | D303 | D304 |
| S77 | D305 | D306 | D307 | D308 |
| S78 | D309 | D310 | D311 | D312 |
| S79 | D313 | D314 | D315 | D316 |
| S80 | D317 | D318 | D319 | D320 |
| S81 | D321 | D322 | D323 | D324 |
| S82 | D325 | D326 | D327 | D328 |
| S83 | D329 | D330 | D331 | D332 |
| S84 | D333 | D334 | D335 | D336 |
| S85 | D337 | D338 | D339 | D340 |
| S86 | D341 | D342 | D343 | D344 |
| S87 | D345 | D346 | D347 | D348 |
| S88 | D349 | D350 | D351 | D352 |
| S89 | D353 | D354 | D355 | D356 |
| S90 | D357 | D358 | D359 | D360 |
| S91 | D361 | D362 | D363 | D364 |
| S92 | D365 | D366 | D367 | D368 |
| S93 | D369 | D370 | D371 | D372 |
| S94 | D373 | D374 | D375 | D376 |
| S95 | D377 | D378 | D379 | D380 |
| S96 | D381 | D382 | D383 | D384 |
| S97 | D385 | D386 | D387 | D388 |
| S98 | D389 | D390 | D391 | D392 |
| S99 | D393 | D394 | D395 | D396 |
| S100 | D397 | D398 | D399 | D400 |
| S101 | D401 | D402 | D403 | D404 |
| S102 | D405 | D406 | D407 | D408 |
| S103 | D409 | D410 | D411 | D412 |
| S104 | D413 | D414 | D415 | D416 |
| S105 | D417 | D418 | D419 | D420 |

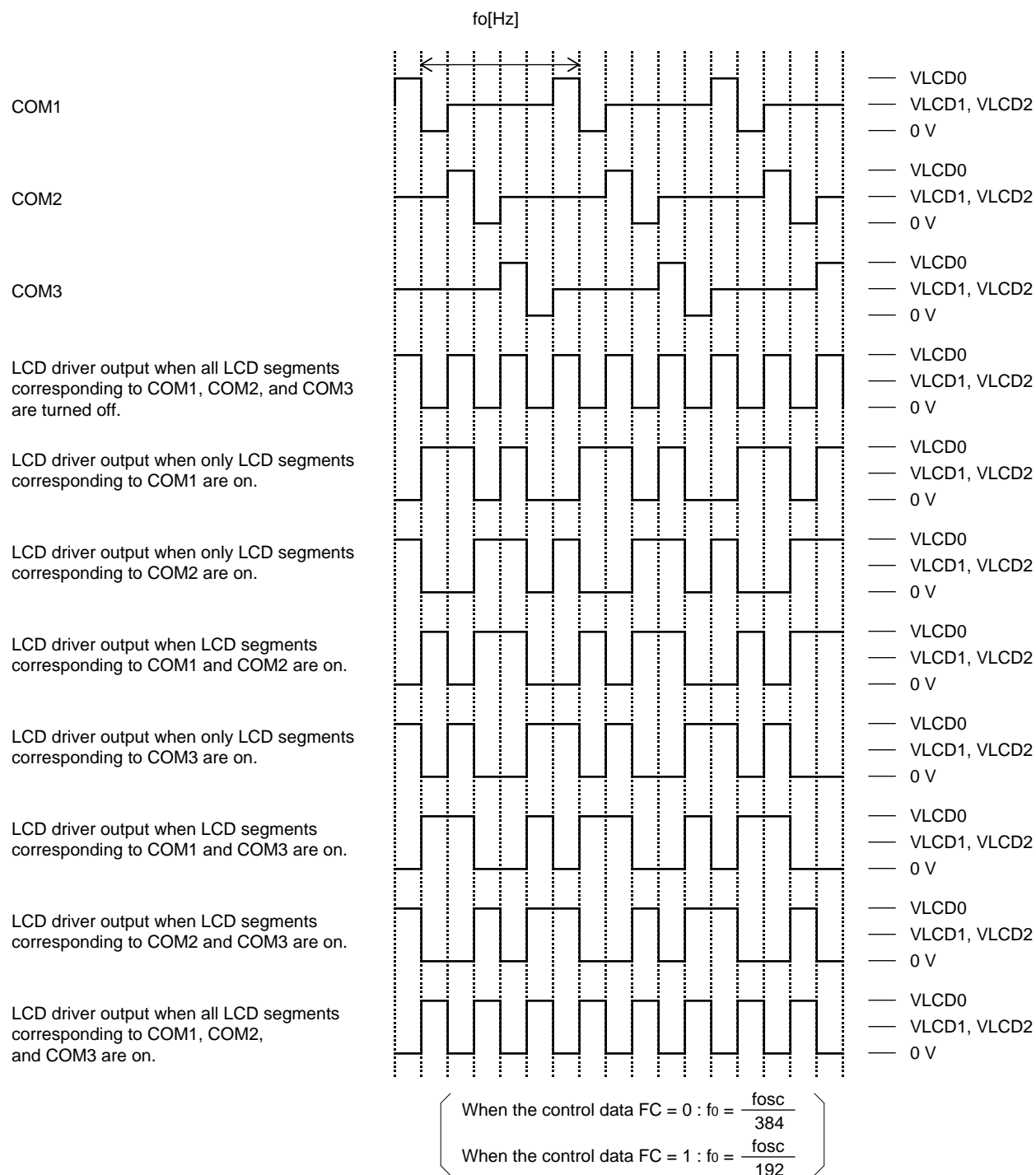
Note: This applies to the case where the S1/P1 to S8/P8 output pins are set to be segment output ports.

LC75847T

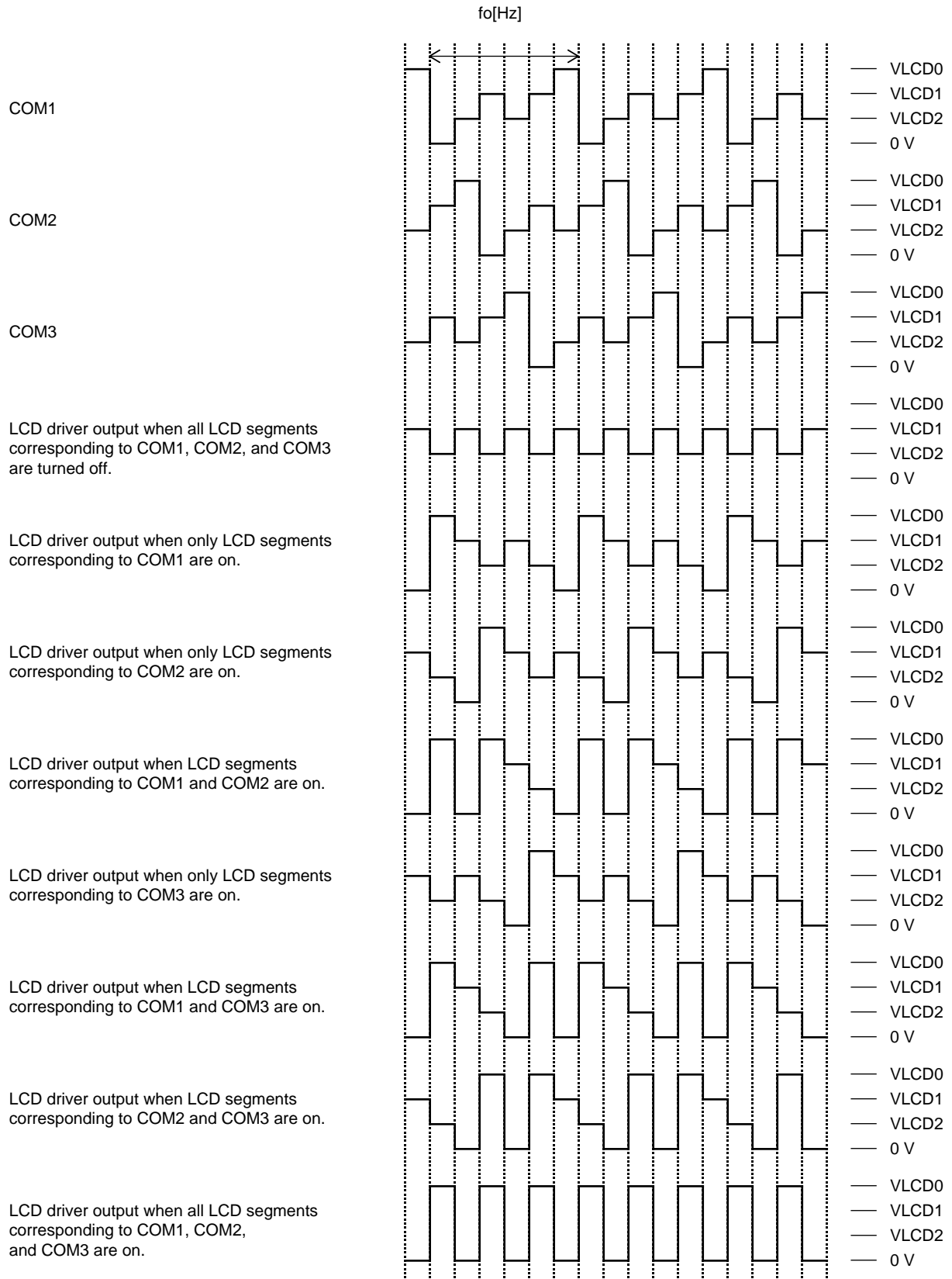
For example, the table below lists the segment output states for the S11 output pin.

| Display data | | | | Segment 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 segment corresponding to COM4 is on. |
| 0 | 0 | 1 | 0 | The LCD segment corresponding to COM3 is on. |
| 0 | 0 | 1 | 1 | The LCD segments corresponding to COM3 and COM4 are on. |
| 0 | 1 | 0 | 0 | The LCD segment corresponding to COM2 is 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 segment corresponding to COM1 is 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. |

1/3 Duty, 1/2 Bias Drive Technique

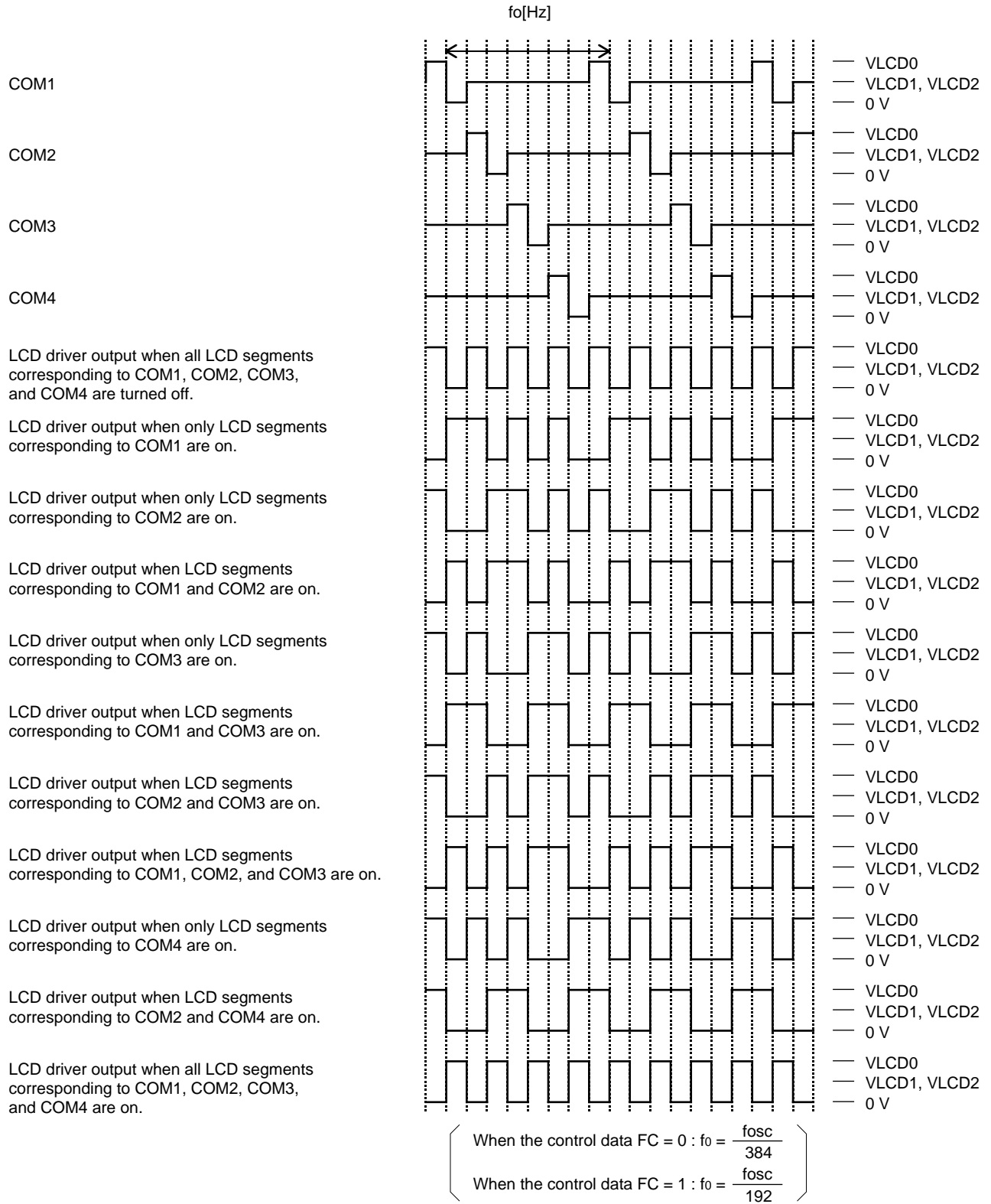


1/3 Duty, 1/3 Bias Drive Technique

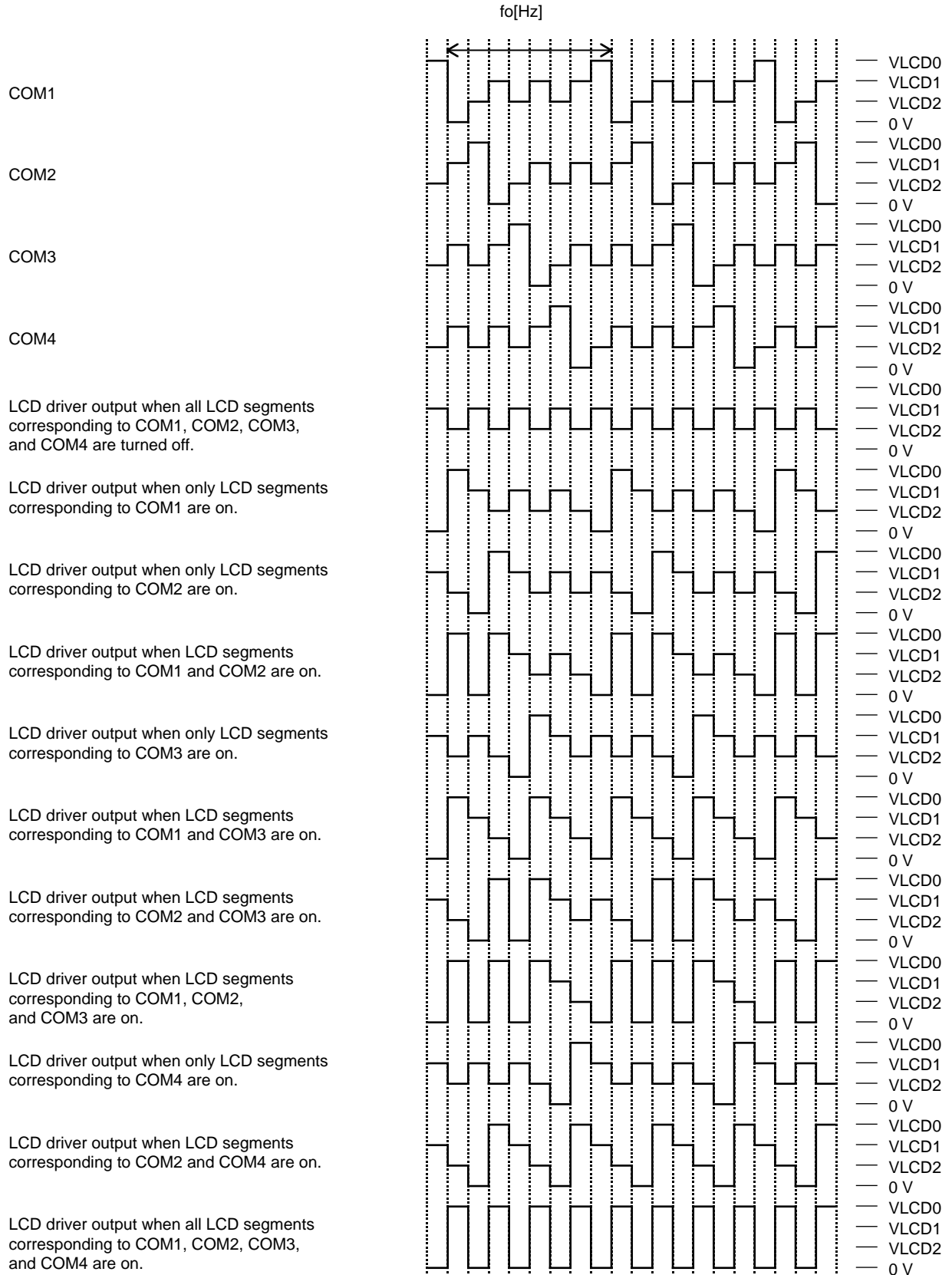


$$\left(\begin{array}{l} \text{When the control data FC} = 0 : f_o = \frac{f_{osc}}{384} \\ \text{When the control data FC} = 1 : f_o = \frac{f_{osc}}{192} \end{array} \right)$$

1/4 Duty, 1/2 Bias Drive Technique



1/4 Duty, 1/3 Bias Drive Technique



COM1

COM2

COM3

COM4

LCD driver output when all LCD segments corresponding to COM1, COM2, COM3, and COM4 are turned off.

LCD driver output when only LCD segments corresponding to COM1 are on.

LCD driver output when only LCD segments corresponding to COM2 are on.

LCD driver output when LCD segments corresponding to COM1 and COM2 are on.

LCD driver output when only LCD segments corresponding to COM3 are on.

LCD driver output when LCD segments corresponding to COM1 and COM3 are on.

LCD driver output when LCD segments corresponding to COM2 and COM3 are on.

LCD driver output when LCD segments corresponding to COM1, COM2, and COM3 are on.

LCD driver output when only LCD segments corresponding to COM4 are on.

LCD driver output when LCD segments corresponding to COM2 and COM4 are on.

LCD driver output when all LCD segments corresponding to COM1, COM2, COM3, and COM4 are on.

- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V
- VLCD0
- VLCD1
- VLCD2
- 0 V

$$\left(\begin{array}{l} \text{When the control data FC} = 0 : f_o = \frac{f_{osc}}{384} \\ \text{When the control data FC} = 1 : f_o = \frac{f_{osc}}{192} \end{array} \right)$$

The $\overline{\text{INH}}$ pin and Display Control

Since the IC internal data (1/3 duty: the display data D1 to D318 and the control data, 1/4 duty: the display data D1 to D420 and the control data) 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 (This sets the S1/P1 to S8/P8, S9 to S105, COM1 to COM3, and COM4/S106 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 meaningless displays at power on. (See Figures 3 and 4.)

Notes on the Power On/Off Sequences

Applications should observe the following sequences when turning the LC75847T power on and off.

- 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 the power supplies can be turned on and off at the same time.

- 1/3 duty

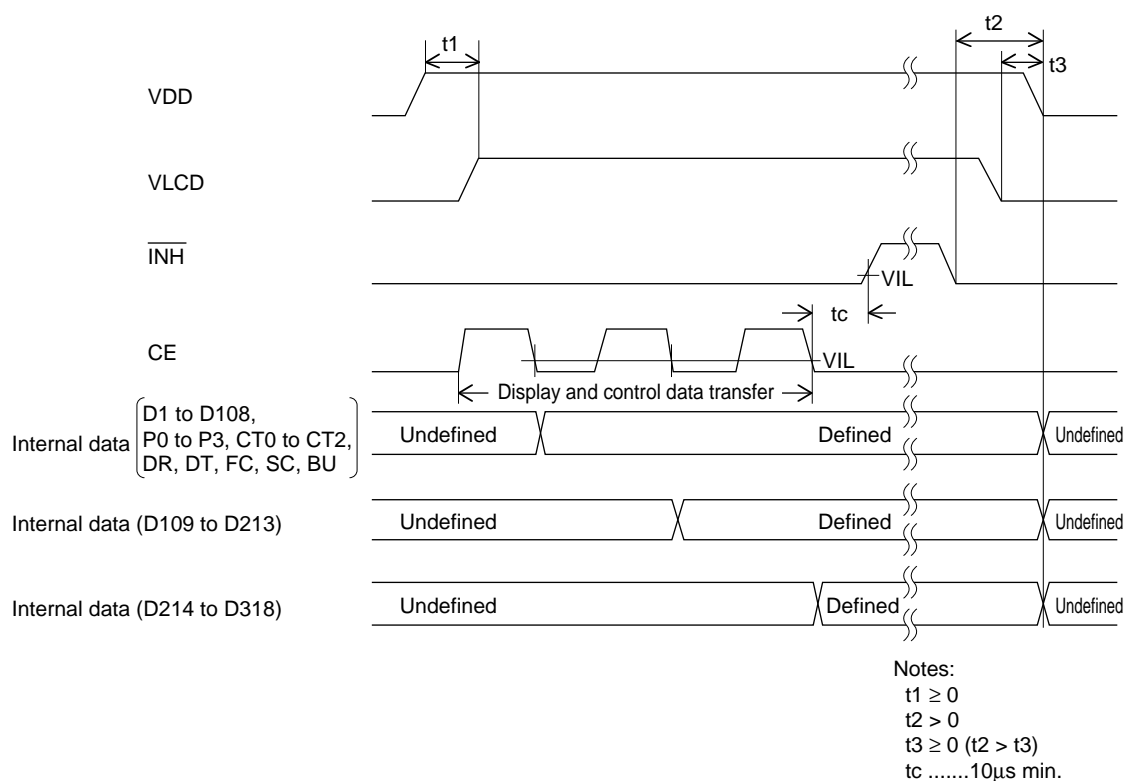


Figure 3

- 1/4 duty

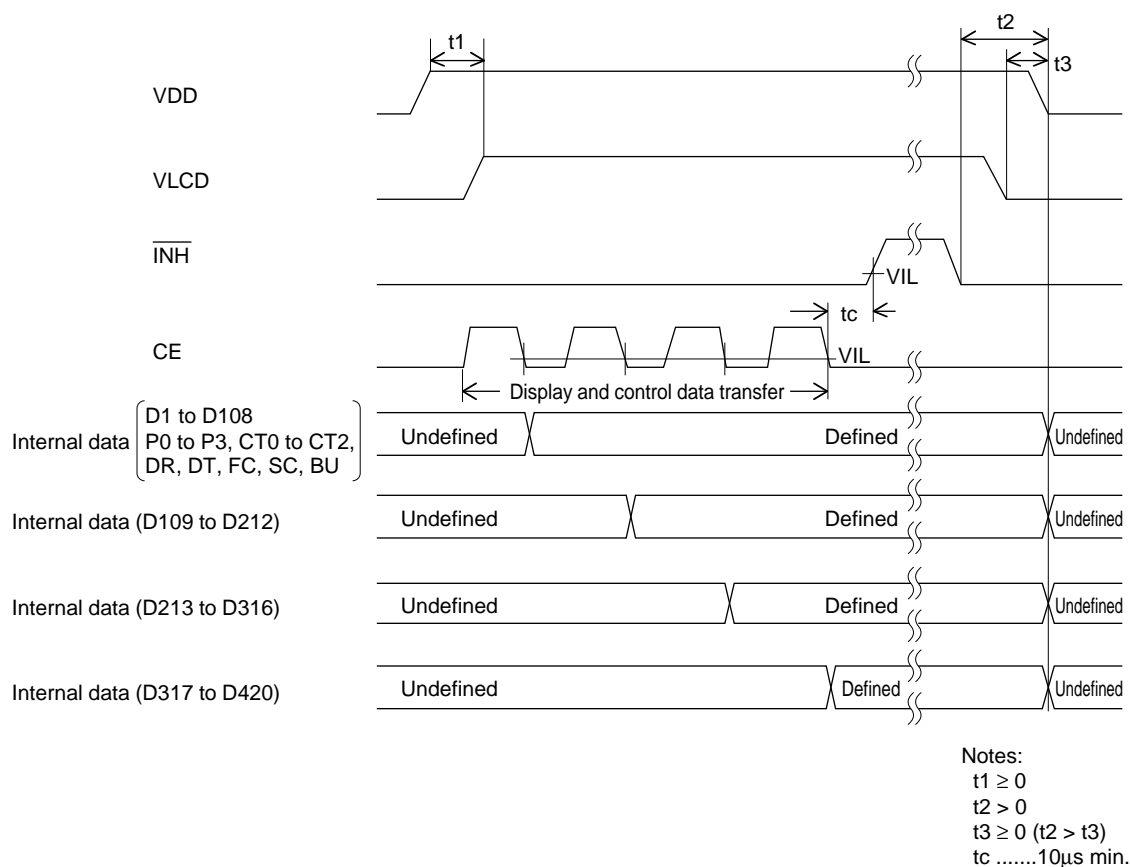


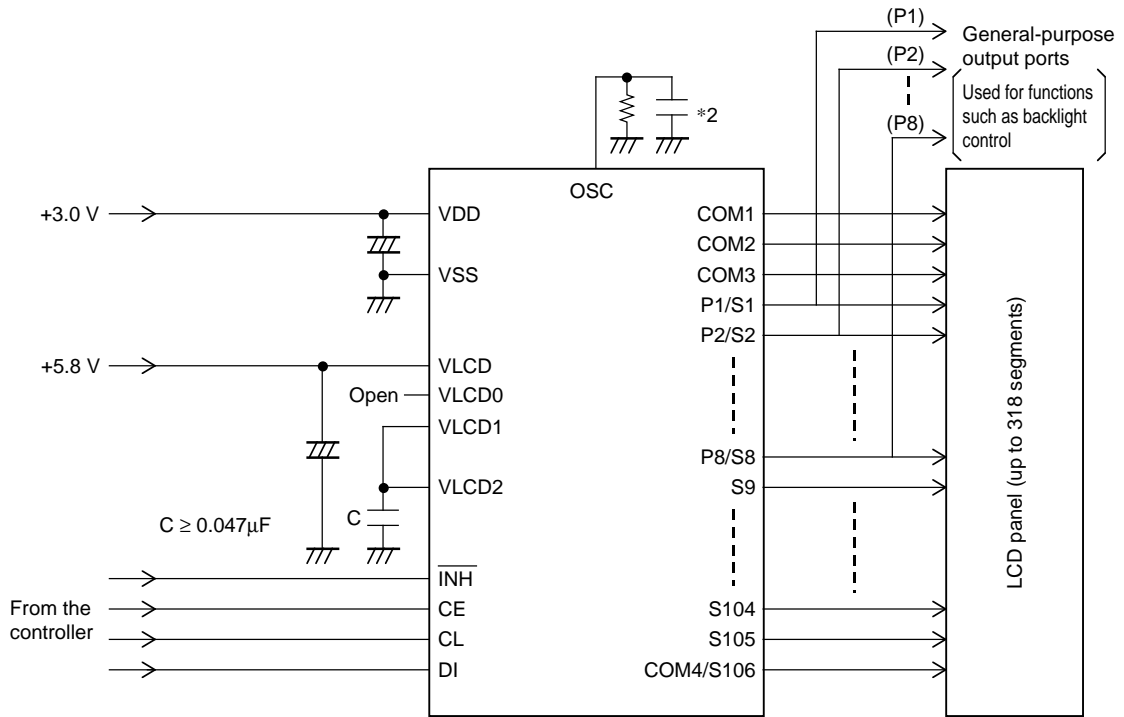
Figure 4

Notes on Controller Transfer of Display Data

Since the LC75847T accepts the display data (D1 to D318) divided into three separate transfer operations when using 1/3 duty drive scheme and the data (D1 to D420) divided into four separate transfer operations when 1/4 duty drive, we recommend that applications transfer all of the display data within a period of less than 30 ms to prevent observable degradation of display quality.

Sample Application Circuit 1

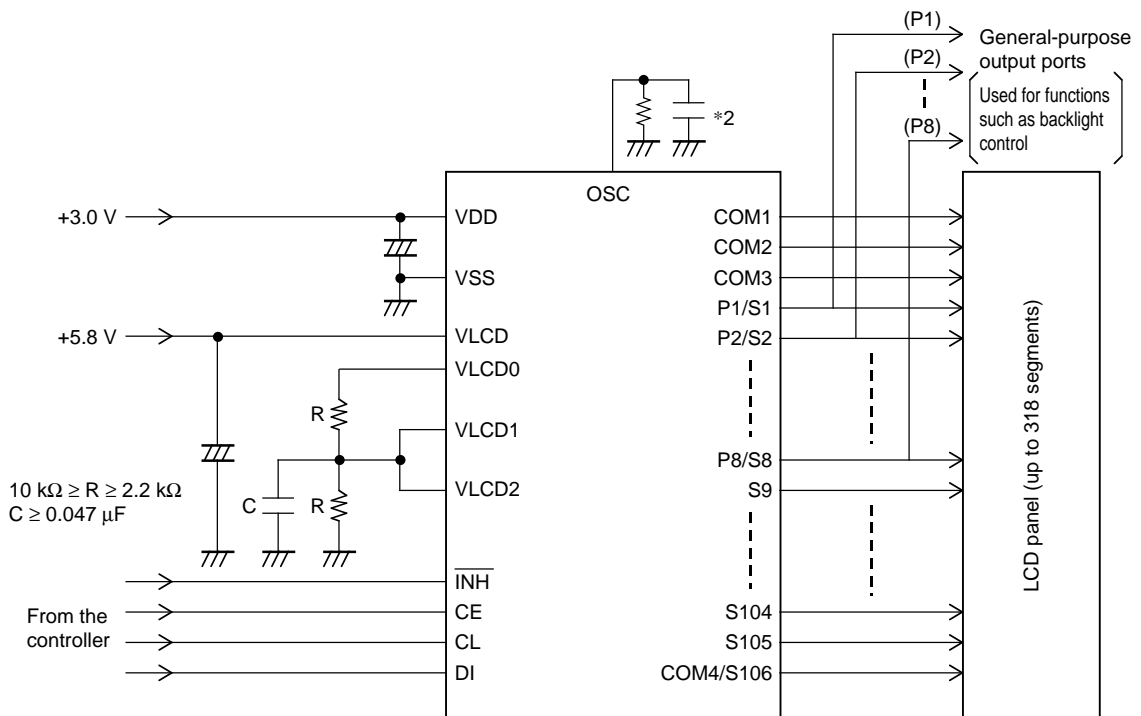
1/3 Duty, 1/2 Bias (for use with normal panels)



Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) 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

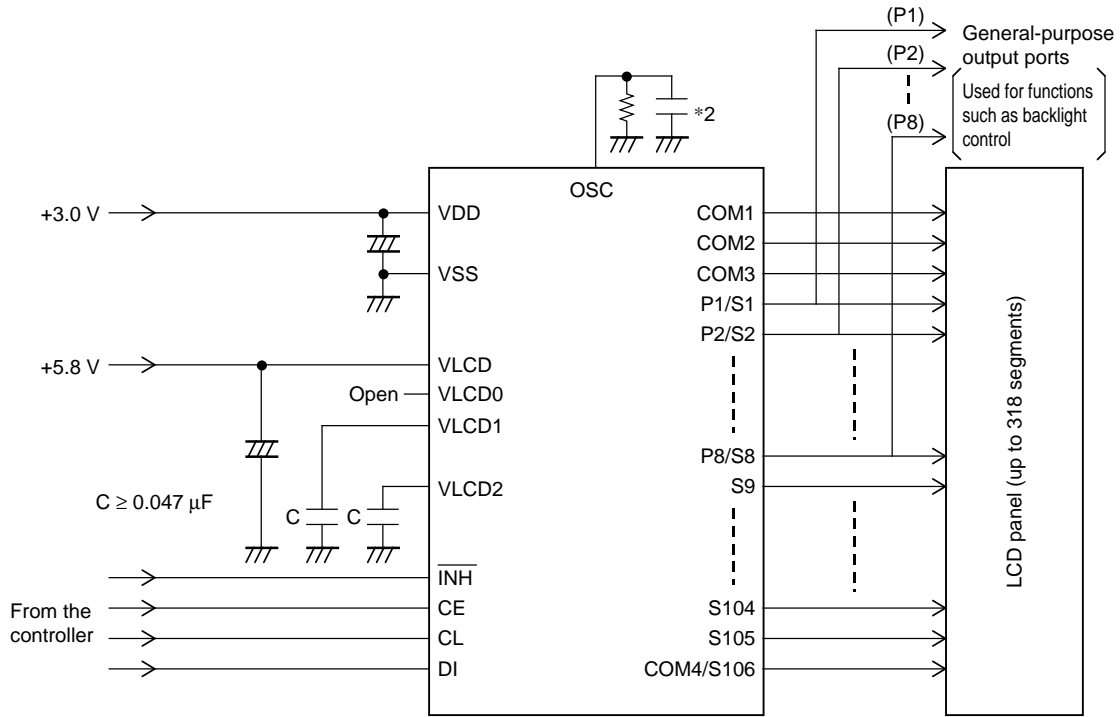
1/3 Duty, 1/2 Bias (for use with large panels)



Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) 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

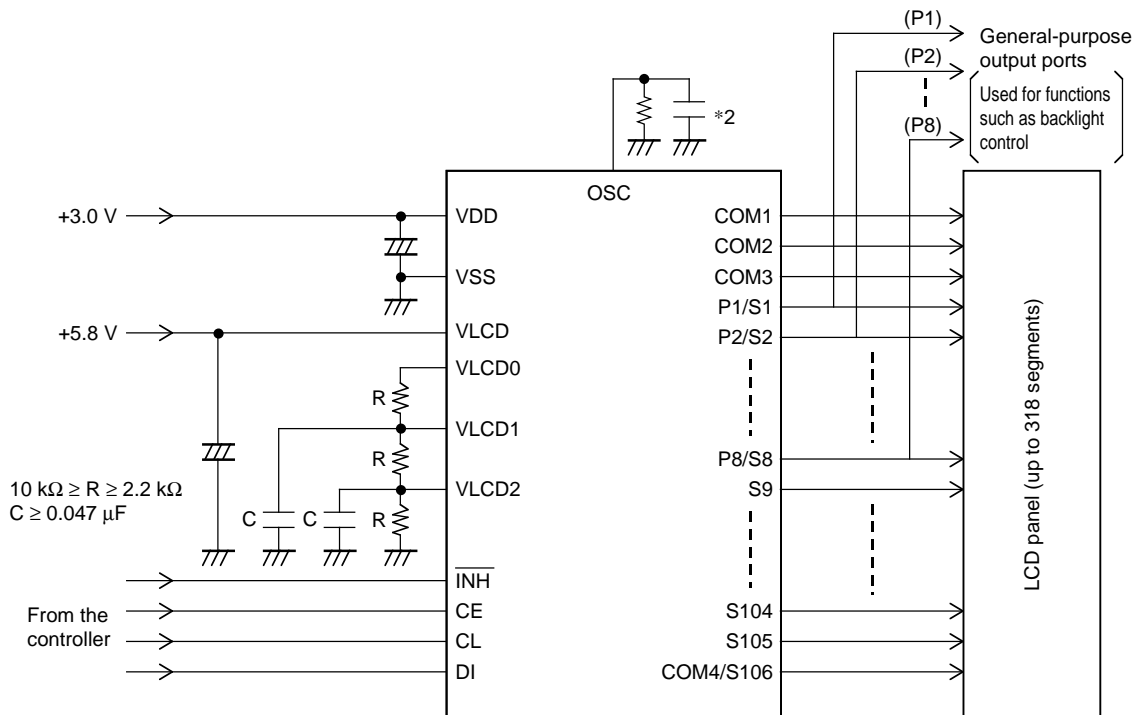
1/3 Duty, 1/3 Bias (for use with normal panels)



Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) 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

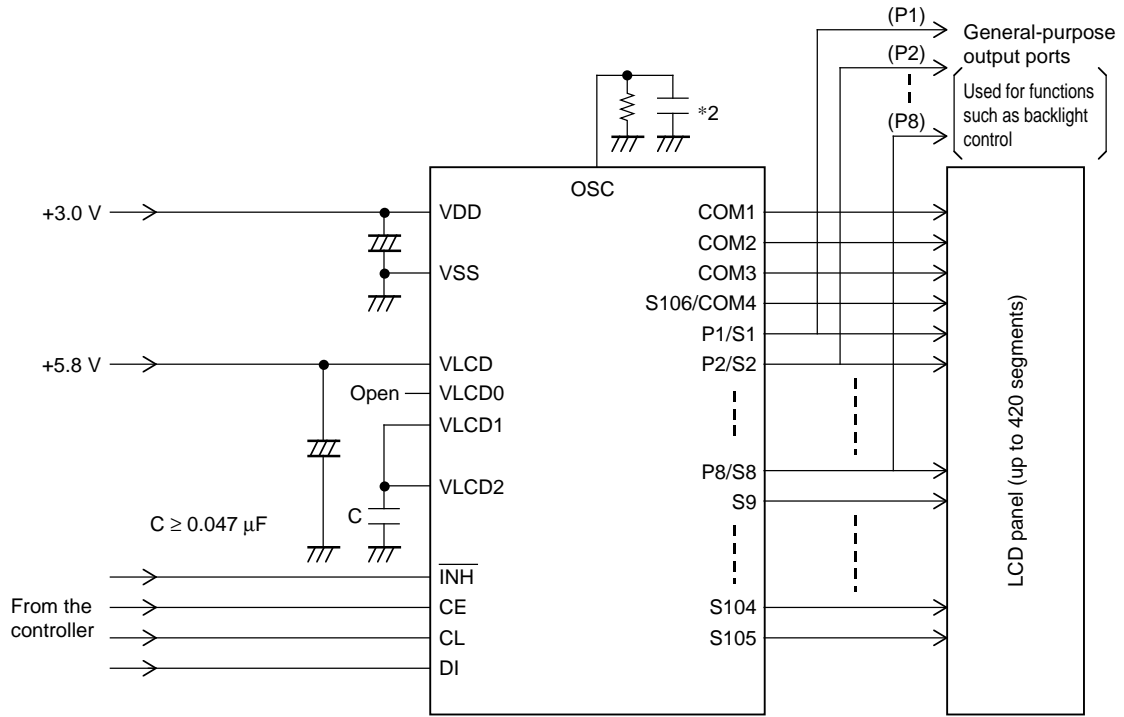
1/3 Duty, 1/3 Bias (for use with large panels)



Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) 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 5

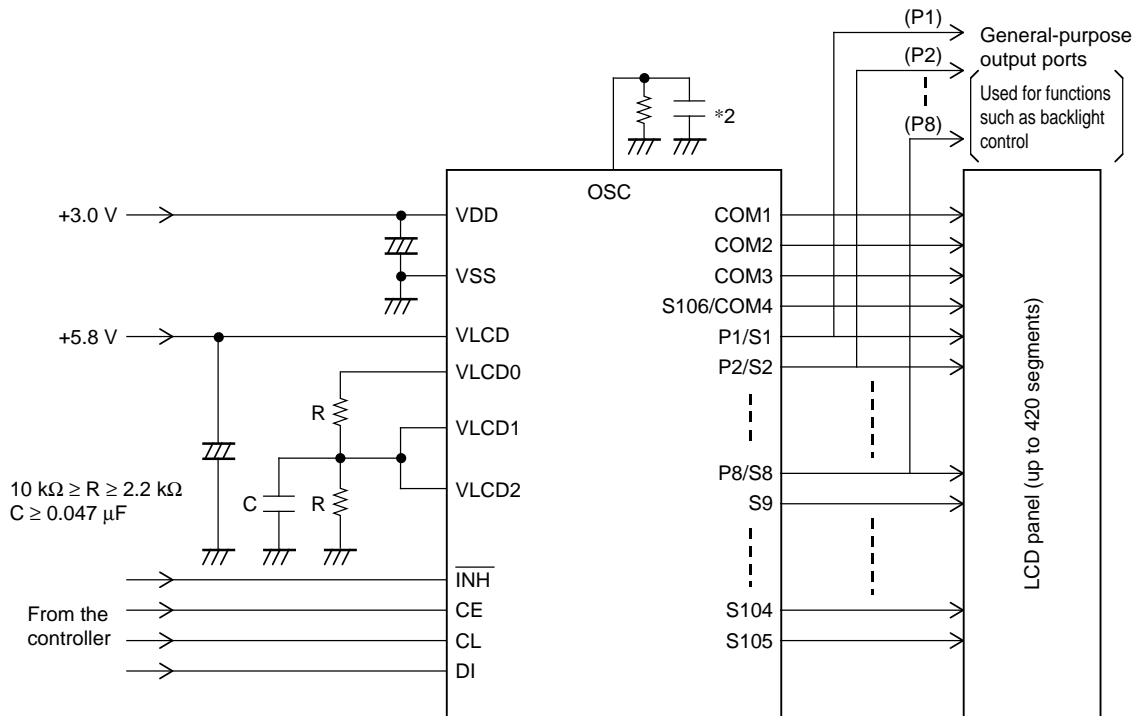
1/4 Duty, 1/2 Bias (for use with normal panels)



Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) 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 6

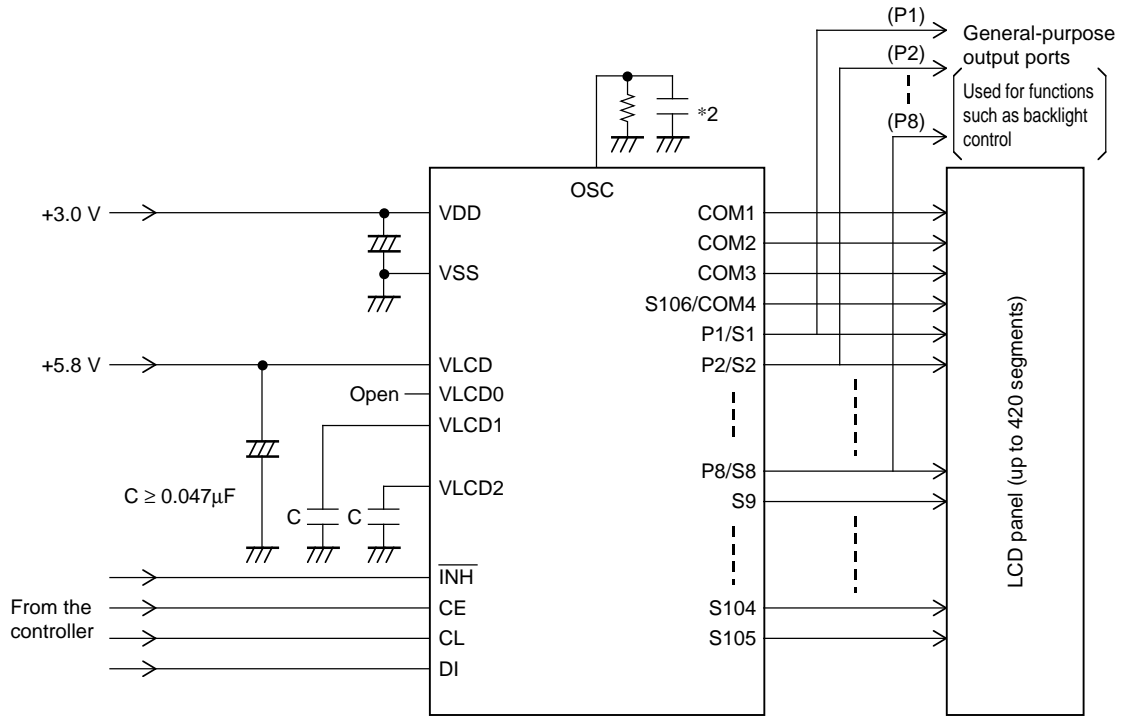
1/4 Duty, 1/2 Bias (for use with large panels)



Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) 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 7

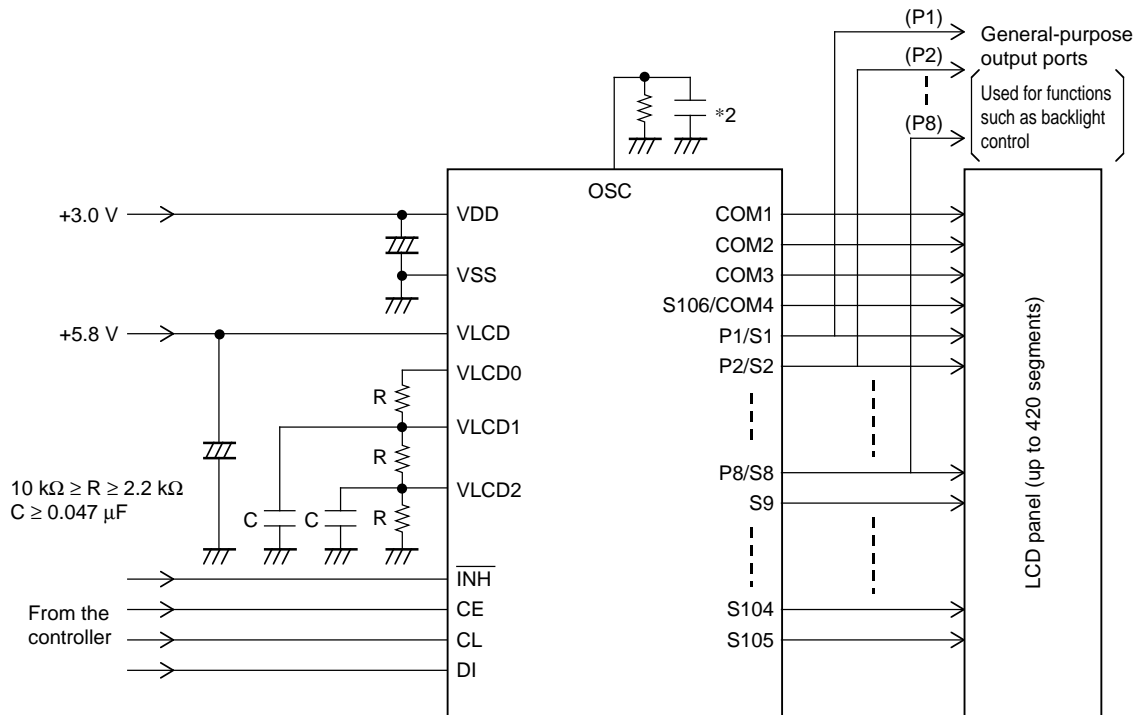
1/4 Duty, 1/3 Bias (for use with normal panels)



Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) 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 8

1/4 Duty, 1/3 Bias (for use with large panels)

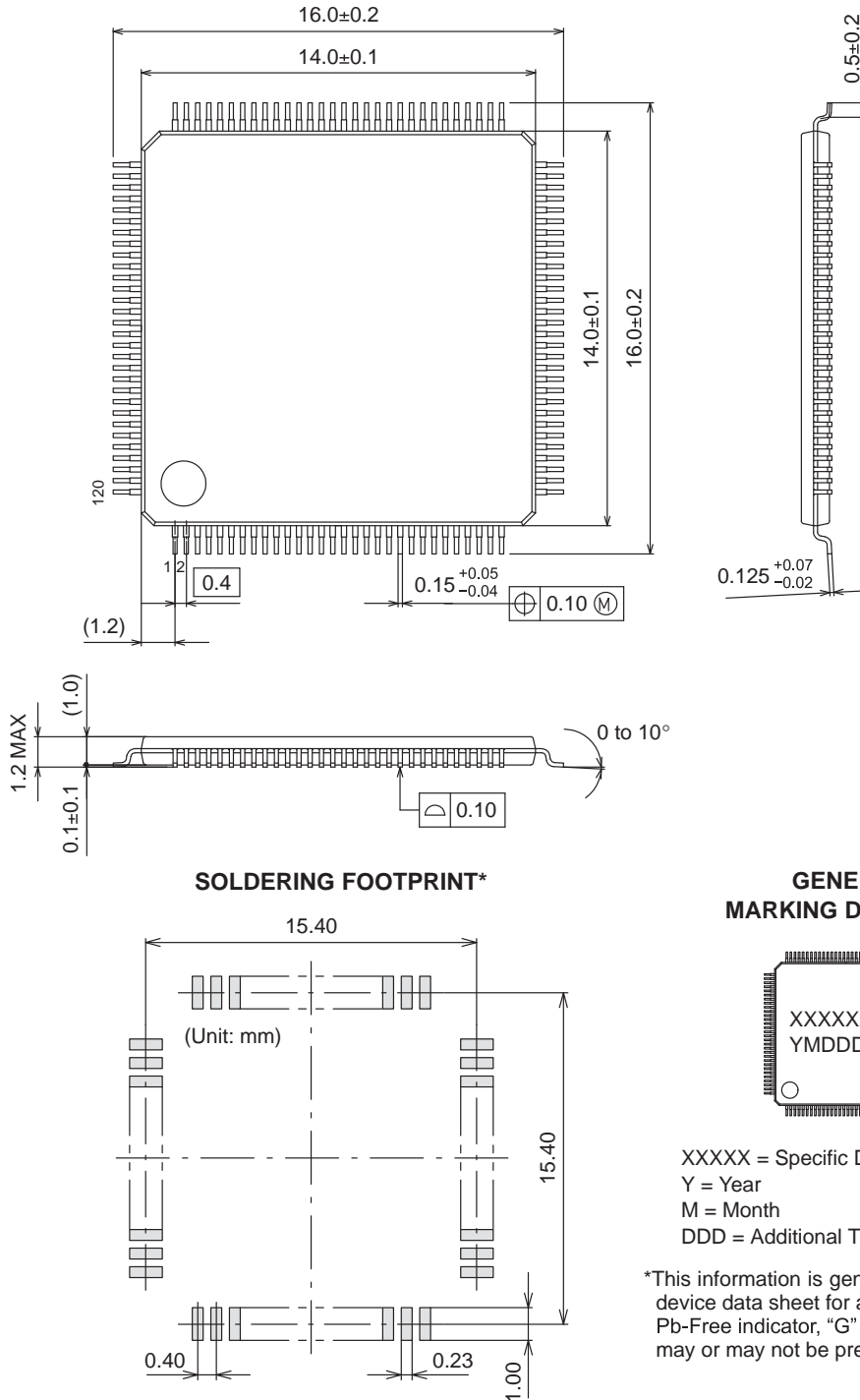


Note: *2 When a capacitor except the recommended external capacitance ($C_{osc} = 1000 \text{ pF}$) is connected the OSC pin, we recommend that applications connect the OSC pin with a capacitor in the range 220 to 2200 pF.

Package Dimensions

unit : mm

TQFP120 14x14 / TQFP120
CASE 932AZ
ISSUE A



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.

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.

ORDERING INFORMATION

| Device | Package | Shipping (Qty / Packing) |
|-------------|----------------------------|--------------------------|
| LC75847T-E | TQFP120 14x14 (Pb-Free) | 450 / Tray JEDEC |
| LC75847TS-E | TQFP120 14x14 (Pb-Free) | 450 / Tray JEDEC |

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