

# 1/8 to 1/10 Duty Dot Matrix LCD Display Controller/Driver



#### Overview

The LC75811E and LC75811W are 1/8 to 1/10 duty dot matrix LCD display controller/drivers that supports the display of characters, numbers, and symbols. In addition to generating dot matrix LCD drive signals based on data transferred serially from a microcontroller, the LC75811E and LC75811W also provide on-chip character display ROM and RAM to allow display systems to be implemented easily.

#### **Features**

- Controls and drives a  $5 \times 7$ ,  $5 \times 8$ , or  $5 \times 9$  dot matrix LCD.
- Supports accessory display segment drive (up to 60 segments)
- Display technique: 1/8 duty 1/4 bias drive ( $5 \times 7$  dots)

1/9 duty 1/4 bias drive (5 × 8 dots) 1/10 duty 1/4 bias drive (5 × 9 dots)

• Display digits:  $12 \text{ digits} \times 1 \text{ line } (5 \times 7 \text{ dots}),$ 

11 digits  $\times$  1 line (5  $\times$  8 or 5  $\times$  9 dots)

· Display control memory

CGROM: 240 characters  $(5 \times 7, 5 \times 8, \text{ or } 5 \times 9 \text{ dots})$ CGRAM: 16 characters  $(5 \times 7, 5 \times 8, \text{ or } 5 \times 9 \text{ dots})$ 

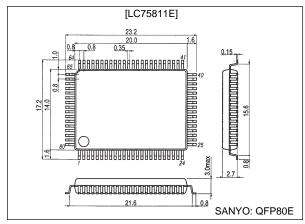
ADRAM:  $12 \times 5$  bits DCRAM:  $48 \times 8$  bits

- Instruction function
   Display on/off control
   Display shift function
- Provides a backup function based on low power modes.
- Serial data input supports CCB format communication with the system controller.
- Independent LCD drive block power supply VLCD
- Provides a RES pin for LSI internal initialization
- · RC oscillator circuit

## **Package Dimensions**

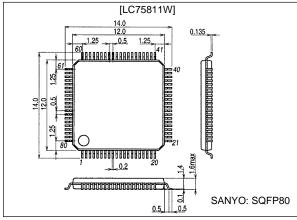
unit: mm

#### 3174-QFP80E



unit: mm

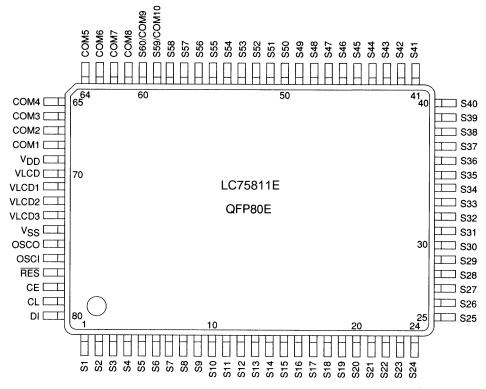
#### 3220-SQFP80

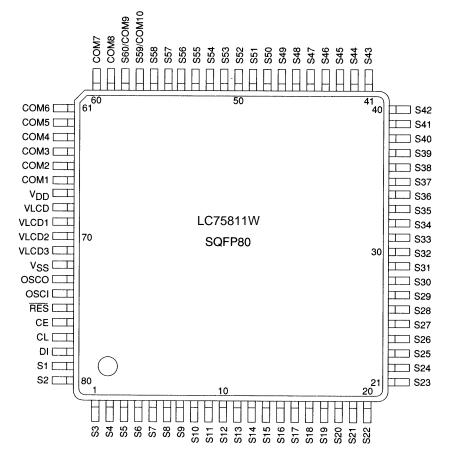


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#### Pin Assignments (Top View)





# Specifications Absolute Maximum Ratings at $Ta=25^{\circ}C,\,V_{SS}=0~V$

Parameter	Symbol	Conditions	Ratings	Unit
Mariana	V <sub>DD</sub> max	$V_{DD}$	-0.3 to +7.0	V
Maximum supply voltage	V <sub>LCD</sub> max	V <sub>LCD</sub>	-0.3 to +11.0	V
	V <sub>IN</sub> 1	CE, CL, DI, RES	-0.3 to +7.0	V
Input voltage	V <sub>IN</sub> 2	OSCI	-0.3 to V <sub>DD</sub> + 0.3	V
	V <sub>IN</sub> 3	V <sub>LCD</sub> 1, V <sub>LCD</sub> 2, V <sub>LCD</sub> 3	-0.3 to V <sub>LCD</sub> + 0.3	V
Output valle se	V <sub>OUT</sub> 1	OSCO	-0.3 to V <sub>DD</sub> + 0.3	V
Output voltage	V <sub>OUT</sub> 2	S1 to S60, COM1 to COM10	-0.3 to V <sub>LCD</sub> + 0.3	V
O dead arranged	I <sub>OUT</sub> 1	S1 to S60	300	μA
Output current	I <sub>OUT</sub> 2	COM1 to COM10	3	mA
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 $85^{\circ}C,\,V_{SS}=0~V$

Parameter	Symbol	Conditions		Ratings		Unit
Farameter	Symbol	Conditions	min	typ	max	Unit
Owner to control to the	V <sub>DD</sub>	V <sub>DD</sub>	2.7		6.0	V
Supply voltage	V <sub>LCD</sub>	V <sub>LCD</sub>	4.5		10.0	V
	V <sub>LCD</sub> 1	V <sub>LCD</sub> 1		3/4 V <sub>LCD</sub>	$V_{LCD}$	V
Input voltage	V <sub>LCD</sub> 2	V <sub>LCD</sub> 2		2/4 V <sub>LCD</sub>	$V_{LCD}$	V
	V <sub>LCD</sub> 3	V <sub>LCD</sub> 3		1/4 V <sub>LCD</sub>	$V_{LCD}$	V
lanut high lavel valtage	V <sub>IH</sub> 1	CE, CL, DI, RES	0.8 V <sub>DD</sub>		6.0	V
Input high level voltage	V <sub>IH</sub> 2	OSCI	0.7 V <sub>DD</sub>		$V_{DD}$	V
lanut laur laural valta an	V <sub>IL</sub> 1	CE, CL, DI, RES	0		0.2 V <sub>DD</sub>	V
Input low level voltage	V <sub>IL</sub> 2	OSCI	0		0.3 V <sub>DD</sub>	V
Recommended external resistance	Rosc	OSCI, OSCO		33		kΩ
Recommended external capacitance	Cosc	OSCI, OSCO		220		pF
Guaranteed oscillation range	fosc	OSC	150	300	600	kHz
Data setup time	t <sub>ds</sub>	CL, DI: Figure 2	160			ns
Data hold time	t <sub>dh</sub>	CL, DI: Figure 2	160			ns
CE wait time	t <sub>cp</sub>	CE, CL: Figure 2	160			ns
CE setup time	t <sub>cs</sub>	CE, CL: Figure 2	160			ns
CE hold time	t <sub>ch</sub>	CE, CL: Figure 2	160			ns
High level clock pulse width	tøH	CL: Figure 2	160			ns
Low level clock pulse width	tøL	CL: Figure 2	160			ns
Minimum reset pulse width	t <sub>WRES</sub>	RES: Figure 3	1			μs

### **Electrical Characteristics in the Allowable Operating Ranges**

D	0	O and Millians		Ratings		11.2
Parameter	Symbol	Conditions	min	typ	max	Unit
Hysteresis	V <sub>H</sub>	CE, CL, DI, RES		0.1 V <sub>DD</sub>		V
Input high level current	I <sub>IH</sub>	CE, CL, DI, RES, OSCI: VI = 6.0 V			5.0	μA
Input low level current	I <sub>IL</sub>	CE, CL, DI, RES, OSCI: VI = 0 V	-5.0			μA
	V <sub>OH</sub> 1	S1 to S60: I <sub>O</sub> = -20 μA	V <sub>LCD</sub> - 0.6			V
Output high level voltage	V <sub>OH</sub> 2	COM1 to COM10: I <sub>O</sub> = -100 μA	V <sub>LCD</sub> - 0.6			V
	V <sub>OH</sub> 3	OSCO: I <sub>O</sub> = -500 μA	V <sub>DD</sub> – 1.0			V
	V <sub>OL</sub> 1	S1 to S60: I <sub>O</sub> = 20 μA			0.6	V
Output low level voltage	V <sub>OL</sub> 2	COM1 to COM10: I <sub>O</sub> = 100 μA			0.6	V
	V <sub>OL</sub> 3	OSCO: I <sub>O</sub> = 500 μA			1.0	V
	V <sub>MID</sub> 1	S1 to S60: I <sub>O</sub> ±20 μA	2/4 V <sub>LCD</sub> - 0.6		2/4 V <sub>LCD</sub> + 0.6	V
Output middle level voltage*1	V <sub>MID</sub> 2	COM1 to COM10: I <sub>O</sub> = ±100 μA	3/4 V <sub>LCD</sub> - 0.6		3/4 V <sub>LCD</sub> + 0.6	V
	V <sub>MID</sub> 3	COM1 to COM10: I <sub>O</sub> = ±100 μA	1/4 V <sub>LCD</sub> – 0.6		1/4 V <sub>LCD</sub> + 0.6	V
Oscillator frequency	fosc	OSCI, OSCO: $R_{OSC} = 33 \text{ k}\Omega$ , $C_{OSC} = 220 \text{ pF}$	210	300	390	kHz
	I <sub>DD</sub> 1	V <sub>DD</sub> : power saving mode			5	μA
O manufacturals	I <sub>DD</sub> 2	V <sub>DD</sub> : V <sub>DD</sub> = 6.0 V, output open, f <sub>OSC</sub> = 300 kHz		450	900	μΑ
Current drain	I <sub>LCD</sub> 1	V <sub>LCD</sub> : power saving mode		·	5	μΑ
	I <sub>LCD</sub> 2	V <sub>LCD</sub> : V <sub>LCD</sub> = 10.0 V, output open, f <sub>OSC</sub> = 300 kHz		200	400	μΑ

Note \*1: Excluding the bias voltage generation divider resistor built into the  $V_{LCD}1$ ,  $V_{LCD}2$ , and  $V_{LCD}3$ . (See figure 1.)

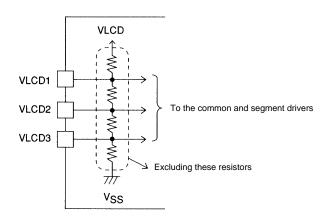
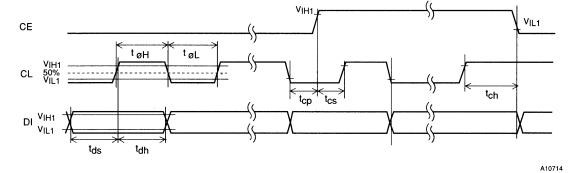


Figure 1

#### • When CL is stopped at the low level



• When CL is stopped at the high level

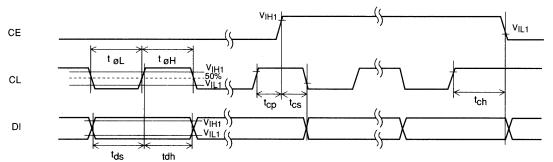


Figure 2

**Block Diagram** — S60/COM9 — S59/COM10 — S58 ဢ SEGMENT DRIVER COMMON DRIVER LATCH V<sub>DD</sub> CGRAM 5×9×16 bits CGROM 5×9×240 bits ADRAM INSTRUCTION VLCD \_\_-60 DECODER bits VLCD1 VLCD2 \_\_-DCRAM 48×8 ADDRESS COUNTER INSTRUCTION VLCD3 REGISTER bits Vss -ADDRESS REGISTER TIMING GENERATOR SHIFT REGISTER RES \_\_\_ CLOCK GENERATOR CCB INTERFACE -Losso 유 

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#### **Pin Functions**

	Pin	No.	<b>-</b>			
Pin	LC75811E	LC75811W	Function	Active	I/O	Handling when unused
S1 to S58 S59/COM10 S60/COM9	1 to 58 59 60	79, 80 1 to 56 57 58	Segment driver outputs. The S59/COM10 and S60/COM9 pins can be used as common driver outputs under the "set display technique" instruction.	_	0	OPEN
COM1 to COM8	68 to 61	66 to 59	Common driver outputs.	_	0	OPEN
OSCI	76	74	Oscillator connections. An oscillator circuit is formed by		ı	GND
osco	75	73	connecting an external resistor and capacitor at these pins.	ı	0	OPEN
CE	78	76	Serial data transfer inputs. These pins are connected to the microcontroller.	Н	ı	
CL	79	77	CE: Chip enable CL: Synchronization clock		ı	GND
DI	80	78	DI: Transfer data	_	ı	
RES	77	75	Reset signal input.  • When RES is low (V <sub>SS</sub> ):  • Display off S1 to S58 = "L" (V <sub>SS</sub> ).  S59/COM10 and S60/COM9 = "L" (V <sub>SS</sub> ). COM1 to COM8 = "L" (V <sub>SS</sub> ). • Serial data transfer is disabled. • The OSCI/OSCO pin oscillator is stopped.  • When RES is high (V <sub>DD</sub> ):  • Display on after a "display on/off control" (display on state setting) instruction is executed. • Serial data transfers are enabled. • The OSCI/OSCO pin oscillator operates.	L	ı	GND
V <sub>LCD</sub> 1	71	69	Used for applying the LCD drive 3/4 bias voltage externally.	ı	ı	OPEN
V <sub>LCD</sub> 2	72	70	Used for applying the LCD drive 2/4 bias voltage externally.		ı	OPEN
V <sub>LCD</sub> 3	73	71	Used for applying the LCD drive 1/4 bias voltage externally.	_	ı	OPEN
V <sub>DD</sub>	69	67	Logic block power supply connection. Provide a voltage of between 2.7 and 6.0 V.	_		_
V <sub>LCD</sub>	70	68	LCD driver block power supply connection. Provide a voltage of between 4.5 and 10.0 V.	_	_	_
V <sub>SS</sub>	74	72	Power supply connection. Connect to ground.			_

#### **Block Functions**

• AC (address counter)

AC is a counter that provides the addresses used for DCRAM and ADRAM.

The address is automatically modified internally, and the LCD display state is retained.

• DCRAM (data control RAM)

DCRAM is RAM that is used to store display data expressed as 8-bit character codes. (These character codes are converted to  $5 \times 7$ ,  $5 \times 8$ , or  $5 \times 9$  dot matrix character patterns using CGROM or CGRAM.) DCRAM has a capacity of  $48 \times 8$  bits, and can hold 48 characters. The table below lists the correspondence between the 6-bit DCRAM address loaded into AC and the display position on the LCD panel.

• When the DCRAM address loaded into AC is 00<sub>H</sub>.

Display digit	1	2	3	4	5	6	7	8	9	10	11	12
DCRAM address (hexadecimal)	00	01	02	03	04	05	06	07	08	09	0A	0B

However, when the display shift is performed by specifying MDATA, the DCRAM address shifts as shown below.

Display digit	1	2	3	4	5	6	7	8	9	10	11	12	
DCRAM address (hexadecimal)	01	02	03	04	05	06	07	80	09	0A	0B	0C	(Left shift)
Display digit	1	2	3	4	5	6	7	8	9	10	11	12	
DCRAM address (hexadecimal)	2F	00	01	02	03	04	05	06	07	08	09	0A	(Right shift)

Note:\*2. The DCRAM addresses are expressed in hexadecimal.



Example: When the DCRAM address is 2E<sub>H</sub>.

DA0	DA1	DA2	DA3	DA4	DA5
0	1	1	1	0	1

Note:\*3.  $5 \times 7$  dots ... 12-digit display  $5 \times 7$  dots  $5 \times 8$  dots ... 12-digit display  $4 \times 8$  dots  $5 \times 9$  dots ... 12-digit display  $3 \times 9$  dots

#### • ADRAM (Additional data RAM)

ADRAM is RAM used to store the ADATA display data. ADRAM has a capacity of  $12 \times 5$  bits, and the stored display data is displayed directly without the use of CGROM or CGRAM. The table below lists the correspondence between the 4-bit ADRAM address loaded into AC and the display position on the LCD panel.

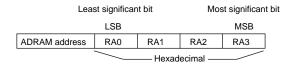
#### • When the ADRAM address loaded into AC is 0<sub>H</sub>. (Number of digit displayed: 12)

Display digit	1	2	3	4	5	6	7	8	9	10	11	12
ADRAM address (hexadecimal)	0	1	2	3	4	5	6	7	8	9	Α	В

However, when the display shift is performed by specifying ADATA, the ADRAM address shifts as shown below.

Display digit	1	2	3	4	5	6	7	8	9	10	11	12	
ADRAM address (hexadecimal)	1	2	3	4	5	6	7	8	9	Α	В	0	(Left shift)
													_
Display digit	1	2	3	4	5	6	7	8	9	10	11	12	
ADRAM address (hexadecimal)	В	0	1	2	3	4	5	6	7	8	9	Α	(Right shift)

Note: \*4. The ADRAM addresses are expressed in hexadecimal.



Example: When the ADRAM address is A<sub>H</sub>

RA0	RA1	RA2	RA3
0	1	0	1

Note: \*5.  $5 \times 7$  dots ... 12-digit display 5 dots  $5 \times 8$  dots ... 12-digit display 4 dots  $5 \times 9$  dots ... 12-digit display 3 dots

#### • CGROM (Character generator ROM)

CGROM is ROM used to generate the 240 kinds of  $5 \times 7$ ,  $5 \times 8$ , or  $5 \times 9$  dot matrix character patterns from the 8-bit character codes. CGROM has a capacity of  $240 \times 45$  bits. When a character code is written to DCRAM, the character pattern stored in CGROM corresponding to the character code is displayed at the position on the LCD corresponding to the DCRAM address loaded into AC.

#### • CGRAM (Character generator RAM)

CGRAM is RAM to which user programs can freely write arbitrary character patterns. Up to 16 kinds of  $5 \times 7$ ,  $5 \times 8$ , or  $5 \times 9$  dot matrix character patterns can be stored. CGRAM has a capacity of  $16 \times 45$  bits.

#### **Reset Function**

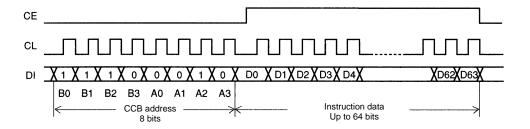
The LC75811E and LC75811W are reset when a low level is applied to the RES pin at power on and, in normal mode. On a reset the LC75811E and LC75811W create a display with all LCD panels turned off. However, after a reset applications must set the contents of DCRAM, ADRAM, and CGRAM before turning on display with a "display on/off control" instruction since the contents of these memories are undefined. That is, applications must execute the following instructions.

- Set display technique
- · DCRAM data write
- ADRAM data write (If ADRAM is used.)
- CGRAM data write (If CGRAM is used.)
- · Set AC address

After executing the above instructions, applications must turn on the display with a "display on/off control" instruction. Note that when applications turn off in the normal mode, applications must turn off the display with a "display on/off control" instruction. (See the detailed instruction descriptions.)

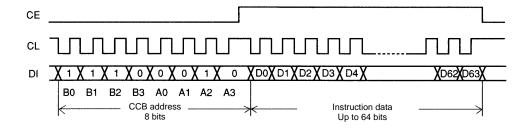
#### **Serial Data Transfer Format**

• When CL is stopped at the low level



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• When CL is stopped at the high level



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• CCB address: 47H

• D0 to D63: Instruction data

The data is acquired on the rising edge of the CL signal and latched on the falling edge of the CE signal. When transferring instruction data from the microcontroller, applications must assure that the time from the transfer of one set of instruction data until the next instruction data transfer is significantly longer than the instruction execution time.

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Instruction	D0 D1D39	D40 D41 D42 D43 D44 D45 D46 D47	D48 D49 D50 D51 D52 D53 D54 D55	D56 D57 D58 D59		D60 D61 D62 D63	Execution time *8
Set display technique				DT1 DT2 X X	0 0	0 1	srl 0
Display on/off control		DG1 DG2 DG3 DG4 DG5 DG6 DG7 DG8	DG9 DG10 DG11 DG12 X X X X	M A SC BU	0 0	1 0	0 µs/27 µs *9
Display shift				M A R/L X	0 0	-	27 µs
Set AC address			DA0 DA1 DA2 DA3 DA4 DA5 X X	RAO RA1 RA2 RA3	0 1	0 0	27 µs
DCRAM data write *6		AC0 AC1 AC2 AC3 AC4 AC5 AC6 AC7	DA0 DA1 DA2 DA3 DA4 DA5 X X	× × × ×	0	0	27 µs
ADRAM data write *7		AD1 AD2 AD3 AD4 AD5 X X X	RAO RA1 RA2 RA3 X X X X	× × × ×	0 1	1 0	27 µs
CGRAM data write	CD1 CD2CD40	CD41 CD42 CD43 CD44 CD45 X X X	CA0 CA1 CA2 CA3 CA4 CA5 CA6 CA7	× × × ×	0 1	1	27 µs
							X: don't care

Notes: \*6. The data format differs when the "DCRAM data write" instruction is executed in the increment mode (IM = 1).

<sup>(</sup>See detailed instruction descriptions .)
\*7. The data format differs when the "ADRAM data write" instruction is executed in the increment mode (IM = 1).
(See detailed instruction descriptions.)
\*8. The execution times listed here apply when fosc = 300 kHz. The execution times differ when the oscillator frequency fosc differs.
Example: When fosc = 210 kHz

 $<sup>27 \</sup>text{ µs} \times \frac{300}{210} = 39 \text{ µs}$ 

<sup>\*9</sup>. When the power saving mode (BU = 1) is set, the execution time is 27 µs (when  $f_{\rm osc}$  = 300 kHz).

#### **Detailed Instruction Descriptions**

• Set display technique ... <Sets the display technique>

	Code												
D56	D57	D58	D59	D60	D61	D62	D63						
DT1	DT2	Х	Х	0	0	0	1						

X: don't care

#### DT1, DT2: Setting the display technique

	DT1 DT2	DT2	Display technique	Output pins				
		Display technique	S60/COM9	S59/COM10				
	0	0	1/8 duty, 1/4 bias drive	S60	<b>S</b> 59			
	1	0	1/9 duty, 1/4 bias drive	COM9	<b>S</b> 59			
Γ	0	1	1/10 duty, 1/4 bias drive	COM9	COM10			

Note: \*10. Sn (n = 59, 60): Segment outputs

COMn (n = 9, 10): Common outputs

• Display on/off control ... < Turns the display on or off>

	Code																						
D40	D41	D42	D43	D44	D45	D46	D47	D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
DG1	DG2	DG3	DG4	DG5	DG6	DG7	DG8	DG9	DG10	DG11	DG12	Х	Х	Х	Χ	М	Α	SC	BU	0	0	1	0

X: don't care

#### M, A: Specifies the data to be turned on or off.

М	Α	Display operating state
0	0	Both MDATA and ADATA are turned off (The display is forcibly turned off regardless of the DG1 to DG12 data.)
0	1	Only ADATA is turned on (The ADATA of display digits specified by the DG1 to DG12 data are turned on.)
1	0	Only MDATA is turned on (The MDATA of display digits specified by the DG1 to DG12 data are turned on.)
1	1	Both MDATA and ADATA are turned on (The MDATA and ADATA of display digits specified by the DG1 to DG12 data are turned on.)

#### Note: \*11. MDATA, ADATA

5 × 7 dot matrix display

5 × 8 dot matrix display

5 × 9 dot matrix display

... ADATA

... ADATA

... MDATA

... MDATA

A10719

#### DG1 to DG12: Specifies the display digit

Display digit	1	2	3	4	5	6	7	8	9	10	11	12
Display digit data	DG1	DG2	DG3	DG4	DG5	DG6	DG7	DG8	DG9	DG10	DG11	DG12

For example, if DG1 to DG6 are 1, and DG7 to DG12 are 0, then display digits 1 to 6 will be turned on, and display digits 7 to 12 will be turned off (blanked).

#### SC: Controls the common and segment output pins.

SC	Common and segment output pin states
0	Output of LCD drive waveforms
1	Fixed at the V <sub>SS</sub> level (all segments off)

Note: \*12. When SC is 1, the S1 to S60 and COM1 to COM10 output pins are set to the VSS level, regardless of the M, A, and DG1 to DG12 data.

#### BU: Controls the normal mode and power saving mode.

BU	Mode
0	Normal mode
1	Power saving mode (In this mode, the OSCI and OSCO pins oscillator is stopped, and the common and segment pins are set to the V <sub>SS</sub> level. In this mode, instructions other than the "display on/off control" instruction cannot be executed. Thus applications must set the LSI to normal mode before executing any of the other instructions.)

#### • Display shift ... < Shifts the display>

Code											
D56	D57	D58	D59	D60	D61	D62	D63				
М	Α	R/L	Х	0	0	1	1				

X: don't care

#### M, A: Specifies the data to be shifted

М	Α	Shift operating state
0	0	Neither MDATA nor ADATA is shifted
0	1	Only ADATA is shifted
1	0	Only MDATA is shifted
1	1	Both MDATA and ADATA are shifted

#### R/L: Shift direction specification

R/L	Shift direction
0	Left shift
1	Right shift

#### • Set AC address... < Specifies the DCRAM and ADRAM address for AC>

	Code														
D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
DA0	DA1	DA2	DA3	DA4	DA5	Х	Х	RA0	RA1	RA2	RA3	0	1	0	0

X: don't care

#### DA0 to DA5: DCRAM address

DA0	DA1	DA2	DA3	DA4	DA5	
LSB					MSB	
Least sign	ificant bit			Mos	st significar	t bit

#### RA0 to RA3: ADRAM address

RA	0	RA1	RA2	RA3	
LSE	3			MSB	
Least	signi	ficant bit	Mo	st significar	nt bit

This instruction loads the 6-bit DCRAM address DA0 to DA5 and the 4-bit ADRAM address RA0 to RA3 into the AC.

• DCRAM data write ... <Specifies the DCRAM address and stores data at that address>

											Co	de											
D40	D41	D42	D43	D44	D45	D46	D47	D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
AC0	AC1	AC2	AC3	AC4	AC5	AC6	AC7	DA0	DA1	DA2	DA3	DA4	DA5	Х	Χ	IM	Х	Х	Х	0	1	0	1

X: don't care

#### DA0 to DA5: DCRAM address

DA0	DA1	DA2	DA3	DA4	DA5	
LSB					MSB	
Least sign	ificant bit			Mos	st significan	t bit

#### AC0 to AC7: DCRAM data (character code)

	AC0	AC1	AC2	AC3	AC4	AC5	AC6	AC7	
	LSB							MSB	
L	east sign	ificant bit					Mo	st significa	nt bit

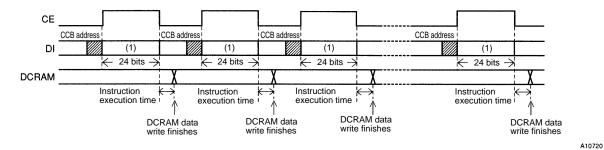
This instruction writes the 8 bits of data AC0 to AC7 to DCRAM. This data is a character code, and is converted to a  $5 \times 7$ ,  $5 \times 8$ , or  $5 \times 9$  dot matrix display data using CGROM or CGRAM.

#### IM: Setting the method of writing data to DCRAM

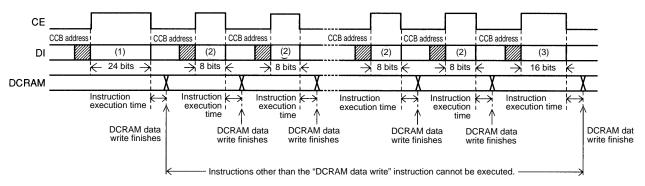
IM	DCRAM data write method
0	Normal DCRAM data write (Specifies the DCRAM address and writes the DCRAM data.)
1	Increment mode DCRAM data write (Increments the DCRAM address by +1 each time data is written to DCRAM.)

#### Notes: \*13.

 $\cdot$  DCRAM data write method when IM = 0



· DCRAM data write method when IM = 1 (Instructions other than the "DCRAM data write" instruction cannot be executed.)



#### Data format at (1) (24 bits)

											Co	de											
D40	D41	D42	D43	D44	D45	D46	D47	D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
AC0	AC1	AC2	AC3	AC4	AC5	AC6	AC7	DA0	DA1	DA2	DA3	DA4	DA5	Х	Χ	IM	Х	Х	Х	0	1	0	1

X: don't care

#### Data format at (2) (8 bits)

			Co	de			
D56	D57	D58	D59	D60	D61	D62	D63
AC0	AC1	AC2	AC3	AC4	AC5	AC6	AC7

#### Data format at (3) (16 bits)

							Co	de							
D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
AC0	AC1	AC2	AC3	AC4	AC5	AC6	AC7	0	Х	Х	Χ	0	1	0	1

X: don't care

#### • ADRAM data write ... <Specifies the ADRAM address and stores data at that address>

											Co	de											
D40	D41	D42	D43	D44	D45	D46	D47	D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
AD <sup>2</sup>	AD2	AD3	AD4	AD5	Χ	Х	Х	RA0	RA1	RA2	RA3	Х	Х	Х	Χ	IM	Х	Х	Х	0	1	1	0

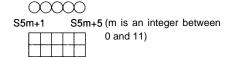
X: don't care

#### RA0 to RA3: ADRAM address

RAC	)	RA1	RA2	RA3	
LSB				MSB	
Least s	ign	ificant bit	Мо	st significar	nt bit

#### AD1 to AD5: ADATA display data

In addition to the  $5 \times 7$ ,  $5 \times 8$ , or  $5 \times 9$  dot matrix display data (MDATA), this LSI supports direct display of the five accessory display segments provided in each digit as ADATA. This display function does not use CGROM or CGRAM. The figure below shows the correspondence between the data and the display. When ADn = 1 (where n is an integer between 1 and 5) the segment corresponding to that data will be turned on.



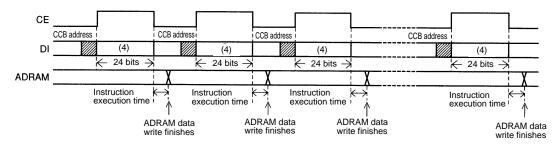
ADATA	Corresponding output pin
AD1	S5m + 1 (m is an integer between 0 and 11)
AD2	S5m + 2
AD3	S5m + 3
AD4	S5m + 4
AD5	S5m + 5
	AD1 AD2 AD3 AD4

#### IM: Setting the method of writing data to ADRAM

IM	1	ADRAM data write method
0	1	Normal ADRAM data write (Specifies the ADRAM address and writes the ADRAM data.)
1		Increment mode ADRAM data write (Increments the ADRAM address by +1 each time data is written to ADRAM.)

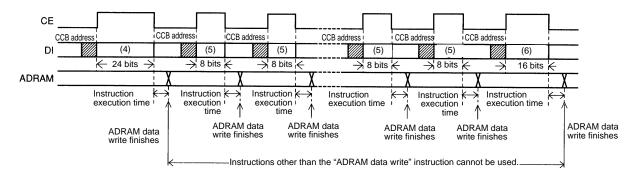
#### Notes: \*14.

 $\cdot$  ADRAM data write method when IM = 0



A10723

· ADRAM data write method when IM = 1 (Instructions other than the "ADRAM data write" instruction cannot be used.)



A10724

#### Data format at (4) (24 bits)

											Co	de											
D40	D41	D42	D43	D44	D45	D46	D47	D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
AD1	AD2	AD3	AD4	AD5	Х	Х	Х	RA0	RA1	RA2	RA3	Х	Х	Χ	Х	IM	Х	Х	Х	0	1	1	0

X: don't care

#### Data format at (5) (8 bits)

			Co	de			
D56	D57	D58	D59	D60	D61	D62	D63
AD1	AD2	AD3	AD4	AD5	Х	Х	Χ
						X: don	't care

#### Data format at (6) (16 bits)

							Со	de							
D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
AD1	AD2	AD3	AD4	AD5	Х	Х	Х	0	Х	Х	Х	0	1	1	0
														X: dor	't care

No. 5915-15/27

#### • CGRAM data write ... < Specifies the CGRAM address and stores data at that address>

							Со	de							
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
CD1	CD2	CD3	CD4	CD5	CD6	CD7	CD8	CD9	CD10	CD11	CD12	CD13	CD14	CD15	CD16

							Co	de							
D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
CD17	CD18	CD19	CD20	CD21	CD22	CD23	CD24	CD25	CD26	CD27	CD28	CD29	CD30	CD31	CD32

							Co	de							
D32	D33	D34	D35	D36	D37	D38	D39	D40	D41	D42	D43	D44	D45	D46	D47
CD33	CD34	CD35	CD36	CD37	CD38	CD39	CD40	CD41	CD42	CD43	CD44	CD45	Х	Х	X

							Co	de							
D48	D49	D50	D51	D52	D53	D54	D55	D56	D57	D58	D59	D60	D61	D62	D63
CA0	CA1	CA2	CA3	CA4	CA5	CA6	CA7	Х	Х	Х	Х	0	1	1	1

X: don't care

#### CA0 to CA7: CGRAM address

CA0	CA1	CA2	CA3	CA4	CA5	CA6	CA7	
LSB							MSB	
Least signi	ficant bit					Mos	st significar	t bit

#### CD1 to CD45: CGRAM data $(5 \times 7, 5 \times 8, \text{ or } 5 \times 9 \text{ dot matrix display data})$

The bit CDn (where n is an integer between 1 and 45) corresponds to the  $5 \times 7$ ,  $5 \times 8$ , or  $5 \times 9$  dot matrix display data. The figure below shows that correspondence. The dots for which the corresponding data CDn is 1 will be turned on.

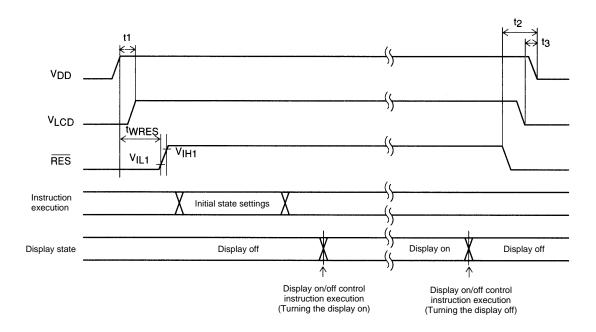
CD1	CD2	CD3	CD4	CD5
CD6	CD7	CD8	CD9	CD10
CD11	CD12	CD13	CD14	CD15
CD16	CD17	CD18	CD19	CD20
CD21	CD22	CD23	CD24	CD25
CD26	CD27	CD28	CD29	CD30
CD31	CD32	CD33	CD34	CD35
CD36	CD37	CD38	CD39	CD40
CD41	CD42	CD43	CD44	CD45

Note:\*15. CD1 to CD35:  $5 \times 7$  dot matrix display data CD1 to CD40:  $5 \times 8$  dot matrix display data CD1 to CD45:  $5 \times 9$  dot matrix display data

#### Notes on the Power On and Power Off Sequences

- At power on: Logic block power supply  $(V_{DD})$  on  $\rightarrow$  LCD driver block power supply  $(V_{LCD})$  on
- At power off: LCD driver block power supply  $(V_{LCD})$  off  $\rightarrow$  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.



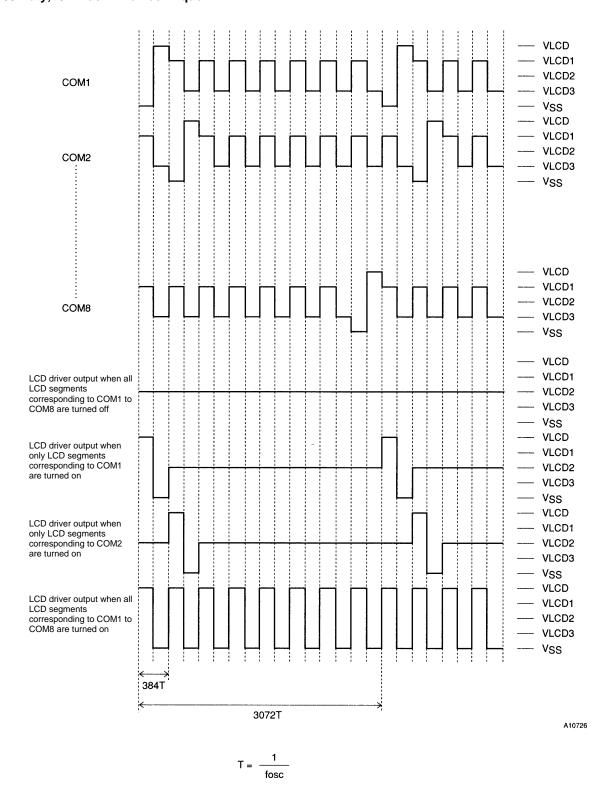
A10725

#### Initial state settings

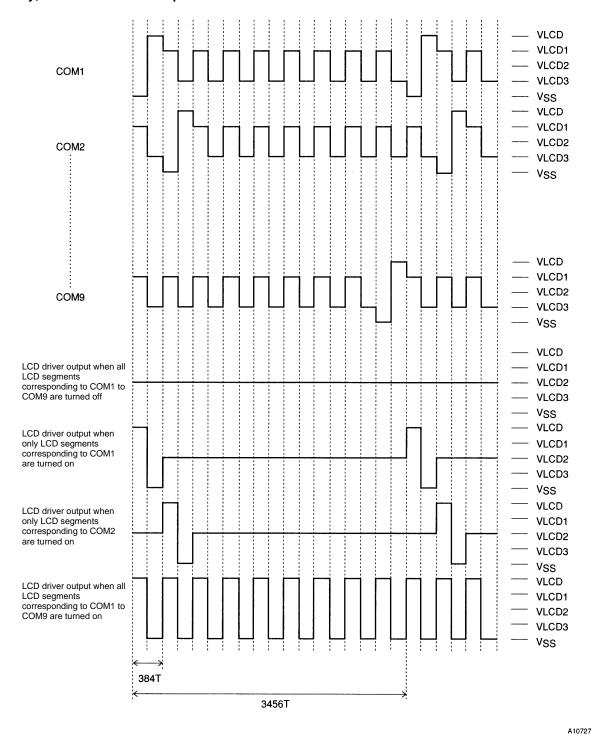
- $t1 \ge 0$
- t2 > 0
- $t3 \ge 0 (t2 > t3)$
- twres.....1 µs min
- Set display technique
- DCRAM data write
- ADRAM data write (If ADRAM is used.)
- CGRAM data write (If CGRAM is used.)
- Set AC address

Figure 3

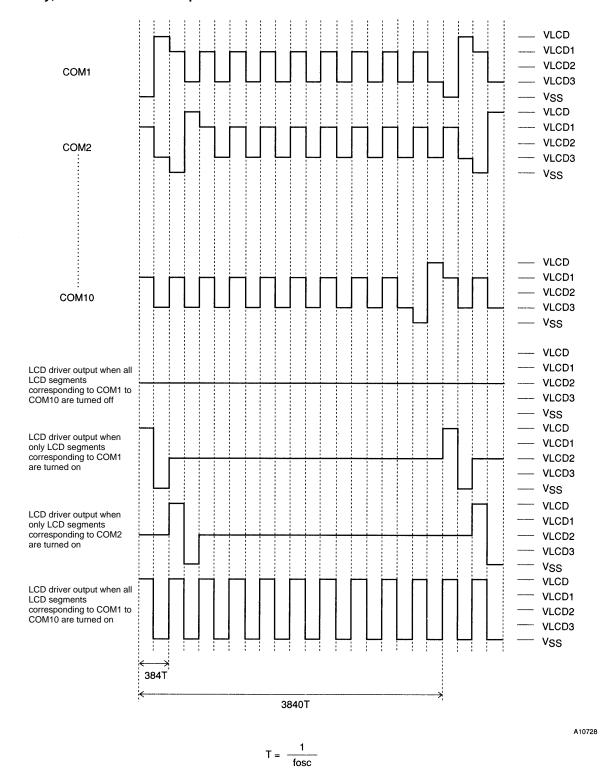
#### 1/8 Duty, 1/4 Bias Drive Technique



#### 1/9 Duty, 1/4 Bias Drive Technique



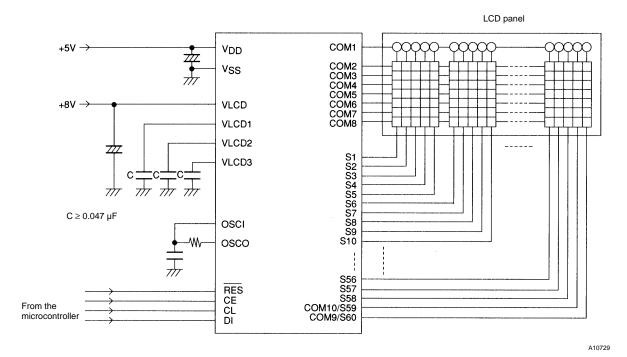
#### 1/10 Duty, 1/4 Bias Drive Technique



No. 5915-20/27

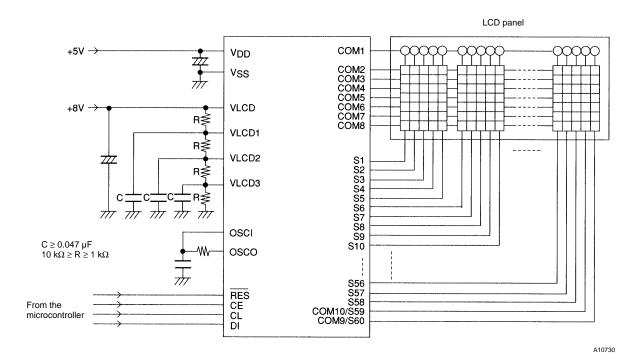
#### **Sample Application Circuit 1**

1/8 Duty, 1/4 Bias Drive (For use with normal panels)



#### **Sample Application Circuit 2**

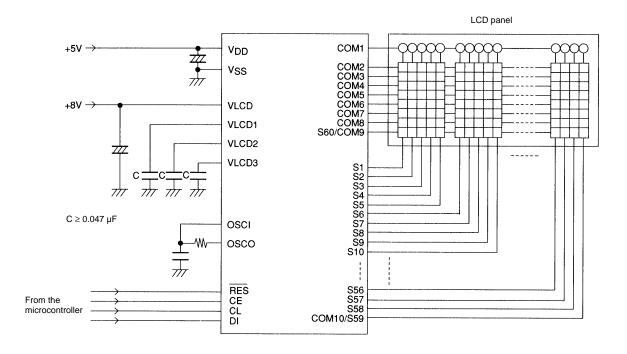
1/8 Duty, 1/4 Bias Drive (For use with large panels)



No. 5915-21/27

#### **Sample Application Circuit 3**

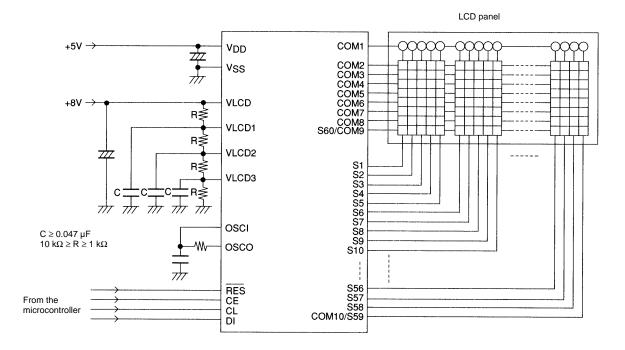
1/9 Duty, 1/4 Bias Drive (For use with normal panels)



A10731

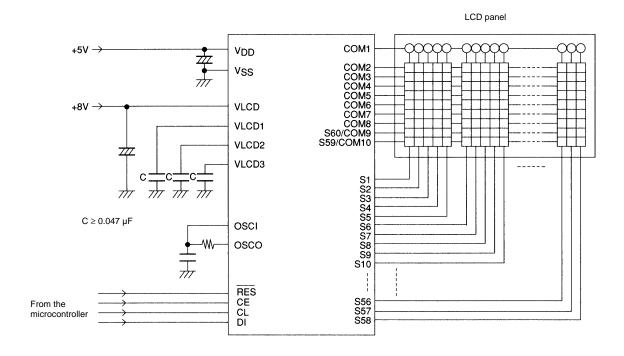
#### **Sample Application Circuit 4**

1/9 Duty, 1/4 Bias Drive (For use with large panels)



#### **Sample Application Circuit 5**

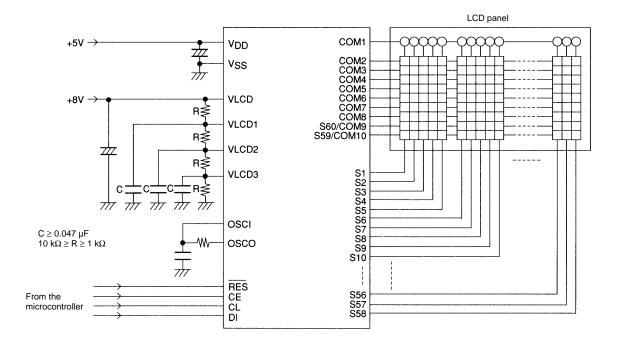
1/10 Duty, 1/4 Bias Drive (For use with normal panels)



A10733

# **Sample Application Circuit 6**

1/10 Duty, 1/4 Bias Drive (For use with large panels)



# Sample Correspondence between Instructions and the Display (When the LC75811-8715 is used)

	LSB Instruction (hexadecimal)	MSB		
No.	D40 to D43 D44 to D47 D48 to D51 D52 to D55 D56 to D59 I		Display	Operation
	Power application			Initializes the IC.
1	(Initialization with the RES pin.)			The display is in the off state.
	Set display technique			Octobra 4/0 district A/A biggs district to the investment
2	0	8		Sets to 1/8 duty 1/4 bias display drive technique
	DCRAM data write (increment mode)			With the First Activity BORAN III and I
3	0 2 0 0 1	Α		Writes the display data " " to DCRAM address 00H
	DCRAM data write (increment mode)			
4	3	5		Writes the display data "S" to DCRAM address 01H
_	DCRAM data write (increment mode)			
5	1	4		Writes the display data "A" to DCRAM address 02H
	DCRAM data write (increment mode)			
6	E	4		Writes the display data "N" to DCRAM address 03H
	DCRAM data write (increment mode)			
7	9	5		Writes the display data "Y" to DCRAM address 04H
	DCRAM data write (increment mode)			
8	F	4		Writes the display data "O" to DCRAM address 05H
	DCRAM data write (increment mode)			
9	0	2		Writes the display data " " to DCRAM address 06H
	DCRAM data write (increment mode)			
10	C	4		Writes the display data "L" to DCRAM address 07H
	DCRAM data write (increment mode)			With the First County DODANA LL COUL
11	3	5		Writes the display data "S" to DCRAM address 08H
10	DCRAM data write (increment mode)			With the First Country Bobbar 11 and 1
12	9	4		Writes the display data "I" to DCRAM address 09H
10	DCRAM data write (increment mode)			W
13	0	2		Writes the display data " " to DCRAM address 0AH
	DCRAM data write (increment mode)			W
14	0	2		Writes the display data " " to DCRAM address 0BH
	DCRAM data write (increment mode)			With the Population of the Court of the Cour
15	С	4		Writes the display data "L" to DCRAM address 0CH
10	DCRAM data write (increment mode)			Weiten the display date "C" to DCD AAA address CDU
16	3	4		Writes the display data "C" to DCRAM address 0DH
17	DCRAM data write (increment mode)			Writes the display date "7" to DCDAM address CTU
17	7	3		Writes the display data "7" to DCRAM address 0EH
10	DCRAM data write (increment mode)			Writes the display date "E" to DODAM address CELL
18	5	3		Writes the display data "5" to DCRAM address 0FH
10	DCRAM data write (increment mode)			Writes the display date "9" to DODAM address 40"
19	8	3		Writes the display data "8" to DCRAM address 10H
20	DCRAM data write (increment mode)			Mistage the display date "4" to DCD AM adds 4411
20	1	3		Writes the display data "1" to DCRAM address 11H
24	DCRAM data write (increment mode)			Writes the display date "1" to DCDAM address 4011
21	1 3 0	Α		Writes the display data "1" to DCRAM address 12H

Continued on next page.

#### Continued from preceding page.

No.	LSB	Inst	ruction (h	nexadecin	nal)	MSB	Dioploy	Operation
NO.	D40 to D43	D44 to D47	D48 to D51	D52 to D55	D56 to D59	D60 to D63	Display	Operation
22			Set AC	address				Loads the DCRAM address 00H and the ADRAM
			0	0	0	2		address 0H into AC
23		D	isplay on	off contro	ol		SANYOLSI	Turns on the LCD for all digits (12 digits) in MDATA
	F	F	F	Х	1	4	3 4 11 0 2 3 1	Turns of the ECD for all digits (12 digits) if MDATA
24			Displa	ay shift			SANYO LSI L	Shifts the display (MDATA only) to the left
					1	С	3 4 11 0 2 3 1 2	Stills the display (MDATA Only) to the left
25			Displa	ay shift			ANYOLSI LC	Shifts the display (MDATA only) to the left
					1	С	ANTO EST ES	Offitto the display (MDATA only) to the left
26			Displa	ay shift			NYOLSI LC7	Shifts the display (MDATA only) to the left
					1	С	14 1 0 2 0 1 2 0 7	Offitto the display (MDATA only) to the left
27			Displa	ay shift			YOLSI LC75	Shifts the display (MDATA only) to the left
					1	С		Offine the display (MEXTITE Only) to the fort
28			Displa	ay shift			O LSI LC758	Shifts the display (MDATA only) to the left
					1	С	0 201 20100	Offine the display (MEXTITY Only) to the lot
29			Displa	ay shift			LSI LC7581	Shifts the display (MDATA only) to the left
					1	С		Cimio dio diopidy (iii2/ii/, oiii), to dio ioit
30			Displa	ay shift			LSI LC75811	Shifts the display (MDATA only) to the left
					1	С		Offine the display (MEXTITY only) to the lot
31		D	isplay on	off control	ol			Set to power saving mode, turns off the LCD for all digits
	0	0	0	Х	8	4		Cot to power daving mode, turns on the Leb for all digital
32		Display on/off control					LSI LC75811	Turns on the LCD for all digits (12 digits) in MDATA
	F	F	F	Х	1	4	201 2070011	Tarrio on the Lob for all digits (12 digits) in WDATA
33			Set AC	address			SANYOLSI	Loads the DCRAM address 00H and the ADRAM
			0	0	0	2	CANTOLOI	address 0H into AC

Note: \*16. This example above assumes the use of 12 digits  $5 \times 7$  dot matrix LCD. CGRAM and ADRAM are not used.

X: don't care

# LC75811-8715 Character Font (Standard)

111					8008880								880888			288288 888888
_	ωζ	:4	(E)	ःध	44	:H	0	:0	Û	¢	शत	10	≪ত	01	•¤	th.
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011	8888888	600000	5288888 888888	8 8688	8 8888	0=00000 8=98988	8 88888	8-8-88								
9		4	+	Ţ.	н	*	Υ P	+	7	4	П	<b></b>	٠,١	К	4	>
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=													8888888			
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0110																
01	,	ď	q	υ	ъ	ø.	44	д	ц	i		×	1	ш	r.	0
10					888888									0000000		
0101	ф	Q	ద	w	E	D	>	W	×	X	23		*	_	<	
0100										888888	888888			868888		
10	0	A	щ	U	Д	ш	Ēι	O	ш	н	ь	×	ı	M	z	0
0011		888888 888888			888 88						8828888 8568888					
8	0	1	7		4	2	9	7	00	6			V	II	^	C-
0010		8888888			888888											
00			:	#	€9	9/0	∞ఠ		J	^	*	+		ı		\
-		8888	88 888 88 888			888888 888888			88888		88888		888 888 888 888	8888888		8888888
0001	ø	8	+1	·ŀ·	н	٠,	0	6	Æ	R	⊌	8	†	ļ	<b>←</b>	→
MSB 0000	CG RAM(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)	(6)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Upper Lower Abits 4bits	0000 LSB	10001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111

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