Data International Co., Ltd.

DATAVISION

APPROVAL   SHEET

Customer :

Part Name :   LCD MODULE

Model No. :   **DV-16236-S1FBLY**

Drawing No. :

Approved By :

Date :

SPECFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE
MODEL NO: DV-16236-S1FBLY

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SPECFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE
MODEL NO: DV-16236-S1FBLY

1. SCOPE

The DV-16236-S1FBLY, dot-matrix LCD unit of a 5 x 7- dot 16-character 2-line dot-matrix LCD panle, LCD driver, controller LSI and yellow green backlight LED fabricated on a single PCB. Incorporating mask ROM-based character generator and display data RAM in the controller LSI, the unit can efficiently display the desired characters under microprocessor control.

2. PRODUCT SPECIFICATIONS

2.1   General

- The LCD of the unit is STN (Super Twisted Nematic) yellow-green Transflective type.
- Low power consumption with the dot-matrix LCD panel and CMOS LSI. Built-in backlight LED with high luminance and stable radiation.
- Thin, lightweight design permits easy installation in a variety of equipment.
- Allowing for being connected at general-purpose CMOS signal level, the unit can be easily interfaced to a microprocessor with common 4-bit and 8-bit parallel inputs and outputs.
- Multiplexing driving : 1/16duty, 1/4bias, 6 o'clock
- Built-in character generator ROM and RAM, and display data RAM:
  Character generator ROM
    225 different 5 x 7 dot-matrix character patterns (Alphanumeric and symbols)
  Character generator RAM
    8 different user programmed 5 x 7 dot-matrix patterns
  Display data RAM
    80 x 8 bits
- Numerous instructions
  Display clear, Cursor home, Display ON/OFF, Cursor ON/OFF, Blink character, Cursor shift, Display shift
- The unit operates from a single 5V power supply

2.2   Mechanical Characteristics

Item	Characteristic
Number of Characters	16×2
Dot dimensions(mm)	0.55×0.65
Dot spacing (mm)	0.05
Character Size (mm)	2.95×5.55
Module dimensions (Horizontal $\times$ Vertical $\times$ Thickness, mm)	$85.0 \times 36.0 \times 14.2$max.
Viewing area (Horizontal $\times$ Vertical, mm)	62.2×17.9
Active area (Horizontal $\times$ Vertical, mm)	56.2×11.49

2.3 Absolute Maximum Ratings (Without LED backling)

Absolute Maximum Ratings*

Item	Symbol	Value	Unit	Notes
Power supply voltage (1)	V_{cc}–GND	–0.3 to +7.0	V	1
Power supply voltage (2)	V_{cc}–V5	–0.3 to +13.0	V	1, 2
Input voltage	Vt	–0.3 to V_{cc} +0.3	V	1
Operating temperature	T_{opr}	–20 to +75	°C	
Storage temperature	T_{stg}	–55 to +125	°C	4

Note: * If the LSI is used above these absolute maximum ratings, it may become permanently damaged. Using the LSI within the following electrical characteristic limits is strongly recommended for normal operation. If these electrical characteristic conditions are also exceeded, the LSI will malfunction and cause poor reliability.

2.4 Electrical Characteristics (Without LED backlight)

DC Characteristics (V_{cc} = 2.7 to 4.5 V, T_a = –20 to +75°C*[3])

Item	Symbol	Min	Typ	Max	Unit	Test Condition	Notes*
Input high voltage (1) (except OSC1)	VIH1	$0.7V_{cc}$	—	V_{cc}	V		6
Input low voltage (1) (except OSC1)	VIL1	–0.3	—	0.55	V		6
Input high voltage (2) (OSC1)	VIH2	$0.7V_{cc}$	—	V_{cc}	V		15
Input low voltage (2) (OSC1)	VIL2	—	—	$0.2V_{cc}$	V		15
Output high voltage (1) (DB0–DB7)	VOH1	$0.75V_{cc}$	—	—	V	$-I_{OH}$ = 0.1 mA	7
Output low voltage (1) (DB0–DB7)	VOL1	—	—	$0.2V_{cc}$	V	I_{OL} = 0.1 mA	7
Output high voltage (2) (except DB0–DB7)	VOH2	$0.8V_{cc}$	—	—	V	$-I_{OH}$ = 0.04 mA	8
Output low voltage (2) (except DB0–DB7)	VOL2	—	—	$0.2V_{cc}$	V	I_{OL} = 0.04 mA	8
Driver on resistance (COM)	R_{COM}	—	2	20	kΩ	±Id = 0.05 mA, VLCD = 4 V	13
Driver on resistance (SEG)	R_{SEG}	—	2	30	kΩ	±Id = 0.05 mA, VLCD = 4 V	13
Input leakage current	I_{LI}	–1	—	1	µA	VIN = 0 to V_{cc}	9
Pull-up MOS current (DB0–DB7, RS, R/$\overline{W}$)	$-I_p$	10	50	120	µA	V_{cc} = 3 V	
Power supply current	I_{cc}	—	0.15	0.30	mA	R_f oscillation, external clock V_{cc} = 3 V, f_{osc} = 270 kHz	10, 14
LCD voltage	VLCD1	3.0	—	11.0	V	V_{cc}–V5, 1/5 bias	16
	VLCD2	3.0	—	11.0	V	V_{cc}–V5, 1/4 bias	16

Note: *   Refer to the Electrical Characteristics Notes section following these tables.

AC Characteristics (V_{CC} = 2.7 to 4.5 V, T_a = −20 to +75°C*[3])

Clock Characteristics

Item		Symbol	Min	Typ	Max	Unit	Test Condition	Note*
External clock operation	External clock frequency	f_{cp}	125	250	350	kHz		11
	External clock duty	Duty	45	50	55	%		
	External clock rise time	t_{rcp}	—	—	0.2	µs		
	External clock fall time	t_{fcp}	—	—	0.2	µs		
R_f oscillation	Clock oscillation frequency	f_{OSC}	190	270	350	kHz	R_f = 75 kΩ, V_{CC} = 3 V	12

Note: *   Refer to the Electrical Characteristics Notes section following these tables.

Bus Timing Characteristics

Write Operation

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Enable cycle time	t_{cycE}	1000	—	—	ns	Figure 27
Enable pulse width (high level)	PW_{EH}	450	—	—		
Enable rise/fall time	t_{Er}, t_{Ef}	—	—	25		
Address set-up time (RS, R/$\overline{W}$ to E)	t_{AS}	60	—	—		
Address hold time	t_{AH}	20	—	—		
Data set-up time	t_{DSW}	195	—	—		
Data hold time	t_H	10	—	—		

Read Operation

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Enable cycle time	t_{cycE}	1000	—	—	ns	Figure 28
Enable pulse width (high level)	PW_{EH}	450	—	—		
Enable rise/fall time	t_{Er}, t_{Ef}	—	—	25		
Address set-up time (RS, R/$\overline{W}$ to E)	t_{AS}	60	—	—		
Address hold time	t_{AH}	20	—	—		
Data delay time	t_{DDR}	—	—	360		
Data hold time	t_{DHR}	5	—	—		

Interface Timing Characteristics with External Driver

Item		Symbol	Min	Typ	Max	Unit	Test Condition
Clock pulse width	High level	t_{CWH}	800	—	—	ns	Figure 29
	Low level	t_{CWL}	800	—	—		
Clock set-up time		t_{CSU}	500	—	—		
Data set-up time		t_{SU}	300	—	—		
Data hold time		t_{DH}	300	—	—		
M delay time		t_{DM}	−1000	—	1000		
Clock rise/fall time		t_{ct}	—	—	200		

Power Supply Conditions Using Internal Reset Circuit

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Power supply rise time	t_{rCC}	0.1	—	10	ms	Figure 30
Power supply off time	t_{OFF}	1	—	—		

Timing Characteristics
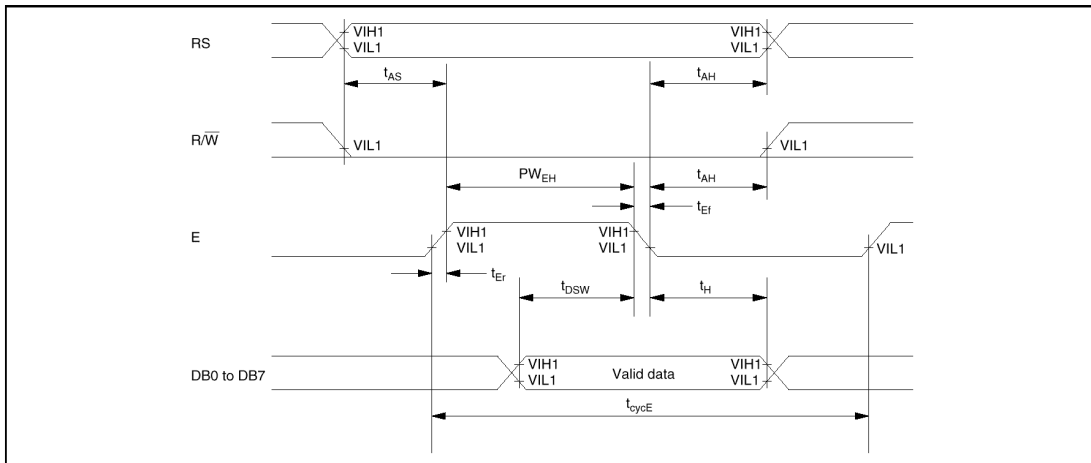
Write Operation
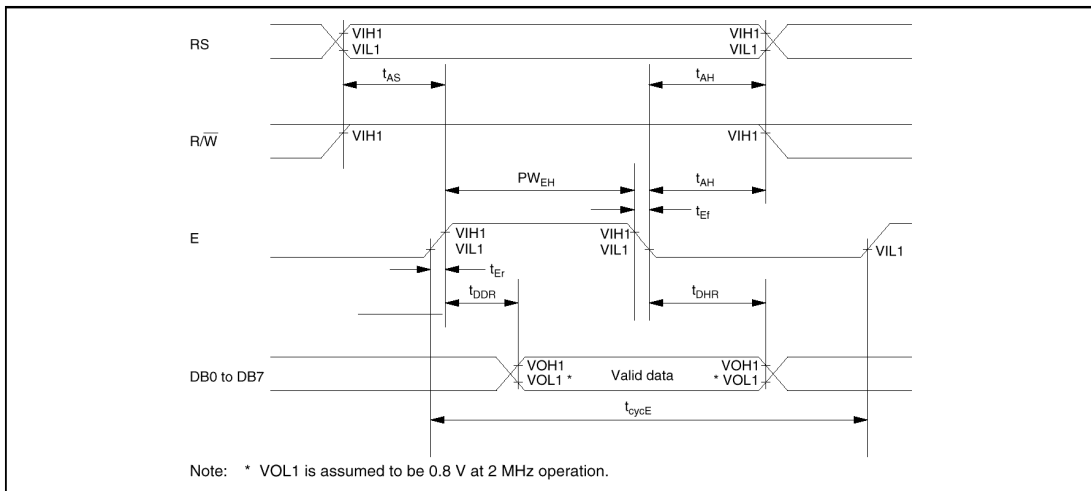
Note: * VOL1 is assumed to be 0.8 V at 2 MHz operation.

Read Operation
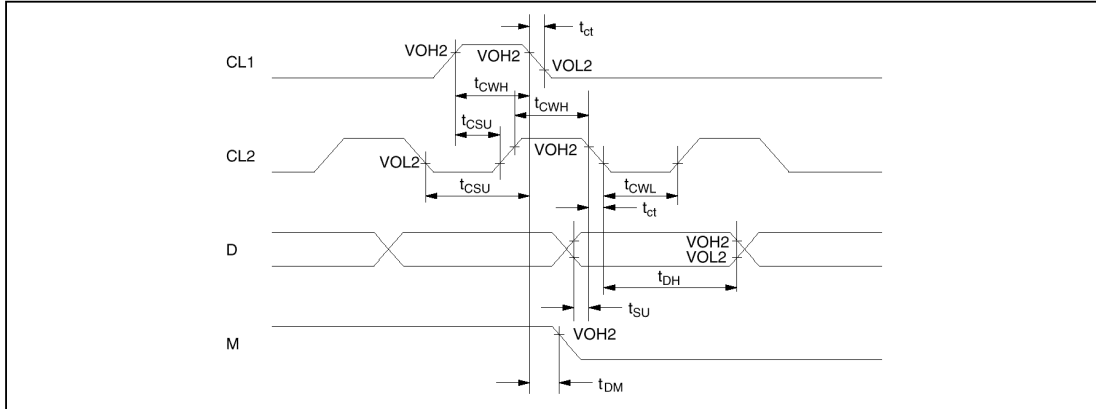
Interface Timing with External Driver

Notes: 1. t_{OFF} compensates for the power oscillation period caused by momentary power supply oscillations.
2. Specified at 4.5 V for 5-V operation, and at 2.7 V for 3-V operation.
3. For if 4.5 V is not reached during 5-V operation, the internal reset circuit will not operate normally.
In this case, the LSI must be initialized by software. (Refer to the Initializing by Instruction section.)

Internal Power Supply Reset

2.5   Optical Characteristics

Absolute maximum ratings

| Item	Symbol	Rating	Unit	Remarks
Storage temperature range	Tst	-20~60	°C	No condensation
Operating temperature range	Top	0~50	°C	No condensation
Maximum AC applied voltage	VAC	10	V	Less than 1 hour
Maximum DC applied voltage	VDC	3.0	V	Less than 1 hour

2.6   Optical Characteristics

1/16 duty, 1/4 bias, Vopr=4.3V

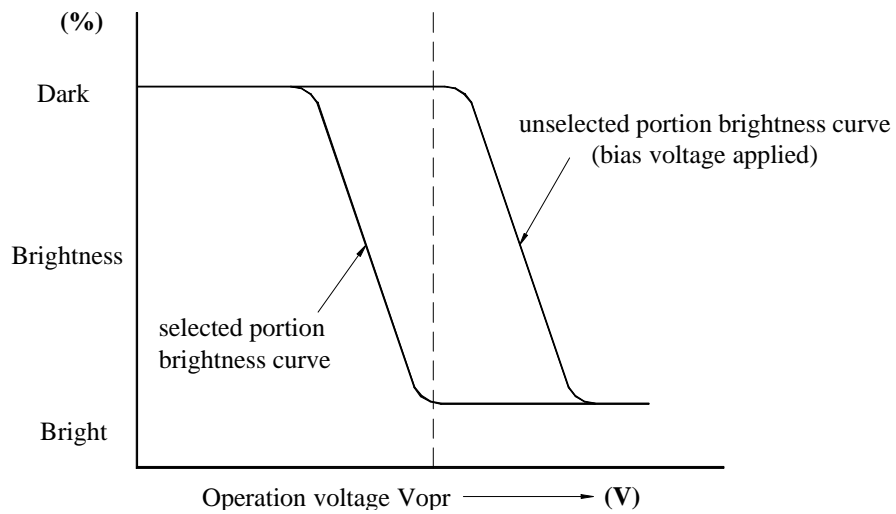| Item	Symbol	Temp.	Min.	Typ.	Max.	Unit
Driving voltage	Vop	0 °C	--	5.10	--	V
		25 °C	--	4.50	--	
		50 °C	--	4.30	--	
Contrast	Cr	25 °C	3	4	--	--
Frame freq.	f	--	--	64	--	Hz
Viewing angle*	θ_1	25 °C	-40	--	40	deg.
	θ_2		-40	--	-40	
Response time	t_{on}	25 °C	--	250	380	ms
	t_{off}		--	200	300	

2.6.1 Definition of optical characteristics
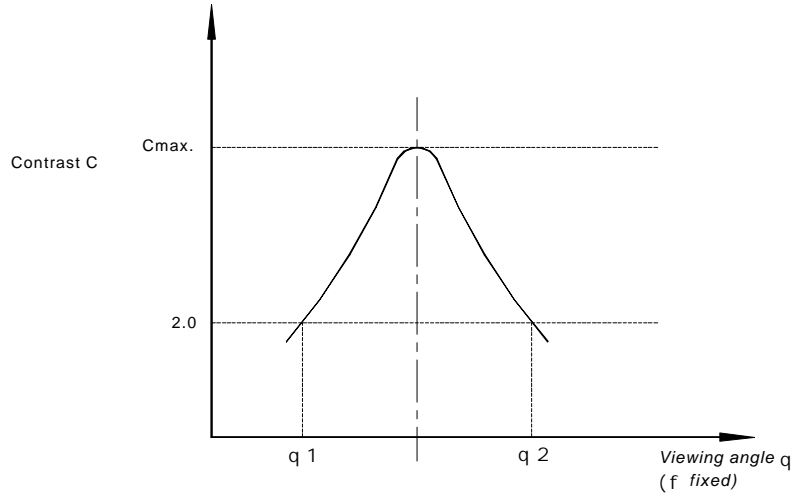
* Definition of angles ϕ and θ
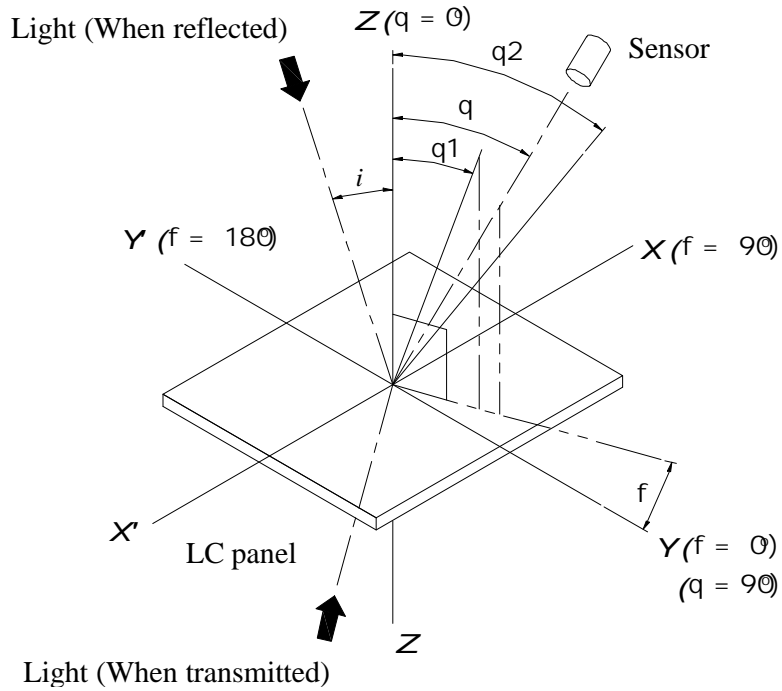
*Definition of contrast C

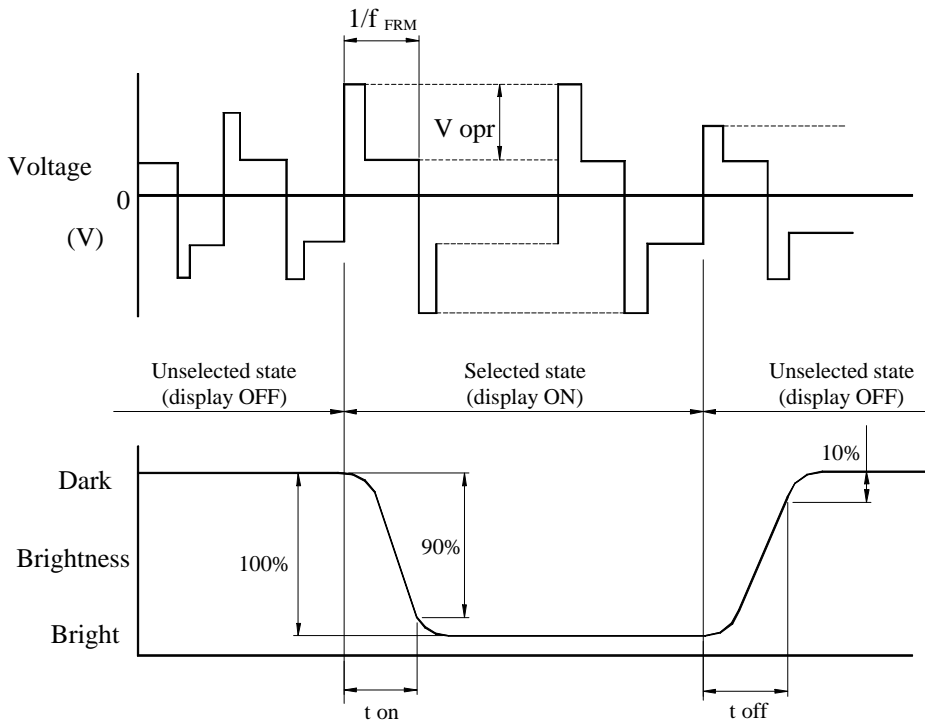$$C = \frac{B1}{B2} = \frac{\text{Brightness of selected portion}}{\text{Brightness of unselected portion}}$$

* Definition of viewing angles $\theta 1$ and $\theta 2$

Contrast C

Cmax.

2.0

q 1   q 2   *Viewing angle* q
(f *fixed)*

Note : Optimum vision with the naked eye and viewing angle θ at Cmax above are not always the same.

* Definition of response time

$1/f_{FRM}$

V_{opr}

Voltage

0

(V)

Unselected state
(display OFF)

Selected state
(display ON)

Unselected state
(display OFF)

Dark

10%

Brightness   90%

100%

Bright

t on   t off

Vopr : Operating voltage (V)   ton : Response time (rsie) (ms)

fFRM : Frame frequency (Hz)   toff : Response time (fall) (ms)

2.7 LED Backlight Characteristics

2.7.1 Absolute maximum ratings

Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_f	If=120mA, Yellow Green	3.9	4.1	4.4	V
*Luminous Intensity	I_V	If=120mA, Yellow Green	250	350	--	LUX
Peak Emission Wavelength	λP	If=20mA, Yellow Green	--	573	--	nm
Spectrum Radiation Bandwidth	$\Delta\lambda$	If=20mA, Yellow Green	--	30	--	nm
Reverse Current	I_R	VR=8V, Yellow Green	--	--	1.2	mA

Note: * Measured at the bare LED backlight unit.

2.7.2 LED Maximum Operating Range

Item	Symbol	Yellow Green	Unit
Power Dissipation	P_{AD}	1.144	W
Forward Current	I_F	260	mA
Reverse Voltage	V_R	8	V

3. RELIABILITY

3.1   Reliability

Test item	Test condition	Evaluation and assessment
Operation at high temperature and humidity	$40\,^{\circ}C\pm2\,^{\circ}C$ 90%RH for 500hours	No abnormalities in functions* and appearance**
Operation at high temperature	$60\,^{\circ}C\pm2\,^{\circ}C$ for 500 hours	No abnormalities in functions* and appearance**
Heat shock	$-20\pm \sim +60\,^{\circ}C$ Left for 1 hour at each temperature, transition time 5 min, repeated 10times	No abnormalities in functions* and appearance**
Low temperature	$-20\pm2\,^{\circ}C$ for 500 hours	No abnormalities in functions* and appearance**
Vibration	Sweep for 1 min at 10 Hz, 55Hz, 10Hz, amplitude 1.5mm 2 hrs each in the X,Y and Z directions	No abnormalities in functions* and appearance**
Drop shock	Dropped onto a board from a height of 10cm	No abnormalities in functions* and appearance**

   *   dissipation current, contrast and display functions

   ** Polarizing filter deterioration, other appearance defects

3.2   Liquid crystal panel service life

   100,000 hours minimum at $25\,^{\circ}C\pm10\,^{\circ}C$

3.3   definition of panel service life
   - Contrast becomes 30% of initial value
   - Current consumption becomes three times higher than initial value
   - Remarkable alignment deterioration occurs in LCK cell layer
   - Unusual operation occurs in display functions

4. OPERATING INSTRUCTIONS

4.1   Input signal Function

NO.	Symbol	Function
1	VSS	0V Power Supply (GND Level)
2	VDD	Power supply for Logic circuit
3	V5	Power Supply for Driving the LCD
4	RS	Data / Instruction select
5	R/W	Read / Write select
6	E	Enable signal
7-14	DB0-DB7	Data Bus line

4.2 Instruction Table

Instructions

Instruction	RS	R/$\overline{\text{W}}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Execution Time (max) (when f_{cp} or f_{osc} is 270 kHz)
Clear display	0	0	0	0	0	0	0	0	0	1	Clears entire display and sets DDRAM address 0 in address counter.	
Return home	0	0	0	0	0	0	0	0	1	—	Sets DDRAM address 0 in address counter. Also returns display from being shifted to original position. DDRAM contents remain unchanged.	1.52 ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 μs
Display on/off control	0	0	0	0	0	0	1	D	C	B	Sets entire display (D) on/off, cursor on/off (C), and blinking of cursor position character (B).	37 μs
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	—	—	Moves cursor and shifts display without changing DDRAM contents.	37 μs
Function set	0	0	0	0	1	DL	N	F	—	—	Sets interface data length (DL), number of display lines (N), and character font (F).	37 μs
Set CGRAM address	0	0	0	1	ACG	ACG	ACG	ACG	ACG	ACG	Sets CGRAM address. CGRAM data is sent and received after this setting.	37 μs
Set DDRAM address	0	0	1	ADD	ADD	ADD	ADD	ADD	ADD	ADD	Sets DDRAM address. DDRAM data is sent and received after this setting.	37 μs
Read busy flag & address	0	1	BF	AC	AC	AC	AC	AC	AC	AC	Reads busy flag (BF) indicating internal operation is being performed and reads address counter contents.	0 μs

Instruction	RS	R/$\overline{\text{W}}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Execution Time (max) (when f_{cp} or f_{osc} is 270 kHz)
Write data to CG or DDRAM	1	0	Write data								Writes data into DDRAM or CGRAM.	37 μs $t_{ADD} = 4$ μs*
Read data from CG or DDRAM	1	1	Read data								Reads data from DDRAM or CGRAM.	37 μs $t_{ADD} = 4$ μs*

I/D	= 1:	Increment	DDRAM:	Display data RAM
I/D	= 0:	Decrement	CGRAM:	Character generator RAM
S	= 1:	Accompanies display shift		
S/C	= 1:	Display shift	ACG:	CGRAM address
S/C	= 0:	Cursor move	ADD:	DDRAM address (corresponds to cursor address)
R/L	= 1:	Shift to the right		
R/L	= 0:	Shift to the left		
DL	= 1:	8 bits, DL = 0: 4 bits		
N	= 1:	2 lines, N = 0: 1 line	AC:	Address counter used for both DD and CGRAM addresses
F	= 1:	5 × 10 dots, F = 0: 5 × 8 dots		
BF	= 1:	Internally operating		
BF	= 0:	Instructions acceptable		

Execution time changes when frequency changes
Example:
When f_{cp} or f_{osc} is 250 kHz, $37\ \mu s \times \frac{270}{250} = 40\ \mu s$

Note: — indicates no effect.

 * After execution of the CGRAM/DDRAM data write or read instruction, the RAM address counter is incremented or decremented by 1. The RAM address counter is updated after the busy flag turns off. In Figure 10, t_{ADD} is the time elapsed after the busy flag turns off until the address counter is updated.

4.3 Instruction Description

Clear Display

Clear display writes space code 20H (character pattern for character code 20H must be a blank pattern) into all DDRAM addresses. It then sets DDRAM address 0 into the address counter, and returns the display to its original status if it was shifted. In other words, the display disappears and the cursor or blinking goes to the left edge of the display (in the first line if 2 lines are displayed). It also sets I/D to 1 (increment mode) in entry mode. S of entry mode does not change.

Return Home

Return home sets DDRAM address 0 into the address counter, and returns the display to its original status if it was shifted. The DDRAM contents do not change.

The cursor or blinking go to the left edge of the display (in the first line if 2 lines are displayed).

Entry Mode Set

I/D: Increments (I/D = 1) or decrements (I/D = 0) the DDRAM address by 1 when a character code is written into or read from DDRAM.

The cursor or blinking moves to the right when incremented by 1 and to the left when decremented by 1. The same applies to writing and reading of CGRAM.

S: Shifts the entire display either to the right (I/D = 0) or to the left (I/D = 1) when S is 1. The display does not shift if S is 0.

If S is 1, it will seem as if the cursor does not move but the display does. The display does not shift when reading from DDRAM. Also, writing into or reading out from CGRAM does not shift the display.

Display On/Off Control

D: The display is on when D is 1 and off when D is 0. When off, the display data remains in DDRAM, but can be displayed instantly by setting D to 1.

C: The cursor is displayed when C is 1 and not displayed when C is 0. Even if the cursor disappears, the function of I/D or other specifications will not change during display data write. The cursor is displayed using 5 dots in the 8th line for 5×8 dot character font selection and in the 11th line for the 5×10 dot character font selection (Figure 13).

B: The character indicated by the cursor blinks when B is 1 (Figure 13). The blinking is displayed as switching between all blank dots and displayed characters at a speed of 409.6-ms intervals when f_{cp} or f_{osc} is 250 kHz. The cursor and blinking can be set to display simultaneously. (The blinking frequency changes according to f_{osc} or the reciprocal of f_{cp}. For example, when f_{cp} is 270 kHz, $409.6 \times 250/270 = 379.2$ ms.)

Cursor or Display Shift

Cursor or display shift shifts the cursor position or display to the right or left without writing or reading display data (Table 7). This function is used to correct or search the display. In a 2-line display, the cursor moves to the second line when it passes the 40th digit of the first line. Note that the first and second line displays will shift at the same time.

When the displayed data is shifted repeatedly each line moves only horizontally. The second line display does not shift into the first line position.

The address counter (AC) contents will not change if the only action performed is a display shift.

Function Set

DL: Sets the interface data length. Data is sent or received in 8-bit lengths (DB7 to DB0) when DL is 1, and in 4-bit lengths (DB7 to DB4) when DL is 0.When 4-bit length is selected, data must be sent or received twice.

N: Sets the number of display lines.

F: Sets the character font.

Note: Perform the function at the head of the program before executing any instructions (except for the read busy flag and address instruction). From this point, the function set instruction cannot be executed unless the interface data length is changed.

Set CGRAM Address

Set CGRAM address sets the CGRAM address binary AAAAAA into the address counter.

Data is then written to or read from the MPU for CGRAM.

		RS	R/$\overline{W}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Clear display	Code	0	0	0	0	0	0	0	0	0	1	
Return home	Code	0	0	0	0	0	0	0	0	0	1	Note: * Don't care.
Entry mode set	Code	0	0	0	0	0	0	0	0	0	1	
Display on/off control	Code	0	0	0	0	0	0	0	0	0	1	

Figure 11

		RS	R/$\overline{W}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Cursor or display shift	Code	0	0	0	0	0	1	S/C	R/L	*	*	Note: * Don't care.
Function set	Code	0	0	0	0	0	DL	N	F	*	*	
Set CGRAM address	Code	0	0	0	0	A	A	A	A	A	A	

Higher order bit   Lower order bit

Figure 12

Set DDRAM Address

Set DDRAM address sets the DDRAM address binary AAAAAAA into the address counter.

Data is then written to or read from the MPU for DDRAM.

However, when N is 0 (1-line display), AAAAAAA can be 00H to 4FH. When N is 1 (2-line display), AAAAAAA can be 00H to 27H for the first line, and 40H to 67H for the second line.

Read Busy Flag and Address

Read busy flag and address reads the busy flag (BF) indicating that the system is now internally operating on a previously received instruction. If BF is 1, the internal operation is in progress. The next instruction will not be accepted until BF is reset to 0. Check the BF status before the next write operation. At the same time, the value of the address counter in binary AAAAAAA is read out. This address counter is used by both CG and DDRAM addresses, and its value is determined by the previous instruction. The address contents are the same as for instructions set CGRAM address and set DDRAM address.

Table 7   Shift Function

S/C	R/L	
0	0	Shifts the cursor position to the left. (AC is decremented by one.)
0	1	Shifts the cursor position to the right. (AC is incremented by one.)
1	0	Shifts the entire display to the left. The cursor follows the display shift.
1	1	Shifts the entire display to the right. The cursor follows the display shift.

Table 8   Function Set

N	F	No. of Display Lines	Character Font	Duty Factor	Remarks
0	0	1	5×8 dots	1/8	
0	1	1	5×10 dots	1/11	
1	*	2	5×8 dots	1/16	Cannot display two lines for 5×10 dot character font

Note: *   Indicates don't care.
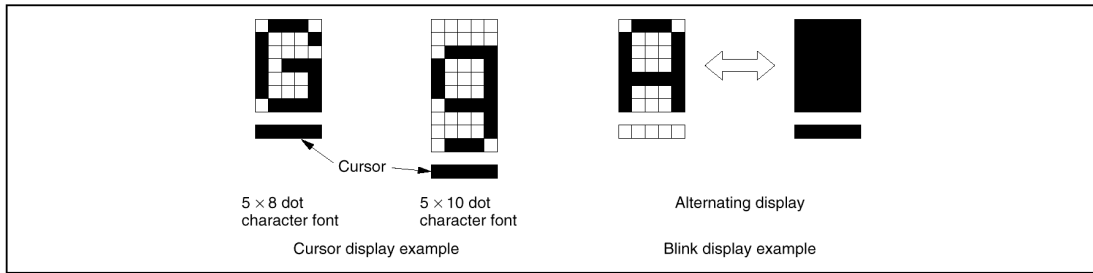
Figure 13   Cursor and Blinking
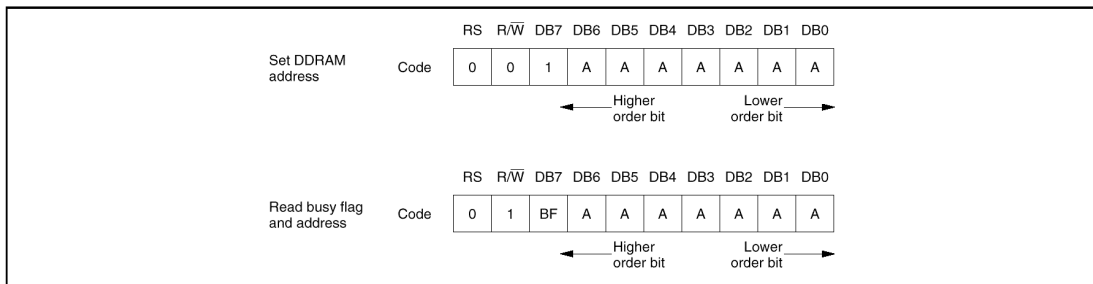
Figure 14

Write Data to CG or DDRAM

Write data to CG or DDRAM writes 8-bit binary data DDDDDDDD to CG or DDRAM.

To write into CG or DDRAM is determined by the previous specification of the CGRAM or DDRAM address setting. After a write, the address is automatically incremented or decremented by 1 according to the entry mode. The entry mode also determines the display shift.
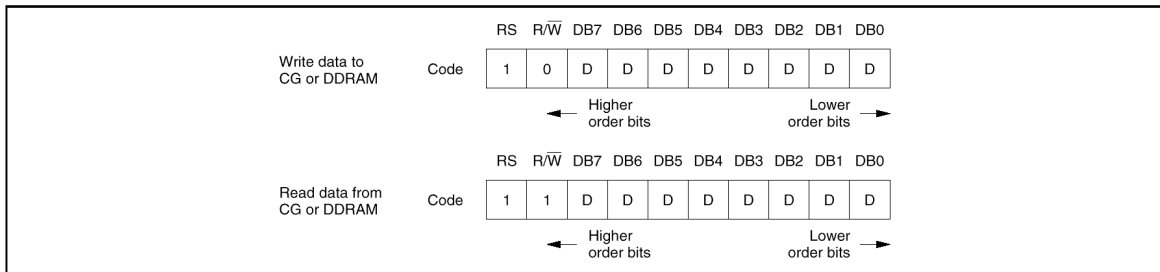
Read Data from CG or DDRAM

Read data from CG or DDRAM reads 8-bit binary data DDDDDDDD from CG or DDRAM.

The previous designation determines whether CG or DDRAM is to be read. Before entering this read instruction, either CGRAM or DDRAM address set instruction must be executed. If not executed, the first read data will be invalid. When serially executing read instructions, the next address data is normally read from the second read. The address set instructions need not be executed just before this read instruction when shifting the cursor by the cursor shift instruction (when reading out DDRAM). The operation of the cursor shift instruction is the same as the set DDRAM address instruction.

After a read, the entry mode automatically increases or decreases the address by 1. However, display shift is not executed regardless of the entry mode.

Note: The address counter (AC) is automatically incremented or decremented by 1 after the write instructions to CGRAM or DDRAM are executed. The RAM data selected by the AC cannot be read out at this time even if read instructions are executed. Therefore, to correctly read data, execute either the address set instruction or cursor shift instruction (only with DDRAM), then just before reading the desired data, execute the read instruction from the second time the read instruction is sent.

		RS	R/W̄	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Write data to CG or DDRAM	Code	1	0	D	D	D	D	D	D	D	D

← Higher order bits   Lower order bits →

		RS	R/W̄	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Read data from CG or DDRAM	Code	1	1	D	D	D	D	D	D	D	D

← Higher order bits   Lower order bits →

Figure 15

4.4 Correspondence between Character Codes and Character Patterns (ROM Code:A00)

Note: The user can specify any pattern for character-generator RAM.

5. NOTES

Safety

- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth.　If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling

- Avoid static electricity as this can damage the CMOS LSI.
- The LCD panel is plate glass; do not hit or crush it.
- Do not remove the panel or frame from the module.
- The polarizing plate of the display is very fragile; handle it very carefully

Mounting and Design

- Mount the module by using the specified mounting part and holes.
- To protect the module from external pressure, leave a small gap by placing transparent plates (e.g. acrylic or glass) on the display surface, frame, and polarizing plate
- Design the system so that no input signal is given unless the power-supply voltage is applied.
- Keep the module dry.　Avoid condensation, otherwise the transparent electrodes may break.

Storage

- Store the module in a dark place where the temperature is $25\,^{\circ}\text{C}\pm10\,^{\circ}\text{C}$ and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crush, shake, or jolt the module (including accessories).

Cleaning

- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with soft cloth soaked with a petroleum benzine.
- Do not use ketonic solvents (ketone and acetoe) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

6. OPERATION PRECAUTIONS

Any changes that need to be made in this specification or any problems arising from it will be dealt with quickly by discussion between both companies.

7. LCM Dimensions