CAT# LCD-111
WINTEK CORPORATION
SPECIFICATIONS FOR LCD MODULE
MODEL : WD-C2401P-1GNN

Contents

1.Precautions in Use of LCM

1.1 Handling of LCM
- Don't give external shock.
- Don't apply excessive force on the surface.
- Liquid in LCD is hazardous substance. Must not tick and swallow. when the liquid is attach to your hand, skin, cloth etc. Wash it out thoroughly and immediately.
- Don't operate it above the absolute maximum rating.
- Don't disassemble the LCM.

1.2 Storage
- Store in an ambient temperature of 5 to 45 °C, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.
- Storage in a clean environment, free from dust, active gas, and solvent.
- Store in anti-static electricity container.
- Store without any physical load.

1.3 Soldering
- Use the high quality solder. (60-63% tin mixed with lead)
- Iron: no higher than 260°C and less than 3-4 sec during soldering.
- Soldering: only to the I/O terminals.
- Rewiring: no more than 3 times.

2. Introduction

Liquid Crystal Displays (LCDs) have widely used in many applications such as industrial measurements, office mechanisms, and household electronic equipment, etc. LCM (LCD Module) integrates with LCD and driving circuit that is easily to be interfaced by user. This LCM contains a standard built-in dot-matrix font set.

2.1 Applications of LCM
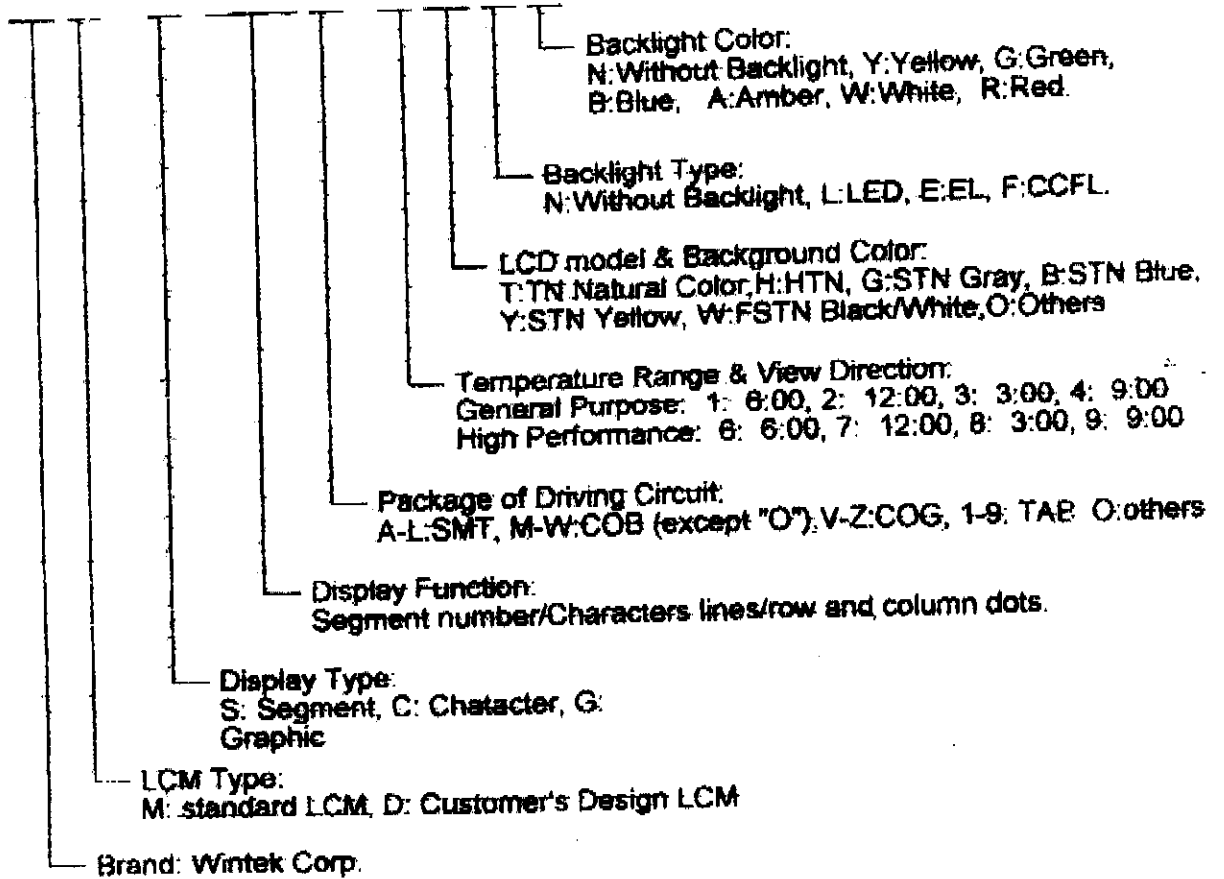- Telephone.
- Fasimile Mechanism.
- Electronic Typewriter.
- Word Processor.
- Electronic Memo Pads.
- Remote Controller.
- Other Electronic Equipment.

2.2 Features of LCM
- Compact, Thin, and Light.
- Wide View Angle.
- Low Power Consumption.
- High Contrast Image.
- Wide Operating Temperature.
- Various Backlight Available.
- High Reliability.
- Easy interface control.

3. Module Classification Information
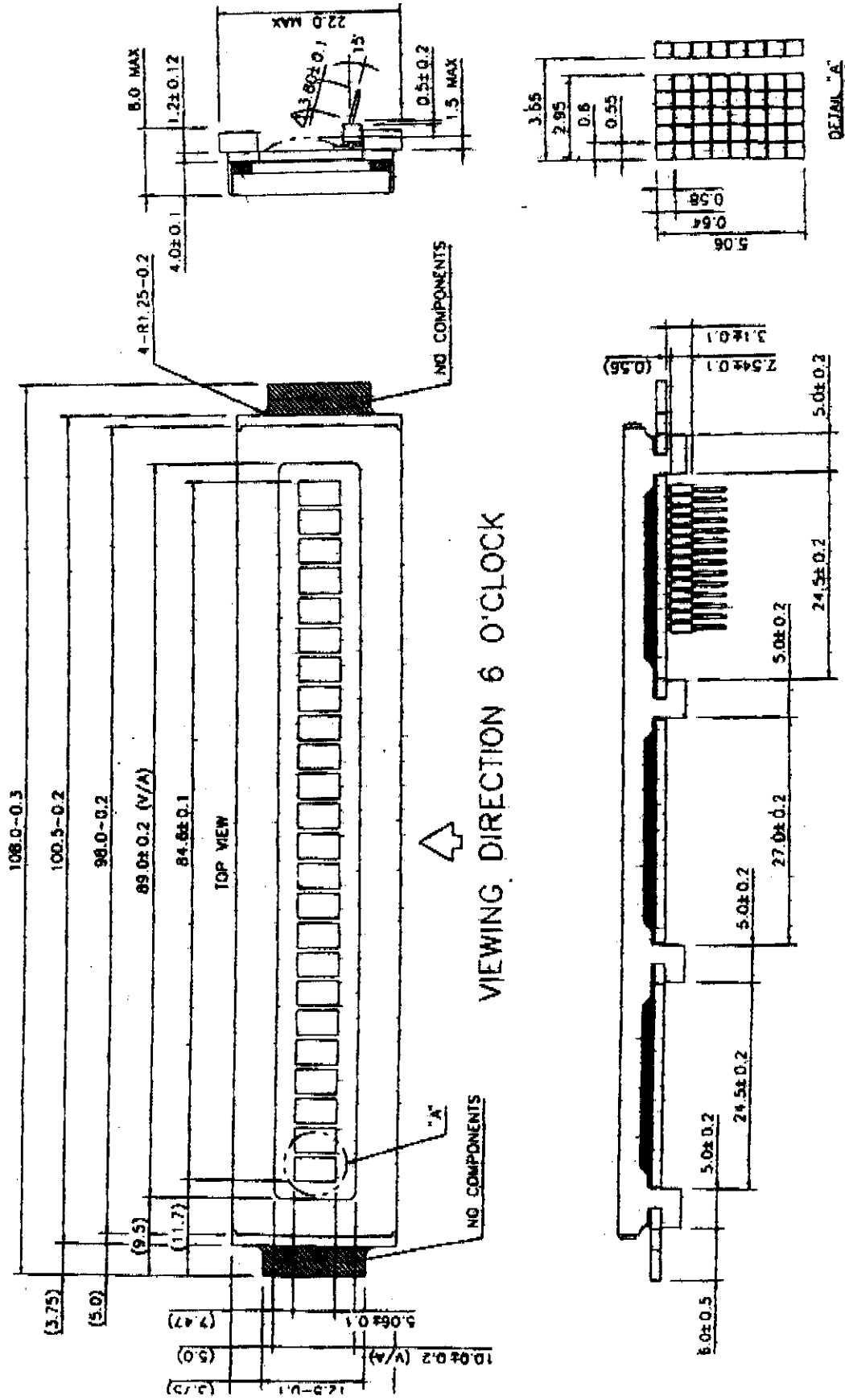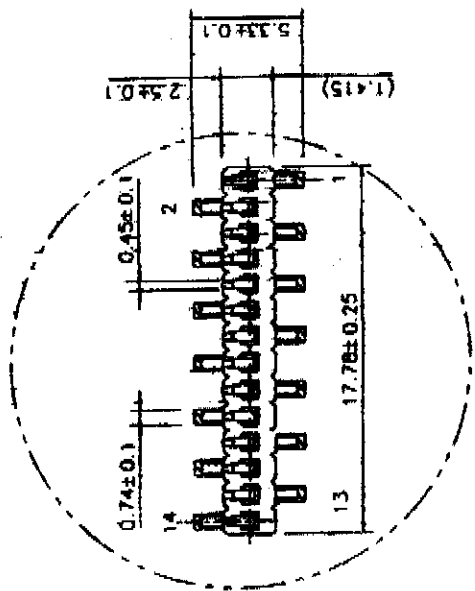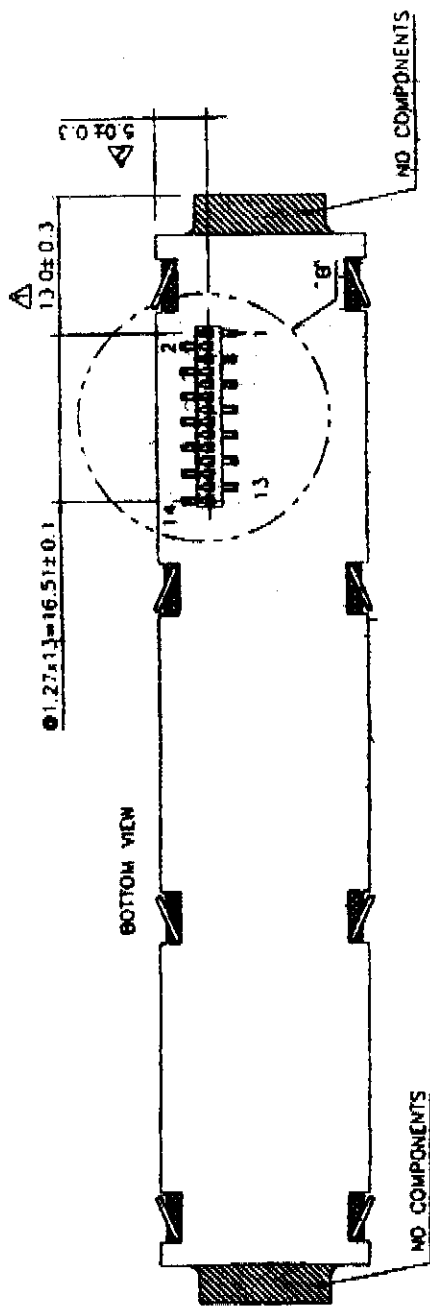
W D - C 2401 P - 1 G N N

— Backlight Color:
N:Without Backlight, Y:Yellow, G:Green,
B:Blue, A:Amber, W:White, R:Red.

— Backlight Type:
N:Without Backlight, L:LED, E:EL, F:CCFL.

— LCD model & Background Color:
T:TN Natural Color,H:HTN, G:STN Gray, B:STN Blue,
Y:STN Yellow, W:FSTN Black/White,O:Others

— Temperature Range & View Direction:
General Purpose: 1: 6:00, 2: 12:00, 3: 3:00, 4: 9:00
High Performance: 6: 6:00, 7: 12:00, 8: 3:00, 9: 9:00

— Package of Driving Circuit:
A-L:SMT, M-W:COB (except "O"),V-Z:COG, 1-9: TAB O:others

— Display Function:
Segment number/Characters lines/row and column dots.

— Display Type:
S: Segment, C: Character, G:
Graphic

— LCM Type:
M: standard LCM, D: Customer's Design LCM

— Brand: Wintek Corp.

4. Mechanical Specification & Diagram

4.1 Mechanical Specification

ITEM	STANDARD VALUE	UNIT
NUMBER OF CHARACTERS	24 CHARACTERS × 1 LINES	-
CHARACTER FORMAT	5 ×7 DOTS with CURSOR	-
MODULE DIMENSION	108.0(W) ×20.0(H) × 8.0(T)	mm
EFFECTIVE DISPLAY AREA	89.0(W) × 10.0(H)	mm
CHARACTER SIZE	2.95(W) × 5.06(H)	mm
CHARACTER PITCH	3.55(W) × 5.06(H)	mm.
DOT SIZE	0.55(W) × 0.58(H)	mm'
DOT PITCH	0.60(W) × 0.64(H)	mm
APPROX. WEIGHT	40	g
CONTROLLER IC	HD66717	
LCD TYPE	STN (GRAY MODE)	
DUTY	1/18	
VIEWING DIRECTION	6 O'clock	
BACK LIGHT	———	

4.2 Mechanical Diagram

VIEWING DIRECTION 6 O'CLOCK

BOTTOM VIEW

5.0±0.3

13.0±0.3

'B'

NO COMPONENTS

NO COMPONENTS

13×1.27×(1)=16.51±0.1

DETAIL 'B'
SCALE: 2X

5.33±0.1

2.54±0.1

(1.15)

17.76±0.25

0.45±0.1

0.74±0.1

5. Absolute Maximum Ratings

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
OPERATING TEMPERATURE	T_{op}	-10	-	+50	°C
STORAGE TEMPERATURE	T_{ST}	-20	-	+60	°C
INPUT VOLTAGE	V_1	-0.3	-	$V_{DD}+0.3$	V
SUPPLY VOLTAGE FOR LOGIC	$V_{DD}-V_{SS}$	-0.3	-	7.0	V
SUPPLY VOLTAGE FOR LCD	$V_{DD}-V_0$	-0.3	-	15.0	V
STATIC ELECTRICITY	Be sure that you are grounded when handling LCM .				

6. Electrical Characteristics

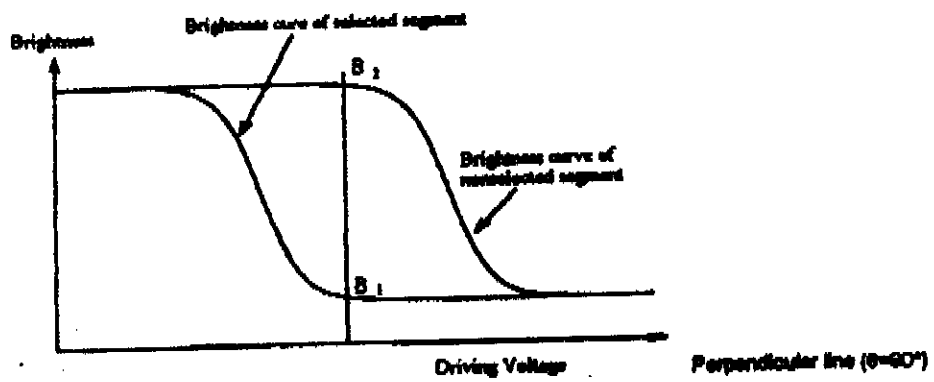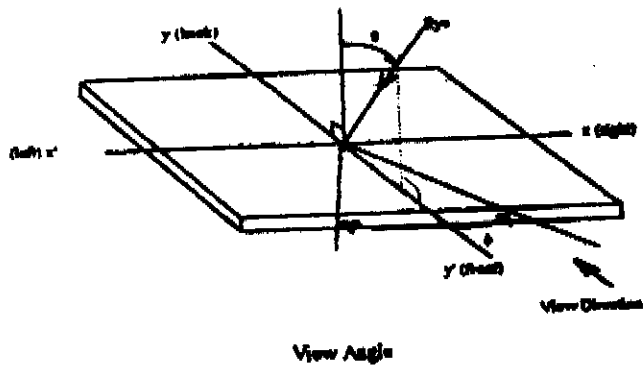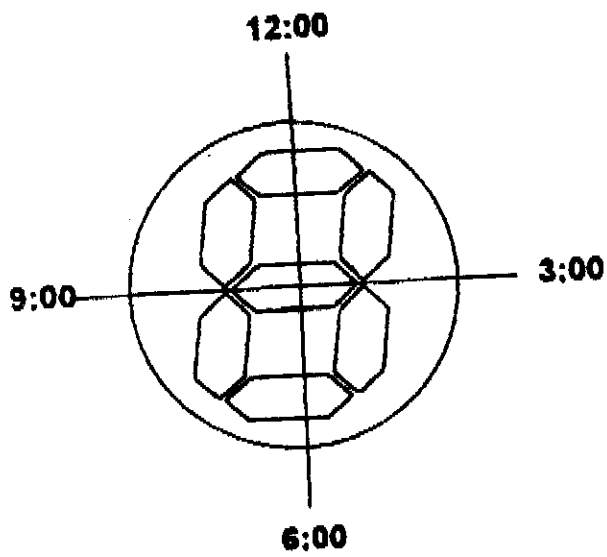| ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	$V_{DD}-V_{SS}$	-	4.75	5.0	5.25	V
SUPPLY VOLTAGE FOR LCD	$V_{DD}-V_0$	Ta=0 °C	-	4.8	-	V
		Ta=25 °C	-	4.5	-	
		Ta=50 °C	-	4.2	-	
INPUT HIGH VOL.	V_{IH}	-	$0.7V_{DD}$	-	V_{DD}	V
INPUT LOW VOL.	V_{IL}	-	-0.3	-	$0.15V_{DD}$	V
OUTPUT HIGH VOL.	V_{OH}	-	$0.75V_{DD}$	-	-	V
OUTPUT LOW VOL.	V_{OL}	-	-	-	$0.2V_{DD}$	V
SUPPLY CURRENT	I_{DD}	$V_{DD}=5.0$ V	-	2.0	4.0	mA

7. Optical Characteristics

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
VIEW ANGLE (V)	θ	CR $\geq$ 2	10	-	40	deg.
VIEW ANGLE (H)	ϕ	CR $\geq$ 2	-30	-	30	deg.
CONTRAST RATIO	CR	——	-	5	-	-
RESPONSE TIME	T_{ON}	——	-	200	300	mS
RESPONSE TIME	T_{OFF}	——	-	200	300	mS

8. Optical Definitions

Nonselected Condition

Selected Condition

Nonselected Condition

Brightness

100%

10%

90%

tr
Rise Time

td
Decay Time (fall time tf)

Response Time

12:00

9:00

3:00

6:00

View Angle

Brightness

Brightness curve of selected segment

B₂

Brightness curve of unselected segment

B₁

Driving Voltage

Perpendicular line (θ=90°)
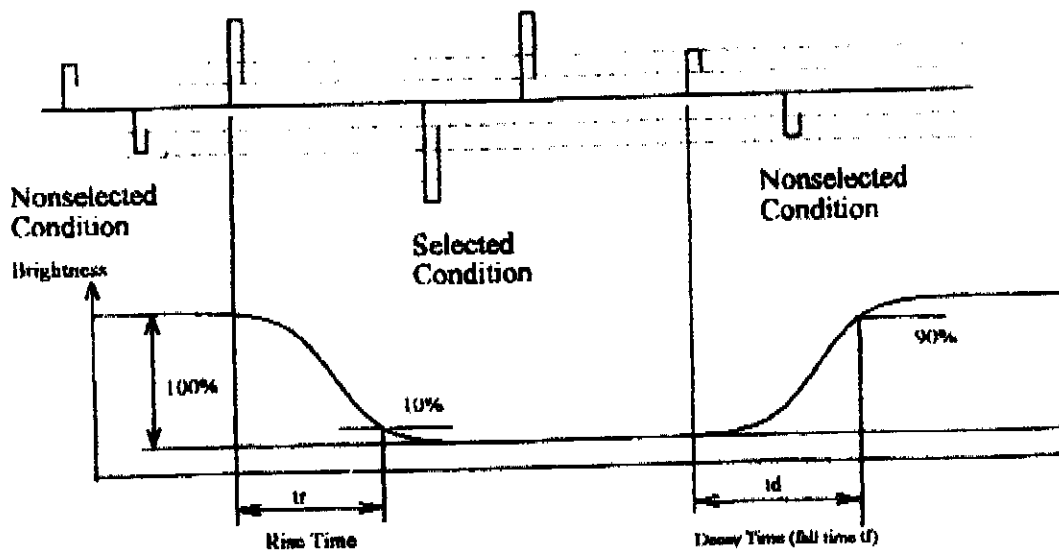
$$\text{Contrast ratio} = \frac{\text{Brightness at unselected segment (B2)}}{\text{Brightness at selected segment (B1)}}$$

Contrast ration (C R)

9. Interface Pin Function

NO	SYMBOL	LEVEL	FUNCTION
1	V_{ss}	-	GND (0 V)
2	V_{rp}	-	VCC (+5 V ± 5%)
3	RESET	-	CONTROLLER RESET
4	RS	H/L	REGISTER SELECT SIGNAL
5	R/$\overline{W}$	H/L	READ/WRITE SELECTION
6	E	H,H→L	ENABLE SIGNAL
7	DB 0	H/L	DATA BIT 0
8	DB 1	H/L	DATA BIT 1
9	DB 2	H/L	DATA BIT 2
10	DB 3	H/L	DATA BIT 3
11	DB 4	H/L	DATA BIT 4
12	DB 5	H/L	DATA BIT 5
13	DB 6	H/L	DATA BIT 6
14	DB 7	H/L	DATA BIT 7

10. Display Address

Relations between DD RAM addresses and positions on the LCD are shown below. The DD RAM address (ADD) is set in the address counter (AC) and is represented in hexadecimal.

24x1 line display

| 1	2	3	4	5		10	11	12	13	14	15	16		20	21	22	23	24	Display Position
00	01	02	03	04		09	0A	0B	10	11	12	13		17	18	19	1A	1B	DD RAM Address

11.Description in Block Diagram

a. **Data Resistor (DR)**: DR is a register used for temporary storage of the date read/write from/into DD RAM and CG RAM.

b. **Instruction Register (IR)**: IR is a register available for storing the instruction codes and address information of display data (DD) RAM and character generator (CG) RAM.

c. **BUSY FLAG (BF)**: When the BUSY FLAG is "1", it shows that LCM is in internal operation and it can not accept the next instruction.

d. **Character Generator (CG) ROM**: This ROM generates character   pattern from 8-bit character   code and provides 192 character patterns.

e. **Character Generator (CG) RAM**: This RAM allows the user to rewrite the character patterns freely according to the program.

f. **Address Counter (AC)**: This address counter is used to give the address information of DD RAM and CG RAM.

g. **Display Data (DD) RAM**: This display data RAM is used to store the display data expressed by 8-bit character code. The capacity is 80×8 bits and data for 80 characters can be storage.

h. **Cursor and Blink Control Circuit**: This circuit generates the cursor and blink.
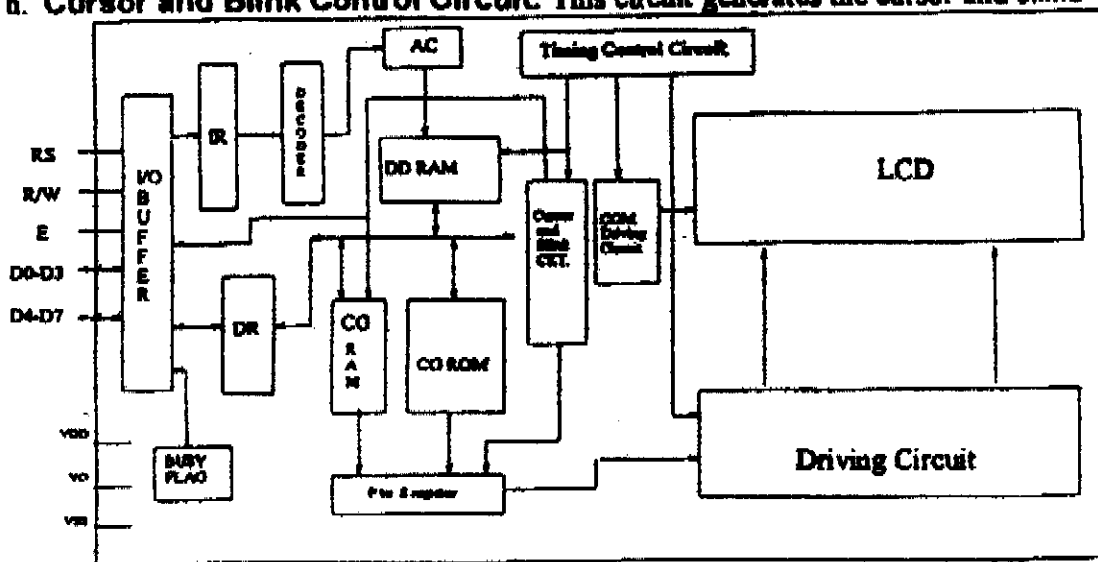
Block Diagram

12. Power Supply for LCD Module

12.1 LCD Driving Source (1/5 Bias)
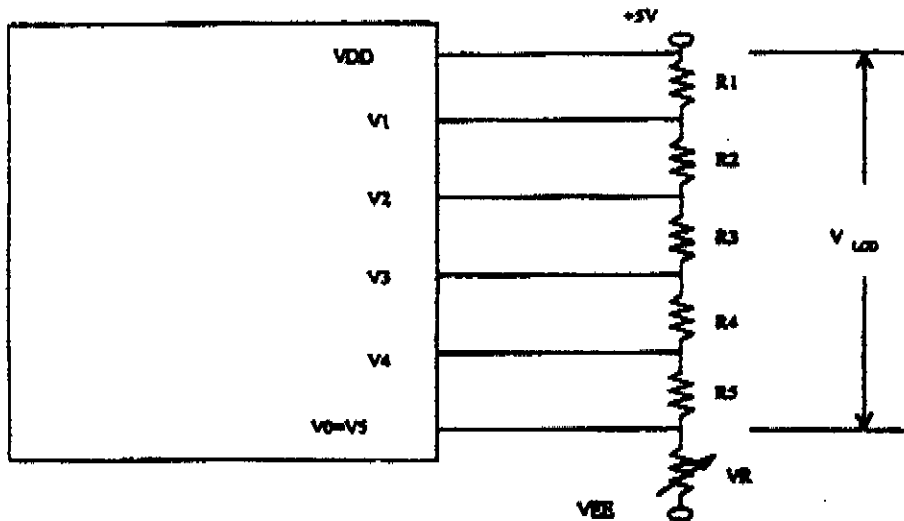
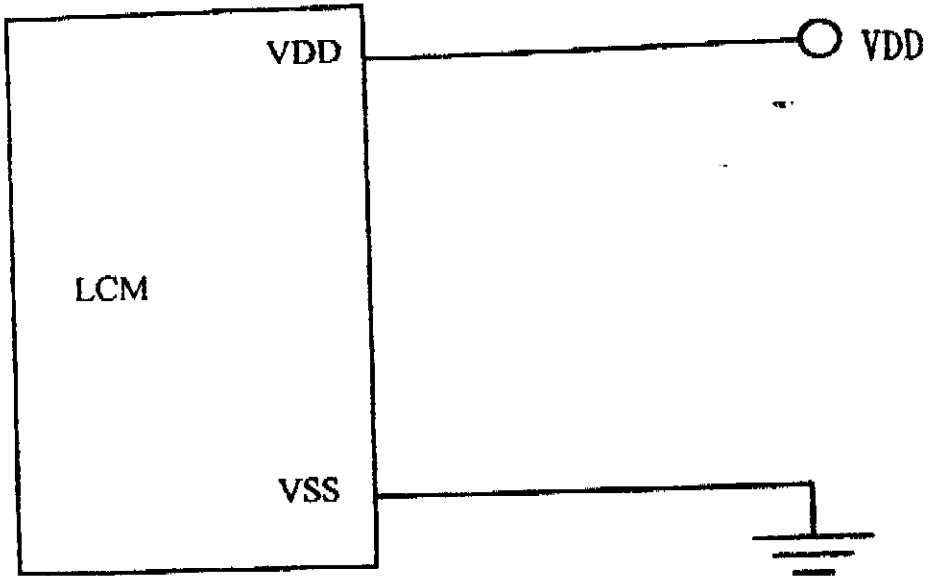$$V_1 = V_{DD} - \frac{1}{5}V_{LCD}$$

$$V_2 = V_{DD} - \frac{2}{5}V_{LCD}$$

$$V_3 = V_{DD} - \frac{3}{5}V_{LCD}$$
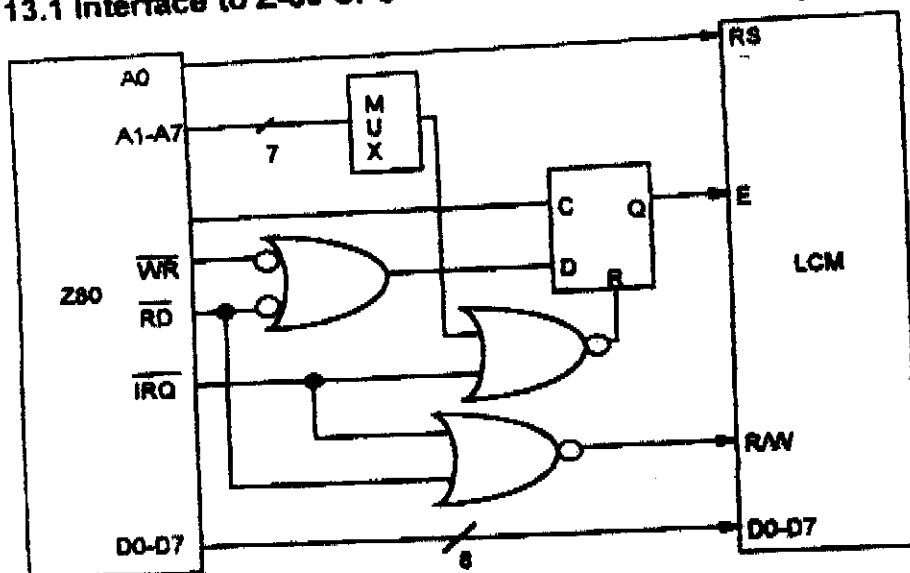
$$V_4 = V_{DD} - \frac{4}{5}V_{LCD}$$

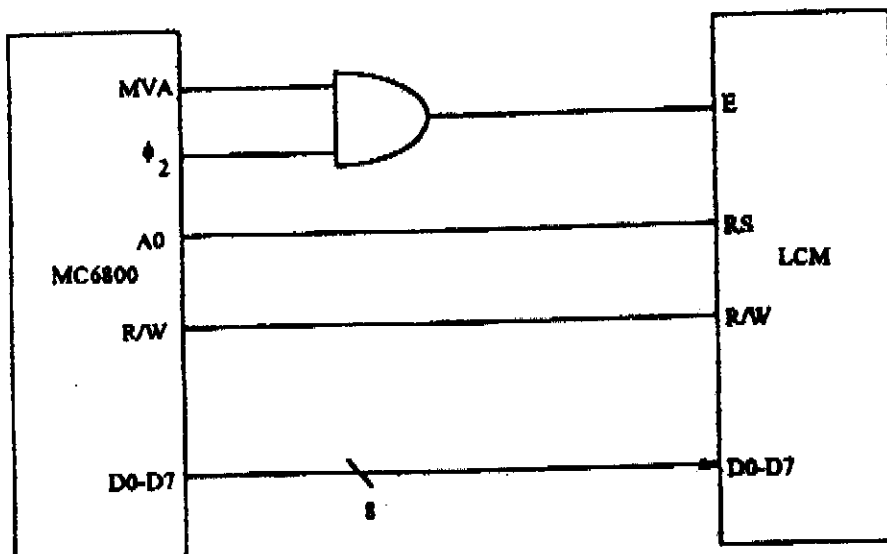$$V_5 = V_{DD} - V_{LCD}$$

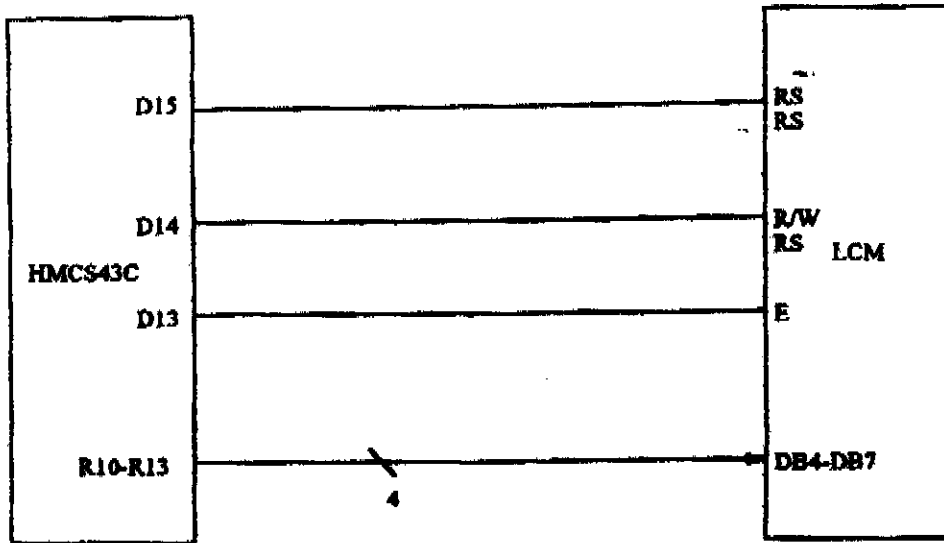## 12.2 Signal Supply Voltage Types

13. Interface to MPU

13.1 Interface to Z-80 CPU

13.2 Interface to MC6800 CPU

13.3 Interface to 4-bit CPU (HMCS43C)

## 13.4 Interface to HD6805 MP
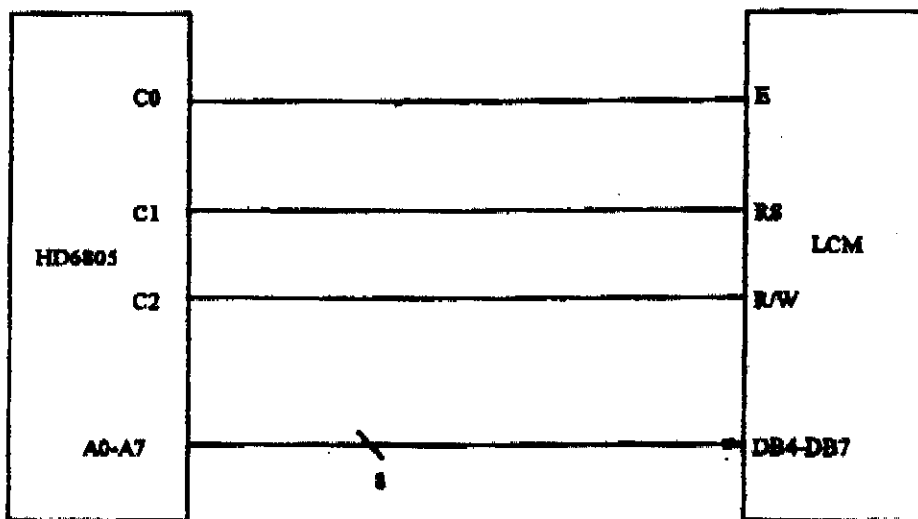
14. Timing Control

14.1 Write Operation
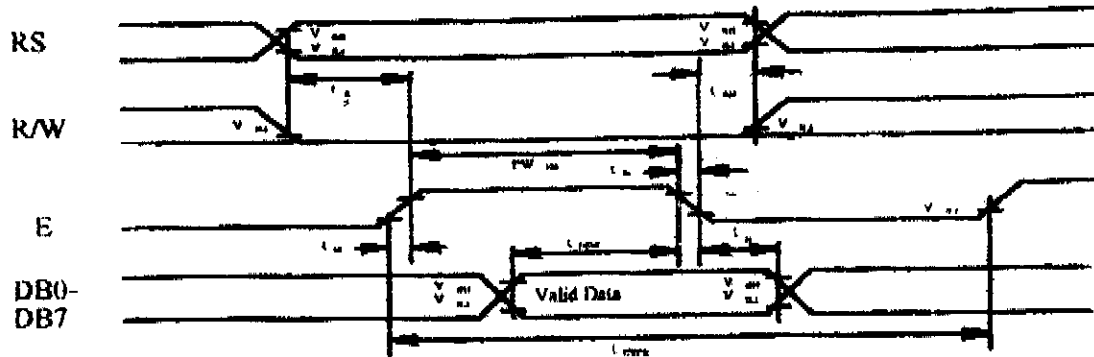
(Writing data from MPU to LCM) VDD=4.25V to 5.25V

| Item	Symbol	Limit (Min.)	Limit (Max.)	Unit
Enable Cycle Time	t_{CYCE}	500	-	nS
Enable Pulse Width (High level)	PW_{EH}	230	-	nS
Enable Rise/Fall Time	t_{Er}, t_{Ef}	-	20	nS
Address Set-Up Time (RS,R/W, E)	t_{AS}	40	-	nS
Address Hole Time	t_{AH}	30	-	nS
Data Set-Up Time	t_{DSW}	80	-	nS
Data Hold Time	t_{H}	5	-	nS

14.2 Read Operation
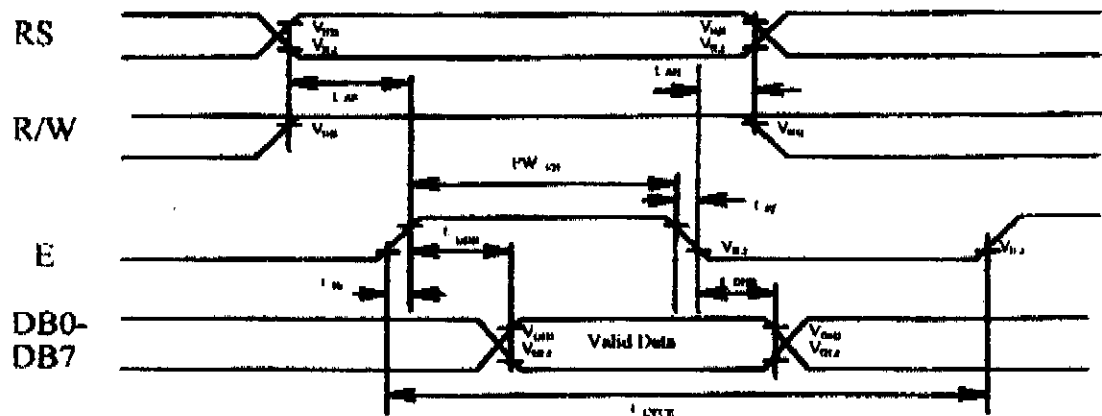
(Reading data from LCM to MPU) VDD=4.25V to 5.25V

Item	Symbol	Limit (Min.)	Limit (Max.)	Unit
Enable Cycle Time	t_{CYCE}	500	-	nS
Enable Pulse Width (High level)	PW_{EH}	230	-	nS
Enable Rise/Fall Time	t_{Er}, t_{Ef}	-	20	nS
Address Set-Up Time (RS,R/W, E)	t_{AS}	40	-	nS
Address Hold Time	t_{AH}	10	-	nS
Data Delay Time	t_{DDR}	-	200	nS
Data Hold Time	t_{DHR}	5	-	nS

14.3 8-bit busy flag check timing
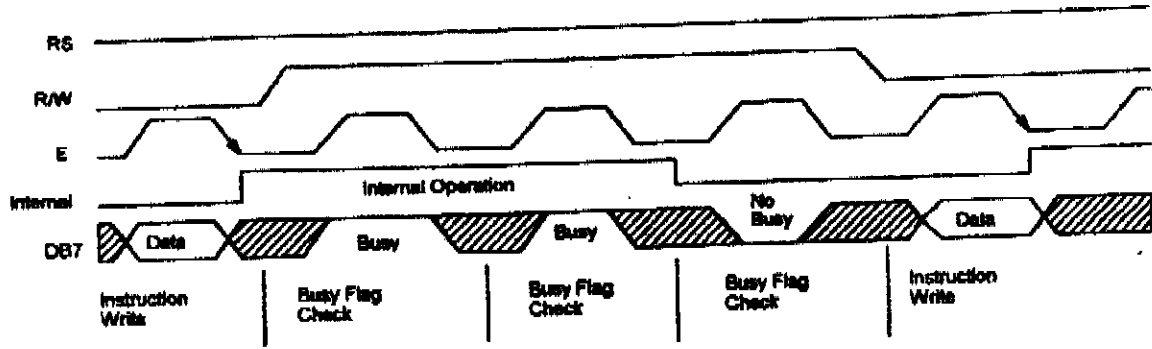
14.4 4-bit busy check timing
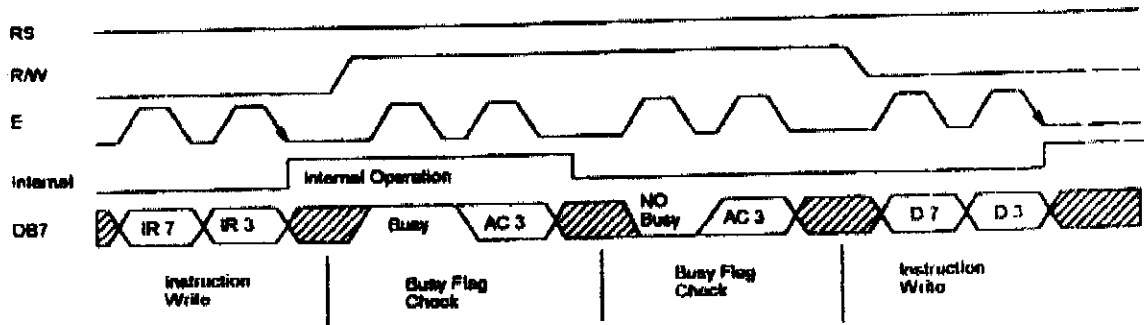
(Note) IR 7, IR 3: Instruction 7th bit, 3rd bit; AC3: Address Counter 3 rd bit

15. Character Generator ROM Map

Correspondence between character code and character

16. User Font Patterns (CG RAM Character)

Character Code (DD RAM Data)	CG RAM Address	Character Pattern (CG RAM Data)
7 6 5 4 3 2 1 0 ←(0 LO)→	A4 A3 A2 A1 A0	7 6 5 4 3 2 1 0 ←(H LO)→
0 0 0 0 * * 0 0	0 0	0 0 0 / 0 0 1 / 0 1 0 / 0 1 1 / 1 0 0 / 1 0 1 / 1 1 0 / 1 1 1
0 0 0 0 * * 0 1	0 0	0 0 0 / 0 0 1 / 0 1 0 / 0 1 1 / 1 0 0 / 1 0 1 / 1 1 0 / 1 1 1

Cursor Position

17. Instruction Set

Instruction operation

Instruction	No.	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Execute Cycle [1]
Status	SR	1	0	BF	AC	AC	AC	AC	AC	AC	AC	Reads busy flag (BF), which indicates internal operations are being performed, and reads address counter (AC).	0
Clear display	CL	0	0	0	0	0	0	0	0	0	1	Clears entire display and sets DDRAM address 0 in address counter.	310
Return home	CH	0	0	0	0	0	0	0	0	1	0	Sets DDRAM address 0 in address counter.	10
Start oscillator	OS	0	0	0	0	0	0	0	0	1	1	Starts oscillation during standby mode.	—
Entry mode set	EM	0	0	0	0	0	0	0	1	I/D	OSC	Sets address update direction after RAM access (I/D), and system clock division (OSC).	10
Cursor control	CR	0	0	0	0	0	0	1	B/W	C	B	Sets black-white inverting cursor (B/W), 8th raster-row cursor (C), and blink cursor (B).	10
Display on/off control	DO	0	0	0	0	0	1	0	DC	DS	LC	Sets character display on/off (DC), segment display on/off (DS), and line-cursor on/off (LC).	10
Power control	PW	0	0	0	0	0	1	1	AMP	SLP	STB	Turns on voltage-follower and booster (AMP), and sets sleep mode (SLP) and standby mode (STB).	10
Display control	DC	0	0	0	0	1	NL1	NL0	DL3	DL2	DL1	Sets the number of display lines (NL) and the line to be doubled in height.	10
Contrast control	CN	0	0	0	1	0	SN2	CT3	CT2	CT1	CT0	Sets the display-start line (SN2) and contrast-adjusting value (CT).	10
Scroll control	SC	0	0	0	1	1	SN1	SN0	SL2	SL1	SL0	Sets the display-start line (SN) and display-start raster-row (SL).	10
Annunciator /SEGRAM address set	AS	0	0	1	0	0	OA	AAN/ $A_{ sss3}$	AAN/ $A_{ sss2}$	AAN/ $A_{ sss1}$	AAN/ $A_{ sss0}$	Turns on annunciator display and sets annunciator/SEGRAM address.	10
CGRAM address set	CA	0	0	1	0	1	A_{co4}	A_{co3}	A_{co2}	A_{co1}	A_{co0}	Sets the initial CGRAM address to the address counter.	10
DDRAM address set (upper bits)	DA	0	0	1	1	0	0	0	0	A_{o06}	A_{o05}	Sets the initial higher DDRAM address to the address counter.	10
DDRAM address set (lower bits)	DA	0	0	1	1	1	A_{o04}	A_{o03}	A_{o02}	A_{o01}	A_{o00}	Sets the initial lower DDRAM address to the address counter.	10

Instruction	No.	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Execution Cycle *1
Write data to RAM	WD	0	1				Write data					Writes data to DDRAM, CGRAM, SEGRAM, or annunciator.	10
Read data from RAM	RD	1	1				Read data					Reads data from DDRAM, CGRAM, or SEGRAM.	10

BF	= 1:	Internally operating	AC: Address counter
I/D	= 1:	Increment	I/D = 0: Decrement
OSC	= 1:	System clock divided by four	
B/W	= 1:	Black-white inverting cursor on	C = 1: 8th raster-row cursor on
B	= 1:	Blink cursor on	
D	= 1:	Display on	
DC	= 1:	Character display on	DS = 1: Segment display on
LC	= 1:	Line containing AC given cursor attribute	
AMP	= 1:	Voltage-follower and booster on	SLP = 1: Sleep mode
STB	= 1:	Standby mode	

NL1,NL0: Number of display lines [00: 1line (1/10 duty ratio), 01: 2 lines (1/18 duty ratio), 10: 3 lines (1/26 duty ratio),11:4 lines (1/34 duty ratio)]

DL3–DL1: Double-height lines (DL1 = 1: 1st line, DL2 = 1: 2nd line, DL3 = 1: 3rd line)

CT3–CT0: Contrast adjustment

SN2–SN0: Display-start line (000: 1st line, 001: 2nd line, 010: 3rd line, 011: 4th line, 100: 5th line)

SL2 – SL0: Display-start raster-row (000: 1st raster-row... 111: 8th raster-row)

DA = 1: Annunciator display on

AAN/A_ann = 0000–0010: Annunciator address   AAN/A_ann = 1000–1111: SEGRAM address

ACG4–ACG0: CGRAM address (00000–11111)

ADD6–ADD0: DDRAM address (0000000–1001011)

Note: 1. Represented by the number of operating clock pulses; the execution time depends on the supplied clock frequency or the internal oscillation frequency.