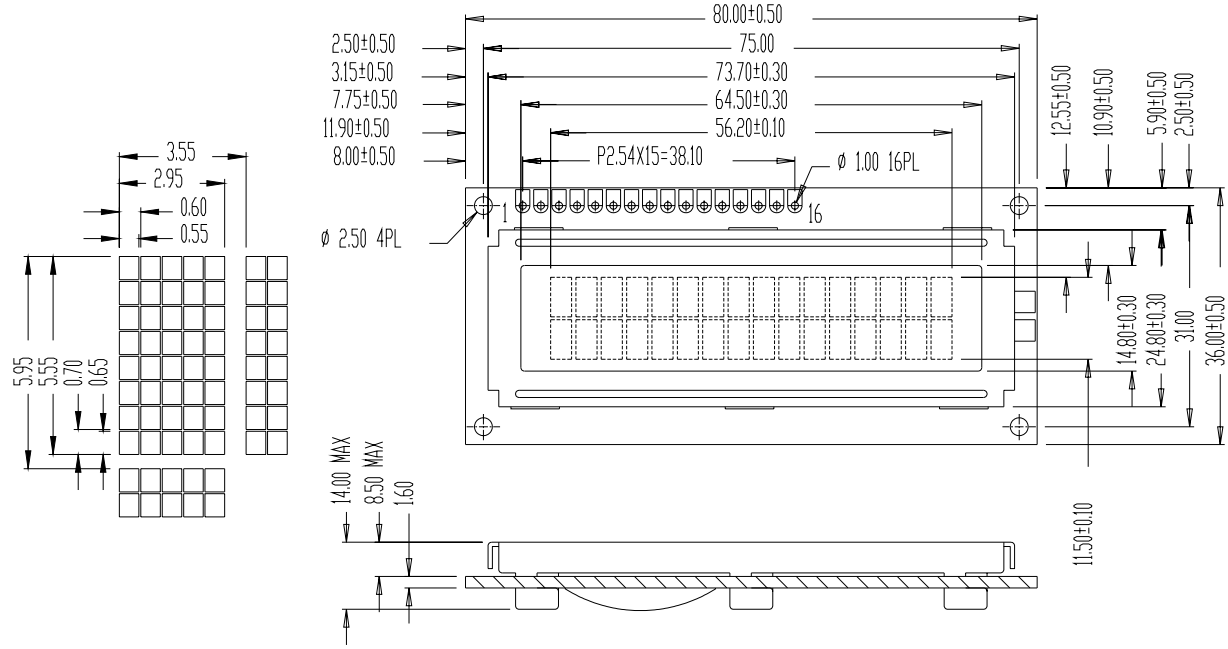
■ PHYSICAL DATA

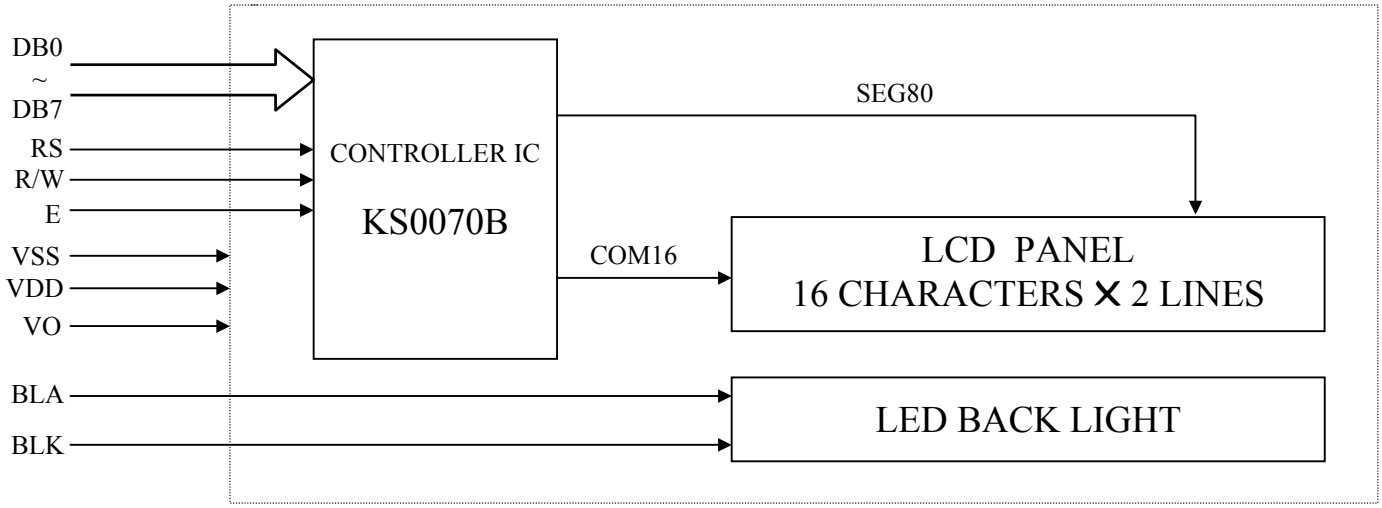
Item	Contents	Unit
LCD type	STN	---
LCD duty	1/16	---
LCD bias	1/5	---
Viewing direction	6	o'clock
Module size (W×H×T)	80 × 36 × 14MAX (3.15″ × 1.42″ × 0.55″MAX)	mm
Viewing area (W×H)	64.5 × 14.8 (2.54″ × 0.58″)	mm
Number of characters (characters×lines)	16 × 2	---
Character matrix (W×H)	5 × 8	dots
Character size (W×H)	2.95 × 5.55 (0.116″ × 0.219″)	mm
Dot size (W×H)	0.55 × 0.65 (0.022″ × 0.026″)	mm
Dot pitch (W×H)	0.60 × 0.70 (0.024″ × 0.028″)	mm

■ EXTERNAL DIMENSIONS



■ BLOCK DIAGRAM

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VSS	VDD	VO	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	BLA	BLK



■ ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	VDD	-0.3	7.0	V
Supply voltage for LCD	VDD - VO	-0.3	VDD+0.3	V
Input voltage	VI	-0.3	VDD+0.3	V
Operating temperature	TOP	0	50	°C
Storage temperature	TST	-10	60	°C

■ ELECTRICAL CHARACTERISTICS (VDD = +5V±10% , VSS = 0V, Ta = 25°C)

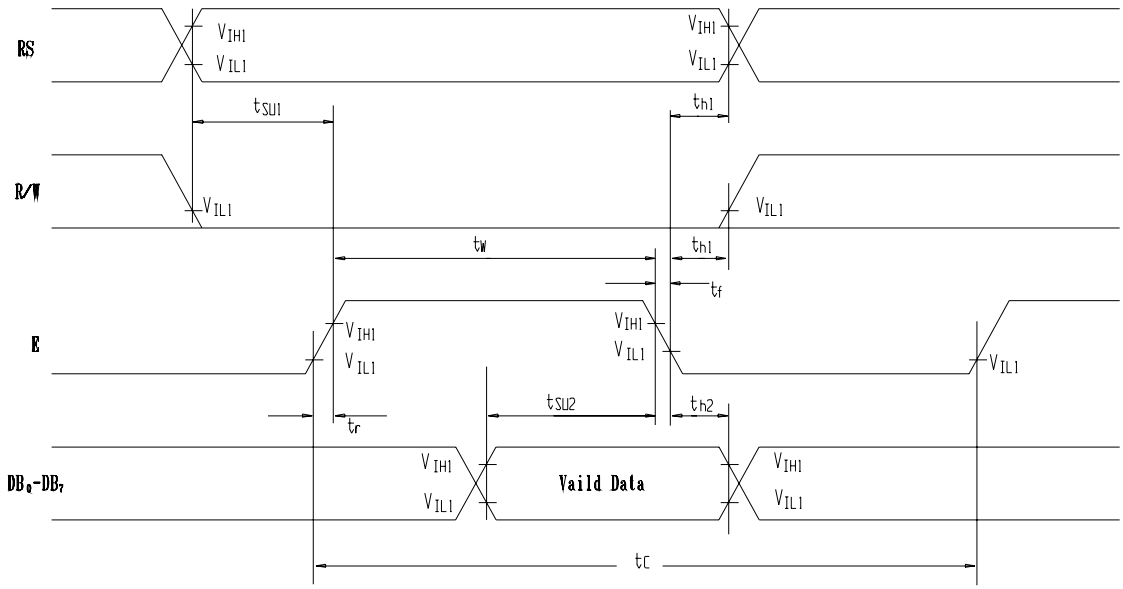
◆ DC Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for logic	VDD	---	4.5	5.0	5.5	V
Supply current for logic	IDD	---	---	1.38	3	mA
Operating voltage for LCD	VDD - VO	0°C	4.7	5.0	5.3	V
		25°C	4.5	4.8	5.1	V
		50°C	4.4	4.7	5.0	V
Supply voltage for back light	VF	---	---	4.2	4.6	V
Supply current for back light	IF	VF=4.2V	---	130	220	mA
Input voltage ' H ' level	VIH	---	2.2	---	VDD	V
Input voltage ' L ' level	VIL	---	-0.3	---	0.6	V

◆ AC Characteristics

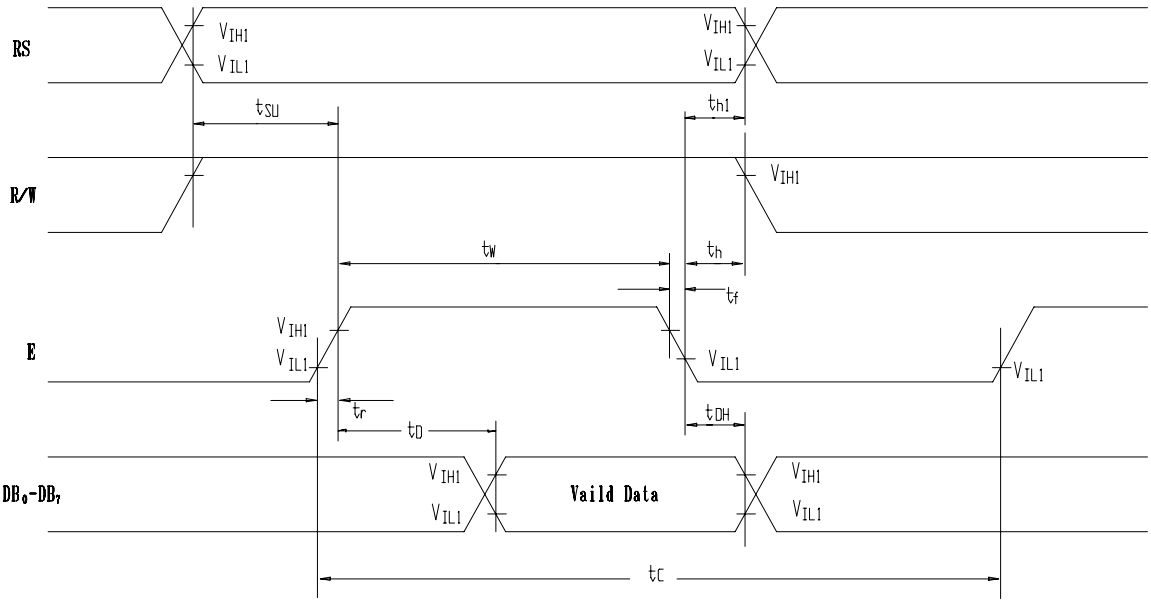
- Write mode

Characteristic	Symbol	Min.	Typ.	Max.	Unit	Test pin
E cycle time	t_C	500	---	---	ns	E
E rise time	t_r	---	---	25	ns	E
E fall time	t_f	---	---	25	ns	E
E pulse width (High, Low)	t_W	220	---	---	ns	E
R/W and RS set-up time	t_{SU1}	40	---	---	ns	R/W, RS
R/W and RS hold time	t_{h1}	10	---	---	ns	R/W, RS
Data set-up time	t_{SU2}	60	---	---	ns	$DB_0 \sim DB_7$
Data hold time	t_{h2}	10	---	---	ns	$DB_0 \sim DB_7$



● Read mode

Characteristic	Symbol	Min.	Typ.	Max.	Unit	Test pin
E cycle time	t_C	500	---	---	ns	E
E rise time	t_r	---	---	25	ns	E
E fall time	t_f	---	---	25	ns	E
E pulse width	t_W	220	---	---	ns	E
R/W and RS set-up time	t_{SU}	40	---	---	ns	R/W, RS
R/W and RS hold time	t_h	10	---	---	ns	R/W, RS
Data output delay time	t_D	---	---	120	ns	$DB_0 \sim DB_7$
Data hold time	t_{DH}	20	---	---	ns	$DB_0 \sim DB_7$



■ OPERATING PRINCIPLES & METHODS

◆ Control and Display Command

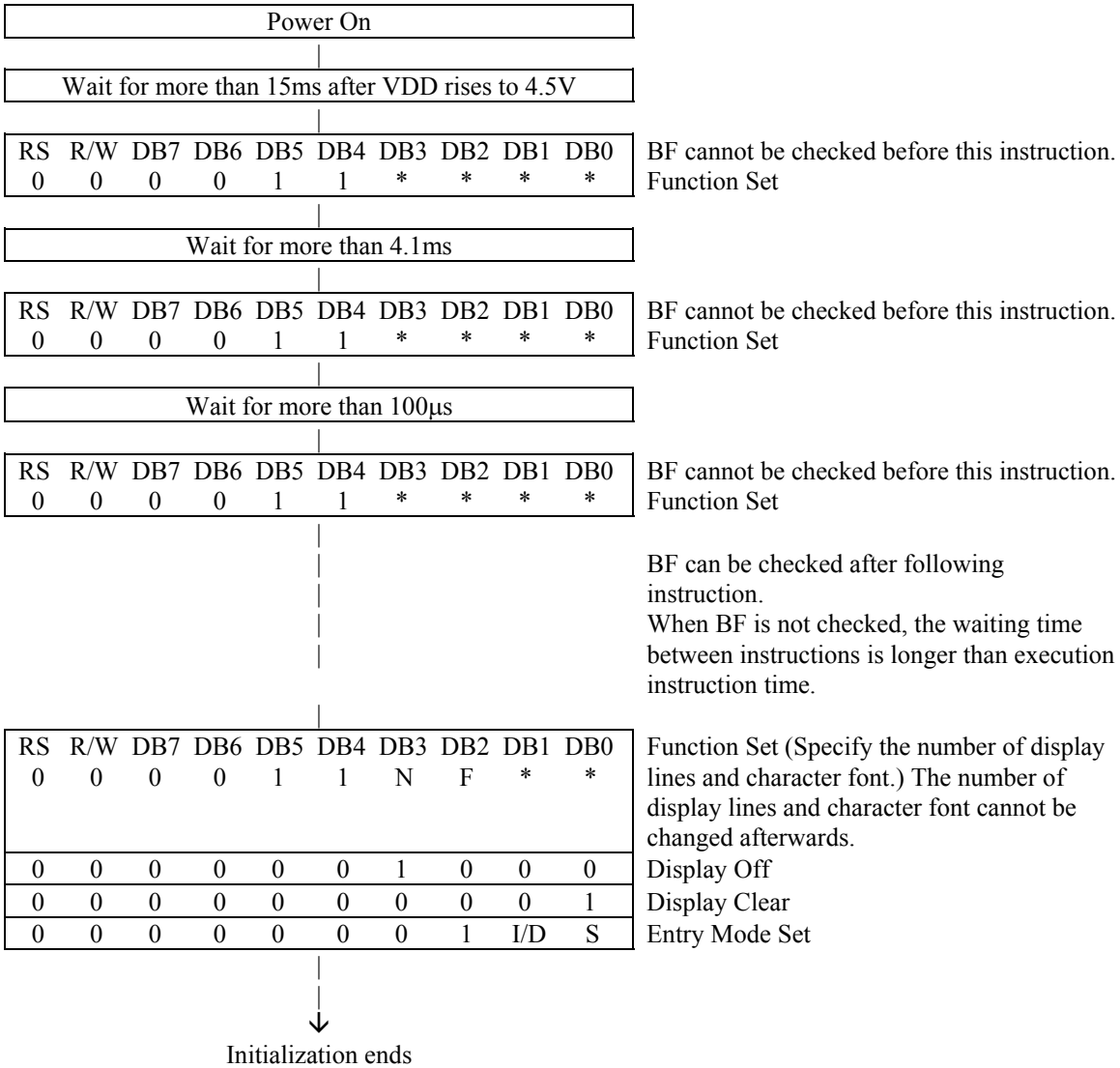
Command	RS	R/W	DB_7	DB_6	DB_5	DB_4	DB_3	DB_2	DB_1	DB_0	Execution Time (f_{osc} = 250kHz)	Remark
DISPLAY CLEAR	L	L	L	L	L	L	L	L	L	H	1.64ms	
RETURN HOME	L	L	L	L	L	L	L	L	H	X	1.64ms	Cursor move to first digit
ENTRY MODE SET	L	L	L	L	L	L	L	H	I/D	SH	42µs	• I/D : Set cursor move di I/D: H Increase; L Decrease • SH: Specifies shift of display SH: H Display is shifted; L Display is not shifted
DISPLAY ON/OFF	L	L	L	L	L	L	H	D	C	B	42µs	• Display D: H Display on; L Display off • Cursor C: H Cursor on; L Cursor off • Blinking B: H Blinking on; L Blinking off
SHIFT	L	L	L	L	L	H	S/C	R/L	X	X	42µs	S/C: H Display shift; L Cursor move R/L: H Right shift; L Left shift
SET FUNCTION	L	L	L	L	H	DL	N	F	X	X	42µs	DL: H 8 bits interface; L 4 bits interface N: H 2 line display; L 1 line display F: H 5 X 10 dots; L 5 X 7 dots
SET CG RAM ADDRESS	L	L	L	H	CG RAM address (corresponds to cursor address)						42µs	CG RAM Data is sent and received after this setting
SET DD RAM ADDRESS	L	L	H	DD RAM address							42µs	DD RAM Data is sent and received after this setting
READ BUSY FLAG & ADDRESS	L	H	BF	Address Counter used for both DD & CG RAM address							0µs	BF: H Busy; L Ready – Reads BF indication internal operating is being performed – Reads address counter contents
WRITE DATA	H	L	Write Data								46µs	Write data into DD or CG RAM

◆ Initializing by Internal Reset Circuit

The KS0070B automatically initializes (resets) when the power is on using the internal reset circuit. The following instruction are executed in initialization. The busy flag is kept in busy state (BF=1) until initialization ends. The busy state is 10ms after VDD rises to 4.5V.

(1) Display Clear
(2) Function Set
DL = 1 : 8-bit interface data
N = 0 : 1-line display
F = 0 : 5x7-dot character font
(3) Display On/Off Control
D = 0 : Display Off
C = 0 : Cursor Off
B = 0 : Blink Off
(4) Entry Mode Set
I/D = 1 : +1 (Increment)
S = 0 : No Shift

◆ Initializing by Instruction



◆ Standard Character Pattern

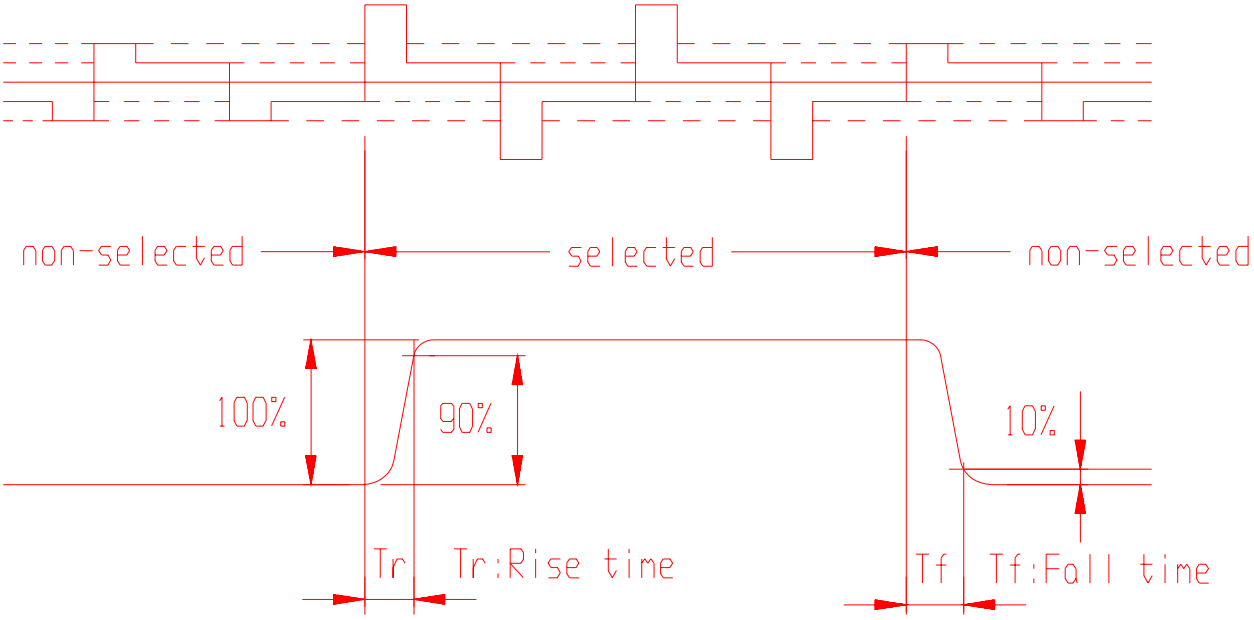
■ DISPLAY DATA RAM ADDRESS MAP

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
First line	00H	01H	02H	03H	04H	05H	06H	07H	08H	09H	0AH	0BH	0CH	0DH	0EH	0FH
Second line	40H	41H	42H	43H	44H	45H	46H	47H	48H	49H	4AH	4BH	4CH	4DH	4EH	4FH

■ ELECTRO-OPTICAL CHARACTERISTICS (V_{OP} = 5.0V, Ta = 25°C)

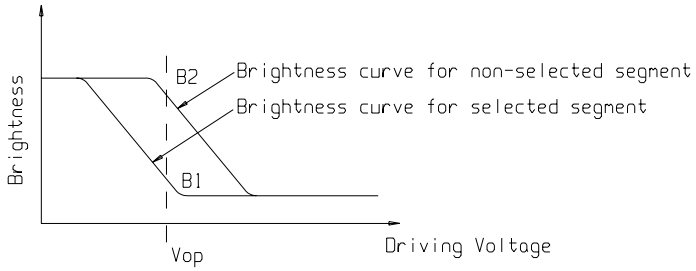
Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Response time	Tr	---	---	275	---	ms	---	1
	Tf	---	---	61	---	ms	---	1
Contrast ratio	Cr	---	---	30.1	---	---	---	2
Viewing angle range	θ	Cr ≥ 2	48	---	---	deg	∅ = 90°	3
			47	---	---	deg	∅ = 270°	3
			60	---	---	deg	∅ = 0°	3
			57	---	---	deg	∅ = 180°	3

Note1: Definition of response time.

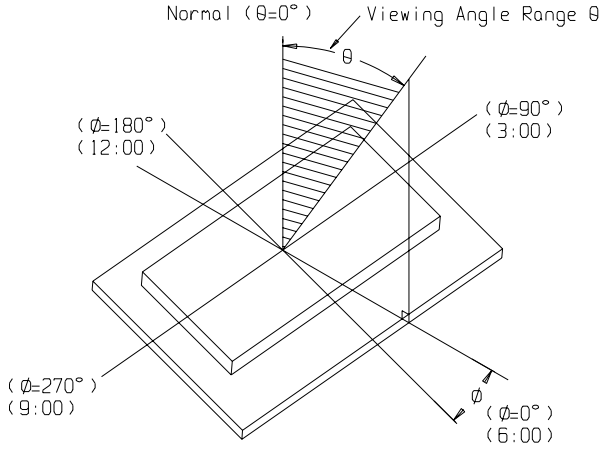


Note2: Definition of contrast ratio 'Cr' .

$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$



Note3: Definition of viewing angle range 'θ'.



■ INTERFACE PIN CONNECTIONS

Pin NO.	Symbol	Level	Description
1	VSS	0V	Ground
2	VDD	5.0V	Supply voltage for logic
3	VO	---	Input voltage for LCD
4	RS	H/L	H : Data, L : Instruction code
5	R/W	H/L	H : Read mode, L : Write mode
6	E	H, H → L	Chip enable signal
7	DB0	H/L	Data bit 0
8	DB1	H/L	Data bit 1
9	DB2	H/L	Data bit 2
10	DB3	H/L	Data bit 3
11	DB4	H/L	Data bit 4
12	DB5	H/L	Data bit 5
13	DB6	H/L	Data bit 6
14	DB7	H/L	Data bit 7
15	BLA	4.2V	Back light anode
16	BLK	0V	Back light cathode

■ PART LIST

Part Name	Description	Quantity
IC	KS0070B.PCC	1
LCD	162C	1
PCB	162C	1
Frame	162C	1
Rubber connector	70.5x6.9x2.2mm YS	2
Resistor	2.2KΩ	5
Resistor	91KΩ	1
LED box	LB162-1	1
LED PCB	LB162A1-3	1
LED light	ED-011YGU	22