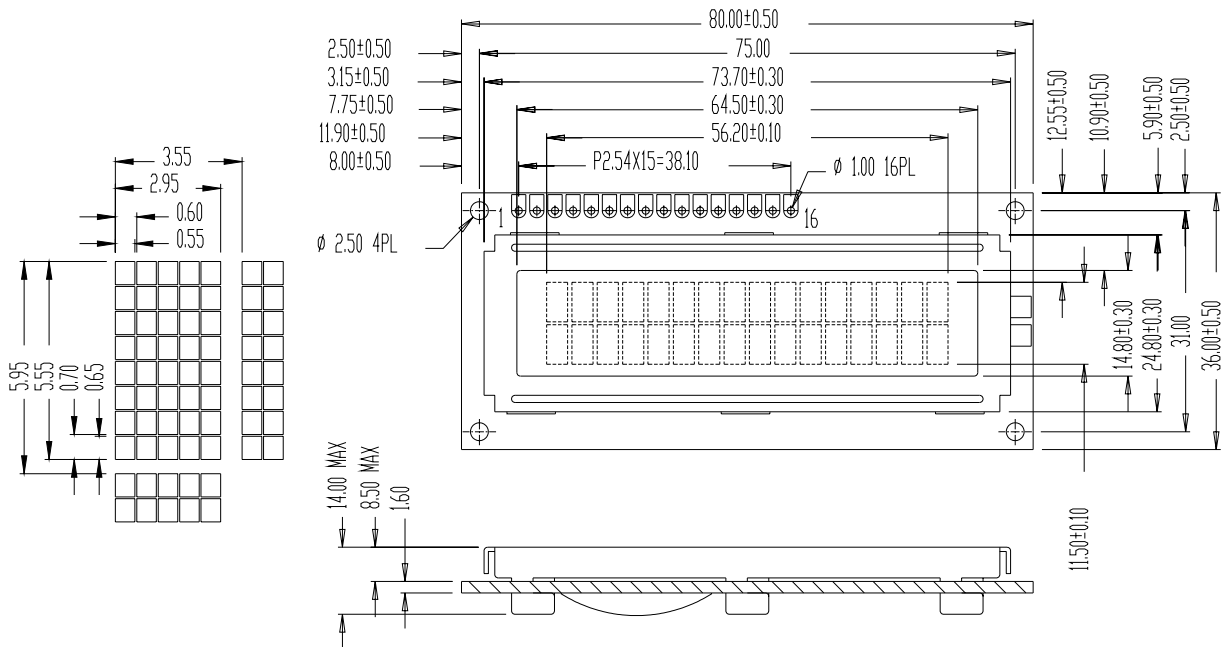


■ PHYSICAL DATA

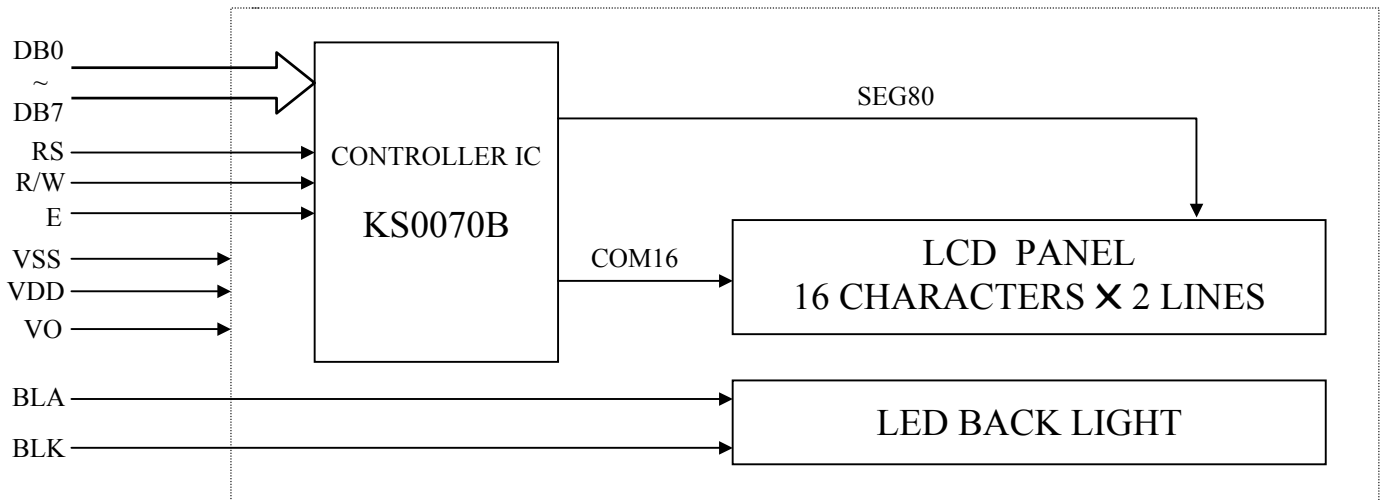
Item	Contents	Unit
LCD type	STN	---
LCD duty	1/16	---
LCD bias	1/5	---
Viewing direction	6	o'clock
Module size (W×H×T)	80 × 36 × 14MAX (3.15" × 1.42" × 0.55"MAX)	mm
Viewing area (W×H)	64.5 × 14.8 (2.54" × 0.58")	mm
Number of characters (characters×lines)	16 × 2	---
Character matrix (W×H)	5 × 8	dots
Character 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)

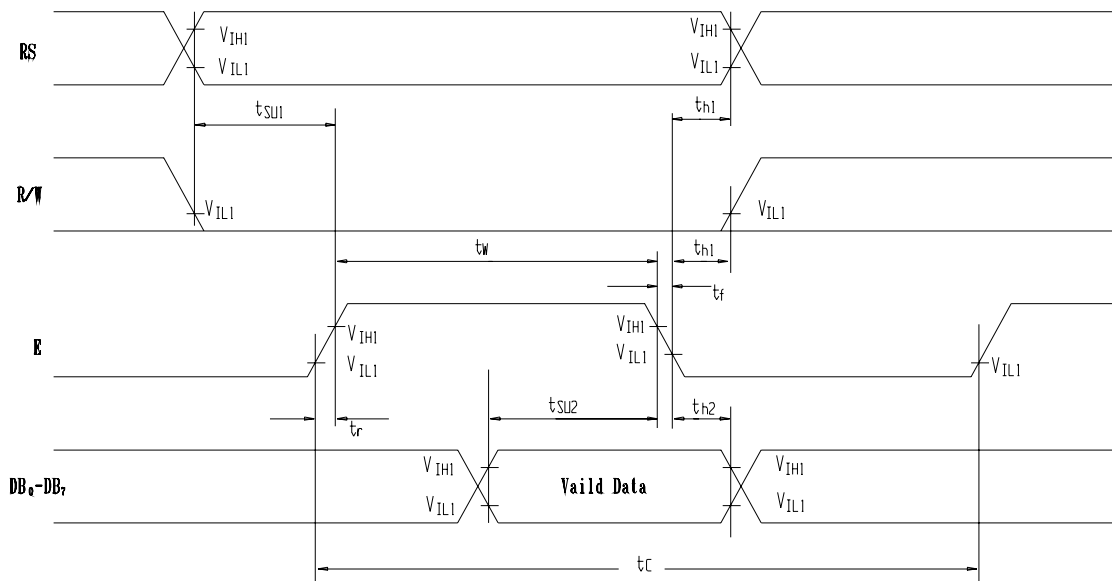
◆ DC Characteristics

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

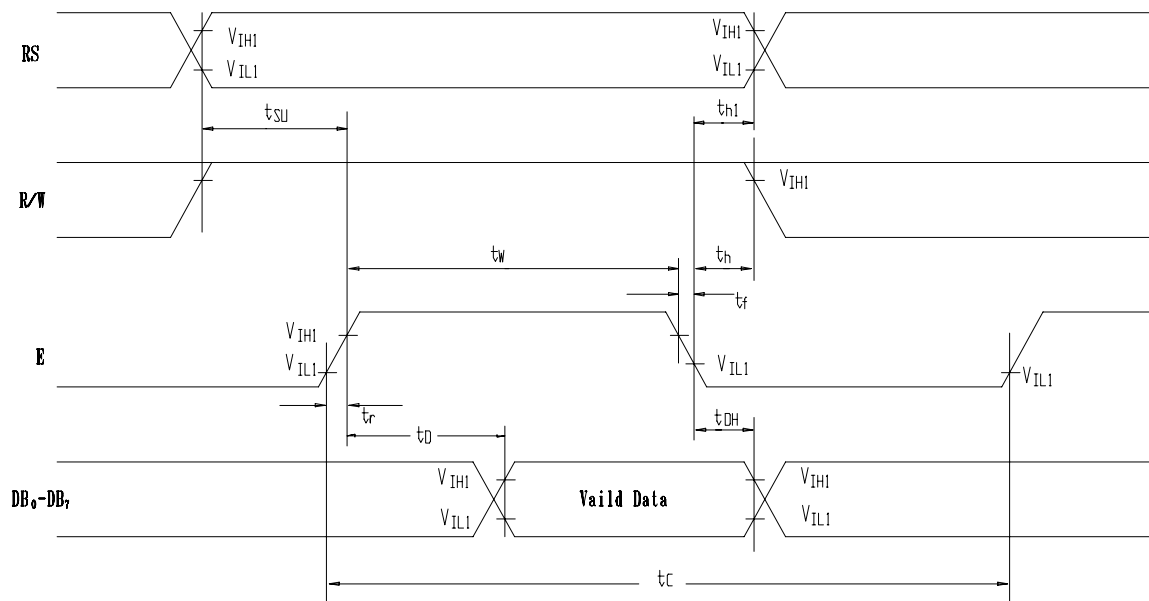
- Write mode

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 ~DB ₇
Data hold time	t _{h2}	10	---	---	ns	DB ₀ ~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 ~DB ₇
Data hold time	t_{DH}	20	---	---	ns	DB ₀ ~DB ₇



■ OPERATING PRINCIPLES & METHODS

◆ Control and Display Command

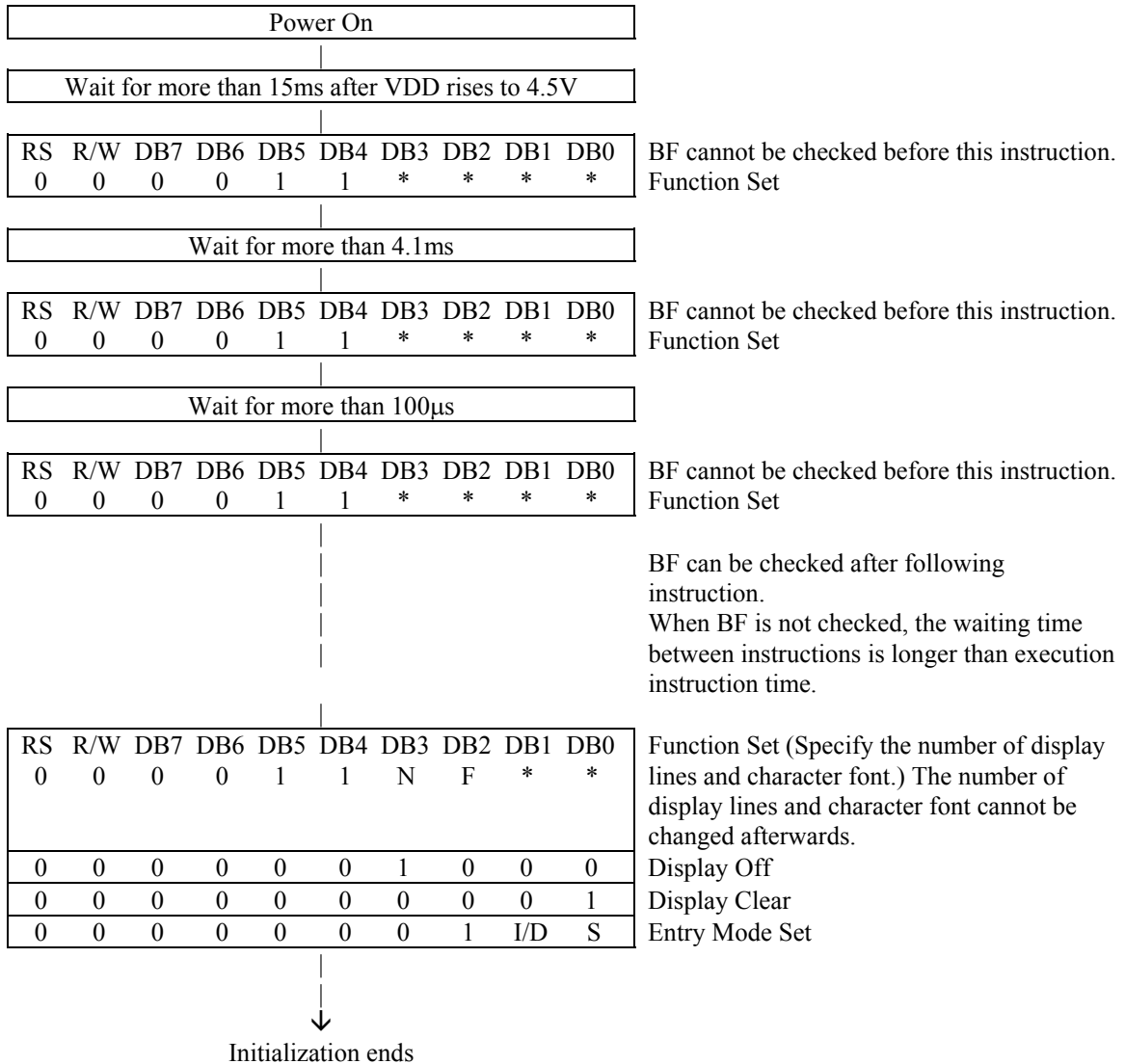
Command	RS	R/W	DB ₇	DB ₆	DB ₅	DB ₄	DB ₃	DB ₂	DB ₁	DB ₀	Execution Time (f _{osc} = 250kHz)	Remark																		
DISPLAY CLEAR	L	L	L	L	L	L	L	L	L	H	1.64ms																			
RETURN HOME	L	L	L	L	L	L	L	L	H	X	1.64ms	Cursor move to first digit																		
ENTRY MODE SET	L	L	L	L	L	L	L	H	I/D	SH	42µs	<ul style="list-style-type: none"> I/D : Set cursor move direction <table border="1"> <tr> <td>I/D</td> <td>H</td> <td>Increase</td> </tr> <tr> <td>I/D</td> <td>L</td> <td>Decrease</td> </tr> </table> SH : Set cursor shift <table border="1"> <tr> <td>SH</td> <td>H</td> <td>Display is shifted</td> </tr> <tr> <td>SH</td> <td>L</td> <td>Display is not shifted</td> </tr> </table> 	I/D	H	Increase	I/D	L	Decrease	SH	H	Display is shifted	SH	L	Display is not shifted						
I/D	H	Increase																												
I/D	L	Decrease																												
SH	H	Display is shifted																												
SH	L	Display is not shifted																												
DISPLAY ON/OFF	L	L	L	L	L	L	H	D	C	B	42µs	<ul style="list-style-type: none"> Display <table border="1"> <tr> <td>D</td> <td>H</td> <td>Display on</td> </tr> <tr> <td>D</td> <td>L</td> <td>Display off</td> </tr> </table> Cursor <table border="1"> <tr> <td>C</td> <td>H</td> <td>Cursor on</td> </tr> <tr> <td>C</td> <td>L</td> <td>Cursor off</td> </tr> </table> Blinking <table border="1"> <tr> <td>B</td> <td>H</td> <td>Blinking on</td> </tr> <tr> <td>B</td> <td>L</td> <td>Blinking off</td> </tr> </table> 	D	H	Display on	D	L	Display off	C	H	Cursor on	C	L	Cursor off	B	H	Blinking on	B	L	Blinking off
D	H	Display on																												
D	L	Display off																												
C	H	Cursor on																												
C	L	Cursor off																												
B	H	Blinking on																												
B	L	Blinking off																												
SHIFT	L	L	L	L	L	H	S/C	R/L	X	X	42µs	<table border="1"> <tr> <td rowspan="2">S/C</td> <td>H</td> <td>Display shift</td> </tr> <tr> <td>L</td> <td>Cursor move</td> </tr> <tr> <td rowspan="2">R/L</td> <td>H</td> <td>Right shift</td> </tr> <tr> <td>L</td> <td>Left shift</td> </tr> </table>	S/C	H	Display shift	L	Cursor move	R/L	H	Right shift	L	Left shift								
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	<table border="1"> <tr> <td rowspan="2">DL</td> <td>H</td> <td>8 bits interface</td> </tr> <tr> <td>L</td> <td>4 bits interface</td> </tr> <tr> <td rowspan="2">N</td> <td>H</td> <td>2 line display</td> </tr> <tr> <td>L</td> <td>1 line display</td> </tr> <tr> <td rowspan="2">F</td> <td>H</td> <td>5 X 10 dots</td> </tr> <tr> <td>L</td> <td>5 X 7 dots</td> </tr> </table>	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			
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	<table border="1"> <tr> <td rowspan="2">BF</td> <td>H</td> <td>Busy</td> </tr> <tr> <td>L</td> <td>Ready</td> </tr> </table> <ul style="list-style-type: none"> – Reads BF indication internal operating is being performed – Reads address counter contents 	BF	H	Busy	L	Ready															
BF	H	Busy																												
	L	Ready																												
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

upper 4 bit lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)														
0001	(2)														
0010	(3)														
0011	(4)														
0100	(5)														
0101	(6)														
0110	(7)														
0111	(8)														
1000	(1)														
1001	(2)														
1010	(3)														
1011	(4)														
1100	(5)														
1101	(6)														
1110	(7)														
1111	(8)														

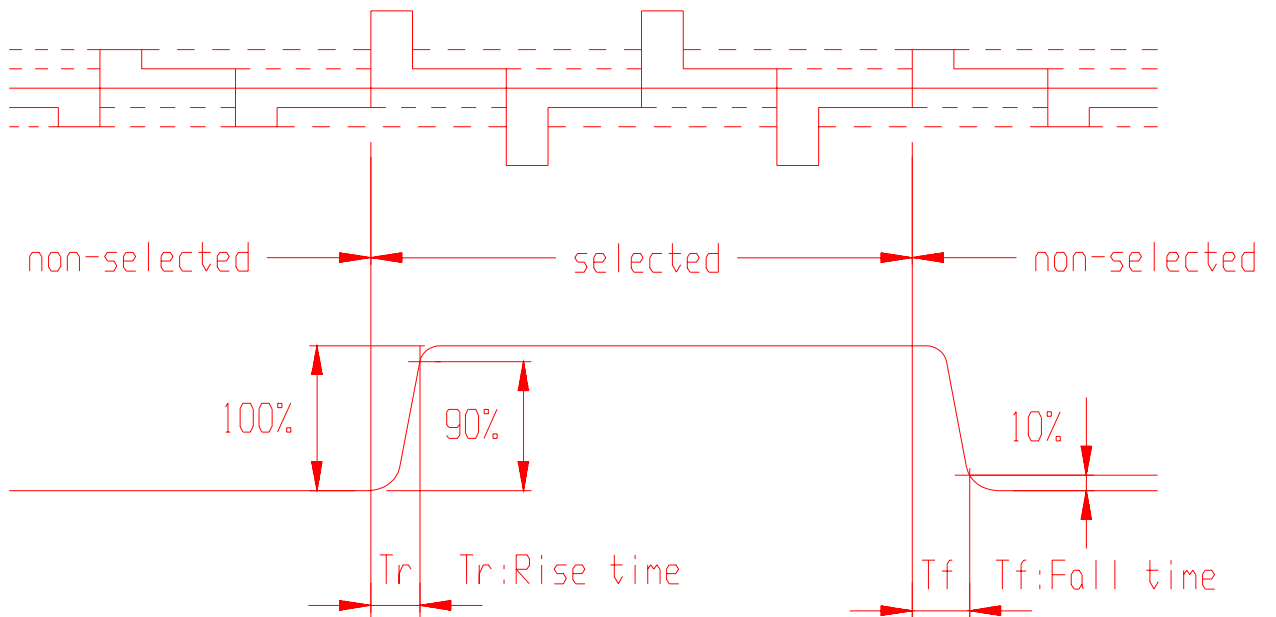
■ DISPLAY DATA RAM ADDRESS MAP

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

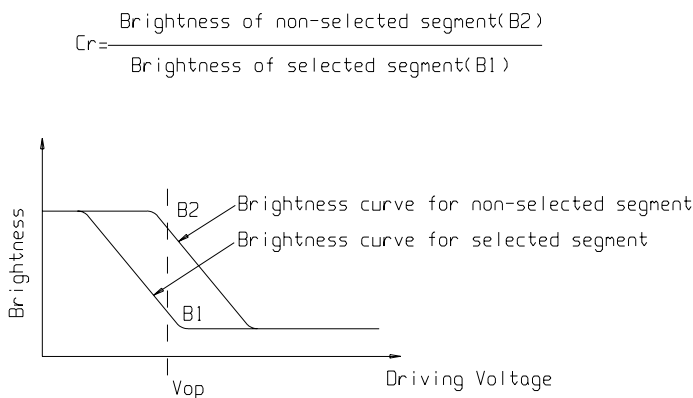
■ ELECTRO-OPTICAL CHARACTERISTICS (V_{OP} = 5.0V, T_a = 25°C)

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

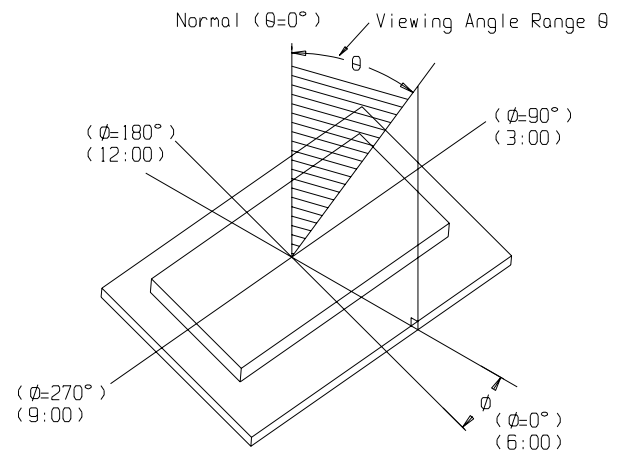
Note1: Definition of response time.



Note2: Definition of contrast ratio 'Cr' .



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	2.2K Ω	5
Resistor	91K Ω	1
LED box	LB162-1	1
LED PCB	LB162A1-3	1
LED light	ED-011YGU	22