

# TIANMA MICROELECTRONICS CO., LTD

## DEVICE SPECIFICATION FOR LCD MODULE

Model No. TM122ADCW6

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Approved by: 張政民	Date: 16/3-2000

To: \_\_\_\_\_

CUSTOMER'S APPROVAL

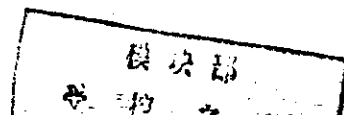
DATE \_\_\_\_\_

By: \_\_\_\_\_

Presented

By: \_\_\_\_\_  
Sell and Market Dep.

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REVISION RECORD

Date	Ref. Page	Revision No.	Revision Items	Check & Approval

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## 1 Display Specifications

- 1.1 Display type: STN
- 1.2 Display color\*:
  - Display color: Blue-Black
  - Background color: Gray
- 1.3 Polarizer mode: Transflective/Positive
- 1.4 Viewing Angle: 6:00
- 1.5 Driving Duty: 1/16
- 1.6 Backlight: LED

\* Color tone is slightly changed by temperature and driving voltage.

## 2 Mechanical Specifications

- 2.1 Outline Dimensions: Refer to outline drawing on page: 2
- 2.2 Display Format: 12 Characters X 2 Lines
- 2.3 Display Fonts: 5 X 7 dots+Cursor
- 2.4 Character Size: 2.65 X5.5 (mm)
- 2.5 Dot Size: 0.45X0.60(mm)
- 2.6 Dot Pitch: 0.55X0.70(mm)
- 2.7 Weight: 25g

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#### 4 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	-0.3	7.0	V	
LCD Driving Voltage	$V_{DD}-V_{EE}$	-0.3	13.0		
Operating Temperature Range	$T_{OP}$	-20	+70	°C	No Condensation
Storage Temperature Range	$T_{ST}$	-30	+80		

#### 5 Electrical Specifications and Instruction Code

##### 5.1 Electrical characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remark	
Supply Voltage (Logic)	$V_{DD}-V_{SS}$	4.5	5.0	5.5	V		
Supply Voltage (LCD Drive)	$V_{DD}-V_{EE}$	-	4.5	-	V		
Input Signal Voltage	'H'Level	$V_{IH}$	$0.7V_{DD}$	-	$V_{DD}+0.3$	V	
	'L'Level	$V_{IL}$	-0.3	-	$0.2V_{DD}$	V	
Supply current (Logic)	$I_{DD}$	-	-	1.1	mA		
Supply current (LCD Drive)	$I_{EE}$	-	-	0.37	mA		
Supply Current (LED)	$I_{LED}$	-	-	110.6	mA		

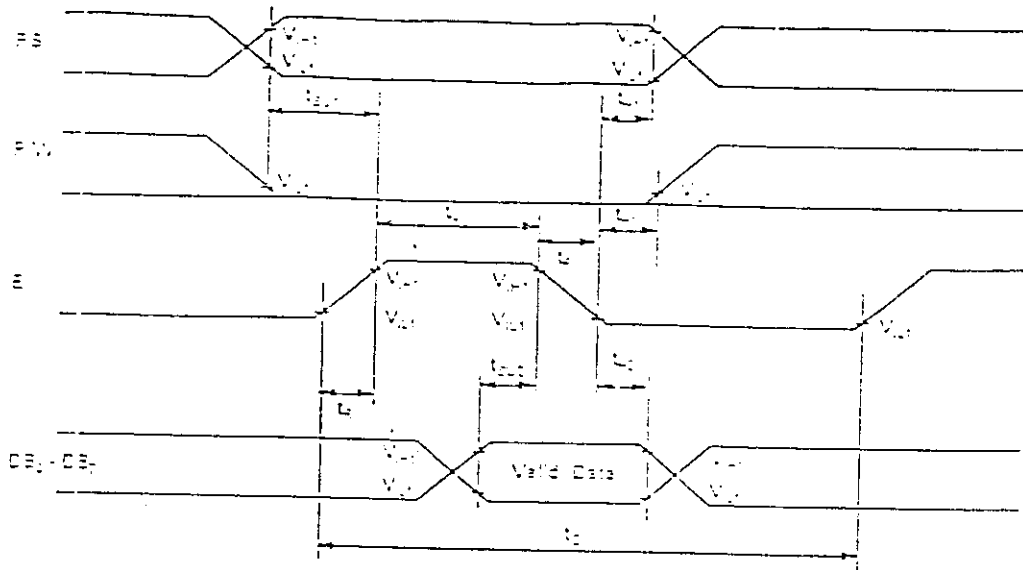
## 5.2 Interface Signals

Pin No.	Symbol	Level	Description
1	V <sub>SS</sub> /K	0V	Ground
2	V <sub>DD</sub>	5.0V	Power supply voltage for logic and LCD(+)
3	V <sub>O</sub>	0.5V	Power supply voltage for LCD(-)
4	RS	H/L	Selects registers
5	R/W	H/L	Selects read or write
6	E	H/L	Starts data read/write
7	DB0	H/L	Data bit0
8	DB1	H/L	Data bit1
9	DB2	H/L	Data bit2
10	DB3	H/L	Data bit3
11	DB4	H/L	Data bit4
12	DB5	H/L	Data bit5
13	DB6	H/L	Data bit6
14	DB7	H/L	Data bit7
15	A	4.2V	The positive electrode of LED backlight

### 5.3 Interface Timing Chart:

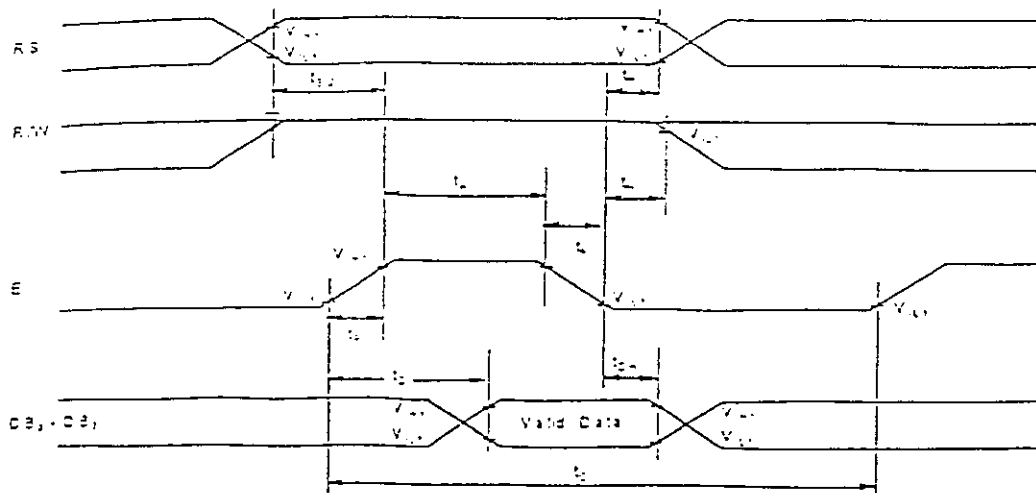
AC Characteristics ( $V_{CC}=5V \pm 10\%$ ,  $V_{EE}=0V$ ,  $T_a = -20 \sim +75^\circ C$ )  
 (1) Write mode (Writing data from Microm to KS0066)

Characteristic	Symbol	Min	Typ	Max	Unit	Test p.n
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
RW and RS Setup Time	$t_{su}$	40	-	-	ns	RW, RS
RW and RS Hold Time	$t_h$	10	-	-	ns	RW, RS
Data Setup Time	$t_{su}$	60	-	-	ns	DB <sub>1</sub> -DB <sub>7</sub>
Data Hold Time	$t_h$	10	-	-	ns	DB <sub>1</sub> -DB <sub>7</sub>



(2) Read mode (Reading data from KS0066 to Microm)

Characteristic	Symbol	Min	Typ	Max	Unit	Test p.n
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
RW and RS Setup Time	$t_{su}$	40	-	-	ns	RW, RS
RW and RS Hold Time	$t_h$	10	-	-	ns	RW, RS
Data Output Delay Time	$t_d$	-	-	100	ns	DB <sub>1</sub> -DB <sub>7</sub>
Data Hold Time	$t_h$	20	-	-	ns	DB <sub>1</sub> -DB <sub>7</sub>



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# 5.4 Instruction Code

## CONTROL and DISPLAY COMMAND

Command	RS	R/W	DB <sub>7</sub>	DB <sub>6</sub>	DB <sub>5</sub>	DB <sub>4</sub>	DB <sub>3</sub>	DB <sub>2</sub>	DB <sub>1</sub>	DB <sub>0</sub>	Execution time (fosc=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	VD	SH	40 $\mu$ s	•VD: set cursor move direction <table border="1"> <tr><td>VD</td><td>H</td><td>Increase</td></tr> <tr><td>VD</td><td>L</td><td>Decrease</td></tr> </table> •SH: Specifies shift of display <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>	VD	H	Increase	VD	L	Decrease	SH	H	display is shifted	SH	L	display is not shifted						
VD	H	Increase																												
VD	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	40 $\mu$ s	•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	40 $\mu$ s	<table border="1"> <tr><td>SC</td><td>H</td><td>Display shift</td></tr> <tr><td>SC</td><td>L</td><td>Cursor move</td></tr> </table> <table border="1"> <tr><td>R/L</td><td>H</td><td>Right shift</td></tr> <tr><td>R/L</td><td>L</td><td>Left shift</td></tr> </table>	SC	H	Display shift	SC	L	Cursor move	R/L	H	Right shift	R/L	L	Left shift						
SC	H	Display shift																												
SC	L	Cursor move																												
R/L	H	Right shift																												
R/L	L	Left shift																												
SET FUNCTION	L	L	L	L	H	DL	N	F	X	X	40 $\mu$ s	<table border="1"> <tr><td>DL</td><td>H</td><td>8 bits interface</td></tr> <tr><td>DL</td><td>L</td><td>4 bits interface</td></tr> </table> <table border="1"> <tr><td>N</td><td>H</td><td>2 line display</td></tr> <tr><td>N</td><td>L</td><td>1 line display</td></tr> </table> <table border="1"> <tr><td>F</td><td>H</td><td>5 x 10 dots</td></tr> <tr><td>F</td><td>L</td><td>5 x 7 dots</td></tr> </table>	DL	H	8 bits interface	DL	L	4 bits interface	N	H	2 line display	N	L	1 line display	F	H	5 x 10 dots	F	L	5 x 7 dots
DL	H	8 bits interface																												
DL	L	4 bits interface																												
N	H	2 line display																												
N	L	1 line display																												
F	H	5 x 10 dots																												
F	L	5 x 7 dots																												
Command	RS	R/W	DB <sub>7</sub>	DB <sub>6</sub>	DB <sub>5</sub>	DB <sub>4</sub>	DB <sub>3</sub>	DB <sub>2</sub>	DB <sub>1</sub>	DB <sub>0</sub>	Execution time (fosc=250KHz)	Remark																		
SET CG RAM ADDRESS	L	L	L	H	CG RAM address (corresponds to cursor address)						40 $\mu$ s	CG RAM Data is sent and received after this setting																		
SET DD RAM ADDRESS	L	L	H	DD RAM address							40 $\mu$ s	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							0 $\mu$ s	<table border="1"> <tr><td>BF</td><td>H</td><td>Busy</td></tr> <tr><td>BF</td><td>L</td><td>Ready</td></tr> </table> - Reads BF indication internal operating is being performed. - reads address counter contents	BF	H	Busy	BF	L	Ready												
BF	H	Busy																												
BF	L	Ready																												
WRITE DATA	H	L	Write Data									48 $\mu$ s	Write data into DD or CG RAM																	
READ DATA	H	H	Read Data									48 $\mu$ s	Read data from DD or CGRAM																	

X: Don't care

# 5.5 Character generator ROM(KS0066U-00)

Upper 4bit Lower 4bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)															
LLLH	(2)															
LLHL	(3)															
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)															
HLLL	(1)															
HLLH	(2)															
HLHL	(3)															
HLHH	(4)															
HHLL	(5)															
HHLH	(6)															
HHHL	(7)															
HHHH	(8)															

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## 6. Optical Characteristics

### 6.1 Optical Characteristics

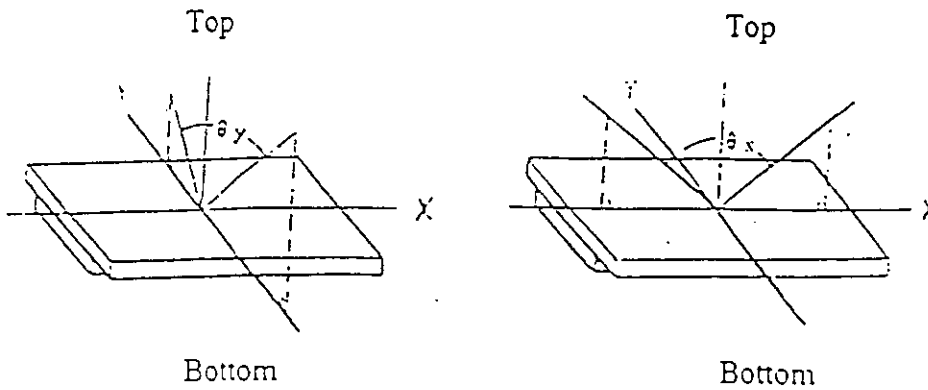
Top=25°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle		$\theta_x$	Cr>2 $\theta_y=0^\circ$	-30	--	30	Deg	
		$\theta_y$						
Contrast Ratio		Cr	$\theta_x=0^\circ$ $\theta_y=0^\circ$	4.0				
Response Time	Turn on	T <sub>on</sub>	$\theta_x=0^\circ$ $\theta_y=0^\circ$			250	ms	
	Turn off	T <sub>off</sub>				250		

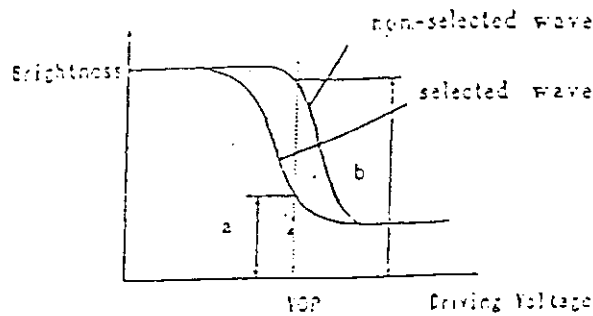
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## 6.2 Definition of optical characteristics

### 6.2.1 Definition of viewing Angle(see fig. as follow)



### 6.2.2 Definition of Contrast Ratio(see fig. as follow)

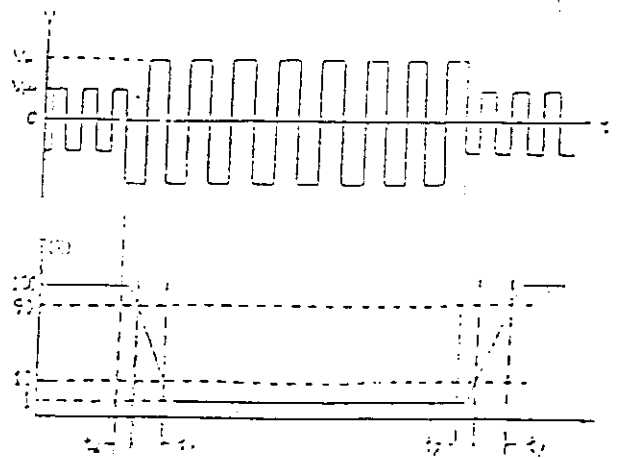


$$\text{Contrast Ratio} = b / a = \frac{\text{non-selected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25 °C ;
- 2) Frame frequency: 64Hz

### 6.2.3 Definition of Response time(see fig. as follow)



Turn-on time:  $t_{on} = t_d + t_r$

Turn-off time:  $t_{off} = t_d + t_r$

Measuring Condition:

- 1) Operating Voltage: 4.5 V ;
- 2) Frame frequency: 64Hz



## 7.2 Failure Judgment Criterion

Criterion Item	Test Item No.									Failure Judgement Criterion
	1	2	3	4	5	6	7	8	9	
Basic Specification	0	0	0	0	0	0	0	0	0	Out of the basic Specification
Electrical specification	0	0	0	0	0					Out of the electrical specification
Mechanical Specification							0	0		Out of the mechanical specification
Optical Characteristic	0	0	0	0	0	0			0	Out of the optical specification
Remark	Basic specification = Optical specification + Mechanical specification									

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## 8 Precautions for use of LCD Modules

### 8.1 Handling Precautions

- 8.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 8.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 8.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 8.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 8.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
- Isopropyl alcohol
  - Ethyl alcohol
- Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
- Water
  - Ketone
  - Aromatic solvents
- 8.1.6 Do not attempt to disassemble the LCD Module.
- 8.1.7 If the logic circuit power is off, do not apply the input signals.
- 8.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- a. Be sure to ground the body when handling the LCD Modules.
  - b. Tools required for assembly, such as soldering irons, must be properly ground.
  - c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
  - d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

