

# *Crystalfontz America, Inc.*

## **SPECIFICATION**

**CUSTOMER :** \_\_\_\_\_

**MODULE NO.:**           **CFAG12864K-TMI-TN**          

<b>SALES BY</b>	<b>APPROVED BY</b>	<b>CHECKED BY</b>	<b>PREPARED BY</b>
<b>ISSUED DATE:</b>			

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# Contents

1. Module Classification Information
2. Precautions in use of LCD Modules
3. General Specification
4. Absolute Maximum Ratings
5. Electrical Characteristics
6. Optical Characteristics
7. Interface Description
8. Contour Drawing & Block Diagram
9. Timing Characteristics
10. Display Control Instruction
11. Detailed Explanation
12. Reliability
13. Backlight Information
14. Inspection specification
15. Material List of Components for RoHs

# 1.Module Classification Information

CFA G 12864 K TMI TN

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

①	Brand: <b>CRYSTALFONTZ AMERICA, INC</b>													
②	Display Type: H→Character Type, <b>G→Graphic Type</b>													
③	Displays Logical Dimensions: <b>128 pixels by 64 pixels</b>													
④	Model PCB Variant: <b>K</b>													
⑤	Backlight Type:	<table border="0"> <tr> <td>N→Without backlight</td> <td><b>T→LED, White</b></td> </tr> <tr> <td>B→EL, Blue green</td> <td>A→LED, Amber</td> </tr> <tr> <td>D→EL, Green</td> <td>R→LED, Red</td> </tr> <tr> <td>W→EL, White</td> <td>O→LED, Orange</td> </tr> <tr> <td>F→CCFL, White</td> <td>G→LED, Green</td> </tr> <tr> <td>Y→LED, Yellow Green</td> <td></td> </tr> </table>	N→Without backlight	<b>T→LED, White</b>	B→EL, Blue green	A→LED, Amber	D→EL, Green	R→LED, Red	W→EL, White	O→LED, Orange	F→CCFL, White	G→LED, Green	Y→LED, Yellow Green	
N→Without backlight	<b>T→LED, White</b>													
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⑥	LCD Mode:	<table border="0"> <tr> <td>B→TN Positive, Gray</td> <td>T→FSTN Negative</td> </tr> <tr> <td>N→TN Negative,</td> <td></td> </tr> <tr> <td>G→STN Positive, Gray</td> <td></td> </tr> <tr> <td>Y→STN Positive, Yellow Green</td> <td></td> </tr> <tr> <td><b>M→STN Negative, Blue</b></td> <td></td> </tr> <tr> <td>F→FSTN Positive</td> <td></td> </tr> </table>	B→TN Positive, Gray	T→FSTN Negative	N→TN Negative,		G→STN Positive, Gray		Y→STN Positive, Yellow Green		<b>M→STN Negative, Blue</b>		F→FSTN Positive	
B→TN Positive, Gray	T→FSTN Negative													
N→TN Negative,														
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<b>M→STN Negative, Blue</b>														
F→FSTN Positive														
⑦	LCD Polarizer Type/ Temperature range/ View direction	<table border="0"> <tr> <td>A→Reflective, N.T, 6:00</td> <td>H→Transflective, W.T,6:00</td> </tr> <tr> <td>D→Reflective, N.T, 12:00</td> <td>K→Transflective, W.T,12:00</td> </tr> <tr> <td>G→Reflective, W. T, 6:00</td> <td>C→Transmissive, N.T,6:00</td> </tr> <tr> <td>J→Reflective, W. T, 12:00</td> <td>F→Transmissive, N.T,12:00</td> </tr> <tr> <td>B→Transflective, N.T,6:00</td> <td><b>I→Transmissive, W. T, 6:00</b></td> </tr> <tr> <td>E→Transflective, N.T.12:00</td> <td>L→Transmissive, W.T,12:00</td> </tr> </table>	A→Reflective, N.T, 6:00	H→Transflective, W.T,6:00	D→Reflective, N.T, 12:00	K→Transflective, W.T,12:00	G→Reflective, W. T, 6:00	C→Transmissive, N.T,6:00	J→Reflective, W. T, 12:00	F→Transmissive, N.T,12:00	B→Transflective, N.T,6:00	<b>I→Transmissive, W. T, 6:00</b>	E→Transflective, N.T.12:00	L→Transmissive, W.T,12:00
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⑧	Special Code	<table border="0"> <tr> <td><b>T→Negative voltage generator on board and temperature compensation</b></td> </tr> <tr> <td><b>A→ICNT7107 ICNT7108</b></td> </tr> </table>	<b>T→Negative voltage generator on board and temperature compensation</b>	<b>A→ICNT7107 ICNT7108</b>										
<b>T→Negative voltage generator on board and temperature compensation</b>														
<b>A→ICNT7107 ICNT7108</b>														

## **2.Precautions in use of LCD Modules**

- (1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2) Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
- (3) Don't disassemble the LCM.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7) Storage: please storage in anti-static electricity container and clean environment.

## **3.General Specification**

<b>Item</b>	<b>Dimension</b>	<b>Unit</b>
Number of Characters	128 x 64 dots	—
Module dimension	113 x 53.0 x 13.6(MAX)	mm
View area	72.0 x 40.0	mm
Active area	66.52 x 33.24	mm
Dot size	0.48 x 0.48	mm
Dot pitch	0.52 x 0.52	mm
LCD type	STN Negative , Transmissive, Blue	
Duty	1/64	
View direction	6 o'clock	
Backlight Type	LED, White	

## **4. Absolute Maximum Ratings**

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	$T_{OP}$	-20	—	+70	°C
Storage Temperature	$T_{ST}$	-30	—	+80	°C
Input Voltage	$V_I$	0	—	$V_{DD}$	V
Supply Voltage For Logic	$V_{DD}$	0	—	6.7	V
Supply Voltage For LCD	$V_{DD}-V_0$	0	—	16.7	V
Supply Voltage For LCD	$V_{DD}-V_{OUT}$	—	—	-10	V

## **5. Electrical Characteristics**

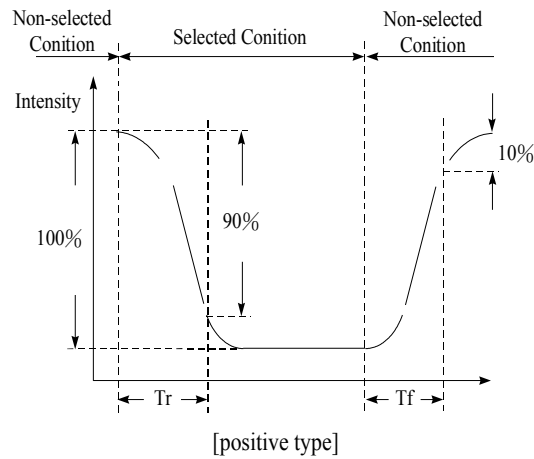
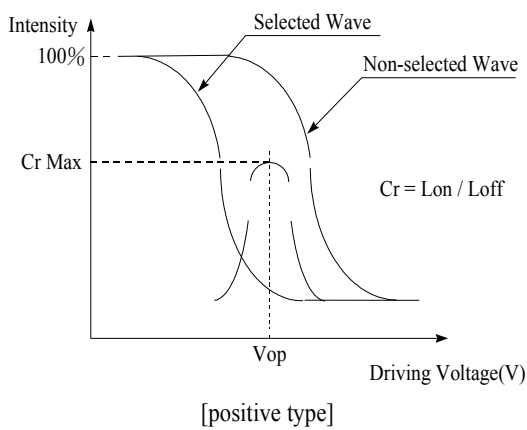
Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	$V_{DD}-V_{SS}$	—	4.5	5.0	5.5	V
Supply Voltage For LCD	$V_{DD}-V_0$	$T_a=-20^{\circ}\text{C}$	—	—	10.8	V
		$T_a=25^{\circ}\text{C}$	—	—	—	V
		$T_a=+70^{\circ}\text{C}$	—	8.8	—	V
			7.5	—	—	V
Input High Volt.	$V_{IH}$	—	2.0	—	$V_{DD}$	V
Input Low Volt.	$V_{IL}$	—	0	—	0.8	V
Output High Volt.	$V_{OH}$	—	2.4	—	$V_{DD}$	V
Output Low Volt.	$V_{OL}$	—	0	—	0.4	V
Supply Current	$I_{DD}$	—	—	8.28	—	mA

# 6. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V) $\theta$	$CR \geq 2$	20	—	40	deg
	(H) $\phi$	$CR \geq 2$	-30	—	30	deg
Contrast Ratio	CR	—	—	3	—	—
Response Time	T rise	—	—	200	300	ms
	T fall	—	—	200	300	ms

## Definition of Operation Voltage (Vop)

## Definition of Response Time (Tr, Tf)



## Conditions :

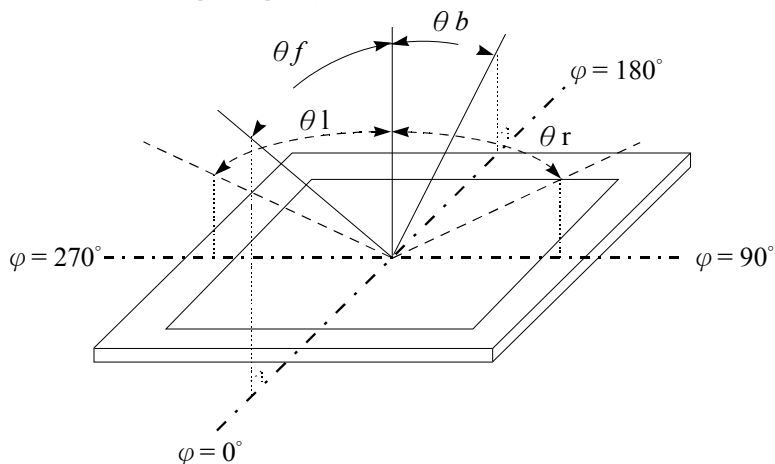
Operating Voltage : Vop

Viewing Angle( $\theta$ ,  $\phi$ ) :  $0^\circ$ ,  $0^\circ$

Frame Frequency : 64 HZ

Driving Waveform : 1/N duty, 1/a bias

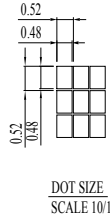
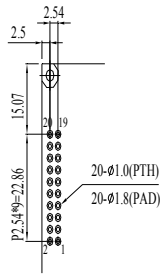
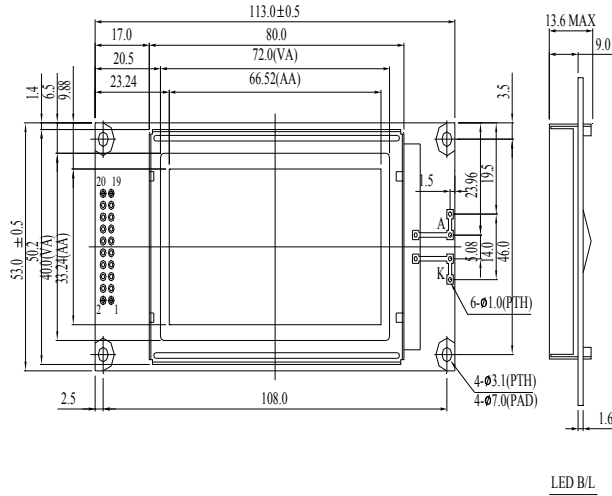
## Definition of viewing angle( $CR \geq 2$ )



## **7.Interface Description**

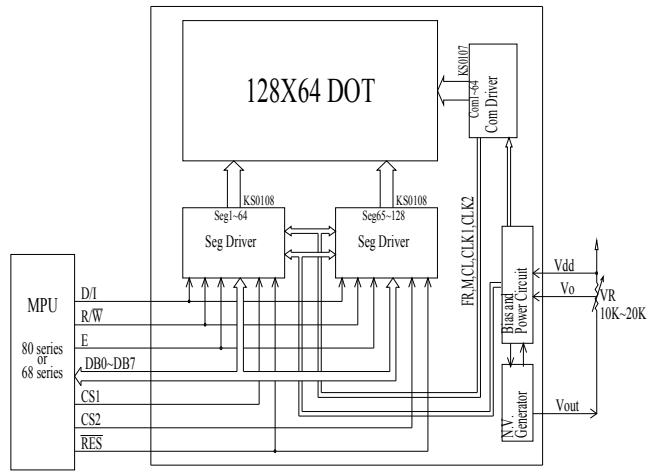
Pin No.	Symbol	Level	Description
1	V <sub>SS</sub>	0V	Ground
2	V <sub>DD</sub>	5.0V	Supply voltage for logic
3	V <sub>O</sub>	(Variable)	Operating voltage for LCD
4	D/I	H/L	H: Data , L : Instruction
5	R/W	H/L	H: Read (MPU←Module) , L: Write (MPU→Module)
6	E	H	Enable signal
7	DB0	H/L	Data bus line
8	DB1	H/L	Data bus line
9	DB2	H/L	Data bus line
10	DB3	H/L	Data bus line
11	DB4	H/L	Data bus line
12	DB5	H/L	Data bus line
13	DB6	H/L	Data bus line
14	DB7	H/L	Data bus line
15	CS1	H	Select Column 1~ Column 64
16	CS2	H	Select Column 65~ Column 128
17	/RST	L	Reset signal
18	Vout	—	Negative Voltage
19	A	—	Power Supply for LED backlight ( + )
20	K	—	Power Supply for LED backlight ( - )

# 8. Contour Drawing & Block Diagram



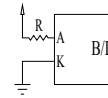
The non-specified tolerance of dimension is  $\pm 0.3\text{mm}$ .

PIN NO.	SYMBOL
1	V <sub>ss</sub>
2	V <sub>dd</sub>
3	V <sub>o</sub>
4	D/I
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	CS1
16	CS2
17	RES
18	V <sub>out</sub>
19	A
20	K

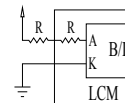


## LED B/L Drive Method

1. Drive from A,K

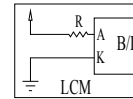


2. Drive from pin19, pin20



(Will never get V<sub>ee</sub> output from pin19)

3. Drive from V<sub>dd</sub>, V<sub>ss</sub>



(Contrast performance may go down.)

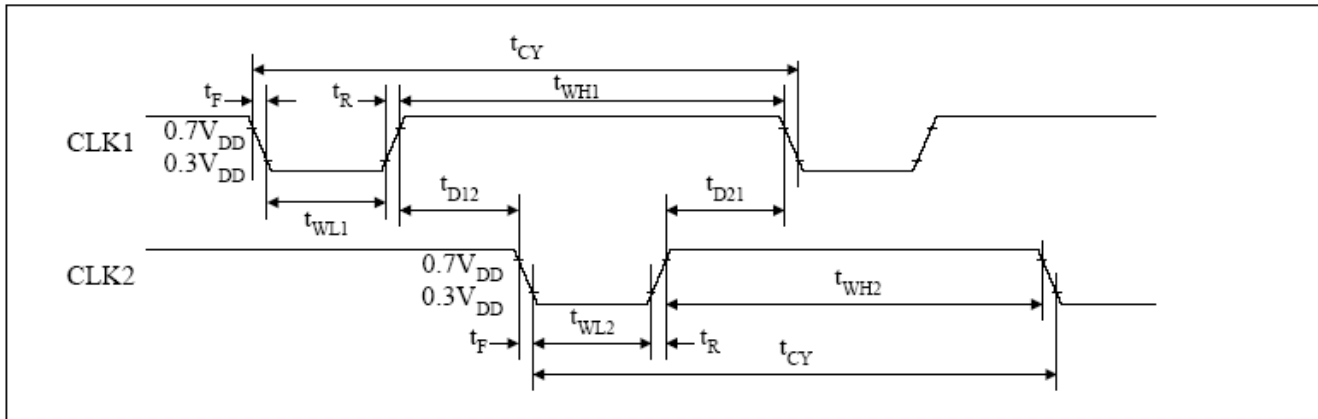
External contrast adjustment.



# 9. Timing Characteristics

## Clock Timing

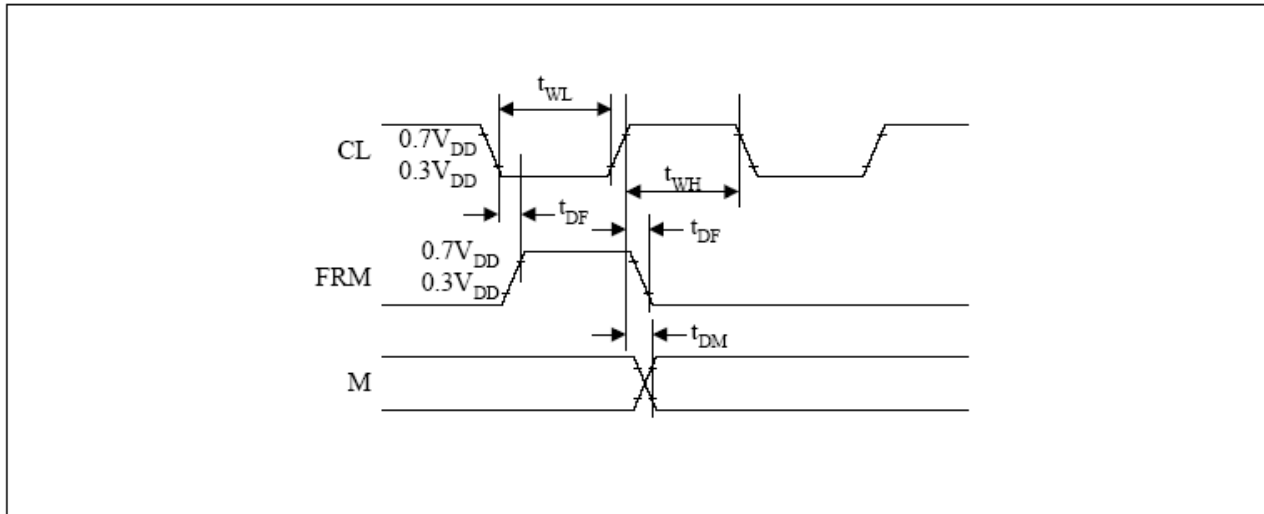
Characteristic	Symbol	Min	Type	Max	Unit
CLK1, CLK2 cycle time	$t_{CY}$	2.5	-	20	$\mu s$
CLK1 "low" level width	$t_{WL1}$	625	-	-	ns
CLK2 "low" level width	$t_{WL2}$	625	-	-	
CLK1 "high" level width	$t_{WH1}$	1875	-	-	
CLK2 "high" level width	$t_{WH2}$	1875	-	-	
CLK1-CLK2 phase difference	$t_{D12}$	625	-	-	
CLK2-CLK1 phase difference	$t_{D21}$	625	-	-	
CLK1, CLK2 rise time	$t_R$	-	-	150	
CLK1, CLK2 fall time	$t_F$	-	-	150	



External Clock Waveform

### Display Control Timing

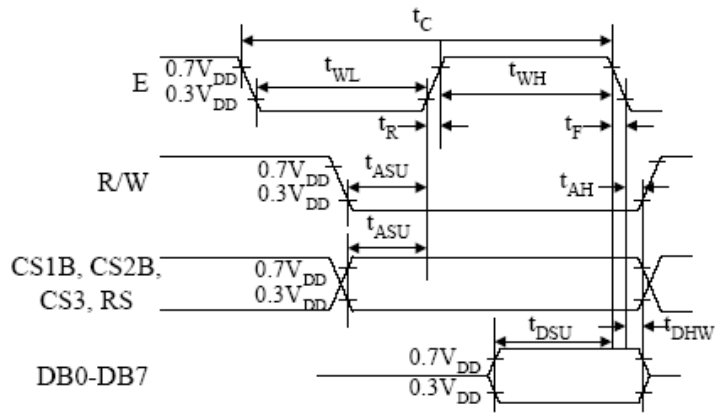
Characteristic	Symbol	Min	Type	Max	Unit
FRM delay time	t <sub>DF</sub>	-2	-	2	μs
M delay time	t <sub>DM</sub>	-2	-	2	
CL "low" level width	t <sub>WL</sub>	35	-	-	
CL "high" level width	t <sub>WH</sub>	35	-	-	



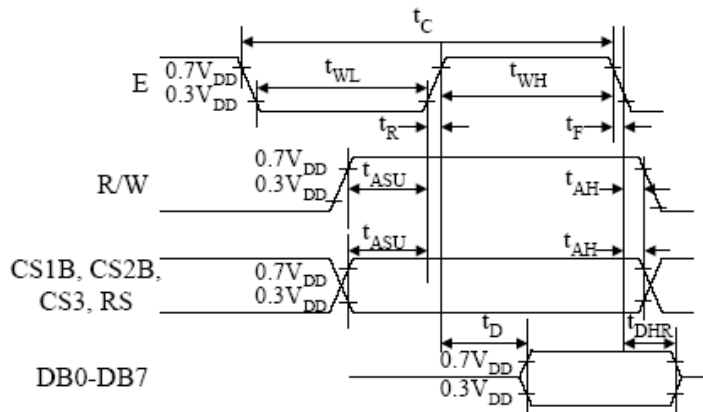
Display Control Waveform

### MPU Interface

Characteristic	Symbol	Min	Type	Max	Unit
E cycle	t <sub>c</sub>	1000	-	-	ns
E high level width	t <sub>WH</sub>	450	-	-	
E low level width	t <sub>WL</sub>	450	-	-	
E rise time	t <sub>r</sub>	-	-	25	
E fall time	t <sub>f</sub>	-	-	25	
Address set-up time	t <sub>ASU</sub>	140	-	-	
Address hold time	t <sub>AH</sub>	10	-	-	
Data set-up time	t <sub>DSU</sub>	200	-	-	
Data delay time	t <sub>D</sub>	-	-	320	
Data hold time (write)	t <sub>DHW</sub>	10	-	-	
Data hold time (read)	t <sub>DHR</sub>	20	-	-	

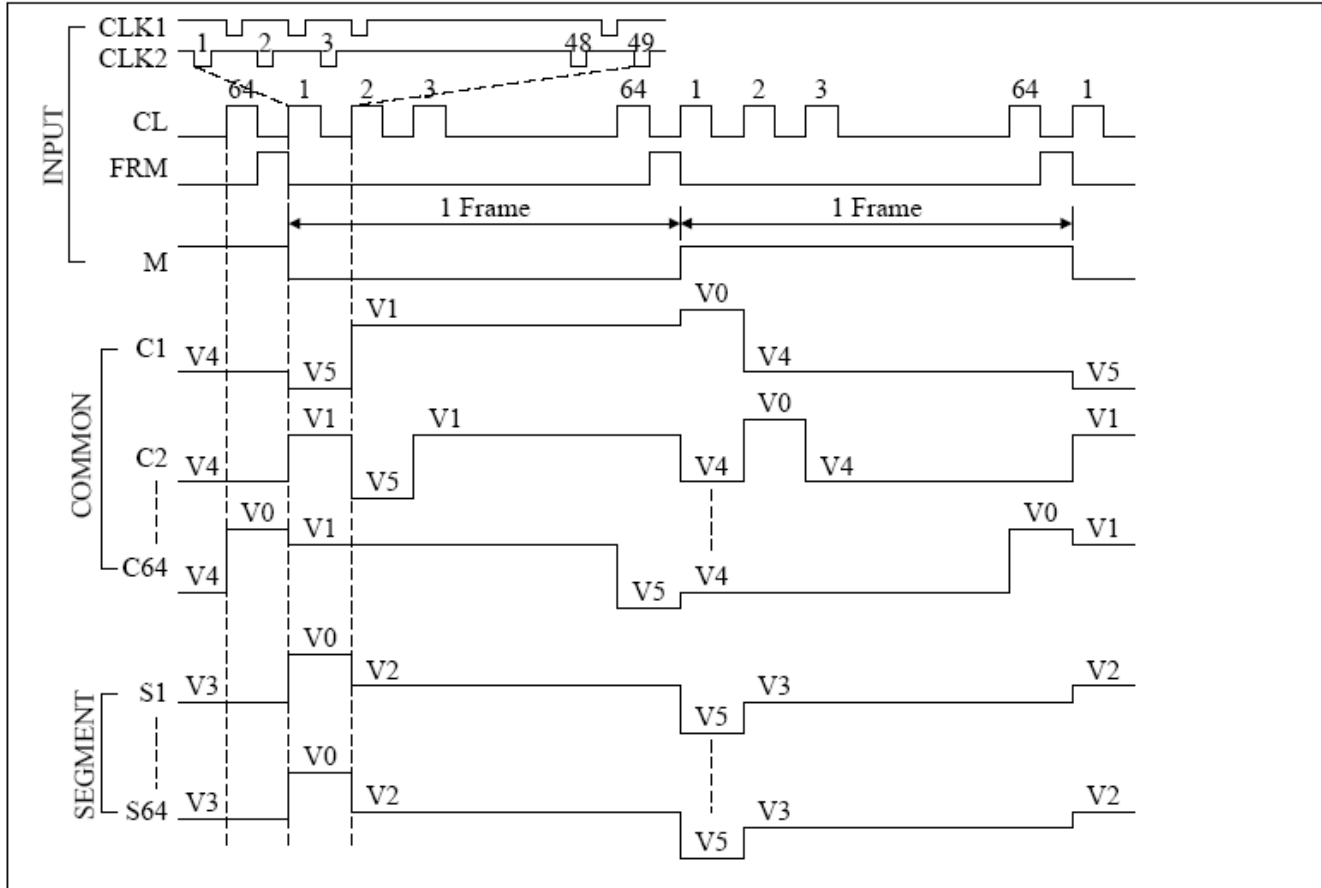


**MPU Write Timing**



**MPU Read Timing**

# TIMING DIAGRAM (1/64 DUTY)



# 10. Display Control Instruction

The display control instructions control the internal state of the NT7108. Instruction is received from MPU to NT7108 for the display control. The following table shows various instructions.

Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function	
Display on/off	L	L	L	L	H	H	H	H	H	L/H	Controls the display on or off. Internal status and display RAM data is not affected. L:OFF, H:ON	
Set address (Y address)	L	L	L	H	Y address (0-63)						Sets the Y address in the Y address counter.	
Set page (X address)	L	L	H	L	H	H	H	Page (0-7)			Sets the X address at the X address register.	
Display Start line (Z address)	L	L	H	H	Display start line (0-63)						Indicates the display data RAM displayed at the top of the screen.	
Status read	L	H	Busy	L	On/Off	Reset	L	L	L	L	Read status. BUSY L: Ready H: In operation ON/OFF L: Display ON H: Display OFF RESET L: Normal H: Reset	
Write display data	H	L	Write data									Writes data (DB0: 7) into display data RAM. After writing instruction, Y address is increased by 1 automatically.
Read display data	H	H	Read data									Reads data (DB0: 7) from display data RAM to the data bus.

# **11.Detailed Explanation**

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	1	1	1	D

**The display data appears when D is 1 and disappears when D is 0. Though the data is not on the**

screen with D=0, it remains in the display data RAM. Therefore, you can make it appear by changing D=0 into D=1.

## **SET ADDRESS (Y ADDRESS)**

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Y address (AC0-AC5) of the display data RAM is set in the Y address counter. An address is set by instruction and increased by 1 automatically by read or write operations of display data.

## **SET PAGE (X ADDRESS)**

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	1	1	AC2	AC1	AC0

X address (AC0-AC2) of the display data RAM is set in the X address register. Writing or reading to or from MPU is executed in this specified page until the next page is set.

## **DISPLAY START LINE (Z ADDRESS)**

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	AC5	AC4	AC3	AC2	AC1	AC0

Z address (AC0-AC5) of the display data RAM is set in the display start line register and displayed at the top of the screen. When the display duty cycle is 1/64 or others (1/32-1/64), the data of total line number of LCD screen, from the line specified by display start line instruction, is displayed.

## STATUS READ

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BUSY	0	ON/OFF	RESET	0	0	0	0

- BUSY

When BUSY is 1, the Chip is executing internal operation and no instructions are accepted.

When BUSY is 0, the Chip is ready to accept any instructions.

- ON/OFF

When ON/OFF is 1, the display is OFF.

When ON/OFF is 0, the display is ON.

- RESET

When RESET is 1, the system is being initialized.

In this condition, no instructions except status read can be accepted.

When RESET is 0, initializing has finished and the system is in usual operation condition.

## WRITE DISPLAY DATA

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Writes data (D0-D7) into the display data RAM. After writing instruction, Y address is increased by 1 automatically.

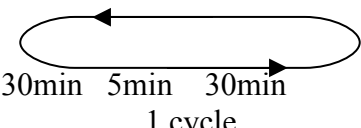
## READ DISPLAY DATA

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Reads data (D0-D7) from the display data RAM. After reading instruction, Y address is increased by 1 automatically.

# 12. Reliability

## Content of Reliability Test (wide temperature, -20°C~70°C)

Environmental Test			
Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80°C 200hrs	2
Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30°C 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70°C 200hrs	—
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20°C 200hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60°C,90%RH max For 96hrs under no-load condition excluding the polarizer, Then taking it out and drying it at normal temperature.	60°C,90%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation -20°C 25°C 70°C  1 cycle	-20°C/70°C 10 cycles	—
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	3
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V,RS=1.5kΩ CS=100pF 1 time	—

**Note1: No dew condensation to be observed.**

**Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.**

**Note3: Vibration test will be conducted to the product itself without putting it in a container.**



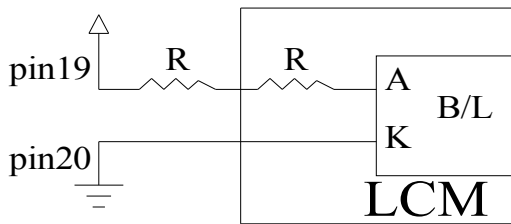
# 13. Backlight Information

## Specification

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION
Supply Current	I <sub>LED</sub>	64	80	120	mA	V=3.5V
Supply Voltage	V	3.4	3.5	3.6	V	—
Reverse Voltage	V <sub>R</sub>	—	—	5	V	—
Luminous Intensity	I <sub>V</sub>	10		—	CD/M <sup>2</sup>	I <sub>LED</sub> =80mA
Wave Length	λ <sub>p</sub>	—		—	nm	I <sub>LED</sub> =80mA
Life Time	—	—	10K	—	Hr.	I <sub>LED</sub> ≤ 80mA
Color	White					

**Note:** The LED of B/L is drive by current only, drive voltage is for reference only. drive voltage can make driving current under safety area (current between minimum and maximum).

2. Drive from pin19, pin20



(Will never get Vee output from pin19)