
SPECIFICATION



(ISO9001:2008)

PRODUCT : LCM
MODEL NO. : HC2021-B-LWH
SUPPLIER : TSINGTEK DISPLAY CO.,LTD
REVISION : B

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[illegible]

PRODUCT CODING SYSTEM

HG 320240 C – B - LW H- NV- L4- TPSD- U- T

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

- (1): Brand and Display Type
 HC→Tsingtek Character Type
 HG→Tsingtek SMT/COB Graphic Type
 HGT→Tsingtek TAB Type
 HGO→Tsingtek COG Type
 HGR→Tsingtek CSTN
 HGF→Tsingtek TFT
 HGS→Tsingtek OLED
 HCS→Tsingtek Character Type OLED
- (2): Character→Words per lines×lines
 Graphic→row dots×column dots
- (3): Series No.
- (4): LCD module:
 Nil→STN Yellow-Green Mode
 G→STN Gray Mode
 B→STN Blue Mode
 F→FSTN Transflective
 T→FSTN Transmission
 OLED module:
 Y→Yellow
 G→Green
 B→Blue
 W→White
- (5): Backlight Type
 Nil→Without Backlight
 LY→LED Yellow-Green Array
 SY→LED Yellow-Green Edge
 LW→LED White
 LB→LED Blue
 LR→LED Red
 LA→LED Amber
 LG→LED Green
- EB→EL Blue
 EG→EL Green
 EW→EL White
 CW→CCFL White
- (6): Temperature
 Nil→Normal Temperature
 H→Wide Temperature
 EH→Super Wide Temperature
- (7): Power Supply
 Nil→5V
 NV→5V Without Booster for LCM Driving Supply
 SV→5V With Temperature Compensation
 LV→3.3V
 LNV→3.3V Without Booster for LCM Driving Supply
 LSV→3.3V With Temperature Compensation
 OV→Please refer to the spc.of LCM
- (8): Power supply for Backlight
 Please refer to the spc.of LCM
- (9): Special Coding
 TP→With Touch Panel
 S→Serial Interface
- (10): Viewing Direction
 Nil→6:00
 U→12:00
 L→9:00
 R→3:00
- (11): Interior Coding

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1. BASIC SPECIFICATIONS

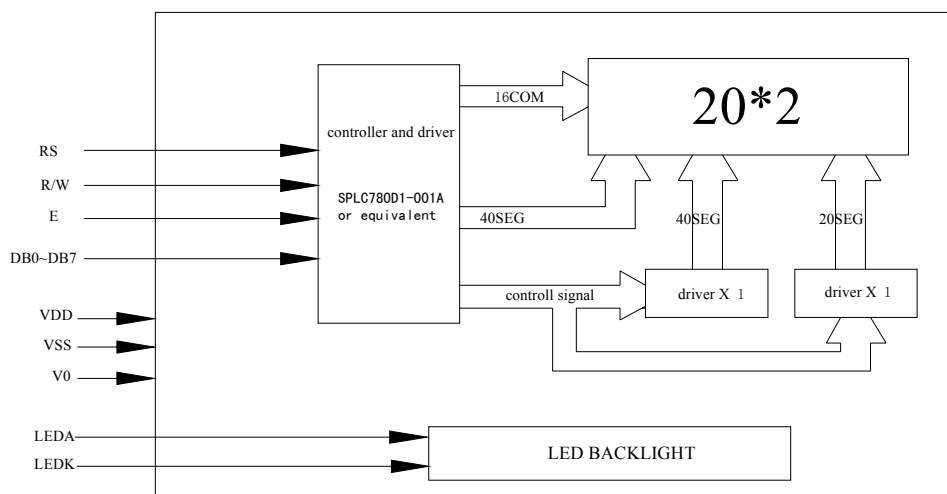
1.1 DISPLAY SPECIFICATION

ITEM	SPECIFICATION
DISPLAY TYPE	STN/BLUE/NEGATIVE/TRANSMISSIVE
COLOR	DISPLAY DOT: WHITE
	DISPLAY BACKGROUNTDND:BLUE
INPUT DATA	4/8 BIT PARALLEL
DUTY	1/16DUTY
VIEW ANGLE	6 O'CLOCK
CONTROLLER	SPLC780D1-001A OR EQUIVALENT
BEZEL	0.6T
BACKLIGHT	LED (WHITE)
OPERATING TEMPERATURE	-20 °C ~70 °C
STORAGE TEMPERATURE	-30 °C ~ 80 °C
OTHERS	

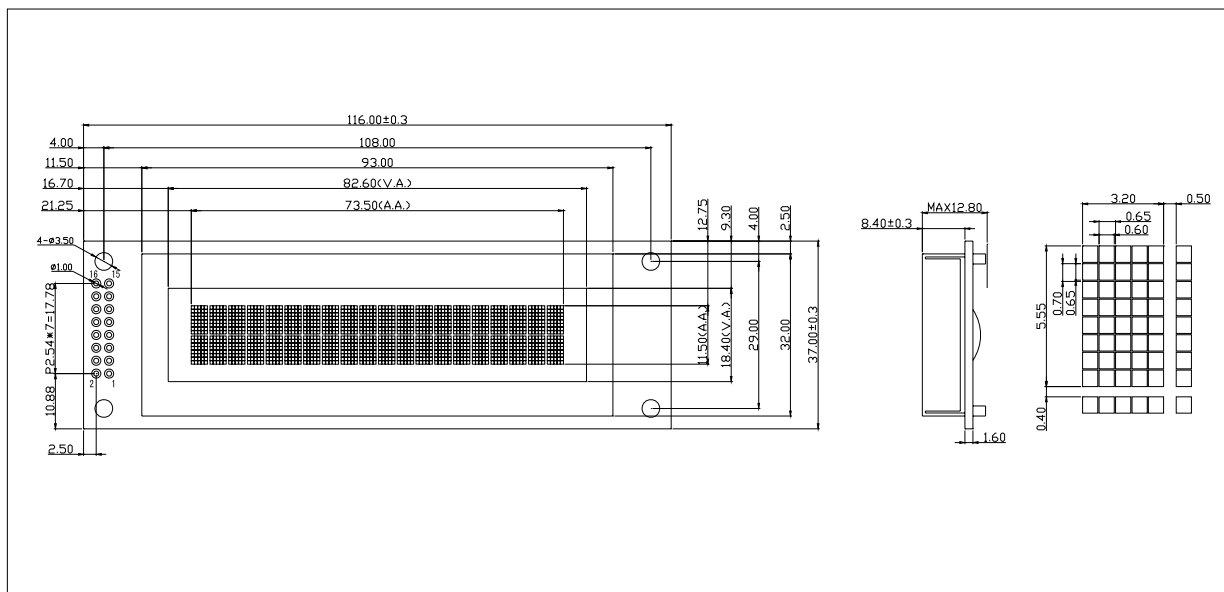
1.2 MECHANICAL SPECIFICATION

ITEM	SPECIFICATION	UNIT	NOTE
DIMENSIONAL OUTLINE	116.0(W)×37.0(H)×12.8MAX.(T)	mm	
VIEW AREA	82.6(W)×18.4(H)	mm	
EFFECTIVE V/AREA	73.5(W)×11.5(H)	mm	
NUMBER OF CHARACTERS	20 characters x 2 Lines	---	
CHARACTER PITCH	3.20(W)×5.55(H)	mm	
DOT SIZE	0.60(W)×0.65(H)	mm	

1.3 BLOCK DIAGRAM



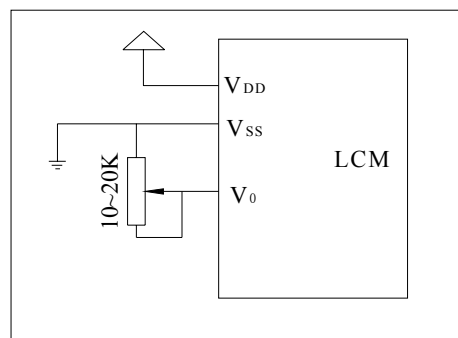
1.4 DIMENSIONAL OUTLINE



1.5 TERMINAL FUNCTIONS

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	V _{SS}	0V	GND
2	V _{DD}	+5.0V	Power Supply for logic
3	V ₀	-	Operating voltage for LCD
4	RS	H/L	H: Data L: Instruction code
5	R/W	H/L	H: Read L: Write
6	E	H→L	Chip Enable signal
7~14	DB0~DB7	H/L	Data bus line
15	LEDA	+5.0V	Power Supply for LED Back Light
16	LEDK	0V	

1.6 POWER SUPPLY AND CONTRAST ADJUST CIRCUIT



2. ABSOLUTE MAXIMUM RATINGS

(Ta=25 °C, V_{SS}=0V)

PARAMETER	SYMBOL	RATINGS	UNITS
POWER SUPPLY FOR LOGIC	V _{DD} -V _{SS}	-0.3 ~ 7.0	V
POWER SUPPLY FOR LCD DRIVER	V _{DD} ~V _S	-0.3 ~ 5.5	V
INPUT VOLTAGE	V _{IN}	V _{SS} ~ V _{DD}	V
OPERATING TEMPERATURE	T _{opr}	-20 ~70	°C
STORAGE TEMPERATURE	T _{stg}	-30 ~ 80	°C

3. ELECTRICAL CHARACTERISTICS

3.1 ELECTRICAL CHARACTERISTICS

(Ta=25 °C ,V_{SS}=0V)

ITEM	SYMBOL	CONDITION	MIN	TYPE	MAX.	UNIT	NOTE
LOGIC CIRCUIT POWER SUPPLY VOLTAGE	V _{DD} -V _{SS}	--	4.5	5.0	5.3	V	
INPUT VOLTAGE	V _{IL}	--	-0.3	--	0.6	V	
INPUT VOLTAGE	V _{IH}	--	2.2	--	V _{DD}	V	
OUTPUT VOLTAGE	V _{OL}	--	0	--	0.4	V	
OUTPUT VOLTAGE	V _{OH}	--	2.4	--	V _{DD}	V	
LOGIC CIRCUIT POWER SUPPLY CURRENT	I _{DD}	V _{DD} -V _{SS} =5.0V	--	1.5	--	mA	
RECOMMENDED LCD DRIVING VOLTAGE	*V _{LCD} Φ=0 θ=0	Ta=25 °C	--	4.7	--	V	

*Note: VLCD is produced by module's inside circuit, do not need the external input. The customer only need to offer +5.0V voltage which is stated in the interface definition.

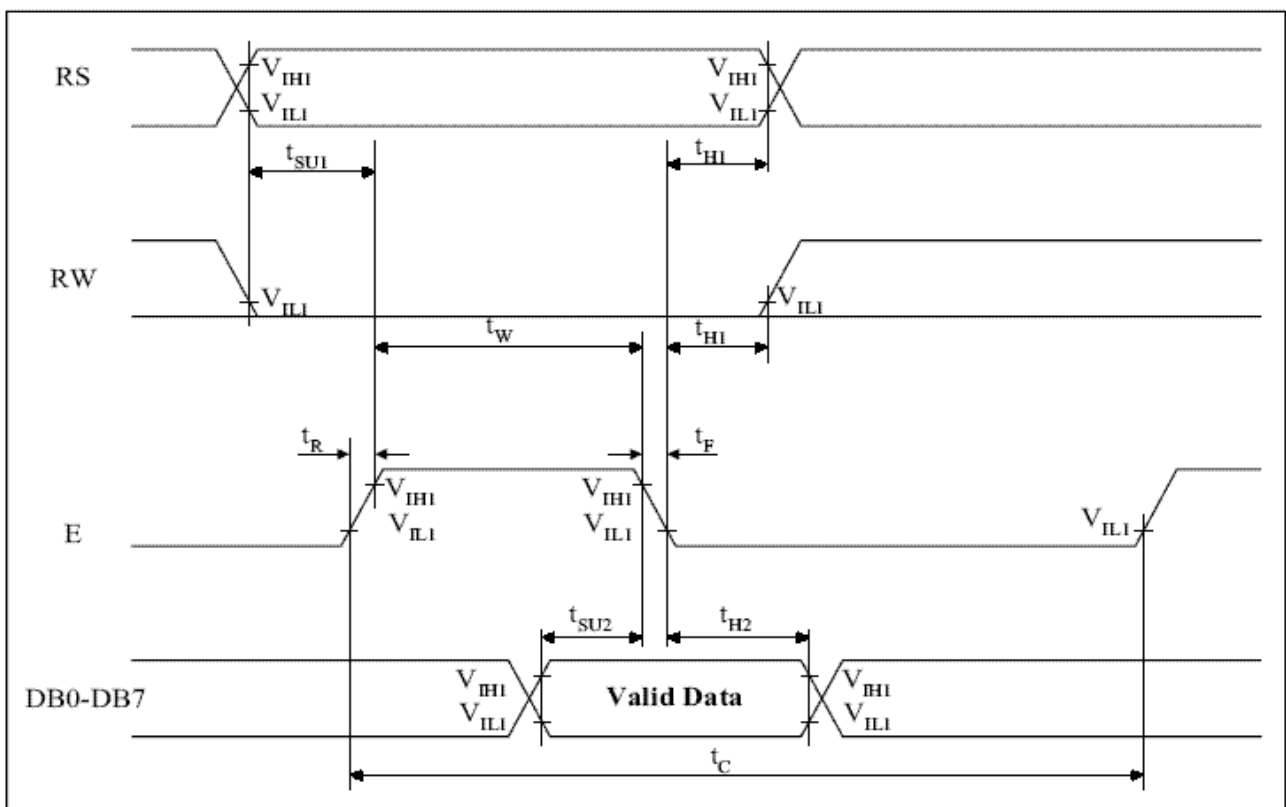
3.2 LED BACKLIGHT SPECIFICATION

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
FORWARD VOLTAGE	Vf	3.0	3.1	3.2	V	If= 30mA
COLOR	WHITE					

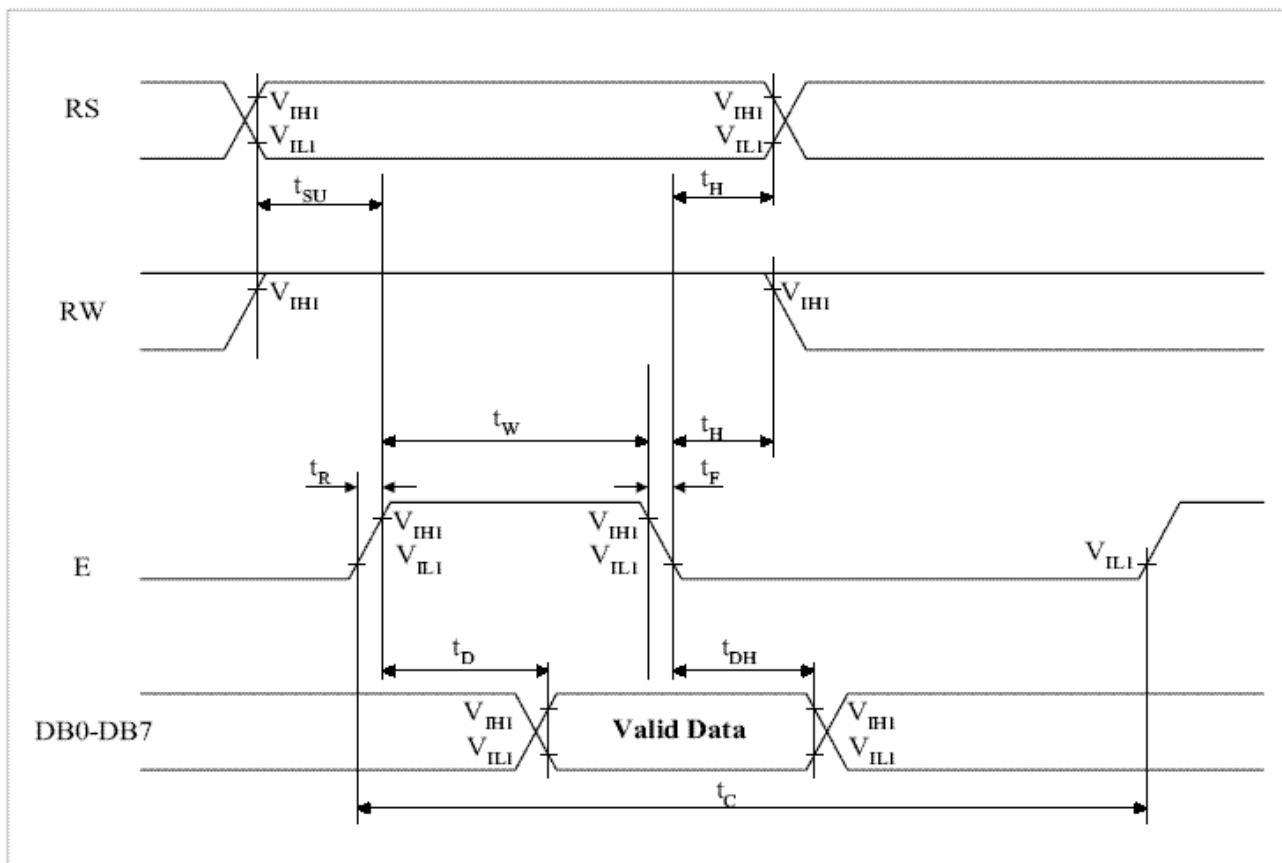
4. TIMING CHARACTERISTICS

($V_{DD} = 4.5V \sim 5.5V$, $T_a = -30 \sim +85^{\circ}C$)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write mode (refer to Fig.6)	E cycle time	t_C	500	-	-	ns
	E rise/fall time	t_R, t_F	-	-	20	
	E pulse width (high, low)	t_W	230	-	-	
	R/W and RS setup time	t_{SU1}	40	-	-	
	R/W and RS hold time	t_{H1}	10	-	-	
	Data setup time	t_{SU2}	60	-	-	
	Data hold time	t_{H2}	10	-	-	
Read mode (refer to Fig.7)	E cycle time	t_C	500	-	-	ns
	E rise/fall time	t_R, t_F	-	-	20	
	E pulse width (high, low)	t_W	230	-	-	
	R/W and RS setup time	t_{SU}	40	-	-	
	R/W and RS hold time	t_H	10	-	-	
	Data output delay time	t_D	-	-	120	
	Data hold time	t_{DH}	5	-	-	



Write mode timing diagram



Read mode timing diagram

5. COMMANDS AND FUNCTION DESCRIPTIONS

System Interface

This chip has all two kinds of interface type with MPU: 4-bit and 8-bit bus. 4-bit bus and 8-bit bus is selected by DL bit in the instruction register.

During read or write operation, two 8-bit registers are used. One is data register (DR), the other is instruction register (IR).

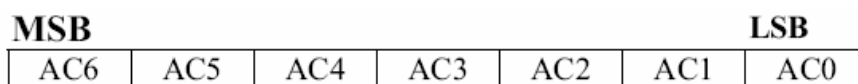
The data register (DR) is used as temporary data storage place for being written into or read from DDRAM/CGRAM, target RAM is selected by RAM address setting instruction. Each internal operation, reading from or writing into RAM, is done automatically. So to speak, after MPU reads DR data, the data in the next DDRAM/CGRAM address is transferred into DR automatically. Also after MPU writes data to DR, the data in DR is transferred into DDRAM/CGRAM automatically.

The Instruction register (IR) is used only to store instruction code transferred from MPU. MPU cannot use it to read instruction data.

To select register, use RS input pin in 4-bit/8-bit bus mode.

Table 1. Various kinds of operations according to RS and R/W bits.

RS	R/W	Operation
L	L	Instruction Write operation (MPU writes Instruction code into IR)
L	H	Read Busy Flag (DB7) and address counter (DB0~DB6)
H	L	Data Write operation (MPU writes data into DR)
H	H	Data Read operation (MPU reads data from DR)

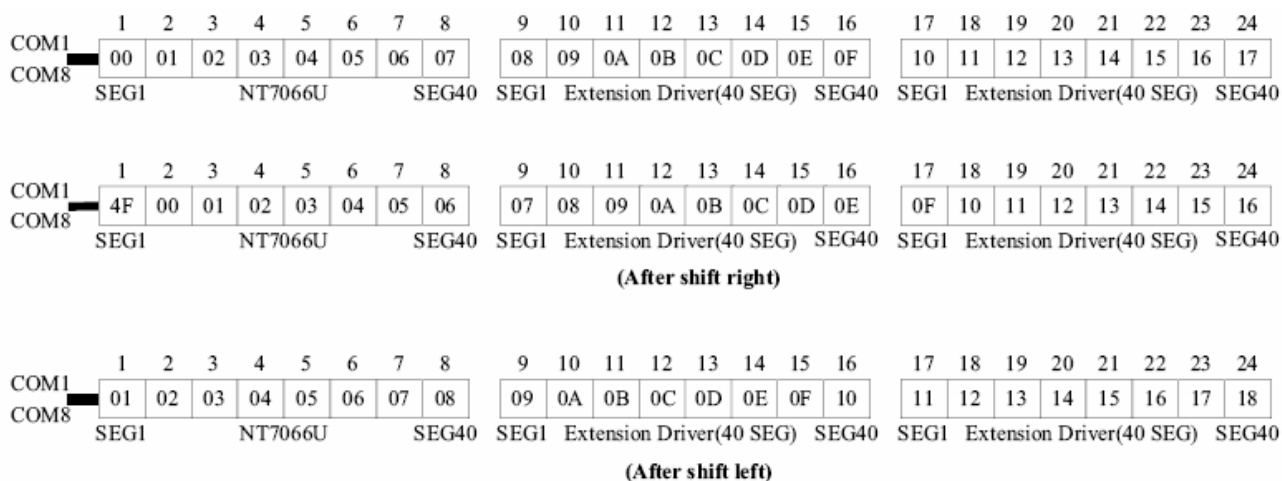
**Fig.1. DDRAM Address**

1) 1 line display

In case of 1 line display, the address range of DDRAM is 00H ~ 4FH. Extension driver will be used. Fig.2 shows the example that 40 segment extension driver is added.

2) 2 line display

In case of 2 line display, the address range of DDRAM is 00H ~ 27H, 40H ~ 67H. Extension driver will be used. Fig.3 shows the example that 40 segment extension driver is added.

**Fig.2. 1-line X 24ch, display with 40 SEG & extension driver.**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
COM1	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17
COM8																								
COM9	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57
COM16	SEGI	NT7066U						SEG40	SEGI	Extension Driver(40 SEG)						SEG40	SEGI	Extension Driver(40 SEG)						SEG40
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
COM1	27	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16
COM8																								
COM9	67	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56
COM16	SEGI	NT7066U						SEG40	SEGI	Extension Driver(40 SEG)						SEG40	SEGI	Extension Driver(40 SEG)						SEG40
	(After shift right)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
COM1	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18
COM8																								
COM9	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58
COM16	SEGI	NT7066U						SEG40	SEGI	Extension Driver(40 SEG)						SEG40	SEGI	Extension Driver(40 SEG)						SEG40
	(After shift left)																							

Fig.3. 2-line X 24ch, display with 40 SEG & extension driver.

CGROM (Character Generator ROM)

CGROM has 5 x 8 dot, 208 character, 5 x 11 dot, 32 characters pattern. (Refer to Table 2)

CGRAM (Character Generator RAM)

CGRAM has up to 5 x 8 dot, 8 characters. By writing font data to CGRAM, user defined character can be used. (Refer to Table 3)

Timing Generation Circuit

Timing generation circuit generates clock signals for the internal operations.

Cursor/Blink Control Circuit

It controls cursor/blink ON/OFF at cursor position.

Table 2. Standard Character pattern (NT7066U-F00)

Higher 4-bit of character code (Hex.)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	CG RAM (1)			Ø	Q	P	˘	P				—	タ	ミ	α	p
1	(2)		!	1	A	Q	a	4			。	ア	チ	△	ä	q
2	(3)		"	2	B	R	b	r			「	イ	ツ	×	β	θ
3	(4)		#	3	C	S	c	s			」	ウ	テ	モ	ε	ω
4	(5)		\$	4	D	T	d	t			、	エ	ト	ト	μ	Ω
5	(6)		%	5	E	U	e	u			・	オ	ナ	1	ε	Ü
6	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
7	(8)		'	7	G	W	g	w			ア	キ	ヌ	ラ	g	π
8	(1)		(	8	H	X	h	x			ィ	ク	ネ	リ	フ	×
Lower 4-bit of character code (Hex.)																
9	(2)		)	9	I	Y	i	y			ウ	ケ	ル	ル	リ	y
A	(3)		*	:	J	Z	j	z			エ	コ	ハ	レ	j	チ
B	(4)		+	;	K	[	k	<			オ	サ	ヒ	ロ	*	π
C	(5)		,	<	L	¥	l	l			カ	シ	フ	ワ	Φ	円
D	(6)		—	=	M	]	m	)			ユ	ズ	ハ	ン	モ	÷
E	(7)		。	>	N	^	n	→			ヨ	セ	ホ	°	ハ	
F	(8)		/	?	O	_	o	←			ッ	リ	マ	°	Ö	■

Table 3. Relationship between Character Code(DDRAM) and Character pattern(CGRAM)

Character Code (DDRAM data)								CGRAM address				CGRAM data								Pattern number
D7 D6 D5 D4 D3 D2 D1 D0	A5 A4 A3	A2 A1 A0	P7 P6 P5 P4 P3 P2 P1 P0																	
0 0 0 0 X 0 0 0	0 0 0	0 0 0	X X X 0 1 1 1 0	Pattern 1																
.	.	0 0 1	1 0 0 0 1																	
.	.	0 1 0	1 0 0 0 1																	
.	.	0 1 1	1 1 1 1 1																	
.	.	1 0 0	1 0 0 0 1																	
.	.	1 0 1	1 0 0 0 1																	
.	.	1 1 0	1 0 0 0 1																	
.	.	1 1 1	. 0 0 0 0 0																	
.																
.																
0 0 0 0 X 1 1 1	1 1 1	0 0 0	X X X 1 0 0 0 1	Pattern 8																
.	.	0 0 1	1 0 0 0 1																	
.	.	0 1 0	1 0 0 0 1																	
.	.	0 1 1	1 1 1 1 1																	
.	.	1 0 0	1 0 0 0 1																	
.	.	1 0 1	1 0 0 0 1																	
.	.	1 1 0	1 0 0 0 1																	
.	.	1 1 1	. 0 0 0 0 0																	

"X": don't care

INTRODUCTION DESCRIPTION

OUTLINE

To overcome the speed difference between internal clock of NT7066U and MPU clock, NT7066U performs internal operation by storing control information to IR or DR. The internal operation is determined according to the signal from MPU, composed of read/write and data bus. (Refer to Table 5). Instruction can be divided largely four kinds,

- (1) NT7066U function set instructions (set display methods, set data length, etc.)
- (2) Address set instructions to internal RAM
- (3) Data transfer instructions with internal RAM
- (4) Others instructions.

The address of internal RAM is automatically increased or decreased by 1.

*Note: During internal operation, Busy Flag (DB7) is read High. Busy Flag check must precede the next instruction.

Contents**1) Clear Display**

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code) to all DDRAM address, and set DDRAM address to "00H" into AC (address counter). Return cursor to the original status. Namely, bring the cursor to the left edge on first line of the display. Make entry mode increment (I/D = "1").

2) Return Home

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	-

Return Home is cursor return home instruction. Set DDRAM address to "00H" into the address counter. Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM do not change.

3) Entry Mode Set

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

Set the moving direction of cursor and display.

I/D: Increment / decrement of DDRAM address (cursor or blink)

When I/D = "High", cursor/blink moves to right and DDRAM address is increased by 1.

When I/D = "Low", cursor/blink moves to left and DDRAM address is decreased by 1.

* CGRAM operates the same as DDRAM, when read from or write to CGRAM.

SH: Shift of entire display

When DDRAM read (CGRAM read / write) operation or SH = "Low", shift of entire display is not performed. If SH = "High" and DDRAM write operation, shift of entire display is performed according to I/D value (I/D = "1" : shift left, I/D = "0" : shift right).

4) Display ON/OFF Control

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Control display / cursor / blink ON / OFF 1 bit register.

D: Display ON / OFF control bit

When D = "High", entire display is turned on.

When D = "Low", display is turned off, but display data is remained in DDRAM.

C: Cursor ON / OFF control bit

When C = "High", cursor is turned on.

When C = "Low", Cursor is disappeared in current display, but I/D register remains its data.

B: Cursor Blink ON / OFF control bit

When B = "High", cursor blink is on, that performs alternate between all the high data and display character at the cursor position.

When B = "Low", blink is off.

5) Cursor or Display Shift

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	-	-

Without Writing or reading of display data, shift right/left cursor position or display. This instruction is used to correct or search display data. (refer to Table 4) During 2-line mode display, cursor moves to the 2nd line after 40th digit of 1st line. Note that display shift is performed simultaneously in all the line. When displayed data is shifted repeatedly, each line shifted individually. When display shift is performed, the contents of address counter are not changed.

Table 4. Shift patterns according to S/C and R/L bits

S/C	R/L	Operation
0	0	Shift the cursor to the left, AC is decreased by 1.
0	1	Shift the cursor to the right, AC is increased by 1.
1	0	Shift all the display to the left, cursor moves according to the display.
1	1	Shift all the display to the right, cursor moves according to the display.

6) Function Set

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	-	-

DL: Interface data length control bit

When DL = "High", it means 8-bit bus mode with MPU.

When DL = "Low", it means 4-bit bus mode with MPU. So to speak, DL is a signal to select 8-bit or 4-bit mode.

When 4-bit bus mode, it needs to transfer 4-bit data by two times.

N: Display line number control bit

When N = "Low", it means 1-line display mode.

When N = "High", 2-line display mode is set.

F: Display font type control bit

When F = "Low", it means 5 x 8 dots format display mode

When F = "High", 5 x 11 dots format display mode.

7) Set CGRAM Address

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

Set CGRAM address to AC. This instruction makes CGRAM data available from MPU.

8) Set DDRAM Address

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC.

This instruction makes DDRAM data available from MPU. When 1-line display mode (N = 0), DDRAM address is from "00H" to "4FH". In 2-line display mode (N = 1), DDRAM address is the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

9) Read Busy Flag & Address

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether NT7066U is in internal operation or not. If the resultant BF is High, it means the internal operation is in progress and you have to wait until BF to be Low, and then the next instruction can be performed. In this instruction you can read also the value of address counter.

10) Write data to RAM

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

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, CGRAM, is set by the previous address set instruction: DDRAM address set, CGRAM address set. RAM set instruction can also determine the AC direction to RAM. After write operation, the address is automatically increased/decreased by 1, according to the entry mode.

11) Read data from RAM

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

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If address set instruction of RAM is not performed before this instruction, the data that read first is invalid, because the direction of AC is not determined. If you read RAM data several times without RAM address set instruction before read operation, you can get correct RAM data from the second, but the first data would be incorrect, because there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction : it also transfer RAM data to output data register. After read operation address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.

* In case of RAM write operation, after this AC is increased/decreased by 1 like read operation. In this time, AC indicates the next address position, but you can read only the previous data by read instruction.

Table 5. Instruction Table

Instruction	Instruction Code										Description	Execution time ($f_{osc}=270KHz$)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC.	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	X	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and make shift of entire display enable.	$37\mu s$
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	$37\mu s$
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	X	X	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	$37\mu s$
Function Set	0	0	0	0	1	DL	N	F	X	X	Set interface data length(DL:4-bit/8-bit), numbers of display line(N: 1-line/2-line), display font type(F: 5X8 dots/ 5X11 dots)	$37\mu s$
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	$37\mu s$
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	$37\mu s$
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or can not be known by reading BF. The contents of address counter can also be read.	$0\mu s$
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	$43\mu s$
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	$43\mu s$

"X": don't care

6. QUALITY SPECIFICATIONS

6.1 ACCEPTABLE QUALITY LEVEL

Inspection items	Sampling procedures	AQL
Visual-operating (Electro-optical)	GB2828-81 Inspection level II Normal inspection Single sample inspection	0.65
Visual-not operating	GB2828-81 Inspection level II Normal inspection Single sample inspection	1.5
Dimension measurement	GB2828-81 Inspection level II Normal inspection Single sample inspection	1.5

6.2 INSPECTION CONDITIONS (THE ENVIRONMENTAL)

-Room temperature: 25 ± 3 °C

-Humidity: $65 \pm 20\%$ RH

6.3 INSPECTION STANDARDS

6.3.1 VISUAL WHILE OPERATING

Items to be inspected	Inspection standard
. No display	. If any pattern is not active at all, they can be rejected.
. Irregular operating	. No irregular operating are allowed . Appeared different display, which they should be chosen in the pattern, or appeared in different position where they should be chosen.
.Irregular display	. Any segment doesn't active, they can be rejected.
. Over current	. The total current required to activate the module should not be exceed the MAX current in specification.
.View angles	. Valves that don't meet the minimum value noted in the specification. they can be rejected.
.Contrast	. Valves that don't meet the minimum value noted in the specification, they can be reject.
.LCD operate voltage	. Meet the specification.

6.3.2 Visual while not operating

Module dimension	. Meet the module outline drawing, not exceed the tolerance.
LCD panel scratch	<p>.Following scratches inside the effective viewing area considered as the defects when their width & length are larger than the following combinations.</p> <p>Number: one or more Width: 0.15 length: 5.0 two or more Width: 0.10 length: 3.0 three or more Width: 0.05 length: 2.0</p> <p>When the defects exceed this, it can be rejected.</p>

7.RELIABILITY

Test Item	Content of Test	Test Condition
High temperature storage	Endurance test applying the high storage temperature for a long time	60℃ 200hrs
Low temperature storage	Endurance test applying the low storage temperature for a long time	-10℃ 200hrs
High temperature operation	Endurance test applying the electric stress (Voltage and Current) and the thermal stress to the element for a long time	50℃ 200hrs
Low temperature operation	Endurance test applying the electric stress under low temperature for a long time	0℃ 200hrs
High temperature /Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time	60℃,90%RH 96hrs
High temperature /Humidity operation	Endurance test applying the electric stress (Voltage and Current) and temperature /Humidity stress to the element for a long time	40℃,90%RH 96hrs
Temperature cycle	<p>Endurance test applying the low and high Temperature cycle</p> <p style="text-align: center;">-10℃→25℃→60℃ 30min←5min←30min</p> <p style="text-align: center;">————— 1 cycle</p>	-10℃/60℃ 10 cycle
Vibration test	Endurance test applying the vibration during transportation and using	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs

Note 1: Condensation of water is not permitted on the module.

Note 2: The module should be inspected after 4 hour storage in normal

8. TEST REPORT

(VDD=5V ,Ta=25℃)

Item	Condition	Standard	Note
High temp. storage	80℃,120 hrs	Appearance without defect	---
Low temp. storage	-30℃,120 hrs	Appearance without defect	---
High temp. operation	70℃,240 hrs	Appearance without defect	---
Low temp. operation	-20℃,240 hrs	Appearance without defect	---
High temp. & humi. Storage	50℃,90% RH,120 hrs	Appearance without defect	---
High temp .& humi.Operation	40℃,90% RH,120 hrs	Appearance without defect	---
Thermal shock	-10℃,30min→+25℃, 5min→+60℃,30min	Appearance without defect	10 cycles

9. PRECAUTIONS FOR USING LCD MODULES

9.1 Precaution

To our module ,we have made accurately assembly and debugging .So customer should do as follows:

- (1) Modules use LCD elements, so we must be treated as such avoid intense shock 、 impact 、 extrusion and falls from a height.
- (2) Avoid to twist and disassemble module's buckle legs.
- (3) Avoid to operate modules on the table if it's surface have printed circuit
- (4) Avoid to touch 、 adjust and modify the rubber that connects LCD and PCB.
- (5) Avoid to add DC(direct current) in module.
- (6) Liquid crystal is harmful Substances .When liquid crystal leaked out and contacted to your hand、 body or clothes ,you must wash it immediately with soap.

9.2 Caution Of Mounting

The panel of the LCD module consists of two thin glass plates with polarizes which easily get damaged since the module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD modules.

9.3 Caution Of LCD Handling & Cleaning

When cleaning the display surface. Use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizes surface.

Do not use the following solvent:

- Water
- Ketone

9.4 Caution Against Static Charge

The LCD modules use COMS LSI drivers. So we recommend that you connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on and ground your body. work/assembly table. And assembly equipment to protect against static electricity. the following ways are recommended.

- (1) If you doesn't intend to mount, please don't take module from bag. The module's packaging bag is handled by antistatic technology.
- (2) If you intend to operate module that you must make sure your body is good grounding , keeping your body and module at the same level.
- (3) The operating equipment requires to good grounding , especially the driver .In order to avoid interference we must make sure good grounding and no leakage.
- (4) Each module have a protective film .It is used to avoid the polaroid LCD is scratched or polluted .Please peel off the Protective Film slowly ,or else will produce static .
- (5) The humidity range at workshop: 50 ~ 60% RH

9.5 Current Protection Devices

Module was not equipped with current protection devices, so we must prepared the current protection devices for using. The proportion of DC voltage is as small as possible ,preferably no more than 50mV. Or else it will cause electrochemical reaction after a time .

9.6 Caution For Operation

-It is indispensable to drive LCM within the specified voltage limit since the higher voltage than the limit shortens LCM life.

-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD, which will come back in the specified operating temperature range.

-If the display area is pushed hard during operation. Some font will be abnormally displayed but it resumes normal condition after turning off once.

-A slight dew depositing on terminals is a cause for Electro-chemical reaction resulting in terminal open circuit.

Under the maximum operating temperature, 50%RH or less is required

9.7 Caution For Soldering

If need soldering, we must notice as follows:

※ Except the connect position of INPUT and OUTPUT doesn't allow to soldering.

※ Soldering iron required to be insulated.

(1) Soldering Conditions:

Iron Temperature : $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$

Soldering Time: < 3-4S

Soldering Materials: Low melting point, can be fully molten solder

(2) Caution for repeat soldering:

Because connect line is through module's pad connected to module. Removing the line we must wait until the solder is completely melted . If solder doesn't completely melted , it is easily lead to the pad damage or loss.Using “ XI QIANG” is the best way to remove the connect line .Besides, we must notice that repeat soldering doesn't allow more than three time.

9.8 Packaging And Storage

When module needs to store a long time ,we should do as follows.If storage method is improper,it will have an effect on the Polaroid ,causing display not good.Meanwhile pads are easily oxidized lead to soldering didn't easily .

- (1) As far as possible to use the original packaging bag.
- (2) If we intend to store bulk modules ,we should put them in anti-static bag and sealing .
- (3) To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.
- (4) The reasonable storage method is low humidity, temperature in 0℃ to 35℃
- (5) Storing with no touch on polarizes surface by the anythingelse.

10.PRECAUTIONS FOR CUSTOMER

- (1) A limit sample should be provided by the both parties on an occasion when the both parties agree its necessity.Judgement by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.
- (2) On the following occasions, the handling of problem should be decided through discussion and agreement between representative of the both parties.
 - When a question is arisen in this specification.
 - When a new problem is arisen which is not specified in this specifications.
 - When an inspection specification change or operating condition change in customer is reported to TSINGTEK, and some problem is arisen in this specification due to the change.
 - When a new problem is arisen at the customer's operating set for sample evaluation in the customer size.