

# DISPLAYTRONIC

*XIAMEN ZETTLER ELECTRONICS CO., LTD.*

## SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

ACM2004F SERIES CHARACTER MODULE VER1.1

CUSTOMER APPROVAL			
1.POLARIZER OPTIONS: <input type="checkbox"/> R=REFLECTIVE <input type="checkbox"/> F=TRANSFLECTIVE <input type="checkbox"/> N=TRANSMISSIVE NEGATIVE <input type="checkbox"/> M=TRANSMISSIVE POSITIVE			
2.BACKLIGHT OPTIONS: <input type="checkbox"/> N=NONE <input type="checkbox"/> E=EL <input type="checkbox"/> L=LED (Y-G ) <input type="checkbox"/> C=CCFL			
3. BACKLIGHT COLOR: <input type="checkbox"/> A= AMBER <input type="checkbox"/> B= BLUE <input type="checkbox"/> G= GREEN <input type="checkbox"/> W=WHITE <input type="checkbox"/> R= RED <input type="checkbox"/> RGB= RED+GREEN+BLUE			
4.FLUID OPTIONS: <input type="checkbox"/> T=TN <input type="checkbox"/> F=FSTN <input type="checkbox"/> Y=STN-YELLOW GREEN <input type="checkbox"/> G=STN-GRAY <input type="checkbox"/> B=STN-BLUE			
5. VIEWING DIRECTION: <input type="checkbox"/> B=BOTTOM VIEW(6 O'CLOCK) <input type="checkbox"/> T=TOP VIEW(12 O'CLOCK)			
6.TEMPERATURE RANGE: <input type="checkbox"/> S=STANDARD TEMPERATURE RANGE <input type="checkbox"/> H=DUAL POWER,WIDE TEMPERATURE RANGE <input type="checkbox"/> W=SINGLE POWER,WIDE TEMPERATURE RANGE			
7.OTHERS REQUIREMENT:			
※ PART NO. : _____			
APPROVAL		COMPANY CHOP	
CUSTOMER COMMENTS			

DISPLAYTRONIC ENGINEERING APPROVAL		
DESIGN BY	CHECKED BY	APPROVED BY

**REVISION RECORD**

REVISION	REVISION DATE	PAGE	CONTENTS
<b>VER1.1</b>	<b>5/9-2006</b>		MODIFY THE COVER,ADD CONTENT AND REVISION RECORD.

**※ CONTENTS**

- 1.0 MECHANICAL SPECS
- 2.0 ABSOLUTE MAXIMUM RATINGS
- 3.0 ELECTRICAL CHARACTERISTICS
- 4.0 OPTICAL CHARACTERISTICS (TA=25°C, VDD= 5.0V±0.25V, TN LC FLUID)
- 4.1 OPTICAL CHARACTERISTICS (TA=25°C, VDD= 5.0V±0.25V, STN LC FLUID)
- 5.0 BLOCK DIAGRAM
- 6.0 PIN ASSIGNMENT
- 7.0 POWER SUPPLY
- 8.0 TIMING CHARACTERISTICS
- 9.0 MECHANICAL DIAGRAM
- 10.0 RELIABILITY TEST
- 11.0 DISPLAY INSTRUCTION TABLE
- 12.0 STANDARD CHARACTER PATTERNS

## 1.0 MECHANICAL SPECS

1. Overall Module Size	146mm(W) x62.5mm(H) x max 13.5mm(D) for LED backlight version 146mm(W) x62.5mm(H) x max 8.5mm(D) for reflective version
2. Dot Size	0.93mm(W) x 1.11mm(H)
3. Charater Pitch	6.01m(W) x 9.76mm(H)
4. Duty	1/16
5. Controller IC	SPLC780D or EQU
6. LC Fluid Options	STN TN
7. Polarizer Options	Reflective, Transflective, Transmissive
8. Backlight Options	LED
9. Temperature Range Options	Standard(0°C ~ 50°C), Wide(-20°C ~ 70°C)

## 2.0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min	Typ	Max	Unit
Operating temperature (Standard)	Top	0	-	50	°C
Storage temperature (Standard)	Tst	-10	-	60	°C
Operating temperature (Wide temperature)	Top	-20	-	70	°C
Storage temperature (Wide temperature)	Tst	-30	-	80	°C
Input voltage	Vin	Vss		Vdd	V
Supply voltage for logic	Vdd- Vss	2.7	-	5.5	V
Supply voltage for LCD drive	Vdd- Vo	3.0		13	V

### 3.0 ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Input voltage (high)	Vih	H level	2.2	-	Vdd	V
Input voltage (low)	Vil	L level	0	-	0.6	V
Recommended LC Driving Voltage	Vdd -Vo	-20°C	-	-	5.5	V
		25°C	4.3	4.5	4.7	
		70°C	3.5			
Power Supply Current	Idd	Vdd=5.0V, fosc=270kHz	-	1.8	2.5	mA
LED Forward Voltage	VF	IF=540 mA	4.0	4.2	4.4	V

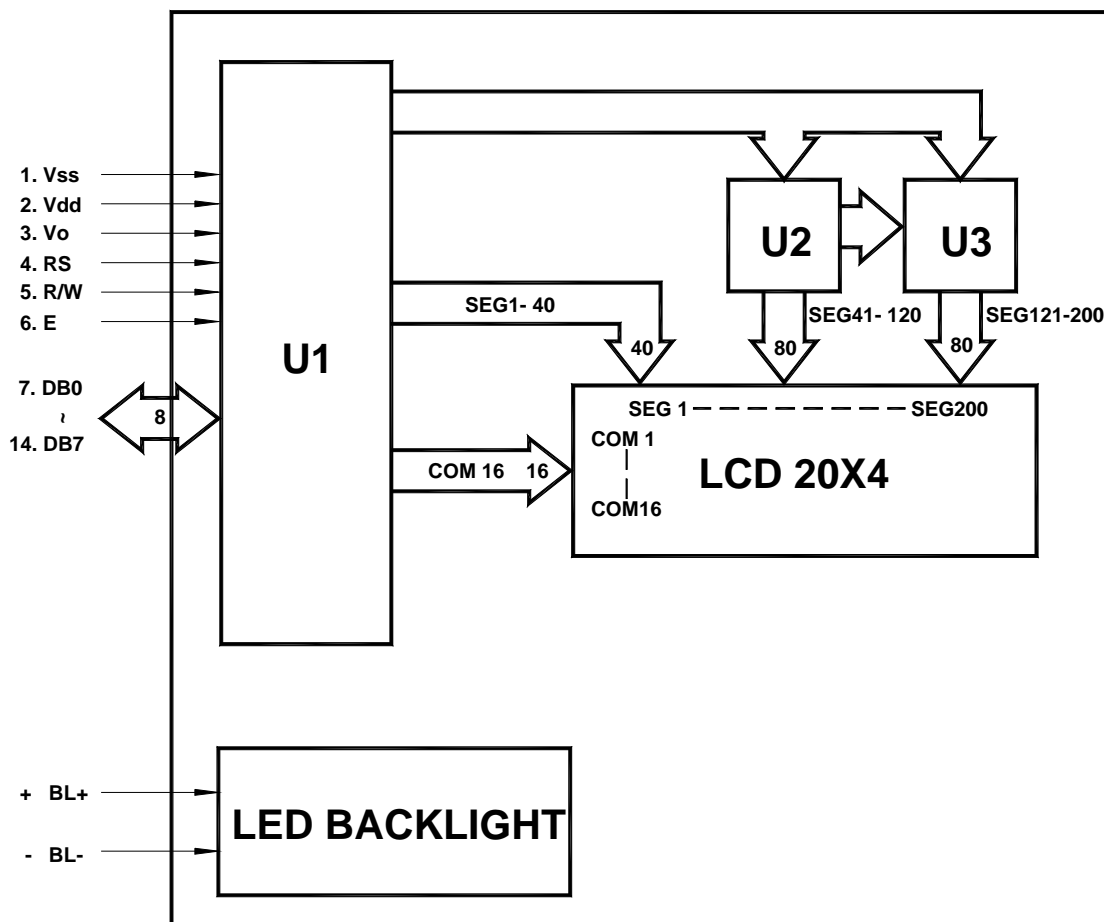
### 4.0 OPTICAL CHARACTERISTICS (Ta=25°C, Vdd= 5.0V±0.25V, TN LC fluid)

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing angle (horizontal)	$\theta$	Cr ≥ 4.0	-25	-	-	deg
Viewing angle (vertical)	$\phi$	Cr ≥ 4.0	-30	-	30	deg
Contrast Ratio	Cr	$\phi=0^\circ, \theta=0^\circ$	-	2	-	
Response time (rise)	Tr	$\phi=0^\circ, \theta=0^\circ$	-	120	150	ms
Response time (fall)	Tf	$\phi=0^\circ, \theta=0^\circ$	-	120	150	ms

4.1 OPTICAL CHARACTERISTICS (Ta=25°C, Vdd= 5.0V±0.25V, STN LC fluid)

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing angle (horizontal)	$\theta$	$Cr \geq 2.0$	-60	-	35	deg
Viewing angle (vertical)	$\phi$	$Cr \geq 2.0$	-40	-	40	deg
Contrast Ratio	Cr	$\phi=0^\circ, \theta=0^\circ$	-	6	-	
Response time (rise)	Tr	$\phi=0^\circ, \theta=0^\circ$	-	150	250	ms
Response time (fall)	Tf	$\phi=0^\circ, \theta=0^\circ$	-	150	250	ms

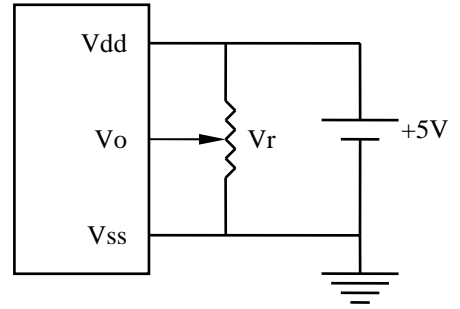
5.0 BLOCK DIAGRAM



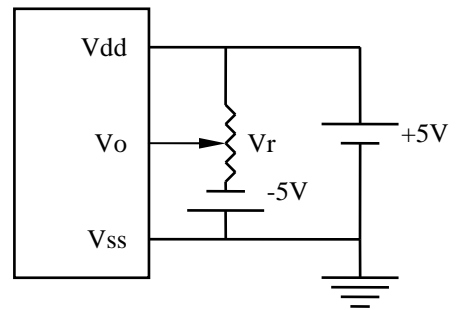
## 6.0 PIN ASSIGNMENT

Pin No.	Symbol	Function
1	Vss	Ground
2	Vdd	+5V
3	Vo	LCD contrast adjust
4	RS	Register select
5	R/W	Read / write
6	E	Enable
7	DB0	Data bit 0
8	DB1	Data bit 1
9	DB2	Data bit 2
10	DB3	Data bit 3
11	DB4	Data bit 4
12	DB5	Data bit 5
13	DB6	Data bit 6
14	DB7	Data bit 7
+	BL+	Power Supply for BL+
-	BL-	Power Supply for BL-

## 7.0 POWER SUPPLY



STANDARD TEMP RANGE



WIDE TEMP RANGE

$$V_r = 10K\Omega \sim 20K\Omega$$

## 8.0 TIMING CHARACTERISTICS

## ACM2004F SERIES CHARACTER MODULE VER1.1

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

Mode	Item	Symbol	Min	Typ	Max	Unit
Write Mode (refer to figure 6)	E Cycle Time	tc	500	-	-	ns
	E Rise / Fall Time	tr,tf	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/Wand RS Setup Time	tsu1	40	-	-	
	R/Wand RS Hold Time	th1	10	-	-	
	Data Setup Time	tsu2	80	-	-	
	Data Hold Time	th2	10	-	-	
Read mode (refer to figure 7)	E Cycle Time	tc	500	-	-	
	E Rise / Fall Time	tr,tf	-	-	20	
	E Pulse Wdth (High, Low)	tw	230	-	-	
	R/Wand RS Setup Time	tsu	40	-	-	
	R/Wand RS Hold Time	th	10	-	-	
	Data Output Delay Time	t <sub>D</sub>	-	-	120	
	Data Hold Time	t <sub>DH</sub>	5	-	-	

( $V_{DD} = 2.7$  to  $4.5V$ ,  $T_a = -30$  to  $+85^{\circ}C$ )

Mode	Item	Symbol	Min	Typ	Max	Unit
Write mode (refer to figure 6)	E Cycle Time	tc	1000	-	-	ns
	E Rise / Fall Time	tr,tf	-	-	25	
	E Pulse Wdth (High, Low)	tw	450	-	-	
	R/Wand RS Setup Time	tsu1	60	-	-	
	R/Wand RS Hold Time	th1	20	-	-	
	Data Setup Time	tsu2	195	-	-	
	Data Hold Time	th2	10	-	-	
Read mode (refer to figure 7)	E Cycle Time	tc	1000	-	-	
	E Rise / Fall Time	tr,tf	-	-	25	
	E Pulse Wdth (High, Low)	tw	450	-	-	
	R/Wand RS Setup Time	tsu	60	-	-	
	R/Wand RS Hold Time	th	20	-	-	
	Data Output Delay Time	t <sub>D</sub>	-	-	360	
	Data Hold Time	t <sub>DH</sub>	5	-	-	
Interface Mode with Extension Driver (refer to figure 8)	Clock Pulse Width (High, Low)	tw	800	-	-	ns
	Clock Rise/Fall Time	tr,tf	-	-	25	
	Clock Setup Time	tsu1	500	-	-	
	Data Setup Time	tsu2	300	-	-	
	Data Hold Time	t <sub>DH</sub>	300	-	-	
	M Delay Time	t <sub>DW</sub>	-1000	-	1000	



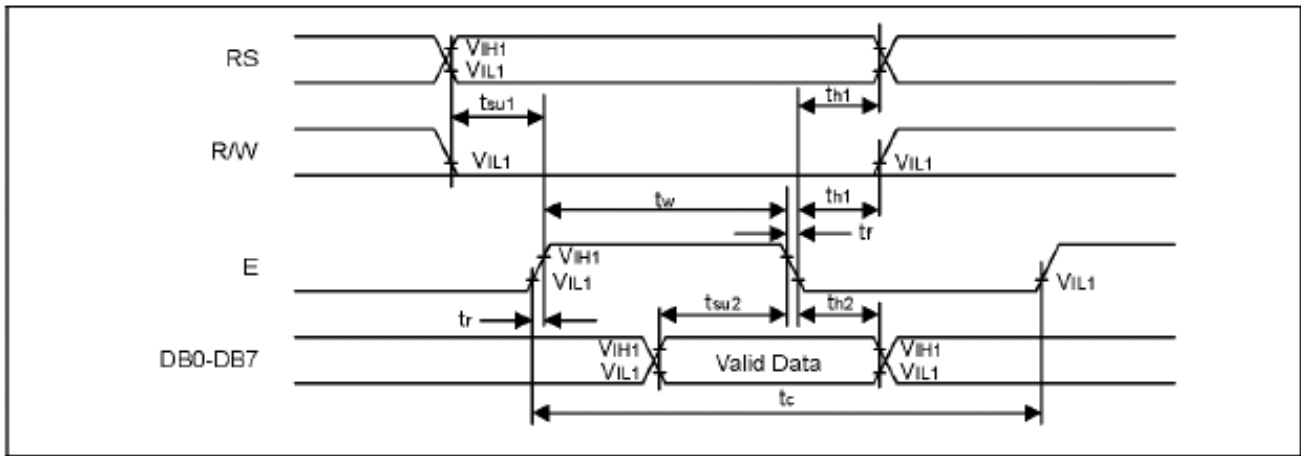


Figure 6. Write Mode Timing Diagram

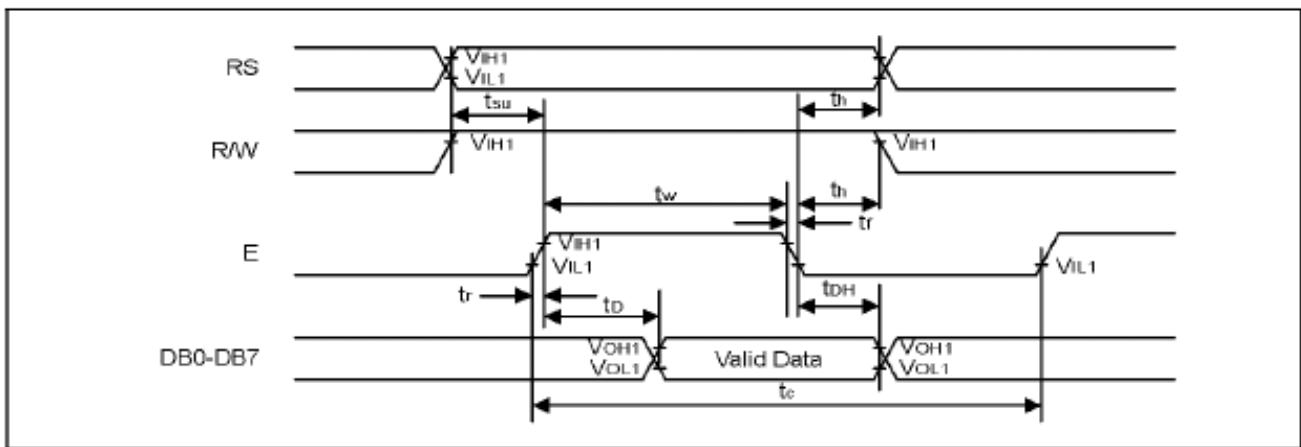


Figure 7. Read Mode Timing Diagram

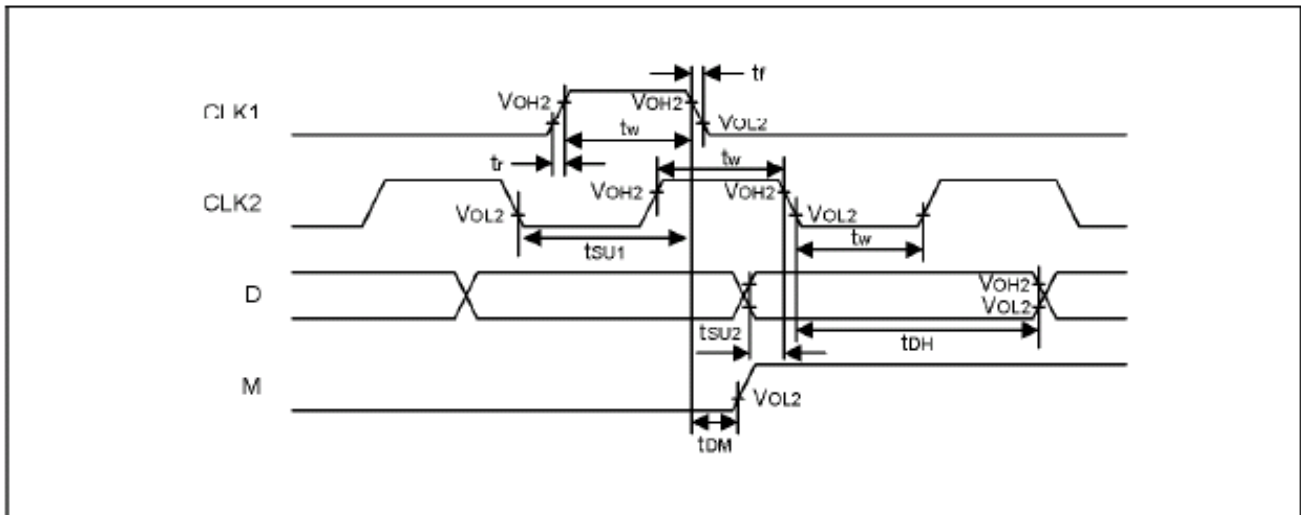
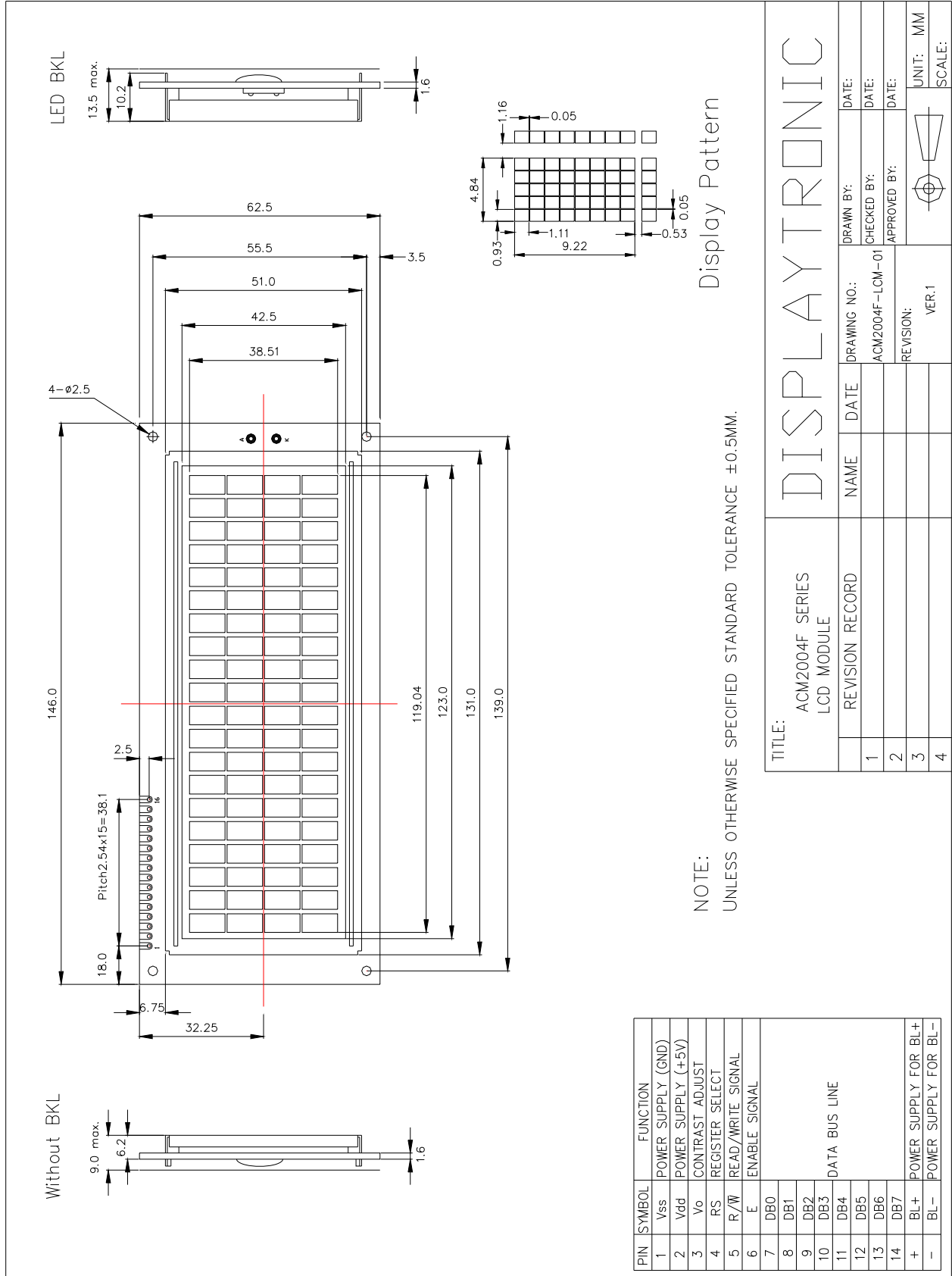


Figure 8. Interface Mode with Extension Driver Timing Diagram

9.0 MECHANICAL DIAGRAM



**10.0 RELIABILITY TEST**

Storage Condition	Content	Evaluations and Assessment*			
		Current Consumption	Oozing	Contrast	Other Appearances
Operation at high temperature and humidity	40°C,90% RH,240hrs	Twice initial value or less	none	More than 80% of initial value	No abnormality
High temperature storage	60°C, 240hrs	Twice initial value or less	none	More than 80% of initial value	No abnormality
Low temperature storage	-20°C, 240hrs	Twice initial value or less		More than 80% of initial value	No abnormality

\*Evaluations and assessment to be made two hours after returning to room temperature (25°C±5°C).

\*The LCDs subjected to the test must not have dew condensation.

**11.0 DISPLAY INSTRUCTION TABLE**

Instruction	Instruction Code										Description Instruction Code	Execution Time (fsoc = 270kHz)	
	RS	R/W	DB7	DB6	DB6	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "OOH" from AC.	1.53ms
Return Home	0	0	0	0	0	0	0	0	0	1	X	Set DDRAM address to "OOH" from AC and return cursor to its original position if shifted.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display	39μs
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39μs
Cursor or Display Shift	0	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.	39ns
Function Set	0	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 : 0 ..)	39μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address counter.	39μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address counter.	39μs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0		Write data into internal RAM (DDRAM/CGRAM).	43μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data from internal RAM (DDRAM/CGRAM).	43μs

12.0 STANDARD CHARACTER PATTERNS

Lower 4 Bits \ Upper 4 Bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)		0	a	P	`	P				-	夕	≡	α	ρ	
xxxx0001	(2)	!	1	A	Q	a	q			。	ア	チ	△	△	q	
xxxx0010	(3)	"	2	B	R	b	r			「	イ	ツ	×	β	θ	
xxxx0011	(4)	#	3	C	S	c	s			」	ウ	テ	ε	ε	∞	
xxxx0100	(5)	\$	4	D	T	d	t			、	エ	ト	ト	μ	Ω	
xxxx0101	(6)	%	5	E	U	e	u			・	オ	ナ	1	ε	ū	
xxxx0110	(7)	&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ	
xxxx0111	(8)	'	7	G	W	g	w			ア	キ	ヌ	ラ	g	π	
xxxx1000	(1)	<	8	H	X	h	x			イ	ク	ネ	リ	フ	Σ	
xxxx1001	(2)	>	9	I	Y	i	y			ウ	ケ	ル	ル	1	γ	
xxxx1010	(3)	*	:	J	Z	j	z			エ	コ	ハ	レ	j	≠	
xxxx1011	(4)	+	;	K	[	k	<			オ	サ	ヒ	ロ	°	≠	
xxxx1100	(5)	,	<	L	¥	l	l			カ	シ	フ	ワ	φ	≠	
xxxx1101	(6)	-	=	M	]	m	>			ユ	ス	ハ	ン	≠	÷	
xxxx1110	(7)	.	>	N	^	n	→			ヨ	セ	ホ	°	≠		
xxxx1111	(8)	/	?	O	_	o	+			ッ	ソ	マ	°	ö	■	

Note: The character generator RAM is the RAM with which the user can rewrite character patterns by program.