Crystal Clear Technology

Product Specification

C416x01xxx00

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1.0 Table of Contents

2.0 Record of revision

Rev	Date	Item	Page	Comment	Originator	Checked By
1.0	14/06/06			Initial Release	Rohaiza	Azhar
2.0	07/07/10			Change the IC controller/driver from Samsung S6A0074 to Rockwork RW1067C	SCChong	Azhar

3.0 General specification

Display format: 4 lines x 20 characters

Character font format: 5 x 8

Character size: 2.45mm x 4.67mm

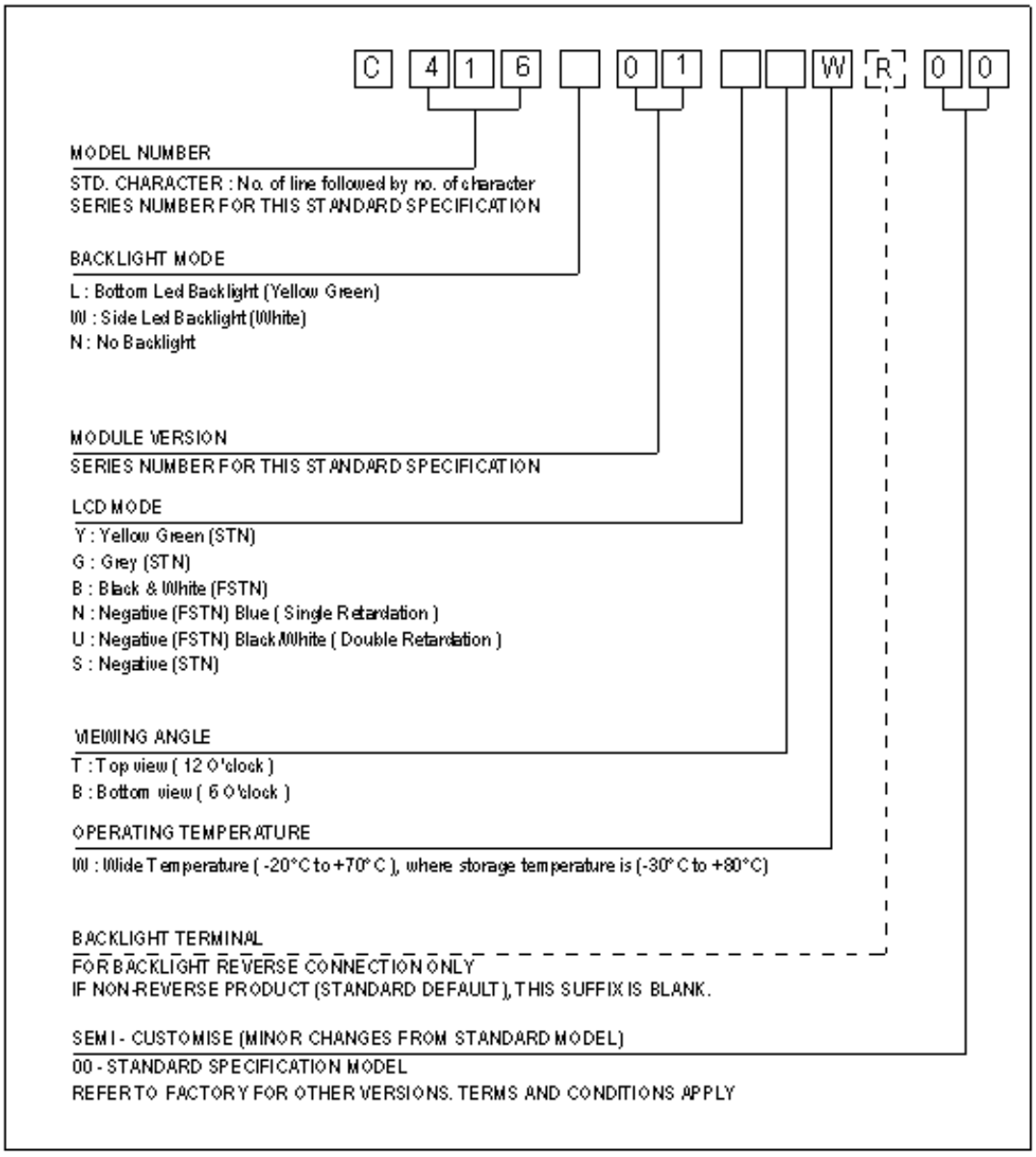
Dot size: 0.45mm x 0.54mm

View area: 50.7mm x 25.0mm

Active area: 55.5mm x 29.5/32.0mm

General dimensions: 69.5mm x 54mm

Controller/Driver: RW1067C or equivalent.



4.0 Absolute maximum rating (at Vss = 0V, ambient temperature = 25°C)

NO	ITEM	SIMBOL	MIN	MAX	UNIT
1.	Power Supply voltage (Logic)	$V_{DD} - V_{SS}$	0	7	V
2.	Power Supply voltage (LCD Driver)	$V_{DD} - V_0$	-	8	V
3.	Operating Temperature	T_{op}	Refer page 3		°C
4.	Storage Temperature	T_{st}	Refer page 3		°C

5.0 Electrical characteristics

NO	ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
1.	Power Supply voltage (Logic)	$V_{CC} - V_{SS}$	-		3.3		V
2.	Power Supply voltage (V_{LCD})	V_{CC}-V_0	25°C	6.5±5%			V
3.	Input Voltage (except OSC1)	V_{IH}	-	$0.7V_{CC}$	-	V_{CC}	V
		V_{IL}	-	-0.3	-	0.6	V
4.	Current Supply	I_{CC}	$V_{CC} - V_{SS}$ = 3.3V	-	0.8	1.2	mA

5.1 Backlight Options

NO	COLOR	FORWARD VOLTAGE (V)			FORWARD CURRENT (mA)			MIN BRIGHTNESS (cd/m2) *
		Min	Typ.	Max	Min	Typ.	Max	
1.	Yellow Green	-	3.0	-	-	40	60	30
2.	White	-	3.3	-	-	60	80	80

*Note : 1. Brightness measured at backlight surface.
2. On LCD surface, brightness is only about 10% to 15% of backlight brightness.
3. Lifetime of backlight: For YG, Amber, Red = 50K hrs. For White, Blue = 20K hrs

6.0 Environmental requirements

NO	ITEM	CONDITION
1.	Operating Temperature	Refer page 3
2.	Storage Temperature	Refer page 3
3.	Operating Humidity	5% to 95%RH
4.	Cycle Test	0 ºC @ 30 min to 50 ºC @ 30min for 1 cycle run for 10 cycles
5.	Lifetime	50000 HOURS (excluding backlight)

Note: The background on LCD has the possibility to be changed in different temperature range.

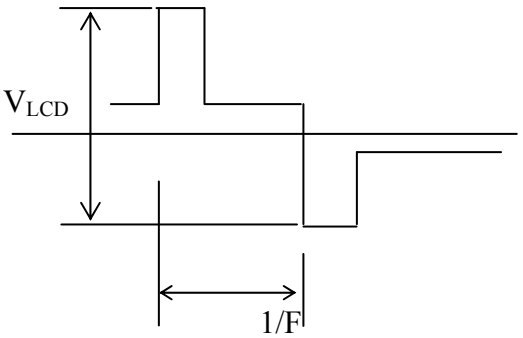
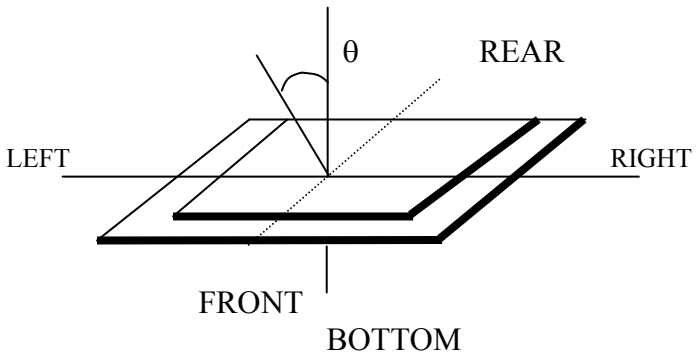
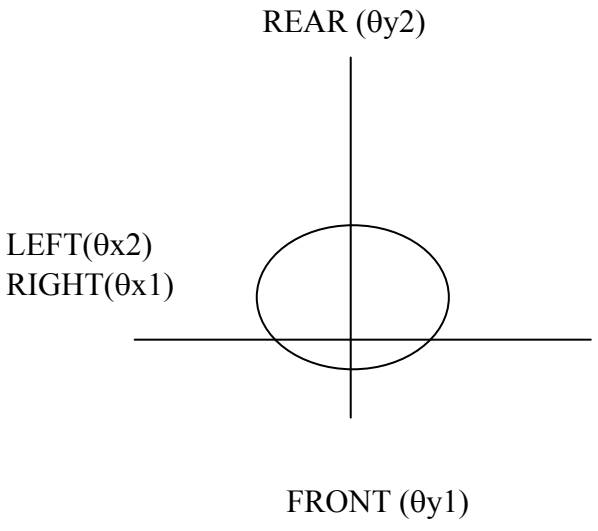
7.0 LCD specification

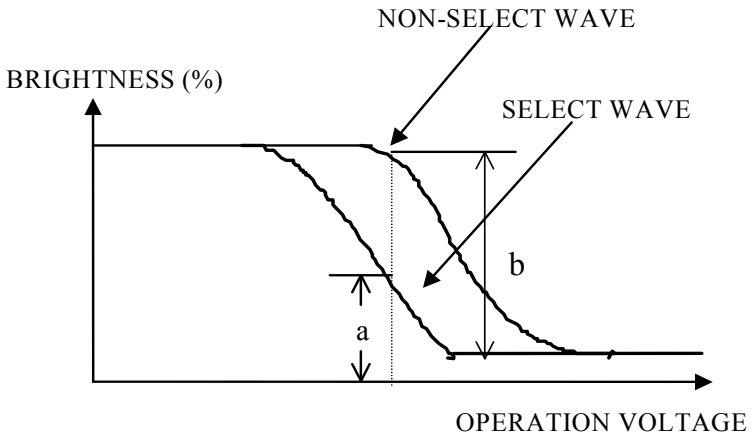
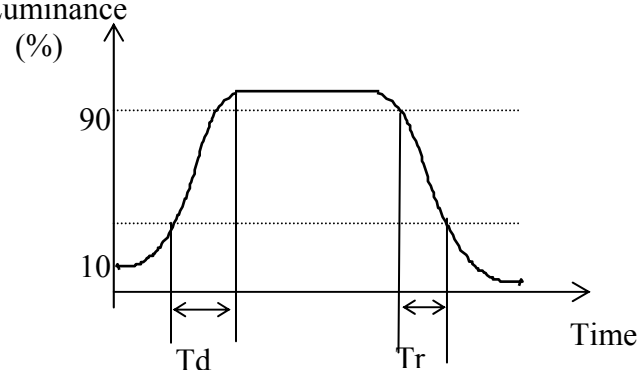
7.1 Electro-optical characteristics (at ambient temperature = 25°C)

NO	ITEM	SYMBOL	CONDITION	LCD TYPE						REF.
				STN YG	STN GREY	STN -VE BLUE	FSTN +VE B/W	FSTN –VE BLUE	FSTN -VE TRUE B/W	
1	Operating Voltage (Volt)	V_{LCD}	θ = 0 Cr = max	6.5 ± 5%						7.1.1
2	Viewing Angle (Deg)	θ x 1	CR ≥ 2 V_{LCD} = 6.5V	+25	+20	+35	+25	+35	+35	7.1.2
		θ x 2		-25	-20	-35	-25	-35	-40	
		θ y 1		-30	-25	-35	-30	-35	-35	
		θ y 2		+30	+25	+35	+30	+35	+35	
3	Contrast Ratio	CR	θ = 0^0 V_{LCD} =6.5V	3.0	2.3	6.0	3.0	6.0	20	7.1.3
4	Response Time (msec)	Rise Time (Tr)	θ = 0^0	200						7.1.4
		Decay Time (Td)	θ = 0^0	250						

Note:

1. Viewing angle data is based on bottom view product by default. Should it be a top view product, values are then swap.
2. Contrast ratio is based on typical data when using white colour as backlight.
3. Equipment Used Eldim; Ez Contrast 120R , Spot Size = 2mm

NO	CHARACTERISTICS	DEFINITIONS
7.1.1	***Definition of Operating Voltage (V_{LCD})***	 V_{LCD} : Operating Voltage F : Frame Frequency
7.1.2	***Definition of Viewing Angle***	 

7.1.3	***Definition of Contrast Ratio***	 Contrast Ratio = Brightness of non-selected state (b) / Brightness of selected state (a) ***Conditions*** (a) Operating Voltage: V_{LCD} (b) Temperature: 25°C (c) Viewing Angle, $\theta = 0^{o}$
7.1.4	*Response Time*	Luminance (%)  Tr: Measured between 10% and 90% of LCD segment maximum response with $V_{ON.}$ Td: With voltage switches to zero and the instant LCD segment reaches 10% of its maximum response.

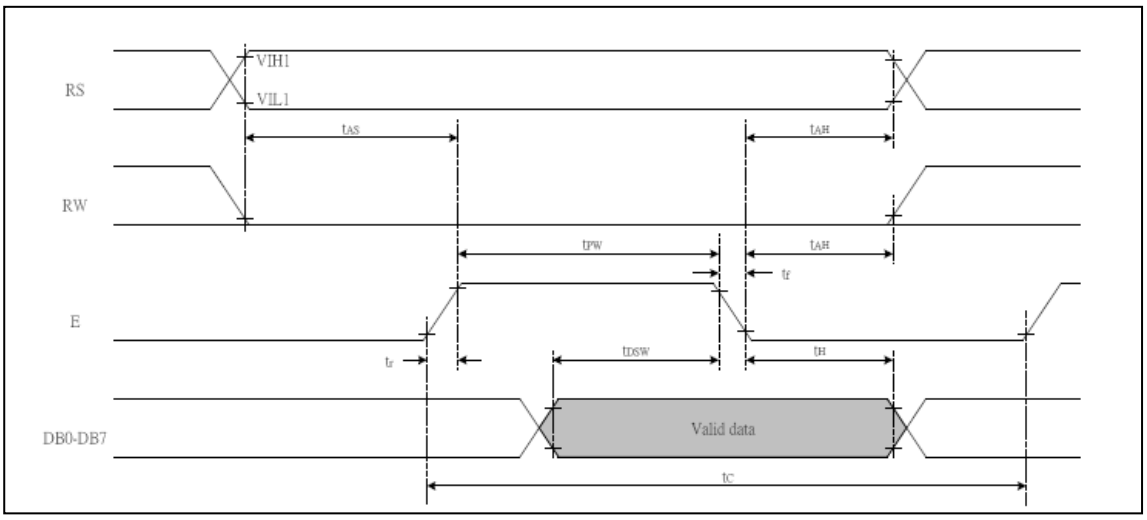
8.0 Interface

8.1	***Display Driver***	RW1067C	
8.2	***Duty Cycle***	1/33, 1/6.7	
8.3	***Pin-out Assignments***		
	Pin No	**Symbol**	**Description**
	1	V_{SS}	Ground terminal of module
	2	V_{DD}	Supply terminal of module
	3	V_O	Chip select input. Enable input/output when "LOW"
	4	RS	Register Select: HIGH – Data register selected LOW – Command register selected
	5	R/W	Read/Write: HIGH = Read operation LOW = Write operation
	6	E	Read/Write Enable Signal
	7 to 14	D0 to D7	Bi-directional Data Bus. Data Transfer is performed once, thru D0 to D7, in the case of interface data length is 8-bits.
	15	A	LED power supply terminal
	16	K	

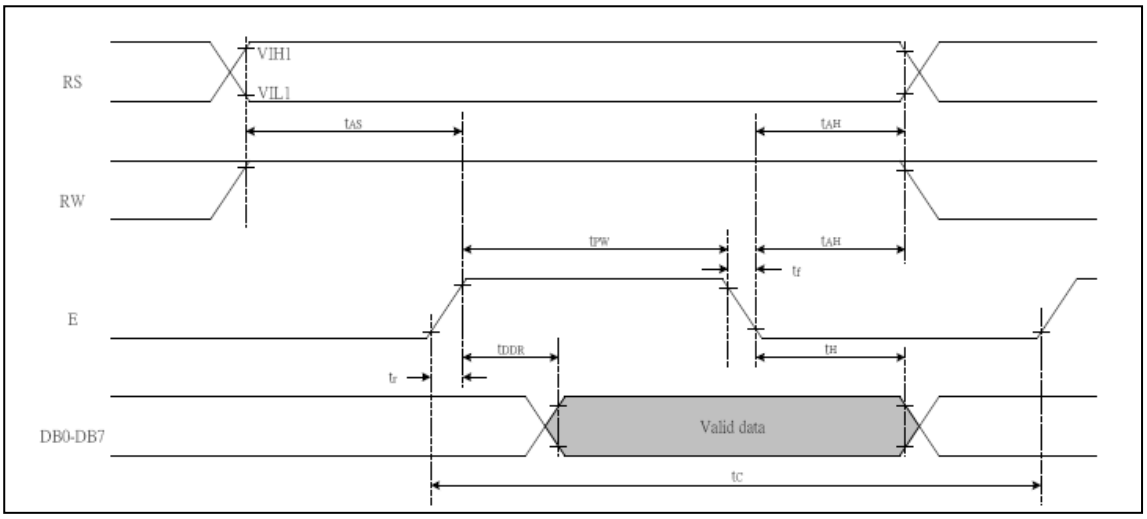
Note:

Interface Mode:
R11 – 4bits/8bits Mode
R12 – Serial Mode

9.0 Timing Characteristics/Timing Diagrams

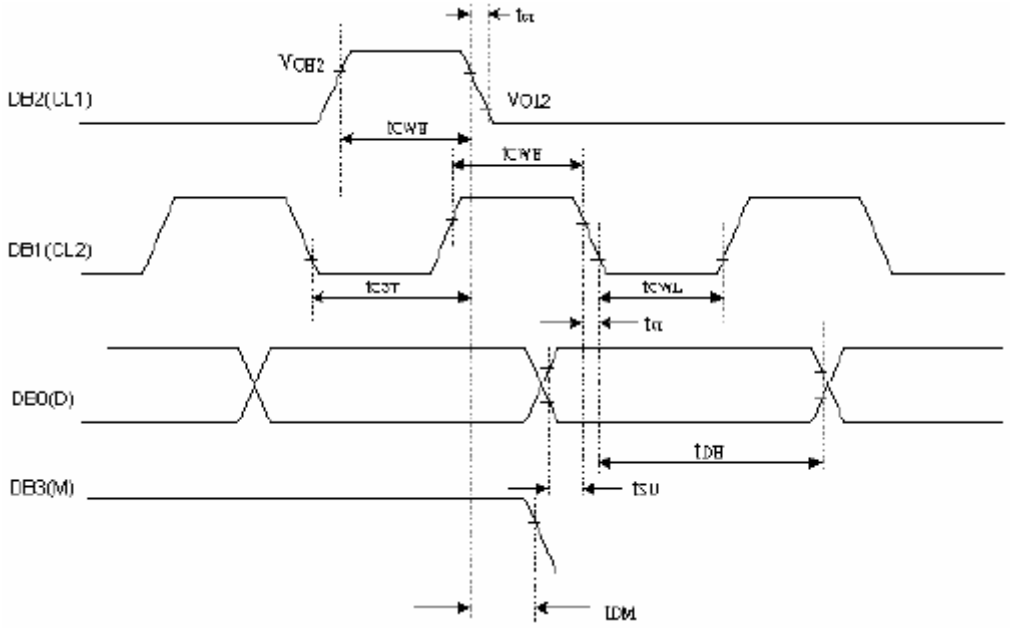


Write mode

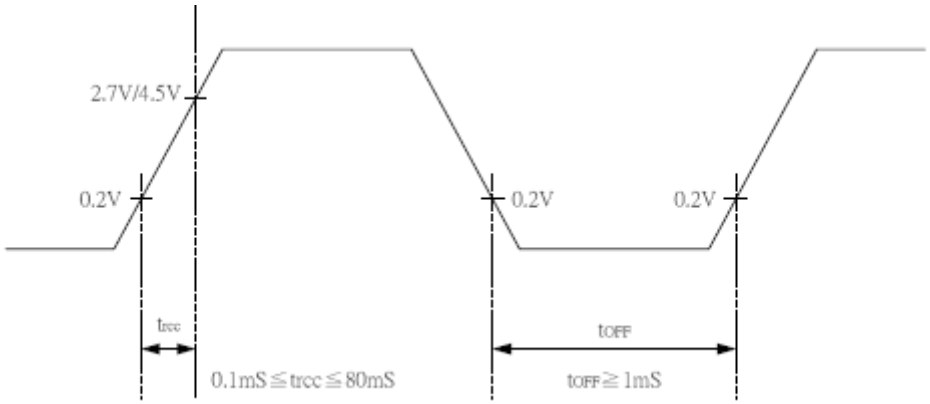


Read mode

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
Internal Clock Operation						
f_{OSC}	OSC Frequency	R =75KΩ	190	270	350	KHz
External Clock Operation						
f_{EX}	External Frequency	-	125	270	410	KHz
	Duty Cycle	-	45	50	55	%
t_R,t_F	Rise/Fall Time	-	-	-	0.2	μs
Write Mode (Writing data from MPU to RW1067)						
t_C	Enable Cycle Time	Pin E (except clear display)	80	-	-	ns
t_{PW}	Enable Pulse Width	Pin E	40	-	-	ns
t_R,t_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
t_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
t_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
t_{DSW}	Data Setup Time	Pins: DB0 - DB7	20	-	-	ns
t_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
Read Mode (Reading Data from RW1067 to MPU)						
t_C	Enable Cycle Time	Pin E	1200	-	-	ns
t_{PW}	Enable Pulse Width	Pin E	480	-	-	ns
t_R,t_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
t_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
t_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
t_{DDR}	Data Setup Time	Pins: DB0 - DB7	-	-	320	ns
t_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
Interface Mode with LCD Driver(RW1060)						
t_{CWH}	Clock Pulse with High	Pins: CL1, CL2	800	-	-	ns
t_{CWL}	Clock Pulse with Low	Pins: CL1, CL2	800	-	-	ns
t_{CST}	Clock Setup Time	Pins: CL1, CL2	500	-	-	ns
t_{SU}	Data Setup Time	Pin: D	300	-	-	ns
t_{DH}	Data Hold Time	Pin: D	300	-	-	ns
t_{DM}	M Delay Time	Pin: M	0	-	2000	ns



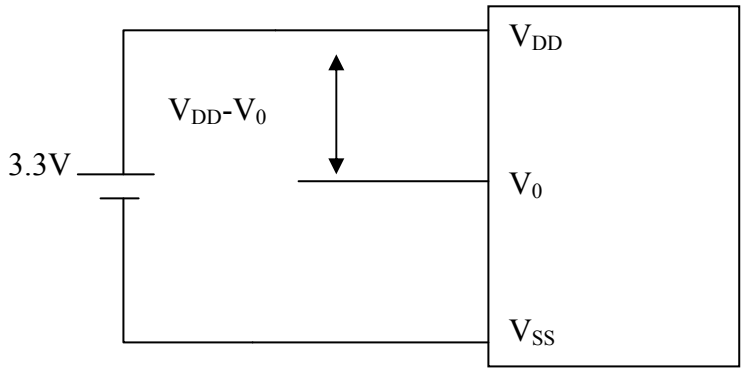
Interface with extension driver



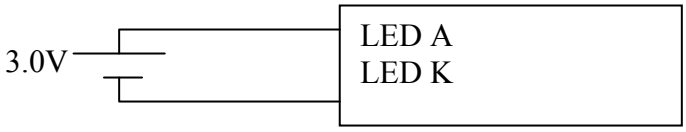
Internal power supply reset

10.0 Power Supply

10.1

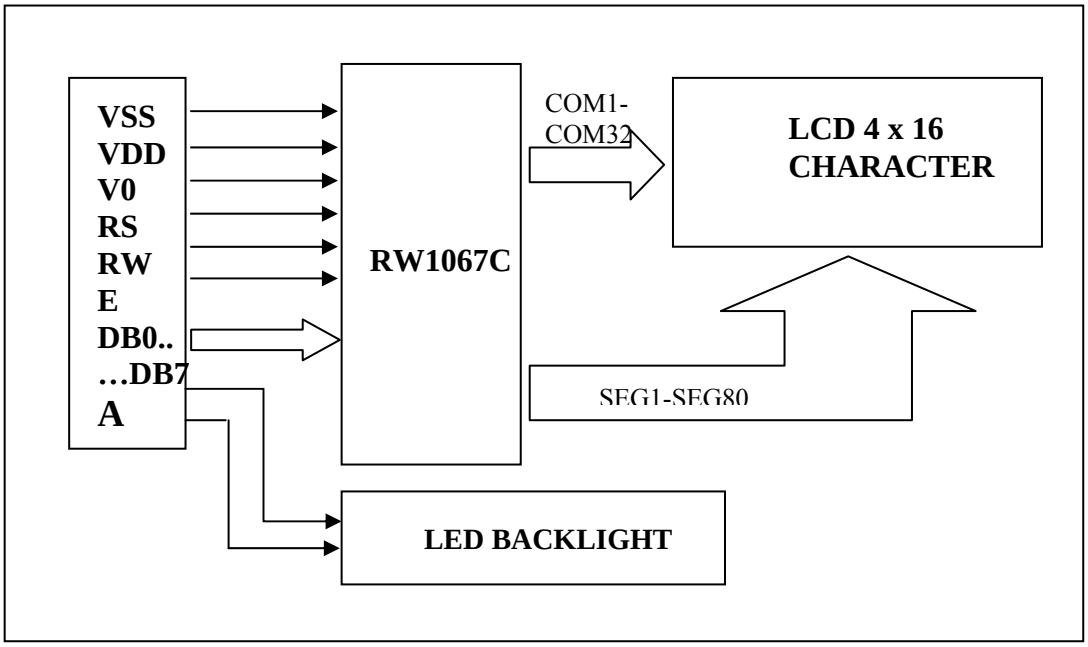


Where V_{DD}-V_0 = LCD Driving voltage



For backlight version only

11.0 Block Diagram



12.0 Instructions

Instruction	RE	Instruction Code										Description	Execution Time (fosc = 270 kHz)
		RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	x	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM, and set DDRAM address to "00H" from AC.	1.53ms
Return Home	0	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.	1.53ms
Power Down Mode	1	0	0	0	0	0	0	0	0	1	PD	Set power down mode bit. PD = "1" : power down mode set, PD = "0": power down mode disable.	37µs
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction. I/D = "1": increment I/D = "0": decrement And display shift enable bit. S = "1": make display shift of the enabled lines by the DS4 - DS1 bits in the Shift Enable instruction. S = "0": display shift disable	37µs
	1	0	0	0	0	0	0	0	1	1	BID	Segment bi-direction function. BID = "1": Seg80→Seg1 BID = "0": Seg1→Seg80	
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set display / cursor / blink on/off D = "1": display on, D = "0": display off, C = "1": cursor on, C = "0": cursor off, B = "1": blink on, B = "0: blink off.	37µs
Extended Function set	1	0	0	0	0	0	0	1	0	B/W	NW	Assign black/white inverting of cursor, and 4-line display mode control bit. B/W = "1": black/white inverting of cursor enable, B/W = "0": black/white inverting of cursor disable NW ="1": 4-line display mode, NW ="0": 2-line display mode.	37µs

Instruction	RE	Instruction Code										Description	Execution Time (fosc = 270 kHz)
		RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Cursor or Display shift	0	0	0	0	0	0	1	S/C	R/L	X	X	Cursor or display shift. S/C = "1" : display shift, S/C = "0" : cursor shift, R/L = "1" : shift to right, R/L = "0": shift to left.	37µs
Shift Enable	1	0	0	0	0	0	1	DS4	DS3	DS2	DS1	(when DC = "1") Determine the line for display shift. DS1 = "1/0": 1st line display shift enable/disable DS2 = "1/0": 2nd line display shift enable/disable DS3 = "1/0": 3rd line display shift enable/disable DS4 = "1/0: "4th line display shift enable/disable.	37µs
Code Bank Selection	1	0	0	0	0	0	1	X	X	CB1	CB0	(when DC = "0") (CB1, CB0) = (0, 0) ROM code Bank 0 selected (0, 1) ROM code Bank 1 selected (1, 0) ROM code Bank 2 selected (1, 1) ROM code Bank 3 selected	37µs
Function Set	0	0	0	0	0	1	IF	X	RE(0)	DC	REV	Set interface data length (IF ="1": 8-bit, IF ="0": 4-bit), extension register, RE("0"), shift enable. DC="1": enable display shift per line. DC="0": enable the selection of code bank. Reverse bit REV ="1": reverse display, REV ="0": normal display.	37µs
	1	0	0	0	0	1	IF	X	RE(1)	BE	0	Set IF,N, RE("1") and CGRAM/SEGRAM blink enable (BE) BE = "1/0": CGRAM/SEGRAM blink enable/disable.	37µs

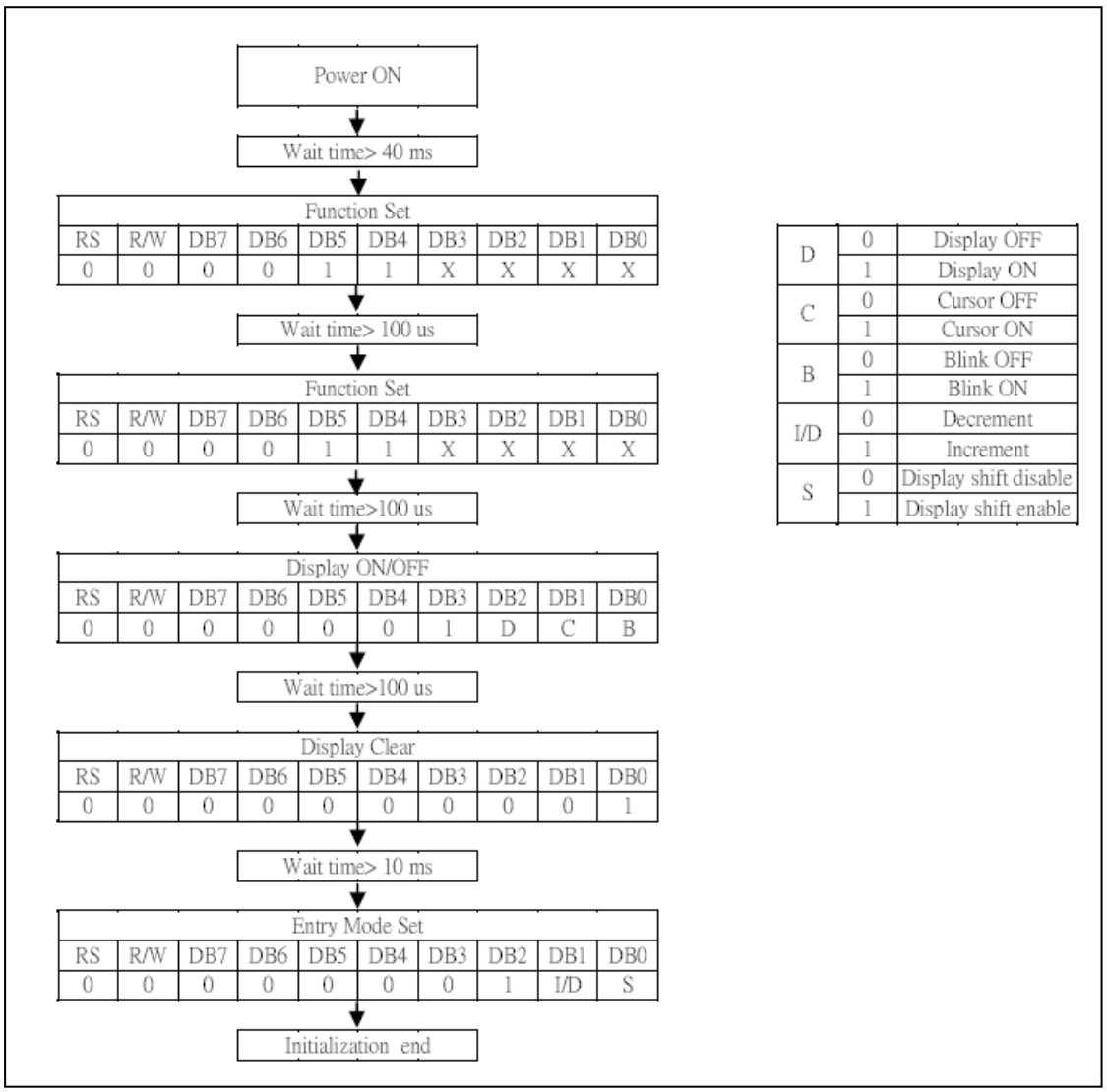
Instruction	RE	Instruction Code										Description	Execution Time (fosc = 270 kHz)
		RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Set CGRAM Address	0	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	37µs
Set SEGRAM Address	1	0	0	0	1	X	X	AC3	AC2	AC1	AC0	Set SEGRAM address in address counter	37µs
Set DDRAM Address	0	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	37µs
Set Data Length	1	0	0	1	SD6	SD5	SD4	SD3	SD2	SD1	SD0	Set data length for 3 line SPI	37µs
Read Busy flag and Address	X	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Can know internal operation is ready or not by reading BF. The contents of address counter can also be read. BF = "1" : busy state, BF ="0": ready state.	0µs
Write Data	X	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM. (DDRAM / CGRAM / SEGRAM).	43µs
Read Data	X	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM. (DDRAM / CGRAM / SEGRAM).	43µs

- Note : 1. When an MPU program with Busy Flag(DB7) checking is made, 1/ 2 FOSC (is necessary) for executing the next instruction by the " E " signal after the Busy Flag (DB7) goes to " Low ".
  2. " X " Don't care

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	0	0	0	0	0	0	0	0	0	0	B1	B0	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	0	1	1	1	1	1	1	0	0	0	B1	B0	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	

8 bit operation example.



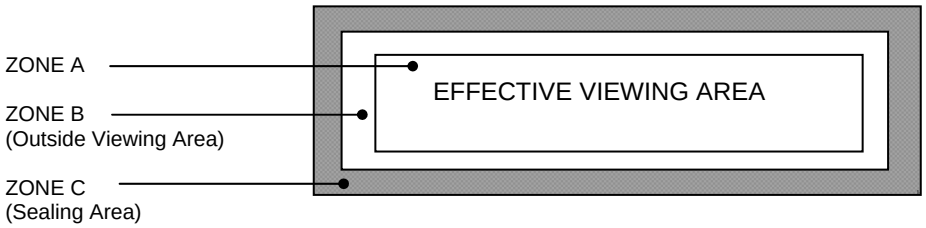
Character Generator ROM

CODE_BANK0 (0C-003)

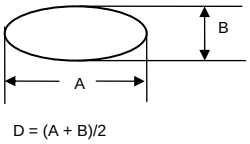
b7~4 / b3~0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM [00]															
0001	CG RAM [01]															
0010	CG RAM [02]															
0011	CG RAM [03]															
0100	CG RAM [04]															
0101	CG RAM [05]															
0110	CG RAM [06]															
0111	CG RAM [07]															
1000	CG RAM [00]															
1001	CG RAM [01]															
1010	CG RAM [02]															
1011	CG RAM [03]															
1100	CG RAM [04]															
1101	CG RAM [05]															
1110	CG RAM [06]															
1111	CG RAM [07]															

13.0 Quality Assurance

13.1 ZONE DEFINITION



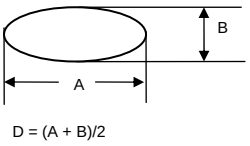
13.1.1 Black Spot, White Spot and Foreign Material

Defect Category	Defect Description	Criterion				Drawing Specification
Black Spot, White Spot and Foreign Material	Black Spot, White Spot and Foreign Material	Zone / Dimension	Acceptable No.			
			A	B	C	
		D ≤ 0.10mm	NC	NC	NC	
		0.10<D ≤ 0.20mm	3	3	NC	
		0.20 < D ≤ 0.30mm	1	2	NC	
		D > 0.30 mm	0	0	NC	
		NC: No count D: Mean Diameter of Defect				

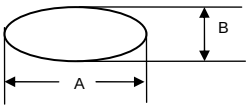
13.1.2 Line Shape and Scratches

Defect Category	Defect Description	Criterion					Drawing Specification
Line shape and scratches	Line shape and scratches	Zone /Dimension		Acceptable No.			
		X	Y	A	B	C	
		-	<0.01mm	NC	NC	NC	
		< 2 mm	< 0.02mm	1	1	NC	
		<1 mm	< 0.0 2mm	1	2	NC	

13.1.3 Pin Hole

Defect Category	Defect Description	Criterion	Drawing Specification
Pin Hole	Pin hole / void at light up segment	D ≤ 0.20mm within 1 part/segment	

13.1.4 Polarizer Bubble/Foreign Material

<table>
<tr><th>Defect Category</th><th>Defect Description</th><th>Criterion</th><th>Drawing Specification</th></tr>
<tr><td></td><td>Polarizer bubble / Foreign material</td><td>
<table>
<tr><td rowspan="2">Zone / Dimension</td><td colspan="3">Acceptable No.</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>D ≤ 0.15mm</td><td>NC</td><td>NC</td><td>NC</td></tr>
<tr><td>0.15 < D ≤ 0.30mm</td><td>3</td><td>5</td><td>NC</td></tr>
<tr><td>0.30 < D ≤ 0.50mm</td><td>2</td><td>3</td><td>NC</td></tr>
<tr><td>0.50 < D ≤ 1.0mm</td><td>0</td><td>1</td><td>NC</td></tr>
<tr><td colspan="4">NC: No count
D: Mean Diameter of Defect
Accept - if air bubble at the seal area does not propagate into effective viewing area</td></tr>
</table>
</td><td> 

D = (A + B)/2</td></tr>
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Note: Total defects shall not exceed five

14. Precaution for using LCM

1. Liquid Crystal Display (LCD)

LCD is made up of glass, organic sealant, organic fluid and polymer based polarizers. The following precautions should be taken when handling.

a) Keep the temperature within the range of use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel off or bubble.
b) Do not contact the exposed polarizer with anything harder than HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin.
c) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or colour fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
d) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
e) Do not drive LCD with DC voltage.

2. Liquid Crystal Display Modules.

2.1 Mechanical Considerations

LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modification. The following should be noted.

a) Do not tamper in any way with the tabs on the metal frame.
b) Do not modify the PCB by drilling extra holes, changing its outline, moving its component or modifying its pattern.
c) Do not touch the elastomer connector, especially insert a backlight panel (for example, EL)
d) When mounting a LCM make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
e) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

2.2 Static Electricity

LCM contains CMOS LSI's and the same precaution for such devices should apply, namely

a) The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
b) The modules should be kept in antistatic bags or other containers to static for storage.
c) Only properly grounded soldering irons should be used.
d) If an electric screwdriver is used, it should be well grounded and shielded from commutator spark.
e) The normal static prevention measures should be observed for work clothes and working benches, the latter conductive (rubber) mat is recommended.
f) Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

2.3 Soldering

a) Solder only to the I/O terminals.
b) Use only soldering irons with proper grounding and no leakage.
c) Soldering temperature: 280 °C
d) Soldering time: 3 to 4 sec
e) Use eutectic solder with resin flux fill.
f) If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

2.4 Operation

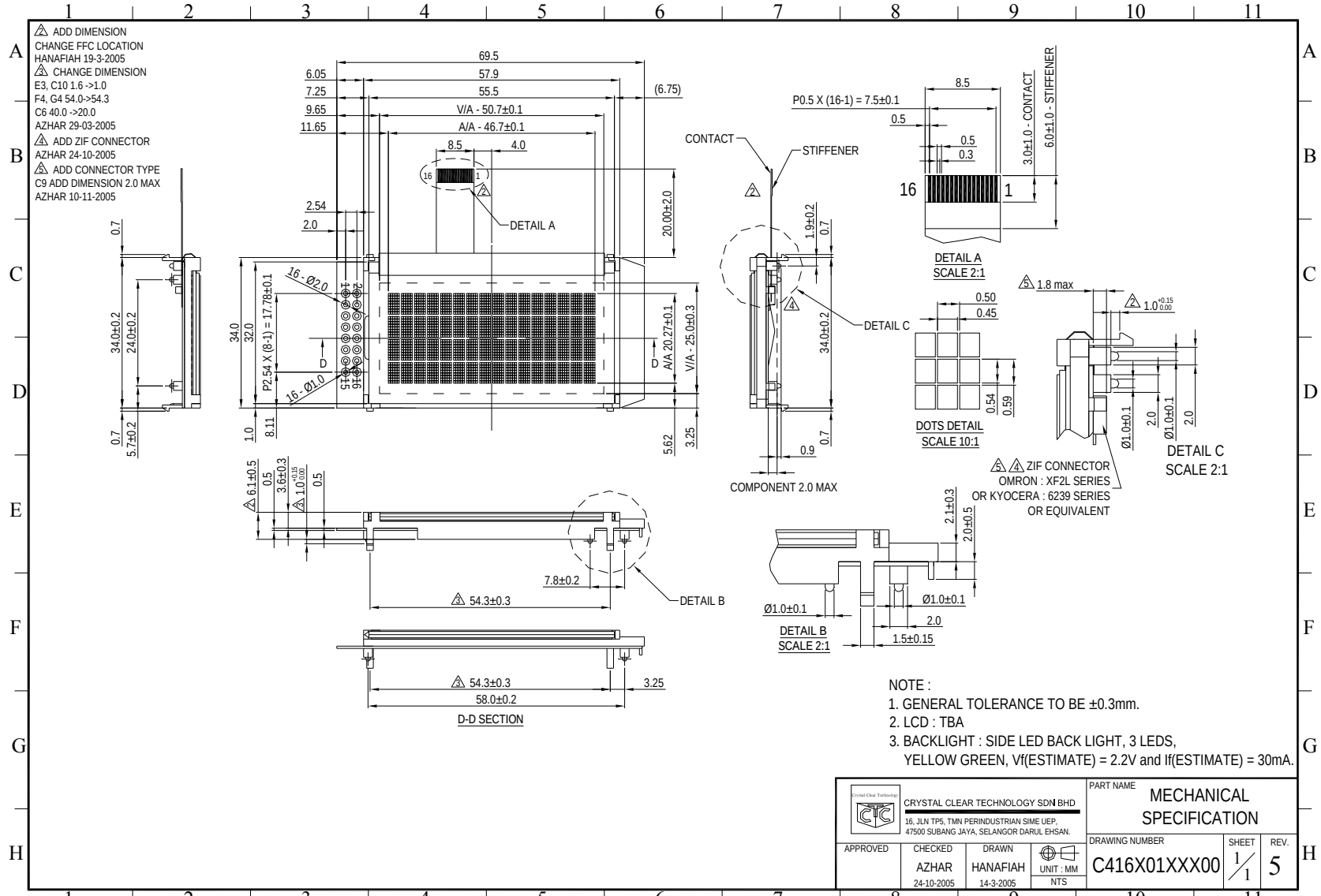
a) The contras can be adjusted by varying the LCD driving voltage V0
b) Driving voltage should be kept within specified range, excess voltage shortens display life.
c) Response time increases with decrease in temperature.
d) Display may turn black or dark blue at temperature above its operational range, this is (however not pressing on the viewing area) may cause the segments to appear "fractured".
e) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".

2.5 Storage

If any fluid leaks out of the damage glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

2.6 Limited Warranty

Unless otherwise agreed between Crystal Clear Technology and customer, Crystal Clear Technology will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with Crystal Clear Technology acceptance standards, for a period of one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Crystal Clear Technology is limited to repair and/or replacement on the terms set forth above. Crystal Clear Technology will not responsible for any subsequent or consequential events.


2 ADD DIMENSION
CHANGE FFC LOCATION
HANAFIAH 19-3-2005
3 CHANGE DIMENSION
E3, C10 1.6 ->1.0
F4, G4 54.0->54.3
C6 40.0 ->20.0
AZHAR 29-03-2005
4 ADD ZIF CONNECTOR
AZHAR 24-10-2005
5 ADD CONNECTOR TYPE
C9 ADD DIMENSION 2.0 MAX
AZHAR 10-11-2005
69.5
57.9
55.5
(6.75)
V/A - 50.7±0.1
A/A - 46.7±0.1
DETAIL A
20.00±2.0
16 - Ø2.0
16 - Ø1.0
P2.54 X (8-1) = 17.78±0.1
A/A 20.27±0.1
V/A - 25.0±0.3
34.0±0.2
24.0±0.2
5.7±0.2
8.11
5.62
3.25
CONTACT
STIFFENER
DETAIL C
COMPONENT 2.0 MAX
P0.5 X (16-1) = 7.5±0.1
3.0±1.0 - CONTACT
6.0±1.0 - STIFFENER
DETAIL A
SCALE 2:1
DOTS DETAIL
SCALE 10:1
1.8 max
ZIF CONNECTOR
OMRON : XF2L SERIES
OR KYOCERA : 6239 SERIES
OR EQUIVALENT
DETAIL C
SCALE 2:1
6.1±0.5
3.6±0.3
54.3±0.3
7.8±0.2
DETAIL B
DETAIL B
SCALE 2:1
58.0±0.2
D-D SECTION
NOTE :
1. GENERAL TOLERANCE TO BE ±0.3mm.
2. LCD : TBA
3. BACKLIGHT : SIDE LED BACK LIGHT, 3 LEDS,
YELLOW GREEN, Vf(ESTIMATE) = 2.2V and If(ESTIMATE) = 30mA.
CRYSTAL CLEAR TECHNOLOGY SDN BHD
16, JLN TP5, TMN PERINDUSTRIAN SIME UEP,
47500 SUBANG JAYA, SELANGOR DARUL EHSAN.
PART NAME
MECHANICAL SPECIFICATION
DRAWING NUMBER
C416X01XXX00
SHEET
1/1
REV.
5
APPROVED
CHECKED
AZHAR
24-10-2005
DRAWN
HANAFIAH
14-3-2005
UNIT : MM
NTS

Crystal Clear Technology
16 Jalan TP5—Taman Perindustrian Sime UEP
47600 Subang Jaya—Selangor DE
Malaysia