

Crystal Clear Technology

Product Specification

G6498X01 series

Crystal Clear Technology sdn. bhd.

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2.0 Record of revision

Rev	Date	Item	Page	Comment	Originator	Checked By
1.0	12/09/08			Initial Release	Syam	Azhar
2.0	02/03/10			Change backlight information	Khairiah	azhar



3.0 General specification

Display format: Graphics 98 (w) x 64 (h) dots

Dot size: 0.28 (w) x 0.28 (h) mm

Dot pitch: 0.30 (w) x 0.30 (h) mm

View area: 33.5 (w) x 22.7 (h) mm

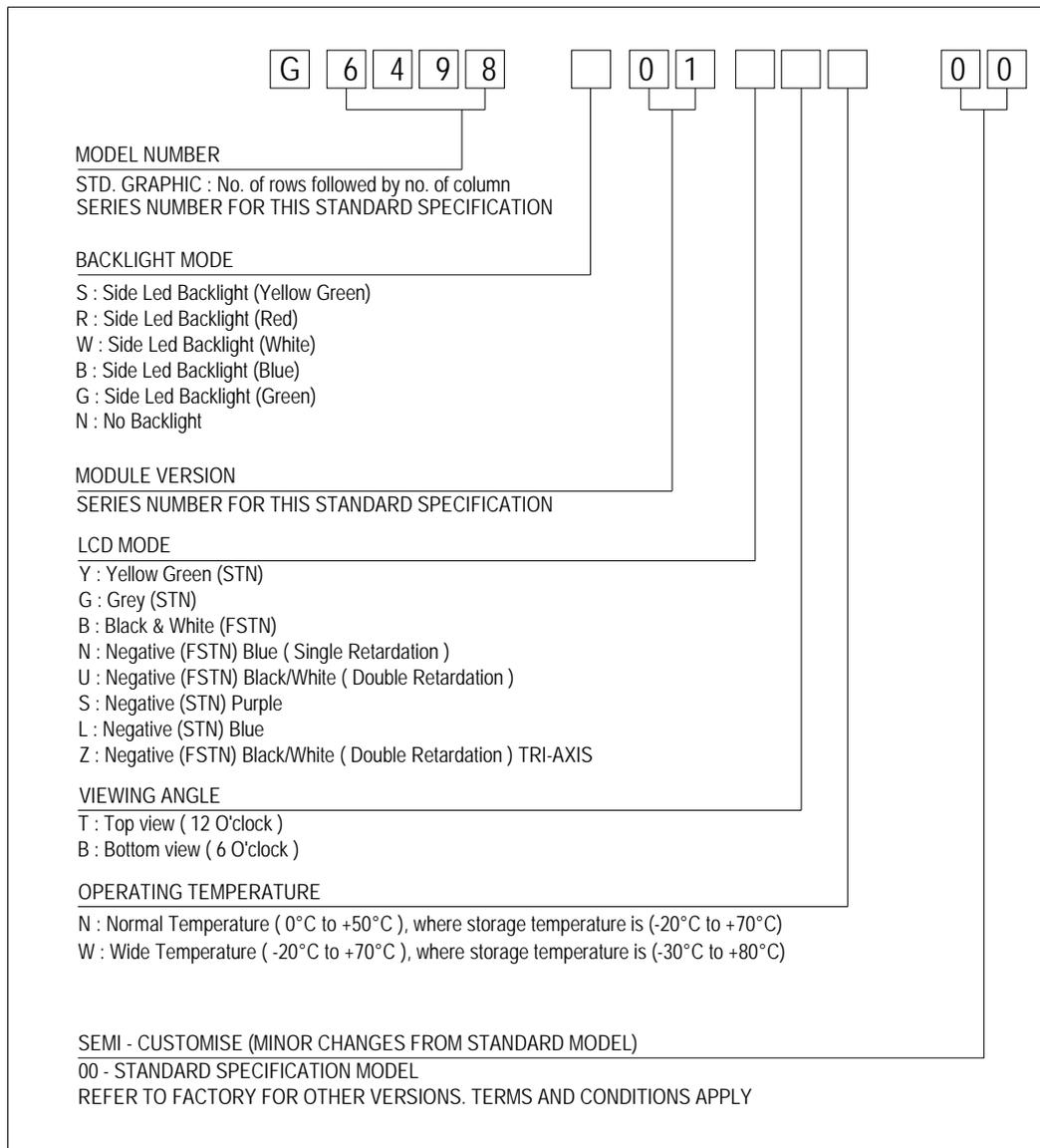
Active area: 29.38 (w) x 19.18 (h) mm

General dimensions: 39.80 (w) x 35.0 (h) x 4.1 (t) mm

Controller/Driver: SSD1818 or equivalent

Interface: Serial

Driving method: 1/64 duty, 1/9 bias



**4.0 Absolute maximum rating (at V_{SS} = 0V, ambient temperature = 25°C)**

NO	ITEM	SIMBOL	MIN	MAX	UNIT
1.	Operating Voltage Range	V _{DD}	-0.3	7.0	V
2.	Operating Temperature	T _{op}	Refer page 3		°C
3.	Storage Temperature	T _{st}	Refer page 3		°C

5.0 Electrical characteristics

NO	ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
1.	Operating Voltage	V _{DD}	-	2.4	3.0	3.5	V
2.	Power Supply voltage	V _{LCD}	25°C	9.5±5%			V
3.	Current Supply	I _{DD}	V _{DD} = 3.3V 4x Boosting	-	200	400	uA

5.1 Backlight Options

NO	COLOR	FORWARD VOLTAGE (V)			FORWARD CURRENT (mA)			MIN BRIGHTNESS (cd/m ²) *
		Min	Typ.	Max	Min	Typ.	Max	
1.	White	-	3.1	3.6	-	40	-	300
2.	Blue	-	3.1	3.6	-	40	-	75
3.	Green	-	3.1	3.6	-	40	-	150
4.	Yellow Green		2.1	2.5	-	30	-	30
5.	Red	-	2.1	2.5	-	30	-	60

*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, Red = 50K hrs. For White, Blue, Green = 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 C @ 30 min to 50 C @ 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

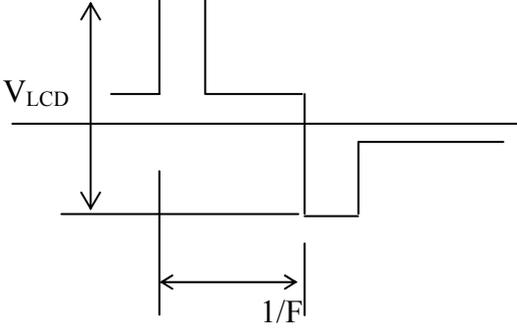
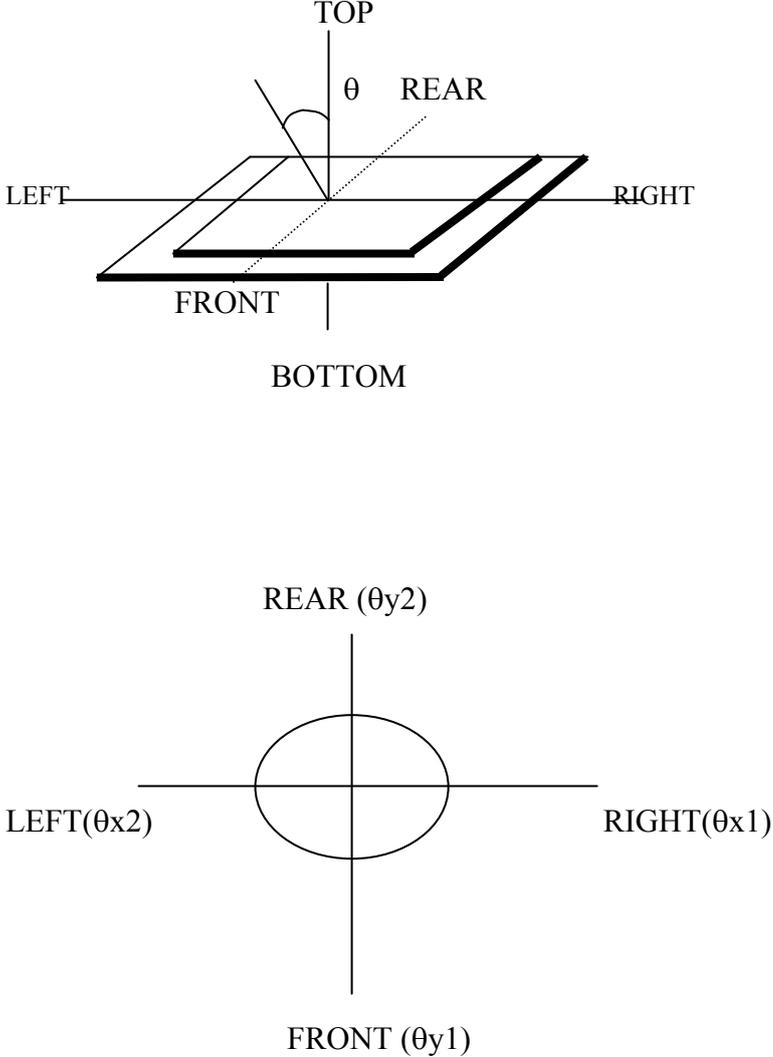
7.1 Electro-optical characteristics (at ambient temperature = 25°C)

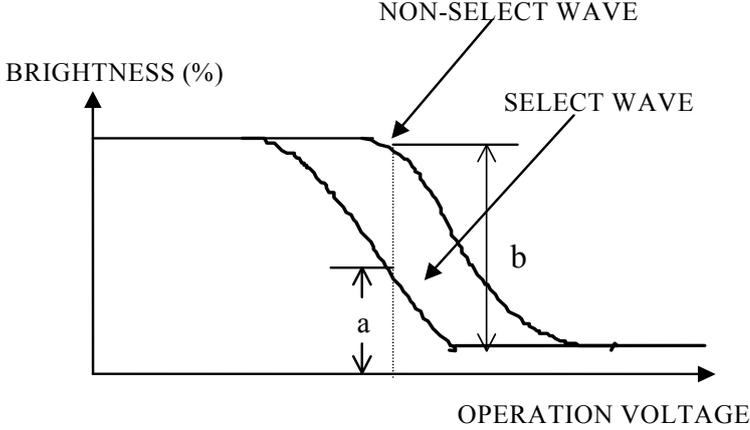
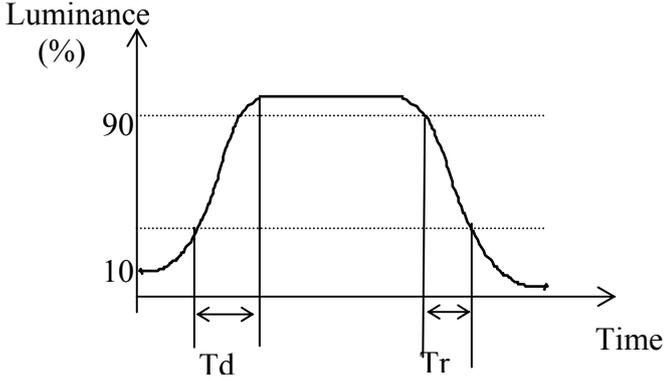
NO	ITEM	SYMBOL	CONDITION	LCD TYPE							REF.
				STN YG	STN GREY	STN -VE BLUE/ PURP LE	FSTN +VE B/W	FSTN -VE BLUE	FSTN - VE TRUE B/W	FSTN -VE TRI AXIS	
1	Operating Voltage (Volt)	V_{LCD}	$\theta = 0$ $Cr = \max$	9.5 ± 5%							7.1.1
2	Viewing Angle (Deg)	$\theta x 1$	$CR \geq 2$ $V_{LCD} = 14.7V$	+25	+20	+35	+25	+35	+35	+40	7.1.2
		$\theta x 2$		-25	-20	-35	-25	-35	-40	-40	
		$\theta y 1$		-30	-25	-35	-30	-35	-35	-50	
		$\theta y 2$		+30	+25	+35	+30	+35	+35	+30	
3	Contrast Ratio	CR	$\theta = 0^0$ $V_{LCD} = 14.7V$	3.0	2.3	6.0	3.0	6.0	20	20	7.1.3
4	Response Time (msec)	Rise Time (Tr)	$\theta = 0^0$	200							7.1.4
		Decay Time (Td)	$\theta = 0^0$	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	<p>Definition of Operating Voltage (V_{LCD})</p>	 <p>V_{LCD} : Operating Voltage F : Frame Frequency</p>
7.1.2	<p>Definition of Viewing Angle</p>	 <p>Diagram illustrating the viewing angle θ relative to the normal of the LCD panel. The panel is labeled with TOP, BOTTOM, LEFT, and RIGHT. The viewing angle θ is shown between the normal and the viewing direction.</p> <p>Diagram illustrating the viewing angle ranges: REAR (θ_{y2}), FRONT (θ_{y1}), LEFT (θ_{x2}), and RIGHT (θ_{x1}).</p>

<p>7.1.3</p>	<p>Definition of Contrast Ratio</p>	 <p>Contrast Ratio = $\frac{\text{Brightness of non-selected state (b)}}{\text{Brightness of selected state (a)}}$</p> <p>Conditions</p> <ul style="list-style-type: none"> (a) Operating Voltage: V_{LCD} (b) Temperature: $25^{\circ}C$ (c) Viewing Angle, $\theta = 0^{\circ}$
<p>7.1.4</p>	<p>Response Time</p>	 <p>Tr: Measured between 10% and 90% of LCD segment maximum response with V_{ON}.</p> <p>Td: With voltage switches to zero and the instant LCD segment reaches 10% of its maximum response.</p>



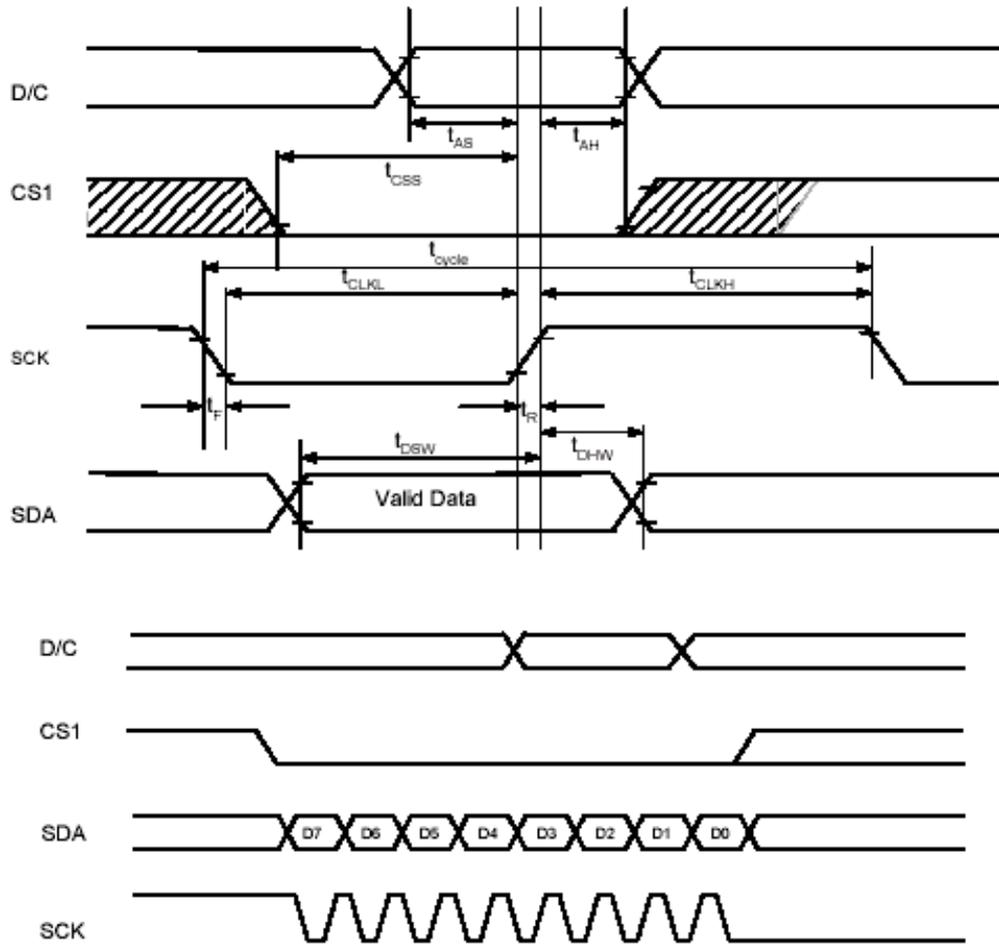
8.0 Interface

8.1	Display Driver	SSD1818 OR EQUIVALENT	
8.2	Pin No	Symbol	Description
	1	VL6	Bias Voltage Terminal
	2	VL5	Bias Voltage Terminal
	3	VL4	Bias Voltage Terminal
	4	VL3	Bias Voltage Terminal
	5	VL2	Bias Voltage Terminal
	6	C4N	Voltage Converter Capacitor Negative Terminal
	7	C2P	Voltage Converter Capacitor Positive Terminal
	8	C2N	Voltage Converter Capacitor Negative Terminal
	9	C1N	Voltage Converter Capacitor Negative Terminal
	10	C1P	Voltage Converter Capacitor Positive Terminal
	11	C3N	Voltage Converter Capacitor Negative Terminal
	12	VEE	DC-DC Voltage Converter Output Terminal
	13	VSS	Ground Terminal
	14	VDD	Power Supply Terminal
	15	SDA	Serial Data Input Terminal
	16	SCK	Serial Clock Input Terminal
	17	D/C	Data/Command Control Input Terminal
	18	/RES	Reset Signal Input Terminal
	19	/CS	Chip Select Input Terminal
	20	NC	No connection



9.0 Functional Descriptions

9.1 Read/Write timing characteristics



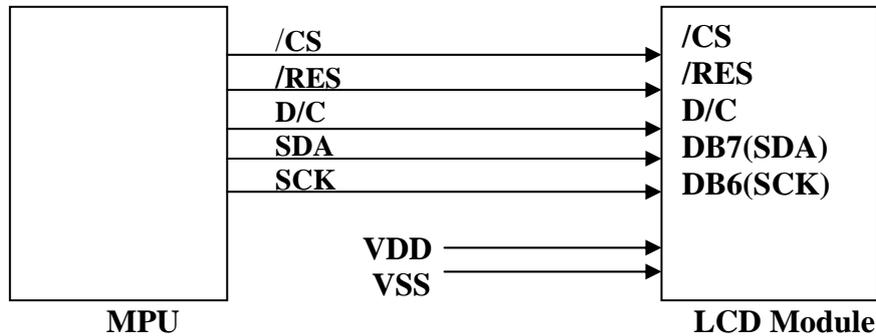
Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	250	-	-	ns
t_{AS}	Address Setup Time	150	-	-	ns
t_{AH}	Address Hold Time	150	-	-	ns
t_{DSW}	Write Data Setup Time	100	-	-	ns
t_{DHW}	Write Data Hold Time	100	-	-	ns
T_{CLKL}	Clock Low Time	100	-	-	ns
T_{CLKH}	Clock High Time	100	-	-	ns
t_{CSS}	Chip Select Setup Time (for D7 input)	120	-	-	ns
t_{CSH}	Chip Select Hold Time (for D0 input)	60	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

Read/Write characteristics (Serial Interface)



9.2 Application Circuits

9.2.1 Serial Interface



10. Instruction Set

10.1 Command Table

Bit Pattern	Command	Description
0000X ₃ X ₂ X ₁ X ₀	Set Lower Column Address	Set the lower nibble of the column address register using X ₃ X ₂ X ₁ X ₀ as data bits. The lower nibble of column address is reset to 0000b after POR.
0001X ₃ X ₂ X ₁ X ₀	Set Higher Column Address	Set the higher nibble of the column address register using X ₃ X ₂ X ₁ X ₀ as data bits. The higher nibble of column address is reset to 0000b after POR.
00100X ₂ X ₁ X ₀	Set Internal Regulator Resistor Ratio	Feedback gain of the internal regulator generating VL6 increases as X ₂ X ₁ X ₀ increased from 000b to 111b. After POR, X ₂ X ₁ X ₀ = 100b
00101X ₂ X ₁ X ₀	Set Power Control Register	X ₀ =0: turns off the output op-amp buffer (POR) X ₀ =1: turns on the output op-amp buffer X ₁ =0: turns off the internal regulator (POR) X ₁ =1: turns on the internal regulator X ₂ =0: turns off the internal voltage booster (POR) X ₂ =1: turns on the internal voltage booster
01X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀	Set Display Start Line	Set GDDRAM display start line register from 0-63 using X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀ . Display start line register is reset to 000000 after POR.
10000001 ** X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀	Set Contrast Control Register	Select contrast level from 64 contrast steps. Contrast increases (VL6 decreases) as X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀ is increased from 000000b to 111111b. X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀ = 100000b after POR
1010000X ₀	Set Segment Re-map	X ₀ =0: column address 00h is mapped to SEG0 (POR) X ₀ =1: column address 67h is mapped to SEG0 Refer to Table 4 on page 17 for example.
1010001X ₀	Set LCD Bias	X ₀ =0: POR default bias: 1/9 X ₀ =1: alternate bias: 1/7 For other bias ratio settings, see "Set 1/4 Bias Ratio" and "Set Bias Ratio" in Extended Command Set.
1010010X ₀	Set Entire Display On/Off	X ₀ =0: normal display (POR) X ₀ =1: entire display on
1010011X ₀	Set Normal/Reverse Display	X ₀ =0: normal display (POR) X ₀ =1: reverse display
1010111X ₀	Set Display On/Off	X ₀ =0: turns off LCD panel (POR) X ₀ =1: turns on LCD panel
1011X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀	Set Page Address	Set GDDRAM Page Address (0-8) for read/write using X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀
1100X ₃ ***	Set COM Output Scan Direction	X ₃ =0: normal mode (POR) X ₃ =1: remapped mode, COM0 to COM[N-1] becomes COM[N-1] to COM0 when Multiplex ratio is equal to N. See Table 4 on page 17 for detail mapping.
11100000	Set Read-Modify-Write Mode	Read-Modify-Write mode will be entered in which the column address will not be increased during display data read. After POR, Read-modify-write mode is turned OFF.
11100010	Software Reset	Initialize internal status registers
11101110	Set End of Read-Modify-Write Mode	Exit Read-Modify-Write mode. RAM Column address before entering the mode will be restored. After POR, Read-modify-write mode is OFF.



1010110X ₀ * * * * * X ₁ X ₀ Set Indicator On/Off	Indicator Display Mode	This second byte command is required ONLY when "Set Indicator On" command is sent. X ₀ = 0: indicator off (POR, second command byte is not required) X ₀ = 1: indicator on (second command byte required) X ₁ X ₀ = 00: indicator off X ₁ X ₀ = 01: indicator on and blinking at ~1 second interval X ₁ X ₀ = 10: indicator on and blinking at ~1/2 second interval X ₁ X ₀ = 11: indicator on constantly
11100011	NOP	Command result in No Operation
11110000	Test Mode Reset	Reserved for IC testing. Do NOT use
1111 * * * *	Set Test Mode	Reserved for IC testing. Do NOT use.
10101110 10100101	Set Power Save Mode	(Standby or Sleep) Standby or sleep mode will be entered using compound commands. Issue compound commands "Set Display Off" followed by "Set Entire Display On".

Extended Command Table

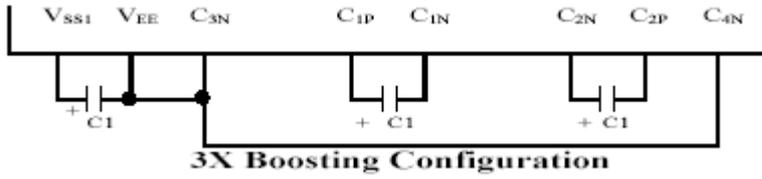
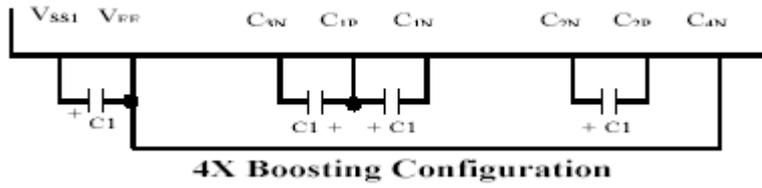
Bit Pattern	Command	Description
10101000 00X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀	Set Multiplex Ratio	To select multiplex ratio N from 2 to the maximum multiplex ratio (POR value) for each member (including icon line). Max. MUX ratio: 64 MUX: 65 N = X ₆ X ₄ X ₃ X ₂ X ₁ X ₀ + 2, e.g. N = 001111b + 2 = 17
10101001 X ₇ X ₆ X ₅ X ₄ X ₃ X ₂ X ₁ X ₀	Set Bias Ratio (X ₁ X ₀)	X ₁ X ₀ = 00(POR) 01 10 11 1/9 or 1/7 1/5 1/6 1/8
	Set TC Value (X ₄ X ₃ X ₂)	X ₄ X ₃ X ₂ = 000: (TC0) Typ. -0.07 X ₄ X ₃ X ₂ = 010: (TC2) Typ. -0.13 X ₄ X ₃ X ₂ = 100: (TC4) Typ. -0.26 X ₄ X ₃ X ₂ = 111: (TC7) Typ. -0.29 X ₄ X ₃ X ₂ = 001, 011, 101, 110: Reserved Increase the value of X ₇ X ₆ X ₅ will increase the oscillator frequency and vice versa.
	Modify Osc. Freq. (X ₇ X ₆ X ₅)	Default Mode: X ₇ X ₆ X ₅ = 011 (POR): Typ. 21.5kHz Remarks: By software program the multiplex ratio, the typical oscillator frequency is listed above.
1010101X ₀	Set 1/4 Bias Ratio	X ₀ = 0: use normal setting (POR) X ₀ = 1: fixed at 1/4 bias regardless of other bias setting commands



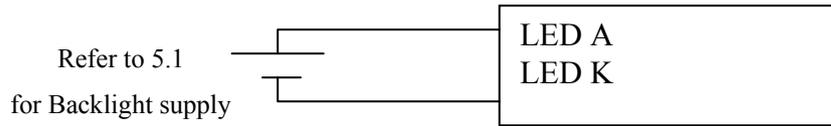
<p>11010100 00X₅X₄0000</p>	<p>Set Total Frame Phases</p>	<p>The On/Off of the Static Icon is given by 3 phases / 1 phase overlapping of the M and MSTAT signals. This command set total phases of the M/MSTAT signals for each frame. The more the total phases, the less the overlapping time and thus the lower the effective driving voltage. X₅X₄ = 00: 5 phases X₅X₄ = 01: 7 phases X₅X₄ = 10: 9 phases (POR) X₅X₄ = 11: 16 phases</p>
<p>11010011 00X₅X₄X₃X₂X₁X₀</p>	<p>Set Display Offset</p>	<p>After POR, X₅X₄X₃X₂X₁X₀ = 0 After setting MUX ratio less than default value, data will be displayed at Center of display matrix. To move display towards Row 0 by L, X₅X₄X₃X₂X₁X₀ = L To move display away from Row 0 by L, X₅X₄X₃X₂X₁X₀ = 64-L Note: max. value of L = (POR default MUX ratio – display MUX)/2</p>
<p>1101000X₀</p>	<p>ICON Mode</p>	<p>X₀ = 0 : icon off (POR) X₀ = 1 : icon mode on</p>
<p>11010110 001111X₁X₀</p>	<p>Enable Band Gap Reference Circuit</p>	<p>X₁X₀ = 00 01 10 11(POR) 100 ms 200 ms 400 ms 800 ms Approx. band gap clock period This command should execute if divider is used without capacitor at VL2 to VL5. Recommendation: set the band gap clock period to approx. 200ms</p>
<p>D₇D₆D₅D₄D₃D₂D₁D₀</p>	<p>Status Register Read</p>	<p>D₇=0: indicates the driver is ready for command. D₇=1: indicates the driver is Busy. D₆=0: indicates reverse segment mapping with column address. D₆=1: indicates normal segment mapping with column address. D₅=0: indicates the display is ON. D₅=1: indicates the display is OFF. D₄=0: initialization is completed. D₄=1: initialization process is in progress after RES or software reset. D₃D₂D₁D₀ = 1001 or 0011, the 4-bit is fixed to either 1001 or 0011 which could be used to identify as Solomon Systech Device.</p>



11. Power Supply



(Where C1 = 0.47 ~ 1.0 uF)

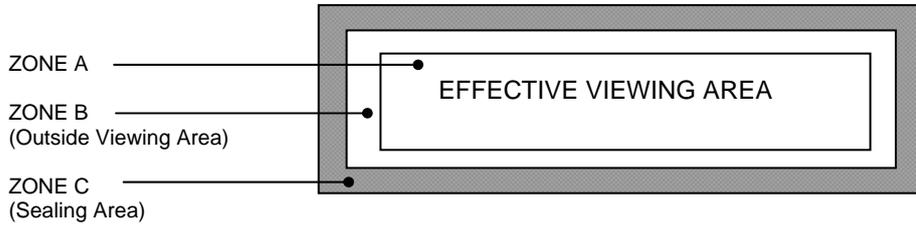


For LED backlight version only



12.0 Quality Assurance

12.1 ZONE DEFINITION



12.1.1 Black Spot, White Spot and Foreign Material

Defect Category	Defect Description	Criterion			Drawing Specification	
		Zone / Dimension	Acceptable No.			
Black Spot, White Spot and Foreign Material	Black Spot, White Spot and Foreign Material		A	B	C	<p>$D = (A + B)/2$</p>
		$D \leq 0.10\text{mm}$	NC	NC	NC	
		$0.10 < D \leq 0.20\text{mm}$	3	3	NC	
		$0.20 < D \leq 0.30\text{mm}$	1	2	NC	
		$D > 0.30\text{ mm}$	0	0	NC	
		NC: No count D: Mean Diameter of Defect				

12.1.2 Line Shape and Scratches

Defect Category	Defect Description	Criterion			Drawing Specification		
		Zone /Dimension		Acceptable No.			
Line shape and scratches	Line shape and scratches	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	

12.1.3 Pin Hole

Defect Category	Defect Description	Criterion	Drawing Specification
Pin Hole	Pin hole / void at light up segment	$D \leq 0.20\text{mm}$ within 1 part/segment	<p>$D = (A + B)/2$</p>



12.1.4 Polarizer Bubble/Foreign Material

Defect Category	Defect Description	Criterion			Drawing Specification	
	Polarizer bubble / Foreign material	Zone / Dimension	Acceptable No.			<p>$D = (A + B)/2$</p>
		$D \leq 0.15\text{mm}$	NC	NC	NC	
		$0.15 < D \leq 0.30\text{mm}$	3	5	NC	
		$0.30 < D \leq 0.50\text{mm}$	2	3	NC	
		$0.50 < D \leq 1.0\text{mm}$	0	1	NC	
		NC: No count				
		D: Mean Diameter of Defect				
Accept - if air bubble at the seal area does not propagate into effective viewing area						

Note: Total defects shall not exceed five



13. 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.

- b) Keep the temperature within the range of use and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel off or bubble.
- c) 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 benzine.
- d) 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.
- e) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
- f) 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.

- a) 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

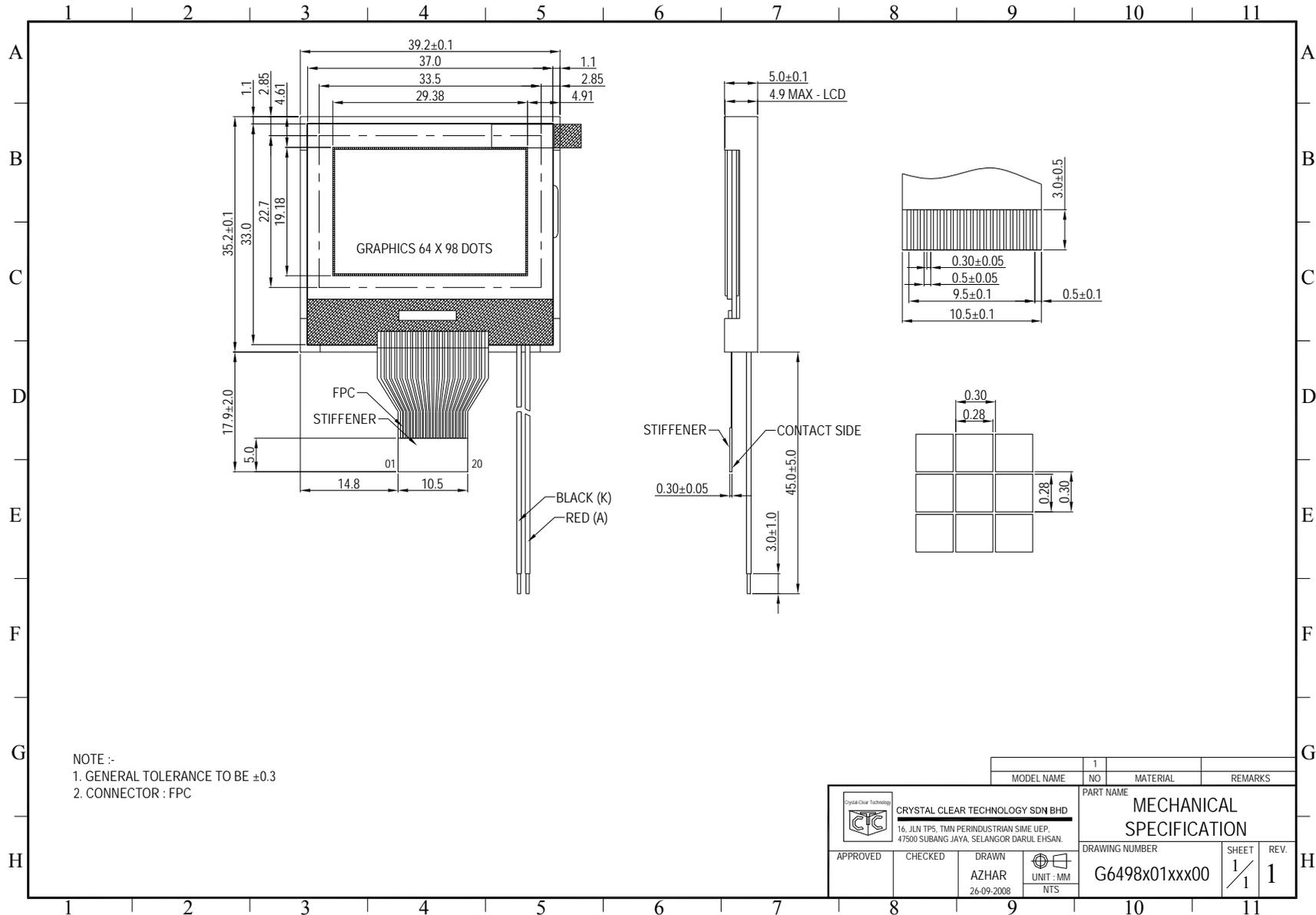
- a) The contrast can be adjusted by varying the LCD driving voltage V_0
- b) Driving voltage should be kept within specified range, excess voltage shortens display life.
- c) Response time increases with decrease in temperature.
- d) Display may turn black or dark blue at temperature above its operational 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 damaged 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.

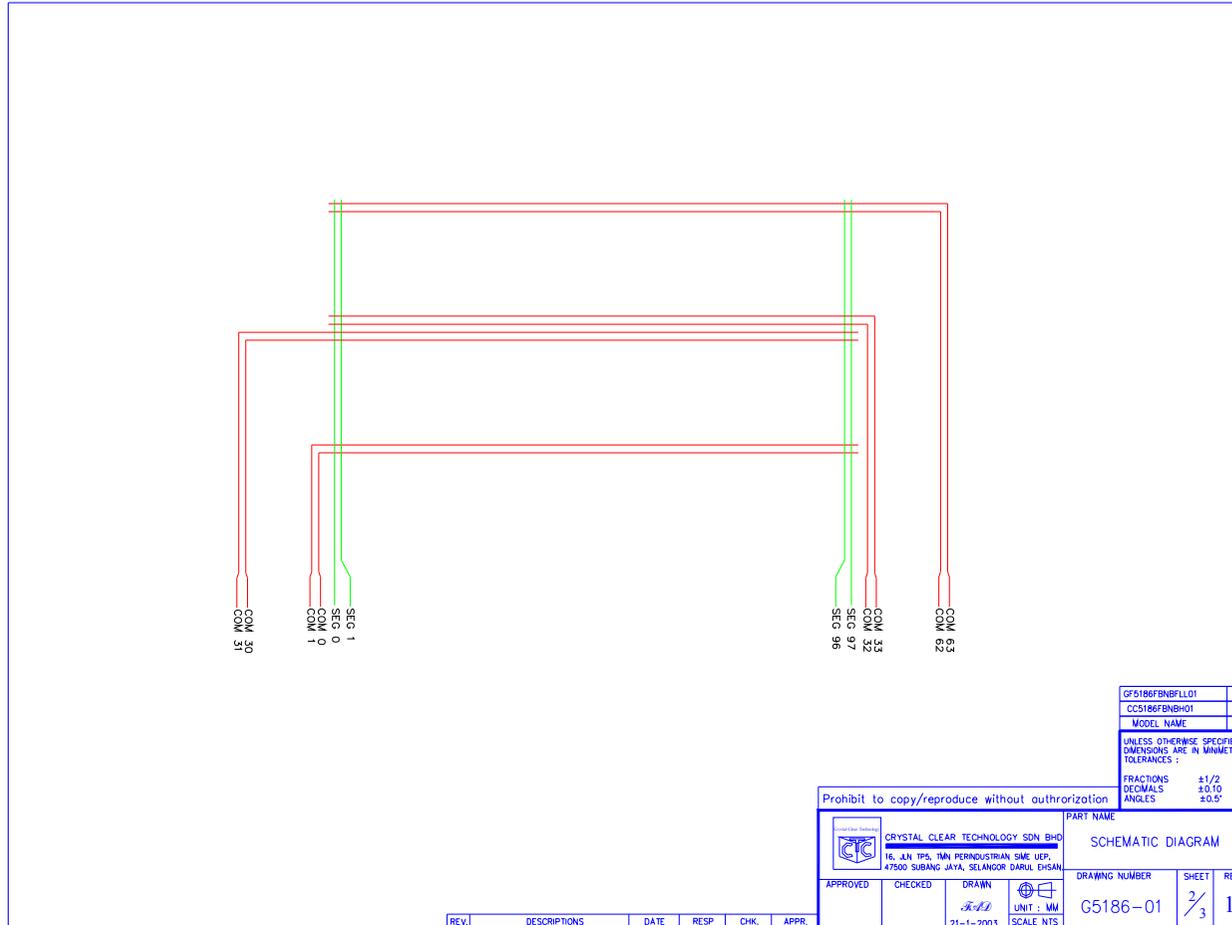
2.6 Limited Warranty

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 be responsible for any subsequent or consequential events.



MODEL NAME		1		
NO		MATERIAL		REMARKS
PART NAME				
MECHANICAL SPECIFICATION				
DRAWING NUMBER		SHEET		REV.
G6498x01xxx00		1/1		1

APPROVED	CHECKED	DRAWN	UNIT : MM
		AZHAR	NTS
		26-09-2008	



GF5186FBNFBLL01	2
CC5186FBNFBH01	1
MODEL NAME	NO.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS TOLERANCES :	
FRACTIONS	±1/2
DECIMALS	±0.10
ANGLES	±0.5°

Prohibit to copy/reproduce without authorization

CRYSTAL CLEAR TECHNOLOGY SDN BHD 16, JLN TRS, TAM PERINDUSTRIAN, SMC UEP, 47500 SUBANG JAYA, SELANGOR DARUL EHSAN.		PART NAME SCHEMATIC DIAGRAM	
APPROVED	CHECKED	DRAWN	SCALE
		<i>[Signature]</i>	UNIT : MM 21-1-2003 SCALE NTS
DRAWING NUMBER G5186-01		SHEET 2/3	REV. 1

REV.	DESCRIPTIONS	DATE	RESP.	CHK.	APPR.

LCD Segment and Common Layout



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