Crystal Clear Technology

Product Specification

C216x22 series

Crystal Clear Technology sdn. bhd.

1.0   Table of Contents   Page

2.0   Record of revision

Rev	Date	Item	Page	Comment	Originator	Checked By
1.0	15/12/10			Initial Release	Chong	Azhar

3.0   General specification

Display format: Characters 2 x 16 COG

Character size: 5 x 8

Character size: 3.94mm x 7.42mm
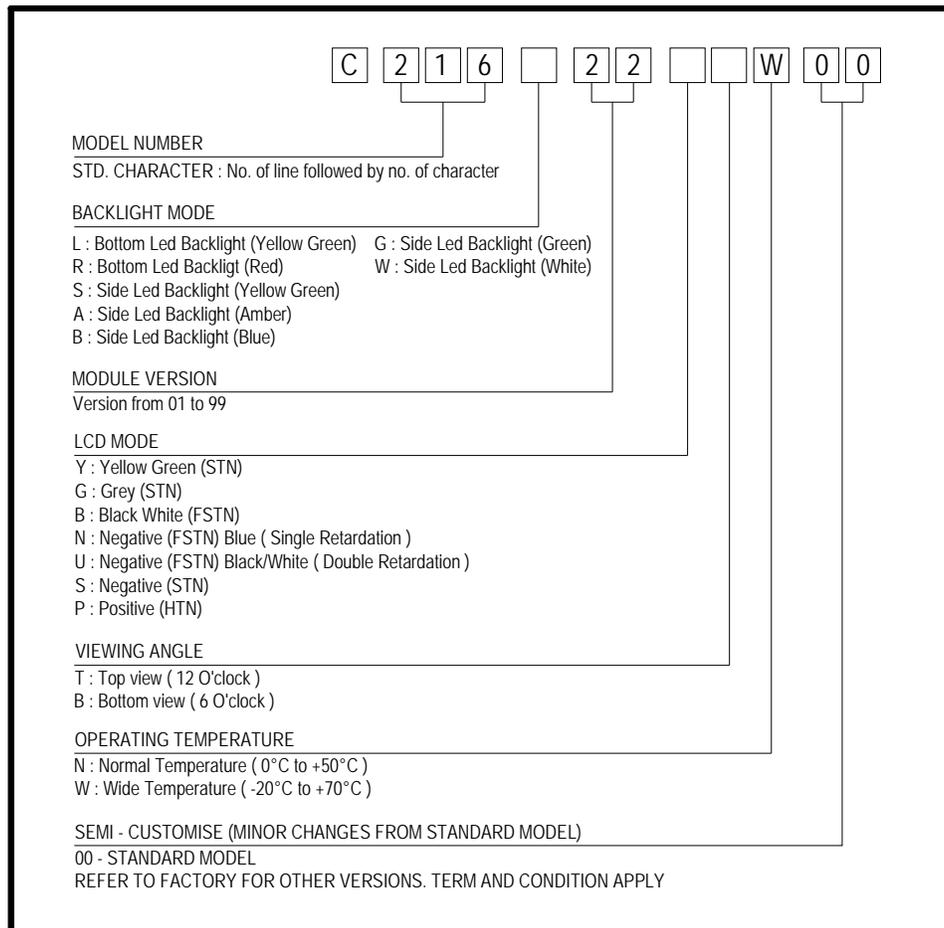
View area: 77.0mm x 20.45mm

Active area: 70.54mm x 15.34mm

General dimensions: 84.3mm x 32.75mm

Controller/Driver: SSD1801 or equivalent

Microprocessor interface: Parallel (Connection: FPC)

Driving Method : 1/16 duty, 1/5 bias

| C | 2 | 1 | 6 | | 2 | 2 | | | W | 0 | 0 |

MODEL NUMBER
STD. CHARACTER : No. of line followed by no. of character

BACKLIGHT MODE

L : Bottom Led Backlight (Yellow Green)   G : Side Led Backlight (Green)
R : Bottom Led Backligt (Red)   W : Side Led Backlight (White)
S : Side Led Backlight (Yellow Green)
A : Side Led Backlight (Amber)
B : Side Led Backlight (Blue)

MODULE VERSION
Version from 01 to 99

LCD MODE

Y : Yellow Green (STN)
G : Grey (STN)
B : Black White (FSTN)
N : Negative (FSTN) Blue (Single Retardation)
U : Negative (FSTN) Black/White (Double Retardation)
S : Negative (STN)
P : Positive (HTN)

VIEWING ANGLE
T : Top view (12 O'clock)
B : Bottom view (6 O'clock)

OPERATING TEMPERATURE
N : Normal Temperature (0°C to +50°C)
W : Wide Temperature (-20°C to +70°C)

SEMI - CUSTOMISE (MINOR CHANGES FROM STANDARD MODEL)
00 - STANDARD MODEL
REFER TO FACTORY FOR OTHER VERSIONS. TERM AND CONDITION APPLY

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}	-0.3	7	V
3.	Operating Temperature	T_{op}	Refer page 3		°C
4.	Storage Temperature	T_{st}	-20ºC to +70ºC		°C

5.0   Electrical characteristics

NO	ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
1.	Power Supply voltage (Logic)	V_{DD}	-	4.5	5.0	5.5	V
2.	Power Supply voltage (V_{LCD})	V_{DD}-V_5	25°C	4.5±5%			V
3.	Current Supply	I_{DD}	V_{DD} = 5V	-	1.0	1.5	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	3.8	-	4.4	-	40	-	25

*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 = 50K hrs.
     (Condition : If = typical value and Ta = 25ºC)

6.0   Environmental requirements

NO	ITEM	CONDITION
1.	Operating Temperature	Refer page 3
2.	Storage Temperature	-20ºC to +70ºC
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.
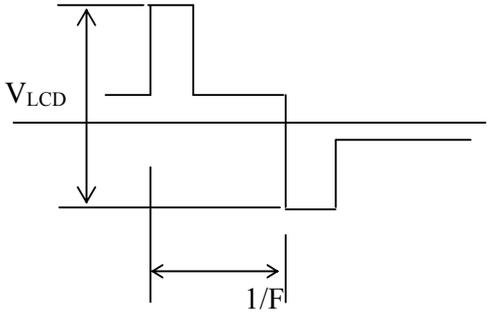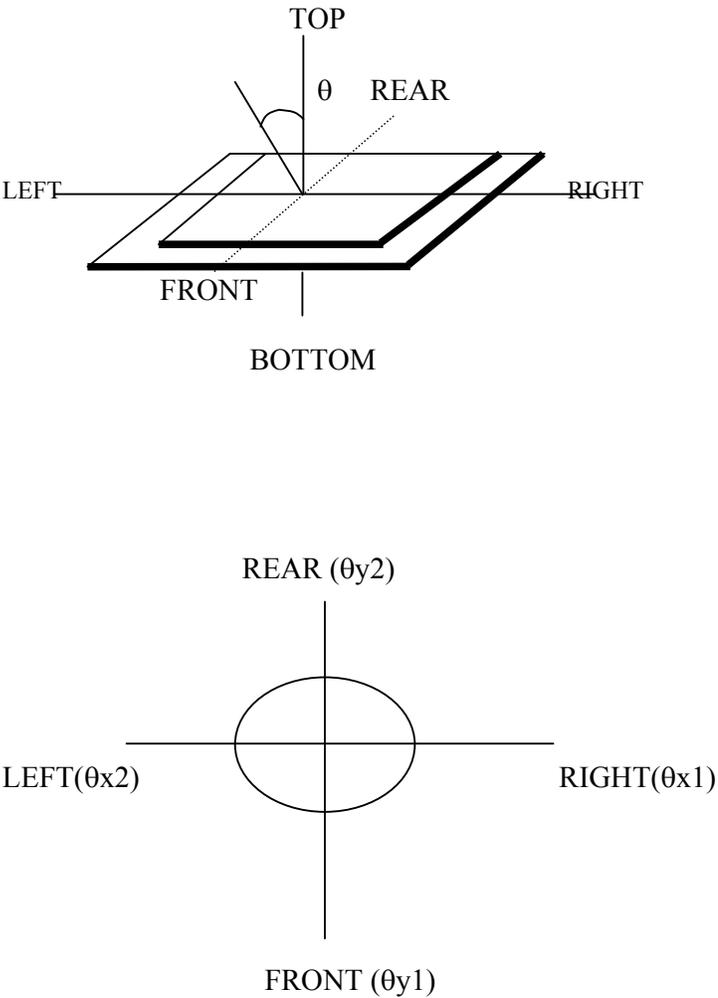
7.0   LCD specification

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

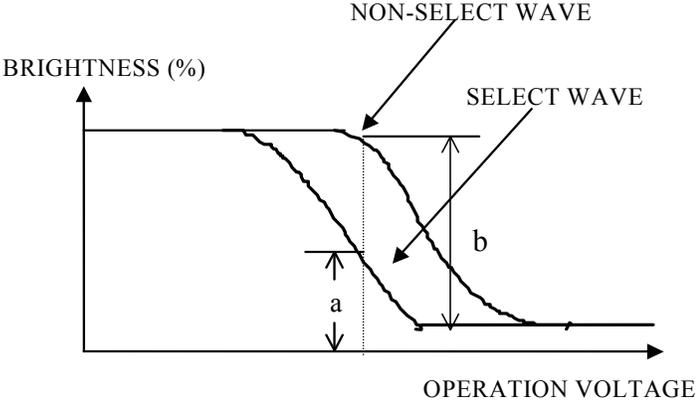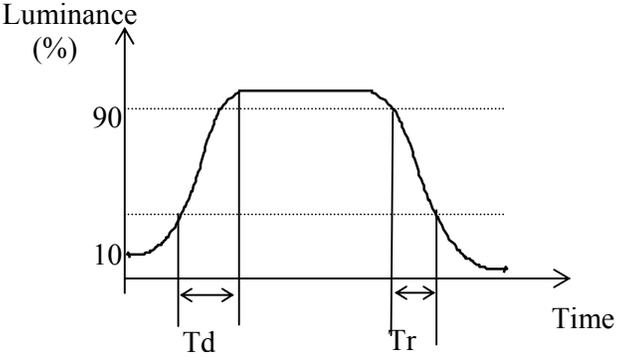| NO	ITEM	SYMBOL	CONDITION	LCD TYPE						REF.
				STN YG	STN GREY	STN -VE BLUE	FSTN +VE B/W	FSTN –VE BLUE	FSTN -VE TRUE B/W	
1	Operating Voltage (Volt)	V_{LCD}	$\theta = 0$ Cr = max	4.5 ± 5%						7.1.1
2	Viewing Angle (Deg)	θ x 1	CR ≥ 2 V_{LCD} = 4.5V	+25	+20	+35	+25	+35	+35	7.1.2
		θ x 2		-25	-20	-35	-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	$\theta = 0^0$ V_{LCD} =4.5V	3.0	2.3	6.0	3.0	6.0	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	*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*	NON-SELECT WAVE BRIGHTNESS (%) SELECT WAVE b a OPERATION VOLTAGE 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 (%) 90 10 Td Tr Time 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

Pin No.	Symbol	Function
1	D/C	Data/Command control
2	R/W	Read and write input
3	E	Enable Signal
4	/CS	Chip select input
5	D7	Data input
6	D6	Data input
7	D5	Data input
8	D4	Data input
9	VL2	LCD Driving Voltage
10	VL3	LCD Driving Voltage
11	VL4	LCD Driving Voltage
12	VL5	LCD Driving Voltage
13	VL6	LCD Driving Voltage
14	VF	Voltage Regulator
15	VOUT	Regulated Voltage output
16	C2N	Negative connection for Capacitor 2
17	C2P	Positive connection for Capacitor 2
18	C1N	Negative connection for Capacitor 1
19	C1P	Positive connection for Capacitor 1
20	VSS	Ground
21	VDD	Driving supply voltage
22	P/S	Parallel/Serial selection input
23	RES	Reset signal input
24	NC	No Connection

9.0   Timing characteristics / Timing diagrams

9.1   Read Timing Signal
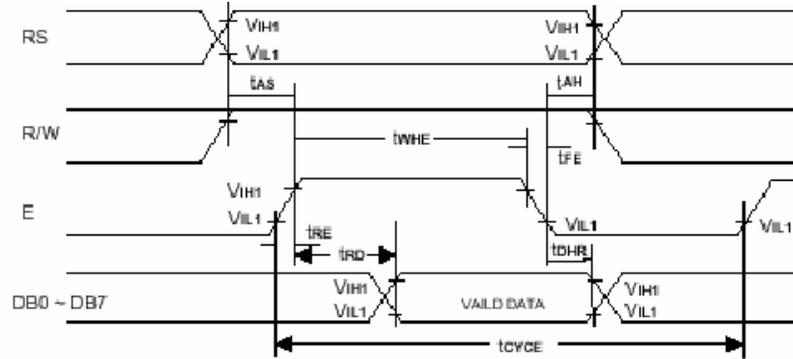
Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
tCYCE	Enable Cycle Time	500	-	-	ns	Figure 1
tWHE	Enable "H" Level Pulse Width	300	-	-	ns	Figure 1
tRE, tFE	Enable Rise/Fall Time	-	-	25	ns	Figure 1
tAS	RS, R/W Setup Time	60[1]	-	-	ns	Figure 1
		100[2]				
tAH	RS, R/W Address Hold Time	10	-	-	ns	Figure 1
tRD	Read Data Output Delay	-	-	190	ns	Figure 1
tDHR	Read Data Hold Time	20	-	-	ns	Figure 1

9.2   Write Timing Signal
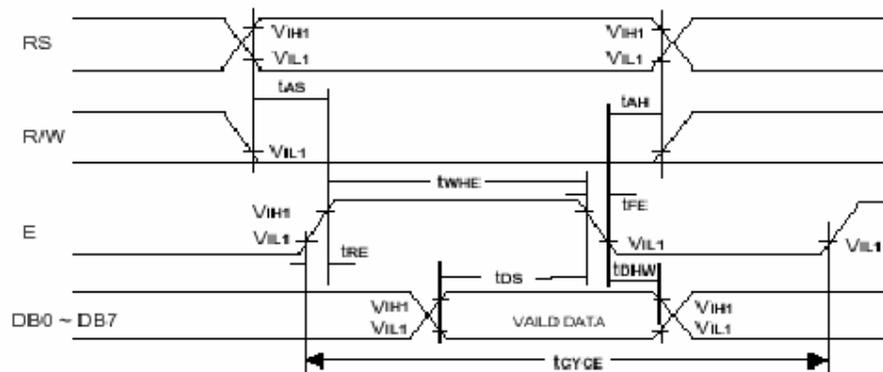
Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t_{CYCE}	Enable Cycle Time	500	-	-	ns	Figure 2
t_{WHE}	Enable "H" Level Pulse Width	300	-	-	ns	Figure 2
t_{RE}, t_{FE}	Enable Rise/Fall Time	-	-	25	ns	Figure 2
t_{AS}	RS, R/W Setup Time	60[1] / 100[2]	-	-	ns	Figure 2
t_{AH}	RS, R/W Address Hold Time	10	-	-	ns	Figure 2
t_{DS}	Data Output Delay	100	-	-	ns	Figure 2
t_{DHR}	Data Hold Time	10	-	-	ns	Figure 2

9.3   Interface with 8-bit MPU
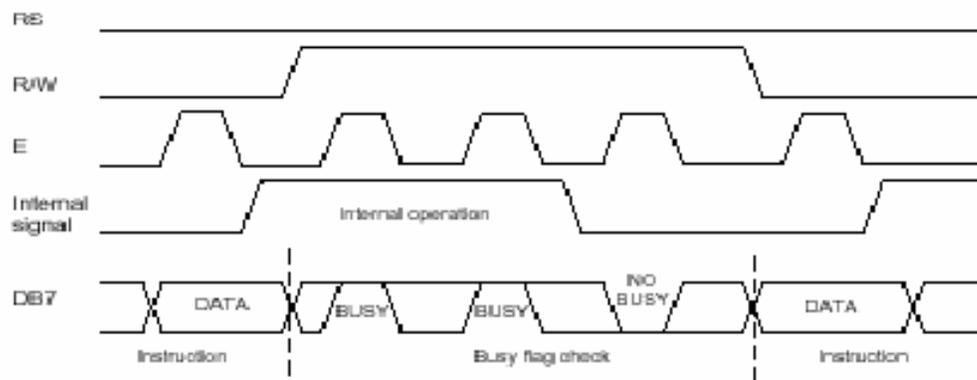
9.4   Interface with 4-bit MPU
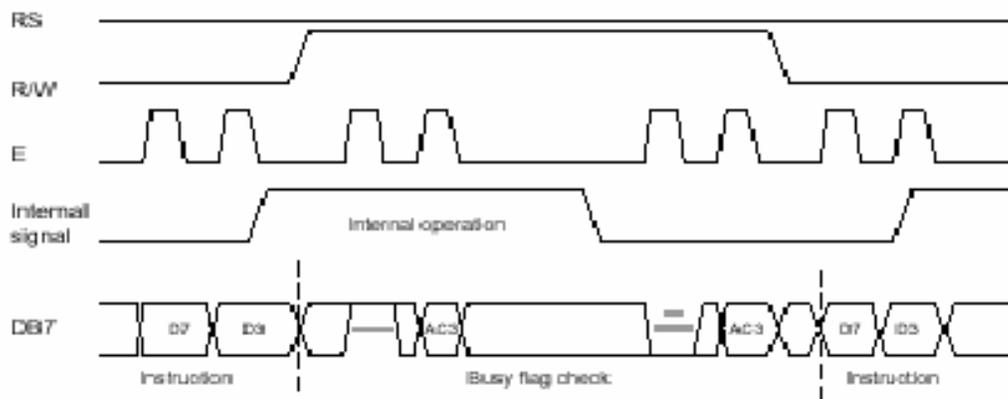
10. Application Block Diagram/Circuit
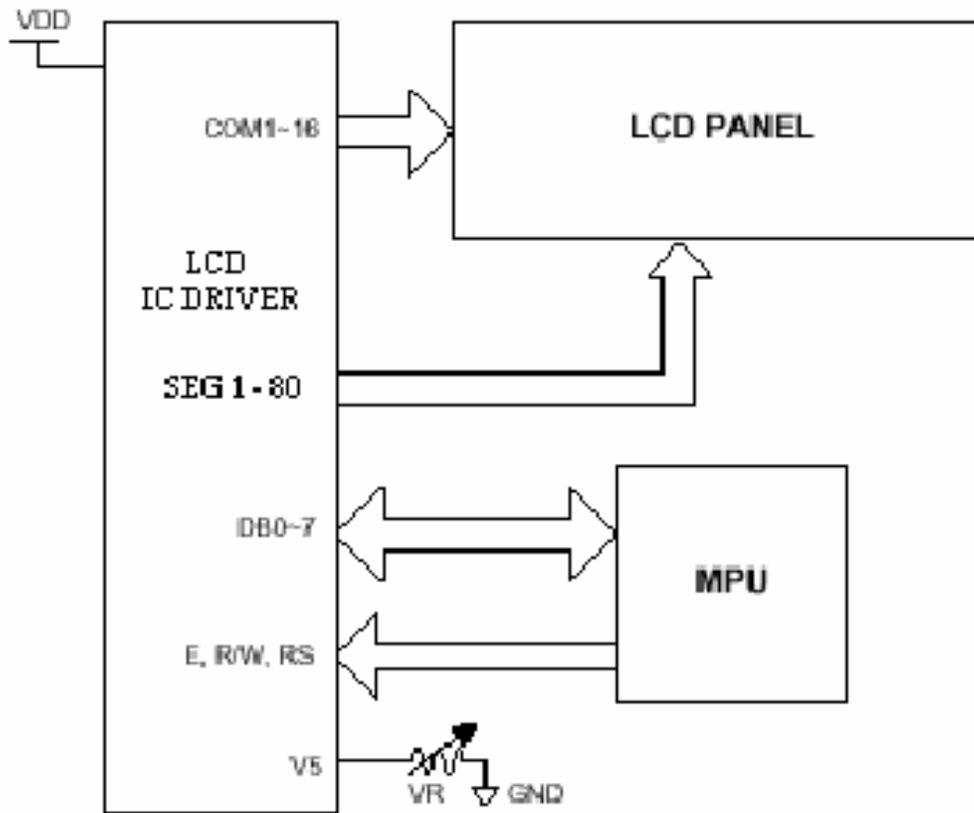
11. Instructions

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function	Execution time (max) (fosc = 250kHz)
						Code						
Display Clear	0	0	0	0	0	0	0	0	0	1	Clear entire display area, restore display from shift, and load address counter with DDRAM address 00h.	1.64ms
Display/ Cursor Home	0	0	0	0	0	0	0	0	1	*	Restore display from shift and load address counter with DDRAM address 00h.	1.64ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Specify direction of cursor movement and display shift mode. This operation takes place after each data transfer (read/write).	40us
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	Specify activation of display (D) cursor (C) and blinking of character at cursor position (B).	40us
Display/ Cursor Shift	0	0	0	0	0	1	S/C	R/L	*	*	Shift displays or move cursor.	40us
Function Set	0	0	0	0	1	DL	1	0	*	*	Set interface data length (DL), number of display line (N), and character font (F).	40us
RAM Address Set	0	0	0	1	ACG						Load the address counter with a CGRAM address. Subsequent data access is for CGRAM data.	40us
DDRAM Address Set	0	0	1	ADD							Load the address counter with a DDRAM address. Subsequent data access is for DDRAM data.	40us
Busy Flag/ Address Counter Read	0	1	BF	AC							Read Busy Flag(BF) and contents of Address Counter (AC)	40us
CGRAM/ DDRAM Data Write	1	0	Write data								Write data to CGRAM or DDRAM	40us
CGRAM/ DDRAM Data Read	1	1	Read data								Read data from CGRAM or DDRAM	40us

Note: Symbol "*" signifies an insignificant bit (disregard)

DDRAM : Display Data RAM
CGRAM : Character Generator RAM
ACG   : Character Generator RAM Address
ADD   : Display Data RAM Address
AC   : Address Counter

I/D	= 1	:	Increment	I/D	= 0	:	Decrement
S	= 1	:	Display Shift On				
D	= 1	:	Display On				
C	= 1	:	Cursor Display On				
B	= 1	:	Cursor Blink On				
S/C	= 1	:	Shift Display	S/C	= 0	:	Move Cursor
R/L	= 1	:	Shift Right	R/L	= 0	:	Shift Left
DL	= 1	:	8-bit	DL	= 0	:	4-bit
BF	= 1	:	Internal Operation				
BF	= 0	:	Ready for Instruction				

Character Generator ROM (SSD1801)

12.0   LCD Module Initialization Flow

12.1   8-bit interface

Power On

Wait for more than 30
ms after VDD on

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

Wait for more than 40us

Display ON/OFF Control									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Wait for more than 40us

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

Wait for more than 1.64ms

Entry Mode Set									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	I/D	S

Initialisation end

12.2 4-bit interface

Power On

↓

Wait for more than 30 ms
after VDD on

↓

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

↓

Wait for more than 40us

↓

Display ON/OFF Control									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	0	D	C	B	X	X	X	X

↓

Wait for more than 40us

↓

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

↓

Wait for more than 1.64ms

↓

Entry Mode Set									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	0	0	I/D	S	X	X	X	X

↓

Initialisation end

13.0 Quality Assurance

13.1 ZONE DEFINITION

ZONE A

ZONE B
(Outside Viewing Area)

ZONE C
(Sealing Area)

EFFECTIVE VIEWING AREA
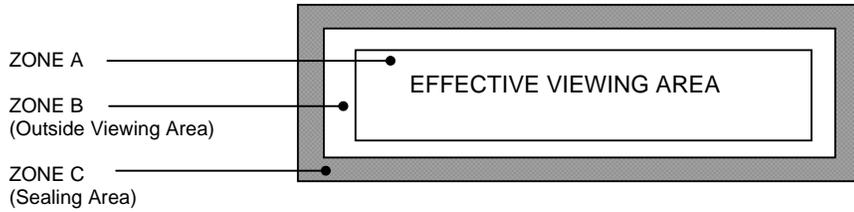
13.1.1 Black Spot, White Spot and Foreign Material

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 $\leq$ 0.10mm	NC	NC	NC	
		0.10<D $\leq$ 0.20mm	3	3	NC	
		0.20 < D $\leq$ 0.30mm	1	2	NC	
		D > 0.30 mm	0	0	NC	
		NC: No count				
		D: Mean Diameter of Defect				

Drawing: B, A, D = (A + B)/2

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 $\leq$ 0.20mm within 1 part/segment	B, A, D = (A + B)/2

13.1.4   Polarizer Bubble/Foreign Material

Defect Category	Defect Description	Criterion				Drawing Specification
	Polarizer bubble / Foreign material					
		Zone / Dimension	Acceptable No.			
			A	B	C	
		D ≤ 0.15mm	NC	NC	NC	
		0.15 < D ≤ 0.30mm	3	5	NC	D = (A + B)/2
		0.30 < D ≤ 0.50mm	2	3	NC	
		0.50 < D ≤ 1.0mm	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

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.

b) Keep the temperature within the range of use and storage. Excessive temperature and humidity could cause polarization degredation, 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 benzin.

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

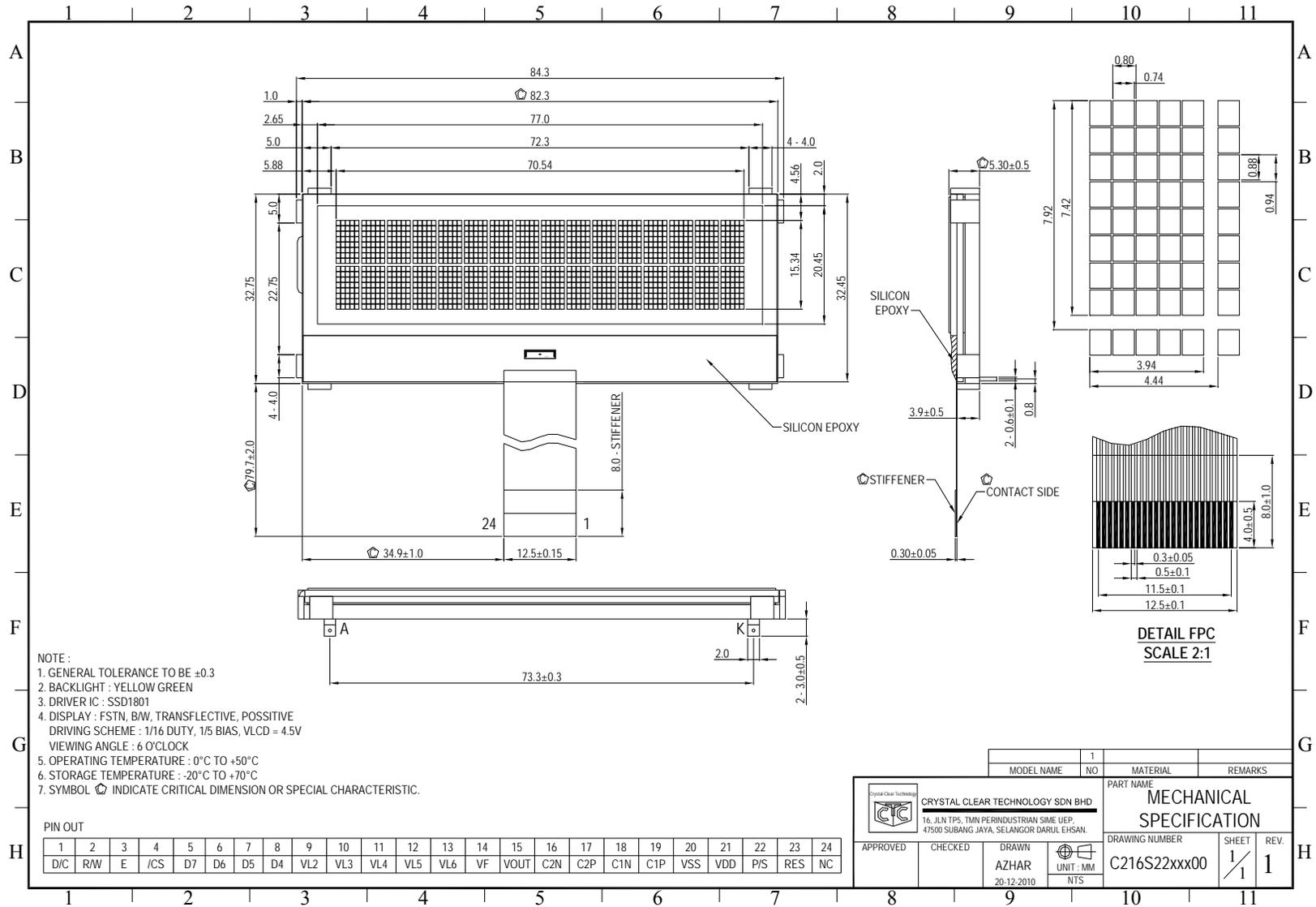a) The contras can be adjusted by varying the LCD driving voltage V0

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.

DETAIL FPC
SCALE 2:1

SILICON EPOXY

STIFFENER

CONTACT SIDE

NOTE :
1. GENERAL TOLERANCE TO BE ±0.3
2. BACKLIGHT : YELLOW GREEN
3. DRIVER IC : SSD1801
4. DISPLAY : FSTN, B/W, TRANSFLECTIVE, POSSITIVE
   DRIVING SCHEME : 1/16 DUTY, 1/5 BIAS, VLCD = 4.5V
   VIEWING ANGLE : 6 O'CLOCK
5. OPERATING TEMPERATURE : 0°C TO +50°C
6. STORAGE TEMPERATURE : -20°C TO +70°C
7. SYMBOL ⬠ INDICATE CRITICAL DIMENSION OR SPECIAL CHARACTERISTIC.

PIN OUT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
D/C	R/W	E	/CS	D7	D6	D5	D4	VL2	VL3	VL4	VL5	VL6	VF	VOUT	C2N	C2P	C1N	C1P	VSS	VDD	P/S	RES	NC

		1		
MODEL NAME		NO	MATERIAL	REMARKS

	PART NAME			SHEET	REV.
CRYSTAL CLEAR TECHNOLOGY SDN BHD 16, JLN TP5, TMN PERINDUSTRIAN SIME UEP, 47500 SUBANG JAYA, SELANGOR DARUL EHSAN.	MECHANICAL SPECIFICATION				
	DRAWING NUMBER			1/1	1

APPROVED	CHECKED	DRAWN		
		AZHAR 20-12-2010	UNIT : MM NTS	C216S22xxx00

21

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