Issued date: 07 January 2002
Spec. No TD-0333
Revision No 1

LIQUID CRYSTAL DISPLAY MODULE

C O G 1 2 8 x 6 4 * *
(I C S 6 B 0 7 2 4 S a m s u n g)
P r e l i m i n a r y

Product Specification
&
Delivery Specification

Approvals

QA	
Design	
Customer approval	

TECDIS

1. REVISION RECORD

Date	Revision	Notes
Jan 2002	1	Issued

2. PRODUCT VERSIONS

Product name	Description
COG128x64C1	Transflective, B/W, 6h,Yellow LED Backlight
COG128x64C2	Transflective, B/W, 6h, NO LED Backlight
COG128x64D1	Reflective, Y/G, 6h, NO LED Backlight
COG128x64E1	Trasmissive, B/N, 6h, White LED Backlight
COG128x64F1	Trasmissive, 12h, double RCF, White LED Backlight

3. SCOPE

This specification covers the engineering requirements for the liquid crystal display module.

4. PRODUCT SPECIFICATIONS

4.1. General

- graphic format : 128 dots x 64 dots
- 1 / 65 duty; 1 / 9 bias
- FSTN LCD
- Wide operating temperature range
- With 28 pins flat cable
- Controller driver IC: S6B0724
- Both interfaces: serial and parallel (6800)
- VDD = 3.3V
- VLCD driving generated by internal voltage booster
- Required external booster capacitors (4 times booster)

4.2. Mechanical Characteristics

Item	Symbol
Dot configuration	128 dots x 64 dots
Dot dimensions (mm)	0.42 x 0.42
Dot spacing (mm)	0.03
Module dimensions(H x V x T, mm)	See mechanical drawings
Viewing area (H x V, mm)	61 x 31.4
Weight (g)	-

4.3. Absolute Maximum Ratings

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Max	Unit
Power supply voltage	VDD		-0.3	7.0	V
Input voltage	Vin		- 0.3	VDD + 0.3	V
Operating temperature	Topr		-20	70	°C
Storage temperature	Tstg		-30	80	°C

4.4. Electrical Characteristics

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Power supply voltage	VDD		2.4	3.3	3.6	V
	VLED	IF = 70 mA		4.1		V
Input voltage	High V_{IH}		0.8VDD	-	VDD	V
	Low V_{IL}		VSS	-	0.2VDD	V
Output voltage	High V_{OH}	IOH = 0.5 mA	0.8VDD	-	VDD	V
	Low V_{OL}	IOL = 0.5 mA	VSS	-	0.2VDD	V
Current consumption*	IDD	Ta = 25°C	-	800	1500	µA

* Test pattern: checker board pattern

4.5. Optical Characteristics

4.5.1. COG128x64C1 Optical Characteristics

1 / 65 duty, bias 1/9, Vop = V0 - VSS

Item	Conditions	Temp.	Symbol	Min	Typ	Max	Unit
Contrast *	θ = + 10° Φ = 0° Vop= 7.8V	25 °C	C	TBD	TBD		
Viewing angle	C ≥ 2 Φ = 0 ° Vop= 7.8V	25 °C	θ1	-	-	TBD	deg
			θ2	TBD	-	-	
			θ2 - θ1	TBD	-	-	
Response time **	θ = 0° Φ = 0° Vop= 7.8V	25 °C	t_{ON}	-	TBD	TBD	ms
			t_{OFF}	-	TBD	TBD	
	θ = 0° Φ = 0° Vop = 7.8V	0 °C	t_{ON}	-	TBD	TBD	
			t_{OFF}	-	TBD	TBD	

4.5.2. COG128x64C2 Optical Characteristics

1 / 65 duty, bias 1/9, Vop = V0 - VSS

Item	Conditions	Temp.	Symbol	Min	Typ	Max	Unit
Contrast *	θ = + 10° Φ = 0° Vop= 7.8V	25 °C	C	TBD	TBD		
Viewing angle	C ≥ 2 Φ = 0 ° Vop= 7.8V	25 °C	θ1	-	-	TBD	deg
			θ2	TBD	-	-	
			θ2 - θ1	TBD	-	-	
Response time **	θ = 0° Φ = 0° Vop= 7.8V	25 °C	t_{ON}	-	TBD	TBD	ms
			t_{OFF}	-	TBD	TBD	
	θ = 0° Φ = 0° Vop = 7.8V	0 °C	t_{ON}	-	TBD	TBD	
			t_{OFF}	-	TBD	TBD	

4.5.3. COG128x64D1 Optical Characteristics

1 / 65 duty, bias 1/9, Vop = V0 - VSS

Item	Conditions	Temp.	Symbol	Min	Typ	Max	Unit
Contrast *	θ = + 10° Φ = 0° Vop= 7.8V	25 °C	C	TBD	TBD		
Viewing angle	C ≥ 2 Φ = 0 ° Vop= 7.8V	25 °C	θ1	-	-	TBD	deg
			θ2	TBD	-	-	
			θ2 - θ1	TBD	-	-	
Response time **	θ = 0° Φ = 0° Vop= 7.8V	25 °C	t_{ON}	-	TBD	TBD	ms
			t_{OFF}	-	TBD	TBD	
	θ = 0° Φ = 0° Vop = 7.8V	0 °C	t_{ON}	-	TBD	TBD	
			t_{OFF}	-	TBD	TBD	

4.5.4. COG128x64E1 Optical Characteristics

1 / 65 duty, bias 1/9, Vop = V0 - VSS

Item	Conditions	Temp.	Symbol	Min	Typ	Max	Unit
Contrast *	θ = + 10° Φ = 0° Vop= 7.8V	25 °C	C	TBD	TBD		
Viewing angle	C ≥ 2 Φ = 0 ° Vop= 7.8V	25 °C	θ1	-	-	TBD	deg
			θ2	TBD	-	-	
			θ2 - θ1	TBD	-	-	
Response time **	θ = 0° Φ = 0° Vop= 7.8V	25 °C	t_{ON}	-	TBD	TBD	ms
			t_{OFF}	-	TBD	TBD	
	θ = 0° Φ = 0° Vop = 7.8V	0 °C	t_{ON}	-	TBD	TBD	
			t_{OFF}	-	TBD	TBD	

4.5.5. COG128x64F1 Optical characteristics

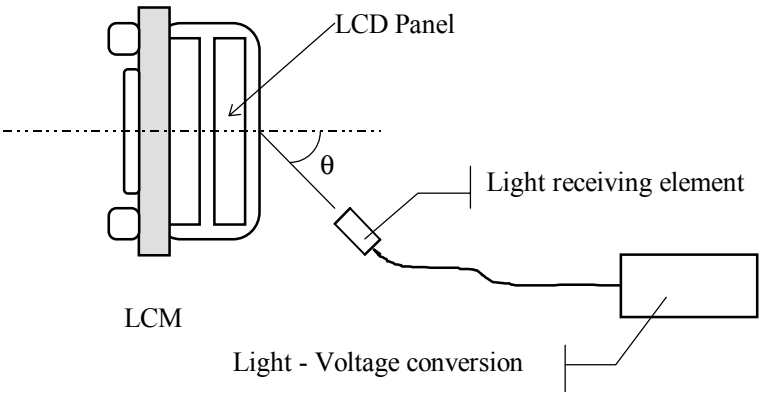
1 / 65 duty, bias 1/9, Vop = V0 - VSS

Item	Conditions	Temp.	Symbol	Min	Typ	Max	Unit
Contrast *	θ = + 10° Φ = 0° Vop= 7.8V	25 °C	C	TBD	TBD		
Viewing angle	C ≥ 2 Φ = 0 ° Vop= 7.8V	25 °C	θ1	-	-	TBD	deg
			θ2	TBD	-	-	
			θ2 - θ1	TBD	-	-	
Response time **	θ = 0° Φ = 0° Vop= 7.8V	25 °C	t_{ON}	-	TBD	TBD	ms
			t_{OFF}	-	TBD	TBD	
	θ = 0° Φ = 0° Vop = 7.8V	0 °C	t_{ON}	-	TBD	TBD	
			t_{OFF}	-	TBD	TBD	

Measuring equipment: Contrast and viewing angle: EZC Eldim
Transmittance mode: spot size 83μ
Response time: Canon illuminometer LC-4SR

Note
1 Refer to 4.5.6 Software Settings

* Contrast measurement
With pixels ON, direct a halogen lamp at the display, receive the reflected light with a light receiving element and convert the quantity of reflected light to voltage; repeat the measurement with pixels OFF. Calculate the contrast as shown in the following section.



4.5.6. Software Settings

COG128x64C1

VDD = 3.3 V

Register Name	Value [Hex]	Notes
LCD Bias Select	A2H	Bias 1/9 with Duty Ratio 1/65
Power control	2FH	
Set reference voltage register	20H	
Regulator Resistor Select	23H	1 + (Rb/Ra) = 4.5

COG128x64C2

VDD = 3.3 V

Register Name	Value [Hex]	Notes
LCD Bias Select	A2H	Bias 1/9 with Duty Ratio 1/65
Power control	2FH	
Set reference voltage register	20H	
Regulator Resistor Select	23H	1 + (Rb/Ra) = 4.5

COG128x64D1

VDD = 3.3 V

Register Name	Value [Hex]	Notes
LCD Bias Select	A2H	Bias 1/9 with Duty Ratio 1/65
Power control	2FH	
Set reference voltage register	(20H)	
Regulator Resistor Select	23H	1 + (Rb/Ra) = 4.5

COG128x64E1

VDD = 3.3 V

Register Name	Value [Hex]	Notes
LCD Bias Select	A2H	Bias 1/9 with Duty Ratio 1/65
Power control	2FH	
Set reference voltage register	(20H)	
Regulator Resistor Select	23H	1 + (Rb/Ra) = 4.5

COG128x64F1

VDD = 3.3 V

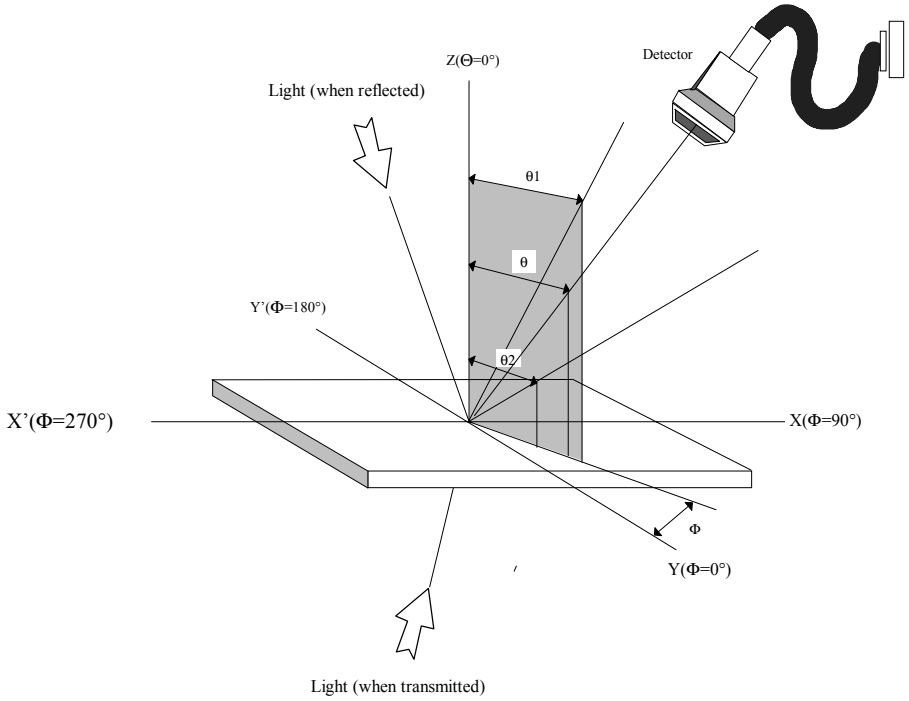
Register Name	Value [Hex]	Notes
LCD Bias Select	A2H	Bias 1/9 with Duty Ratio 1/65
Power control	2FH	
Set reference voltage register	(20H)	
Regulator Resistor Select	23H	1 + (Rb/Ra) = 4.5

Note:
Vop depends on Register Value (0 to 63) and 1+Rb/Ra (internal resistors) (3 to 6.4)

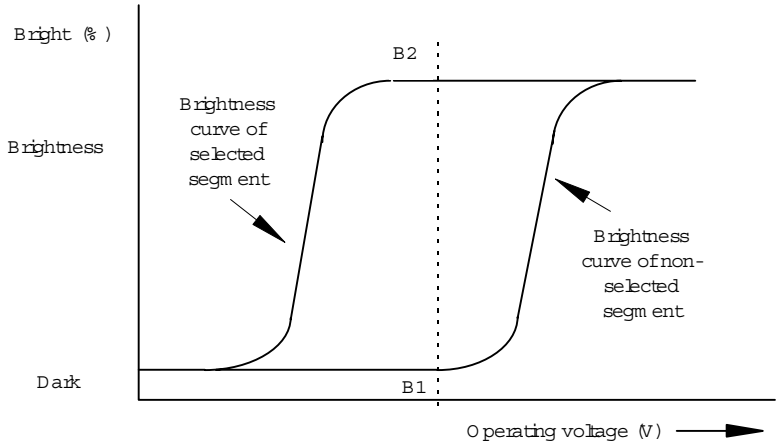
4.5.7. Vop tolerance

The required driving voltage (Vop) is equal to Vop typ ± 6%.

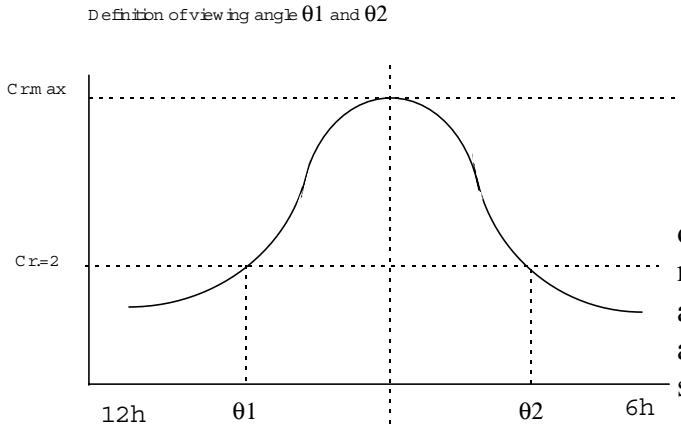
4.5.8. Definition of optical characteristics



Definition of contrast Cr. $Cr. = \frac{B1}{B2} = \frac{\text{Brightness of not selected segment}}{\text{Brightness of selected segment}}$

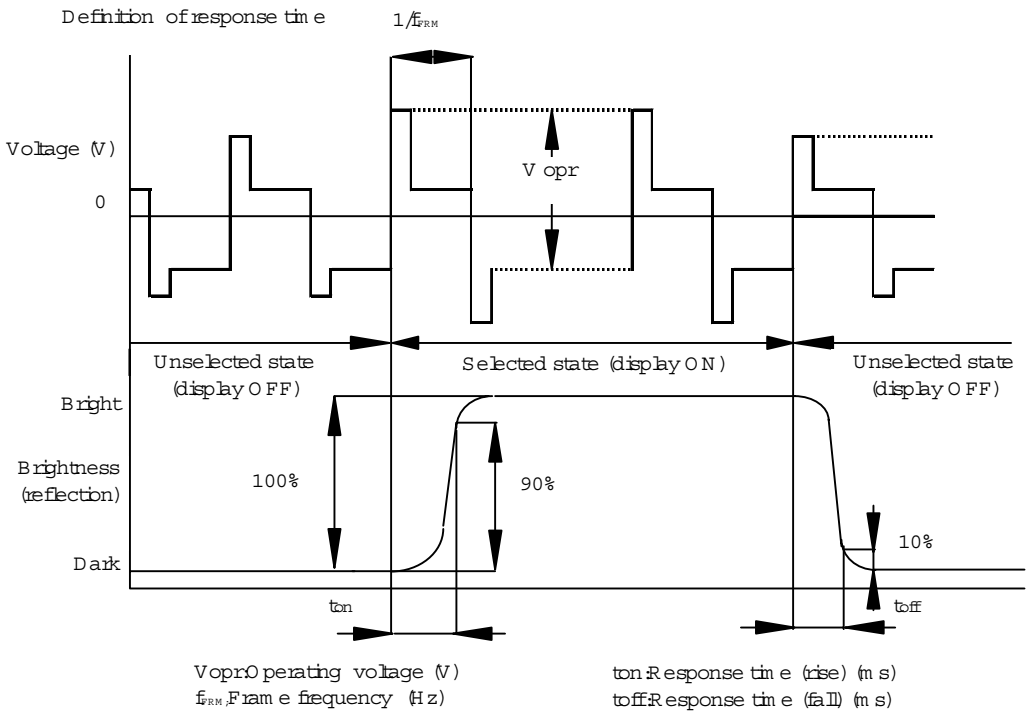


4.5.9. Definition of viewing angle

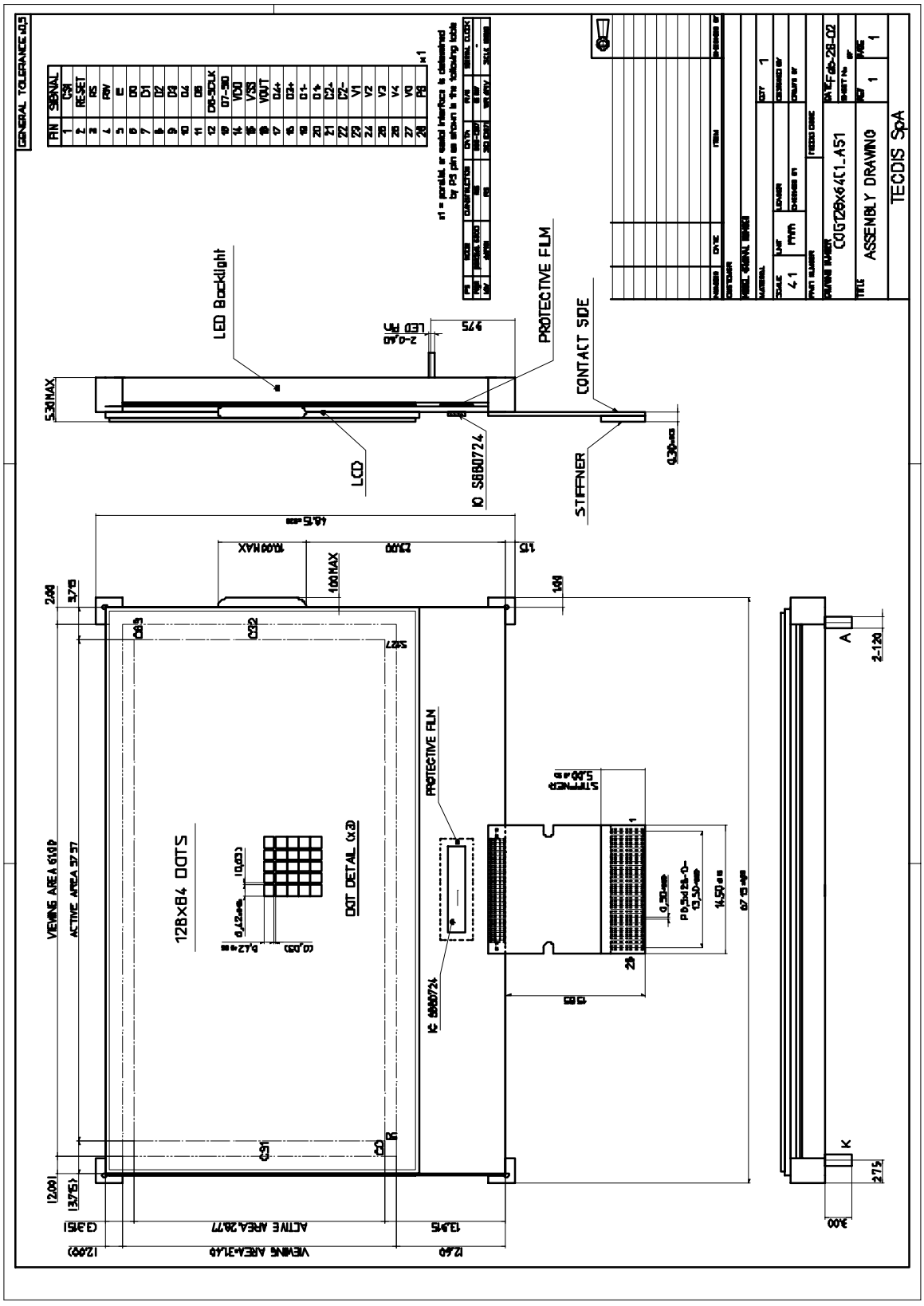


optimum vision with the naked eye and viewing angle θ at CR. max above are not always the same

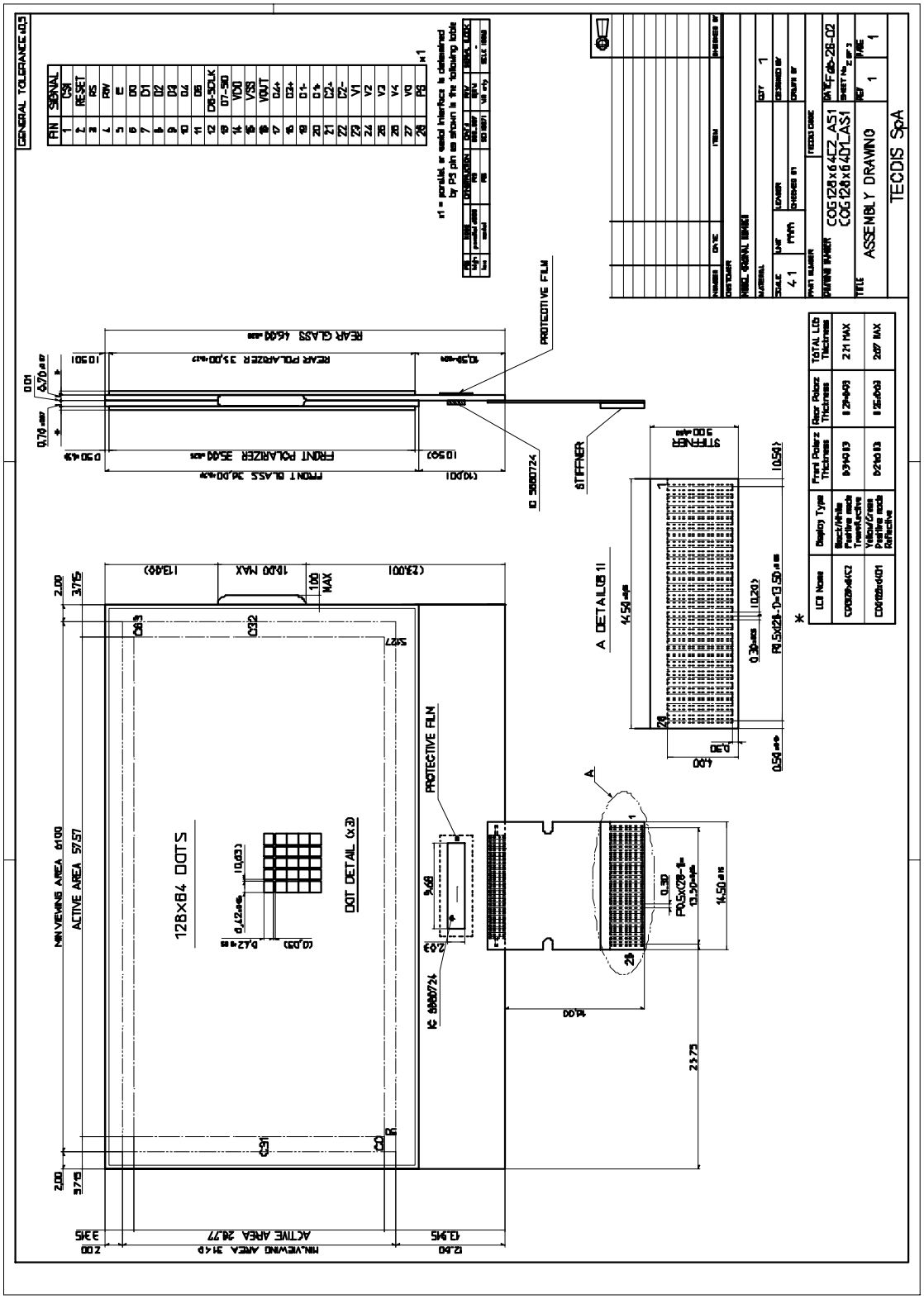
4.5.10. Definition of response time



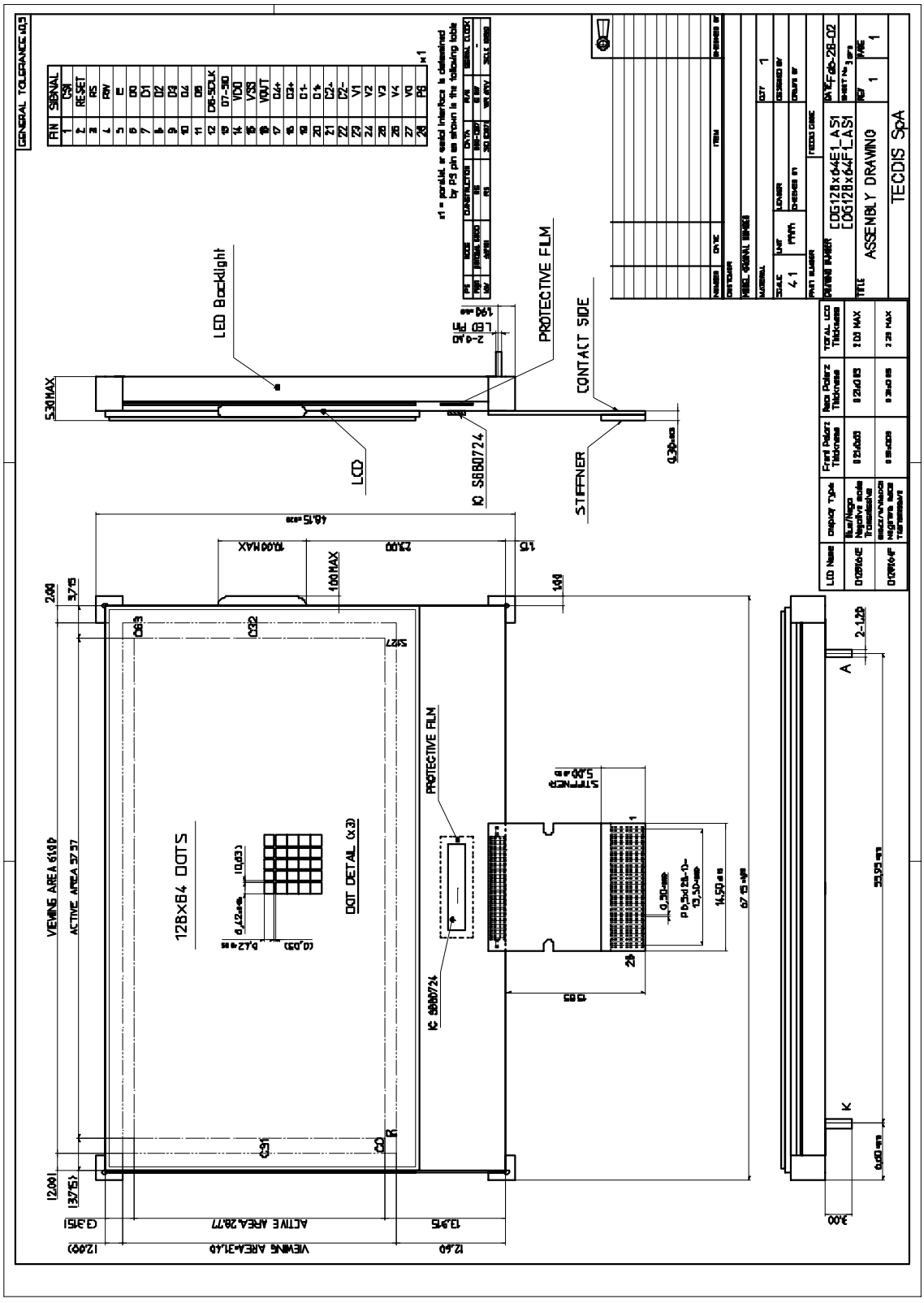
4.6. COG128x64C1 Mechanical Dimensions



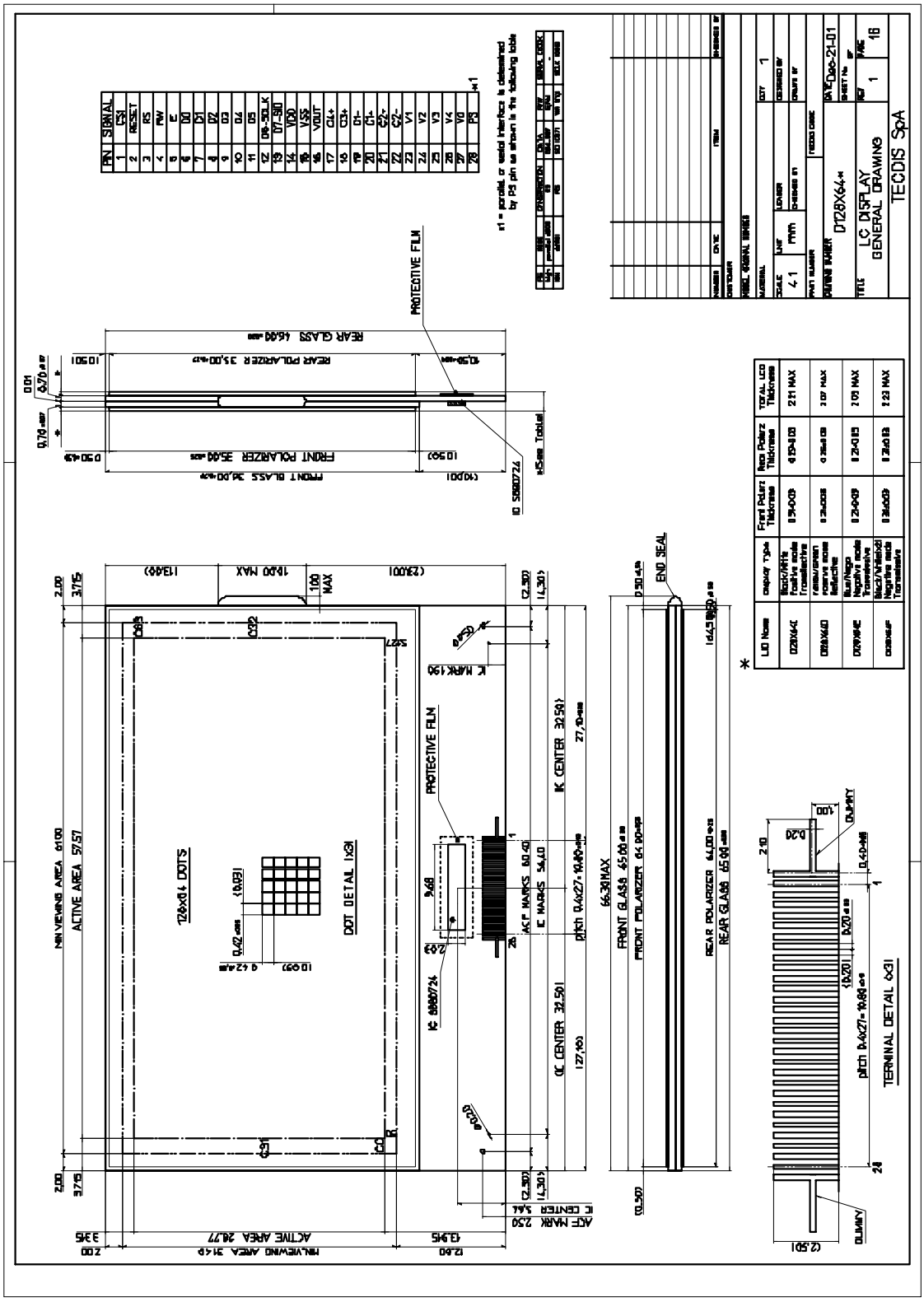
4.7. COG128x64C2 & COG128x64D1 Mechanical Dimensions



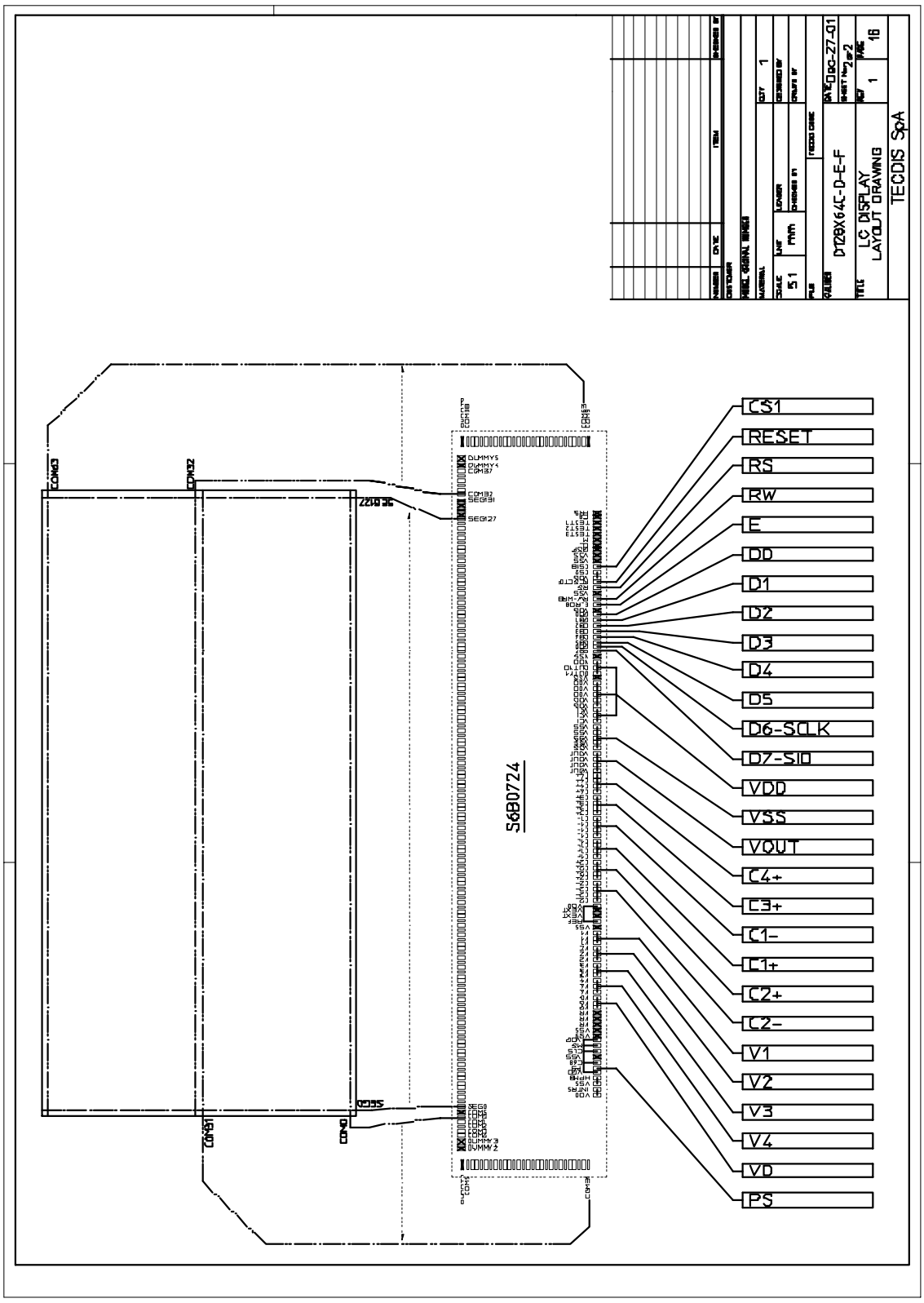
4.8. COG128x64E1 & COG128x64F1 Mechanical Dimensions



4.9. LCD Mechanical Dimensions



4.10. LAYOUT Drawing



4.11. Pin connection (signal function)

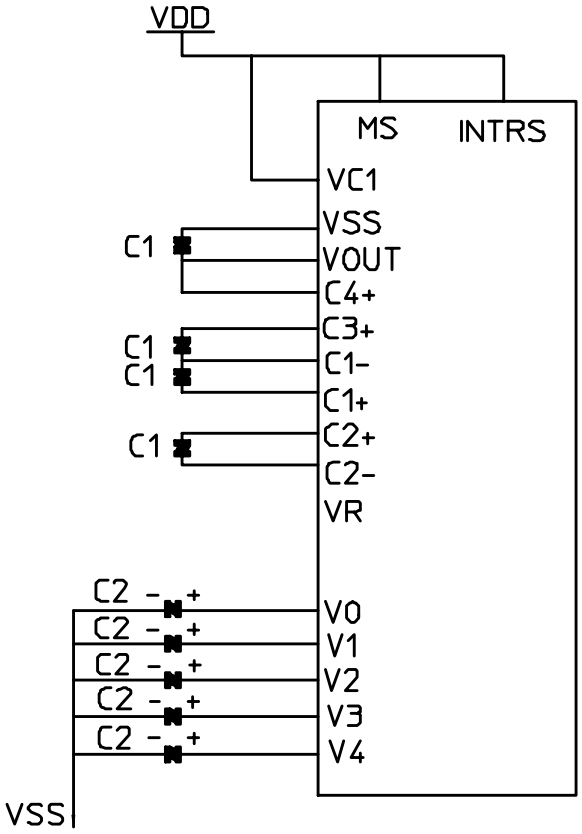
No.	Symbol	Function
1	CS1	Chip Select input. Data input/output is enabled when CS1 is LOW. When CS1 is non-active, D7 to D0 will be High Impedance.
2	RESET	Hardware reset input. Initialization is performed by edge sensing (rising or falling) of the RESET signal.
3	RS	Register Select input. RS = "H": D0 to D7 is display data RS = "L": D0 to D7 is control data
4	RW	6800- series MPU interface (RW): Read/Write signal High = Read mode Low = Write mode
5	E	6800-series MPU interface (E): Active High enable clock input pin of the 6800-series MPU
6	DO	Data Bus
7	D1	
8	D2	
9	D3	
10	D4	
11	D5	
12	D6 – SCLK	
13	D7-SID	
14	VDD	Power Supply
15	VSS	Ground
16	VOUT	Voltage converter output
17	C4+	Capacitor 4 "+" connection (for the internal voltage converter)
18	C3+	Capacitor 3 "+" connection (for the internal voltage converter)
19	C1-	Capacitor 1 "-" connection (for the internal voltage converter)
20	C1+	Capacitor 1 "+" connection (for the internal voltage converter)
21	C2+	Capacitor 2 "+" connection (for the internal voltage converter)
22	C2-	Capacitor 2 "-" connection (for the internal voltage converter)
23	V1	LCD drive voltage levels
24	V2	LCD drive voltage levels
25	V3	LCD drive voltage levels
26	V4	LCD drive voltage levels
27	V0	LCD drive voltage levels
28	PS *	parallel or serial interface is determined by PS pin as shown in the following table.

PS	MODE	D/INSTRUCTION	DATA	R/W	SERIAL CLOCK
High	Parallel 6800	RS	BD0-DB7	E, RW	-
low	Serial	RS	SID(DB7)	WR only	SCLK(DB6)

4.12. Reference circuit example

Value of external capacitors:

Item	Value	Unit
C1	1.0 to 47	uF
C2	0.47 to 1.0	uF



4.13. ZIF connector

For your reference, here are two ZIF connectors which can be used with COG128x64. Use one of these or an equivalent.

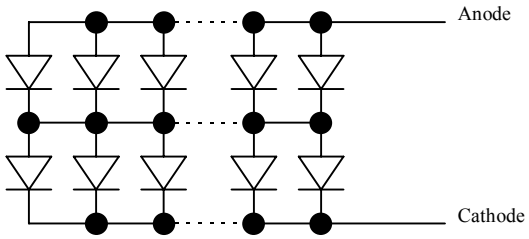
Maker	Type
JST	28FLZ-RSM1-TB
Molex	52437

5. YELLOW LED BACKLIGHT CHARACTERISTICS

5.1. Electroptical Characteristics

Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward voltage	VF	IF = 70 mA	3.8	4.1	4.4	V
Reverse current	IR	VR = 8 V	-	-	0.2	mA
Peak emitting wavelength	IR	IF = 70 mA	-	570	-	nm
Spectral half-width	DI	IF = 70 mA	-	30	-	nm
Brightness	L	IF = 70 mA	60		-	cd/m^2



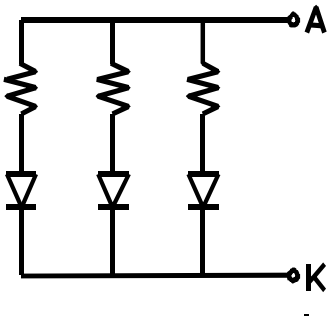
Total number of LED chips = 2 x 7 = 14

6. WHITE LED BACKLIGHT CHARACTERISTICS

6.1. Electroptical Chatacteristics

Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward voltage	VF	IF = 60 mA	-	5.0	-	V
Reverse current	IR	VR = 5 V	-	-	0.2	mA
Peak emitting wavelength	IR	IF = 60 mA	-	0.30	-	nm
Spectral half-width	DI	IF = 60 mA	-	0.32	-	nm
Brightness on diffuser	L	IF = 60 mA	-	160	-	cd/m^2
		IF = 30 mA	-	80	-	cd/m^2



Total number of White LED chips = 3

7. RELIABILITY

7.1. Reliability

Test item	Test Condition	Evaluation and assessment
High temperature and humidity	60°C ± 2°C 90% RH for 500 hours	No abnormalities in functions* and appearance**
High temperature	70°C ± 2°C for 500 hours	No abnormalities in functions* and appearance**
Heat shock	-20°C + 60°C, Left for 1 hour at each temperature, transition time 5 min,repeated 10 times	No abnormalities in functions* and appearance**
Low temperature	-20 ± 2°C for 500 hours	No abnormalities in functions* and appearance**

* Dissipation current, contrast and display functions
** Polarizing filter deterioration, other appearance defects

7.2. Liquid crystal panel service life

100,000 hours minimum at 25°C ± 10 °C, 65% RH maximum.

7.3. Definition of panel service life

- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCD cell layer
- Unusual operation occurs in display functions

7.4. Liquid crystal panel service life

100,000 hours minimum at 25°C ± 10 °C, 65% RH maximum.

8. OPERATIONS PRECAUTIONS

Safety
- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth or in your eyes.
- If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling
- Avoid static electricity as this can damage the CMOS LSI.
- The LCD panel is plate glass; do not hit or crush it.
- Do not remove any part or component from the module.
- The polarizing plate of the display is very fragile; handle it very carefully.

Mounting and Design
- To protect the module from external pressure, place a transparent plate (e.g. acrylic or glass) on the display surface. Leave a small gap between the transparent plate and the display surface.
- Design the system so that no input signal is given unless the power-supply voltage is applied.
- Keep the module dry.Avoid condensation, otherwise the transparent electrodes may break.

Storage
- Store the module in a dark place where the temperature is 25°C ± 10°C and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crash, shake or jolt the module (including accessories).

Cleaning
- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with a soft cloth soaked with a perfluorine-hexane or iso-propanol.
- Do not use ketonic solvents (ketone and acetone) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

9. DELIVERY SPECIFICATIONS: SCOPE

This Specification covers the delivery requirements for the liquid crystal display module delivered by Tecdis S.p.A. See Product Specifications for specifications and reliability.

10. MARKINGS

No marking is required

11. SHIPPING METHOD

11.1. Individual Packaging

The products are packaged in antistatic trays (to prevent static electricity).

11.2. Internal Packaging

Cartons are used for internal packaging : INNER BOXES .Labels clearly specifying the contents are affixed to the internal packaging.

11.2.1. Inner Box Label

Following informations are described:

- Tecdis address
- Tecdis code
- Customer code
- Lot number
- Production date
- Number of LCMs
- Inner box dimensions

11.3. External Packaging

Cartons are used exsternall packaging : MASTER CARTONS .Labels clearly specifying the contents are affixed to the external packaging.

11.3.1. Master Carton Label

Following informations are described:

- Tecdis address
- Tecdis code
- Customer code
- Data of print
- Number of LCMs
- Gross W. Kg
- Net W. Kg

12. RECEIVING INSPECTION

12.1. General

Check the quality and the quantity of the product that ordered within one month after having received it. This completes the acceptance inspection. You shall inform Tecdis S.p.A. of the results.

12.2. Note

We will follow Item 11 to deal with any products that don't conform to the Product Specifications.

13. QUALITY ASSURANCE

13.1. Conformity

The performance, functions and reliability of the shipped products conform to the Product Specifications.

13.2. Responsibility

You are responsible for any defect in quality caused after receiving inspection.

13.3. Warranty

The quality warranty is valid for one year after delivery.

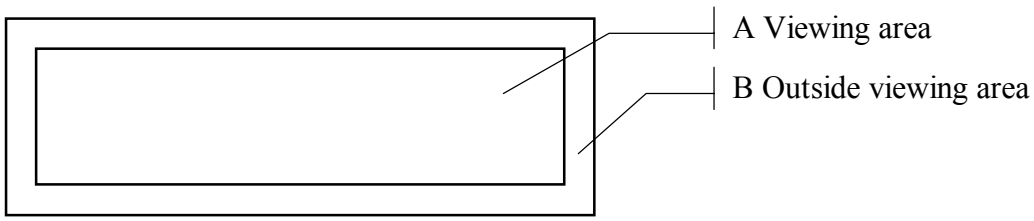
13.4. Shipping Assurance.

13.4.1. Shipping inspection standards.

Shipping inspection standard is MIL-STD 105 D single sampling level, level II.
The quality assurance levels are shown below:

Rank	Zone		Defect	A.Q.L.
Major defect	A	Display area (Appearance) (Functions)	Display functions Current consumption Missing display functions No display	0.15%
Minor defect	A	Display area	Polarizing plate defect Uneven contrast Crosstalk Black spots Black streaks Bubbles Cromaticity Uniformity Scratches Dirt	0.15%
	B	Boundary of display area to viewing area	Glass Chip	

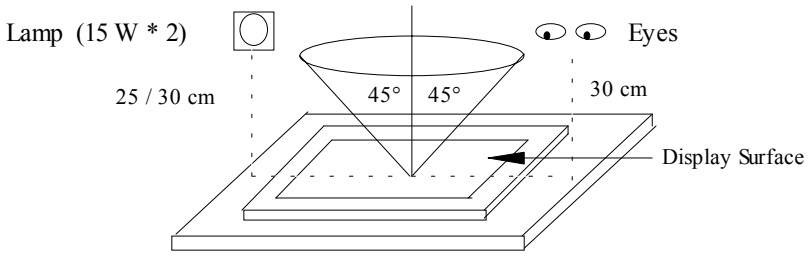
13.4.2. Zone definitions



A:Viewing area.
B: Outside viewing area.

13.4.3. Visual inspection

- Inspect under 15W fluorescent lamp (approximately 2500 lux) leaving 25 cm to 30 cm between the modules and lights and 30 cm between the module and the eye (measuring position).
- Appereance is inspected at the best contrast voltage (best contrast is adjusted to consider clearness and crosstalk on screen).
- Inspect the module at 45° right and left, front and rear.
- Use the maximum angle for the viewing angle direction contrast during the contrast inspection.



13.4.4. Visual standards

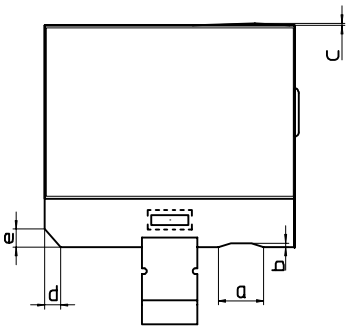
When the panel doesn't display

13.4.4.1. Tolerance number of defect

When the number of defects in items 1 to 5 of "Individual appereance standard defects" is totalled, the maximum number of defects is 5 in zone A.

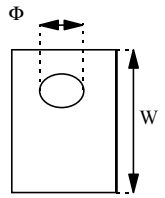
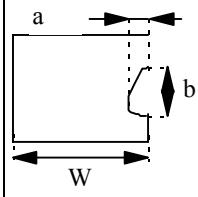
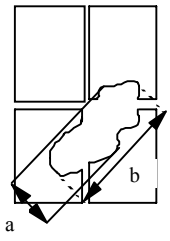
13.4.4.2. Individual appearance defects standards (display OFF)

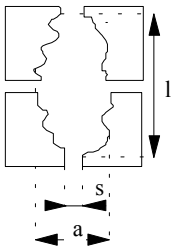
No	Item	Detail	Section (mm)	Zone A	Zone B
1	Black / white spots	Black/White spots caused by dust, bubbles or defective alignment in the cell or polarizer (plus black sopots of the backlight)	Φ ≤ 0.15	Any number	Any number
			0.15 < Φ ≤ 0.25	3	
			0.25 < Φ ≤ 0.30	2	
			0.30 < Φ	0	
2	Black / white streaks	Black/White streaks caused by alignment scratches or dust in the orientation of the cell or polarizer.	W ≤ 0.01	Any number	Any number
			W ≤ 0.02 L ≤ 5.0	3	
			W ≤ 0.03 L ≤ 4.0	2	
			W ≤ 0.05 L ≤ 3.0	1	
			W ≤ 0.06 L ≤ 2.0	1	
			Other than above	0	

No	Item	Detail	Section (mm)	Zone A	Zone B
3	Bubble between glass and polarizer	Bubbles between the glass and the polarizer	Φ ≤ 0.20	Any number	Any number
			0.20 < Φ ≤ 0.50	3	
			0.50 < Φ ≤ 1.0	1	
			1.0 < Φ	0	
			W ≤ 0.15 L ≤ 5.0	2	Any number
			W ≤ 0.15 L ≤ 10.0	1	
			Other than above	0	
4	Scratches on the polarizer	Scratches on the polarizer	Visible with the naked eye	Same as No2	Any number
			Not visible with the naked eye	Any number	
5	Dent on polarizer	Dent on the polarizer	Φ ≤ 0.50	2	Any number
			0.50 < Φ ≤ 1.00	1	
			1.00 < Φ	0	
6	Chromaticity and uniformit	Streaks and uneven color		Level of sample for approval set as limit sample	
7	Dirt	Dirt on the polarizer, panel frame, PC board		Products pass if the dirt can be wiped off easily	
8	Glass Chip	Chip and rest glass		Chip	a≤3.0mm Max
					b≤1.0mm Max
					d≤1.0mm Max
					e≤2.0mm Max*
				Glass rest	c = 0.25Max

Note:* On the layer without ITO is accepted a chip smaller or equal than half thickness of glass

13.4.4.3.Individual appearance defects standards (display ON)

No	Item	Detail	Section (mm)	Standard. Max No of defects
1	No display	Part or all of the screen doesn't light because of an open or a short circuit		Must not occur.
2	Display missing	Part of display segment missing because of pin holes or an open. 		W = 0.42
			Φ ≤ 0.10	Any number
			0.10 < Φ ≤ 0.20	4
			0.20 < Φ ≤ 0.25	2
			0.25 < Φ ≤ 0.30	2
			0.30 < Φ	0
3	Display missing	Part of display segment missing because of pin holes or an open. 		W = 0.42
			a ≤ 0.10 b ≤ 0.10	Any number
			a ≤ 0.20 b ≤ 0.25	4
			a ≤ 0.25 b ≤ 0.30	2
			a > 0.25 b > 0.30	0
4	Display missing a,b	Thin part of display segment / common missing 	a ≤ 0.03	Any number
			a ≤ 0.05 b < 0.5	3
			a ≤ 0.10 b ≤ 0.3	2
			a ≤ 0.20 b ≤ 0.3	1
			Other than above	0

No	Item	Detail	Section (mm)		Standard. Max No of defects
5	Display missing a,l	Thin part of display segment / common missing 	a	l	
			a ≤ 1.2S		Any number
			a ≤ 1.4S	l ≤ 10.0	2
			a ≤ 1.4S	l > 10.0	0
			a > 1.4S		0

14. DEALING WITH CUSTOMER COMPLAINTS

14.1. General

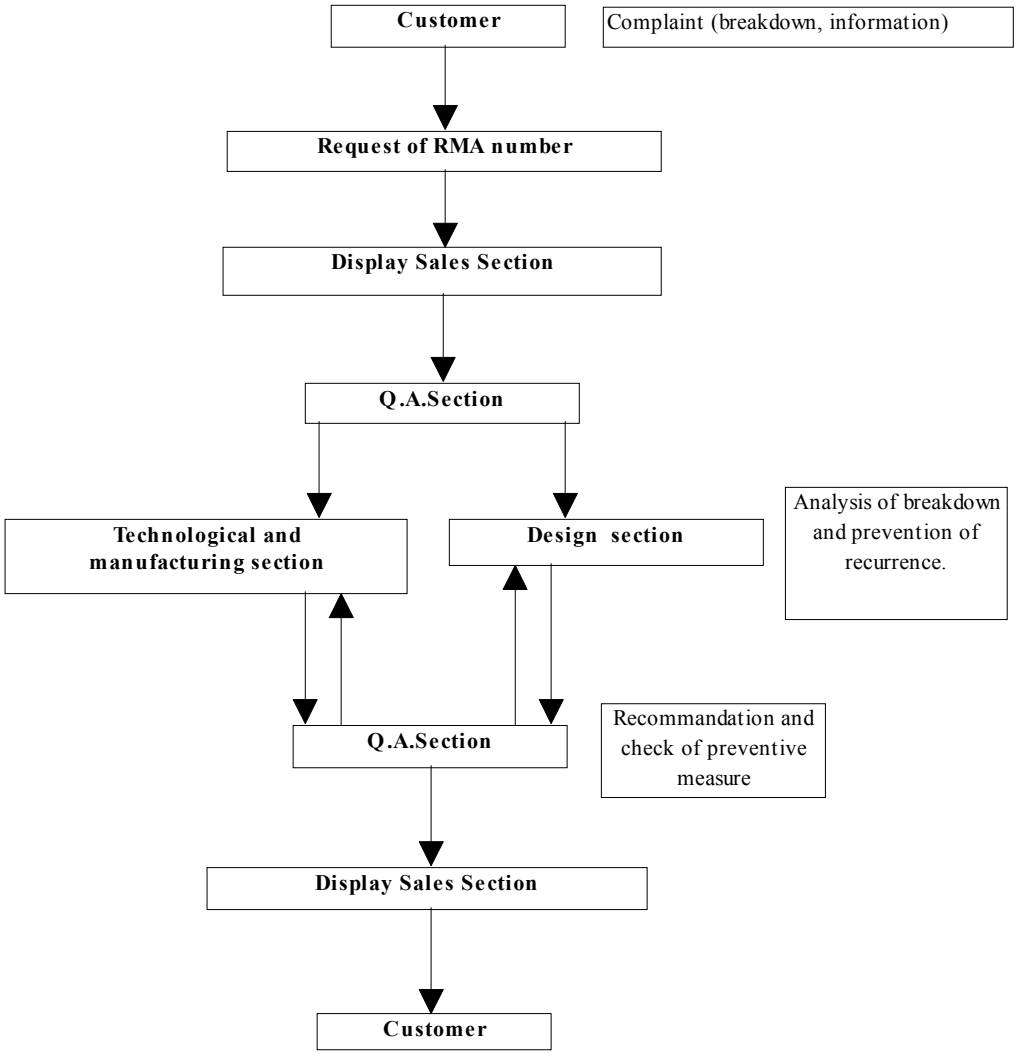
- If any defective products are found during the acceptance inspection that Tecdis S.p.A. is clearly responsible for, treat them as lot out or defective products and return them toTecdis S.p.A. Any product that are not clearly defective or that Tecdis S.p.A. is not clearly responsible for will be dealt with by discussion between both companies.

- When defective products are caused after acceptance inspection, inform Tecdis S.p.A. The product will be dealt with by discussion between both companies.

- When returning defective products to Tecdis S.p.A., pack them individually in their original packing to prevent static electricity, and pad them with cushions to prevent vibration. Do not place them on top of one other.

14.2. Complaint processing Chart

Inspection and notification of any defect is shown in the diagram below:



15. CHANGE OF SPECIFICATIONS

Any changes that need to be made in this specification or any problems arising from it will be dealt with by discussion between both companies.