

**Display Elektronik GmbH**

**DATA SHEET**

**LCD MODULE**

**DEM 128128C FGH-PW**

*Product Specification*

*Version: 2.1.2*

**23.03.2022**

# GENERAL SPECIFICATION

MODULE NO. :

# DEM 128128C FGH-PW

CUSTOMER P/N:

Version No.	Change Description	Date
0	First Issue	27.10.2009
1	Update Backlight Characteristics	12.12.2009
2	Update Functions & Features	18.10.2013
2.1.0	Change Production Line	12.12.2018
2.1.1	Change the Vop to 11.2V from 11.5V;Change the BL Voltage; Update the LCD drawing(IC layout) on page 19	26.12.2018
2.1.2	Add the Idd current value on page 7	23.03.2022

**PREPARED BY:** PS

**DATE:** 23.03.2022

**APPROVED BY:** MH

**DATE:** 23.03.2022

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**1. FUNCTIONS & FEATURES**

- DEM 128128C FGH-PW LCD Type :

Module	LCD Type	Remark
DEM 128128C FGH-PW	FSTN Transflective Positive Mode	

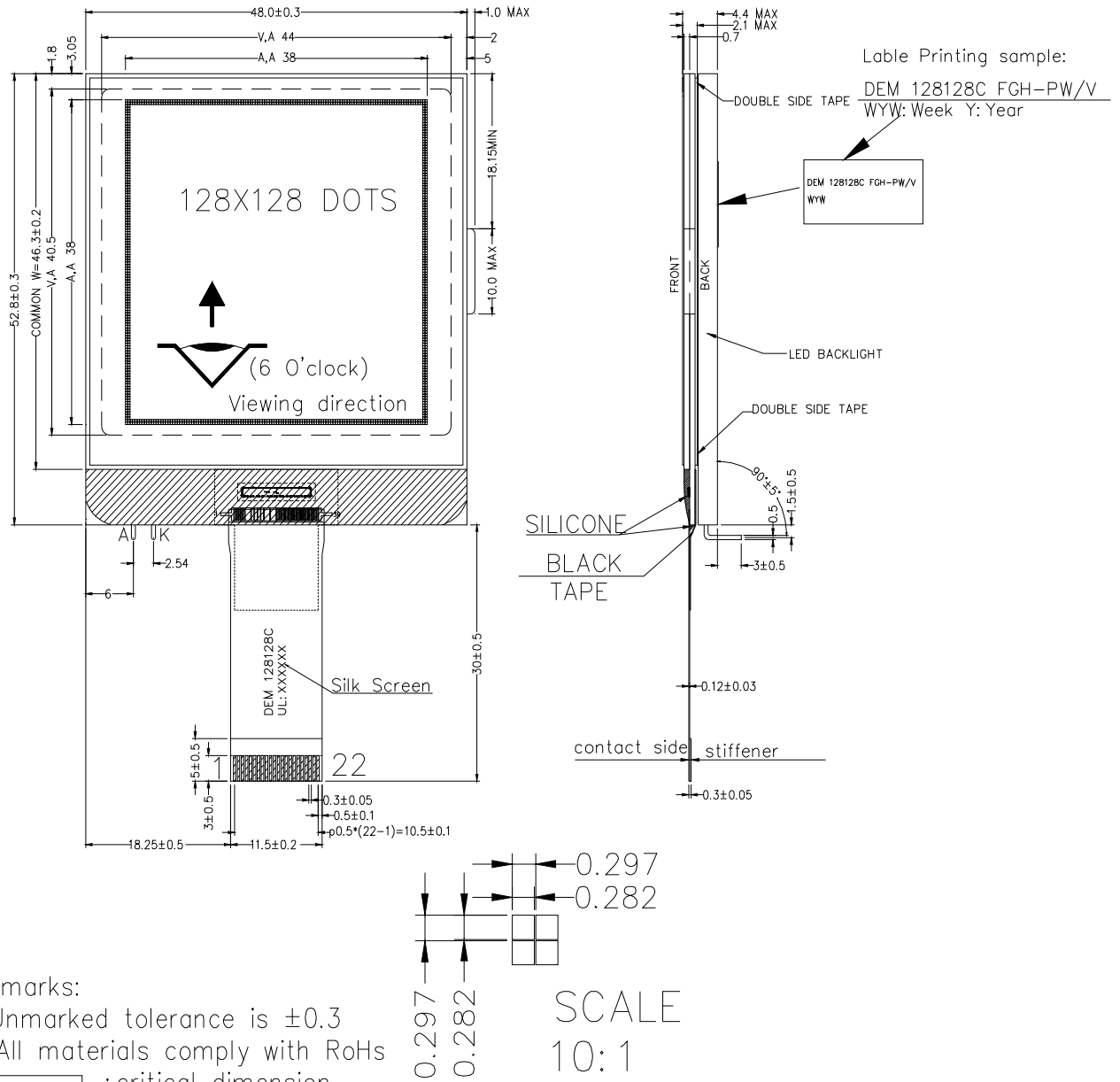
- Format : 128 x 128 Dots
- Driving Scheme : 1/128 Duty, 1/10 Bias
- Viewing Direction : 6 o'clock
- Power Supply Voltage( $V_{DD}$ ) : 3.3 Volt (typ.)
- LCD driving voltage( $V_{LCD}$ ) : 11.2 Volt (typ.)
- Operation Temperature : -20 to +70°C
- Storage Temperature : -30 to +80°C
- Backlight : Edge, White LED
- Interface : 8-Bit-MCU; SPI; I2C
- RoHS Compliant

**2. MECHANICAL SPECIFICATIONS**

- Module Size : 48.00 x 52.80 x 4.40 mm (without FPC length)
- Viewing Area : 44.00 x 40.50 mm
- Active Area : 38.00 x 38.00 mm
- Dot Pitch : 0.297 x 0.297 mm
- Dot Size : 0.282 x 0.282 mm



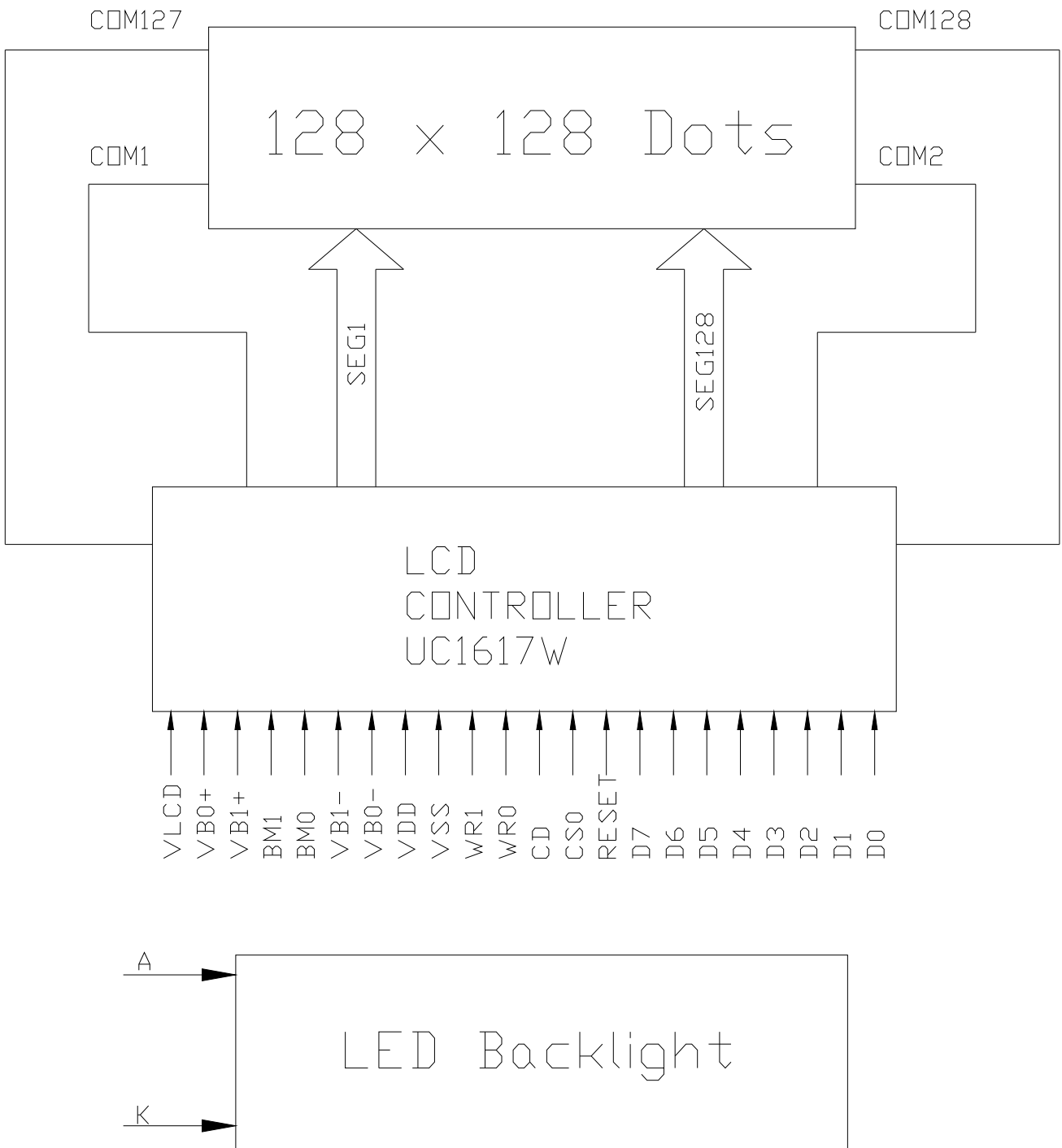
**3. EXTERNAL DIMENSIONS**



Remarks:

1. Unmarked tolerance is  $\pm 0.3$
2. All materials comply with RoHs
3.  ...: critical dimension.

4. BLOCK DIAGRAM

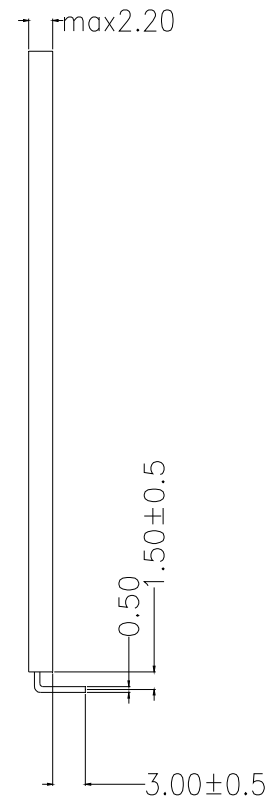
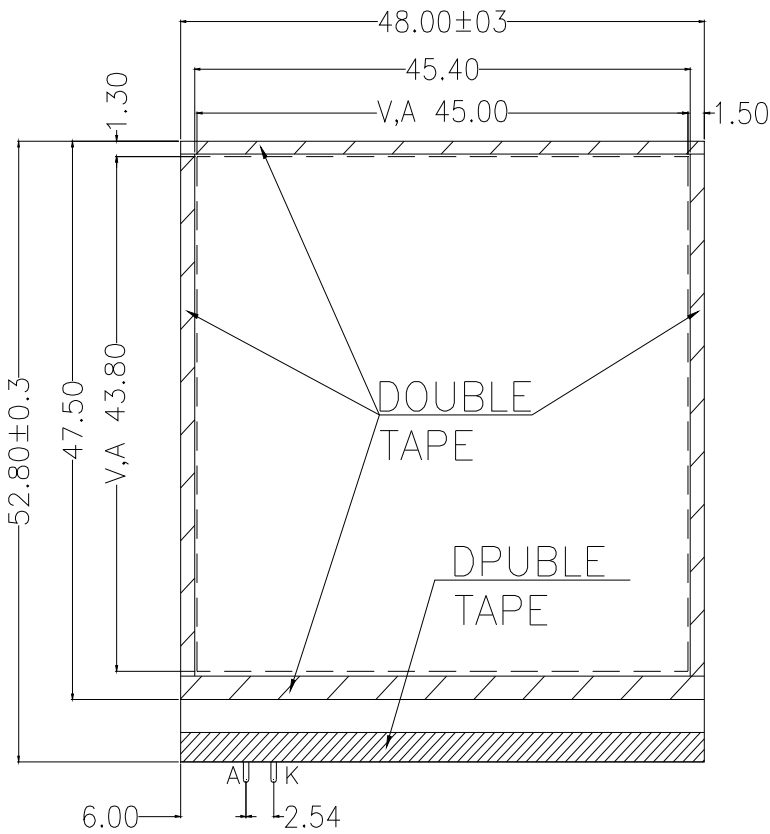


5. PIN ASSIGNMENT

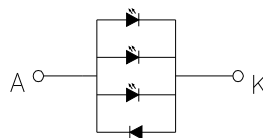
PIN No.	Symbol	Description																																																																																																												
1	VLCD	Main LCD Power Supply																																																																																																												
2	VB0+	LCD Bias Voltages.																																																																																																												
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6. BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS

Item	Symbol	min.	typ.	max.	Unit	Condition
Forward Voltage	V <sub>f</sub>	2.6	2.8	3.0	V	I <sub>f</sub> = 45 mA T=25° C
Power Dissipation	P <sub>d</sub>	130.5	139.5	148.5	mW	
Luminous Uniformity	ΔL <sub>v</sub>	70			%	
Luminance	L <sub>v</sub>	300	350		cd/m <sup>2</sup>	
Color Coordinate	X	0.260		0.30		
	Y	0.260		0.30		
Lifetime		50000h			Hours	



Circuit Diagram  
COLOR:WHITE



Remarks:  
 1. Unmarked tolerance is ±0.3  
 2. All materials comply with RoHS  
 3.  ...:critical dimension.

**7. ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Min.	Max.	Unit
V <sub>DD</sub>	Logic Supply Voltage	-0.3	+4.0	V
V <sub>LCD</sub>	LCD Generated Voltage	-0.3	+19.8	V
V <sub>IN</sub>	Digital Input Signal	-0.4	V <sub>DD</sub> + 0.5	V
T <sub>OPR</sub>	Operating Temperature Range	-20	+70	°C
T <sub>STR</sub>	Storage Temperature Range	-30	+80	°C

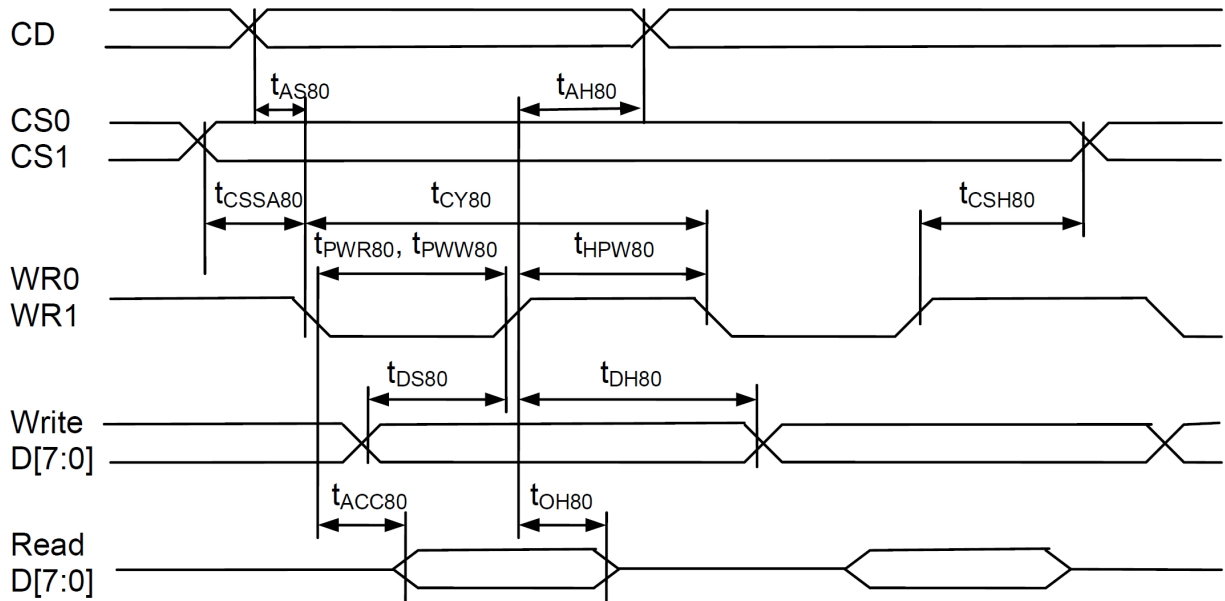
**8. ELECTRICAL CHARACTERISTICS****8-1 DC Characteristics**

Item	Symbol	Min	Typ	Max	Condition	Unit	Remark
Operating Voltage	V <sub>DD</sub>	2.7	3.3	3.45		V	
LCD Driving Voltage	V <sub>LCD</sub>	10.9	11.2	11.5		V	
Operating Current	I <sub>DD</sub>	---	0.5	---		mA	

8-2 AC characteristics

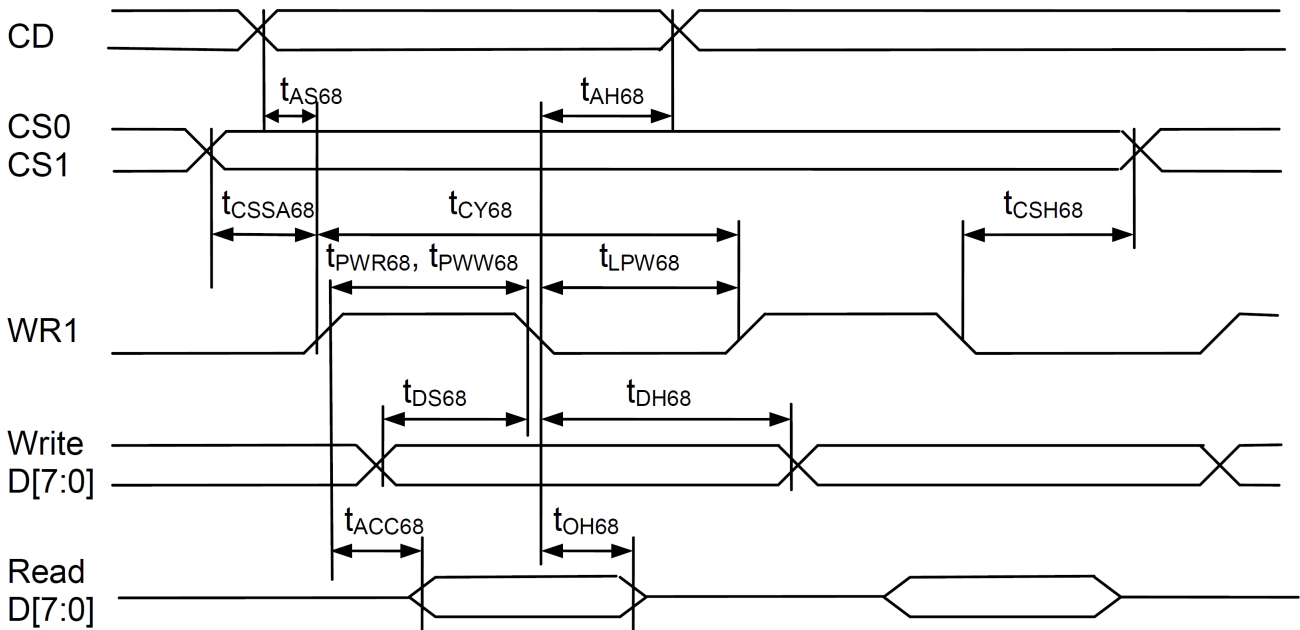
Parallel Bus Timing Characteristics (for 8080 MCU)

Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{AS80}$ $t_{AH80}$	CD	Address setup time Address hold time		0 0	-	nS
$t_{CY80}$		System cycle time (read) (write)		170 130	-	nS
$t_{PWR80}$	WR1	Pulse width (read)		85	-	nS
$t_{PWW80}$	WR0	Pulse width (write)		65	-	nS
$t_{HPW80}$	WR0, WR1	High pulse width (read) (write)		85 65	-	nS
$t_{DS80}$ $t_{DH80}$	D0~D7	Data setup time Data hold time		30 0	-	nS
$t_{ACC80}$ $t_{OH80}$		Read access time Output disable time	$C_L = 100\text{pF}$	- -	65 30	nS
$t_{CSSA80}$ $t_{CSH80}$	CS1/CS0	Chip select setup time Chip select hold time		5 5		nS



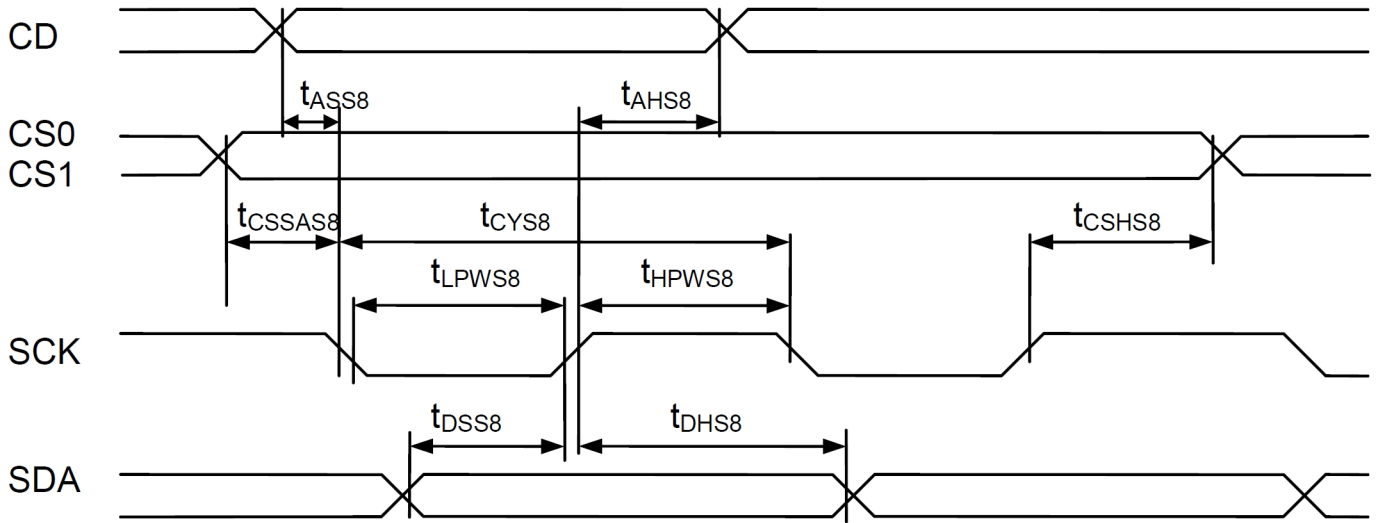
Parallel Bus Timing Characteristics (for 6800 MCU)

Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{AS68}$ $t_{AH68}$	CD	Address setup time Address hold time		0 0	-	nS
$t_{CY68}$		System cycle time (read) (write)		170 130	-	nS
$t_{PWR68}$	WR1	Pulse width (read)		85	-	nS
$t_{PWW68}$		Pulse width (write)		65	-	nS
$t_{LPW68}$		Low pulse width (read) (write)		85 65	-	nS
$t_{DS68}$ $t_{DH68}$	D0~D7	Data setup time Data hold time		30 0	-	nS
$t_{ACC68}$ $t_{OH68}$		Read access time Output disable time	$C_L = 100pF$	- -	70 30	nS
$t_{CSSA68}$ $t_{CSH68}$	CS1/CS0	Chip select setup time Chip select hold time		5 5		nS



Serial Bus Timing Characteristics (for S8 / S8uc)

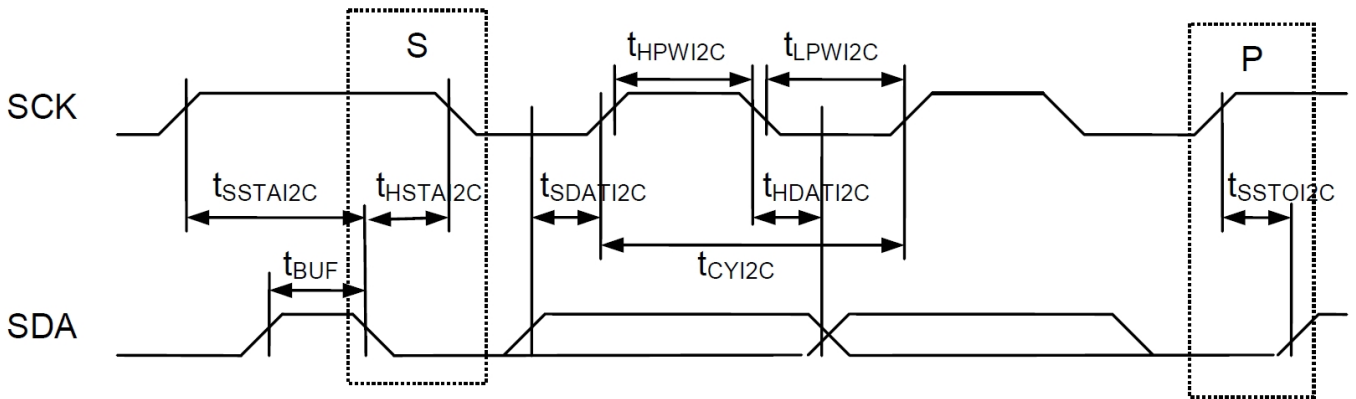
Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{ASS8}$	CD	Address setup time		0	–	nS
$t_{AHS8}$		Address hold time		0	–	nS
$t_{CYS8}$	SCK	System cycle time		40	–	nS
$t_{LPWS8}$		Low pulse width		20	–	nS
$t_{HPWS8}$		High pulse width		20	–	nS
$t_{DSS8}$	SDA	Data setup time		15	–	nS
$t_{DHS8}$		Data disable time		0	–	nS
$t_{CSSAS8}$	CS1/CS0	Chip select setup time		5		nS
$t_{CSHS8}$		Chip select hold time		5		nS





Serial Bus Timing Characteristics (for I2C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{CYI2C}$	SCK	SCK cycle time (read) (write)	$t_r+t_f \leq 100nS$	580 275	-	nS
$t_{LPWI2C}$		Low pulse width (read) (write)		290 165	-	nS
$t_{HPWI2C}$		High pulse width (read) (write)		290 110	-	nS
$t_r, t_f$	SCK SDA	Rise time and fall time		-	-	nS
$t_{SSDAI2C}$		Data setup time		28	-	nS
$t_{HDAI2C}$		Data hold time		11	-	nS
$t_{SSTA12C}$		START Setup time		28	-	nS
$t_{HSTA12C}$		START Hold time		28	-	nS
$t_{SSTOI2C}$		STOP setup time		28	-	nS
$T_{BUF}$		Bus Free time between STOP and START condition		165	-	nS



9. COMMAND TABLE

The following is a list of host commands supported by UC1617

C/D: 0: Control, 1: Data

W/R: 0: Write Cycle, 1: Read Cycle

# Useful Data bits

– Don't Care

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default	
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A	
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A	
3	Get Status	0	1	1	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A	
				Ver		PMO[5:0]								
				Product Code			PID		MID					
4	Set Page_C Address	0	0	0	0	0	#	#	#	#	#	Set CA[4:0]	0H	
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b	
6	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b	
7	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[3:2]	11b	
8	Set Adv. Program Control (double-byte command)	0	0	0	0	1	1	0	0	R	R	Set APC[R][7:0], R = 0, 1 or 2	N/A	
		0	0	#	#	#	#	#	#	#	#			#
9	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0H	
	Set Scroll Line MSB	0	0	0	1	0	1	-	#	#	#	Set SL[6:4]	0H	
10	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	00H	
	Set Row Address MSB	0	0	0	1	1	1	-	#	#	#	Set RA[6:4]	00H	
11	Set V <sub>BIAS</sub> Potentiometer (double-byte command)	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	4EH	
		0	0	#	#	#	#	#	#	#	#			#
12	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[9:8]	00b: Disable	
13	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b	
14	Set Fixed Lines	0	0	1	0	0	1	0	0	0	0	Set {FLT, FLB}	0	
				#	#	#	#	#	#	#	#			
15	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	00b	
16	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0b	
17	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0b	
18	Set Display Enable	0	0	1	0	1	0	1	1	#	#	Set DC[3:2]	10b	
19	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	000b	
20	Set N-Line Inversion	0	0	1	1	0	0	1	0	0	0	Set NIV[3:0]	6H	
				-	-	-	-	#	#	#	#			
21	Set LCD Gray Shade	0	0	1	1	0	1	0	#	#	#	Set LC[7:5]	001b	
22	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A	
23	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A	
24	Set Test Control (double-byte command)	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A	
		0	0	#	#	#	#	#	#	#	#			
25	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 11	
26	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	AC[3]=0	
27	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	AC[3]=1	
28	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[6:0]	127	
		0	0	-	#	#	#	#	#	#	#			
29	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[6:0]	0	
		0	0	-	#	#	#	#	#	#	#			
30	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[6:0]	127	
		0	0	-	#	#	#	#	#	#	#			

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default		
31	Set Window Program	0	0	1	1	1	1	0	1	0	0	Shared with MTP commands	Set WPC0	0	
	Starting Page_C Address	0	0	-	-	-	#	#	#	#	#		Set WPP0	0	
32	Set Window Programming	0	0	1	1	1	1	0	1	0	1		Set WPC1	31	
	Starting Row Address	0	0	-	#	#	#	#	#	#	#		Set WPP1	127	
33	Set Window Programming	0	0	1	1	1	1	0	1	1	0	Set AC[4]	0: Disable		
	Ending Page_C Address	0	0	-	-	-	#	#	#	#	#				
34	Set Window Programming	0	0	1	1	1	1	0	1	1	1			Set MTPC[5:0]	10H
	Ending Row Address	0	0	-	#	#	#	#	#	#	#				
35	Enable window program	0	0	1	1	1	1	1	0	0	#	Set MTPM[7:0]	0		
	Set MTP Operation control	0	0	1	0	1	1	1	0	0	0				
36	Set MTP Write Mask	0	0	1	0	1	1	1	0	0	1			Shared with Window Program commands	N/A
	Set V <sub>MTP1</sub> Potentiometer	0	0	#	#	#	#	#	#	#	#				
37	Set V <sub>MTP2</sub> Potentiometer	0	0	1	1	1	1	0	1	0	1	Set MTP1	N/A		
	Set MTP Write Timer	0	0	#	#	#	#	#	#	#	#				
38	Set MTP Read Timer	0	0	1	1	1	1	0	1	1	1			Set MTP2	N/A
	Set MTP Write Mask	0	0	#	#	#	#	#	#	#	#				
39	Set MTP Write Mask	0	0	1	0	1	1	1	0	0	1	Set MTP3	N/A		
	Set MTP Write Mask	0	0	#	#	#	#	#	#	#	#				
40	Set MTP Write Mask	0	0	1	0	1	1	1	0	0	1			Set MTP4	N/A
	Set MTP Write Mask	0	0	#	#	#	#	#	#	#	#				
41	Set MTP Write Mask	0	0	1	0	1	1	1	0	0	1	Set MTP4	N/A		
	Set MTP Write Mask	0	0	#	#	#	#	#	#	#	#				

**Notes:**

Any bit patterns other than the commands listed above may result in undefined behavior.

The interpretation of commands (37)~(41) depends on register MTPC[3].

Commands (38)~(41) are shared with commands (31)~(34) and have exactly the same code.

When MTPC[3]=0, commands (38)~(41) are interpreted as Window Programming commands.

When MTPC[3]=1, they are the MTP Control commands.

MTPM and PM are actually the same register. Only one of the commands (37 or 11) is valid at any time, and it is determined by MTPC[3].

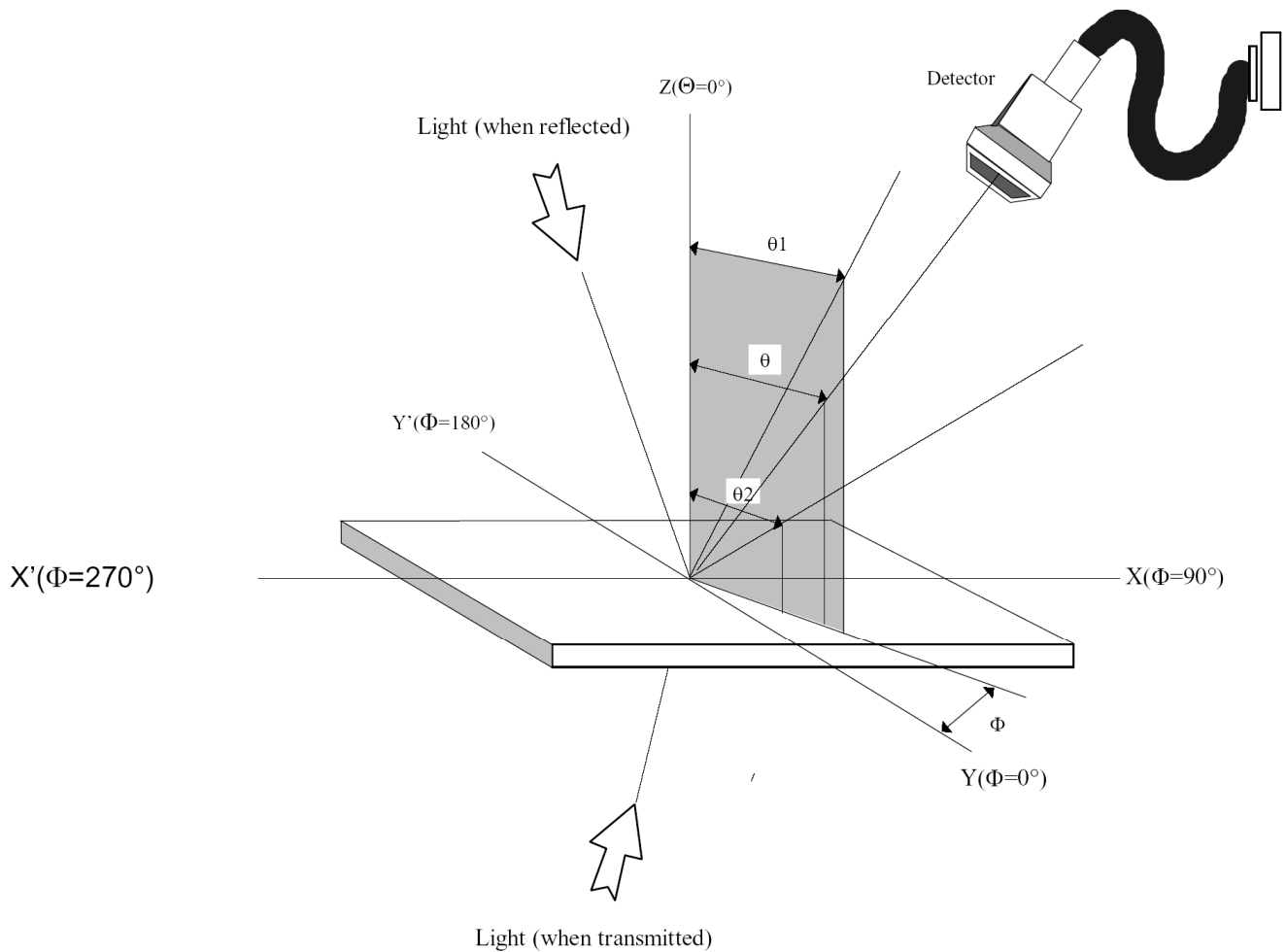
After MTP-ERASE or MTP-PROGRAM operation, before resuming normal operation, please always

- a) Remove TST4 power source,
- b) Do a full VDD ON-OFF-ON cycle.

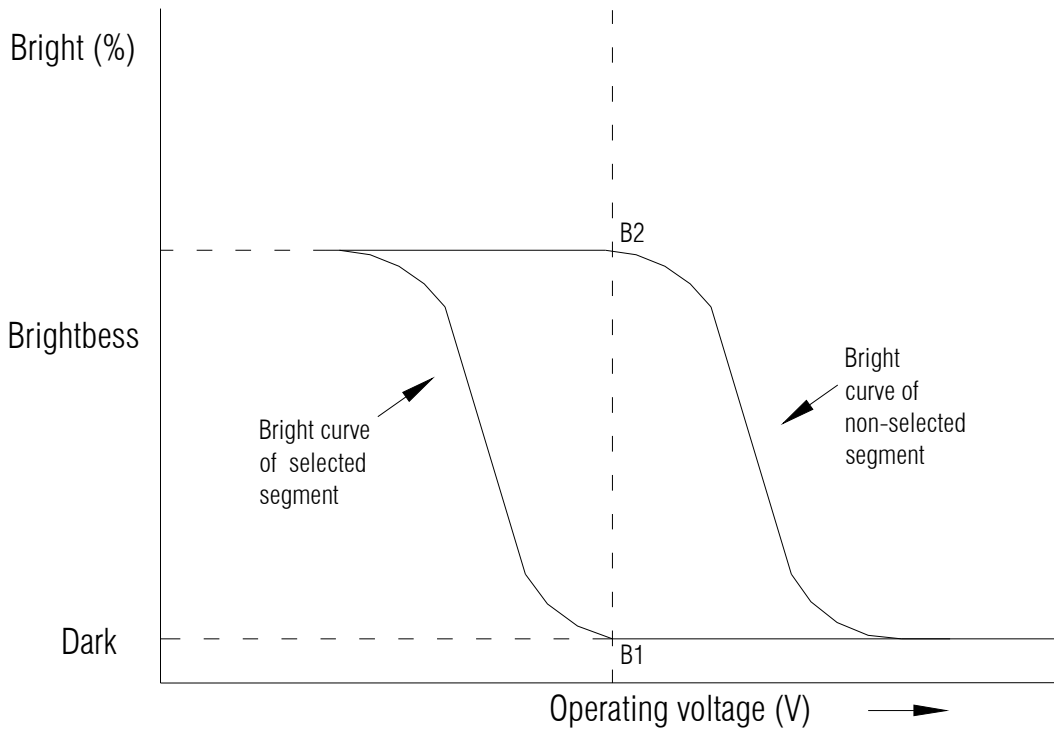
10. ELECTRO-OPTICAL DEFINITION

Optical Characteristics

Item	Symbol	Description	Condition	Min	Typ	Max	Unt
Operating Voltage of LCD	$V_{OP}$	---	$T_a=-20^{\circ}C$	11.4	11.7	12.0	V
		---	$T_a=25^{\circ}C$	10.9	11.2	11.5	
		---	$T_a=70^{\circ}C$	10.4	10.7	11.0	
Response Time	$T_r$	Rise	$25^{\circ}C$	---	250	500	ms
	$T_f$	Fall	$25^{\circ}C$	---	300	600	ms
Contrast	$Cr$		$VDD=3.3V, 25^{\circ}C$	2	4	---	
Viewing Angle	$\theta$	6 o'clock axis	$Cr \geq 2.0$ $VDD=3.3V, 25^{\circ}C$	---	40	---	Deg
		12 o'clock axis	$VDD=3.3V, 25^{\circ}C$	---	35	---	Deg
		3 o'clock axis	$VDD=3.3V, 25^{\circ}C$	---	35	---	Deg
		9 o'clock axis	$VDD=3.3V, 25^{\circ}C$	---	35	---	Deg

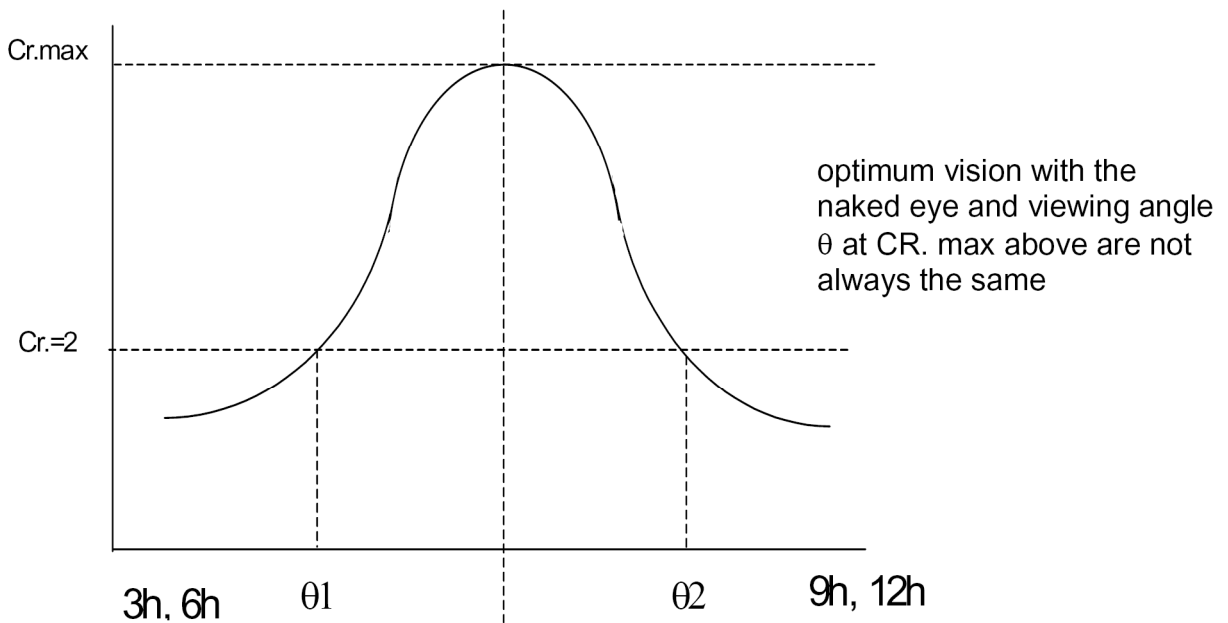


Definition of contrast  $Cr. = \frac{B2}{B1} = \frac{\text{Bright curve of not selected segment}}{\text{Bright curve of selected segment}}$

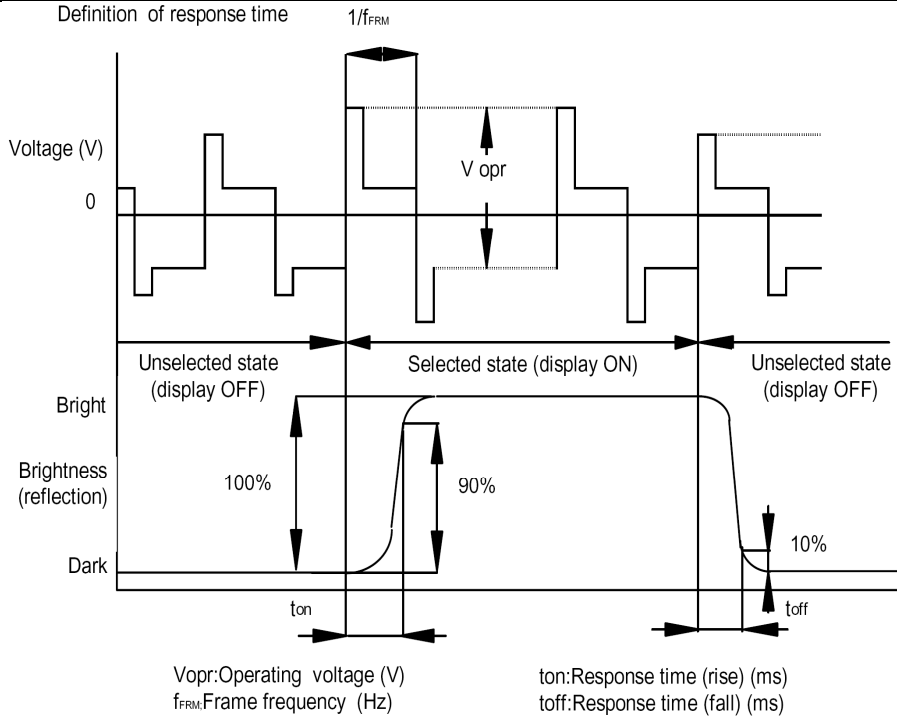


**Definition of Viewing Angle**

Definition of viewing angle  $\theta 1$  and  $\theta 2$

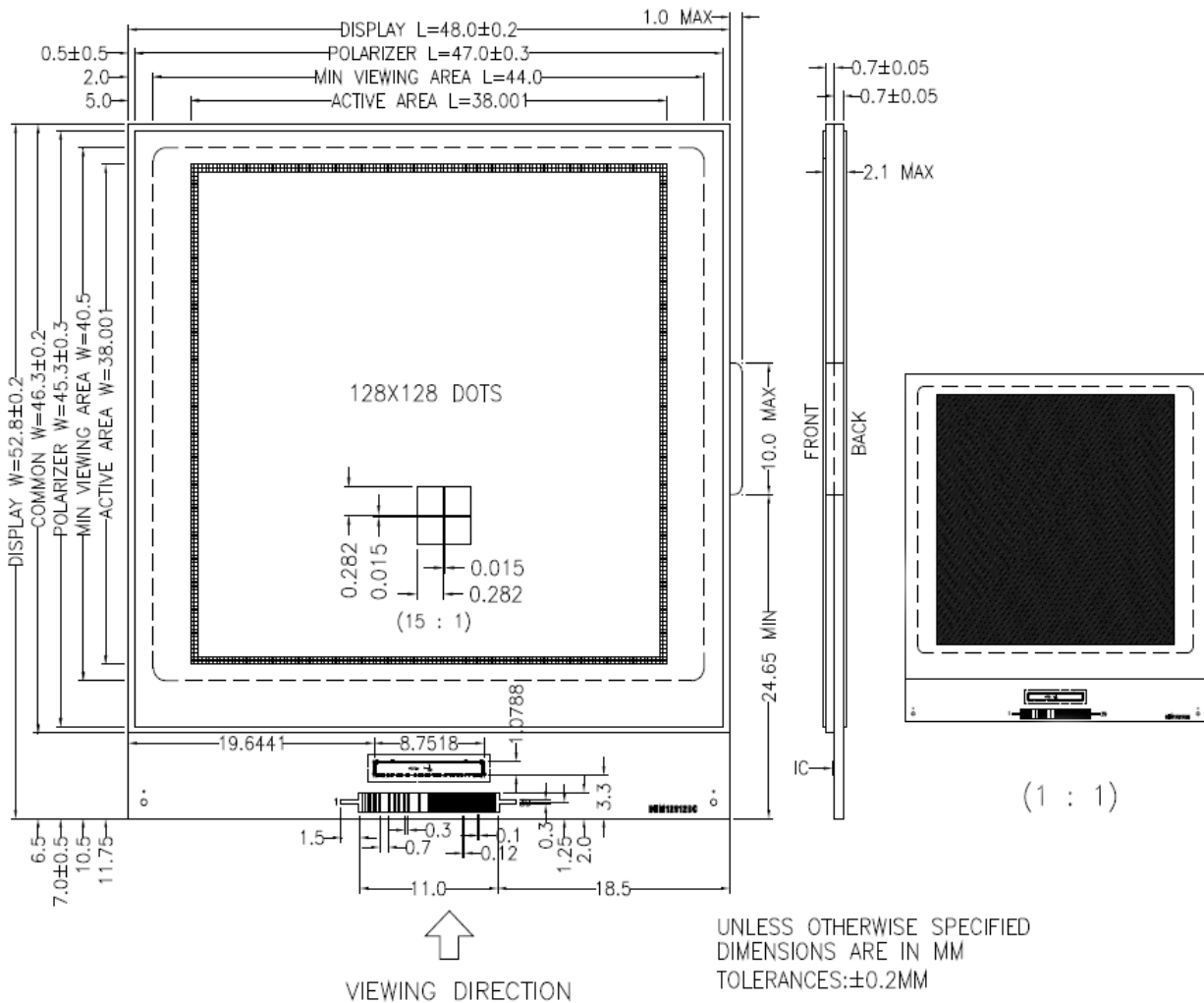


**Definition of Response Time**

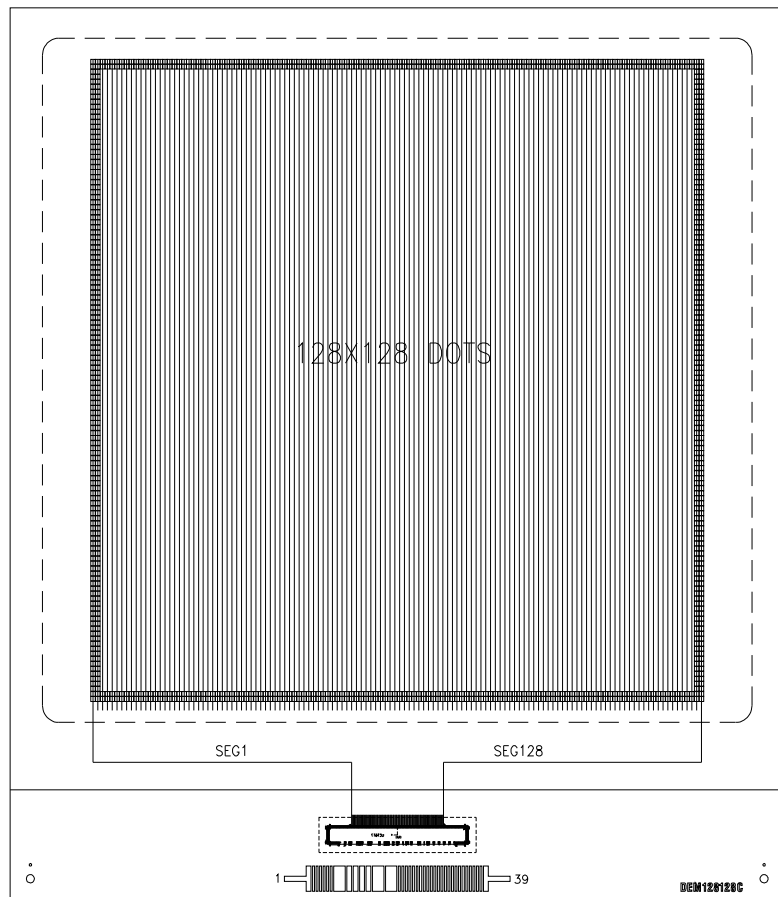


## 11. LCD DRAWING

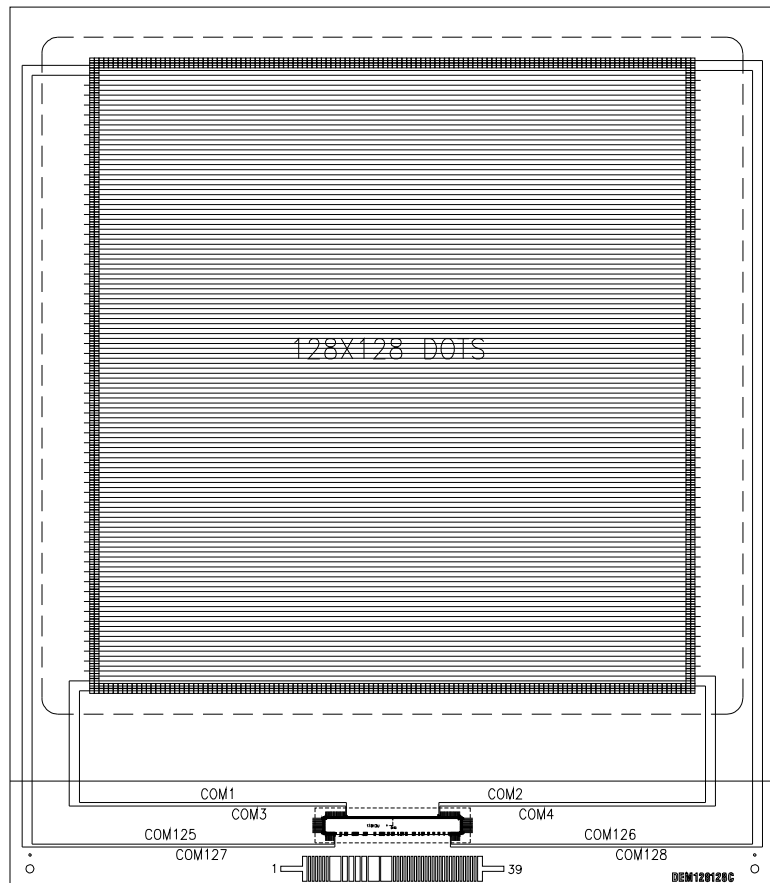
### 11.1. LCD ARTWORK



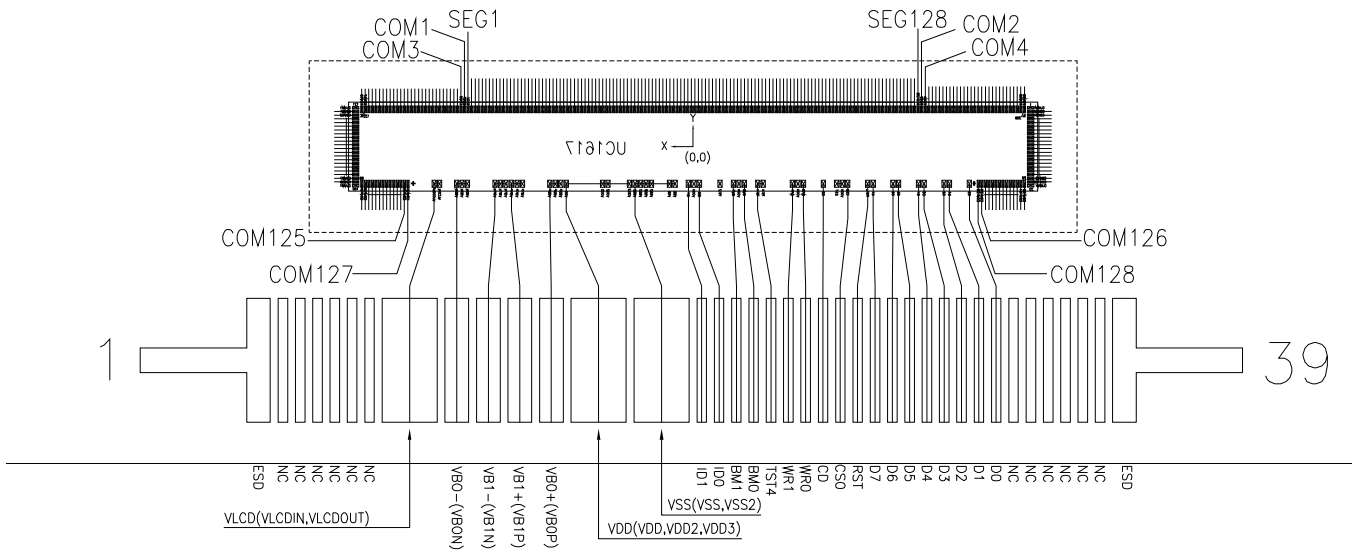
11.2. SEGMENT LAYOUT



11.3. COMMON LAYOUT



**11.5. IC LAYOUT**



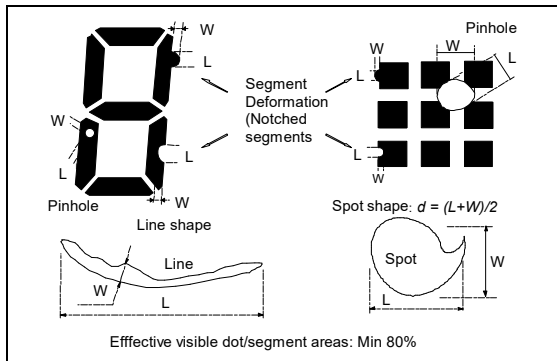


12. QUALITY DESCRIPTION

DEFECT SPECIFICATION:

Specific type-related items are covered in this sheet.

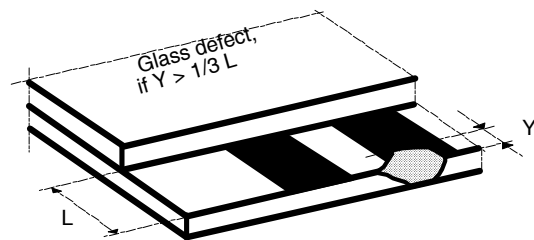
- a: Table for Cosmetic defects  
(Note: nc = not counted).  
Sizes and number of defects  
(Max. Qty)



Examples/ Shapes

- b: Glass defects
- b1: Glass defects at contact ledge

Defect Type	Max. Defect Size [ $\mu\text{m}$ ] d or L W	Max. Quantity
Black or White Spots	$d \leq 150$	nc
	$150 < d \leq 300$	5
Black or White Lines	-- $W \leq 10$	nc
	$L \leq 5000$ $W \leq 30$	3
Pinhole	$L \leq 2000$ $W \leq 50$	2
	$d \leq 150$ $150 < d \leq 300$	nc 1/segment
(Total defects)		(5)
Segment Deformation	$W \leq 100$	nc
Bubble (e.g. under pola)	$d \leq 150$	nc
	$200 < d \leq 400$	3
	$400 < d \leq 600$	1



b2: Glass chipping in other areas shall not be in conflict with the product's function.

**13. MODULE ACCEPT QUALITY LEVEL (AQL)**

Inspection Standard: MIL-STD-105E Table Normal Inspection Single Sampling Level II.

**14. RELIABILITY TEST**

Operating life time: 50,000 Hours (at room temperature without direct irradiation of sunlight)

Reliability characteristics shall meet following requirements.

<b>Tests Item</b>	<b>Condition</b>
High Temperature Storage	+80°C x 96HR
Low Temperature Storage	-30°C x 96HR
High Temperature Operation	+70°C x 96HR
Low Temperature Operation	-20°C x 96HR
High Temperature, High Humidity	+60°C x 90%RH x 96HR
Thermal Shock	-20°C x 30min → 25°C x 10s → +70°C x 30 min x 5 cycles
Vibration Test	Frequency x Swing x Time 40Hz x 4mm x 4hrs
Drop Test	Height x no. of drop 1.0m x 6 drops

**15. LCD MODULES HANDLING PRECAUTIONS**

- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
  - Be sure to ground the body when handling the LCD module.
  - Tools required for assembly, such as soldering irons, must be properly grounded.
  - To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
  - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below -20°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

**16. OTHERS**

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
  - Exposed area of the printed circuit board
  - Terminal electrode sections