Specification For Approval

( ) Preliminary Specification
(♦) Final Specification

Customer	**EZZE MOBILE TECH**
Model Name	**NM220DZ2B**
Description	**Liquid Crystal Display Module**

Proposed by TOVIS		Approved by Customers
APPROVED BY	SIGNATURE	
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Record of Revision

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1. PRODUCT DESCRIPTION

1.1. ABSTRACT

The NM220DZ2B module is a color Thin Film Transistor Liquid Crystal Display with a white Light Emission Diode (hereinafter "LED") backlight system. The front LCD (hereinafter "Main LCD") employs amorphous Silicon TFT as the active element. It is a transmissive type display operating in the normally black mode. The Main LCD has a 2.2 inch diagonally measured active display area with 240 * RGB * 320 resolution. Each pixel is divided into R,G,B dots which are arranged in vertical stripes. The gray scale of the dots is determined with a 6 bit gray scale signal for each dot, thus, presenting a palette of 262,000 colors.

1.2. FEATURES

- Display mode: IPS mode 262K colors
- LCD Driver IC: R61516 (1 chip for Gate & Source Driver)
- Interface : 8/9/16/18 bit CPU interface
- Backlight : 3 white LED
- Sleep, Still, Moving mode display
- Low power consumption driving
- Mobile Phone Application

1.3. GENERAL DESCRIPTION

Properties	Spec. of Main LCD	Unit
Active Screen Size	33.84 x 45.12	mm
Color Depth	262,000 Colors	-
Resolution	240 X RGB X 320	-
Pixel Format	RGB Vertical Stripe	-
Pixel Size	0.141 X 0.141	mm
Display Operating Mode	Normally Black	-
User Viewing Direction	-	O'clock

2. MECHANICAL DESCRIPTION

Properties		Outside dimensions	Unit
Module size	Horizontal	40.0 (Max)	mm
	Vertical	56.0 (Max)	mm
	Depth	2.2 ± 0.1	mm
Weight(Approx)		-	g

3. ABSOLUTE MAXIMUM RATINGS

Properties	Symbol	Min	Max	Unit	Note
Input Voltage *1)	IOVCC/ VCI	-0.3	4.6	V	at 25℃,VSS=0
Storage Humidity *2)	Hstg	10	*3)	% (RH)	
Storage Temperature	Tstg	-30	80	℃	
Operating Ambient Humidity *2)	Hopr	10	*4)	% (RH)	
Operating Ambient Temperature	Topr	-20	70	℃	

*1) The Input Voltage must be above VSS(GND).
*2) Non-condensation.
*3) Temp. ≤ 60℃ , 90% RH MAX
*4) Temp. ＞60℃ , Absolute humidity shall be less than 90% RH at 60℃

4. OPTICAL CHARACTERISTICS

Optical characteristics are determined after the unit has been 'ON' and stable for about 10 minutes in a dark environment at 25 ℃. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and Θ equal to 0°

Fig. 1 presents additional information concerning the measurement equipment and method.

Ta = 25 ±5℃

Parameter		Symbol	Values			Units	Notes
			Min.	Typ.	Max.		
Luminance of white		L_{WH}	-	210	-	cd/m^2	1
Contrast Ratio		CR	300	400	-	-	1, 2
Uniformity of luminance (with L/G)		-	70	-	-	%	5
Response Time	Rising + Falling	Tr + Tf	-	35	-	ms	3
CIE color coordinates	White	Wx	0.247	0.297	0.347	-	-
		Wy	0.264	0.314	0.364		
	Red	Rx	0.585	0.635	0.685		
		Ry	0.290	0.340	0.390		
	Green	Gx	0.290	0.340	0.390		
		Gy	0.561	0.611	0.661		
	Blue	Bx	0.096	0.146	0.196		
		By	0.000	0.049	0.059		
Viewing Angle (CR > 10)	X axis right (ϕ=0°)	θx	-	80	-	degree	4
	X axis left (ϕ=180°)	θx	-	80	-		
	Y axis up (ϕ=90°)	θy	-	80	-		
	Y axis down (ϕ=270°)	θy	-	80	-		

Note1. White Brightness Definition

- Surface luminance is the center point across the LCD surface 50cm from the surface with all pixels displaying white under the condition of back light LED current 20mA/1EA.

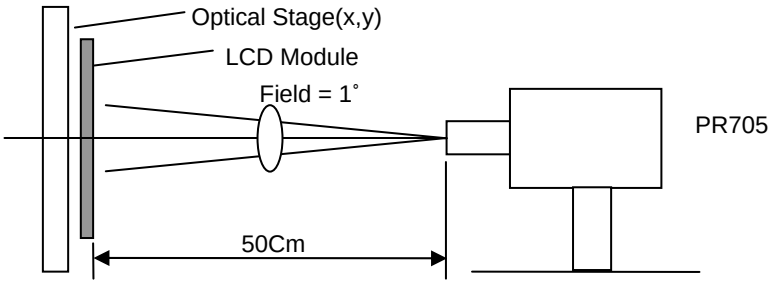
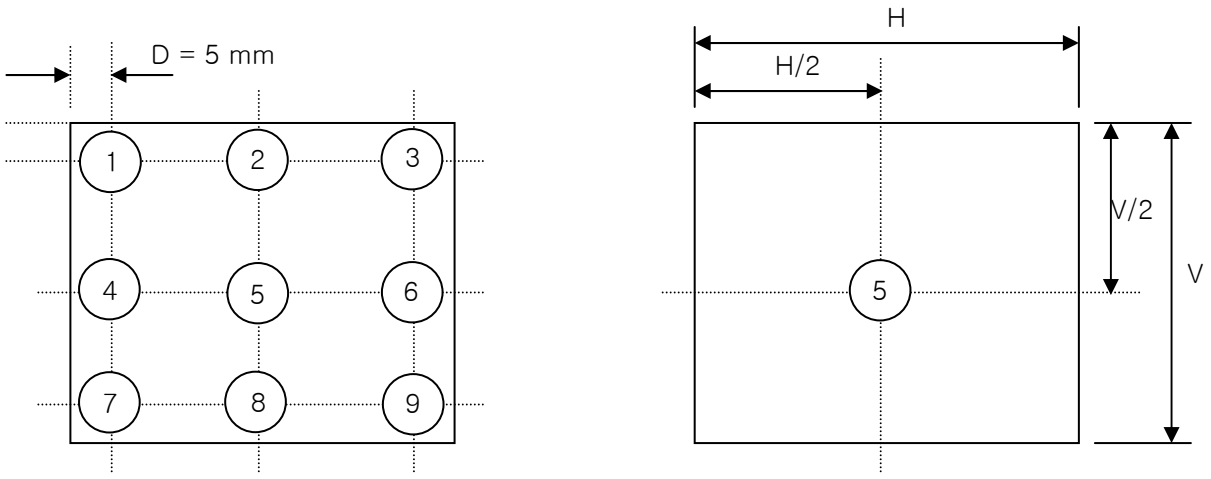


Fig. 1 Optical Characteristic Measurement Equipment and Method



[Measurement point for luminance uniformity] [Measuring point for surface luminance]

Fig. 2 Luminance

Note 2. Contrast Ratio (CR) is defined mathematically as

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

Note 3. Response time

The response time is defined as the following figure and shall be measured by switching the input signal for " black " and " white ".

Response Time (Tr) = Rising Time + Falling Time

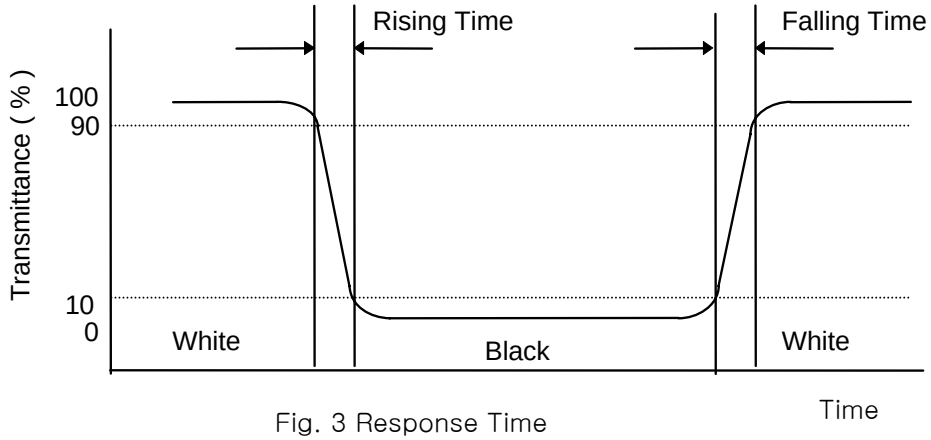


Fig. 3 Response Time

Note 4. Viewing angle

The definition of viewing angle range is that the contrast ratio is higher than CR 10.(CR >10)

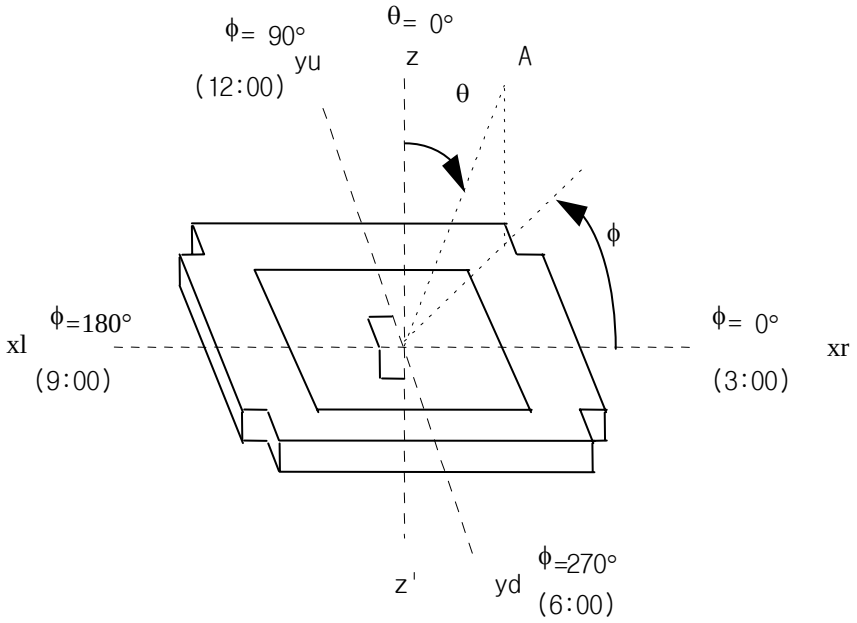


Fig. 4 Viewing Angle

Note 5. Uniformity of Luminance

- The 9-spot luminance variation of a module, (spot locations are show is Fig. 2 Luminance), is defined as the luminance value of the brightest spot divided by the least bright spot and is expressed as :

Luminance var 9-spot[%] = Luminance min spot / Luminance max spot

5. ELECTRICAL CHARACTERISTICS

5. 1 TFT-LCD Module

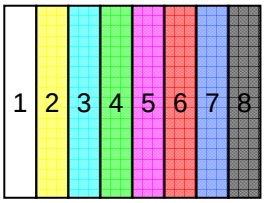
Ambient Temperature : Ta = 25 ±5℃

Characteristics		Symbol	Min	Typ.	Max	Unit	Note
Power supply voltage		VDD	2.75	2.8	2.85	V	-
Logic signal input Voltage		VIdL	-0.3	-	0.2VDD	V	
		VIdH	0.8VDD	-	VDD	V	
Logic signal output Voltage		VOdL	-	-	0.2VDD	V	
		VOdH	0.8VDD	-	VDD	V	
Power Consumption	262K	P_{65K}	-	28.68	41	mW	2), 3)
	Sleep mode	P_{slp}	-	-	0.2	mW	1)

Note. 1) In Sleep mode, Display operation is completely halted, GRAM data and the contents of each register are kept and can not be changed.

2) Display Pattern at Typ. Power Consumption is “Color-Bar Pattern” as follows.

1. White
2. Yellow
3. Light blue
4. Green
5. Purple
6. Red
7. Blue
8. Black



3) Display Pattern at Max. Power Consumption is “White-Pattern” in case of this module.

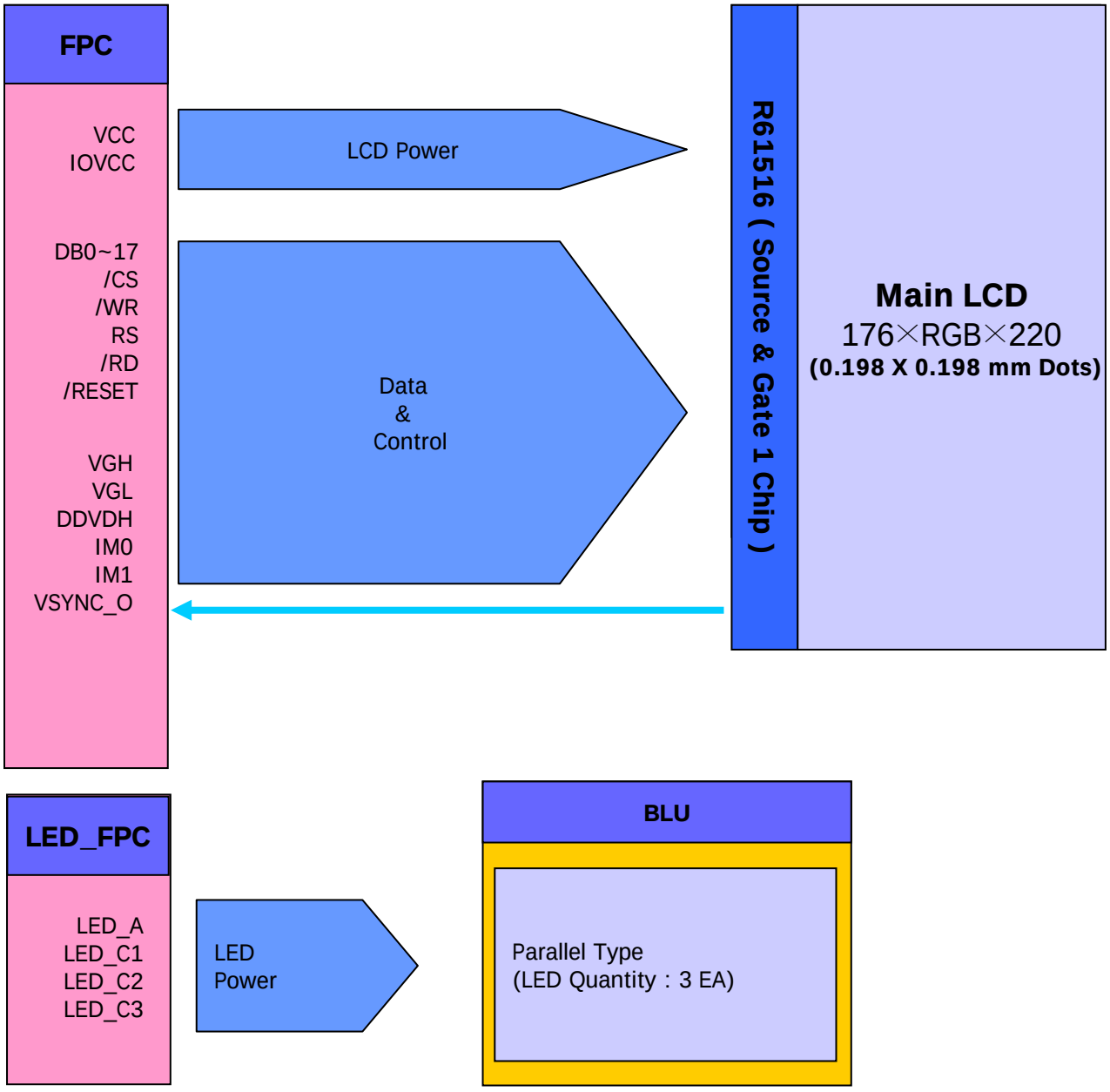
5. 2 Back light Unit

: The edge-lighting type of back light unit which are connected in parallel.

Ta = 25 ±5℃

Items	Symbol	Unit	Min	Typ	Max	Remark
LED Forward Current	I_f	mA	-	20mA	-	
LED Forward Voltage	V_f	V	3.0	-	3.6	
LED Power Consumption	P_{LED}	mW	180	-	216	3LEDs

6. BLOCK DIAGRAM



7. INPUT SIGNAL SEQUENCE

7.1. Input Signal & Power :

Pin No.	Pin Name	I/O	Description
1	GND	–	Ground
2	IM1	I	Interface select signal #1
3	IM0	I	Interface select signal #0
4	RESET/	I	Reset signal
5	GND	–	Ground
6	DB17	I/O	Parallel bidirectional data bus
7	DB16	I/O	Parallel bidirectional data bus
8	DB15	I/O	Parallel bidirectional data bus
9	DB14	I/O	Parallel bidirectional data bus
10	DB13	I/O	Parallel bidirectional data bus
11	DB12	I/O	Parallel bidirectional data bus
12	DB11	I/O	Parallel bidirectional data bus
13	DB10	I/O	Parallel bidirectional data bus
14	DB9	I/O	Parallel bidirectional data bus
15	IOVCC	I	Power supply
16	DB8	I/O	Parallel bidirectional data bus
17	DB7	I/O	Parallel bidirectional data bus
18	DB6	I/O	Parallel bidirectional data bus
19	DB5	I/O	Parallel bidirectional data bus
20	DB4	I/O	Parallel bidirectional data bus
21	DB3	I/O	Parallel bidirectional data bus
22	DB2	I/O	Parallel bidirectional data bus
23	DB1	I/O	Parallel bidirectional data bus
24	DB0	I/O	Parallel bidirectional data bus
25	CS	I	Chip select signal
26	RS	I	Resister select signal
27	WR	I	Data write signal
28	RD	I	Data read signal
29	VSYNC_OUT	O	Tear effect out signal
30	GND	–	Ground
31	DDVDH	I	Source driver liquid crystal and VCOM drive power supply
32	VCC	I	Power supply
33	VGL	I	LCD driver power supply
34	VGH	I	LCD driver power supply
35	GND	–	Ground

7.3. Relations with Input signal and display colors

Display colors		Data signal(0 : Low level, 1: High level)																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Dark	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Dark	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
		0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note) Definition of Gray

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray(n = Gray Level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

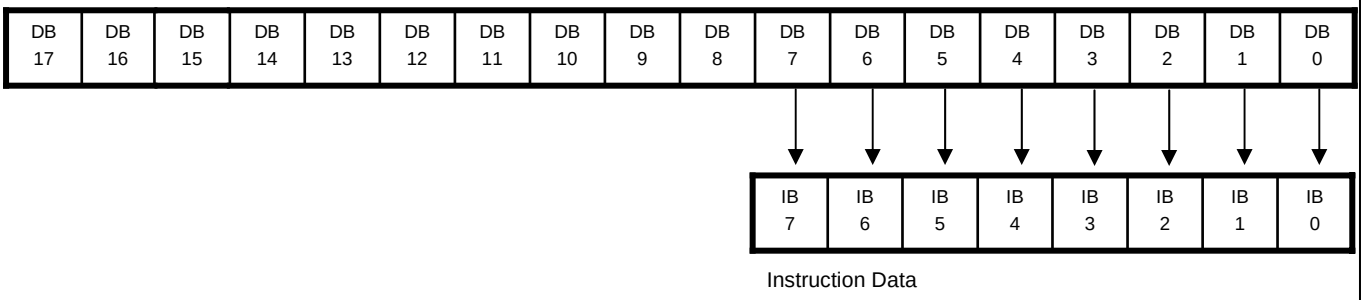
8. INTERFACE CONNECTIONS

8.1. Register Selection (80 System Bus)

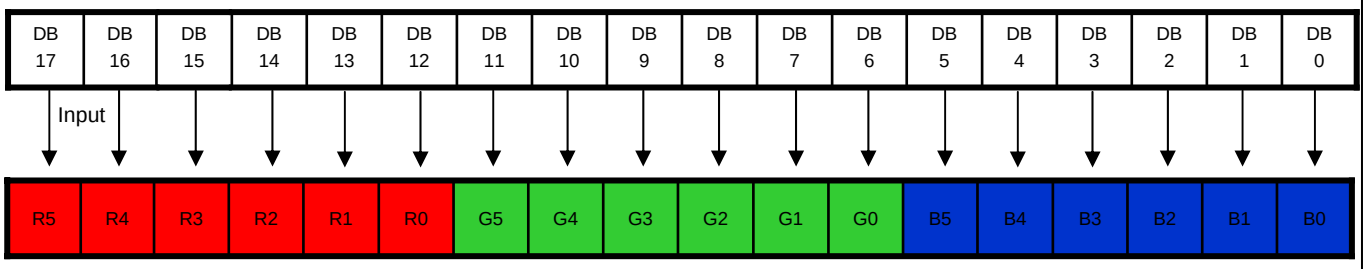
_WE	_RD	ADS	Operation
0	1	0	Write indexes to IR[1)]
1	0	0	Read internal statuses
0	1	1	Write to the control registers or GRAM through WDR[1)]
1	0	1	Read From the GRAM through RDR[1)]

Note 1) : IR (16-bit index register),
WDR(18-bit write-data register),
RDR(18-bit read-data register)

8.2. 16bit CPU Interface Data and Instruction Flow

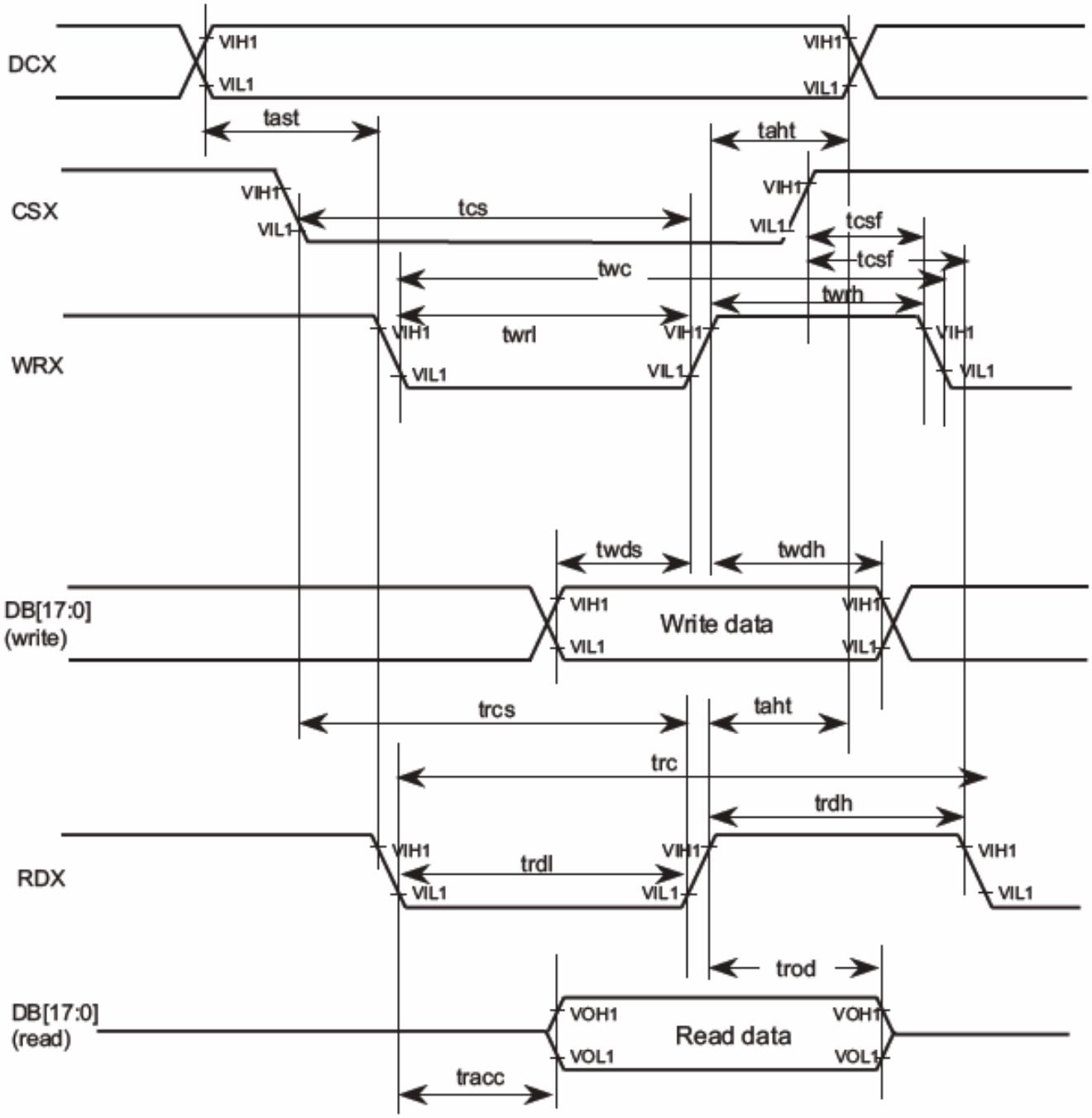


Instruction Data

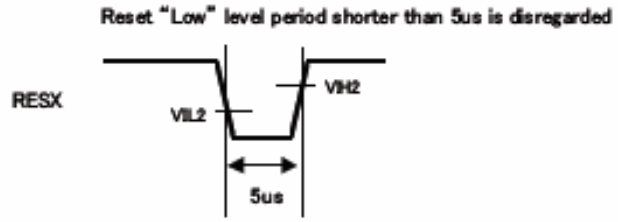


GRAM write Data

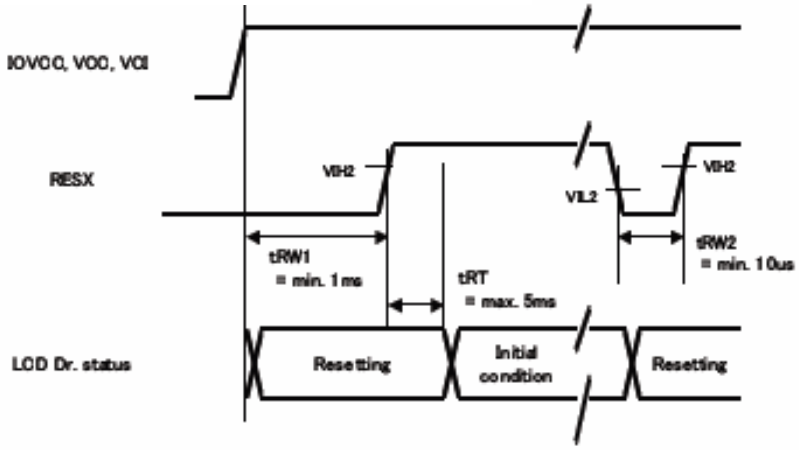
8.3. 80-system Bus 16 bit CPU Interface Operation



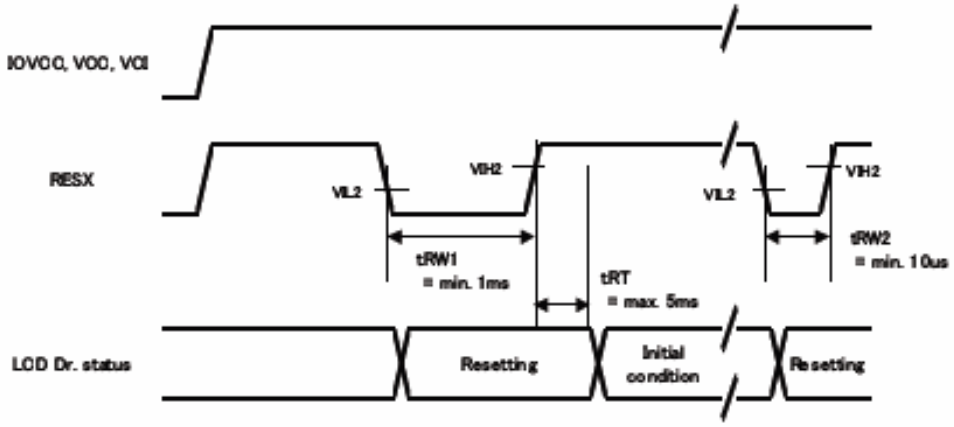
8.4. Reset Timing Characteristics



Reset Timing in Power On Operation



Reset Timing in Normal Operation



8.5. 80-system Bus Interface Timing Characteristics

Normal Write Mode(HWM = 0), IOVcc=1.65V~3.1V

Item	Symbol		Unit	Test Condition	Min	Max
Address setup time	DCS	Tast	ns		0	–
Address hold time (Write/Read)		That	ns		10	–
Chip select setup time (write)	CSX	Tcs	ns		35	–
Chip select setup time (Read)		Trcs	ns		170	–
Chip select wait time (Write/Read)		Tcsf	ns		20	–
Write cycle time	WRX	Twc	ns		100/80	–
Write control pulse “High” period		Twrh	ns		35	–
Write control pulse “Low” period		Twrf	ns		35	–
Read cycle time	RDX	Trc	ns		450	–
Read control pulse “High” period		Trdh	ns		250	–
Read control pulse “Low” period		Trdl	ns		170	–
Write data setup time	DB [17:0]	Twds	ns	CL Max. 30pF Min. 8pF	15	–
Write data hold time		Twdh	ns		25	–
Read access time		Tracc	ns		10	150
Output disable time		Trod	ns		10	–
Rise /Fall time	–	Tr/Tf	ns		–	15

8.6. Reset Timing Characteristics

(Vcc=2.4V~3.1V)

Ta = -40℃ ~ 85℃

Parameter	Symbol	Unit	Condition	Min.	Max.
Reset Low-level width 1	t_{RW1}	ms	Power On	1	–
Reset Low-level width 2	t_{RW2}	us		10	–
Reset Time	t_{RT}	ms		–	5

9. MAIN REGISTER VALUE

9.1. Command Description

Refer to Data Sheet (R61516 / Renesas)

9.2. Reset

The R61516's initial internal settings is done with a RESET input. During the RESET period, no access, Whether it is command write or frame memory data write operation, is accepted, The source driver unit and power supply circuit unit are also reset to the respective initial states when RESET signal is inputted to the R61516

9.3. Display On / OFF Sequence

Power Off

Enter power supply (IOVCC, VCC=VCI, The voltages may be input in any order)

Low≥1ms

HW Reset

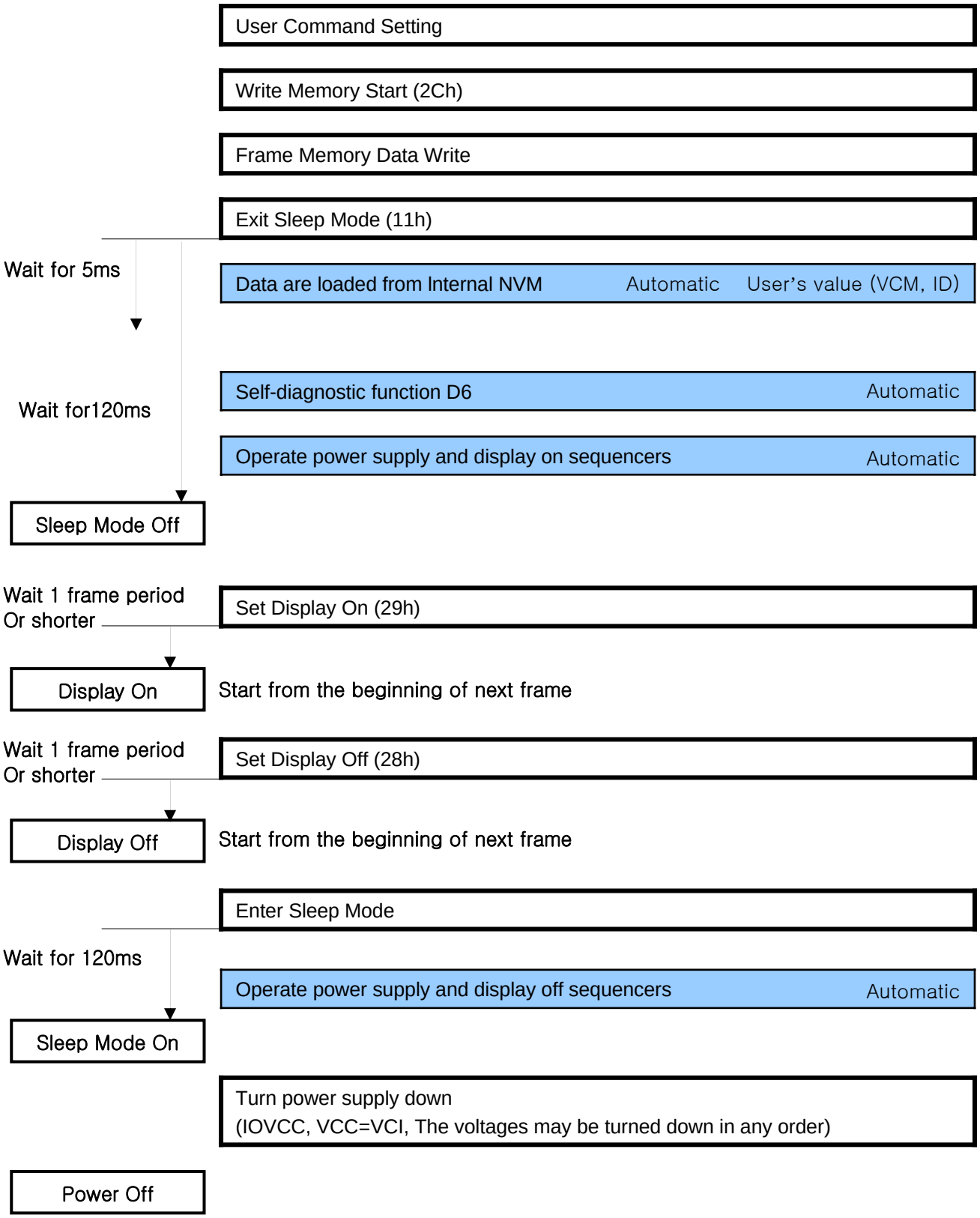
5ms wait

Data are loaded from internal NVM

Sleep Mode On

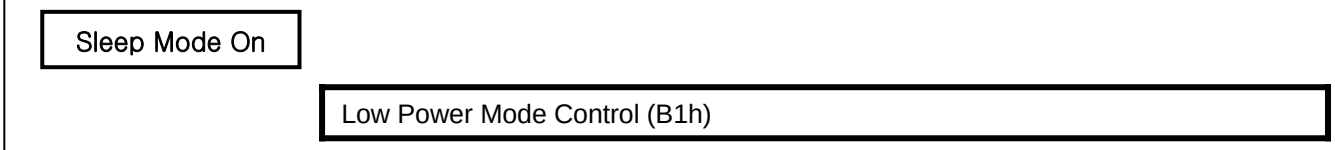
Panel Control Commands
Manufacturer Command Access Protect
Frame Memory Access and Interface setting
Display Mode and Frame Memory Write Mode setting
Panel Driving Setting
Display Timing Setting for Normal Mode
Display Timing Setting for Partial Mode
Display Timing Setting for Idle Mode
Source/VCOM/Gate Driving Timing Setting
Gamma Set A
Gamma Set B
Gamma Set C
Power Setting (Common)
VCOM Setting
Power Setting for Normal Mode
Power Setting for Partial Mode
Power Setting for Idle Mode
Sequencer Control 1
Sequencer Control 2

See Next Page


User Command Setting
Write Memory Start (2Ch)
Frame Memory Data Write
Exit Sleep Mode (11h)
Wait for 5ms
Data are loaded from Internal NVM
Automatic
User's value (VCM, ID)
Wait for120ms
Self-diagnostic function D6
Automatic
Operate power supply and display on sequencers
Automatic
Sleep Mode Off
Wait 1 frame period
Or shorter
Set Display On (29h)
Display On
Start from the beginning of next frame
Wait 1 frame period
Or shorter
Set Display Off (28h)
Display Off
Start from the beginning of next frame
Enter Sleep Mode
Wait for 120ms
Operate power supply and display off sequencers
Automatic
Sleep Mode On
Turn power supply down
(IOVCC, VCC=VCI, The voltages may be turned down in any order)
Power Off

9.4. Deep Standby Mode ON/OFF Sequence

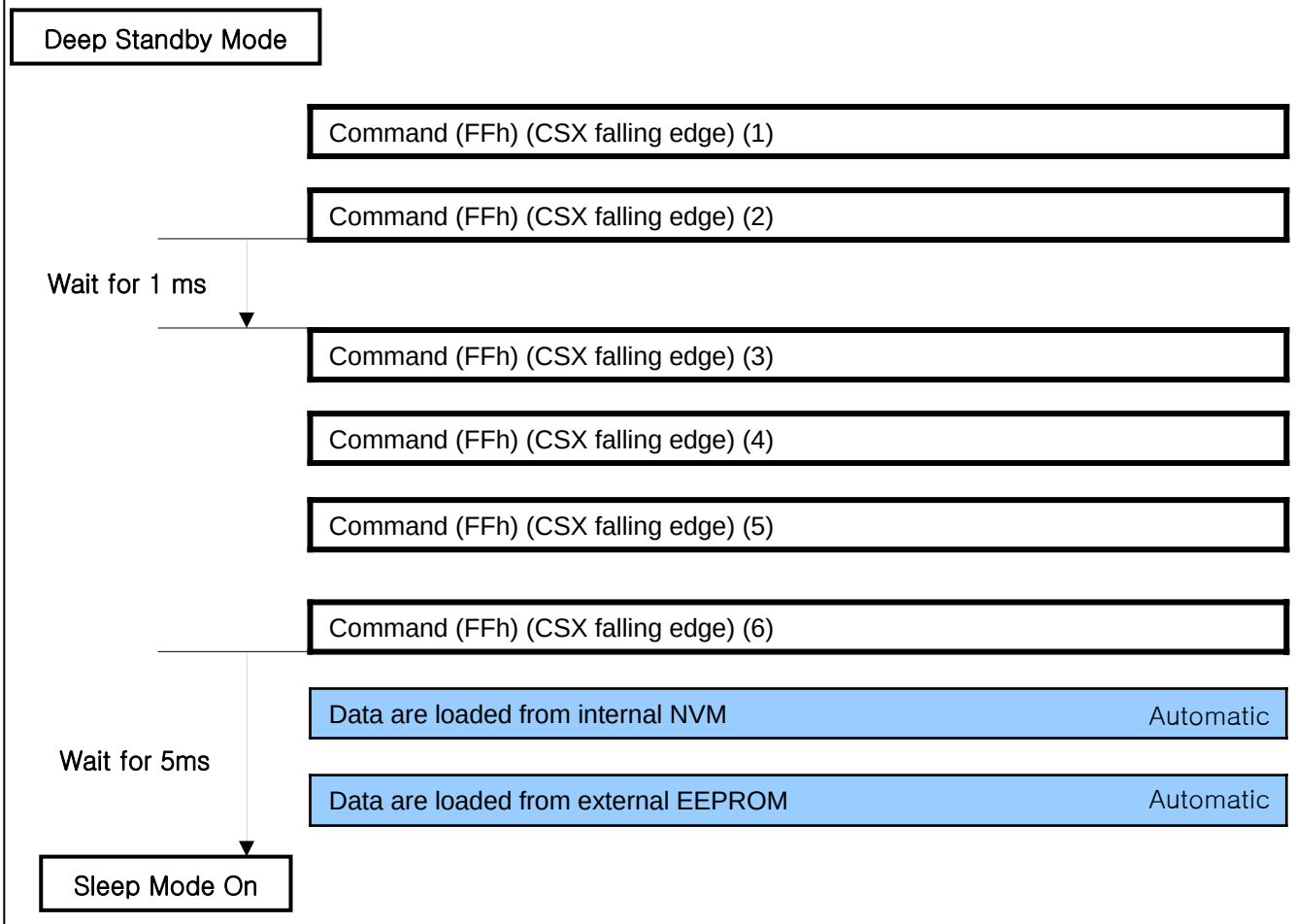
9.4.1. Deep Standby Mode ON Sequence



Enter Deep Standby Mode

* Deep Standby mode is entered only when the LCD driver is in Sleep Mode

9.4.2. Deep Standby Mode OFF Sequence



Deep Standby Mode is exited at the falling edge of the 6th CSX.

* See Power supply and Display ON / OFF sequences for the operation from Sleep Mode to display operation.
* The Command FFh may not be input, (Deep Standby Mode is exited only be inputting CSX)

9.5. Display On Value

Manufacturer Command Access Protect	L	COMMAND	0xB0
	H	PARAMETER	0x00
Frame Memory Access and Interface setting	L	COMMAND	0xB3
	H	PARAMETER1	**0x02**
	H	PARAMETER2	0x00
	H	PARAMETER3	0x00
	H	PARAMETER4	0x01
	H	PARAMETER5	0x00
Display Mode and Frame Memory Write Mode setting	L	COMMAND	0xB4
	H	PARAMETER1	0x00
Panel Driving Setting	L	COMMAND	0xC0
	H	PARAMETER1	0x03
	H	PARAMETER2	0x4F
	H	PARAMETER3	0x00
	H	PARAMETER4	0x00
	H	PARAMETER5	0x00
	H	PARAMETER6	0x00
	H	PARAMETER7	0x00
	H	PARAMETER8	0x00
Display Timing Setting for Normal Mode	L	COMMAND	0xC1
	H	PARAMETER1	0x01
	H	PARAMETER2	0x00
	H	PARAMETER3	**0x17**
	H	PARAMETER4	**0x08**
	H	PARAMETER5	**0x08**
Source/Vcom/Gate driving timing setting	L	COMMAND	0xC4
	H	PARAMETER1	**0x11**
	H	PARAMETER2	**0x01**
	H	PARAMETER3	**0x33**
	H	PARAMETER4	**0x04**

Gamma set A	L	COMMAND	0xC8
	H	PARA1	**0x00**
	H	PARA2	**0x0A**
	H	PARA3	**0x14**
	H	PARA4	**0xDF**
	H	PARA5	**0x0A**
	H	PARA6	**0x14**
	H	PARA7	**0x10**
	H	PARA8	**0x06**
	H	PARA9	**0x11**
	H	PARA10	**0x13**
	H	PARA11	**0x06**
	H	PARA12	**0x10**
	H	PARA13	**0x14**
	H	PARA14	**0xDA**
	H	PARA15	**0x0F**
	H	PARA16	**0x14**
	H	PARA17	**0x0A**
	H	PARA18	**0x00**
	H	PARA19	**0x31**
	H	PARA20	**0x11**
Gamma set B	L	COMMAND	0xC9
	H	PARA1	**0x00**
	H	PARA2	**0x0A**
	H	PARA3	**0x14**
	H	PARA4	**0xDF**
	H	PARA5	**0x0A**
	H	PARA6	**0x14**
	H	PARA7	**0x10**
	H	PARA8	**0x06**
	H	PARA9	**0x11**
	H	PARA10	**0x13**
	H	PARA11	**0x06**
	H	PARA12	**0x10**
	H	PARA13	**0x14**
	H	PARA14	**0xDA**
	H	PARA15	**0x0F**
	H	PARA16	**0x14**
	H	PARA17	**0x0A**
	H	PARA18	**0x00**
	H	PARA19	**0x31**
	H	PARA20	**0x11**
Gamma set C	L	COMMAND	0xCA
	H	PARA1	**0x00**
	H	PARA2	**0x0A**
	H	PARA3	**0x14**
	H	PARA4	**0xDF**
	H	PARA5	**0x0A**
	H	PARA6	**0x14**
	H	PARA7	**0x10**
	H	PARA8	**0x06**
	H	PARA9	**0x11**
	H	PARA10	**0x13**
	H	PARA11	**0x06**
	H	PARA12	**0x10**
	H	PARA13	**0x14**
	H	PARA14	**0xDA**
	H	PARA15	**0x0F**
	H	PARA16	**0x14**
	H	PARA17	**0x0A**
	H	PARA18	**0x00**
	H	PARA19	**0x31**
	H	PARA20	**0x11**

Power setting(Common)	L	COMMAND	0xD0
	H	PARAMETER1	0x07
	H	PARAMETER2	0xC4
	H	PARAMETER3	**0xDF**
Vcom setting	L	COMMAND	0xD1
	H	PARAMETER1	**0x4E**
	H	PARAMETER2	**0x0D**
	H	PARAMETER3	0x03
Power setting for Normal mode	L	COMMAND	0xD2
	H	PARAMETER1	0x63
	H	PARAMETER2	0x25
Power setting for Idle mode	L	COMMAND	0xD4
	H	PARAMETER1	0x63
	H	PARAMETER2	0x25
Sequencer control 1	L	COMMAND	0xD6
	H	PARAMETER1	0x01
	H	PARAMETER2	0x05
	H	PARAMETER3	**0x72**
Sequencer control 2	L	COMMAND	0xD7
	H	PARAMETER1	0x06
	H	PARAMETER2	0x06
	H	PARAMETER3	0x08
User command setting	L	COMMAND	0x0E
	H	PARAMETER1	0x08
	L	COMMAND	0x35
	H	PARAMETER1	0x00
	L	COMMAND	0x36
	H	PARAMETER1	0x00
	L	COMMAND	0x3A
	H	PARAMETER1	0x06
Exit sleep mode	L	COMMAND	0x11
Wait min.120ms			
Display On	L	COMMAND	0x29
Write memory start	L	COMMAND	0x2C

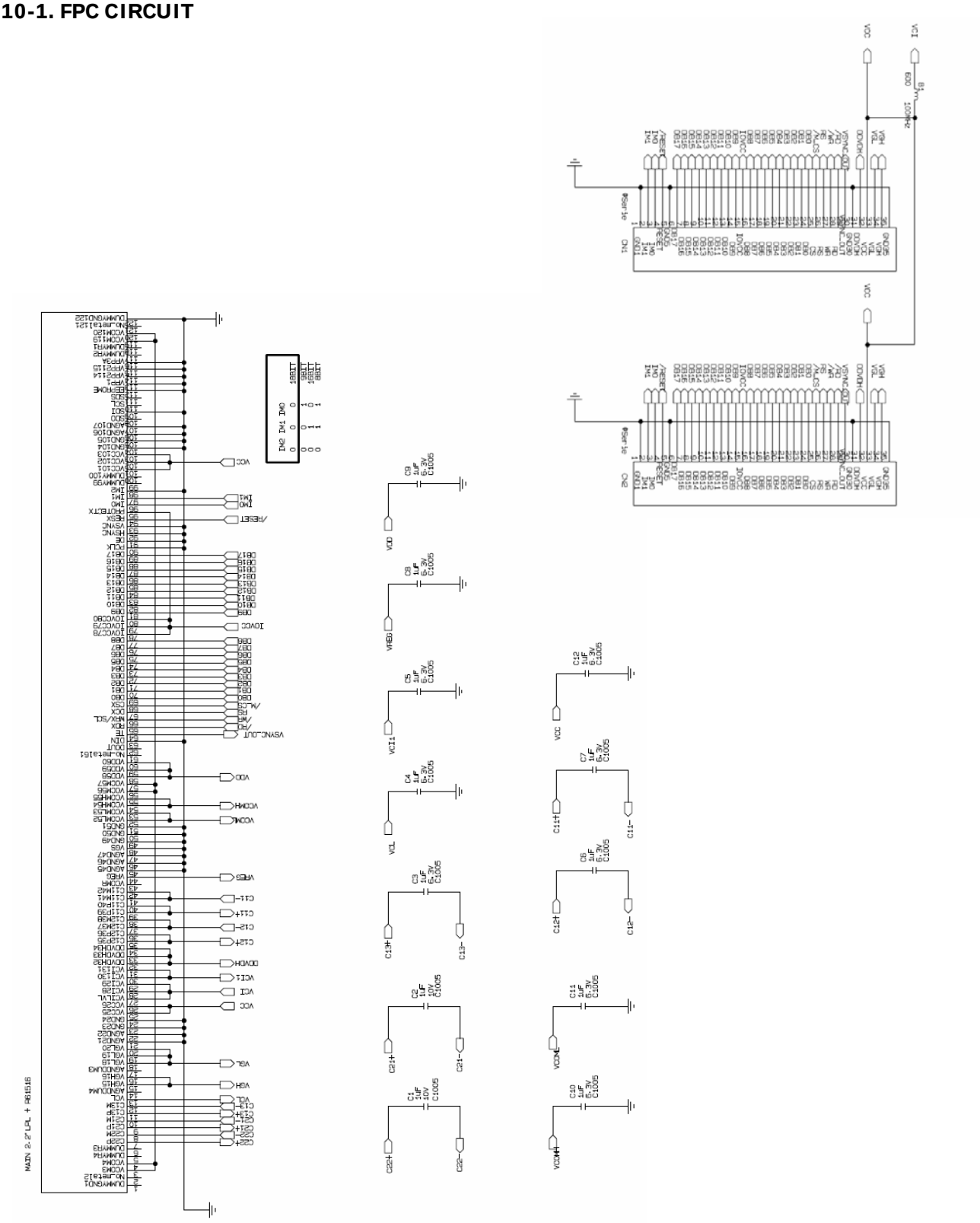
9.6. Display OFF & Sleep Mode On Value

Display ON			
Display OFF	L	COMMAND	0x28
Wait min.120ms			
Enter sleep mode	L	COMMAND	0x10
Wait min.120ms			

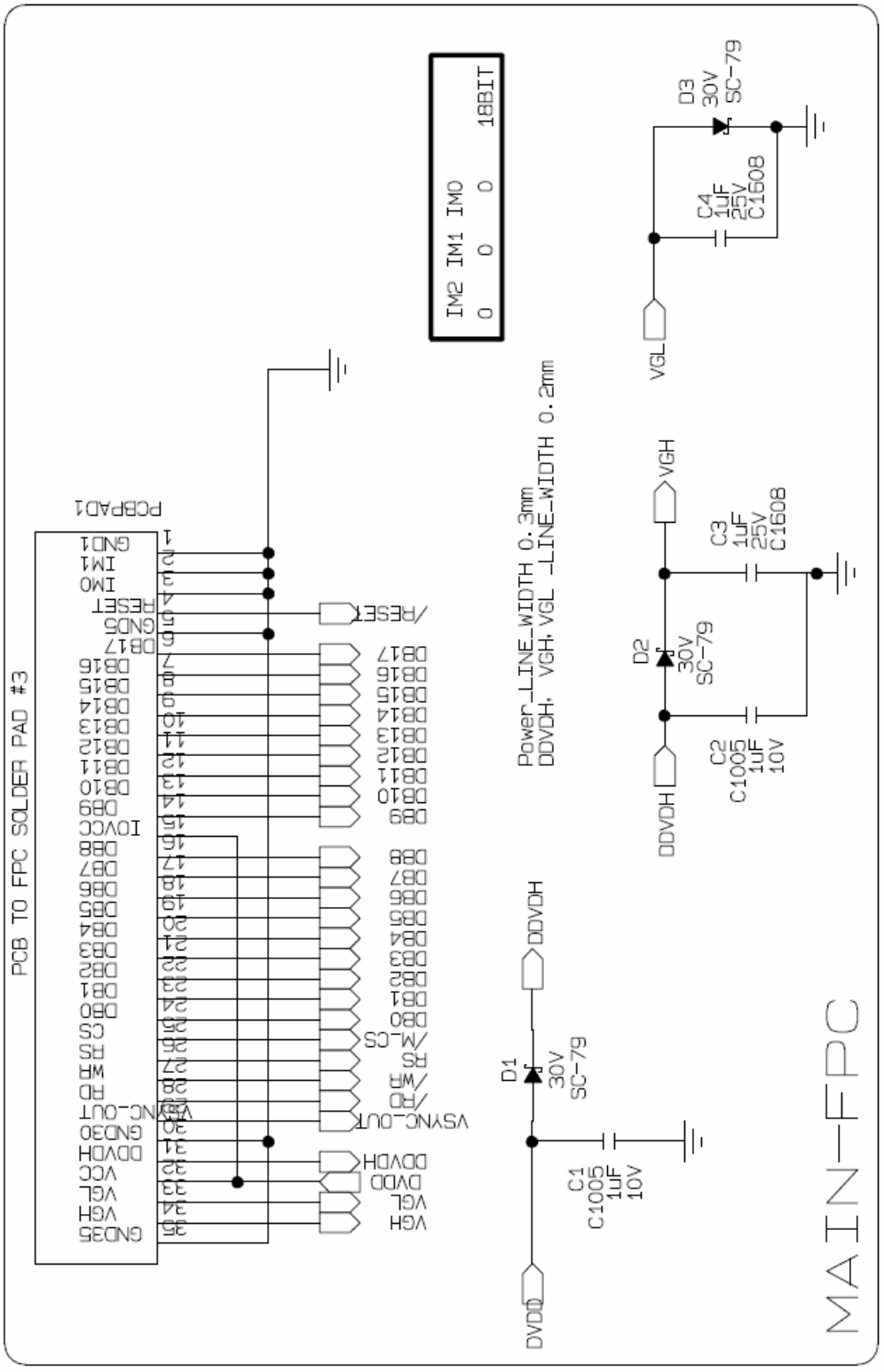
9.7. Exit Sleep Mode Value

Display OFF			
Exit sleep mode	L	COMMAND	0x11
Wait min.120ms			
Display On	L	COMMAND	0x29

10-1. FPC CIRCUIT



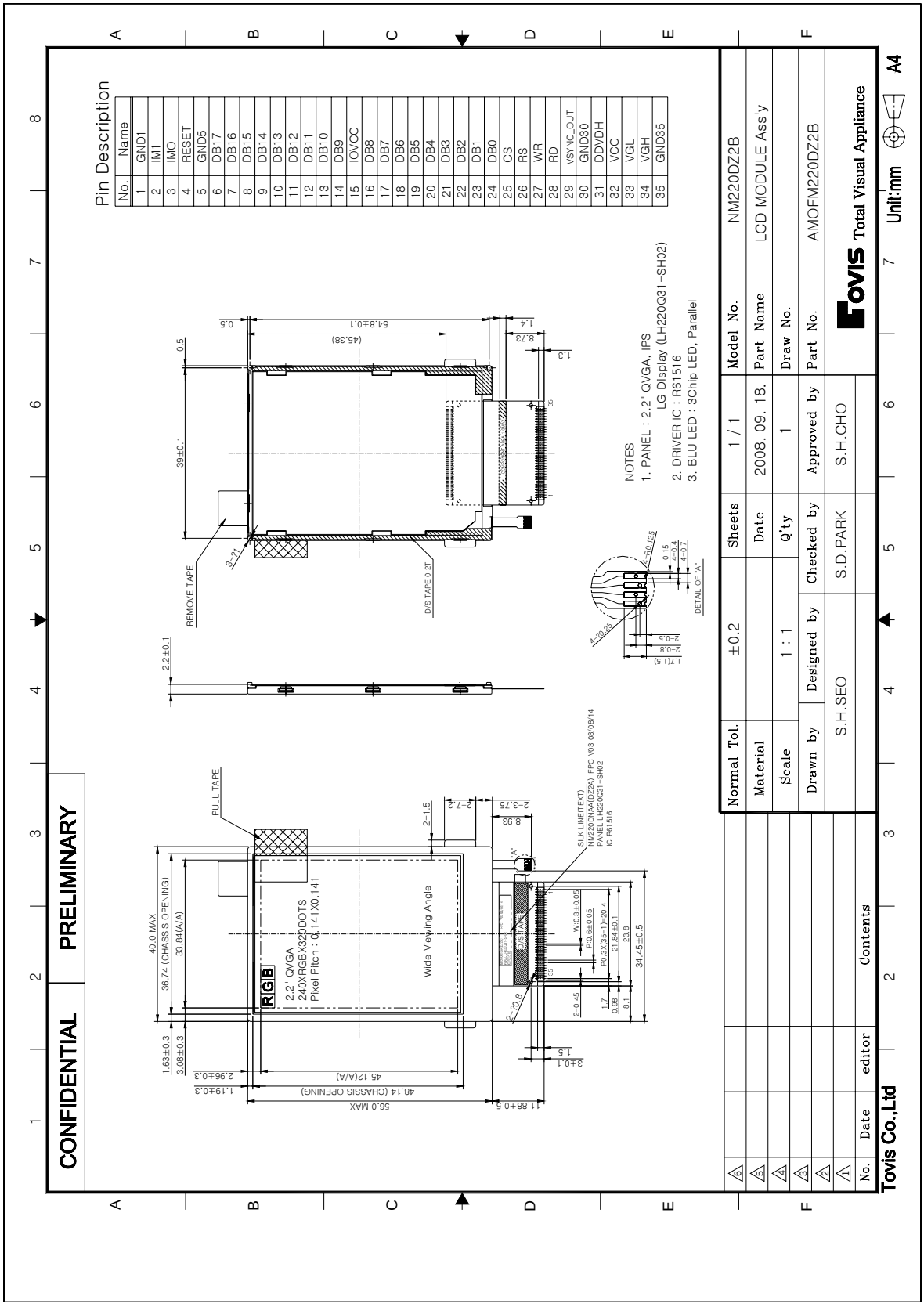
10-2. FPC & PCB SOLDER PAD CIRCUIT



11. RELIABILITY

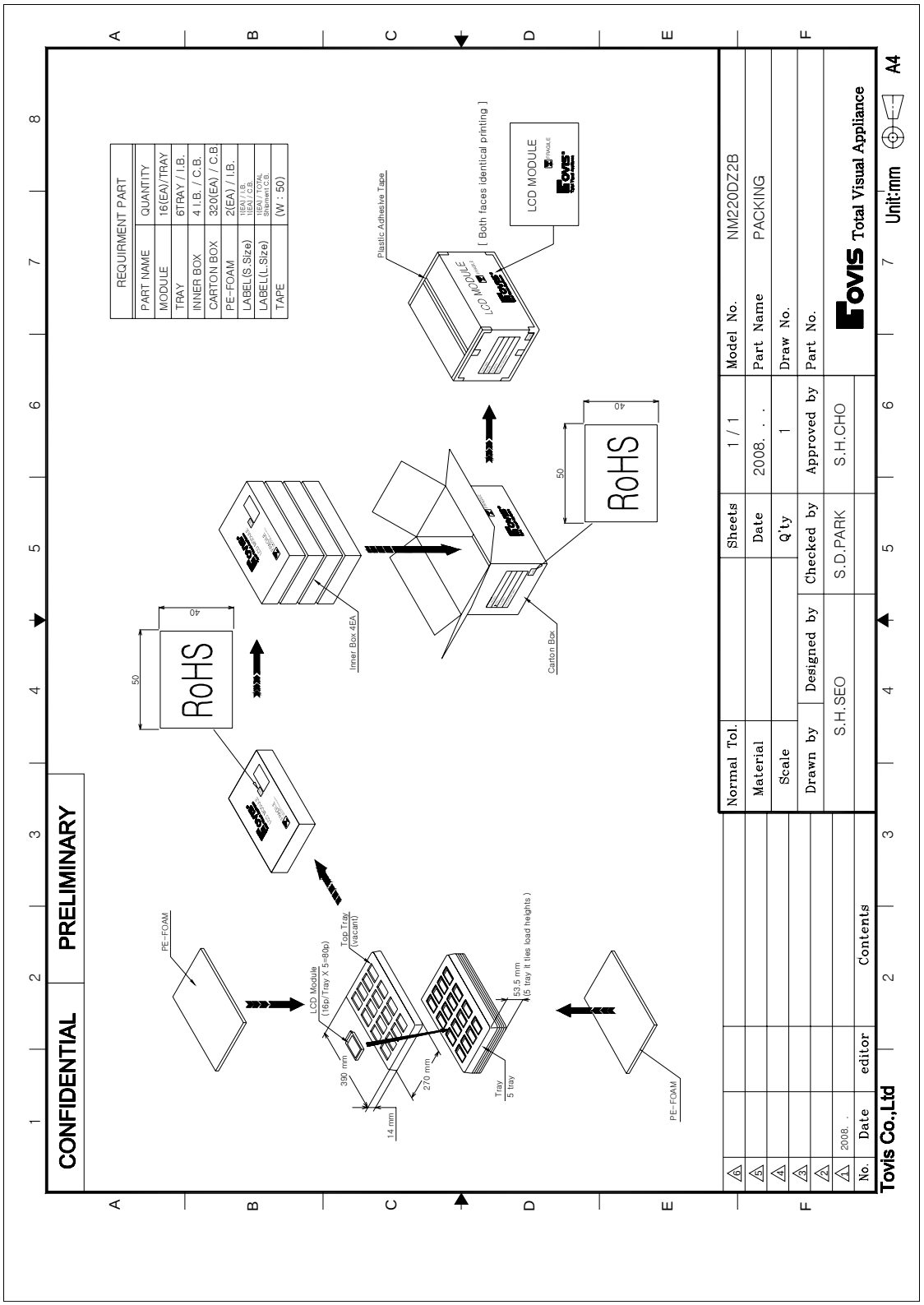
No	Test Item	Test Conditions	Remark
1	Low Temperature Operation	-20℃, 96 Hr	
2	High Temperature and High Humidity Operation	60℃, 90% RH, 96 Hr	
3	High Temperature Storage	80℃, 96Hr	
4	Low Temperature Storage	-30℃, 96 Hr	
5	Electrostatic Withstanding Voltage	Air : 330 ohm 150pF ± 200V	
		Contact : 330 ohm 150pF ± 200V	

12. Dimensional Outline



13. PACKING FORM & DESIGNATION OF LOT MARK

13.1. Packing Form and Marking Drawing



13.2 Designation of Lot Mark

a) Lot Mark

A	B	C	D	E	F	G	H

A : OEM MAKER CODE, DHL = ‘ H ’, SEAJONG = ‘ S ’ ,IDS = ‘I’

B : YEAR

C : MONTH

D,E : DATE

Note:

1. YEAR

YEAR	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Mark	5	6	7	8	9	0	1	2	3	4

2. MONTH

MONTH	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mark	1	2	3	4	5	6	7	8	9	A	B	C

14. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

14.1. Mounting Precautions

(1) You must mount a module using holes arranged in four corners.

(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.

(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.

(4) You should adopt radiation structure to satisfy the temperature specification.

(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.

(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)

(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal - hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.

(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.

(9) Do not open the case because inside circuits do not have sufficient strength.

(10) When you treat the LCD module, use finger-coat and grounded wrist-band to protect from ESD.

14.2. Operating Precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature .(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.

14.3. Static Electricity

(1) Ground soldering iron tips, tools and testers when they operate.
(2) Ground your body when handling the products.
(3) Do not apply voltage the input terminal without applying power supply.
(4) Do not apply voltage that exceeds the absolute maximum rating.
(5) Store the products in an anti-electrostatic container.