FORMIKE ELECTRONIC CO.,LTD

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH030GM03-F01

【 】 Preliminary Specification

【 ◆ 】 Finally Specification

CUSTOMER'S APPROVAL	
SIGNATURE:	DATE:

APPROVED BY	PM REVIEWD	PD REVIEWD	PREPARED BY
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Prepared By :

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Http:// www.wandisplay.com

- This specification is subject to change withouth notice.Please contact FORMIKE or it's representative before designing your product based on this specification.

TABLE OF CONTENTS

1. GENERAL DESCRIPTION

The KWH030GM03-F01 model is a Color TFT LCD supplied by Formike. This main Module has a 3.0 inch diagonally measured active display area with 240 X RGB X 400 resolutions. Each pixel is divided into Red, Green and Blue sub-pixels and dots that are arranged in vertical stripes. LCD color is determined with Dithering 65K/262K Color signal for each pixel. The KWH030GM03 has been designed to apply the interface method that enables low power, high speed, and high contrast. The KWH030GM03 is intended to support applications where thin thickness, wide viewing angle, low power are critical factors and graphic displays are important.

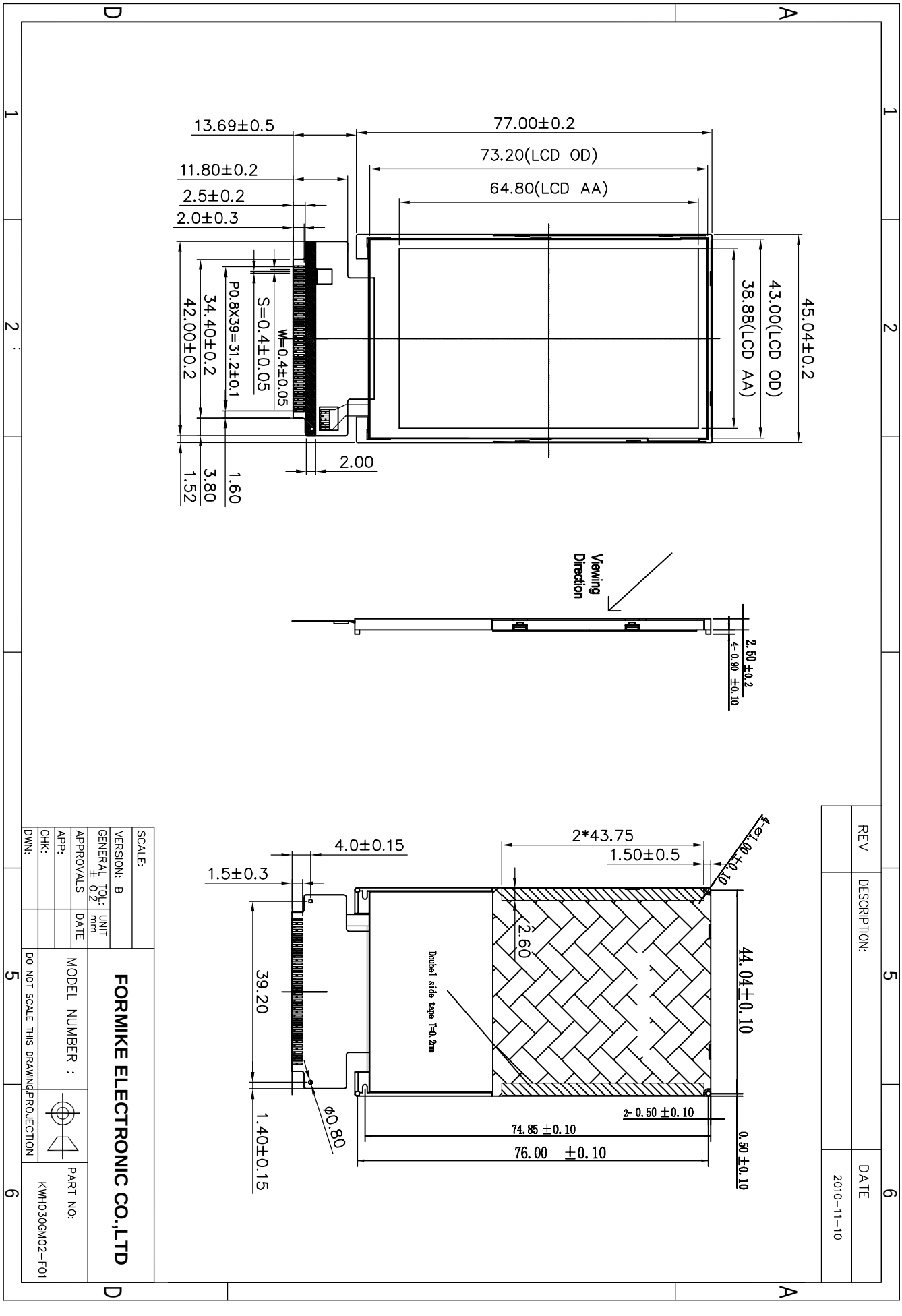
2. FEATURES

Display Mode	Transmissive Type
	a-Si color TFT LCD, Normally white type
Screen Size	3.0 inch WQVGA
Display Format	Graphic 240*RGB*400 Stripe type
Color	65K/262K color
Interface	MCU 80 - system 8/9/16/18 bit Interface
Driver IC	R61509V
Backlight	White LED
Viewing Direction	12 O'clock

3. MECHANICAL SPECIFICATION

Item	Specifications	Unit
Dimensional outline	45.04(W)×77.0(H)×2.50(D)	mm
Resolution	240×(R, G, B)×400	dot
Active area	38.88(W)×64.8(H)	mm
Pixel pitch	0.162 (W)×0.162(H)	mm

＊ Without FPC


13.69±0.5
77.00±0.2
73.20(LCD OD)
11.80±0.2
64.80(LCD AA)
2.5±0.2
2.0±0.3
45.04±0.2
43.00(LCD OD)
38.88(LCD AA)
P0.8X39=31.2±0.1
S=0.4±0.05
W=0.4±0.05
34.40±0.2
42.00±0.2
2.00
1.52
3.80
1.60
Viewing Direction
2.50 ±0.2
4-0.90 ±0.10
4.0±0.15
2*43.75
1.50±0.5
1.5±0.3
4-1.00±0.10
2.60
Doubel side tape T=0.2mm
44.04±0.10
39.20
2-0.50±0.10
74.85 ±0.10
76.00 ±0.10
0.50 ±0.10
φ0.80
1.40±0.15
REV
DESCRIPTION:
DATE
2010-11-10
SCALE:
VERSION: B
GENERAL TOL: ± 0.2
UNIT mm
APPROVALS
DATE
APP:
CHK:
DWN:
DO NOT SCALE THIS DRAWING
PROJECTION
FORMIKE ELECTRONIC CO.,LTD
MODEL NUMBER :
PART NO:
KWH030GM02-F01

5. MODULE FUNCTION DESCRIPTION

No	Pin Name	Function
1	NC	Not Connect
2	NC	Not Connect
3	NC	Not Connect
4	NC	Not Connect
5	GND	Power Ground
6	VCC	Power input (+2.8V)
7	VCC	Power input (+2.8V)
8	FMARK	FMARK signal PIN
9	CS	Chip Select Input PIN
10	RS	Register Select Input PIN
11	WR	Chip Select Input PIN
12	RD	Read Data Select Input PIN
13	DB0	
14	DB1	
15	DB2	IM1/IM0 : 1/1
16	DB3	8 bit I/F : DB17~10
17	DB4	
18	DB5	IM1/IM0 : 0/1
19	DB6	9 bit I/F : DB17~9
20	DB7	
21	DB8	IM1/IM0 : 1/0
22	DB9	16bit I/F : DB17~10 and DB8~1
23	DB10	
24	DB11	IM1/IM0 : 0/0
25	DB12	18bit I/F : DB17~0
26	DB13	
27	DB14	Note :
28	DB15	Unused pins must be fixed GND level
29	DB16	
30	DB17	
31	IM1	MPU-Interface Mode Select
32	IM0	
33	NC	Not Connect
34	RESET	Reset Select Input PIN
35	GND	Power Ground
36	A	B/L Power input PIN anode
37	K1	B/L Power input PIN negative
38	K2	B/L Power input PIN negative
39	K3	B/L Power input PIN negative
40	K4	B/L Power input PIN negative

6. MAXIMUM RATINGS

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

Item	Symbol	Values		Unit	Condition
		Min.	Max.		
Power Supply for Logic	VCC -GND	2.5	3.3	V	
Storage Temperature	T_{ST}	-30	80	°C	
Operating Temperature (Ambient Temperature)	T_{OP}	-20	70	°C	
Humidity	-	-	90	%RH	

7. ELECTRICAL CHARACTERISTIC

A. Typical operating conditions (GND=0V)

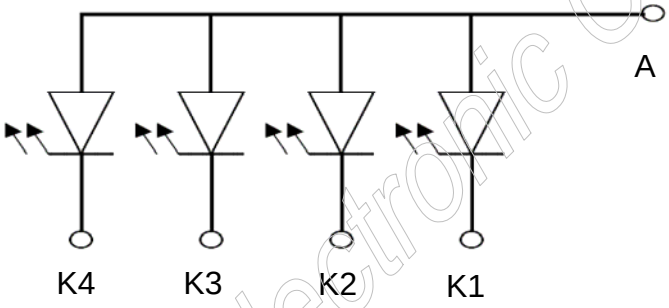
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
IC Power Voltage	Vcc	2.5	2.8	3.3	V	
High-level Input Voltage	V_{IH}	$0.8V_{DD}$	-	V_{DD}	V	
Low-level Input Voltage	V_{IL}	-0.3	-	$0.2V_{DD}$	V	
High-level Output Voltage	V_{OH}	$0.8V_{DD}$	-	-	V	
Low-level Output Voltage	V_{OL}	-	-	$0.2V_{DD}$	V	
Consumption current of V_{CCI}	I_{CC}	-	8.25	16.5	mA	
Consumption current of LED	I_{LED}	-	80	-	mA	

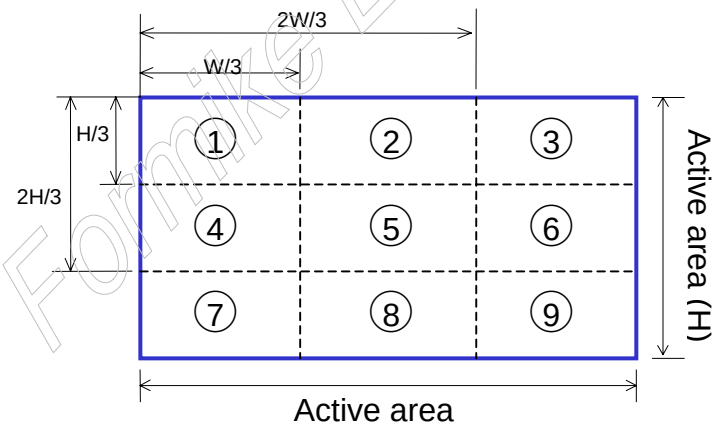
8. BACKLIGHT CHARACETRISTIC

8.1.Characteristic

Item	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_{LED}	I_{LED}=80mA	-	3.3	3.5	V
Forward current	I_{LED}	One-chip		20		mA
POWER CONSUMPTION	P_{LED}	I_{LED}=80mA	-	265	-	mW
Luminous color	White					
Chip connection	4-chip parallels connection					

8.2.Lightguide Specification

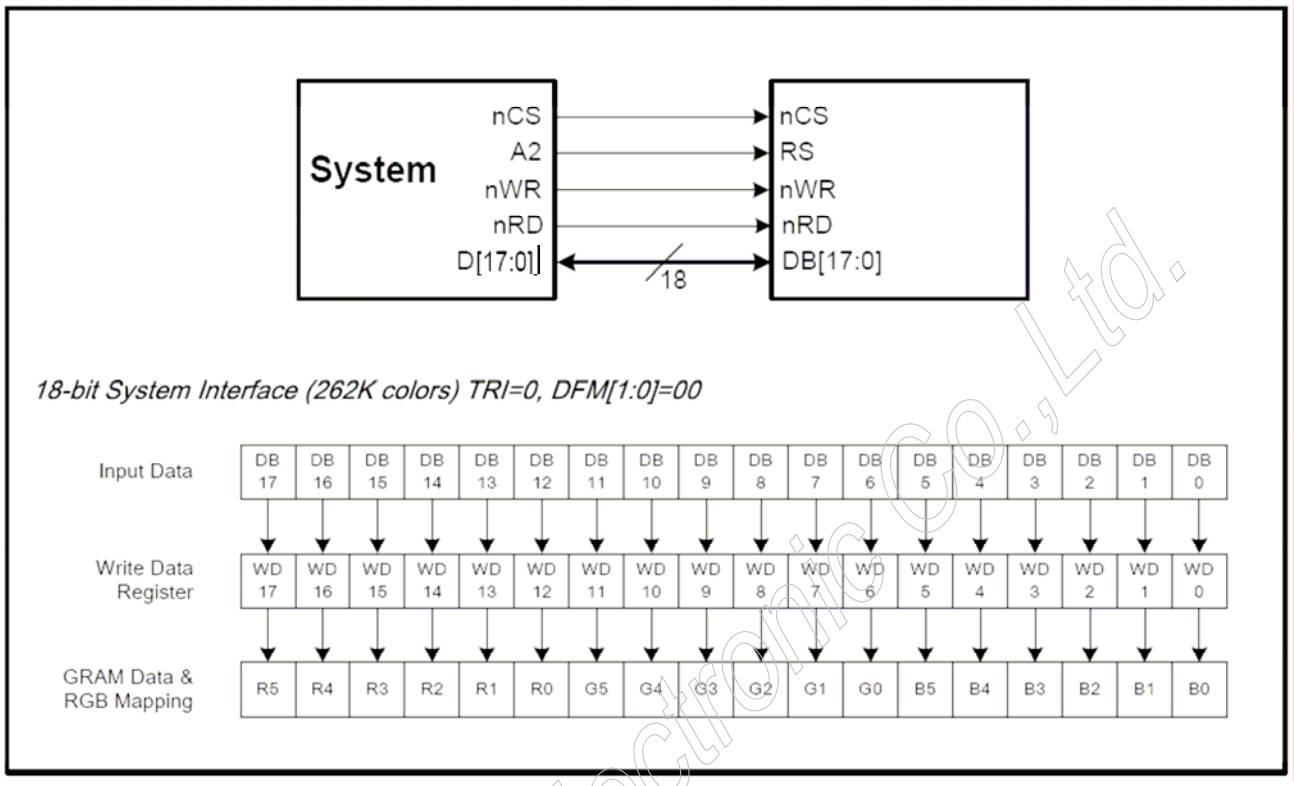




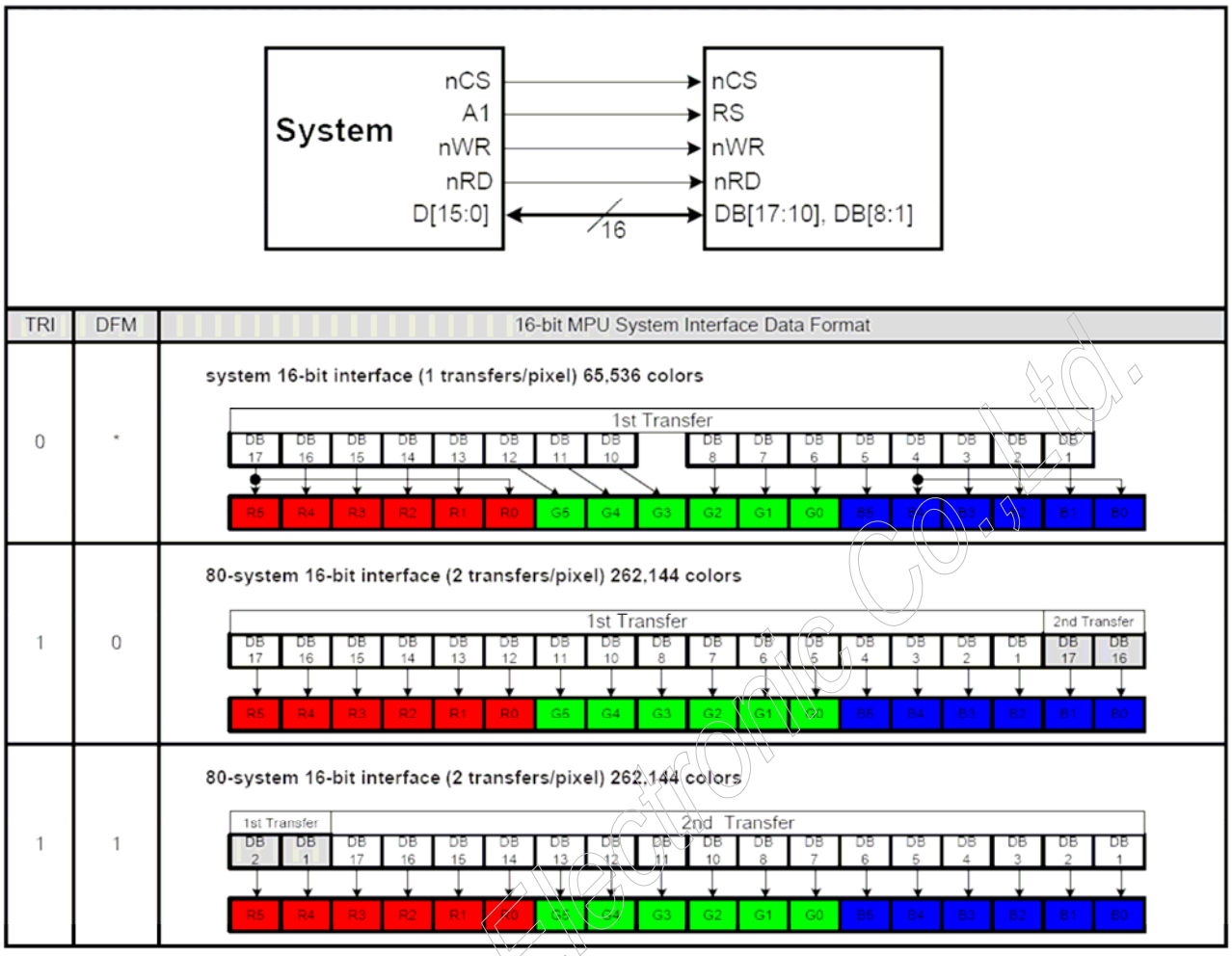
a. Test Instrument：BM-7 (Distance =500mm；Field = 1°)
b. Light Source：LED * 4 (White)
c. Conditions：V_f = 3.3V(typ)；I_f = 80 mA(typ)
d. Measure Brightness：1 ~ 9
e. Uniformity = (Min。Brightness / Max。Brightness)*100%
f. Uniformity ≧ 80%

9. MPU SYSTEM INTERFACE

9.1.MPU SYSTEM 18bits INTERFACE

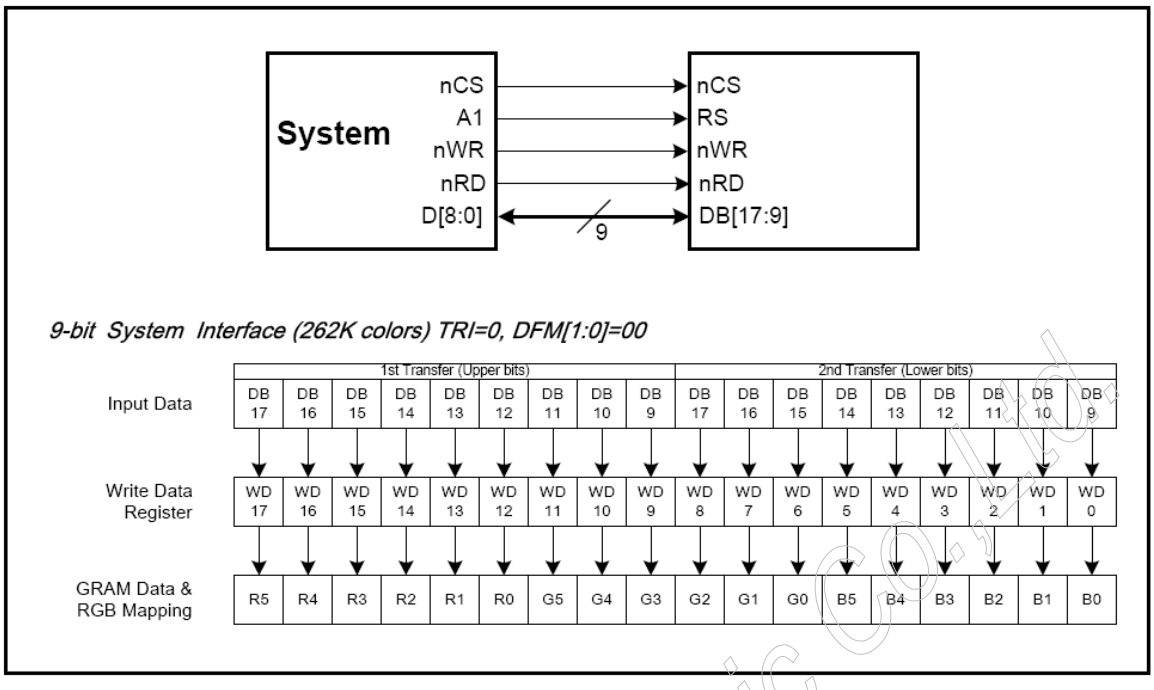


9.2.MPU SYSREM 16bits INTERFACE

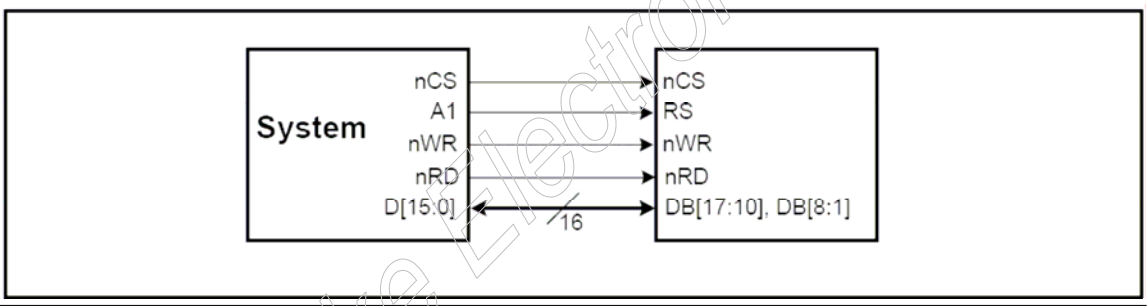


TRI	DFM	16-bit MPU System Interface Data Format
0	*	system 16-bit interface (1 transfers/pixel) 65,536 colors
1	0	80-system 16-bit interface (2 transfers/pixel) 262,144 colors
1	1	80-system 16-bit interface (2 transfers/pixel) 262,144 colors

9.3.MPU SYSTEM 9bits INTERFACE



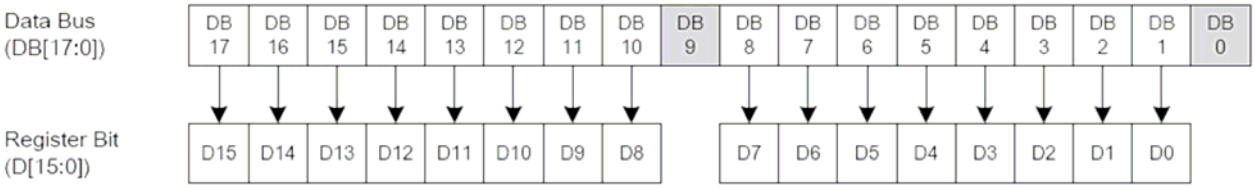
9.4.MPU SYSTEM 8bits INTERFACE



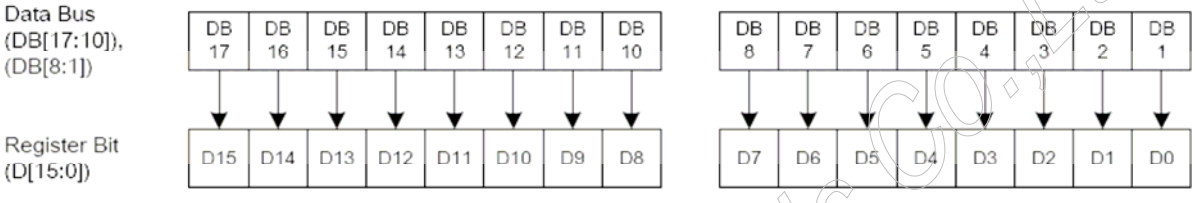
TRI	DFM	8-bit MPU System Interface Data Format
0	*	system 8-bit interface (2 transfers/pixel) 65,536 colors
1	0	80-system 8-bit interface (3 transfers/pixel) 262,144 colors
1	1	80-system 8-bit interface (3 transfers/pixel) 262,144 colors

9.5.MPU SYSTEM 18/16/9/8bits Data Bus

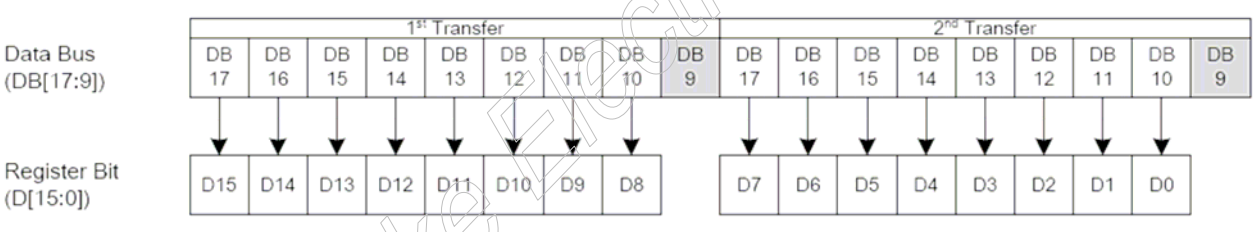
i80/M68 system 18-bit data bus interface



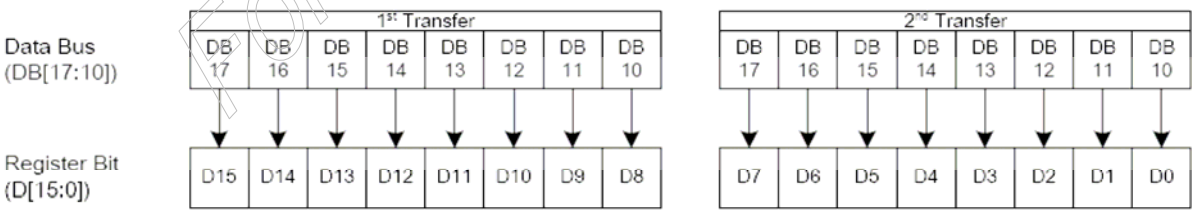
i80/M68 system 16-bit data bus interface



i80/M68 system 9-bit data bus interface



i80/M68 system 8-bit data bus interface/Serial peripheral interface (2/3 transmission)

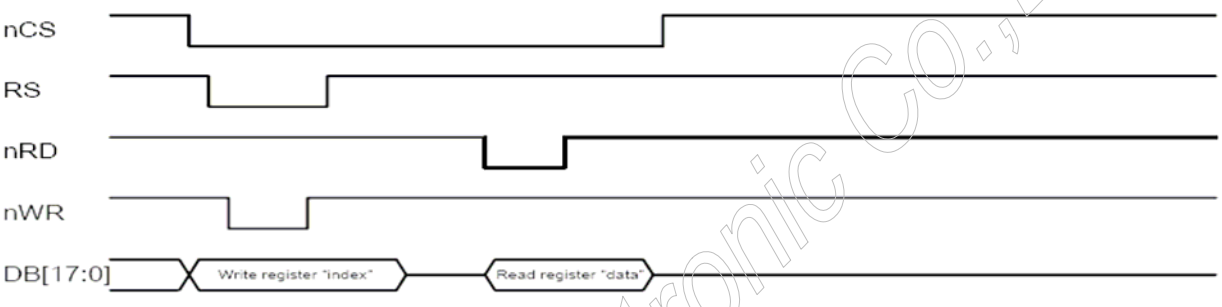


9.6.MPU SYSTEM 18/16/9/8bits TIMING

i80 18-/16-bit System Bus Interface Timing

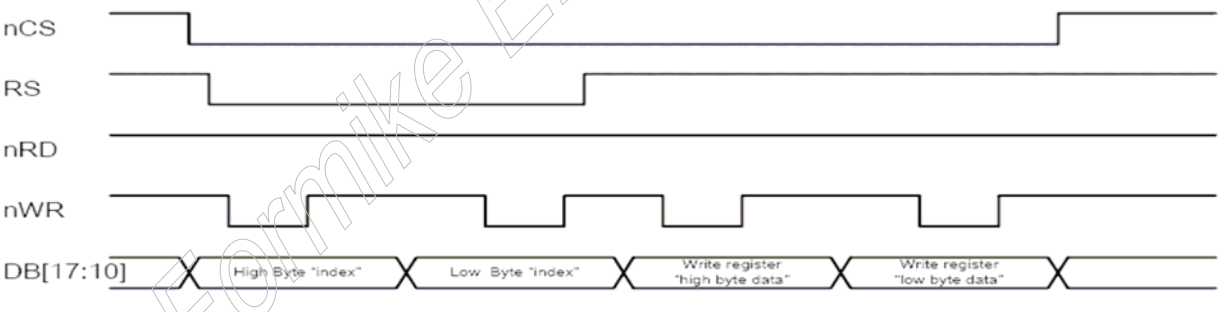
(a) Write to register

(b) Read from register

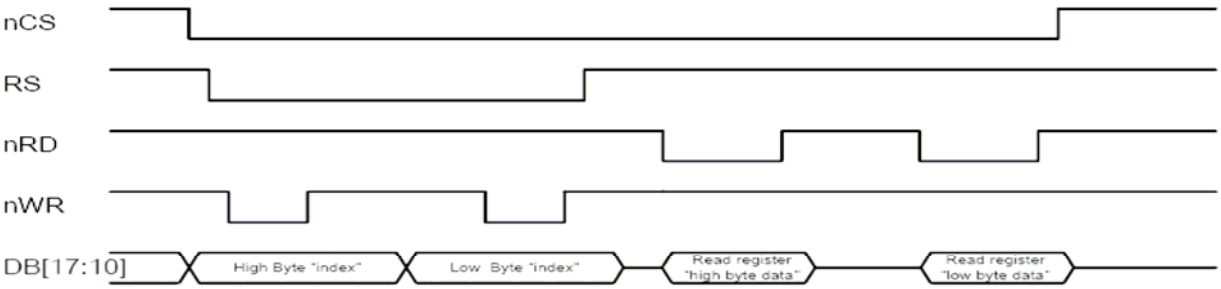


i80 9-/8-bit System Bus Interface Timing

(a) Write to register



(b) Read from register

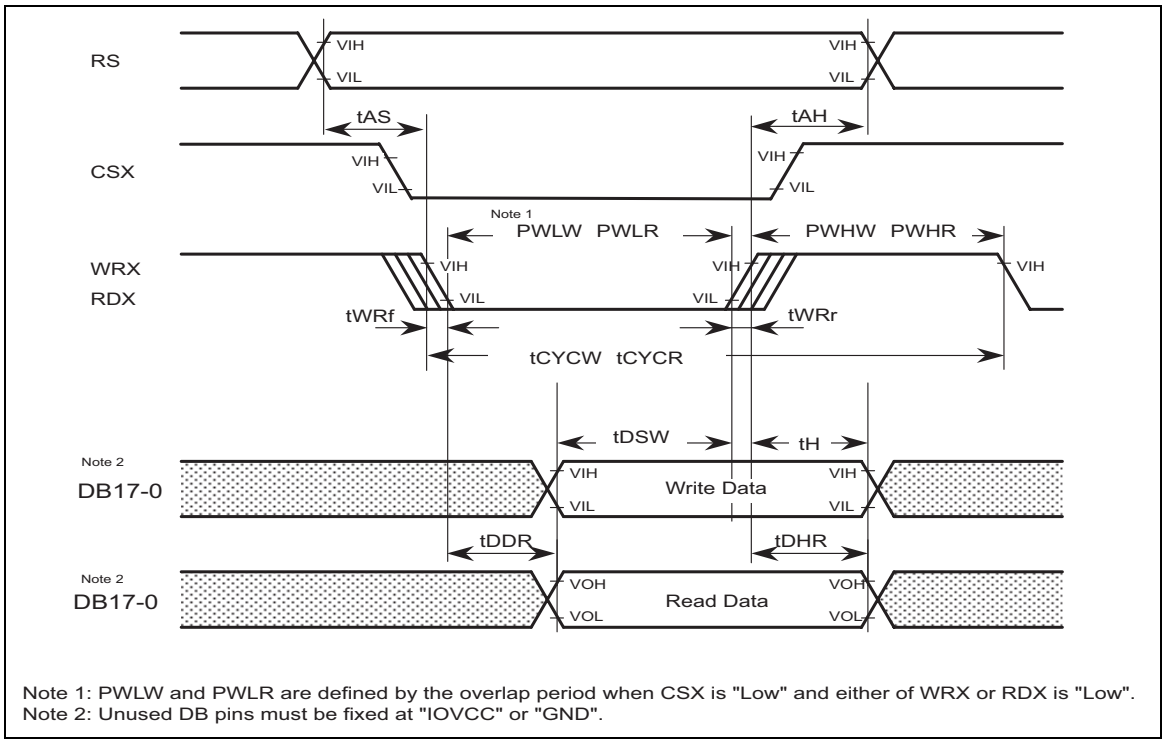


9.7.MPU SYSTEM 18/16/9/8bits TIMING Characteristics

Items		Symbol	Unit	Test condition	Min.	Typ.	Max.
Bus cycle time	Write	t_{CYCW}	ns	Figure A	75 (TBD)	—	—
	Read	t_{CYCR}	ns	Figure A	450 (TBD)	—	—
Write low- level pulse width		PW_{LW}	ns	Figure A	30 (TBD)	—	—
Read low-level pulse width		PW_{LR}	ns	Figure A	170 (TBD)	—	—
Write high-level pulse width		PW_{HW}	ns	Figure A	25 (TBD)	—	—
Read high-level pulse width		PW_{HR}	ns	Figure A	250 (TBD)	—	—
Write/ Read rise/fall time		t_{WRr}, t_{WRf}	ns	Figure A	—	—	15
Setup time	Write (RS to CSX, WRX)	t_{AS}	ns	Figure A	0 (TBD)	—	—
	Read (RS to CSX, RDX)		ns	Figure A	10 (TBD)	—	—
Address hold time		t_{AH}	ns	Figure A	2 (TBD)	—	—
Write data setup time		t_{DSW}	ns	Figure A	25 (TBD)	—	—
Write data hold time		t_H	ns	Figure A	10 (TBD)	—	—
Read data delay time		t_{DDR}	ns	Figure A	—	—	150
Read data hold time		t_{DHR}	ns	Figure A	5 (TBD)	—	—

Timing Characteristics

80-system Bus Interface



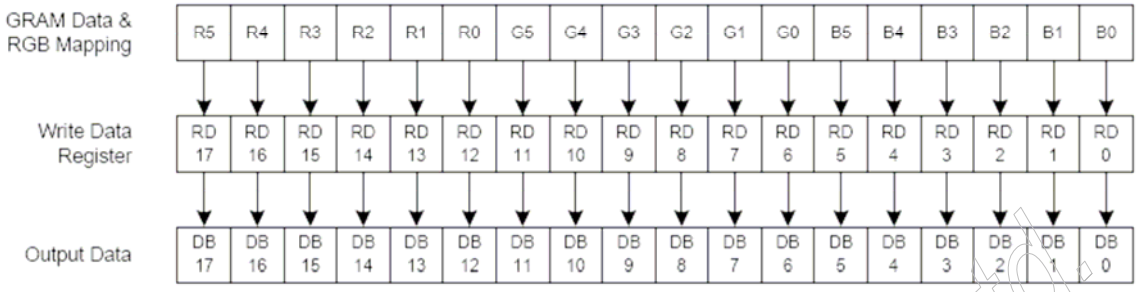
Note 1: PWLW and PWLR are defined by the overlap period when CSX is "Low" and either of WRX or RDX is "Low".
Note 2: Unused DB pins must be fixed at "IOVCC" or "GND".

Figure A 80-system Bus Interface

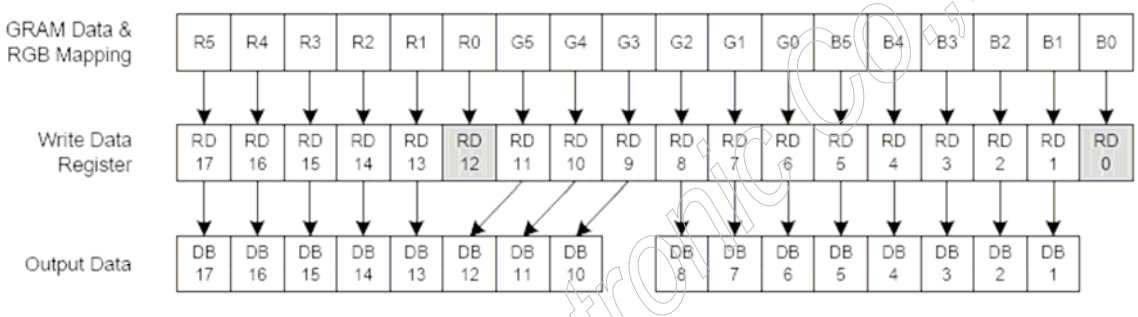
9.8.MPU SYSTEM 18/16/9/8bits GRAM Address Map & Read/Write

9.8.1. MPU SYSTEM 18/16/9/8bits GRAM Address

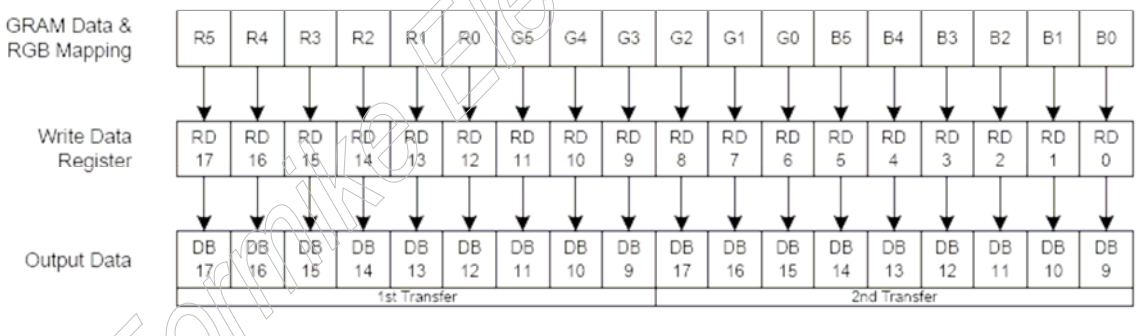
18-bit System Interface



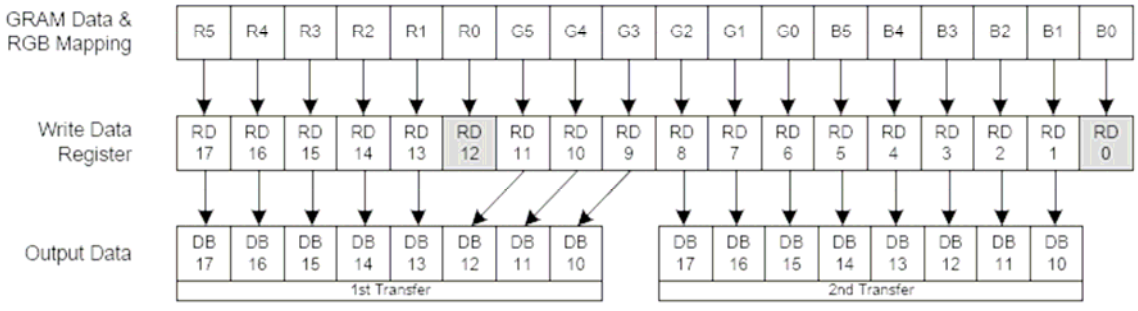
16-bit System Interface



9-bit System Interface

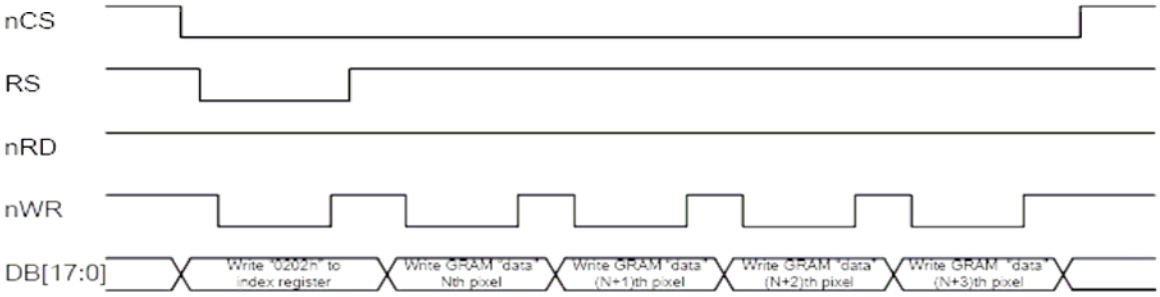


8-bit System Interface / Serial Data Transfer Interface

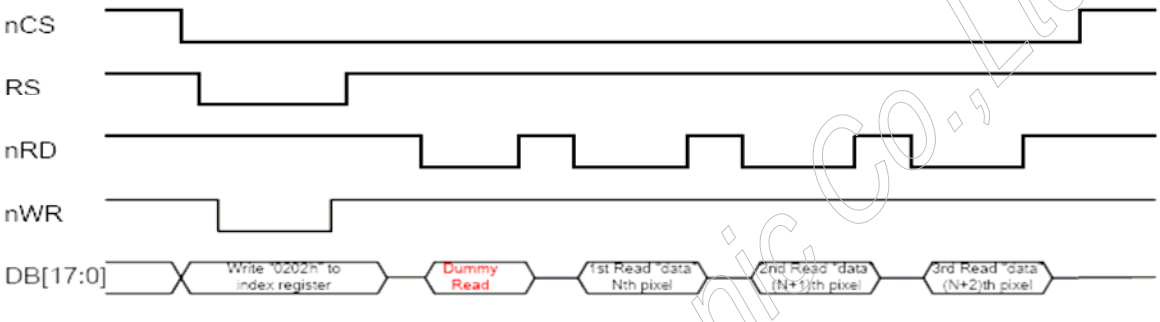


i80 18-/16-bit System Bus Interface Timing

(a) Write to GRAM

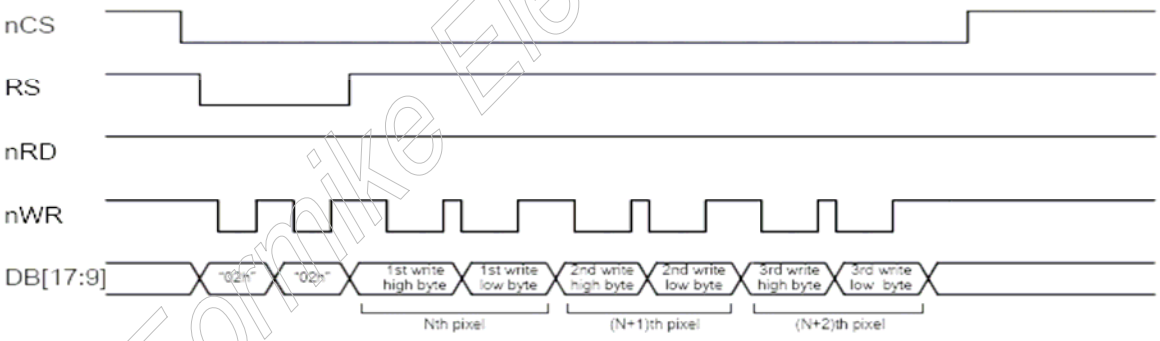


(b) Read from GRAM

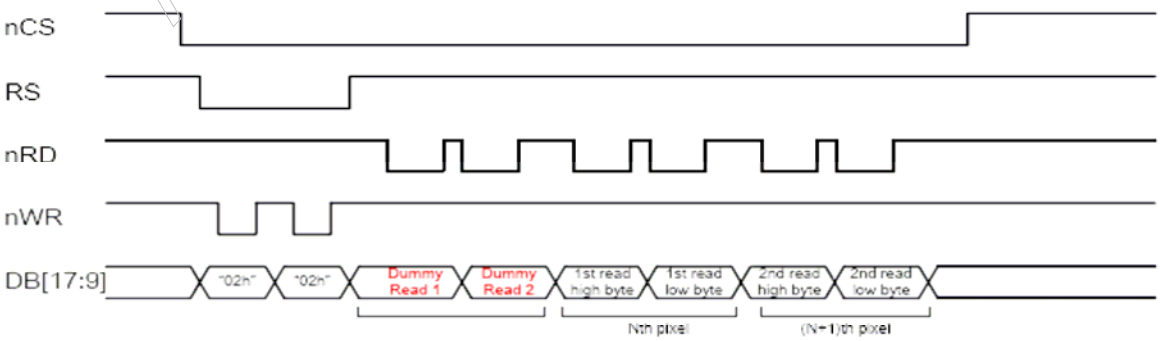


i80 9-/8-bit System Bus Interface Timing

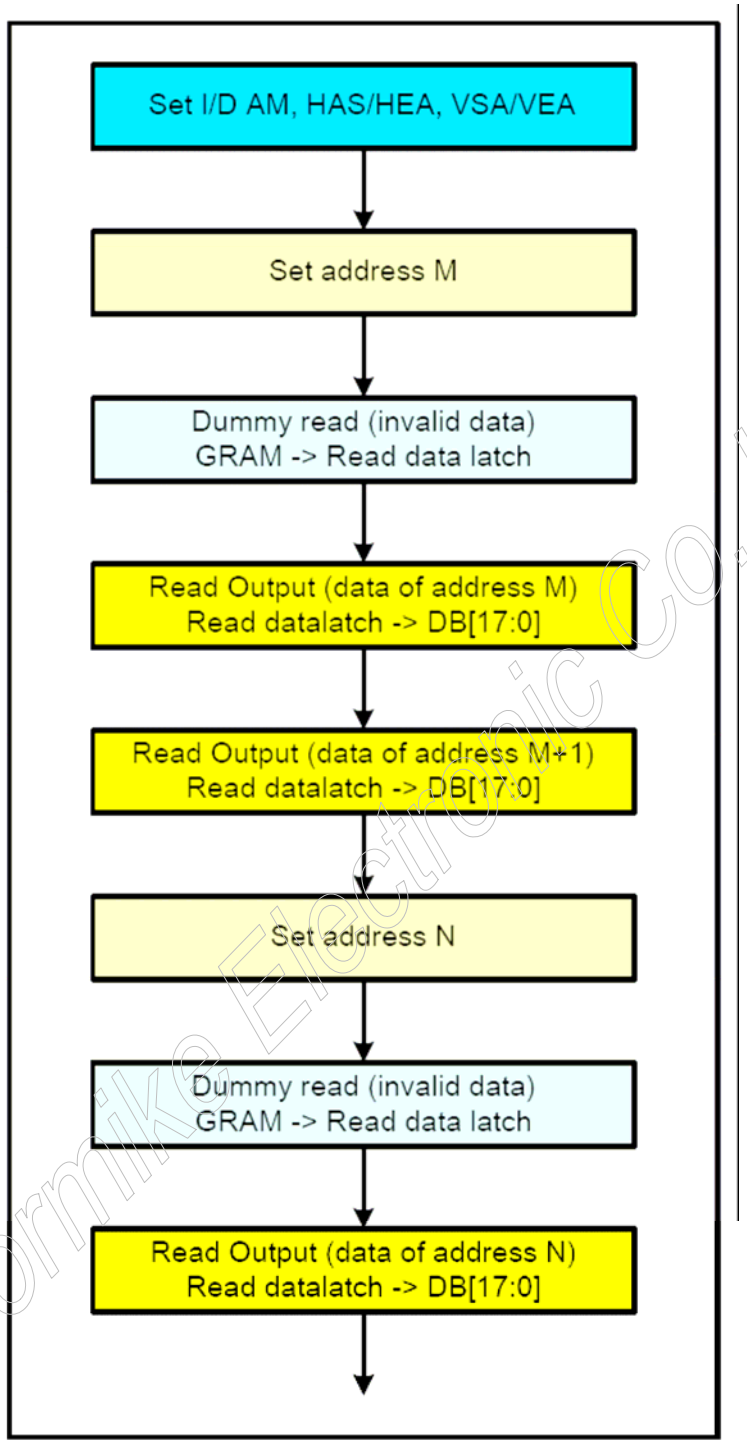
(a) Write to GRAM



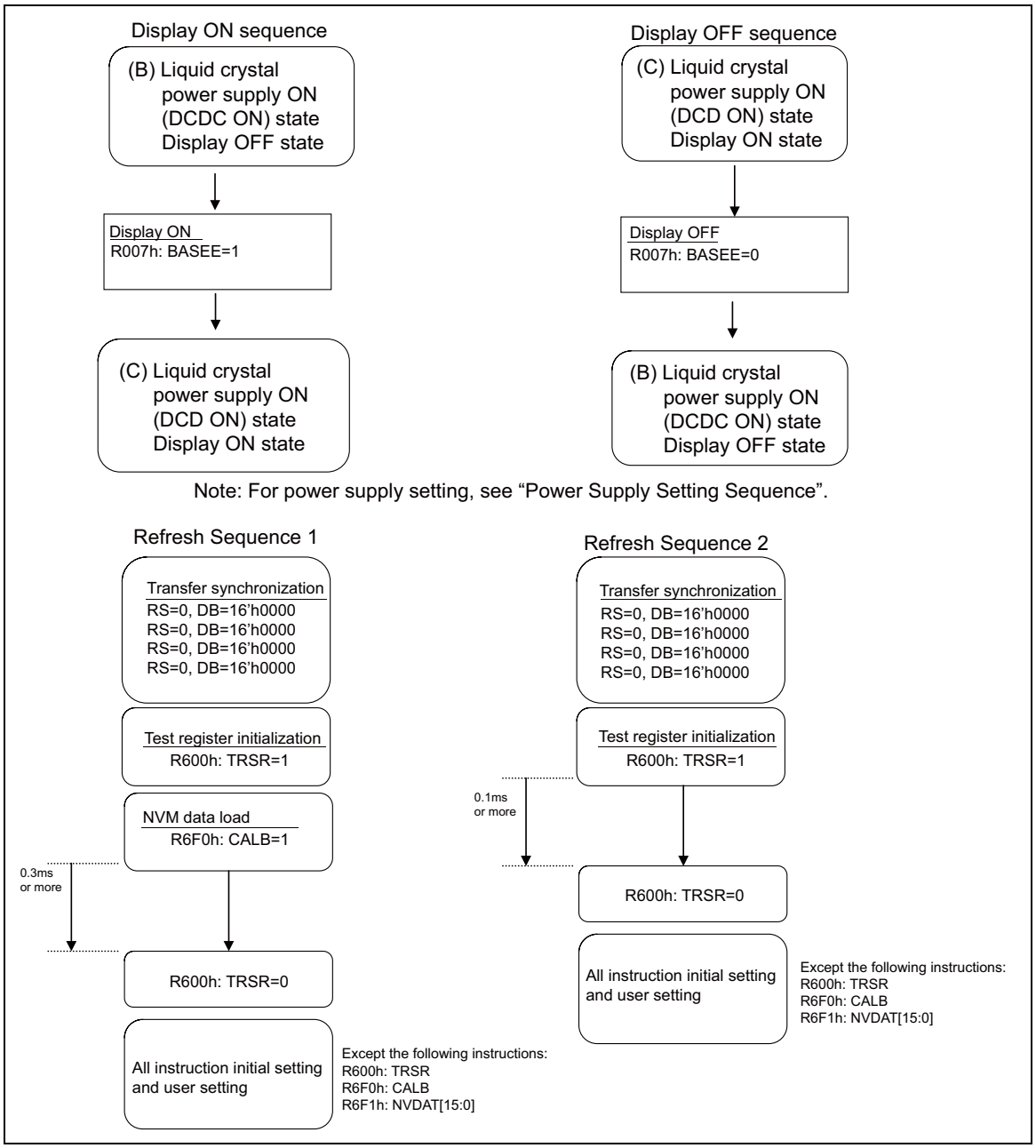
(b) Read from GRAM



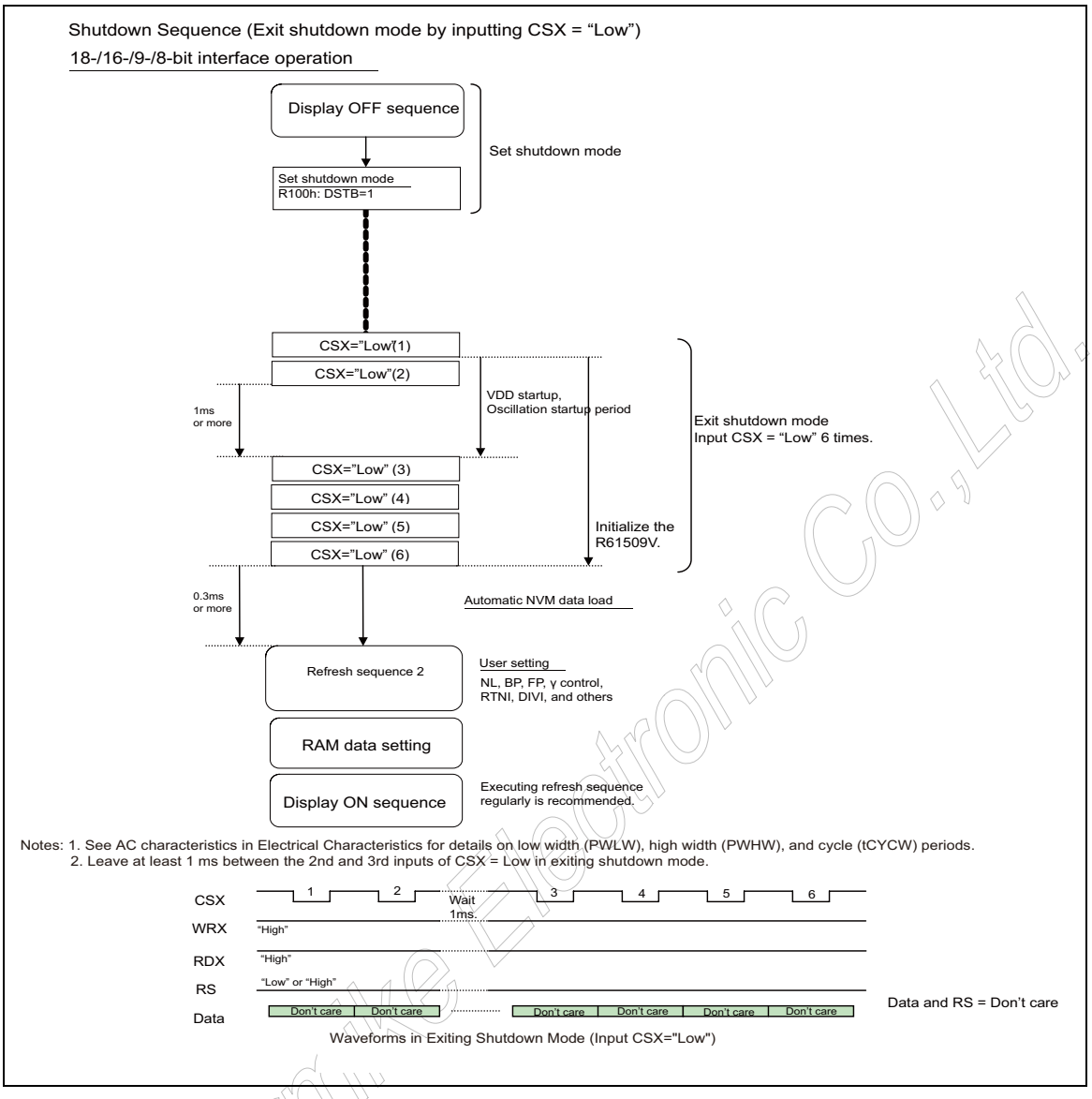
9.8.2. GRAM Data Read Back Flow Chart



9.9.Display ON/OFF Sequence



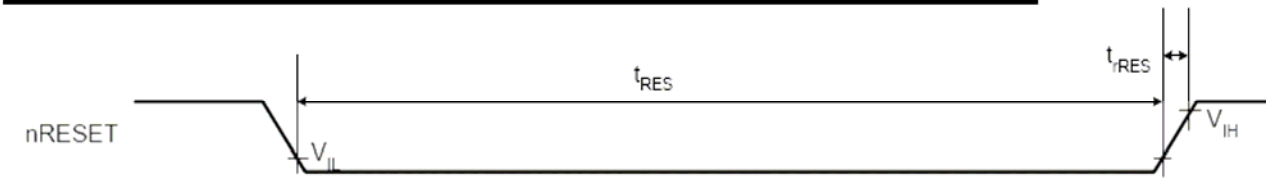
9.10.Standby and Sleep Mode



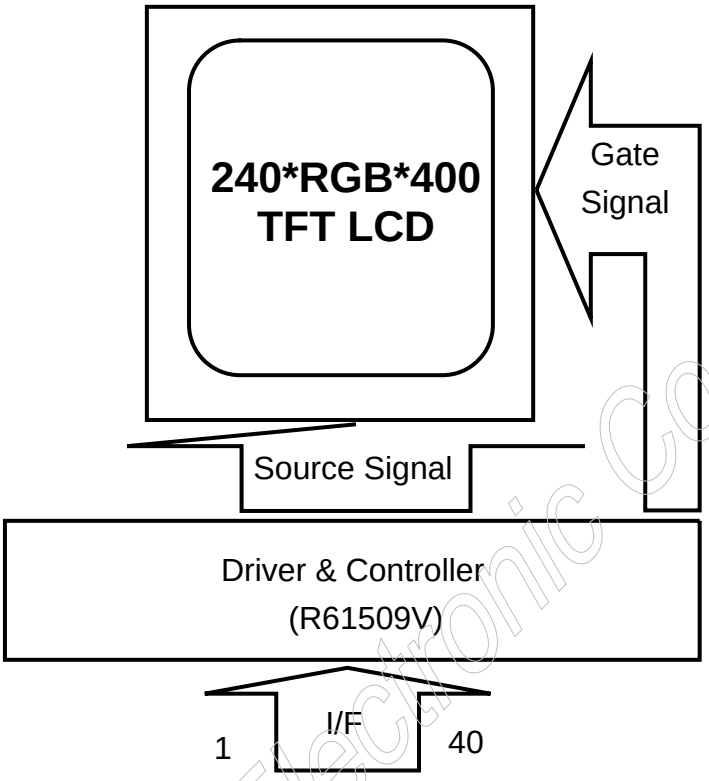
9.11.Reset Timing Characteristics

Reset Timing Characteristics (VCC = 1.8 ~ 3.3 V, IOVCC = 1.65 ~ 3.3 V)

Item	Symbol	Unit	Min.	Typ.	Max.
Reset low-level width	t_{RES}	ms	1	-	-
Reset rise time	t_{rRES}	μs	-	-	10



9.12.Block diagram of LCD



10.ELECTRO-OPTICAL CHARACTERISTICS

10.1.Optical characteristics

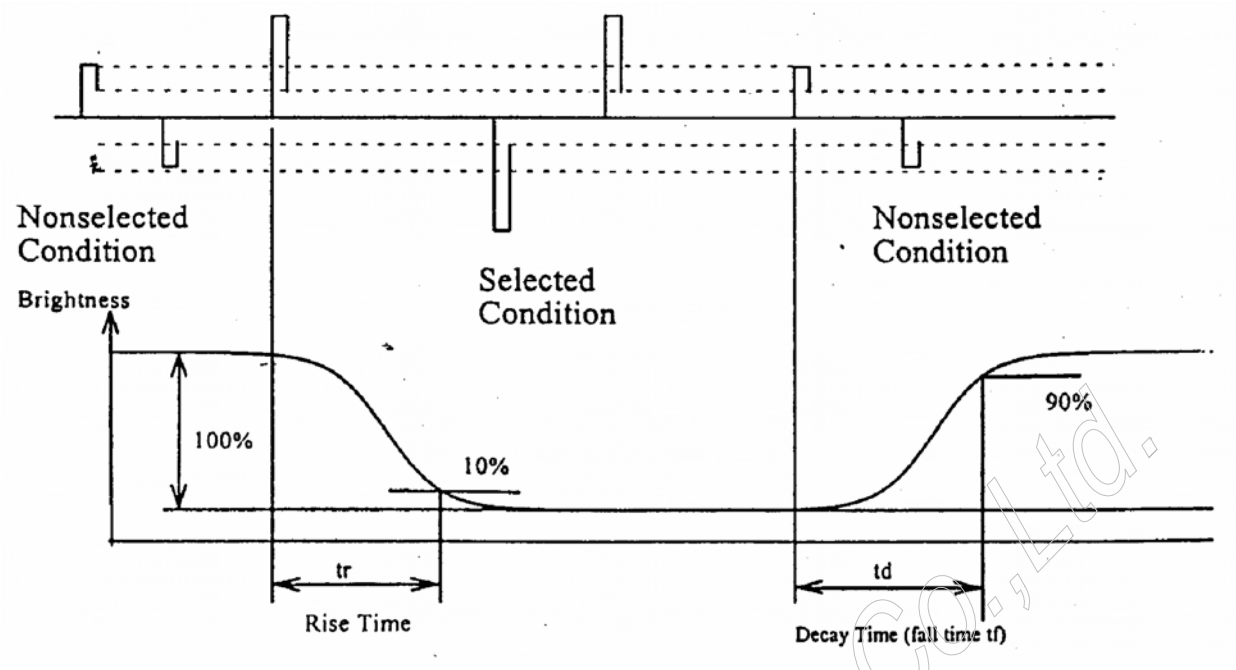
LED backlight transmissive module:

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit	Conditions
Response time	Tr	25℃	-	10	20	ms	θ=0°, ϕ=0°
	Tf	25℃	-	20	30	ms	(Note 2)
Contrast ratio	CR	25℃	-	(450)	-	-	θ=0°, ϕ=0° LED:ON,LIGHT:OFF (Note 3)
Visual angle range front and rear	θ	25℃	(Θ Upper)55 (Θ Lower)65			Degree	Note 2
Visual angle range left and right	ϕ	25℃	(ϕ Right)65 (ϕ Left)65			Degree	Note 2
Visual angle direction priority			12”				(Note4)
Brightness				(350)	-	Cd/㎡	I_{LED}=20mA full White pattern

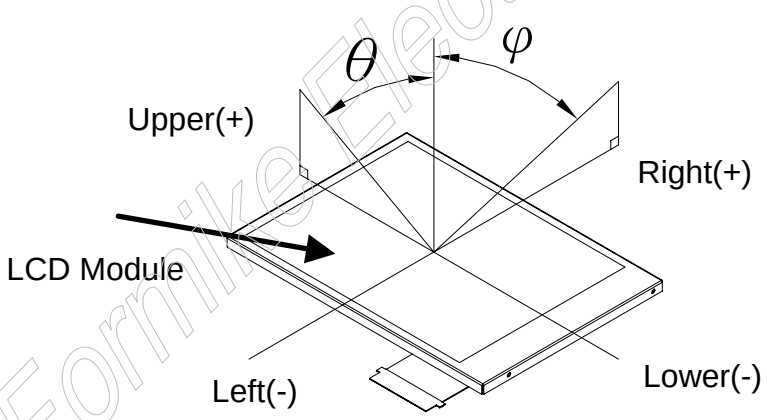
10.2.CIE(x, y) chromaticity

Item	Symbol	Transmissive			Conditions
		Min.	Typ.	Max.	
Red	X	---	(0.31)	---	θ=0°, ϕ=0°
	y	---	(0.32)	---	
Green	X	---	(0.63)	---	θ=0°, ϕ=0°
	y	---	(0.35)	---	
Blue	X	---	(0.37)	---	θ=0°, ϕ=0°
	y	---	(0.56)	---	
White	X	---	(0.15)	---	θ=0°, ϕ=0°
	y	---	(0.09)	---	

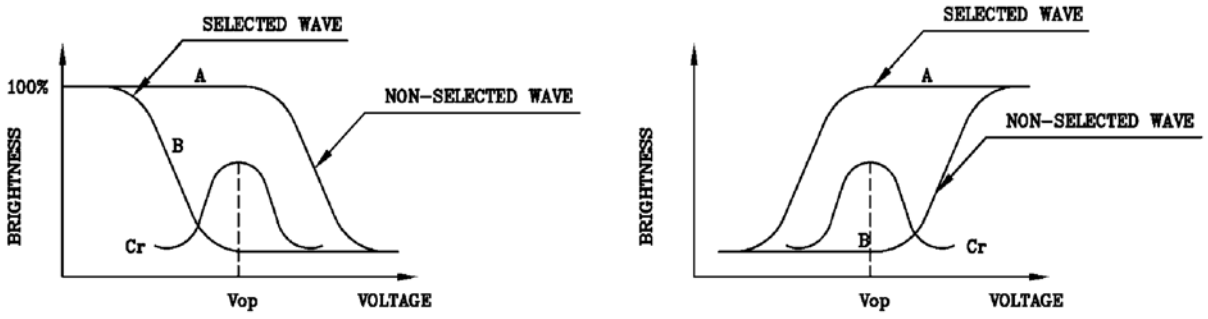
NOTE 1: Response time definition



NOTE 2 : ϕ 、θ definition



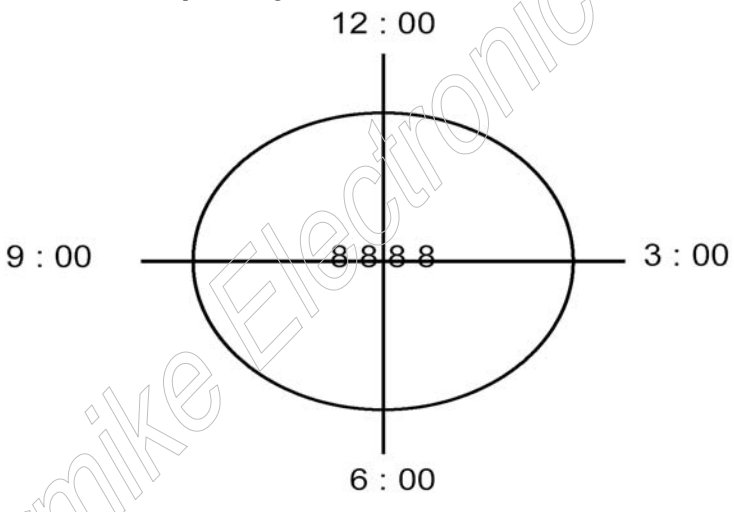
NOTE 3: Contrast Definition



(positive type) (negative type)

Contrast Ratio : Cr=A/B

NOTE 4: Visual angle direction priority



11.RELIABILITY

11.1.MTTF

The LCD module shall be designed to meet a minimum MTTF value of 50,000 hours with normal condition. (25°C in the room without sunlight; not include lifetime of backlight and Touch Panel).

11.2.Tests

NO.	ITEM	CONDITION	CRITERION
1	High Temperature Operating	+70℃ 240 hrs	◦ No defect of operational function in room temperature are allowable. ◦ Leakage current should be below double of initial value.
2	Low Temperature Operating	-20℃ 240 hrs	
3	High Temperature Non-Operating	+80℃ 240 hrs	
4	Low Temperature Non-Operating	-30℃ 240 hrs	
5	High Temperature/ Humidity Non-Operating	60℃；90%RH；240 hrs	
6	Temperature Shock Operating	-20℃ ◄→ 70℃ (30min) (5min) (30min) 50CYCLES	
7	Electro-static Discharge	HBM：±2kv	

Note 1: Test after 24 hours in room temperature.
Note 2: The sampling above is individually for each reliability testing condition.
Note 3: The color fading of polarizing filter should not care.
Note 4: All of the reliability testing chamber above, is using D.I. water.(Min value:1.0 MΩ-cm)
Note 5: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

11.3.Color Performance

No.	ITEM	Criterion (initial)
1	Luminance	>50%
2	NTSC	>70%
3	Contrast Ratio	>50%

12.INSPECTION CRITERIA

12.1.Inspection Conditions

12.1.1.Environmental conditions

The environmental conditions for inspection shall be as follows

Room temperature: 23±5°C

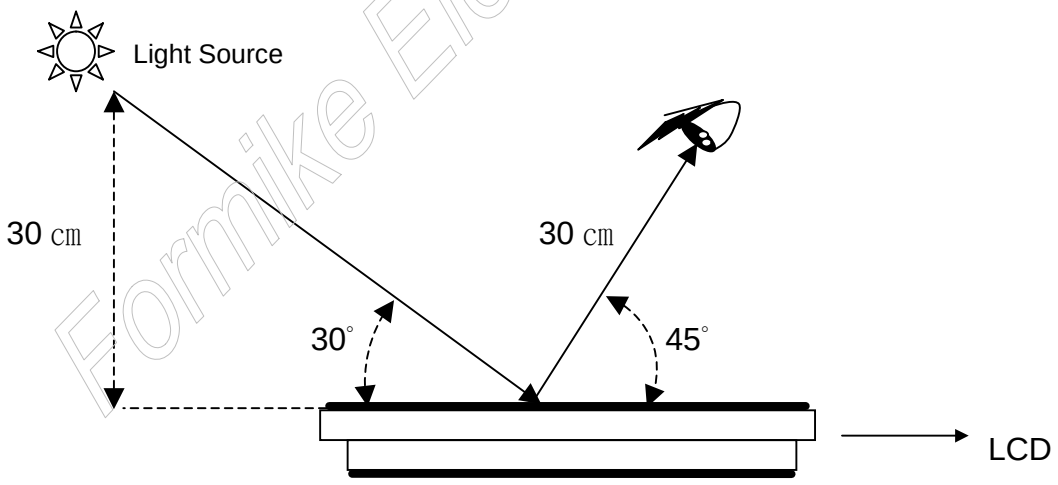
Humidity: 50±20%RH

12.1.2.The external visual inspection

With 1000±200 lux fluorescent lamp as the light source, the inspection was in the distance of 30cm or more from the LCD to the inspector's eyes .

12.2.Light Method

1. Inspection is implemented over 30cm vertical distance and 30° incidence under 1000±200 lux. (As showed below)
2. Viewing direction for inspection over 30㎝ far and is 45° against from LCD (As showed below)



12.3.Classification Of Defects

12.3.1.Major defect

A major defect refers to a defect that may substantially degrade usability for product

applications.

12.3.2.Minor defect

A minor defect refers to a defect which is not considered to be able substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

Notes: If the LCD/LCM's cosmetic and display performance do not specify in "inspection criterion", it should be based on these delivered samples.

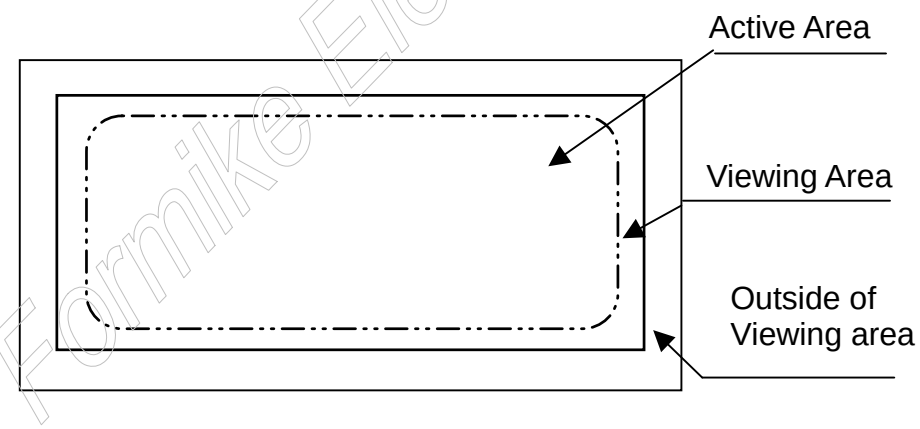
12.4.Sampling & Acceptable Quality Level

Inspection Item	Major defect	Minor defect
Cosmetic	1.0%	1.5%
Electrical test	0.4%	0.65%

12.5.Definition Of Inspection Area

V.A: Viewing Area

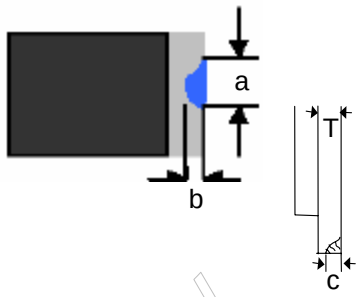
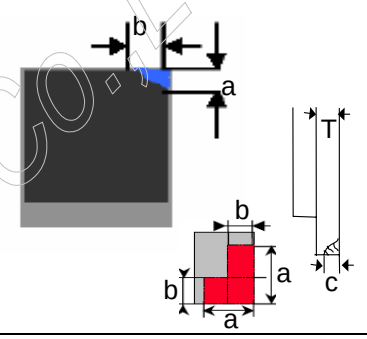
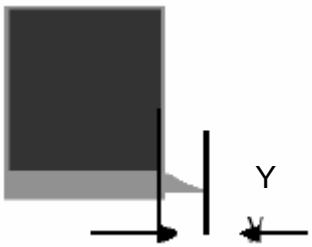
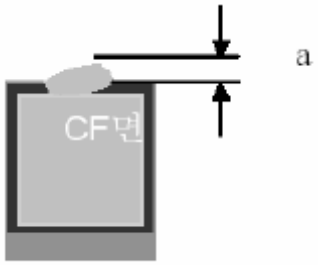
A.A: Active Area



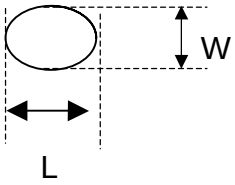
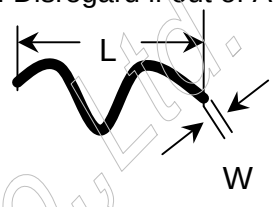
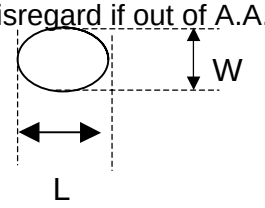
12.6.Items and Criteria

12.6.1.Visual inspection criterion in cosmetic

Glass defect			
No	Item	Criteria	Remark

Glass defect			
No	Item	Criteria	Remark
1	Glass Chipping (All Glass Edge) (Minor)	1.c<T 1). b<0.2mm, a Ignore, N Ignore 2). 0.2mm≦b<1.0mm , a>3.0mm, N≦1, a<3.0mm, N≦3 2. Damage to cause sealant outflow 【Reject】 3.Damage to exceed alignment Mark 【Reject】	
2	Glass Chipping (All Glass Corner) (Minor)	1.c<T a≦3.0mm and b≦1.0mm 2.c=T a≦2.0mm and b≦2.0mm 3.Damage to exceed alignment Mark 【Reject】	
3	Glass burr (Minor)	y ≦ 0.2 mm	
4	End Seal (Minor)	a ≦ 1.0 mm	

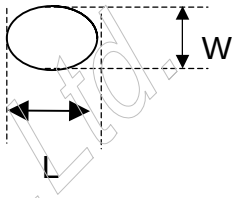
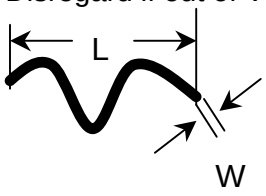
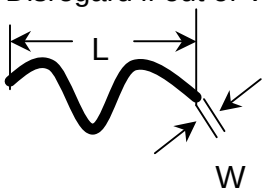
LCD appearance defect				
No	Item	Criteria		Remark
1	Dirty Spots, Round	Defect Spec.	Permissible Q'ty	1: ϕ =(L+W)/2, L: Length, W:

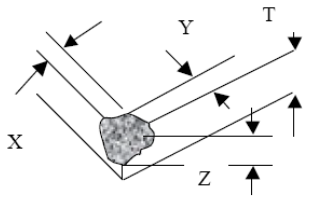
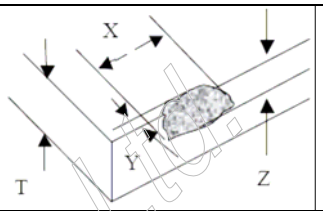
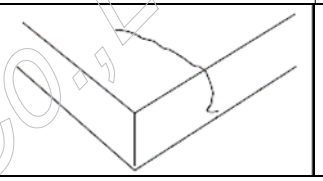
LCD appearance defect				
	type (Minor)	$\phi \leqq 0.1$mm	Disregard	Width 2: Disregard if out of A.A. 
		0.1mm< $\phi \leqq 0.3$mm	2	
		$\phi > 0.3$mm	0	
2	Fiber, Scratches (Minor)	Defect Spec.	Permissible Q'ty	1: L: Length, W: Width 2: Disregard if out of A.A. 
		L≦5.0mm, W≦0.03mm	Disregard	
		L≦2.0mm, W≦0.1mm	2	
		L＞2.0mm, W＞0.1mm	0	
3	Polarizer bubble (Minor)	Defect Spec.	Permissible Q'ty	1: ϕ =(L+W)/2, L: Length, W: Width 2: Disregard if out of A.A. 
		$\phi \leqq 0.1$mm	Disregard	
		0.1mm< $\phi \leqq 0.3$mm	2	
		0.3mm< ϕ	0	

FPC				
No	Item	Criteria		Remark
1	Copper peeling (Minor)	Copper peeling 【Reject】		
2	No release film or Peeling (Minor)	No release film or peeling 【Reject】		
3	Finger Spots, Impurities defect (Minor)	Defect Spec.	Permissible Q'ty	1. No bridge 2. Disregard if the dirty removed
		$\phi \leqq 0.35$mm	2	
		ϕ >0.35mm	0	

Silicon			
No	Item	Criteria	Remark

Silicon			
1	Amount of silicon (Minor)	ITO exposed 【Reject】	

Touch Panel				
No	Item	Criteria		Remark
1	Dirty Spots, Round type (Minor)	Defect Spec.	Permissible Q'ty	1: ϕ=(L+W)/2, L: Length, W: Width 2: Disregard if out of V.A. 
		$\phi \leqq 0.4$mm	Disregard	
		$\phi > 0.4$mm	0	
2	Line defect (Minor)	Defect Spec.	Permissible Q'ty	1: L: Length, W: Width 2: Disregard if out of V.A. 
		L≦5.0mm,W≦0.03mm	Disregard	
		L≦2.0mm, W≦0.1mm	2	
		L>2.0mm, W>0.1mm	0	
3	Scratches (Minor)	Defect Spec.	Permissible Q'ty	1: L: Length, W: Width 2: Disregard if out of V.A. 
		L<10mm, W<0.05mm	Disregard	
		L<10mm, 0.05mm≦W≦0.10mm	4	
		0.10mm<W	0	
4	Fog Spots defect (Minor)	Defect Spec.	Permissible Q'ty	Judging by 45° Inspection
		$\phi \leqq 0.7$mm	Disregard	
		$\phi > 0.7$mm	0	
5	Fog Line defect (Minor)	Defect Spec.	Permissible Q'ty	Judging by 45° Inspection
		L≦10mm or W≦3.0mm	Disregard	
		L>10mm and W>3mm	0	
6	Concave (Minor)	By limit sample		

Touch Panel			
7	Raised (Minor)	By limit sample	
8	Corner chip (Minor)	X≦1.5mm, Y≦1.5mm,Z≦T	
9	Edge chip (Minor)	X≦3.0mm, Y≦1.5mm,Z≦T	
10	Crack (Minor)	Not allowed	
11	Newton's ring (Minor)	Invisible under daylight	

Bezel			
No	Defect	Criteria	Remark
1	Oxidized spot (Minor)	Oxidized spot, rust 【Reject】	
2	Outline deformation (Minor)	By engineering diagram	
3	Greasiness (Minor)	Greasiness 【Reject】	
4	Spots, round Type (Minor)	H≦By engineering diagram 【Disregard】	H=Total height (thickness)
5	Plating (Minor)	Bubble, peeling 【Reject】	

Electrical test within V.A.			
No	Item	Criteria	Remark

Electrical test within V.A.				
1	Open, Short (Major)	Not allowable		
2	No display (Major)	Not allowable		
3	Darker or lighter line (Minor)	Darker or lighter line 【Reject】		Judging by ND filter 2%
4	Flicker of pattern (Major)	Not allowable		
5	High current (Major)	Current consumption exceeds product spec. 【Reject】		
6	High voltage (Major)	Voltage exceeds product spec. 【Reject】		
7	Mura (Minor)	By limit sample		Judging by ND filter 2%
8	Point defect (Major)	Bright dot	N≦1	1: 1dot= 1R or 1G or 1B 2: 2 or more dots in adjacent are not allowed
		Dark dot	N≦3	
		Total dot defect (Bright dot+ Dark dot)	N≦3	
		Minimum distance between dark dot and dark dot	L≧5 mm	
9	Noise display (Major)	Not allowable		
10	Flicker of back light (Major)	Not allowable		

13.RoHS COMPLIANT WARRANTY

RoHs Hazardous substances including:

- Cd< 100 ppm
- Pb< 1000 ppm
- Hg< 1000 ppm
- Cr +6 < 1000 ppm
- PBDE < 1000 ppm
- PBB < 1000 ppm

14.PRECAUTIONS FOR USE

14.1.Safety

(1) Do not swallow any liquid crystal, even if there is no proof that liquid crystal is poisonous.
(2) If the LCD panel breaks, be careful not to get liquid crystal to touch your skin.
(3) If skin is exposed to liquid crystal, wash the area thoroughly with alcohol or soap.

14.2.Storage Conditions

(1) Store the panel or module in a dark place where the temperature is 23±5°C and the humidity is below 50±20%RH.
(2) Store in anti-static electricity container.
(3) Store in clean environment, free from dust, active gas, and solvent.
(4) Do not place the module near organics solvents or corrosive gases.
(5) Do not crush, shake, or jolt the module.
(6) Do not exposed to direct sun light of fluorescent lamps.

14.3.Installing LCD Module

Attend to the following items when installing the LCM.
(1) Cover the surface with a transparent protective plate or touch panel to protect the polarizer and LC cell.
(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

14.4.Precautions For Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (Vo). Adjust Vo to show the best contrast.
(2) Driving the LCD in the voltage above the limit will shorten its lifetime.
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
(4) When turning the power on, input each signal after the positive/negative voltage becomes stable.
(5) Do not apply water or any liquid on product which composed of T/P.

14.5.Handling Precautions

(1) Avoid static electricity which can damage the CMOS LSI; please wear the wrist strap when handling.
(2) The polarizing plate of the display is very fragile. so, please handle it very carefully.
(3) Do not give external shock.
(4) Do not apply excessive force on the surface; it may cause display abnormal .
(5) Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
(6) Do not use ketonics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.
(7) Do not operate it above the absolute maximum rating.
(8) Do not remove the panel or frame from the module.
(9) Do not apply water or any liquid on product, which composed of T/P.

14.6.Warranty

(1) The period is within 12 months since the date of shipping out under normal using and storage conditions.
(2) The warranty will be avoided in case of defect induced by customer.