



DATA IMAGE CORPORATION

TFT Module Specification Preliminary

ITEM NO.: **FG0305H0DSSWMG01**

Table of Contents

1. COVER & CONTENTS	1
2. RECORD OF REVISION	2
3. GENERAL SPECIFICATIONS	3
4. ABSOLUTE MAXIMUM RATINGS	3
5. ELECTRICAL CHARACTERISTICS	4
6. OPTICAL CHARACTERISTICS.....	11
7. PIN CONNECTIONS	14
8. BLOCK DIAGRAM	17
9. INTERFACE.....	18
10. QUALITY ASSURANCE	21
11. LCM PRODUCT LABEL DEFINE	22
12. PRECAUTIONS IN USE LCM	24
13. OUTLINE DRAWING	25
14. PACKAGE INFORMATION.....	26

Customer Companies	R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
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	1	2011/Jul/27		26

2. RECORD OF REVISION

Rev	Date	Item	Page	Comment
1	27/Jul/11'			Initial Release

3. GENERAL SPECIFICATIONS

The FG0305H0DSSWMG01 is a kind of transmissive TFT, active matrix color liquid crystal display (LCD) comprising an amorphous silicon TFT attached to each signal electrode. The resolution of a 3.5" contains 480(RGB)x800 pixels and can display up to 16.7M colors.

This module supports several interface modes,

.MPU mode

MIPI-DBI Type B (80 System) interface (16 / 18 / 24 bit bus)

.DPI (RGB) mode

16 bit/pixel R(5), G(6), B(5)

18 bit/pixel R(6), G(6), B(6)

24 bit/pixel R(8), G(8), B(8)

The interface mode is selected by the external hardware pins **BS1~0** and internal registers.

Parameter		Specifications	Unit
Screen Size		3.5diagonal	inch
Pixel configuration		RGB Stripe	
Display Format		480(RGB) X 800	Dot
Active Area		45.36x75.6	mm
Pixel Size		94.5 X 94.5	um
Outline Dimension		86.8 X50.76X2.7	mm
Viewing direction		Free	
Weight		TBD	g
Temperature Range	Operation	-20~70	°C
	Storage	-30~80	°C

4. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	MIN.	Typ.	MAX.	Unit	Comment
Power supply Voltage	VDDIO	-0.3		3.6	V	Notes 1,2
Power supply Voltage	VCC	-0.3		5.5	V	Notes 1,2

Notes:

1. If the LSI is used above these absolute maximum ratings, it may become permanently damaged.
Using the LSI within the following electrical characteristics limit is strongly recommended for normal operation.
If these electrical characteristic conditions are also exceeded, the LSI will malfunction and cause poor reliability.
2. VDDIO,VCC, GND must be maintained.

5. ELECTRICAL CHARACTERISTICS

5.1.1 DC CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power Supply Voltage	VCC		2.3	3.0	3.3	V
	VDDIO	--	1.65	1.8	VCC	V
Input high voltage	VIH	VDDIO=1.65V~3.3V	0.7VDDIO	--	VDDIO	V
Input low voltage	VIL	VCC=2.3V~3.3V	0	--	0.3VDDIO	V
output high voltage (Note)	VOH		0.8VDDIO	--	VDDIO	V
output low voltage (Note)	VOL		0	--	0.2VDDIO	V
Current consumption	ICC	VCC=3.0V	--	TBD		mA
	IVDDIO	VDDIO=1.8V		TBD		uA

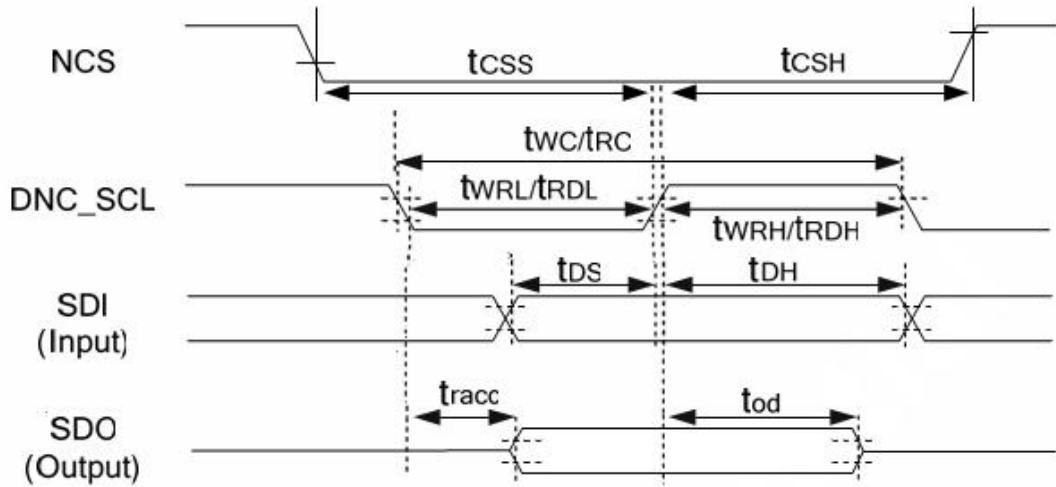
Note: SDO、LED_PWM

5.1.2 BACKLIGHT CHARACETRISTIC

Item	Symbol	Min.	Typical	Max.	Unit
LED module Forward voltage	VLED	--	21.7	--	V
LED module current	ILED	--	20	--	mA

5.2. AC Characteristics

5.2.1. Serial interface characteristic

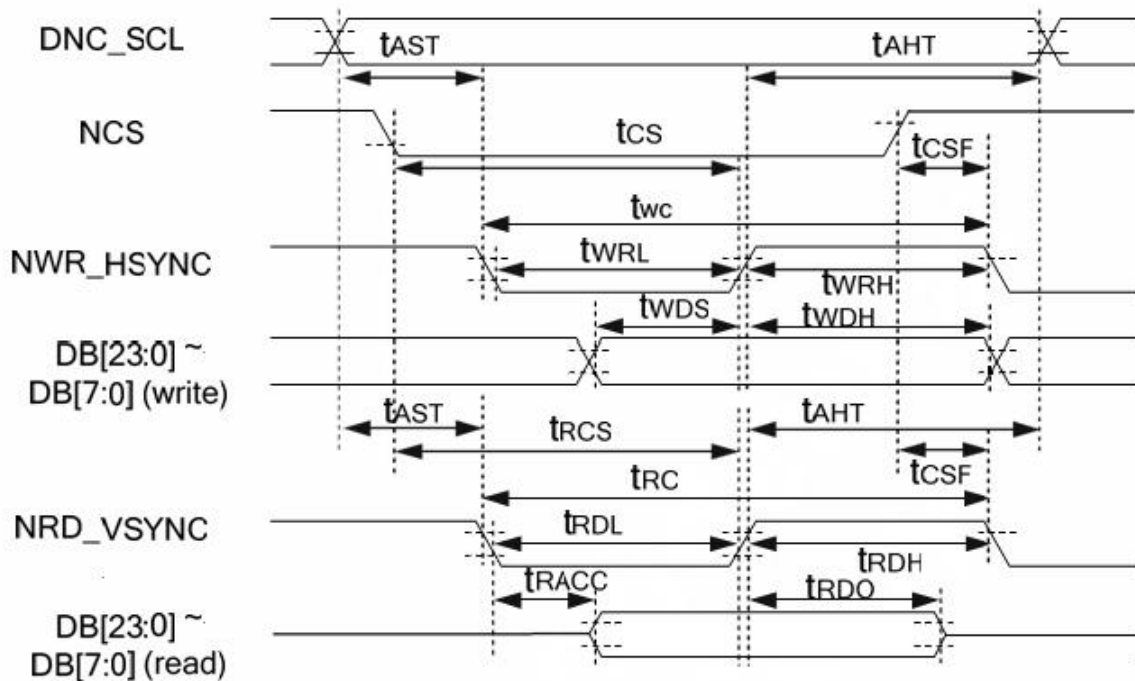


(GND=0V, VDDIO=1.8V, VCC=2.8V, T_A = 25°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
NCS	t_{CSS}	Chip select setup time (Write)	TBD		ns	
	t_{CSH}	Chip select setup time (Read)	TBD			
DNC_SCL (Write)	t_{WC}	Write cycle	TBD		ns	
	t_{WRH}	Control pulse "H" duration	TBD			
	t_{WRL}	Control pulse "L" duration	TBD			
DNC_SCL (Read)	t_{RC}	Read cycle	TBD		ns	
	t_{RDH}	Control pulse "H" duration	TBD			
	t_{RDL}	Control pulse "L" duration	TBD			
SDI (Input)	t_{DS}	Data setup time	TBD		ns	For maximum C _L =30pF For minimum C _L =8pF
	t_{DH}	Data hold time	TBD			
SDO (Output)	t_{RACC}	Read access time	TBD		ns	
	t_{OD}	Output disable time	TBD			

Note: The input signal rise time and fall time (t_r , t_f) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of VDDIO for Input signals.

5.2.2. DBI Type B interface characteristics

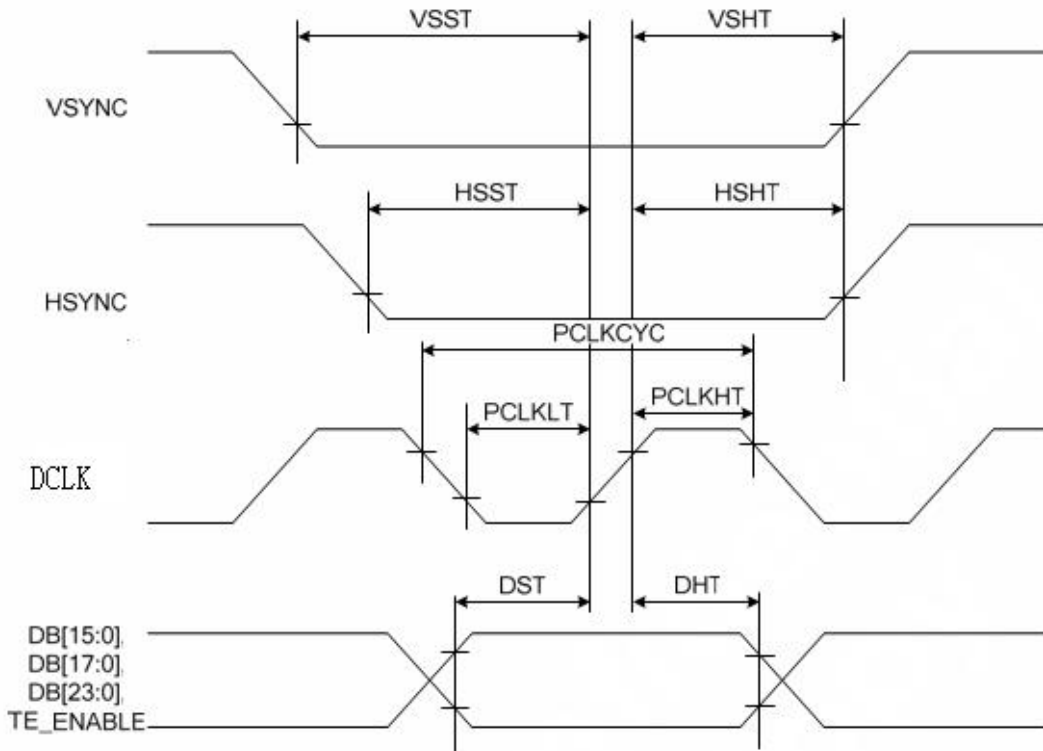


(GND=0V, VDDIO=1.8V, VCC=2.8V, TA=25°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DNC_SCL	tAST	Address setup time	TBD		ns	
	tAHT	Address hold time (Write/Read)	TBD			
NCS	tCS	Chip select setup time (Write)	TBD		ns	
	tRCS	Chip select setup time (Read ID)	TBD			
	tRCSFM	Chip Select setup time (Read FM)	TBD			
	tCSF	Chip select wait time (Write/Read)	TBD			
NWR_HSYNC	tWC	Write cycle (write register)	TBD	TBD	ns	
	tWC	Write cycle (write GRAM@SLPOUT)	TBD	TBD		
	tWC	Write cycle (write GRAM@SLPIN)	TBD	TBD		
	tWRH	Control pulse "H" duration	TBD	TBD		
	tWRL	Control pulse "L" duration	TBD	TBD		
NRD_VSYNC	tRC	Read cycle (read register)	TBD	TBD	ns	For maximum CL=30pF For minimum CL=8pF
	tRC	Read cycle (GRAM)	TBD	TBD		
	tRDH	Control pulse "H" duration	TBD	TBD		
	tRDH	Control pulse "L" duration	TBD	TBD		
DB23-DB0	tWDS	Data setup time	TBD		ns	
	tWDH	Data hold time	TBD			
	tRACC	Read access time	TBD			
	tRDO	Output disable time	TBD			

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of VDDIO for Input signals.

5.2.3. DPI interface characteristics

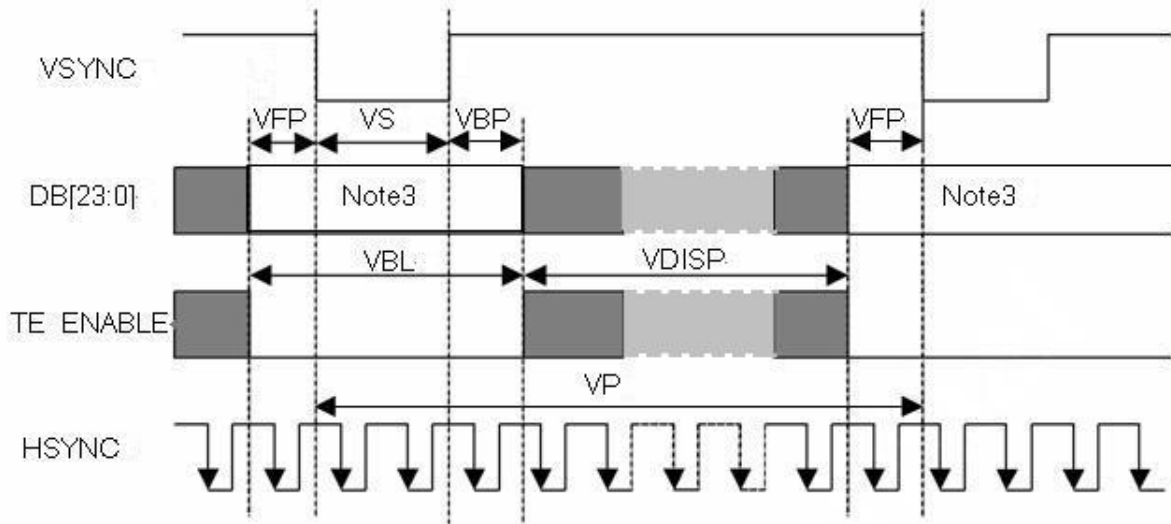


Resolution=480x800 (GND=0V, VDDIO=1.8V, VCC=2.8V, TA=25°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical sync. setup time	VSST		TBD			ns
Vertical sync. hold time	VSHT		TBD			ns
Horizontal sync. setup time	HSST		TBD			ns
Horizontal sync. hold time	HSHT		TBD			ns
Pixel clock cycle when RGB I/F is running	PCLKCYC	VRR ⁽⁵⁾ = Min . 50 Hz Max. 70 Hz	TBD (Note 3)		TBD (Note 4)	ns
Pixel clock low time	PCLKLT		TBD			ns
Pixel clock high time	PCLKHT		TBD			ns
Data setup time DB[23:0]	DST		TBD			ns
Data hold time DB[23:0]	DHT		TBD			ns

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.
(2) Input signals are measured by 0.30 x VDDIO for low state and 0.70 x VDDIO for high state.
(3) 32.2 MHz
(4) 20.3 MHz
(5) VRR : Vertical Refresh Rate, equal to VSYNC frequency.

Vertical Timings for RGB I/F

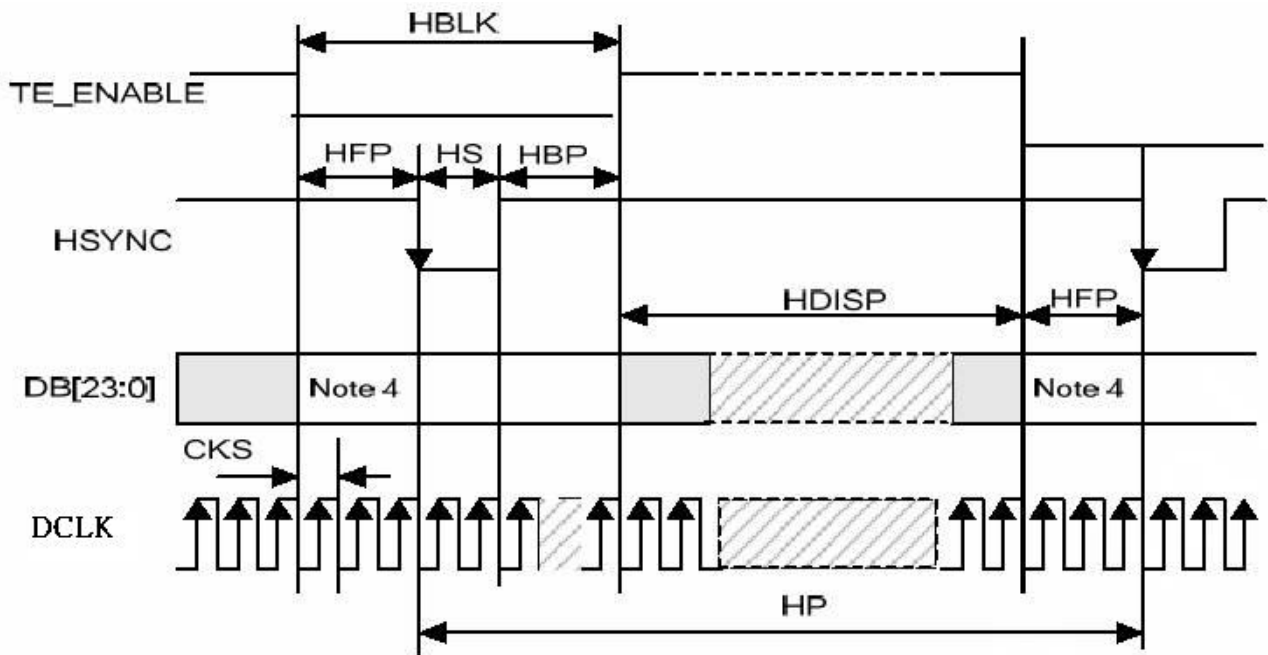


Resolution=480x800 (GND=0V, VDDIO=1.8V, VCC=2.8V, TA=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical cycle	VP		TBD		TBD	Line
Vertical low pulse width	VS		TBD		TBD	Line
Vertical front porch	VFP		TBD		TBD	Line
Vertical back porch	VBP		TBD		TBD	Line
Vertical data start point		VS+VBP	TBD		TBD	Line
Vertical blanking period	VBL	VS+VBP+VFP	TBD		TBD	Line
Vertical active area		VDISP		TBD		Line
Vertical Refresh rate	VRR		TBD		TBD	Hz

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.
(2) Input signals are measured by 0.30 x VDDIO for low state and 0.70 x VDDIO for high state.
(3) Data lines can be set to "High" or "Low" during blanking time – Don't care.
(4) VRR must keep from 50Hz to 70Hz when adjust other items

Horizontal Timings for RGB I/F

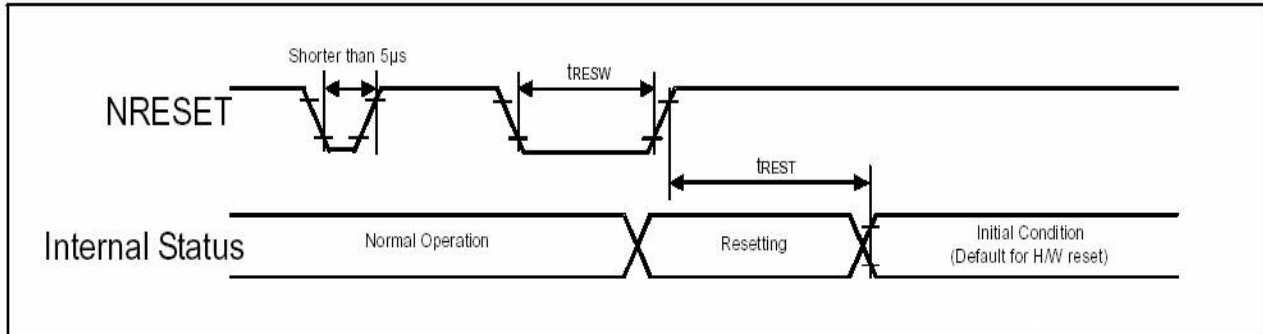


Resolution=480x800 (GND=0V, VDDIO=1.8V, VCC=2.8V, TA=25°C)

Item	Symbol	Condition	Min	Typ.	Max.	Unit
HS cycle	HP	Note 3	TBD		TBD	CKS
HS low pulse width	HS		TBD		TBD	CKS
Horizontal back porch	HBP		TBD		TBD	CKS
Horizontal front porch	HFP		TBD		TBD	CKS
Horizontal data start point		HS+HBP	TBD		TBD	CKS
Horizontal blanking period	HBLK	HS+HBP+HFP	TBD		TBD	CKS
Horizontal active area	HDISP			TBD		CKS
Pixel clock frequency	CKS	VRR = Min. 50 Hz	TBD		TBD	MHz
When RGB I/F is running		- Max. 70 Hz	TBD		TBD	ns

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.
 (2) Input signals are measured by 0.30 x VDDIO for low state and 0.70 x VDDIO for high state.
 (3) HP is multiples of eight CKS.
 (4) Data lines can be set to "High" or "Low" during blanking time – Don't care.
 (5) VRR must keep from 50Hz to 70Hz when adjust other items

5.2.4 Reset Input Timing



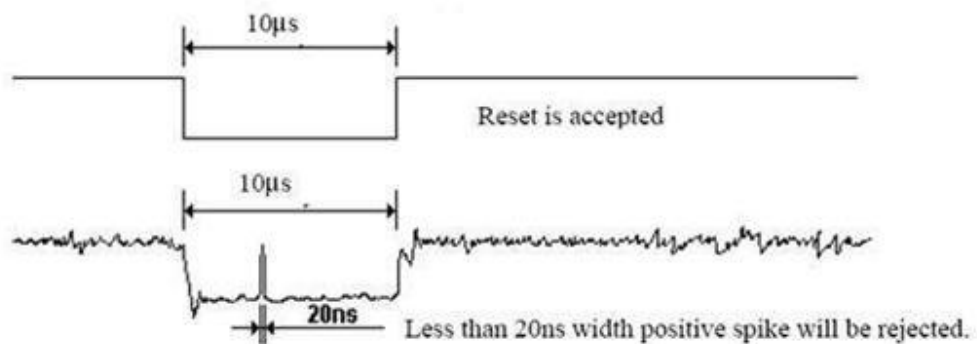
Symbol	Parameter	Related pins	Min.	Typ.	Max.	Note	Unit
tRESW	Reset low pulse width ⁽¹⁾	NRESET	10				µs
tREST	Reset complete time ⁽²⁾		5			When reset is applied during Sleep In mode	ms
			120			When reset is applied during Sleep Out mode	ms

Note: 1. Spike due to an electrostatic discharge on NRESET line does not cause irregular system reset according to the table below.

NRESET Pulse	Action
Shorter than 5 µs	Reset Rejected
Longer than 10 µs	Reset
Between 5 µs and 10 µs	Reset Start

2. During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then returns to Default condition for H/W reset.

3. Spike Rejection also applies during a valid reset pulse as shown below:



4. When Reset is applied during Sleep In Mode.
5. When Reset is applied during Sleep Out Mode.
6. It is necessary to wait 5msec after releasing NRESET before sending commands. Also Sleep Out command cannot be sent for 120msec.

6. OPTICAL CHARACTERISTICS

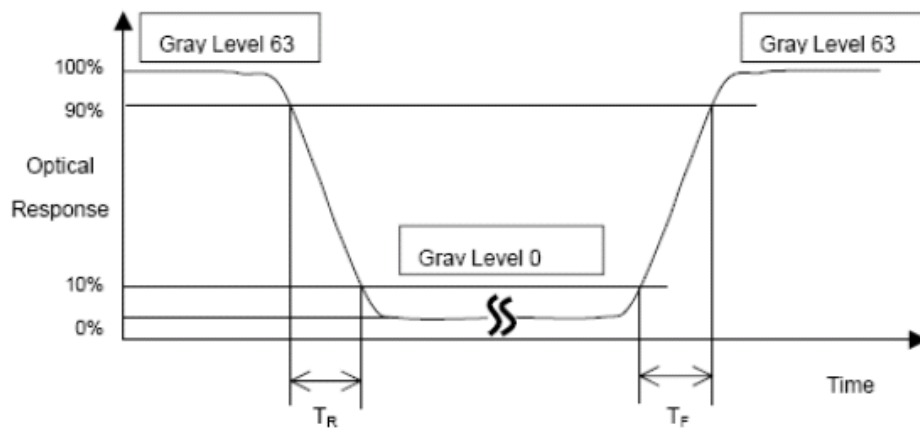
Item	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Brightness	B	Center point	240	300		Cd/m ²	Note: 4,5
Contrast Ratio	CR	Viewing normal Angel $\theta_x = \theta_y = 0^\circ$		500			Note: 1,4
Response Time	TR+TF			30		ms	Note: 2
Chromaticity	Red		XR	Typ- 0.05	TBD	Typ+ 0.05	
		YR	TBD				
	Green	XG	TBD				
		YG	TBD				
	Blue	XB	TBD				
		YB	TBD				
	White	XW	TBD				
		YW	TBD				
Viewing Angle	Hor.	θ_{x+}		80		deg.	Note: 3,4
		θ_{x-}		80			
	Ver.	θ_{y+}		80			
		θ_{y-}		80			
Uniformity	B-uni		70	80		%	Note: 6

Note1: Definition of contrast ratio:

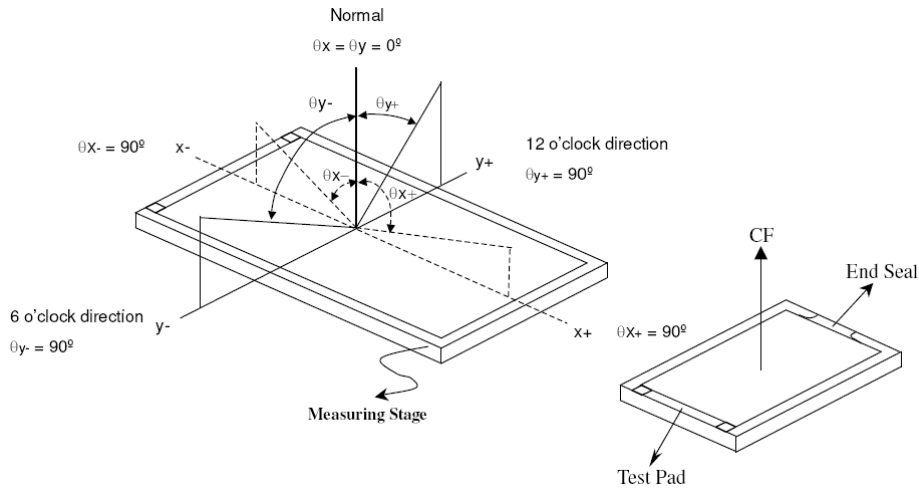
The contrast ratio is defined as following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 2: Definition of Response Time (TR,TF):

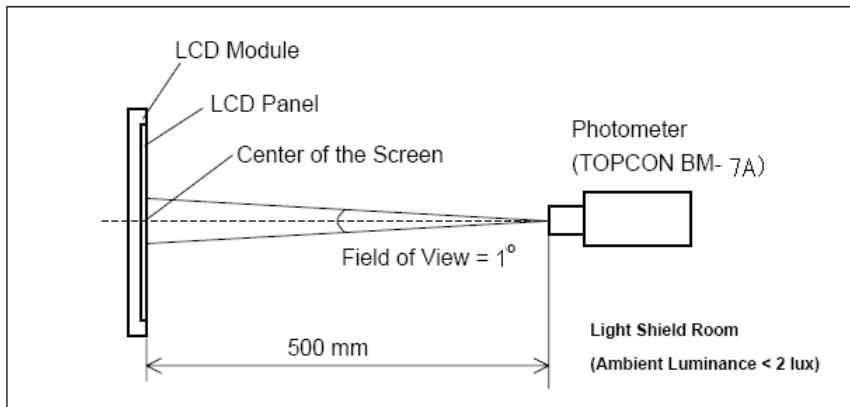


Note 3: Definition of Viewing Angle



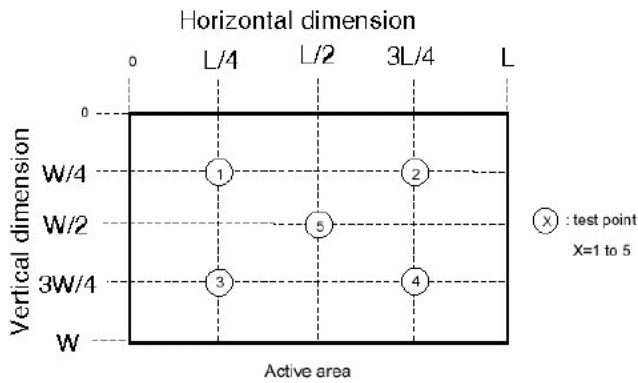
Note 4: Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 2-3 minutes in a windless room.



Note 5: Measured at the center area of the panel and at the viewing angle of the $\theta_x = \theta_y = 0^\circ$

Note 6: Definition of Brightness Uniformity (B-uni)



$$B\text{-uni} = \frac{\text{Minimum luminance of 5 points}}{\text{Maximum luminance of 5 points}}$$

7. PIN CONNECTIONS

PIN NO.	Symbol	Description	Remark
1	GND	Ground.	
2	VCC	Power supply for the main power.	
3	VCC		
4	VDDIO	Power supply for the I/O circuit.	
5	GND	Ground.	
6	B0 (DB0)	LCD Blue data bit0 ~ bit7.	NOTE 1
7	B1 (DB1)		
8	B2 (DB2)		
9	B3 (DB3)		
10	B4 (DB4)		
11	B5 (DB5)		
12	B6 (DB6)		
13	B7 (DB7)		
14	GND	Ground.	
15	G0 (DB8)	LCD Green data bit0 ~ bit7.	NOTE 1
16	G1 (DB9)		
17	G2 (DB10)		
18	G3 (DB11)		
19	G4 (DB12)		
20	G5 (DB13)		
21	G6 (DB14)		
22	G7 (DB15)		
23	GND	Ground.	
24	LED_PWM	Backlight On/Off control pin. If use CABC function, the pin can connect to external LED driver IC.	
25	BS0	Select the interface mode.	NOTE 2
26	BS1	Must be connected to GND or VDDIO.	
27	LEDK	Power supply for LED backlight (Cathode)	
28	GND	Ground.	
29	LEDA	Power supply for LED backlight (Anode)	
30	GND	Ground.	
31	VDDIO	A power supply for the I/O circuit.	
32	TE_ENABLE	A data ENABLE signal in RGB I/F mode.	

		Has to be fixed to GND level if not used.	
33	NWR_HSYNC	DBI Type-B: Serves as a write signal and write data at the low level. DPI: Line synchronizing signal. Must be connected to GND or VDDIO if not used.	
34	NRD_VSYNC	DBI Type-B: Serves as a read signal and read data at the low level. DPI: Frame synchronizing signal. Must be connected to GND or VDDIO if not used.	
35	DCLK	DPI: Dot clock signal. Must be connected to GND or VDDIO if not used.	
36	NCS	Chip select signal. Low: chip can be accessed; High: chip cannot be accessed. If this pin is not used, please connect it to GND or VDDIO.	
37	DNC_SCL	DBI Type-B: Data / Command Selection pin When operate in serial interface, it serves as SCL (Serial Clock) If not used, let it open or connected to VDDIO.	
38	SDI	Serial data input pin.	
39	SDO	Serial data output pin. Let it to open if not used.	
40	NRESET	Reset pin.	
41	GND	Ground.	
42	R0 (DB16)	LCD Red data bit0 ~ bit7.	NOTE 1
43	R1 (DB17)		
44	R2 (DB18)		
45	R3 (DB19)		
46	R4 (DB20)		
47	R5 (DB21)		
48	R6 (DB22)		
49	R7 (DB23)		
50	GND	Ground.	

NOTE 1:

RGB interface

Data bus	Used	Unused
16-bit bus	DB21~DB17 DB13~DB8 DB5~DB1	DB23~DB22, DB16~DB14, DB7~DB6, DB0
18-bit bus	DB21~DB16, DB13~DB8 DB5~DB0	DB23~DB22, DB15~DB14, DB7~DB6
24-bit bus	DB23~DB0	

DBI TYPE-B interface

Data bus	Used	Unused
16-bit bus	DB15~DB0	DB23~DB16
18-bit bus	DB17~DB0	DB23~DB18
24-bit bus	DB23~DB0	

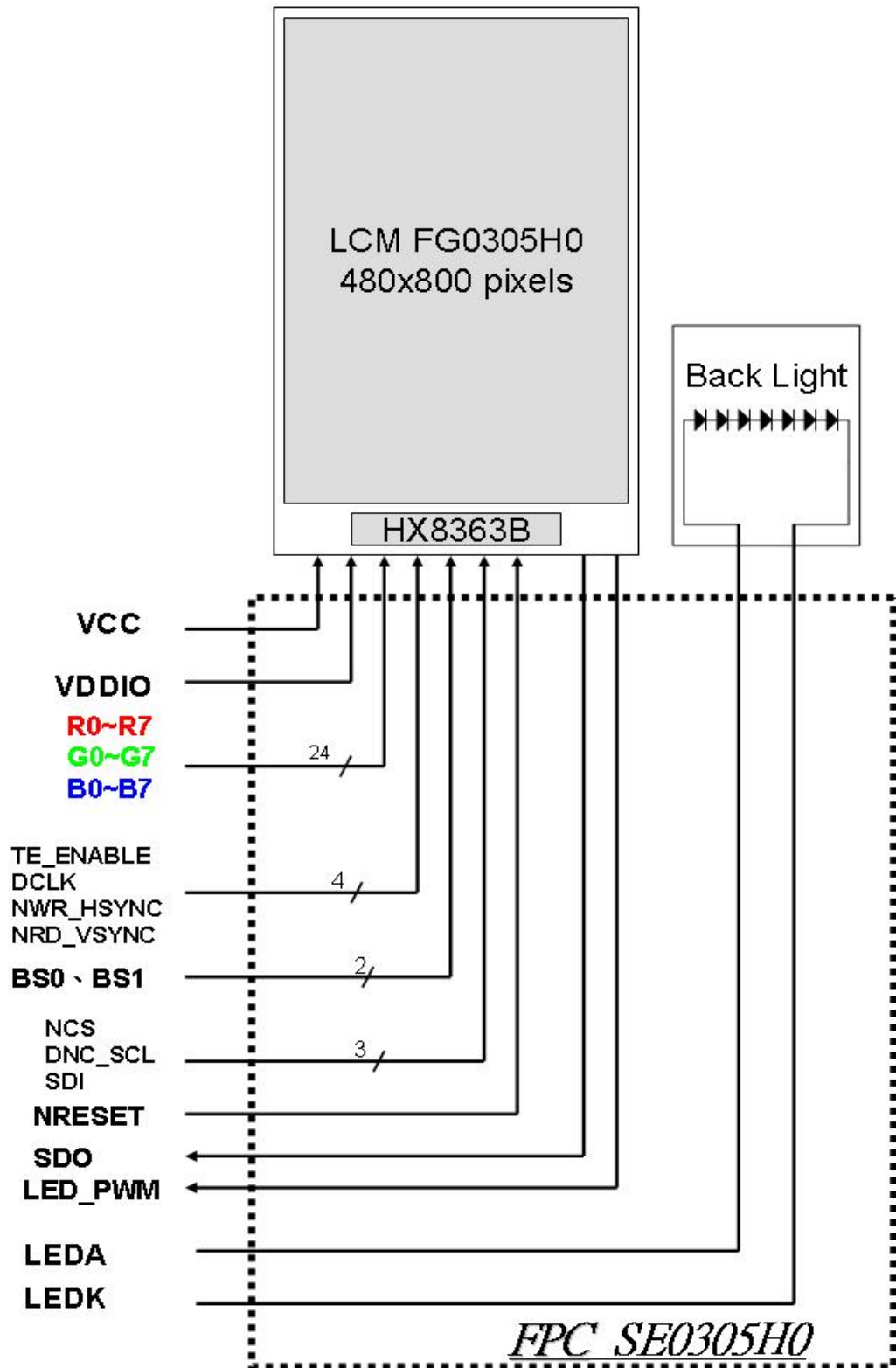
The unused pins can connect to VDDIO, GND or open.

NOTE 2:

The FG0305H0 supports DBI (Display Bus Interface) and DPI (Display Pixel Interface) interfaces.

BS1	BS0	interface mode
0	0	DPI(3 wire serial + RGB interface)
1	0	DBI TYPE-B

8. BLOCK DIAGRAM

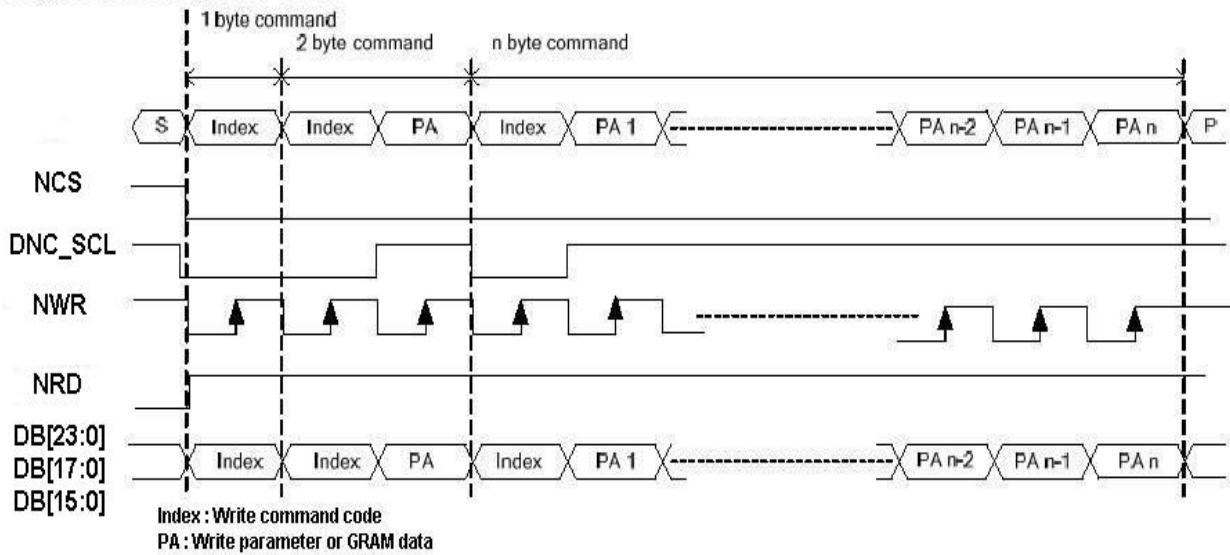


9. Interface

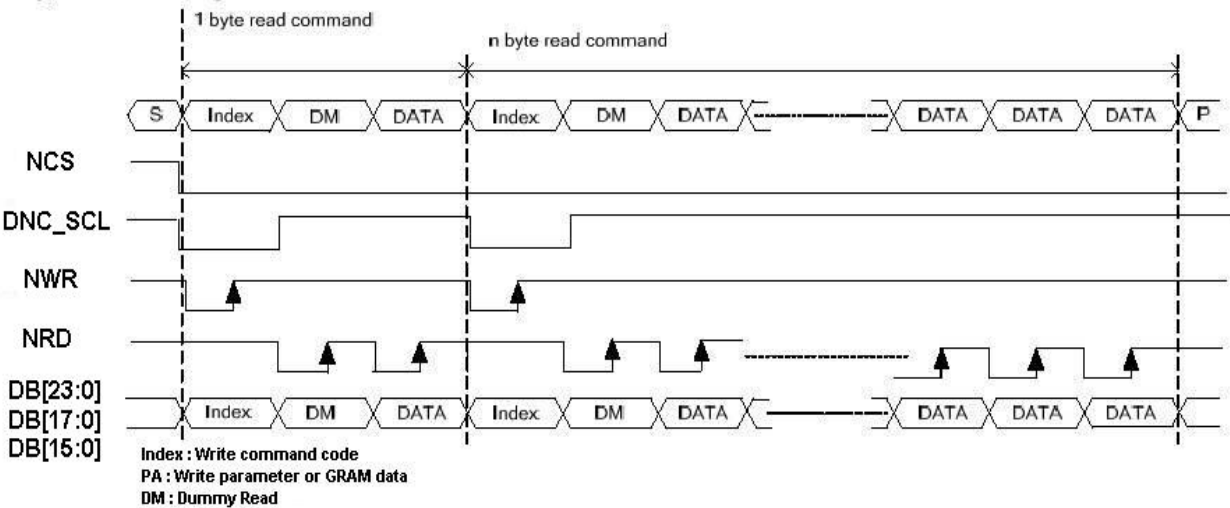
9.1 MIPI DBI TYPE B interface

The selection of DBI-B interface is by setting “BS[1:0]=10” pins, the interface is use DBI TYPE B system. The parallel interface timing diagram is described as below.

DBI Type B write to register or GRAM



DBI Type B read from register or GRAM



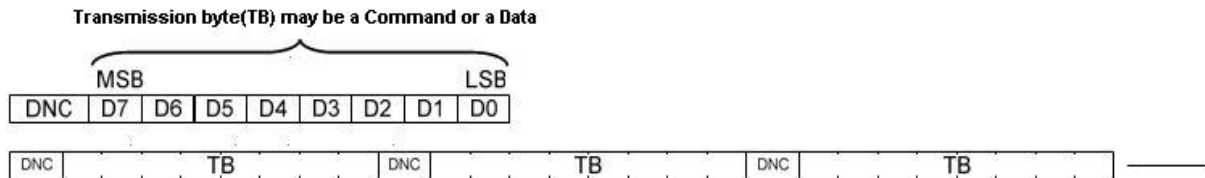
9.2 Serial data transfer interface

The FG0305H0 supports 3 wire serial data transfer interface. The 3 wire serial bus uses chip select line (NCS), serial input/output data (SDI and SDO) and the serial transfer clock line (DNC_SCL).

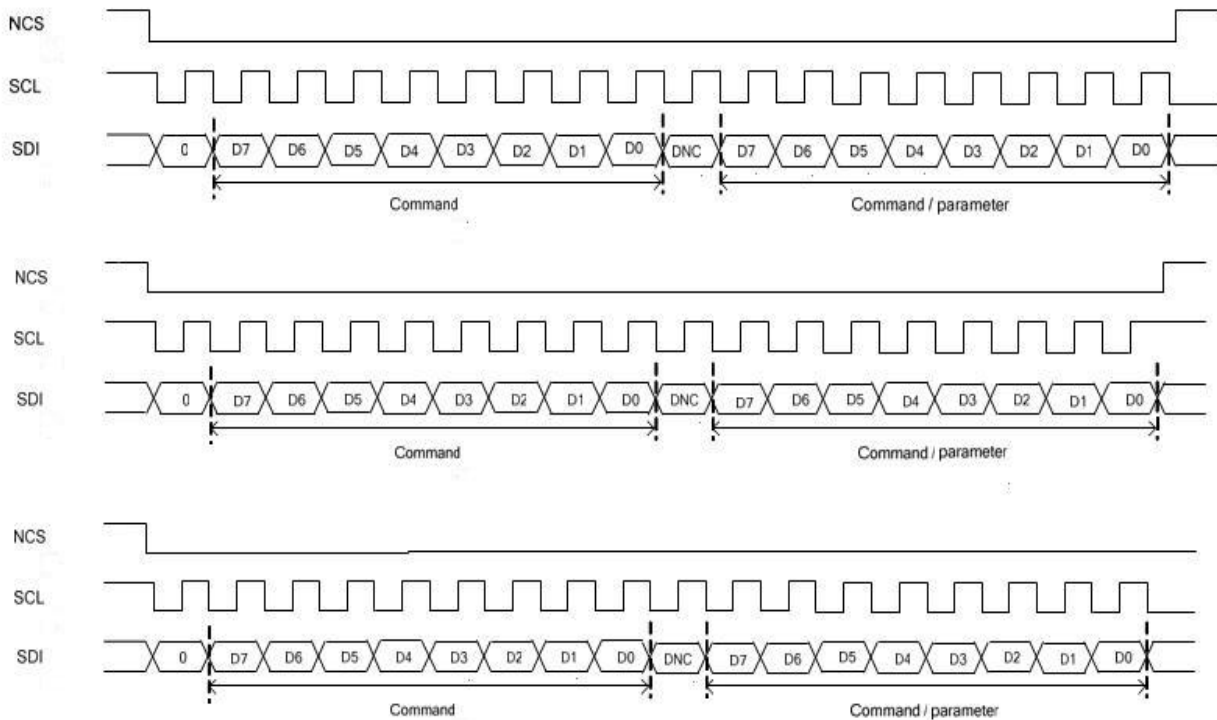
Serial data write mode

The 3-Pin serial data packet contains a control bit DNC and a transmission byte. If DNC is low, the transmission byte is command byte. If DNC is high, the transmission byte is stored to command register. The MSB is transmitted first. The serial interface is initialized when NCS is high. In this state, SCL clock pulse or SDI/SDO data have no effect. A falling edge on NCS enables the serial interface and indicates the start of data transmission.

3 wire Serial Data Stream Format



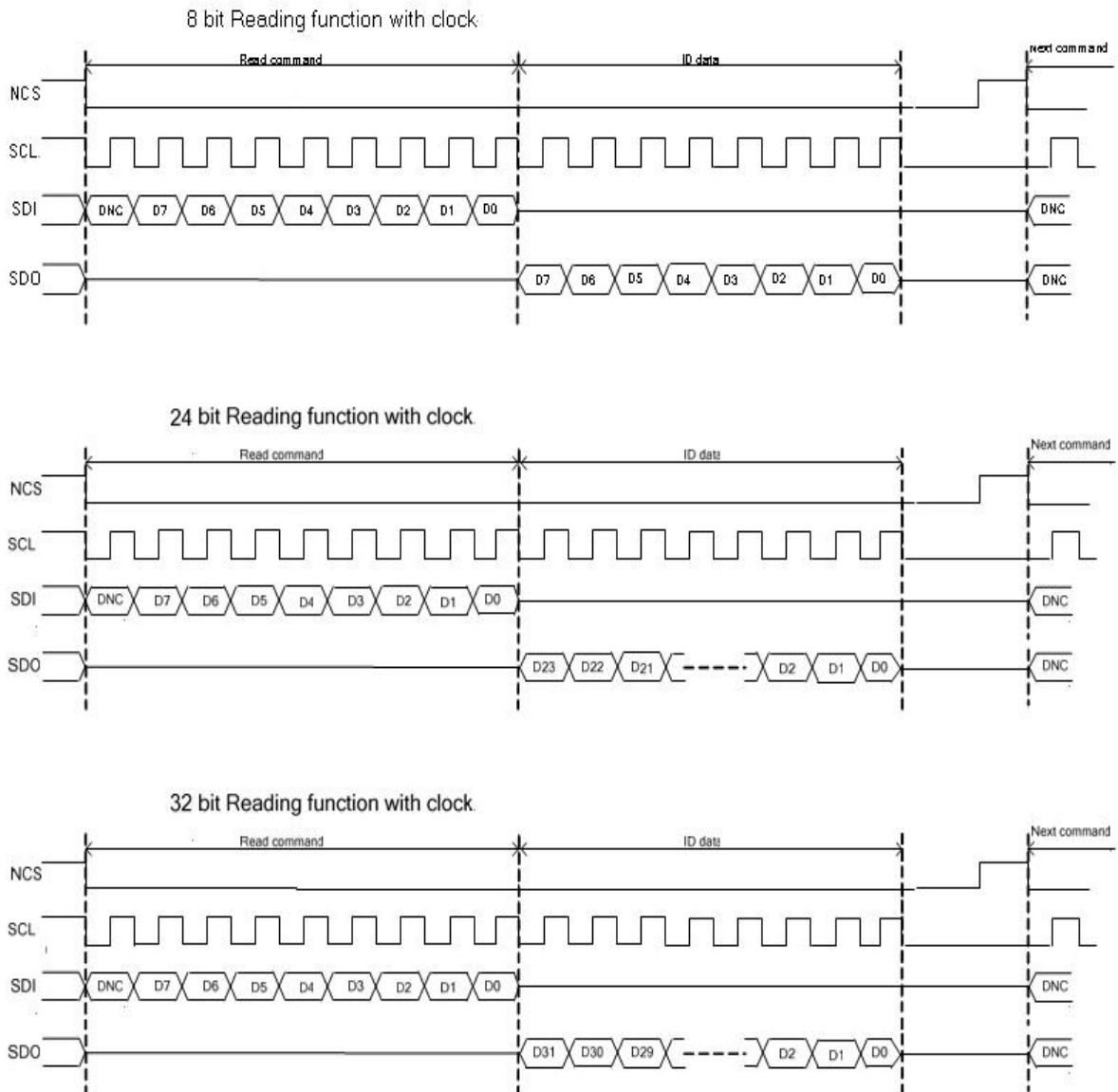
3 wire Serial Interface Protocol



Serial Data Read Mode

The micro controller firstly has to send a command and then the following byte is transmitted in the opposite direction. The read mode has three types of command data transmitted (8- /24- /32-bit) according command code.

3 wire Serial Interface Protocol



10. QUALITY ASSURANCE

Test Condition

10.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $20 \pm 5^{\circ}\text{C}$

Humidity : $65 \pm 5\%$

10.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

10.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

10.1.4 Test Frequency

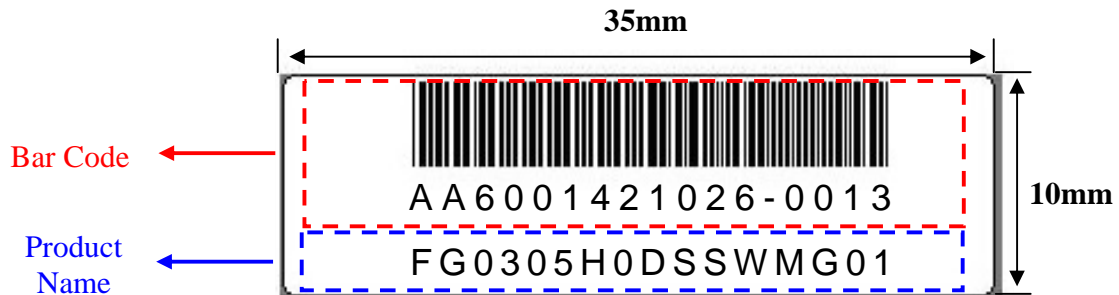
In case of related to deterioration such as shock test. It will be conducted only once.

10.1.5 Test Method

No.	Reliability Test Item & Level	Test Level
1	High Temperature Storage Test	T=80°C,240hrs
2	Low Temperature Storage Test	T=-30°C,240hrs
3	High Temperature Operation Test	T=70°C,240hrs
4	Low Temperature Operation Test	T=-20°C,240hrs
5	High Temperature and High Humidity Operation Test	T=50°C,90% RH,240hrs
6	Temperature Cycle Test (No operation)	-30°C → +25°C → +80°C,100Cycles 30 min 5min 30 min
7	Vibration Test (No operation)	Frequency:10 ~ 55 Hz Amplitude:1.0 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z
8	Shock Test (No operation)	100G, 6ms Direction : ± X,± Y,± Z Cycle : 3 times

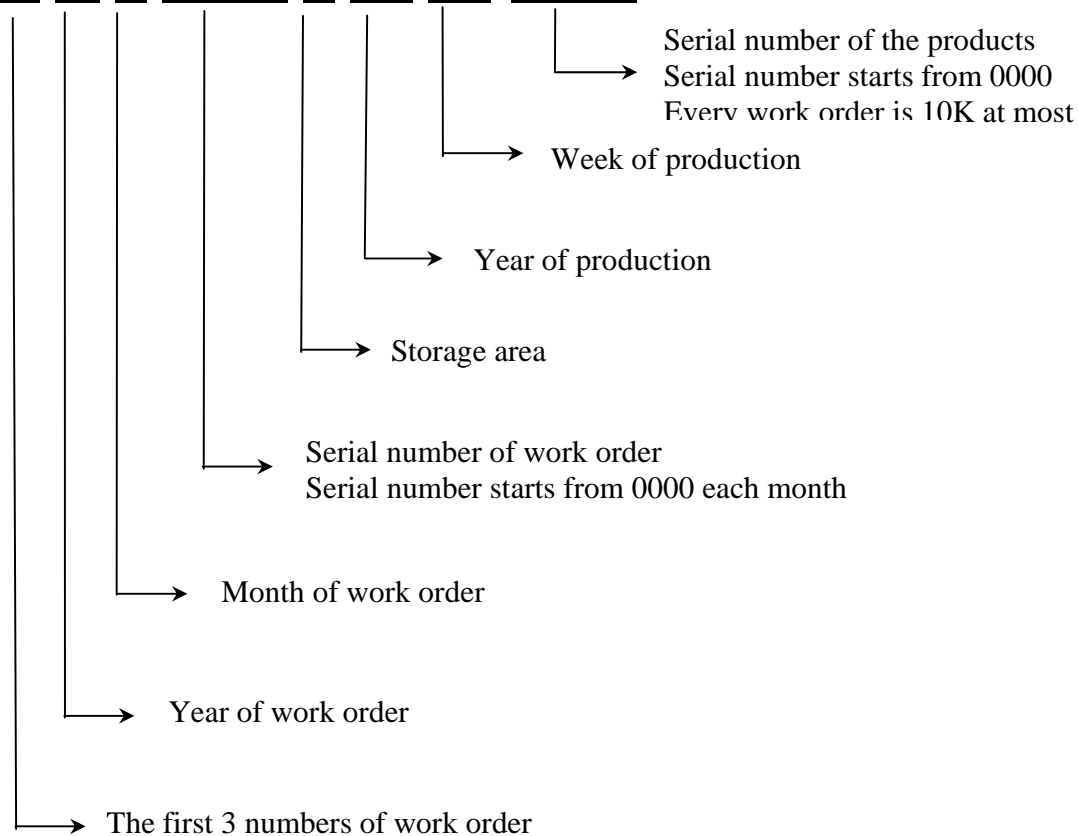
11.LCM PRODUCT LABEL DEFINE

Product Label style:

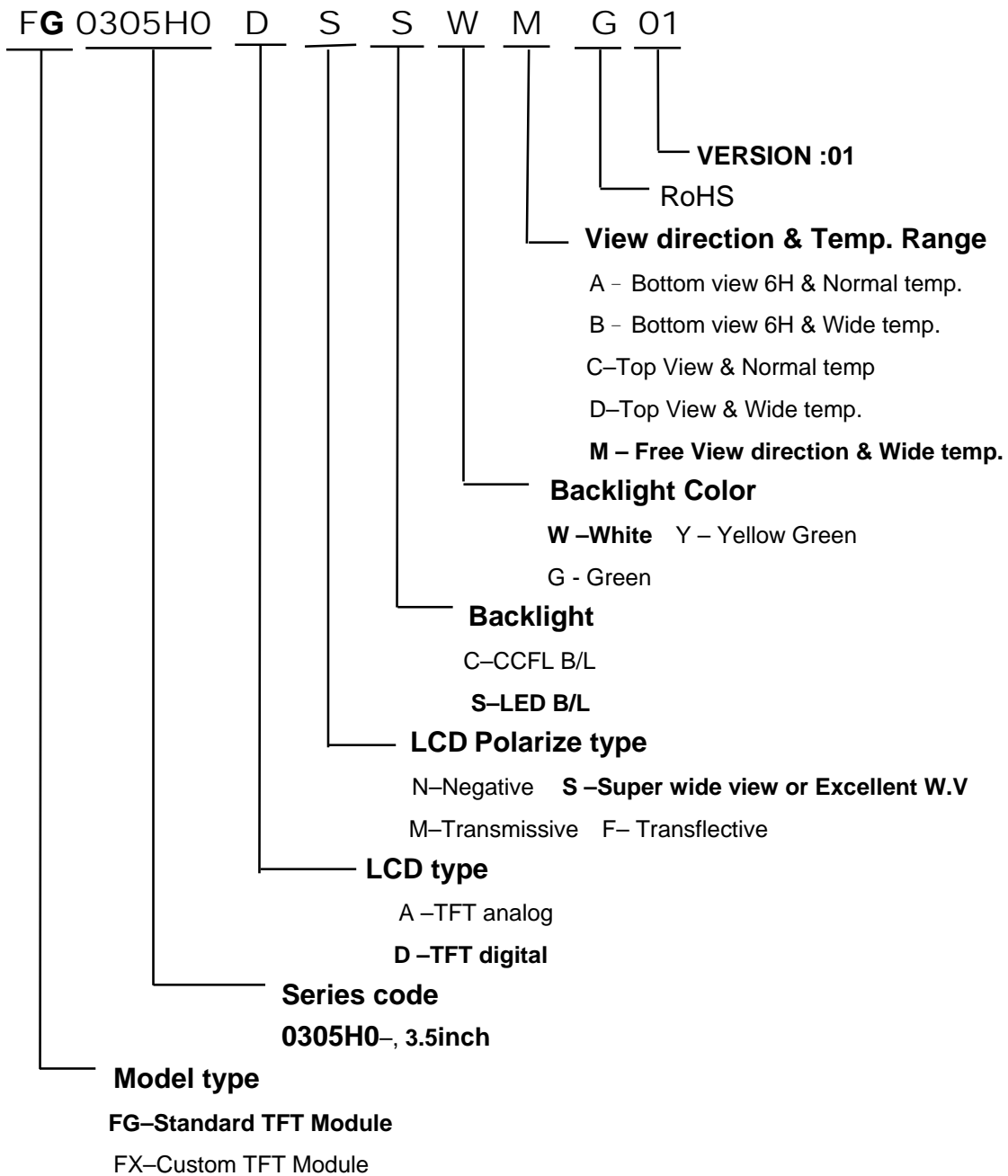


BarCode Define:

A A 6 0014 2 10 26-0013



Product Name Define:



12. PRECAUTIONS IN USE LCM

1. ASSEMBLY PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners or four sides.
- (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) 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.
- (4) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (5) Do not open the case because inside circuits do not have sufficient strength.
- (6) Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.
- (7) Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.
- (8) Please pay attention to handling lead wire of backlight so that it is not tugged in connecting with inverter.

2. OPERATING PRECAUTIONS

- (1) Please be sure to turn off the power supply before connecting and disconnecting signal input cable.
- (2) Please do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification
- (3) 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.
- (4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (5) 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 minimize the interference.
- (6) Please consider that LCD backlight takes longer time to become stable of radiation characteristics in low temperature than in room temperature.

3. ELECTROSTATIC DISCHARGE CONTROL

- (1) The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such the copper leads on the PCB and the interface terminals with any parts of the human body.

- (2) The modules should be kept in antistatic bags or other containers resistant to static for storage.
- (3) Only properly grounded soldering irons should be used.
- (4) If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.
- (5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended
- (6) Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

4. STORAGE PRECAUTIONS

- (1) When you store LCDs for a long time, it is recommended to keep the temperature between 0°C-40°C without the exposure of sunlight and to keep the humidity less than 90%RH.
- (2) Please do not leave the LCDs in the environment of high humidity and high temperature such as 60°C 90%RH
- (3) Please do not leave the LCDs in the environment of low temperature; below -20°C.

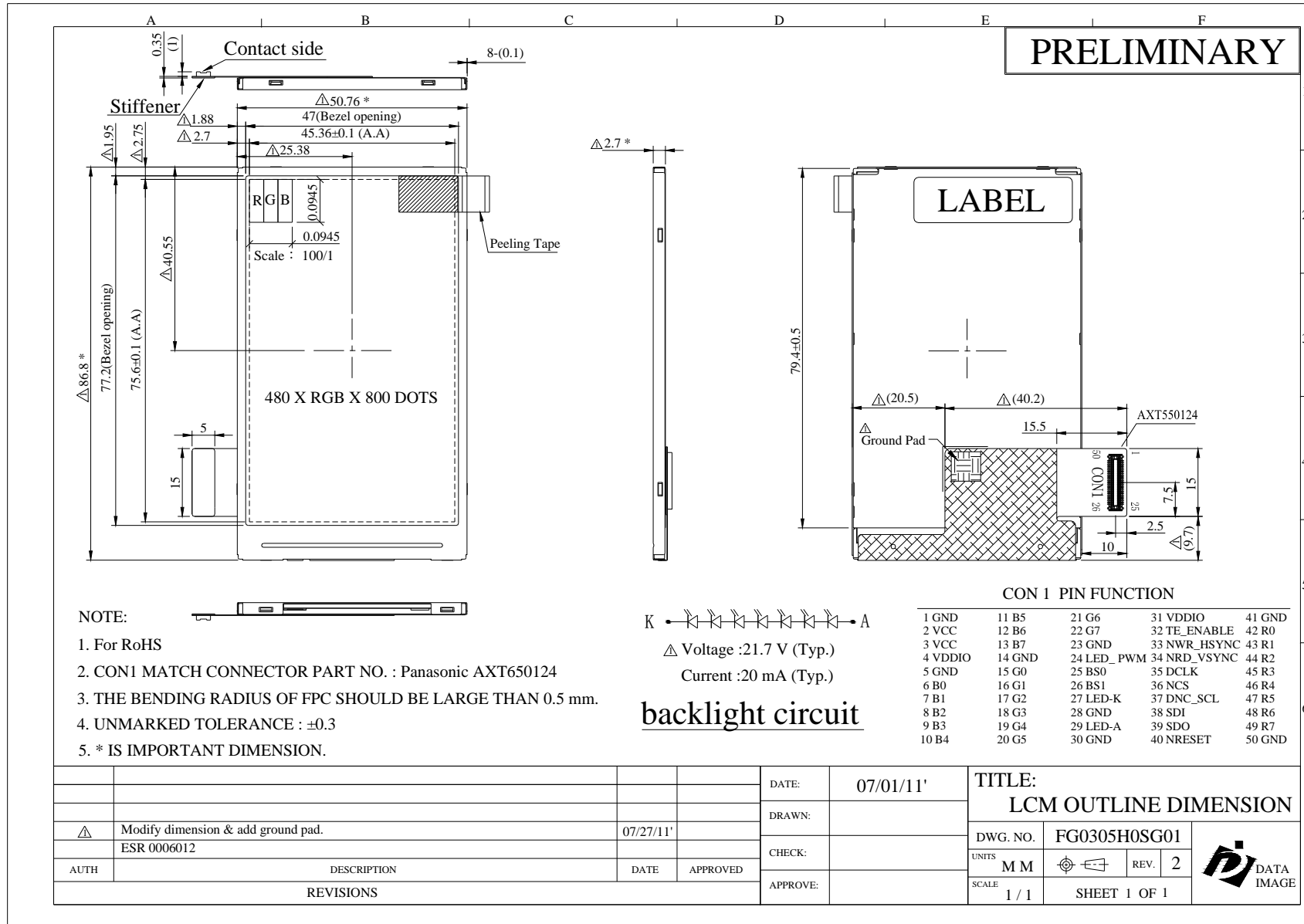
5. OTHERS

- (1) A strong incident light into LCD panel might cause display characteristics' changing inferior because of polarizer film, color filter, and other materials becoming inferior. Please do not expose LCD module direct sunlight and strong UV rays
- (2) Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.
- (3) For the packaging box, please pay attention to the followings:
 - a. Please do not pile them up more than 5 boxes. (They are not designed so.) And please do not turn over.
 - b. Please handle packaging box with care not to give them sudden shock and vibrations. And also please do not throw them up.
 - c. Packing box and inner case for LCDs are made of cardboard. So please pay attention not to get them wet. (Such like keeping them in high humidity or wet place can occur getting them wet.)

6. LIMITED WARRANTY

Unless otherwise agreed between DATA IMAGE and customer, DATA IMAGE will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with DATA IMAGE acceptance standards, for a period on one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of DATA IMAGE is limited to repair and/or replacement on the terms set forth above. DATA IMAGE will not responsible for any subsequent or consequential events.

13. OUTLINE DRAWING



14. PACKAGE INFORMATION TBD