Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 128160A TMH-PW-N

1,77“ TFT

Product Specification ***Ver.: 2***

21.01.2015

Revise Records

Rev.	Date	Contents	Written	Approved
0	20.07.2010	Preliminary Specification	CL	MH
1	09.06.2013	Correct Block Diagram Add Backlight Lifetime	LXJ	MH
2	21.01.2015	Correct Interface Description	LXJ	MH

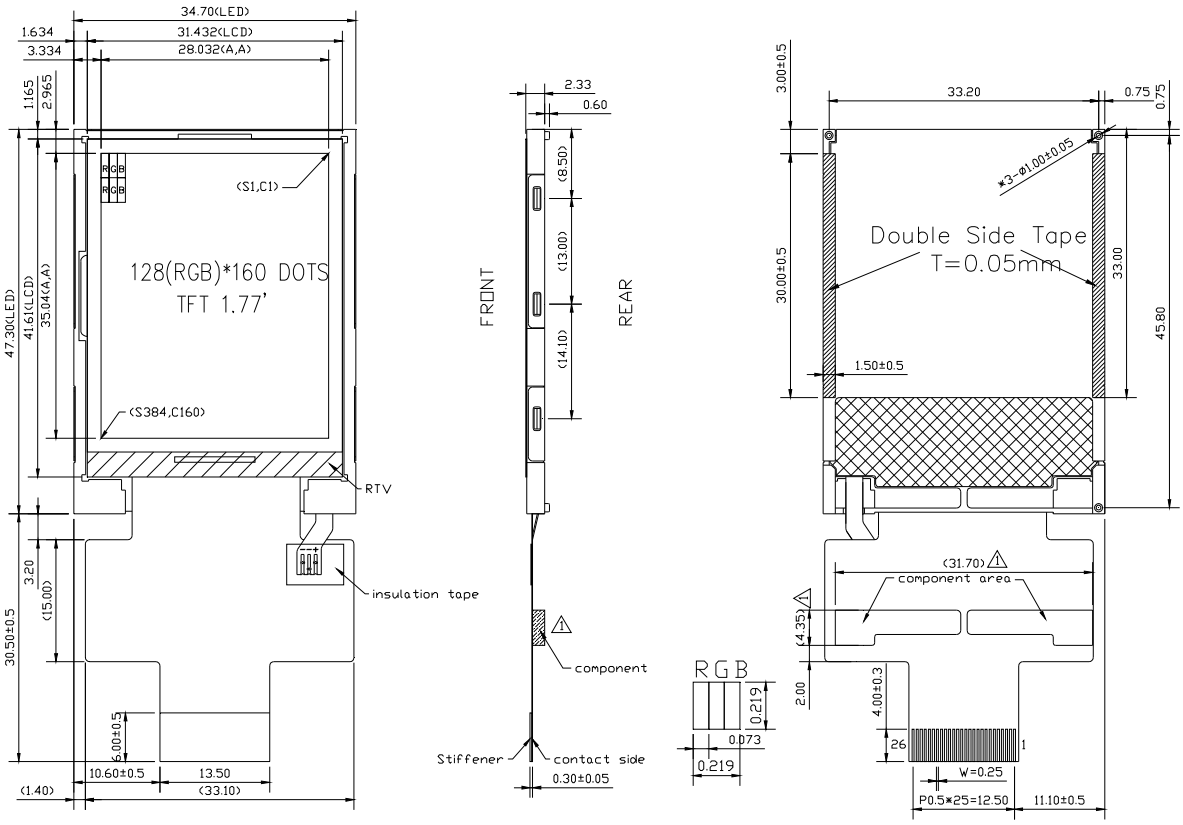
Special Notes

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1. LCM DRAWING



2. GENERAL DESCRIPTION

MAIN TECHNICS：	TFT NEGATIVE TRANSMISSIVE
DISPLAY CONTENT：	GRAPHIC
DISPLAY TYPE：	262k-COLORS
DRIVER METHOD：	1/160 DUTY
VIEWING DIRECTION：	12:00
CONTROLLER:	ST7735R (SITRONIX)
BACKLIGHT：	LED LIGTHGUIDE, WHITE, 50.000h
OPEATING TEMPERATURE：	-20°C to +70°C
STORAGE TEMPERATURE：	-30°C to +80°C
INTERFACE:	16-Bit-Parallel-MCU- Interface
REFERENCE DOCUMENTS:	ST7735R datasheets

3. MECHANICAL SPECIFICATIONS

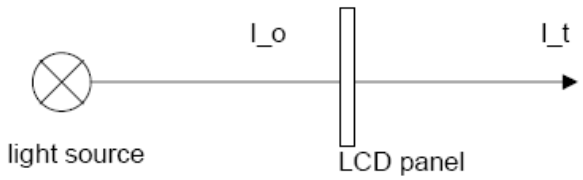
ITEM	CONTENT	UNIT
PIXEL'S NUMBER	128 x RGB x 160	PIXEL
MODULE DIMENSION	34.70 x 77.80 x 2.93	mm
ACTIVE AREA	28.032 x 35.04	mm
PIXEL SIZE	0.219 x 0.219	mm

4. ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Specifications			Unit	Note
			Min.	Typ.	Max.		
Transmittance（Without Polarizer）*		T%	-	16	-	%	*[1]Here the data are design value. [2]Chromaticity measuring machine: CFT-01. **Reference Only**
Contrast ratio*		Cr (Θ=0°)	150	300	-		
Response time (25℃)*		T_r+T_f	-	35	50	ms	
Viewing angle (Cr≥ 10)*		Θ21	-	35	-	deg	
		Θ22	-	15	-		
		Θ12	-	45	-		
		Θ11	-	45	-		
Chromaticity of CF	Red	x	0.604	0.624	0.644		
		y	0.302	0.322	0.342		
		Y	15.6	20.6	25.6		
	Green	x	0.268	0.288	0.308		
		y	0.54	0.56	0.58		
		Y	53.6	58.6	63.6		
	Blue	x	0.127	0.147	0.167		
		y	0.097	0.117	0.137		
		Y	8.3	13.3	18.3		
	White	x		0.307			
		y		0.328			
		Y		30.8			
Color gamut of CF (NTSC%)		S		58		%	

[1]Transmittance (T%)

The transmittance of the panel including polarizers is measured without electrical driving.



The Transmittance is defined as:

$$Tr = \frac{I_t}{I_o} \times 100\%$$

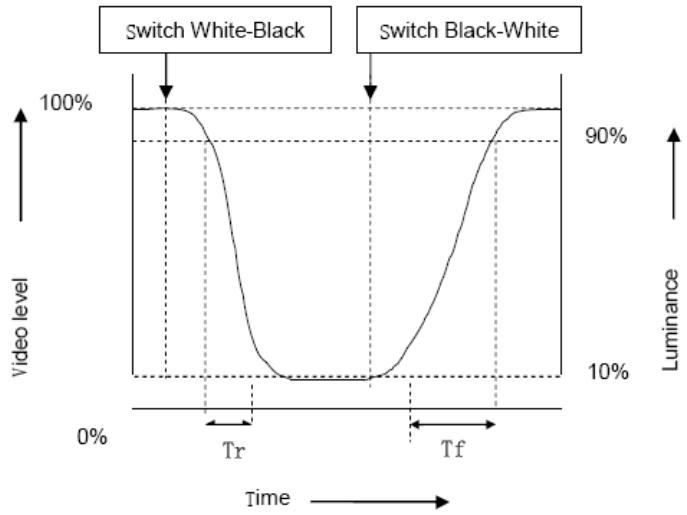
here,

I_o: the brightness of the light source.

I_t : the brightness after panel transmission.

[2] Response Time(Tr、Tf)

The rise time 'Tr' is defined as the time for luminance to change from 90% to 10% as a result of a change of the electrical condition. The fall time 'Tf' is defined as the time for luminance to change from 10% to 90% as a result of a change of the electrical condition.

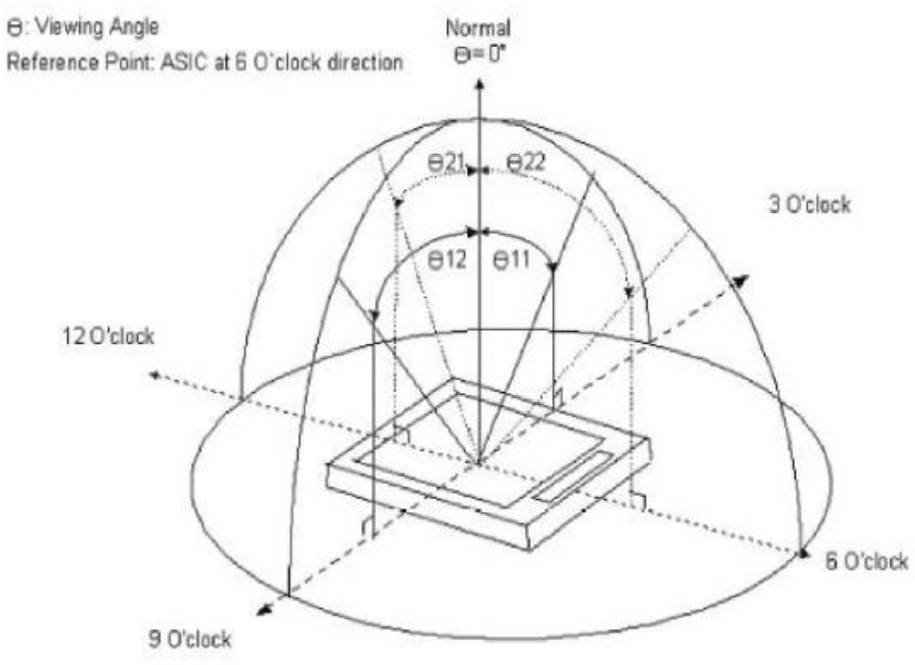


[3] Contrast ratio (Cr)

The contrast ratio (Cr), measured on a module, is the ratio between the luminance (L_w) in a full white area (R=G=B=1) and the luminance (L_d) in a dark area (R=G=B=0):

$$Cr = \frac{L_w}{L_d}$$

[4]Viewing angle diagram



[5] Definition of color gamut

Measuring machine:CFT-01. NTSC'S Primaries: R(x,y,Y)、G(x,y,Y)、B(x,y,Y).

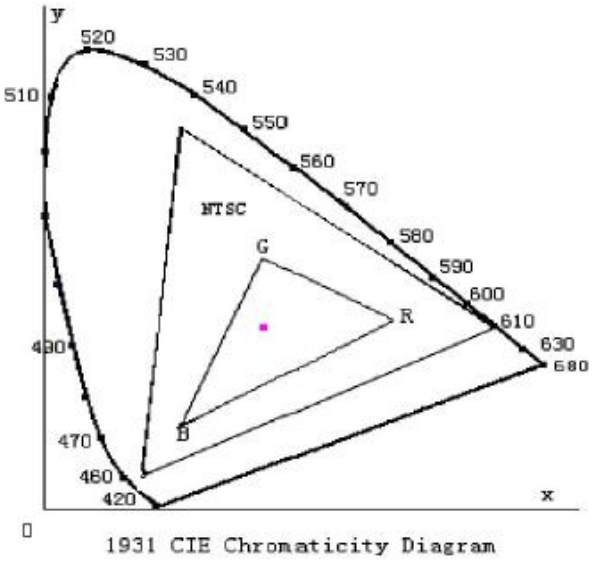
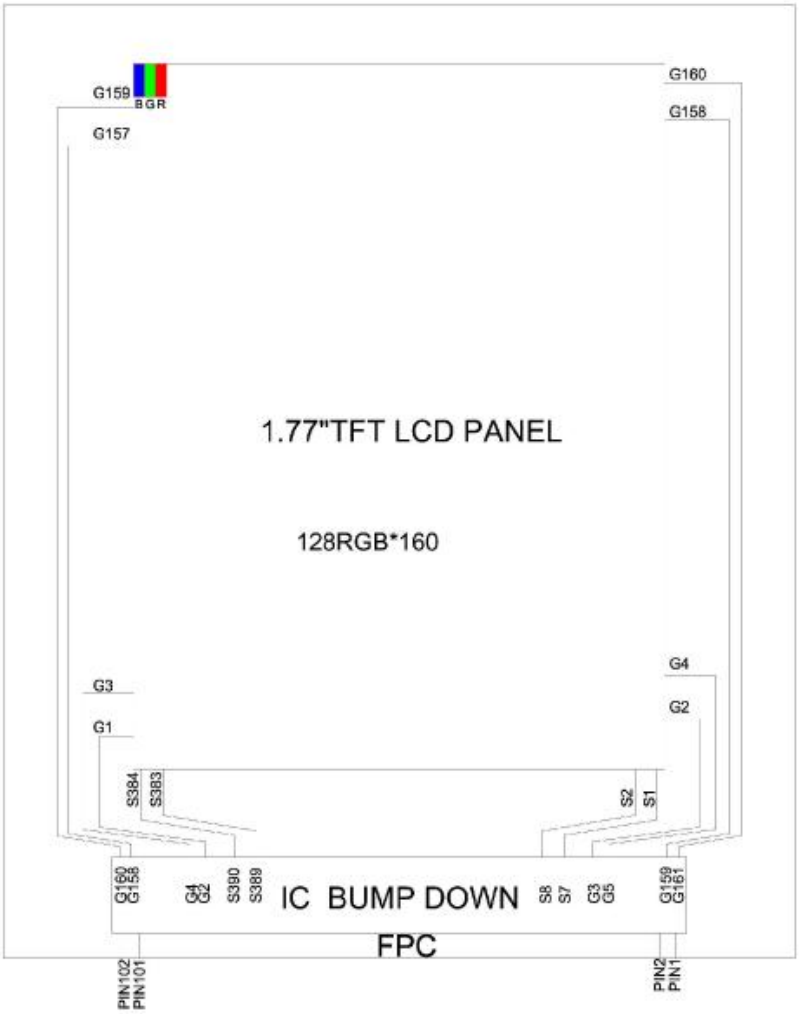


Fig. 1931 CIE chromaticity diagram

Color gamut: $S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$

5. BLOCK DIAGRAM



6. ELECTRONIC CHARACTERISTICS

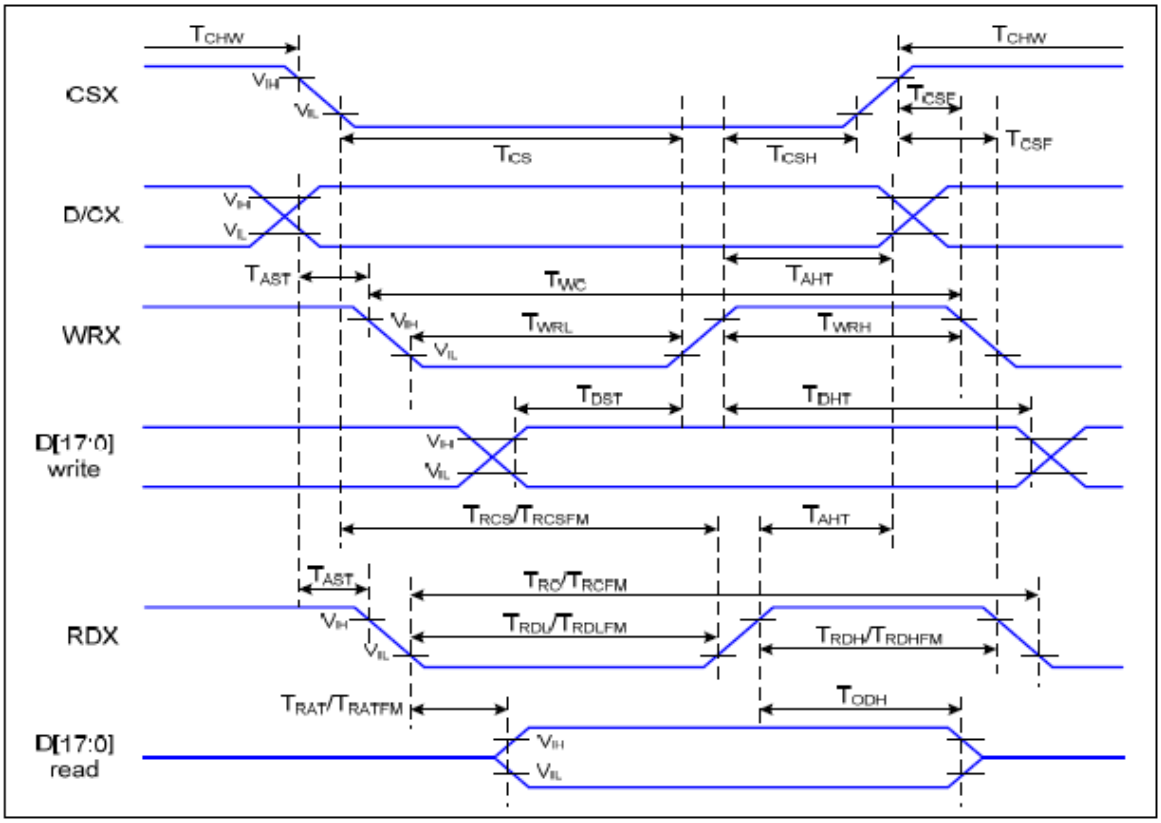
6.1 MAXIMUM VALUES

ITEM	SYMBOL	STANDARD VALUE		UNIT
		MIN	MAX	
Logic supply voltage	**V_{DD}**	**-0.3**	**+4.6**	**V**
Operating Temperature	**Top**	**-20**	**+70**	**°C**
Storage Temperature	**Tst**	**-30**	**+80**	**°C**

6.2 DC CHARACTERISTICS

Parameter	Symbol	Condition	Specification			Unit	Related Pins
			Min	Typ	Max		
Power & operation voltage							
System voltage	VDD	Operating voltage	2.3	2.75	4.8	V	
Interface operation voltage	VDDI	I/O supply voltage	1.65	1.8	3.7	V	
Gate driver high voltage	VGH		10		15	V	
Gate driver low voltage	VGL		-12.4		-7.5	V	
Gate driver supply voltage		| VGH-VGL |	17.5		27.5	V	
Input / Output							
Logic-high input voltage	VIH		0.7VDDI		VDDI	V	Note 1
Logic-low input voltage	VIL		VSS		0.3VDDI	V	Note 1
Logic-high output voltage	VOH	IOH = -1.0mA	0.8VDDI		VDDI	V	Note 1
Logic-low output voltage	VOL	IOL = +1.0mA	VSS		0.2VDDI	V	Note 1
Logic-high input current	IIH	VIN = VDDI			1	uA	Note 1
Logic-low input current	IIL	VIN = VSS	-1			uA	Note 1
Input leakage current	IIL	IOH = -1.0mA	-0.1		+0.1	uA	Note 1
VCOM voltage							
VCOM amplitude	VCOM		-2		-0.425	V	
Source driver							
Source output range	Vsout		0.1		GVDD	V	
Gamma reference voltage	GVDD		3.15		4.7	V	
Source output settling time	Tr	Below with 99% precision			20	us	Note 2
Output offset voltage	Voffset				35	mV	Note 3

6.3 TIMING CHARACTERISTICS



Ta=25 ℃, VDDI=1.65~3.7V, VDD=2.3~4.8V

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	TAST	Address setup time	0		ns	-
	TAHT	Address hold time (Write/Read)	10		ns	
CSX	TCHW	Chip select "H" pulse width	0		ns	-
	TCS	Chip select setup time (Write)	15		ns	
	TRCS	Chip select setup time (Read ID)	45		ns	
	TRCSFM	Chip select setup time (Read FM)	355		ns	
	TCSF	Chip select wait time (Write/Read)	10		ns	
	TCSH	Chip select hold time	10		ns	
WRX	TWC	Write cycle	66		ns	
	TWRH	Control pulse "H" duration	15		ns	
	TWRL	Control pulse "L" duration	15		ns	
RDX (ID)	TRC	Read cycle (ID)	160		ns	When read ID data
	TRDH	Control pulse "H" duration (ID)	90		ns	
	TRDL	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	TRCFM	Read cycle (FM)	450		ns	When read from frame memory
	TRDHFM	Control pulse "H" duration (FM)	90		ns	
	TRDLFM	Control pulse "L" duration (FM)	355		ns	
D[17:0]	TDST	Data setup time	10		ns	For CL=30pF
	TDHT	Data hold time	10		ns	
	TRAT	Read access time (ID)		40	ns	
	TRATFM	Read access time (FM)		340	ns	
	TODH	Output disable time	20	80	ns	

7. PINS DESCRIPTION

Pin No.	Symbol	Description
1	VDD	Power Supply Pin :+3.0V
2	GND	Ground
3	WRB	Write enable in MCU parallel interface
4	D0	Data Bus
5	D2	
6	D4	
7	D6	
8	CSB	L:Chip Selected H:Chip Unselected
9	RESET	Reset: L: Enable; H: Disable
10	D7	Data Bus
11	D5	
12	D3	
13	D1	
14-21	D8-D15	
22	D/C	L:Command data;H:display data or parameter
23	RDB	Read enable in 8080 MCU parallel interface
24	LEDK1	Led Cathode1
25	LEDK2	Led Cathode2
26	LEDA	Led Anode

8. INSTRUCTION DESCRIPTION

Instruction	Refer	D/CX	WRX	RDX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
NOP	10.1.1	0	↑	1	-	0	0	0	0	0	0	0	0	(00h)	No Operation
SWRESET	10.1.2	0	↑	1	-	0	0	0	0	0	0	0	1	(01h)	Software reset
RDDID	10.1.3	0	↑	1	-	0	0	0	0	0	1	0	0	(04h)	Read Display ID
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	ID17	ID16	ID15	ID14	ID13	ID12	ID11	ID10		ID1 read
		1	1	↑	-	1	ID26	ID25	ID24	ID23	ID22	ID21	ID20		ID2 read
		1	1	↑	-	ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30		ID3 read
RDDST	10.1.4	0	↑	1	-	0	0	0	0	1	0	0	1	(09h)	Read Display Status
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	BSTON	MY	MX	MV	ML	RGB	MH	ST24		-
		1	1	↑	-	ST23	IFPF2	IFPF1	IFPF0	IDMON	PTLON	SLOUT	NORON		-
		1	1	↑	-	VSSON	ST14	INVON	ST12	ST11	DISON	TEON	GCS2		-
		1	1	↑	-	GCS1	GCS0	TEM	ST4	ST3	ST2	ST1	ST0		-
RDDPM	10.1.5	0	↑	1	-	0	0	0	0	1	0	1	0	(0Ah)	Read Display Power
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	BSTON	IDMON	PTLON	SLPOUT	NORON	DISON	-	-		-
RDD MADCTL	10.1.6	0	↑	1	-	0	0	0	0	1	0	1	1	(0Bh)	Read Display
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	MY	MX	MV	ML	RGB	MH	-	-		-
RDD COLMOD	10.1.7	0	↑	1	-	0	0	0	0	1	1	0	0	(0Ch)	Read Display Pixel
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	0	0	0	0	-	IFPF2	IFPF1	IFPF0		-
RDDIM	10.1.8	0	↑	1	-	0	0	0	0	1	1	0	1	(0Dh)	Read Display Image
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	VSSON	D6	INVON	-	-	GCS2	GCS1	GCS0		-
RDDSM	10.1.9	0	↑	1	-	0	0	0	0	1	1	1	0	(0Eh)	Read Display Signal
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	TEON	TEM	-	-	-	-	-	-		-

Instruction	Refer	D/C	WR	RDX	D17-	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
SLPIN	10.1.10	0	↑	1	-	0	0	0	1	0	0	0	0	(10h)	Sleep in & booster off
SLPOUT	10.1.11	0	↑	1	-	0	0	0	1	0	0	0	1	(11h)	Sleep out & booster on
PTLON	10.1.12	0	↑	1	-	0	0	0	1	0	0	1	0	(12h)	Partial mode on
NORON	10.1.13	0	↑	1	-	0	0	0	1	0	0	1	1	(13h)	Partial off (Normal)
INVOFF	10.1.14	0	↑	1	-	0	0	1	0	0	0	0	0	(20h)	Display inversion off
INVON	10.1.15	0	↑	1	-	0	0	1	0	0	0	0	1	(21h)	Display inversion on
GAMSET	10.1.16	0	↑	1	-	0	0	1	0	0	1	1	0	(26h)	Gamma curve select
		1	↑	1	-	-	-	-	-	GC3	GC2	GC1	GC0		-
DISPOFF	10.1.17	0	↑	1	-	0	0	1	0	1	0	0	0	(28h)	Display off
DISPON	10.1.18	0	↑	1	-	0	0	1	0	1	0	0	1	(29h)	Display on
CASET	10.1.19	0	↑	1	-	0	0	1	0	1	0	1	0	(2Ah)	Column address set
		1	↑	1	-	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8		X address start: 0≦XS≦X
		1	↑	1	-	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0		
		1	↑	1	-	XE15	XE14	XE13	XE12	XE11	XE10	XE9	XE8		X address end: S≦XE≦X
		1	↑	1	-	XE7	XE6	XE5	XE4	XE3	XE2	XE1	XE0		
RASET	10.1.20	0	↑	1	-	0	0	1	0	1	0	1	1	(2Bh)	Row address set
		1	↑	1	-	YS15	YS14	YS13	YS12	YS11	YS10	YS9	YS8		Y address start: 0≦YS≦Y
		1	↑	1	-	YS7	YS6	YS5	YS4	YS3	YS2	YS1	YS0		
		1	↑	1	-	YE15	YE14	YE13	YE12	YE11	YE10	YE9	YE8		Y address end:S≦YE≦Y
		1	↑	1	-	YE7	YE6	YE5	YE4	YE3	YE2	YE1	YE0		
RAMWR	10.1.21	0	↑	1	-	0	0	1	0	1	1	0	0	(2Ch)	Memory write
		1	↑	1	-	D7	D6	D5	D4	D3	D2	D1	D0		Write data
RGBSET	10.1.22	0	↑	1	-	0	0	1	0	1	1	0	1	(2Dh)	LUT for 4k,65k,262k color
		1	↑	1	-	-	-	R005	R004	R003	R002	R001	R000		Red tone 0
		1	↑	1	-	-	-	:	:	:	:	:	:		:
		1	↑	1	-	-	-	Ra5	Ra4	Ra3	Ra2	Ra1	Ra0		Red tone "a"
		1	↑	1	-	-	-	G005	G004	G003	G002	G001	G000		Green tone 0
		1	↑	1	-	-	-	:	:	:	:	:	:		:
		1	↑	1	-	-	-	Gb5	Gb4	Gb3	Gb2	Gb1	Gb0		Green tone "b"
		1	↑	1	-	-	-	B005	B004	B003	B002	B001	B000		Blue tone 0
		1	↑	1	-	-	-	:	:	:	:	:	:		:
		1	↑	1	-	-	-	Bc5	Bc4	Bc3	Bc2	Bc1	Bc0		Blue tone "c"
RAMRD	10.1.23	0	↑	1	-	0	0	1	0	1	1	1	0	(2Eh)	Memory read
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	D7	D6	D5	D4	D3	D2	D1	D0		Read data

Instruction	Refer	D/CX	WRX	RDX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
PTLAR	10.1.24	0	↑	1	-	0	0	1	1	0	0	0	0	(30h)	Partial start/end address set
		1	↑	1	-	PSL15	PSL14	PSL13	PSL12	PSL11	PSL10	PSL9	PSL8		Partial start address (0,1,2, ..P)
		1	↑	1	-	PSL7	PSL6	PSL5	PSL4	PSL3	PSL2	PSL1	PSL0		
		1	↑	1	-	PEL15	PEL14	PEL13	PEL12	PEL11	PEL10	PEL9	PEL8		Partial end address (0,1,2, .., P)
		1	↑	1	-	PEL7	PEL6	PEL5	PEL4	PEL3	PEL2	PEL1	PEL0		
TEOFF	10.1.25	0	↑	1	-	0	0	1	1	0	1	0	0	(34h)	Tearing effect line off
TEON	10.1.26	0	↑	1	-	0	0	1	1	0	1	0	1	(35h)	Tearing effect mode set & on
		1	↑	1	-	-	-	-	-	-	-	-	TEM		Mode1: TEM="0" Mode2: TEM="1"
MADCTL	10.1.27	0	↑	1	-	0	0	1	1	0	1	1	0	(36h)	Memory data access control
		1	↑	1	-	MY	MX	MV	ML	RGB	MH	-	-		-
IDMOFF	10.1.28	0	↑	1	-	0	0	1	1	1	0	0	0	(38h)	Idle mode off
IDMON	10.1.29	0	↑	1	-	0	0	1	1	1	0	0	1	(39h)	Idle mode on
COLMOD	10.1.30	0	↑	1	-	0	0	1	1	1	0	1	0	(3Ah)	Interface pixel format
		1	↑	1	-	-	-	-	-	-	IFPF2	IFPF1	IFPF0		Interface format
RDID1	10.1.31	0	↑	1	-	1	1	0	1	1	0	1	0	(DAh)	Read ID1
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	ID17	ID16	ID15	ID14	ID13	ID12	ID11	ID10		Read parameter
RDID2	10.1.32	0	↑	1	-	1	1	0	1	1	0	1	1	(DBh)	Read ID2
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	1	ID26	ID25	ID24	ID23	ID22	ID21	ID20		Read parameter
RDID3	10.1.33	0	↑	1	-	1	1	0	1	1	1	0	0	(DCh)	Read ID3
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy read
		1	1	↑	-	ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30		Read parameter

9. BACKLIGHT PARAMETERS

9.1 ABSOLUTE MAXIMUM RATINGS

(Unless specified, The Ambient temperature Ta=25°C)

Item	Symbol	Condition	Rating	Unit
Operating temperature range	Topr		-20~+70	°C
Storage temperature range	Tst		-30~+80	°C

9.2 ELECTRICAL/OPTLCAL CHARACTERISTICS

(Unless specified, The Ambient temperature Ta=25°C)

Item	Symbol	min	typ	max	Unit	Condition
Forward Voltage	Vf	2.9	3.1	3.3	V	If=30mA
Luminance	Lv	-	310	-	cd/m^2	If=30mA
Color Coordinate	X	0.26	-	0.30	-	If=30 mA,
	Y	0.26	-	0.30	-	
LED Lifetime	-		50.000		h	Half Brightness

10. Product Quality & Reliability

10.1 Standard for Quality Test

10.1.1 Inspection :

Before delivering, the supplier should take the following tests, and affirm the quality of product.

10.1.2 Electro-Optical Characteristics:

According to the individual specification to test the product.

10.1.3 Test of Appearance Characteristics:

According to the individual specification to test the product.

10.1.4 Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

10.1.5 Delivery Test:

Before delivering, the supplier should take the delivery test.

A. Test method: According to GB/2828,General Inspection Level □ take a single time.

B. The defects classify of AQL as following:

Major defect: AQL=0.25

Minor defect: AQL=1.0

Total defects: AQL=1.0

10.2 Standard for inspection

10.2.1 Manner of appearance test:

a. The test must be under a 40W fluorescent light, and the distance of view must be at 30~35 cm.

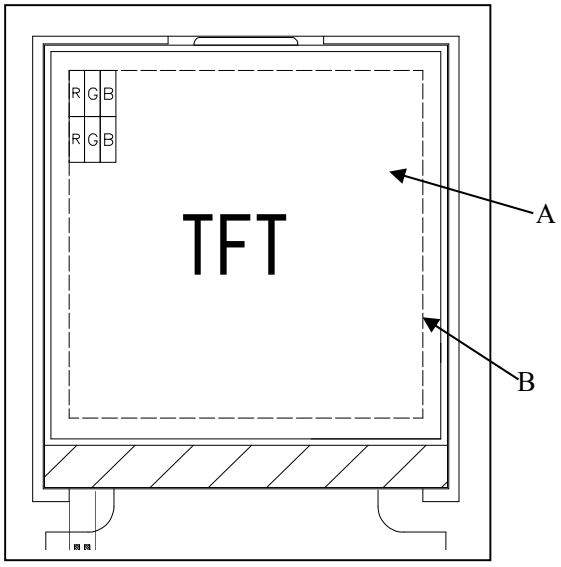
b. When test the model of transmissive product must add the reflective plate.

c. The test direction is base on about around 45° of vertical line.

10.2.2 Definition of area: A B

A Area : Viewing area.

B Area : Out of viewing area.(Outside viewing area)



10.2.3 Basic principle:

A. In principle the defect out of Area A should be acceptable if the defect does not affect assemblage and the quality of productions.

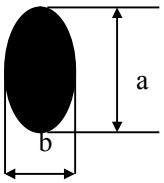
B. If defects that can not describe clearly, acceptable samples will be the standard.

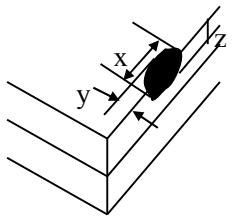
C. The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.

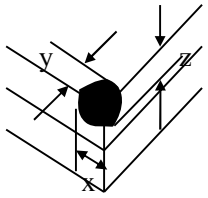
D. Must add new item on time when it is necessary.

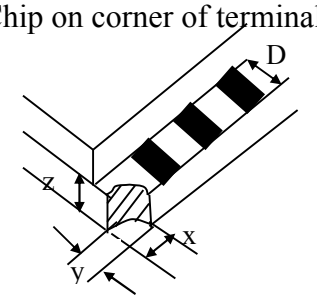
10.2.4 Standard of inspection

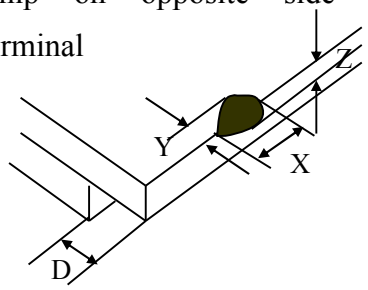
Defect	Inspect item		Criteria
1 Minor	Scratch and fold on polarizer. Scratch on glass. Glass fiber etc. （by bare eyes，defect outside A area is acceptable）		1) width ≤ 0.02 mm length ignore acceptable 2) 0.02 mm<width≤0.05 mm length ≤ 3 mm two are acceptable 3) width>0.05 mm reject

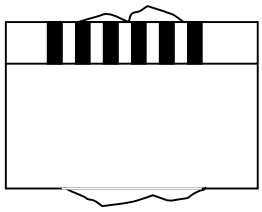
Defect	Inspect item		Criteria
2 Minor	Chip on glass(round type) Chip on polarizer(round type) Air bubble between polarizer and glass  Φ=(a + b)/2		Φ≤0.1mm acceptable 0.1<Φ≤0.2mm two are acceptable 1.The distance between any two dots should be more than 5mm. 2.Defect outside A area is acceptable. 3.If the air bubble is black, it can be judged as black spot.

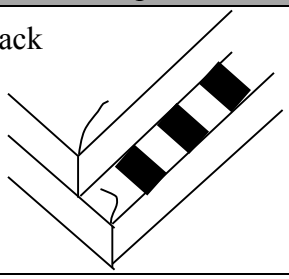
Defect	Inspect item		Criteria
3 Minor	Chip out  x: length y: width z: thickness		x≤3 mm z≤t y≤1/3 s reject t: glass thickness. S: distance between glass edge and inside of edge sealing

Defect	Inspect item		Criteria
4 Minor	Chip on corner of neat edge  X: length Y: width S: width of edge sealing		x≤3 mm y≤3 mm z≤t acceptable any chip exposes the silver dot reject

Defect	Inspect item		Criteria
5 Minor	Chip on corner of terminal edge  D: terminal length		x<0.3 mm or y<0.3 mm ignore x≤3 mm y<D two are acceptable

Defect	Inspect item		Criteria
6 Minor	Chip on opposite side of terminal 		a≥80mm，x≥7mm reject a<80mm， x>5mm reject y>1/2D reject z>1/2t，y>1/4D reject D: terminal length

Defect	Inspect item		Criteria
7 Minor	Cutting/breaking defect (flare) 		According to the dimension of drawing

Defect	Inspect item		Criteria
8 Minor	Crack 		Any crack trend to extend reject

Defect	Inspect item		Criteria
9 Major	Liquid leakage, open sealant		reject

Defect	Inspect item		Criteria
10 Minor	Rainbow		According to samples

Defect	Inspect item		Criteria
11 Major	FPC、TCP、FLEX are broken or not connected firmly		reject

Defect	Inspect item		Criteria
12 Minor	The component on PCB or FPC is missing ,soldered unfirmly or bridged		reject

Defect	Inspect item		Criteria
13 Minor	The soldering tin is not enough		The height that soldering tin covers the bump of component is 1/2 less than the height of bump reject

Defect	Inspect item		Criteria
14 Minor	The soldering tin overflows		The soldering tin covers whole bump reject

Defect	Inspect item		Criteria
15 Minor	The component is broken		reject

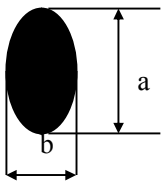
Defect	Inspect item		Criteria
16 Minor	The shape of pinouts is not the same as that in the criterion		It makes the LCM work badly reject

Defect	Inspect item		Criteria
17 Minor	The pinout is broken		reject

Defect	Inspect item		Criteria
18 Minor	The frame is scratched visibly		Length ignore Width >0.5mm reject

Defect	Inspect item		Criteria
19 Minor	The frame is rusted (accumulation)		When the shape is as dot,reference to defect 23 When the shape is as line,reference to defect 24

Defect	Inspect item		Criteria
20 Minor	Scratch and fold on touchpanel. （by bare eyes，defect outside A area is acceptable）		1) width≤0.02 mm acceptable 2) 0.02 mm<width≤0.05 mm length≤5 mm two are acceptable 3) width>0.05 mm reject

Defect	Inspect item		Criteria
21 Minor	Black & white dots on touchpanel (round type) Air bubble on touchpanel Φ=(a + b)/2 		1) Φ≤0.1 mm acceptable 2) 0.1<Φ≤0.3 mm three are acceptable 3) Φ>0.3 mm reject 1.The distance between any two dots should be more than 5mm. 2.Defect outside A area is acceptable. 3.If the air bubble is black, it can be judged as black spot.

Defect	Inspect item		Criteria
22 Minor	Touchpanel warps		According to the dimension of drawing.

Defect	Inspect item		Criteria
23 Minor	Dirty on rear of touchpanel		It's visible at condition of30±5 cm, 45°

10.3 RELIABILITY

Item	Condition	Criterion
High temperature operation	**70°C， 96 hrs**	**-Cosmetic defects are not allowed after the test(Polarizer change is exceptional)** **-Contrast ratio change over 50% of initial value should not be happened** **-The current consumption should be below double of initial value** **-Brightness decrease should be lower than 50% of initial value**
Low temperature operation	**-20°C， 96 hrs**	
Moisture storage	**60°C，90%RH, 96 hrs**	
High temperature storage	**80°C， 96 hrs**	
Low temperature storage	**-30°C， 96 hrs**	
Thermal shock	**-30°C (30 minute)** **25°C (5 minute)** **80°C (30 minute)** **CYCLES: 10**	

11. PRECAUTIONS IN USING

11.1 Liquid crystal display (LCD)

The LCD panel is made up of glass, organic fluid and polarizer. When handling, please pay attention to the following items:

1) Keep the operation and storage temperature of the LCD within the range specified in the LCD specification. Otherwise, excessive temperature and humidity would cause polarization degradation, bubble generation or polarizer peel-off.
2) Prevent it from mechanical shock by dropping it from a high place, etc.
3) Don't contact, push or rub the exposed polarizers with anything harder than HB pencil lead.
4) Avoid using chemicals such as acetone, toluene, ethanol and isoropylalcohol to clean the front/rear polarizers and reflectors, which will cause damage to them.
5) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause deformation or color fading. The LCM is assembled and adjusted with a high degree of precision.
6) Do not put or attach anything on the display area. Avoid touching the display area with bare hand.

11.2 Precaution for handling LCD modules

The LCM is assembled and adjusted with a high degree of precision, do not applying excessive shocks to it or making any alterations or modifications to it, the following precautions should be taken when handing.

1) Do not drop, bend or twist the module.
2) Do not alter or making any modification on the shape of the metal frame.
3) Do not change the shape, the pattern wiring or add any extra hole on the PCB.
4) Do not modify or touch the zebra rubber strip(conductive rubber) with another object.
5) Do not change the positions of components on the PCB.

11.3 Eletro-static discharge control

Careful attention should be paid to control the electrostatic discharge of the modules, since the modules contain no. of CMOS LSI.

1) Make sure you are grounded properly when remove the module from its antistatic bag. Be sure that the module and have the same electric potential.
2) Only properly grounded soldering iron should be used.
3) Modules should be stored in antistatic bag or other containers resistant to static after remove from its original package.
4) When using the electric screw-driver is used, make sure the screw driver had been ground potentiality to minimize the transmission of EM wave produced by commutator sparks.
5) In order to reduce the generation of static electricity, a relative humidity of 50-60% is recommended.

11.4 Precaution for soldering

1) Soldering should apply to I/O terminals only.
2) Soldering temperature is 280℃+(-)10℃.
3) Soldering time 3-4 seconds.
4) Eutectic solder (rosin flux filled) should be used.
5) If soldering flux is used, be sure to remove any remaining flux after finishing the soldering operation and LCD surface should be covered during soldering to prevent any damage to flux spatters.
6) When remove the lead wires from the I/O terminals, use proper de-soldering methods, e.g. suction type de-soldering irons. Do not repeat wiring by soldering more than three times at the pads and plated though holes may be damaged.

11.5 Precaution for operation

1) Adjust liquid crystal driving voltage (Vo) to varies viewing angle and obtain the contrast.
2) Vo should be kept in proper range stated in the specification. Excess voltage will shorten the LCD life.
3) Response time is greatly delayed at low temperature. It will recover when go back to normal temperature.
4) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore it should be used under the relative condition of 50% RH.

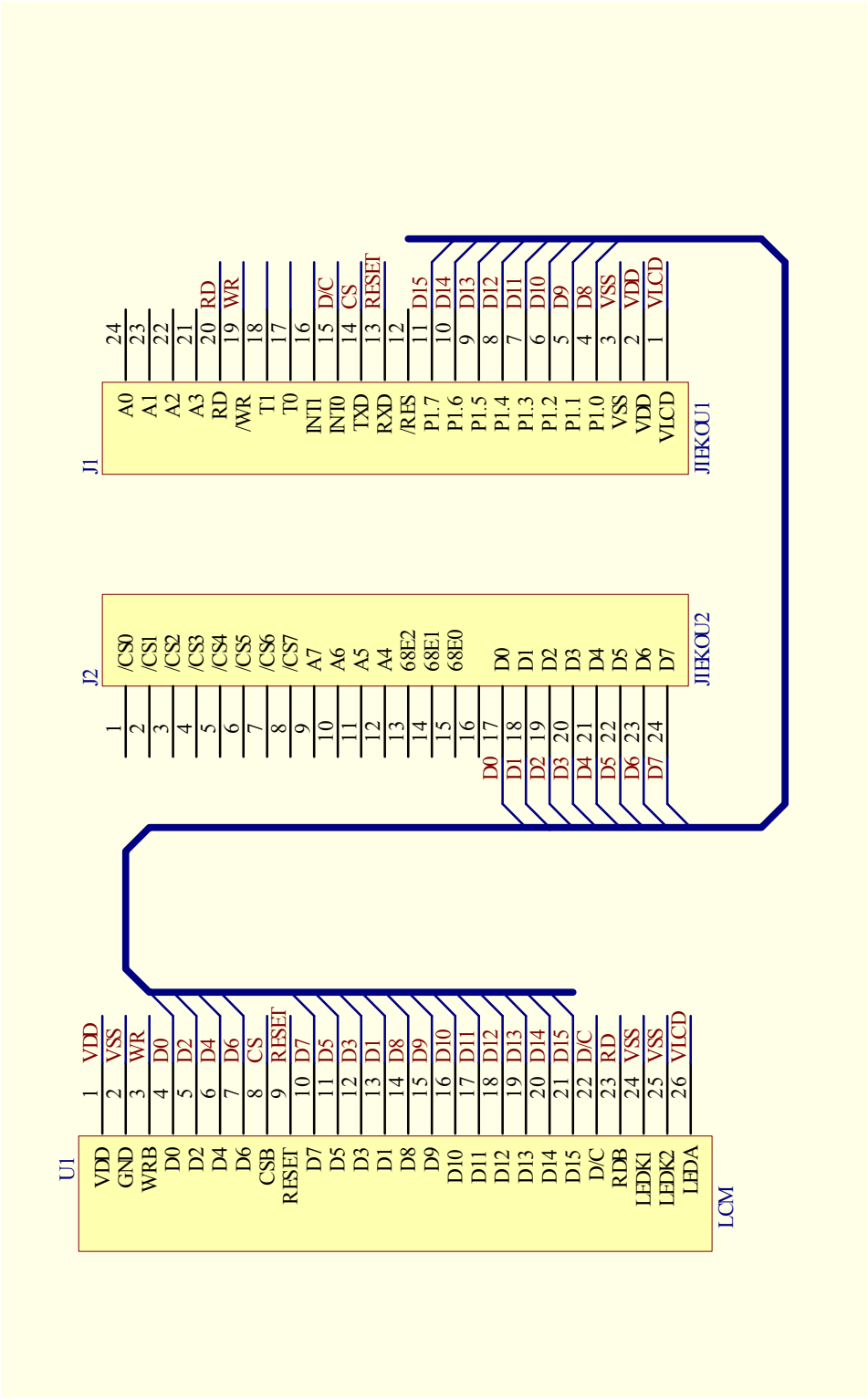
11.6 Storage

When long term storage is required, following precautions are necessary:

1) Storage them in a sealed polyethylene bag (antistatic), seal the opening, and store it where it is not subjected to direct sunshine, or to the light of fluorescent lamp. If properly sealed, there is no need for desiccant.
2) Store them in the temperature range of -30℃~ 80℃ and at low humidity is recommended.

12. APPLICATION

12.1 REFERENCE CIRCUIT



12.2 APPENDIX

INITIALIZATION FOR REFERENCE

```
BINITIAL:
        MOV REG,#11H     ;Sleep out
        LCALL BWRCTRL
        MOV TIME1,#200 ;Delay 120ms
        LCALL DELAY
;----ST7735R Frame Rate----
        MOV REG,#0B1H
        LCALL BWRCTRL
        MOV DAT,#01H
        LCALL BWRDATA
        MOV DAT,#2CH
        LCALL BWRDATA
        MOV DAT,#2DH
        LCALL BWRDATA

        MOV REG,#0B2H
        LCALL BWRCTRL
        MOV DAT,#01H
        LCALL BWRDATA
        MOV DAT,#2CH
        LCALL BWRDATA
        MOV DAT,#2DH
        LCALL BWRDATA

        MOV REG,#0B3H
        LCALL BWRCTRL
        MOV DAT,#01H
        LCALL BWRDATA
        MOV DAT,#2CH
        LCALL BWRDATA
        MOV DAT,#2DH
        LCALL BWRDATA
        MOV DAT,#01H
        LCALL BWRDATA
        MOV DAT,#2CH
        LCALL BWRDATA
        MOV DAT,#2DH
        LCALL BWRDATA
;----End ST7735R Frame Rate----
```

```
;----ST7735R Power Sequence----
        MOV REG,#0B4H    ;Dot inversion
        LCALL BWRCTRL
        MOV DAT,#03H
        LCALL BWRDATA

        MOV REG,#0B6H    ;Extend gate non-overlap time
        LCALL BWRCTRL
        MOV DAT,#0B4H
        LCALL BWRDATA
        MOV DAT,#0F0H
        LCALL BWRDATA

        MOV REG,#0C0H
        LCALL BWRCTRL
        MOV DAT,#0A2H
        LCALL BWRDATA
        MOV DAT,#02H
        LCALL BWRDATA
        MOV DAT,#84H
        LCALL BWRDATA

        MOV REG,#0C1H
        LCALL BWRCTRL
        MOV DAT,#0C5H
        LCALL BWRDATA

        MOV REG,#0C2H
        LCALL BWRCTRL
        MOV DAT,#0AH
        LCALL BWRDATA
        MOV DAT,#00H
        LCALL BWRDATA

        MOV REG,#0C3H
        LCALL BWRCTRL
        MOV DAT,#8AH
        LCALL BWRDATA
        MOV DAT,#2AH
        LCALL BWRDATA

        MOV REG,#0C4H
        LCALL BWRCTRL
        MOV DAT,#8AH
```

```
                LCALL BWRDATA
                MOV DAT,#0EEH
                LCALL BWRDATA
  ;----End ST7735R Power Sequence----

                MOV REG,#0C5H ;VCOM
                LCALL BWRCTRL
                MOV DAT,#18H
                LCALL BWRDATA

  ;----ST7735R Gamma Sequence----
                MOV REG,#0E0H
                LCALL BWRCTRL
                MOV DAT,#03H
                LCALL BWRDATA
                MOV DAT,#1BH
                LCALL BWRDATA
                MOV DAT,#08H
                LCALL BWRDATA
                MOV DAT,#0AH
                LCALL BWRDATA
                MOV DAT,#3AH
                LCALL BWRDATA
                MOV DAT,#35H
                LCALL BWRDATA
                MOV DAT,#2CH
                LCALL BWRDATA
                MOV DAT,#2EH
                LCALL BWRDATA
                MOV DAT,#2BH
                LCALL BWRDATA
                MOV DAT,#26H
                LCALL BWRDATA
                MOV DAT,#2CH
                LCALL BWRDATA
                MOV DAT,#3CH
                LCALL BWRDATA
                MOV DAT,#00H
                LCALL BWRDATA
                MOV DAT,#01H
                LCALL BWRDATA
                MOV DAT,#03H
                LCALL BWRDATA
                MOV DAT,#10H
```

```
            LCALL BWRDATA

            MOV REG,#0E1H
            LCALL BWRCTRL
            MOV DAT,#04H
            LCALL BWRDATA
            MOV DAT,#1AH
            LCALL BWRDATA
            MOV DAT,#08H
            LCALL BWRDATA
            MOV DAT,#0AH
            LCALL BWRDATA
            MOV DAT,#24H
            LCALL BWRDATA
            MOV DAT,#22H
            LCALL BWRDATA
            MOV DAT,#1FH
            LCALL BWRDATA
            MOV DAT,#26H
            LCALL BWRDATA
            MOV DAT,#28H
            LCALL BWRDATA
            MOV DAT,#29H
            LCALL BWRDATA
            MOV DAT,#33H
            LCALL BWRDATA
            MOV DAT,#3CH
            LCALL BWRDATA
            MOV DAT,#00H
            LCALL BWRDATA
            MOV DAT,#01H
            LCALL BWRDATA
            MOV DAT,#03H
            LCALL BWRDATA
            MOV DAT,#10H
            LCALL BWRDATA
;----End ST7735R Gamma Sequence----
            MOV REG,#0F0H ;Enable test command
            LCALL BWRCTRL
            MOV DAT,#01H
            LCALL BWRDATA

            MOV REG,#0F6H ;Disable ram power save mode
            LCALL BWRCTRL
```

```
MOV DAT,#00H
LCALL BWRDATA

MOV REG,#0FFH ;Improve booster efficiency
LCALL BWRCTRL
MOV DAT,#88H
LCALL BWRDATA
MOV DAT,#08H
LCALL BWRDATA

MOV REG,#36H
LCALL BWRCTRL
MOV DAT,#80H
LCALL BWRDATA

MOV REG,#3AH ;65k mode
LCALL BWRCTRL
MOV DAT,#05H
LCALL BWRDATA

MOV REG,#29H ;Display on
LCALL BWRCTRL     ……..TO YOUR CODE
```