

AZ DISPLAYS

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

CUSTOMER APPROVAL			
※ PART NO. : <u>ATM4825AS SERIES (AZ DISPLAYS) VER1.0</u>			
APPROVAL		COMPANY CHOP	
CUSTOMER COMMENTS			

AZ DISPLAYS ENGINEERING APPROVAL		
DESIGNED BY	CHECKED BY	APPROVED BY
GU		

REVISION RECORD

REVISION	REVISION DATE	PAGE	CONTENTS
PRELIMINARY VER1.0	2020-06-25 2020-08-27		FIRST ISSUE FORMAL RELEASE

※ **CONTENTS**

- 1.0 GENERAL SPECS
- 2.0 ABSOLUTE MAXIMUM RATINGS
- 3.0 ELECTRICAL CHARACTERISTICS
- 4.0 OPTICAL CHARACTERISTICS
- 5.0 BLOCK DIAGRAM
- 6.0 PIN ASSIGNMENT
- 7.0 TIMING CHARACTERISTICS
- 8.0 COMMAND LIST
- 9.0 MECHANICAL DIAGRAM
- 10.0 RELIABILITY TEST
- 11.0 PRECAUTION FOR USING LCM
- 12.0 REFERENCE INITIAL CODE
- Appendix: P/N description

1.0 GENERAL SPECS

ATM4825AS series design is based on ZETTLER patented HC product ATM4825A series. Besides all the features of ATM4825A series, this product adopts SPI interface which can greatly save user's MCU resource. Traditional 480*256 mono products require 15 MCU GPIOs while ATM4825AS series require only 5 GPIOs. Furthermore, ATM4825AS integrates more functions into this SPI interface, now user can control font/column setting via SPI interface, and user can even change the font/background color and control the backlight brightness via this SPI interface without consuming extra hardware/software resource on their main board.

1. Display Format	480*256 DOTS
2. Power Supply LCM	5.0V/3.3V (Refer to P/N description in last page)
3. Overall Module Size	144.0mm(W) x 104.0mm(H) x max 10.0mm(D) *
4. Viewing Area(W*H)	113.5mm(W) x 64.0mm(H)
5. Pixel Pitch (W*H)	0.231mm(W) x 0.231mm(H)
6. Active Area(W*H)	110.88mm(W) x 59.136mm(H)
6. Viewing Direction	Free viewing angle
7. Driving Method	TFT
8. Controller IC	SPI to parallel bridge chip + RA8835 or compatible
9. Interface	4-WIRE SPI, Write only
10. Display Mode	8 color mode optional, controlled via SPI command
11. Backlight Options	White LED/Side, integrated PWM dimming function
12. Operating temperature	-20°C ~ 70°C
13. Storage temperature	-30°C ~ 80°C
14. RoHS	RoHS compliant

* Doesn't contain connector height

2.0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min	Typ	Max	Unit
Operating temperature	Top	-20	--	70	°C
Storage temperature	Tst	-30	--	80	°C
Input voltage	Vin	Vss-0.3	--	Vdd+0.3	V
Supply voltage for logic	Vdd- Vss	-0.3	-	7.0	V

3.0 ELECTRICAL CHARACTERISTICS

3.1 Electrical Characteristics Of LCM

Item	Symbol	Condition	Min	Typ	Max	Unit
Power Supply Voltage	Vdd	25°C	4.8	5.0	5.2	V
			3.0	3.3	3.6	
Power Supply Current	Idd	Vdd=5.0V	--	--	100	mA
		Vdd=3.3V	--	--	90	
Input voltage (high)	Vih	Pins:(SI / SCL / CSB / RS, RESET)	0.8Vdd	--	Vdd	V
Input voltage (low)	Vil		0	--	0.2Vdd	V

3.2 The Characteristics Of LED Backlight

3.2.1 Electrical-Optical Characteristics Of LED Backlight (Ta=25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage ⁽¹⁾⁽⁵⁾	Vf	--	3	5	5.5	V
Forward Current ⁽⁵⁾	If	Vf = 5V	--	206	--	mA
Luminance ⁽³⁾	Lv	Vf = 5V	200	250	--	cd/m ²
Uniformity ⁽²⁾	Δ	(Lvmin/Lvmax)%	70%	75%	--	-
Chroma coordinate	x	Vf = 5V	0.26	--	0.36	-
	y		0.28	--	0.38	-
Lifetime ⁽⁴⁾	-	Vf = 5V	-	50000	-	Hours

NOTE:

(1) Forward voltage means voltage applied to Pin9 & Pin10

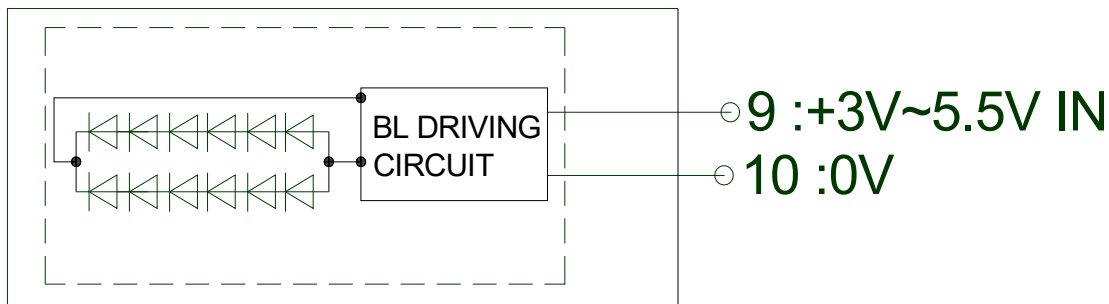
(2) The luminance is the average value of 5 points, The measurement instrument is BM-7 luminance colorimeter. The diameter of aperture is Φ5mm

(3) Luminance when LCM displaying white color.

(4) Backlight lifetime means luminance value larger than half of the original after 20000 hours' continuous working.

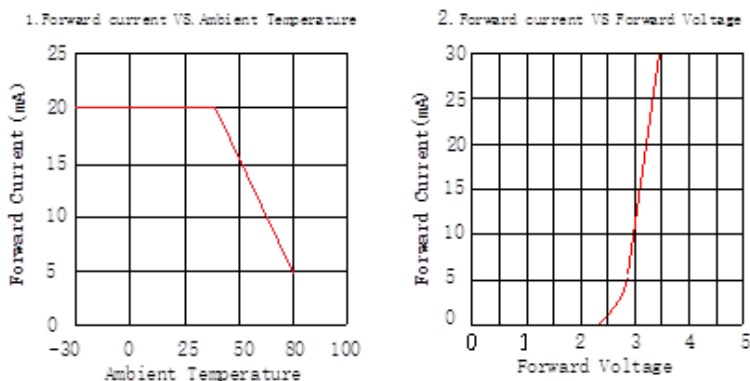
(5) Input current of Pin 9 might change because the voltage of PIN9 will affect the efficiency of backlight driving circuit, but current for LEDs will keep constant within the range of input voltage.

3.2.2 Backlight Control Circuit For LCM (2x6=12 pcs LED)



PIN10 is connected to PIN2(VSS) internally

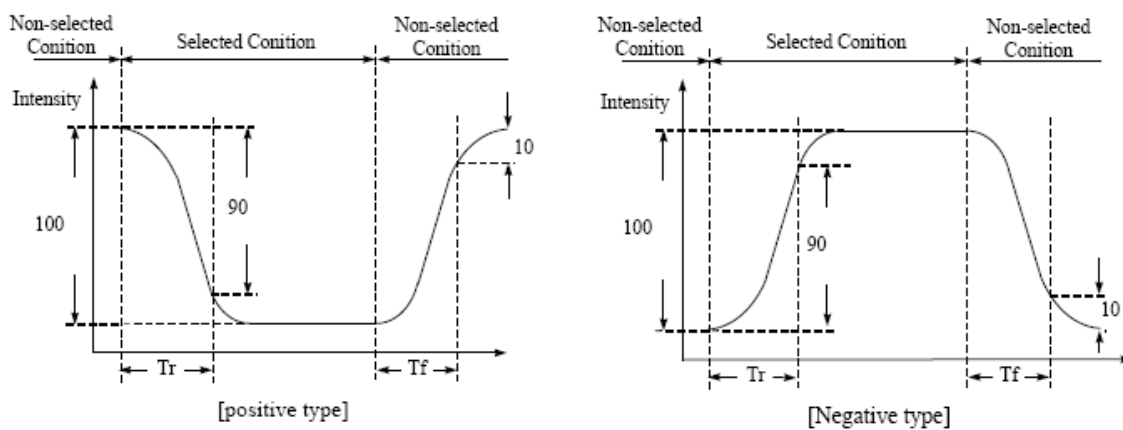
3.2.3 LED Characteristics Curves (for single led)



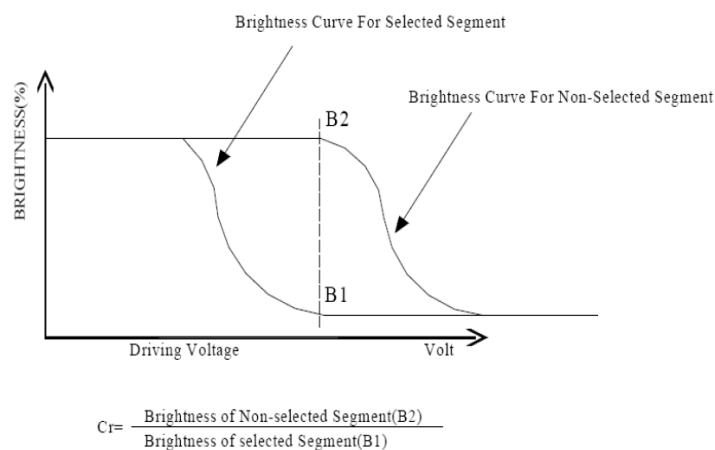
4.0 OPTICAL CHARACTERISTICS (Ta=25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing angle (Left - right)	$\theta 2$	$Cr \geq 2.0$	-80	-	80	deg
Viewing angle (Up-down)	$\theta 1$	$Cr \geq 2.0$	-80	-	80	deg
Contrast Ratio ($\theta 1=0^\circ$, $\theta 2=0^\circ$)	Cr	FT:white,BG:black	400	500		-
		FT:black,BG:white	400	500		-
		FT:white,BG:blue	48	60		-
		FT:black,BG:Y-G	320	400	-	-
Response time (rise)	Tr	$\theta 1=0^\circ$, $\theta 2=0^\circ$	-	10	20	ms
Response time (fall)	Tf	$\theta 1=0^\circ$, $\theta 2=0^\circ$	-	15	30	ms

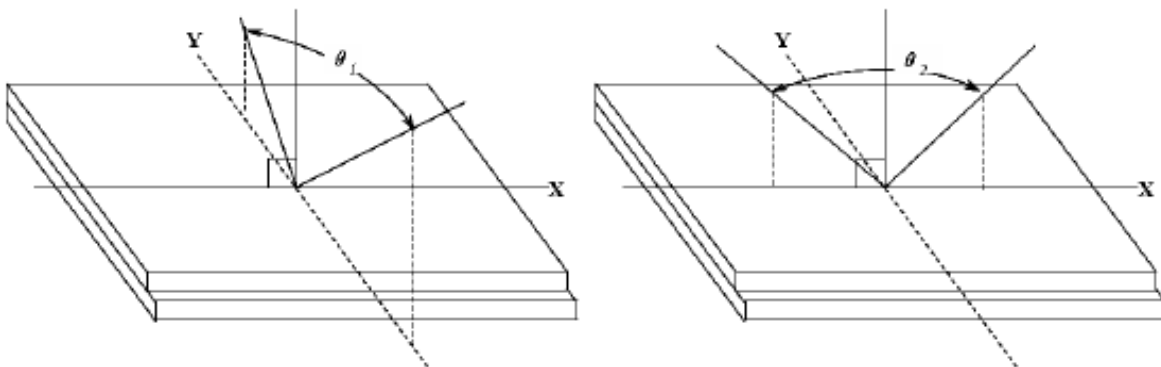
(1). Definition of Optical Response Time



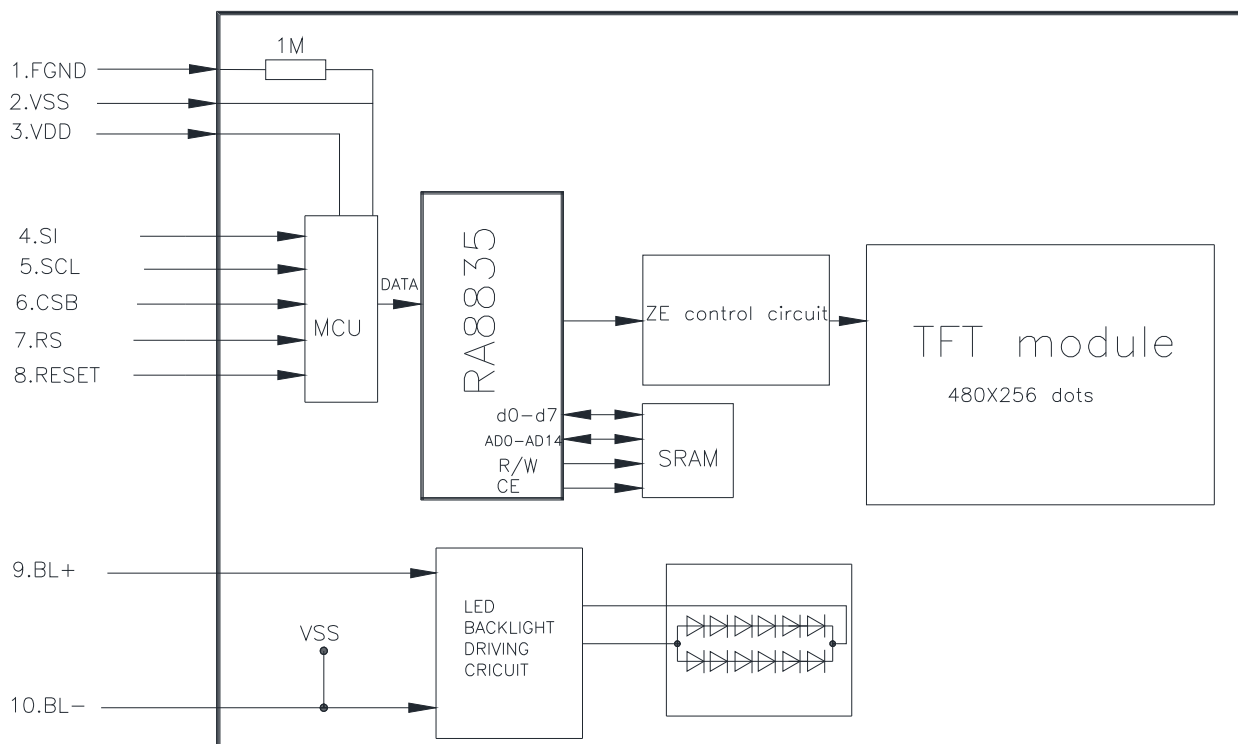
(2). Definition of Contrast Ratio



(3). Definition of Viewing Angle θ_2 and θ_1



5.0 BLOCK DIAGRAM



6.0 PIN ASSIGNMENT

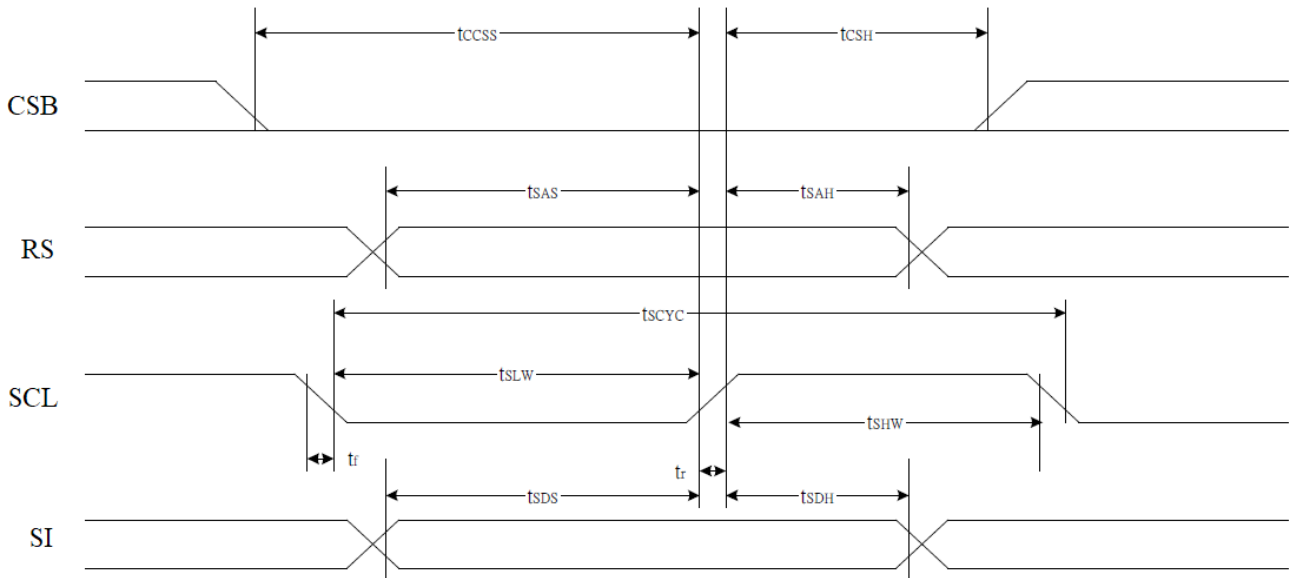
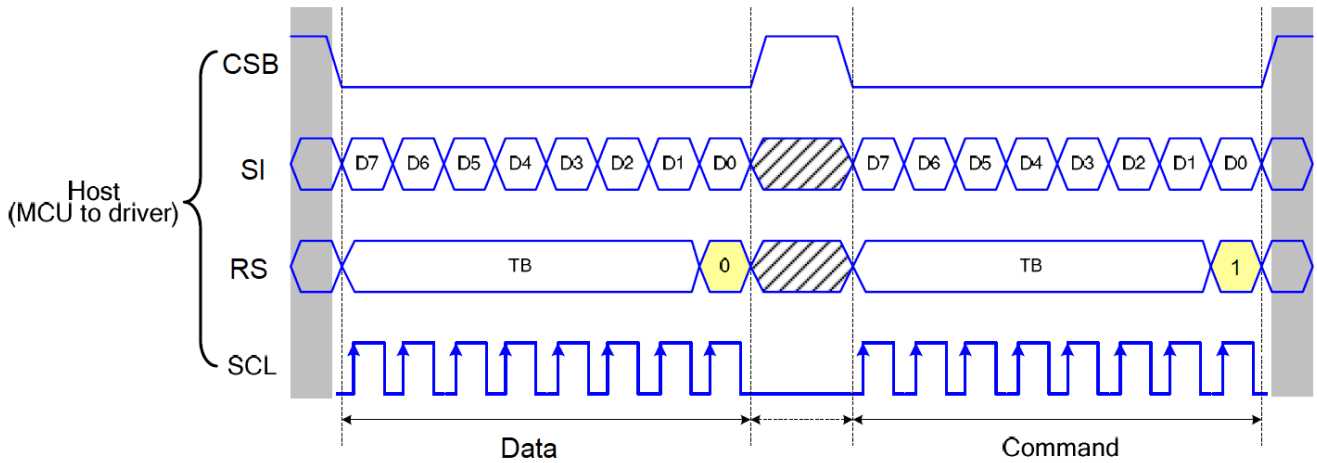
Pin No.	Symbol	Function	I/O
1	FGND	Frame Ground, connected to VSS via a 1M ohms resistor internally	P
2	VSS	Power ground	P
3	VDD	5V/3.3V	P, Refer to P/N description
4	SI	SPI data, write only	I
5	SCL	SPI clock, latching at rising edge	I
6	CSB	Chip Enable, enabled "L"	I
7	RS	Command/Data RS = H, Command RS = L, Data	I
8	RESET	Reset, enabled "L"	I, refer to note for detailed information
9	BL+	Power supply for LED driving circuit, 5V typical	P
10	BL-	Power ground for LED driving circuit, internally connected to VSS	P

Note:

There're two methods to control the RESET signal:

1. Simply leave this pin open, the LCM has internal power on reset which can ensure reliable reset, please delay at least 100ms after power on before sending any command/data to LCM, or the command/data might be missed.
2. Connect this pin to a GPIO, after power on, pull the GPIO to LOW level for at least 1ms, after this, pull the GPIO to HIGH for at least 100ms, then you can start sending command/data to LCM.

7.0 TIMING CHARACTERISTICS



Item	Signal	Symbol	Rating		Units
			Min	Max	
Serial Clock Period	SCL	tSCYC	1000	--	ns
SCL "H" pulse width		tSHW	500	--	
SCL "L" pulse width		tSLW	500	--	
Address setup time	RS	tSAS	400	--	
Address hold time		tSAH	200	--	
Data setup time	SI	tSDS	400	--	
Data hold time		tSDH	200	--	
CS-SCL setup time	CSB	tCSS	400	--	
CS-SCL hold time		tCSH	800	--	

Note: SPI read is not supported

Set RS to "H" when sending command and "L" when sending data

8.0 COMMAND LIST

ATM4825AS series' command list are fully compatible with RA8835, please refer to RA8835 to get the command list. Besides the RA8835 standard command list, ATM4825AS has an extra set of commands to control display color, display brightness, font/column setting, we'll add command details after we finish the design.

STANDARD COMMAND(REFER TO RA8835 DATASHEET)

INSTRUCTION	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	DESCRIPTION
System set	0	1	0	0	0	0	0	0	Initialize device and display
Sleep in	0	1	0	1	0	0	1	1	Enter standby mode
Display on/off	0	1	0	1	1	0	0	X	Enable and disable display and display flashing
Scroll	0	1	0	0	0	1	0	0	Set display start address and display regions
CSRFORM	0	1	0	1	1	1	0	1	Set cursor type
CGRAM ADR	0	1	0	1	1	1	0	0	Set start address of character generator RAM
CSRDIR	0	1	0	0	1	1	X	X	Set direction of cursor movement
HDOT SCR	0	1	0	1	1	0	1	0	Set horizontal scroll position
OVLAY	0	1	0	1	1	0	1	1	Set display overlay format
CSRW	0	1	0	0	0	1	1	0	Set cursor address
MWRITE	0	1	0	0	0	0	1	0	Write to display memory

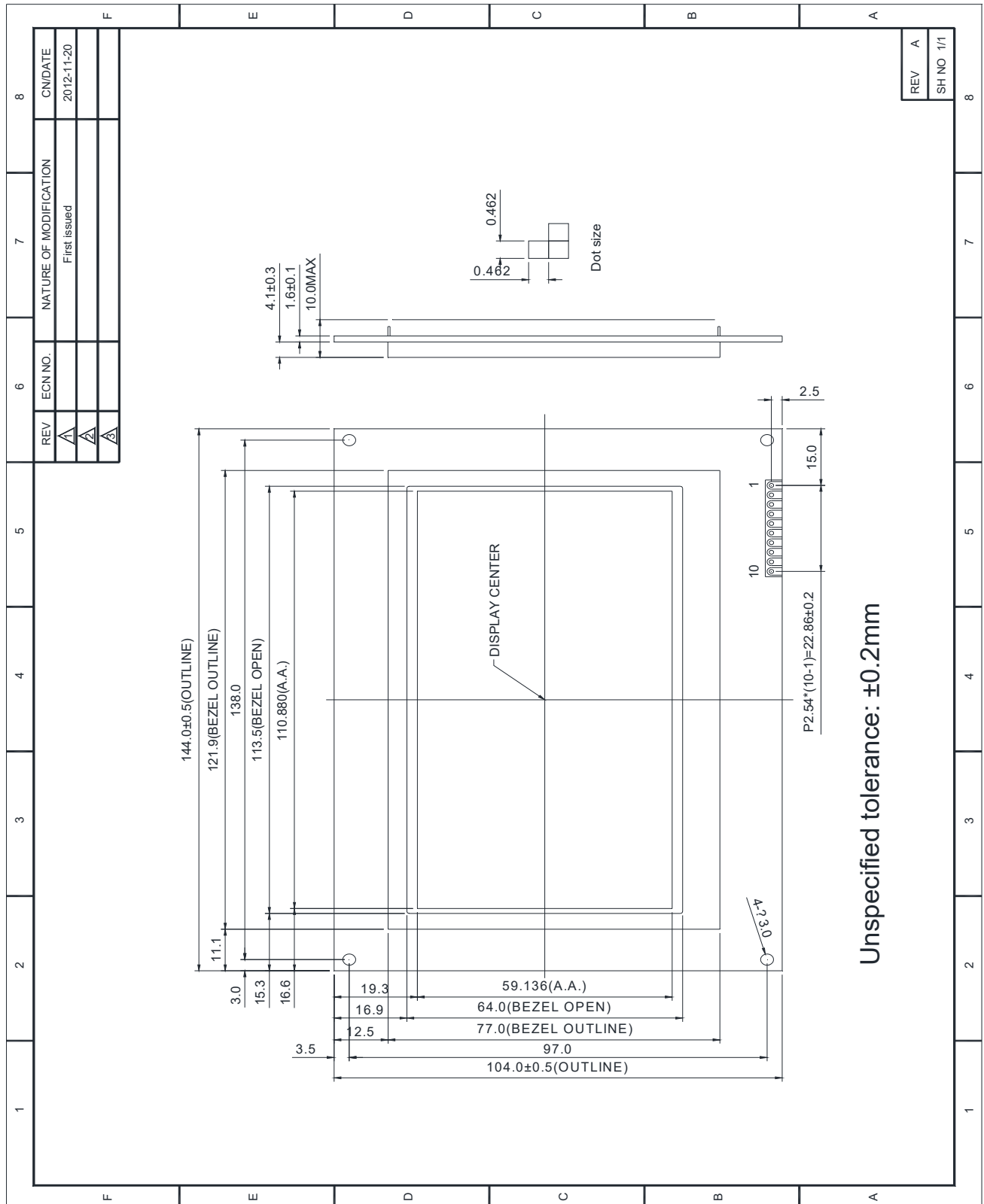
ATM4825AS SERIES TFT GRAPHIC MODULE V1.0

Extension command list:

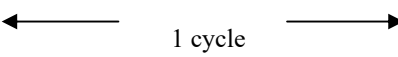
INSTRUCTION	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	DESCRIPTION
Display Color Set	0	0	1	1	1	0	0	0	Black Font, White Background(Default)
						0	0	1	White Font, Black Background
						0	1	0	Black Font, Yellow-Green Background
						0	1	1	White Font, Blue Background
						1	0	0	Red font, white background
						1	0	1	Green font, white background
						1	1	0	Blue font, white background
						1	1	1	Cyan font, white background
Backlight Brightness Set (Total 16 levels from off(0x10) to brightest(0x1f))	0	0	0	1	0	0	0	0	Backlight off(Default)
					0	0	0	1	Backlight on, dimmest
					0	0	1	0	Backlight on, 2 nd dimmest
					-	-	-	-	-
					-	-	-	-	-
					1	1	0	1	3 rd brightest
					1	1	1	0	2 nd brightest
					1	1	1	1	Backlight on, brightest

All are one byte command, set RS to "H" when using these commands.

9.0 MECHANICAL DIAGRAM



10.0 RELIABILITY TEST

NO	Test Item	Description	Test Condition	Remark
1	Environmental Test	High temperature storage Applying the high storage temperature Under normal humidity for a long time Check normal performance	80 °C 96hrs	
2		Low temperature storage Applying the low storage temperature Under normal humidity for a long time Check normal performance	-30°C 96hrs	
3		High temperature Operation Apply the electric stress(Voltage and current) Under high temperature for a long time	70 °C 96hrs	Note1
4		Low temperature Operation Apply the electric stress Under low temperature for a long time	-20°C 96hrs	Note1 Note2
5		High temperature/High Humidity Storage Apply high temperature and high humidity storage for a long time	90% RH 40°C 96hrs	Note2
6		Temperature Cycle Apply the low and high temperature cycle -30°C <> 25°C <> 80°C <> 25°C 30min 10min 30min 10min  Check normal performance	-30°C/80°C 10 cycle	
7	Mechanical Test	Vibration test(Package state) Applying vibration to product check normal performance	Freq:10~55~10Hz Amplitude:0.75mm 1cycle time:1min X.Y.Z every direction for 15 cycles	
8		Shock test(package state) Applying shock to product check normal performance	Drop them through 70cm height to strike horizontal plane	
9	Other			

Remark

Note1: Normal operations condition (25°C±5°C).

Note2: Pay attention to keep dewdrops from the module during this test.

11.0 PRECAUTION FOR USING LCM

1. When design the product with this LCD Module, make sure the viewing angle matches to its purpose of usage.
2. As LCD panel is made of glass substrate, Dropping the LCD module or banging it against hard objects may cause cracking or fragmentation. Especially at corners and edges.
3. Although the polarizer of this LCD Module has the anti-glare coating, always be careful not to scratch its surface. Use of a plastic cover is recommended to protect the surface of polarizer.
4. If the LCD module is stored at below specified temperature, the LC material may freeze and be deteriorated. If it is stored at above specified temperature, the molecular orientation of the LC material may change to Liquid state and it may not revert to its original state. Excessive temperature and humidity could cause polarizer peel off or bubble. Therefore, the LCD module should always be stored within specified temperature range.
5. Saliva or water droplets must be wiped off immediately as those may leave stains or cause color changes if remained for a long time. Water vapor will cause corrosion of ITO electrodes.
6. If the surface of LCD panel needs to be cleaned, wipe it swiftly with cotton or other soft cloth. If it is not still clean enough, blow a breath on the surface and wipe again.
7. The module should be driven according to the specified ratings to avoid malfunction and permanent damage. Applying DC voltage cause a rapid deterioration of LC material. Make sure to apply alternating waveform by continuous application of the M signal. Especially the power ON/OFF sequence should be kept to avoid latch-up of driver LSIs and DC charge up to LCD panel.
8. Mechanical Considerations
 - a) LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.
 - b) Do not tamper in any way with the tabs on the metal frame.
 - c) Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
 - d) Do not touch the elastomer connector; especially insert a backlight panel (for example, EL).
 - e) When mounting a LCM makes sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
 - f) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.
9. Static Electricity
 - a) Operator

Wear the electrostatics shielded clothes because human body may be statically charged if not wear shielded clothes. Never touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.

b) Equipment

There is a possibility that the static electricity is charged to the equipment, which has a function of peeling or friction action (ex: conveyer, soldering iron, working table). Earth the equipment through proper resistance (electrostatic earth: 1×10^8 ohm).

Only properly grounded soldering irons should be used.

If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.

The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.

c) Floor

Floor is the important part to drain static electricity, which is generated by operators or equipment.

There is a possibility that charged static electricity is not properly drained in case of insulating floor. Set the electrostatic earth (electrostatic earth: 1×10^8 ohm).

d) Humidity

Proper humidity helps in reducing the chance of generating electrostatic charges. Humidity should be kept over 50%RH.

e) Transportation/storage

The storage materials also need to be anti-static treated because there is a possibility that the human body or storage materials such as containers may be statically charged by friction or peeling.

The modules should be kept in antistatic bags or other containers resistant to static for storage.

f) Soldering

Solder only to the I/O terminals. Use only soldering irons with proper grounding and no leakage.

Soldering temperature : $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$

Soldering time: 3 to 4 sec.

Use eutectic solder with resin flux fill.

If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

g) Others

The laminator (protective film) is attached on the surface of LCD panel to prevent it from scratches or stains. It should be peeled off slowly using static eliminator.

Static eliminator should also be installed to the workbench to prevent LCD module from static charge.

10. Operation

- a) Driving voltage should be kept within specified range; excess voltage shortens display life.
 - b) Response time increases with decrease in temperature.
 - c) Display may turn black or dark blue at temperatures above its operational range; this is (however not pressing on the viewing area) may cause the segments to appear "fractured".
 - d) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".
11. If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. The toxicity is extremely low but caution should be exercised at all the time.
 12. Disassembling the LCD module can cause permanent damage and it should be strictly avoided.
 13. LCD retains the display pattern when it is applied for long time (Image retention). To prevent image retention, do not apply the fixed pattern for a long time. Image retention is not a deterioration of LCD. It will be removed after display pattern is changed.
 14. Do not use any materials, which emit gas from epoxy resin (hardener for amine) and silicone adhesive agent (dealcohol or deoxym) to prevent discoloration of polarizer due to gas.
 15. Avoid the exposure of the module to the direct sunlight or strong ultraviolet light for a long time.
 16. The brightness of LCD module may be affected by the routing of CCFL cables due to leakage to the chassis through coupling effect. The inverter circuit needs to be designed taking the level of leakage current into consideration. Thorough evaluation is needed for LCD module and inverter built into its host equipment to ensure specified brightness.

12.0 REFERENCE INITIAL CODE

//Power on and wait for power stable, then reset. If RESET pin is not connected, only 100ms delay is necessary.

```
GPIO_WriteBit(GPIO_RESET,0);    //set Reset to low level
Delay1ms(); //Delay at least 1ms
GPIO_WriteBit(GPIO_RESET,1);    //Set Reset to high level, normal working state
Delay100ms();    //Delay at least 100ms
```

//Set standard command according to RA8835 datasheet, user can change according to actual use.

```
SPI_cmd(0x40); //System set
SPI_dat(0x30); //OV=1, WS=0, SINGLE PANEL; M2=0, 8 PIXEL CHARACTER; M1=0, NO D6
               //CORRECTION; M0=0 INTERNAL CG ROM
SPI_dat(0x87); //WF=1, 2 FRAME; FX=111, 8 BIT CHARACTER WIDTH
SPI_dat(0x07); //FY=111, 8 BIT CHARACTER HEIGHT
SPI_dat(0x3b); // C/R=59
SPI_dat(0x3f); // TC/R= C/R+4 =63
SPI_dat(0xff); // L/F=256-1, 256 lines
SPI_dat(0x3c); // APL=60
SPI_dat(0x00); // APH=0
SPI_cmd(0x44); //Scroll set0
SPI_dat(0x00); //character layer
SPI_dat(0x00); //
SPI_dat(0xff); //256 lines
SPI_dat(0x80); //graphic layer
SPI_dat(0x07); //
SPI_dat(0xff); //256 lines
SPI_cmd(0x5d); //Cursor form set
SPI_dat(0x07); // x size:8
SPI_dat(0x87); // y size:8 cursor shape: block
SPI_cmd(0x5b); //Overlayer set
SPI_dat(0x00); // OV=0, 2 layer composition; DM2, DM1=0, 1st block character mode; MX1, MX0=0, OR
               //mode
SPI_cmd(0x4c); //Cursor direction, +1
SPI_cmd(0x46); //Set ram address to character layer
SPI_dat(0x00); //
SPI_dat(0x00); //

SPI_cmd(0x42); //mwrite
for(i=0; i<60*32; i++)
    SPI_dat(0x20); //clear character layer
```

```
SPI_cmd(0x46); //Set ram address to graphic layer
```

```
SPI_dat(0x80); //
```

```
SPI_dat(0x07); //
```

```
SPI_cmd(0x42); //mwrite
```

```
for(i=0; i<60*256; i++)
```

```
    SPI_dat(0x00); //clear graphic layer
```

```
SPI_cmd(0x59); //display on
```

```
SPI_dat(0x01); // 0000 0100 1st layer on, cursor off; 00010000 0x10, 2st layer on, 0001 0100
```

```
    //0x14 both layer on
```

//Set extension command according to the specification, these settings can be changed during normal working process

SPI_cmd(0x1f); //To reduce abnormal display, backlight is off when power on, this command is used to turn on the backlight and set it to highest brightness, this command can be put anywhere in the initial code.

SPI_com(0x38); //Set black font on white background, this command can be omitted as this is default mode

Appendix: P/N description

No.	Module P/N	VDD	Remark
1	ATM4825AS-FLW-XFW	5V	5V version
2	ATM4825AS-FLW-XFW-M	3.3V	3.3V version