# ZETTLER DISPLASYS

# SPECIFICATIONS FOR
# LIQUID CRYSTAL DISPLAY

| CUSTOMER APPROVAL |
|---|
| |
| ※ **PART NO. :** **AQM0802A-FLW-GBW(ZETTLER DISPLAYS)** VER1.1 |

| APPROVAL | | COMPANY CHOP | |
|---|---|---|---|
| **CUSTOMER COMMENTS** | | | |

| ZETTLER DISPLAYS ENGINEERING APPROVAL | | |
|---|---|---|
| **DESIGN BY** | **CHECKED BY** | **APPROVED BY** |
| Jacky Li | LIU HANG | GU ZH |

## AQM0802A-FLW-GBW(ZETTLER DISPLAYS) CHARACTER MODULE VER1.1

## REVISION RECORD

| REVISION | REVISION DATE | PAGE | CONTENTS |
|---|---|---|---|
| **VER1.0** | **2015-04-03** | | **FIRST ISSUE** |
| **VER1.1** | **2015-05-19** | **P4** | **ADD BL INFORMATION** |

# ※ **CONTENTS**

## 1.0 GENERAL SPECS

| | | |
|---|---|---|
| 1. | Display Format | 8*2 Character |
| 2. | Power Supply | 3.3V |
| 3. | Overall Module Size | 30.0mm(W) x 19.5mm(H) x max 5.5mm(D) |
| 4. | Viewing Aera(W*H) | 27.0mm(W) x 10.5mm(H) |
| 5. | Dot Size (W*H) | 0.45mm(W) x 0.50mm(H) |
| 6. | Dot Pitch (W*H) | 0.50mm(W) x 0.55mm(H) |
| 7. | Character Size (W*H) | 2.45mm(W) x 4.35mm(H) |
| 8. | Character Pitch (W*H) | 2.95mm(W) x 4.90mm(H) |
| 9. | Viewing Direction | 6:00 O'Clock |
| 10. | Driving Method | 1/16Duty,1/5Bias |
| 11. | Controller IC | ST7032I OR EQUIV |
| 12. | Display mode | STN（GRAY）/Positive/ Transflective |
| 13. | Backlight Options | LED-SIDE(White) |
| 14. | Operating temperature | -20ºC ~ 70ºC |
| 15. | Storage temperature | -30ºC ~ 80ºC |
| 16. | RoHS | RoHS Compliant |

## 2.0 ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Operating temperature | Top | -20 | - | 70 | ºC |
| Storage temperature | Tst | -30 | - | 80 | ºC |
| Input voltage | Vin | Vss | -- | Vdd | V |
| Supply voltage for logic | Vdd- Vss | 2.7 | - | 5.5 | V |
| Supply voltage for LCD drive | Vdd- Vo | 3.0 | - | 7.0 | V |

## 3.0 ELECTRICAL CHARACTERISTICS

### 3.1 Electrical Characteristics Of LCM

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Power Supply Voltage | Vdd | 25ºC | -- | 3.3 | -- | V |
| Power Supply Current | Idd | Vdd=5.0V, fosc=270kHz | -- | -- | -- | mA |
| Input voltage (high) | Vih | H level | 0.8Vdd | -- | Vdd | V |
| Input voltage (low) | Vil | L level | 0 | -- | 0.2Vdd | V |
| Recommended LC Driving Voltage | Vdd -Vo | -20ºC | -- | -- | -- | V |
| | | 25ºC | 4.3 | 4.5 | 4.7 | |
| | | 70ºC | -- | -- | -- | |

## 3.2 The  Characteristics Of LED  Backlight

### 3.2.1  Electrical-Optical  Characteristics Of LED Backlight **(Ta=25⁰C)**

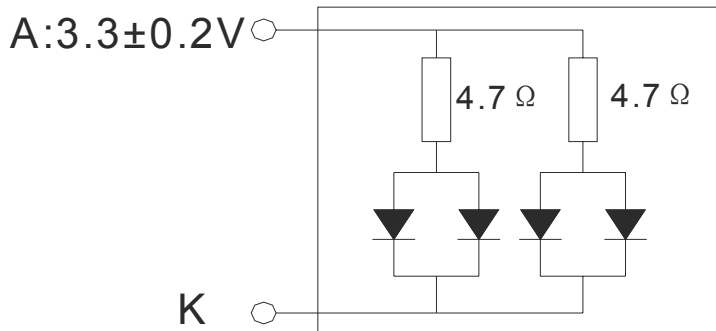| Item | Symbol | Condition | Min | Typ | Max | Unit |
|------|--------|-----------|-----|-----|-----|------|
| Forward Voltage[1] | Vf | If=60mA | 3.1 | 3.3 | 3.5 | V |
| Reverse Voltage | Vr | - | -- | -- | 4 | V |
| Luminance[2] | Lv | If=60mA | 100 |  | -- | cd/㎡ |
| Uniformity[3] | $\Delta$ | (Lvmin/Lvmax)% | 70% | -- | -- | - |
| Peak wave length | $\lambda$ p | -- | -- | -- | -- | nm |
| Chroma coordinate | x | If=60mA | 0.26 | -- | 0.30 | um |
|  | y | If=60mA | 0.27 | -- | 0.31 | um |
| Lifetime[4] | - | If=60mA | - | 20000 | - | Hours |

NOTE:
(1) Forward voltage means voltage applied directly to the LED
(2)The luminance is the average value of 5 points,The measurement instrument is BM-7 luminance colorimeter.The diameter of aperture is  $\Phi$5mm
(3) Luminance means the backlight brightness without LCD.
(4) Backlight lifetime means luminance value larger than half of the original after 20000 hours' continuous working.

### 3.2.2 Backlight Control  Circuit  For  LCM（1x4=4  pcs  LED）



### 3.2.3  LED   Typical Electro-Optical Characteristics Curve（for single led）
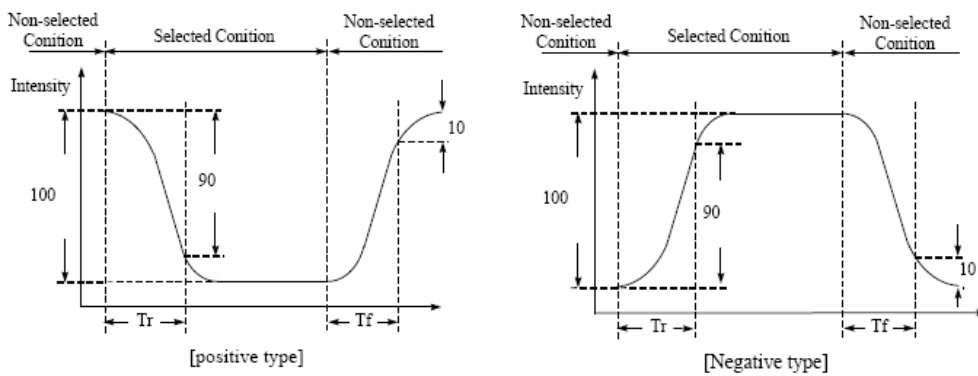
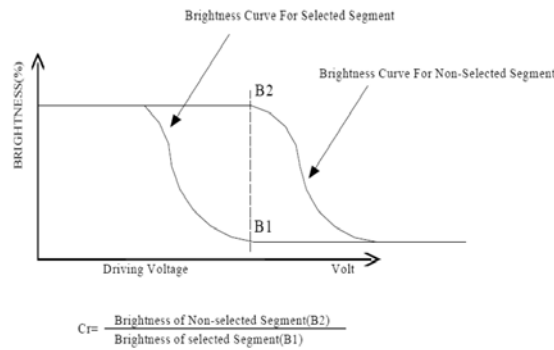1.  Forward current vs. Ambient temperature        2. Forward current vs. Forward voltage
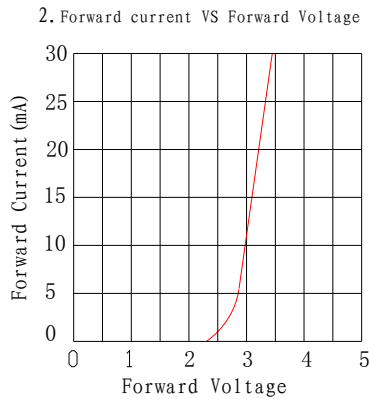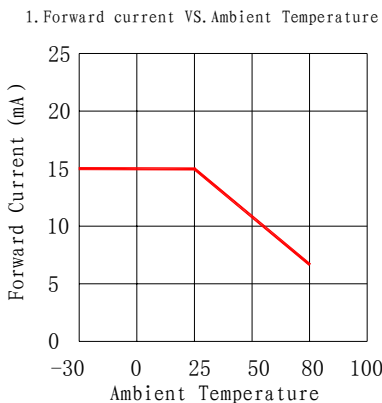
## 4.0 OPTICAL CHARACTERISTICS (Ta=25⁰C, Vdd= 3.3V±0.25V)

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Viewing angle (horizontal) | $\theta$ | Cr $\geq$ 2.0 | -35 | - | 35 | deg |
| Viewing angle (vertical) | $\phi$ | Cr $\geq$ 2.0 | -25 | - | 40 | deg |
| Contrast Ratio | Cr | $\phi$=0°, $\theta$=0° | - | 3 | - | |
| Response time (rise) | Tr | $\phi$=0°, $\theta$=0° | - | 180 | 300 | ms |
| Response time (fall) | Tf | $\phi$=0°, $\theta$=0° | - | 150 | 250 | ms |

**(1). Definition of Optical Response Time**



[positive type]          [Negative type]

# (2). Definition of Contrast Ratio



$$Cr= \frac{Brightness\ of\ Non\text{-}selected\ Segment(B2)}{Brightness\ of\ selected\ Segment(B1)}$$

# (3). Definition of Viewing Angle θ and Φ
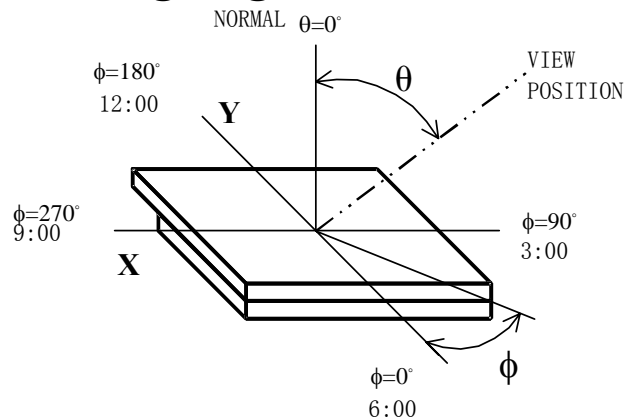
## 5.0 BLOCK DIAGRAM
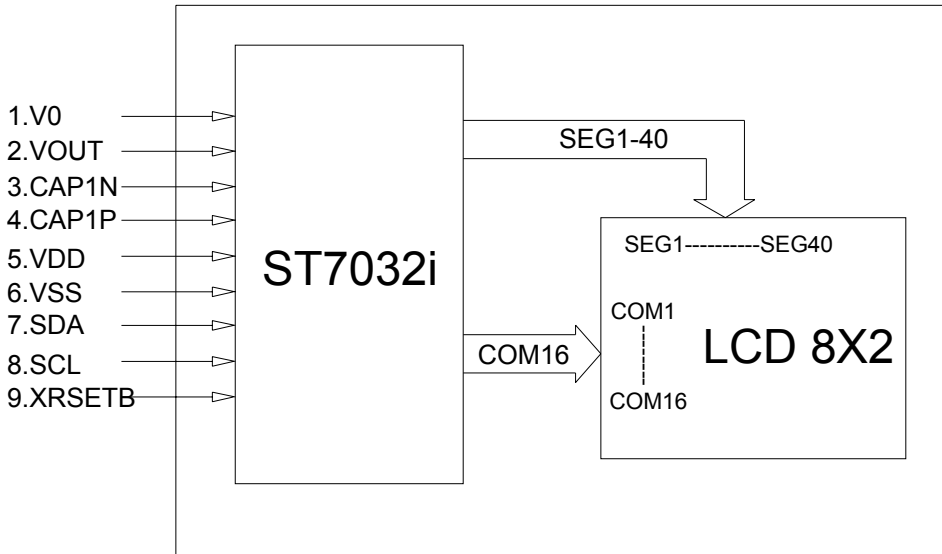


## 6.0  PIN ASSIGNMENT

| Pin No. | Symbol | Function |
|---------|--------|----------|
| 1 | VO | Test PIN for VLCD,leave it open |
| 2 | VOUT | DC/DC voltage converter output |
| 3 | CAPIN | For voltage booster circuit(VDD-VSS) |
| 4 | CAPIP | External capacitor about 0.1u~4.7uf |
| 5 | VDD | +3.3V |
| 6 | VSS | Ground |
| 7 | SDA | Serial data input |
| 8 | SCL | Serial clock input |
| 9 | XRSETB | Chip reset signal. Active when low |

## 7.0 POWER SUPPLY
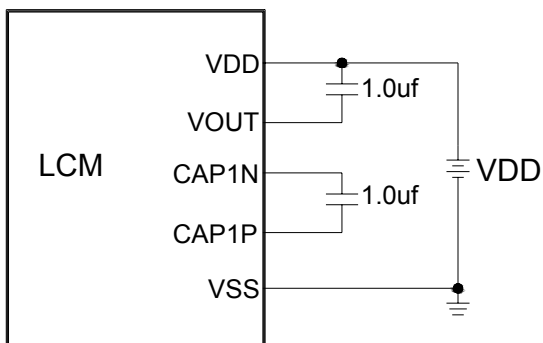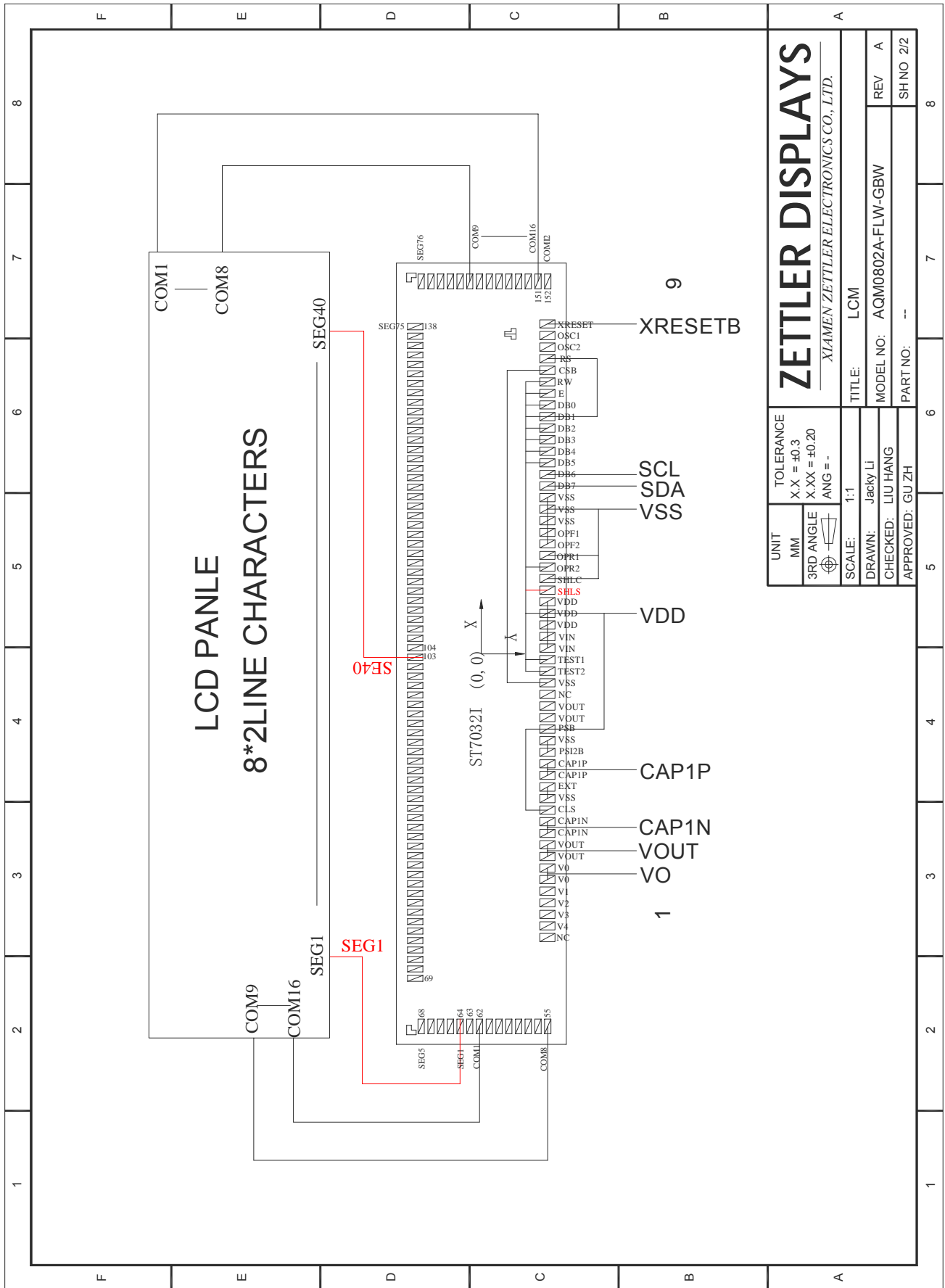
## 8.0 TIMING CHARACTERISTICS

● **I2C interface**
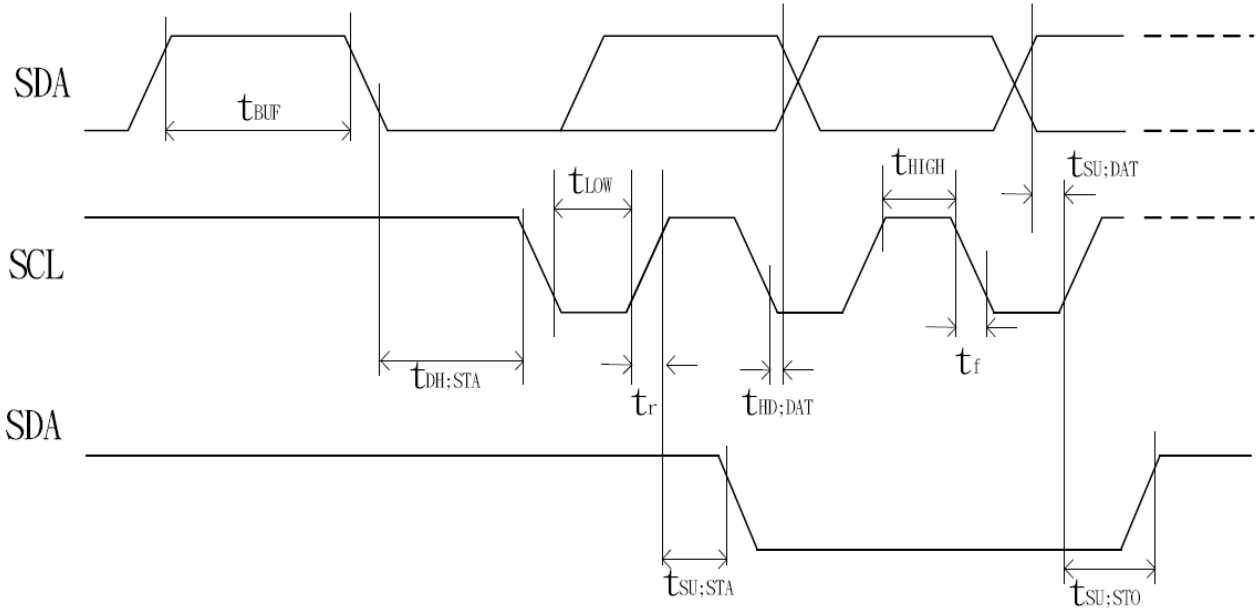


( Ta =-30°C to 85°C )

| Item | Signal | Symbol | Condition | VDD=2.7 to 4.5V Rating | | VDD=4.5 to 5.5V Rating | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Max. | Min. | Max. | |
| SCL clock frequency | SCL | $f_{SCLK}$ | | DC | 400 | DC | 400 | KHz |
| SCL clock low period | | $t_{LOW}$ | — | 1.3 | — | 1.3 | — | us |
| SCL clock high period | | $t_{HIGH}$ | | 0.6 | — | 0.6 | — | |
| Data set-up time | SI | $t_{SU;DAT}$ | — | **180** | — | 100 | — | ns |
| Data hold time | | $t_{HD:DAT}$ | | 0 | 0.9 | 0 | 0.9 | us |
| SCL,SDA rise time | SCL, SDA | $t_r$ | — | $20+0.1C_b$ | 300 | $20+0.1C_b$ | 300 | ns |
| SCL,SDA fall time | | $t_f$ | | $20+0.1C_b$ | 300 | $20+0.1C_b$ | 300 | |
| Capacitive load represent by each bus line | | $C_b$ | — | – | 400 | – | 400 | pf |
| Setup time for a repeated START condition | SI | $t_{SU;STA}$ | — | 0.6 | – | 0.6 | – | us |
| Start condition hold time | | $t_{HD;STA}$ | — | 0.6 | – | 0.6 | – | us |
| Setup time for STOP condition | | $t_{SU;STO}$ | — | 0.6 | – | 0.6 | – | us |
| Bus free time between a Stop and START condition | SCL | $t_{BUF}$ | — | 1.3 | – | 1.3 | – | us |

## 9.0 MECHANICAL DIAGRAM
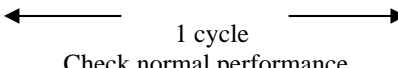
LCD PANLE
8*2LINE CHARACTERS

ST7032I  (0, 0)

COM1
COM8

SEG40

SEG40

SEG1

SEG1

COM9
COM16

XRESETB
SCL
SDA
VSS
VDD
CAP1P
CAP1N
VOUT
VO

XRESET
OSC1
OSC2
RS
CSB
RW
E
DB0
DB1
DB2
DB3
DB4
DB5
DB6
DB7
VSS
VSS
VSS
OPF1
OPF2
OPR1
OPR2
SHLC
SHLS
VDD
VDD
VDD
VIN
VIN
TEST1
TEST2
VSS
NC
VOUT
VOUT
PSB
VSS
PSI2B
CAP1P
CAP1P
EXT
VSS
CLS
CAP1N
CAP1N
VOUT
VOUT
V0
V0
V1
V2
V3
V4
NC

ZETTLER DISPLAYS
XIAMEN ZETTLER ELECTRONICS CO., LTD.

| UNIT MM | TOLERANCE X.X = ±0.3 X.XX = ±0.20 ANG = - | | TITLE: | LCM | REV A |
|---|---|---|---|---|---|
| 3RD ANGLE | | | MODEL NO: | AQM0802A-FLW-GBW | SH NO 2/2 |
| SCALE: 1:1 | | | | | |
| DRAWN: Jacky Li | | | PART NO: | -- | |
| CHECKED: LIU HANG | | | | | |
| APPROVED: GU ZH | | | | | |

## 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 ⁰C 96hrs | |
| 2 | | Low temperature storage | Applying the low storage temperature Under normal humidity for a long time Check normal performance | -30⁰C 96hrs | |
| 3 | | High temperature Operation | Apply the electric stress(Volatge and current) Under high temperature for a long time | 70 ⁰C 96hrs | Note1 |
| 4 | | Low temperature Operation | Apply the electric stress Under low temperature for a long time | -20⁰C 96hrs | Note1 Note2 |
| 5 | | High temperature/High Humidity Storage | Apply high temperature and high humidity storage for a long time | 90% RH 40⁰C 96hrs | Note2 |
| 6 | | Temperature Cycle | Apply the low and high temperature cycle -30⁰C＜＞25⁰C＜＞80⁰C ＜＞25⁰C 30min 10min 30min 10min ←—— 1 cycle ——→ Check normal performance | -30⁰C/80⁰C 10 cycle | |
| 7 | Mechanical Test | Vibration test(Package state) | Applying vibration to product check normal performance | Freq:10-55Hz Max Acceleration 5G 1cycle time:1min time X.Y.Z direction for 15 mines | |
| 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 (25⁰C±5⁰C).

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

# 11.0 DISPLAY INSTRUCTION TaBle

➢ **instruction table at "Extension mode"**
(when "EXT" option pin connect to Vss, the instruction set follow below table)

| Instruction | Instruction Code | | | | | | | | | | Description | Instruction Execution Time | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | OSC= 380KHz | OSC= 540kHz | OSC= 700KHz |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC | 1.08 ms | 0.76 ms | 0.59 ms |
| Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | x | Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. | 1.08 ms | 0.76 ms | 0.59 ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | Sets cursor move direction and specifies display shift. These operations are performed during data write and read. | 26.3 us | 18.5 us | 14.3 us |
| Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | D=1:entire display on C=1:cursor on B=1:cursor position on | 26.3 us | 18.5 us | 14.3 us |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | DH | *0 | IS | DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS: instruction table select | 26.3 us | 18.5 us | 14.3 us |
| Set DDRAM address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter | 26.3 us | 18.5 us | 14.3 us |
| Read Busy flag and address | 0 | 1 | BF | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read. | 0 | 0 | 0 |
| Write data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM/ICONRAM) | 26.3 us | 18.5 us | 14.3 us |
| Read data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM/ICONRAM) | 26.3 us | 18.5 us | 14.3 us |

*Note * : this bit is for test command , and must always set to "0"*

| Instruction table 0(IS=0) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cursor or Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | x | x | S/C and R/L: Set cursor moving and display shift control bit, and the direction, without changing DDRAM data. | 26.3 us | 18.5 us | 14.3 us |
| Set CGRAM | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter | 26.3 us | 18.5 us | 14.3 us |

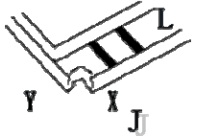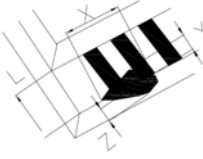| Instruction table 1(IS=1) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Internal OSC frequency | 0 | 0 | 0 | 0 | 0 | 1 | BS | F2 | F1 | F0 | BS=1:1/4 bias BS=0:1/5 bias F2~0: adjust internal OSC frequency for FR frequency. | 26.3 us | 18.5 us | 14.3 us |
| Set ICON address | 0 | 0 | 0 | 1 | 0 | 0 | AC3 | AC2 | AC1 | AC0 | Set ICON address in address counter. | 26.3 us | 18.5 us | 14.3 us |
| Power/ICON control/Contrast set | 0 | 0 | 0 | 1 | 0 | 1 | Ion | Bon | C5 | C4 | Ion: ICON display on/off Bon: set booster circuit on/off C5,C4: Contrast set for internal follower mode. | 26.3 us | 18.5 us | 14.3 us |
| Follower control | 0 | 0 | 0 | 1 | 1 | 0 | Fon | Rab2 | Rab1 | Rab0 | Fon: set follower circuit on/off Rab2~0: select follower amplified ratio. | 26.3 us | 18.5 us | 14.3 us |
| Contrast set | 0 | 0 | 0 | 1 | 1 | 1 | C3 | C2 | C1 | C0 | Contrast set for internal follower mode. | 26.3 us | 18.5 us | 14.3 us |
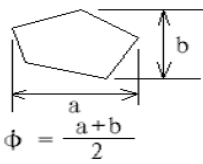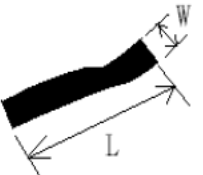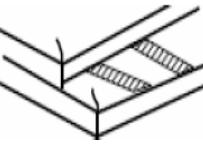
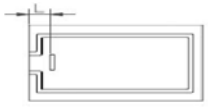## 12.0 STANDARD CHARACTER PATTERNS



ST7032-0D (ITO option OPR1=1, OPR2=1)
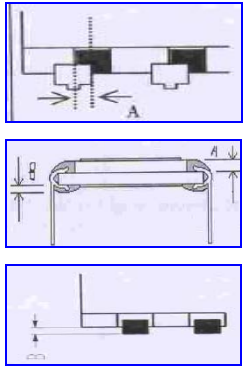
## 13.0 APPEARANCE CRITERIA

| Item | Description | Picture | Specification | | | MA | MI | Inspection Method |
|---|---|---|---|---|---|---|---|---|
| Dot defects （black/white dot） | Scratches black dot white dot on the polarizer dirty spot and bubble between the polarizer and glass in the display area. | $\phi = \dfrac{a+b}{2}$ <br> J:the distance between dot and dot. | ≤0.1 | Ignored | | ● | | Visual/ contrast by Inspection standard film |
| | | | 0.1＜φ≤0.20 | 2 | J＞5 | | | |
| | | | 0.20＜φ≤0.25 | 1 | J＞10 | | | |
| | | | 0.25＜φ≤0.30 | 0 | | | | |
| | | | 0φ>0.3 | 0 | | | | |
| black/white line defect (straight line or curve etc. Line type defects) | Fibres in active area, scratches and black line on the glass or polarizer. | J:the distance between dot and dot. | W≤0.01 | Ignored | | ● | | Visual/ contrast by Inspection standard film |
| | | | W≤0.02 L≤5 | 2 | J＞5 | | | |
| | | | W≤0.03 L≤4 | 1 | J＞10 | | | |
| | | | W≤0.04 L≤3 | 0 | J＞10 | | | |
| | | | W≤0.05 L≤2 | 0 | | | | |
| Chip on corner | sidestep on the lower glass | Y:width of chip X:length of chip L:width of sidestep J:distance between electrode and the farthermost edge. | Y≤1/2L, X≤1 | Ignored | | | ● | Visual/ contrast by Inspection standard film |
| | | | Y≤1/2L, X≤2 | 2 | | | | |
| | | | Y≤1/2L, X≤3 | 1 | | | | |
| | | | Y≤1/2L, X≤1/3J | 0 | J≤3 | | | |
| | | | Y≤1/2L, X≤2/3J | 0 | J≤3 | | | |
| Crack | | Y:width of crack X:length of crack L:width of sidestep T:deepth of crack Z:thickness of single glass | Y≤1/5L X≤5 Z≤1/2T | Ignored | | | ● | Visual/ contrast by Inspection standard film |
| | | | Y≤1/4L X≤5 Z≤1/2T | 2 | | | | |
| | | | Y≤1/3L X≤5 Z≤1/2T | 1 | | | | |
| | | | Y≤1/3L X≤10 Z≤1/2T | 0 | | | | |
| | | | Y≤1/3L X≤15 Z≤1/2T | 0 | | | | |
| Crack | | | Cracks in any area | rejected | | ● | | Visual |
| Polarizer | | | ≤0.8 | Accepted | | | ● | Visual/ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | be applicable for up/bottom polarizer | 0.8<L≤1.0 | Rejected | | | contrast by Inspection standard film |
| | | | 1.0<L≤1.5 | Rejected | | | |
| | | | 1.5<L≤2.0 | Rejected | | | |
| | | | Any seeable polarizer slanting or excursion in active area will be rejected. | | | | |
| | | | The polarizer edge should be even and be line. Any indention within 1/3 of silkscreen line will be rejected. | | | | |
| | | | Wrong direction, missing or extra, incorrect sticking for polarizer and dirty surface(grease) on polarizer will be rejected. | | | | |
| | | | seeable black silkscreen line from the arond can be accepted. | | | | |
| | | | Refer to the drawing size requirement. | | | | |
| End seal | | L:The distance from the block to edge of glass. | UV glue of seal on the glass surface | Rejected | | ● | Visual/ contrast by Inspection standard film |
| | | | The UV glue of seal overflow into the active area. | Rejected | | | |
| | | | Direction of end seal is different from the drawing. | Rejected | | | |
| | | | Glue capacity of end seal < (1/3)*L | Rejected | | | |
| | | | the height and length of end seal is out of the drawing requirements. | Rejected | | | |
| Silkscreen line | | | silkscreen line overflow into the active area. | Rejected | | ● | Visual/ contrast by Inspection standard film |
| | | | silkscreen line deviated in active area. | Rejected | | | |
| | | | bubble of silkscreen line ≥ 1/3 witdth of silkscreen line | Rejected | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| PIN | |  | Glue on PIN：there is glue on the PIN without pin clip will be rejected. PIN glue solidification：PIN glue doesn't solidify completely. The sunken or glue stain by touching will be rejected.<br>PIN deflection：if deflection angle ＞± 5°，rejected；contrarily, please refer to the drawing requirement.  Without continuous glue on pins will be rejected. PIN glue stains on polarizer or inleakage polarizer and glass, rejected.<br>PIN glue exceeds the up polarizer, rejected.<br>Missing or extra, broken pin, rejected. PIN loosen：no permission for pin loose or drop.                              Clip PIN:pin center exceeds 1/3 ITO width，rejected.                        No pin glue, rejected.                    UV glue range: UV glue must be exceeded over 1~1.5 pin distance from both side. if not, rejected.            PIN length and direction must be same with the drawing requirements. | | ● | Visual/ contrast by Inspection standard film |
| Protective film | | | LCD protective film can not stick on the polarizer and the product protective film raised ≤1/3 length or width of polarizer from same direction of axis and its total length should be ≤15mm .  This defect can be accepted. | | ● | Visual |
| Rainbow | | | rainbow is not in active area. | Accepted | ● | Visual/co ntrast by golden sample |
| | | | Rainbow in active area. | Rejected | | |
| | | | with obvious discoloration and uneven color. | Rejected | | |
| backgroud color | | | There are obvious different background color from the same product lot. | Rejected | ● | Visual/co ntrast by golden sample |

## NOTE:

Inspection condition:

Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lux(20W*2--- 40W) light intensity, all directions for inspecting  the sample should be within 45° against perpendicular line.

## 14.0   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

**Ware the electrostatics shielded clothes because human body may be statically charged if not ware 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: $1x10^8$ 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: $1x10^8$ 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 : 340~370° 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.