

LIQUID CRYSTAL DISPLAY MODULE

M 1 6 3 2

( T r a n s f l e c t i v e   t y p e )

Product Specification  
&  
Delivery Specification

Approvals

|                   |                                                                                      |
|-------------------|--------------------------------------------------------------------------------------|
| QA                |  |
| Design            |  |
| Customer approval |                                                                                      |

**TECDIS**

|            |                                              |           |
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## 1. REVISION RECORD

| Date     | Revision | Notes              |
|----------|----------|--------------------|
|          |          |                    |
|          |          |                    |
|          |          |                    |
|          |          |                    |
| Jan 2002 | 1        | Issued NEW Version |

## 2. REFLECTIVE MODE VERSIONS

| Product Name | Description       |
|--------------|-------------------|
| M16327UYT    | 16x2 STN TF WR 6H |
|              |                   |
|              |                   |
|              |                   |

### 3. SCOPE

This specification covers the engineering requirements for the liquid crystal display module.

### 4. PRODUCT SPECIFICATIONS

#### 4.1. General

- 5x8 dot matrix
- 1/16 duty
- Wide operating temperature range

#### 4.2. Mechanical Characteristics

| Item                             | Symbol                                 |
|----------------------------------|----------------------------------------|
| Dot configuration                | 5x8 dot matrix,16 characters x 2 lines |
| Dot dimensions (mm)              | 0.50 x 0.55                            |
| Dot spacing (mm)                 | 0.07                                   |
| Module dimensions(H x V x T, mm) | 85.0 x 30.0x 15.8 MAX                  |
| Viewing area (H x V, mm)         | 62.0 x 16.0                            |
| Weight (g)                       | -                                      |

#### 4.3. Absolute Maximum Ratings

| Item                  | Symbol | Condition | Min       | Max       | Unit |
|-----------------------|--------|-----------|-----------|-----------|------|
| Power supply voltage  | VDD    |           | -0.3      | 6.0       | V    |
|                       | VLC    |           | VDD – 7.0 | VDD       | V    |
| Input voltage         | Vin    |           | -0.3      | VDD + 0.3 | V    |
| Operating temperature | Topr   |           | -20       | 70        | °C   |
| Storage temperature   | Tstg   |           | -30       | 80        | °C   |

#### 4.4. Electrical Characteristics

VDD=5.0V±5%, VSS = 0 V, Temp = 0 to 50 °C

| Item                 | Symbol               | Condition             | Min  | Typ | Max  | Unit |
|----------------------|----------------------|-----------------------|------|-----|------|------|
| Power supply voltage | VDD                  |                       | 4.75 | 5.0 | 5.25 | V    |
|                      | VDD-VLC              |                       | 3    | -   | 6.3  |      |
| Input voltage        | High V <sub>IH</sub> |                       | 2.2  | -   | VDD  | V    |
|                      | Low V <sub>IL</sub>  |                       | 0    | -   | 0.6  | V    |
| Output voltage       | High V <sub>OH</sub> | IOH = 0.205 mA        | 2.4  | -   | -    | V    |
|                      | Low V <sub>OL</sub>  | IOL = 1.2 mA          | -    | -   | 0.4  | V    |
| Current consumption* | IDD                  | Ta = 25°C VLC = 0.25V | -    | 1.6 | 2.5  | mA   |
|                      |                      |                       | -    | 0.2 | 1.0  | mA   |

\* Test pattern: checker board pattern

## 4.5. Optical Characteristics

### 4.5.1. Optical characteristics

1 / 16 duty,  $V_{opr}=VDD-VLC$

| Item          | Conditions                                                          | Temp. | Symbol                | Min | Typ | Max | Unit |
|---------------|---------------------------------------------------------------------|-------|-----------------------|-----|-----|-----|------|
| Contrast *    | $\theta = + 25^\circ$<br>$\Phi = 0^\circ$<br>$VDD = 4.75 \text{ V}$ | 21 °C | C                     |     | 5   |     |      |
| Viewing angle | $C \geq 2$<br>$\Phi = 0^\circ$<br>$Vop = 4.75 \text{ V}$            | 21 °C | $\theta 1$            | -   | -   | -15 | deg  |
|               |                                                                     |       | $\theta 2$            | 55  | -   | -   |      |
|               |                                                                     |       | $\theta 2 - \theta 1$ | 70  | -   | -   |      |
| Response time | $\theta = 0^\circ$<br>$\Phi = 0^\circ$<br>$Vop = 4.75 \text{ V}$    | 21 °C | $t_{ON}$              | -   | 150 | 200 | ms   |
|               |                                                                     |       | $t_{OFF}$             | -   | 200 | 220 |      |
|               | $\theta = 0^\circ$<br>$\Phi = 0^\circ$<br>$Vop = 4.75 \text{ V}$    | 0 °C  | $t_{ON}$              | -   | 750 | 800 |      |
|               |                                                                     |       | $t_{OFF}$             | -   | 600 | 700 |      |

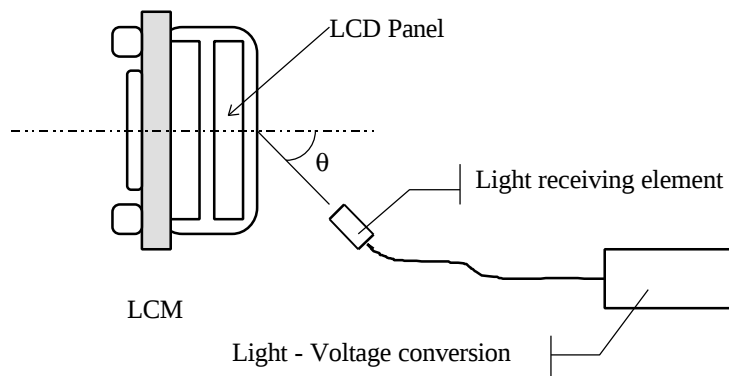
Measuring equipment:

Contrast and viewing angle: EZC Eldim

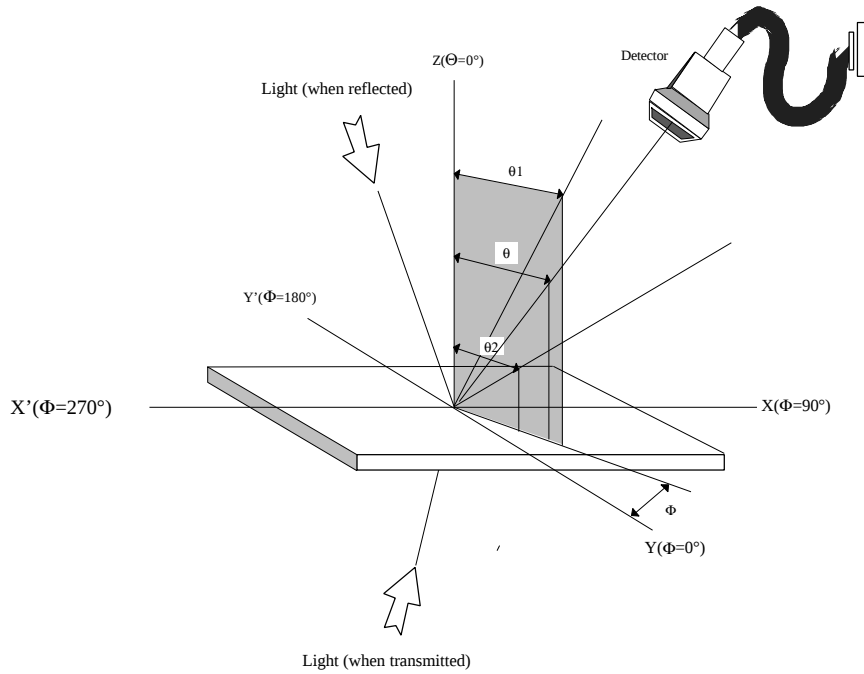
Response time: Canon illuminometer LC-4SR

\* Contrast measurement

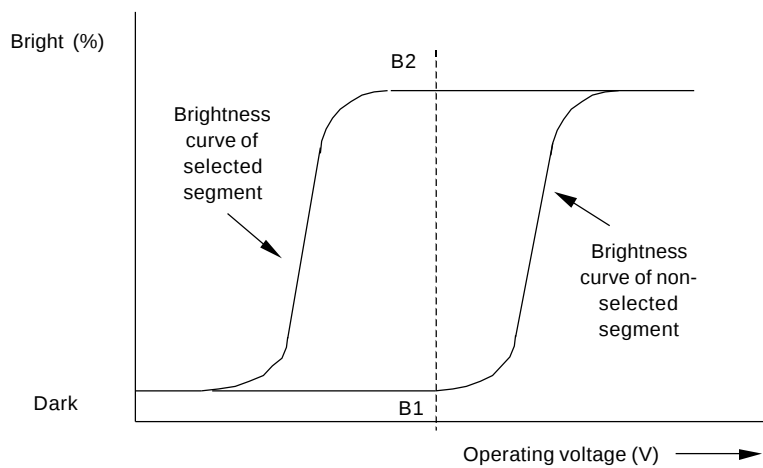
With pixels ON, direct a halogen lamp at the display, receive the reflected light with a light receiving element and convert the quantity of reflected light to voltage; repeat the measurement with pixels OFF. Calculate the contrast as shown in the following section.



#### 4.5.2. Definition of optical characteristics

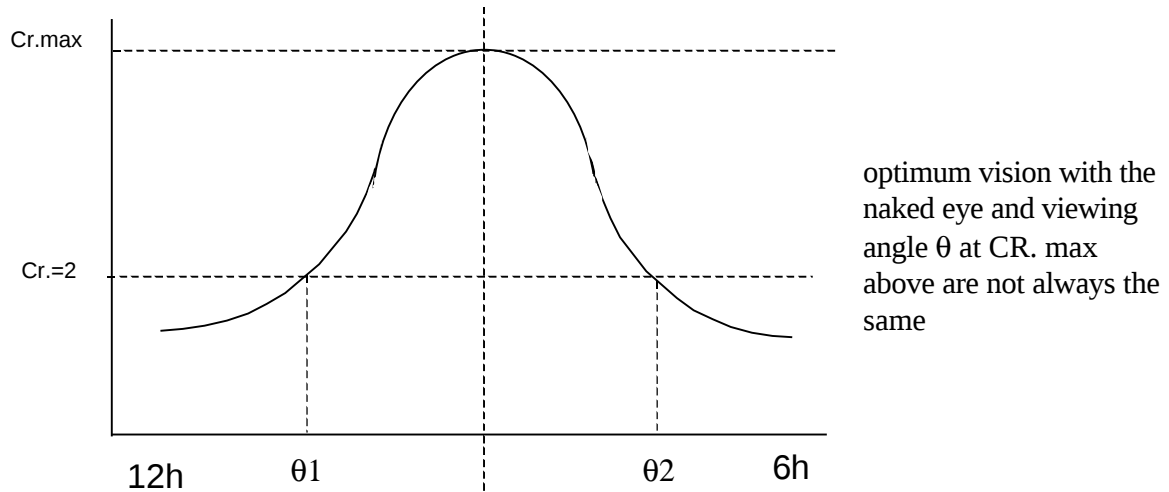


Definition of contrast Cr. 
$$Cr. = \frac{B1}{B2} = \frac{\text{Brightness of not selected segment}}{\text{Brightness of selected segment}}$$

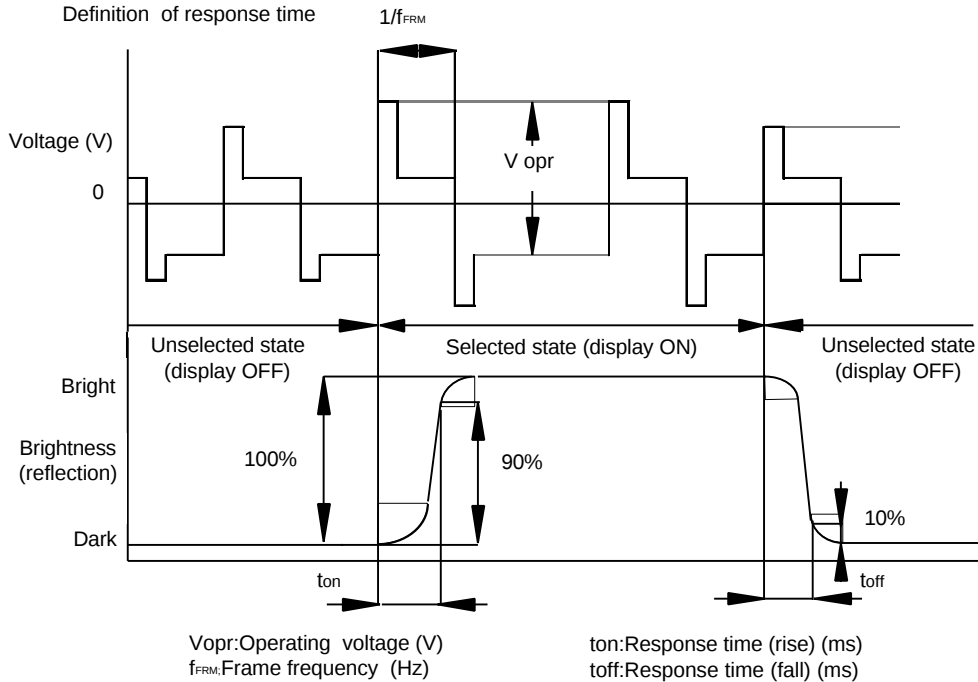


### 4.5.3. Definition of viewing angle

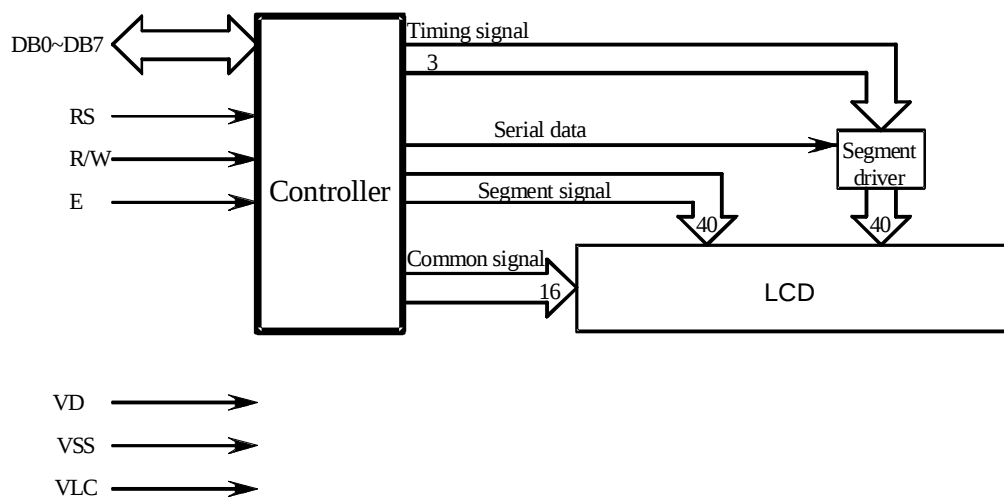
Definition of viewing angle  $\theta_1$  and  $\theta_2$



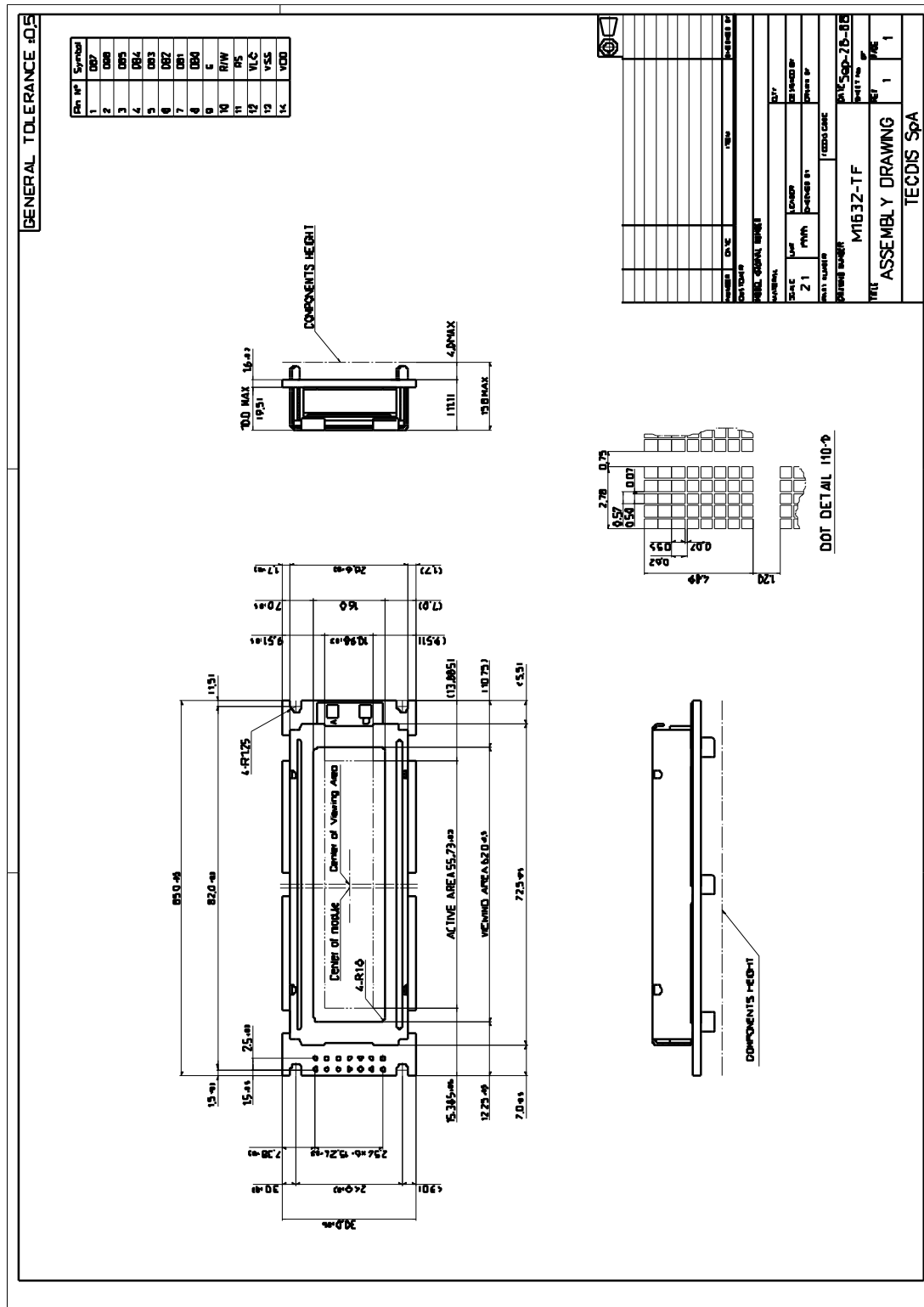
### 4.5.4. Definition of response time



#### 4.6. Circuit Block Diagram



#### 4.7. Mechanical Dimensions



#### **4.8. Pin connection (signal function)**

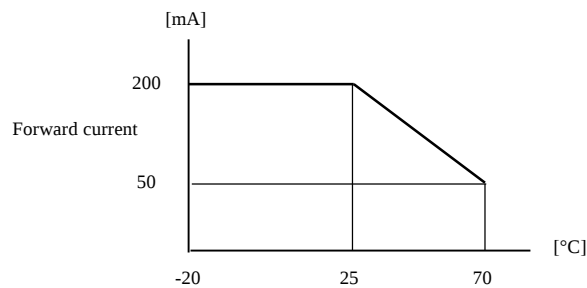
| <b>No.</b> | <b>Symbol</b> | <b>Function</b>                           |
|------------|---------------|-------------------------------------------|
| 1          | VSS           | GND                                       |
| 2          | VDD           | Power supply voltage +5 V                 |
| 3          | VLC           | Liquid crystal driving voltage            |
| 4          | RS            | H: Data register; L: Instruction register |
| 5          | R/W           | H: Read; L: Write                         |
| 6          | E             | Enable                                    |
| 7          | DB0           | Data Bus Line                             |
| 8          | DB1           | Data Bus Line                             |
| 9          | DB2           | Data Bus Line                             |
| 10         | DB3           | Data Bus Line                             |
| 11         | DB4           | Data Bus Line                             |
| 12         | DB5           | Data Bus Line                             |
| 13         | DB6           | Data Bus Line                             |
| 14         | DB7           | Data Bus Line                             |

## 5. LED BACKLIGHT CHARACTERISTICS

### 5.1. Absolute Maximum Ratings

$T_a = 25\text{ }^{\circ}\text{C}$

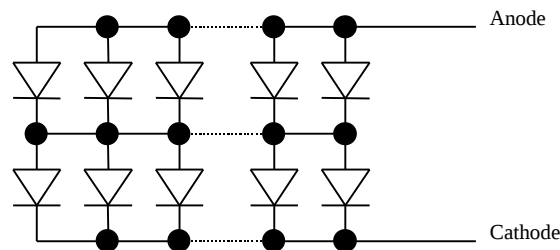
| Item                  | Symbol    | Standard    | Unit               |
|-----------------------|-----------|-------------|--------------------|
| DC forward current    | $I_F$     | 200         | mA                 |
| DC backward voltage   | $V_R$     | 8           | V                  |
| Power dissipation     | PD        | 0.92        | W                  |
| Operating temperature | $T_{opr}$ | - 20 ~ + 70 | $^{\circ}\text{C}$ |
| Storage temperature   | $T_{stg}$ | -40 ~ + 80  | $^{\circ}\text{C}$ |



### 5.2. Electrical Characteristics

$T_a = 25\text{ }^{\circ}\text{C}$

| Item            | Symbol | Condition             | Min | Typ | Max  | Unit            |
|-----------------|--------|-----------------------|-----|-----|------|-----------------|
| Forward voltage | $V_F$  | $I_F = 112\text{ mA}$ | 3.8 | 4.1 | 4.4  | V               |
| Reverse current | $I_R$  | $V_R = 8\text{ V}$    | -   | -   | 0.16 | mA              |
| Brightness      | L      | $I_F = 112\text{ mA}$ | 40  | 50  | -    | $\text{cd/m}^2$ |



Total number of LED chips =  $2 \times 8 = 16$

## 6. RELIABILITY

### 6.1. Reliability

| Test item                                  | Test Condition                                                                                    | Evaluation and assessment                       |
|--------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------|
| Operation at high temperature and humidity | 60°C ± 2°C 90% RH for 500 hours                                                                   | No abnormalities in functions* and appearance** |
| Operation at high temperature              | 80°C ± 2°C for 500 hours                                                                          | No abnormalities in functions* and appearance** |
| Heat shock                                 | -40°C + 80°C, Left for 1 hour at each temperature, transition time 5 min, repeated 10 times       | No abnormalities in functions* and appearance** |
| Low temperature                            | -30 ± 2°C for 500 hours                                                                           | No abnormalities in functions* and appearance** |
| Vibration                                  | Sweep for 1 min at 10 Hz, 55 Hz, 10 Hz, amplitude 1.5 mm 2 hrs each in the X, Y, and Z directions | No abnormalities in functions* and appearance** |
| Drop shock                                 | Dropped onto a board from a height of 30 cm                                                       | No abnormalities in functions* and appearance** |

\* Dissipation current, contrast and display functions

\*\* Polarizing filter deterioration, other appearance defects

### 6.2. Liquid crystal panel service life

100,000 hours minimum at 25°C ± 10 °C, 65% RH maximum.

### 6.3. Definition of panel service life

- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCD cell layer
- Unusual operation occurs in display functions

## 7. OPERATIONS PRECAUTIONS

### Safety

- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth or in your eyes.
- If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

### Handling

- Avoid static electricity as this can damage the CMOS LSI.
- The LCD panel is plate glass; do not hit or crush it.
- Do not remove any part or component from the module.
- The polarizing plate of the display is very fragile; handle it very carefully.

### Mounting and Design

- To protect the module from external pressure, place a transparent plate (e.g. acrylic or glass) on the display surface. Leave a small gap between the transparent plate and the display surface.
- Design the system so that no input signal is given unless the power-supply voltage is applied.
- Keep the module dry. Avoid condensation, otherwise the transparent electrodes may break.

### Storage

- Store the module in a dark place where the temperature is  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crash, shake or jolt the module (including accessories).

### Cleaning

- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with a soft cloth soaked with a perfluorine-hexane or iso-propanol.
- Do not use ketonic solvents (ketone and acetone) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

## 8. DELIVERY SPECIFICATIONS: SCOPE

This Specification covers the delivery requirements for the liquid crystal display module delivered by Tecdis S.p.A. See Product Specifications for specifications and reliability.

## 9. MARKINGS

| Marking  | Method  | Component     |
|----------|---------|---------------|
| M1632*** | Etching | Circuit board |

## 10. SHIPPING METHOD

### 10.1. Individual Packaging

The products are packaged in antistatic bags (to prevent static electricity).

### 10.2. Internal Packaging

Cartons are used for internal packaging : INNER BOXES .Labels clearly specifying the contents are affixed to the internal packaging.

#### 10.2.1. Inner Box Label

Following informations are described:

- Tecdis address
- Tecdis code
- Customer code
- Lot number
- Production date
- Number of LCMs

### 10.3. External Packaging

Cartons are used external packaging : MASTER CARTONS .Labels clearly specifying the contents are affixed to the external packaging.

#### 10.3.1. Master Carton Label

Following informations are described:

- Tecdis address
- Tecdis code
- Customer code
- Data of print
- Number of LCMs
- Gross W. Kg
- Net W. Kg

## **11. RECEIVING INSPECTION**

### ***11.1. General***

Check the quality and the quantity of the product that ordered within one month after having received it. This completes the acceptance inspection. You shall inform Tecdis S.p.A. of the results.

### ***11.2. Note***

We will follow Item 11 to deal with any products that don't conform to the Product Specifications.

## **12. QUALITY ASSURANCE**

### ***12.1. Conformity***

The performance, functions and reliability of the shipped products conform to the Product Specifications.

### ***12.2. Responsibility***

You are responsible for any defect in quality caused after receiving inspection.

### ***12.3. Warranty***

The quality warranty is valid for one year after delivery.

## **12.4. Shipping Assurance.**

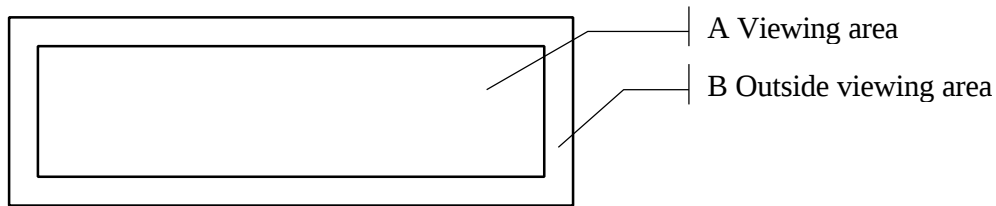
### **12.4.1. Shipping inspection standards.**

Shipping inspection standard is MIL-STD 105 D single sampling level, level II.

The quality assurance levels are shown below:

| <b>Rank</b>  | <b>Zone</b> |                                             | <b>Defect</b>                                                                                                                                        | <b>A.Q.L.</b> |
|--------------|-------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Major defect | A           | Display area<br>(Appearance)<br>(Functions) | Display functions<br>Current consumption<br>Missing display functions<br>No display                                                                  | 0.4%          |
| Minor defect | A           | Display area                                | Polarizing plate defect<br>Uneven contrast<br>Crosstalk<br>Black spots<br>Black streaks<br>Bubbles<br>Cromaticity<br>Uniformity<br>Scratches<br>Dirt | 1.0%          |

#### 12.4.2. Zone definitions

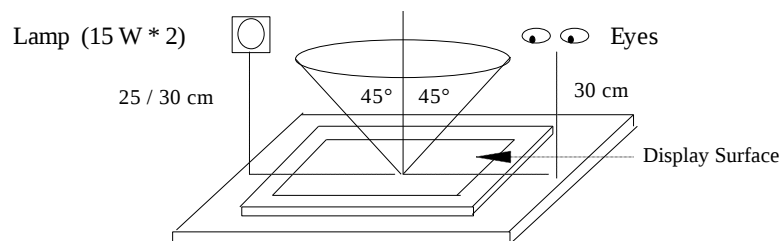


A: Viewing area.

B: Outside viewing area.

#### 12.4.3. Visual inspection

- Inspect under 15W fluorescent lamp (approximately 2500 lux ) leaving 25 cm to 30 cm between the modules and lights and 30 cm between the module and the eye ( measuring position).
- Appereance is inspected at the best contrast voltage (best contrast is adjusted to consider clearness and crosstalk on screen).
- Inspect the module at 45° right and left, front and rear.
- Use the maximum angle for the viewing angle direction contrast during the contrast inspection.



#### 12.4.4. Visual standards

When the panel doesn't display

##### 12.4.4.1. Tolerance number of defect

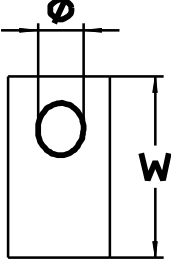
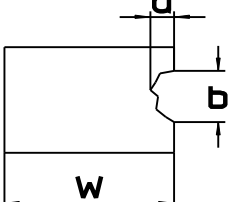
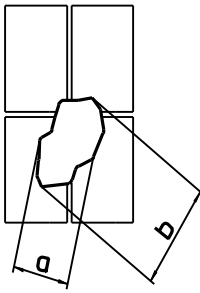
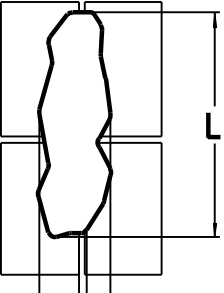
When the number of defects in items 1 to 5 of “Individual appearance standard defects” is totalled, the maximum number of defects is 5 in zone A.

##### 12.4.4.2. Individual appearance defects standards (display OFF)

| No | Item                               | Detail                                                                                                                        | Section (mm)                   |               | Zone A                                           | Zone B     |
|----|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------|--------------------------------------------------|------------|
| 1  | Black/white spots                  | Black/White spots caused by dust, bubbles or defective alignment in the cell or polarizer (plus black spots of the backlight) | $\Phi \leq 0.10$               |               | Any number                                       | Any number |
|    |                                    |                                                                                                                               | $0.10 < \Phi \leq 0.20$        | 1             |                                                  |            |
|    |                                    |                                                                                                                               | $0.20 < \Phi$                  | 0             |                                                  |            |
| 2  | Black/white streaks                | Black/White streaks caused by alignment scratches or dust in the orientation of the cell or polarizer                         | $W \leq 0.01$                  |               | Any number                                       | Any number |
|    |                                    |                                                                                                                               | $W \leq 0.02$                  | $L \leq 0.20$ | 3                                                |            |
|    |                                    |                                                                                                                               | $W \leq 0.03$                  | $L \leq 0.20$ | 2                                                |            |
|    |                                    |                                                                                                                               | $W \leq 0.05$                  | $L \leq 0.20$ | 1                                                |            |
|    |                                    |                                                                                                                               | $W \leq 0.06$                  | $L \leq 0.20$ | 1                                                |            |
|    |                                    |                                                                                                                               | Other than above               |               | 0                                                |            |
| 3  | Bubble between glass and polarizer | Bubble between the glass abd the polarizer                                                                                    | $\Phi \leq 0.20$               |               | Any number                                       | Any number |
|    |                                    |                                                                                                                               | $0.20 < \Phi \leq 0.50$        | 3             |                                                  |            |
|    |                                    |                                                                                                                               | $0.50 < \Phi \leq 1.0$         | 1             |                                                  |            |
|    |                                    |                                                                                                                               | $1.0 < \Phi$                   | 0             |                                                  |            |
|    |                                    |                                                                                                                               | $W \leq 0.15$                  | $L \leq 5.0$  | 2                                                |            |
|    |                                    |                                                                                                                               | $W \leq 0.15$                  | $L \leq 10.0$ | 1                                                |            |
|    |                                    |                                                                                                                               | Other than above               |               | 0                                                |            |
| 4  | Scratches on the polarizer         | Scratches on the polarizer                                                                                                    | Visible with the naked eye     |               | Same as No2                                      | Any number |
|    |                                    |                                                                                                                               | Not visible with the naked eye |               | Any number                                       |            |
| 5  | Dent on polarizer                  | Dent on the polarizer                                                                                                         | $\Phi \leq 0.50$               |               | 2                                                | Any number |
|    |                                    |                                                                                                                               | $0.50 < \Phi \leq 1.0$         |               | 1                                                |            |
|    |                                    |                                                                                                                               | $1.0 < \Phi$                   |               | 0                                                |            |
| 6  | Chromaticity and uniformity        | Streaks and uneven color                                                                                                      |                                |               | Level of sample for approval set as limit sample |            |

| No | Item | Detail                                  | Section (mm) | Zone A                                            | Zone B |
|----|------|-----------------------------------------|--------------|---------------------------------------------------|--------|
| 7  | Dirt | Dirt on the polarizer, panel frame, PCB |              | Products pass if the dirt can be wiped off easily |        |

#### 12.4.4.3. Individual appearance defects standards (display ON)

| No | Item                | Detail                                                                                                                                                 | Section (mm)                | Standard Max No of defects |            |  |
|----|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------|------------|--|
| 1  | No display          | Part or all of the screen doesn't light because of an open or a short circuit                                                                          |                             | Must not occur             |            |  |
| 2  | Display missing     | Part of display segment missing because of pin holes or an open<br>  |                             |                            | W=0.32     |  |
|    |                     |                                                                                                                                                        | $\Phi \leq 0.10$            |                            | Any number |  |
|    |                     |                                                                                                                                                        | $0.10 < \Phi \leq 0.20$     |                            | 3          |  |
|    |                     |                                                                                                                                                        | $0.20 < \Phi \leq 0.25$     |                            | 2          |  |
|    |                     |                                                                                                                                                        | $0.25 < \Phi \leq 0.30$     |                            | 1          |  |
|    |                     |                                                                                                                                                        | $0.30 < \Phi$               |                            | 0          |  |
| 3  | Display missing     | Part of display segment missing because of pin holes or an open<br> |                             |                            | W=0.32     |  |
|    |                     |                                                                                                                                                        | $a \leq 0.10$ $b \leq 0.10$ |                            | Any number |  |
|    |                     |                                                                                                                                                        | $a \leq 0.20$ $b \leq 0.25$ |                            | 3          |  |
|    |                     |                                                                                                                                                        | $a \leq 0.25$ $b \leq 0.30$ |                            | 2          |  |
|    |                     |                                                                                                                                                        | $a > 0.25$ $b > 0.30$       |                            | 0          |  |
| 4  | Display missing a,b | Thin part of display segment / common missing<br>                   | $a \leq 0.03$               |                            | Any number |  |
|    |                     |                                                                                                                                                        | $a \leq 0.05$ $b < 0.50$    |                            | 3          |  |
|    |                     |                                                                                                                                                        | $a \leq 0.10$ $b \leq 0.30$ |                            | 2          |  |
|    |                     |                                                                                                                                                        | $a \leq 0.20$ $b \leq 0.30$ |                            | 1          |  |
|    |                     |                                                                                                                                                        | $a \leq 0.25$ $b \leq 0.30$ |                            | 0          |  |
| 5  | Display missing a,L | Thin part of display segment / common missing<br>                   | $a \leq 1.2S$               |                            | Any number |  |

| No | Item | Detail | Section (mm)                | Standard Max No of defects |
|----|------|--------|-----------------------------|----------------------------|
|    |      |        | $a \leq 1.4S$ $L \leq 10.0$ | 2                          |
|    |      |        | $a \leq 1.4S$ $b > 10.0$    | 0                          |
|    |      |        | $a > 1.4S$                  | 0                          |

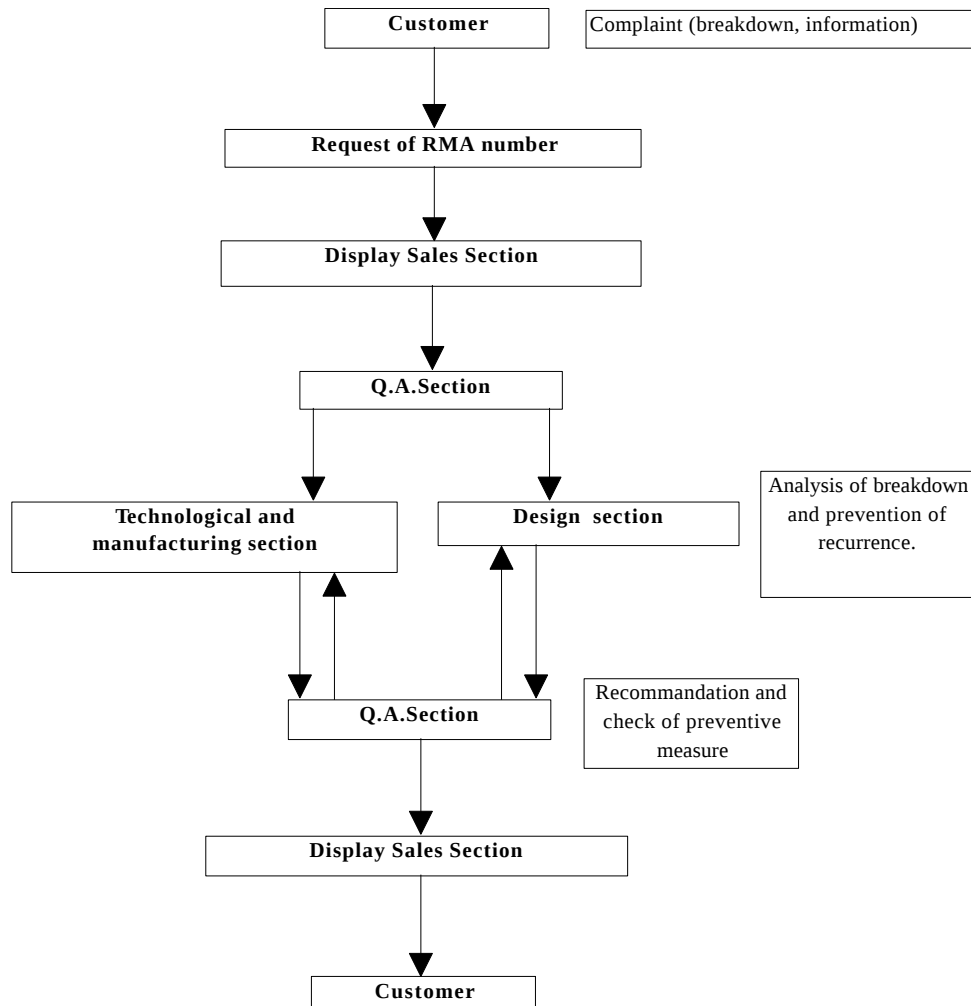
## **13. DEALING WITH CUSTOMER COMPLAINTS**

### ***13.1. General***

- If any defective products are found during the acceptance inspection that Tecdis S.p.A. is clearly responsible for, treat them as lot out or defective products and return them to Tecdis S.p.A. Any product that are not clearly defective or that Tecdis S.p.A. is not clearly responsible for will be dealt with by discussion between both companies.
- When defective products are caused after acceptance inspection, inform Tecdis S.p.A. The product will be dealt with by discussion between both companies.
- When returning defective products to Tecdis S.p.A., pack them individually in their original packing to prevent static electricity, and pad them with cushions to prevent vibration. Do not place them on top of one other.

### 13.2. Complaint processing Chart

Inspection and notification of any defect is shown in the diagram below:



### 14. CHANGE OF SPECIFICATIONS

Any changes that need to be made in this specification or any problems arising from it will be dealt with by discussion between both companies.