

## 10.2" Color TFT Display



### FEATURES

- Type: TFT
- Diagonal dimension: 10.2"
- Display format: 800 x 480 (RGB)
- Built-in controller: RA8875
- +3.3 V, +5 V power supply
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

MECHANICAL DATA		
ITEM	DIMENSION	UNIT
Dot matrix	800 x 480, RGB (TFT)	dots
Module dimension	235.0 x 145.8 x 12.1	mm
Active area	222.0 x 132.48	mm
Dot pitch	0.0925 x 0.276	mm
LCD type	TFT, normally white, transmissive	
View direction	12 o'clock	
Gray scale inversion direction	6 o'clock	
Backlight type	LED, normally white	
Controller IC	RA8875	
Interface	Digital 8080 family MPU	

#### Note

- Color tone changed by temperature and driving voltage

ABSOLUTE MAXIMUM RATINGS					
ITEM	SYMBOL	STANDARD VALUE			UNIT
		MIN.	TYP.	MAX.	
Operating temperature	T <sub>OP</sub>	-20	-	+70	°C
Storage temperature	T <sub>ST</sub>	-30	-	+80	°C

#### Notes

- Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above
- Temperature ≤ 60 °C, 90 % RH max. temperature > 60 °C, absolute humidity shall be less than 90 % RH at 60 °C

ELECTRICAL CHARACTERISTICS						
ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN.	TYP.	MAX.	
Supply voltage for LCM	V <sub>DD</sub>	-	3.0	3.3	3.6	V
Supply current for LCM	I <sub>DD</sub>	(1)	-	190	195	mA
Operation current for LED driver	I <sub>LED</sub>	V <sub>LED</sub> = +5 V (2)(3)	500	-	750	mA
Power consumption		V <sub>LED</sub> = +5 V (2)(3)	2500	-	3750	mW
Supply voltage for LED driver	V <sub>DD</sub>	V <sub>LED+</sub>	-	5	-	V
LED life time	t	(3)(4)(5)	20 000	-	-	h

#### Notes

- (1) This value is test for V<sub>DD</sub> = 3.3 V, T<sub>amb</sub> = 25 °C only
- (2) Base on V<sub>LED</sub> = 5 V for the backlight driver IC specification
- (3) T<sub>amb</sub> = 25 °C
- (4) Brightness to be decreased to 50 % of the initial value
- (5) The single LED lamp case

INTERFACE PIN FUNCTION		
PIN NO.	SYMBOL	FUNCTION
1	GND	System ground pin of the IC; connect to system ground
2	V <sub>DD</sub>	Power supply: +3.3 V
3	NC	No connection
4	RS	Data / command select
5	WR	Write strobe signal
6	RD	Read strobe signal
7	DB0	Data bus
8	DB1	Data bus
9	DB2	Data bus
10	DB3	Data bus
11	DB4	Data bus
12	DB5	Data bus
13	DB6	Data bus
14	DB7	Data bus
15	DB8	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
16	DB9	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
17	DB10	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
18	DB11	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
19	DB12	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
20	DB13	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
21	DB14	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
22	DB15	Data bus (when select 8 bits mode, this pin is "no connection") <sup>(1)</sup>
23	WAIT	Wait signal output (H: active)
24	NC	No connection
25	CS	Chip select
26	RST	Hardware reset
27	L / R	Left / right selection, default L / R = H <sup>(2)(3)</sup>
28	U / D	Up / down selection, default U / D = L <sup>(2)(3)</sup>
29	NC	No connection
30	NC	No connection
31	NC	No connection
32	NC	No connection
33	VLED-	Power for LED driver IC (ground)
34	VLED-	Power for LED driver IC (ground)
35	VLED+	Power for LED driver IC (+5 V)
36	VLED+	Power for LED driver IC (+5 V)

**Notes**

- <sup>(1)</sup> When select 8 bit mode, DB0 to DB7 be used, DB8 to DB15 no connection. When select 16 bit mode, DB8 to DB15 be used  
<sup>(2)</sup> Selection of scanning mode

SETTING OF SCAN CONTROL INPUT		SCANNING DIRECTION
U / D	L / R	
GND	V <sub>DD</sub>	Up to down, left to right
V <sub>DD</sub>	GND	Down to up, right to left
GND	GND	Up to down, right to left
V <sub>DD</sub>	V <sub>DD</sub>	Down to up, left to right

- <sup>(3)</sup> Definition of scanning direction, refer to the figure as below:



1. U / D = L; L / R = H



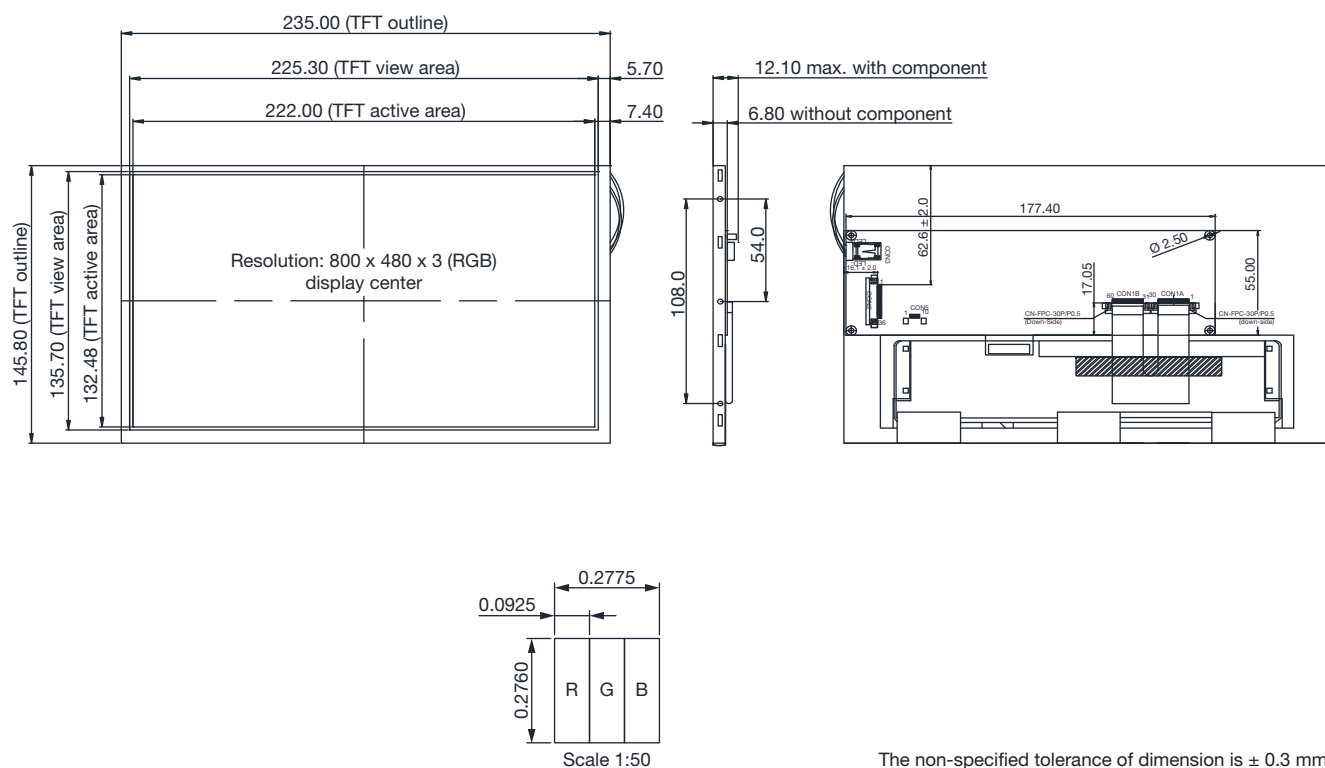
2. U / D = L; L / R = L



3. U / D = H; L / R = H



4. U / D = H; L / R = L

**DIMENSIONS** in millimeters


The non-specified tolerance of dimension is ± 0.3 mm.

**MODULE CLASSIFICATION INFORMATION**

<table><tr><td>LC</td><td>F</td><td>-</td><td>102</td><td>P</td><td>T</td><td>I</td><td>F</td><td>G</td><td>D</td><td>B</td><td>N</td><td>0</td><td>H</td></tr><tr><td>1</td><td>2</td><td></td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr></table>															LC	F	-	102	P	T	I	F	G	D	B	N	0	H	1	2		3	4	5	6	7	8	9	10	11	12	13
LC	F	-	102	P	T	I	F	G	D	B	N	0	H																													
1	2		3	4	5	6	7	8	9	10	11	12	13																													
1	Brand				Vishay Intertechnology, Inc.																																					
2	Display type				F: TFT type J: custom TFT																																					
3	Display size				10.2" TFT																																					
4	Model serials number				P																																					
5	Backlight type				F: CCFL, white S: LED, high light white T: LED, white Z: Nichia LED, white																																					
6	LCD polarize type, temperature range, gray scale inversion direction				A: transmissive, N.T, IPS TFT C: transmissive, N.T, 6:00 F: transmissive, N.T, 12:00 I: transmissive, W.T, 6:00 K: transfective, W.T, 12:00 L: transmissive, W.T, 12:00 N: transmissive, super W.T, 6:00 Q: transmissive, super W.T, 12:00 R: transmissive, super W.T, O-TFT V: transmissive, super W.T, VA TFT X: transmissive, W.T, VA TFT Y: transmissive, W.T, IPS TFT Z: transmissive, W.T, O-TFT																																					
7	TFT type				A: TFT LCD B: TFT + FR + control board C: TFT + FR + A/D board D: TFT + FR + A/D board + control board E: TFT + FR + power board F: TFT + control board G: TFT + FR H: TFT + D/V board I: TFT + FR + D/V board J: TFT + power board																																					
8	Resolution				A: 128160    F: 640480    K: 800600    Q: 480800    V: 176220    2: 1024324 B: 320234    G: 800480    L: 240400    R: 640320    W: 1280398    3: 7201280 C: 320240    H: 1024600    M: 1024768    S: 480128    X: 1024250 D: 480234    I: 320480    N: 128128    T: 800320    Y: 1920720 E: 480272    J: 240320    P: 1280800    U: 8001280    Z: 800200																																					
9	-				D: digital L: LVDS M: MIPI																																					
10	Interface				A: 8 bit B: 16 bit H: HDMI I: I <sup>2</sup> C interface N: without control board R: RS232 S: SPI interface U: USB																																					
11	Touch panel				C: capacitive touch panel (G-F-F) G: capacitive touch panel (G-G) N: without touch panel T: resistive touch panel																																					
12	Version				0																																					
13	Special code				H: RoHS-compliant with RoHS Directive regulations																																					

**SUMMARY**

TFT 10.2" is a TN transmissive type color active matrix TFT liquid crystal display that use amorphous silicon TFT as switching devices. This module is a composed of a TFT\_LCD module. It is usually designed for industrial application and this module follows RoHS compliance.

**GENERAL SPECIFICATIONS**

ITEM	DIMENSION	UNIT
Size	10.2	inch
Dot matrix	800 x 480 (RGB)	dots
Module dimension	235.0 x 145.8 x 12.1	mm
Active area	222.0 x 132.48	mm
Dot pitch	0.0925 x 0.276	mm
LCD type	TFT, normally white, transmissive	
View direction	12 o'clock	
Gray scale inversion direction	6 o'clock	
Aspect ratio	16:9	
Backlight type	LED, normally white	
Controller IC	RA8875	
Interface	Digital 8080 family MPU 8 bit / 16 bit	
With or without touch panel	Without touch panel	
Surface	Anti-glare	

**Note**

- Color tone slight changed by temperature and driving voltage

**DC CHARACTERISTICS**

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN.	TYP.	MAX.	
Low level input voltage	$V_{IL}$	-	GND	-	0.2 $V_{DD}$	V
High level input voltage	$V_{IH}$	-	0.8 $V_{DD}$	-	$V_{DD}$	V

**INTERFACE TIMING****8080 Mode**

The following timing charts are used to describe the timing specification of the standard 8080 interfaces.

**8080 MODE WRITE CYCLE**

SYMBOL	PARAMETER	RATING		UNIT	SYMBOL
		MIN.	MAX.		
$t_{CYC8}$	Cycle time	50	-	ns	$t_C$ is one system clock period: $t_C = 1/SYS\_CLK$
$t_{CC8}$	Strobe pulse width	20	-	ns	
$t_{AS8}$	Address setup time	0	-	ns	
$t_{AH8}$	Address hold time	10	-	ns	
$t_{DS8}$	Data setup time	20	-	ns	
$t_{DH8}$	Data hold time	10	-	ns	
$t_{ACC8}$	Data output access time	0	20	ns	
$t_{OH8}$	Data output hold time	0	20	ns	

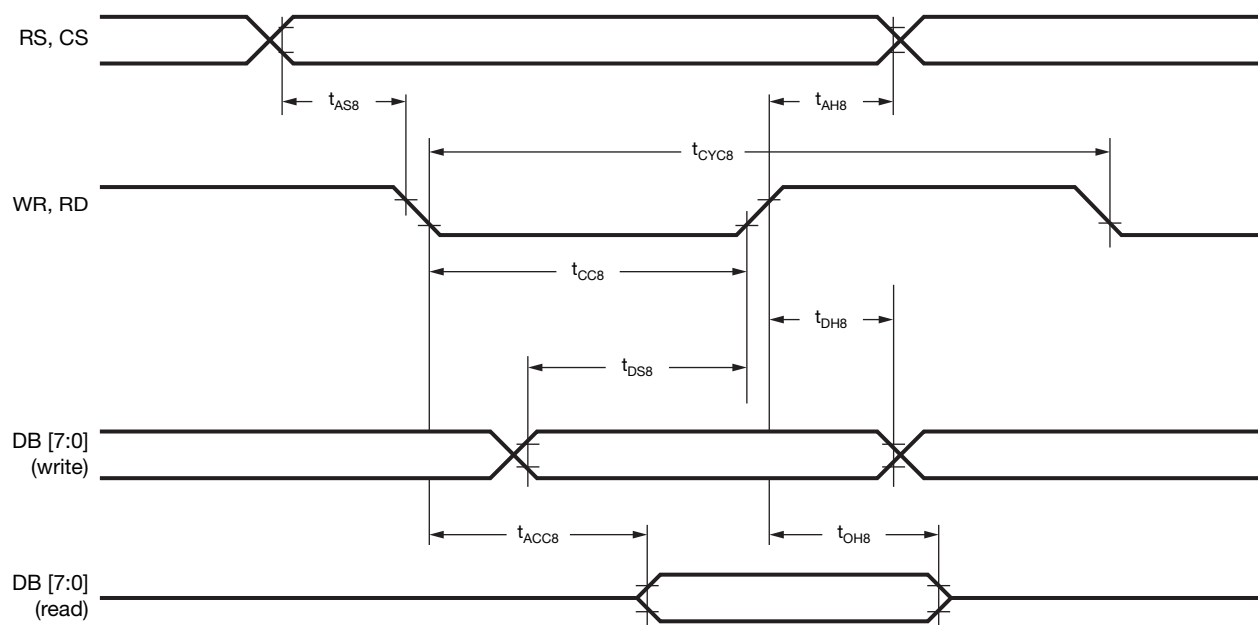
**8080 8-bit / 16-bit Interface**


Fig. 1

The data bus width of RA8875 can be selected to 8-bit / 16-bit by setting the bit [1:0] of SYSR. When bit [1:0] of SYSR is cleared to “00”, then the data bus is 8-bit. If bit [1:0] of SYSR is set to “11”, then the data transition is set as 16-bit.

**Pixel Data Format**

16-bit mode color

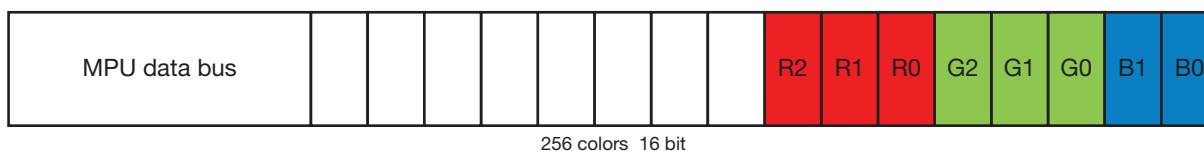
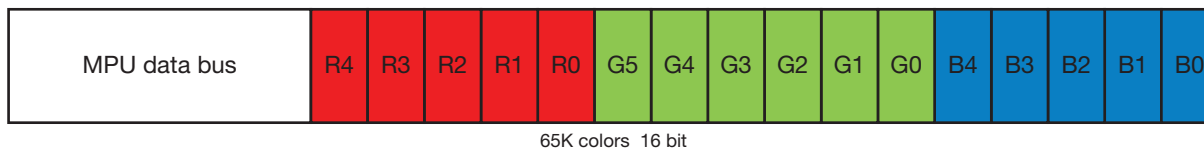


Fig. 2

8-bit mode color

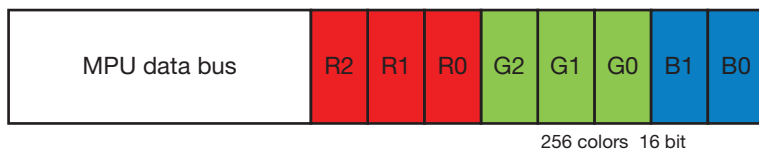
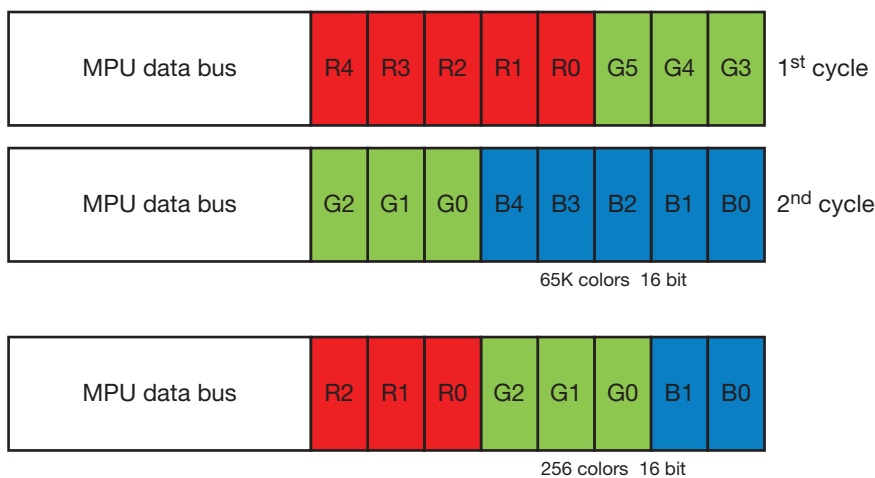


Fig. 3

**OPTICAL CHARACTERISTICS**

TFT LCD CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ )						
ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Response time <sup>(3)(5)</sup>	$t_r$	$\Theta = 0^{\circ}, \Phi = 0^{\circ}$	-	15	30	ms
	$t_f$		-	20	40	ms
Contrast ratio <sup>(4)(5)</sup>	CR	At optimized viewing angle	250	300	-	
Color chromaticity	White	$W_x$ <sup>(2)(6)(7)</sup>	0.26	0.31	0.36	
		$W_y$	0.28	0.33	0.38	
Viewing angle (gray scale inversion direction) <sup>(1)</sup>	Horizontal	$\Theta_R$	55	65	-	deg
		$\Theta_L$	55	65	-	
	Vertical	$\Phi_T$	35	45	-	deg
		$\Phi_B$	55	65	-	
Brightness	-	Center of display	250	350	-	cd/m <sup>2</sup>

**Notes**

<sup>(1)</sup> Definition of viewing angle range

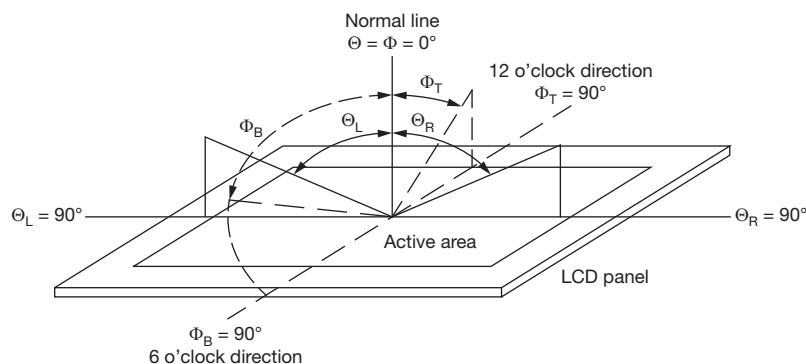


Fig. 4 - Definition of Viewing Angle

<sup>(2)</sup> Test equipment setup:

after stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7orBM-5 luminance meter 1.0° field of view at a distance of 50 cm and normal direction

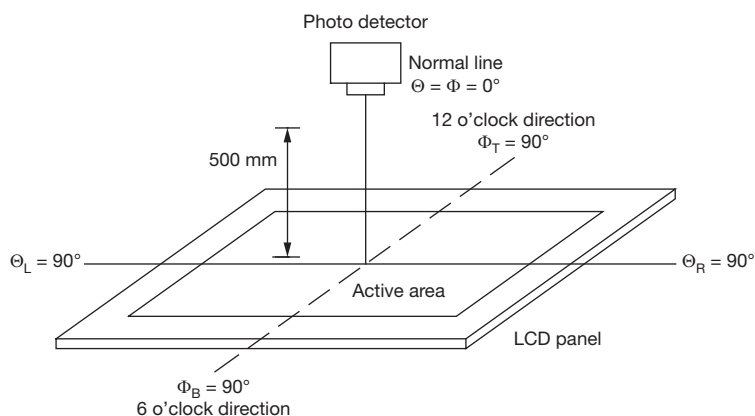


Fig. 5 - Optical Measurement System Setup



(3) Definition of response time:

the response time is defined as the LCD optical switching time interval between “white” state and “black” state. Rise time,  $t_r$ , is the time between photo detector output intensity changed from 90 % to 10 %. And fall time,  $t_f$ , is the time between photo detector output intensity changed from 10 % to 90 %

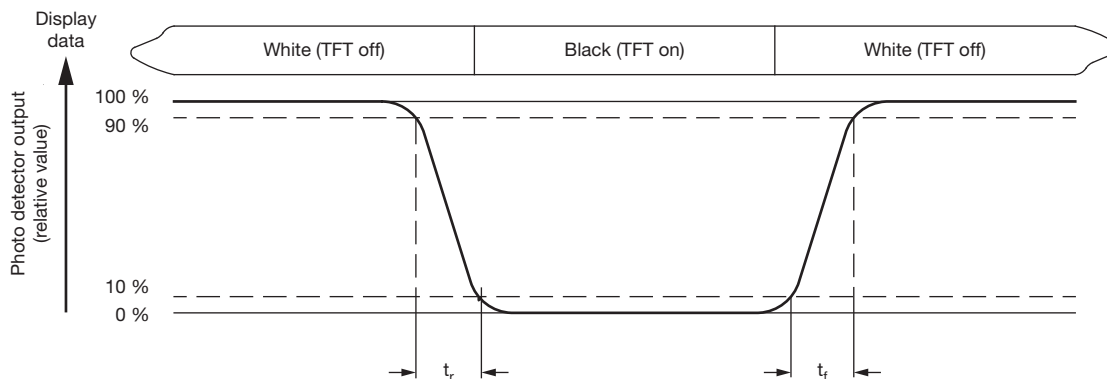


Fig. 6

(4) Definition of contrast ratio:

the contrast ratio is defined as the following expression

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the white state}}{\text{Luminance measured when LCD on the black state}}$$

(5) White  $V_I = V_{I50} \pm 1.5 \text{ V}$

Black  $V_I = V_{I50} \pm 2.0 \text{ V}$

“±” means that the analog input signal swings in phase with  $V_{COM}$  signal.

“±” means that the analog input signal swings out of phase with  $V_{COM}$  signal.

The 100 % transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened

(6) Definition of color chromaticity (CIE 1931): color coordinates measured at the center point of LCD

(7) Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened

## BLOCK DIAGRAM

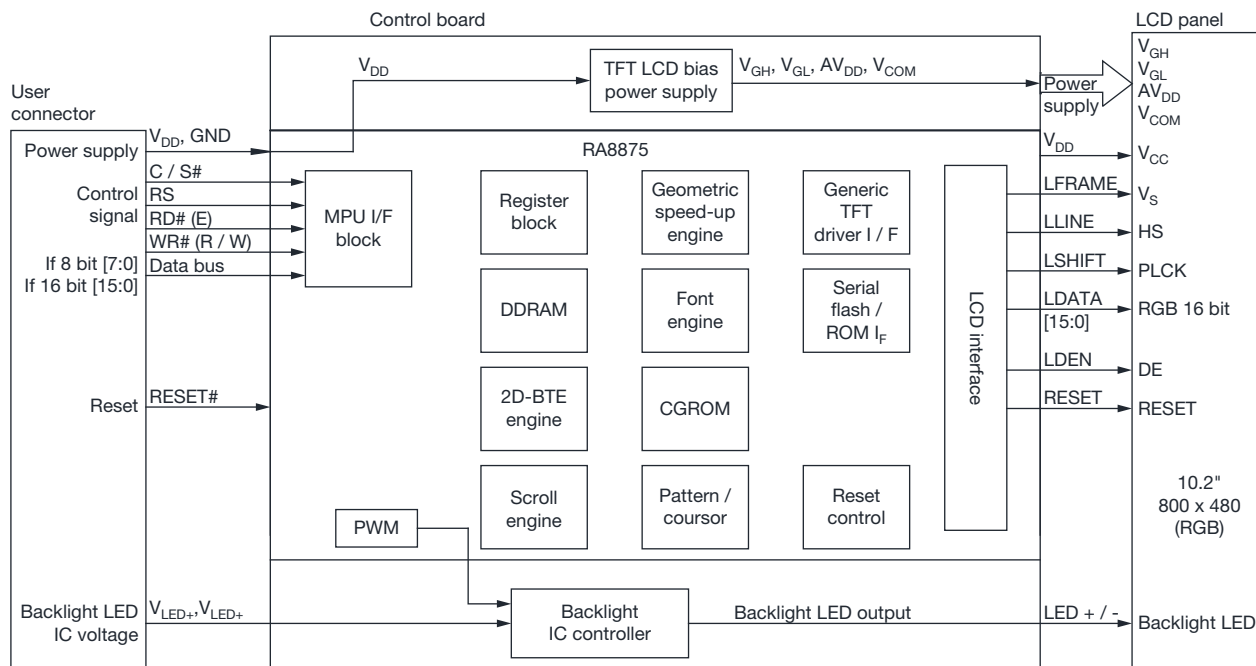
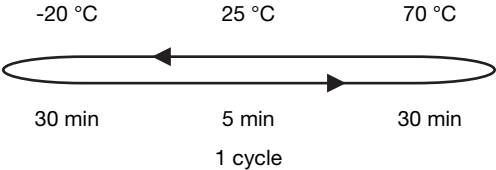


Fig. 7



RELIABILITY		
ENVIRONMENTAL TEST		
TEST ITEM	CONTENT OF TEST	TEST CONDITION
High temperature storage <sup>(1)</sup>	Endurance test applying the high storage temperature for a long time.	80 °C, 200 h
Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 °C, 200 h
High temperature operation	Endurance test applying the electric stress (voltage and current) and the thermal stress to the element for a long time.	70 °C, 200 h
Low temperature operation <sup>(2)</sup>	Endurance test applying the electric stress under low temperature for a long time.	-20 °C, 200 h
High temperature / humidity operation <sup>(1)(2)</sup>	The module should be allowed to stand at 60 °C, 90 % RH max.	60 °C, 90 % RH, 96 h
Thermal shock resistance	<p>The sample should be allowed stand the following 10 cycles of operation</p>  <p>-20 °C      25 °C      70 °C</p> <p>30 min      5 min      30 min</p> <p>1 cycle</p>	-20 °C / 70 °C, 10 cycles
Vibration test <sup>(3)</sup>	Endurance test applying the vibration during transportation and using.	Total fixed amplitude: 1.5 mm, vibration frequency: 10 Hz to 55 Hz, one cycle 60 s to 3 directions of X, Y, Z for each 15 minutes
Static electricity test	Endurance test applying the electric stress to the terminal.	$V_S = \pm 600 \text{ V}$ (contact), $\pm 800 \text{ V}$ (air), $R_S = 330 \Omega$ , $C_S = 150 \text{ pF}$ , 10 times

**Notes**

- (1) The function test shall be conducted after 4 hours storage at the normal temperature and humidity after remove from the test chamber
- (2) No dew condensation to be observed
- (3) The packing have to including into the vibration testing

**INITIAL CODE FOR REFERENCE**

```
void Initial_RA8875()
{
    RES = 1;
    Delay1ms(10);
    RES = 0;           //Active low
    Delay1ms(50);
    RES = 1;
    Delay1ms(100);
    LCD_CmdWrite(0x88);
    LCD_DataWrite(0x0c);
    Delay1ms(1);
    LCD_CmdWrite(0x89);
    LCD_DataWrite(0x02);
    Delay1ms(1);
    LCD_CmdWrite(0x10);
    LCD_DataWrite(0x0c);
    LCD_CmdWrite(0x04);
    LCD_DataWrite(0x81);
    Delay1ms(1);

    //Horizontal set
    LCD_CmdWrite(0x14);
    LCD_DataWrite(0x63);
    LCD_CmdWrite(0x15);
    LCD_DataWrite(0x00);
    LCD_CmdWrite(0x16);
    LCD_DataWrite(0x03);
    LCD_CmdWrite(0x17);
    LCD_DataWrite(0x03);
    LCD_CmdWrite(0x18);
    LCD_DataWrite(0x0B);
    LCD_CmdWrite(0x19);
    LCD_DataWrite(0xdf);
    LCD_CmdWrite(0x1a);
    LCD_DataWrite(0x01);
    LCD_CmdWrite(0x1b);
    LCD_DataWrite(0x20);
    LCD_CmdWrite(0x1c);
    LCD_DataWrite(0x00);
    LCD_CmdWrite(0x1d);
    LCD_DataWrite(0x16);
    LCD_CmdWrite(0x1e);
    LCD_DataWrite(0x00);
    LCD_CmdWrite(0x1f);
    LCD_DataWrite(0x01);

    //setting active window X
    LCD_CmdWrite(0x30);
    LCD_DataWrite(0x00);
    LCD_CmdWrite(0x31);
    LCD_DataWrite(0x00);
    LCD_CmdWrite(0x34);
    LCD_DataWrite(0x1F);
    LCD_CmdWrite(0x35);
    LCD_DataWrite(0x03);

    //setting active window Y
    LCD_CmdWrite(0x32);
    LCD_DataWrite(0x00);
    LCD_CmdWrite(0x33);
    LCD_DataWrite(0x00);
    LCD_CmdWrite(0x36);
    LCD_DataWrite(0xdf);
    LCD_CmdWrite(0x37);
    LCD_DataWrite(0x01);
}
```



## LCM SAMPLE ESTIMATE FEEDBACK SHEET

Module Number: \_\_\_\_\_

### 1. Panel Specification

- |                           |                               |                                    |
|---------------------------|-------------------------------|------------------------------------|
| 1. Panel type:            | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 2. View direction:        | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 3. Numbers of dots:       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 4. View area:             | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 5. Active area:           | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 6. Operating temperature: | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 7. Storage temperature:   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 8. Others:                | _____                         |                                    |

### 2. Mechanical Specification

- |                            |                               |                                    |
|----------------------------|-------------------------------|------------------------------------|
| 1. PCB size:               | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 2. Frame size:             | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 3. Material of frame:      | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 4. Connector position:     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 5. Fix hole position:      | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 6. Backlight position:     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 7. Thickness of PCB:       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 8. Height of frame to PCB: | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 9. Height of module:       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 10. Others:                | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |

### 3. Relative Hole Size

- |                            |                               |                                    |
|----------------------------|-------------------------------|------------------------------------|
| 1. Pitch of connector:     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 2. Hole size of connector: | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 3. Mounting hole size:     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 4. Mounting hole type:     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 5. Others:                 | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |

### 4. Backlight Specification

- |  |                               |                                    |
|--|-------------------------------|------------------------------------|
| 1. Backlight type:                                     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 2. Backlight color:                                    | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 3. Backlight driving voltage (reference for LED type): | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 4. Backlight driving current:                          | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 5. Brightness of backlight:                            | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 6. Backlight solder method:                            | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 7. Others:   | _____                         |                                    |



**5. Electronic Characteristics of Module**

- |                              |                               |                                    |
|------------------------------|-------------------------------|------------------------------------|
| 1. Input voltage:            | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 2. Supply current:           | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 3. Driving voltage for LCD:  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 4. Contrast for LCD:         | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 5. Backlight driving method: | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 6. Negative voltage output:  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 7. Interface function:       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 8. LCD uniformity:           | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 9. ESD test:                 | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |
| 10. Others:                  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG, _____ |

**6. Summary**

Sales signature: \_\_\_\_\_

Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Customer signature: \_\_\_\_\_



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.