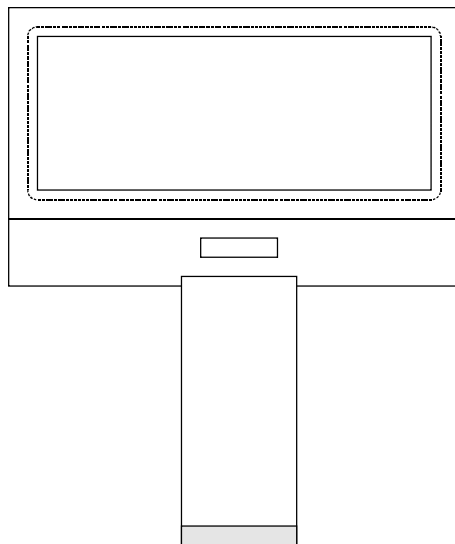




## PRODUCT SPECIFICATION

# HDG12864L-7

128x64 GRAPHICS  
Chip-On-Glass  
LCD DISPLAY MODULE



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## 1. General Specifications

### 1-1.Features

- A. Drive Method: 1/65 Duty, 1/9 Bias
- B. The Module Operating Voltage: 3V;
- C. The LCD Operating Voltage : 9.0V;
- D. Viewing Direction: 6:00
- E. Operating Temperature: 0°C~50°C
- F. Storage Temperature: -20°C~70°C
- G. Display type: FSTN Positive
- H. 4 times Voltage Converter Circuit ( $V_{out} = 4 \times V_{CI}$ )

### 1-2.Mechanical Data:

- (1) Module Size ----- 70.0 w \* 43.0 h mm
- (2) Viewing Area ----- 59.0 w \* 30.5 h mm
- (3) Dot Size ----- 0.39 w \* 0.39 h mm
- (4) Number of Dots ----- 128 \* 64 Dots

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1-3.Pin Connections:

Pin No.	Symbol	Function
1	NC	No Connect
2	V0	LCD driver supply voltages
3	V4	LCD driver supply voltages
4	V3	LCD driver supply voltages
5	V2	LCD driver supply voltages
6	V1	LCD driver supply voltages
7	C2-	Capacitor 2- connection pin for voltage converter
8	C2+	Capacitor 2+connection pin for voltage converter
9	C1+	Capacitor 1+ connection pin for voltage converter
10	C1-	Capacitor 1- connection pin for voltage converter
11	C3+	Capacitor 3+connection pin for voltage converter
12	Vout	Voltage converter input/ output pin
13	VSS	Ground
14	VDD	Power supply
15	SI	Serial input data
16	SCL	Serial input clock
17	RS	Register select input pin
18	/RES	Reset input pin
19	/CS1	Chip select input pins
20	NC	No Connect

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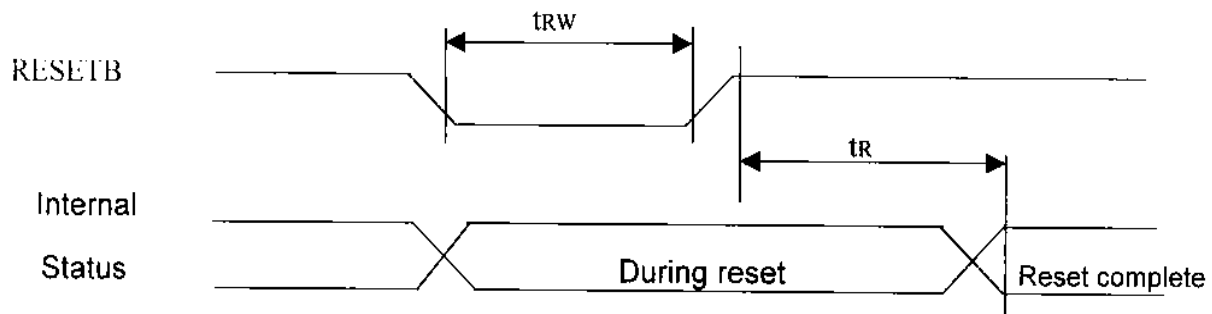
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#### 1-4. Absolute Maximum Ratings:

Characteristics	Symbol	Ratings
Supply Voltage	VDD	-0.3V to +7.0V
Supply Voltage	VLCD	-0.3V to +17.0V
Input Voltage	V <sub>IN</sub>	-0.3V to V <sub>dd</sub> +0.3V

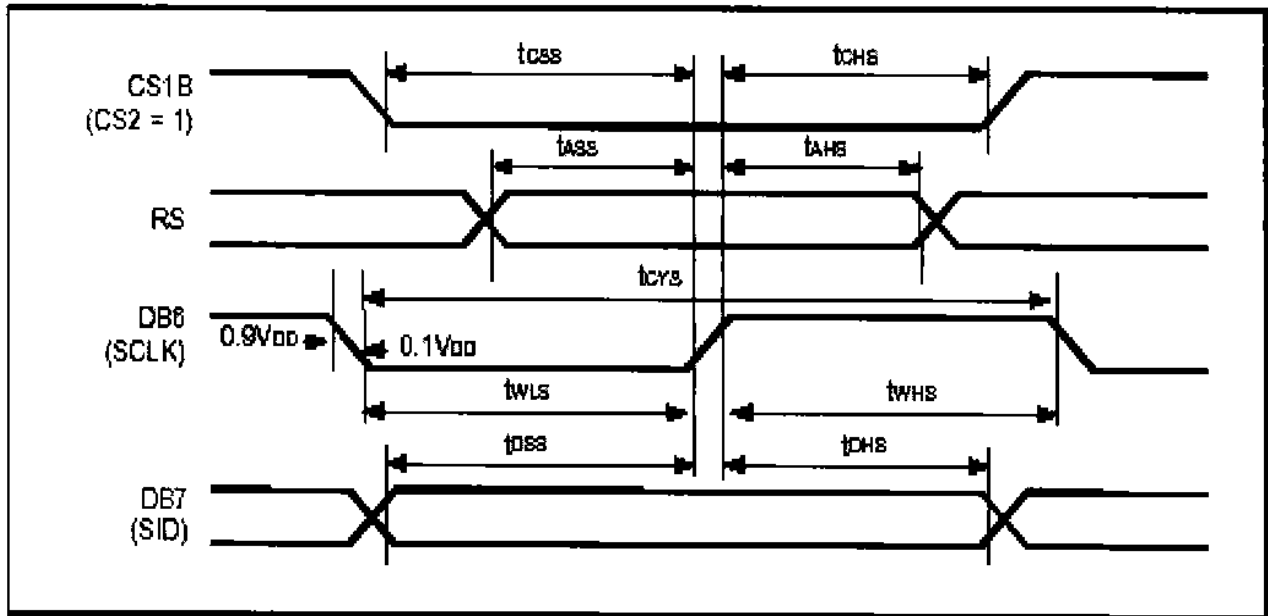
#### 1-5. Reset Input Timing:



Item	Signal	Symbol	Min.	Typ.	Max.	Unit
Reset low pulse width	RESETB	trw	1.0	-	-	us
Reset time	-	tr	-	-	1.0	us

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## 1-6. Serial Interface Characteristics



Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Serial clock cycle		$t_{CYS}$	250	-	-		
SCLK high pulse width	DB6 (SCLK)	$t_{WHS}$	100	-	-	ns	
SCLK low pulse width		$t_{WLS}$	100	-	-		
Address setup time	RS	$t_{ASS}$	150	-	-	ns	
Address hold time		$t_{AHS}$	150	-	-		
Data setup time	DB7 (SID)	$t_{DSS}$	100	-	-	ns	
Data hold time		$t_{DHS}$	100	-	-		
CS1B setup time	CS1B	$t_{CSS}$	150	-	-	ns	
CS1B hold time		$t_{CHS}$	150	-	-		

### 1-7. Instruction Table

Instruction	RS	RW	BD7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Display ON/OFF	0	0	1	0	1	0	1	1	1	DON	Turn on/off LCD panel when DON=0: display OFF when DON=1: display ON
Initial display line	0	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specify DDRAM line for COM0
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
Read status	0	1	BUSY	ADC	ONOFF	RESETB	0	0	0	0	Read the internal status
Write display data	1	0	Write data								Write data into DDRAM
Read display data	1	1	Read data								Read data from DDRAM
ADC select	0	0	1	0	1	0	0	0	0	ADC	Select SEG output direction When ADC=0: normal direction(SEG0-SEG131) When ADC=1: reverse direction (SEG131-SEG0)
Reverse display ON/OFF	0	0	1	0	1	0	0	1	1	REV	Select normal/reverse display When REV=0: normal display When REV=1: reverse display
Entire display ON/OFF	0	0	1	0	1	0	0	1	0	EON	Select normal/entire display ON When EON=0: normal display When EON=1: entire display ON
LCD bias select	0	0	1	0	1	0	0	0	1	BIAS	Select LCD bias
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	Release modify-read mode
Reset	0	0	1	1	1	0	0	0	1	0	Initialize the internal functions
SHL select	0	0	1	1	0	0	SHL	*	*	*	Select COM output direction When SHL=0: normal direction(COM0-COM63) When SHL=1: reverse direction (COM63-COM0)
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Regulator resistor select	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set reference voltage mode	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode
Set reference voltage register	0	0	*	*	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set static indicator mode	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode
Set static indicator register	0	0	*	*	*	*	*	*	S1	S0	Set static indicator register
Power save											Compound instruction of display OFF and entire display ON
NOP	0	0	1	1	1	0	0	0	1	1	Non-Operation command
Test instruction-1	0	0	1	1	1	1	*	*	*	*	Don't use this instruction
Test instruction-2	0	0	1	0	0	1	*	*	*	*	Don't use this instruction

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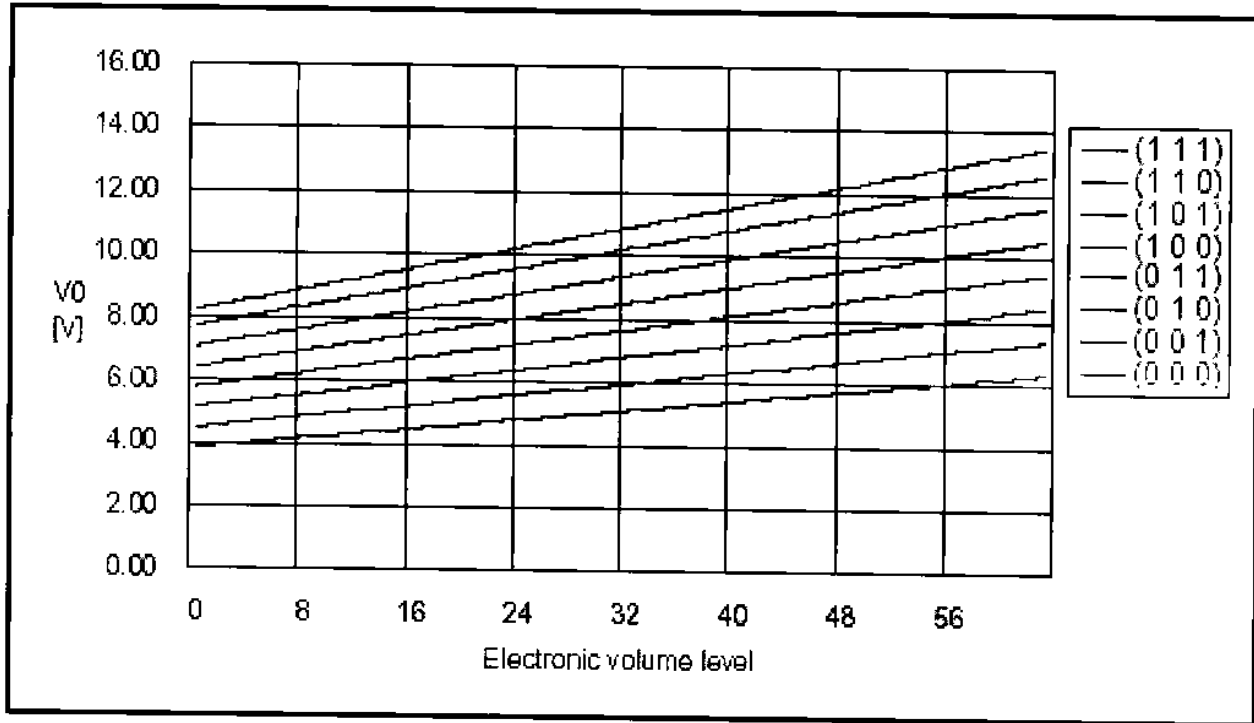
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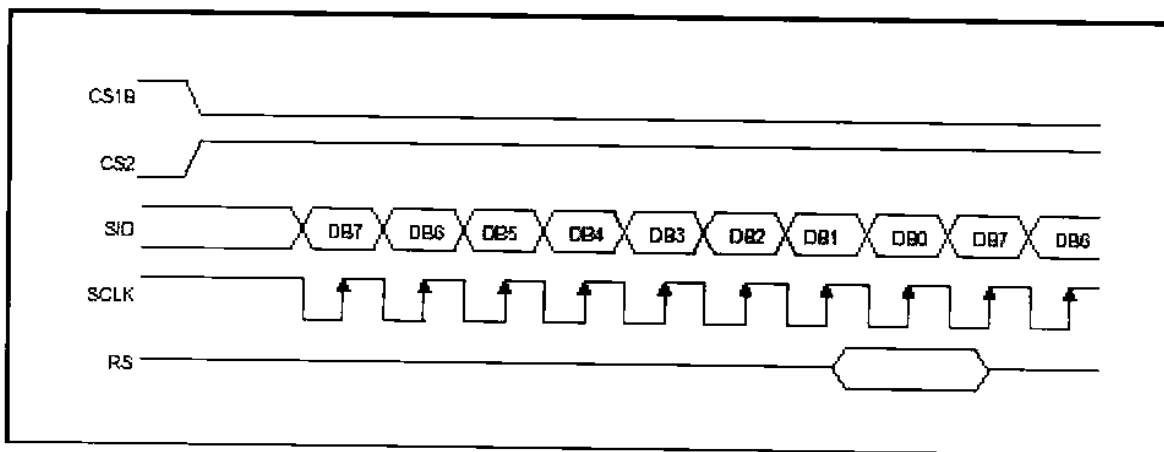
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### 1-8. Electronic Volume Level

The following figure shows V0 voltage measured by adjusting internal regulator resistor ratio (Rb / Ra) and 6-bit electronic volume registers for each temperature coefficient at Ta = 25 °C.

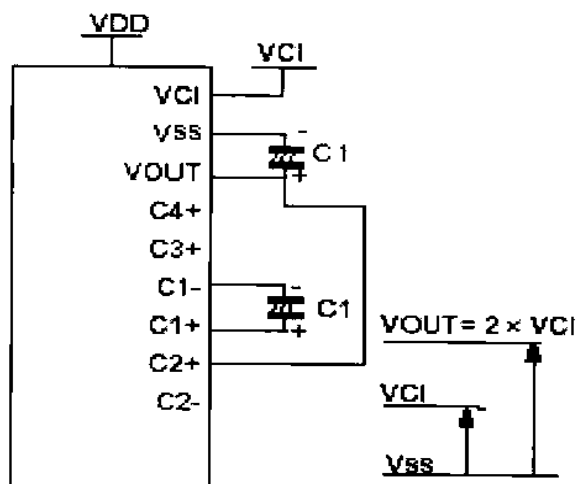


### 1-9. Serial Interface Timing

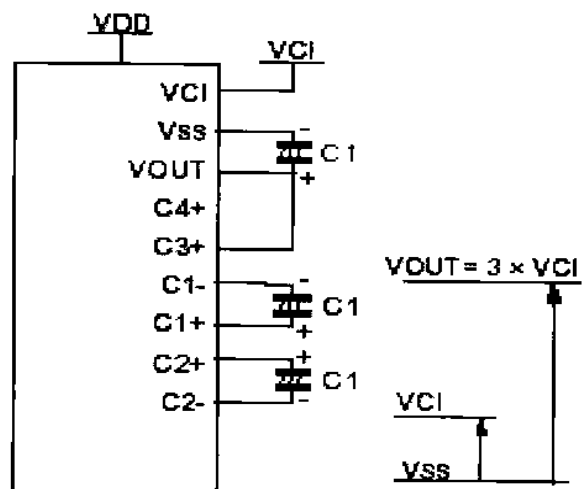


## 1-10. Voltage Converter Circuits

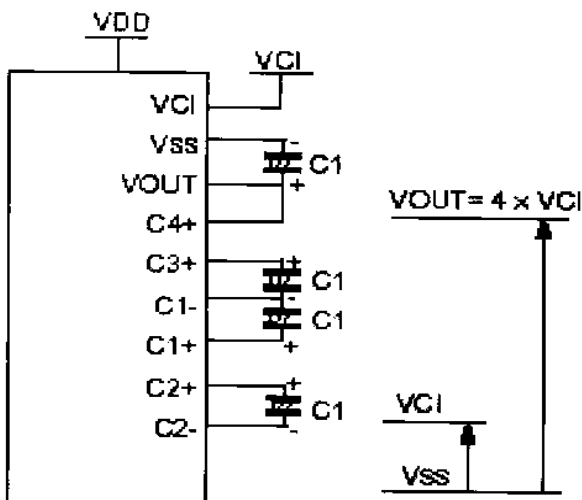
These circuits boost up the electric potential between VCI and Vss to 2, 3, 4 or 5 times toward positive side and boosted voltage is outputted from VOUT pin.



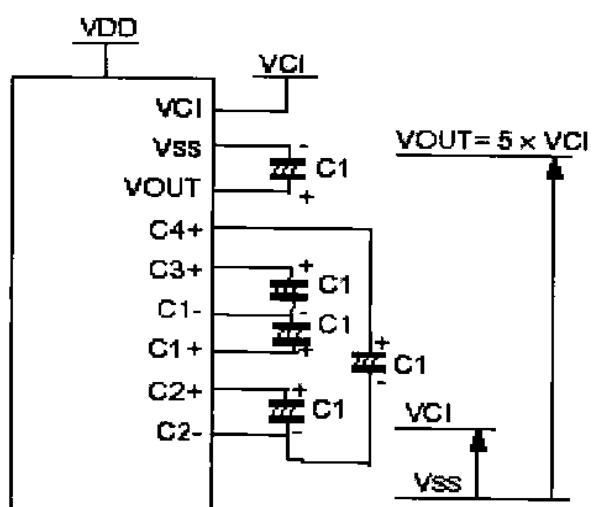
Two Times Boosting Circuit



Three Times Boosting Circuit



Four Times Boosting Circuit



Five Times Boosting Circuit



## 2.The Characteristics and The Reliability Test

### 1.Electro-Optic Characteristics:

Condition:TEMP=(23±3)°C

NO	Item	Symbol	Min	Typ.	Max	Unit	Condition
1	Supply Voltage(Logic)	Vdd-Vss		3.0		V	
2	LCD Operating Voltage	Vdd-V <sub>0</sub>		9.2		V	0°C
				9.0		V	25°C
				8.8		V	50°C
3	Response Time	Ton		112		ms	
		Toff		80		ms	
4	Contrast	CR	3				
5	Viewing Angel	12H	θ1		59	Deg	(CR≥3.0)
		6H	θ2		70		
		3H	θ3		60		
		9H	θ4		60		
6	LCD Threshold Voltage	Vth		7.01		V	25°C

## 2. Characteristics of backlight (LED unit)

### 2.1 White LED

#### (1).Absolute Maximum Ratings:

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Current	IFM		30	40	mA	Ta=25°C
Reverse Voltage	VR		5		V	Ta=25°C
Power Dissipation	PD		0.135		W	Ta=25°C

#### (2).Electrical-optical Characteristics:

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Voltage	VF		4.5		V	
Reverse current	IR		0.2		mA	
Luminous	LV		50		cd/m <sup>2</sup>	VF=4.5V
Color	WHITE					

### 2.2 Yellow-green LED

#### (1).Absolute Maximum Ratings:

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Current	IFM		60	120	mA	Ta=25°C
Reverse Voltage	VR		10		V	Ta=25°C
Power Dissipation	PD		0.27		W	Ta=25°C

#### (2).Electrical-optical Characteristics:

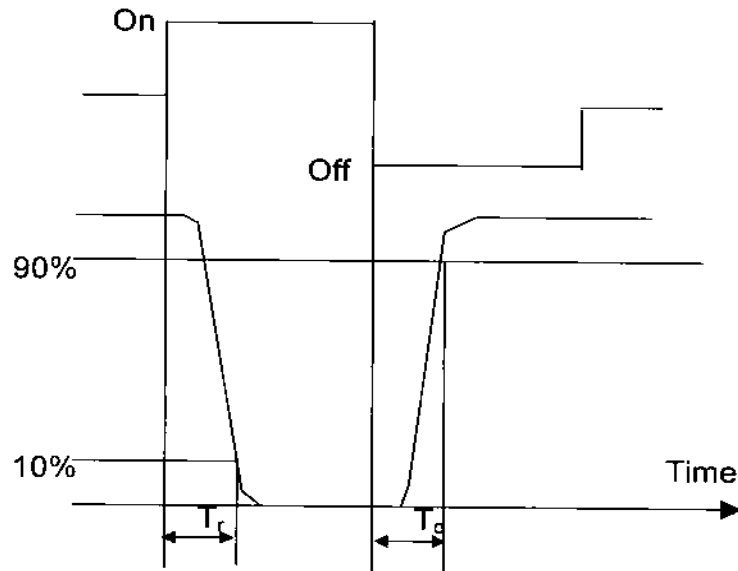
Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Voltage	VF		4.5		V	
Reverse current	IR		0.6		mA	
Luminous	LV		50		cd/m <sup>2</sup>	VF=4.5V
Color	YELLOW-GREEN					

### 3. Reliability Test

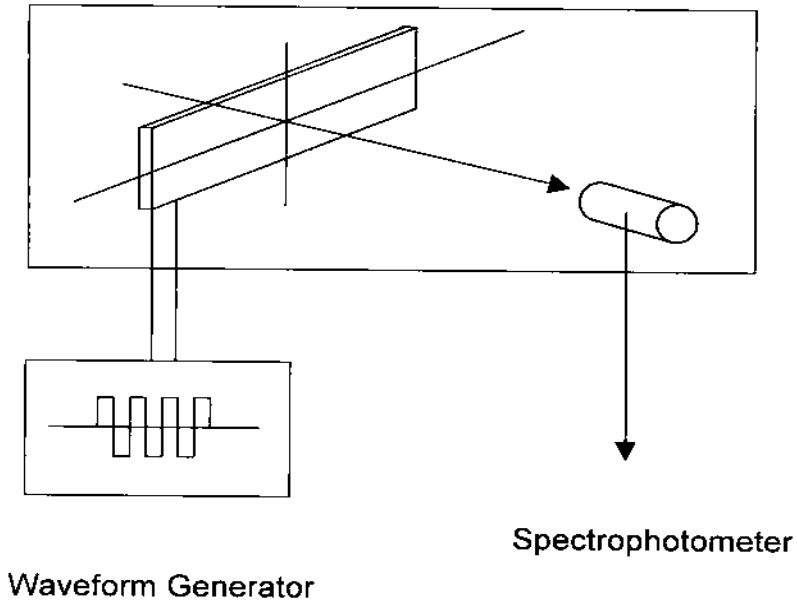
No	Items	Test Condition	Equipment	Test Result
1	High TEMP Storage	TEMP: $70 \pm 2^\circ\text{C}$ Time: 96h Restore: 24h	Tenny	Passed
2	Low TEMP Storage	TEMP: $-20 \pm 3^\circ\text{C}$ Time: 96h Restore: 24h	Tenny	Passed
3	High TEMP Operating	TEMP: $50 \pm 2^\circ\text{C}$ Vop: 3V Timp: 24h Restore: 24h	Tenny	Passed
4	Low TEMP Operating	TEMP: $0 \pm 2^\circ\text{C}$ Vop: 3V Timp: 24h Restore: 24h	Tenny	Passed
5	High TEMP High Hum Storage	TEMP: $40 \pm 2^\circ\text{C}$ Hum: 95%Rh Time: 96h Restore: 24h	Tenny	Passed
6	Thermal Shock	<p>TEMP: (<math>^\circ\text{C}</math>)</p> <p>The diagram shows a thermal shock profile with 5 cycles. Each cycle consists of a 30-minute ramp from 25°C to 70°C, a 5-minute dwell at 70°C, a 30-minute ramp from 70°C to -20°C, and a 5-minute dwell at -20°C. The temperature starts at 25°C and ends at -20°C. The total duration of the 5 cycles is indicated as 5 Cycles.</p> <p>Restore: 24h</p>	Tenny	Passed

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## B. Response Time



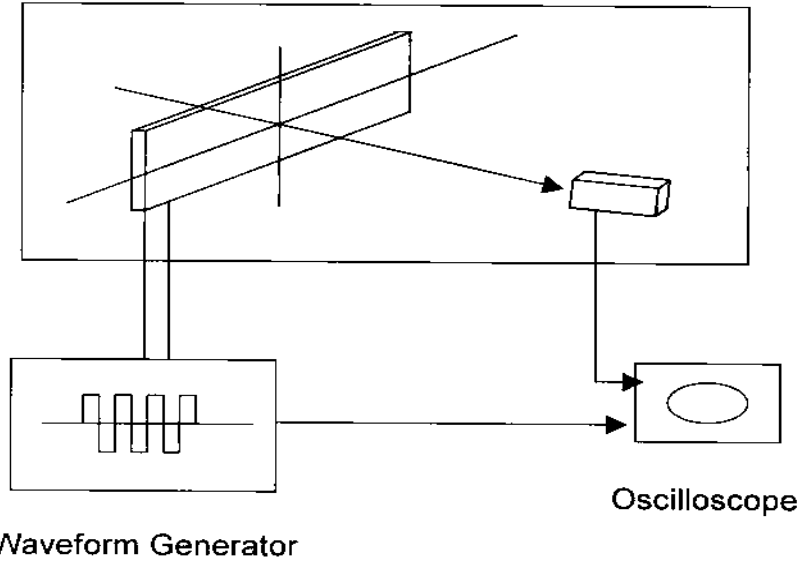
## 2. Contrast Measuring (1) Equipment



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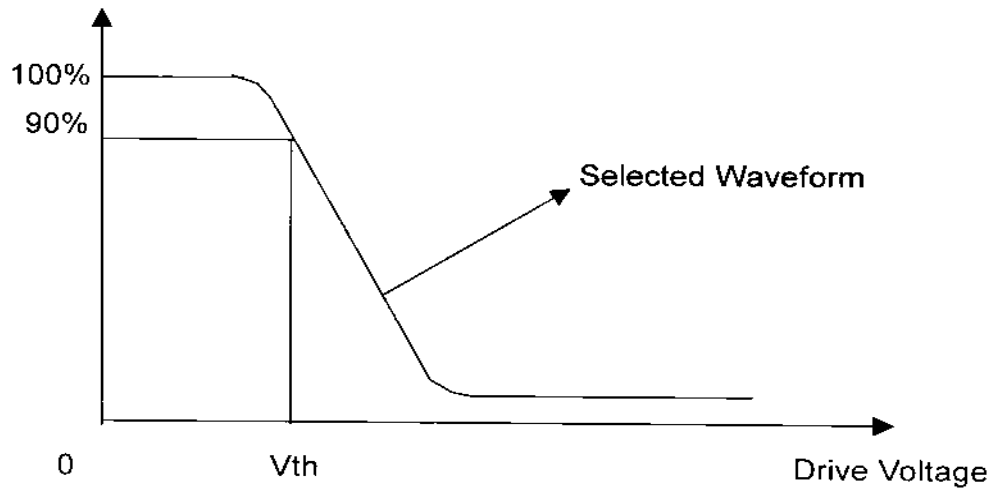
### 3.The LCD Measuring Method and Equipment

1. Threshold Voltage and Response Time Measuring
  - (1) Equipment



- (2) Definition

- A. Threshold Voltage ( $V_{th}$ )  
Brightness



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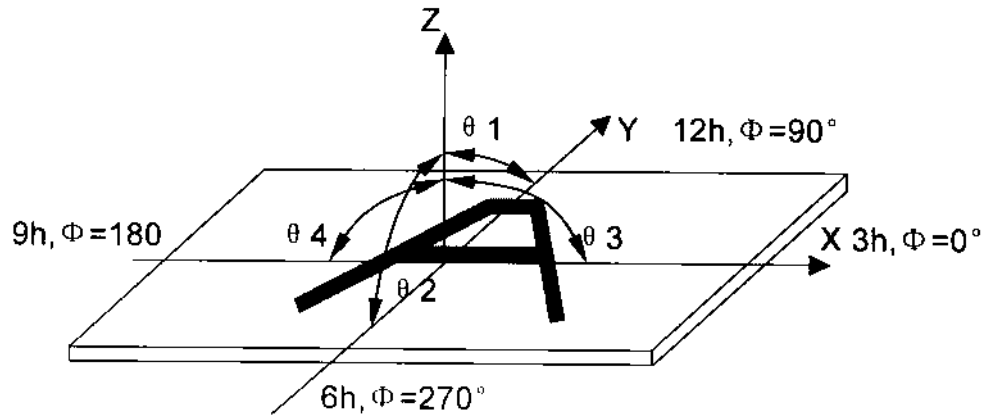
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(2) Definition:

A. Viewing Angle:



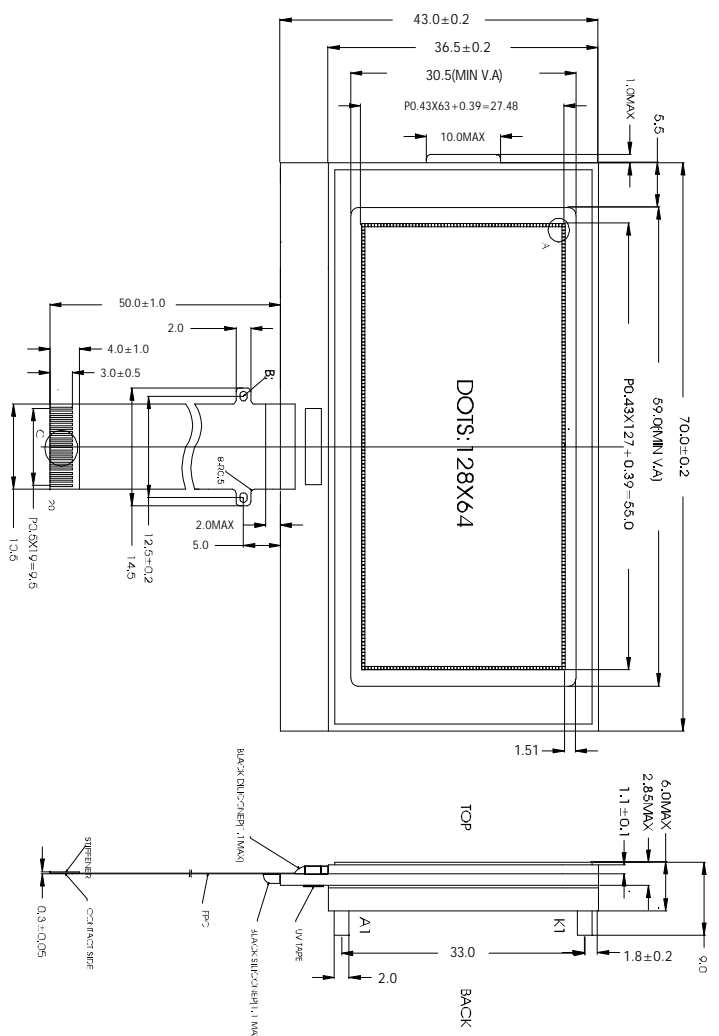
B. Contrast Ratio (Positive)

$$CR = \frac{\text{Brightness of non-selected wave-form}}{\text{Brightness of selected wave-form}}$$

3. Reliability Test:

Equipment : TENNY

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Pin	Symbol	Pin	Symbol
1	NC	11	C3+
2	V0	12	VOUT
3	V4	13	VSS
4	V3	14	VDD
5	V2	15	S1
6	V1	16	SCL
7	C2-	17	RS
8	C2+	18	/RES
9	C1+	19	/CS1
10	C1-	20	NC

Note:

1. Display Type: FSIN
2. Polarizer Mode: Transmissive/Positive
3. Drive Method: 1/65 Duty 1/9 Bias
4. Viewing Direction: 6:00
5. Operating Temp: 0°C~50°C  
Storage Temp: -20°C~70°C
6. Controller: S680724A01-BOCY
7. Resolution: 128X64 Dots
8. Logic Voltage: 3.0V  
LCD Operating Voltage: 9.0V
9. Backlight: LED White ; VOLTAGE: 4.5V
10. Unmarked Tolerances: ±0.3

