

LiteMax LF1503

Sunlight Readable 15" LCD Display

Preliminary Product Document

Rev: 0.2
Date: Jan 4, 2001

LiteMax Electronics Inc.

No.8, Lane 89, Sec. 3, Chung-yang Rd., Tucheng City, Taipei
County, Taiwan R.O.C.
Tel : 886-2-2267-6766
Fax: 886-2-2267-6779
Homepage: <http://www.litemax.com.tw>

General Introduction

The LITEMAX model LF1503 is a 15" color TFT-LCD product. Its brightness is up to 800 cd/m². The LF1503 consists of TFT LCD panel module (CP1503), LCD controller board and backlight inverter (LI2202).

Because the backlight of LF1503 uses the LITEMAX technique, the color quality, brightness and viewing angle can be improved for display.

A.LCD Panel Module (CP1503)

1. Introduction

CP1503 is a 15", ultra brightness LCD panel module. This module consists of CPT CLAA150XA03 TFT color LCD and a LITEMAX ultra brightness (UB) backlight mounted onto the back of the LCD. The entire is about 26.9 mm thick and has the same footprint as the original CPT CLAA150XA03 LCD.

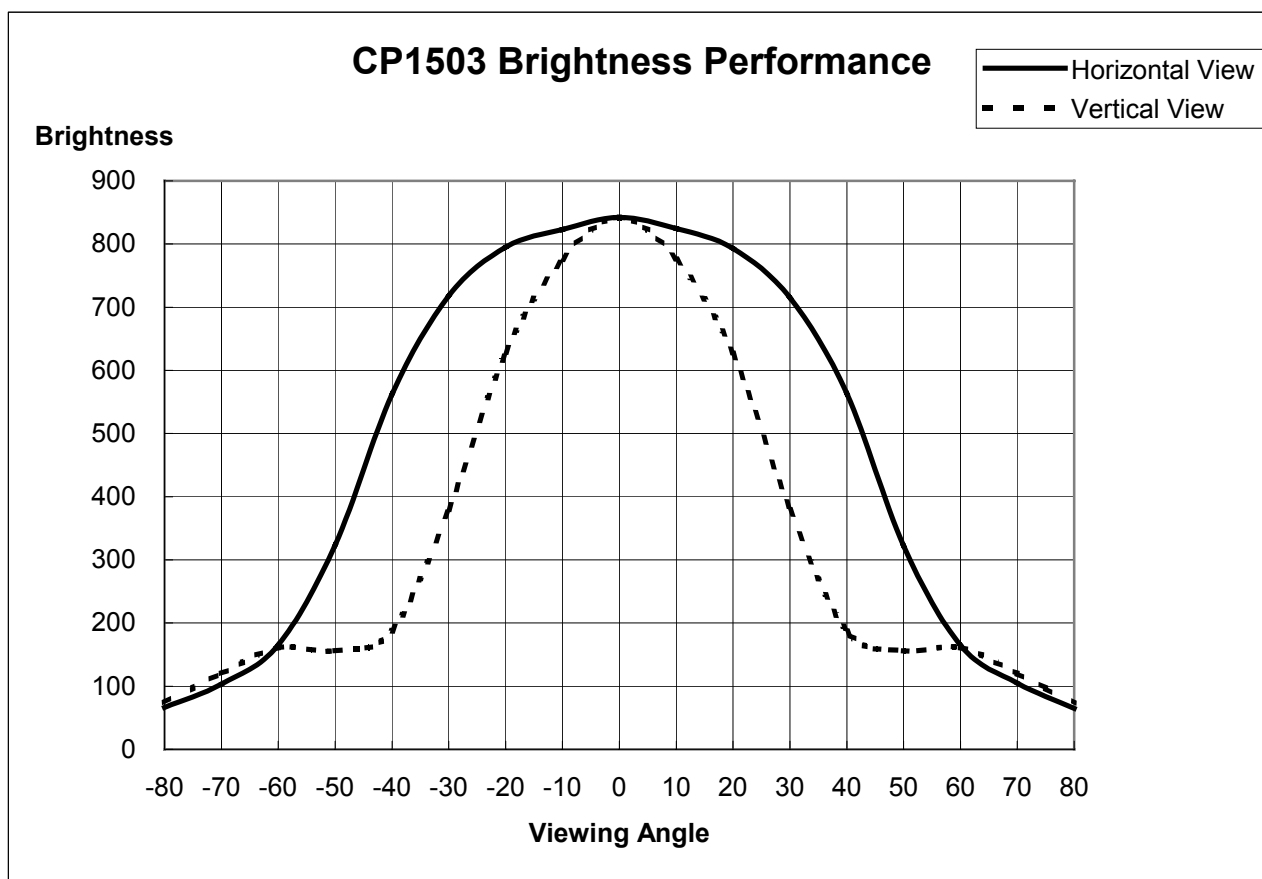
The CP1503 panel module has a higher contrast, wide view-angle LCD and a wider operating temperature range. In the normal mode operation, the CP1503 module delivers 800 Cd/m² (nits) LCD screen brightness at a backlight power of 33.6 Watts. With a dimming inverter, the module can be operated in a reduced brightness mode with lower power consumption and longer lamp life.

With a wide dimming range of LITEMAX inverter, the CP1503 LCD panel module presents a super color image over ambient illumination levels from full bright sunshine to total darkness, making it highly suitable for various outdoor applications.

2. Optical Performance

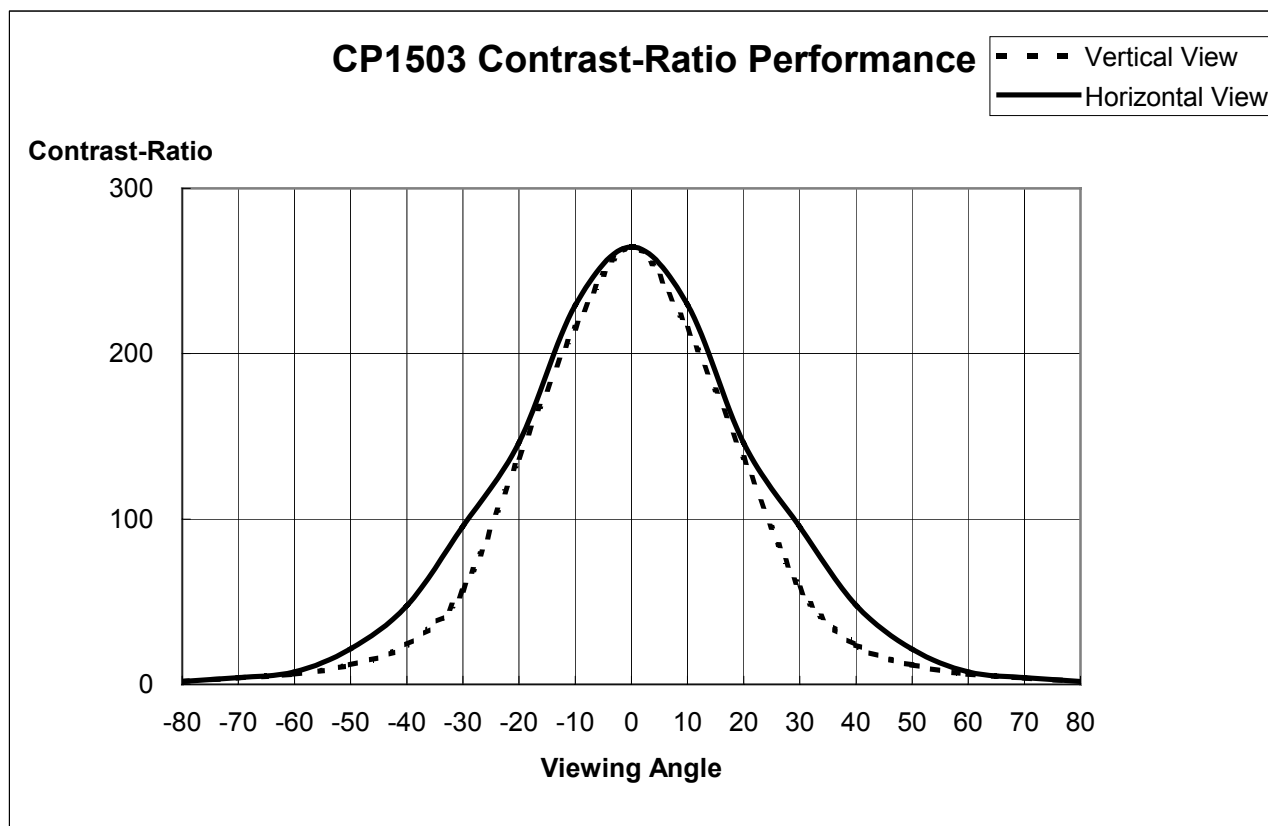
The typical CP1503 LCD panel module screen luminance and contrast ratio versus viewing angle are shown in the figures below:

1. Brightness Performance



The LCD screen luminance is measured with the LCD in the 'Off' state (i.e. the pixels are not energized). This is the 'White' state with maximum luminance. Quite often, this 'Off' state is brighter than the 'White' displayed on the screen after the LCD is turned on. The difference may be caused by the graphics card and/or on the LCD controller card driving this display. When the LCD is driven properly, the luminance difference between the 'Off' state and the 'White' color should be less than 10 %.

2. Contrast-Ratio Performance



The inherent contrast ratio (CR) of the LCD is the luminance ratio between the 'White' and the 'Black' states measured in a dark room. In outdoor environments, the contrast ratio of the display drops significantly due to the surface reflections and glare caused by the ambient illumination at the front surface of the LCD and other surfaces such as touch screen or the protective window.

3. Characteristics

| Parameters | Typical value | Units | Condition |
|-----------------------------|--------------------|-------------------|----------------------------------|
| LCD Screen Luminance | 800 | Cd/m ² | center |
| Luminance Uniformity | 20% or better | | Note 2 |
| LCD Contrast Ratio | 350 | | White vs Black |
| Screen Dimming Ratio | 200:1 | | With LI2202 inverter |
| LCD Screen Chromaticity | | | |
| White (LCD in off state) | x=0.3380, y=0.3437 | | Measured at normal direction |
| Red | x=0.6019, y=0.3485 | | Measured at normal direction |
| Green | x=0.3123, y=0.5726 | | Measured at normal direction |
| Blue | x=0.1584, y=0.1451 | | Measured at normal direction |
| Viewing Angle | | | |
| 3:00 to 9:00 direction | -55 ~ 55 | degrees | Contrast Ratio ≥ 10 |
| 6:00 to 12:00 direction | -55 ~ 55 | degrees | Contrast Ratio ≥ 10 |
| 3:00 to 9:00 direction | -70 ~ 70 | degrees | Screen luminance ≥ 100 nits |
| 6:00 to 12:00 direction | -70 ~ 70 | degrees | Screen luminance ≥ 100 nits |
| Backlight Power Consumption | 33.6 | Watts | Excluding inverter losses |
| LCD Module Weight | 3870 | Grams | with Encasong |
| Number of CCFLs | 12 | | |

Note 1: All data are measured at 25° C \pm 2 ° C ambient temperature.

Note 2: Uniformity = (Lmax/Lmin-1) \times 100%

Lmax (Lmin) is the maximum (minimum) luminance measured with a 10 mm diameter meter aperture over the LCD active area except the last 10 mm area from the edge.

4. Optical specification, Signal Timing Specification and Signal Timing Wave Form

In addition to the data described on characteristic, please refer to CPT CLAA150XA03 for other information.

5. Interface connection

5.1 Electrical Interface Connection

Please refer to CPT CLAA150XA03.

5.2 Backlight Lamp Connections

The ultra brightness (UB) backlight in the CP1503 module uses a total of 12 cold cathode fluorescent lamps (CCFL) to achieve the required luminance. The lamps can be electrically separated into 2 groups. Group(A) contains lamps #1, #2, #3, #4, #5, #6 and Group(B) contains lamps #7, #8, #9, #10, #11, #12.

The lead wires connecting the lamps are terminated with four 4-pins connectors (JST). The following are the connector pin out assignments.

| Pin # | Group A Connector | Group B Connector |
|----------|-------------------|-------------------|
| 1 (Red) | Lamp#1 | Lamp#7 |
| 2(Red) | Lamp#2 | Lamp#8 |
| 3(Red) | Lamp#3 | Lamp#9 |
| 4(Red) | Lamp#4 | Lamp#10 |
| 1(Red) | Lamp#5 | Lamp#11 |
| 2(Red) | Lamp#6 | Lamp#12 |
| 3 | No Connection | No Connection |
| 4(White) | Common | Common |

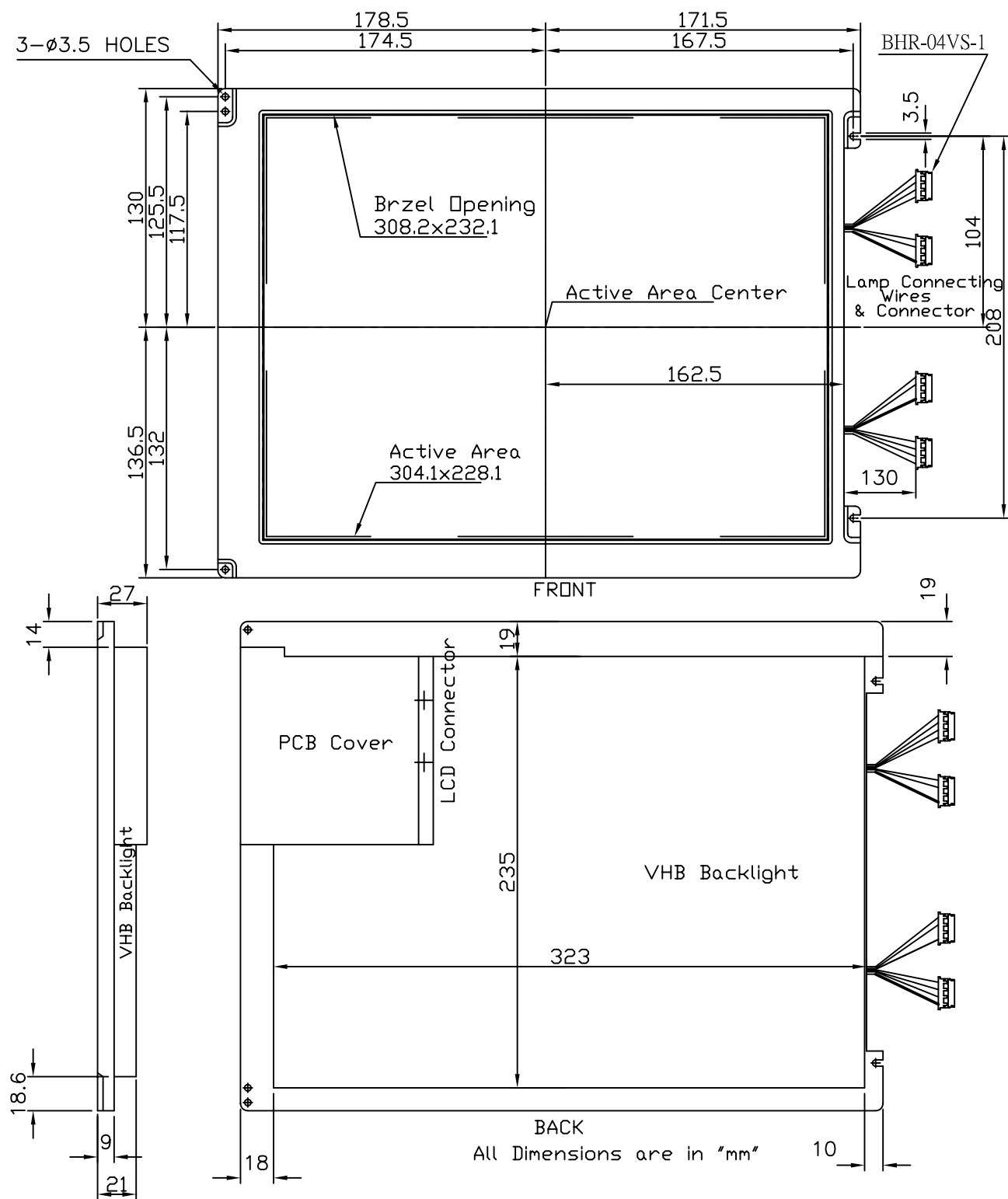
6. Backlight Lamp Driving Specification

It is recommended to use an inverter with a 1300 Vrms starting voltage to run the UB backlight in the CP1503 LCD panel module. At the maximum LCD screen luminance, the lamp voltage and current are listed below:

| | | |
|-------------------|-----|-------|
| Operating Voltage | 515 | Vrms |
| Lamp Current | xx | mArms |

At this driving condition, the backlight delivers the specified maximum LCD screen brightness with power consumption about 33.6 Watts. Since most inverters used to driver CCFLs have efficiency between 75 % - 80 %, the total DC power input to the inverter is about 42 Watts. When the backlight is dimmed down, the power consumption decreases.

7. Mechanical Characteristics



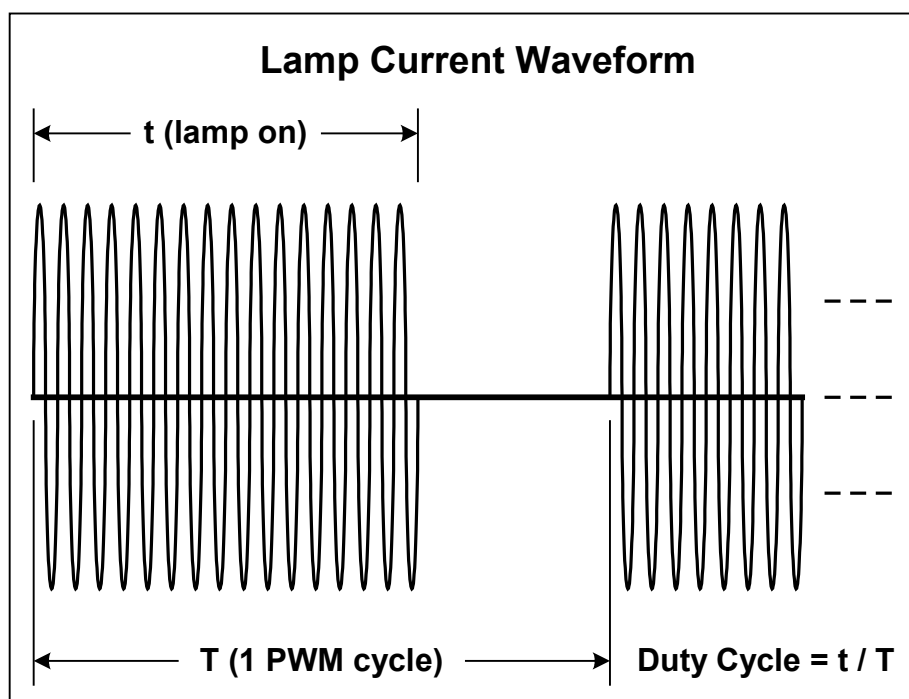
B. LITEMAX LI2202 inverter

1. Introduction

LI2202 is a CCFL inverter to operate LITEMAX ultra brightness (UB) backlights. The inverter has an on-board pulse width modulation (PWM) dimming circuit for extremely wide range luminance adjustment. Over the entire dimming range, there is no noticeable lamp flickering and the uniformity of the backlight is well maintained. When using LI2202 with LITEMAX LCD modules, it is not necessary to synchronize the PWM circuit to vertical sync signal of the LCD.

2. Dimming Control

The LI2202 accepts a 0-5V analog voltage for dimming control. It has a pulse width modulation (PWM) dimming circuit for luminance adjustment. As the dimming voltage V_d decreases from +5V, the lamp current waveform is pulse width modulated at a repetition rate high enough to prevent LCD flicker. Within each PWM cycle, the lamps in the backlight are turned fully 'ON' for a fraction of the cycle time. The human eyes, being very slow with respect to the PWM rate, respond to the average light produced over the PWM cycle. As a result, the luminance of the backlight and/or the LCD screen is approximately to the duty cycle of the PWM waveform.



The lamp current waveform with the PWM circuit set at less than 100%

In general, inverters with PWM dimming have a very wide luminance adjustment range. For most practical cases, the LI2202 inverter can achieve a dimming ratio up to 200:1. Hence, the luminance of the backlight or LCD screen can be adjusted from 100% to 0.5%.

The 0- 5V dimming voltage can be generated simply by a potentiometer, by a digitally controlled UP/DOWN counter or a digital potentiometer. The inverter provides a regulated +5V supply to power the dimming circuit. However, the maximum current drain from this source should be kept less than 5 mA.

At a Vd input about 0.34V and less, the duty cycle of the PWM waveform is 0% and thus, the lamps are 'OFF'. In order to fully utilize the available dimming voltage, Vd should be biased to about 0.34V and then ramping up to 5.0V.

3. Electrical Characteristics

The LI2202 inverter operates at 12V DC input and can drive up to 12 lamps for a maximum output power about 40 Watts. In addition, the inverter has a regulated +5V output serving as a voltage source for the dimming control circuit.

| Parameters | Min | Typ | Max | Units | Conditions |
|-----------------------------|------|-----------|------|-------|-----------------|
| Input Voltage (Vin) | 11.5 | 12 | 12.5 | Vdc | |
| Input current (I) | | 3.8 | | Adc | Vin=12, Vd=5 V |
| Lamp Starting Voltage (Vst) | | 1300 | | Vrms | Vin=12, Vd=5 V |
| Frequency (f) | 55 | 58 | 60 | Khz | |
| ON/OFF Control -OFF | | | 0.2 | Vdc | |
| -ON | | Floating* | | | |
| Dimming Voltage(Vd) | | | | | |
| @ 100% Duty Cycle | | 4.9 | 5 | Vdc | Max brightness |
| @ 0% Duty Cycle | | 0.34 | 0.36 | Vdc | Zero brightness |
| 5V Output (+5VOUT) | 4.85 | 5 | 5.25 | Vdc | 11.5<Vin<12.5V |
| 5V Output Source Current | | | 5 | mA | |

*Please refer to Application Note AN001 for details of On/Off control and dimming control with an external PWM signal.

Absolute Maximum Rating

| Parameters | Min | Max | Units |
|------------------------------|-----|-----|-------|
| Inverter Input Voltage (Vin) | 11 | 13 | Vdc |
| Operating Temperature Range | 0 | 50 | C |
| Storage Temperature Range | -20 | 80 | C |

4. Interface Connector

Input Connector (CN1)

| Pin# | Function |
|------|-----------------|
| 1 | 5V Output |
| 2 | 12V Input |
| 3 | 12V Input |
| 4 | Dimming Control |
| 5 | Ground |
| 6 | Ground |
| 7 | ON/OFF Control |

Output Connector (CN2, CN4)

| PIN# | Function |
|------|-----------------|
| 1, 2 | Lamp Connection |
| 3 | No connection |
| 4 | Lamp Common |

Output Connector (CN3, CN5)

| PIN# | Function |
|------------|-----------------|
| 1, 2, 3, 4 | Lamp Connection |

5. Mechanical

