PRODUCT SPECIFICATION

FOR

MODEL LF1745

17" SUNLIGHT READABLE LCD

Rev: **A0**
Date: **Oct 1, 2003**

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Introduction and Overview

This is a product specification that specifies form, fit, and function of the 17"LCD and its options. The LF1745 is a product of high bright LCD monitors intended for use in a variety of industrial and commercial applications. Some of these applications include automatic teller machines (ATMs), fuel dispensing systems, ticketing and information kiosks, and intelligent vending machines. The LCD panel for LF1745 has a particularily fast response time of 16ms and consequently very well suited for video applications.

The LF1745 is a 17" active matrix TFT LCD with a native resolution of SXGA (1280X1024). It has a typical luminance of 1000 nits with a +12VDC input. The video interface is through a standard 15 pin analog input with an integrated On-Screen Display(OSD). The sheet-metal external housing is intended for industrial applications where the product is integrated into a larger host system. Commercial applications would most likely require an additional external façade. This product includes packaging designed to withstand standard shipping conditions.

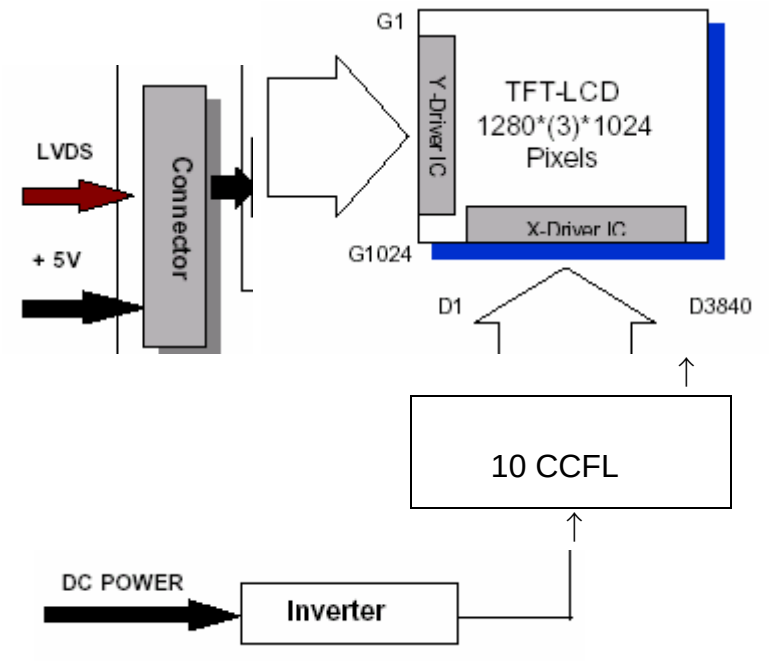
The option available is a power supply with US or EU cord options and a VGA cable. The power supply is appropriately rated and tested for this displays.

Characteristics

ITEMS	SPECIFICATIONS
17" Sunlight Readable TFT-LCD	
Display Area	337.92 (H) x 270.34 (V) mm
Diagonal size of display	17 inches
Drive system	a-Si TFT active matrix
Display Colors	262 k
Resolution (Number of pixels)	1280 (H) x 1024 (V) pixel
Pixel Arrangement	R.G.B Vertical Stripe
Dot Pitch	0.088 (H) x 0.088 (V) (mm)
Pixel Pitch	0.264 (H) x 0.264 (V) (mm)
Module size	358.5 (H) x296.5 (V) x 29 (D) mm
Weight	1700 g (typ.)
Contrast ratio	500:1 (typ.)
Viewing angle	At the contrast ratio 10:1 Horizontal: Left side 75° (typ.), Right side 75° (typ.) Vertical: Up side 75° (typ.), Down side 75° (typ.)
Designed viewing direction	Optimum grayscale (γ=2.2): perpendicular
Color gamut	At LCD panel center / 60% (typ.)[against NTSC color space]
Response Time	16ms
Luminance	1000 cd/m2
Signal system	Parallel 8-bit interface (2 port) [8-bit digital signals for data of RGB colors,

	Dot clock (CLK), Data enable (DE)]
Supply voltage	LCD panel signal processing board: 5V / Backlight inverter: 12V
Backlight	Direct light type: 10 cold cathode fluorescent lamps [Replaceable parts :] Backlight unit : AU1745 Inverter : LI3601(Rev.2)
Power consumption	55 W

Function Block Diagram



Functions and Environments

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input Voltage	Vin	11.5	12	12.5	Volts	
Input Current	Iin		4.5		Amps	Vin=12V
Power	Pin		55		Watts	
White Luminance			800		cd / m2	Center; Normal
Luminance Uniformity	BNU		80		%	9-point;10% from edge
Contrast Ratio	CR		500			
Viewing Angle			± 75		degree	Horizontal (CR=10)
			± 75		degree	Vertical (CR=10)
Response Time			16 ms			Tr + Tf
Operating Temperature	Top	0		50	°C	
Operating Humidity	Hop	30		85	°RH	Non-condensing
Storage Temperature	Tst	-20		+60	°C	
Storage Humidity	Hst	10		85	°RH	Non-condensing

Reliability and Lifetime

Monitor Reliability
Demostrated MTTF testing in progress

Backlight Reliability and Lifetime
CCF lamps; 40,000 hour rated lifetime @ 25°C
CCF lamp life is defined as time to 50% of initial brightness
Backlight end-of-life for this 1745 product is defined as 1000 nits center luminance at 25°C

Typical values indicated for luminance and uniformity are indicative of typical steady state values measured at initial use at 25°C after warm-up to steady state. Actual luminance and uniformity values are directly dependent on the environmental usage profile. Repeated cold temperature start-up can cause accelerated aging of the backlight lamps resulting in reduced luminance and uniformity.

Extended High Temperatures and Solar Loading
Extended operation at the upper temperature extreme or in conjunction with extended direct solar loading can cause permanent mura or localized pixel non-uniformity effects. Other side effects could include latent image and flicker. These effects are not covered under the warranty. Please consult us for further guidance on system design to effectively manage environments requiring extended high temperatures or direct sun-loading. Cooling kit and CEG vandal glass options can effectively address these issues.

Reliability Test

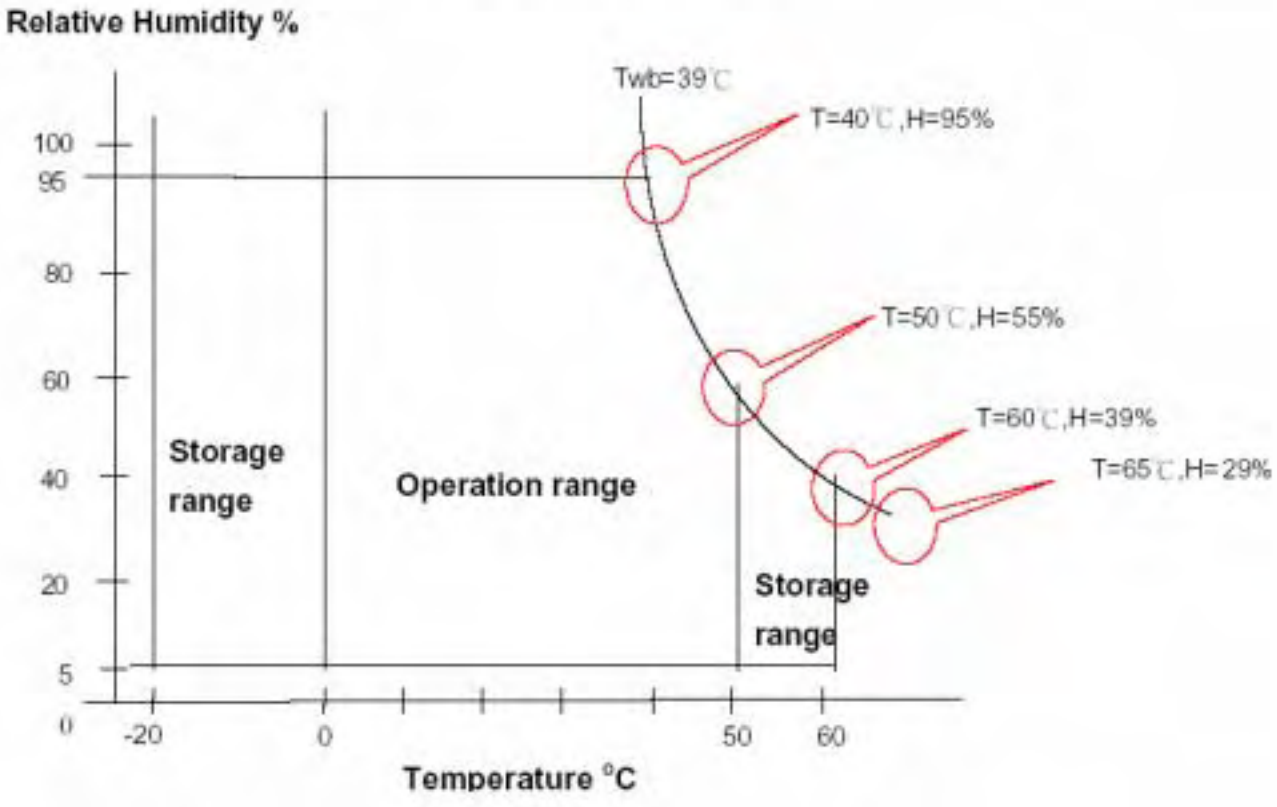
Test Item		Test ondition	Judgement
High temperature/humidity operation		1. 60±2°C, RH=60%, 240 hours, 2. Display data is white.	Note 1
Heat cycle (operation)		1. 0°C±3°C…1 hour 2. 55°C±3°C…1 hour 3. 50 cycles, 4 hours/cycle 4. Display data is white.	Note 1
Thermal shock (non-operation)		1. -20°C±3°C…1 hour 2. 60°C±3°C…1 hour 3. 100 cycles, 4 hours/cycle 4. Temperature transition time is within 5 min.	Note 1
Vibration (non-operation)		5-100Hz, 11.76m/s2, 1 minute/cycle, XYZ direction 10 times each direction	Note 1
ESD (non-operation)		150pF, 150Ω, ±10kV 9 places on a panel (Note 3) 10 times each place at one-second intervals	Note 1
Dust (non-operation)		Sample dust: No.15 Hourly 15 seconds stir, 8times repeat	Note 1
Low pressure	operation	53.3 kPa 0°C±3°C…24 hours 55°C±3°C…24 hours	Note 1
	non-operation	15 kPa -20°C±3°C…24 hours -60°C±3°C…24 hours	Note 1

Electrical characteristics

Absolute maximum ratings of the module is as following:

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	VIN	-0.3	+5.5	[Volt]	
Select LVDS data order	SELLVDS	NC	NC	[Volt]	
CCFL Inrush current	ICFLL	-	38	[mA]	
CCFL Current	ICFL	-	7.6	[mA] rms	
Operating Temperature	TOP	0	+50	[°C]	Note 1
Operating Humidity	HOP	8	95	[%RH]	Note 1
Storage Temperature	TST	-20	+60	[°C]	Note 1
Storage Humidity	HST	8	95	[%RH]	Note 1

Note 1 : Maximum Wet-Bulb should be 39℃ and No condensation.



Signal and Power Interface

Connectors

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

Connector Name / Designation	Interface Connector / Interface card
Manufacturer	JAE or compatible
Type Part Number	FI-X30S-HF
Mating Housing Part Number	FI-X30S-H

Connector Name / Designation	Lamp Connector / Backlight lamp
Manufacturer	JST
Type Part Number	BHR-04VS-1
Mating Type Part Number	SM04(4.0)B-BHS-1-TB

Signal Pin

Pin#	Signal Name	Pin#	Signal Name
1	RxO0-	2	RxO0+
3	RxO1-	4	RxO1+
5	RxO2-	6	RxO2+
7	GND	8	RxOC-
9	RxOC+	10	RxO3-
11	RxO3+	12	RxE0-
13	RxE0+	14	GND
15	RxE1-	16	RxE1+
17	GND	18	RxE2-
19	RxE2+	20	RxEC-
21	RxEC+	22	RxE3-
23	RxE3+	24	GND
25	NC	26	NC
27	NC	28	Power
29	Power	30	Power

Signal Description

The module using a pair of LVDS receiver SN75LVDS82 (Texas Instruments) or compatible. LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS83(negative edge sampling) or compatible. The first LVDS port(RxOxxx) transmits odd pixels while the second LVDS port(RxExxx) transmits even pixels.

PIN #	SIGNAL NAME	DESCRIPTION
1	RxO0-	Negative LVDS differential data input (Odd data)
2	RxO0+	Positive LVDS differential data input (Odd data)
3	RxO1-	Negative LVDS differential data input (Odd data)
4	RxO1+	Positive LVDS differential data input (Odd data)
5	RxO2-	Negative LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG)
6	RxO2+	Positive LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG)
7	GND	Power Ground
8	RxOC-	Negative LVDS differential clock input (Odd clock)
9	RxOC+	Positive LVDS differential clock input (Odd clock)
10	RxO3-	Negative LVDS differential data input (Odd data)
11	RxO3+	Positive LVDS differential data input (Odd data)
12	RxE0-	Negative LVDS differential data input (Even clock)
13	RxE0+	Positive LVDS differential data input (Even data)
14	GND	Power Ground
15	RxE1-	Positive LVDS differential data input (Even data)
16	RxE1+	Negative LVDS differential data input (Even data)
17	GND	Power Ground
18	RxE2-	Negative LVDS differential data input (Even data)
19	RxE2+	Positive LVDS differential data input (Even data)
20	RxEC-	Negative LVDS differential clock input (Even clock)
21	RxEC+	Positive LVDS differential clock input (Even clock)
22	RxE3-	Negative LVDS differential data input (Even data)
23	RxE3+	Positive LVDS differential data input (Even data)
24	GND	Power Ground
25	NC	-
26	NC	-
27	NC	-
28	POWER	Power
29	POWER	Power
30	POWER	Power

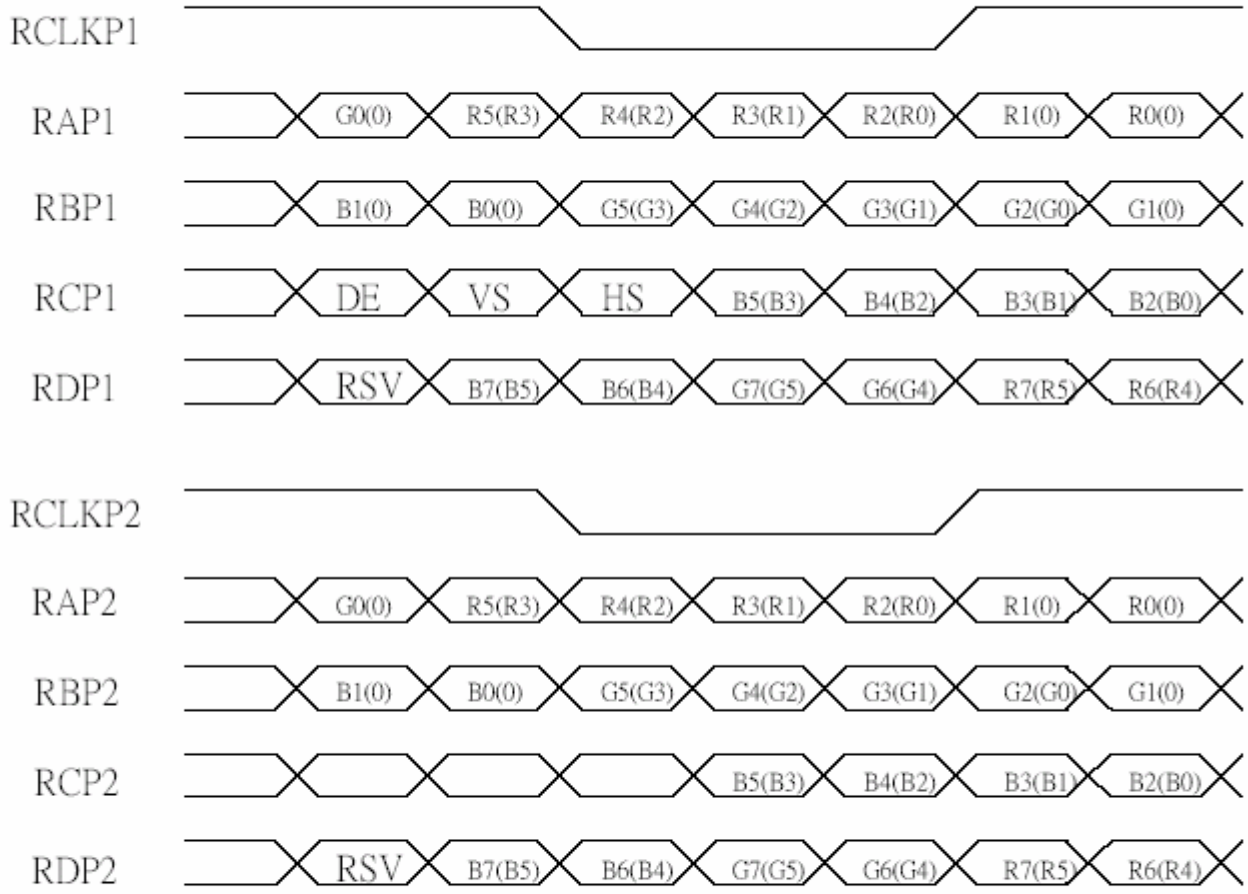
Note: Input signals of odd and even clock shall be the same timing.

LVDS DATA Name	Description
DSP	Display Timing: When the signal is high, the pixel data shall be valid to be displayed
V-S	Vertical Sync: Both Positive and Negative polarity are acceptable
H-S	Horizontal Sync: Both Positive and Negative polarity are acceptable

Interface connection

TI LVDS X' mitter SN75LVDS83	Module LVDS signal (interface connector pin7)
Signal Name	Low(open)
D0	Red0
D1	Red1
D2	Red2
D3	Red3
D4	Red4
D5	Red7
D6	Red5
D7	Green0
D8	Green1
D9	Green2
D10	Green6
D11	Green7
D12	Green3
D13	Green4
D14	Green5
D15	Blue0
D16	Blue6
D17	Blue7
D18	Blue1
D19	Blue2
D20	Blue3
D21	Blue4
D22	Blue5
D23	NA
D24	H Sync
D25	V Sync
D26	Display Timing
D27	Red6

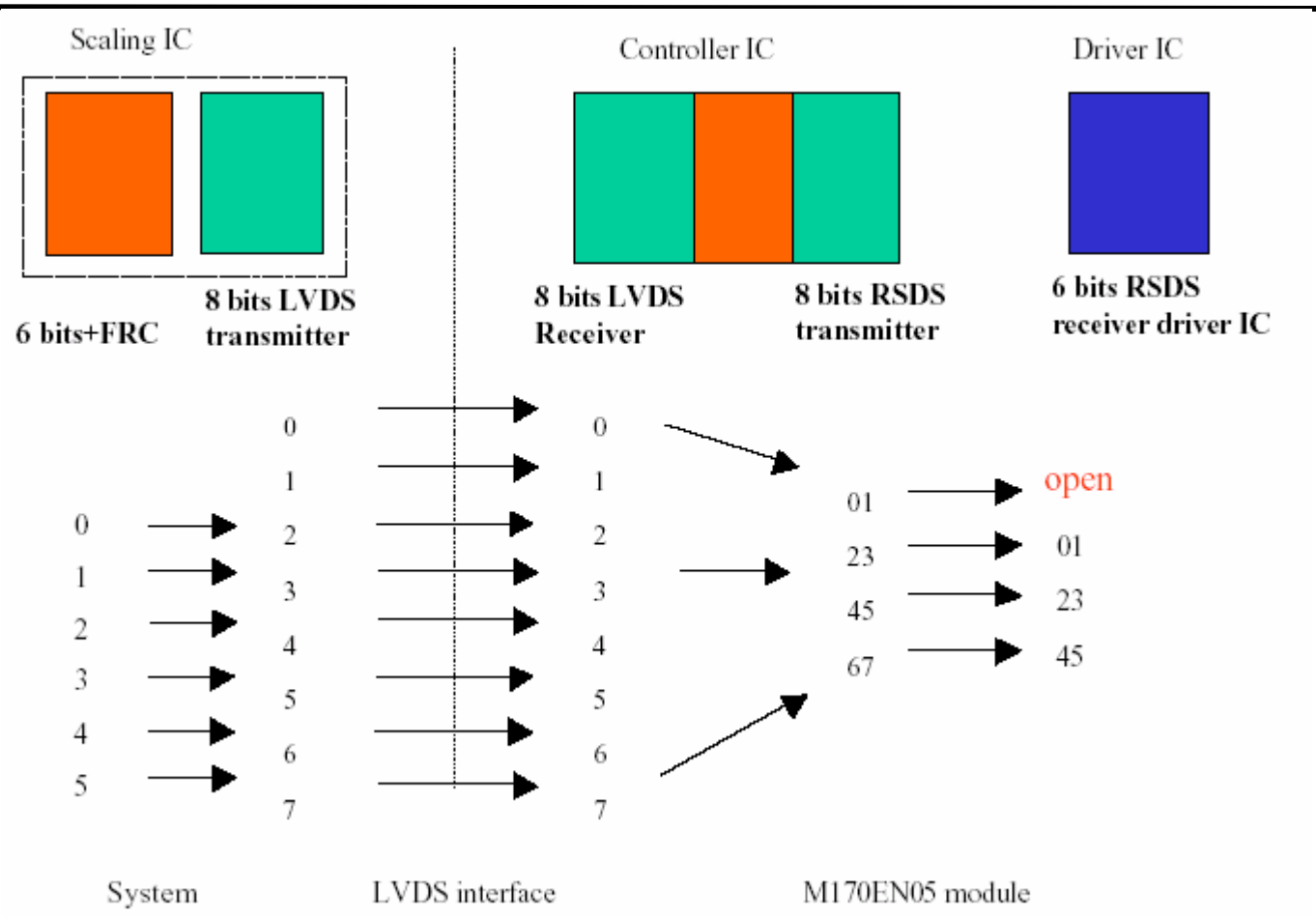
8bits input: M170EN05 only catch bit 2 to bit 7 for 6 bit display
6bits input data format marked with ( ).



Note: R/G/B data 7:MSB, R/G/B data 0:LSB

O = "First Pixel Data"

E = "Second Pixel Data"



Electrical Interface Connection

Input signals shall be low or Hi-Z state when Vin is off
It is recommended to refer the specifications of SN75LVDS82DGG (Texas Instruments) in detail.

Each signal characteristics are as follows;

Parameter	Condition	Min	Max	Unit
Vth	Differential InputHigh Voltage(Vcm=+1.2V)		100	[mV]
Vtl	Differential Input Low Voltage(Vcm=+1.2V)	-100		[mV]

Interface Timings

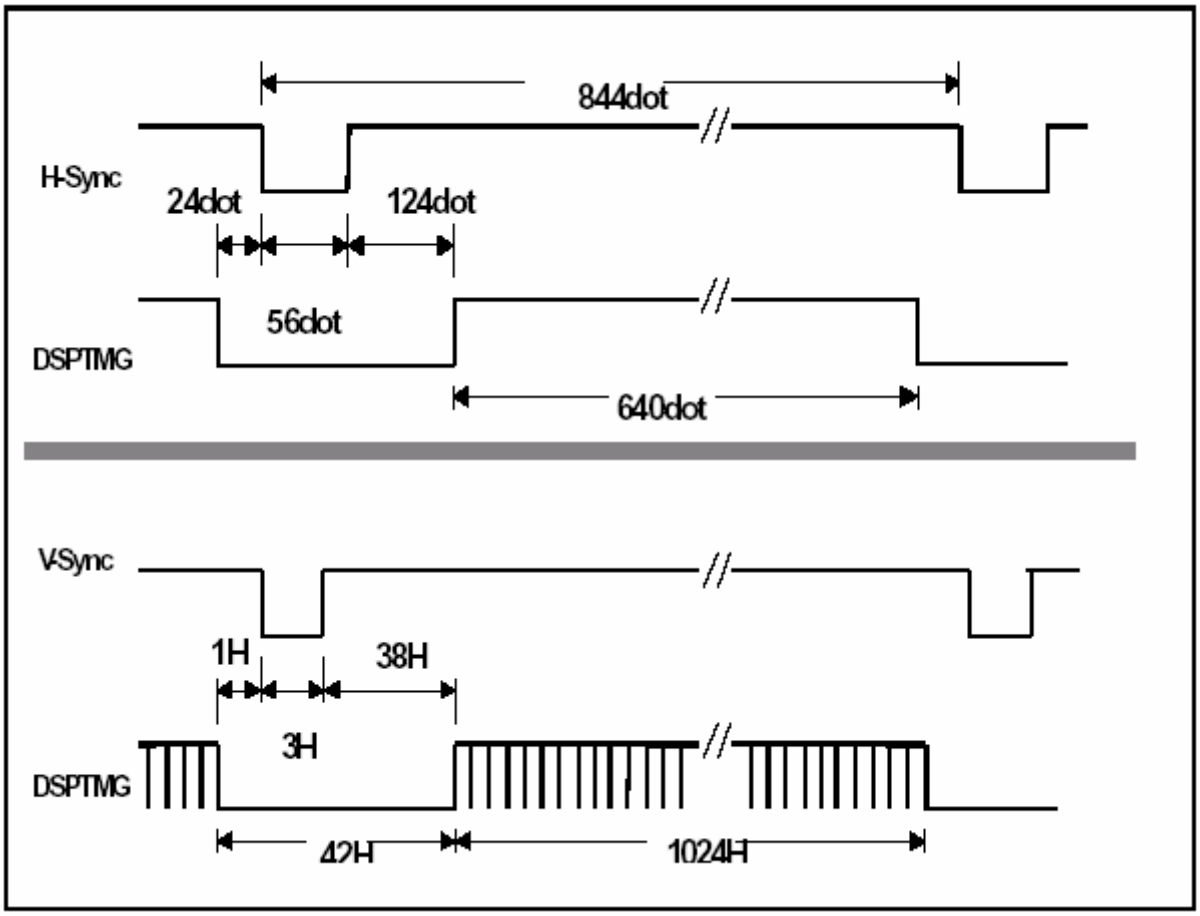
Basically, interface timings described here is not actual input timing of LCD module but output timing of SN75LVDS82DGG (Texas Instruments) or equivalent.

Timing Characteristics

Signal	Item	Symbol	MIN	TYP	MAX	Unit
DTCLK	Freq.	Fdck	50	67.5	70	MHz
DTCLK	Cycle	Tck	14.2	14.8	20	ns
+V-Sync	Frame Rate	1/Tv	56.25	75	77	Hz
+V-Sync	Cycle	Tv	13	13.33	17.78	ms
+V-Sync	Cycle	Tv	1035	1066	2047	lines
+V-Sync	Active level	Tva	3	3		lines
+V-Sync	V-back porch	Tvb	7	38	63	lines
+V-Sync	V-front porch	Tvf	1	1		lines
+DSPTMG	V-Line	m	-	1024	-	lines
+H-Sync	Scan rate	1/Th	-	80.06	-	KHz
+H-Sync	Cycle	Th	800	844	1023	Tck
+H-Sync	Active level	Tha (*1)	4	56		Tck
+H-Sync	Back porch	Thb (*1)	4	124		Tck
+H-Sync	Front porch	Thf	4	24		Tck
+DSPTMG	Display Pixels	n	-	640	-	Tck

Note: Typical value refer to VESA STANDARD (*1) Tha+Thb should be less than 1024 Tck.

Timing Definition



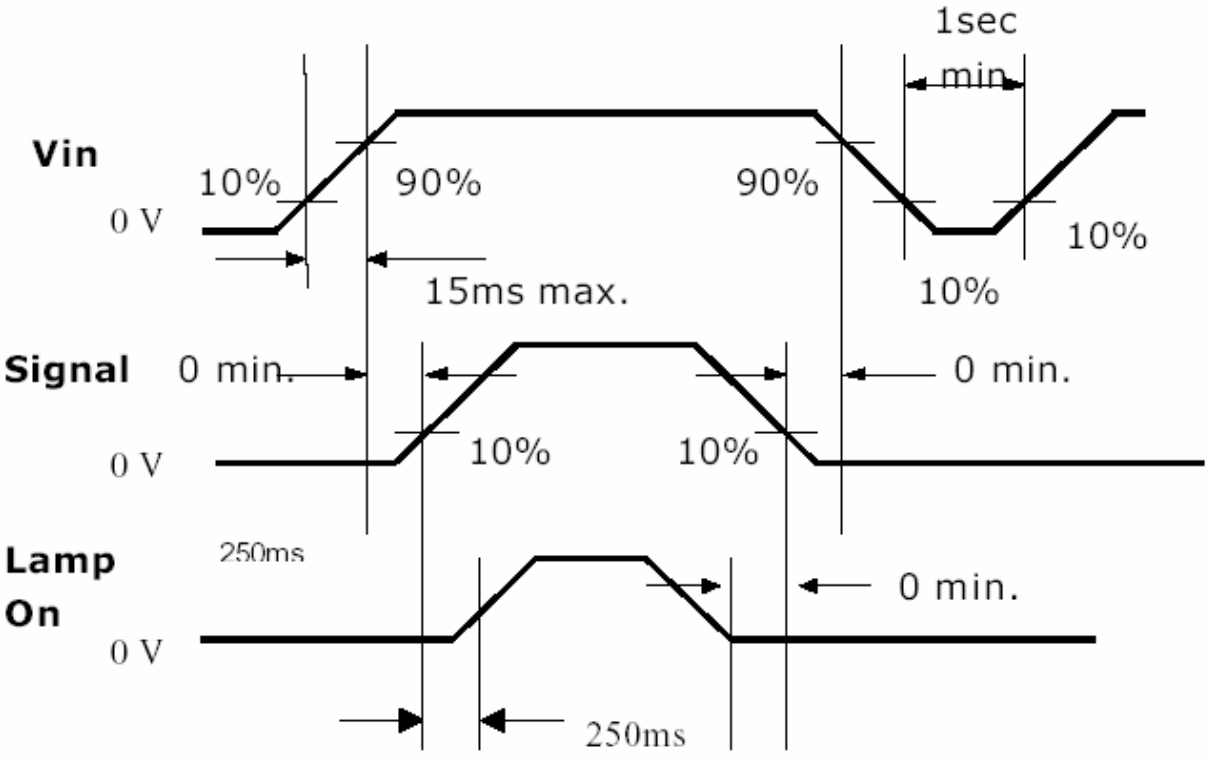
Power Consumption

Input power specifications are as follows;

Symbol	Parameter	Min	Typ	Max	Units	Condition
VDD	Logic/LCD Drive Voltage	4.5	5	5.5	[Volt]	
IDD	VDD current		950	1200	[mA]	
PDD	VDD Power		4.75	6.6	[Watt]	Vin=5V, All Black Pattern
VDDrp	Allowable Logic/LCD Drive Ripple Voltage			100	[mV] p-p	
VDDns	Allowable Logic/LCD Drive Ripple Noise			100	[mV] p-p	

Power ON/OFF Sequence

Vin power and lamp on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when Vin is off.



Backlight Lamp Connections

Signal for Lamp connector

Pin #	Signal Name
1	Lamp High Voltage
2	Lamp High Voltage
3	No Connection
4	Ground

Parameter guideline for CFL Inverter

Symbol	Parameter	Min	Typ	Max	Units	Condition
(L63)	White Luminance	230	300	-	[cd/m^2]	(Ta=25°C)
ISCFL	CCFL standard current	6.5	7.0	7.5	[mA] rms	(Ta=25°C)
IRCFL	CCFL operation range	3.0	7.0	7.5	[mA] rms	(Ta=25°C)
ICFL	CCFL Inrush current	-	26	34	[mA]	Note 1
fCFL	CCFL Frequency	40	50	80	[KHz]	(Ta=25°C) Note 2
ViCFL (0°C)	CCFL Ignition Voltage	1700			[Volt] rms	(Ta=0°C) Note 3
ViCFL (25°C)	CCFL Ignition Voltage	1200			[Volt] rms	(Ta=25°C) Note 3
TCFL	CCFL Dark start time			1.0	sec	(Ta=25°C)
VCFL	CCFL Discharge Voltage (Reference)	540	700	860	[Volt] rms	(Ta=25°C) Note 4
PCFL	CCFL Power consumption		19.6	25.8	[Watt]	(Ta=25°C) Note 4

Note 1: Duration=50 [msec]
Note 2: CCFL Frequency should be carefully determined to avoid interference between inverter and TFT LCD
Note 3: CCFL inverter should be able to give out a power that has a generating capacity of over 1700 voltage. Lamp units need 1700 voltage minimum for ignition
Note 4: Calculator value for reference (ICFL×VCFL=PCFL)
Note 5: Lamp soldering method is required to use "Hook Soldering".

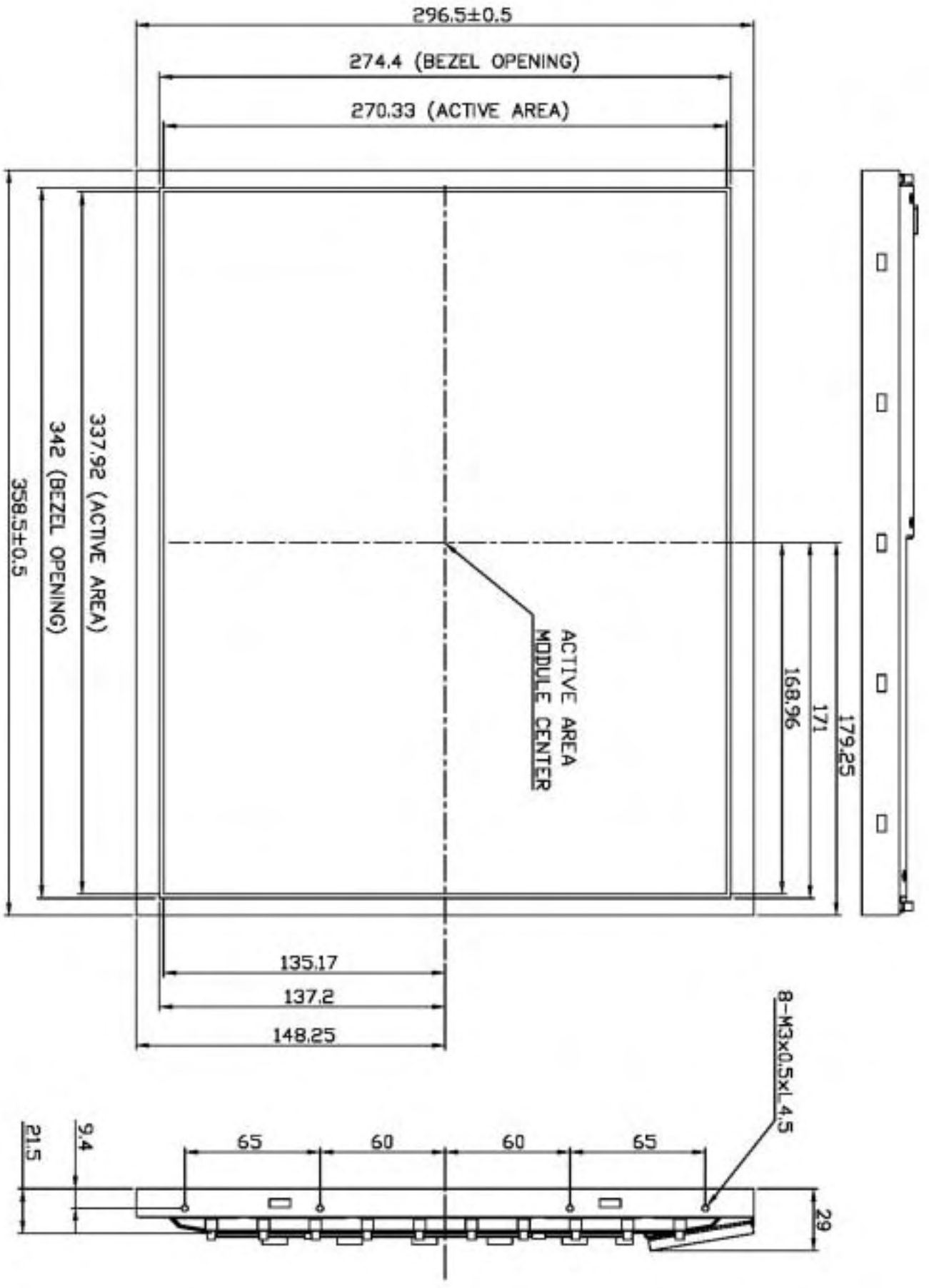
Backlight Lamp Driving Specification

It is recommended to use an inverter with a 1300 Vrms starting voltage to run the HB backlight in the AU1745 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 50.4 Watts. Since most inverters used to drive CCFLs have efficiency about 75% to 80%, the total DC power input to the inverter is about 63.0 Watts. When the backlight is dimmed down, the power consumption decreases.

Mechanical Outline on AU1745 Panel Drawing


296.5±0.5
274.4 (BEZEL OPENING)
270.33 (ACTIVE AREA)
358.5±0.5
342 (BEZEL OPENING)
337.92 (ACTIVE AREA)
ACTIVE AREA
MODULE CENTER
168.96
171
179.25
135.17
137.2
148.25
8-M3x0.5xL4.5
21.5
9.4
65
60
60
65
29

LI3601 inverter

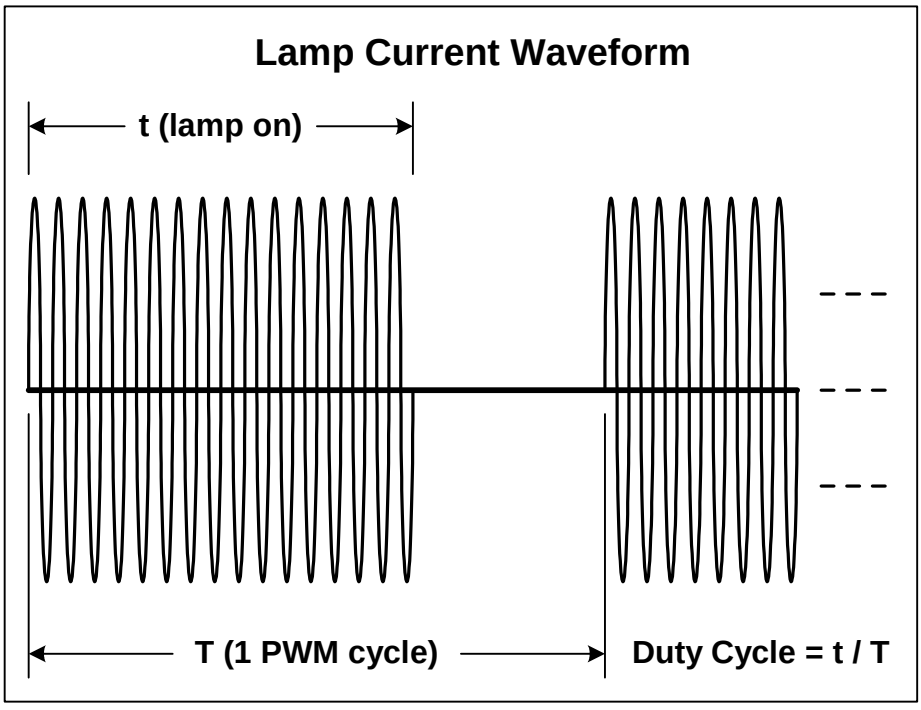
1. Introduction

LI3601 is a CCFL inverter to operate high brightness (HB) 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 LI3601 with LCD modules, it is not necessary to synchronize the PWM circuit to vertical sync signal of the LCD.

2. Dimming Control

The LI3601 accepts a 0V to 5V analog voltage for dimming control. It has a pulse width modulation (PWM) dimming circuit for luminance adjustment. As the dimming voltage (Vd) 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 LI3601 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 0V to 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 LI3601 inverter operates at 12V DC and can drive up to 12 lamps for a maximum output power about 63 Watts. In addition, the inverter has a regulated +5V output serving as a voltage source for the dimming control circuit.

Electrical Characteristics

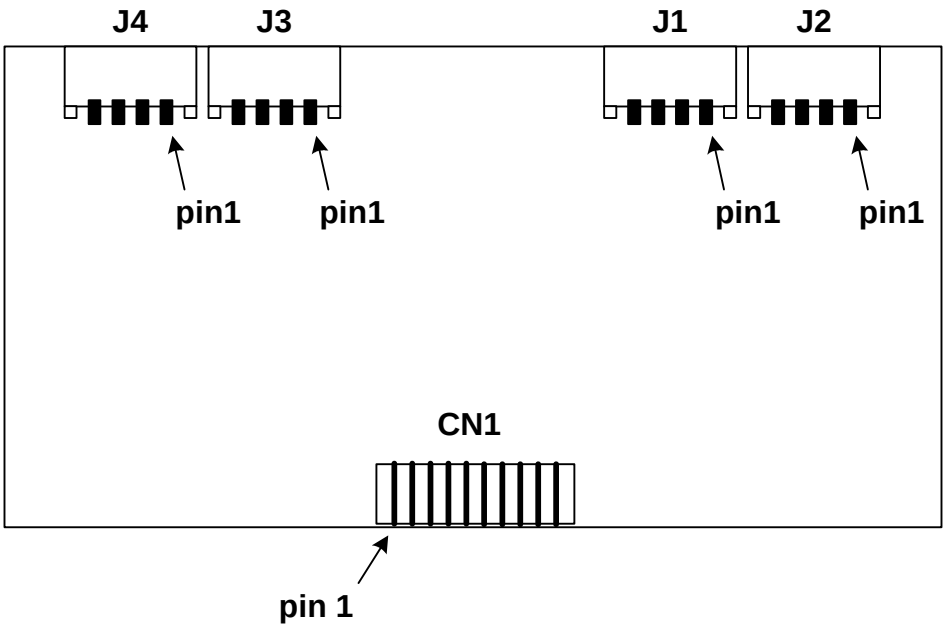
Parameters	Min	Typ	Max	Units	Conditions
Input Voltage (Vin)	11.5	12	12.5	Vdc	
Input current (I)		5.25		Adc	Vin=12, Vd=5 V
Lamp Starting Voltage (Vst)		1300		Vrms	Vin=12, Vd=5 V
Frequency (f)	55	58	60	Khz	
ON/OFF Control -OFF			0.2	Vdc	
-ON		Floating*			
Dimming Voltage(Vd)					
@ 100% Duty Cycle		4.9	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
8	NC
9	PWMCTRL
10	NC

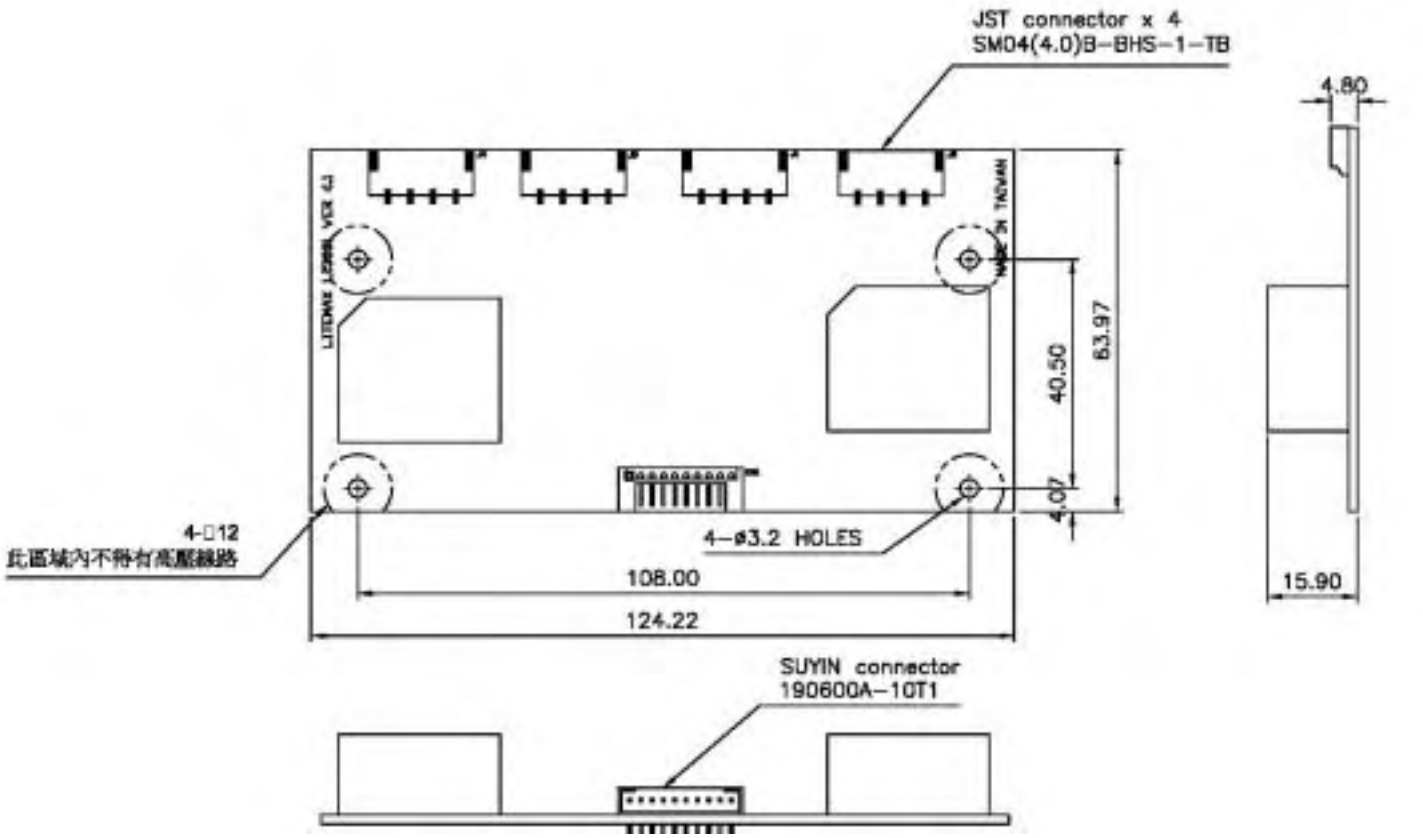
Output Connector (J2, J3)

PIN#	Function
1	Lamp Connection
2	Lamp Connection
3	Lamp Connection
4	Lamp Connection

Output Connector (J1, J4)

PIN#	Function
1	Lamp Connection
2	Lamp Connection
3	NC
4	Lamp Common

5. Mechanical

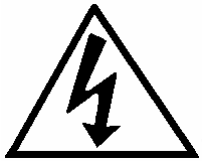


Precautions

Meaning of Caution Signs

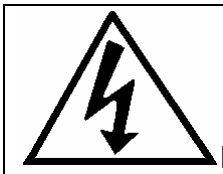
The following caution signs have very important meaning. **Be sure to understand following contents, respectively.**

CAUTION : This sign has a meaning that customer will be injured himself and/or the module will sustain a damage, if he makes a mistake in operations.



This sign has a meaning that customer will get an electric shock if he makes a mistake in operations.

Cautions


Don’t touch HIGH VOLTAGE PART of the inverter while turn on. Customer will be in danger of an electric shock.

Attentions

Handling the product

1. When customer pulls out products from carton box, take hold of both ends without touch the circuit board. If customer touches it, products may be broken down and/or out of adjustment, because of stress to mounting parts.

2. If customer places products temporarily, turn down the display side and place on a flat table.
3. Handle products with care avoid electrostatic discharge (e.g. Decrease with earth band, ionic shower, etc.), because products (LCD modules) may be damaged by electrostatic.
4. The torque for mounting screws should never exceed 0.39N.m. Over torque may cause mechanical damage to the product.
5. Do not press or friction, because LCD panel surface is sensitive. If customer will clean the product surface, we recommend the cloth with ethanolic liquid.
6. Do not push-pull the interface connectors while turn on, because wrong power sequence may break down the product.
7. Connection cables such as flexible cable, and so on, are danger of damage. Do not hook cable nor pull them.

Environment

1. Dewdrop atmosphere must be avoided.
2. Do not operate and/or stores in high temperature and/or high humidity atmosphere. If customer store the product, keep in antistatic pouch in room temperature, because of avoidance for dusts and sunlight.
3. Do not operate in high magnetic field. Circuit boards may be broken down by it.
4. Use an original protection sheet on product surface (polarizer). Adhesive type protection sheet should be avoided, because it may change color and/or properties of the polarizer.

Specification for Products

1. Do not display the fixed pattern for a long time because it may cause image sticking. If the fixed pattern is displayed on the screen, use a screen saver.
2. The product may be changed of color by viewing angle because of the use of condenser sheet for backlight unit.
3. The product may be changed of luminance by voltage variation, even if power source applies recommended voltage to backlight inverter.
4. Optical characteristics may be changed by input signal timings.

Other

1. All GND, GNDB, VDD and VDDB terminals should be connected without a non-connected signal line.
2. Do not disassemble a product and/or adjust volume.
3. If customer would like to replace backlight lamps, see “Replacement Manual for Backlight”.
4. If customer user screwnails, pay attention not to insert waste materials in inside of products.
5. When customer returns product for repair and so on, pack it with original shipping package because of avoidance of some damages during transportation.

General specifications for the LCD

The following items are neither defects nor failures.

1. Reponse time, luminance and color gamut may be changed by ambient temperature.
2. The LCD may be seemed luminance uniformity, flicker, vertical seam and/or small spot by display patterns.
3. Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.

Revision History

Date	Rev.	Description
Oct 1, 2003	**A**	**Initial release**