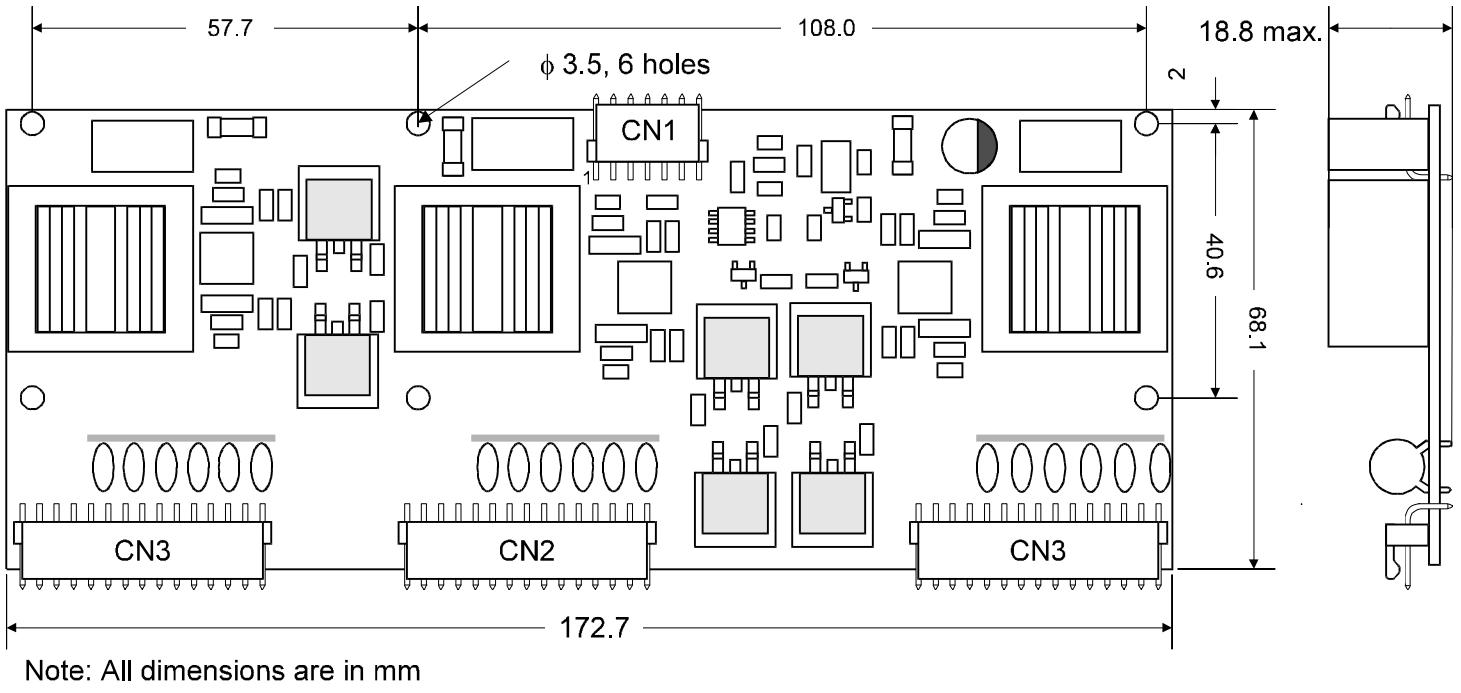
Landmark Technology

CCFL Inverter BI330C for 18.1" - 21.3" LCD Backlights & Modules



Introduction

BI330C is a CCFL inverter which operates the VHB backlights in Landmark 18.1" to 21.3"very high brightness and sunlight readable LCD modules. The inverter has an on-board pulse width modulation (PWM) dimming circuit to provide an extremely wide luminance adjustment range. Over the entire dimming range, there is no noticible lamp flickering and the uniformity of the backlight is well maintained. When using the BI330C with Landmark LCD modules, it is not necessary to synchronize the PWM circuit to the vertical sync signal of the LCD.

The BI330C inverter operates at a 12V DC input and can drive up to 18 CCFLs for a maximum lamp power of 60 Watts. In addition, the inverter has a regulated +5V output which serves as a voltage source for the dimming control circuit.

Absolute Maximum Rating

Parameters	Min.	Max.	Units
Inverter Input Voltage (Vin)	11.0	13.0	Vdc
Operating Temperature Range	0	50	^{o}C
Storage Temperature Range	-20	80	^{o}C

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Electrical Characteristics

Parameters	Min.	Typ.	Max.	Units	Conditions
Input Voltage (Vin)	11.5	12	12.5	Vdc	
Input Current (I) with 18.1" LM133-181LW31		5.8		Adc	Vin = 12V, Vd = 5V
Lamp Starting Voltage (Vst)		1,700		Vrms	Vin = 12V, Vd = 5V
Frequency (f)	40	44	48	KHz	
ON/OFF Control - OFF		0	0.2	Vdc	
- ON	4.8	5		V dc	
Dimming Voltage (Vd)					
Duty Cycle 100%		4.9	5	Vdc	Max. backlight brightness
Duty Cycle 0%	≤ 0.54	≤ 0.56	≤0.58	Vdc	Zero backlight brightness
+5V Output (+5VOUT)	4.85	5	5.25	Vdc	11.5 < Vin < 12.5V
+5V Output Source Current			5	mA	

Inverter Selection & Typical Dimming Range
with Landmark Sunlight Readable LCD Modules

Landmark LCD Module Models	Inverters Required	LCD Screen Luminance Range Minimum	Maximum	Dimming Ratio
LM133-181LW31 (18.1")	BI330B	~ 4 Cd/m^2	700 Cd/m^2	200:1
LM136B-213U3 (21.3")	BI330B	~ 5 Cd/m^2	950 Cd/m^2	200:1

Connector Pin Assignments

Input Connector CN1 (Molex 22-05-3071)

Pin #	Function
1	+5 V Output
2, 3	+12 V Input
4	Dimming Control
5, 6	Ground
7	On/Off Control

Mating Housing - Molex 22-01-3077

Output Connectors CN2, CN3, CN4 (Molex 22-05-3151)

Pin #	Function
1, 3, 5, 7, 9, 11	Lamp Connections
2, 4, 6, 8, 10, 12	No Connections
15	Lamp Commons

Typical Electro-optical Performances

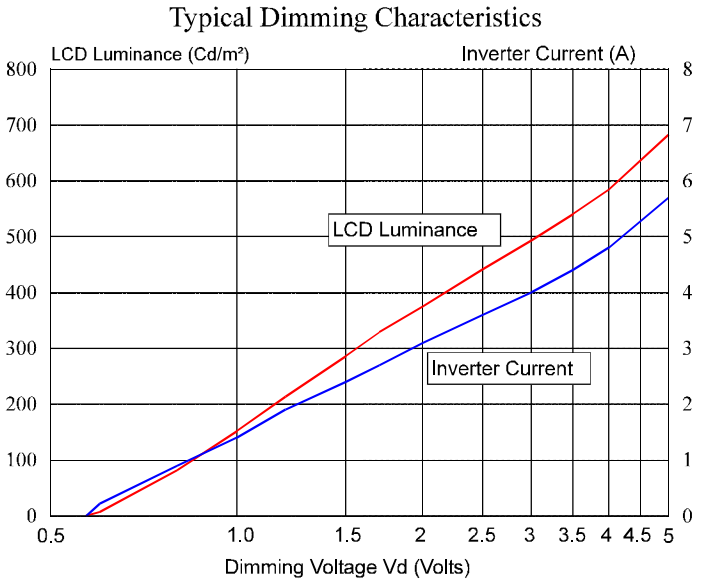


Fig. 2. Typical LCD Screen Luminance & Inverter Current vs. Dimming Voltage - LM133-181LW31 18.1" very high brightness LCD module with BI330C inverter

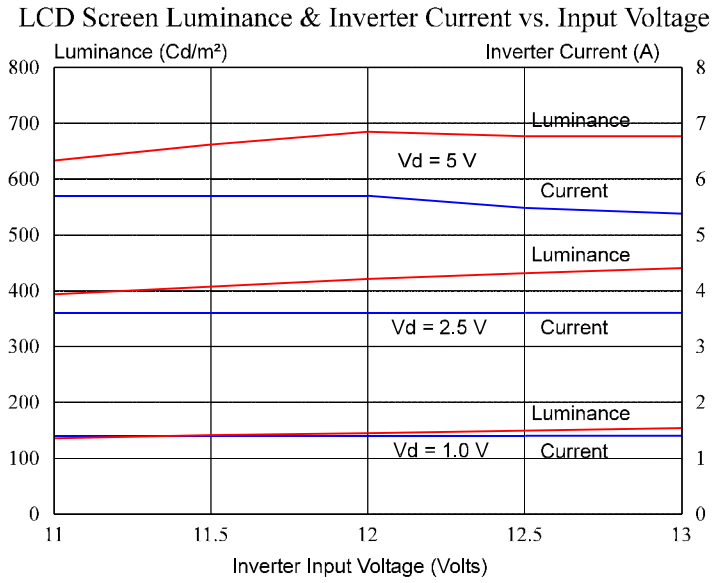
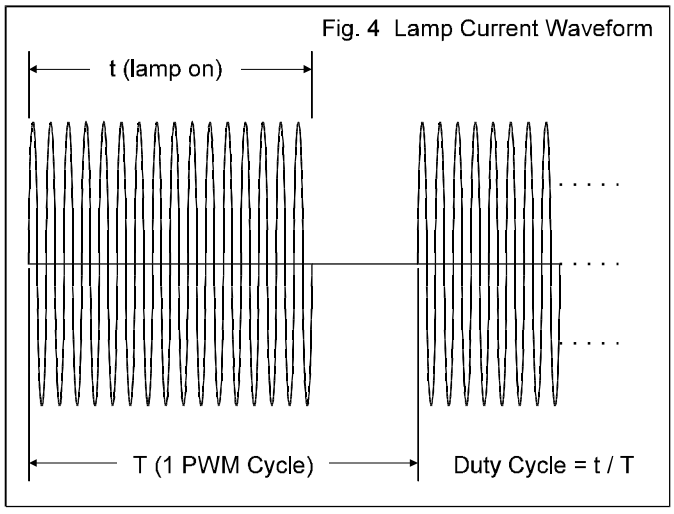


Fig. 3. Typical LCD Screen Luminance & Inverter Current vs. Input Voltage at various dimming settings - LM133-181LW31 18.1" very high brightness LCD module with BI330C inverter

Dimming Control

BI330C inverter accepts a 0 - 5V analog voltage for dimming control. Typical dimming characteristics with Landmark VHB Backlights and sunlight readable LCD modules are shown in Fig. 2.

BI330C inverter 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 screen 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 proportional to the duty cycle of the PWM waveform.



Dimming Control
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In general, inverters with PWM dimming have a very wide luminance adjustment range. For most practical cases, the BI330C inverter can achieve a maximum dimming ratio of about 200:1. Hence, the luminance of the backlight or the LCD screen can be adjusted from 100% to 0.5%.

The 0 - 5V dimming voltage can be generated simply by using a potentiometer (Fig. 5) or by a voltage step generating circuits as shown in Fig 6. The inverter provides a regulated +5V supply (Pin #1 of the input connector CN1) to power the dimming circuit. However, the maximum current drain from this source should be kept at less than 5 mA.

At a Vd input of about 560 mV, the duty cycle of the PWM waveform reaches 0% and thus, the lamps are "OFF" 100%. In order to fully utilize the available dimming range, Vd should be biased to about 0.54V and then ramps up to 5.0V

The LCD luminance and the inverter current vary almost linearly if Vd is plotted in log scale (Fig. 2). Thus, it is recommended that a logarithmic voltage step generating circuit be used to provide a nearly linear luminance adjustment.

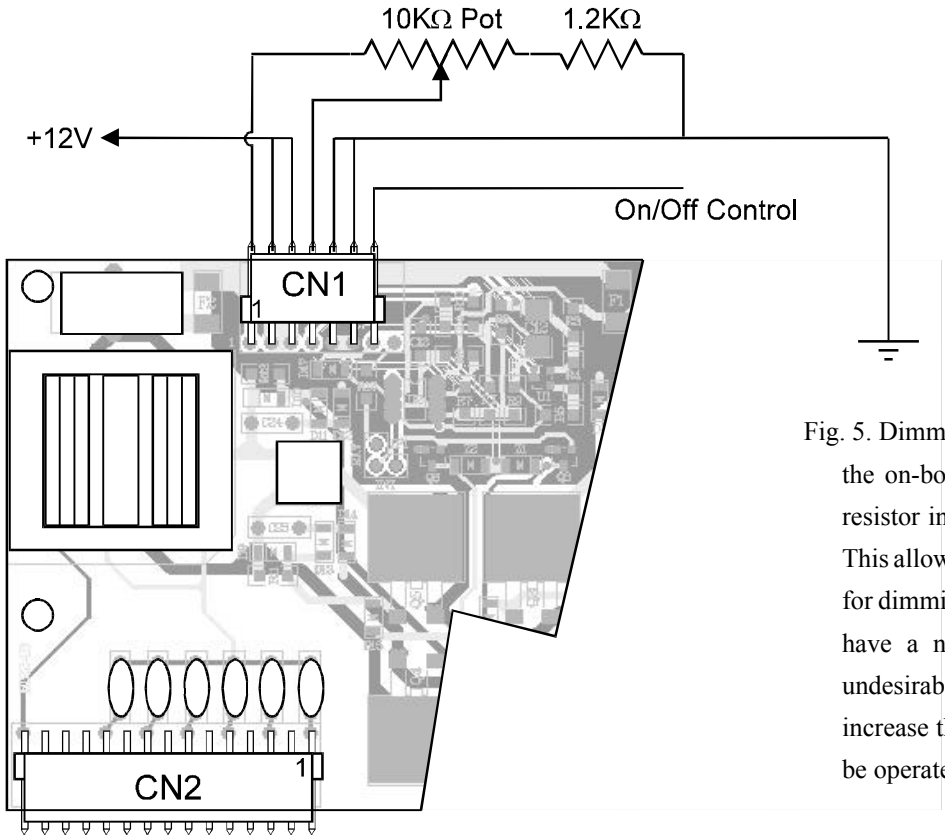

Fig. 5. Dimming control using a 10 K? potentiometer with the on-board +5V regulated supply. Adding a 1.2K? resistor in series sets the minimum V_d to about 0.54V. This allows the full adjustable range of the potentiometer for dimming control. Use a logarithmic potentiometer to have a nearly linear luminance adjustment, If it is undesirable to turn the LCD to zero luminance, please increase the 1.2K resistor to about 1.5K. The LCD will be operated at a low brightness but not totally dark.

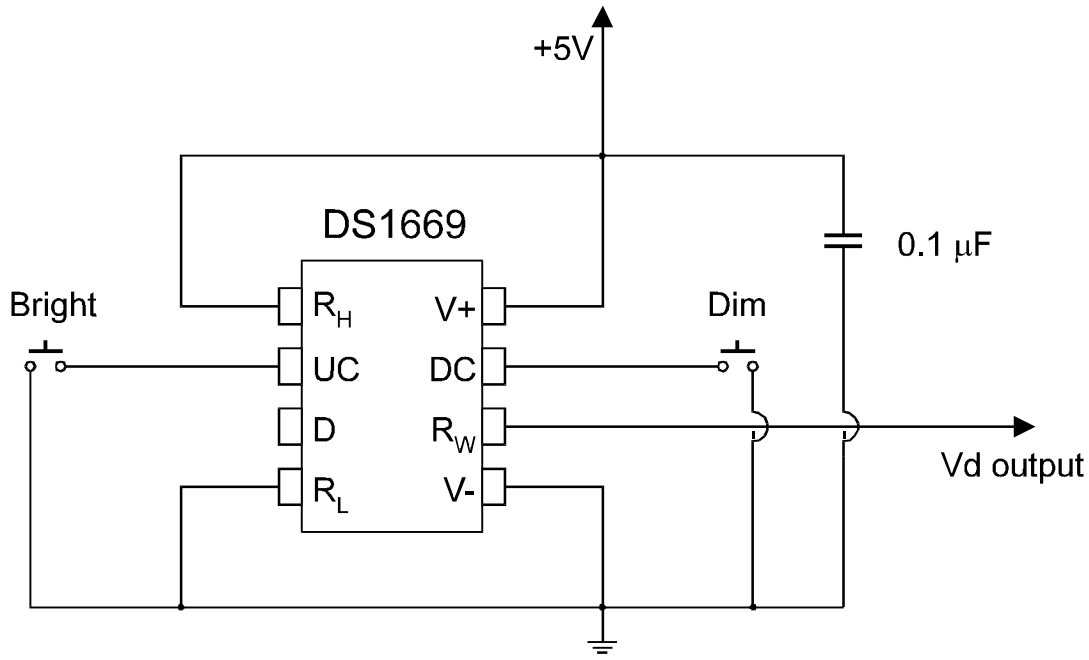

Fig. 6. Dimming voltage generation using a 6-bit digital potentiometer DS1669 from Dallas Semiconductor. This circuit provides 64 linearly distributed voltage steps from 0 to 5 V. To create a near logarithmic voltage distribution, connect a 10 K? resistor across the Rw and V-. Since the current drain of the DS1669 chip is very small, the +5V regulated supply on the BI330C inverter can be used to power this circuit.