



# PanelMatch™ RangeMax™ LXMG1813-12-6x

12V 6W CCFL Programmable Inverter Module

PRODUCTION DATASHEET

## DESCRIPTION

The LXMG1813-12-6x is a Single Output 6W CCFL (Cold Cathode Fluorescent Lamp) Inverter Module designed for the driving LCD backlight lamps for panels in the range of 3.9" to 15".

Utilizing the full-bridge drive topology capabilities of the Microsemi's highly integrated LX1697 CCFL backlight controller the inverter allows a wider input voltage range (9V to 16.8V) and wider lamp output voltage range 390V to 790V compared to Microsemi's existing Direct Drive™ inverter solutions.

For applications needing fully automatic brightness control an 'S' version (LXMG1813-12-6xS) of the inverter includes a connector to mate the inverter with an external light sensor board (the LXMG1800\_LS) which can extend the life of the display and save power (particularly important for battery powered products).

The maximum output current of the inverter is externally programmable over a range of 4mA to 7mA in 1mA steps to allow the inverter to properly match (PanelMatch™) to a wide array of LCD panel lamp current specifications. For lower input voltage requirements the LXMG1811-05-6x or -6xS will work from a 5V input supply.

The modules include a dimming input that permits brightness control from a DC voltage source, a PWM signal or an external potentiometer. The resultant "burst drive" that energizes the lamp was designed to ensure that no premature lamp degradation occurs, while allowing significant power savings at lower dim levels.

Other benefits of the inverter's topology include stable fixed-frequency operation, secondary-side strike voltage regulation and both open/shorted lamp protection with fault timeout.

## KEY FEATURES

- PanelMatch Externally Programmable Maximum Output Current
- Wide Input Voltage Range
- Fixed Frequency Operation
- Output Short-Circuit Protection and Automatic Strike-Voltage Regulation and Timeout
- RangeMAX Wide Range Dimming (50:1+)
- Rated From -30°C to 80°C
- UL60950 Pending
- RoHS Compliant

## APPLICATIONS

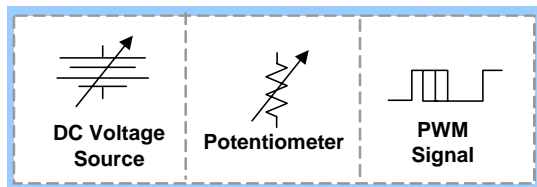
- Medical Instrument Displays
- Portable Instrumentation
- Desktop Displays
- Industrial Display Controls

## BENEFITS

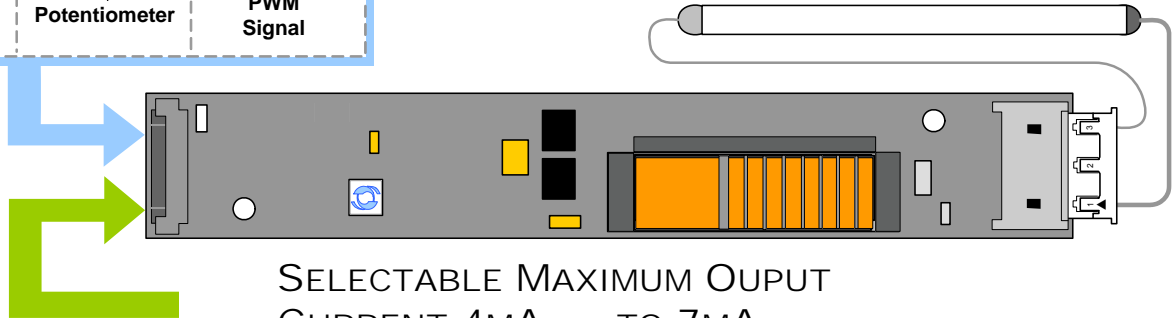
- Smooth, Flicker Free Full-Range Brightness Control
- Programmable Output Current Allows Inverter to Mate with a Wide Variety of LCD Panel's Specifications

**IMPORTANT:** For the most current data, consult MICROSEMI's website: <http://www.microsemi.com>  
Protected by U.S. Patents: 5,923, 129; 5,930,121; 6,198,234; Patents Pending

## PRODUCT HIGHLIGHT



## UNIVERSAL DIMMING INPUT "PWM", V<sub>DC</sub>, OR POTENTIOMETER



SELECTABLE MAXIMUM OUTPUT CURRENT 4MA<sub>RMS</sub> TO 7MA<sub>RMS</sub>

## PACKAGE ORDER INFO

PART NUMBER	OUTPUT CONNECTOR	INVERTER MATES DIRECTLY TO PANEL CONNECTORS
LXMG1813-12-61	JST SM02(8.0)B-BHS-1-TB(LF)(SN), Yeon Ho 20015WR-05A00 or equivalent	JST BHR-03VS-1
LXMG1813-12-62	JST SM02B-BHSS-1-TB(LF)(SN), Yeon Ho 35001WR-02A00 or equivalent	JST BHSR-02VS-1



**ABSOLUTE MAXIMUM RATINGS**

Input Signal Voltage ( $V_{IN}$ ).....	-0.3V to 19V
Input Power.....	8W
Output Voltage, no load.....	1800V <sub>RMS</sub>
Output Current.....	8mA <sub>RMS</sub>
Output Power.....	6W
Input Signal Voltage (SLEEP Input).....	-0.3V to $V_{IN}$
Input Signal Voltage (BRITE).....	-0.3V to 5.5V
Ambient Operating Temperature, zero airflow.....	-30°C to 80°C
Storage Temperature Range.....	-40°C to 85°C

Note: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of specified terminal.

**RECOMMENDED OPERATING CONDITIONS (R.C.)**

This module has been designed to operate over a wide range of input and output conditions. However, best efficiency and performance will be obtained if the module is operated under the condition listed in the 'R.C.' column. Min. and Max. columns indicate values beyond which the inverter, although operational, may not function optimally.

Parameter	Symbol	Recommended Operating Conditions			Units
		Min	R.C.	Max	
Input Supply Voltage Range (Fully Regulated Lamp Current)	$V_{IN}$	9	12	16.8	V
Input Supply Voltage Range (Functional)		8.4	12	16.8	
Output Power	$P_O$		4.2	6.0	W
Linear BRITE Control Input Voltage Range	$V_{BRT\_ADJ}$	0.85		2.06	V
Lamp Operating Voltage	$V_{LAMP}$	390	590	790	V <sub>RMS</sub>
Lamp Current (Full Brightness)	$I_{O(LAMP)}$	4		7	mA <sub>RMS</sub>
Operating Ambient Temperature Range	$T_A$	-30		80	°C

**ELECTRICAL CHARACTERISTICS**

The following specifications apply over the recommended operating condition and ambient temperature of 0°C to 60°C except where otherwise noted; BRITE > 2.05V, SLEEP > 2.0V,  $V_{IN} = 12V$ .

Parameter	Symbol	Test Conditions	LXMG1813-12-6x			Units
			Min	Typ	Max	
<b>OUTPUT PIN CHARACTERISTICS</b>						
Full Bright Lamp Current	$I_{L(MAX)}$	SET <sub>1</sub> = Ground, SET <sub>2</sub> = Ground	3.5	4.0	4.5	mA <sub>RMS</sub>
Full Bright Lamp Current	$I_{L(MAX)}$	SET <sub>1</sub> = Ground, SET <sub>2</sub> = Open	4.5	5.0	5.5	mA <sub>RMS</sub>
Full Bright Lamp Current	$I_{L(MAX)}$	SET <sub>1</sub> = Open, SET <sub>2</sub> = Ground	5.5	6.0	6.5	mA <sub>RMS</sub>
Full Bright Lamp Current	$I_{L(MAX)}$	SET <sub>1</sub> = Open, SET <sub>2</sub> = Open	6.5	7.0	7.5	mA <sub>RMS</sub>
Full Bright Lamp Current	$I_{L(MAX)}$	$V_{IN} = 9$ to 16.8V; SET <sub>1</sub> = Open, SET <sub>2</sub> = Ground	5.4	6.0	6.6	mA <sub>RMS</sub>
Min. Average Lamp Current	$I_{L(MIN)}$	BRITE ≤ 0.85V, SET <sub>1</sub> = SET <sub>2</sub> = Ground, $I_{L(MIN)} = I_{LMAX} * \sqrt{\text{Burst Duty Cycle}}$		1.0		mA <sub>RMS</sub>
Lamp Start Voltage	$V_{LS}$	-30°C < $T_A$ < 80°C, $V_{IN} \geq 8.4V$	1400	1600		V <sub>RMS</sub>
Operating Frequency	$f_O$		49.8	53	56.2	kHz
Burst Frequency	$f_{BURST}$	Output Burst Frequency	195	208	220	Hz



**ELECTRICAL CHARACTERISTICS (CONTINUED)**

The following specifications apply over the recommended operating condition and ambient temperature of 0°C to 60°C except where otherwise noted; BRITE > 2.05V, SLEEP > 2.0V, VIN = 12V.

Parameter	Symbol	Test Conditions	LXMG1813-12-6x			Units
			Min	Typ	Max	
<b>BRITE INPUT</b>						
Input Current	I <sub>BRT</sub>	BRITE = 0V		-10		μA
		BRITE = 2.1V		-6		μA
Minimum Input for Max. Lamp Current	V <sub>BRT_ADJ</sub>	I <sub>O(LAMP)</sub> = Maximum Lamp Current	1.85	1.96	2.06	V
Maximum Input for Min. Lamp Current	V <sub>BRT_ADJ</sub>	I <sub>O(LAMP)</sub> = Minimum Lamp Current	0.85			V
Potentiometer used for BRITE Control	R <sub>BRT</sub>		400	500	600	kΩ
Minimum PWM Input Frequency	F <sub>BRT_PWM</sub>	%BRT_PWM < 50% (Visual Artifact Avoidance)	3		100	kHz
<b>SLEEP BAR INPUT</b>						
RUN Mode	V <sub>SLEEP</sub>		2.0		V <sub>IN</sub>	V
SLEEP Mode	V <sub>SLEEP</sub>		-0.3		0.8	V
<b>SET<sub>1,2</sub> INPUT</b>						
SET <sub>1,2</sub> Low Threshold	V <sub>L</sub>			0		V
Input Current	I <sub>SET</sub>	SETx = 0V		-520		μA
<b>POWER CHARACTERISTICS</b>						
Sleep Current	I <sub>IN(MIN)</sub>	SLEEP ≤ 0.8V		10	20	μA
Run Current	I <sub>RUN</sub>	SET <sub>1</sub> = Open SET <sub>2</sub> = Ground, V <sub>LAMP</sub> = 590V <sub>RMS</sub>		370		mA
Supply Current under Fault condition	I <sub>FAULT</sub>	Fault condition		8		mA
Strike (Open Lamp)	T <sub>S_DWELL</sub>		1.5	2	2.5	Sec
Typical Efficiency	η	SET <sub>1</sub> = Open SET <sub>2</sub> = Ground, V <sub>LAMP</sub> = 590V <sub>RMS</sub>	75	80		%

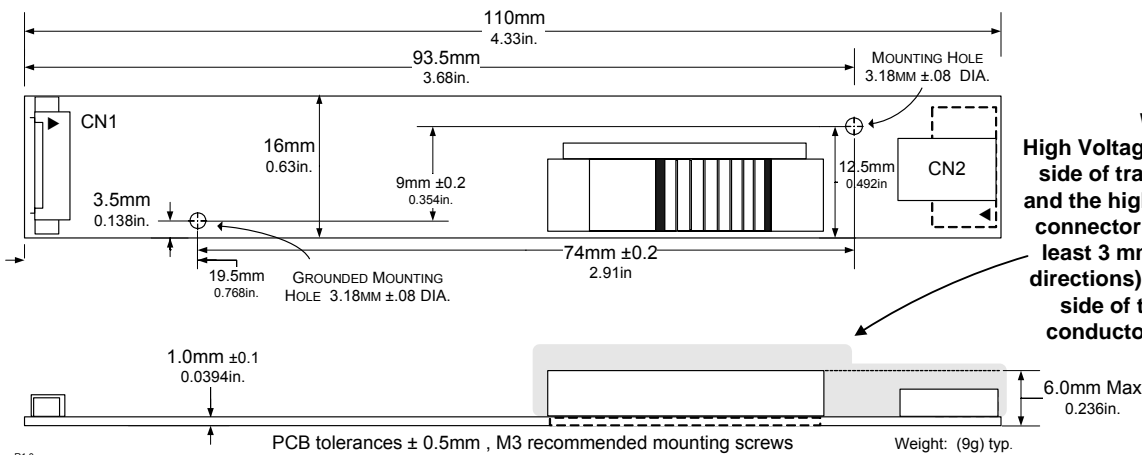
**FUNCTIONAL PIN DESCRIPTION**

CONN	PIN	DESCRIPTION
<b>CN1 (Molex 53261-0871 or equivalent) mates with 51021-0800 housing, 50079-8100 pins. Mates with LX9501G input cable assembly</b>		
CN1-1	V <sub>IN</sub>	Main Input Power Supply (9V ≤ V <sub>IN</sub> ≤ 16.8V), Functional 8.4V to 16.8V
CN1-2		
CN1-3	GND	Power Supply Return
CN1-4		
CN1-5	SLEEP	ON/OFF Control. (0V ≤ SLEEP ≤ 0.8V = OFF, SLEEP ≥ 2.0V = ON)
CN1-6	BRITE	Brightness Control (0.85V to 2.06V). 2.06V ensures maximum lamp current. Leaving the pin open provides maximum lamp current
CN1-7	SET <sub>1</sub>	SET <sub>1</sub> MSB Connecting this pin to ground decreases the output current (see Table 1)
CN1-8	SET <sub>2</sub>	SET <sub>2</sub> LSB Connecting this pin to ground decreases the output current (see Table 1)
<b>CN2 for LXMG1813-12-61 and -62 (JST SM02(8.0)B-BHS-1-TB(LF)(SN); Yeon Ho 20015WR-05A00, SM02B-BHSS-1-TB(LF)(SN); Yeon Ho 35001WR-02A00) or equivalent</b>		
CN2-1	V <sub>HI</sub>	High voltage connection to high side of lamp. Connect to lamp terminal with shortest lead length. <b>DO NOT</b> connect to Ground.
CN2-2	V <sub>LO</sub>	Connection to low side of lamp. Connect to lamp terminal with longer lead length. <b>DO NOT</b> connect to Ground

**TABLE 1**
**OUTPUT CURRENT SETTINGS**

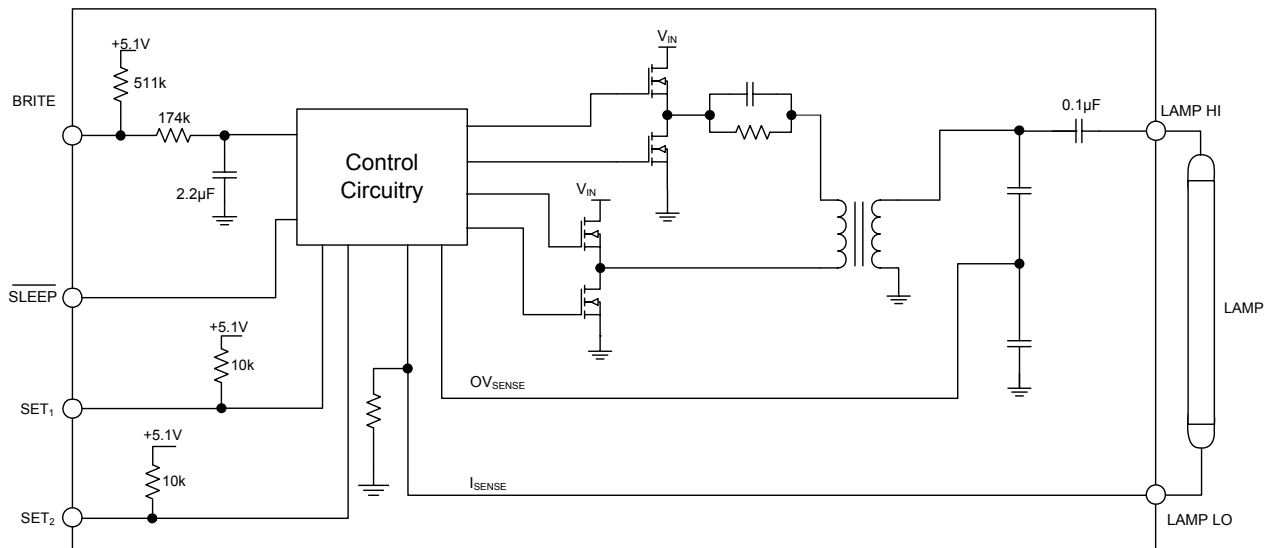
SET <sub>1</sub> (Pin 7)	SET <sub>2</sub> (Pin 8)	Nominal Output Current
Open*	Open*	7.0mA
Open*	Ground	6.0mA
Ground	Open*	5.0mA
Ground	Ground	4.0mA

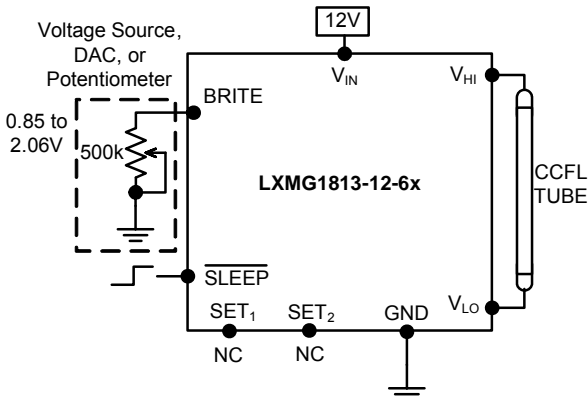
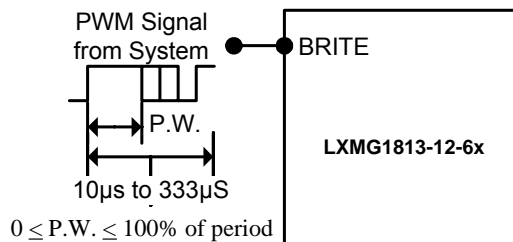
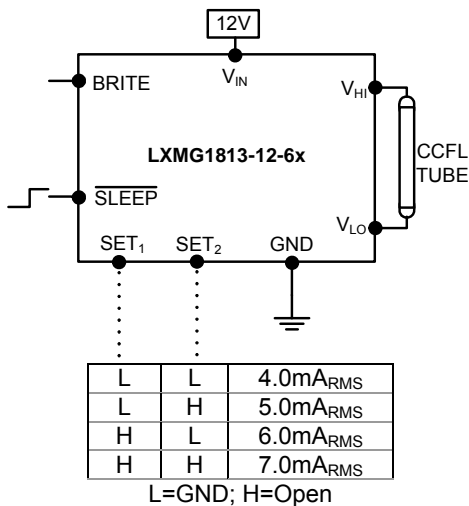
\* If driven by a logic signal it should be open collector or open drain only, not a voltage source.

**PHYSICAL DIMENSIONS**
**LXMG1813-12-6x**


**Warning**  
High Voltage is present at high side of transformer, its core and the high side of the output connector, please provide at least 3 mm clearance (in all directions) on the component side of the board to any conductor when mounting

All dimensions are in millimeters, inches are for reference only

**SIMPLIFIED BLOCK DIAGRAM**


**TYPICAL APPLICATION**

**Figure 1 – Brightness Control**

**Figure 1A – PWM Brightness Control**

**Figure 2 – Max Output Current (SET<sub>1</sub> and SET<sub>2</sub> Inputs)**

- The brightness control may be a voltage output DAC or other voltage source, a digital pot or 500k manual pot. The inverter contains an internal 511k pull-up to typically 5.1V to bias the pot. A PWM signal from a micro-controller may also be used as shown in Figure 1A. Logic levels may be used up to 5V, however the inverter will reach maximum current at less than 100% duty cycle. This can be calculated as approximately 2V divided by the logic high voltage level; with 3.3V logic level this corresponds to about 60% duty cycle for maximum lamp current.
- If you need to turn the inverter ON/OFF remotely, connect to TTL logic signal to the SLEEP input.
- Connect V<sub>HI</sub> to high voltage wire from the lamp. Connect V<sub>LO</sub> to the low voltage wire (wire with thinner insulation). Never connect V<sub>LO</sub> to circuit ground as this will defeat lamp current regulation. If both lamp wires have heavy high voltage insulation, connect the longest wire to V<sub>LO</sub>. This wire is typically white.
- Use the SET<sub>1</sub> and SET<sub>2</sub> (see Figure 2) inputs to select the desired maximum output current. Using these two pins in combination allows the inverter to match a wide variety of panels from different manufacturers. Generally the best lamp lifetime correlates with driving the CCFL at the manufacturer's nominal current setting. However the SET<sub>1</sub> and SET<sub>2</sub> inputs allow the user the flexibility to adjust the current to the maximum allowable output current to increase panel brightness at the expense of some reduced lamp life.
- Although the SET pins are designed such that just leaving them open or grounding them is all that is needed to set the output current, they can also be actively set. Using an open collector or open drain logic signal will allow you to reduce the lamp current for situations where greater dim range is required. Since the dim ratio is a factor of both the burst duty cycle and the peak output current, using this technique the effective dim ratio can be increased greater than the burst duty cycle alone. Conversely, the SET inputs could be used to overdrive the lamp temporarily to facilitate faster lamp warm up at initial lamp turn on. Of course any possible degradation on lamp life from such practices is the user's responsibility since not all lamps are designed to be overdriven.
- The inverter has a built-in fault timeout function. If the output is open (lamp disconnected or broken) the inverter will attempt to strike the lamp up to about two seconds, after which (without success) the inverter will shutdown. In this mode the inverter will draw about 8mA from V<sub>IN</sub>. In order to restart the inverter it is necessary to toggle the sleep input or cycle the V<sub>IN</sub> input supply.



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NOTES

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