

LXMG1617-05-4x

5V 4W CCFL Programmable Inverter Module

**PRODUCTION DATASHEET** 

## DESCRIPTION

The LXMG1617-05-4x is a Single Output 4W Direct Drive<sup>™</sup> CCFL (Cold energizes the lamp Cathode Fluorescent Lamp) Inverter specifically to ensure that no premature Module specifically designed for driving lamp degradation occurs, while allowing LCD backlight lamps. It is ideal for significant power savings at lower dim driving typical 8.4" to 12.1" TFT panels.

LXMG1617 modules provide the designer with a vastly superior display the system battery or AC adapter directly brightness range. This brightness range is to high frequency, high-voltage waves achievable with virtually any LCD display. required to ignite and operate CCFL

The maximum output current is externally programmable over a range of 5 to 6.5mA in 0.5mA steps to allow the inverter to properly match to a wide array Microsemi's new LX1689 backlight of LCD panel lamp current specifications. controller, which provides a number of The modules include a dimming input that cost and performance advantages due to permits brightness control from a dc the controller's high level of integration. voltage source, a PWM signal or an external potentiometer.

**RangeMAX**<sup>TM</sup> Digital Technique provides flicker-free brightness and both open/shorted lamp protection control in any wide range typically (50:1+) with fault timeout. dimming application.

IMPORTANT: For the most current data, consult MICROSEMI's website: http://www.microsemi.com Protected By U.S. Patents: 5,923,129; 59320,121; 6,198,234; Patents Pending

The resultant "burst drive" that was designed levels.

The modules convert DC voltage from lamps. A 12V input inverter is also available (LXMG1617-12-4x).

The modules design is based on

Other benefits of this new topology are stable fixed-frequency operation, Dimming secondary-side strike-voltage regulation

# **KEY FEATURES**

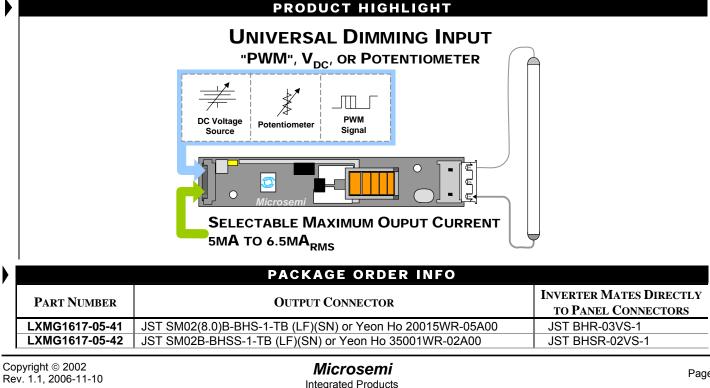
- Externally Programmable Maximum Output Current
- Easy to Use Brightness Control
- **Output Short-Circuit Protection** and Automatic Strike-Voltage Regulation and Timeout
- RangeMAX Wide Range Dimming
- **Fixed Frequency Operation**
- Rated From -20 to 70°C
- UL60950 E175910 **RoHS Compliant**

### APPLICATIONS

- Notebook And Sub-Notebook
  - Portable Instrumentation
- **Desktop Displays**
- Industrial Display Controls

### BENEFITS

- Smooth, Flicker Free 2%-100% Full-Range Brightness Control
- Programmable output current allows inverter to mate with a wide variety of LCD panel's specifications
- Output Open Circuit Voltage **Regulation Minimizes Corona Discharge For High Reliability**



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#### ABSOLUTE MAXIMUM RATINGS (NOTE 1)

Input Signal Voltage (V <sub>IN1</sub> ) Input Power Output Voltage, no load	5.5W
Output Voltage, no load Output Current Output Power	7.5mA <sub>RMS</sub> (Internally Limited)
Input Signal Voltage (SLEEP Input) Input Signal Voltage (BRITE) Ambient Operating Temperature, zero airflow Storage Temperature Range	-0.3V to 5.5V 20°C to 70°C

Note 1: 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, will not function optimally.

Symbol	Recommended Operating Conditions			Units	
Symbol	Min	R.C.	Max	Onits	
V <sub>IN1</sub>	4.75	5	5.25	V	
	4.5	5	5.5		
Po		3.5	4.0	W	
VBRT_ADJ	0.5		2.0	V	
VLAMP	465	550	635*	V <sub>RMS</sub>	
IOLAMP	5		6.5	mA <sub>RMS</sub>	
T <sub>A</sub>	-20		70	°C	
	Po Vbrt_adj Vlamp Iolamp	Symbol Min   V <sub>IN1</sub> 4.75   Po 4.5   VBRT_ADJ 0.5   VLAMP 465   IoLAMP 5	$\begin{tabular}{ c c c c c c c c c c c } \hline Min & R.C. \\ \hline Min & R.C. \\ \hline & & & & & & & \\ \hline & & & & & & & \\ \hline & & & &$	$\begin{tabular}{ c c c c c c c c c c c } \hline Min & R.C. & Max \\ \hline Min & R.C. & Max \\ \hline & & & & & & & & \\ \hline V_{\rm IN1} & & & & & & & \\ \hline & & & & & & & & & \\ \hline & & & &$	

\* Total output power must not exceed 4W. Higher voltage lamps may require maximum output current to be set lower than 6.5mA<sub>RMS</sub>

#### ELECTRICAL CHARACTERISTICS

Unless otherwise specified, the following specifications apply over the recommended operating condition and ambient temperature of 25°C except where otherwise noted.

Parameter	Symbol	Test Conditions	LXM	LXMG1617-05-4x		
Farameter	Symbol	Test Collutions	Min	Тур	Max	Units
OUTPUT PIN CHARACTERISTICS						
Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , SLEEP $\ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = Ground$ , $I_{SET2} = Ground$	4.5	5	5.5	mA <sub>RMS</sub>
Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = Ground$ , $I_{SET2} = Open$	5.0	5.5	6.0	mA <sub>RMS</sub>
Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = Open$ , $I_{SET2} = Ground$	5.5	6	6.5	mA <sub>RMS</sub>
Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , SLEEP $\ge 2.0V$ , $V_{IN1} = 5V_{DC}$ I <sub>SET1</sub> = Open, I <sub>SET2</sub> = Open	6.0	6.5	7.0	mA <sub>RMS</sub>
Min. Average Lamp Current	I <sub>L(MIN)</sub>	$V_{BRT_{ADJ}} \le 0.5V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = I_{SET2} = Ground$		0.30		mA <sub>RMS</sub>
Lamp Start Voltage	V <sub>LS</sub>	-20°C < T <sub>A</sub> < 70°C, V <sub>IN1</sub> > 4.5V <sub>DC</sub>	1300	1400		$V_{\text{RMS}}$
Operating Frequency	fo	$V_{BRT_{ADJ}} = 2.5V_{DC}, \overline{SLEEP} \ge 2.0V, V_{IN1} = 5V$	76	80	83	kHz
Burst Frequency	<b>f</b> <sub>BURST</sub>	Output Burst Frequency	148	156	163	Hz

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		-		<b>•</b> • •		LXM	G1617-0	)5-4x	
		Parameter		Symbol	Test Conditions	Min	Тур	Max	Unit
	BRITE INPUT								
	Input Current			I <sub>BRT</sub>	V <sub>BRT_ADJ</sub> = 0V <sub>DC</sub>		-300		μA <sub>DC</sub>
	· ·				$V_{BRT_{ADJ}} = 3V_{DC}$		50	0.05	
		Input for Max. L	•	V <sub>BRT_ADJ</sub>	I <sub>O(LAMP)</sub> = Maximum Lamp Current		2.0	2.05	V <sub>DC</sub>
		Input for Min. L	amp Current	V <sub>BRT_ADJ</sub>	I <sub>O(LAMP)</sub> = Minimum Lamp Current	0.4	0.5		V <sub>DC</sub>
•	SLEEP INPUT					1	1	1	
	RUN Mod	-		V		2.0		V <sub>IN1</sub>	V <sub>DC</sub>
	SLEEP M	ode		V		-0.3		0.8	V <sub>DC</sub>
•	SET <sub>1,2</sub> INF	TUY							
	SET <sub>1,2</sub> Lov	w Threshold		VL				0.4	V
	Input Curr	ent		I <sub>SET</sub>	$V_{SET} \le 0.4V$		-300		μA
	POWER CHARACTERISTICS								
	Sleep Current		I <sub>IN(MIN)</sub>	$V_{IN1} = 5V_{DC}, \ \overline{SLEEP} \le 0.8V$	0.0	5	50	μA <sub>D</sub>	
	Run Current		I <sub>RUN</sub>	$V_{IN1} = 5V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $I_{SET1} = Open$ $I_{SET2} = Ground$ , $V_{LAMP} = 550V_{RMS}$		830		mA <sub>D</sub>	
	Efficiency		η	$V_{IN1} = 5V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $I_{SET1} = Open$ $I_{SET2} = Ground$ , $V_{LAMP} = 550V_{RMS}$		80		%	
				FUNC	TIONAL PIN DESCRIPTION				
	CONN	Pin			DESCRIPTION				
C	N1 (Molex	53261-0871)	Mates with	51021-080	00 housing, 50079-8100 pins. Mates with LX	(9501G inpl	ut cable a	assembl	y
	CN1-1								-
$\frac{CN1-1}{CN1-2}$ Main Input Power Supply (4.75V $\leq$ V <sub>IN1</sub> $\leq$ 5.25V)									
	CN1-3 GND Power Suppl		Power Supply Return						
	CN1-5 SLEEP ON/OFF Control. (0V < SLEEP < 0.8 = OFF, SLEEP >= 2.0V = ON, SLEEP Floating = OFF					F)			
				rightness Control (0.5V to 2.0V <sub>DC</sub> ). 2.0V <sub>DC</sub> gives 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)						

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CN2-2

Connection to low side of lamp. Connect to lamp terminal with longer lead length.

 $V_{LO}$ 

DO NOT connect to Ground.

DO NOT connect to Ground



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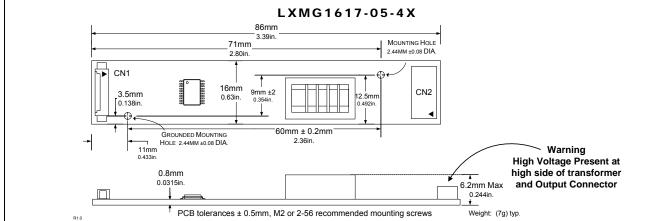
## TABLE 1 SETTING OUTPUT CURRENT

#### **OUTPUT CURRENT SETTINGS**

SET <sub>1</sub> (Pin 7)	SET <sub>2</sub> (Pin 8)	Nominal Output Current
Open*	Open*	6.5mA
Open*	Ground	6.0mA
Ground	Open*	5.5mA
Ground	Ground	5.0mA

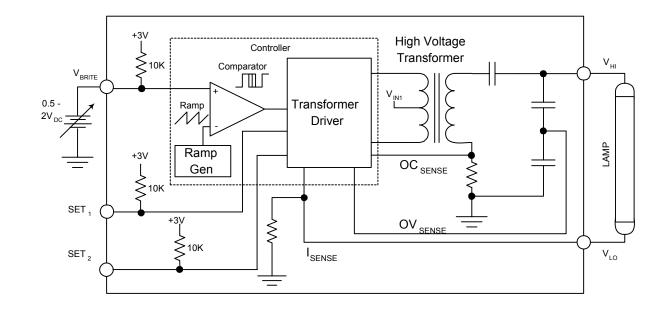
\* If driven by a logic signal it should be open collector or open drain only, not a voltage source.





All Dimensions are in millimeters, inches are for reference only

#### SIMPLIFIED BLOCK DIAGRAM



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#### TYPICAL APPLICATION

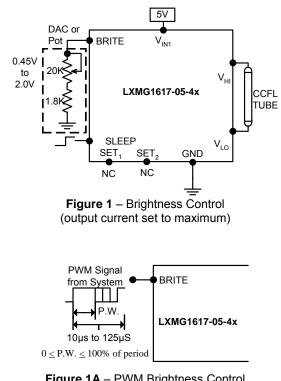
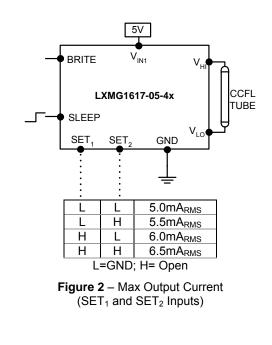


Figure 1A - PWM Brightness Control



- The brightness control may be a voltage output DAC or other voltage source, a digital pot or 20K manual pot. The inverter contains an internal 10K pull-up to 3V to bias the pot add a 1.8K resistor to set the lower threshold voltage. A 3.3V Logic Level PWM signal from a micro-controller may also be used as shown in Figure 1A.
- If you need to turn the inverter ON/OFF remotely, connect to TTL logic signal to the  $\overline{SLEEP}$  input.
- Connect V<sub>HI</sub> to high voltage wire from the lamp. Connect  $V_{IO}$  to the low voltage wire (wire with thinner insulation). Never connect VLO to circuit ground as this will defeat lamp current regulation. If both lamp wires have heavy high voltage insulation, connect the longest wire to VLO. 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 manufactures. Generally the best lamp lifetime correlates with driving the CCFL at the manufactures 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 a open collector or open drain logic signal will allow you to reduce the lamp current for situations where greater dim range is required, as an example in nighttime situations. In conjunction with a light sensor or other timer the panel could be set to higher brightness (maximum output current) for daytime illumination and lower brightness (minimum or typical output current) at nighttime. 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 users 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) or shorted the inverter will attempt to strike the lamp for several seconds. After about 2 seconds without success the inverter will shutdown. In order to restart the inverter it is necessary to toggle the sleep input or cycle the V<sub>IN1</sub> input supply.

APPLICATION



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#### NOTES

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