

LXM1617-05-6x

5V 6W CCFL Programmable Inverter Module

**PRODUCTION DATASHEET** 

#### **DESCRIPTION**

The LXM1617-05-6x is a Single Output 6W Direct Drive<sup>TM</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 12.1" to 15" TFT panels.

LXM1617 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

externally programmable over a range of 5 available (LXM1617-12-6x). to 8mA in 1mA steps to allow the inverter to properly match to a wide array of LCD Microsemi's new LX1689 backlight panel lamp current specifications. The controller, which provides a number of 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 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; 5,930,121; 6,198,234; Patents Pending

The resultant "burst drive" was designed levels.

The modules convert DC voltage from The maximum output current is lamps. A 12V input inverter is also

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
- RangeMAX Wide Range Dimming
- Regulation and Timeout Rated From -20 to 70° C
- UL60950 E175910

### **APPLICATIONS**

- Notebook And Sub-Notebook Computers
- 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

### PRODUCT HIGHLIGHT

# UNIVERSAL DIMMING INPUT "PWM", $V_{DC}$ , OR POTENTIOMETER DC Voltage Potentiometer Source SELECTABLE MAXIMUM OUPUT CURRENT 5MA TO 8 M A <sub>R M S</sub>

>		PACKAGE ORDER INFO	
	PART NUMBER	OUTPUT CONNECTOR	INVERTER MATES DIRECTLY TO PANEL CONNECTORS
	LXM1617-05-61	JST SM02(8.0)B-BHS-1-TB or Yeon Ho 20015WR-05A00	JST BHR-03VS-1
	LXM1617-05-62	JST SM02B-BHSS-1-TB or Yeon Ho 35001WR-02A00	JST BHSR-02VS-1
	LXM1617-05-63	Honda QZ-19-A3MYL #02	Honda QZ-19-3F01

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ABSOLUTE MAXIMUM RA	TINGS (NOTE 1)
Input Signal Voltage (V <sub>IN1</sub> ) Input Power Output Voltage, no load Output Current Output Power	
Input Signal Voltage (SLEEP Input)	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 terminal.	respect to Ground. Currents are positive into, negative out of specified

### 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.

Parameter	Symbol Recommended Operating Conditions			Units	
i didiletei	Gymbol	Min	R.C.	Max	Onits
Input Supply Voltage Range (Fully Regulated Lamp Current)	V <sub>IN1</sub>	4.75	5	5.25	V
Input Supply Voltage Range (Functional)		4.5	5	5.5	
Output Power	Po			6.0	W
Linear BRITE Control Input Voltage Range	V <sub>BRT_ADJ</sub>	0.5	2.0	$V_{IN}$	V
Lamp Operating Voltage	V <sub>LAMP</sub>	545	640	735*	$V_{RMS}$
Lamp Current (Full Brightness)	I <sub>OLAMP</sub>	5		8	mA <sub>RMS</sub>
Operating Ambient Temperature Range	T <sub>A</sub>	-20		70	°C

<sup>\*</sup> Total output power must not exceed 6W. Higher voltage lamps may require maximum output current to be set lower than 8mA<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	LXM1617-05-6x			Units
	Farameter	Syllibol	rest Conditions	Min	Тур	Max	Units
•	OUTPUT PIN CHARACTERISTICS						
	Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = Ground$ , $I_{SET2} = Ground$	4.4	5	5.6	mA <sub>RMS</sub>
	Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = Ground$ , $I_{SET2} = Open$	5.4	6	6.6	mA <sub>RMS</sub>
	Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = Open$ , $I_{SET2} = Ground$	6.4	7	7.6	mA <sub>RMS</sub>
	Full Bright Lamp Current	I <sub>L(MAX)</sub>	$V_{BRT\_ADJ} \ge 2.0V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $V_{IN1} = 5V_{DC}$ $I_{SET1} = Open$ , $I_{SET2} = Open$	7.4	8	8.6	mA <sub>RMS</sub>
	Min. Average Lamp Current	I <sub>L(MIN)</sub>	$V_{BRT\_ADJ} \le 0.5 V_{DC}$ , $\overline{SLEEP} \ge 2.0 V$ , $V_{IN1} = 5 V_{DC}$ $I_{SET1} = I_{SET2} = Ground$		0.30		mA <sub>RMS</sub>
	Lamp Start Voltage	$V_{LS}$	$-20^{\circ}\text{C} < \text{T}_{A} < 70^{\circ}\text{C}, \text{V}_{\text{IN1}} > 4.5\text{V}_{\text{DC}}$	1400	1650		$V_{RMS}$
	Operating Frequency	f <sub>O</sub>	$V_{BRT\_ADJ} = 2.5V_{DC}, \overline{SLEEP} \ge 2.0V, V_{IN1} = 5V$	57	60	63	kHz
	Burst Frequency	f <sub>BURST</sub>	Output Burst Frequency	222	234	246	Hz



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### **ELECTRICAL CHARACTERISTICS (CONTINUED)**

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

	Parameter	Symbol	vmbol Test Conditions		LXM1617-05-6x		
	Farameter	Syllibol	rest Conditions	Min	Тур	Max	Units
	BRITE INPUT						
	Input Current	I <sub>BRT</sub>	$V_{BRT\_ADJ} = 0V_{DC}$		-300		μA <sub>DC</sub>
		ואמי	$V_{BRT\_ADJ} = 2.5V_{DC}$		50		$\mu A_{DC}$
	Minimum Input for Max. Lamp Current	$V_{BRT\_ADJ}$	I <sub>O(LAMP)</sub> = Maximum Lamp Current		2.0	2.05	$V_{DC}$
	Maximum Input for Min. Lamp Current	$V_{BRT\_ADJ}$	I <sub>O(LAMP)</sub> = Minimum Lamp Current	0.4	0.5		$V_{DC}$
•	SLEEP INPUT						
	RUN Mode	V <sub>SLEEP</sub>		2.0		V <sub>IN1</sub>	$V_{DC}$
	SLEEP Mode	V <sub>SLEEP</sub>		-0.3		0.8	$V_{DC}$
•	SET <sub>1,2</sub> INPUT						
	SET <sub>1,2</sub> Low Threshold	$V_L$				0.4	V
	Input Current	I <sub>SET</sub>	V <sub>SET</sub> ≤ 0.5V		-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>DC</sub>
	Run Current	I <sub>RUN</sub>	$V_{\text{IN1}} = 5V_{\text{DC}}$ , $\overline{\text{SLEEP}} \ge 2.0V$ , $I_{\text{SET1}} = \text{Open}$ $I_{\text{SET2}} = \text{Ground}$ , $V_{\text{LAMP}} = 640V_{\text{RMS}}$		1090		mA <sub>DC</sub>
	Efficiency	η	$V_{IN1} = 5V_{DC}$ , $\overline{SLEEP} \ge 2.0V$ , $I_{SET1} = Open$ $I_{SET2} = Ground$ , $V_{LAMP} = 640V_{RMS}$		85		%

FUNCTIONAL PIN DESCRIPTION							
Conn	Pin	DESCRIPTION					
CN1 (Molex	(53261-0890)	Mates with 51021-0800 housing, 50079-8100 pins. Mates with LX9501 input cable assembly					
CN1-1	$V_{IN1}$	Main Input Power Supply (4.75V < V <sub>IN1</sub> < 5.25V)					
CN1-2	VINT	Wall input tower dupply (4.70V \(\frac{1}{2}\) VINT \(\frac{1}{2}\) 0.25V)					
CN1-3	GND	Power Supply Return					
CN1-4	OND	1 ower cuppiy return					
CN1-5	SLEEP	ON/OFF Control. (0V < SLEEP < 0.8 = OFF, SLEEP >= 2.0V = ON					
CN1-6 BRITE Brightness Control (0.5V to 2.0V <sub>DC</sub> ). 2.0V <sub>DC</sub> gives maximum lamp current.							
CN1-7	1-7 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>M1617-05-61</b> (8.0)B-BHS-1-	and -62 TB   Yeon Ho 20015WR-05A00 or SM02B-BHSS-1-TB   Yeon Ho 35001WR-02A00)					
CN2-1 V <sub>HI</sub> High voltage connection to high Side of lamp. Connect to lamp terminal with shortest lead lengt <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							
CN2 for LXM1617-05-63 (Honda QZ-19-A3MYL#02)							
CN2-3 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.							
CN2-1 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							

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Weight: (9g) typ

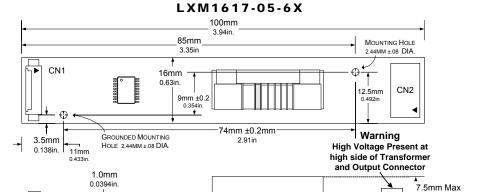
### TABLE 1 SETTING OUTPUT CURRENT

#### **OUTPUT CURRENT SETTINGS**

SET₁ (Pin 7)	SET <sub>2</sub> (Pin 8)	Nominal Output Current
Open*	Open*	8.0mA
Open*	Ground	7.0mA
Ground	Open*	6.0mA
Ground	Ground	5.0mA

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

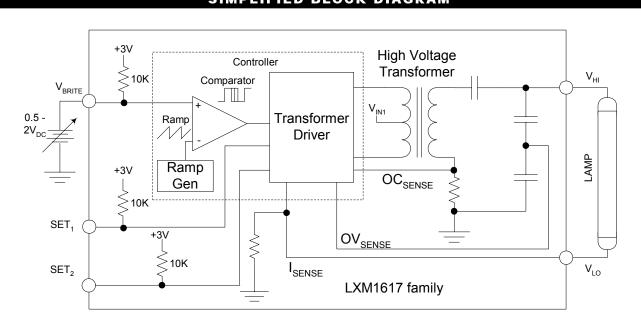
### PHYSICAL DIMENSIONS



All dimensions are in millimeters, inches for reference only

### SIMPLIFIED BLOCK DIAGRAM

PCB tolerances  $\pm$  0.2mm , M2 or 2-56 recommended mounting screws



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### TYPICAL APPLICATION

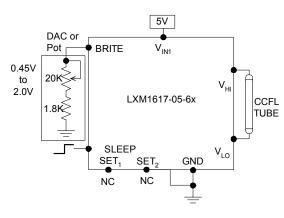


Figure 1 – Brightness Control (output current set to maximum)

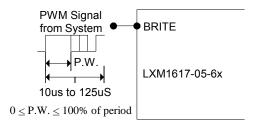


Figure 1A - PWM Brightness Control

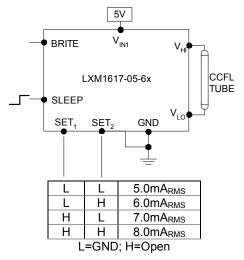


Figure 2 – Max Output Current (SET<sub>1</sub> and SET<sub>2</sub> Inputs)

- The brightness control may be a voltage output DAC or other voltage source, a digital pot or 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 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 SET₁ and SET₂ (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 SET₁ and SET₂ 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 to 4 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.



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NOTES

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