DESCRIPTION

The LXMG1811-05-6x 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 LX6512 CCFL backlight controller the inverter allows a wider lamp output voltage range 280V to 730V compared to Microsemi's existing Direct Drive™ inverter solutions.

For applications needing fully automatic brightness control an 'S' version (LXMG1811-05-6xS) 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 higher input voltage requirements the LXMG1813-12-6x or -6xS will work from a 9V to 16V 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.

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

KEY FEATURES

- PanelMatch Externally Programmable Maximum Output Current
- Wide Lamp 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
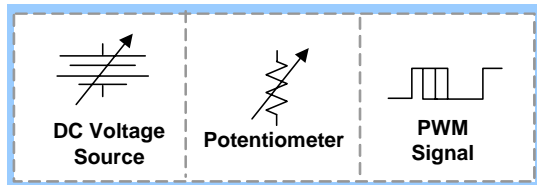- UL60950 Pending
- RoHS Compliant

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

PRODUCT HIGHLIGHT

DC Voltage Source | **Potentiometer** | **PWM Signal**

UNIVERSAL DIMMING INPUT
"PWM", VDC**, OR POTENTIOMETER**
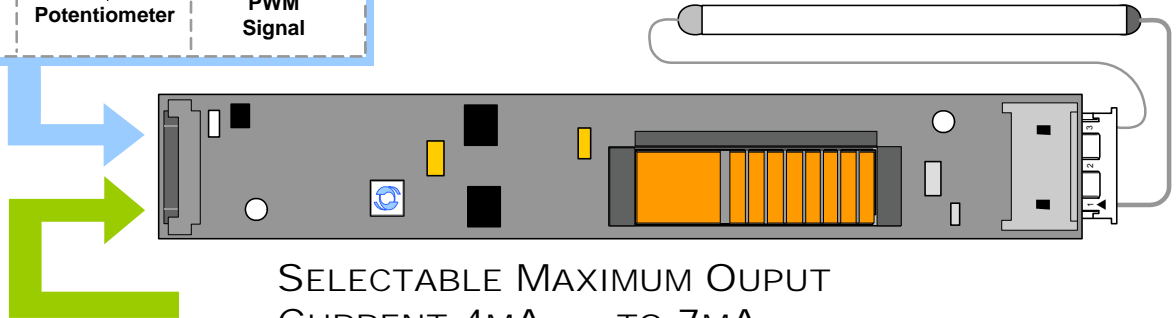
SELECTABLE MAXIMUM OUPUT CURRENT 4MARMS** TO 7MA**RMS****

PACKAGE ORDER INFO

PART NUMBER	OUTPUT CONNECTOR	INVERTER MATES DIRECTLY TO PANEL CONNECTORS
LXMG1811-05-61	JST SM02(8.0)B-BHS-1-TB(LF)(SN), Yeon Ho 20015WR-05A00 or equivalent	JST BHR-03VS-1
LXMG1811-05-62	JST SM02B-BHSS-1-TB(LF)(SN), Yeon Ho 35001WR-02A00 or equivalent	JST BHSR-02VS-1

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ABSOLUTE MAXIMUM RATINGS

Input Signal Voltage (V_{IN})..-0.3V to 6V
Input Power 8W
Output Voltage, no load .... 1800V_{RMS}
Output Current .... 8mA$_{RMS}$
Output Power 6W
Input Signal Voltage ($\overline{SLEEP}$ 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}	4.75	5.0	5.25	V
Input Supply Voltage Range (Functional)		4.5	5.0	5.5	
Output Power	P_O		4.2	6.0	W
Linear BRITE Control Input Voltage Range	V_{BRT_ADJ}	0		2.5	V
Lamp Operating Voltage	V_{LAMP}	280	500	730	V_{RMS}
Lamp Current (Full Brightness)	$I_{O(LAMP)}$	4.0		7.0	mA$_{RMS}$
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 ≥ 2.5V, $\overline{SLEEP}$ ≥ 2.1V, V_{IN} = 5V.

Parameter	Symbol	Test Conditions	LXMG1811-05-6x			Units
			Min	Typ	Max	
OUTPUT PIN CHARACTERISTICS						
Full Bright Lamp Current	$I_{L(MAX)}$	SET$_1$ = Ground, SET$_2$ = Ground	3.5	4.0	4.5	mA$_{RMS}$
Full Bright Lamp Current	$I_{L(MAX)}$	SET$_1$ = Ground, SET$_2$ = Open	4.5	5.0	5.5	mA$_{RMS}$
Full Bright Lamp Current	$I_{L(MAX)}$	SET$_1$ = Open, SET$_2$ = Ground	5.4	6.0	6.6	mA$_{RMS}$
Full Bright Lamp Current	$I_{L(MAX)}$	SET$_1$ = Open, SET$_2$ = Open	6.3	7.0	7.7	mA$_{RMS}$
Full Bright Lamp Current	$I_{L(MAX)}$	V_{IN} = 4.5 to 5.5V; SET$_1$ = Open, SET$_2$ = Ground	5.3	6.0	6.7	mA$_{RMS}$
Min. Average Lamp Current	$I_{L(MIN)}$	BRITE = 0V, SET$_1$ = SET$_2$ = Ground, $I_{L(MIN)}$ = I_{LMAX} * $\sqrt{\text{Burst Duty Cycle}}$		1.0		mA$_{RMS}$
Lamp Start Voltage	V_{LS}	-30°C < T_A < 80°C, V_{IN} ≥ 4.5V	1400	1650		V_{RMS}
Operating Frequency	f_O		47.7	53	58.3	kHz
Burst Frequency	f_{BURST}	Output Burst Frequency	173	206	239	Hz

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▶ 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 ≥ 2.5V, $\overline{SLEEP}$ ≥ 2.1V, V_{IN} = 5V.

Parameter	Symbol	Test Conditions	LXMG1811-05-6x Min	Typ	Max	Units
▶ BRITE INPUT						
Input Current	I_{BRT}	BRITE = 0V		-17		µA
		BRITE = 3V		-5		µA
Minimum Input for Max. Lamp Current	V_{BRT_ADJ}	$I_{O(LAMP)}$ = Maximum Lamp Current	2.1	2.3	2.5	V
Maximum Input for Min. Lamp Current	V_{BRT_ADJ}	$I_{O(LAMP)}$ = Minimum Lamp Current		0	0.1	V
Potentiometer used for BRITE Control	R_{BRT}		400	500	600	kΩ
Minimum PWM Input Frequency	F_{BRT_PWM}	$\%_{BRT\_PWM}$ < 50% (Visual Artifact Avoidance)	3		100	kHz
▶ SLEEP BAR INPUT						
RUN Mode	$V_{\overline{SLEEP}}$		2.1		V_{IN}	V
SLEEP Mode	$V_{\overline{SLEEP}}$		0		0.8	V
▶ SET$_{1,2}$ INPUT						
SET$_{1,2}$ Low Threshold	V_L			0		V
Input Current	I_{SET}	SETx = 0V		-400		µA
▶ POWER CHARACTERISTICS						
Sleep Current	$I_{IN(MIN)}$	$\overline{SLEEP}$ ≤ 0.8V		5	20	µA
Run Current	I_{RUN}	SET$_1$ = Open SET2 = Ground, V_{LAMP} = 500V_{RMS}		750		mA
Strike (Open Lamp)	T_{S_DWELL}		1.0	1.4	2.0	Sec
Supply Current under Fault condition	I_{FAULT}	Fault condition		5		mA
Typical Efficiency	η	SET$_1$ = Open SET$_2$ = Ground, V_{LAMP} = 500V_{RMS}	75	80		%

▶ FUNCTIONAL PIN DESCRIPTION

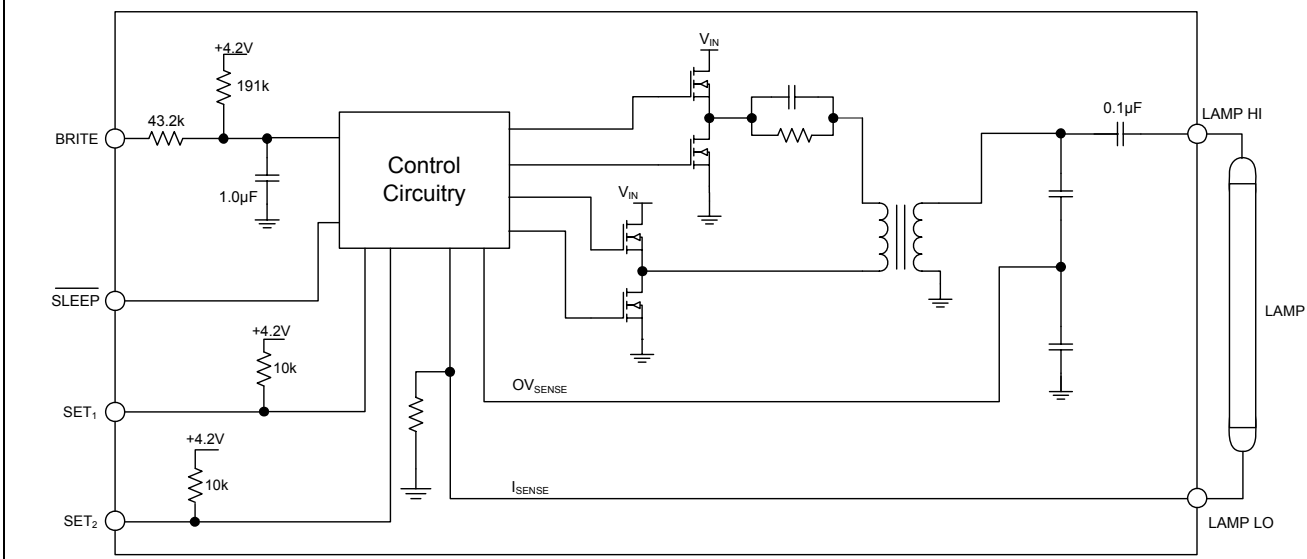| CONN	PIN	DESCRIPTION
CN1 (Molex 53261-0871 or equivalent) mates with 51021-0800 housing, 50079-8100 pins. Mates with LX9501G input cable assembly		
CN1-1	V_{IN}	Main Input Power Supply 4.75V ≤ V_{IN} ≤ 5.25V (Functional 4.5V to 5.5V)
CN1-2		
CN1-3	GND	Power Supply Return
CN1-4		
CN1-5	$\overline{SLEEP}$	ON/OFF Control. (0V ≤ $\overline{SLEEP}$ ≤ 0.8V = OFF, $\overline{SLEEP}$ ≥ 2.1V = ON
CN1-6	BRITE	Brightness Control (0V to 2.5V). 2.5V gives maximum lamp current.
CN1-7	SET$_1$	SET$_1$ MSB Connecting this pin to ground decreases the output current (see Table 1)
CN1-8	SET$_2$	SET$_2$ LSB Connecting this pin to ground decreases the output current (see Table 1)
CN2 for LXMG1811-05-61 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		
CN2-1	V_{HI}	High voltage connection to high side of lamp. Connect to lamp terminal with shortest lead length. **DO NOT** connect to Ground.
CN2-2	V_{LO}	Connection to low side of lamp. Connect to lamp terminal with longer lead length. **DO NOT** connect to Ground

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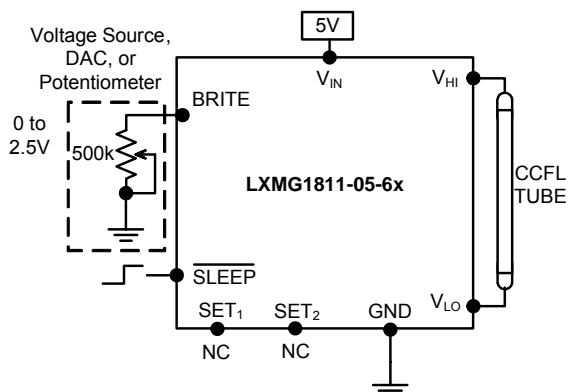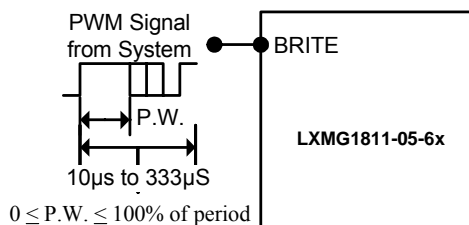Rev 1.0, 2008-11-25

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TABLE 1

OUTPUT CURRENT SETTINGS

SET$_1$ (Pin 7)	SET$_2$ (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

LXMG1811-05-6x

110mm
4.33in.

93.5mm
3.68in.

MOUNTING HOLE
3.18MM ±.08 DIA.

CN1

16mm
0.63in.

9mm ±0.2
0.354in.

12.5mm
0.492in.

CN2

3.5mm
0.138in.

74mm ±0.2
2.91in.

19.5mm
0.768in.

GROUNDED MOUNTING
HOLE 3.18MM ±.08 DIA.

1.0mm ±0.1
0.0394in.

6.0mm Max
0.236in.

R1.0

PCB tolerances ± 0.5mm , M3 recommended mounting screws

Weight: (9g) typ.

All dimensions are in millimeters, inches are for reference only
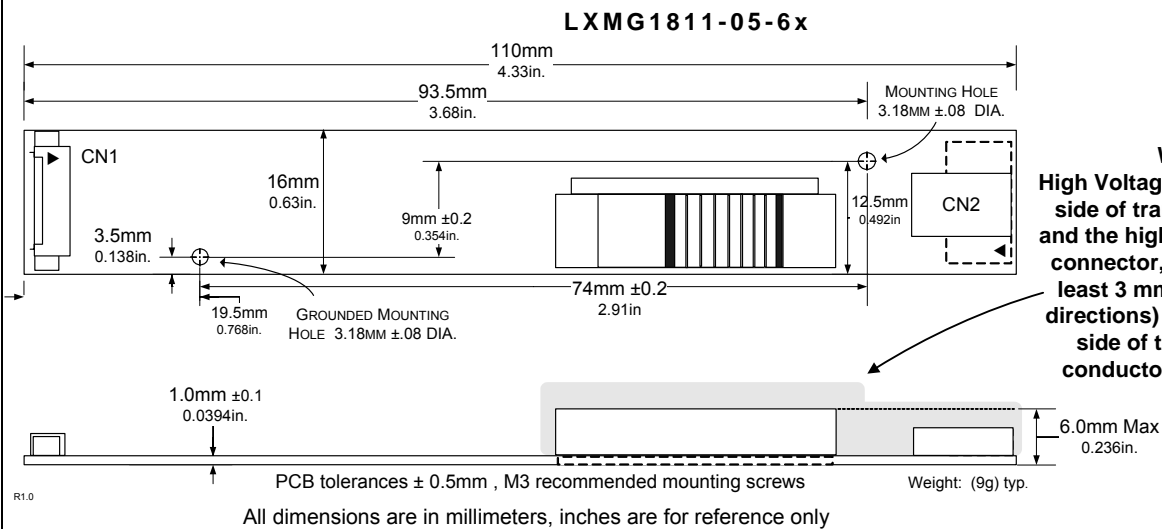
⚠️
Warning
High Voltage is present at high side of transformer, its core and the high side of the output connector, please provide at least 3 mm clearance (in all directions) on the component side of the board to any conductor when mounting

SIMPLIFIED BLOCK DIAGRAM

+4.2V
191k

V_{IN}

0.1µF

LAMP HI

BRITE
43.2k

Control
Circuitry

1.0µF

V_{IN}

LAMP

SLEEP

+4.2V
10k

OV_{SENSE}

SET$_1$

+4.2V
10k

I_{SENSE}

SET$_2$

LAMP LO

BLOCK DIAGRAM

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TYPICAL APPLICATION

Figure 1 – Brightness Control

Figure 1A – PWM Brightness Control
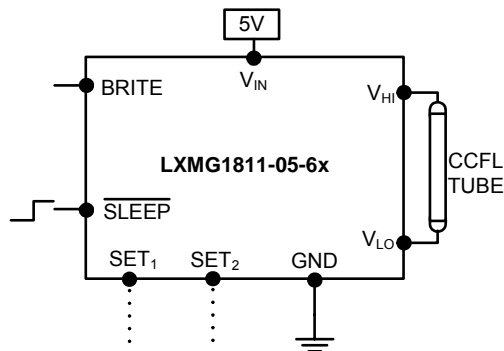
SET$_1$	SET$_2$	
L	L	4.0mA$_{RMS}$
L	H	5.0mA$_{RMS}$
H	L	6.0mA$_{RMS}$
H	H	7.0mA$_{RMS}$

L=GND; H=Open

Figure 2 – Max Output Current
(SET$_1$ and SET$_2$ 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 234.2k pull-up to typically 4.2V to bias the pot. 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 2.3V divided by the logic high voltage level; with 3.3V logic level this corresponds to about 70% duty cycle for maximum lamp current.

- If you need to turn the inverter ON/OFF remotely, connect to TTL logic signal to the $\overline{SLEEP}$ input.

- Connect V$_{HI}$ to high voltage wire from the lamp. Connect V$_{LO}$ to the low voltage wire (wire with thinner insulation). Never connect V$_{LO}$ 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$_{LO}$. This wire is typically white.

- Use the SET$_1$ and SET$_2$ (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 manufacture's nominal current setting. However the SET$_1$ and SET$_2$ 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 1.4 seconds, after which (without success) the inverter will shutdown. In this mode the inverter will draw about 5mA from V$_{IN}$. In order to restart the inverter it is necessary to toggle the sleep input or cycle the V$_{IN}$ input supply.

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