



# PanelMatch™ RangeMAX™ LXMG1627-12-44

12V Dual 4W CCFL Programmable Inverter Module

PRODUCTION DATASHEET

## DESCRIPTION

The LXMG1627-12-44 is a Dual 4W Output *Direct Drive*™ CCFL (Cold Cathode Fluorescent Lamp) Inverter Module specifically designed to be compatible with the Sharp LQ104S1DG51/61 10.4", LQ121S1DG41/61 12.1" as well as the 10.4" Toshiba Matsushita LTA104D182F/183F and the Samsung LTM121SI-T01 12.1" or similar dual lamp displays that have individual lamp output connectors on one side of the panel.

LXMG1627 modules provide the designer with a vastly superior display brightness range. The RangeMAX™ Digital Dimming Technique supplies flicker-free brightness control for any wide range (typically 50:1+) dimming application.

The included dimming input permits brightness control from either, a DC voltage source, a PWM signal or an external potentiometer.

The maximum output current is externally programmable (through the input connector) over a range of 5mA to 6.5mA in 0.5mA steps.

This allows the inverter to match the panel's lamp current specifications.

The modules convert a DC voltage from the system battery or AC adapter directly to high frequency, high-voltage waves required to ignite and operate CCFL lamps. A 5V input inverter version is also available: LXMG1627-05-44.

The module's design utilizes Microsemi's LX6512 backlight controller, which provides a number of cost and performance advantages due to the controller's high level of integration.

Other benefits of this new topology are stable fixed-frequency operation, secondary-side strike-voltage regulation and both open/shorted lamp protection with fault timeout for open lamp condition.

The new LXMG1627-xx-44 modules are designed therefore as a wider temperature range near drop-in-replacement for the LXMG1623-xx-44 inverters, the major difference being the input voltage adjustment range of the BRITE (dimming) pin.

## KEY FEATURES

- Externally Programmable Maximum Output Current
- Easy to Use Brightness Control
- RangeMAX Wide Range Dimming
- Output Open & Short-Circuit Protection and Automatic Strike-Voltage Regulation and Timeout
- Fixed Frequency Operation
- Rated From -30°C to 80°C
- UL60950 E175910 Pending
- RoHS Compliant

## APPLICATIONS

- LCD's Requiring Both Output Connectors on One Side of Panel
- Sharp LQ104S1DG51/61 and LQ121S1DG41/61
- Samsung LTM121SI-T01
- Toshiba Matsushita LTA104D182F/183F
- Desktop Displays
- Industrial Display Controls

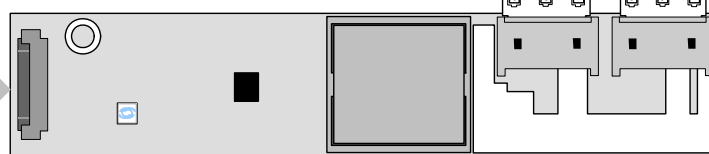
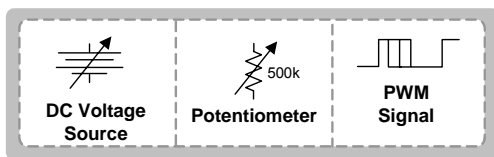
## BENEFITS

- 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

**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  
5.0MA<sub>RMS</sub> TO 6.5MA<sub>RMS</sub>

## PACKAGE ORDER INFO

| PART NUMBER    | OUTPUT CONNECTOR  | INVERTER MATES DIRECTLY TO<br>PANEL CONNECTORS |
|----------------|---|--|
| LXMG1627-12-44 | JST SM02(8.0)B-BHS-1-TB (LF)(SN) or Yeon Ho 20015WR-05A00 or equivalent | JST BHR-03VS-1                                 |



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### ABSOLUTE MAXIMUM RATINGS

|   |   |
|---|---|
| Input Signal Voltage ( $V_{IN}$ ) .....           | -0.3V to 16V                              |
| Input Power .....                                 | 10W                                       |
| Output Voltage, no load .....                     | Internally Limited to 180V <sub>RMS</sub> |
| Output Current .....                              | 9mA <sub>RMS</sub>                        |
| Output Power (each output) .....                  | 4.0W                                      |
| 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                             |
| Operating Relative Humidity, non-condensing ..... | ≤90%                                      |
| 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, might not function optimally.

| Parameter   | Symbol         | Recommended Operating Conditions |      |      | Units             |
|---|----------------|----------------------------------|------|------|-------------------|
|   |                | Min                              | R.C. | Max  |                   |
| Input Supply Voltage Range (Fully Regulated Lamp Current) | $V_{IN}$       | 10.8                             | 12   | 13.2 | V                 |
| Input Supply Voltage Range (Functional)                   |                | 10.2                             | 12   | 14.4 |                   |
| Output Power (each output)                                | $P_O$          |                                  | 3.5  | 4.0  | W                 |
| Linear BRITE Control Input Voltage Range <sup>1</sup>     | $V_{BRT\_ADJ}$ | 0                                |      | 2.5  | V                 |
| Lamp Operating Voltage                                    | $V_{LAMP}$     | 450                              | 530  | 610  | V <sub>RMS</sub>  |
| Lamp Current (Full Brightness)                            | $I_{OLAMP}$    | 5.0                              |      | 6.5  | mA <sub>RMS</sub> |
| Operating Ambient Temperature Range                       | $T_A$          | -30                              |      | 80   | °C                |

<sup>1</sup> The BRITE minimum input voltage level is 0V to 2.5V, whereas it is 0.5V to 2.0V in the LXMG1623-12-44 inverter.

### ELECTRICAL CHARACTERISTICS

Unless otherwise specified, the following specifications apply over the recommended operating condition and ambient temperature of 0°C to 60°C, BRITE ≥ 2.5V, SLEEP ≥ 2.0V,  $V_{IN}$  = 12V except where otherwise noted.

| Parameter                               | Symbol        | Test Conditions   | LXMG1627-12-44 |      |     | Units             |
|---|---------------|---|----------------|------|-----|-------------------|
|   |               |   | Min            | Typ  | Max |                   |
| <b>OUTPUT PIN CHARACTERISTICS</b>       |               |   |                |      |     |                   |
| Full Bright Lamp Current (each output)  | $I_{L(MAX)}$  | SET <sub>1</sub> = Ground, SET <sub>2</sub> = Ground  | 4.5            | 5.0  | 5.5 | mA <sub>RMS</sub> |
| Full Bright Lamp Current (each output)  | $I_{L(MAX)}$  | SET <sub>1</sub> = Ground, SET <sub>2</sub> = Open  | 5.0            | 5.5  | 6.0 | mA <sub>RMS</sub> |
| Full Bright Lamp Current (each output)  | $I_{L(MAX)}$  | SET <sub>1</sub> = Open, SET <sub>2</sub> = Ground  | 5.5            | 6.0  | 6.5 | mA <sub>RMS</sub> |
| Full Bright Lamp Current (each output)  | $I_{L(MAX)}$  | SET <sub>1</sub> = Open, SET <sub>2</sub> = Open  | 6.0            | 6.5  | 7.0 | mA <sub>RMS</sub> |
| Output Current Lamp to Lamp Deviation   | $I_{LL\%DEV}$ | SET <sub>1</sub> = Open, SET <sub>2</sub> = Open  |                | 3    | 10  | %                 |
| Min. Average Lamp Current (each output) | $I_{L(MIN)}$  | BRITE = 0V, SET <sub>1</sub> = SET <sub>2</sub> = Ground,<br>$I_{L(MIN)} = I_{LMAX} * \sqrt{\text{Burst Duty Cycle}}$ |                | 1.2  |     | mA <sub>RMS</sub> |
| Lamp Start Voltage                      | $V_{LS}$      | -30°C < $T_A$ < 80°C, $V_{IN}$ > 10.8V  | 1400           | 1600 |     | V <sub>RMS</sub>  |
| Operating Frequency                     | $f_O$         |   | 54             | 60   | 66  | kHz               |
| Burst Frequency                         | $f_{BURST}$   | Output Burst Frequency  | 198            | 233  | 268 | Hz                |



**ELECTRICAL CHARACTERISTICS (CONTINUED)**

Unless otherwise specified, the following specifications apply over the recommended operating condition and ambient temperature of 0°C to 60°C,  $\overline{\text{BRITE}} \geq 2.5\text{V}$ ,  $\overline{\text{SLEEP}} \geq 2.0\text{V}$ ,  $V_{\text{IN}} = 12\text{V}$  except where otherwise noted.

| Parameter                           | Symbol                                 | Test Conditions  | LXMG1627-12-44 |      |                 | Units         |
|-------------------------------------|--|--|----------------|------|-----------------|---------------|
|                                     |  |  | Min            | Typ  | Max             |               |
| Input Current                       | $I_{\text{BRT}}$                       | $\overline{\text{BRITE}} = 0\text{V}$  | -16            | -18  | -20             | $\mu\text{A}$ |
|                                     |  | $\overline{\text{BRITE}} = 2.5\text{V}$  | -5             | -7   | -9              | $\mu\text{A}$ |
| Minimum Input for Max. Lamp Current | $\overline{\text{BRITE}}_{\text{MIN}}$ | $I_{\text{O(LAMP)}} = \text{Maximum Lamp Current}$   | 2.1            | 2.3  | 2.5             | V             |
| Maximum Input for Min. Lamp Current | $\overline{\text{BRITE}}_{\text{MAX}}$ | $I_{\text{O(LAMP)}} = \text{Minimum Lamp Current}$   | 0              |      |                 | V             |
| Minimum PWM Input Frequency         | $F_{\text{BRT\_PWM}}$                  | $\%_{\text{BRT\_PWM}} < 50\%$ (Visual Artifact Avoidance)  | 8              |      |                 | kHz           |
| <b>SLEEP BAR INPUT</b>              |  |  |                |      |                 |               |
| RUN Mode                            | $V_{\overline{\text{SLEEP}}}$          |  | 2.0            |      | $V_{\text{IN}}$ | V             |
| SLEEP Mode                          | $V_{\overline{\text{SLEEP}}}$          |  | -0.3           |      | 0.8             | V             |
| <b>SET<sub>1,2</sub> INPUT</b>      |  |  |                |      |                 |               |
| SET <sub>1,2</sub> Low Threshold    | $V_{\text{L}}$                         |  |                | 0    |                 | V             |
| Input Current                       | $I_{\text{SET}}$                       | SETx = 0V  |                | -420 |                 | $\mu\text{A}$ |
| <b>POWER CHARACTERISTICS</b>        |  |  |                |      |                 |               |
| Sleep Current                       | $I_{\text{IN(MIN)}}$                   | $\overline{\text{SLEEP}} \leq 0.8\text{V}$   |                | 5    | 20              | $\mu\text{A}$ |
| Run Current                         | $I_{\text{IN(RUN)}}$                   | SET <sub>1</sub> = Open, SET <sub>2</sub> = Ground, $V_{\text{LAMP}} = 530\text{V}_{\text{RMS}}$ |                | 550  |                 | mA            |
| Strike (Open Lamps)                 | $T_{\text{S\_DWELL}}$                  |  | 1.0            | 1.2  | 2               | Sec           |
| Supply Current After Fault Timeout  | $I_{\text{FAULT}}$                     | Fault Timeout  |                | 7    |                 | mA            |
| Efficiency                          | $\eta$                                 | SET <sub>1</sub> = Open, SET <sub>2</sub> = Ground, $V_{\text{LAMP}} = 530\text{V}_{\text{RMS}}$ |                | 82   |                 | %             |

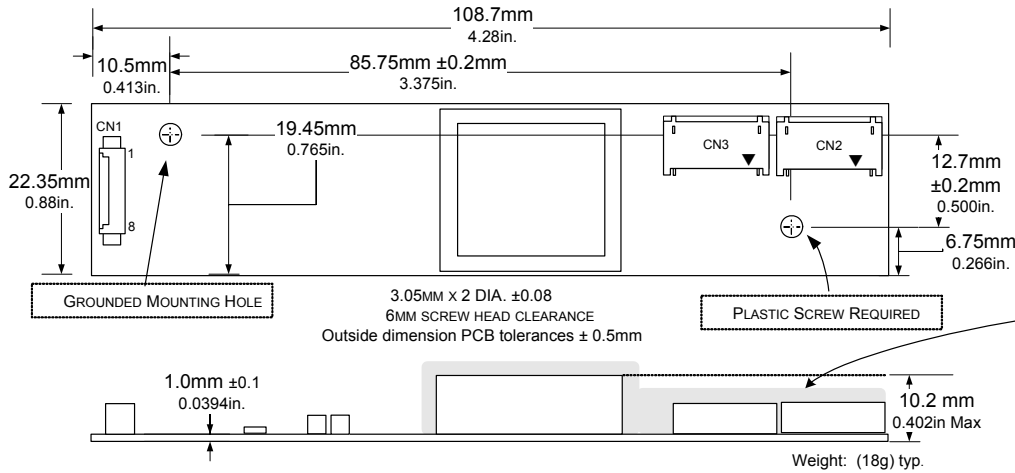
**FUNCTIONAL PIN DESCRIPTION**

| CONN  | PIN                       | DESCRIPTION   |
|---|---------------------------|---|
| <b>CN1</b> (Molex 53261-0871 or equivalent) Mates with 51021-0800 housing, 50079-8100 pins. Mates with LX9501G input cable assembly |                           |   |
| CN1-1   | $V_{\text{IN}}$           | Main Input Power Supply ( $10.8\text{V} \leq V_{\text{IN}} \leq 13.2\text{V}$ )   |
| CN1-2   |                           |   |
| CN1-3   | GND                       | Power Supply Return   |
| CN1-4   |                           |   |
| CN1-5   | $\overline{\text{SLEEP}}$ | ON/OFF Control. ( $0\text{V} \leq \overline{\text{SLEEP}} \leq 0.8 = \text{OFF}$ , $\overline{\text{SLEEP}} \geq 2.0\text{V} = \text{ON}$ ) |
| CN1-6   | BRITE                     | Brightness Control (0V to 2.5V). 2.5V insures 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, CN3 for LXMG1627-12-44</b> (JST SM02(8.0)B-BHS-1-TB (LF)(SN) or Yeon Ho 20015WR-05A00 or equivalent)                        |                           |   |
| CN2-1<br>CN3-1  | $V_{\text{HI}}$           | 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<br>CN3-2  | $V_{\text{LO}}$           | Connection to low side of lamp. Connect to lamp terminal with longer lead length. <b>DO NOT</b> connect to Ground                           |

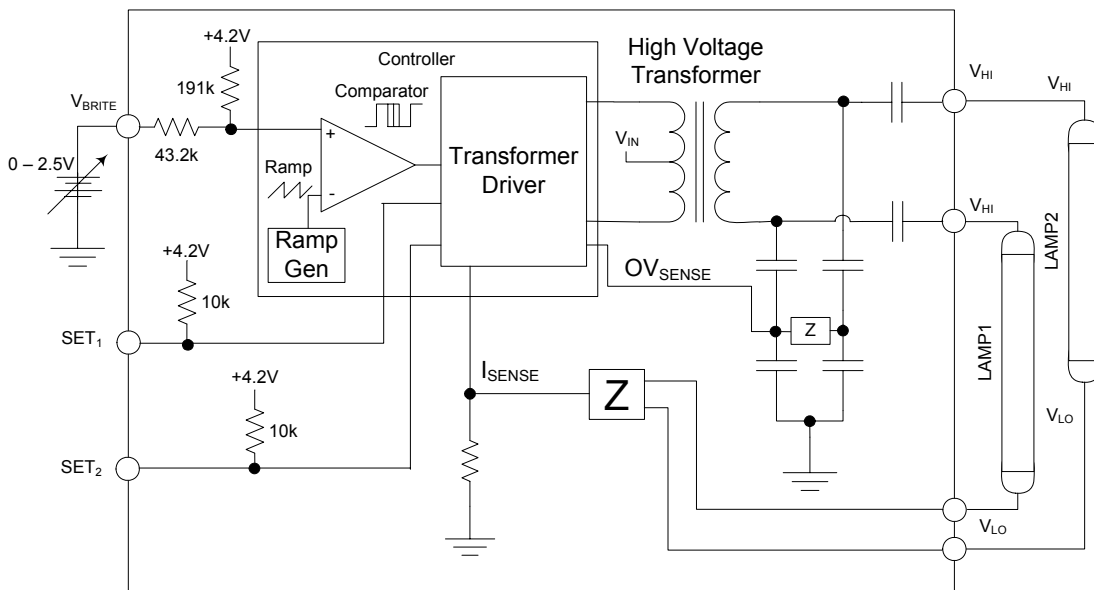
**TABLE 1**
**OUTPUT CURRENT SETTINGS**

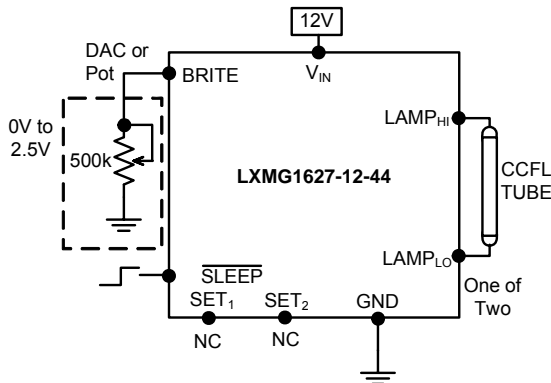
| SET <sub>1</sub><br>(Pin 7) | SET <sub>2</sub><br>(Pin 8) | Nominal Output Current |
|-----------------------------|-----------------------------|------------------------|
| Open*                       | Open*                       | 6.5mA                  |
| Open*                       | Ground                      | 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.

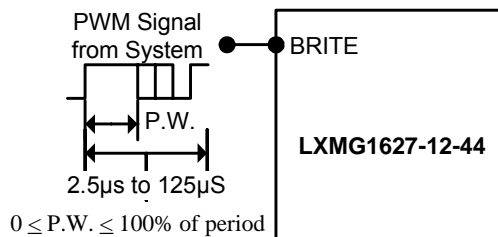
**PHYSICAL DIMENSIONS**
**LXMG1627-12-44**


**Warning**  
High Voltage is present at high side of transformer, its core and the high side of the output connectors, please provide at least 2 mm clearance (in all directions) on the component side of the board to any conductor when mounting

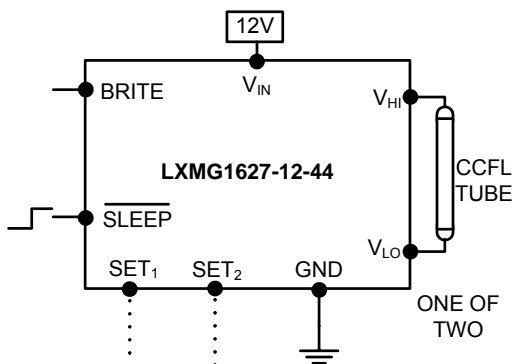
**SIMPLIFIED BLOCK DIAGRAM**


**TYPICAL APPLICATION**


**Figure 1 – Brightness Control**  
(Output current set to maximum)



**Figure 1A – PWM Brightness Control**



|   |   |                      |
|---|---|----------------------|
| L | L | 5.0mA <sub>RMS</sub> |
| L | H | 5.5mA <sub>RMS</sub> |
| H | L | 6.0mA <sub>RMS</sub> |
| H | H | 6.5mA <sub>RMS</sub> |

L=GND; H=Open

**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 191k pull-up resistor in series with 43.2k to 4.2V to bias the pot (see block diagram). A PWM Logic level signal (figure 1A) 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 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, as an example in nighttime situations. 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 for about 1.2 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>IN</sub> input supply. If either high side lamp output is directly connected to ground the inverter will immediately shutdown.



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NOTES

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