PanelMatch™ RangeMAX™ LXMG1627-05-44

5V Dual 4W CCFL Programmable Inverter Module

PRODUCTION DATASHEET

DESCRIPTION

The LXMG1627-05-44 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 12V input inverter version is also available: LXMG1627-12-44.

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.

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

- 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

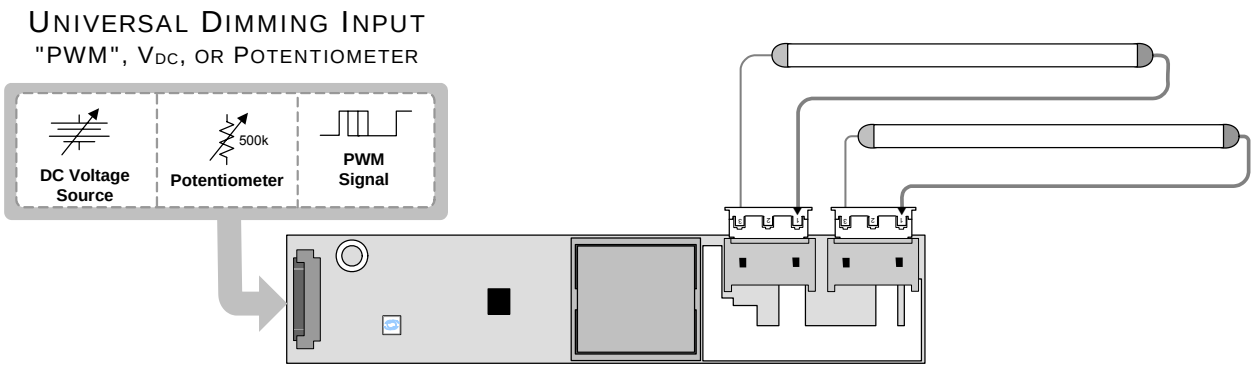
APPLICATIONS

- 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

PRODUCT HIGHLIGHT



PACKAGE ORDER INFO

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

Rev. 1.0, 2008-12-04

Microsemi
Analog Mixed Signal Group
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ABSOLUTE MAXIMUM RATINGS

Input Signal Voltage (V_{IN}) ..... -0.3V to 6V
Input Power 10W
Output Voltage, no load ..... Internally Limited to 1800V_{RMS}
Output Current ..... 9mA_{RMS}
Output Power (each output) 4.0W
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
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}	4.75	5	5.25	V
Input Supply Voltage Range (Functional)		4.5	5	5.5	
Output Power (each output)	P_O		3.5	4.0	W
Linear BRITE Control Input Voltage Range[1]	V_{BRT_ADJ}	0		2.5	V
Lamp Operating Voltage	V_{LAMP}	450	530	610	V_{RMS}
Lamp Current (Full Brightness)[2]	I_{OLAMP}	5.0		6.5	mA_{RMS}
Operating Ambient Temperature Range	T_A	-30		80	°C

[1] The BRITE minimum input voltage level is 0V to 2.5V, whereas it is 0.5V to 2.0V in the LXMG1623-05-44 inverter.
[2] At input voltages below 5V the inverter may not be able to output the full 6.5mA_{RMS} per lamp in all configurations.

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, $\overline{SLEEP}$ ≥ 2.0V, V_{IN} = 5V except where otherwise noted.

Parameter	Symbol	Test Conditions	LXMG1627-05-44			Units
			Min	Typ	Max	
OUTPUT PIN CHARACTERISTICS						
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET_1 = Ground, SET_2 = Ground	4.5	5.0	5.5	mA_{RMS}
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET_1 = Ground, SET_2 = Open	5.0	5.5	6.0	mA_{RMS}
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET_1 = Open, SET_2 = Ground	5.5	6.0	6.5	mA_{RMS}
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET_1 = Open, SET_2 = Open	6.0	6.5	7.0	mA_{RMS}
Output Current Lamp to Lamp Deviation	$I_{LL\%DEV}$	SET_1 = Open, SET_2 = Open		3	10	%
Min. Average Lamp Current (each output)	$I_{L(MIN)}$	BRITE = 0V, SET_1 = SET_2 = Ground, $I_{L(MIN)} = I_{LMAX} * \sqrt{\text{Burst Duty Cycle}}$	0.7	1.2	1.7	mA_{RMS}
Lamp Start Voltage	V_{LS}	-30°C < T_A < 80°C, V_{IN} > 4.75V	1400	1600		V_{RMS}
Operating Frequency	f_O		54	60	66	kHz
Burst Frequency	f_{BURST}	Output Burst Frequency	198	233	268	Hz

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ELECTRICAL CHARACTERISTICS (CONTINUED)

Unless otherwise specified, the following specifications apply over the recommended operating condition and ambient temperature of 0°C to 60°C, BRITE ≥ 2.5V, $\overline{SLEEP}$ ≥ 2.0V, V_{IN} = 5V except where otherwise noted.

Parameter	Symbol	Test Conditions	LXMG1627-05-44			Units
			Min	Typ	Max	
Input Current	I_{BRT}	BRITE = 0V		-18		µA
		BRITE = 2.5V		-7		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			V
Minimum PWM Input Frequency	F_{BRT_PWM}	$\%_{BRT\_PWM}$ < 50% (Visual Artifact Avoidance)	8			kHz
SLEEP BAR INPUT						
RUN Mode	$V_{\overline{SLEEP}}$		2.0		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		-420		µA
POWER CHARACTERISTICS						
Sleep Current	$I_{IN(MIN)}$	$\overline{SLEEP}$ ≤ 0.8V		5	20	µA
Run Current	$I_{IN(RUN)}$	SET_1 = Open, SET_2 = Ground, V_{LAMP} = 530V_{RMS}		1460		mA
Strike (Open Lamps)	T_{S_DWELL}		1.0	1.3	2	Sec
Supply Current After Fault Timeout	I_{FAULT}	Fault Timeout		7		mA
Efficiency	η	SET_1 = Open, SET_2 = Ground, V_{LAMP} = 530V_{RMS}		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)
CN1-2		
CN1-3	GND	Power Supply Return
CN1-4		
CN1-5	$\overline{SLEEP}$	ON/OFF Control. (0V ≤ $\overline{SLEEP}$ ≤ 0.8 = OFF, $\overline{SLEEP}$ ≥ 2.0V = ON)
CN1-6	BRITE	Brightness Control (0V to 2.5V). 2.5V insures 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, CN3 for LXMG1627-05-44 (JST SM02(8.0)B-BHS-1-TB (LF)(SN) or Yeon Ho 20015WR-05A00 or equivalent)		
CN2-1 CN3-1	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 CN3-2	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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TABLE 1

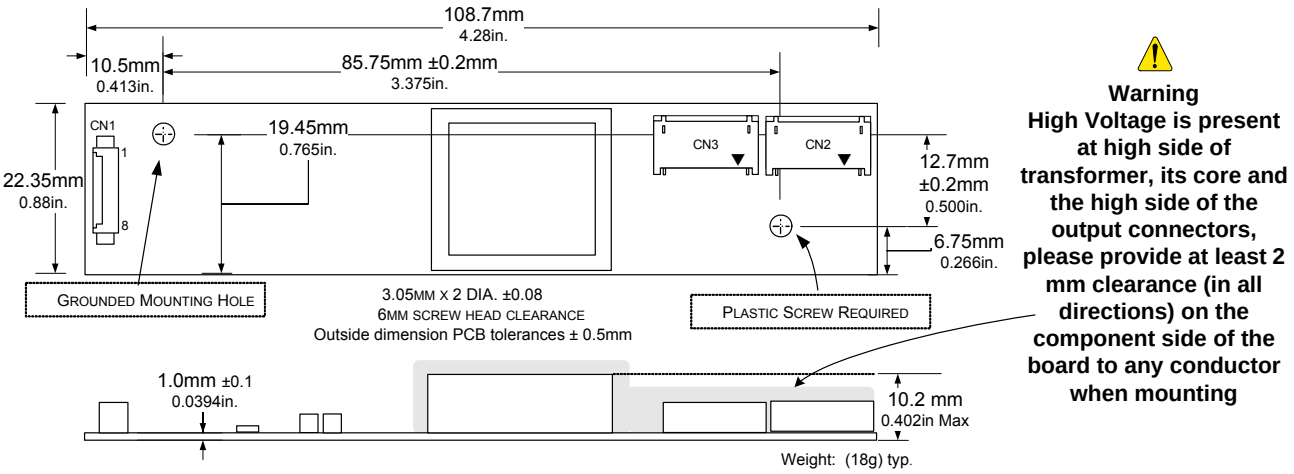
OUTPUT CURRENT SETTINGS

SET_1 (Pin 7)	SET_2 (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

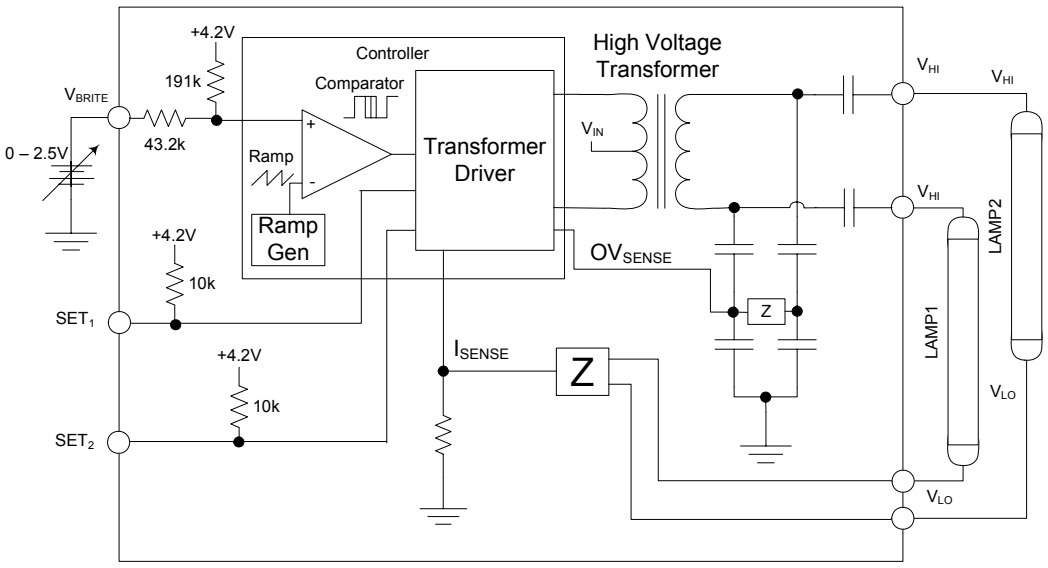
LXMG1627-05-44



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

Dimensions are in millimeters (inches are for reference only)

SIMPLIFIED BLOCK DIAGRAM



PACKAGE DATA

TYPICAL APPLICATION

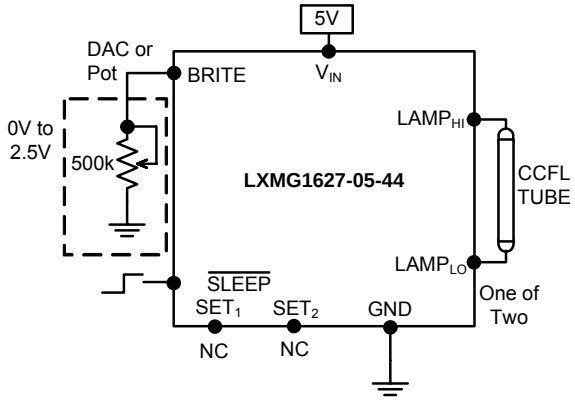


Figure 1 – Brightness Control
(Output current set to maximum)

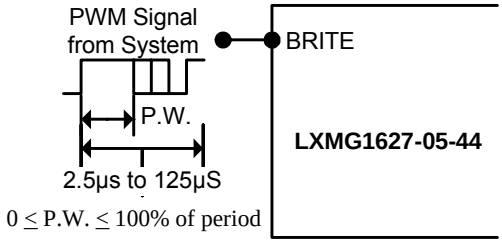
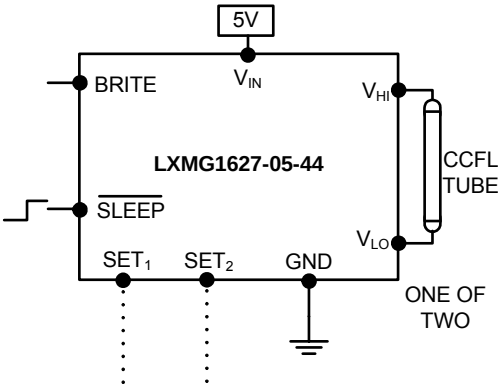


Figure 1A – PWM Brightness Control



L	L	5.0mA$_{RMS}$
L	H	5.5mA$_{RMS}$
H	L	6.0mA$_{RMS}$
H	H	6.5mA$_{RMS}$

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 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 $\overline{\text{SLEEP}}$ 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 manufacturer'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, 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 1.3 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_{IN} input supply. If either high side lamp output is directly connected to ground the inverter will immediately shutdown.

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NOTES