

**DESCRIPTION**

The LXMG1645-24-53 is a Quad 5W Output CCFL (Cold Cathode Fluorescent Lamp) Inverter Module specifically designed for driving NEC NL12876BC26-25 LCD panel or similar quad lamp panels.

The inverter includes a dimming input that permits brightness control from a PWM signal. RangeMAX™ Digital Dimming Technique provides flicker-free brightness control in any wide range (typically 50:1+) dimming application.

The module converts a DC voltage from the system battery or AC adapter directly to high frequency, high-voltage waves required to ignite and operate CCFL lamps. The resultant “burst drive” that energizes the lamp was designed specifically to ensure that no premature lamp degradation occurs, while allowing

significant power savings at lower dim levels.

The inverter also has a dedicated FAIL pin that indicates an open/shorted lamp condition. In addition when only one or two lamps on either side sustain a fault the lamps on the other side will remain in normal operation. This mode of operation during lamp(s) failure is called StayLit™ since the panel is able to still remain on although at reduced brightness.

The module’s design is based on 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 and secondary-side strike-voltage regulation.

**KEY FEATURES**

- StayLIT™ Redundancy
- PWM Brightness Control
- RangeMAX™ Wide Range Dimming
- Output Short-Circuit Protection and Automatic Strike-Voltage Regulation
- Fixed Frequency Operation
- Rated From -30 to 80°C
- UL 60950 Pending
- RoHS Compliant

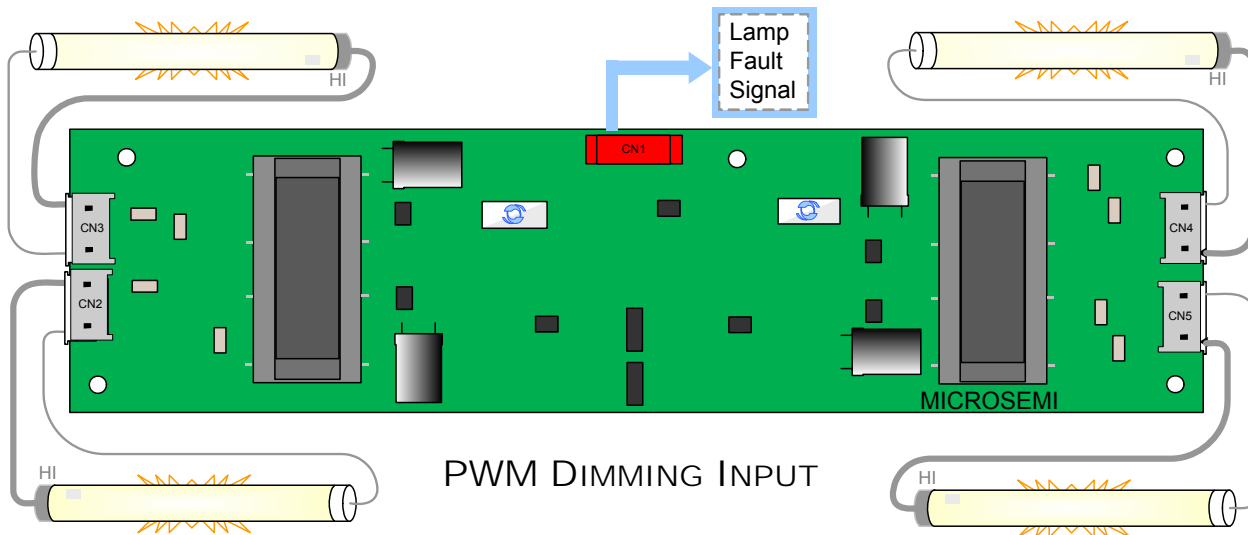
**APPLICATIONS**

- High Brightness Displays
- Desktop Displays
- Medical Monitors

**BENEFITS**

- Smooth, Flicker Free 2%-100% Optical Brightness Range

**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**

**PACKAGE ORDER INFO**

PART NUMBER	OUTPUT CONNECTORS	INVERTER MATES DIRECTLY TO PANEL CONNECTORS
LXMG1645-24-53	Four JST SM02(8.0)B-BHS-1-TB(LF)(SN) or Yeon Ho 20015WR-05A00	JST BHR-03VS-1

**ABSOLUTE MAXIMUM RATINGS**

Input Signal Voltage (V <sub>IN</sub> , FAIL) .....	-0.3V to 30V
Input Power .....	24W
Output Voltage, no load .....	1900V <sub>RMS</sub>
Output Current(each output).....	9.0mA
Output Power(each output) .....	5W
Input Signal Voltage (ENABLE, PWM) .....	-0.3V to 5.5V
Ambient Operating Temperature, zero airflow .....	-30°C to 80°C
Operating Relative Humidity, Non-condensing .....	0% to 95%
Storage Temperature Range .....	-40°C to 90°C

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 <sub>IN</sub>	21.6	24	26.4	V
Output Power (each output)	P <sub>O</sub>		4.0	5.0	W
DC BRITE Control Input Voltage Range	V <sub>BRT</sub>	0		3.0	V
Direct Low Frequency PWM	Duty Control Range	F <sub>DUTY</sub>	10	100	%
	Burst Frequency <sup>1</sup>	F <sub>PWM</sub>	100	120	Hz
	Amplitude	V <sub>PWM</sub>	3.0	5.5	V
	Rise/Fall Time	T <sub>r</sub> , T <sub>f</sub>	0	3	μS
Lamp Current (Full Brightness) <sup>2</sup>	I <sub>OLAMP</sub>	5.5	6.0	6.5	mA <sub>RMS</sub>
Lamp Operating Voltage	V <sub>LAMP</sub>	530	625	720	V <sub>RMS</sub>

**ELECTRICAL CHARACTERISTICS**

Unless otherwise specified, the following specifications apply over the recommended operating condition and ambient temperature of 0°C to 60°C except where otherwise noted; ENABLE ≥ 2.5V, V<sub>IN</sub> = 24V, F<sub>DUTY</sub>=100%, F<sub>PWM</sub> = 120Hz, T<sub>a</sub> = 25°C.

Parameter	Symbol	Test Conditions / Comment	Min	Typ	Max	Units
<b>OUTPUT CHARACTERISTICS</b>						
Full Bright Lamp Current (Each Lamp)	I <sub>OL100n</sub> <sup>3</sup>	PWM = 100% or Open	5.5	6.0	6.5	mA <sub>RMS</sub>
Full Dim Lamp Current (Each Lamp)	I <sub>OL100n</sub>	V <sub>B</sub> = 3V, PWM=10%		1.6		mA <sub>RMS</sub>
Lamp Run Voltage (Each Lamp)	V <sub>L,RUN</sub>	PWM = 100% or Open		670		V <sub>RMS</sub>
Lamp Start Voltage (Each Lamp)	V <sub>LS</sub>	T <sub>A</sub> = -30°C, V <sub>IN</sub> ≥ 21.6V		1820		V <sub>RMS</sub>
Operating Frequency	F <sub>O</sub>		45.5	47.5	48.0	kHz
Optical Dim Range (by PWM) <sup>4</sup>	N:1 <sub>BRTp</sub>	Center Area Brightness, Max/Min		50		Ratio
Output Current Lamp to Lamp Deviation	ΔI <sub>OLm,n</sub>	$\frac{ I_{OLm} - I_{OLn} }{I_{OLm}}$ m=1,2,3,4, n= 1~4 not m		5		%

**ELECTRICAL CHARACTERISTICS**

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Parameter	Symbol	Test Conditions / Comment	Min	Typ	Max	Units
<b>PWM INPUT, PWM DIM CONTROL</b>						
PWM High Level Amplitude	V <sub>PWM</sub> <sup>H</sup>		3			V
PWM Low Level Amplitude	V <sub>PWM</sub> <sup>L</sup>				0.3	V
PWM Jitter	Jitter				3	μs
PWM Frequency Range	F <sub>PWM</sub>		100	120	225	Hz
PWM Duty Range	F <sub>DUTY</sub>		10		100	%
<b>ENABLE INPUT</b>						
Disable Off	V <sub>EN_OFF</sub>		0		0.5	V
ENABLE On	V <sub>EN_ON</sub>		2.5		5.5	V
ENABLE On	V <sub>EN_ON</sub>	T <sub>a</sub> = -30°C	2.8		5.5	V
V <sub>IN</sub> Quiescent Current	I <sub>Q</sub>	ENABLE = 0V		260	400	μA
Power On Sequence V <sub>IN</sub> to ENABLE	T <sub>PWR_ON</sub>	V <sub>IN</sub> = 24V +/- 10% before ENABLE Goes High	1			msec
<b>POWER CHARACTERISTICS</b>						
Supply Current	I <sub>RUN</sub>	No Lamp Fault		710	853	mA
V <sub>IN</sub> Under Voltage Lock Out Threshold	V <sub>IN UVLO</sub>	V <sub>IN</sub> Rising Edge		20		V
V <sub>IN</sub> UVLO Hysteresis	V <sub>HYS</sub>			0.7		V
Supply Current During Fault Timeout	I <sub>FLT</sub>	All 4 Lamps Open		30		mA
Efficiency	η	Load = 110k Resistive Load	85	90		%
<b>STRIKE TIMEOUT</b>						
Strike (All Open Lamps)	T <sub>S_DWELL</sub>			1200		msec
Open Lamp Output Voltage	V <sub>STK</sub>	All Lamps Not Connected		1650		V <sub>RMS</sub>
<b>FAIL</b>						
FAIL Pin Voltage	V <sub>FLT_N</sub>	No Fault , Pull-up 2.4kΩ to V <sub>IN</sub>		V <sub>IN</sub>		V
FAIL Pin Leakage Current	I <sub>FLT_LKG</sub>	No Fault , Pull-up 2.4kΩ to V <sub>IN</sub>			10	μA
FAIL Pin Voltage	V <sub>FLT_F</sub>	Open Lamp , Pull-up 2.4kΩ to V <sub>IN</sub>			0.4	V
FAIL Invalid Time	T <sub>STRIKE</sub>	All 4 Lamps Open			2.5	sec
FAIL Sensing Time	T <sub>D_FAIL</sub>	From Occurrence of One Lamp Open or Short			275	msec
<b>STRIKE MODE</b>						
StayLIT™ Strike Time Period	T <sub>SL_TO</sub>	Only One of Two Lamps Ignited on CN2~CN3 or CN4 ~ CN5		600		msec
<b>LAMP CURRENT</b>						
Lamp Current Of Non-Faulty Side ( Open or Short)	I <sub>L_FN</sub>	Open or Short One Lamp, Full Bright	5.7	6.2	6.7	mA <sub>RMS</sub>
Lamp Current Of Non-Faulty Side ( Short or Short)	I <sub>L_FN</sub>	Open or Short One Lamp, Full Dim		1.65		mA <sub>RMS</sub>

<sup>1</sup> Direct PWM (low) frequency should be selected such to not have optical interference.

<sup>2</sup> Lamp current is specified with NEC NL12876BC26-25 and all 4 lamps connected with frame of panel grounded.

<sup>3</sup> n is lamp number CN1 → 1, CN2 → 2, CN3 → 3, CN4 → 4

<sup>4</sup> At room temp, 1 hour full brightness operation and 1 hour full dim operation measurement ratio.

**FUNCTIONAL PIN DESCRIPTION**

CONN	PIN	DESCRIPTION
<b>CN1</b> (Wurth Elektronik 690367291076 or equivalent)		
CN1-1	V <sub>IN</sub>	Main Input Power Supply 21.6V ~ 26.4V
CN1-3		
CN1-5		
CN1-2	GND	Power Supply Return
CN1-4		
CN1-6		
CN1-7	NC	NC
CN1-8	ENABLE	ON/OFF Control, ON: 2.5V ~ 5.5V, OFF: 0 ~ 0.5V or Open
CN1-9	PWM	Low Frequency Burst PWM Dimming input
CN1-10	FAIL	Fail Status Output: Normal State: Open Drain Output, Fail State '0V'
<b>CN2, CN3, CN4, CN5</b> (JST SM02(8.0)B-BHS-1-TB(LF)(SN)   Yeon Ho 20015WR-05A00 or equivalent)		
CN2-1, CN3-1 CN4-1, CN5-1	LAMP <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.
CN2-3, CN3-3 CN4-3, CN5-3	LAMP <sub>LO</sub>	Connection to Low Side of Lamp. Connect to Lamp Terminal with Longer Lead Length. <b>DO NOT</b> connect to ground

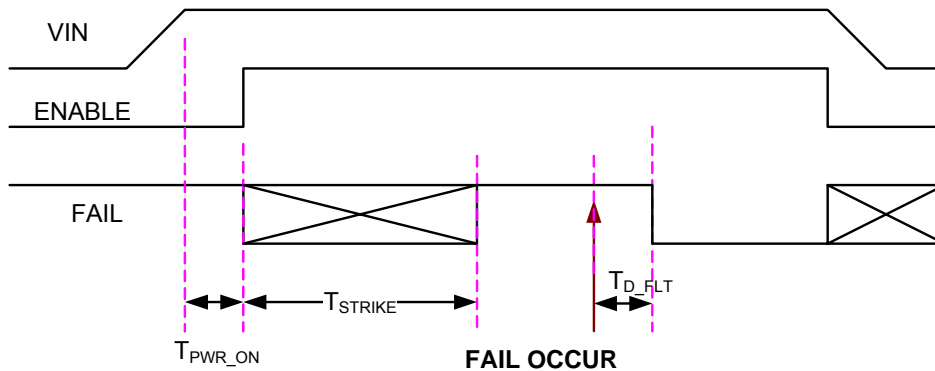
**STAYLIT FUNCTION TABLE**
**FAULT Definition: (F)**

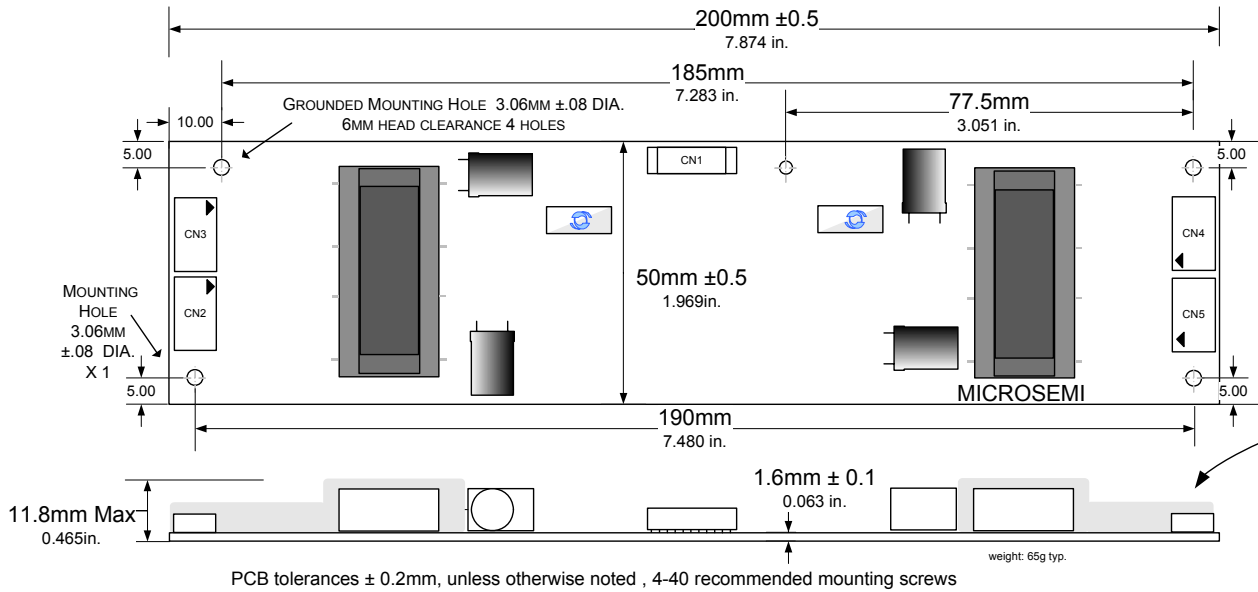
1. OPEN:(O) Lamp is not connected ( either high side wire open or return wire open)
2. SHORT1:(S1) Lamp high side wire is shorted to lamp return side wire
3. SHORT2:(S2) Lamp high side wire is shorted to ground
4. SHORT3:(S3) Lamp return wire is shorted to GND
5. ARCING: Lamp High side wire is creating the arcing path after the inverter is enabled.

**F** means either **O, S1, S2, OR S3**

**N** = Connected lamp and normal operation

Fault Conditions				Inverter Operation	FAIL SIGNAL		
Lamp 1	Lamp 2	Lamp 3	Lamp 4		Fault Exists Prior to Turn-on	Fault Occurs During Ignition	Fault Occurs During Run Mode
N	N	N	N	<b>ALL ON</b>	Action After $T_{STRIKE}$	Action After $T_{STRIKE}$	Action After $T_{D\_FLT}$
N	N	N	F	With Exception of Affected Lamps for 'O, S1, S2' Fault Conditions, All Unaffected Lamps Are <b>ON</b> , Including Affected Lamp in a Single <b>S3</b> Fault Condition.  An <b>S1</b> Fault Will Typically Reduce Opposing Operational Lamp Current By 43%	Open Drain to LOW	Open Drain to LOW	Open Drain to LOW
N	N	F	N				
N	N	F	F				
N	F	N	N				
N	F	N	F				
N	F	F	N				
N	F	F	F				
F	N	N	N				
F	N	N	F				
F	N	F	N				
F	N	F	F				
F	F	N	N				
F	F	N	F				
F	F	F	N	<b>ALL OFF</b>			
F	F	F	F				



**MECHANICAL DIMENSIONS**


**Warning**  
High Voltage is present at high side of each transformer, its core and the high side of the output connector pins, please provide at least 3 mm clearance (in all directions) on the component side of the board to any conductor when mounting



RangeMax™ StayLIT™

LXMG1645-24-53

24V Quad 5W CCFL Inverter Module

PRODUCTION DATA SHEET

NOTES

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