

DESCRIPTION

The LXMG1645-12-51 and LXMG1645-12-52 are Quad 5W Output CCFL (Cold Cathode Fluorescent Lamp) Inverter Modules specifically designed for driving 15" to 18" quad lamp LCD panels.

The inverters include two dimming inputs that provide brightness control, V_BRITE and P_BRITE. A voltage on V_BRITE pin adjusts the lamp current amplitude with 0V providing maximum brightness. The P_BRITE input accepts a low frequency PWM signal which directly controls the lamp drive waveform. This PWM RangeMAX™ Digital Dimming Technique provides flicker-free brightness control over a wide range (typically 50:1+).

The maximum output current is externally programmable using the SET₁ and SET₂ pins on the input connector over a range of 6mA to 7.5mA in 0.5mA steps.

This allows the inverter to be properly matched to a wide array of LCD panel lamp current specifications, a function which we call PanelMatch™.

In addition the inverter has a dedicated V_STATUS pin that indicates a fault has occurred such as an open or shorted lamp. V_STATUS is an open drain configuration whose output is low during normal operation. When one or more lamps sustain a fault the other lamp(s) will continue to operate and the V_STATUS pin will toggle high. This mode of operation during lamp(s) failure is called StayLIT™ since the panel is able to still remain on although at reduced brightness.

Other benefits of this new topology are stable fixed-frequency operation and secondary-side strike-voltage regulation.

KEY FEATURES

- StayLIT™ Redundancy
- PanelMatch™ Adjustable Output Current
- V_STATUS Fault Output
- Dual Brightness Control Inputs
- 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

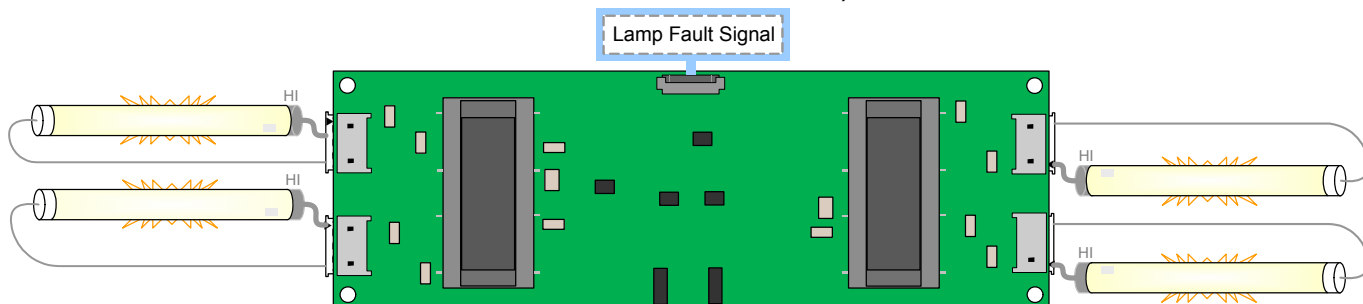
APPLICATIONS

- High Brightness Displays
- Desktop Displays
- Medical Monitors

BENEFITS

- Smooth, Flicker Free 10-100% Full-Range Brightness Control

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
LXMG1645-12-51
TWO DIMMING INPUTS - PWM AND V_{DC}, OR POTENTIOMETER


Lamp Current Programmable from 6mA to 7.5mA per Lamp in 0.5mA Steps

PACKAGE ORDER INFO

PART NUMBER	OUTPUT CONNECTORS	INVERTER MATES DIRECTLY TO PANEL CONNECTORS
LXMG1645-12-51	Four JST SM02(8.0) B-BHS-1-TB(LF)(SN) or Yeon Ho 20015WR-05A00 or equivalent connectors	JST BHR-03VS-1 or equivalent connectors
LXMG1645-12-52	Four JST SM02B-BHSS-1-TB(LF)(SN) or Yeon Ho 35001WR-02A00 or equivalent connectors	JST BHSR-02VS-1 or equivalent connectors

ABSOLUTE MAXIMUM RATINGS

Input Signal Voltage (V_{IN} , ENABLE).....	-0.3V to 15V
Input Signal Voltage (V_{STATUS} with Series Resistor).....	-0.3V to 30V
Input Power	26.4W
Output Voltage, No Load	1900V _{RMS}
Output Current (Each Output)	9.0mA
Output Power (Each Output)	6.0W
Input Signal Voltage (V_{BRITE} , P_{BRITE} , SET ₁ , SET ₂).....	-0.3V to 5.5V
Ambient Operating Temperature, Zero Airflow	-30°C to 85°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_{IN}	10.8	12	13.2	V
Output Power (Each Output)		P_O		3.6	5.5	W
DC BRITE Control Input Voltage Range		V_{BRT}	0		2.5	V
Direct Low Frequency PWM	Duty Control Range	F_{DUTY}	10		100	%
	Burst Frequency ¹	F_{PWM}	100	120	250	Hz
	Amplitude	V_{PWM}	3.0		5.5	V
	Rise/Fall Time	t_r, t_f	0		3	μs
Lamp Current (Full Brightness)		I_{O100}	6		7.5	mA _{RMS}
Lamp Operating Voltage		V_{LAMP}	510	600	690	V _{RMS}
Operating Ambient Temperature Range		T_A	-20		80	°C
Operating Humidity Range (Non-condensing)		RH_A	0		95	%

¹ Direct Low Burst PWM frequency should be selected such to not have optical interference. At input voltages below 12V the inverter may not be able to output the full 7.5mA_{RMS} at the maximum lamp voltage.

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; $V_{IN} = 12V$, $ENABLE \geq 2.1V$, $V_{BRITE} = 0V$ or 0Ω , $P_{BRITE} = 100\%$ or Open

Parameter	Symbol	Test Conditions / Comment	Min	Typ	Max	Units
OUTPUT CHARACTERISTICS						
Full Bright Lamp Current (Each Lamp)	$I_{OLMAXHH}$	SET ₁ = Open, SET ₂ = Open	7.0	7.5	8.0	mA _{RMS}
	$I_{OLMAXHL}$	SET ₁ = Open, SET ₂ = Ground	6.5	7.0	7.5	
	$I_{OLMAXLH}$	SET ₁ = Ground, SET ₂ = Open	6.0	6.5	7.0	
	$I_{OLMAXLL}$	SET ₁ = Ground, SET ₂ = Ground	5.5	6.0	6.5	
Full Dim Lamp Current (Each Lamp)	$I_{OLVMINH}$	SET ₁ = Open, SET ₂ = Open, $V_{BRITE} = 2.5V$		2.15		mA _{RMS}
	$I_{OLVMINHL}$	SET ₁ = Open, SET ₂ = Ground, $V_{BRITE} = 2.5V$		2.00		
	$I_{OLVMINLH}$	SET ₁ = Ground, SET ₂ = Open, $V_{BRITE} = 2.5V$		1.85		
	$I_{OLVMINLL}$	SET ₁ = Ground, SET ₂ = Ground, $V_{BRITE} = 2.5V$		1.65		
	$I_{OLPMINH}$	SET ₁ = Open, SET ₂ = Open, $P_{BRITE} = 10\%$		1.95		
	$I_{OLPMINHL}$	SET ₁ = Open, SET ₂ = Ground, $P_{BRITE} = 10\%$		1.80		
	$I_{OLPMINLH}$	SET ₁ = Ground, SET ₂ = Open, $P_{BRITE} = 10\%$		1.65		
	$I_{OLPMINLL}$	SET ₁ = Ground, SET ₂ = Ground, $P_{BRITE} = 10\%$		1.50		
Lamp Start Voltage (Each Lamp)	V_{L_STK0}	$T_A = 0^\circ C$, $V_{IN} > 10.8V$		1820		V _{RMS}
	V_{L_STK25}	$T_A = 25^\circ C$, $V_{IN} > 10.8V$		1720		V _{RMS}
Operating Frequency	F_O		45.5	47.5	48.0	kHz
V_{BRITE} Optical Dim Range	N:1_VBRT	Center Area Brightness, Full/Min, $T_A = 25^\circ$		43		Ratio
P_{BRITE} Optical Dim Range	N:1_PBRT	Center Area Brightness, Full/Min, $T_A = 25^\circ$		47		Ratio
Output Current Lamp to Lamp Deviation	$\Delta I_{OLm,n}$	$\frac{ I_{OLm} - I_{OLn} }{I_{OLm}}$ m = 1,2,3,4, n = 1~4 not m		5		%
V_{BRITE} INPUT, VDC						
Input Bias Current	I_{VBRT}	$V_{BRITE} = 0V$ or 0Ω		107		μA
		$V_{BRITE} = 2.5V$ or $50k\Omega$		52		
BRITE Adjust Voltage Range	V_{BRT}	I_{OLMAXx}		0	0.2	V
		$I_{OLVMINx}$		2.5		
	%BRT_PWM	Minimum P_{BRITE} Control Duty, $V_{BRITE} = 2.5V$		11	15	%
BRITE Adjust Resistor Range	$R_{BRT(k\Omega)}$	I_{OLMAXx}		0	2	k Ω
		$I_{OLVMINx}$		50		
	%BRT_PWM	Minimum P_{BRITE} Control Duty, $R_{BRITE} = 50k\Omega$	9	11	13	%
BRITE Burst Mode Frequency	F_{BRT_PWM}	$V_{BRITE} > 0.3V \leq 2.5V$	120	142	165	Hz
P_{BRITE} INPUT, PWM						
PWM High Level Amplitude	V_{PWMH}		3		5	V
PWM Low Level Amplitude	V_{PWML}		0		0.3	V

ELECTRICAL CHARACTERISTICS

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Parameter	Symbol	Test Conditions / Comment	Min	Typ	Max	Units
PWM Jitter	Jitter				3	μs
PWM Frequency Range	F _{PWM}		100	120	250	Hz
PWM Duty Range	% _{PWM}		10		100	%
ENABLE INPUT						
Disable OFF	V _{EN_OFF}		0		0.8	V
ENABLE ON	V _{EN_ON}		2.1		V _{IN}	V
Enable Bias Current	I _{EN_ON}	ENABLE = 2.1V (68kΩ Pull-up 12V _{IN})		150		μA
V _{IN} Quiescent Current	I _Q	ENABLE ≤ 0.8V		230		μA
POWER CHARACTERISITICS						
V _{IN} Under Voltage Lock Out Threshold	V _{IN UVLO}	V _{IN} Rising Edge		10.6		V
V _{IN} UVLO Hysteresis	V _{HYS}			350		mV
Supply Current	I _{RUN}	No Lamp Fault Condition, I _{LAMP} = 6.0mA		1.37	1.75	A
Supply Current During Fault Timeout	I _{FAULT}	All Four Lamps Open		32		mA
Efficiency	η	Load = 100kΩ Resistive Load	85	90		%
STRIKE TIMEOUT						
Strike (All Open Lamps)	T _{S_DWELL}	All Four Lamps Open		1650		ms
Open Lamp Output Voltage	V _{STK}			1650		V _{RMS}
V_STATUS PIN						
V_STATUS Pin Max Voltage	V _{STATUS_MAX}	750Ω ≥ Series Resistor to Voltage Source			30	V
V_STATUS Pin Leakage Current	I _{STATUS_LKG}	Fault, V_STATUS Pull-up 750Ω to V _{IN}		155		μA
V_STATUS Pin Max Sink Current	I _{STATUS_SNK}	No Fault, V_STATUS Pull-up 750Ω to V _{IN}	10	15.5	20	mA
V_STATUS Pin Voltage	VOL _{STATUS}	No Fault, V_STATUS Pull-up 750Ω to V _{IN}			0.4	V
V_STATUS Invalid Time Power ON	T _{STRIKE}	ENABLE to V_STATUS = LOW			2.5	sec
V_STATUS Pin Invalid Time In Run Mode	T _{D_FLT}	Open Lamp(s) to V_STATUS = high		150	275	ms
STRIKE MODE						
StayLIT™ Strike Time Period	T _{D_FLT}	Only One of Two Lamps Ignited on CN2 ~ CN3 or CN4 ~ CN5		750		ms
LAMP CURRENT DURING StayLIT™						
Max Lamp Current Of No-Fault Side (Open)	FIL1~4a	SET ₁ = Open, SET ₂ = Open, One Lamp Open	7.2	7.7	8.2	mA _{RMS}
	FIL1~4b	SET ₁ = Open, SET ₂ = Ground, One Lamp Open	6.7	7.2	7.7	
	FIL1~4c	SET ₁ = Ground, SET ₂ = Open, One Lamp Open	6.2	6.7	7.2	
	FIL1~4d	SET ₁ = Ground, SET ₂ = Ground, One Lamp Open	5.7	6.2	6.7	
Max Lamp Current Of No-Fault Side (Short)	FIL1~4a'	SET ₁ = Open, SET ₂ = Open, One Lamp Short	7.3	7.8	8.3	mA _{RMS}
	FIL1~4b'	SET ₁ = Open, SET ₂ = Ground, One Lamp Short	6.8	7.3	8.3	

ELECTRICAL CHARACTERISTICS

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Parameter	Symbol	Test Conditions / Comment	Min	Typ	Max	Units
	FIL1~4c'	SET ₁ = Ground, SET ₂ = Open, One Lamp Short	6.3	6.8	7.3	mA _{RMS}
	FIL1~4d'	SET ₁ = Ground, SET ₂ = Ground, One Lamp Short	5.8	6.3	6.8	
Min Lamp Current Of No-Fault Side (Open)	IL1~4e	SET ₁ = Open, SET ₂ = Open, $V_{BRITE} = 2.5V$, One Lamp Open		2.20		mA _{RMS}
	IL1~4f	SET ₁ = Open, SET ₂ = Ground, $V_{BRITE} = 2.5V$, One Lamp Open		2.05		
	IL1~4g	SET ₁ = Ground, SET ₂ = Open, $V_{BRITE} = 2.5V$, One Lamp Open		1.90		
	IL1~4h	SET ₁ = Ground, SET ₂ = Ground, $V_{BRITE} = 2.5V$, One Lamp Open		1.70		
Min Lamp Current Of No-Fault Side (Short)	IL1~4e'	SET ₁ = Open, SET ₂ = Open, $V_{BRITE} = 2.5V$, One Lamp Short		2.25		mA _{RMS}
	IL1~4f'	SET ₁ = Open, SET ₂ = Ground, $V_{BRITE} = 2.5V$, One Lamp Short		2.10		
	IL1~4g'	SET ₁ = Ground, SET ₂ = Open, $V_{BRITE} = 2.5V$, One Lamp Short		1.95		
	IL1~4h'	SET ₁ = Ground, SET ₂ = Ground, $V_{BRITE} = 2.5V$, One Lamp Short		1.87		

¹ ENABLE should be pull up from V_{IN} using 68k Ω , with open collector or open drain

FUNCTIONAL PIN DESCRIPTION

CONN	PIN	DESCRIPTION
CN1 (Molex 053261-1071 or equivalent)		
CN1-1, CN1-2	V_{IN}	Main Input Power Supply 10.8V to 13.2V
CN1-3, CN1-4	GND	Power Supply Return
CN1-5	ENABLE	ON/OFF Control. ON: Pull-Up 68k Ω from V_{IN} and OC or OD or $\geq 2.1V$, OFF: 0 ~ 0.8V
CN1-6	V_{BRITE}	Analog Brightness Control (0V to 2.5V), 0V = Full brightness, 2.5V = Min brightness Resistor 0 ~ 50k Ω (Max ~ Min brightness), No Connection to P_{BRITE} to Use V_{BRITE} Option
CN1-7	P_{BRITE}	Low Frequency Burst PWM Dimming Input, Connection to P_{BRITE} Overrides V_{BRITE} Option
CN1-8	V_{STATUS}	Fault Status Output: Normal State: Low, Fail State : High Open Drain (Internally Pulled up with 47k Ω to 5V)
CN1-9	SET ₁	SET ₁ MSB Connecting This Pin to Ground Decreases the Output Current
CN1-10	SET ₂	SET ₂ LSB Connecting This Pin to Ground Decreases the Output Current
CN2, CN3, CN4, CN5		
LXMG1645-12-51 (JST SM02(8.0)B-BHS-1-TB(LF)(SN) or Yeon Ho 20015WR-05A00 or equivalent)		
LXMG1645-12-52 (JST SM02B-BHSS-1-TB(LF)(SN) or Yeon Ho 35001WR-02A00 or equivalent)		
CN2-1 to CN5-1	LAMP _{Hi}	High Voltage Connection to High Side of Lamp. Connect to Lamp Terminal with Shortest Lead Length. DO NOT Connect to Ground.
CN2-2 to CN5-2	LAMP _{Lo}	Low Voltage Connection to Return Side of Lamp. Connect Lamp Terminal with Longer Lead Length. DO NOT 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.

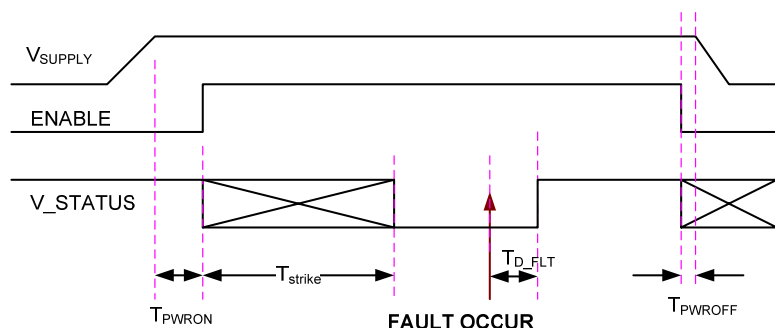
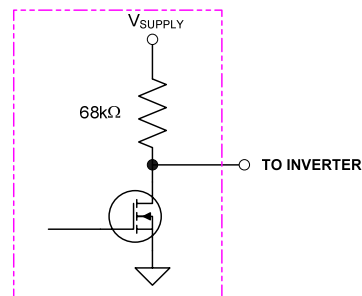
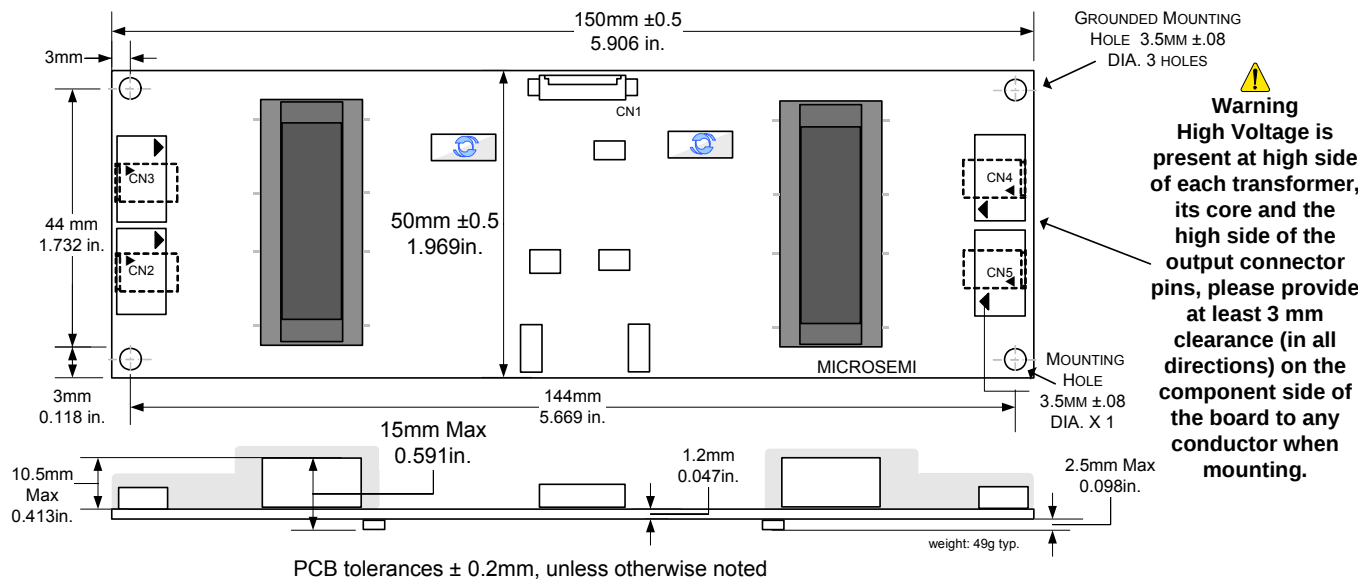
F means either **O**, **S1**, **S2**, or **S3** Fault Condition

N = Connected Lamp and Normal Operation

Fault Conditions				Inverter Operation	V_STATUS 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	ALL ON	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 ON , Including Affected Lamp in a Single S3 Fault Condition. An S1 Fault Will Typically Reduce Opposing Operational Lamp Current By 38%	Low to High	Low to High	Low to High
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				
F	F	F	F	ALL OFF			

OTHER FAULT PROTECTION OPERATION

Fault Condition	Protection Methods
Board Internal Short, V_STATUS always High and Operates or Fail Safe	Operates if Not Fault Shutdown, Fuse Protected if Over Current from V _{IN}


V_STATUS Timing Diagram

**ENABLE Interface from System Side
(Note¹ above)**
MECHANICAL DIMENSIONS




RangeMax™ StayLIT™ LXMG1645-12-5x

12V Quad 5W CCFL Inverter Module

PRODUCTION DATA SHEET

NOTES

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