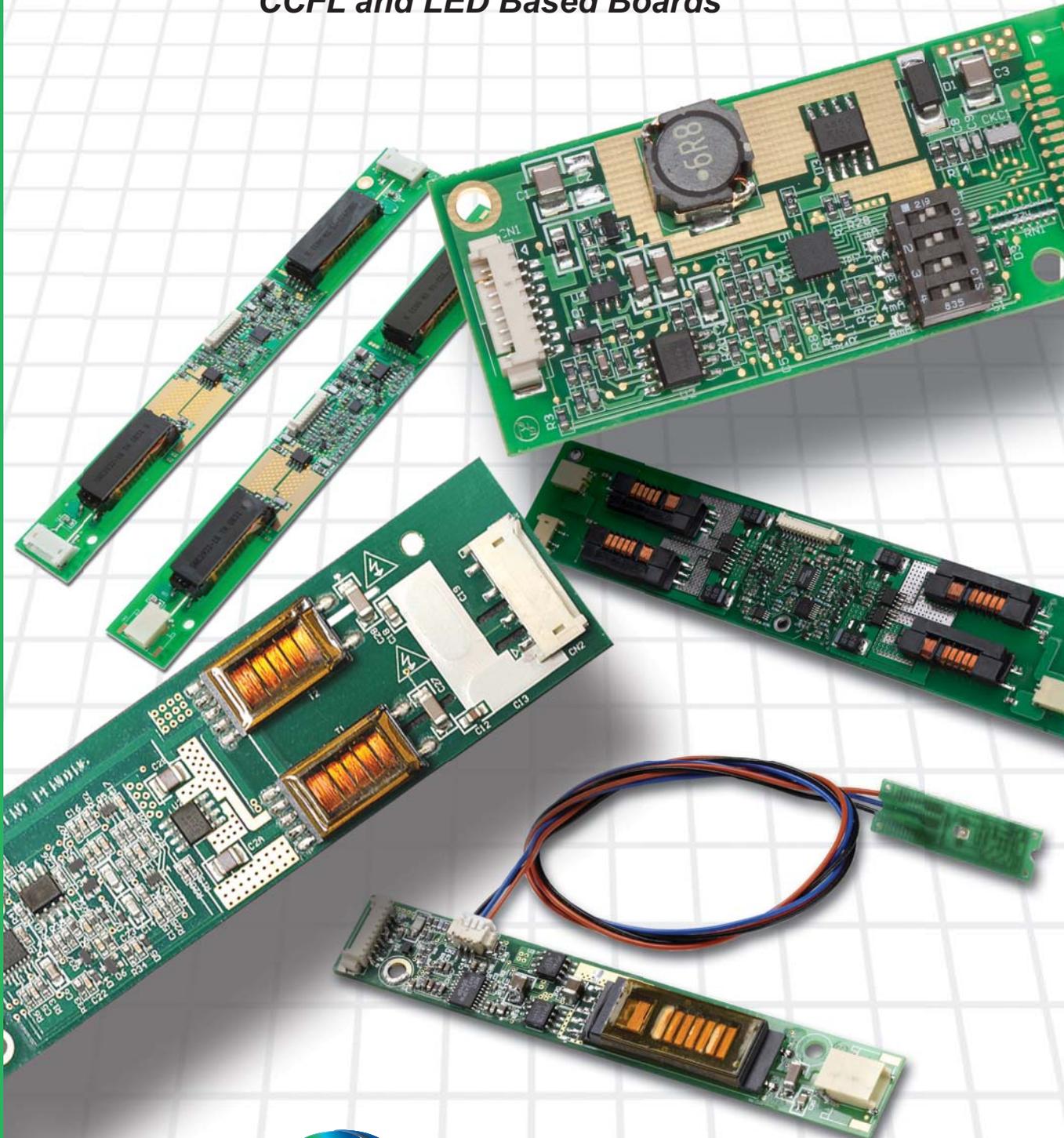


# Backlight System Solutions

*CCFL and LED Based Boards*



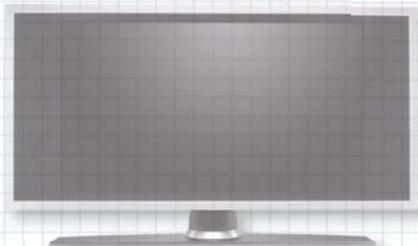
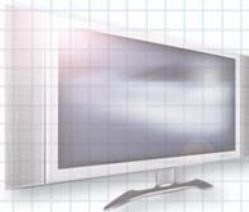
# Microsemi Analog Mixed-Signal Group

Microsemi Corporation is a leading manufacturer of high performance analog/mixed signal integrated circuits and high reliability semiconductors.

Microsemi's Analog Mixed Signal Group (AMSG) specializes in innovative light management solutions specifically targeting demanding CCFL or LED display requirements in Automotive, LCD TV, Monitors and Notebook backlit platforms.

## Contents

	<b>Microsemi High Performance System Solutions</b>	3
	<b>Microsemi High Performance CCFL System Solution Family</b>	3
	Product Offerings and Selector Guide	3
	Key Features	4
	Benefits	5
	<b>Microsemi High Performance LED System Solution Family</b>	6-7
	Product Offerings	6
	- LX1996 LED Driver	6
	- 6-String System Solution (LXMG1960-28-0x)	7
	Key Features & Benefits	7
	<b>Complementary Products: Visible Light Sensors</b>	8-10
	<b>Sales Support On-line Tools</b>	11
	Selector Guide	11
	LCD Panel-Microsemi Part Number Cross Reference	11
	New Products	11
	Competitive Pricing and Lead Times	11
	Sample Orders	11



# Microsemi High Performance System Solutions

Microsemi provides individual ICs or complete plug-in solutions that migrate its proven, IP-differentiated backlighting technology into a broad range of mid-sized panel designs. Microsemi system solutions are identified by product numbers like LXMGxxxx-xx-xx.

Ease of integration, design flexibility and a proven

operational and sales support structure all combined to deliver attractive cost-to-feature benefits of outstanding reliability, efficiency and service

Microsemi system solutions can be used with many 4- to 19-inch panel applications including medical, POS, kiosk, ATM, and lottery terminals.

## High Performance CCFL System Solution Family

Microsemi offers a whole portfolio of CCFL system solutions for single, dual and quad lamp CCFL backlit panels with features developed to support safe and robust operations, flexible design in and improved supply chain management. All designs are based on Microsemi patented CCFL drivers IC.

**• Single CCFL Lamp Panel backlight solutions:**

- Wide Range Digital Dimming: LXMG1617A-xx-xx
- Analog Range Dimming: LXMG1618A-xx-xx
- High Performance – Wide Input/Output Range: LXMG181x-xx-xx

- Automotive Grade Solution: LXMG1614E-14-11

**• Dual CCFL Lamp Panel backlight solutions:**

- Wide Range Digital Dimming: LXMG1627-xx-xx
- Analog Range Dimming: LXMG1628-xx-xx
- Common Lamp Return :LXMG1626-xx-6x
- StayLIT™: LXMG1626-xx-4x

**• Quad CCFL Lamp Panel backlight solutions:**

- Wide Range Digital Dimming: LXMG1643-xx-xx
- Analog Range Dimming: LXMG1644-xx-xx

Type	Typ V <sub>IN</sub> [V]	Range V <sub>IN</sub> [V]	V <sub>LAMP</sub> Range [V]	Typ I <sub>OLAMP</sub> [mA]	V <sub>LS</sub> [V] Min/Typ	Max Dimming	Operating Temp [°C]	Base PN	Status	DIMENSIONS (L,W,H) [mm]			
Single Lamp	3.3	[3.0 → 3.6]	[325,435]	3.5 to 5.0	1000/1200	<5:1 100:1	[-30,80]	LXMG1618A-03-2x	NEW - "A" Series	86 x 16 x 4.7			
			[465,635]	5.0 to 6.5	1300/1400	<5:1 100:1		LXMG1617A-03-2x					
			[545,735]	5.0 to 8.0	1500/1650	<5:1 100:1		LXMG1618A-05-2x					
	[475 → 5.50]	<b>[300,750]</b>	<b>4.0 to 7.0</b>	<b>1500/1650</b>	50:1	LXMG1617A-05-2x							
	[465,635]	5.0 to 6.5	1300/1400	<5:1 100:1	LXMG1618A-05-4x								
	[545,735]	5.0 to 8.0	1500/1650	<5:1 100:1	LXMG1617A-05-4x								
	5	[4.75 → 5.25]	[465,635]	5.0 to 6.5	1300/1400	<5:1 100:1		LXMG1618A-05-6x	NEW - "A" Series	100 x 16 x 7.5			
			[545,735]	5.0 to 8.0	1500/1650	<5:1 100:1		LXMG1617A-05-6x					
			[465,635]	5.0 to 6.5	1300/1400	<5:1 100:1		LXMG1811-05-6x / 6xS "LXMG181x" Series					
			[545,735]	5.0 to 8.0	1500/1650	<5:1 100:1		LXMG1618A-12-4x					
			[9.0 → 16.80]	<b>[300,750]</b>	<b>4.0 to 7.0</b>	<b>1500/1650</b>		50:1			LXMG1617A-12-4x		
			[9.0 → 16.0]	[500,1000]	3.8 to 8.8	/2000		100:1			LXMG1617A-12-6x		
Dual Lamp	5	[4.75 → 5.25]	[320,420]	5.0 to 6.0	1250/1400	100:1	[-30,80]	LXMG1614E-14-11	AUTOMOTIVE	130 x 23 x 8.5			
			[385,485]	5.0 to 6.5	1400/1600	50:1		LXMG1626-05-46	STAYLIT	113 x 30 x 6.5			
			[350,530]	5.0 to 6.5	1400/1600	50:1		LXMG1626-05-45	NEW	134 x 30 x 8			
			[450,610]	5.0 to 6.5	1400/1600	50:1		LXMG1627-05-4x	NEW	108.7 x 22.35 x 10.2			
			[460,620]	5.0 to 7.0	1450/1600	100:1		LXMG1627-05-44		133 x 25 x 7.5			
			[510,690]	5.0 to 7.0	1450/1600	100:1		LXMG1626-05-66	Active	133 x 25 x 7.5			
			[480,720]	5.0 to 8.0	1400/1500	50:1		LXMG1626-05-65	NEW	165 x 21 x 10			
			[1,1250]	3.5 to 5.0	1400/1650	50:1		[-30, 80]	LXMG1627-05-6x	NEW	165 x 21 x 7.5		
			[320,420]	5.0 to 6.0	1250/1400	100:1		[-30,80]	LXMG1626-12-64	Active	165 x 21 x 7.5		
			[385,485]	5.0 to 6.0	1250/1400	100:1		[-30,80]	LXMG1626-12-46	STAYLIT	113 x 30 x 6.5		
			[350,500]	6	1500/1650	50:1		[0,70]	LXMG1626-12-45	STAYLIT	113 x 30 x 6.2		
			[350,500]	6.5	1500/1650	50:1		[0,70]	LXMG1626-12-45	See LXMG1626-12-45 or LXMG1626-12-46	124 x 32 x 8.5		
	12	[10.8 → 13.2]	[350,530]	5.0 to 6.5	1250/1400	<5:1	[-30,80]	LXMG1624-12-4x	NEW	134 x 30 x 8			
			[450,610]	5.0 to 6.5	1400/1600	50:1		LXMG1627-12-4x		115 x 30 x 6.5			
			[460,620]	5.0 to 7.0	1450/1600	100:1		[-20,70]	LXMG1627-12-44	NEW	108.7 x 22.35 x 10.2		
			[470,640]	6	1500/1650	100:1		[0,70]	LXMG1626-12-66		Active	133 x 25 x 7.5	
			[480,720]	5.0 to 8.0	1500/1650	50:1		[-30,80]	LXMG1626-12-67	NEW	165 x 21 x 10		
			[500,750]	6.5	1350/1500	100:1		[0,70]	LXMG1628-12-6x	NEW	165 x 21 x 7.5		
			[510,690]	5.0 to 6.5	1450/1650	100:1		[-20,70]	LXMG1627-12-6x	NEW	165 x 21 x 7.5		
			[510,690]	7	1500/1650	100:1		[0,70]	LXMG1622-12 NRND	Consult Factory	124 x 32 x 7.6		
			[510,690]	5.0 to 6.5	1450/1650	100:1		[-20,70]	LXMG1621-01 NRND	See LXMG1626-12-65	124 x 32 x 8.5		
			Quad Lamp	12	[530,720]	5.0 to 8.0		1500/1650	<5:1	[-20,70]	LXMG1626-12-65	Active	133 x 25 x 7.5
					[530,730]	5.0 to 8.0		1500/1650	50:1		LXMG1644-12-61		188 x 36 x 8
					[530,730]	5.0 to 8.0		1500/1650	50:1		LXMG1643-12-61		
[530,730]	5.0 to 8.0	1500/1650			50:1	LXMG1643-12-62							
[530,730]	5.0 to 8.0	1500/1650			50:1	LXMG1643-12-63							
[530,730]	5.0 to 8.0	1500/1650			50:1	LXMG1643-12-64							

NRND-Not recommended for new designs

## Key Features

- **PanelMatch™** provides custom lamp current settings and simplifies supply chain management when multiple panels are used (perfect for distributors and integrators)
- **RangeMax™ digital dimming** (wide range dimming up to 100:1+) and analog dimming versions enhance user experience and extend lamp and battery life
- **Extended Operating Temperature Range** from -30 °C to +80°C available
- **Compact** direct drive design
- **Reliable and robust** designs with calculated MTBF of 100 years or more for a typical dual lamp system solution
- **RoHS, UL certified** components, UL60950 E175910
- **Universal Dimming Input:** the system solutions are designed to be driven by a PWM, a constant Voltage source or a Potentiometer depending on customer preference
- **Output Open/Short Circuit Protection** and Automatic Strike-Voltage Regulation and Timeout built-in to ensure safe operations
- **5V (digital dimming only) and 12V input** supply voltage, 4W and 6W maximum power outputs
- Available with **JST BHR-03VS-1, BHSR-02VS-1** output connectors or equivalent
- **Automotive-grade solution** (temperature range and strike capability) available through LXMG1614E-14-11 which integrates Microsemi patent awarded design

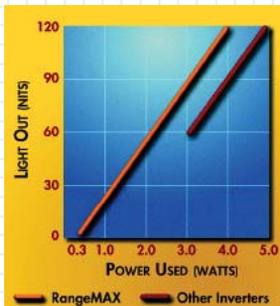
## Benefits

The products are designed with flexibility for customer in mind to minimize the number of SKUs necessary to support the very wide range of panel lamp configurations across different suppliers.

- **PanelMatch™** increases the customer supply chain effectiveness since the same Microsemi part can be used to drive panels with significantly different lamp current (in 1mA increments up to 3mA maximum difference).

### Examples of PanelMatch™ Programmable Output

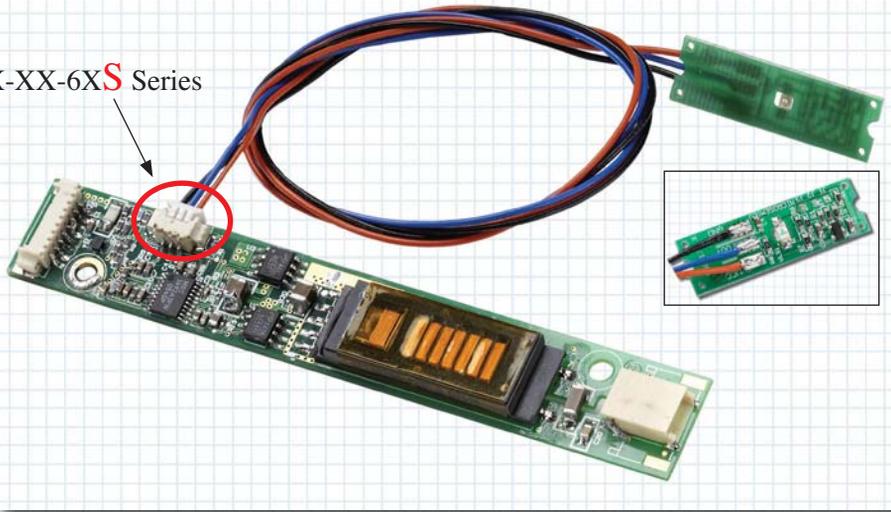
Output Characteristics	Symbol	Test Conditions	LXMG1627-12-6x			Units
			Min	Typ	Max	
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET1 = Ground, SET2 = Ground	4.4	5.0	5.6	mARMS
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET1 = Ground, SET2 = Open	5.4	6.0	6.6	mARMS
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET1 = Open, SET2 = Ground	6.4	7.0	7.6	mARMS
Full Bright Lamp Current (each output)	$I_{L(MAX)}$	SET1 = Open, SET2 = Open	7.4	8.0	8.6	mARMS



- **RangeMax™ Digital Dimming for Extended Lamp Life**  
RangeMax digital dimming technology provides smooth, jitter-free, wide-range brightness and advanced power management capability and reduces cost of ownership for the end system. This technology is proven to extend the lamp life as measured by light output at the end of the time period compared to the alternative amplitude adjustment method. The life extension depends on the dimming ratio used by the customer. A 100:1 digital dimming ratio can provide an 80-90% increased light output after 20k hours. Since the lamp is usually the first component needing replacement in a panel, this translates into direct ownership and warranty cost savings.

- **Our new high performance single lamp family (LXMG181x-xx-xx)** is designed to support a wide input voltage range (VIN) at Fully Regulated Lamp Current, and an enhanced Lamp Driving capability compared to the LXMG1617A/LXMG1618A.

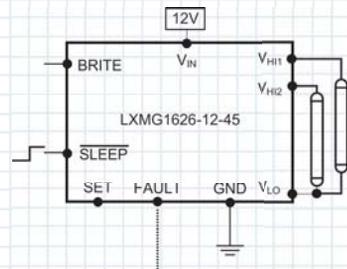
LXMG181X-XX-6XS Series



- **Wider Input/Output Voltage – Current** support to simplify the Supply Chain: fewer part numbers (4 instead of 24) to drive an extended list of displays thus greatly simplifying the customer supply change and minimizing the need for re-qualification and redesign of the backlight driving units in case a display is changed. Distributors and Integrators dealing with multiple displays will now be able to stock fewer parts to meet their needs.

- **Plug-n-Play Integration with Microsemi Visible Light Sensors**

The biggest advantage of the LXMG181X Series lies in its availability in a ready and easy to use kit (VEasyLIT): the customer can order the inverter (i.e. LXMG1811-05-61S) and a Light Sensor Board (LXMG1800\_LS) which can be hooked up to the inverter by simply joining the provided connectors. This small light sensor board can be mounted easily in the product's bezel with the addition of a small hole or light diffuser so ambient light can be detected. It includes user adjustable gain settings to adjust for the product's typical ambient light conditions.



Lamp(s) Status	FAULT	Inverter Operation
Normal Operation	Low	Normal full lamp current
One Lamp Open	High	Normal @ ~½ lamp current*
Both Lamps Open	High	Shutdown
One Lamp High Side Short to Ground	High	Normal @ ~½ lamp current*
Both Lamps High Side Short to Ground	High	Shutdown

- **StayLIT™ Fault Detection and Management Circuit** is available with the Dual Lamp CCFL Family LXMG1626-12-4x. A dedicated pin allows the module to detect an open/shorted lamp condition. In addition, when only one of the two lamps in the LCD fails open, the second lamp will continue to operate with a FAULT signal toggling to indicate the failed condition. Perfect for Medical/Industrial/Consumer Application where continued SAFE operation is key.

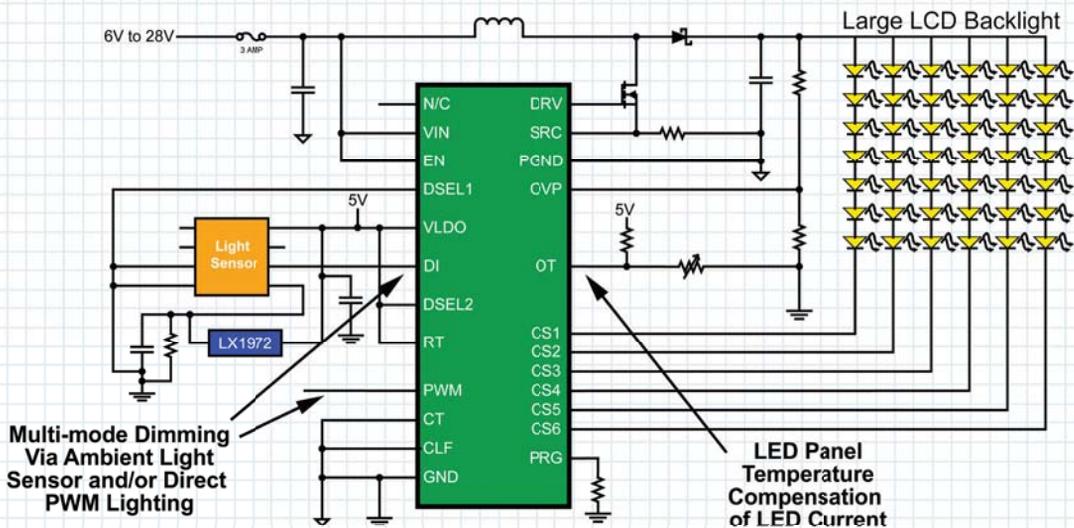
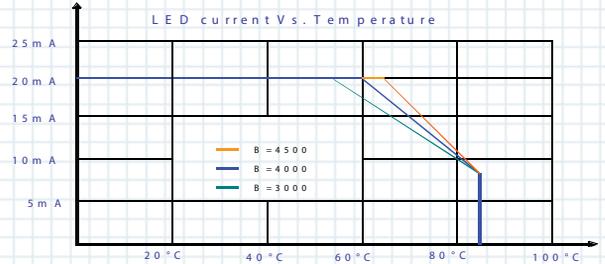


# High Performance LED System Solutions

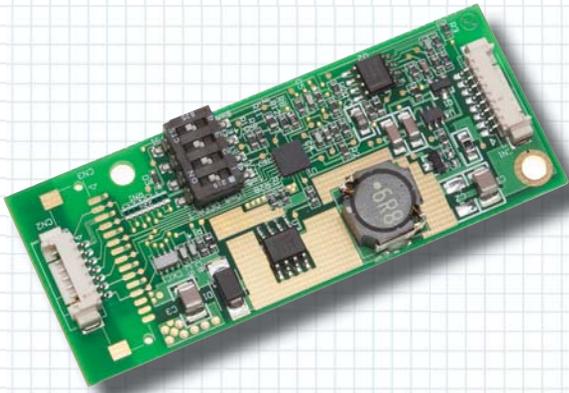
Microsemi is now giving customers easy access to its new LED driver IC, the LX1996™.

## LX1996™ LED Driver

- White LED Backlight Controller for 7"-14" size display panels
- Up to 6 LED strings with  $\pm 1.5\%$  precision current matching
- Wide input voltage range from 6.5V to 28V
- LED panel temperature compensation of LED current
- Direct Ambient Light Sensor Interface for brightness control
- Multi-mode dimming options by PWM and/or analog signal, including:
  - 25kHz direct digital, eliminating audible noise
  - Digital-to-analog or direct analog with low current ultrasonic PFM mode
  - Combined Direct analog and digital for up to 1000:1 dimming range
- Analog-to-digital with synchronizable internal clock
- High efficiency over full dimming range
- Low standby current to extended battery life
- On-chip thermal shut-down
- Over-voltage protection
- Short-circuit protection, eliminating the need for a fuse
- Packaged in a thermally efficient 24-pin 4x4mm MLPQ package



## LXMG1960-28-0x™ 6-String System Solution



The LX1996 is now integrated in an easy-to-plug-in 6-strings, wide input voltage driver system solution, identified by part number LXMG1960-28-0x.

Feature	LXMG1960-28-0X
LED Strings (up to)	6
Wide Input Voltage	4.75V-28V
Output voltage per string up to	35V
Current per String	25mA Max
Adjustable LED string current step for matching various panel requirements	10 - 25 mA in 1mA steps
Typical string to string current matching	1%
Dimming Method	Supports multiple methods of dimming such as DC voltage, PWM signal and potentiometer
Dimming Ratio	Combined Analog and Digital provides up to 1000:1 Dim ratio
Output LED short protection and over voltage protection	Available
Over temperature protection	Available

LXMG1960-28-01/03 module is a boost white LED driver for medium size LCD LED backlight panels. It is designed to drive up to six strings of LEDs to a maximum of 35V at up to 25mA per string.

The product consists of a boost converter and six programmable 10-25 mA precision current sinks. It is designed to work over a wide input voltage range (4.75V to 28V) for maximum flexibility. However the converter is a boost only design requiring the input supply voltage to not exceed the output LED string voltage.

The module includes two separate dimming inputs: BRITE\_A which adjusts the LED display brightness by controlling the amplitude of the LED string current, and BRITE\_D which allows direct PWM control of the string drive current. Either input can be used to control the panel brightness, or both can be used simultaneously to provide greater than 1000:1 dimming. The BRITE\_A input is very flexible and can be controlled by a PWM signal, the application of a DC control voltage or use of a potentiometer tied as a rheostat. The BRITE\_D input accepts a direct PWM signal in the range of 100 Hz to 25kHz with a minimum pulse width of 4μS. If only one PWM signal is available, the BRITE\_A and BRITE\_D inputs can be connected together and provide a very wide dimming range.

Precision current mirror circuitry typically provides for 1% percent string to string matching at the rated output current. The LXMG1960-28-0x includes over voltage protection (OVP), and short and open LED protection. If one string opens, its current sink will be disabled and the other strings will continue to operate normally. Likewise, if one or several LEDs in a string short, it will continue to operate, but if the entire string is shorted it will be disabled and the other strings will continue to function. With the use of an external thermistor the module can provide current fold-back in an over temperature situation.

The module comes in a small form factor PCB and uses an 8-pin input and one of two output connectors.

### Key Features & Benefits

- Drives up to 6-String LED panels
- Strings can be combined for higher current
- Wide input voltage 4.75V-28V
- String voltage up to 35V
- PanelMatch feature provides custom current settings and simplifies supply chain management when multiple panels are used (perfect for distributors and integrators). For this LED system solution the current level is selected in 1mA increments (from 10 to 25mA) through an on-board DIP switch.
- 1% typical string-to-string current matching
- Combined analog and digital dimming can provide for greater than 1000:1 ratio
- Supports multiple methods of dimming such as DC voltage, PWM signal and potentiometer
- Over voltage protection
- LED temperature protection input

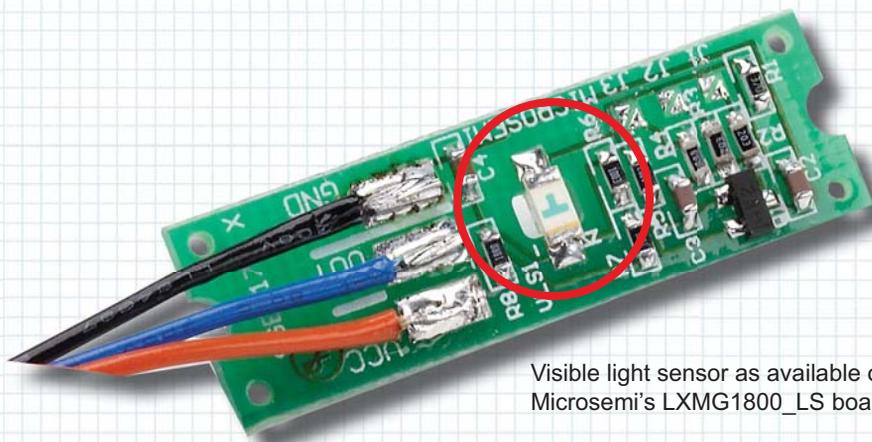
# Complimentary Products: Visible Light Sensors

All Microsemi system solutions can be interfaced with Microsemi patented Visible Light Sensor products to sense ambient light and adjust backlight intensity accordingly. Adjusting the backlight brightness automatically and optimally extends battery and lamp life. Microsemi Light Sensors are designed to match the human eye response and ignore UV or IR components. They are ideal for applications like cars, kiosks, POS, medical displays.

## Visible Light Sensors Selector Guide

Part Number Package	Useful Light Range (Lux)	Light Output Function	Output Topology	Input Supply Range	Output Current @ 100 Lux	Properties / Applications
LX1970 MSOP-8	< 1 - 1.2K	Linear	Current Sink and Current Source vs. Light	2V - 5.5V	~38µA	General purpose sensor for illumination and display control applications.
LX1971 MSOP-8	< 1 - 15K	Square Root	Current Sink and Current Source vs. Light	3V - 5.5V	~10µA	Wide dynamic range with extreme sensitivity at low ambient light conditions.
LX1972 1206	< 1 - 5K	Linear	Two Terminal Current Source vs. Light	2V - 5.5V	~10µA	Low cost, small size, high performance general purpose "human eye" response sensor. Packaged for top light applications.
LX1974 1206	< 1 - 5K	Linear	Two Terminal Current Source vs. Light	2V - 5.5V	~10µA	Same as LX1972, but with tape-and-reel orientation for bottom light applications.
LX1972A 1206	< 1 - 5K	Linear	Two Terminal Current Source vs. Light	2V - 5.5V	~10µA	Patented <i>Best Eye</i> ™ technology provides near perfect immunity to non visible light spectra. Applications demanding superior IR and UV immunity.
LX1973 MSOP-8	.01 - 500	Quarter Root	Current Source vs. Light	4.5V - 5.5V	380µA	High precision in ultra low lighting conditions. Internal dark current cancellation.
LX1973A MSOP-8	.01 - 500	Quarter Root	Current Source vs. Light	4.5V - 5.5V	360µA	High precision in low lighting. Includes <i>Best Eye</i> ™ for superior IR and UV immunity.
LX1973B MSOP-8 (Lens)	.005 - 400	Quarter Root	Current Source vs. Light	4.5V - 5.5V	410µA	High precision in low lighting. Includes <i>Best Eye</i> ™ for superior IR and UV immunity. 60% dark current reduction over the LX1973A.

IMPORTANT: For the most current data, consult Microsemi's website: <http://www.microsemi.com>  
Protected By U.S. Patents: 6,787,757; Patents Pending



Visible light sensor as available on Microsemi's LXMG1800\_LS board

The LX1972 and the LX1972A are low cost silicon light sensors with spectral response that closely emulates the human eye.

The LX1972A provides improved spectral response using Microsemi's BestEye™ technology. Patented circuitry produces peak spectral response at 520nm, with IR response less than ±5% of the peak response, about 900nm.

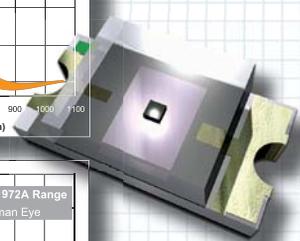
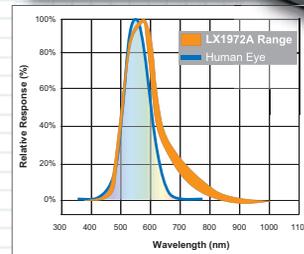
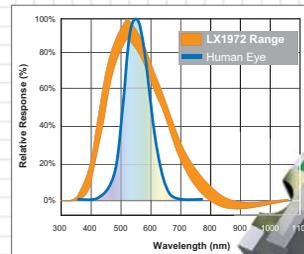
The photo sensor is a pin diode array with a linear, accurate, and very repeat-able current transfer function. High gain current mirrors on the chips multiply the PIN diode photo-current to a sensitivity level that can be voltage scaled with a standard value external resistor. Output current from these simple to use two-pin devices can be used directly or converted to a voltage by placing it in series with a single resistor at either of its two pins.

Internal temperature compensation allows dark current to be kept below 200nA over the full specification temperature range (-40°C to +85°C) providing high accuracy at low light levels. Usable ambient light condition range is from 1 lux to more than 5000 lux.

### Key Features

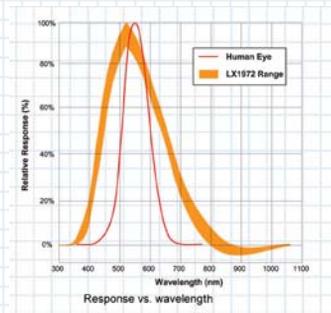
- Near human-eye spectral response - LX1972
- Nearly perfect Best Eye human-eye spectral response - LX1972A
- Very low IR sensitivity
- Highly accurate & repeatable output current vs. light
- Scalable output voltage
- Temperature stable
- Integrated high gain photo current amplifiers
- No optical filters needed
- Tiny 1206 package

# LX1972 LX1972A



# LX1974

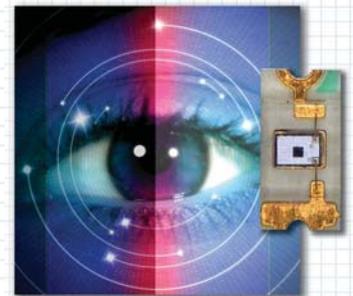
The LX1974 light sensor provides a spectral response that closely emulates the human eye. Patented circuitry produces peak spectral response at 520nm, with IR response less than ±5%, of the peak response, above 900nm. The photo sensor is a PIN diode array with a linear, accurate, and very



repeatable current transfer function. High gain current mirrors on the chip multiply the PIN diode photo-current to a sensitivity level that can be voltage scaled with a standard value external resistor.

Output current from this simple to use two-pin device can be used directly or converted to a voltage by placing it in series with a single resistor at either of its two pins. Dynamic range is determined by the resistors (typically in the range

of 10K to 100K) and power supply values. Typically the LX1974 needs only 1.8V of headroom to operate at 1000 Lux illumination. Internal temperature compensation allows dark current to be kept below 200nA over the full specification temperature range (-40 to +85°C), providing high accuracy at low light levels. Usable ambient light conditions range is from 1 to more than 5000 Lux.



### Key Features

- Near human-eye spectral response
- Very low IR sensitivity
- Highly accurate & repeatable output current vs. light
- Scalable output voltage
- Temperature stable
- Integrated high gain photo current amplifiers
- No optical filters needed

# LX1973A LX1973B

The LX1973B is a very wide dynamic range light sensor that improves on the low-level sensitivity of Microsemi's popular LX1973A. Like the LX1973A, the LX1973B also incorporates Microsemi's patent-pending Best Eye technology for the highest performance human-eye spectral response available in the market today. In addition, the LX1973B extends the low-level sensitivity down to unprecedented levels using an innovative dome-lens package and unique dark-current cancellation technology. Users can expect to resolve changes in ambient light to 0.001 lux and below. No other sensor on the market combines the five-decade dynamic range, low-level sensitivity, and rock-solid thermal and spectral response of the LX1973B.

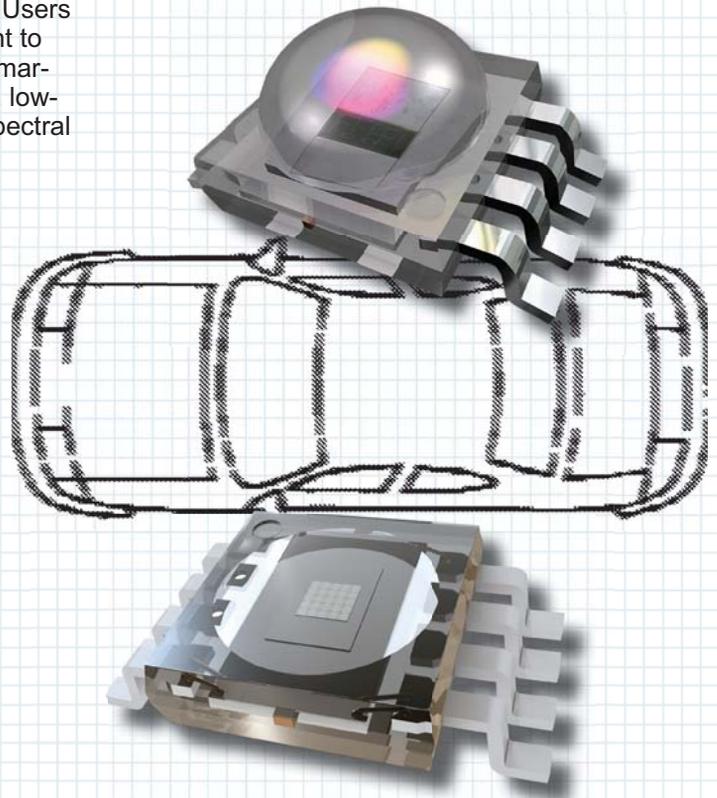
## Key Features

- Nearly perfect Best Eye human-eye spectral response
- 25 °C dark current < 0.005 lux
- Five-decade compressed output
- 15% accuracy over temperature
- Scalable output voltage
- No optical filters needed

## Perfect for Automotive Applications

### Applications

- Auto Headlamp Control
- Auto Mirror Contrast Control



# Sales Support On-line Tools

*Significant support and information is always available and updated on-line at [www.microsemi.com](http://www.microsemi.com)*

## **Selector Guide**

- A family selector guide is always available at:  
<http://www.microsemi.com/inverters/CCFLSelectorGuide.pdf>
- The on line version links directly to the products datasheets
- Laminated copies are available

## **LCD Panel-Microsemi Part Number Cross Reference**

- Once the customer selects the LCD panel, the recommended Microsemi system solution part can be found at:  
<http://www.microsemi.com/products/backlight/overview.asp>
- Should the panel not be listed please contact your sales representative directly

## **New Products specific on-line information**

- <http://www.microsemi.com/newDualLampCCFL.asp>
- <http://www.microsemi.com/newSingleCCFL.asp>

## **Competitive Pricing and Lead Times**

- Please contact your sales representative

## **Sample Orders**

- Please contact your sales representative or use  
<http://www.microsemi.com/store/request.asp?REQTYPE=SAMPLE>



***Microsemi***<sup>®</sup>

Microsemi Corporation  
Analog Mixed Signal Group  
11861 Western Avenue  
Garden Grove, CA. 92841,  
714-898-8121  
Fax: 714-893-2570

**[www.microsemi.com](http://www.microsemi.com)**