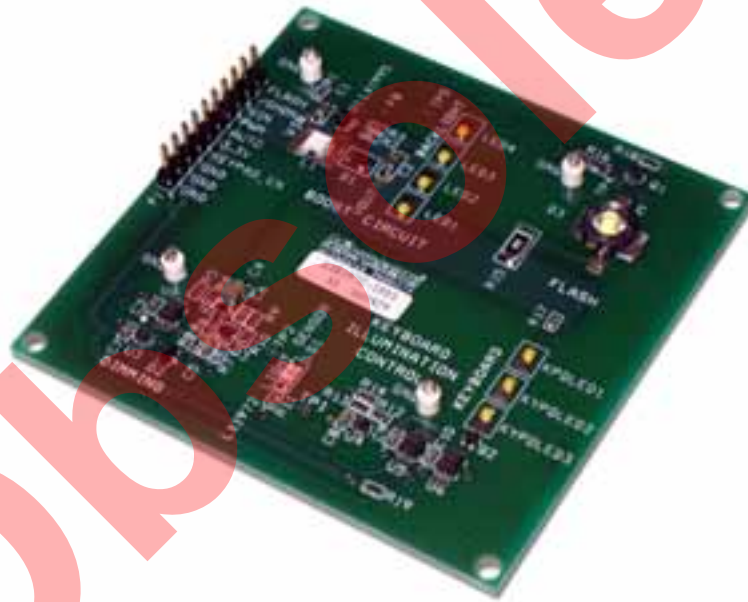


PDA SMART PHONE LED POWER MANAGEMENT EVALUATION BOARD LX1972 & LX1995



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TM

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Obsolete

INTRODUCING TO PRODUCT

This evaluation board demonstrates several LED power management evaluation circuits. The LX1995 LED driver IC is used in conjunction with the LX1972 Light Sensor to provide a LCD backlight that is variable with ambient light. The backlight sensitivity to ambient light can be adjusted using the PWM input signal [PWM]. The effect of the light sensor can be removed by changing the logic state of the [AUTO] signal. With AUTO in a logic low state, the LCD backlight is variable with the PWM input, but the effect of the light sensor is disabled.

The evaluation board also provides the capability to provide power to a camera flash LED. During the period when the flash is enabled, the LCD backlight is off, however, this may not be an issue since the shutter speed is relatively fast when the image is being captured. The flash LED can be a single Luxeon type LED (as shown) or could alternatively be several medium power high brightness LEDs wired in series (this option must be added on by the evaluation board user).

The evaluation board (in AUTO mode) also provides a means to sense when there is sufficient ambient light to view the keyboard so that the keyboard LEDs can be held off when the KEYBOARD ENABLE signal is high to conserve power. This effect is overridden if AUTO is a logic low. In total darkness, the Keyboard LEDs will illuminate when the KEYBOARD ENABLE signal is high, regardless of the state of the AUTO logic signal.

This evaluation board contains several discrete logic gates that may be implemented in programmable logic in the final product. Without the discrete logic devices, the circuitry needed to implement these functions is quite small in size.

The LX1995-2 is well suited for this application, because it is capable of driving loads up to 1.25 watts from a lithium ion battery. The fixed feedback voltage node of the LX1995 is suitable for switching between feedback from two different current sense resistors. If more power is necessary, consult Microsemi for higher power LX1995 versions.

KEY FEATURES

LX1972

- 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

LX1995

- < 1 μ A Shutdown Current
- > 85% Maximum Efficiency
- Efficient at Low Current Levels
- < 70 μ A Quiescent Supply Current in Operating Mode
- V_{IN} Range 1.6V to 5.5V
- Logic Controlled Shutdown
- Dimming Options: PWM or Varying DC Voltage
- Tiny 5-Pin TSOT Package
- Smallest External Components

APPLICATIONS

LX1972

- Portable Electronic Displays
- LCD TV Backlight Systems
- Digital Still Cameras (DSC)
- Desk top Monitors
- Notebook Computers

LX1995

- Pagers
- Wireless Phones
- PDAs
- LED Driver
- Digital Camera Displays
- GPS Receivers

PART SPECIFIC INFORMATION

Part Number	Product	Description
LX1972IBC	Ambient Light Detector	In 1206 package.
LX1995-1CSG	Miniature LED Driver	325mA Switch Current in 5-Pin TSOT package
LX1995-2CSG	Miniature LED Driver	500mA Switch Current in 5-Pin TSOT package
LX1995-1CSE	Miniature LED Driver	325mA Switch Current in 5-Pin SOT-23 package
LX1995-2CSE	Miniature LED Driver	325mA Switch Current in 5-Pin SOT-23 package

TABLE 1 – PART INFORMATION

EVALUATION BOARDS	
LX1972-1995 EVAL KIT	LX1995 LED driver using LX1972 Light Sensor.

TABLE 2 – EVALUATION BOARD INFORMATION

SCHEMATIC FOR LX1972-1995

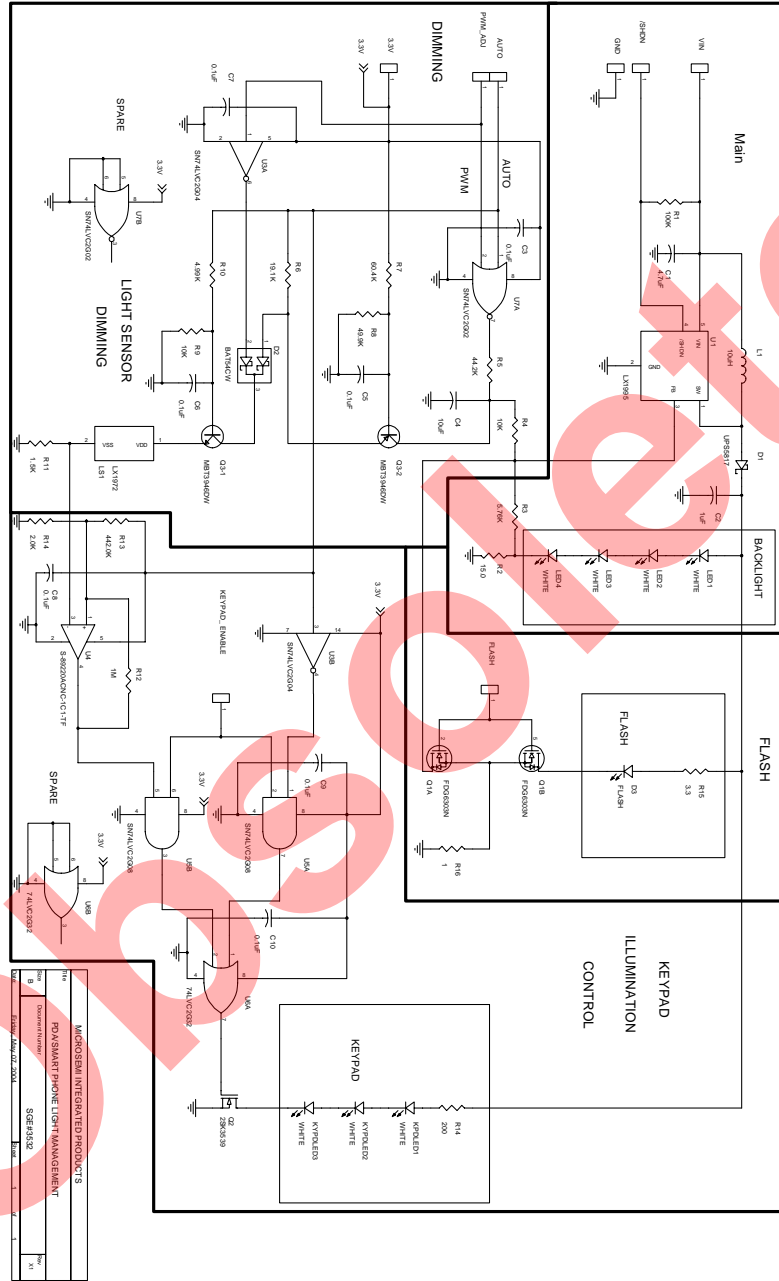


Figure 1 – LX1972-1995 EVAL KIT Schematic

P1 PIN DEFINITIONS: (REFER TO FIG.1)

PIN1-3 GND	Negative power terminals or can be used to GND scope probes.
PIN4 KEYPAD_EN	Has PULL UP resistor. Tie logic level LO to disable keypad LED's
PIN5 3.3V	Positive 3.3V power terminal LOGIC gates
PIN6 Auto	Pull Logic level HI to enable Light sensor dimming. Tie to Logic level LO. For PWM dimming only.
PIN7 PWM	Apply 10Khz , 3.3V dimming signal and vary duty cycle to adjust level
PIN8 V _{IN}	Positive power terminal for LED Driver
PIN9 /SHDN	Pull logic LO to disable the WHITE LED driver
PIN10 FLASH	Pull logic HI to enable Flash LED(D3)

TEST POINT DEFINITIONS: (REFER TO FIG.1)

FB	Feedback pin of the LED driver
V _{IN}	Positive power terminal to the LED driver
V _{OUT}	Output voltage of the LED driver
TP1	VSS pin of the LX1972 light sensor
TP2	VDD pin of the LX1972 light sensor
TP3	Collector of the PNP transistor of package Q3
TP4	Measure Flash LED current. Tied to R16(1 ohm). Divide voltage by 1.
TP5	Measure the current in the Backlight LED's. Take voltage and divide by 15

LX1972-1995 EVAL KIT Hook Up*Example 1: PWM Backlight Dimming*

1. Apply +3.7V between V_{IN} and GND
2. Tie Auto pin LO
3. Apply +3.3V between 3.3V and GND

4. Connect Pulse generator between PWM and GND
5. Vary duty cycle and monitor TP5 voltage and convert to current by Dividing voltage by 15.

Example 2: PWM Backlight AUTO Dimming

1. Apply +3.7V between V_{IN} and GND
2. Tie Auto pin HI
3. Apply +3.3V between 3.3V and GND
4. Connect Pulse generator between PWM and GND.
5. Set duty cycle.
6. Using a calibrated light source and position over the light sensor aperture. Then vary the ambient light.
7. Monitor TP5 and convert to current by dividing by 15.

Example 3: Flash

1. Apply +3.7V between V_{IN} and GND
2. Apply +3.3V between 3.3V and GND
3. Connect P1 Flash pin to +3.3V by jumper
4. Measure current by monitoring TP4 and dividing voltage by 1.

Example 4: Keypad Light Sensor Control

1. Apply +3.7V between V_{IN} and GND
2. Apply +3.3V between 3.3V and GND
3. Let KEYPAD_EN float
4. Tie Auto HI
5. Tie PWM HI
6. Cover light Sensor aperture and see keyboard LED's come on.

LX1972-1995 PRINTED CIRCUIT BOARD LAYOUT

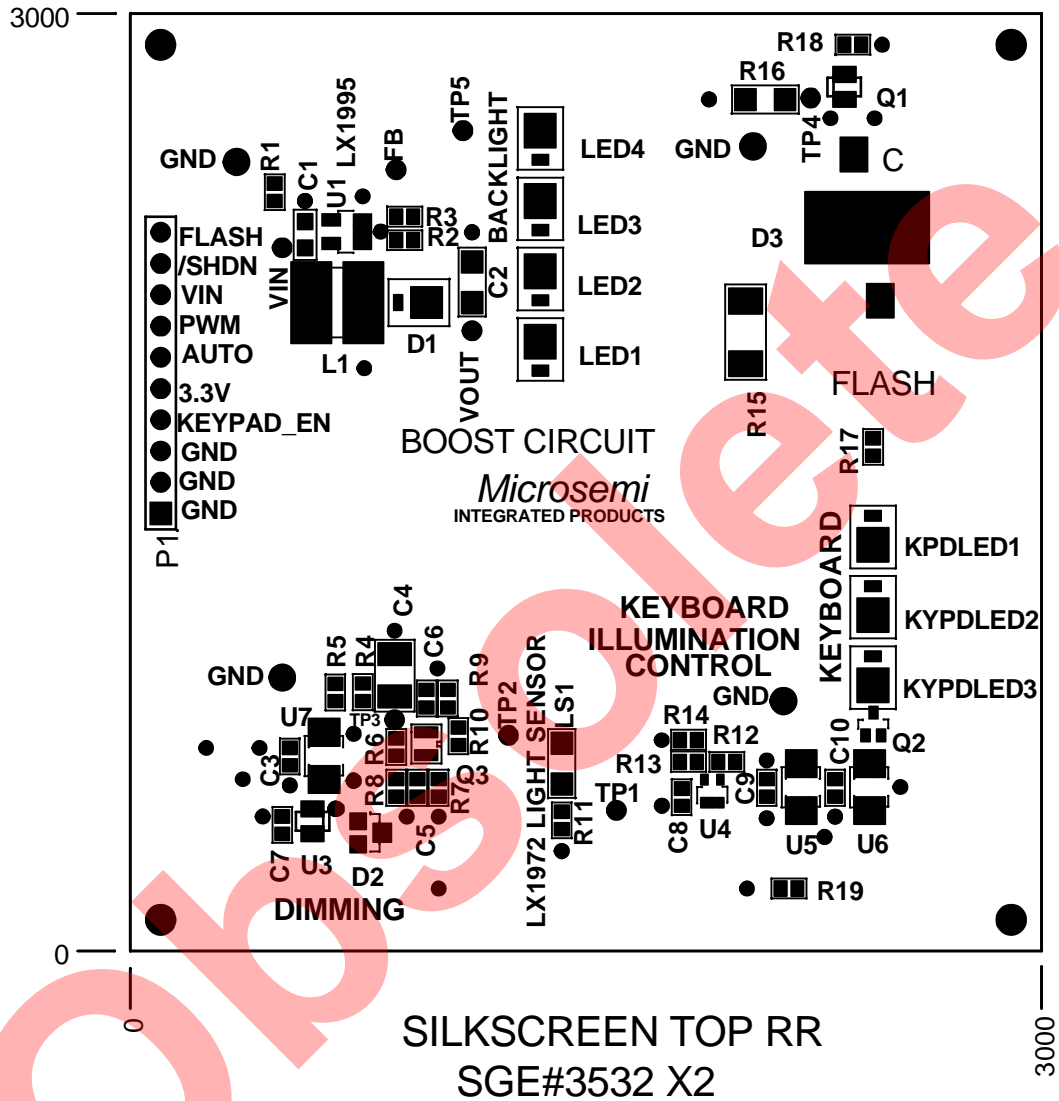


Figure 2 – Top Side LX1972-1995 EVAL KIT silkscreen

LX1972-1995 CHARACTERISTIC CURVES

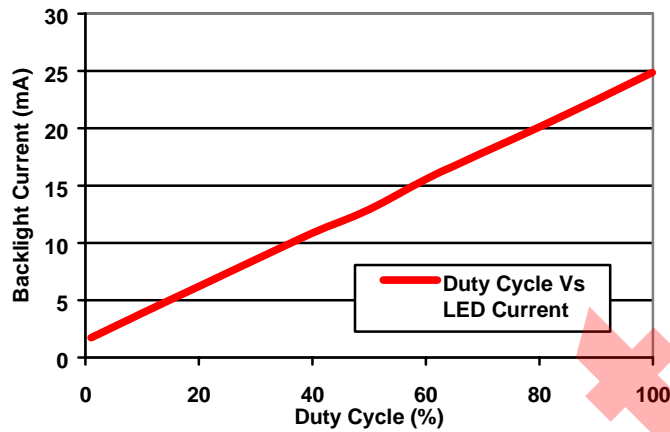


Figure 3 – Duty Cycle versus LED Current

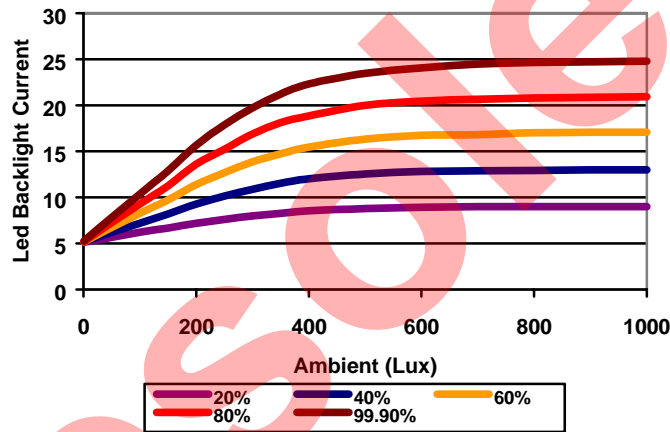


Figure 4 – Ambient Light

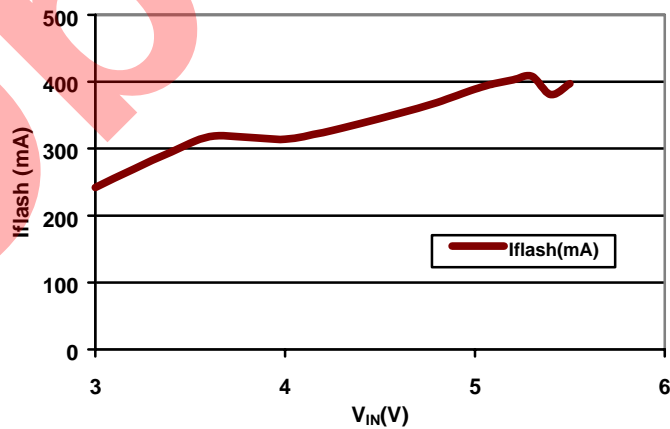


Figure 5 – VIN versus I flash

Dimming Mode		
Duty Cycle (%)	VSNS(mV)	ISNS (mA)
1	26	1.733
10	58	3.968
20	93	6.2
30	128	8.533
40	163	10.867
50	194	12.933
60	233	15.533
70	268	17.867
80	302	20.133
90	337	22.467
99.9	373	24.867

PDA / Smart Phone Evaluation PCB Dimming Data

PDA Smart Phone Flash Regulation	
V _{IN} (V)	I flash (mA)
3.0	242
3.2	269
3.4	295
3.6	318
3.8	317
4.0	314
4.2	324
4.4	338
4.6	353
4.8	369
5.0	389
5.1	397
5.2	403
5.3	408
5.4	381†
5.5	397

† LX1995 Stops switching at this point

PWM Dimming Auto Mode										
Amb (LUX)	DC 20%		DC 40%		DC 60%		DC 80%		DC 99.9%	
	V _{SN} (mV)	I _{SNS} (mA)	V _{SN} (mV)	I _{SNS} (mA)	V _{SN} (mV)	I _{SNS} (mA)	V _{SN} (mV)	I _{SNS} (mA)	V _{SN} (mV)	I _{SNS} (mA)
1	77.3	5.153	77.6	5.173	77.8	5.187	78.2	5.213	79	5.267
50	85	5.667	93	6.2	101	6.733	109	7.267	117	7.8
100	93	6.2	108	7.2	124	8.267	139	9.267	155	10.333
150	100	6.667	123	8.2	146	9.733	169	11.267	193	12.867
200	108	7.2	139	9.267	171	11.4	204	13.6	235	15.667
250	114	7.6	152	10.133	190	12.667	228	15.2	268	17.867
300	120	8	163	10.867	208	13.867	253	16.867	296	19.733
350	124	8.267	173	11.533	221	14.733	272	18.133	318	21.2
400	128	8.533	180	12	232	15.467	283	18.867	335	22.333
500	132	8.8	188	12.533	245	16.333	300	20	352	23.467
600	134	8.933	192	12.8	251	16.733	307	20.467	361	24.067
700	135	9	193	12.867	252	16.8	310	20.667	367	24.467
800	135	9	194	12.933	255	17	312	20.8	370	24.667
900	135	9	195	13	256	17.067	313	20.867	371	24.733
1000	135	9	195	13	256	17.067	314	20.933	372	24.8

LX1972-1995 BILL OF MATERIALS

MISCELLANEOUS COMPONENTS

Line Item	Part Description	Manufacturer & Part #		Case	Reference Designators	Qty
1	Mini White LED Driver	MICROSEMI	LX1995-1SC	TSOT	U1	1
2	Visible Light Sensor	MICROSEMI	LX1972	1206	LS1	1
3	Schottky Diode: 1A, 20V	MICROSEMI	UPS5817	PWR	D1	1
4	LED: White	MICROSEMI	UPLD		KPDLED1, KYPDLED2, KYPDLED3, LED1, LED2, LED3, LED4	7
5	Dual Schottky Diode: 30V, 200mA	DIODES INC	BAT54CW	SOT23	D2	1
6	LED, SMT White: Flash	LUXEON			D3	1
7	Inductor 47µF, Low Profile Power Wafer	COILCRAFT	LPO3310-473MX		L1	1
8	MOSFET N-Channel	PANASONIC	2SK3539	SMINI	Q2	1
9	FET Dual N-Channel	FAIRCHILD	FDG6303N	SC70	Q1	1
10	Dual Transistor NPN & PNP	ON SEMI	MBT3946DW1T1	SOT363	Q3	1
11	Test Point White Loop	KEYSTONE	5007		GND	4
12	IC CMOS Single Comparator 10µA	SEIKO INST.	S-89220ACNC-1C1-TR	SC70	U4	1
13	IC Dual Inverter	TI	SN74LVC2G04DCKR	SC70	U3	1
14	IC Dual 2 Input AND Gate	TI	SN74LBC2G08DCTR	MSOP	U5	1
15	IC Dual 2 Input OR Gate	TI	SN74LVC2G32DCTR	MSOP	U6	1
16	IC Dual 2 Input NOR Gate	TI	SN74LVC2G02DCTR	MSOP	U7	1
17	10 Pin .100 Straight Header				P1	1

CAPACITORS

Line Item	Part Description	Part Description	Case	Reference Designators	Qty
1	Capacitor, X5R, 6.3V, 4.7µF, 10%	TAIYO YUDEN JMK212BJ475KG	0805	C1, C2	2
2	Capacitor, X7R, 16V, 0.1µF, 10%	PANASONIC ECJ1VB1C104K	0603	C3, C5, C6, C7, C8, C9, C10	7
3	Capacitor, X5R, 20%, 10µF, 20%	TAIYO YUDEN EMK325BJ106MN	1210	C4	1

RESISTORS

Line Item	Part Description	Part Description	Case	Reference Designators	Qty
1	Resistor, 100K, 5%, 1/10W	ROHM MCRO3EZPJ104	0603	R1	1
2	Resistor, 150hm, 1%, 1/10W	ROHM MCRO3EZPF15R0	0603	R2	1
3	Resistor, 5.76K, 1%, 1/10W	ROHM MCRO3EZPJ5761	0603	R3	1
4	Resistor, 10K, 5%, 1/10W	ROHM MCRO3EZPJ103	0603	R4, R9	2
5	Resistor, 44.2K, 1%, 1/10W	ROHM MCRO3EZPJ4422	0603	R5	1
6	Resistor, 19.1K, 1%, 1/10W	ROHM MCRO3EZPF1912	0603	R6	1
7	Resistor 60.4K, 1%, 1/10W	ROHM MCRO3EZPF6042	0603	R7	1
8	Resistor, 49.9K, 1%, 1/10W	ROHM MCRO3EZPF4992	0603	R8	1
9	Resistor, 4.99K, 1%, 1/10W	ROHM MCRO3EZPF4991	0603	R10	1
10	Resistor, 1.5K, 5%, 1/10W	ROHM MCRO3EZPJ152	0603	R11	1
11	Resistor, 1M, 5%, 1/10W	ROHM MCRO3EZPJ105	0603	R12	1
12	Resistor, 442K, 1%, 1/10W	ROHM MCRO3EZPF4423	0603	R13	1
13	Resistor 2K, 1%, 1/10W	ROHM MCRO3EZPF2001	0603	R14	1
14	Resistor, 3.30hm, 5%, 1/2W	PANASONIC ERJ-12ZYJ3R3U	2010	R15	1
15	Resistor, 10hm, 5%, 1/4W	PANASONIC ERJ-8RQJ1R0V	1206	R16	1
16	Resistor, 2000hm, 5%, 1/2W	PANASONIC ERJ-12ZYJ201U	2010	R17	1

LX1972 Protected by U.S. Patents: 6,787,757: Patents Pending