LSI/CSI

LS6501LP

A3800

LSI Computer Systems, Inc. 1235 Walt Whitman Road, Melville, NY 11747 (631) 271-0400 FAX (631) 271-0405

PIR SENSOR INTERFACE

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FEATURES:

- Low Quiescent Current
- Direct Interface with PIR Sensor
- Two-Stage Differential Amplifier
- Amplifier Gain and Bandwidth externally controlled
- Window Comparator and Digital Filter limit Noise
- Triac or Relay Output Drive
- Programmable Output Duration Timer
- Ambient Light Level Inhibit input
- Selectable Dead Time
- Single or Dual Pulse Detection
- Timing derived from RC Oscillator or 50Hz/60Hz AC
- Regulated 5V Output for PIR Sensor
- Motion Detection LED Indicator
- Triac can drive Incandescent or Fluorescent Lamps
- LS6501LP (DIP), LS6501LP-S, -SW (SOIC)-See Figure 1

APPLICATIONS:

- Automatic Light Control
- Intrusion Alarm

PIN ASSIGNMENT - TOP VIEW

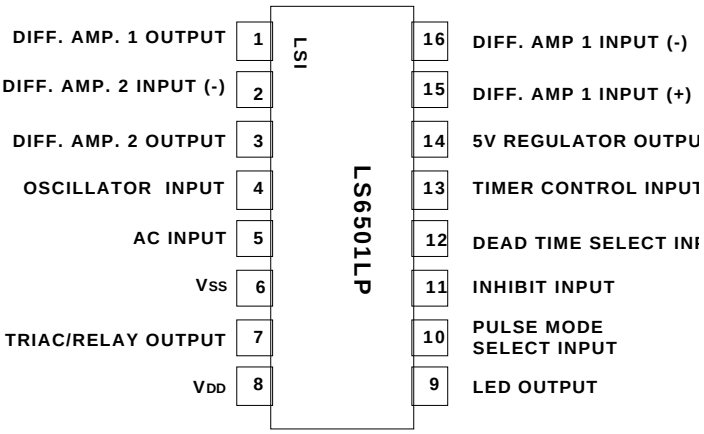


FIGURE 1

DESCRIPTION: (See Figure 2)
The LS6501LP is a monolithic, CMOS Silicon Gate integrated circuit, designed for detecting motion from a PIR Sensor and initiating appropriate responses. The detailed description of the functional blocks is as follows:

DIFFERENTIAL AMPLIFIER
Each stage of the two stage Differential Amplifier can be set to have its own amplification and bandwidth. The two inputs to the first stage allow for single ended or differential connection to PIR Sensors. This stage can be biased anywhere in its dynamic range. The second stage is internally biased so that the Window Comparator's lower and higher thresholds can be fixed relative to this bias.

WINDOW COMPARATOR
The Window Comparator provides noise filtering by enabling only those signals equal to or greater than a fixed threshold at the output of the Differential Amplifier to appear at the output of the Window Comparator.

COMPARATOR DIGITAL FILTER
The output of the Window Comparator is filtered so that motion must be present for a certain duration before it can be recognized and appear as pulses at the Digital Filter output.

OUTPUT DURATION TIMER
The voltage level at the TIMER CONTROL input can select 16 different timeouts for this Timer (See Table 1). The selection can be made by varying the setting of a potentiometer. The Timer is retriggerable and controls the ON duration of the TRIAC/RELAY output. The trigger for the Timer is generated from pulses appearing at the Digital Filter output.

SINGLE PULSE/DUAL PULSE MODES
A Single Pulse or Dual Pulse (two pulses occurring within a specified time period) at the Digital Filter output can be selected as the trigger for the Output Duration Timer. This selection is made by the logic level at the PULSE MODE SELECT input. Logic 0 = Single Pulse Mode, logic 1 = Dual Pulse Mode.

LED OUTPUT
This is an open drain output which is turned on by pulses generated by a retriggerable one-shot. The one-shot is triggered by the leading edge of pulses appearing at the Digital Filter output. When turned on, this output can sink current from a series Resistor-LED network returned to a positive voltage (V_{DD} to 12.5V maximum). This results in the LED lighting whenever motion is detected.

INHIBIT
The Output Duration Timer can be inhibited from triggering by the voltage level at the INHIBIT input. When this voltage level exceeds the Inhibit Threshold, the Timer will be prevented from triggering if it is OFF. If the Timer is ON, the INHIBIT input is blocked from affecting the Timer. There is approximately 10% hysteresis between the Inhibit and Enable thresholds at the INHIBIT input. The LED output is not affected by the INHIBIT input. An adjustable Ambient Light Level Inhibit can be implemented by connecting a Light Determining Resistor (LDR) network to the INHIBIT input (See Figures 3 and 4).

DEAD TIME
False turn-ons are prevented from occurring by establishing a Dead Time between the end of the timeout of the Output Duration Timer and the retriggering of that Timer. The state of the DEAD TIME SELECT input determines the Dead Time duration (See Table 2).

OSCILLATOR
For battery operation, an external RC is connected to the OSCILLATOR input to produce a 50Hz or 60Hz clock. A 30Hz clock can be used to extend timing durations (See Tables 1 and 2).

DC POWER SUPPLY
V_{DD}-Vss is 8V±1V. Typical quiescent current is 250µA (TRIAC/RELAY, LED and REGULATOR outputs not loaded).

DC REGULATOR
The LS6501LP includes a Regulator which provides a nominal +5V to the Differential Amplifier and Window Comparator and is available as an output to supply the PIR Sensor.

TRIAC/RELAY OUTPUT
This open drain output turns ON when the Output Duration Timer is triggered. The output drives a Triac when the OSCILLATOR input is tied to ground and 50/60Hz is applied to the AC input (See Figure 3). The output drives a Relay when the AC input is tied to ground and an RC network is connected to the OSCILLATOR input (See Figure 4).

TRIAC DRIVE (See Figure 3)
With the Output Duration Timer ON and a 2.7V P-P 60Hz signal applied to the AC input, the output produces a negative-going pulse in each half-cycle delayed a nominal 1.2ms from the zero crossing. There is no more than 150µs difference between the zero-crossing delay of each pulse.

RELAY DRIVE (See Figure 4)
With the Output Duration Timer ON and the OSCILLATOR input active, the output can sink current continously. This output can sink current from a relay coil returned to a positive voltage (V_{DD} to 12.5V maximum).

TABLE 1
OUTPUT DURATION TIMER AS A FUNCTION OF TIMER CONTROL INPUT VOLTAGE
(f = Frequency at AC input or OSCILLATOR input)

INPUT VOLTAGE	f = 30Hz	f = 50Hz	f = 60Hz	UNIT
0	30	18	15	sec
1/16 V_{DD}	60	36	30	sec
2/16 V_{DD}	90	54	45	sec
3/16 V_{DD}	120	72	60	sec
4/16 V_{DD}	4	2.4	2	min
5/16 V_{DD}	6	3.6	3	min
6/16 V_{DD}	8	4.8	4	min
7/16 V_{DD}	10	6	5	min
8/16 V_{DD}	12	7.2	6	min
9/16 V_{DD}	14	8.4	7	min
10/16 V_{DD}	16	9.6	8	min
11/16 V_{DD}	18	10.8	9	min
12/16 V_{DD}	20	12	10	min
13/16 V_{DD}	24	14.4	12	min
14/16 V_{DD}	28	16.8	14	min
15/16 V_{DD}	30	18	15	min

TABLE 2
DEAD TIME DURATION AS A FUNCTION OF THE STATE OF DEAD TIME SELECT INPUT
(f = Frequency at AC input or OSCILLATOR input)

INPUT STATE	f = 30Hz	f = 50Hz	f = 60Hz	UNIT
0	2	1.2	1	sec
OPEN	8	4.8	4	sec
1	16	9.6	8	sec

ABSOLUTE MAXIMUM RATINGS:

PARAMETER	SYMBOL	VALUE	UNIT
DC supply voltage	V_{DD}-V_{SS}	+10	V
Any input voltage	V_{IN}	V_{SS}-0.3 toV_{DD} + 0.3	V
Operating temperature	T_A	-40 to +85	°C
Storage temperature	T_{STG}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS:

(All voltages referenced to V_{SS}, T_A = -40˚C to +55˚C, 7V≤ V_{DD} ≤9V, unless otherwise specified.)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	CONDITIONS
SUPPLY CURRENT:						
V_{DD} = 8V	I_{DD}	-	250	350	µA	TRIAC/RELAY,
V_{DD} = 7V-9V	I_{DD}	-	300	420	µA	LED and REGULATOR outputs not loaded
REGULATOR:						
Voltage	V_R	4.5	-	6	V	-
Current	I_R	-	-	200	µA	-
DIFFERENTIAL AMPLIFIERS:						
Open Loop Gain, Each Stage	G	70	-	-	dB	-
Common Mode Rejection Ratio	CMRR	60	-	-	dB	-
Power Supply Rejection Ratio	PSRR	60	-	-	dB	-
Output Drive Current	I_D	-	-	25	µA	-
Input Sensitivity (Minimum Detectable Voltage to first amplifier when both amplifiers are cascaded for a net gain of 7,500)	V_S	70	-	-	µV	TA=25˚C, with Amplifier Bandpass configuration as shown in Figure 3
Input Dynamic Range	-	0	-	2.5	V	-
Diff. Amp 2 Internal Reference	V_{IR}	-	.4V_R	-	V	-
COMPARATOR:						
Lower Reference	V_{THL}	-	V_{IR}-.5V	-	V	-
Higher Reference	V_{THH}	-	V_{IR}+.5V	-	V	-
DIGITAL FILTER:						
Input Pulse Width	T_{PW}	66.3	-	-	ms	60Hz operation
(for recognition)	T_{PW}	79.6	-	-	ms	50Hz operation
INHIBIT INPUT:						
Inhibit Threshold	V_{THI}	-	≥.5V_{DD}	-	V	-
Enable Threshold	V_{THE}	-	≤.45V_{DD}	-	V	-
OSCILLATOR:						
Resistor	R_O	-	2.2	-	MΩ	60Hz Oscillator
Capacitor	C_O	-	.01	-	µF	Frequency
Resistor	R_O	-	4.3	-	MΩ	30Hz Oscillator
Capacitor	C_O	-	.01	-	µF	Frequency

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	CONDITIONS
OUTPUT DRIVE CURRENT:						
Triac (AC MODE)	I_O	-40	-	-	mA	With 3V Triac Gate Drive
Relay (DC MODE)	I_O	-10	-	-	mA	With 1V Max. across the LS6501LP.
TRIAC OUTPUT TIMING:						
Pulse Width	T_{TPW}	20	30	45	µs	V_{DD} = 8V, f=60Hz and
Delay from zero crossover	T_{OD}	1.00	1.2	1.32	ms	2.7V P-P AC input
Delay difference between zero crossovers	T_{ODD}	-	-	150	µs	f = 60Hz
AC INPUT IMPEDANCE	Z_{AC}	270	-	-	KΩ	-
LED OUTPUT:						
Sink Current	I_{LS}	-	-	8	mA	V_{DD} = 8V, Vo = .5V Max.
Pulse Width	T_{LPW}	.75	1	1.25	sec	f = 60Hz.
DUAL PULSE MODE:						
Time between pulse-pairs for motion recognition	T_R	-	-	5.125	sec	-

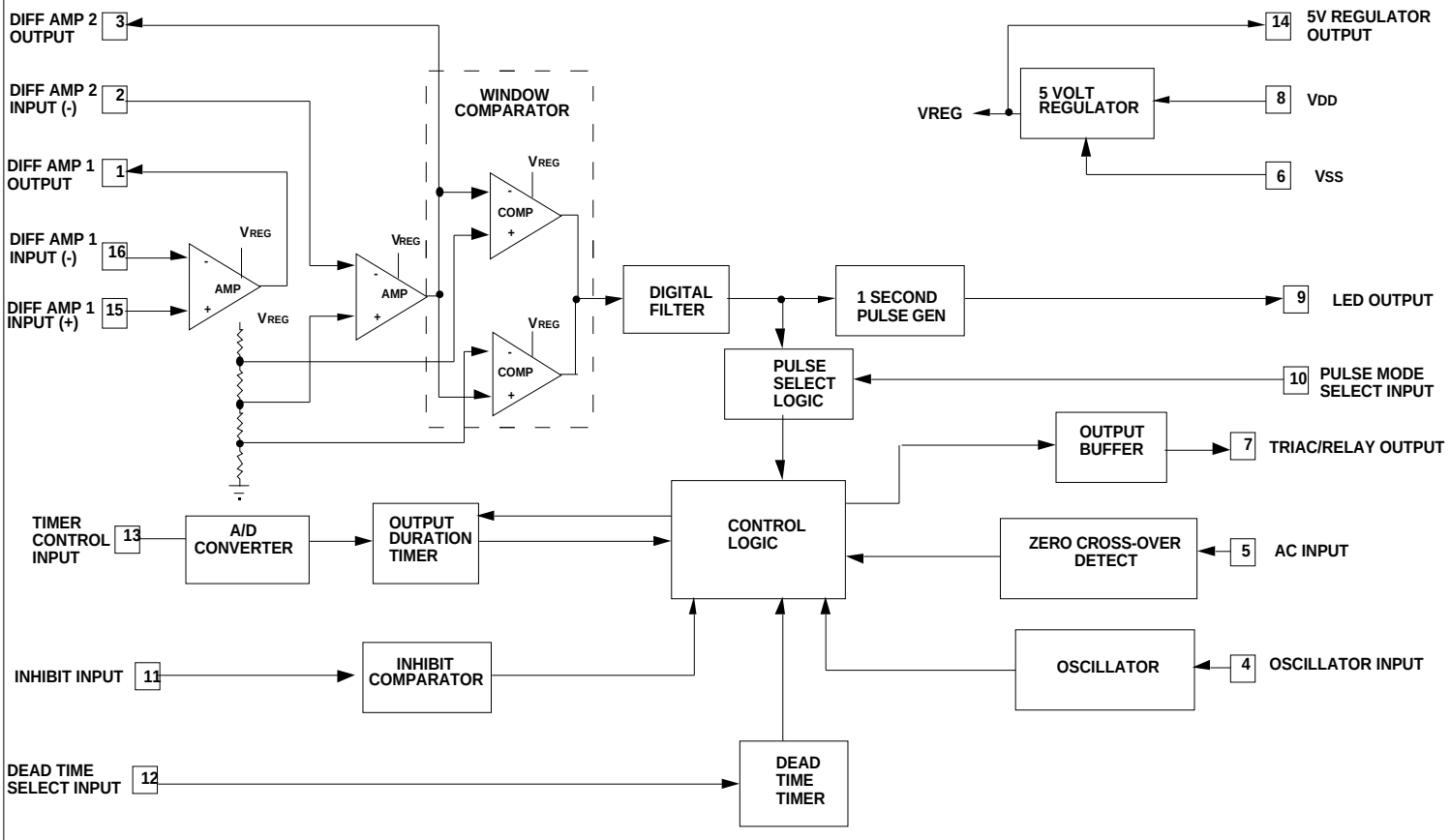
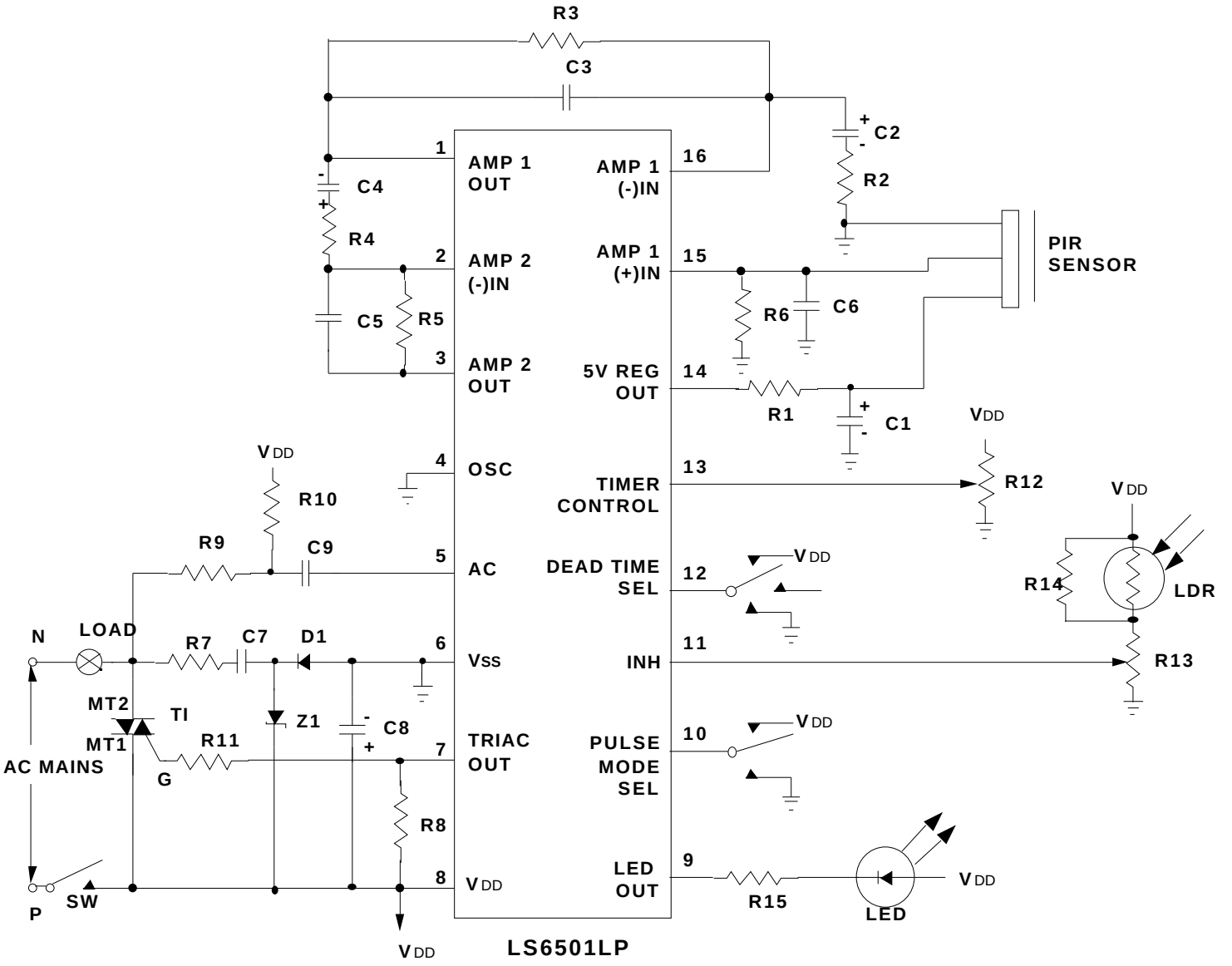


FIGURE 2. LS6501LP BLOCK DIAGRAM



R1 = 36KΩ
R2 = 36KΩ
R3 = 2.7MΩ
R4 = 36KΩ
R5 = 2.7MΩ
R6 = 36KΩ
R7 = 270Ω,1/2W
* R7 = 1KΩ,1W

R8 = 1KΩ
R9 = 910KΩ
R10 = 7.5KΩ
* R10 = 3.6KΩ
R11 = 100Ω
R12 = 1.0MΩ
R13 = 1.0MΩ
R14 = 910KΩ
R15 = 3.6KΩ

C1 = 100µF
C2 = 33µF
C3 = .01µF
C4 = 33µF
C5 = .01µF
C6 = .1µF
C7 = .47µF,250V
* C7 = .33µF,400V

C8 = 1000µF
C9 = .1µF,250V
* C9 = .1µF,400V
D1 = 1N4004
LDR = SILONEX HSL-19M52 (Typical)
Z1 = 9.1V, 1/2W
T1 = Q4008L4 (Typical)
* T1 = Q5004L4 (Typical)

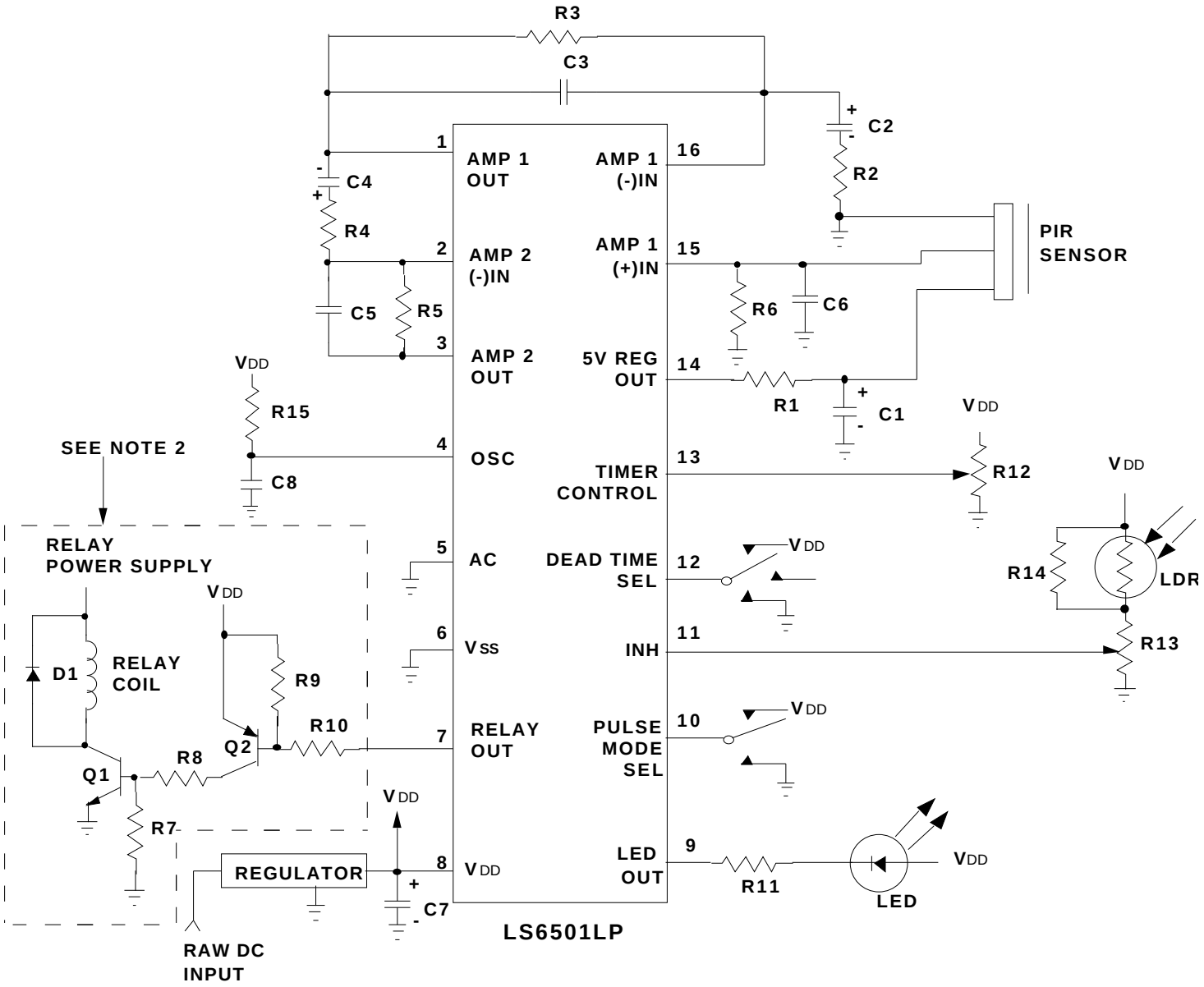
PIR = HEIMANN LHi 954, 958, 978, 874 or 878 (Typical)

All Resistors 1/4W, all Capacitors 10V unless otherwise specified.

* = Component change for 220VAC

NOTES: 1. The R9, R10, C9 network provides a 2.7V Peak-to-Peak AC signal input to Pin 5.
2. The C8, D1, Z1, C7, R7 components generate the DC Supply Voltage for the LS6501LP.
3. The R2, C2, R3, C3, R4, C4, R5, C5, R6, C6 components and the two on-chip Differential Amplifiers set a nominal gain of 5,500 with bandpass filtering of .13Hz to 6Hz.

FIGURE 3. TYPICAL TRIAC WALL SWITCH APPLICATION



R1 = 36KΩ
R2 = 36KΩ
R3 = 2.7MΩ
R4 = 36KΩ
R5 = 2.7MΩ
R6 = 36KΩ
R7 = 10KΩ
R8 = 3.6KΩ
R9 = 10KΩ
R10 = 18KΩ
R11 = 3.6KΩ
R12 = 1.0MΩ
R13 = 1.0MΩ
R14 = 910KΩ
R15 = 2.4MΩ

C1 = 100µF
C2 = 33µF
C3 = .01µF
C4 = 33µF
C5 = .01µF
C6 = .1µF
C7 = 100µF
C8 = .01µF

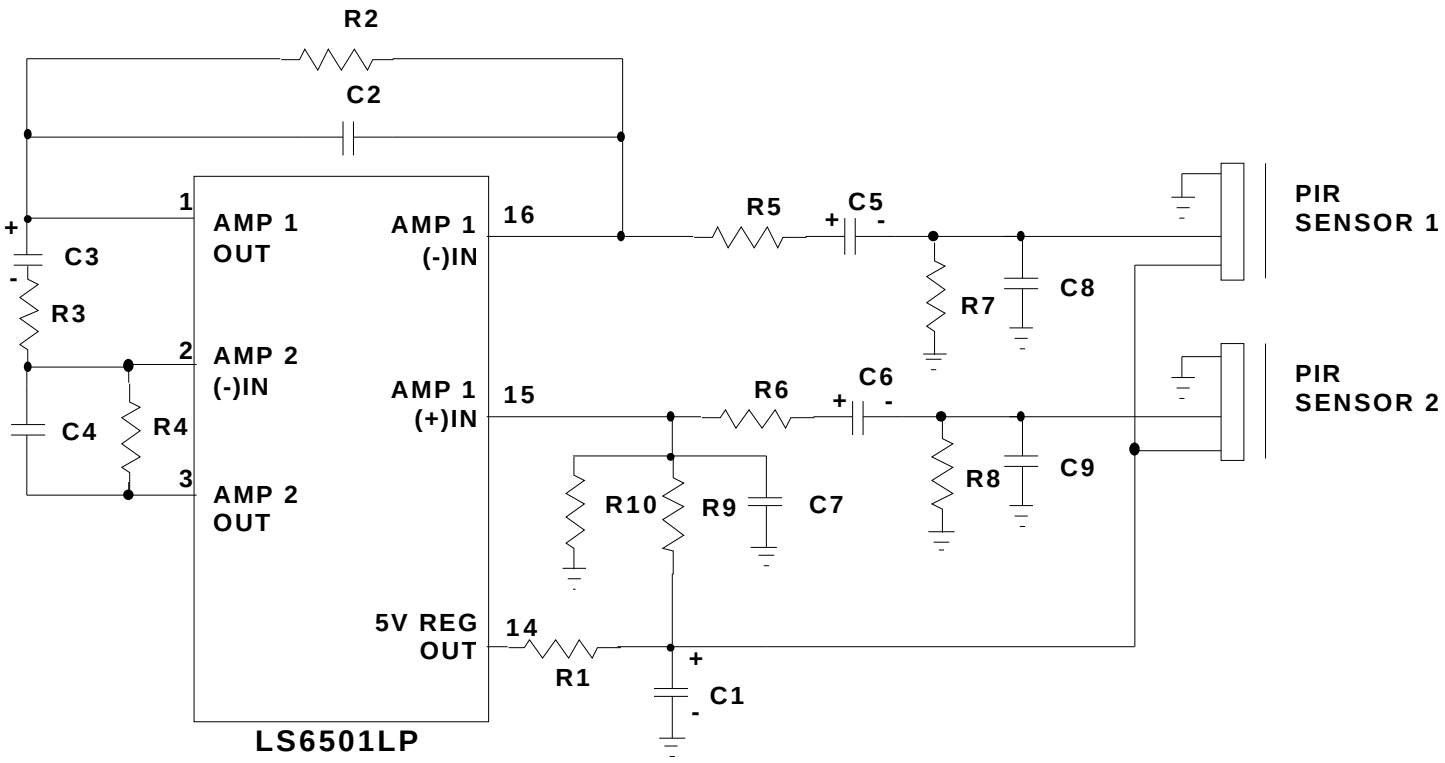
LDR = SILONEX NSL-19M52 (Typical)
Q1 = 2N3904
Q2 = 2N3906
REGULATOR = MC78L08 (Typical)
RELAY = No typical P/N

PIR = HEIMANN LHi 954, 958, 978, 874 or 878 (Typical)

All Resistors 1/4W, all Capacitors 10V

NOTES: 1. The "Raw DC Voltage" into the Regulator can range between 11V and 25V and generates an 8V DC Supply Voltage for the LS6501LP.
2. The R10, R9, Q2, R8, R7, Q1 components interface LS6501LP Pin 7 to a Relay Coil returned to a separate High-Voltage DC Supply.
3. A Relay Coil returned to a maximum of 12.5V can be directly driven by the LS6501LP Pin 7.

FIGURE 4. TYPICAL DC RELAY APPLICATION



R1 = 36KΩ	C1 = 100µF
R2 = 2.7MΩ	C2 = .01µF
R3 = 36KΩ	C3 = 33µF
R4 = 2.7MΩ	C4 = .01µF
R5 = 36KΩ	C5 = 33µF
R6 = 36KΩ	C6 = 33µF
R7 = 36KΩ	C7 = .01µF
R8 = 36KΩ	C8 = .1µF
R9 = 5.6MΩ	C9 = .1µF
R10 = 5.6MΩ	PIRs = HEIMANN LHi 954, 958, 978, 874 or 878 (Typical)

All Resistors 1/4 W. All Capacitors 10V

NOTE: A pair of PIR Sensors may be used in applications where a wider optical field of view is needed.

FIGURE 5. LS6501LP DIFFERENTIAL INTERFACE TO PIR SENSOR PAIR