LSI/CSI

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LS6511N LS6512 LS6513

PIR SENSOR INTERFACE

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FEATURES:
- Direct Interface with PIR Sensor
- Two-Stage Differential Amplifier
- Amplifier Gain and Bandwidth externally controlled
- True and Complementary Output Drives
- Separate digital filters for processing positive and negative input signals
- Single Pulse/Dual Pulse/ Concurrent Pulse Detection
- Adjustable Output Pulse Width
- Optional 5V Shunt Regulator Output
- 75μA Typical Supply Current
- Undervoltage Detection
- **LS6511N**(DIP); **LS6511N-S** (SOIC) - **See Figure 1A**
  LS6512(DIP); **LS6512-S** (SOIC) - **See Figure 1A**
  LS6513(DIP); **LS6513-S** (SOIC) - **See Figure 1B**

APPLICATIONS:
Security system intrusion detection, automatic doors, motion triggered events such as remote animal photography, etc.

DESCRIPTION (See Figure 5)
The **LS6511N**, **LS6512** and **LS6513** are CMOS integrated circuits designed for detecting motion from a PIR Sensor and initiating appropriate responses.

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. Signal levels as low as 100μV can be detected.

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 2 outputs of the Window Comparator. One output detects positive input signals while the other output detects negative input signals.

COMPARATOR DIGITAL FILTER
The outputs of the Window Comparator are filtered so that motion must be present for a certain duration before it can be recognized and appear as pulses at the Digital Filter outputs. An external RC network sets the duration time. Nominal duration is 50ms.

MODE SELECT
A tristate input pin selects how the detected signals are processed. Single Pulse (SP) Mode is when detection from either a positive or negative input signal at the Digital Filter outputs will cause an LED / RELAY output to occur. Concurrent Pulse (CP) Mode is when detection from a positive and negative input signal must occur within a specific time before an output will occur. Dual Pulse (DP) mode is when any two detections within a specific time will cause an output to occur. SP Mode = 0; CP Mode = Open; DP Mode = 1.

PROGRAMMABLE RETRIGGERABLE ONE-SHOTS
Positive and negative input signals at the digital filter outputs will generate retriggerable one-shot pulses. In the Concurrent Pulse Mode, outputs from each one-shot must occur together at some point in time to cause an output to occur. The one-shot pulse width is programmable using an external RC network. Typical pulse widths used vary between 1 and 12 seconds.

WINDOW TIMER
In the Dual Pulse Mode any two detections must occur within a timing window to cause an output to occur. The timing window is programmable using an external RC network. Typical windows are between 1 and 5 seconds.

$\overline{\text{ENABLE}}$ Input
A low on the Enable input for **LS6513** allows the LED / Relay and LED / Relay outputs to respond to the PIR input detection. If the Enable input is high, then the two outputs remain in their dormant state. The LED / Relay and LED / Relay outputs on **LS6511N** and **LS6512** are always enabled.

$\overline{\text{SEL}}$ UDV Input
For the **LS6513**, a low on this input allows undervoltage to be detected. If left floating, undervoltage detection will not occur.

OUTPUT DURATION TIMER
The duration timer is retriggerable and programmable using an external RC network. Typical duration times are between 0.5 and 15 seconds. Successive input detections will restart the timer.

OUTPUTS
The LED / RELAY Output is an open drain output that will sink current when an input signal is detected and processed. The **LS6511N** will also sink current when the Power Supply drops below 3.5V (Typical) (Undervoltage Detection). The Undervoltage Detection will be removed when the Power Supply rises above 3.7V (Typical). The LED / RELAY Output performs identically but is opposite in polarity. The output can sink current from a relay coil returned to a positive voltage (V_{DD} to 15V maximum). The **LS6512** will not respond to an undervoltage detection. The **LS6513** can be selected to respond or not respond to a power supply undervoltage.

The undervoltage detection feature in the **LS6511N** assures that in security systems tampering with the power supply by loading it and causing it to be reduced in value will be quickly detected.

In battery operated non-security systems applications the undervoltage feature is not desireable because it produces unwanted outputs as the batteries age. The **LS6512** should be selected for these applications.

SHUNT REGULATOR
The **LS6511N** includes a 5V Shunt Regulator Output which can be tied to the V_{DD} Pin so that the circuit can be powered from a higher voltage power supply.

Note: See Figures 2, 3 and 4 for application schematics.

PIN ASSIGNMENT - TOP VIEW

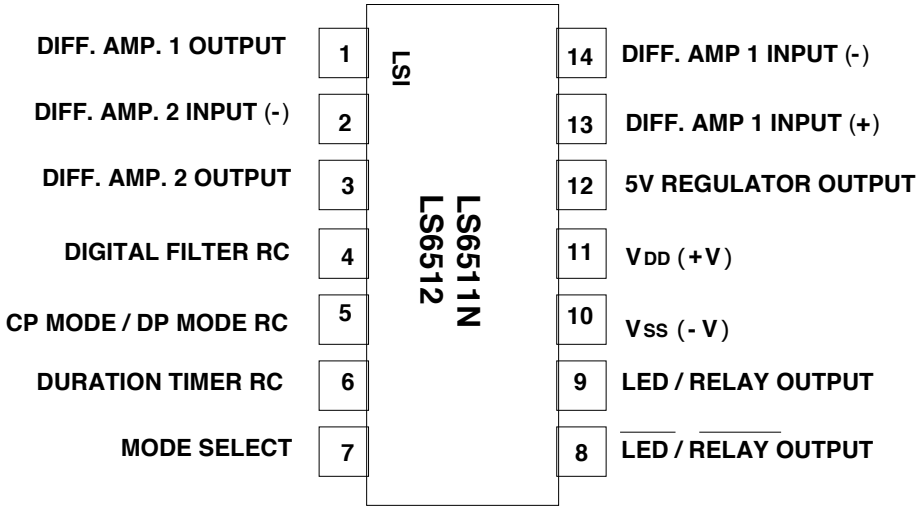


FIGURE 1A

PIN ASSIGNMENT - TOP VIEW

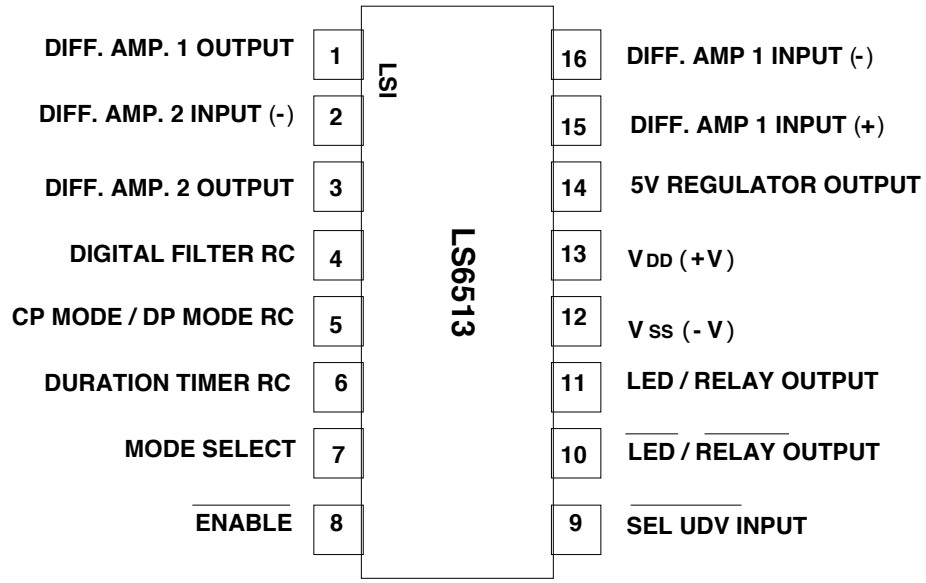


FIGURE 1B

ABSOLUTE MAXIMUM RATINGS:

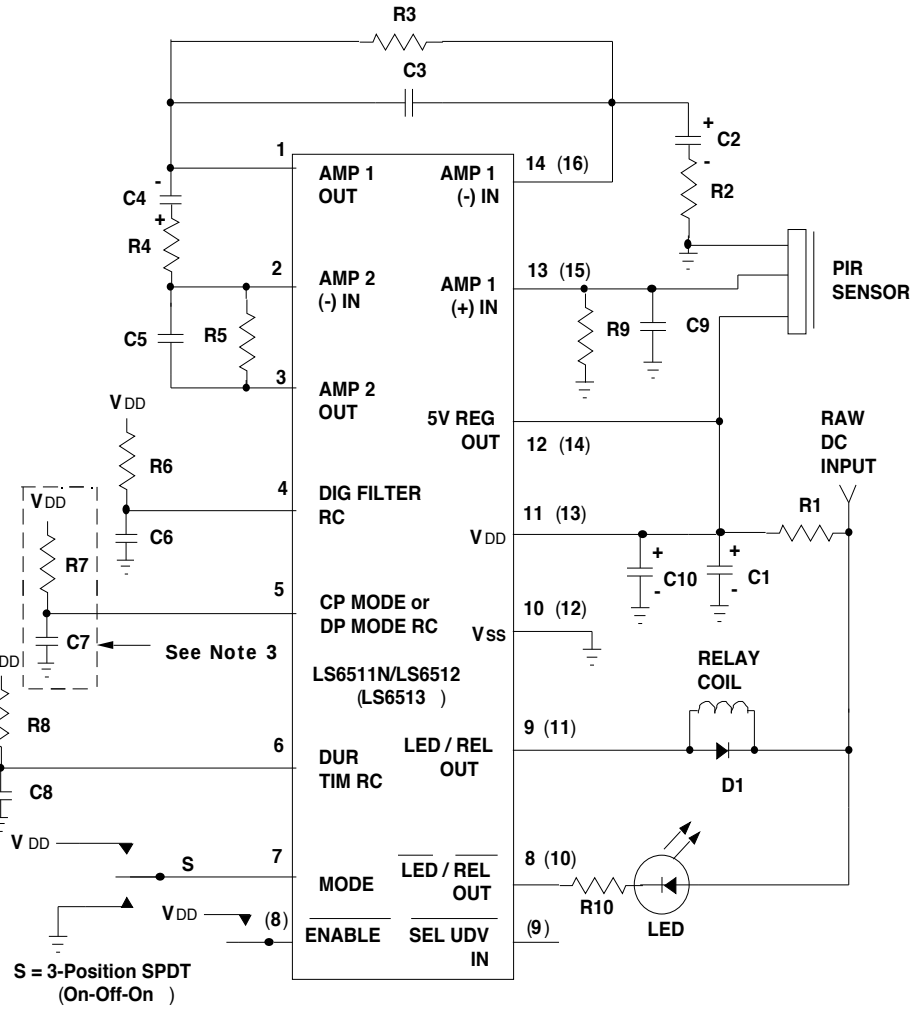
PARAMETER	SYMBOL	VALUE	UNIT
DC supply voltage	V_{DD} - V_{SS}	+7	V
Any input voltage	V_{IN}	V_{SS} - 0.3 to V_{DD} + 0.3	V
Operating temperature	T_A	-40 to +85	°C
Storage temperature	T_{STG}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS:
(All voltages referenced to V_{SS}, T_A = -40˚C to +55˚C, 4.5V ≤ V_{DD} ≤ 6.5V, unless otherwise specified.)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	CONDITIONS
SUPPLY CURRENT:						
VDD = 5V	I_{DD}	-	75	100	µA	LED/RELAY, $\overline{\text{LED}}$/$\overline{\text{RELAY}}$
VDD = 4.5V - 6.5V	I_{DD}	-	125	160	µA	and REGULATOR outputs not loaded
REGULATOR:						
Voltage	V_R	-	5	-	V	-
Current	I_R	-	-	15	mA	-
UNDERVOLTAGE:						
DETECTION	U_{DV}	2.9	3.5	4.1	V	} LS6511N
RECOVERY	U_{RV}	3.05	3.7	4.4	V	} LS6513
MIN. OPERATING VOLTAGE	V_{DM}	-	-	3.0	V	} LS6512 } LS6513
DIFFERENTIAL AMPLIFIERS:						
Open Loop Gain, Each Stage	G	70	-	-	dB	-
Common Mode Rejection Ratio	C_{MRR}	60	-	-	dB	-
Power Supply Rejection Ratio	P_{SRR}	60	-	-	dB	-
Input Sensitivity (Minimum Detectable Voltage to first amplifier when both amplifiers are cascaded for a net gain of 8,000)	V_S	100	-	-	µVp-p	T_A = 25˚C, with Amplifier Bandpass configuration as shown in Figure 3
Input Dynamic Range	-	0	-	1.75	V	-
Diff. Amp 2 Internal Reference	V_{IR}	-	0.35V_{DD}	-	V	-
COMPARATOR:						
Lower Reference	V_{THL}	-	V_{IR} - 0.5V	-	V	At V_{DD} = 5.0V
Higher Reference	V_{THH}	-	V_{IR} + 0.5V	-	V	At V_{DD} = 5.0V
DIGITAL FILTER:						
For 50ms Filter Time	R_{DF}	-	2.2	-	MΩ	-
	C_{DF}	-	0.01	-	µF	-
ONE SHOT	R_{OS}	-	2.2	-	MΩ	-
(1 Second)	C_{OS}	-	0.22	-	µF	-
WINDOW TIMER	R_{WT}	-	2.2	-	MΩ	-
(2.5 Second)	C_{WT}	-	0.68	-	µF	-
Concurrent Pulse Window	T_{CP}	-	1	-	sec	R_{CP} ≤ 2.2MΩ } C_{CP} = 0.22uF } } Pin 5
Dual Pulse Window	T_{DP}	-	2.5	-	sec	R_{DP} = 2.2MΩ } C_{DP} = 0.68uF }
DURATION TIMER	T_{DT}	-	4	-	sec	R_{DT} = 2.2MΩ } Pin 6 C_{DT} = 0.68µF }
OUTPUT DRIVE CURRENT	I_O	-20	-	-	mA	V_{DD} = 5V
(V_O = 0.5V Max.)	I_O	-10	-	-	mA	V_{DD} = V_{DM}

FIGURE 2. TYPICAL RELAY APPLICATION

NOTE 1: The relay coil is normally energized and the LED is off. When an alarm occurs, the relay coil becomes de-energized and the LED is turned on.



R1 = See NOTE 2
R2 = 36kΩ
R3 = 1.5MΩ
R4 = 36kΩ
R5 = 1.5MΩ
R6 = 2.2MΩ (Typical)
R7 = 2.2MΩ (Typical)
R8 = 2.2MΩ (Typical)
R9 = 36kΩ
R10 = 2.2kΩ (Typical)

C1 = 100µF
C2 = 10µF
C3 = 0.003µF
C4 = 10µF
C5 = 0.003µF
C6 = 0.01µF (Typical)
C7 = 0.22µF (CP Mode; Typical)
C7 = 0.68µF (DPMode; Typical)
C8 = 0.22µF (Typical)
C9 = 0.1µF C10 = 0.1µF

D1 = 1N4001
Relay = No typical P/N

PIR = Perkin-Elmer LHi 958, 978 (Typical)
Nicera RE200B, SDA02-54 (Typical)

All Resistors 1/4W. All Capacitors 10V.

NOTE 2: R1 is selected to provide sufficient current to drive the LS6511N and PIR Sensor. Any surplus current is available to drive additional loads applied to the 5V Shunt Regulator output or is absorbed by the 5V Shunt Regulator. Refer to specifications for current limits.

NOTE 3: In SP Mode, R7 and C7 are not used and Pin 5 is tied to Vss.

NOTE 4: Adjust the value of R9 if the selected PIR Sensor causes the input static voltage at Pin 13 to be out of the Input Dynamic Range of 0V to 1.75V. (**See Electrical Characteristics on Page 2**)

NOTE 5: Sensitivity can be adjusted to a lower value by increasing the value of R2 or R4 or by decreasing the value of R3 or R5.

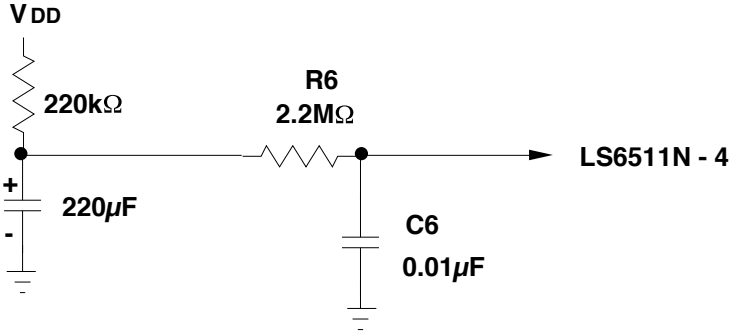
NOTE 6: Pins shown in parentheses and connections shown by broken lines are for **LS6513** only.

NOISE CONSIDERATIONS

Layout of any circuit using a high-gain PIR amplifier is critical. The PIR amplifier components should be located close to the amplifier pins on the chip in order to minimize noise pickup.The oscillator and relay drive components should be located away from the amplifier components.

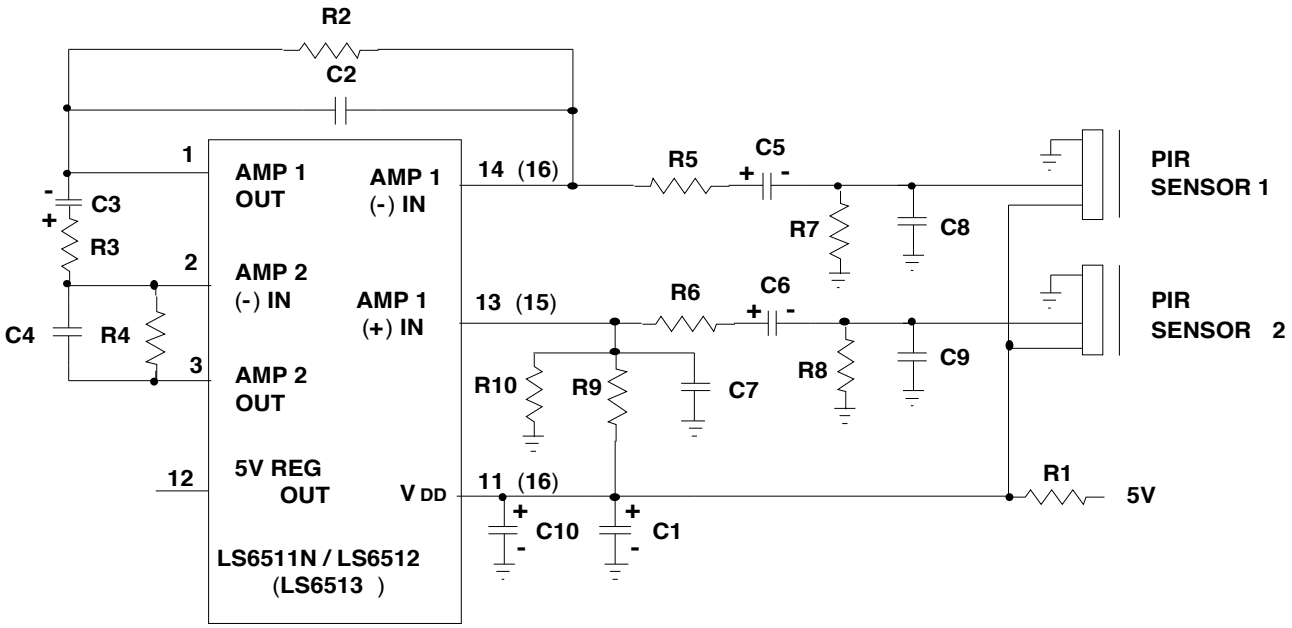
Other steps that can help reduce noise is adding a ground shield backplane to the PCB and enhancing the filtering of VDD; i.e., adding a 0.1uF high frequency capacitor across C1 and increasing C1 to 220 µF.

FIGURE 3. INHIBITING OUTPUTS UPON POWER TURN-ON



Using the typical application circuit as shown in Figure 2, the Outputs on Pins 8 and 9 occur on power-up because of the large settling time in the amplifier stages. In applications where this is not desireable, the digital filter oscillator must be disabled on power-up long enough to enable the PIR amplifiers to stabilize. Replacing the R6-C6 circuit shown in Figure 2 with the circuit shown in Figure 3 will disable the digital filter oscillator until the voltage across the 220µF capacitor reaches a value high enough for the oscillator to begin oscillating. Component values that can be changed to speed up stabilization include C2, C3, C4 and C5. C3 and C5 become 0.001µF and C2 and C4 become 10µF.

FIGURE 4. DIFFERENTIAL INTERFACE TO PIR SENSOR PAIR



R1 = 1kΩ	R6 = 36kΩ	C1 = 100μF	C6 = 10μF
R2 = 1.5MΩ	R7 = 36kΩ	C2 = 0.003μF	C7 = 0.01μF
R3 = 36kΩ	R8 = 36kΩ	C3 = 10μF	C8 = 0.1μF
R4 = 1.5MΩ	R9 = 5.6MΩ	C4 = 0.003μF	C9 = 0.1μF
R5 = 36kΩ	R10 = 2.4MΩ	C5 = 10μF	C10 = 0.1μF

PIRs = **Perkin-Elmer** LHi 954, 958, 978; **Nicera** RE200B, SDA02-54 (Typical)

All Resistors 1/4 W. All Capacitors 10V.

NOTES: 1) A pair of PIR Sensors may be used in applications where a wider optical field of view is needed.
2) External 5V Regulator drives the LS6511N and PIR sensor.

FIGURE 5. BLOCK DIAGRAM