

## Features

- 2-stage operational amplifier as filter
- Built-in noise rejection circuit
- On-chip regulator
- Override function (PT8A2621 only)
- Synchronous with AC 220V/50Hz and 110V/60Hz
- Pulse output (PT8A2611) for TRIAC drive or level output (PT8A2621) for relay drive
- CDS to enable/disable output
- Adjustable output on time duration
- ON/AUTO/OFF selectable by MODE pin
- Auto-reset if the ZC signal disappears over 3 seconds
- 40 seconds warm-up
- Quick check mode for initial installation
- Operating voltage: 5V
- Stand-by current: 80μA
- Package: 16-pin DIP and 16-pin SOP

## Applications

- Energy saving auto-switch in Garden, kitchen, bathroom, corridor, storage or yard
- Auto light in meeting room

## General Description

The PT8A2611 and PT8A2621 are low power mixed signal CMOS LSI designed for the automatic lamp control using PIR sensor as motion detector.

With on chip noise filter and voltage regulator, the IC provides stable operations throughout temperature range. CDS input to disable day time operation is desired.

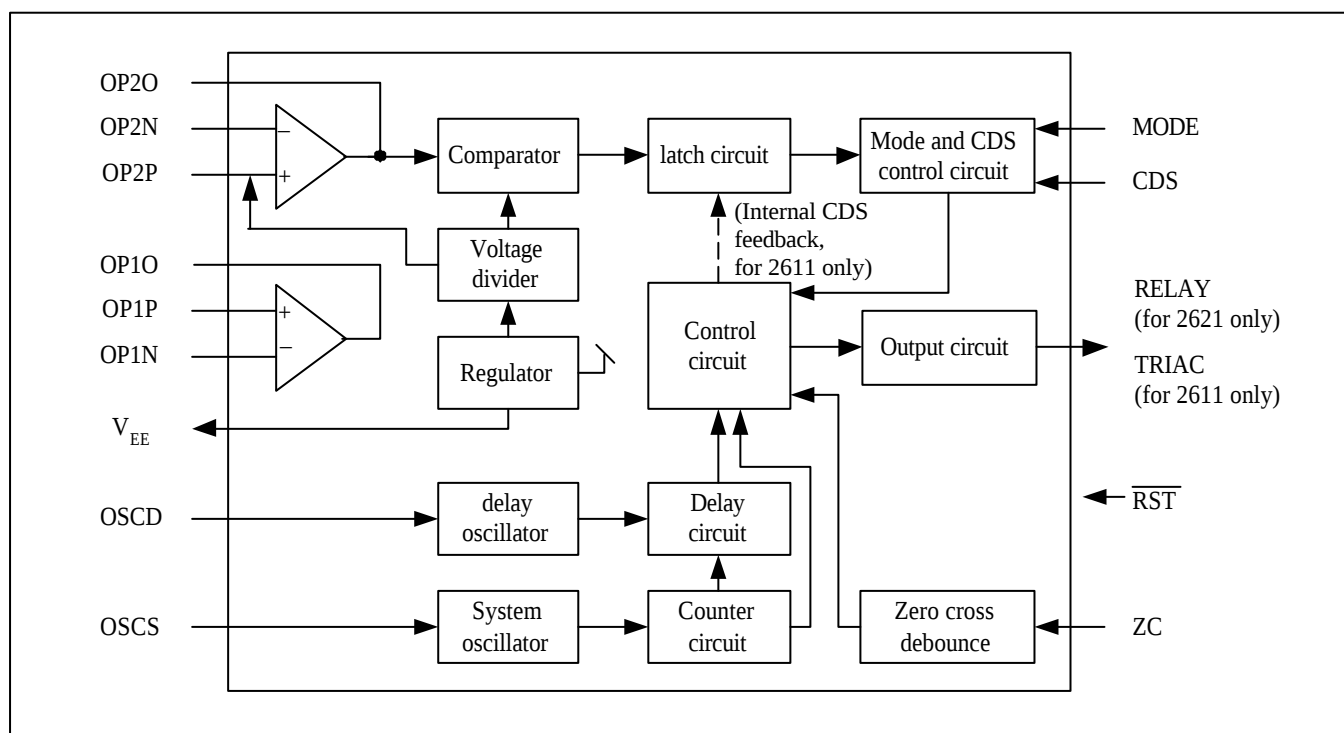
## Function Comparison

|                 | Override    | CDS feedback                                       | Output |
|-----------------|-------------|----------------------------------------------------|--------|
| <b>PT8A2611</b> | No function | Internal                                           | TRIAC  |
| <b>PT8A2621</b> | Twice       | With external components (see Fig. 10, D9 and R15) | RELAY  |

## Ordering Information

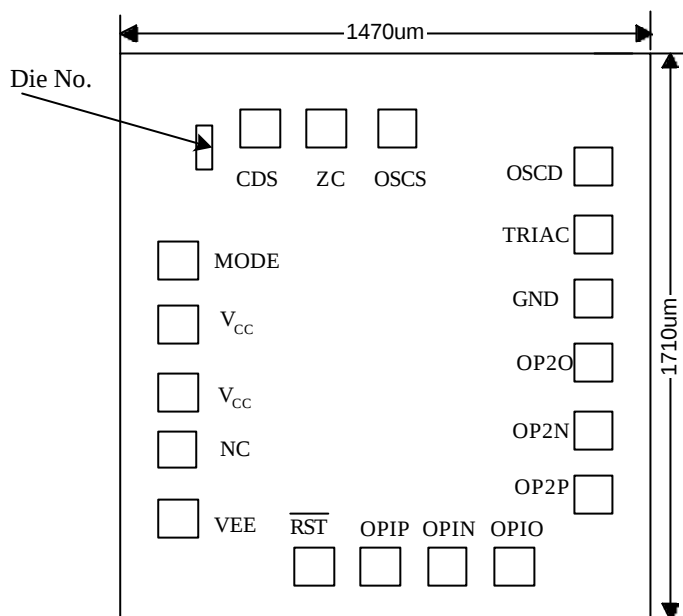
| Part Number             | Package       |
|-------------------------|---------------|
| PT8A2611P / PT8A2621P   | 16 - Pin PDIP |
| PT8A2611W / PT8A2621W   | 16 - Pin SOP  |
| PT8A2611DE / PT8A2621DE | Die Form      |

## Block Diagram



## Pad Location

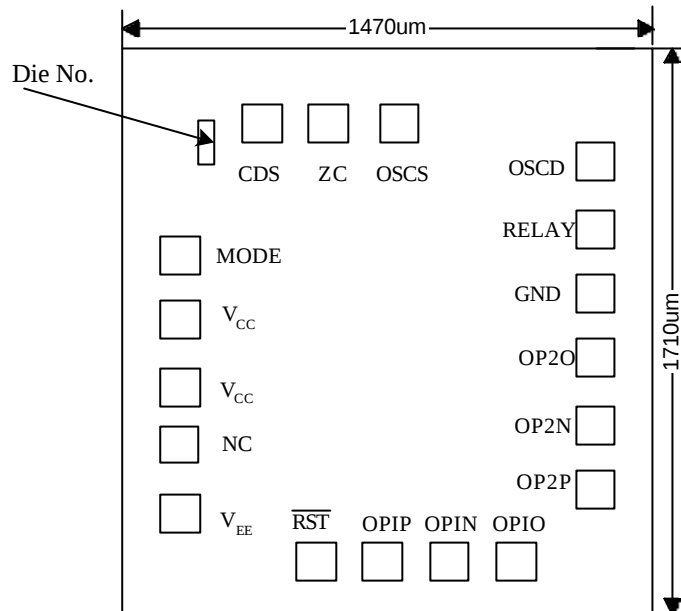
### Pad Location of PT8A2611DE



| Pad Coordinate  |              |              |                 |              |              |
|-----------------|--------------|--------------|-----------------|--------------|--------------|
| Pad Name        | X Coordinate | Y Coordinate | Pad Name        | X Coordinate | Y Coordinate |
| GND             | 570          | 65.4         | NC              | 570          | -268.6       |
| TRIAC           | 570          | -101.6       | V <sub>EE</sub> | -570         | 232.4        |
| OSCD            | 570          | 399.4        | RST             | 303.9        | -687.2       |
| OSCS            | 570          | 232.4        | OP1P            | -44.8        | 689.2        |
| ZC              | -378.8       | 689.2        | OP1N            | -211.8       | 689.2        |
| CDS             | -30.1        | -687.2       | OP1O            | -570         | -435.6       |
| MODE            | 570          | -435.6       | OP2P            | -570         | -268.6       |
| V <sub>cc</sub> | -197.1       | -687.2       | OP2N            | -570         | -101.6       |
| V <sub>cc</sub> | 136.9        | -687.2       | OP2O            | -570         | 65.4         |

Note: Substrate is connected to GND

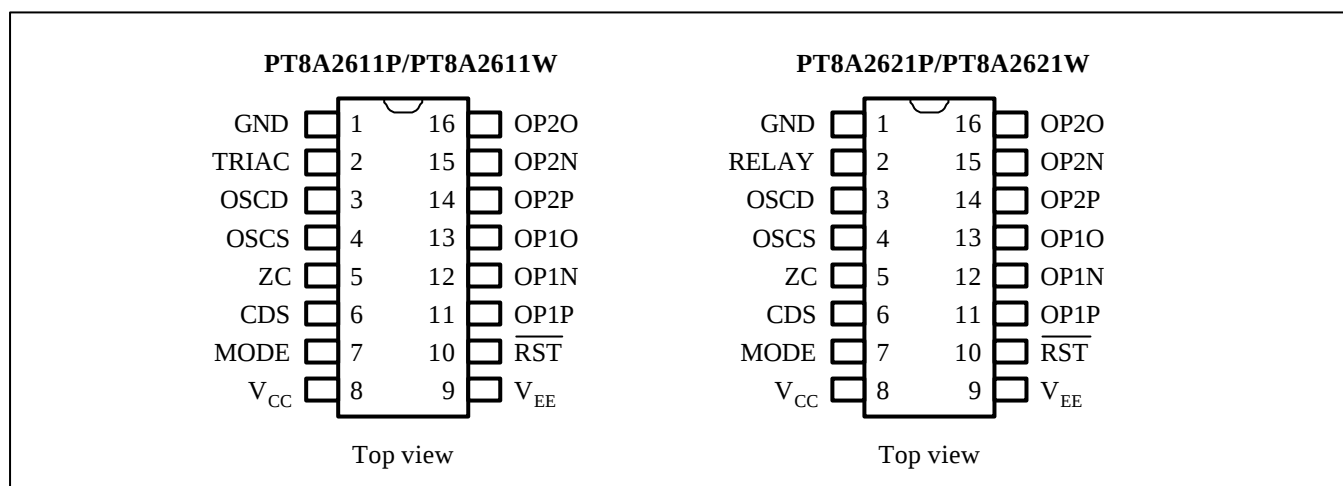
**Pad Location of PT8A2621DE**



| Pad Coordinate  |              |              |                 |              |              |
|-----------------|--------------|--------------|-----------------|--------------|--------------|
| Pad Name        | X Coordinate | Y Coordinate | Pad Name        | X Coordinate | Y Coordinate |
| GND             | 570          | 65.4         | NC              | 570          | -268.6       |
| RELAY           | 570          | -101.6       | V <sub>EE</sub> | -570         | 232.4        |
| OSCD            | 570          | 399.4        | RST             | 303.9        | -687.2       |
| OSCS            | 570          | 232.4        | OP1P            | -44.8        | 689.2        |
| ZC              | -378.8       | 689.2        | OP1N            | -211.8       | 689.2        |
| CDS             | -30.1        | -687.2       | OP1O            | -570         | -435.6       |
| MODE            | 570          | -435.6       | OP2P            | -570         | -268.6       |
| V <sub>cc</sub> | -197.1       | -687.2       | OP2N            | -570         | -101.6       |
| V <sub>cc</sub> | 136.9        | -687.2       | OP2O            | -570         | 65.4         |

Note: Substrate is connected to GND

## Pin Assignment



## Pin Description

| Pin  |      | Name                    | Type   | Description                                                                                                                                                                         |
|------|------|-------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2611 | 2621 |                         |        |                                                                                                                                                                                     |
| 1    | 1    | GND                     | Ground | Ground                                                                                                                                                                              |
|      | 2    | RELAY                   | O      | RELAY drive output through an external NPN transistor, active high                                                                                                                  |
| 2    |      | TRIAC                   | O      | TRIAC drive two-pulse output, active negative pulse.                                                                                                                                |
| 3    | 3    | OSCD                    | I/O    | Output timing oscillator I/O, connected to an external RC to adjust output duration.                                                                                                |
| 4    | 4    | OSCS                    | I/O    | System oscillator I/O, connected to an external RC to set the system frequency. The system frequency = 16kHz for normal application.                                                |
| 5    | 5    | ZC                      | I      | Schmitt input for AC zero crossing detection.                                                                                                                                       |
| 6    | 6    | CDS                     | I      | Connected to a CDS voltage divider for daytime/night auto-detection. Low input to this pin can disable PIR input. CDS is a schmitt trigger input with 5-second input debounce time. |
| 7    | 7    | MODE                    | I      | Mode select, connecting to $V_{CC}$ - output always on, connection GND - output always off, open - auto detection                                                                   |
| 8    | 8    | $V_{CC}$                | Power  | Power supply                                                                                                                                                                        |
| 9    | 9    | $V_{EE}$                | O      | Internal voltage regulator output, 3.6V with respect to ground. Connected to the drain of PIR sensor                                                                                |
| 10   | 10   | $\overline{\text{RST}}$ | I      | Chip reset input, active low, kept floating or connected an RC network                                                                                                              |
| 11   | 11   | OP1P                    | I      | Non-inverted input of first operational amplifier, connected directly to source of PIR sensor                                                                                       |
| 12   | 12   | OP1N                    | I      | Inverted input of first operational amplifier                                                                                                                                       |
| 13   | 13   | OP1O                    | O      | Output of first operational amplifier                                                                                                                                               |
| 14   | 14   | OP2P                    | I      | Non-inverted input of second operational amplifier.                                                                                                                                 |
| 15   | 15   | OP2N                    | I      | Inverted input of second operational amplifier                                                                                                                                      |
| 16   | 16   | OP2O                    | O      | Output of second operational amplifier                                                                                                                                              |

## Functional Descriptions

The PT8A2611 and PT8A2621 are CMOS LSI chips designed for automatic PIR lamp control. They can operate in 2-wire configuration for triac applications or in 3-wire configuration for relay applications.

The PIR sensor detects infrared power variations caused by motion of a human body and transfer to a voltage variation. If the PIR output voltage variation conforms to criteria, the lamp is turned on for an adjustable duration. The PT8A2611 (or 2621) offers three operating modes (ON, AUTO, OFF) which can be set through a MODE pin. When the device is working in AUTO mode, the user can override the mode to switch it to TEST mode or manual ON mode, or return to the AUTO mode by switching power switch.

## OSCS and OSCD Pins

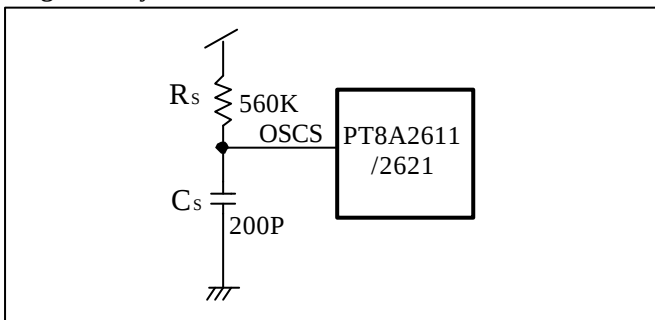
OSCS is a system oscillator I/O pin connected to an external RC to generate system frequency of 16kHz. OSCD is an output timing oscillator I/O pin. It's connected to an external RC to obtain the desired turn-on duration by selecting various values of RC or using a variable resistor.  $F_{OSCD}$  is the frequency of OSCD pin, output timing can be calculated as the formula:

$$T_D = 21504 / F_{OSCD}$$

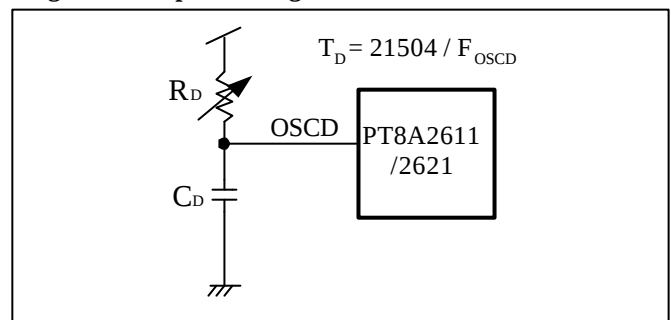
## CDS Input Circuit

CDS is a CMOS schmitt trigger input pin. It is used to distinguish between day time and night time. When the input voltage of CDS is high the PIR input is enabled, when CDS low the PIR input disabled. The input disable-to-enable debounce time is 5 seconds. Connect this pin to  $V_{CC}$  when not using it. The CDS input is ignored by PT8A2611 when the TRIAC output is active, however, PT8A2621's CDS can not be ignored anytime.

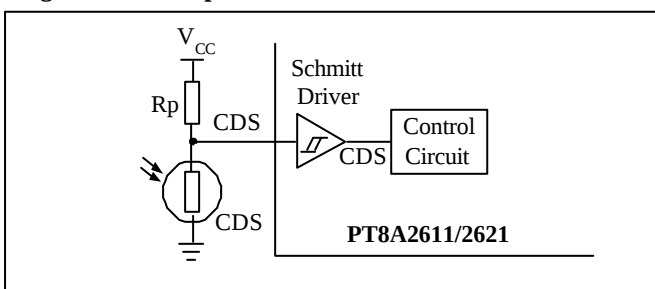
**Figure 1. System Oscillator**



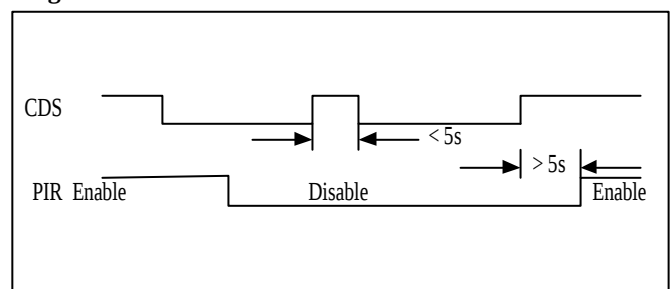
**Figure 2. Output Timing Oscillator**



**Figure 3. CDS Input Circuit**



**Figure 4. CDS Enable Debounce**



**Table 1. CDS Pin Function**

| CDS  | Status   | PIR      |
|------|----------|----------|
| LOW  | Day Time | Disabled |
| HIGH | Night    | Enabled  |

## MODE

MODE is a tri-state input pin for operation mode selection. See the following table 2.

**Override Control (for PT8A2621 only):** The term “override” refers to the change of operating mode by switching the power switch twice within 3 seconds. When the chip is working in the AUTO mode (MODE pin openned), the output is activated by a valid PIR trigger signal and the output active duration is controlled by the OSCD oscillation period. The lamp can be switched to ON from the AUTO mode by either switching the MODE pin to  $V_{CC}$  or switching the power switch twice within 3

seconds. The device can be toggled from ON to AUTO by switching the power switch twice within 3 seconds again (override operation).

If the chip is overridden to ON and there is no further override operation, it will return to AUTO automatically after an internal preset ON time duration (8 hours).

Note:Flash is only for the TRIAC Rev.

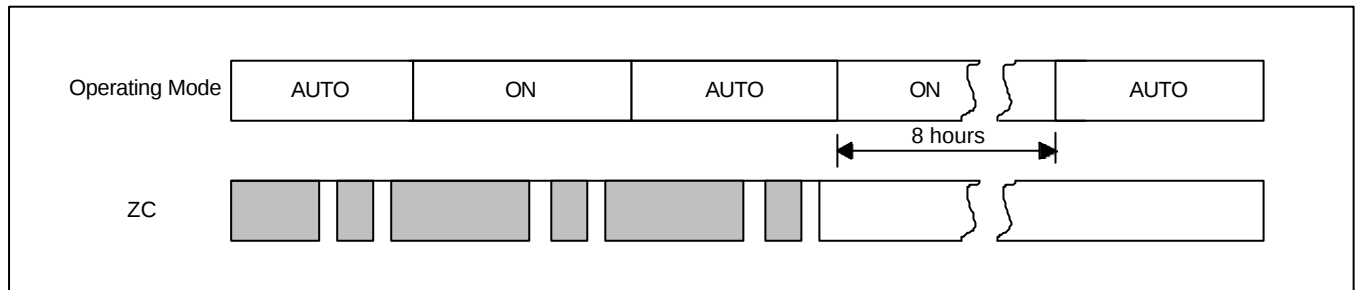
## RST Pin

$\overline{RST}$  is used to reset the device. It is internal pull-high and active low. The use of  $C_{RST}$  can extend the power-on initial time. If the  $\overline{RST}$  pin is openned (without  $CRST$ ), the initial time is 40 seconds. See Figure 6.

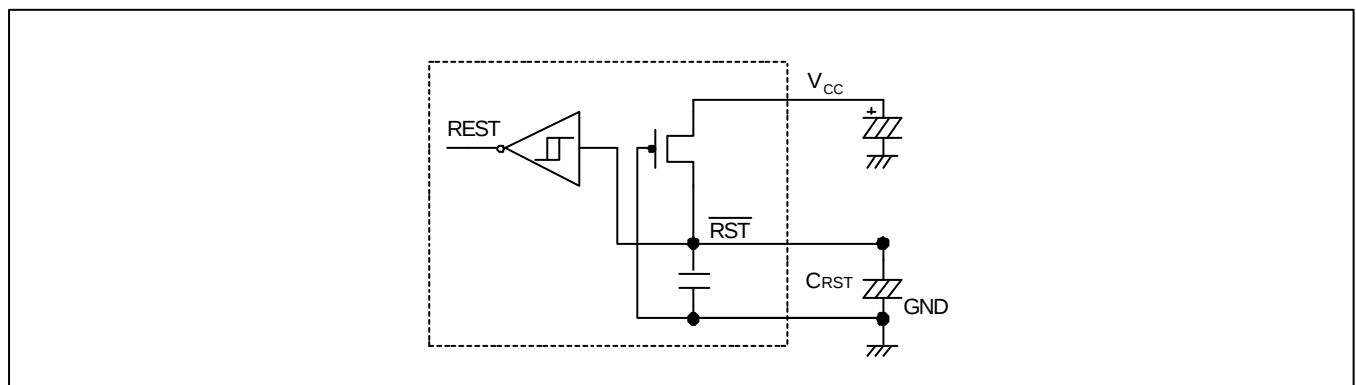
**Table 2. Operation Modes by MODE Pin**

| MODE Status | Operation Mode | Description                                                                                                                                                                        |
|-------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{CC}$    | ON             | Output is always ON: RELAY pin sends high level for relay driving; TRIAC pulse train output is synchronized by ZC for triac driving.                                               |
| GND         | OFF            | Output is always OFF: RELAY pin sends low level for relay driving; TRIAC pin sends high level for triac driving.                                                                   |
| Open        | AUTO           | Outputs remain in the OFF state until activated by a valid PIR trigger input signal. When working in the AUTO mode, the device allows override control by switching the ZC signal. |

**Figure 5. Override Timing (for PT8A2621)**



**Figure 6.  $\overline{RST}$  Application Example**



### Power On Initial

The PIR signal amplifier requires a warm up period after power-on. The input should be disabled during this period.

In the AUTO mode within the first 40 seconds of the initial time the chip allows override control to enter the quickly install mode, After 40s of the initial time the chip allows override control between ON and AUTO. It will remain in the warm up period if the total initial time has not elapsed after returning to AUTO.

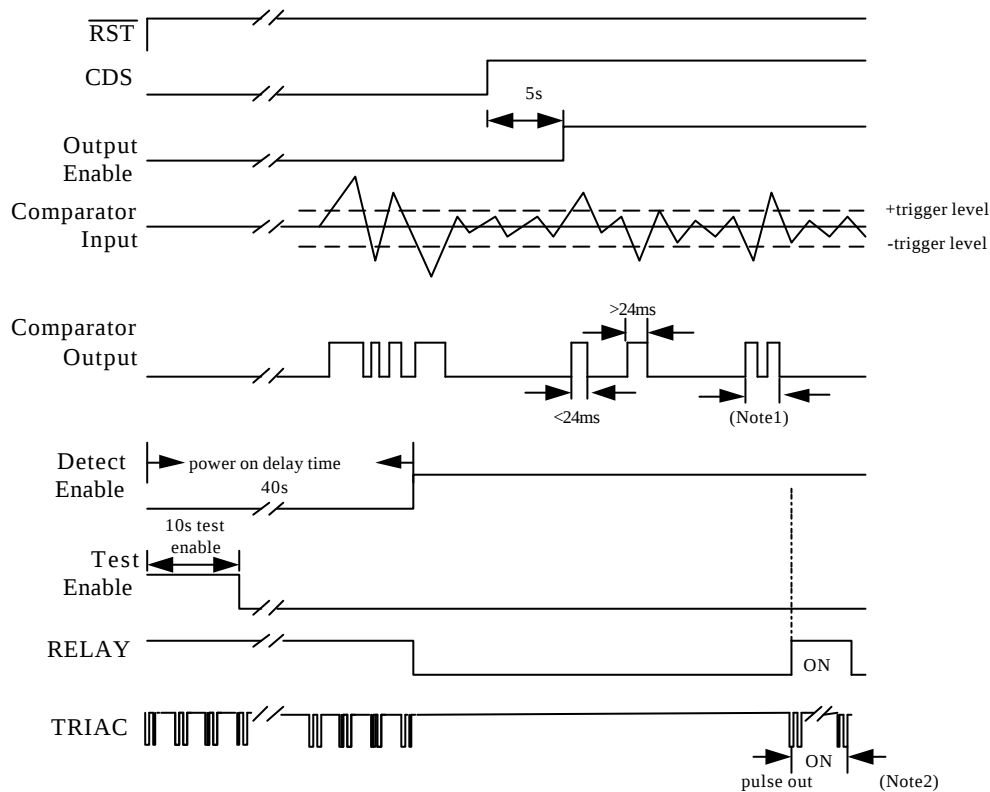
In case that the ZC signal disappears more than 3 seconds, the chip will restart the initialization operation. However, the re-start initial time is always 40 seconds and cannot be extended by adding  $C_{RST}$  to the  $\overline{RST}$  pin as shown in Figure 4.

### Trigger

The trigger timing is shown in Figure 7.

Retrigger -- If another signal is attained in trigger hold time, the circuit will be retriggered, and the trigger hold time will be started from this time.

**Figure 7. Trigger Timing**



- Notes:**
- The output is activated if the trigger signal conforms to the following criteria:
    - More than 3 triggers within 2 seconds,
    - A trigger signal sustain duration  $\geq 0.34$  seconds, and
    - 2 triggers within 2 seconds with pulse duration of one  $\geq 0.16$  seconds.
    - The effective comparator output width is 24ms. ( $F_{osc}=16KHz$ )
  - The output duration is set by an external RC connected to the OSCD pin.

## Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested)

|                                                                         |                 |
|-------------------------------------------------------------------------|-----------------|
| Storage Temperature .....                                               | -40°C to +125°C |
| Supply Voltage to Ground Potential (Inputs & V <sub>CC</sub> Only) .... | -0.3 to +6.0V   |
| Supply Voltage to Ground Potential (Outputs & D/O Only) .....           | -0.3 to +6.0V   |
| DC Input Voltage .....                                                  | -0.3 to +6.0V   |
| DC Output Current .....                                                 | 20mA            |
| Power Dissipation .....                                                 | 500mW           |

### Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Recommended Operation Conditions

| Sym               | Description                                        | Min                | Typ | Max                | Units |
|-------------------|----------------------------------------------------|--------------------|-----|--------------------|-------|
| V <sub>CC</sub>   | Supply Voltage                                     | 4.75               | 5.0 | 6.0                | V     |
| V <sub>IH</sub>   | Input HIGH Voltage(MODE, $\overline{\text{RST}}$ ) | 0.8V <sub>CC</sub> | -   | -                  | V     |
| V <sub>IL</sub>   | Input LOW Voltage(MODE, $\overline{\text{RST}}$ )  | -                  | -   | 0.2V <sub>CC</sub> | V     |
| f <sub>SYS</sub>  | System Oscillator Frequency                        | 12.8               | 16  | 19.2               | kHz   |
| f <sub>DOSC</sub> | Delay Oscillator Frequency                         | 12.8               | 16  | 19.2               | kHz   |
| T <sub>A</sub>    | Operation Temperature                              | -25                | 25  | 70                 | °C    |

## DC Electrical Characteristics

| Sym              | Description                              | Test Conditions        | Min  | Typ | Max | Units  |
|------------------|------------------------------------------|------------------------|------|-----|-----|--------|
| I <sub>IH</sub>  | Input high level leakage current(ZC,CDS) | V <sub>IH</sub> = 4.5V | -0.1 | -   | 0.1 | μA     |
| I <sub>IL</sub>  | Input low level leakage current(ZC,CDS)  | V <sub>IL</sub> = 0.5V | -0.1 | -   | 0.1 | μA     |
| I <sub>OH</sub>  | Output Source Current (RELAY, TRIAC)     | V <sub>OH</sub> = 4.5V | -6   | -   | -   | mA     |
| I <sub>OL</sub>  | Output Sink Current (RELAY, TRIAC)       | V <sub>OL</sub> = 0.5V | 15   | -   | -   | mA     |
| V <sub>TH1</sub> | CDS Transfer High Voltage                |                        | 3.0  | 3.2 | 3.6 | V      |
| V <sub>TL1</sub> | CDS Transfer Low Voltage                 |                        | 1.5  | 1.7 | 2.1 | V      |
| V <sub>TH2</sub> | ZC Transfer High Voltage                 |                        | 2.6  | 2.9 | 3.2 | V      |
| V <sub>TL2</sub> | ZC Transfer Low Voltage                  |                        | 1.0  | 1.4 | 1.6 | V      |
| V <sub>TH3</sub> | OSCS Transfer High Voltage               |                        | 2.2  | 2.4 | 2.8 | V      |
| V <sub>TL3</sub> | OSCS Transfer Low Voltage                |                        | 1.0  | 1.4 | 1.6 | V      |
| V <sub>TH4</sub> | OSCD Transfer High Voltage               |                        | 2.2  | 2.4 | 2.8 | V      |
| V <sub>TL4</sub> | OSCD Transfer Low Voltage                |                        | 0.4  | 0.6 | 0.8 | (ZC,)V |

**Note:** These specifications apply for V<sub>CC</sub> = 5.0V and -25°C ≤ T<sub>A</sub> ≤ 70°C, unless otherwise specified.

## AC Electrical Characteristics

### Voltage Regulator

| Sym              | Description               | Test Conditions                            | Min | Typ | Max | Units |
|------------------|---------------------------|--------------------------------------------|-----|-----|-----|-------|
| $V_{EE}$         | Output Voltage            | No load                                    | 3.2 | 3.6 | 4.0 | V     |
| $V_{OP2P}$       | Noninverting input of OP2 | No load                                    | 1.6 | 1.8 | 2.0 | V     |
| $\Delta V_O$     | Line Regulation           | $4.5V \leq V_{CC} \leq 5.5V$ , $I_L = 1mA$ | -   | 30  | 50  | mV    |
| $\Delta V_{LDR}$ | Load Regulation           | $V_{CC} = 5V$ , $0.5mA \leq I_L \leq 2mA$  | -   | 60  | 100 | mV    |
| $I_L$            | Regulator Output Current  | $V_{CC} = 5V$                              | 4   | -   | -   | mA    |

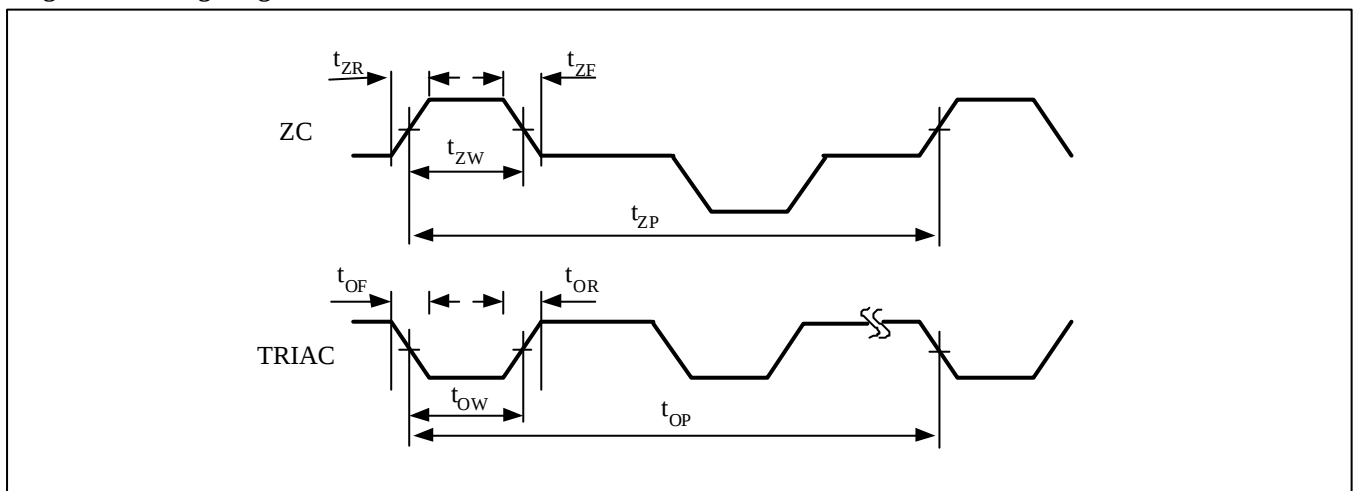
### Operational Amplifier and Window Comparator

| Sym      | Description                  | Test Conditions | Min | Typ  | Max | Units |
|----------|------------------------------|-----------------|-----|------|-----|-------|
| BW       | 3dB Bandwidth                | -               | 10  | -    | -   | kHz   |
| $V_{TH}$ | Windows Comparator Threshold | $V_{CC} = 5V$   | 1.9 | 2.05 | 2.2 | V     |
| $V_{TL}$ |                              | $V_{CC} = 5V$   | 1.4 | 1.55 | 1.7 | V     |

**Oscillator and ZC Input Pulse and Trigger Output Pulse**

| Sym       | Description           | Test Conditions                                                   | Min  | Typ  | Max  | Units   |
|-----------|-----------------------|-------------------------------------------------------------------|------|------|------|---------|
| $f_{OSC}$ | Oscillator Frequency  | $V_{CC} = 5V, R_s = 560\Omega,$<br>$C_s = 200pF$ , see above fig1 | 12.8 | 16   | 19.2 | kHz     |
| $t_{ZR}$  | ZC Pulse Rise Time    |                                                                   | -    | 30   | 100  | ns      |
| $t_{ZF}$  | ZC Pulse Fall Time    |                                                                   | -    | 30   | 100  | ns      |
| $t_{ZP}$  | ZC Pulse Period       |                                                                   | 15.1 | 20   | 22.2 | ms      |
| $t_{ZW}$  | ZC Pulse Width        |                                                                   | 0.8  | 1    | -    | ms      |
| $t_{OR}$  | TRIAC Pulse Rise Time |                                                                   | -    | 30   | 100  | ns      |
| $t_{OF}$  | TRIAC Pulse Fall Time |                                                                   | -    | 30   | 100  | ns      |
| $t_{OP}$  | TRIAC Pulse Period    |                                                                   | 6.6  | 10   | 11   | ms      |
| $t_{OW}$  | TRIAC Pulse Width     |                                                                   | 52   | 62.5 | 76   | $\mu s$ |

**Figure 8. Timing Diagram**

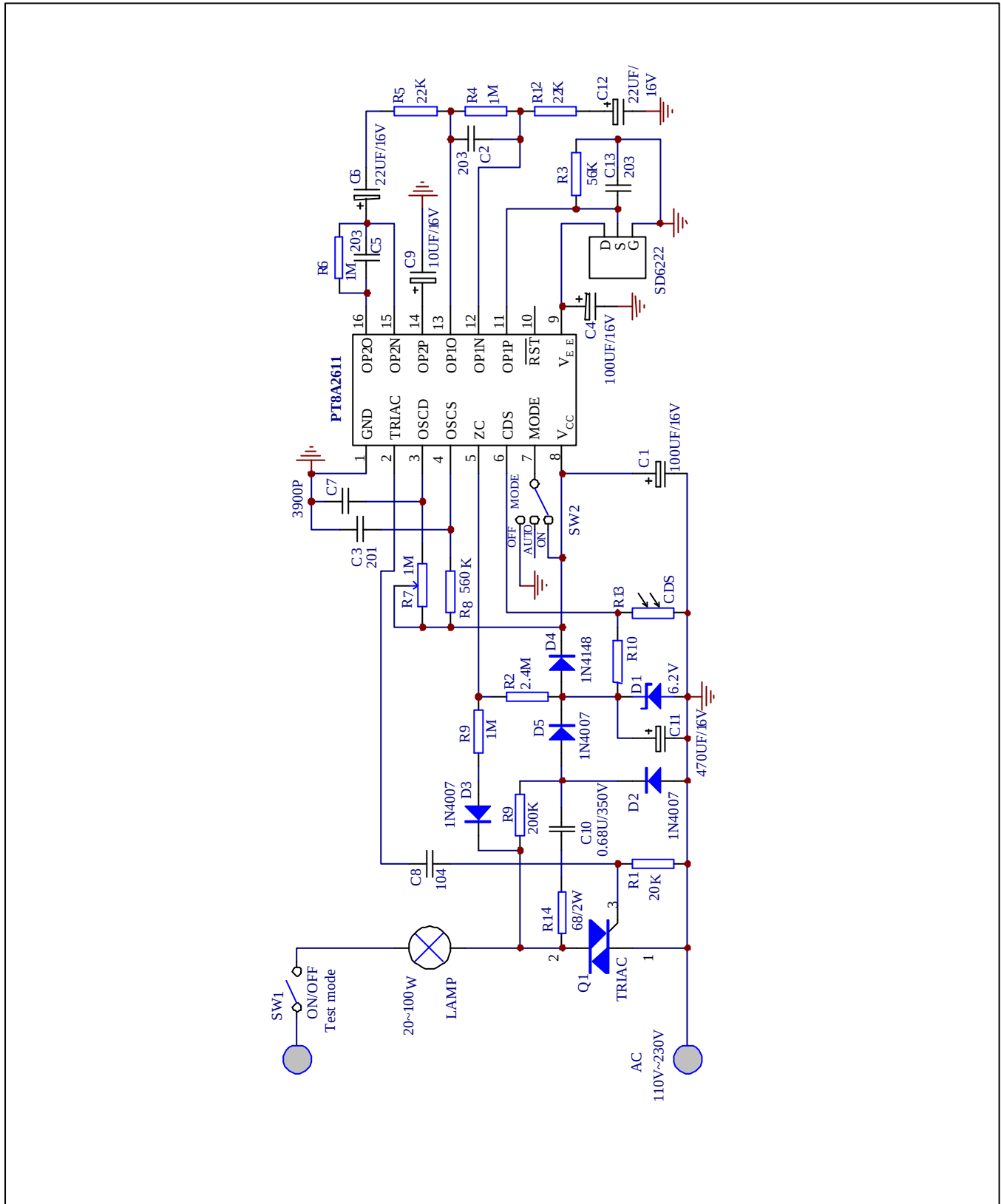


**Power Dissipation**

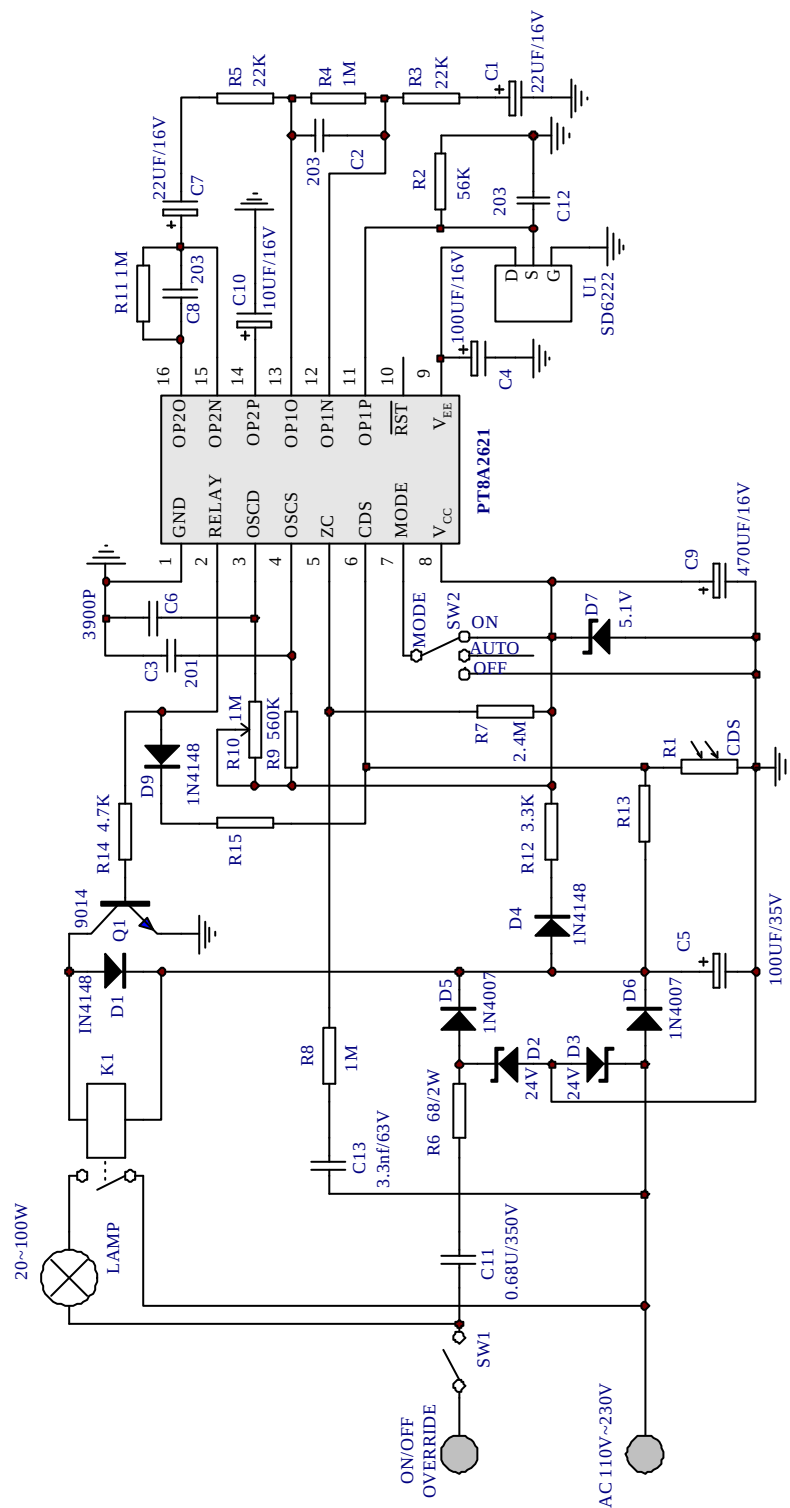
| Sym       | Description                    | Test Conditions                                                                                                                               | Min | Typ | Max | Units   |
|-----------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|---------|
| $I_{CC}$  | Power Supply Current           | $V_{CC} = 5V, R_s = 560k\Omega, C_s = 200pF,$<br>$R_D = 560k\Omega, C_D = 200pF,$<br>other input pins = GND, all<br>outputs float. see fig1,2 | -   | 80  | 100 | $\mu A$ |
| $I_{CCQ}$ | Quiescent Power Supply Current | $V_{CC} = 5V$ , All Input Pins = GND,<br>all outputs float.                                                                                   | -   | 60  | 80  | $\mu A$ |

## Typical Application Circuits

Figure 9. Two-Wire Application Circuit of PT8A2611



### Figure 10. Three-Wire Application Circuit of PT8A2621



**Notes**

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