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SS0613

TOUCH CONTROLLED CONTINUOUS DIMMER AND AC MOTOR SPEED CONTROLLER

GENERAL DESCRIPTION

SS0613 is a high performance CMOS touch control continuous dimmer specifically designed for brightness and ON/OFF control of incandescent lamps or speed control of AC motors. SS0613 controls lamp or AC motor by controlling the firing angle of a triac connected with the lamp or AC motor. All internal timings are synchronized with the line frequency by a phase lock loop circuit and output occurs once every half cycle of line frequency.

The brightness/speed of the output is controlled by applying a low level at the SENSOR input or high level at the SLAVE input.

Functions are implemented with very few interface components, see application sample circuit.

If the sensor is touched briefly, about 50ms to 332ms,lamp or AC motor is:

(a) Turned off it if it was on.
(b) Turned on it if it was off. The brightness/speed result is full or depending on the circuit type, a previous brightness/speed stored in memory.

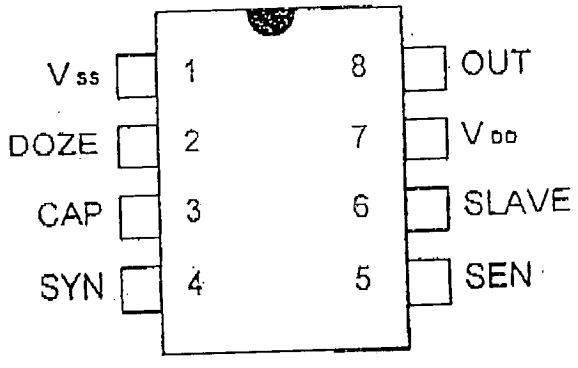
If the sensor is touched more than 350ms, light intensity slowly changes and continues to change if touch is maintained, The direction of change reverses whenever the maximum or minimum is reached.

The circuit also provides an input for slow dimming. When slow clock is applied to this input, lamp can be dimmed solwly until total turn off occurs.

FEATURES

High performance CMOS with continuous function and high sensitive touch control feature, can be used on metal sensor plate
*Phase-locked loop synchronization allows use in a wall switch and produces pure AC waveform across output load
*Provides brightness control of incandescent lamp and speed control of AC motor without use of mechanical switch
*Has speed control of AC motor, like shaded pole and universal series motors
*Control Duty Cycle from 23% to 88%.(conduction angles for AC half cycles between 41° and 159° respectively)
*Operated on 50Hz/60Hz line frequency
*Wind range from 3V to 12V DC supply voltage
*Input for extensions or remote sensors
*Input for slow dimming
*Provides control through transformers for low voltage lighting applications
*8-pin plastic DIP

PIN DIAGRAM



TOP VIEW

Vss (Pin 1)
Supply voltage positive terminal.

DOZE (Pin 2)
A clock applied to this input causes brightness to decrease in equal increments with each negative transition of the clock. Eventually, when the lamp is off, this input has no further effect. The lamp can be turned on again by activating either the SENSOR input or the SLAVE input. For the transition from maximum brightness to off, a total of 83 clock pulses are needed at the DOZE input.
When SENSOR or SLAVE Input is active, DOZE input is disabled.

CAP (Pin 3)
CAP input is for external component connection for the PLL filter capacitor.

SYN (Pin 4)
The AC line frequency (50Hz/60Hz), synchronizes all internal timings through a phase locked loop. The signal for this input maybe obtained from the line voltage by employing the circuit arrangement shown in the application notes.

SEN (Pin 5)
A low level applied to the SEN input controls the turn on or turn off of output as well as its phase angle with respect to the SYN input. See general description and SENSOR DURATION TABLE.

SLAVE (Pin 6)
The SLAVE input is functionally similar to the SEN input with the exception of active level which is a logical high compared to the logical low level for the SEN input. It is recommended that SLAVE input be used instead of SEN input when long extension wires are used between sensing plates/switches and dimmer chips.

VDD (Pin 7)
Supply voltage negative terminal.

OUT (Pin 8)
The output is a low level pulse occuring once every half cycle of the synchro signal. The phase angle "Ø" of the output in relation to the synchro signal controls lamp brightness.

SENSOR / TOUCH DURATION TABLE				DIMMING DIRECTION REVERSAL
MOMENTARY (32ms to 332ms) *Note 1		PROLONGED (More than 332ms) *Note 1		
PRE-TOUCH BRIGHTNESS	POST-TOUCH BRIGHTNESS	PRE-TOUCH BRIGHTNESS	POST-TOUCH BRIGHTNESS	
Off	Memory *Note 2	Off	Starts varying at Memory *Note 3	YES
Max.	Off	Max.	Starts varying at Max.	N/A
Intermediate	Off	Intermediate	Starts varying at Pre-Touch Brightness	YES

Note 1: The time figure is based on 60Hz synchro frequency. For 50Hz figures are 39ms and 399ms.
Note 2: "Memory" refers to brightness stored in memory. Brightness is stored in the memory when light is turned off by momentary sensor touch. After first power-up, momentary touch produces max. brightness.
Note 3: First time after power-up, prolonged touch causes intensity to vary starting at min.

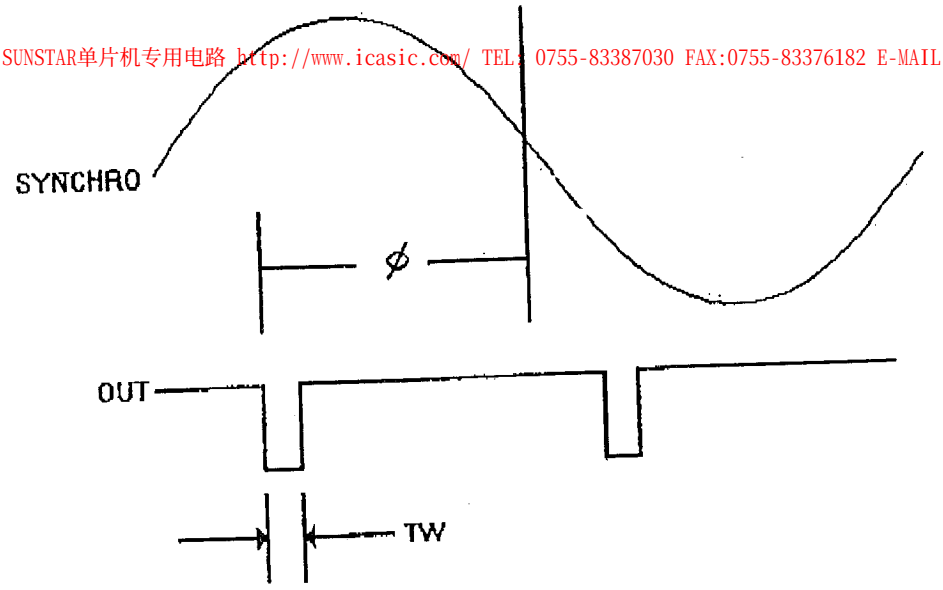
SYMBOL	PARAMETER	MIN.	TYP	MAX.	UNIT
fs	AC Frequency	40	60	70	Hz
Ts1	Sensor Duration (On/Off)	50	—	332	ms
Ts2	Sensor Duration (Dimming)	350	—	Infinite	ms
Df	Doze Frequency	—	—	500	Hz
TW	Output Pulse Width	—	33	—	us
Phase	Output Phase-Angle	41	—	159	degrees
—	Max to Max Dimming Time	—	7.64	—	sec
—	A1B1=B2A2 Duration		934	—	ms
—	B1B2 Min Intensity Dwell	—	500	—	ms

**Note: In the circuit arrangement described in application notes, synchro input signal is delayed in phase to line frequency by about 7^{o} resulting in a ∅ range between 34^{o} and 159^{o}. With higher R-C value the phase angle may be shifted down further.

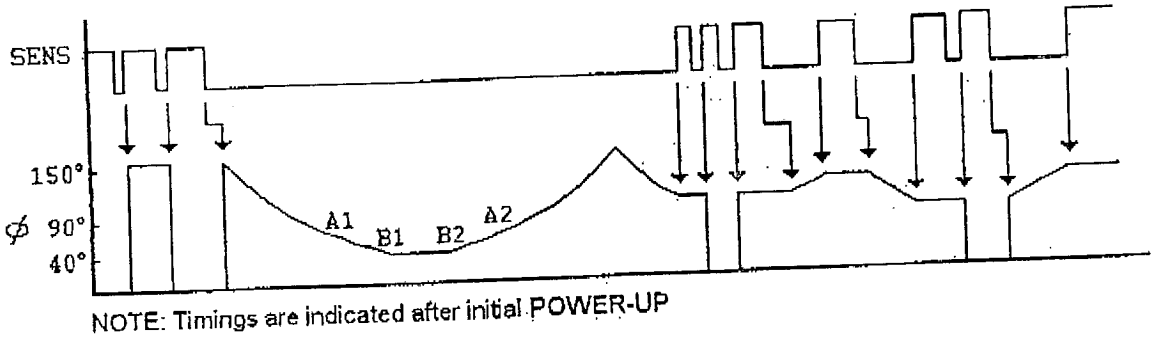
In continuous dimming operation (when the sensor input is continuously held low) the output phase angle ∅ sweeps up and down between 41% and 159% continuously. The time vs ∅ curve, however is not a linear one (Page 4). Between two maximum on this curve, there are 4 discontinuous points labeled A1、B1、B2、A2. The discontinuities are as follows:

1. From maximum to A1. In this region, ∅ is changed by equal increments ($\triangle\varnothing$) for every 2 synchro clocks.
2. From A1 to B1. In this region, the increments ($\triangle\varnothing$) take place for every 4 synchro clocks.
3. From B1 to B2. In this region ∅ is held at a constant level ($\triangle\varnothing=0$).
4. From B2 to A2. Same as 2. / From A2 to Maximum. Same as 1.

The slower rate of change in ∅ over A1 B1 B2 A2 region is to accommodate for eye adjustment at lower light intensity.



OUTPUT PHASE ANGLE

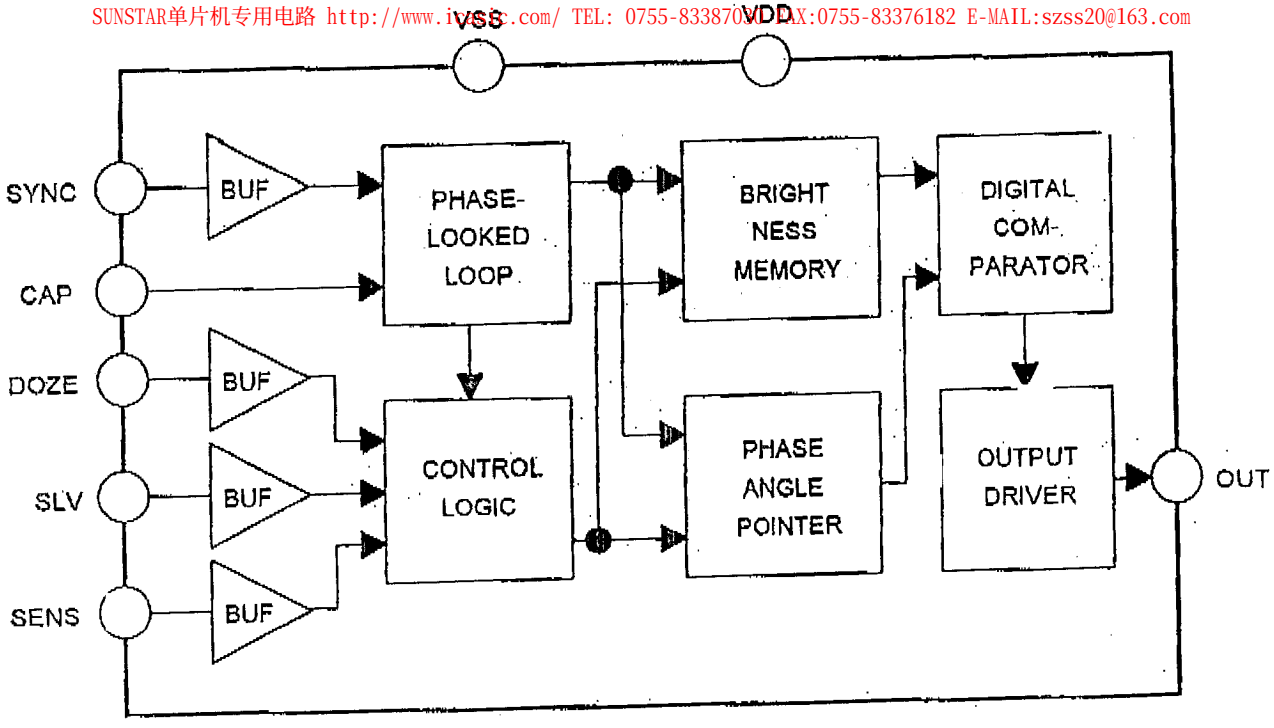


OUTPUT PHASE-ANGLE, ø, VS SENSOR INPUT

SYMBOL	PARAMETER	VALUE	UNIT
Vss	DC Supply Voltage	+15	Volt
V IN	Any Input Voltage	Vss - 15 to Vss + 0.5	Volt
T A	Operation Temperature	-20 to +70	^{0}C
Tstg	Storage Temperature	-40 to +125	^{0}C

DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	MIN.	TYP	MAX.	UNIT	Conditions
Vss	Supply Voltage	3	5	12	Volt	
Iss	Supply Current	—	400	600	uA	* Vss =+5V, output off
V IH	High Level Input Voltage	2	3	8	Volt	
V IL	Low Level Input Voltage	1	2	5	Volt	
Ios	Output Sink Current	—	10	—	mA	* Vss =+5V, V OL= Vss-4
VOH	Output High Voltage	—	5	—	Volt	
VOL	Output Low Voltage	—	1.5	—	Volt	



APPLICATION EXAMPLES

Implementation of the light dimmer/AC motor speed controller circuit is shown in Page 7 & 8. Here the brightness of the lamp (motor speed) is set by touching the sensor plate. The function of different components are as follows:

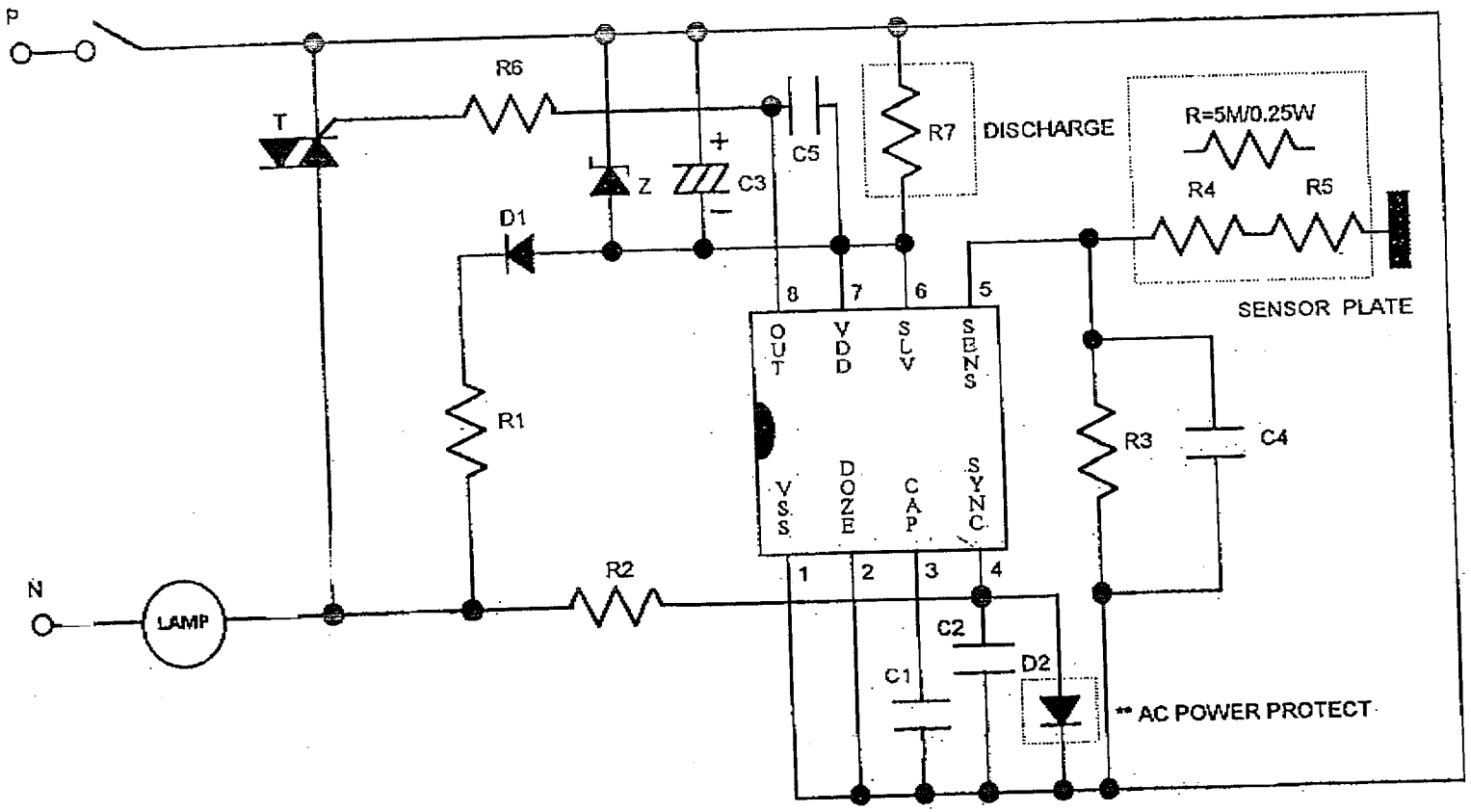
- *The 5V DC supply for the chip is provided by Z, D, R1and C3.
- *R2 and C2 generate the filtered signal for the SYNC input for synchronizing the internal PLL with the line frequency.
- *R3, R4 and R5 set up the sensitivity of the SENS input. C4 provides noise filtering.
- *C1 is the filter capacitor for the internal PLL.
- *R6 provides current limiting and isolation between the chip output and the triac gate.
- *C6 and L are RF filter circuit. (Page 8)
- *R7 and C7 sunbber network may be required for some inductive loads. (Page 8)

In case of momentary power failure, circuit state remains unchanged for up to 1 sec. Output is shut off during long power interruption.

A TYPICAL LAMP DIMMER CONTROLLER APPLICATION CIRCUIT WHEN NEUTRAL NOT AVAILABLE

(FOR 5V OPERATION VOLTAGE)

SS0613



110V

C1 = 0.047uF
C2 = 4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
R1 = 22K or 39K/1W
R2 = 1.5M/0.25W

R3 = 100K to 500K/0.25W (select for sensitivity)
R4,R5 = 2.7M/0.25W
R6 = 100/0.25W
R7 = 10K/0.25W
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL500D or Q4004L4 Triac

220V

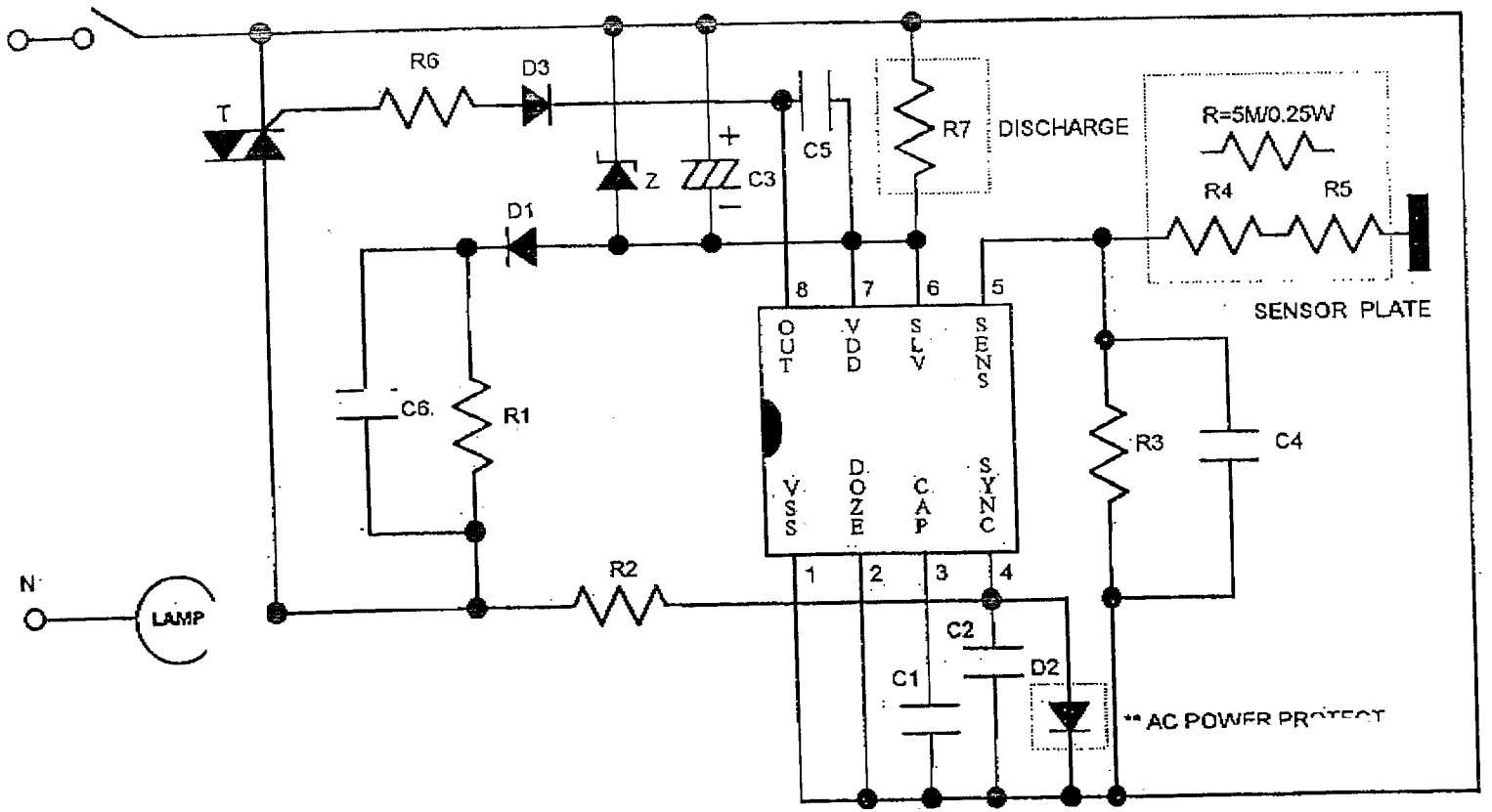
C1 = 0.047uF
C2 = 4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
R1 = 39K/2W
R2 = 1.5M/0.25W

R3 = 100K to 500K/0.25W (select for sensitivity)
R4,R5 = 4.7M/0.25W
R6 = 100/0.25W
R7 = 10K/0.25W
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL5004 L4 Triac

A TYPICAL LAMP DIMMER CONTROLLER APPLICATION CIRCUIT WHEN NEUTRAL NOT AVAILABLE

(FOR 9 ~ 12V OPERATION VOLTAGE)

SS0613



110V

C1 = 0.047uF
C2 = 4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
C6 = 224/200V
R1 = 22K or 39K/1W
R2 = 1.5M/0.25W

R3 = 100K to 500K/0.25W (select for sensitivity)
R4,R5 = 2.7M/0.25W
R6 = 100/0.25W
R7 = 10K/0.25W
D1,D2,D3 = 1N4148
Z = 5.6V/0.5W
T = TL500D or Q4004L4 Triac

220V

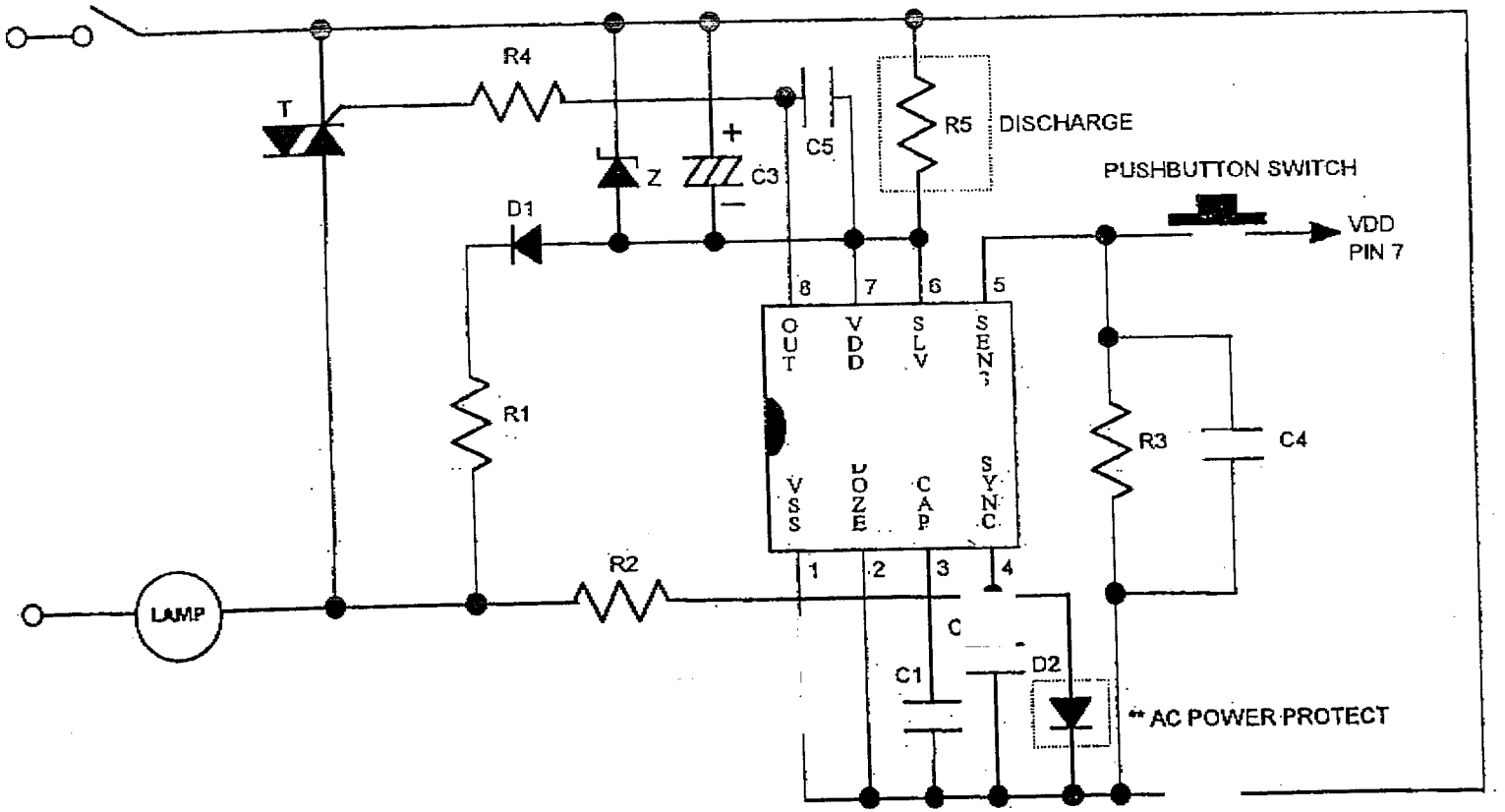
C1 = 0.047uF
C2 = 4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
C6 = 224/400V
R1 = 39K/2W
R2 = 1.5M/0.25W

R3 = 100K to 500K/0.25W (select for sensitivity)
R4,R5 = 4.7M/0.25W
R6 = 100/0.25W
R7 = 10K/0.25W
D1,D2,D3 = 1N4148
Z = 5.6V/0.5W
T = TL5004 L4 Triac

A TYPICAL FOOT OPREATED LAMP DIMMER APPLICATION CIRCUIT

SS0613

(FOR 5V OPERATION VOLTAGE)



110V

C1 = 0.047uF
C2 =4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
R1 = 22K or 39K/1W
R2 = 1.5M/0.25W

R3 = 100K to 500K/0.25W
(select for sensitivity)
R4 = 100/0.25W
R5 = 10K/0.25W
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL500D or
Q4004L4 Triac

220V

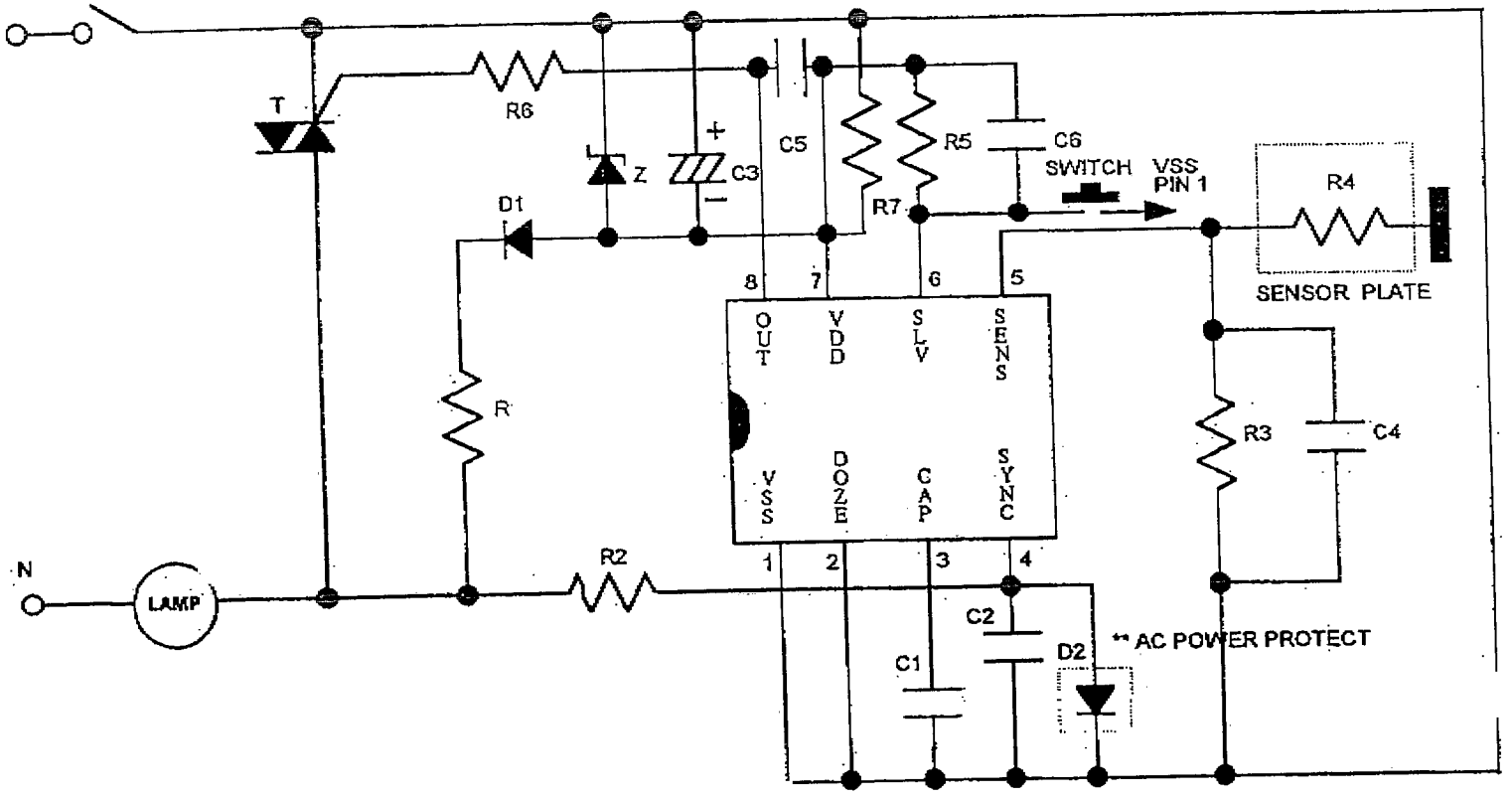
C1 = 0.047uF
C2 =4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
R1 = 39K/2W
R2 = 1.5M/0.25W

R3 = 100K to 500K/0.25W
(select for sensitivity)
R4 = 100/0.25W
R5 = 10K/0.25W
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL5004 L4 Triac

A TYPICAL LAMP DIMMER WITH SWITCH CONTROL APPLICATION CIRCUIT

(FOR 5V OPERATION VOLTAGE)

SS0613



110V

C1 = 0.047uF
C2 =4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
C6 = 0.1uF
R1 = 22K or 39K/1W
R2 = 1.5M/0.25W

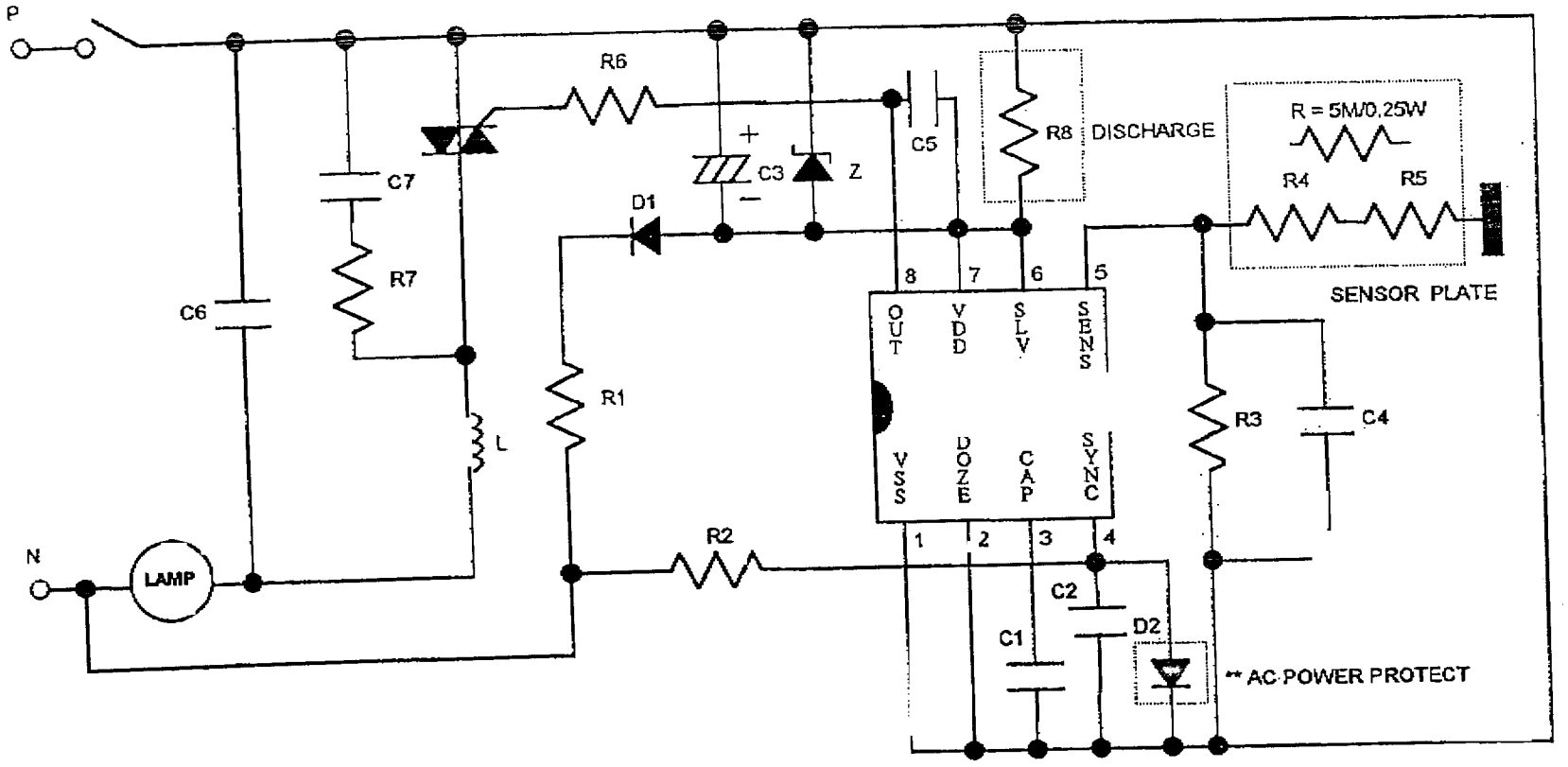
R3 = 100K to 500K/0.25W
(select for sensitivity)
R4 = 5M/0.25W
R5 = 56K/0.25W
R6 = 100/0.25W
R7 = 10K/0.25W (Discharge)
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL500D Ttiac

220V

C1 = 0.047uF
C2 = 4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
C6 = 0.1uF
R1 = 39K/2W
R2 = 1.5M/0.25W

R3 = 100K to 500K/0.25W
(select for sensitivity)
R4 = 5M/0.25W
R5 = 56K/0.25W
R6 = 100/0.25W
R7 = 10K/0.25W (Discharge)
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL5004 L4 Triac

A TYPICAL LAMP DIMMER CONTROLLER APPLICATION CIRCUIT WHEN NEUTRAL AVAILABLE



110V

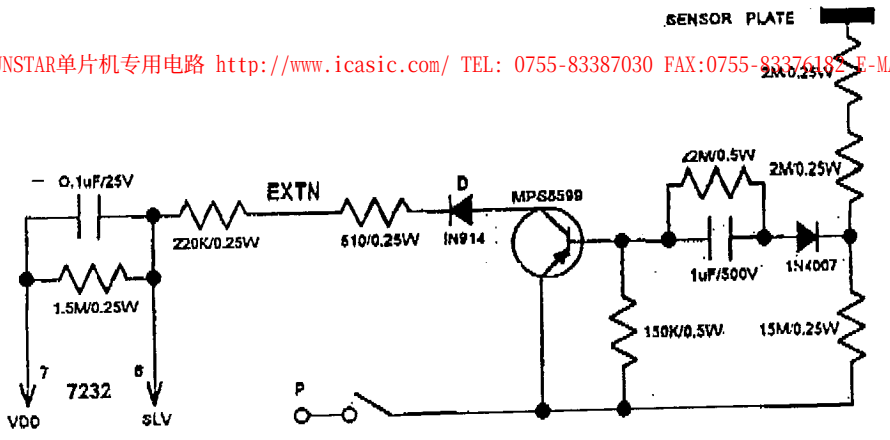
C1 = 0.047uF
C2 = 4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
C6 = 0.15uF/150VAC
C7 = 0.047uF/150VAC
R1 = 22K or 39K/1W
R2 = 1.5M/0.25W

R3 = 200K to 500K/0.25W
(select for sensitivity)
R4,R5 = 2.7M/0.25W
R6 = 100/0.25W
R7 = 1.8K/1W
R8 = 10K/0.25W
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL500D or
Q4004L4 Triac (Typical)
L = 100uH (RFI Filter)

220V

C1 = 0.047uF
C2 = 4700pF
C3 = 47uF/16V
C4 = 680pF
C5 = 0.1uF
C6 = 0.15uF/300VAC
C7 = 0.047uF/300VAC
R1 = 39K/2W
R2 = 1.5M/0.25W

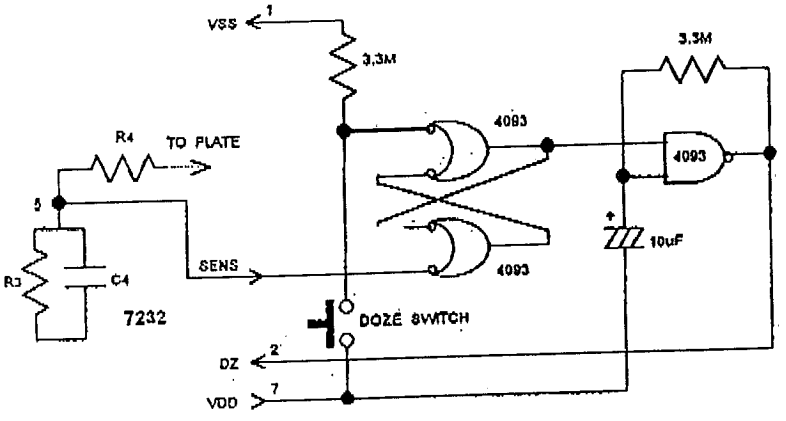
R3 = 200K to 500K/0.25W
(select for sensitivity)
R4,R5 = 4.7M/0.25W
R6 = 100/0.25W
R7 = 1.8K/2W
R8 = 10K/0.25W
D1,D2 = 1N4148
Z = 5.6V/0.5W
T = TL5004 L4 Triac (Typical)
L = 200uH (RFI Filter)



**NOTE: Connection between Pin 6 and Pin 7 should be broken when SLAVE is used.

All switching and dimming functions can also be implemented by utilizing the SLAVE input. This can be done by a mechanical switch or electronic switch with a sensing plate. When plate is touched, a logical high level is generated at the EXTENSION terminal for both half cycles of the line frequency.

DOZE APPLICATION CIRCUIT



** NOTE: Connection between Pin 1 and Pin 2 should be broken when DOZE circuit is used.

The DOZE circuit generates a slow clock (0.04Hz) at the DZ terminal. If the sensor plate (Page 7) is not touched, the SENS terminal of the DOZE circuit sits at a logical high level. A momentary pressing of the DOZE switch sets the SR flip-flop, enabling the oscillator. Every negative transition of the clock (DZ terminal) causes the light intensity to be reduced by equal increments, until light is shut-off. The oscillator has no further effect on the dimmer circuit. When light is turned on again by touching the sensor plate, SR flip-flop is reset and DZ clock is turned off.

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