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TOUCH CONTROL LAMP DIMMER

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FEATURES:

- Phase-lock loop synchronization allows use in Wall Switch applications.
- Provides brightness control of incandescent lamps with touch plates or pushbutton switches.
- Controls the duty cycle from 23% to 88% (conduction angles for AC half-cycles between 41° and 158°, respectively.)
- Operates at 50Hz/60Hz line frequency.
- Extension input for remote activation.
- +12V to +18V Power Supply voltage (Vss VDD).
- LS7232ND (DIP); LS7232ND-S (SOIC) See Figure 1

DESCRIPTION:

LS7232ND is a MOS integrated circuit designed to control brightness of incandescent lamps. The output of this IC controls the brightness of a lamp by controlling the firing angle of a triac connected in series with the lamp. All internal timings are synchronized with the line frequency by means of a built-in phaselock loop circuit. The output occurs once every half-cycle of the line frequency. Within the half-cycle, the output can be positioned anywhere between 158° conduction angle for maximum brightness and 41° conduction angle for minimum brightness in relation to the AC line frequency. The positioning of the output is controlled by applying a low level at the SENS input or a high level at the EXT input.

These functions may be implemented with very few interface components, as shown in Figure 5. When implemented in this manner, touching of the Touch Plate causes the lamp brightness to change as follows:

- If the Touch Plate is touched momentarily (42ms to 333ms), the lamp is:
 - a) turned off if it was on,
 - b) turned on if it was off.

The brightness resulting is either full brightness or, depending on the mode, a previous brightness stored in the IC memory.

If the Touch Plate is touched for a prolonged time (more than 342ms) the light intensity changes slowly. As long as the touch is maintained, the change continues; the direction of change reverses whenever the maximum or minimum brightness is reached.

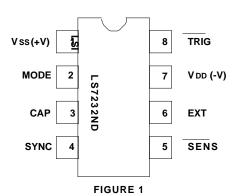
INPUT/OUTPUT DESCRIPTION:

Vss (Pin 1)

Supply voltage positive terminal.

The LS7232ND can operate in either of 3 modes, Mode 0, Mode 1 or Mode 2. A full description of the operating modes is provided in Table 1. The MODE input level selects the operating mode as follows:

PIN ASSIGNMENT - TOP VIEW



MODE Input	Mode	Functional Equivalent*
VDD	0	LS7231
Vss	1	LS7232
Float	2	LS7233

*NOTE: The LS7232ND can replace LS7231, LS7232 and LS7233 where the DOZE input is not used. The LS7232 PCB requires no change. The LS7233 PCB requires that the Pin 2 connection be opened. The LS7231 PCB requires that the Pin 2 connection be made to VDD instead of Vss.

CAP (Pin 3)

The CAP input is for the PLL filter capacitor. A 0.047µF capacitor should be connected to this input.

SYNC (Pin 4)

The AC Line Frequency is applied to this input through an external RC circuit (See Figure 5). The Phase-Lock Loop in the IC synchronizes all internal timings to the AC signal at the SYNC input.

SENS (Pin 5)

A low level activates this input (See Table 1) which controls the turn-on, turn-off and conduction angle, Ø (See Figure 3), of the TRIG signal with respect to the SYNC input.

EXT (Pin 6)

The EXT input is functionally identical to the SENS input except that a high level activates this input. It is recommended that the EXT input be used instead of the SENS input when long extension wires are employed between the IC and the Sensing Circuitry (See Figure 5 and Figure 6) because the EXT input is less susceptible to noise.

The functional differences of the modes of the LS7232ND are explained in Table 1 and the TRIG output conduction angle diagrams in Figure 4.

TABLE 1

MODE	TOUCH TYPE				DIMMING DIRECTION			
	SHORT (Ts1 [Ouration)	LON	REVERSAL (Note 3)				
	PRE-TOUCH Ø	POST-TOUCH Ø	PRE-TOUCH Ø	POST-TOUCH Ø	(Note 3)			
0	Off Max	Max Off	Off Max	Starts varying at Min Starts varying at Max	N/A N/A			
(LS7231)	Intermediate	Off	Intermediate	Starts varying at Pre-Touch brightness	NO			
1	Off	Memory (Note 1)	Off	Starts varying at Memory (Note 2)	YES			
(LS7232)	Max Intermediate	Off Off	Max Intermediate	Starts varying at Max Starts varying at Pre-Touch brightness	N/A YES			
2	Off Max Intermediate	Max Off Off	Off Max Intermediate	Starts varying at Min Starts varying at Max Starts varying at	N/A N/A			
(LS7233)	memediate	Oii	intermediate	Pre-Touch brightness	YES			

 $\textbf{NOTE 1: "Memory" refers to the conduction angle, \emptyset, which existed prior to the current off-state.}$

First time after power-up, the Memory value defaults to maximum conduction angle.

NOTE 2: First time after power-up, LONG touch causes intensity to vary starting at minimum conduction angle.

NOTE 3: NO = Dimming direction does not reverse from prior dimming direction.

YES = Dimming direction does reverse from prior dimming direction.

N/A = Does not apply

VDD (Pin 7)

Supply voltage negative terminal.

TRIG (Pin 8)

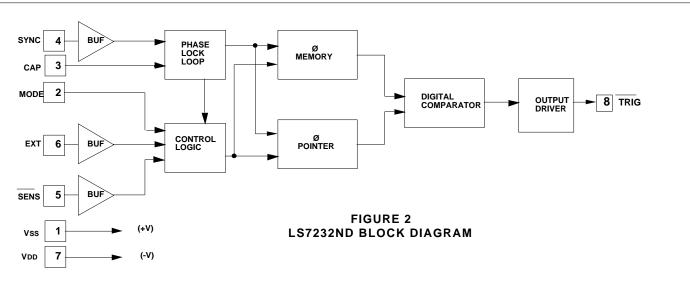
The TRIG output is a low level pulse occurring once every half-cycle of the SYNC input. The conduction angle, Ø, of the output in relation to the SYNC signal controls the lamp brightness.

In continuous dimming operation (i.e. when the $\overline{\text{SENS}}$ input is continuously held low) the TRIG conduction angle, \emptyset , sweeps up and down between 41° and 158° continuously. The time vs \emptyset curve is not linear (See Figure 4). Between two maxima 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, Ø is changed by equal increments (Ø) for every 2 SYNC clocks.
- 2. From A1 to B1. In this region, the increments (Ø) take place for every 4 SYNC clocks.
- 3. From B1 to B2. In this region \emptyset is held at a constant level ($\emptyset = 0$).
- 4. From B2 to A2. Same as 2.
- 5. From A2 to Max. Same as 1.

The slower rate of change in \emptyset over A1B1B2A2 region is to accommodate for eye adjustment at lower light intensity.



ABSOLUTE MAXIMUM RATINGS:					
PARAMETER	SYMBOL	VALUE	UNIT		
DC Supply Voltage	Vss	+20	V		
Any Input Voltage	Vin	Vss - 20 to Vss + 0.5	V		
Operating Temperature	TA	0 to +80	°C		
Storage Temperature	Tstg	-65 to +150	°C		

DC ELECTRICAL CHARACTERISTICS: (TA = 25°C, all voltages referenced to VDD)

PARAMETER Supply Voltage Supply Current	SYMBOL Vss Iss	MIN +12 -	TYP - 1.0	MAX +18 1.4	UNIT V mA	CONDITION - Vss = +15V, output off
Input Voltages:						·
SYNC Lo	Virl	0	_	Vss - 9.5	V	-
SYNC Hi	Virh	Vss - 5.5	_	Vss	V	-
SENS Lo	VIOL	0	_	Vss - 8	V	-
SENS Hi	VIOH	Vss - 2	_	Vss	V	-
EXT Lo	VIVL	0	_	Vss - 8	V	-
EXT Hi	VIVH	Vss - 2	_	Vss	V	-
Input Current:						
SYNC, SENS, EXT Hi	Іін	_	_	110	μΑ	With Series 1.5M
SYNC, SENS, EXT Lo	IIL	-	_	100	nA	Resistor to AC Line -
TRIG Hi Voltage	Voн	_	Vss	_	V	-
TRIG Lo Voltage	Vol	_	Vss - 8	_	V	Vss = +15V
TRIG Sink Current	los	25	_	_	mA	Vss = +15V
						VoL = Vss - 4V

TIMING CHARACTERISTICS (See Figures 2 and 3): All timings are based on fs = 60Hz, unless otherwise specified. 50Hz timings are 1.2 times 60Hz timings.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
SYNC Frequency	fs	40	-	70	Hz
SHORT TOUCH	Ts1	42	-	333	ms
(ON/OFF Operation)					
LONG TOUCH	Ts2	342	-	infinite	ms
(Dimming Operation)					
TRIG Pulse Width	Tw	-	33	-	μs
TRIG Conduction-Angle	Ø	41	-	158	deg
(See Note 1)					
Ø Period (Max to Max in	-	-	7.64	-	sec
continuous dimming)					
A1B1 = B2A2 duration	-	-	934	-	ms
B1B2 Min. intensity dwell	-	-	500	-	ms

NOTE 1.

In the circuit schematic shown in Figure 5, the SYNC input signal is delayed in phase with respect to the AC Line by about 7°. This delay reduces the conduction angle, Ø, with respect to the AC Line by 7° from the values shown above.

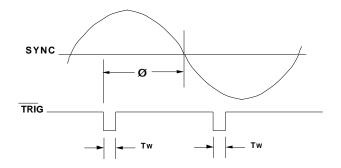


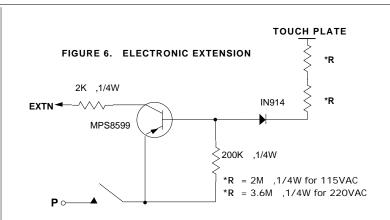
FIGURE 3. $\overline{\text{TRIG}}$ OUTPUT CONDUCTION ANGLE, Ø

APPLICATION EXAMPLE:

A typical implementation of a lamp dimmer circuit is shown in Fig. 5. Here the brightness of the lamp is set by touching the Touch Plate. The functions of different components are as follows:

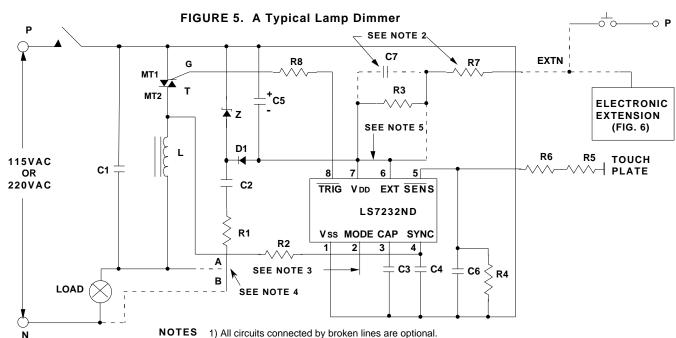
- The 15V DC supply for the chip is provided by Z, D1, R1, C2 and C5.
- R2 and C4 generate the filtered signal for the SYNC input for synchronizing the internal PLL with the line frequency.
- R3 and C7 act as a filter circuit for the electronic extension. If extensions are not used, the EXT input (Pin 6) should be tied to VDD (Pin 7).
- R4, R5, R6 set up the sensitivity of the SENS input. C6 provides noise filtering.
- C3 is the filter capacitor for the internal PLL.
- R8 provides current limiting and isolation between the chip output and the triac gate.
- C1 and L are RF filter circuits.

In the case of momentary power failure, the circuit state remains unchanged for a period of up to 1 sec. For longer power interruptions, the output is shut off.



EXTENSIONS:

All switching and dimming functions can be implemented by utilizing the EXT input. This can be done by either a pushbutton switch or the electronic switch in conjunction with a Touch Plate, shown in Figure 6. When the plate is touched, a logic high level is generated at the EXT input of the IC for both half- cycles of the line frequency. (See Figure 5)



- 2) C7 is used only with electronic extension and R7 is used only with mechanical switch.
- 3) See I/O Description for MODE (Pin 2)
- 4) Use Connection A when Neutral is not available. Use Connection B when Neutral is available.
- 5) Connection between Pin 6 & Pin 7 should be broken when EXT is used.

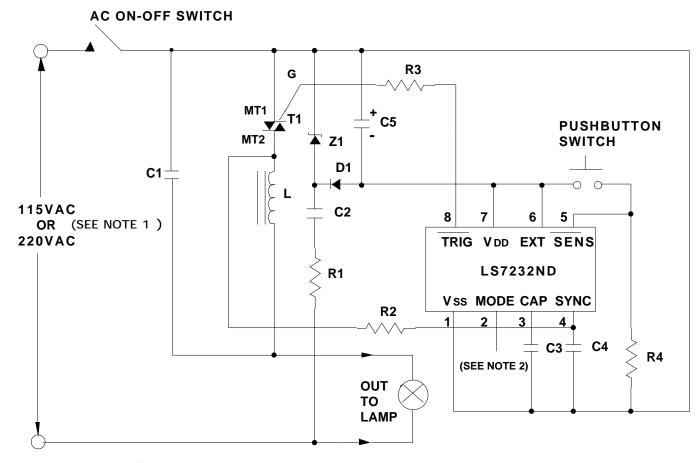
C1 = 0.15μF, 200V (1) C2 = 0.33μF, 200V C3 = 0.047μF, 25V C4 = 470pF, 25V C5 = 47μF, 25V C6 = 680pF, 25V	R4 = 1M to 5M , 1/4W (Select for sensitivity) R5, R6 = 2.7M , 1/4W R7 = 150k , 1/4W R8 = 100 , 1/4W D1 = IN4148
$C7 = 0.1 \mu F$, 25V (2) R1 = 270 , 1W R2 = 1.5M , 1/4W R3 = 1.5M , 1/4W	Z = 15V, 1W (Zener) T = Q4006L4 Triac (Typical) L = 100µH (RFI Filter)

- (1) For Connection A. Use 0.22µF for Connection B.
- (2) For Connection A. Use 1/4W for Connection B.

220V	
$C1 = 0.15\mu F$, 400V	R4 = 1M to $5M$, $1/4W$
(3) $C2 = 0.22 \mu F$, $400 V$	(Select for sensitivity)
$C3 = 0.047 \mu F, 25V$	R5, R6 = 4.7M , 1/4W
C4 = 470pF, 25V	R7 = 150k , 1/4W
$C5 = 47\mu F, 25V$	R8 = 100 , 1/4W
C6 = 680pF, 25V	D1 = 1N4148
$C7 = 0.1 \mu F, 25 V$	Z = 15V, 1W (Zener)
(4) R1 = 1k , 2W	T = Q5004L4 Triac (Typical)
R2 = 1.5M , 1/4W	L = 200µH (RFI Filter)
R3 = 1.5M , 1/4W	

- (3) For Connection A. Use 0.1µF for Connection B.
- (4) For Connection A. Use 1/4W for Connection B.

FIGURE 7. A SWITCH-OPERATED LAMP DIMMER



NOTE 1: Operation is independent of Line Plug Polarity

NOTE 2: See I/O Description for MODE (Pin 2)

115V
$C1 = 0.15 \mu F$, 200V
$C2 = 0.22 \mu F, 200 V$
$C3 = 0.047 \mu F, 25V$
C4 = 470pF, 25V
$C5 = 47\mu F$, 25V
R1 = 270 , 1/4W
R2 = 1.5M , $1/4W$
R3 = 100 , 1/4W
R4 = 1M , 1/4W
D1 = IN4148
Z1 = 15V, 1W (Zener)
T1 = Q4008L4 (Typical)
L = 100µH (RFI Filter)

220V

C1 = 0.15μ F, 400VC2 = 0.1μ F, 400VC3 = 0.047μ F, 25VC4 = 470pF, 25VC5 = 47μ F, 25VR1 = 1k , 1/4WR2 = 1.5M , 1/4WR3 = 100 , 1/4WR4 = 1M , 1/4WD1 = 1N4148Z1 = 15V, 1W (Zener) T1 = 0.15004 (Typical) L = 0.15μ F, 0.1500 (Zener)

APPLICATIONS:

- 1. Foot-Switch Dimmer for large floor lamps.
- 2. Hand-Switch Dimmer for end-table lamps.

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