Data Sheet

Dimmer switch IC LS7232

RS **stock number 655-616**

Description

The LS7232 is specifically designed for brightness or ON/OFF control of incandescent lamps used on the ac line. The output controls the brightness of a lamp by controlling the firing angle of a triac connected in series with the lamp. All internal timings are synchronised with the line frequency by means of a built-in phase locked loop circuit. The output occurs once every half cycle of the line frequency. Within the half cycle, the output can be positioned anywhere between 159° phase angle for maximum brightness and 41° phase angle for minimum brightness in relation to the line frequency. The positioning of the output is controlled by applying a low level at the sensor input or a high level at the extension input.

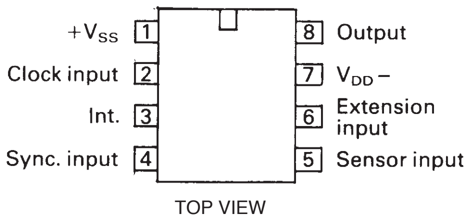
These functions may be implemented with very few interface components. When implemented in this manner a touching of the sensor plate causes the lamp brightness to change as follows:

1. If the sensor is touched momentarily (32ms to 332ms), the lamp is:
   a) turned off if it was on,
   b) turned on if it was off. The brightness to which the light is turned on is the previous brightness stored in the memory.
2. If the sensor is touched for a prolonged time (more than 332ms) 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.

   The circuit also provides an input for slow dimming. By applying a slow clock to pin 2, the lamp can be dimmed slowly until total turn off occurs. This feature can be useful in children's bedroom lights.

Features

- Provides ON/OFF or brightness control of incandescent lamps without the use of mechanical switches
- Controls brightness by controlling the 'duty cycle' hence reducing the power dissipation
- Controls the 'duty cycle' from 23% to 88% (on time angles for ac half cycles between 41° and 159° respectively)
- Operates on 50Hz/60Hz line frequency
- Input for extensions or remote sensors
- Input for slow running
- 12V to 18Vdc supply voltage
- Pin compatible with S576B.



Absolute maximum ratings

Parameter	Symbol	Value
dc supply voltage	VSS	+20Volts
Any input voltage	VIN	VSS + .5 Volts
Operating temperature	T_A	0 to +80°C
Storage temperature	Tstg	–65 to +150°C

Input/Output description:

+VSS (pin 1)
Supply voltage positive terminal.

CLOCK INPUT (pin 2)

A clock applied to this input caused the brightness to decrease in equal increments with each negative transition of the clock. Eventually, when the lamp becomes off, this input has no further effect. The lamp can be turned on again by activating either the SENSOR input or the EXTENSION input. For the transition from maximum brightness to off, a total of 83 clock pulses are needed at the CLOCK input.

When either the SENSOR or the EXTENSION input is active, the CLOCK input is disabled.

INT.(pin 3)

The Int. input is for external component connection. A capacitor of .047µF±20% or better should be used at this input.

SYNC. (pin 4)

The ac line frequency (50Hz/60Hz), when applied to this input, synchronises all internal timings through a phase locked loop. The signal for this input may be obtained from the line voltage by employing the circuit arrangement shown in the application notes.

SENSOR (pin 5)

A low level applied to the SENSOR input controls the turn on or turn off of the output as well as its phase angle with respect to the SYNC input.

EXTENSION (pin 6)

The EXTENSION input is functionally similar to the SENSOR input with the exception that the active level is a logical high as compared with the logical low level for the sensor input. It is recommended that the EXTENSION input be used instead of the SENSOR input when long extension wires are used between the sensing plates (or switches) and the dimmer chips.

–VDD (pin 7)

Supply voltage negative terminal.

OUTPUT (pin 8)

The OUTPUT is a low level pulse occurring every half cycle of the SYNC signal. The phase angle, Ø of the output in relation to the SYNC signal controls the lamp brightness.

In continuous dimming operation (ie. when the sensor input is continuously held low) the output phase angle, Ø sweeps up and down between 41° and 159° continuously. The time vs Ø curve, however, is not a linear one (see Figure 2). Between two maxima on this curve, there are four discontinuous points labelled A_1, B_1, B_2, A_2. The discontinuities are as follows:

1. From maximum to A_1. In this region, Ø is changed by equal increments (ΔØ) for every two synchro clocks.
2. From A_1 to B_1. In this region, the increments (ΔØ) take place for every four synchro clocks.
3. From B_1 to B_2. In this region Ø is held at a constant level (ΔØ=0).
4. From B_2 to A_2. Same as 2.

From A_2 to Maximum. Same as 1.

The slower rate of change in Ø over A_1 B_1 B_2 A_2 region is to accommodate for eye adjustment at lower light intensity.

dc electrical characteristics (T_A=0 to +80°C, all voltages referenced to VDD)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions/Remarks
Supply voltage	V_{SS}	+12	-	+18	Volts	
Supply current	I_{SS}		1.0	1.7	mA	@V_{SS} = +15V, output off
Input voltage						
Clock LO	V_{IL}	0	-	V_{SS} -6	Volts	
Clock HI	V_{IH}	V_{SS} –2	-	V_{SS}	Volts	
Sync LO	V_{IRL}	0	-	V_{SS} -9.5	Volts	
Sync HI	V_{IRH}	V_{SS} –5.5	-	V_{SS}	Volts	
Sensor LO	V_{IOL}	0	-	V_{SS} -8	Volts	
Sensor HI	V_{IOH}	V_{SS} –2	-	V_{SS}	Volts	
Extension LO	V_{IVL}	0	-	V_{SS} -8	Volts	
Extension HI	V_{IVH}	V_{SS} –2	-	V_{SS}	Volts	
Input current						
Sync HI	I_{IH}	-	-	700	µA	V_{input} = V_{SS} = +15V leakage current
Sync LO	I_L	-	-	15	nA	
Clock HI	-	-	-	5	nA	
Clock LO	-	-	-	5	nA	
Output HI voltage	-	-	V_{SS}	-	Volts	
Output LO voltage	-	-	V_{SS} –4	-	Volts	
Output sink current	-	25	-	-	mA	@ V_{SS} = +15V, V_O = V_{SS}–3

Frequency characteristics (Figures 1 and 2). All timings are based on f_s=60Hz, unless otherwise specified

Parameter	Symbol	Min.	Typ.	Max.	Unit
Sync. frequency	fs	40	-	70	Hz
Sensor duration (ON/OFF operation)	TS1	32	-	332	ms
Sensor duration (dimming operation)	TS2	332	-	infinite	ms
Clock frequency	-	-	-	500	Hz
Output pulse width	TW	40	-	55	µs
Output phase angle (Note 1)	0	41	-	159	degrees
Ø period (max. to max. in continuous dimming)	-	-	3.74	159	sec
A_1 B_1 = B_2 A_2, duration	-	-	934	-	ms
B_1 B_2, min intensity dwell	-	-	500	-	ms

Note 1. In the circuit arrangement described in the application notes, the sync input signal is delayed in phase in relation to the line frequency by about 6°, resulting in a Ø range between 35° and 152°. With higher R-C value the phase angle range may be shifted down further.

Figure 1 Output phase angle Ø

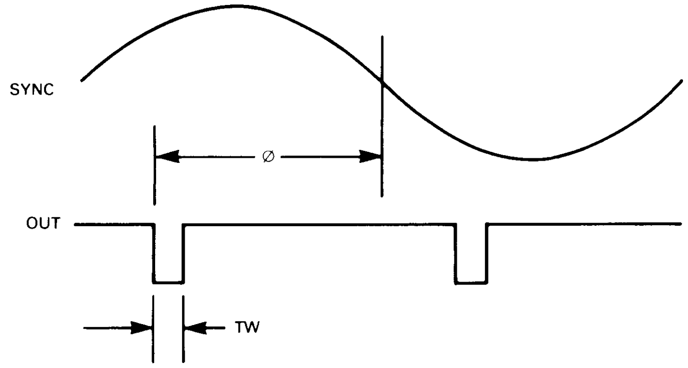


Figure 2 Output phase-angle, Ø vs. sensor input

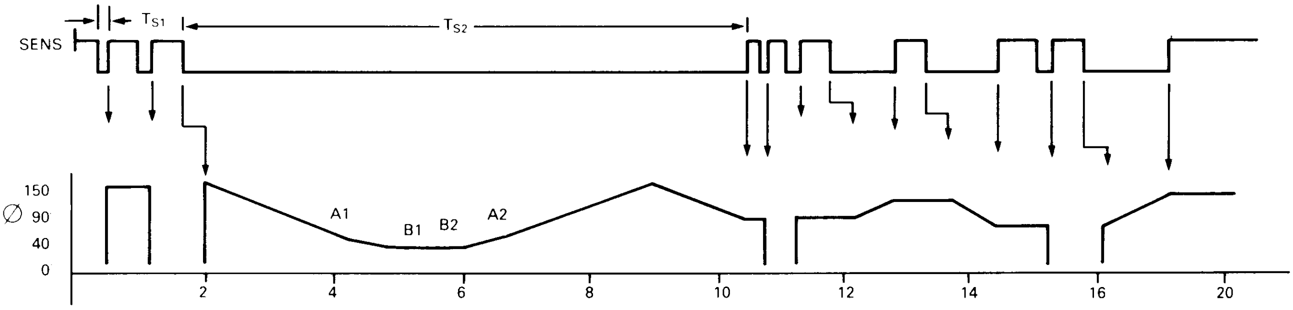
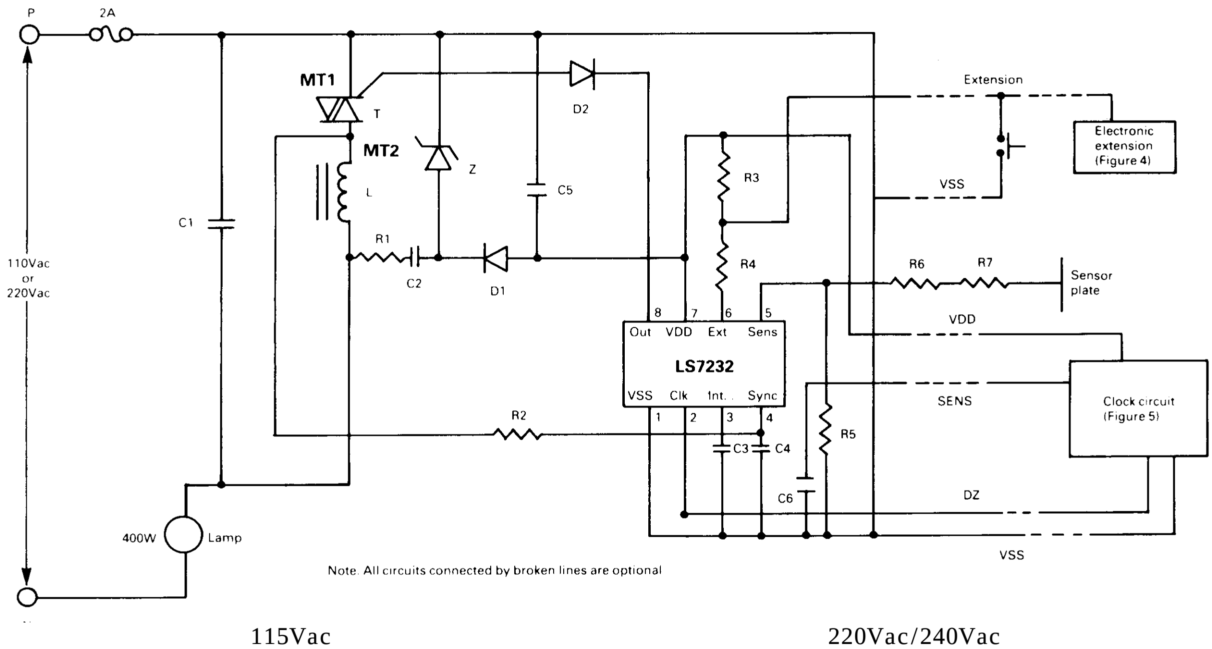


Figure 3 A typical light dimmer



115Vac

C1=0.1µF/250Vac, Class X2
C2=0.22µF/250Vac, Class X2
C3=0.047µF/50V
C4=470pF/630V
C5=47µF/25V
C6=680pF/50V
R1=270Ω/2W
R2=1.5M/¼W
R3=330kΩ/¼W
R4=470kΩ/1/4/W
R5=1MΩ to 5MΩ (select for sensitivity)/¼W
R6, R7=2.7MΩ/1/4W
D1, D2=IN4148
Z=BZX85C15
T=TIC216M or TIC225M
L=100µH, 6A(RFI filter)

220Vac/240Vac

C1=0.1µF/250Vac, Class X2
C2=0.22µF/250Vac, Class X2
C3=0.047µF/50V
C4=470pF/630V
C5=47µF/25V
C6=680pF/50V
R1=1kΩ/1W
R2=1.5MΩ
R3, R4=470kΩ
R5=1.8MΩ
R6, R7=4.7MΩ
D1, D2=IN4148
Z=BZX85C15
T=TIC216M or TIC225M
L=200µH, 3A(RFI filter)

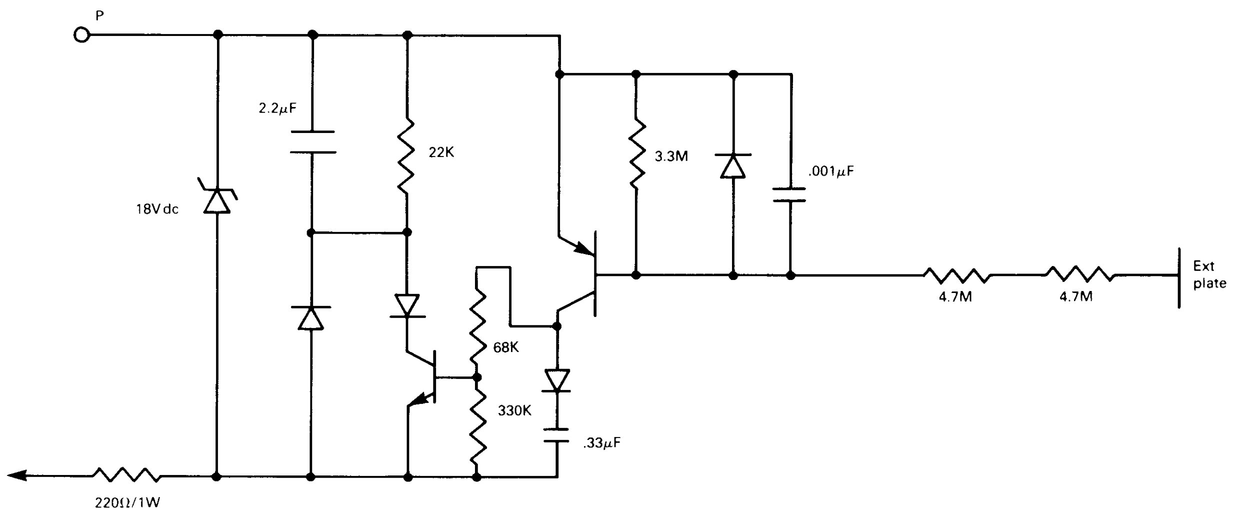
Application examples

A typical implementation of the light dimmer circuit is shown in Figure 3. Here the brightness of the lamp is set by touching the sensor plate. The functions of different components are as follows:

- The 15V dc supply for the chip is provided by Z, D_1, R_1, C_2 and C_5.
- R_2 and C_4 generate the filtered signal for the SYNC input for synchronising the internal PLL with the line frequency.
- R_3 and R_4 are current limiting resistors in the event the extension circuit is incorrectly polarised. If extensions are not used, the EXTENSION input (pin 6) should be tied to V_{DD} (pin 7).
- R_5 sets up the sensitivity of the sensor input.
- C_3 is the filter capacitor for the internal PLL.
- D_2 limits the positive excursion of triac gate to about V_{SS} +0.5V. This positive excursion of the gate may occur during the triggered state of certain triacs.
- C_1 and L are RF filter circuits.

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

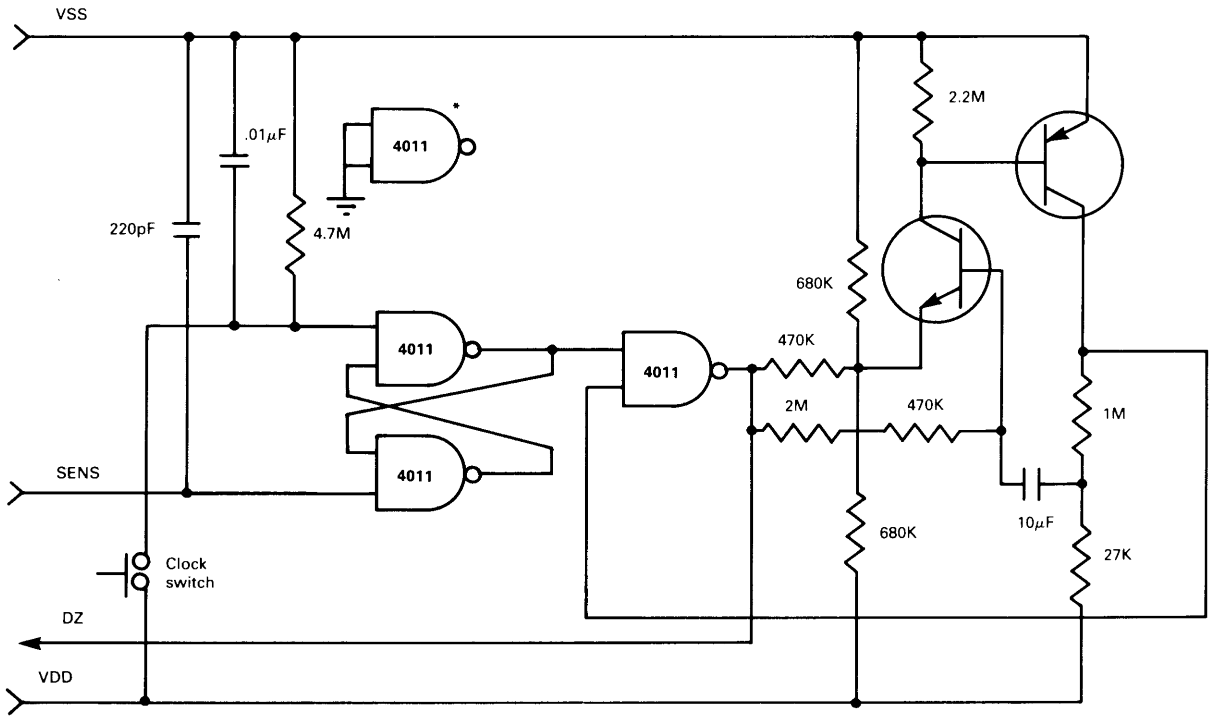
Figure 4 Electronic extension



Extensions (Figure 4)

All switching and dimming functions can also be implemented by utilising the EXTENSION input. This can be done by either a mechanical switch or the electronic switch in conjunction with a sensing plate as shown in Figure 4. When the plate is touched, a logical high level is generated at the EXTENSION terminal for both half cycles of the line frequency.

Figure 5 Clock circuit



*Spare gate

Clock circuit (Figure 5)

The CLOCK circuit shown in Figure 5 generates a slow clock (0.04Hz) at the DZ terminal. If the sensor plate (Figure 3) is not touched, the SENS terminal of the CLOCK circuit of Figure 5 sits at a logical high level. A momentary pressing of the CLOCK 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 eventually the light is shut off. The oscillator has no further effect on the dimmer circuit. When the light is turned on again by touching the sensor plate, the SR flip-flop is reset and the DZ clock is turned off.

When the CLOCK circuit is used, the connection between CLOCK input (pin 2) and V_{SS} (pin 1) as shown in Figure 3, should be removed.

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