TOUCH-CONTROLLED LAMP DIMMER CIRCUIT

GENERAL DESCRIPTION

The TEA1010 is a bipolar integrated circuit for switching and regulating lamps and other loads with a minimum of external components. It provides ON/OFF switching and a physiological power regulation (equal brightness steps). It is suited for touch plates and for switches, and may combine local and remote control. It produces negative pulses to drive a triac. The circuit is suited for resistive and for inductive loads, i.e. it is not only suited for dimming lamps but also for regulating motors in fans, vacuum cleaners, etc.

Types TEA1010 and TEA1010T switch on at the maximum brightness level upon a brief touch of the contacts, types TEA1010M and TEA1010MT switch on at the level at which they were switched off.

The circuits feature:
- Alternative ON/OFF switching by a brief touch of one or both contacts.
- ON switching at minimum brightness by a long touch of one or both contacts.
- Gradual change to maximum brightness during a long touch of the UP contact.
- Gradual change to minimum brightness during a long touch of the DOWN contact.
- No action during a long touch of both contacts in the ON state.

purple binder, tab 4

QUICK REFERENCE DATA

Supply voltage, d.c. (derived from mains voltage)	V_{CC}	typ.	15	V
Supply current	I_{CC}	typ.	1	mA
Output current	I_O	max.	100	mA
Firing phase range	φ	typ.	30^o to 140^o	
Time to change from minimum to maximum brightness, or vice versa	t_v	typ.	3,8	s
Power dissipation in the ON state	P	typ.	19	mW
Operating ambient temperature range	T_{amb}		0 to + 85	^oC

PACKAGE OUTLINE

TEA1010 ; TEA1010M : 8-lead DIL; plastic (SOT-97A).
TEA1010T; TEA1010MT: 8-lead flat pack; plastic (SO-8; SOT-96A).

FUNCTIONAL DESCRIPTION

The TEA1010 generates negative output pulses to trigger a triac. These output pulses are phase shifted with respect to the mains voltage. The amount of phase shift is determined by the difference between the initial states of two 7-bit counters. Both counters are driven by the same clock pulse generator. One of the counters is preset to a number determined by the required phase angle. The higher the required brightness, the smaller the required phase angle, the lower the number to which the counter is preset. The relation between brightness and preset number has been chosen so that almost equal brightness steps are obtained (physiological control). The minimum phase shift corresponds with 32 clock pulses and the maximum with 160.

Upwards and downwards regulation inputs UP and DN (pins 7 and 6)

The device ignores signals with a duration of less than 80 ms. Signals with a duration of 80 to 320 ms are accepted as brief commands, these cause the circuit to switch on and off alternatively. Signals that last longer than 320 ms are interpreted as long commands. A long command via the UP input causes the output phase angle to decrease, i.e. the brightness to increase gradually; a long command via the DN input has the opposite effect. A long signal on both inputs will switch on the lamp at minimum brightness. If the lamp is already on, a long signal on both inputs will have no effect.

The UP and DN inputs may be activated by touch plates or by switches. For the input arrangements see Fig. 2.

Slave input SLV (pin 2)

The SLV input operates in the same manner as the UP and DN inputs, but with a two-wire connection, ideal for remote control. The SLV input is only suited for switches. For the arrangement see Fig. 3. If the SLV input is not used it must be connected to the load via a 1,5 MΩ resistor (see Fig. 4).

Oscillator RC connection OSC (pin 1)

The frequency of the clock pulse generator is determined by an external resistor and capacitor, both connected to the OSC terminal (see Fig. 4). The generator switches at levels equal to 1/6 and 1/2 of the difference between the injector voltage V_{inj} and the supply voltage V_{CC}. The clock pulse period is about 50 μs.

Output Q (pin 3)

Since the circuit has an open-collector output, it is capable of sinking current, i.e. drawing a current into the output. Therefore it is especially suitable for delivering negative trigger pulses.

The maximum output current is 100 mA. A gate resistor R_G must be connected between the output Q and the triac gate to limit the output current to the minimum required by the triac (see Fig. 4). This minimizes the total supply current and the power dissipation.

A negative-going trigger pulse is generated at the output after every zero crossing of the mains voltage. The output pulse has a maximum duration of one clock pulse period, i.e. 50 μs. To reduce the power dissipation the output pulse is terminated as soon as the triac has switched on.

Supply V_{CC} and V_{EE} (pins 8 and 4)

The TEA1010 is supplied from the a.c. mains via a capacitor C_D and a diode to the V_{EE} connection; the V_{CC} connection is connected to the line (see Fig. 4). A smoothing capacitor C_S has to be connected between the V_{CC} and V_{EE} connections. The circuit contains a string of stabilizer diodes between the V_{CC} and V_{EE} connections that limit the d.c. supply voltage.

During the positive half of the mains cycles the current through external voltage dropping capacitor C_D charges the external smoothing capacitor C_S up to the stabilizing voltage of the internal stabilizer diodes. C_D should be chosen such that it can supply the current I_{CC} for the TEA1010 itself plus the average output current $I_{3(AV)}$, and recharge the smoothing capacitor C_S.

Any excess current is bypassed by the internal stabilizer diodes. Note that the maximum rated supply current must not be exceeded.

During the negative half of the mains cycles external smoothing capacitor C_S supplies the circuit. Its capacitance must be high enough to maintain the supply voltage above the minimum specified limit.

A supply voltage at the V_{EE} connection that is negative with respect to V_{CC} and the line is developed at the V_{EE} pin. Note that in the characteristics the voltages are mainly measured with respect to V_{EE} and not with respect to V_{CC} and the line.

The circuit has an internal power-on reset.

Synchronization input SYN (pin 5)

The connection to the SYN input should be short and must be decoupled via a capacitor to V_{CC} (pin 8).

PINNING

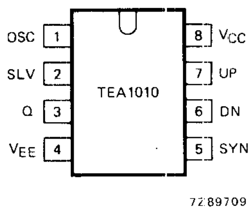


Fig. 1 Pinning diagram.

1	OSC	oscillator RC connection
2	SLV	slave input
3	Q	output
4	V_{EE}	common
5	SYN	synchronization input
6	DN	downward regulation input
7	UP	upward regulation input
8	V_{CC}	positive supply connection

DEVELOPMENT SAMPLE DATA

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage range, d.c.	V_{CC}	−0,5 to + 18	V
Supply current, d.c.	I_{CC}	max. 20	mA
peak, max. 10 μs	I_{CCM}	max. 2	A
Input voltage range, all inputs	V_I	−0,5 to + 18	V
Input current, all inputs	$\pm I_I$	max. 20	mA
Output voltage range	V_O	−0,5 to + 18	V
Output current range	I_O	−20 to + 150	mA
Power dissipation	P_{tot}	max. 250	mW
Storage temperature range	T_{stg}	−55 to + 125	°C
Operating ambient temperature range	T_{amb}	0 to + 85	°C

CHARACTERISTICS

V_{CC} = 5 to 18 V; T_{amb} = 0 to + 85 °C

	symbol	min.	typ.	max.	unit
Supply V_{CC} (pin 8)					
Internally stabilized supply voltage, at I_{CC} = 1,5 to 20 mA	V_{CC}	13,3	15	16,8	V
Supply current at V_{CC} = 15 V, unloaded,					
OFF state	I_{CC}	–	1	1,2	mA
ON state	I_{CC}	–	1,25	1,5	mA
Power dissipation, unloaded,					
OFF state	P	–	15	–	mW
ON state	P	–	19	25	mW
Thermal resistance					
TEA1010; TEA1010M	$R_{th\ j\text{-}a}$	–	162	–	K/W
TEA1010T; TEA1010MT	$R_{th\ j\text{-}a}$	–	65	–	K/W
Power-on reset threshold voltage	V_{CCpor}	1,5	–	4,8	V
Oscillator RC connection OSC (pin 1)					
Injector voltage	V_{inj}	550	–	700	mV
Synchronization input SYN (pin 5)					
Input current (r.m.s. value)	$I_{5(rms)}$	3	–	–	μA
Upwards and downwards regulation inputs UP and DN (pins 7 and 6)					
Input voltage	$V_{6\text{-}4}$; $V_{7\text{-}4}$	1	–	–	V
Input current	$-I_6$; $-I_7$	–	3 $I_{5(rms)}$	–	μA
Slave input SLV (pin 2)					
Input current	$\pm I_2$	10	–	–	μA
Output Q (pin 3)					
Output current	I_3	–	–	100	mA

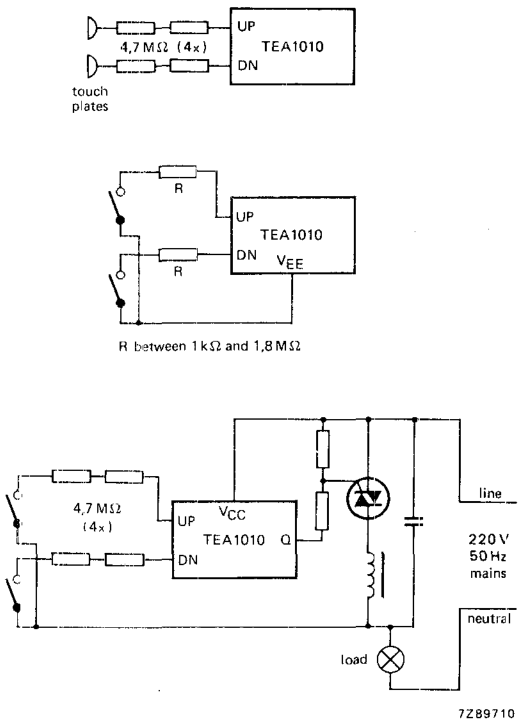


Fig. 2 Alternative arrangements for the UP and DN inputs.

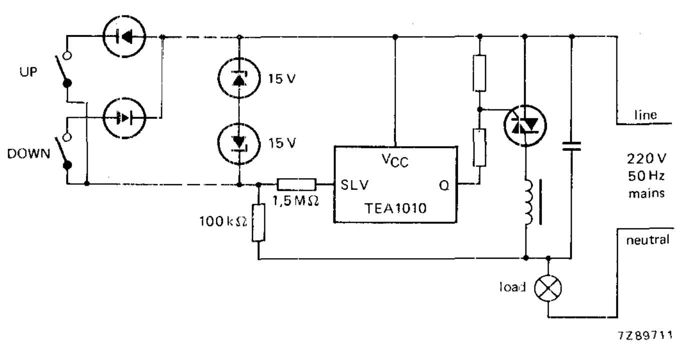
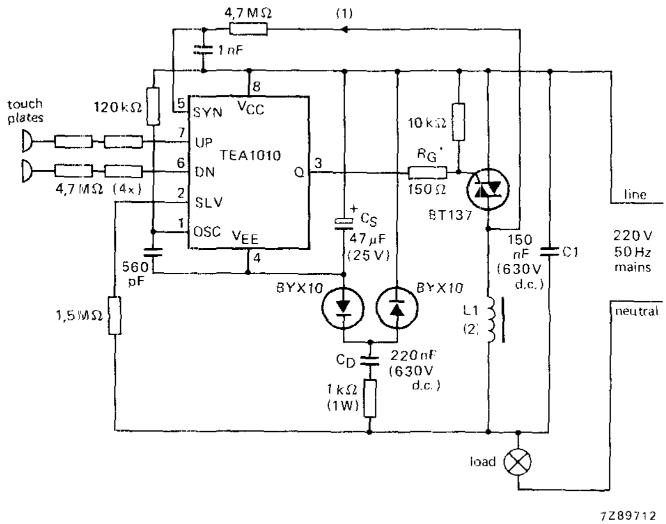


Fig. 3 SLV input arrangement.

APPLICATION INFORMATION

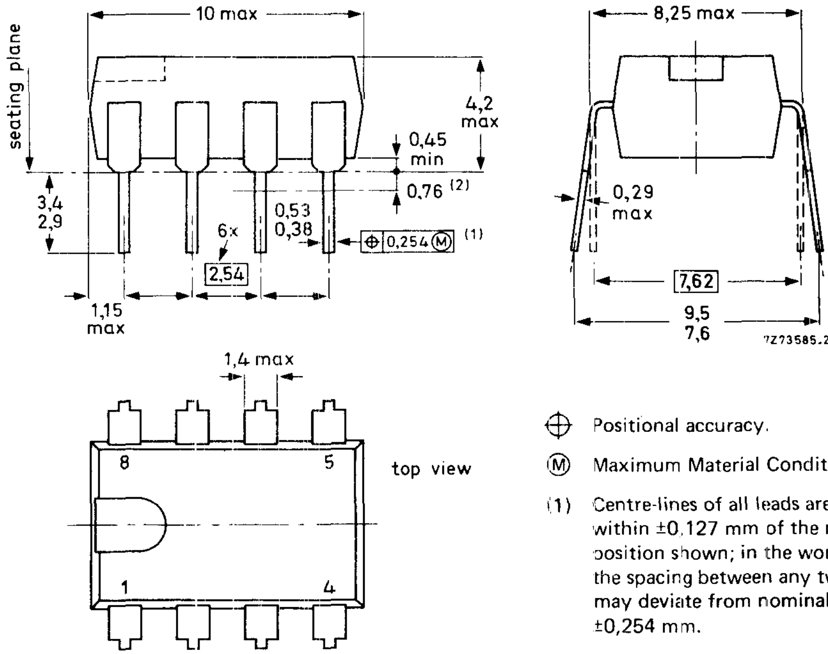


(1) The connection to the SYN input should be short and must be decoupled near to pins 5 and 8.
(2) For example, Vakuumschmelze FD 2.5 1N1 KN.

Fig. 4 Touch-controlled lamp dimmer circuit for max. 450 W. L1 and C1 form a radio-frequency interference filter with a quality factor Q of less than 1. This filter is necessary to satisfy the regulations of C.I.S.P.R. and V.D.E.

FURTHER APPLICATION INFORMATION AVAILABLE ON REQUEST

8-LEAD DUAL IN-LINE; PLASTIC (SOT-97A)



Dimensions in mm

⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ±0,127 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ±0,254 mm.

(2) Lead spacing tolerances apply from seating plane to the line indicated.

DEVELOPMENT SAMPLE DATA

SOLDERING

1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it).
If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 °C and 400 °C, for not more than 5 seconds.

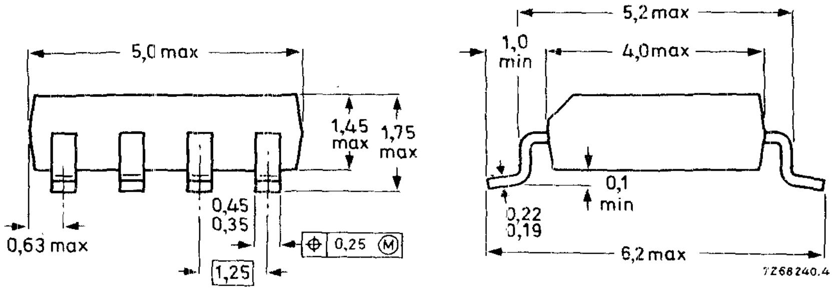
2. By dip or wave

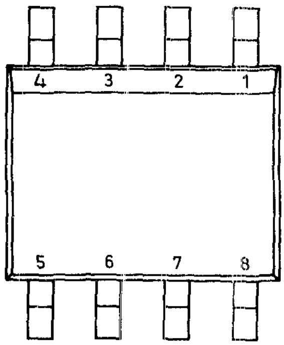
The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.
The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

3. Repairing soldered joints

The same precautions and limits apply as in (1) above.

8-LEAD FLAT PACK; PLASTIC (SO-8; SOT-96A)





top view

Dimensions in mm

⌖ Positional accuracy.

Ⓜ Maximum Material Condition.

SOLDERING

The reflow solder technique

The preferred technique for mounting miniature components on hybrid thick or thin-film circuits is reflow soldering. Solder is applied to the required areas on the substrate by dipping in a solder bath or, more usually, by screen printing a solder paste. Components are put in place and the solder is reflowed by heating.

Solder pastes consist of very finely powdered solder and flux suspended in an organic liquid binder. They are available in various forms depending on the specification of the solder and the type of binder used. For hybrid circuit use, a tin-lead solder with 2 to 4% silver is recommended. The working temperature of this paste is about 220 to 230 °C when a mild flux is used.

For printing the paste onto the substrate a stainless steel screen with a mesh of 80 to 105 μm is used for which the emulsion thickness should be about 50 μm. To ensure that sufficient solder paste is applied to the substrate, the screen aperture should be slightly larger than the corresponding contact area.

The contact pins are positioned on the substrate, the slight adhesive force of the solder paste being sufficient to keep them in place. The substrate is heated to the solder working temperature preferably by means of a controlled hot plate. The soldering process should be kept as short as possible: 10 to 15 seconds is sufficient to ensure good solder joints and evaporation of the binder fluid.
After soldering, the substrate must be cleaned of any remaining flux.