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Data Sheet
INTEGRATED CIRCUIT
2002 Nov 08

TCA280B

General purpose triggering circuit

INTEGRATED ELECTRONIC SOLUTIONS
1BUTLER DRIVE
HENDON SA 5014
AUSTRALIA

Integrated Electronic Solutions

General purpose triggering circuit TCA280B

CONTENTS

(1) The contents of this document are subject to the disclaimer on page 28

1 FEATURES

- Adjustable proportional range
- Adjustable hysteresis
- Adjustable firing burst repetition time
- Adjustable pulse width
- Supplied from the mains
- Provides supply for external temperature bridge
- Low supply current, low dissipation

2 GENERAL DESCRIPTION

The TCA280B is a bipolar integrated circuit delivering positive pulses for triggering a triac or a thyristor. The flexibility of the circuit makes it suitable for a variety of applications, such as:

- Synchronous on/off switching
- Phase control
- Time-proportional control
- Temperature control
- Motor speed control

3 QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
V_{CC}	DC supply voltage	derived from mains voltage	–	14	–	V
I_{CC}	supply current	average value	–	1	–	mA
$-I_{QAH}$	output current	see note 1.	–	–	200	mA
t_w	output pulse width		–	190	–	µs
P_{tot}	total power dissipation	unloaded	–	15	–	mW
T_{amb}	operating ambient temperature range		–20	–	+80	°C

Note

1. Negative current is defined as conventional current flow out of a device. A negative output current is suitable for positive triac current triggering.

4 ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TCA280B P	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-1
TCA280B T	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5 PINNING INFORMATION

5.1 Pinning layout

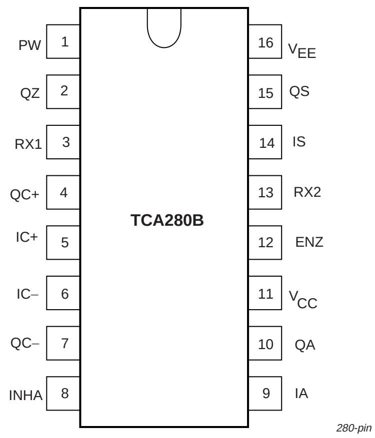


Fig.1 Pin configuration

5.2 Pin description

SYMBOL	PIN	DESCRIPTION
PW	1	pulse width control input
QZ	2	zero-crossing detector output
RX1	3	external resistor
QC+	4	comparator non-inverting output
IC+	5	comparator non-inverting input
IC–	6	comparator inverting input
QC–	7	comparator inverting output
INHA	8	output stage inhibiting input
IA	9	output stage input
QA	10	output stage output
V_{CC}	11	positive supply
ENZ	12	enable input, zero crossing detector
RX2	13	external resistor and diode
IS	14	sawtooth generator trigger input
QS	15	sawtooth generator output
V_{EE}	16	negative supply

6 BLOCK DIAGRAM

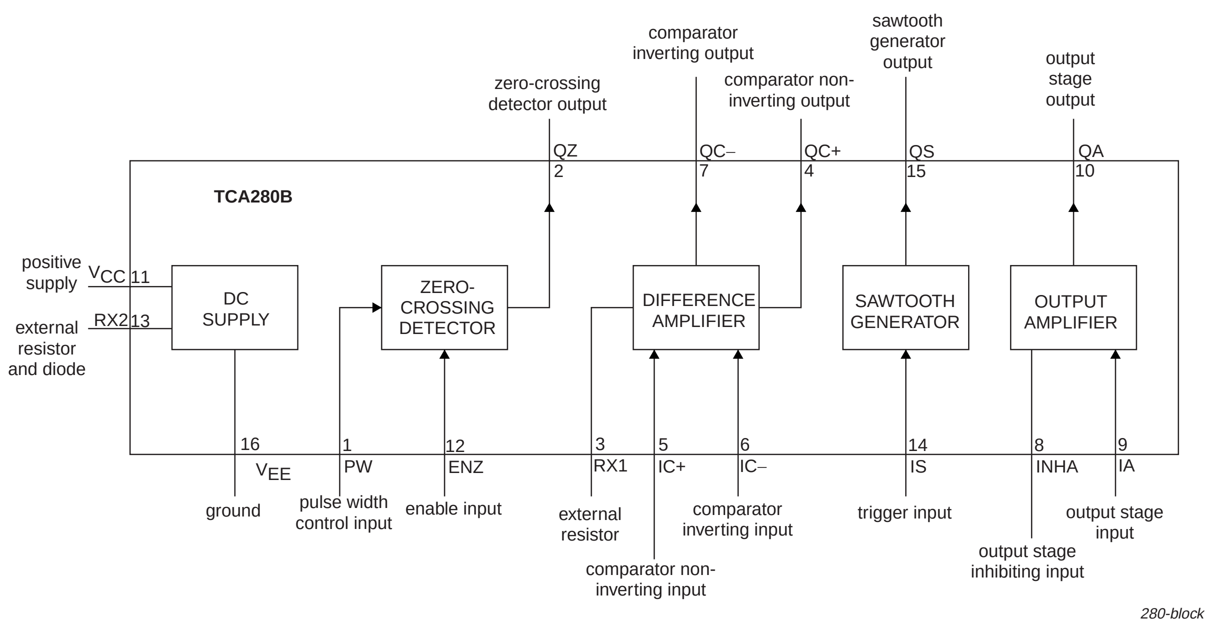


Fig.2 Block diagram

7 FUNCTIONAL DESCRIPTION

The TCA280B contains four circuits, that may be interconnected to perform the functions required, and a supply section. The four circuits are a zero-crossing detector, a differential amplifier, a sawtooth generator and an output stage.

7.1 Supply: Vcc and RX2 (pins 11 and 13)

The TCA280B may be supplied by an external DC power supply connected to Vcc (pin 11), but can be supplied directly from the mains voltage. For this purpose the circuit contains a number of stabilizer diodes, and a transistor connected between V_{CC} and V_{EE}, that limit the DC supply voltage. An external resistor Rd and an external diode (mains voltage rated) has to be connected from the mains to RX2; V_{EE} is connected to the neutral line (see Figs 5 and 6). A smoothing capacitor C1 has to be connected between V_{CC} and V_{EE}. The circuit produces a positive supply voltage at V_{CC}, this may be used to supply an external circuit such as a temperature sensing bridge.

An external diode in series with the resistor Rd must be included (see Figs 5 and 6). The maximum reverse current (10 µA) through pin 13 must not be exceeded or circuit operation cannot be guaranteed. Note that the diode also reduces the required power rating of resistor Rd by nearly 50%.

During the positive half of the mains cycle the current through the external voltage dropping resistor Rd charges the external smoothing capacitor C1 to the stabilizing voltage of the internal stabilizer diodes/transistor network. The value of Rd should be chosen such that it can supply the current for the TCA280B (see Fig.4) plus any current drawn by an external (peripheral) circuit connected to V_{CC} and recharge the smoothing capacitor C1. Any excess current is bypassed by the internal diode/ transistor stabilizing network. The maximum rated current must not be exceeded.

During the negative half of the mains cycle the external smoothing capacitor supplies the circuit. Its capacitance must be high enough to maintain the supply voltage above the minimum specified limit. For values of Rd and C1 see Figs 5 and 6.

A suitable VDR connected across the mains provides protection for the TCA280B and the triac against mains-borne transients.

7.2 Zero-crossing detector

The TCA280B contains a zero-crossing detector to produce pulses that coincide with the zero crossings of the mains voltage for minimum RF interference and transients on the mains supply.

The pulse width control input PW (pin 1) allows adjustment of the pulse width at output QZ (pin 2), to the value required for the triac, by choosing the value of the external synchronization resistor RS between PW and the AC mains. The pulse width is inversely proportional to the input current and to the mains frequency. The zero-crossing detector is inhibited when the ENZ input (pin 12) is HIGH, and enabled when ENZ is LOW, e.g. connected to V_{EE}.

Output QZ, which produces negative-going output pulses, is an n-p-n open-collector output that requires an external resistor connected to V_{CC}.

7.3 Comparator

IC+ and IC– (pins 5 and 6) are differential inputs of a comparator or differential amplifier, with QC+ and QC– (pins 4 and 7) as complementary outputs. QC+ and QC– are p-n-p open collector outputs requiring external collector resistors to V_{EE}.

QC+ will be HIGH and QC– will be LOW when IC+ is higher than IC–.

The comparator contains a long-tailed pair with a current source in its tail. The tail current is activated by a current into RX1 (pin 3). When an inductive load is driven with phase control the trigger pulse may be. terminated at the instant of firing of the thyristor or triac. This may be achieved by connecting RX1 via a resistor to the anode of the thyristor or triac.

7.4 Sawtooth generator

The sawtooth generator may be used to produce bursts of trigger pulses, with the net effect that the load is periodically switched on and off. The heart of the sawtooth generator is a thyristor arrangement. The firing burst repetition time is usually determined by an external resistor and capacitor connected to the sawtooth generator trigger input IS (pin 14). The repetition time is typical 0.7 x RC.

The output QS (pin 15) is an n-p-n open-collector output. During the flyback period of the sawtooth pulse the transistor is ON and is capable of sinking current.

7.5 Output stage

The output stage is driven by current drawn from input IA (pin 9). This drive may be inhibited by drawing current from inhibiting input INHA (pin 8). Hence the output will be HIGH only if, current is drawn from IA and no current is from of INHA i.e. if inhibiting input INHA (pin 8) is HIGH and input IA (pin 9) is LOW. Both inputs may be used as a single input provided the other one is suitably biased.

The output QA (pin 10) is an n-p-n open-emitter output capable of sourcing an output current i.e. conventional current flow out of the circuit.

A gate resistor RG should be connected between the output QA and the triac or thyristor gate to limit the output current to the minimum required by the triac or thyristor. This minimizes the total supply current and the power dissipation. Output QA is protected with a diode to V_{EE} (pin 16) against damage by undershoot of the output voltage, e.g. caused by an inductive load.

8 LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage (voltage source) supply current (current source)		–	17	V
$I_{RX2(AV)}$	average		–	17	mA
$I_{RX2(RM)}$	repetitive peak		–	80	mA
$I_{RX2(SM)}$	non-repetitive peak	t < 10 µs	–	2	A
$I_{RX2(RV)}$	reverse		–	–10	µA
V_I	input voltage, all inputs		–	17	V
V_{ID}	differential input voltage between IC+ and IC–		–	7	V
I_I	input current, all inputs		–	10	mA
 $I_{QA(AV)}$ $I_{QA(SM)}$	output current average non-repetitive peak	 t < 300 µs	 –30 –600	 – –	 mA mA
P_{tot}	total power dissipation	see Fig 3	–	–	
T_{stg}	storage temperature		–55	+125	°C
T_{amb}	operating ambient temperature		–20	+80	°C

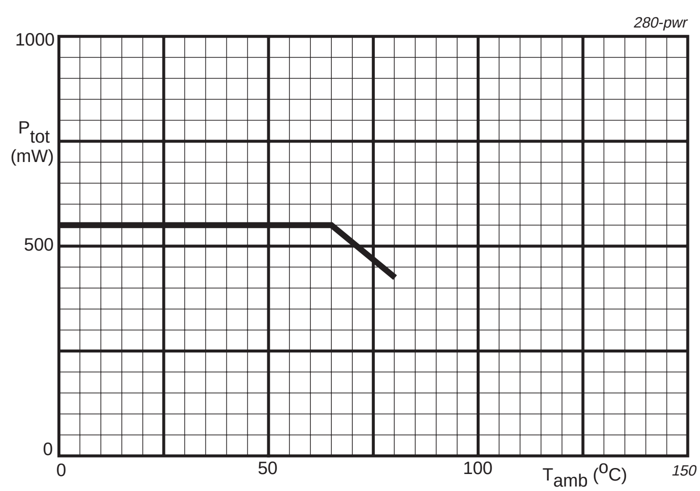


Fig.3 Power derating curve

9 CHARACTERISTICS

V_{CC} 11 to 17 V; V_{EE} = 0 V; I_{RX1} = 10 µA or I_{RX1} = -30 µA;
At T_{amb} = 25°C; Voltages are specified with respect to V_{CC}.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply						
V_{CC}	supply voltage, external		11	–	17	V
V_{CC}	supply voltage, internally generated	$I_{RX2(RMS)}$ = 5 mA, unloaded	11.0	14.3	15.0	V
I_{CC}	supply current, unloaded		0.3	–	0.75	mA
$\Delta I_{CC}/\Delta V_{CC}$	variation with supply voltage		–	–	0.03	mA/V
Pulse width control input PW (pin 1)						
	input voltage					
V_{PW}		I_{PW} = 100 µA,	–	–	1.9	V
V_{PW}		I_{PW} = –100 µA	–0.25	–	–	V
$I_{PW(RMS)}$	input current (RMS value)	I_{QZ} = 0.5 mA	30	–	50	µA
t_w	pulse width	$I_{PW(RMS)}$, f = 50 Hz (at pin 2)	–	190	–	µs
$\Delta t/\Delta V$	variation with supply voltage		–	27	–	µs/V
Zero-crossing detector enable input ENZ (pin 12)						
V_{ENZH}	input voltage HIGH	inhibit	1.2	–	–	V
V_{ENZL}	input voltage LOW	enable	–	–	0	V
Zero-crossing detector output QZ (pin 2)						
I_{QZH}	output current HIGH		–1	–	–	µA
I_{QZL}	output current LOW		–	–	–40	mA
Comparator input IC+ and IC– (pins 5 and 6)						
$\pm V_{ID}$	differential input voltage		–	–	7	V
I_{IC+}	input bias current	$v_{IC+} > v_{IC-}$ + 1V	–	5	10	µA
I_{IC-}	input bias current	$v_{IC-} > v_{IC+}$ + 1V	–	5	10	µA
Comparator outputs QC+ and QC– (pins 4 and 7)						
V_{OH}	output voltage	I_{OH} = –0.3 mA	V_{CC} – 1.5	–	–	V
I_{OH}	output current HIGH		–	–	–0.3	mA
I_{OL}	output current LOW		–90	–	–	nA
Sawtooth generator trigger input IS (pin 14)						
V_{ISH}	input trigger voltage		7.0	–	8.3	V
I_{ISH}	input trigger current		–	–	3	µA
V_{ISL}	thyristor holding voltage		1.8	–	2.8	V
I_{ISL}	thyristor holding current		95	–	210	µA
Sawtooth generator output QS (pin 15)						
I_{QSL}	output current LOW		–	–	–5	mA
I_{QSH}	output current HIGH		–100	–	–	nA

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Output stage inhibiting input INHA (pin 8)						
I_{INHA}	input current	I_{IA} = –100 μA	–50	–	–20	μA
V_{INHA}	input voltage	I_{IA} = –100 μA	–	V_{CC} – 2	–	V
Output stage IA (pin 9)						
I_{IA}	input current	I_{QA} = –200 μA	–	–	15	μA
V_{IA}	input voltage	I_{IA} = –50 μA	V_{CC} – 8.3	–	V_{CC} – 7	V
Output stage output (pin 10)						
V_{QAH}	output voltage HIGH	I_{QAH} = –200 mA V_{CC} = 13 V INHA open circuit	V_{CC} – 2.8	–	–	V
I_{QAH}	output current HIGH		–200	–	–	mA
I_{QAL}	output current LOW		–	–	1	μA

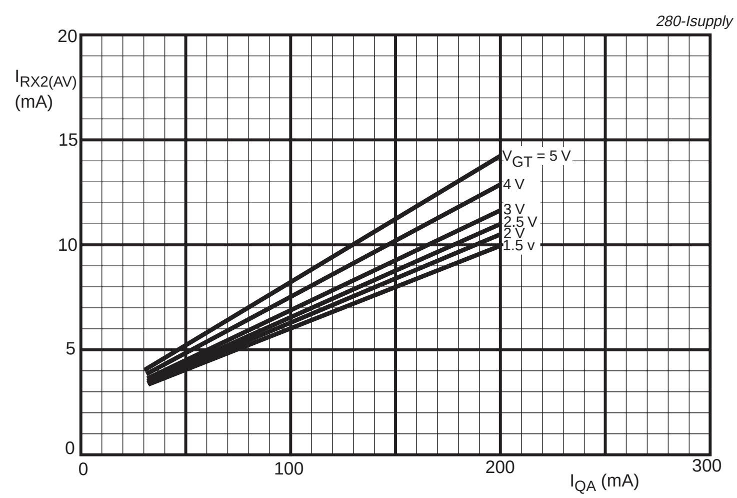
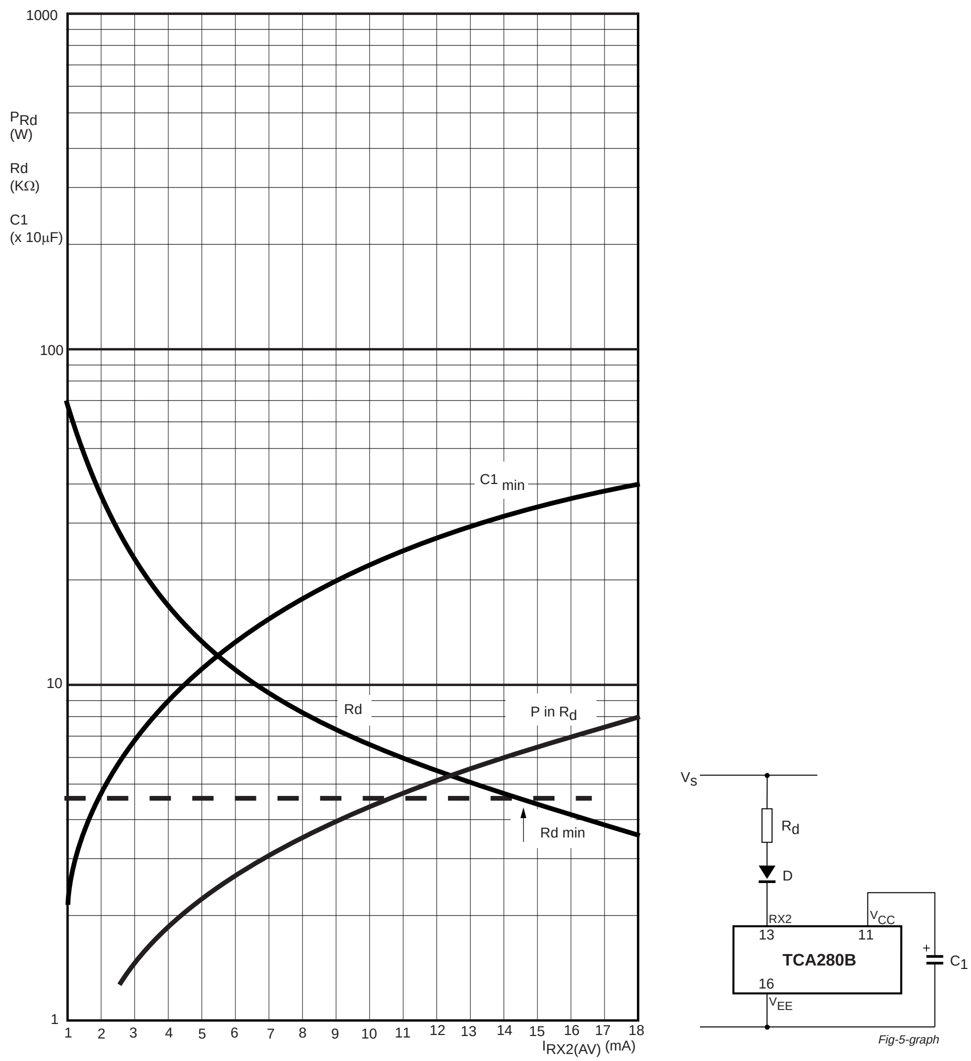
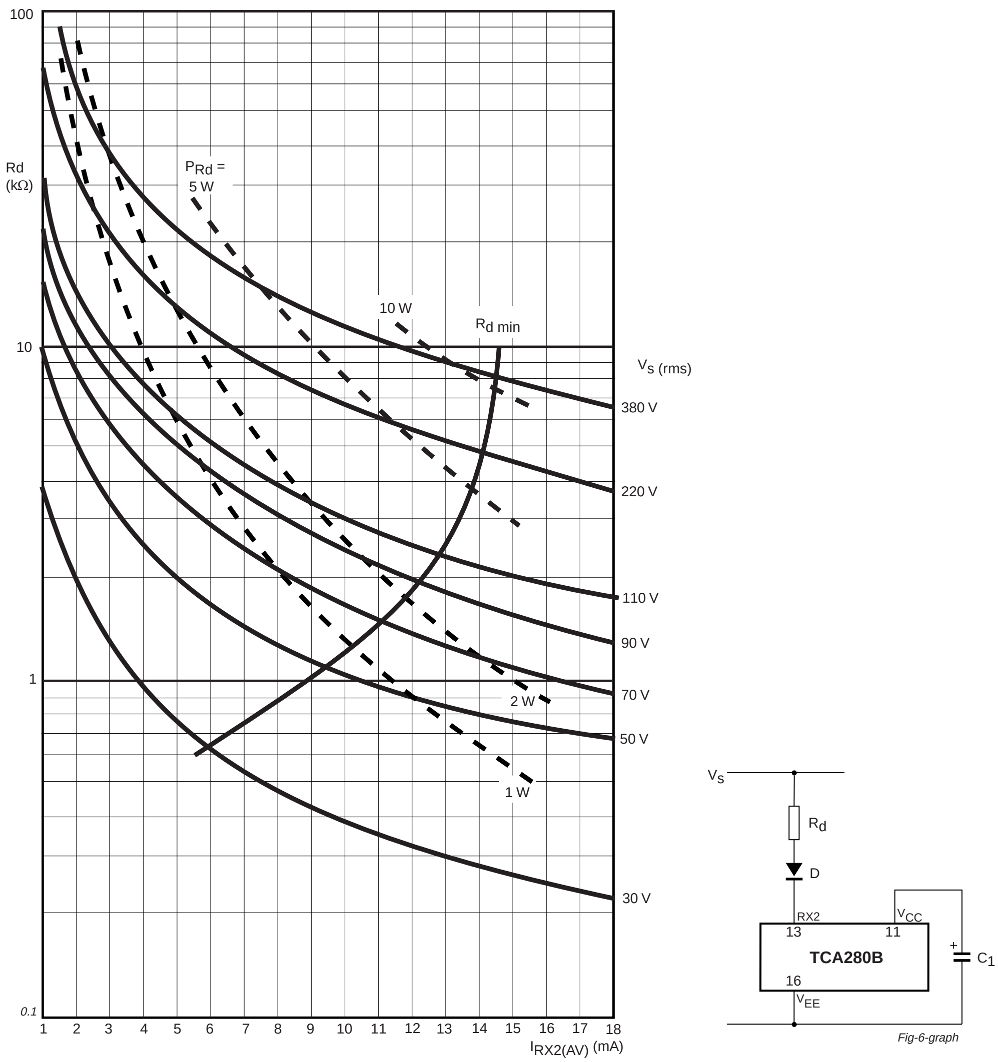


Fig.4 Average supply current $I_{RX2(AV)}$ as a function of output current I_{QA} with triac gate trigger voltage V_{GT} as a parameter, typical performance.



Note: In certain applications the time proportional controller requires a value of smoothing capacitor (C1) three times higher; typical performance.

Fig.5 Voltage dropping resistor Rd, dissipation P_{Rd} in this resistor, and recommended minimum value of smoothing capacitor C1 as a function of average supply current $I_{RX2(AV)}$, for the supply arrangement with series diode D. $I_{RX2(AV)}$ includes the supply of any external (peripheral) circuit supplied from V_{CC}.



Note: $I_{RX2(AV)}$ includes the supply current of any external (peripheral) circuit supplied from V_{CC}.

Fig.6 Voltage dropping resistor Rd and power dissipation P_{Rd} in this resistor as a function of supply current $I_{RX2(AV)}$, for the supply arrangement with series diode. Also shown is the RMS mains supply voltage ($V_{S(Rms)}$) as a function Of $I_{RX2(AV)}$; typical performance.

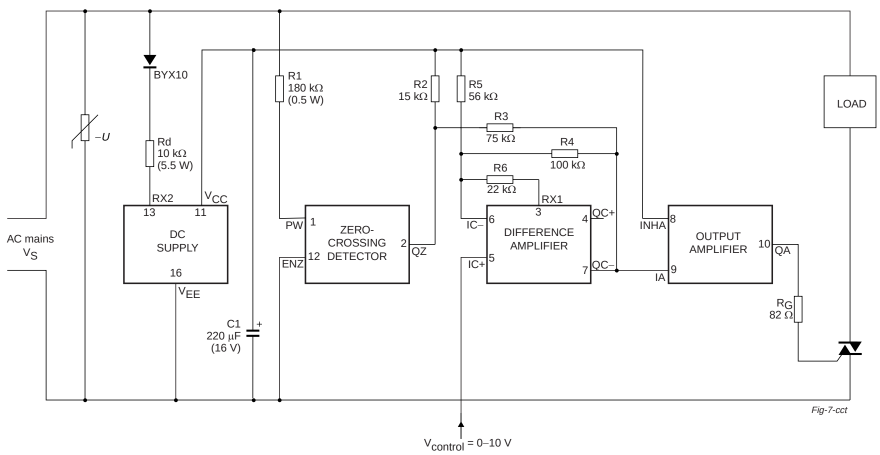


Fig.7 Typical application of the TCA280B as a static switch for resistive loads. The arrangement gives triggering around the zero crossings of the mains voltage. The values shown for R_d, R_G and C1 give a gate current I_{GT} = 100 mA typical at V_{GT} = 2.5 V and a trigger pulse duration t_w = 160 µs typical.

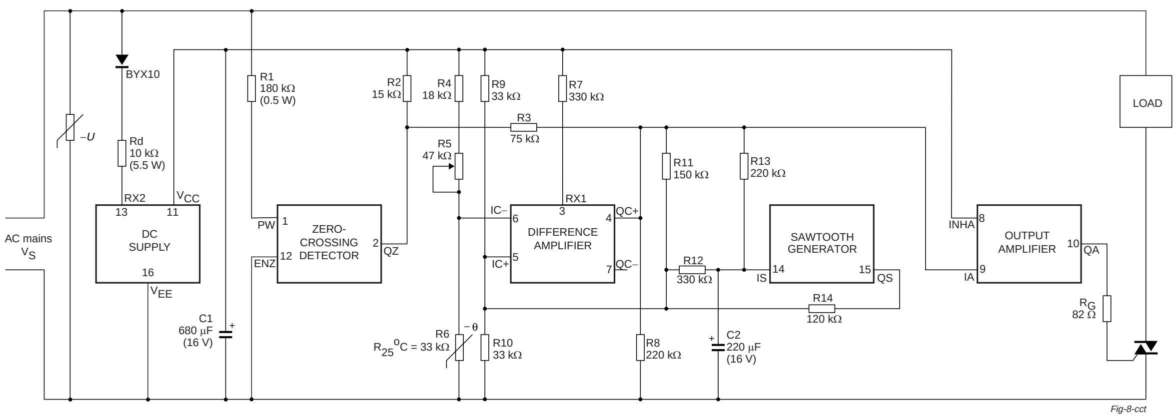


Fig.8 Typical application of the TCA280B as a time proportional temperature controller. The arrangement gives triggering around the zero crossings of the mains voltage as long as the voltage produced by the temperature bridge connected to IC+ (pin 5) is higher than the voltage on IC– (pin 6). The voltage on IC– is a sawtooth superimposed on a DC reference voltage. The sawtooth has a repetition time of approximately 30 s; this time is determined by C2. The proportional band is determined by the amplitude of the sawtooth; this can be chosen by the value of R12. The values shown for R_d, R_G and C1 give a gate current I_{GT} = 100 mA typ. at V_G = 2.5 V and a trigger pulse duration t_w = 160 µs typ.

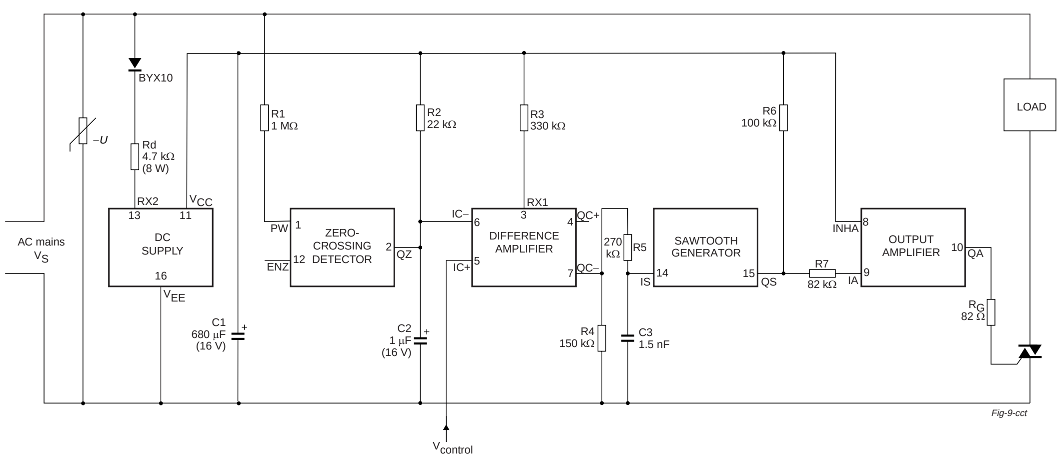


Fig.9 Typical application of the TCA280B as a single-phase control circuit. The circuit produces bursts of trigger pulses at the gate of the triac or thyristor. The pulses coincide with the zero crossings of the mains voltage. The arrangement forms a full-wave AC controller when used with a triac, and a controlled half-wave rectifier when used with a thyristor.

10 APPLICATION INFORMATION

The reliability of modern thyristors and triacs has given a strong impetus to the introduction of electronic power control in industrial as well as non-industrial areas. Because of the low cost of these devices and simplification in trigger circuitry, electronic power control now enjoys a host of applications such as electronic household cookers, panel radiators, fans, hobby tools, and even vacuum cleaners.

The monolithic integrated trigger circuit TCA280B, referred to as a trigger module, supplies the pulses for triggering these thyristors and triacs. This module can be connected to the mains via a dropping resistor and, in most cases, no trigger transformer is needed.

The TCA280B is an inexpensive, versatile trigger module and, being a monolithic IC in 16-pin dual in-line package, it takes up hardly any space at all. It is ideally suited for applications such as:

1. On/off control: static switch.

   On/off control is a method of power control where triggering. should preferably occur symmetrically with respect to the zero crossing of the triac current to avoid r.f. interference. That is, triggering must start before the current has dropped to the holding value, and must continue until the current has risen again above the latching level. Under these conditions radio interference is kept at a minimum.

2. Phase control: single phase and three phase control (half cycle and full cycle).

   Phase control is stepless control of output power by varying the conduction angle of the triac or thyristor, 180 degree conduction corresponding to full output power. Step changes in thyristor voltage and current during turn-on give rise to r.f. interference, so that phase control is limited to a few hundred watts if the regulations on interference are to be complied with. It should be noted that phase control is not permitted for heating purposes.

3. Time proportional control: temperature and motor. speed control.

   Time proportional control is on/off control with a fixed repetition rate of load switching. The system is called time proportional because the power in the load averaged over the repetition period is varied. This system provides more accurate temperature control, avoiding the overshoot which is inherent in on/off control. Triggering conditions are the same as for on/off control.

10.1 The TCA280B circuit

Fig.10 shows the circuit diagram of the TCA280B. It comprises the following circuit sections:

- d.c. supply fed from the mains via a dropping resistor and diode;
- zero-crossing detector for synchronization of the trigger pulses;
- difference amplifier passing a signal from a sensor, or indication of a potentiometer setting or switch position, etc.;
- inhibiting stage rendering the difference amplifier immune to sensor signals, etc.;
- ramp function generator operating as the sawtooth oscillator in time proportional control;
- output amplifier amplifying the trigger pulses and feeding the triac (or thyristor) gate.

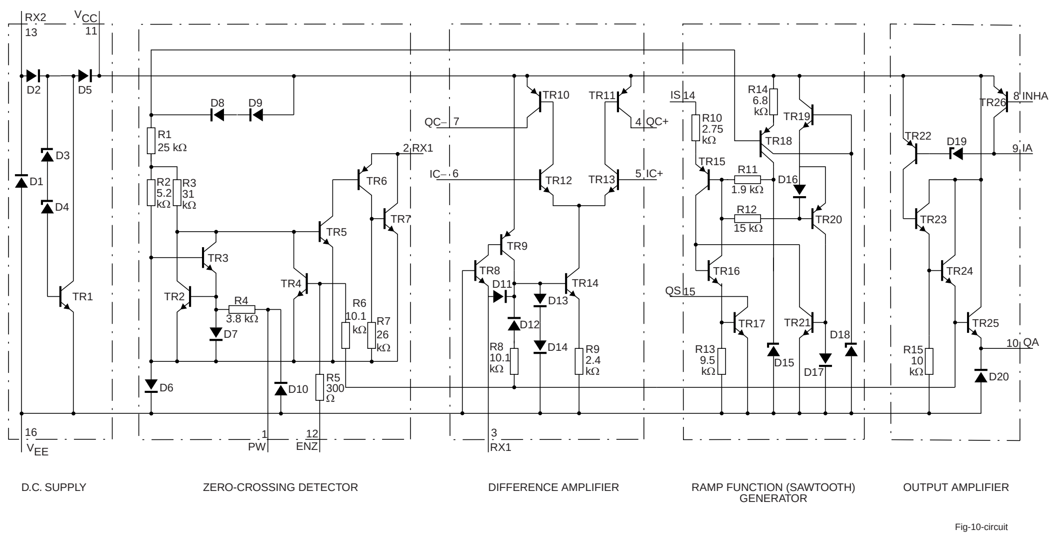


Fig.10 Circuit diagram of the monolithic integrated trigger module TCA280B

10.2 Current supply

Fig. 11 shows the circuit diagram of the d.c. supply section. Pin 16 is the common point of reference for the supply, output, and control voltages, as well as for the synchronizing signals. This pin is connected to the cathode of the thyristor or terminal 1 of the triac, and to one pole of the mains. The other mains terminal is connected to pin 13 via a dropping resistor and series mains rated diode.

The regulator diodes D3, D4, and transistor TR 1. form a voltage stabilizing network of about 15 V during the positive half cycle. The voltage at pin 13 equals 15 V plus the drop across D2, making it 15.7 V. The block voltage across this network is further rectified by diode D5, and smoothed by an electrolytic capacitor C1 between pins 11 and 16 to serve as the supply voltage (14.4 V) for the other functional stages.

During the negative half-cycle, the current is blocked by the external diode in series with the supply resistor. The total power loss in the dropping resistor is reduced by about 50% by connecting the diode in series with it. The value of Rd depends mainly on the current required for triggering the triac or the thyristor. The minimum value of Rd is 4.7 kΩ, as otherwise the maximum permissible current through pin 13 would be exceeded (see the Limiting Values table).

If voltages higher or lower than 220 V are used, an accordingly higher or lower dropping resistor must be connected to pin 13. If the trigger module is fed direct from a d.c. power supply, it is possible at voltages of 11 V to 17 V to have a direct connection to pin 11. For some applications it is recommended or even necessary to keep the control circuit electrically separated from the mains. This is achieved with an isolating transformer for circuit supply and synchronization. In addition trigger transformers are then needed to feed the trigger pulses to the gate of the triac or thyristor.

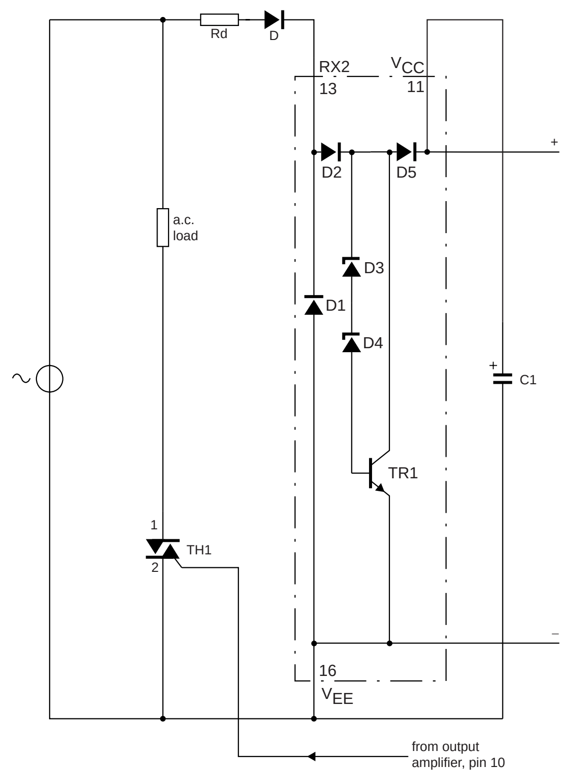


Fig.11 Connection of the d.c. supply

10.3 Zero-crossing detector

The function of the zero-crossing. detector (Fig. 12) is to synchronize the trigger pulses with the mains voltage when the trigger module is used as a static switch or as a time-proportional switch.

If the load is purely resistive, the synchronization voltage is obtained direct from the mains via a resistor. As a result trigger pulses start shortly before, and end shortly after, each zero-crossing of the mains voltage. In this manner radio interference is reduced to a minimum.

If the load contains an inductive component, the synchronization voltage is taken from terminal 2 of the triac. The trigger pulse is then produced at the earliest possible moment, i.e. immediately following zero-crossing of the phase-shifted load current. The pulse is initiated by the step function of the synchronizing voltage when the triac is turned off.

In phase control the zero-crossing detector is used to generate a sawtooth voltage synchronous with the mains. As soon as the d.c. control voltage corresponding to a preset trigger angle is exceeded, this voltage starts the trigger pulse. Depending on the direction and the value of the current through pin 1, the output transistor TR7 will be activated. If a positive current of 50 µA flows through pin 1, the current through R3 will flow through TR2 to pin 16, if a negative current of 50 µA flows through pin 1, the current through R3 will find its way to pin 16 via TR3. In both cases the output transistor TR7 is not activated.

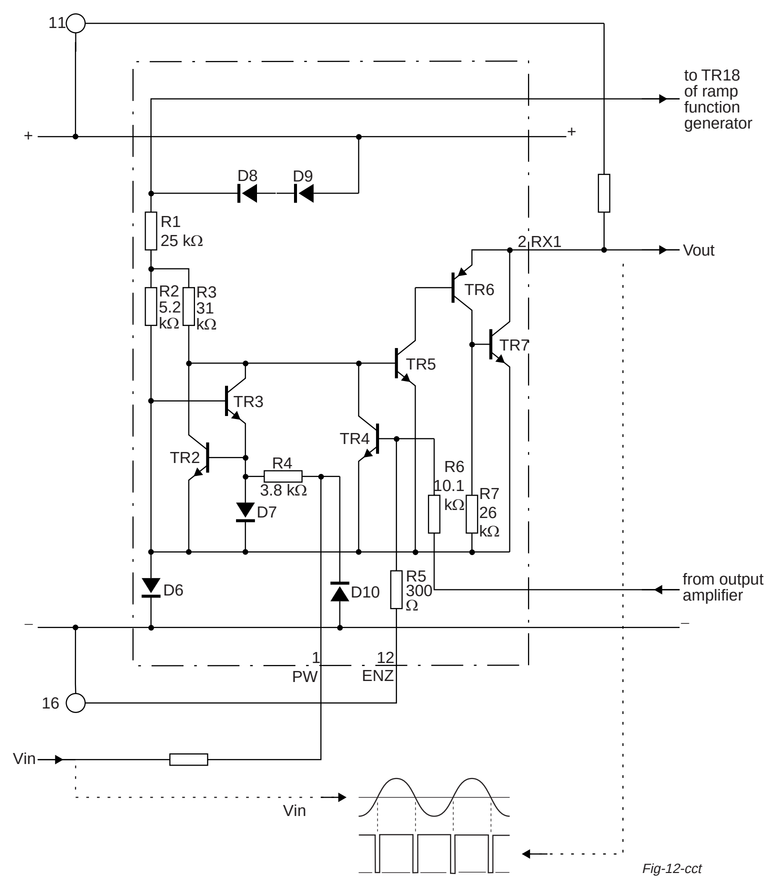


Fig.12 Zero-crossing detector

10.4 Inhibiting stage

Fig. 13 shows the circuit diagram of the current source of the difference amplifier (TR14, R9, D13, D14). If the current flowing. through pin 3 is positive, the current source of the difference amplifier is supplied via D11: if the current is negative, supply is via TR8 and TR9. The amplifier is inhibited by cutting off the current supply to pin 3, so that TR14 is cut off. This stage is needed for single-pulse phase control. When controlling inductive loads, it serves to delay the trigger pulse until the voltage on terminal 2 of the triac is restored when the trigger angle is adjusted to be smaller than the phase angle between the load current and the load voltage. Thus the load receives maximum power. The inhibiting stage blocks TR14 as long as the triac keeps conducting. Not until the voltage on pin 3 is restored. by the triac switching off, will the current source be switched on again. thus starting the (delayed) trigger pulse.

10.5 Difference amplifier

The difference amplifier (Fig. 13) consists of transistors TR12 and TR13 forming a long-tail pair. Any current through pin 3 exceeding 10 μA activates the current source, and thus the difference amplifier. In all cases where the inhibiting stage is not used, pin 3 must receive current via a resistor connected to the supply voltage to keep the difference amplifier at standby for operation. TR10 and TR11 are the output stages of the difference amplifier.

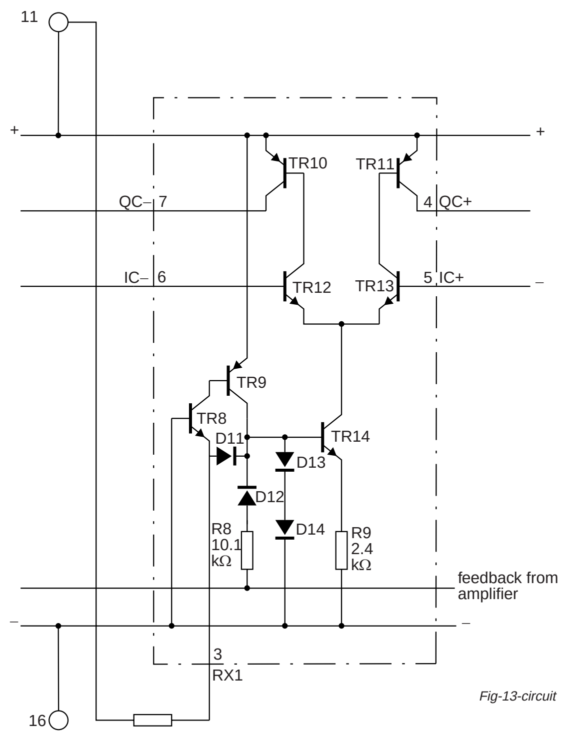


Fig.13 Connection of the difference amplifier

10.6 Ramp function generator

Fig 14 shows the circuit diagram of the ramp function generator which consists of the voltage reference diode D15, the current source TR18, the unijunction transistor TR15–TR16, and the inverting amplifier TR17. The unijunction transistor starts to conduct when the voltage between pins 14 and 16 exceeds the voltage across D15 plus the base-emitter threshold voltage of TR15, and cuts off again when its current drops below the holding level. This level is determined by R12.

With a time-proportional switch, the sawtooth voltage produced by the ramp function generator serves to provide the repetition frequency of load switching that can be adjusted with the control voltage.

In phase control with trigger burst, the flyback of the sawtooth is used as the drive signal for generating the trigger pulse. During flyback, TR17 is conducting.

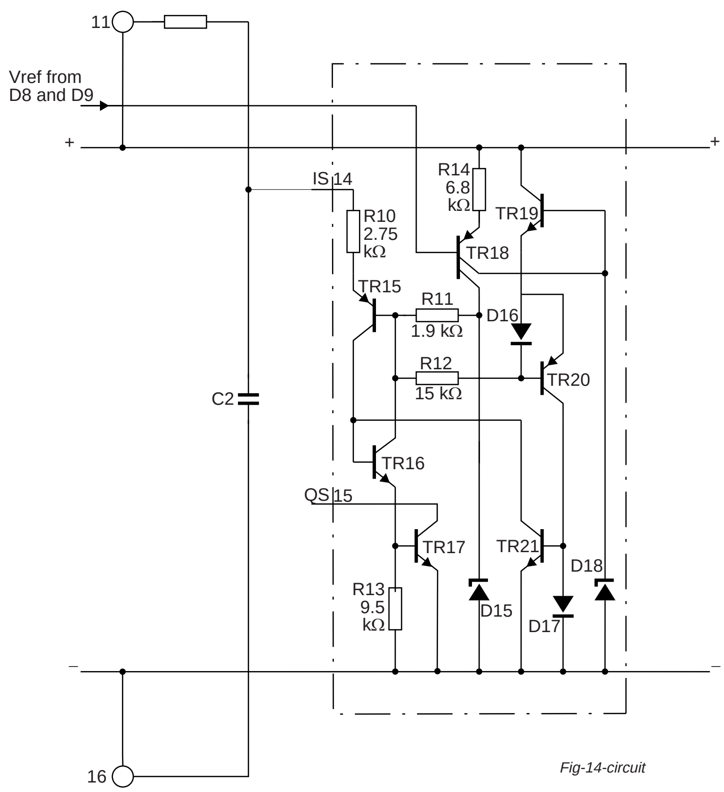


Fig.14 Connection of the ramp function (sawtooth) generator

10.7 Output amplifier

The output amplifier (Fig 15) produces a trigger pulse at pin 10 as soon as TR22 is driven via D19. The voltage regulator diode D19 prevents spurious triggering caused by uncontrolled pulses during the rise time of the operating voltage when the trigger stage is switched on. Transistor TR26 represents a low-ohmic parallel connection for the base current supplied to pin 9. Consequently, the trigger pulses can be produced only when TR26 is off.

Feedback loops from the output amplifier, to the zero-crossing detector and the inhibiting stage via R6 and R8 (see Figure 10), respectively, increase the rise time of the pulses, and provide a holding circuit for the pulse generating network for the required pulse duration.

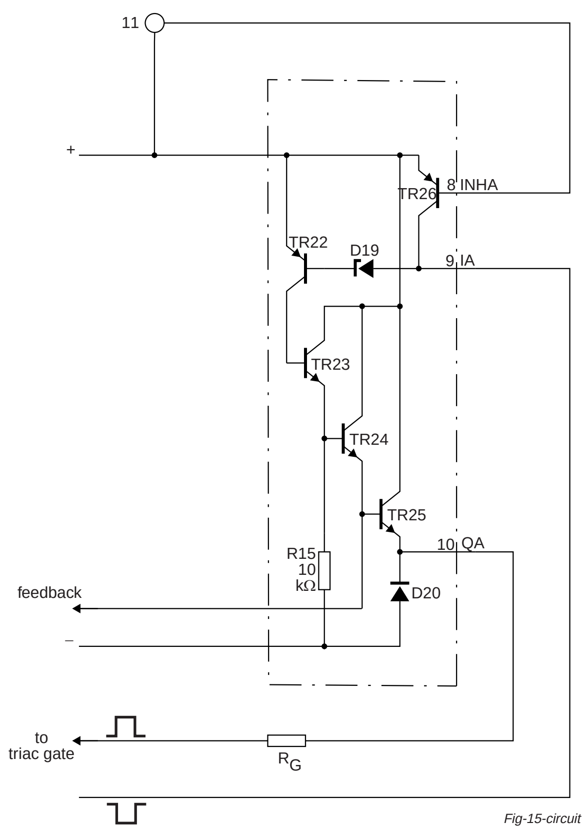
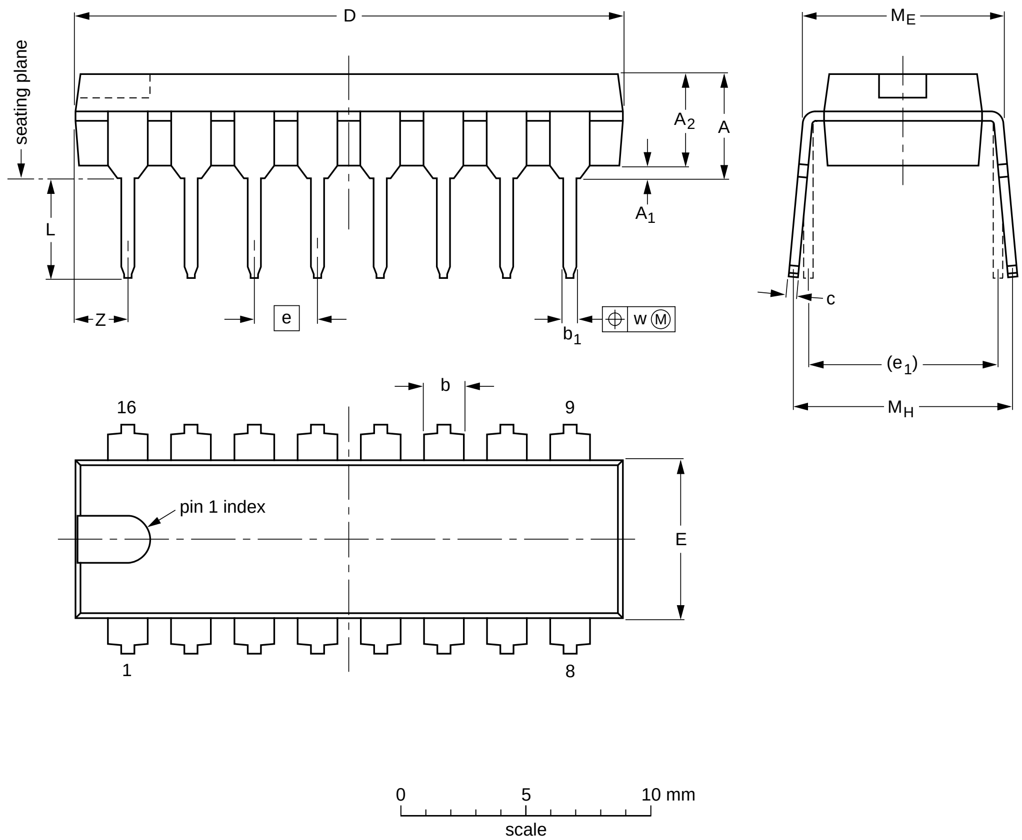


Fig.15 Connection of the output amplifier

11 PACKAGE OUTLINES

DIP16: plastic dual in-line package; 16 leads (300 mil); long body **SOT38-1**

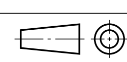


DIMENSIONS (inch dimensions are derived from the original mm dimensions)

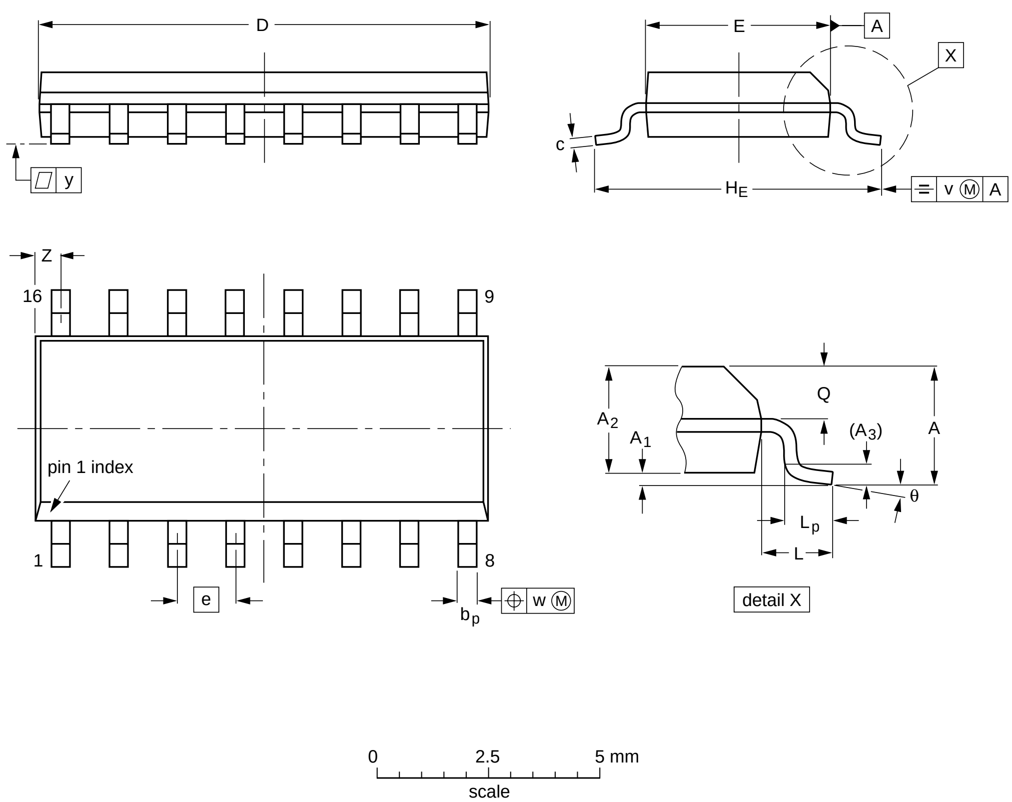
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-1	050G09	MO-001AE				~~92-10-02~~ 95-01-19

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D [(1)]	E [(1)]	e	H_E	L	L_p	Q	v	w	y	Z [(1)]	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				~~95-01-23~~ 97-05-22

12 SOLDERING

12.1 Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Data book"* (order code 9398 652 90011).

12.2 DIP

12.2.1 SOLDERING BY DIPPING OR BY WAVE

The maximum permissible temperature of the solder is 260 °C; solder at 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 maximum storage temperature ($T_{stg\ max}$). 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.

12.2.2 REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

12.3 SO

12.3.1 REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

12.3.2 WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

12.3.3 REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally- opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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13 DEFINITIONS

Data sheet status	
Engineering sample information	This contains draft information describing an engineering sample provided to demonstrate possible function and feasibility.Engineering samples have no guarantee that they will perform as described in all details.
Objective specification	This data sheet contains target or goal specifications for product development. Engineering samples have no guarantee that they will function as described in all details.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later. Products to this data may not yet have been fully tested, and their performance fully documented.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

14 IES INFORMATION

INTEGRATED ELECTRONIC SOLUTIONS PTY. LTD.
ABN 17 080 879 616

Postal address:

Integrated Electronic Solutions
PO Box 2226
Port Adelaide SA 5015
AUSTRALIA

Street Address:

Integrated Electronic Solutions
1 Butler Drive
Hendon SA 5014
AUSTRALIA

Telephone: +61 8 8348 5200
Facsimile: +61 8 8243 1048

World Wide Web: www.ies-sa.com

Email: IES@ies.sa.com.au

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