

TRIGGER MODULE

The TCA280A is a monolithic integrated circuit designed for thyristor and triac control. It contains the following circuit sections:

- d.c. power supply (intended for direct a. c. supply)
- zero-crossing detector (for synchronization of the trigger circuit)
- difference amplifier (used as a sensing amplifier)
- ramp function generator (operating as the sawtooth oscillator in time-proportional control)
- output amplifier (amplifying the trigger pulses and feeding the thyristor or triac gate)

Various control modes possible when using the TCA280A are:

- phase control
- synchronous on/off switching (static switch)
- time proportional control

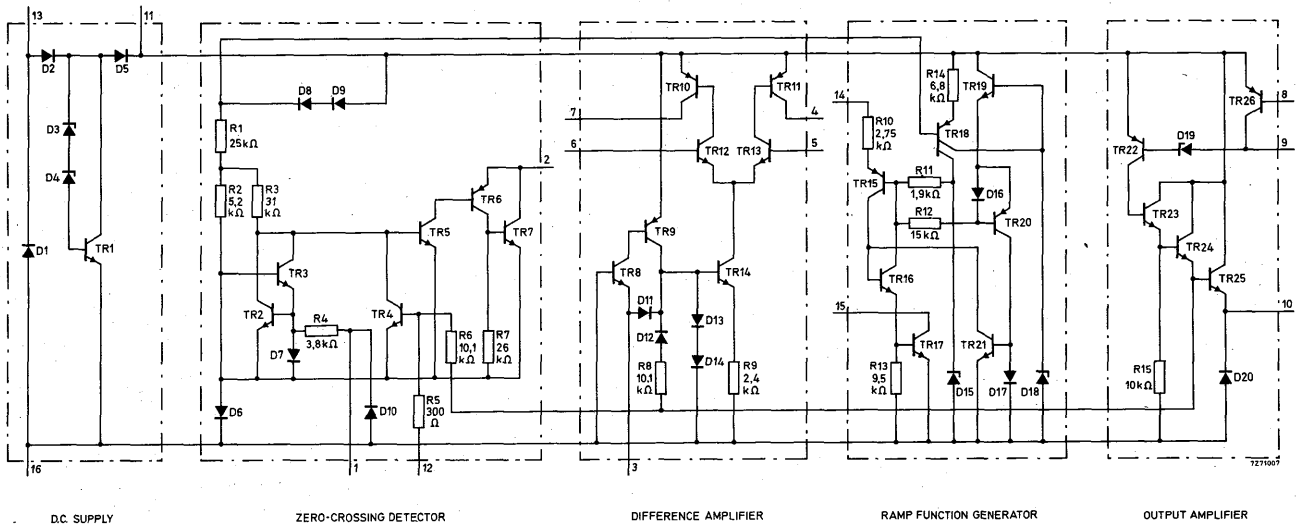
The device is designed to be supplied directly from the a. c. mains through a dropping resistor, alternatively, supply can be obtained from a 14,5 V(d. c.) source connected between pins 11 and 16.

The output current capability permits triggering of large thyristors and triacs.

PACKAGE OUTLINE plastic 16-lead dual in-line (see general section.)

CIRCUIT DIAGRAM

TCA280A



April 1974

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

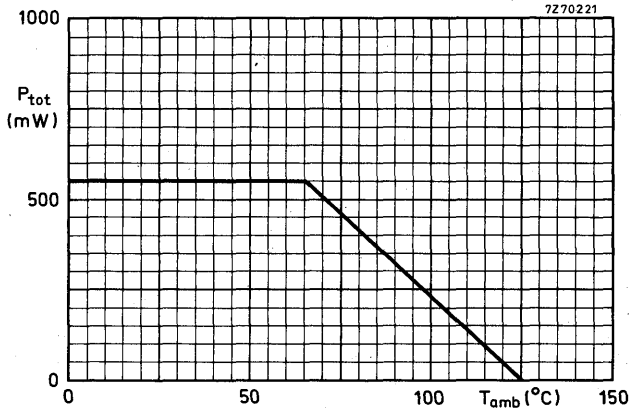
Voltages

V_{11-16}	max.	17	V
V_{11-7}	max.	17	V
V_{11-4}	max.	17	V
V_{8-16}	max.	17	V
V_{8-11}	max.	17	V
V_{9-16}	max.	17	V
V_{5-16}	max.	17	V
V_{6-16}	max.	17	V
$\pm V_{5-6}$	max.	7	V
V_{15-16}	max.	17	V

Currents

$\pm I_{13(AV)}$	max.	30	mA
$\pm I_{13M}$	max.	80	mA
$\pm I_{13SM}$	max.	2	A ¹⁾
$-I_{10(AV)}$	max.	30	mA
$-I_{10M}$	max.	600	mA ²⁾
$\pm I_{1M}$	max.	10	mA
I_2	max.	200	mA
$\pm I_3$	max.	10	mA
$I_5; I_6$	max.	10	mA
$-I_8; -I_9$	max.	10	mA
I_{12}	max.	10	mA
I_{15}	max.	10	mA

Total power dissipation



Temperatures

Storage temperature	T_{stg}	-55 to +125	°C
Operating ambient temperature	T_{amb}	-20 to +80	°C

1) $t \leq 10 \mu s$

2) $t \leq 300 \mu s$

TCA280A

CHARACTERISTICS at $T_{amb} = 25\text{ }^{\circ}\text{C}$

Power supply

<u>Supply voltage</u> at $I_{13} = 5\text{ mA}$; $I_{10} = 0$	V_{11-16}	typ.	14,4	V
			13 to 15	V
<u>Supply voltage range</u> for external supply	V_{11-16}		11 to 17	V

Zero-crossing detector

<u>Input current</u> at $V_{11-16} = 13\text{ V}$; $I_2 = 0,5\text{ mA}$	$\pm I_1$		30 to 50	μA	
<u>Input voltage</u> at $I_2 = 0,1\text{ mA}$					
	$-I_1$	$-V_{1-16}$	<	0,25	V
	$+I_1$	$+V_{1-16}$	<	1,9	V

Difference amplifier

Input currents

$-V_{5-11} = 3\text{ V}$; $+I_3 = 10\text{ }\mu\text{A}$ or $-I_3 = 30\text{ }\mu\text{A}$	I_5	typ.	5	μA
		<	10	μA
$-V_{6-11} = 3\text{ V}$; $+I_3 = 10\text{ }\mu\text{A}$ or $-I_3 = 30\text{ }\mu\text{A}$	I_6	typ.	5	μA
		<	10	μA

Output currents

$-V_{5-11} = 3\text{ V}$; $+I_3 = 10\text{ }\mu\text{A}$ or $-I_3 = 30\text{ }\mu\text{A}$	$-I_4$		0,3 to 1,2	mA
$-V_{6-11} = 3\text{ V}$; $+I_3 = 10\text{ }\mu\text{A}$ or $-I_3 = 30\text{ }\mu\text{A}$	$-I_7$		0,3 to 1,2	mA

Ramp function generator

<u>Trigger current</u>	I_{14T}	<	3	μA
<u>Holding current</u>	I_{14H}		95 to 210	μA
<u>Trigger voltage</u> at $I_{14} < I_{14T}$	V_{14-16}		7,0 to 8,3	V
<u>On-state voltage</u> at $I_{14} > I_{14T}$	V_{14-16}		1,8 to 2,8	V

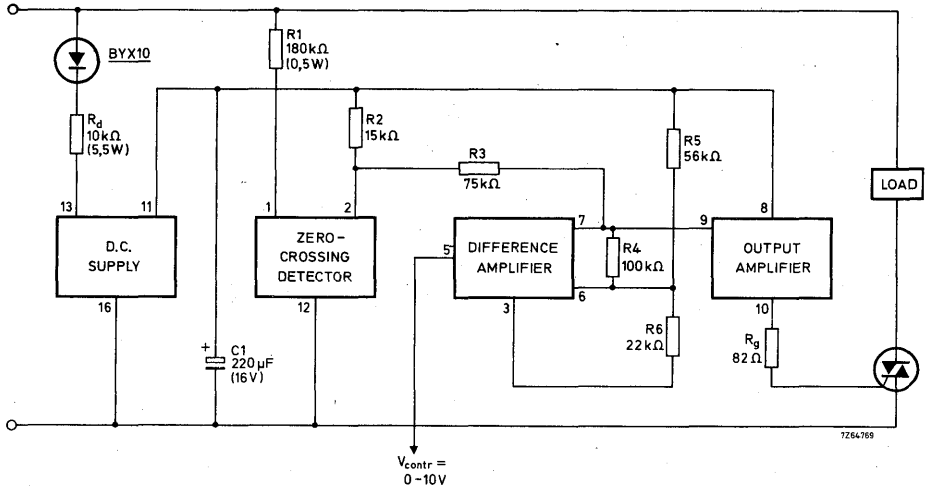
Output amplifier

<u>Input currents</u> at $-I_9 = 100\text{ }\mu\text{A}$	$-I_8$		19 to 53	μA
at $-I_{10} = 200\text{ mA}$	$-I_9$	<	15	μA
<u>Output current</u> (off-state)				
$I_9 = 0$; $V_{10-16} = 0$	$-I_{10}$	<	1	μA
<u>Output voltage drop</u>				
$-I_{10} = 200\text{ mA}$; $-I_9 = 50\text{ }\mu\text{A}$; $V_{11-16} = 13\text{ V}$	V_{11-10}	<	2,8	V

APPLICATION INFORMATION

The following are a few examples of the various control circuits possible with the TCA280A.

1. Synchronous on/off switching (static switch-resistive load)



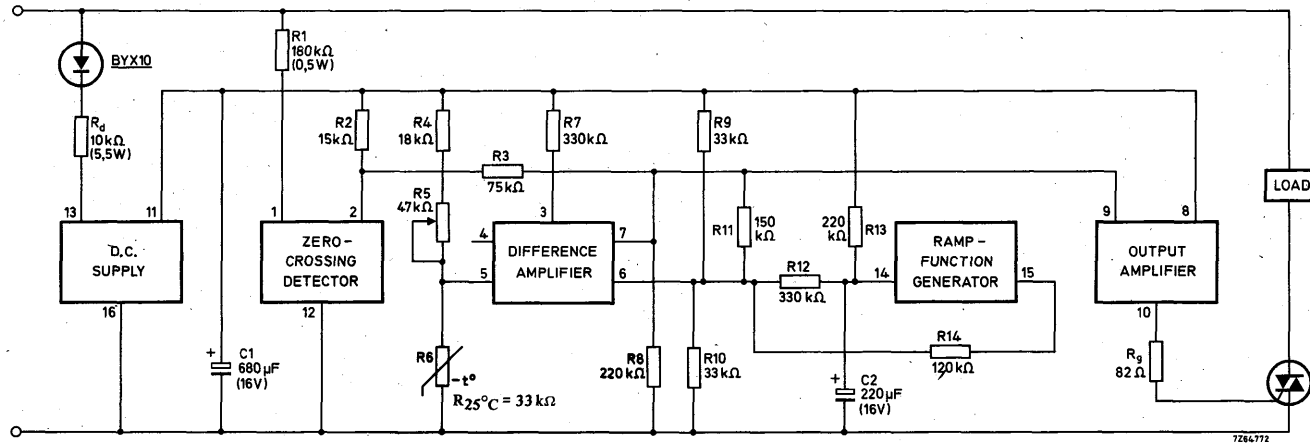
The synchronous switch gives triggering around the zero crossings of the mains voltage with a typical pulse duration of 160 μ s.

Note

Values of R_d , R_g , and C_1 are chosen for triacs requiring a gate current I_G typ. 100 mA at V_G typ. 2.5 V. For other conditions see graphs on pages 8, 9, 10 and 11.

APPLICATION INFORMATION (continued)

2. Time proportional temperature controller



Triggering is as in the circuit described on page 5 (synchronous on/off switching; resistive load), as triggering coincides with the zero crossings of the mains voltage. However, no triggering can occur if the voltage at pin 5 of the difference amplifier, supplied by the temperature-conscious bridge formed by R4, R5 and the NTC thermistor R6 in one branch, and R9 and R10 in the other, drops below the voltage at pin 6.

The voltage at pin 6 (V_{6-16}) is a sawtooth, produced by the ramp-function generator (pin 14), superimposed on a d.c. reference voltage.

Its repetition time is about 30 s and can be adjusted by varying C2.

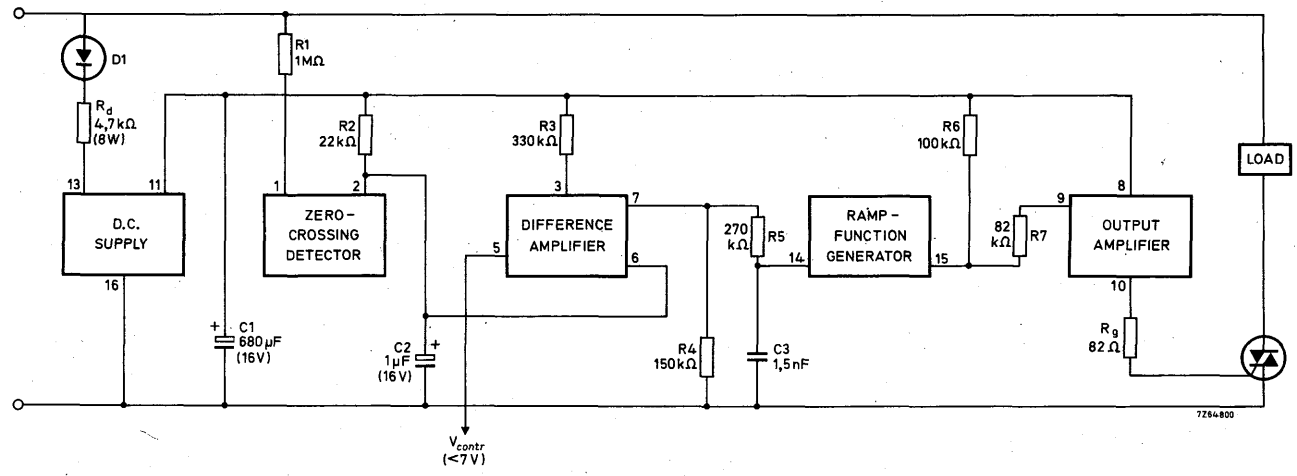
The amplitude of V_{6-16} determines the proportional band and can be adjusted by varying R12.

Note

See note on page 5.

APPLICATION INFORMATION (continued)

3. Single phase control circuit using trigger pulse bursts.

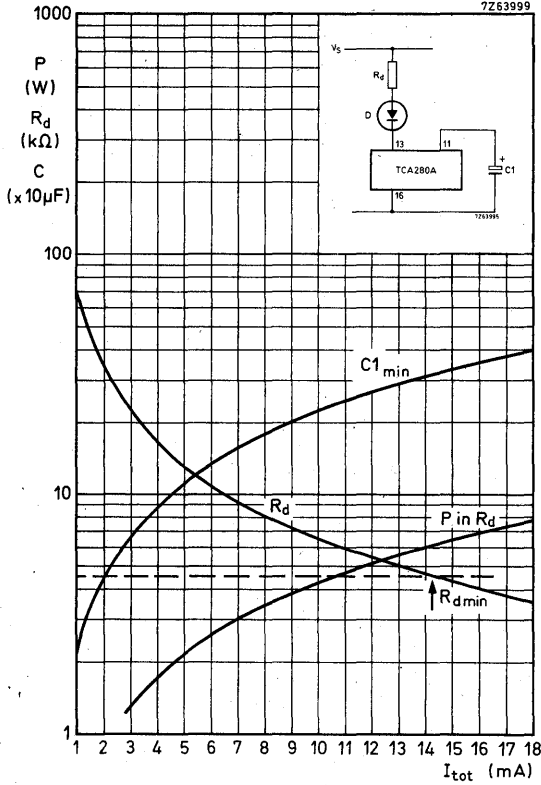


This circuit used in conjunction with a triac, provides a full-wave a.c. controller, and if used in conjunction with a thyristor, a controlled half-wave rectifier.

Note
See note on page 5.



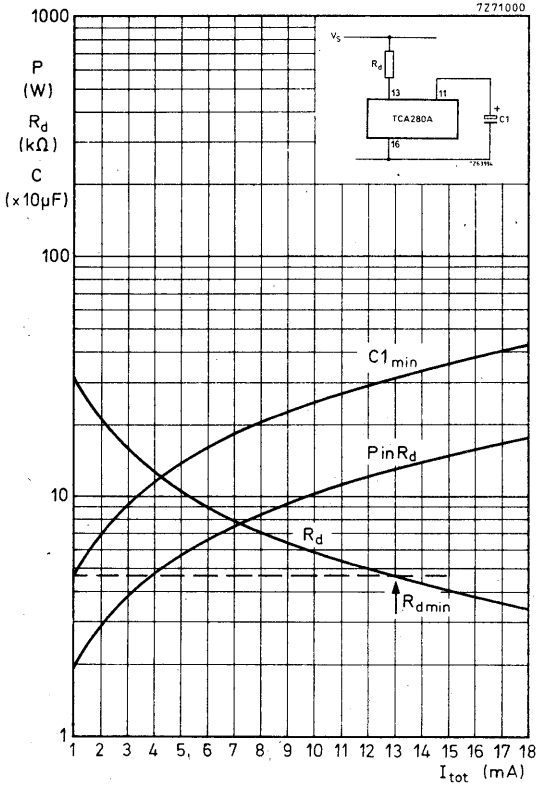
APPLICATION INFORMATION (continued)



Graph for determining the values of R_d , dissipation P in R_d , and minimum recommended value of $C1$ as functions of I_{tot} for the circuit conditions shown (with diode D). I_{tot} is the maximum average current through D , and is the total of the current consumed by the IC and by the external components.

It should be noted that certain applications like the time proportional controller require an up to three times higher value of $C1$.

APPLICATION INFORMATION (continued)

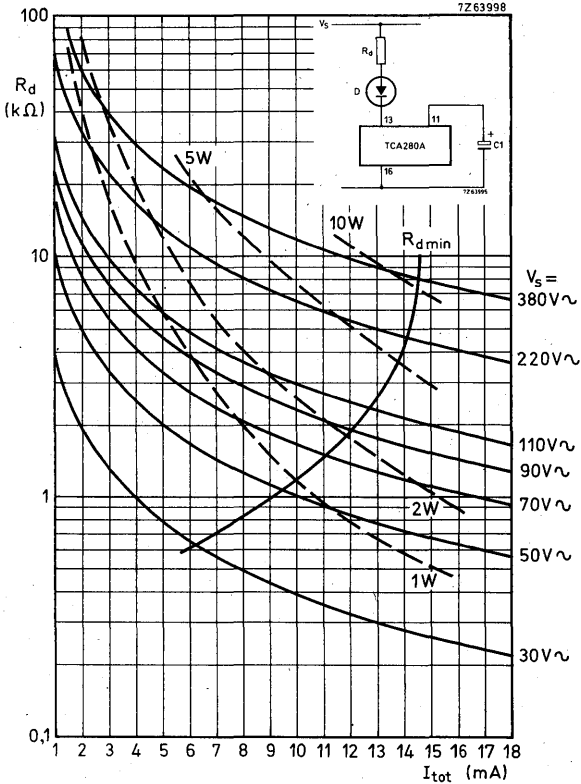


Without diode

Note

This graph is not suitable for phase control applications; use the graph on page 8.

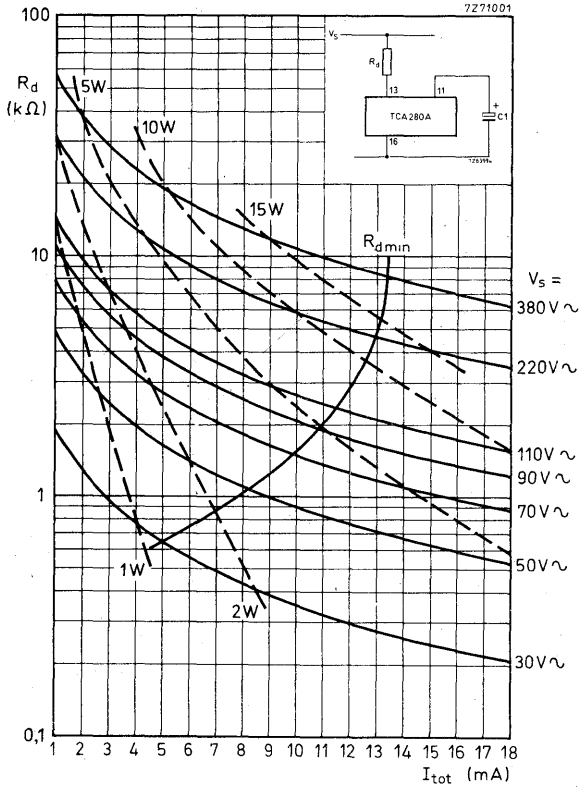
APPLICATION INFORMATION (continued)



Graph for determining the value of R_d and corresponding dissipation at different mains voltages for the circuit conditions shown (with diode D)

I_{tot} is the maximum average current through D5, and is the sum total of the current consumed by the IC and by the external components.

APPLICATION INFORMATION (continued)

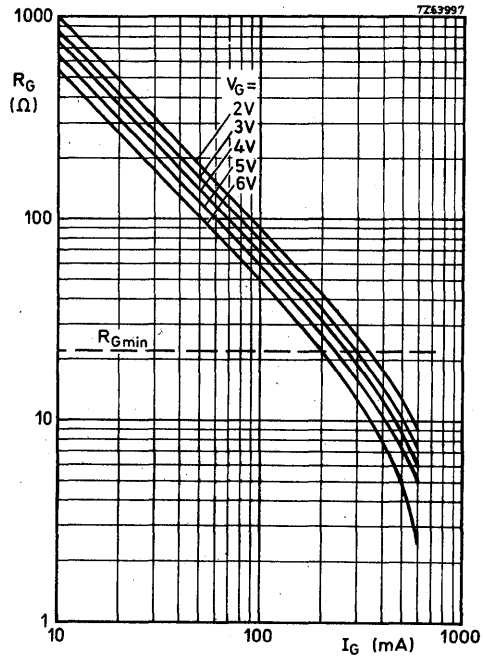


Without diode

Note

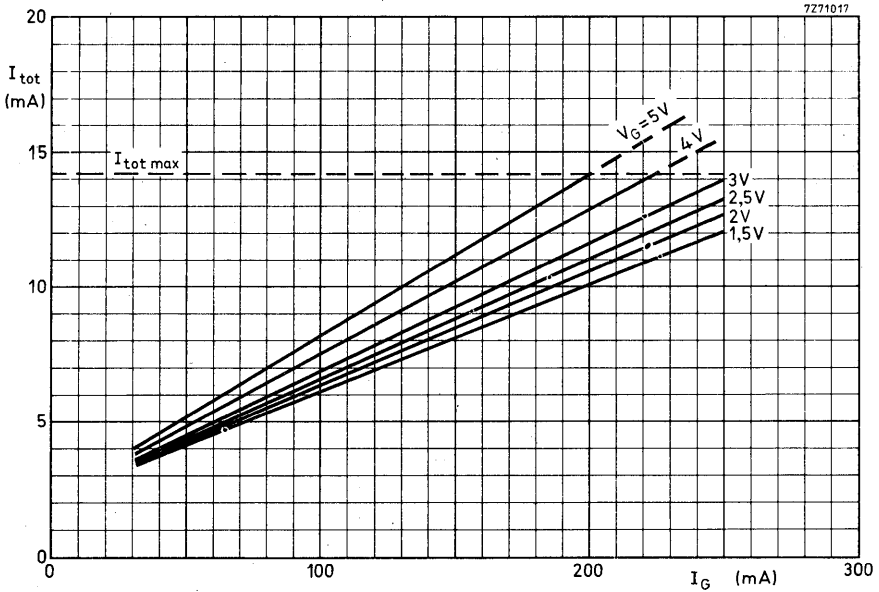
This graph is not suitable for phase control applications; use the graph on page 10,

APPLICATION INFORMATION (continued)



Graph showing R_G as a function of I_G of the TCA280A for various values of V_G . The minimum value of R_G at which the current I_{I0} is kept within the specified limits is 22 Ω .

APPLICATION INFORMATION (continued)



Graph for determining I_{tot} corresponding to a given I_G with V_G as a parameter. Once I_{tot} is known, the required values of R_d , R_G and $C1$ can be found from the graphs on pages 8, 9, 10, 11 and 12.

Note that this graph can be used only if the highest possible R_G is used.