LINEAR INTEGRATED CIRCUIT

SGS **TDA7270S**

MULTIFUNCTION SYSTEM FOR TAPE PLAYERS

The TDA 7270S is a multifunction monolithic integrated circuit in a 16-lead dual in-line plastic package specially designed for use in car radios cassette players, but suitable for all applications requiring tape playback.
It has the following functions:

- Motor speed regulator
- Automatic stop
- Manual stop
- Pause
- Cassette ejection
- Radio – Playback automatic switching.

The circuit incorporates also:

- Thermal protection
- Short circuit protection to ground (all the pins)

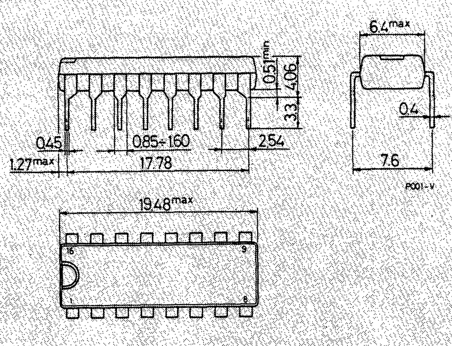
ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage	20	V
I_1	Sink peak current at pin 1	2	A
I_5	Sink peak current at pin 5	2	A
P_{tot}	Power dissipation at $T_{amb} \leq 80°C$	1	W
T_{stg} ; T_j	Storage and junction temperature	-40 to 150	°C

ORDERING NUMBER: TDA 7270 S

MECHANICAL DATA

Dimensions in mm



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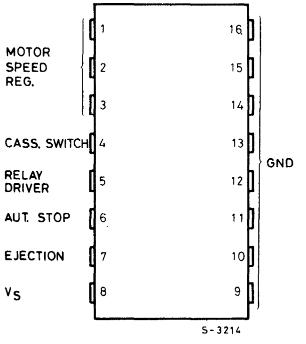
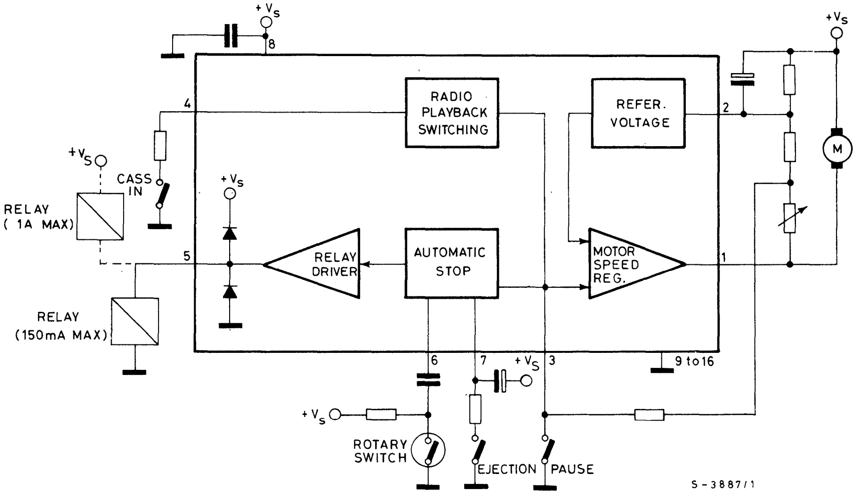
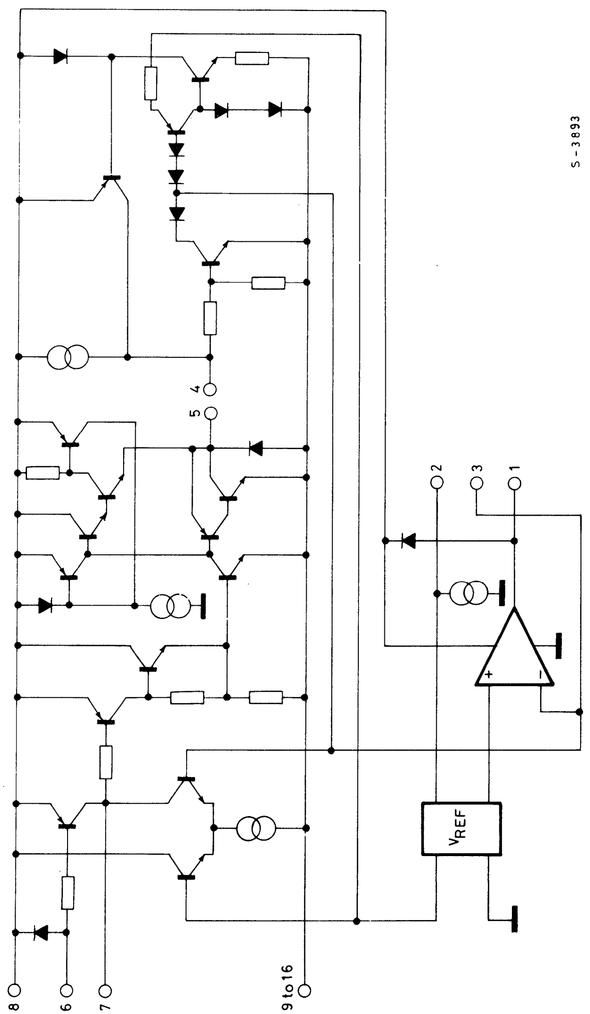
CONNECTION DIAGRAM
(top view)



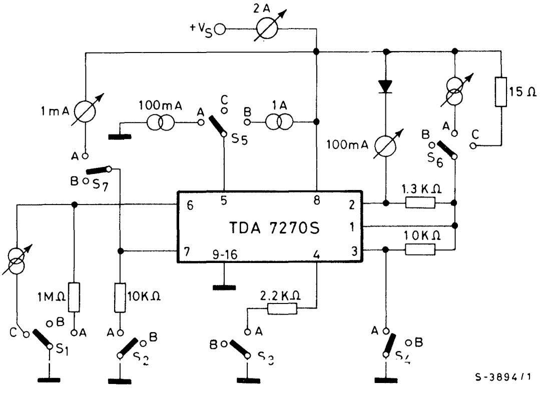
BLOCK DIAGRAM



SCHEMATIC DIAGRAM



TEST CIRCUIT



THERMAL DATA

$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	70	°C/W
$R_{th\ j\text{-}case}$	Thermal resistance junction-pins	max	15	°C/W

ELECTRICAL CHARACTERISTICS (Refer to the test circuit; T_{amb}= 25°C; V_s = 14V; S_7 at B, unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_s	Supply voltage		6		18	V
I_d	Quiescent drain current	Automatic stop-S_3 at B S_4 at B		5	10	mA
		Pause - S_3 at A; S_4 at A		9	15	
I_5	Maximum output current for relay driving		150			mA
T_{sd}	Thermal shut-down case temperature	P_{tot} = 1W ($\frac{\Delta V_{ref}}{V_{ref}}$ = -5%)	105	125		°C

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
MOTOR SPEED CONTROL						
I_{MS}	Starting current (pin 1)		1			A
V_{ref}	Reference voltage (pin 2-3)	I_M= 100 mA	1.15	1.25	1.35	V
$\frac{\Delta V_{ref}}{V_{ref}} / \Delta V_s$		I_M= 100 mA V_s = 8 to 18V		0.1	0.4	%/V
$\frac{\Delta V_{ref}}{V_{ref}} / \Delta I_M$		I_M= 50 to 400 mA		0.01	0.03	%/mA
$\frac{\Delta V_{ref}}{V_{ref}} / \Delta T$		I_M= 100 mA T_{amb}= -20 to 70°C		0.01		%/°C
V_2	Operating voltage	I_M= 100 mA $\frac{\Delta V_{ref}}{V_{ref}} = -5\%$	2.4			V
K	Reflection coeff.(K= I_M/I_T see fig. 12)	I_M= 100 mA	18	20	22	—
$\frac{\Delta K}{K} / \Delta V_s$		I_M= 100 mA V_s= 8V to 18V		0.3	1	%/V
$\frac{\Delta K}{K} / \Delta I_M$		I_M= 50 to 400 mA		0.005	0.02	%/mA
$\frac{\Delta K}{K} / \Delta T$		I_M= 100 mA T_{amb}= -20 to 70°C		0.01		%/°C
PAUSE						
I_3	Current consumption	S_4 at A	1.4			mA
V_{8-1}		S_4 at A			0.2	V
EJECTION						
I_7		S_2 in A	20			μA
V_{5-8}	Saturation voltage	I_5 = 100 mA		2.1	3	V
V_5	Saturation voltage	I_{5-8}= 1.5A		2.2	3	V
V_4	(Pause condition)	S_1 at A S_3 at A S_4 at A	6			V
V_4	(Radio)	S_1 at A S_3 at B S_4 at B	6	9		V
V_4	(Tape)	S_1 at A S_3 at A S_4 at B			1.7	V
R_o	Output impedance at pin 4	S_3 at B		16	22	KΩ
AUTOMATIC STOP						
V_{8-1}	Saturation voltage	S_1 at B S_2 at B S_3 at B			1	μA
I_6	Minimum current to avoid stop	S_1 at C			1	μA
I_{7-8}	Load current for delay circuit	I_6= 0 S_7 at A S_2 at B	10.5	15	19.5	μA

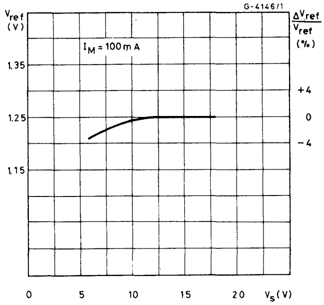


Fig. 1 - Reference voltage vs. supply voltage.

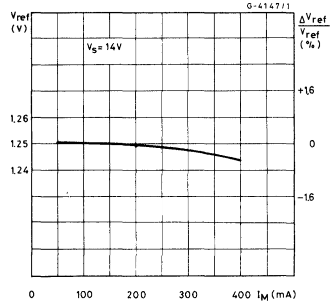


Fig. 2 - Reference voltage vs. motor current.

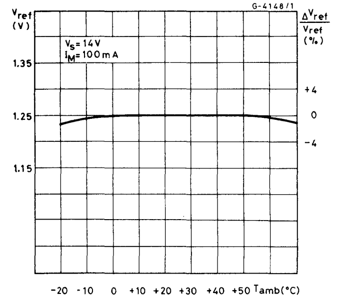


Fig. 3 - Reference voltage vs. ambient temperature.

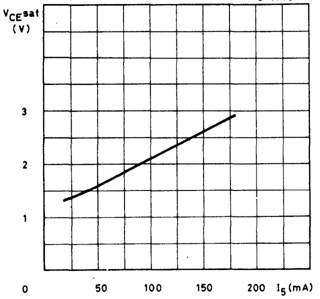


Fig. 4 - Saturation voltage (pins 5-8) vs. pin 5 current.

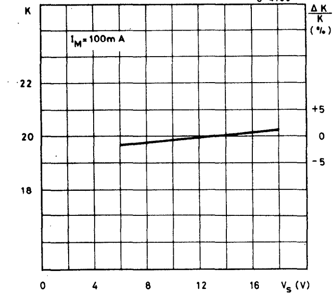


Fig. 5 - Reflection coefficient vs. supply voltage.

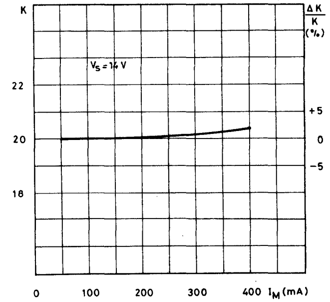


Fig. 6 - Reflection coefficient vs. motor current.

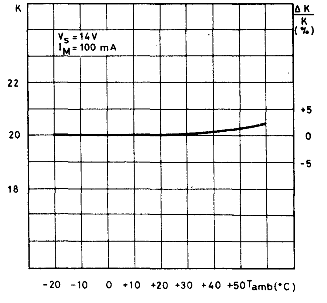


Fig. 7 - Reflection coefficient vs. ambient temperature.

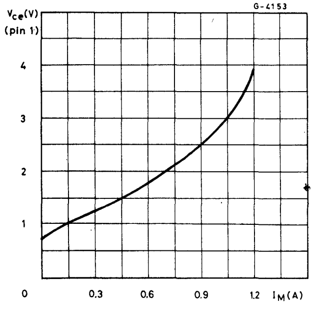


Fig. 8 - Pin 1 saturation voltage vs. motor current.

APPLICATION INFORMATION

The TDA 7270S incorporates four different functional blocks:

1) Motor speed control.
2) Autostop circuit.
3) Radio/Playback switching
4) Relay driver.

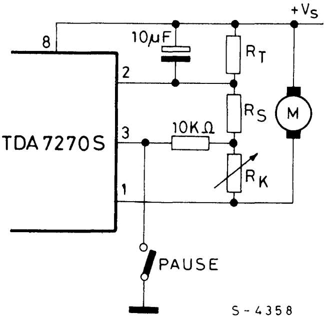
The motor speed control is a conventional circuit providing correction for the internal losses of the motor. Fig. 9 shows the external circuit.
The values of R_T, R_S and R_K determine the regulation characteristics and motor speed.

$$R_T = K \cdot R_M$$

where K = the IC regulator reflection coefficient and R_M = motor internal resistance.
The following condition must be always satisfied

$$R_S \leqslant 4\,R_T$$

Fig. 9



The voltage applied across the motor is given by

$$V_{8-1} = V_{ref}\left[1 + \frac{R_T}{R_S}\left(1 + \frac{1}{K}\right) + \frac{R_K}{R_S}\right]$$

and this is proportional to R_K which therefore adjusts the speed.
The voltage between pin 2 and the supply must not fall below 0.3V and so

$$\left[V_{ref\ min}\left(\frac{R_T}{R_S}\right) + I_{M\ min}\left(\frac{R_T}{K_{max}}\right)\right] > 0.3V$$

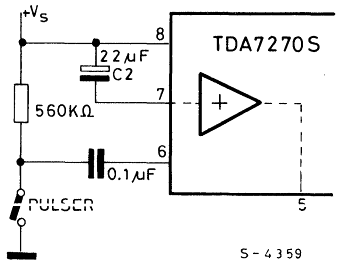
The "pause" condition corresponds to $V_3 < 50$ mV; in this condition the motor will stop ($V_{1\text{-}8} < 0.2$V), the capacitor C_2 on the autostop circuit (see below) will no longer be charged and the pin 4 (cassette/radio switch output) will be pulled high.

APPLICATION INFORMATION (continued)

The autostop circuit is shown in fig. 10.
In normal operation the capacitor C_2 (22 μF) is slowly charged by a constant current drawn by pin 7 of 15 μA, and each time the pulser (a switch on the cassette take-up speed shaft) closes, C_2 is discharged. If the cassette stops, and the pulse stops, the voltage on pin 7 falls.
This switches the power amplifier state and pin 5 goes low. Pin 5 can be used for one of two purposes:

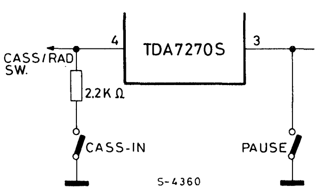
1) to drive a stop warning light connected from pin 5 supply V_s.
2) to actuate a solenoid wired either to ground (to release the cassette) or to supply (to eject the cassette).

Fig. 10



The **pause and/or cassette/radio switching** shown in fig. 11 has an input/output on pin 4.
If pin 4 is not used it should be grounded.

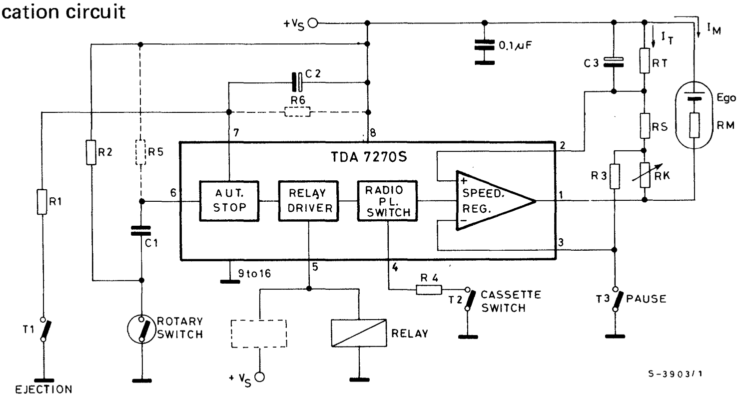
Fig. 11



This pin has the following logic.

Cass IN	Pause	Pin 4	Function
Open	Open	> 6V	motor off/radio on
Open	Close	> 6V	motor off/radio on
Close	Open	< 1.7V	motor on/cass. on
Close	Close	> 6V	pause/radio on

Fig. 12 - Application circuit



DESCRIPTION OF OPERATION (Refer to fig. 12)

When the cassette is introduced the switch T_2 closes, the motor start to turn and the rotary switch generates the pulses which keep the levels of pin 5 and pin 7 high. A relay between pin 5 and ground holds the cassette. If there are no pulses at pin 6 (because tape stopped) or if the ejection switch T_1 is closed, the voltages at pin 5 and pin 7 drop; the relay is thus de-energized and the cassette ejected; as soon as the cassette is ejected, the switch T_2 opens and the motor stops. The capacitor at pin 7 discharges allowing the system to start again when another cassette is inserted. In other types of mechanical systems the cassette is ejected by energizing a relay; in this case the relay must be connected between pin 5 and the supply; the sequence of operations is then the same as described above. If the pause switch T_3 is closed, the motor stops even though there are no pulses at pin 6, the voltage levels at pins 7 and 5 remain high so the cassette is not ejected and the motor is ready to start again as soon as the pause key is released. A voltage for driving the radio-tape switching is available at pin 4. This voltage level is high ($>$ 6V) with stopped motor and is low ($<$ 1.7V) with running motor.

APPLICATION SUGGESTION (See figure 12)

Component	Recommended value	Purpose	Larger than recommended value	Smaller than recommended value	Allowed range Min.	Max.
R_1	10 KΩ	Limits current from pin 7	Delayed ejection. Possibility that ejection does not work	High driving current at pin 7	0	100KΩ
R_2	560 KΩ	By rotary switch it produces pulses which disable the automatic stop	Undesired operation of automatic switch	Possibility of audio interference spikes	100KΩ	2MΩ
R_3	10 KΩ	Limits the motor current during pause (T_3 closed)	Reference voltage variation	Higher motor current during pause (T_3 closed) with delayed stop of motor	1KΩ	47KΩ
R_4	2.2 KΩ	Fixes voltage of pin 4 during pause and playback	Voltage at pin 4 increases	Voltage at pin 4 decreases. Radio-Playback switching could not work	1.5KΩ	2.7KΩ
R_5	560 KΩ	Compensates for current loss between pin 6 and ground	Limited compensation	Necessity to increase C_1 and decrease R_2	100KΩ	∞
R_6	1 MΩ	Compensates for current loss between pin 7 and ground. Also reduces recovery time	Limited compensation	Possibility that automatic stop will not work	560KΩ	∞
R_T	$K \cdot R_M$ (typical values)	Compensates for voltage drops at motor terminals vs. ΔI_M	Danger of oscillations	Poor speed regulation versus ΔI_M	See note on next page	

APPLICATION SUGGESTION (continued)

Component	Recommended value	Purpose	Larger than recommended value	Smaller than recommended value	Allowed range	
					Min.	Max.
R_S	See Note (*)	Fixes the current value in R_T and and R_K for $I_M = 0$	Danger of saturation of non inverting input of regulator (pin 2). Considerable speed variation for small variation of R_K	Impossibility to obtain a low motor speed		$4\ R_T$
R_K	See Note (*)	Fixes the requested V_{8-1}	Wide speed variation versus ΔR_K	Limited speed variation versus ΔR_K		
C_1	0.1 μF	DC isolation	Electrolytic capacitors cannot be used	Undesired automatic stop	0.047 μF	
C_2	22 μF	Integrates the pulses of the rotary switch	High recovery time	Low recovery time. Undesired automatic stop	3.3 μF	
C_3	10 μF	By pass	Wow and flutter problems	Instability at low temperature	5 μF	22 μF
Rotary switch frequency	20 Hz	Keeps automatic stop off	Possibility of audio interference spikes	Necessity to increase C_1 and C_2		

NOTE (*):

– $V_{8-1} = V_{ref} \left[1 + \frac{R_T}{R_S} \left(1 + \frac{1}{K}\right) + \frac{R_K}{R_S} \right]$ from which it can be seen that V_{8-1} varies linearly with R_K.

– The voltage between pin 2 and the supply must not fall below 0.5V, so the following expression must be verified

$$\left[V_{ref\,min} \left(\frac{R_T}{R_S}\right) + I_{M\,min} \left(\frac{R_T}{K_{max}}\right) \right] > 0.3V$$

– During the pause, the voltage between pin 3 and ground must be lower than 1.3V.

Fig. 13 - Speed variation vs. supply voltage

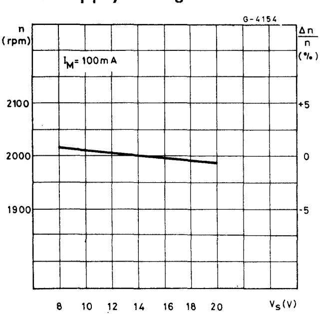


Fig. 14 - Speed variation vs. motor current

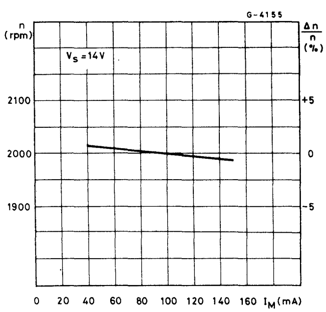
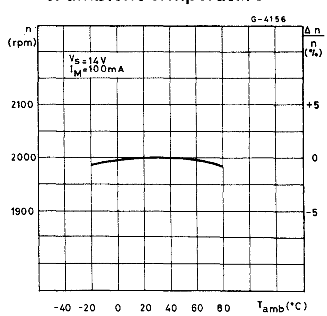


Fig. 15 - Speed variation vs. ambient temperature



APPLICATION SUGGESTION (continued)

Fig. 16 - Delay time of the relay driver (C_2= 2.2 μF)

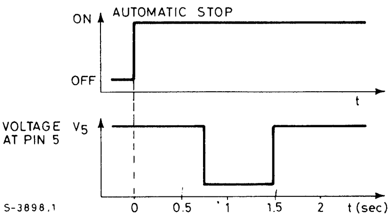
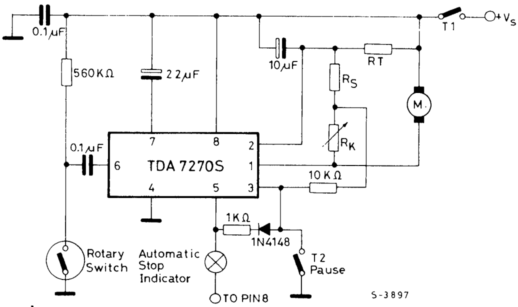


Fig. 17 - Low cost application circuit



The circuit shown in fig. 17 offers the following functions:

1) motor speed regulation
2) automatic stop
3) autostop warning light
4) pause.

The circuit incorporates an additional resistor/diode from pin 3 to pin 5. When the cassette stops, and the pulser no longer generates pulses, pin 5 falls to a low level and the stop indicator is on.
Pin 3 is pulled low through the 1 KΩ resistor and the diode, however pin 3 must not be pulled lower than 1.3V since this would cause pin 5 to go high again. The current of about 1 mA out of pin 3 causes V_{3-5} to be about 1.5V.
In this way the motor remains stopped and pin 5 remains low.

MOUNTING INSTRUCTIONS

Fig. 18 - Example of heatsink using PC board copper

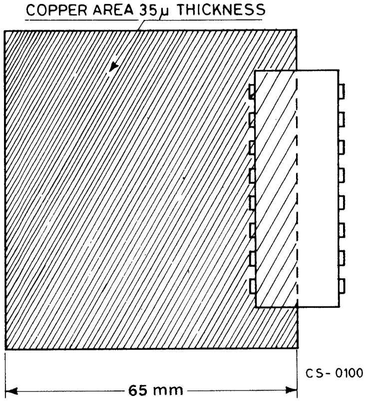
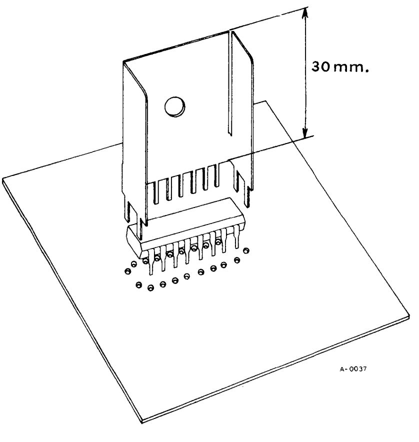


Fig. 19 - Example of external heatsink



Figures 18 and 19 show two ways to make the device dissipate.
In both cases, R_{th}= 35°C/W.