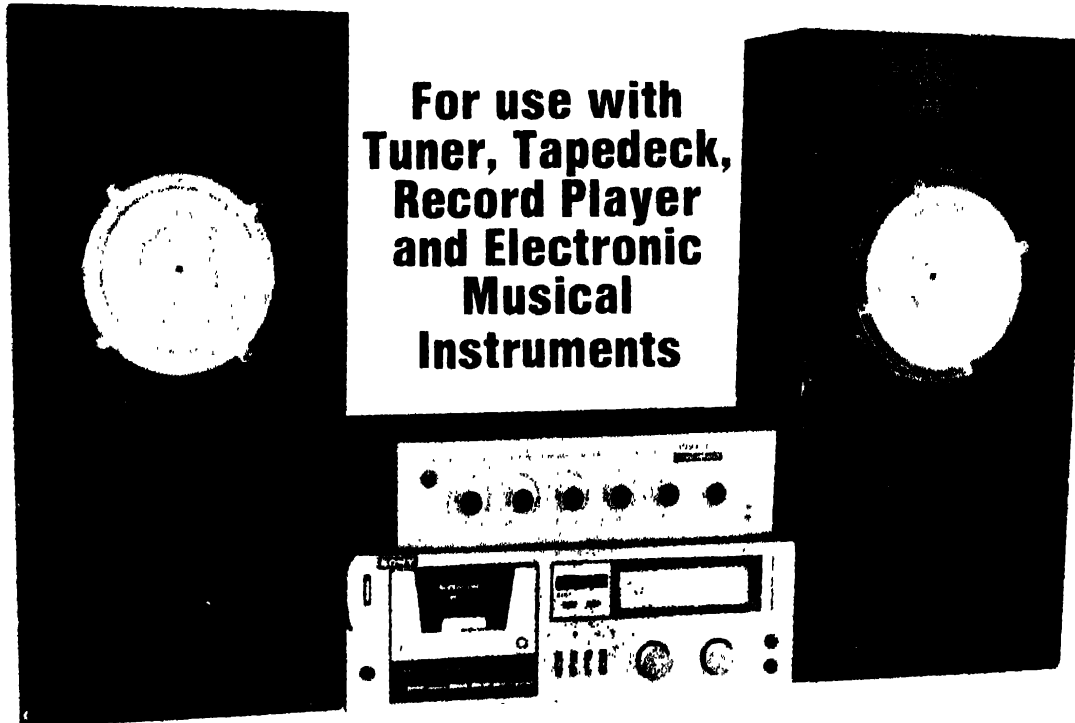


20W+20W STEREO AMPLIFIER



For use with
Tuner, Tapedeck,
Record Player
and Electronic
Musical
Instruments

A stereo system is probably one of the most popular projects for an electronic hobbyist and the professional alike. The one described here costs less than a thousand rupees, including the speaker system.

The stereo amplifier is built around integrated circuits only and does not employ any discrete transistor. 741 op-amps are used in the preamplifier and active tone control. The power amplifier section is built around a TDA 2020. The use of integrated circuits, especially in the power amplifier stage, greatly simplifies construction.

The TDA 2020 integrated circuit features internal protections. No damage occurs if the output circuit is shorted. Since it also incorporates thermal protection, there is no danger of thermal runaway if excess power is dissipated in relation to the heatsinking used. High temperatures cause the IC to shut-down, but normal working is restored when

SPECIFICATIONS

SENSITIVITY

Input A: 5 mV (47k impedance)
Input B: 50 mV (500k impedance)
Input C: 150 mV (1.5M impedance)

POWER OUTPUT

With $\pm 17V$ and 4-ohm speaker: 20W
With $\pm 17V$ and 8-ohm speaker: 10.5W

TOTAL HARMONIC DISTORTION

At 20W: Less than 1%
At 8W: Less than 0.2%

FREQUENCY RESPONSE

20 Hz to 20 kHz ($\pm 3dB$)

TONE CONTROLS

Bass: +9dB to -12dB at 100Hz
Treble: +12dB to -20dB at 10 kHz

(Note: Good soldering is the most important thing for a successful project. Dry joints can give rise to nasty problems, especially if they occur in high current areas in the power output stage.)

the temperature has fallen. Both the channels are powered with the same dual power supply of $\pm 17V$.

The complete circuit diagram of the stereo amplifier (only one channel shown, the other being similar) is shown in Fig. 1.

Preamplifier

Input to the preamplifier is via DC blocking capacitor C1. Resistor chain comprising R1, R2 and R3 forms an attenuator. The voltage across R3 is applied to IC1 input. The values of these resistors have been calculated such that the sensitivity is 5 mV in position A, 50 mV in position B, and 150 mV in position C. Values of R1 and R2 can be altered to suit individual requirement of input of sensitivity. The gain of the first stage is approximately fifty. (The preamp does not provide any kind of equalisation. So tape head/magnetic phono inputs should be passed through suitable equalisers before feeding to this amplifier.)

Tone control

Preamp output at pin 6 of IC1 is fed to tone control circuitry via C2. The tone control being 'active' type, gives both boost and cut of treble and bass.

The circuit has almost unity gain throughout the audio range when bass and treble are set to their mid-way positions. The gain for a frequency of 1 kHz is unity at all settings of the tone controls. All other frequencies are boosted or cut as the controls are rotated.



— An inside view of the author's prototype.

The performance of the tone control is tabulated below:

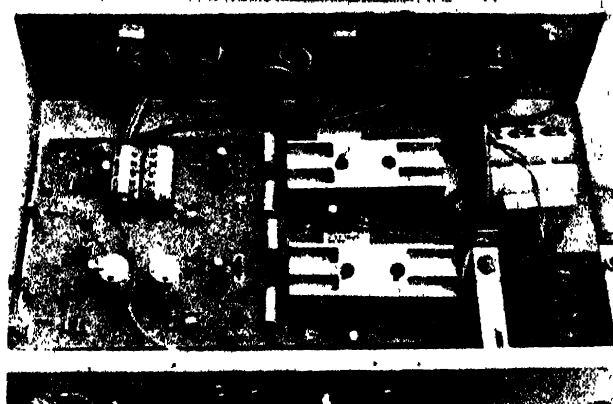
Frequency	Max. Cut	Max. Boost
Bass (at 100Hz)	-12dB	+9dB
Treble (at 10kHz)	-20dB	+12dB

Output of the tone control is fed to volume control VR3 through C5. The signal level across VR3 will be around 240 mV for an input voltage of 5 mV across R3. There is no need for a balance control since each channel has separate volume control.

Power amplifier

From VR3 coupling is by C6 to the input pin 7 of IC3. Negative feedback from the output (pin 14) to the inverting input (pin 8) is set by R14, R15 and C10. The presence of C10 offers unity feedback at DC so as to keep output offset to a very small value. This enables direct coupling of the speakers to the output. R14 and C10 dictate the low-frequency roll-off characteristics. C9 is a frequency compensation capacitor. C13 and C14 are HF decoupling capacitors fitted very close to the pins of IC3.

The maximum supply for TDA 2020 is $\pm 20V$. But this is not recommended as the IC may be damaged if higher



— Another view of author's prototype.

voltage should arise, and the power output obtained is not a great deal more with a more than ± 17 volts supply. With 4-ohm speaker and $\pm 17V$ supply, power output obtained is 20 watts. With 8-ohm speaker and $\pm 17V$ supply, the output will be reduced to 13.5 watts.

Construction

The full-size printed circuit board layout for one channel is shown in Fig. 2. The same layout can be used for making a combined PCB for both the channels, which will have a size of 22cm by 13cm. All components, except power supply and volume, treble and bass control pots, are soldered into the PCB.

It is preferable to assemble the low-profile components—such as resistors, diodes and small capacitors—first, followed by ICs. Take care to see that all polarised components—such as diodes, electrolytic capacitors and integrated circuits—are mounted with correct orientation.

Before installing IC3, holes should be drilled in the PCB to suit the heatsink used. In the prototype a solid aluminium heatsink of 8.5cm length, 3cm width and 2.2cm height was used. It is important to note that C9 and a few resistors lie under the heatsink. Care should be taken to ensure that excepting the IC no component makes contact with the heatsink.

The heatsink mounting nut and bolt should be well isolated from the PCB foil. In any case it should not make

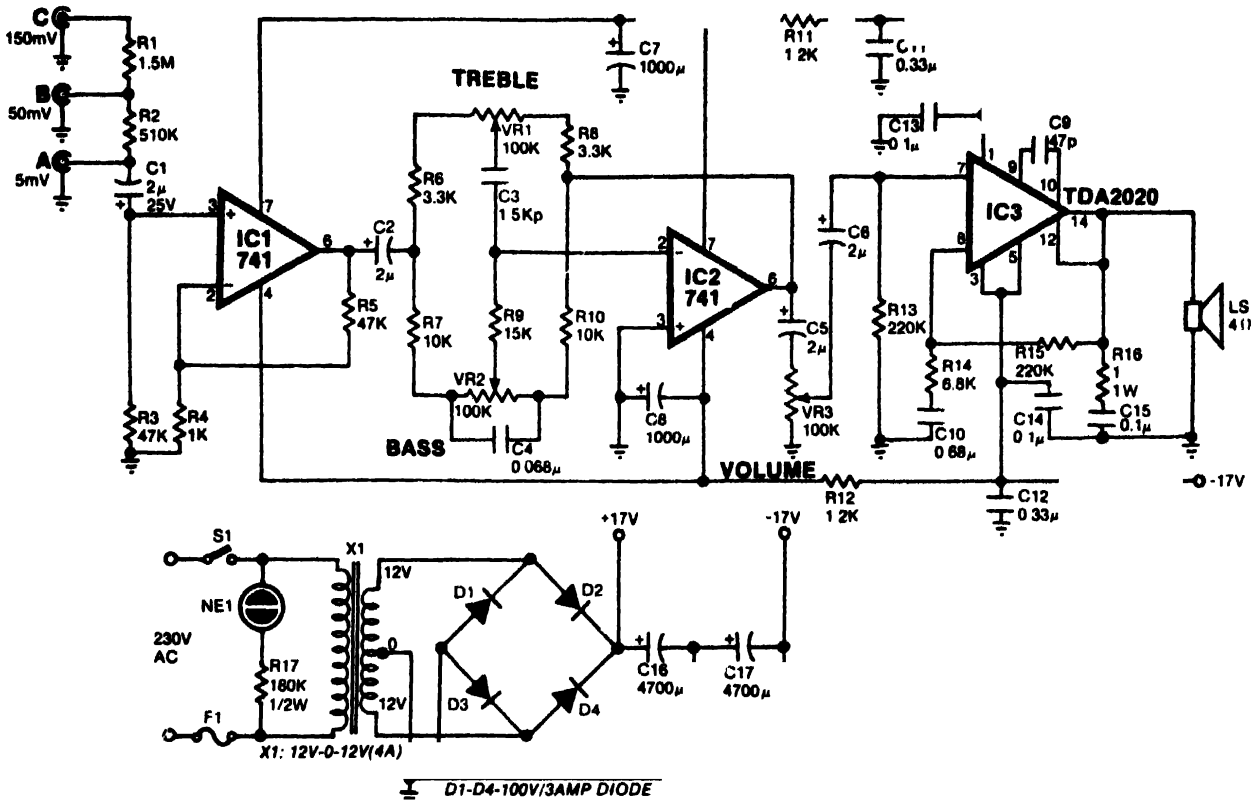


Fig. 1: Circuit diagram for one channel of a 20W plus 20W stereo amplifier; the second channel is identical.

contact with the negative or positive rail of the supply or the earth (0V). Before soldering IC3, the heatsink should be fixed. Apply a thin coat of heatsink compound (silicon grease) and mount the heatsink with suitable nuts and bolts. (They should not make contact with chassis.) After fixing the heatsink, IC3 can be soldered.

Required lengths of colour coded ribbon cable can be used for wiring volume and tone control pots. C4 is soldered over the bass control pot.

Power supply

The simplest part of this project is its power supply. It may be constructed without using a PCB.

The transformer used in the prototype had a secondary of 12-0-12 volts, rated 4A. (For mono only the current rating can be halved.) Silicon diodes of 3-amp and 100-volt reverse rating or a suitable bridge rectifier can be used. (Prototype used a bridge.) The transformer should be mounted away from input wiring side to keep the hum pick-up to a minimum.

The primary of the transformer is in series with the on-off switch of the left-channel volume control. Fuse F1 can be mounted in the back panel. A neon pilot lamp with a 180k resistor in series is connected across the primary of the transformer. The positive of the supply goes to pin 1 of IC3 and the negative to pins 3 and 5.

From PCB earth (0V) a thick wire (such as the braid of a shielded wire) should be soldered to the nearest point in the

PARTS LIST

Semiconductors:

- IC1, IC2 -- LM741, operational amplifier
- IC3 -- TDA 2020, power amp.
- D1-D4 -- Any 100V, 3A diode (or bridge rectifier)

Capacitors:

- C1, C2, C5, C6 -- 2 μ F, electrolytic capacitor
- C3 -- 1.5kpF, ceramic capacitor
- C4 -- 0.068 μ F, polyester capacitor
- C7, C8 -- 1000 μ F (25V), electrolytic capacitor
- C9 -- 47pF, ceramic capacitor
- C10 -- 0.68 μ F, Mylar capacitor
- C13, C14, C15 -- 0.1 μ F, polyester capacitor
- C16, C17 -- 4700 μ F (25V), electrolytic capacitor
- C11, C12 -- 0.33 μ F, Mylar capacitor

Resistors (all 1/4 watt unless otherwise stated):

- R1 -- 1.5-megohm
- R2 -- 510-kilohm
- R3, R5 -- 47-kilohm
- R4 -- 1-kilohm
- R6, R8 -- 3.3-kilohm
- R7, R10 -- 10-kilohm
- R9 -- 15-kilohm
- R11, R12 -- 1.2-kilohm
- R13, R15 -- 220-kilohm
- R14 -- 6.8-kilohm
- R16 -- 1-ohm (1W)
- R17 -- 180-kilohm (1/2W)
- VR1, VR2, VR3 -- 100-kilohm (lin.)

Miscellaneous:

- X1 -- Mains transformer with 12V-0-12V, 4A secondary
- F1 -- 500mA fuse with holder
- S1 -- On/off switch
- LS -- Full-range speaker (4-ohm)
- RCA sockets, speaker sockets, heatsink, PCB, ribbon cable, shielded wire, cabinet, nuts and bolts, neon, etc.

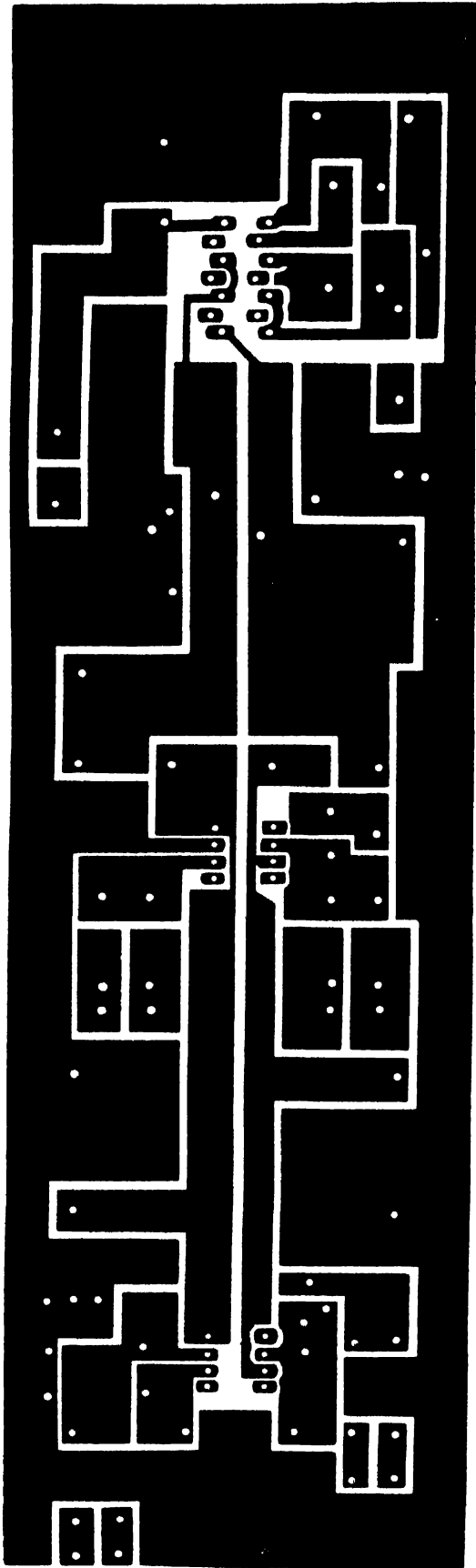


Fig. 2: Actual-size PCB layout for one channel.

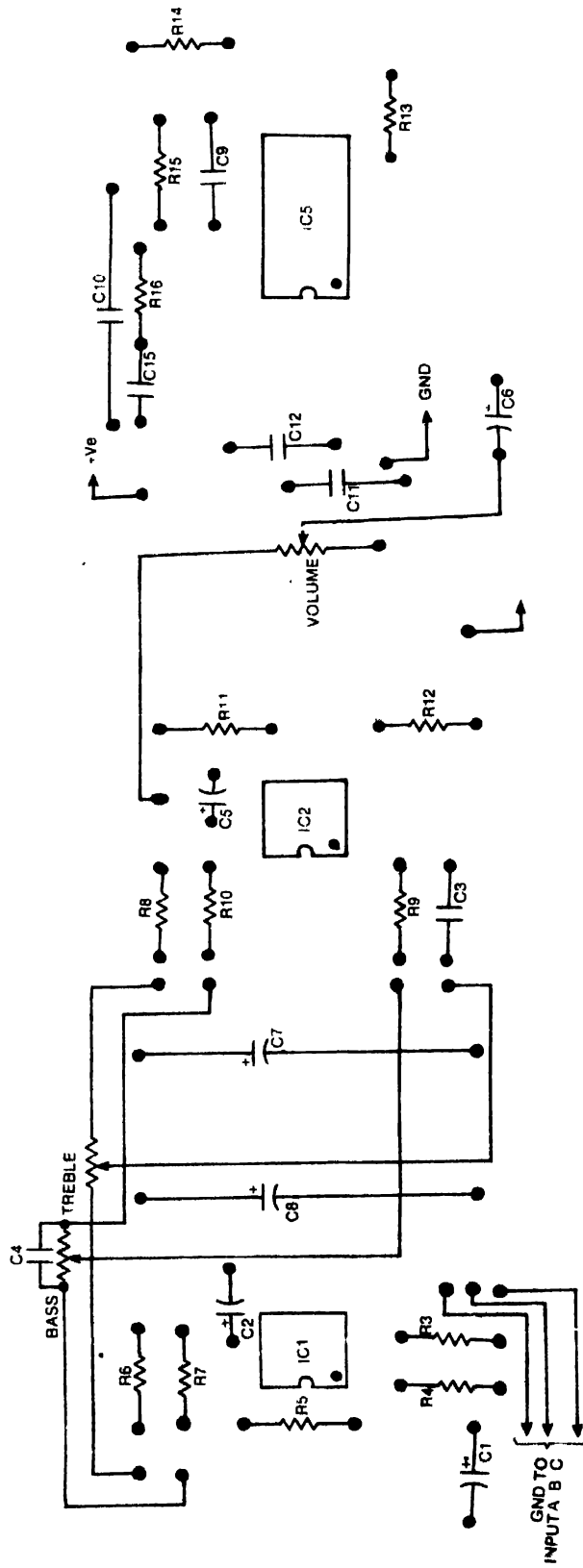
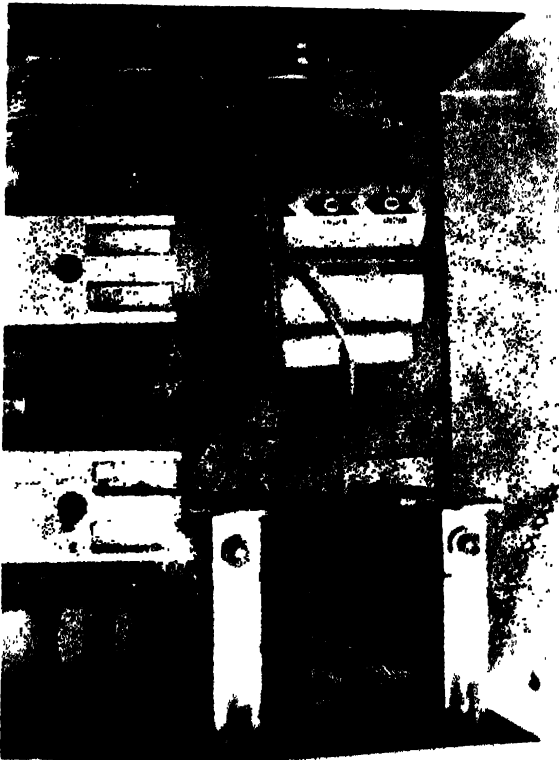


Fig. 3: Component layout for one channel.



— An inside view of the power supply section. chassis. To the same earth point the power supply common (0V) should be soldered well. Speaker sockets can be wired

from pin 14 of each TDA 2020 and the chassis point where PCB is earthed. Having a common ground point this way will help to reduce ground loops, hum and instability problems.

Input wiring

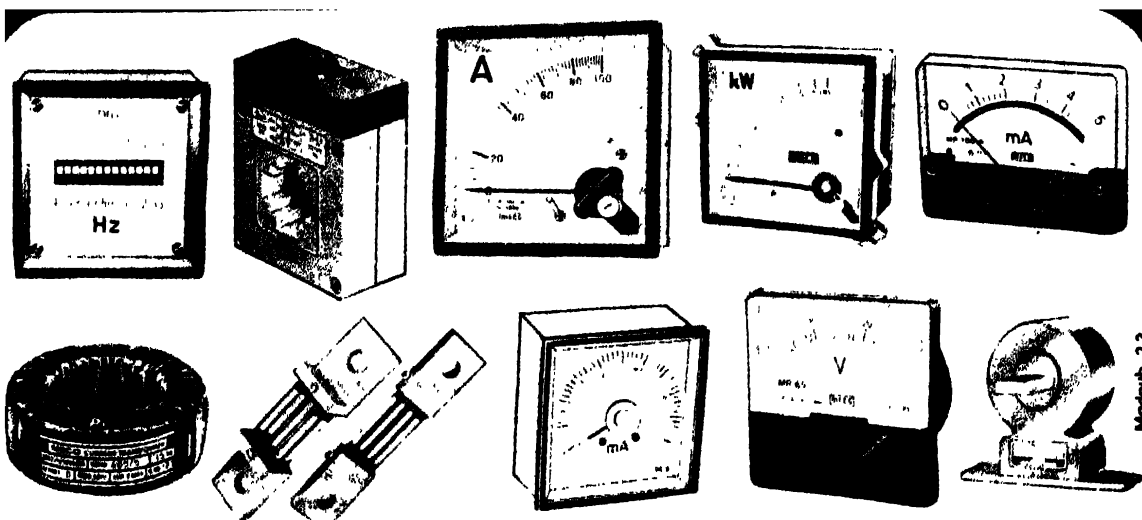
From C1 and the nearest earth point (where R3 is earthed) a short length of shielded wire is connected to input socket A. R1 and R2 are wired in series to input sockets C and B respectively. The grounds of input sockets are earthed together with the braid of input shielded wire. Mounting should be in such a way that the sockets do not make contact with the chassis. (For this RCA sockets mounted on a piece of bakelite sheet can be used.) After completion of wiring check for possible mistakes before switching on.

The PCB can be assembled using spacers and 1/8-size, 2.5cm nuts and bolts. A cabinet for housing the stereo amplifier, measuring about 32×20×8 cm, may be procured from the market.

Speakers

With the prototype full range speakers of 4-ohm impedance, 15cm dia, and 20W capacity (Bolton make) were used with suitable enclosures. R16 and C15 provide speaker damping. Sound quality obtained with various inputs was very good. □

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