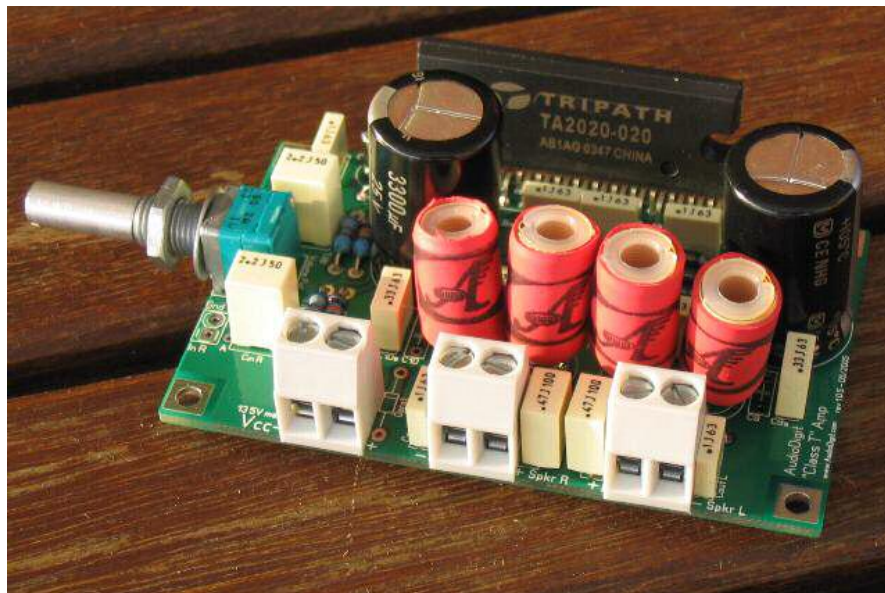


# AudioDigit "Class T" Amp

*"Audiophile quality" stereo integrated amplifier Kit with "Class T" technology  
and optimized output filter with "air core inductors"*



On sale at:

[www.Autocostruire.it](http://www.Autocostruire.it)

Designed by / technical info:

[www.AudioDigit.com](http://www.AudioDigit.com)

## Assembly Instructions

Vers. 1.0.5 - June 2005

## **Thank you for your purchase of the "AudioDigit Class T Amp 2020 kit".**

This kit has been designed to allow the DIY audio enthusiast to build, at a reasonable price, a high quality stereo integrated amplifier with up to 20+20W of output power on 4 Ohm.

The amplifier is based on Tripath's "Class T" technology. The amplifier will give you a very good sound, and it's extremely simple to build: no SMD components. The kit can be configured before assembly both as an integrated amplifier with volume control or as a power amplifier only.

The "AudioDigit Class T Amp 2020" has been designed according the general rules of the class T amplifiers of Tripath, but has been optimized in many details to get excellent sound quality.

The amp in fact uses:

- Output "air core" inductors", with no core hysteresis problems
- Polyester filtering capacitors
- High quality Alps volume pot (ALPS series RK97)
- Precision 1% resistors in all the circuit
- Optimized compact layout to minimize EMI radiations

Before proceeding with the assembly, it's important to read carefully these instructions in order to understand the possible variations and the correct building sequence.

### IMPORTANT NOTE:

*Building this kit is not complex, all that is required is careful work and good soldering, possibly verifying with a lens that the joint is correct. Good soldering are obtainable with a good low power soldering iron (a soldering station is a welcome bonus), and, most of all, by keeping always the soldering tip CLEAN : use a sponge with a little water.*

*It's essential also to assemble the kit following the correct building sequence. The PCB board is small (only 80x50 mm) and some components will be partially hidden by bigger ones when assembled. With the correct building sequence you'll get your finished work in no time and without problems.*

### **Tools needed to assemble the kit:**

All the components needed to create a complete working amplifier are included in the kit. You'll need only:

- A good quality 15 - 20W soldering iron, or (better) a soldering station with temperature control
- Good quality lead , diameter 0,5 - 0,7 mm
- A "multimeter", for the check of components and their values (resistances, capacitances ...)
- A lens to check the soldering joints
- For the first tests a stabilized power supply (with adjustable voltage and current) is highly desirable, it will allow to check gradually that the circuit has no short circuits and that the correct amount of DC current is absorbed when idle.

## Setup

Check carefully the schematics that is included in the appendix. Verify component names and positions. Once you have identified the components you can follow the building sequence described below.

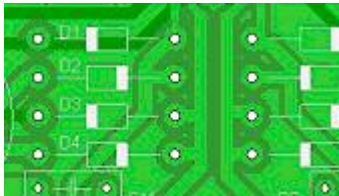
The custom output air core inductors "by Autocostruire", that is the red cylinders with the "Autocostruire" logo on them, will probably come with their leads already prepared with a little lead on them. Check them, and eventually prepare them for soldering by scratching the protecting paint on the "legs" and applying a little solder.



This is essential, realizing that they are not ready while in the middle of their assembly can be a problem. If their legs are easy to solder when still far from the circuit ... it will be easy to put them into position. Please check that the size of their legs is still so small as to enter into the holes on the PCB.

## Component "orientation"

Be careful to the correct orientation of the components. Some of them are not "polarized", so any direction will do, even if aligning their signs is good for aesthetics reasons. Some components like the "diodes" MUST be inserted in the correct direction: the "cathode" is marked by a "line", they must be inserted respecting the direction, see the images and the PCB signs and follow them. Be warned that if they are inserted in the wrong way the amplifier won't work and can also be damaged.



As you can see on the signs on the PCB D1 faces left (left position of the reference cathode line), while D2 faces right ... and so on. Check in the image at right that these mounting instructions are respected in the actual circuit.



## Creating good soldering joints:

This kit is easy to assemble, and you can get it working in no time if you use the correct soldering procedure. You need a good soldering iron with a small tip, that you must always keep clean with a sponge and water. Don't use soldering irons that are too powerful, you risk to burn components, and with a tip that's too big (more than 1 mm diameter) you will seriously risk to connect adjacent pins. Use also good quality soldering wire.

The correct soldering sequence is as follows:

- Put the component to be soldered in the correct final position
- Touch with the tip of the iron both component and PCB trace for 1 to 2 seconds.
- Add the soldering wire, use a very small quantity of it
- Remove the iron as soon as you see that the soldering wire is melting around the component and PCB trace, no more that 2 or 3 seconds at most.
- That's all: the soldering joint should be small, regular, brilliant and with no shorts to adjacent traces or pins. Check it with a lens, especially when soldering the chip with a lot of legs ...

### **VERY IMPORTANT: the correct assembly sequence**

It's MANDATORY to assemble the components in the following sequence, in order to avoid that some small parts become impossible to solder because their space is hidden by bigger ones.

1. Chip TA2020
2. Small low height components around the TA2020 chip, and ALL low height components EXCEPT the (0.33 uF ) capacitors of the output filter (in general C8, C8a, C9, C9a, C10, C10a, C11, C11a)
3. Output inductors
4. 0.33uF output capacitors, or the output parallels (in general C8, C8a, C9, C9a, C10, C10a, C11, C11a)
5. Input volume pot and components
6. Output "Zobel networks" (RzL, CzL e RzR e CzR)
7. Speakers and power connectors (if you want to assemble them).

**Be warned: the correct building sequence is essential to avoid problems.**

### **Possible building choices::**

#### **Option A) "Integrated Amp" or "Power amp"**

The AudioDigit "Class T Amp" can be assembled both as a power amplifier or as an integrated amplifier. On the PCB you can identify the two "A" marks in the nearby of the input (left side of the PCB when the chip is far from you), just beside the InL e InR pins. If you want to assemble a power amplifier you have to

- Avoid soldering the volume pot
- Solder together the InL and InR pins to the "A" traces adjacent to them.

This will allow the input signal to jump over the volume pot and enter directly the input capacitors CinL and CinR.

You can also change the gain of the circuit by changing the values of the input and feedback resistors (Rin and Rf). In the kit you will find a 20K value for Rin, and 68K for Rf, using them you will build an "integrated amp" with good input sensibility, compatible with the output level of a CD player.

If we lower Rf the gain lowers too. You can see the options of gain in the table in the circuit schematics. With suitable values even  $G = 1$  is attainable.

#### **Option B) Output filter optimization with respect to speakers impedance**

Class T amplifiers use an output filter made by inductors and capacitors that is needed to filter the high frequency "spread spectrum" carrier of the amplifier. These components, together with the impedance of the speaker, realize a resonant circuit.

We can get different "cut frequencies" and "Q" of the output filter by varying L or C. The most practical way to do that is to use a parallel of "C" values.

With the components coming with the kit (L = 10uH, C = 0,33uF) you get a circuit that is optimized for a 6 Ohm speaker. Most nominal 8 Ohm speakers are in reality 6 Ohm ones, on the average. This configuration exhibits a very good sound, thanks also to the "air core" inductors that are less prone to saturation.

In order to further optimize the sound quality, and maybe to adjust it to the owner's tastes, it's possible to assemble the kit in different configurations. A precise knowledge of the actual speaker impedance is mandatory, and a measurement is highly desirable.

In the table you will find the "Fc" (cut frequency) and "Q" per for different C values (you can get them by using either one or a parallel of two of the values of 0.33 uF and 0.22 uF).

Cut frequency "Fc" and quality factor ("Q") of the output filter									
In general: $f_c = 1/(2 \pi \cdot \text{SQR}(\text{LoCo}))$ and $Q = R_l \cdot C_o / \text{SQR}(\text{LoCo})$									
Ohm speaker	4			6			8		
Co	2,20E-07	3,30E-07	5,50E-07	2,20E-07	3,30E-07	5,50E-07	2,20E-07	3,30E-07	5,50E-07
Lo	1,00E-05	1,00E-05	1,00E-05	1,00E-05	1,00E-05	1,00E-05	1,00E-05	1,00E-05	1,00E-05
Fc	107302	87612	67864	107302	87612	67864	107302	87612	67864
Q	0,593296	0,726636	0,938083	0,889944	1,089954	1,407125	1,186592	1,453272	1,876166

Higher "Q" values, like in a crossover filter, will imply a boost at Fc and a lower control of the oscillations. As a rule of thumb you can use 0.55uF (a parallel between 0.33 and 0.22) for real 4 Ohm speakers, and only 0.22 uF for real 8 Ohm speakers. It's possible also to fine tune "by ear" the sound, all you have to do is to solder or remove a capacitor ....

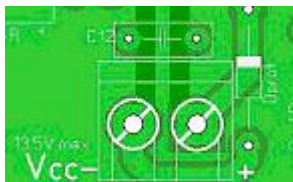
### Option C) "Minimalist assembly"

Some audiophiles actually think that EVERY component in the circuit actually contributes to the final sound. The favour "minimalist" circuits, where the absolute minimum of components are employed.

In our case, to follow the "minimalist approach", you can choose NOT to assembly the protection diodes D1 ... D8, and the output "Zobel network".

### Final Test and first switch on:

You must connect the speakers (or a dummy load, maybe a high power 8 Ohm resistor), the inputs (connecting to the input pins) ad a power supply voltage between 12 and 13.5V.

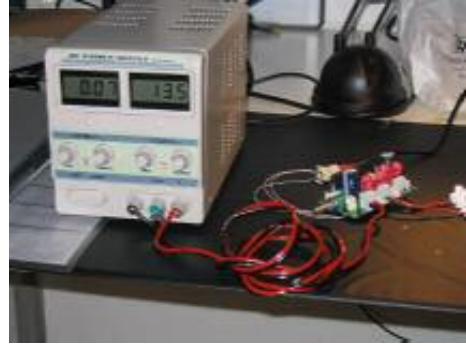


Pay attention to the power supply connection, verify with care the "+" and "-" terminals. The POSITIVE terminal is on the right, like in the figure.

#### IMPORTANT NOTE:

- The amplifier must be switched on ONLY WITH THE SPEAKERS or a dummy load CONNECTED.
- The "Class T amp" has an output bridged circuit, so the "-" speaker terminal IS NOT AT EARTH LEVEL, it's only the reference negative terminal.
- IT'S NOT ABSOLUTELY POSSIBLE TO CONNECT the two "-" speakers connectors together: the circuit can be severely damaged (and in any case, being already a bridged circuit, NO improvement could be obtained).

For the first switch on of the kit , after a careful check of the assembly, orientation of components, and quality of the soldering joints, a stabilized power supply (with controllable voltage and current) like the one in the figure is highly recommended. It's not mandatory, but ... it helps to remain calm and avoid problems, as it allows to preset a low value of current and voltage and verify progressively that everything is ok when we increase the voltage. If something is wrong (maybe a short?) the current limit will avoid big problems.



So:

- Let's connect the speakers, the inputs and power supply.
- Let's rotate completely counter - clockwise the volume pot (zero volume)
- Let's increase progressively the voltage, limiting the current to a very low value (10-50 mA)
- You will notice that while the voltage increases (BE CAREFUL NOT TO GO OVER 13.5V) the current rises too.
- At around 10V of voltage you should hear a small "click" on the speakers (it's the TA2020 chip that's coming up!)
- If everything is OK you should obtain the situation of the photo: 13.5V of voltage and an idle current of 50 to 70 mA.

Let's rotate a little the volume control ... and let's start listening!

### **Burn in:**

Someone says that the burn in procedure is not useful at all, someone else says it's essential .... The sound of the Class T Amp should be very good since the beginning, we have noticed some improvements after half an hour, probably it's the TA2020 reaching a stable temperature. A short burn in period (some tens of hours) should produce further benefices ....

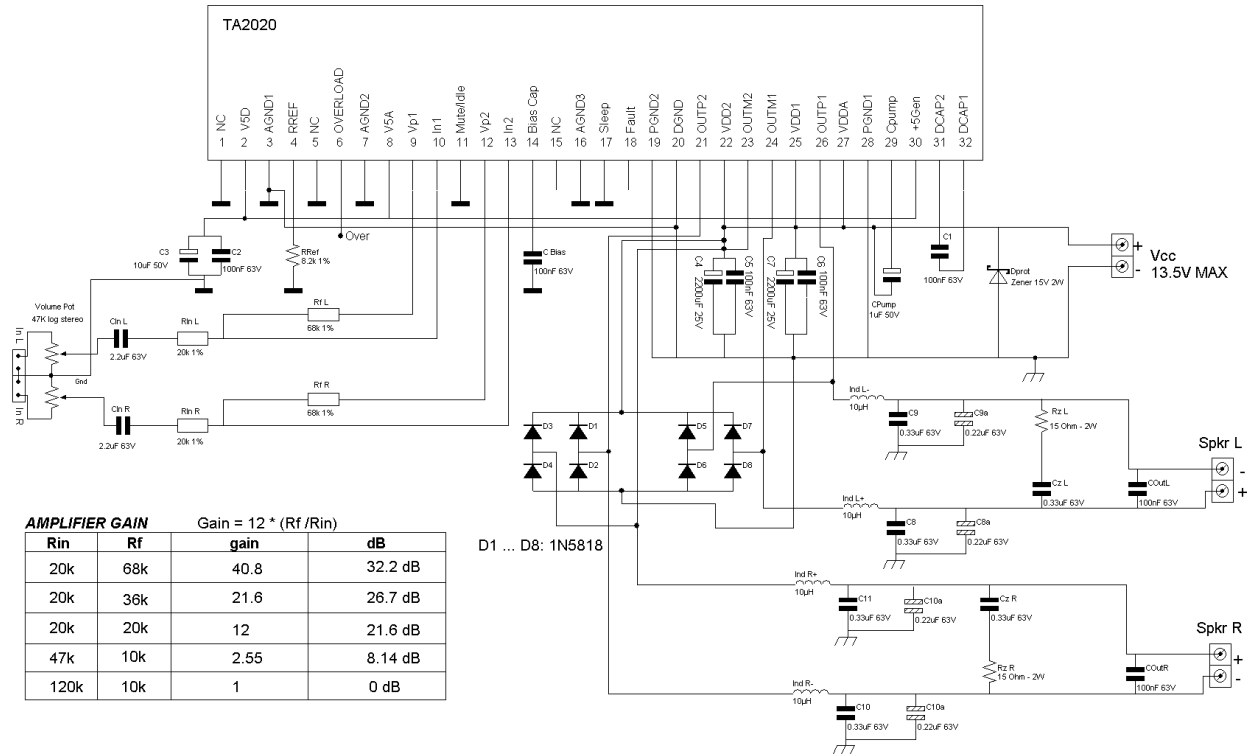
## **GOOD LISTENING!**

**Class T Amp kit - component list:**

<b>AudioDigit Class T Amp</b>				<b>Bill of materials</b>	
<b>Item</b>	<b>Qty</b>	<b>Description</b>	<b>Codes</b>	<b>value</b>	<b>rating</b>
1	8	Bypass capacitors – polyester 100nF 63V, 5mm pitch	C1, C2, Cbias, C5, C6 , Cout L, Cout R, C12	100nF	63V
2	6	Polyestere capacitors 0.33uF , 5 mm pitch	C8, C9, C10, C11, CzR, CzL	0.33uF	63V
2 bis	4	Alternative output filter capacitors polyester 0.22uF, 5 mm pitch	C8a, C9a, C10a, C11a	0.22uF	63V
3	1	Electrolytic capacitor 1uF, 5mm pitch	Cpump	1 uf	50V
3 bis	1	Electrolytic capacitor 10uF, 5mm pitch	C3	10 uF	50V
4	2	Electrolytic capacitor 2200uF 25V	C4, C7	2200uF	25V
5	2	Input capacitors, polyester	CinL, CinR	2.2uF	50V
6	8	Output protection diodes, 1N5818	D1, D2, D3, D4, D5, D6, D7, D8	diode	
7	4	Custom output filter inductors 10uH, air core, by Autocostruire	IndL+, Ind L-, Ind R+, Ind R-	inductor	
8	1	Resistor 8.2 k 1% 1/4w	Rref	res	
9	2	Resistor 20K 1% 1/4w	RInL, RInR	res	
10	2	Resistor 68k 1% 1/4 w	RfL, RfR	res	
11	2	Resistor 15 Ohm 2W	RzL, RzR	res	
12	1	Zener diode, 15V power supply protection	Dprot	diode	
13	3	Connectors for speaker outputs (2) and power supply (1)	ConL, ConR, Vcc	Connector	
14	1	chip Tripath TA2020	Ta2020	chip	
15	1	PCB		pcb	
18	1	Volume pot - ALPS series RK097	Volume pot	47K stereo logarithmic	

**AudioDigit Class T Amp kit - Schema e layout di montaggio:**

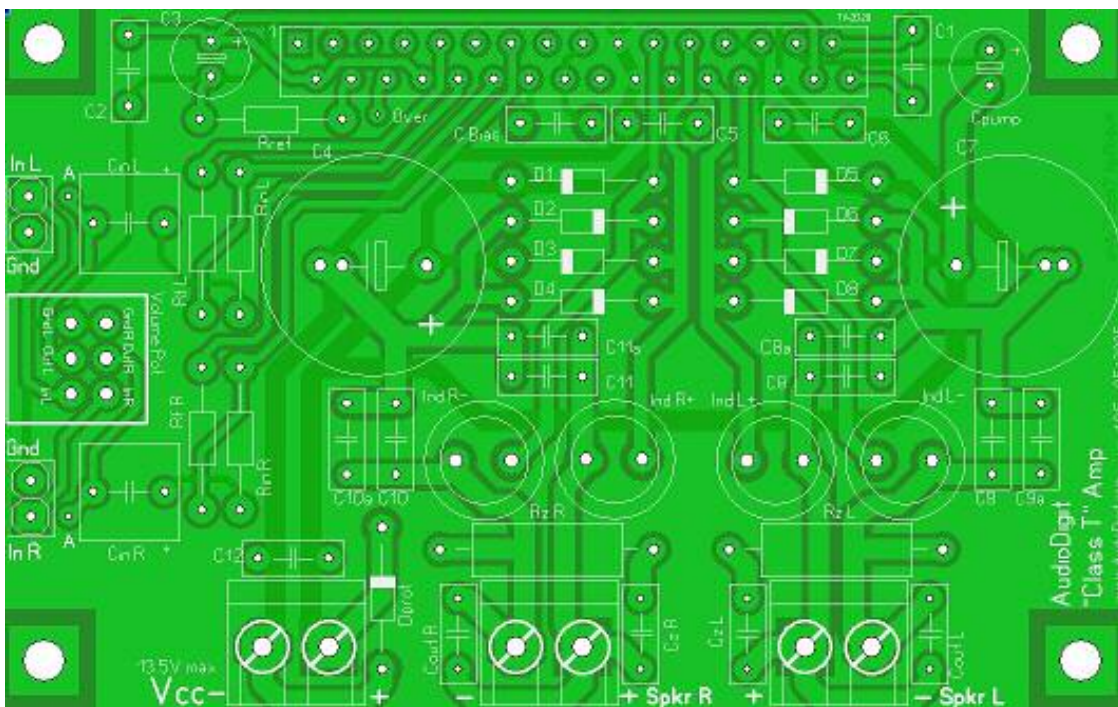
Description	Rev. n.	Date	Author
AudioDigit Class T Amp	1.0.5	20/06/2005	DZ
20 + 20W Class T amplifier with TA2020			



**AMPLIFIER GAIN**      Gain = 12 \* (Rf / Rin)

Rin	Rf	gain	dB
20k	68k	40.8	32.2 dB
20k	36k	21.6	26.7 dB
20k	20k	12	21.6 dB
47k	10k	2.55	8.14 dB
120k	10k	1	0 dB

**Board Layout:**



AudioDigit "Class T" amp kit:

