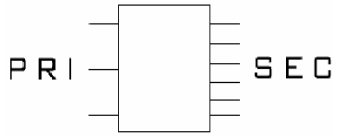
The Walkman Blaster Project.

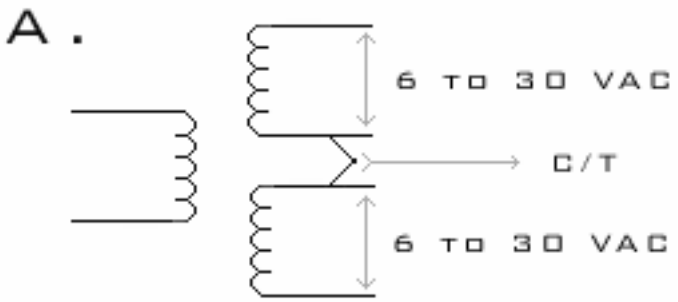
MAPPING UNMARKED 'found' TRANSFORMERS

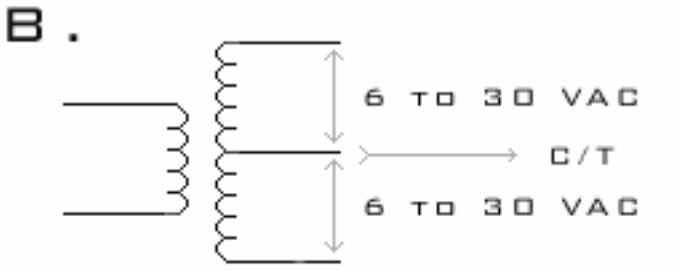
1. Draw an ACCURATE top view of your transformer show each wire/pin



Primary – Few Pins
Secondary – More Pins

2. Use an OHMmeter set to do a continuity test (beep for continuity). Test pairs of wires on each side for continuity carefully record these on transformer map. (hint: secondary side usually has more then two pairs)
3. HIGH VOLTAGE TEST: use AC test leads & an AC power supply





Symbol for Center Tap (C/T)

i Apply 110 VAC to PRI wires/pins
ii Use AC voltmeter to check SEC pair voltages.
iii **you need**: two sec pairs with the same voltage
OR three sec wires/pins that share a C/T and have the same voltage across them.

ABOUT YOUR WALKMAN/DISCMAN BLASTER

The amplifier uses two LM1875 operational amplifiers, often called "op-amps". Your op-amps are rated at 20 watts per channel, and up to 30 watts per channel under certain conditions, while operating within a 8 to 30 volt range.

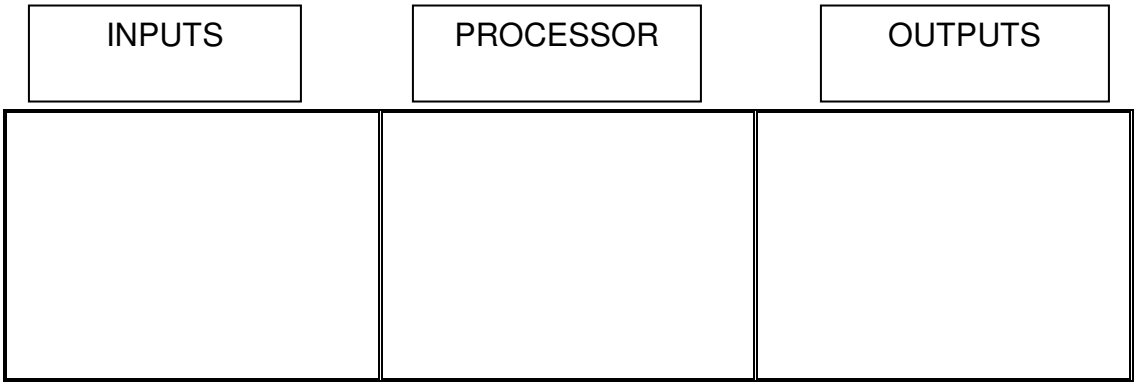
In theory the chip can handle up to 4 amps of continuous current. If we were to calculate the maximum power output based on the highest values, it means that there is the potential for 120 watts per channel (P=VI)!

That's an extremely high output and the cost to you for the transformer and power supply would be very expensive, and the speakers to handle this output, even more.

CUSTOMIZE YOUR SYSTEM

Before going further you need to decide on the make-up of your "blasters" system.

Take a minute now to think of which parts (components) these will be made up of. Don't be afraid to guess at what these components will be. Ask lots of questions NOW



You can see there are reasons to limit the power output of the system. What you will find is that 5 to 10 watts per channel of clean, clear distortion is more than enough power to fill a decent size room. Twenty watts per channel will blast you away!

Output & Your Speaker

As you know, the output of your system is your speakers and two of these are required for stereo output. This circuit gives you the option of using either 4 ohm or 8 ohm speakers.

Without a lot of "speaker theory" you must realize that the resistive property of speakers is thought to be improved by using speakers at the lower 4 Ohm rating.

In fact, your amplifier will respond by delivering twice the power to the speakers using the 4 ohm variety over the 8 ohm speakers. Do a little thinking about Ohm's Law and how power (wattage) is determined and **explain the speaker power gain below**. **(P =V x I) (Watts)** **/10**

More thinking! Which speaker type to choose?

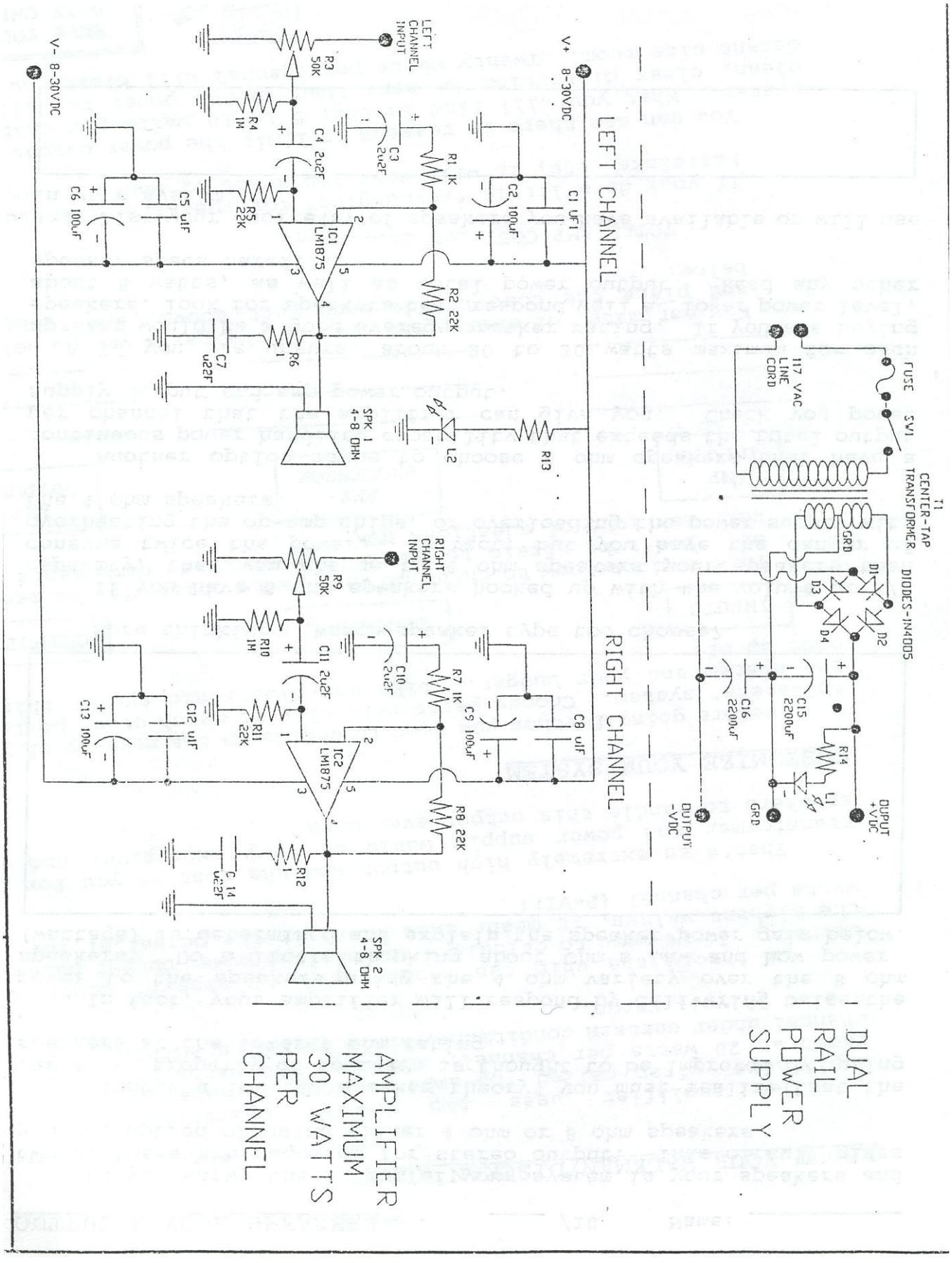
If you have 8-ohm speakers hooked up with the volume at 1/2 capacity, then you change to 4-ohm speakers your speakers then consume twice the power. Correct, but you have the danger of overheating the op-amp chips, or overloading the power supply with the 4 ohm speakers.

Another option maybe to choose 8 ohm speakers that have a continuous power handling capability that exceeds the total output per channel that the amplifier can give you. Check your power supply output and amp power output.

If you were unsure, about 20 to 30 watts maximum for each 1 speaker would be a good average speaker rating. If you are buying speakers, look for speakers that respond well at lower power level, about 5 watts, as well as total Power output. Read any other speaker specs carefully.

List the choice(s) of speakers you have available or will use In your system

Amplifier and Power Supply Schematic



Parts List

From the schematic of the "Dual Rail Power Supply" & "30 Watt .per Channel Amp" make a complete parts list using the standard format (check a magazine if you are unsure). Include all the support hardware you need. It would be a good idea to separate out Power supply and amplifier parts.

Parts List:

Part Number	Value	Cost

TRANSFORMER POWER OUTPUT

As you found out early the transformer you choose is what determines the wattage output of your amp. Transformers are rated in voltage on the primary side, voltage on the secondary side, and maximum amperage output. The primary side is always the high voltage side, usually 117 VAC and the secondary side is the low voltage side. These three rating are usually stamped on the side of the transformer. Ask for help if they are not!

Since your amp uses both positive and negative voltage, and a common ground, the transformer you use must have a center tap. See the schematic and find the centre tap wire on your transformer.

In order to build your power supply you will need a transformer. This can be a purchased transformer or a scrounged one. It will cost about $16 for a 2 Amp 12V transformer. If you scrounge one it will cost nothing but a little time to figure it out. Transformers are rated in voltage on the primary side, voltage on the secondary side, and maximum amperage output. The primary side is always the high voltage side, usually 117 VAC and the secondary side is the low voltage side. These three rating are usually stamped on the side of the transformer. Ask for help if they are not! (get the figuring out page from me if you are following this route!)

Since your amp uses both positive and negative voltage, and a common ground, the transformer you use must have a centre tap. See the schematic and find the centre tap wire on your transformer.

Transformer check:

- Get an AC line cord and solder it to the primary side. Insulate the joins with tape.

- Plug in the transformer and connect an **oscilloscope** to the secondary side of the transformer. You will connect one side of the probe lead to one secondary wire and the other to as instructed below. Record the following:

Total voltage (outside wires):_____ VAC P/p (peak to peak)

Centre Tap voltage (centre to one side & centre to other side) :

_____ VAC p/p And _____VAC p/p (peak to peak)

- Connect a **DMM** set on VAC to the secondary side of the transformer & record:

Total voltage (outside wires) :_____ VAC RMS

Centre Tap voltage (centre to one side & centre to other side)

VAC RMS_____ & _____ VAC RMS

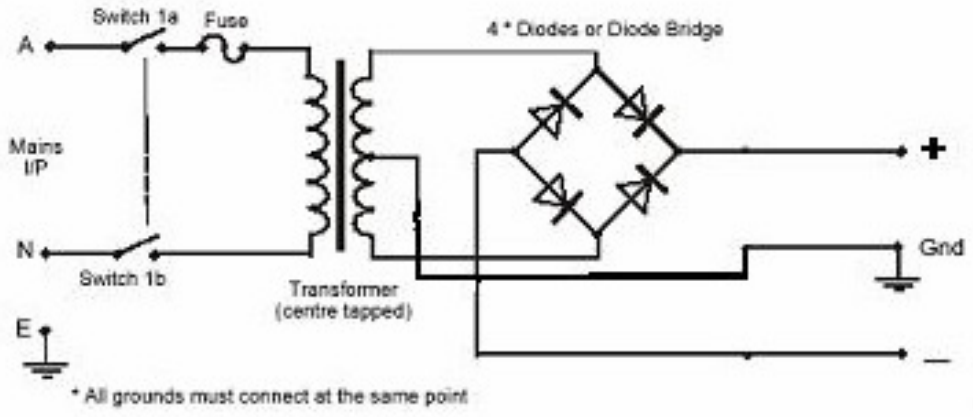
- State the ratio of VAC P/P to VAC RMS below

Audio power ratings are usually given in VAC RMS, but are often measured in VAC P-P. You know the power output of your transformer in watts is P = V x I. Give the power output per channel for your amp below (show your work and use RMS values not peak)

D.C. "STUFF"

Most audio circuits require DC voltage, and as you just found out your transformer is providing AC voltage. The process of changing from AC to DC voltage is called rectification.

Standard circuit for a mains derived split rail power supply



We will use 4 diodes as shown in the above diagram. This is called a bridge rectifier:
Explain its function here:

_____

_____

Using your breadboard wire up this circuit. You must have it checked carefully before powering. Make sure that all wires on the AC side are taped up so as to avoid electrical shock.

Signed :_____

Now plug in your transformer and take the following readings

Use an **oscilloscope** connected to the DC output side of the diodes and record:		Use **DMM set to VDC** connected to the DC output side of the diodes and record:	
Positive voltage (Gnd to top peak)		Positive Voltage:	
Negative voltage (Gnd to top peak)		Negative Voltage:	

State the ratio of V_{DC} to V_{AC}RMS from the **DMM** below

(I.E. divide V_{DC} by V_{AC} RMS)

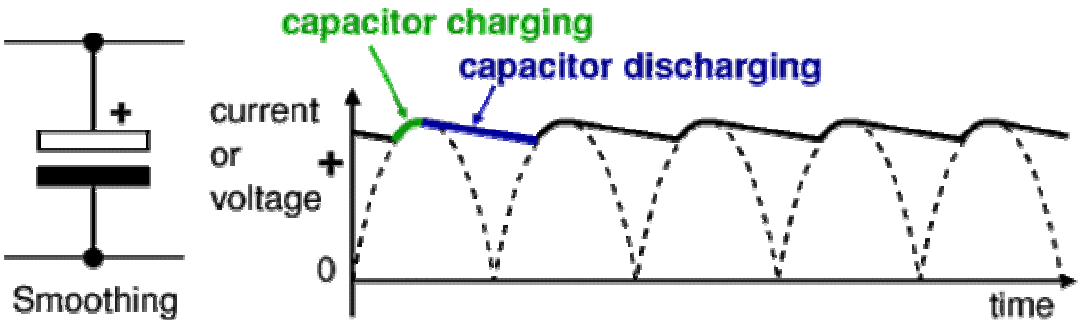
Give the updated power per channel of your circuit below (P=V x I)

Power supply lab part 2

We have taken 120 VAC and put it through a transformer making it smaller. This was rectified using four diodes and now we have varying DC. This DC is not really useable for a DC electronic circuit. Especially an amplifier that requires “clean” DC.
So what’s next, how do we clean it up?… the first step is smoothing.

Smoothing

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the un-smoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.



Note that smoothing significantly increases the average DC voltage to almost the peak value (1.4 × RMS value). For example 6V RMS AC is rectified to full wave DC of about 4.6V RMS (1.4V is lost in the bridge rectifier), with smoothing this increases to almost the peak value giving 1.4 × 4.6 = 6.4V smooth DC.

Smoothing is not perfect due to the capacitor voltage falling a little as it discharges, giving a small **ripple voltage**. For many circuits a ripple, which is 10% of the supply voltage, is satisfactory and the equation below gives the required value for the smoothing capacitor. A larger capacitor will give less ripple.

$$\text{Smoothing capacitor for 10\% ripple, } C = \frac{5 \times Io}{Vs \times f}$$

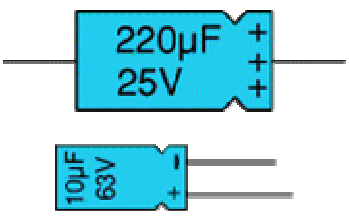
Io = output current from the supply
Vs = supply voltage (peak value of unsmoothed DC)
f = frequency of the AC supply (60Hz in Canada)

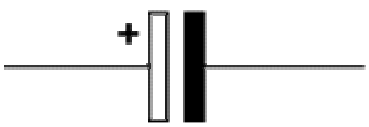
Referring back to the value of rectified DC you measured on the oscilloscope calculate the size of capacitor you would need for 10% ripple and 2.5% ripple below:

10%	2.5%
C (μF) = $\frac{5 \text{ X} \_\_\_\_}{\text{X } 60 \text{ Hz}}$ =	C (μF) = $\frac{1.25 \text{ X} \_\_\_\_}{\text{X } 60 \text{ Hz}}$ =

All the electrolytic capacitors we use have a voltage rating. This is commonly called the working voltage of the capacitor and usually we stay well below the maximum value to avoid having it explode on us

Examples:





Circuit symbol:

Electrolytic capacitors are polarised and **they must be connected the correct way round**, at least one of their leads will be marked + or -. They are not damaged by heat when soldering.

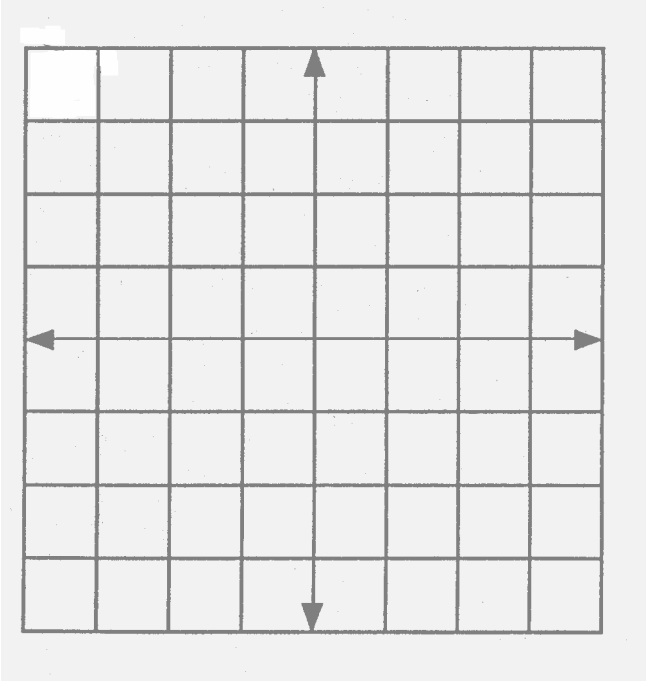
It is easy to find the value of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating. The voltage rating can be quite low (6V for example) and it should always be checked when selecting an electrolytic capacitor. It the project parts list does not specify a voltage, choose a capacitor with a rating which is greater than the project's power supply voltage. 25V is a sensible minimum for most battery circuits.

Using the RMS value of the output wave of the Bridge rectifier, calculate the correct voltage rating for your capacitors.

_____V RMS X 1.414 = [ ]

Redraw the schematic of your power supply below and include the capacitors. Label all of the parts and polarities where appropriate.

Get this signed : _____



Build the circuit you drew and measure the ripple on an oscilloscope. Draw it accurately on the grid provided and include the units of the dials on the scope.

Volts / Div = _____

Time / Div = _____

How much ripple do you have on the scope?

POWER SUPPLY BOARD

Your amp power supply is complete on a bread board. Now its time to build that baby!

1) Make your PC board and drill holes with a Dremel and a # 60 Drill bit
2) Remember the following
    - Power diodes burn easily, put them in the right way around
    - Capacitors placed backwards ina circuit can explode
    - This circuit has a high voltage connection
    - Do not plug it in without an instructor checking it
3) An LED needs about 20 mA of current, measure the voltage at Vpos and Gnd and then calculate the size resistor you need!
4) The fuse holders, transformer wires and AC line cord need 1/16” holes