WTPA Component Guide

Hardware Rev 1.01
April 16, 2009
TMB

This is basically a big set of descriptions and pictures of WHAT and HOW MANY of those whats go into a single WTPA kit.

This doc isn't really about theory or about how to use WTPA, it's just what goes into it and a very little about the components involved. So without further adieu here's what goes in WTPA, divided up by type of component.

The component type and value explain what the thing is, and the reference designator is the part's name in the schematic and on the printed circuit board.
Quantity per board ought to be pretty self explanatory.

Note: if you're a printing-stuff type of person it might help to have this list in hand while you're building the kit. Sometimes I like that.

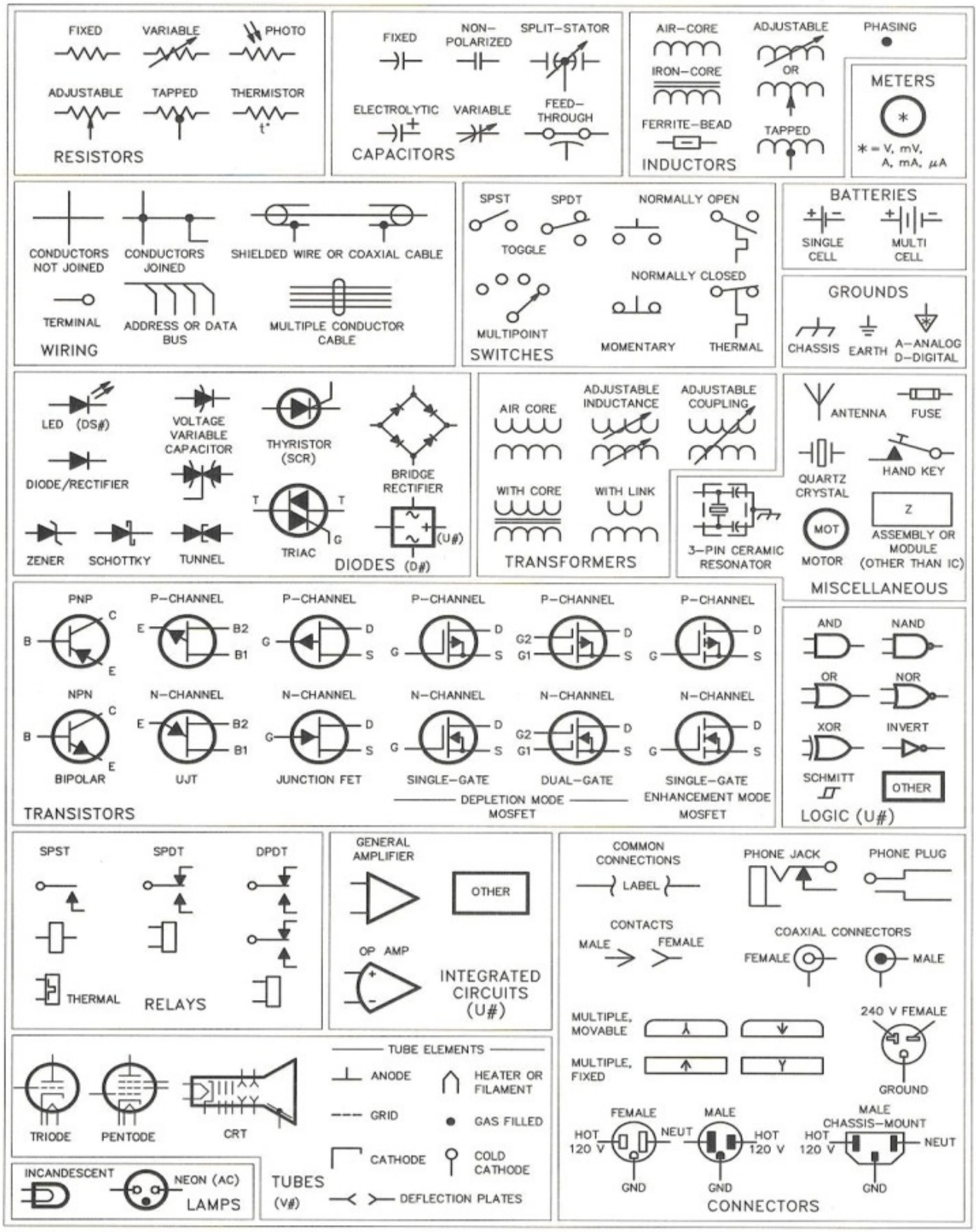
Note: **THE MOST IMPORTANT THING YOU SHOULD TAKE AWAY FROM THIS DOC** if you aren't already familiar with electronics: some components are POLAR. Namely, the diodes and some of the electrolytic capacitors. POLAR components need to maintain a certain orientation with respect to voltages. What this means for the kitbuilder is that although the polar components CAN fit into the board one of two ways, one way is backwards, and bad things will happen either immediately or down the road if you put them in the wrong way.

The board has markings on the caps and diodes to help you remember this.

(**Note**: you can always find the most recent WTPA notes on www.narrat1ve.com if this doc gets outdated, or just if you're curious).

What Is It?	Value	QtyPer	Ref Designator:
5v Reg	7805	1	IC6
MCU	ATMEGA164-20P	1	IC1
MIDI Opto	6N138	1	OK1
Dual Opamp	TLV2472	1	IC9
Quad Opamp	TLV2474	1	IC7
Parallel Latch	74LS373N	4	IC2, IC3, IC4, IC8
SRAM Memory	CY7C1049D_8	1	IC5
Resistor	59k	9	R10, R18, R21, R23, R25, R27, R29, R31, R33
Resistor	118k	13	R15, R16, R20, R22, R24, R26, R28, R30, R32, R34, R35, R38, R49
Resistor	220	6	R1, R3, R4, R5, R6, R52
Resistor	470	10	R8, R11, R39, R40, R41, R42, R43, R44, R45, R46
Resistor	10k	13	R2, R7, R9, R14, R36, R37, R47, R48, R53, R54, R55, R56, R57
Resistor	1M	1	R12
Resistor	?	2	R50, R51
Bypass Cap	0.1uF	13	C3, C5, C6, C7, C8, C9, C10, C11, C13, C16, C21, C25, C30
Coupling Cap	1.0uF	2	C19, C22
Coupling Cap	10uF	3	C14, C15, C17
PSU Cap	470uF	2	C4, C12
Xtal Cap	20pF	2	C1, C2
Potentiometer	1kB	3	VR2, VR4, VR5
Potentiometer	500kA	2	VR1, VR3
Potentiometer	Coarse**	1	VR6
Potentiometer	Fine**	1	VR7
40 Pin Socket	--	1	
20 Pin Socket	--	4	
14 Pin Socket	--	1	
8 Pin Socket	--	2	
Tact Switch	--	6	S0, S1, S2, S3, S4, S5
20Mhz Xtal	--	1	X1
5mm LED	--	9	LED0, LED1, LED2, LED3, LED4, LED5, LED6, LED7, POWER
Diode	1N4004	5	D1, D2, D3, D4, D5
PCB	--	1	

Now, here's what all these different parts look like in schematic representation. I used to be really good about drawing pretty pictures, but now I just jack things from the internet like everybody else:



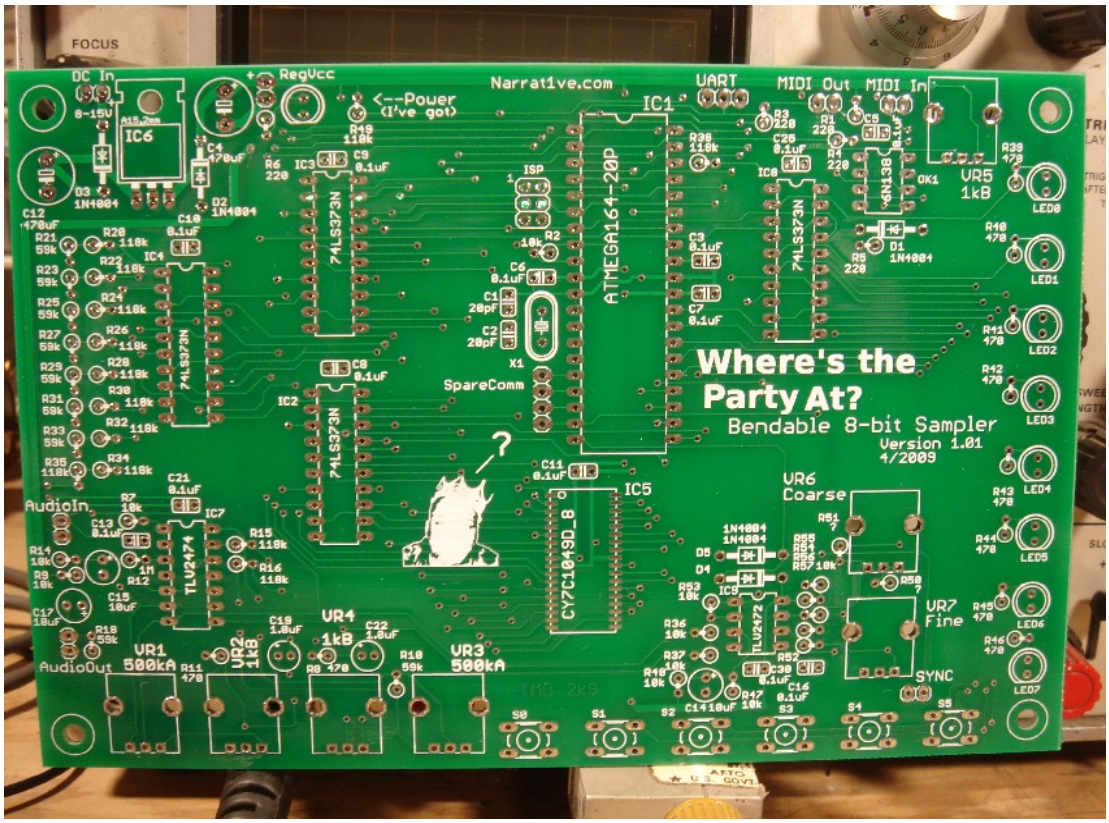
Don't take that chart too seriously, though. An op-amp hasn't had that weird curve in the back since Widlar was giving sheep to bartenders. If you want to try and figure out what's going on in the schematics, you'll need to know these symbols. Since debugging a messed up kit often involves that, I've included that chart. If you don't know, now you know.

PHYSICAL REPRESENTATIONS:

So now I know what I've got for WTPA and what it looks like on paper, so what is it in real life? It all starts with:

The Bare Board:

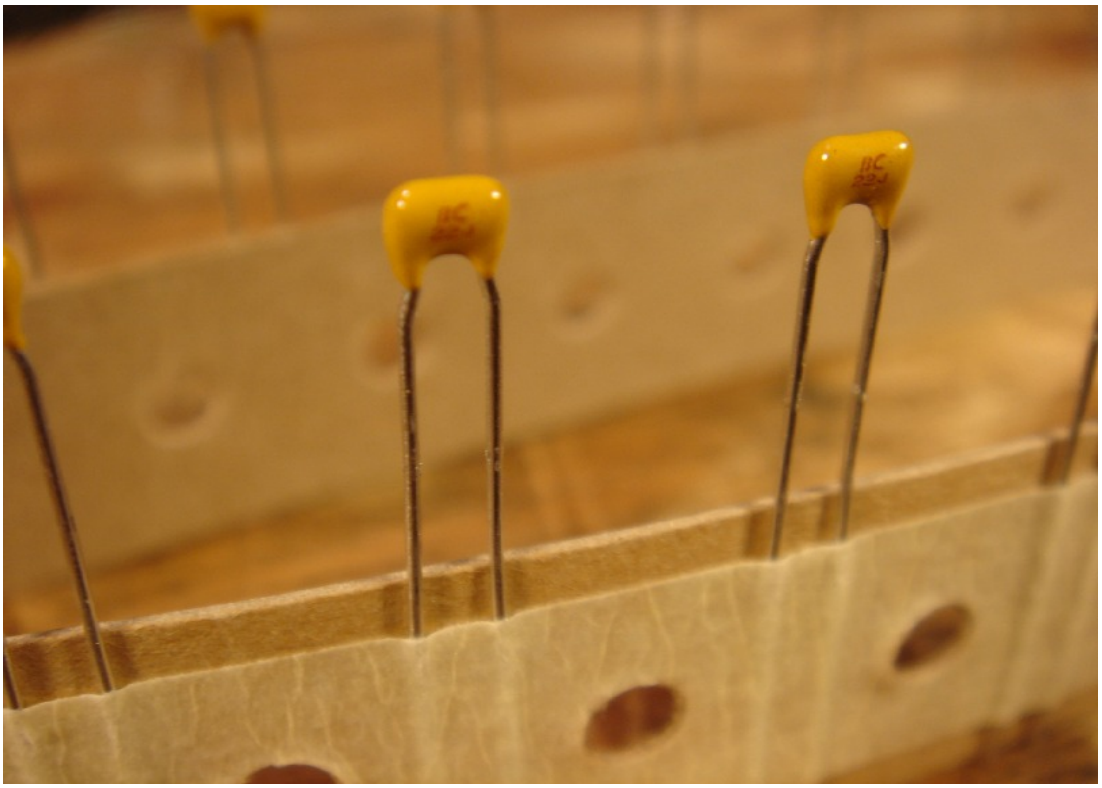
This is the roadmap where you put all the parts, and makes all the electrical connections. It's basically two layers of flat copper, cut into traces, with a layer of fiberglass in between, and a protective green covering applied. There's a silkscreen on this one, too – it helps you understand where everything goes and lets me make corny jokes. It should look like this when you get it:



CAPACITORS:

There are two general types of capacitors in WTPA, ceramic and electrolytic. Their names refer to what's inside of them and they imply some characteristic differences. But for our purposes, they're the little yellow guys (ceramic) and the cans (electrolytic).

Ceramic:



There are two values of ceramic capacitors in WTPA, 0.1uF – there are lots of them – and 20pf, of which you should have 2. The 0.1uFs get used for a lot, most often for power supply filtering (we call it bypassing). The two 20pFs are used to stabilize the crystal oscillator. Neither are polar.

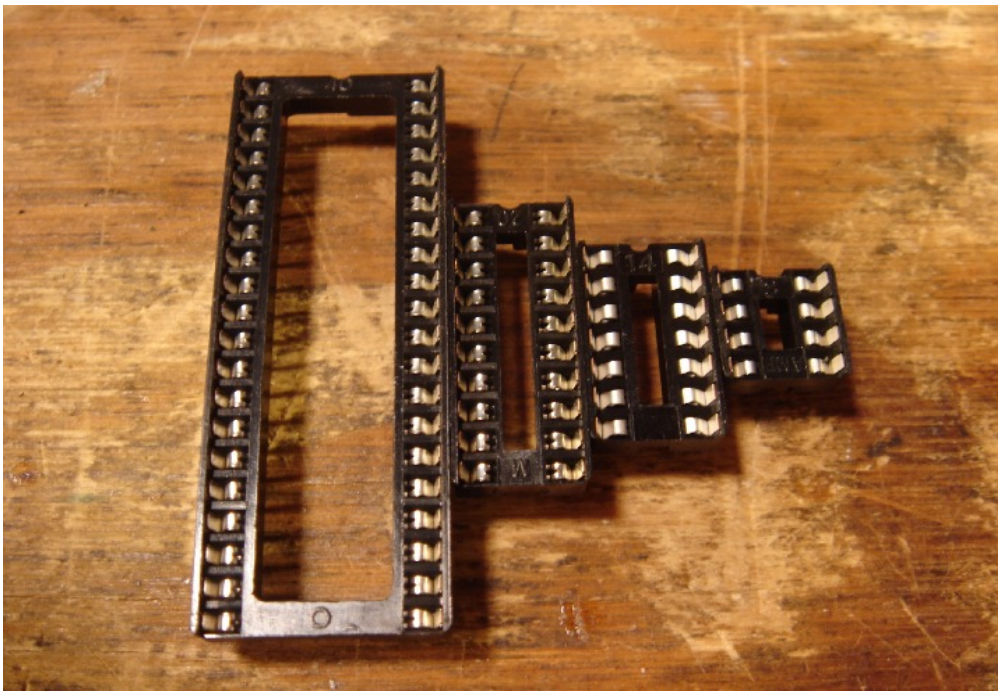
Electrolytic:

There are three kinds of electrolytic caps: the 470uFs (the big guys), the 22uFs (the black ones) and the 1.0uF (light blue in this photo). The colors aren't important, the numbers are. They'll all be labeled. The big guys are the main power supply filters, the 22uFs are filters for analog references and also the audio output AC coupling, and the 1.0uF caps are inter-stage audio coupling caps.

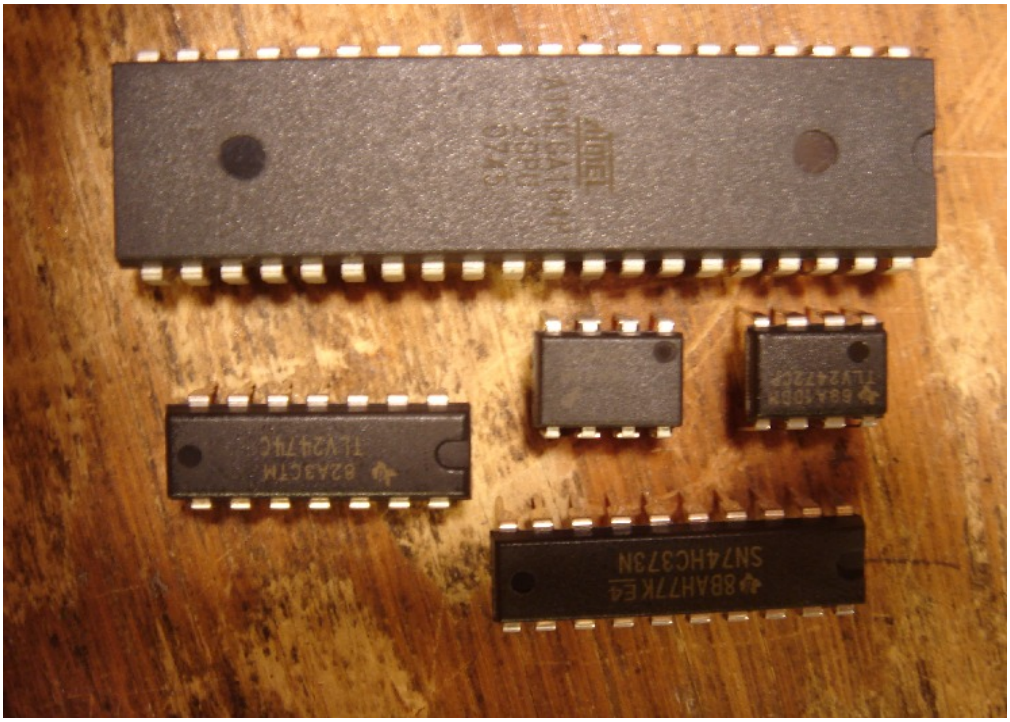
The 470uF and 22uF caps are polar! The 1.0uF is not.
The PCBs are marked with a + where the positive lead of the cap should go, and the caps themselves have a stripe with a – running down the side above the negative lead.
Note: If you want to sound smart and impress the Swedish Bipolar Bikini Team you'll call the “positive lead” the anode and the “negative lead” the cathode.

Sockets and ICs
Are like peas in a pod. You don't NEED to use the sockets at all, but if you haven't done much with electronics before I recommend that you do. Sometimes they are helpful, and sometimes detrimental, but the job of sockets is to allow you to change chips. They also make it impossible to damage an IC when soldering it, because you don't solder it. In WTPA you might change chips to try new experiments, you might change chips to upgrade firmware, or you might change chips because you broke one when bending.
The ICs themselves do all the heavy lifting in the chip. The 40-pin guy is the microcontroller (the brain), and the 20-pin guys are parallel latches which allow the microcontroller to effectively have more output pins. The 14-pin guy is a quad op-amp and is responsible for all the audio amplification and level shifting. One 8-pin IC is a dual op-amp that is configured as an oscillator and used as the analog clock source, and the other 8-pin chip is an optocoupler, which lets WTPA receive MIDI messages.

Sockets:



ICs:

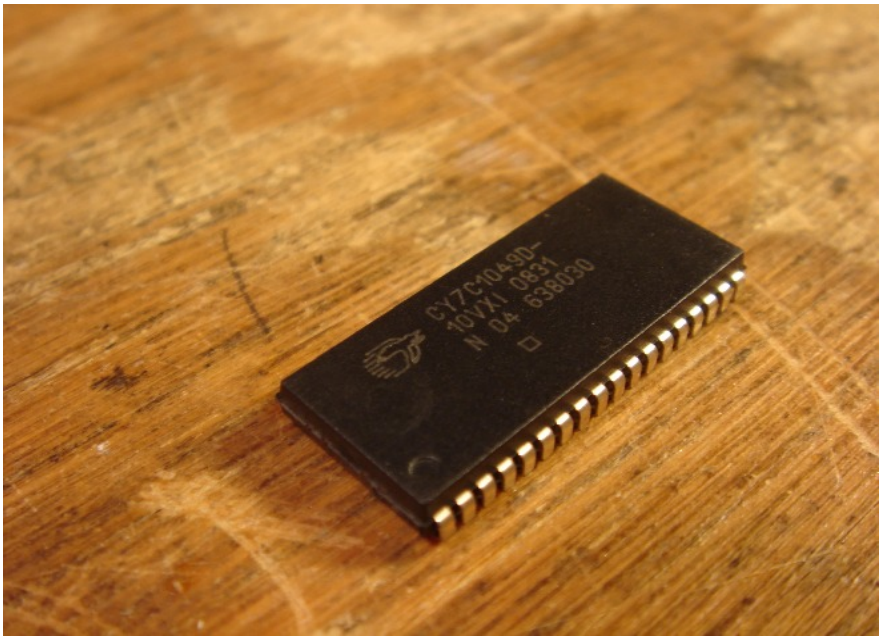


Next is the dreaded...

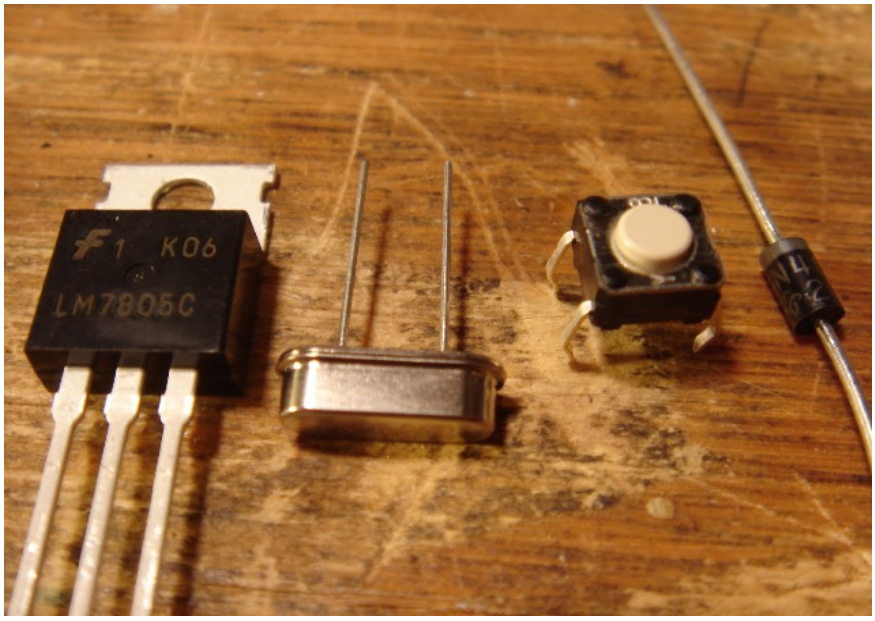
SRAM:

The SRAM is technically an IC, but I'm treating it specially because it is in a fundamentally different kind of package – a surface mount package. That means its legs don't poke through the board, they sit on top of it. They typically require a little bit more skill to solder, but are doable with a little patience. Electrically, the differences between DIP / through hole (the dead bug style ICs) and SMT ICs are small. The big difference is size – which can be good or bad depending on your outlook.

Functionally, the SRAM (that's Static Random Access Memory) holds all the audio we've sampled.



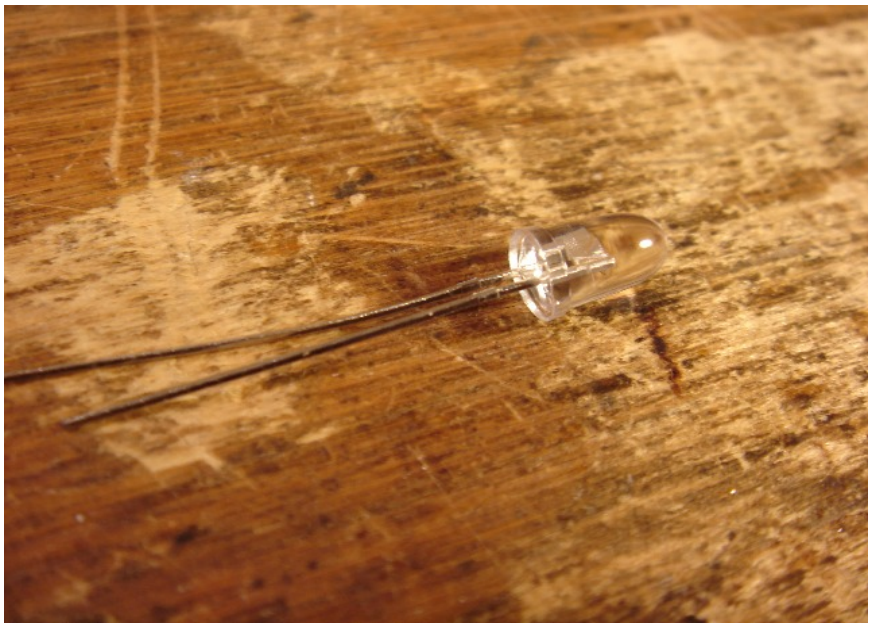
Diodes, the Crystal, the Regulator, Switches:



These components are sort of a miscellany. The regulator is really an IC (again) but (again) I took a picture of it because it looks different. The crystal (the silver guy) is what lets the microcontroller generate an accurate clock for it's CPU. The switches are for user input. The diodes (**WHICH ARE POLAR**) are used to protect WTPA from hooking up power and inputs incorrectly. The bar on one side (the cathode or “negative side”) goes in the direction of the arrow on the PCB.

LEDs:

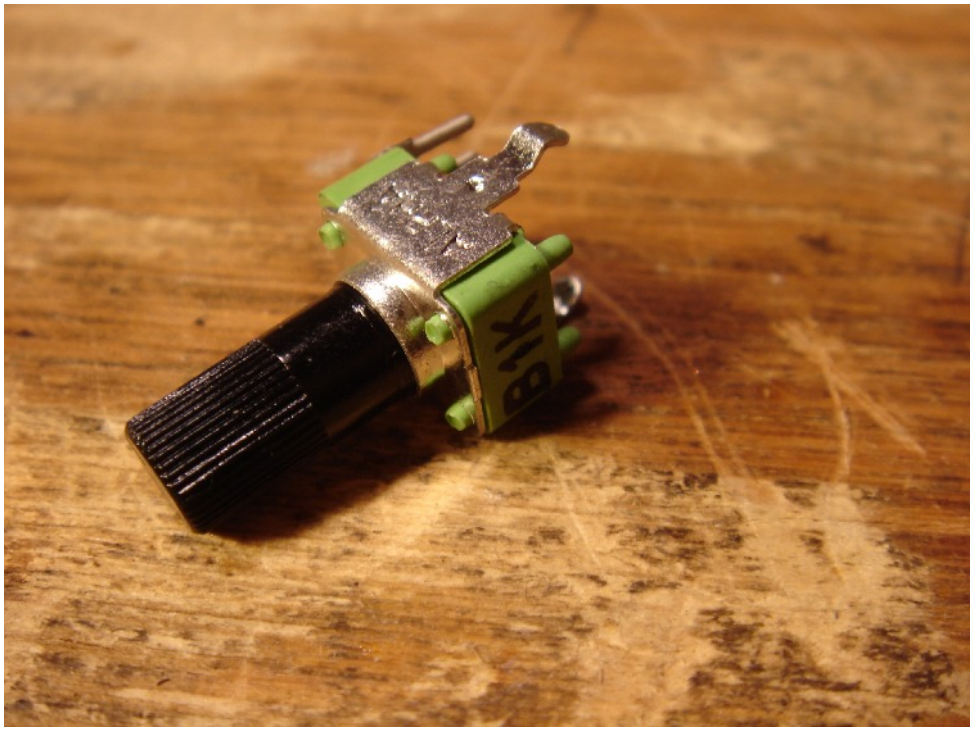
LED stands for Light Emitting Diode. Like our other diodes, it goes in one way (it's **POLAR**) Unlike our other diodes, it lights up!



The LONG LEAD on the LED is the anode (positive). It is oriented towards the top of the PCB everywhere in WTPA. There is also a flat on the other side of the LED (the cathode) which matches the diagram on the PCB.
NOTE: Don't test the polarity of LEDs by hooking them up to a battery (or the power supply) to see if they glow. Backwards they won't glow, forwards and they'll burn out immediately.

Potentiometers:

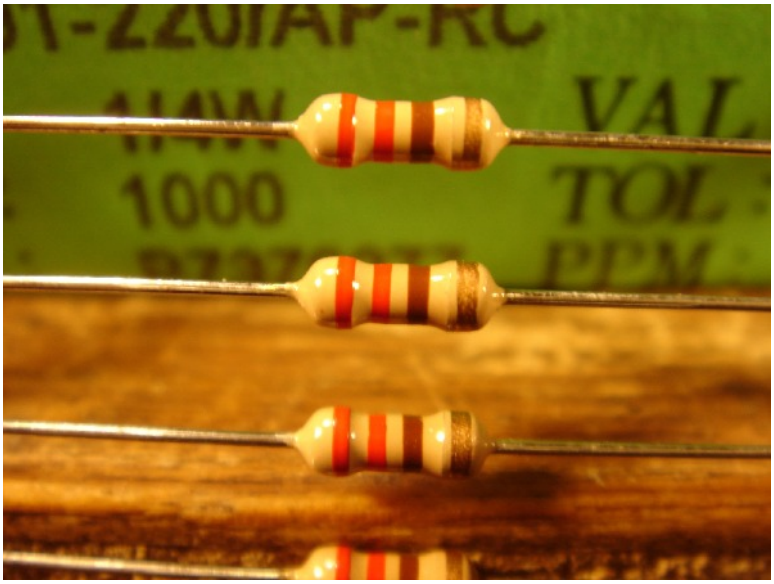
Often called pots. These are variable resistors which internally wipe copper leaf over a carbon strip. They let us adjust electrical parameters and are the most interesting of the resistive family. **THERE ARE 4 KINDS OF POTS IN WTPA** but physically they look exactly the same! You've got to read the text to tell them apart.



We can see that this pot says B1K (not to be confused with B2K). This means it is a linear taper 1-kilo-ohm potentiometer. The board is labeled for the 500kA ("A" means logarithmic or "audio" taper) and 1kB pots, but the coarse and fine pots are the 10kA and 1kA pots respectively.

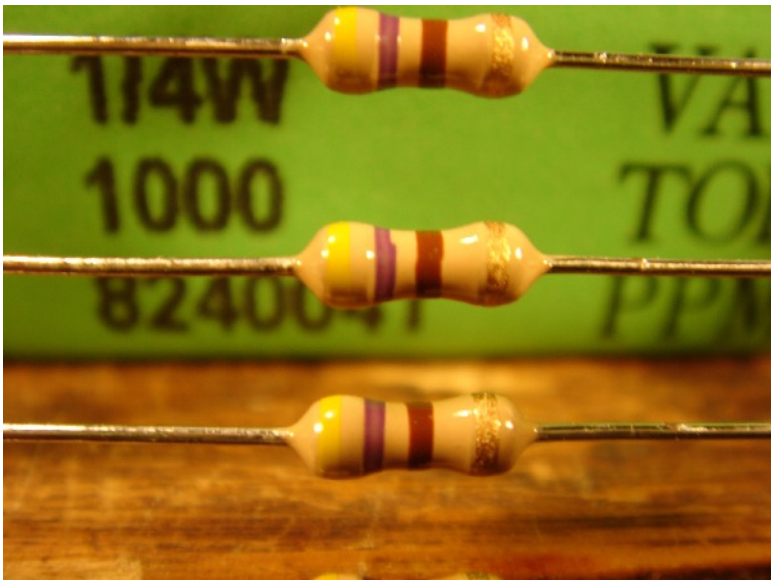
Resistors:
There are 6 kinds of resistors in WTPA – four kinds of blue 1% metal film resistors and two kinds of tan 5% carbon-film resistors. They do ALL kinds of stuff in WTPA. The 1% resistors are less noisy (audio wise) and have a better tolerance which is sometimes important. ALL of the LEDs have values which are conveyed by their color code. The resistor color code is outside the scope of this doc, but suffice it to say that the code IS DIFFERENT for the 1% and 5% resistors. It's really easy to find these codes on the internet. Do yourself a favor and memorize them. But here are some pictures to help:

220 Ohm



The code for these is RED RED BROWN GOLD. (22 * 10 +/- 5%)

470 Ohm



The code for these is YELLOW PURPLE BROWN GOLD. (47 * 10 +/- 5%)

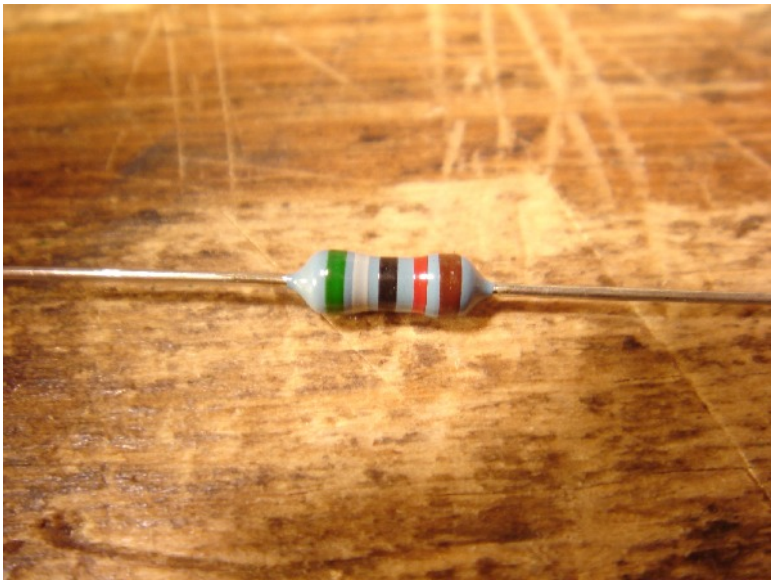
10k Ohm

The color code for these are BROWN BLACK BLACK RED BROWN (100 * 100 +/- 1%)

118k Ohm

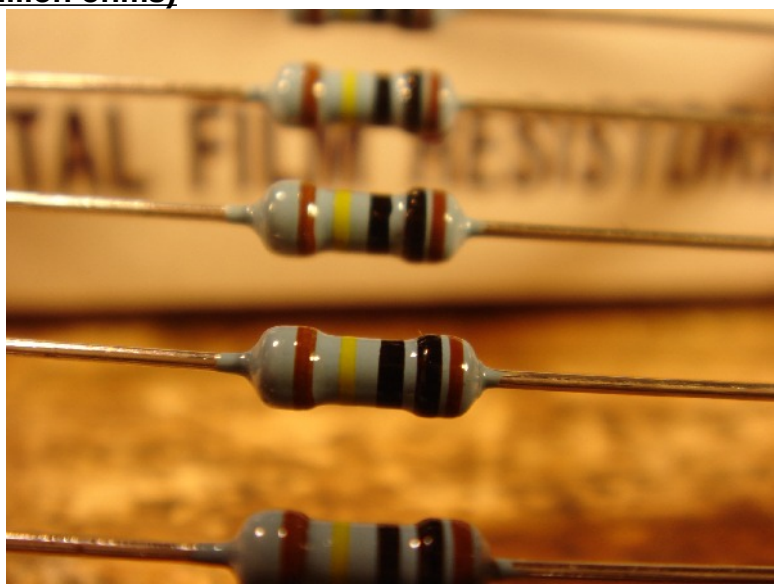
The color code for these are BROWN BROWN PURPLE ORANGE BROWN
(118 * 1000 +/- 1%)

59k Ohms



The color code for these are GREEN WHITE BLACK RED BROWN
(590 * 100 +/- 1%)

1 Megohm (one million ohms)



The color code for these are BROWN BLACK BLACK YELLOW BROWN
(100 * 10,000 +/- 1%)

Conclusion:
So hopefully this has familiarized you with the denizens of the WTPA universe. You now know what's in your kit, and what it looks like, and some rules about some components. You've got a little bit of an idea about everything, but there's so much more! At www.narrat1ve.com there should be more info on ASSEMBLING the kit, using it, and perhaps most importantly, HOW IT ALL WORKS. Good luck!
--TMB, April 2009