Yana – The Parts

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I. The Parts

These are the basic parts necessary to make and calibrate Yana. Yana is not a kit. Therefore, extra information is needed so that you obtain the correct parts.

A. Components

When searching eBay, be sure to look for the lowest price. The recommended seller may not currently offer the lowest price.

1. Nuts, Screws, and Washers

The spacer washers are special. Read about them **C1**. Radio Shack has screws, nuts, and metal washers. If you can find M1.6 metric screws, use them instead of the 2-56 screws.

Item	Qty
2-56 x ½ screw	2
4-40 x ½ screw	11
2-56 nut	2
4-40 nut	11
2-56 spacer washer	6
4-40 metal washer	3
4-40 spacer washer	22

2. Perfboard

To make 8 x 3 holes, break along the 9 hole line and the 4 hole line (i.e. one row larger). Perfboard is used for many Yana add-ons not listed here.

Module	Hole Size
Output	3 x 8
Rotary	4 x 7
Red TFT	8 x 8(lead)6x8(smd)

Search Radio Shack, eBay, and Amazon for "perfboard."

3. Pin Headers

To have ample headers for Yana add-ons purchase the following numbers of 40 hole single row strips. These larger strips will be cut to make smaller strips. I found the long pins on eBay: they serve as gender changers.

Type	Number
Male straight	3
Male straight Long	1
Male angle	2
Female straight	4

Search Tayda and eBay for "10 pcs pin-headers."

4. Foil Shielding

1 Roll 2" wide Foil Duct Tape (also used to shield Yana add-ons)
1 Clear thin plastic sheet (mylar overhead transparency, flat
blister pack cover, thick polyethelene, or whatever occurs to you:
be original). Search Home Depot and eBay for "aluminum foil
tape."

5. Printed Circuit Board

Either double or single sided is ok. The copper provides a ground plane. Radio Shack
has PCB. However, I prefer FR4 fiberglass material. I buy in bulk from the following
dealer on eBay. The baseboard is two-sided, 1/16" thick cut to 60 x 89 mm.
http://stores.ebay.com/PCB-Laminates-Copper-Clad/_i.html

6. DC coaxial jack

I like the batteries external so I don't forget them and they're easier to
recharge. This is a standard power jack.
Search Tayda for "dc jack."

7. Knob

Only one knob is needed to run Yana. Search Tayda for "mxr knob."

8. Yana case

This box is very well made and the right size: 100 x 68 x 50 mm.
Search eBay for "100x68x50 project box."

9. Female sma pigtail

Do not get a reverse polarity (rp) sma fitting. Search eBay for "female
sma ipx pigtail –rp."

10. Resistors

If you will use smd resistors, get size 0805, otherwise get ¼ watt
leaded values. The divider 100 ohm resistor is ¼ watt leaded.

Value	Qty	Module
470 ohms	5	TFT Divider
220 ohms	5	TFT Divider
100 ohms	1	TFT Divider
100 ohms	1	0805 AD8307
3.9K ohms	1	0805 AD9851

Search at Tayda for resistors.

11. Capacitors

Use either small disk ceramic or 0805 ceramic smd capacitors.

Value	Qty	Module
.1 uF	1	Output

Search at Tayda for capacitors.

12. Toroid

After testing the output transformer, I found the best choice is a BN43-2402 binocular toroid wound with 14 turns tapped at 10 turns above ground. Use #32 (or greater) magnet (enameled) wire. The SWR bridge transformer is wound on a BN43-2402 binocular toroid with 6 bifilar turns of #32 (or greater) magnet (enameled) wire.

Core	Qty	Module
BN43-2402	2	Output, SWR

Search on eBay or Kits and Parts dot Com for "BN43-2402."

13. Wire

In the prototype I used light weight stranded wire colored as in the wiring color codes given in the Wiring section. For the second Yana I found some old flat computer ribbon cable (used on old hard drives and CD players). I like the second approach (flat ribbon cable) better. It is best to scrounge wire from discarded electronics. Old stranded CAT5 network cable can be stripped for the wires inside. Solid core wire is probably not flexible enough for Yana.

Since I wrote the above paragraph, it occurred to me that Yana can be plugged together by purchasing a pack of 40pcs of 10cm pin plug jumpers on eBay for about $1. Get ones that are female on both ends. One listing reads:
40pcs 10cm 1Pin F/F Jumper Wire Dupont Cable for Arduino UNO R3 Raspberry Pi
You might wish to get the 20cm pack and cut the wires to the right length. This would require installing a pin plug strip on the cut end.

Enameled wire for winding toriods can be found on solenoids, in relays, in clocks, in transformers, and other coils used in old electronics. The 14 turn binocular output

transformer needs #32 or smaller enameled wire. So you'll need some pretty fine stuff.

14. sma Connectors

Four male PCB sma connectors are
needed: two for extenders and two for the
SWR bridge. Notice that there are two
versions intended for PCB edge and center mounting. Either type will work in Yana.
The SWR bridge uses one female PCB sma connector. Search eBay for "sma PCB
female" and "sma PCB male."

15. sma Cables

A 10 cm male to male cable is needed to calibrate Yana. Extra cables
are needed to connect test items to Yana. Two 10 cm and two 30 cm
male to male cables are useful to connect devices to Yana. Search
eBay for "sma male 10 cm –female" and "sma male 30 cm –female".
15 cm (6.5") cables seem to be cheaper right now and they will work in
place of the 10 cm cables. When you receive the cables, use an
ohmmeter to check the cables for continuity. I've received shorted cables.

B. Modules

1. Arduino Nano

eBay clones are fine. **Warning: The Nano may come with no
boot loader.** See the code installation section for what to do.

If you or your guru cannot install a boot loader, then buy a Nano
with the loader preinstalled. I found the eBay modules advertised
as "Nano Compatible" came without a boot loader installed. If
there is any doubt, email the seller and ask if the boot loader is installed.
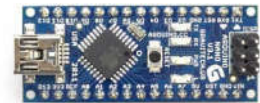
Chinese Nano clones come with a CH340 usb controller. You may need to install a
driver on your computer to access this chip. The driver is free on the web.
http://www.ebay.com/itm/USB-CH340G-Nano-V3-0-16M-5V-ATmega328P-Micro-
Controller-Board-For-Arduino-SE-
/361523397837?hash=item542c7944cd:g:P1sAAOSwZtJW~I9i

The Nano below comes without boot loader.
http://www.ebay.com/itm/Atmega328P-Nano-3-0-Controller-Board-Compatible-Arduino-
Nano-CH340-USB-Driver-
/201601653987?hash=item2ef0651ce3:g:TKUAAOSwZJlXNJQz

2. DDS module

Buy the AD9851, **NOT THE AD9850**. Get the one with all pin
headers lined up along the long sides and with no internal
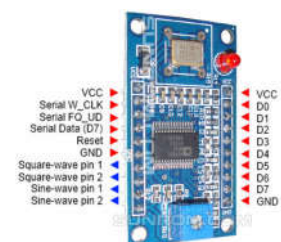
headers. The crystal oscillator should be 30MHz. The board may be labeled AD9850 but have a AD9851 chip on it. In any case, this board has the right filter for the AD9851 which is from the AD9851 data sheet. (To my knowledge, all AD9850 modules have the wrong filter.)
http://www.ebay.com/itm/AD9851-DDS-Signal-Generator-Module-0-70MHz-2-Sine-Wave-and-2-Square-Wave-M-/172051686440?hash=item280f146428:g:Sa0AAOSwKtlWi5YO

3. Detector module

On eBay search for "RF Signal Power Detector Meter" and "AD8307 module." You want one with an AD8307 and a voltage regulator. Do not buy the shielded version: it is more expensive and limited in bandwidth.
http://owenduffy.net/blog/?p=7559
and
http://owenduffy.net/blog/?p=7661

 eBay now sells a slightly different module which is a good choice. The PCB is 30mm long instead of 33mm so adjustments must be made.

4. TFT display

The module is a 128 x 160 TFT red module with a ST7735 controller. Be sure the TFT pins point down and are labeled in this order: LED SCK SDA A0 RESET CS GND VCC. The pin order is critical. The displays come in red and blue. Do not get a blue display because they come in a variety of pin-outs not supported by Yana. Search eBay for "st7735 128x160."

5. Rotary encoder with button

Be sure to get one with a button.
Search eBay for "push button rotary encoder."

C. Made Parts

1. Spacing Washers

Spacers are costly and often not the right size. I've found that stacked homebrew spacer washers are far more useful and flexible. Generally 1/16" material is best for washers. If printed circuit board is used to make washers, then there should be no copper foil on the side of the washer that is toward a module. Copper could short traces on the module. To insulate the copper, with a paper punch, make disks of polyethelene. Make a hole in the center of a disk and place the disc over a washer to insulate the copper from a module.

First Method. If you do not have a hole punch skip to the **Second Method**. A hole punch is a very useful tool for the homebrewer. It makes clean precise holes.

Any plastic that does not shatter when punched will work. FR4 printed circuit board will work. As shown, I punch washers from the cutoff tabs from wiring outlet boxes. These boxes are excellent, inexpensive electronic project boxes. A washer for a 3/32" screw uses the knock-out (punched round piece) from a 7/32" punch. With long nose pliers center this knock-out (there is a center-mark from the 7/32" punch) on a 3/32" punch. After punching the hole, the washer may be removed by closing long nose pliers on the punch above the washer and opening the punch. The plier tips will push the washer off the punch. A washer for a 1/8" screw is made with ¼" and 1/8" punches. For a given hole, I make the washer diameter 1/8" inch larger than the hole.

Second Method. Cut a ¼" wide strip of printed circuit board. Beginning 1/8" from the end, drill 1/8" holes every ¼" along the strip. Use diagonal cutters to snip these square washers apart. Washers for 3/32" holes can be made the same way.

Shims: When thickness needs minor adjustments make shims using paper or thick polyethelene with a paper punch then make the hole with an awl or small punch.

2. **Pin-Headers of a given size**

Cut shorter pin-header strips from 40 pin strips. The challenge is cutting female strips. I advise watching a Ladyada video:
https://www.youtube.com/watch?v=sHrgpfe-8Ik
She cuts from the hole side, I cut from the pin side centering the cutter over the pin and the hole on the opposite side. I use flush cut classic diagonal cutters which are different from hers. Thus, pretty much any sharp cutter will work. She shows how to trim the header nicely: no sanding or filing necessary. I think flush cut diagonal cutters win on the trimming task. The whole process is very quick.

I leave remainder female strips of length 2, 3, and 4 in my supply since a single pin-header is rarely needed. A length 5 female header can be cut into two 2-pin-headers: the most useful size.

If you decide to use a pack of pin header jumpers, fewer pin headers will be needed.

xxx The list should be correct for Yana Basic. The rest needs writeup and checking.

II. The List

Yana Basic:			Yana Bridge:		
Modules:	Quantity:	Source:	Parts:	Quantity:	Source:
Nano	1	eBay	BN43-2402	1	Various
AD9851	1	eBay	100 ohm	6	Tayda
AD8307	1	eBay	Male PCB sma	2	eBay
TFT 1.8 inch Display	1	eBay	Female PCB sma	1	eBay
Parts:			Perfboard	cut	Amazon
Rotary encoder	1	eBay			
Sma female jumper	1	eBay	Calibration*:		
Pin Headers (male)	strips	Tayda	Male PCB sma	2	eBay
90deg Header (male)	strips	Tayda			
Pin Headers (female)	strips	Tayda	15cm sma jumper	1	eBay
Knob	1	Tayda	perfboard	cut	Amazon
100 ohm	1	Tayda	pin headers (male)	strips	Tayda
220 ohm	5	Tayda	pin headers (female)	strips	Tayda
470 ohm	5	Tayda	100 ohm	3	Tayda
.1uF	1	Tayda	270 ohm	1	Tayda
DC coaxial	1	Tayda	390 ohm	1	Tayda
BN43-2402	1	Various	3.3K	1	Tayda
Enameled wire	some	scrounge	68	2	Tayda
Hookup wire	some	scrounge	82	2	Tayda
Screws & nuts	some	scrounge			
Spacers	some	scrounge	Calibrator:		
Case	1	eBay	Kopski		QEX
Perfboard	cut	Amazon			
Foil tape	cut	Home Depot			
PCB	cut	eBay			

* "Calibration" only includes parts for a 50 ohm load, 30db attenuator, and "through" cable. Parts for the "Calibrator" are just referenced as "Kopski."

III. Power for Yana

I recommend 7-9v DC. Current draw is about 160mA. (The same current is measured on both the prototype and "release model" Yana.) The regulators are rated to 12v, but I've found the Nano regulator runs exceedingly hot at 12v. Below 7v the regulators drop out.

Here are some suggestions with my preferred choice last.

A. 9v alkaline battery

A 9v alkaline battery has about 300mAh which is less than 2 hours of operation for Yana. This source could get expensive.

B. AA alkaline or NIMH batteries

Battery holders for multiple AA batteries are available cheaply on eBay.

1. Six fresh cells will supply about 8.4v with about 1200-1800mAh. That is 7.5 to over 11 hours of running Yana. NIMH batteries can be recharged.   I've found that NIMH batteries discharge when not in use.

2. Eight depleted alkaline cells will supply 8-9v. Most modern appliances fail when the AA battery drops to around 1.1v. Yet there is still quite a bit of capacity. The batteries are "free" since their other use paid the way.

C. Two Li-Ion 18650 cells

This has become my preferred solution. The battery pack is smaller than a AA pack and far more robust than NIMH batteries.

Laptop battery packs are generally made from multiple 18650 cells. When a battery pack fails, generally at most one cell has failed and the remaining cells run at diminished, but still considerable, capacity. The laptop packs can be scrounged for free or bought cheaply on eBay.

You need:
i.   two (4 or more is better) 18650 cells,
ii.   a two cell battery holder,
iii.   a DC coaxial plug, and
iv.   two 18650 battery chargers.

I had a Windows 98 laptop in which the batteries finally failed around 2000. I took the pack out. I brought them back into service with Yana and they proved to have considerable capacity. Wow. In that same period I've thrown out many NiCd and NIMH cells which could not be resurrected. I keep two cells for running Yana and two for backup when the charge runs down.

i. Sources for cells. First view a Youtube video. The video begins with what can go wrong then shows how to disassemble a pack.
https://www.youtube.com/watch?v=qc7UlvsQ-So

Scrounge old dead laptop packs from friends or search eBay. Search "8800mAh laptop battery." A price less than $1 per cell is good. A 12 cell pack will yield many good cells. Do not buy cheap 18650 cells on eBay, they're junk. Buy only laptop packs. The cheap packs are all depleted laptop packs despite what the seller claims. A battery pack claiming 10.4 or 11.1 volts at 8800mAh should contain 12 cells, three parallel combos of four cells each placed in series.

ii. A battery holder. A two cell holder is cheap on eBay. Search for "18650 battery holder." Here's one for less than $1.
http://www.ebay.com/itm/Plastic-Battery-Storage-Case-Box-Holder-For-2-x-18650-3-7V-With-Wire-Leads-JL-/161856590662?hash=item25af679346:g:3e4AAOSwo0JWHLys

iii. DC coaxial plug. Try Tayda.
http://www.taydaelectronics.com/dc-power-plug-2-1mm-x-5-5mm-x-14mm.html

iv. Two 18650 Battery Chargers. With two chargers, two batteries can be charged at the same time. I use very inexpensive boxes (about $1 each) that plug into a usb phone charger or computer. Search for "18650 power bank" on eBay.

The box contains a charger (served through a micro usb connector) and a 5v booster (served through a standard usb connector). Despite claims, the 5v booster poops out at 100-200mA. I use only the charger function. The flashing LED changes at almost full charge. However if you use an "USB Charge Doctor" (found on eBay), you will see that charging can continue for some more time adding to the battery capacity. (Charge until current falls below .1: 10mA.)

IV. Useful Tools and Parts

Here are some useful, but not essential, tools for the homebrewer.

1. Helping Hand

Many tasks take three or more hands. Search the web and you will find many creations by Hams that are very inexpensive helping hands. I have two alligator style Helping Hands. http://www.ebay.com/itm/Stand-Helping-Soldering-Iron-Magnifying-Tool-Third-Hand-Magnifier-W-Vise-Clamp-/331652589198?hash=item4d3808e68e:g:0LoAAOSwx-9Wx9-P I remove the magnifying glass since it makes the Helping Hand top heavy. The removed glass comes in handy separately.

2. Soldering Station

There are two styles: those with paper thin tips and those with heavy tips. The heavy tip type are far superior for soldering since the tip holds enough heat to heat a joint, solder it, and get off quickly. My station is a Xytronic 379. Hakko makes very popular stations. If a station will accept Hakko tips, that station uses heavy tips. A conical tip is best for all purpose smd work (ignore Dave Jones). I've found the long thin tips do not hold enough heat. (Heat is different from temperature. Most stations allow you to adjust the temperature. A paper thin tip at high temperature, when placed on copper foil, can cool almost instantly. Then it takes awhile for the contact point to come up to temperature while every part nearby fries.)

Dave Jones on EEVBlog #954 describes a bargain test lab with the Yihua 936, a clone of (but definitely not) the Hakko 936. Try eBay. Shaved pencil lead can improve thermal contact: http://www.eevblog.com/forum/reviews/yihua-soldering-iron-mods/

3. Hand Punch

A hand punch is a luxury well worth having. I've already mentioned the punch for making washers. I make holes in PCB and chasses. I have almost retired my hand drill because of the punch. https://www.amazon.com/XtremepowerUS-Power-Punch-Sheet-Metal/dp/B008BM6TFY/ref=sr_1_2?s=industrial&ie=UTF8&qid=1466191489&sr=1-2&keywords=sheet+metal+hole+punch+kit

4. Half height Outlet Boxes

These are inexpensive ($1.16 per box) and make excellent project boxes. The tabs are cut off and used to make spacer washers.

http://www.homedepot.com/p/Carlon-1-Gang-8-cu-in-Zip-Box-Non-Metallic-Switch-and-Outlet-Box-Blue-B108B-UPC/100404057

A cover cut from acrylic plastic on the outlet box makes a nice project box. Acrylic is easy to cut and does not shatter like polystyrene.
http://www.homedepot.com/p/OPTIX-11-in-x-14-in-x-093-in-Acrylic-Sheet-MC-27/202090111
Aluminum foil duct tape can be used to shield a box making it RF tight. The 40db taps for Yana were made using these shielded boxes.
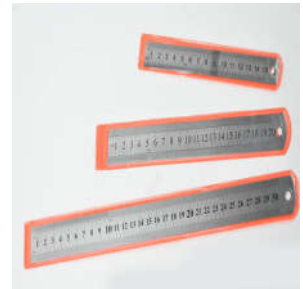
5. Magnifier Glasses

Discount stores sell non-prescription reading glasses. I have 3.00 but higher might be better (the higher the power, the more your nose is in your work). These are more useful for me than a magnifier light.

http://www.walmart.com/ip/Optx-2020-3-Pair-ValuPac-Classic-Reading-Glasses-3.50/38092958
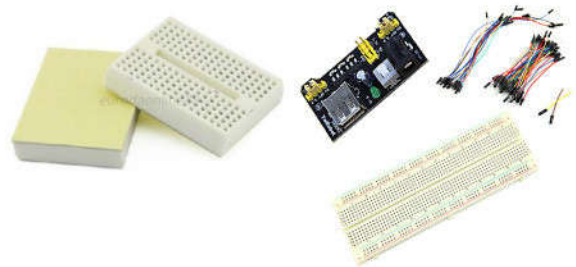
6. A Good Ruler

Get a ruler that has millimeters. You'll like it: no fractions and the numbers add up easily. The ruler will also have inches to 1/32nd so you'll have your old favorite measure too. A steel rule is good.

http://www.ebay.com/itm/6-8-12-Stainless-Steel-Double-Side-Machinist-Straight-Measuring-Ruler-Scale-/231800536955?var=&hash=item35f8637f7b:m:mF1H2mptrJa1edAdP0nVEXA

7. Breadboard

Of course, a larger breadboard is good for both soldering and prototyping. You can buy the larger size as a package with power supply and jumpers: a good deal. However, for soldering pins, the smallest size works and is very handy.

http://www.ebay.com/itm/Hot-Sale-170-Tie-points-White-Mini-Solderless-Prototype-Breadboard-Test-Purpose-/201452761315?hash=item2ee78530e3:g:yyIAAOSwYHxWJv3n
http://www.ebay.com/itm/Hot-MB102-Power-Supply-Module-3-3V-5V-Breadboard-Board-830-Point-65-Jumper-cable-/162104458464?hash=item25be2dbce0:g:YrQAAOSwc1FXYK-H

8. Nibbling Tool

A nibbling tool is very useful for cutting large or rectangular holes. Trim the hole almost to size then finish off with a file to create a nice smooth outline.

http://www.ebay.com/itm/Nibbling-Cutter-Tool-HT-204-Circuit-Specialists-/222311045493?hash=item33c2c55975:g:dskAAOSw5cNYJMV8

9. T-Handle Tapered Reamer

Handy for enlarging holes from ¼" up to ½". It is also useful for deburring holes or fine tuning hole size. There are also models that go up to 5/8".

On eBay search for "tapered t reamer."