Xtreme Ideas Technology Development

RHP4K Kit Assembly Guide

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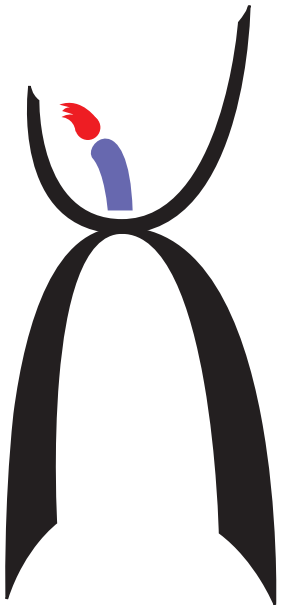

RHP4K Kit Assembly Guide
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Introduction

Thank you and congratulations on your purchase of Xtreme Ideas Technology Development's RHP4K kit. The RHP4K is available in kit form for those who are experienced in board assembly. Those who wish to build this kit should be familiar with the following:

- Basic through-hole soldering - no bridging or cold joints
- DIP and PGA assembly (use of masking tape and / or corner tacking)
- Basic SMT (surface mount technology) skills. The SMT assembly techniques required to complete this board are reviewed for the reader's benefit. Those who are experienced with through-hole work should be able to pick up these basic SMT skills in a few minutes.
- Polarization rules and nomenclature for all common devices - capacitors, diodes, ICs, SIP resistor packs.

If you are unsure about any of the above items, you are strongly recommended to seek assistance from someone knowledgeable, rather than guess and possibly cause permanent or irreversible damage to kit parts.

The purpose of this guide is to provide the assembler with suggestions as to what order the parts should go on the board, as well as to provide a complete list of items so that none are left off. Assembly suggestions are given when necessary. The additional purpose of the guide is to provide a power-on checklist which if followed should help catch most common and / or disastrous assembly errors before they can cause permanent damage to the hardware.

As a note to those unfamiliar with SMT size codes: most two-terminal SMT devices will come in one of a few standard SMT footprints, designated by a four-digit number. The first two digits specify the length of the device; the second two digits specify the width. The units of these numbers are tens of mils (0.01" - a "centi-inch"). So, a 1206 SMT device is 0.12" x 0.06" in size. Some manufacturers will use EIA codes to identify a package size. An EIA code is a single alphabetic character. "A" is the smallest device, "B" is the next largest, etc. These alphabetic codes are equated to a four digit number, but the units are in 0.1 mm (metric, like the rest of the world). Thus, and A size device is equivalent to a metric 3216 device, which is 3.2mm x 1.6mm. This may seem confusing, but there are only two sizes of devices in your kit, 1206 and EIA size A. All the devices are 1206 size, except for the tantalum caps, which look like distinctive black plastic parallelepipeds.

Parts Checklist

Your kit should come with the following parts:

Qty	Description	
1	RHP4K Assembly Guide, Xtreme Ideas Part Number 1008-001-001-X0	
1	PC Board, RHP4K/1S, Xtreme Ideas Part Number 1000-001-001-X1	
1	74LS367 hex tri-state buffer	16 pin DIP
1	74LS00 quad NAND gate	14 pin DIP
1	74LS74 dual D flip-flop with set and clear	14 pin DIP
2	74LS245 octal tri-state bus transceiver	20 pin DIP
1	74LS574 octal D-flip flop w/broadside pinout	20 pin DIP
1	7407 hex open-collector buffer	14 pin DIP
1	QS3257S1 quad quickswitch 2-1 multiplexer	16 pin SOIC
1	10 MHz TTL oscillator in full can (14 pin DIP) package	
3	14 pin machine tool sockets	
2	16 pin machine tool sockets	
4	20 pin machine tool sockets	
1	84 pin PLCC to PGA socket	
1	FPC compliant oscillator socket (6 pins in 14 pin DIP form factor)	
1	single-row .1” spacing male header strip, 30 positions	
2	dual-row .1”x.1” spacing male header strip, 60 positions	
1	right-angle male power receptacle	white nylon with screw-down mounts
1	36-pin right angle female centronics connector	
8	shorting blocks	
24	0.1 uF 1206 SMT caps (nonpolarized, tan in color)	
6	10 uF EIA size A (3216) 6.3V tantalum SMT can (polarized, stripe is positive, black in color)	
2	330 ohm 1206 SMT resistors	black, marked “331”
5	4.7K 1206 SMT resistors	black, marked “472”
1	150 ohm 1206 SMT resistor	black, marked “151”
1	10K SIP resistor pack	pin 1 marked with bar
1	330 ohm DIP resistor pack	
1	1N5820 Schottky Diode	black, polarized with stripe marking cathode
1	10 segment green bar LED	
1	ferrite bead choke	
1	8 position DIP switch	

1	1A picofuse	olive green, marked with “1A”
3	1/2″ 4-40 hex spacer	
3	1/4″ 4-40 panhead screws	
6	#4 washers	
3	#4 lockwashers	
2	3/8″ 6-32 panhead screws	
2	#6 washers	
2	#6 lockwashers	
1	14 inch section of 37 conductor ribbon cable	
2	male IDC centronics 36 pin connectors	
1	female IDC centronics 36 pin connectors	
1	virgin female power plug	white nylon
2	female power crimp pins for virgin female power plug	

Assembly Procedure

The following tools will be required to assemble your RHP4K kit:

- Fine-tip 30-40W soldering iron (preferably 1/16" or 1/32" conical chisel tip)
- Solder (preferably with no-clean or water-soluble core, 0.020" diameter, eutectic alloy)
- Tweezers, tips angled at 45 degrees, medium-tip (1-2 mm wide)
- Needlenose pliers
- Flathead screwdriver (with roughly 1/8" tip)
- Flush or diagonal cutters (to trim excess leads and cut header strips to length)
- IDC cable vise or standard vise, or large pliers with a wide head (for assembling IDC cables)

The following tools may be helpful but are not required:

- Masking tape (to hold in parts while board is inverted)
- Arm-mounted lamp with magnifying lens, or just a good source of light
- Solder paste in syringe
- Standard crimping tool for assembling the power connector crimp pins

Please peruse the entire assembly instructions before beginning assembly. It is recommended that you follow the general order of assembly because some parts are easier to put on before the surrounding parts are soldered in place.

Assembly Instructions

1. Place all the 0.1 uF 1206 SMT caps on the reverse (solder) side of the board. There are 24 caps numbered from C1-C24. Note that C25-30 are for the 10 uF tantalum caps.

There are two procedures one can use to attach these SMT devices. In the first method, you apply a drop of solder paste from a syringe on one of the device's two pads. Do not apply too much paste as excess paste could lead to shorting and bridges. Then, use a pair of tweezers to carefully place the part in the middle of the footprint. While holding the device in place, use the soldering iron to heat the device and pad such that the paste melts and forms a proper fillet between the device and pad. Once you have removed the iron, the device will cool and stay in place. Then use the soldering iron and standard solder wire to join the other device terminal to its respective pad.

In the second method, instead of applying a solder paste, heat one of the device pads with your iron and melt a little solder wire onto the pad so a thin coating of solid solder covers the pad. Then, using tweezers, place the device carefully in the middle of the footprint. While holding the device in place, use the soldering iron to heat the device and pad such that the thin coating

of solder remelts again and forms a proper fillet between the device and pad. Once you have removed the iron, the device will cool and stay in place. Then use the soldering iron and standard solder wire to join the other device terminal to its respective pad.

In both methods, be sure to let the device cool after heating one side. These devices are small enough such that an iron left on one side of the device long enough will heat both pads and the device will slide off the board. Incidentally, this is the method used to remove two-terminal SMT devices using conventional tools. Also, beware that the metal tabs on either side of the device are relatively fragile and a stiff pull at a device with only one terminal soldered in place will tear the device from its tab, leaving the metal tab on the board and you with a now much less useful one-terminal device.

For two terminal devices, both methods (using solder paste and wire) work equally well. The real advantage of solder paste comes in when you are trying to attach relatively fine pitch, high pin count SMT devices (such as a 100 pin TQFP). In that case, the extra height added by the thin coating of solder is often enough to bend pins out of shape, and depending on the pitch, you are liable to cause serious bridging while applying the initial solder coating. Fortunately, the QS3257S1 device (U7A) has a coarse enough pitch such that bridging is not a problem if you are careful. When attaching that device, just apply the solder to pads 1 and 8 (the corners) of the device and attach those first, and then go about attaching the remaining pins.

- ☐ ...C2
- ☐ ...C17
- ☐ ...C20
- ☐ ...C23
- ☐ ...C13
- ☐ ...C18
- ☐ ...C7
- ☐ ...C6
- ☐ ...C11
- ☐ ...C10
- ☐ ...C5
- ☐ ...C9
- ☐ ...C8
- ☐ ...C4
- ☐ ...C16
- ☐ ...C1
- ☐ ...C3
- ☐ ...C21
- ☐ ...C22
- ☐ ...C24
- ☐ ...C15
- ☐ ...C14
- ☐ ...C12
- ☐ ...C19

2. Place all the 10 uF EIA size A SMT tantalum caps on the reverse (solder) side of the board. Note that these devices are polarized; the bar marks the positive (+) side. The pads for the tantalum caps

are marked with a + sign in the copper layer as well as with a slightly rounded silk screen outline. There are six caps numbered C25-30.

- ☐ ...C25
- ☐ ...C26
- ☐ ...C27
- ☐ ...C28
- ☐ ...C29
- ☐ ...C30

3. Place all the 4.7K 1206 SMT resistors (marked “472”) on the top (component) side of the board. Use the same technique used to attach the SMT capacitors.

- ☐ ...R5
- ☐ ...R2
- ☐ ...R4
- ☐ ...R3
- ☐ ...R6

4. Place the 150 ohm 1206 SMT resistor (marked “151”) on the top (component) side of the board.

- ☐ ...R8

5. Place the 330 ohm 1206 SMT resistors (marked “331”) on the top (component) side of the board.

- ☐ ...R1
- ☐ ...R7

6. Place the QS3257S1 on the top (component) side of the board. This SMT device has 16 pins and has an SOIC-16 package. Note pin 1 location. Inspect your work for solder bridges between pins. See SMT assembly hints in step 1 if you are having trouble attaching this device.

- ☐ ...U7A

7. Place the 1A fuse on the top side of the board. The fuse is non-polarized; the + sign on the silkscreen next to the fuse is used to mark the + side of the power connector and has nothing to do with the fuse.

- ☐ ...F1

8. Place the 1N5820 Schottky diode on the top side of the board. Note the polarization stripe of the diode; it should align with the stripe on the board. Also note that you will have to bend the leads as close to the device as possible to make it fit. When soldering the device, be sure to heat it thoroughly - it is attached to some large areas of copper which heats slowly.

- ☐ ...D1

9. Place the ferrite bead on the top side of the board.

- ☐ ...L1

Devices F1, D1, L1, C30, C28 and C23 constitute the input power protection and filtering components. F1 protects the board against shorts; D1 protects the board against Vcc going

negative; L1, C30, C28, and C23 constitute a miniature pi-filter network to help cut back on EMI and other high frequency noise on the power rails.

10. Solder the 8-position DIP switch directly to the board. This device is not socketed because the force required to toggle the switches is enough to push the device out of its socket.

☐...S1

11. Solder the DIP IC sockets to the board. A suggested technique is to first place all the sockets on the board and hold them down with masking tape. Then, turn the board over and solder two pins on opposite corners of each socket (this is called “tacking”). Flip the board over again and remove the masking tape. Inspect the sockets for levelness and flushness to the board. If any sockets are not level and flush with the board, use the soldering iron to reheat the tacked pins while pushing down on the device with your other hand. Be careful not to burn yourself since the heated pin is hot on the top side as well. Also remember to note the location of pin 1 on the sockets.

☐...U5
☐...U9
☐...RP2 (“RP330”)
☐...JP9 (“BARLED10”)
☐...U2
☐...U6
☐...U3
☐...U8
☐...U4
☐...U10 (special FPC-compliant socket)

12. Solder the 84 pin PLCC to PGA socket for the FPGA. You can use the tacking technique in step 10, but be especially careful on this socket to note the orientation of pin 1. Pin 1 is designated by a beveled corner, both on the socket and on the silkscreen. The lettering “U1 FPGA” is also next to the pin 1 corner on the board. Misorienting this socket will render your kit unusable, or in the best case, a big pain to fix.

☐...U1

13. Solder on RP1, the 10K 10 pin SIP Rpack. Note that pin 1 is marked with a stripe. This device is polarized.

☐...RP1

14. Solder on JP11. A single 60-position dual-row 0.1” x 0.1” spacing male header will do the trick. You can use the tacking technique in step 10 to help make sure this connector is level and flush with the board.

☐...JP11

15. Solder on JP8 and JP7. You will have to cut JP8 and JP7 from the remaining 60-position dual-row 0.1” x 0.1” spacing male header. Use your diagonal or flush cutters to cut out 8-position (4 x 2) segments for JP8 and JP7.

☐...JP8

☐...JP7

16. Solder on JP4-6. You should use a single 6-position (3 x 2) segment for JP4-6.
☐...JP4-6

17. Solder on JP1-3. You should use a single 6-position (3 x 2) segment plus a single 3-position (3 x 1) segment cut from the single-row male header strip provided in your kit.
☐...JP1-3

18. Attach JP9 (36 pin right angle female centronics connector) and solder it in. Before mounting JP9, inspect the pins to make sure that all the pins are straight. If any pins are bent, they will not go into the holes and it will be impossible to reattach them once the device is soldered in. JP9 should snap neatly into its mounting holes.
☐...JP9

19. Attach JP10 (2 pin right angle male white nylon power connector). Put the device in the board, but before soldering, hold it in place using the 3/8" 6-32 screws. The assembly should be stacked in the following order, from top to bottom: 6-32 3/8" panhead screw, power connector mounting ear, PC board, #6 washer, #6 lock washer, and #6 hex nut. Once both mounting ears have been bolted in place and the device properly aligned with the edge of the board, you can turn the board over and solder the pins. Apply a generous amount of solder so that the holes are entirely filled.
☐...JP10

20. Attach the standoffs to the board. There are three mounting holes, one at the top, and two at the bottom, through which the standoffs are mounted. The standoff assembly should be stacked in the following order, from top to bottom: 1/4" 4-40 panhead screw, #4 washer, PC board, #4 washer, #4 lockwasher, and 1/2" 4-40 hex spacer. The standoffs are provided so metallic debris on the tabletop do not touch the bottom of the board.
☐...Standoffs

21. Assemble the IEEE1284 cable extension assembly. Attach the male IDC 36-pin centronics connector using a cable vise or other suitable tool to one end of the cable. Attach one of the female IDC 36-pin centronics connectors to the other end of the cable. Always remember to note the location of pin 1. Then attach the remaining female IDC 36-pin centronics connector about 5-6 inches away from the other female centronics connector. This cable assembly is used to allow both an RHP4K/1S and a terminator assembly to be connected on the same IEEE1284 bus.
☐...Cable extension assembly

22. You may now wish to assemble the female power plug. This plug is intended to be attached to a 5 volt power supply provided by the assembler. If you do not have a power supply at this time, you may wish to assembly the power plug anyway but leave sufficient wire length so when a power supply is available, it can be attached to your device. The +5V side of the plug can be determined in one of two ways. The first way is to simply plug the virgin connector shell into JP10 now assembled on your board. Because the connector is polarized, you can only plug it in in one orientation. The

board is marked with a + sign next to the terminal that should be connected to +5. The second method of determining which side is positive is to hold the connector such that you can see the prongs (shields) that go into the mating connector. Rotate the connector until the flat side of these prongs are on the top. The right prong is the positive prong.

The power plug is assembled using a standard crimp tool or a pair of pliers if you don't have a crimp tool. Strip about 3/8" to 1/4" off the end of the wire you wish to connect. Insert this wire into the crimp side of the female crimp pins, such that about 1/16" of the insulation is inside the wide, open crimp flange. Crimp the flange using a crimp tool or pinch the flange closed using a pair of pliers. It is recommended that after you do this, add a little bit of solder to the assembly to make sure it all holds. Insert the wire and crimp pin assembly into the back of the connector shell. You should feel a tactile click when you have inserted the pin far enough. The pin has one-way spurs to insure that the crimp pin assembly does not fall out the back once it is inserted.

☐...Power plug assembly

At this time, the assembler is strongly recommended to continue on to the pre-power on checkoff procedure. Do not insert any chips or apply power to the board at this time.

Power-on and Troubleshooting

The following procedure is provided to help assist the assembler test the board prior to power on and stuffing with chips. The assembler is reminded that he or she is liable for any assembly errors and consequences thereof, and is also responsible for purchasing his or her own replacement parts in the unlikely chance that something is permanently damaged.

1. Using an ohmmeter, check the resistance between power and ground. Measure the resistance at the power input pins, and across the power pins of any socket on the board (i.e., pins 14 and 7 of U8). When measuring, hold the ohmmeter on the pins for a few seconds to allow the decoupling capacitors to charge so you can have a steady-state measurement. The resistance should be around 1K, although some may get measurements all the way down to a few hundred ohms. If one measures a resistance between zero and a few tens of ohms, there is most likely a short between +5 and ground. Check your board for solder bridges. Inspect the surface mount caps especially, since it is possible for one to add too much solder and force a bridge underneath the device. Do not go on until all shorts are removed.

2. Install the green 10-segment bar LED (socket JP9, right above the right angle centronics connector). Note the orientation of pin 1.

3. Apply power to the board. The second green LED from the centronics connector should light up; that is your power LED. Use your sense of smell and touch to see if anything is getting warm. If you installed any of the tantalum capacitors backward, they will get hot and release a substance which will discolor your board and have a foul odor. The substance is relatively harmless. If you wired in diode (D1) or the power connector (JP10) backward, D1 should shunt a large amount of current and get quite warm but it should not be permanently damaged, because the fuse (F1) will blow. You will have to replace F1 if that happens. You can tell if F1 is blown by measuring the voltage drop across it. If it is any more than a few tenths of a volt, it is probably at least partially blown.

4. With the power still applied to the board, measure the +5V rail at one of the chip sockets to make sure a good solid +5 is coming through to the board.

5. Remove power from the board.

6. Install the shorting blocks for master-mode configuration. This means installing shorting blocks across the “MAS” side of JP1, JP2, and JP3, and all the shorting blocks in JP4-6 (in revision X1 of the board, the silkscreen is erroneous and labels these jumpers as “SLAVE”).

7. Install the clock termination jumper (above TP3 on the side of the board with the long dual-row 60 position .1” x .1” spacing male header). *Make sure you jumper the two pins closer to R8, and not across TP3 and the bottom half of the clock termination jumper.* This will short clock to ground and your board will not work.

8. Install all the ICs, crystal (or FPC, if available), and FPGA (if available). As usual, note the location of pin 1. The notch on the ICs should line up with the notch in the silkscreen on the board. The FPGA has a bevelled corner that should line up with the bevelled corner of the FPGA socket. Do not force the FPGA into the socket in the wrong orientation. Try to push the entire FPGA into the socket at once, as pushing in one side first risks bending socket pins or the FPGA pins.

9. While lightly holding your hand over the board so as to feel if any parts are getting hot, apply power to your fully assembled RHP4K. Check to see if any of the parts get hot, or if any are emitting a burning odor. If any parts are getting hot or smell like they are burning, you have most likely put it in backwards.

10. Power down the board and connect it to the host via the terminated cable assembly if available.

11. Power on the board again, and attempt to upload a test configuration to the RHP4K using the upload tool. The uploading program and test bitfiles are available for a few FPGA varieties from Xtreme Ideas Technology Development. Check the web page for the most recent version and downloading instructions. If your board fails this test, check for bent pins on ICs and cold solder joints, as well as solder bridges.

12. If your board passes the test bitfile, you can be sure that most of the basic features of the board are working fine. The untested features are the memory expansion connector, node ID assignment, and scalable configuration hardware. There is currently no diagnostic available to test these features without the prior purchase of additional hardware.

Congratulations on finishing the assembly of your RHP4K kit!

Notes