Extracted from:

Build an Awesome PC, 2014 Edition

Easy Steps to Construct the Machine You Need

This PDF file contains pages extracted from *Build an Awesome PC, 2014 Edition*, published by the Pragmatic Bookshelf. For more information or to purchase a paperback or PDF copy, please visit http://www.pragprog.com.

Note: This extract contains some colored text (particularly in code listing). This is available only in online versions of the books. The printed versions are black and white. Pagination might vary between the online and printed versions; the content is otherwise identical.

Copyright © 2014 The Pragmatic Programmers, LLC.

All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior consent of the publisher.

The Pragmatic Bookshelf

Dallas, Texas • Raleigh, North Carolina





Build an *Awesome PC*

2014 Edition

Easy Steps to Construct the Machine You Need

Mike Riley

Edited by Jacquelyn Carter

Build an Awesome PC, 2014 Edition

Easy Steps to Construct the Machine You Need

Mike Riley

The Pragmatic Bookshelf

Dallas, Texas • Raleigh, North Carolina



Many of the designations used by manufacturers and sellers to distinguish their products are claimed as trademarks. Where those designations appear in this book, and The Pragmatic Programmers, LLC was aware of a trademark claim, the designations have been printed in initial capital letters or in all capitals. The Pragmatic Starter Kit, The Pragmatic Programmer, Pragmatic Programming, Pragmatic Bookshelf, PragProg and the linking *g* device are trademarks of The Pragmatic Programmers, LLC.

Every precaution was taken in the preparation of this book. However, the publisher assumes no responsibility for errors or omissions, or for damages that may result from the use of information (including program listings) contained herein.

Our Pragmatic courses, workshops, and other products can help you and your team create better software and have more fun. For more information, as well as the latest Pragmatic titles, please visit us at http://pragprog.com.

The team that produced this book includes:

Jacquelyn Carter (editor) Candace Cunningham (copyeditor) David J Kelly (typesetter) Janet Furlow (producer) Ellie Callahan (support)

For international rights, please contact rights@pragprog.com.

Copyright © 2014 The Pragmatic Programmers, LLC. All rights reserved.

Printed in the United States of America. ISBN-13: 978-1-941222-17-1 Encoded using the finest acid-free high-entropy binary digits. Book version: P1.0—May 2014

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior consent of the publisher.

Installing the CPU-Cooling Unit

The heat generated by the i7-4770K (and most other modern-day PC CPUs) is intense. If you were to electrify your MOBO and touch the CPU while powering up, you would burn your finger within a few seconds of contact. In addition to damaging you, this heat will damage the CPU and MOBO. So it's critical that we install a component to safely dissipate that heat.

Rather than go with a more expensive and advanced water-cooling option, I decided to keep things simple with this PC build by taking a more traditional fan-based cooling approach. While the fans can generate more noise than a water-cooled approach, they are far cheaper and consistently proven to adequately cool the CPU. If you have no plans for trying to overclock the CPU, save yourself a few dollars and install the CPU fan bundled with the i7-4770K. It's adequate for the job and obviously engineered by Intel to cool its CPU. But it's designed for average operation in an average PC. We're building a high-end PC, so average just won't do. That's why I chose the Cooler Master Hyper N520 to perform the function of cooling down our hot CPU.

The Hyper N520 features five copper cooling pipes that connect to large aluminum plates attached to two fans to quickly dissipate the heat generated by the CPU (refer to the next figure). Its assembly is far larger than the stock CPU fan that Intel ships with the i7-4770K. Its larger size also makes attaching the fan to the motherboard slightly cumbersome. You need to be extra cautious and patient during the installation as a result.



Figure 21—The contents of the Hyper N520 CPU fan package

The fan also comes with two types of bottom brackets that go on the back of the motherboard to anchor the fan firmly on top of the CPU. One bracket is for AMD CPUs while the one we're interested in is for Intel LGA 1150 CPU sockets. This socket size requires us to attach the two LGA 1150–sized side brackets to the base of the Hyper N520. Remove the protective plastic film from the copper base and align and mount the side brackets one at a time. Do so with the spring-loaded mounting screws facing down from the main body of the cooling fan, as shown in Figure 22, *LGA 1150-sized side brackets mounted on the Hyper N520*, on page 9.





Note the four drill holes on the motherboard surrounding the CPU socket. This is where we will position the posts of the Hyper N520. The rear bracket sized for the LGA 1150–style socket will be on the back side of the motherboard, holding the mounted fan in place. But before we attach the Hyper N520 to the motherboard, we have to complete a very important step!

The square top of our CPU will be covered by the square bottom copper plate of the CPU fan. But while heat will transfer from a hot aluminum surface to a cooler cooper surface, the efficiency is reduced due to the gap between the two metals and the drop in conductivity due to the change in surface types. To greatly improve the effectiveness of heat transfer, we need to apply thermal paste to the top of the CPU before positioning the copper plate of the N520 over the CPU. This paste fills in any irregularities on the surface of the CPU cover and the cooling fan's contact plate, thereby ensuring the most efficient heat transfer between the two surfaces.

As you saw with the unboxing of the Hyper N520, the package included a tube of thermal paste. While this may be adequate for most, I found it to be a bit too fluid for my comfort. I have always had great success with Arctic Silver 5 high-density polysynthetic thermal paste.⁴ Purchasing a tube adds

^{4.} http://www.arcticsilver.com/as5.htm

roughly \$10 to the overall cost of the PC build, but that expense is worth the peace of mind of using a high-quality cooling compound.

True to its name, Arctic Silver contains silver, an excellent conductor of heat. It is also a highly sticky substance that you don't want to have land on anything but the top of the CPU cover.

Several schools of thought exist when applying thermal paste. Some prefer a drop the size of a pea while others prefer the size of a grain of rice. Some use a putty knife or the edge of a credit card to spread that amount evenly across the surface of the CPU top cover. Others let the CPU fan's connecting surface spread the paste when sandwiched between the CPU and the fan's connecting flat metal surfaces. I have used the latter approach for years without incident. I shy away from the spreading method so as not to accidentally sandwich any foreign materials in between the CPU and fan surfaces.

Before squeezing out a pea-sized dollop of Arctic Silver in the middle of the CPU cover, test squeezing out the measurement on a paper plate. This will give you a sense of how much pressure to apply to the syringe while voiding out any de-coagulated fluids that may have settled near the tip during shipment. When you're confident of your measurement and squeezing technique, place a small amount of Arctic Silver onto the CPU cover. Refer to the following figure for details.



Figure 23—A pea-sized drop of Arctic Silver on the CPU cover

Be careful not to overuse the thermal paste.

Carefully position the base of the Hyper N520 on top of the CPU (as you see in the next figure), allowing the weight of the copper base to evenly distribute the paste in between the two metal plates. Try not to pull apart the sandwich and change the orientation of the plates once each side has touched the thermal paste, as this could introduce unwanted pockets of air in between. Also be very careful not to allow the paste to ooze beyond the boundary of the two metal surfaces. If the conductive paste touches areas it's not supposed to be on, it could short out your CPU or motherboard. Should any excess paste bleed from the sides of the thermal sandwich, wipe it away using a cotton swab slightly dampened with rubbing alcohol.



Figure 24—Note the orientation of the Hyper N520 correctly mounted on the MOBO.

When you're satisfied with the position of the fan, thread the mounting screws into the LGA 1150 mounting plate placed on the back of the MOBO. The rear area of the PC case exposes the back portion of the MOBO explicitly so that the CPU-cooling fan's mounting plate can be installed. Position the rear mounting plate so that the four arms are flat against the back of the MOBO. You will see that the metal surfaces of the mounting plate are protected by insulating tape so that the mounting plate's metal does not touch the metal traces on the MOBO. Refer to the next figure for details.





Reposition the mounting screws toward the middle of the mounting posts (they can slide into three different positions to accommodate different-sized sockets). Doing so will align the screws with the CPU-fan mounting holes on the MOBO. Tighten the nuts around each mounting screw, starting with the upper left and lower right, followed by the upper right and lower left. This will help maintain an evenly distributed amount of tension on the clamp and motherboard as you tighten the mounting screws. Be sure the fan is firmly in place and doesn't wiggle or slide once attached, but don't overtighten the mounting screws or you might bend and damage the motherboard.

The last item on the CPU-fan installation checklist is to plug the fan's wires into the CPU fan power plugs on the motherboard. The CPU fan power connectors are located to the upper right of the CPU socket on the MOBO. Cooler Master ships the N520 with both fan power wires attached to a Y-splitter. This allows both cooling fans to be powered by a single CPU fan connector on the motherboard. The drawback is both fans will always be on or off, running at the same speed. This limits the ability to control the speed of each fan independently. Fortunately, the Maximus VI Formula has two CPU-fan power connectors. So disconnect the longer of the two fan wires attached to the Y-splitter and plug each fan wire into the two available fan-connector slots.

With the mounting of the CPU fan onto the motherboard, you are nearly done with the most difficult, time-consuming portion of a PC build. All that is left to do with the motherboard is to connect the remaining case fans and power and data cables to it. Let's start with the fan and front-panel data cables.