

# Building Morpheus v1.00a

Version 0.90 (no diagrams or photo's ... yet)

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Updated documentation will always be available at <http://Mikronauts.com>

This is a preliminary version, the finished document will have photo's taken at various stages of assembly. All the test programs will be available soon.

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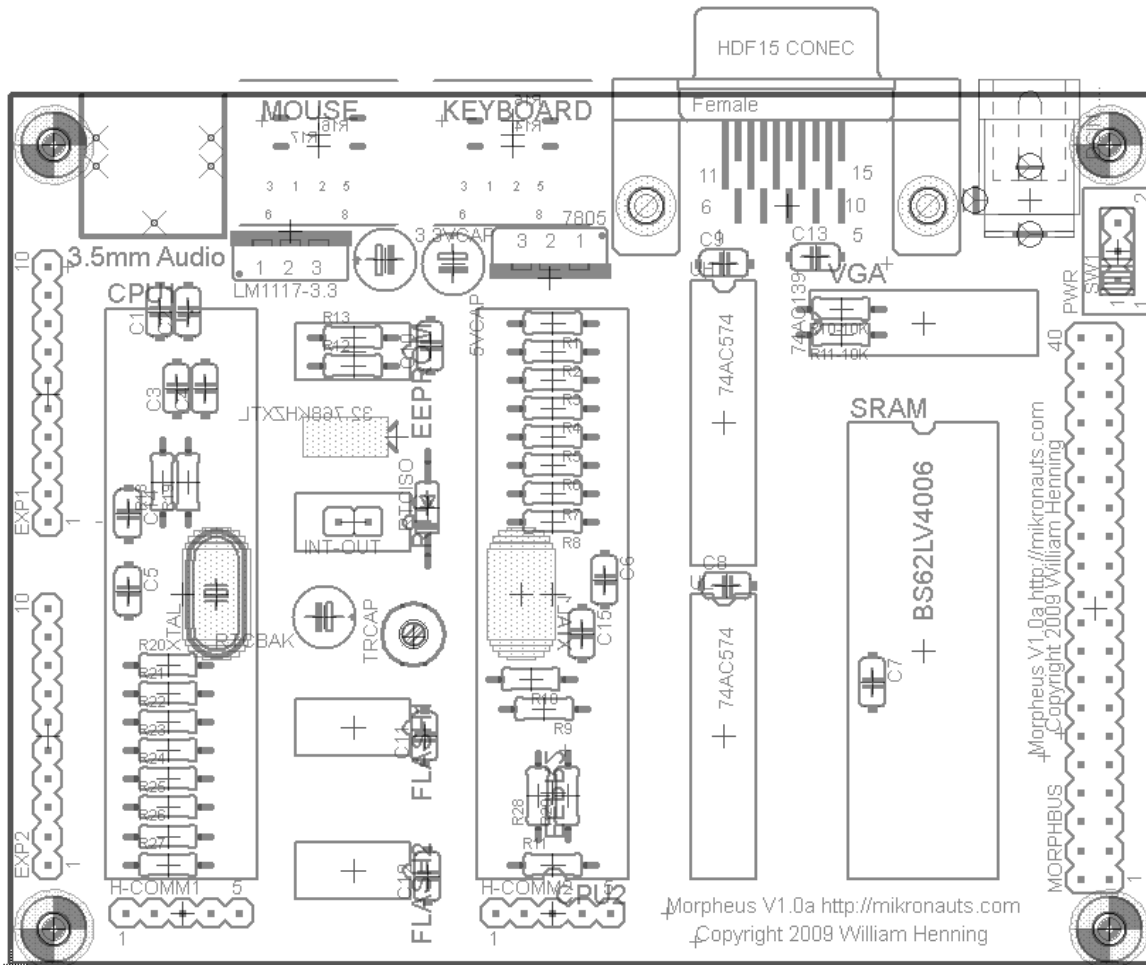
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### Introduction

As you look at your Morpheus, you will see the white silk screening showing you where the parts go. Most of the parts locations are indicated on the top of the board, however in my experience, you will have a much easier build if most of the passive components are actually placed on the bottom of the board.

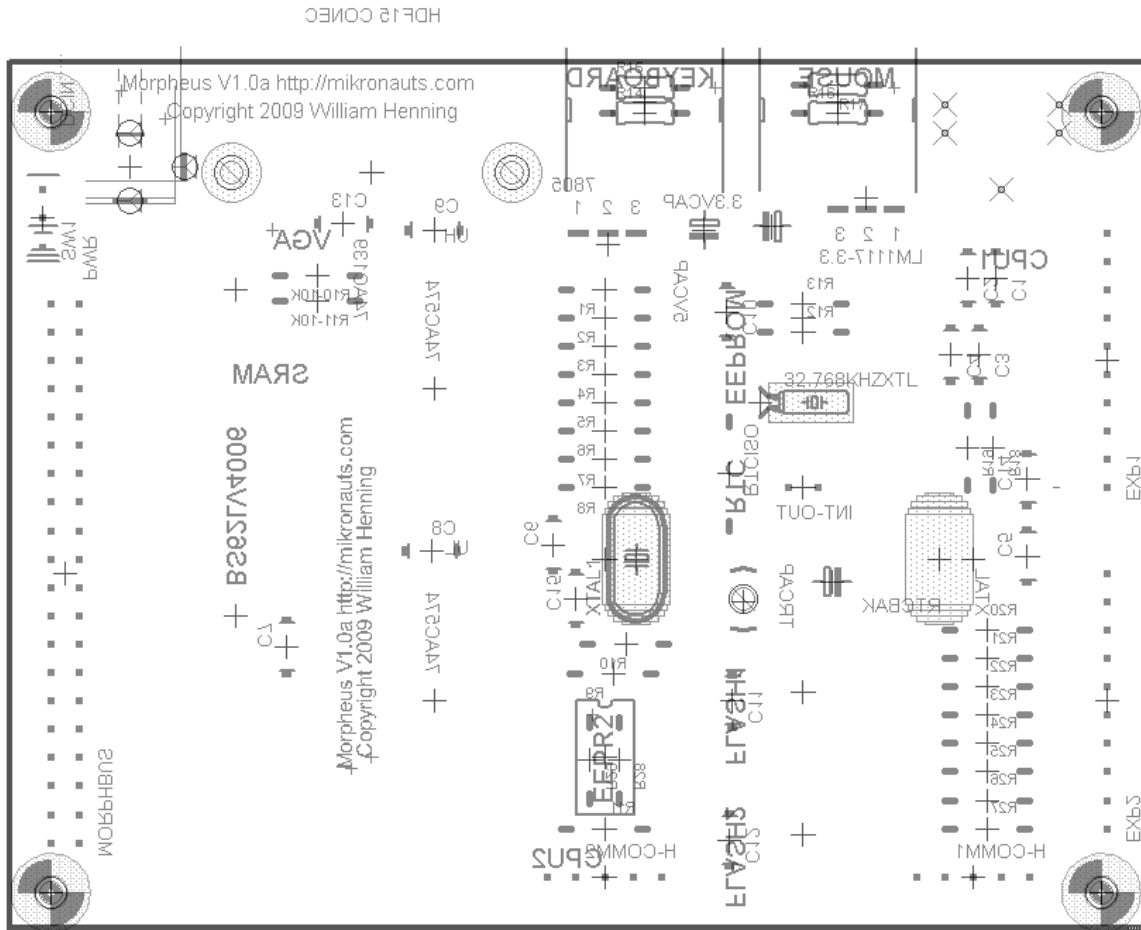
To make your life easier, I am including some views of the board without the clutter of the traces and pads – this way you will find the part locations even easier.

### Top of board:



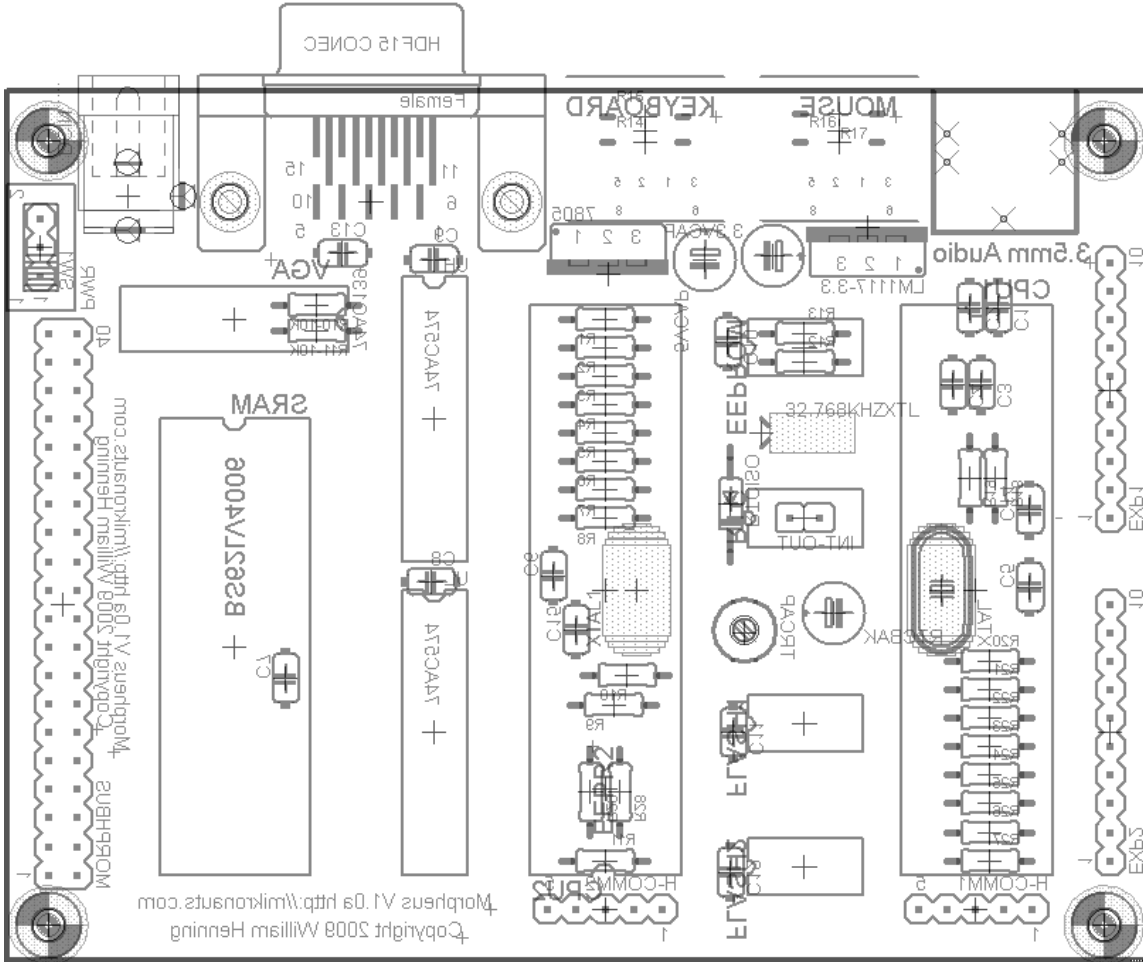
**Bottom of the Board:**

I left the part name layer turned on so you can see which resistors are where on the bottom of the board.



**X-Ray view of the top of the board, through the bottom:**

This view will be VERY useful to you when mounting the passive components on the back of the board.



## ***Section One – Parts that go on the back of the board!***

### **CPU1**

- install a 5MHz crystal at Xtal
- install .1uF bypass capacitor C5, and 10uF electrolytic capacitor C14
- install 10K resistors R18, R19
- install 10nF audio capacitors C3, C4
- install 1uF ceramic capacitors C1, C2
- install 2K2 resistors R20-R27 (you can substitute 2K resistors)

### **CPU2**

- Install a 5MHz crystal at XTAL1
- (OPTIONAL) install 10K pullup resistor R11 (pulls up RESET)
- (OPTIONAL) install 10K pullup resistors R28, R29 (pullups for optional EEPROM)
- (OPTIONAL) install 8 pin DIP socket EEPR2 (for optional EEPROM)
- install .1uF bypass capacitor C6, and 10uF electrolytic capacitor C15

I suggest installing R28, R29 and the DIP socket even if you are not planning to use the EEPROM for CPU2 as it is FAR easier at this stage than re-working the board later.

The 256 color VGA circuit requires the following:

- install 270R resistors R9, R10 right next to the crystal for CPU2
- install 470R resistors R2, R5, R8
- install 1K resistors R1, R4, R7
- install 2K resistors R3, R6

**BE VERY CAREFUL TO INSTALL THE RIGHT RESISTORS IN THE RIGHT PLACES, OTHERWISE THE COLORS WILL BE WRONG!**

Note: it is possible to populate the board for “regular” 64 color VGA however the resulting layout will look a bit messy

### **Keyboard**

- install 10k pullup resistors R14, R15 on the back side of the board

### **Mouse**

- install 10k pullup resistors R16, R17 on the back side of the board

### **EEPROM**

- install 10k pullup resistors R12, R13 on the back of the board

**RTC**

- install 1N4007 diode at ISO (near pin1 of RTC)
- (OPTIONAL) install 20pF trimmer capacitor at TRCAP
- install 32.768KHz crystal where indicated on back of board

**Flash 1**

- install decoupling capacitor C11

**Flash 2**

- install 100nF decoupling capacitor C12

**74HC139 Decoder**

- install 10k pullup resistors R10-10K, R11-10K on the top back side of the board
- install 100nF decoupling capacitor C13

**74HC574 Latch UH**

- install 100nF decoupling capacitor C9

**74HC574 Latch UL**

- install 100nF decoupling capacitor C8

**SRAM**

- install 100nF decoupling capacitor C7

**7805 Voltage Regulator**

- "Turn" it around and install in on the bottom, make sure pin 1 still goes to pin 1 etc
- You can install it on the top, but you will need some insulation between the TO220 case and the Mem+ board if you install one on top of Morpheus

## ***Section Two – Parts that go on the top of the board!***

### **CPU1**

- Install 40 pin DIP socket, pin 1 is towards the audio connector

### **CPU2**

- Install 40 pin DIP socket, pin 1 is towards H-COMM2

### **EEPROM**

- install 8 pin dip socket on top of board, pin1 towards SRAM

### **RTC**

- install 8 pin dip socket on top of board, pin1 towards SRAM
- install 470uF electrolytic capacitor at TBAK

### **FLASH1**

- install 8 pin dip socket on top of board, pin1 towards SRAM

### **FLASH2**

- install 8 pin dip socket on top of board, pin1 towards SRAM

### **74HC139 Decoder**

- Install 16 pin DIP socket at 74HC139, pin 1 is towards the far end of the board

### **74HC574 Latch UH**

- Install 20 pin DIP socket at UH, pin 1 is towards the VGA connector

### **74HC574 Latch UL**

- Install 20 pin DIP socket at UL, pin 1 is towards the VGA connector

### **SRAM**

- Install 32 pin DIP socket, pin1 is towards the VGA connector

### **LM1117-3.3 or AS2810-3.3 Voltage Regulator**

- I install a TO-263-3 version of the AS2810-3.3 on top of the board
- TO-220 case regulators should go on the bottom, make sure pin 1 is at pin 1



### 3.3VCAP CAPACITORS

- actually one is for the 5V regulator – I install both on top

## ***Section 3 – Installing the connectors!***

(They go on TOP of the board)

### **Audio Connector**

- the holes may be too small for the leads depending on the specific connector – either drill a hole next to the existing three holes (I would recommend .1" to the left), run some wires to a different style of audio jack, or run wires to two RCA line level audio jacks like I do.

### **Mouse Connector**

- Make sure there is room between the pullup resistors for the tab to push thru
- Press to fit

### **Keyboard Connector**

- Make sure there is room between the pullup resistors for the tab to push thru
- Press to fit

### **VGA Connector**

- Be careful of bypass capacitors C9 and C13 – if you mounted them on top you will have trouble fitting the VGA connector
- Press to fit

### **Power Connector**

- For this revision of the board, use a two screw terminal with 0.2" (5.08mm) spacing
- the power jack holes are too small, and + and – are reversed
- I fixed the power reversal problem for this revision TWICE, that's why its back

### **Power Switch**

- You can mount several styles, I use a SPDT 0.1" spacing terminal mini-switch

### **EXP1, MORPHBUS, H-COMM1 & H-COMM2**

- install these on the top of the board, solder their tails on the bottom
- (OPTIONAL) EXP2 if you want to monitor the FLASH1 & FLASH2 SPI signals
- their positions are clearly silk screened on the board

## ***Section 4 – The Smoke Test***

If you have gotten this far, and are reasonably skilled at soldering, you probably have a working board – but just in case something went wrong, it would be nice to make sure that you don't fry the expensive chips!

### **PLEASE TRY THESE TESTS!**

(and feel free to do more testing – I welcome suggestions for additional tests)

#### **Test #1: Power to Ground Shorts**

Read the resistance between 3.3V and GND somewhere handy on the board – I'd suggest pin 1 and pin 2 of EXP1 or EXP2 as being easy to get to.

If you read less than 300 ohms, you have a short somewhere. Look over everywhere you soldered, use a bright light and a magnifying glass.

Once you found the short, use solder wick to clear it.

Repeat this test until there are no more shorts.

#### **Test #2: Voltage Regulation**

Apply power to the board and turn it on.

If either of the voltage regulators gets VERY hot, turn the power off, and go back to Test#1, checking for shorts. Make sure the power is hooked up right, that is + and – are not reversed.

If everything looks OK, check the +5 supply – a handy place to check is on the MORPHBUS connector. Otherwise make sure the voltage regulator is mounted correctly, and that there are no shorts.

Check the +3.3 supply rail – again, pins 1&2 of the EXP1 or EXP2 connectors are handy for this.

If you don't get a voltage between 3.25 and 3.35, check for shorts, and check to see that the regulator is mounted correctly.

**Test #3: Power at Integrated Circuits**

Check the power and ground pins on the sockets for all the chips.

**I STRONGLY suggest you print the pin out page from all the data sheets to help you test the board.**

CPU1  
CPU2  
EEPROM  
EEPR2  
RTC  
FLASH1  
FLASH2  
74HC139  
74HC574 UH  
74HC574 UL  
SRAM  
MORPHBUS  
EXP1  
EXP2  
H-COMM1  
H-COMM2  
MOUSE  
KEYBOARD  
VGA

(next version of this document will give the pin numbers, for now refer to data sheets)

## \*\*\* WARNING \*\*\*

**REMEMBER TO OBSERVE STATIC ELECTRICITY PRECAUTIONS WHEN HANDLING THE CHIPS AND A BOARD WITH CHIPS! YOU SHOULD USE A GROUNDING STRAP WHEN HANDLING STATIC SENSITIVE DEVICES!**

### Test #4: Morpheus Sub Systems

In order to check the keyboard and mouse, you need some LED's and some 270R resistors. Mount them on a solder less breadboard, with the LED's anode connected to one of pins 2-10 in EXP1, the cathode going through the resistor to ground (pin 2 on the connector). Don't forget the resistors, otherwise you may damage the I/O pins on your propeller!

At this point, install a Propeller into the CPU1 socket. You should NOT install any other chips yet.

For the following tests, plug your PropPlug into H-COMM1

#### Audio Test:

- connect the the audio output to an amplifier
- download and run Chip's singing monks demo
- run it

#### Keyboard Test:

- Plug a PS/2 keyboard into the Keyboard socket.
- Download and run "kbttest.spin"
- Press different keys, and you should see the ASCII code on the eight LED's

#### Mouse Test: (using a keyboard)

- Plug a PS/2 keyboard into the Keyboard socket.
- Download and run "mousetest.spin"
- Press different keys, and you should see the ASCII code on the eight LED's

At a later date I will write a "real" mouse test, however the keyboard suffices for testing the mouse socket and wiring.

#### EEPROM Test

- Install a 24LC256 into the EEPROM socket above the RTC
- Download and program the "kbttest.spin" into the EEPROM
- Power down, then power up Morpheus
- see if it runs the test from the EEPROM

**RTC test:**

- Install the PCF8563 into the RTC socket
- Download and run "RTCTest.spin"
- Run PST
- press enter, that will display the current time/date
- enter the current date/time as YY/MM/DD HH:MM:SS – ie 09/07/08 13:54:33<enter>
- that will set the time
- power Morpheus off
- power it on
- run "RTCTest.spin" again
- it should show the correct time date

**Flash1 Test:**

- Install the W25X080 into FLASH1
- Download and run "Flash1Test.spin"
- Run PST, and press enter
- PST will tell you the ID and size of the Flash chip
- PST will: program, read, erase a sector and give you pass/fail for each stage

**Flash2 Test:**

- Install the W25X080 into FLASH2
- Download and run "Flash2Test.spin"
- Run PST, and press enter
- PST will tell you the ID and size of the Flash chip
- PST will: program, read, erase a sector and give you pass/fail for each stage

If both flash tests pass, leave the Flash chip in Flash2, and install the 23K256 into Flash1

For the following two tests, plug your PropPlug into H-COMM2

**VGA 256 color test:**

- Install the second Propeller into the CPU2 socket
- Plug your PropPlug into H-COMM2
- Plug a VGA monitor into the VGA connector
- Download and run the "VGA256test.spin" file
- You should see it cycle through some test patterns
- if the shades of red, green, or blue are out of order, check that you soldered the correct resistor values into the D/A converter under CPU#2

**XMM test:**

- Install the 74HC139 decoder chip into its socket
- Install the 74HC574 chips into their sockets
- Install the BS62LV4006 chip into the SRAM socket
- Plug your PropPlug into H-COMM2
- Plug a VGA monitor into the VGA connector
- Download and run the "XGA256test.spin" file
- If you see it draw a red/green/blue pattern you are done!

**That's it! If all the tests pass, you have successfully built your first Morpheus!**

NOTE: I will be uploading the test programs to my site as they are ready for your use.

## ***Appendix A: Data Sheets***

Propeller: <http://www.parallax.com/Portals/0/Downloads/docs/prod/prop/WebPM-v1.1.pdf>

Propeller: <http://www.parallax.com/Portals/0/Downloads/docs/prod/prop/PropellerDatasheet-v1.2.pdf>

SRAM: <http://www.bsi.com.tw/product/BS62LV4006.pdf>

RTC: <http://www.standardics.nxp.com/products/pcf/datasheet/pcf8563.pdf>

EEPROM: <http://ww1.microchip.com/downloads/en/DeviceDoc/21203P.pdf>

SPI RAM: <http://ww1.microchip.com/downloads/en/DeviceDoc/22100D.pdf>

FLASH: [http://www.winbond.com.tw/NR/rdonlyres/0971C40C-F202-49CA-90AF-0F0268ECF0E5/0/W25X10L\\_W25X20L\\_W25X40L\\_W25X80L.pdf](http://www.winbond.com.tw/NR/rdonlyres/0971C40C-F202-49CA-90AF-0F0268ECF0E5/0/W25X10L_W25X20L_W25X40L_W25X80L.pdf)

74HC139: [http://www.nxp.com/acrobat\\_download/datasheets/74LV139\\_4.pdf](http://www.nxp.com/acrobat_download/datasheets/74LV139_4.pdf)

74HC574: [http://www.nxp.com/acrobat\\_download/datasheets/74LV574\\_4.pdf](http://www.nxp.com/acrobat_download/datasheets/74LV574_4.pdf)