

# Internet of Things Arduino workshop – VHS, March 2014

Thanks for coming out tonight for the internet of things SMD workshop. This is the 5<sup>th</sup> SMD workshop I've run at vhs and it's a fun one. With these notes you should have also received a PCB, a bag of components and photo(s).

To make identifying the components easier many of them are colour coded. The colours are shown in the parts list later in these notes along with the component values and their schematic reference. Using the colour codes, the photo(s) and the markings on the pcb silkscreen you will match up the components with their location and solder them in place. A suggested order of assembly is given below, this is based on height of the components. Most of the components can be installed in either orientation, exceptions to this are noted in both the order of assembly below and the parts list on the reverse.

An image of the schematic can be seen at <https://raw.githubusercontent.com/vhs/vhs-pcbs/master/ethernet-gateway/schematic-rev-0.3.png> - these are not printed to save paper.

If you haven't looked the suggest youtube video, please do so now. It shows a technique I suggest for mounting SMD components - [http://www.youtube.com/watch?v=P\\_6XJR3D27Y](http://www.youtube.com/watch?v=P_6XJR3D27Y) or search for "I (heart) SMT vancouver.hackspace.ca".

This board is originally the work of Ishan Kehribar, his email address is on the pcb. I ([t@tomk.in](mailto:t@tomk.in)) placed the design onto a dangerous prototypes sick-of-beige 5050 eagle template and added the USB serial port for Arduino GUI compatibility. I also changed some of the components to match parts in our SMD parts stock to keep the price down (the falling Canadian dollar made this harder).

## Suggested order of assembly

Start on the reverse side, tape the board down with the open hardware cog logo showing.

- C1, C2
- R1, R2, R4, R3
- C12, C13
- C18, R7, C9
- C15
- R5, R6, R8 (not marked on the silkscreen, use photo)
- C5, C6, C7 (not marked on the silkscreen, use photo – all are surrounding IC1)
- IC1 (not included in the kit please ask for it) - sit the IC in place and make sure it is straight. Note the circle showing pin 1 on the PCB must match the dimple on the chip. Also check the photo matches. Solder a corner pin – I suggest heating the pad and applying solder to the pad, this will allow the solder to flow up onto the pin. If you can avoid touching the pin, you'll avoid moving the chip. Repeat for a diagonally opposite corner, take a good look at the chip, this is your last chance to move it, once happy solder all the remaining pins.
- Leave C8 and C20 until later.

Flip the board over and tape it down again. To make it easy on yourself, the board should not wobble, tape it firmly.

- C16, C17
- C3, C4, C11, C14, C19,
- R9, R10, R11
- R12, R13
- R14, R15, R16
- D1, L1, L2, IC2
- U2 – as per IC1, opposite corners first when confident in placement solder all pins
- IC3 – as per U2/IC1, pitch is very fine, feel free to ask for help if you need it!!
- LEDs – check orientation by observing internal green markers and matching the photo and data sheet.

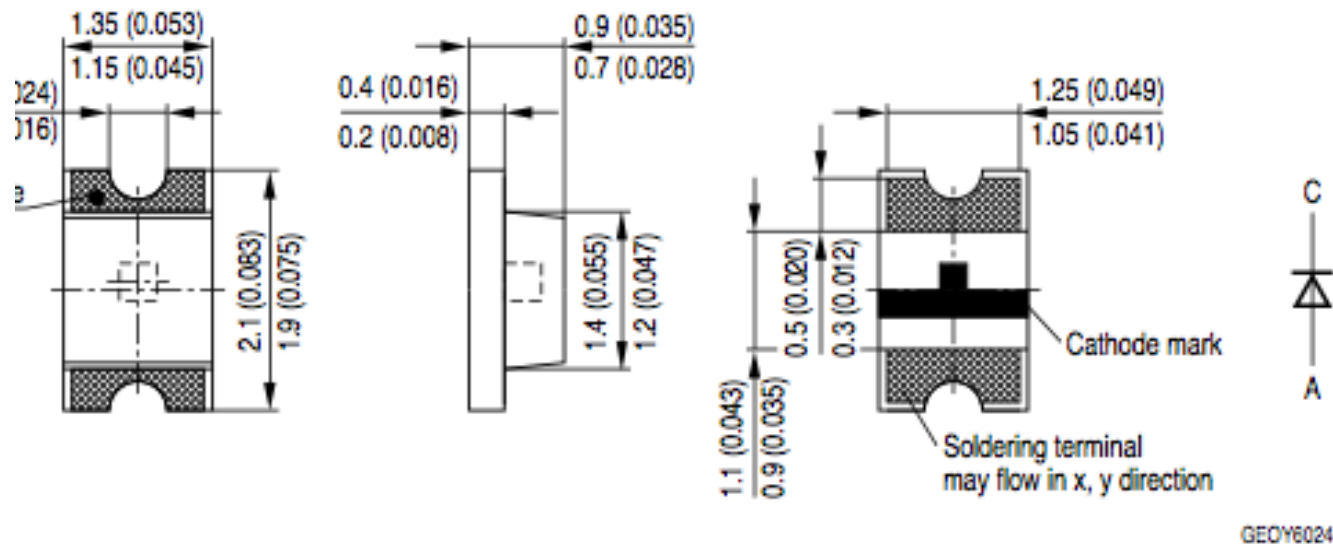
- C10 (check red band matches the photo)
- USB1 (solder pins before tabs, treat as per IC1, be sparing with solder, take care not to bridge pins)
- B1, B2 (use a tiny amount of solder)

Flip the board back over and do C8 and C20 (again check red band matches the photo)

Now do the through hole components.

- JP1, JP2, J3, install shunt on JP1 as per photo
- J1, make sure all the pins are straight before inserting
- I suggest omitting J2 and using USB power until you are sure you have an AC adaptor that matches the supplied connector. Please use 5V to reduce the load on the 3.3V regulator.

## LED Data Sheet



## PCB Rework

As per the published workshop invite there are two errors on the PCB unfortunately. All the boards distributed have had the necessary tracks cut, there are two wire bridges to add.

- Bridge the cut track near IC3 to pin 2 of IC3. This should be done with wire wrap wire and is necessary for the board to be able to be programmed by the Arduino GUI. Please feel free to ask for assistance.
- On the underside the power supply to the expansion header JP2 has been cut because of a short. To re-instate the 5V power to JP2 (if required) you will need to bridge the cut track as shown in the photo. This is best done with heavy wire (eg. from a resistor lead). Please feel free to ask for assistance.

## Bring up

- Connect the board to the smoke tester and verify the power LED lights
- Carefully check the temperature of all the ICs, remove power if hot to touch
- Connect USB and verify serial port is present on system
- Connect to stk500v2 programmer and program the 8MHz Arduino UNO bootloader and fuses

```
avrdude -F -c stk500v2 -p m328p -P /dev/tty.usbserial* -U lfuse:w:0xe2:m  
avrdude -F -c stk500v2 -p m328p -P /dev/tty.usbserial* -U flash:w:optiboot_atmega328.hex
```

- Load blink sketch and verify LED1 and LED2 are blinking (digital pins 5 and 6 in sketch)
- Connect Ethernet and verify link and activity are working
- Load the twitter sketch, check serial port for ip address and twitter feed for a matching tweet

## Using the board at home

This board is not compatible with the Arduino Ethernet shield. The parts used on this shield are too expensive to make a workshop worthwhile. This board uses the enc28j60 ethernet controller. To write sketches for it you will need an appropriate library. This controller is popular, there are many options – I am using [https://github.com/ntruchsess/arduino\\_uip](https://github.com/ntruchsess/arduino_uip). The library comes with lots of example programs, I suggest you try them out. *Note that some of the examples use a mac address that looks invalid to meet, I suggest you stick to MAC addresses with the first byte as zero.*

- You will need to modify your Arduino installation to add the 8MHz UNO (normal UNO is 16Mhz). Edit boards.txt (...../Contents/Resources/Java/hardware/arduino/boards.txt) to add the following.

```
#####  
uno8.name=Arduino Uno (Internal Oscillator)  
uno8.upload.protocol=arduino  
uno8.upload.maximum_size=32256  
uno8.upload.speed=57600  
uno8.bootloader.low_fuses=0xff  
uno8.bootloader.high_fuses=0xde  
uno8.bootloader.extended_fuses=0x05  
uno8.bootloader.path=optiboot  
uno8.bootloader.file=optiboot_atmega328.hex  
uno8.bootloader.unlock_bits=0x3F  
uno8.bootloader.lock_bits=0x0F  
uno8.build.mcu=atmega328p  
uno8.build.f_cpu=8000000L  
uno8.build.core=arduino  
uno8.build.variant=standard
```

- Restart the Arduino GUI, select Board from the Tools menu and you should see “Arduino Uno (Internal Oscillator)” as a new option.
- Install the enc28j60 libraries from [https://github.com/ntruchsess/arduino\\_uip](https://github.com/ntruchsess/arduino_uip)
- If you want to use twitter, you will need to install the libraries and get your own arduino-tweet.appspot.com account

Qty	Value	Colour	Device	Polarized	Parts	Description
2		Black in clear package	SWITCH_TACT_SMT4.6X2.8		B1, B2	SMT Tact Switches
13	0.1uF	White (no colour)	C-EUC0805		C1, C2, C3, C4, C5, C6, C7, C9, C11, C14, C15, C18, C19	CAPACITOR, European symbol
2	22pF	Blue	C-EUC0805		C12, C13	CAPACITOR, European symbol
2	47pF	Red	C-EUC0805		C16, C17	CAPACITOR, European symbol
3	10uf	Yellow in clear pkg	CAP_TANTALUMB/3528_WAVE	*	C8, C10, C20	Tantalum Capacitors
1	1N4148		DIODEDO-1N4148	*	D1	Diode
1	IC_ENC28J60-SOIC-28	pls ask for it	IC_ENC28J60-SOIC-28	*	IC1	Ethernet Controller with SPI Interface
1	REG1117	3/4 pin in black pkg	REG1117	*	IC2	800mA and 1A Low Dropout (LDO) Positive Regulator
1	IC_FT230X-SSOP-16	Fine pitch in black pkg	IC_FT230X-SSOP-16	*	IC3	BASIC USB to UART IC
1	MAGJACK	Sliver	MAGJACK	*	J1	RJ-45 with LEDs
1		Black	CON_DC_M-DC_PTH	*	J2	DC power connector
1	AVR_SPI_PRG_6PTH	3x2 pin	AVR_SPI_PRG_6PTH		J3	AVR ISP 6 Pin
1	PWRSRC	1x3 pin	JP2W		JP1	JUMPER
1		2x10 pin	PINHD-2X10		JP2	PIN HEADER
2		green	INDUCTOR0805		L1, L2	Inductors
3		in clear pkg	LED-0805		LED1, LED2, LED3	Light Emitting Diode
4	49R9	yellow	R-EU_R0805		R1, R2, R3, R4	RESISTOR, European symbol
2	27R	yellow/grey	R-EU_M0805		R12, R13	RESISTOR, European symbol
3	10k (103 not 102 photo is incorrect)	black	R-EU_R0805		R14, R15, R16	RESISTOR, European symbol
6	2k32	blue	R-EU_R0805		R5, R6, R8, R9, R10, R11	RESISTOR, European symbol
1	6k8	pink	R-EU_R0805		R7	RESISTOR, European symbol
1	ATMEGA328P	square, pins on all sides	ATMEGA328_SMT		U2	32-Pin Atmega328 part
1	CON-USB-F-MINI-B		CON-USB-F-MINI-B		USB1	USB Female connector
1	25MHz		OSC-XTAL-HC-49U-PTH		XTAL1	25Mhz

There are spare 0.1uF and 2k32 resistors included.

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March 13, 2014  
V1.4