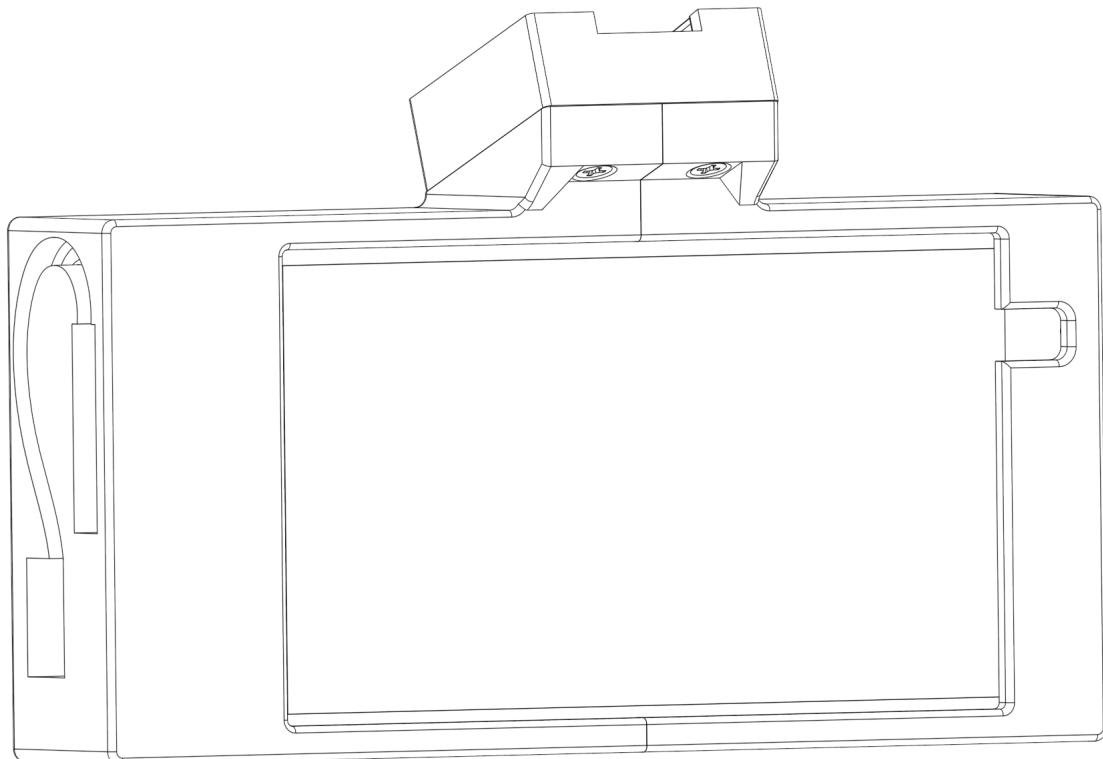


# neo

research platform



comma.ai

[github.com/commaai/neo](https://github.com/commaai/neo)

suppliers

# electronics

1. download [digikey.csv](#)
2. go to [digikey.com/classic/Ordering](#) and register or log in
3. click  and navigate to the downloaded csv file
4. change the "First part Record Begins on Row" to 2
5. change the first column to "Digi-Key Part Number"
6. change the second column to "Quantity"
7. leave the rest as undefined then click
8. this bom includes spares of various components and should cost

Row	Digi-Key Part Number	Quantity	Undefined	Undefined
1	digikey part num	qty	ref des	value
2	1276-1817-1-ND	2	"C1	C2"
3	490-1532-1-ND	9	"C3	C4
4	490-3296-1-ND	3	"C9	C10
5	490-10744-1-ND	2	"C12	C15"
6	P12372-ND	1	C14	330uF
7	1276-1784-1-ND	1	C8	4.7uF
8	S1011EC-40-ND	1	J1	uart cor
9	WM1731-ND	1	J2	fan con
10	1175-1008-ND	1	J3	usb a
11	AE10398-ND	1	J4	rj45
12	670-2294-ND	1	J5	jae 20 p
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...

# board

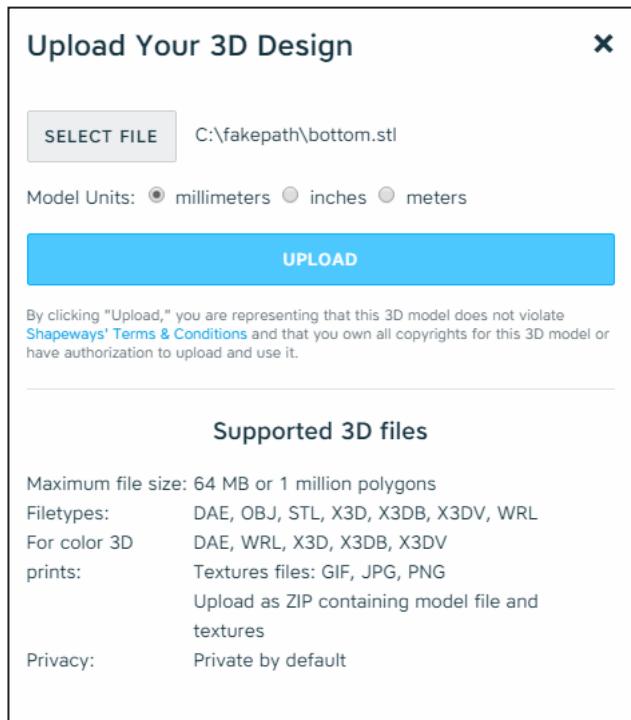
1. download [neo.brd](#)
2. go to [oshpark.com/uploads/new](#) and drag the downloaded brd file into the window
3. enter your email and click continue
4. scroll to the bottom of the next page and click
5. OSHpark requires a minimum of 3 boards per order

# cables

1. order cat6 cable from [amazon.com/dp/B00N2VISLW](#)
2. order OTG USB cable from [amazon.com/dp/B0194WSKOM](#)
3. optional: order serial debug cable from [sfe.io/p9717](#)
4. optional: order 12V 2A power supply from [amazon.com/dp/B019Q3U72M](#)

# 3d prints

1. download all stl files from [github.com/commaai/neo/case](https://github.com/commaai/neo/case)
2. go to [shapeways.com](https://shapeways.com) and login or register
3. click upload in the top right corner
4. select one of the downloaded files (keep units in millimeters) and then click upload



5. repeat for the remaining three files (you can only upload one at a time)
6. hover over “MAKE” on the top menu bar and then click “My Models”
7. select the material and finish of the 4 prints (we recommend “Black Strong & Flexible”) and then click “ADD TO CART”

# hardware

1. download [mcmaster.csv](#)
2. open the file in your favorite text editor and select all
3. go to [mcmaster.com](#) and click "BUILD ORDER" in the upper right corner
4. click "Paste products and quantities" then paste the previously copied text

The image consists of two side-by-side screenshots of the McMaster-Carr website's build order interface.

**Left Screenshot:** Shows the initial state of the form. It includes fields for 'Quantity' and 'Product', and a checkbox labeled 'Paste products and quantities' which is circled in red. Below the form are 'ADD' and 'Build order line by line' buttons.

**Right Screenshot:** Shows the form after text has been pasted into the 'Paste in products and quantities' field. The pasted text lists several hardware items:

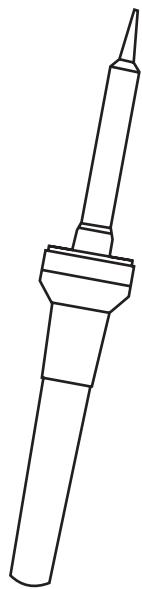
```
mcmaster part num,pack qty,qty used,ref des,description
92010A005,1,1,A,m2 10mm flat head
92010A122,1,4,B,m3 12mm flat head
92000A013,1,7,C,m2 6mm pan head
91828A111,1,6,D,m2 hex nut
```

Below this list are the 'ADD' and 'Build order line by line' buttons.

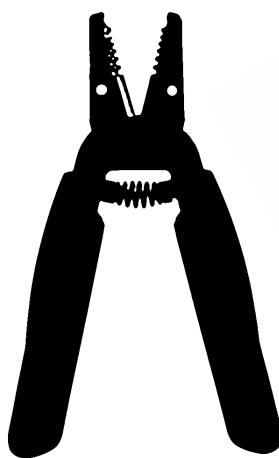
5. click add and all the neccessary hardware will be added to your cart

# electronics assembly

# tools



soldering iron

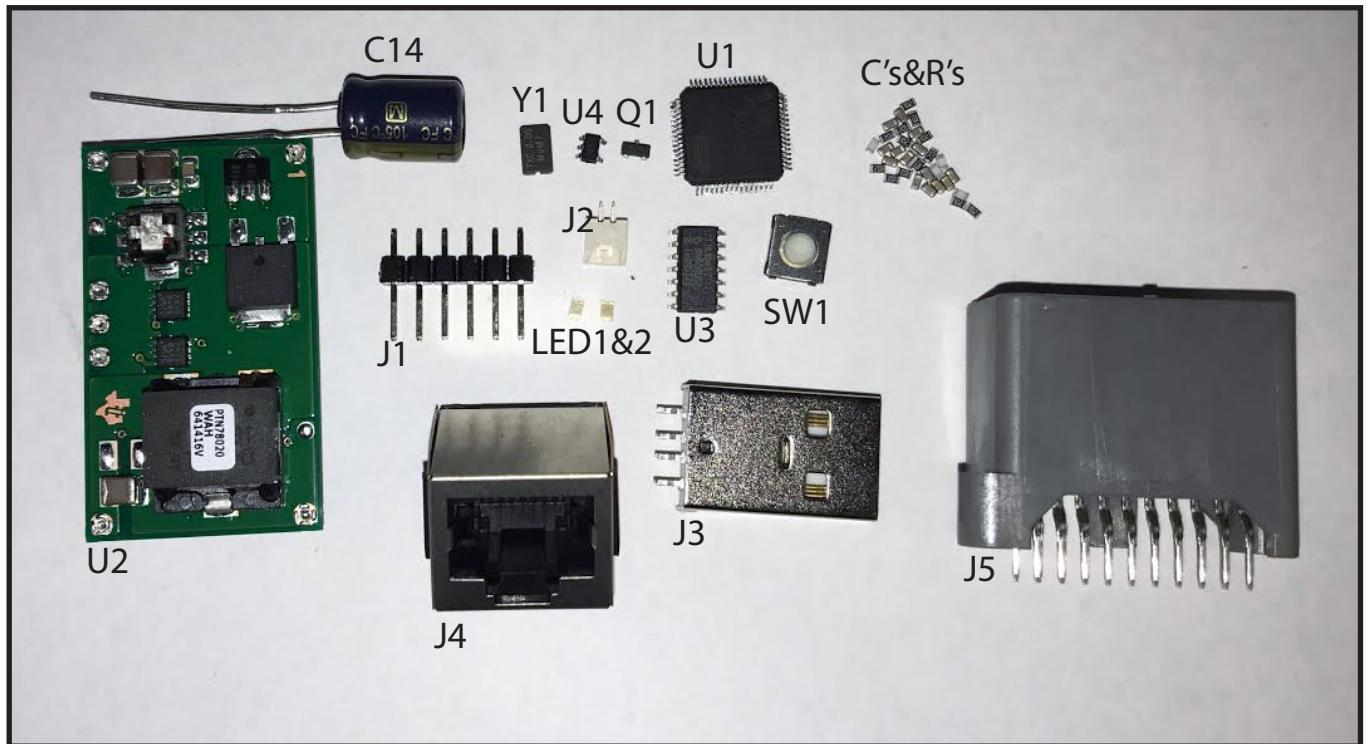


wire strippers

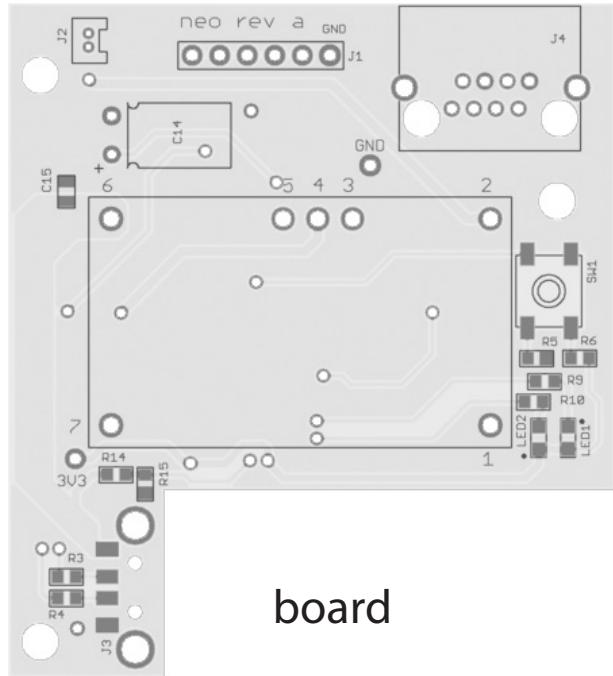


tweezers

# parts



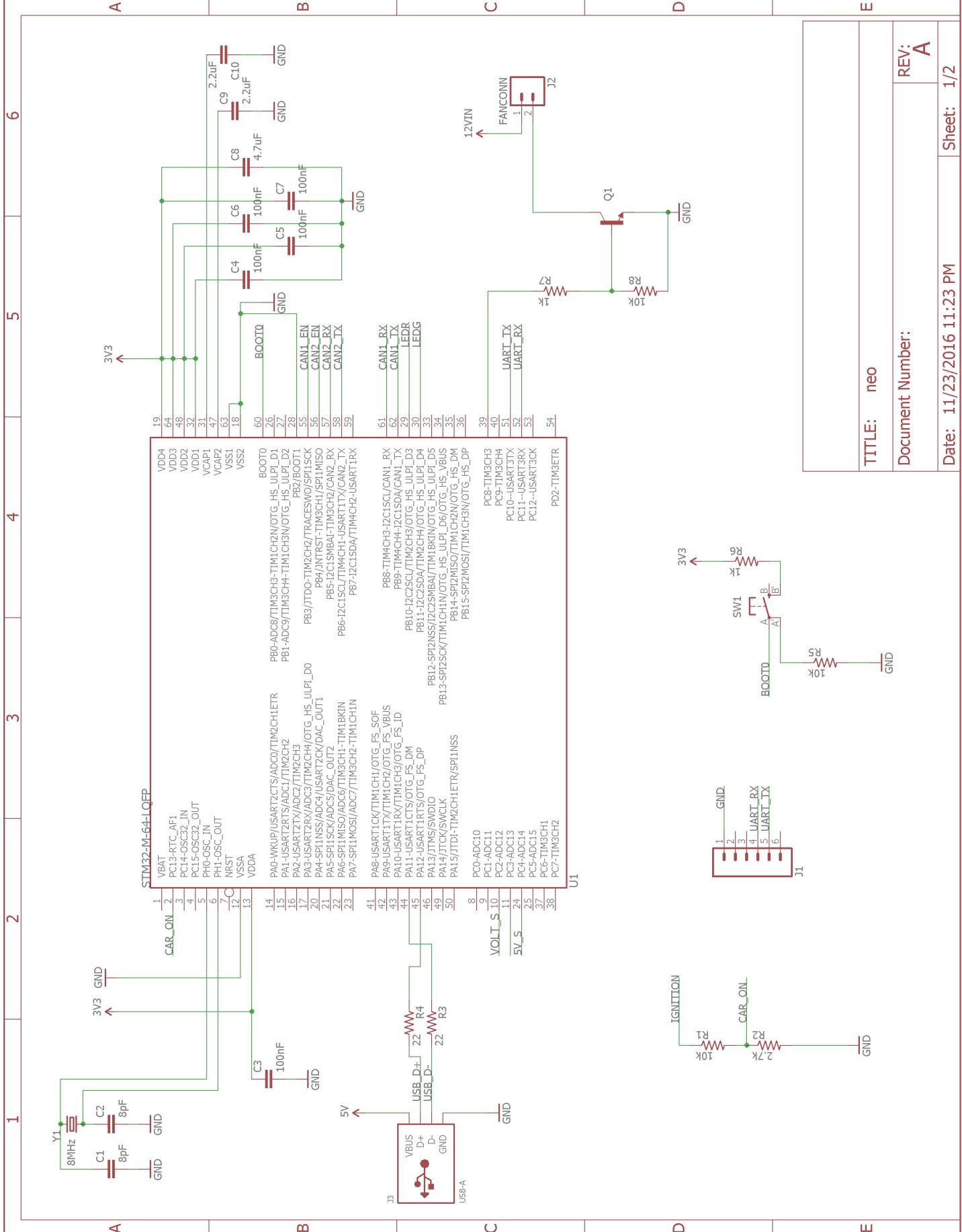
cat6 cable



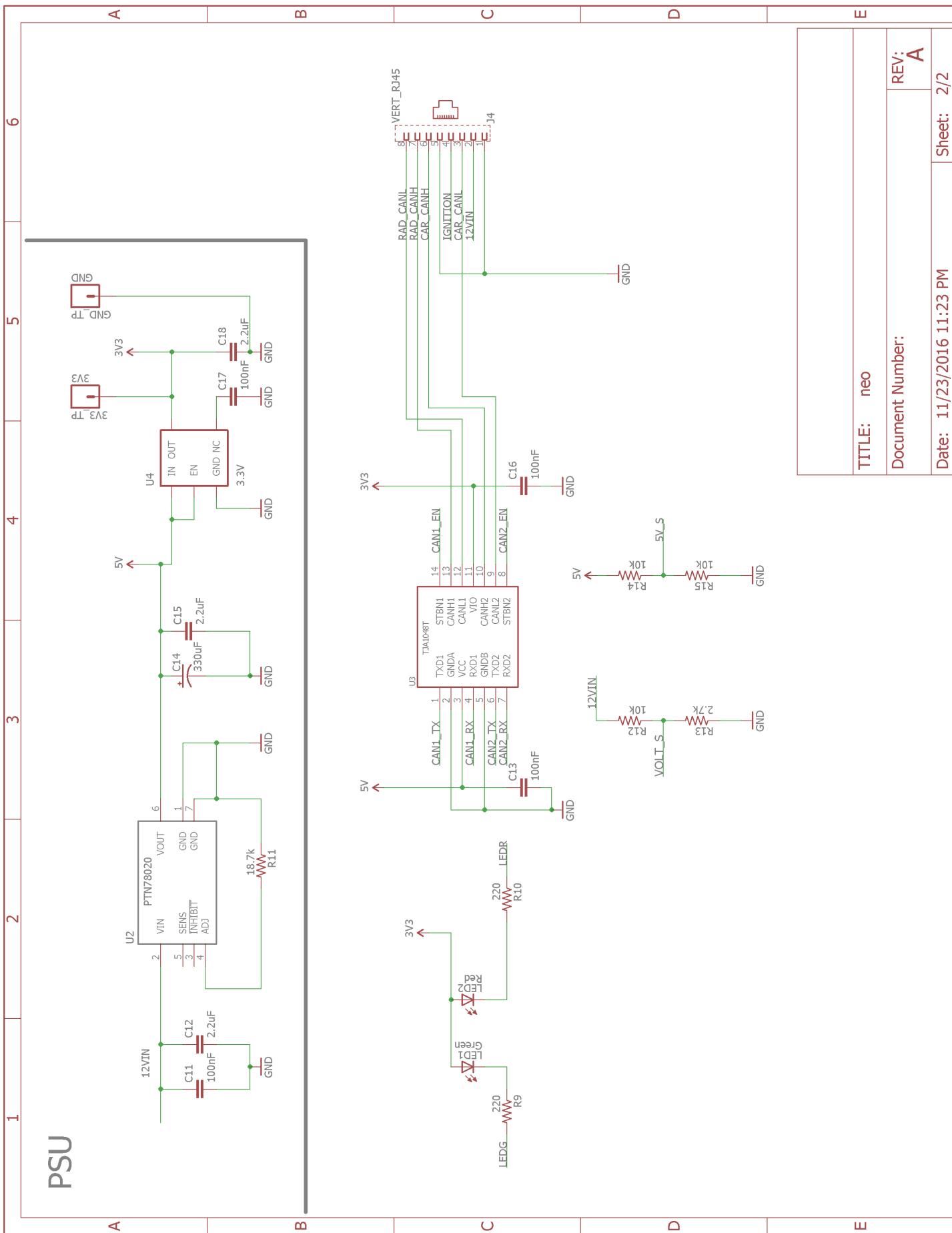
board

# bill of materials

digikey part num	qty	ref des	value	footprint
1276-1817-1-ND	2	C1, C2	8pF	0603
490-1532-1-ND	9	C3, C4, C5, C6, C7, C11, C13, C16, C17	100nF	0603
490-3296-1-ND	3	C9, C10, C18	2.2uF	0603
490-10744-1-ND	2	C12, C15	2.2uF	0805
P12372-ND	1	C14	330uF	radial
1276-1784-1-ND	1	C8	4.7uF	0603
S1011EC-40-ND	1	J1	uart connector	thru hole-6
WM1731-ND	1	J2	fan connector	thru hole-2
1175-1008-ND	1	J3	usb a	smd-4
AE10398-ND	1	J4	rj45	thru hole-8
670-2294-ND	1	J5	jae 20 pin	thru hole-20
475-1410-1-ND	1	LED1	green	0805
475-1415-1-ND	1	LED2	red	0805
MMBT2222ALT1GOSCT-ND	1	Q1	mmbt2222a	sot23-3
311-10KGRCT-ND	6	R1, R5, R8, R12, R14, R15	10k	0603
311-18.7KHRCT-ND	1	R11	18.7k	0603
311-1.0KGRCT-ND	2	R6, R7	1k	0603
311-2.7KGRCT-ND	2	R2, R13	2.7k	0603
311-22GRCT-ND	2	R3, R4	22	0603
311-220GRCT-ND	2	R9, R10	220	0603
P12961SCT-ND	1	SW1	spst	smd-4
497-11153-ND	1	U1	stm32f205	lqfp-64
296-20515-ND	1	U2	ptn78020w	thru hole-7
568-8681-1-ND	1	U3	tja1048	so14
296-36844-1-ND	1	U4	3.3v	sot23-5
887-1667-1-ND	1	Y1	8MHz	smd-2
603-1840-ND	1	H1	12V fan	40x10mm
345-1108-ND	4	H2, H3, H4, H5	heatsink	28mm



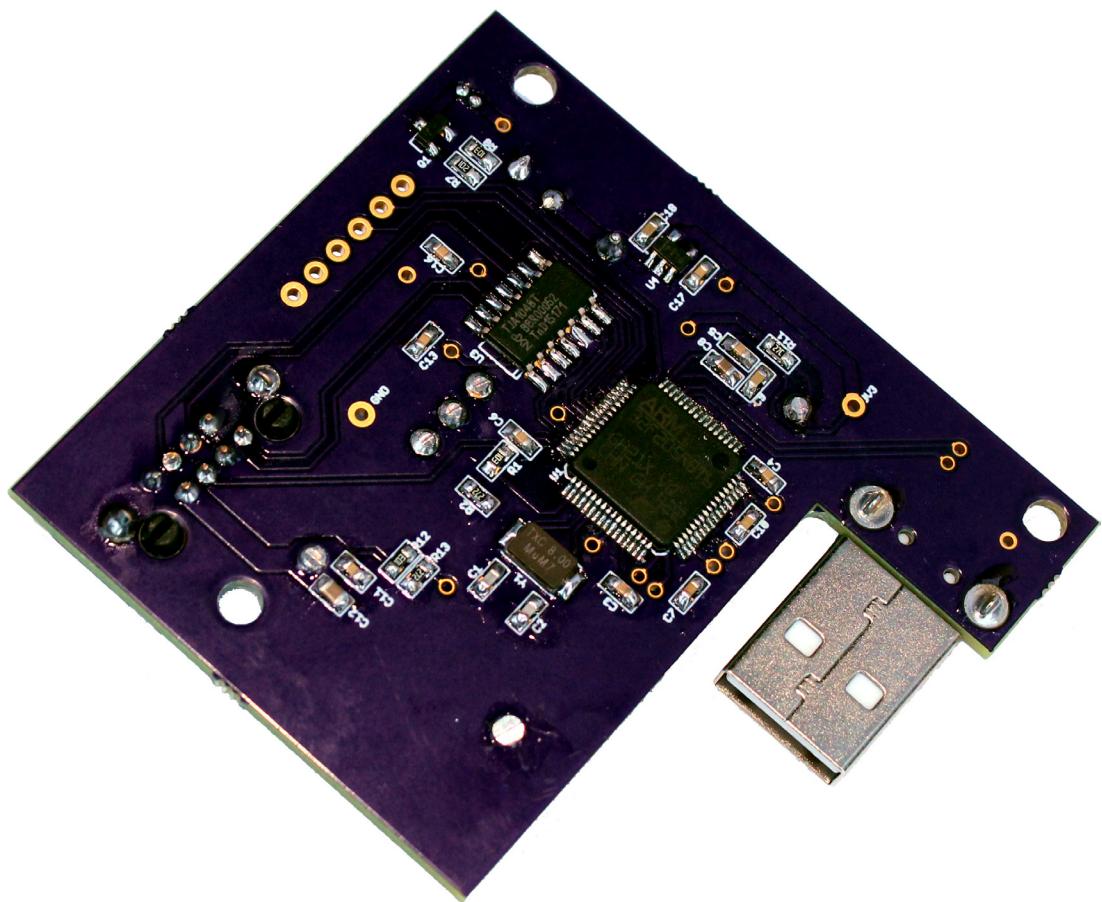
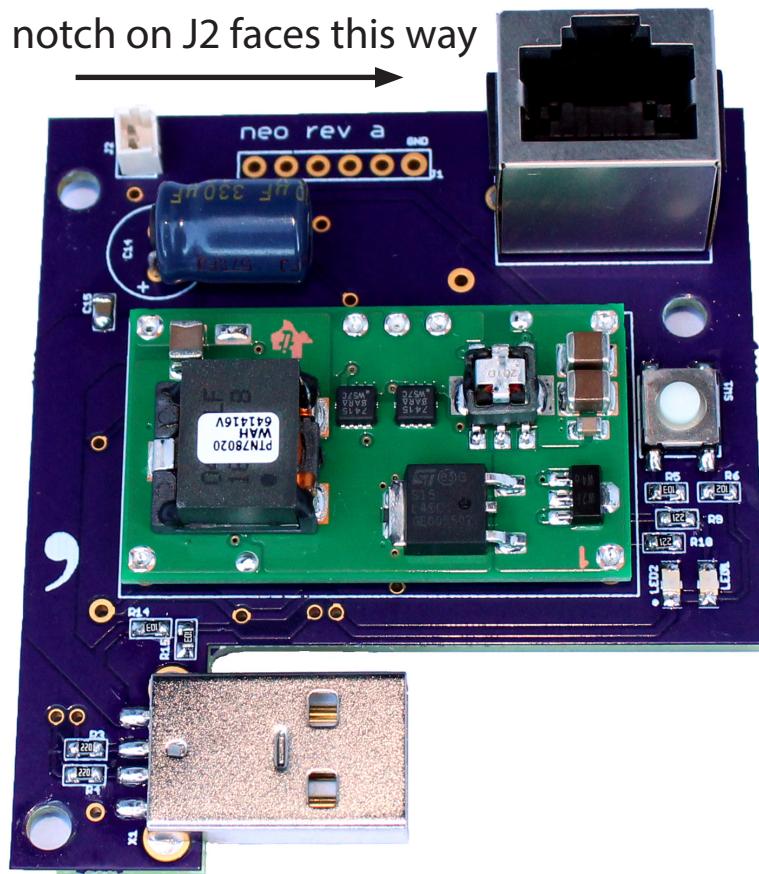
# PSU



# build notes

1. solder U1 onto the front of the board and check for any shorts between pins, this is the microcontroller that interacts with the OnePlus3
2. solder C1-13 in any order onto the front of the board
3. solder R1, R2, R7, R8, R11-13 onto the front of the board
4. solder Q1 onto the front of the board, this controls the speed of the fan
5. solder U3 onto the front of the board, this is the CAN transceiver
6. solder U4 onto the front of the board, this is the 5V to 3.3V converter
7. solder Y1 onto the front of the board, this is the main crystal resonator
8. optional for uart debug: fashion J1 by breaking away 6 pins from the 40 pin connector then solder onto the back of the board, this is the uart breakout connection
9. solder J2 onto the back of the board with the notch on the right (see image below), this is the connector for the fan
10. solder J3 onto the back of the board, make sure it remains level with the board so that the otg usb cable will lay flat when connected
11. solder J4 onto the back of the board, make sure the plastic legs are fully snapped into their holes, this is the breakout to the research vehicle
12. J5 is used externally from the board, put it aside for later
13. solder LED1 and LED2 to the back of the board, note that the green and red LEDs do not have the same polarity so if they are mixed up they will not operate properly
14. solder R3-6, R9, R10, R14, R15 onto the back of the board
15. solder SW1 onto the back of the board, this is used to put the microcontroller into DFU mode to flash the initial firmware (should not be required for future firmware flashes)
16. bend pins of C14 before soldering so that the curved surface lays on the back of the board (see image below)
17. solder C15 onto the back of the board
18. solder U2 onto the back of the board, this is the 12V to 5V power supply
19. go to page 14 and build the breakout cable in order to test the board

notch on J2 faces this way



# breakout cable

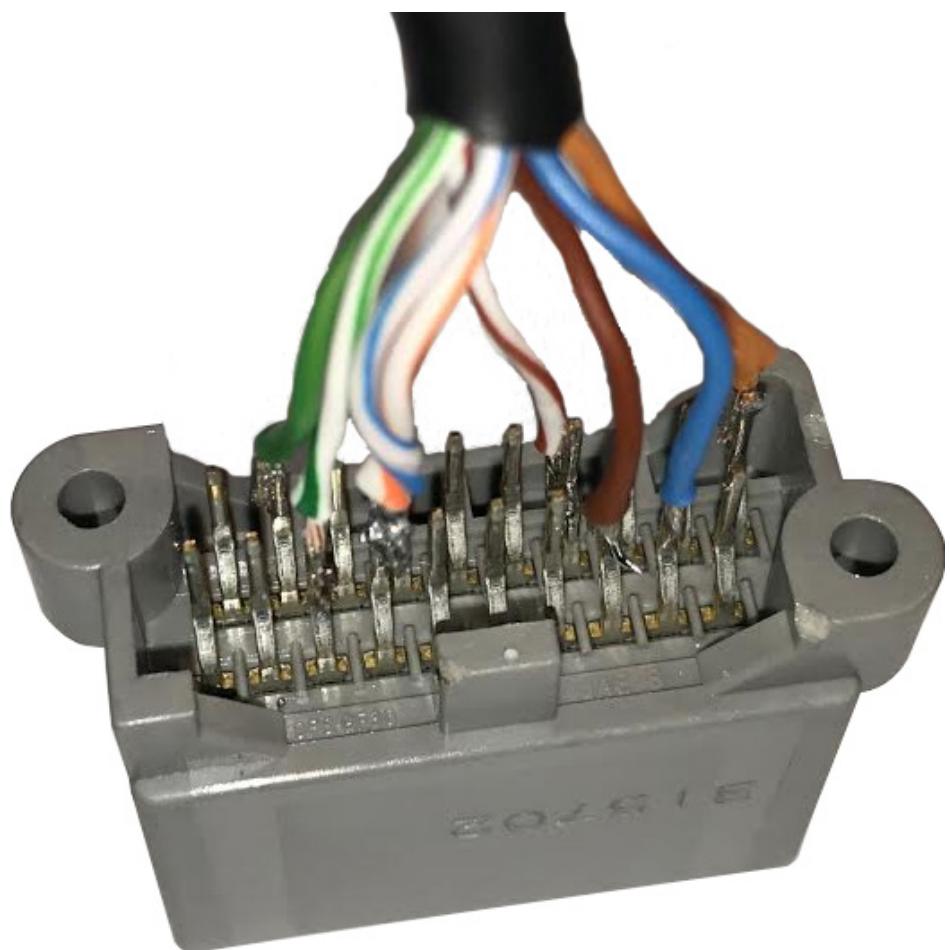
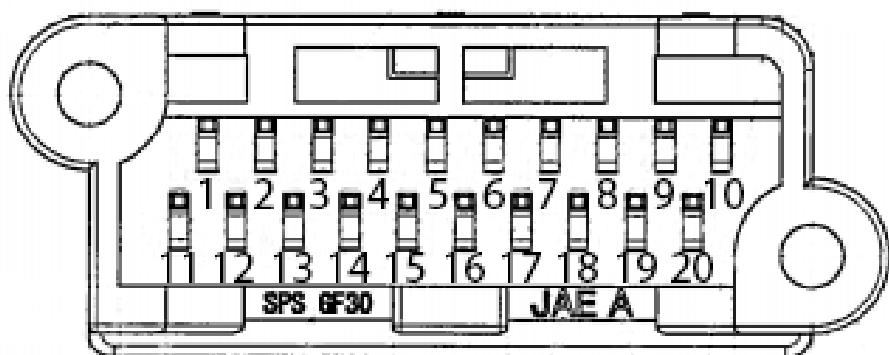
1. cut off ~8" of the cat6 cable and strip the internal wires
2. for a Honda vehicle, make the connections in the JAE column (for all other vehicles make the connections show in the OBDII column)
3. cover the back of the JAE (or OBDII) connector with hot glue in order to prevent any shorts or breaking of wires

*note: you can build an AC-DC adapter using the 12V power supply mentioned on page 3.*

rj45 pin	cat5 (t568b) wire	signal	JAE	OBDII
1	 orange stripe	gnd	14	4
2	 orange	+12V	10	16
3	 green stripe	car CAN low	13	14
4	 blue	ignition	19	---
5	 blue stripe	gnd	14	4
6	 green	car CAN high	2	6
7	 brown stripe	radar CAN high	7	---
8	 brown	radar CAN low	18	---

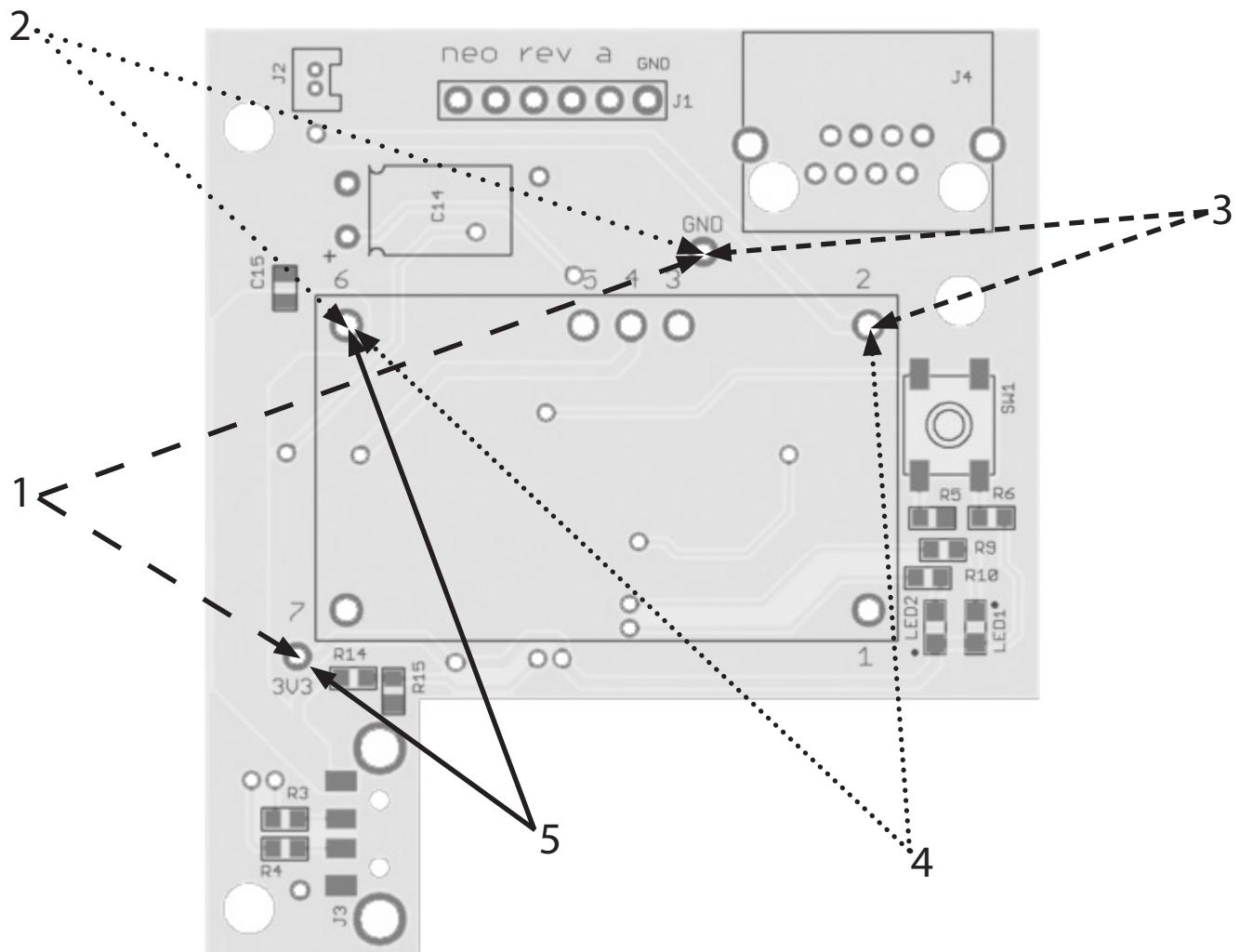
# jae connector (J5)

back



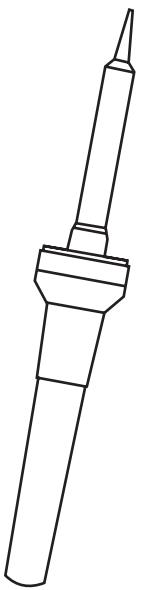
# test the board

1. check for any shorts between the pairs of points shown below, fix if any exist
2. setup the OnePlus3 with NEOS by following the instructions at  
[github.com/commaai/neo/releases/tag/swag](https://github.com/commaai/neo/releases/tag/swag)
3. plug the female end of the OTG USB cable into the board and the USB C connector into the OnePlus3
4. plug the rj45 connector into the board and hold down SW1 while you plug the breakout cable into the car (or 12V adapter), this puts the microcontroller into DFU mode
5. the OnePlus3 will upload the firmware to the microcontroller, if the red LED on the board begins to flash then your board is working properly
6. if you have any issues or submit an issue request at  
[github.com/commaai/neo/issues](https://github.com/commaai/neo/issues)

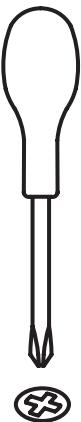


case  
assembly

# tools



soldering iron



phillips head

# parts

A



1x

B



4x

C



7x

D



6x

E



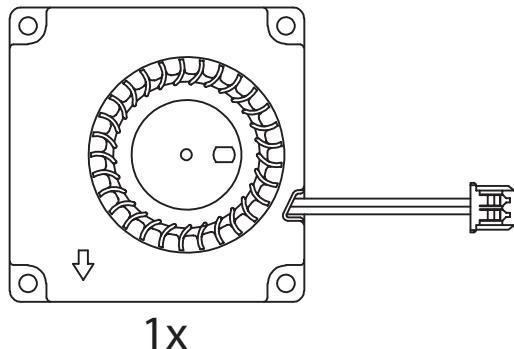
4x

F



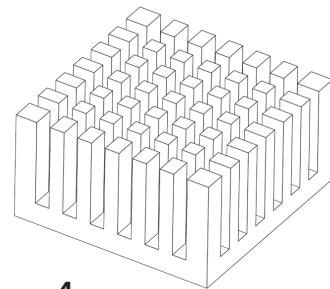
2x

blower fan (H1)



1x

heatsinks (H2-5)



4x

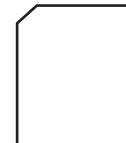
OnePlus3



1x

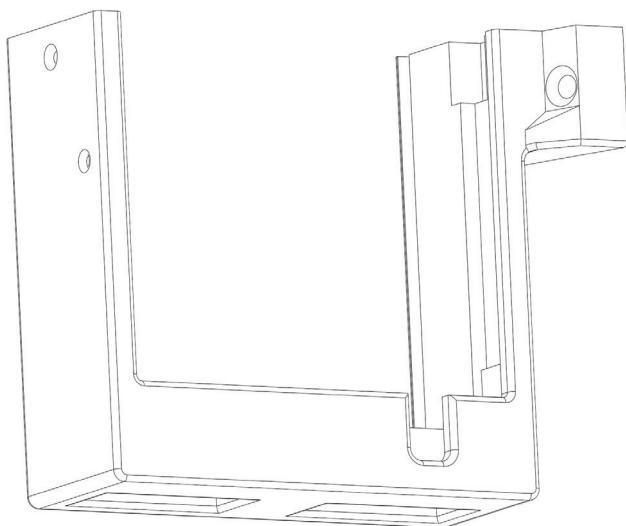
order on [oneplus.net](http://oneplus.net)

unlimited data SIM



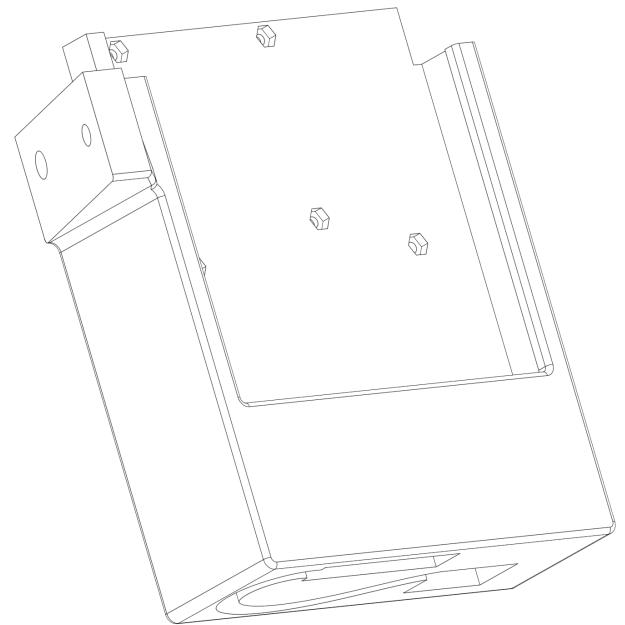
1x

case top



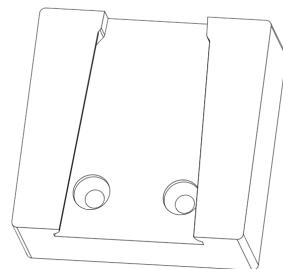
1x

case bottom



1x

mount



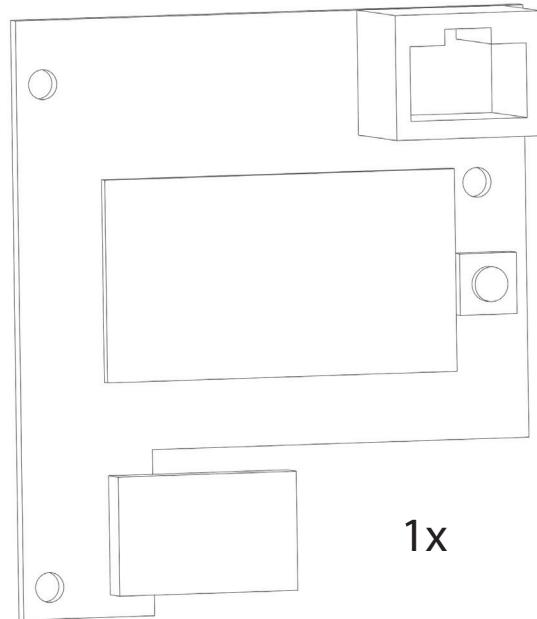
1x

back cover

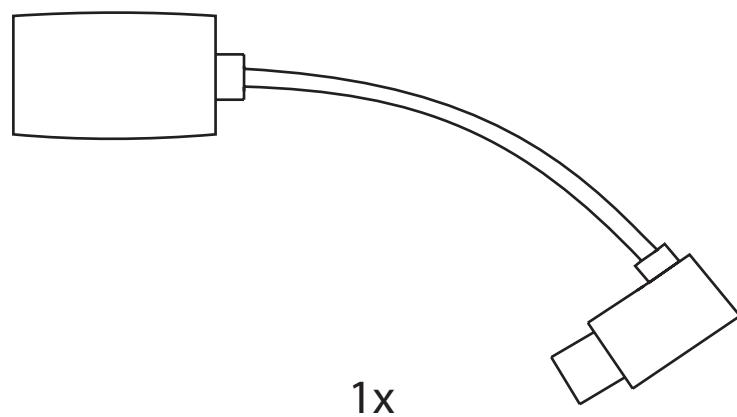


1x

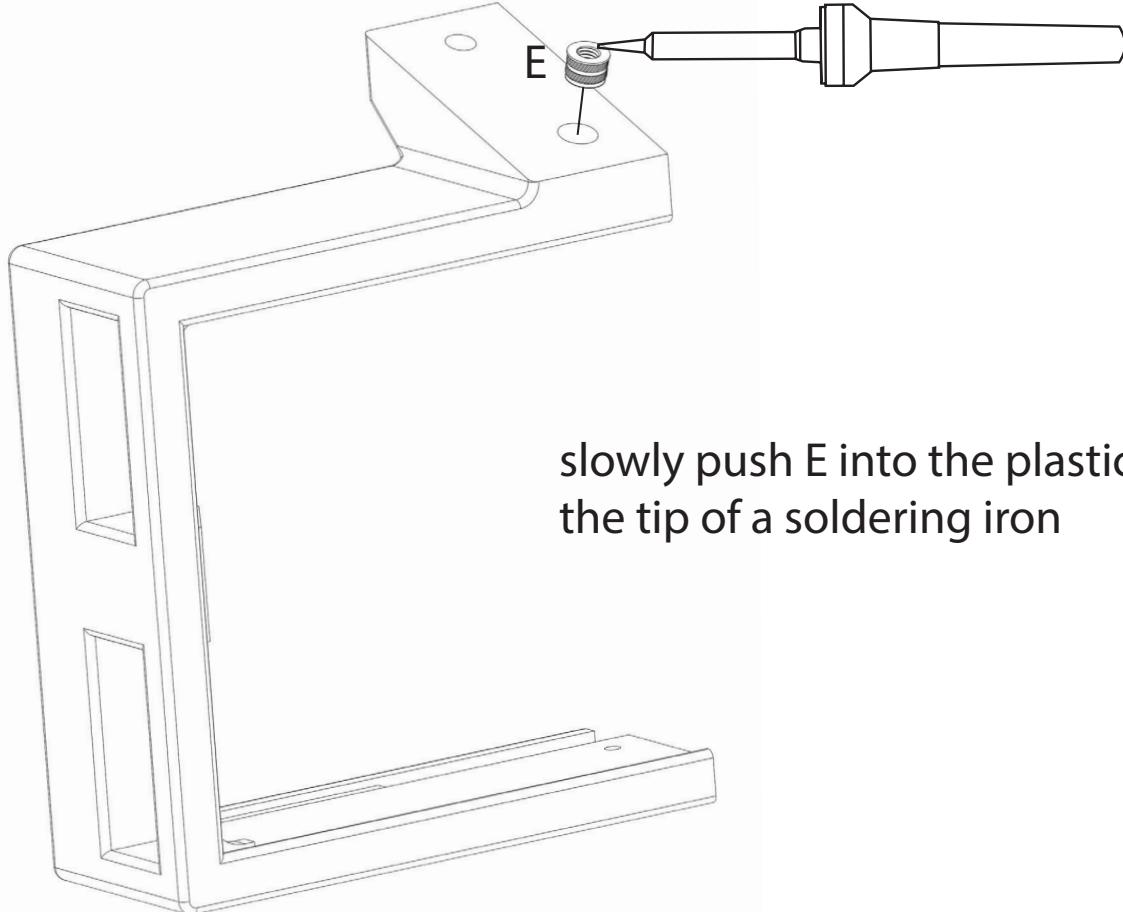
assembled pcb



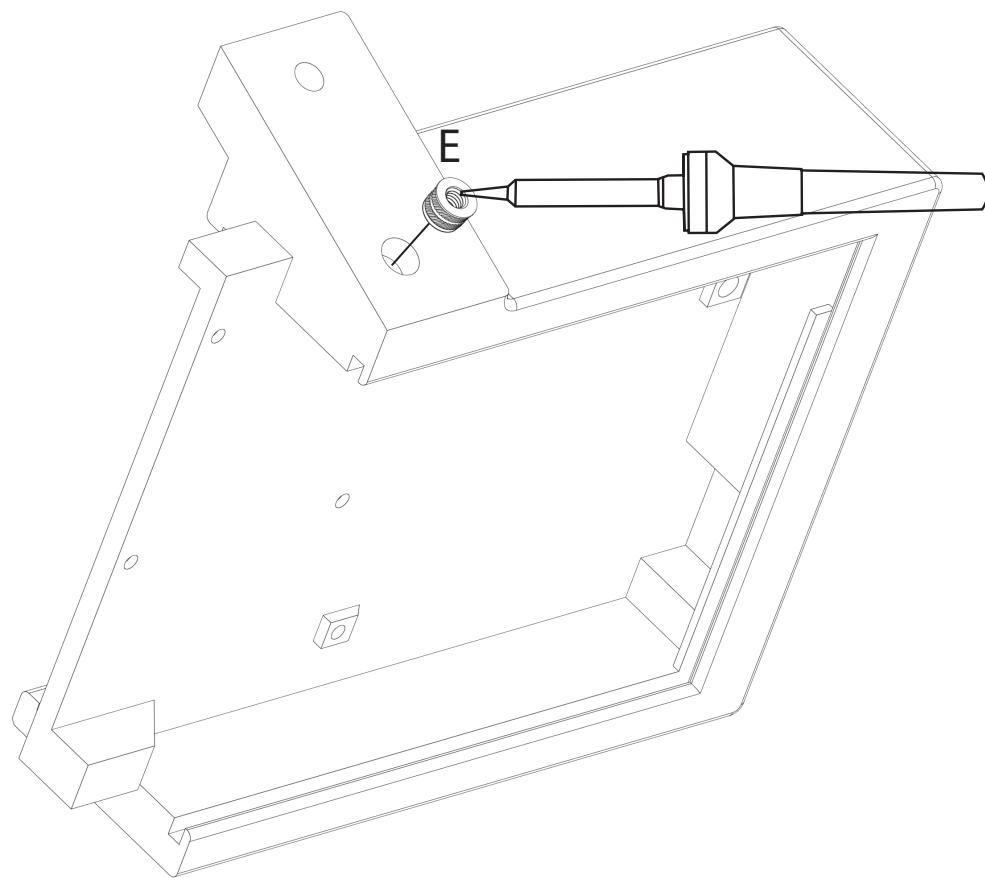
usb otg cable



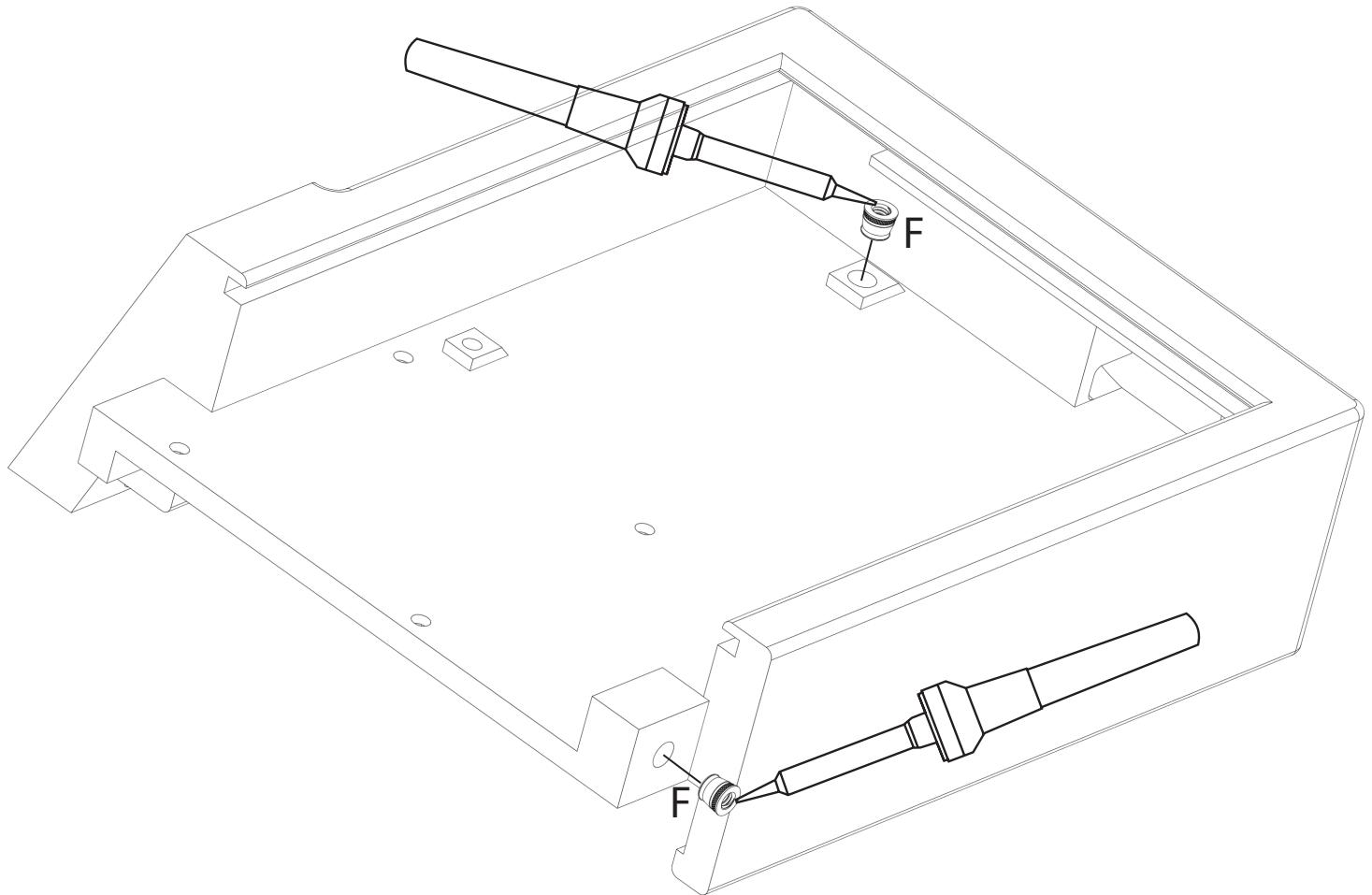
1



slowly push E into the plastic using  
the tip of a soldering iron

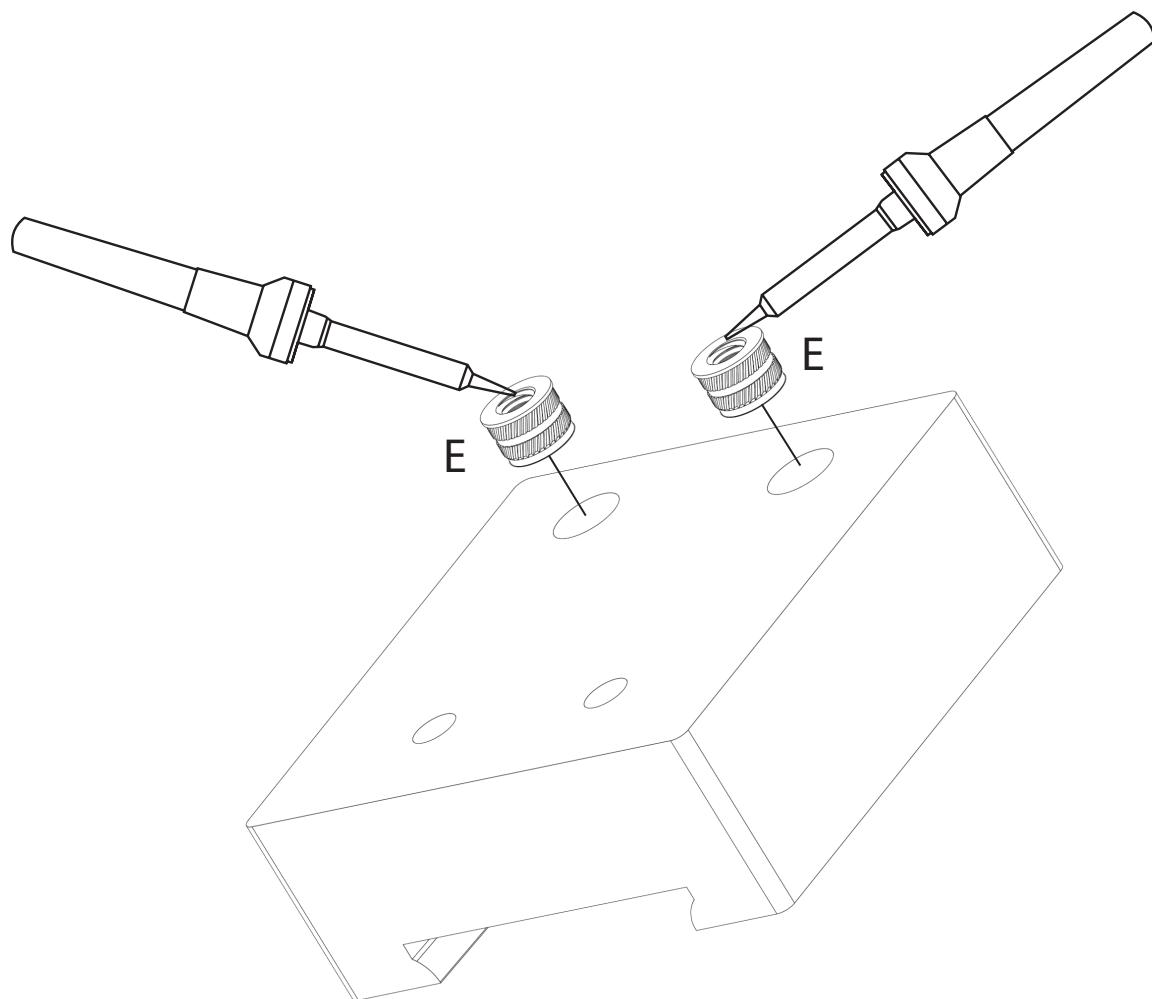


# 2



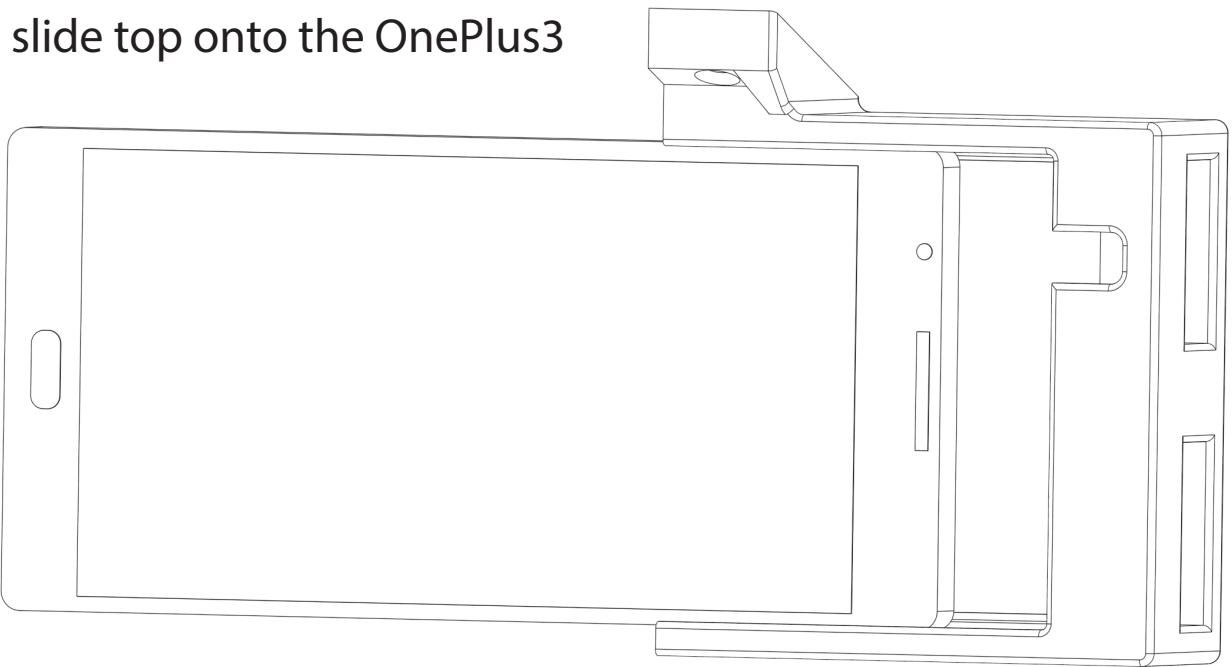
item F will take significantly less force to insert than item E

3

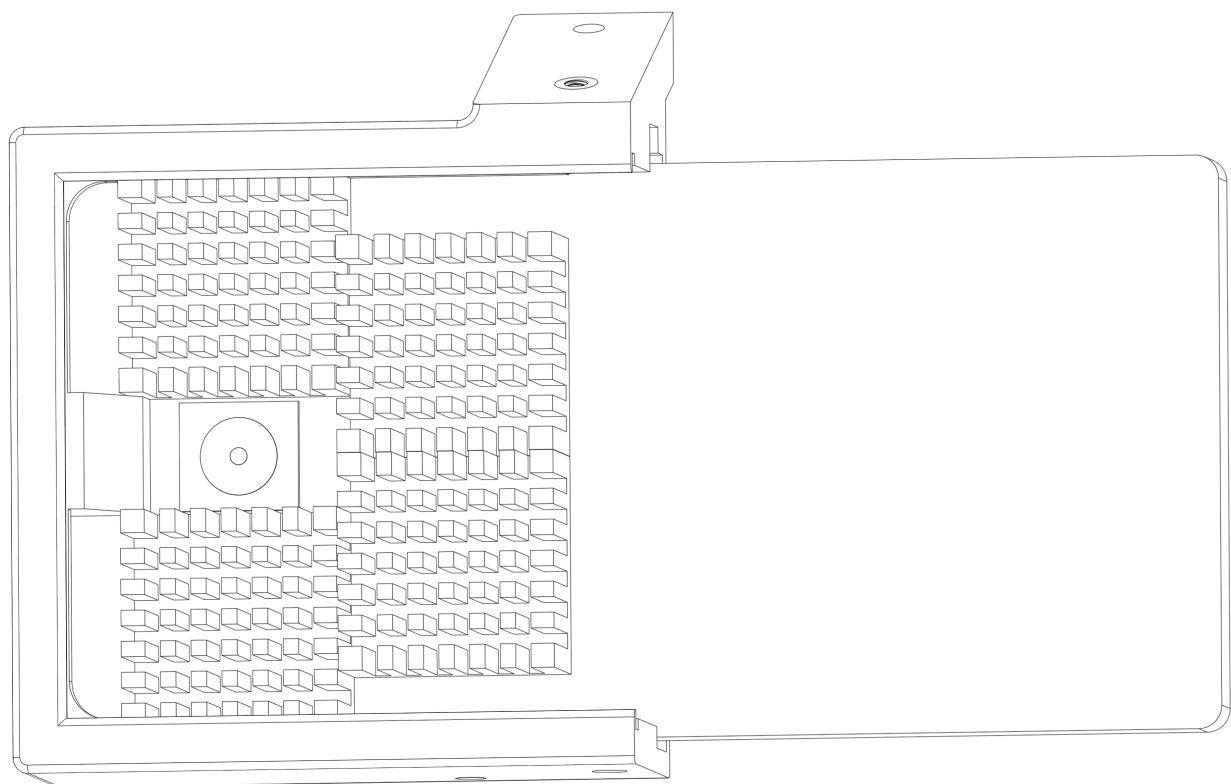


# 4

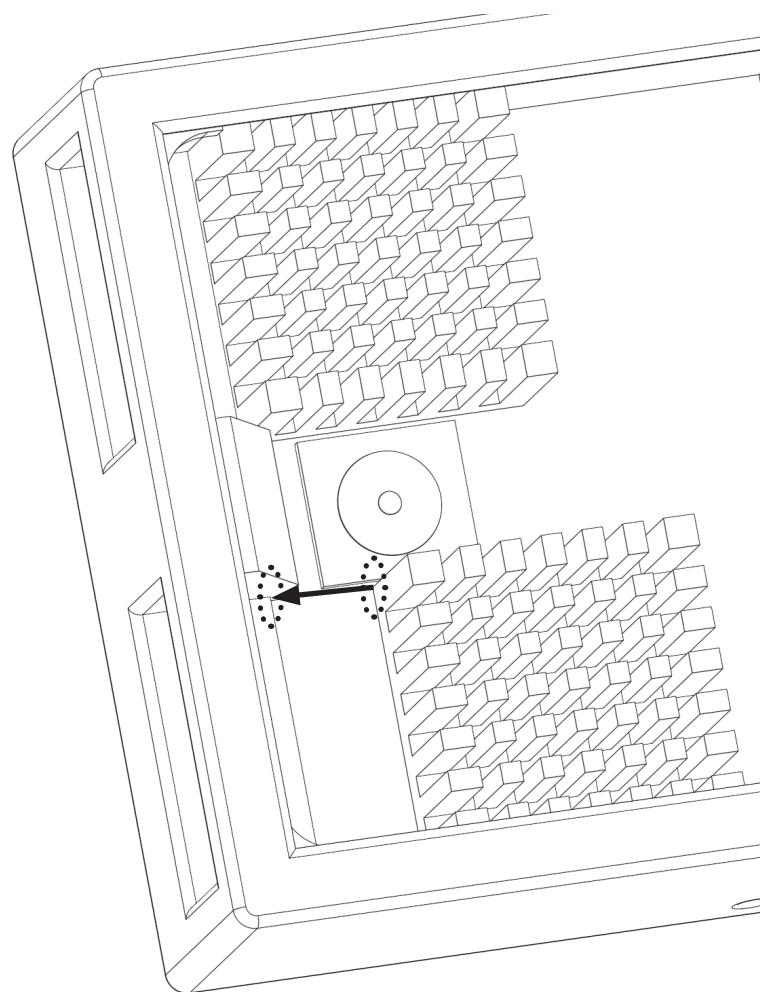
slide top onto the OnePlus3



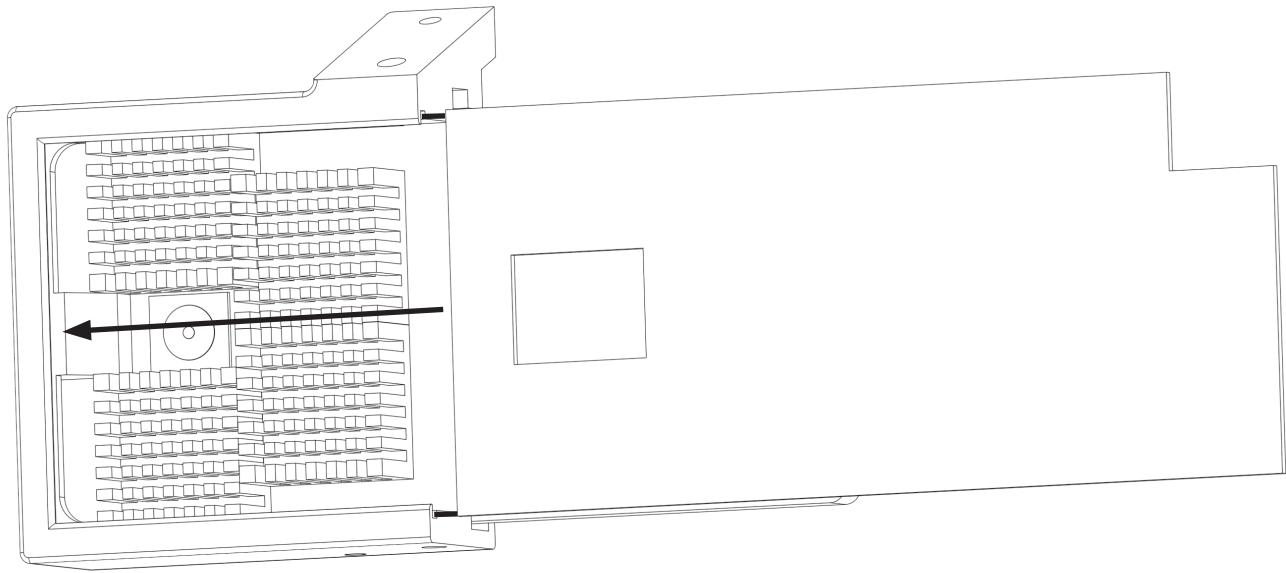
remove paper backing from heatsinks and  
stick to the OnePlus3



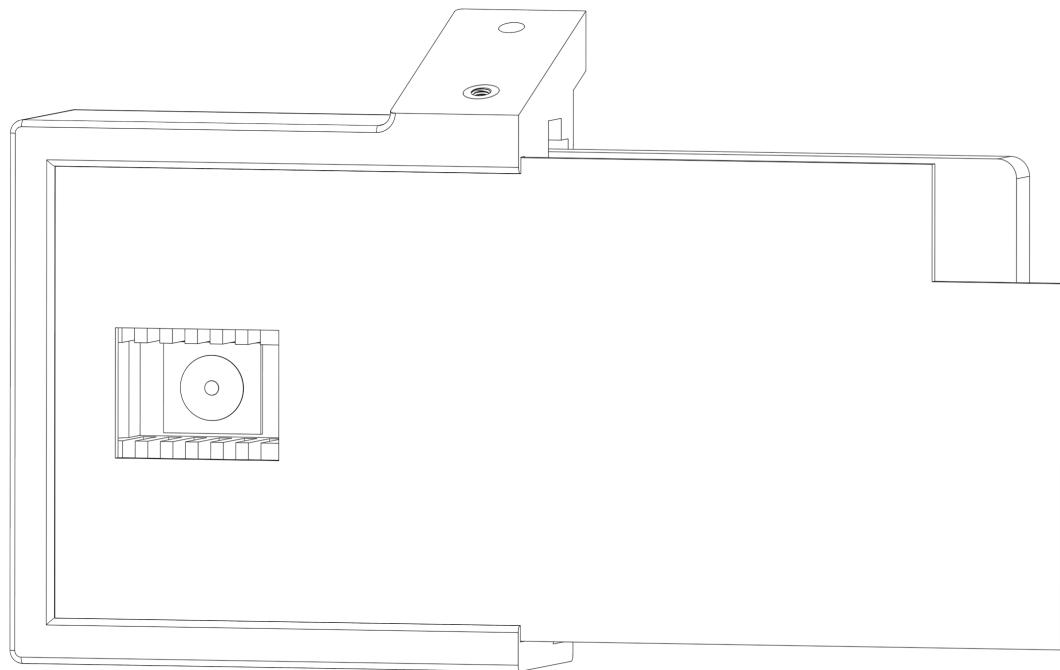
make sure the corners of the top heatsinks  
are flush with the corners of the plastic case



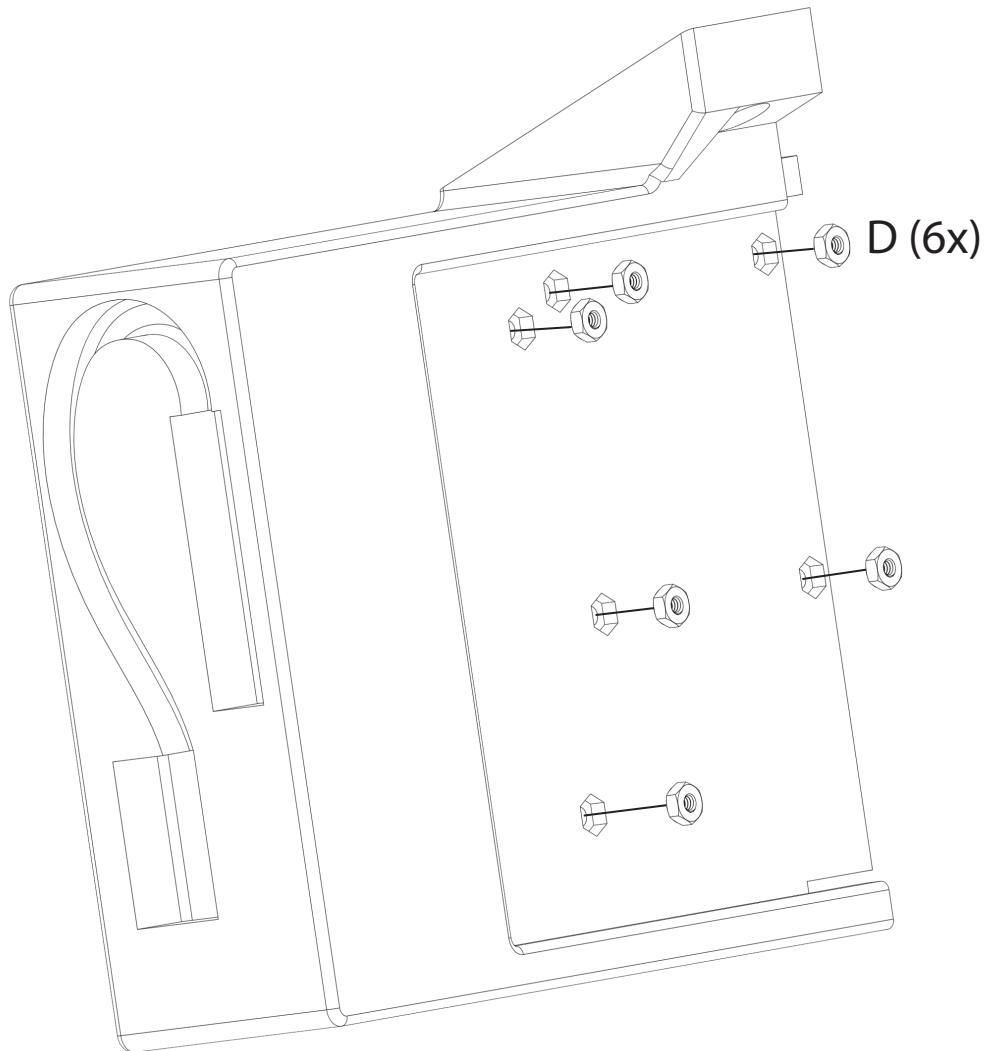
# 5



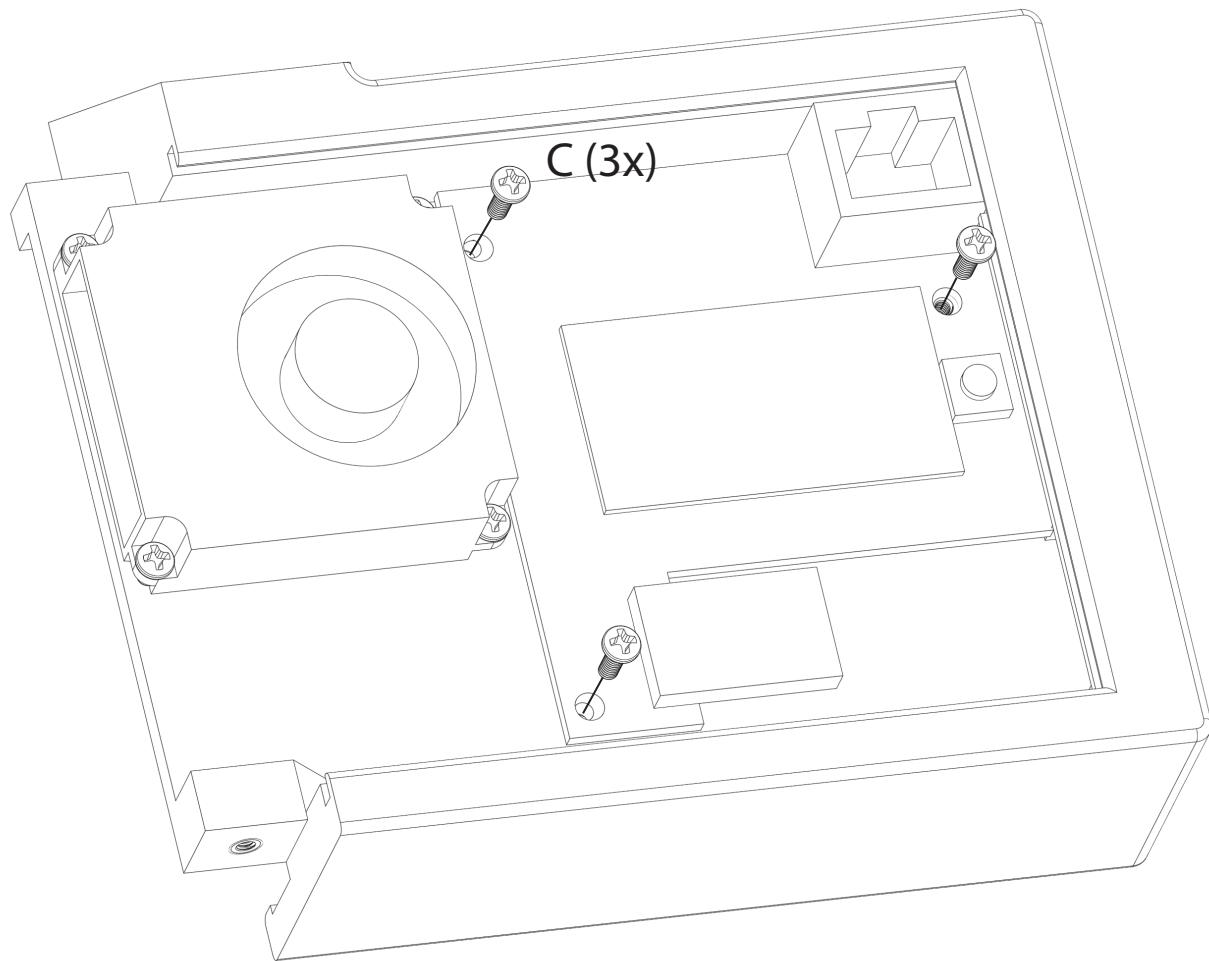
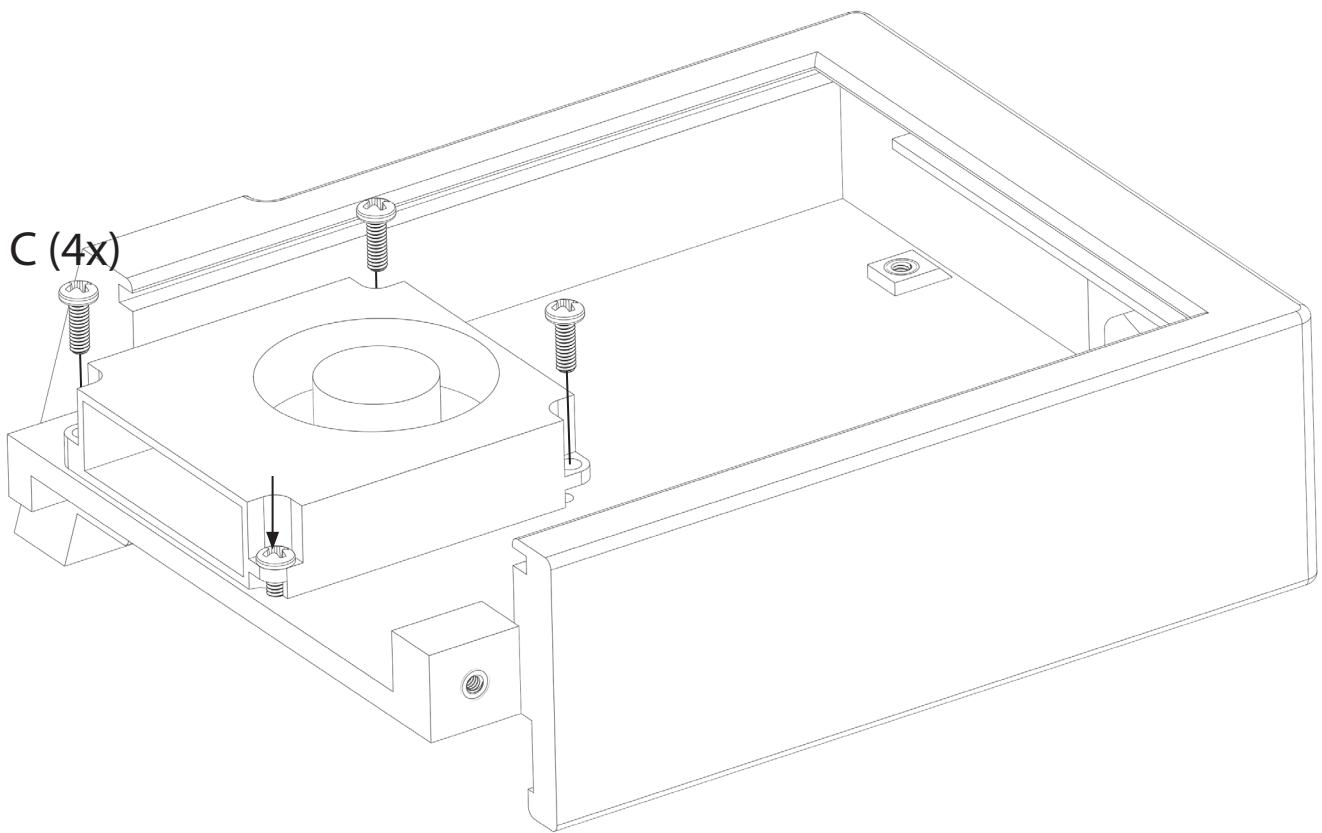
slide the cover into the top part of the case  
then set aside to work with the bottom



6



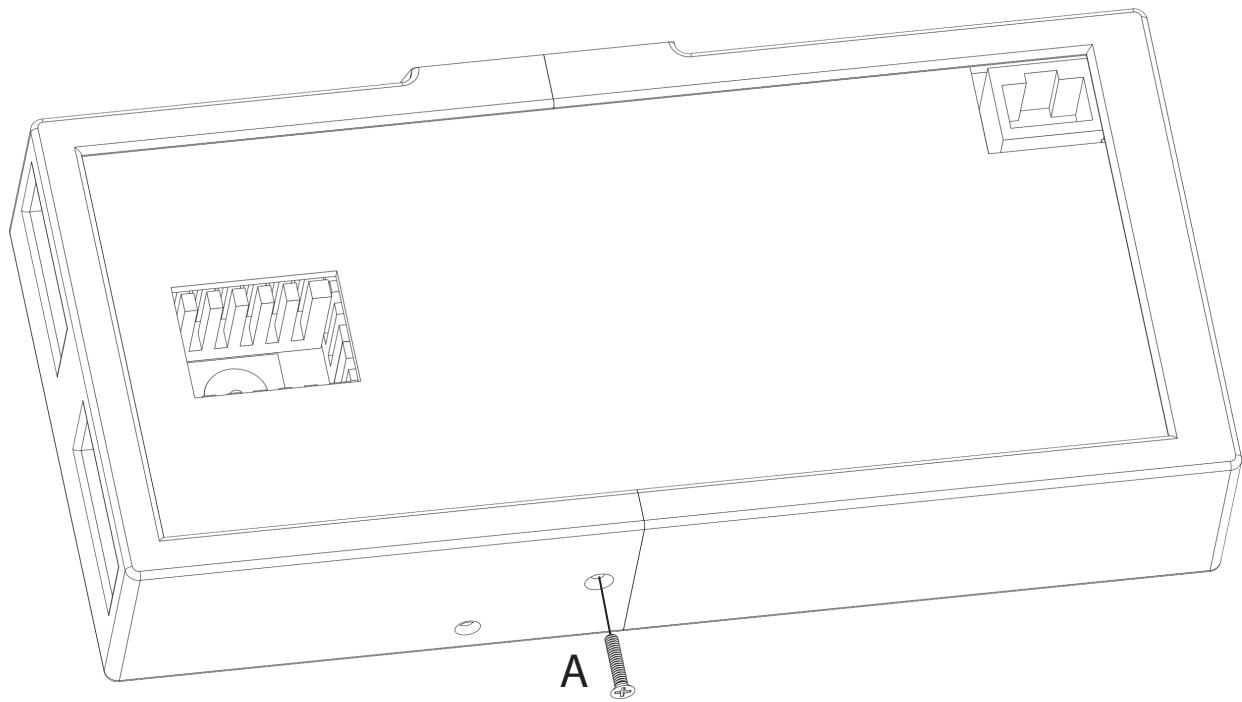
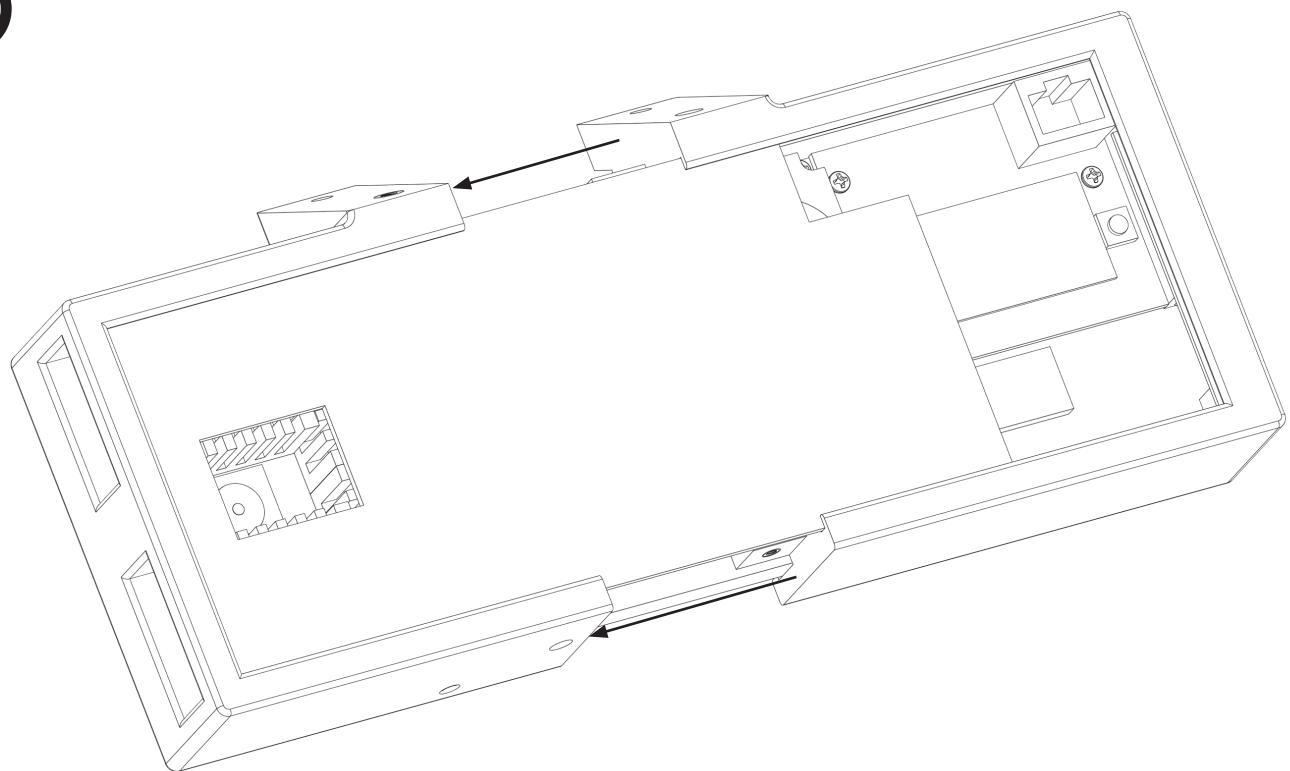
7



,

29

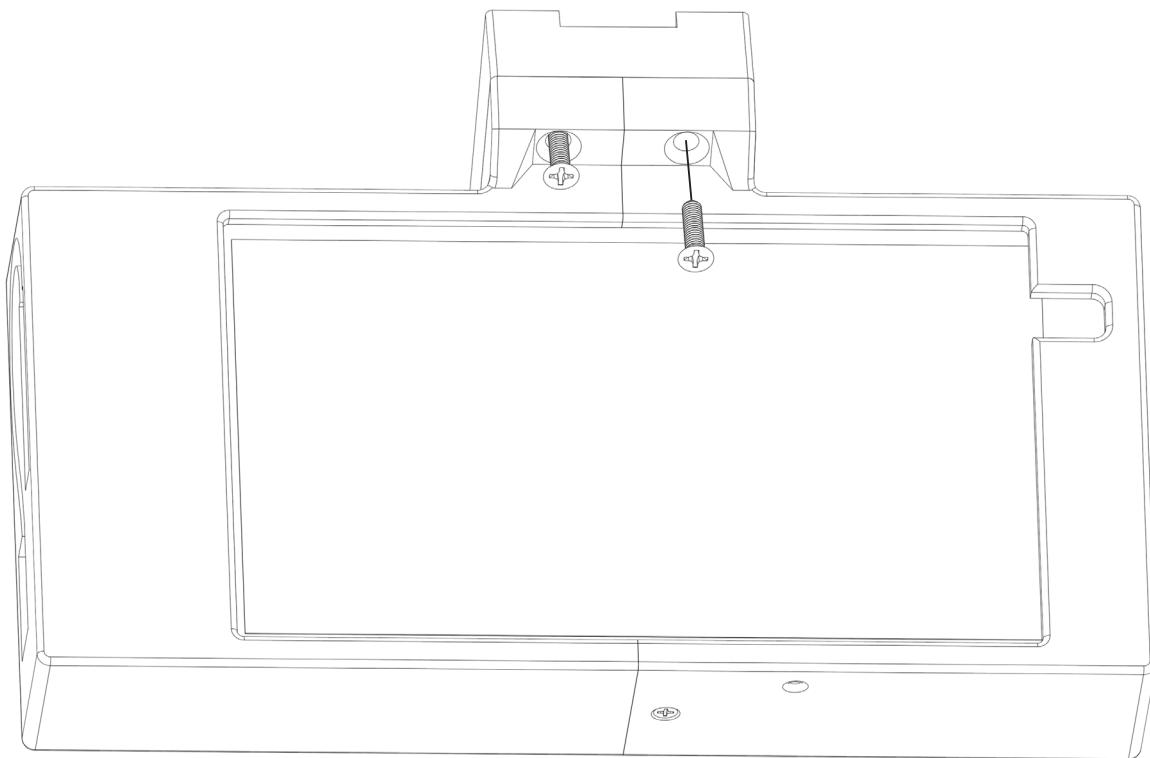
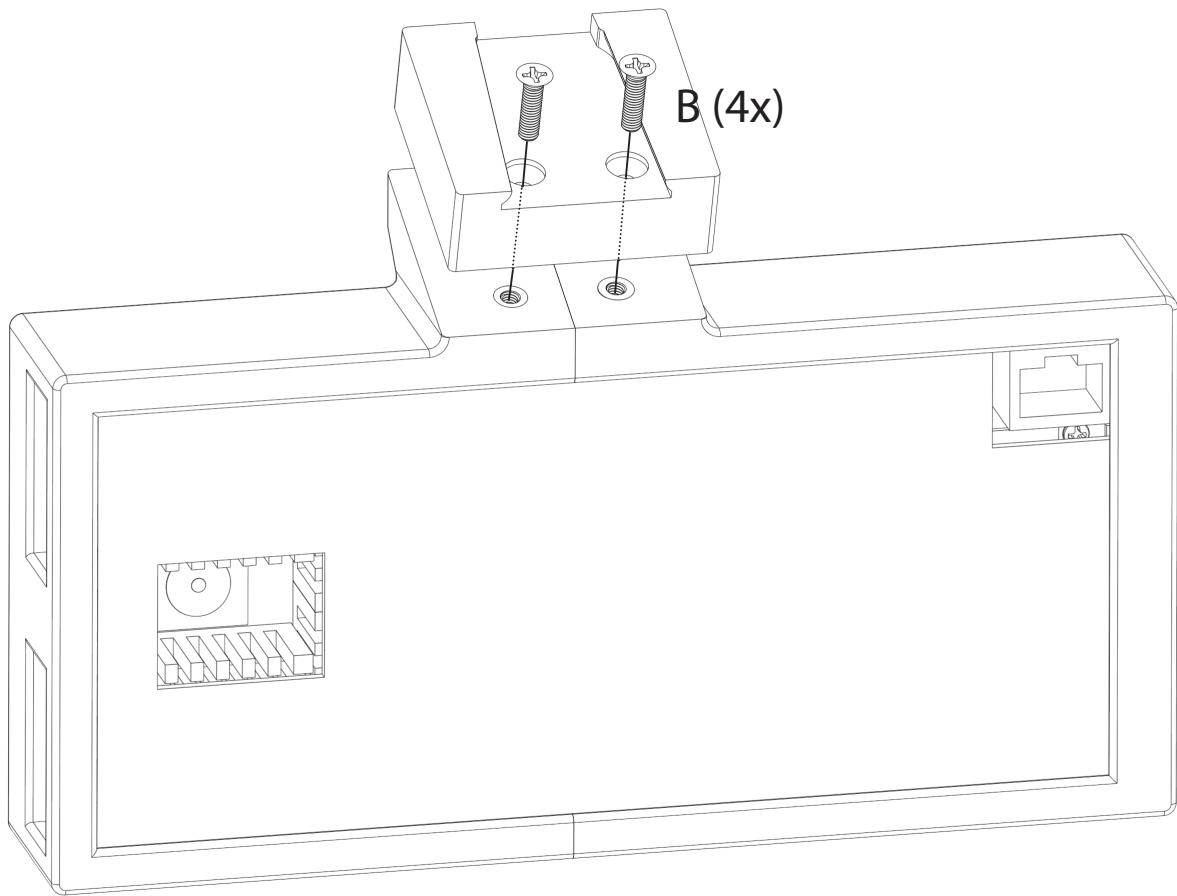
8



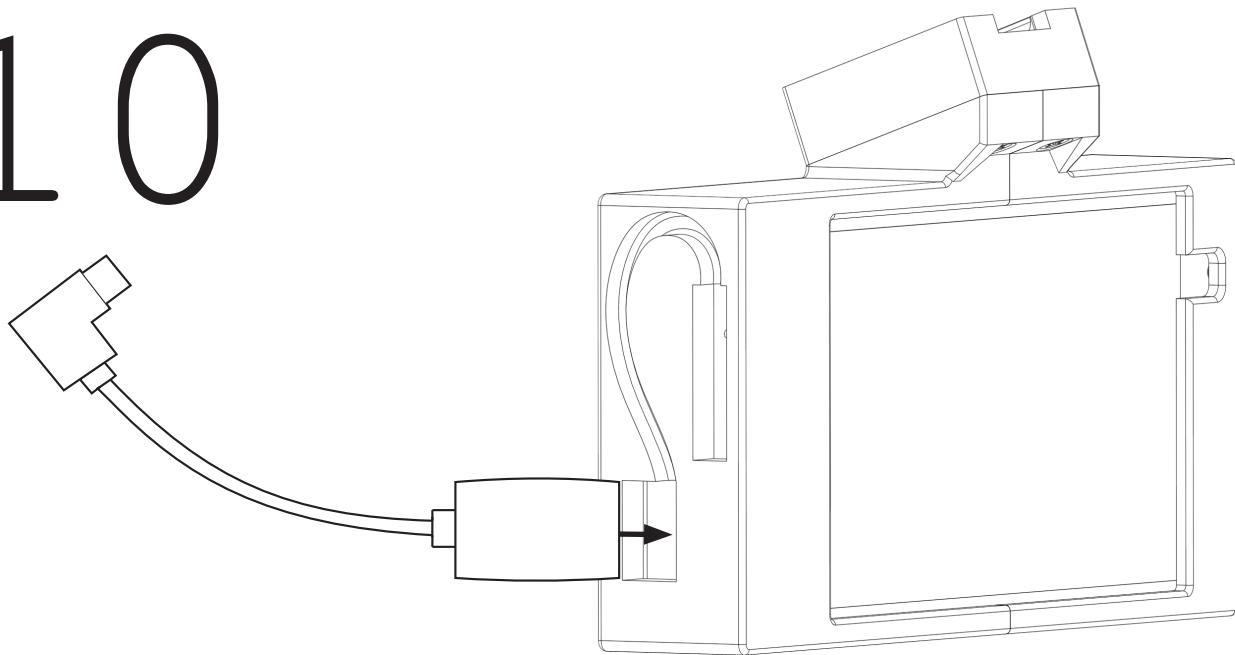
,

30

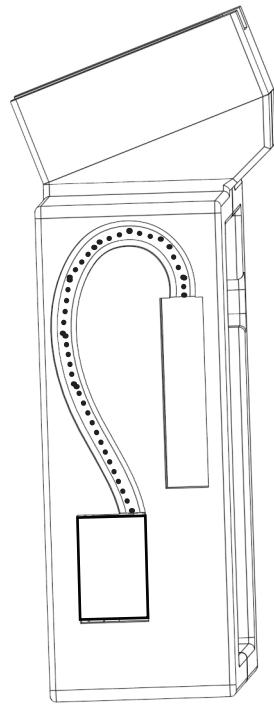
9



# 10

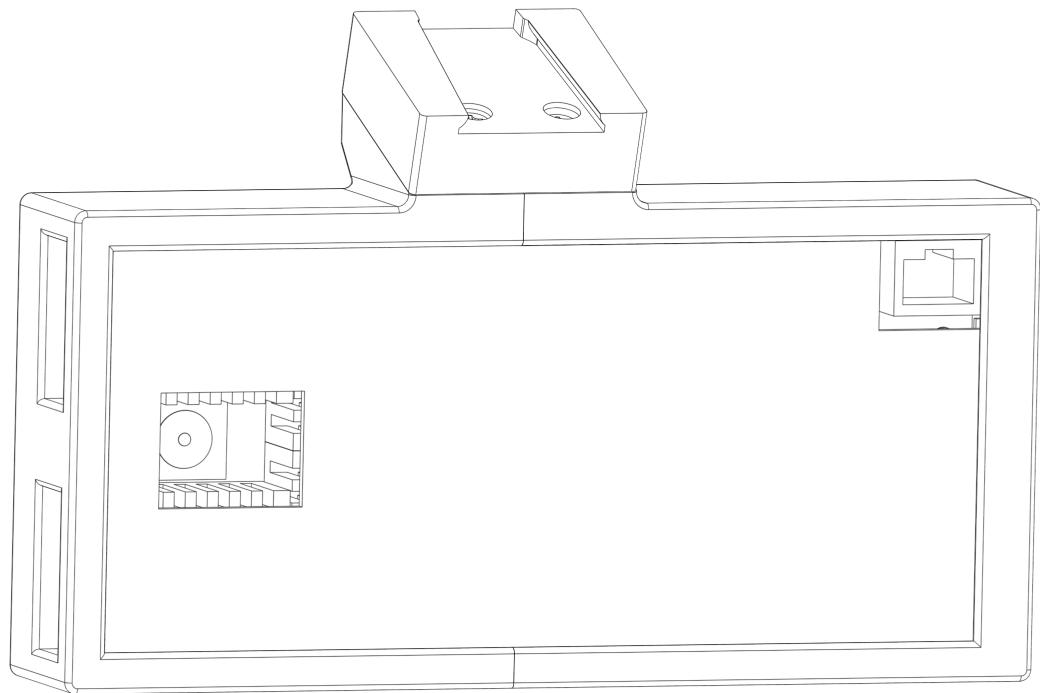
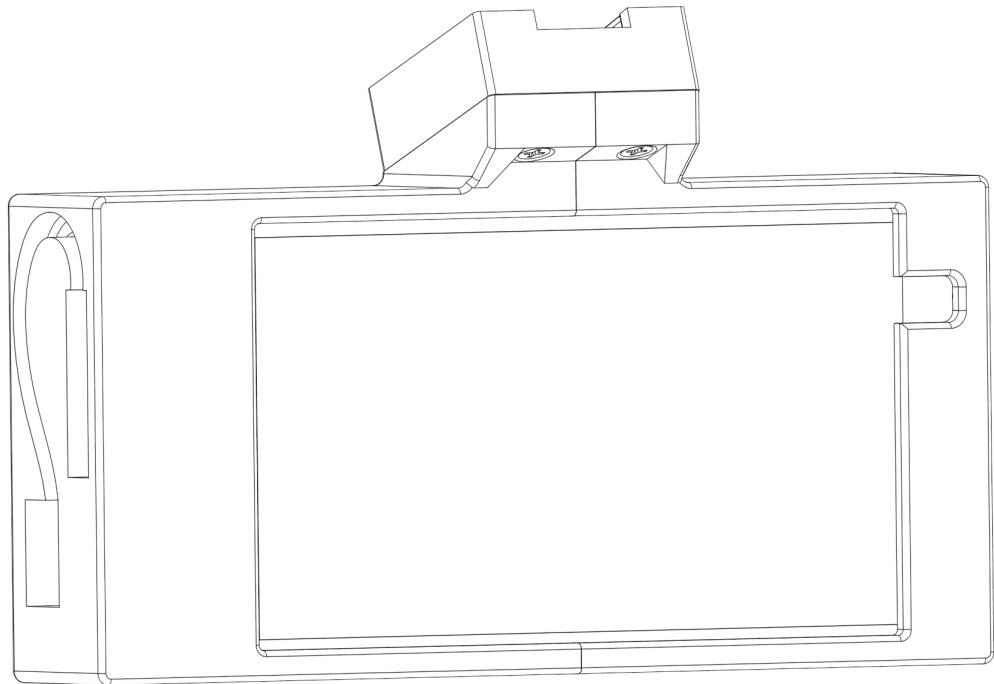


push the cable into the slot on the bottom of the case until it clicks into the interface board



snake the cable through the channel in the bottom of the case and plug the usb c connector into the OnePlus3 (this may take a few tries)

# done





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