13.37 HAX trinket soldering kit (duo)

Welcome to the 13.37 HAX trinket soldering workshop.

During this workshop you will gain some experience soldering various electronic parts on a small **P**rinted **C**ircuit **B**oard (**PCB**) using different techniques. End product is a “trinket” – a small gimmick. This trinket has a few functions: It serves as a flashlight, you can write your name on it and wear it on a lanyard as a badge, and can detect the presence of other trinkets around it.

This kit contains the electronic parts for **two** trinkets. Please open the bag and check and get familiar with its contents. **If parts are packaged in a strip, please do not take them out yet.** Some parts are **S**urface **M**ounted **D**evices (**SMD**) without leads that go through holes in the PCB, other parts are **T**hrough **H**ole (**TH**) devices

type	nr	What	Identification	Front/Back
1	2	PCBs	Green, BACK SIDE with text “hackwinkel. nl”	n.a.
2	4	MOSFETs	3 pin devices, 4 in black plastic strip	SMD F
3	2	boost convertors	3 pin devices, 2 in black plastic strip	SMD F
4	2	diodes	2 pin black devices, 2 in black plastic strip	SMD F
5	4	IR transmitters	2 pin white devices, 2 in black plastic strip	SMD F + B
6	4	RGB LEDs	6 pin white devices, 4 in black plastic strip	SMD F + B
7	2	Inductors	470, 2 in white plastic strip	SMD F
8	2	capacitors	Brown, “small”, 2 in transparent plastic strip	SMD F
9	2	capacitors	Brown, “large|”. 2 in transparent plastic strip	SMD F
10	4	resistors	3301, “small”, 4 in paper strip	SMD F
11	4	resistors	100, “large”, 4 in paper strip	SMD F + B
12	8	resistors	101, “small”, 8 in paper strip	SMD F
13	12	resistors	181, “small”. 12 in paper strip	SMD F + B
14	2	microcontrollers	16 pins, unpackaged	SMD F
15	2	buttons	|”huge”, 4 pins, unpackaged	SMD B
16	4	IR receivers	Black, 3 pins, unpackaged	TH F + B
17	8	White LEDs	Transparent 2 pins, unpackaged	TH F + B
18	2	Battery holder	Able to hold a AA cell	F

When you assemble an electronics kit, there is a preferred order in which to do this. In general this order is “from small height component to large height component” and “from centre of the PCB to the edge”. In this particular case, there are components on **both sides of the PCB**, which complicates matters a bit, plus, to make our life more enjoyable, we are going to use the “**hotplate reflow soldering**” technique for most parts.

When reflow soldering one does not use solder wire and a soldering iron, but instead of that solder paste and a means of heating the whole PCB to soldering temperature in one go. Solder paste is a mixture of small (20-49 um) balls of solder in a “flux” paste. It has the consistency of Nutella, but is

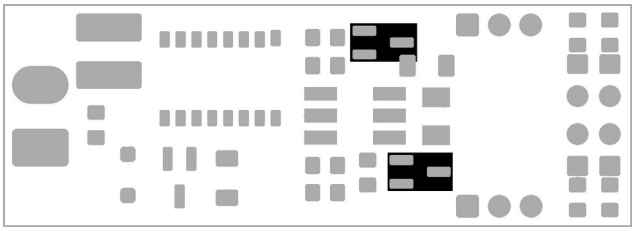
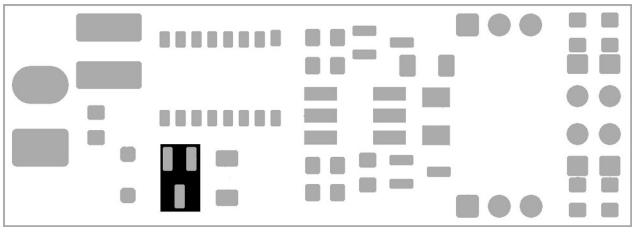
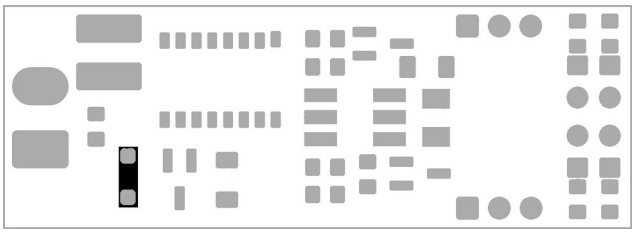
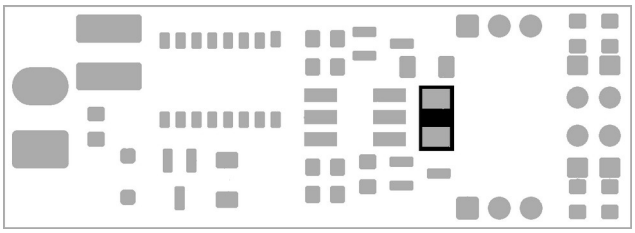
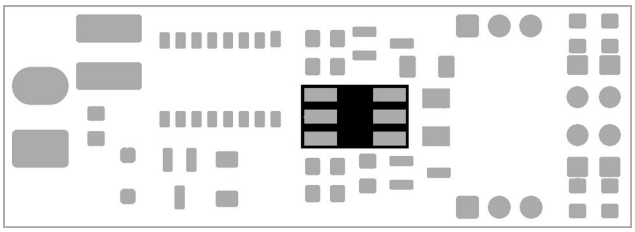
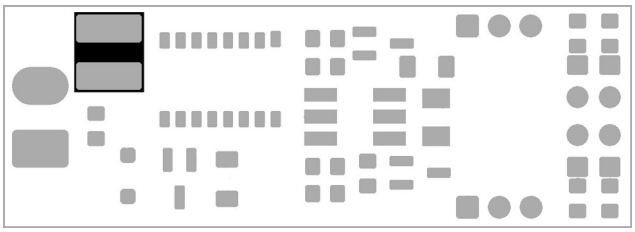
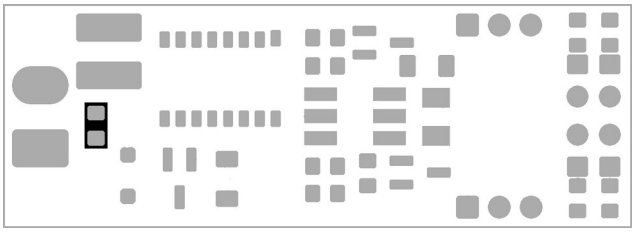
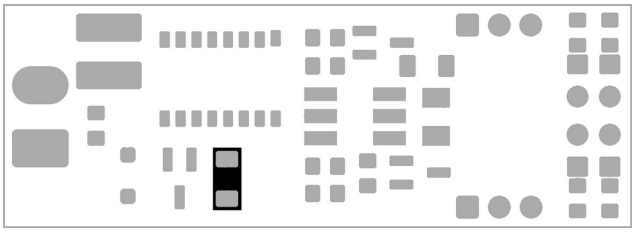
gray and should not be consumed. Flux is a substance that will remove oxide layers when heated, allow the (then liquid solder) to flow nicely, and in the process will be converted into smoke. Solder wire also contains flux, for the same reasons.

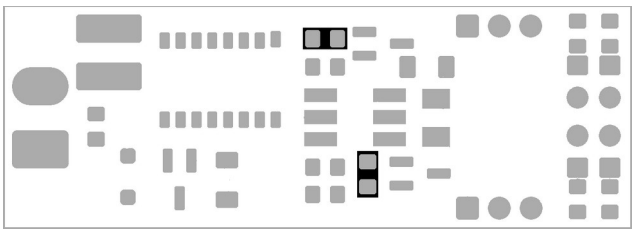
We are going to use a stencil and a spatula to apply small dabs of solder paste to the contact pads on the PCB. How this is done will be demonstrated.

After the solder paste is applied to the front side of the PCB , we are going to place the components marked "**SMD F**" in the table above, **in the order shown** (part type 2 – 14). If parts are marked "**SMD F + B"** we are going to place **half** of the components, on the front side of the PCB only.

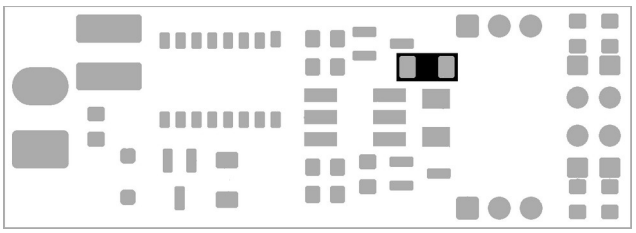
When placing parts we want to make sure that **every metal contact of a part touches the correct dab of solder paste**. In some cases (MOSFETs and boost converters) the orientation of a part on the PCB is evident from the locations of the PCB contacts. In some cases (resistors, inductors and capacitors) orientation does not matter as long as metal contacts touch the solder paste. I**n some cases orientation is important**. Mounting such parts in the wrong orientation may destroy them.

Place the front side SMD parts on the PCB with solder paste according to the table below:

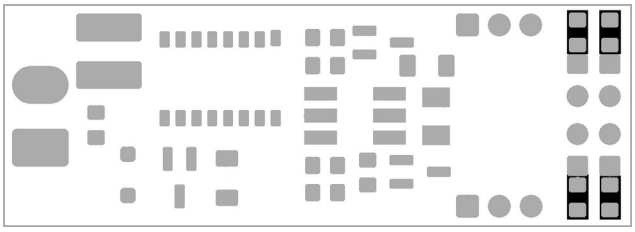
 2 of type 2, orientation evident	 1 of type 3, orientation evident
 1 of type 4, lines toward bottom of image	 1 of type 5, larger pad towards bottom image
 1 of type 6, "stick" like pad towards left	 1 of type 7, orientation not important
 1 of type 8, orientation not important	 1 of type 9, orientation not important



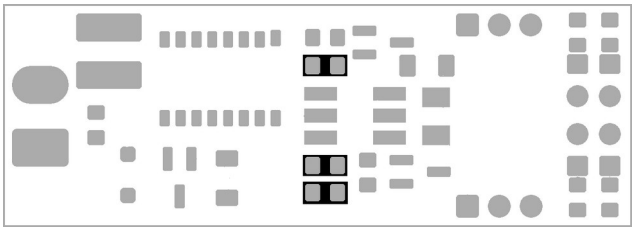
2 of type 10, black side up, orientation n.i.



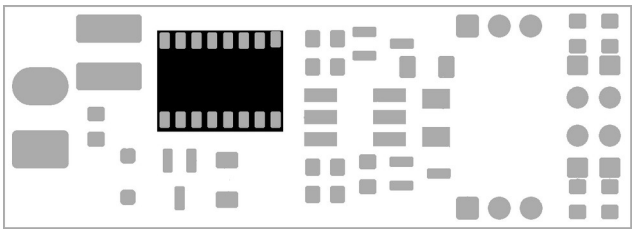
1 of type 11, black side up, orientation n.i.



4 of type 12, black side up, orientation n.i.



3 of type 13, black side up, orientation n.i.



1 of type 14, dimple/dot towards centre of PCB

After placing al these parts, it is time to |reflow the solder using a hot plate. You will be instructed how to do this.

After the front side SMD parts have been soldered, it is time to turn our attention to the bottom side SMD parts. Of course these can't be soldered using the same technique as one would have to place the PCB with parts on the front side, front-side down on the hotplate, melting the parts. We will sonder these parts manually.

Soldering SMD parts manually is easy with three or more hands. As we usually lack extra hands, we'll make do with two plus an accessory: a PCB holder. Slip the PCB, components down, into the PCB holder, and place it on the table in front of you.

The following requires some confidence. You will NOT hurt yourself if you remain careful, and you will NOT destroy parts if you heat them a little longer. The biggest problem is people being 'scared' and removing the heat too quickly. Read this carefully, and if this is the first time you do this, do a practice-run of the moves without a soldering iron

To solder SMD components manually, we start by putting a small amount of fresh tin on **one** of the PCB pads for it. It is important that you **tin only one of its PCB pads**,because otherwise it will be nearly impossible to solder the part flat on the PCB. Next, you take the pad, ant put it in the correct orientation as close as possible next to the tinned pad, so you can push it in position using a nail or a toothpick once the tin is molten again.
Re-heat the pre-tinned pad, melting the tin, keep the soldering iron touching the tin while you push the part in position, then hold the part in position for a few seconds more while you remove the soldering iron. If you use your nails, then they may get hot. If you like this, use a toothpick. Try not to remove the soldering iron too quickly. While the solder is melted, you may align the part. After fixing the part to the PCB with one of its contacts in this way, solder the other contact(s) by touching the contact and pad at the same time for a second, then add a tiny bit of solder wire,

remove the solder wire, then WAIT a second before removing the soldering iron. Repeat this until all the contacts of the part are soldered

The following SMD parts need to be soldered on the back side of the PCB in **the given order**.

1 of type 5	Exactly on the opposite side of the PCB from the other IR transmitter. The larger pad needs to point in the opposite direction, and the arrow on the PCB points towards the smaller pad.
1 of type 6	Exactly on the opposite side of the PCB from the other RGB LED. The "stick"-like pad needs to be away from the IR transmitter
1 of type 11	On the two pads close to the IR transmitter, with black side up, orientation not important
3 of type 13	On the remaining 3 locations for SMD resistors, in a similar arrangement as the other 3 resistors of this type on the front of the PCB
1 of type 15	Orientation of the button is not important

Next up are the Through-hole parts.

We start with the IR receivers.The IR receivers have a (blind) flat side and a (sensitive) side with a bulge on it. If you put the IR receiver in front of you, with the back side on the table and the pins pointing towards you, the pins are numbered 1, 2 and 3 from left to right. Put the leads of **one** of the IR receivers through a row of three holes is such a way that pin 1 is in the hole with a square pad, AND in such a way that you can bend the IR receiver with the blind side towards the PCB. Bend the leads in such a way that the back side of the body of the IR receiver ends up in the square printed on the PCB. Solder the leads. Trim the leads using pliers, holding the lead you are cuttin to prevent them from catapulting away and hurting someone. Do the same, on the other side of the PCB, with the other IR receivers

Next are the LEDs If you look through the package material at the leads, you will see that one ends in a triangular "table" on which the (very small) ctual LED chip rests. The other pin is connected to the top of the LED-chip via a very thin wire. If you look at the PCB, you will see an array of 4 by 2 holes, some of which have a square pad, while others have a round pad. **The square pads must be connected to the "table" pin**, and the round pads must be connected to the other pin of the LEDs. The intention is to mount the leds at a right angle to the PCB, two on either side. The row of 4 holes right next to the edge of the PCB can serve LEDs on one side of the PCB, while the other row of 4 holes can serve the LEDs on the other side. The accessory has two holes and two |"barriers|" to help you bend the legs of the LEDS to the correct length for the "edge row" or "inner row" respectively. Bend and solder the "edge row" LEDs first, taking care to do so in the **correct orientation**, then trim the leads. Next bend and mount the "inner row" LEDs and trim back the leads.

Last is the battery holder: Solder the red wire to the oval pad and the black wire to the rectangular pad.

If no housing is available you can 3d-print one yourself, using a transparent material for the head, and any material for the body and button. Insert the PCB in the "head", insert the battery holder in the "bottom", carefully push body and head together, and insert the button cap through the hole.

Operating manual

Insert a 1.5V alkaline AA battery. This can also be a battery that is considered “empty” by most other electronics – the trinket will start to run from less than 1V battery voltage, and continue (with reduced functionality) until the battery voltage drops below ~ 0.5V

Remove the battery when not in use. As this trinket really drains the battery, there is a high probability of battery leakage if the battery is left in.

A short button-press will switch on the flashlight. After a few seconds or after a second button-press the flashlight will be switched off again.

A long button-press will switch on the flashlight. After about a minute or after a second button-press the flashlight will be switched off again.

The trinket will detect other trinkets. When other trinkets are detected the RGB leds will show different colours. When no other trinkets are detected, it will emit short white flashes.

The trinket will announce its presence. Using short pulses of infrared light, about once a minute.

The KISS communication protocol of the trinket may be compatible with previous years’ projects: the tag and the label.