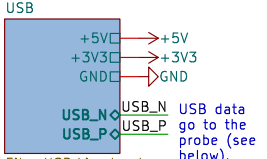
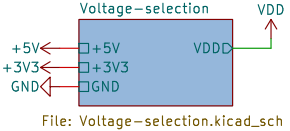
USB

The USB-C connector provides the GND reference and 5V power, which is then converted into 3V3. The whole power circuitry is in this USB sheet.

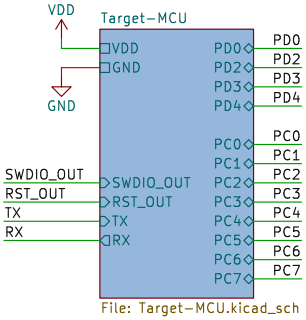


VOLTAGE SELECTION

The Voltage Selection sheet takes the voltage levels as input and selects one of them to become VDD – the power level for the Target MCU and the IO Pin Headers.

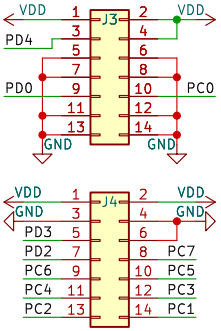


TARGET MCU



IO Pin Headers

All pins from the MCU are routed to these Pin Headers, except for:
- PA1 and PA2, used for crystal.
- PD1 and PD7, used for flashing.
- PD5 and PD6, used for UART-link with on-board probe.

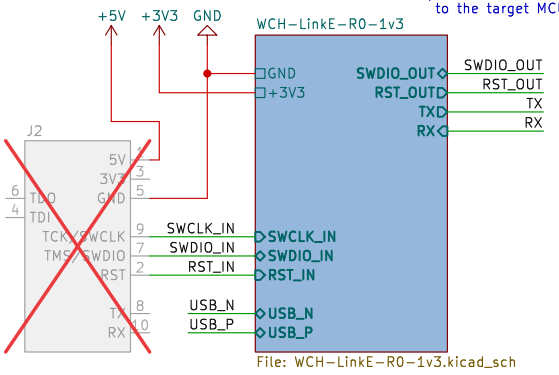


WCH-LinkE-R0-1v3

The WCH-LinkE-R0-1v3 on-board probe must be flashed when used for the first time with an external probe, through J2:
- SWCLK_IN
- SWDIO_IN
- RST_IN

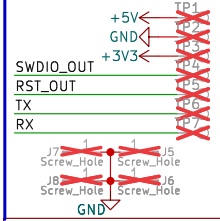
From then onwards, the USB signals give access to the on-board probe.

Signals SWDIO_OUT and RST_OUT flash and debug the target MCU. TX and RX provide a UART link to the target MCU.



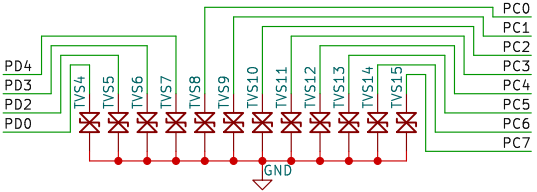
Test Pads

Test Pads located between flash/debug probe and target MCU.



IO protection

All IO pins from the Pin Headers first pass through these TVS diodes to protect the board against external voltage transients.



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Sheet: /

File: tiny-scarab.kicad_sch

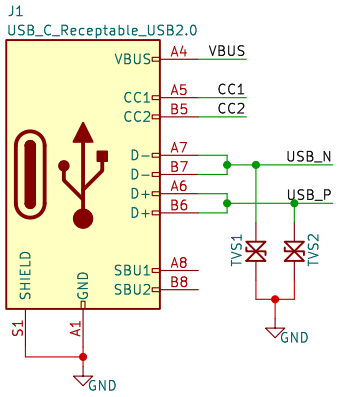
Title: Tiny Scarab

Size: A5	Date: 2024-01-04	**Rev: 0.1**
KiCad E.D.A. kicad 7.0.10		Id: 1/5

USB

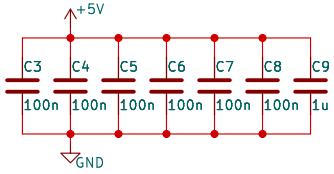
Connector

This USB connector only provides the basic USB2.0 data signals. They are protected with TVS diodes right at the entrance.



Capacitance

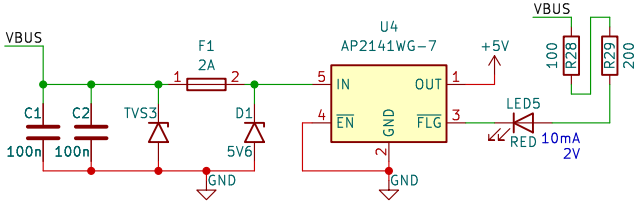
Provide plenty of capacitors on the 5V line.



VBUS Protection

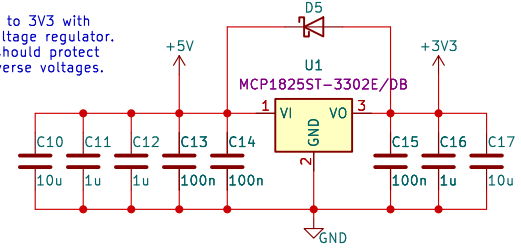
The incoming VBUS power first goes through a TVS diode to protect the board from transient voltages from the cable. Next, a fuse and zener diode work together to protect against permanent overvoltages: the zener shorts to GND such that the fuse burns.

Finally, chip AP2141WG-7 only lets 500mA pass through. In case of overcurrent, it will pull down its FLG pin which then lights up a red LED.



3V3 Conversion

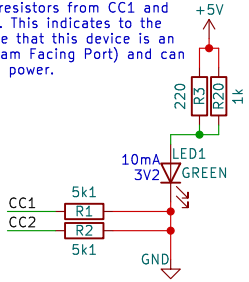
Convert 5V to 3V3 with a linear voltage regulator. Diode D6 should protect against reverse voltages.



LED & Power Handshake

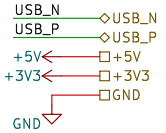
Indicate power presence with an LED.

Attach 5k1 resistors from CC1 and CC2 to GND. This indicates to the power source that this device is an UFP (Upstream Facing Port) and can thus receive power.



Sheet Output

Export the USB data signals from this sheet, as well as all the power lines (power lines are global symbols, so exporting them is not strictly needed)



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Sheet: /USB/

File: USB.kicad_sch

Title: Tiny Scarab

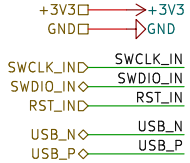
Size: A5	Date: 2024-01-04	**Rev: 0.1**
KiCad E.D.A. kicad 7.0.10		Id: 2/5

WCH-LinkE-R0-1v3

Sheet Input

The WCH-LinkE-R0-1v3 on-board probe must be flashed when used for the first time with an external probe, through these signals:
- SWCLK_IN
- SWDIO_IN
- RST_IN

From then onwards, the USB signals give access to the on-board probe.



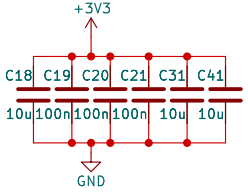
CH32V305FBP6

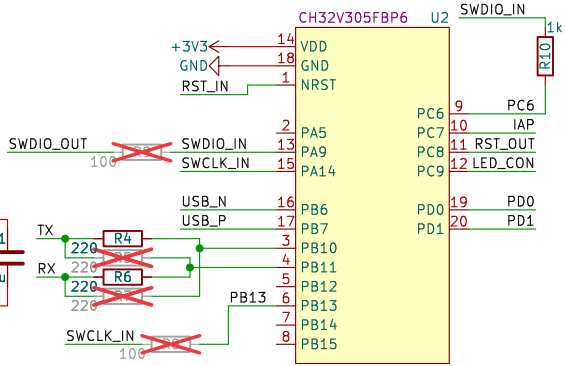
The CH32V305FBP6 is the heart of the WCH-LinkE-R0-1v3 on-board probe. It must be flashed through signals SWDIO_IN, SWDIO_IN and RST_IN.

From then onwards, it gets its instructions from the USB signals USB_N and USB_P.

It outputs the following signals to flash and debug the target MCU:
- SWDIO_OUT
- RST_OUT
- TX
- RX

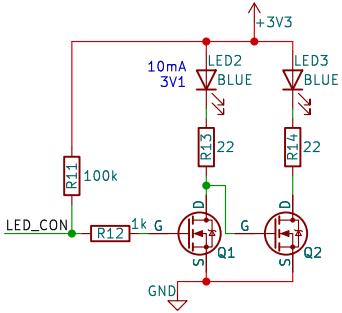
Note: Resistor R9 must be mounted after flashing the CH32V305FBP6 MCU.





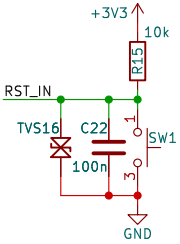
Mode LEDs

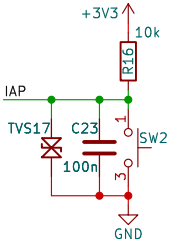
The CH32V305FBP6 MCU outputs the LED_CON signal to indicate if it works in ARM-mode or RISC-V-mode.



RST and IAP Buttons

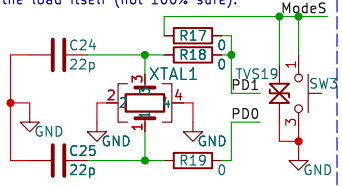
The RST button resets the CH32V305FBP6 MCU, the IAP button brings it into IAP mode.





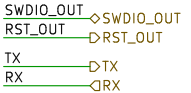
Crystal

12MHz crystal - the load capacitors might not be needed because the crystal provides the load itself (not 100% sure).



Sheet Output

Signals SWDIO_OUT and RST_OUT flash and debug the target MCU. TX and RX provide a UART link to the target MCU.



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Sheet: /WCH-LinkE-R0-1v3/

File: WCH-LinkE-R0-1v3.kicad_sch

Title: Tiny Scarab

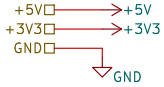
Size: A5	Date: 2024-01-04	**Rev: 0.1**
KiCad E.D.A. kicad 7.0.10		Id: 3/5

VOLTAGE SELECTION

Sheet Input

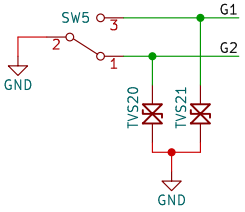
The input to this schematic sheet is all the voltage levels:
> GND
> +5V
> +3V3

It's not strictly necessary to input them here, as they're global symbols.



Slide Switch

The slide switch pulls either signal G1 or signal G2 to GND.



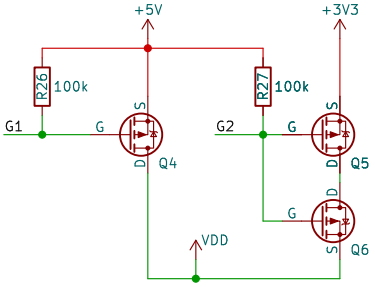
Voltage Selection Circuit

This circuit connects VDD to either 5V or 3V3. When G1 is low, it makes PMOS Q4 conduct. When G2 is low, it makes PMOS Q5 and Q6 conduct.

PMOS Q5 and Q6 are in anti-series (notice how Q6 is differently oriented than Q5) such that the body diodes won't let the 5V flow into the 3V3 when Q4 is conducting and Q5 and Q6 are off.

The selected PMOS is DMP1045U-7. This PMOS has a low on-resistance. When the V_GS = 3V3, the resistance is less than 40mΩ.

This PMOS conducts 500mA without issues – it can actually go way higher.



Sheet Output

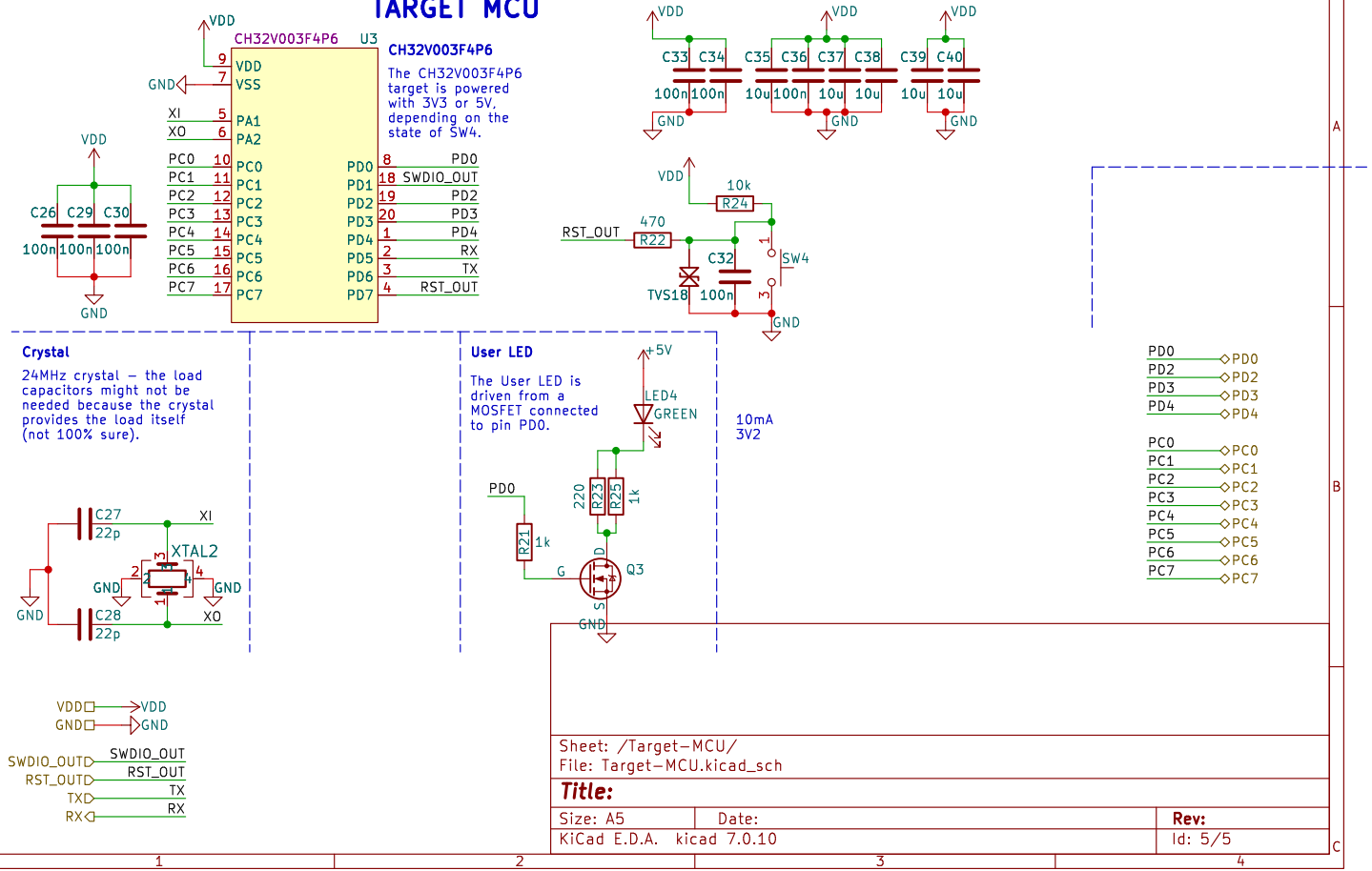
The output of this sheet is the VDD voltage level. As it's a global symbol, it's strictly not necessary to output it here.

Sheet: /Voltage-selection/
File: Voltage-selection.kicad_sch

Title:

Size: A5	Date:	**Rev:**
KiCad E.D.A. kicad 7.0.10		Id: 4/5

TARGET MCU



Sheet:	/Target-MCU/
File:	Target-MCU.kicad_sch
Title:	
Size: A5	Date:
Rev:	
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