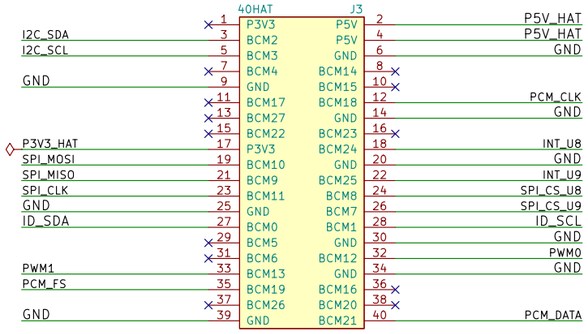
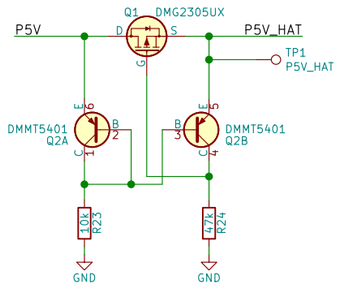
This is based on the official Raspberry Pi spec to be able to call an extension board a HAT.
https://github.com/raspberrypi/hats/blob/master/designguide.md

40-Pin HAT Connector



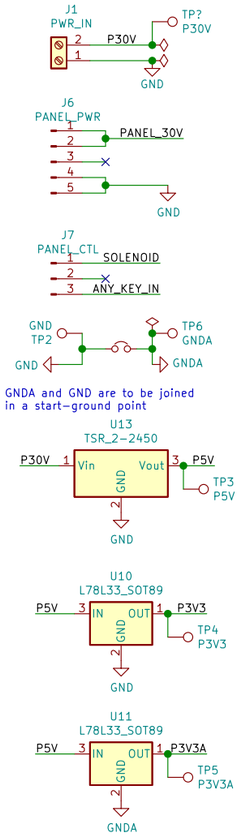
5V Powered HAT Protection

This is the recommended 5V rail protection for
a HAT with power going to the Pi.
See https://github.com/raspberrypi/hats/blob/master/designguide.md
#back-powering-the-pi-via-the-j8-gpio-header



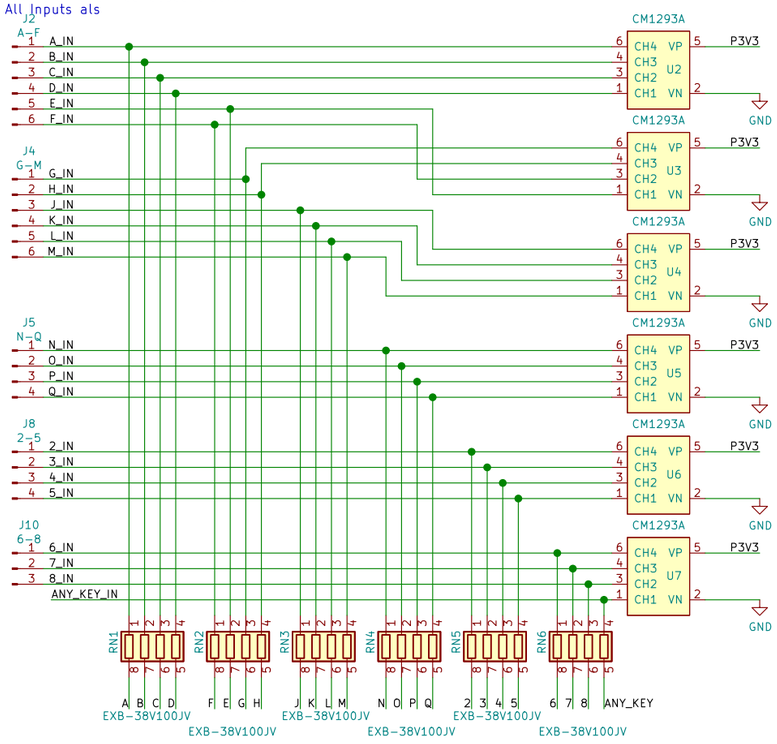
Power Input

The Hat is powered from an external Power-Supply Block that provides at least 5V 3A and 30V 500mA. The 5V is used to backpower the Pi.



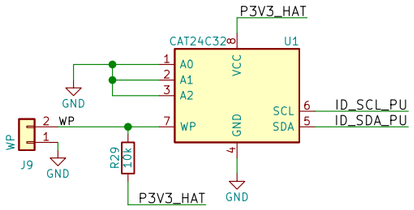
Panel Input & Protection

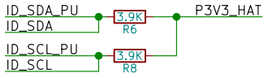
All Inputs are equipped with 3.3V ESD Suppression Diodes and series resistors for ESD and inductive coupled Transients to support the the long cable runs and close high-current solenoids and incandescent bulbs.
All Inputs als



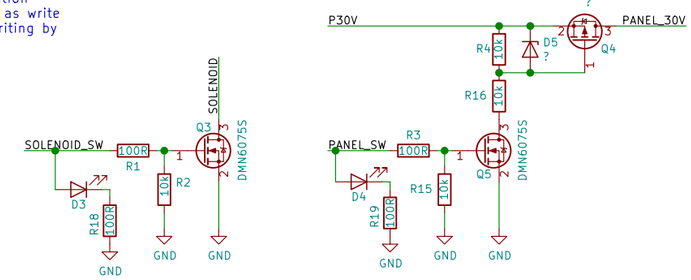
HAT ID-EEPROM

The HAT spec requires this EEPROM with system information to be in place in order to be called a HAT. It is set up as write protected (WP pin held high) and can be enabled for writing by placing a jumper on J9 or by bridging TP1.

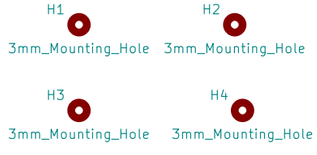




Panel Power Switching



Mounting Holes

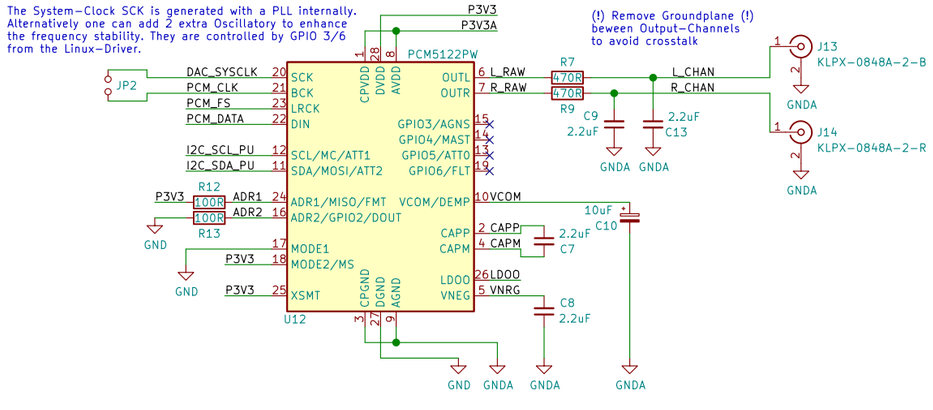


Audio DAC

The System-Clock SCK is generated with a PLL internally. Alternatively one can add 2 extra Oscillatory to enhance the frequency stability. They are controlled by GPIO 3/6 from the Linux-Driver.

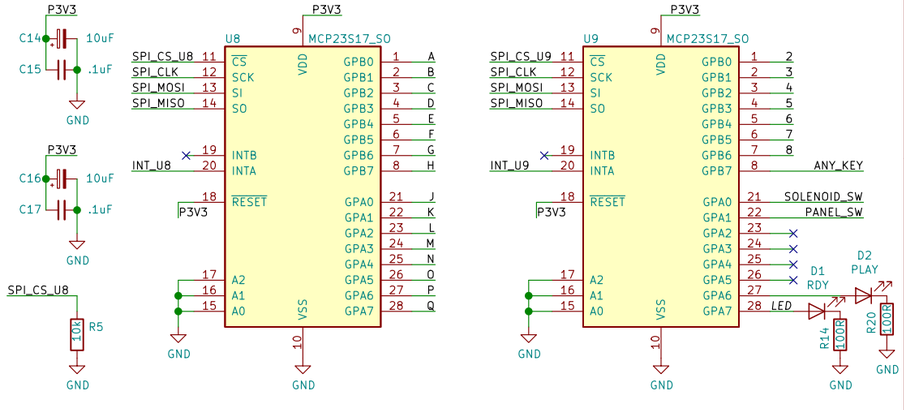
Audio Connector

(!) Remove Groundplane (!) beween Output-Channels to avoid crosstalk



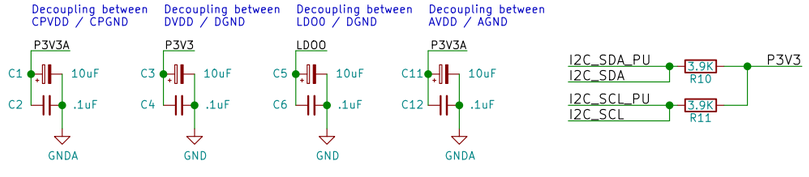
GPIO Port Extender

The MCP23S17 (SPI 16bit Port Extender) is used to drive and read from the Panel-IOs and to drive the Panel-Power FETs. This device supports an Address-Based selection mode: only the Chip-Select is used for both chips; The Interrupt-Mirror-Feature is used, to only have one Interrupt for all 4 Banks.



PWM Connectors

Decoupling



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