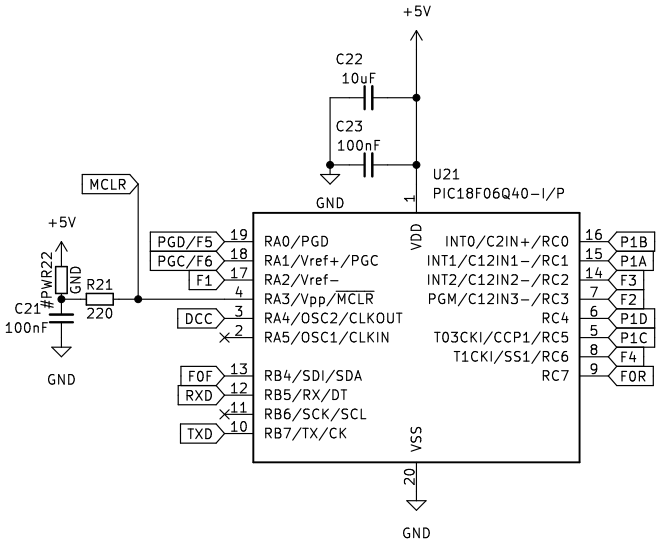
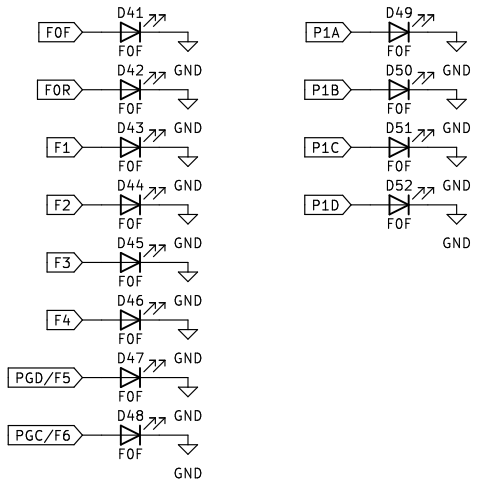


Because we power from the USB Serial-to-TTL adapter, we use an extra 10uF capacitor locally to smooth out the power.

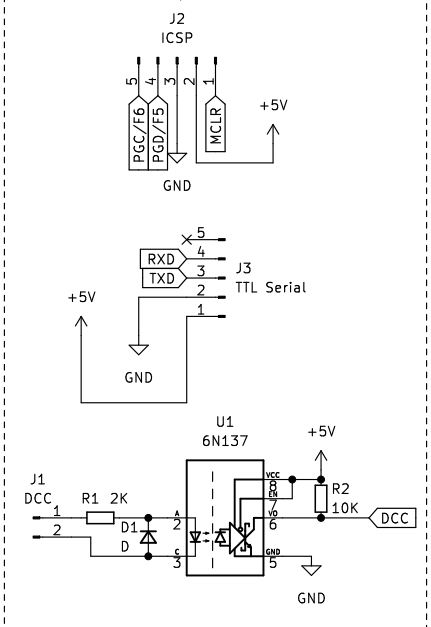


Use "5v LEDs", that is LEDs with built in resistors to reduce part count on the breadboard.

Alternatively use a LED and resistor calcualted to draw approximate 5ma at 5V. DO NOT drive the LEDs at 20ma, or all on will exceed the PIC power capabilities.

It is safe to leave PIC18F outputs unconnected, so only lights needed for development/debugging need to be installed.

External Connectivity



Because we are powered from the USB adapter, plugging the DCC signal directly into the micro-controller is dangerous. Use a 6N137 opto-isolator to safely inject the signal. A 4N37 can also be used with minor circuit changes.

USB to TTL Adapters:

https://www.amazon.com/HiLetgo-CP2102-Converter-Adapter-Downloader/dp/B00LODGRV8/

https://www.amazon.com/FT232RL-Serial-Converter-Adapter-Arduino/dp/B07XF2SLQ1/

https://www.amazon.com/IZOKEE-CP2102-Converter-Adapter-Downloader/dp/B07D6LLX19/

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