Railflyer PCB review

Truck PCB (2012-10-23)

Revisited 30.11.

- No current limiting resistor on the LEDs but LED22 and LED23.
- If no external resistor is used there might be a problem with to high current through the LEDs which reduces lifetime or can destroys several LEDs
- Christopher states, that maximum of 10 LEDs per truck are switched on, but 20 mA each. This means a total current of 200 mA per truck. This is to much for the 3.3V regulator.

Suggestions to solve this:

- Use the regulated 5V instead of the 3.3V here.
- Use current sources instead the transistor/resistor combination.
- Connect the LEDs in series instead of parallel: i.e. if the LEDs need less than 2.5V voltage drop.

Further problem: +5V is not available at the moment. Use the free contacts 2 and 3 for this OR if each truck PCB gets its own motor driver the Motor N and P signals.

General problems and suggestions

- Wires go through parts on schematic: cleaned up.
- Logo and text: Removed.
- Checked package of 2SC4617 (Q1-Q11): Ok
- Check the used LEDs, particularly LED9-LED16. Transistor can only drive up to 150 mA!!!

Processor PCB (2012-10-22)

General problems and suggestions

- As send by Christopher board and schematics are not consistent: That is bad :(
- Following steps to solve this: Renamed J2 to FRONT_TRUCK (rotated and mirrored for correct pinning), renamed J1 to REAR_TRUCK, Rotated and mirrored J7 for correct pinning (Pin 1 is low battery, P20 is 3,3V now)
- Layer 2 and Layer 3 in board removed as not needed.
- Board: Some vias are to close together: Shorts possible while soldering.

- Board: For current wires the distance inbetween is too low
- Keep the connections to the truck PCBs as short as possible to prevent EMI issues!
- Renamed DCC_P to DCC_R for consistence with Power PCB
- Resized the smallest vias to standard 0.25 mm drill
- Resized motor and DCC wires to 0.4 mm drill

Sound chip IC3 (SGTL5000)

This IC converts a I2S stream into an audio stream.

- The package is QFN-20 (SGTL5000XNLA3/R2), checked.
- I2C: Address is 0x14/0x15, up to 400 kHz are supported
- C3 is too far away from VDDA pin: Fixed.
- Ground connection is suboptimal, resized ground layer.
- Capacitors are 0201: Ok.

Serial flash IC2 (MT29F4G01)

This IC stores the wav-Files for sound generation. Altough a Flash with parallel bus access, only the SPI pins are used (as a common SPI flash/eeprom SO8).

- Package: Checked.
- Optimized routing for VCC.
- Missing decouple C: Added C5 (100nF).

Accelerometer IC4 (MMA7361LC)

This IC measures 3 axes acceleration (as analog signals).

- Package: LGA. Checked.
- 0g-Detect is open: ok.
- Sleep pin is open: not ok, connected to controller with pulldown (for saving battery power).
- g-Select pin is open: ok, internal pulldown resistor enables 1.5g operation.
- Three outputs (X,Y and Z) go to ADC inputs of controller: ok, decoupling/filter is installed (C1-C3).

Microcontroller IC1 (MC13224V)

This controller controls the locomotive and is connected via wireless or DCC to the command station.

- I2C Pullups are missing: Added R4 and R5.
- VDD and capacitor not optimal: Optimized.
- Antenna: Ok
- Pinnings: Checked

BEMF circuit

This circuit can be used to measure the back EMF of the connected motors. It is a simple voltage divider with hold element.

• Traces are ok, values must be checked in prototyping phase

Power PCB (2012-10-12)

Battery monitor IC6 (MAX17059)

This part is for monitoring the battery voltage and has an I2C interface.

• correct: version for 2 cell monitor
• Not correct: C36, bypass VDD and GND with 100nF NOT Cell and GND
• Not correct: Connect CTG to GND!
• Recommendation: ALRT is open drain, pullup needed (better do not use the internal MC ones, so the board works stand alone)
• I2C: Address is 0x6C/0x6D, up to 400 kHz are supported
• Package: TDFN-8, mark pin 1 on ground plane, pinning is correct.
• Bypass-C is not optimal routed
• Routing of SDA/SCL to connector J2 is okay

Battery charger IC5 (MAX1873)

This part is for loading the battery.

• D7 can be omitted, VDCC is sourced by a bridge rectifier which prevents back source.
• Shunt R17 with 0.04 Ohms limits load current to 2.5 A from rails
• Shunt R15 with 0.08 Ohms limits load current to 2.5 A

Voltage regulator IC4 (TL1963ADCQ)

This part regulates voltage to 5V from input voltage which can be up to 20V DC. Current can be up to 1.5A.

• Input capacitance is missing (10 uf)
• Correct: Calculated output voltage due resistor ratio: 5.0336
• Output capacitance C1 is ok

Voltage regulator IC3 (MIC5205-3.3)

This part regulates voltage to 3.3V from input voltage 5V. Current can be up to 150 mA.

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* No errors but the ouput current might be a show stopper
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H-Bridge interface and H-Bridge

- C3 is far away from H-Bridge, bring it nearer

DCC Track input

- Decoupling capacitor at IC1 is missing (100nF)

General suggestions

1. Circuit around D9, C38 and R42 is not considered in BOM, maybe it is a smoother for VDCC voltage, leave it for now.
2. Bad: All schematics one one Eagle sheet, better use two (for printing and reading)
3. Bad: I would avoid using P$ as prefix for pin assignments
4. Board: For current wires the distance inbetween is too low
5. Board: Remove old logos as ordered