AN-5068
FAN5904 Reference Schematics Design

Summary

This document describes Fairchild's recommended schematics design for FAN5904 in an application. The schematics in this document may not be exactly the same as those used in the evaluation board as extra components are added to evaluation boards for measurement purposes. The recommended schematics in this document are for the final application.

Schematics Design Principles

Figure 1 is the recommended schematics design for FAN5904. The purposes of the external components are explained here:

1. **C9** represents a capacitor at the battery connection. It compensates the battery lead inductance. It is optional and not part of FAN5904 application. Depending on the system design, this capacitor may not be necessary.
2. **C10** is the main input capacitor for FAN5904 decoupling. This capacitor must be placed close to PVIN and grounded to PGND of the device. When placing C10, ensure the current first reaches PVIN, then to AVIN; even though PVIN and AVIN are connected together. PVIN pins are the input pins of the power train that carries high current. C10 needs to be close to PVIN to minimize input voltage variation.
3. **C8** is an RF capacitor that filters high-frequency variation on the power line. Its purpose is to provide low impedance to ground for high-frequency noise and prevent either high-frequency noise coupled into the RF DC-DC regulator from power input or to prevent it going out from PVIN. This capacitor should be placed close to PVIN, between C10 and PVIN, and as close as possible to PVIN to minimize the current loop. It needs to be grounded to PGND with shortest distance.
4. **C11** is same as C8. It is an RF capacitor used at RF DC-DC output end. For both C8 and C11, 68 pF is recommended according to Fairchild's experiment but the values should be determined by trials because the frequency with lowest impedance is determined by the RF capacitor values, trace inductance, and other components on the trace. Different PCB layouts create different lowest impedance frequency points. Table 1 is a reference of capacitors to provide lowest impedance at between 850 MHz to 900 MHz, but these values may not be accurate for all PCB layouts. These capacitors are needed if the GND plane cannot be optimized for the RF DC-DC regulator. With optimized ground layout, such as a large solid ground right under the RF DC-DC regulator, these capacitors may not benefit system performance. Fairchild recommends adding these capacitors if PCB space allows.
5. **C12** is the output capacitor. FAN5904 is designed to work with 4.7 µF output capacitor. Higher value slows down the output transition and lower value yields to higher output voltage ripple.
6. **C13** represents decoupling capacitors for PA. It is not part of FAN5904 application design. Values should be recommended by PA vendors or be determined by system design.
7. **R5, R6, R7**, and **R8** are optional input resistors for control inputs. These resistors damp noise going into the RF DC-DC device. In general, these resistors are not necessary.
8. **R9** and **C14** form a low-pass filter to minimize noise going to VCON. VCON is a sensitive input pin that controls output voltage. Proper filtering is necessary to ensure clean output voltage. The resistor and capacitor values should be determined by the system design.

When laying out the FAN5904; C10, C8, C11, and C12 should be connected to PGND (A1, B1) with the shortest and widest trace on the top layer. This minimizes ground connection inductance to ensure stable RF DC-DC output. AGND (C1) can be connected to PGND at the ground plane in the inner PCB layer.

To prevent noise coupling in mobile applications, it is recommended to make a shielding can for RF DC-DC circuit block only. Sharing one shielding can for RF DC-DC and other devices may cause noise reflecting from metal shielding to couple from one device to the others.

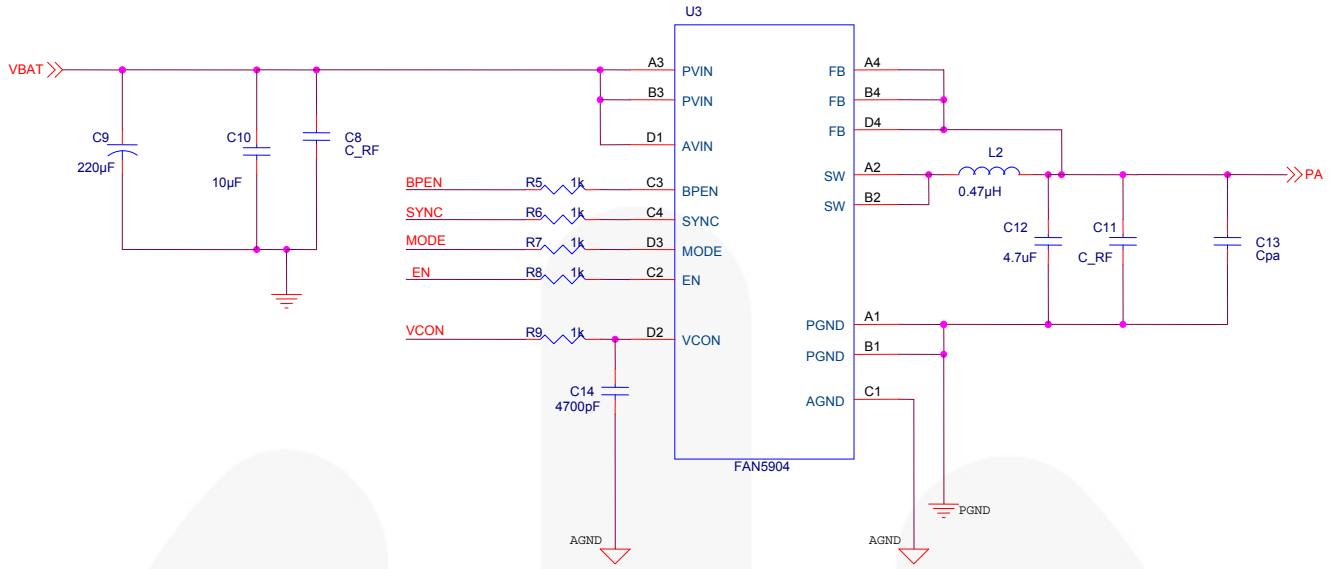

Figure 1. Application Schematic

Table 1. Recommended FR Capacitors for WCDMA Band V

$f_{RESONANCE}$ (MHz)	Size (Metric)	Value (pF)	Material Voltage (V)	MFG	Part Number
898	1005 (H=0.5 mm)	82 ±5%	COG 25	Murata	GRM1555C1E820JA01
898	1005 (H=0.3 mm)	82 ±5%	COG 50	Murata	GRM1555C1E820JA01
885	0201 (H=0.3 mm)	150 ±10%	X7R 16	Murata	GRM033R71C15KA01
885	0201 (H=0.3 mm)	150 ±10%	X7R 25	Murata	GRM033R71E15KA01

Table 2. Bill of Materials

Reference No.	Value	Package	Function	Usage
C10	10 µF	0402	V_{IN} Bypassing	**Required**
C8	TBD	0201 / 0402	V_{IN} Noise Filtering	Recommended
C11	TBD	0201 / 0402	V_{OUT} Noise Filtering	Recommended
C12	4.7 µF	0402	V_{OUT} Bypassing	**Required**
C14	4700 pF	0402	V_{CON} Noise Filtering	**Required**
L2	0.47 µH or 1.0 µH	VLS201610MNT-R47N VLS252010MNT-R47N VLS201610MNT-1R0N VLS252010MNT-1R0N	Output Inductor	**Required**
R9	1 kΩ	0402	Damping	**Required**
R5	1 kΩ	0402	Damping	Optional
R6	1 kΩ	0402	Damping	Optional
R7	1 kΩ	0402	Damping	Optional
R8	1 kΩ	0402	Damping	Optional
C9	220 µF	AVX TAJE227K010RNJ	V_{IN} Bypassing	Optional
C13	TBD	0402	PA V_{IN} Bypassing	**Required**

Related Resources

FAN5903 — 600 mA Buck Converter for 3G, 3.5G, 4G RFPAs

FAN5904 — Multi-Mode Buck Converter for GSM/EDGE, 3G, and 4G PAs

AN-9045 — WLCSP Assembly Guidelines