QN8075 Hardware Application Note

August, 2011

Revision History

Revision	Change Description	Date	Approval
V0.1	Initial draft	August 20, 2011	RanXu

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1. Introduction

The QN8075 is a high performance, low power, full-featured single-chip stereo FM receiver designed for cell phones, MP3 players, and portable radios.

It has two small packages SOP16 and SSOP16 to help you meet the limitation of PCB area. This reference design will provide a basic application for most users, and it cannot cover all FM receiver system applications. In additional, this application note is just a supplementary for hardware system design based on QN8075 datasheet. If you have any special requirement for QN8075, please contact with Quintic engineers.

2. Main features for QN8075

- RX only
- I^2C only
- QN8075 supports external crystal and external rejection clock input (Supports 32.768 KHz and multiple MHz clocks input)
- RDS supported
- Auto seek
- Super low power

3. QN8075 Reference Design

The following schematics show the typical system applications for QN8075. .

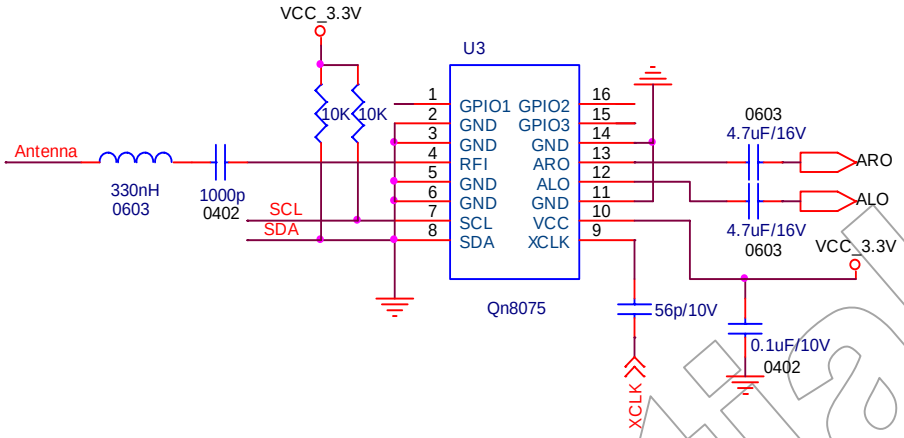

Figure 1 QN8075 Typical Application Circuit

3.1 Power Supply

The QN8075 provides integrated voltage regulator. There needs to be only one decoupling capacitor about 0.1uF on the battery power supply. A 10uF capacitor can be added for best performance. In addition, the supported power supply voltage range is 2.7V to 5.0V.

3.2 FM Signal Input

To improve the efficiency of antenna for FMR, QN8075 integrates a cap-bank block. There should be an original series 330nH inductor on RFI, one 1000pF AC coupling capacitor need to be in series on RFI. A tunable internal capacitor with the external 330nH inductor can be adjusted together by software to maximize efficiency at the Resonant Frequency.

3.3 I^{2}C Interface

QN8075 supports standard I^{2}C protocol and two pull-up resistors value should be 4.7K to 10k on bus.

3.4 Clock Input

External Clock Input:

32.768KHz or greater than 1MHz external clock input can be acceptable in QN8075, if the external clock is sin wave , a 56pF capacitor should be in series on XCLK. If the external clock is square wave, the capacitor should replaced by a 0ohm resistor.

3.4.1 External crystal input

The support of external crystal input is for Qn8075-TCNE / Qn8075-UCNE only.

Schematic is shown in figure 2.

Supports 32.768 KHz and multiple MHz clocks input

Crystal precision <±50ppm

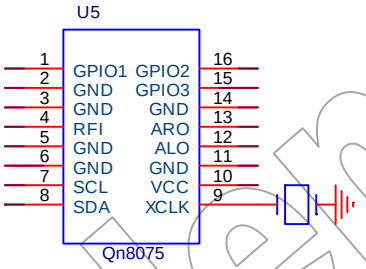

Figure 2. External Crystal Input Reference Design

3.5 Audio Interface

QN8075 can directly drive 32-ohm loads when outputting volume is less than 0.45Vp. For other case, a external audio driver can be selected. For example, LM4811 is a headphone audio driver with volume control which shows as following figure. Also QN8075 has integrated volume controller, audio drivers without volume control is acceptable.

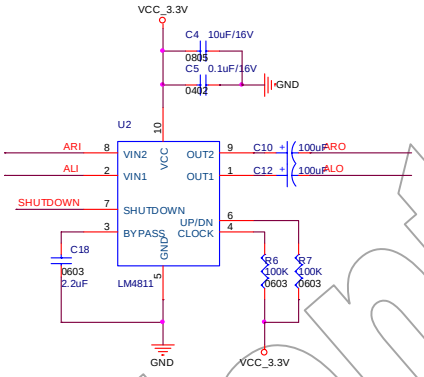

Figure 3

3.6 Antenna

The following circuit is a typical application utilizing earphone line as a FM antenna. Three ferrite beads are used to prevent interference of FM signal with audio signal. A typical ferrite bead value is about 2.5K@100MHz.

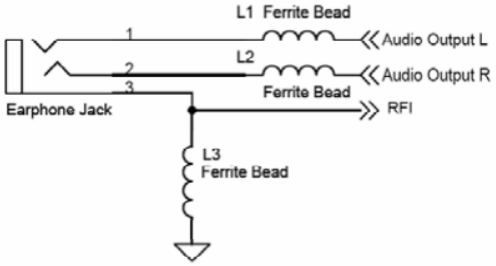

Figure 4

3.7 Reference Schematic

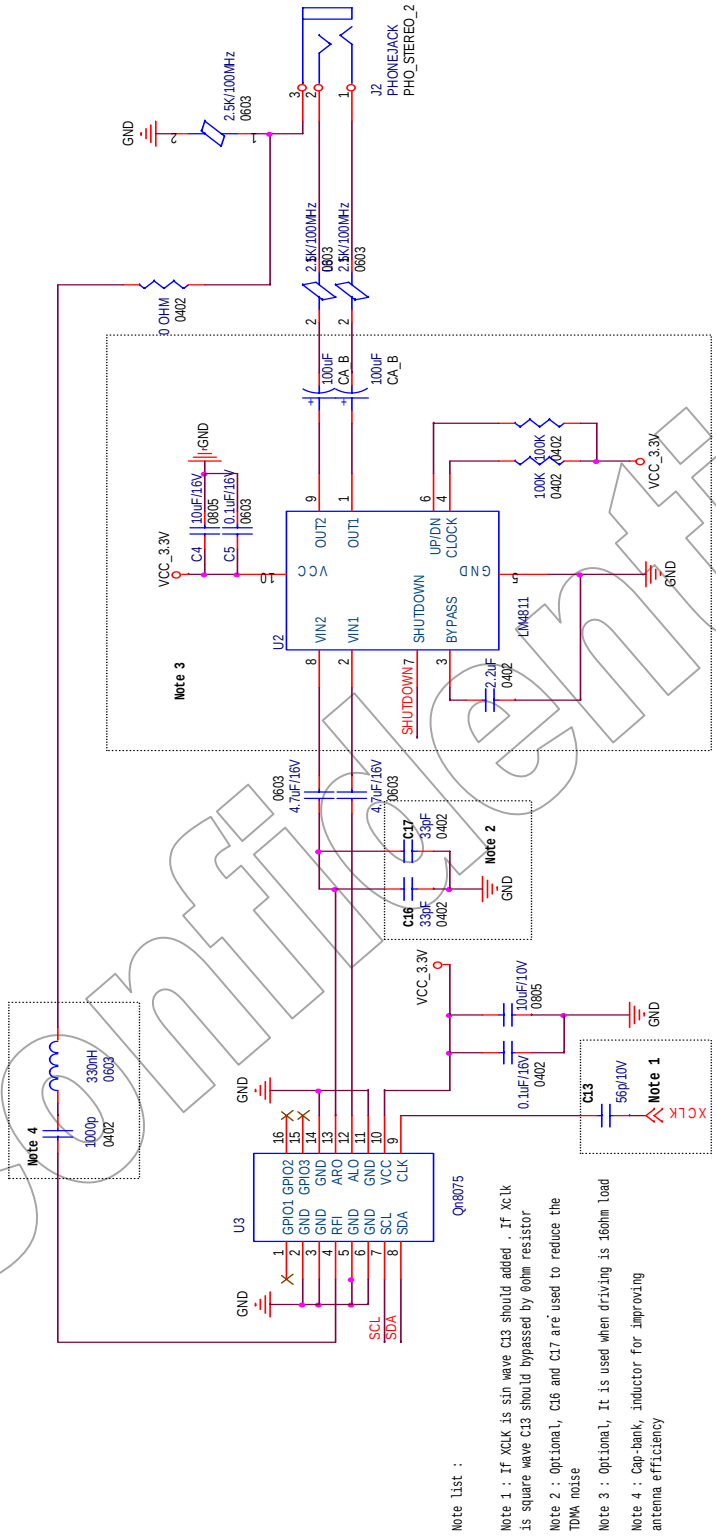

Figure 5.QN8075 Reference Design

4. PCB Design

1) Audio out traces should be also far away from high frequency interference source and digital interference source and the two traces should be as short as possible. The two traces should be shield by ground.

2) RFI trace must be shielded by ground for best EMC. Especially in cell phone system, RFI should far away all kinds' interference.

3) AGND, GND and middle expose pad should be connected together on surface layer and the middle expose pads should have sufficient ground connection.

4) The distance of between SDA and SCL traces should be far enough and the two traces should be also far away from QN8075. The two pull-up resistors of I^2C should be placed from QN8075 as far as possible. Make I^2C trace as short as possible

5) Use External Crystal Input, Make the trace between Crystal to XCLK pin as short as possible.

5. RX Antenna

As we known, the radio broadcast signal is absorbed by the receiving antenna, generally speaking, the longer the antenna, the more energy absorbed. Furthermore, it is easy to obtain more energy in the outside environment, meaning the receiving result better. The other way round, the result will be worse in the inside environment even receives nothing.

5.1 Simple Monopole Antenna

Long antenna will get better performance; however, short monopole antenna is sufficient if only just to listen in, whose length can not be shorter than 15cm. If in an outside environment, the antenna may be a little shorter. When listen to the music or songs which need high SNR, the long antenna is obligatory.

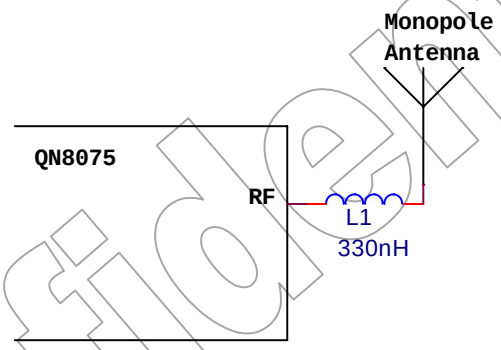

Figure 6. Rx application of monopole antenna

5.2 Earphone Wire Antenna

Making use of the earphone wire as receiver antenna is the most popular application. The common length of earphone wire is about 1m or longer, which just accord with the command of receiving antenna. Commonly, utilizing the ground wire “absorb” the energy of radio broadcast and transfer them to the receiving system to deal with.

Generally, the earphone wire is flexible and easy to wrap, which could affect the receiving result. Therefore, draw the earphone straight if the result is not satisfactory.

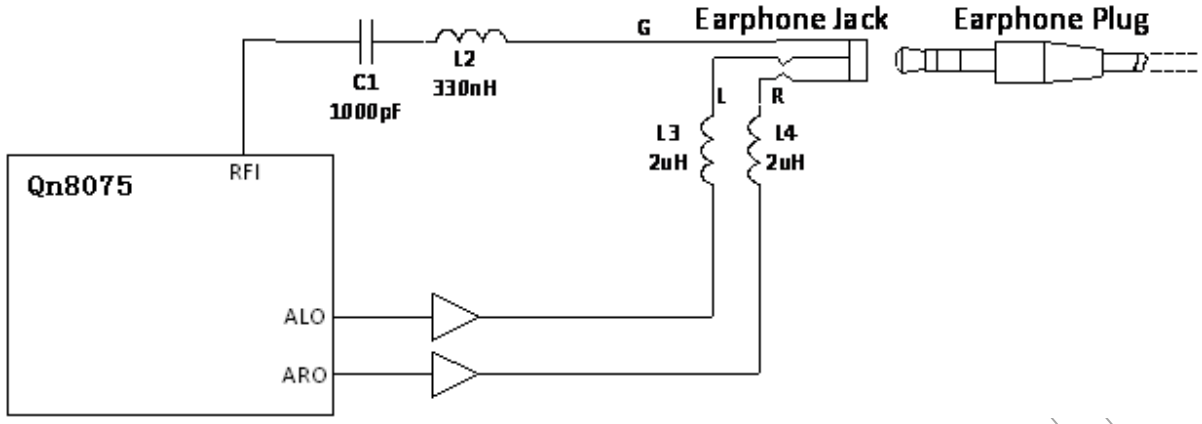

Figure 7 Reuse earphone wire as Rx antenna

5.3 Embedded Antenna

QAF2405 can also be used as Rx antenna, for Rx application, its matching network is shown as figure6, L1 is a high Q coil inductor, whose value may be adjusted based on different PCB layout.

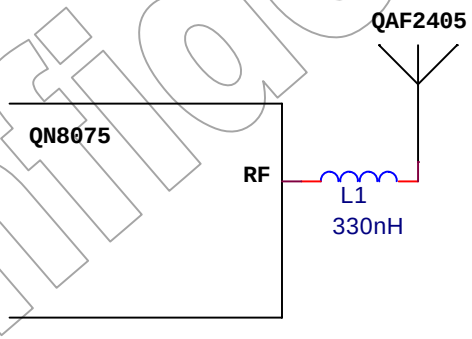

Figure 8. RX Matching of QAF2405

5.4 Share Embedded and Earphone Antenna

As above description, embedded antenna has the advantage of small outline and saving external space; corresponding, earphone antenna can obtain more field strength of signal from the open air and have good receiving effect. Therefore, combine two kinds of antenna together can make up for the shortcomings to each other and being more flexible for different application scenarios.

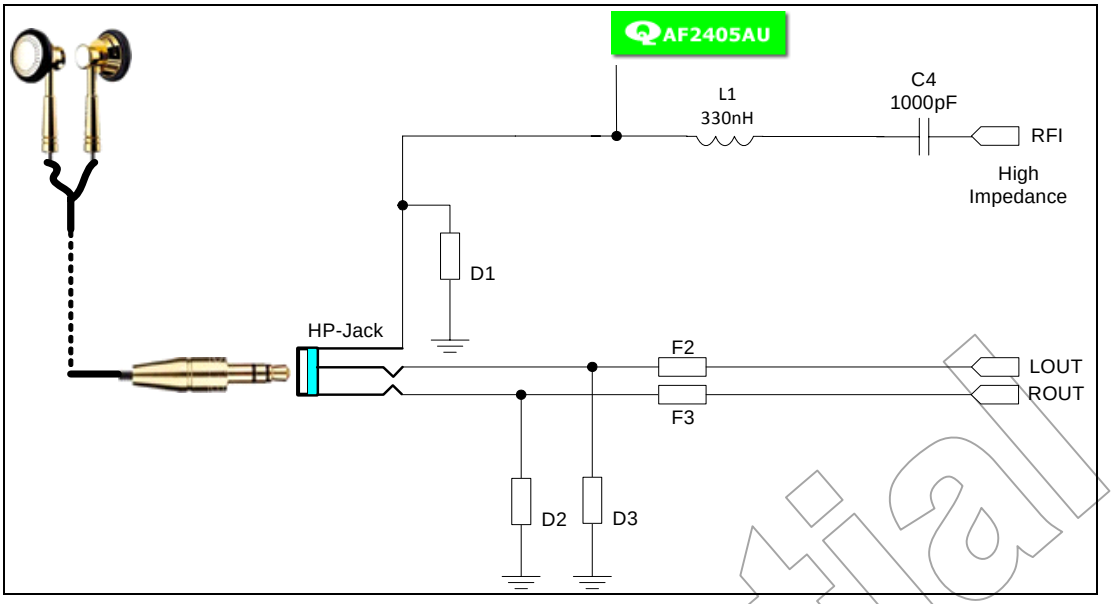

Figure 9.Reference schematic of sharing embedded and earphone antenna

Since the headphone antenna and the embedded antenna have different efficiencies, the combination of these two will provide weak antenna diversity gain. Simulation and test results show that the matching network designed for the embedded antenna can also improve the headphone antenna performance slightly in some configurations. In cases where the headphone impedance changes dramatically, the energy received by the embedded antenna can compensate for the performance loss of the headphone antenna such that the overall antenna system performance can still be preserved.

Select ESD protection diodes D1-D3 (optional) with minimum capacitance. Inductors F2 and F3 are 2uH to block FM signals. Please place D1-D3 and F2-F3 as close as possible to the headphone connector for maximum effectiveness. Fine tune the matching network according to the specific industrial design. L1 should be coil inductor with high Q.

Table1 summarizes of the advantages and disadvantages of these three antenna application types.

Antenna	Advantages	Disadvantages
Headphone Antenna	Good reception performance	Lengthy, not easy to integrate into the device; Impedance is sensitive to physical configuration
Embedded Antenna	Small form-factor saves space Highly integrated	Performance less than headphone antenna for weak signals; Extra requirements for industrial design
Shared Antenna	Better and more reliable than single antenna; Provides flexibility for different application scenarios	More complexity in the design

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