

Remote Tuner Architecture Reduces Wiring Weight and Cost While Improving Noise Immunity

Introduction

In a traditional radio architecture, wiring four antennas to the radio head unit requires up to 20 meters (60 feet) of copper cables. A new architecture detaches the tuners from the radio head unit, placing them near the antennas and serializing their outputs. This reduces the length of the wiring by roughly a factor of four. The overall effect is significantly lower weight and cost, improved noise immunity, reduced heat generation, and less complexity in the radio head unit (Figure 1).



Figure 1. Typical Automotive Radio Head Unit

The Traditional Head Unit Architecture

The head unit is the command center for a car's audio system. It lets the driver choose the audio source, set the volume, select a song or select a radio station. It traditionally incorporates the radio tuners, baseband processing ICs, and applications processor, in addition to audio signal processing and amplifiers, as illustrated in Figure 2.

The complexity of the traditional head unit creates many design challenges. Heat generated by the concentration of electronics may require the use of heatsinks and degrade reliability. The monolithic nature of a traditional head unit also implies that any change to the features of the radio requires at least partial redesign of the extremely complex head unit.

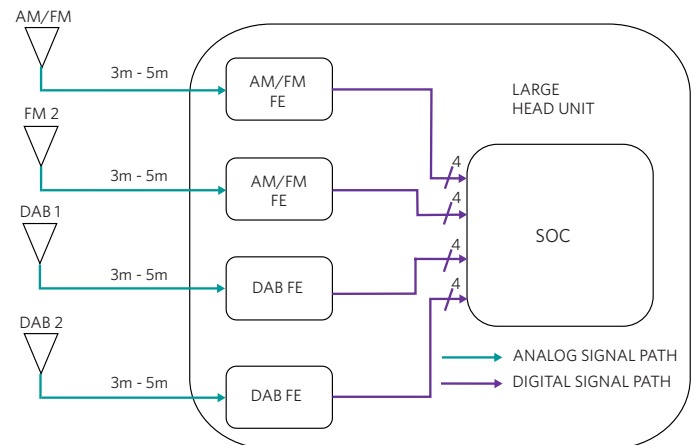


Figure 2. Traditional Head Unit Architecture

As the primary user interface for a car's infotainment system, the head unit is almost universally located in the center console. This places it in close proximity to the driver, which simplifies interaction between the driver and head unit. However, it also results in the head unit being located far from antennas placed on the roof or in the rear or side windows. These antennas often require a lengthy maze of wires to connect to the head unit, which increases cost and susceptibility to noise.

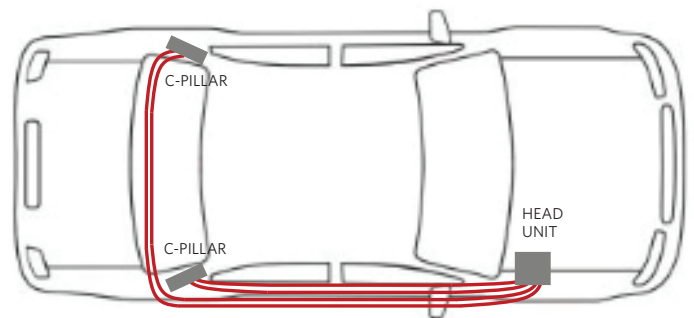


Figure 3. Traditional Architecture Wiring

Figure 3 is an example of a traditional architecture in which two pairs of antennas located in the rear window are routed to the central head unit. Note that there are multiple cables running in

parallel for the entire length of the path between both antenna modules and the head unit.

Remote Tuner Architecture

Maxim Integrated has developed an innovative “Remote Tuner Architecture” which removes the tuners from the head unit. In the example remote tuner architecture shown in Figure 4, a pair of tuners is placed in each c-pillar. The remote tuner modules are denoted RTB1 and RTB2.

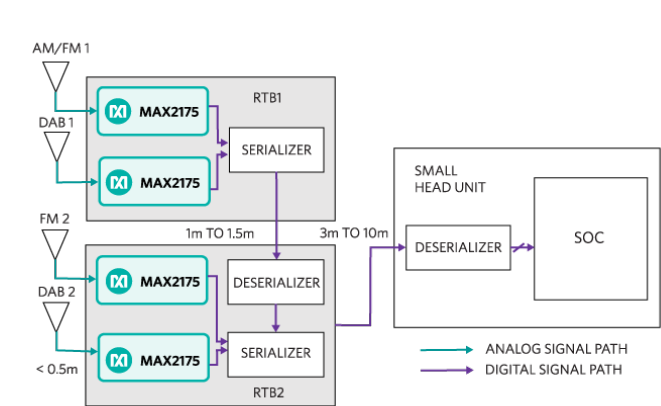


Figure 4. Remote Tuner Architecture

The two remote tuner modules are connected together with a single short coax serial link, and the ensemble of four is then brought to the head unit via a single coax serial link. This coax carries the tuners’ output to the head unit and also provides I²C communication and power to the tuners, eliminating additional cables. This architecture results in a smaller and cooler head unit and a dramatic reduction in the number of cables (Figure 5).

The digital serial interconnects are immune to ambient noise, dramatically easing the difficulties associated with routing the cables and improving reception of weak signals.

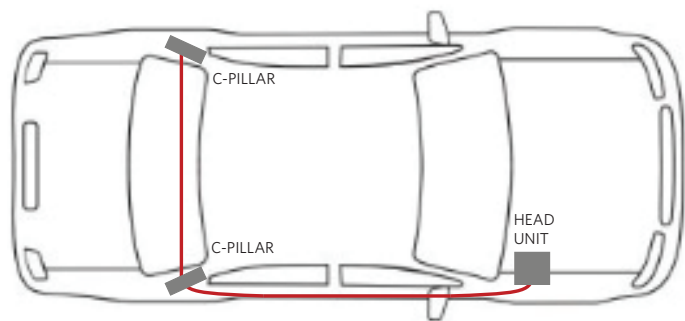


Figure 5. Remote Tuner Architecture Wiring

Another advantage of the remote unit architecture is scalability—it’s very easy to add more tuners for background scan and phase diversity without changing the design of the head unit.

The Remote Tuner Demo System

A pair of remote tuner modules can be used to demonstrate the new architecture.

The first remote tuner module (RTB1 in Figure 4 and Figure 6) includes a pair of AM/FM/Digital radio tuners, a serializer and a PMIC. This module supports single module systems is used or in conjunction with the second module (RTB2 in Figure 4) in multi-module systems.

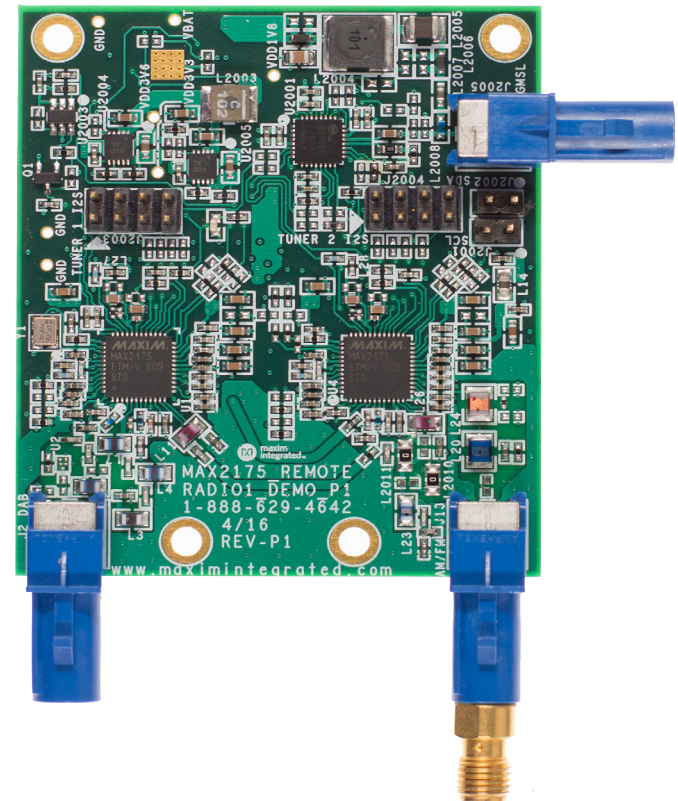


Figure 6. Remote Unit Module RTB1

The second module (RTB2 in Figure 4 and Figure 7) supports multi-module systems. It includes a pair of tuners, power management, and serializer/deserializer chipset to enable daisy chaining of multiple modules.

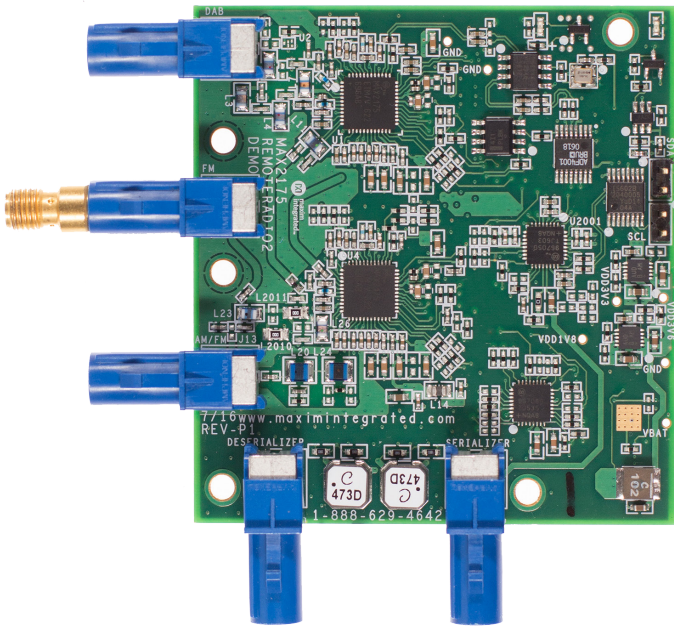


Figure 7. Remote Unit Module RTB2

A baseband/head unit adapter (Figure 8) includes a deserializer and connectors that enable convenient interfacing to baseband processors or to a logic analyzer for evaluation.

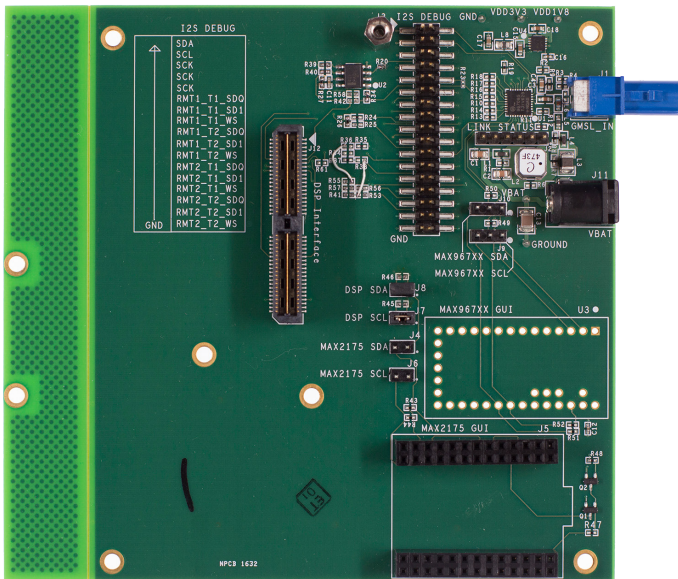


Figure 8. Head Unit Adapter

Alternatively, the tuner modules can be connected directly to any head unit with an appropriate GMSL deserializer and FAKRA connector.

The demo boards include six Maxim Integrated ICs (refer to the “Learn more” section). Maxim’s future roadmap envisions further integration of the ICs, to provide an even smaller and more cost effective solution.

Conclusion

We have discussed the shortcomings of the traditional radio head unit architecture and the advantages of using a remote tuner architecture, in which the tuners are moved from the head unit into close proximity of the antennas. This new partitioning proposed by Maxim Integrated allows dramatic savings in wiring complexity, weight and cost, as well as reduced noise coupling. The remote tuner architecture results in a smaller, cooler, scalable head unit, making it easy to add more tuners as required by the current and future proliferation of radio features and bands. Maxim’s future roadmap envisions further integration of the ICs, to enable an even smaller and more cost effective remote tuner solution.

AM: Amplitude Modulation

C-PILLAR: The vertical or near vertical supports of a car’s window area.

BASEBAND: Frequency domain of signals after down-conversion in a tuner.

FM: Frequency Modulation

GMSL: Gigabit Multimedia Serial Link

IC: Integrated Circuit

PHASE DIVERSITY: Robust reception implemented with multiple antennas receiving the same signal.

PMIC: Power Management IC

SW: Short Wave

TUNER: A device that receives radio frequency (RF) transmissions and downconverts them into an intermediate frequency (IF) ready for demodulation.

Learn more:

[MAX2175 RF to Bits Automotive Radio Tuner](#)

[MAX96711 14-bit GMSL Serializer](#)

[MAX96708 14-bit GMSL Deserializer](#)

[MAX20002 Synchronous Buck Converter](#)

[MAX15027 1A, Low-Dropout Linear Regulator](#)

Please contact us if you would like to learn more about the remote tuner modules.

Design Solutions No. 28

Need Design Support?

Call 888 MAXIM-IC (888 629-4642)

Maxim Integrated
160 Rio Robles
San Jose, CA 95134 USA
408-601-1000
maximintegrated.com

