

# **THE DRE200 – MAKING DIGITAL RADIO AFFORDABLE, PORTABLE AND AVAILABLE NOW**

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## **ABSTRACT**

In 2001, Texas Instruments (TI) announced their first product for the Eureka Digital Audio Broadcasting (DAB) digital radio market, the TMS320DRE200. This product intended to address several issues facing the digital radio receiver market today: cost, power and product variety.

Before this introduction, Eureka DAB digital radio solutions were expensive. As a result, digital radios were priced out of reach for most consumers. In July 2001, TI announced a bill of material cost of less than \$40 dollars, enabling manufacturers to create less expensive radios for customers.

Power consumption of earlier solutions was extremely high. Consequently, battery-operated and portable radios were non-existent. This paper details the advances made by the DRE200 and how it enabled the first commercial handheld and portable radios.

Finally, initial DAB products focused on the home hi-fi and trunk-mounted car radios and typically provided only DAB radio functionality. This paper also shows how the DRE200 expands DAB product capabilities by hosting a variety of features, including MP3 functionality.

## **INTRODUCTION**

Before presenting the business potential of TI's DAB chipset, one must understand what TI sells. TI's digital radio offering consists of the following: a \$5000 DRE200 evaluation module (EVM) to allow designers to evaluate our solution in the real world environment and a DRE200 turnkey reference design to give customers a quick time-to-market option that involves little design effort on the part of the designer. TI's worldwide support structure accompanies both offerings. We have local field support and technical support in the U.S. that can help companies from design concept to actual product. TI's digital radio team firmly believes that winning the digital radio market will happen for TI only if its customers are successfully able to field and sell products to their customers, be it retailers, distributors, broadcasters, other receiver manufacturers or the end consumers themselves. This has empirically been shown with the customers that we have today. We actively assist our customers achieve business around the world, matching their strengths with needs in Europe, Canada, Australia and Asia.

## **DRE200 EVM**

The DRE200 EVM is an excellent tool for both first-time and experienced DAB users alike. The EVM allows the designer of a digital radio receiver to assess the performance of the DRE200 digital baseband and the total receiver design for Eureka-147 digital audio broadcast radio. The board should provide ample information to benchmark the receiver characteristics. It also provides insight

into how a low-cost, low-power and differentiated solution can be built using TI's DRE200 digital baseband and analog products. To the latter point, TI provides schematics and a full bill of materials (BOM) that help show silicon costs in full detail. This visibility helps companies effectively plan their cost structure, margins and prices. Also during the evaluation, decisions regarding engineering and manufacturing can be made. Whether a company decides to build a radio on their own (some of whom use the evaluation board as a reference), use a turnkey reference design or go to a customized reference design with third party assistance from Radioscape (eliminating design burden from customer), TI always acts as the face to the customer, with consulting and supporting decisions made by the company.

## **DRE200 TURNKEY REFERENCE DESIGN**

The Turnkey Reference Design is a collection of deliverables including circuit diagrams, sample boards and documentation that make the job of a customer very easy to design, manufacture and mass-market DAB radio products. The design uses TI's DRE200 chipset. The Turnkey Reference Design has been created to incorporate all of the standard features needed to create a DAB Radio.

The main benefits of the Turnkey Reference Design are:

- It can enable a customer to get to market with DAB products quickly and cost effectively. Time period from design concept to manufacture could be reduced to as low as 3 to 6 months.
- It will massively reduce the learning curve and complexity of creating DAB products, especially the difficulties associated with RF design and layout.
- The Turnkey Reference Design is flexible enough to create a range of products from one reference design. Specifically, it can be used to create a DAB-only radio or a multifunctional unit, such as a CD player and DAB radio.
- It enables companies to market products that are differentiated from their competitor's products in the way that they specify.

The sample boards and support material provided with the Turnkey Reference Design are applicable for battery-operated low power receiver products. The Turnkey Reference Design includes support to modify its hardware and software for product differentiation. Support will be provided for modifying the human-machine interface (HMI), the liquid crystal display (LCD), the digital to audio converter (DAC), power configurations (for car radio, mains operation, etc.) and several other aspects of the system.

Customers finally have the option to specify the characteristics of the DAB radio they would like to build and can have a third party customize the reference design for them. In this case, TI acts as a partner coordinating the necessary arrangement with the third party, Radioscape. In addition, TI still provides access to its worldwide support structure for digital radio and continues to help the customer in acquiring digital radio business.

## **MAKING DIGITAL RADIO AFFORDABLE**

The EVM and the reference design not only help the designer create the digital radio, they demonstrate the silicon bill of material. This includes all the integrated circuits on a printed circuit board, including passives, LCD and the circuit board itself. In making a business case for a product, the supplier must convey the full system design cost to the customer so that the appropriate margins and pricing can be set.

In the past for digital radio, this silicon BOM cost had been very expensive, costing hundreds of U.S. dollars. As a result, companies were forced to charge high prices to their customer, which in most cases were marked up more by the retailer (understandably). The overall cost to the consumer ended up in the thousands of US dollars range, making digital radio unaffordable.

TI recognized that the problem began with the silicon BOM. The first DRE200 design brought the costs down to \$65. However, while TI realized that this was the lowest bill of material in the industry, it wasn't low enough to make DAB digital radio a viable consumer proposition. At retail, prices would still remain in the hundreds of dollars.

Through further cost optimization, integration and bundling (achieving economies of scale) of TI analog and digital parts, TI announced mid-last year of a \$40 (U.S.) BOM. Further cost reductions are forthcoming and have been realized recently with specific system implementations (e.g. AC power vs. 3V implementation). At the \$40 price point for receiver manufacturers, the BOM is attractive enough to produce low-cost digital radios that will ultimately help make DAB a consumer reality.

However, making digital radios cheap isn't enough to help turn the DAB market around.

## **MAKING DIGITAL RADIO PORTABLE**

The power of analog radio today is its portability, contributing to the ubiquitous nature of the technology. Consumers use radio practically everywhere: in a car, in the home or carried by an individual.

While previous chipsets have addressed aftermarket car and home units, OEM in-dash car, portable and battery-operated units have not been available. The primary reason for this is the large power consumption of the chipset itself, sometimes in excess of 2W, makes the latter types of radios infeasible to design. OEM car typically requires less than 1 W of power consumption for an in-dash unit and battery-operated radios must have dissipation numbers in the hundreds of mW range.

TI began addressing this by first choosing a low power consuming baseband, the DRE200. This DSP-based baseband operates at 170 mW. More importantly it uses software to control the rest of the system to operate as efficiently as possible, thus further reducing the power consumption of TI's chipset. The result is seen in commercial products such as Personal Telecom's DR101 and DR201, which operate for more than 8 hours on 2 AA batteries. Achieving this also helps digital radio with the final benefit of the DRE200: a variety of radios available now.

## **MAKING DIGITAL RADIO AVAILABLE NOW**

Both the turnkey reference design and evaluation board are available now and have been since last year, giving companies the ability to begin development as soon as possible on a robust, proven

platform. Through the efforts of these companies and the support of TI, a wide range of radios have been developed.

The DRE200 is a programmable solution that allows features to be added, broadening the variety of available radios. For instance, the DR201 has both DAB and MP3 decoding using the same baseband. This makes for a more compelling consumer proposition and allows receiver manufacturers to charge a premium for offering a differentiated product.

Other products are coming on-line or available now based on the DRE200 chipset including: PCI card, home hi-fi, DVD/DAB combination, portable shelf system, DAB module and battery-operated radios. These radios, in conjunction with those available today, give consumers a range of choices when buying a digital radio.

## **CONCLUSIONS**

The DRE200 solution presents a compelling business case for receiver manufacturers. It has a low cost BOM, thus allowing for inexpensive radios to be offered to customers. It has low power consumption, extending battery life for listeners. Through the use of a programmable platform, an eclectic mix of radios can be created, increasing product choice and making DAB digital radios a more compelling consumer proposition. All of these attributes are demonstrated in the DRE200 evaluation module and turnkey design, both available today.