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# The AMBE+2<sup>™</sup> version 1.6 Vocoder

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A fundamental part of any digital radio system is the vocoder. The term vocoder stands for voice encoder/decoder. The vocoder is the function within a digital radio that converts the analog speech signal into a digital bit stream, and conversely after transmission and reception, converts the digital bit stream back into a speech signal. Vocoder are typically implemented as a software algorithm in a Digital Signal Processor (DSP). The vocoder is responsible for converting speech into a compact bit stream to allow the speech to be sent with few bits to allow for spectrally efficient transmission.

The vocoder that was initially chosen for Project 25 was the Improved Multi-Band Excitation (IMBE™) vocoder in 1993, a product of Digital Voice Systems, Inc. (DVSI). This choice was based on comprehensive listening tests of various vocoders that were available at the time. The IMBE vocoder outperformed the other contestant vocoders, and as a result was selected as the standard. This was the vocoder that was used in Project 25 equipment for many years.

Over the course of time, improvements were being made in vocoder technology. These included improved audio performance, improved performance in noisy environments, lower rate vocoders, and the addition of additional capabilities. One such improved vocoder was the AMBE+2™, by DVSI. This improved vocoder was evaluated by Project 25 in comparison the original baseline IMBE vocoder. New comprehensive listening tests were conducted, and as a result of these tests the Project 25 Steering Committee decided in October 2005 to adopt this new vocoder as the Project 25 standard.

At about this time, reports were surfacing about communication difficulties that were identified with digital radios when used in extremely noisy environments, typically associated with firefighter applications. Extreme noisy environments from saws, pumps, and Personal Alert Safety System (PASS) alarms, coupled with voice degradation due to self contained breathing masks were causing degraded communications. Acoustic testing showed an improvement in performance when the new vocoder was used instead of the baseline IMBE vocoder.

EF Johnson Technologies realizes that voice quality and improved performance in noisy environments is crucial to our customers. As a result of this realization, EF Johnson Technologies made a commitment to redesign all of its products to include the AMBE+2™ vocoder. EF Johnson Technologies became one of the first manufacturers to adopt this vocoder, and the first to retrofit existing product over to the improved vocoder.

In 2009, DVSI made additional enhancements to the AMBE+2™ with the release of version 1.6 of the vocoder. Among the improvements that were made in this latest version are improvements in the ability of the vocoder to transmit tones, such as telephone signaling tones. And, perhaps most



**Project 25  
Vocoder History**

*DVSI vocoder was selected as the digital vocoder for the P25 standard. Since it was adopted in 1993, the P25 Steering Board has adopted two upgraded versions.*

**IMBE**

*Base vocoder originally selected..... 1993*

**AMBE+2 (v 1.4)**

*Improved audio quality, better tones ..... 2005*

**AMBE+2 (v 1.6)**

*Improved noise suppression for fire pass alarms .... 2009*

important, are improvements in rejecting high frequency background noise. This has particular importance in preventing voice degradation in the presence of firefighter PASS alarms. The new vocoder is fully interoperable with the previous AMBE+2™ vocoder, as well as the baseline IMBE™ vocoder, and will interoperate with any Project 25 radio.

Preliminary testing of this latest version of the vocoder by the National Institute of Standards and Technology (NIST) has shown additional improvement in performance in noisy environments over previous versions. This new release was also adopted by the Project 25 Steering Committee as the required standard in August 2009. As a result, EF Johnson Technologies has implemented version 1.6 of the vocoder into all of its products. EF Johnson Technologies remains committed to supplying the best audio performance available to the industry.

Customers have been field testing the new AMBE+2, version 1.6 vocoder. Visit the Maple Bluff web site and "Hear the Difference:" [www.maplebluffire.com/videos/Narrowband-radio-test](http://www.maplebluffire.com/videos/Narrowband-radio-test)



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