

## **Dynamic Range Compensation in Mobile Phones**

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### **Abstract**

Mobile telephony applications have very demanding requirements for the dynamic range of speech signals, and have limited ability to reproduce these due to product restrictions in size, power and cost. There are three major problems with dynamic range in telephone applications: 1) the high peak-to-RMS ratio naturally characteristic of speech signals; 2) the wide variation in RMS levels of speech signals; and 3) the high level of background noise common in telephony. Previous solutions such as automatic gain control (AGC) do not address all of these problems and provide only limited improvements. Waves has developed, patented and offers a DSP algorithm technology that addresses all of these problems with superior and more natural sounding results. The first mobile telephony products with this technology are now shipping from Sanyo that delivers dramatic handsfree audio quality improvement while simultaneously enabling a smaller handset design.

### **Background**

Mobile telephony must support speech signals that are characterized with large dynamic range due to variations between speakers, normal variations in speech level and variations in relative position between the speaker and microphone. At the same time mobile telephony has severe restrictions on supply voltage, power consumption, physical size of speaker and speaker enclosure, and cost. The speakerphone or handsfree function is particularly challenging since this output device must also generate enough loudness to be heard clearly in relatively noise environments.

The industry has widely adopted automatic gain control (AGC) to address dynamic range limitations of the output speaker. AGCs deliver constant output levels, except when noise is detected. These methods must use slow response times in order not to eliminate all of the variations in speech levels, but still most of the natural variation is removed creating an unnatural response. AGCs are designed to improve clarity partly by sacrificing natural speech response and have been used in early telephony systems as well.

AGCs can not compensate for the high peak-to-RMS ratio found in speech signals, since this requires peak limiting with fast response times. AGCs also attempt to reduce background noise through muting by utilizing the same envelope detection signal path. This performance is also degraded since its response time requirement is also different than the AGC designed for RMS variation adjustment.

**MaxxVolume**

Waves MaxxVolume solution addresses all three dynamic range compensation problems in mobile telephony by implementing several control paths in parallel, each optimized for address a different problem. This solution utilizes separate controls for peak limiting, dynamic range compression and noise gating to deliver a comprehensive solution to dynamic range compensation. The overall performance is substantially improved in terms of intelligibility/clarity, maximum loudness, and more natural response than with industry standard AGC based solutions.

**Mobile Phone Solution**

Waves patented MaxxVolume dynamic compensation algorithm is bundled with its patented MaxxBass bass extension algorithm under the MaxxVoice brand. Waves MaxxVolume implementation is available as an ARM9 licensable algorithm to the mobile phone industry.

Waves is the world's leading developer and provider of professional digital audio processing tools. Waves technologies are used to improve sound quality in the creation of hit records, major motion pictures, and popular video games the world over. Under its Maxx® brand, Waves delivers semiconductor and algorithm licensing solution to compensate for acoustic limitations in mainstream CE products. [www.waves.com](http://www.waves.com)