**Voice-Controlled Digital Answering Machine**

**Overview**
A single hybrid-architecture device, incorporating both a microcontroller (MCU) and a digital signal processor (DSP), offers the peripherals needed to produce a voice-controlled digital telephony answering device (DTAD) at a low cost.

**Key Benefits**
- Provides a single-device solution that combines MCU functionality and DSP processing power
- Supports inexpensive ESSI connections to Codec/DAA
- Contains GPIO ports for LCD and keyboard connection
- Provides a variety of vocoders and telephony algorithms
- Contains an integrated real-time clock
- Contains a voice recognition system
- Offers out-of-the-box software components that are designed to expedite time-to-market and reduce development costs

**Sample Design: Voice-Controlled Digital Telephony Answering Device**

- **Message Storage**
- **I/O Board**
- **Key Pad**
- **LCD**
- **GPIO**
- **SPI**
- **ESSI**
- **Codec**
- **Audio AMPS**
- **Telco**
- **Line I/F**
- **TC**
- **Timer**
- **EAB/EDB**

Launched by Motorola

freescale semiconductor
**Design Challenges**
As telephone systems become more sophisticated, consumers expect a wider variety of features when upgrading equipment. Creating a voice-controlled DTAD that can meet these expectations requires components that offer the right combination of peripherals in a compact package and at a reasonable consumer cost.

**Freescale Semiconductor Solution**
Several of Freescale Semiconductor’s DSP56800E devices are appropriate for a DTAD application. For example, as shown in the figure on page 1, the DSP56858 provides the following interfaces:

- Flexible PLL clock source provides various crystals and/or oscillators that help to reduce system cost
- SSI or ESSI peripherals for seamless connection to Codecs (for user interface and telco interface)
- An SPI for connection to a Flash card device
- An integrated time-of-day peripheral providing real-time clock
- Additional general purpose input/output (GPIO) ports for LCD and keypad support

Included in Freescale Semiconductor’s embedded Software Development Kit are:

- VRLite-1 for memory-optimized, isolated-word, speaker-dependent speech recognition system
- A wide variety of vocoder algorithms for voice compression
- A comprehensive set of drivers and framework code, enabling quick completion of the software application
- The out-of-the-box software components for all on-chip peripherals, in combination with software libraries for motor control, communication, and signal processing, make it easier to develop the most demanding real-time embedded applications

The figure on page 1 shows a sample design featuring the DSP56858 and a real-time clock at the heart of a voice-controlled DTAD. An ESSI connection supports a Codec for user and telco interfaces, and a second ESSI connects to a Codec that enables audio amplification. An SPI provides a link to a message storage unit incorporating Flash. A GPIO connects to an LCD and another GPIO connects to a keypad. Keypad and LCD can also be interfaced through EMI and memory mapped latch.

A voice-controlled DTAD with VRLite application can provide an audible menu, making a phone directory search a natural conversation.

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### Freescale Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Product Highlights</th>
<th>Additional Information</th>
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</thead>
<tbody>
<tr>
<td>DSP56852</td>
<td>120 MHz, 120 MIPS, SCI, SPI, ISSI, EMI, COP, Quad Timer and &gt; 1K boot ROM &gt; 6K program RAM &gt; 4K data RAM &gt; Up to 2MB program and 6MB of data</td>
<td>MCU-friendly instruction set, improved OnCE for debug, up to 4 programmable chip select signals, and up to 11 GPIO available in an 81 MAPBGA</td>
</tr>
<tr>
<td>DSP56853</td>
<td>120 MHz, 120 MIPS, 2 SCI, SPI, ESSI, HI, EMI, COP, DMA, TOD, Quad Timer and &gt; 1K boot ROM &gt; 12K program RAM &gt; 4K data RAM &gt; Up to 2MB program and 8MB of data</td>
<td>MCU-friendly instruction set, enhanced OnCE for debug, 6 channels of DMA, up to 4 programmable chip select signals, and up to 41 GPIO available in a 128-pin LQFP</td>
</tr>
<tr>
<td>DSP56854</td>
<td>120 MHz, 120 MIPS, 2 SCI, SPI, ESSI, HI, EMI, COP, DMA, TOD, Quad Timer and &gt; 1K boot ROM &gt; 16K program RAM &gt; 16K data RAM &gt; Up to 2MB program and 8MB of data</td>
<td>MCU-friendly instruction set, enhanced OnCE for debug, 6 channels of DMA, up to 4 programmable chip select signals, and up to 41 GPIO available in a 128-pin LQFP</td>
</tr>
<tr>
<td>DSP56855</td>
<td>120 MHz, 120 MIPS, 2 SCI, ESSI, EMI, COP, DMA, TOD, Quad Timer and &gt; 1K boot ROM &gt; 24K program RAM &gt; 24K data RAM &gt; Up to 2MB program and 8MB of data</td>
<td>MCU-friendly instruction set, enhanced OnCE for debug, 6 channels of DMA, up to 4 programmable chip select signals, and up to 18 GPIO available in a 100-pin LQFP</td>
</tr>
<tr>
<td>DSP56857</td>
<td>120 MHz, 120 MIPS, 2 SCI, SPI, 2 ESSI, HI, COP, DMA, TOD, Quad Timer and &gt; 1K boot ROM &gt; 40K program RAM &gt; 24K data RAM</td>
<td>MCU-friendly instruction set, enhanced OnCE for debug, 6 channels of DMA, up to 4 programmable chip select signals, and up to 47 GPIO available in both a 144-pin LQFP and a 144 MAPBGA</td>
</tr>
<tr>
<td>DSP56858</td>
<td>120 MHz, 120 MIPS, 2 SCI, SPI, 2 ESSI, HI, EMI, COP, DMA, TOD, Quad Timer and &gt; 1K boot ROM &gt; 40K program RAM &gt; 24K data RAM &gt; Up to 2MB program and 8MB of data</td>
<td>MCU-friendly instruction set, enhanced OnCE for debug, 6 channels of DMA, up to 4 programmable chip select signals, and up to 47 GPIO available in both a 144-pin LQFP and a 144 MAPBGA</td>
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</tbody>
</table>
### Development Tools

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Product Name</th>
<th>Vendor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>MSW3SDK000AA</td>
<td>Freescale Semiconductor</td>
<td>Software infrastructure that enables development of efficient, high-level software applications that are fully portable and reusable across all of the DSP56800/DSP56800E family of processors.</td>
</tr>
<tr>
<td>Software</td>
<td>CWDSP56800E</td>
<td>Freescale Semiconductor</td>
<td>CodeWarrior™ Software Development Tools for DSP56800E (Metrowerks)</td>
</tr>
<tr>
<td>Software</td>
<td>ENGRCHCVR</td>
<td>Freescale Semiconductor</td>
<td>A premium component that enables development of a voice recognition system.</td>
</tr>
<tr>
<td>Software</td>
<td>ENGRCHG711</td>
<td>Freescale Semiconductor</td>
<td>G.711 Log-PCM</td>
</tr>
<tr>
<td>Software</td>
<td>ENGRCHG726</td>
<td>Freescale Semiconductor</td>
<td>G.726 Adaptive Differential Pulse Code Modulation (µDPCM) Speech Codec</td>
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<tr>
<td>Software</td>
<td>ENGRCHG723</td>
<td>Freescale Semiconductor</td>
<td>G.723.1A Dual-Rate Speech Coder</td>
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<tr>
<td>Software</td>
<td>ENGRCHG729</td>
<td>Freescale Semiconductor</td>
<td>G.729AB</td>
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<tr>
<td>Hardware</td>
<td>DSP56852EVM</td>
<td>Freescale Semiconductor</td>
<td>Evaluation Module for the DSP56852</td>
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<tr>
<td>Hardware</td>
<td>DSP56858EVM</td>
<td>Freescale Semiconductor</td>
<td>Evaluation Module for the DSP56858, DSP56857, DSP56855, DSP56854, and DSP56853</td>
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<tr>
<td>Hardware</td>
<td>TDC1</td>
<td>Freescale Semiconductor</td>
<td>Daughter card for DSP56852EVM and DSP56858EVM that has a telephone connector, display, and keypad.</td>
</tr>
</tbody>
</table>

**Disclaimer**

This document may not include all the details necessary to completely develop this design. It is provided as a reference only and is intended to demonstrate the variety of applications for the device.