# dsPIC30F Speech Encoding/Decoding Library

## Summary

The **dsPIC30F Speech Encoding/Decoding Library** performs toll-quality voice compression and voice decompression. The library is based on a modified version of Speex source code and features a 16:1 compression ratio. It samples speech at 8 kHz and compresses it to a rate of 8 kbps. Storing compressed speech for playback requires approximately 1 KByte of memory for each second of speech. The library is especially suitable for the following voice-based applications:

- Answering machines
- Building and home safety systems
- Intercoms
- Smart appliances
- Voice recorders
- Walkie-talkies
- Any application using message playback

## Description

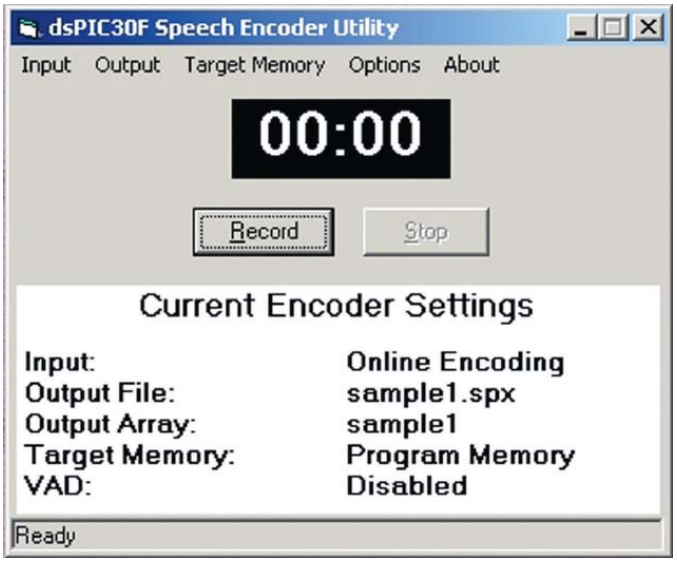
The Speech Encoding/Decoding Library is a modified version of the Speex speech coder made specifically for the dsPIC30F family of Digital Signal Controllers (DSCs). Encoding uses Code Excited Linear Prediction (CELP), which is a popular coding technique. CELP provides a reasonable trade-off between performance and computational complexity. The library samples speech at 8 kHz and compresses it to a rate of 8 kbps. The library is appropriate for half-duplex systems, such as answering machines, intercoms and walkie-talkies. With the decoder's small footprint, the library is also ideal for playback-only applications, such as building safety systems and smart appliances.

Predominantly written in assembly language, the Speech Encoding/Decoding Library optimizes computational performance and minimizes RAM usage. A well-defined API makes it easy to integrate with your application.

A flexible analog interface gives your design several options to consider. The speech encoder samples speech at 8 kHz using either an external codec or the on-chip 12-bit analog-to-digital converter. The speech decoder plays decoded speech through an external codec or the on-chip pulse-width-modulator (PWM).

A PC-based Speech Encoder Utility program (pictured above) allows you to create your own encoded speech files for playback. Encoded speech files are made from either a PC microphone or existing WAV file. Once you create the encoded speech files, they are added to your MPLAB® C30 project, just like a regular source file, and built into your application.

The Speech Encoder Utility allows you to select four target memory areas to store your speech file: program memory, data EEPROM, RAM and external flash memory. External flash memory allows you to store many minutes of speech (1 minute of speech requires 60 KB) and it is supported through a dsPIC30F general purpose I/O port.




## Features

Key features of the Speech Encoding/Decoding Library include:

- Fixed 8 kHz sample rate
- Fixed 8 kbps output rate
- PESQ-based Mean Opinion Score: 3.7 – 4.2 (out of 5.0)
- Code Excited Linear Prediction (CELP)-based coding
- Two analog input interfaces – codec or on-chip 12-bit ADC
- Two analog output interfaces – codec or on-chip PWM
- Optional Voice Activity Detection
- Playback-only applications will benefit from the Speech Encoder Utility. It allows you to make encoded speech files from your desktop using a PC microphone or WAV file
- Storing compressed speech requires 1 KB of memory per second of speech
- Off-chip support for playback of long speech samples
- Royalty free (only one-time license fee)
- Full compliance with Microchip MPLAB® C30 Language Tools
- *dsPIC30F Speech Encoding/Decoding Library User's Guide* is provided to help the user understand and use the library (DS70154)
- Designed to run on dsPICDEM™ 1.1 General Purpose Development Board (DM300014)

## Resource Requirements

**Decoder:**

Playback Interface: Si-3000 Audio Codec or PWM
Computational Power: 3 MIPs
Program Flash Memory: 15 KB
RAM*: 3.2 KB

**Encoder:**

Sampling Interface: Si-3000 Audio Codec or 12-bit ADC
Computational Power: 19 MIPs (worst case)
Program Flash Memory: 33 KB
RAM*: 5.4 KB (1.2 KB is scratch)

*Full-duplex support is presently not possible due to RAM requirements, but support will be provided with future devices. Half-duplex support is now possible and requires 6.8 KB of RAM.

## Host Requirements

- PC-compatible system with an Intel Pentium® class or higher processor or equivalent
- A minimum of 16 MB RAM
- A minimum of 40 MB available for hard drive space.
- CD-ROM drive
- Microsoft Windows® 98, Windows NT® 4.0 or Windows XP®

## Devices Supported

- dsPIC30F5011
- dsPIC30F5013
- dsPIC30F6011
- dsPIC30F6012
- dsPIC30F6013
- dsPIC30F6014

## Part Numbers and Ordering Information

**dsPIC30F Speech Encoding/Decoding Library**

| Part Number | Description | Availability |
|---|---|---|
| SW300070-EVAL | dsPIC30F Speech Encoder/Decoder Library Software License (Evaluation Only) | Q2/2005 |
| SW300070-5K | dsPIC30F Speech Encoder/Decoder Library Software License (Up to 5K Units) | Q2/2005 |
| SW300070-25K | dsPIC30F Speech Encoder/Decoder Library Software License (Up to 25K Units) | Q2/2005 |
| SW300070-100K | dsPIC30F Speech Encoder/Decoder Library Software License (Up to 100K Units) | Q2/2005 |

**Note:** Quantities are per project, payable as a one-time license fee based on estimated lifetime volume for products resulting from the project. Please consult the factory for quantities above 100K.

**dsPIC® DSC Development Tools from Microchip**

| | |
|---|---|
| MPLAB® IDE<br>MPLAB® Visual Device Initializer (included in MPLAB® IDE) | Free |
| MPLAB® C30 C Compiler | SW006012 |
| MPLAB® ICD 2 In-Circuit Debugger/Programmer | DV164005, DV164007 |
| MPLAB® ICE 4000 | ICE4000 |
| MPLAB® PM3 Universal Device Programmer | DV007004 |
| dsPIC30F Math Library (included in download of MPLAB® C30 C Compiler) | Free |
| dsPIC30F DSP Library | Free |
| dsPIC30F Peripheral Library | Free |
| dsPICworks™ Data Analysis and DSP Software | Free |
| dsPIC® DSC Digital Filter Design | SW300001 |
| dsPIC30F Soft-Modem Library | SW300002/3/4/5 |
| dsPIC® DSC Speech Recognition Library | SW300010/11/12 |
| dsPIC® DSC Symmetric Key Embedded Encryption Library | SW300050 |
| dsPIC® DSC Asymmetric Key Embedded Encryption Library | SW300055 |
| dsPIC30F Acoustic Echo Cancellation Library | SW300060 |
| dsPIC30F Noise Suppression Library | SW300040 |
| CMX-RTX™ for dsPIC30F | SW300031 |
| CMX-Tiny+™ for dsPIC30F | SW300032 |
| CMX-Scheduler™ for dsPIC® Devices | Free at www.cmx.com |
| dsPICDEM™ Starter Demonstration Board | DM300016 |
| dsPICDEM™ 28-pin Starter Demonstration Board | DM300017 |
| dsPICDEM™ 1.1 General Purpose Development Board | DM300014 |
| dsPICDEM™ MC1 Motor Control Development System | DM300020 |
| dsPICDEM.net™ 1 Connectivity Development Boards | DM300004-1 |
| dsPICDEM.net™ 2 Connectivity Development Boards | DM300004-2 |

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