MIDIBox SpeakJet

What is it?

MIDIBox SpeakJet Synthesiser is a project that uses the MagnevationSpeakjet controlled by midibox as a standalone synthesizer.

The SpeakJet IC was brought to market in February 2004, and is available from a variety of vendors for around $25 USD.

From the SpeakJet Web Site:
The SpeakJet is a completely self contained, single chip voice and complex sound synthesizer. It uses a mathematical sound algorithm to control an internal five channel sound synthesizer to generate on-the-fly, unlimited vocabulary speech synthesis and complex sounds.

The SpeakJet is preconfigured with 72 speech elements (allophones), 43 sound effects, and 12 DTMF touch tones. Through the selection of these sounds and in combination with the control of the pitch, rate, bend, and volume parameters, the user has the ability to produce unlimited phrases and sound effects, with thousands of variations, at any time.

The SpeakJet can be controlled simultaneously by logic changes on any one of its eight event input lines, and by a single I/O line from a CPU allowing for both CPU-controlled and standalone operations.

Other features include an internal 64 byte input buffer, internal programmable EEPROM, three programmable outputs, and direct user access to the internal five channel sound synthesizer.

To build this Midi-playable nifty synthesizer project, you will need:

- 1 MBHP Core Module (PIC18F, host of kII speakJet application → see below, communicates via IIC with the SJ-IIC-Module)
- 1 MBHP SpeakJet-ICC-Module (PIC16F, receives IIC commands from Core and communicates via Serial Transmission with the Speakjet → breadboard construction described below)
- 1 2×16 LCD, optional (displays last sent commands and various settings)

The MBHP SpeakJet IIC Module

This project is in progress at the moment. Please visit the Forum (and especially the first SpeakJet thread or see the links below for more info.

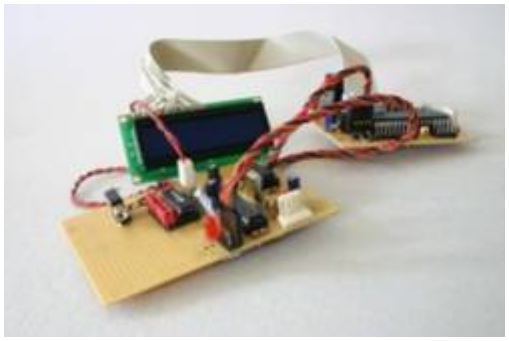
- IIC SpeakJet Module [uCApps]

SpeakJet-IIC-Module Breadboard v1.3

- **SpeakJet Breadboard Construction** – Description and How-To of this breadboard construction:
- Breadboard Design with lowPassFilter v1.3 (PDF, 604 kB)
- Breadboard Design with lowPassFilter v1.3 (FreeHandMX sourcefile with a lot of nice electronical symbols, 264 kB)

SpeakJet-IIC-Module Breadboard v1.0

- Preliminary Breadboard with lowPassFilter (PDF, 480 kB)
- Preliminary Breadboard with lowPassFilter (FreeHandMX sourcefile with a lot of nice electronical symbols, 292 kB)
- Picture Gallery: SpeakJet Breadboard



The SpeakJet Control Application Software

The SJ Control Application Software provides full access to all SJ-Functions via MIDI!

kII is a MIDI control application for the MBHP_SpeakJet Module. By connecting a Core equipped with this program to the SpeakJet Module via IIC you can control nearly all functions of the SpeakJet Chip by Midi-Messages.

kII stands for “Kempelen Two”, Baron Wolfang von Kempelen has been a hungarian inventor and creator of famous automats. Whereas his most famous creatin has been the “Turkish Chessplayer” (which was a late-revealed fake with a chess-player sitting inside), he also invented one of the first talking machines ever. Baron Kempelen lived from 1734 to 1804.

If you are improving the application, please send me an email or PM me in the forum, so I can update the project! *–audiocommander*

Features:

- Full MSA and SCP Control via Midi!
- Trigger Allophones and SoundFX by Notes
- Trigger Allophones only by Notes
- Trigger SoundFX only by Notes
- Jaw/Tongue control: set position of jaw and tongue by CC, play pitched Allophone by Notes
- Different Jaw/Tongue sets available: Vowels/Consonants/Pauses

- Change the pitch of currently played Allophones by Notes 0..59
- Play the 5 Oscillators by Notes, one OSC per Channel
- Harmonic subtractive syntesis Multi-OSC playmode by Notes(!)
- Control Waveforms (shapes) of harmonic synthesis Multi-OSC mode
- Change Allophone Pitch by using the 14bit PitchBend-Wheel
- Control Bend with CH_AFTERTOUCH
- Control Speed by CC
- Control Master Volume by CC
- Send Pauses by CC
- Send Next Slow/High/Low/Fast by CC
- Control OSC-Frquencies and Levels by CC
- Control ENV-Frequency and Type by CC
- Control Distortion (OSC 4 & 5) by CC
- Fire Phrases by CC
- Supports System Realtime Messages START, STOP, CONTINUE, RESET
- Send PANIC by Foot & AllNotes/SoundsOFF Messages
- Custom assignable controls by editing the definition listing (IIC_SpeakJetMidiDefines.h)

Sometimes it's more important to know what it can't do (yet?):

- AIN sensors to trigger & control natural speech (allophone) output [1)]
- Multiple MBHP-IIC-Speakjet Modules (cascaded SpeakJets!) [2)]
- Bankstick support to save patches [2)]
- Phrase storage (use the Phrase-A-Lator from Magnevation via RS232!) [3)]

[1)] will be available with the next version
[2)] would be nice, I'm thinking about it...
[3)] don't wait for it (or help coding :)

Download:

- SpeakJet Application Software 'kII' – *v 0.1.5 build 20061210* (138 kb)
- runs on the PIC18F Core to enable the full control of the SpeakJet Module by MIDI-Messages. The package contains the source, an X-Code 2.0 project, ACSim-Classes and precompiled .hex and .syx files.
- Note that you will also need the PIC16F Firmware for the SpeakJet IIC Module!
- Check out the audio-examples at the bottom of this page!

LCD-Values:
A 16×2 LCD is optional. You see following infos:



- N: (Note) Base Note Listener. '-' ⇒ inactive, '*' ⇒ next note will get new base
- H: (Harmony) Current Base Note, eg 'D#'
- V: (Value) Last Value (0..127)
- J: (Jaw) Jaw Position, 0x0 opened, 0xB closed
- T: (Tongue) Tongue Position, 0x0 front, 0x5 back
- O: (OSC) Subtractive Synthesis Waveshape: SAW, TRIANGLE, SQUARE
- E: (ENV) Envelope Waveshape: SINE, SAW, TRIANGLE, SQUARE
- R: (REC) Record Buffer Mode (hidden feature)

MIDI-Implementation-Chart:

Function	**#define**	**default assingment**	**Channel Mode**	**Description**
== NOTES ==				
Voice				
Soundcodes	SJCH_SOUNDCODES	CH 1	Omni	Play all available Sounds
Allophones	SJCH_ALLOPHONES	CH 2	Omni	Play all available Vocal Allophones
Sound-FX	SJCH_FX	CH 3	Omni	Play all available Sound-FX
Pitch	SJCH_PITCH	CH 4	Omni	Change the pitch of current Sounds; if nothing is triggered, you can't hear anything!
Vowels	SJCH_VOWELS	CH 5	Omni	Trigger Pitched Allophone; Jaw- and Tongue-Controls are needed to change the vowel
Consonants	SJCH_CONSONANTS	CH 6	Omni	Trigger Pitched Consonants; Jaw- and Tongue-Controls are needed to change the consonant
Vowels/Cons	SJCH_VOWELS_CONSONANTS	CH 7	Omni	Trigger Pitched Allophones; Jaw- and Tongue-Controls are needed to change the consonant

Function	#define	default assingment	Channel Mode	Description
== NOTES ==				
Voice				
Vowels w. Pauses	SJCH_VOWL_PAUS	CH 8	Omni	Trigger Pitched Vowels with Pauses; Jaw- and Tongue-Controls are needed to change the consonant
Vowels/Cons w. Pauses	SJCH_VOWL_CONS_PAUS	CH 9	Omni	Trigger Pitched Vowels & Consonants with Pauses; Jaw- and Tongue-Controls are needed to change the consonant
Vocal Percussion	SJCH_PERCUSSIVE	CH 10	Omni	Trigger percussive sounds only
Synth				
OSC1	SJCH_OSC1	CH 11	Poly	Play OSC 1
OSC2	SJCH_OSC2	CH 12	Poly	Play OSC 2
OSC3	SJCH_OSC3	CH 13	Poly	Play OSC 3
OSC4	SJCH_OSC4	CH 14	Poly	Play OSC 4
OSC5	SJCH_OSC5	CH 15	Poly	Play OSC 5
Synth	SJCH_OSC_Omni	CH 16	Omni	Subtractive Soundsynthesis with all 5 OSCs (Single Voice only). Apply different waveforms for both synth & envelope and add distortion for soundmodelling!
== CONTROL CHANGE (Sliders) ==				
Voice				
Phrases	SJCC_PHRASE	CC 9	Omni	Fire SpeakJet Phrase
Jaw Open	SJCC_MOUTH_JAW	CC 40	Omni	Open Jaw, eg: closed 'u', opened 'a'
Tongue Position	SJCC_MOUTH_TONGUE	CC 41	Omni	Position Tongue, eg: front 'th', back 'err'
Stress	SJCC_MOUTH_STRESS	CC 43	Omni	Bend Voice from high env to low env (pitch independent)
Speed	SJCC_MOUTH_SPEED	CC 44	Omni	Speed up or slow down allophone lengths
Pauses	SJCC_MOUTH_PAUSES	CC 45	Omni	Inserts Pauses from 0 to 640 ms (0..127)
Volume	SJCC_MASTER_VOL	CC 108	Omni	Set Main Volume
Synth				
OSCx Freqency	SJCC_OSCx_FREQ	CC 101..105	Poly	Set Frequency of OSC 1 to 5
OSCx Level	SJCC_OSCx_LVL	CC 111..115	Poly	Set Volume of OSC 1 to 5

Function	#define	default assingment	Channel Mode	Description
== NOTES ==				
Voice				
Envelope Frequency	SJCC_ENV_FREQ	CC 106	Omni	Set Envelope's frequency
Envelopy Waveform	SJCC_ENV_TYPE	CC 116	Omni	Set Waveshape of ENV: Saw, Sine, Triangle, Square
Distortion	SJCC_DISTORTION	CC 118	Omni	Set Distortion Amount (0..127)
Harmonizer				
Base Note	SJCC_HARMONY_BASE	CC 39	Omni	Set base note (0..127)
== CONTROL CHANGE (Buttons) ==				
Voice				
Phrases 0..3	SJCC_PHRASEx	CC 29..32	Omni	Fire SpeakJet Phrases 0 to 3
Pauses 0..6	SJCC_PAUSEx	CC 21..24	Omni	Fire Pauses; currently implemented: 1,2,3,5
Slower	SJCC_NEXT_SLOW	CC 25	Omni	Play next Allophone slower
Lower	SJCC_NEXT_LOW	CC 26	Omni	Play next Allophone lower
Higher	SJCC_NEXT_HIGH	CC 27	Omni	Play next Allophone higher
Faster	SJCC_NEXT_FAST	CC 28	Omni	Play next Allophone faster
Synth				
Synth Waveshape	SJCC_OSC_WAVESHAPE	CC 50	Omni	Toggle Synth Waveshape: Saw, Triangle, Square
Envelope Waveshape	SJCC_ENV_WAVESHAPE	CC 51	Omni	Toggle Env Waveshape: Saw, Triangle, Square, Sine
Harmonizer				
Base Note	SJCC_HARMONY_LISTEN	CC 37	Omni	Toggle on to set new base note by next incoming note
Scale	SJCC_HARMONY_SCALE	CC 38	Omni	Next Scale; 0=none, 1=major, 2=minor
== PITCH WHEEL ==				
Voice				
Pitch	SJCC_PITCH	-	Omni	Changes the Pitch of Soundcodes
== POLY AFTERTOUCH ==				
Voice				

Function	#define	default assingment	Channel Mode	Description
== NOTES ==				
Voice				
Bend	MIDI_POLY_AFTER	-	Omni	Changes the Bending of Soundcodes
Bend	MIDI_CH_AFTER	-	Omni	Changes the Bending of Soundcodes
== SYSTEM REALTIME MESSAGES ==				
START, CONTINUE	MIDI_START, MIDI_CONTINUE	-	-	Start Enunciating
STOP	MIDI_STOP	-	-	Pause Enunciating
RESET	MIDI_RESET	-	-	Hardware-Reset (similar to switching power off/on)

Tools & Helpers:
If you're a developer and are working on your own implementations, you will find these sources useful:

- SpeakJet Control Overview (SCP and MSA Control Overview)
- SpeakJet Definition List (SCP and MSA Command #defines)
- Midi Definition List incl. Note2Frequency definitions (see MIDI Specification)

For Further Information...

- Midibox.org SpeakJet thread

- SpeakJet User Manual / Datasheet
- SpeakJet web site with audio samples (Flash)
- SpeakJet Yahoo Group

- SpeakJet Demo-Mode (mp3)
- SpeakJet Demo - advanced possibilities (mp3, lowQuality, 32kHz, 80kbps, 3.1MB), *shows what is possible with the current state of the project; you can hear how I control the five oscillators and later on mix it with MSA allophones (all from my microKONTROL, so easily controllable by any other midibox 8)*
- Latest SpeakJet Application Demo (kII) (mp3, midQuality, 44.1kHz, 96kbps, mono, 2,28MB), *shows different control examples from phoneme tables controlled by jaw/tongue movement, single OSCs and also my approach to program a subtractive synthesis out of the 5 OSCs... try to hear the different waveshapes and the adding of distortion...*

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