

# 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 kll 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.

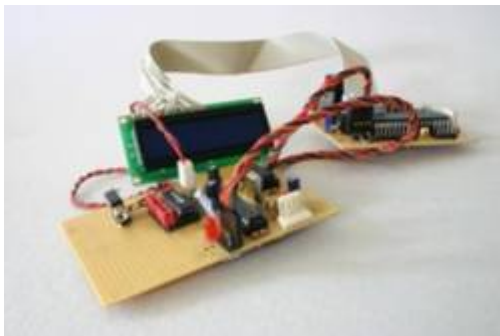
- [IIC SpeakJet Module](#) <sup>uCApps</sup>

### 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 electrical 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 electrical 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!

kll 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.

kll stands for "Kempelen Two", Baron Wolfgang 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 synthesis 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-Frequencies 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 <sup>1)</sup>
- Multiple MBHP-IIC-SpeakJet Modules (cascaded SpeakJets!) <sup>2)</sup>
- Bankstick support to save patches <sup>2)</sup>
- Phrase storage (use the [Phrase-A-Lator](#) from Magnevation via RS232!) <sup>3)</sup>

<sup>1)</sup> will be available with the next version

<sup>2)</sup> would be nice, I'm thinking about it...

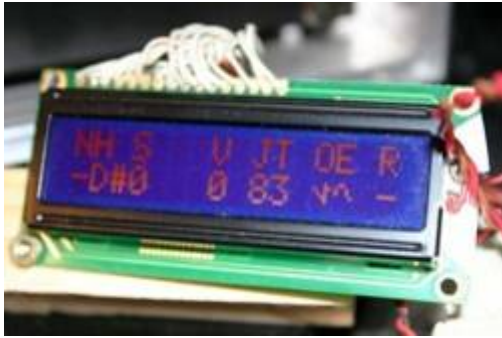
<sup>3)</sup> don't wait for it (or help coding :)

### **Download:**

- [SpeakJet Application Software 'kll'](#) - 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 16x2 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   |
|--------------------|------------------------|--------------------|--------------|---|
| <b>== NOTES ==</b> |                        |                    |              |   |
| <b>Voice</b>       |                        |                    |              |   |
| Soundcodes         | SJCH_SOUND_CODES       | 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  |
|---------------------------------------|---------------------|--------------------|--------------|--|
| <b>== NOTES ==</b>                    |                     |                    |              |  |
| <b>Voice</b>                          |                     |                    |              |  |
| 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   |
| <b>Synth</b>                          |                     |                    |              |  |
| 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! |
| <b>== CONTROL CHANGE (Sliders) ==</b> |                     |                    |              |  |
| <b>Voice</b>                          |                     |                    |              |  |
| 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  |
| <b>Synth</b>                          |                     |                    |              |  |
| 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  |
|---------------------------------------|---------------------|--------------------|--------------|--|
| <b>== NOTES ==</b>                    |                     |                    |              |  |
| <b>Voice</b>                          |                     |                    |              |  |
| 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)                       |
| <b>Harmonizer</b>                     |                     |                    |              |  |
| Base Note                             | SJCC_HARMONY_BASE   | CC 39              | Omni         | Set base note (0..127)                               |
| <b>== CONTROL CHANGE (Buttons) ==</b> |                     |                    |              |  |
| <b>Voice</b>                          |                     |                    |              |  |
| 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                           |
| <b>Synth</b>                          |                     |                    |              |  |
| 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    |
| <b>Harmonizer</b>                     |                     |                    |              |  |
| 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                 |
| <b>== PITCH WHEEL ==</b>              |                     |                    |              |  |
| <b>Voice</b>                          |                     |                    |              |  |
| Pitch                                 | SJCC_PITCH          | -                  | Omni         | Changes the Pitch of Soundcodes                      |
| <b>== POLY AFTERTOUCHE ==</b>         |                     |                    |              |  |
| <b>Voice</b>                          |                     |                    |              |  |

| Function                              | #define                   | default assingment | Channel Mode | Description  |
|---------------------------------------|---------------------------|--------------------|--------------|--|
| <b>== NOTES ==</b>                    |                           |                    |              |  |
| <b>Voice</b>                          |                           |                    |              |  |
| Bend                                  | MIDI_POLY_AFTER           | -                  | Omni         | Changes the Bending of Soundcodes                  |
| Bend                                  | MIDI_CH_AFTER             | -                  | Omni         | Changes the Bending of Soundcodes                  |
| <b>== SYSTEM REALTIME MESSAGES ==</b> |                           |                    |              |  |
| 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 \(kll\)](#) (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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