INTRODUCTION

The Vocoder 2000 is a signal processing device, which takes two input signals and produces one output. These two signals are known as the 'speech' and the 'excitation'. The output from the Vocoder is a signal which contains a proportion of the harmonic structure of the excitation and the formant structure (the articulation) of the speech. Thus it is possible to make normally inarticulate sounds speak. For instance, if you were to take speech and an organ, it would be possible to make a 'talking organ'.

The heart of the Vocoder is the analysing and synthesizing filter bank. The speech is analysed into 16 frequency bands which cover the audio spectrum. The time varying energy levels in each channel is extracted by an envelope follower. This is in fact a real time spectrum analysis of the speech. Another signal, the excitation is introduced into the Vocoder.

This is the signal that we will make talk. The excitation signal is also analysed into 16 frequency bands throughout the audio spectrum. However, the signal that is presented to each band is multiplied by a control voltage, which is the envelope from the speech channels. Thus the time varying spectrum of the speech is imposed upon the excitation signal; that is the excitation is filtered in a way entirely prescribed by the speech signal.

The speech and the excitation signals are connected via ¼" mono jack sockets to the input amplifiers. The signal level is adjusted and given a pre-emphasis, a top lift. A switch connects a VU meter to either the speech or the excitation signal. A device called a voiced/unvoiced detector looks at the speech signal and decides whether or not the speech is unvoiced ('s' sounds) or voiced (sounds derived from vocal chord vibrations). These voiced/unvoiced decisions can be used to turn on or off the machine's internal oscillator and noise source. Also, the unvoiced decision can be used to alter the external excitation signal so that it becomes more 'S' like. This is done by operating the 'S' generator switch. The Vocoder 2000 has two internal excitation sources, the noise source and the oscillator. The noise source is generated by zener diode and can be used continuously, or gated on by the unvoiced decisions or it can be switched off so that it has no effect. The oscillator produces a pulse waveform which can also be used continuously or gated on by the voiced decision or it can be switched off. Also the pitch of the oscillator can be manually set as well as the option of being varied by a control voltage generated by the filter bank analysis. The slew freeze section controls the synthesis section of the filter bank. It is possible to freeze or to slew limit the control voltages inside the filter and this will of course have an effect on the Vocoder's output. When frozen, the formant structure remains fixed. When heavily slewed, the output sounds very reverberant. This is because information in the filter bank is time smeared. There are two possible types of time smearing that are available, symmetrical [ ] and asymmetrical \_\_\_. The symmetrical option takes as long for a sound to build up as it does to decay, but the asymmetrical gets loaded with a sound structure immediately and then it slowly decays.

When you are making a piece of orchestral music talk, the amplitude dynamics of the speech will be imposed upon the output. Thus there will be lots of big gaps in the Vocoder output which might not be very desirable. To overcome

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this problem we use a device called a pause stuffer. This fills in the
silences by fading up the music signal, immediately fading it down when
the Vocoder output reappears. Speech or excitation can be used to 'stuff'
the pauses and there is a choice of fade in times. The output mixer is
used to select either the Vocoder output or the speech or external
excitation signal. It is also possible to control any of these signals
with an external swell pedal.
Comparator signal same as in Fig. 1. This is only true when the signal FUV is present.

Adjust PR3 so that when synthesizing normal speech, the 's' are correctly positioned.

Filtered sum of F1, 2, 4, 10 speech envelopes. It goes, returning to OV during silent intervals.

Filtered envelope from F16.

Comparator output. The effect for unvoiced decisions.

Voiced/unvoiced detector.

V2000
VCA Q7
ANY DUAL TRANSISTOR (npn) WILL DO.

Filter Bank Output x100 Gain.

Post-Going, Full Wave Rectified Version of the Filter Bank Output Signal.

Lowpass Filtered Signal of Above. Limited to ±2.7V.


VCA Output. The Speech or the Excitation Signal is Controlled in Level by the Envelope of the Vocoder.

Output Mixer

Mixer Output of the Filter Bank, with a Treble Cut.

SLEW / FREEZE

'F'
NOT FROZEN = -12V
FROZEN = -4V → -1V

'F V U Y'
NOT FROZEN = 0V
FROZEN = -12V

SHORTED TO THE -VE RAIL WHEN FROZEN.

TO FREEZE SWITCH SW8: FREEZE = +12V

USUALLY -VE.
+VE WHEN FROZEN.

TIME SYMMETRY

SPEECH SIGNAL X10 GAIN.

FULL WAVE (+VE GOING) RECTIFIED SPEECH SIGNAL.

SPEECH SIGNAL S.

-VE GOING PULSES WHEN SPEECH IS LOUD.

THE PEAK DETECTED ENVELOPE OF THE SPEECH SIGNAL.

MODIFIED COMPARATOR OUTPUT SELECTED BY S00 9, TIME SYM.

* V2000
SPEECH PREAMP

+12V

SPEECH OUTPUT PLUS DC

+1.5V

+6V

AC COUPLED SPEECH OUTPUT

MUTE INPUT

LINE INPUT

SPEECH BRASS OUTPUT 100mVpp AVG.
(SPEECH SIGNAL BUT TREBLE LEFT)

VU SIGNAL. THE GOING SOMEWHERE
SELECTED NOISE TRANSISTOR.

+6V to +8V

NOISE SIGNAL PLUS DC.

AC COUPLED NOISE SIGNAL.

CONTROL SIGNAL FOR GATE. ONE 0V OFF = -12V

GATED NOISE OUTPUT, CONTROLLED BY S07.

LF ENVELOPE FROM F1 MOVES WHEN SPEECH IS BEING ANALYSED. CAN BE FROZEN. SELECTED BY S07.

PITCH CONTROL VOLTAGE 0 → -12V.

ON/OFF/UOV SWITCH. ON = -12V OFF = H2V UOV MOVES +1V AND -1V WITH THE SPEECH SIGNAL.

OSCILLATOR PULSE OUTPUT

10V
Speech Bus Signal \( \times 18 \) Gain

Adjust so that there is no excitation breakthrough. Vary the slew knob when setting up.

Low-pass Filter \( F_1 \)

Same as above \( \times 2.3 \) Gain.

Low-pass Filter \( F_2 \)

Same as above \( \times 18 \) Gain.

LP version of E Bus Signal \( \times 18 \) Gain.
BP FILTERED VERSION OF SPEECH.

ADJUST SO THAT THERE IS NO EXCITATION BREAKTHROUGH. VARY THE SLOW KNOB WHEN SETTING UP.

BP FILTERED VERSION OF SPEECH SIGNAL.
SPEECH BOSS 100WPP.

FULL WAVE RECTIFIED VERSION OF BP SIGNAL.

ANALOGUE RECORDED.

BP FILTERED VERSION OF SPEECH

LP FILTERED ENVELOPE OF SPEECH SIGNAL.

PRODUCT OF THE SPEECH ENVELOPE X THE FILTERED EXCITATION SIGNAL.

BP VERSION OF E BOSS SIGNAL.

E BOSS 10WPP

BAND PASS FILTERS F2 TO F15

V2000
SPEECH BUSS SIGNAL X 40 GAIN

SPEECH BUSS 100mV pp

FULL WAVE RECTIFIED VERSION OF HP SIGNAL

HP FILTERED VERSION OF SPEECH SIGNAL.

ADJUST SO THAT THERE IS NO EXCITATION BREAKTHROUGH. VARY THE SREW KNOB WHEN SETTING UP.

LP FILTERED ENVELOPE OF SPEECH SIGNAL

EBUSS 1 Vpp

PRODUCT OF SPEECH ENVELOPE X THE EXCITATION (FILTERED) SIGNAL. ADJUST PR2 SO THAT WITH NO EXCITATION AND SOME SPEECH, THE SPEECH BREAKTHROUGH IS MINIMAL.

SAME AS ABOVE X 2-3 GAIN.

HIGH PASS FILTER, F16

SAME AS A/4 PM 7 AS LONG AS THE SELECT FREQUENCY FUNCTION IS SET AT FAST.

HP VERSION OF EBUSS SIGNAL X 19 GAIN.

HP OUTPUT OFF CHANNEL.
PSU ELECTRONICS MOUNTED NEAR TO BACK PANEL.

FRONT AND BACK PANEL COMPONENTS

V2000
PARTS

GENERAL NOTES

All unmarked diodes are IN148 or IN914 or equivalents.
CA3090. Made by RCA. No equivalents.
741. Op amp made by virtually everyone.
458. Dual 741. Made by many producers.

CA1458 RCA
09T7538393 FAIRCHILD
MG1458 MOTOROLA
LM1458 NATIONAL SEMICONDUCTOR
RC1458 RAYTHEON
SG1458 SILICON GENERAL
NS558 SIGNETICS
SN72S58 TEXAS INSTRUMENTS.

2N5163 GENERAL PURPOSE N FET.
2N5461 GENERAL PURPOSE P FET.
BC164C LOW NOISE NPN TRANSISTOR.
BC258B LOW NOISE PNP TRANSISTOR.
MA7812. 1/2 A PLASTIC POSITIVE 12V REGULATOR.
Most PC capacitors — made by Siemens.