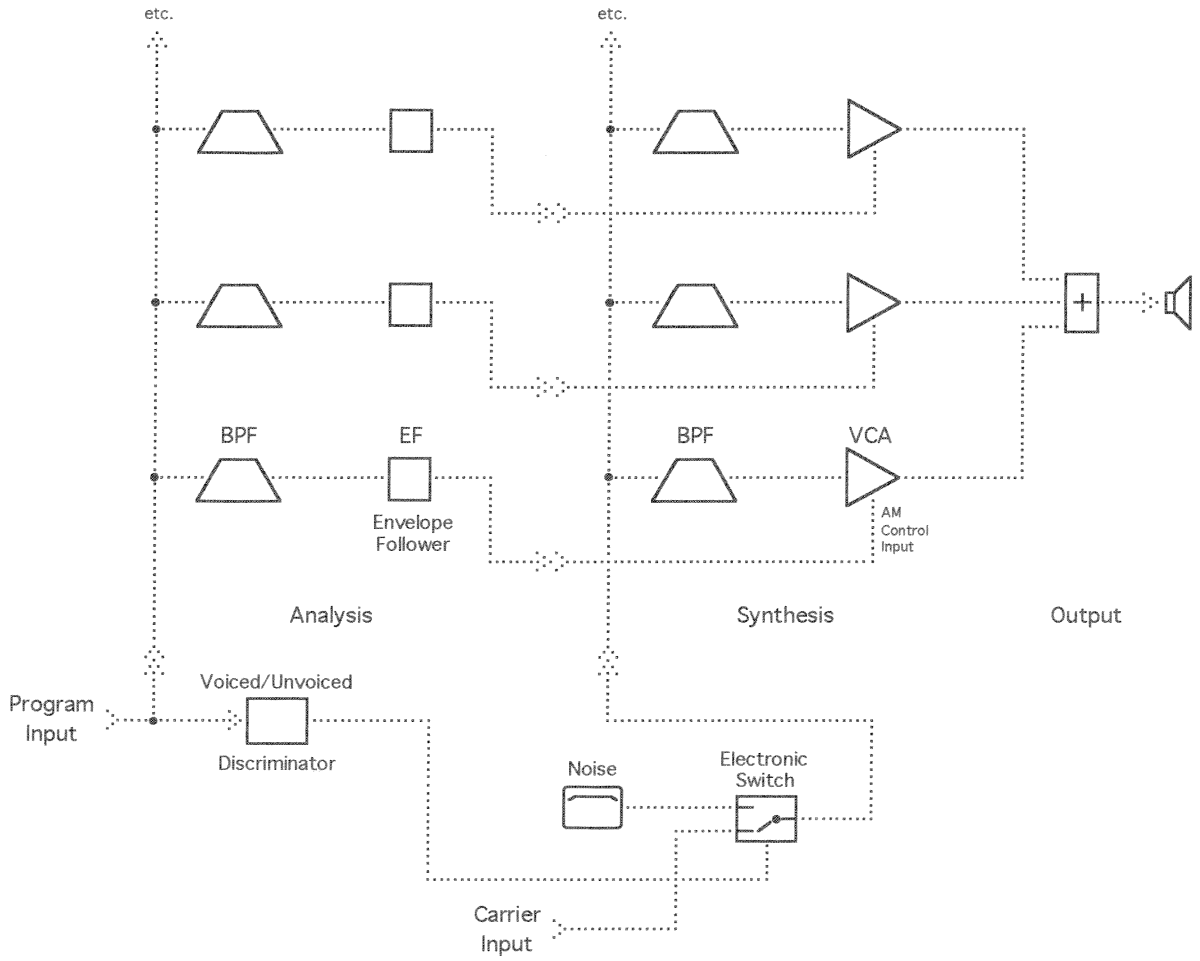
Channel Vocoder

A Channel Vocoder impresses the dynamic spectral characteristics of a *Program* signal onto the (static) spectrum of a *Carrier* signal. A Channel Vocoder uses signal analysis & synthesis data reduction techniques historically oriented toward speech and singing voice synthesis.

A Channel Vocoder has *identical* Band Pass Filter (BPF) *banks* in its Analysis and Synthesis sections. An Analysis BPF & EF (Envelope Follower) with Synthesis BPF & VCA (Voltage Controlled Amplifier) constitute a "channel." The two BPFs *in a channel* have the same (fixed) center frequency. A Vocoder has multiple channels with *unique* frequency bands, overlapping to span broadband audio frequencies.

A signal connected to the *Program* input passes through all Band Pass Filters in the Analysis section. The output of each BPF is connected to an associated *Envelope Follower.* An Envelope Follower outputs a signal (voltage) that is proportional to the instantaneous *power* present at the EF signal input. The Analysis section therefore generates *many* dynamic *envelopes,* each of which represents the relative energy in a *particular* frequency band within the Program signal's bandwidth from moment to moment.

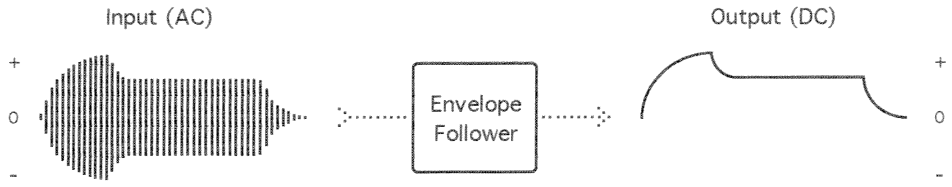
A signal connected to the *Carrier* input *may* (more below) pass through all Band Pass Filters in the Synthesis section. The output of each BPF is connected to the *signal* input of a *Voltage Controlled Amplifier.* A VCA's gain is proportional to the signal level connected to the VCA's (AM) *control* input.



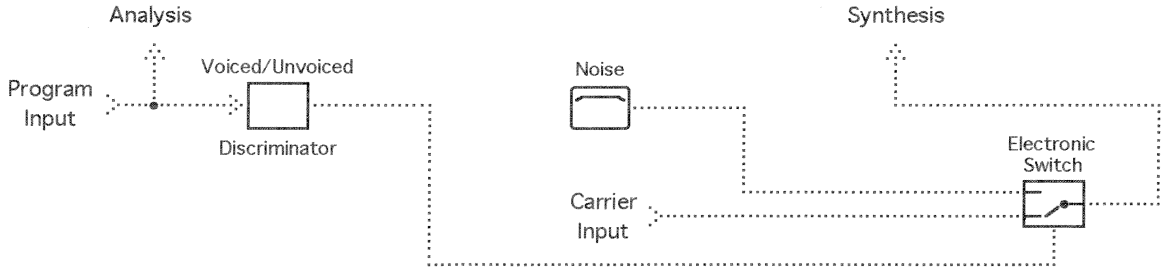
The output of each Envelope Follower in the Analysis section is connected to the *control* input of that channel's VCA in the Synthesis section. The spectrum of the input *Carrier* signal is therefore forced to "follow" the (dynamic) changes of the spectrum of the input *Program* signal from moment to moment. The VCA outputs for all channels are summed (mixed), and this *Output* of the Vocoder is monitored.

An electronic musical instrument connected to the Carrier Input therefore "talks" as one speaks into a microphone connected to the Program Input. The "pitch" heard is determined by the frequency of the instrument (Carrier signal), which functions like vocal cords. The microphone (Program Signal) impresses dynamic *timbral* changes onto the Carrier, just as the tongue & oral cavity shape speech.

The Envelope Follower (EF) in each channel *rectifies* and "smoothes" the Program signal's Alternating Current (AC) into "fluctuating" Direct Current (DC). Therefore, each Envelope Follower produces the *envelope,* or changes of signal intensity over time, for the unique frequency band at that EF input:



Human speech has "voiced" and "unvoiced" sounds. Voiced sounds, such as vowels, result from vocal cord vibrations. Unvoiced sounds, such as consonants (s,f, sh, or ch), are caused by turbulence as air is forced out of the oral and nasal openings. An internal *Noise Source* mimics turbulent *unvoiced* sounds when it is momentarily switched into the *Synthesis* signal path in lieu of the electronic oscillator that is typically connected to the external *Carrier* Input. *Program* input is "parsed" by a *Voiced/Unvoiced Discriminator;* this produces a signal that allows the *Electronic Switch* to select between the *external* Carrier signal and *internal* Noise source, as voiced/unvoiced content of the Program signal dictates:



The Channel Vocoder is essentially a "complementary" filter; it processes both Program and Carrier signals simultaneously. Filters imply use of broadband signals, and the ideal Carrier signal for musical purposes may be the "buzz" waveform, which has many harmonics of equal amplitude (see *Carrier Input* graphic below). The Program signal is also typically broadband, and features dynamic spectral (timbre) changes. When the *Program* signal is a *vowel,* the buzz waveform Carrier Input is filtered to exhibit the *formant* structure of *that vowel.* (Formants labeled F1, F2, and F3 depict representative *boosted frequency bands,* or formants). *Vocoder Output* consists of the Carrier signal, or "excitation function," processed by the time-varying spectral changes of the Program signal "driving function:"