

THEORY OF OPERATION-AR-318

SAMPLE/HOLD, CLOCK, AND NOISE GENERATOR

I. Sample/Hold

This is basically an input buffer, electronic switch, capacitor, and output buffer. The signal input is attenuated by a factor of two (to place less of a demand on the switching circuit), and buffered by a voltage follower consisting of U5 with current booster Q2 and Q3. The booster is biased by Q4, which is a constant current source. The output goes to a FET switch Q5, which is normally off. However, when any wave form with a sharp rise is applied to the S/H TRIG input, or when the MANUAL TRIGGER button is pressed, a short pulse is applied to the base of Q7. This, in turn, turns on Q6, so the voltage at the cathode of D3 momentarily jumps from about -14 volts (which holds Q5 off), to plus 15v. This lets R24 reduce Q5's gate-source voltage to 0, which makes Q5 conduct. The output of Q2 and Q3 is thus briefly connected to C17. In a very short time C17 charges up (or down) to 1/2 the S/H input voltage. After the pulse is over, it stays charged, because both Q5 (when off) and U6 have an extremely high impedance. However, U6 does buffer C17's voltage, and amplify it by a factor of 2 (to make up for the input loss).

A positive voltage (of at least 2 volts) at the GATE input will keep the switch Q5 on continuously until the input voltage drops. Then, the output will follow, or TRACK, the input.

II. Clock

This is basically a voltage controlled sawtooth oscillator. U7 sums voltages from the CLOCK FREQUENCY control (P1) and any control input present. The inverted sum is attenuated by R43 and R44, and applied to Q8 and Q9, which form an exponentially controlled current source. The current is trimmed to the right range by T1 (CLOCK FREQ. trim). Now, C22 is initially discharged (both sides at -15v). As current from Q9 charges it up, the voltage on the plus side of C22 rises uniformly, until it reaches about -5 volts. This voltage triggers unijunction transistor Q10, which suddenly discharges C22, and the cycle repeats. If the current from Q9 is made to increase by turning up the CLOCK FREQ. control, C22 charges faster, discharges sooner, and therefore the frequency increases. Now, the resulting sawtooth waveform across C22 is buffered by emitter follower Q11, and biased by R50, R66, and U8 to give an output waveform of 0 to +10 volt level. The sawtooth appearing at pin2 of U9, however, varies from approximately +3 volts to -3v. This is converted to a square wave of about -15v to +13v level by U9, which is open loop. D6, R64, and R65 provide the 0 to +10 volt square wave output. The square wave is also differentiated by C26 and R60, and rectified by D7 to give a trigger pulse output. This trigger operates the S/H in the "clock" position of the S/H TRIG switch.

THEORY OF OPERATION-AR-318 (cont)

Any fast rising waveform, such as a square wave, applied to the CLOCK SYNC input, is differentiated to form a pulse by C27, R57, and R58. This turns on Q14, Q13, and Q12 momentarily, which discharges C22 and thus synchronizes the clock oscillator. The SYNC pulse also appears at the CLOCK TRIG outputs, due to D8 and R62, and also triggers the S/H. C28 holds the pulse on for about 0.4ms, in case the sync. output is very short.

III. Noise Generator

Q1 is operated in the reverse-breakdown mode, with current supplied through R1. This generates a few millivolts of white noise, which is coupled by C3 into U1. U1 has D C feedback through R2 and R3, but has essentially no feedback at audio frequencies. The noise is amplified to the clipping point by U1, and filtered above 20 KHz by R4, C5, and R5. The output, even though clipped, is still "white", that is, equal energy per cycle of frequency over the audio range. U2, with its associated components, provides a decreasing frequency response of 3db per octave, plus some gain at the lower frequencies, to provide pink noise. This has equal energy per octave across the audio range, and sounds uniform, because we hear on an octave basis, not per cycle of frequency. The output is rectified by D9, which generates strong, low, frequencies. These are selected and amplified by C10, R12, U3, R13, and C11. R11 biases the output of U3 to be negative, so C13 is properly biased. U4 completes the amplification and filtering (with C14 and R15). The output is a slow, random, waveform containing frequencies from approximately 0.2 Hz to 7Hz.