

THEORY OF OPERATION AR-324

DUAL LFO, LAG, INVERTER

I. Low Frequency Oscillator (LFO)

There are two identical LFO circuits. The basic waveform is a triangle. Voltage from the logarithmic pot P1 is applied to the emitter resistor, R18, of Q8. D5 balances the base-emitter voltage of Q8. The current from emitter to collector is then an exponential function of the rotation of P1. Now, U3 is a comparator with positive feedback, which will latch on to either +13 volts or -15. Assume it is positive. Then U1 has a positive voltage at pin 2, its negative input. Then, a current will be drawn into pin 6, approximately equal in magnitude to the current from Q8 into pin 5. This causes C9 to charge negatively. The resulting negative-going voltage is buffered by voltage follower U4, and applied to pin 3 of U3 through R26. Then the voltage across R26 is negative enough to compensate for the positive voltage across R24, pin 3 becomes negative. This is the positive input of an op amp, so the input then jumps negative. This, through R24, makes the input even more negative. However, the change in input makes U1 supply current out of pin 6, which reverses the direction of charge of C9. Its voltage rises now, until it becomes positive enough to reverse U3 again. This cycle repeats, and generates a triangle wave, whose frequency rises as more current is put into U1 by turning up P1. Incidentally, the output of U3 is a square wave, which is shifted to a level of 0 to +10 volts by D2, R22, and R23.

Meanwhile, Q7 is adjusted to have the same current range as Q8, by trimpot T1. The current out of the collector of Q7 charges up C3 linearly; that is, its voltage rises uniformly. (Initially, when discharged, the + side of C3 is at -15 volts.) When the output of U3 jumps positive, C8 differentiates the wave to give a pulse. This turns on Q4, which turns on Q5. The two transistors hold one another on, discharging C3 rapidly, until it is so discharged that it can't supply enough current to keep Q4 and Q5 on. Then, they become non-conducting again, and C3 starts to charge again. The current in Q7 is adjusted so that C3 charges by about 7 volts (+side of C3 at -8 volts) by the time the pulse discharges it. The resulting sawtooth wave is buffered by emitter follower Q3, and amplified by U2, to give a sawtooth output level of 0 to 10 volts.

Finally, any fast rising waveform, such as a square wave, applied to the SYNC input, is differentiated by C6, R2, and R3 to give a pulse, which momentarily turns on O1 and O2. C7 holds the pulse appearing at R6 on for about 20 microseconds, which is long enough to reset the oscillator by doing 3 things.

THEORY OF OPERATION

AR-324 (cont)

1. It makes U3 switch to a positive output (if it is not already positive) .
 2. It allows R27 to turn on FET switch Q6, which discharges C9.
 3. It turns on Q4 and Q5, discharging C3.
- Thus, the oscillator will be synchronized with the external synd input signal.

II Lag Circuit

This is a circuit which provides a variable amount of slowing down, or low pass filtering.

A signal at the input goes through R29 and the variable resistance of P2, and must charge or discharge C11. The higher its resistance, the less current can flow from the signal, and so C11 will take longer to change its voltage. The output is buffered by U5, connected as a high impedance voltage follower. R28 provides a path to ground for C11 and pin 3 of U5 when the input is not connected to anything.

III Inverter Circuit

This is a standard op amp inverter, coupled to the input through a variable attenuator, or level control (P3). Maximum gain is -1.