Craig Anderton's ELECTRONIC GUITARIST

"Multi-talented Noise Gate," Part I

This column may look pretty technical—and it is, but hopefully that will please those readers who have been asking for more details on circuit design. For those of you who aren't into explicit descriptions of how electrons run around a circuit from point A to point B, come back next month; then we will talk about construction, modifications, and some quite unusual applications. If you don't know what a noise gate is, either thumb through some of the ads in *GP* and read the descriptions, or check the chapter on noise reduction in my book, *Home Recording For Musicians* [available from GPI Books].

IC1A is a buffer stage that minimizes input loading and provides a low-impedance, unbalanced output for driving other circuitry in the noise gate (for more on buffers, see my November '77 and October '76 columns). After this conditioning, the input signal sets out towards IC1B through C6 and a *light-dependent resistor,* or LDR; this LDR is one half of a CLM6000 opto-isolator. When light from an LED (the other half of the CLM6000) shines on this LDR, its resistance goes down, and the input signal passes through the LDR "gate" to IC1B; when there is no light, the resistance of the LDR goes up, blocking the signal. This is what provides the "gating" action. IC1B is a simple output buffer that presents a constant load for the gating network.

The trigger circuit is designed in such a way that the presence of an input signal turns on the LED inside the CLM6000, and the absence of an input shuts off the LED. LDRs, such as the one in the CLM6000, have a fast attack/slow decay characteristic that is desirable for our application.

The trigger circuit may derive its input from a choice of sources, depending on the setting of S1. On "internal," the trigger reacts to the signal present at the input of the noise gate. On "external," other signals can provide the gating action (which we'll explore next month). IC2 samples whichever input is chosen by S1 and acts as a *comparator with variable threshold.* This means that control R5 sets a certain threshold; signals above this threshold (such as your guitar signal) produce a rectangular wave at IC2's output that, after being processed by Q1 and Q2, turns on the LED and opens the gate; signals below this threshold (such as annoying background hiss) are not "recognized" by the comparator, so the LED turns off.

IC2's output connects to Q1, which acts as a phase splitter—so the signals passing through C3 and C4 are 180° out of phase. D3 and D4 clip off the negative portions of these signals. The resulting out-of-phase positive-polarity signals are summed through R10 and R11, where they become a control voltage that turns on Q2 and pulls current through the LED, which then turns on the gate. This novel trigger circuit gives a very fast response, so the overall gate response is limited only by the attack time of the CLM6000.

S3 determines the amount of noise reduction. In position 1 there is no reduction, and the circuit is bypassed; at the other extreme of the switch there is almost as much attenuation as an on/off switch in the "off" position. (We'll discuss S3 more fully next month.)

Finally, a note about IC2: The 741 has an internal high-frequency rolloff that can be advantageous under some conditions, since it takes more high-frequency energy to open the gate than an equivalent level of low-frequency energy—thus, 50mV of annoying high-frequency hiss will have a harder time opening the gate (all other things being equal) than 50mV of low-frequency guitar or voice. If you prefer an even response over the full bandwidth of the device, use a 748, 201, or 301 in a mini-dip package with about a 3pF compensating capacitor hooked between terminals 1 and 8 of the above-mentioned ICs to prevent oscillation during transitions. There's still lots to cover—see you next issue.

All resistors are ¼W, 5% preferred over 10%.

R1-R3	2.7kΩ
R4	10kΩ
R5	10kΩ, linear taper pot
R6	22kΩ
R7, R8	47kΩ
R9-R11	82kΩ
R12-R13	100kΩ
R14	470kΩ
R15	1MΩ

All capacitors rated 10 or more Volts.

C1	.05μF (mylar preferred)
C2-C4	.1μF (mylar preferred)
C5	.22μF
C6	2.7μF, tantalum or aluminum electrolytic
C7-C8	2.7 to 100μF, tantalum or aluminum electrolytic
IC1	4739 dual low-noise op amp (Raytheon, Exar)
IC2	741 or 748 op amp (see text)
D1-D4	1N4001 or equivalent silicon diodes
Q1, Q2	2N3904 or equivalent transistor
CLM6000	opto-isolator (Clairex)
S1	SPDT toggle switch
S2	DPDT or DPST toggle switch
S3	SP6T rotary switch
B1, B2	9V batteries
J1-J3	¼" mono open circuit phone jacks
Misc.	Case, circuit board, sockets, etc.

Noise Gate Specifications

Frequency response (100k load): 40-20kHz ±0.5dB

Current consumption: ±7mA typical (gate open)

Reduction (in dB): switch selected, approximately 0, -10, -15, -22, -33, and greater than -50dB

Input impedance: typically greater than 400kΩ

Signal loss through gate: less than 0.8dB