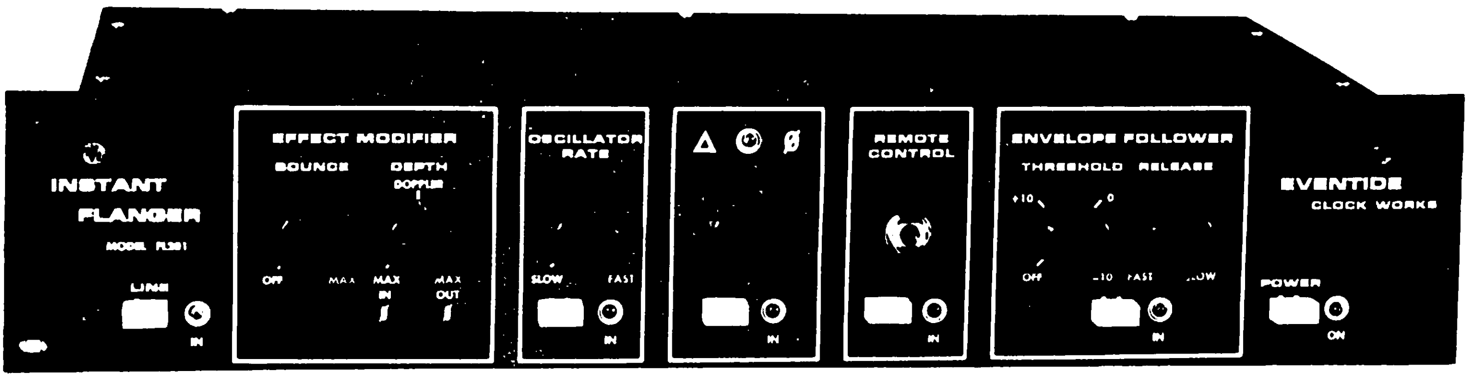
Eventide
the next step

INSTANT FLANGER T.M.
MODEL FL201



INSTRUCTION MANUAL

EVENTIDE CLOCKWORKS, INC. – 265 WEST 54TH STREET, NEW YORK CITY, 10019 – (212) 581-9138

WARRANTY

THE EVENTIDE CLOCK WORKS, INC. MODEL FL201 INSTANT FLANGER is warranted against defects in material and workmanship for a period of one year from date of purchase from Eventide or authorized dealer or distributor. In case of difficulty, contact Eventide or your dealer for repair or return instructions.

This warranty does not apply to mechanical defects caused by use or rough handling, or to damage caused by improper operation not in accordance with this manual. Cause of defect is in the sole judgement of Eventide.

This warranty is voidable at Eventide's option under the following circumstances:
User makes UNAUTHORIZED MODIFICATIONS (electrical or mechanical).
The unit is connected to an IMPROPER VOLTAGE SUPPLY.
Any other condition occurs which causes catastrophic failure or impairs Eventide's ability to render proper service

If the unit is modified by the customer without permission, the customer agrees to pay for any time or parts necessary to remove the modification before repair.

LIMITATION OF LIABILITY

EVENTIDE WILL NOT BE RESPONSIBLE FOR CONSEQUENTIAL DAMAGES caused by failure for whatever reason of equipments of its manufacture. Sole liability is for repair or replacement (at Eventide's option) of the defective equipment under the terms described above.

SHIPPING CHARGES

Returns under warranty should be shipped prepaid to Eventide. Repaired equipment will be returned to the customer prepaid, by United Parcel in states where such service is available, and by a suitable method in other states. When shipping by a more expensive method is requested by the customer, he will be billed for the difference.

FOREIGN REPAIRS

Since Eventide does not maintain a higher list price for equipment sold outside the Continental United States, the warranty does not cover return shipping charges beyond this area. All shipping and brokerage charges must be paid by the customer, less a freight allowance equal to the highest domestic rate in effect at the time of shipment.

EVENTIDE CLOCK WORKS INC.

WARRANTY REGISTRATION FORM INSTANT FLANGER FL201

SERIAL NUMBER________________________DATE PURCHASED__________________

FROM WHOM PURCHASED____

____

NAME OF PURCHASER____

ADDRESS____

CITY______________________________STATE________ZIP_____TEL__________

OPTIONAL-PLEASE FILL OUT
IF YOU HAVE THE TIME

NATURE OF YOUR BUSINESS____

____

APPLICATION FOR FLANGER____

____

____

Name of individual to whom
updates should be sent. ________________________________Title____________

How did you learn about
the Eventide Instant Flanger?_______________________________________

IMPORTANT: PLEASE FILL OUT THIS FORM TO INSURE WARRANTY PROTECTION. IF YOU DO NOT DO SO, THE ONLY DATE WE HAVE TO GO BY IS THE SHIPPING DATE, AND YOU WILL LOSE THE PORTION OF THE WARRANTY DURING WHICH THE UNIT WAS IN STOCK AT YOUR DISTRIBUTOR.

A business reply envelope is provided for your convenience. Form should be mailed within 10 days of purchase

INSTANT FLANGER™ MODEL 2830
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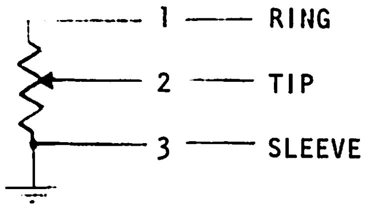
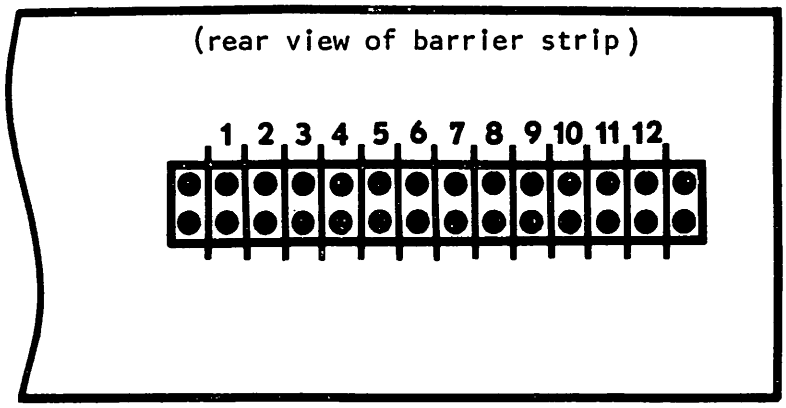
SYSTEM INTERCONNECTION

INSTANT FLANGER FL201

typical remote connection





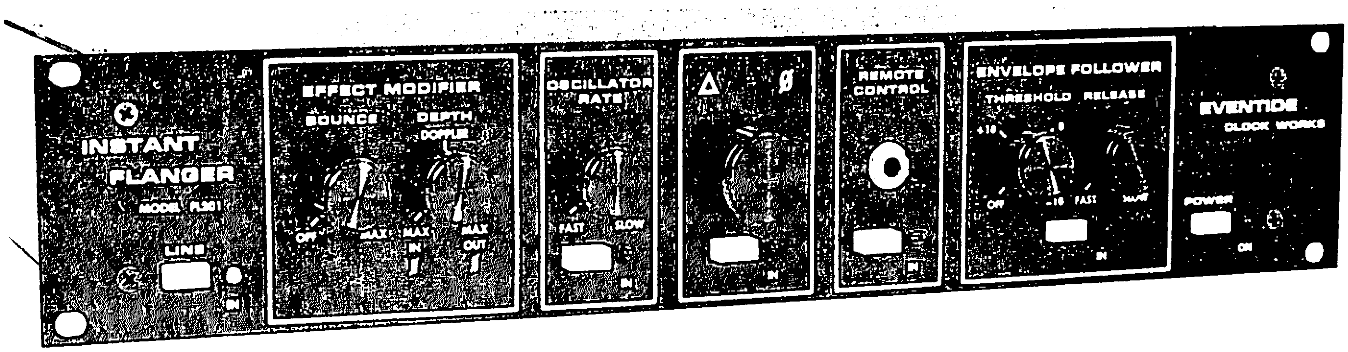
Terminal Number	Function	Function (option 03)
1	Remote control bias OUT	Remote control bias OUT
2	Remote control signal IN	Remote control signal IN
3	Remote control GROUND	Remote control GROUND
4	Audio INPUT (10K ohm)	Audio INPUT+ (600 ohm)
5	Audio GROUND	Audio INPUT return
6	Common GROUND	Common GROUND
7	Auxiliary OUTPUT (600 ohm unbal.)	Auxiliary OUTPUT (600 ohm)
8	Auxiliary GROUND	Auxiliary OUTPUT return
9	Common GROUND	Common GROUND
10	Main OUTPUT (600 ohm unbal.)	Main OUTPUT (600 ohm)
11	Main GROUND	Main OUTPUT return
12	Common GROUND	Common GROUND
	(all common grounds are connected	to the chassis)

The remote control bias OUT is a DC signal at a voltage level of nominal +5VDC and an impedance level nominally 3000 ohms. This output is protected against short circuiting and may be connected across a potentiometer of 10K or greater maximum resistance to achieve remote control of the INSTANT FLANGER. Remote control input impedance is nominally 47K ohm, decreasing to 3000 ohm if the control voltage range 0 to +6 volts is exceeded in either direction. The remote input may be damaged by an input voltage in excess of ± 24 Volts.

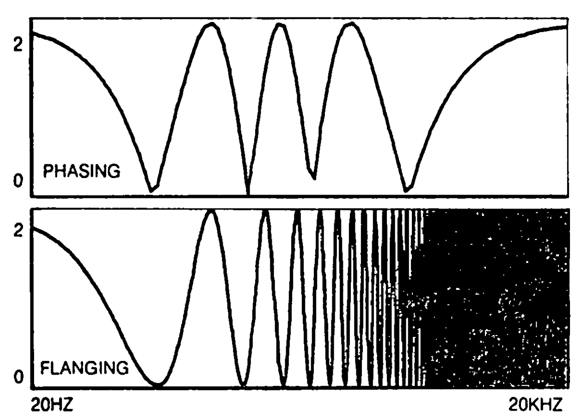
The front panel remote control jack is connected in parallel with the rear panel barrier strip as follows: SLEEVE to 3 (GROUND); RING to 1 (bias OUT); TIP to 2 (signal IN). The rear panel INput (pin 2) is connected through a normal on the front panel jack so that inserting a plug in the front panel disables the input on the barrier strip.

Eventide's instant flanger

Sound studios and professional musicians who require the ultimate in versatility and quality know us by name. Eventide has built a world wide reputation by developing the original *Instant Phaser.* The next step — *The Instant Flanger* — Eventide's latest generation of studio quality flanging equipment.



- INTERNAL REGULATED POWER SUPPLY
- REMOTE CONTROL CAPABILITY
- DUAL OUTPUTS FOR PSEUDO-STEREO
- INTERNAL ENVELOPE FOLLOWER
- LINE IN/OUT CONTROL AND INDICATOR
- HIGH LEVEL INPUT AND OUTPUT
- OPTIONAL BALANCED LINE IN/OUT
- FULL FREQUENCY RESPONSE TO 15KHZ
- AUTOMATIC OPERATION WITH OSCILLATOR
- MODE INDICATING LAMPS



New control configuration: oscillator, manual, remote and envelope may be used in any combination!

Old model phasing units used analog circuitry to modify the frequency spectrum. *Eventide's Instant Flanger* uses a true time delay circuit, producing many more nulls and thus a much deeper effect than previously available with an all-electronic unit.

To simulate true tape flanging we have introduced an effect modifier block which allows the operator to imitate motor or servo hunting "bounce". Our exclusive "depth" control will permit any desired percentage of direct versus delayed signal, and relative phase of each.

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EVENTIDE CLOCKWORKS, INC. • 265 WEST 54TH STREET • NEW YORK, N.Y. 10019 • 212-581-9290

Eventide specifications:

MODEL FL201 INSTANT FLANGER

INPUT LEVEL	0 to +4 dbm nominal level. Clipping occurs at +18 dbm for frequencies where the Flanger gain is unity.
INPUT IMPEDANCE	10K unbalanced. 600 ohm transformer balanced available OPTION 03
OUTPUT LEVEL	0 to +4dbm nominal level. Maximum output level before clipping is +18dbm. Output level may be up to 6db greater than input level, depending upon nature and frequency of input signal.
OUTPUT IMPEDANCE	600 ohms nominal, single ended. Transformer balancing OPTION 03
FREQUENCY RESPONSE	DIRECT CHANNEL: +1db, 50-15KHz. May be nulled at least 30db (typ. 40db) across entire audio range. DELAYED CHANNEL: +1.5db, 50-10KHz, down at least 3db at 15KHz. Low pass filter at input prevents aliasing.
DISTORTION	DIRECT CHANNEL: Lower than .05% below clipping point. DELAYED CHANNEL: Lower than 1% at nominal 0 to +8dbm input level, increases as input frequency increases due to pre-emphasis circuit. Typical at 1KHz, depth at maximum in phase, 0dbm input level: 2nd harmonic down 55db, 3rd harmonic down 80db, other harmonics undetectable.
DYNAMIC RANGE	DIRECT CHANNEL: 112db in 15KHz bandwidth. DELAYED CHANNEL: referred to 3% distortion, delay = 1 millisecond, 75db. Apparent dynamic range =85db due to pre/deemphasis.

NOTE: ALL OUTPUT MEASUREMENTS ARE REFERRED TO THE MAIN OUTPUT. AUXILIARY OUTPUT MEASUREMENTS ARE APPROXIMATELY 50% BETTER, AND THE DELAY IS 50% OF THE MAIN DELAY

DELAY TIME	Variable by means of front panel controls or external control voltage between limits of 200 microseconds and 10 milliseconds (as factory set). May be internally adjusted to give up to 50 milliseconds of delay for special effects, with serious degradation of all performance parameters.
CONTROL VOLTAGE	The voltage-controlled delay is designed to operate with an input between 0 and +6 volts. This variable voltage may be supplied externally or by any of the following controls, either singly or in any combination.
MANUAL	Controls delay time by manual control. CW rotation decreases delay and increases flanging frequency.
OSCILLATOR	Variable between .05 Hz and 20Hz, varies the flanging effect continuously and automatically.
ENVELOPE FOLLOWER	The input signal amplitude is used to control the flanging effect. Minimum input level -10dbm required, threshold and time constant are independently adjustable.
BOUNCE	Control used to simulate effect of tape recorder flanging by varying delay in the same manner as a motor or servo "hunting".
FLANGING INDICATOR	A light emitting diode (LED) is provided to give a visual indication of the control voltage level and thus the flanging frequency.
CONSTRUCTION	All solid state. All front panel indicators are LED's. Internal circuit boards plug in and are readily serviceable.
DIMENSIONS	48.26cm (19") wide; 8.89cm (3.5") high, 22.86cm (9") deep.
POWER REQUIRED	115VAC, 50-60Hz, +12% or 230VAC, 50-60Hz +12%; nominal 10 watts.

Eventide distributor:

CONTROL AND INDICATOR DESCRIPTION

IN/OUT SWITCH

This control switches the Instant Flanger in and out of an audio circuit. When the switch is in the OUT position, the unit is completely bypassed by a DC path and power need not be applied.

EFFECT MODIFIER GROUP

These controls vary the nature of the effect produced by the Instant Flanger. They operate on the control signals and audio signals in the following manner:

BOUNCE: As this control is rotated clockwise, the flanging control signal is progressively substituted for by a damped sine wave initiated by *changes* in the control signal. This damped signal swings the flanging back and forth by a diminishing amount for each swing, simulating the "hunting" effect created by an AC or servo motor changing speed. At full clockwise rotation of the BOUNCE control, only *changes* in the control signal will affect the flanging. At full CCW rotation, only the control signal *itself* will affect the flanging.

DEPTH: The DEPTH control adjusts the relative mix of the delayed signal and the direct signal. This is done in such a way as to enhance the pseudo-stereo capability of the Instant Flanger. The delayed signal is always present at full amplitude at both the MAIN and AUXiliary outputs. The DEPTH control adds a variable amount of direct signal to both of these outputs, so that when the DEPTH control is at either extreme, the delayed signal is at the same amplitude as the direct signal. When the DEPTH control is centered ("DOPPLER"), the direct signal is cancelled.
In the extreme CCW position, the direct signal is IN PHASE with the delayed signal at the MAIN output, and OUT OF PHASE with the delayed signal at the AUXiliary output. Thus, for short delay times ($\Delta\Phi$ control fully CW), low frequencies will be *reinforced* (as described in the theory section of this manual) at the MAIN output, and *cancelled* at the AUXiliary output. As the delay time at each output is different, the flanging effect will not disappear when the MAIN and AUXiliary outputs are mixed to monaural.
In the DOPPLER position, only the delay-varied signal is present and thus the frequency response of the Flanger is flat. As long as the control voltage remains constant, there is no effect on the signal. As it is varied, however, the delay varies, creating an apparent change in distance between signal source and listener, and consequently varying the frequency of the signal in a manner precisely analogous to the variation produced by the doppler effect. The more rapidly the control voltage is changed, the greater will be the relative frequency deviation.
SUMMARY: The table opposite gives the effect present at each output for various settings of the DEPTH control.

DEPTH CONTROL OPERATION

EFFECT MODIFIER GROUP CONT'D

DEPTH CONTROL POSITION	MAIN OUTPUT	AUXILiary OUTPUT
MAX CCW (MAX IN Φ)	IN-PHASE CANCELLATION LOW FREQUENCIES PRESENT AT SHORT DELAYS.	OUT-OF-PHASE CANCELLATION. LOW FREQUENCIES MISSING AT SHORT DELAYS
CENTERED (DOPPLER)	FLAT RESPONSE. FREQUENCY VARIES WITH CONTROL CHANGE.	FLAT RESPONSE. FREQUENCY VARIES WITH CONTROL CHANGE
MAX CW (MAX OUT OF Φ)	OUT-OF-PHASE CANCELLATION. LOW FREQUENCIES MISSING AT SHORT DELAYS.	IN-PHASE CANCELLATION. LOW FREQUENCIES PRESENT AT SHORT DELAYS.

OSCILLATOR GROUP

The OSCILLATOR RATE control varies the speed of an internal oscillator which may be connected to the control voltage bus by means of the push-ON/push-OFF switch located immediately beneath it. This oscillator generates a triangular waveform whose period is nominally 20 seconds with the RATE control fully CCW (SLOW), and 50 milliseconds with the RATE control fully CW (FAST). The control is logarithmic so that the speed can be easily controlled and set. An LED (IN) located next to the switch becomes illuminated when the oscillator is connected to the control bus.

$\Delta\Phi$ GROUP

This control may be used to control the flanging effect manually. A variable brightness LED located immediately above the knob gives a visual indication of the control voltage magnitude and thus the relative flanging frequency. This LED is operative regardless of the control voltage source.

REMOTE CONTROL GROUP

The REMOTE CONTROL connector may be used to connect an external signal source to the control voltage bus. The jack is a standard TIP-RING-SLEEVE, and the method of connection is detailed on the page titled "System Interconnection". The remote control is enabled by the switch below the jack, and an LED becomes illuminated when the switch is depressed.

ENVELOPE FOLLOWER GROUP

When the push-ON/push-OFF switch is depressed, the control voltage is varied by the amplitude of the audio input signal. The THRESHOLD control varies the amplitude of the signal applied to the envelope rectifier. The calibrations around this control indicate the approximate signal input amplitude required for proper operation of the envelope follower. The RELEASE control varies the control voltage decay time following the removal of the input signal. The release time varies from several milliseconds (FAST) to several seconds (SLOW).

POWER

Self explanatory.

APPLICATIONS

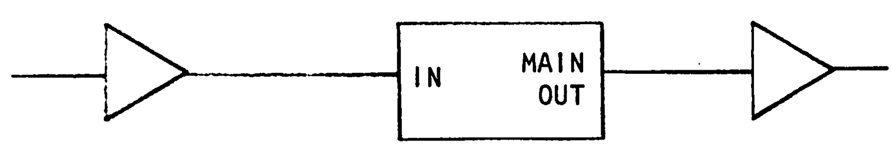
OF THE EVENTIDE INSTANT FLANGER

The Instant Flanger is designed primarily for the generation of the Flanging effect from which its name is derived. However, through theory and experience, we have determined many other applications for which the Flanger is suitable. These applications are divided into two groups: GROUP 1 encompasses those uses which may be implemented using the standard Flanger with the normal complement of studio or portable equipment. GROUP 2 details applications which are a bit more obscure, may require internal modification or readjustment of the Flanger, or possibly some specialized equipment.

To simplify drawings, the Flanger will be depicted as a block with two inputs (remote and audio), and two outputs (main and auxiliary). Only one wire will be shown as going to each point, although in fact each signal port will have a return and shield, and the remote input will have at least a return and the bias output may be used as well.

GROUP 1

MONAURAL FLANGING



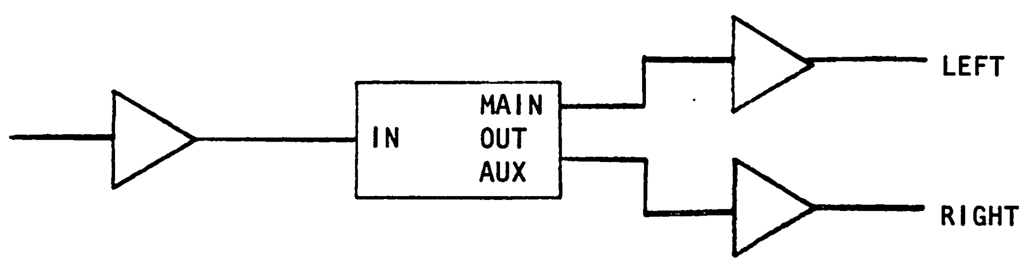
This is the most common and also the simplest use of the Instant Flanger. A signal source is connected to the input, and the output is connected to the appropriate amplifier or attenuator. The various sources of control voltage may then be used to vary the effect.

SIGNAL REQUIREMENTS: In ALL cases, the input signal to the Flanger must be at an appropriate level, typically 0dbm. Signals significantly above this level will cause clipping (at +12 to +18 dbm), and signals significantly below this level will cause degradation of the signal to noise ratio. As an aid in determining signal level when no VU meter is available, the Flanger may be set in the Envelope Follower mode and the signal applied to the input. With the THRESHOLD control set to 0 and the RELEASE control at 12 o'clock, the $\Delta\Phi$ LED should be driven to at least half brightness. In operation, difficulty in obtaining an LED indication in the envelope follower mode, when the other modes are functioning properly, *almost conclusively implies an insufficient input signal level, which must be remedied before proceeding with use.*

The Instant Flanger is an improvement over older phasing units, and will produce a much "deeper" effect. However, in order to produce an effect, there must be an appropriate signal to act on. The theory section discusses the basis of the flanging effect, and notes that nulls are produced through the frequency spectrum and that transient effects are significant. Certain instruments, such as the organ and flute, produce relatively pure signals. Since there are no sharp transients and little spectral dispersion, attempts to flange such instruments will be disappointing. The Instant Flanger can modify these instruments' sounds usefully, by adding doppler shift and creating pseudo-stereo effects, but it will not "flange" them too well.

Generally, the best flanging is obtained when the control voltage is varying slowly. At high rates of change, such as when the oscillator is running near the top of its range, the frequency shift in the output will be so great that the signal is virtually unrecognizable. Also, since flanging depends upon frequency cancellation, the variation cannot be so great as to cause, by doppler shift, the output frequency to be materially different from the input frequency. By the same token, at longer delay settings (low control voltage), if the input frequency varies very rapidly, less cancellation will occur. The last two sentences are serious oversimplifications, and while they do provide some explanation for the subjective effects perceived, they are not the last word on operation and the user is strongly encouraged to experiment with the various control functions.

STEREO FLANGING



All the above comments regarding signal levels and characteristics apply to this application. The two outputs, MAIN, and AUXILIARY, both have the same general effect on the applied signal, *i.e.*, they delay the input and mix it with the undelayed input. In detail, however the two outputs vary in that the amount of fixed phase shift and variable delay is half as much in the Auxiliary output as in the Main output. In addition, the relative phase of the delayed signal mixed with the input signal is reversed. (When the DEPTH control indicates MAX IN Φ, the auxiliary output is really MAX OUT OF Φ).

When the control voltage is high and the delay is short, low frequencies will be emphasized in the MAIN output and cancelled in the AUX output. This alone produces a pseudo-stereo effect. As the delay increases, the frequency nulls decrease in frequency and the distinct high/low separation gets averaged out. However, since the delay for each channel is different, the nulls interlace and so as a single frequency is swept slowly up, it will appear to move from channel to channel at a rate dependent upon the number of nulls, which is proportional to the total delay. Of course, a complex input combined with a constantly varying delay will not produce such a deterministic effect,

PSEUDO-STEREO

The Instant Flanger can be used to produce a good pseudo stereo effect, even on signals such as the organ and flute, which are not ordinarily "flangible".

The setup is identical to the block diagram under "Stereo Flanging", and the only difference in operation is that the Instant Flanger should be in manual and the manual control should be set to a position which gives the most desirable effect. In general, the farther clockwise the control is turned, the more pronounced the effect will be.

Compatible mono is not achieved using this method of stereo generation, as mixing the two outputs is not the equivalent of the input signal. This also means, however, that stereo flanging does not disappear as the two channels are mixed, and thus it is possible to flange both channels without worrying that the effect will not be audible on the radio or on mono disc.

DOPPLER EFFECT

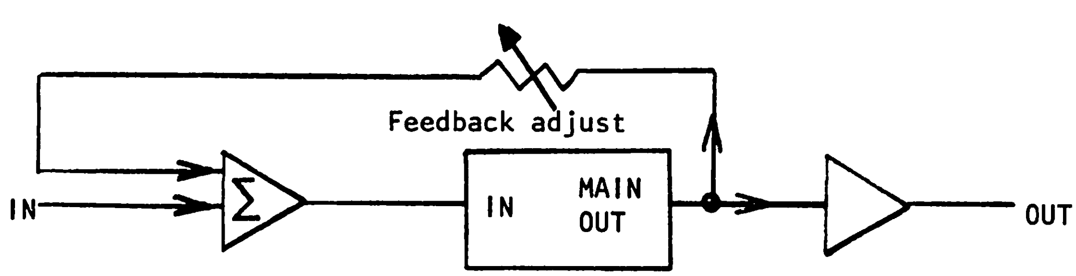
As the Instant Flanger uses a true variable delay network, the effect produced by varying the delay is precisely analogous to the doppler shift produced by varying the source-observer distance of a sound source. The more rapidly the distance is varied, the greater the absolute frequency shift. Since the delay may be varied only between fixed limits, large frequency shifts may be obtained for short periods, and small shifts for longer periods. In addition to the obvious possibilities for producing vibrato on musical signals, one can consider the following:

FEEDBACK REDUCTION: It is common knowledge that shifting the output frequency a few Hz relative to the input reduces howl by preventing large amplitude signals from building up at a fixed resonant frequency. This is normally accomplished by using a sideband shifter. Another possible method is to generate a continuous, small doppler shift using the flanger set in the Oscillator mode. We have not tried this under practical circumstances, but it will work at least theoretically. Undoubtedly, the optimum setting for the oscillator control will result in a compromise between feedback reduction and frequency shift in the speaker's voice.

PERSPECTIVE: It should be possible to gang an audio attenuator with a DC control signal pot (or use an identical attenuator for DC). By varying amplitude and delay, a better audio representation of a moving source might be obtained. Again, the total delay is rather limited, and simulating movement of more than 10 feet probably cannot be done realistically.

FEEDBACK

An extremely interesting and unusual effect can be obtained by feeding the Flanger output back to its input, in a manner similar to that below.



As the level of the feedback is increased, the equivalent of many (one per notch) high-Q tuned circuits is generated and connected in the signal path. This in turn causes a very unusual "ringing" effect. There are many of these "filters", only the ones which have resonances in common with input signal frequencies are excited, and thus the ringing accentuates the signals already present. This phenomenon is vastly different from the rather unpleasant effect caused by high-Q third octave filters.

In using this effect, caution should be exercised not to employ too much feedback, as the system will eventually go into oscillation, generally at a peaking frequency which has fractionally higher amplitude than its neighbors.

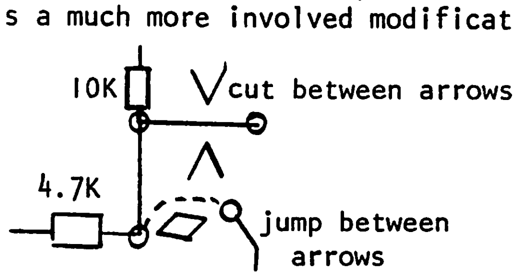
GROUP 2

MODIFICATIONS

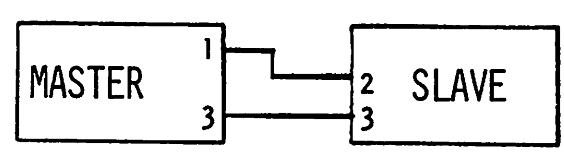
There are a few modifications which can be performed with little difficulty, and have been requested in the past for special applications. Although these modifications can be performed at the factory, their desirability frequently does not become evident until the unit is in use, and time pressures make return inconvenient, impractical, or too expensive. We therefore detail below these modifications. Performing one or more of these modifications, if done carefully and correctly, will not void the warranty.

MASTER/SLAVE OPERATION

One Instant Flanger may be used to control another one, for quad or other applications requiring independent signal channels. The remote (slave) unit requires no change. The control (master) unit requires a small P.C. board change as detailed below. Once this modification is made, connecting the units together and placing the slave unit in REMOTE will enable the master unit control voltage to be routed to the slave and the delay will be controlled similarly. (Please note that the precise delay *vs.* control voltage is not a specified parameter and the two units will not track precisely. It is possible to make them track precisely, but this is a much more involved modification and should not be performed in the field.



The diagram above shows a small section of the PC board immediately in front of the rear panel barrier strip. Cut the PC trace where indicated (bottom of board), and jump where indicated. The remote bias terminal now becomes the control voltage output.



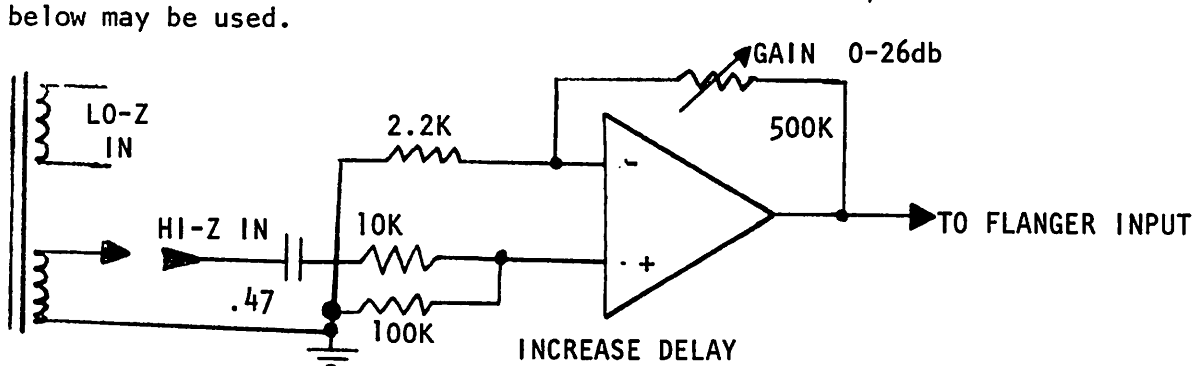
The units should be connected as shown above.
SLAVE---connector pin---MASTER
1-----leave open
2-----connect to-------1
3-----connect to-------3
Pin 3 is a common ground.

INCREASE GAIN

When used with semiprofessional or home equipment, it frequently is desirable to increase the system gain, to preserve dynamic range and allow proper operation of the envelope follower. Provision has been made for the addition of gain varying resistors to the input and output stages. Using the schematic diagram, locate the input stage and the 10K resistor which has two unused P.C. holes immediately next to it. This is the input resistor to the operational amplifier, and lowering it will decrease the input impedance of the Flanger to the parallel resistance value of the 10K resistor and the one to be installed. Placing a 10K resistor in the holes will increase the gain by 6db. A 3.9K resistor will increase the gain by 11db. This should be sufficient to interface with any low-level equipment available. We do not recommend increasing the gain more than 11 db by this method. If it is desired to operate the unit from a microphone or instrument level, see below. Without further modification, the output level will be studio level. If it is desired to bring the output level down to be commensurate with the input (and this *will* be desirable if you plan to use the IN/OUT switch), it is also necessary to pad the feedback resistors on both outputs. Using the schematic, locate the output amplifiers, and connect a resistor whose value is approximately 2.2X the value of the resistor you added earlier in parallel with the 22K feedback resistors.

PREAMPLIFIER

Driving the Flanger directly from an instrument or mic level input can be accomplished by installing a pre-amp internally. There is sufficient power reserve to use the Flanger supply for the pre-amp. As in all high-gain circuits, good wiring practice should be observed. If a transformer input is used, the transformer should be physically located as far from the power transformer as possible to prevent 60Hz pickup, and, if output transformers are installed, as far from them as possible to prevent coupling and feedback. There are sufficient spare PC pads in the unit to do a neat installation of a simple circuit. The circuit below may be used.



INCREASE DELAY

The plug-in circuit board is factory adjusted to vary the delay between limits established consistent with optimum flanging performance. By readjusting the proper pot on this card, the maximum delay can be increased or decreased. The pot to adjust is painted red. DO NOT ADJUST ANY OTHER CONTROL ON THIS CARD!! Increasing the delay allows additional special effects such as reverberation, 60 Hz elimination, and doubling. As the delay is increased past the factory adjustment point, various undesirable effects will occur: The dynamic range of the delay path will decrease, distortion will increase, and frequency response will decrease. As the delay is increased to the maximum, an effect called aliasing will become painfully evident, when input signals acquire beat notes and extravagant intermodulation distortion. A high frequency carrier will also appear in the output. Even with these horrendous effects, you can achieve some useful results by following the recommendations outlined below.

COMB FILTER

As the delay is increased past 10 milliseconds or so, the flanging effect grows less pronounced. This is because the combs are so close together that the frequency spectrum is averaged psychoacoustically, and for a frequency to be cancelled, it must be very stable for a long period. There is one case in which this occurs—when a signal is plagued with 60Hz hum! Frequently, 60Hz hum is accompanied by a strong harmonic structure. In order to get rid of this interference, a notch filter is typically used. However, if a notch filter is used to null the 60Hz interference, the harmonics are still present. Using the Instant Flanger's comb filter effect, the fundamental and all harmonics can be nulled simultaneously. To adjust the unit, set the $\Delta\Phi$ control fully CCW, and deactivate any other control voltage sources. Apply a 55 Hz signal from an oscillator to the Flanger input, and monitor the output on a VU or voltmeter. Set the DEPTH control to MAX OUT OF Φ and adjust the internal pot until a null is achieved. Be sure not to pass the first null. Rotating the manual control CW will increase the null frequency to 60 Hz. A small leeway is permitted for manual adjustment, since neither the adjustment oscillator or the Flanger oscillator is likely to be precisely correct for long. Note that the adjustment you have just made allows the Flanger to delay up to about 18 milliseconds. At this point, the quality degradation is not yet serious.

DOUBLING
(Automatic Double Tracking)

The delay as set above allows a reasonable measure of "doubling," as normally achieved with a digital delay line. With the short delay available, it works best with instruments such as acoustic guitar or others that do not have strong low frequency components and do have fast attack times. An interesting possibility is that a random or pseudo-random variation can be imposed upon the delay *via* the remote control input, which can better synthesize the natural variations inherent in performances with multiple artists.

Obtaining a random control voltage should be fairly simple in a studio-turn up the gain on a random amplifier, and use it to feed another amp. The output of the second should be quite noisy. Fashion a low pass filter from a resistor and electrolytic capacitor, and connect the output of the filter to the remote input. Do not be concerned about the negative excursions at the filter output—if the voltage exceeds the zener diode negative threshold, the filter capacitor will charge up to a small DC level. Note that the directions in this paragraph are quite imprecise. It will take some experimentation to determine the proper frequency content and delay variation for best effect. (When you find out, please send us a note for inclusion in later editions of this manual.)

REVERBERATION

At 18 milliseconds and longer delays, introducing feedback (see earlier diagram) around the Flanger will introduce a strong reverb effect, similar to that of a poor quality spring unit, but more distinct.

OTHER APPLICATIONS

Other possible applications for the Flanger include time base correctors to eliminate tape wow and flutter, communication system scramblers based on time compression and more exotic technologies, and instrumentation applications galore. If you have suggestions or new applications, or have a pet idea you'd like us to evaluate, write us a letter.

THEORY OF OPERATION

This section consists of an article written as an introduction to the process known as Phasing or Flanging, and establishes definitions of both processes. Included is a set of graphs showing the analytical basis of the effect.

Following the article is a brief description of the circuitry in the Eventide Instant Flanger, and its block diagram. A later section will discuss the operation of the various internal controls in the flanger and their adjustment.

INTRODUCTION TO FLANGING

Since its invention or discovery in the mid 1960's, the special effect known as "PHASING" or "FLANGING" has been one of the most popular additions to the mixer's repertoire. Phasing was introduced to the mass audience in the song "Itchycoo Park" by Small Faces and has been used (yes, and overused) to some extent by virtually every artist since that time. Just in case you've been on an interstellar voyage or in the Phillipine jungles since the 1960's, the phasing effect has been described by various individuals as "a swimming effect", as "a jet plane going through the music", as "a whooshing" sound, as "one of the best ways discovered to cover up mistakes", and as "something that makes you think the music is circling around you". All of these descriptions have merit.

The phasing effect's versatility can be partially explained by the following facts:

1. It affects three of the most important characteristics of a musical signal— pitch, amplitude, and harmonic distribution.
2. It affects signals over a very wide frequency range, and thus applies to virtually every signal source from a bass guitar to a snare drum.
3. It produces dynamic changes in pitch, which is interesting in itself and can be used to cover up mistakes.
4. It can be used to generate a pseudo-stereo signal with interesting characteristics and little effort (pseudo quad too).
5. When used tastefully it can add a hell of a lot of interest to a recording or live performance. (When used without taste it can still add a lot of interest. Short of running an entire concert through a phasing device, its hard to misuse.)

WHAT IS PHASING? WHAT IS FLANGING?

The terms "PHASING" and "FLANGING" have been used interchangably to describe the effect obtained. In point of electronic fact, there are two substantially different ways of obtaining the effect, and the effect thus obtained is also substantially different. The original effect (used on Itchykoo Park) was allegedly obtained by feeding a signal into two tape recorders, mixing the output, and then placing a drag on one of the reel flanges to slow down the machine. Because this method ties up two tape machines, requires 22 patch cords, and is a bit awkward (how many engineers have calibrated fingers?), several manufacturers designed electronic "black boxes" to achieve the effect with greater ease. Typically these devices accept a signal input and produce a phased output, the phasing being controlled by front panel knobs. One manufacturer (Eventide Clock Works) designed a unit specifically for recording studio applications. This unit has several methods of controlling the phasing: in addition to a front panel "$\Delta\Phi$" control, it has provisions for using an internal envelope detector or a variable frequency oscillator, thus phasing automatically either by following the signal amplitude or in a repetitive fashion.

However, (and its a big however).......

HOWEVER these black boxes, for technical reasons, could not generate the same effect as the finger on the flange. And although the black boxes had many advantages which could not (and cannot) be duplicated by the tape flanging method, the effect was not as pronounced or "deep", and thus the tape method continued to be used when a particularly strong effect was desired. To prevent confusion, In the remainder of this article we will refer to PHASING and FLANGING by the following definitions:

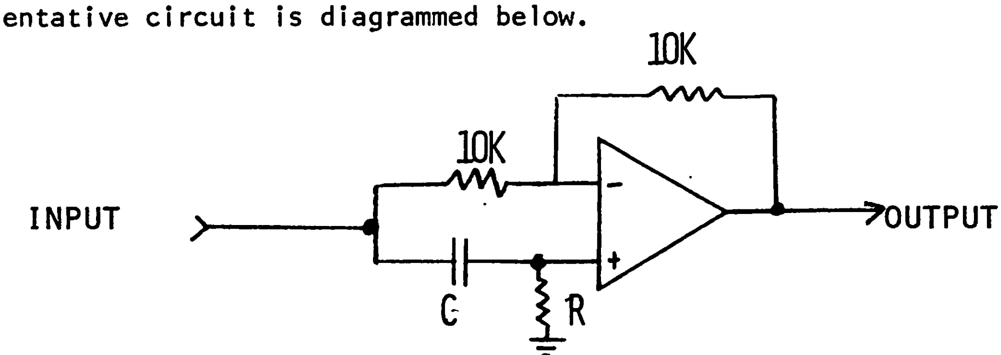
PHASING: The effect obtained by using electronic phase-shift networks to generate cancellations in the frequency spectrum of a signal.

FLANGING: The effect obtained by using differential delay to generate cancellations in the frequency spectrum of a signal, regardless of the method used to generate the delay.

The difference in the sound of the two methods can be well explained by theory, and we proceed to do so below.

PHASING

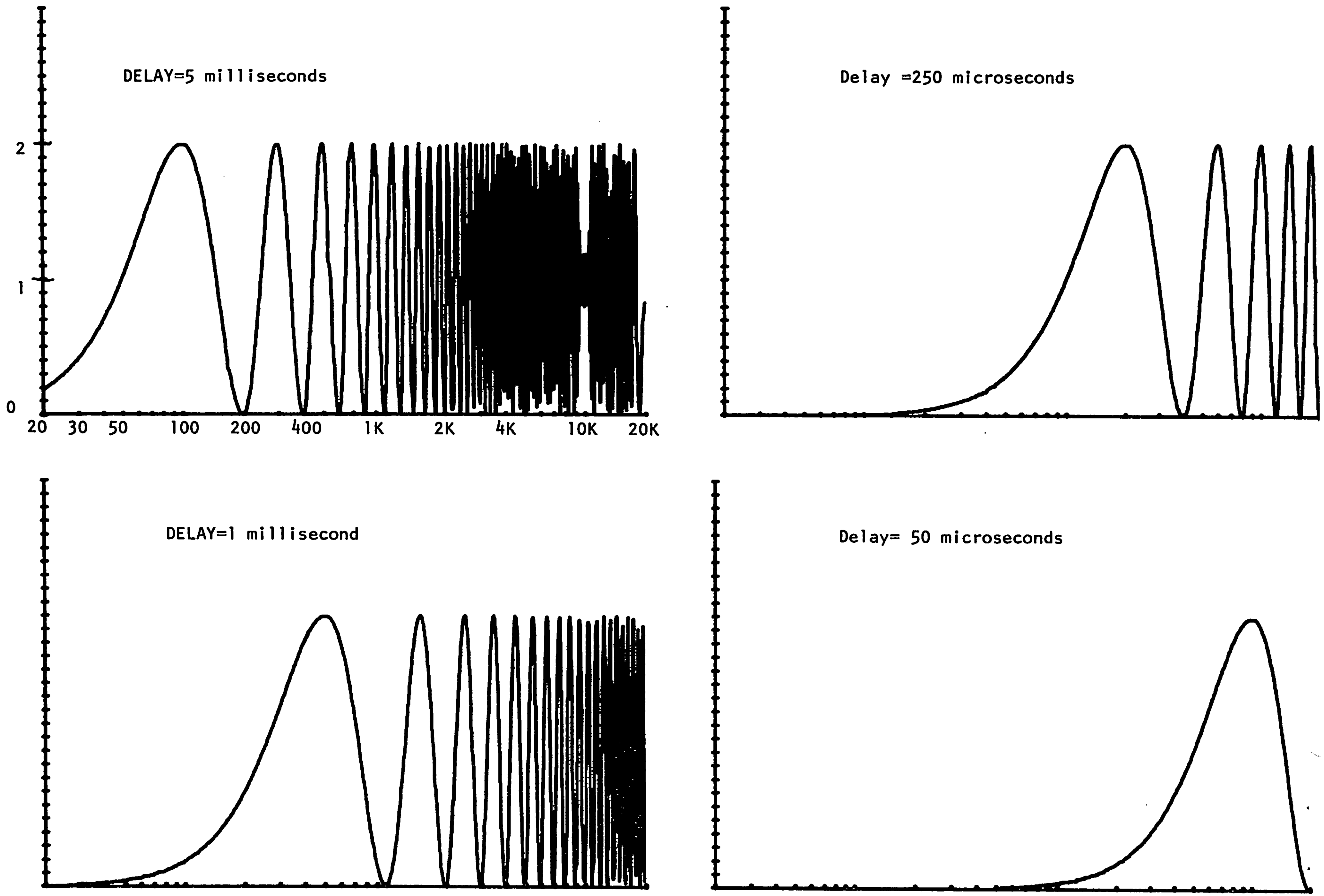
The basis of the "black box" phasing device is an electronic circuit known as the "ALL-PASS NETWORK". As one might assume, this type of network passes signals of all frequencies, but its output phase versus input phase varies as a function of frequency. A representative circuit is diagrammed below.



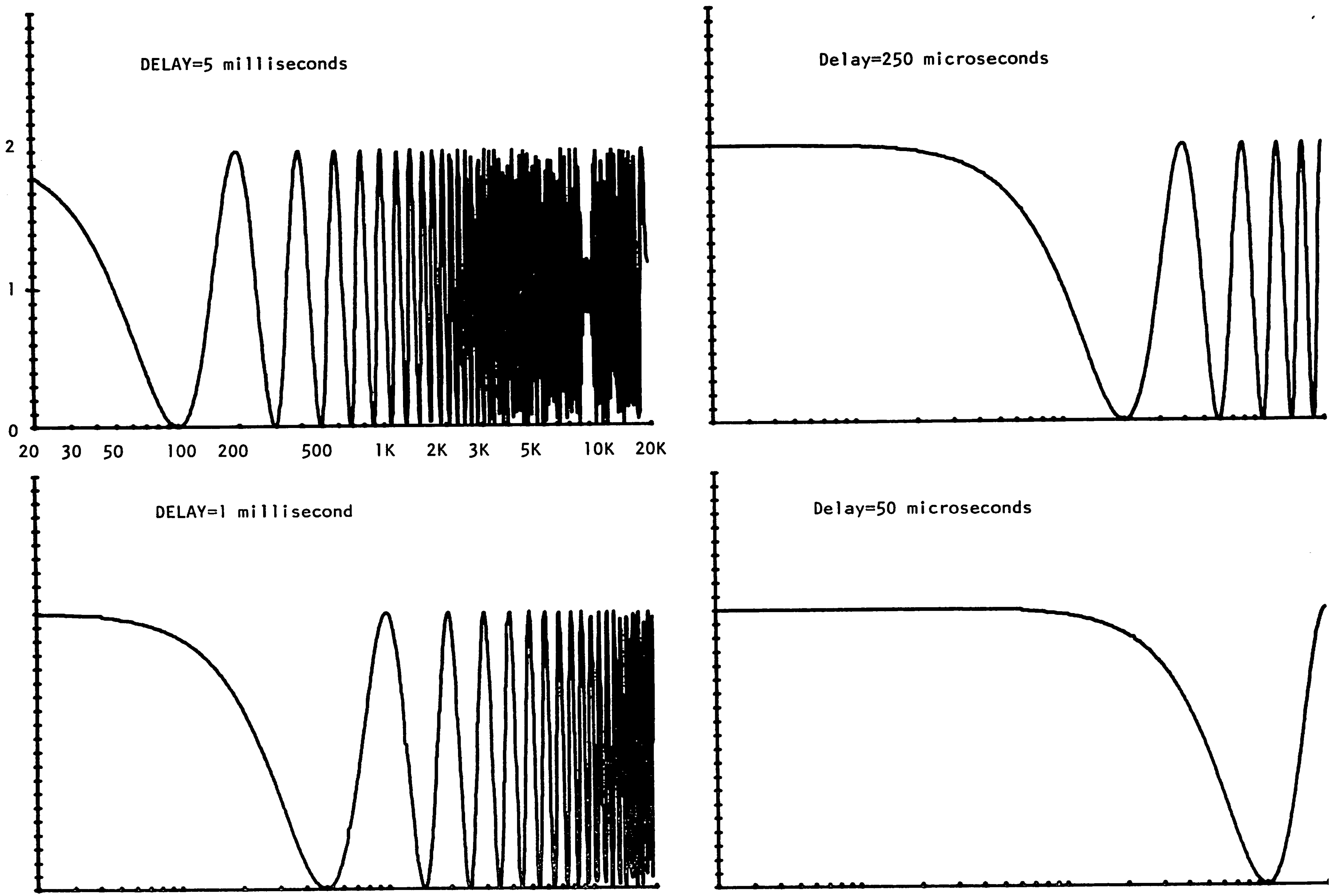
Since the circuit has a single RC time constant, the maximum phase variation, assuming ideal components, is 180 degrees. In actuality, it can only approach this value since C is limited by stray capacitance and R must not exceed a reasonable value, depending upon the operational amplifier used. The output of the network sounds the same as the input (flat frequency response), but the phase is shifted according to the RC network constants. Thus, by adding the input of the network to the output of the network in a 1:1 ratio, the added signals will be reinforced at frequencies where the phase shift is near 0, and cancelled at frequencies where the phase shift is near 180 degrees. Since our example uses a single network, there will be no complete cancellation. To produce the phasing effect, several such networks are connected in series, and their phase shifts added. This gives rise to such advertising claims as "over 1200 degrees of phase shift!" which is true, impressive, and probably irrelevant. The other requisite for phasing is some method for varying the time constant of the networks over a wide range. In the example shown, varying R over a 400:1 range varies the cancellation frequency over the same amount, causing the phasing to shift from beyond audibility to the mid-bass region. As an added plus, during the period that R is changing, a frequency shift similar to doppler shift is created. This applies to the output of the all-pass network whether or not it is added to the input. Thus it is possible to generate a deep vibrato with no extra circuitry.

The frequency response of 8 all-pass networks is shown graphically for several values of R. The graphs are plotted on identical axes. Since the horizontal axis is logarithmic, the relative spacing of the nulls remains constant, although the absolute

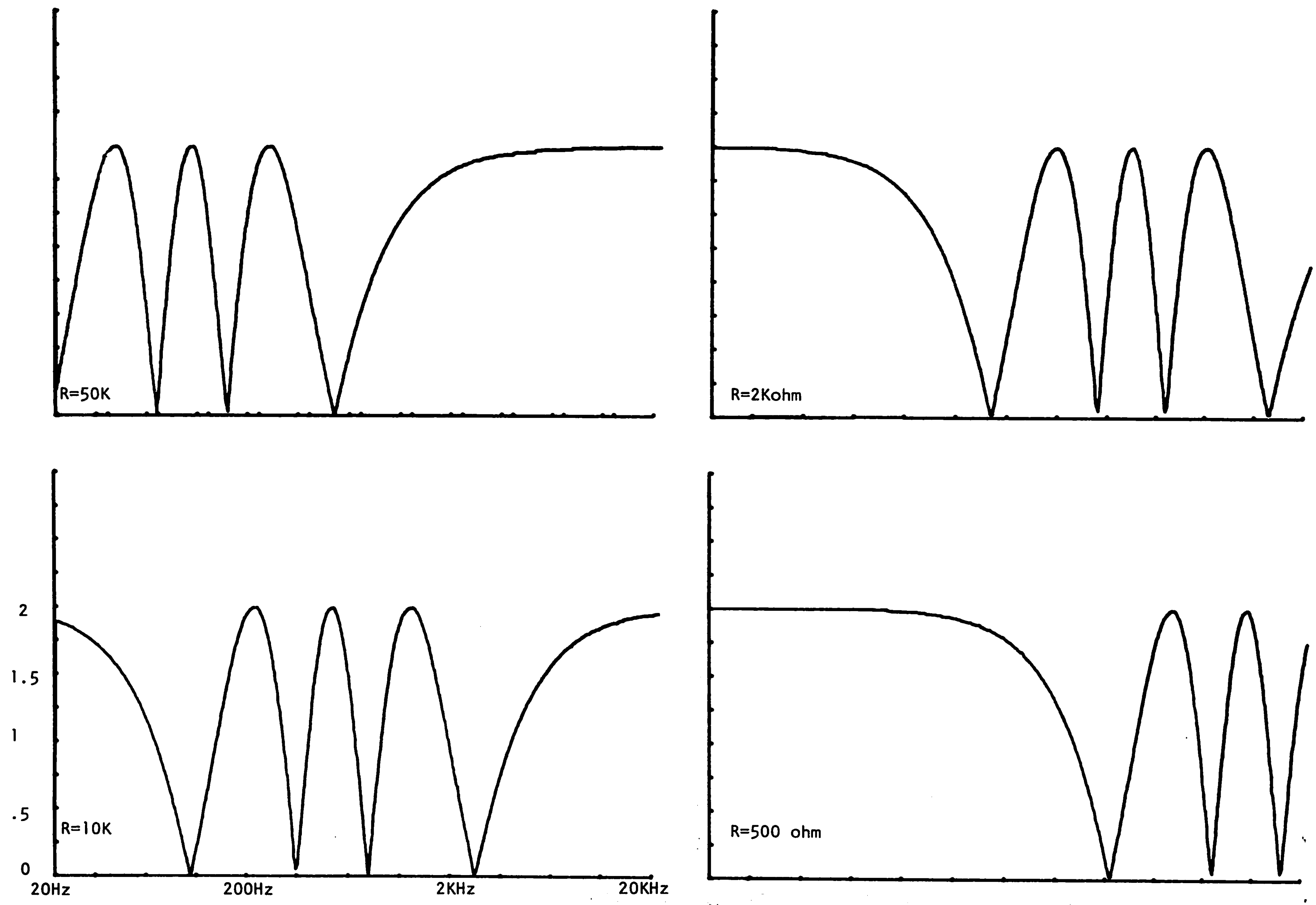
FREQUENCY RESPONSE OF SIGNAL ADDED TO ITS DELAYED REPLICA
(ADDITION 180 degrees out of phase)



FREQUENCY RESPONSE OF SIGNAL ADDED TO ITS DELAYED REPLICA



FREQUENCY RESPONSE OF STANDARD ALL-PASS NETWORK WHEN INPUT ADDED ALGEBRAICALLY TO OUTPUT (all C=.033uf)



spacing in number of Hertz varies as R varies. In observing the graphs, note the following characteristics:

1: Below and above the ranges of the phase shift networks, the output of the system asymptotically approaches 2X the input.
2: The frequency ratio of the nulls is not constant and not harmonically related.
3: The shape of the nulls is sharp, the peaks rounded.
4: The total number of nulls is fixed and dependent upon the number of all-pass networks.
5: At any time the nulls are clustered within one portion of the frequency spectrum.

FLANGING

As we stated earlier, flanging is produced by mixing the output of two tape recorders, one of which is running a little slower than the other. Since the head-to-head distance is fixed, the transit time of the tape from the record head to the play head determines the path delay. Assume that the speed difference between tape machines is such that the differential delay between transit times is equal to 1 millisecond. Since one millisecond is the period of a 1KHz signal, it might be expected that a 1KHz input to the system would result in an additive signal, since the two outputs would add in-phase. On the other hand, a 500Hz input would have a 180 degree phase shift at 1 millisecond delay, and thus would completely cancel. Slightly less obvious is the fact that all signals at odd multiples of 500 Hz will undergo the same cancellation, since, for instance, the phase shift of 1500 Hz is 360+180 degrees at 1 millisecond delay. Several graphs are presented showing the frequency response of a signal mixed with its delayed replica. Incidentally, all the graphs show the steady state response. We'll have a few words on transients later. In observing the graphs, note the following characteristics.

1: Below the first null, the output of the system asymptotically approaches 2X the input. There are always nulls at high frequencies.
2: The frequency ratio of the nulls <u>is</u> constant and harmonically related.
3: The shape of the nulls is uniform, and similar to the peaks.
4: The number of nulls increases as the delay increases.
5: At long delays, the entire frequency spectrum is substantially modified.

COMPARISON

The consequences of the differences in characteristics are striking. Intuitively, one can feel that the flanging response should have more effect on the music, and in this case intuition is correct.

1: Because there are always nulls at high frequencies, the "jet plane" effect is more pronounced, even when the delay is fairly long.
2: Because the nulls are harmonically related, the effect on the tone of many instruments is more musically interesting. For instance: Assume an instrument is being played with a fundamental frequency of 440Hz. It will have harmonics at 880Hz, 1320Hz, 1760Hz,2200Hz, etc. At a delay of 1.136 milliseconds, the fundamental and all odd harmonics will be cancelled out, leaving only the even harmonics. If the instrument shifts pitch, its entire tonality will change.
3: There's nothing much that can be said intuitively for advantages of sharp or rounded peaks, and since there's no simple way of comparing them subjectively, let's pass on this one.
4: The number of nulls increases as delay increases, and thus there is an overall

broader effect on the input signal. It should be noted, however, that when the nulls are very closely spaced, the effect decreases since there is an averaging between the nulls and the peaks in psycho-acoustic realms. As a practical matter, useful flanging occurs in the delay range of 50 microseconds to about 5 milliseconds, and devolves to a doubling effect after about 15 milliseconds.

5: Same comments as above.

The above comparisons refer only to the steady state behavior of the phasing/flanging systems. In reality, two transient conditions occur (and interact). At issue are the subjective effects when:

1: Material is being phased or flanged while the time constant or delay of the network is being varied; and

2: The input is being changed while the constants of the network are held fixed.

The results in the first case were alluded to earlier. If a phase shift network has its constants changed, a frequency shift analogous to doppler shift will occur. Since the networks do not affect all frequencies equally, the change will be different for different frequencies. Thus, harmonic ratios will not be preserved during the change. On the other hand, changing the delay in the case of flanging is precisely analogous to doppler shift, and frequency shift will take place in the well-known manner. Subjectively, it appears that the rate at which the doppler or pseudo-doppler shift takes place is more significant than the type of network that produces it. This is only the result of a few hurried observations and you should feel free to disagree with this conclusion.

Far more interesting is the second case. A phasing network can produce only a limited amount of delay at frequencies in the range that is of musical interest. Transient effects arise because the signal applied to the network input does not affect the final result until it reaches the end of the network. The other branch of signal is direct. For instance, if the delay time were 5 milliseconds and a 1900Hz signal were applied to a flanging network, the output would be a null as indicated in the graph, but, before the null was achieved, 9 complete cycles of the tone would pass through the network, resulting in a cross between a click and a short "beep". Actual musical signals are not nearly so deterministic, and the subjective effects are impossible to describe. That's one of the main reasons why the flanging effect is more pronounced than phasing. In effect, each signal has two characteristics-its steady state and its transient. Although this does not apply particularly to violins, organs, etc., plucked string instruments, and especially drums, take on a whole new aspect when flanged. This effect becomes distinct from the frequency nulling at about 1 millisecond, and increases in importance up to about 5 milliseconds.

In summary, then, the comparison between phasing and flanging comes down to this: Flanging produces a more pronounced effect, primarily because of the extra nulls in the frequency response, and the longer period before transients are nulled out of the final result. It is more difficult to achieve because of the bulky equipment and inconvenient setup and not as controllable.

Reread that last sentence. It's a lie.

FLANGING FOR THE MILLIONS

It seems that achieving short delays in signals has always been difficult. How would you build a delay line variable from, say, near 0 to 5 milliseconds?

If you need a short delay, you can use distributed capacitance and inductance of a coil of wire. As the delay increases, however, the bandwidth suffers. Above a few tens of microseconds, it becomes unusable for high quality audio.

If you need a very short delay, you use a piece of wire and wait for the speed of light to bring you your signal.

If you need a very long delay, you record your signal on tape and play it back later.

If you need a super long delay, you inscribe the data on a silicon wafer and send it into a solar escape orbit.

If you need a few hundred milliseconds of delay, you convert your signal into digital format and store it in shift registers. It will come back unaltered after the desired delay and be converted to analog and reused .

But what about five milliseconds?

The delay is too short to justify the overhead cost of digital technology. A speaker at one end of a tube and a microphone at the other? Fine for fixed delays but try to adapt it for rapid variation! Ultrasonic delay? Suffers from dynamic range problems, and how to vary it? Tape delay? Works, but what a nuisance! Magnetic disc? Costs a fortune and has (ugh) moving parts.

Enough teasing. A new type of semiconductor has been produced in recent years. It is known generically as the "Charge Coupled Device" and popularly as the "Bucket Brigade" delay. Until very recently, the state of development of these devices was such that they were impractical to use for audio. They had insufficient dynamic range and suffered from many undesirable electronic characteristics beyond the scope of this article. As this is written, at least one device is available which is suitable for short delay use in audio with sufficient range, both in delay and amplitude. Earlier devices had been designed primarily for video applications which are more demanding at high frequencies but can get along with 40db range.

Using these devices to generate delay enables one to build an all-electronic (no moving part)"black box" which produces flanging in a manner precisely analogous, but without the bulk and inconvenience, to the two tape machine-22patch cord method. An additional benefit is that the delay is controlled electronically instead of mechanically, enabling one to do the same sort of tricks, such as signal or oscillator controlled flanging,as can be done by the common phasing unit.

Electronics marches on. Rank upon serried rank of electrons, each one following the other, filling holes in semiconductor crystal lattices left vacant by its forebears. And, to the tune of marching electrons, EVENTIDE CLOCK WORKS brings you a new, and better, black box......the INSTANT FLANGER. Call your professional distributor, call us, arrange to hear one soon.

APPENDIX

For you mathematics people, the formulas used to create the graphs shown are given below.

PHASE RESPONSE OF ALL-PASS NETWORK

$$\Theta=(-2\tan^{-1}\omega R_1C_1)+(-2\tan^{-1}\omega R_2C_2)+(-2\tan^{-1}\omega R_nC_n)$$

FREQUENCY RESPONSE OF ALL-PASS NETWORK

$$H=\sqrt{(1+\cos\Theta)^2+(\sin\Theta)^2}$$

FREQUENCY RESPONSE OF SIGNAL ADDED TO ITS DELAYED REPLICA

$$H=\frac{\cos\frac{(T_d)(360)}{1/f}+1}{2}$$

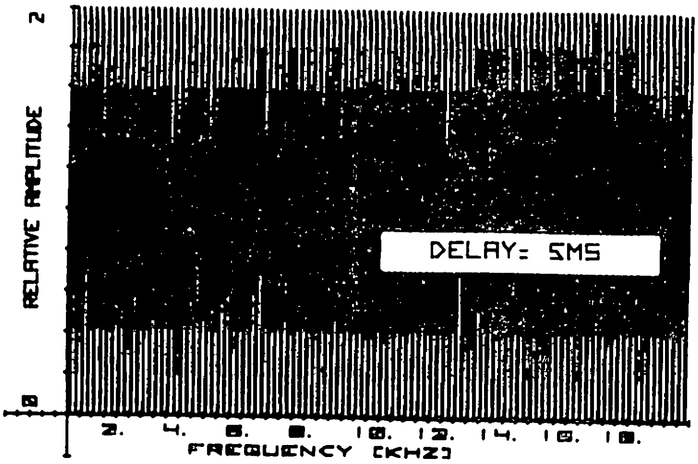
WHERE:

R is the resistance component of the all-pass network
C is the capacitance component of the all-pass network
ω is the frequency in radians/sec $(2\pi f)$
T_d is the delay time in seconds
f is frequency in Hz

The raggedness in the 5 millisecond graph is due to an insufficient number of samples per cycle to faithfully reproduce the true shape of the curve. This is known as "aliasing" and was deliberately left in the graph to show what happens when the clock rate (sampling rate) is too low in a digital or analog sampling system. This is part of what happens when the delay is increased beyond the factory adjustment as described in the Applications section.

BODE PLOT [FREQUENCY VS AMPLITUDE]

OF VARIOUS DELAY TIMES [LEFT] AND PHASE NETWORKS [RIGHT].



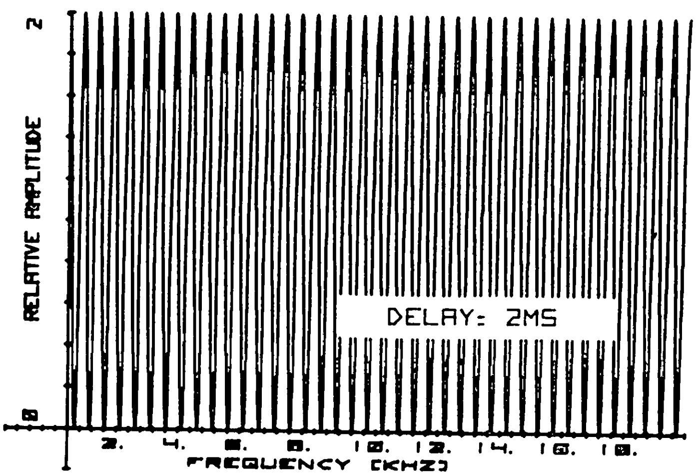
IN EACH CASE THE GRAPHED RESPONSE IS OBTAINED BY THE ALGEBRAIC ADDITION OF THE INPUT SIGNAL TO THE PROCESSED SIGNAL.

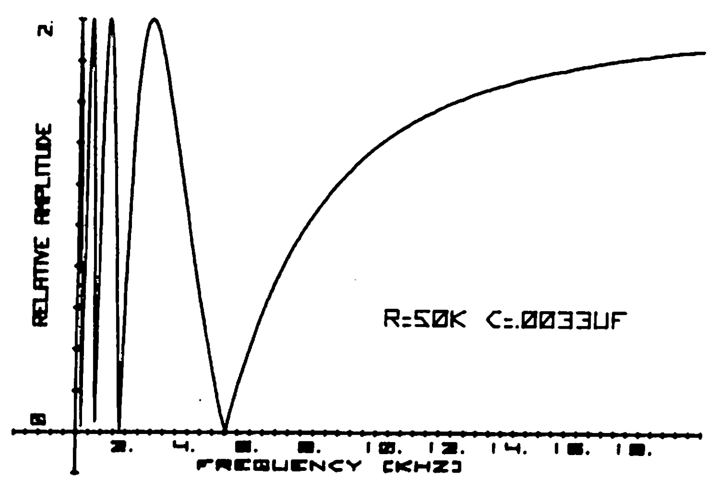
LEFT

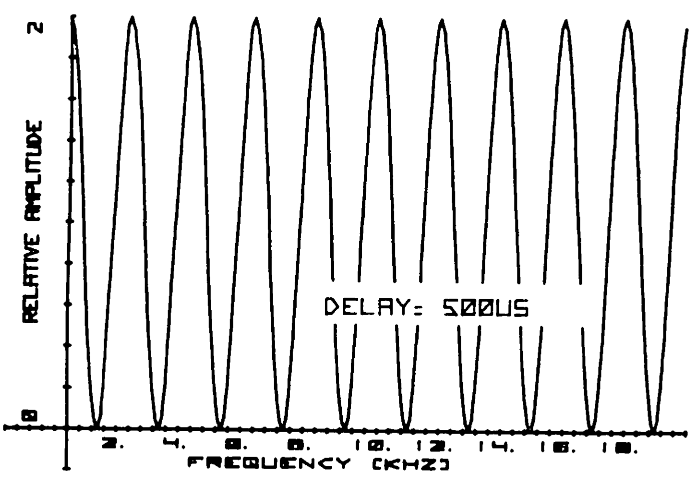
SIGNAL PROCESSED THROUGH TRUE DELAY CIRCUIT WITH DELAY AS SHOWN.

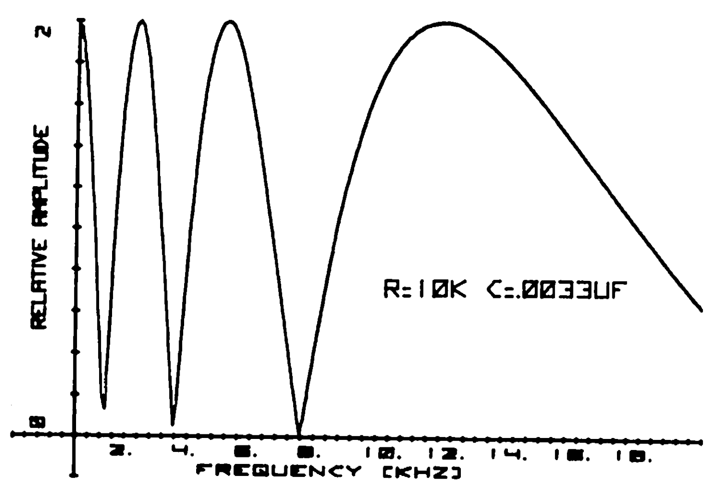
BELOW

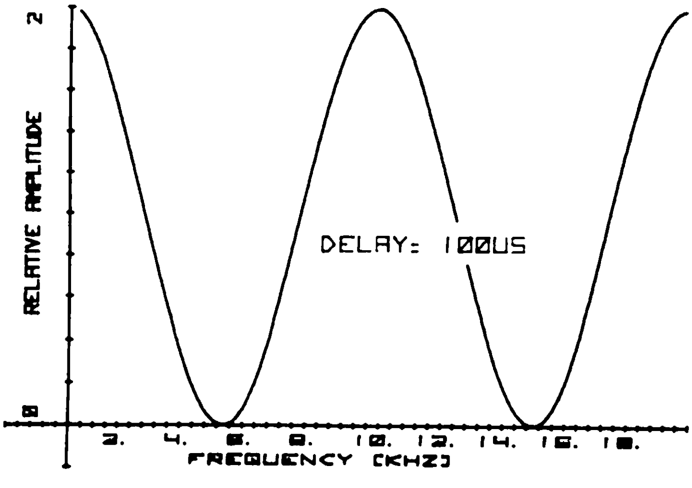
SIGNAL IS PROCESSED THROUGH 8 IDENTICAL NETWORKS WITH R-C CONSTANTS SHOWN

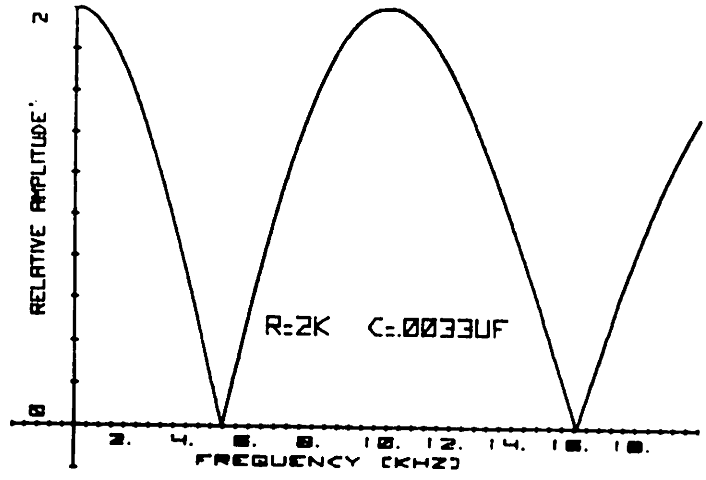


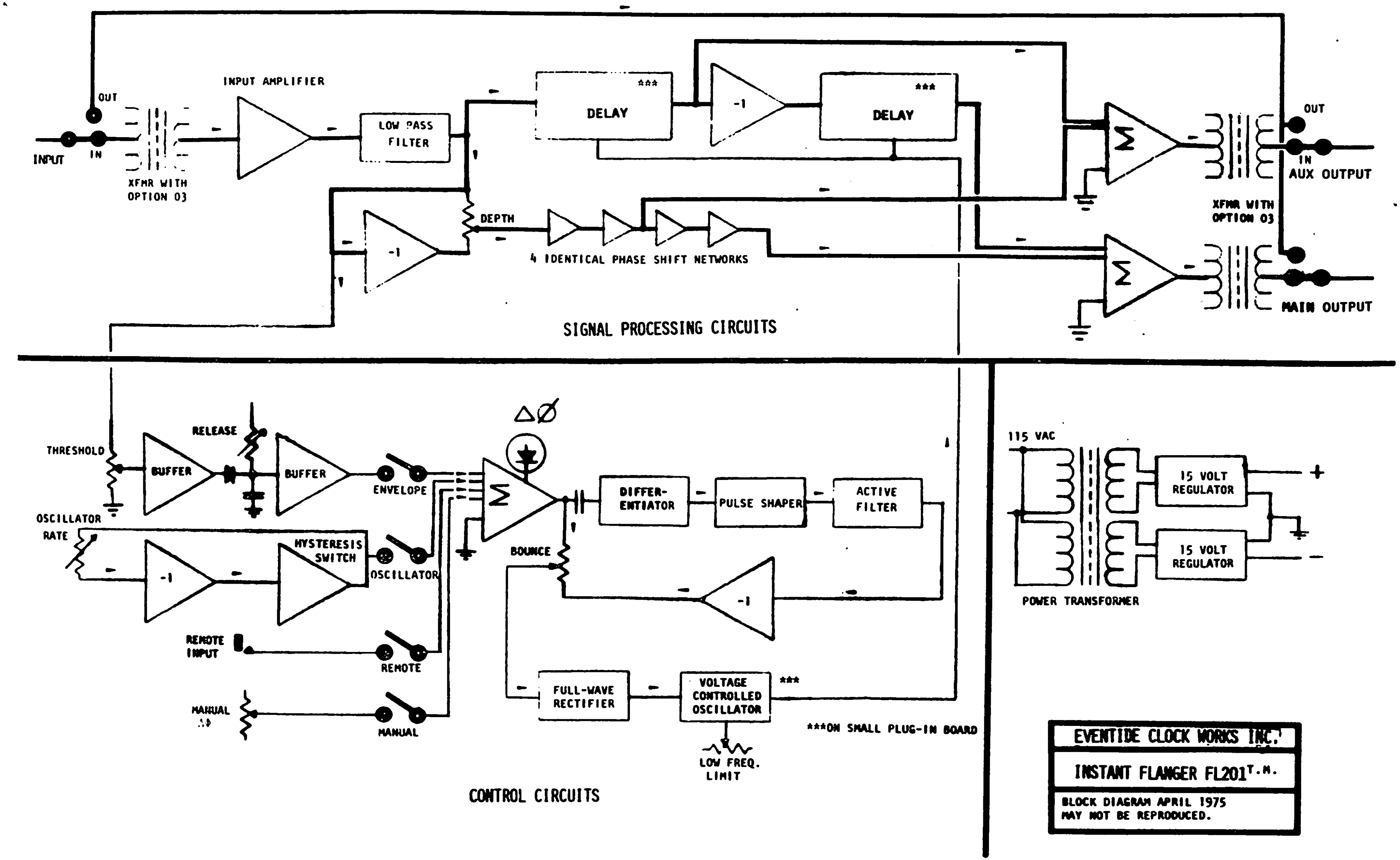











INPUT
IN
OUT
XFMR WITH OPTION 03
INPUT AMPLIFIER
LOW PASS FILTER
DELAY
***
-1
DELAY
***
DEPTH
-1
4 IDENTICAL PHASE SHIFT NETWORKS
Σ
Σ
OUT
IN
AUX OUTPUT
XFMR WITH OPTION 03
MAIN OUTPUT
SIGNAL PROCESSING CIRCUITS
THRESHOLD
BUFFER
RELEASE
BUFFER
ENVELOPE
OSCILLATOR RATE
-1
HYSTERESIS SWITCH
OSCILLATOR
REMOTE INPUT
REMOTE
MANUAL
MANUAL
ΔØ
Σ
BOUNCE
DIFFER-ENTIATOR
PULSE SHAPER
ACTIVE FILTER
-1
FULL-WAVE RECTIFIER
VOLTAGE CONTROLLED OSCILLATOR
***
LOW FREQ. LIMIT
***ON SMALL PLUG-IN BOARD
CONTROL CIRCUITS
115 VAC
15 VOLT REGULATOR
15 VOLT REGULATOR
+
−
POWER TRANSFORMER
EVENTIDE CLOCK WORKS INC.
INSTANT FLANGER FL201T.M.
BLOCK DIAGRAM APRIL 1975
MAY NOT BE REPRODUCED.

CIRCUIT DESCRIPTION

There are three major groups of circuits in the Instant Flanger:

The signal processing circuitry
The control voltage processing circuitry
The power supply/lamp driver circuitry.

The power supply serves only to supply the proper operating voltages to the remaining circuits. It is conceptually and electronically very simple and we will waste no further words on it. The lamp driver consists of a single transistor current sink which maintains constant current regardless of input voltage. All the front panel LED's (except the variable one) are connected in series with this current sink. When a particular circuit is not operative, its respective LED is shorted by the associated control switch. The purpose of this arrangement is to avoid using regulated power to drive lamps, and to increase efficiency by not requiring separate dropping resistors for each lamp.

The SIGNAL PROCESSING circuitry is defined as all stages through which the input signal passes on the way to the output. These circuit blocks are shown in the upper half of the block diagram.

The input is initially applied to IC1 (through a 1:1 transformer if the Flanger contains option 03). IC1 buffers and amplifies the signal, and provides some high frequency rolloff. IC2 and its associated passive components form a low-pass active filter which rolls off rapidly above 15KHz. This prevents high frequency signals which may be present from entering the delay circuitry and generating "aliasing" or beat notes. IC3 is an inverting amplifier which applies a signal equal in amplitude and opposite in phase to R14, the depth control. With the wiper at one end, the depth control output is connected to the output of IC2; at the other end, to the output of IC3. When the control is centered, these two signals cancel each other and no direct signal is applied to the outputs.

The output of the depth control is applied to a group of fixed phase shift networks in such a manner that there is twice as much phase shift in the main output as there is in the auxiliary. These networks are of the type discussed in the article earlier. These networks are used to enhance the subjective effect produced by the Flanger-they are not variable and do not contribute to the frequency sweeping effect. After these networks, the signal goes to the output buffer amplifiers and thence to the outside world. The output amplifiers are fast op-amps buffered by a complementary transistor pair in a configuration optimized to prevent crossover distortion. The operational amplifiers operate in a fast summing mode, and their other input is the signal from the delay circuitry.

The delay circuit consists of two charge-coupled, or "bucket brigade" shift registers, located on a small plug-in circuit board. There are two entirely independent circuits on this board, and they are connected externally through inverting amplifier IC17. Each section has an identical delay, so that the second output is precisely twice the delay of the first. The short delay output is connected to the summing point of the of the auxiliary output buffer amplifier, and the long delay output is connected to the summing point of the main output buffer amplifier. This card also contains a voltage-controlled oscillator whose frequency determines the delay of the circuit by changing the rate at which data are shifted from "bucket" to "bucket." The wide range of this oscillator and the critical nature of the circuitry on the board make it very inadvisable to attempt troubleshooting or adjustment in the field, and the board should be returned to the factory if trouble is suspected. The troubleshooting section will explain how to determine if this board is operating properly.

The voltage source for the voltage-controlled oscillator is derived from the CONTROL VOLTAGE PROCESSING circuitry. There are four basic sources from which the control voltage may be derived: The Oscillator, the Envelope Follower, the Manual Control, and the Remote Control. Each of these circuits generates (or receives) a signal in the range 0 to 5 volts DC, and selectively applies it to a bus if its associated switch is depressed.

The OSCILLATOR uses a Complementary MOS NAND gate in a linear/digital configuration. Its operation is as follows: Assume C20 is discharged: IC6-1 is low, and so IC6-3 is high. IC6-4,5,6 and IC6-10, 9,8 are connected in a positive feedback arrangement in which R45 produces hysteresis. If IC6-3 is high, IC6-8 is also high, and C20 charges through current limiting resistor R39 and the oscillator rate control, R40. IC6-1,2,3 acts as a linear amplifier with very high input impedance so as not to load the capacitor, and an output inverted from the input. When C20 is sufficiently charged so that IC6-3 is low enough to overcome the hysteresis caused by the current through R45, IC6-8 will switch low, and the capacitor will start to discharge. IC6-2,5,9 are spare gate inputs and disable the oscillator when switched low. The output from IC6-3 is applied to IC7, which adjusts the final oscillator output level to the proper voltage range and offset. Although theoretically the oscillator described should generate a dual exponential ramp, the levels are controlled so that the input current to the capacitor remains fairly constant (positive or negative) and so a linear up-down ramp is produced.

The ENVELOPE FOLLOWER picks off the input signal through threshold control R31. This signal is buffered by IC9 and rectified by D3, and used to charge a capacitor C19. D1 and D2 are protective diodes which prevent the output of the envelope follower from exceeding +5 volts. C19 is discharged through the release control R35, which determines the time constant of the circuit. Q1, the FET buffers the capacitor so that it cannot discharge into the control bus.

The MANUAL (ΔΦ) CONTROL is a potentiometer (R55) connected across the positive power supply with a series dropping resistor (R54) whose value limits the maximum input to the control bus from the pot.

The REMOTE CONTROL applies an externally generated signal to the control bus. R53 and zener diode D5 protect the Flanger from accidental application of inputs outside the specified range.

The control voltage is summed by IC8. To prevent overload, each time an additional control input is selected, an additional resistor is connected in the feedback loop of the amplifier. Thus, the gain for each input is decreased as more inputs are added. If for instance, the Remote Control and Manual inputs are both selected, the manual control will not cover the full range, even if there is no input at the remote control jack.

Feedback for IC8 is through LD-7, a light emitting diode above the manual control. R65 loads the amplifier after the feedback so that sufficient current is drawn to illuminate the LED. IC10 inverts the control signal polarity and applies it to one side of the BOUNCE control. When this control is in the Normal position, the output from the pot is derived from IC10.

The output of IC10 is simultaneously applied to IC11 through C22. IC11 is a "differentiator"-its output depends upon the rate of change of the input. Thus, when the oscillator changes from positive slope to negative slope, the output of IC11 changes polarity. This signal is applied to IC12, a gain of 10 amplifier with a small amount of positive feedback. This feedback assures that any output from the amplifier will have at least a minimum voltage swing with a sharp rise time. This signal is then applied to IC13, which is a low frequency active filter with fairly high Q, and will oscillate about its center frequency when it receives a pulse input. The output of the filter is level shifted by IC14 and applied to the other end of the Bounce control. The effect of all this circuitry is to generate a damped sinusoidal oscillation at a low frequency when the control voltage changes direction. This corresponds in classical flanging to removing the load from the reel motor. The damped oscillation in flanging is caused by the mechanical inertia of the motor— when it reaches its proper speed, it cannot stop changing speed instantly, and thus tends to overshoot, causing it to slow down, etc.

Varying the Bounce control (R80) varies the relative amount of direct control and damped oscillation applied to the voltage controlled oscillator. In the full CW position, only the change in control voltage as an effect on the delay-the magnitude of the control voltage is not considered.

IC15 and IC16 buffer the output of the bounce control, and prevent the possibility of any negative excursion getting to the VCO by rectifying any negative signal output generated by the damped oscillation of the active filter.

ALIGNMENT PROCEDURE

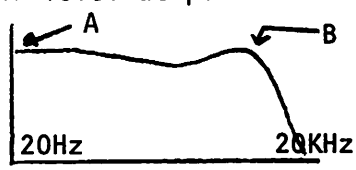
This alignment procedure is presented for reference. There are no adjustments in the Instant Flanger which require periodic adjustment. Alignment may be required if components are replaced, and may be desirable as an aid to trouble-shooting.

REQUIRED TEST EQUIPMENT

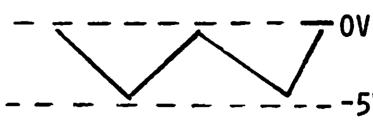
Oscillator capable of at least +18dbm at 1 KHz, and 0dbm 20Hz-20KHz
DC coupled oscilloscope or AC coupled oscilloscope and DC voltmeter.

PROCEDURE

1: Apply 1KHz, 0dbm signal to the Flanger input.
2: Check TP1 for 0dbm signal.
3: Sweep input frequency from 50Hz to 20 KHz while observing amplitude at TP2. Note initial level and level at peak "B". Adjust R90 so that A and B are equal.



4: Check envelope follower by changing oscillator level between +10 and -10 dbm.
5: Check $\Delta\Phi$ control by measuring voltage at wiper. Should be 0 volts fully CCW, and +5 volts fully CW.
6: Press OSCILLATOR button in, and release all other function buttons. Check TP10 for oscillation. Frequency range should exceed specification in either direction. Average DC value of waveform should be -5 to -9 volts.
7: Observe TP11. Adjust R46 (oscillator level) for a 5V peak to peak triangle wave, and R48 so that the most positive peak of the signal is at ground, $\pm$100 mv.



8: Check remote input— Depress remote button, release other function buttons. TP11 should read 0V. Short rear terminals + to IN (pins 1 and 2). TP11 should read -5VDC.
9: Depress manual button, center $\Delta\Phi$ control. Check TP3 and TP4 for sine wave input. (Oscillator at 1KHz). If none, or distorted, refer to troubleshooting.
10: Set DEPTH control at MAX OUT OF Φ. Observe TP5 and TP6 for cancellation with rotation of the manual control. Adjust SDC level trimpot R10 for deepest nulls with 1KHz input.
11: Check overall operation against specs.

This completes alignment of the Instant Flanger. If difficulty is encountered at any point, refer to the troubleshooting section.

TROUBLESHOOTING PROCEDURE

The Instant Flanger is a reliable, solid state device. Under normal circumstances it should require neither preventive nor corrective maintenance. All units are "burned in" at the factory for a period long enough to eliminate early failure of semiconductor components. If the Flanger appears to be defective, the first step is to make certain that it's being operated properly. *IF ALL ELSE FAILS, READ THE INSTRUCTIONS!* If *that* fails too, follow the suggestions and procedures below.

In all electronic equipment, the first components to suspect in case of difficulty are the mechanical ones. The most likely parts to become defective, especially after long use, are the front panel controls. The next most likely to fail are the internal controls (due to environmental stresses) and the power supply components (due to thermal stresses). Next in line are the input and output circuits, which interface with the outside world and are thus subject to misconnection. Under normal use, however, all these failures are unlikely. They should be kept in mind because other failures are even more unlikely.

Before proceeding past step 2 below, one should familiarize himself with the Theory of Operation section.

SYMPTOM	POSSIBLE CAUSE
NO LED's, no output.	Plugged into 115 (or 230) VAC, 50-60Hz outlet? Fuse OK? Switch OK? Open top cover. Visually check AC connector and fuse holder. Check switch contacts for continuity. Check power transformer windings.
LED's function normally. No output or AC hum on output.	Check all power supply voltages with 'scope. IC1 pin 4 should have -15V$\pm$.5V, less than 10mv ripple. IC1 pin 7 should have +15V$\mp$.5V, less than 10mv ripple. Check for signal at input. Check TP1, TP2, IC3-6, IC18-6, IC19-6 IC20-6, IC21-6, IC5-6, IC4-6. Signal missing at any point isolates break to related op amp and circuitry. If variable delay signal present but no direct signal, problem is IC3, 18, 19, 20, or 21.
Direct signal present but no delay.	Check plug-in board socket for: Signal on Pin 2, +15VDC on Pin 11, -15VDC on Pin9, 0-5VDC on Pin 17. Check for signal on TP3 and TP4. If present on TP3 but not TP4, check IC17-6. If signal present at socket pin 2 and not TP3, or at IC17-6 and not TP4, then plug-in board is defective.
Signal path OK but no variable flanging.	Check for variable control voltage at TP13. If present, plug-in board defective. If missing, check IC16 and IC15. Turn BOUNCE control to NORmal, depress manual button and rotate ΔΦ. If LED varies but no change in control voltage, IC10 NG. If no LED change, IC8 NG or LD7 defective.
All functions operative except OSC.	Perform step 6 of alignment procedure. If no result, IC6, C20, or R40 defective. If OK, perform step 7. If no result, IC 7 is defective or OSC switch is defective.
All functions operative except envelope follower.	Measure input level-be sure at least 0dbm present. Check for variable level (with turning of THRESHOLD) at IC9-3. Check for high slew rate waveform at IC9-6. Should not exceed 6 volts positive, maximum positive level varies with input level. Check charging of C19. If not charging, check D3. Check voltage at TP9. If not going positive with

TROUBLESHOOTING PROCEDURE
CONTINUED

Bad Env. Fol. contd.	increasing input, Q1 is defective or D4 is defective. If OK this far, Envelope Follower switch is defective.
All functions OK but BOUNCE inoperative.	Put Flanger in OSCILLATOR mode at high rate. Should be high amplitude square wave at IC11-6, and same, in phase at IC12-6. Lower oscillator frequency to about 1Hz. Check IC13 for damped sine wave at Pin 6. If missing, IC13 or tantalum capacitor defective. If present, check for same type of signal aprox. 5V p-p at IC14-6, and finally at CW end of BOUNCE pot. If present, defective pot.
Everything OK but indicator LED's	Check Q6. If all work except when one switched on, check for open LED (they are all in series, with switches shorting them— not applying voltage.)

NOTES ON CHANGING COMPONENTS

If it becomes necessary to replace an IC or other component with more than two pins. some form of solder removal tool is necessary. We recommend the Edsyn "Soldavac" or similar tool consisting of a spring-loaded plunger that creates a vacuum and sucks the solder out of its hole. We strongly recommend against pressure tools, such as the familiar rubber bulb, or the less familiar (and deservedly so) CO_2 pistol with soldering iron tip, as these tools can get minute solder blobs in invisible places and can easily cause more trouble than you started with. After replacing a component, make absolutely certain that there is no spare solder, and no short circuit around the area you worked on. It might be helpful to remove the solder flux with a chlorinated or fluorinated solvent, so that the solder joints are clear and clean.

If no desoldering tool is available, the best way to remove a component is to destroy it by cutting its leads off as near the body as possible and removing them one-by-one. The main objective is to avoid damaging the printed circuit board.

WHAT TO DO IF ALL ELSE FAILS

With the exception of the plug-in variable delay card, the technical data in this manual is sufficient to enable a competent technician to maintain and repair the Instant Flanger. Although there are certain components used in the unit which may be unavailable or difficult to obtain through normal distributor channels, if a component should fail, first try to obtain it locally. This pertains especially to standard devices such as resistors, capacitors, transistors, and operational amplifier IC's. The schematic has been deliberately marked with parts values and generic types rather than manufacturer's part numbers. Thus, a Motorola type MLM301AP1 becomes a "301", replaceable with a similar part by Fairchild, National Semiconductor, or other alternate source.

Other components, such as the switches, transformers, regulators, and tantalum capacitors are obtainable on short notice only with great difficulty. If one of these components becomes defective, contact the factory for assistance. If the plug-in variable delay card appears defective, it *must* be returned to the factory for repair. Any evidence of tampering will automatically void the warranty on this assembly. It should be wrapped in common aluminum foil before shipping, and should not be handled excessively when not in its socket.

Eventide Clock Works Inc. stands ready to repair any equipment of its manufacture, whether in or out of warranty. If the equipment is within warranty, please return it to us prepaid. We will fix it and return it to you prepaid at no additional charge. (If you specify return shipping other than by U.P.S., we will bill you for the difference in shipping charges.) If the unit is out of warranty, return it to us prepaid. We will repair and return it to you, C.O.D. for repair and return shipping. If you cannot accept a C.O.D. shipment and/or require an estimate of repair charges, please notify us in the letter detailing the problem with the unit.

Speaking of which, ALL RETURNED EQUIPMENT MUST BE ACCOMPANIED WITH A DOCUMENT INDICATING THE NATURE OF THE PROBLEM. THIS IS ESPECIALLY TRUE IF THE PROBLEM IS OF AN INTERMITTENT NATURE. It is true even if information was requested and given over the telephone. It would also help to indicate to whom the equipment is to be returned, and when and from whom it was purchased. Failure to include such a document will result in much time wasting letter writing.

IN CASE OF EMERGENCY----------

We realize that our equipment is used in recording studios and at live concerts, and such enterprises are not time conscious in the "business hours" sense. If your equipment has problems which must be solved immediately, call our technical service number 212 581-9138. There is a good chance that you will find a technically competent person available at the oddest of hours. (If this person sounds sleepy, keep talking until he becomes rational.) If your problem is not an emergency, please call 212 581-9290 during working hours, typically 9AM-9PM, New York time.