ROLAND SYNTHESIZER SYSTEM 700

The complete system consists of the MAIN CONSOLE, the KEYBOARD CONTROLLER, and five optional blocks for a total of 47 modules.

MAIN CONSOLE:
The MAIN CONSOLE contains all the basic modules necessary in a professional system for the synthesizing of sound and can be used alone with the KEYBOARD CONTROLLER as a complete synthesizer in itself. Modules included are: VCO (3), VCF (2), VCA (2), LFO (2), S/H, ADSR (2 x 1), OUTPUT MODULE (which includes PANNING controls, REVERBERATION, and a PHASE SHIFTER), and others.

KEYBOARD CONTROLLER:
The 61 key (5 octave) two voice KEYBOARD CONTROLLER has PORTAMENTO and PITCH BEND controls.

OPTIONS:
Optional blocks can be chosen and arranged according to the particular needs of each studio. All of the modules in the optional blocks are interchangeable, thus the numbers and types of modules can also be changed to suit the studio. The main modules of the optional blocks are: BLOCK 3 ≪Sequencer≫: 3 channel, 12 step sequencer; BLOCK 4 ≪VCO bank≫: VCO (6), ADSR (2 x 1); BLOCK 5 ≪VCF/VCA bank≫: VCF (2), VCA (3), ADSR (2 x 2),; BLOCK 6 ≪Interface/Mixer≫: frequency-to-voltage converter interface, 9 channel audio mixer, fixed filter bank, VCA; BLOCK 7 ≪Phase Shifter/ Audio Delay≫: 2 channel phase shifter, 2 channel audio delay.

MAIN FEATURES:
All modules are made from high quality parts to ensure high reliability and durability with circuit designs which give high stability for ease in recording perfect sounds.

All major modules contain both audio signal input and control voltage input mixers for better signal to noise ratios and ease in synthesizing sounds.

Input and outputs are designed for matching with other professional audio equipment for ease of use in the studio.

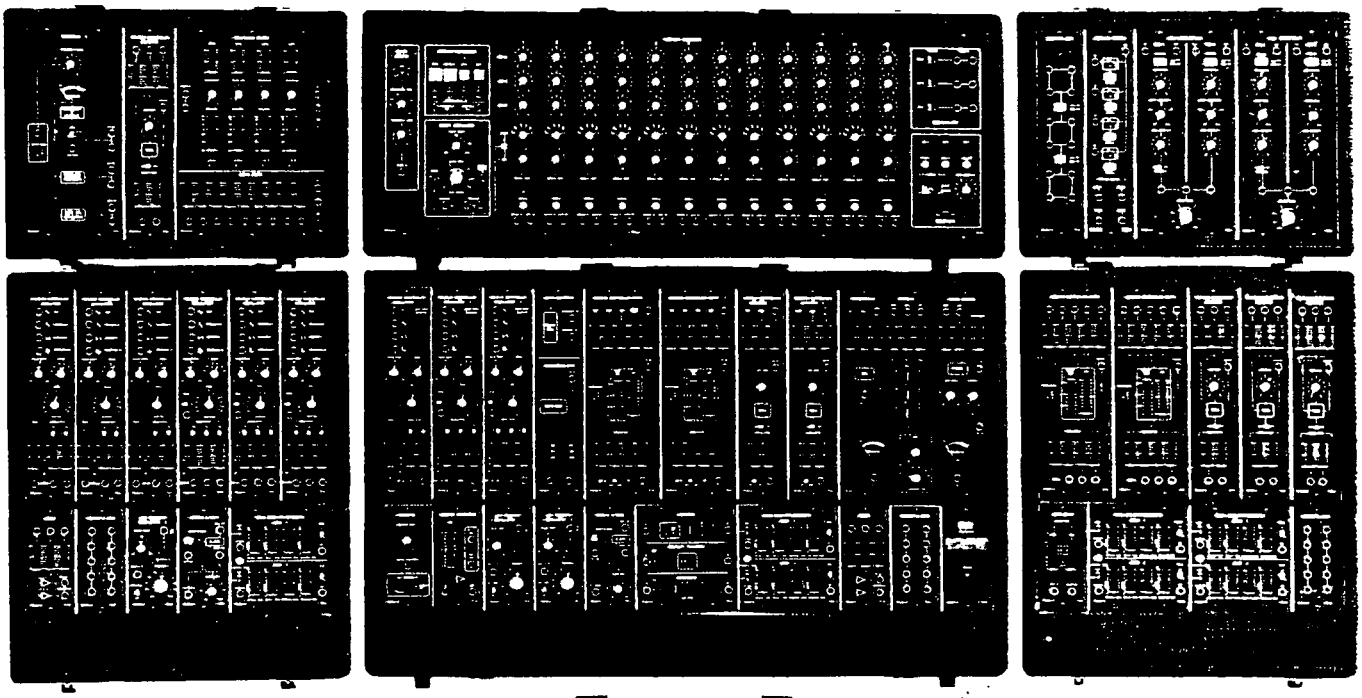
On the MAIN CONSOLE, most common connections are made internally without the use of patch cords. All modules have provisions for external patch cord connections for greater freedom in patching.

External sound sources (such as other musical instruments) can be used as a source of control.

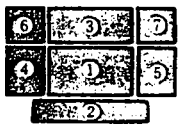
The PULSE SHAPER and the sequencer's MASTER CONTROLLER input and output jacks allow the recording of consecutive sequences on tape without a break in rhythm.

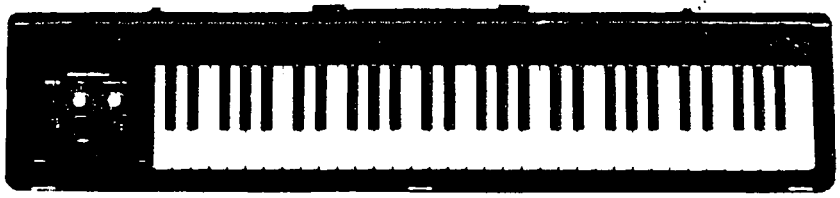
Except for the MAIN CONSOLE, all modules are completely interchangeable and can be arranged to suit individual tastes. (The MAIN CONSOLE can be special ordered direct from the factory in other arrangements).

A complete system, the System 700 contains all the elements necessary for the synthesis of sound.



BLOCK NUMBER





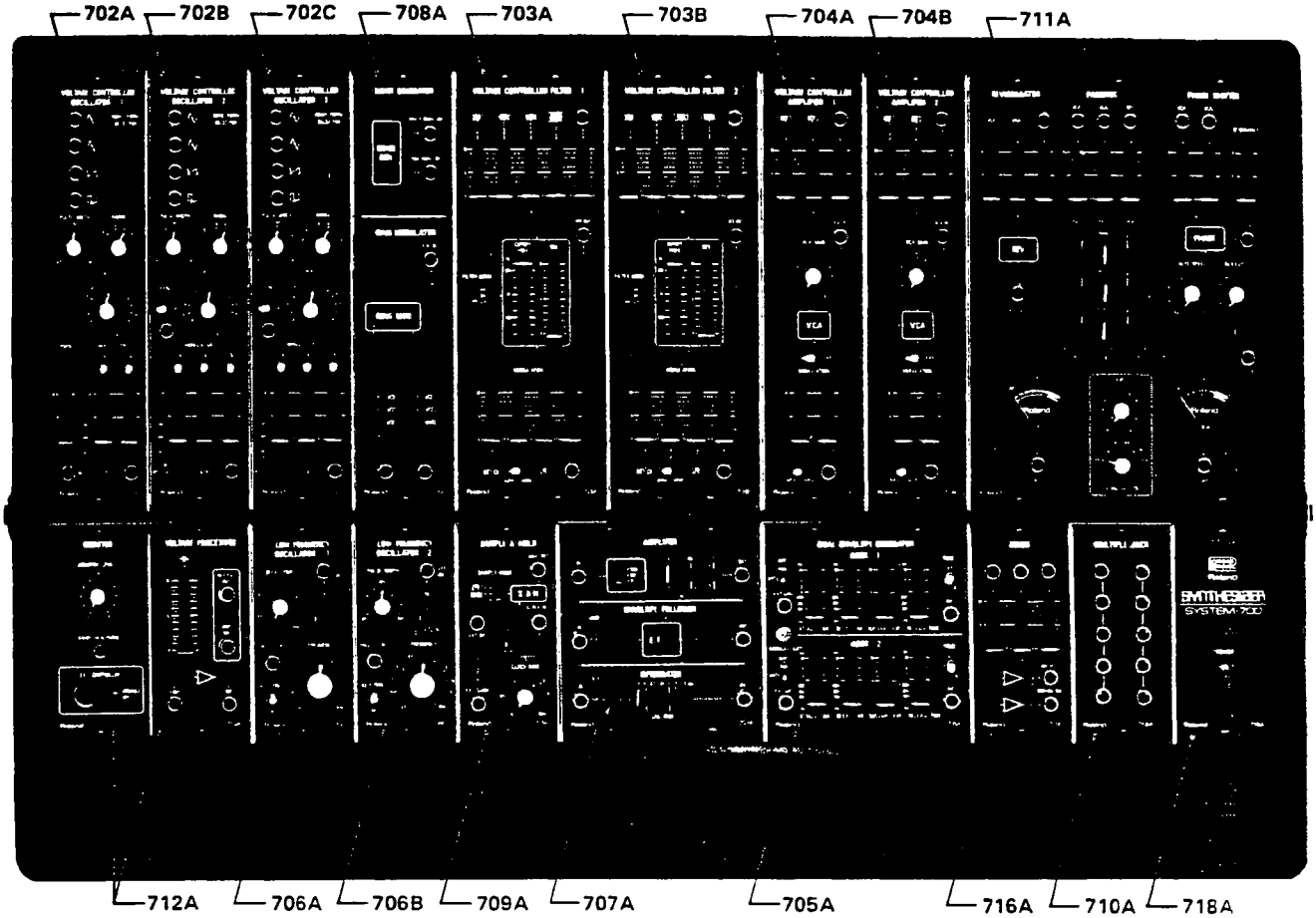
ROLAND'S FINEST CREATIVE ANSWER

SYNTHESIZER SYSTEM 700

Roland's 'System' Synthesizer Series are specifically engineered for professional recording studios. The top-of-the-line 700 provides full control over all synthesizer functions, extremely stable output and a frequency range from 0.1 to 100kHz. And this revolutionary new product is one of the most competitively priced, full-feature units on the market today.

ROLAND SYNTHESIZER

A basic unit for sound synthesis with full feature



The MAIN CONSOLE

702A 702B 702C

VCO-1/VCO-2/VCO-3

- All VCO's are extremely stable and have a frequency range of 0.1Hz. – 100kHz.
- The VCO's generate four basic wave forms with manual control of the pulse wave (10% – 90%). VCO-1 also allows for modulation of the pulse wave by an external control voltage.
- The inputs of the control voltage input mixer are: LFO-1, external, ADSR-1 (VCO-2 only), and S&H (VCO-3 only). The MODULATION ATTENUATOR switches (1, 1/10) make precise low settings easy.
- Simultaneous use of all wave forms is possible through external patch cords.
- All VCO's feature KEYBOARD CONTROL VOLTAGE ON/OFF switches.
- VCO-2 and VCO-3 are equipped for synchronization for additive synthesis or special tone coloring, etc.

708A

NOISE GENERATOR

- Generates white and pink noise; white noise is internally connected to the VCF-1 inpu mixer.

RING MODULATOR

- "X" inputs are: VCO-1, VCO-2, VCO-3 and external; "Y" inputs are: VCO-1, VCO-2, noise, and external. Green LED indicate existence of signal at the RING MODULATOR output.

703A 703B

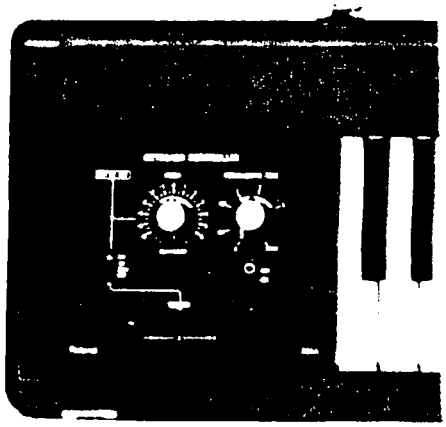
VCF-1/VCF-2

- The inputs of the five channel audio signa mixer are: VCO-1, VCO-2, VCO-3, whit noise (VCF-1 only), ring modulator (VCF-

KEYBOARD CONTROLLER

701A

- 61 key (5 octave) two voice keyboard controller.
- Controller section has: PITCH (tuning) control, PORTAMENTO TIME (0-10 sec) with separate ON/OFF switch, PITCH BENDER (–, +) with center off click stop, and a PITCH BEND RANGE switch (OFF, 0.1v, 1v, 5v).
- All connections for single voice operation are made through one DIN patch cord. Rear panel also contains additional output jacks for: KEYBOARD CONTROL VOLTAGE 1, KEYBOARD CONTROL VOLTAGE 2 (second voice), GATE OUT, KEY TRIGGER out, and BEND CONTROL VOLTAGE out.



SYSTEM 700

in itself.

only), and external.
- FILTER MODE switches allow for high pass, band pass, and low pass filtering.
- The RESONANCE control acts in all three modes.
- The four channel control voltage input mixer allows control of the filter cutoff point by: keyboard control voltage, ADSR-1 or ADSR-2 (selected by switch), LFO-1, and external sources.
- The green LED indicates a normal signal at the VCF output; red LED indicates overload (distort) signal.

704A 704B

VCA-1/VCA-2

- The inputs of the three channel audio signal input mixer are: VCF-1, VCF-2, and external.
- The inputs of the two channel control voltage mixer are: ADSR-1 or ADSR-2 (selected by switch) and external.
- The LIN/EXP switch allows for exponential control of VCA for percussive sounds.
- The green LED indicates a normal signal at the output; red LED indicates an overload.

711A OUTPUT section

REVERBERATOR

- The inputs of the three channel audio signal input mixer are: VCA-1, VCA-2, and external.
- Outputs are: to external and to PANNING.

PANNING

- The inputs of the three channel audio signal input mixer are: VCA-1, VCA-2, and REVERB; each input is supplied with switching type jacks for option of three external inputs.
- Each of the three channels has its own PAN control.
- Two channel stereo output: left and right, with VU meters.

STANDARD OSCILLATOR

- Frequencies: 110, 220, 440, 880, 1760Hz, and 1kHz.
- LEVEL control and CHANNEL SELECTOR (left, left + right, right) allows for free calibration of equipment.

PHASE SHIFTER

- The inputs of the two channel audio signal input mixer are: VCA-1, VCA-2; each has a switching type jack for an option of two external inputs.
- RESONANCE, AUTO SPEED, and INTENSITY controls allow for versatile control of phase effects.
- Selector switch allows for external control of sweep speed.

712A

MONITOR

- Allows stereo monitoring through headphones with separate MONITOR LEVEL control.

EXTERNAL KEYBOARD CONTROLLER

- When using other blocks, this section allows division of control: One keyboard controller for the MAIN CONSOLE, a second keyboard controller for the other blocks.
- The CONSOLE/OFF switch allows for instant change between one and two keyboard control.

VOLTAGE PROCESSOR

- Generates a fixed control voltage of from 0 to +10 volts. Inverted output is: 0 to −10 volts.

KEYBOARD CV OUTPUT/GATE OUTPUT

- These jacks allow convenient access to keyboard control voltage and gate pulse.

706A 706B

LFO-1/LFO-2

- Low frequency oscillators with four output wave forms.
- Provision is made for control of frequency by external control voltage.
- KEY TRIG ON/OFF switches allow phase locking of wave forms to keyboard gate pulse.
- LFO-1 has a DELAY TIME control (2ms to 10 sec).
- LFO-2 has manual control of pulse width (10% – 90%).

709A

SAMPLE & HOLD

- Three sample modes: LFO-1, noise, and external.
- Sample rate controlled by internal or external clock.
- CLOCK OUT for ADSR control.

707A

AMPLIFIER

- A high gain amplifier. GAIN control: 0 to 1; RANGE switch: X10, X100, X1000.

ENVELOPE FOLLOWER

- Generates a control voltage which is a function of the level of the input signal. Plugging an external source into the IN jack cuts off the internal connection to the OUT of the AMPLIFIER above.

INTEGRATOR

- Adds a lag time (0-3 sec) to changing control voltages (similar to the portamento effect with keyboard control voltages). Plugging an input into the IN jack cuts off the internal connection to the OUT of the ENVELOPE FOLLOWER.

705A

DUAL ENVELOPE GENERATOR

- Separate GATE INPUT selector switches allow for triggering of each ADSR from GATE + TRIGGER, GATE only, or an external gate/trigger.
- MANUAL GATE button allows for manual triggering.
- TIME attenuator switches (X1, X1/10) allows for ease and precision in setting short attack, decay, and release times.

716A

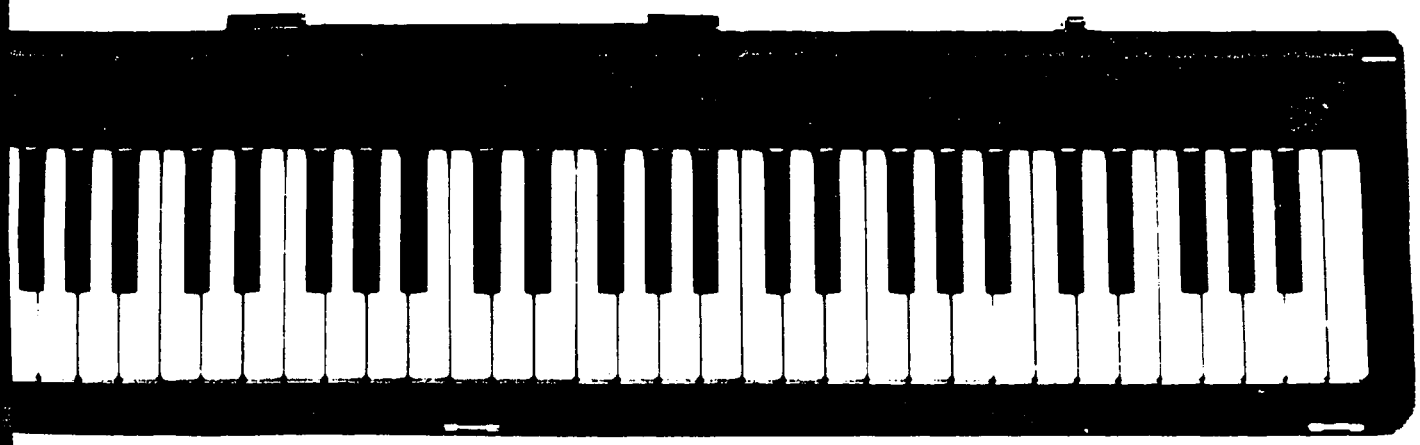
MIXER

- A three channel audio/control voltage mixer with INVERT and NON-INVERT outputs.

710A

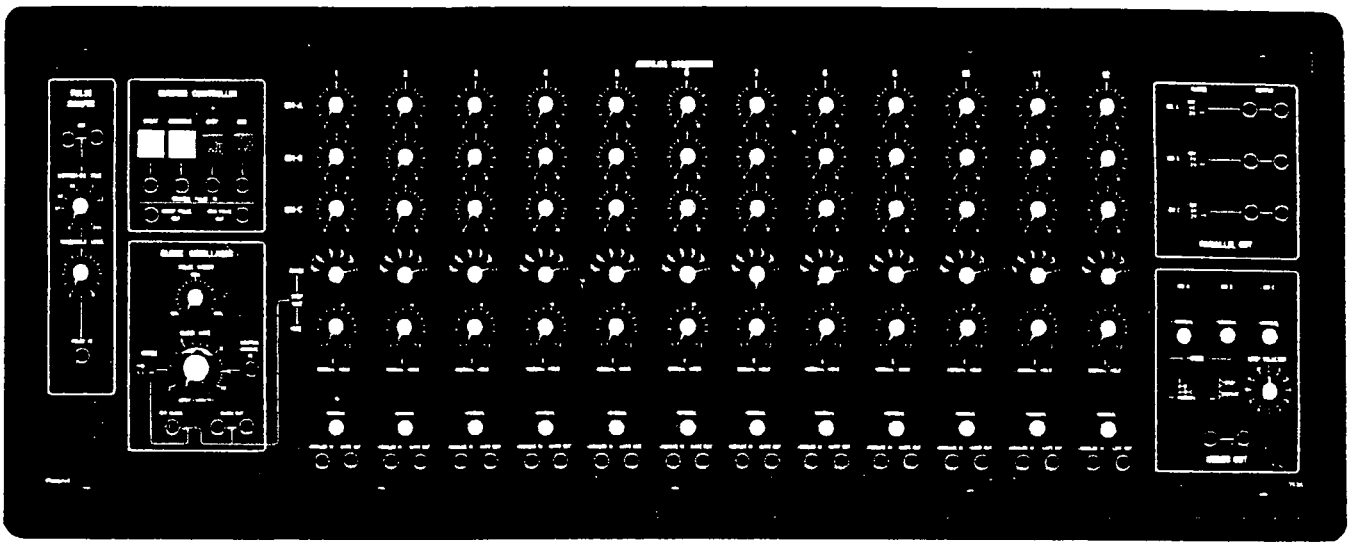
MULTIPLE JACKS

- Two rows of five jacks connected together for external combination of different signals or control voltages.



STEM 700

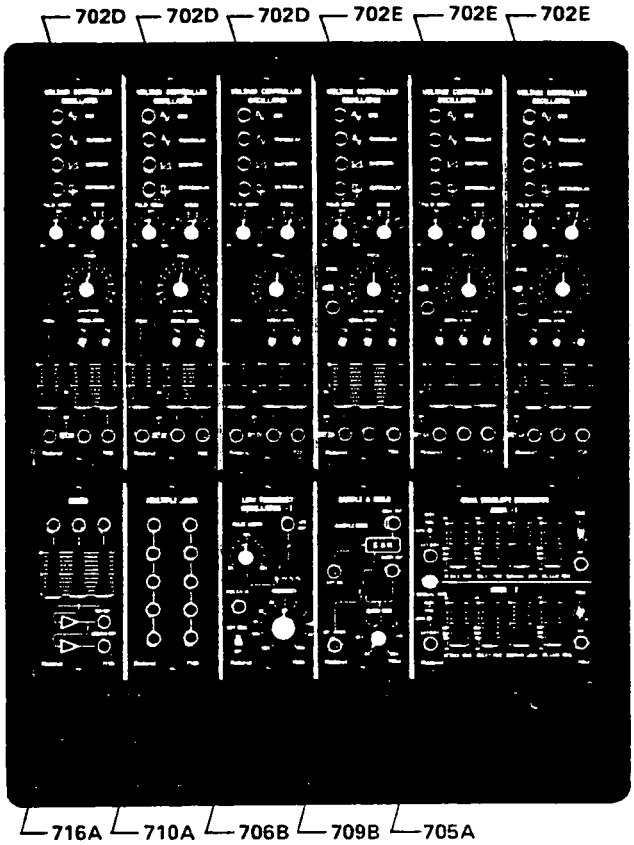
An ANALOG SEQUENCER with easy control of step time and features for recording successive sequences without breaks in rhythm, as well as analog switching.



ANALOG SEQUENCER

- The 717A ANALOG SEQUENCER is a 3 channel, 12 step sequencer.
- In series mode, control voltage sequences of up to 36 steps can be programmed by means of the VOLTAGE REGISTERS.
- In parallel mode, the 3 channel feature permits three voice sequences, or simultaneous control of the three qualities of sound: pitch (VCO frequency), tone color (VCF cutoff point), and loudness (VCA gain).
- Each channel has a three position (2V, 4V, 10V) RANGE SWITCH for control of VOLTAGE REGISTER sensitivity.
- The divisions (1, 1/2, 1/4, 1/8, 1/16, 1/32) of the STEP TIME DIVIDE controls make assignment of time values for each note in a sequence very simple, saving much time in programming a sequence.
- The STEP TIME FINE controls allow the setting of the timing of each step at any point between the STEP TIME DIVIDE control settings for programming dotted notes as well as for programming accelerando, rubato, etc.
- The MODE switches and STEP SELECTOR control in the SERIES OUT section allow for extremely versatile control of the number of steps in each sequence.
- Total speed (tempo) of the sequence is controlled by the CLOCK OSCILLATOR. The CLOCK can also be controlled externally either by a control voltage or pulses (recorded on tape, for example). The PULSE WIDTH knob controls the width of the gate pulse output.
- The MASTER CONTROLLER allows for either manual or external control of the sequencer run functions. With START, the sequence will always start with Step 1 (Channel A in series mode). Pressing END, the sequence will continue to run until it reaches the END STEP (selected by the STEP SELECTOR in the SERIES OUT section), then stop automatically. The output of the END PULSE OUT jack can be recorded on tape. After setting up a new sequence, this recorded pulse can be used for triggering the START function for recording the new sequence immediately after the previous sequence without any break in rhythm.
- The NORMAL/HOLD switches allow for holding of a VOLTAGE REGISTER setting over into the next step (or beyond). At the CLOCK OUT jacks, there will be no gate pulse for those steps whose NORMAL/HOLD switch is in the HOLD position, thus allowing for the programming of rests in a sequence.
- The MANUAL buttons allow manual selection of any step in the sequence for setting, changing, or checking the VOLTAGE REGISTERS.
- The GATE OUT jacks allow individual gate pulses from each of the steps to be used for separate functions.
- The ANALOG IN jacks allow the sequencer to be used as an electronic switching device. These jacks will accept control voltages or audio signals. With audio signal inputs, the VOLTAGE REGISTERS act as output sound level controls.
- The PULSE SHAPER section reshapes pulses (as recorded on tape, for example) so they can be used for triggering or controlling the sequencer.

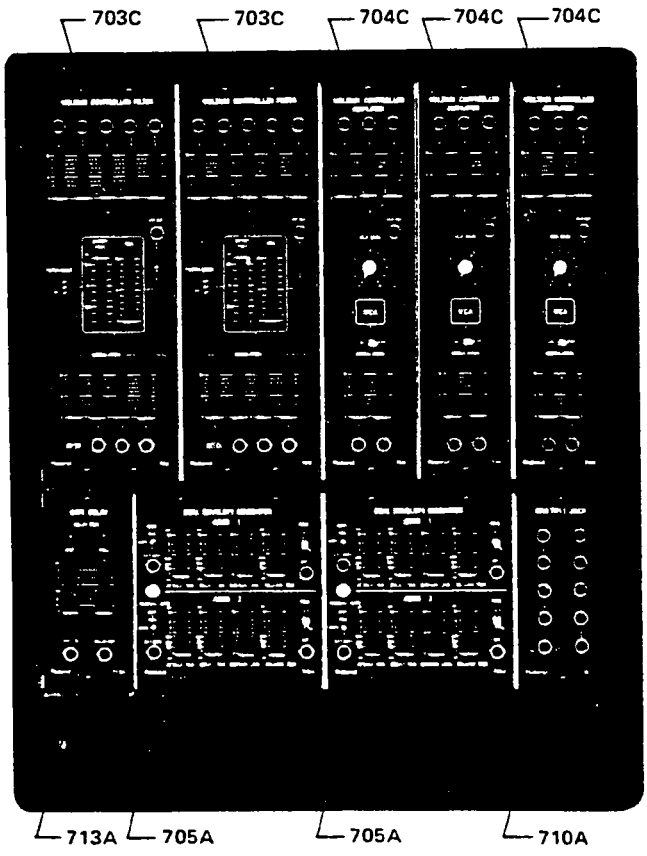
Optional blocks for greatly expanding the synthesizer functions.



BLOCK 4

[redacted]

- Six VCO's arranged in two groups of three: 3 702D's (same as 702A on MAIN CONSOLE) and 3 702E's (same as 702B and 702C). All connections (except keyboard control voltage) are made externally.
- Also included are: LFO-2 (706B), SAMPLE & HOLD (709B), DUAL ENVELOPE GENERATOR (705A), MIXER (716A), and MULTIPLE JACKS (710A). All are the same as on the MAIN CONSOLE and greatly enhance the use of the VCO's in sound synthesis.



BLOCK 5

VCF/VCA bank

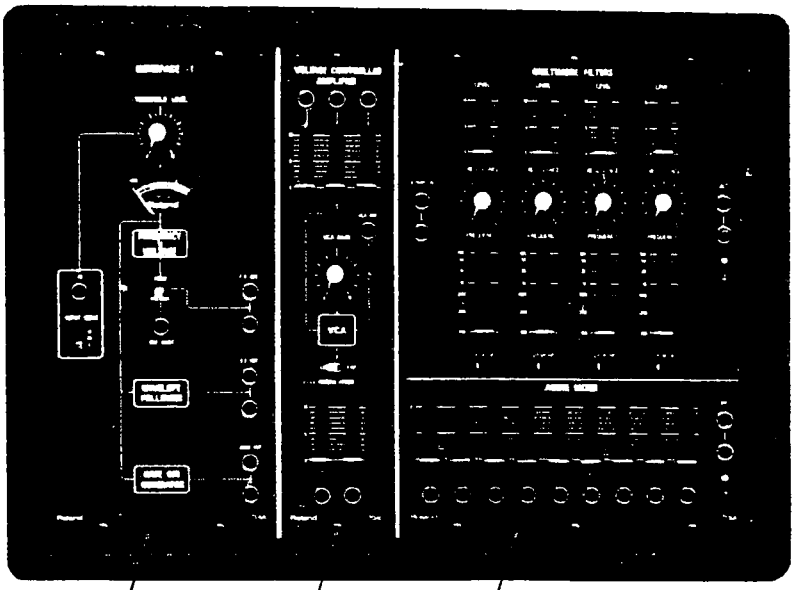
- Cabinet is exactly the same as the VCO bank.
- The two VCF's (703C) are the same as the VCF's (703A, 703B) on the MAIN CONSOLE but all connections (except for keyboard control voltage) are made externally.
- The three VCA's (704C) are the same as the VCA's (704A, 704B) on the MAIN CONSOLE except that all connections are made externally.
- The two DUAL ENVELOPE GENERATORs (705A) are exactly the same as on the MAIN CONSOLE, with internal connections for the keyboard gate and trigger.
- The GATE DELAY (713A) is capable of delaying (0-3 sec) the rise and falls points of the keyboard gate or trigger pulses.
- The MULTIPLE JACKS (710A) are exactly the same as on the MAIN CONSOLE.
- All the above modules add greatly to the possibilities in multi-channel sound production.

OPTION for application of external sources for sound control.

BLOCK 6

INTERFACE/MIXER

- INTERFACE (714A) extracts from the input signal (electric guitar, electronic organ, microphone, etc.) a control voltage proportional to the input frequency and the envelope, and generates gate pulses, all of which can be used to control the synthesizer.
- The MULTI-MODE FILTER (part of the 715A module) consists of four fixed filters in parallel, each with LP/BP/HP mode switches, CUTOFF FREQUENCY, RESONANCE, and LEVEL controls.
- The 9 channel AUDIO MIXER (part of the 715A module) allows incomparable mixing possibilities not found elsewhere.
- The VCA (704C) is exactly the same as in the VCF/VCA bank.

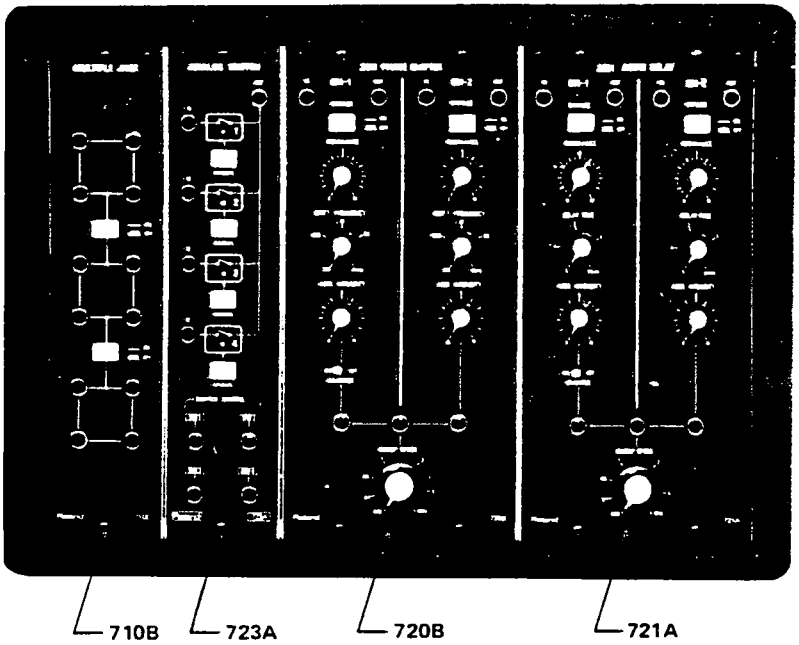


OPTION for acoustical inovation

BLOCK 7

PHASE SHIFTER/AUDIO DELAY

- The cabinet is exactly the same as the INTERFACE/MIXER cabinet.
- The TWO CHANNEL PHASE SHIFTER (720B) has separate RESONANCE, SHIFT FREQUENCY, and MODULATION INTENSITY controls for each channel with one SWEEP SPEED controlling both channels for creating dynamic acoustical effects with subtle or deep feelings of movement. Channel 1 has an INVERT switch for greater variety of effects.
- The TWO CHANNEL AUDIO DELAY (721A), like the PHASE SHIFTER, has separate RESONANCE, SHIFT FREQUENCY, and MODULATION INTENSITY controls with one SWEEP SPEED for special tone coloring effects. Channel 1 has an INVERT switch.
- The MULTIPLE JACKS (710B) are three groups of four connected jacks each. The groups are capable of being joined by ON/OFF switches.
- The four input ANALOG SWITCH (723A) can be operated manually by the ON/OFF switches or by means of external control voltages. Inputs can be either audio signals or control voltages. Green LED's light when switches are operating.



SYSTEM 700 SYNTHESIZER

INSTRUCTION MANUAL

Roland

Guarantee is void if any unauthorized changes are made in this synthesizer. Specifications are subject to change without notice.

Printed in Japan
Feb. '77 C-2

Section 1

GENERAL

General information on the system and setting up

Section 2

MODULES

Specifications, and brief outline of the controls and their functions

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Section 3

APPLICATIONS

Practical examples of using some of the modules, especially special features

---

Section 4

SEQUENCER

Operating instructions for the 717A ANALOG SEQUENCER, with examples for using

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Section 5

CALIBRATION

Complete alignment procedures for the electronic technician or repairman

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Appendix

Useful information related to synthesizers

Main features of the SYSTEM 700 SYNTHESIZER:

High circuit stability.

Logical and easy to use panel layout.

Advantages of both the internally connected type synthesizer and the patch cord type.

Input mixers on each module means high level signals in patch cord which eliminates jack contact resistance problems and gives a better S/N.

Green LED's to show presence of signal at outputs and red LED's to show overdrive condition.

Three channel, twelve step Analog Sequencer with versatile function and timing controls.

Two channel Phase Shifter and Audio Delays units for unique stereo effects.

Frequency to Voltage converter for controlling the synthesizer form other sound sources.

INTRODUCTION:

The SYSTEM 700 SYNTHESIZER INSTRUCTION MANUAL has been designed for people with a solid background in synthesizer theory. For those having little or no knowledge, or who wish to review, we recommend the series of instruction manuals designed for the ROLAND System 100 Synthesizer. A brief outline of the contents of these manuals can be found on the back of this page.

MODEL 101 SYNTHESIZER INSTRUCTION MANUAL

Gives basic synthesizer theory and step-by-step recording examples using a stereo tape deck.

MODEL 101 SYNTHESIZER PATCH BOOK

Gives a set of forty basic patches (plus eight test patches) which are easily adaptable to the System 700. Also includes the music for the recording examples mentioned above.

MODEL 102 EXPANDER UNIT INSTRUCTION MANUAL

Gives some basic theory for using two VCO's, two VCF's, and two ADSR's, as well as theory for the ring modulator and sample and hold.

MODEL 102 EXPANDER UNIT PATCH BOOK

Contains thirty patches, including one "video" patch (output connected to an oscilloscope), which are easily adaptable to the System 700.

MODEL 103 AUDIO MIXER INSTRUCTION MANUAL

Contains useful information on getting better results from the equipment in a synthesizer studio, as well as information on using a four channel tape deck for making synthesizer tapes.

MODEL 104 SEQUENCER INSTRUCTION MANUAL

Thirty-six pages of sequencer theory with application examples.

GENERAL

SECTION

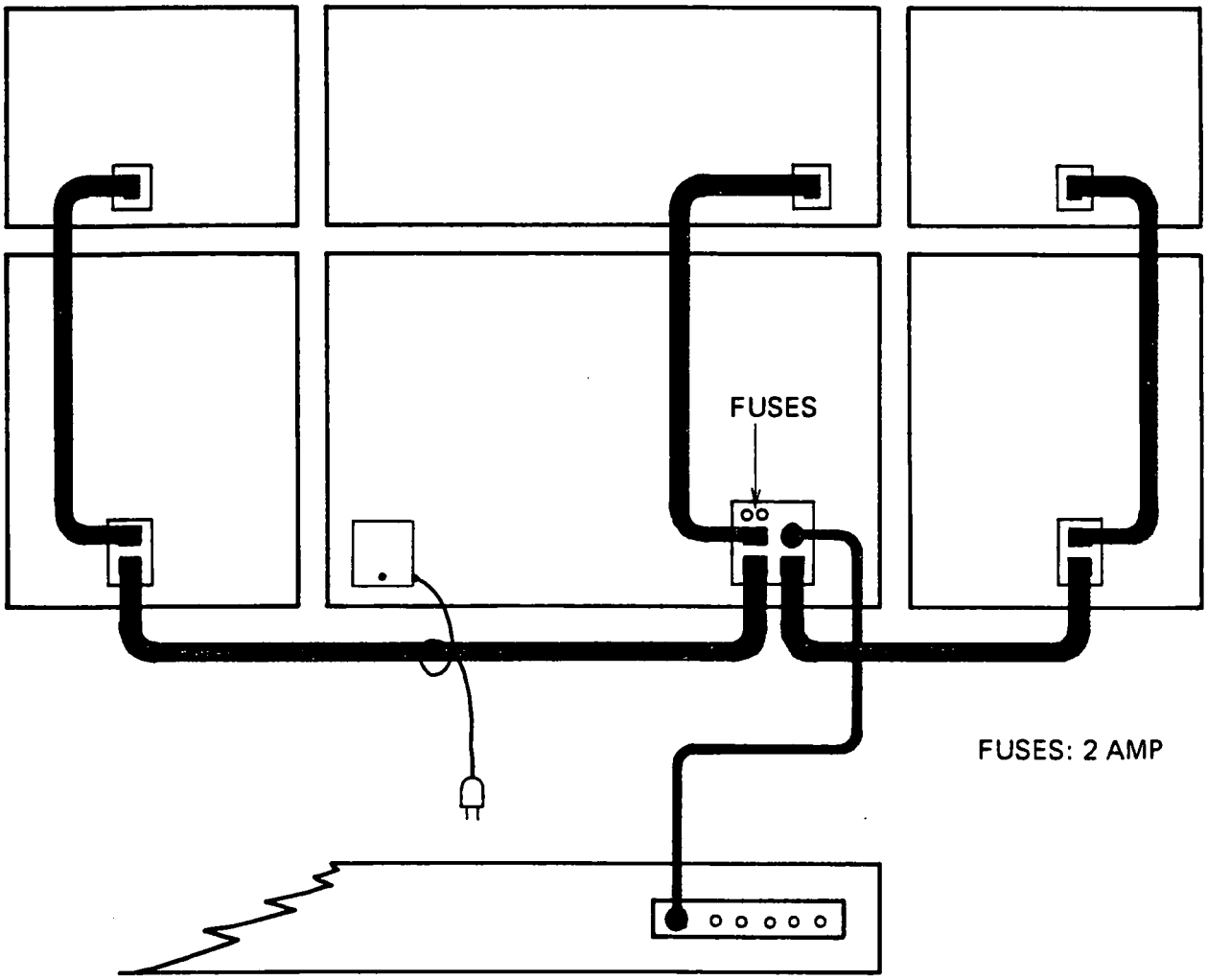
1

SETTING UP

Before setting up, it is recommended that the serial numbers be checked and written down on the last pages of this section in case they are needed. Serial numbers are located as shown in fig. 1-4 (p. 5).

The units are connected as shown in fig. 1-1. Be sure that the CONSOLE/OFF switch on the 712A module (Main Console, lower left) is in the OFF position.

Fig. 1-1 Rear view of System 700 showing bus cord connections



(See Section 3, page 712 for using two KEYBOARD CONTROLLERS)

THE MAIN COSOLE

The most common module interconnections are made internally; for this reason, the arrangement of modules on the Main Console cannot be changed except on special order direct from the factory.

THE OPTIONAL BLOCKS

The modules in the Optional Blocks can be arranged in any desired manner.

Note that the VCO's and VCF's receive keyboard control voltage internally. Since there is no provision for keyboard control voltage to the upper blocks (Blocks 6 and 7), it is not advisable to use the VCO's or VCF's there.

THE MODULES IN GENERAL

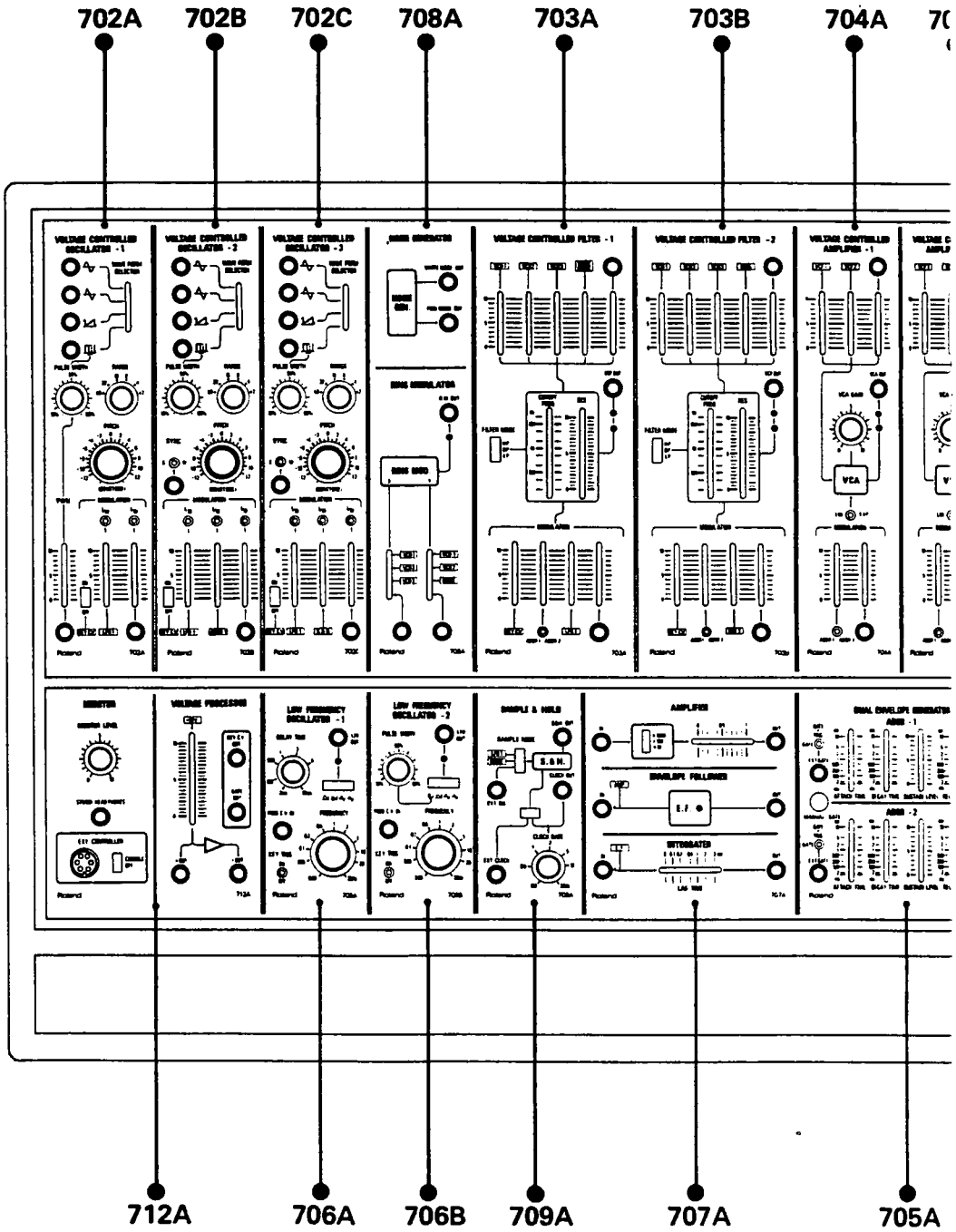
The upper line of sliders are the audio signal input mixers. An input of more than about 13v. p-p (possible when more than one input slider is at "10") will cause the red LED at the OUTPUT to light indicating an overload (distort) condition.

The lower line of sliders are the control voltage input mixers. The normal range of control voltages is from 0 to ±10v. Using more than one slider at "10" may cause the module to operate at a point too high for the ear to detect.

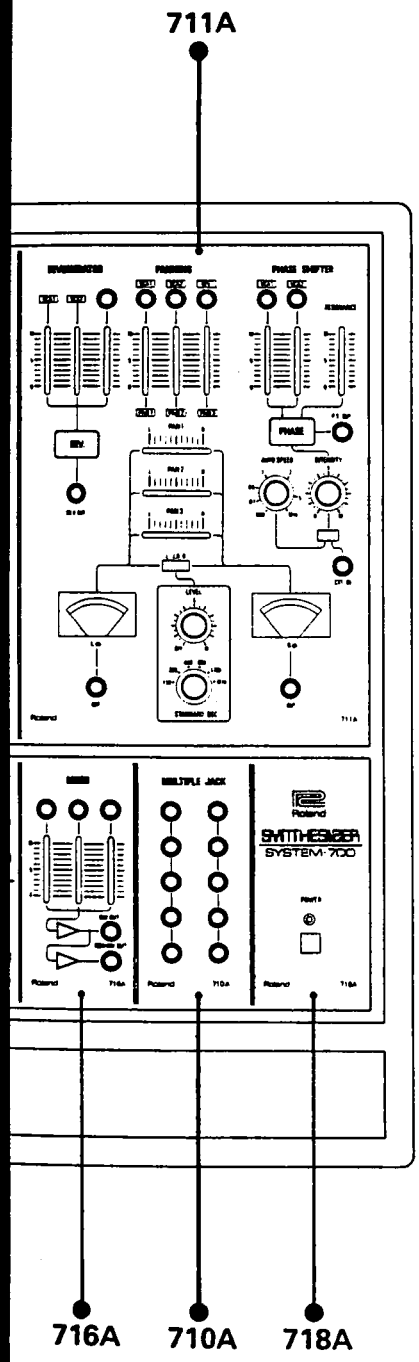
In between the two input mixers are located the module function controls and the OUTPUT. Outputs for optimum performance should be: Audio: 10v. p-p; Control Voltage: 0 to ±10v.; Digital (gate pulses, etc.): +15v. Shorting the outputs to ground or to each other for short periods of time (a few seconds) will not damage the modules; however, to maintain the output specifications as outlined in this manual, the output loads should be 10kΩ or greater.

MAIN CONSOLE (Block 1)

Overall dimensions (with cover): 830mm x 570mm x 305mm
Weight: 36kg (System total: 124kg)

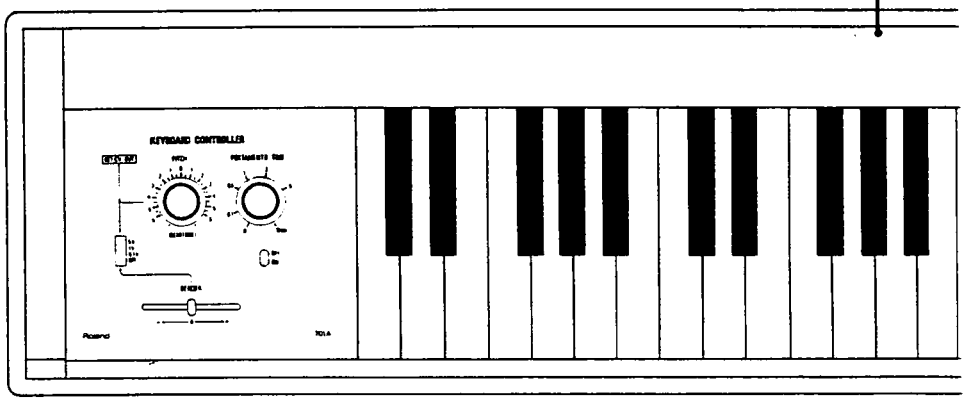


MAIN CONSOLE SERIAL NUMBER _____



KEYBOARD CONTROLLER (Block 2)

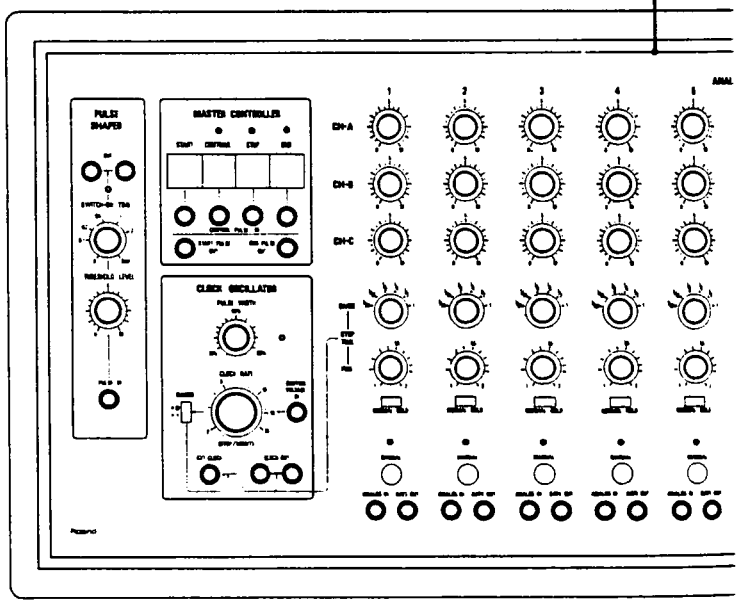
701A



BLOCK 2 SERIAL NUMBER _____

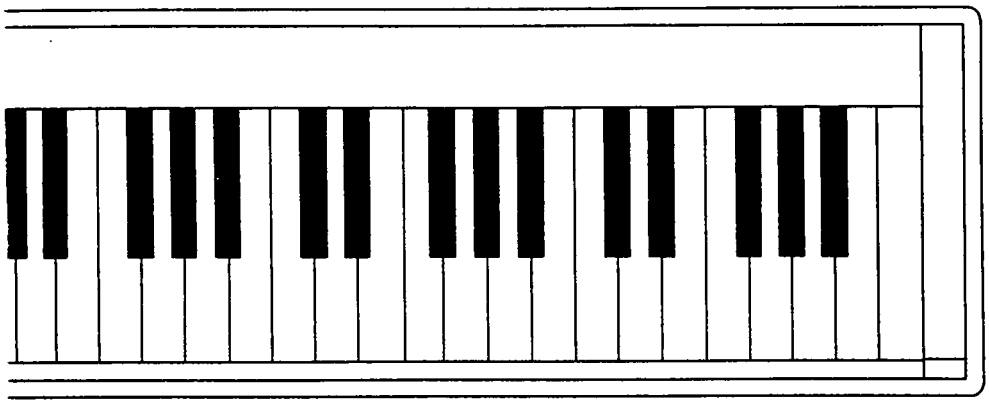
ANALOG SEQUENCER (Block 3)

717A

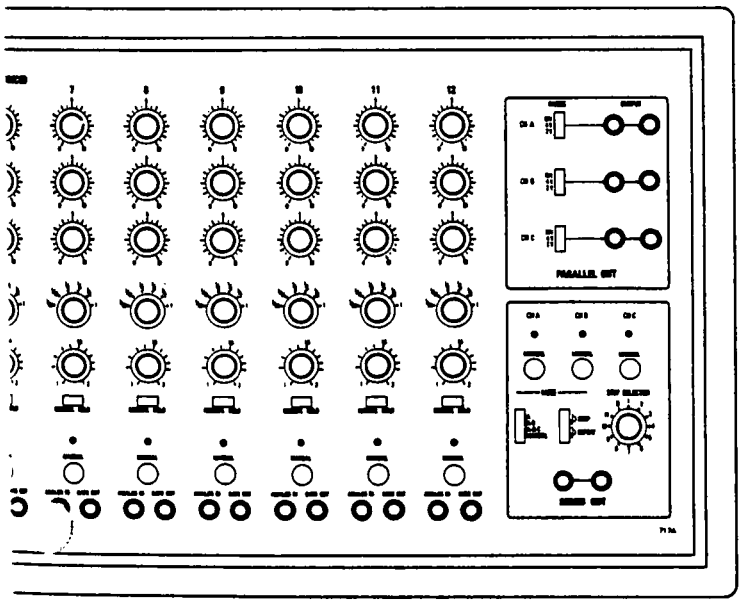


BLOCK 3 SERIAL NUMBER _____

Overall dimensions (with cover): 1075mm x 120mm x 240mm
Weight: 10kg

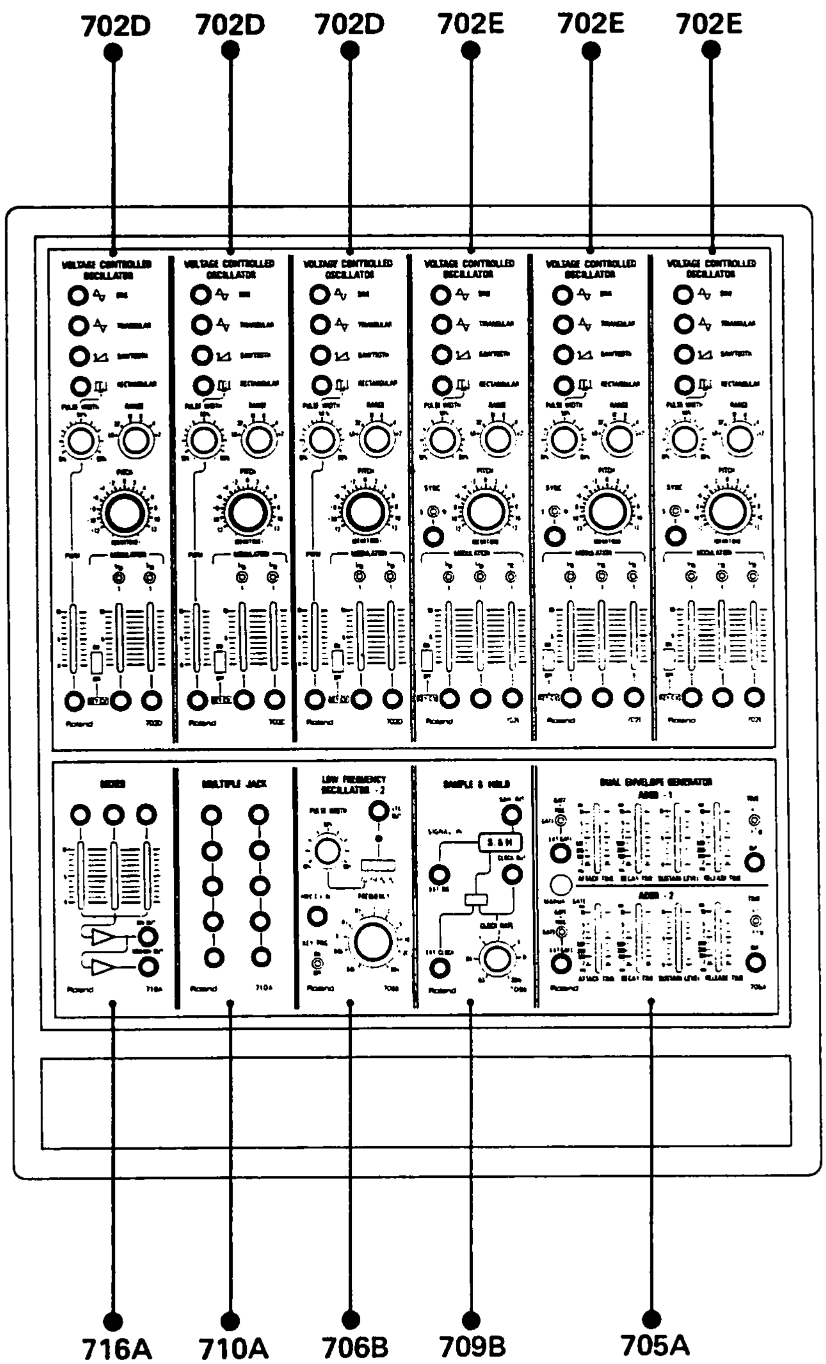


Overall dimensions (with cover): 838mm x 360mm x 305mm
Weight: 19kg



VCO BANK (Block 4)

Overall dimensions (with cover):	445mm x 570mm x 305mm
Weight:	19kg

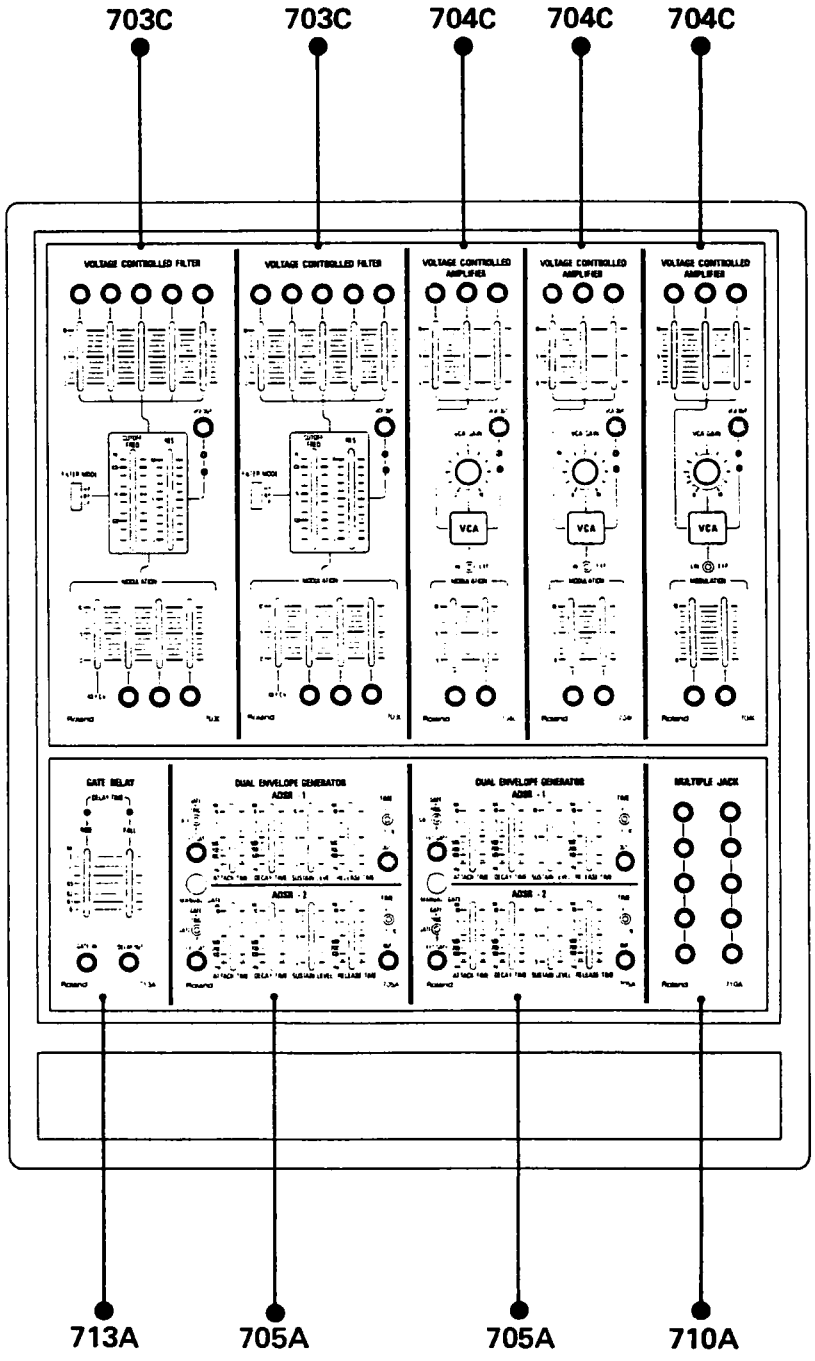


BLOCK 4 SERIAL NUMBER ____________

SECTION 1

VCF/VCA BANK (Block 5)

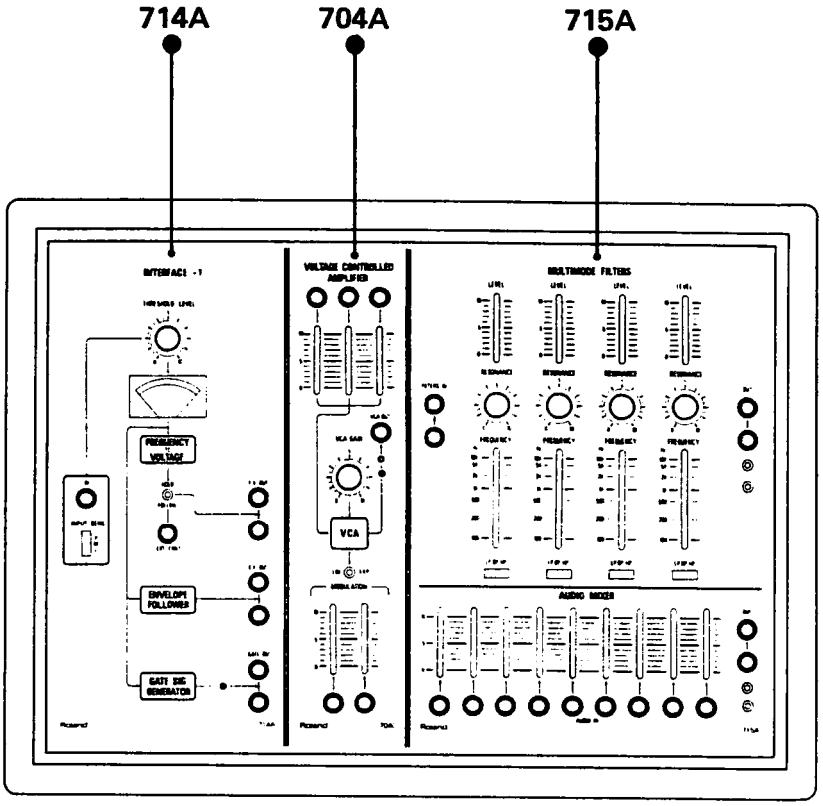
Overall dimensions (with cover): 445mm x 570mm x 305mm
Weight: 18kg



BLOCK 5 SERIAL NUMBER _____

INTERFACE/MIXER (Block 6)

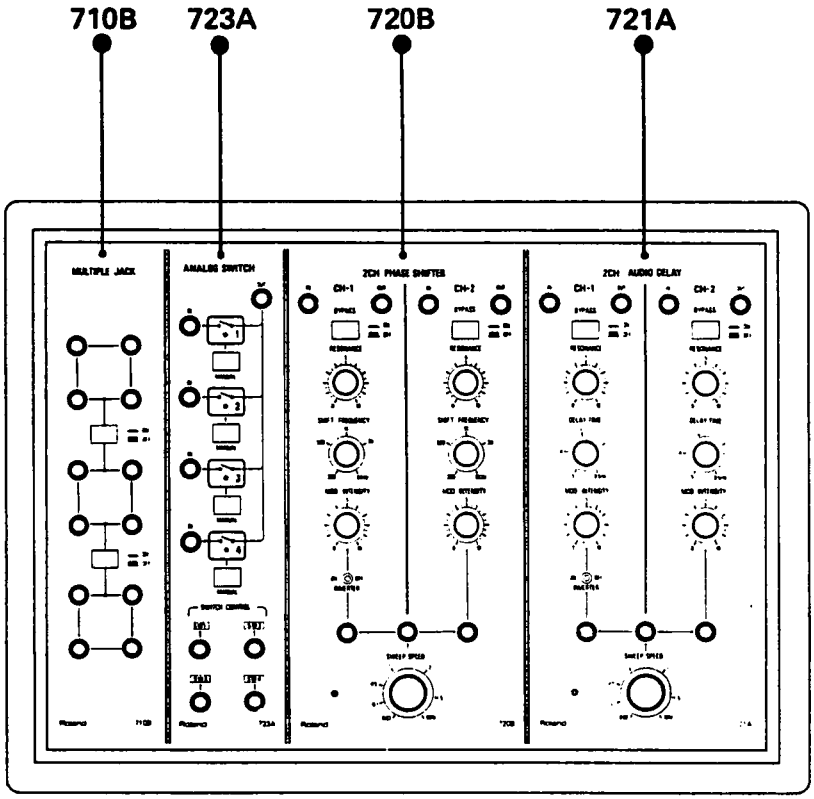
Overall dimensions (with cover):	445mm x 360mm x 305mm
Weight:	11kg



BLOCK 6 SERIAL NUMBER _____

PHASE SHIFTER/AUDIO DELAY (Block 7)

Overall dimensions (with cover): 445mm x 360mm x 305mm
Weight: 11kg



BLOCK 7 SERIAL NUMBER _____

EXPANDING THE SYSTEM 700

The power supply in the Main Console is designed to handle the standard complement of modules contained in the seven blocks of the complete System 700 plus a second Keyboard Controller. Using other modules in addition to this standard complement requires the use of a second power supply. Since each block contains its own regulator circuits, building a power supply is rather simple. Fig. 1-2 shows the wiring diagram.

Fig. 1-2 Wiring diagram for secondary power supply.

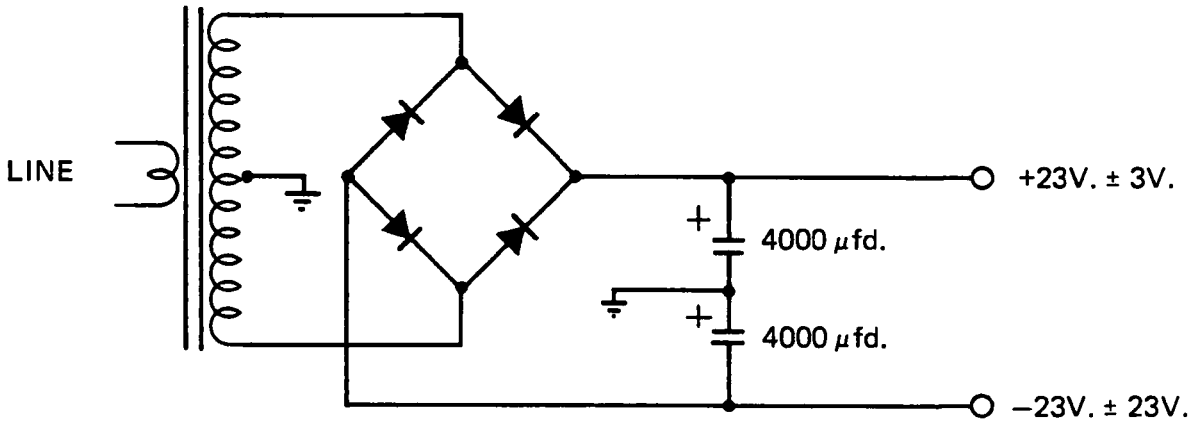
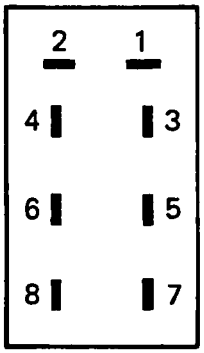


Fig. 1-3 Bus plug pin assignments.



1. −23V (±3V.)
2. +23V (±3V.)
3. KEY GATE
4. KEY TRIGGER
5. GROUND
6. KEY CV1
7.] GROUND
8.]

(See Section 2, page 701 for DIN plug pin assignments)

SERIAL NUMBERS

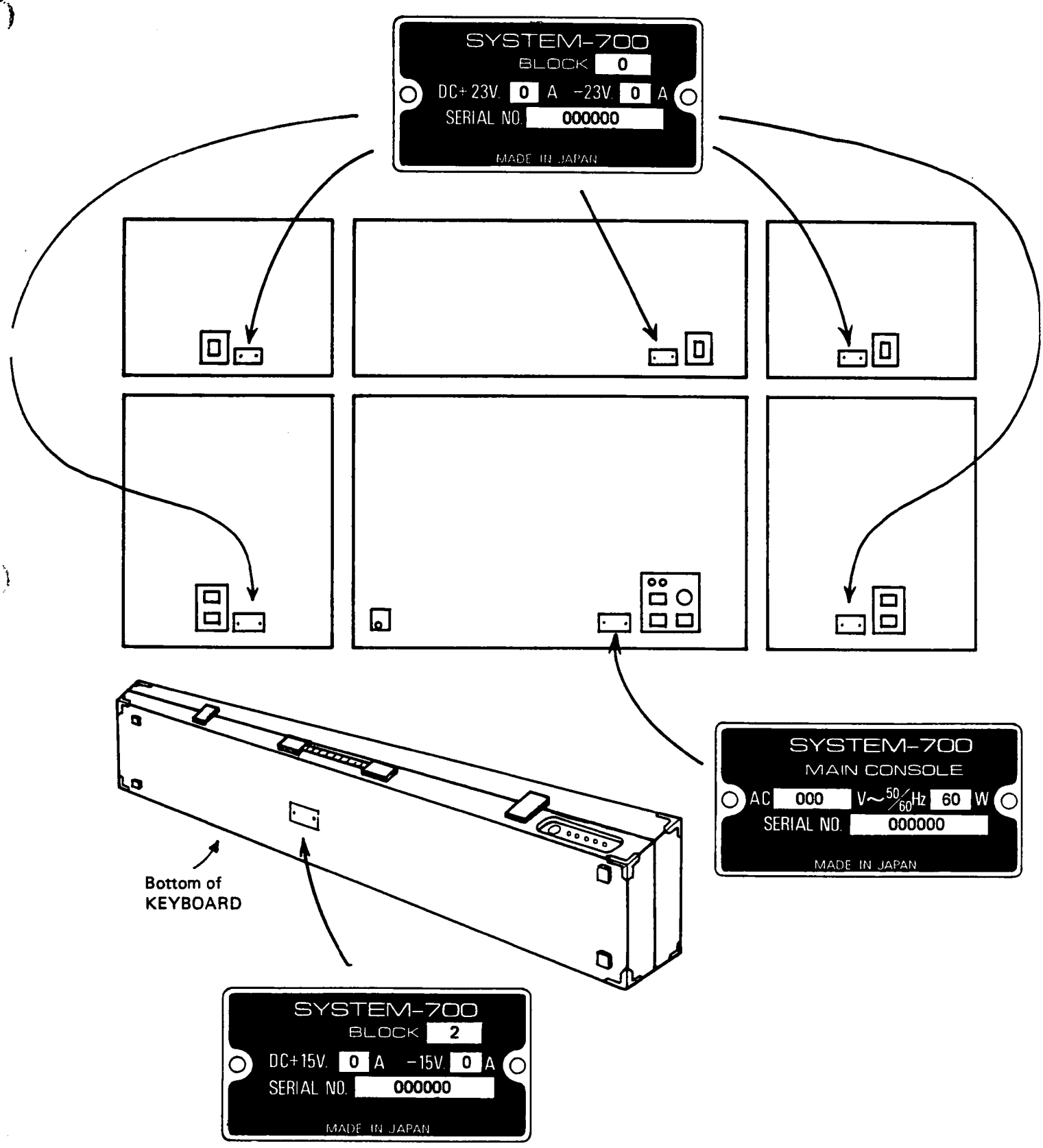
In any correspondence to us dealing with this synthesizer be sure to include serial numbers as the internal wiring may differ in certain serial number groups.

For the 701 KEYBOARD CONTROLLER and the 717 ANALOG SEQUENCER, use the serial number as given on the maker's plate.

If the modules are the original ones that came with the synthesizer, use the serial number as given on the maker's plates on the concerned blocks. Maker's plates are located as shown in fig. 1-4.

For modules bought separately, or modules which have been shifted from one block to another, we will need the module model number and the module serial number as given on the module inspection cards located inside the synthesizer. Section 5 (CALIBRATION) shows their location and how to remove modules.

Fig. 1-4 Rear view of System 700 showing maker's plate locations



SECTION 1

LIST OF MODULES

701 Keyboard Controller

702 VCO

703 VCF

704 VCA

705 Dual Envelope Generator

706 LFO

707 Amplifier/Envelope Follower/Integrator

708 Noise Generator/Ring Modulator

709 Sample & Hold

710 Multiple Jack

711 Output Module

712 Monitor/Voltage Processor

713 Gate Delay

714 Interface (F/V converter)

715 Multimode Filters/Audio Mixer

716 Mixer (Signal/CV)

717 Analog Sequencer

718 Power Switch

719

720 2CH Phase Shifter

721 2CH Audio Delay

722

723 Analog Switch

724

725

726

727

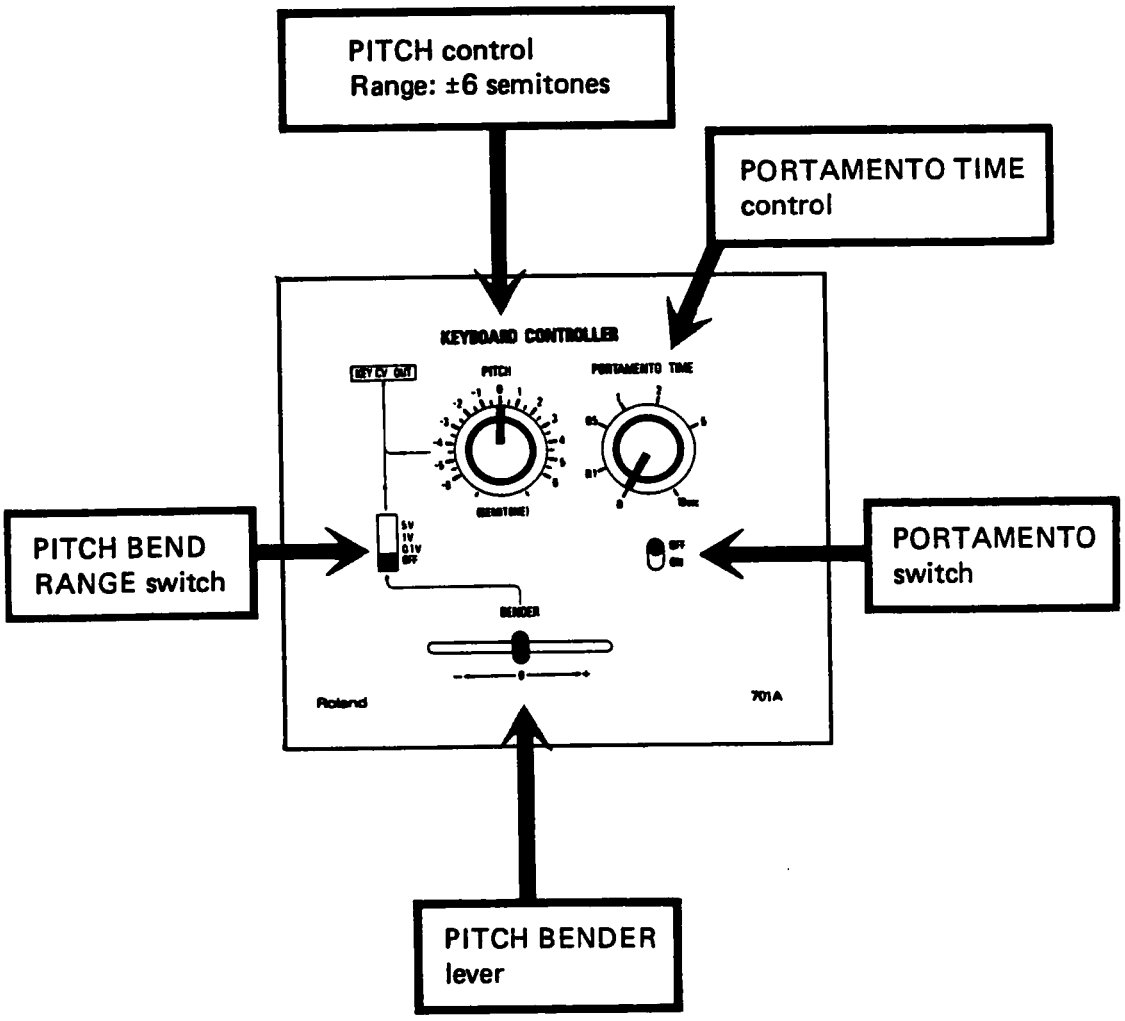
728

MODULES

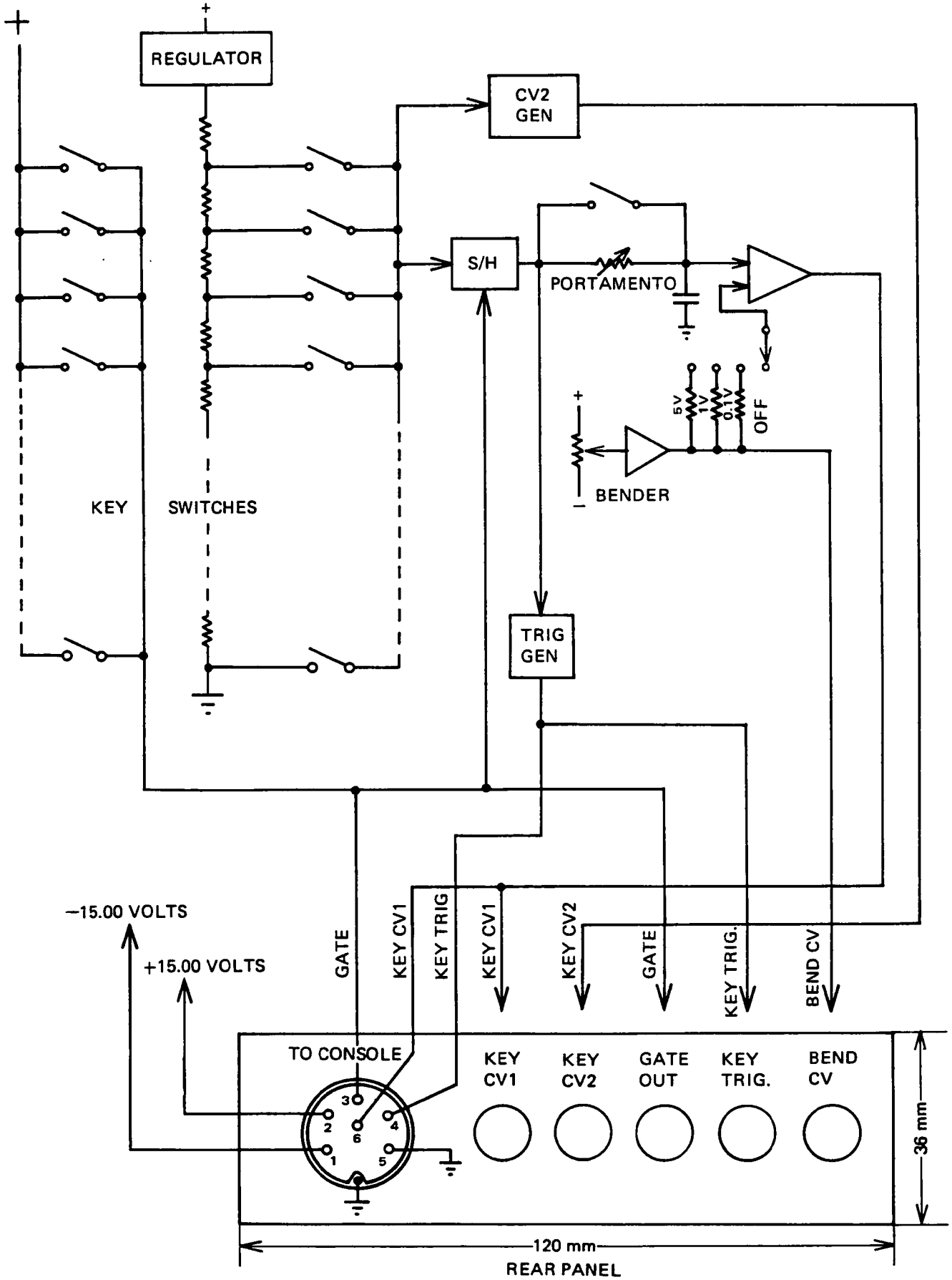
SECTION

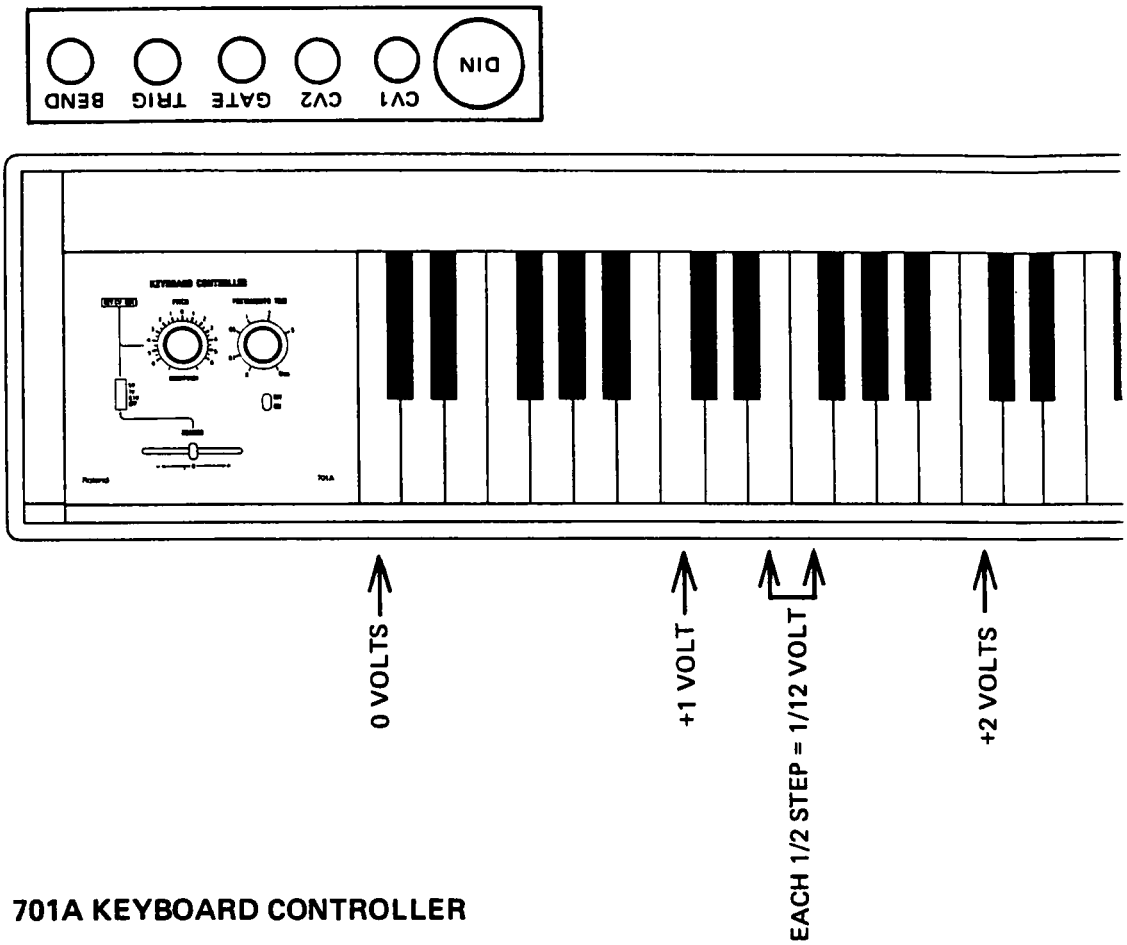
2

701A KEYBOARD CONTROLLER



701A KEYBOARD CONTROLLER block diagram





701A KEYBOARD CONTROLLER

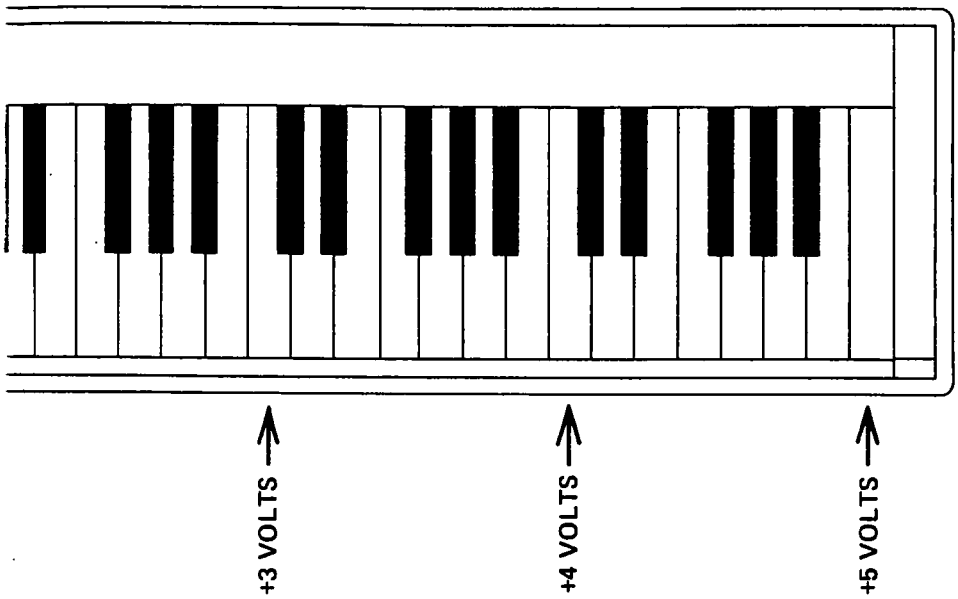
Specifications:

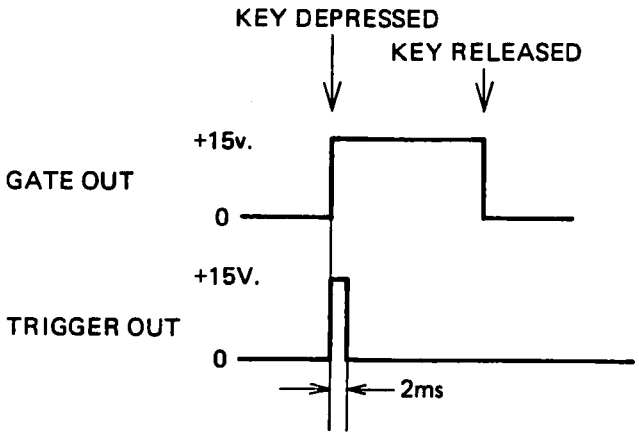
61 keys C-C (5 octaves):

Key voltage:	1 volt/1 octave
Portamento time:	0 – 10 seconds
Bend control voltage out:	0 – ± 5v
Gate voltage:	+15v
Trigger voltage:	+15v 2ms
Power supply requirements:	+15.00V ± 0.1% @40ma
	–15.00V ± 0.1% @36ma
Control panel size:	135 mm x 155 mm

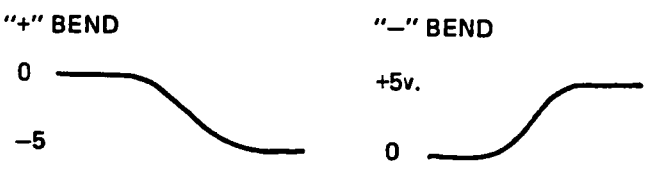
NOTE:

In this manual, unless otherwise specified, all KEYBOARD CONTROL VOLTAGE indications refer to KEYBOARD CONTROL VOLTAGE 1 (CV1).

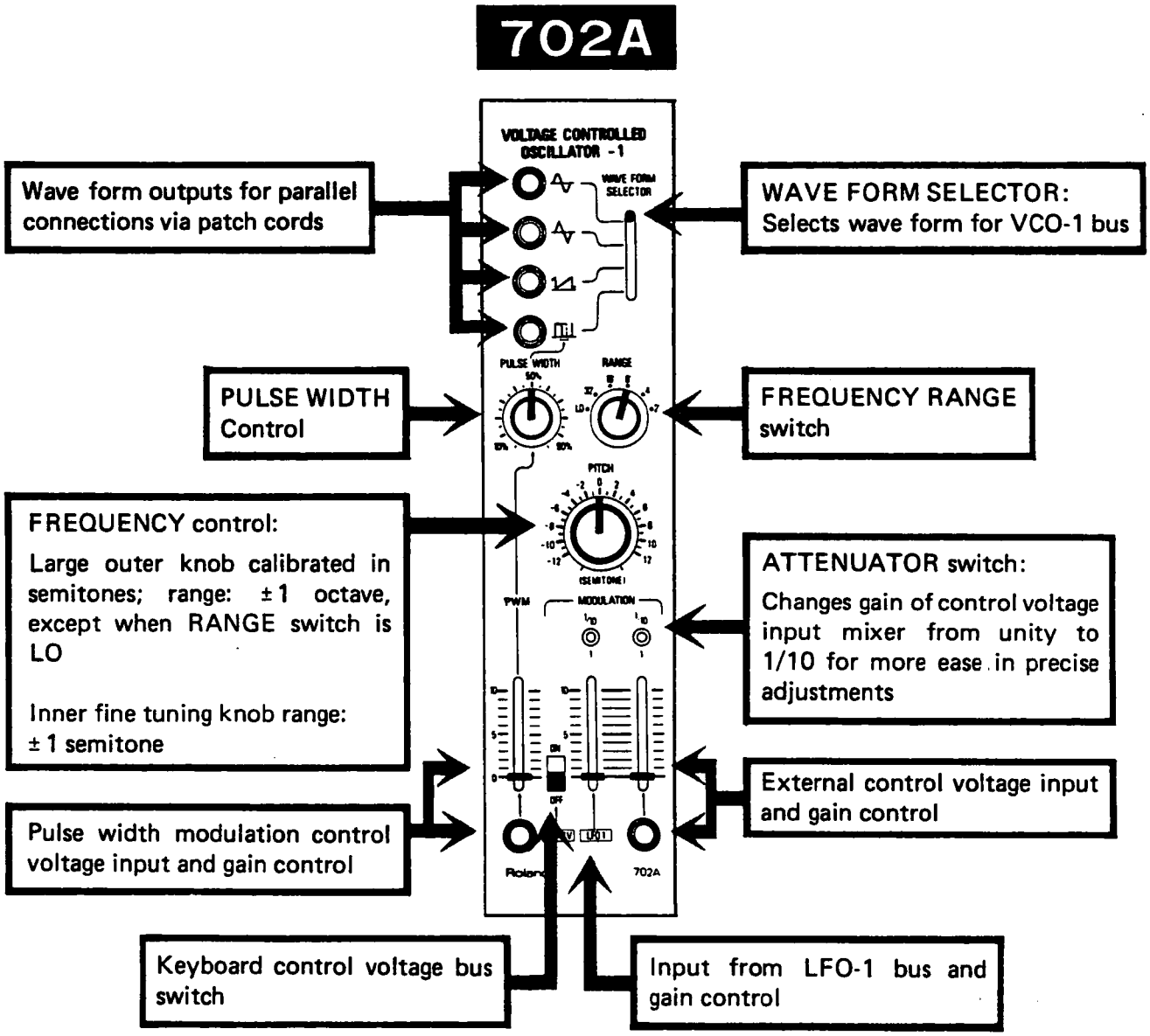




PITCH BEND OUT:



702A VOLTAGE CONTROLLED OSCILLATOR (VCO-1)

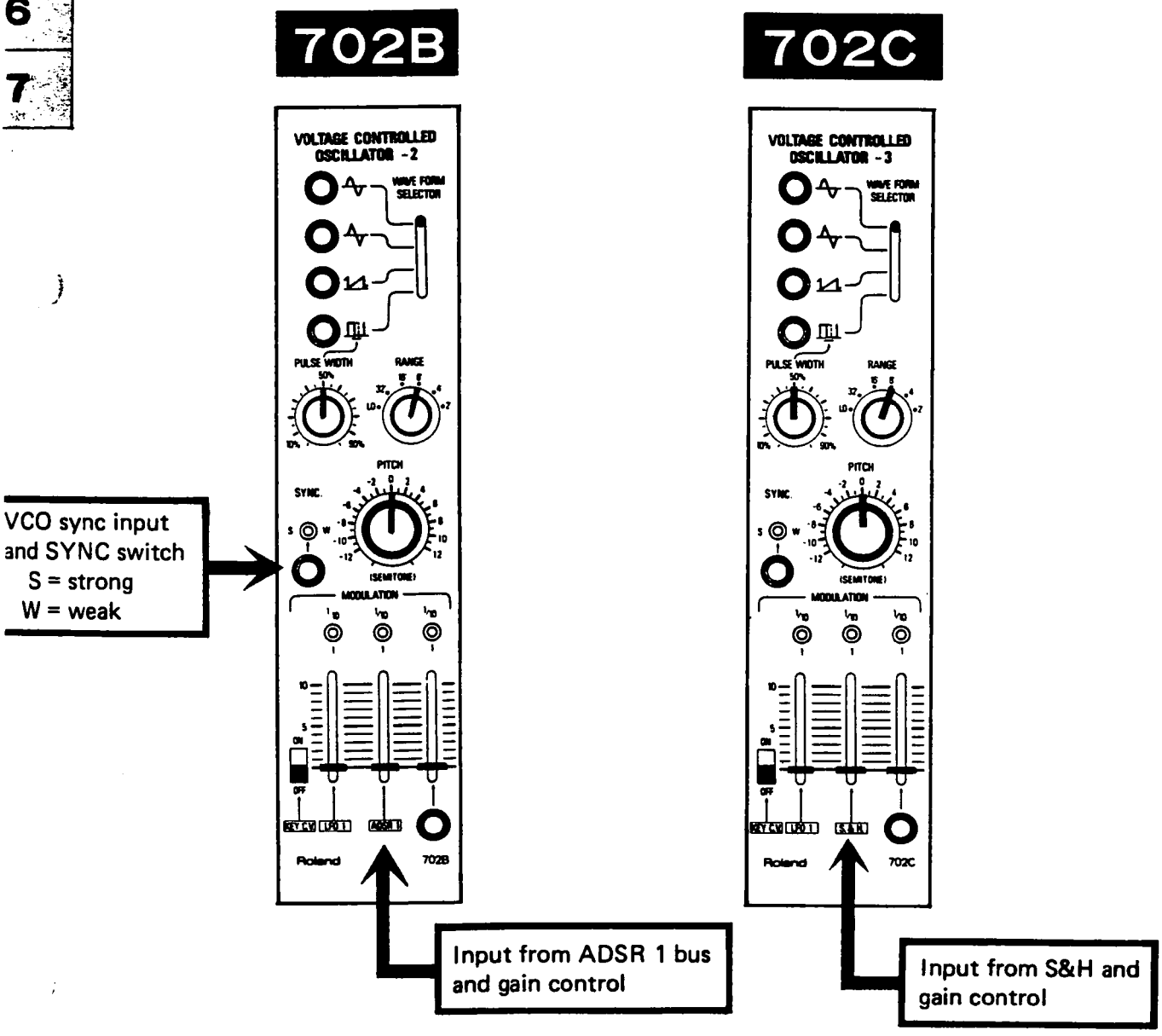


702B VOLTAGE CONTROLLED OSCILLATOR (VCO-2)

The 702B VCO-2 is exactly the same as the 702A VCO-1 except for bus connections and the differences noted below.

702C VOLTAGE CONTROLLED OSCILLATOR (VCO-3)

The 702C VCO-3 is exactly the same as the 702B VCO-2 except for bus connections.



BLOCK

4

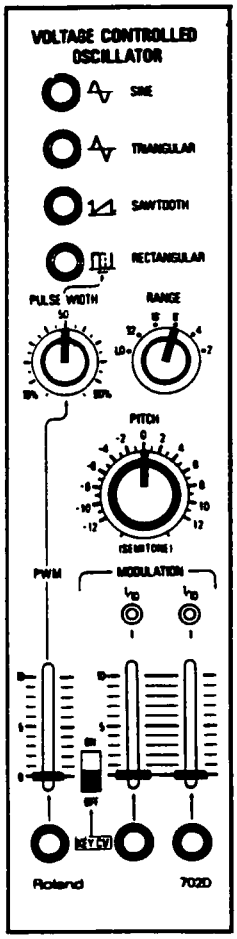
702D VOLTAGE CONTROLLED OSCILLATOR (VCO)

The 702D VCO is exactly the same as the 702A VCO-1 except that the keyboard control voltage is the only internal connection.

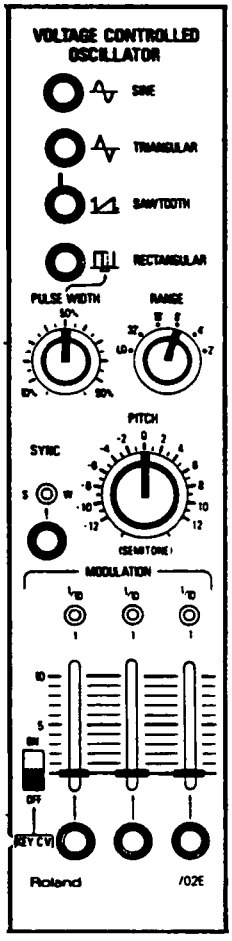
702E VOLTAGE CONTROLLED OSCILLATOR (VCO)

The 702E VCO is exactly the same as the 702B and 702C VCO's except that the keyboard control voltage is the only internal connection.

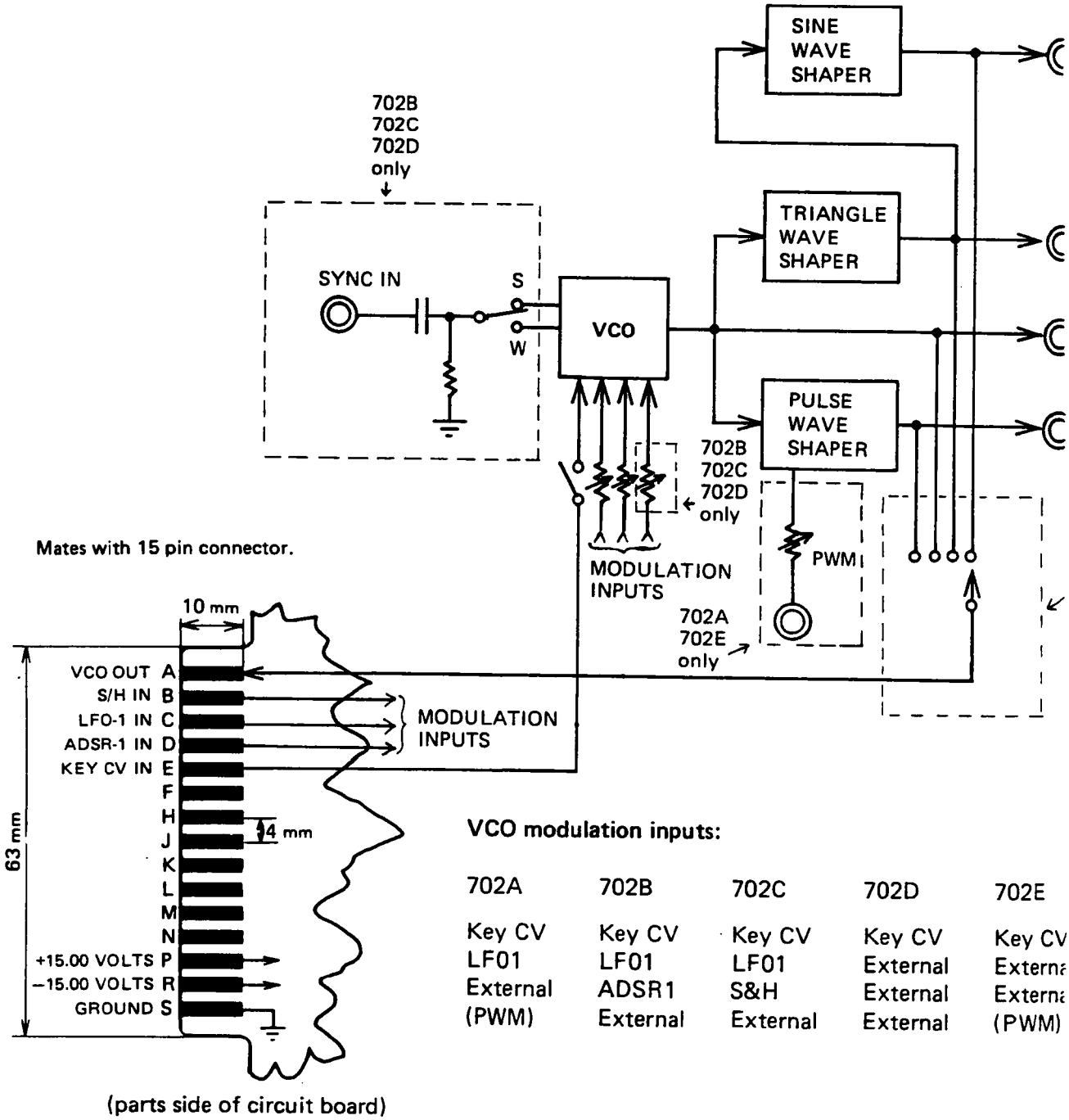
702D



702E



702 VCO



VCO modulation inputs:

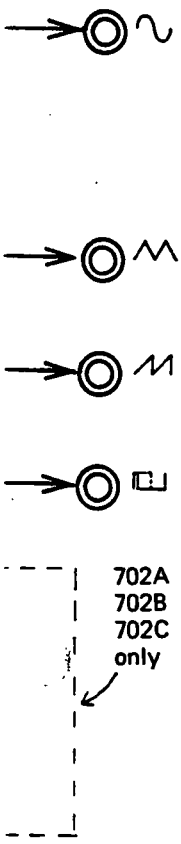
702A	702B	702C	702D	702E
Key CV	Key CV	Key CV	Key CV	Key CV
LF01	LF01	LF01	External	Externa
External	ADSR1	S&H	External	Externa
(PWM)	External	External	External	(PWM)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

702 VOLTAGE CONTROLLED OSCILLATOR (VCO)

Specifications:

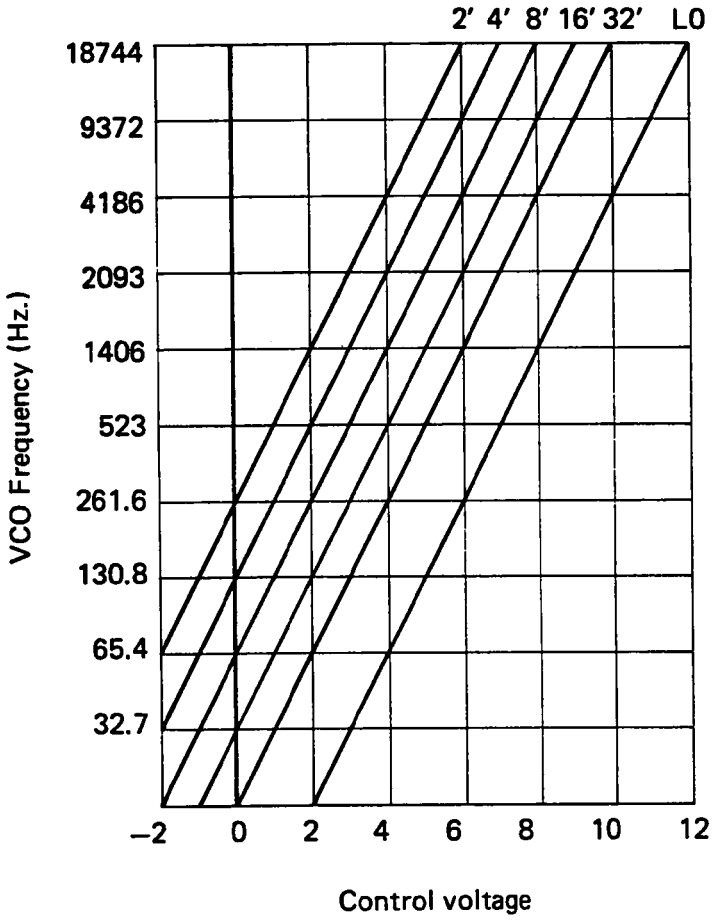
Frequency range:	0.1 Hz – 100 kHz
Output:	10v. p-p
Sensitivity:	1 octave/1 volt
Stability (after 3 minute warm-up period):	
±10% variation in line voltage:	0.05%
0° – 40°C temperature variation:	0.1%
Input impedance:	more than 50kΩ
Output impedance:	600Ω
Square wave PWM input sensitivity: (702A, 702D)	10%/1 volt
Power supply requirements:	+15.00V ± 0.1% @44ma
	−15.00V ± 0.1% @35ma
Panel size:	65 x 280 mm



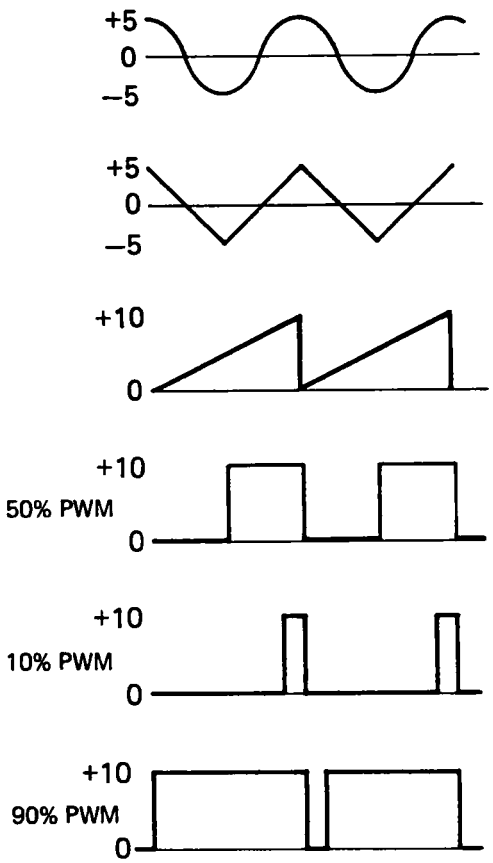
702E

Key CV
External
External
(PWM)

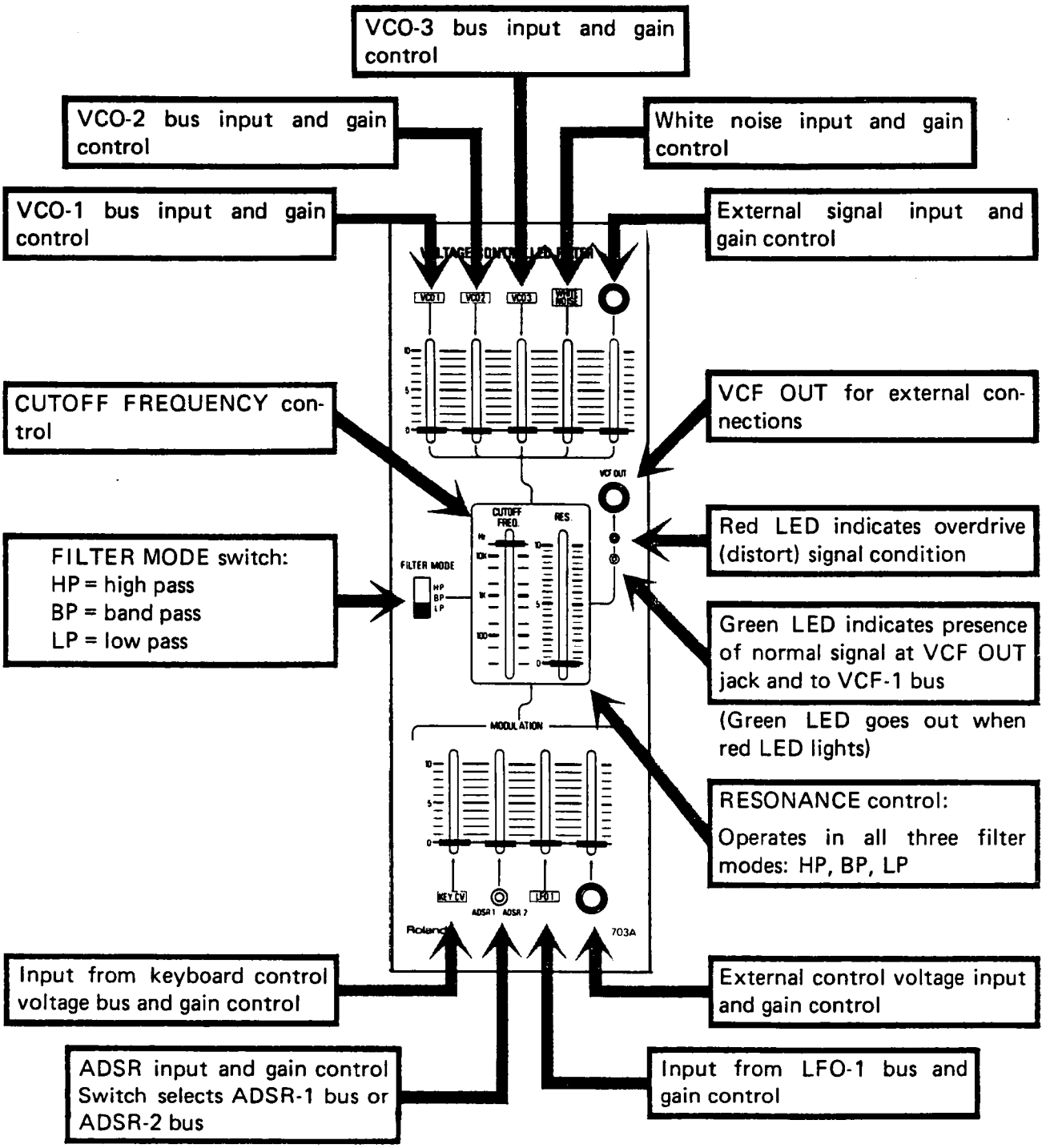
VCO



VCO wave forms and phase relationships

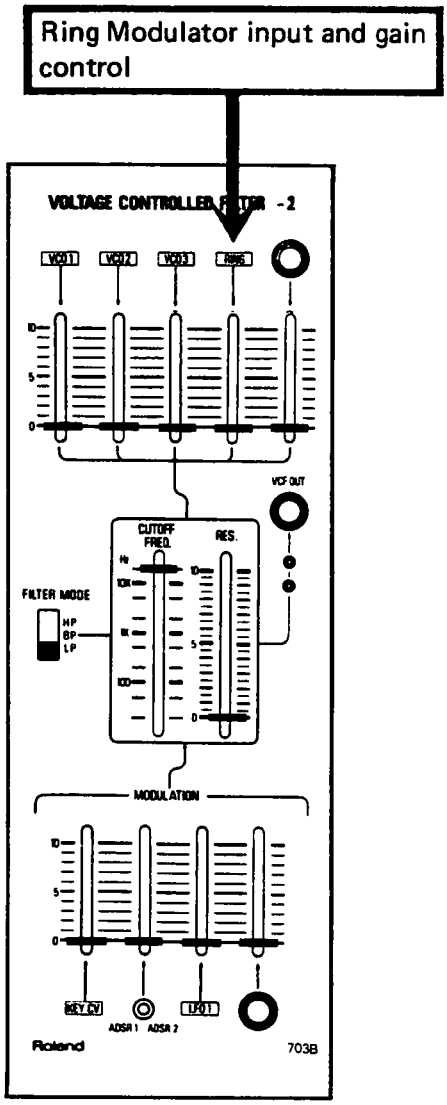


703A VOLTAGE CONTROLLED FILTER (VCF-1)



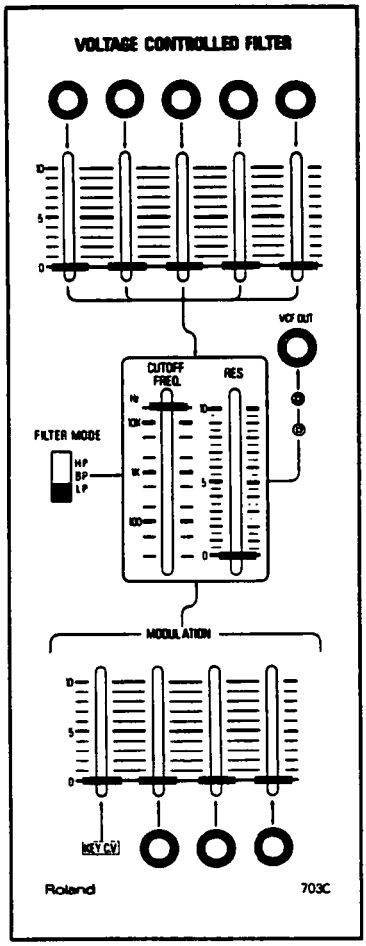
703B VOLTAGE CONTROLLED FILTER (VCF-2)

The 703B VCF-2 is exactly the same as the 703A VCF-1 except for one internal connection.

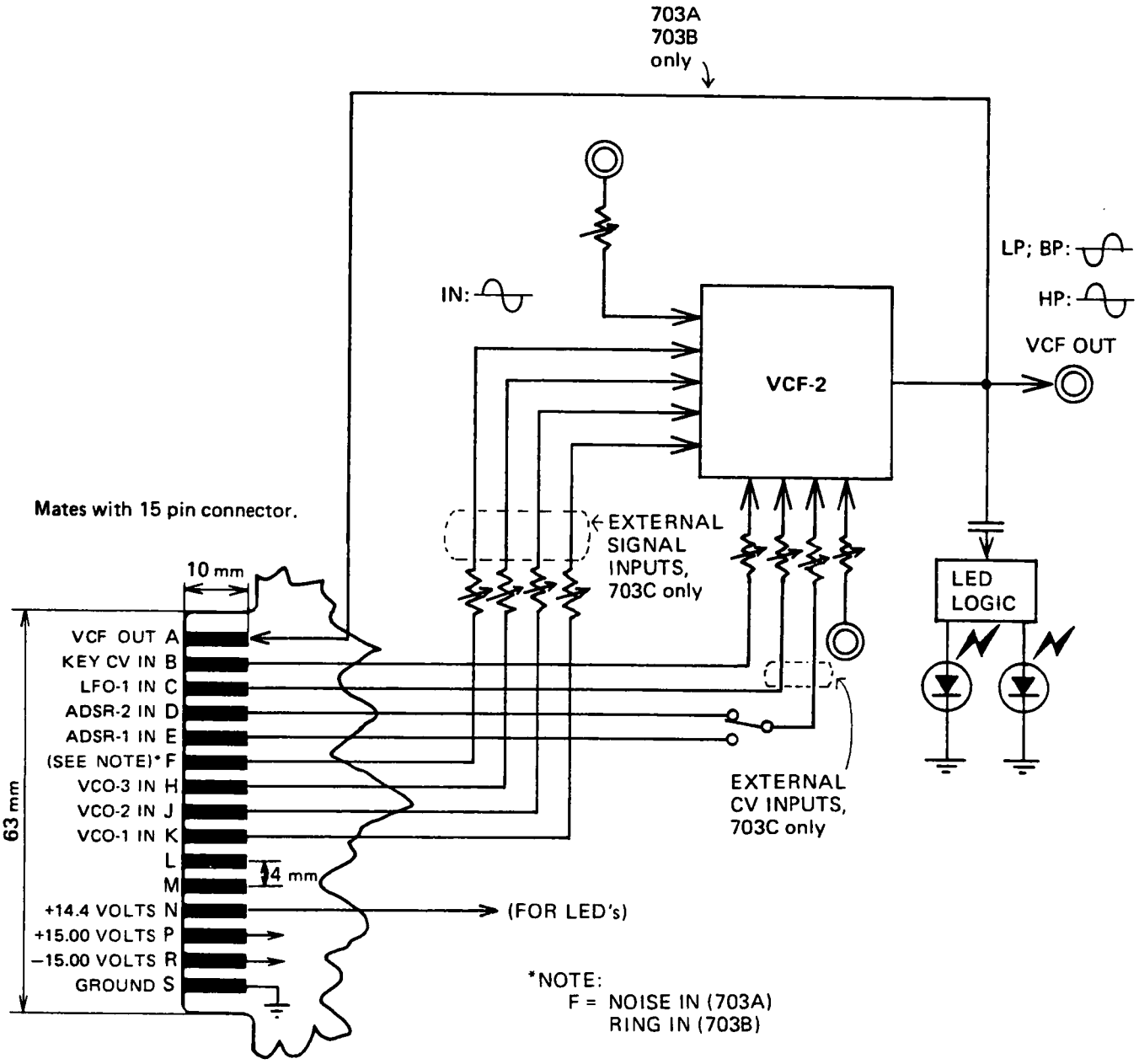


703C VOLTAGE CONTROLLED FILTER (VCF)

The 703C VCF is exactly the same as the 703A and 703B VCF's except the keyboard control voltage is the only internal connection.



703 VCF



(parts side of circuit board)

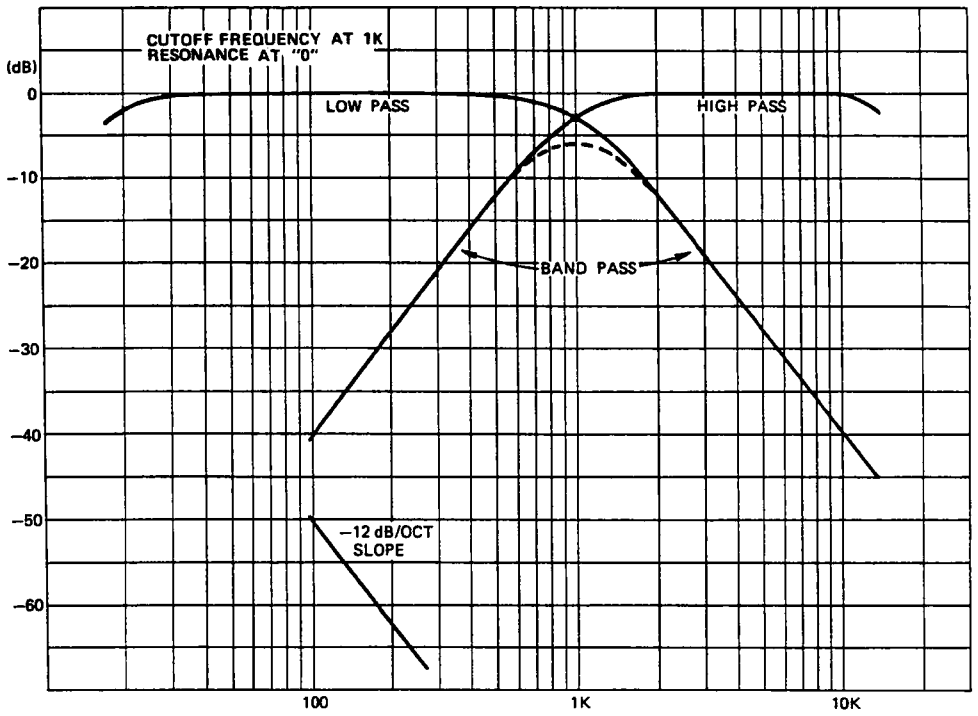
NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

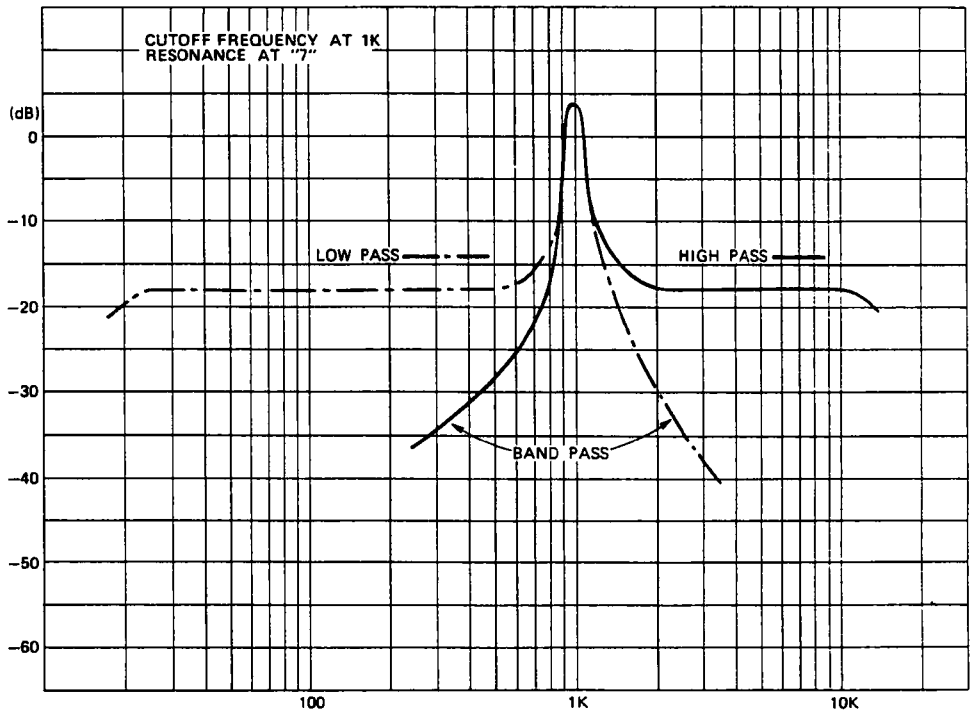
703 VOLTAGE CONTROLLED FILTER (VCF)

Specifications:

Frequency response:	20 Hz. – 20 kHz.
S/N (LP mode; no modulation)	
Cutoff frequency high:	more than 70dB
Cutoff frequency low:	more than 85dB
Cutoff frequency range:	5 Hz. – 30 kHz.
Resonance control:	0 – self oscillation
Fall off rate above cutoff:	RESONANCE at "0": 12dB/octave
	RESONANCE at "7": 24dB/octave
Control sensitivity:	1 octave/1 volt
Filter modes:	LP, BP, HP
Input impedance:	more than 50KΩ
Output impedance:	600Ω
Red LED lights when inputs total about 13v p-p or above	
Power supply requirements:	+15.00V ± 0.1% @21ma
	−15.00V ± 0.1% @21ma
	+14.4V ± 5% @11ma (for LED's)
Panel size:	98 mm x 280 mm

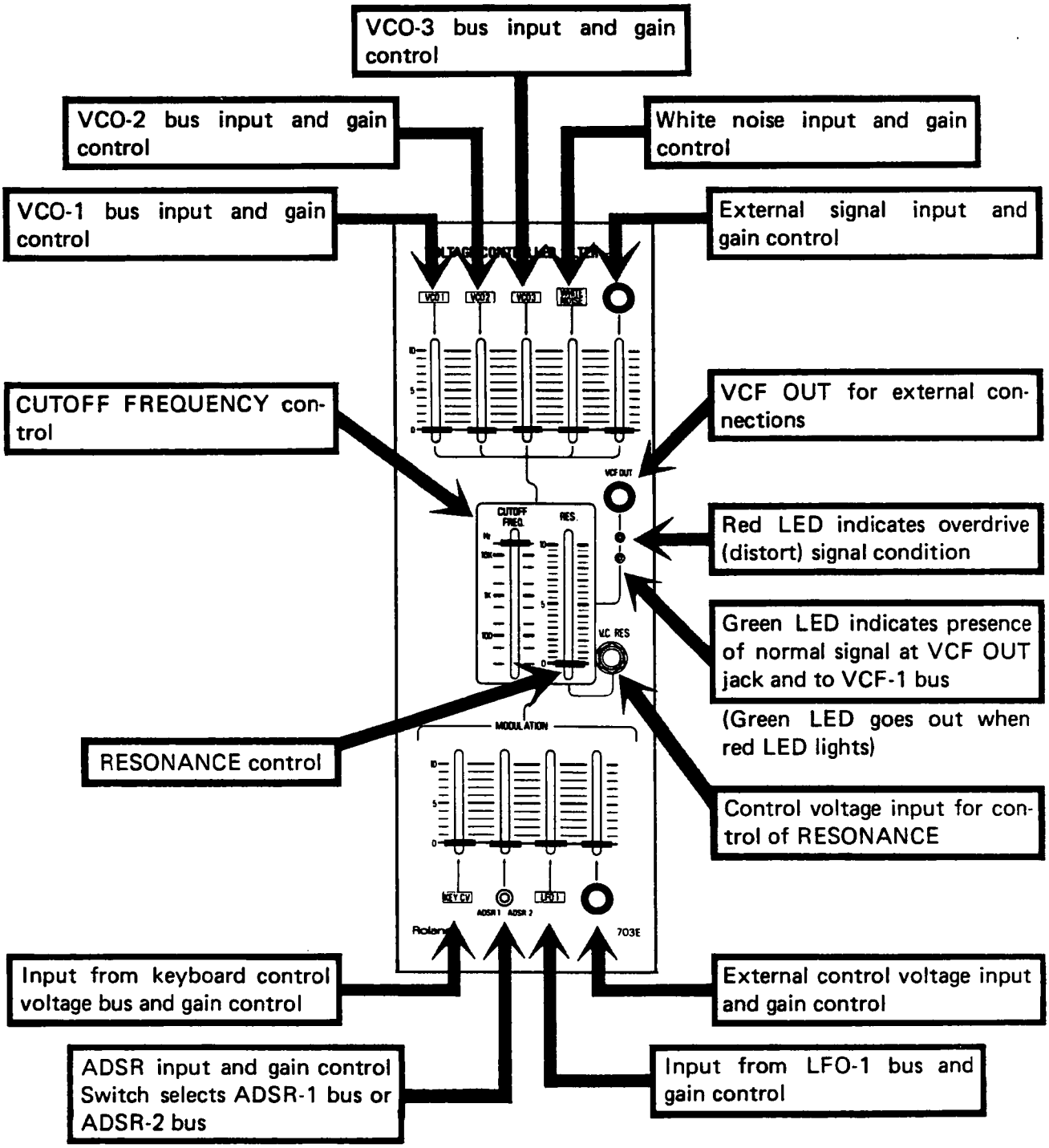
VCF Filter Mode Response





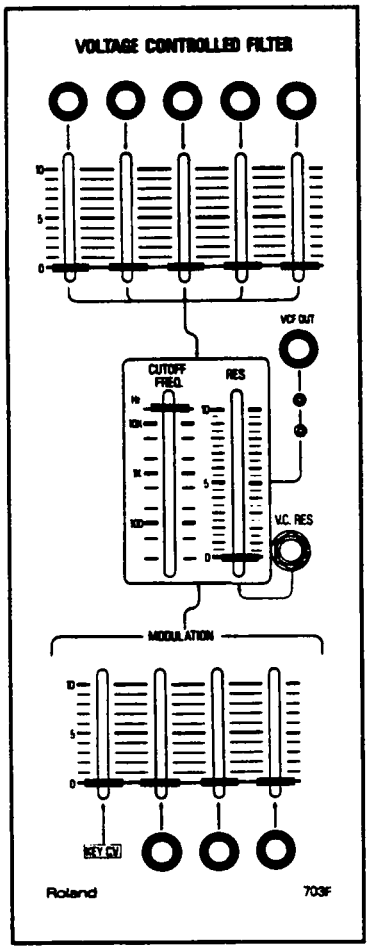
703E LOW PASS VOLTAGE CONTROLLED FILTER (VCF)

The 703E, 703F, and 703G are low pass filters with a fall off rate of 24dB per octave and feature RESONANCE which is controllable from an external voltage source.



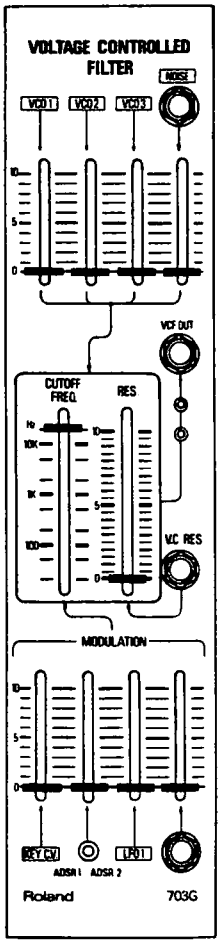
703F LOW PASS VOLTAGE CONTROLLED FILTER (VCF)

The 703F VCF is exactly the same as the 703E VCF except the keyboard control voltage is the only internal connection.

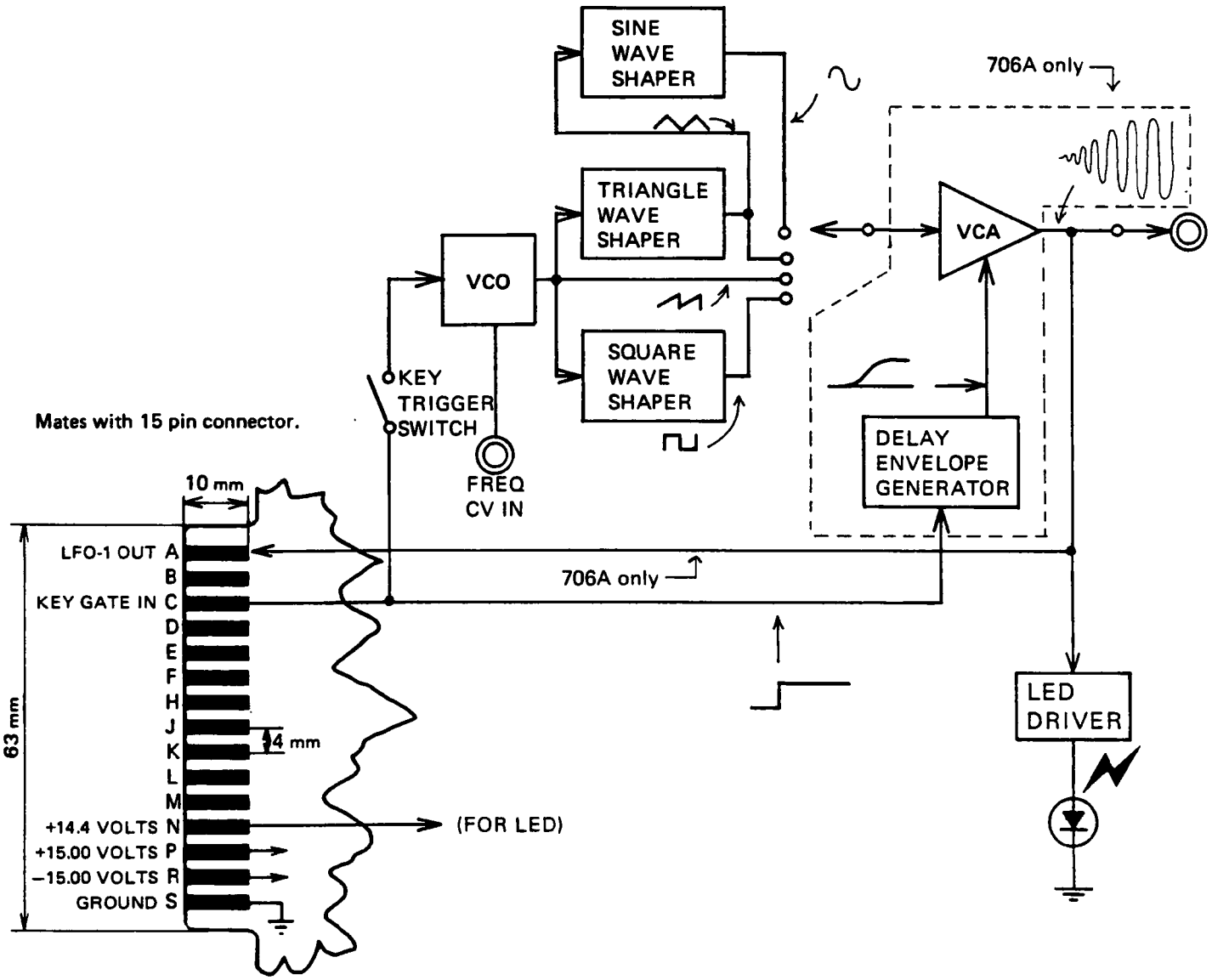


703G LOW PASS VOLTAGE CONTROLLED FILTER (VCF)

The 703G VCF is exactly the same as the 703E VCF except for a narrower panel layout designed to fit the System 700 Laboratory System.



706 LFO



(parts side of circuit board)

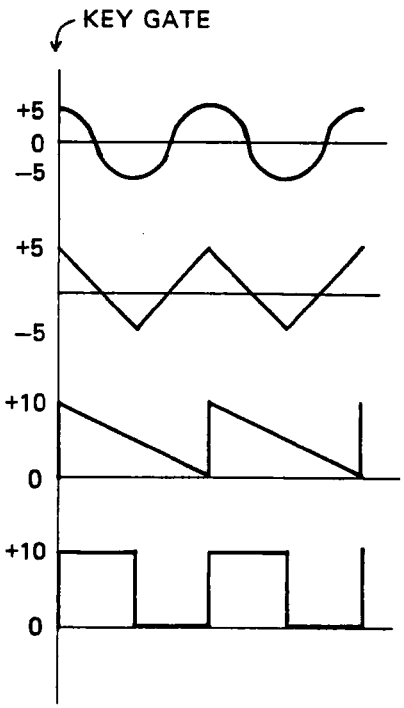
NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

706 LOW FREQUENCY OSCILLATOR LFO

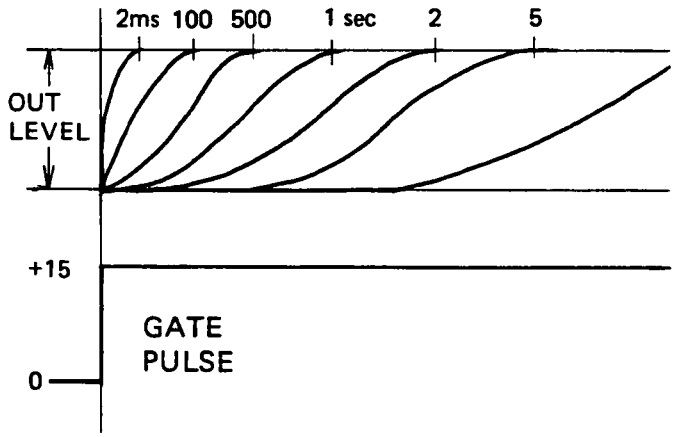
Specifications:

Frequency range:	0.01 Hz. – 30 Hz.
Output:	10V p-p
Control input sensitivity:	1 octave/1 volt
Input impedance:	more than 50kΩ
Output impedance:	600Ω
Power supply requirements:	
706A LFO-1:	+15.00V ± 0.1% @34ma −15.00V ± 0.1% @24ma +14.4V ± 5% @3.5ma (for LED)
706B LFO-2:	+15.00V ± 0.1% @26ma −15.00V ± 0.1% @16ma +14.4V ± 5% @3.5ma (for LED)
Panel size:	65 x 140 mm

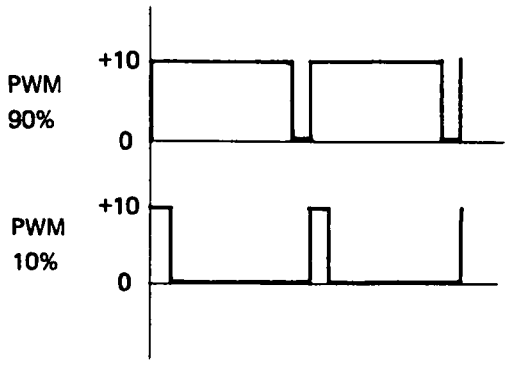
LFO wave forms and phase relationships:



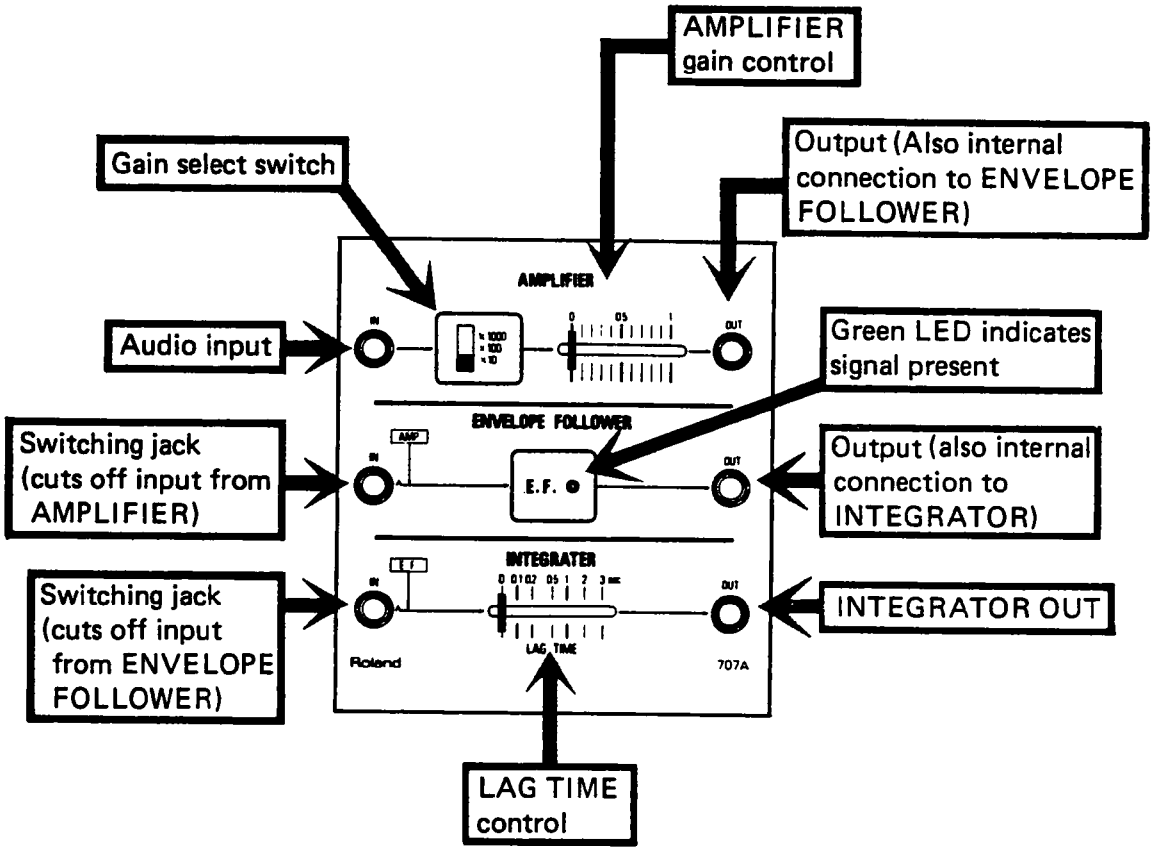
DELAY output of LFO-1 (706A)



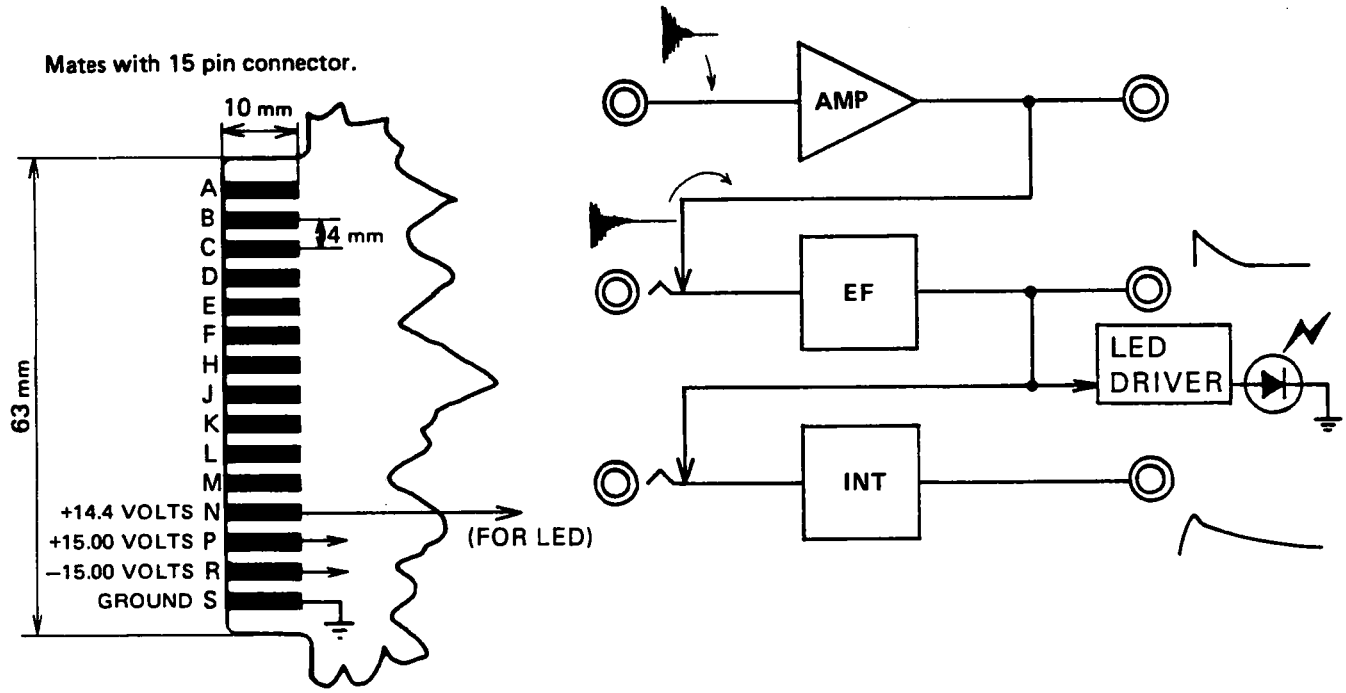
LFO-2 (706B) PWM:



707A AMPLIFIER/ENVELOPE FOLLOWER/INTEGRATOR



707A AMPLIFIER/ENVELOPE FOLLOWER/INTEGRATOR



(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

SECTION 2

707A AMPLIFIER/ENVELOPE FOLLOWER/INTEGRATOR

Specifications:

AMPLIFIER

S/N:	(X10) more than 75dB; (X100) more than 65dB; (X1000) more than 50dB
Frequency response:	20 Hz. – 20kHz
Gain:	20dB, 40dB, and 60dB
Maximum output:	20V p-p
Input impedance:	more than 50kΩ
Output impedance:	600Ω

ENVELOPE FOLLOWER

AC/DC convert sensitivity:	1 volt/1 volt p-p
Input impedance:	more than 50kΩ
Output impedance:	600Ω

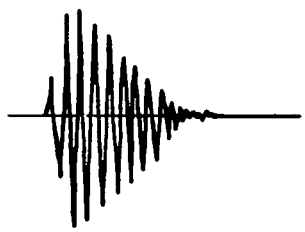
INTEGRATOR

Lag time:	50 ms – 3 sec
Input impedance:	more than 50kΩ
Output impedance:	600Ω

Power supply requirements:	+15.00V ± 0.1% @15ma –15.00V ± 0.1% @15ma +14.4V ± 5% @8ma (for LED)
Panel size:	131 mm x 140 mm

ENVELOPE FOLLOWER:

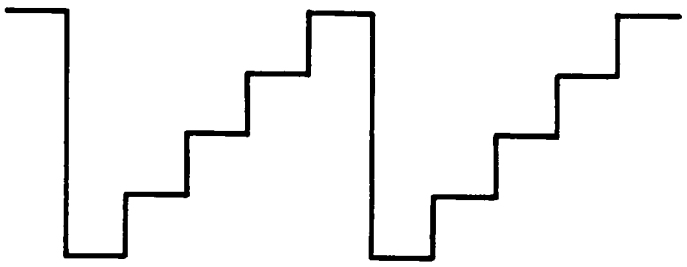
Generates a DC control voltage according to the volume of an audio input signal.

Input: 

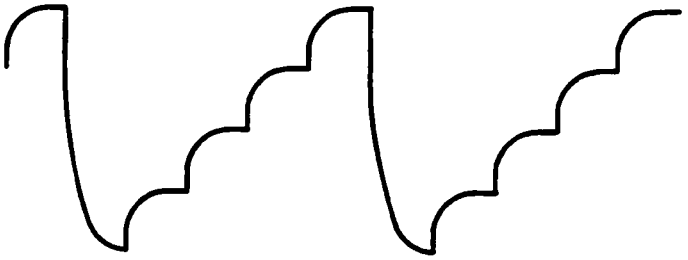
Output: 

INTEGRATOR Wave Forms

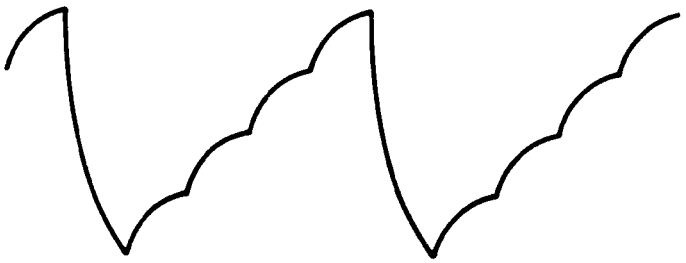
Input:



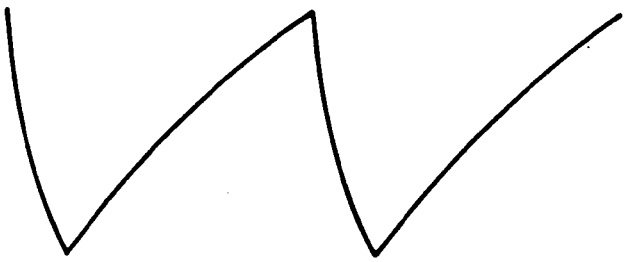
Output:
0.1

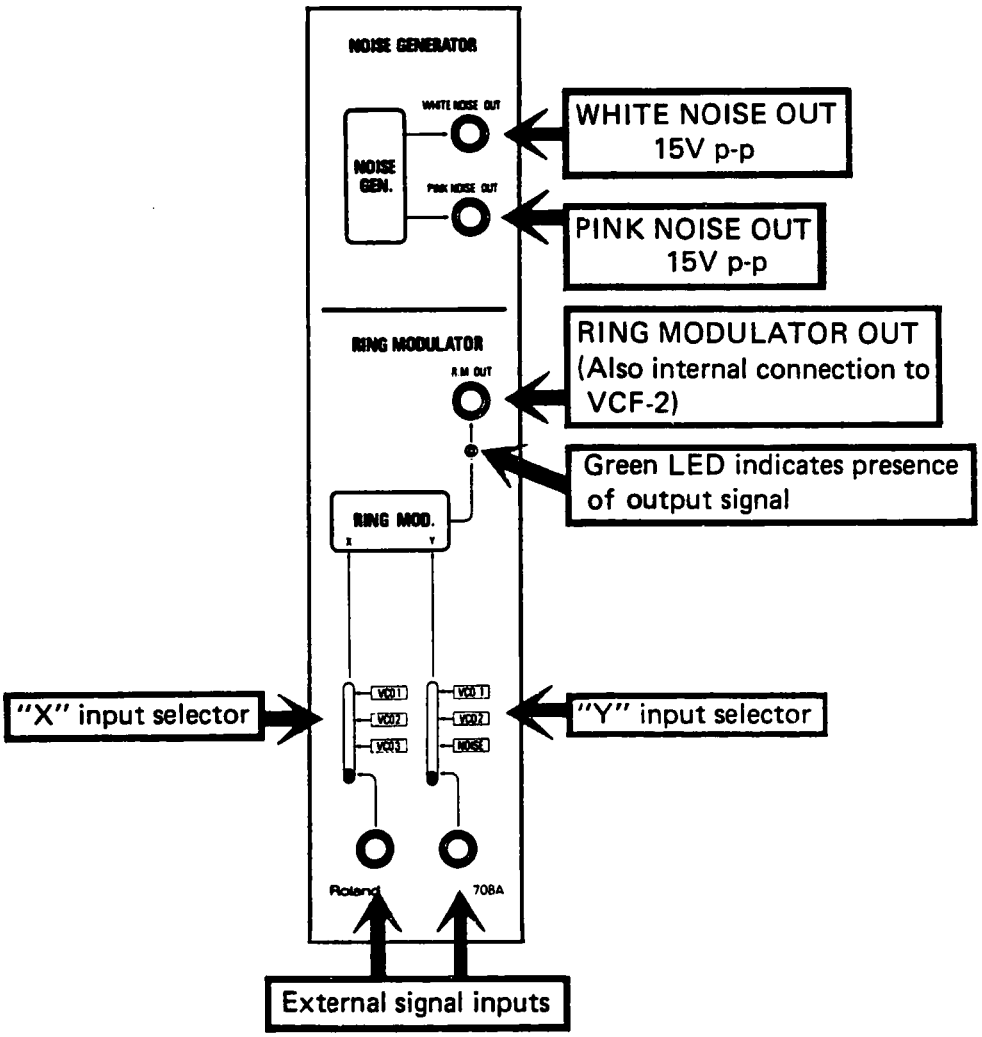


0.5

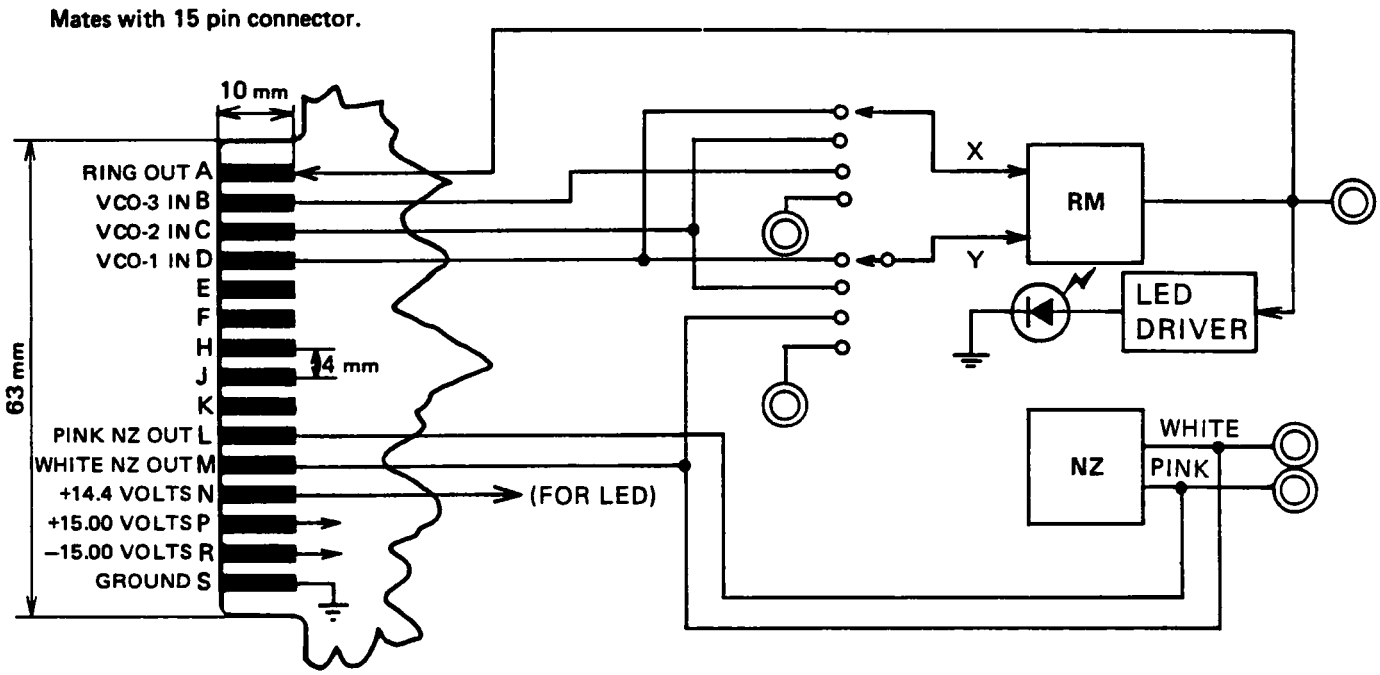


3 sec





708A NOISE GENERATOR/RING MODULATOR



(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

SECTION 2

708A NOISE GENERATOR/RING MODULATOR

Specifications:

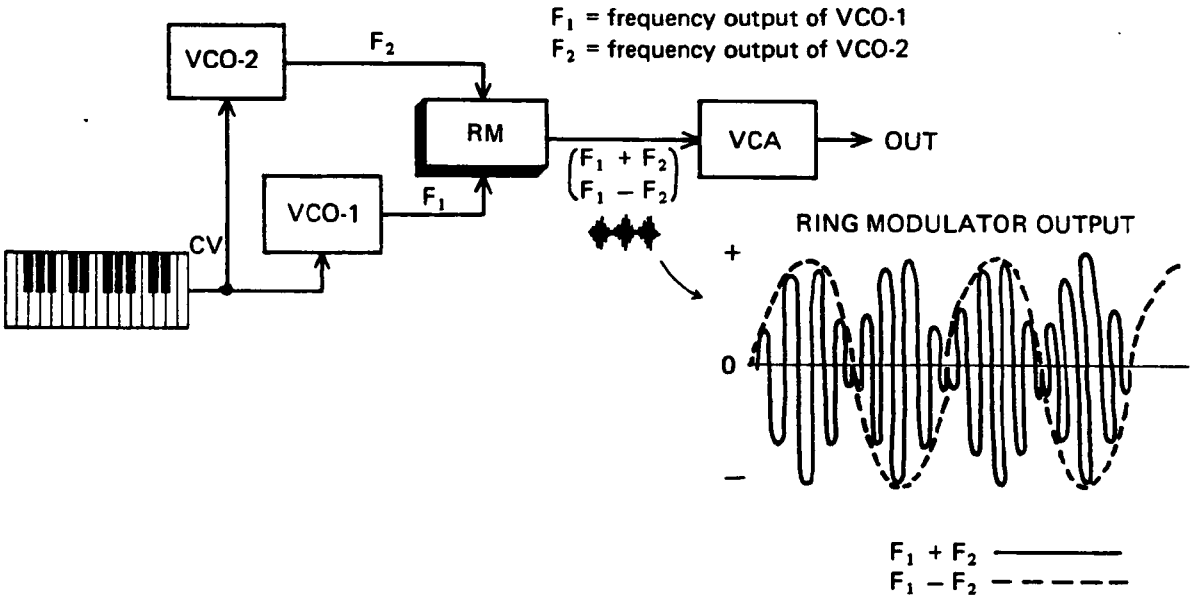
NOISE GENERATOR

Output:	
White:	15V P-P
Pink:	15V P-P
Pink noise slope:	3dB/octave
Output impedance:	600Ω

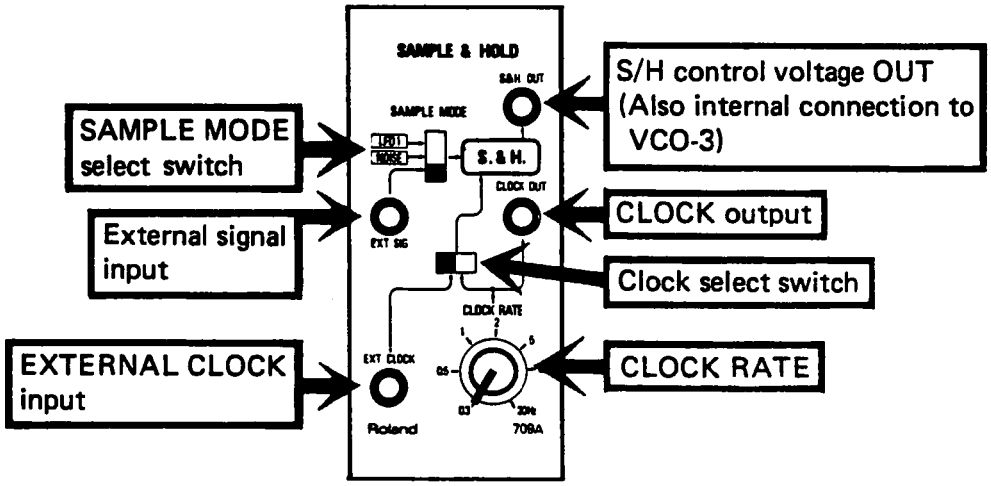
RING MODULATOR

Frequency response:	20 Hz. – 20 kHz.
Input rejection:	60dB
Maximum input level:	X + Y = 20V P-P
Input impedance:	more than 50kΩ
Output impedance:	600Ω
Power supply requirements:	+15.00V ± 0.1% @39ma
	−15.00V ± 0.1% @15ma
	+14.4V ± 5% @5.5ma (for LED)
Panel size:	65 mm x 280 mm

RING MODULATOR

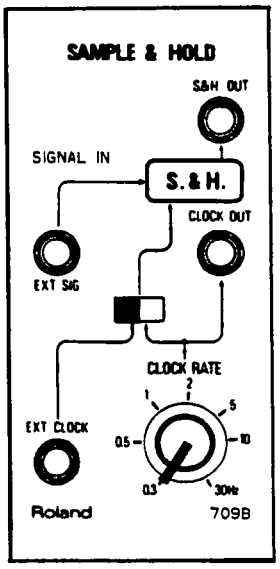


709A SAMPLE & HOLD

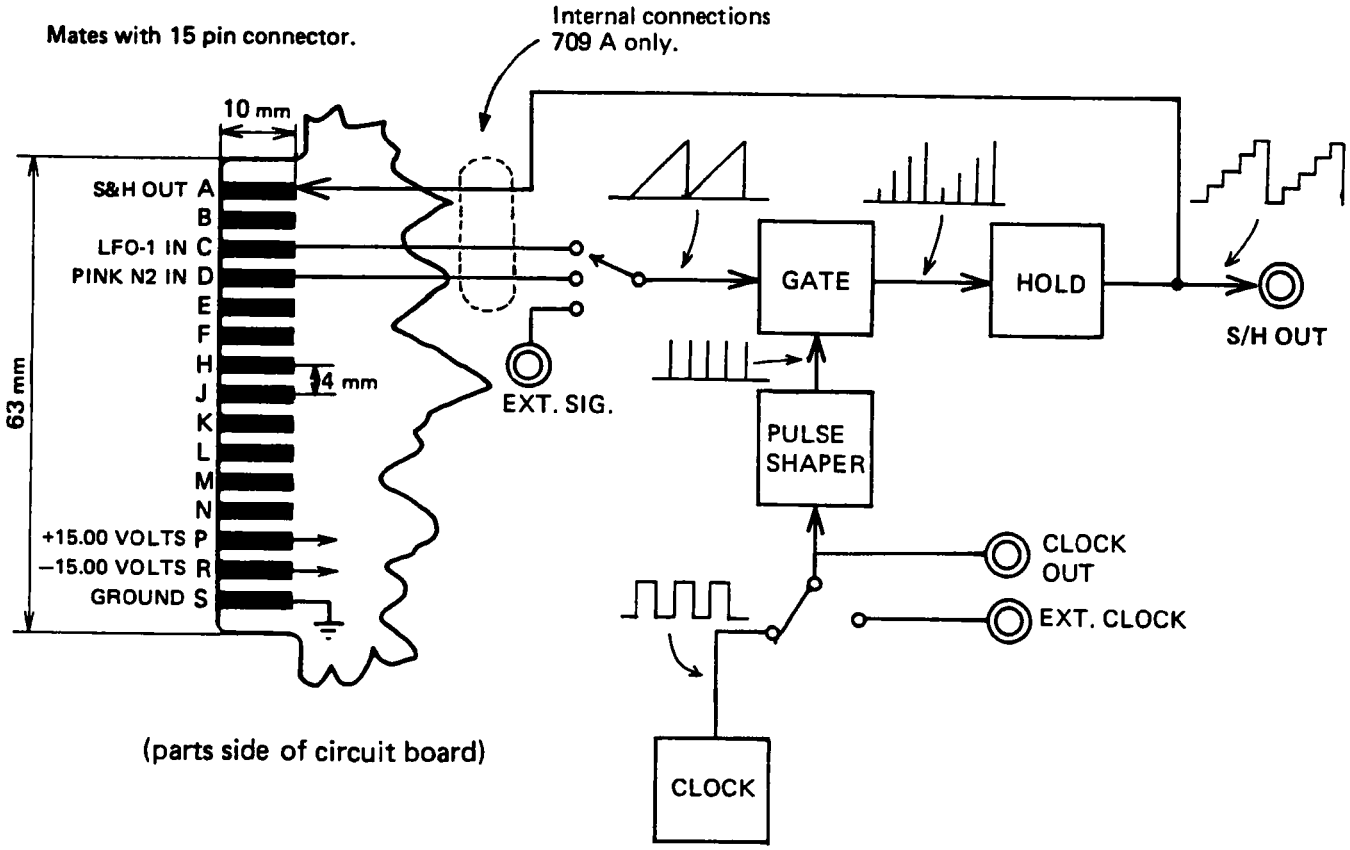


709B SAMPLE & HOLD

The 709B SAMPLE & HOLD is exactly the same as the 709A SAMPLE & HOLD except tha there are no internal connections.



709 S&H



(parts side of circuit board)

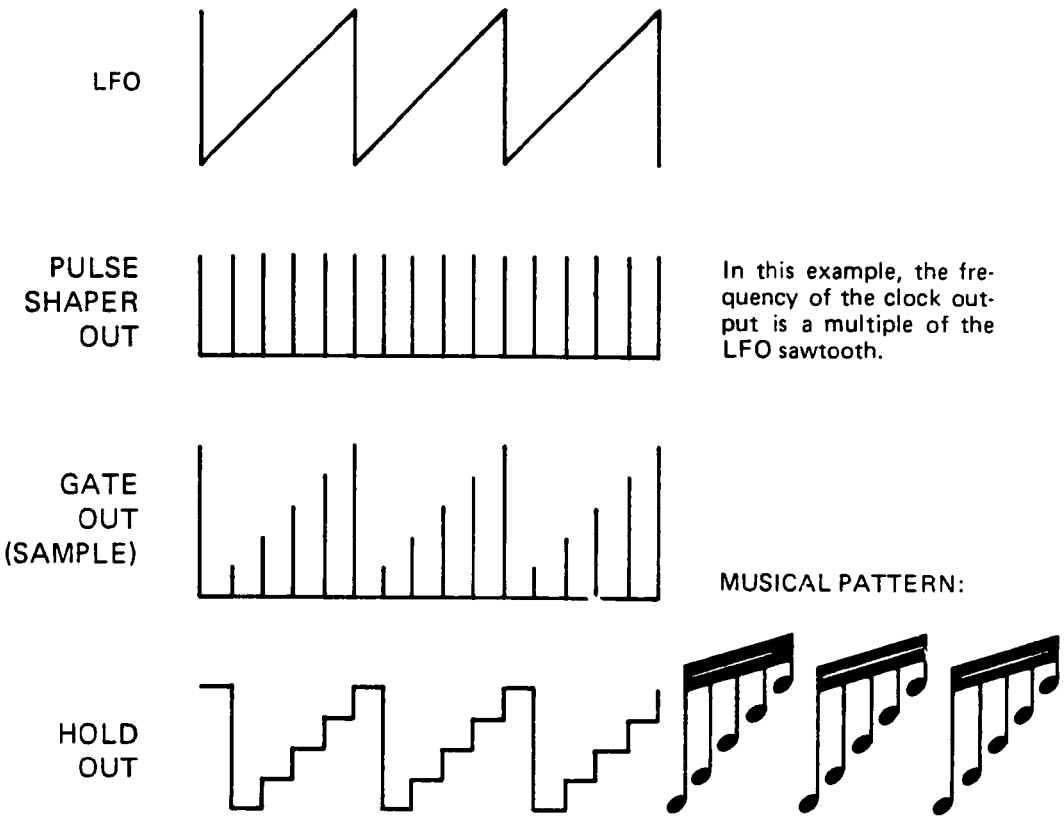
NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

709 SAMPLE AND HOLD (S&H)

Specifications:

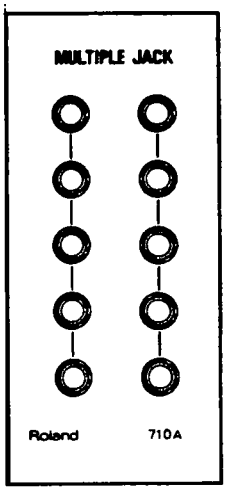
Maximum signal input:	±10V
External clock input sensitivity:	+5V (square or pulse wave)
S/H output:	±10V (20V p-p)
Clock out:	+15V square wave
Sample clock time:	0.3 Hz. – 30 Hz.
Sample time:	0.3 ms
Power supply requirements:	+15.00V ± 0.1% @15ma
	–15.00V ± 0.1% @16ma
Panel size:	65 mm x 140 mm

S/H wave forms



In this example, the frequency of the clock output is a multiple of the LFO sawtooth.

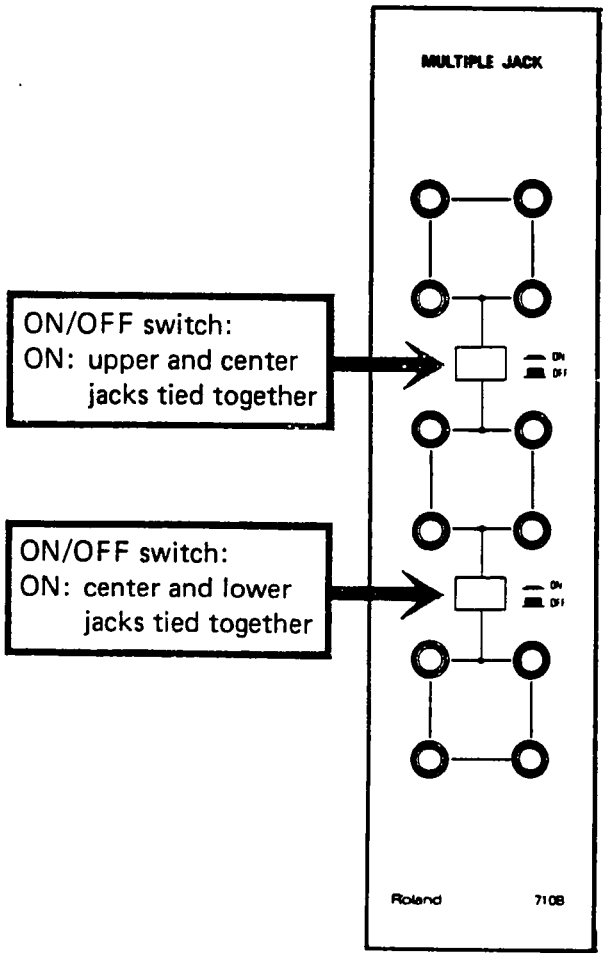
710A MULTIPLE JACK



BLOCK

1
2
3
4
5
6
7

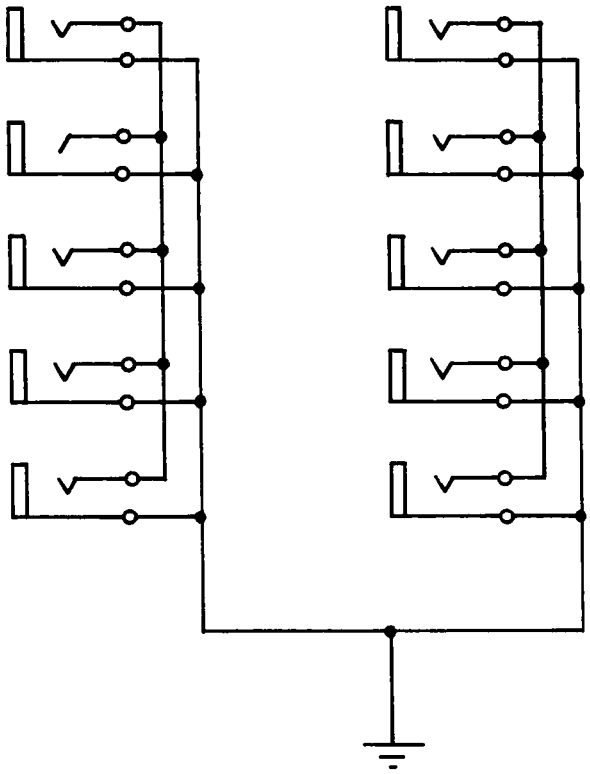
710B MULTIPLE JACK



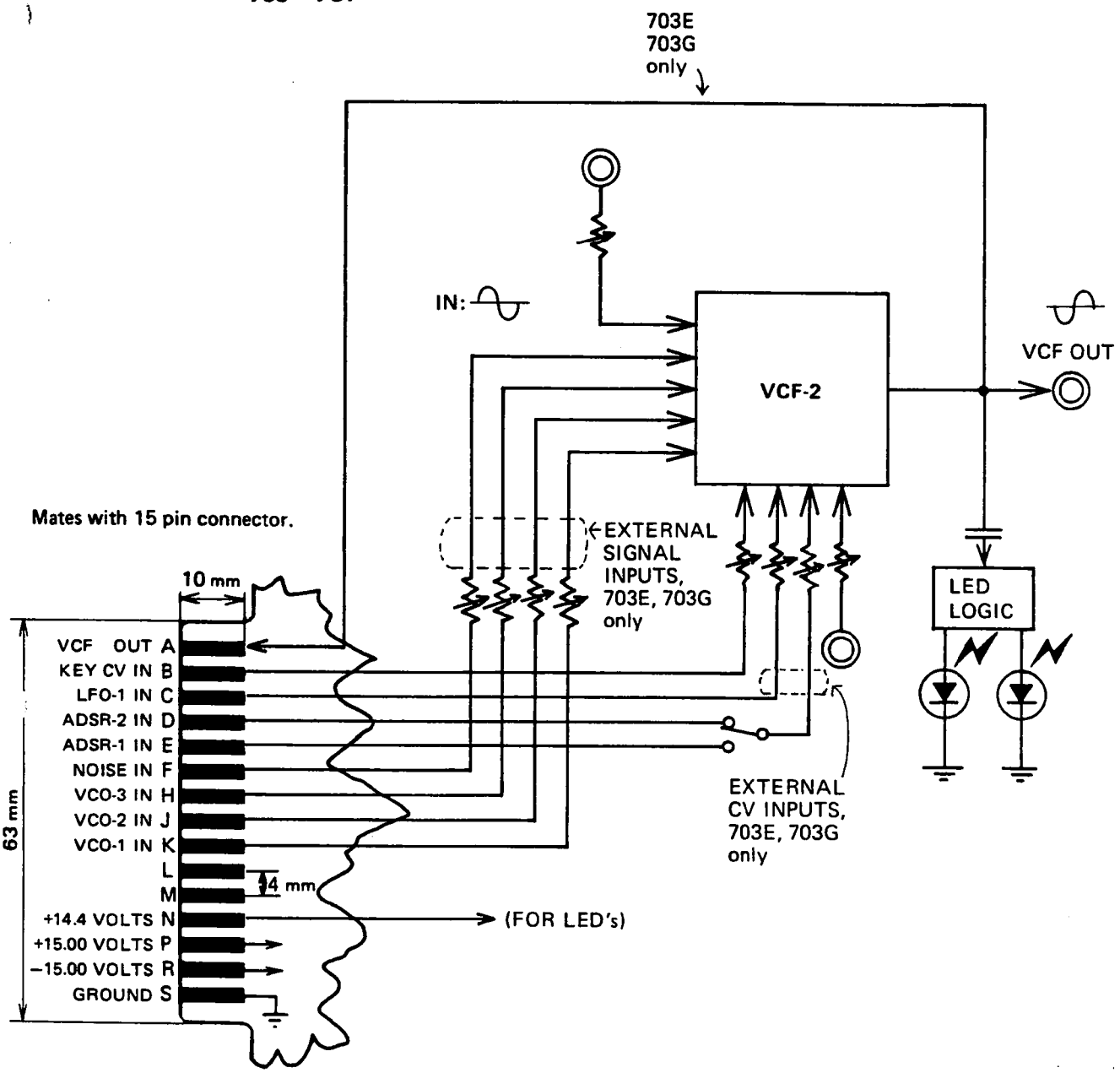
710A MULTIPLE JACKS

Panel size: 65 x 280 mm

Wiring diagram:



703 VCF



(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

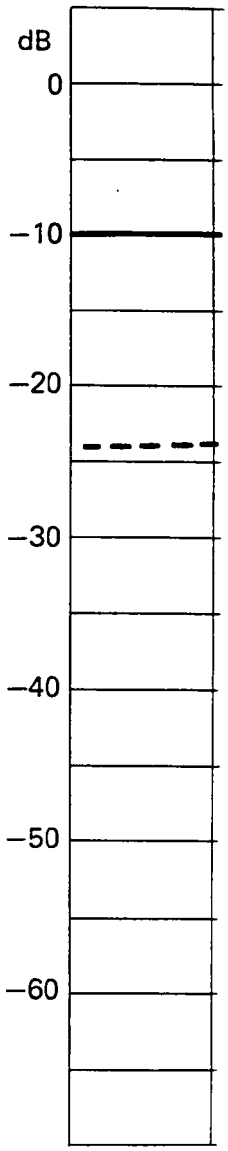
703 VOLTAGE CONTROLLED FILTER (VCF)

Specifications:

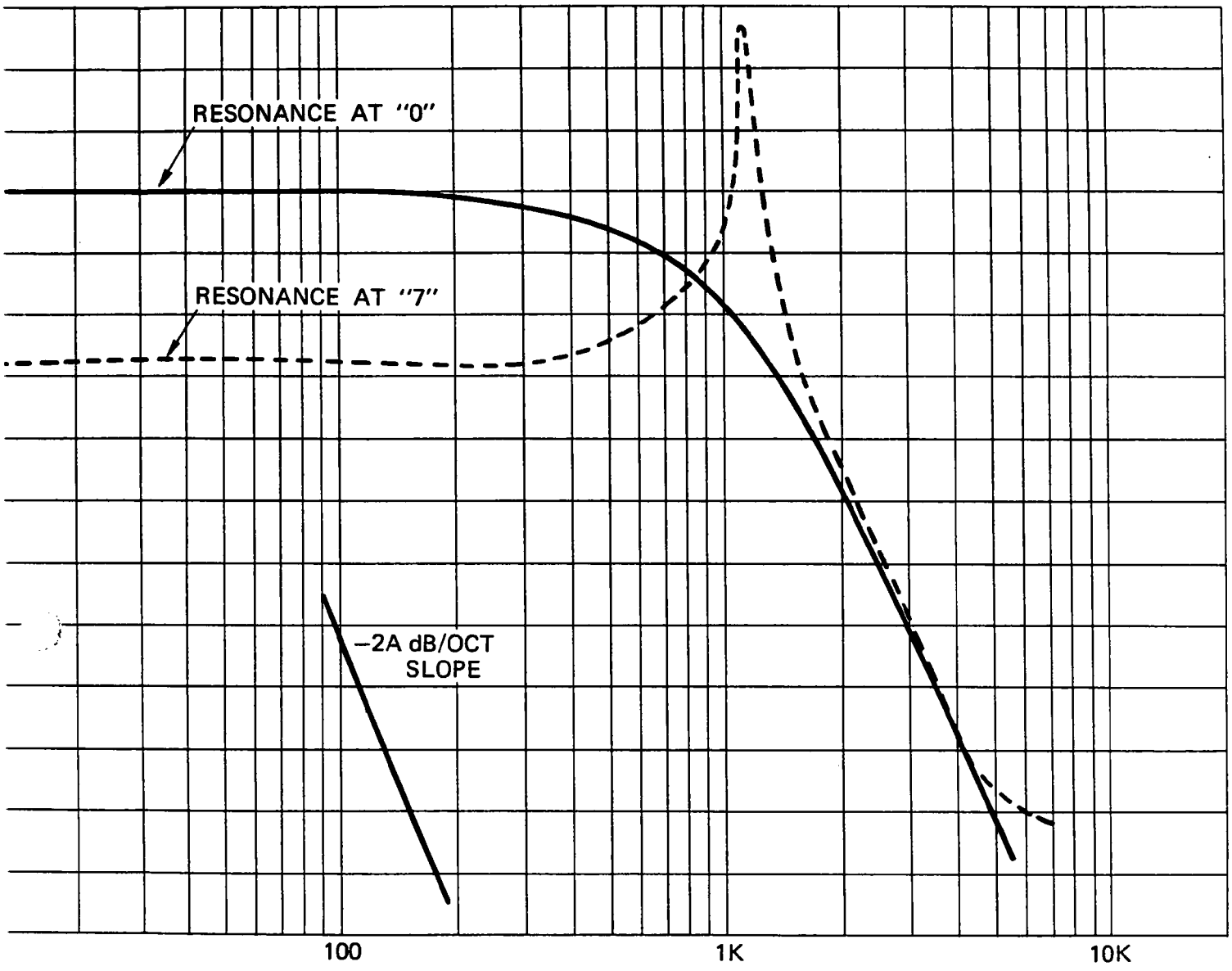
Frequency response:	20 Hz. – 20 kHz.
S/N (No modulation)	
Cutoff frequency high:	more than 70dB
Cutoff frequency low:	more than 85dB
Cutoff frequency range:	5 Hz. – 20 kHz.
Resonance control:	0 – self oscillation
Fall off rate above cutoff:	24dB/octave
Control sensitivity:	1 octave/1 volt
Input impedance:	more than 50KΩ
Output impedance:	600Ω

Red LED lights when inputs total about 13v p-p or above

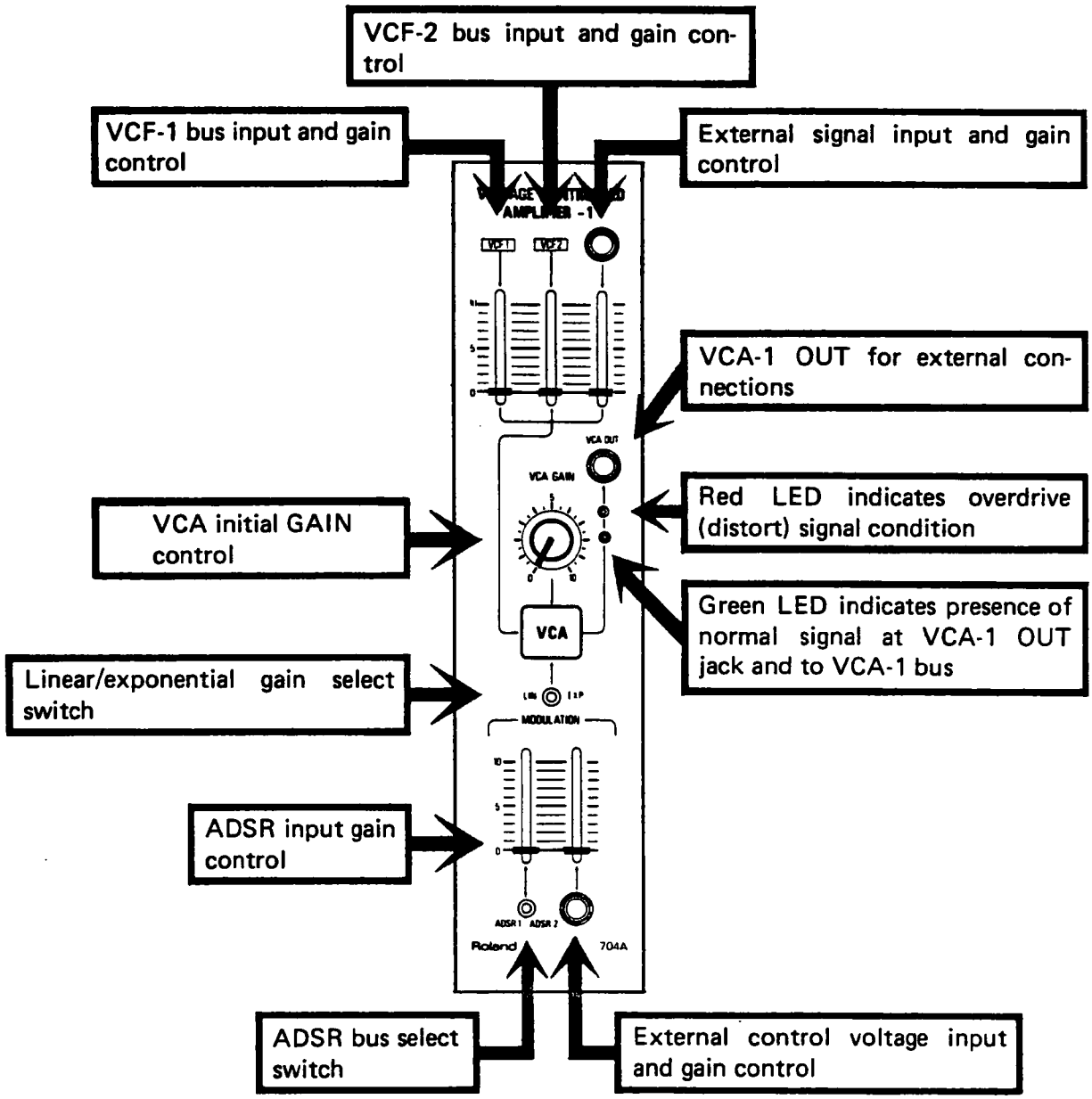
Power supply requirements:	+15.00V ± 0.1% @21ma
	−15.00V ± 0.1% @21ma
	+14.4V ± 5% @11ma (for LED's)
Panel size:	98 mm x 280 mm



CUT OFF FREQUENCY AT 1K

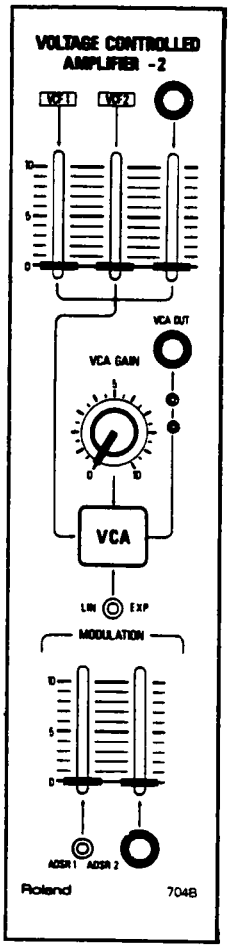


704A VOLTAGE CONTROLLED AMPLIFIER (VCA-1)



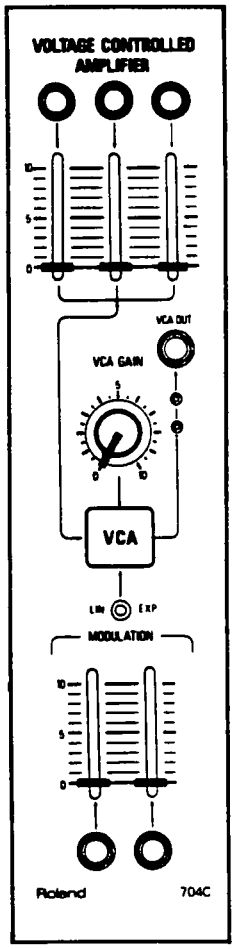
704B VOLTAGE CONTROLLED AMPLIFIER (VCA-2)

The 704B VCA-2 is exactly the same as the 704A VCA-1 except for the internal connections at the 711A OUTPUT module connector.

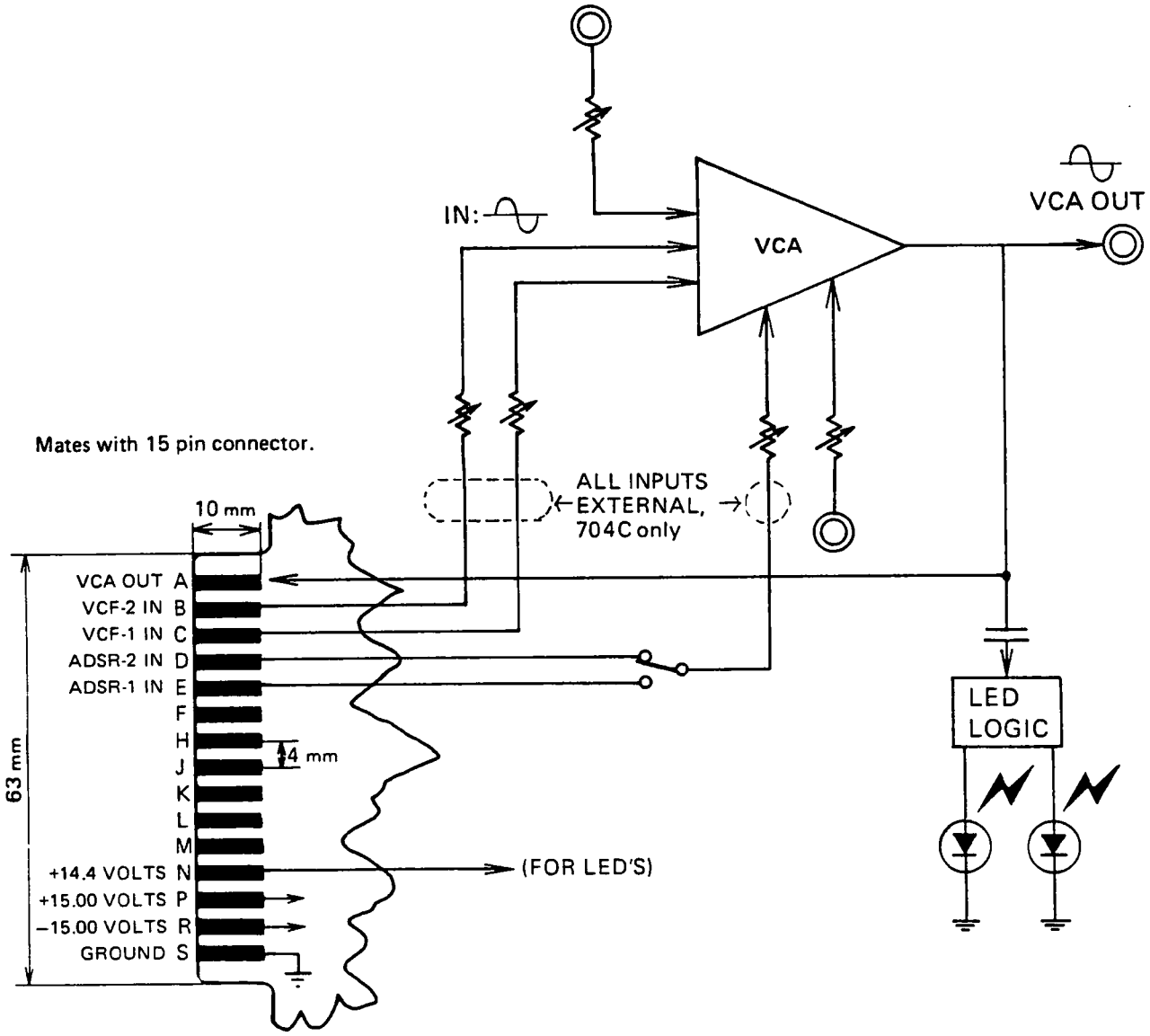


704C VOLTAGE CONTROLLED AMPLIFIER VCA

The 704C VCA is exactly the same as the 704A and 704B VCA's except that there are no internal bus connections.



704 VCA



(parts side of circuit board)

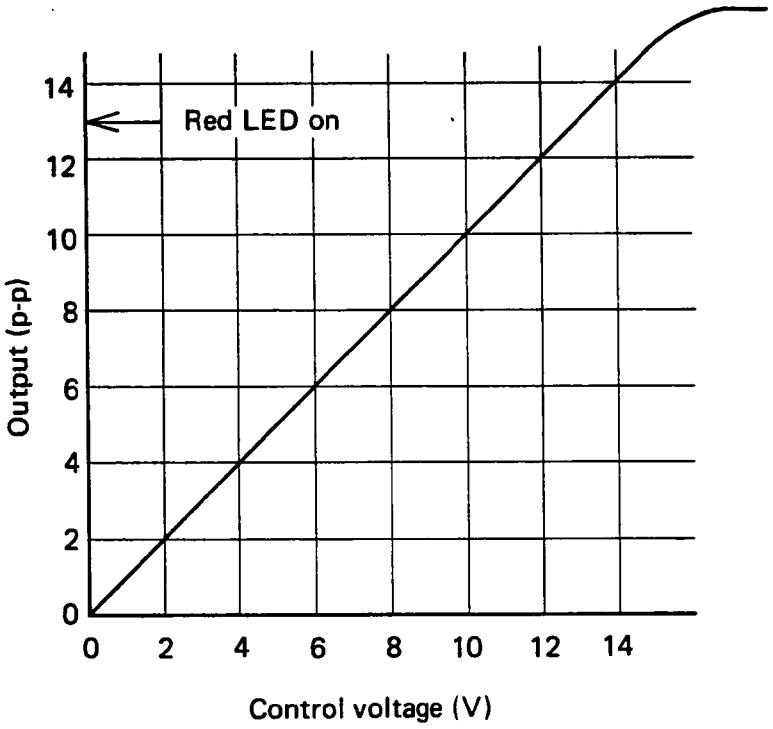
NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

704 VOLTAGE CONTROLLED AMPLIFIER (VCA)

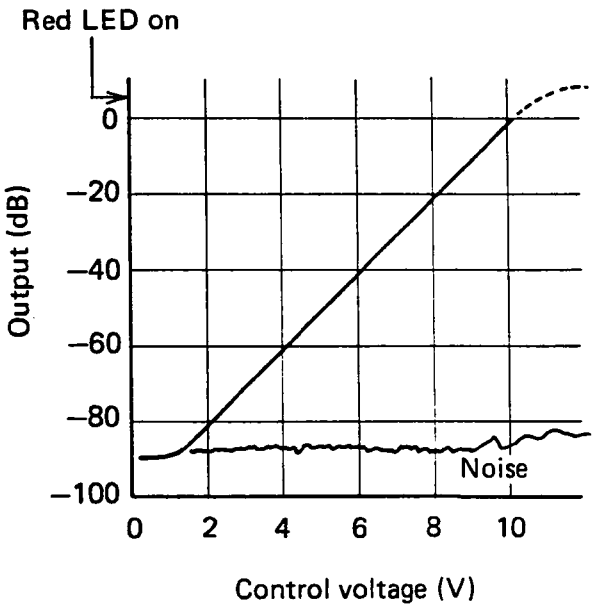
Specifications:

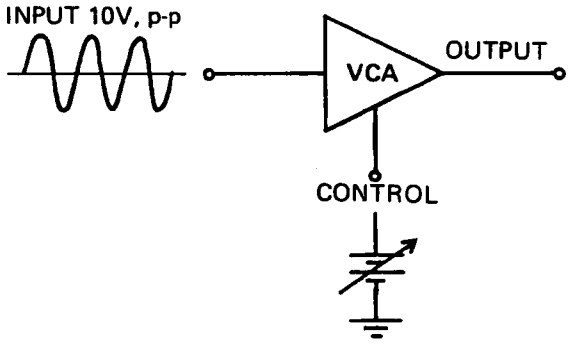
Frequency response:	DC – more than 20 kHz.
S/N (no modulation):	more than 85dB
Control sensitivity:	LIN 10%/1 volt
	EXP 10dB/1 volt
Input impedance:	more than 50kΩ
Output impedance:	600Ω
Power supply requirements:	+15.00V ± 0.1% @15ma
	−15.00V ± 0.1% @8ma
	+14.4V ± 5% @11ma (for LED's)
Panel size:	65 x 280 mm

VCA LINEAR RESPONSE



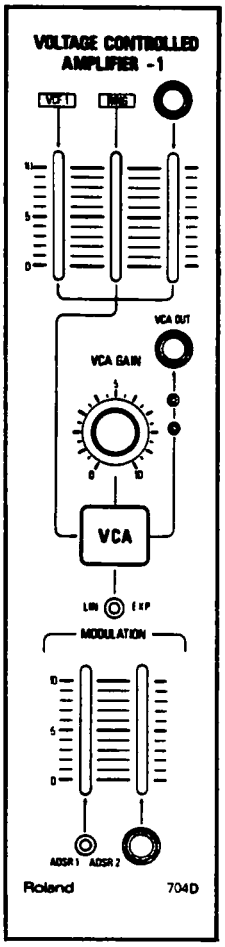
VCA EXPONENTIAL RESPONSE





704D VOLTAGE CONTROLLED AMPLIFIER

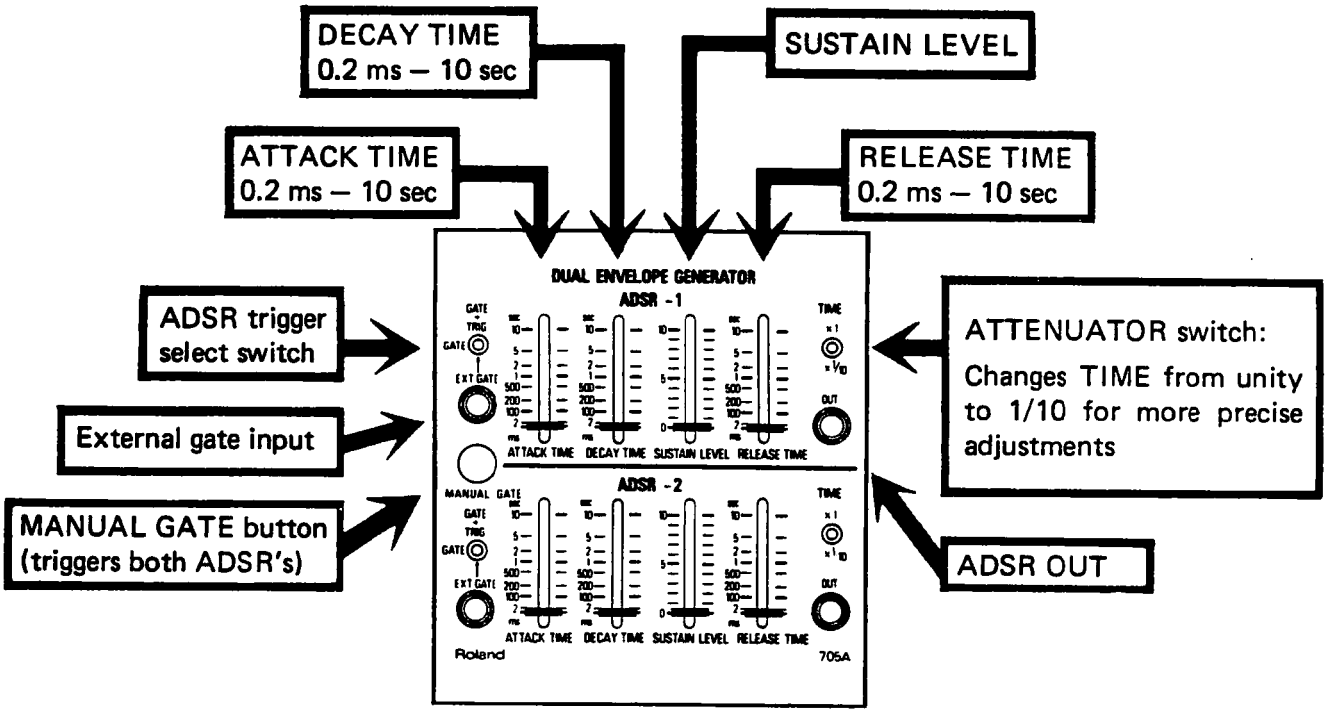
The 704D VCA is used in the System 700 Laboratory System and is the same as the other 704 series VCA's except for internal connections.



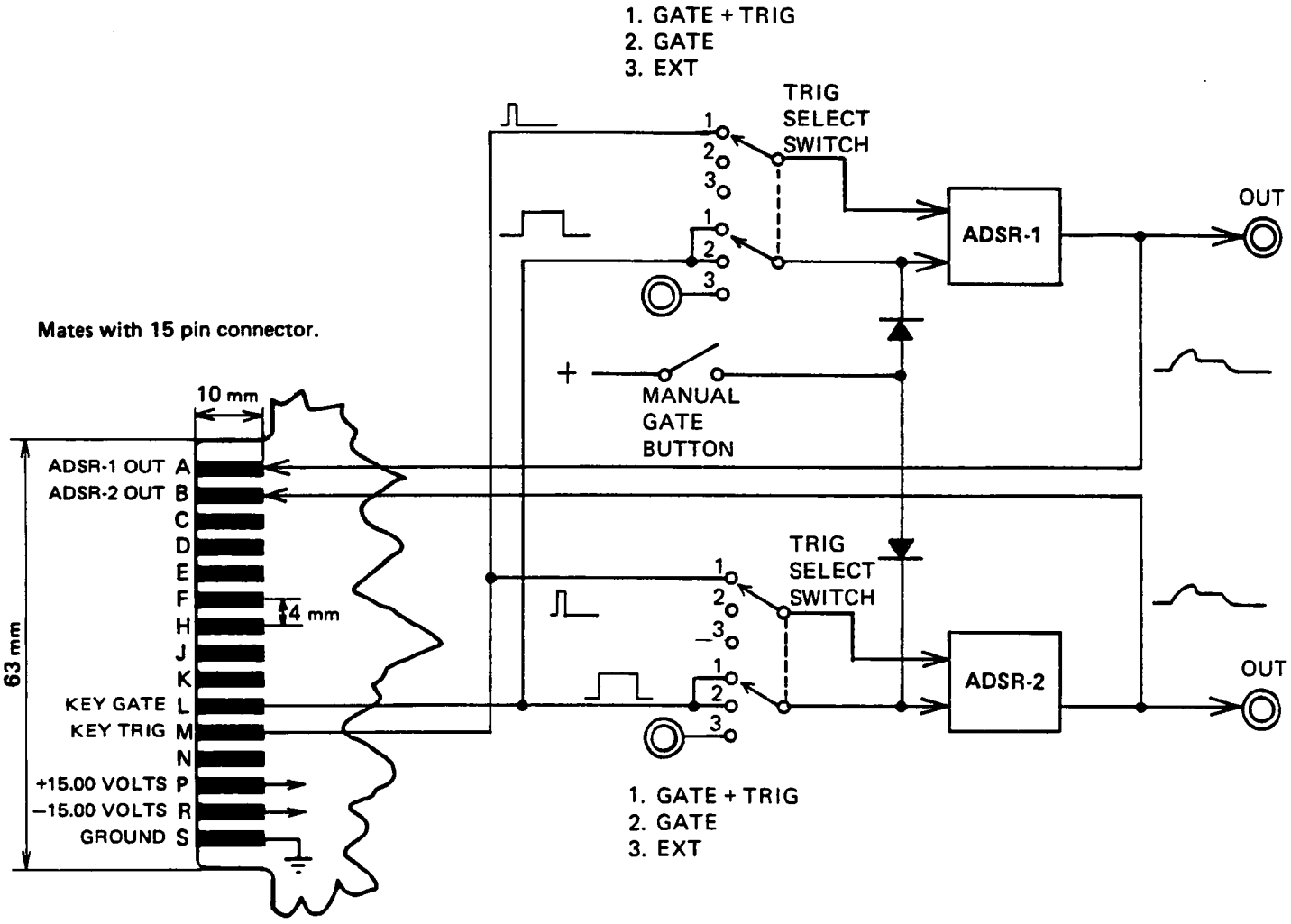
BLOCK

Specifications are exactly the same as for other VCA's in this series.

705A DUAL ENVELOPE GENERATOR (ADSR)



705A ADSR



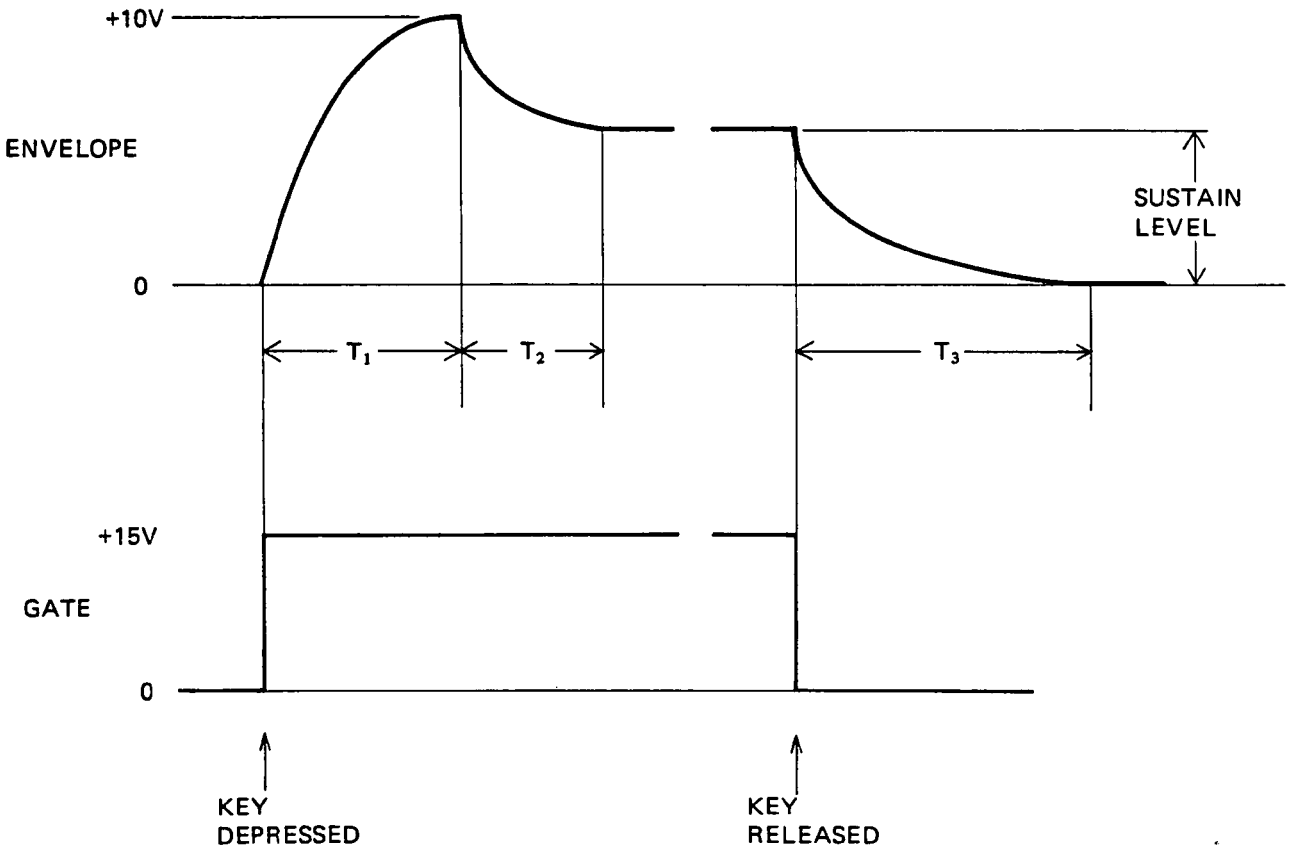
(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

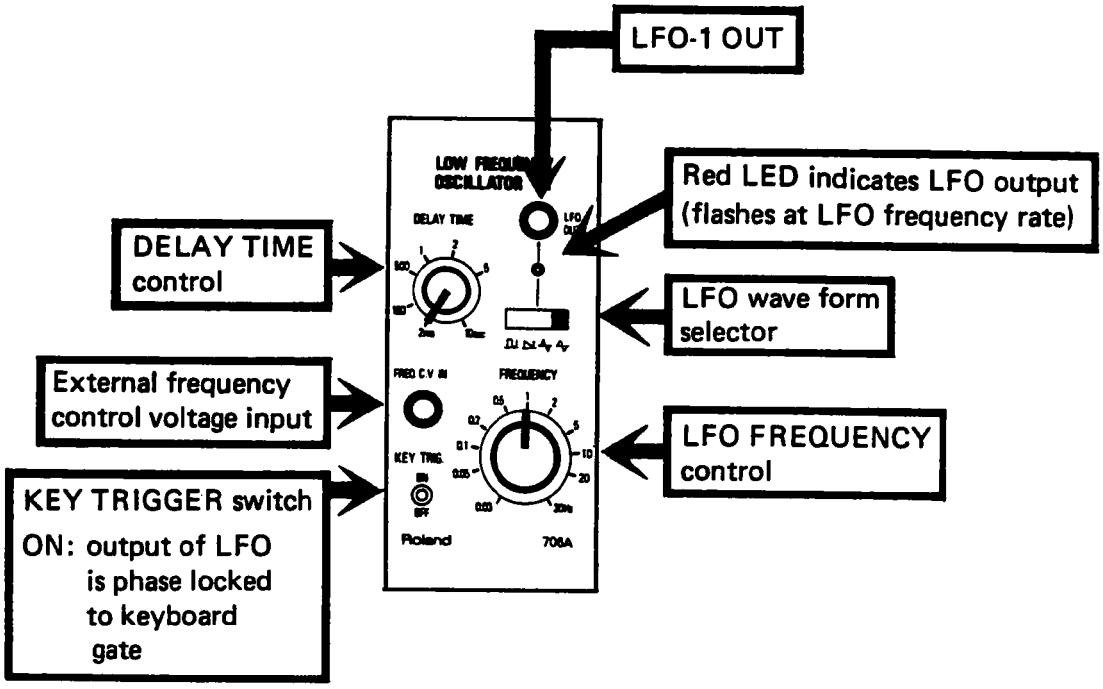
705A DUAL ENVELOPE GENERATOR

Specifications:

Attack time (T_1):	2 ms – 10 sec
Decay time (T_2):	2 ms – 10 sec
Sustain level:	0 – 100% (0 – 10 volts)
Release time (T_3):	2 ms – 10 sec
Power supply requirements:	+15.00V ± 0.1% @23ma
	–15.00V ± 0.1% @12ma
Panel size:	131 x 140 mm

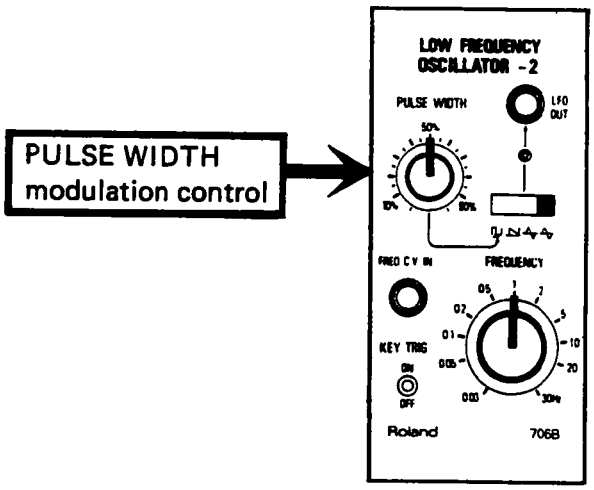


706A LOW FREQUENCY OSCILLATOR (LFO-1)



706B LOW FREQUENCY OSCILLATOR (LFO-2)

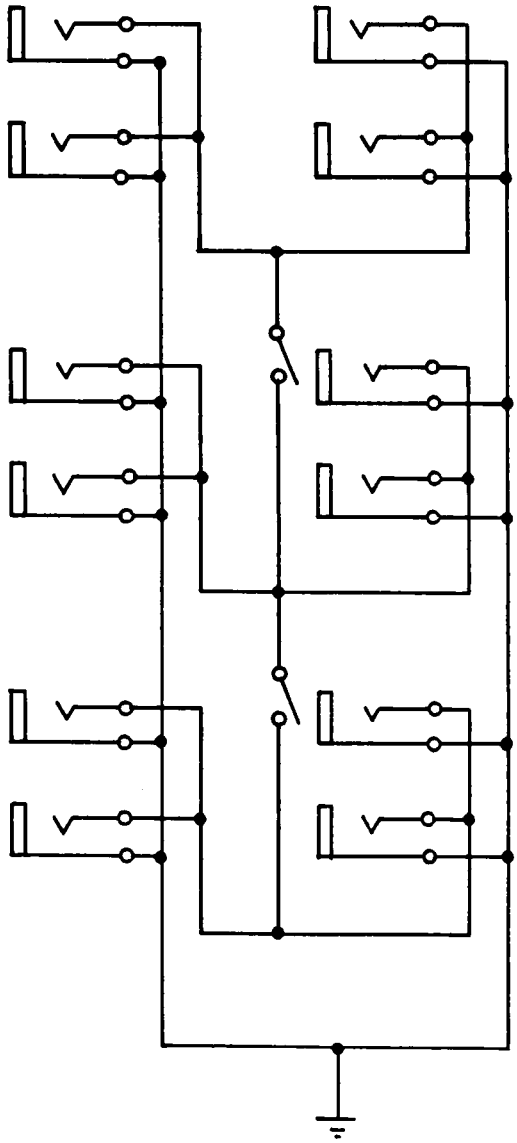
The 706B LFO-2 is exactly the same as the 706A LFO-1 except as shown below.



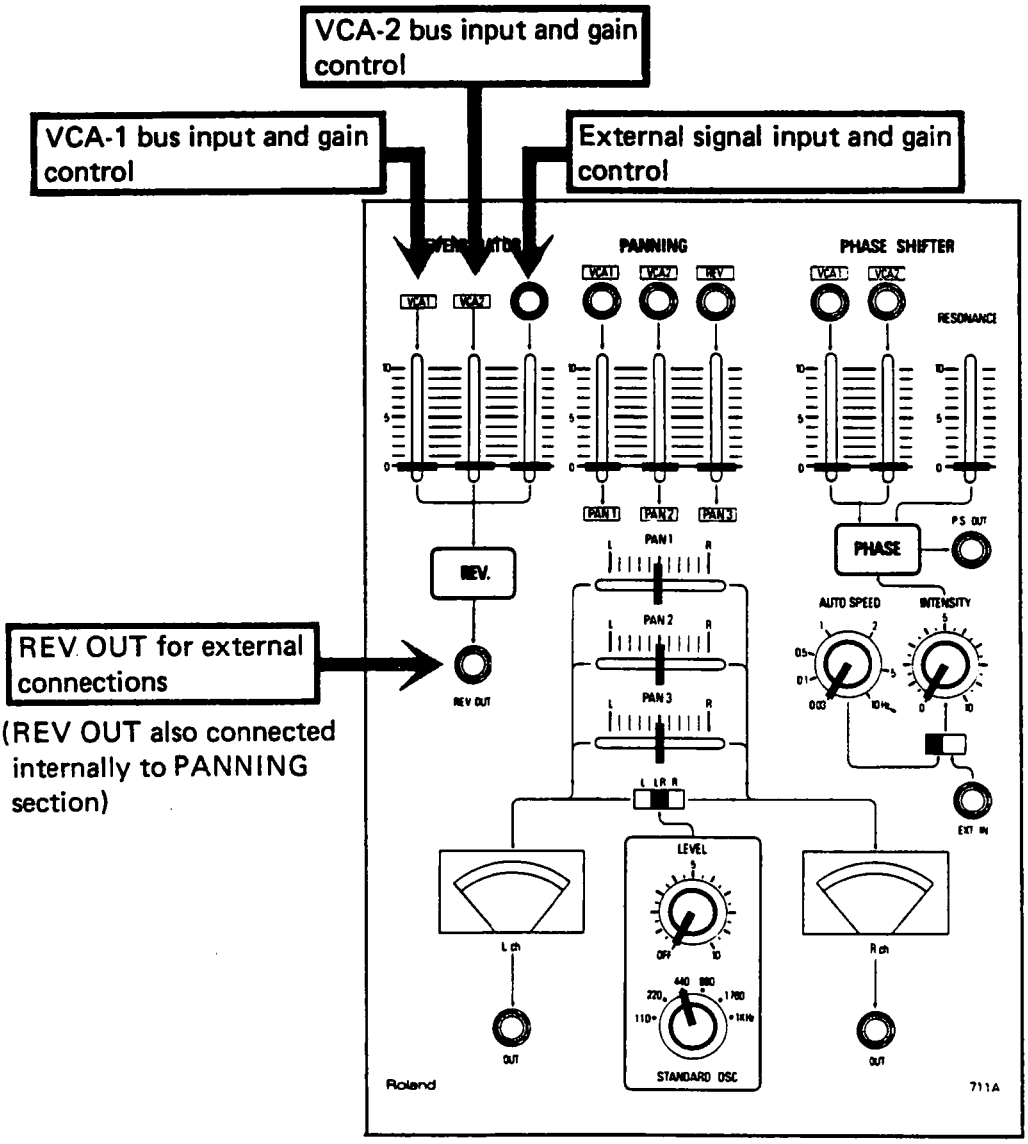
710B MULTIPLE JACK

Panel size: 65 x 140 mm

Wiring diagram:



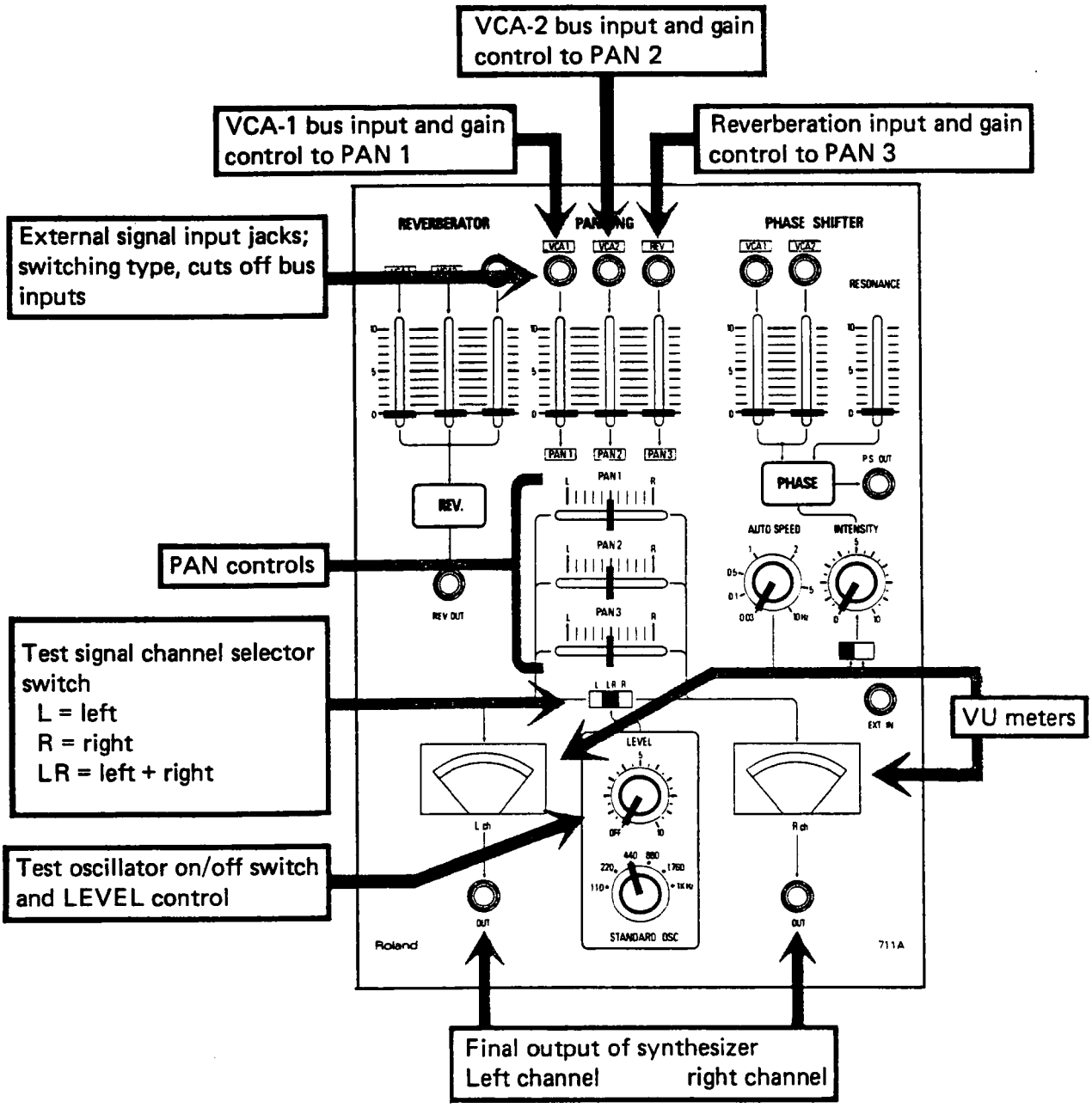
711A OUTPUT MODULE — Reverberator Section



REV OUT for external connections

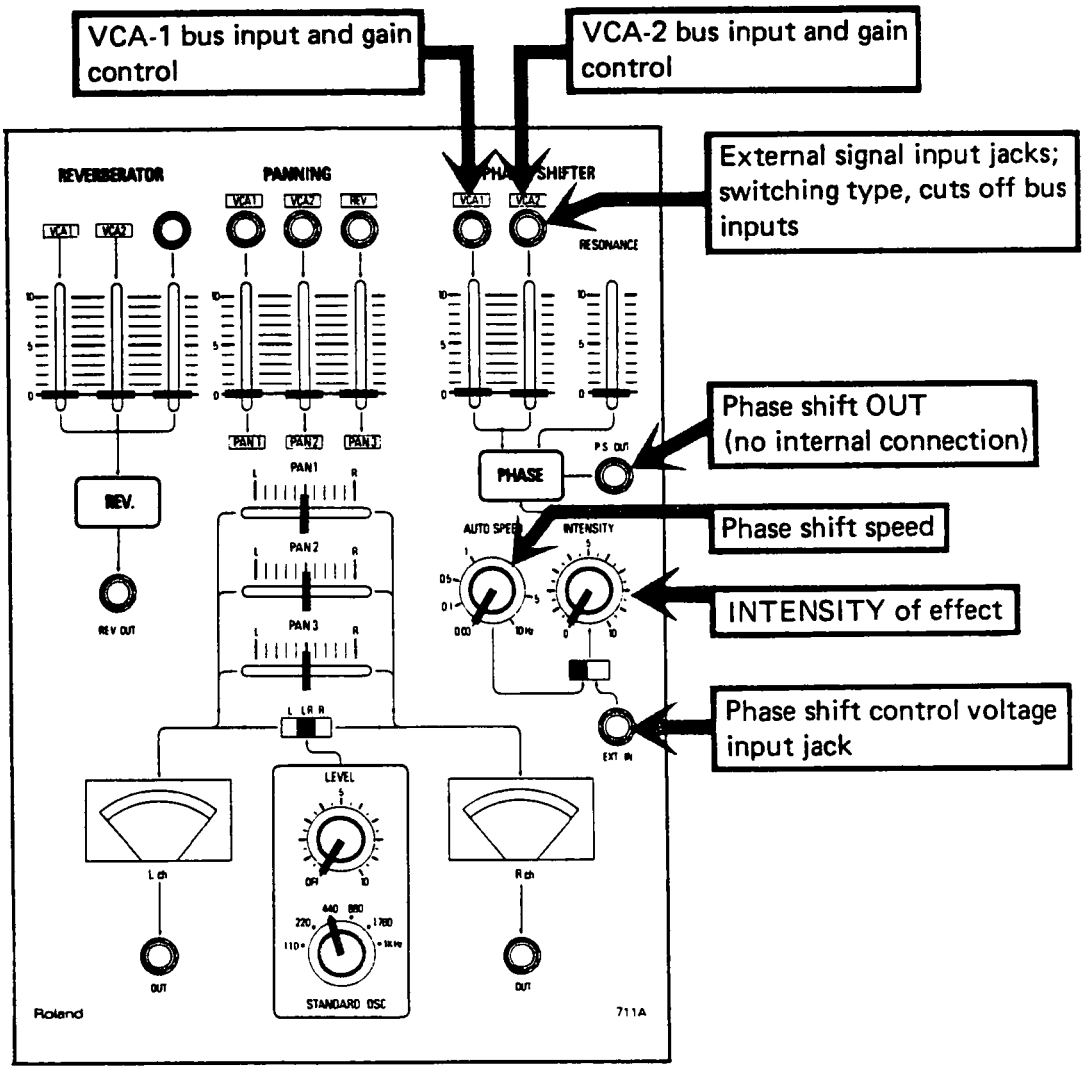
(REV OUT also connected internally to PANNING section)

711A OUTPUT MODULE — Panning Section



Output impedance = 600Ω

711A OUTPUT MODULE — Phase Shifter Section



SECTION 2

711A OUTPUT MODULE

Specifications:

REVERBERATOR

Maximum reverb time:	2 sec
Input impedance:	more than 50kΩ
Output impedance:	600Ω

PANNING

Frequency response:	20 Hz – 20 kHz.
S/N:	more than 75dB (reverb off)
Stereo separation:	more than 54dB
Input impedance:	more than 50kΩ
Output:	0.775V/1kΩ

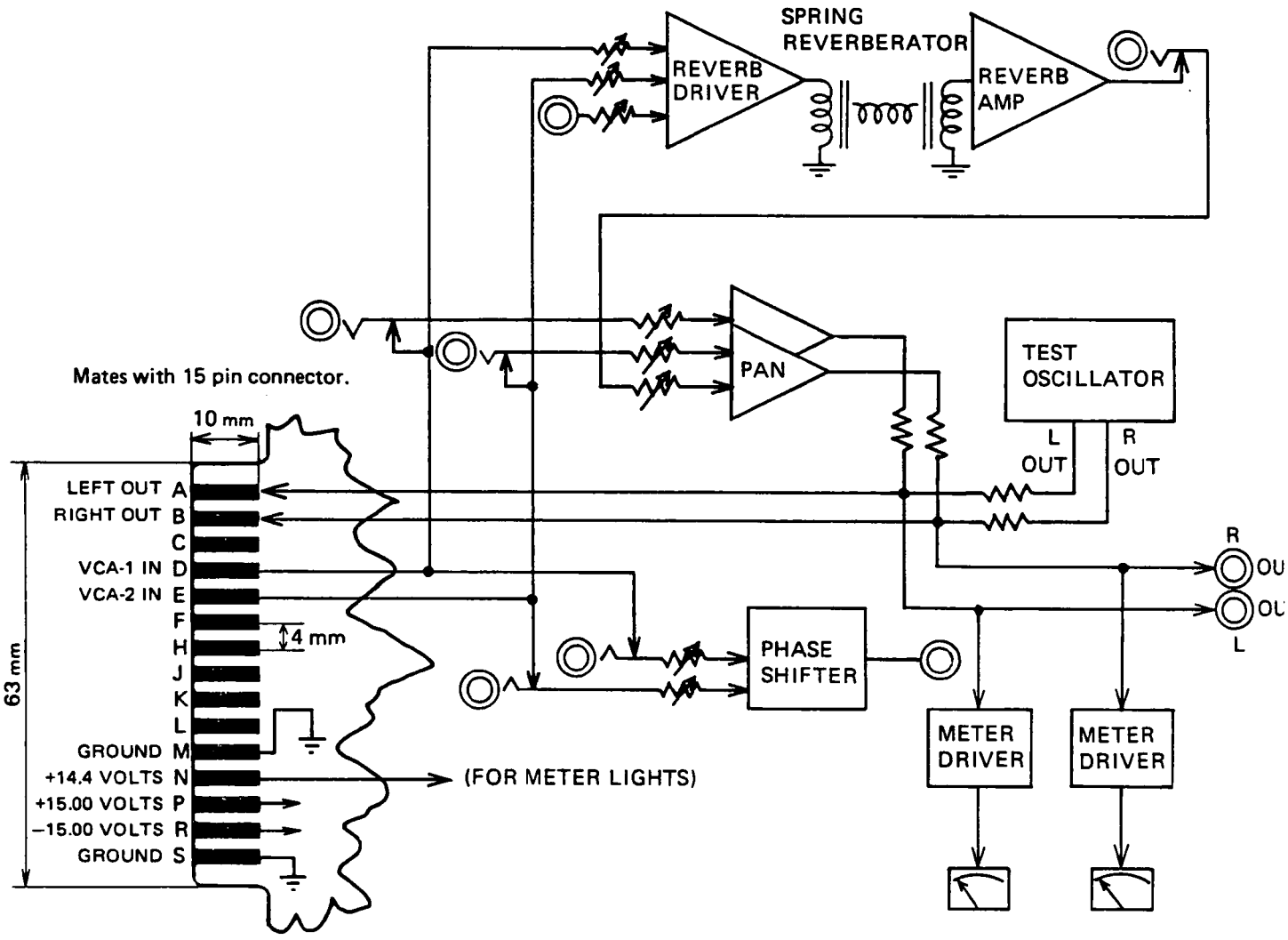
STANDARD OSCILLATOR

Square wave:	110 Hz, 220 Hz, 440 Hz, 880 Hz, 170 Hz,
Sine wave:	1 kHz.

PHASE SHIFTER

Phase shift:	1440°
Center notch range:	100 Hz – 10 kHz.
Sweep oscillator:	0.03 Hz – 10 Hz.
Shift frequency:	fixed: 1 kHz.
Maximum audio input level:	10V P-P
Maximum control input level:	10V
Input impedance (audio and control):	more than 50kΩ
Output impedance:	600Ω
Power supply requirements:	+15.00V ± 0.1% @46ma –15.00V ± 0.1% @39ma +14.4V ± 5% @175ma (for VU meter lamps)
Panel size:	197mm x 280 mm

711A OUTPUT MODULE

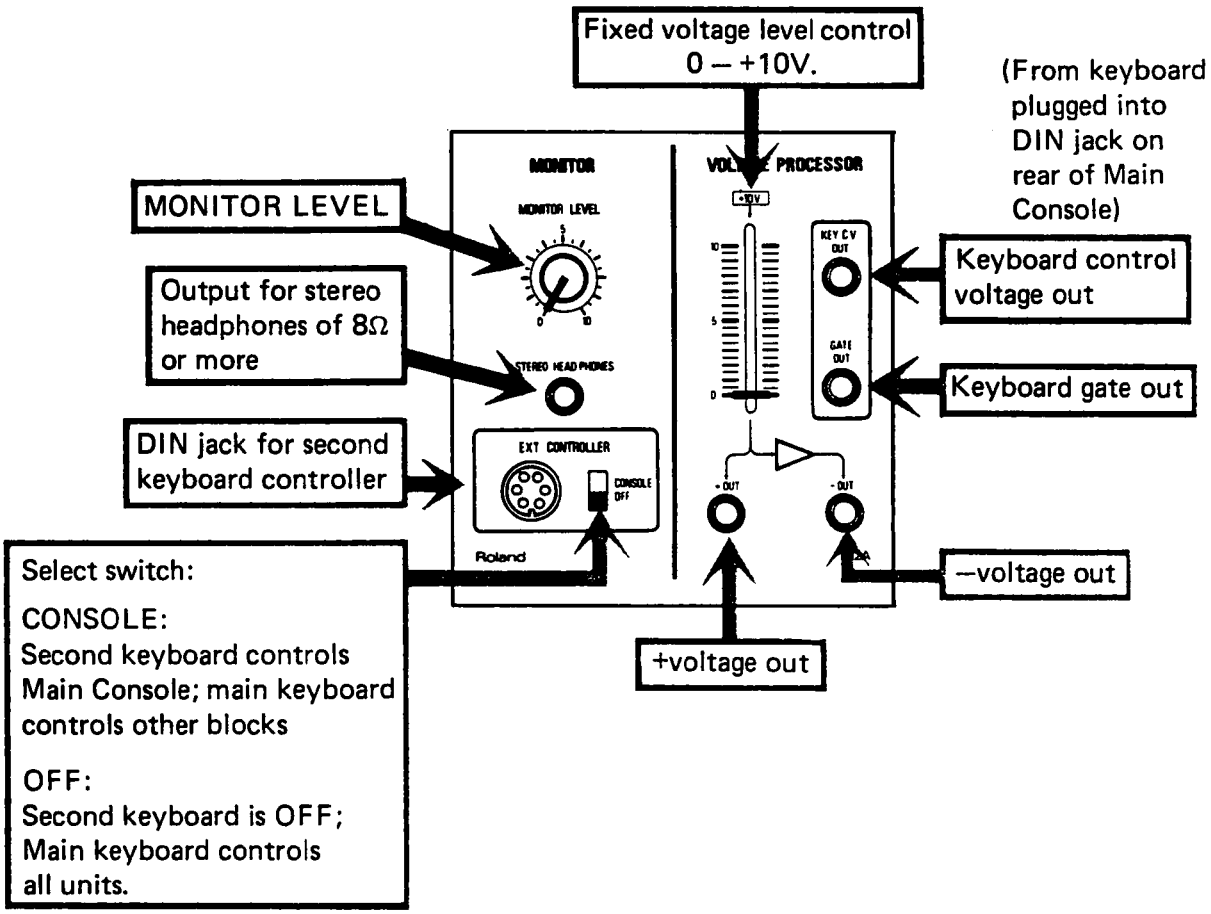


(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

712A MONITOR/VOLTAGE PROCESSOR

This module also contains the DC regulator for the Main Console.



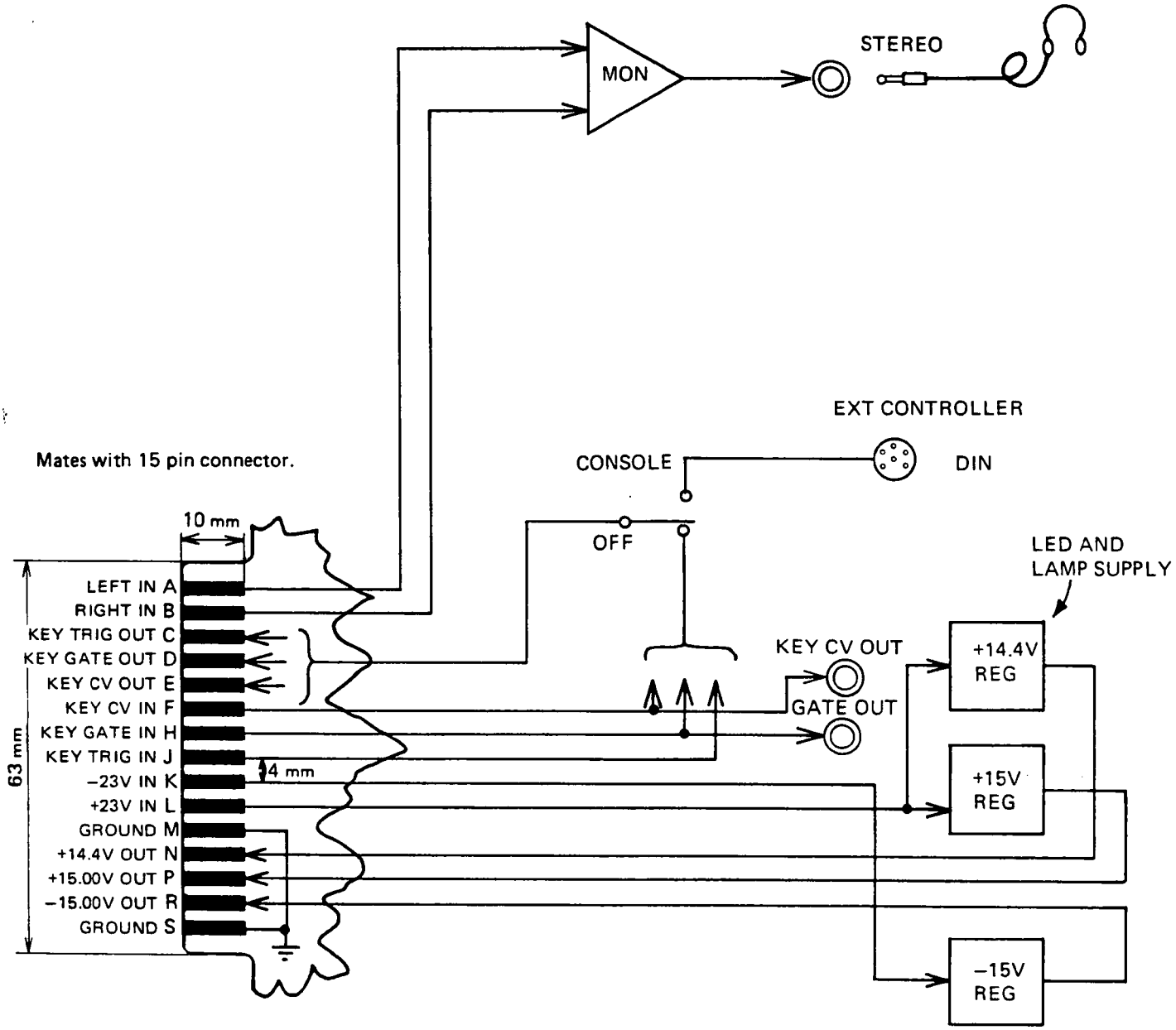
712A MONITOR/VOLTAGE PROCESSOR

VOLTAGE PROCESSOR

Output voltage: 0 – +10V
0 – –10V

MONITOR

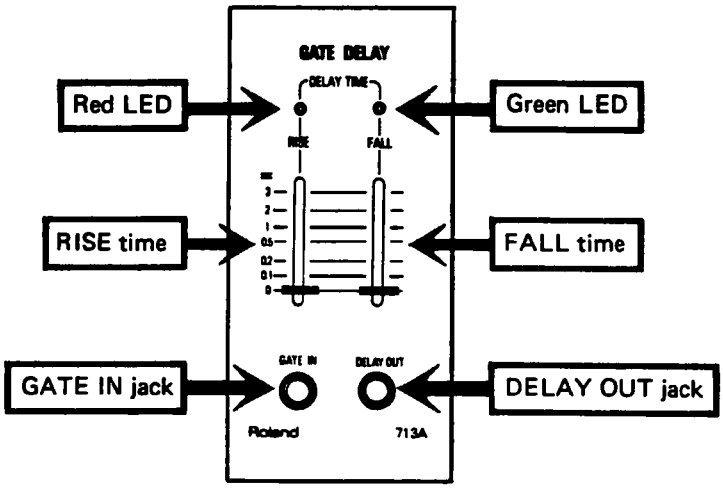
Output: 8Ω stereo headphones

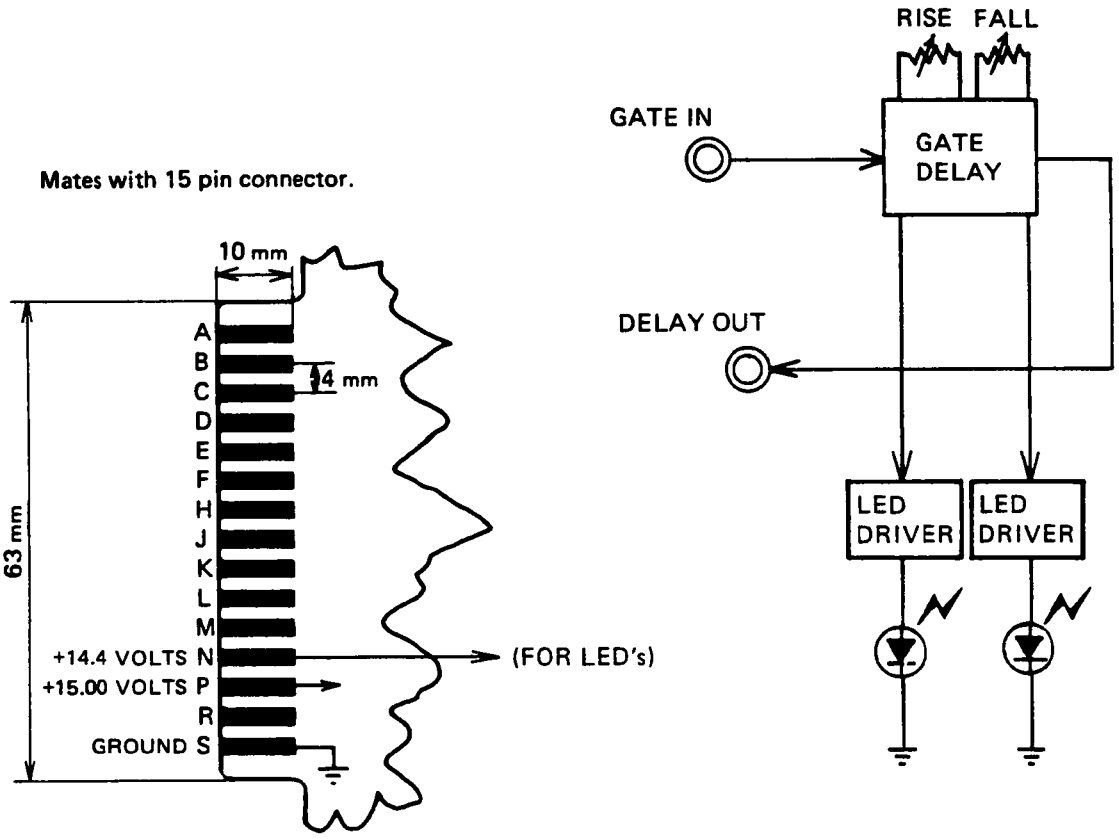


(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

713A GATE DELAY





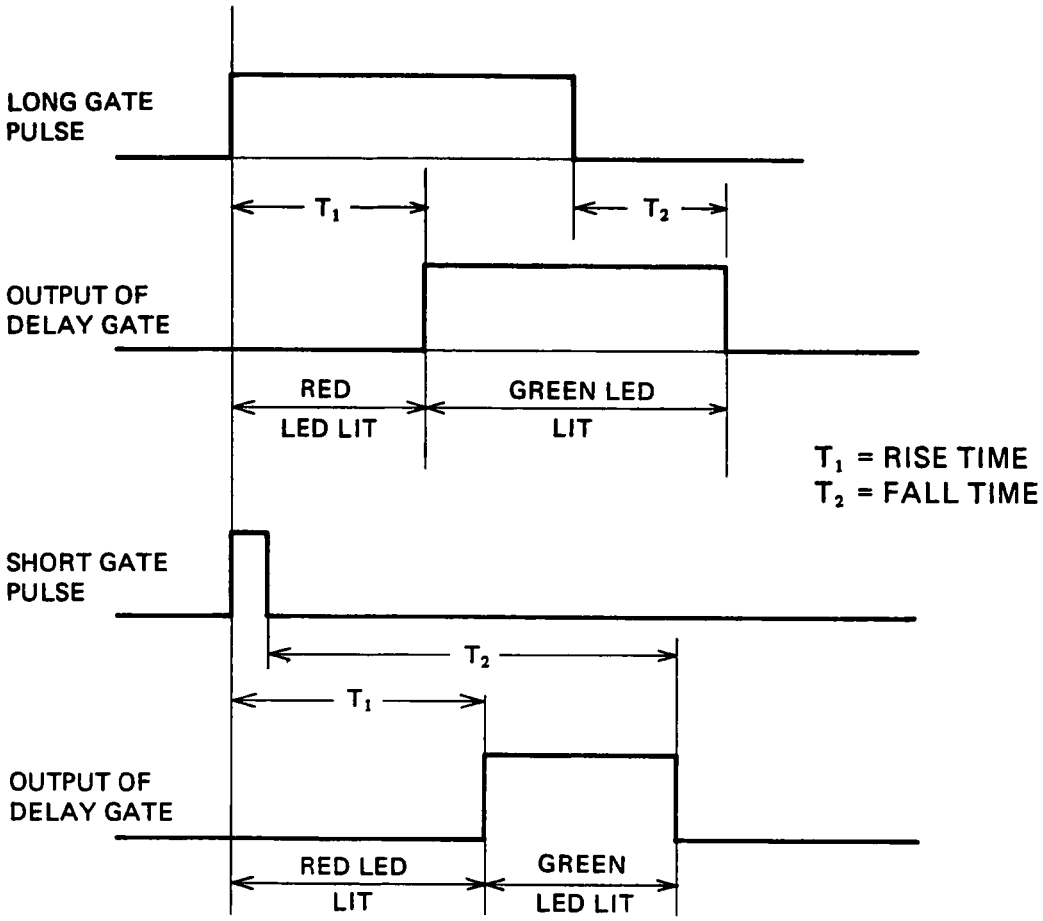
(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

713A GATE DELAY

Specifications:

Delay time rise (T_1):	0 – 3 sec
Delay time fall (T_2):	0 – 3 sec
Input threshold level:	+5v
Output:	+15V. (MAX)
Power supply requirements:	+15.00V ± 0.1% @26ma
	–15.00V ± 0.1% @0ma
	+14.4V ± 5% @12ma
Panel size:	65 x 140 mm

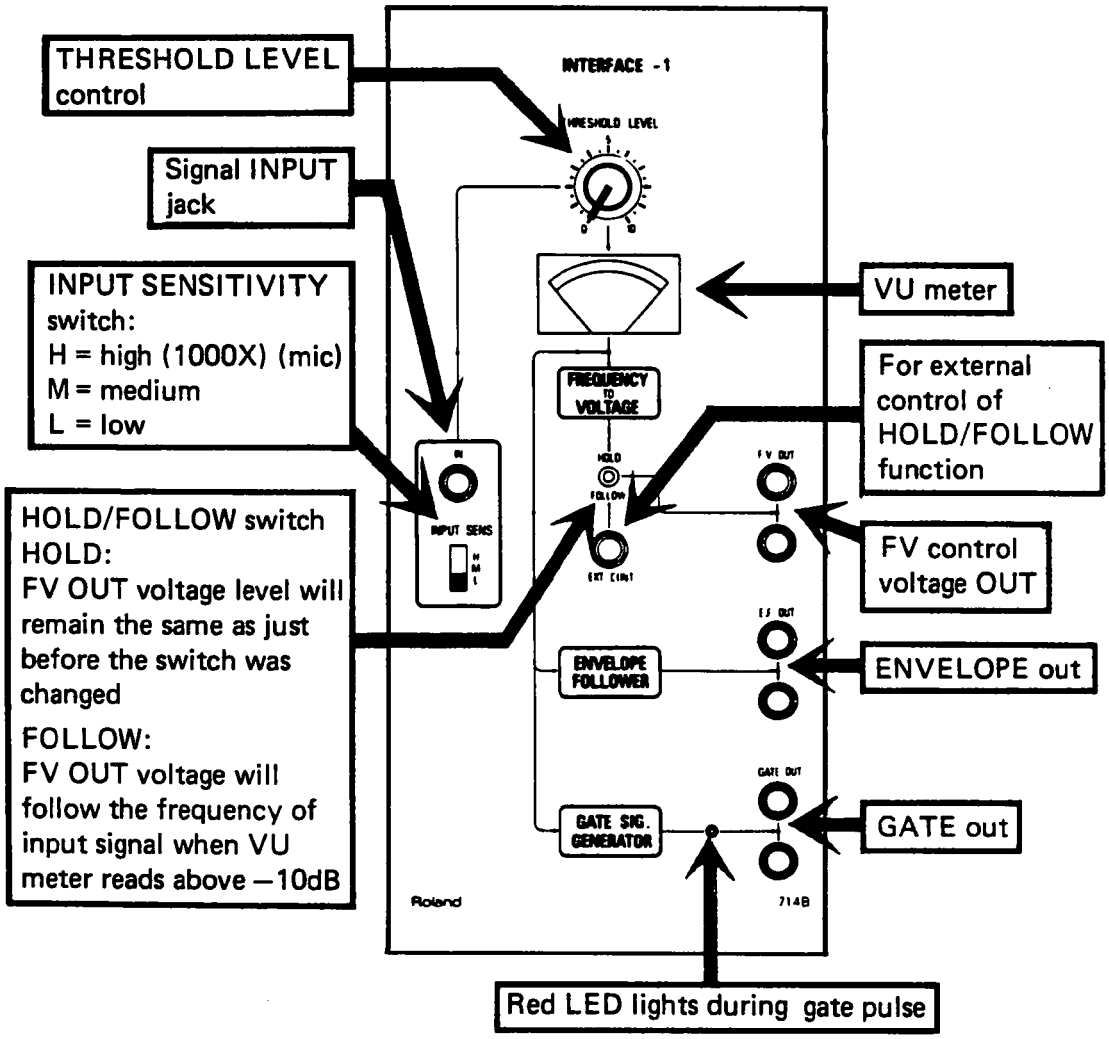


NOTE: If T_2 + GATE PULSE is less than T_1, DELAY GATE output is 0.

714B INTERFACE

The 714B INTERFACE is the improved version of the 714A INTERFACE.

For correct operation, set the INPUT SENS switch and the THRESHOLD LEVEL control so VU meter reads 0dB or less.



714B INTERFACE

Specifications:

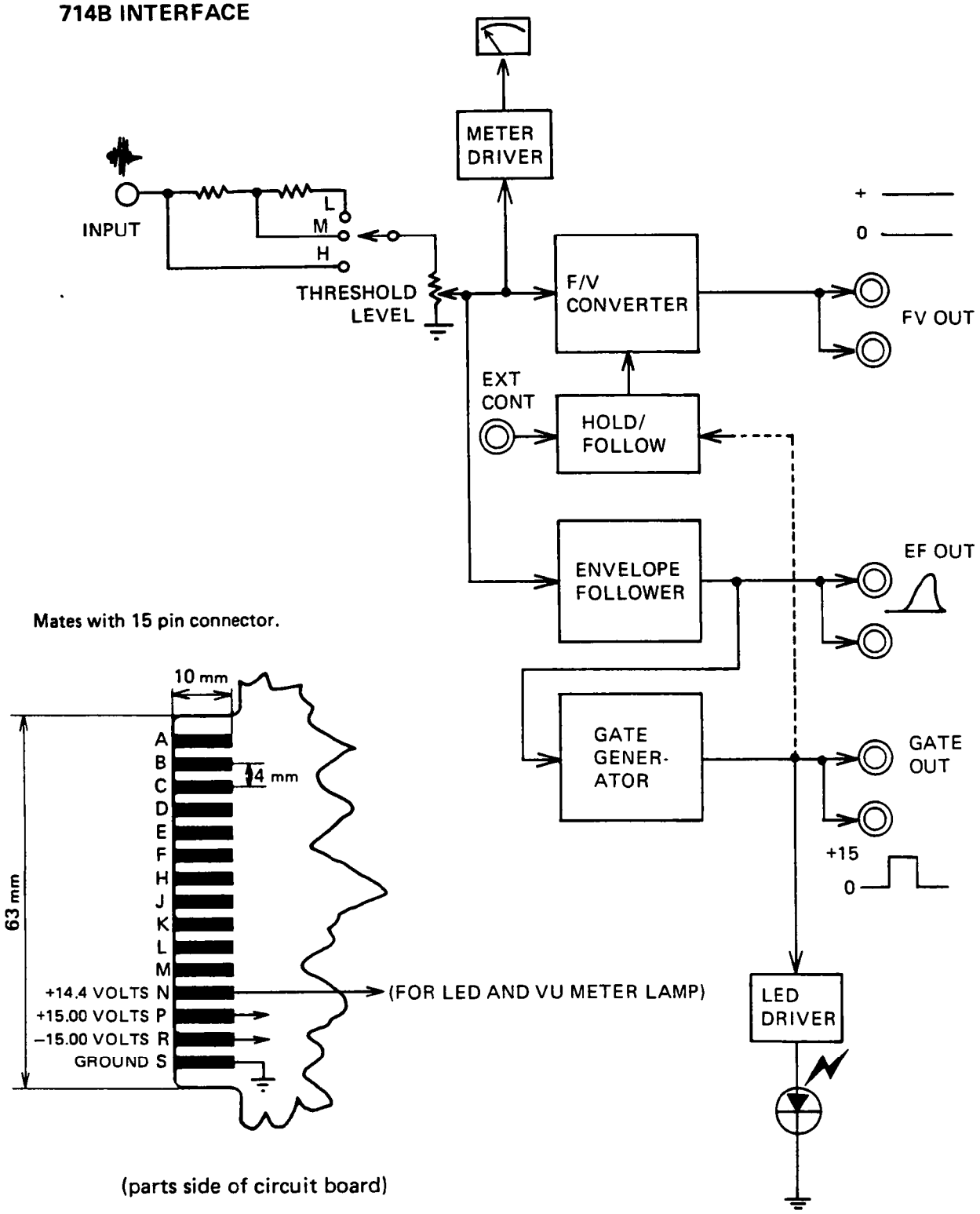
Input frequency range:	80 Hz – 4 kHz
Input level range:	–60dB to 0dB
F/V input sensitivity:	1 volt/1 octave
F/V voltage out stability (after 3 minute warm up period):	
±20% variation in line voltage:	0.05%
0 to 40°C temperature variation:	0.1%
F/V out:	0 to +6 volts

NOTE: When the VU meter reading falls below –10dB, the F/V HOLD function is activated and the F/V OUT voltage stops following the input signal frequency.

EF out:	0 to +10 volts
GATE out:	+15 volts when VU meter reads above –10dB
EXT CONT input threshold:	+5 volts
Signal input impedance:	more than 50kΩ
Output impedances:	600Ω
Power supply requirements:	+15.00V ± 0.1% @45ma
	–15.00V ± 0.1% @43ma
	+14.4V ± 5% @75ma (LED and VU lamp)
Panel size:	131 mm x 280 mm

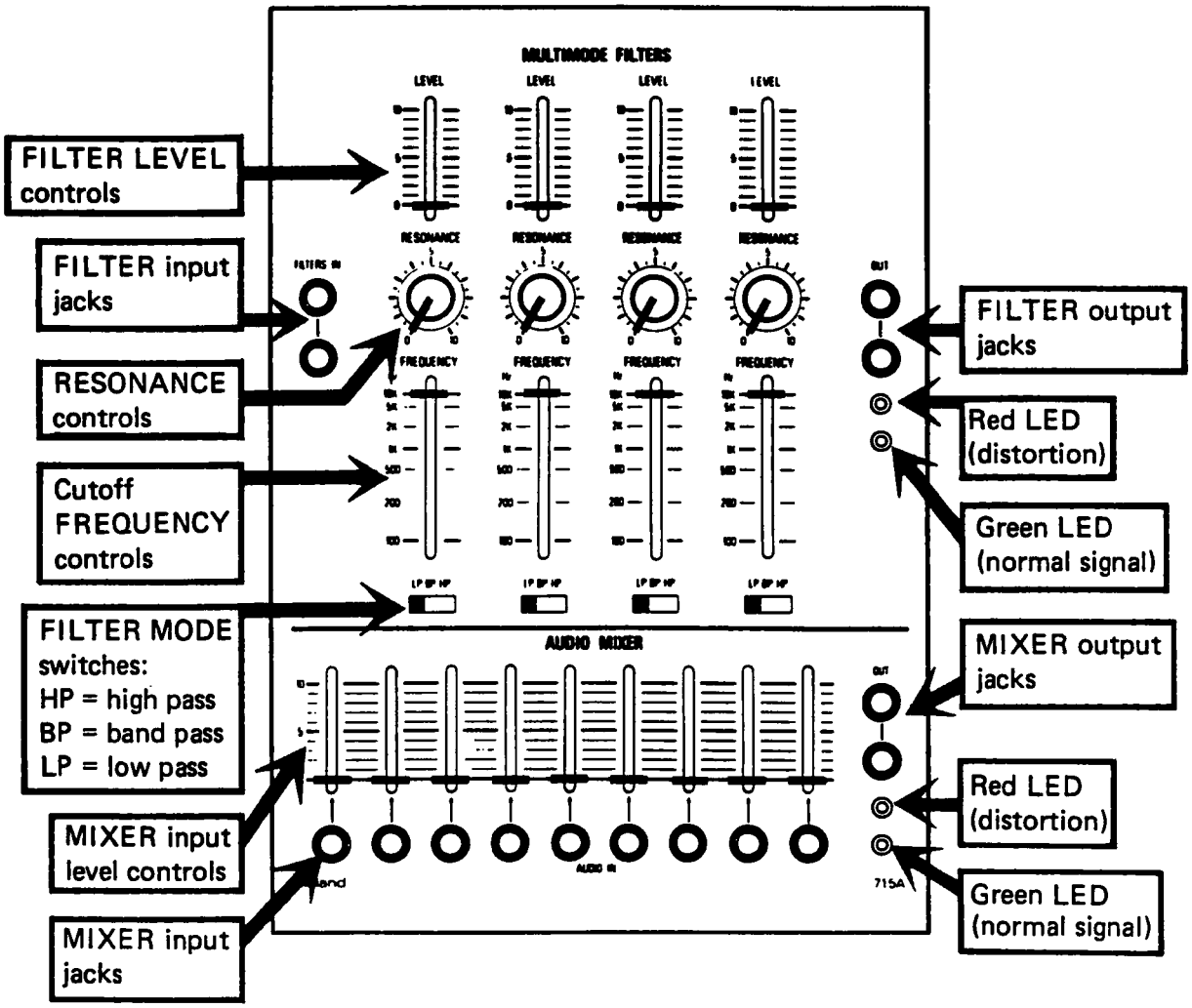
Note that portamento will occur between pitches which occur during the same gate pulse. As long as each pitch has its own separate gate pulse, this portamento will not occur.

714B INTERFACE

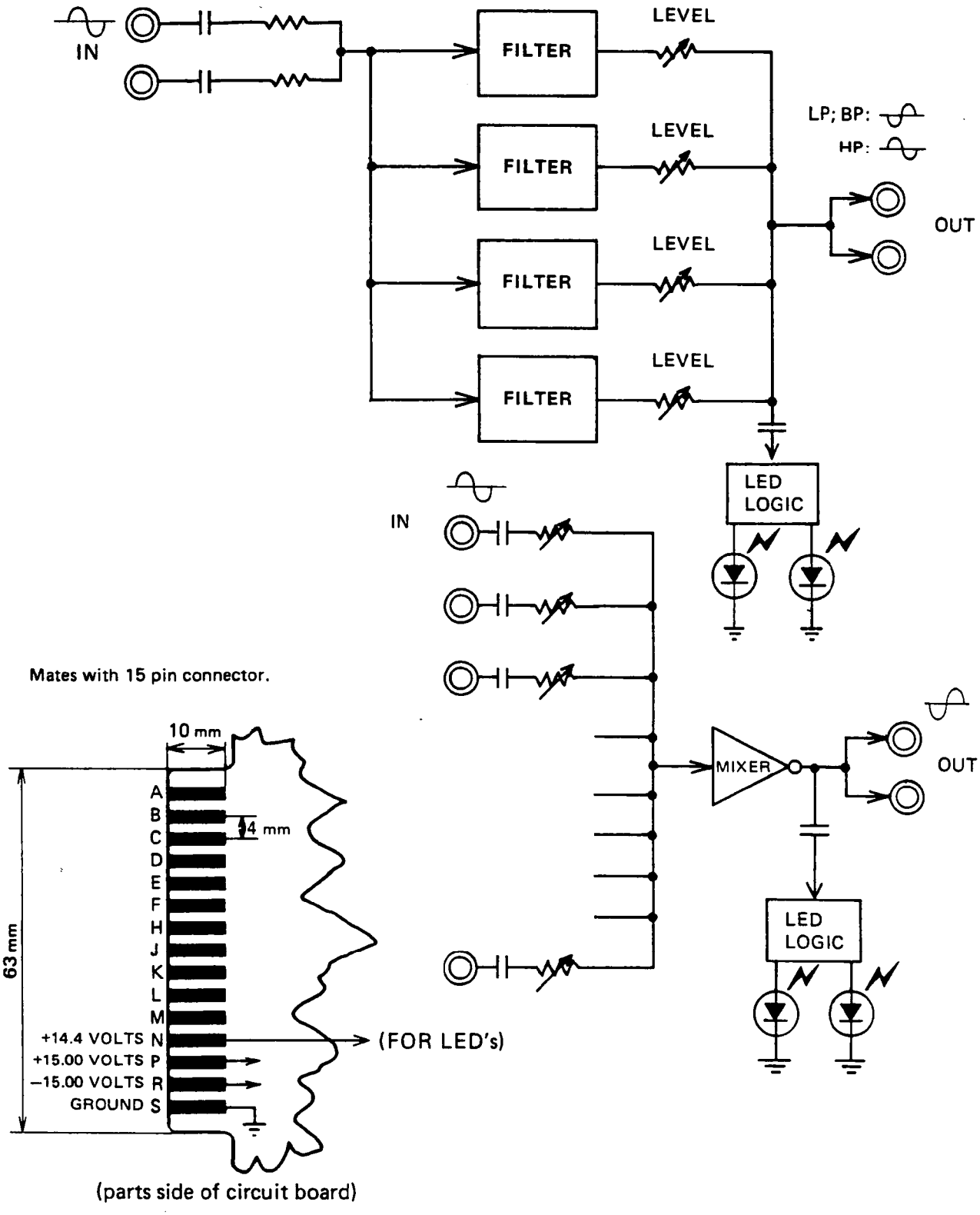


NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

715A MULTIMODE FILTER/AUDIO MIXER



715A MULTIMODE FILTER/AUDIO MIXER



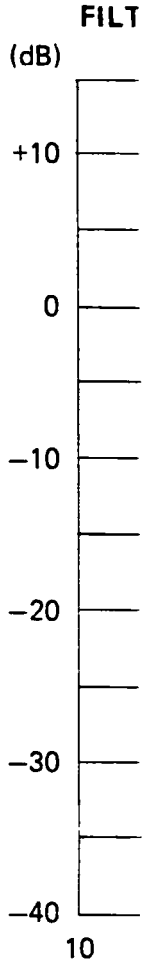
NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

715A MULTIMODE FILTER/AUDIO MIXER

FILTER specifications:

Frequency response:	20 Hz. – 20 kHz.
S/N:	more than 99dB
Cutoff frequency range:	20 Hz. – 30 kHz.
Response:	
20 Hz. to cutoff frequency:	Flat
Fall off rate above cutoff:	RESONANCE at "0": 12dB/octave
	RESONANCE at "7": 24dB/octave
Filter modes:	LP, BP, HP
Input impedance:	more than 50KΩ
Output impedance:	600Ω

Red LED lights when inputs total about 13v p-p or above.

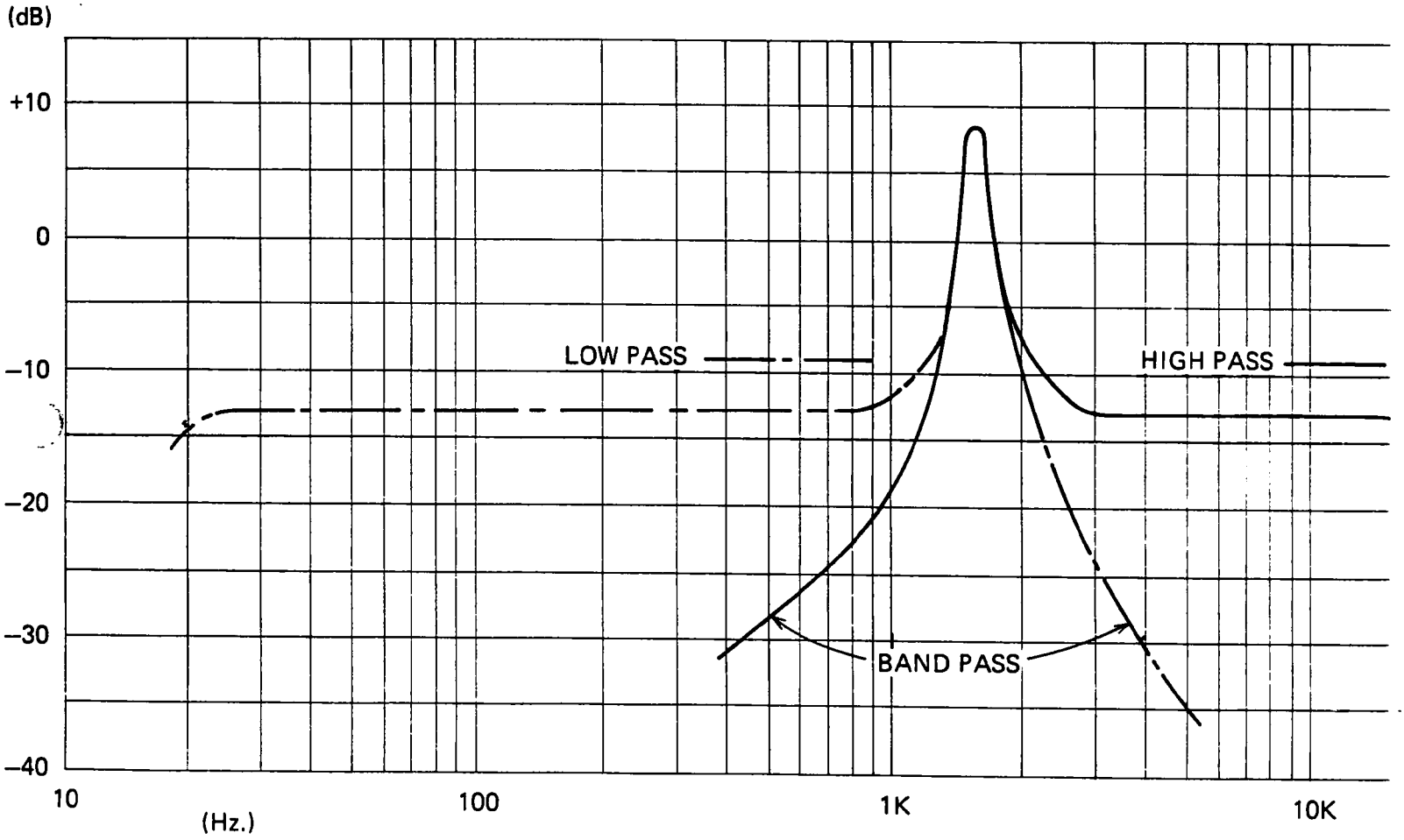


MIXER specifications:

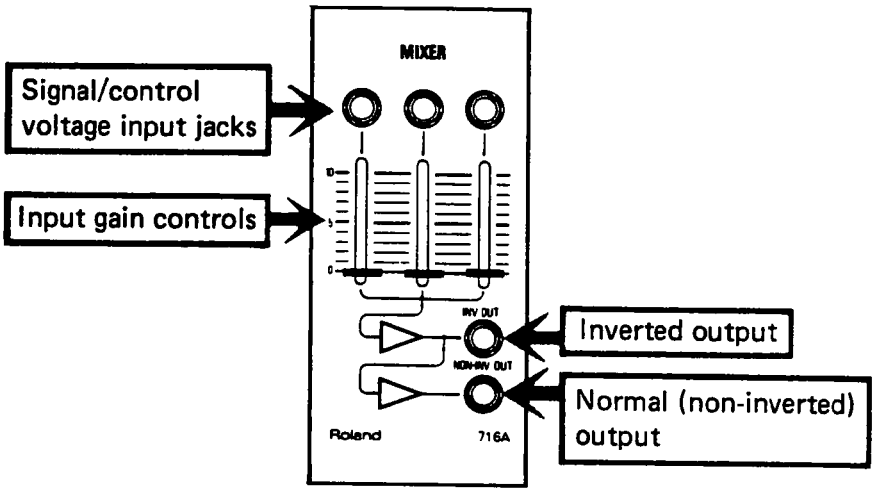
Frequency response:	20 Hz. – 20 kHz.
S/N:	more than 89dB
Max input:	10V p-p (Red LED lights at about 13V, p-p)
Amplification factor:	Unity
Input impedance:	more than 50 kΩ
Output impedance:	600Ω

Power supply requirements:	+15.00V ± 0.1% @50ma
	–15.00V ± 0.1% @50ma
	+14.4V ± 5% @28ma (for LED's)
Panel size:	197 mm x 280 mm

FILTER RESPONSE



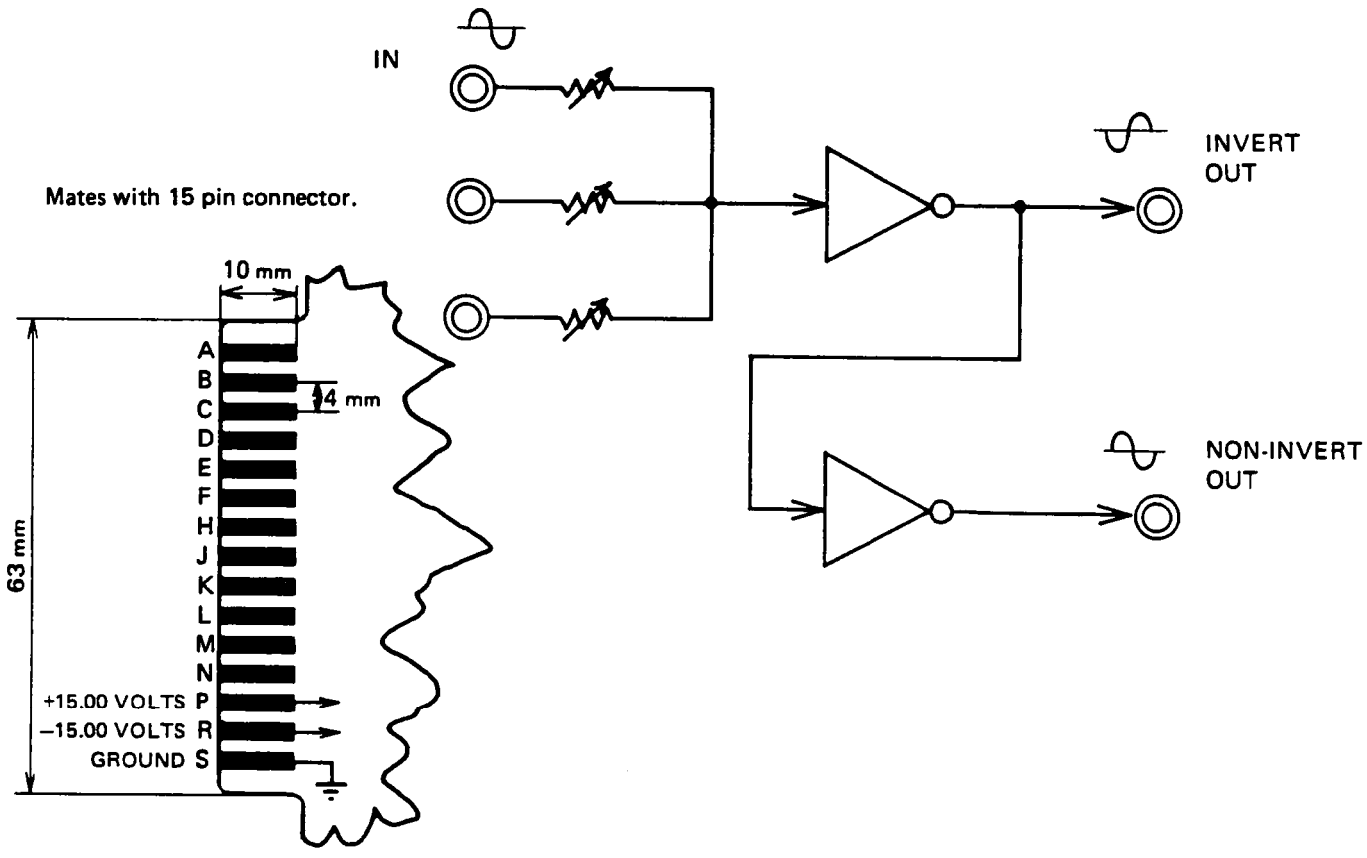
716A MIXER (Audio and control voltage)



716A MIXER

Specifications:

Frequency response:	DC – 20 kHz.
Maximum input:	± 10v
Amplification factor:	Unity
S/N:	more than 70dB
Power supply requirements:	+15.00V ± 0.1% @7ma
	–15.00V ± 0.1% @7ma
Panel size:	65 mm x 140 mm

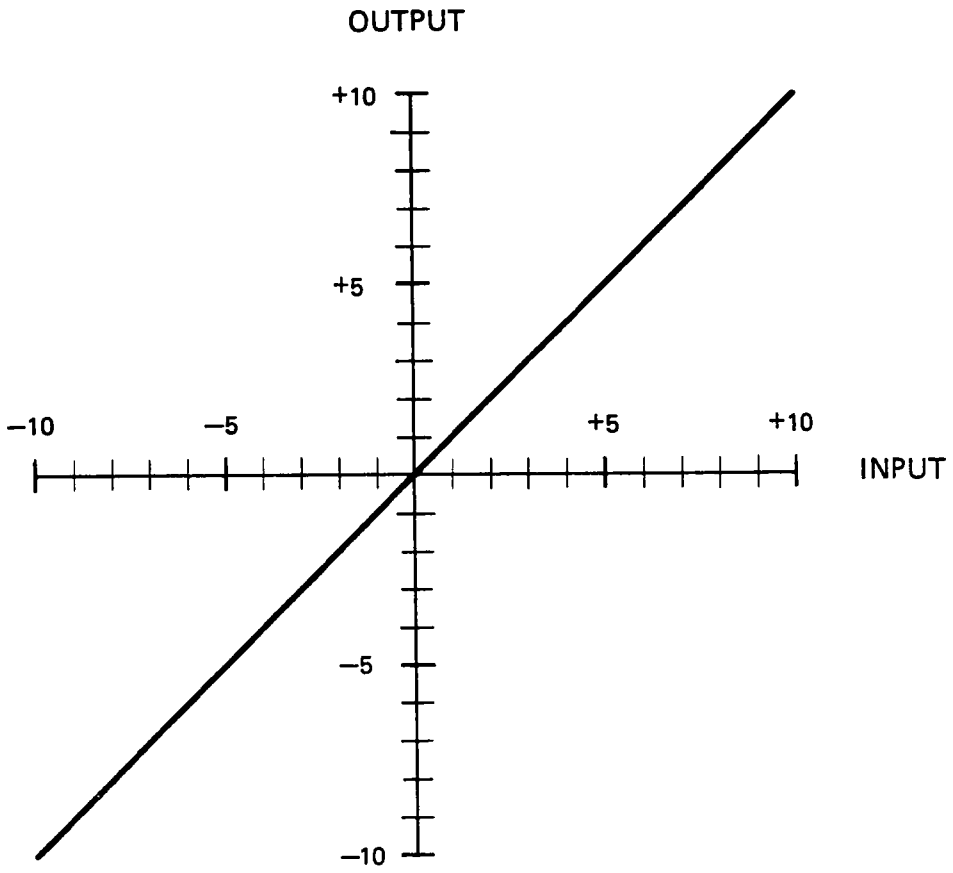


(parts side of circuit board)

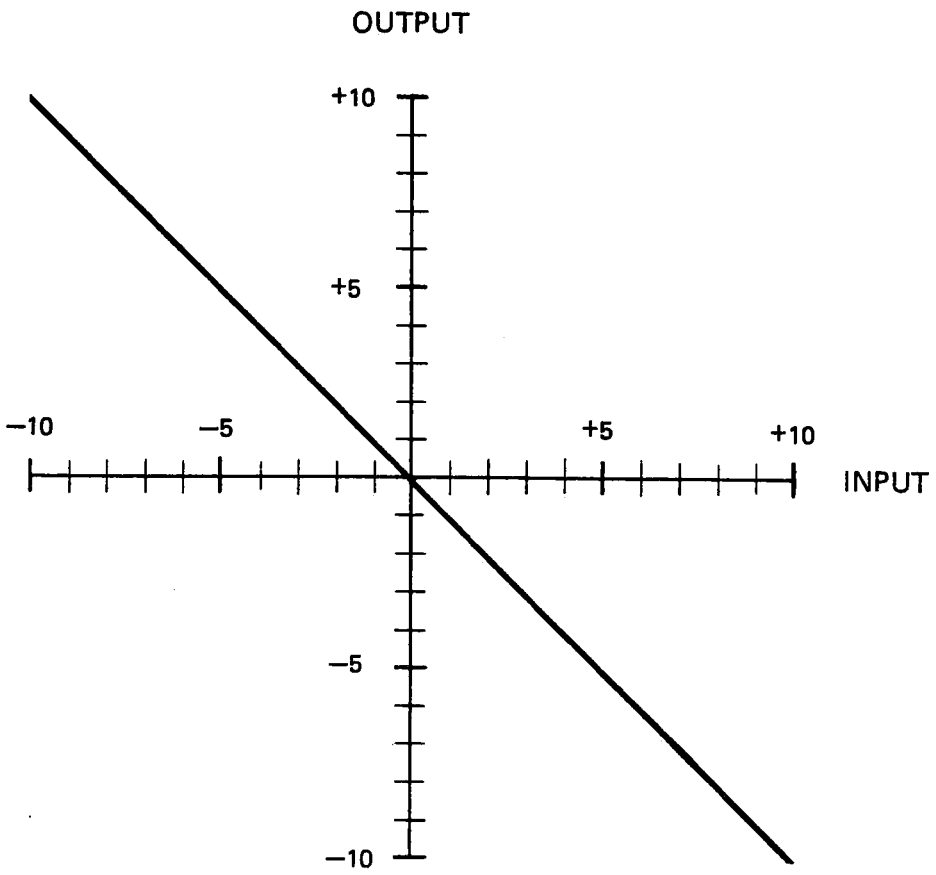
NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

716A MIXER

NON-INVERT OUT

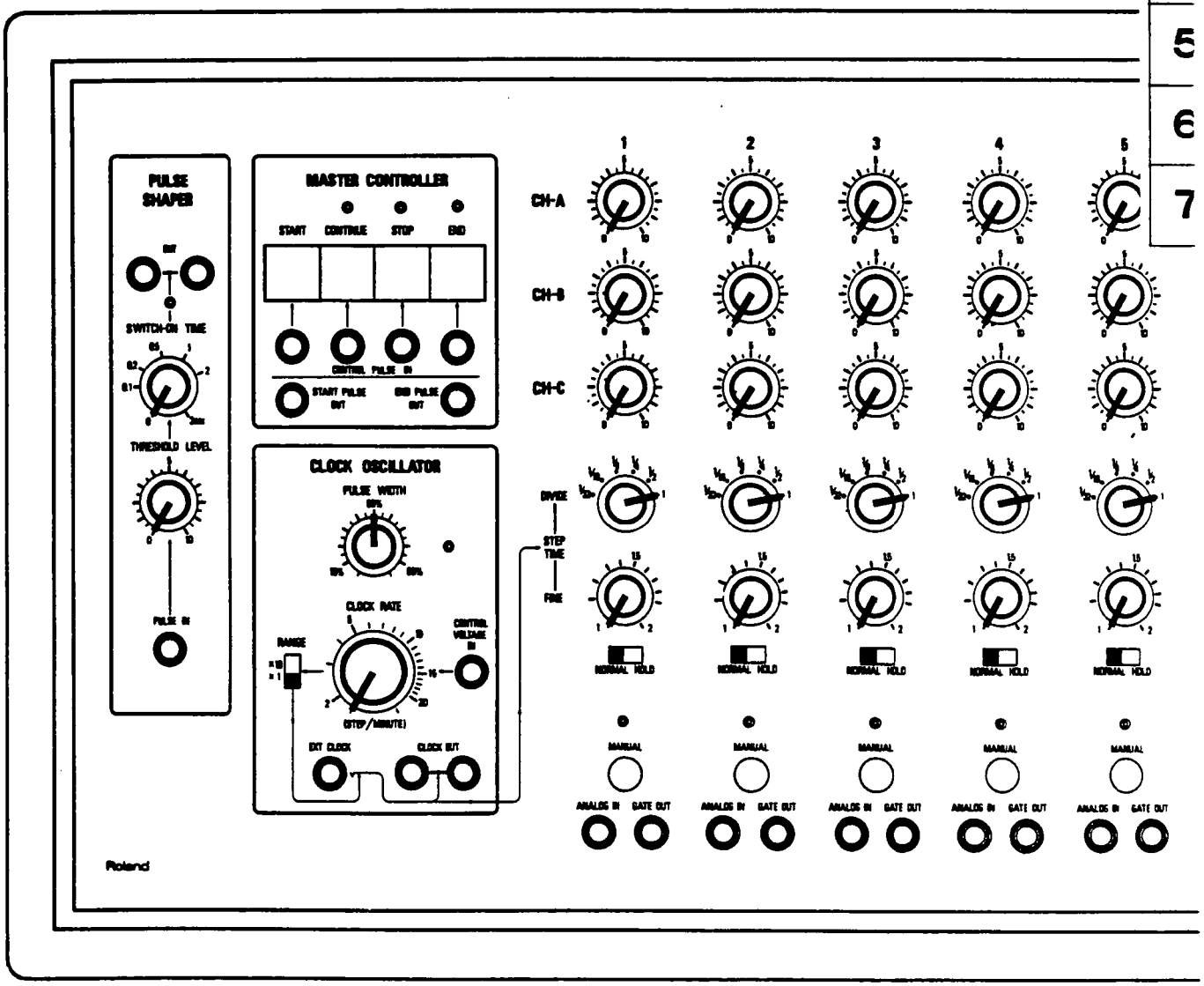


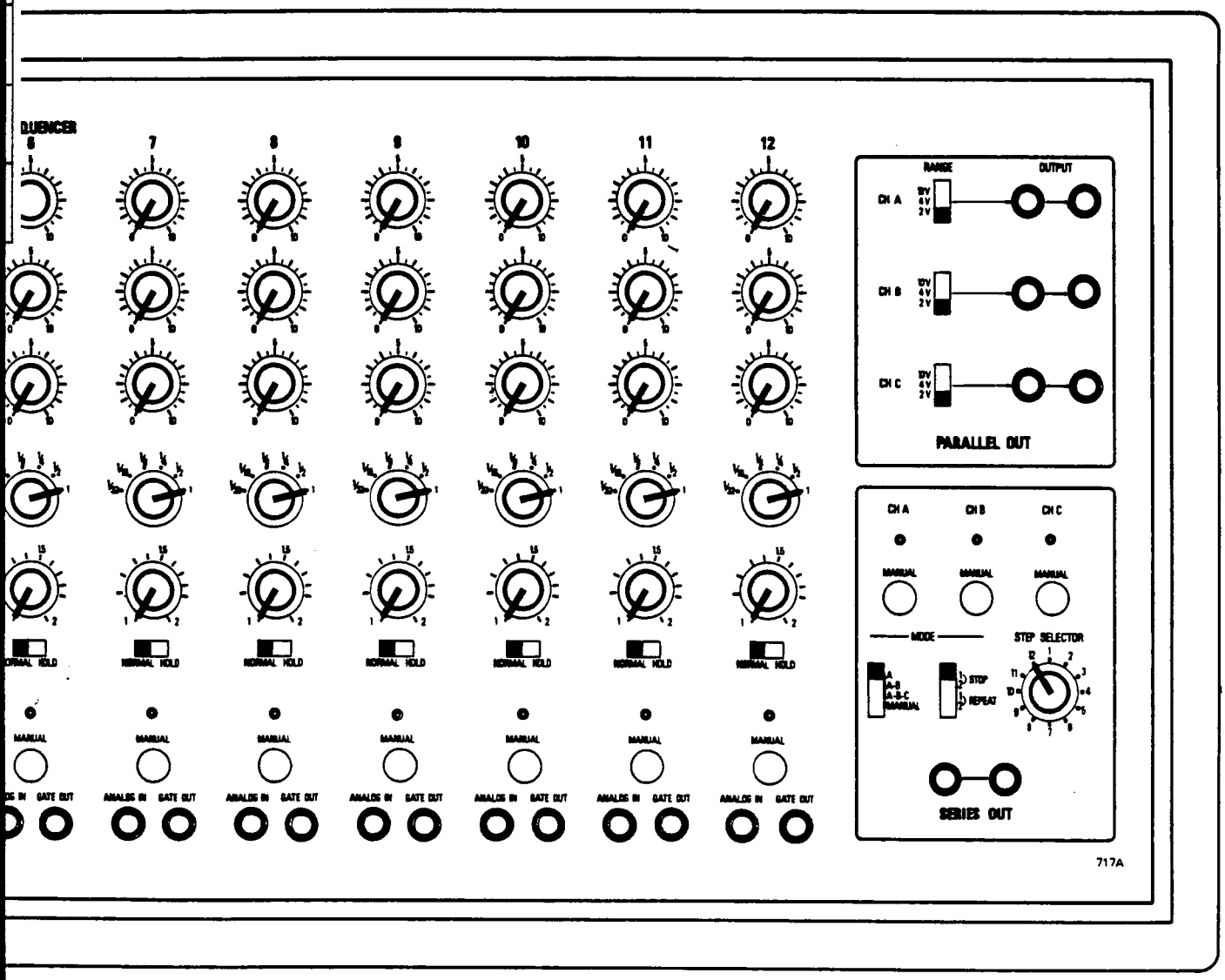
INVERT OUT



717A ANALOG SEQUENCER

See SECTION 4 (SEQUENCER) for details on operating.

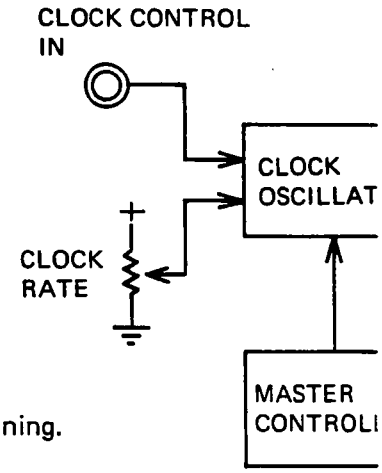




717A ANALOG SEQUENCER

Specifications:

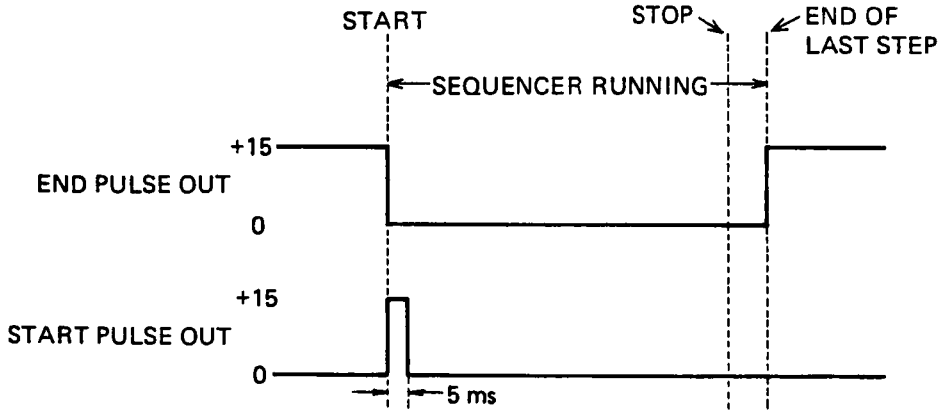
Steps:	
Parallel out:	0 – 12
Series out:	0 – 36
Output voltage:	0-2.5V; 0-5V; 0-10V
Analog input:	±10V/17kΩ
Gate out:	+15V
Clock out:	+15V square wave
External clock in sensitivity:	more than +10V
Clock control voltage in sensitivity:	1V doubles clock rate
Clock frequency:	2 steps/1 min – 20 steps/1 min
	20 steps/1 min – 200 steps/1 min
Start pulse out:	+15V, 0.5 ms
End pulse out:	+15V continuous when sequencer is not running.
Control pulse in sensitivity:	+7V
Output impedances:	600Ω

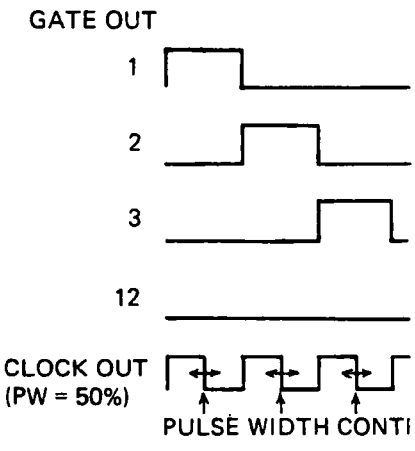


PULSE SHAPER SECTION

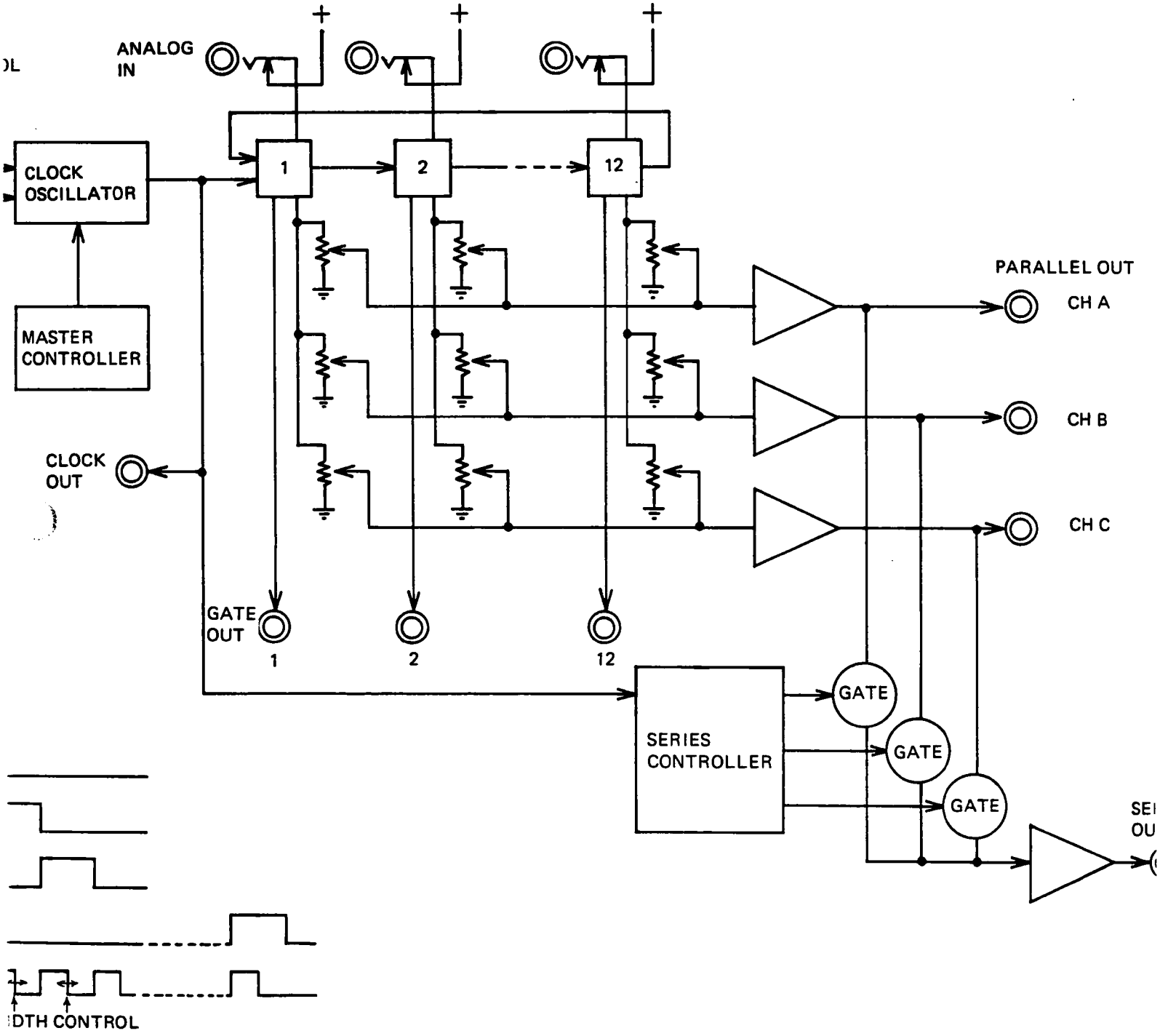
Input level:	0 – +10V
Switch on time:	0 – 3 sec
Pulse out:	+15
Input impedance:	100kΩ
Output impedance:	600Ω

POWER SUPPLY REQUIREMENTS:
+23V ± 10% @150ma
–23V ± 10% @70ma
(The SEQUENCER contains its own voltage regulator)





717A ANALOG SEQUENCER block diagram

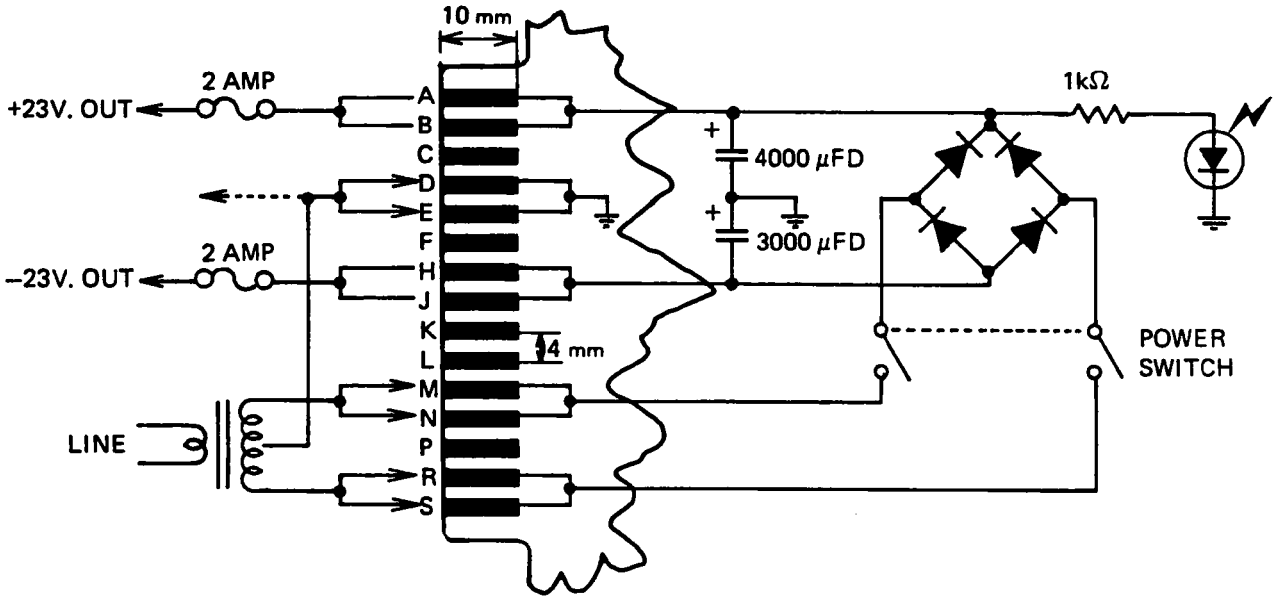


SECTION 2

718A POWER SWITCH

CURRENT REQUIREMENTS:	+23V	–23V
MAIN CONSOLE	500ma	380ma
KEYBOARD CONTROLLER	70	70
SEQUENCER	174	95
BLOCK 4	300	300
BLOCK 5	160	70
BLOCK 6	215	110
BLOCK 7	70	55
TOTAL	1489	1080

Mates with 15 pin connector.

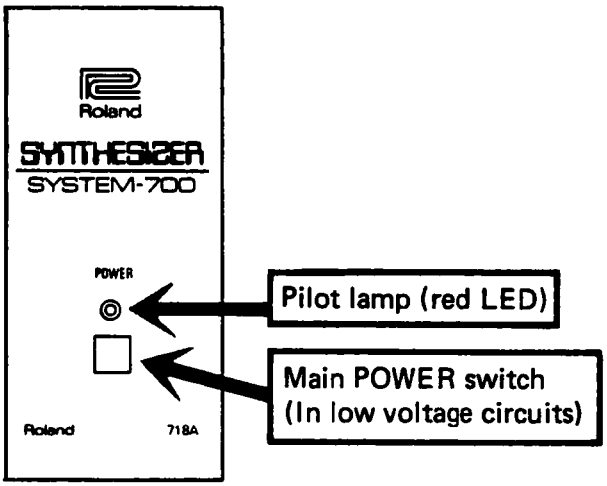


(parts side of circuit board)

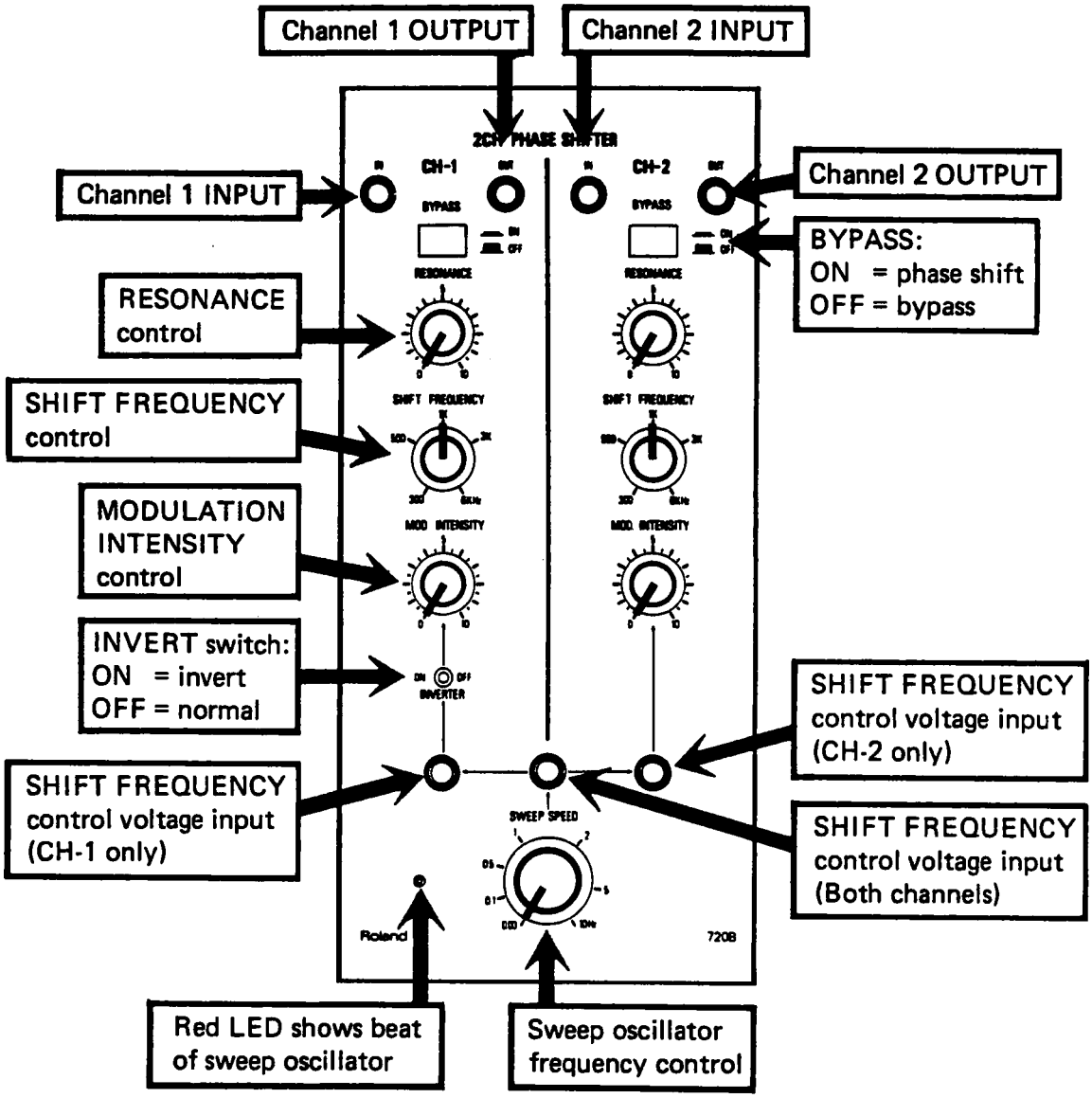
NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

718A POWER SWITCH

The Main Console regulator is located on the 712A module circuit board.



720B 2 CHANNEL PHASE SHIFTER

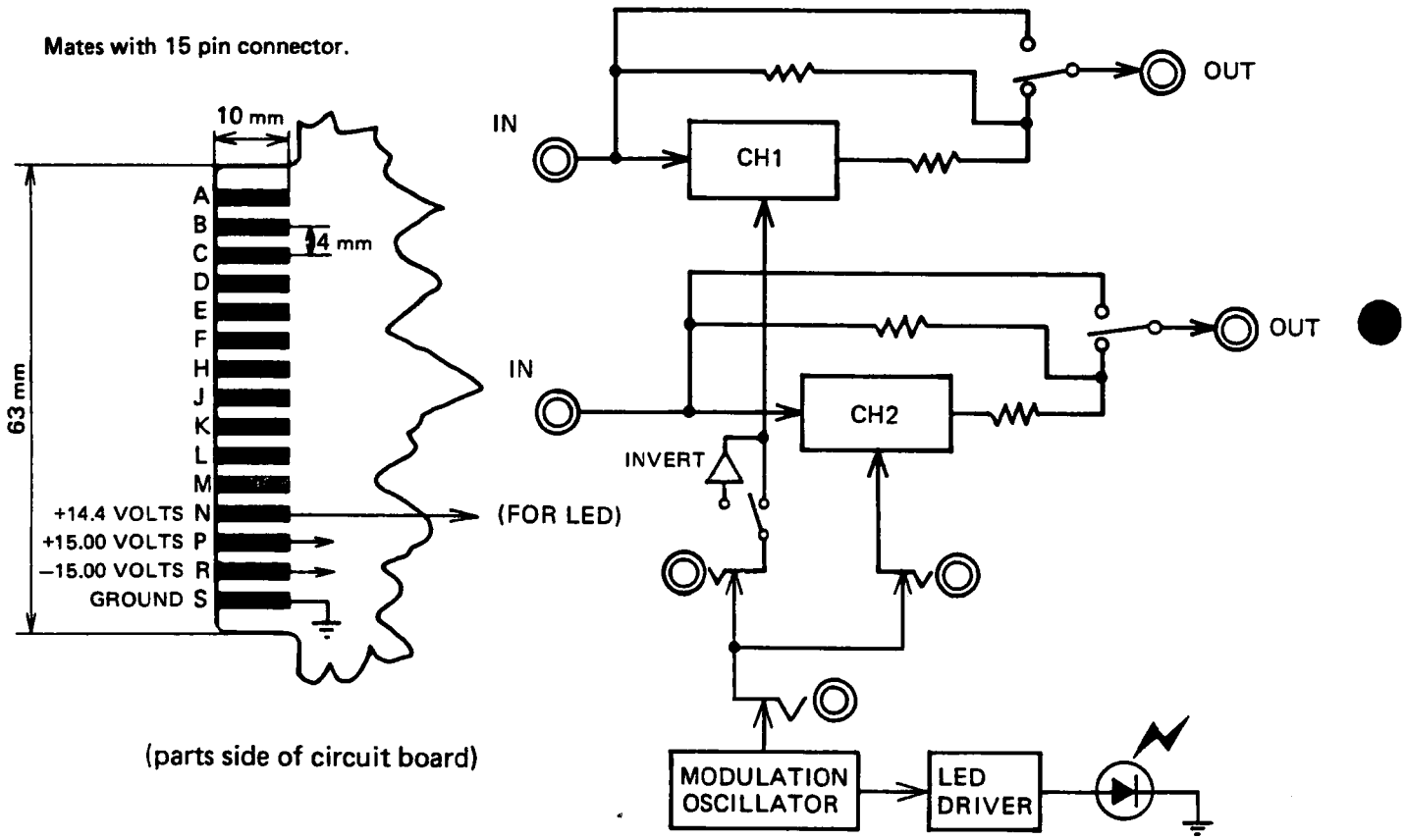


SECTION 2

720B 2 CHANNEL PHASE SHIFTER

Specifications:

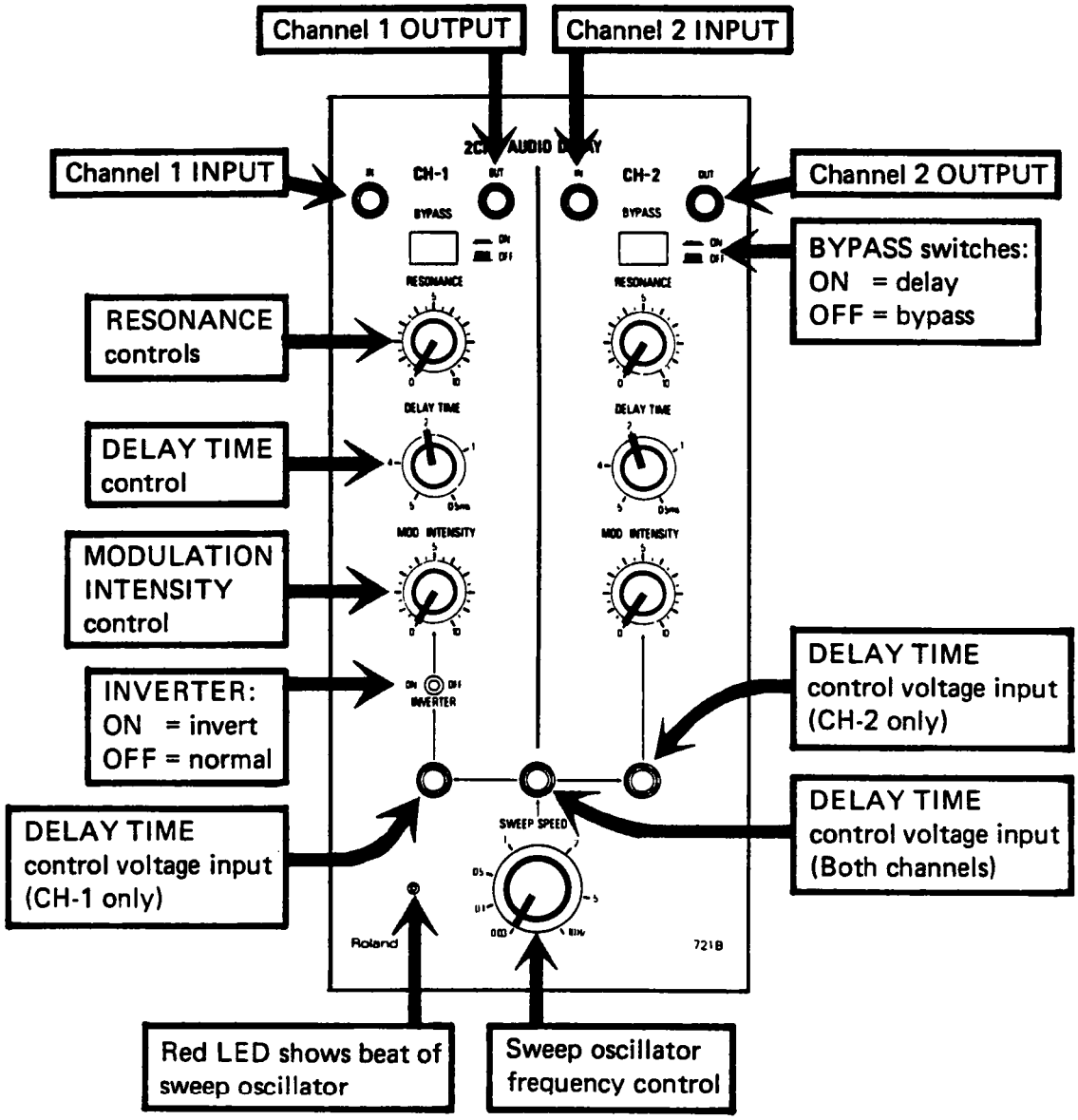
Phase shift:	1440°
Center notch range:	100 Hz – 10 kHz.
Sweep oscillator:	0.03 Hz. – 10 Hz.
Shift frequency range:	300 Hz – 6 kHz.
Maximum input level:	10V P-P
Audio and control input impedance:	more than 50kΩ
Output impedance:	600Ω
Frequency range:	20 Hz. – 20 kHz.
Maximum control input level:	10V
S/N:	more than 50dB
Power supply requirements:	+15.00V ± 0.1% @23ma –15.00V ± 0.1% @31ma +14.4V ± 5% @6ma (for LED's)
Panel Size:	131 mm x 280 mm



NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

721B 2 CHANNEL AUDIO DELAY

The 721B AUDIO DELAY has an improved signal-to-noise ratio over the 721A AUDIO DELAY.

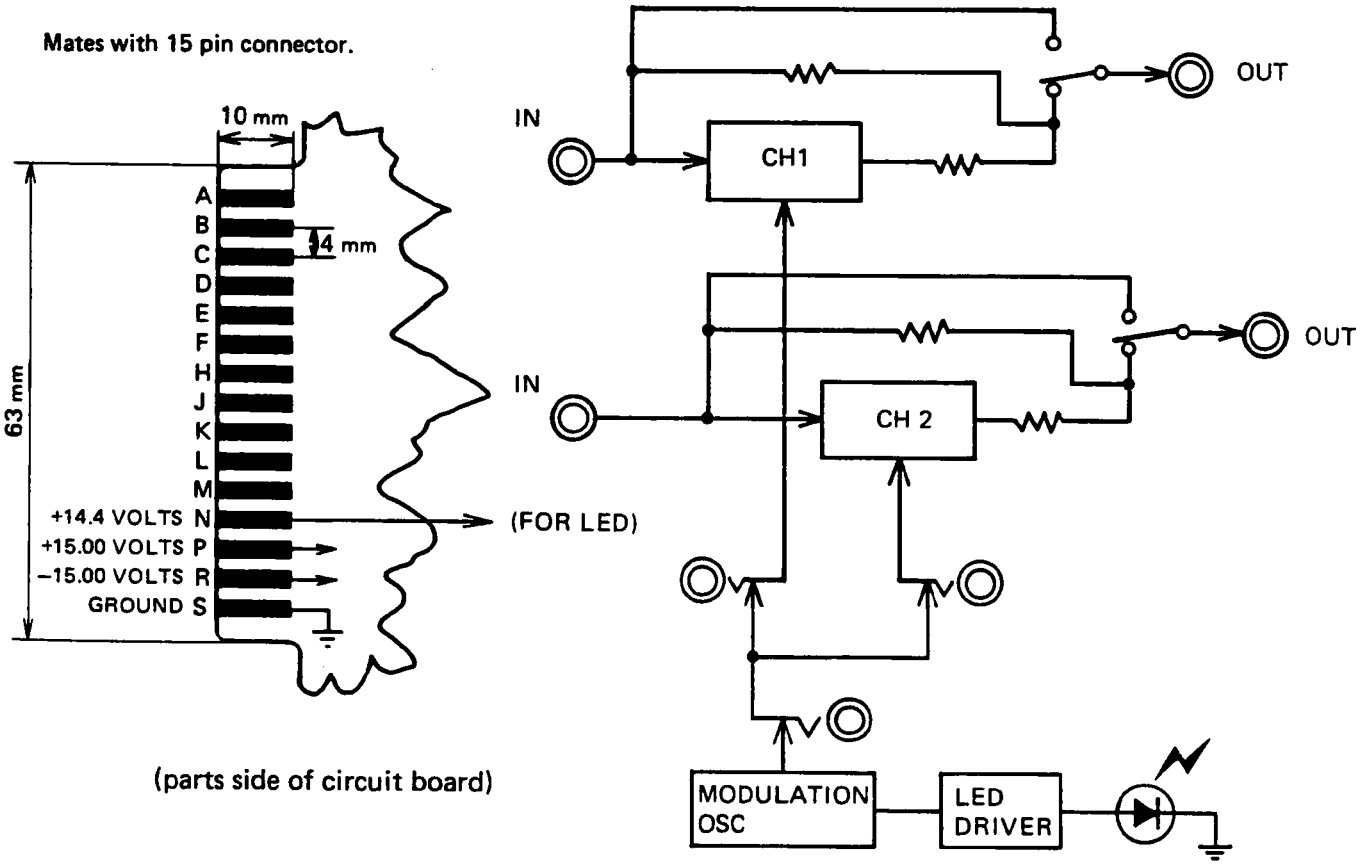


SECTION 2

721B 2 CHANNEL AUDIO DELAY

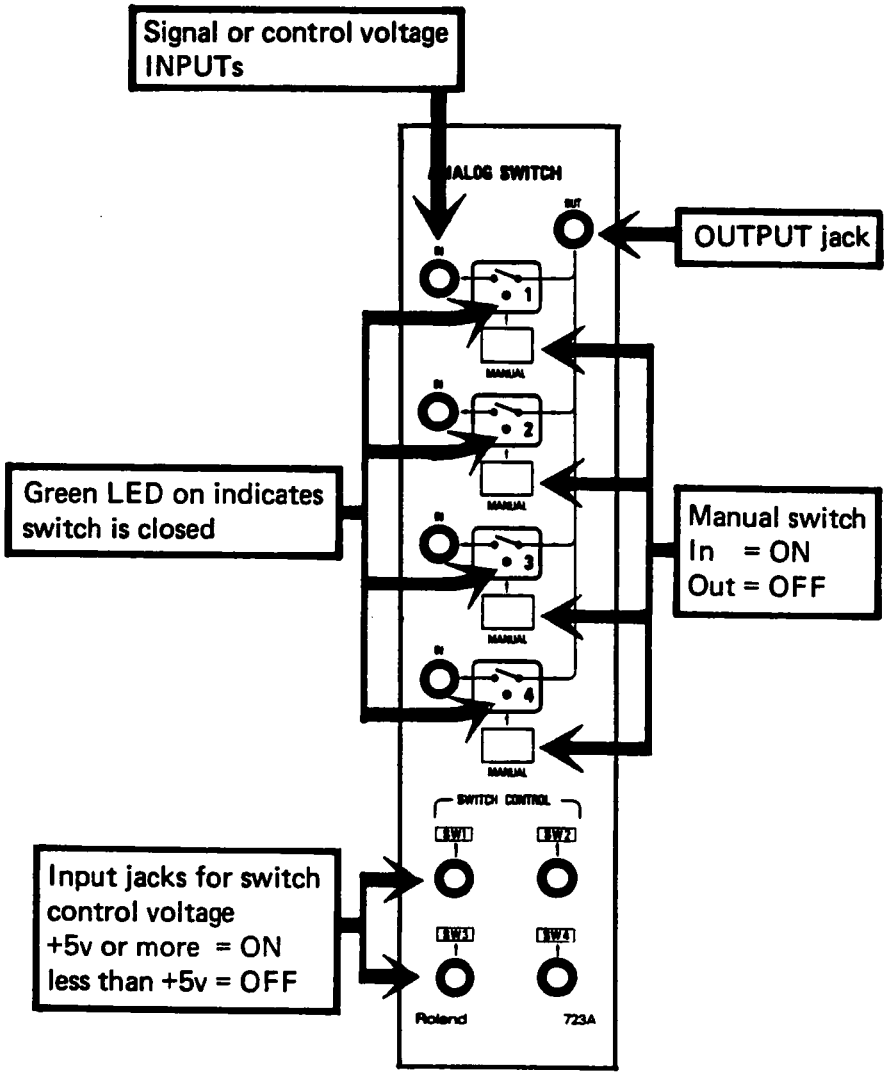
Specifications:

Delay time:	0.5 ms – 5 ms
Sweep Oscillator:	0.03 Hz. – 10 Hz.
Maximum input level:	10V P-P
Audio and control input impedance:	more than 50kΩ
Output impedance:	600Ω
Frequency range:	20 Hz. – 20 kHz.
Maximum control input level:	10V
S/N:	more than 60dB
Power supply requirements:	+15.00V ± 0.1% @31ma –15.00V ± 0.1% @30ma +14.4V ± 5% @6ma (for LED's)
Panel size:	131 mm x 280 mm



NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

723A ANALOG SWITCH

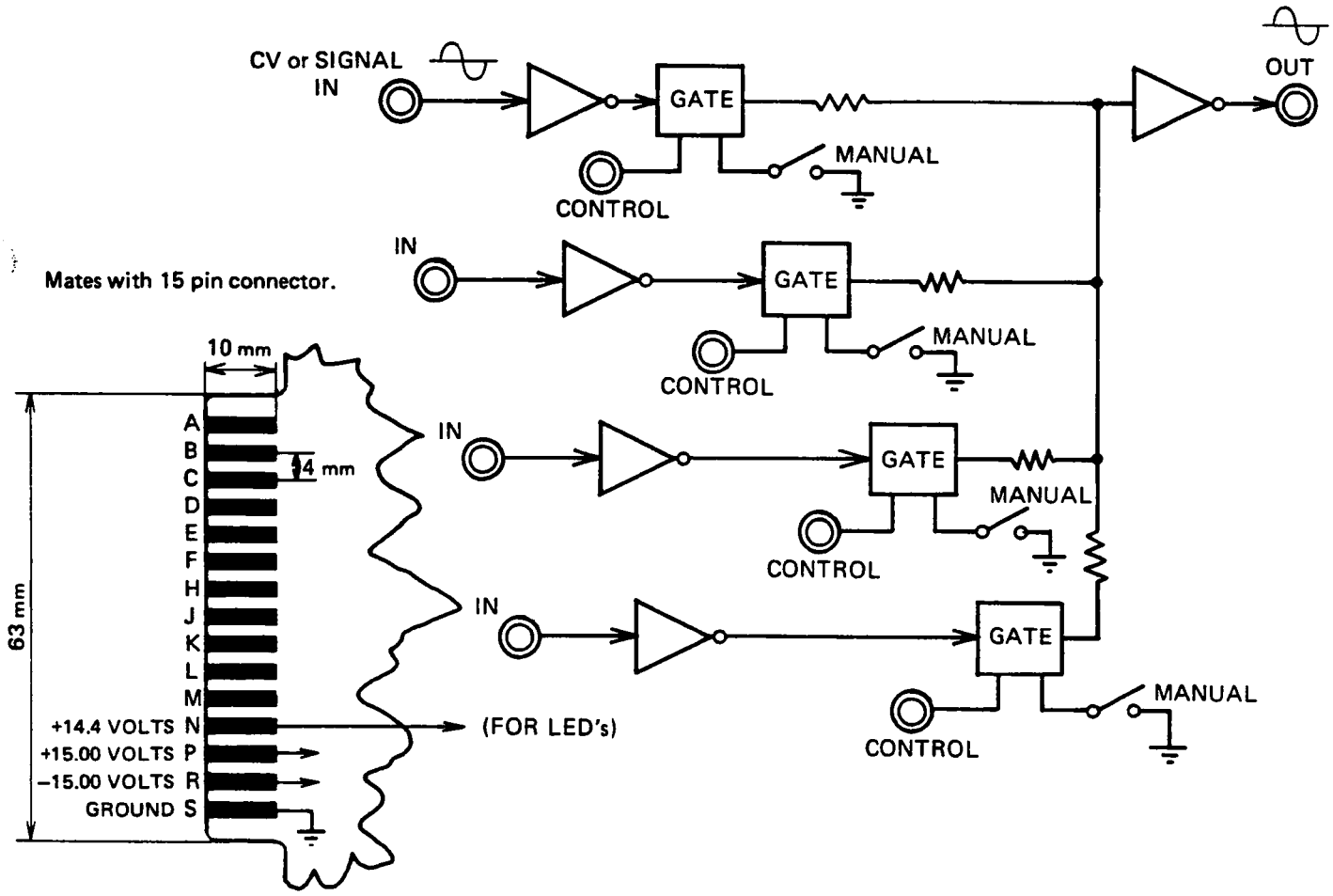


SECTION 2

723A ANALOG SWITCH

Specifications:

Analog input impedance:	more than 50kΩ
Control output impedance:	600Ω
Control input threshold:	+5v
Input:	± 10V
Frequency response:	DC – 20 kHz.
S/N:	more than 75dB
Power supply requirements:	+15.00V ± 0.1% @12ma
	–15.00V ± 0.1% @23ma
	+14.4V ± 5% @60ma (for LED's)
Panel size:	65 mm x 280 mm



(parts side of circuit board)

NOTE: Guarantee is void if any unauthorized changes are made in this module. Specifications subject to change without notice.

APPLICATIONS

SECTION

3

701A KEYBOARD CONTROLLER

The 701A KEYBOARD CONTROLLER has five outputs:

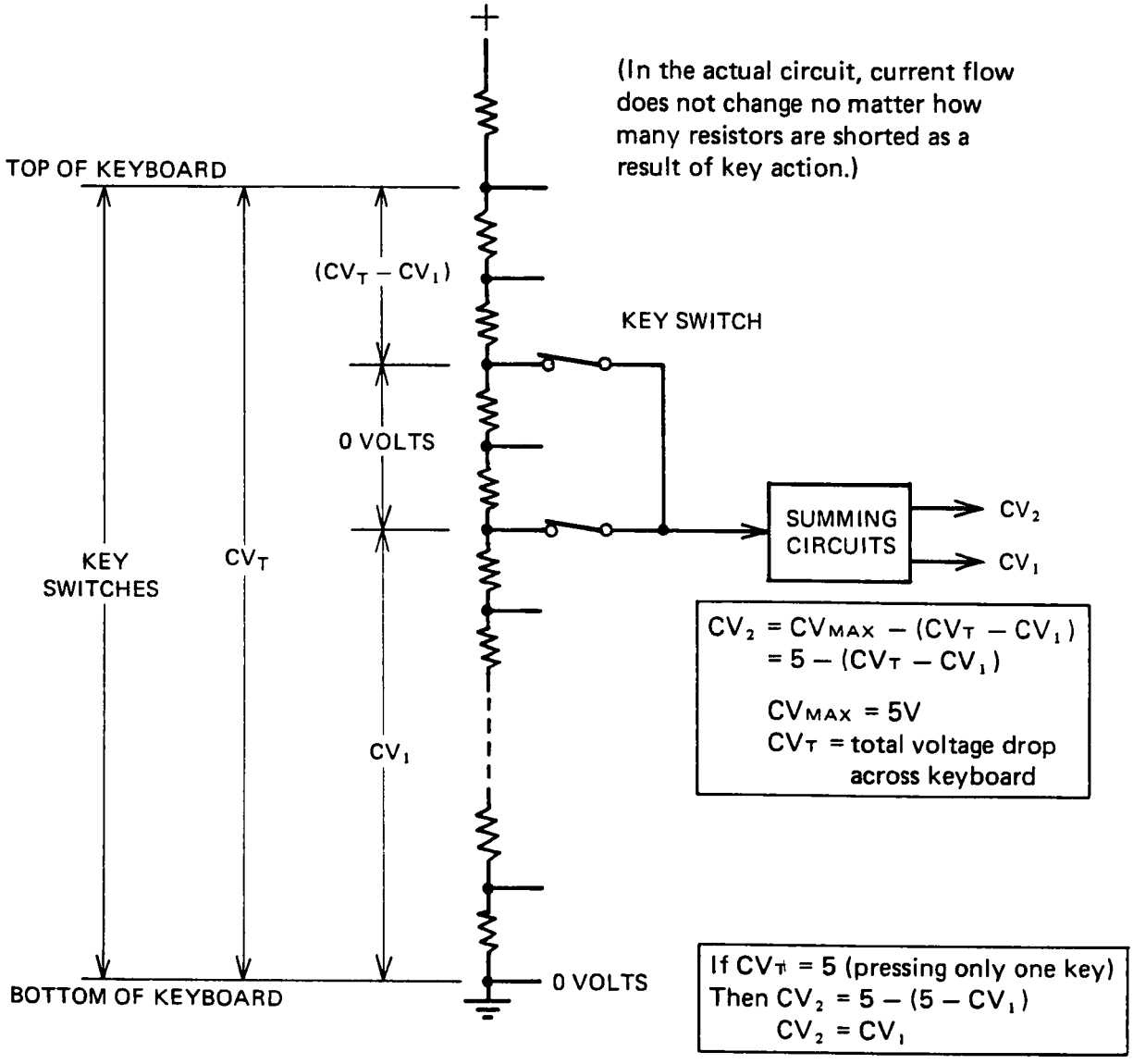
1. KEYBOARD CONTROL VOLTAGE 1 (CV1)

CV1 is the total voltage drop between the bottom of the keyboard (0 volts) and the lowest key depressed.

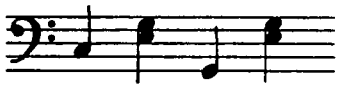
2. KEYBOARD CONTROL VOLTAGE 2 (CV2)

CV2 is the theoretical voltage drop between the bottom of the keyboard and the highest key depressed. Fig. 701-1 shows a simplified diagram of how CV2 is produced.

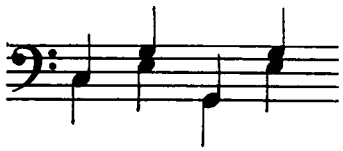
Fig. 701-1 Simplified diagram of KEYBOARD CONTROL VOLTAGE generation.



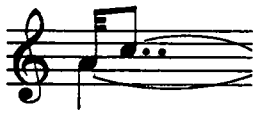
The current flow through the resistor train is constant so that CV1 remains stable no matter how many resistors are shorted out by pressing upper keys. Releasing all but one key produces unison. For this reason, the following:



would become:



Care should be taken to strike keys simultaneously unless the following effect is deliberately intended:

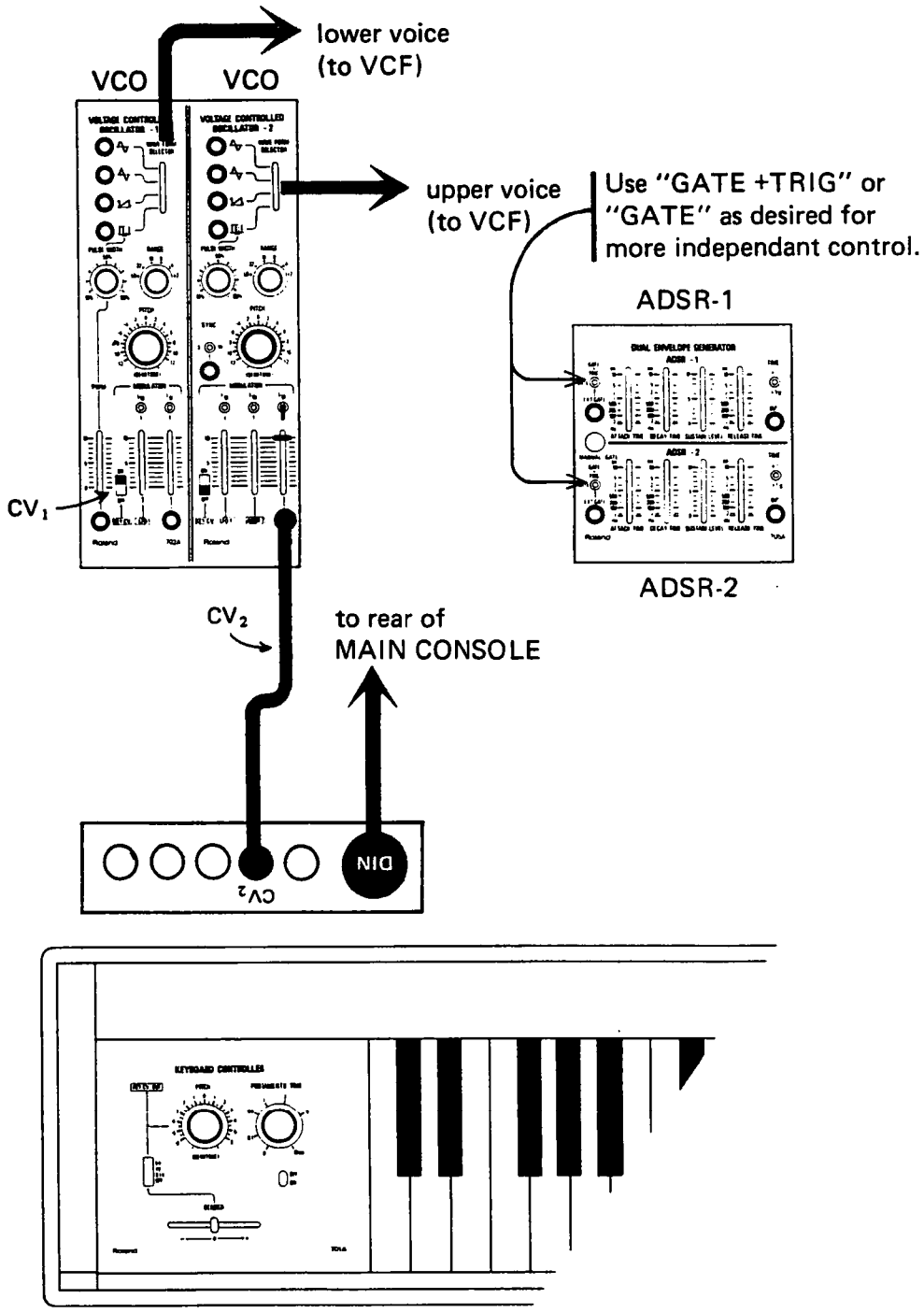


A certain amount of independance can be achieved by careful consideration and setting of the ADSR trigger select switches.

Fig. 701-2 shows the arrangement for using the two voice feature.

(See also p. 712-2, "Using two keyboard controllers; four voices")

Fig. 701-2 Using the two voice feature



3. GATE PULSE

The GATE OUT is +15 volts when any key is depressed. Playing a passage legatissimo (pressing the next key before releasing the previous one) produces one gate pulse for the entire passage.

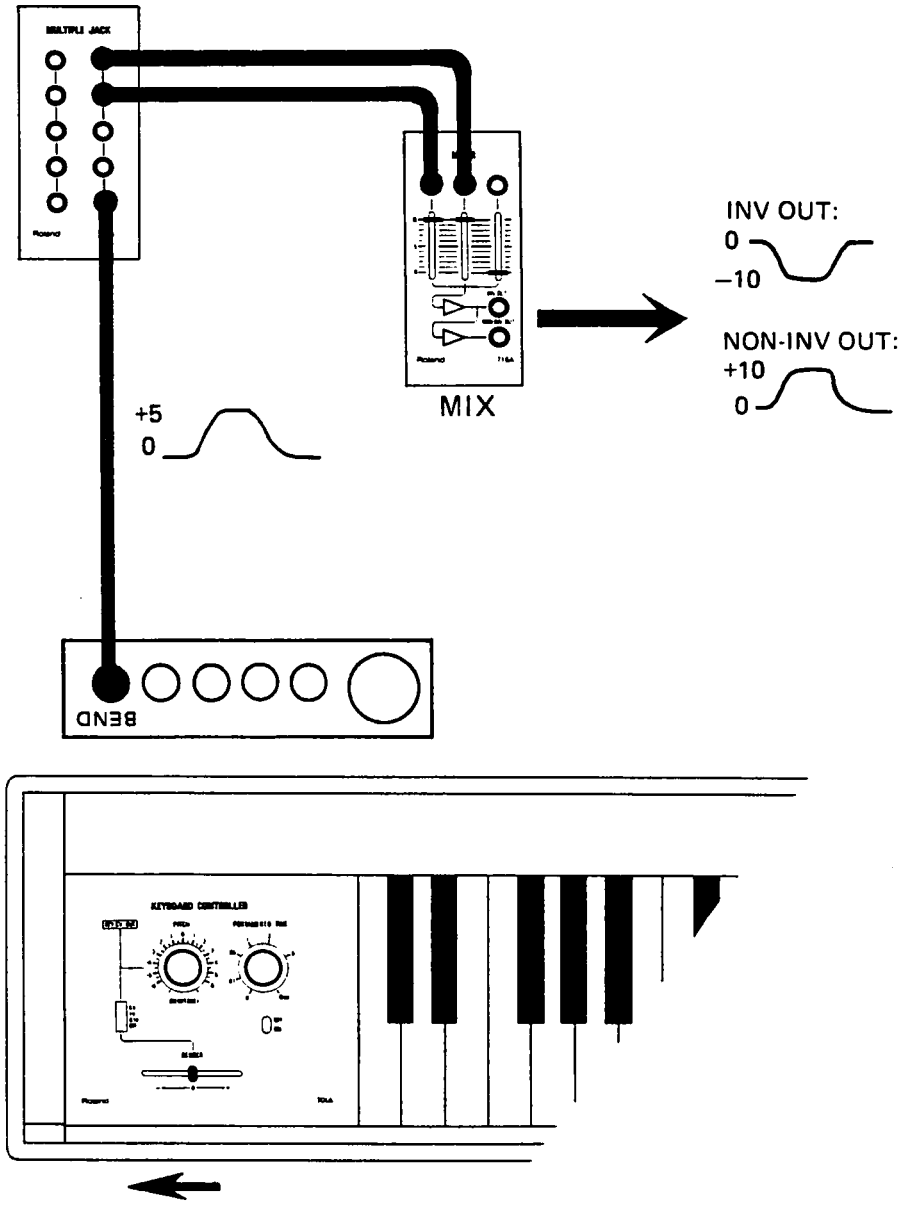
4. TRIGGER PULSE

A +15 volt, 2 millisecond trigger pulse is produced each time a key is depressed. When two or more keys are depressed, a trigger pulse will be produced each time the lowest key in the group is depressed or released.

5. BEND CV OUT

The BEND CV OUT jack on the rear panel is connected directly to the BENDER lever on the KEYBOARD CONTROLLER panel and is not related to the PITCH BEND RANGE switch. The output is 0 to ±5 volts, depending on the direction of throw of the BENDER lever. Fig. 701-3 shows how this VOLTAGE output can be doubled so as to be more useful in controlling synthesizer functions.

Fig. 701-3 Doubling BEND CV OUT

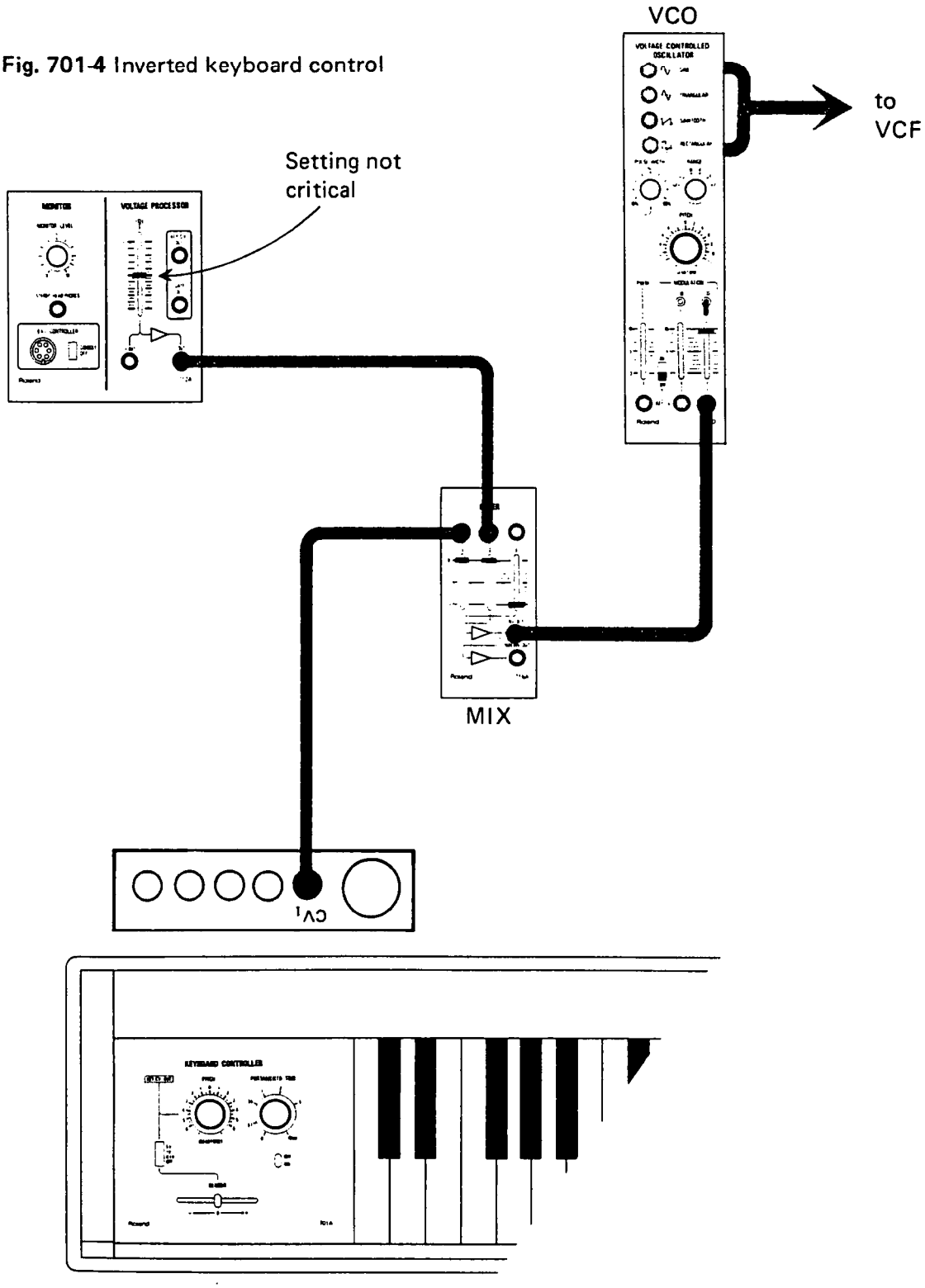


Also see fig. 713-2 which shows how to use the GATE DELAY as a pulse shaper to form clean gate or switching pulses from the BEND CV OUT.

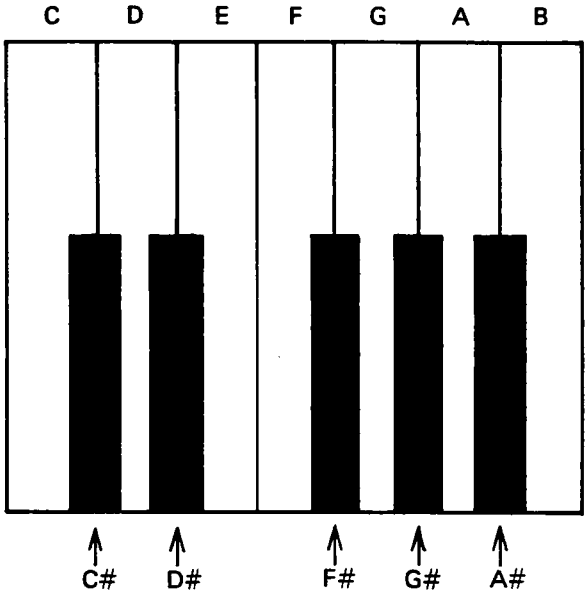
Inverted keyboard control

Fig. 701-4 shows how to obtain an inverted control of the synthesizer by the keyboard. Playing up the keyboard produces pitches going down. The 712A VOLTAGE PROCESSOR is used to bias the VCO so that it produces its full range of frequencies.

Fig. 701-4 Inverted keyboard control



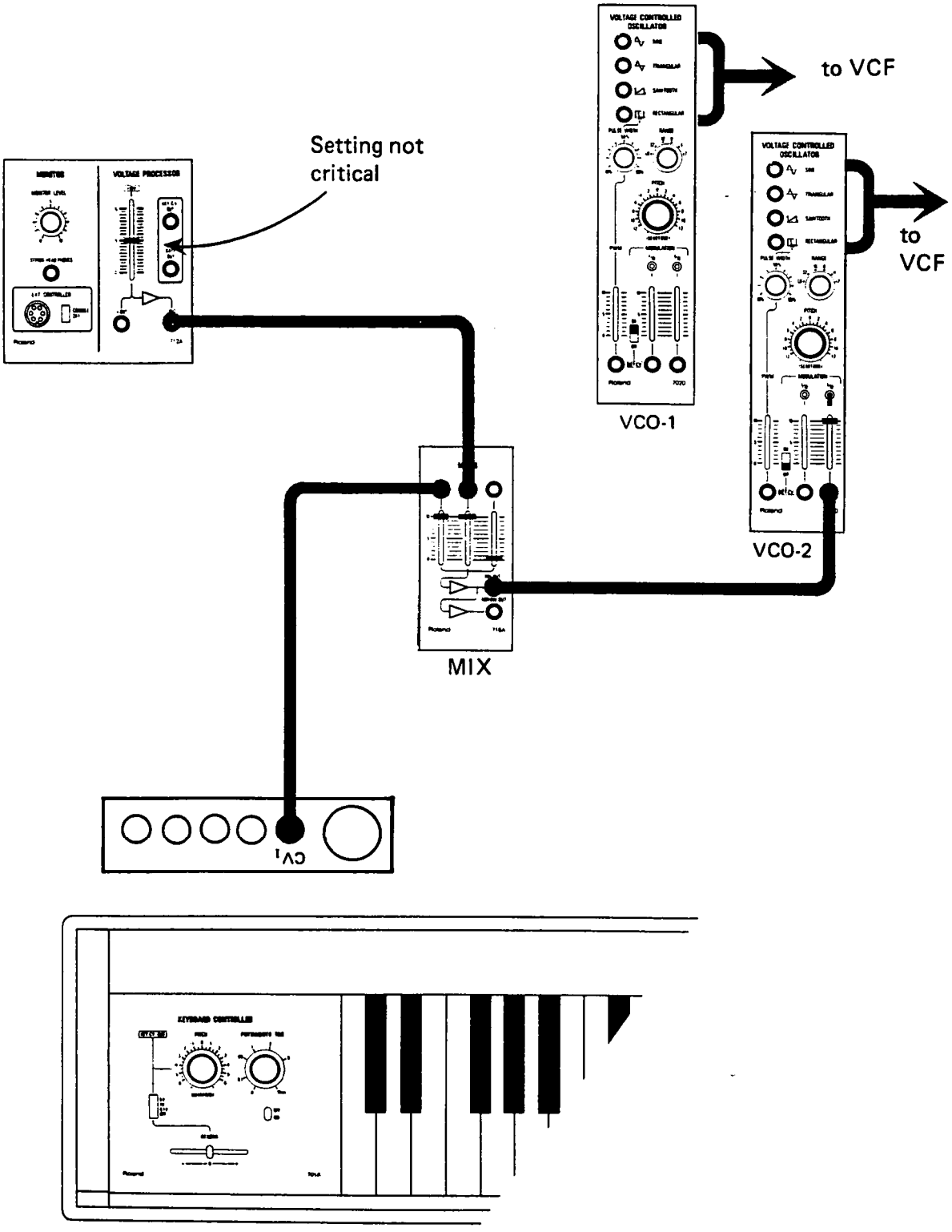
This arrangement also allows the keyboard to be played naturally from behind.



"Automatic" duets (Fig. 701-5)

Set the synthesizer and tune VCO-1 in the normal way. Strike the key on the keyboard which is an augmented fifth above the key in which the melody is to be played (for example: key of F major; strike C#) and tune VCO-2 to unison with VCO-1. The octave used when playing will depend on the effect desired. Any melody played on the keyboard now will produce a counter melody with suggestions of harmony. (This doesn't work for minor keys).

Fig. 701-5 "Automatic" duets



702 VOLTAGE CONTROLLED OSCILLATOR

VCO SYNC

The VCO SYNC input jacks allow the 702B, 702C, and 702E VCO's to be phase locked to any other VCO (or external pulse; see p.702-10) and require a positive going vertical edge of over +5 volts. Phase locking makes additive synthesis possible by completely eliminating the beat frequency between VCO's. Fig. 702-1 shows how to phase lock VCO's to a master VCO (VCO-1 in the drawing).

Fig. 702-1 VCO sync

(Wave forms shown in fig. 702-4.)

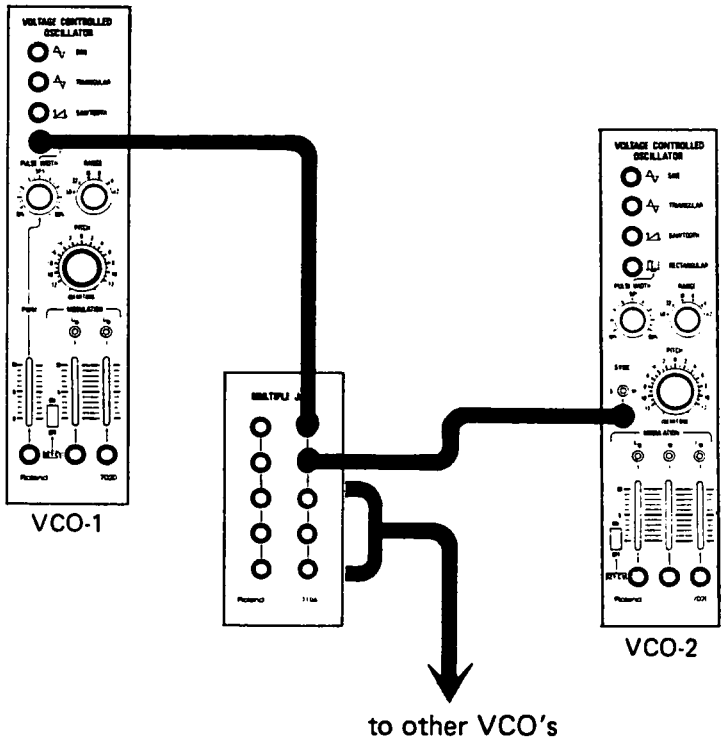
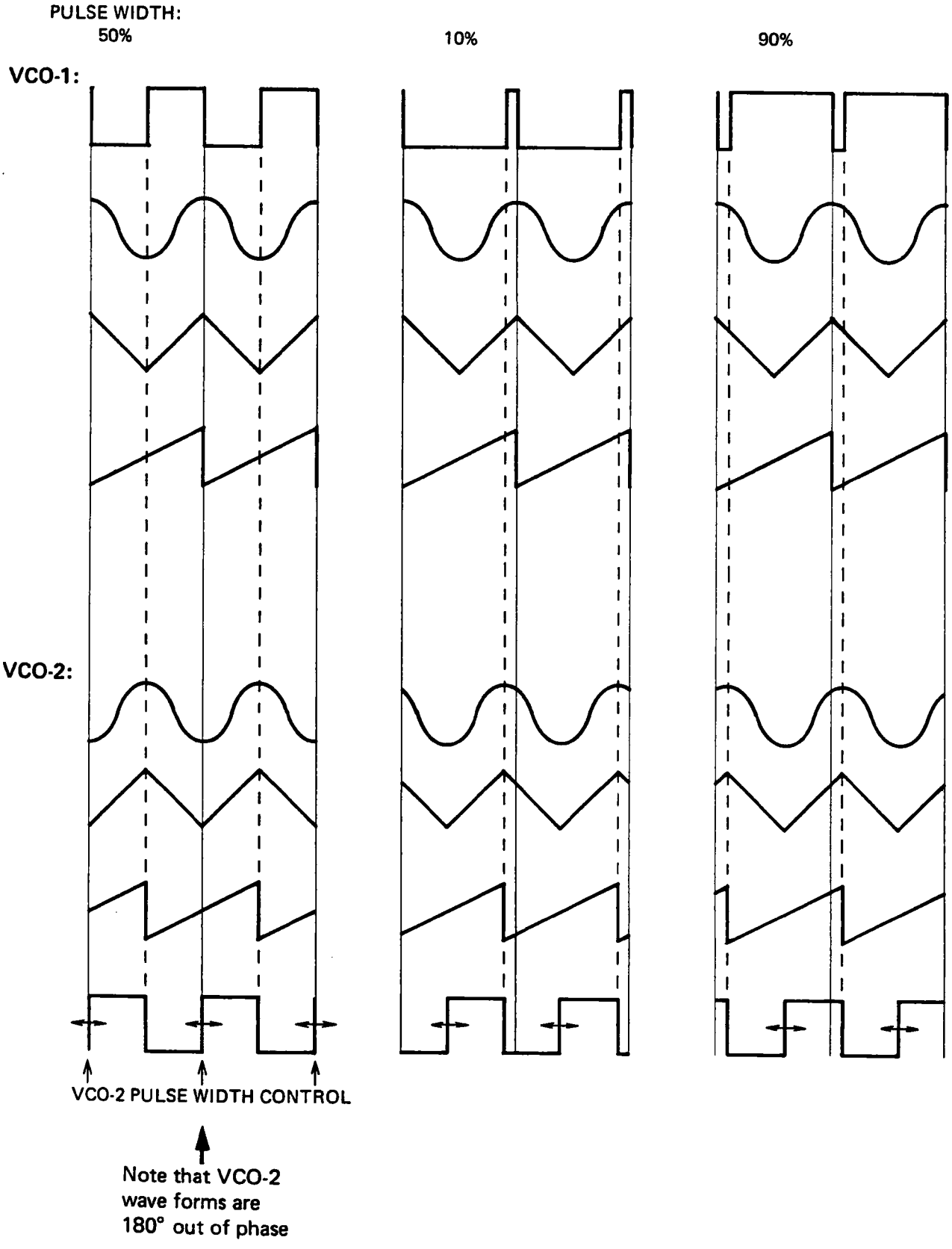


Fig. 702-2 shows the phase relations of the outputs.

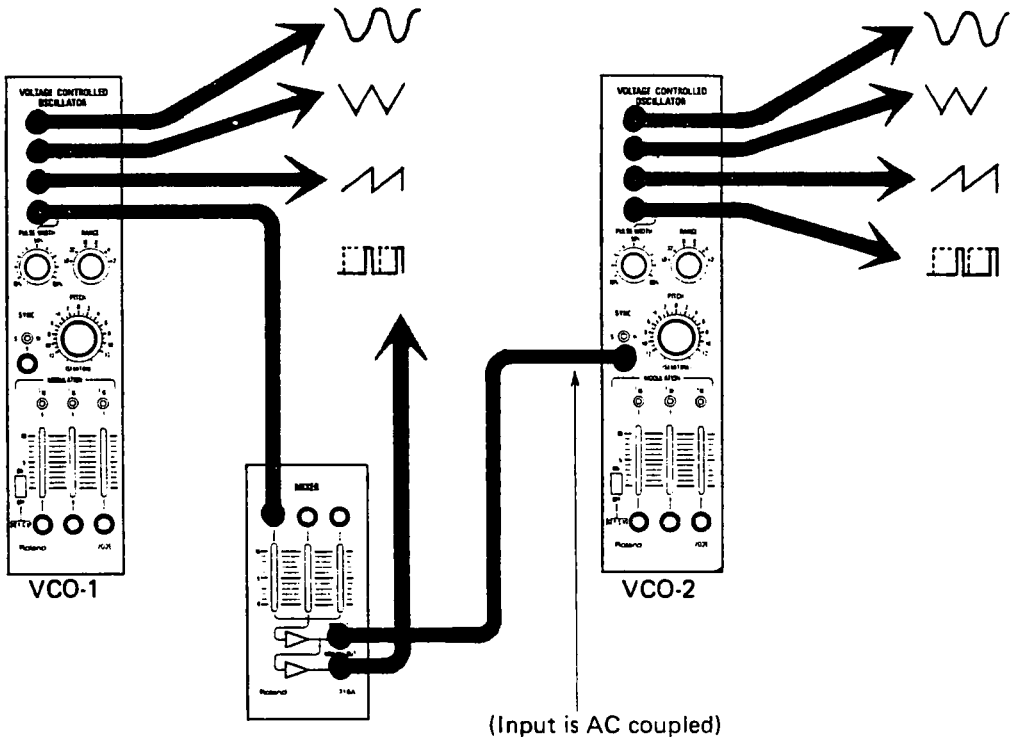
Fig. 702-2 VCO SYNC phase relationships

Dotted lines show sync points.



With the VCO-1 PULSE WIDTH control at minimum or maximum, the signals are close enough to being in phase for most purposes; however, fig. 702-3 shows how to obtain outputs exactly in phase when needed.

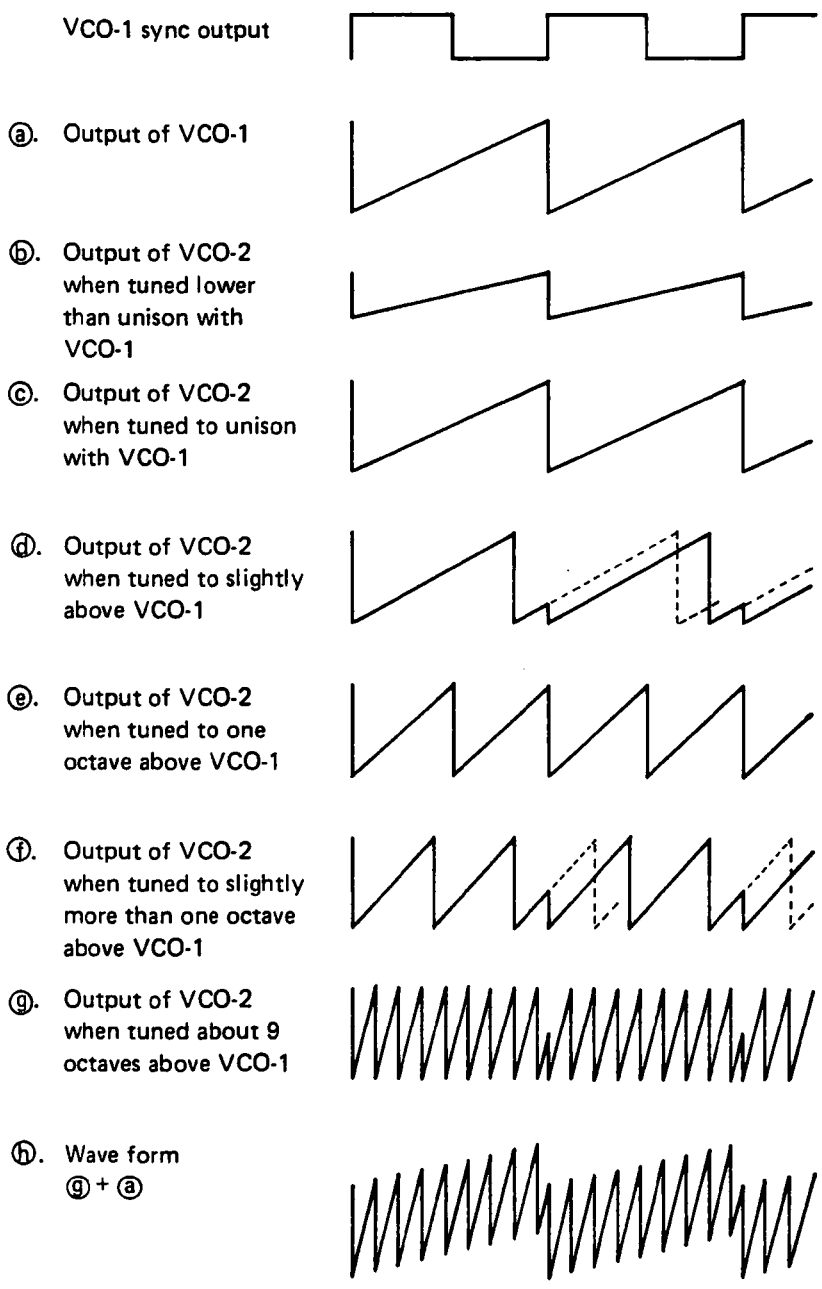
Fig. 702-3 Obtaining in phase output with Sync



STRONG SYNC

Fig. 702-4 shows sawtooth wave forms using STRONG SYNC.

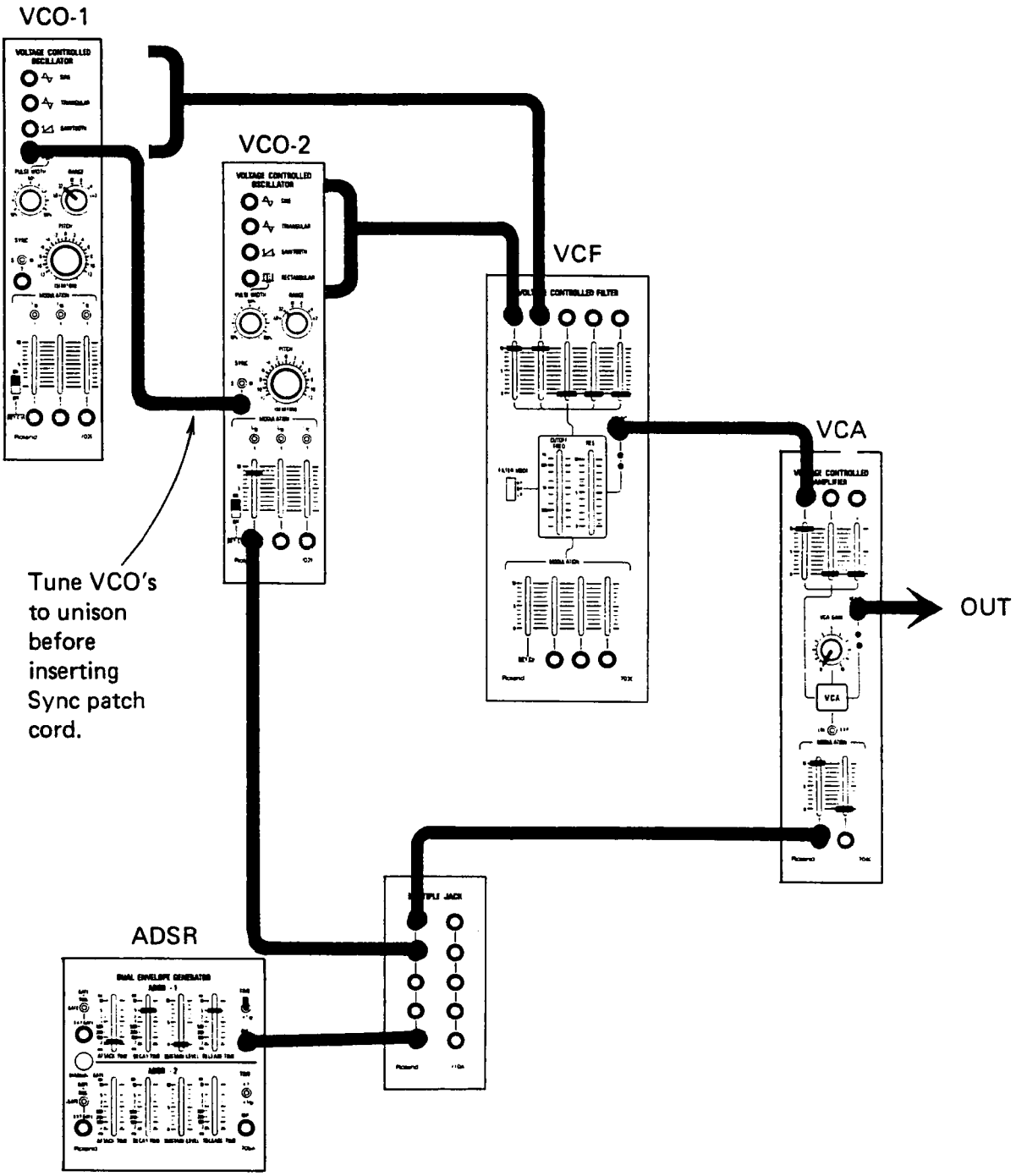
Fig. 702-4 VCO sync wave forms for the sawtooth wave (STRONG SYNC).



(For simplicity, all wave forms are shown in phase)

With STRONG SYNC, VCO-2 can be tuned to any frequency which is a multiple of the VCO-1 frequency; in other words, pitches which fall within the natural harmonic series* of the VCO-1 pitch. When VCO-2 is tuned to any other frequency, the result is a distorted wave (as shown in fig. 702-4 ⓓ, ⓕ, and ⓗ) which can be very useful as a source of rich tone color. Fig. 702-5 shows one way of making use of this tone color.

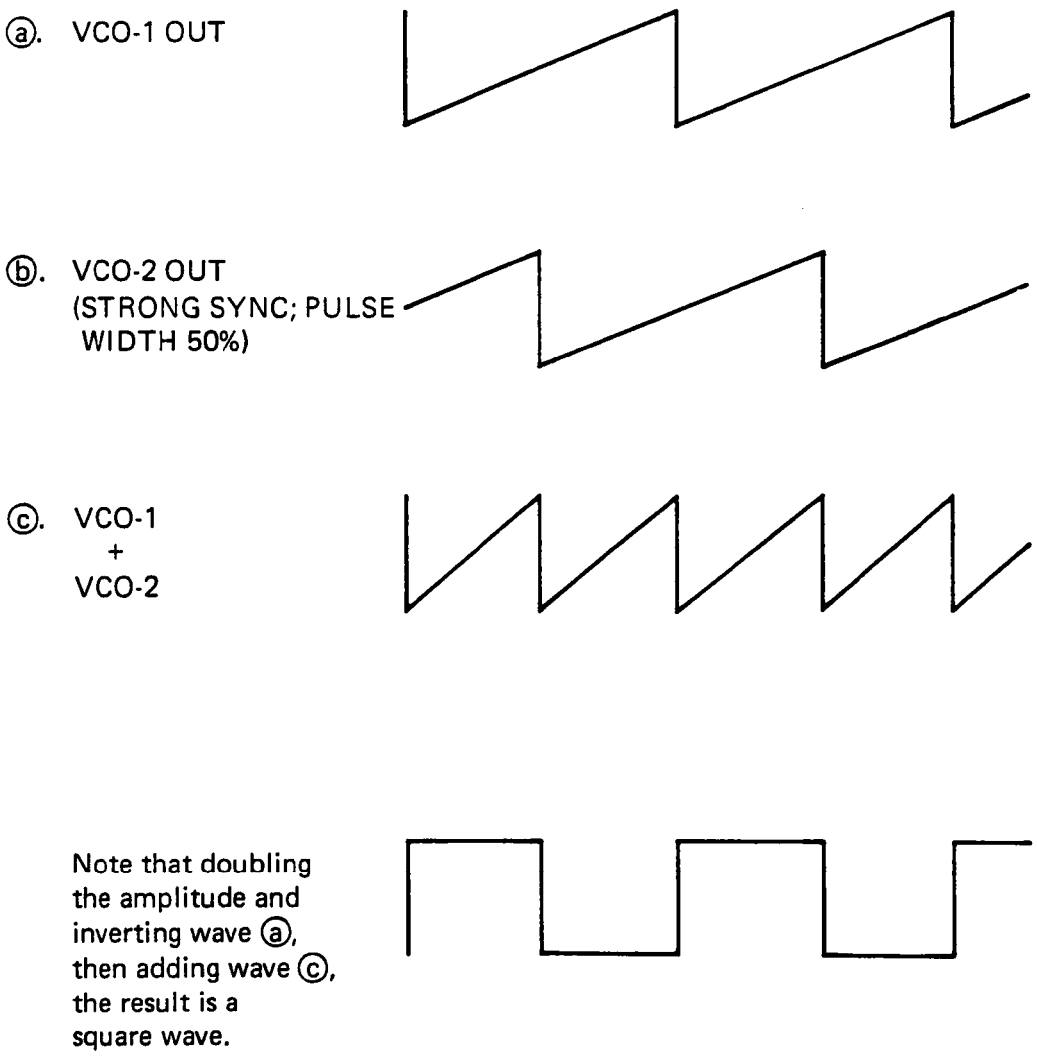
Fig. 702-5 Tone color production with VCO Sync.



*Shown in the APPENDIX

Note that with the VCO-1 PULSE WIDTH at "50%" and the two VCO's tuned to unison, if the two sawtooth waves are added together, the result is a sawtooth wave one octave above the tuned frequency.

Fig. 702-6 Addition of unison sawtooth waves in SYNC mode



WEAK SYNC

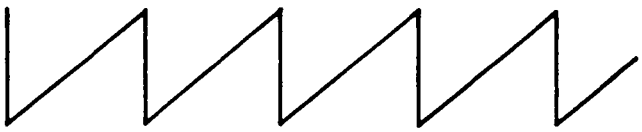
With weak sync, VCO-2 can be tuned to many intervals not obtainable with STRONG SYNC. Two examples are shown below.

Between the intervals which are tunable with WEAK SYNC, VCO-2 will not track and a beat frequency appears.

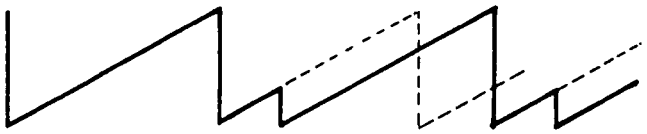
With WEAK SYNC, VCO-2 can also be tuned to intervals below VCO-1 which are fractions of the VCO-1 frequency. Between these intervals, VCO-2 will track, but the output will be distorted as shown in fig. 702-7. Again, this distortion can be a source of tone color.

Fig. 702-7 VCO sync wave forms for the sawtooth wave (WEAK SYNC).

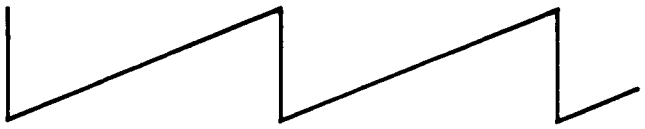
ⓐ. Output of VCO-1



ⓑ. Output of VCO-2 when tuned lower than unison with VCO-1



ⓒ. Output of VCO-2 when tuned one octave below VCO-1



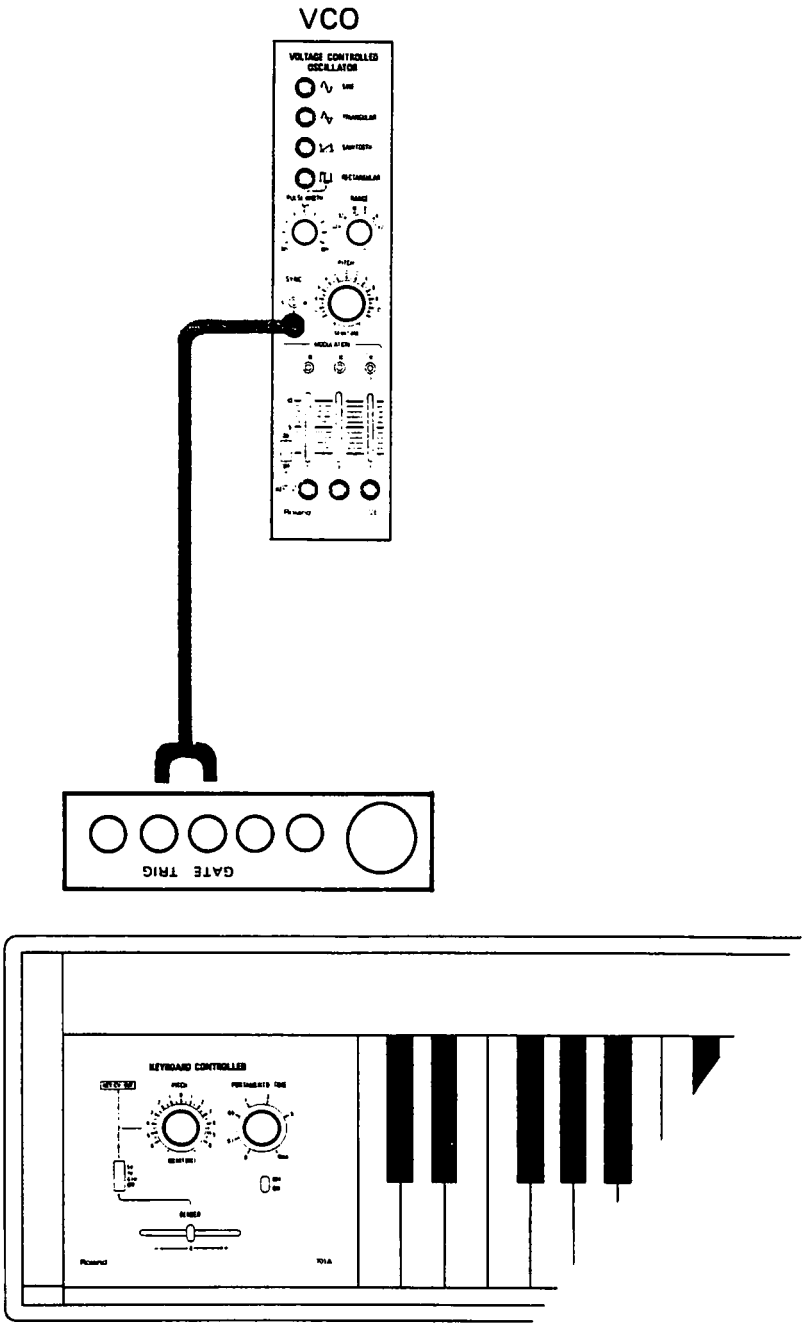
ⓓ. Output of VCO-2 when tuned more than one octave below VCO-1

(For simplicity, all wave forms are shown in phase)

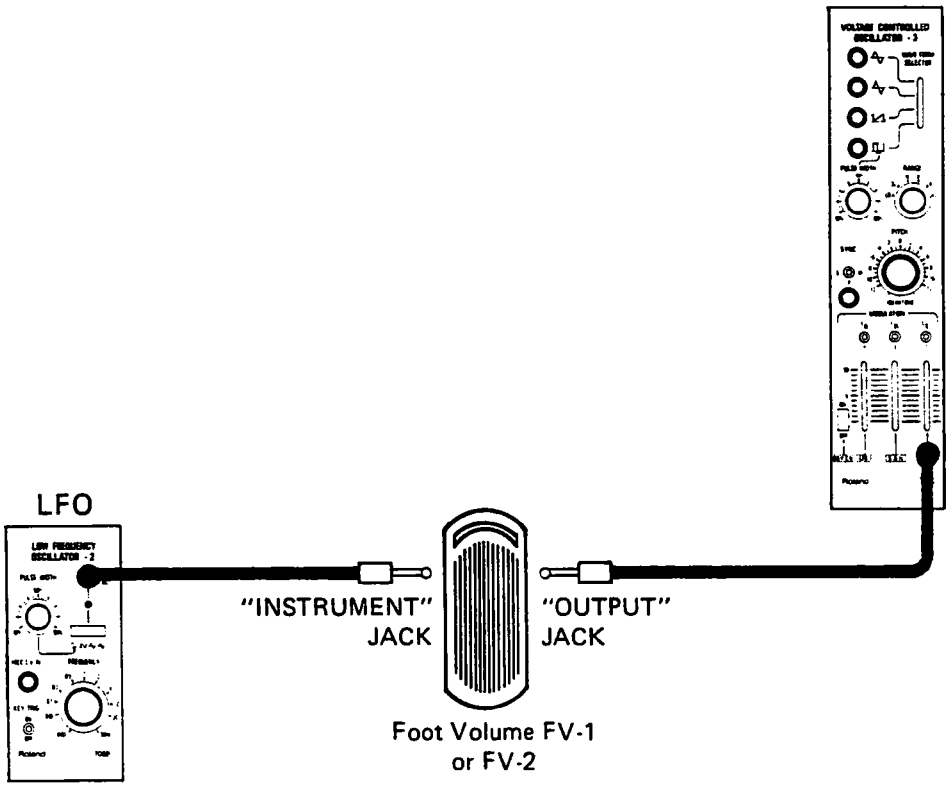
Using VCO SYNC

If it is desireable to avoid the tone coloring caused by slightly mistuned VCO's, tune the VCO's before inserting the SYNC patch cord. Note that when using weak sync, it will probably be necessary to turn the VCO-2 FINE TUNING knob slightly counterclockwise for the VCO-2 frequency to lock exactly onto the VCO-1 frequency.

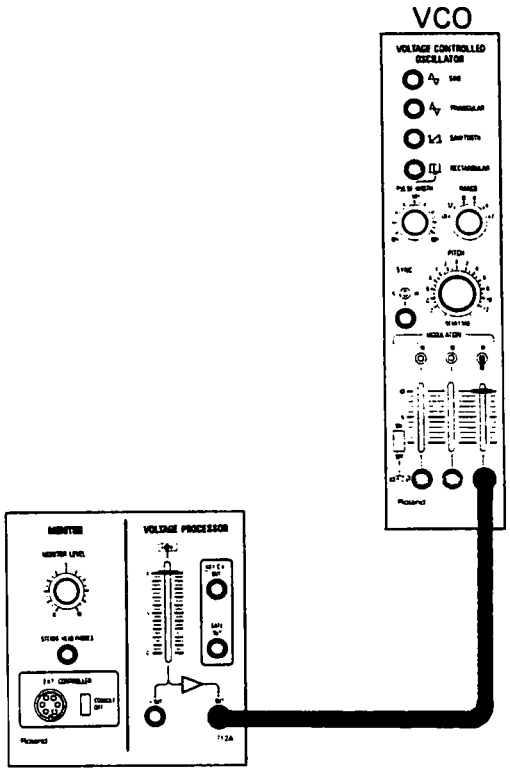
Fig. 702-8 Phase locking VCO wave form to keyboard GATE or TRIGGER



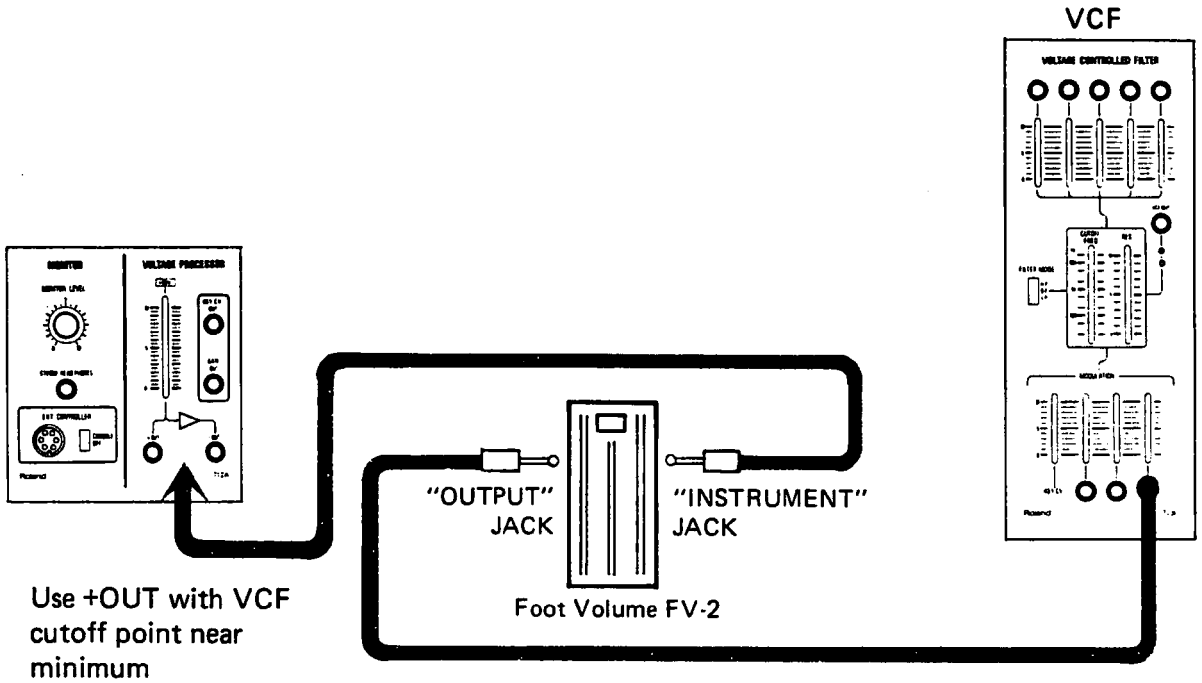
Foot controled vibrato



Obtaining the lowest frequencies in the VCO range



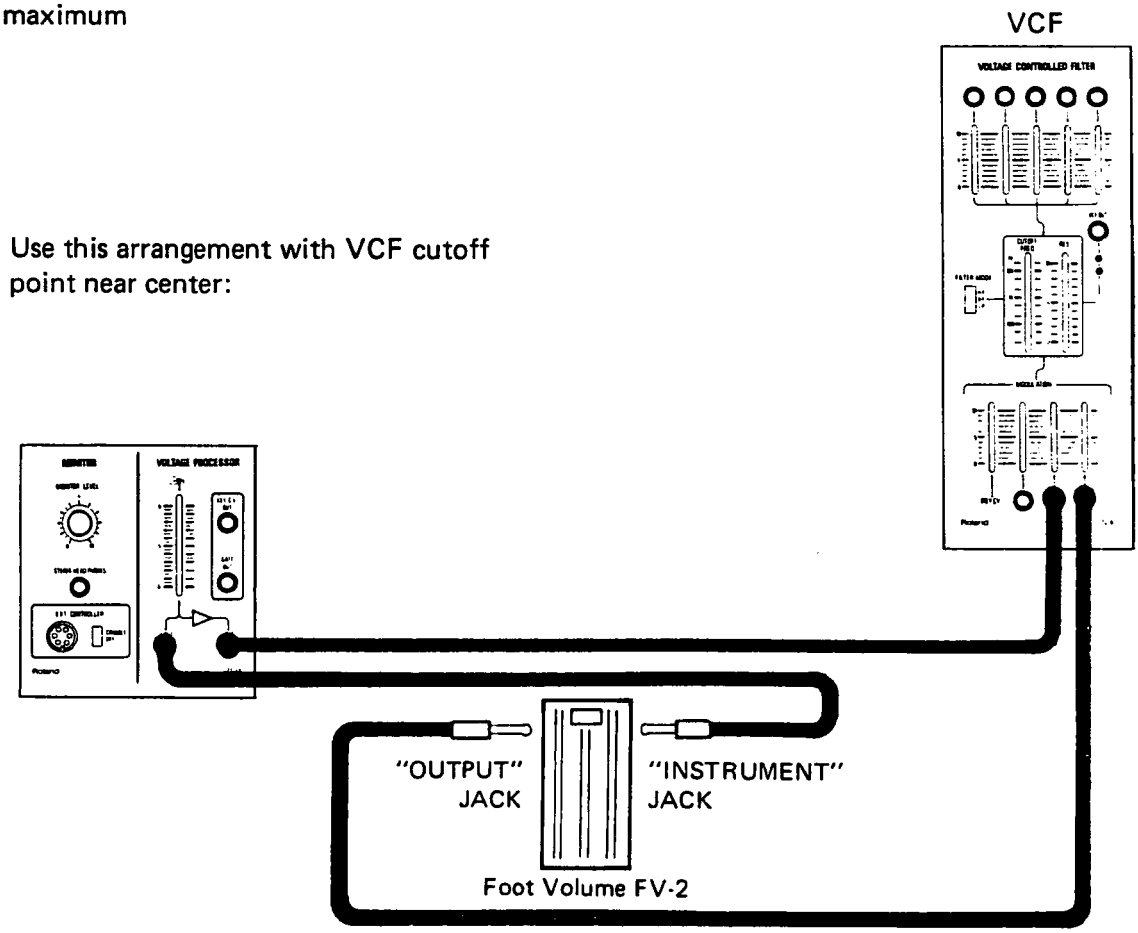
Foot control of VCF cutoff point



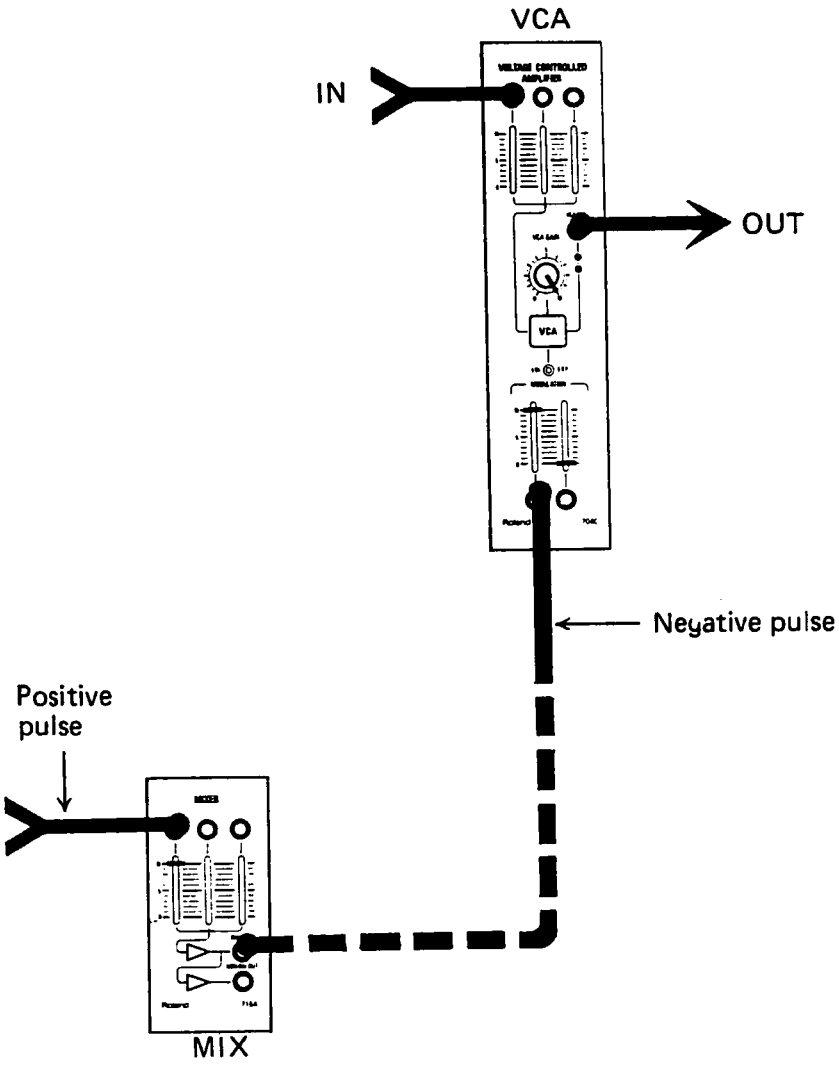
Use +OUT with VCF cutoff point near minimum

Use –OUT with VCF cutoff point near maximum

Use this arrangement with VCF cutoff point near center:



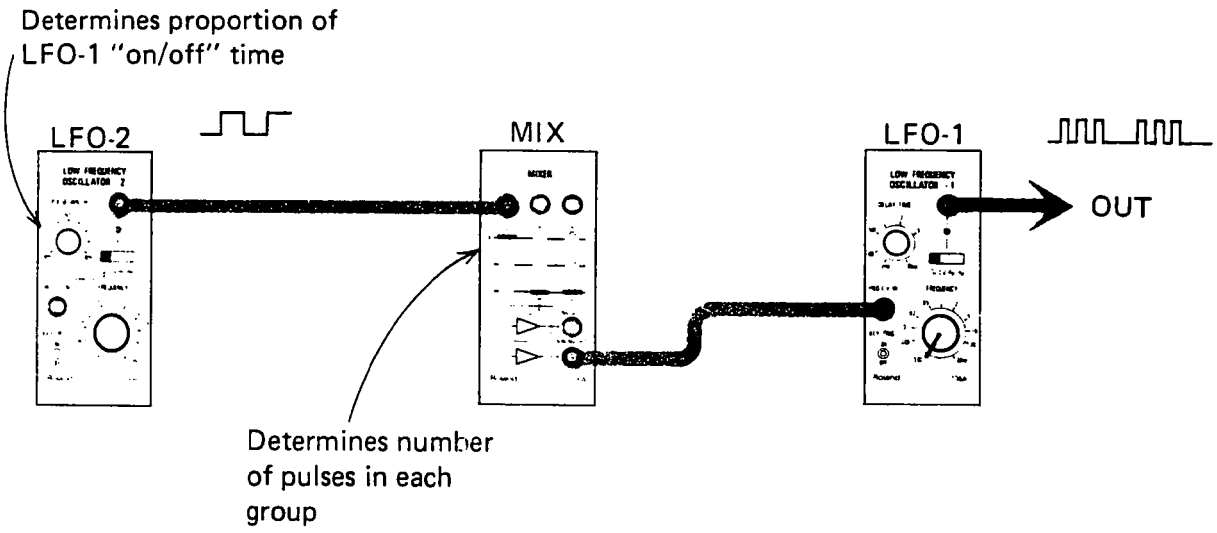
Using the 704 VCA as a normally open gate



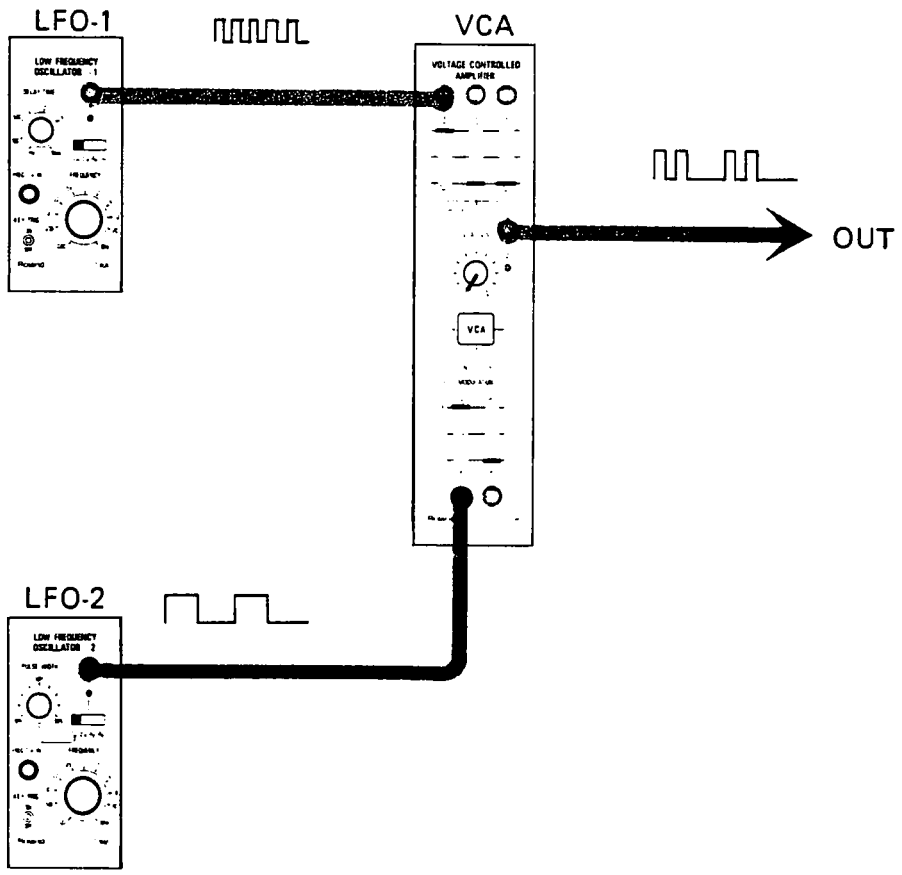
706 LOW FREQUENCY OSCILLATOR

The 706 series LFO's are designed as quick and easy sources of low frequency wave forms. When more sophisticated functions are desired (such as simultaneous use of different wave forms, etc.), use a VCO in the LO range.

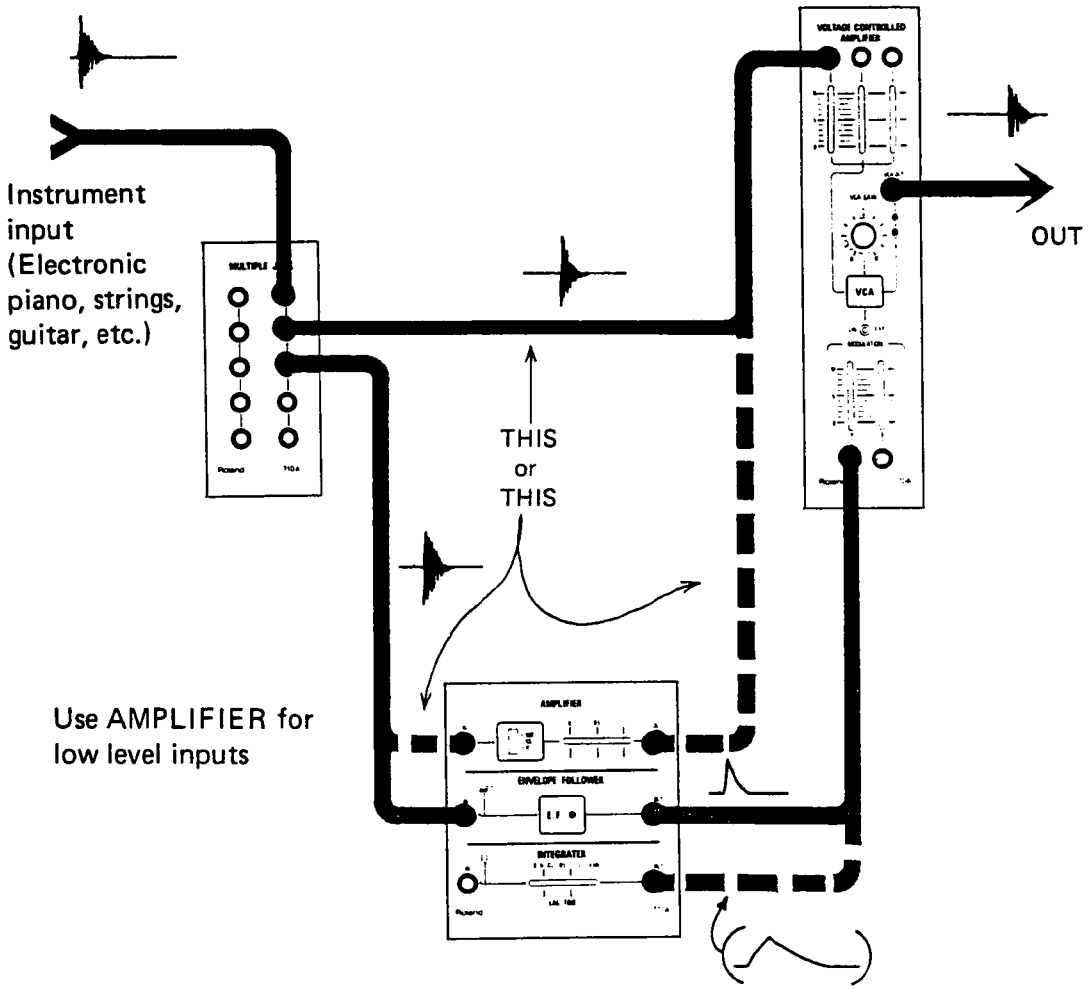
Producing pulse patterns without a sequencer



OR:

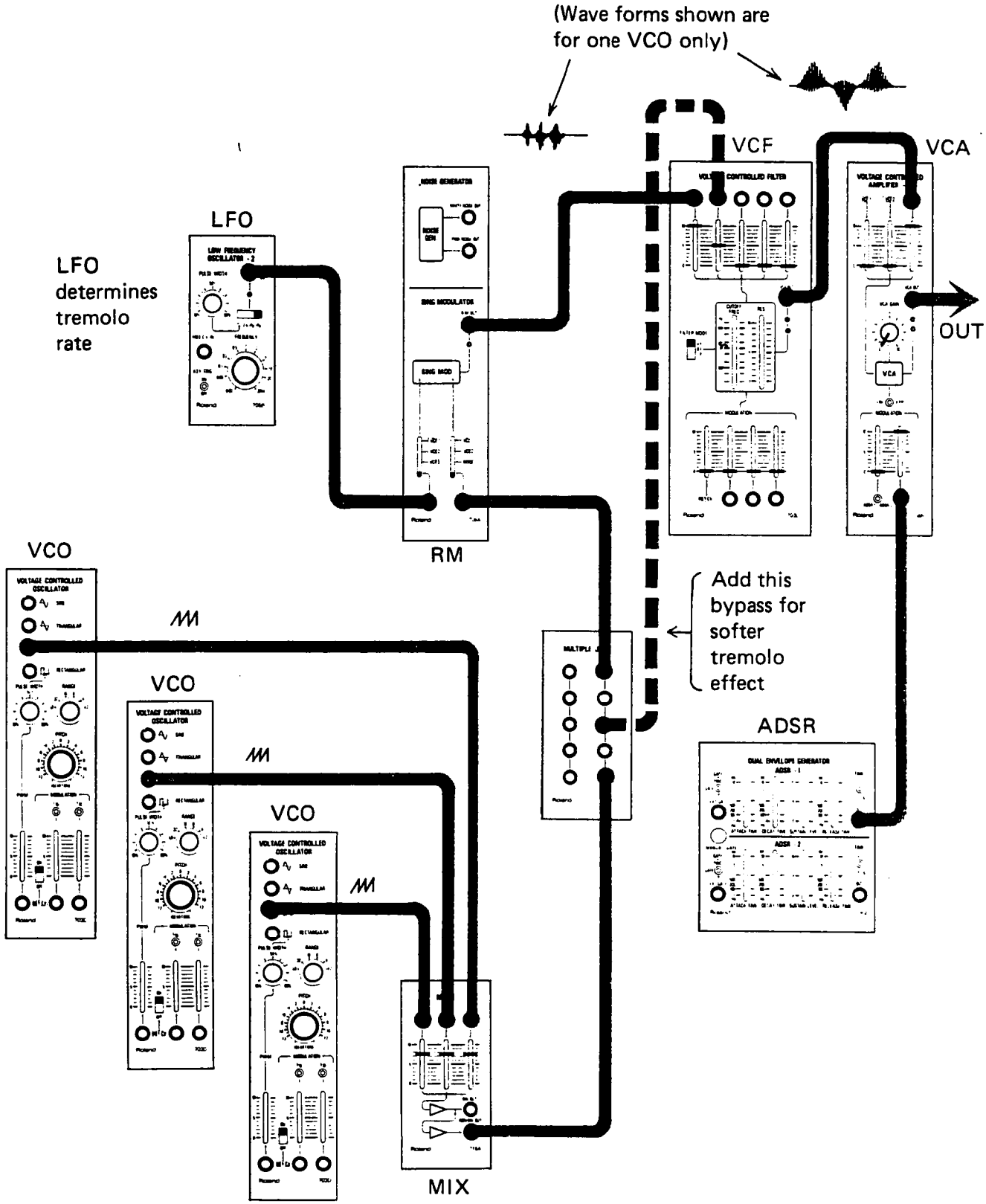


Using the 707A module to improve S/N of external sound source



The INTEGRATOR may be needed with certain types of envelopes (or it can be used to purposely alter the envelope).

Using the 708A RING MODULATOR to create bowed tremolo string sounds



711A OUTPUT MODULE

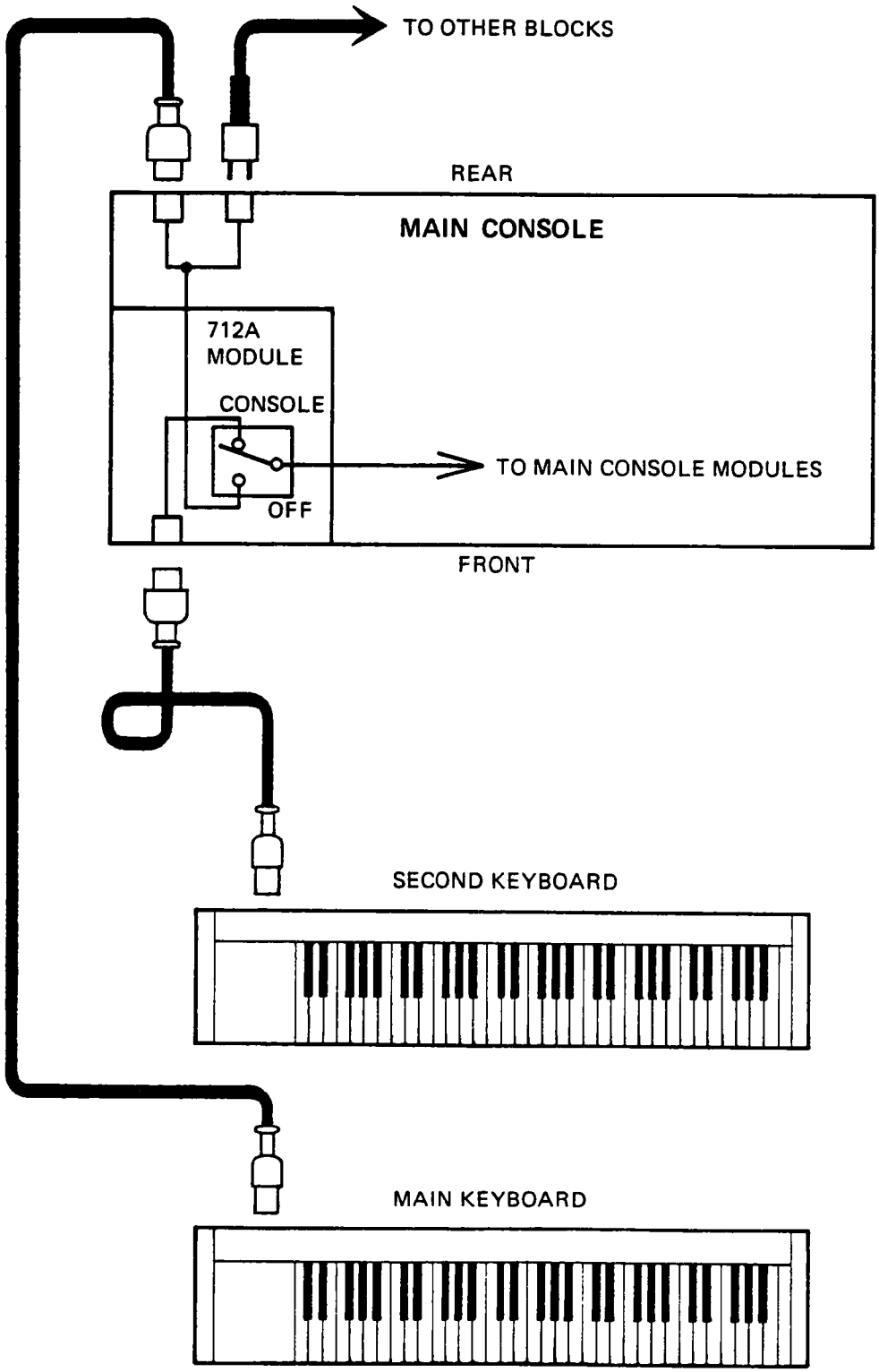
Standard test oscillator

The test oscillator is calibrated in octaves to serve as a convenient tuning device for the VCO's. The 110Hz, 220Hz, 440Hz, 880Hz, and 1760Hz outputs are obtained from one master oscillator and a frequency divider circuit to insure that the octave intervals remain perfect and beat free.

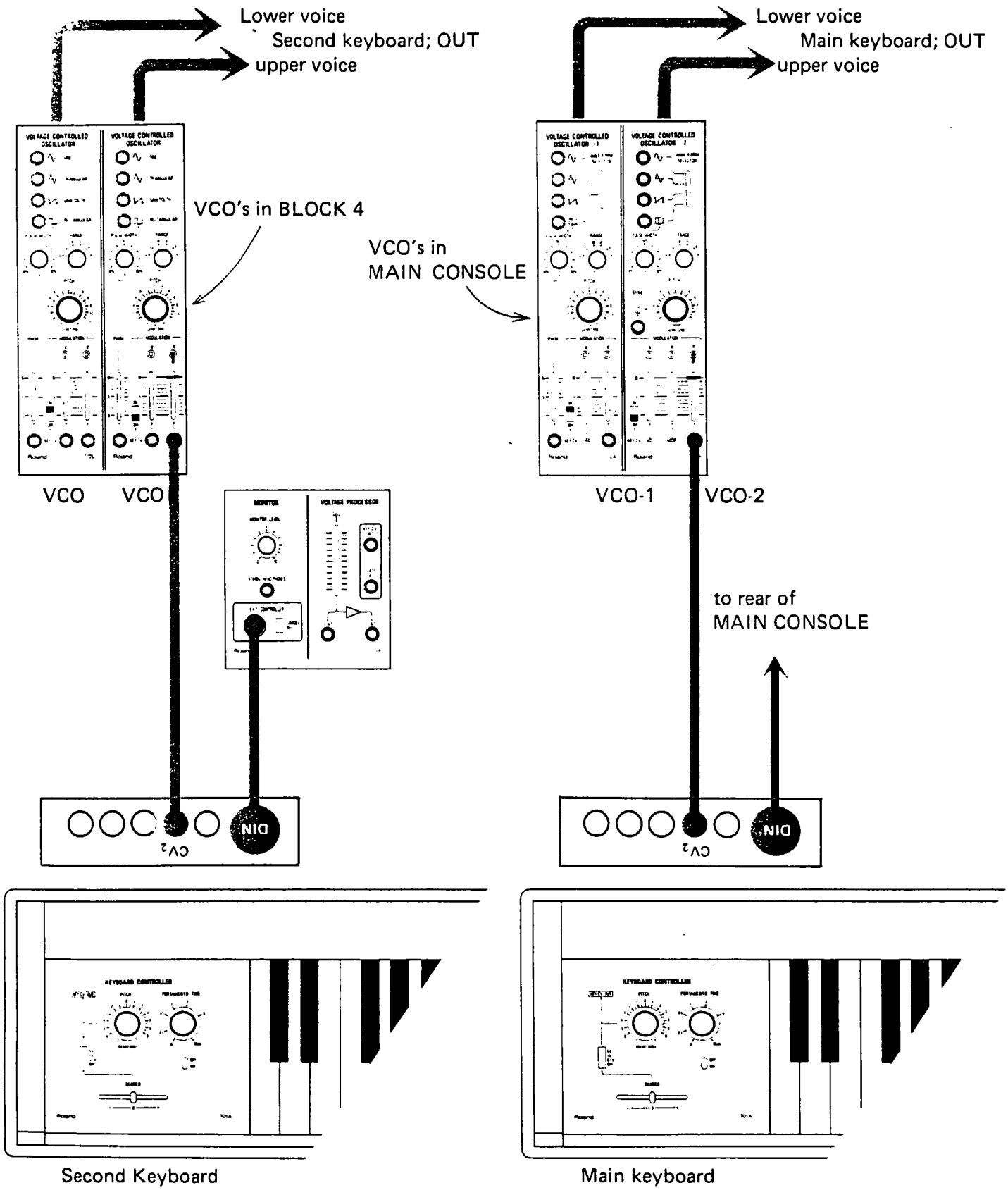
The 1kHz sine wave output is generated by a second oscillator and can be used for establishing and recording 0dB reference points.

712A MONITOR/VOLTAGE PROCESSOR

Using two KEYBOARD CONTROLLERS

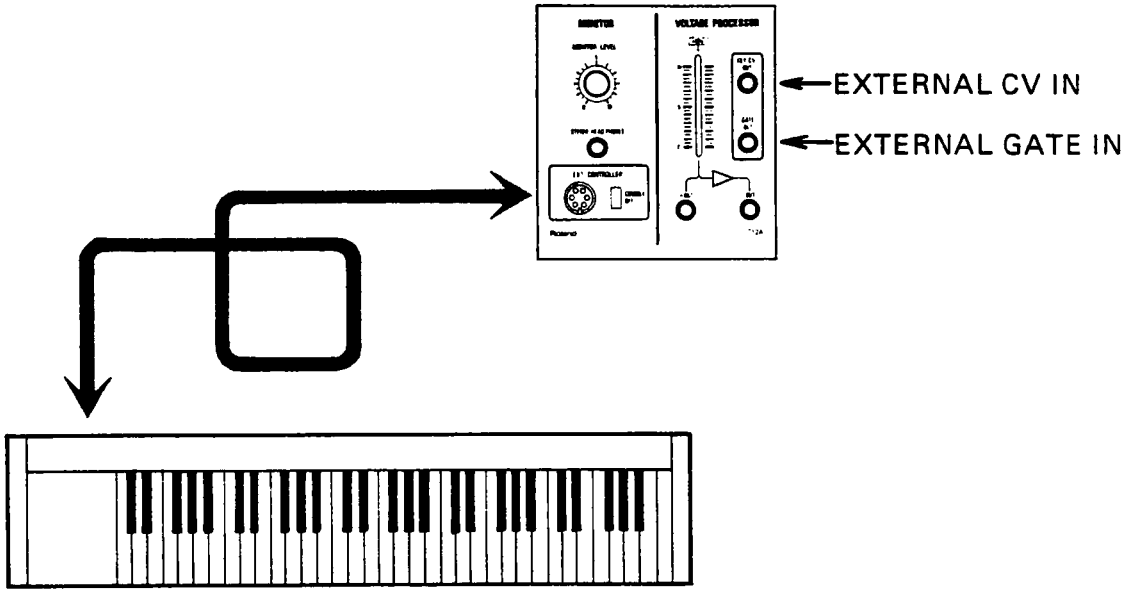


Using two keyboard controllers; four voices



NOTE:

The KEY CV OUT and GATE OUT jacks may also be used for feeding control voltages and gate pulses into the system from an external source (such as a computer) if the keyboard is disconnected from the DIN jack on the rear of the Main Console.



If a second keyboard is used as shown above, the CONSOLE/OFF switch positions are:

CONSOLE:	Second keyboard controls Main Console; external source controls other blocks.
OFF:	Second keyboard is OFF; external source controls all units.

Using the 713A DELAY GATE

This patch produces the sound of a cracking whip.

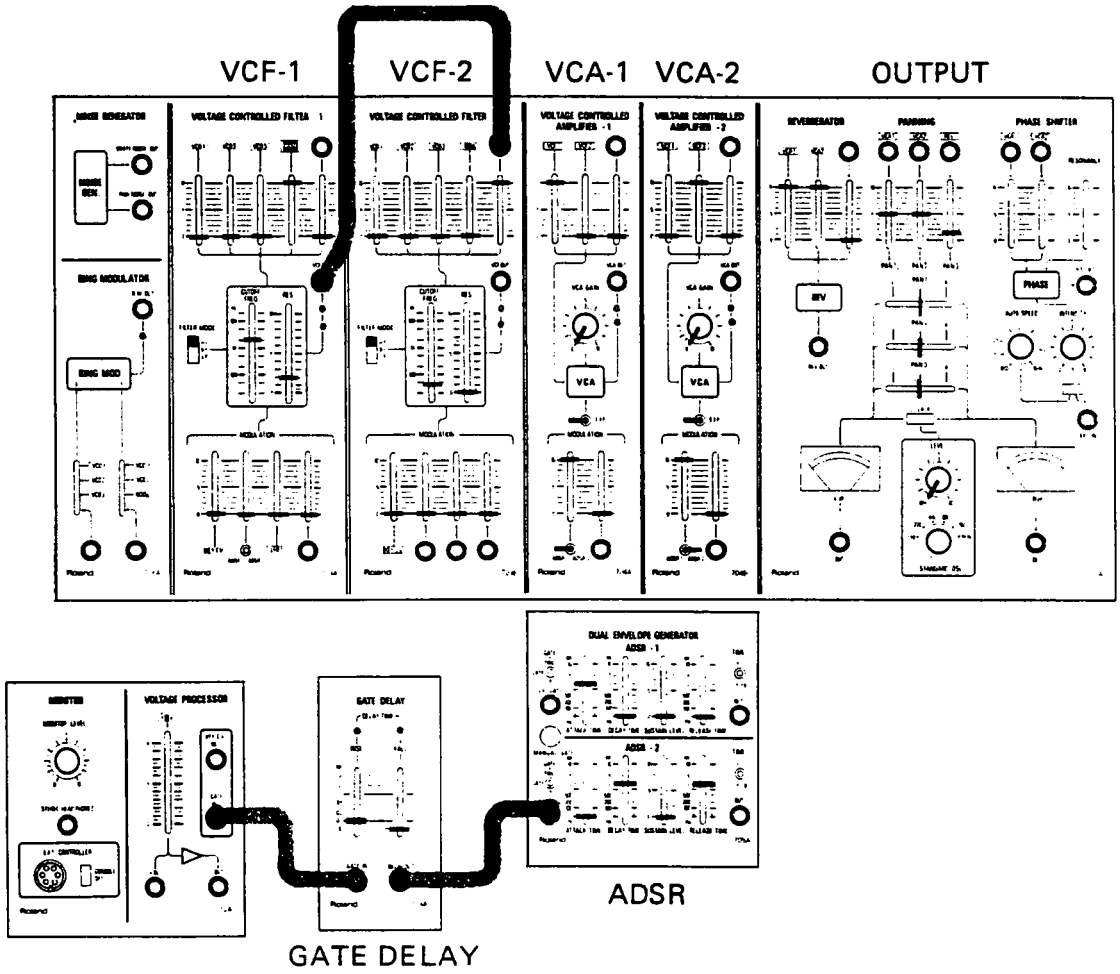
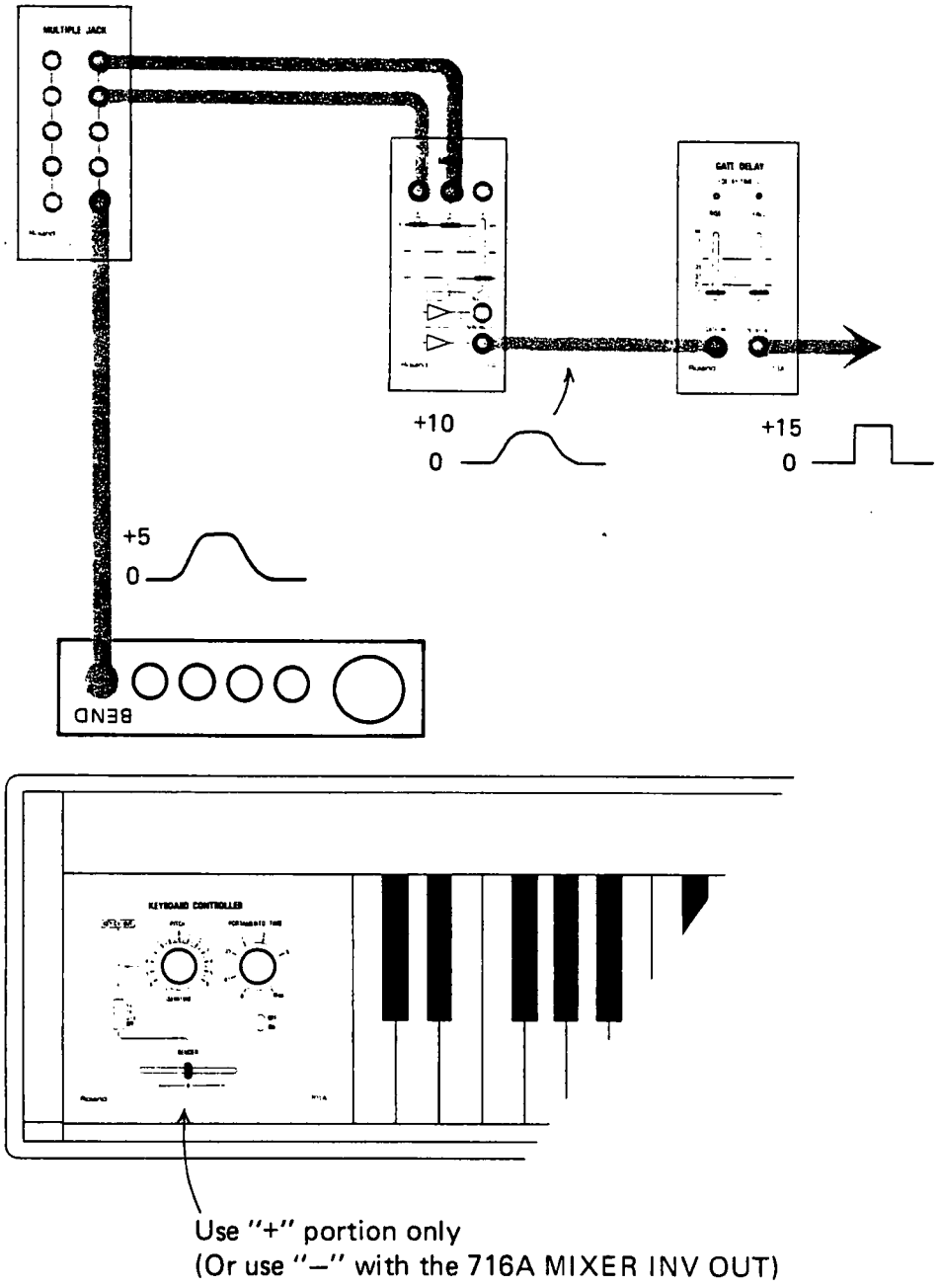


Fig. 713-2 Using the 713A GATE DELAY as a pulse shaper for PITCH BEND CV OUT



714A INTERFACE

The 714A INTERFACE consists of three major sections:

1. The FREQUENCY TO VOLTAGE (F/V) converter

With the HOLD/FOLLOW switch in FOLLOW, the F/V converter will convert the frequency of the input signal into a control voltage of 1 volt per octave. If the input signal falls below −10dB (as shown on the VU meter), the internal S/H (sample and hold) circuit is activated and holds the control voltage output level at the same point until the input again rises above −10dB.

Changing the HOLD/FOLLOW switch to HOLD will cut off the input to the F/V converter section and hold the control voltage output at its previous level.

The EXT CONT (external control) jack allows an external voltage to control the HOLD/FOLLOW function (see APPENDIX, p. 1). With the HOLD/FOLLOW switch in FOLLOW, a voltage of over +5 volts will cause the circuit to HOLD.

2. The ENVELOPE FOLLOWER

The ENVELOPE FOLLOWER extracts the envelope from the input signal and can be connected directly to VCA modulation inputs to shape the synthesizer output sound, or it can be routed through the INTEGRATOR (707A) to alter the envelope. The HOLD/FOLLOW switch has no effect on the ENVELOPE FOLLOWER.

3. The GATE SIGNAL GENERATOR

The output of the GATE SIGNAL GENERATOR is +15 volts whenever the VU meter level is above −10dB. (This output is fed to the HOLD/FOLLOW circuit to activate the FOLLOW function of the F/V converter).

Operation of the 714A INTERFACE

The INPUT SENS switch and THRESHOLD LEVEL control should be set so as to produce "0" or less on the VU meter. Keep in mind that the F/V HOLD/FOLLOW function is activated when the VU meter goes above −10dB.

Uses of the 714A INTERFACE

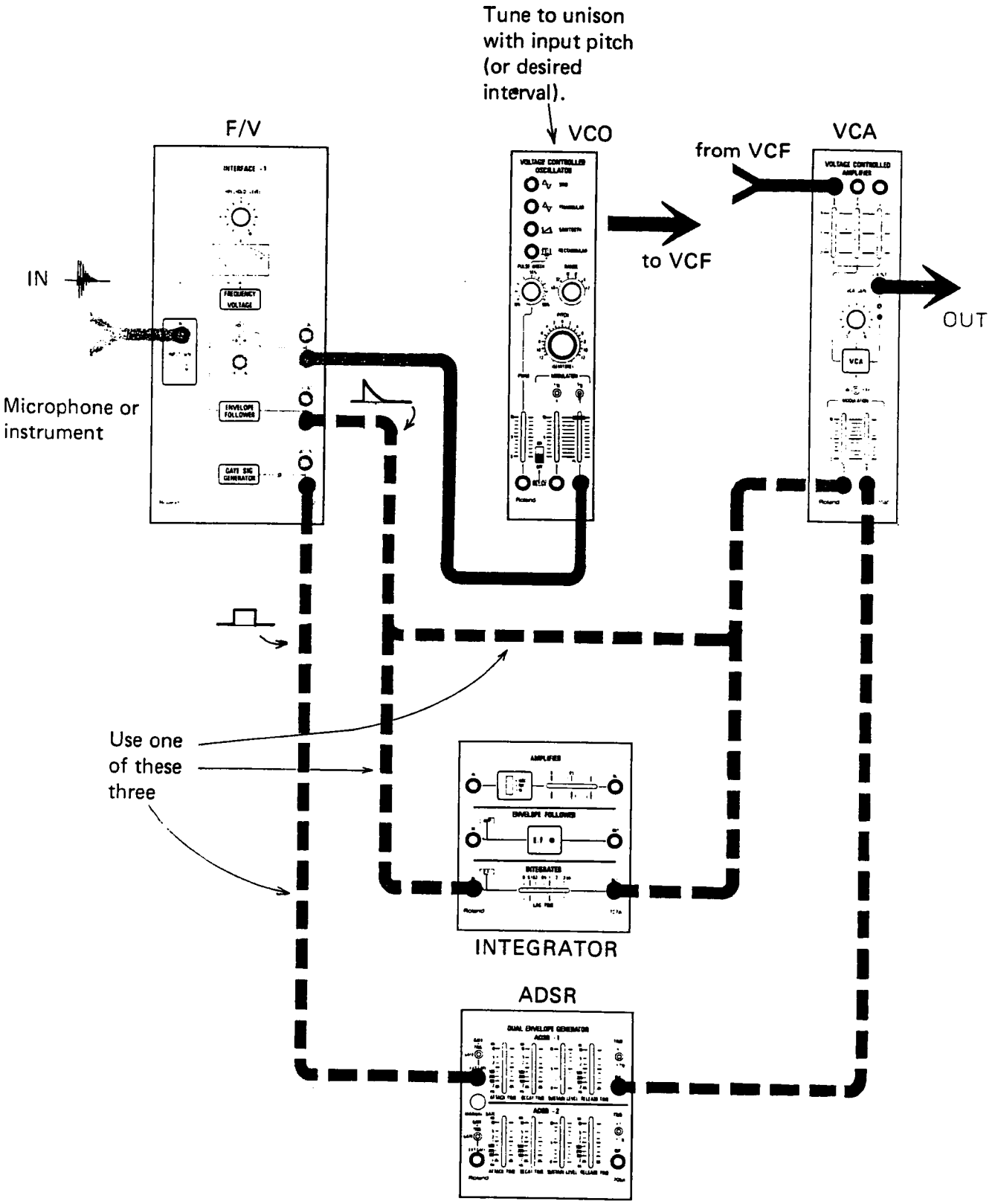
The F/V converter is excellent for using external sound sources for controlling the synthesizer. Good sound sources would be such things as singing or other monophonic sources such as solo brass or woodwind instruments.

CAUTION:

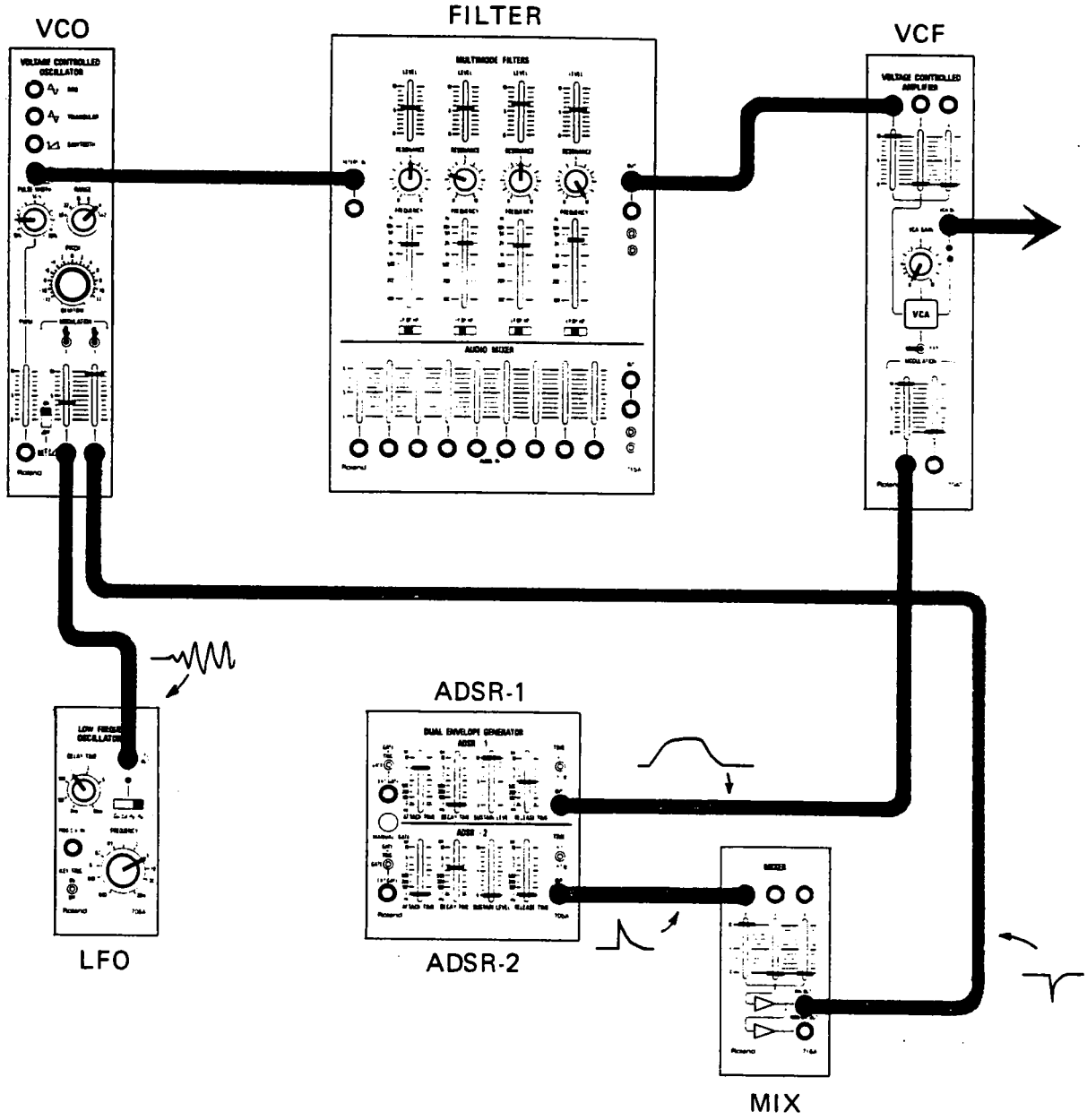
When using a polyphonic instrument to control the synthesizer, it is necessary to completely dampen the old pitch before sounding the new one.

With instruments such as guitars and pianos, dampening the sound is relatively easy. With an instrument such as a string synthesizer which may contain a certain amount of uncontrollable sustain element in the output sound, control of the synthesizer may prove difficult as this sustain element will confuse the FOLLOW circuit. The result will be a sound like a VCO modulated by noise.

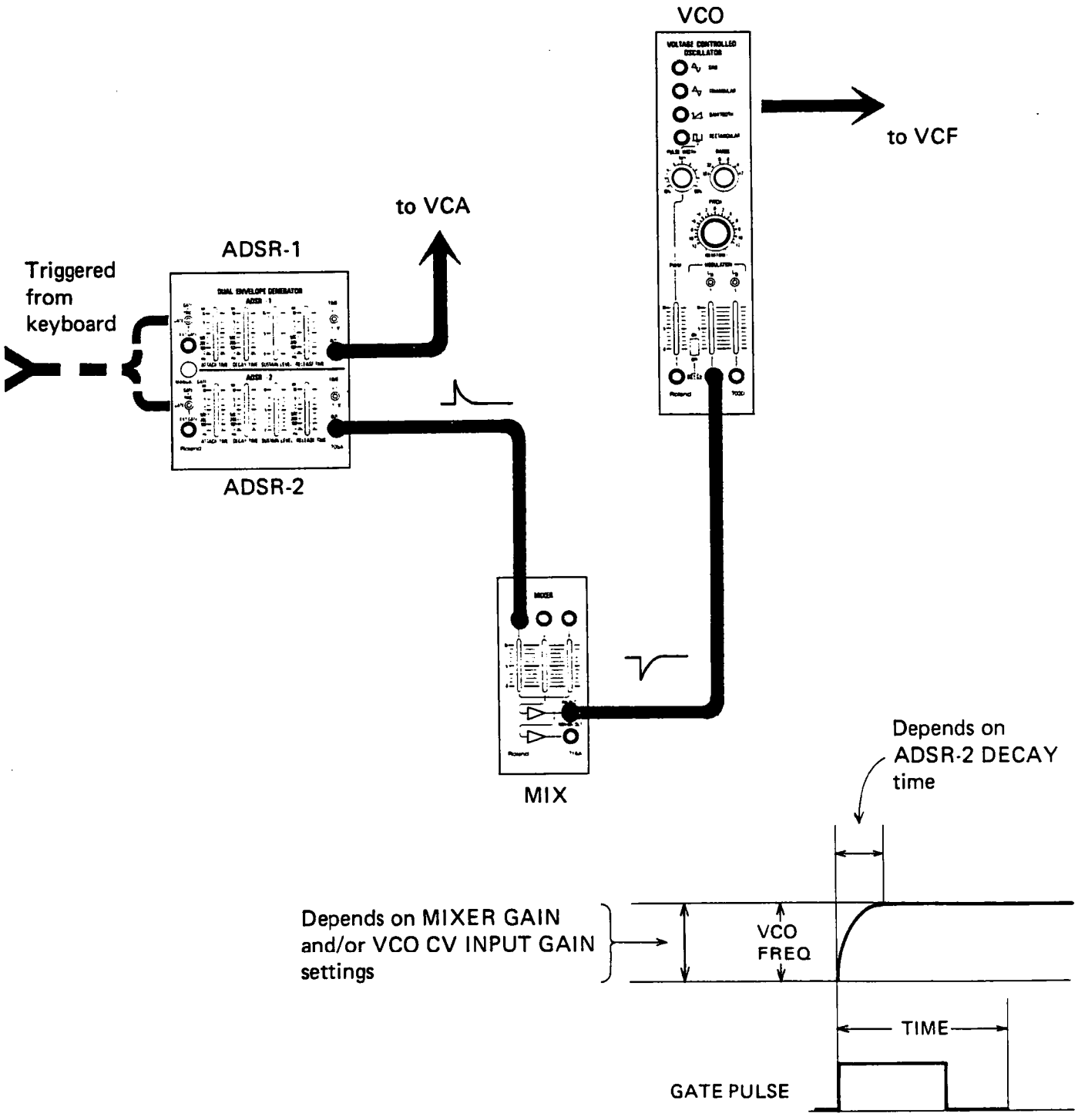
Using the 714A INTERFACE



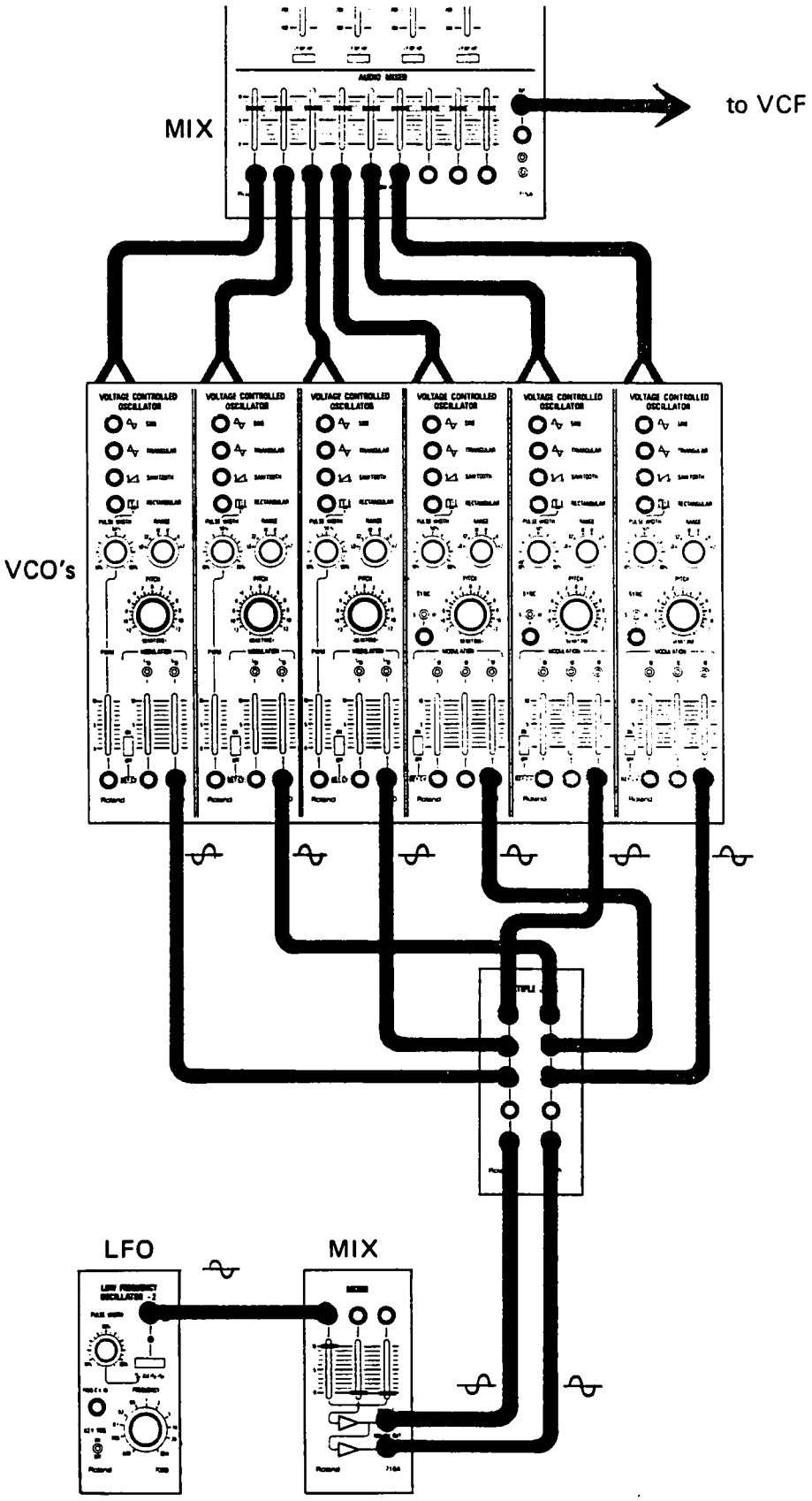
Using the 715A MULTIMODE FILTER to create a singing voice



Using the 716A MIXER to create glide



LARGE Chorus effect using normal and inverted LFO modulation

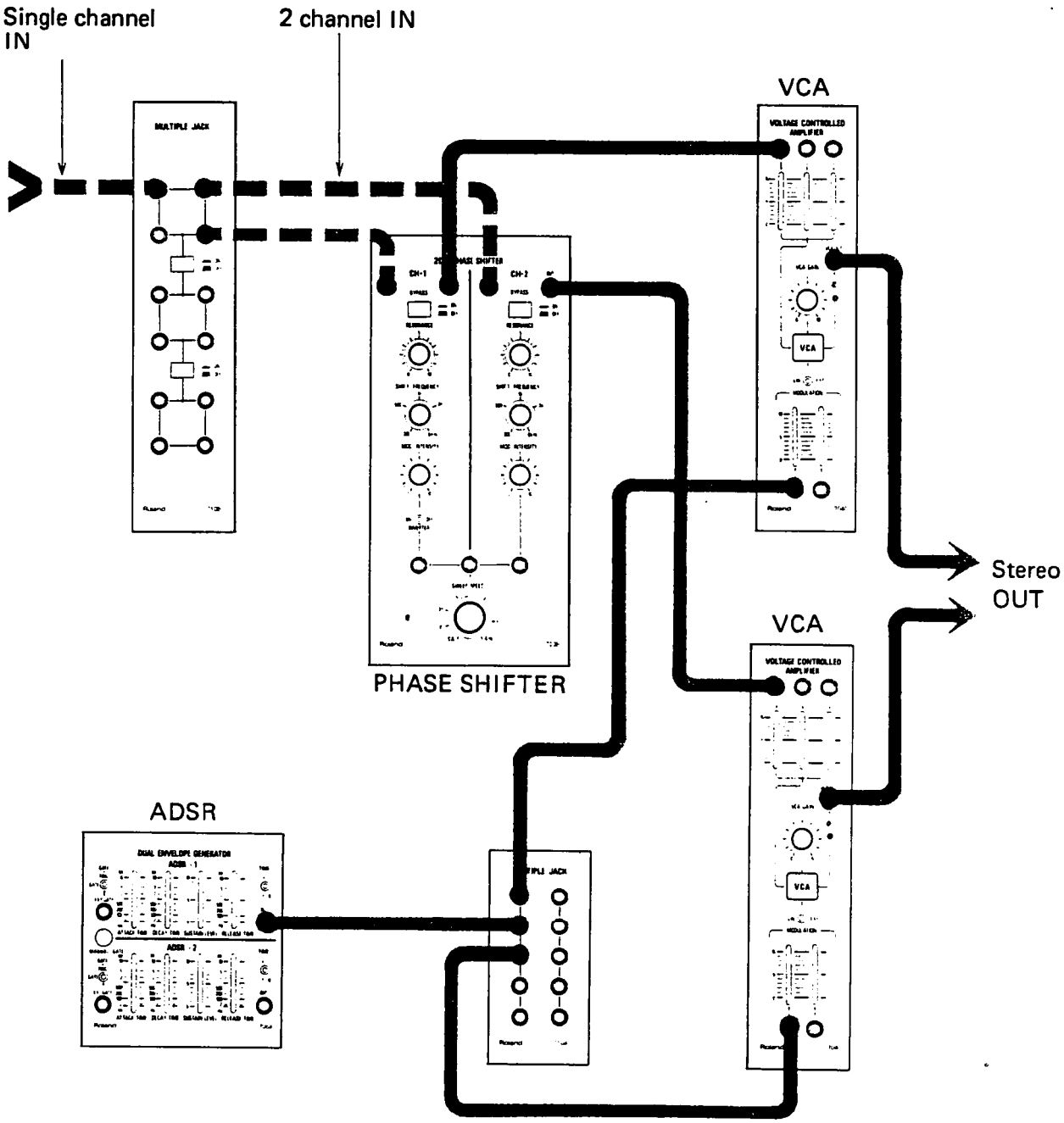


Applications of the 717A SEQUENCER are shown in SECTION 4.

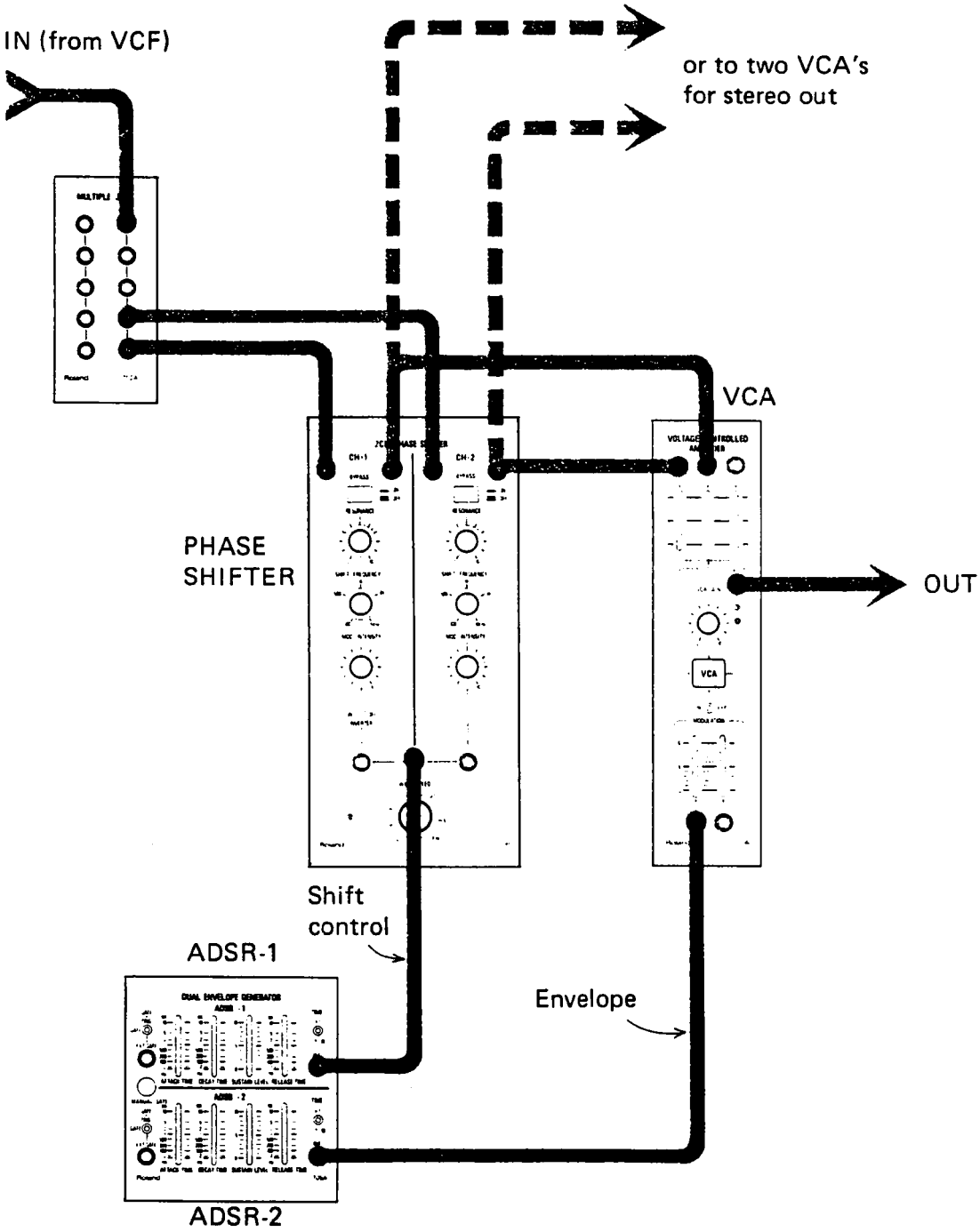
720A 2CH PHASE SHIFTER

(The 721A AUDIO DELAY is used in the same way)

Connecting this way reduces S/N.



ADSR control of PHASE SHIFTER sweep oscillator



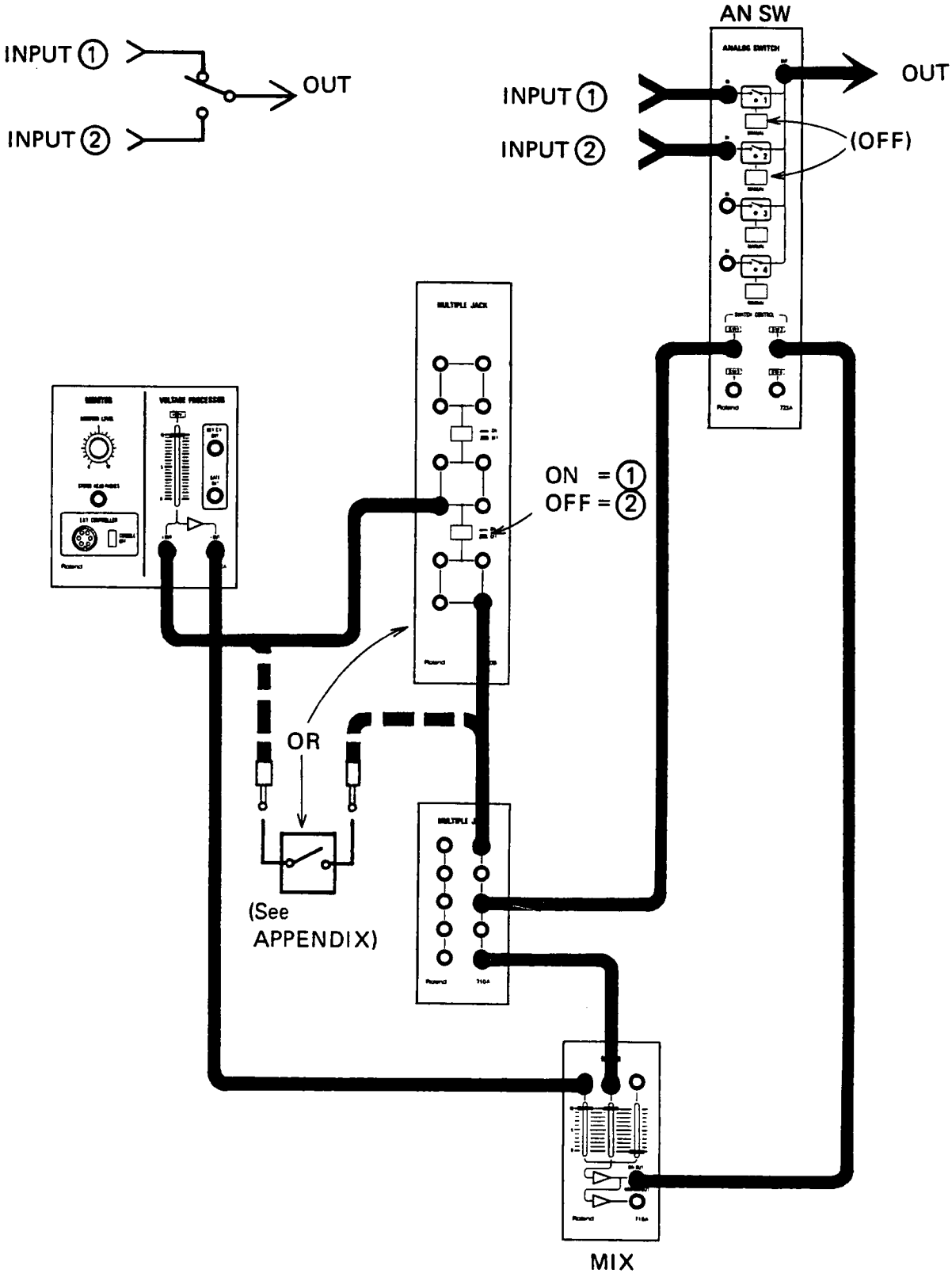
This arrangement is good for creating certain sounds such as the Japanese shakuhachi.

721A 2CH AUDIO DELAY

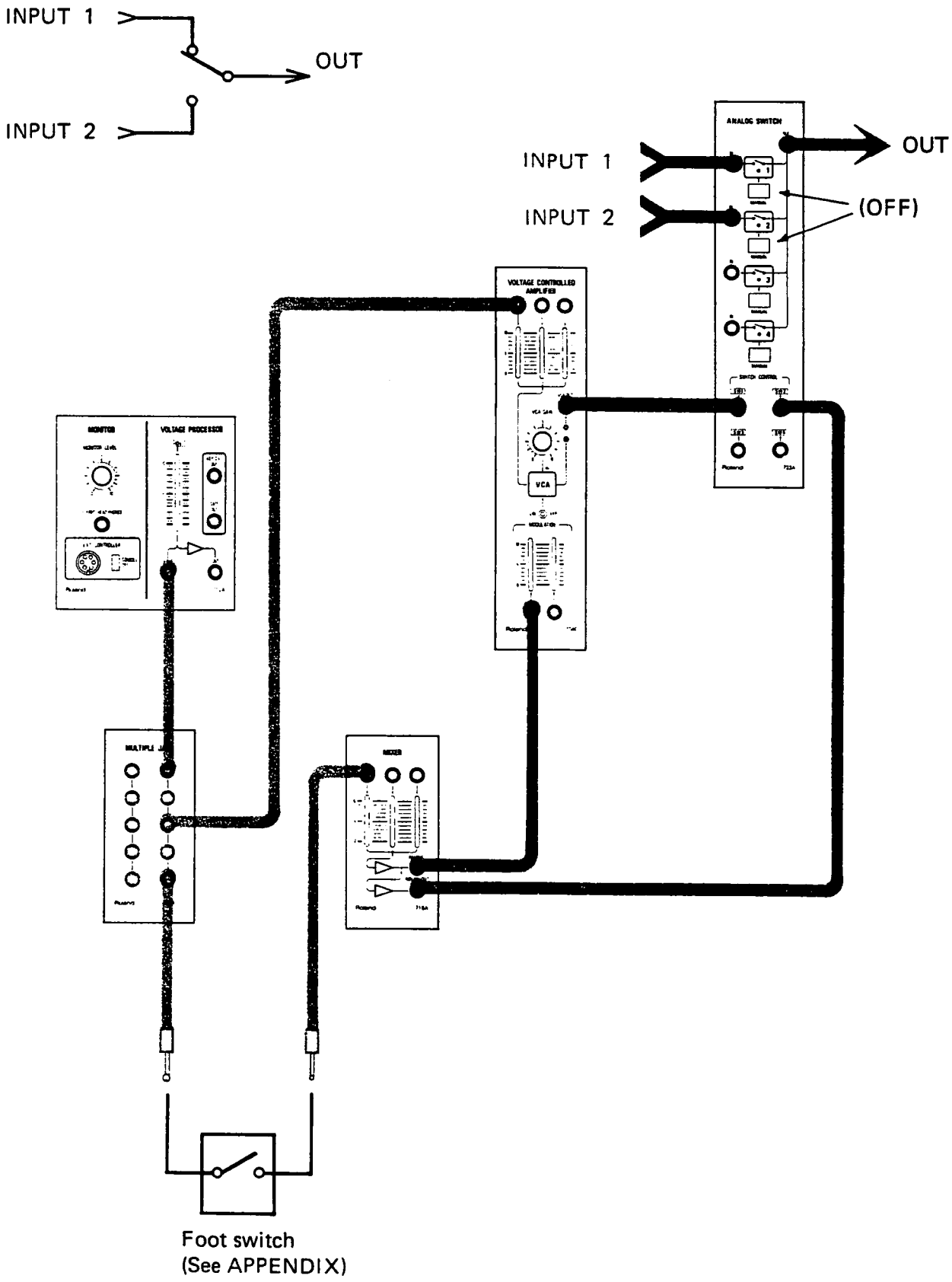
(See 720A 2CH PHASE SHIFTER)

723A ANALOG SWITCH

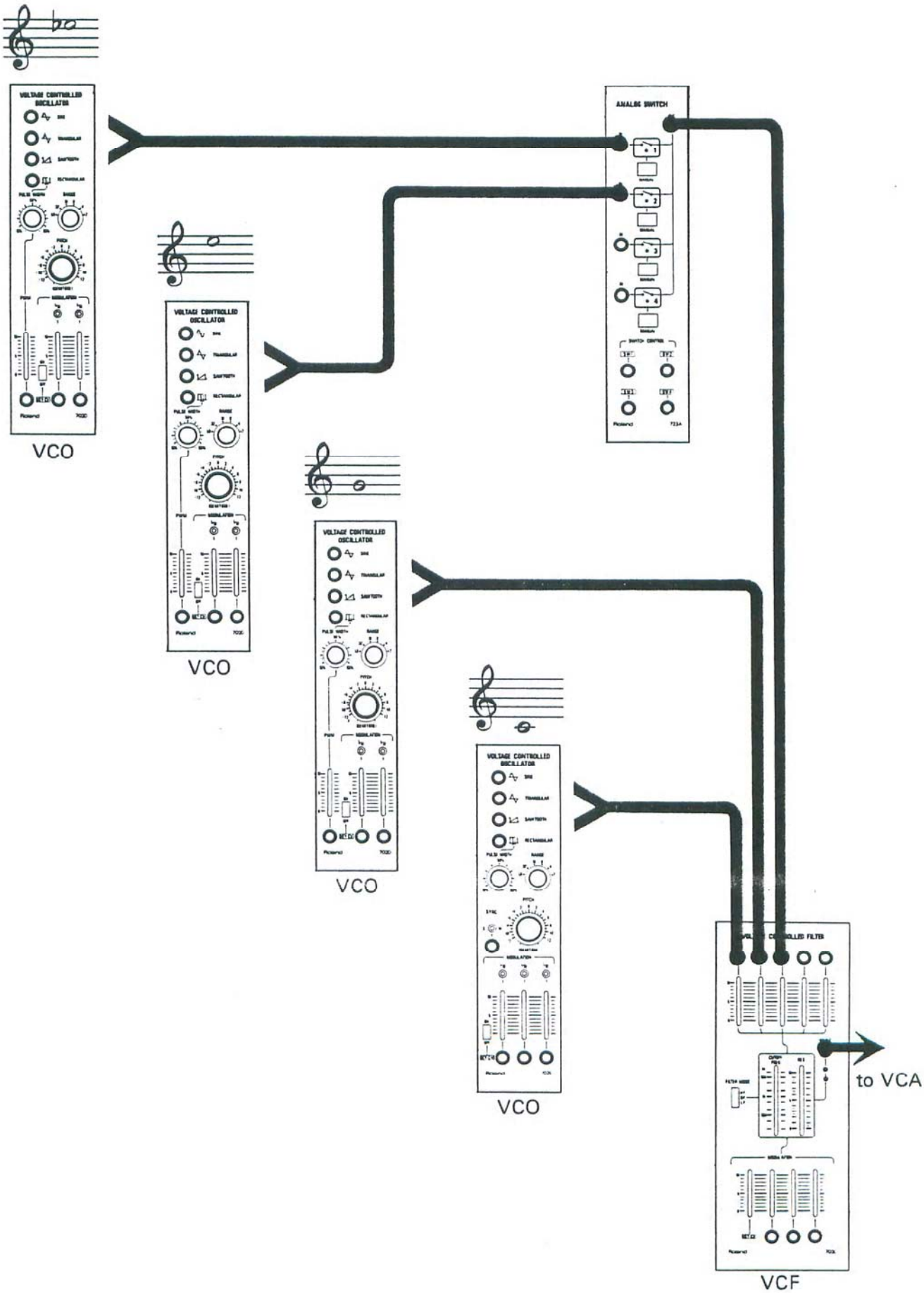
One touch transfer control



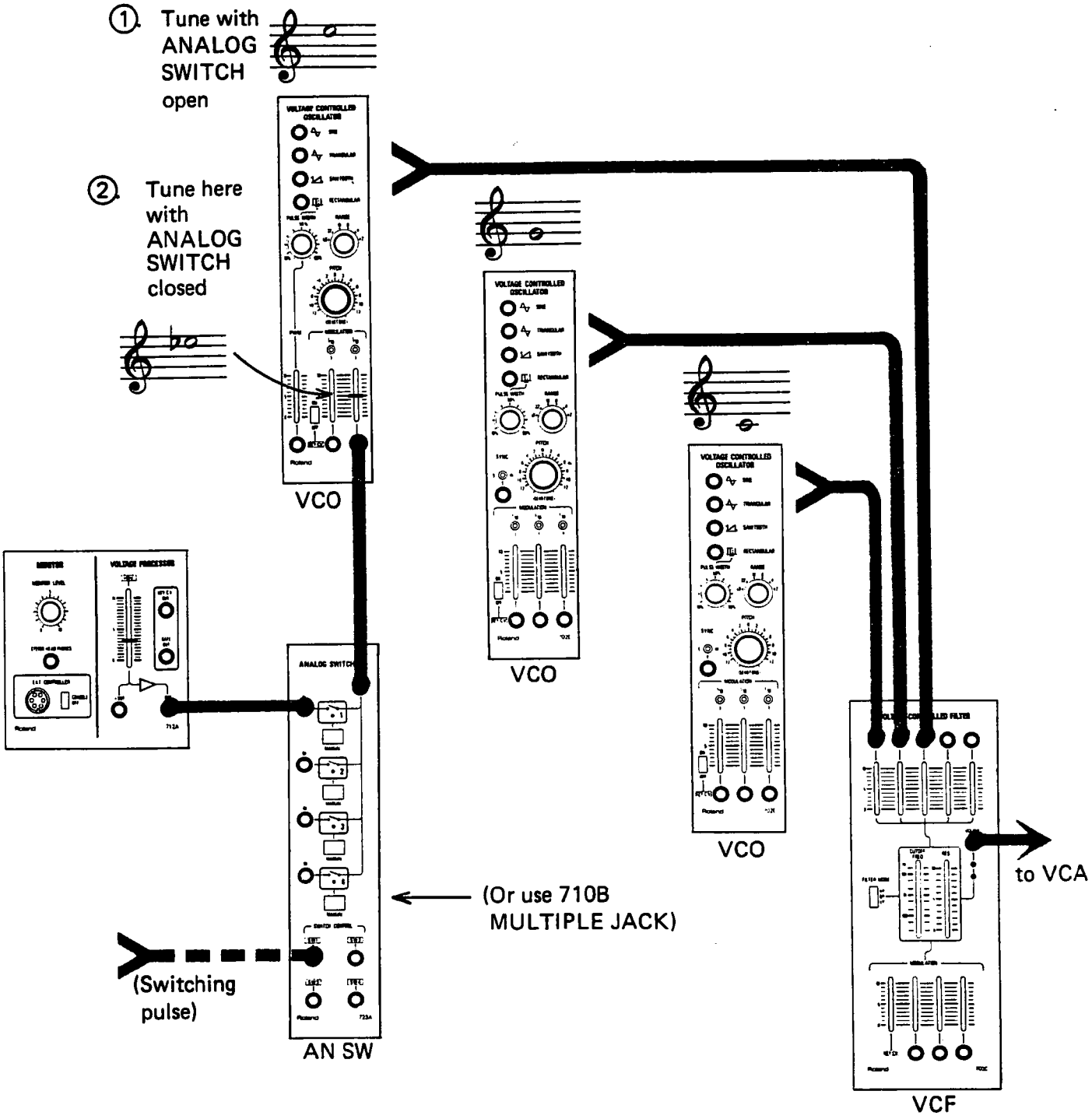
Foot control of transfer function



Using the 723A ANALOG SWITCH to control the major/minor quality of triads



Controlling major/minor quality of triads

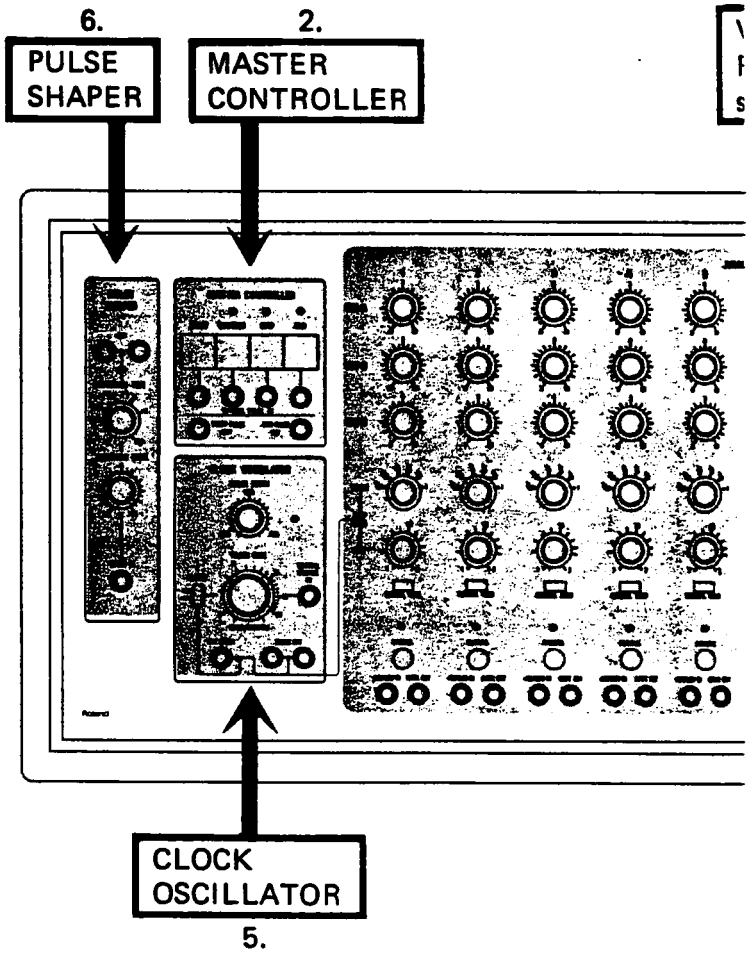


SEQUENCER

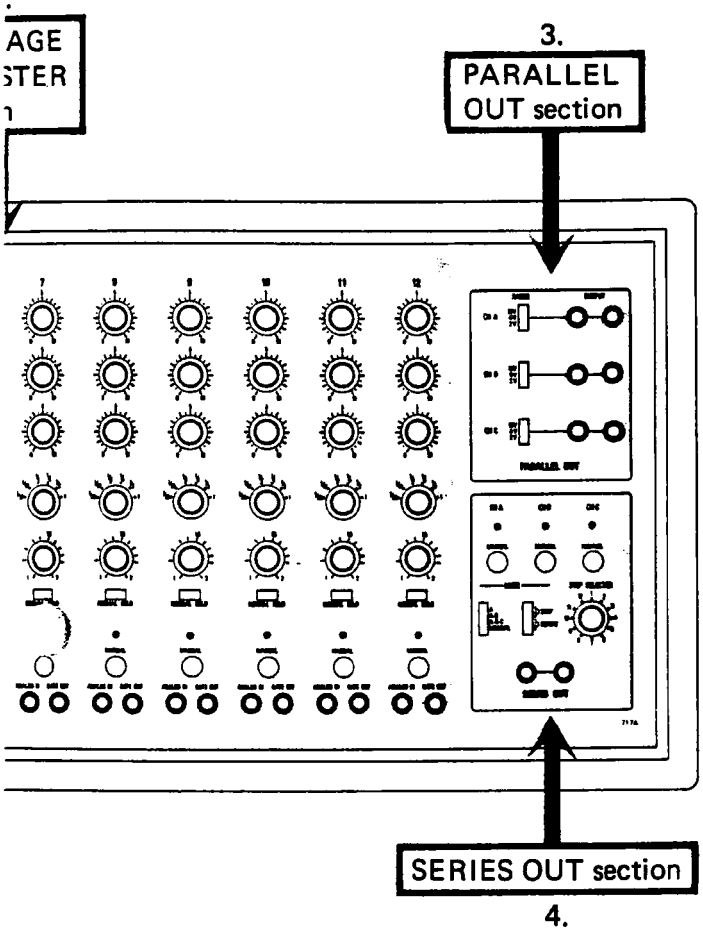
SECTION

4

717A ANALOG SEQUENCER



SECTION 4

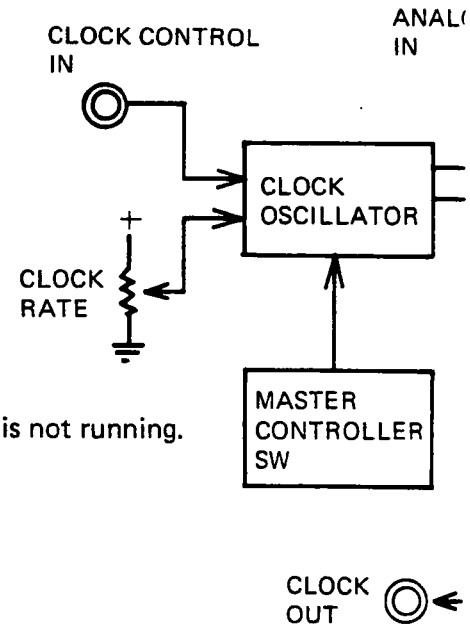


SECTION 4

717A ANALOG SEQUENCER

Specifications:

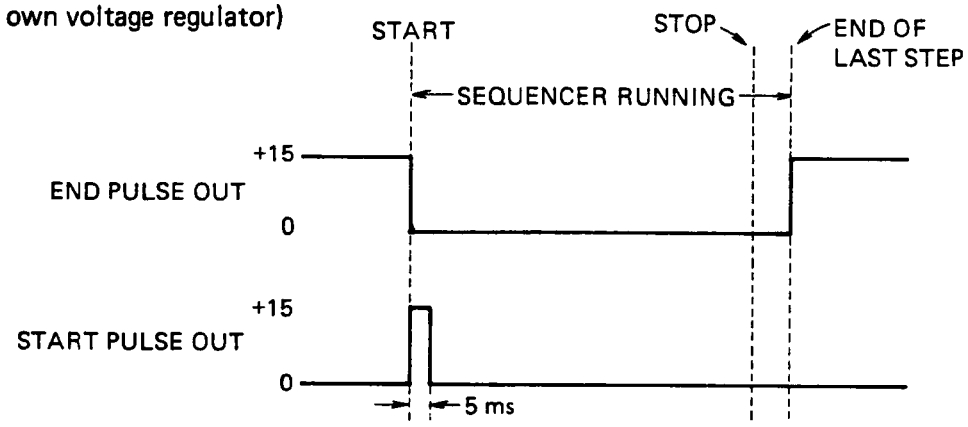
Steps:	
Parallel out:	0 – 12
Series out:	0 – 36
Output voltage:	0-2.5V; 0-5V; 0-10V
Analog input:	±10V/17kΩ
Gate out:	+15V
Clock out:	+15V square wave
External clock in sensitivity:	more than +10V
Clock control voltage in sensitivity:	1V doubles clock rate
Clock frequency:	2 steps/1 min – 20 steps/1 min 20 steps/1 min – 200 steps/1 min
Start pulse out:	+15V 0.5 ms
End pulse out:	+15V continuous when sequencer is not running.
Control pulse in sensitivity:	+7V
Output impedances:	600Ω

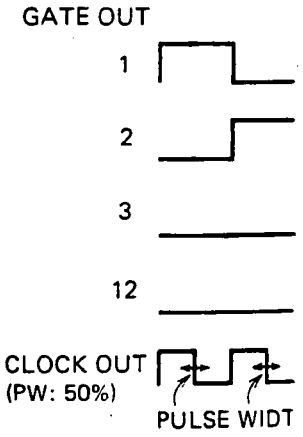


PULSE SHAPER SECTION

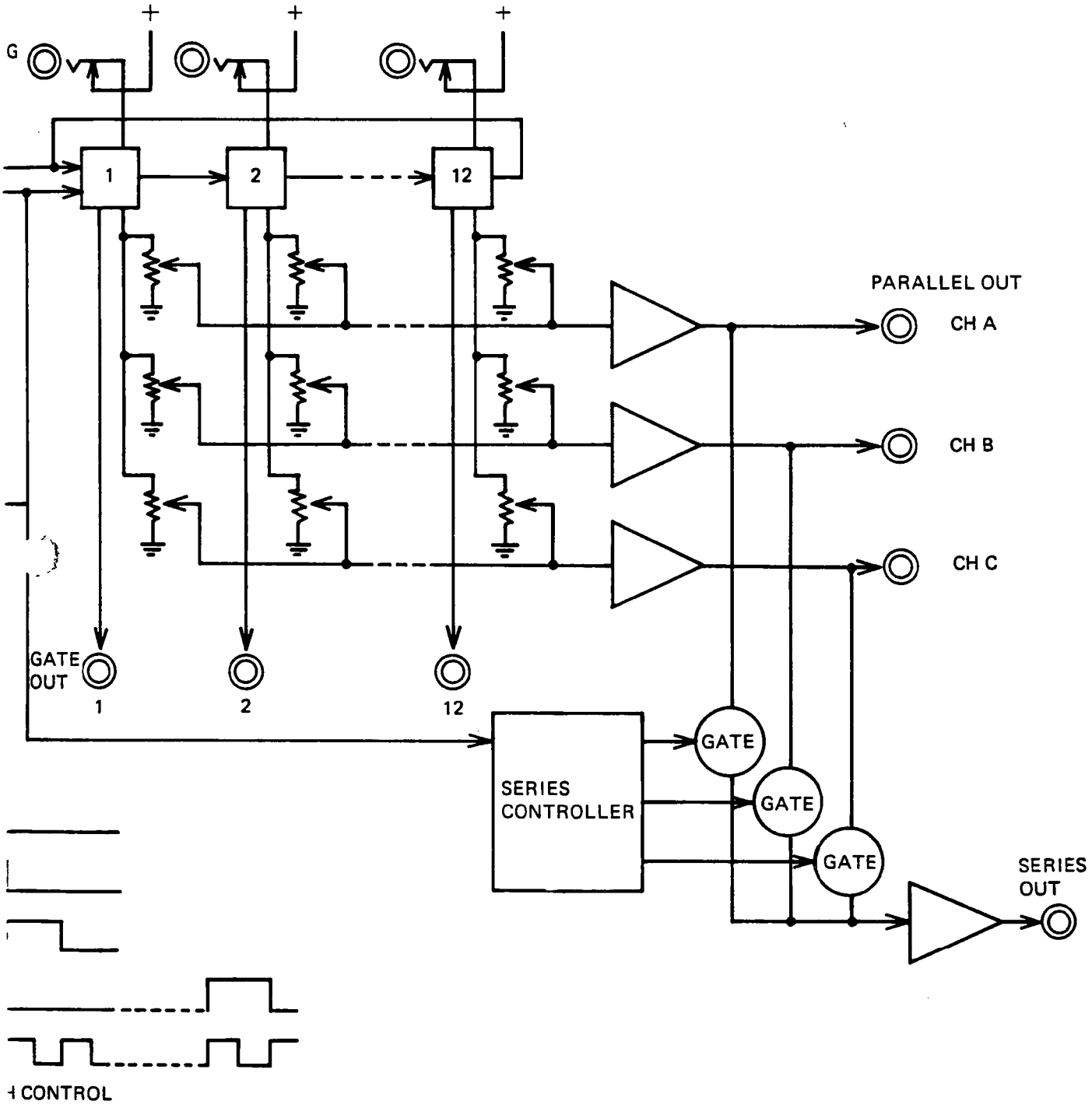
Input level:	0 – +10V
Switch on time:	0 – 3 sec.
Pulse out:	+15V
Input impedance:	100kΩ
Output impedance:	600Ω

POWER SUPPLY REQUIREMENTS:
+23V ± 10% @150ma
–23V ± 10% @70ma
(The SEQUENCER contains its own voltage regulator)

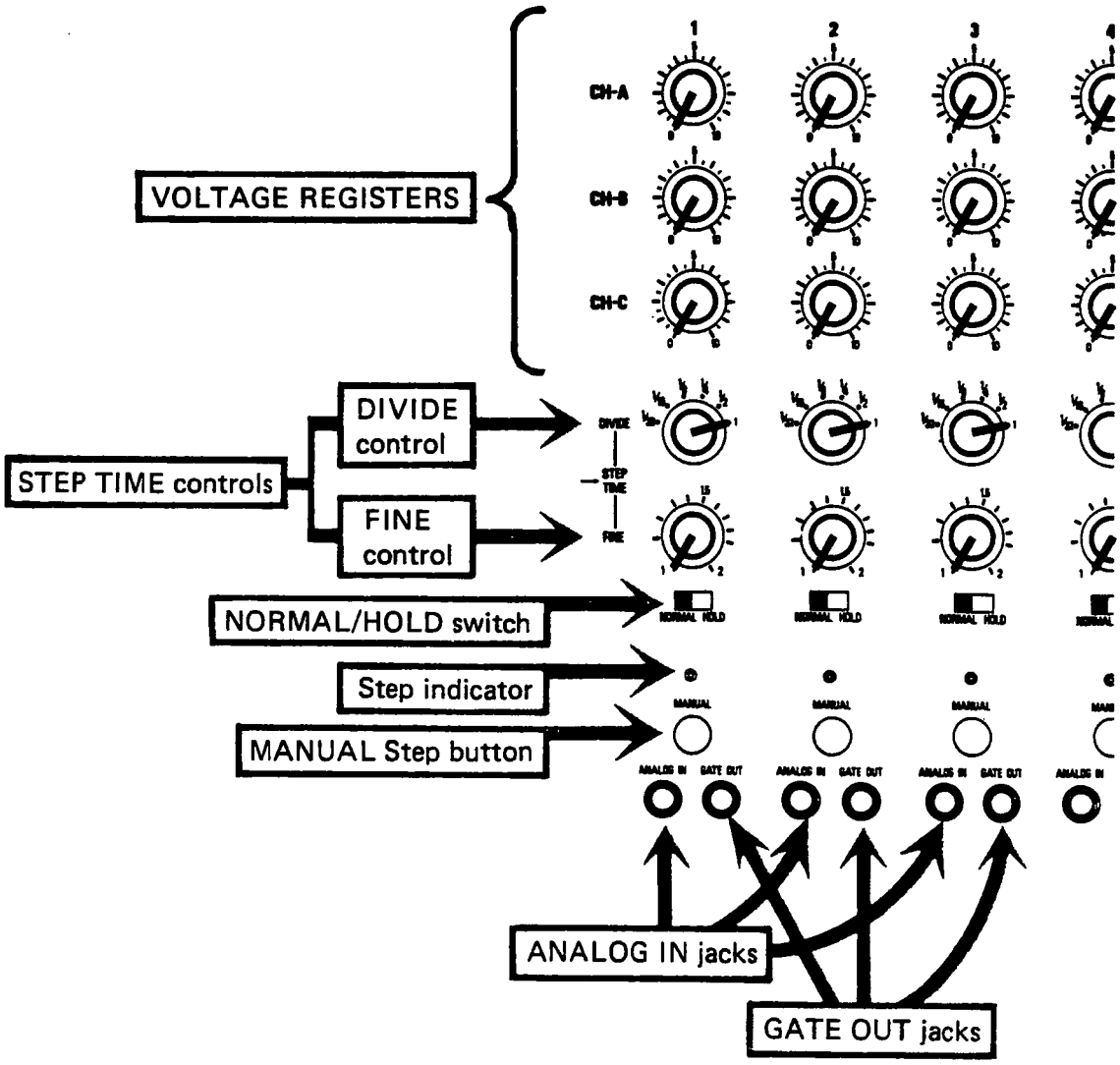




717A ANALOG SEQUENCER block diagram



1. VOLTAGE REGISTER section



1. VOLTAGE REGISTER SECTION

The VOLTAGE REGISTERS determine the voltage outputs for each step in the sequence.

The STEP TIME controls determine the relative time between each step in the sequence.

The DIVIDE control is conveniently divided into fractions of 1 for ease in programming note time values in musical sequences.

The FINE control allows for setting infinite increments between the DIVIDE control settings for programming dotted notes, accelerando, rubato, etc.

The FINE controls are calibrated to increase the Step time from 1 to 2 times the DIVIDE control setting.

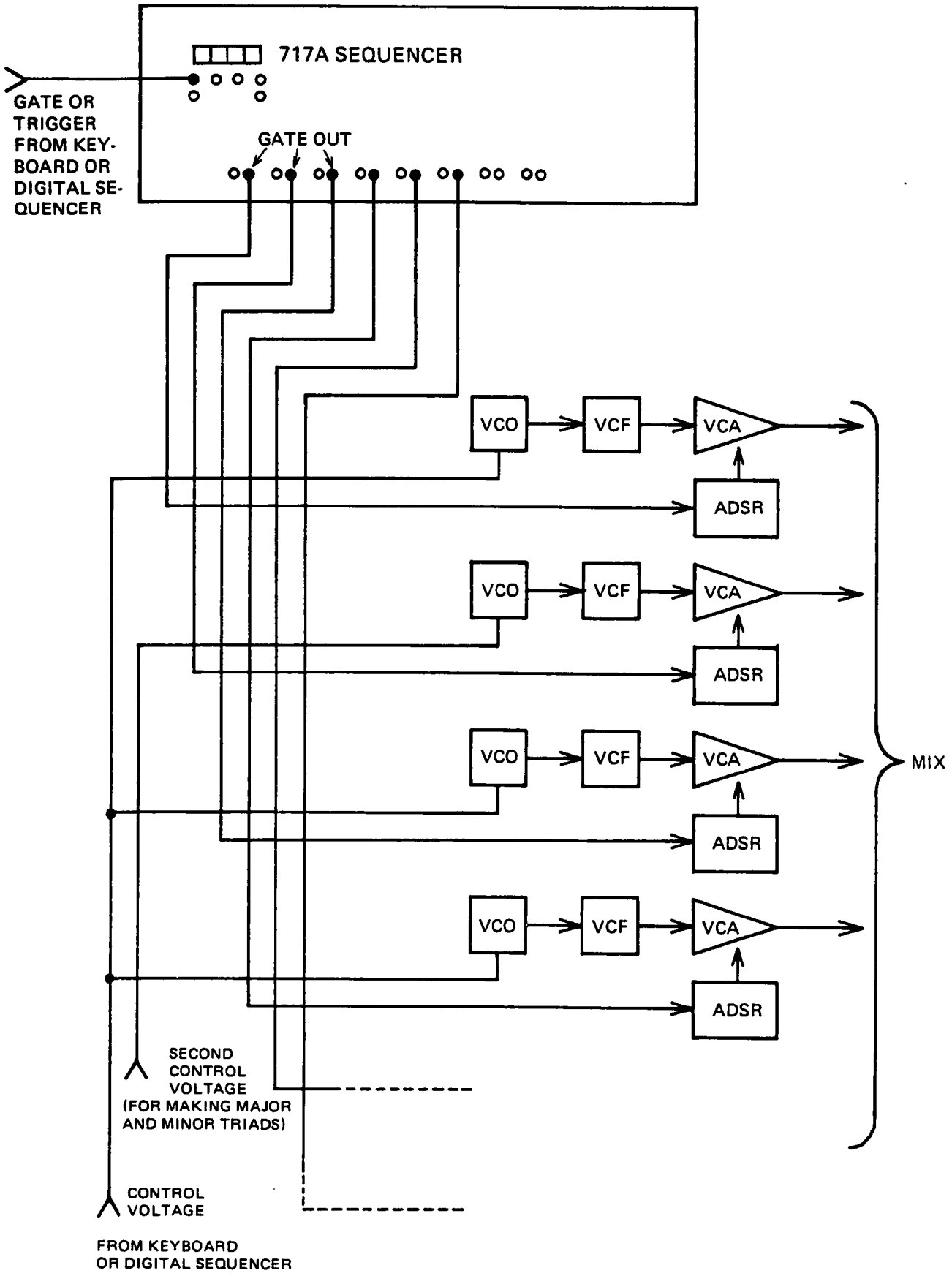
When a NORMAL/HOLD switch is in HOLD, there is no gate pulse output at the CLOCK OUT jack for that step. The voltage output of the previous VOLTAGE REGISTER is held over. This allows for the programming of parallel melodies which are different rhythmically, or for the programming of rests.

The red LED shows which Step is in effect at the output. Pushing a MANUAL button immediately establishes that step at the output whether the sequencer is running or not.

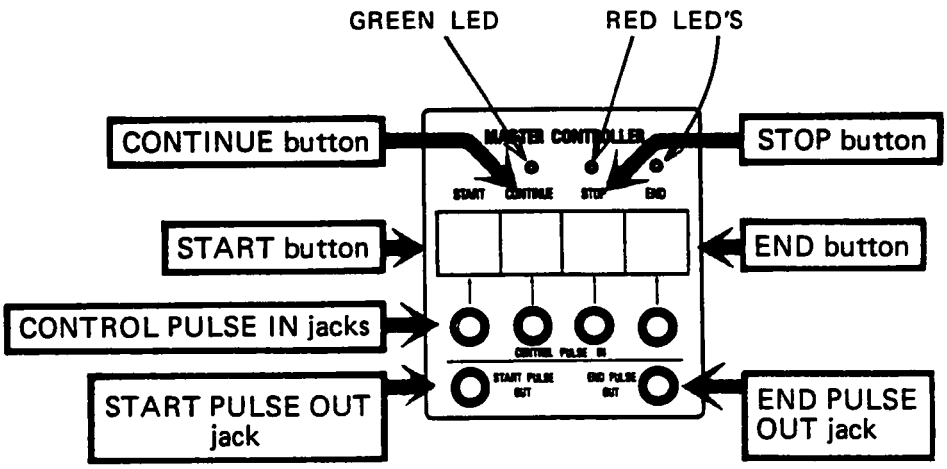
Gate pulses appear at the GATE OUT jacks even with the NORMAL/HOLD switch in HOLD. When the sequencer is not running, +15 volts appears at the GATE OUT jack whose LED is lit.

The ANALOG IN jacks allow the sequencer to be used as an electronic switching device. The jacks will take both audio signals and control voltages. When using ANALOG IN, the VOLTAGE REGISTERS act as output level controls.

SUSTAINED ARPEGGIO



2. MASTER CONTROLLER



2. MASTER CONTROLLER

The MASTER CONTROLLER controls the sequencer run functions.

The sequence will always start with Step 1 (Channel A when in SERIES mode) when START is pushed.

Pushing CONTINUE starts the sequence at the Step after the Step in effect at the time the button is pushed.

The green LED above CONTINUE lights when the sequencer is running.

STOP stops the sequence immediately.

The red LED above STOP lights when the sequencer is not running.

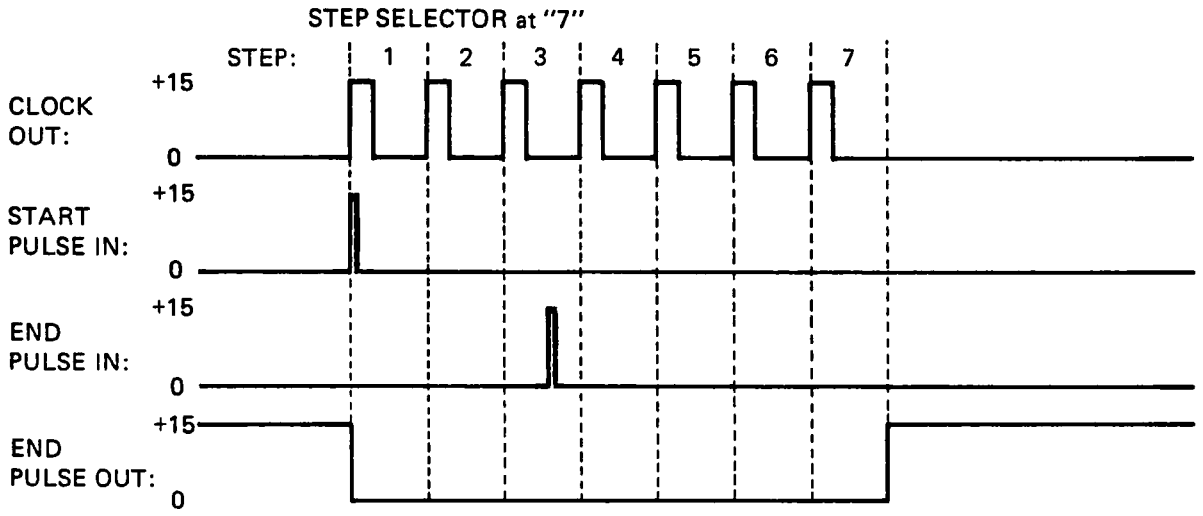
After END is pushed, the sequencer will stop running the next time the End Step (see p.4-3) shows up in the sequence.

The red LED above END lights when END is pushed and remains lit until the sequencer stops running to show that the END function has been activated.

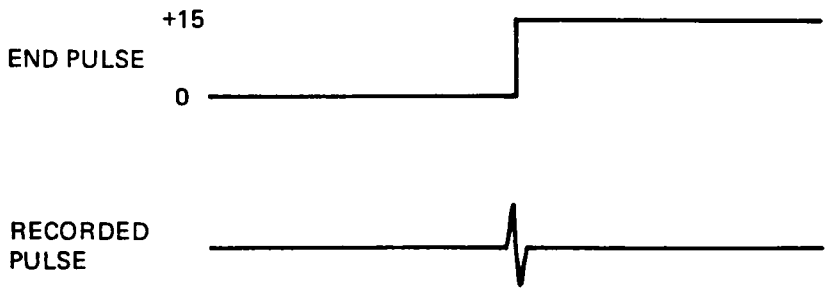
The CONTROL PULSE IN jacks allow the sequencer run functions to be controlled externally.

The START PULSE OUT jack allows simultaneous triggering of a second sequencer in parallel or can be used to trigger some other synthesizer function when the sequence run is started.

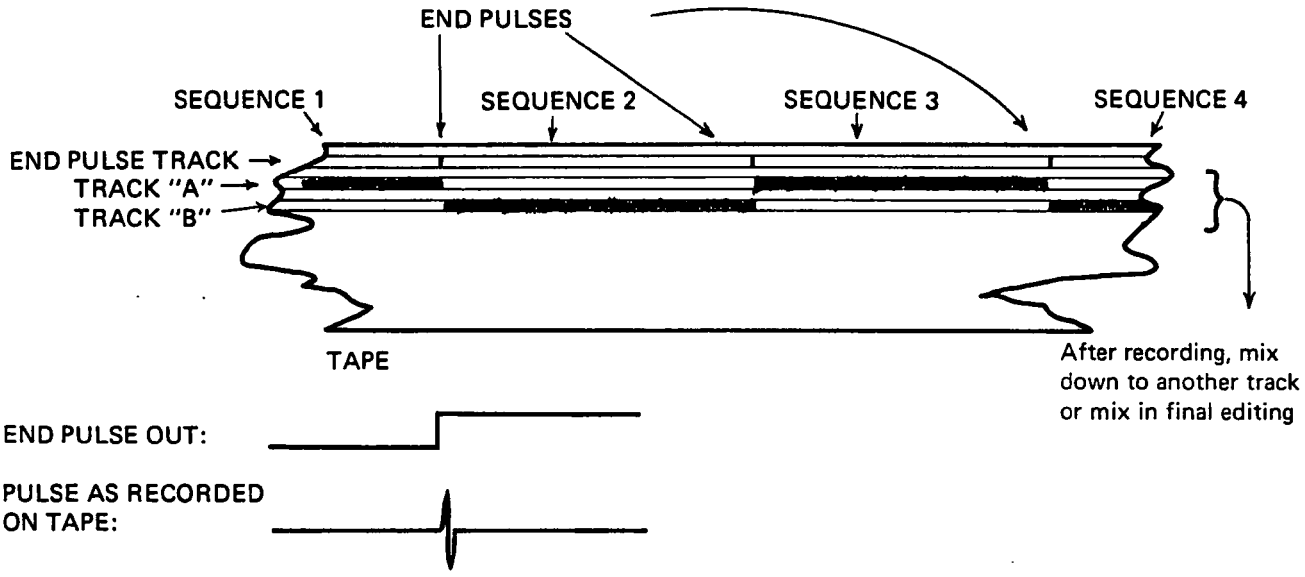
The output of the END PULSE OUT jack is +15 volts whenever the sequencer is not running. This +15 volts can be used for triggering a second sequencer in series, as well as other functions.

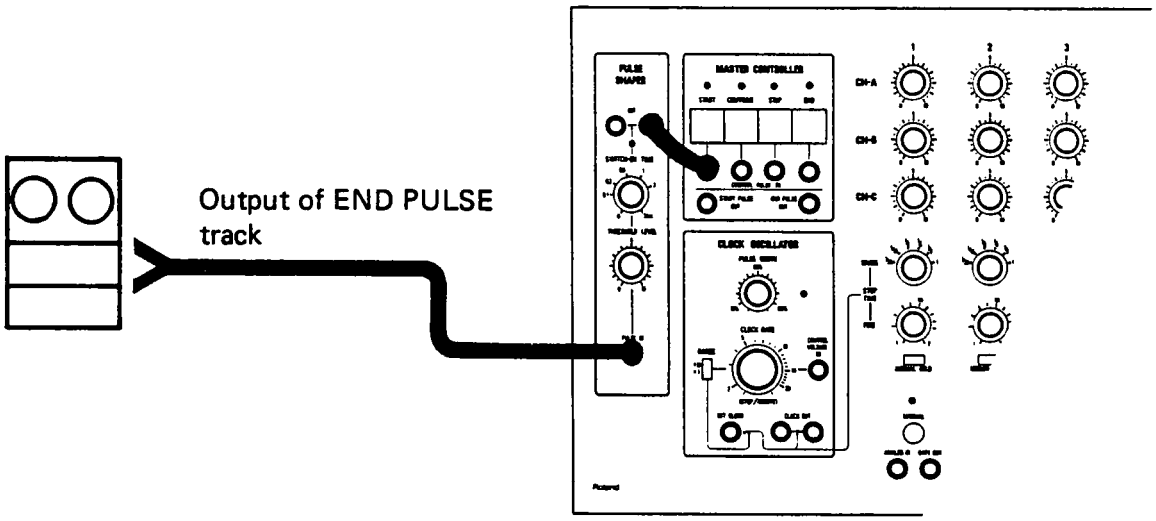


The END PULSE OUT can be recorded on tape and then by means of the PULSE SHAPER (see p.6-3) can be used for triggering the sequencer START function. In this way, any number of different sequences may be recorded on tape one after another without break in rhythm.

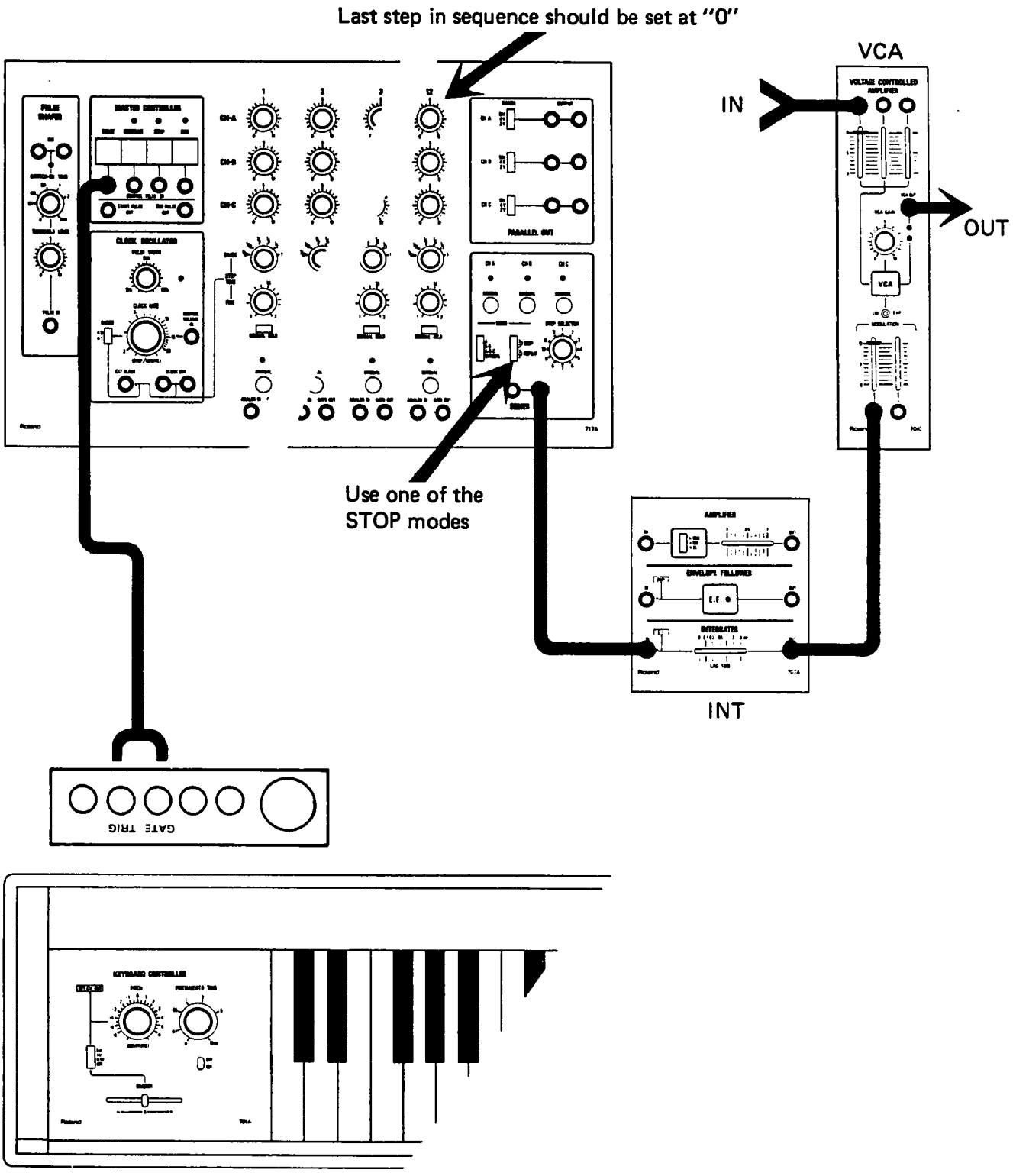


Recording successive sequences on tape.

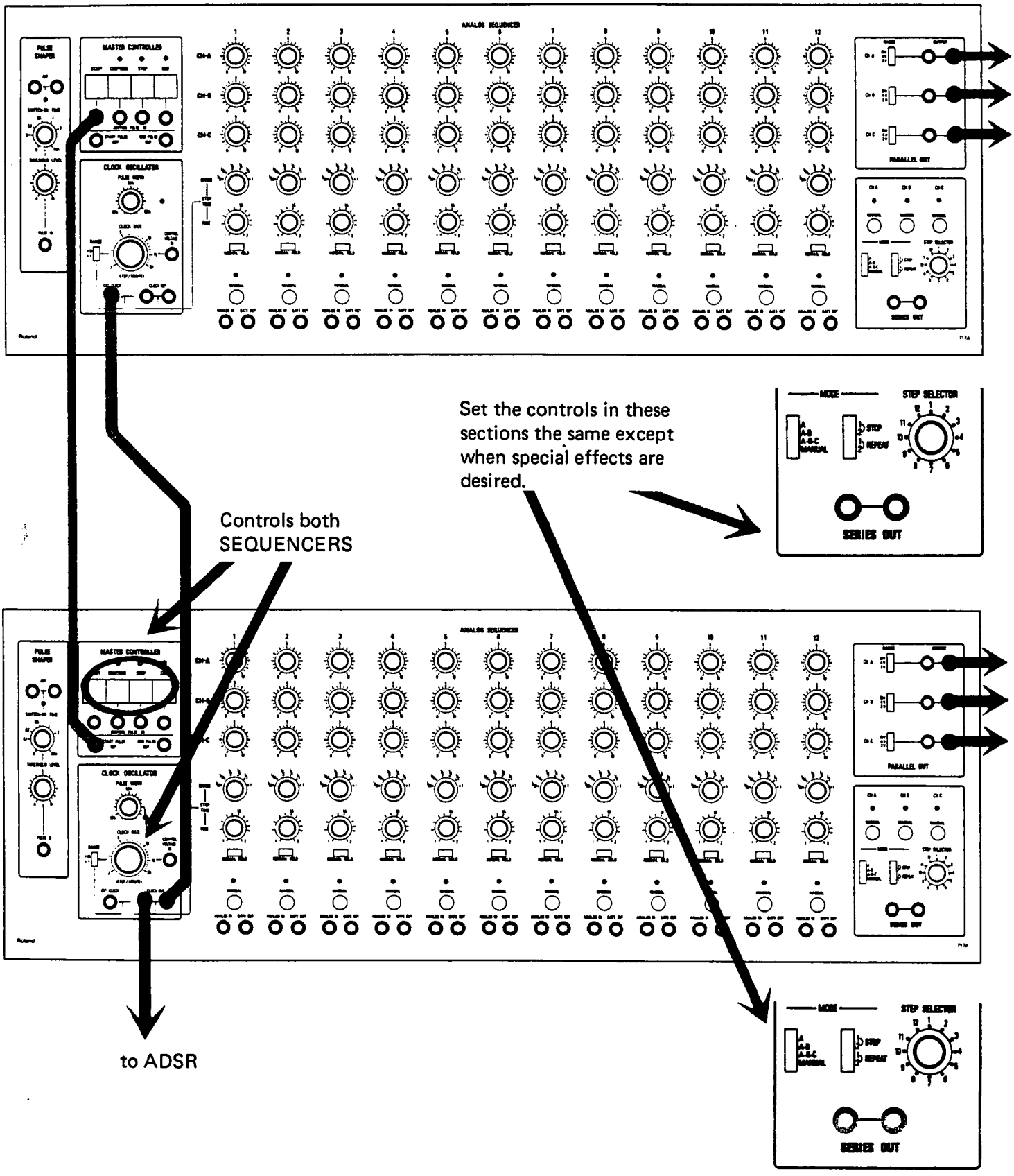




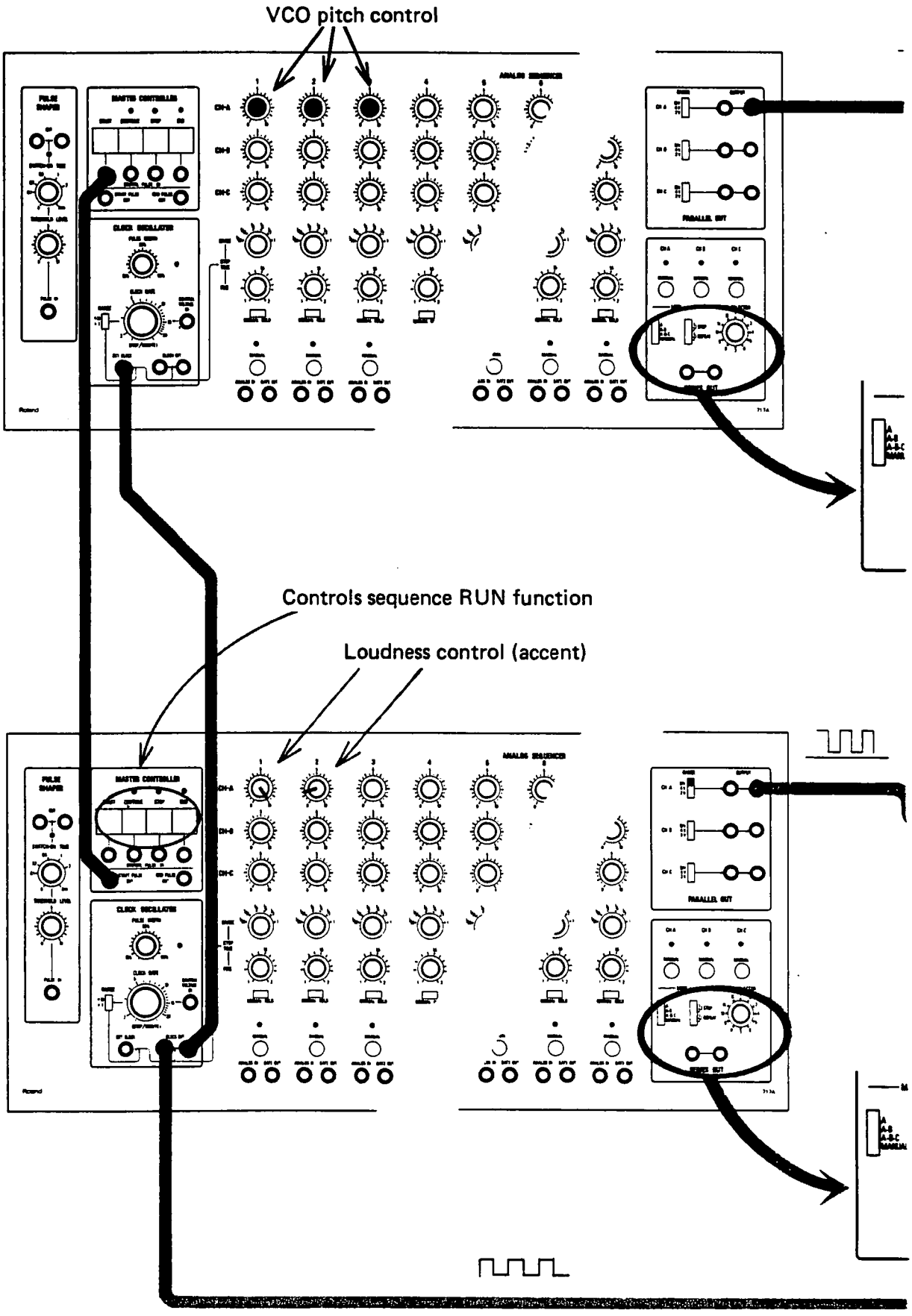
The SEQUENCER as a special envelope generator

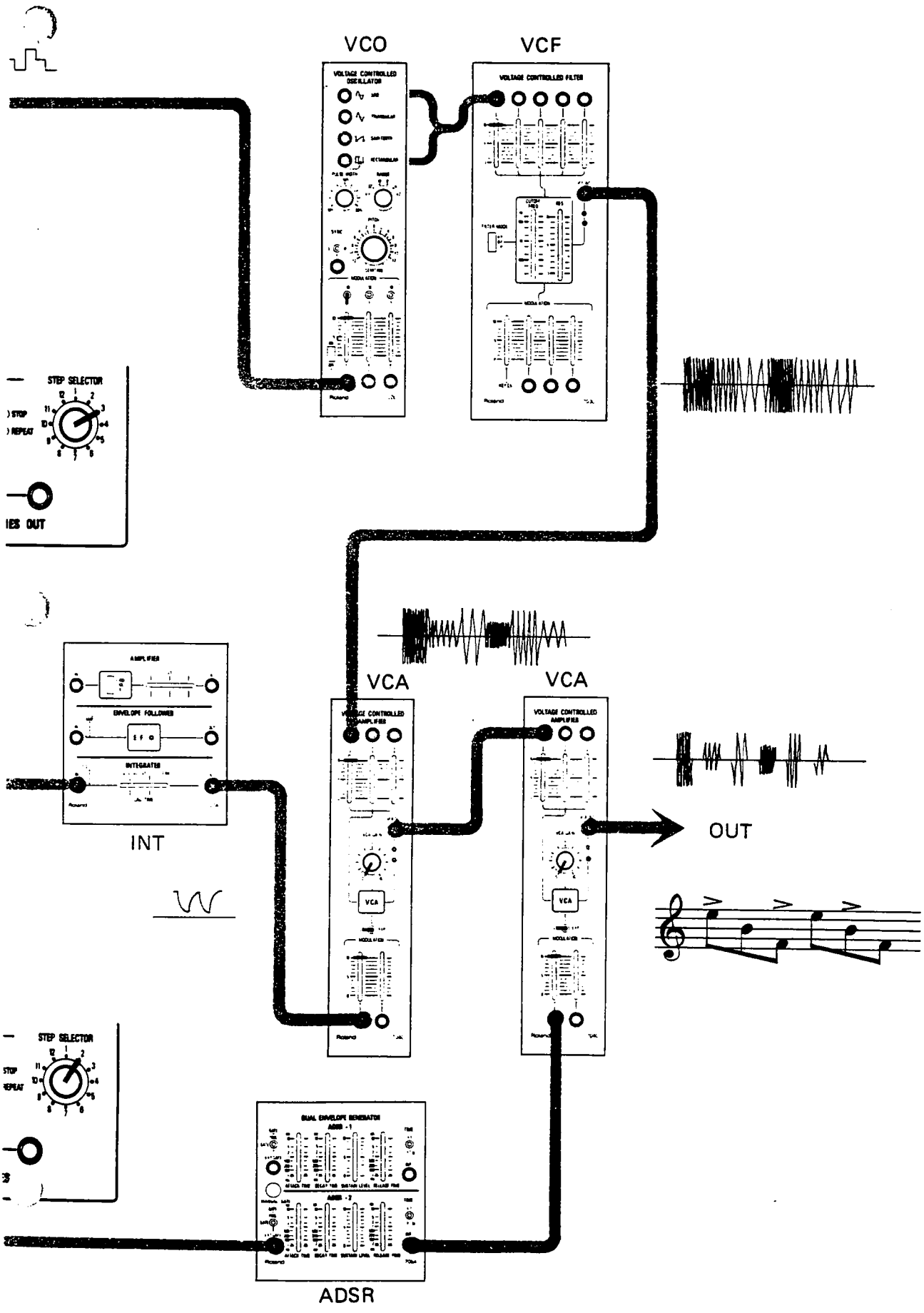


Two SEQUENCERS in parallel

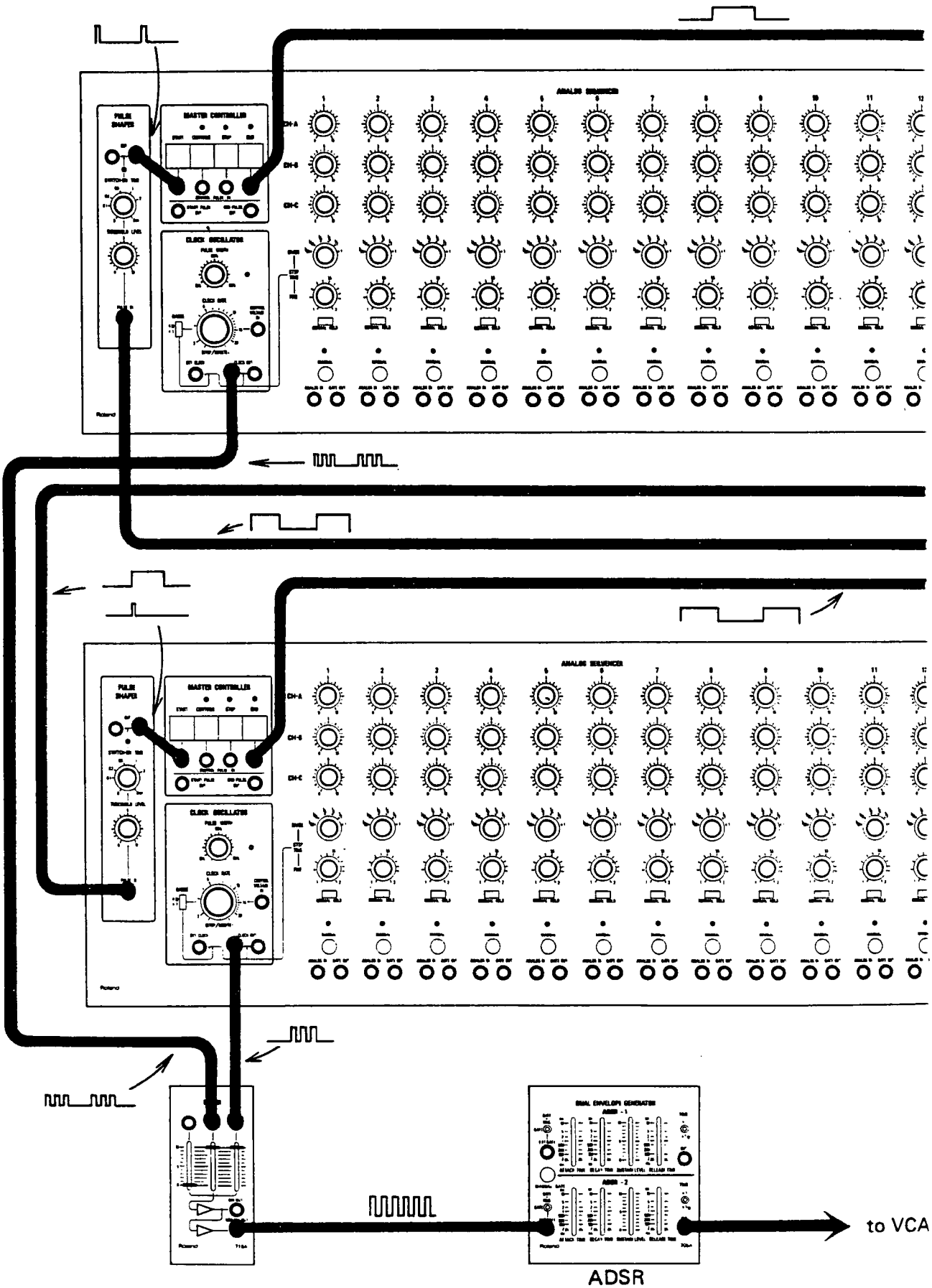


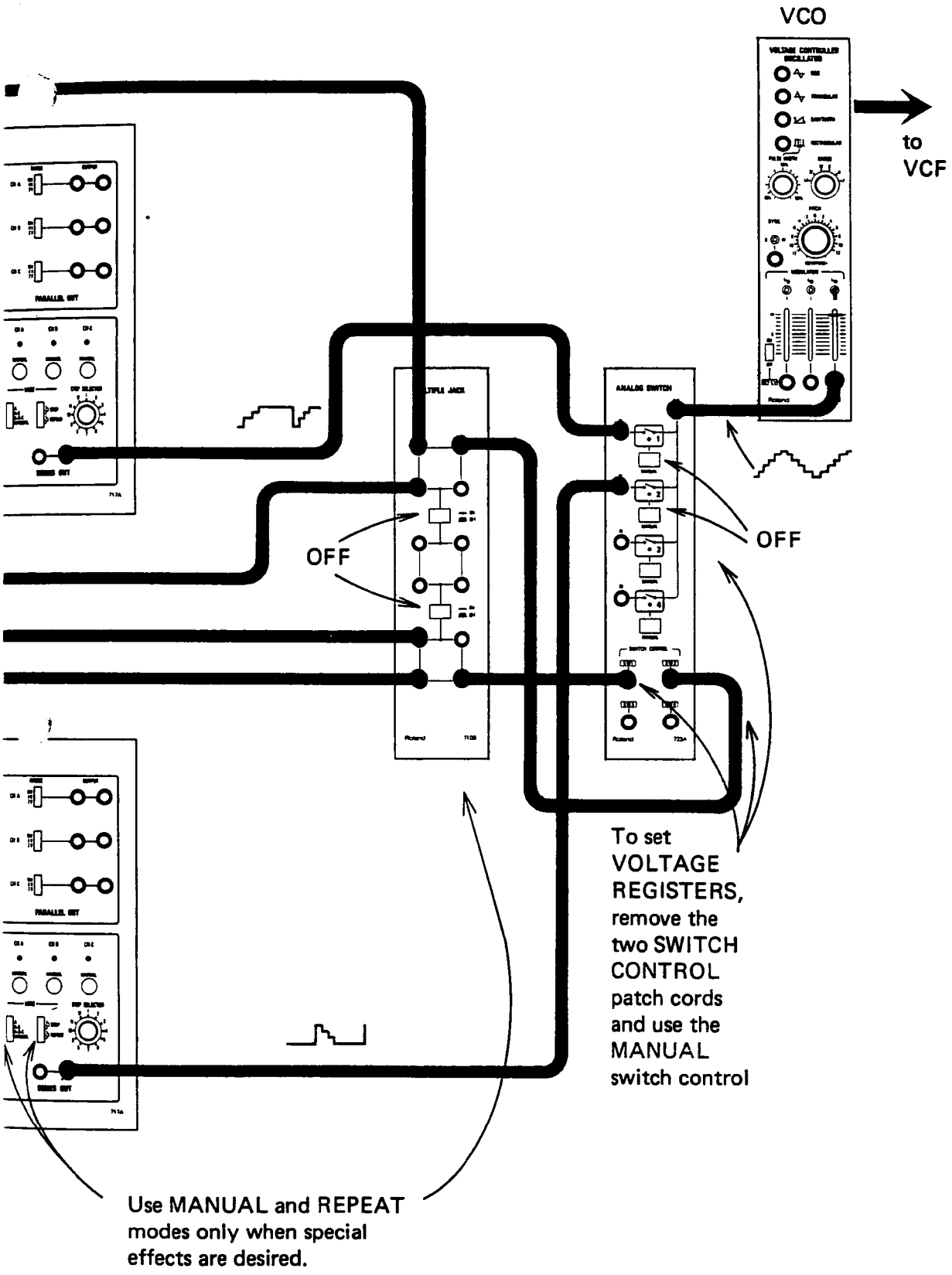
SEQUENCERS in parallel



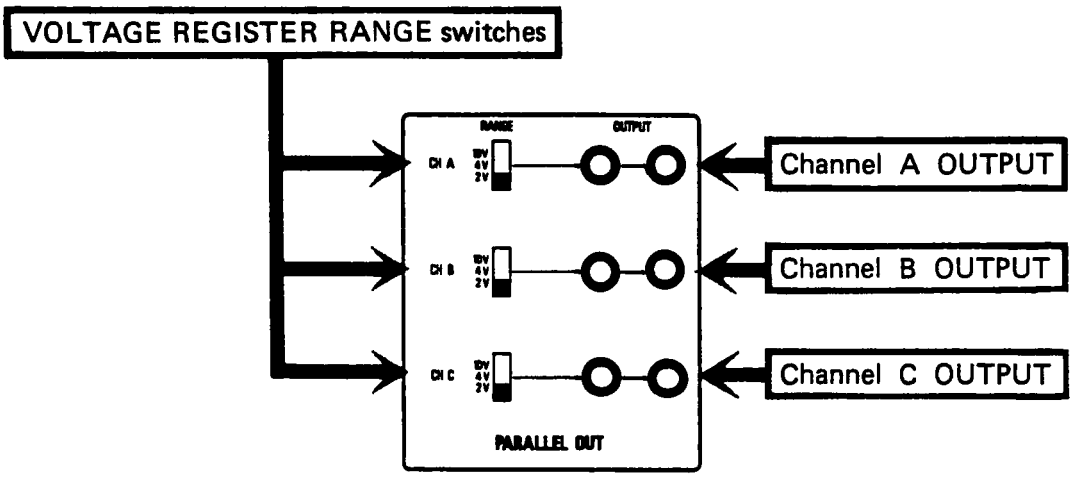


SEQUENCERS in series





3. PARALLEL OUT section

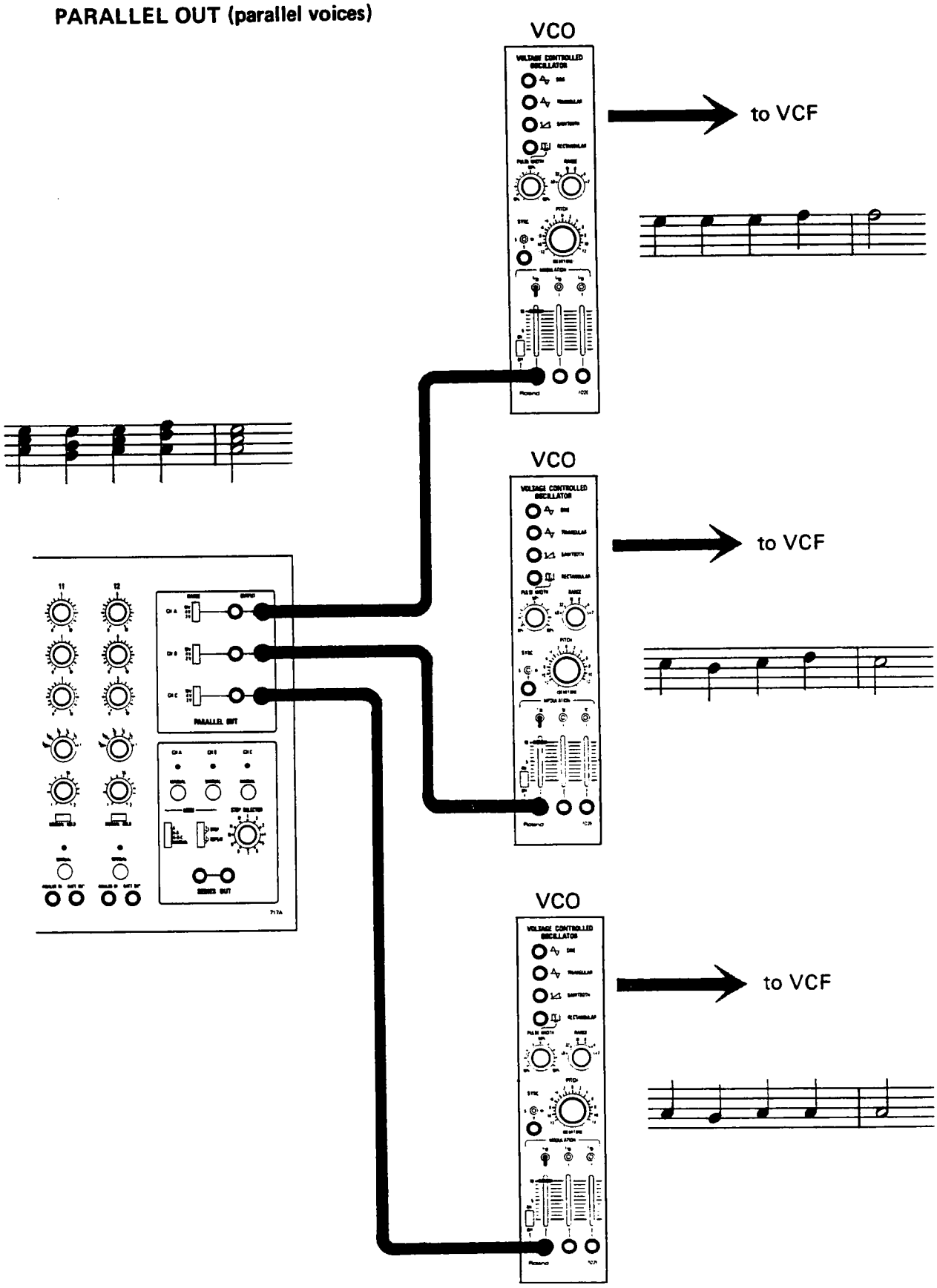


3. PARALLEL OUT

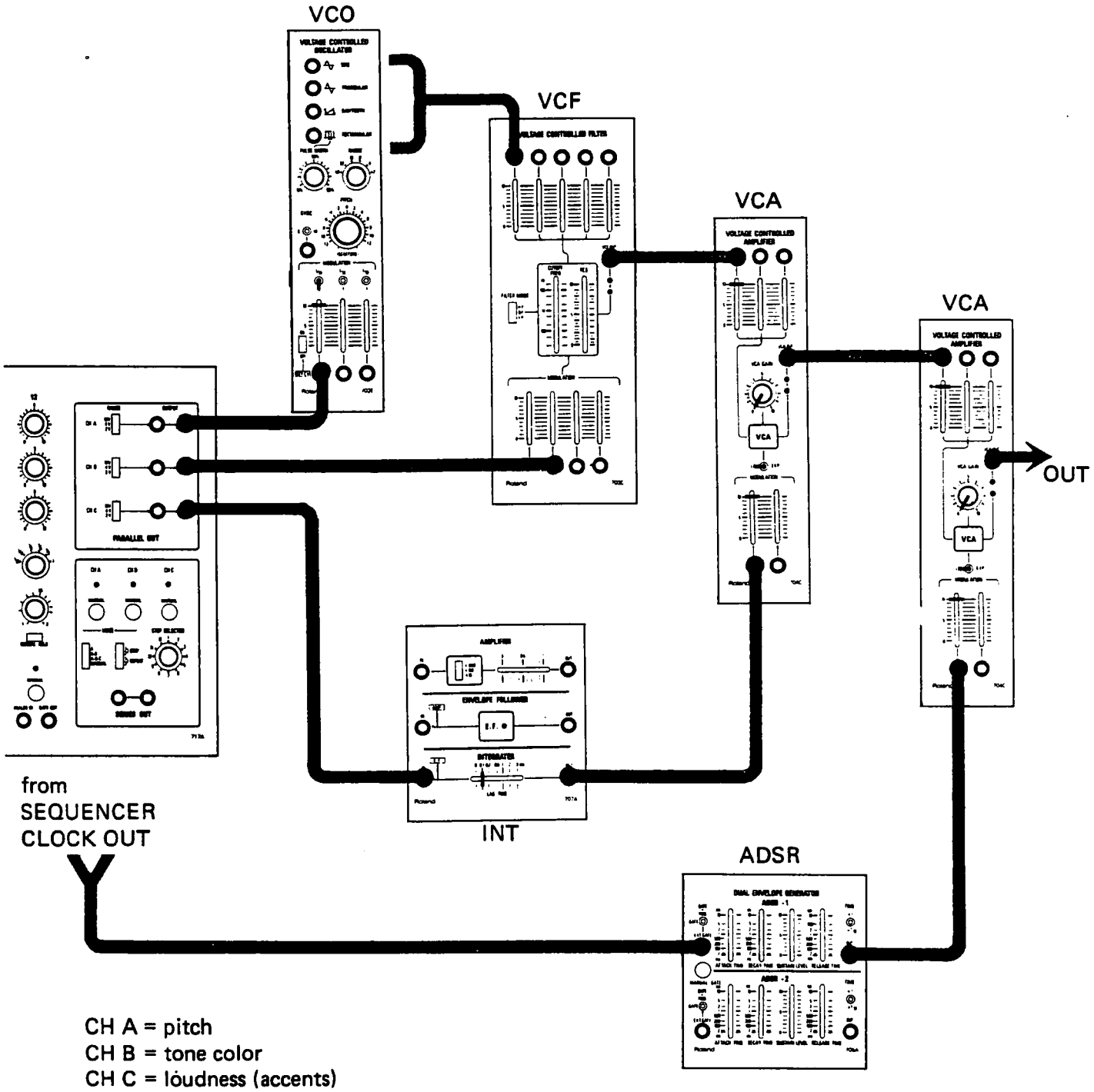
The PARALLEL OUT section allows for the setting of three parallel control voltages for each step in the sequence to allow for such things as the simultaneous control of VCO (pitch), VCF (tone color), and VCA (loudness); or for the programming of three parallel voice lines.

The RANGE switches determine the range covered by the VOLTAGE REGISTERS.

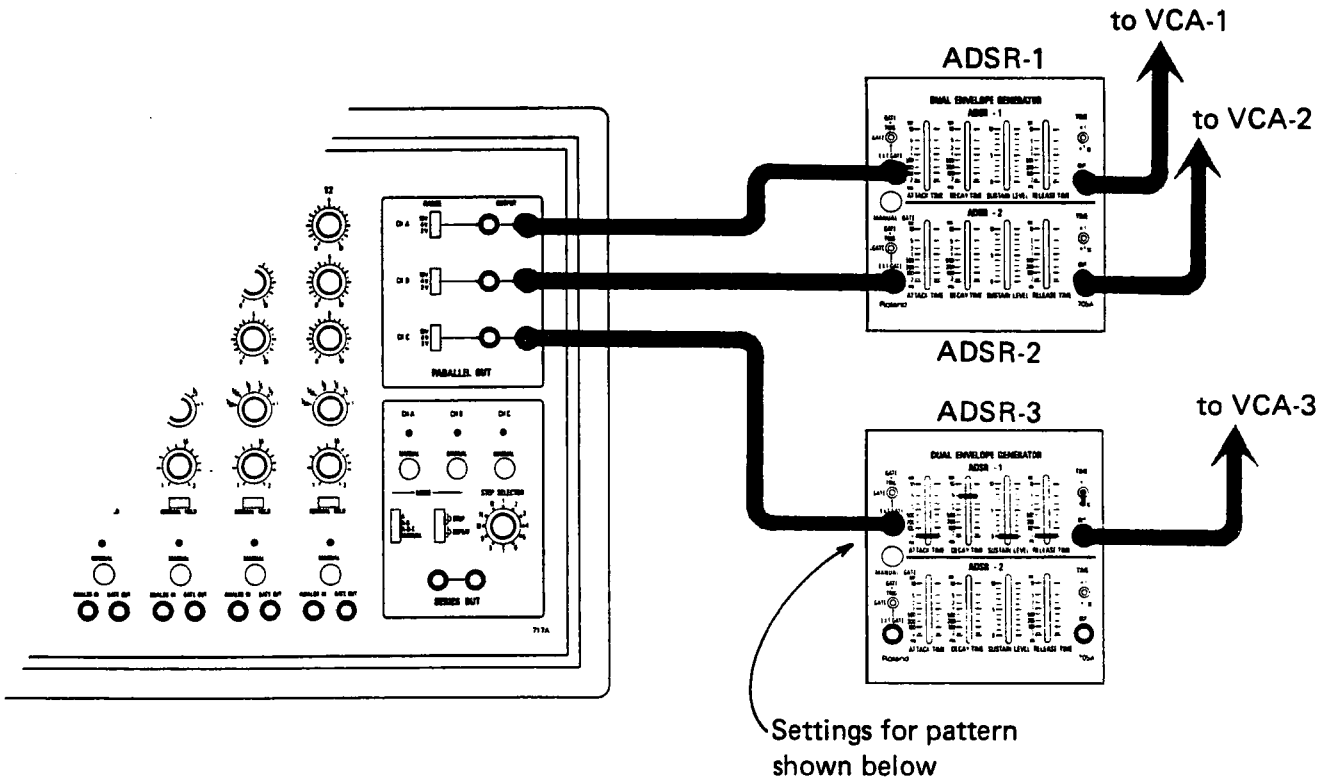
PARALLEL OUT (parallel voices)



Parallel control



DIGITAL RHYTHM CONTROL



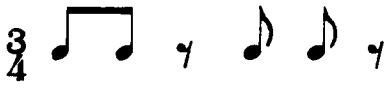
With the VOLTAGE REGISTERS set as follows:

STEP:	1	2	3	4	5	6	7	8	9	10	11	12
CH A:	10	0	10	0	10	0	0	0	10	0	0	0
CH B:	10	0	10	0	0	0	10	0	10	0	0	0
CH C:	10	10	10	10	10	10	10	10	0	0	10	0

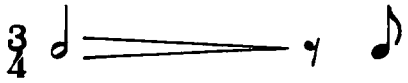
the rhythmic patterns would be:

CH A:

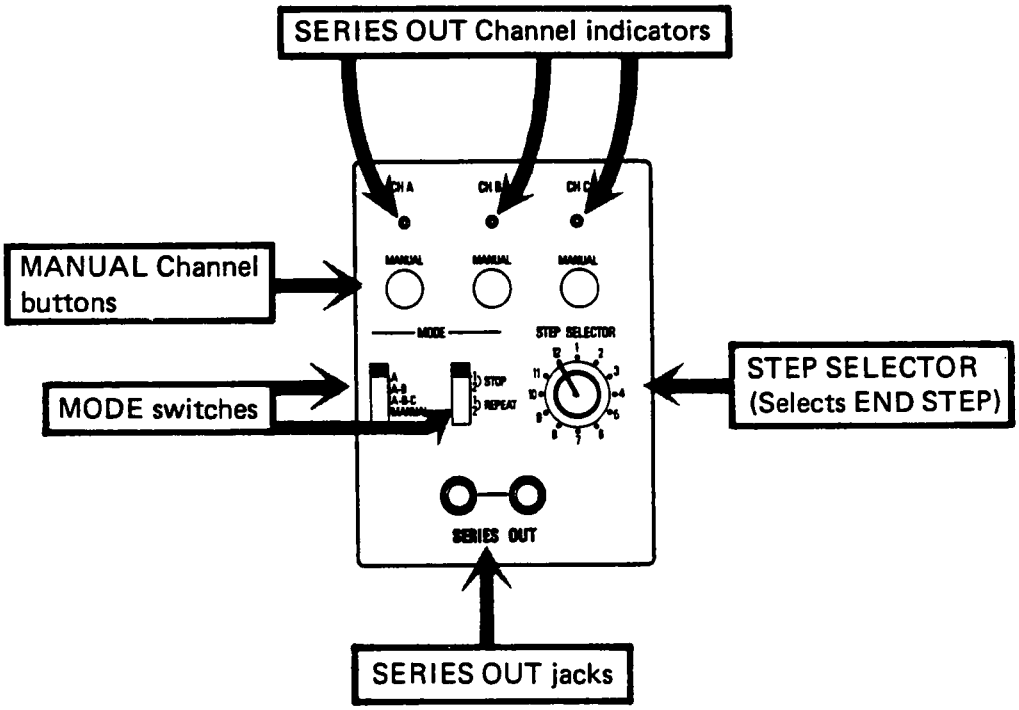
CH B:



CH C:



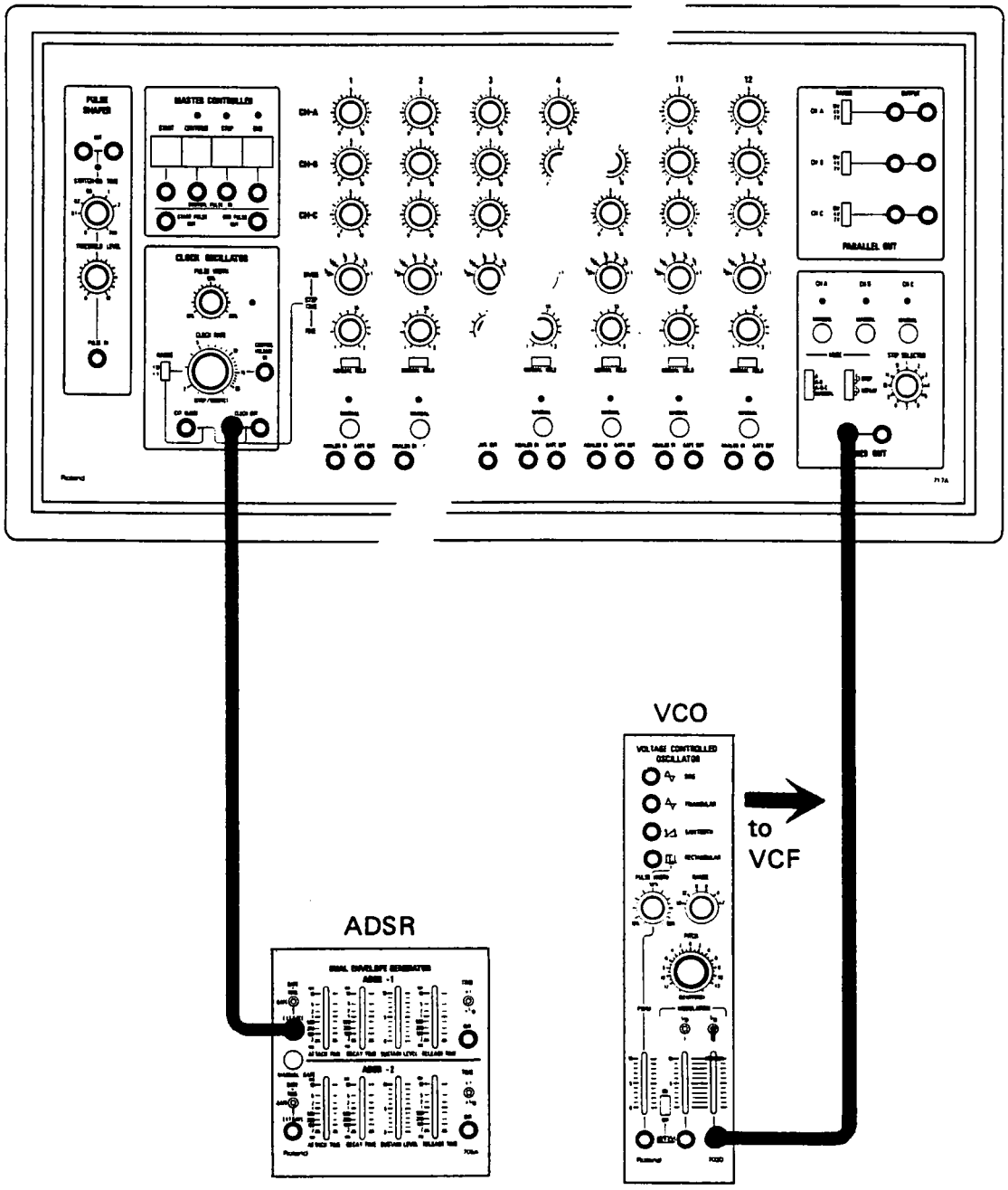
4. SERIES OUT section



4. SERIES OUT section

The SERIES OUT section allows for using the three channels of the sequencer in series for extended sequences of up to 36 steps.

SERIES OUT



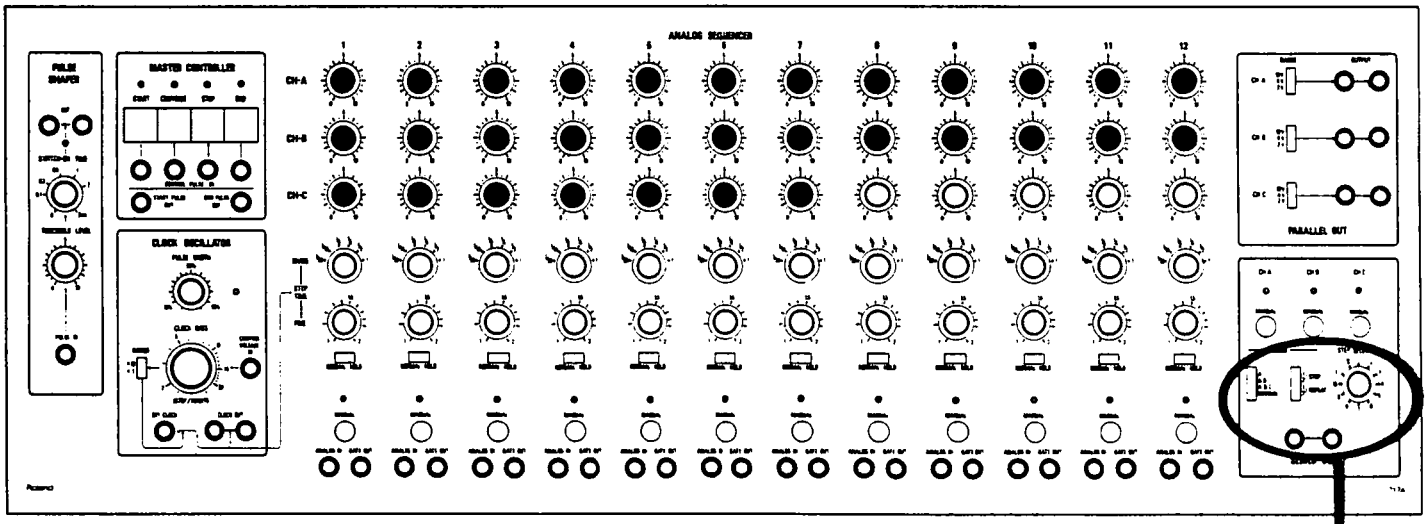
Pushing one of the MANUAL buttons immediately establishes that channel at the SERIES OUT whether the sequencer is running or not. The red LED's show which channel is in effect at the SERIES OUT.

The STEP SELECTOR decides which step will be designated the END STEP. The following will help to clarify the function of the END STEP.

The MODE switches

"1" indicates that only the last channel in the sequence will contain the END STEP, the other channels will run all the way to Step 12.

PATTERN 1:

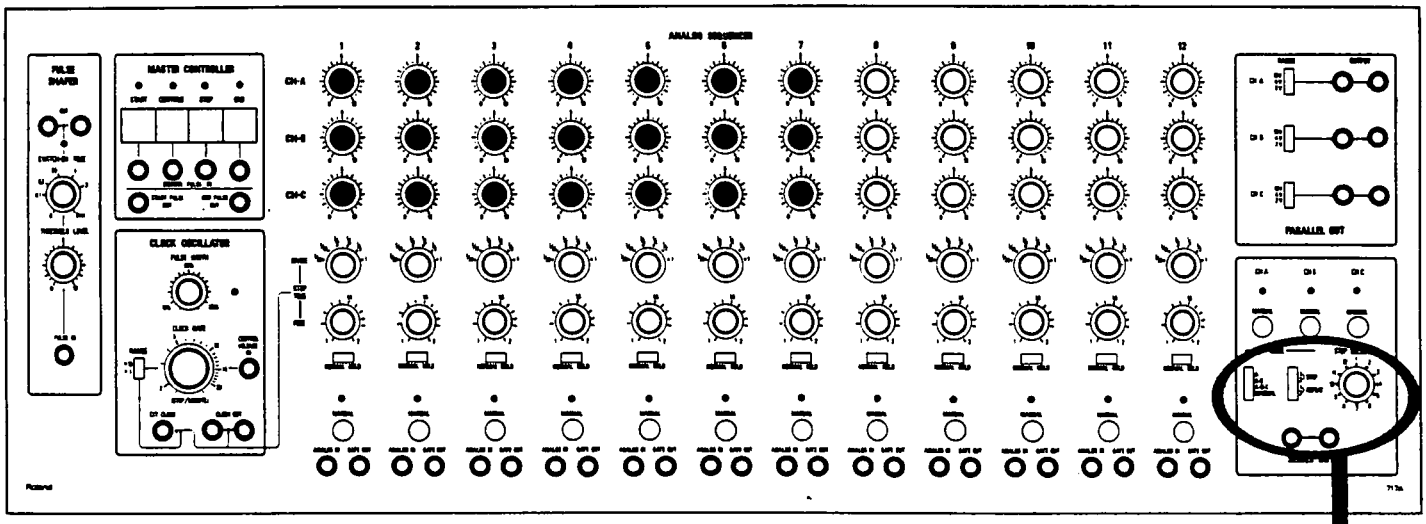


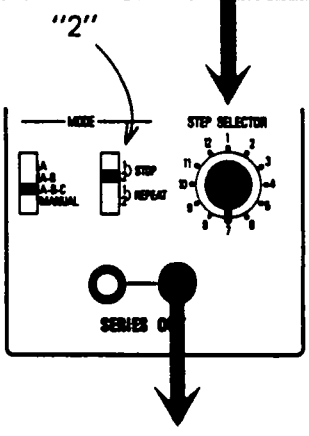
Sequence :

SERIES OUT = CH A: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; CH B: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; CH C: 1, 2, 3, 4, 5, 6, 7; (STOP)

"2" indicates that all channels will contain the END STEP.

PATTERN 2:





Sequence :

SERIES OUT = CH A: 1, 2, 3, 4, 5, 6, 7; CH B: 1, 2, 3, 4, 5, 6, 7; CH C: 1, 2, 3, 4, 5, 6, 7; (STOP)

In STOP, the sequence will run only once, stopping on the final END STEP.

In REPEAT, the sequence will repeat itself until the STOP or END button is pushed.

"A" indicates that Channel A will contain the final END STEP.

"A-B" indicates that Channel B will contain the final END STEP, and that the sequence will consist of Channels A and B in series.

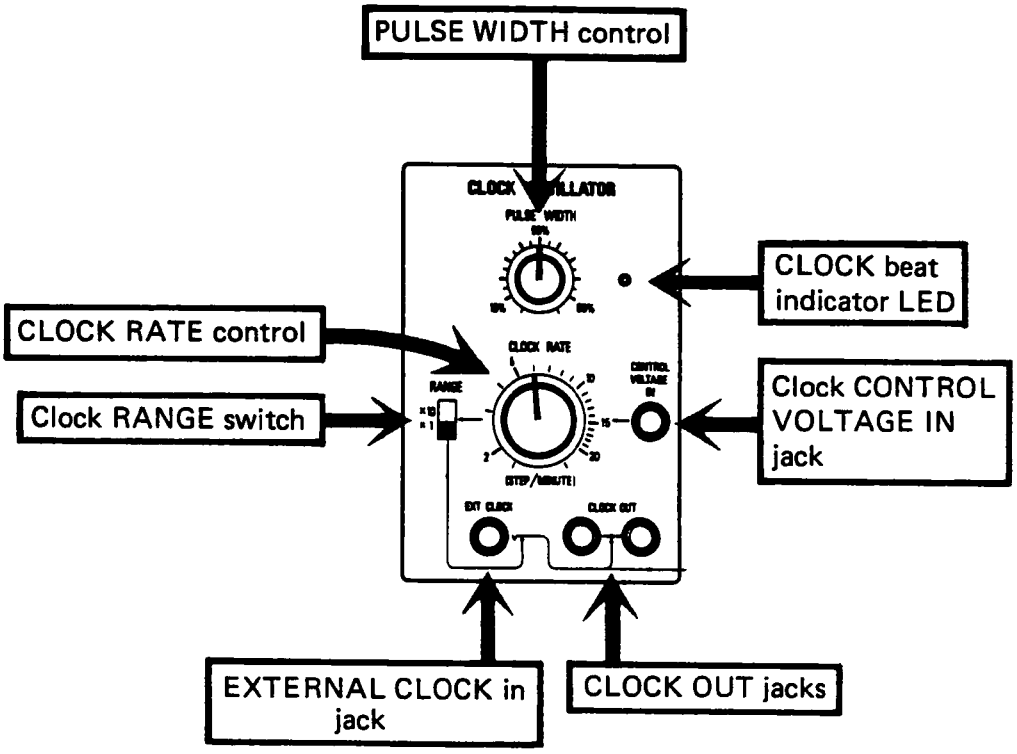
"A-B-C" indicates that Channel C will contain the final END STEP, and the channel sequence will be A, B, C.

In MANUAL mode, the above functions are altered slightly. The "one time" action of the MODE switch STOP is inoperative. With the MODE STOP/REPEAT switch in either of the "1" positions, the sequence will run to Step 12 and repeat. In either of the "2" positions, the sequencer will run to the END STEP, then repeat. In all cases, pushing the END button will stop the sequence on the next END STEP.

The MANUAL position allows for more freedom in manually changing channels. Pushing one of the channel MANUAL buttons will establish that channel at the SERIES OUT until another MANUAL button is pressed.

Pushing START, the sequence will begin with Channel A, as in other modes. To start with another channel, push the CH B or CH C-MANUAL button, push the Step 12 MANUAL button, and use the CONTINUE button to start the sequence.

5. CLOCK OSCILLATOR



5. CLOCK OSCILLATOR

The CLOCK OSCILLATOR determines the overall speed (tempo) of the sequence.

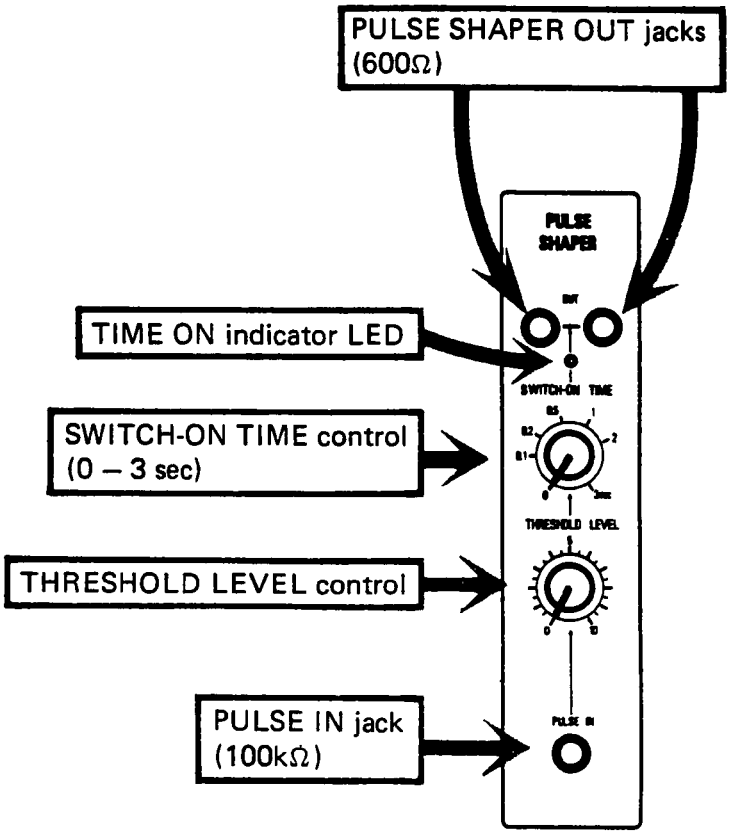
The PULSE WIDTH control varies the width of the CLOCK OUTPUT pulses which are usually used for triggering an ADSR.

The CLOCK RATE determines the overall speed of the sequence and is calibrated in steps per minute (with DIVIDE and FINE at "1" and RANGE at "X1"). The RANGE switch multiplies the CLOCK rate by 1 or 10.

The CONTROL VOLTAGE IN jack allows an external control voltage to control the CLOCK rate. (Sequencer CLOCK controls still affect CLOCK rate.)

The EXT CLOCK jack allows the use of outside pulses to act as the sequencer clock. The internal CLOCK is cut off when using this jack. The PULSE SHAPER section (starting on p. 6-1) shows how to use clock pulses recorded on tape for driving the sequencer.

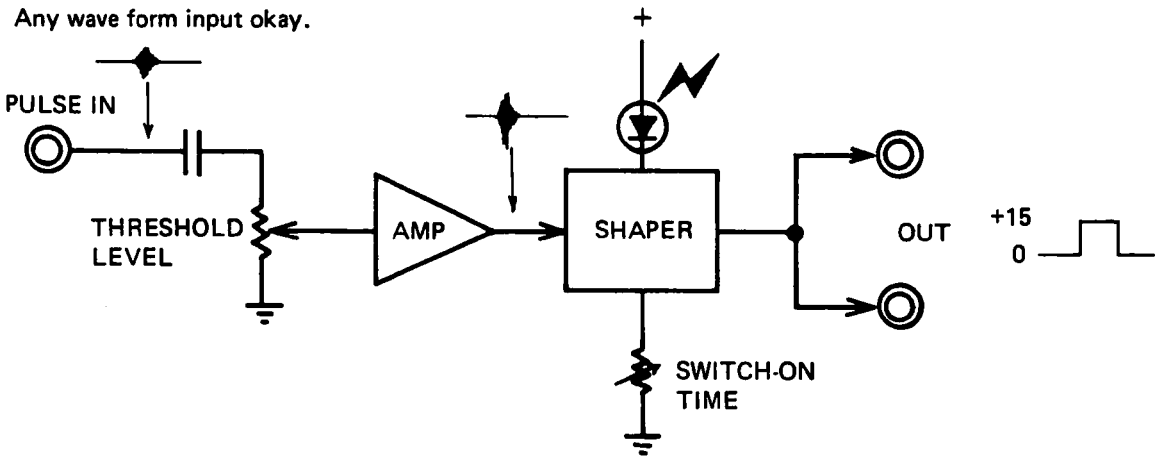
6. PULSE SHAPER



6. PULSE SHAPER

The PULSE SHAPER amplifies and shapes input pulses to a form useable for triggering synthesizer functions.

Block diagram:



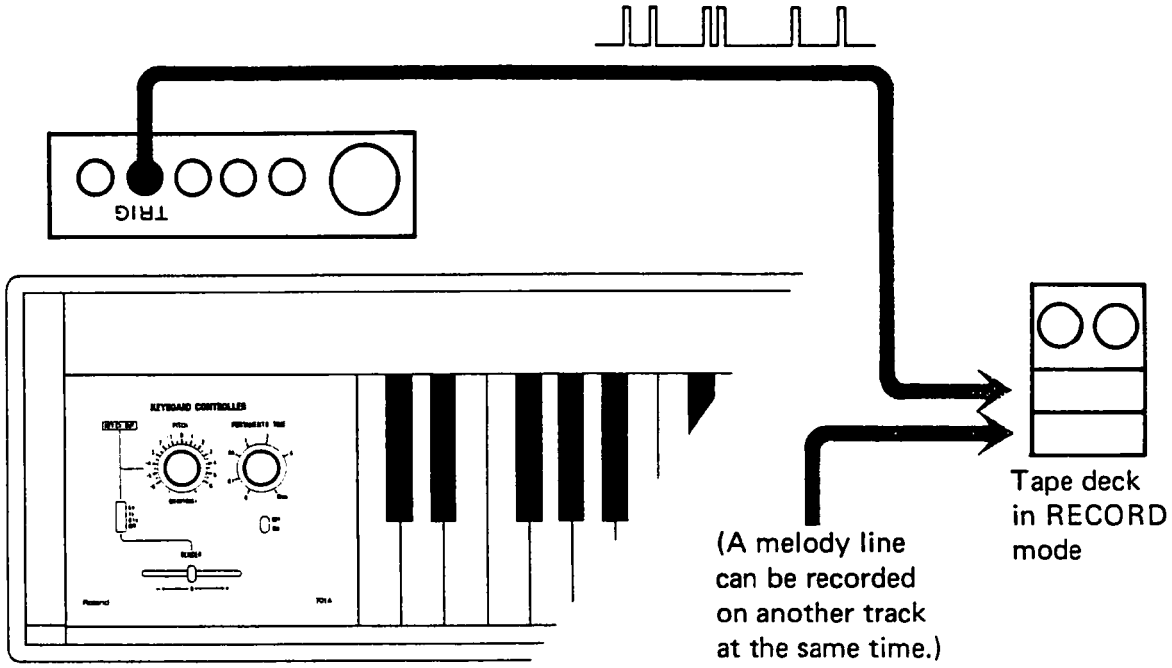
Using the PULSE SHAPER

Set the THRESHOLD LEVEL at "0" and the SWITCH-ON TIME to about "0.5" second. With the pulse source connected to the PULSE IN jack, raise the THRESHOLD LEVEL to just above the point where the LED lights for the incoming pulses. (Using a higher THRESHOLD LEVEL may cause noise in the pulse source to trigger the PULSE SHAPER). Set the SWITCH-ON TIME to the desired pulse length.

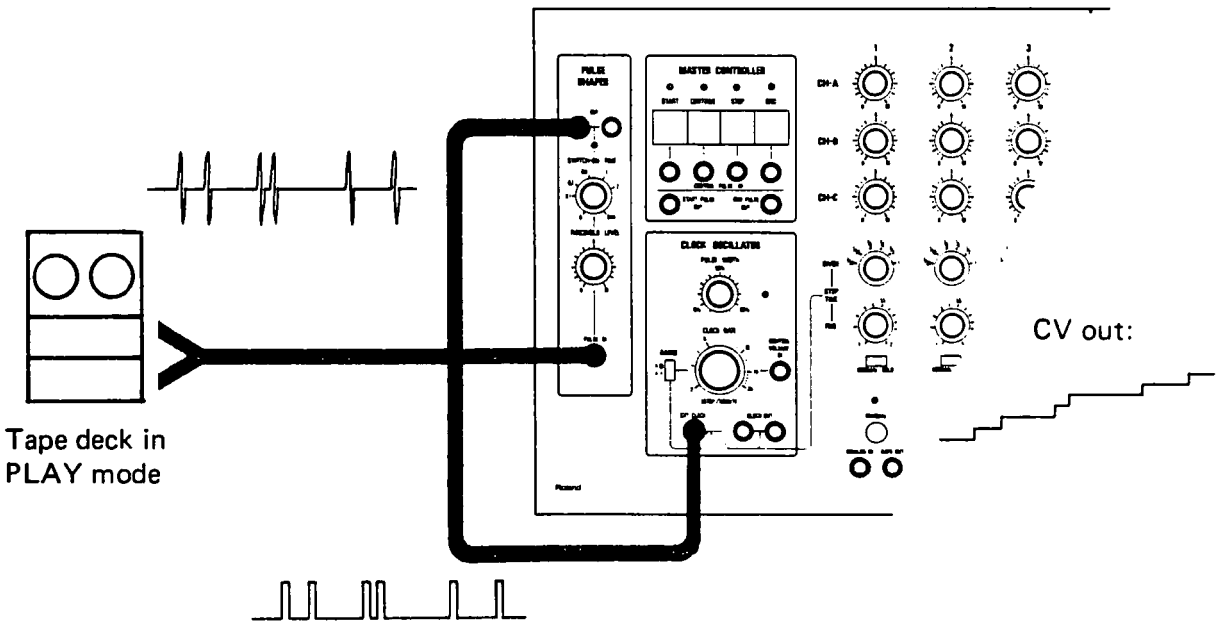
See also p.2–4.

Triggering the SEQUENCER from tape

Recording the pulses:



Triggering the SEQUENCER:



CALIBRATION

SECTION

5

WARNING:

The contents of this section are designed for qualified electronic technicians or repairmen. **DO NOT ATTEMPT ADJUSTMENT WITHOUT THE PROPER ELECTRONIC TEST EQUIPMENT.** Some of the internal adjustments are very critical and even a slight change in setting can make the related module useless as a synthesizer element. Guarantee is void if any unauthorized changes are made in this synthesizer or if repairs are made by other than qualified technicians.

See the SYSTEM 700 SYNTHESIZER SERVICE SUPPLEMENT for circuit diagrams and descriptions.

NOTE:

There are no calibration adjustments for the following modules:

705A DUAL ENVELOPE GENERATOR
709 SAMPLE & HOLD
710 MULTIPLE JACK
713A GATE DELAY
715A MULTIMODE FILTER/AUDIO MIXER
716A MIXER
718A POWER SWITCH
723A ANALOG SWITCH

CAUTION:

Removing the 718A POWER SWITCH module and/or the 710A MULTIPLE JACK module next to it exposes the high voltage primary connections to the power transformer. If the 2 AMP fuse on the terminal strip needs replacing, remove the power cord from the wall socket.

PRELIMINARIES

The following equipment is needed for calibration:

Digital Voltmeter	(DVM)
Oscilloscope	(OSC)
Frequency Counter	(FREQ)
Audio Generator	(GEN)
Decibel meter	(DB)
(Tuning Meter)	(TUNE)
(Audio Amplifier and Speaker)	

In addition, an extention card will be needed to supply power to the modules during adjustment.

Since most measurements are made from the front panel jacks, some kind of a conversion plug for the test equipment may prove useful.

Although not necessary, an audio amplifier and speaker can be very convenient when making adjustments.

All ground connections can be made to the chassis of the module being tested or to Pin S on the extention card.

Be sure all front panel controls are set as shown in the drawings (where applicable) before making adjustments.

Pressing a key on the keyboard establishes the control voltage for that key at the keyboard output. This voltage will remain after the release of the key, but due to leakage, the voltage will slowly drift downwards. For this reason, all measurements and adjustments related to the keys should be done while holding the related key down. A small lead weight may prove useful.

Allow at least ten minutes as a warm up period for the power supply voltages to stabalize.

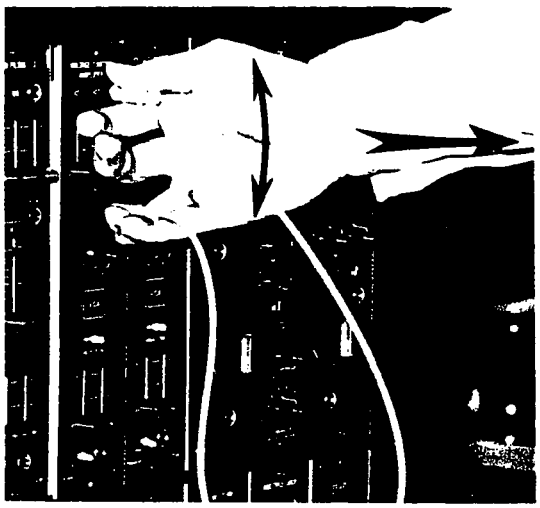
Adjustments should be made in the following order:

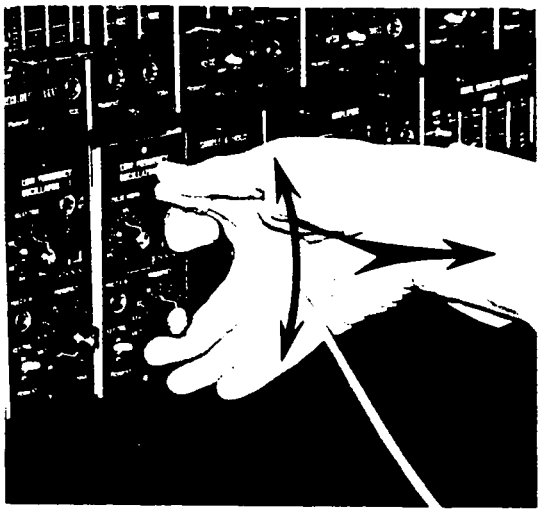
Voltage Regulators
Keyboard Controller
Voltage Controlled Oscillators

After that, any convenient order can be used.

REMOVING THE MODULES

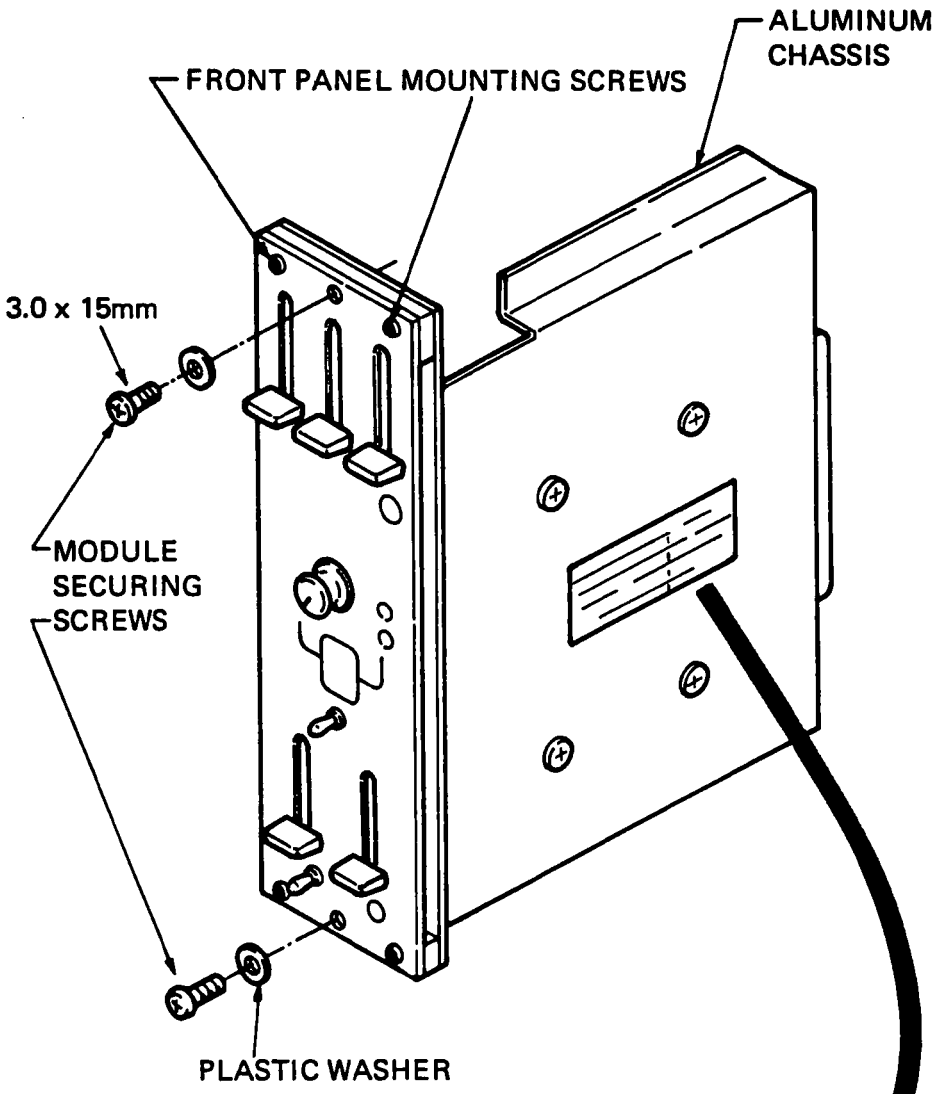
The front panel of each module is mounted to the aluminum chassis by means of screws in each corner of the panel. The remaining screws along the top and bottoms edges are the screws securing the modules in the block frames. Remove these securing screws and grasp the module on its right edge using a patch cord and/or the rotating knobs as handles. Do not use the knobs of the slider controls as pulling handles.





As you pull the module out, work it up and down until it breaks loose from the connector in the frame.

When replacing modules, you may have to jiggle them from side to side to get the printed circuit card to line up properly with the connector in the frame. Do not use force.



INSPECTION CARD	
MODEL	MODULE
SER. NO.	
ASSEMBLY	CALIBRATION
INSPECTION	TEST

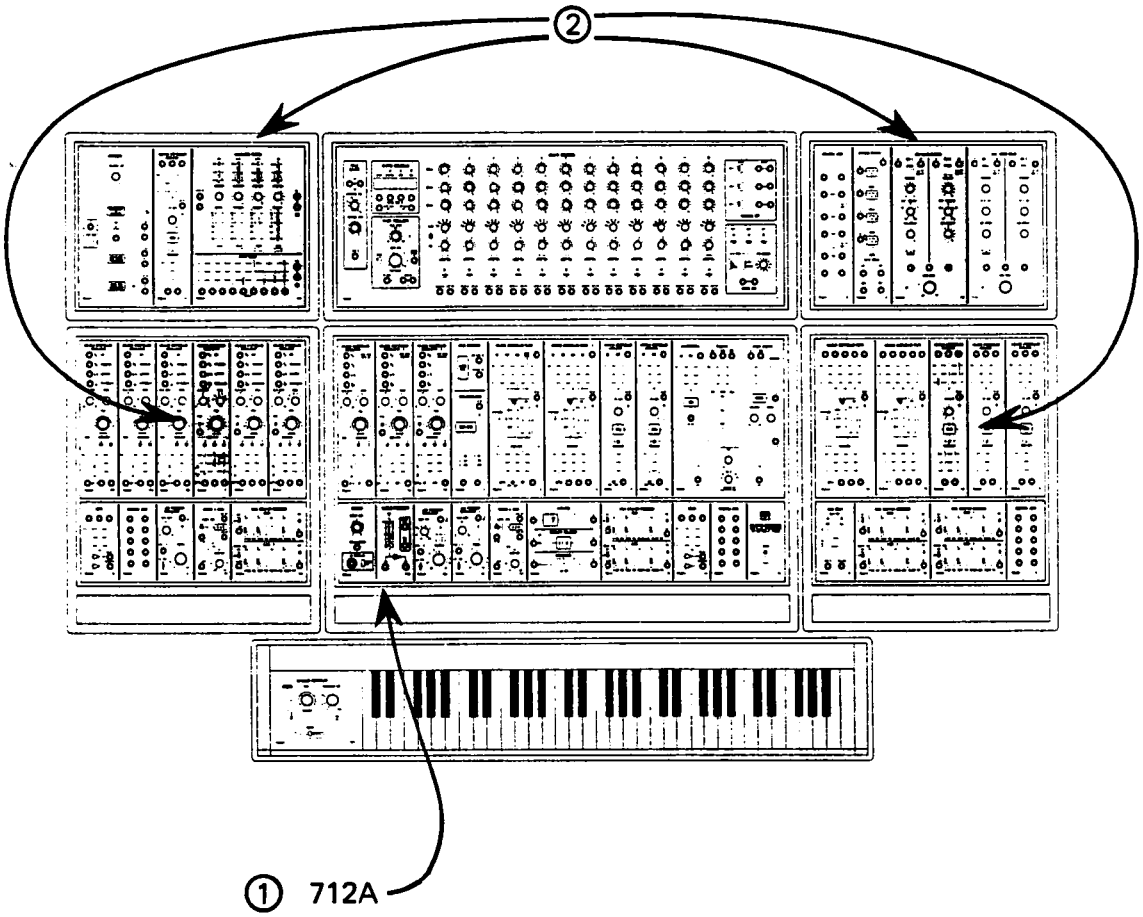
INCLUDE THIS INFORMATION IN ANY CORRESPONDENCE TO US.

THE VOLTAGE REGULATORS

The Voltage Regulators for the Main Console and the Keyboard Controller are located in the Main Console on the 712A MONITOR/VOLTAGE PROCESSOR module circuit board.

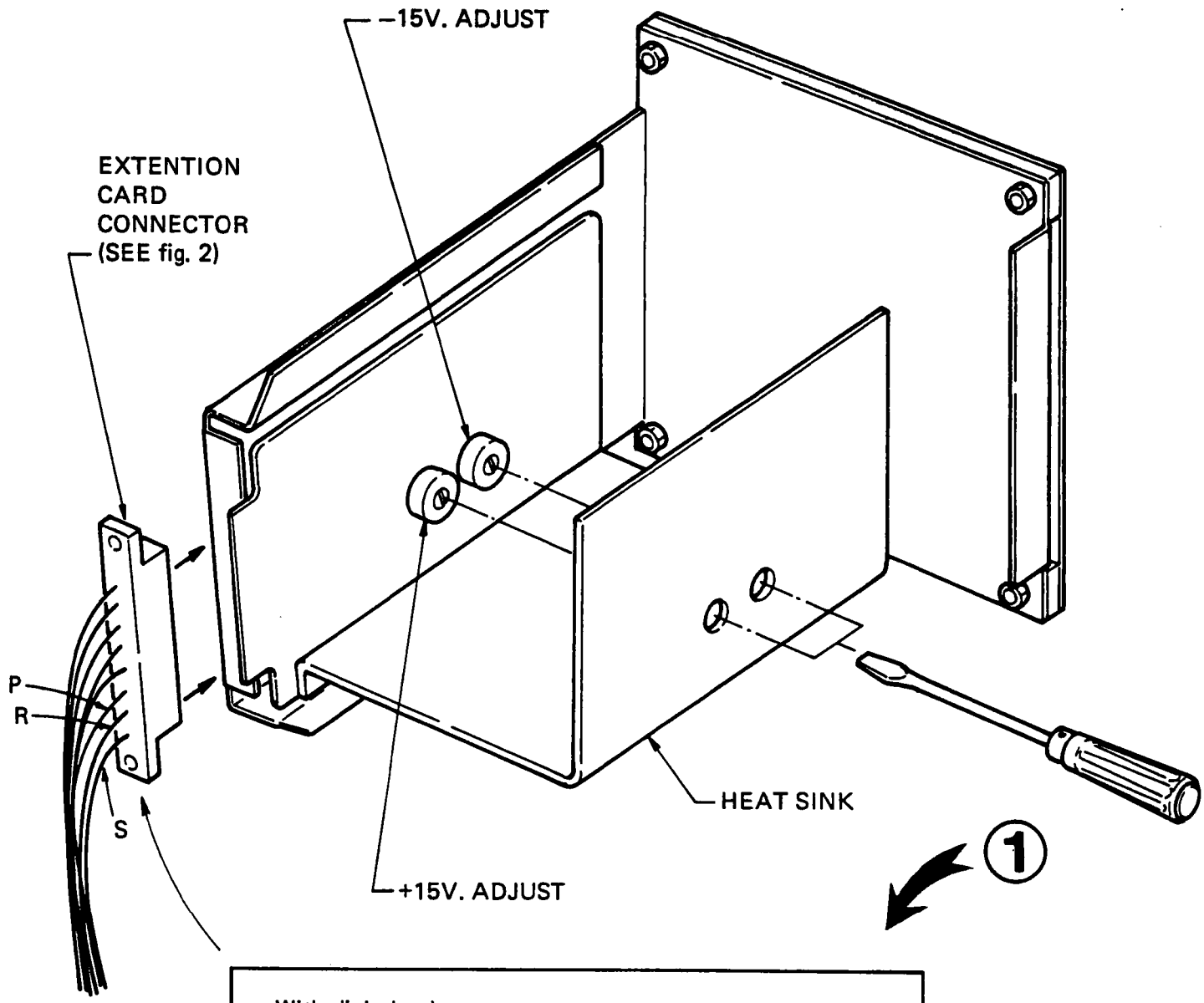
The 717A SEQUENCER Voltage Regulator can be adjusted if and when the Sequencer is calibrated.

The Regulators for the remaining blocks are a part of the frame and harness wiring assemblies and can be reached by removing the modules shown below.



712A MONITOR/VOLTAGE PROCESSOR

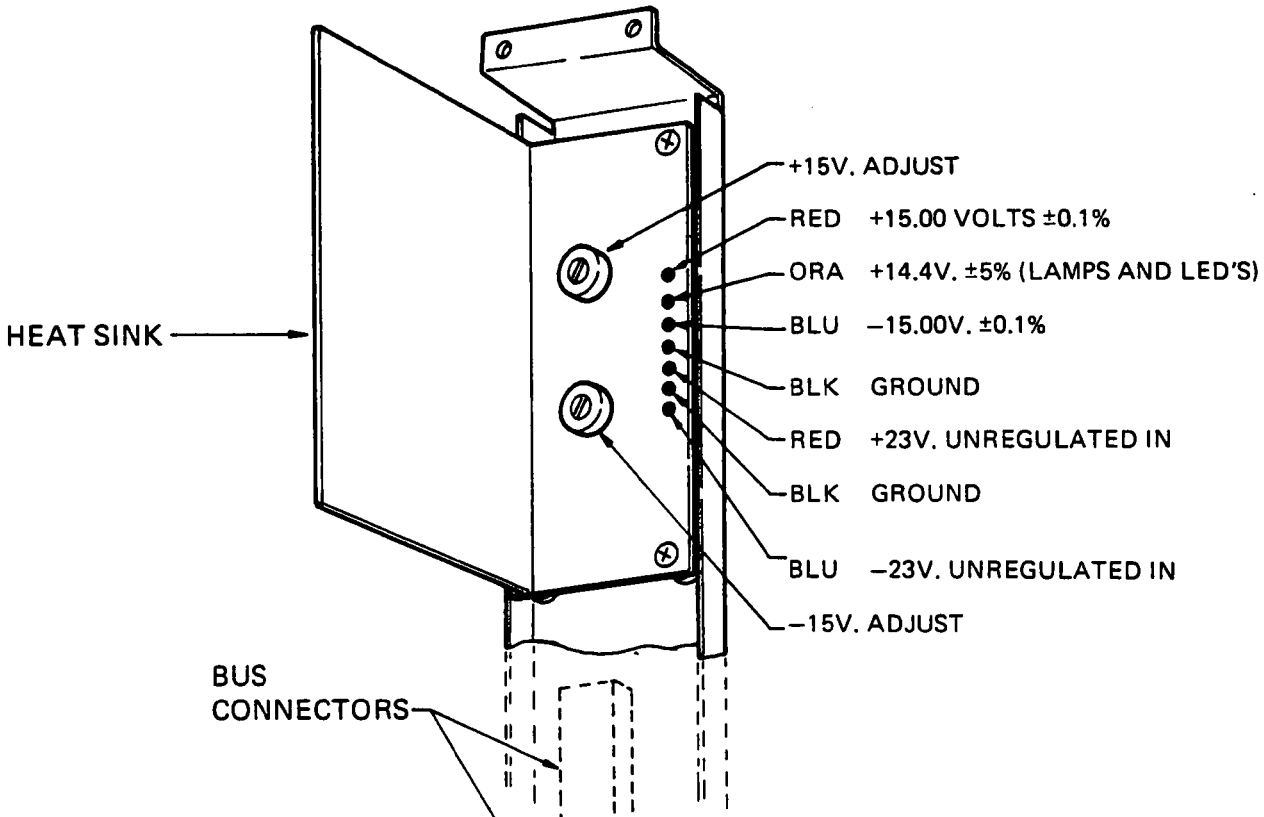
Fig. 1 Main Console voltage regulators



With digital voltmeter:
Set "+15V ADJUST" for +15.00v, ± 10mv at Pin P
Set "−15V ADJUST" for −15.00v, ± 10mv at Pin R
Pin S is ground (or use HEAT SINK)

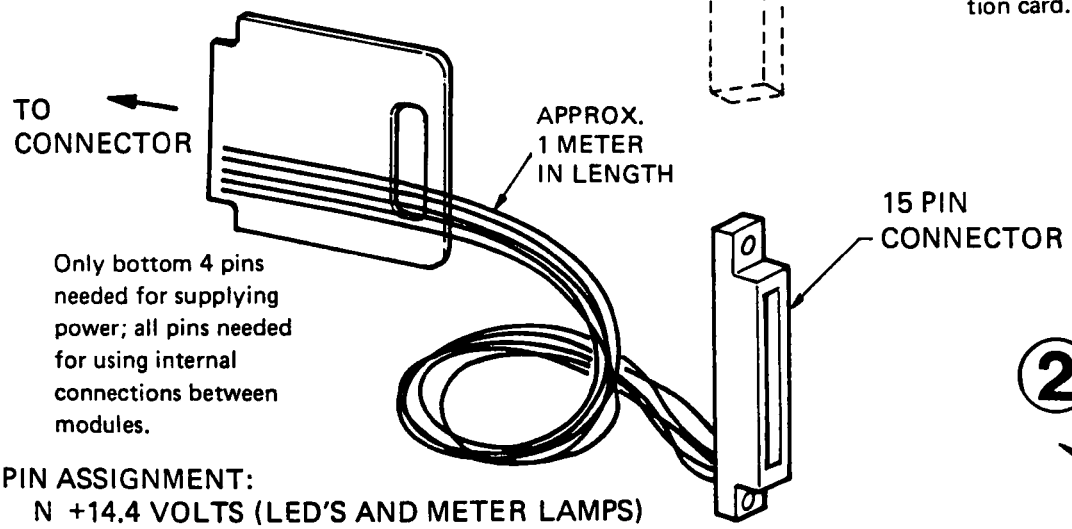
NOTE: Regulator settings are very critical for proper VCO operation. Take voltage measurements directly from one of the VCO connectors to minimize voltage drop in the harness wiring. After replacing the 712A Regulator in the block frame, check that the voltages at the VCO connector are correct.

Fig. 2 VOLTAGE REGULATORS (BLOCK FRAMES)



NOTE: For Block 4 (VCO Bank), take voltage measurements directly from the VCO connector without using the extention card.

EXTENTION CARD:



Only bottom 4 pins needed for supplying power; all pins needed for using internal connections between modules.

PIN ASSIGNMENT:
- N +14.4 VOLTS (LED'S AND METER LAMPS)
- P +15.00 VOLTS
- R −15.00 VOLTS
- S GROUND

With digital voltmeter:
Set "+15V ADJUST" for +15.00v, ±10mv at Pin P
Set "−15V ADJUST" for −15.00v, ±10mv at Pin R
Pin S is ground (or use HEAT SINK)

Fig. 701-1 701A KEYBOARD CONTROLLER

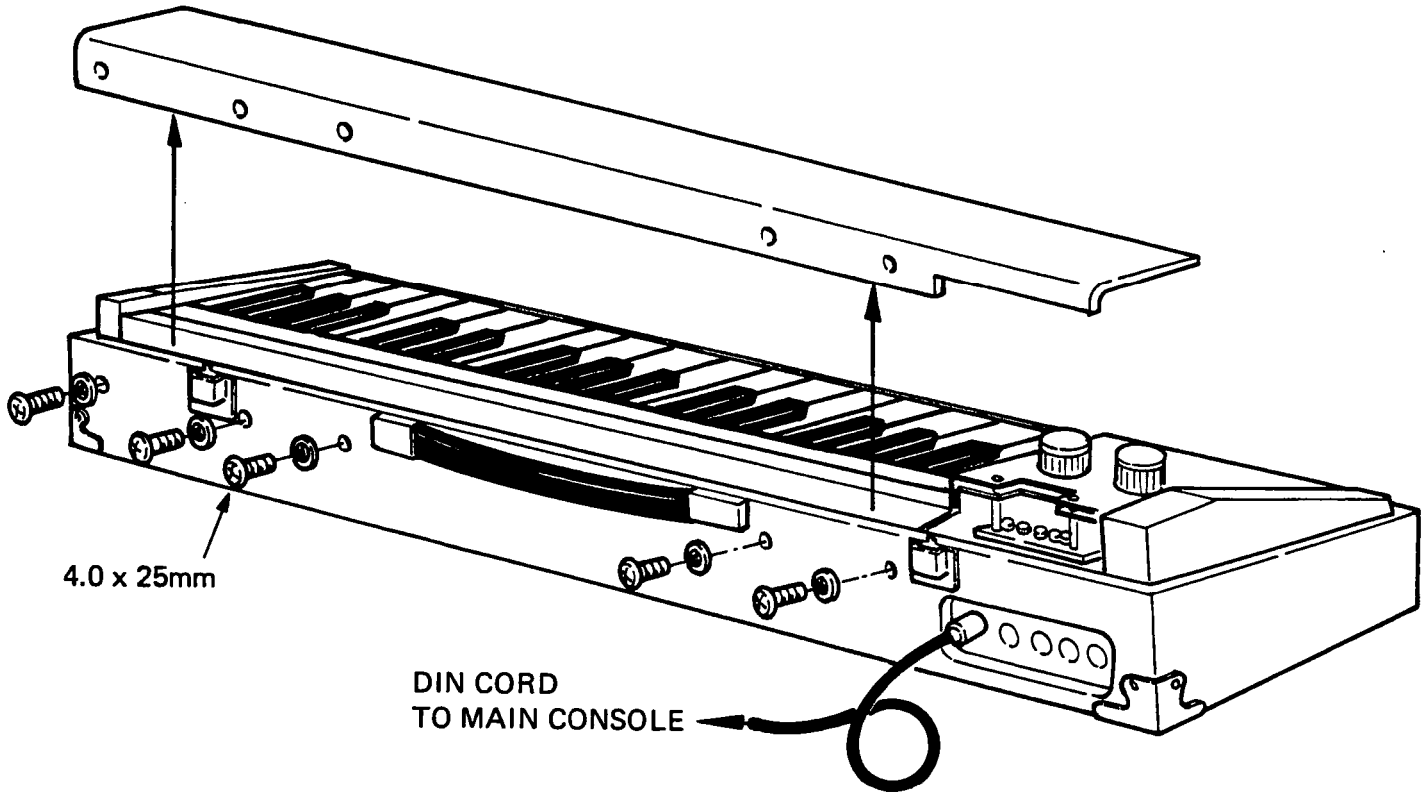


Fig. 701-2a

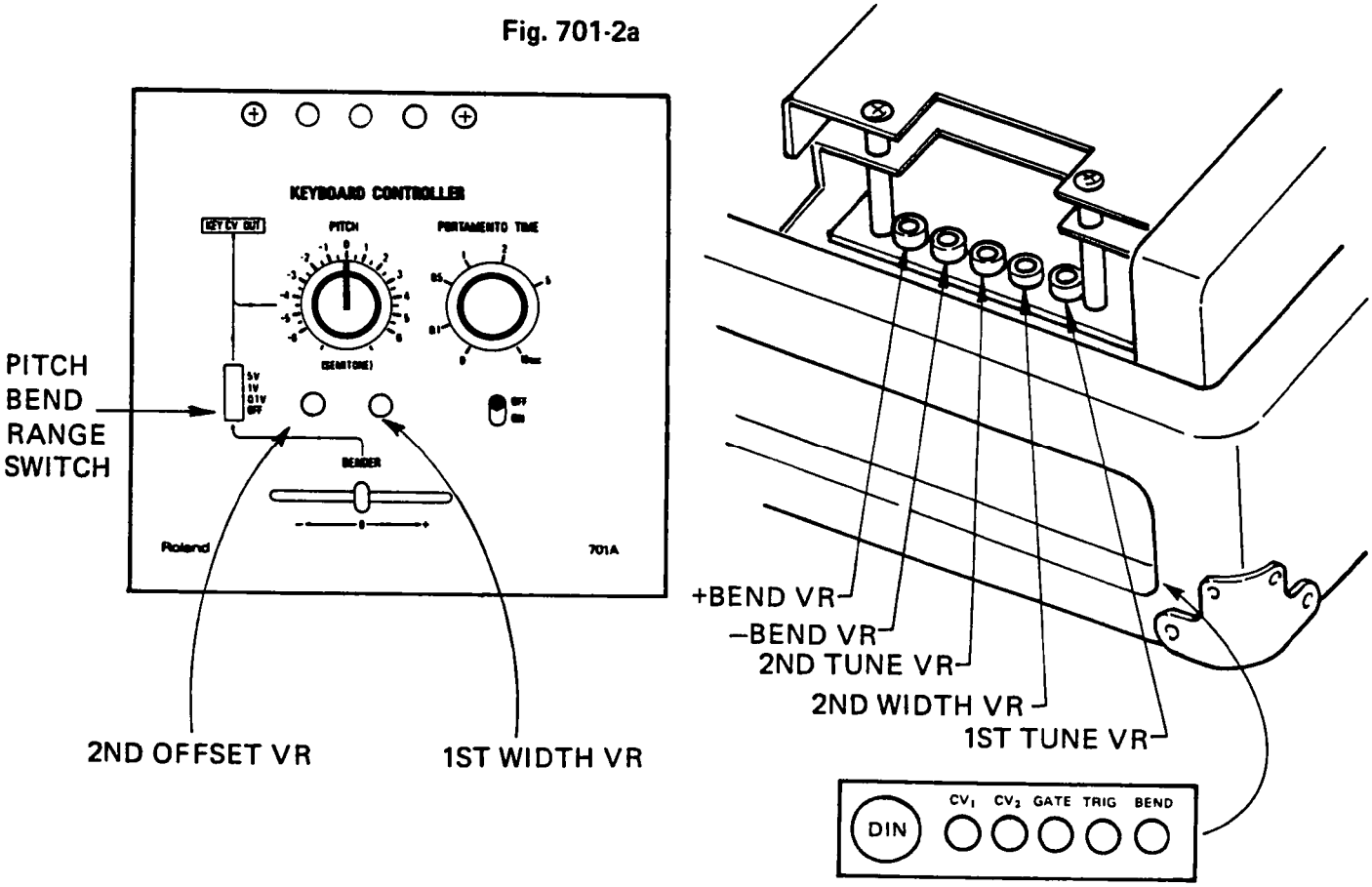
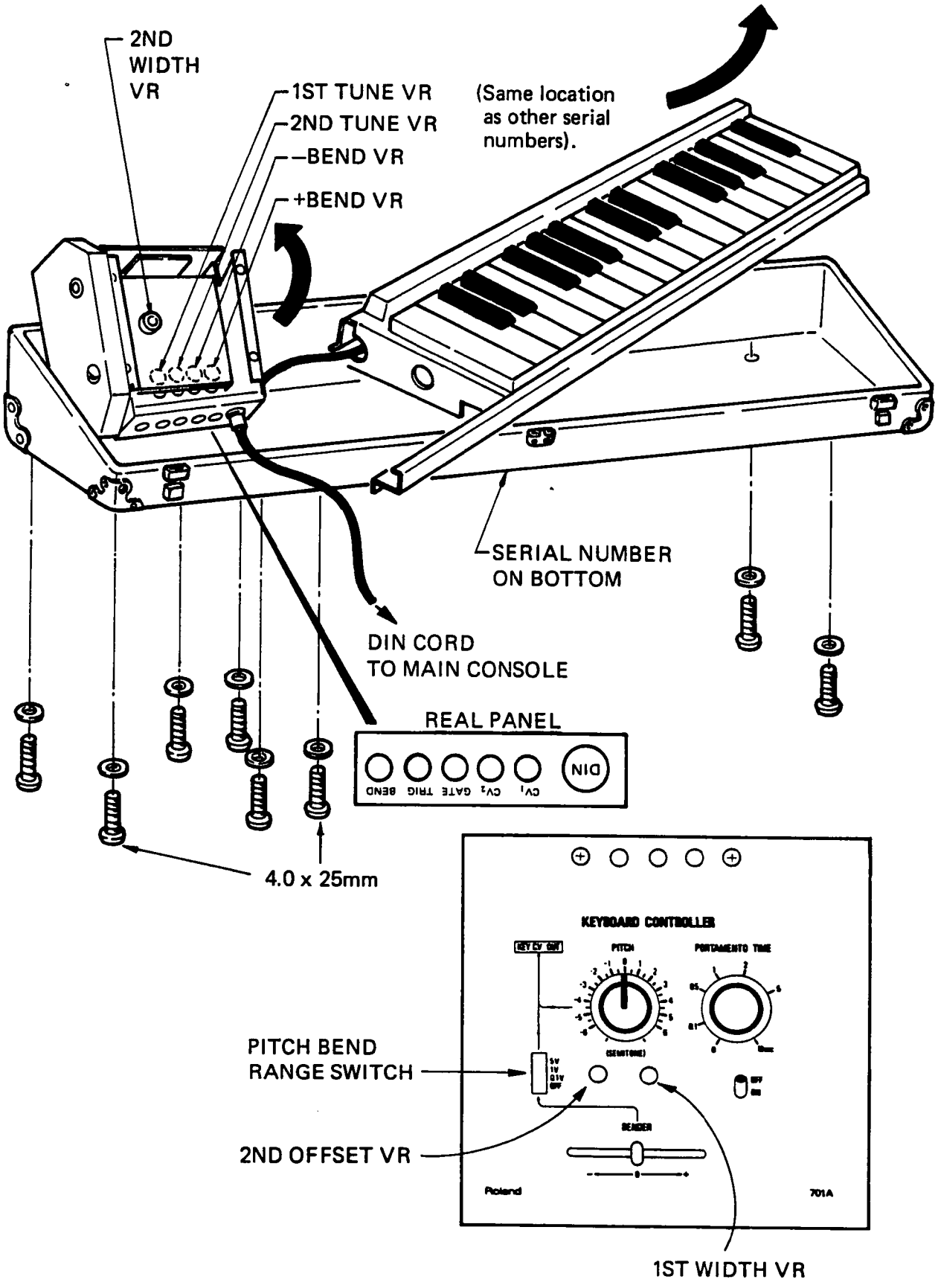
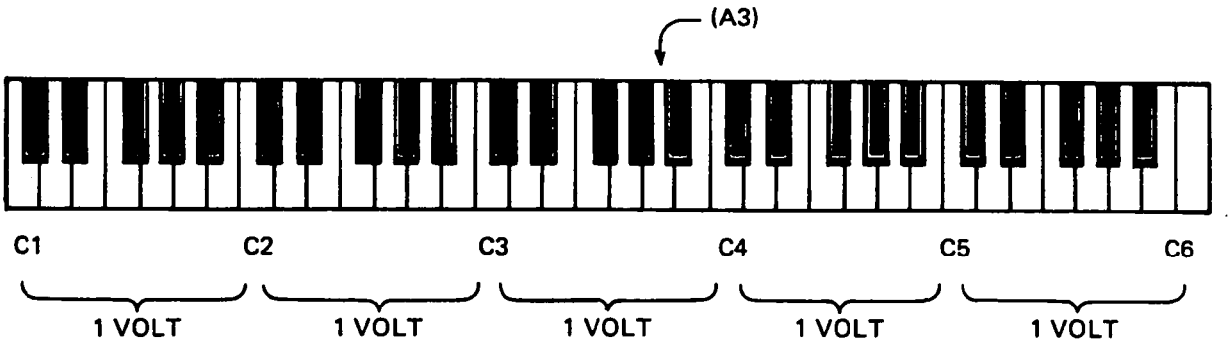


Fig. 701-2b SERIAL NUMBERS 460100 – 470120 ONLY



701A KEYBOARD CONTROLLER procedures

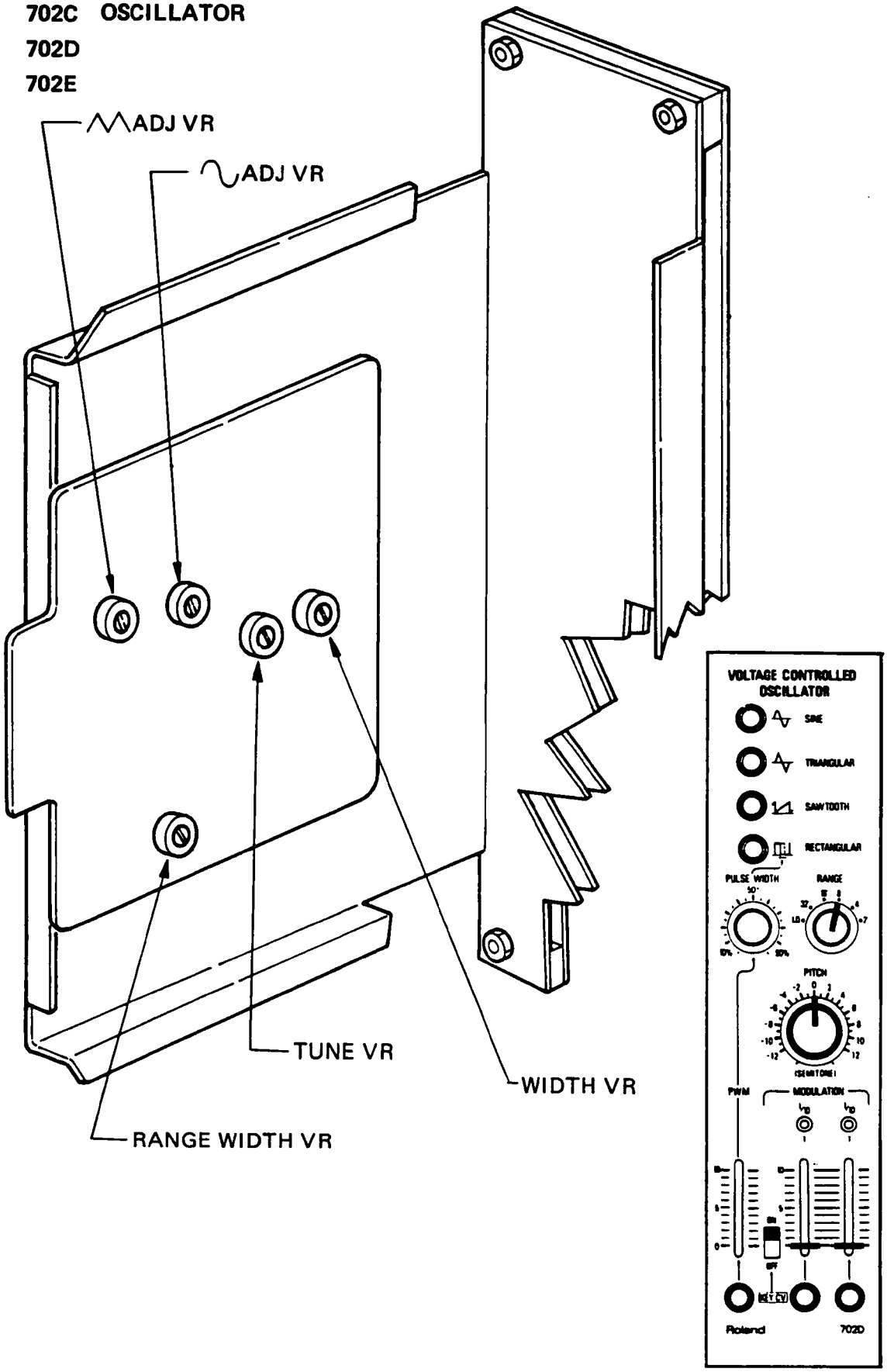


Adjustment	Equip-ment	Jack (rear panel)	Control	Procedure and value
Keyboard tuning	DVM	CV1	1ST TUNE VR	Strike C1 key; adjust for 0 volts.
CV1 width	DVM	CV1	1ST WIDTH VR	Strike C6 key; adjust for +5.00 volts, ±0
+ bend range	DVM	CV1	+ BEND VR	Strike C1 key; adjust for any one of the following three conditions with BENDER all the way "+": PITCH BEND RANGE switch at: CV1 out: "0.1V" +0.10 volt "1V" +1.00 volt "5V" +5.00 volt
– bend range	DVM	CV1	– BEND VR	Strike C1 key; adjust for any one of the following three conditions with BENDER all the way "–": PITCH BEND RANGE switch at: CV1 out: "0.1V" –0.10 volt "1V" –1.00 volt "5V" –5.00 volts
Offset	DVM	CV2	2ND OFFSET VR	Hold C6 key down while tapping on C1 key; set so voltage does not change.
2nd voice tuning	DVM	CV2	2ND TUNE VR	Strike C1 key; adjust for 0 volts.
CV2 width	DVM	CV2	2ND WIDTH VR	Strike C6 key; adjust for +5.00 volts, ±0

Double check that all the above conditions are met.

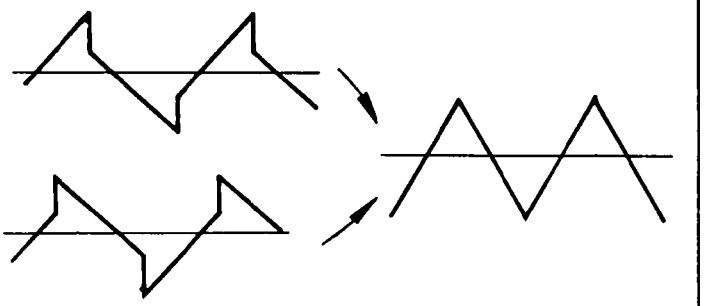
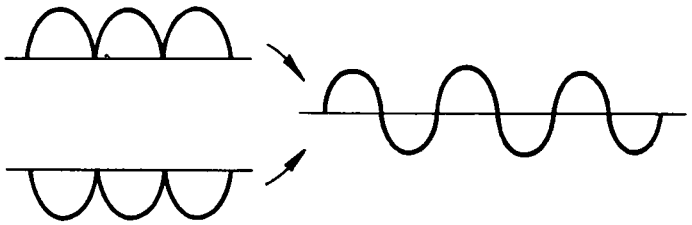
Fig. 702-1 702A
702B
702C
702D
702E

VOLTAGE CONTROLLED OSCILLATOR



702 VOLTAGE CONTROLLED OSCILLATOR procedures

(Procedures same for all models)

Adjustment	Equip-ment	Jack (front panel)	Control	Procedure and value
⩘ adjust	OSC	⩘	⩘ ADJ VR	
∿ adjust	OSC	∿	∿ ADJ VR	

Checking VCO frequency width:

Check	FREQ	Any output jack on front panel	PITCH (front panel)	Press C1 and adjust for some convenient reading (such as 100); call this "X". Check that C2 produces 2X; C3 = 4X; C4 = 8X; C5 = 16X; and C6 = 32X. If C6 is not within ±1Hz., VCO WIDTH needs adjusting.

Adjusting VCO width and frequency:

NOTE: Check regulator output voltages and keyboard calibration, if this hasn't already been done.

There are three methods which can be used for setting the VCO width.

TUNING METER method	FREQUENCY COUNTER method	OSCILLOSCOPE/AUDIO GENERATOR method
Connect the tuning meter input lead to any output jack on the VCO front panel.	Connect the counter input lead to any output jack on the VCO front panel.	Connect the VERTICAL input lead to any output jack on the VCO front panel. Connect the HORIZONTAL lead to the audio generator. Set the generator for about 65Hz. (At 8' range, C1 = 65.406Hz.)
Press C1; select proper pitch on tuning meter and adjust the VCO PITCH control for unison.	Press C1; adjust PITCH control for a convenient reading (such as 100Hz.); call this "X"	Press C1; adjust PITCH control for stable 1:1 Lissajous figure.
Press C2; note whether it is sharp or flat. If sharp, turn WIDTH VR so pitch becomes a little sharper. If flat, turn WIDTH VR so pitch becomes a little flatter.	Press C2; note frequency. Correct reading is 2X. If the reading is high, adjust WIDTH VR so it is a little higher; if low, a little lower.	Press C2; adjust WIDTH VR so that speed of rolling increases slightly. CAUTION: If the figure is turning slowly, be careful not to turn WIDTH VR in direction which causes the pattern to reverse direction.
Press C1; adjust VCO PITCH control for unison.	Press C1; If necessary, adjust PITCH control for a reading which is easy to double mentally.	Press C1; adjust PITCH for stable 1:1 Lissajous figure.

NOTE: If during the procedure both front panel PITCH controls go all the to one of the stops, reset them to center and use the TUNE VR once, then use the VCO PITCH controls in successive steps. Do not use the RANGE switch; leave it set in one position during the entire width adjustment procedure.

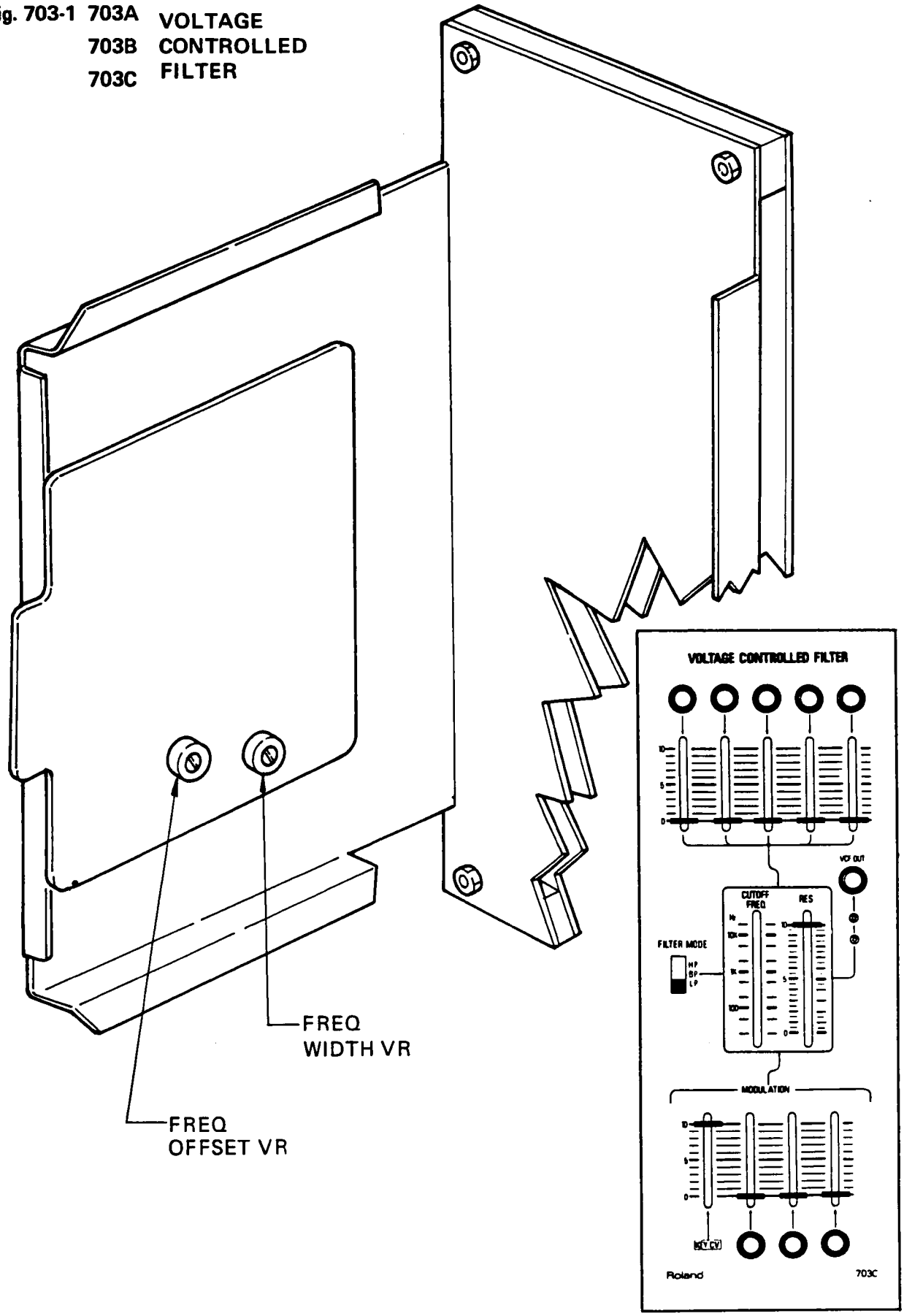
TUNING METER method (continued)	FREQUENCY COUNTER method (continued)	OSCILLOSCOPE/AUDIO GENERATOR method (continued)
Repeat the above steps until C1 and C2 remain in tune.	Repeat the above steps until C2 reads twice C1, ±1Hz.	Repeat the above steps until the figures for C1 and C2 remain stable.

When C1 and C2 are correct, repeat the procedure using C1 and C6. (If this proves difficult, try with C4, then with C6). With the frequency counter, the correct frequencies are: C1 = X, C2 = 2X, C3 = 4X, C4 = 8X, C5 = 16X, C6 = 32X; all within ±1Hz.

Adjusting VCO RANGE width and VCO frequency:

Adjustment	Equip-ment	Jack (front panel)	Control	Procedure and value
RANGE width adjust	FREQ	Any output jack on front panel	RANGE WIDTH VR	Set RANGE at 2'; press A3 (slightly above center of keyboard); set front panel PITCH controls so as to produce 1760Hz. Set RANGE switch at 32'; (strike A3) and set RANGE WIDTH VR so frequency output is 110Hz.
VCO tuning	TUNE	Same as above	TUNE VR	Set RANGE at 8', and PITCH controls at center "0"; Strike A3 and adjust for A = 440Hz.

Fig. 703-1 703A VOLTAGE
703B CONTROLLED
703C FILTER

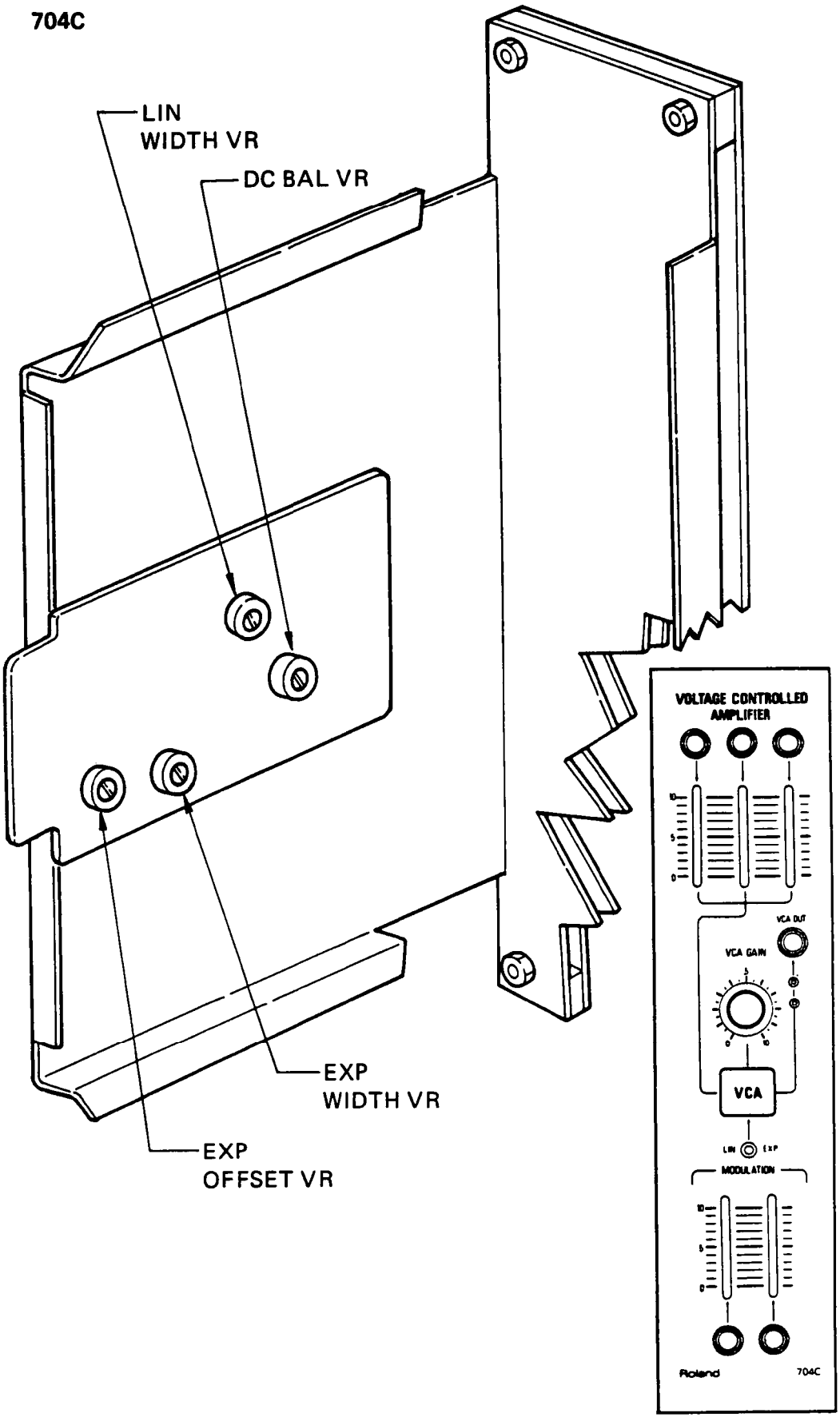


703 VOLTAGE CONTROLLED FILTER procedures

(Procedures same for all models)

Adjustment	Equip-ment	Jack	Control	Procedure and value
VCF freq. width	FREQ	VCF OUT	FREQ WIDTH VR	1. Strike C2 key, adjust front panel CUTOFF FREQ and/or CO FREQ OFFSET VR for a convenient reading (such as 100Hz). 2. Strike C5 key; correct reading is 8 x C2 reading. If high, adjust CO FREQ WIDTH VR for a slightly higher reading; if low, for a slightly lower reading. 3. Repeat the above until C5 = 8 x C2.
VCF CO freq.	FREQ	VCF OUT	FREQ OFFSET VR	Set front panel CUTOFF FREQ at "1K" and KEY CV at "0"; adjust CO FREQ OFFSET VR for 1kHz.

Fig. 704-1 704A
704B VOLTAGE CONTROLLED AMPLIFIER
704C



704 VOLTAGE CONTROLLED AMPLIFIER procedures

(Preocedures same for all models)

Fig. 704-2

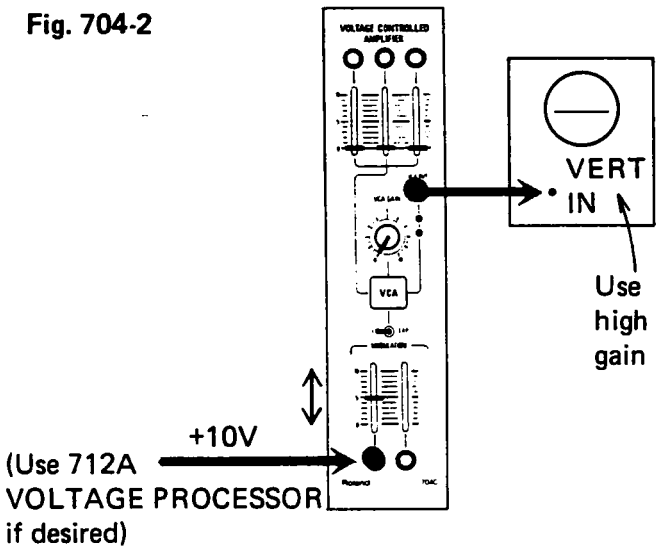
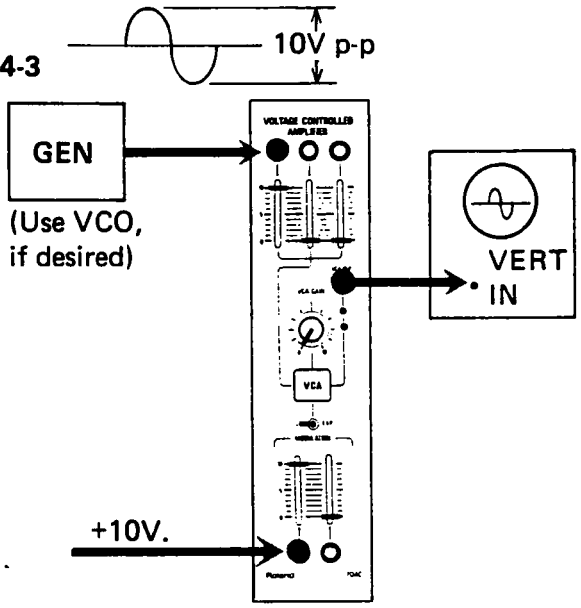


Fig. 704-3



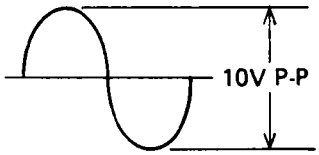
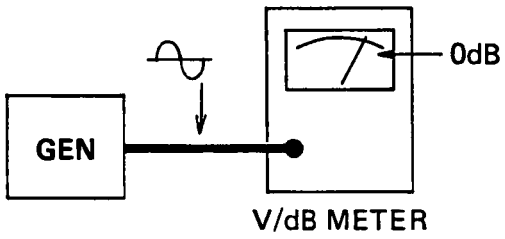
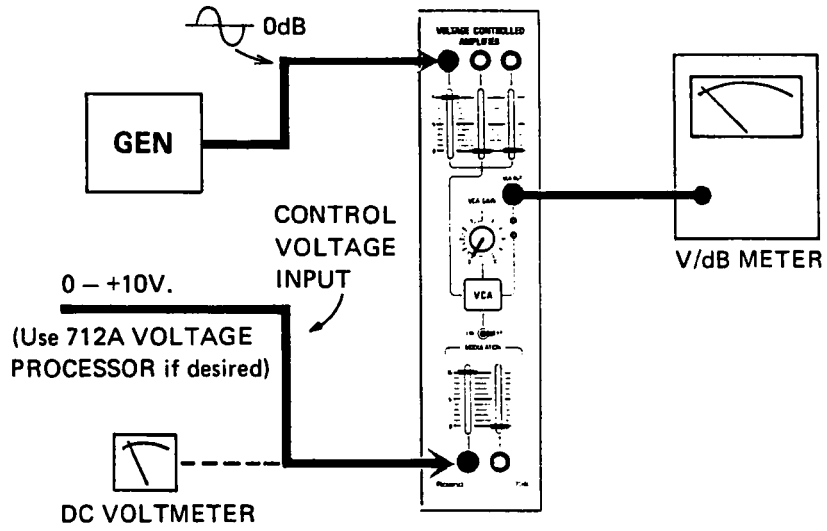
Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
DC Balance	704-2	OSC	VCA OUT	DC BAL VR	Adjust so that moving the MODULATION control up and down produces minimum change.
VCA Gain	704-3	OSC	VCA OUT	LIN WIDTH VR	Adjust so OSC shows: 

Fig. 704-4

A. Setting Audio Generator output:

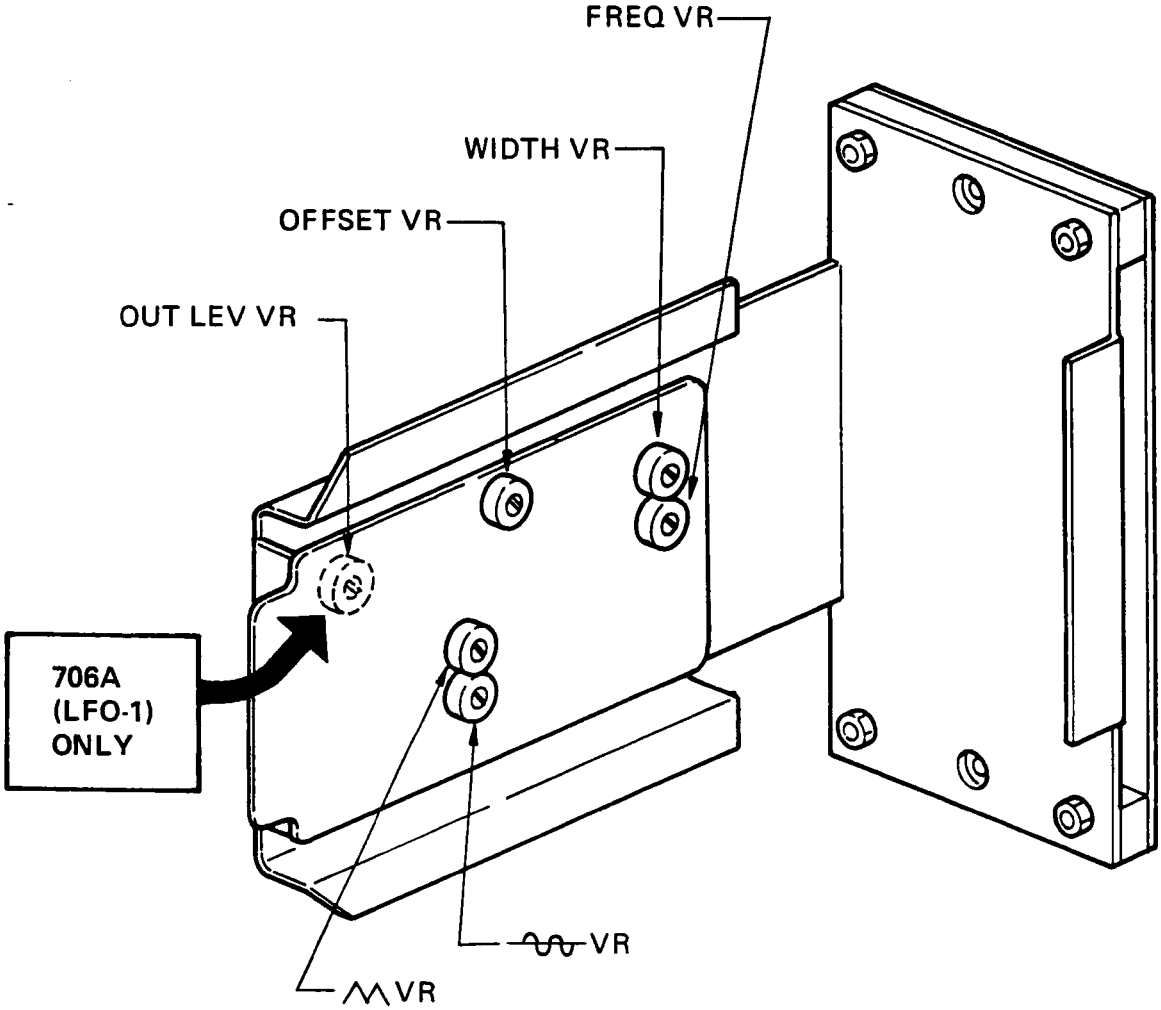


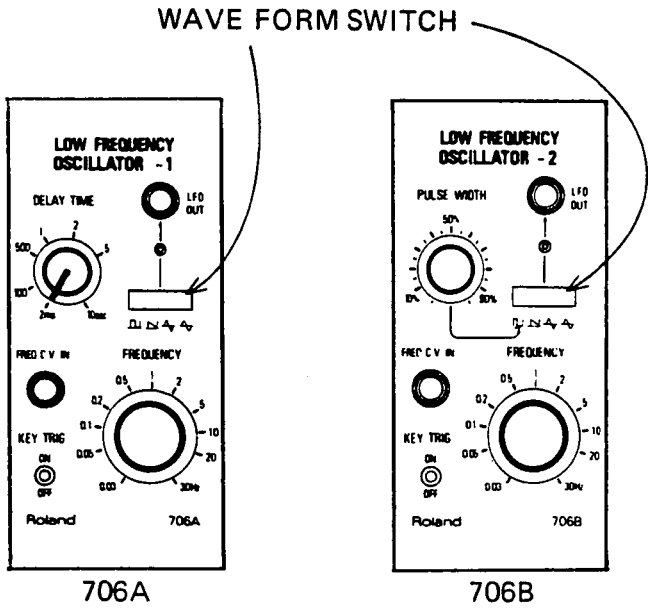
B. Calibrating VCA:



Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Exp. gain	704-4	GEN & DB	VCA OUT	EXP OFFSET VR & EXP WIDTH VR	1. With the signal input at 0dB and the control voltage input at +10v, adjust EXP OFFSET VR for 0dB output. 2. Lower control voltage input to +9v; adjust EXP WIDTH VR for –10dB. 3. Repeat above two steps until +10v produces 0dB and +9v produces –10dB. 4. Check that the following control voltages produce the indicated outputs: +10v 0dB +4v –60dB +9v –10dB +3v –70dB +8v –20dB +2v –80dB +7v –30dB +1v –90dB +6v –40dB 0v –100dB +5v –50dB

Fig. 706-1 706A
706B LOW FREQUENCY OSCILLATOR

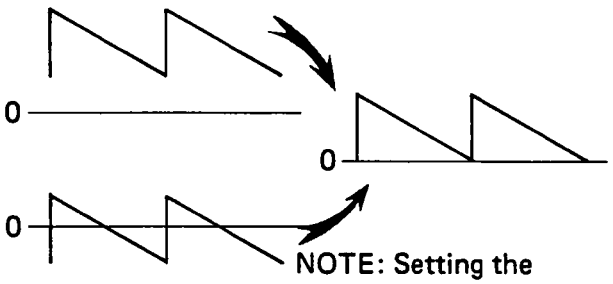
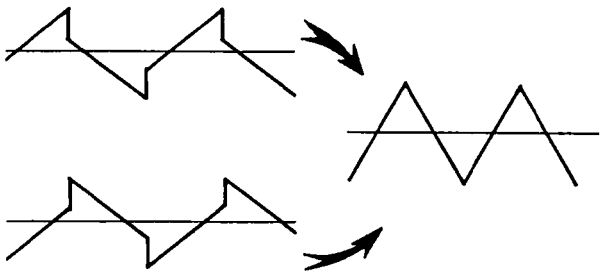




706A 706B

706 LOW FREQUENCY OSCILLATOR procedures

(Procedures are the same for all LFO models)

Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
⊓⊔ and ⋀⋁	706-1	OSC	LFO OUT	OFFSET VR	(With WAVE FORM switch at ⋀⋁)  NOTE: Setting the 0 point automatically sets ⊓⊔ at 50% duty cycle.
⋀⋀	706-1	OSC	LFO OUT	⋀⋀ VR	(With WAVE FORM switch at ∿) 

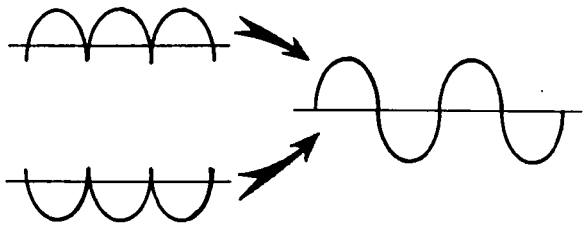
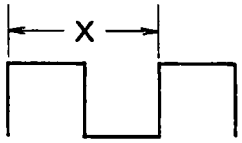
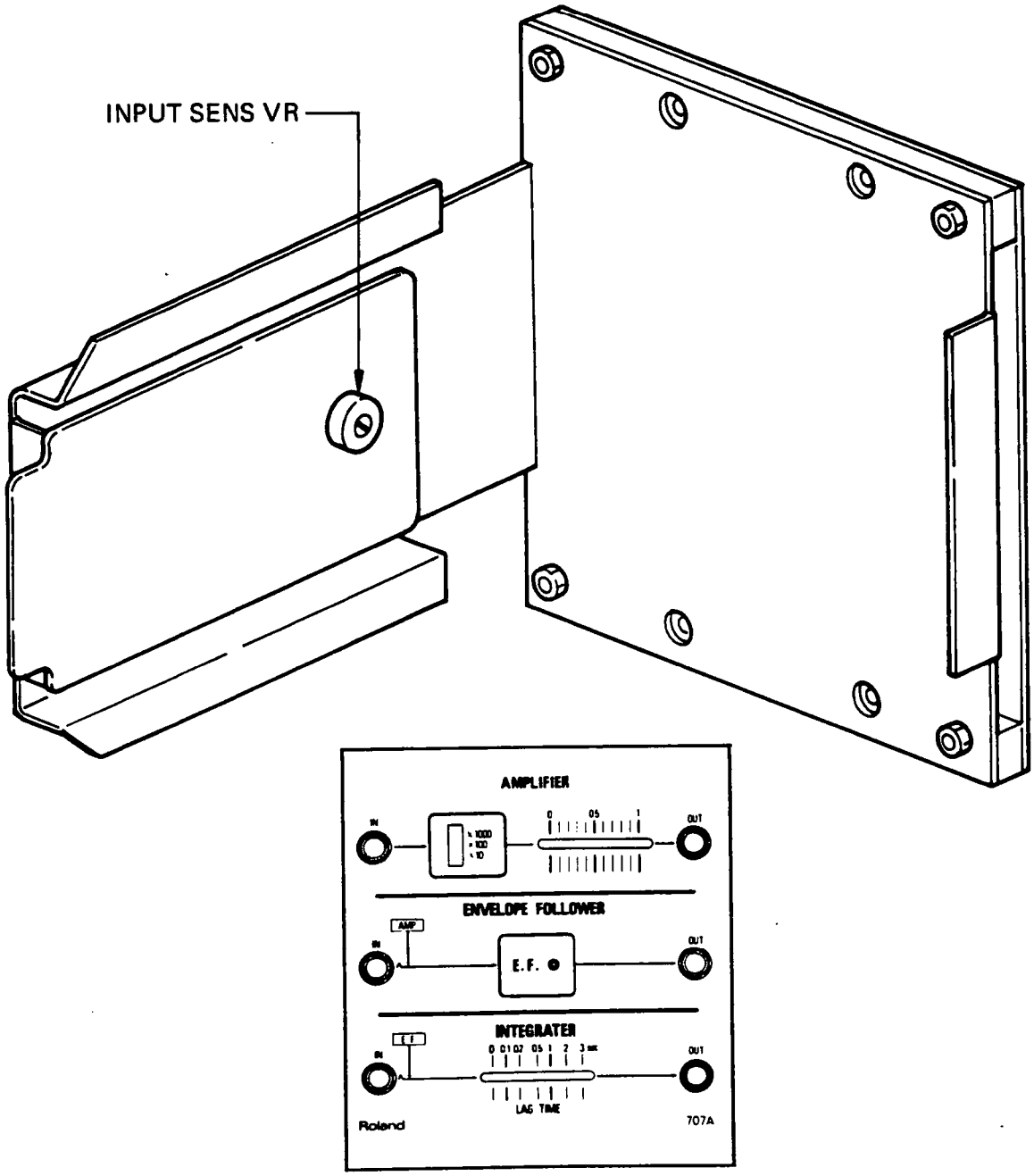
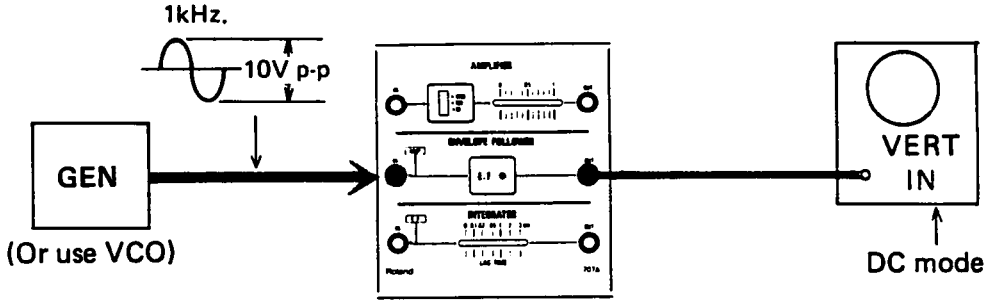
Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
∿	706-1	OSC	LFO OUT	∿VR	(With WAVE FORM switch at ∿) 
Width and freq.	706-1	OSC	LFO OUT	FREQ and WIDTH VR's	(With WAVE FROM switch at ⊓⊔)  1. Set FREQUENCY (front panel) at "10", adjust FREQ VR for X = 100MS. 2. Set FREQUENCY at "0.2" and check X. (Use stop watch and red LED on front panel, if desired). If X is greater than 5 seconds, adjust WIDTH VR to slightly increase time; if less, to slightly decrease time. 3. Repeat above two steps until X = 100MS with FREQUENCY at "10" and X = 5 seconds at "0.2".
Out level	706-1	OSC	LFO OUT	OUT LEV VR	Adjust for 10V p-p.

Fig. 707-1 707A AMPLIFIER/ENVELOPE FOLLOWER/INTEGRATOR



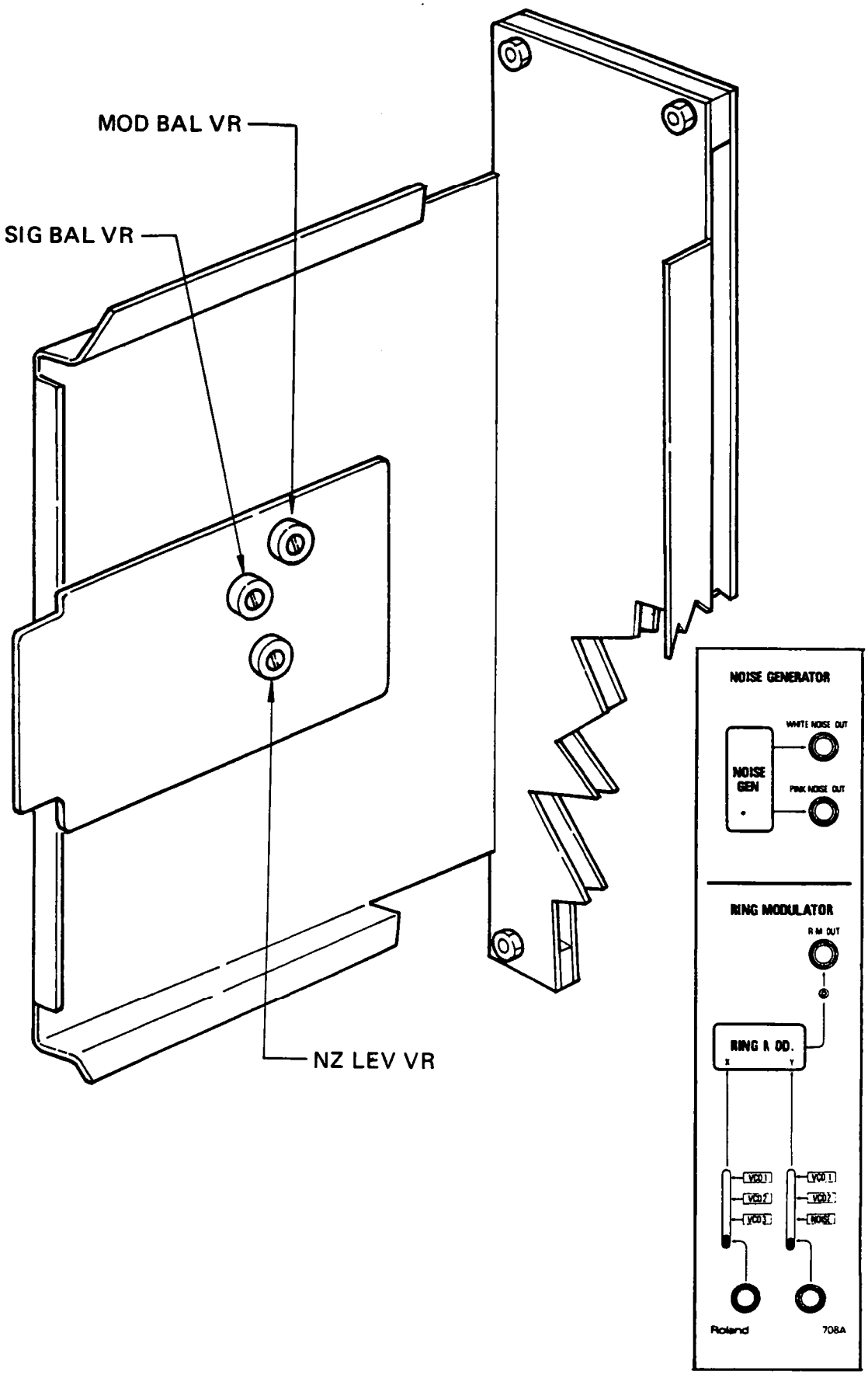
707A AMPLIFIER/ENVELOPE FOLLOWER/INTEGRATOR procedures

Fig. 707-2



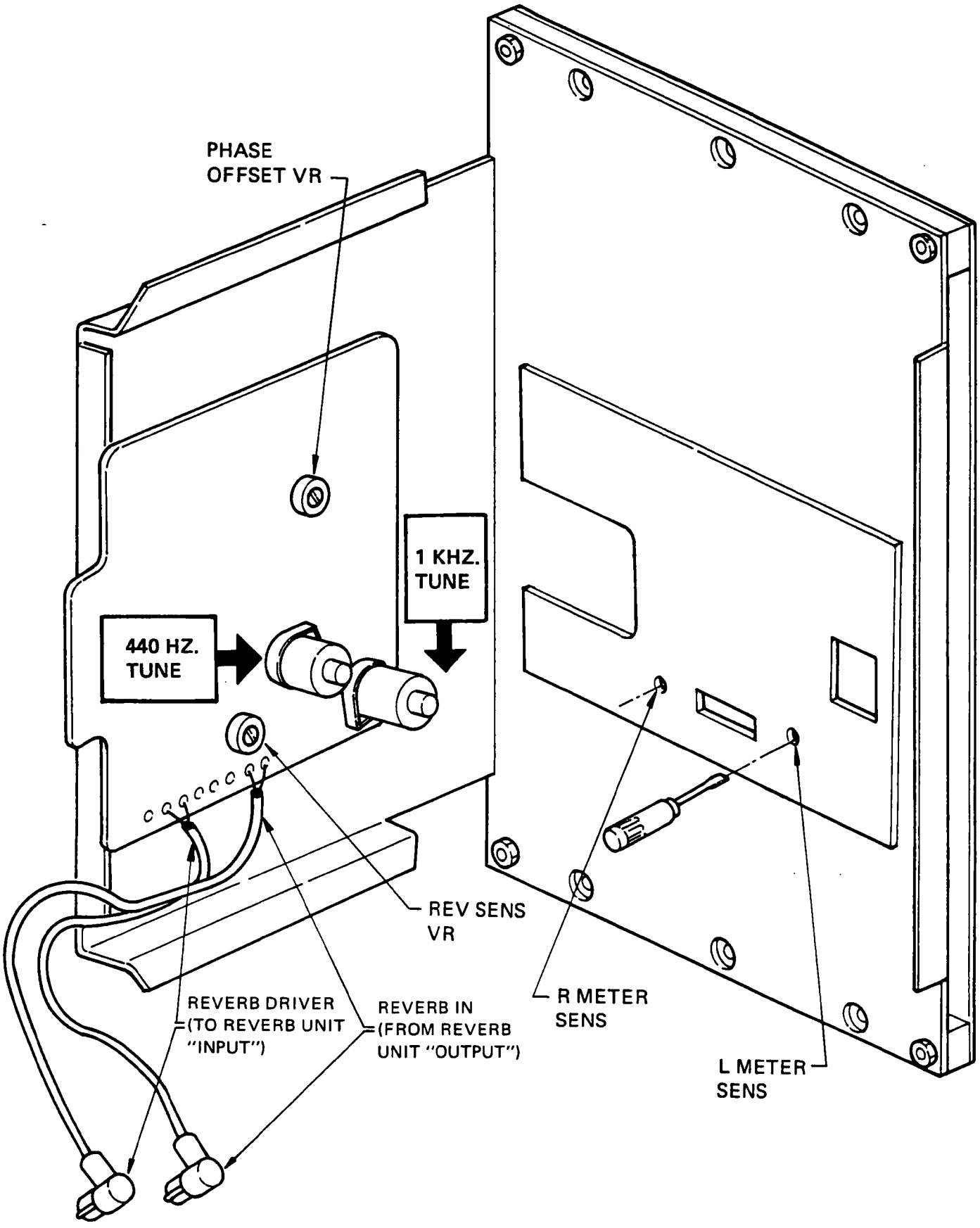
Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Level	707-2	OSC	EF OUT	INPUT SENS	Adjust for +10 volts.

Fig. 708-1 708A NOISE GENERATOR/RING MODULATOR



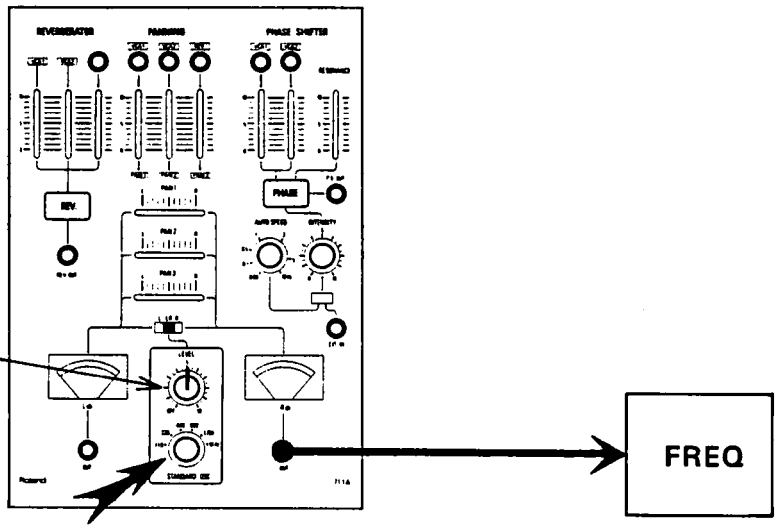
Adjustment	Equip-ment	Jack	Control	Procedure and value
Noise level	OSC	WHITE NOISE OUT	NZ LEV VR	
"X" balance	OSC	RM OUT	SIG BAL VR	With any audio signal at the "X" input only, adjust for minimum output.
"Y" balance	OSC	RM OUT	MOD BAL VR	With any audio signal at the "Y" input only, adjust for minimum output.

Fig. 711-1 711A OUTPUT MODULE



STANDARD OSCILLATOR

Fig. 711-2

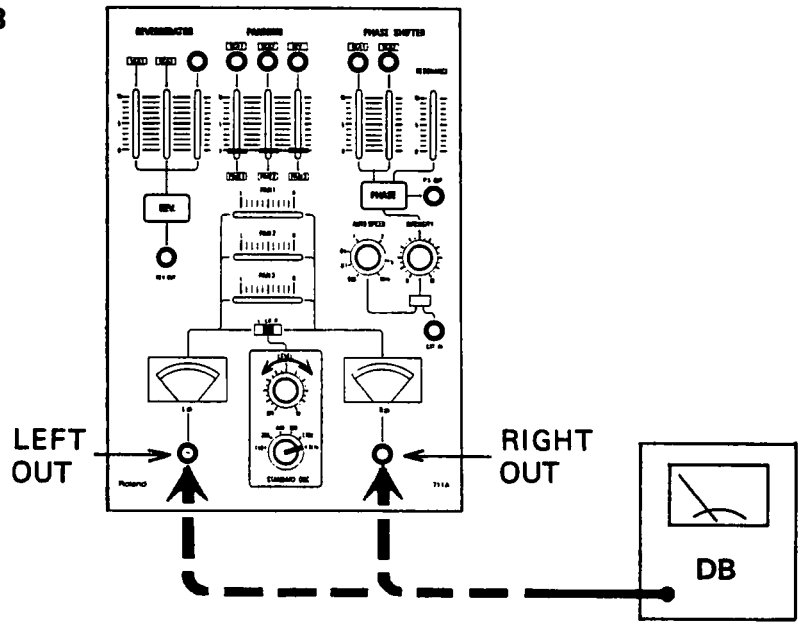


Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Osc. calibr.	711-2	FREQ	OUT (L or R)	440HZ TUNE	With STANDARD OSC frequency selector at "440HZ", adjust for 440Hz.
				1KHZ TUNE	With STANDARD OSC frequency selector at "1KHZ", adjust for 1kHz.

711A OUTPUT MODULE procedures

PANNING

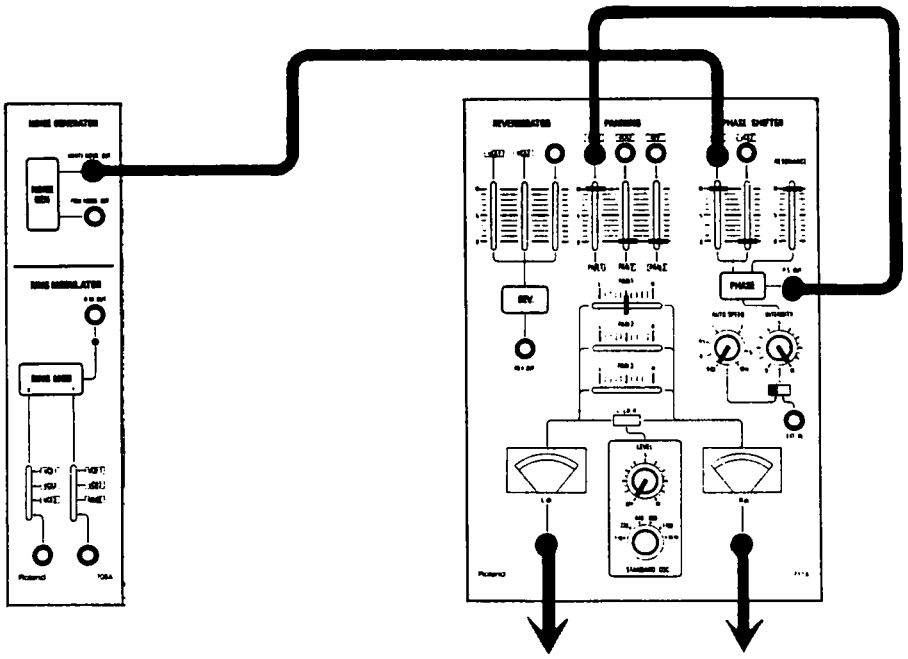
Fig. 711-3



Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Meter calibration	711-3	DB	LEFT OUT	L METER SENS	Adjust STANDARD OSC. LEVEL control so dB meter reads "0"; adjust L METER SENS so left VU meter reads 0dB.
			RIGHT OUT	R METER SENS	Adjust STANDARD OSC. LEVEL control so dB meter reads "0"; adjust R METER SENS so right VU meter reads 0dB.

PHASE SHIFTER

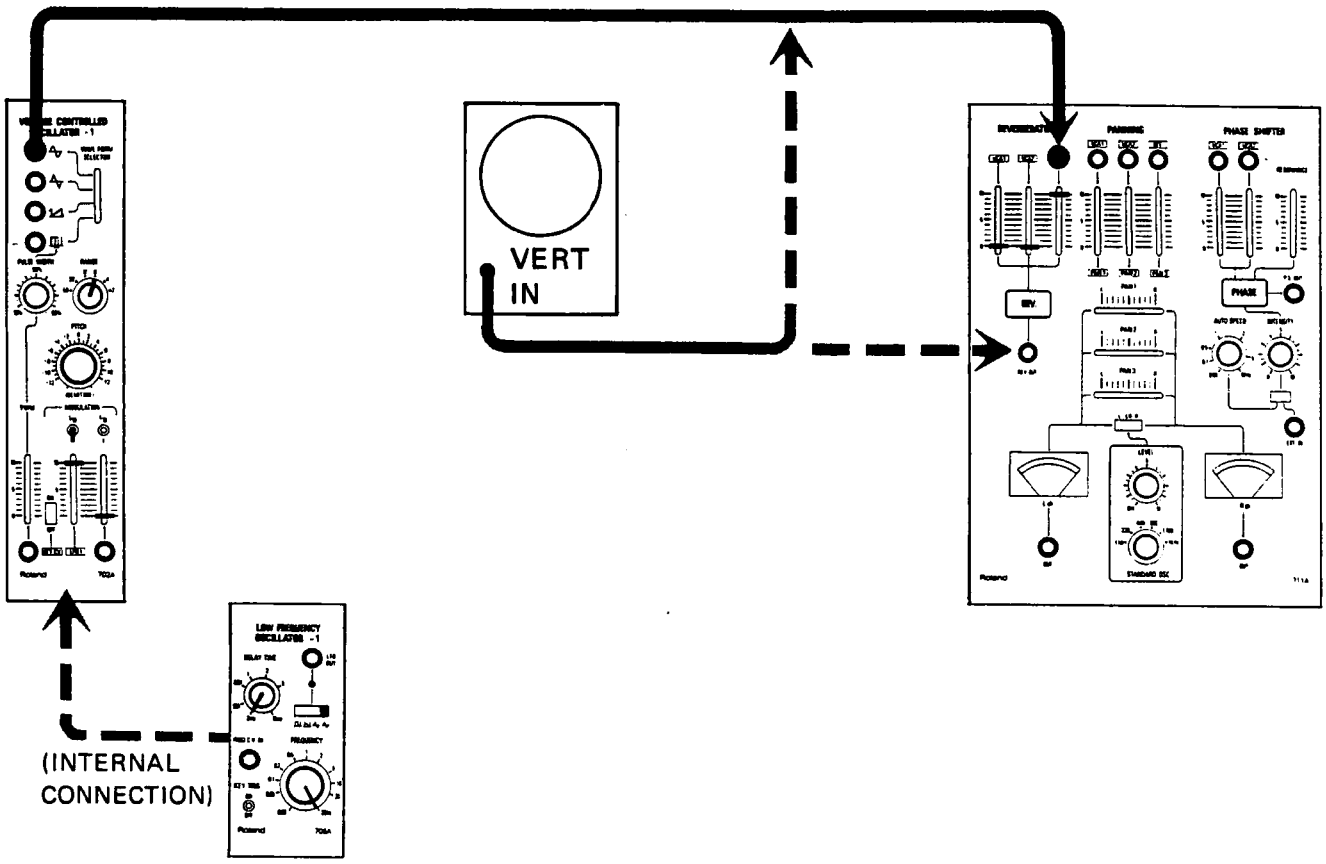
Fig. 711-4



Adjustment	Fig.	Equipment	Jack	Control	Procedure and value
Phase shift offset	711-4	(Audio amp)		PHASE OFFSET VR	Adjust so sound continuously changes, with no "flat" spots at the top and bottom of sweep.

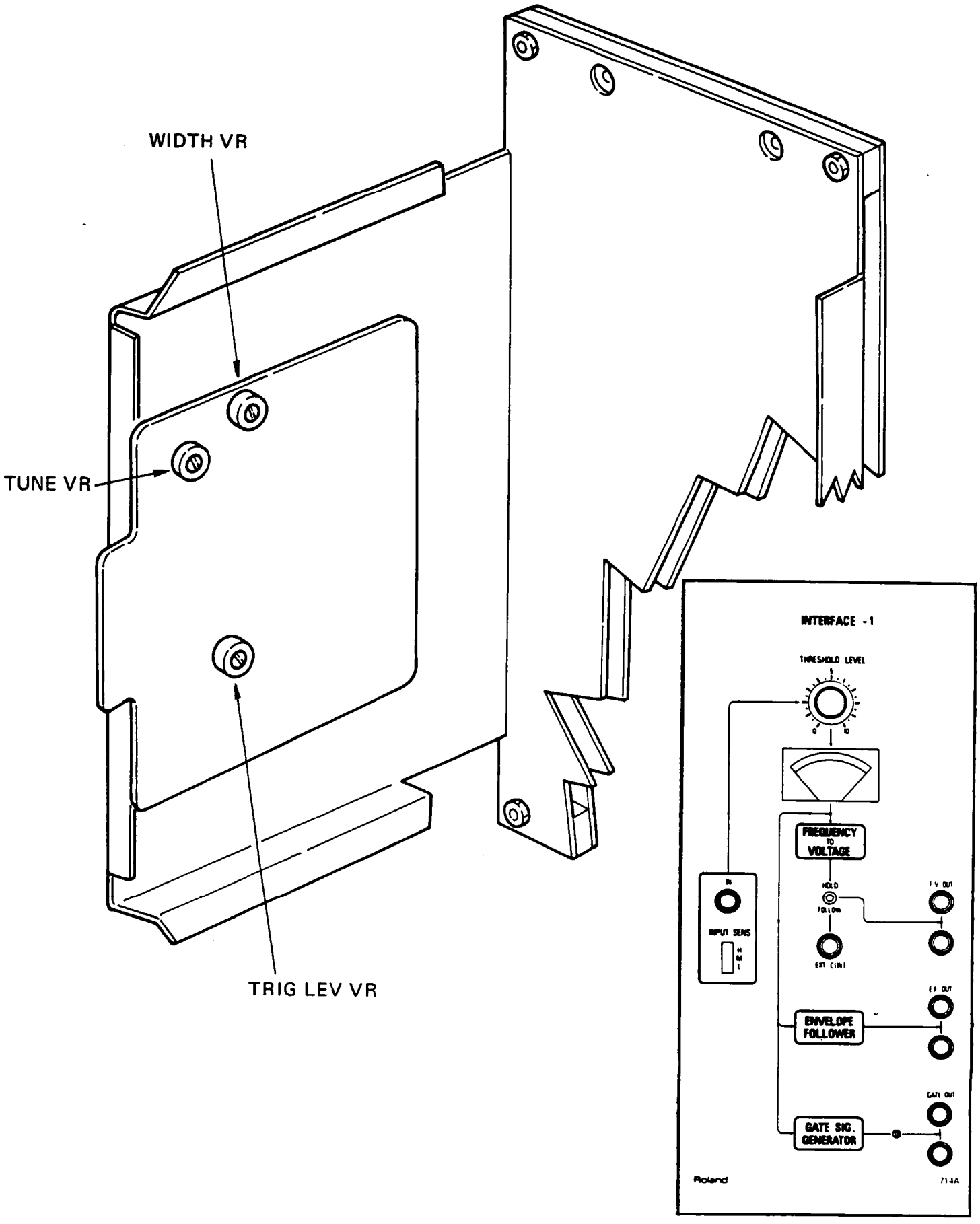
REVERBERATOR

Fig. 711-5



Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Reverb level	711-5	OSC	REV OUT	REV SENS VR	Adjust so input and output peaks are the same level.

Fig. 714-1 714A INTERFACE



Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Gate trigger level	714-1	GEN (or VCO)	IN	TRIG LEV VR	With sine wave input, set THRESHOLD LEVEL and INPUT SENS controls to produce −10dB on the front panel VU meter. Adjust TRIG LEVEL VR so that red LED at GATE OUT jack just lights.

Fig. 714-2

ⓐ Tune VCO's to unison with A3 = 440Hz.
(See p. 701-3 this section for key designations)

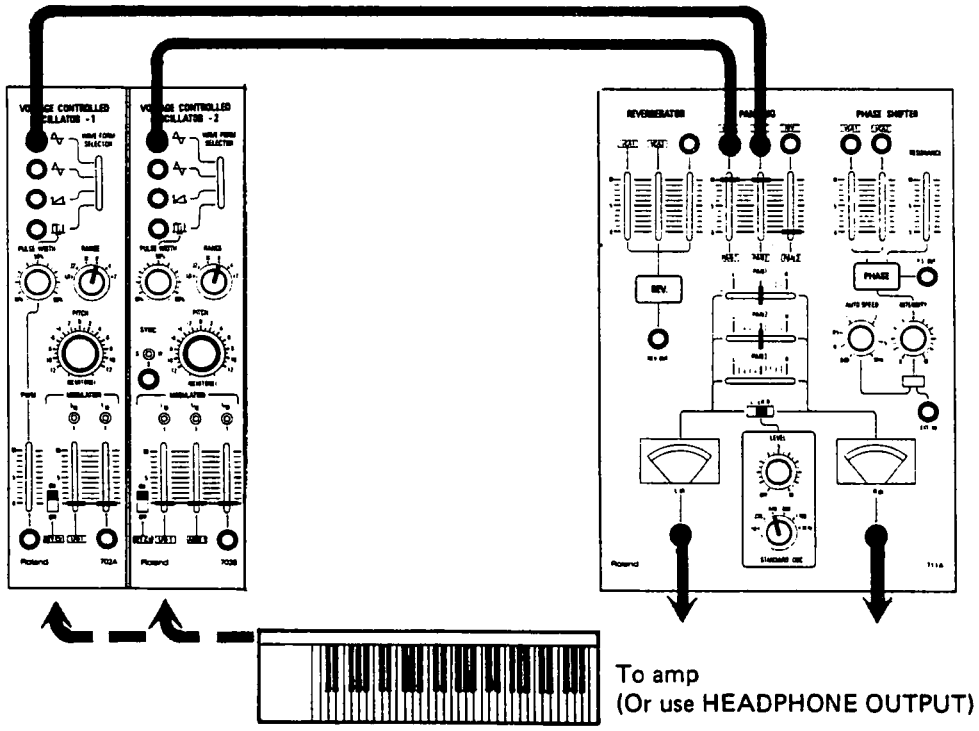
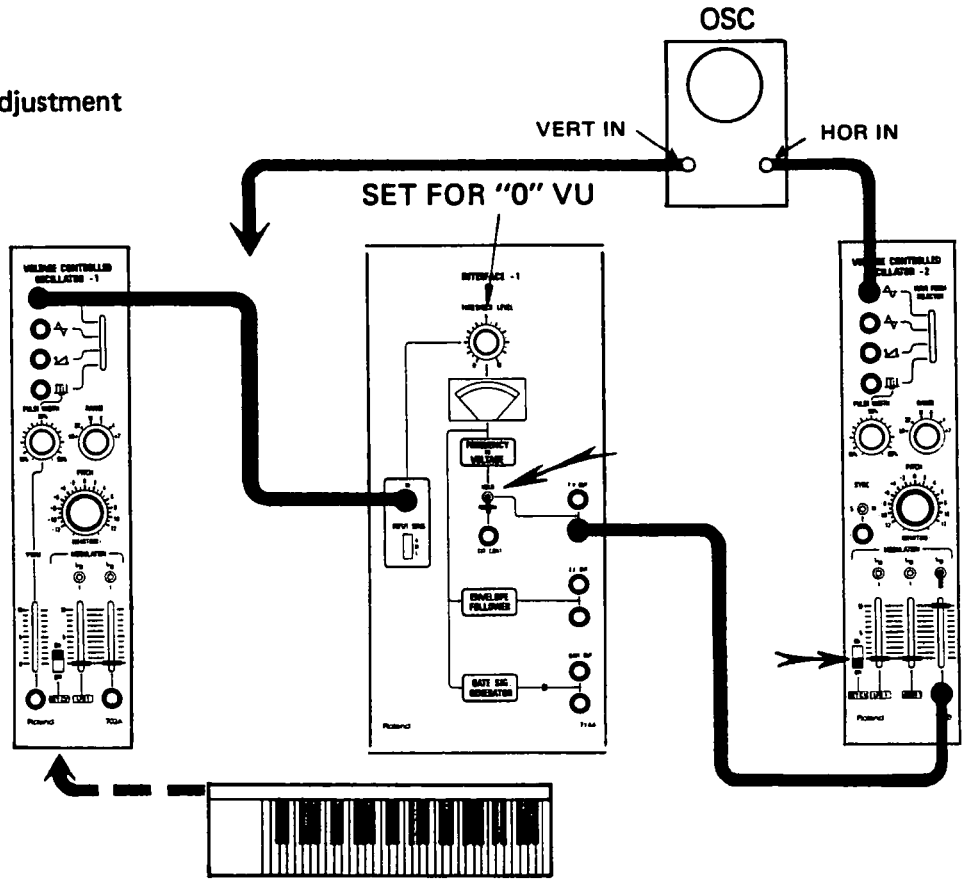


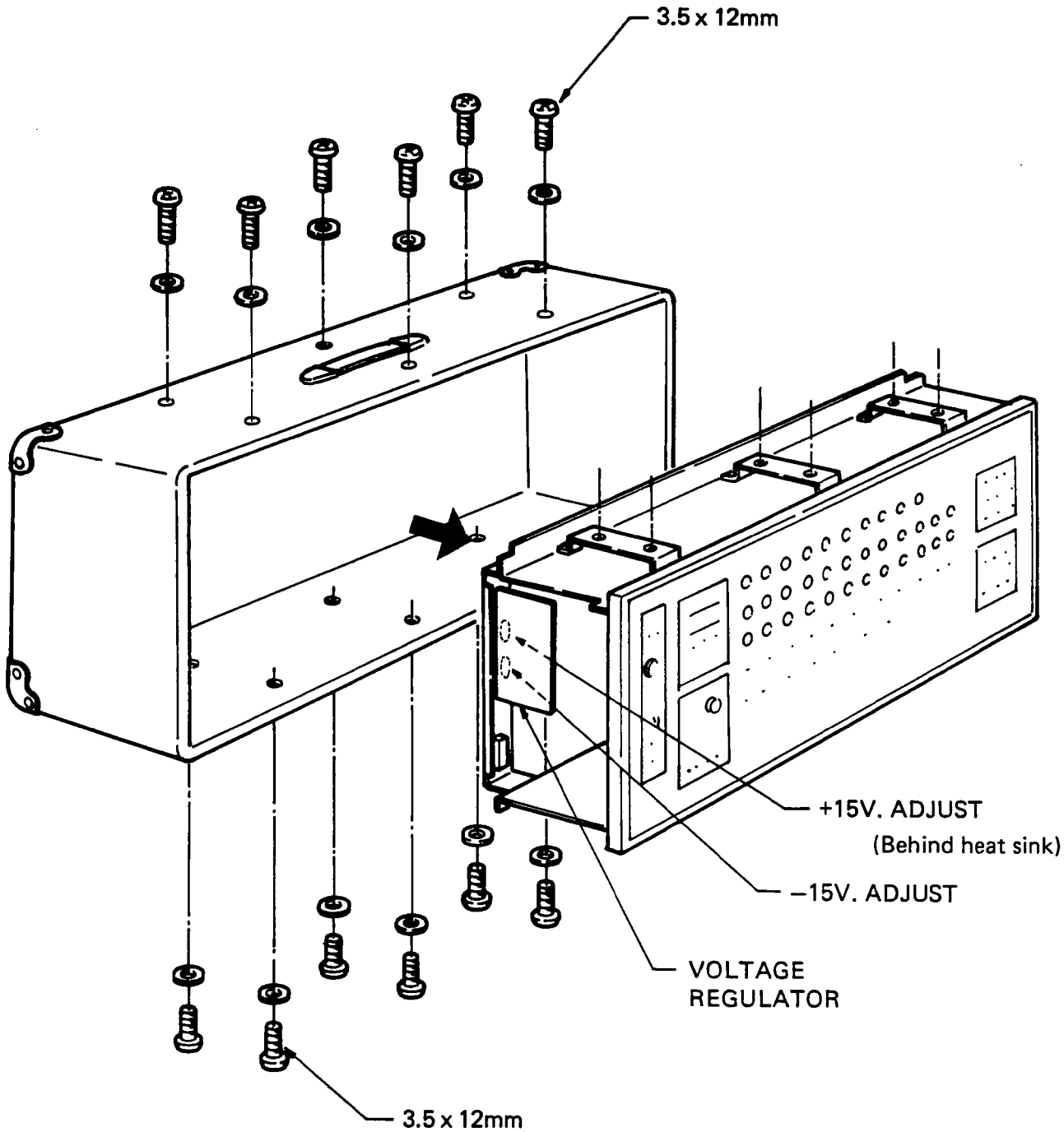
Fig. 714-2

ⓑ. WIDTH VR adjustment



Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Preliminary	714-2a	(Audio amp)		VCO front panel controls	Tune VCO-1 and VCO-2 to unison.
VCO width	714-2b	OSC	(See fig. 714-2b)	TUNE and WIDTH VR's	1. Press C1 on the keyboard and adjust TUNE VR and/or VCO-2 PITCH controls for stable 1 : 1 Lissajous figure. 2. Press C2, adjust WIDTH VR so speed of rolling figure increases slightly. CAUTION: If figure is rolling slowly, be careful not to turn WIDTH VR in direction which causes the pattern to reverse direction. 3. Repeat the above two steps until pressing C1 and C2 both produce stable 1 : 1 Lissajous figures. 4. Repeat the above using C1 and C6. 5. Check that all keys on the keyboard produce a stable 1 : 1 Lissajous figure.
Tuning	714-2	OSC (and audio amp)		TUNE VR	1. Tune VCO's to unison as per fig. 714-2a. 2. Using the arrangement shown in fig. 714-2b, adjust TUNE VR for stable 1 : 1 Lissajous figure.

Fig. 717-1 717A ANALOG SEQUENCER



Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
+15.00V	717-1	DVM	See insert, fig. 717-2	+15V ADJUST	+15.00V, ±10mv
–15.00V	717-1	DVM		–15V ADJUST	–15.00V, ±10mv

Fig. 717-2

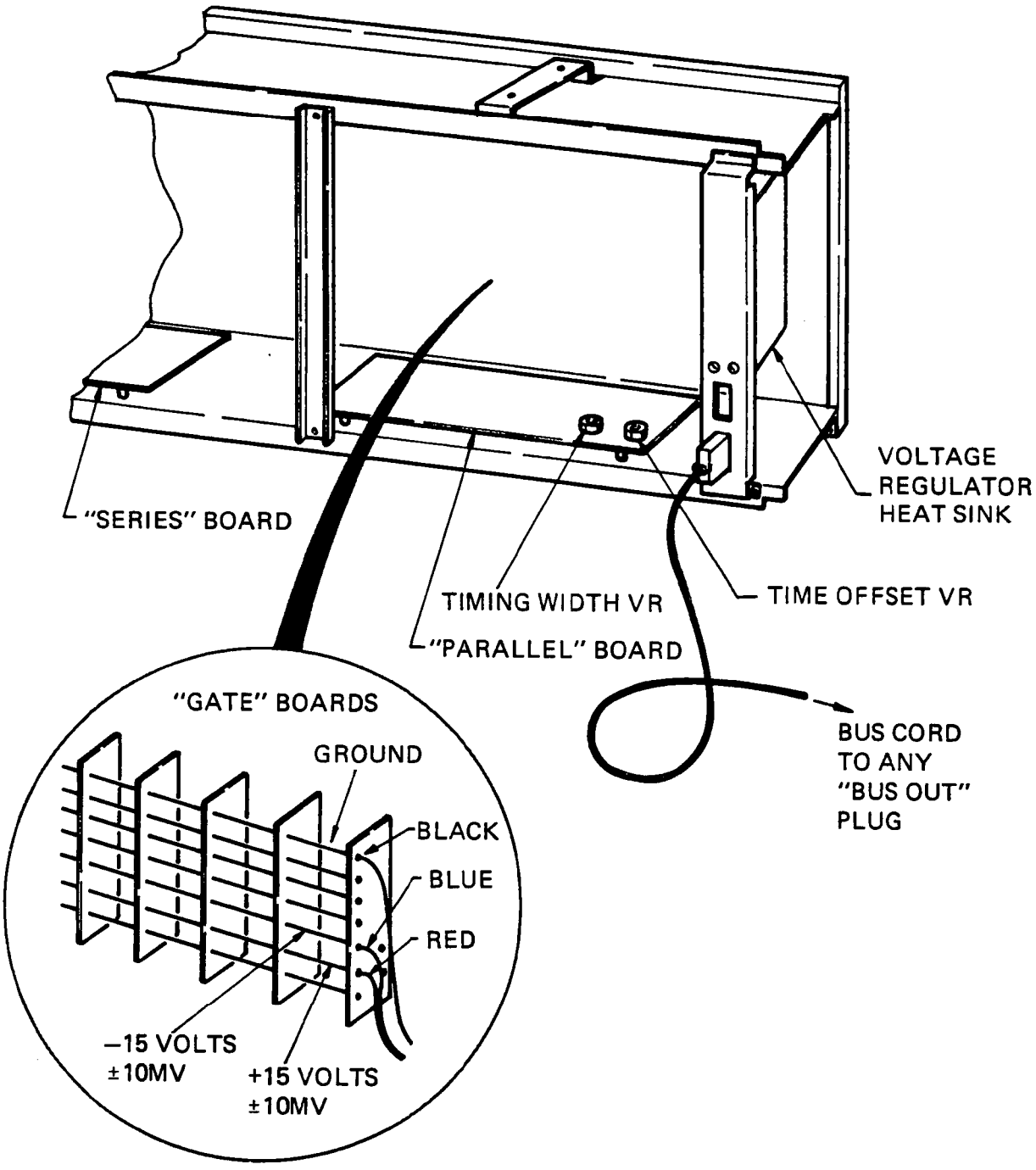
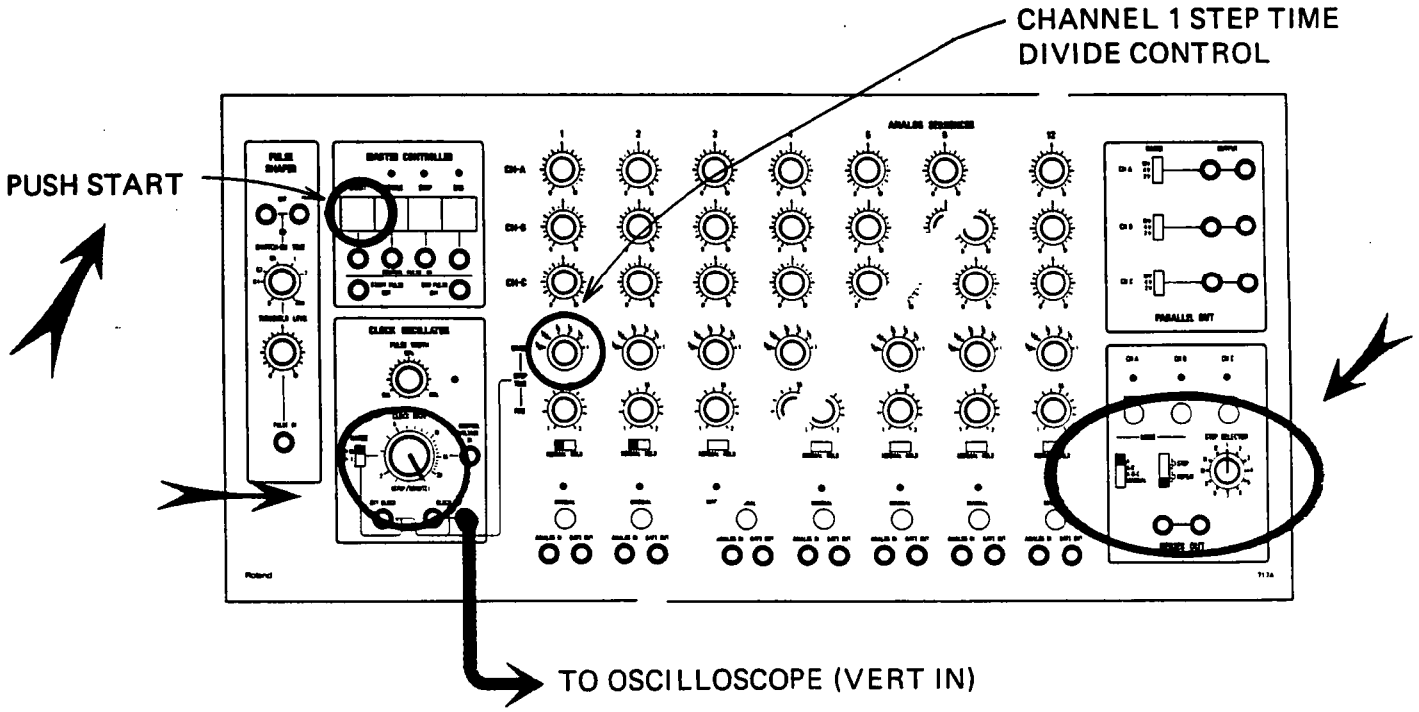


Fig 717-3 Front panel settings for TIME WIDTH VR adjustment



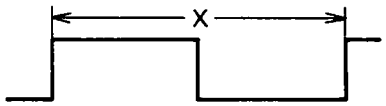
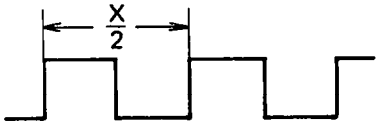
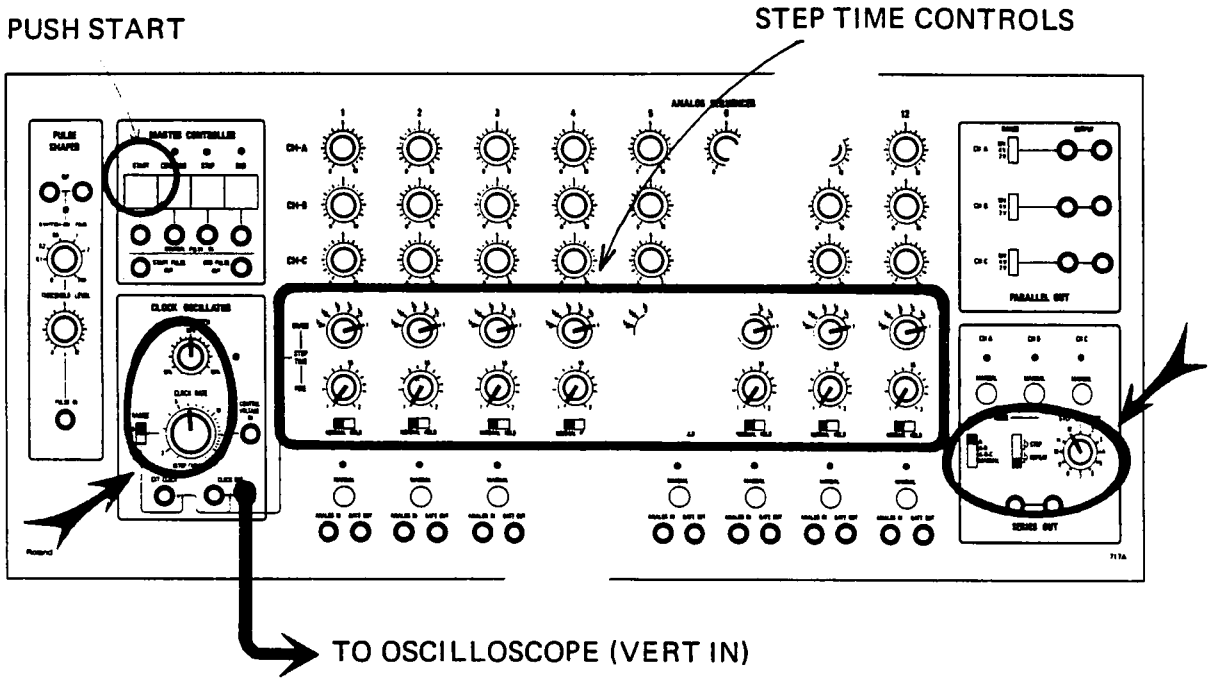
Adjustment	Fig.	Equip-ment	Control	Procedures and value
Time width adjust (Method 1)	717-3	OSC	TIME WIDTH VR	Set the Channel 1 STEP TIME DIVIDE control at "1/16" and note the wave form.  Set the Channel 1 STEP TIME DIVIDE control at "1/32" and adjust TIME WIDTH VR for X/2.  Repeat the above steps until these conditions are met.

Fig. 717-4 Front panel settings for TIME OFFSET VR adjustment



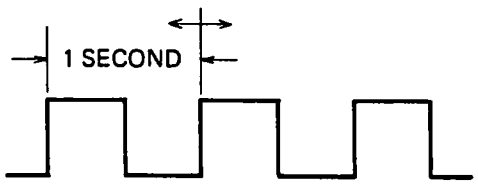
Adjustment	Fig.	Equip-ment	Control	Procedures and value
Time calibration	717-5	OSC	TIME OFFSET VR	(Set all TIME STEP controls at "1"). 

Fig. 720-1 720B 2CH PHASE SHIFTER

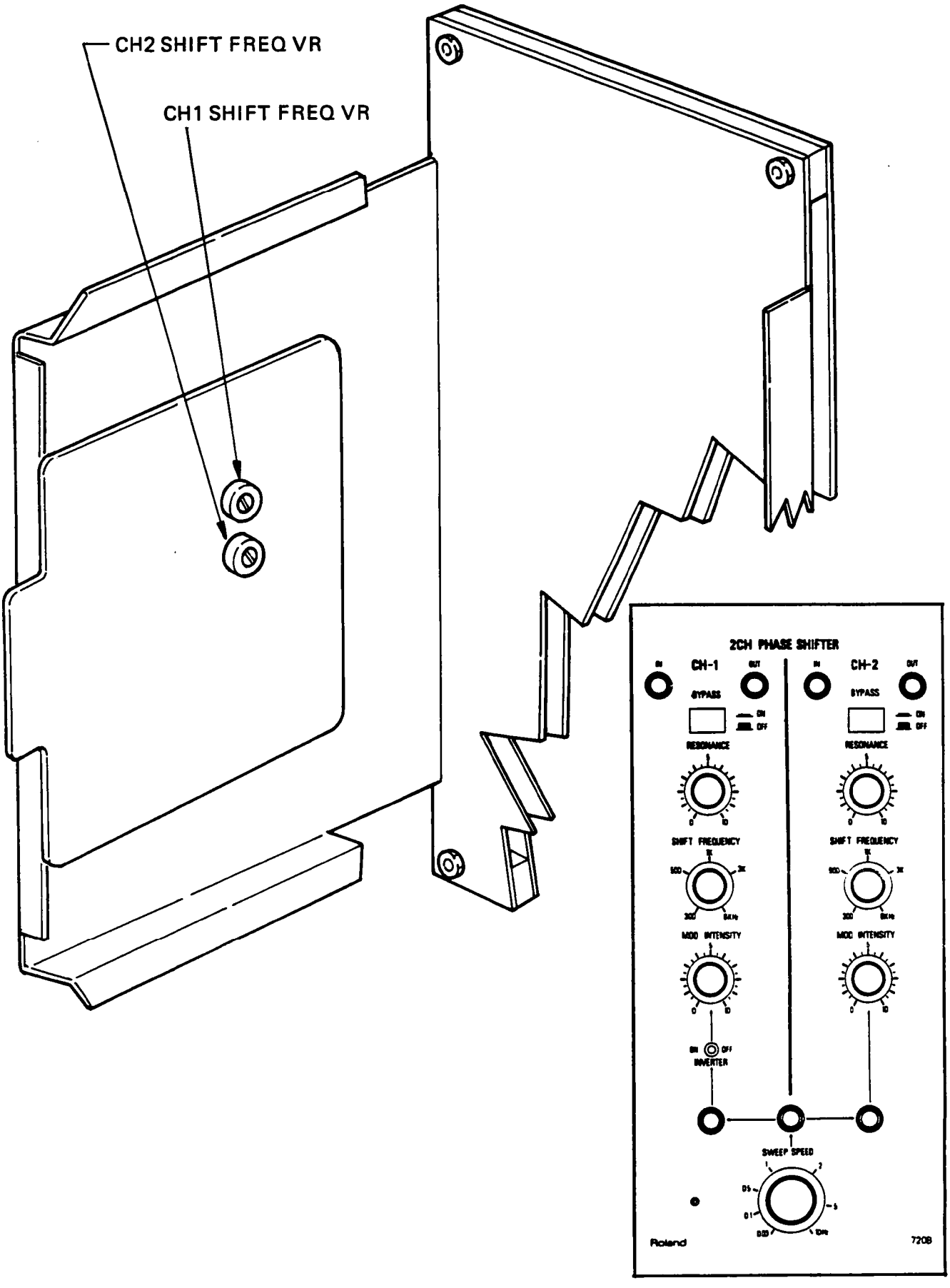
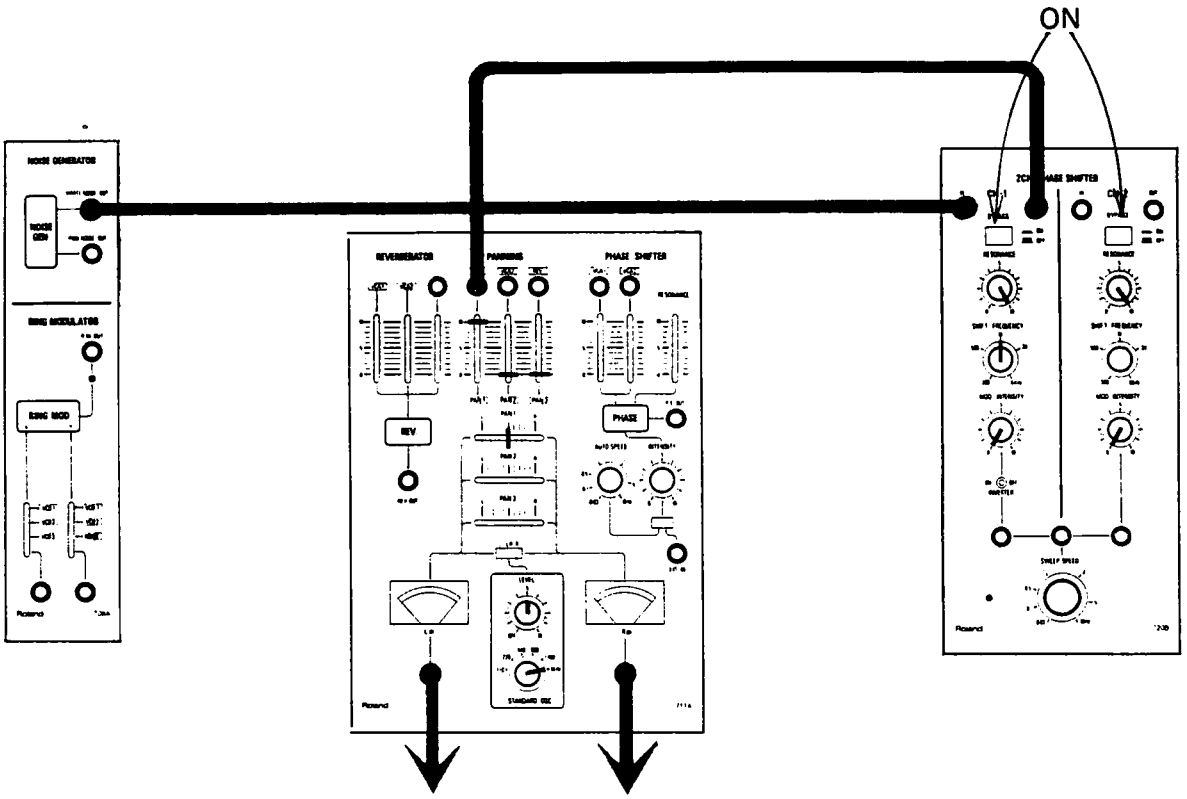


Fig. 720-2



720B 2CH PHASE SHIFTER procedures

(procedures same for both channels)

The adjustment of the 720B 2CH PHASE SHIFTER is not critical and is a purely subjective matter. One method is shown below.

Adjustment	Fig.	Equip-ment	Jack	Control	Procedures and value
Shift frequency	720-1	(Audio amp)		SHIFT FREQ VR	Use the SHIFT FREQ VR to "tune" the pitch of the noise output to the approximate pitch of the test oscillator output.
Check					Check that the SHIFT FREQUENCY control produces changes in the noise over its entire range of rotation.

Fig. 721-1 721A 2CH AUDIO DELAY

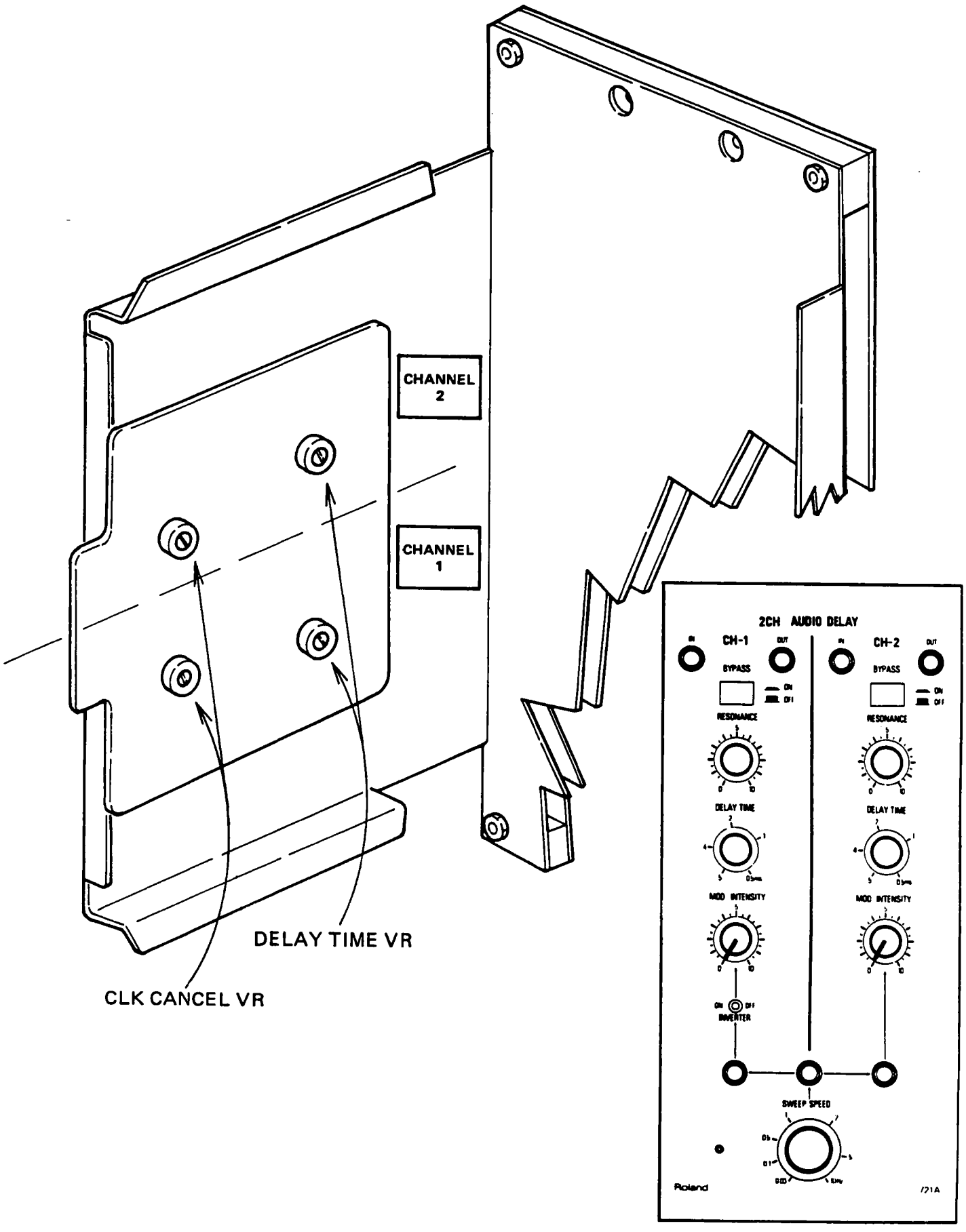
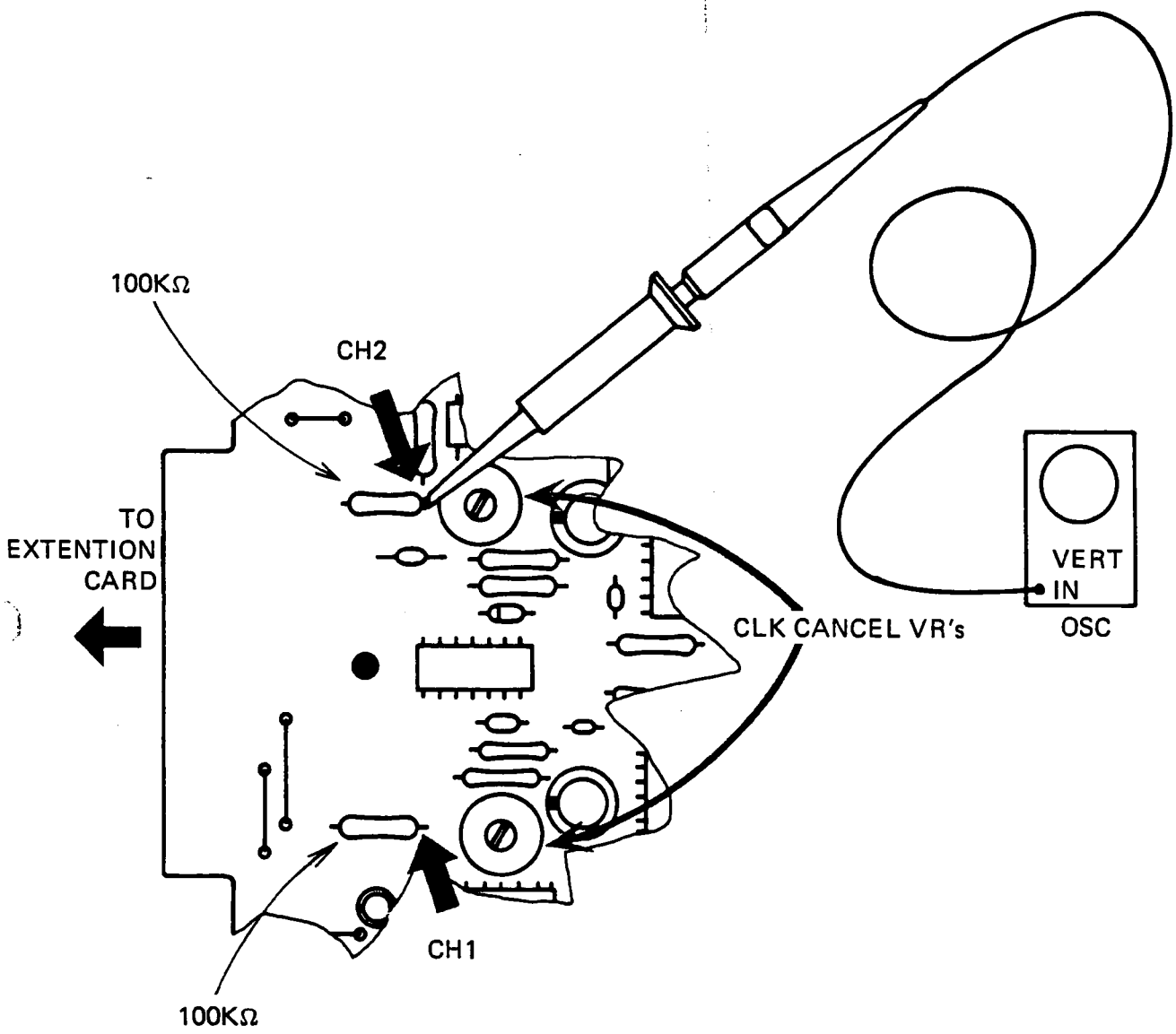


Fig. 721-2 Test points for CLK CANCEL adjustment



721A AUDIO DELAY procedures

(Procedures same for both channels)

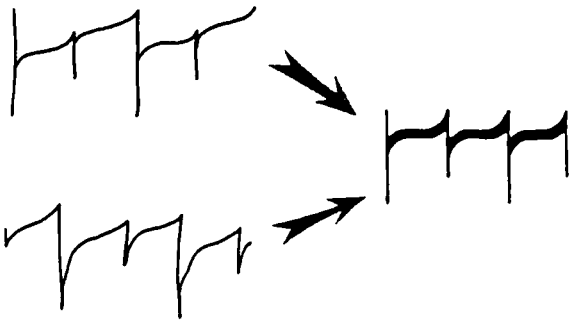
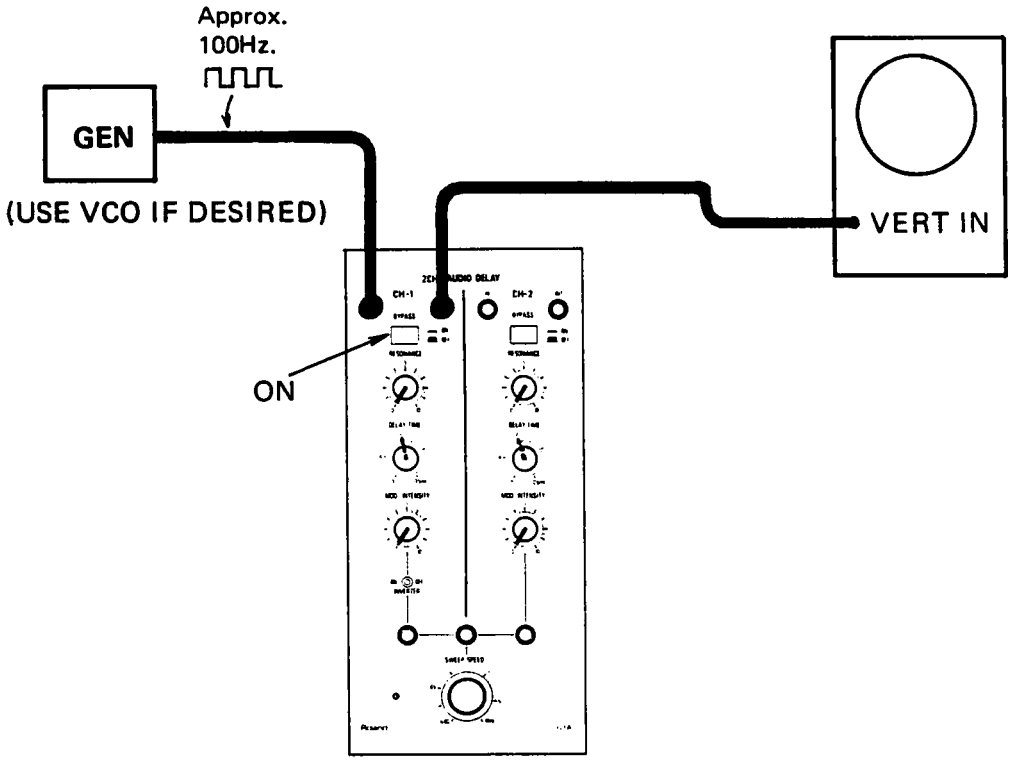
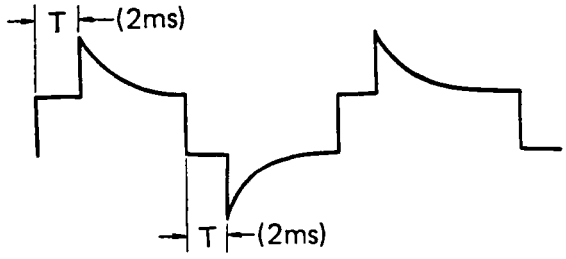
Adjustment	Fig.	Equip-ment	Jack	Control	Procedures and value
Clock Cancel	721-2	OSC	None (See fig. 721-2)	CLK CANCEL VR	

Fig. 721-3



Adjustment	Fig.	Equip-ment	Jack	Control	Procedure and value
Delay calibration	721-3	OSC & GEN	OUT & IN	DELAY TIME VR	Adjust so that T equals value shown by DELAY TIME control on front panel.  (Do Channel 2 in the same way.)