

GR-33B, G-33/G-88

SERVICE NOTES

First Edition

SPECIFICATIONS

PITCH SHIFT RANGE --- PITCH A/B: ± 1300 cents
 ATTACK TIME ----- 0-3 seconds
 DECAY TIME ----- 0-10 seconds
 POWER CONSUMPTION --- 24 watts
 DIMENSIONS ----- 400(W) x 290(D) x 100(H)
 WEIGHT ----- GR-33B: 5Kg; G-33/G-88: 4.2Kg

Panel N-230 (2221323000) LED GL-3AR2 (15029102) Knob N-112 (2247011200) large Handle N-204 (R/L same) (2231020400) Washer N-701 (2213370101)

Pots (5 pcs) EVHRR360B54 (13219104) Pots (5 pcs) EVHRR360A26 (13219102)

Knob N-113 (2247011300) sma LED TLR-105 (15029109)

When replacing, place a washer on the top of pot's shaft for a space between knob bottom and panel top.

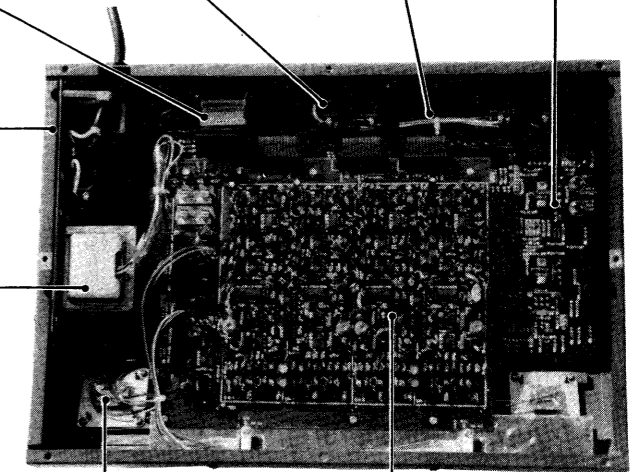


all Slide switches SSB02204 (13159106) Switch w/matt (2312390300)

Flexible PCB (2291016700) Chassis N-214 (2281021401) Wiring ass'y N-208 (2341020800) CONTROL BOARD OP-9222-040

Chassis N-229 (2281322900)

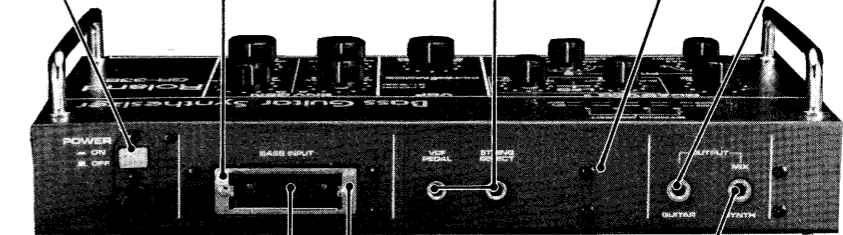
Power transformer
 PT-N-185 (22450185N0) 100V
 PT-N-186 (22450186C) 117V
 PT-N-187 (22450187D) 220/240V



Wiring ass'y N-207 (2341320700) VOICING BOARD OP-9222-030

Power switch Common to all voltage areas ESB-70294 (13129110) Button N-510 (2247051000) Screw 3 x 15mm nickel binder Jack SG-7630 (13449107) Screw 3 x 6mm black, binder Jack SG-7640R (13449202)

Chassis N-228 (2281322800) w/rubber feet Rubber foot No.40 Connector SLC-1204-2324F (13429405) w/lock shell SLC-1204-24L1 (12139302) Jack SG-7630G (13449108) Rubber foot No.41



* G-88, ** G-33

Machine head
 * PG-123 gold (2228331300)
 ** PG-121 nickel (2228331400)
 Wood screws
 Round 2.4 x 10mm * gold ** nickel

End pin
 * gold (2228331100)
 ** nickel (2228331200)
 Screw Oval 3 x 25mm
 * gold ** nickel
 Felt washer black

Guitar pickup
 PU-144 (2238360500)

Divided pickup
 w/touch plates
 (2238360200)

Bridge/tailpiece
 *TP-150 (2213330600) brass
 ** TP-151(2213330700) nickle

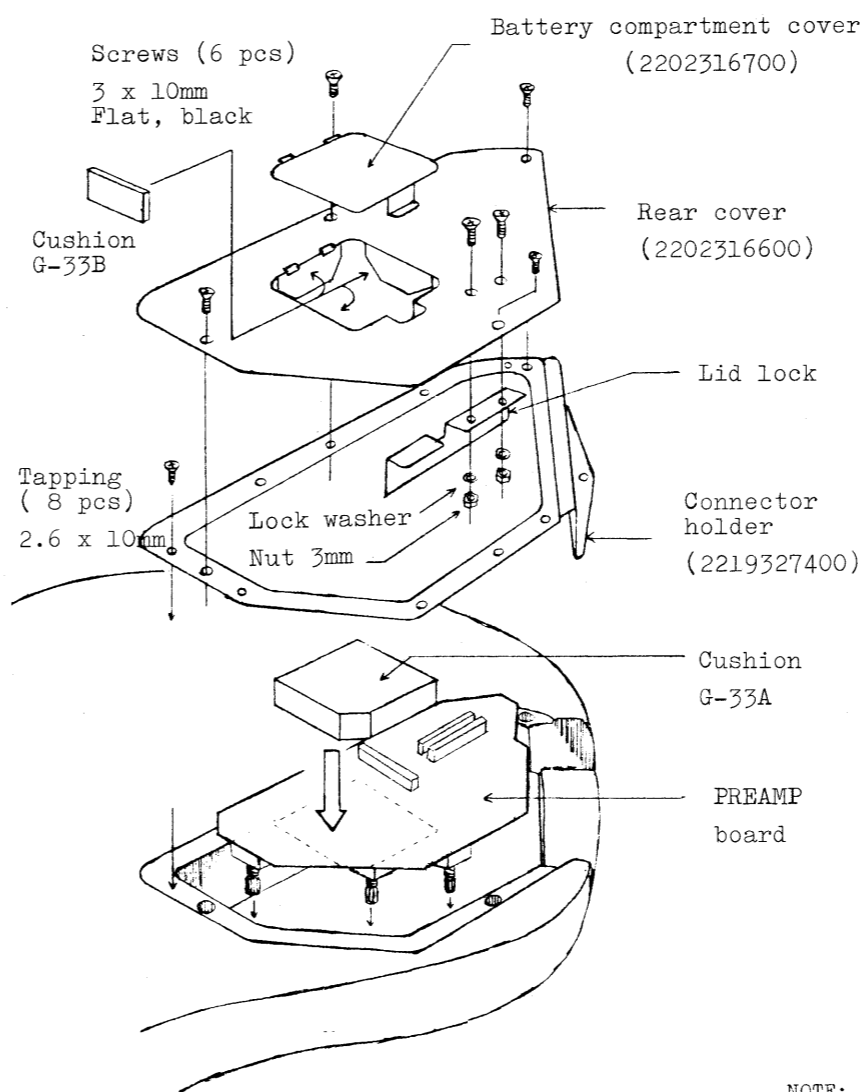
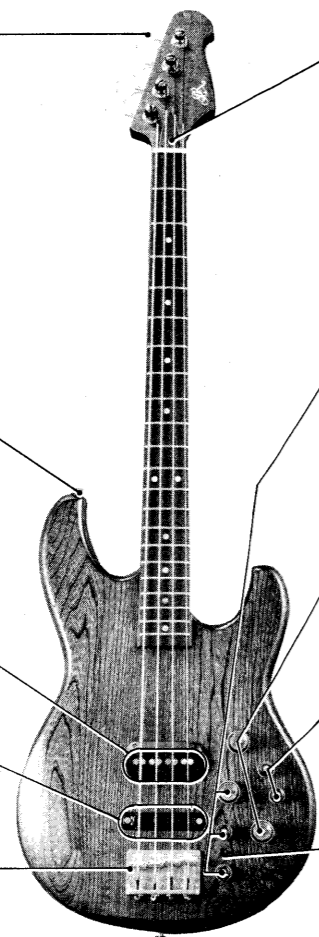
Adjust rod cover
 (* 2202316900) brass
 (** 2202362100) plastic
 Screws 2x8mm pan, tapping
 * gold ** black

Pots (3pcs)
 EVH-RTA304B54
 (13219106)

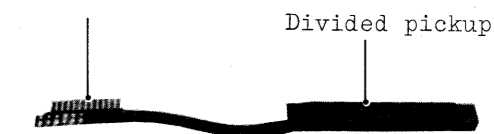
Knobs KN-02 gold
 (3pcs) (2247018800)
 Pots (2pcs)
 EWJ-EWA322B54 dual ganged
 (13219766)

Pots (2pcs)
 EVH-RXA304B54 w/center click
 (13219763)
 Knobs (4pcs)
 KN-02S black
 (2247019000)

Switch FTE-43B (13169604)

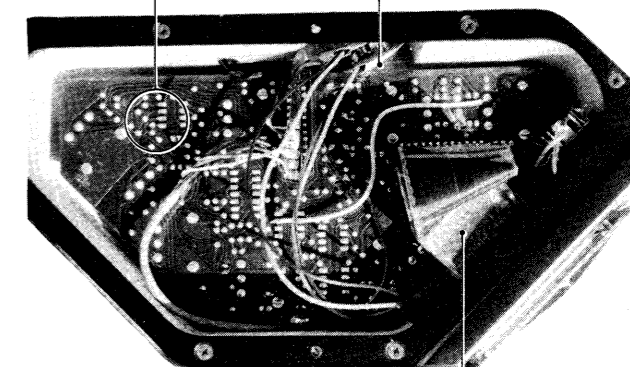


Flexible pcb
 (2291338400)



PREAMP Board

Battery connector
 SL-2102 (13419206)



Flexible pcb
 (2291106700)

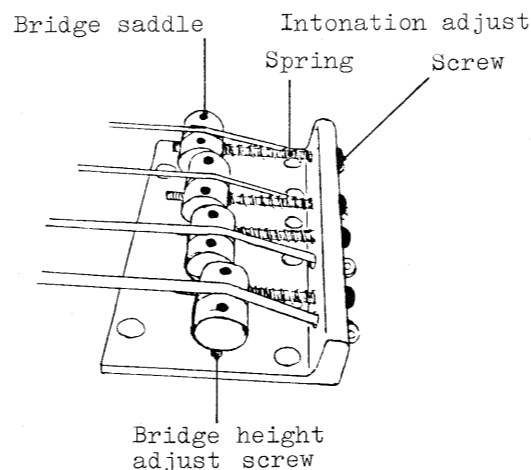
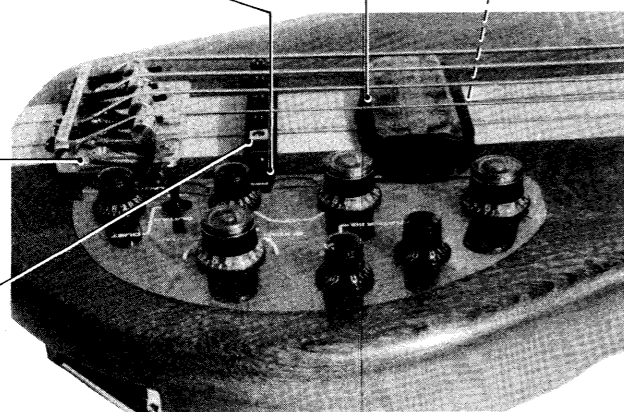
Pickup holder
 (2219327300)
 Screws 2.3 x 12mm
 flat, tapping black

Height adjust screw
 3 x 25mm pan
 * gold ** nickel
 Spring 0.8 x 6 x 25mm

Pickup base
 (2235330800)
 not shown

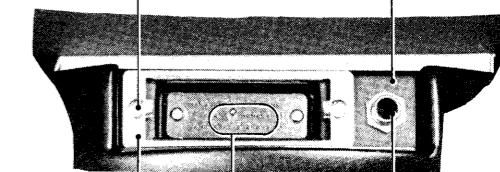
Screw
 3 x 25mm oval
 * gold **nickel

Height adjust screw
 3 x 22mm
 pan head 4.5mm dia



NOTE:
 Head diameter is
 slightly smaller
 than ordinary 3mm
 screw's.

Screw 3 x 16mm
 pan head 4.5mm dia
 nickel Connector holder
 (2219327400)



Jack SG-7850#01
 (1344939900)

Connector w/lock shell
 SLC-1204-2324F
 (13439605)

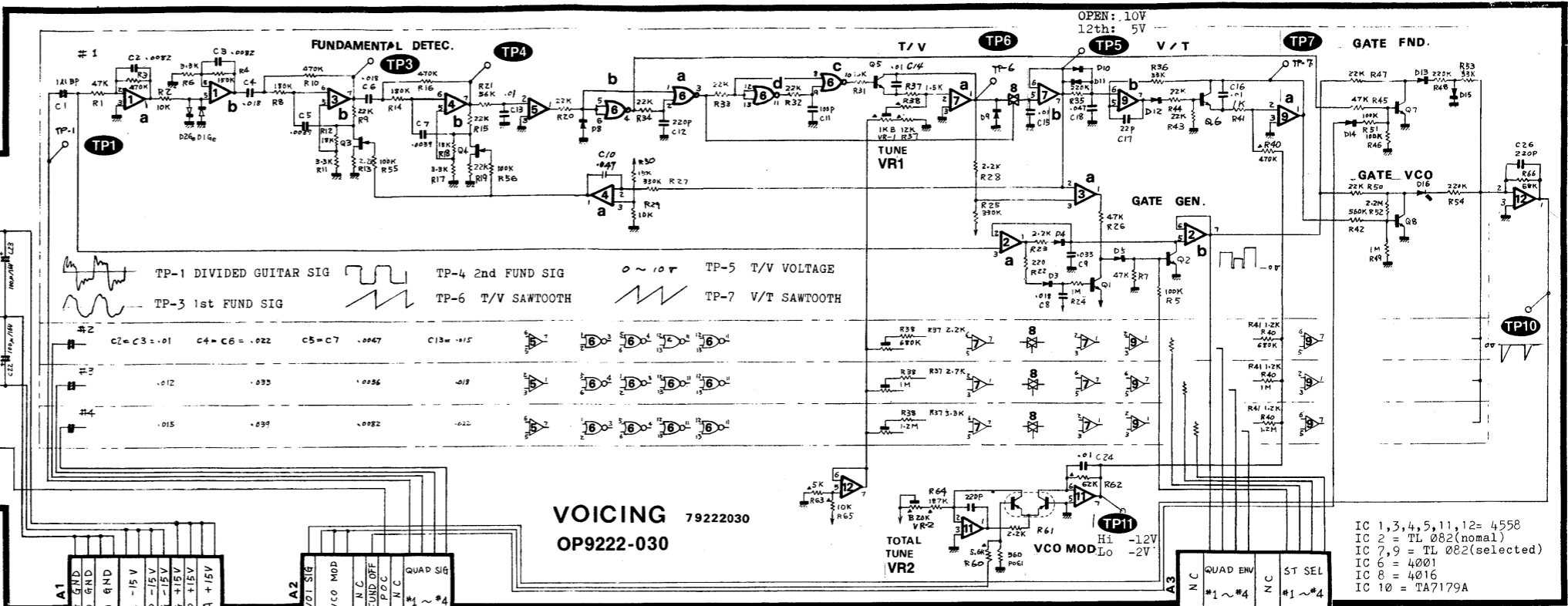
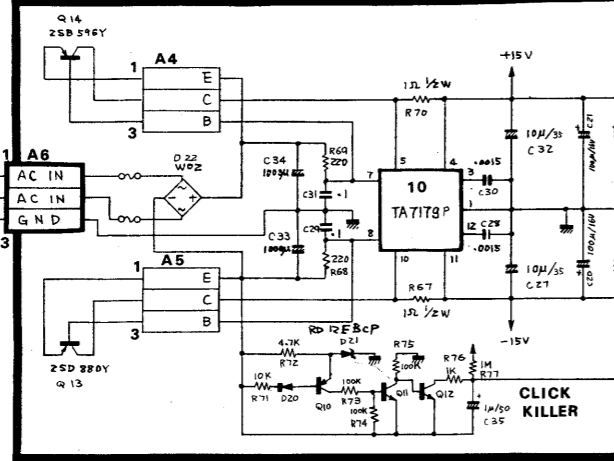
Lock shell SLC-1204-24L1
 (12139302)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40



GR-33B
CIRCUIT DIAGRAM

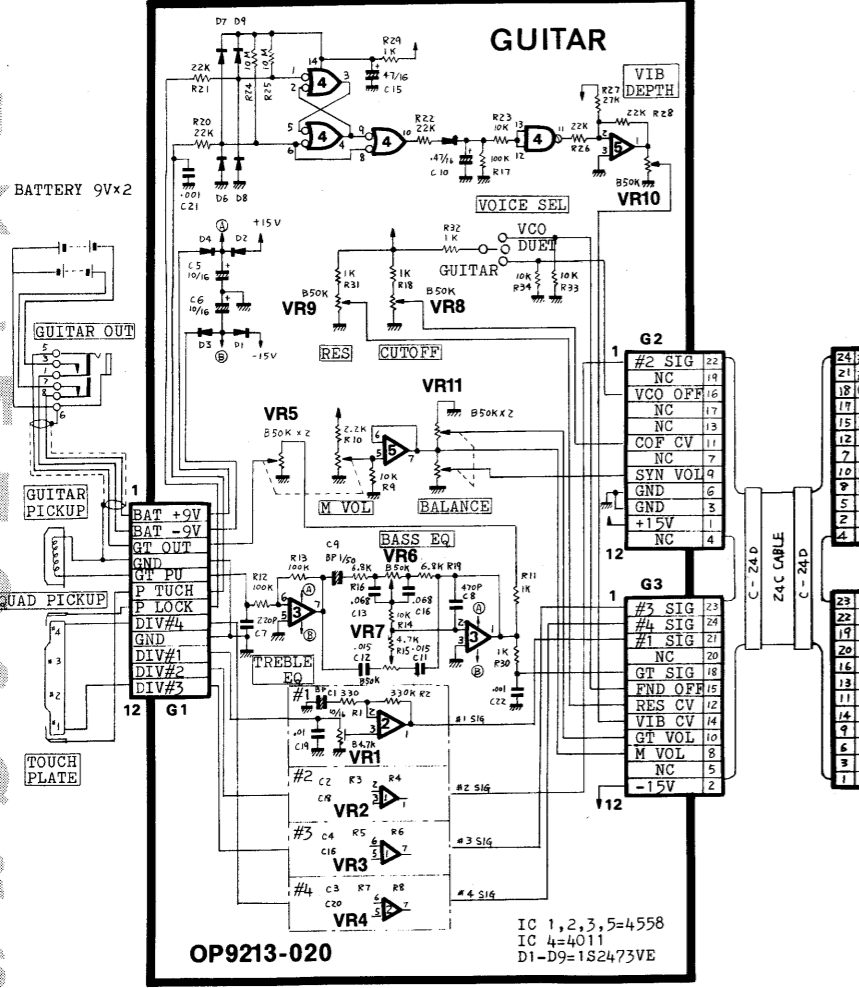
SECONDARY RATING
20VAC x 2 @ 300mA



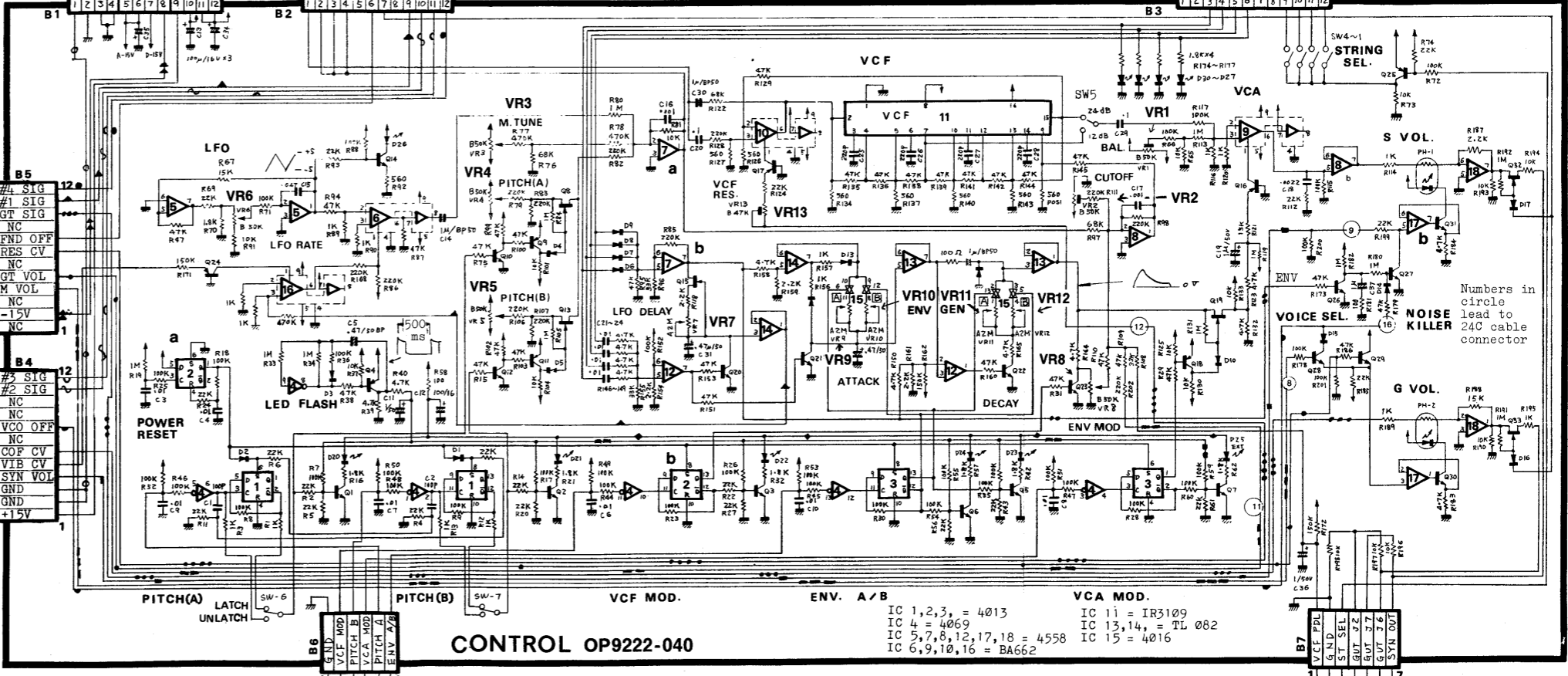
TP-1 DIVIDED GUITAR SIG
TP-3 1st FUND SIG
TP-4 2nd FUND SIG
TP-5 T/V VOLTAGE
TP-6 T/V SAWTOOTH
TP-7 V/T SAWTOOTH

VOICING 79222030
OP922-030

IC 1,3,4,5,11,12= 4558
IC 2 = TL 082(nomal)
IC 7,9 = TL 082(selected)
IC 6 = 4001
IC 8 = 4016
IC 10 = TA7179A



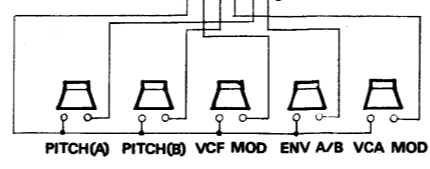
OP9213-020
IC 1,2,3,5=4558
IC 4=4011
D1-D9=1S2473VE



CONTROL OP922-040

IC 1,2,3, = 4013
IC 4 = 4069
IC 5,7,8,12,17,18 = 4558
IC 6,9,10,16 = BA662
IC 11 = IR3109
IC 13,14, = TL 082
IC 15 = 4016

Numbers in circle lead to 24C cable connector



- TP-1 DIVIDED GUITAR SIG
- TP-3 1st FUND SIG
- TP-4 2nd FUND SIG
- TP-6 T/V SAWTOOTH
- 5 T/V VOLTAGE
- TP-7 V/T SAWTOOTH
- 2SA 733Q
- 2SC 1740,945Q
- 2SK 30A GR
- 1S 188
- 1S 2473

VCF PDL ST SEL GUITAR OUT MIX/SYNTH OUT

CIRCUIT DESCRIPTION

GR-33B circuits are mostly built on two PCBs:
Voicing Board OP-9222-030 and Control Board
OP-9222-040.

VOICING BOARD OP-9222-030

1. FUNDAMENTAL DETECTOR
2. T/V CONVERTER
3. V/T CONVERTER
4. GATE GENERATOR
5. CHOPPER GATE
6. POWER SUPPLY

1. FUNDAMENTAL DETECTOR

This detector, the heart of GR-33B, strips incoming signals off harmonics and leaves fundamental. In the following, only channel #1 circuit is described since this detector is composed of the same four circuits.

The output signal coming from the divided pickup is applied through LPF/Buffer IC1a to COMPRESSION circuit consisting of clamp diodes D1-Ge and D2-Ge followed by another LPF IC1b.

1-1. Band-Pass Filter (BPF)

A two-stage filter, consisting of cascaded IC3b and IC4b, largely jumps its frequency response when a string is plucked with low fretting and then higher fretting, and vice versa. When channel #1 string at lower fret(0-6th) is played, Q3 and Q4 are cut off by the potential from IC4a whose pin 2 is kept positive with respect to pin 3 by T/V output (IC7b). Q3 and Q4, during off, make 1st and 2nd filters' component values the same to provide overall peak frequency at F1 that corresponds to fundamental of the

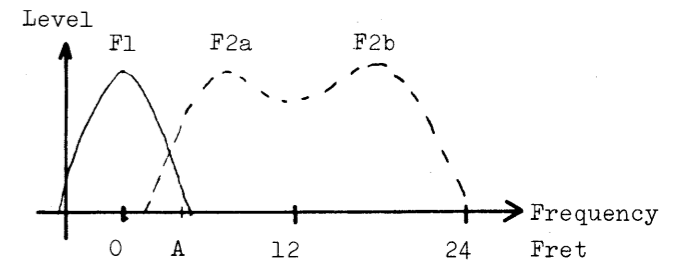


Fig. 1 Filter changes frequency response according to the fret position.

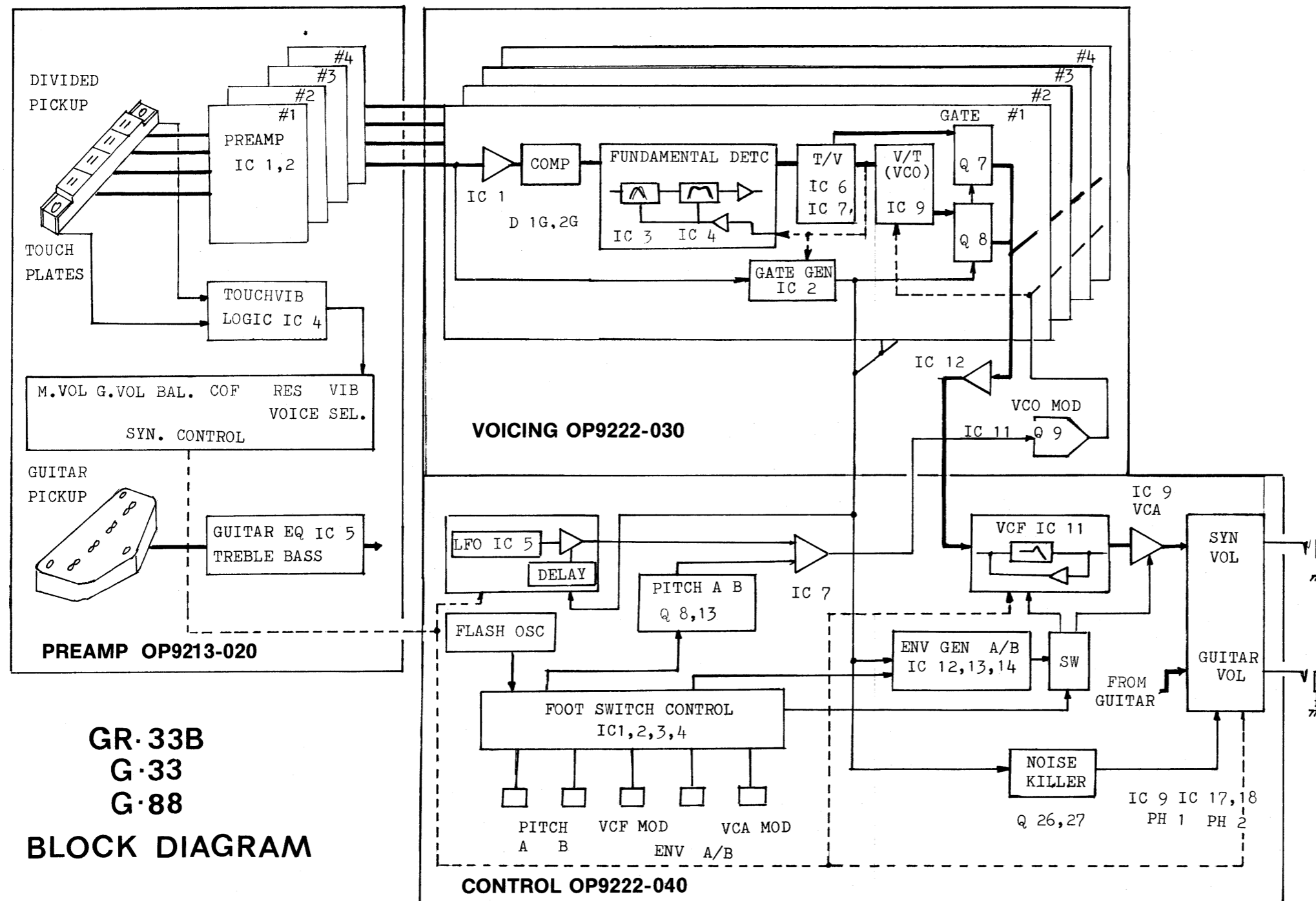
open string. The filter attenuates the 1st overtone or 2nd harmonic content in the passing signal by 24dB.

Picking string with a fretting higher than point A in Fig. 1 causes IC7b to output voltage below that on IC4a pin3 whose output turns to positive. Q3 and Q4, during conducting period, connect R13 and R19 to circuit, making filters' constants different to each other. Resultants are discrete peak frequencies: F2a (frequency around 5-6th frets) from IC3b and F2b (around 18th) from IC4b. Second harmonics of fret-notes in this region are also rolled off by 24dB.

NOTE:
These response curves do not affect sound volume since signal flowing through the filter is used only for pitch determinant. The fundamental is trimmed into squarewave in comparator IC5 and is fed to the next stage, T/V converter IC6, Q5 and IC7.

2. T/V CONVERTER

This circuit is composed of two-stage mono-stable multivibrator IC6(MM1,MM2), constant-current integrator Q5, IC7a, D9, and sample and hold circuit IC8 and IC7b. MM1 and MM2 output pulse width positive-going pulses \underline{c} and \underline{d} upon receiving edges of respective inputs. There is time lapse with \underline{c} and \underline{d} due to the time constant of R38 and CMOS's input capacitance.



GR-33B
G-33
G-88
BLOCK DIAGRAM

The voltage across capacitor C14 increases linearly when charged at a constant rate and decreases to zero when pulse d triggers Q5. The voltage across D9 (pin 7 of IC7a) takes the shape of sawtooth e. Its maximum value is proportional to the time interval between two pulses:

0-10V at open string, and 0-5V at 12th fret. The square wave from MM1 serves as a fundamental in DUET mode.

The waveform is sampled by IC8 each time pulse c is applied and is held by C15 before being reset by pulse d. DC output from IC7b is then applied to IC9b.

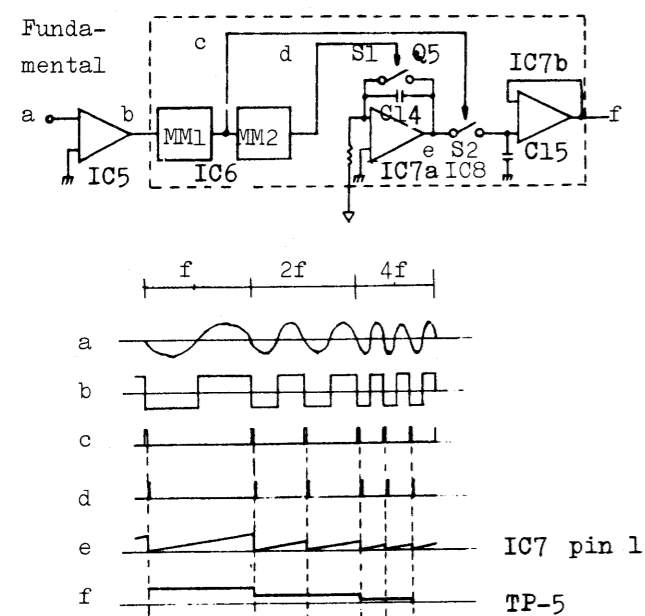


Fig. 2 T/V Converter Timing chart

3. V/T CONVERTER (VCO)

This V/T converter is similar to the T/V Converter in operation. When the charge on C16 increases constantly and reaches the potential equal to that on C18, it causes output from IC9b to conduct Q6 taking the shape of sawtooth waveform whose amplitude is inversely proportional to fret frequency, that is, the lower the fret, the higher the amplitude. This VCO waveform can be modulated or shifted by varying the current flowing into C16. The more the current, the faster charges C16 up to the level on C18. As a result, VCO frequency increases with its amplitude held constant.

4. GATE GENERATOR

The gate generator comprises three circuits - Peak Hold: IC2a, D4 and C9; Reset: IC3a and Q2; Reset Disable: D3, C8 and Q1 - and GATE output IC2b.

4-1. Peak Hold

When picked signal is applied to pin 3 of IC2a, it charges C9 through D4 during ATTACK time. The chargeable potential is proportionate to the signal peak and may be varied from picking to picking. IC2b delivers this voltage as a gate signal at a constant level until Q2 is fired by reset signal.

The signal level at IC2a pin 3 is decreasing after attack time is finished, to the level below that on pin 2 when IC2a turns pin 1 to negative going. D4 being reverse biased, C9 still holds previously charged voltage.

4-2. Reset

Comparator IC3a senses voltage difference between the T/V and S/H outputs, which will be caused by complex harmonics content in string signal at picking and by 2nd harmonic at decay time. Voltage difference between pins 2 and 3 of IC3a turns pin 1 to positive that conducts Q2 via D5, turning IC2b pin 7 (gate out) to 0V.

Reset signals that are inevitably presented to D5 anode should become inoperative during attack time to reproduce very important edge of sound. Below describes how this is done.

4-3. Reset Disable

During attack time IC2a charges C8 through D3 and conducts Q1, shifting positive output voltage from IC3a pin 1 to below D5 forward bias voltage. Duration of this state is determined by C8 R24 time constant because D3 anode will go to negative after attack time is over as explained above in 4-1.

CONTROL BOARD OP-9222-040

The followings are main circuits on the board:

1. FOOT SWITCH CONTROL
2. LFO
3. VCO MOD (PITCH SHIFT)
4. VCF
5. ELECTRONIC VOLUME CONTROL

1. FOOT SWITCH CONTROL

Pressing the footswitch (momentary-close type) applies trigger pulse to C(clock) pin of flip-flops IC1-IC3 through buffer IC4. In this configuration D-F/F is connected as type T-F/F. Capacitor 0.01mfd across the switch prevents contact bounce (chattering) which could cause false triggering.

POWER RESET IC2a generates initial reset pulse for other F/Fs when the power is turned on. Outputs from LED FLASH IC4, D3, Q4 and F/F are ORed at the base of LED drivers Q1,2,3,5,6, 7. LED blinks at the rate of oscillator output when F/F is reset.

2. LFO

One half of IC5 forms hysteresis comparator and the rest half acts as a miller integrator, generating triangular output waveform. The waveform is directed to VCO MOD on VOICING brd via IC6 whose gain is current controlled by VIB DEPTH from Guitar Controller.

3. VCO MOD (PITCH SHIFT)

When PITCH A (B) is pressed, it causes Q8(Q13) connecting to pot PITCH A(B) to be turned on, voltage set by the pot is fed via IC7a to Q9 (anti-log) at VCO MOD on VOICING board.

4. VCF

One chip VCF (IC11 1R3109) comprising anti-log circuit makes up 24 or 12 dB/oct LPF along with its external Rs and Cs. The output is positively fed back to its input for resonant effect through Q17 and VCA IC10 whose gain or amount of resonance is controlled by RESONANCE on guitar controller.

When emphasis is high at a frequency, response curve lower than the peak frequency decreases in level, resulting in relatively small VCF output in this region. This detrimental effect is compensated for by parallelly feeding audio signals via VCA which controls amount of feedback and signals at the same rate.

Besides various control voltages, pitch control voltage is fed to VCF control pin via IC7a and IC8a to shift VCF cutoff point in accordance with pitch shift at VCO to maintain suitable filter band width.

Each GATE GEN output from VOICING board is summed at IC7b whose output level determines ENV GEN output level. The shape of ENV GEN output is determined by either A or B ATTACK and DECAY settings being selected by ENV A/B footswitch.

5. ELECTRONIC VOLUME CONTROL

Before being output from OUTPUT jacks, the audio signals are controlled their volumes by photoelectric cells PH1 and PH2 which in turn are remote-controlled at guitar controller.

Output from NOISE KILLER Q26 is also applied to PH1 through Q27. When ENV GEN outputs zero volts, IC17b is disabled, shutting in residual noises in the synthesizer channel.

G-33, G-88

G-33 and G-88 can be used as the ordinary electric bass guitar as well as a guitar controller dedicated to GR-33B. To make them operate as the bass guitar without connection to GR-33B, the circuits that process sound from single-coil pickup can operate from batteries built in.

1. BUFFER

To compensate for sensitivity variations among heads on quadruple pickup, outputs from IC1 and IC2 can be balanced in amplitude by adjusting individual trimmers (VR1-VR4).

2. TOUCH VIBRATO

When a player touches the one of Touch Plates, his body is connecting ground to pin 1 (6) of flip-flop(IC4- c, d), causing; (1)the pin voltage to down below threshold, (2) F/F to reverse its output to L, (3) OR gate(IC4a) to output H, which is inverted through IC3, potential divided by VR10 and fed to connector G3. Since pin 1 of IC4a is led to the touch plate named P.TOUCH, pin 3 goes to L as soon as hand leaves off the plate.

G-33/G-88 ADJUSTMENTS

If tailpiece, bridge, truss rod and/or pickup(s) have been replaced on a given Guitar Controller, or if it seems to be aged or in such conditions under which appropriate play cannot be performed, proceed to adjustments in the order numbered:

- 1 PRELIMINARY; 2 TRUSS ROD; 3 STRING HEIGHT;
- 4 STRING LENGTH

PRELIMINARY ADJUSTMENT

Tighten the strings to eliminate slack.
Check Divided and Bass pickups for clearance from strings.

Lower the pickup, if the top face touches any strings, enough to allow of picking.

Tune the Guitar to playing pitch in Bass set-up.

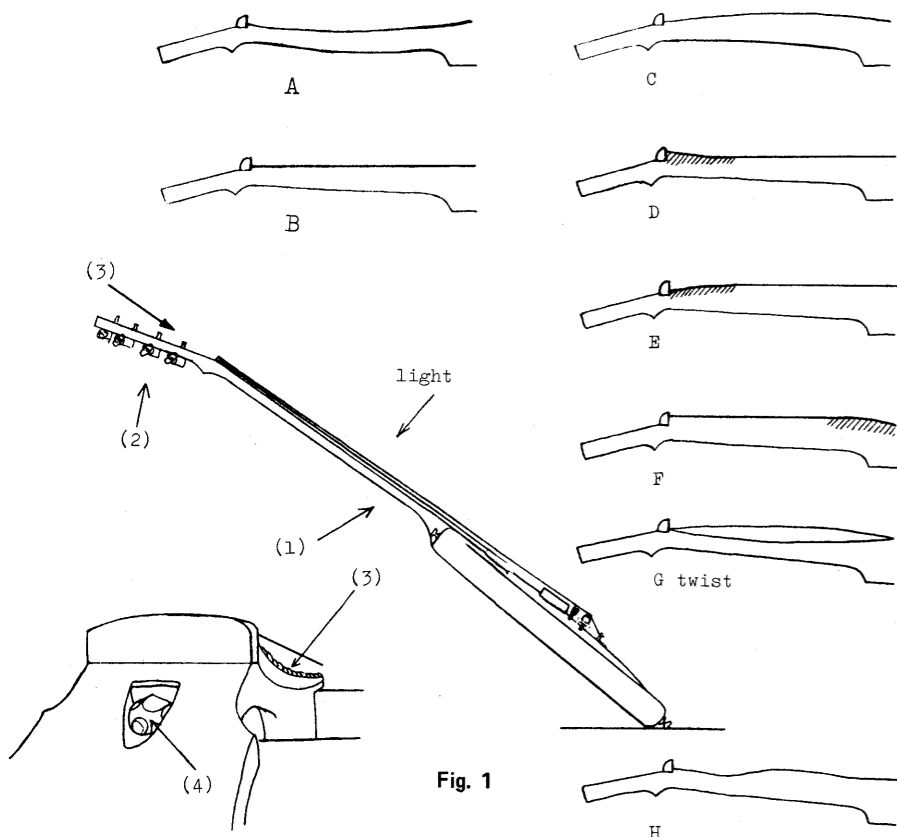
TRUSS ROD

- Checking Fingerboard and Neck for Cambered, Pulled, Twisted - see Fig. 1

Hold the neck joint with one hand(1); with the other hand, gently hold the guitar head(2). Position the guitar on the table.

View the curve of the fingerboard and neck across the top of the head from both edges alternately(3). With Bass guitar, neck of slight concave bend is considered ideal. Fig. 1, A.

B to H in Fig. 1 are as examples would occur. Of course any combinations of these examples might be found on the guitar.



To adjust truss rod, remove the rod cover. Tighten or loosen the nut(4) with an 8mm nut driver, small degree at a time while checking the result. DO NOT OVER TIGHTEN.

B, C, D -- Adjust truss rod. Check that there is no buzzing when the strings are played open. (Slight curvature dashed in D can be ignored.)

E, F, G, H -- When possible action cannot be obtained after compensation by truss rod adjustment, any adjustments it needs should be left to someone with experience on guitar repair.

ACTION (STRING) HEIGHT

- Bridge, Divided Pickup -

Since bridge height has great effect on divided pickup's sensitivity, adjustment for the one should be associated by for the other.

PRECAUTIONS

Eliminate bridge whose stud(s) does not slip into grooves. Fig. 2.

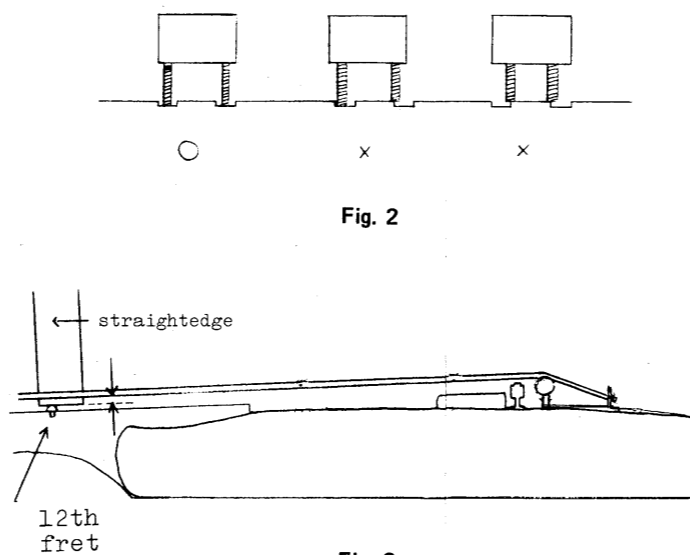
Bridge height and position on the bridge frame should be determined with the strings at tuned tension, which may be loosened slightly for easier bridge movement.

BRIDGE HEIGHT

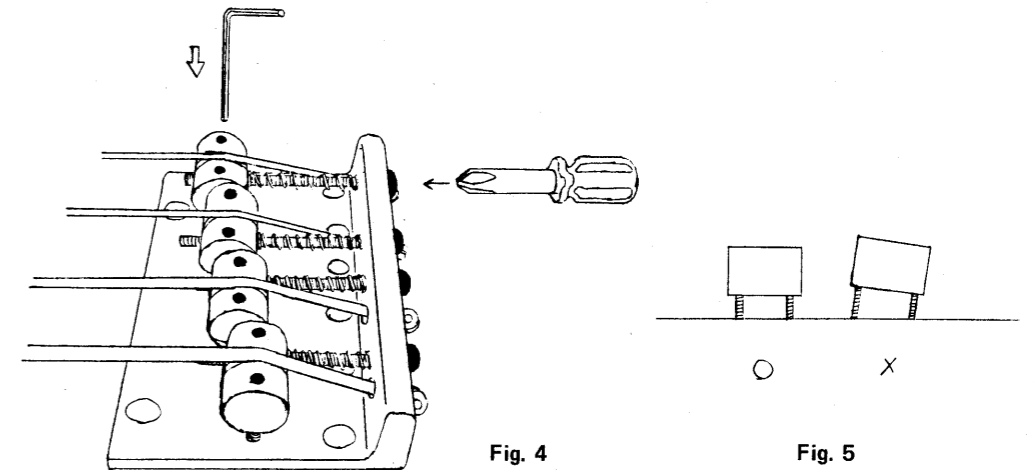
Action height adjustments must be taken with a full set of strings on the guitar, the gauge and type will be used, tuned to playing pitch.

With the strings open, measure the distance between 12th fret and the bottom of 1st and 4th strings.

Standard clearances: 1st -- 2.0mm, 4th -- 3.0mm Fig. 3



To adjust bridge height, turn two adjustment nuts using hexagonal nut driver as shown in Fig. 4. Keep bridge top plane as parallel with bridge frame face as possible. Fig. 5



DIVIDED PICKUP HEIGHT

- Coarse -

Raise divided pickup by turning height adjustment screws alternately until #1 and #4 heads contact with string. If #2 or #3 touches first, raise corresponding bridge. (Re)-adjust #2 and #3 bridges' height for the same string contact as #1 and #4.

- Fine -

After all strings rest on heads, readjust pickup height for the following clearances with respective string fretted at 21st.

- Between #1 head top and string bottom --- 1.5mm
- Between #4 head top and string bottom --- 2.0mm

STRING LENGTH (OCTAVE ADJUSTMENT)

Test intonation at the 12th fret whether string is sharp or flat in terms of overall intonation.

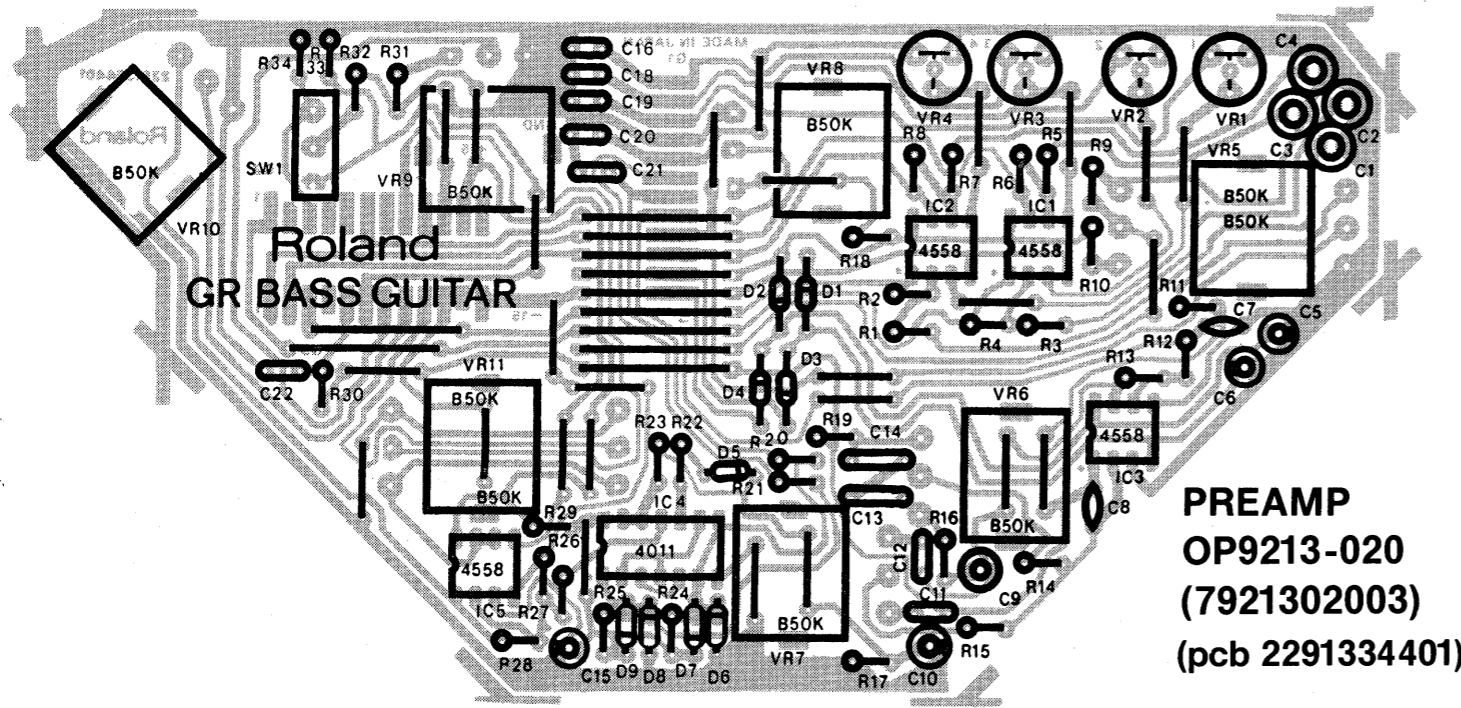
If a string is going sharp at the 12th fret, move back the bridge to add string length by turning the intonation adjustment screw at the bridge frame (Fig. 4). If flat, forwards.

BASS GUITAR PICKUP (Single-Coil) HEIGHT

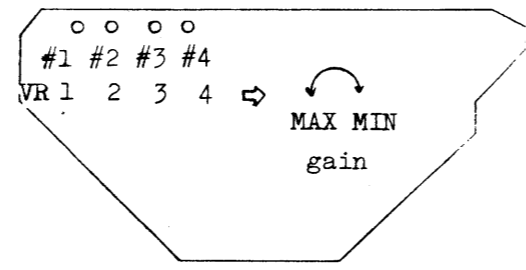
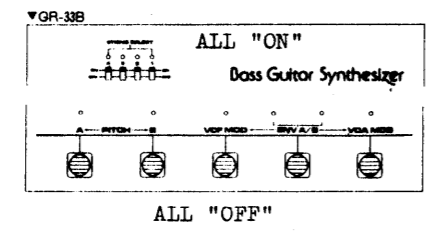
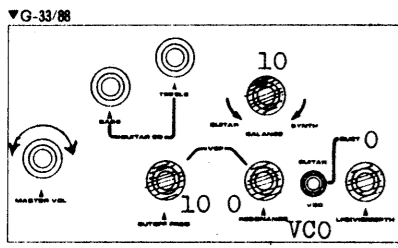
Possible action on guitar pickup (polepiece/string bottom) depends greatly on strings and players, with strings supplied 4-5mm works well. However, pickup's top surface must be held parallel to the strings.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V

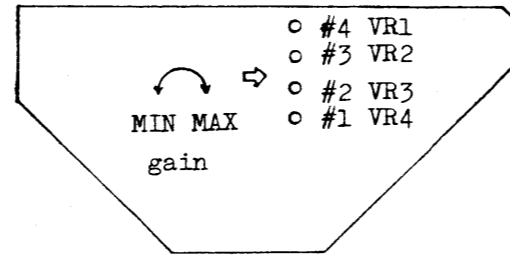


Serial Number 040500 and subsequent



Effective serial number to the modifications is not strict. Both types would be present on products bearing the same lot number, mostly 030400-040599.

NOTE: As can be seen in the figure below, clockwise rotation in trimmer on early pcb increases buffer gain. On later pcb the reverse will be true.



Serial Number up to 030499

UNIFORMING PICKUP HEAD SENSITIVITIES

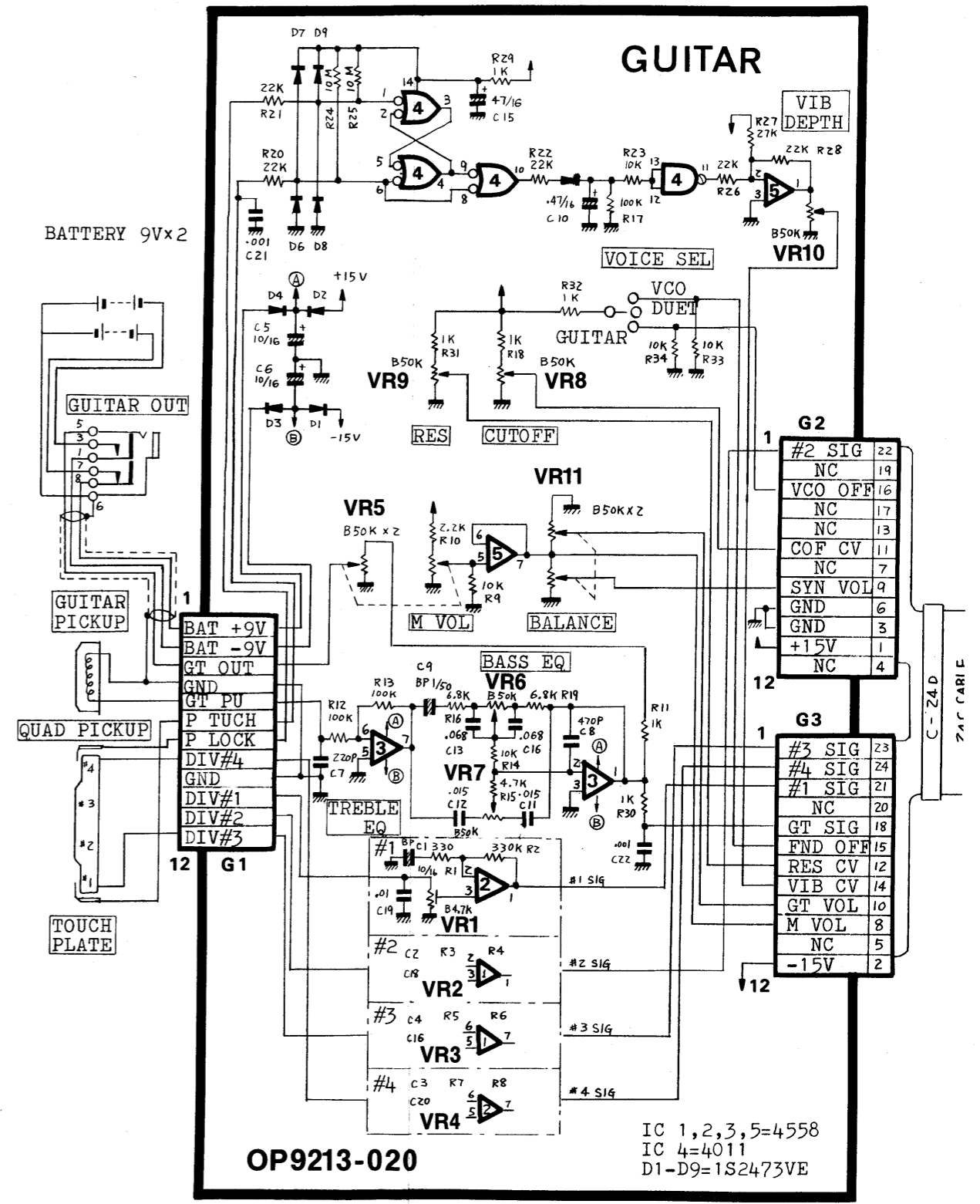
Replacement of Preamp Board or Divided Pickup, or readjustment of the pickup height, all requires VR1-VR4 of Preamp board to be readjusted for uniform head sensitivities. Remove battery cover, batteries and rear panel.

Connect: G-33 or G-88 to GR-33B. Scope to TP-1 of VOICING board. Set controls as shown above.

Play controller in a way ordinary electric bass guitar is played. Avoid using peculiar technique. While plucking, set VR1-VR4 respectively (see note at the right) for the same amplitude (max. approx. 25Vp-p). VR1-VR4 do not take wide travel range before they change buffer gain drastically. So by degrees at a time.

BALANCING SYNTHESIZER & BASS SOUND LEVELS

No standard is applied to this adjustment. Synthesizer sound is largely variable as controls setting is changed, especially CUTOFF FREQ and RESONANCE. Presume the player's routine knob settings. Compare synthesizer sound with bass sound by switching VOICE SELECT. Readjust the trimmers as necessary (VR1-VR4).



OP9213-020

IC 1,2,3,5=4558
IC 4=4011
D1-D9=1S2473VE

ADJUSTING VCF

DO NOT ATTEMPT THIS ADJUSTMENT PRIOR TO COMPLETION OF VCO TUNE

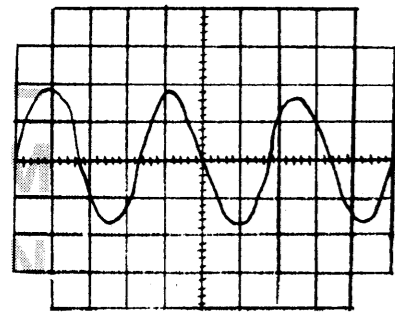
CUTOFF FREQUENCY

1. Turn RES VR13 fully clockwise(FCW), through hole in the pcb from the foil side. VCF will resonate when a string is plucked.

Set controls as illustrated at the right (footswitches: all off). Connect oscilloscope to MIX/SYNTH jack.

CONTROL OP9222-040 (7922204001) (pcb 2291334303)

2. Play string at open and adjust CUTOFF VR2 for 5kHz. Fig. 1.

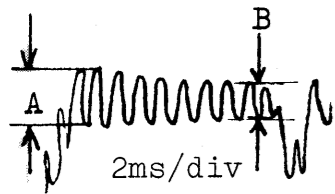


50µs/div

Fig. 1

RESONANCE

1. With VR13 at FCW, reset CUTOFF FREQ on G-33/G-88 to 5. 2. Pluck 2nd string at open. Adjust VR13 for A:B = 2:1. Fig. 2.



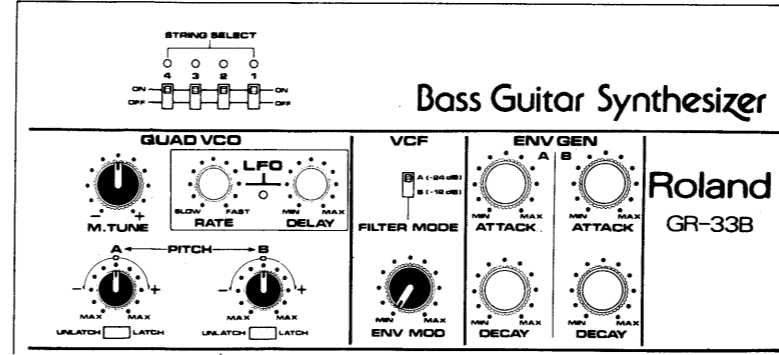
2ms/div

Fig. 2

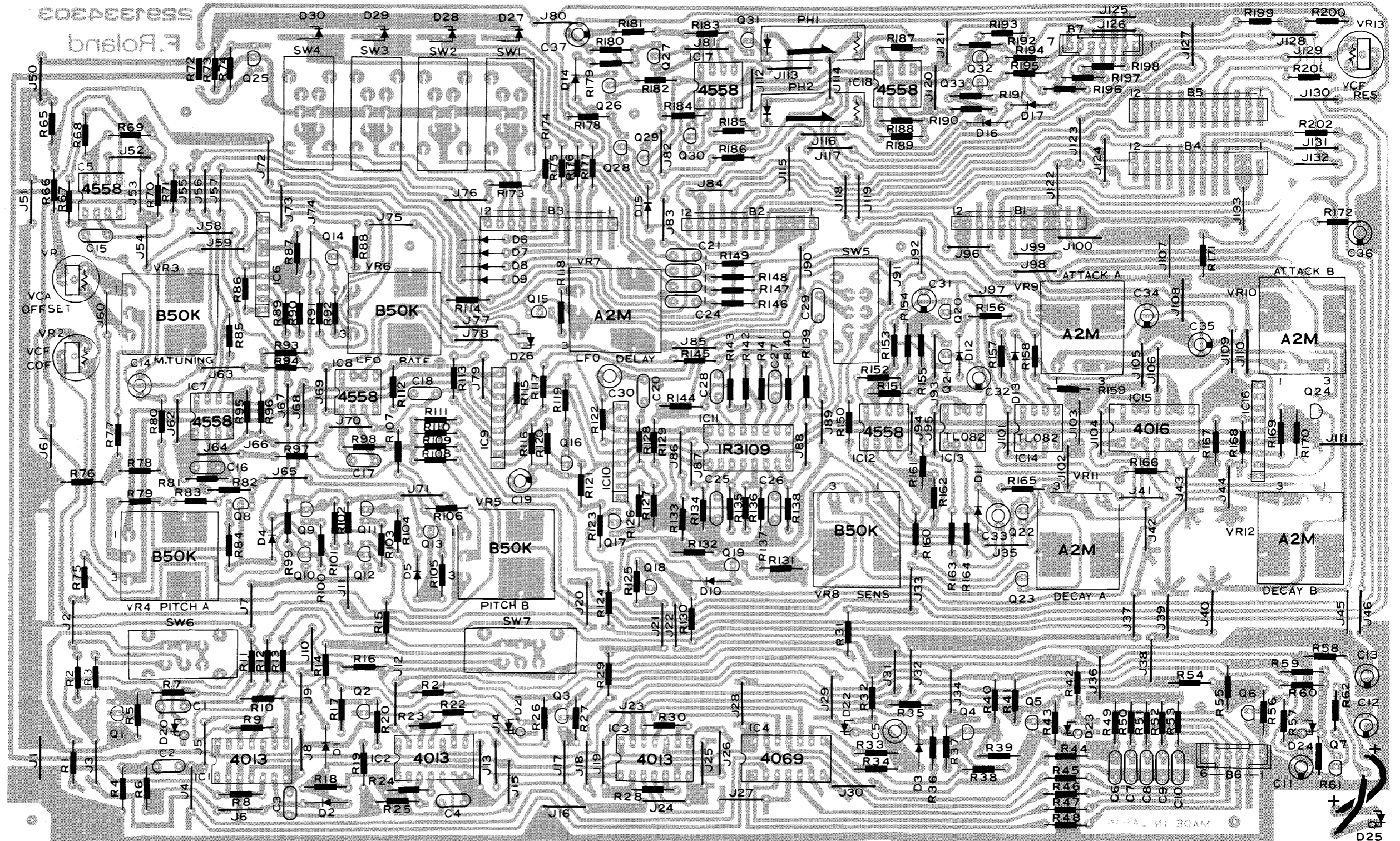
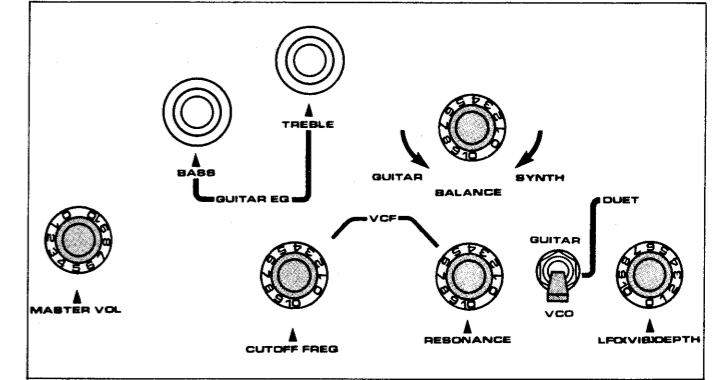
VCA OFFSET BALANCE

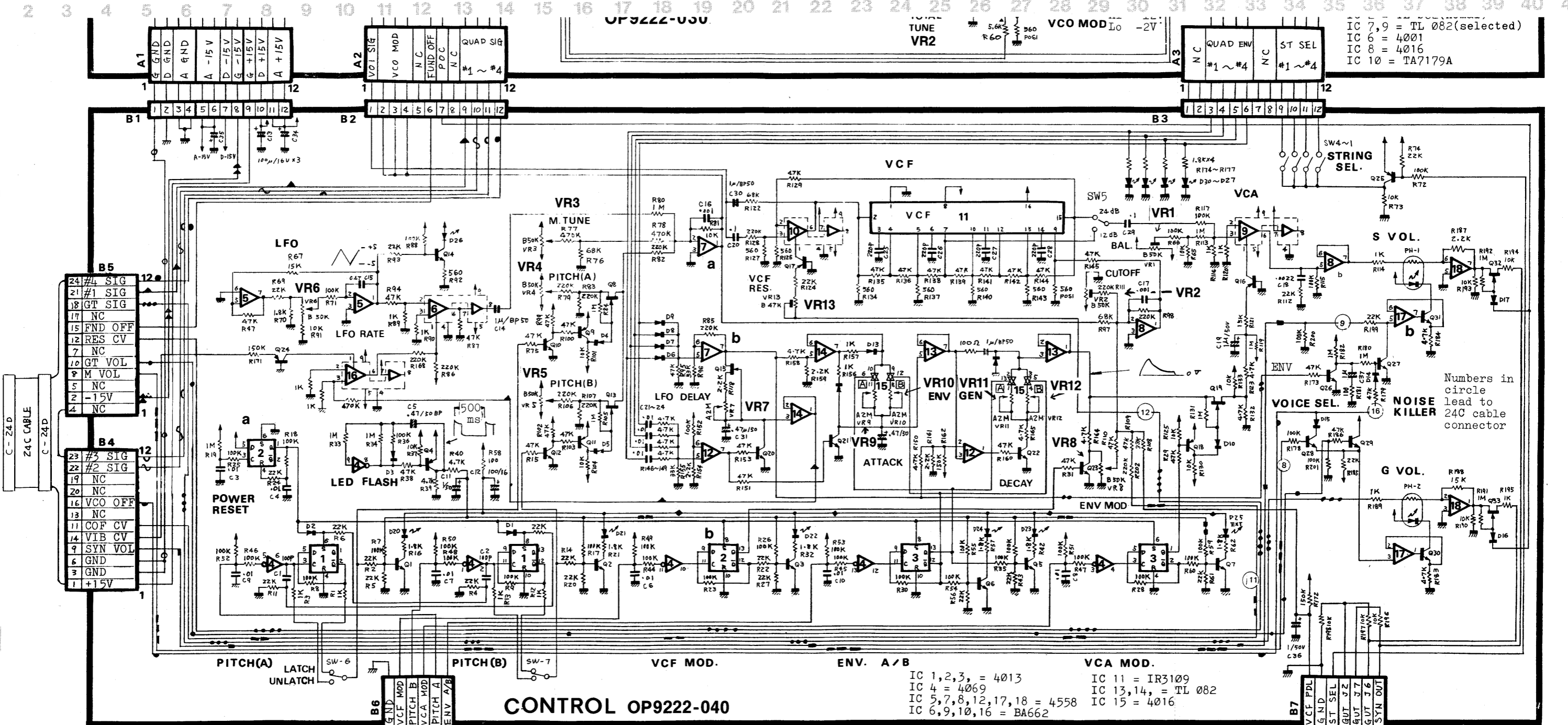
Set BAL VR1 for 0V at IC8 pin 7 with no input signal applied.

GR-33B



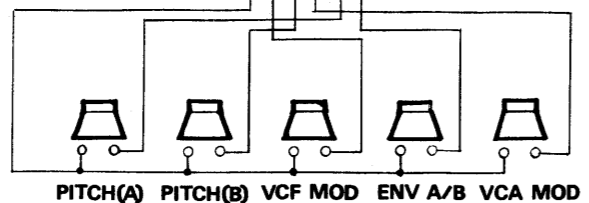
G-33/88



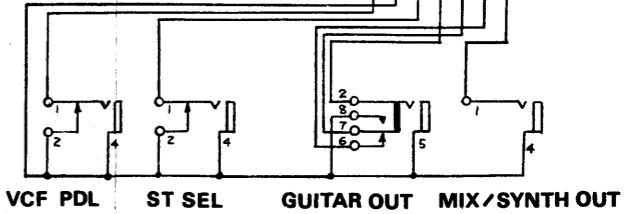


IC 7,9 = TL 082(selected)
 IC 6 = 4001
 IC 8 = 4016
 IC 10 = TA7179A

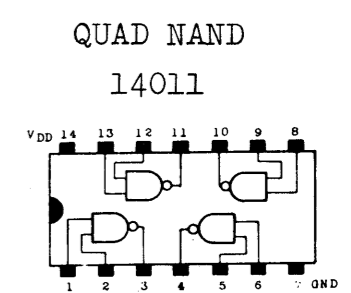
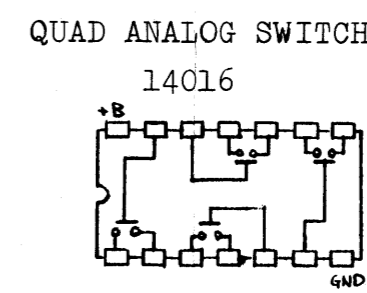
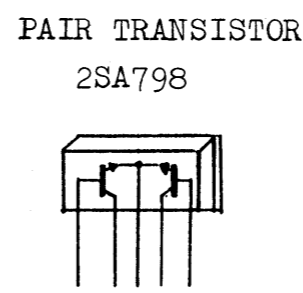
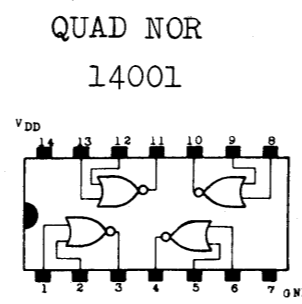
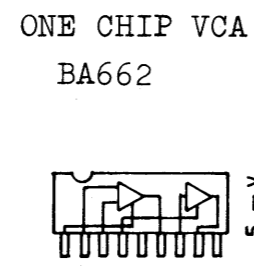
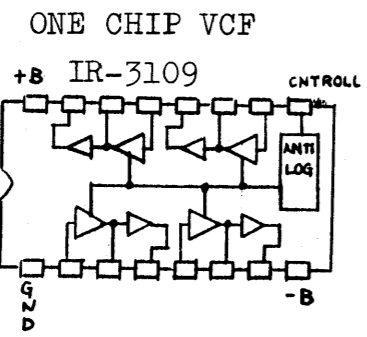
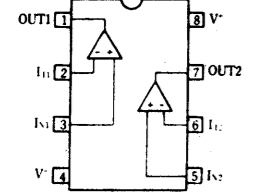
IC 1,2,3, = 4013
 IC 4 = 4069
 IC 5,7,8,12,17,18 = 4558
 IC 6,9,10,16 = BA662
 IC 11 = IR3109
 IC 13,14, = TL 082
 IC 15 = 4016



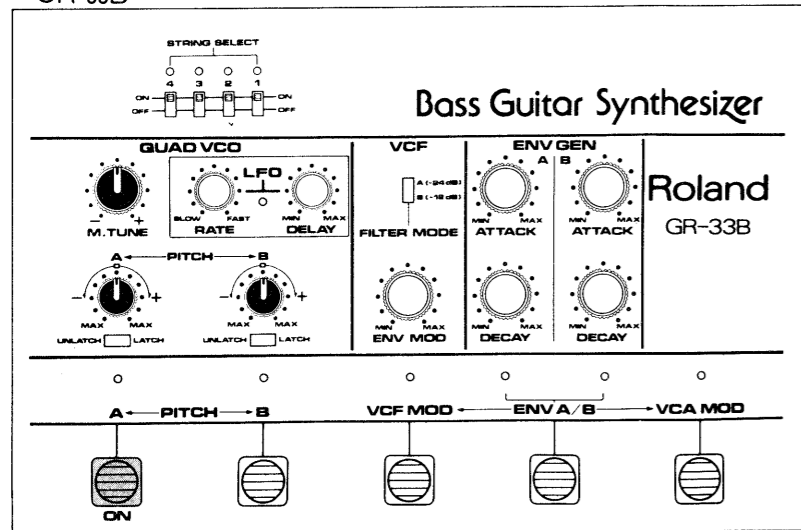
- 2SA 733Q
- 2SC 1740, 945Q
- 2SK 30A GR
- 1S 188
- 1S 2473



OP AMP
 uPC4558, uPC4559
 TL082



▼GR-33B

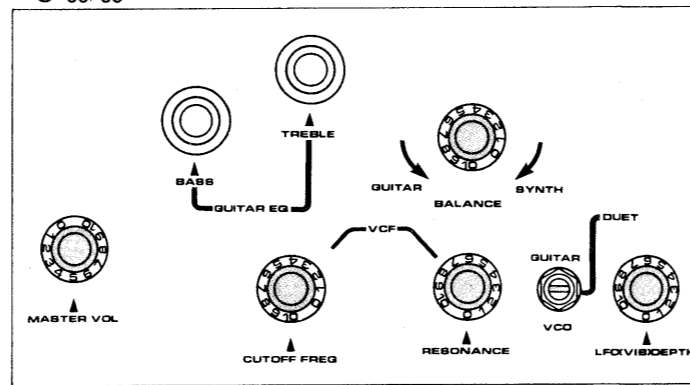


VCO TUNING

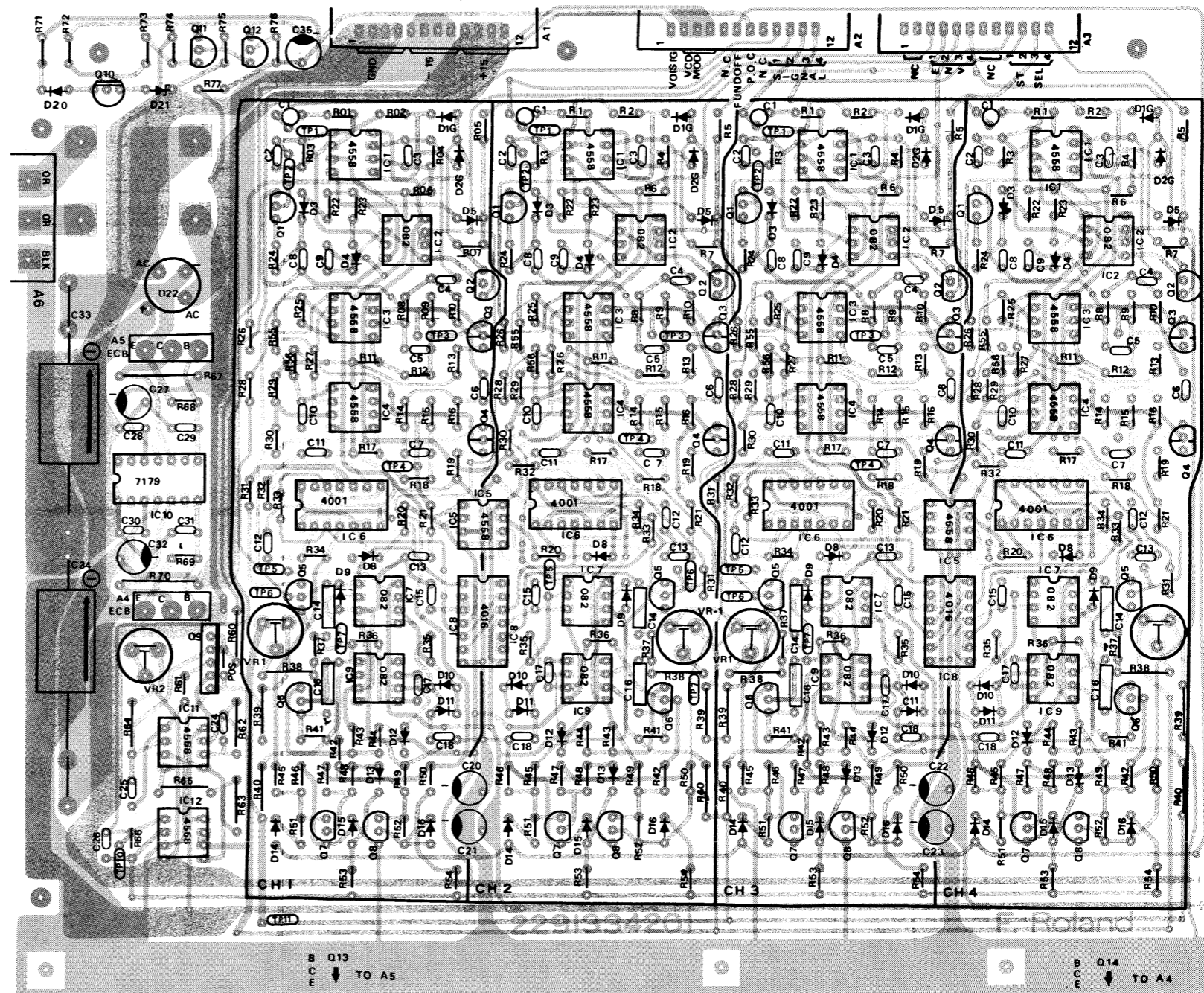
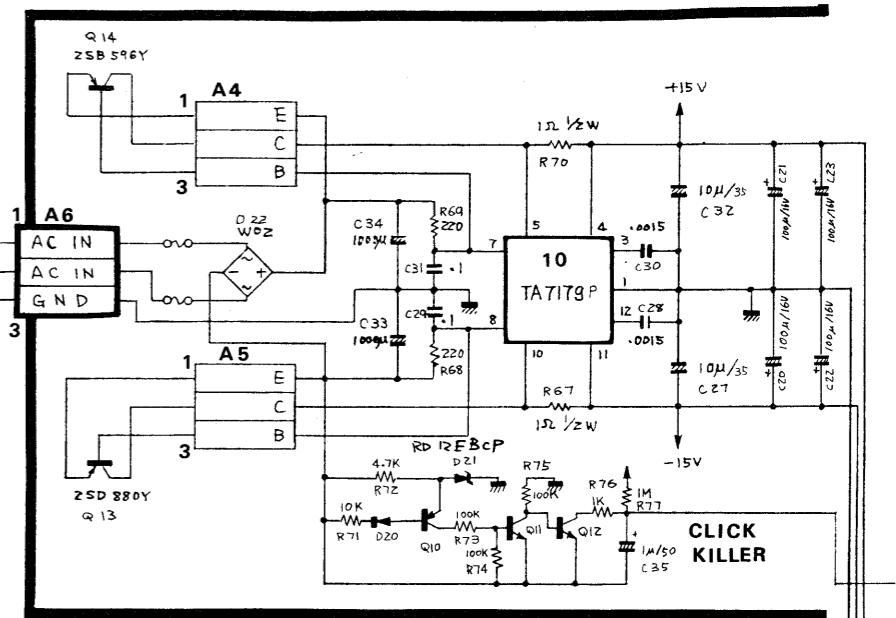
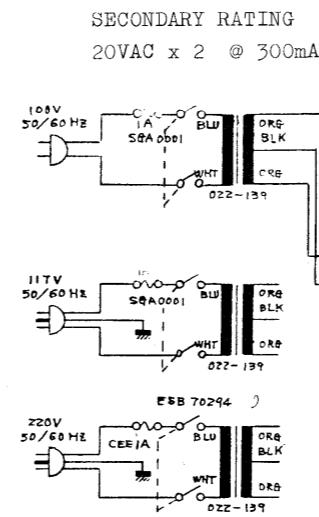
Set controls on guitar controller and GR-33B as illustrated above.

1. Set each TUN VR1(#1-#4) at its midpoint.
2. Play on 1st string at 12th fret. Beat notes will be heard. Tune VCO by turning TOTAL TUNE(trimmer) VR2 until zero beat is heard. Do not turn VR1.
3. Pluck 2nd string with 12th fretting. Set VR1 on channel #2 for zero beat.
4. In the same manner tune #3 and #4 VCOs.
5. Check all strings for detune at open string and 21st fret notes.
6. Fine tune every VCO with VR1 over a string scale.

▼G-33/88

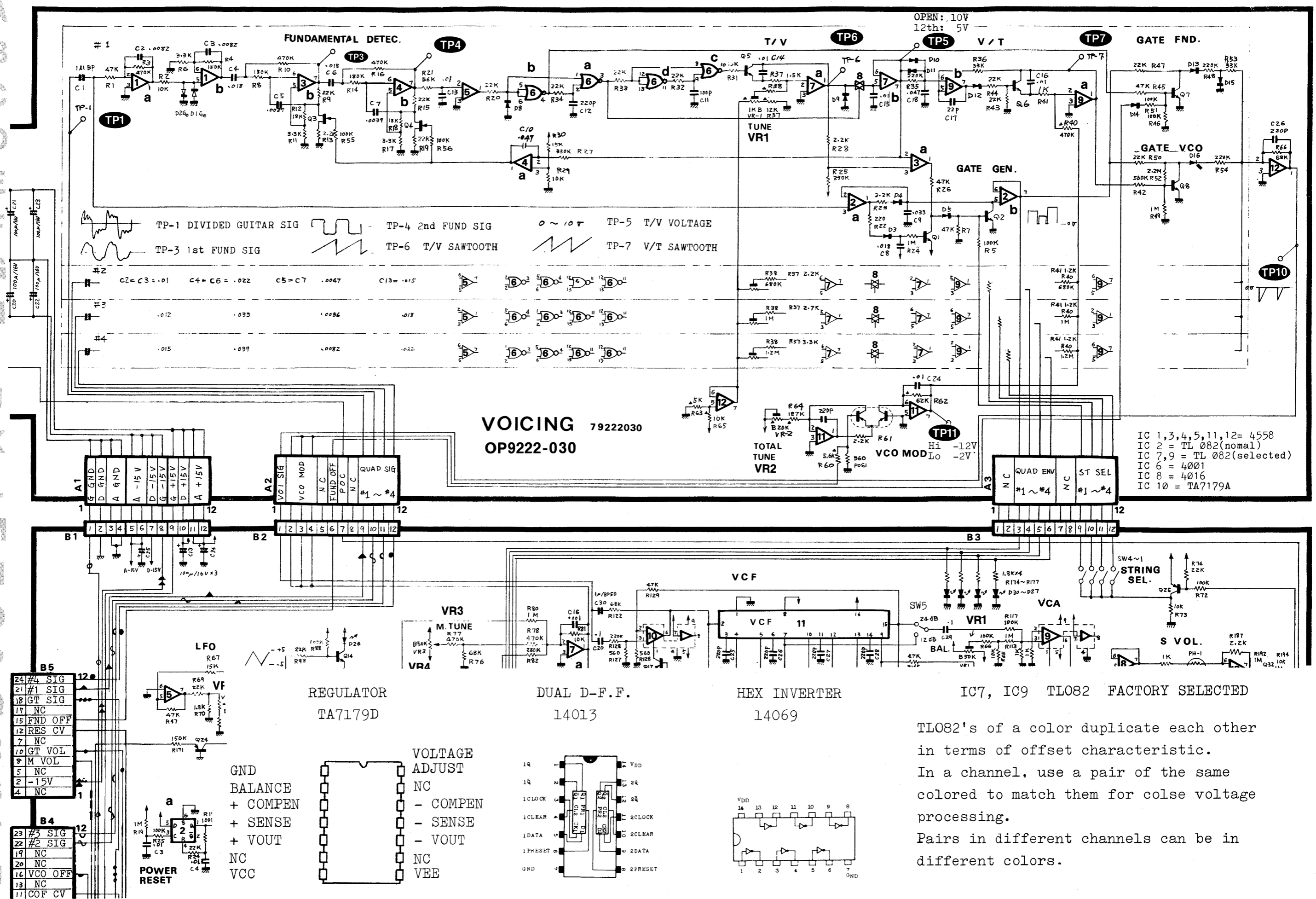


VOICING BOARD
 OP9222-030 (7922203002)
 (PCB 2291334201)



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V



IC7, IC9 TL082 FACTORY SELECTED

TL082's of a color duplicate each other in terms of offset characteristic. In a channel, use a pair of the same colored to match them for colse voltage processing. Pairs in different channels can be in different colors.

GR-33B PARTS LIST

SEMICONDUCTOR

PANEL. CHASSIS
 2221323000 Panel (front) N-230)
 2231020400 Handle (R, L same) N-204
 2213370101 Washer N-701 , hadle
 2281322800 Chassis N-228
 (panel, bottom, w/rubber feet)
 2281322900 Chassis N-229 power
 2281021401 Chassis N-214 rear, jack

KNOB. BUTTON
 2247011200 Knob N-112 large
 2247011300 Knob N-113
 2247051000 Button N-510 power sw.

SWITCH
 2312390300 Switch N-903 foot w/matt
 13159106 Slide SSB02204
 13129110 Power ESB-70294

JACK
 13449107 SG-7630
 13449108 SG-7630G green
 13449202 SG-7640R red

POWER TRANSFORMER
 22450185N0 PT-N-185 100V
 22450186C0 PT-N-186 117V
 22450187D0 PT-N-187 220/240V

PCB ASSEMBLY
 7922203002 OP9222-030 VOICING
 2291334201 Voicing less parts
 7922204001 OP9222-040 CONTROL
 2291334303 Control less parts
 2291016600 Flexible wiring N-166
 2291016700 Flexible wiring N-167

Transistor
 15119106 2SA733- P or Q
 15119108 2SA798-G dual common emitter
 15119806 2SB596- Y or O
 15129113 2SC1740-R
 15129815 2SD880- Y or O
 15139103 2SK30A-GR

Diode
 15019122 1S188FM germanum
 15019103 1S2473
 15019108 1S2473FV vertical mount leads
 15019236 W-02 rectifier stack
 15019548 RD-12EBCP zener
 15229909 ERS-B33G561
 posistor, 560 ohms
 15029109 TLR-105 LED foot switch
 15029102 GL3AR2 LED
 15229702 P-873A (red) photocuplar

IC
 15189105 uPC4558
 15189118 TL082
 151891180A TL082 factory selected
 15199110T0 TA7179P
 15229802 BA662A
 15229801 1R3109
 15159101Z0 MC14001BP
 15159105Z0 MC14013BP
 15159106Z0 MC14016BP
 15159116Z0 MC14069BP

POTENTIOMETER
 13219104 FVHRA360B54 50KB
 13219102 FVHRA360A26 2MA
 13299116 SR19RB47K 47KB carbon trimmer
 13299540 CR19RB1k 1KB metal
 13299544 CR19RB22K 22KB trimmer

RESISTOR
 Metal film 1/4W 1% CRB25FX
 13769227D0 5K 13769167D0 5.6K
 13769173D0 10K 13769175D0 12K
 13769192D0 62K 13769244D0 187K
 13769215D0 560K 13769217D0 680K
 13769221D0 1M 13769249D0 1.2M

CONNECTOR

13429405 SLC-1204-2324F w/lock shell
 12139302 SLC-1204-24L1 lock shell
 13429135 5222-6A 6p
 13429143 5222-7A 7p
 3022-12A 12p
 2341320700 Connector/wiring assy N-207
 2341020800 Connector/wiring assy N-208
 13439604 SLC-1204-1324M (C-24D)
 13429404 SLC-1204-1324F (C-24D)
 2291016700 Flexible PCB N-167 12p long
 2291016600 Flexible PCB N-166
 made out of N-167
 13429121 FH1-12S2.54DS 12P
 flexible PCB socket

G-88. G-33 PARTS LIST

*G-88 **G-33

PCB ASSEMBLY
 7921302003 OP-9213-020 PREAMP
 2291334401 Preamp less parts

POTENTIOMETER
 13219106 EVH-RTA304B54
 13219763 EVH-RXA304B54 center detent
 13219766 EWJ-EWA322B54 50KB x 2
 dual ganged
 13299113 SR19R 4.7K trimmer

SEMICONDUCTOR
 15019108 1S2473FV diode V-mount
 15189105 uPC4558
 15159104Z0 MC14011B

JACK. CONNECTOR
 13439605 SLC-1204-2324M 24 conductors
 w/locking shell below
 12139302 SLC-1204-24L1 lock shell
 1344939900 Jack SG-7850#01
 13419206 SL-2102 (battery connector)
 13429121 FH1-12S-2.54DS 12p
 flexible pcb socket

SWITCH
 13169604 FTE-43B power

KNOB
 2247018800 KN-02G large
 224701900 KN-02S small black

GUITAR
 2238360200 Divided pickup
 2219327300 Pickup holder (D.pickup)
 2238360500 Pickup PU-144 Bass
 2235330800 Pickup base (bass)
 *2213330600 Bridge/tailpiece TP-150
 brass
 **2213330700 Bridge/tailpiece TP-151
 nickel
 *2228331300 Machine head PG-123 gold
 **2228331400 Machine head PG-121 nickel
 *2202316900 Adjust rod cover brass
 **2202362100 Adjust rod cover plastic
 *2228331100 End pin gold
 **2228331200 End pin nickel

2219327400 Holder N-274
 pcb housing frame
 2202316600 Cover N-166 rear panel
 2202316700 Cover N-167
 battery compartment lid
 2219510600 Holder N-106 (trimmer)