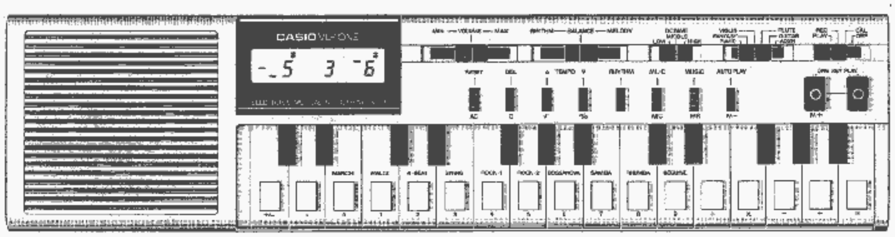
SERVICE MANUAL

With price

VL-1 (GX-221AA)

FEB. 1981



CASIO

2. THE ABC's OF SOUND

2-1. What is the sound?

A gong is a good example of how sound occurs (see Fig. 2-1).
When a gong is struck, the metal first bulges outward, compressing the air molecules nearby and giving them energy. The molecules compressed by the gong bump against others and set in motion a wave which travels through the air. When these waves reach the eardrum, we recognize it as a sound.
Instruments that use electricity to magnify their sound waves are called electric musical instruments. An electric guitar is a good example. Instruments whose sound waves originate with electrical impulses, as with a synthesizer, are called electronic musical instruments.

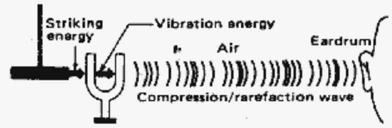


Fig. 2-1

2-2. The three basic properties of sound and the envelope

The three basic properties of any pure sound are its **pitch**, its **timbre** and its **volume**. *Its other important characteristic is the envelope, which shows how the amplitude changes between the time of attack and its release.
When a sound's vibrations are converted into electronic signals, the curve can be read from an oscilloscope (Fig. 2-2).

* Sometimes the length of a sound is considered one of its basic properties as well.

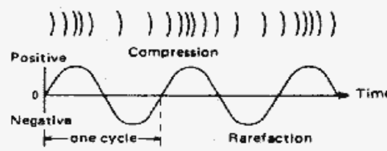


Fig. 2-2

(A) PITCH

Pitch is simply the rate at which vibrations are produced. This is called frequency. In the Fig. 2-3, the frequency of wave **b**, is double that of wave **a**. When the frequency doubles, the sound raises one octave in pitch.
Notes expressed in frequency (No. of Hz) raise an octave as the frequency doubles.

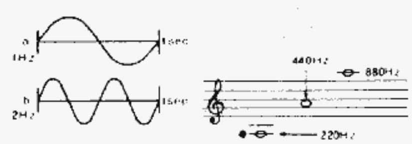


Fig. 2-3

(B) VOLUME

Volume depends upon the strength, or amplitude, of the vibrations producing the sound. If the vibration is strong, with a wide wave, the sound will be loud. If the vibration is gentle, with a narrow wave, the sound will be soft. (Fig. 2-4),

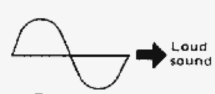


Fig. 2-4

(C) TIMBRE

The timbre of a sound is complicated. If the sound is A above middle C, for example, the frequency is 440 Hz. That sets the pitch.
But the timbre is determined by higher, softer tones called overtones. These tones are usually one octave, two octaves, three octaves, etc., above the fundamental note. If they harmonize well, the tone quality is said to be good. (see Fig. 2-5)

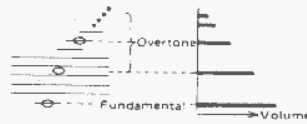


Fig. 2-5

The proportion of the frequency of the overtones to that of the fundamental is called the "overtone spectrum." The graph (Fig. 2-6) is the waveform of a violin note.
Now you can understand the basic of how a strong fundamental combines with progressively softer overtones to from a complex sound wave the shape of which determines the quality and characteristics of the timbre.
Ordinarily speaking, round wave shapes cause soft rounded sounds. Square shapes cause sharp sounds. Shown below are the three basic sound wave shapes.

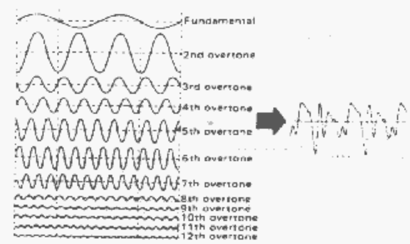
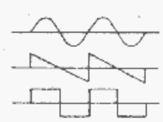


Fig. 2-6

Wave shape	Name	Tone quality	Representative instrument
	Sine wave	Soft	Flute, Whistle
	Sawtooth wave	Brilliant	Violin, Trumpet
	Square wave	Naïve	Clarinet, Oboe

(D) ENVELOPE

There is one more important characteristic of sound besides the three basic properties — the way it sounds. In other words, the sounds strengths and weaknesses from the attack through the release. The sound of a violin, for example, starts weak and builds smoothly to its strongest (loudest) point. A plucked string such as a guitar, on the other hand, starts with its strongest sound and tapers off from there. The changes in a sound from its attack through its release can be visualized. A line is drawn connecting the apexes of the positive waves. The result, called an envelope curve, is the shape of that particular sound. Below (Fig. 2-7), the shapes of the envelope curves of four sounds are shown for your reference.

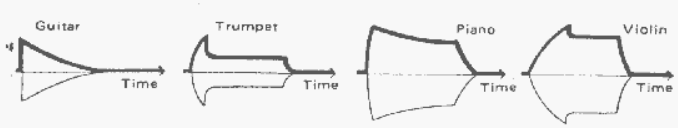


Fig. 2-7

3. LINEA CIRCUIT

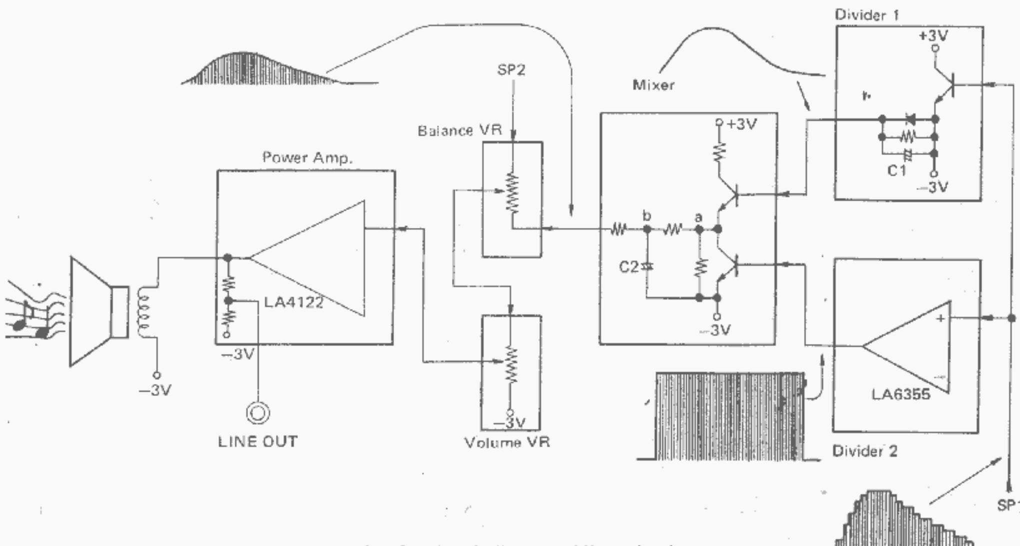


Fig. 3-1 Block diagram of linea circuit

1. In accordance with a hit key, the LSI generates a melody signal SP1.
2. Signal SP1 contains pitch signal (frequency of the sound) within a stepped envelope.
3. Divider 2 extracts only the pitch signal from SP1.
4. Envelope is extracted by the divider 1 and also the stepped envelope is smoothed by the capacitor c1 in the divider 1.
5. The mixer is composed of a transistor AND gate which mixes the pitch and the envelope.
6. Capacitor c2 in the mixer shape the square pitch signal to smooth round signal.

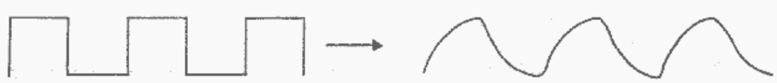


Fig. 3-2 Pitch signal of "FLUTE"

7. The LSI also generates the rhythm signal SP2 and in the valance VR, both rhythm signal SP2 and the melody signal SP1 are mixed.
8. The mixed SP1 and SP2 enter into the power amplifier through the volume VR.
9. The sound signal is amplified and sent to the speaker.
10. The output signal of the amplifier is decreased about 1/3 by the resistors r1 and r2 and sent to the LINE OUT terminal.

***Note;** Only decreasing sound such as "GUITAR" or "PIANO" have the envelope curve.
Envelope for continuous sound such as "FLUTE" or "VIOLIN" is a straight line.

4. RHYTHM

In accordance with the selected rhythm, the LSI generates the rhythm signal SP2.
Signal SP2 contains three rhythm sound which are "Po", "Pi" and "Sha". The followings are waveforms of the rhythm signal.

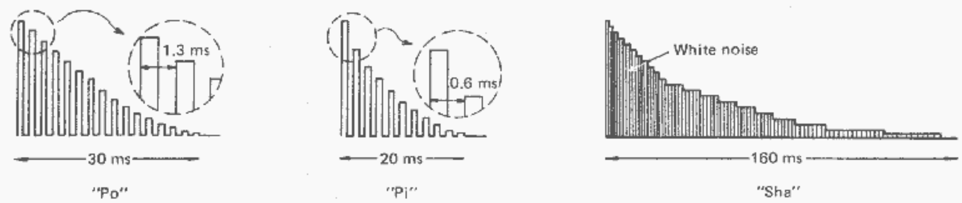
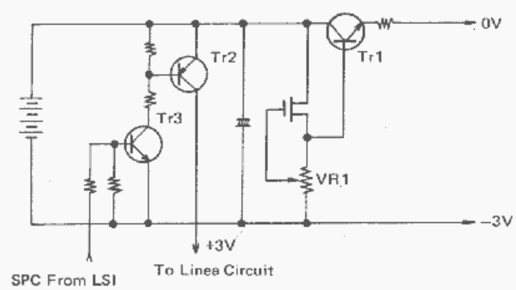


Fig. 4-1

5. POWER SUPPLY CIRCUIT

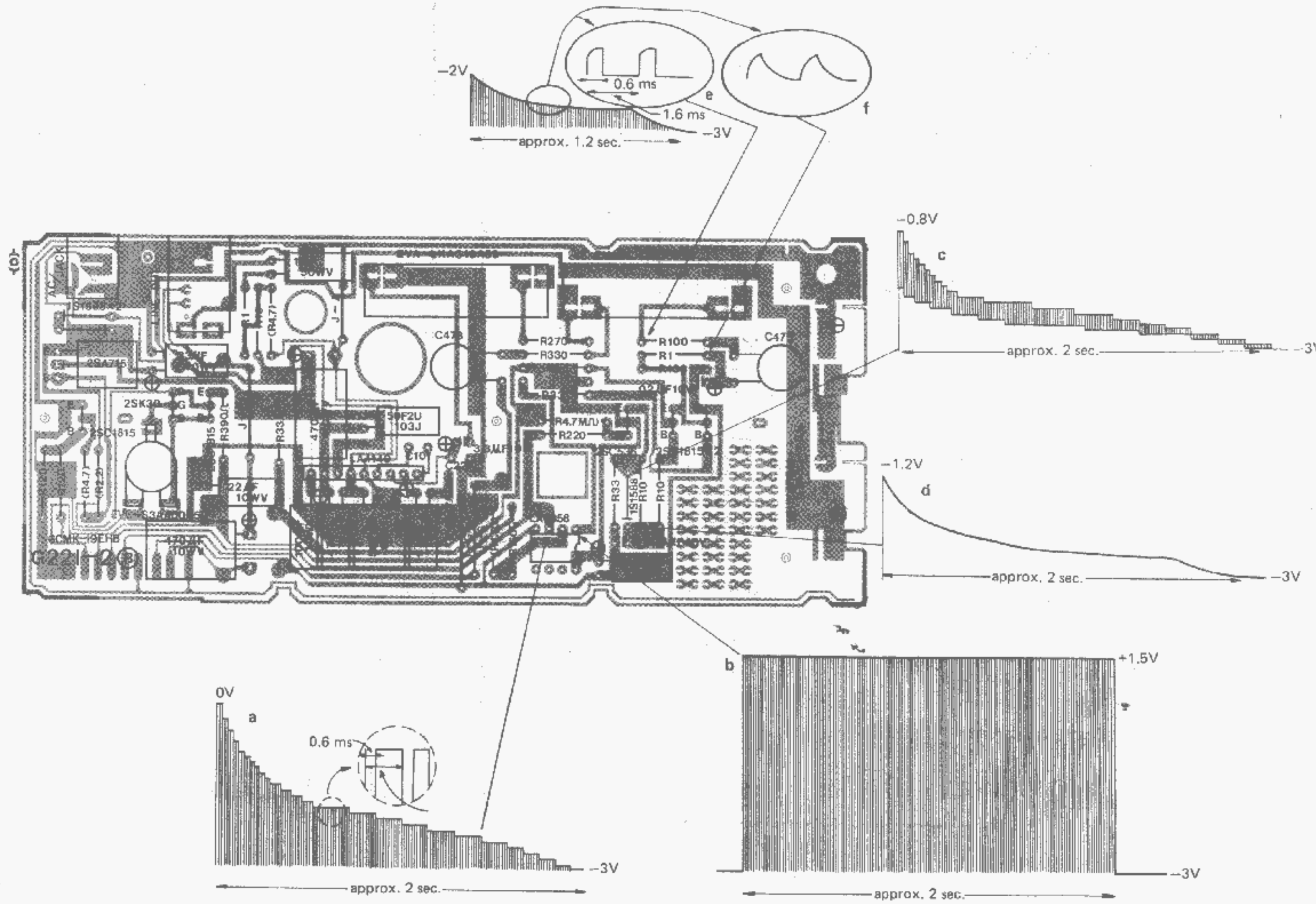
The circuit generates VDD (−3 volt which is LSI drive voltage) and +3 volt for the linea circuit.



The transistor Tr1 and the variable resistor VR1 drops the battery voltage (6 volt) to 3 volt.
Transistors Tr2 and Tr3 are for Calculation-Music switching.
When the MODE switch is set at "CAL", signal SPC from the LSI is at "L" (LOW) level (−3 V) causing the transistors Tr2 and Tr3 to turn off so that the battery voltage is not applied to the linea circuit.
If the MODE switch is at "REC" or "PLAY", signal SPC raise to "H" (HIGH) level (GND or 0 volt), Tr2 and Tr3 turn on and the battery voltage can be applied to the linea circuit.

6. P.C. BOARD LAYOUT AND DETAIL WAVEFORMS

Note; Following waveforms can be seen when a VL-1 is set at "PIANO", "MIDDLE OCTAVE" and hitting key "6".



7. ADJUSTMENT

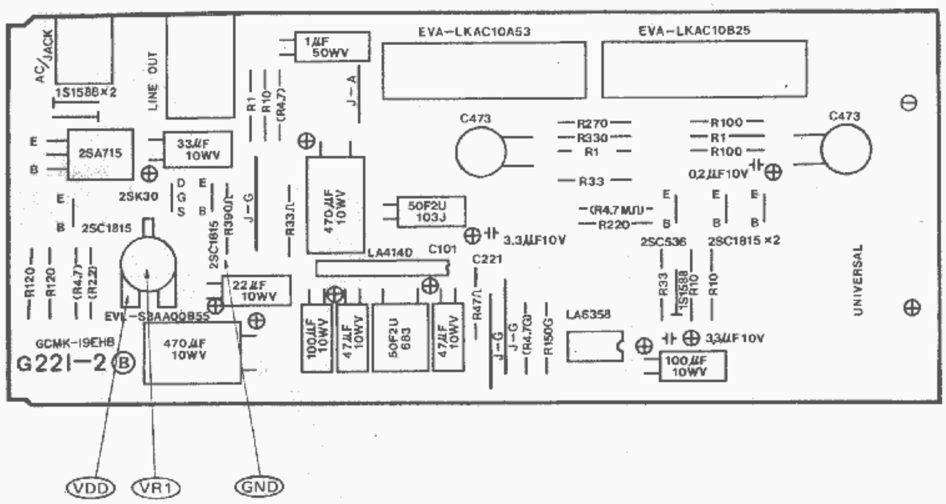
7-1. VDD (–3 volt) Setting

After the power supply circuit is repaired, voltage VDD should be adjusted.

(1) Connect an AC adaptor AD-4160 to the VL-1.

(2) Set a voltmeter or an oscilloscope between GND and VDD.

(3) Set the VDD at –3 volt by turning the variable resistor VR1.



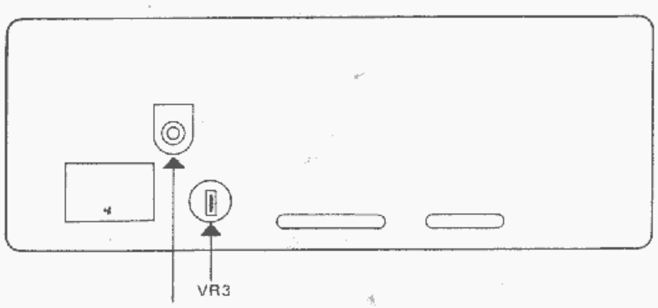
7-2. Tuning

(1) With using a pitch tuning meter, set the "Ra" (key 6) in OCTAVE MIDDLE at 440 Hz by adjusting VR2.

Note; As the pitch will be lowered after the upper case is fixed, it is suggested to set about five percent higher than 440 Hz.

(2) Fix the upper case.

(3) Fine-adjust the pitch with VR3.



Note; Pitch is also tuned by using a piano or tuning whistle for guitar.