USER MANUAL

Protek B803

2MHz Sweep Function Generator

2MHz Sweep Function Generator

Protek

SUMMARY

Normal use of test equipment may expose you to a certain of danger from electrical shock because testing must often be performed at the place where exposed voltage is present. To minimize electrical shock, the instrument chassis and cabinet must be connected to an electrical ground.

1. Don' t expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high voltage circuits.
2. Use an insulated floor material stand on.
3. On testing instruments or any equipment with a 3-wire AC power plug, use only a 3-wire outlet. This is a safety feature to keep the housing or other exposed elements at earth ground.
4. Remember that AC line voltage is present on some power input circuit points such as on-off switches, fuses, power transformers, etc., even when the equipment is turned off.
5. Never work alone. Someone should be nearby to render aid if necessary. First add training is highly recommended.
6. For increasing the product quality, the appearance and the specifications may be changed without pre-notice.

◈ INSTALLATION CATEGORY INFORMATION ◈

This instrument may be damaged if operated with LINE VOLTAGE (AC 100/120/220/230V ±10%) set for the wrong applied ac input-source voltafe or if the worng line fuse is installed.

Before connecting the power cord to a power input-source is set for the correct nominal ac input-source voltage and line fuse.

The power-source must be stand where put out easly when happen a problem of instrument

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SECTION Ⅰ.

1. INTRODUCTION

This Sweep Function Generator is the most versatile signal source which can be used as a function generator, a pulse generator or a sweep generator.
With this versatility, it has a great deal of applications in both analog and digital electronics in the engineering, manufacturing, servicing, and educational fields.

This instrument has a VCG(Voltage Controlled Generator) that produces a sinewave, a squarewave or a triangle wave at the frequency range of 0.02Hz~2MHz, and has a 4-digit display that the frequency of 10Hz~2MHz can be displayed. The function of continuously variable DC offset allows the output to be injected directly into circuits at the correct bias level.

Variable symmetry function converts the instrument to a pulse generator being capable of generating rectangular or pulse waves, ramps or sawtooth waves and skewed sines of variable duty cycle.

The sweep generator offers linear or log sweep with variable sweep rate and sweep width up to 1000 : 1 frequency change. This allows one continuous sweep to cover the entire 20 to 20,000Hz audio band. The frequency response of any active or passive device up to 2MHz can be determined.

2. SPECIFICATIONS

1) General

○ Frequency Range	:	0.02Hz to 2MHz in 7 ranges.
○ Variable Range	:	Each Range Provides 100:1 frequency control.
○ Output	:	Sine, Triangle, Squarewave. TTL square wave. Pulse, Ramp, Skewed sine wave.
○ Frequency Accuracy	:	Over 1Hz±1Count±Time Base error.
○ Stability	:	± 0.1% after 20 minutes.
○ VCF input	:	VCF(Voltage Controlled Frequency) tunable by 0 to -10VDC. Frequency may be programmed with DC Voltages. FM-Modulated (Max. Input Voltage : -13VDC)
○ Variable Symmetry	:	Variable Over 1:1 to 4:1 at lower than 1MHz, 1:1 to 2:1 to 2MHz. Controls all output waveforms including TTL(sync out). Adjusts square wave to ramp or sawtooth, sine wave to skewed sine wave.
○ DC offset	:	Continuously variable; Greater than ±10V (open circuit). Greater than ±5V (50Ω).

2) Square wave characteristic : **Variable amplitude.**

○ Rise/Fall Time	:	Less than 100nsec at Max.Output.

3) Sine wave characteristic

○ Distortion	:	Less than 2% from 10Hz to 100kHz.

○ Amplitude flatness : Better than ±3dB to 2MHz at Max. output.

4) Triangle wave characteristic

○ Nonlinearity : Less than 1% to 100kHz.

5) Sweep characteristic

○ Internal : Linear.

○ Sweep rate : 0.5Hz (2sec periods) to 50Hz (20msec) Continously Variable.

○ Sweep width : Variable from 10:1 to 1000:1.

6) Output characteristic

○ Amplitude : 1Vp to 20Vp (open circuit).
0.5Vp to 5Vp (50Ω).

○ Attenuation : Fixed Attenuation 20dB ±1dB, 20dB Continuosly Variable.

○ Impedance : 50Ω ±5%

7) Frequency counter characteristic

○ Display : 4-digits, red LED display.

○ Measuring range : 10Hz~2MHz.

○ Accuracy : 0.01% ±1count.

○ Sensitivity : 50mVrms, 10Hz ~ 100Hz
100Hz ~ 1kHz
1kHz ~ 10kHz
10kHz ~ 100kHz
100kHz ~ 1MHz
1MHz ~ 2MHz

○ Max. input voltage level : 70Vp

○ Input impedance : 1MΩ

8) Others

○ Power requirements : 100/120/220/230V±10% 50/60Hz 13W

Voltage selected by Switch at rear pannel.

○ Operating Environment : 0° C to 50° C (accuracy specified at 25° ± 5° C)

○ Dimension : 220m/m(W) × 85m/m(H) × 300m/m(L)

○ Weight : 2,500g

* This instrument is Installation Category (Over voltage Category) : II

SECTION Ⅱ. OPERATING INSTRUCTIONS

1. INTRODUCTION

This Sweep Function generator is capable of genrating an immense variety of óutput waveforms. The best benefit and satisfaction can be gained from the instrument by fully understanding it' s capability and proficiency in its operating. One of the best ways to initially gain this familarization is to connect the generator to an oscillscope, observe the waveform and notice the effects of the various controls on the waveforms. Use this manual as required for reference until becoming accustomed to the operating podcedures.

2. PANEL FEATURES

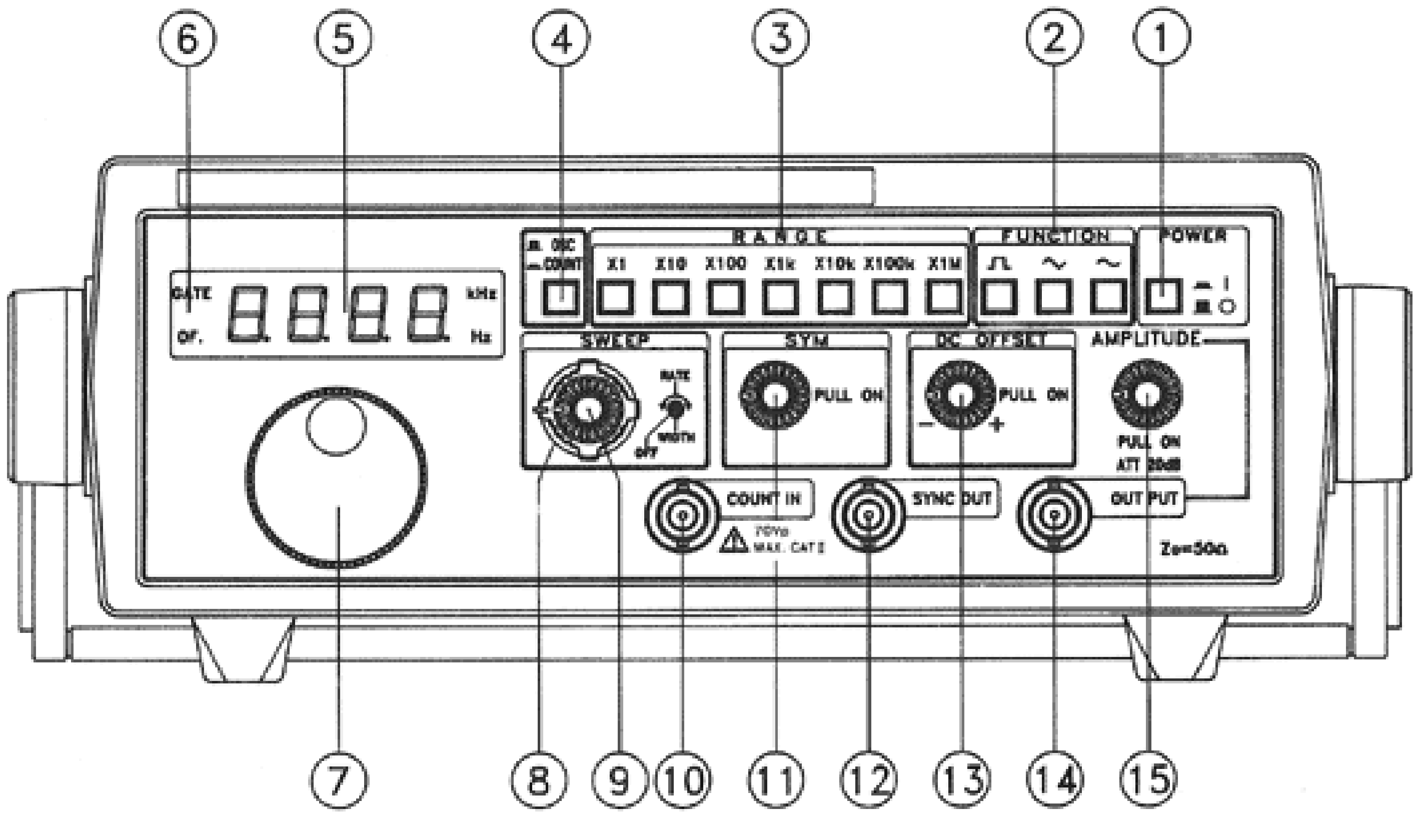


Fig. 1 Front panel

1) **POWER ON-OFF :** Line voltage input 100V, 120V, 220V or 230V$\pm$10%
2) **FUNCTION SWITCH :** Selects sine wave, square wave or triangle wave output.
3) **RANGE SWITCH :** Frequency range selector.
4) **OSC/COUNT :** Oscillator or counter mode selection switch.
5) **DISPLAY :** Displays the input or output frequency.
6) **O. F. LED :** Flickers when the input frequency is overflow.
7) **FREQUENCY DIAL :** Controls the output frequency in selected range.
8) **SWEEP RATE CONTROL :** Adjusts the sweep rate of internal sweep generator.
9) **SWEEP WIDTH CONTROL :** Adjusts the sweep magnitude.
10) **COUNT IN :** Connector for measuring the external signal when used as frequency tester.
11) **SYMMETRY CONTROL :** Adjusts the symmetry of output waveform from 1:1 (CAL position) to 4:1.

12) **SYNC OUT** : A TTL square wave output with the main generator, useful for synchronizing external instruments or driving a counter. The TTL counterparts of 50Ω output signal is fixed at the level of TTL square wave or pulse.
13) **DC OFFSET CONTROL** : Adds positive or negative DC component to output signal.
14) **OUTPUT** : Terminal for all the main generator functions. 20Vp-p (open), 10Vp-p (50 Ω).
15) **AMPLITUDE CONTROL** : Adjusts the output level from 0 to - 20dB. When the control is pulled on, It is operated as ATTENUATOR(20dB).

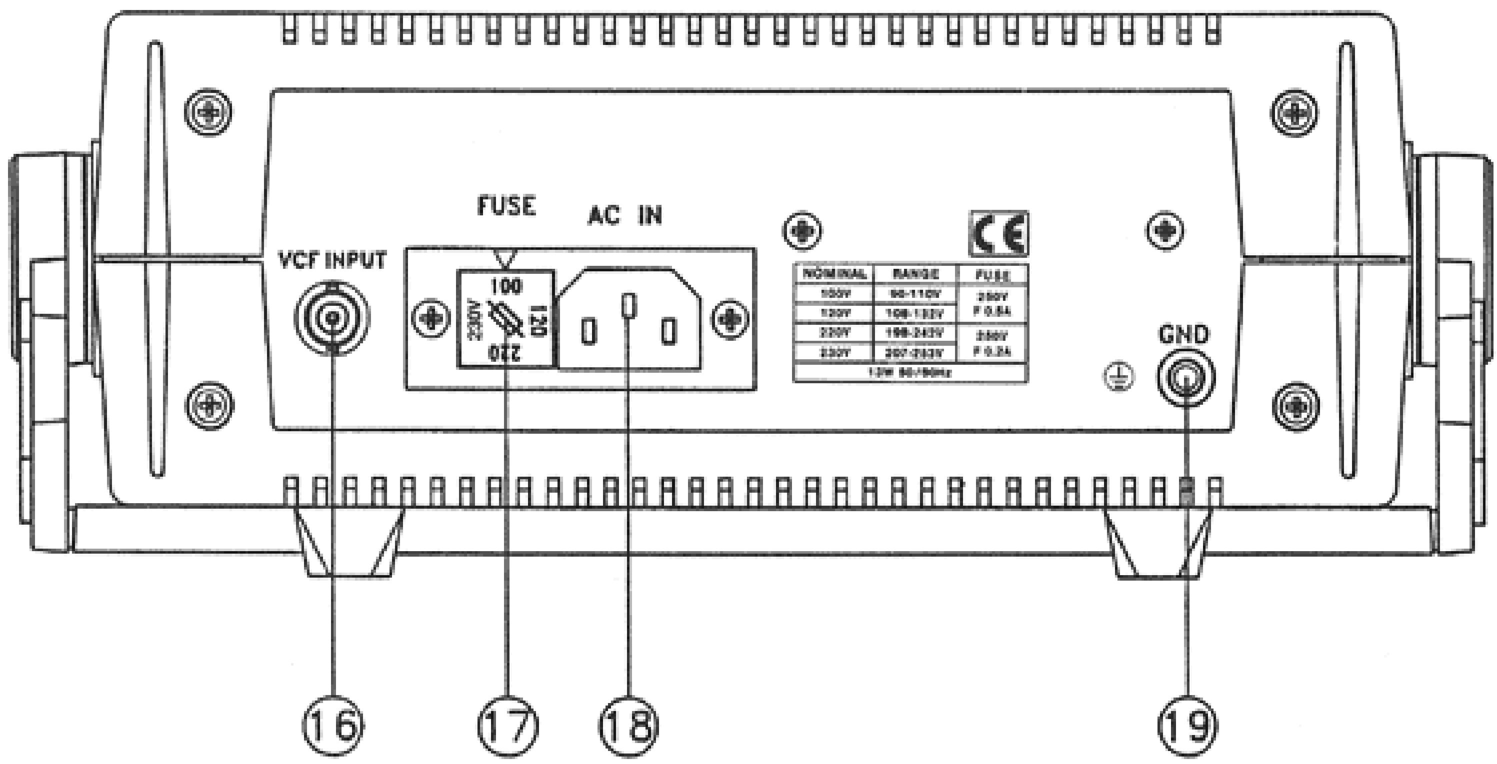


Fig. 2 Rear panel

16) **VCF INPUT** : Voltage Controlled Frequency input terminal. Permits external sweep or frequency control. Sweep width control should be off when applying external sweep voltage at this BNC.
17) **VOLTAGE SELECTOR** : Selects the AC line voltage.
18) **AC INLET** : AC power connector.
19) **GND** : Ground terminal.

3. Operating characterisitics

Use as Function Generator

1) Connect AC power cord into receptacle on rear panel and pulg into outlet.
2) Turn on equipment. Set range switch to any position.
3) Make sure that the output is symmetrical and unaffec by the sweep generator. Set the following controls as specified.

Controls.	Position
Sweep width	OFF
Symmetry	OFF
DC offset	OFF

Attenuator 0dB (pushed in)

4) Select the Range switch at more than a measured frequency. Set the Range Switch and FREQ dial as follows; The output frequency equals the FREQ dial setting times the Range Switch setting. For example, a FREQ dial setting 0.6 and a Range width setting 10k produces a 6kHz output (0.6×10=6k). A FREQ dial setting 2.0 and a Range Switch setting 1M produces 2MHz output (2.0×1M=2M).
5) Select sine, square or triangle waveform output by pressing function button.
Fig. 3 illustrates the output waveforms and their phase relationships.
6) Connect the 50Ω BNC cable to the point where it is desired to inject the signal.
7) Adjust the 50Ω output to the desired amplitude with the AMPLITUDE control. Also pull Fixed 20dB ATTENUATOR button as nessary to reduce the amplitude to the required level, or push button to increase the amplitude.
8) A positive or negative DC component can be added to the signal output at 50Ω BNC by use of the DC offset control, as required by the circuit into which the signal is being injected.
9) A fixed amplitude TTL square wave is available at the Sync Out BNC. This signal is unaffected by the AMPLITUDE, the ATTENUATOR and the DC OFFSET controls. Since the TTL output is for use indigtall corcuit, only a square wave type signal is present, even though the Function switch selects sine or triangle wave.

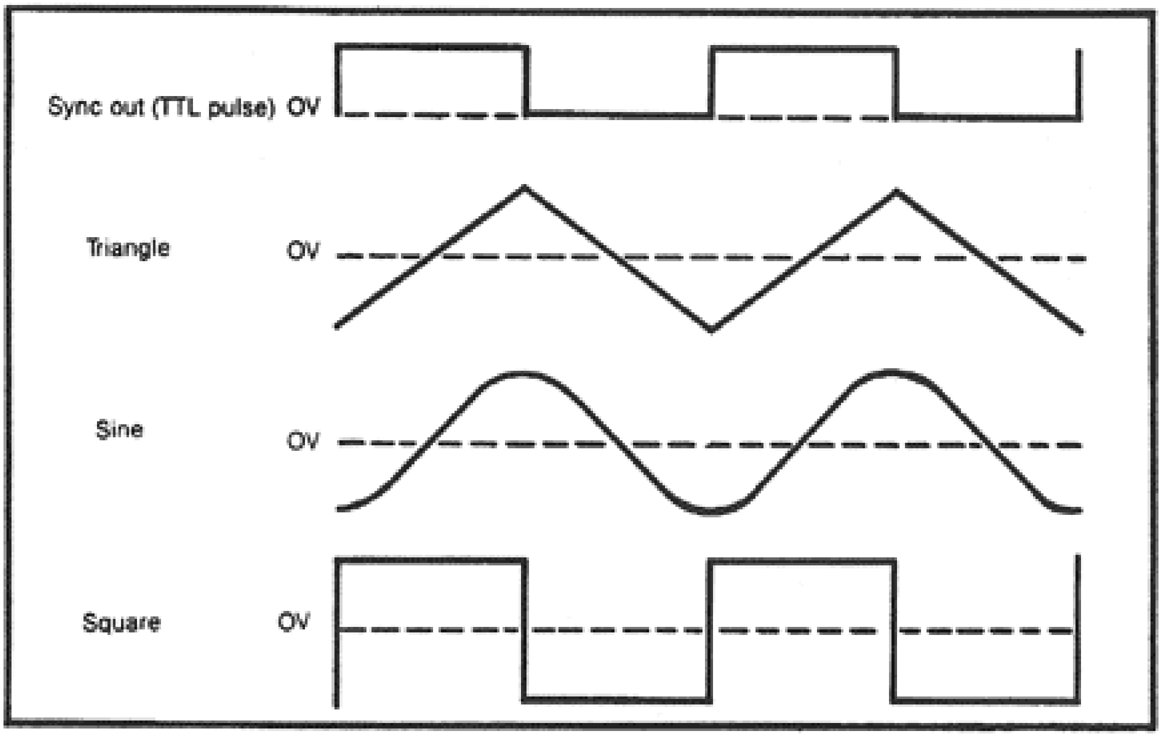


Fig. 3 Output waveforms and phase relationships.

- **Considerations**

Knowledge of the following factors is essential for proper operation of the instrument.;

1) The DC offset control can be varied up to ±10 volts (open-circuit), or ±5 volts (50Ω). Also remember that the sum of conbined signal and DC offset is also limited to ±10 volts when open-circuit, or ±5 volts when 50Ω.
Clipping occurs slightly above these levels. Fig 4 illustrates the various operating conditions

encountered when using DC offset. If the desired output signal is large or if a large DC offset is used an oscilloscope should be used to make sure that the desired combination is obtained without clipping. The probability of clipping is reduced by keeping the Amplitude control in the lower half of its adjustment range when possible.

2) To set the DCV offset to zero or a specific DC voltage, press the Function Switches slightly so that all switches can be released (all buttons out).
This removessignal from the output and leaves the DC only. Measure the DC output with oscilloscope or DC voltmeter and adjust the DC offset control for the desired value. Also the Amplitude control does not effect the DC offset.

3) The impedance of output BNC is labeled 50Ω. This means that the source impedance is 50Ω, but the output may be conneted into any circuit with impedance.
However, the output level varies in proportion to the terminating impedance. If it is desired to maintain a constant output level while injecting signal into various circuits with various inpedance, a constant terminating impedance is necessary.
When the generator output is connected to a coaxial connector on the equipment under test, it usually presents a 50Ω terminating impedance. Most other circuit points are usually moderate to high impedance. A reasonably constant terminating impedance may be maintained while injecting signal into moderate and high impedance circuits (500Ω and up) by adding a coaxial tee in the output cable and connecting a 50Ω termination to one leg. Remove the 50Ω termination when injecting into a 50Ω circuit. Also keep DC injection point. The DC offset should be set to match the circuit voltage, or a blocking capacitor may be required to avoid DC loading with 50Ω.

4) When using the higher output frequency and when using the square wave output, terminate the cable 50Ω to minimze ringing. Keep the cables as short as possible.

5) To set output amplitude to a specific level, measure peak-to-peak amplitude on an oscilloscope.

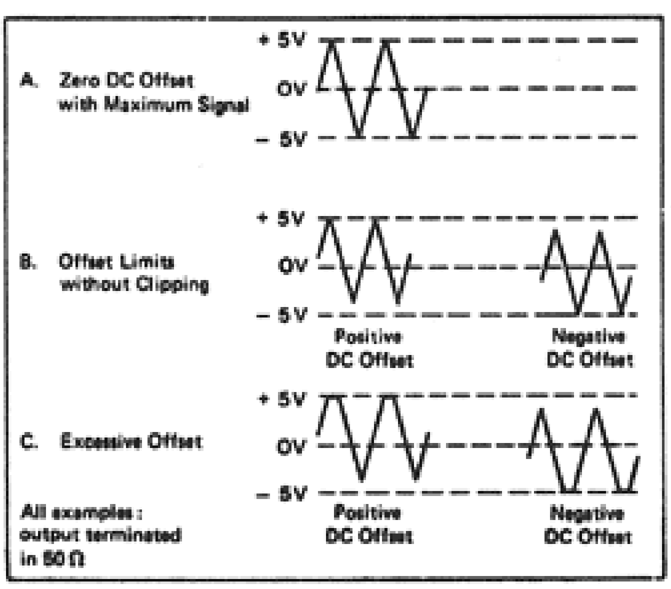


Fig. 4 Use of DC OFFSET control.

USE as Pulse Generator

In a symmetrical square wave, sine wave, or triagle wave, the positive and negative transitions are of equal time duration or 1:1 ratio. This is the condition that the SYMMETRY control is set to the CAL position. By rotating the SYMMETRY control, the right and left symmetry can be controlled up to maxinum 4:1 ratio.

Square waves can be changed into rectangular waves or pulses, triangle waves into saw tooth waves and sine waves into skewed sine waves. These are provided to the output. Fig. 5 illustrates the types of possible waveform.

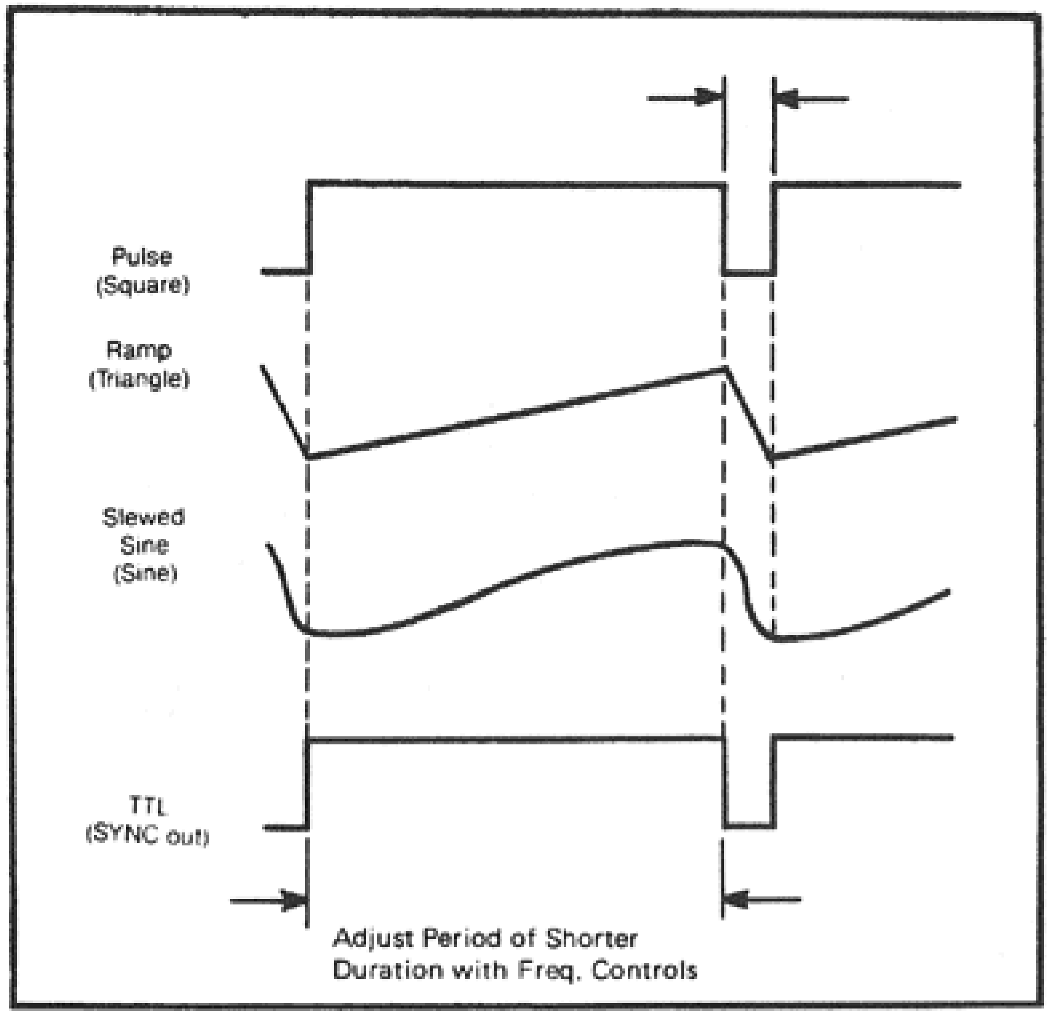


Fig. 5 Pulse, ramp, and skewed sine generation.

Procedure :

1) Set up generator as described for generator function. Display the output of the generator on an oscilloscope.
2) Select the desired type of waveform with the Function Switches. Press the square wave button for pulses, triangle button for ramp waves, or sine button for skewed sine waves.
3) If both a specific pulse width and a repetition rate are required (both specific rise time and fall time for ramp wave), the wave form may be obtained as follows:
   a. Adjust the shorter duration portion of the waveform (pulse width for pulse, fall time for ramp waves)

with the frequency controls (FREQ dial and RANGE switch).

b. Adjust the longer duration portion of the waveform (rest time for pulse, rise time for ramp waves) with the SYMMETRY control.

4) If a specific pulse width (specific fall time for ramp wave) is not critical, but a specific repetition rate is required, the desired waveform may be obtained as follows.

a. Observe the oscilloscope and adjust the SYMMETRY control to obtain the approximate desired pulse width vs. rest time ratio (rise time vs. fall time)

b. Adjust the repetition rate with the frequency controls (FREQ dial and RANGE Switch). The frequency controls affect both the pulse width and repetition rate.

• Considerations

1) When generating ramp waves or skewed sine waves, it may be easier to measure the time periods on the oscilloscope by using the square wave mode, then switch to the desired operating mode.
2) For ease and accuracy in measurement, use a higher sweep speed on the oscilloscope to expand the pulse width for measurement, then reduce sweep to measure the repetition rate.
3) Repetition rate can be expressed as a frequency or time period. Measure the repetition rate as a time period on the oscilloscope and convert to frequency if required. The repetition rate includes the full cycle, both the pulse width and rest time for pulse, both the rise time and fall time for ramp waves.
4) Repetition rate can be measured accurately and easily as frequency or time period with a frequency counter.
5) Pulse width also can be measured by a frequency counter, but only with the SYMMETRY control set to CAL before the pulse waveform is stretched. Pulse width equals one-half the time period of the square wave (see Fig. 6C). If the counter is not equipped for period measurement, calculate the frequency which is equivalent to the desired pulse width and measure the frequency of the waveform.

$$\text{Desired Frequency} = \frac{1}{\text{desired pulse width} \times 2}$$

• **Typical Example**

Assume that it is desired to generate a pulse waveform with a 0.2 millisecond pulse width and repetition rate of 500Hz. The following procedure (Fig. 6) describes how to interpret measurements to obtain this waveform.

Steps of the procedure must be performed in the sequence as specified.

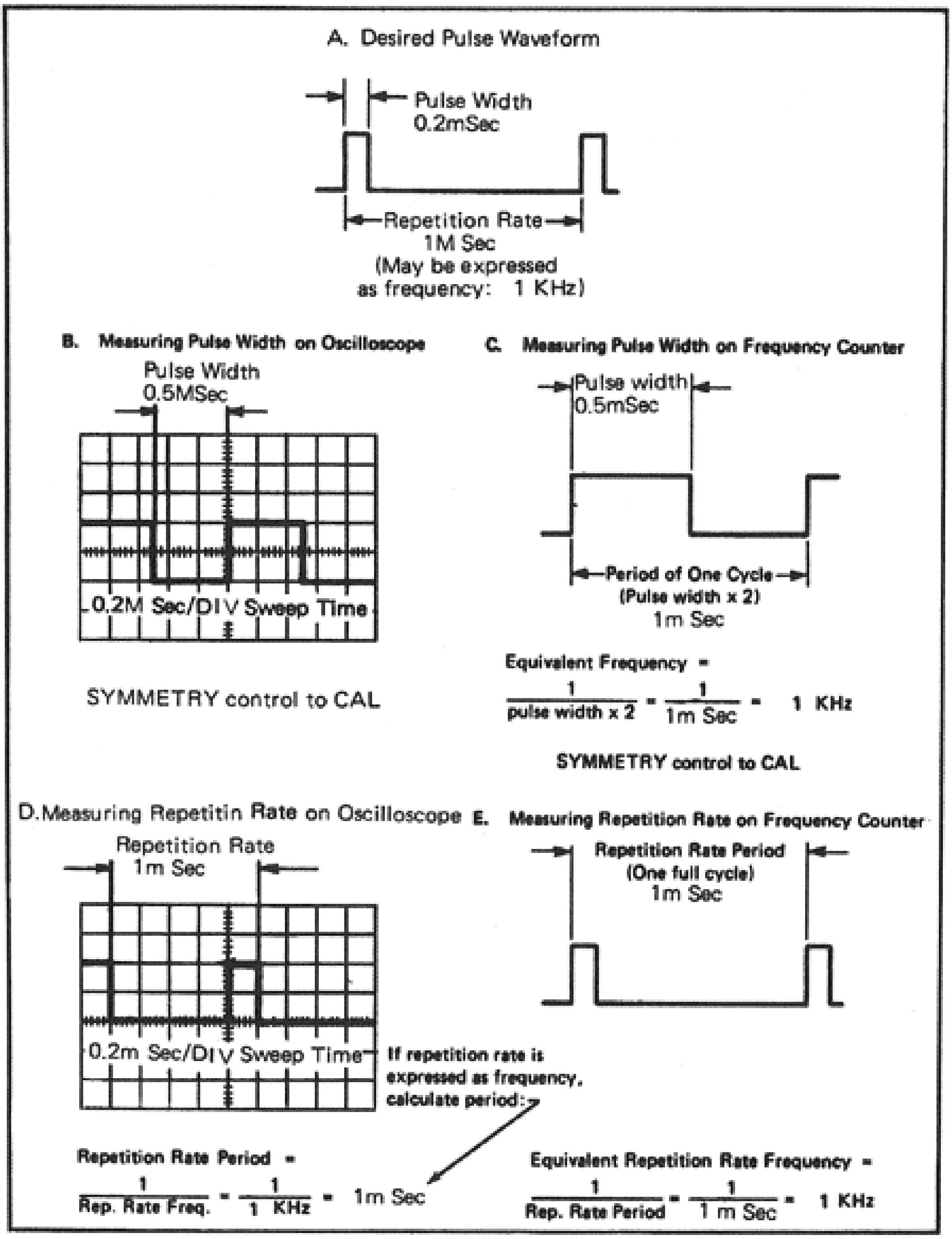


Fig. 6 Typical pulse measurement and set-up technique.

1) Set the SYMMETRY control to CAL.
2) Adjust FREQ dial (and RANGE switch if necessary) for desired pulse width.
   a. Increase oscilloscope sweep to expand waveform for convenient calibration time measurement.
   b. Calculate frequency which is equivalent to desired pulse width
      ($\text{freq} = \dfrac{1}{\text{pulse width} \times 2}$) and measure frequency of waveform on counter.
3) Adjust the SYMMETRY control to obtain the desired repetition rate.
   a. Reduce oscilloscope sweep speed. Display waveform and measure repetition rate period using calibrated time measurement. If repetition rate is stated as a time period such as 1 milliseconds, adjust the SYMMETRY control so that a complete cycle of pulse width and rest time may equal 1ms. If the desired repetition rate is expressed as a frequency, such as 1kHz, first calculate the equivalent time ($\text{period} = \dfrac{1}{\text{FREQ}}$), then proceed as described above.
   b. If desired repetition rate is stated as a frequency, measure the frequency on a frequency counter and adjust the SYMMETRY control to obtain the desired repetition rate.
4) Adjust the pulse waveform to the desired amplitude with AMPLITUDE control and ATTENUATION control.
   Measure the peak-to-peak voltage amplitude on the oscilloscope. (Fixed amplitude at proper TTL levels from TTL OUT BNC, SYNC OUT BNC)

USE as Sweep Generator

1) Set equipment in the same way as function generator operation.
2) Select the proper frequency to be swept with the RANGE switch and the highest frequency to be swept with the FREQ dial.
3) Adjust the amount of sweep with the sweep width control.
4) Adjust the repetition rate of the sweep with the sweep rate control.
5) To sweep the entire 20Hz to 20,000Hz audio range, set the RANGE switch to 10k, the FREQ dial to a desired frequency, and the sweep width control fully clockwise.

*** Considerations**

1) The frequency dial should be set to the most right direction (fully clockwise) for getting the highest sweep range. The highest frequency of the generator is determined by the dial setting. The sweep generator will sweep from low and to that point. Therefore, a high dial setting is required to obtain the sweep covering a wide frequency range. The setting to the most right direction (fully clockwise) must be used to obtain the maximum sweep width of 1000:1 (the highest frequency sweep is 1000 times that of the lowset frequency swept). If a low dial setting and a SWEEP WIDTH setting are used simultaneously, the generator will sweep to the range limit and cease operation for a portion of the sweep cycle, effectively clipping the sweep.

SYNC Output

The output is specifically designed for compatibility with SYNC digital logic circuits. Set-up time is considerably reduced because the fixed logic level and polarity are ready for direct injection into TTL circuits. There is a need for protection from accidental application of too high amplitude or incorrect DC offset which might damage semiconductors. Another advantage is the extremely fast rise time and fall time of the signal.

To use the SYNC output, connect a cable from the SYNC OUT BNC of the generator to the point at which it is desired to inject the signal. The SYNC output may be used in several modes of operation.

Ex) Using the square wave generator or pulse generator modes, clock pulses can be generated for testing, troubleshooting, or circuit analysis. The instrument can even be used as substitute for master clock generator;up to 20 TTL circuits can be driven form the SYNC OUT BNC.

External Frequency Control by VCF Input

Within a given range, the output frequency of the generator is normally controlled by the FREQ dial setting. However, it also may be controlled by applying voltage at the VCF INPUT BNC on FRONT PANEL. There are three basic modes of external VCF control possible, as follows:

a. Applying an AC voltage produces FM modulation output.

b. Applying a specific fixed DC voltage will produce a specific output frequency (described in following "Programmed Frequency Selection" paragraph).

C. Applying a ramp voltage (or other type waveform if desired) provides externally controlled sweep generator operation (described in following "Use as Externally Controlled Sweep Generator" paragraph).

* **Considerations**

The following considerations apply to all modes of operation involving external control of the VCF (voltage-controlled frequency) :

1) The output frequency of the generator is determined by the voltage applied to the VCF. First of all, this voltage is established by the setting of the FREQ dial. Any voltage applied to the VCF input BNC is summed with the voltage from the dial setting. A Negative voltage input drives the VCF to a lower frequency. However, the VCF can never be dirven beyond its range limits (the highest and lowest frequencies that can be attained with the dial on a given range).

2) With the FREQ dial set at Max. (fully clockwise), and 0 volt at the VCF INPUT BNC, the generator output frequency is at the higher limit of the selected range. Decreasing the voltage to -10 volts drives the generator frequency to the lower limit of the range. Between 0 and -10 volts, the generator output frequency is proportional to the VCF input voltage. The VCF input voltage can be correlated to equivalent dial settings, as given in Table 2.

VCF IN Voltage (Volts)	Equivalent Dial Setting
0	fully counter clock wise position
- 1	↓
- 2	
- 3	
- 4	
- 5	
- 6	
- 7	
- 8	
- 9	
- 10	fully clock wise position

Table 2. Correlation between VCF IN voltage and Equivalent dial setting

3) The FREQ dial is usually set to Max. (fully clockwise) when using external VCF. This reduces the dialed VCF voltage to zero, and allows the external VCF voltage to exercise complete control. It also reduces the effects of dial setting inaccuracy.
4) If the summed dial setting and VCF Input voltage exceeds -10volts, ocillation ceases and no output is produced. If the swing of the VCF Input signal is too great, oscillation will cease each time the instantaneous voltage reaches.

Programmed Frequency Selection

A specific output frequency can be selected each time a specific VCF Input voltage is applied (assuming a common dial setting). Such operation may be advantageous at the place where there is a requirement to return to a specific frequency periodically. Set-up time is reduced by eliminating the need for frequency measurement and precision tuning each time the frequency is needed. Just set the dial at its Max. (fully clockwise) and turn on the external VCF voltage.

A set of two or more specific frequencies may be programmed by using multiple DC voltage values which may be selected by a switch or electronic switching circuits. This type of operation would be desirable in production testing where signals at several specific frequencies are required for various tests. FSK (frequency shift keying) signals also may be generated in this manner.

To maintain the original accuracy each time the operation is repeated, the FREQ dial must be accurately set to the same position. Probably the easiest way to assure this common dial setting is to set it against its Max. (fully clockwise).

USE as Externally Controlled Sweep Generator

A ramp voltage, or any other type waveform desired, can be applied for externally controlled sweep generator operation. A 0 ~ -10 volt swing will sweep frequencies over a 1000:1 ratio (with dial set to Max.).

Set up the equipment as described for internally controlled sweep generator operation, except turn the SWEEP WIDTH control to OFF. Apply the sweep voltage with no DC component at the VCF Input BNC. The amplittude of the external sweep signal will now determine the sweep width, and the frequency or repetition rate of the external sweep signal will destermine the sweep rate.

Use as Frequency Counter

The instrument can be used as a frequency counter when the OSC/COUNT switch is pushed in. Connect a desired sognal to COUNT IN terminal and observe the displayed frequency by selecting the range switch to the proper range.

In case that the O.F.LED frickers, it means that the frequency more than the selected frequency range is inputted.

The frequency of 10Hz ~ 2MHz range can be measured with this instrument.

"Caution"

Because the sensitivity of the frequency counter is 50mVrms, it is impossible to measure a signal less than 50mVrms. In case that the signal more than voltage level 140Vp-p is inputted, this instrument may be damaged.

SECTION Ⅲ. APPLICATIONS

1. Primary Applications

Because of the great versatility of this Sweep Function Generator. It would be inpossible to include all the possible applications in this manual. However, a lot of primary applications are described in detail to allow users to adapt the procedures to other applications. This instrument has lots of applications as a signal source in electronics design labs, schools, serice shops, and production facilities. It has an application wherever there is a need to test or analyze audio, radio, digital, communications, medical electronics, sonar, industrial electronics, subsonic, ultrasonic and lots of other electronic devices and circuits.

1) Troubleshooting by signal substitution.

   When troubleshooting a demaged audio equipment, The trouble point can be easily found by injecting an audio signal from this Sweep Function Generator to substitute for the mormal signal. By starting from the speaker side and moving toward the audio input side at a time, sound will be heard from the speaker for each stage that is operating normally. When a signal is applied to the defective stage, no sound will be heard from the speaker.

2) Amplifier Overload Characteristic.

   It is difficult to determine the overload point by using a sinewave signal when we test overload characteristic. The triangle waveform is ideal for this type of test because any deviation from absolute linearity can be easily detected. Using the triangle output, the peak overload condition for an amplifier can be readily determined. The overload characteristic waveform tested by a triangle waveform is shown in Fig. 7.

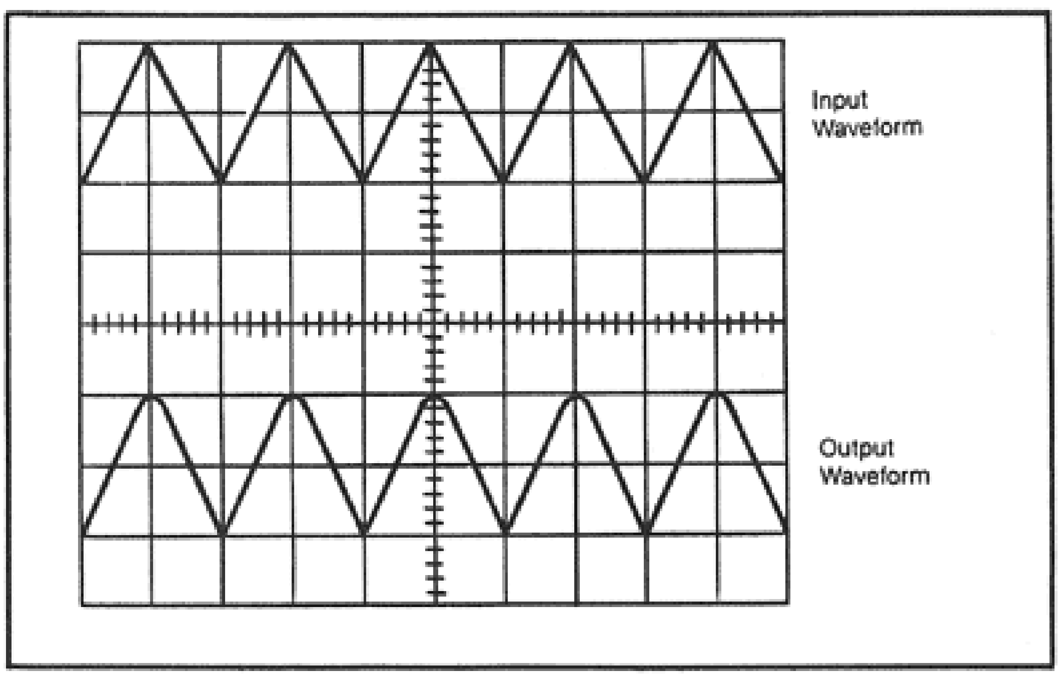


Fig. 7 Amplifier overload characteristics.

3) Amplifier performance evaluation using squarewaves.

The standard sinewave frequency response curves do not give a full evaluation of the amplifier transient response. In this case, By using a squarewave having a high harmonic in conjunction with an oscilloscope, the performance test for the amplifier operating condition can be implemented. Refer to Fig. 8.

a. Connect this instrument to oscilloscope. The 50ohms termination at the amplifier input is essential when using squarewaves to eliminate the ringing effects generated by the fast rise time.
b. When using the triangle output of this instrument, set the amplitude control so that there is no signal clipping over the range of frequencies to be used.
c. Select the squarewave output and adjust the frequency by several check points within the passband of the amplifier, such as 20Hz, 100Hz and 10kHz.
d. At each frequency checkpoint the waveform obtained by the amplifier output provides information regarding amplifier performance with respect to the frequency of the squarewave input. Fig. 8 indicates the possible waveform obtained by the amplifier output.

Square wave evaluation is not practical for narrow-band amplifiers. The restricted bandwidth of the amplifier cannot reproduce all frequency components of the square wave in the proper phase and amplitude relationships.

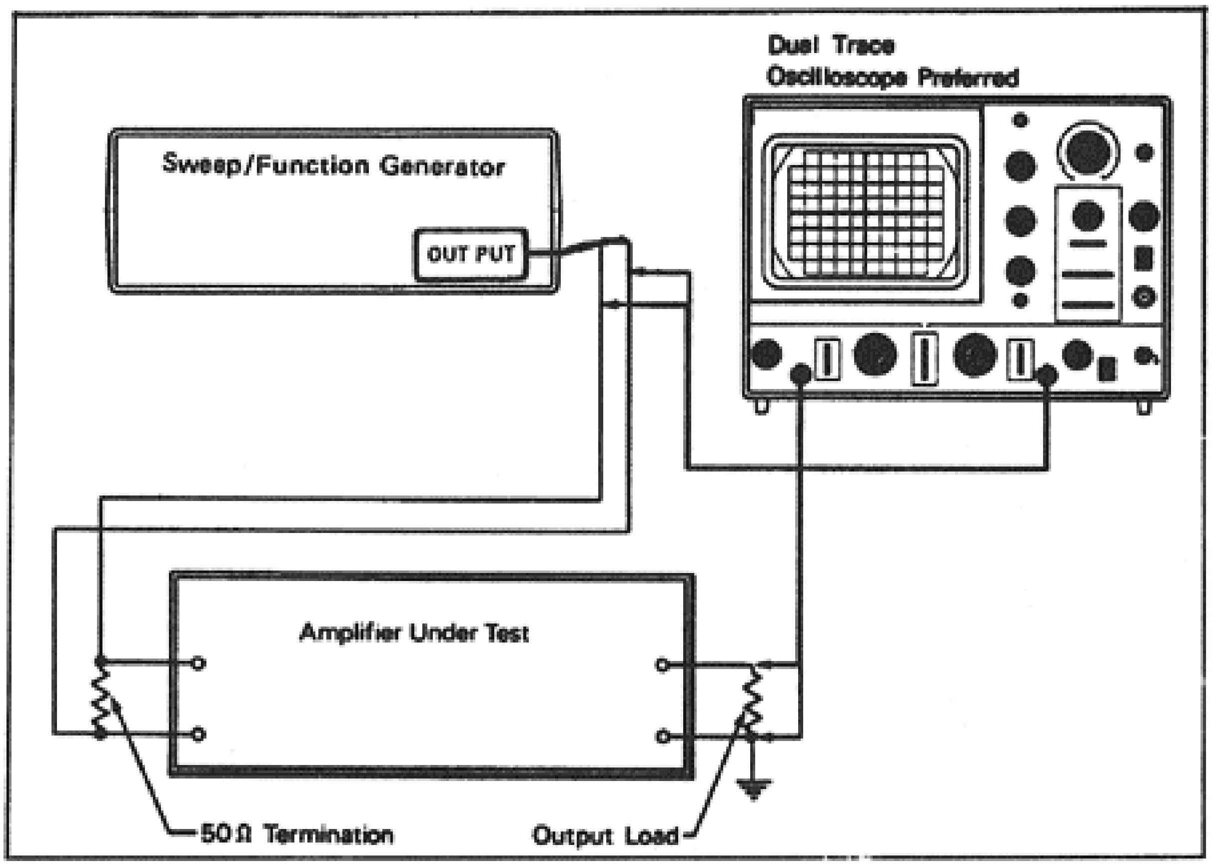


Fig. 8-A Amplifier performance evaluation using square waves.

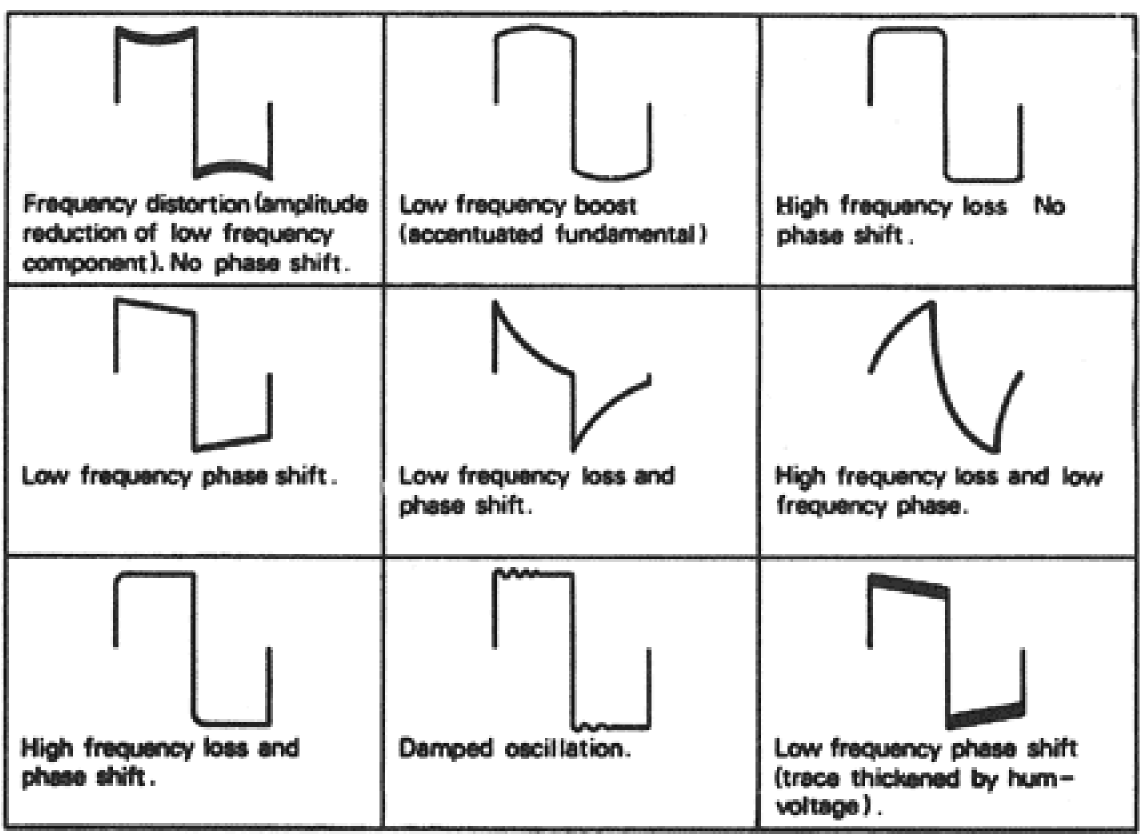


Fig. 8-B Test Waveforms.

4) Testing speakers and Impedance Networks.

This instrument can be used to provide information regarding the input impedance of a speaker or any other impedance network VS. frequency. In addition, the resonant frequency of the network can be determined.

a. Connect this equipment to a speaker or other impedance network. The oscilloscope may be used to verify that this instrument is not in a clipping condition.

b. If the voltmeter method is used, vary this instrument over the full range of frequency and log the voltage measured at the speaker terminals VS. frequency.
The dB scales of the AC voltmeter are convenient for converting this information to satndard response units.

c. If the oscilloscope method is used, use sweep operation as for frequency response measurment.

d. In speaker testing, an obvious increase of voltage will occur at some low frequency. This is the resonance frequency of the speaker system (Fig. 10).
The speaker enclosure will modify the results obtained from the same speaker without enclosure.
A properly designed enclosure will produce a small peak on each side of the peak obtained without an enclosure. The enclosure designer can use the response characte to evaluate the effects of varying port sizes, damping materials, and other basic enclosure factors.

e. In testing other impedance networks, resonance will not necessarily occur at low frequency. However, as resonance is approached the signal level will increase. The impedance of the network can be measured at the resonance point, or at other frequencies. Refer to follows.;
- Connect a variable resistor in series with impedance network as shown in fig. 10.
- Measure the voltage at points E_1 and E_2 respectively and adjust variable resistor R_1 so that voltage E_2 can equal the half of voltage E_1.
- The impedance of the network equals the resistance of variable resistor R_1.

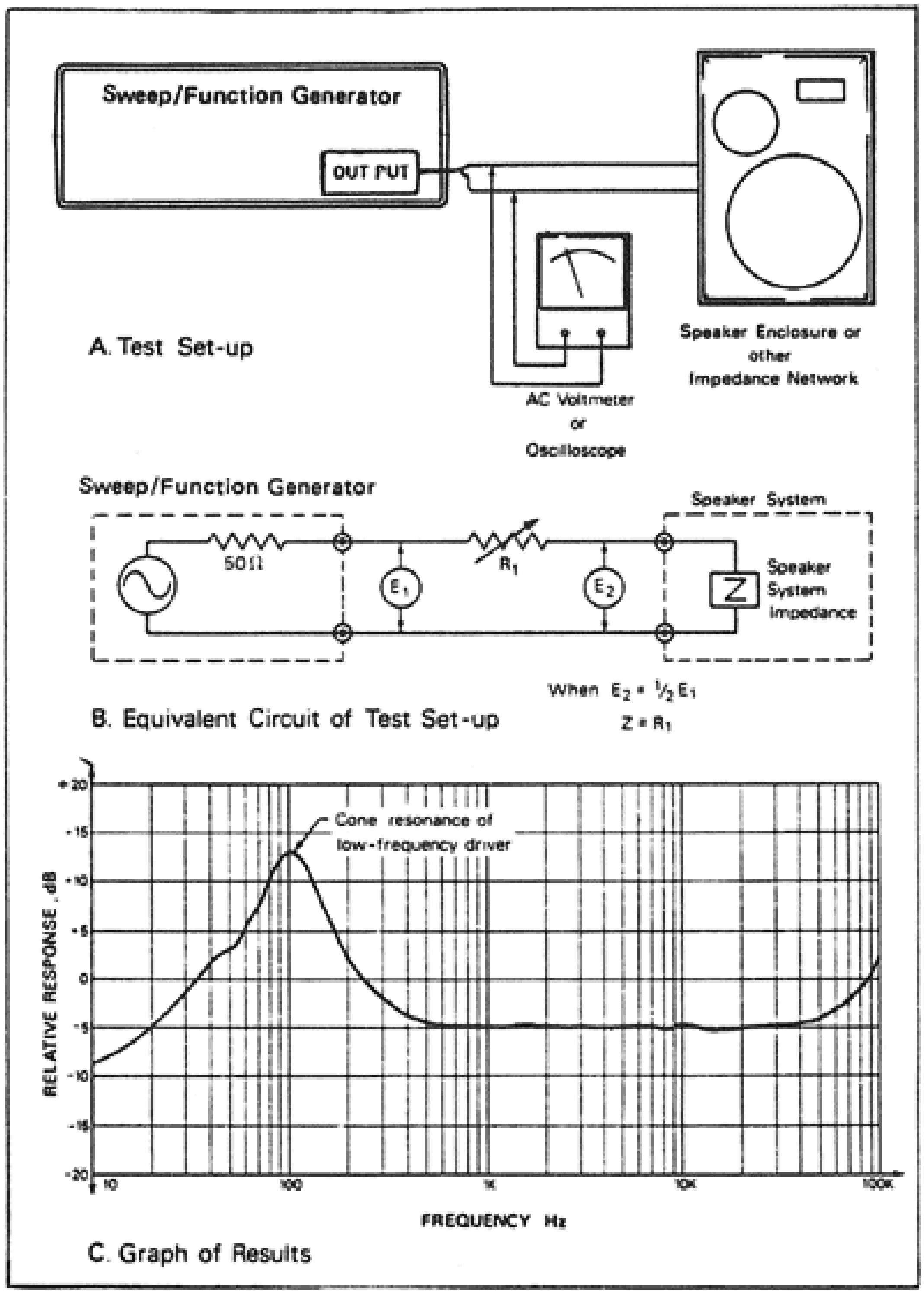


Fig. 9 Testing speaker systems and impedance networks.

5) AM communications receiver adjustment

This instrument can be used for adjustment of AM communications receiver IF s and discriminators using the 455kHz IF frequency. For accurate frequency adjustment, a 455kHz crystal-controlled marker source should be used.

a. Use sweep operation and apply signal to the input of the 455kHz IF section.
b. When signal at the output of the 455kHz IF section is displayed, a response curve similiar to Fig. 10 A should be obtanined. The marker "pip" should be in the center of the response curve.
c. When the output of the discriminator is displayed, a response curve similiar to Fig. 10 B should be obtained.
   The "S" curve should be balanced on each side of the marker "pip".

In some receivers the IF selectivity is "packaged", which means all adjustments are preset. In this case the receiver alignment can only be evaluated and-verified without adjustment. Where the tuned circuits are adjustable, the manufacturer' s procedure must be followed to insure that the proper overall response is obtained.

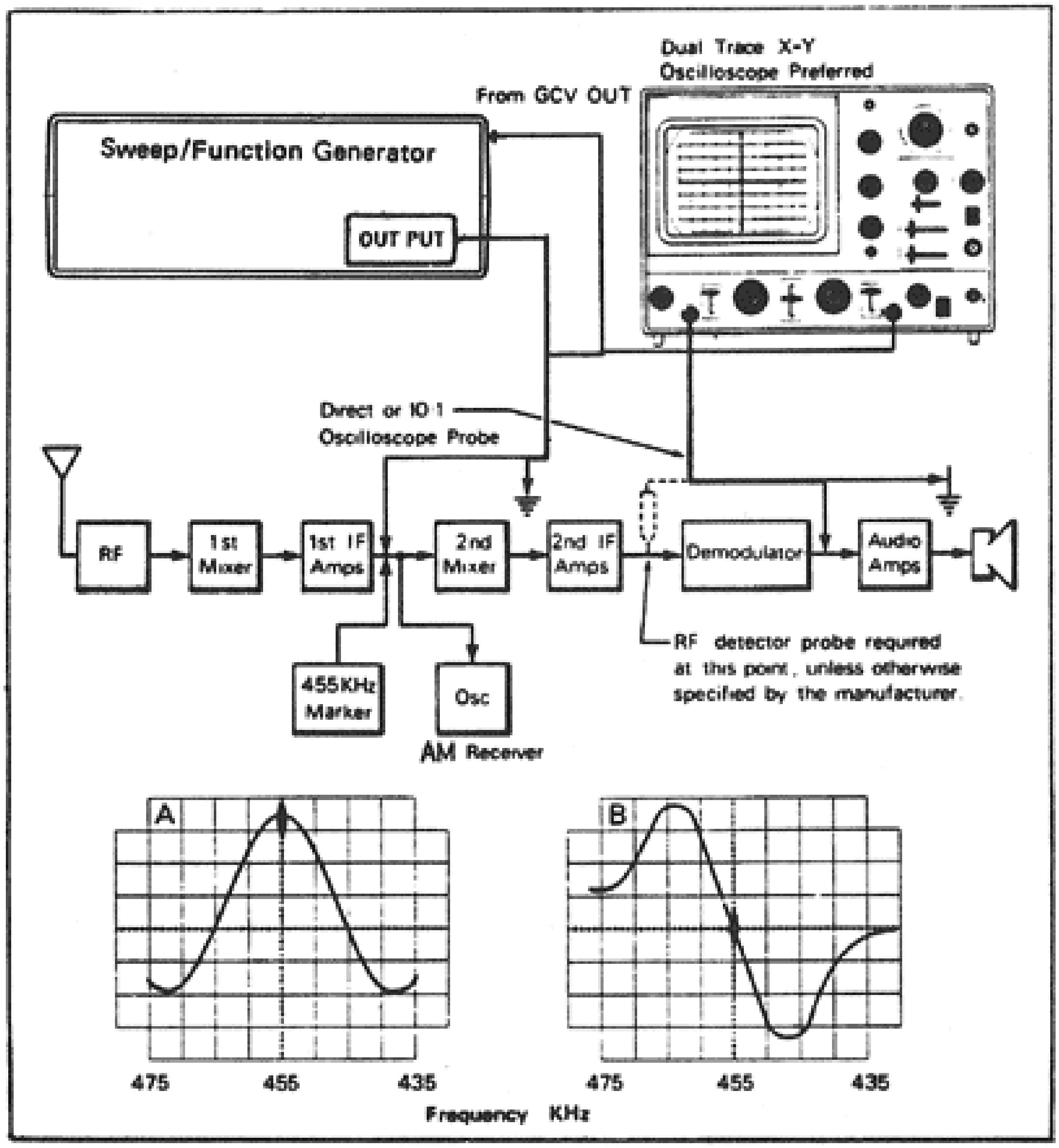


Fig. 10 Alignment of AM communications receiver IF' s and discriminator.

6) Testing Digital Logic Circuit

This instrument is well-suited for testing digital logic circuits. It can supply square waves, pules, or a gated pulse train, and these waveforms may be swept in a desired frequency. It can supply clock pulses for bread-boarding and design analysis. Effects of varying pulse frequency, waveshape and DC offset can be analyzed. It can provide the correct digital drive signals to circuit boards that are removed from a system.

It can drive quiescent equipment into a dynamic condition for testing. In troubleshooting digital logic circuits, it can provide the proper signals for the signal tracing or signal substitution method of fault isolation.

a. Connect the equipment to a digital logic circuit. (Fig. 11)
b. Set up this instrument to generate square waves and pulses, as described in the "operating instruction" portion of the manual.
c. For testing TTL logic circuit, use the TTL signal from the SYNC OUT terminal. The amplitude and DC offset are preset for direct injection without the need for set-up adjustment.
d. For CMOS, negative logic, or any other modified circuit from standard TTL logic, use the 50Ω

output, display the signal on the oscilloscope and adjust the AMPLITUDE and DC offset controls as required to obtain the correct waveform before applying the signal to the circuit under test. A coupling capacior may be used to block the DC offset from the circuit under test if required.

e. Timimg realtionships between the input signal and other points in the circuit are usually of primary interest in digital circuits. A dual-trace oscilloscope allows both signals to be displayed simultaneously for time relationship comparison.

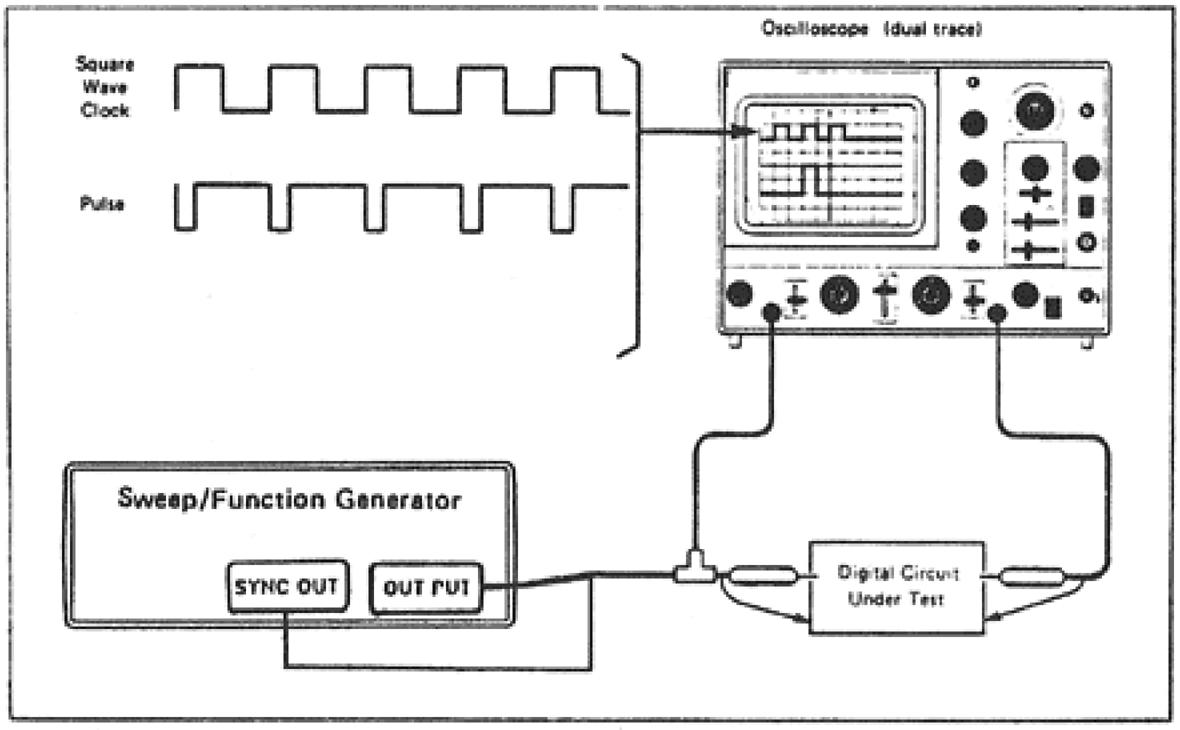


Fig. 11 Testing digital logic circuits.

2. Preset Frequency Selection

In test and design work where several frequencies are used repeatedly, it is convenient to be able to preselect these frequencies with minimum effort. Owing to the VCF feature, this instrument can be used together with preset voltages and a frequency selector switch. Refer to Fig. 12.

1) Set the FREQ dial to the most right direction (fully clockwise).
2) Connect the 50Ω output to a frequency counter.
3) With the frequency selector switch in the F1 position, adjust R1 for the desired frequency as observed on the frequency counter. Repeat this for the frequencies desired.
4) With the FREQ dial set at the fully clock wise position, and a maximum available A-voltage of about 10 volts, frequencies encompassing a 1000:1 range can be obtained by this method on each frequency range.
5) To maintain frequency accuracy each time the set-up is used, the dial must always be set to exactly the same position. To assure this accuracy, set the dial solidly to the most right direction (fully clockwise).

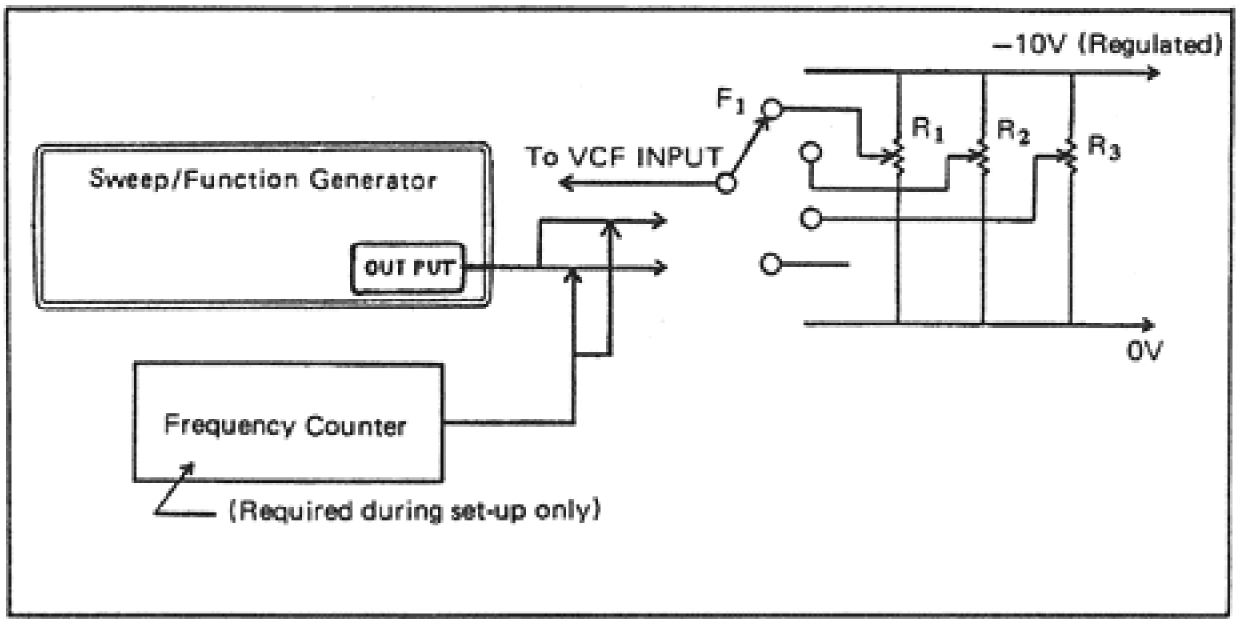


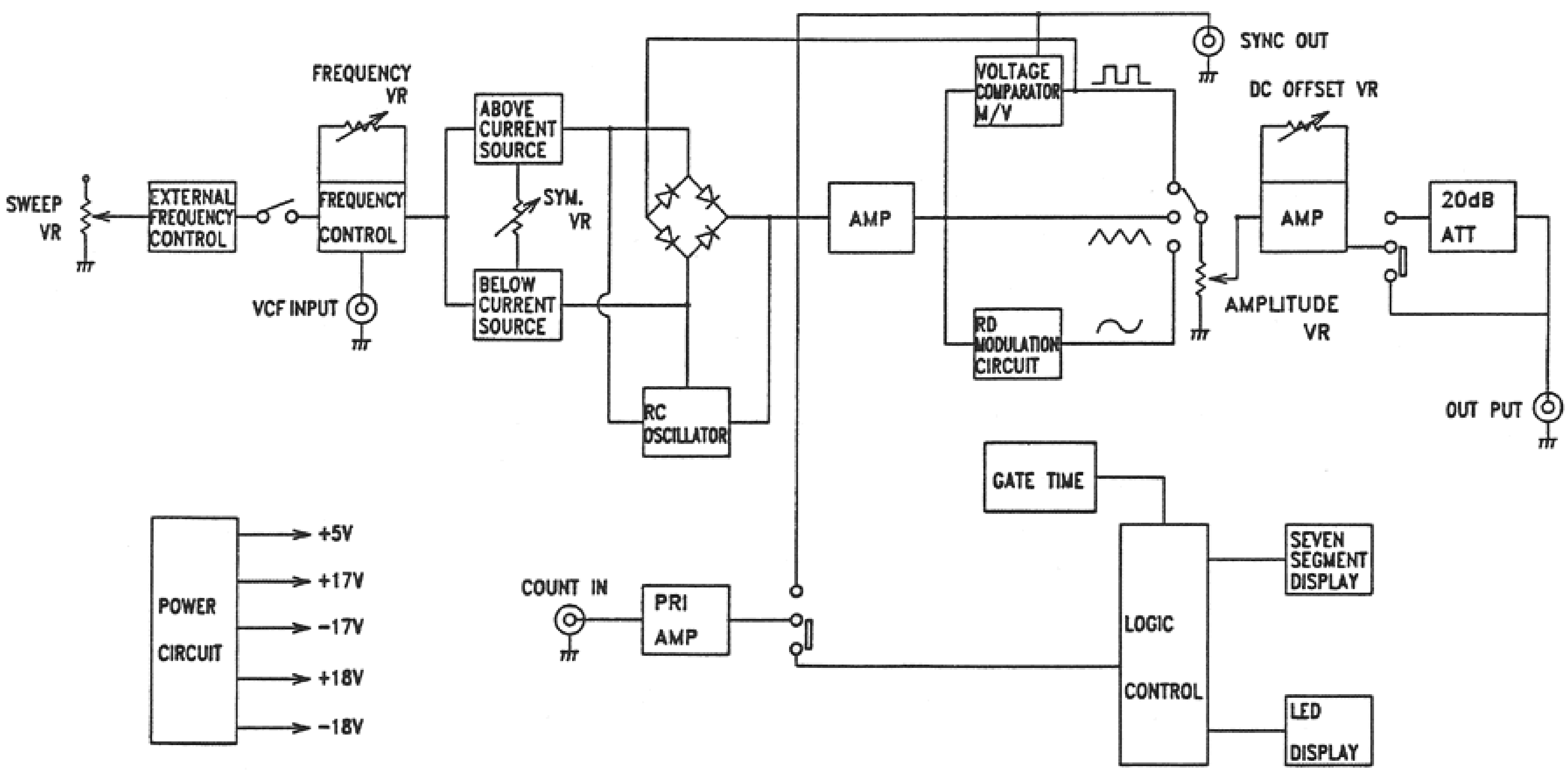
Fig. 12 Preset Frequency Selection

3. Additional Applications

The triangle or ramp output of this instrument can be used at its lowest frequency to simulate a slowly varying DC source. This can be used to check threshould levels of TTL and CMOS logic as well as voltage comparators. Chart recorders can be checked by this method. Analog meter movements can be exercised zero to full scale to observe defects, such as sticky meter movements.

NO.	SYMBOLE	DESCRLPTION	NO.	SYMBOLE	DESCRLPTION
1	⎓	Direct current	7	○	OFF (SUPPLY)
2	~	Altemating current	8	⧈	Equioment protected throughout by DOUBLE INSULATION or REIN-FORCED INSULATION (equivalent to Class II of IEC 536-see annex H)
3	⏚	Earth (ground) TERMINAL	9	⚡	Caution, risk of electric shock Easily-touched higher temperature parts
4	⊜	PROTECTIVE CONDUCTOR ERMINAL	10	⚠	Caution (refer to accompanying documents)
5	⊥	Frame or chassis TERMINAL	11	⊓	In-position of a bistable push control
6	|	ON (SUPPLY)	12	⊓	Out-position of a bistable push control

4 BLOCK DIAGRAM



5. PARTS LIST

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-A10-815	DISPLAY PCB ASS'Y	9205C (HC)	KIT	1	
2-C02-015	LED	KL-R34D	EA	3	LED1 LED2 LED3
2-C04-117	SEVEN SEGMENT LED	KD-R3911KM	EA	4	FND1 FND2 FND3 FND4
2-C43-311	MAIN PCB	9205C-05	EA	1	
2-A10-815	MAIN PCB ASS'Y	9205C (HC)	KIT	1	
2-C28-023	CERAMIC CAPACITOR	100PF 50V J (DD107CH101J50)	EA	2	C266 C267
2-C28-001	CERAMIC CAPACITOR	1PF 50V C (DD104CK010C50)	EA	1	C26
2-C28-049	CERAMIC CAPACITOR	200PF 50V J (DD110CH201J50)	EA	1	C10
2-C28-013	CERAMIC CAPACITOR	22PF 50V J (DD104CH220J50)	EA	3	C25 C264 C265
2-C28-017	CERAMIC CAPACITOR	33PF 50V J (DD105CH330J50)	EA	2	C24 C261
2-C28-019	CERAMIC CAPACITOR	47PF 50V J (DD106CH470J50)	PCS	1	C42
2-C33-317	ELECTROLYTIC CAPACITOR	0.33UF 50V (SMBP1H04R33M)	PCS	1	C1
2-C33-124	ELECTROLYTIC CAPACITOR	1000UF 16V M (SMS1C04102M)	EA	4	C228 C229 C230 C248
2-C33-014	ELECTROLYTIC CAPACITOR	100UF 25V M (SM1E04101M)	EA	2	C27 C28
2-C33-064	ELECTROLYTIC CAPACITOR	10UF 16V M (SRE1C04100M)	EA	2	C13 C5
2-C33-007	ELECTROLYTIC CAPACITOR	10UF 25V M (SRE1C04100M)	EA	4	C11 C12 C2 C3
2-C33-318	ELECTROLYTIC CAPACITOR	1UF 50V M (SM1E04100M)	PCS	2	C39 C40
2-C33-036	ELECTROLYTIC CAPACITOR	2200UF 35V (SM1V04222M)	EA	2	C37 C38
2-C33-031	ELECTROLYTIC CAPACITOR	220UF 25V M (SM1E04221M)	EA	1	C246
2-C33-026	ELECTROLYTIC CAPACITOR	22UF 16V M (SM1C04220M)	EA	2	C237 C263
2-C33-319	ELECTROLYTIC CAPACITOR	22UF 50V M (SMBP1H04220M)	PCS	1	C44
2-C33-123	ELECTROLYTIC CAPACITOR	470UF 25V M (SMS1E04471M)	EA	2	C31 C32
2-C33-048	ELECTROLYTIC CAPACITOR	47UF 10V M (SM1A0447M)	EA	1	C29
2-C33-127	ELECTROLYTIC CAPACITOR	47UF 16V M (SRE1C04470M)	EA	2	C7 C8
2-C31-019	METALIZED FILM CAPACITOR	0.1UF 63V (MMY168 104J63V)	EA	4	C33 C34 C35 C36
2-C31-074	METALIZED FILM CAPACITOR	2.2UF 250V K (MMR225F100V)	EA	1	C21
2-C31-089	POLYESTER FILM CAPACITOR	0.022UF 100V F (MRA223F100V)	PCS	1	C19
2-C31-090	POLTESTER FILM CAPACITOR	2200UF 100V F (MRA222F100V)	PCS	1	C18
2-C30-085	POLYPROPYLEN FILM CAPACITOR	0.1UF 100V K (PRA104K100V)	EA	4	C22 C23 C30 C6
2-C30-008	POLYPROPYLEN FILM CAPACITOR	0.1UF 250V F (PRA104F250)	EA	1	C260
2-C31-019	POLYPROPYLEN FILM CAPACITOR	0.22UF 100V K (MRA224K100)	EA	1	C20

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C28-026	SEMI CONDUCTOR CERAMIC CAPACITOR	0.1UF 50V M (DD314BC104M50)	EA	17	C14 C15 C16 C247 C249 C251 C252 C253 C254 C255 C256 C257 C258 C256 C41 C43 C9
2-C34-004	STYROL CAPACITOR	150PF 125V J (SRF151J125)	EA	1	C17
2-C31-037	TRIMMER CAPACTION	30PF (CV05E3003)	PCS	1	TC1
2-C21-454	CONNECTOR	TPH-1217-24A	EA	1	
2-C32-053	CRYSTAL	3.579545MHZ +-20PPM	EA	1	XTAL1
2-C02-004	DIODE	1N 4148	EA	37	D1 D10 D11 D12 D13 D14 D15 D16 D17 D18 D19 D2 D20 D207 D208 D209 D210 D211 D212 D213 D214 D215 D216 D217 D218 D219 D220 D221 D3 D31 D32 D33 D34 D35 D36 D8 D9
2-C03-026	DIODE	1S 1588	PCS	14	D21 D22 D23 D24 D25 D26 D27 D28 D29 D30 D4 D5 D6 D7
2-C03-007	DIODE	2W02	EA	2	BR1 BR2
2-C02-002	DIODE	HZ 15.2	EA	2	ZD1 ZD2
2-C02-003	DIODE	HZ 3C1	EA	2	ZD4 ZD5
2-C03-023	DIODE	HZ 5C2	EA	6	ZD11 ZD12 ZD13 ZD14 ZD6 ZD7
2-C03-009	DIODE	HZ 6C2	EA	3	ZD10 ZD3 ZD9
2-C46-241	DIODE	RMOC32V	EA	1	ZD8
2-C02-018	FET	J310	EA	2	Q214 Q8
2-C05-021	IC	MC 7812 CT	EA	1	U9
2-C21-263	IC	MM 5369 AA/N(60HZ ONLY)	EA	1	IC204
2-C05-009	IC	SN 74F00 PC	EA	1	U6
2-C21-264	IC	SN 74LS 92 N	EA	2	IC205 IC206

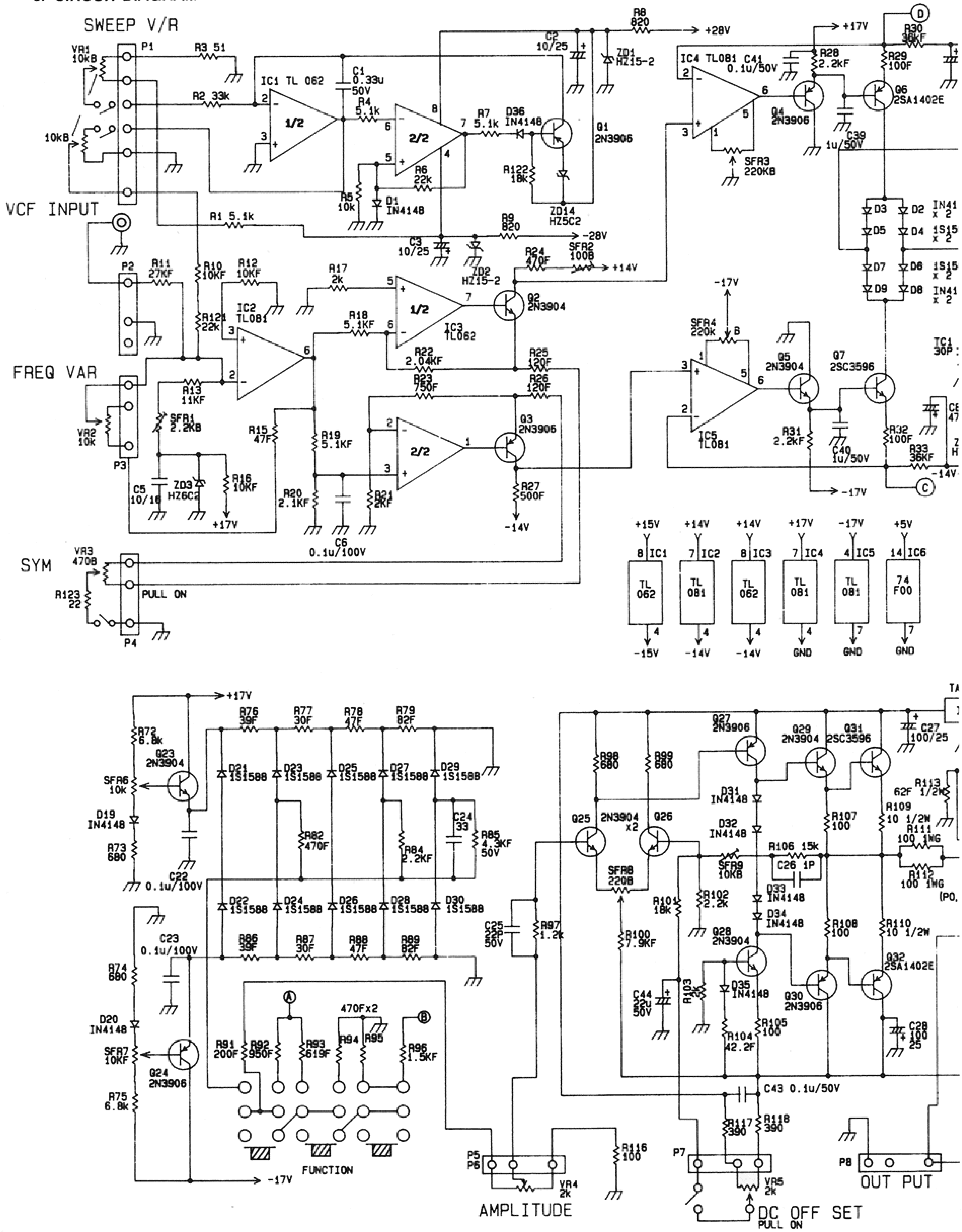
CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C04-136	IC	TA 78018AP	EA	1	U7
2-C02-126	IC	TA 78L005 AP	EA	1	IC203
2-C04-137	IC	TA 79018P	EA	1	U8
2-C04-030	IC	TC 4013BP	EA	1	IC210
2-C04-032	IC	TC 4066 BP	EA	1	IC209
2-C04-073	IC	TC 4081 BP	EA	1	IC211
2-C04-029	IC	TC 4093 BP	EA	1	IC207
2-C04-031	IC	TC 4518BP	EA	1	IC208
2-C04-028	IC	TC 5054P	EA	1	IC212
2-C04-006	IC	TL 062DP	EA	2	U1 U3
2-C05-032	IC	TL 081 CP	EA	3	U2 U4 U5
2-C05-065	IC	ULH 2003A	EA	1	IC213
2-C04-016	REGULATOR IC	MC 7912 CT	EA	1	U10
2-C32-059	INDUCTOR	47UH K (LAL03TB470K)	EA	2	L1 L2
2-C43-308	MAIN PCB	9205C-01	EA	1	
2-C18-032	CARBON FILM RESISTOR	1.2K OHM 1/4W J (RD14BY2F122J)	EA	3	R262 R37 R97
2-C11-003	CARBON FILM RESISTOR	1.3K OHM 1/4W J	EA	1	R35
2-C15-053	CARBON FILM RESISTOR	10 OHM 1/2W J	EA	2	R109 R110
2-C10-008	CARBON FILM RESISTOR	10 OHM 1/4W J (RD14BY2E100J)	EA	5	R263 R40 R41 R64 R65
2-C10-022	CARBON FILM RESISTOR	100 OHM 1/4W J (RD14BY2E101J)	EA	6	R105 R107 R108 R116 R62 R63
2-C11-044	CARBON FILM RESISTOR	100K OHM 1/4W J (RD14BY2E104J)	EA	6	R258 R261 R270 R271 R278 R279
2-C11-023	CARBON FILM RESISTOR	10K OHM 1/4W J (RD14BY2E103J)	EA	6	R38 R39 R5 R58 R61
2-C11-024	CARBON FILM RESISTOR	11K OHM 1/4W J (RD14BY2E113J)	EA	1	R49
2-C10-025	CARBON FILM RESISTOR	120 OHM 1/4W J (RD14BY2E121J)	EA	12	R273 R274 R275 R276 R277 R280 R281 R282 R283 R284 R285 R286
2-C18-016	CARBON FILM RESISTOR	130 OHM 1/4W J	EA	2	R57 R60
2-C18-044	CARBON FILM RESISTOR	15K OHM 1/4W J (RD14BY2E153J)	EA	1	R106

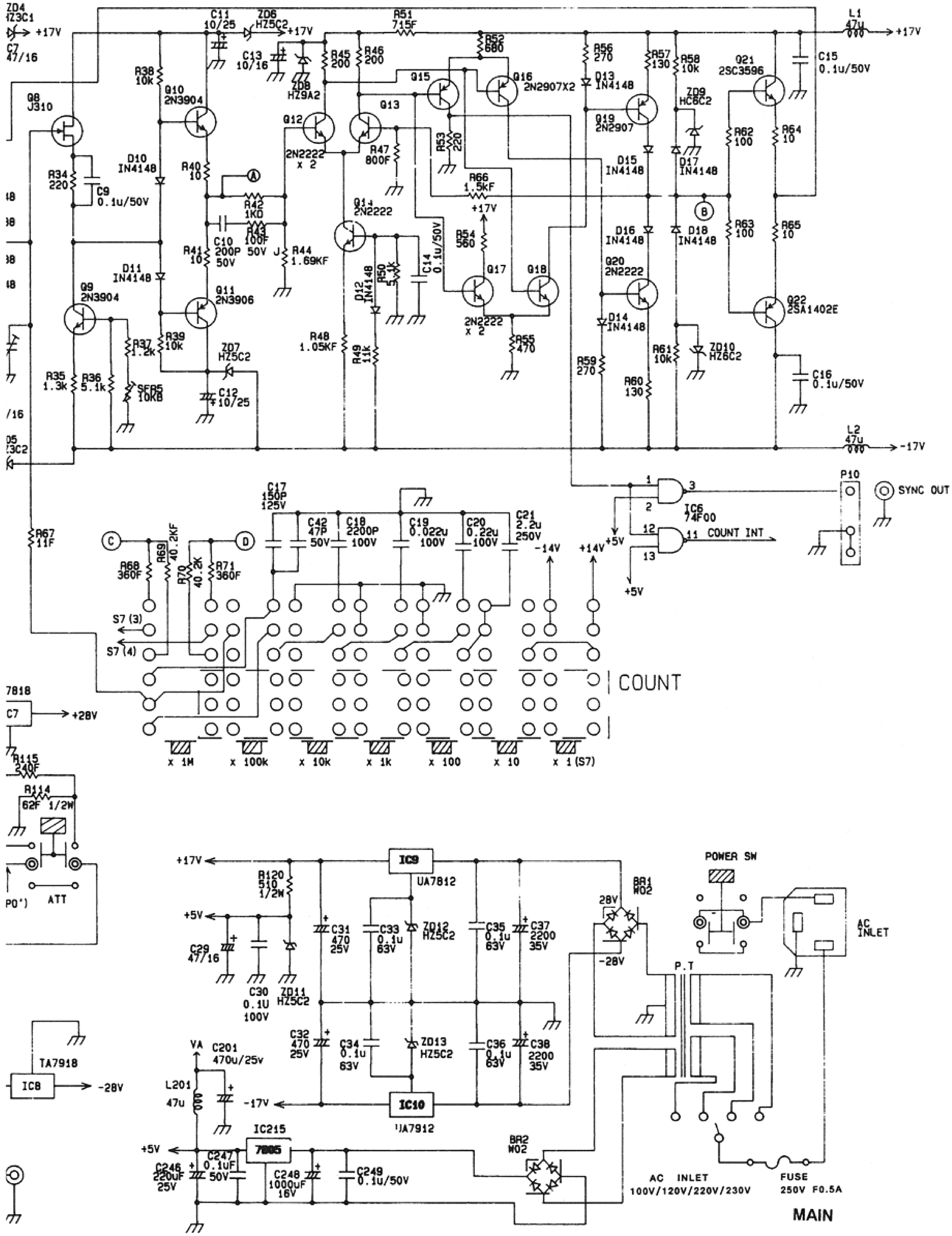
CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C11-027	CARBON FILM RESISTOR	18K OHM 1/4W J (RD14BY2E183J)	EA	2	R101 R122
2-C11-001	CARBON FILM RESISTOR	1K OHM 1/4W J (RD14BY2E102J)	EA	1	R260
2-C18-051	CARBON FILM RESISTOR	1M OHM 1/4W J (RD14BY2E105J)	EA	2	R259 R264
2-C11-007	CARBON FILM RESISTOR	2.2K OHM 1/4W J (RD14BY2E222J)	EA	1	R102
2-C10-028	CARBON FILM RESISTOR	200 OHM 1/4W J (RD14BY2E201J)	EA	2	R45 R46
2-C18-018	CARBON FILM RESISTOR	220 OHM 1/4W J (RD14BY2E221J)	EA	2	R34 R53
2-C11-052	CARBON FILM RESISTOR	220K OHM 1/4W J (RD14BY2E221J)	EA	2	R266 R268
2-C11-029	CARBON FILM RESISTOR	22K OHM 1/4W J (RD14BY2E223J)	EA	2	R121 R6
2-C18-020	CARBON FILM RESISTOR	270 OHM 1/4W J (RD14BY2E271J)	EA	2	R56 R59
2-C11-006	CARBON FILM RESISTOR	2K OHM 1/4W J	EA	3	R103 R119 R17
2-C11-066	CARBON FILM RESISTOR	330K OHM 1/4W J	EA	2	R267 R269
2-C11-032	CARBON FILM RESISTOR	33K OHM 1/4W J (RD14BY2E333J)	EA	1	R2
2-C18-039	CARBON FILM RESISTOR	4.7K OHM 1/4W J (RD14BY2E472J)	EA	1	R265
2-C18-024	CARBON FILM RESISTOR	470 OHM 1/4W J (RD14BY2E471J)	EA	1	R55
2-C11-054	CARBON FILM RESISTOR	470K OHM 1/4W J (RD14BY2H474J)	EA	1	R272
2-C18-040	CARBON FILM RESISTOR	5.1K OHM 1/4W J (RD14BY2E512J)	EA	4	R1 R36 R4 R7
2-C18-009	CARBON FILM RESISTOR	51 OHM 1/4W J	EA	1	R3
2-C18-099	CARBON FILM RESISTOR	510 OHM 1/2W J	EA	1	R120
2-C10-037	CARBON FILM RESISTOR	560 OHM 1/4W J (RD14BY2E561J)	EA	1	R54
2-C18-041	CARBON FILM RESISTOR	6.8K OHM 1/4W J (RD14BY2E682J)	EA	2	R72 R75
2-C10-038	CARBON FILM RESISTOR	680 OHM 1/4W J (RD14BY2E681J)	EA	5	R52 R73 R74 R98 R99
2-C18-029	CARBON FILM RESISTOR	820 OHM 1/4W J (RD14BY2E821J)	EA	2	R8 R9
2-C18-082	METAL FILM RESISTOR	1.05K OHM 1/4W F	PCS	1	R48
2-C13-006	METAL FILM RESISTOR	1.5K OHM 1/4W F (RN14BK2E1501F)	EA	2	R66 R96
2-C18-085	METAL FILM RESISTOR	1.69K OHM 1/4W	EA	1	R44
2-C12-018	METAL FILM RESISTOR	100 OHM 1/4W F (RN14BK2E1000F)	EA	3	R29 R32 R43
2-C18-094	METAL FILM RESISTOR	10K OHM 1/4W F (RN14BK2E1002F)	EA	3	R10 R12 R16
2-C18-052	METAL FILM RESISTOR	11 OHM 1/4W F	EA	1	R67
2-C13-034	METAL FILM RESISTOR	11K OHM 1/4W F	PCS	1	R13
2-C18-060	METAL FILM RESISTOR	120 OHM 1/4W F (RN14BK2E1200F)	EA	2	R25 R26
2-C17-009	METAL FILM RESISTOR	1K OHM 1/4W F (RN14BK2E1001D)	EA	1	R42

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C18-087	METAL FILM RESISTOR	2.04K OHM 1/4W F	EA	1	R22
2-C18-088	METAL FILM RESISTOR	2.1K OHM 1/4W F	EA	1	R20
2-C13-012	METAL FILM RESISTOR	2.2K OHM 1/4W F (RN14BK2E2201F)	EA	3	R28 R31 R84
2-C12-022	METAL FILM RESISTOR	200K OHM 1/4W F (RN14BK2E2000F)	EA	1	R91
2-C18-064	METAL FILM RESISTOR	240K OHM 1/4W F	EA	1	R115
2-C13-062	METAL FILM RESISTOR	27K OHM 1/4W F (RN14BK2E2702F)	EA	1	R11
2-C13-010	METAL FILM RESISTOR	2K OHM 1/4W F (RN14BK2E2001F)	EA	1	R21
2-C18-053	METAL FILM RESISTOR	30 OHM 1/4W F	EA	2	R77 R87
2-C12-030	METAL FILM RESISTOR	360 OHM 1/4W F (RN14BK2E3600F)	EA	2	R68 R71
2-C13-046	METAL FILM RESISTOR	36K OHM 1/4W F (RN14BK2E3602F)	EA	2	R30 R33
2-C19-054	METAL FILM RESISTOR	39 OHM 1/4W F 50PPM	EA	2	R76 R86
2-C12-031	METAL FILM RESISTOR	390 OHM 1/4W F (RN14BK2E3900F)	EA	2	R117 R118
2-C18-090	METAL FILM RESISTOR	4.02K OHM 1/4W F	EA	2	R69 R70
2-C13-058	METAL FILM RESISTOR	4.3K OHM 1/4W F (RN14BK2E4301F)	EA	1	R85
2-C18-055	METAL FILM RESISTOR	42.2 OHM 1/4W F	PCS	1	R104
2-C18-056	METAL FILM RESISTOR	47 OHM 1/4W F (RN14BK2E47R0F)	EA	3	R15 R78 R88
2-C18-071	METAL FILM RESISTOR	470 OHM 1/4W F (RN14BK2E4700F)	EA	4	R24 R82 R94 R95
2-C13-064	METAL FILM RESISTOR	5.1K OHM 1/4W F (RN14BK2E5101F)	EA	3	R18 R19 R50
2-C18-073	METAL FILM RESISTOR	500 OHM 1/4W F	EA	1	R27
2-C18-076	METAL FILM RESISTOR	619 OHM 1/4W F	EA	1	R93
2-C18-180	METAL FILM RESISTOR	62 OHM 1/4W F (MRS)	EA	2	R113 R114
2-C18-093	METAL FILM RESISTOR	7.9K OHM 1/4W F	EA	1	R100
2-C18-077	METAL FILM RESISTOR	715 OHM 1/4W F	EA	1	R51
2-C18-078	METAL FILM RESISTOR	750 OHM 1/4W F (RN14BK2E7500F)	EA	1	R23
2-C18-079	METAL FILM RESISTOR	800 OHM 1/4W F	EA	1	R47
2-C18-058	METAL FILM RESISTOR	82 OHM 1/4W F (RN14BK2E82R0F)	EA	2	R79 R89
2-C18-080	METAL FILM RESISTOR	950 OHM 1/4W F	EA	1	R92
2-C16-144	METAL OXIDE RESISTOR	100 OHM 1W G(ERG1SG101P)	EA	2	R111 R112
2-C39-234	PUCH INTERLOCK SWITCH	9205C (ITT)	EA	1	
2-T19-003	TR	2N 2222A(CAN)	PCS	6	Q12 Q13 Q14 Q17 Q18 Q20

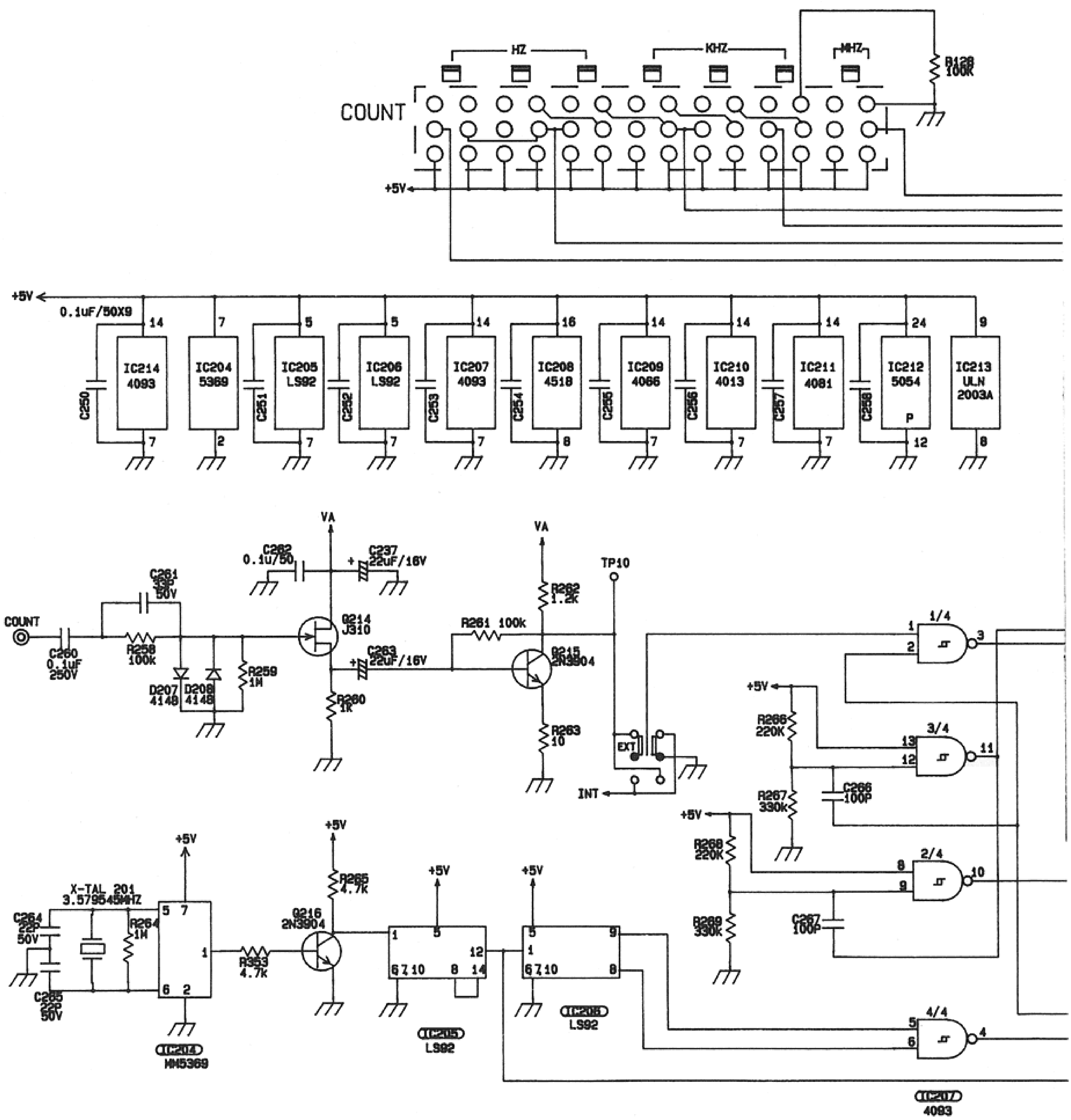
CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C01-002	TR	2N 2907 (PNP)	EA	6	Q15 Q16 Q19
2-C01-012	TR	2N 3904 (NPN TO-92TYPE)	EA	6	Q10 Q2 Q215 Q216 Q23 Q25 Q26 Q28 Q29 Q5 Q9
2-C01-001	TR	2N 3906 (PNP TO-92TYPE)	EA	11	Q1 Q11 Q24 Q27 3 Q30 Q4
2-C01-008	TR	2SA 505-Y	EA	3	Q22 Q32 Q6
2-C06-036	TR	2SC 495-Y	EA	3	Q21 Q31 Q7
2-C29-016	SEMI FIXED RESISTOR	100 OHM B (RH 1051C12J1XA)	EA	1	SER2
2-C29-022	SEMI FIXED RESISTOR	10K OHM B (RH 1051C14J5GA)	EA	4	SER5 SFR6 SFR7 SFR9
2-C29-020	SEMI FIXED RESISTOR	2.2K OHM B (RH 1051CJ3J3WA)	EA	1	SER1
2-C29-017	SEMI FIXED RESISTOR	220 OHM B (RH 1051CJ2J2CA)	EA	1	SER8
2-C29-025	SEMI FIXED RESISTOR	220K OHM B (RH 1051CJ4J30A)	EA	2	SER3 SFR4
2-C21-002	CONNECTOR WAFER	LW 0640-3A	EA	11	P0 P0' P10 P2 P3 P4 P5 P6 P7 P8 P9
2-C21-251	CONNECTOR WAFER	LW 0640-4A	EA	1	
2-C21-005	CONNECTOR WAFER	LW 0640-6A	EA	1	P1
2-C21-056	CONNECTOR WAFER	LW 1145-5A	EA	1	P.T
	FUSE	250V F200mA	EA	2	

6. CIRCUIT DIAGRAM

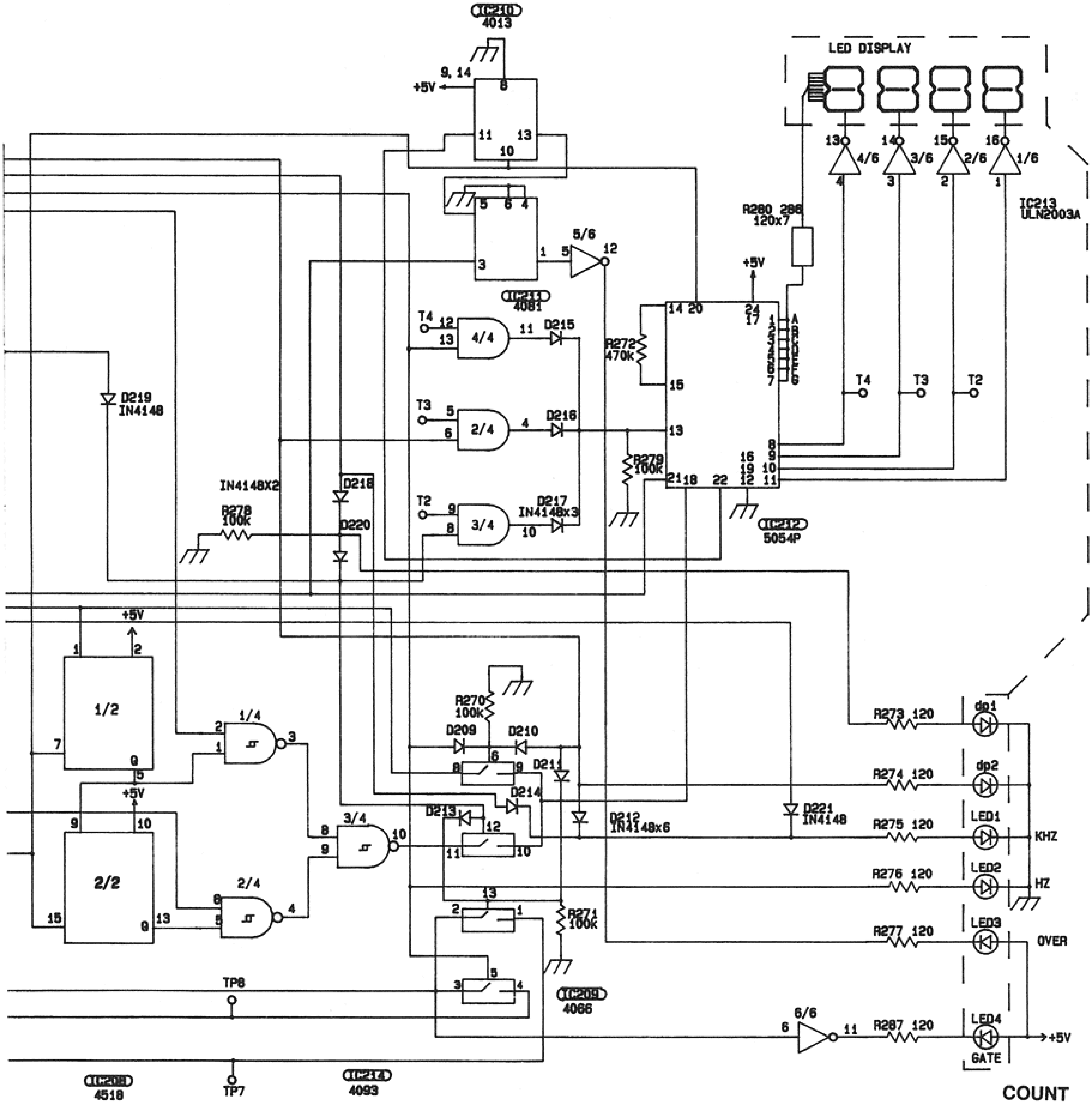




ZD4 HZ3C1
+17V
C7 47/16
C11 10/25
ZD6 HZ5C2
+17V
R51 715F
L1 47u
+17V
C13 10/16
R45 200
R46 200
R52 680
R56 270
R57 130
R58 10k
Q21 2SC3596
C15 0.1u/50V
R38 10k
Q10 2N3904
ZD8 HZ9A2
Q15
Q16 2N2907X2
D13 IN4148
ZD9 HZ6C2
Q8 J310
Q13
Q12
Q19 2N2907
R53 220
R62 100
R64 10
R34 220
C9 0.1u/50V
D10 IN4148
R40 10
A
R42 1KD
R43 100F
2N2222 x 2
R47 800F
D15 IN4148
D17 IN4148
R66 1.5kF
B
C10 200P 50V
50V
Q14 2N2222
+17V
R54 560
R41 10
R44 1.69KF
D16 IN4148
D18 IN4148
R63 100
R65 10
D11 IN4148
C14 0.1u/50V
Q17
Q18
Q20 2N2222
Q9 2N3904
Q11 2N3906
D12 IN4148
R50 5.1K
2N2222 x 2
Q22 2SA1402E
R37 1.2k
R39 10k
R48 1.05KF
R49 11k
R55 470
D14 IN4148
R61 10k
ZD10 HZ6C2
ZD7 HZ5C2
R59 270
C16 0.1u/50V
R35 1.3k
R36 5.1k
SFR5 10KB
C12 10/25
R60 130
/16
D5 HZ3C2
L2 47u
-17V
C17 150P 125V
1
2
3
IC6 74F00
P10
SYNC OUT
C42 47P 50V
C18 2200P 100V
C19 0.022u 100V
C20 0.22u 100V
C21 2.2u 250V
+5V
12
13
11
COUNT INT
R67 11F
C
R69 40.2KF
D
R68 360F
R70 40.2K
R71 360F
-14V
+14V
+5V
S7 (3)
S7 (4)
COUNT
7818
IC7
+28V
R115 240F
R114 62F 1/2W
x 1M
x 100k
x 10k
x 1k
x 100
x 10
x 1 (S7)
PO')
ATT
+17V
IC9
UA7812
R120 510 1/2W
POWER SW
BR1 W02
28V
+5V
C31 470 25V
C33 0.1u 63V
ZD12 HZ5C2
C35 0.1u 63V
C37 2200 35V
AC INLET
C29 47/16
C30 0.1U 100V
ZD11 HZ5C2
-28V
P.T
VA
C201 470u/25v
C32 470 25V
C34 0.1u 63V
ZD13 HZ5C2
C36 0.1u 63V
C38 2200 35V
TA7918
IC8
-28V
L201 47u
-17V
IC10
UA7912
IC215
7805
BR2 W02
+5V
C247 0.1uF 50V
C246 220uF 25V
C248 1000uF 16V
C249 0.1u/50V
AC INLET 100V/120V/220V/230V
FUSE 250V F0.5A
MAIN



HZ
KHZ
MHZ
R128 100K
COUNT
+5V
0.1uF/50X9
IC214 4093
IC204 5369
IC205 LS92
IC206 LS92
IC207 4093
IC208 4518
IC209 4066
IC210 4013
IC211 4081
IC212 5054
IC213 ULN 2003A
C250
C251
C252
C253
C254
C255
C256
C257
C258
VA
C262 0.1u/50
C237 22uF/16V
C261 33P 50V
COUNT
C260 0.1uF 250V
R258 100k
D207 4148
D208 4148
R259 1M
Q214 J310
C263 22uF/16V
R260 1K
R261 100k
R262 1.2K
Q215 2N3904
R263 10
TP10
EXT
INT
1/4
3/4
2/4
4/4
R266 220K
R267 330k
C266 100P
R268 220K
R269 330k
C267 100P
X-TAL 201 3.579545MHZ
C264 22P 50V
C265 22P 50V
R264 1M
IC204 MM5369
Q216 2N3904
R265 4.7K
R353 4.7k
IC205 LS92
IC206 LS92
IC207 4093


IC210
4013
LED DISPLAY
IC213
ULN2003A
R280 286
120x7
IC211
4081
R272
470K
R279
100K
IC212
5054P
D215
D216
D217
IN4148x3
D218
D220
IN4148X2
R278
100K
D219
IN4148
T4
T3
T2
1/2
2/2
1/4
2/4
3/4
4/4
5/6
6/6
R270
100K
D209
D210
D211
D212
IN4148x6
D213
D214
D221
IN4148
R271
100K
IC209
4066
R273 120
R274 120
R275 120
R276 120
R277 120
R287 120
dp1
dp2
LED1
LED2
LED3
LED4
GATE
KHZ
HZ
OVER
+5V
TP8
TP7
IC208
4518
IC214
4093
COUNT