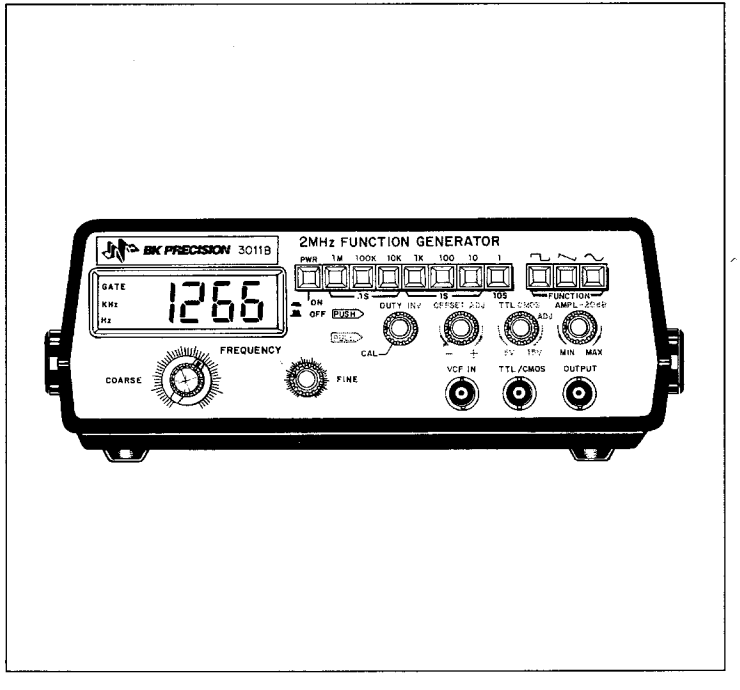
INSTRUCTION MANUAL

BK PRECISION

MODEL 3011B



2 MHz DIGITAL DISPLAY FUNCTION GENERATOR

BK PRECISION®

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must be performed where exposed voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

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. Discharge high-voltage capacitors after removing power.

2. If possible, familarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.

3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet.

4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.

5. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as the on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.

6. Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooded cabinet insulates the chassis to protect

(continued on inside rear cover)

Instruction Manual

for

Model 3011B

2 MHz
DIGITAL DISPLAY
FUNCTION GENERATOR

MAXTEC INTERNATIONAL CORP.
6470 W. Cortland St. • Chicago, IL 60635

TABLE OF CONTENTS

SPECIFICATIONS

(All specifications apply with coarse frequency dial between 0.2 and 2 times range).

Basic Outputs: Sine Wave, Triangle Wave, Square Wave, TTL Pulse, and CMOS Pulse.

Frequency Range: 0.2 Hz to 2 MHz (7 ranges). Four digit frequency counter display.

Frequency Control: Separate coarse and fine tuning controls.

Maximum Amplitude: 20 V p-p (open circuit).
10 V p-p (into 50 Ω load).

Amplitude Control: Continuously variable, 20 dB range typical.

Attenuator: -20 dB ±1 dB.

Output Impedance: 50 Ω ±6%.

DC Offset: Continuously variable, from -10 V to +10 V (open circuit), -5 V to +5 V into 50 Ω.

Duty Cycle Control: Continuously variable from 1:1 to 10:1.

Sine Wave Function:
- Distortion: 0.2 Hz to 20 kHz; ⩽1%, 20 kHz to 200 kHz; ⩽2%.
- Frequency Response: 0.2 Hz to 100 kHz, ⩽0.2 dB, 100 kHz to 2 MHz; ⩽1 dB.

Square Wave Function:
- Symmetry: 0.2 Hz to 100 kHz; ⩽2%.
- Rise Time: ⩽120 ns.

Triangle Wave Linearity: 0.2 Hz to 100 kHz; 98%, 100 kHz to 2 MHz; 95%.

TTL Output:
- Level: ⩾3 V p-p.
- Rise Time: ⩽30 ns.

CMOS Output:
- Level: Continuously adjustable from 4 V p-p (±1 V p-p) to 14.5 V p-p (±0.5 V p-p).
- Rise Time: ⩽120 ns.

VCF (Voltage Controlled Frequency) Input:

Input Voltage:	Approximately +10 V (±1 V) causes 10:1 frequency change.
Impedance:	Approximately 10 kΩ.

Frequency Counter (Internal Only):

Accuracy:	±Time Base Accuracy ±1 Count.
Time Base Accuracy:	±10 PPM (23^{o} C ±5^{o} C).

Power Source: 120/220/240 V AC ±10%, 50/60 Hz.

Weight: 5.5 lb (2.5 kg).

Dimensions (W x H x D): 9.65 x 3.75 x 11", 245 x 95 x 280 mm.

Accessories Supplied:
One cable, BNC to insulated clips.
Power Cord.
Spare Fuse.
Instruction Manual.
Schematic Diagram & Parts List.

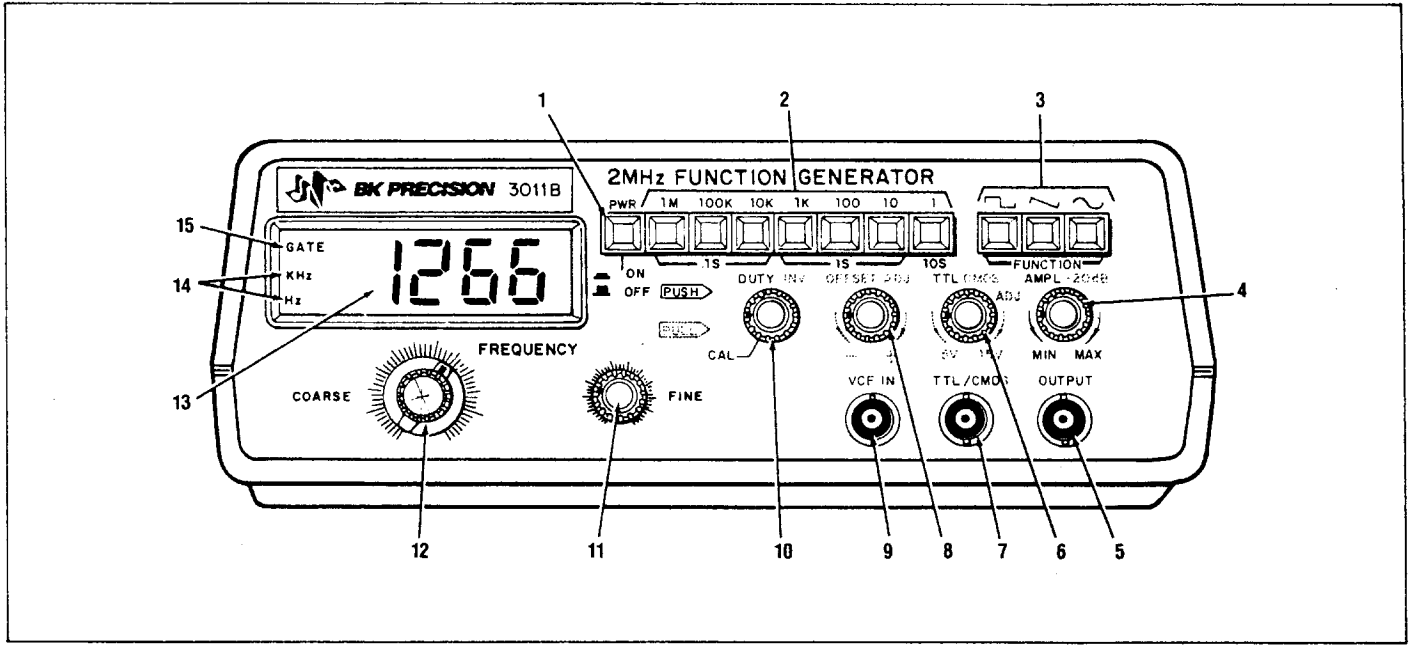


Fig. 1. Controls And Indicators.

1. **PWR Switch.** Turns power on and off.

2. **Range Selectors.** Selects frequency range. Decade frequency type, seven ranges from 1 Hz to 1 MHz. Frequency can be adjusted from 0.2 to 2 times the range selected. For example, if the **100 K** range is selected, frequency can be adjusted (see **Frequency Control**) from 20 kHz to 200 kHz. Numbers under pushbuttons indicate gate time (see **GATE LED**).

3. **Function Selectors.** Selects square, triangle, or sine waveform at **OUTPUT** jack.

4. **AMPL Control.** Controls amplitude of signal at **OUTPUT** jack. When control is pulled out, signal is attenuated 20 dB (PULL -20dB).

5. **OUTPUT Jack.** Waveform selected by **FUNCTION** switches as well as the superimposed DC **OFFSET** voltage is available at this jack.

6. **TTL/CMOS.** When control is pushed in, a TTL signal is present at the **TTL/CMOS** jack. Level is fixed at 3 V p-p and turning control has no effect. When the control is pulled out (PULL CMOS), a CMOS signal is present at the **TTL/CMOS** jack. Turning the control clockwise increases the amplitude and turning the control counterclockwise decreases amplitude (amplitude is adjustable from approximately 4 V p-p to 14.5 V p-p).

7. **TTL/CMOS Jack.** Square wave selected by **TTL/CMOS** control (either TTL or CMOS) is available at this jack. The output is independent of the **AMPL** and **OFFSET** controls.

8. **OFFSET Control.** When control is pushed in, DC offset is set at zero. When control is pulled out (PULL ADJ), clockwise rotation changes DC offset in a positive direction and counterclockwise rotation changes DC offset is a negative direction. Full clockwise rotation gives approximately +5 V into 50 Ω load (+10 V open circuited). Full counterclockwise rotation gives approximately -5 V into 50 Ω load (-10 V open circuit).

9. **VCF IN Jack.** Voltage Controlled Frequency input. Permits external sweep or frequency control. Positive voltage decreases the output frequency.

10. **DUTY Control.** Rotation adjusts the duty cycle of both the main **OUTPUT** signal and the **TTL/CMOS** signal. Fully counterclockwise rotation is the **CAL** position (normal duty cycle). Duty cycle changes when control is rotated away from **CAL** position. When control is pulled out (PULL INV), the square wave at the main **OUTPUT** and the TTL or CMOS signal are inverted.

11. **FINE Frequency Control.** Vernier adjustment of output frequency for ease of setting to a precise frequency.

12. **COARSE Frequency Control.** Coarse adjustment of output frequency (main output and **TTL/CMOS** output) from .2 to 2 times the selected range.

13. **Frequency Counter Display.** Displays frequency of internally generated frequency.

14. **Hz and kHz LED.** Indicates whether display is showing Hz or kHz.

15. **GATE LED.** Indicates when frequency counter display is updated. When the **10 K** through **1 M** frequency switches are selected, the LED will flash 10 times per second (every 0.1 second). When the **10** through **1 K** switches are selected, the LED will flash once each second and when the **1** switch is selected, the LED will light every 10 seconds. As the LED turns off, the display is updated.

FREQUENCY AND WAVEFORM SELECTION

1. With the unit plugged into a power source, depress the **PWR** switch.

2. Select the desired frequency range by depressing the appropriate range switch. The output frequency is displayed, with the appropriate decimal point, on the LED display. The **Hz** or **kHz** indicator is also lit.

3. Rotation of the **COARSE** frequency control will quickly set the output frequency to the approximate desired value. The **FINE** frequency control should then be used to easily set the output to the specific desired value. The frequency selected is available at both the **TTL/CMOS** jack and the **OUTPUT** jack.

4. Select the waveform desired (square, triangle, or sine) by depressing the appropriate **FUNCTION** switch. The phase relationships of the waveforms available are shown in Fig. 2. Be sure that the **DUTY** control is set to **CAL.**

5. The amplitude of the selected output signal at the main **OUTPUT** jack is adjusted with the **AMPL** control. Maximum signal level is 10 V p-p (into 50 Ω), and signal level can be decreased by turning the control counterclockwise, or pulling the control out for an additional 20 dB step of attenuation (PULL -20dB).

6. For information on the TTL and CMOS signals, see the "**TTL/CMOS OUTPUT**" section of this manual.

7. A DC component can be added to the signal at the main **OUTPUT** jack by use of the **OFFSET** control. The DC component introduced is independent of the **AMPL** control and does not apply to the **TTL/CMOS** jack. The level of DC can be varied by ±10 volts open circuited or ±5 volts into 50 Ω.

CONSIDERATIONS

1. The **COARSE** frequency control adjusts from approximately two-tenths to two times the indicated range value. For example, if the **10 K** range is selected and the **COARSE** frequency control is set to the most counterclockwise major line, the output frequency is approximately 2 kHz. When the **COARSE** frequency control is set to the most clockwise major line, the output frequency is approximately 20 kHz. Fig. 3 shows these major lines.

2. It is best not to set the **COARSE** frequency control beyond either the 0.2 or 2 position. Instead, select the next lower or higher range. When the **COARSE** control is set to such a position, erratic operation could occur.

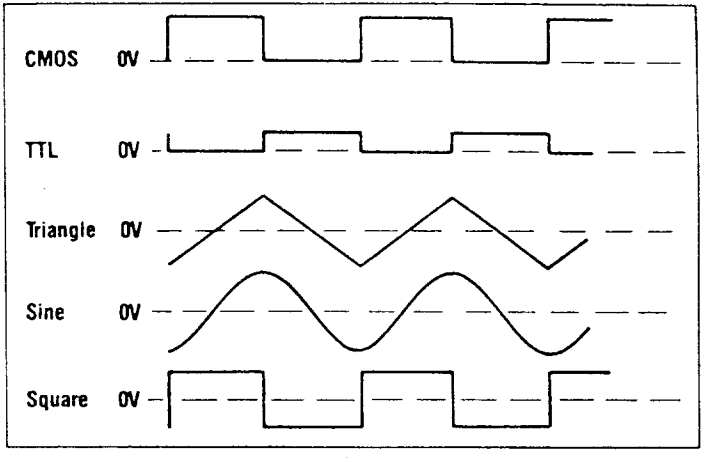


Fig. 2. Output Waveform And Phase Relationship.

3. It is advisable to set the **FINE** frequency control to the approximately center of its range before setting the **COARSE** frequency control. This assures that the **FINE** control will not reach its limit of rotation while trying to finalize the frequency setting.

4. The **FINE** frequency control spans about 10% of the range. This gives a fine tuning capability so that it is easy to set the frequency to a precise value.

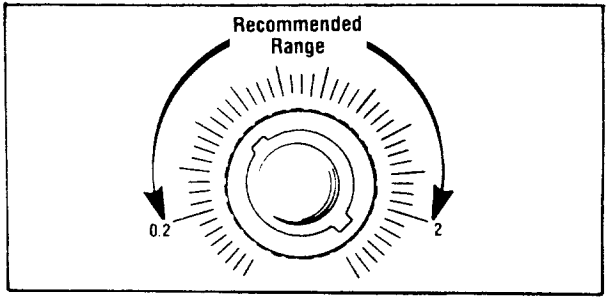


Fig. 3. COARSE Frequency Control.

5. When the 1 **Hz** range is selected, the gate time is 10 seconds. This means that the display is updated once every 10 seconds, and that the resolution is 0.1 second. However, the result of a frequency change may not be displayed until 10 seconds later. Keep adjusting the frequency in progressively smaller steps and waiting for the display update until the desired frequency is obtained.

6. When using the higher output frequencies and when using the square wave output, terminate the cable into 50 Ω to minimize ringing. Also, keep cables as short as possible.

7. Remember that the output signal swing of the generator is limited to ±10 volts open circuited or ±5 volts into

50 Ω. This applies to the combined signal and DC offset. Clipping occurs slightly above these levels. Fig. 4 illustrates the various operating conditions encountered when using the DC offset. If the desired output signal is large or if a large DC offset is required, an oscilloscope should be used to make sure that the desired combination is obtained without undesirable clipping.

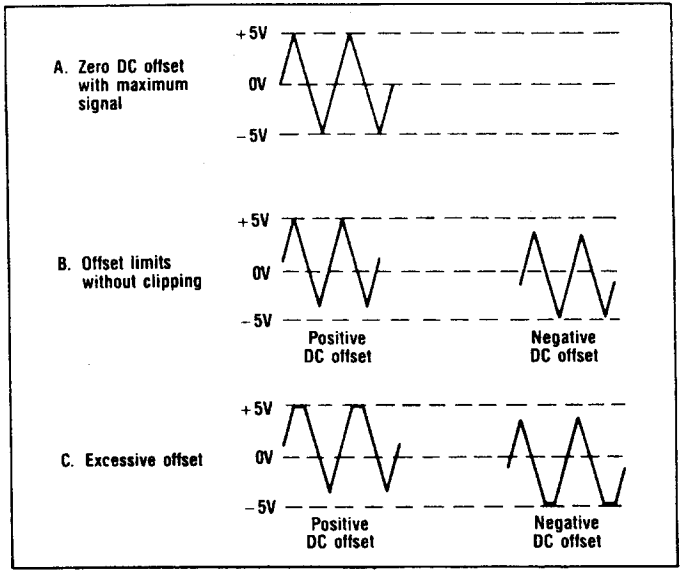


Fig. 4. Use of DC OFFSET Control.

VOLTAGE CONTROLLED FREQUENCY OPERATION

The Model 3011B can be operated as a voltage-controlled oscillator (VCO) by using an external control voltage applied to the **VCF IN** jack. The externally applied voltage will vary the frequency which is preselected by the range switches and the frequency control controls. Applying approximately +10 V will cause the frequency to decrease by about 10 times (a 10:1 ratio).

CAUTION

Do not apply more than ±15 volts (dc or dc + ac peak) to the **VCF IN** jack. Inputs of more than 15 volts will not cause any further shift in the frequency and could cause damage to the Function Generator.

1. Select the desired frequency range and function.
2. Set the DC offset, if required.
3. Set the starting frequency and amplitude to the desired level.

NOTE

Keep the (starting) **COARSE** frequency control between the 0.2 and 2 positions (see Fig. 3).

4. To operate the function generator as a sweep generator, apply a positive going ramp signal to the **VCF IN** jack. As the voltage increases, the frequency decreases. A

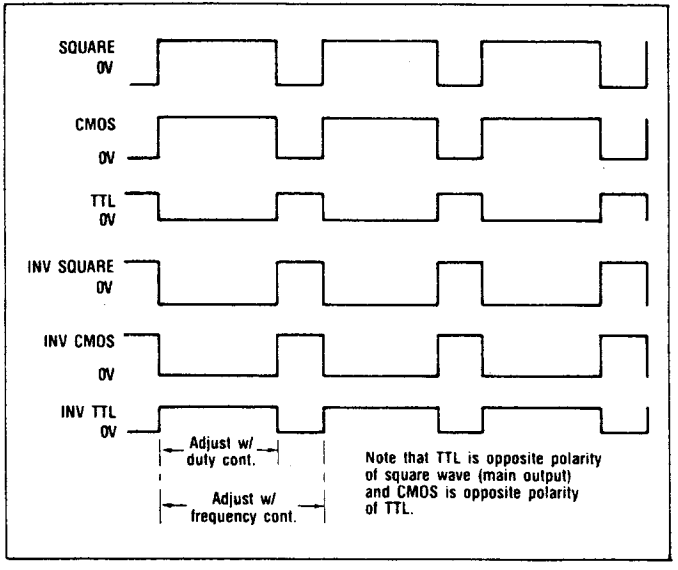


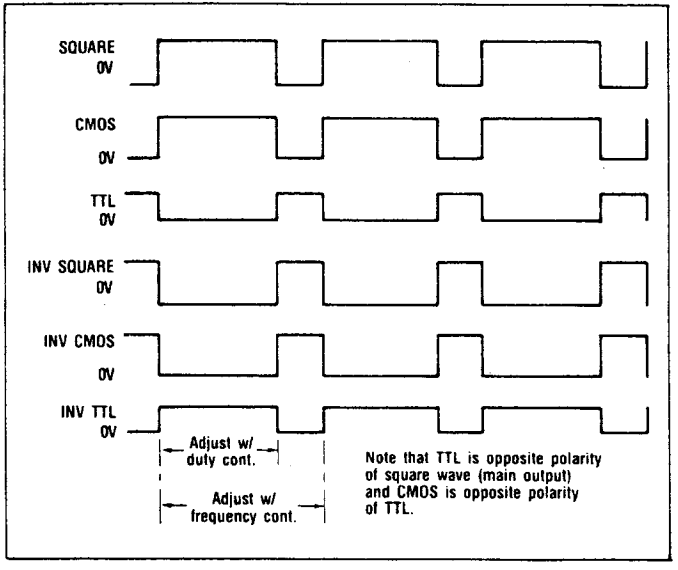
Fig. 5. Effect Of **DUTY** Control On Square Wave, TTL, And CMOS Signal.

3. Adjust the **DUTY** control so that the desired duty cycle is obtained (display on an oscilloscope for set-up if desired).

4. Adjust the frequency of the signal using the **COARSE** and **FINE** frequency controls. The **DUTY** control can be pulled out to cause a negative going pulse (PULL INV) at either the main **OUTPUT** jack (for square wave only) or the **TTL/CMOS** jack (the triangle and sine wave cannot be inverted).

FUNCTION GENERATOR APPLICATIONS GUIDEBOOK

B & K-Precision offers a "Guidebook to Function Generators" which describes numerous applications for this instrument, including hook-up details. It also includes a glossary of function generator terminology and an explanation of function generator circuit operation. It may be obtained free of charge by filling out and mailing the postage paid card enclosed with the Model 3011B.



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OUTPUT PROTECTION CONSIDERATIONS

Use care when connecting the function generator output to a signal injection point. Excessive voltage at the point of signal injection is fed into the function generator and causes internal damage. The TTL output is particularly susceptible to damage from external voltage greater than +6 volts or any negative polarity voltage.

Damage of this type usually occurs by accidentally connecting the output of the function generator to a voltage in the equipment under test. The following protective measures are strongly recommended:

1. The user should understand the equipment under test well enough to identify valid signal injection points (ie; the base of a transistor, a logic input of a gate, etc.). The voltage at valid signal injection points is rarely high enough to damage the instrument.

2. If in doubt about the safety of a signal injection point, measure the voltage present at the intended point of signal injection before connecting the function generator output to that point.

3. When applying the main output of the function generator to a circuit point containing a dc level, adjust the **DC OFFSET** control so that dc level at the main output matches the circuit voltage.

4. Connect the **TTL OUTPUT** only to TTL-level circuits. Connect the **CMOS OUTPUT** only to CMOS circuits. Measure the Vcc of the circuit under test and adjust the **CMOS ADJust** as instructed in the manual.

5. When the function generator is used by students or other inexperienced users, the following circuit could be added into your TTL output probe or test clip set. It will protect the TTL output of the generator against external voltages up to ±20 volts.

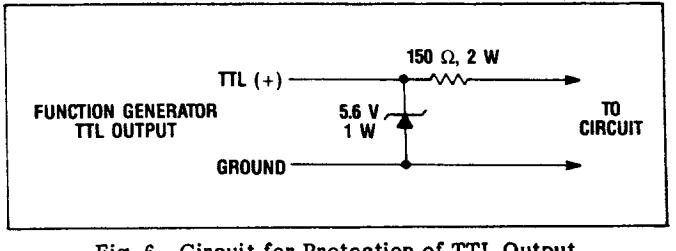

Fig. 6. Circuit for Protection of TTL Output.

WARNING

The following instructions are for use by qualified service personnel only. To avoid electrical shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.

Remember that ac line voltage is present on line voltage input circuits any time the instrument is plugged into an ac outlet, even if turned off. Always unplug the Function Generator before performing service procedures.

DISASSEMBLY AND REASSEMBLY

In order to access the fuse and the line voltage selector, the bottom half of the case must be removed. To remove the bottom of the case:

Disassembly

1. Unplug the Function Generator and turn the unit upside down. Remove the four screws and the rubber foot pads from the bottom of the unit.

2. Lift the bottom section of the case up.

Reassembly

1. Line up the slots in the bottom case half with the front panel and put the two case halves together.

2. Replace the rubber foot pads and screws.

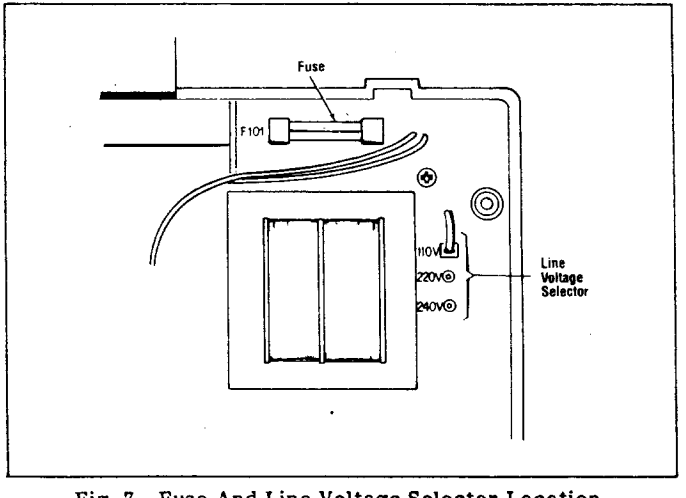

Fig. 7. Fuse And Line Voltage Selector Location.

LINE VOLTAGE SELECTION

1. If the line voltage needs to be changed, disassemble the function generator case (see the **DISASSEMBLY** section above) and unplug the plastic connector by pulling it straight up (see Fig. 7 for location).

2. Align the plastic connector with the desired voltage selector pin and push the plug down over the pin. Be sure that the correct fuse is installed (0.5 A for 110 V operation and 0.3 A for 220 or 240 V operation) in the fuse holder. Reassemble the case.

FUSE REPLACEMENT

1. To replace the fuse, disassemble the case and remove the blown fuse (see Fig. 7 for location).

2. The fuse should not normally open unless a problem has developed with the unit. Try to determine and correct the cause of the blown fuse, then replace only with the correct value fuse (0.5 A for 110 V operation and 0.3 A for 220 or 240 V operation). Reassemble the case.

INSTRUMENT REPAIR SERVICE

Because of the specialized skills and test equipment required for instrument repair and calibration, many customers prefer to rely upon **B & K-Precision** for this service. We maintain a network of **B & K-Precision** authorized service agencies for this purpose. To use this service, even if the instrument is no longer under warranty, follow the instructions given in the WARRANTY SERVICE INSTRUCTIONS portion of this manual. There is a nominal charge for instruments out of warranty.

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the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result from connecting the ground lead of most test instruments to a "hot chassis". To test "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 or 1604 Isolation Transformer, or Model 1653 or 1655 AC Power Supply are suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.

7. On test 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.

8. Never work alone. Someone should always be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.