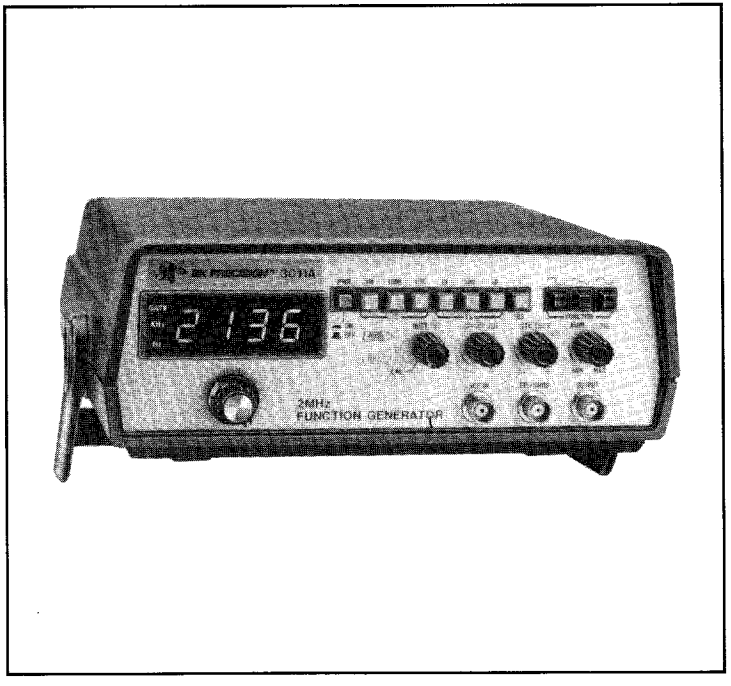
INSTRUCTION MANUAL

BK PRECISION®

MODEL 3011A



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)

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SPECIFICATIONS

(All specifications apply with 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.

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.

SPECIFICATIONS

Frequency Counter (Internal Only):

Accuracy:	±Time Base Accuracy ±1 Count.
Time Base Accuracy:	±10 PPM (23° C ±5° 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.

CONTROLS AND INDICATORS

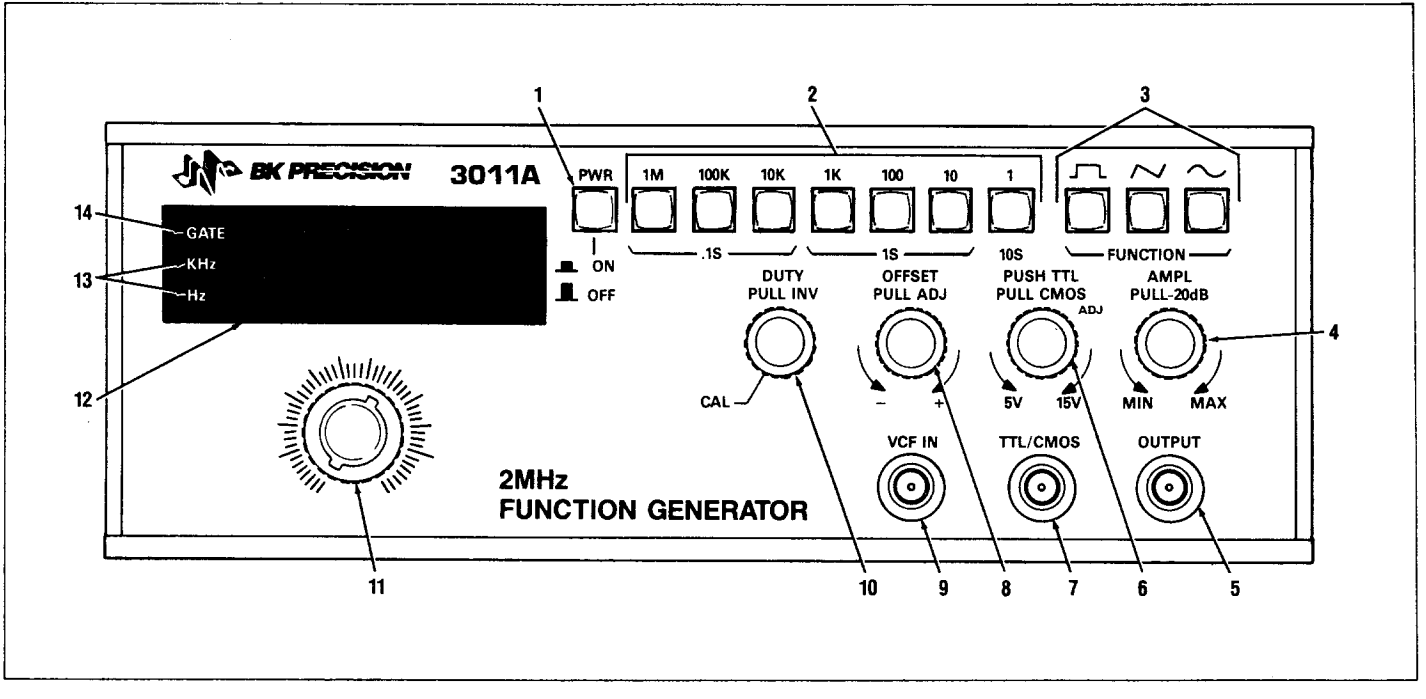


Fig. 1. Controls And Indicators.

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

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

6. **PUSH TTL/PULL 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, 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 **PUSH TTL/PULL CMOS** control (either TTL or CMOS) is available at this jack. The output is independent of the **AMPL/PULL -20 dB** and **OFFSET/PULL ADJ** controls.

8. **OFFSET/PULL ADJ Control.** When control is pushed in, DC offset is set at zero. When control is pulled out, 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/PULL INV Control.** Adjusts the duty cycle of both the main **OUTPUT** signal and the **TTL/CMOS** signal. When control is pulled out, the square wave at the main **OUTPUT** and the TTL or CMOS signal are inverted. Fully counterclockwise rotation is the **CAL** position (normal duty cycle). Duty cycle changes when control is rotated away from **CAL** position.

11. **Frequency Control.** This control adjusts the frequency of the main output (square, triangle, or sine wave) and the **TTL/CMOS** output from approximately 0.2 to 2 times the selected range. The last major line in the counterclockwise position is the 0.2 position and the last major line in the clockwise position is the 2 position.

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

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

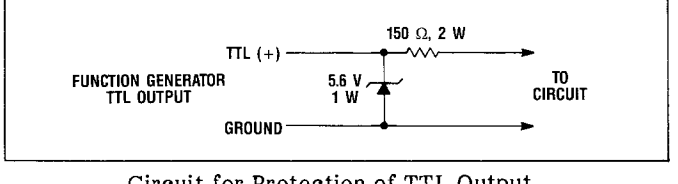
14. **GATE LED.** Indicates when frequency counter display is updated. When the **10 K** through **1 M** frequency switches are selected, the LED will flash 10 times per second (every 0.1 second). When the **10** through **1 K** switches are selected, the LED will flash once each second and when the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

OUTPUT PROTECTION CONSIDERATIONS

Use care when connecting any function generator output to a signal injection point. Excessive voltage at the point of signal injection can be reflected into the function generator circuitry causing internal damage. The TTL output is particularly susceptible to damage from externally applied 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 across a voltage in the equipment under test. To be completely safe, adherence to the following protective measures is 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 across valid signal injection points rarely is high enough to damage the instrument.
2. If in doubt about the safety of a signal injection point, measure the in-circuit voltage present at the point of signal injection before connecting a function generator output to the circuit, ascertaining whether it is safe to connect the generator to the circuit.
3. When using the main output of the function generator and connection across a circuit point containing a dc level is unavoidable, adjust the **DC OFFSET** control on the generator to match the existing circuit voltage.
4. Connect the **TTL OUTPUT** only to TTL-level circuits. Connect the **CMOS OUTPUT** only to CMOS circuits (Model 3011A). Measure the Vcc of the circuit under test and adjust the **CMOS ADJust** as instructed in the manual.
5. When 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.



Circuit for Protection of TTL Output.

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. Turning the frequency dial will vary the output frequency from approximately two-tenths the indicated range value (selected with the range switches) to two times the value. For example, if the **10 K** range is selected, when the frequency dial is set to the counterclockwise most major line, the output frequency will be approximately 2 kHz. When the frequency dial is set to the clockwise most major line, the output frequency will be approximately 20 kHz. Fig. 3 shows these major lines. The frequency selected is available at both the **TTL/CMOS** jack and the **OUTPUT** jack.

NOTE

A. It is best not to set the frequency dial beyond either the 0.2 or 2 (times frequency range) position. Instead, select the next lower or higher range. When the frequency dial is set to such a position, erratic operation could occur.

B. When the **1 Hz** range is selected, the gate time is 10 seconds. This means that the display is only updated once every 10 seconds. Because of this long gate time, the frequency dial must be adjusted very slowly. Each time that the display is updated, the dial can be adjusted a little bit further toward the desired value.

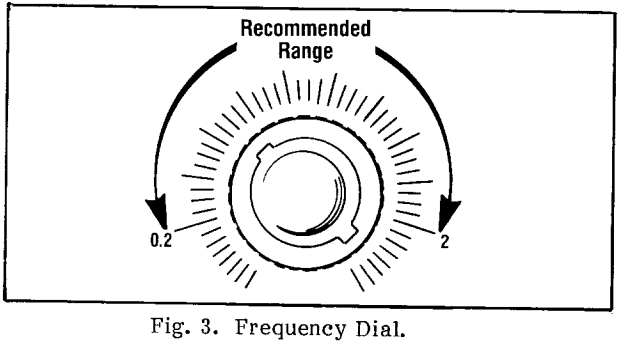


Fig. 3. Frequency Dial.

3. 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. 4. Be sure that the **DUTY** control is set to **CAL.**

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

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

6. A DC component can be added to the signal at the main **OUTPUT** jack by use of the **OFFSET/PULL ADJ** control. The DC component introduced is independent of the **AMPL/PULL -20 dB** 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.

NOTE

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. 5 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.

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.

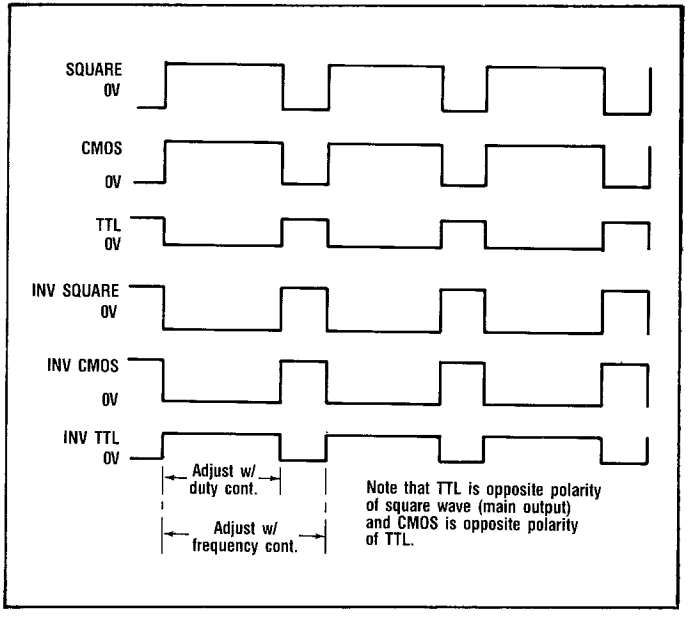


Fig. 4. Output Waveform And Phase Relationship.

DC OUTPUT

The DC **OFFSET** feature allows this Function Generator to be used as a bipolar DC power supply with an internal impedance of about 50 Ω.

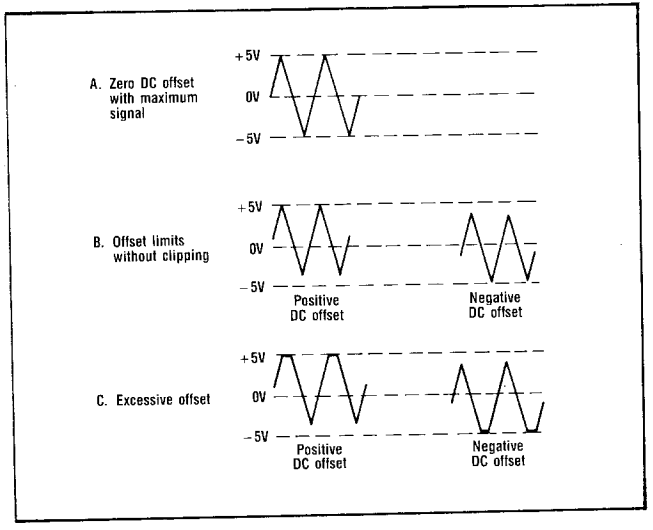


Fig. 5. Use of DC OFFSET Control.

1. Depress the **FUNCTION** switches slightly so that all the switches are released (all buttons out) and turn the **AMPL/PULL -20 dB** control fully counterclockwise (to **MIN**). This removes the signal component from the output.

NOTE

Do not pull the **AMPL/PULL -20 dB** control out. This will attenuate the DC **OFFSET** by 20 dB.

2. The output now consists of a DC voltage which can be varied continuously from -10 volts to +10 volts (open circuit) by use of the DC **OFFSET** control.

VOLTAGE CONTROLLED FREQUENCY OPERATION

The Model 3011A 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 dial. 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 occur 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) frequency control dial 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 ramp that goes from 0 to +10 V will cause the frequency to decrease by a factor of 10 (i.e., if the starting frequency is 10 kHz, when the ramp reaches +10 V, the output frequency will be 1 kHz). The rate of sweep can be adjusted by varying the frequency of the ramp signal.

5. Specific frequencies can be selected by applying a fixed dc voltage to the **VCF IN** jack or the frequencies can be stepped by applying a stepped dc voltage.

TTL/CMOS OUTPUT

The **TTL/CMOS** output jack provides a fast rise time square wave output (no triangle or sine output available). Either a fixed 3 V p-p TTL or a variable (approximately 4 V p-p to 14.5 V p-p) CMOS output are available. The output pulses always go positive with respect to ground. This signal can be used as an external sync pulse for oscillscopes or as a variable frequency signal source for exercising logic circuits.

NOTE

Because of the fast rise time of this output, cable length should be minimized to limit ringing and overshoot.

1. Select the desired frequency range and adjust the frequency dial as required. The **AMPL/PULL -20 dB** and **OFFSET/PULL ADJ** control have no effect on the signal at the **TTL/CMOS** jack.

2. Select a TTL signal by pushing in the **PUSH TTL/PULL CMOS** control. Select a CMOS signal by pulling out the **PUSH TTL/PULL CMOS** control and adjust the level of the CMOS signal by rotating the control (the TTL level is fixed).

DUTY CYCLE CONTROL

The Model 3011A Function Generator has a variable duty cycle control to provide ramps (sawtooth) or pulses. The duty cycle control effects both the main **OUTPUT** and the **TTL/CMOS** output. If a standard square, triangle, or sine waveform are desired (normal duty cycle) the **DUTY** control should be set to **CAL** (fully counterclockwise). Fig. 5 illustrates the function of the **DUTY/PULL INV** control.

NOTE

As the **DUTY** cycle is changed, the frequency will decrease. Be sure to set the desired frequency after the **DUTY** cycle has been adjusted.

1. Select the desired function (either square or triangle wave if the main **OUTPUT** is to be used or TTL or CMOS if the **TTL/CMOS** output is to be used) and frequency range.

2. Adjust the amplitude and DC offset if the main **OUTPUT** is to be used or adjust the CMOS level if a CMOS signal is to be used (the TTL has a fixed level).

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

4. Adjust the frequency of the signal using the frequency control dial. The **DUTY/PULL INV** control can be

pulled out to cause a negative going pulse at either the main **OUTPUT** jack (for square wave only) or the **TTL/CMOS** jack (the triangle and sine wave cannot be inverted).

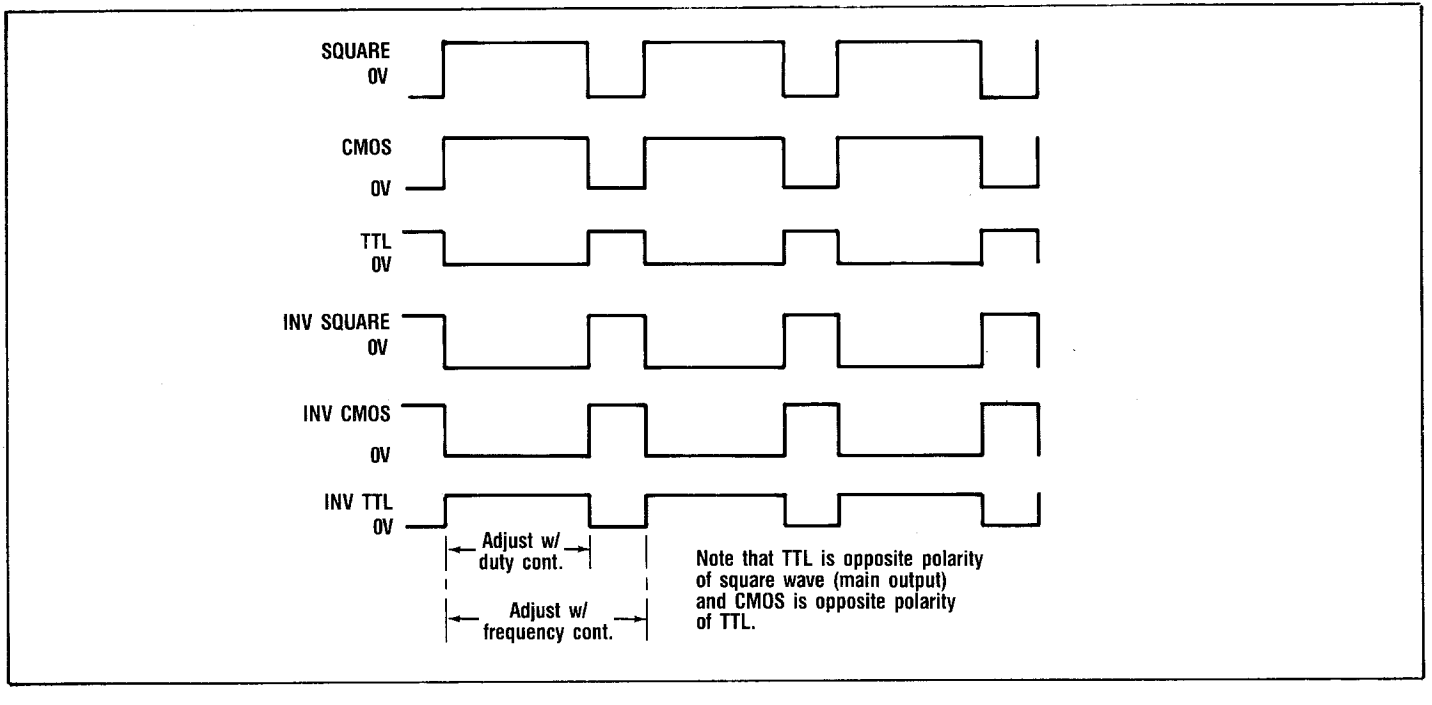


Fig. 6. Effect Of **DUTY/PULL INV** Control On Square Wave, TTL, And CMOS Signal.

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.

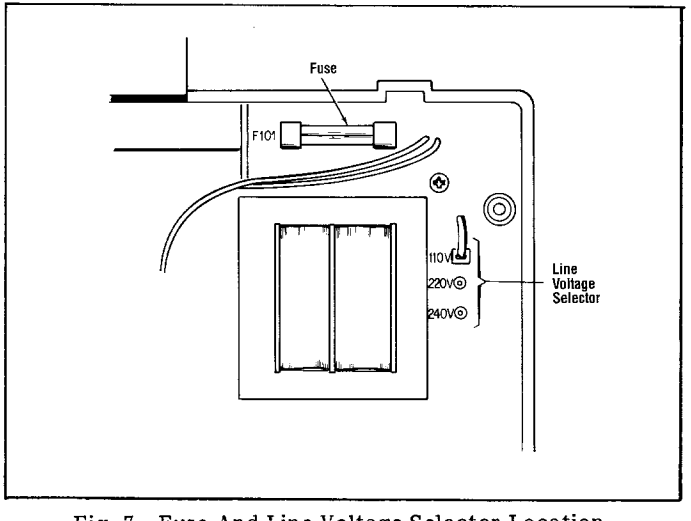


Fig. 7. Fuse And Line Voltage Selector Location.

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.

WARRANTY SERVICE INSTRUCTIONS
(For U.S.A. and its Overseas Territories)

To send in your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred in U.S.A.) to the nearest **B & K-Precision** authorized service agency (see list enclosed with unit).

If your list of authorized **B & K-Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write to:

B & K-Precision, Factory Service Department
Maxtec International Corporation
6470 West Cortland Street
Chicago, Illinois 60635
Tel (312) 889-1448

Also use this address for technical inquiries
and replacement parts orders.

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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.