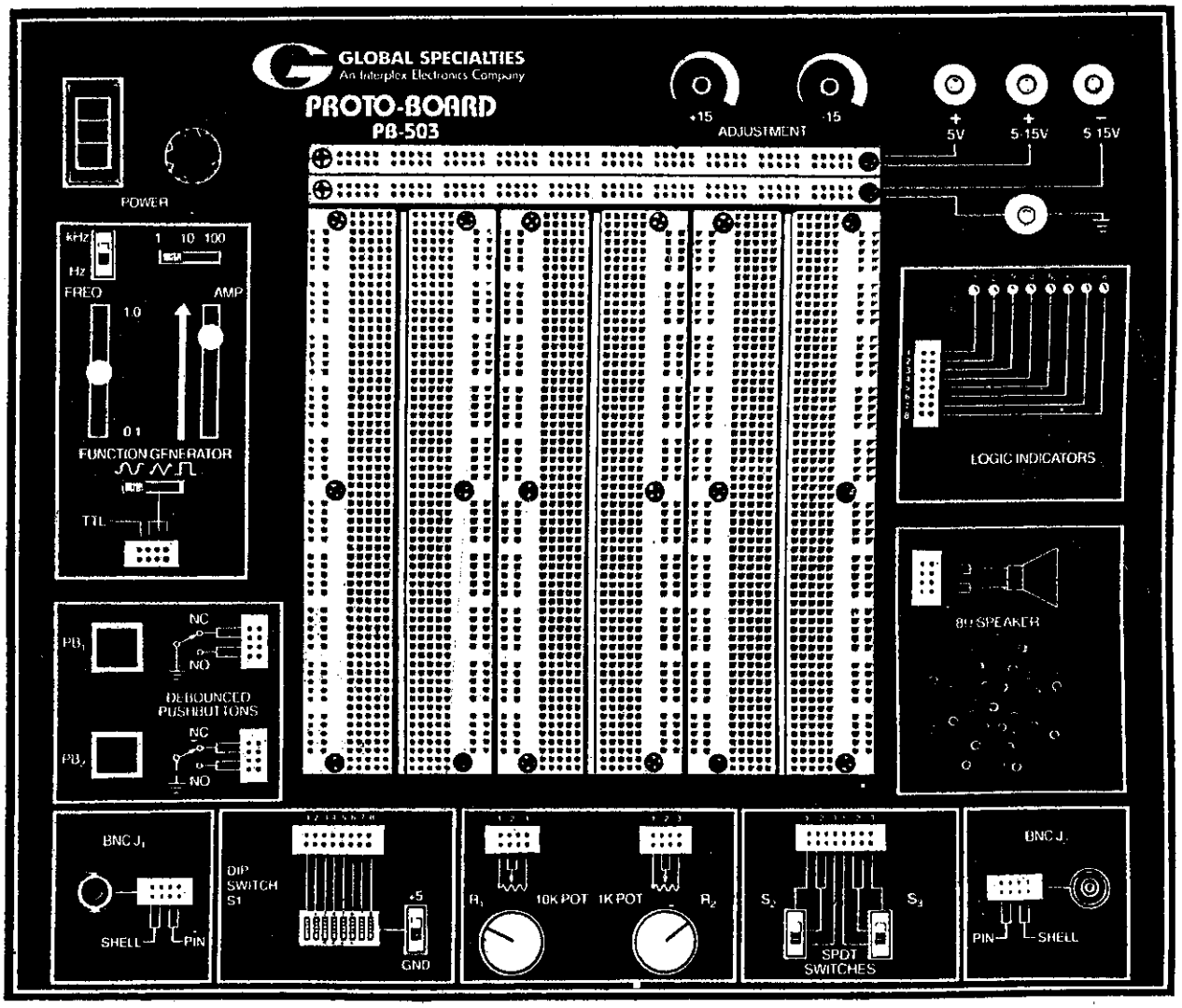
PB-503
ANALOG/DIGITAL
PROTO-BOARD®

Instruction Manual



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WARNING

FEDERAL REGULATION (PART 15 OF FCC RULES) PROHIBITS THE USE OF COMPUTING EQUIPMENT WHICH CREATES RADIO OR TV INTERFERENCE

Interplex Electronics specifically warns the user of this instrument that it is intended for use in a classroom or laboratory environment for the purpose of learning and experimentation. When building experimental circuits, it may emit interference that will affect radio and television reception and the user may be required to stop operation until the interference problem is corrected. Home use of this equipment is discouraged since the likelihood of interference is increased by the close proximity of neighbors.

CORRECTIVE MEASURES:

Interference can be reduced by the following practices.

1) Install a commercially built RFI power filter in the power line at the point where the cord enters the unit.

2) Avoid long wires. They act as antennas.

3) If long wires must be used, use shielded cables or twisted pairs which are properly grounded and terminated.

CAUTION :

FOR CONTINUED PROTECTION AGAINST FIRE, REPLACE ONLY WITH FUSE OF SPECIFIED VOLTAGE AND CURRENT RATINGS.

115VAC - 1/2Amp., 250V Slow Blow Fuse
230VAC - 1/4Amp., 250V Slow Blow Fuse

ABOUT GLOBAL SPECIALTIES®

Thank-you for selecting a GLOBAL SPECIALTIES® product. You won't be disappointed! Because we've never strayed from the original founders' simple idea, lower the high cost of electronic design and testing. Over the years, we've offered you electronic testing and prototyping equipment that was engineered for the professional, but economically priced. The "best for less", never compromising quality in order to give you, our customer, a real value.

The way we accomplish our goal is by cutting the industry giants down to size. Most test equipment comes with excess features that you don't want, but have to pay for anyway. We eliminate these high cost features, lower the price, but not the performance. The result is smarter tools for the value minded user.

We pioneered the breadboarding industry allowing you to create circuits as fast as you can think. Our breadboards are constructed to last. We use high impact plastic and nickel silver contacts, plus "Made in U.S.A." quality and an unconditional lifetime guarantee. Our logic probes offer speeds and storage capabilities only equaled by the fastest oscilloscopes. When it comes to frequency counters we offer you far more performance for far less money. Handheld or benchtop, frequency counters or universal counter-timers, whatever your application you can count on us. Our complete family of bench-top instruments offers you features and performance unequaled, dollar for dollar.

In our endeavor to continually strive for the "best for less" we never lose sight of the future. We are always searching for ways to improve our existing products and design new products using the latest technology. We do this by asking you, our customers, what your needs are, and what your likes and dislikes are. Feel free to contact us by phone, mail or fax with your comments. Tell us how we can put Global to work for you.

In closing, we at GLOBAL SPECIALTIES® would like to express our appreciation to our many loyal customers. We pledge to not rest on our laurels nor will we forget our main objective, to supply the "best for less".

TABLE OF CONTENTS

SPECIFICATIONS

POWER
3-wire AC line input (117 V, 60 Hz typical) with power on indicator.
Fixed DC output: +5 V @ 1.0 A, ripple <5 mV.
Variable DC output: +5 V to +15 V @ 0.5 A, ripple <5 mV.
Variable DC output: -5 V to -15 V @ 0.5 A, ripple <5 mV.

FUNCTION GENERATOR
Frequency range: 0.1 Hz to 100 kHz in six ranges.
Output voltage: 0 to ±10 V (20 Vp-p).
Output impedance: 600 ohms (except TTL).
Output current: 10 mA maximum, short circuit protected.
Output waveforms: sine, square, triangle, TTL.
Sine wave: distortion <3% (10 Hz to 100 kHz).
TTL pulse: rise and fall time <25 nS.
drive 10 TTL loads.
Square wave: rise and fall time <1.5 μS

LOGIC INDICATORS
8 LED's, active high, 1.4 volt (nominal) threshold, inputs protected to ±20 volts.

DEBOUNCED PUSHBUTTONS (PULSERS)
Two pushbutton-operated, open-collector output pulsers, each with one normally-open, one normally-closed output. Each output can sink up to 250 mA.

POTENTIOMETERS
One 1 K ohm, one 10 K ohm, all leads available and uncommitted.

BNC CONNECTORS
Two BNC connectors, pin available and uncommitted, shell connected to ground.

SWITCHES
Two SPDT slide switches, all leads available and uncommitted. 8-pole DIP switch: one side of all eight switches connected and switchable to +5 V or ground, other side of all eight switches separate, available, and uncommitted.

SPEAKER
0.25 W, 8 ohms

BREADBOARDING AREA
Three UBS-100 sockets with 840 tie-points each for a total of 2520 uncommitted tie-points. Two QT-59B Bus strips internally connected to power and ground. Fifty tie-points each for +5 V, +15 V, -15 V and ground.

ENCLOSURE
High impact metal case.

WEIGHT
5 lbs. 14 oz. (2.66kg)

OVERALL DIMENSIONS
6½ x 16 x 11½ inches H x W x D
(16.5 x 41 x 29 cm)

INTRODUCTION

The PB-503 Analog/Digital Proto-Board® is a versatile, time-saving tool for circuit designers, engineering technicians, students, and hobbyists. A large breadboard area and a wide choice of built-in circuit accessories allow rapid and accurate construction of virtually any type of analog or digital circuit.

Circuit power is provided by three power supplies, two variable and one fixed. The circuit breadboard area includes over 2500 contact points. A multiple-waveform function generator supplies sine, triangle, and square wave output for analog circuits. A built-in speaker may be used for analog output.

Outputs include a TTL-level square wave generator, two debounced pushbutton switches, and a bank of eight DIP switches. Eight LEDs may be used as indicators.

Two built-in potentiometers and two SPDT switches are provided for circuit control and adjustment. Connections to external test equipment or signal sources may be made using two BNC connectors on the PB-503.

The PB-503 eliminates the clutter and confusion that often results when constructing sophisticated circuits. Alligator clips and similar connectors are seldom needed. Sockets on the PB-503 allow insertion of components or wires of up to 20 gauge.

A detailed panel layout and description of the PB-503 is given in the section "Description of Individual Features."

DESCRIPTION OF INDIVIDUAL FEATURES

In order to properly use the full capabilities of the PB-503, it is highly recommended that the user become familiar with the panel layout and the features of the Proto-Board components. (See Figure 1)

Power

By combining the three DC power supplies On the PB-503, the user may work with virtually any type of integrated circuit or discrete component. The fixed 5 volt supply has become an industry standard for powering digital IC's. IC's which require +5 V, +12 V, and —5 V are easily accommodated by the PB-503. The variable supply output voltages may be changed by using the screwdriver adjustment on the front panel. The positive and negative outputs are continuously variable from +5 to +15 volts and —5 to —15 volts respectively. Both variable supply outputs are referenced to circuit common. This creates a split supply which is often used with differential and operational amplifiers (op amps). The adjustments are recessed to prevent inadvertent voltage changes which could be destructive to a circuit.

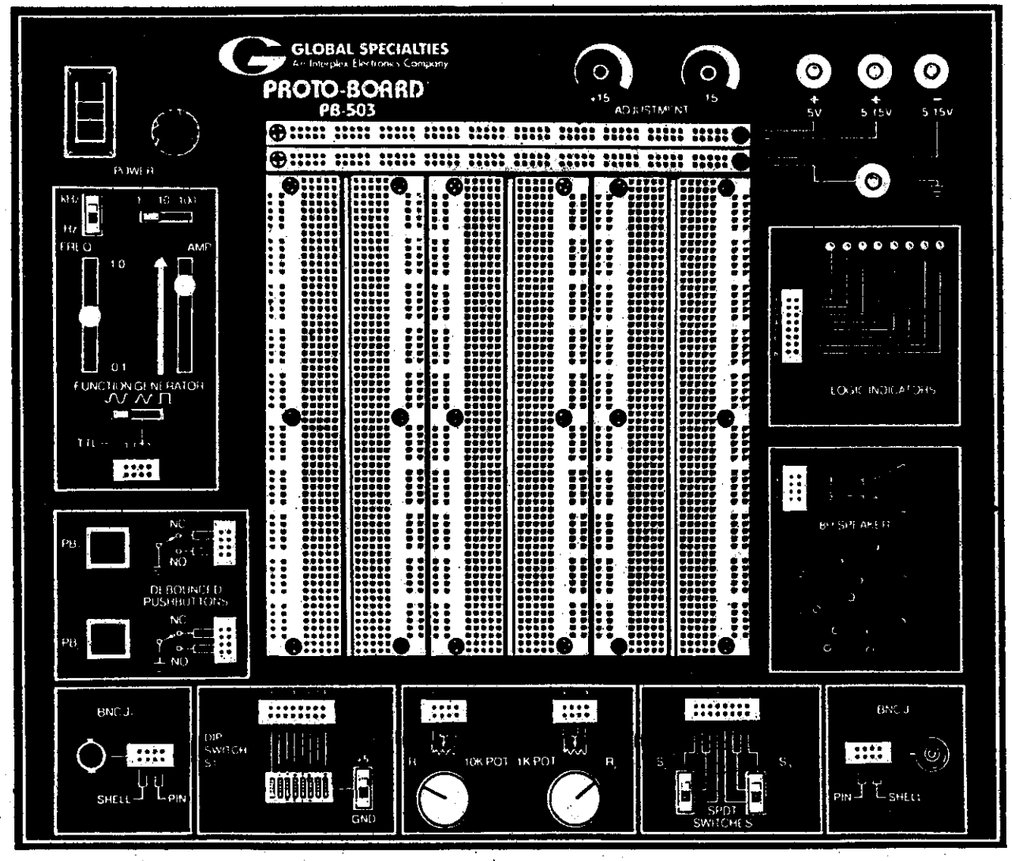


FIGURE 1. PB-503 panel layout

Function Generator

The multi-waveform function generator provides continuously variable frequency signals from 0.1 Hz (for extra-low frequency work) to radio frequency signals of 100 kHz. The frequency is selected in six ranges, with each range covering one decade. The sine wave output is factory adjusted for minimum distortion. The triangle waveform is adjusted for best linearity. The standard square wave and TTL level output are both set at a 50% duty cycle. The TTL output can drive up to 10 TTL loads. The low output impedance of the sine, square, and triangle waveforms (600 ohms) assures maximum coupling of the output signal to the device being driven. A maximum output current of 10 mA with short circuit protection provides adequate drive capability for virtually any circuitry.

Logic Indicators

A bank of eight LEDs is provided for use as built-in logic indicators. The buffered LEDs are active-high, requiring 1.4 volts (nominally) to light and indicate a "logic one" condition. Each LED input is protected to a maximum of ±20 volts.

Debounced Pushbuttons (Pulsers)

The PB-503 uses clocked flip-flops to provide debounced pushbutton switch functions. The push-button circuitry has open-collector outputs which can sink up to 250 mA each. This type of debouncing gives the user a sharp, glitch-free trigger source which assures reliable operation in digital circuits. Each pushbutton has a normally-open and a normally-closed output. If necessary, a pull-up resistor can connect any pulser output to any of the positive voltage sources.

Potentiometers

Two potentiometers are provided on the PB-503. The resistance values chosen (1 K and 10 K ohms) may be used in common circuit applications such as volume controls, DC offset controls for op amps, and timing circuit controls. All leads for both potentiometers are available and uncommitted.

BNC Connectors

The PB-503 may be connected to other pieces of equipment via two BNC connectors. This allows the use of shielded cable to minimize noise and interference.

Switches

Two single pole, double throw (SPDT) switches are provided for general switching functions. All leads are available and clearly marked on the PB-503 for easy connection. An eight-pole DIP switch provides a convenient source of digital outputs. All eight switches have one side connected to a common lead which may be switched to either +5 volts or ground. The remaining sides of all eight switches are separate, available, and uncommitted. This arrangement makes connecting special digital circuitry such as an eight-bit input port quick and easy.

CHECKING OUT THE PB-503

The PB-503 may be checked out for proper operation by making a few simple measurements and connections. Begin by connecting the AC line cord to a suitable receptacle. The POWER Indicator should light when the POWER switch is turned on.

If a DC voltmeter is available, check for +5 volts between the ground terminal and the +5 volt terminal. Repeat the measurement for the positive (+) variable supply terminal and the negative(-) variable supply terminal. Check the variability of each supply by turning the appropriate adjusting screw. If a voltmeter is not available, a quick test of the +5 volt supply may be made by connecting a wire between the +5 volt terminal and one of the LED logic indicator inputs. If the LED lights, the power supply system should be working properly.

Each logic indicator LED may be tested by connecting its input to the +5 volt terminal, If the LED lights, it is operating properly.

The function generator may be tested by connecting its output to one of the speaker inputs. Connect the other speaker input to the ground terminal (or one of the connectors on the ground bus strip). Switch the function generator to the 1 kHz position and move the frequency control all the way to the top. Move the amplitude control upward until you hear a tone coming from the speaker. Switch the waveform selector to select sine, square, triangle, and TTL. A changing but clearly audible tone should be heard in each position. Changing the position of the frequency control should vary the pitch of the tone.

If an oscilloscope is available, you may check the function generator for proper waveform and frequency using standard measurement techniques.

The debounced pushbuttons can be checked by connecting one side of a resistor (20 ohms, to 100 K) to +5 volts and the other side to PB1 -1, the NC point. Then connect PB1.-1 to LED-1. The LED should light when PB1 is pressed and extinguish when PB1 is released. Next, move the connections from PB1-1 to PB1-2, the NO point. Now the LED should be lit when PB1 is not pressed, and go out when PB1 is pressed. Repeat these steps to test PB2.

DIP switch S1 may be tested by connecting one side of a resistor (1 K, to 100 K) to +5 volts and the other side to S1 -1. Then connect S1 -1 to LED-1 and switch the 5 V/GND switch to the GND position. Now, when the S1-1 is pushed up to the open position LED-1 will light, and when the S1-1 is brought back to the closed position the LED will extinguish. Next, remove the side of the resistor connected to +5 volts and connect it to ground. Switch the 5 V/GND switch to the 5 V position and observe that LED-1 is extinguished when S1 -1 is open and lit when S1 -1 is closed. Repeat these steps for S1 -2 through S1 -8 to. verify the operation of the rest of the switches.

By using an ohmmeter, the potentiometers can be checked as follows:

Select an appropriate range for measuring 10 K and connect the ohmmeter leads to R1 -1 and R1 -2. With R1 rotated fully counterclockwise a reading of zero ohms should be observed. As the potentiometer is rotated clockwise, the resistance reading will be seen to increase linearly up to 10 K ±20%. Now move the ohmmeter lead from R1-1 to R1-3; with R1 fully clockwise the ohmmeter will read zero ohms, and the resistance will increase linearly to the full value noted previously as the potentiometer is rotated counterclockwise. Select an ohmmeter range appropriate for 1 K and repeat these steps on R2 to verify its function.

To test SPDT switch S2, put S2 in the up position and connect an ohmmeter to S2-1 and S2-2. The ohmmeter should read zero ohms. When the switch is brought to the down position, an open circuit should be indicated. Move the ohmmeter lead from S2-1 to S2-3 and observe a short circuit with S2 down, and an open with S2 up. These steps can be repeated on S3 to test its functions.

BREADBOARDING TECHNIQUES

This section contains information which may prove useful when constructing circuits using the PB-503. While there are no hard and fast rules for breadboarding, the following tips may save time and trouble.

Unless a circuit is being prepared for a demonstration or display, avoid cutting component leads very short. While short wires and leads may look neat, the clipped components will only fit into a limited "span" of connector sockets, limiting the use of the component. It is perfectly permissable to use untrimmed components while exploring different circuit possibilities. The only time short leads may be necessary is when operating at higher frequencies and experiencing mysterious malfunctions. Sometimes the only way to correct high frequency circuit problems is to shorten all circuit connections.

Be cautious when using components which have been removed from a tape reel used in automatic insertion equipment. Suppliers of surplus components often sell components which are taped together in small batches. Removing the components from the tape does not always remove the adhesive from the leads of the components. Placing a formerly taped component into a socket connector may result in a poor electrical connection and, worse still, leave tape adhesive in the socket. Avoid this problem by either carefully cleaning taped component leads, clipping the taped portion of the lead off, or avoiding the use of taped components altogether.

Be especially careful when inserting integrated circuits into the breadboard sockets. Unless the IC pins are straight, it is very easy to crush the pin into a zig-zag shape or fold the pins underneath the body of the IC. Either way the result is a bad connection or no connection at all.

Always use solid wire for breadboard connections. When stripping the wire ends, be careful not to strip more than about three-eighths of an inch of insulation from the wire. Too much bare wire may result in unintentional connections near the wire end.

After you have built up a few circuits, you will have a good collection of prestripped jumper wires. Save them. By reusing these wires, you can save even more time and effort in assembling future circuits. You may also purchase a kit of precut jumper wires, in assorted lengths, by asking for Global Specialties WK-1 Wire Jumper Kit No. 111-0044.

ANALOG CIRCUIT EXAMPLES

The following section shows examples of analog circuits which may be easily constructed using the PB-503. (See Figures 2 and 3)

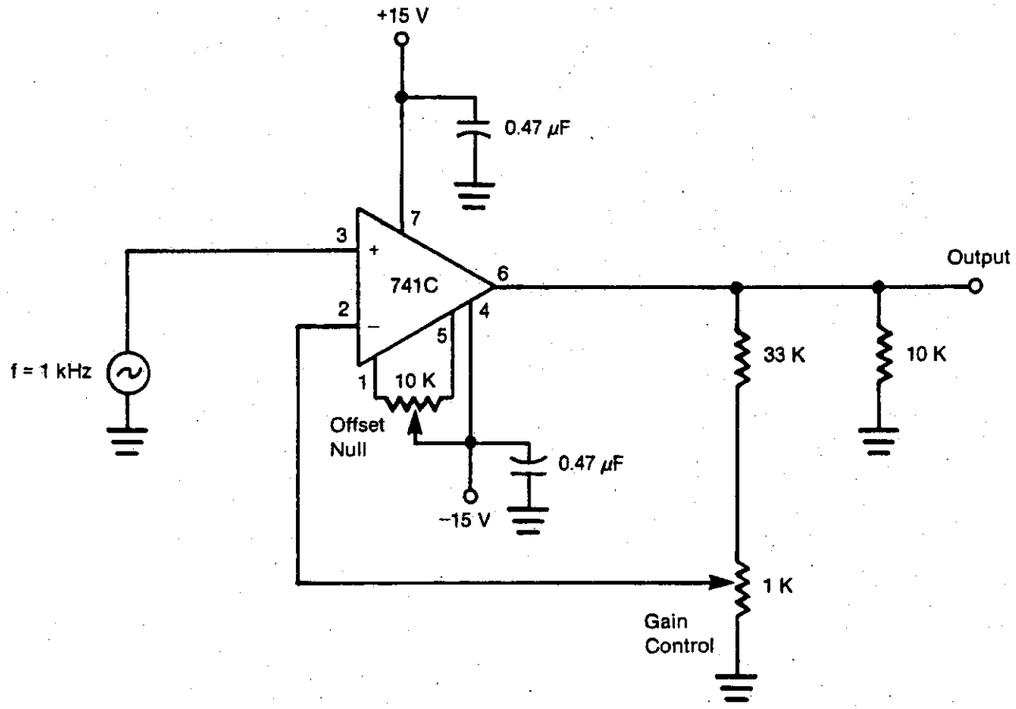


FIGURE 2. Variable gain audio amplifier with output DC offset null control

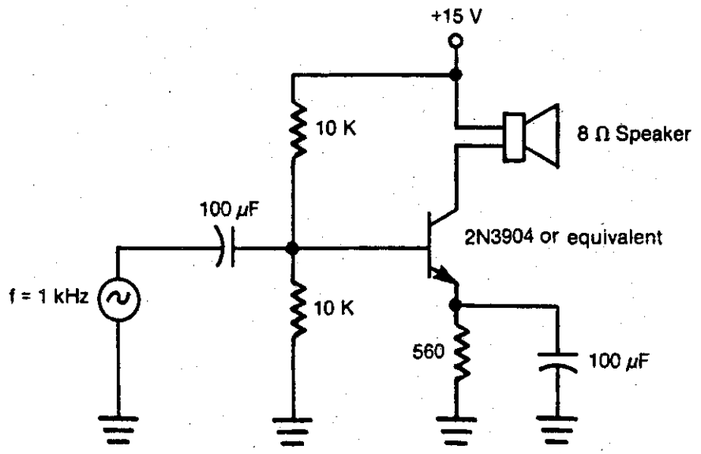


FIGURE 3. One-transistor audio amplifier

DIGITAL CIRCUIT EXAMPLES

The following section shows examples of analog circuits which may be easily constructed using the PB-503. (See Figures 4, 5 and 6)

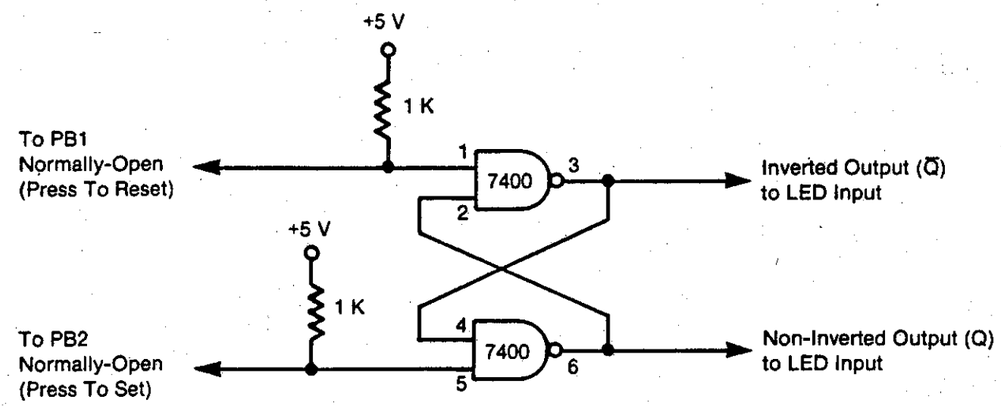


FIGURE 4. Basic set-reset flip-flop built with two NAND gates

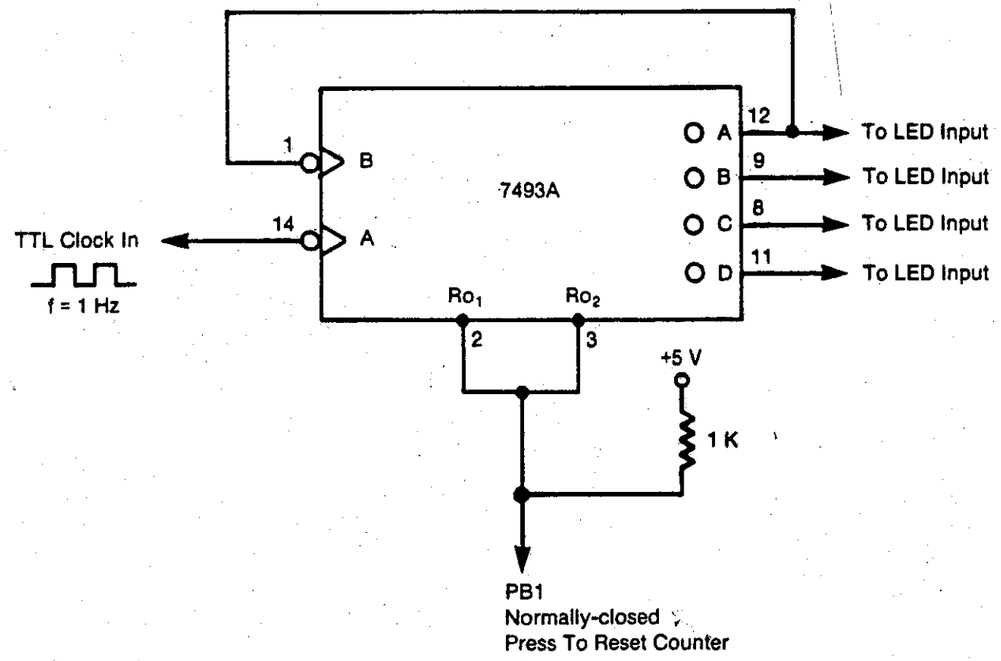
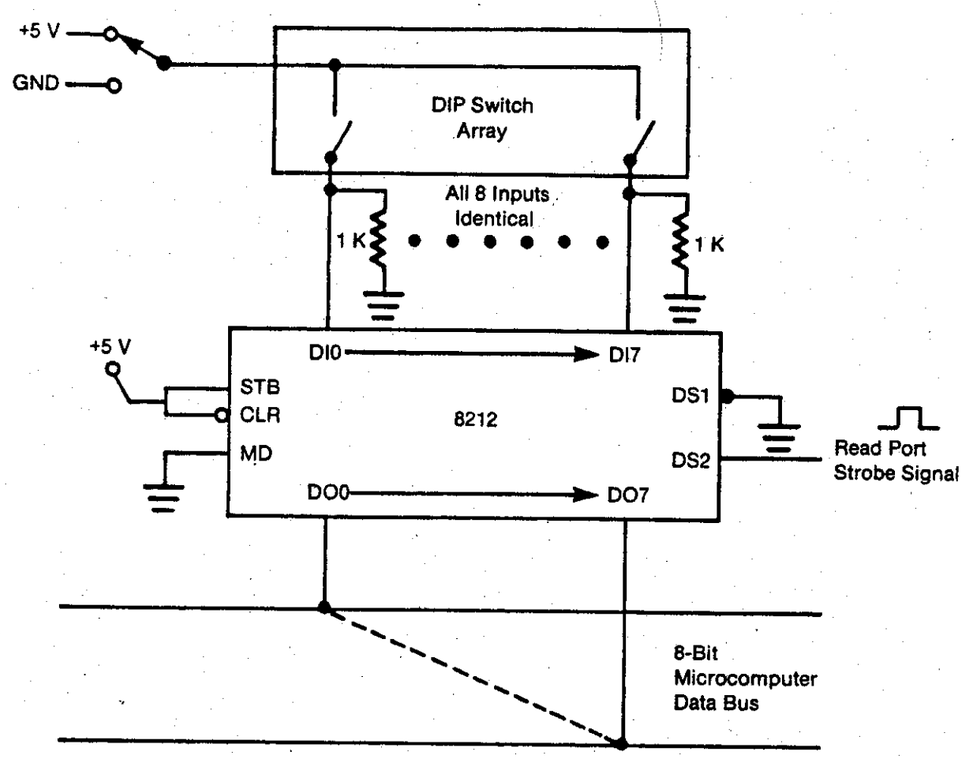
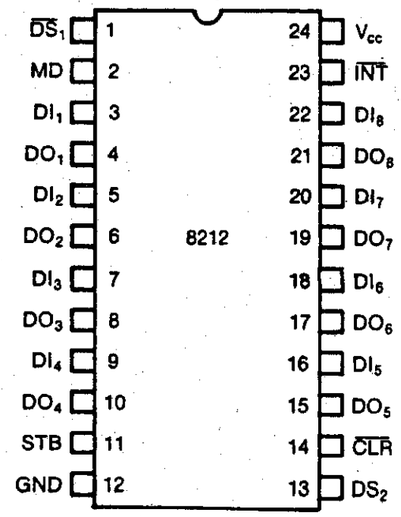


FIGURE 5. 4 Bit resettable binary counter



Pin Configuration



Pin Names

DI_1 - DI_8	Data In
DO_1 - DO_8	Data Out
$\overline{DS_1}$, DS_2	Device Select
MD	Mode
STB	Strobe
$\overline{INT}$	Interrupt (Active Low)
$\overline{CLR}$	Clear (Active Low)

FIGURE 6. 8-Bit microcomputer input port

NOTES :

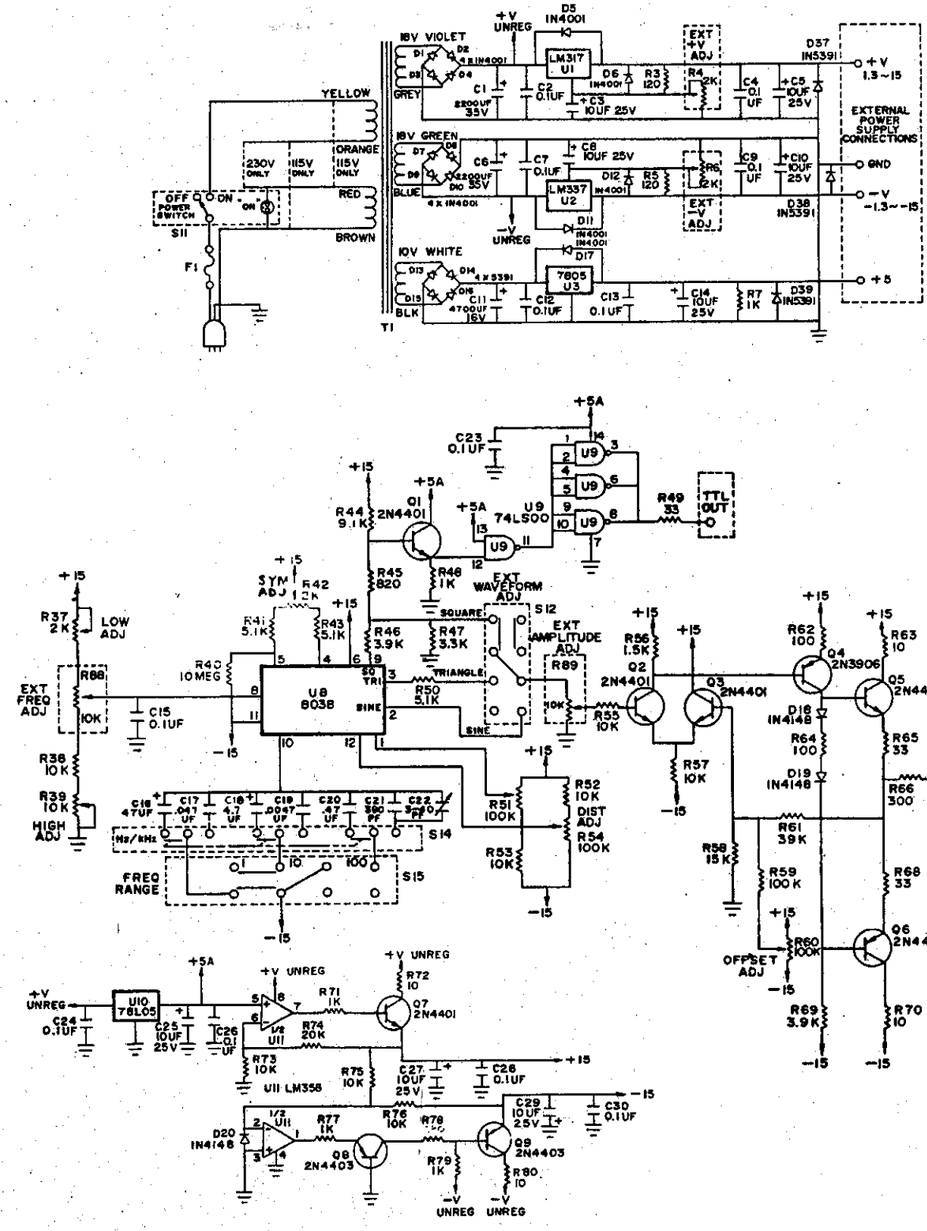
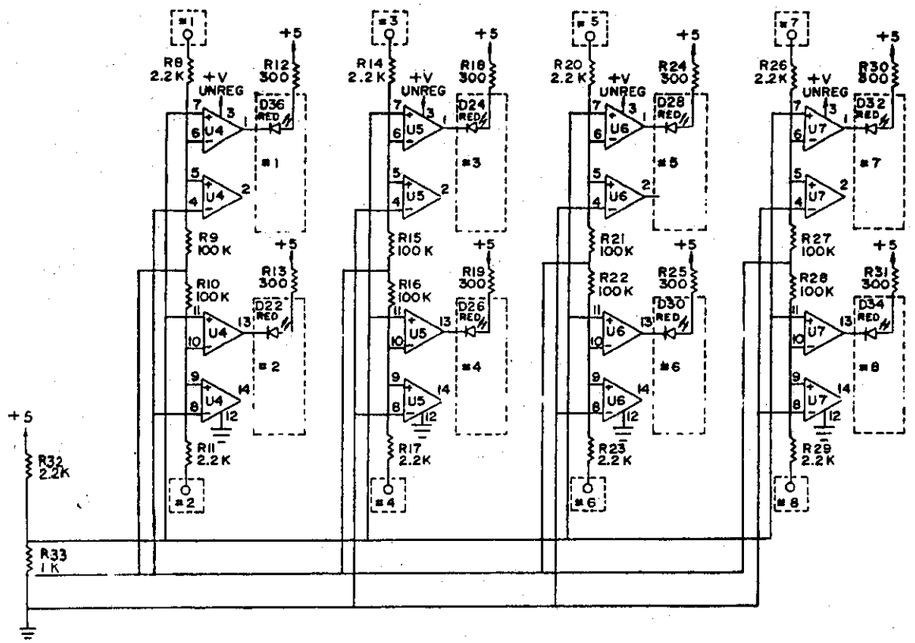
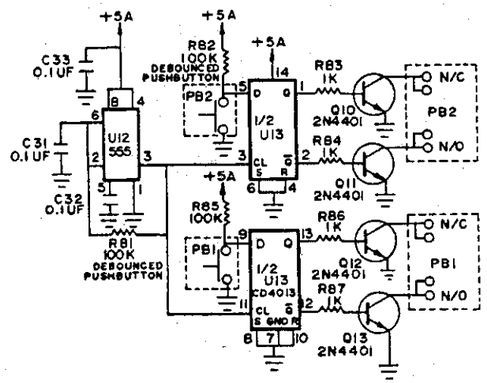
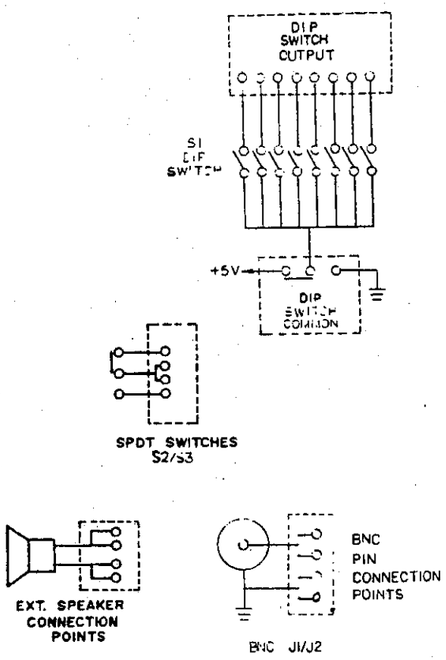


FIGURE 7. PB-503 Circuit Schematic







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To obtain a return merchandise authorization (RMA) required for all returns, phone our Customer Service Department for an RMA and all shipping instructions: Tel. 1-800-572-1028 or write:

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Global Specialties® warrants this device to be free from defective material or workmanship for a period of one full year from date of original purchase.

Global Specialties® under this warranty is limited to repairing the defective device when returned to the factory, shipping charges prepaid, within one full year from date of original purchase.

Units returned to Global Specialties® that have been subject to abuse, misuse, damage or accident, or have been connected, installed or adjusted contrary to the instructions furnished by Global Specialties®, or that have been repaired by unauthorized persons will not be covered by this warranty.

Global Specialties® reserves the right to discontinue models, change specifications, price or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees, or agents.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Global Specialties® is authorized to assume any other obligation in connection with the sale and purchase of this device.

BREADBOARDING SOCKETS LIFETIME GUARANTEE

All Global breadboarding sockets are guaranteed for life. If a socket ever fails to meet your requirements, return it and we will replace it, NO QUESTIONS ASKED.

Specifications to change without notice.