OPERATION

Two 9-volt batteries connected in parallel power the speed gun. A diode is connected to each battery to prevent one battery from charging the other battery. The diodes' anodes are connected to the batteries' positive terminals and the diode's cathodes are connected together. A mechanical switch connects the diode's cathodes to the TK1145SCT, low dropout controllable voltage regulator. When switched to the "on " position the mechanical switch turns on the speed gun by connecting the diodes to the voltage regulator. The regulator supplies +4.5V to a PIC16C72 microcontroller, which controls the operation of the speed gun. The microcontroller generates a 20khz square wave, which is converted to approximately –2.5V by the switched capacitor (charge pump) circuit. This negative voltage is supplied to a LM324 quad opamp (operational amplifier's) and to an LM385-1.2 voltage regulator, which outputs a constant –1.2V. A resistor divider adjusts the –1.2V to approximately -.2V and -.3V, which is needed by the FETs (Field Effect Transistors) used in the RF oscillator and the RF amplifier, respectively. After a predetermined delay the microcontroller sends a control signal to the second voltage regulator signaling it to supply +4.5V to the opamp's positive supply and to the FET's drains. The delay insures that the negative voltage is applied to the FET's gates before the positive drain voltage is applied, reducing the risk of damage to the FETs. The positive voltage applied to the RF amplifier is reduced by three diode drops to approximately two volts. Once the speed gun is fully powered, the oscillator generates a very stable signal at 10.525GHz. The oscillator draws 30mA at +4.5 V and produces approximately 8mW of RF power. The voltages applied to the oscillator are regulated to maintain the oscillator's output power and frequency for any battery voltage. This signal is split with half of the signal being transmitted and half being fed to the mixer. The transmit antenna has a gain of 18db, with the main lobe located at bore sight. The transmitted signal reflects off a target and is received by the receive antenna. This signal is amplified by the RF amplifier and inputted into the mixer, where it is mixed with part of the oscillator signal. A signal results whose frequency is equivalent to the Doppler shift. The frequency varies from approximately 450Hz to 4KHz for speeds from 15mph to 125mph. The signal is amplified approximately 1500X by two LM324 gain blocks and filtered by a LM324 active lowpass filter with cutoff of approximately128mph = 4KHz. The signal is level shifted to approximately 2.2V and inputted into the microcontroller. The waveform is digitized by the microcontroller's A/D (analog to digital converter). The frequency and speed are determined by the microcontroller and displayed on an LCD. The speed gun contains a number of different modes, including a "continuous" mode and a "trigger" mode. In the continuous mode the display is updated every three seconds and in the trigger mode the display is updated upon triggering the speed gun. The gun radiates continually in both modes. A recall feature continually stores the last 10 valid readings and displays the results when the recall button is pressed. A "memory update switch" controls how often the readings are stored in memory. TruSpeed is placed in these different operating modes using two momentary switches and two slide switches. These switches change the configuration of a voltage divider and its output voltage. The microcontroller samples the voltage divider to determine the correct operating mode. These switches do not control the RF circuitry. The speed gun also features a low battery indicator showing when the battery voltage reaches a certain level. The A/D samples the battery voltage and displays "LOWBAT "on the LCD.

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