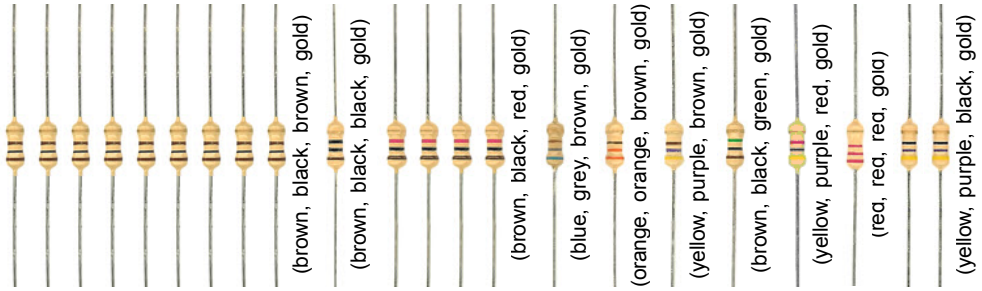
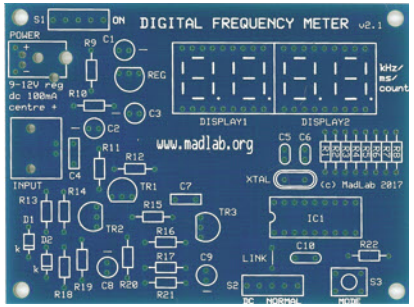
Frequency Meter



R1,2,3,4,5,6,7,8,21 (100R) | R9 (10R) | R10,18,19,22 (1k) | R11 (680R) | R12 (330R) | R13 (470R) | R14 (1M) | R15 (4k7) | R16 (2k2) | R17,20 (47R)

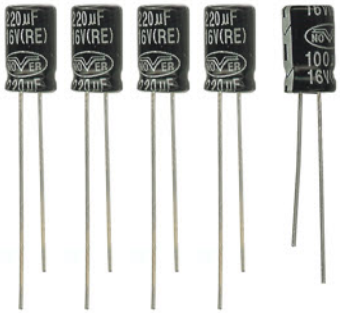
D1 D2 (1N4148)



IC1 (PIC16F628)

IC1 socket

Battery snap



C1 C2 C3 C9 C8 (220u electrolytic) (100u elect)

C10 (100n)

XTAL (20MHz)

TR1 (BC547) TR2 (BF256B) TR3 (BC547) REG (78L05)

POWER

S1 S2

S3

LINK

C5 C6 (22p) C4 C7 (100n)

Rubber feet

DISPLAY1

DISPLAY2

INPUT

1. Identify the different components using the spotter chart.
2. Fit and solder all the resistors (R1 to R22) to the circuit board. Identify the resistors by the coloured stripes on the body. They can be fitted either way around.
3. Solder the diodes (D1 and D2) matching the black stripe to the 'k' sign on the board.
4. Solder the chip socket (IC1) matching the notch in the socket to the notch on the board. **Do not solder the chip directly to the board.**
5. Fit and solder the electrolytic capacitors (C1, C2, C3, C8 and C9) to the board putting the shorter leg into the hole with the – sign. The shorter leg also has a stripe on the side of the body. Fit and solder the other capacitors (C4, C5, C6, C7 and C10) either way around.
6. Solder the short piece of wire to the holes marked LINK.
7. Solder the crystal (XTAL) to the board either way around.
8. Solder the transistors (TR1, TR2 and TR3) matching the half-circle shape of the transistor to the half-circle shape on the board. Be careful not to mistake the regulator for a transistor or to mix up the transistors.
9. Solder the regulator (REG) matching the half-circle shape of the regulator to the half-circle shape on the board.
10. Solder the dual 7-segment displays (DISPLAY1 and DISPLAY2) matching the decimal points to the PCB symbols. Care should be taken when soldering these components to avoid solder bridges between the pins.
11. Solder the slide switches (S1 and S2) and the pushbutton (S3) either way around.
12. Solder the BNC socket (INPUT) to the board.

continued overleaf

13 Two options are available for a power source - battery or mains adapter. Either fit and solder the DC power socket to the board or push the battery snap leads up through the larger holes in the board from the metal side of the board then solder the metal tip of the red lead to the + hole and the metal tip of the black lead to the – hole.

14 Carefully bend the legs of the chip inwards a little with your fingers. Fit the chip into its socket matching the small notch in the chip to the notch in the socket.

15 Attach rubber feet to the corners of the board. Alternatively the corner holes can be used to mount the PCB within a small case.

16 Connect a battery **(9V PP3)** to the battery snap or a mains power supply to the power connector (9 - 12V regulated DC at 100mA with a centre-positive 2.1mm plug). If *Frequency Meter* is working properly all the LED segments are turned on for about a second. After the self-test the display is blanked and then, if no input signal is present, one second later a single zero is displayed.

If battery powered, the meter should be turned off when not being used as the LEDs draw a fairly large current. Use a good quality alkaline battery such as a Duracell.

HOW TO USE

A standard oscilloscope-type probe can be connected to the BNC input socket. These probes generally have a crocodile clip attached. This should be connected to an earth point (0V) on the device to be examined.

In frequency mode, signal pulses are counted over a fixed time interval of 1/8 second or 1 second. High frequency pulses are counted over 1/8 s to make the meter more responsive with no loss of displayed accuracy.

In pulse length mode, pulses are measured to a resolution of 1 microsecond. Note that if this mode is selected and no pulses are present then the meter will lock out.

The input amplifier will accept any periodic signal (sine, triangular, square wave etc.) with a peak-to-peak amplitude of at least 50mV. The amplifier has a high input impedance to minimise its effect on the input signal. All pulses trigger on the rising edge.

The input amplifier can be switched out of circuit via slide switch S2. The position marked 'DC' bypasses the amplifier and routes the input signal directly to the microcontroller (via a current-limiting series resistor). Obviously this requires a clean TTL-level signal to function, but it has the advantage that low frequency signals can be measured (below the amplifier's lower limit of about 15Hz).

The mode is selected by holding down the MODE pushbutton S3 for about a second. The modes are displayed ("FrE", "PulS", "Cntr") and cycled through. Pressing and immediately releasing the pushbutton clears the display and also resets the count in pulse count mode.

Underflows (frequencies less than 1Hz or pulse lengths less than 1us) or no signal at all are displayed as a single zero, and overflows (frequencies greater than ~8MHz or pulse lengths greater than ~8s) are displayed as the letter ‘E’ (for error).

Sub-hertz frequencies (down to 1/16 Hz) can be measured by selecting pulse length mode and taking the reciprocal of twice the displayed value. Switch S2 must be in the DC position.

In pulse count mode, if the count exceeds 9999 then it wraps and keeps counting but all the decimal points are set.

The display shows the signal frequency in kHz or pulse length in ms, according to the following table:

Frequency	Pulse	Display
< 1Hz	< 1us	0
1Hz	1us	0.001
10Hz	10us	0.010
100Hz	100us	0.100
1.000kHz	1.000ms	1.000
10.00kHz	10.00ms	10.00
100.0kHz	100.0ms	100.0
1.000MHz	1.000s	1000.
> ~8MHz	> ~8s	E