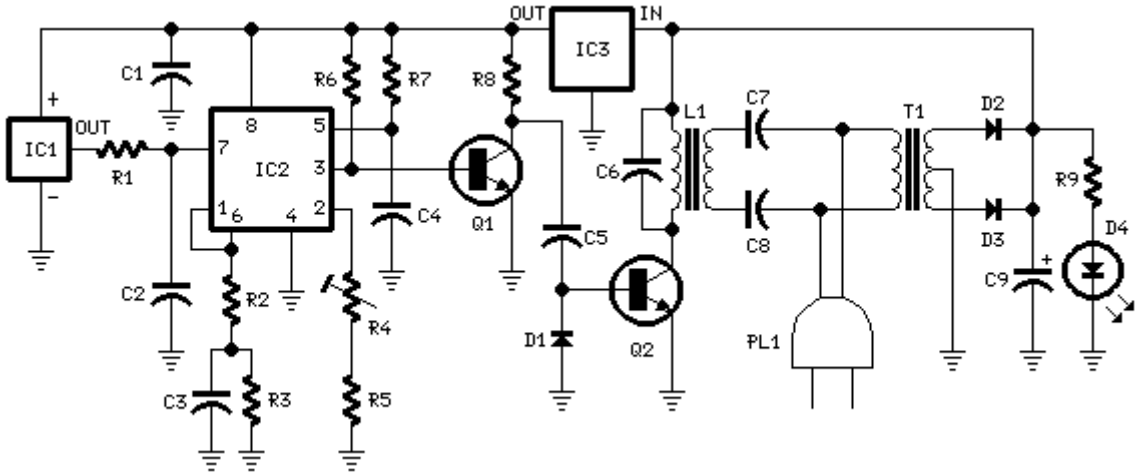
Digital Remote Thermometer

Remote sensor sends data via mains supply
Temperature range: 00.0 to 99.9 °C

Transmitter circuit diagram:



Transmitter parts:

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R1,R3_________100K   1/4W Resistors
R2____________47R    1/4W Resistor
R4____________5K     1/2W Trimmer Cermet
R5____________12K    1/4W Resistor
R6____________10K    1/4W Resistor
R7____________6K8    1/4W Resistor
R8,R9_________1K     1/4W Resistors

C1____________220nF   63V Polyester Capacitor
C2____________10nF    63V Polyester Capacitor
C3____________1µF     63V Polyester Capacitor
C4,C6_________1nF     63V Polyester Capacitors
C5____________2n2     63V Polyester Capacitor
C7,C8_________47nF   400V Polyester Capacitors
C9___________1000µF   25V Electrolytic Capacitor

D1___________1N4148   75V 150mA Diode
D2,D3________1N4002  100V 1A Diodes
D4____________5mm. Red LED

IC1___________LM35   Linear temperature sensor IC
IC2___________LM331  Voltage-frequency converter IC
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IC3_____78L06 6V 100mA Voltage regulator IC

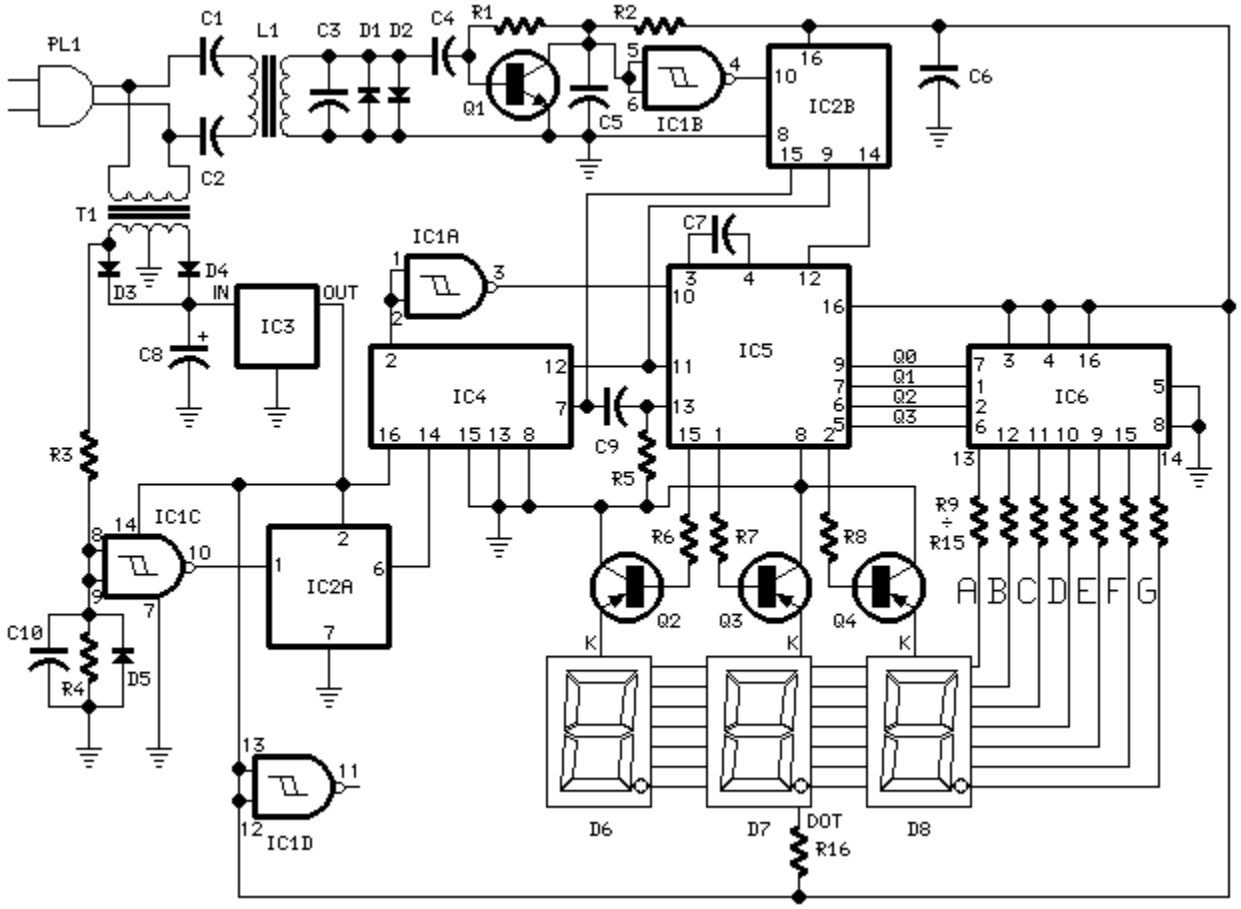
Q1_____BC238 25V 100mA NPN Transistor
Q2_____BD139 80V 1.5A NPN Transistor

L1_____Primary (Connected to Q2 Collector): 100 turns
Secondary: 10 turns
Wire diameter: 0.02mm. enameled
Plastic former with ferrite core. Outer diameter: 4mm.

T1_____220V Primary, 12+12V Secondary 3VA Mains transformer

PL1_____Male Mains plug & cable

Receiver circuit diagram:



Receiver Parts:

R1_____100K 1/4W Resistor
R2_____1K 1/4W Resistor

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R3,R4,R6-R8__12K   1/4W Resistors
R5___________47K   1/4W Resistor
R9-R15______470R   1/4W Resistors
R16_________680R   1/4W Resistor

C1,C2________47nF 400V Polyester Capacitors
C3,C7_________1nF  63V Polyester Capacitors
C4___________10nF  63V Polyester Capacitor
C5,C6,C10____220nF  63V Polyester Capacitors
C8__________1000µF  25V Electrolytic Capacitor
C9___________100pF  63V Ceramic Capacitor

D1,D2,D5____1N4148  75V 150mA Diodes
D4,D4_______1N4002 100V 1A Diodes
D6-D8_______Common-cathode 7-segment LED mini-displays

IC1_________4093   Quad 2 input Schmitt NAND Gate IC
IC2_________4518   Dual BCD Up-Counter IC
IC3_________78L12  12V 100mA Voltage regulator IC
IC4_________4017   Decade Counter with 10 decoded outputs IC
IC5_________4553   Three-digit BCD Counter IC
IC6_________4511   BCD-to-7-Segment Latch/Decoder/Driver IC

Q1__________BC239C 25V 100mA NPN Transistor
Q2-Q4_______BC327  45V 800mA PNP Transistors

L1__________Primary (Connected to C1 & C2): 10 turns
            Secondary: 100 turns
            Wire diameter: 0.02mm. enameled
            Plastic former with ferrite core. Outer diameter: 4mm.

T1__________220V Primary, 12+12V Secondary 3VA Mains transformer

PL1_________Male Mains plug & cable
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Device purpose:

This circuit is intended for precision centigrade temperature measurement, with a transmitter section converting to frequency the sensor's output voltage proportional to the measured temperature. The output frequency bursts are conveyed into the mains supply cables.
The receiver section counts the bursts coming from mains supply and shows the counting on three 7-segment LED displays. The least significant digit displays tenths of degree and then a 00.0 to 99.9 °C range is obtained.
Transmitter-receiver distance can reach hundred meters, provided both units are connected to the mains supply within the control of the same light-meter.

Transmitter circuit operation:

IC1 is a precision centigrade temperature sensor with a linear output of 10mV/°C driving IC2, a voltage-frequency converter. At its output pin (3), an input of 10mV is converted to 100Hz frequency pulses. Thus, for example, a temperature of 20°C is converted by IC1 to 200mV and then by IC2 to 2KHz. Q1

is the driver of the power output transistor Q2, coupled to the mains supply by L1 and C7,C8.

Receiver circuit operation:

The frequency pulses coming from mains supply and safely insulated by C1,C2 & L1 are amplified by Q1; diodes D1,D2 limiting peaks at its input. Pulses are filtered by C5, squared by IC1B, divided by 10 in IC2B and sent for the final count at the clock input of IC5.
IC4 is the time-base generator: it provides reset pulses for IC1B and IC5 and enables latches and gate-time of IC5 at 1Hz frequency. It is driven by a 5Hz square wave obtained from 50Hz mains frequency picked-up from T1 secondary, squared by IC1C and divided by 10 in IC2A.
IC5 drives the displays' cathodes via Q2,Q3 & Q4 at a multiplexing rate frequency fixed by C7. It drives also the 3 displays' paralleled anodes via the BCD-to-7 segment decoder IC6.
Summing up, input pulses from mains supply at, say, 2KHz frequency, are divided by 10 and displayed as 20.0°C.

Notes:

- D6 is the Most Significant Digit and D8 is the Least Significant Digit.
- R16 is connected to the Dot anode of D7 to permanently light the decimal point.
- Set the ferrite cores of both inductors for maximum output (best measured with an oscilloscope, but not critical).
- Set trimmer R4 in the transmitter to obtain a frequency of 5KHz at pin 3 of IC2 with an input of 0.5Vcc at pin 7 (a digital frequency meter is required).
- More simple setup: place a thermometer close to IC1 sensor, then set R4 to obtain the same reading of the thermometer in the receiver's display.
- Keep the sensor (IC1) well away from heating sources (e.g. Mains Transformer T1).
- Linearity is very good.
- **Warning!** The circuits are connected to 220Vac mains, then some parts in the circuit boards are subjected to **lethal potential!**. Avoid touching the circuits when plugged and enclose them in plastic boxes.
