

Ultrasonic Sonar Module

Hardware Manual Rev 1r0



US-100 compact ultrasonic sonar module is a low cost solution for circuit applications that requires distance measurements from an object, such as walls, furniture, and even pets. User circuit initiates a measurement by driving the US-100 trigger input to logic HIGH. The US-100, in response, will send a short bursts of ultrasonic sound wave, and then outputs a pulse as soon as a returning echo is detected. The user circuit resolves the distance by measuring the pulse width of the output pulse. Distances up to 4.5 meters from the sensor can be measured, with resolving resolution depending mainly on the user circuit.

Features:

- Technology: 40kHz Ultrasonic Sonar
- Sensor Range: 2cm- 350cm (Temperature Compensated)
- Power Input: 3V-5VDC @ 3.5mA Typ
- Trigger Input : TTL
- Echo Output: TTL
- PCB Size: 20x45mm

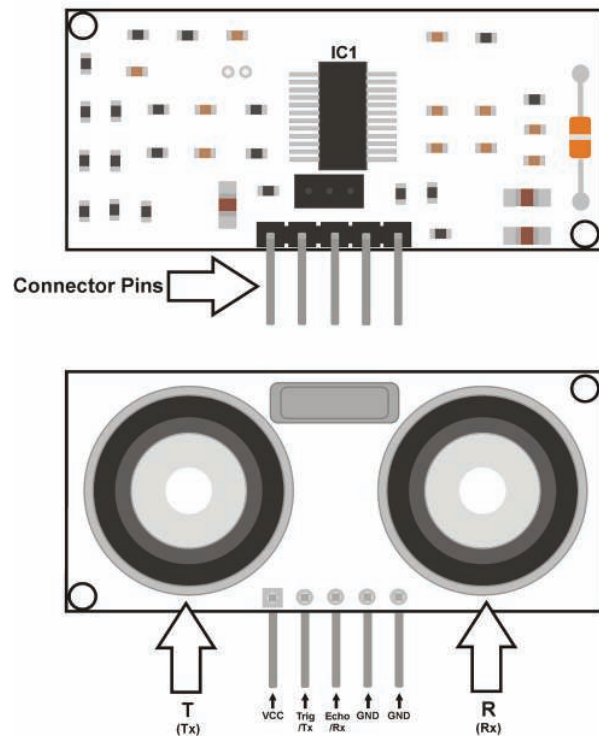


Figure 1. Ultrasonic Sonar illustration showing its major Components.

Important: JP1 is normally OPEN (uninstalled).

Table 1. Ultrasonic Distance Sensor Pin Assignments and Descriptions.

Pin No.	ID	Description
1	VCC	5V Power Input
2	Trig	Trigger Input active HIGH
3	Echo	Pulse output
4	GND	ground
5	GND	ground

NOTE: The OEM manufacturer of the US-100 sonar module, for unknown reason, will not provide us a user manual or any other information for that matter. Hence, all information contained in this document were obtained by actual measurements and experimentation.

TIMING DIAGRAM

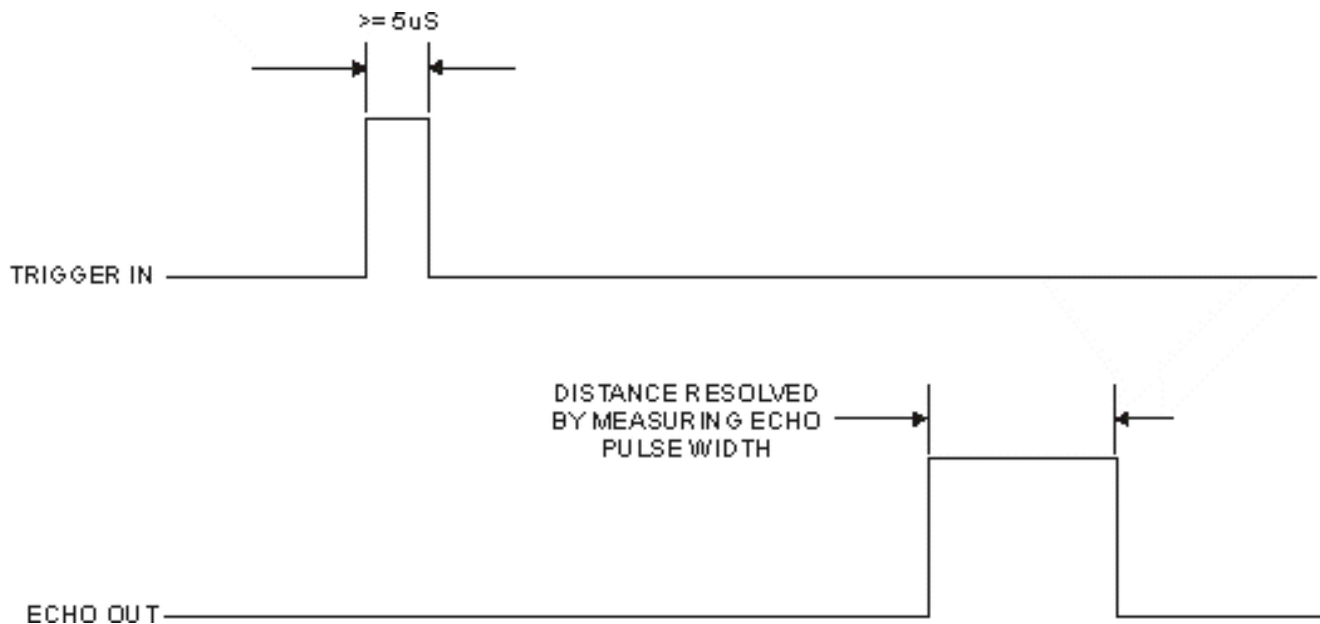


Figure 2. US-100 Timing Diagram. Distance measurement is initiated by sensing a pulse to the trigger input. The US-100 will respond with a pulse with a duration corresponding to the round trip echo time.

RESOLVING DISTANCE

As the timing diagram shown in figure 2 illustrates, distance measurement is initiated by activating the trigger input with a pulse. The US-100 will respond with an echo output pulse. The echo response pulse width corresponds to the time it takes for the ultrasonic sound to travel from the sensor to the object and back. Hence the distance from the object can be computed by:

$$\text{Distance} = \text{Pulse Width} * \text{Speed of Sound} / 2$$

A pulse width value greater than 60mS indicates an out of range condition.

The actual speed of sound depends on several environmental factors, with temperature having the most pronounced effect. The speed of sound in dry air is determined approximately by:

$$V = 331.4 + 0.6T \text{ m/s}$$

But one of the features of US-100 is its built-in temperature compensation. Hence, with temperature effect out of the equation, the distance formula is

reduced to:

$$\text{Distance} = \text{PulseWidth} * 165.7 \text{ meters}$$

Where: PulseWidth in seconds

DETECTION WINDOW CONSIDERATIONS

The US-100 has a detection pattern that spreads out from the sensor mouth at >15 degrees angle. One obvious and probably undesirable effect of this characteristic is the sensor will have an effective larger detection window the further away the object of interest is from the sensor. This will allow the sensor to “see” more objects, hence, will be increasingly distracted by other nearby objects, making it more prone to error.

Long distance detection requires the target object cross section be large enough for accurate and reliable detection.

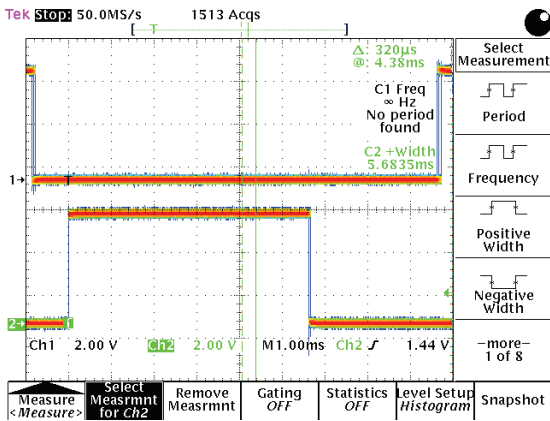


Figure 3. US-100 echo output (lower trace) reports a 5.68ms pulse width when a test object is position about a meter from the sensor. Converting this to equivalent distance yields a value of 0.94m.

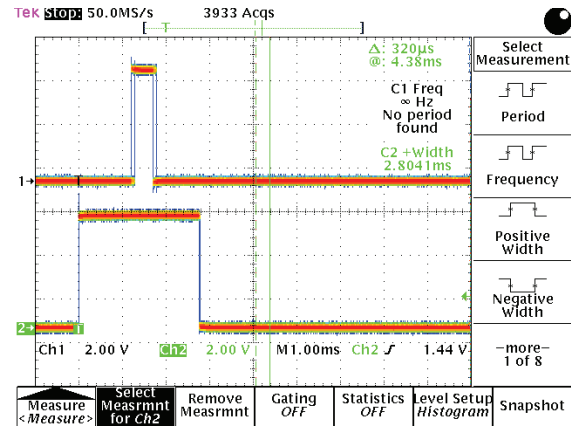


Figure 4. With the test object moved closer to about half meter, the pulse width as outputted by US-100 is correspondingly reduced in half (2.8ms).

APPLICATION HINTS

The US-100 will work with power supply voltages 3V to 5VDC. For best logic level matching, use the same Vdd source the host controller is using. Lower supply voltage may result in a reduction in distance detection range.

The US-100 requires only two I/O port to interface with a host controller. As shown in Fig. 5, the host controller must be assigned one output port to drive the US-100 trigger input, and one input port to read and measure the echo pulse width output.

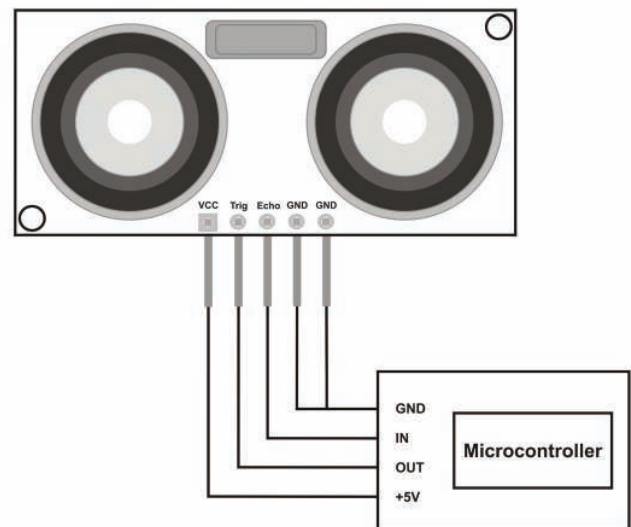


Figure 5. US-100 to host controller wiring example.

gizDuino Wiring and Demo Code

```
// Demo sketch
// This sketch will output distance info via the UART port

// port assignment
// change as may be necessary
const int trigger=6;
const int echo=7;
float distance;

void setup(){
  Serial.begin(9600);
  pinMode(trigger,OUTPUT);
  pinMode(echo,INPUT);
}

void loop(){

  // Trigger US-100 to start measurement
  // Set up trigger
  digitalWrite(trigger,LOW);
  delayMicroseconds(5);
  // Start Measurement
  digitalWrite(trigger,HIGH);
  delayMicroseconds(10);
  digitalWrite(trigger,LOW);
  // Acquire and convert to mtrs
  distance=pulseIn(echo,HIGH);
  distance=distance*0.0001657;
  // send result to UART
  Serial.println(distance);
  delay(50);
}
```

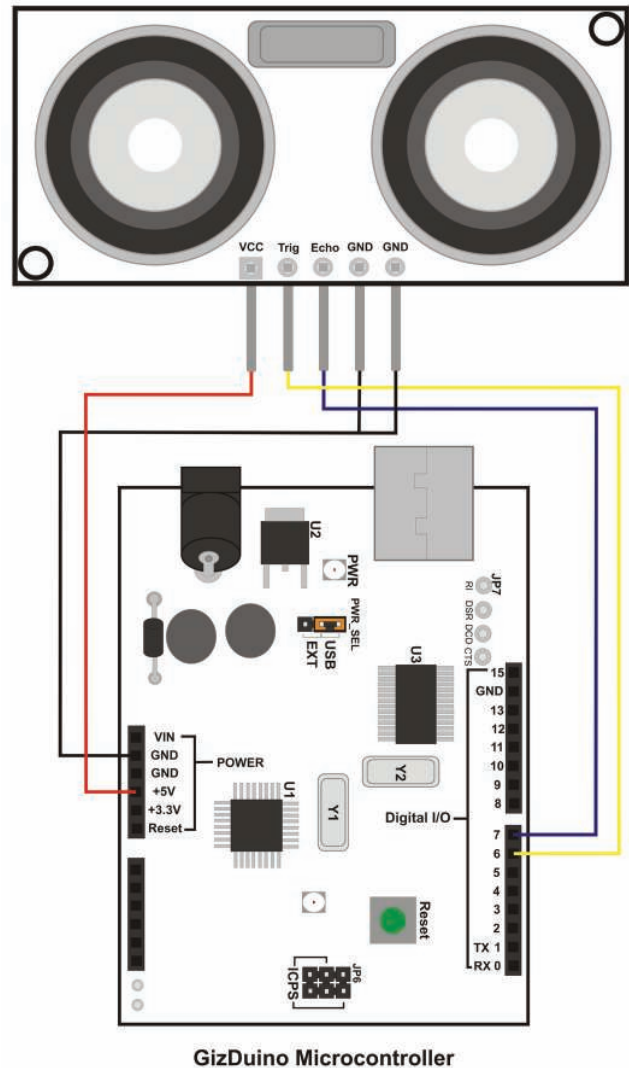


Figure 6. US-100 Ultrasonic Sonar Connected to a gizDuino Microcontroller kit. In this example, the trigger and echo pins are connected to port 6 and 7 respectively. You can change the connection and use other ports instead.