

Distance Sensors



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It's a What?



- \$ 3.70
- Ultrasonic
- 2-400 cm
- Analog (~3mm prec.)
- HC-SR04

Image courtesy of sainsmart.com



- \$ 15
- Infrared
- 100-550 cm
- Analog (~1cm prec.)
- Sharp GP2Y0A02YK0F

Image courtesy of sparkfun.com



- \$ 50
- Ultrasonic
- 0-765 cm
- Digital, 1cm LSB
- MaxSonar-EZ3

Image courtesy of sparkfun.com

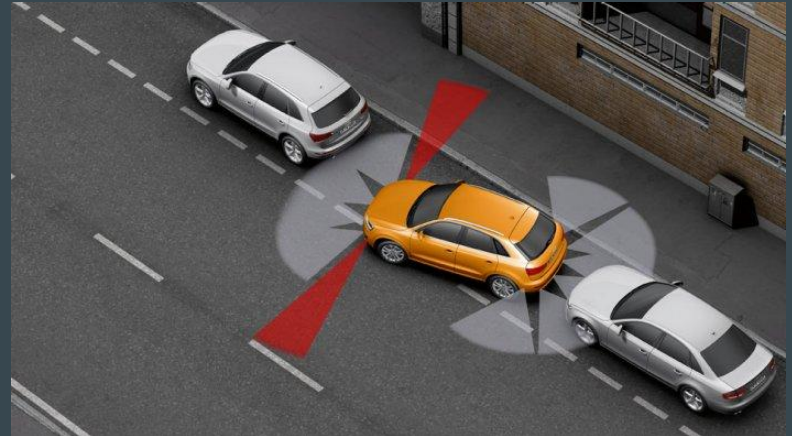


- \$\$\$\$\$
- IR Laser
- 0.15-300 m
- Digital, 3mm LSB
- SICK Dx100

Image courtesy of sick.com

General Applications

- Obstacle Detection
- Parking Assist
- Radar Gun
- Flight Safety
- General Navigation
- Robotics
- Sensing Distance



Images courtesy of insurancehunter.ca and google.com

Flavors by Function

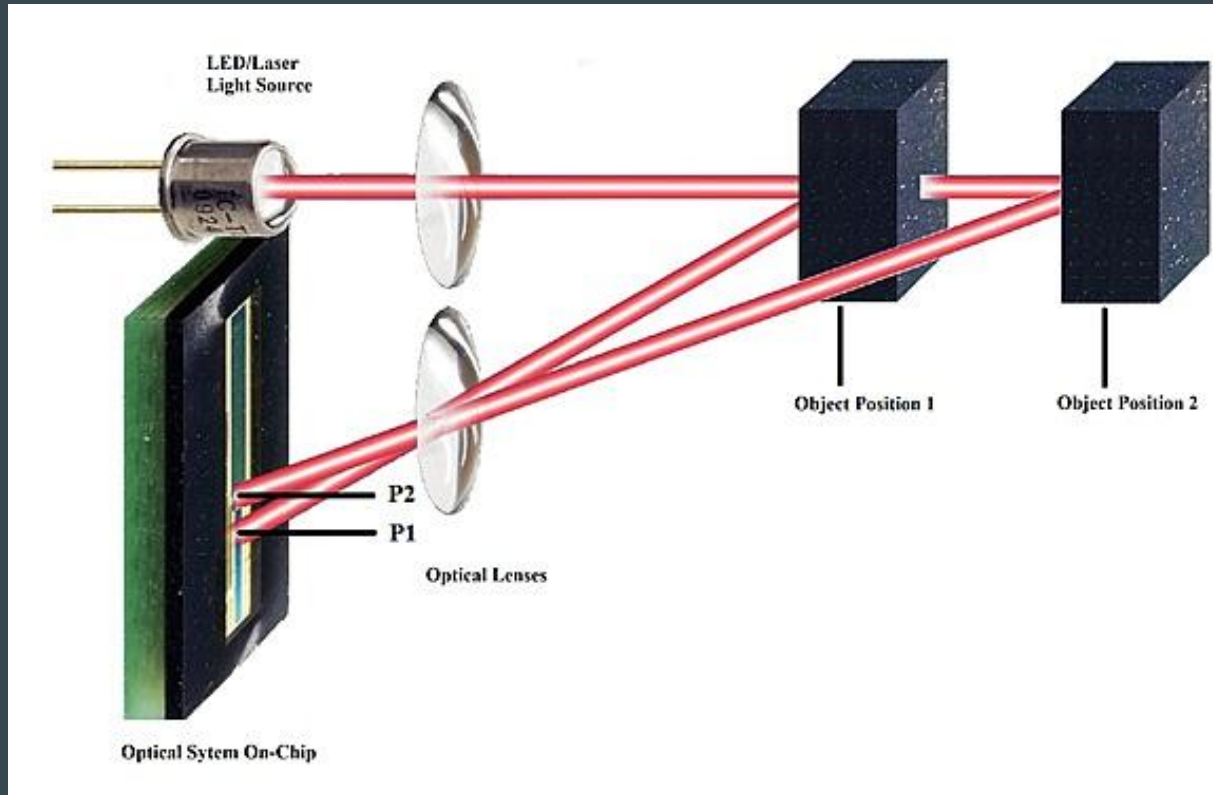
- Proximity vs Distance/Range Finder
- Range (min/max)
- Precision (m/V) (mm, cm, in)
- Angle Measurement
- Outputs (Analog, I2C, SPI, etc)

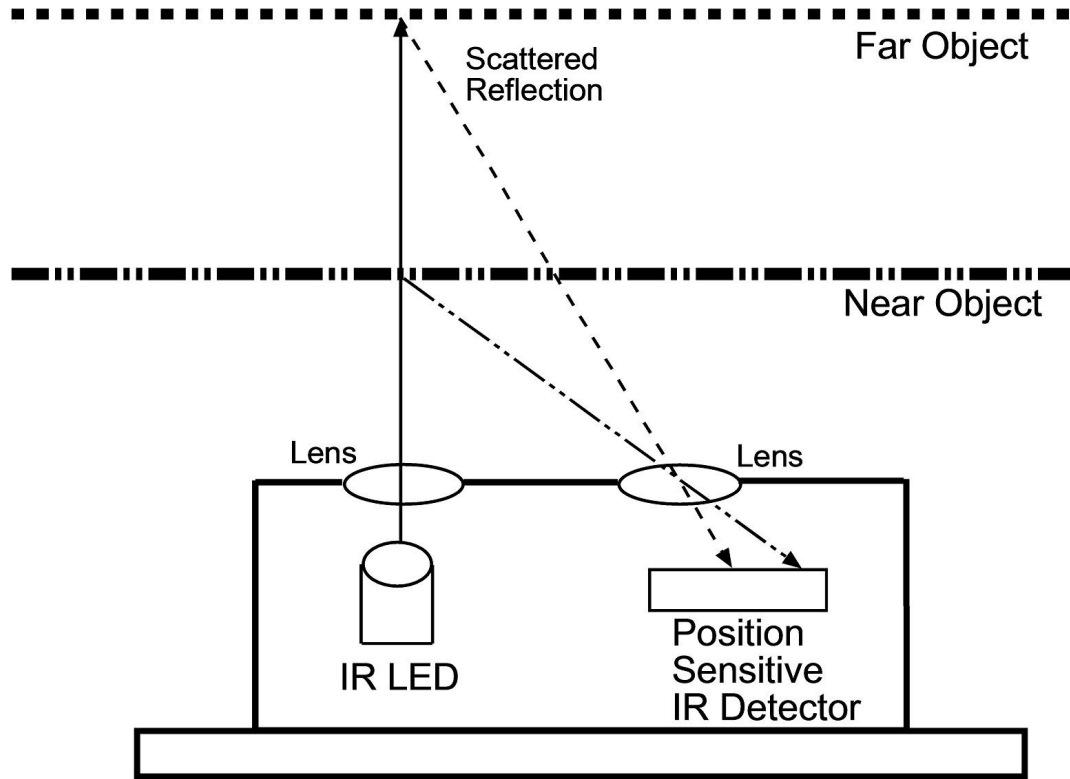
Flavors by Form

Ultrasonic

Infrared Light (IR)

Infrared Distance Sensor





Meet the Sharp GP2Y0A710K0F

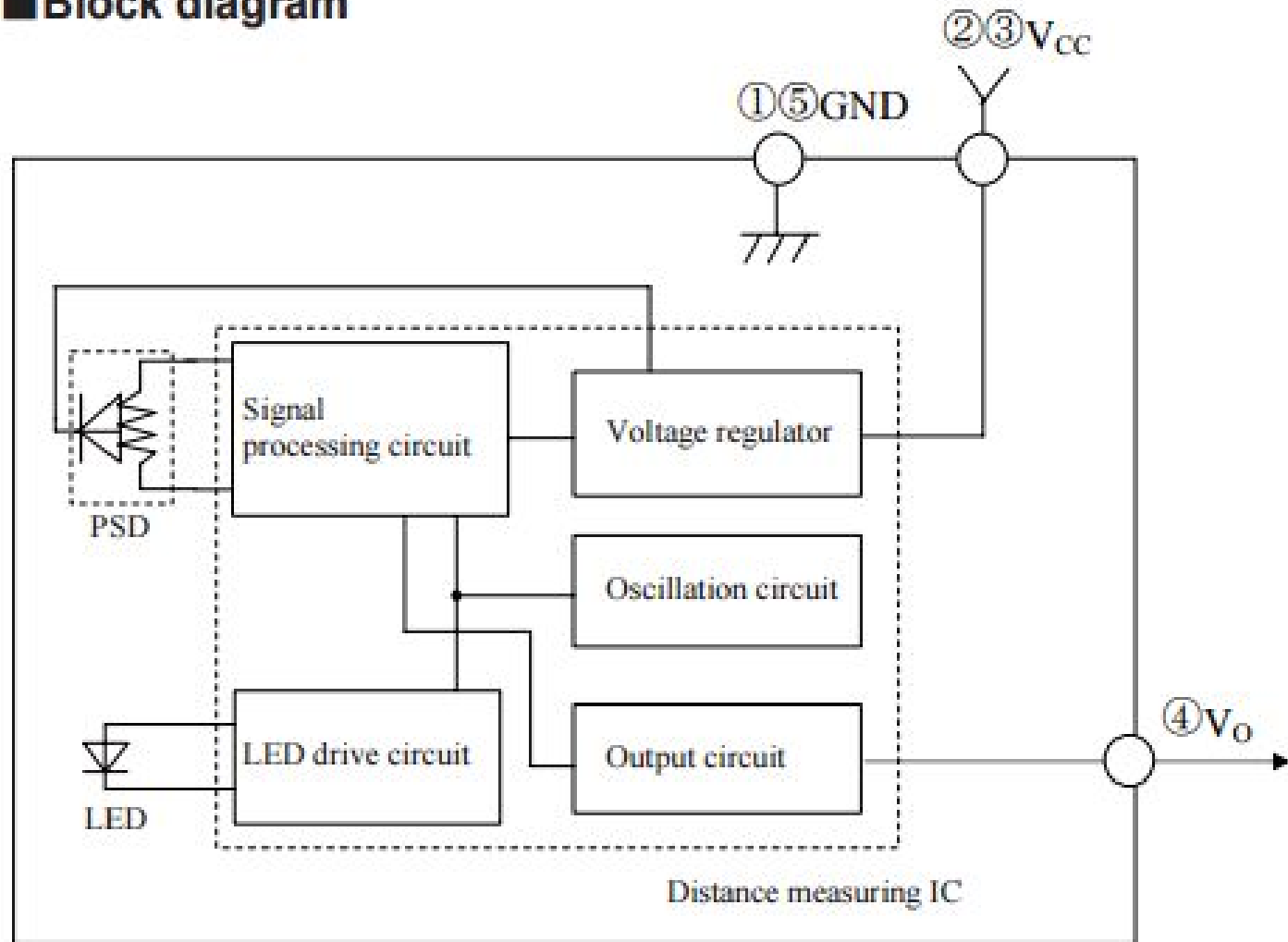
- Price: \$16
- Interface: Analog
- Power Supply: 4.5-5.5 Volts
- Working Current: 30-50 mA
- Distance Range: 100 - 550 cm
- Precision: ~1 cm.
- Dimensions: 58 x 17.6 x 22.5 mm

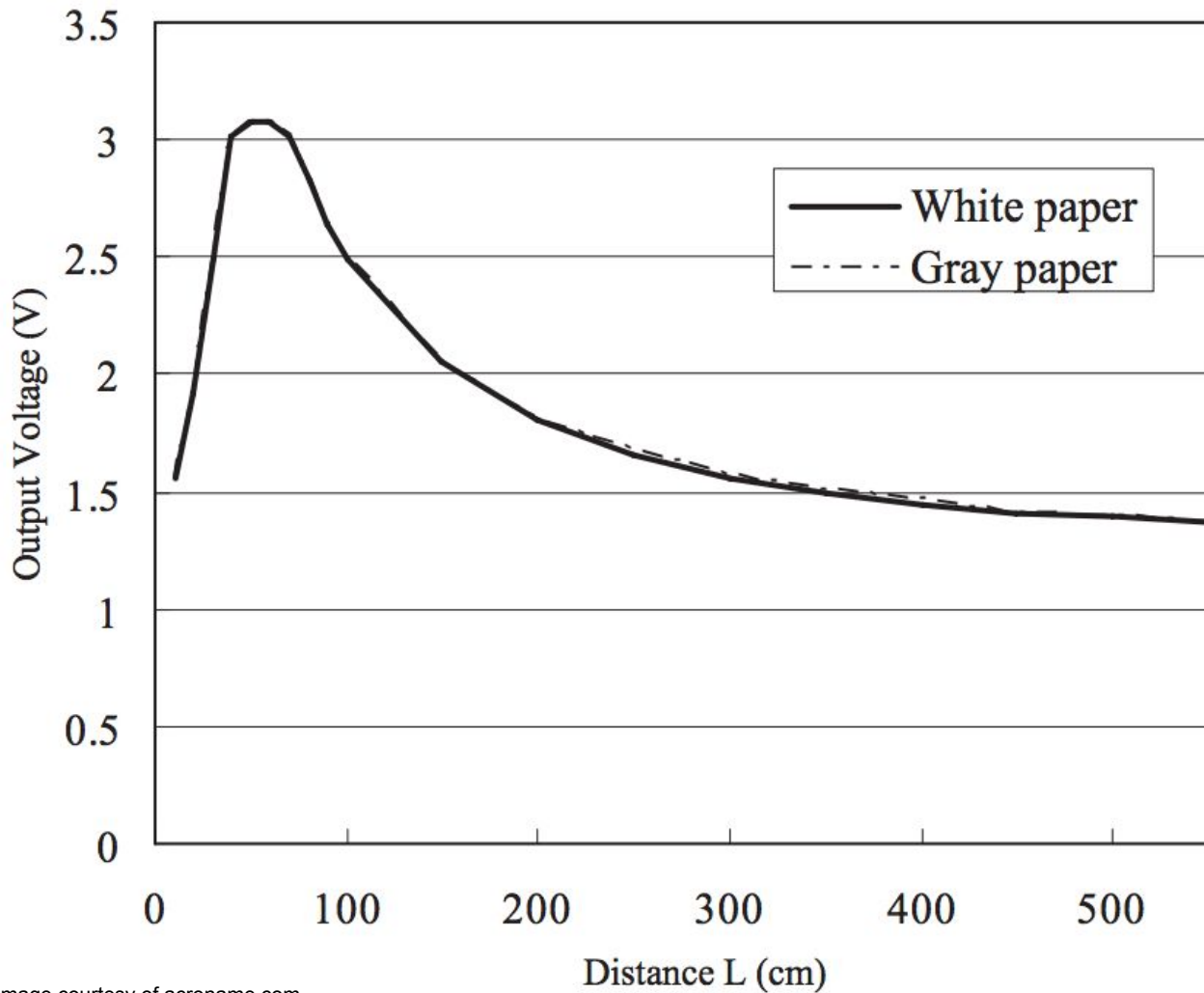
[Purchase Datasheet](#)



Image courtesy of acroname.com

■ Block diagram





Characteristics of IR Sensor

- Narrow/focused area = high accuracy
- Don't work in sunlight
- Can be affected by an object's color

Ultrasonic Distance Sensor

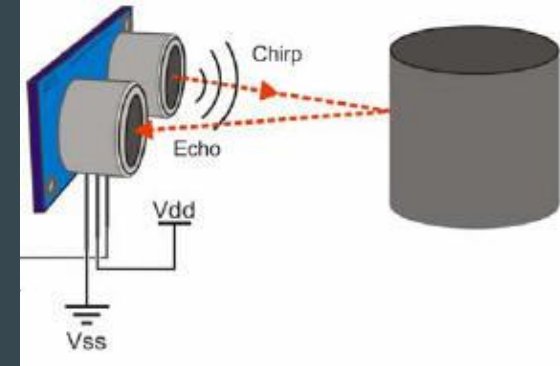


Image courtesy of seminarsonly.com

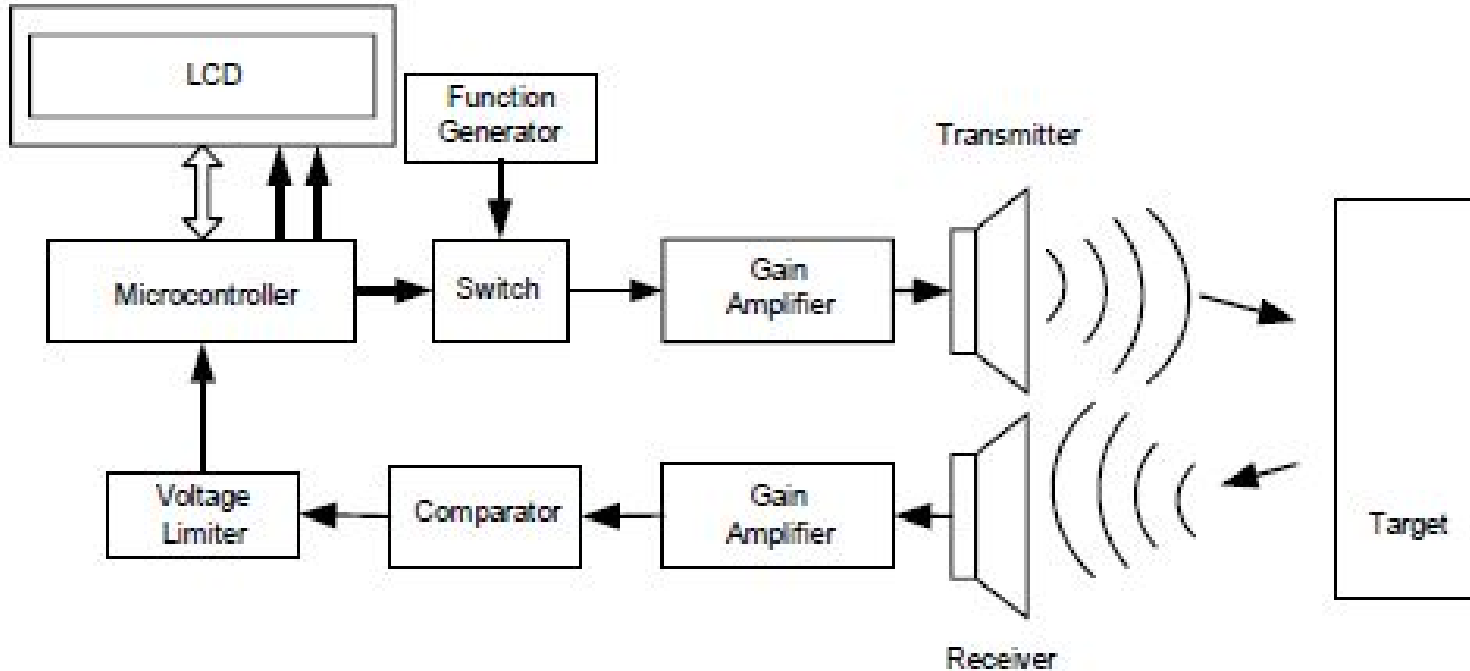


Image courtesy of tehnomagazin.com

How it Works - Ultrasonic Sensor

- AC current passed through piezoelectric transducer
 - different currents cause the piezoelectric crystal to expand and contract
- Return ultrasonic wave measured expands and contracts piezoelectric transducer crystal, generating an AC current
- Converts to DC voltage
- ADC converter, depending on how expensive the device

Meet the HC - SR04

- Price: \$3.70
- Power Supply: +5V DC
- Working Current: 15mA
- Effectual Angle: $< \pm 15^\circ$
- Distance Range : 2cm – 400 cm
- Resolution : 0.3 cm
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm

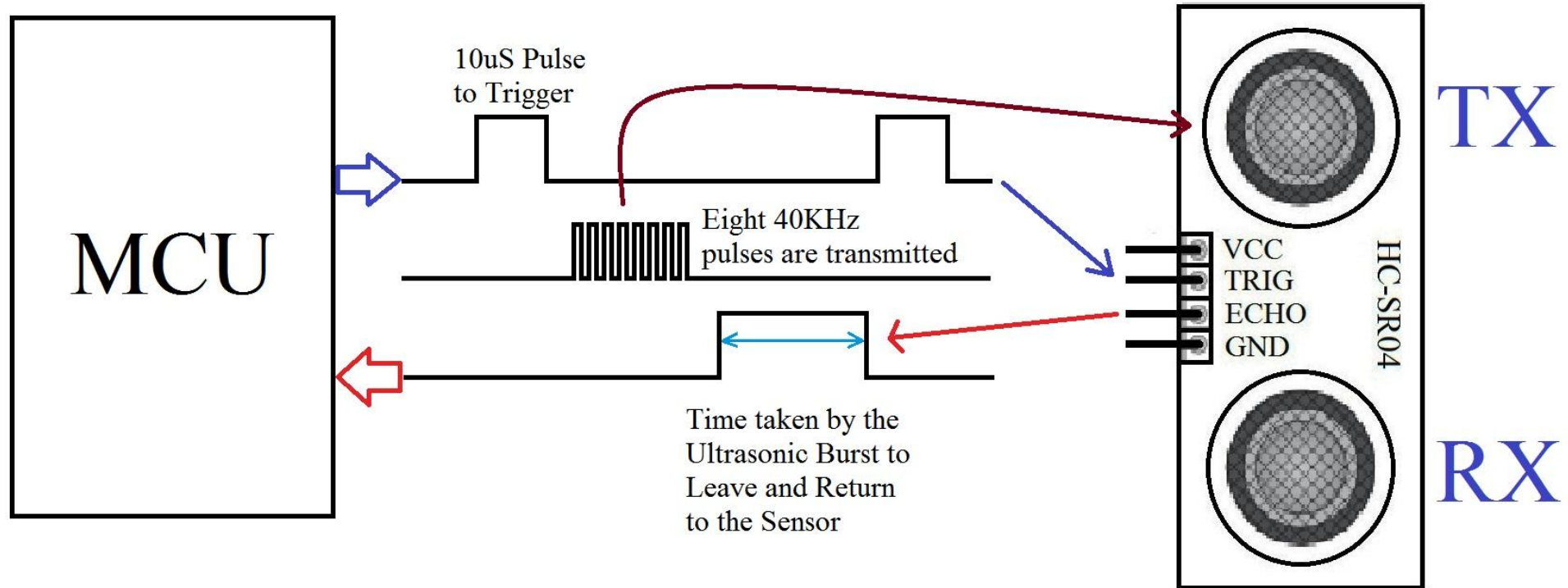
[Datasheet](#)

[Purchase](#)



Image courtesy of sainsmart.com

Interfacing - Ultrasonic Sensor (HC - SR04)



Interfacing - Ultrasonic Sensor (HC - SR04)

- Send 10us pulse trigger
- Listen for Echo to go high, start timer
- Capture when it goes low, and throw interrupt
- Calculate Distance:
 - $\text{distance(cm)} = \text{pulse_width(us)}/58$

Characteristics of Ultrasonic Sensors

- Some can measure angles
- Don't work in noisy environment
- Can be affected by an object's consistency (i.e. foam)
- Object must be perpendicular to sensor
- Accuracy can be affected by angle

Infrared vs. Ultrasonic

Infrared

- Narrow focus area
- Can be used in noisy environment
- Minimum sensing distance (100 cm for GP2Y0A710K0F)
- Color can affect reading

Ultrasonic

- Some can measure angles
- Can be used in sunlight
- Minimum sensing distance (2 cm for HC-SR04)
- Shape, angle, and texture can affect reading
- Often more accurate vs IR sensor of similar price ranges

MaxSonar-EZx Series

- \$ 26-50
- Ultrasonic

Distance Ranges

- Min 0-15cm
- Max 500cm - 765cm
- 0.1cm - 3cm LSB Precision

Outputs

- Analog Voltage
- RS232
- UART
- TTL Serial
- Pulse Width



Image courtesy of sparkfun.com

MB1013

HRLV-MaxSonar®-EZ1™ Beam Pattern

Sample results for measured beam pattern are shown on a 30-cm grid. The detection pattern is shown for dowels of varying diameters that are placed in front of the sensor.

A 6.1-mm (0.25-inch) diameter dowel

B 2.54-cm (1-inch) diameter dowel

C 8.89-cm (3.5-inch) diameter dowel

D 11-inch wide board moved left to right with the board parallel to the front sensor face.

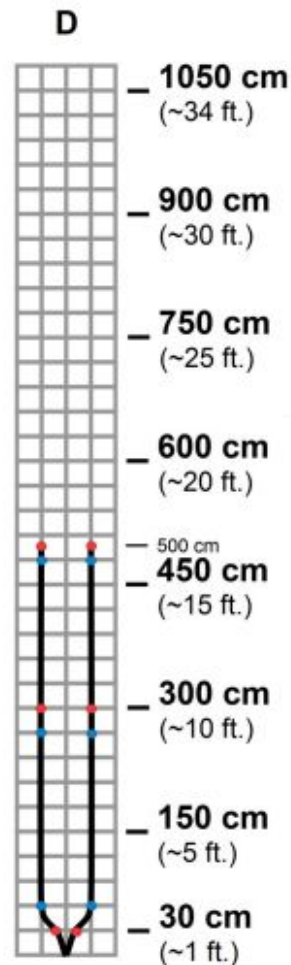
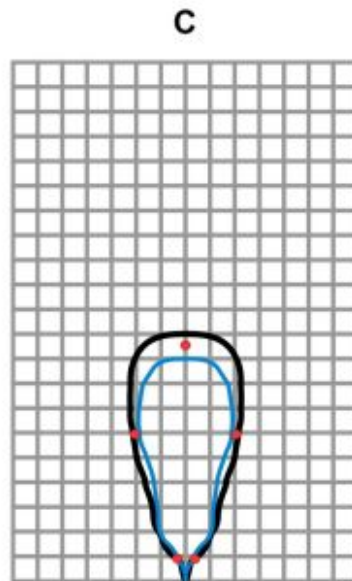
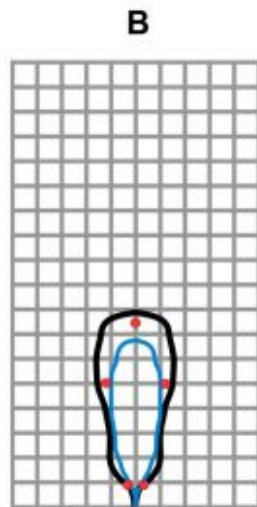
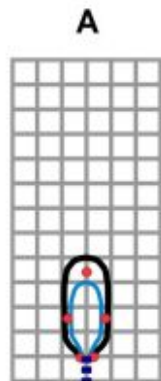
This shows the sensor's range capability.
Note: For people detection the pattern typically falls between charts A and B.

■ Partial Detection

— 5.0 V

● 3.3 V

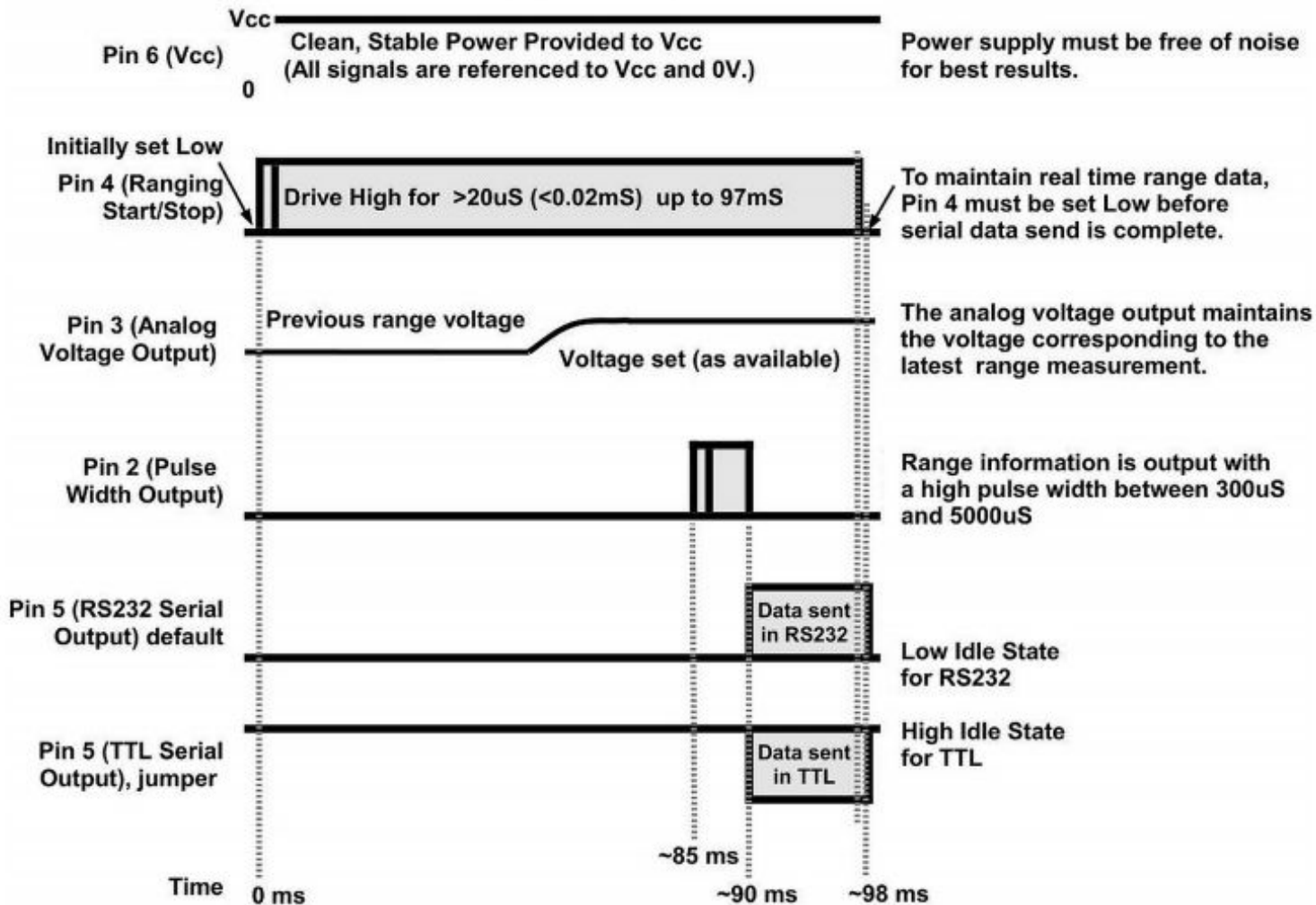
— 2.7 V



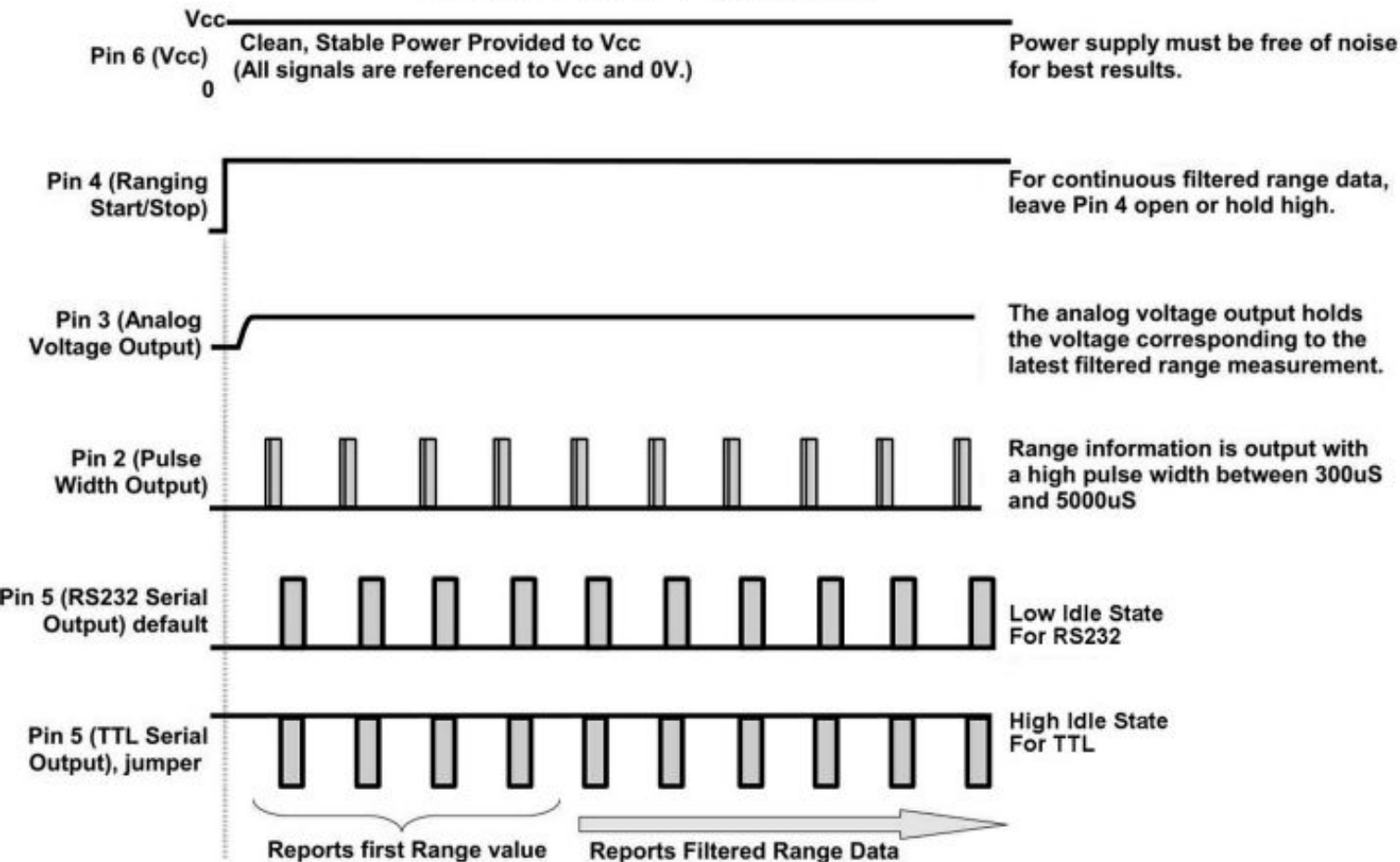
Beam Characteristics are Approximate

Beam Patterns drawn to a 1:95 scale for easy comparison to our other products.

Realtime Triggered Operation



Filtered Freerun Operation

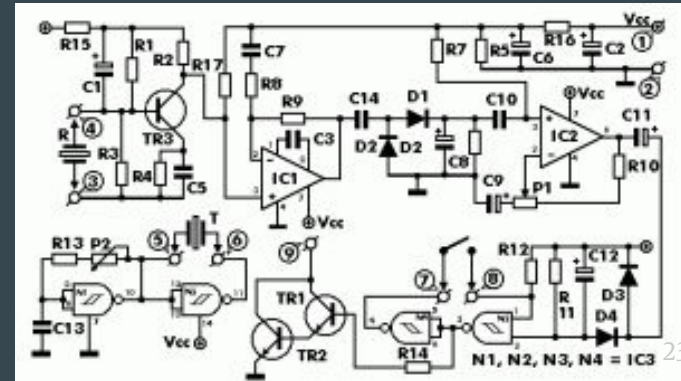
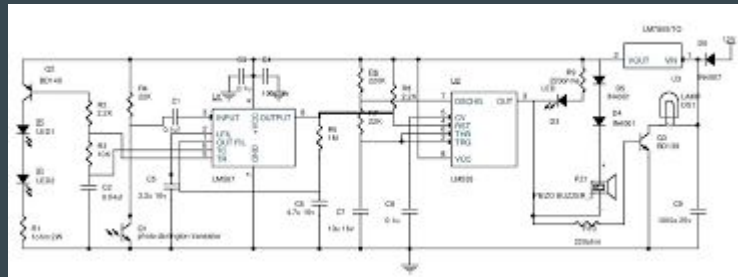
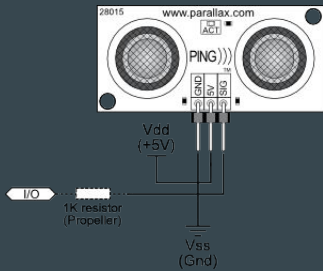
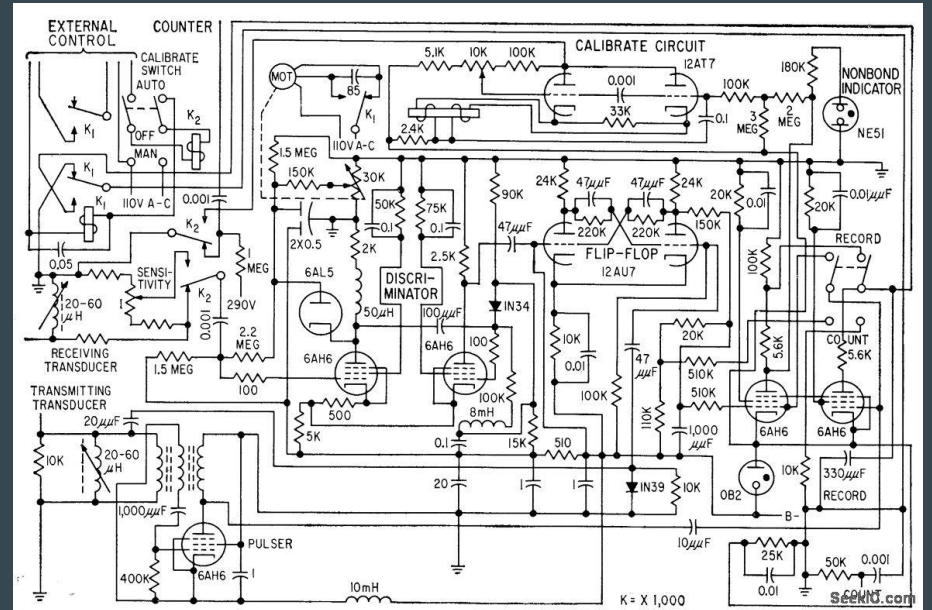
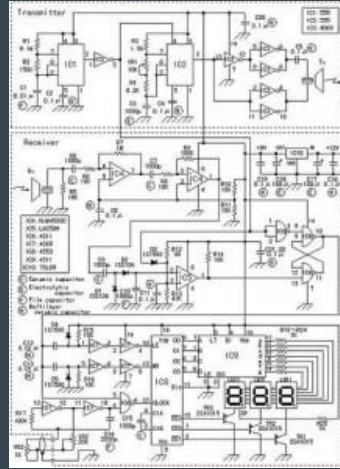
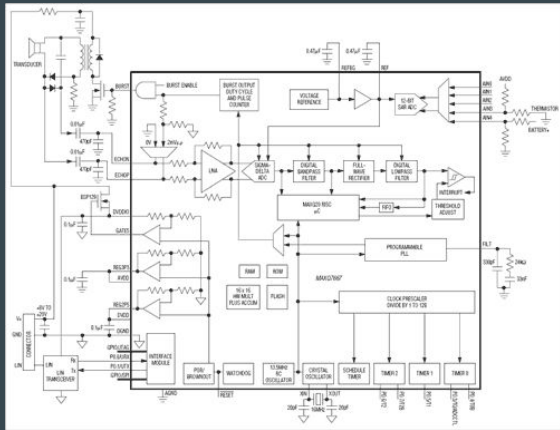


For detailed reading to reading timing look at Realtime Triggered Operation timing diagram.

Summary

- Two main types of distance sensors
 - Ultrasonic
 - Infrared (IR)
- Many parameters & capabilities to consider
 - distance range
 - precision
 - indoor/outdoor
 - robustness, accuracy, noise resistance
 - interfaces

Questions?



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