Distance sensor

GP2Y0A21YK0F

Distance Measuring Sensor Unit
Measuring distance: 10 to 80 cm
Analog output type

Reference document: gp2y0a21yk_e-3493 (3).pdf

Description:

GP2Y0A21YK0F is a distance measuring sensor unit, composed of an integrated combination of PSD (position sensitive detector) , IRED (infrared emitting diode) and signal processing circuit. The variety of the reflectivity of the object, the environmental temperature and the operating duration are not influenced easily to the distance detection because of adopting the triangulation method. This device outputs the voltage corresponding to the detection distance. So this sensor can also be used as a proximity sensor.

Features:

1. Distance measuring range : 10 to 80 cm
2. Analog output type
3. Package size : 29.5×13×13.5 mm
4. Consumption current : Typ. 30 mA
5. Supply voltage : 4.5 to 5.5 V

■Absolute Maximum Ratings

(Ta=25℃,Vcc=5V)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	-0.3 to +7	V
Output terminal voltage	V_O	-0.3 to V_{CC}+0.3	V
Operating temperature	T_{opr}	-10 to +60	℃
Storage temperature	T_{stg}	-40 to +70	℃

■Electro-optical Characteristics

(Ta=25℃,Vcc=5V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Average supply current	I_{CC}	L=80cm (Note 1)	—	30	40	mA
Distance measuring	ΔL	(Note 1)	10	—	80	cm
Output voltage	V_O	L=80cm (Note 1)	0.25	0.4	0.55	V
Output voltage differential	ΔV_O	Output voltage differece between L=10cm and L=80cm (Note 1)	1.65	1.9	2.15	V

* L : Distance to reflective object

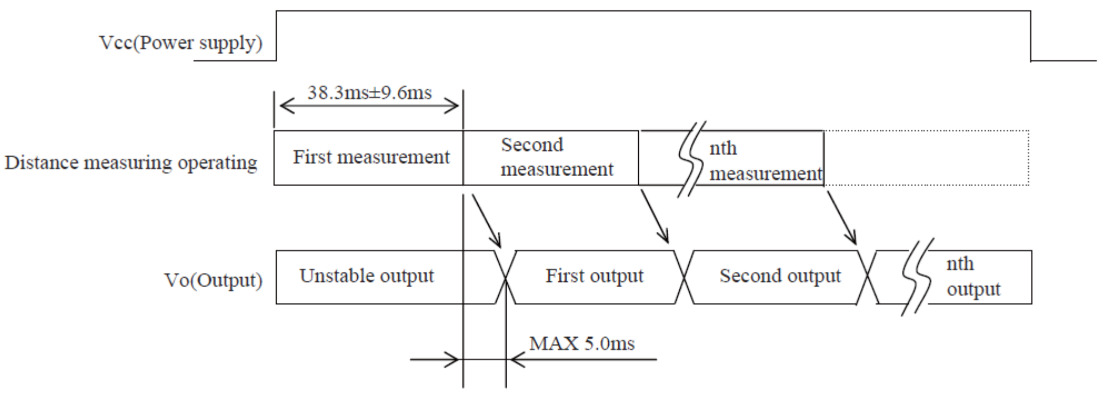
Note 1 : Using reflective object : White paper (Made by Kodak Co., Ltd. gray cards R-27・white face, reflectance; 90%)

■Recommended operating conditions

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	4.5 to 5.5	V

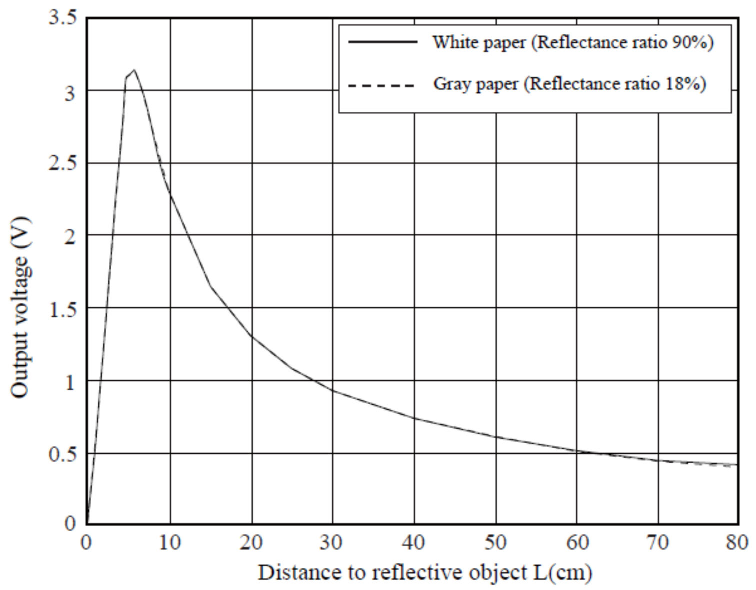
We Will consider the worst case scenario: a 40 mA consumption.

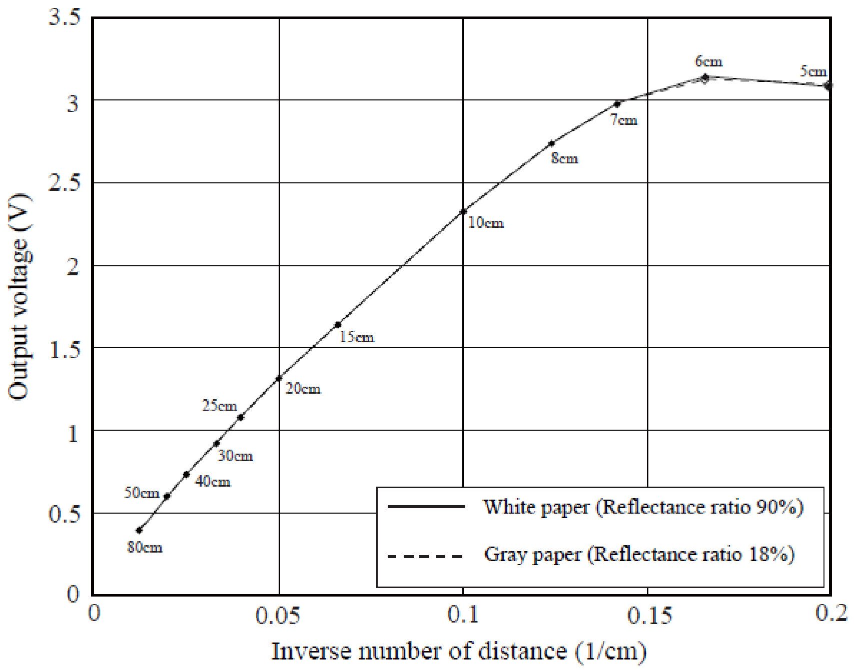
Fig. 1 Timing chart



When Reading the values, we have to take into account that we need to wait 55 ms t oread the first stable measurement. This doesn’t take into account the delay of the analog to digital conversion. So we cannot expect to work with this sensor with a higher response time than 100 ms (security margin). Which we don’t need for our purposes.

Fig. 2 Example of distance measuring characteristics(output)





In this graph we can see that if we use the inverse number of distance, we have a quasi-linear behaviour in the rango of 80 cm to 7 cm.
We Will test the sensors in order to obtain a similar graph of our device.
For this test, we Will use a White paper and place the sensor into 8 different distance (80, 70, 60, … , 10). Then we Will test 10 cm to 15 cm with 1 cm increment to test the precisión of the device. We Will do these tests twice to test its accuracy (repeteability).

To obtain a more linear behaviour, a linearization circuit may be applied.

Maintenance:
The optics must be kept clean. The lens shouldn't be washed.
The optical filter which has the most efficient transmittance at the emitting wavelength range of LED for this product (λ = 870 ± 70nm).

● **Advice for the power supply**

• In order to stabilize power supply line, we recommend to insert a by-pass capacitor of 10μF or more between Vcc and GND near this product.

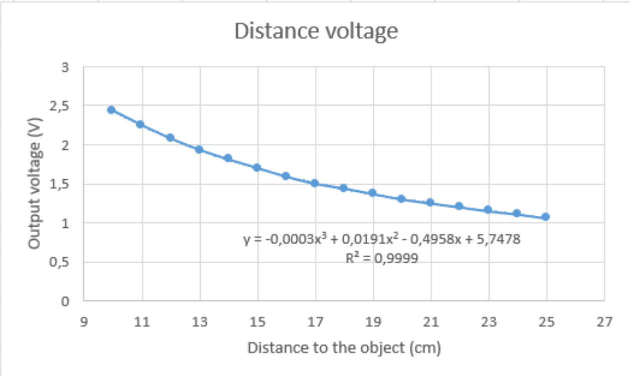
Wiring:

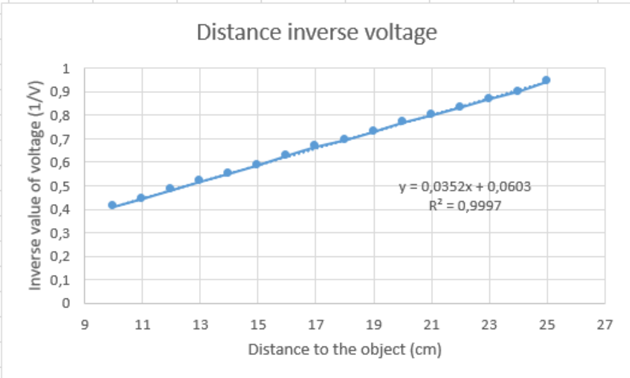
- Red: Power supply (5V)
- Black: Ground
- Yellow: Analog signal (to be measured in an analog pin with the ADC).
- 10 uF capacitor between Power supply and ground to ensure a stable power supply.

TEST

I have performed a test for a rango of 10 cm to 25 cm.

Distance (cm)	Voltage (V)	Inverse V
10	2,43	0,411523
11	2,245	0,445434
12	2,075	0,481928
13	1,93	0,518135
14	1,81	0,552486
15	1,7	0,588235
16	1,59	0,628931
17	1,5	0,666667
18	1,44	0,694444
19	1,37	0,729927
20	1,3	0,769231
21	1,25	0,8
22	1,2	0,833333
23	1,15	0,869565
24	1,11	0,900901
25	1,06	0,943396



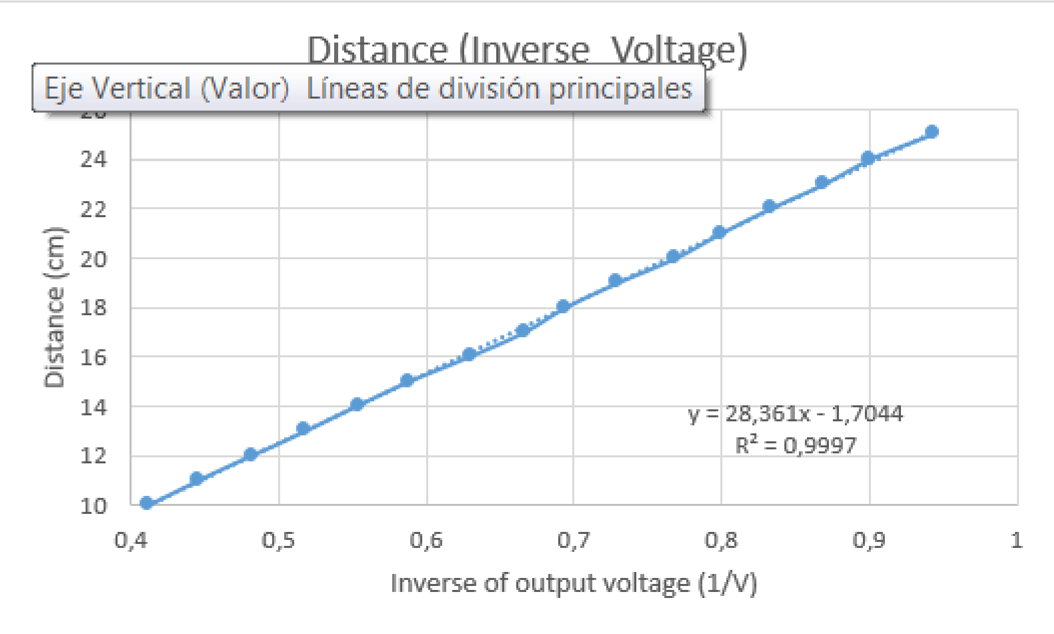


We can find a third degree polynomial approximation for the given rang (10 to 25 cm) with R^2 = 0.9999.

If we compute the inverse value of the voltage as it's recommended in the datasheet, we find a linear approximation with an R^2 = 0.9997. It's much easier for a microcontroller to use a linear function rather than a third-degree function.

If we plot the data with the inverse voltage as the independent value and distance as a dependent value of the inverse voltage, we obtain the function that we Will apply to Arduino to obtain the desired distance.

$$Distance(inverse\ voltage) = inverse\ voltage \cdot 28.361 - 1.7044$$


Distance (Inverse Voltage)
Eje Vertical (Valor) Líneas de división principales
24
22
20
18
16
14
12
10
Distance (cm)
y = 28,361x - 1,7044
R² = 0,9997
0,4
0,5
0,6
0,7
0,8
0,9
1
Inverse of output voltage (1/V)