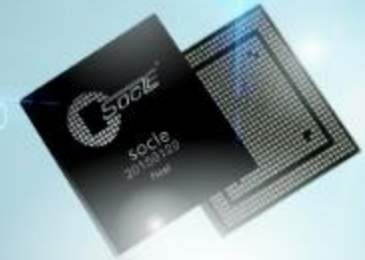




Sharp Dust Sensors Product Introduction



虹晶股份有限公司 Socle Technology Corp.

July 2018



Dust Sensor Applications

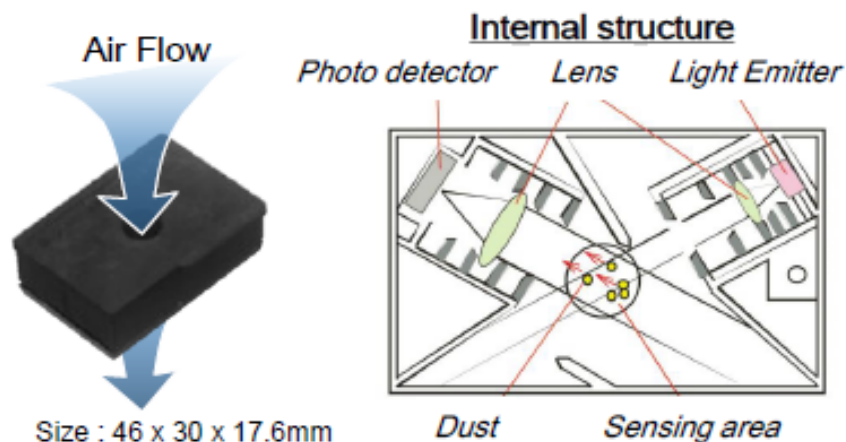
- Air purifier / air cleaner
- Air conditioner
- Air quality monitor
- Vacuum cleaner
- HVAC, environmental monitoring
- Portable consumer products
- Wearable products and smartphone integration
- Customers range from home appliance makers to startup companies
- Lots of interest from research institutions / universities (search GP2Y1010)



Dust Sensor Principles

Principle

Measuring the intensity of the scattered light by dust



Applications

Air pollution Alert

Fan control

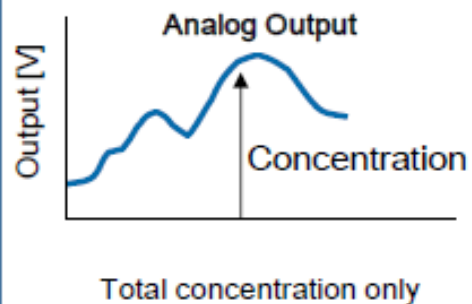
Information by smartphone

Air purifier

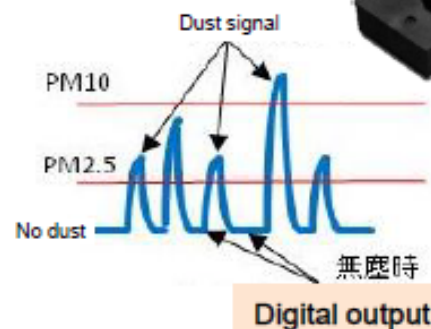
Air conditioner

Environment Sensor

Conventional Model



New Model



☆Particle counter method by new original control IC

☆Selectable particle size (PM2.5/PM10)

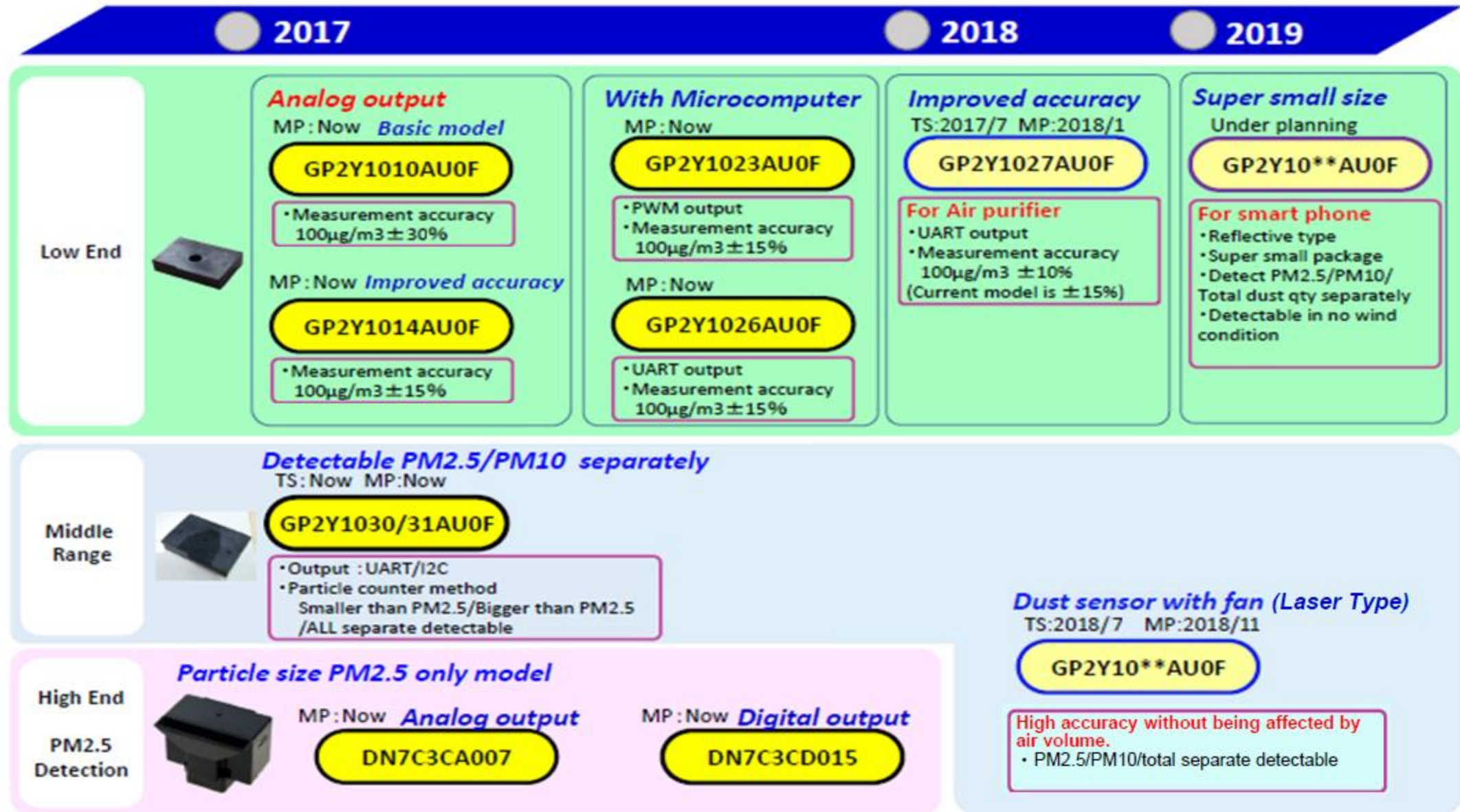
☆Compact and Low power consumption

Key Concepts

Dust Size is the diameter of a dust particle which is measured in microns (μm) which is the same as a micrometre.	PM_{2.5} is particulate matter < 2.5 microns in diameter such as combustion particles, organic compounds and metals. Also called fine particles and most are hazardous to human health.	PM₁₀ is particulate matter < 10 microns in diameter such as dust, pollen and mold. Human hair is 50 to 70 microns in diameter.
Dust Density is measured in units of mass / volume such as $\mu\text{g}/\text{m}^3$ or mg/m^3 .	Output Voltage Sharp Dust Sensors generally output a voltage. The higher the voltage, the higher the dust density.	Sensitivity Accuracy Detect changes in dust density of $100 \mu\text{g}/\text{m}^3$ with Accuracy of 15%.
Design Considerations Placement and orientation of sensor, mounting method	Fan / Airflow Sharp dust sensors generally require some airflow. This can be from a fan or wind generating air speed of $0.5\sim 3\text{m/s}$.	Output At No Dust When there is no dust, sensor may still output a value Voc which can help distinguish between sensor not working versus no dust situation.

Sharp Dust Sensors - Current Product Lineup

PART NUMBER	SUITABLE FOR NEW DESIGN	NOTE
<u>DUST SENSORS</u>		
GP2Y1010AU0F	N	Active, older model, very well-known product
GP2Y1014AU0F	Y	Low cost, high volume sales worldwide, lots of interest from cost down projects, similar to GP2Y1010AU0F
GP2Y1023AU0F	N	Active, but not very popular, PWM output model
GP2Y1026AU0F	Y	Launched in 2017, promotable model for new designs. Demo kit with sensor, cable, and Arduino source code available.
GP2Y1027AU0F	Y	New product launched in Q1, 2018
GP2Y1030AU0F	Y	Launched in 2017, few production customers, high cost
<u>PM2.5 ONLY SENSOR MODULES</u>		
DN7C3CA007	N	Very few production customers, very high cost, may be phased out
DN7C3CD015	N	Very few production customers, very high cost, may be phased out



Comparison between Recommended Models for New Design

PART NUMBER	KEY FEATURES	OUTPUT INTERFACE	SENSITIVITY ACCURACY
GP2Y1014AU0F	Improved accuracy over GP2Y1010AU0F	Analog output	$0.5 \pm 0.075V$ $100\mu g/m^3$ Accuracy $\pm 15\%$
GP2Y1026AU0F	Built-in LED pulse drive circuit, built-in microcomputer to provide offset correction, averaging, and temperature correction. Supports wider range of dust concentrations.	Digital output (UART)	$0.35 \pm 0.06V$ $100\mu g/m^3$ Accuracy $\pm 15\%$
GP2Y1027AU0F	Similar to GP2Y1026AU0F but with improved accuracy	Digital output (UART)	$100\mu g/m^3$ Accuracy $\pm 10\%$
GP2Y1030AU0F	Particle counter method, detect PM _{2.5} or PM ₁₀ separately or both	Digital output (UART)	$100\mu g/m^3$ Accuracy $\pm 15\%$

GP2Y1014AU0F - Analog output, basic model

- Analog output, similar in function to GP2Y1010AU0F
- Newer sensor model which can replace GP2Y1010AU0F
- Improved accuracy over GP2Y1010AU0F (15% versus 30%)
- Lower cost than GP2Y1010AU0F due to higher volume worldwide sales



Comparison between GP2Y1010AU0F and GP2Y1014AU0F			
Model		GP2Y1010AU0F	GP2Y1014AU0F
Outline		Normal sensitivity For general customer	Improved Accuracy Narrow output range when there is no dust For general customer
Performance	Output at no dust	0 ~ 1.5V	0.1 ~ 1.1V
	Sensitivity Accuracy	Normal sensitivity $0.5 \pm 0.15V / (0.1mg/m^3)$ Accuracy $\pm 30\%$	Normal sensitivity $0.5 \pm 0.075V / (0.1mg/m^3)$ Accuracy $\pm 15\%$

GP2Y1014AU0F - Specification

Parameter	GP2Y1014AU0F
Light emitting element	LED
Minimum dust size	0.5μm
Sensing range (PM2.5)@tabacco-smoke	~ 580ug/m ³ (Actual value)
Sensitivity accuracy	±15%
Output interface	Analog voltage
Sensing time	< 1 second
Sensing of each dust size separately	No (measures total dust density only)
Sensor lifetime	5 years
User maintenance	suction by vacuum cleaner
Power consumption	105 mW
Operating Temp.	-10 ~ 65°C

GP2Y1026AU0F - Digital output (UART), built-in microcomputer

Features

1.High accuracy. : $\pm 15\%$

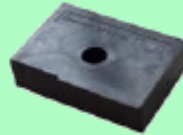
2.Built-in LED Pulse Drive Circuit

3.Built-in Microprocessor.

★Dust concentration is converted to Uart signal output.

★No need for offset correction nor averaging in set.

4.Built-in Temperature Correction.



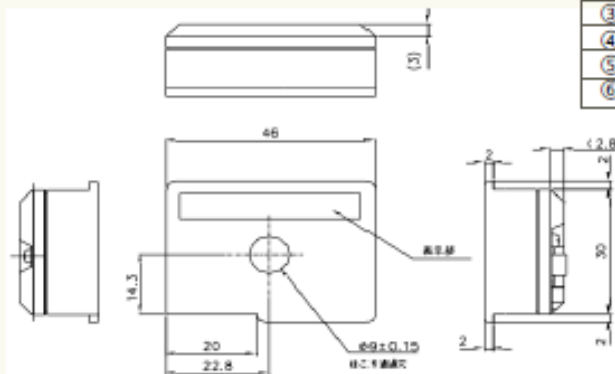
Specifications

Parameter	Symbol	Value	*
Size	—	46×34×17.6mm	Same
Output interface	—	Serial Uart	Same
Operating supply voltage	V _{CC}	5 ± 0.25 V	Same
Current consumption	I _{CC}	Max 20mA	Same
Sensitivity	K	±15%	◎
Operating temp.	T _{opr}	-10 to 65 °C	Same
Storage temp.	T _{stg}	-20 to 80 °C	Same
Temp. correction	—	Correction by microcomputer	◎



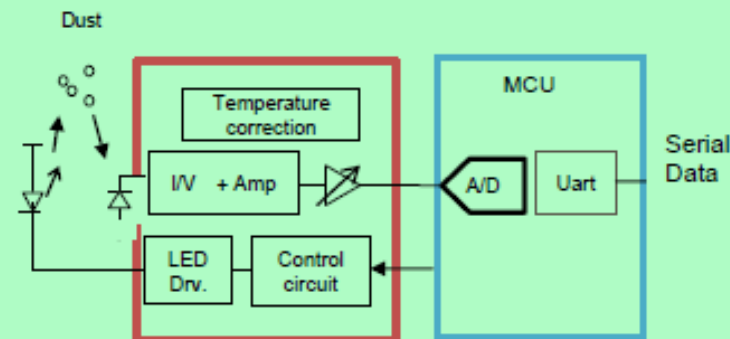
*Comparison with model GP2Y1051AU0F

Outline dimensions



No.	Terminal name
①	GND
②	V _{CC}
③	NC
④	NC
⑤	RxD
⑥	TxD

Block diagram



GP2Y1027AU0F - Digital output (UART), high accuracy (NEW)

Features

1.High accuracy. : $\pm 10\%$
(Current model(GP2Y1026AU0F) is $\pm 15\%$)

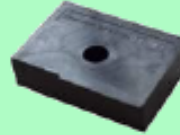
2.Built-in LED Pulse Drive Circuit

3.Built-in Microprocessor.

★Dust concentration is converted to Uart signal output.

★No need for offset correction nor averaging in set.

4.Built-in Temperature Correction.

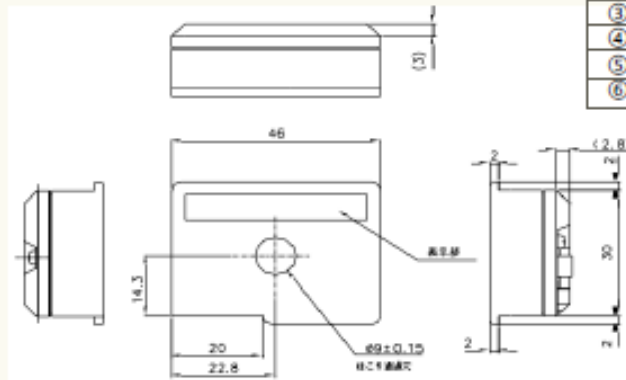


Specifications

*Comparison with model GP2Y1026AU0F

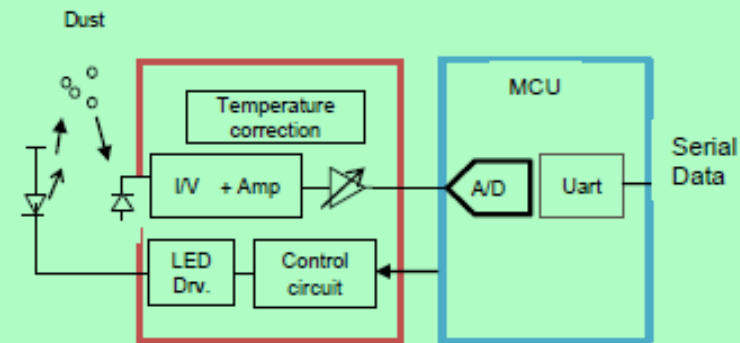
Parameter	Symbol	Value	*
Size	—	46×34×17.6mm	Same
Output interface	—	Serial Uart	Same
Operating supply voltage	V _{CC}	5 ± 0.25 V	Same
Current consumption	I _{CC}	Max 20mA	Same
Sensitivity	K	±10%	◎
Operating temp.	T _{opr}	-10 to 65 °C	Same
Storage temp.	T _{stg}	-20 to 80 °C	Same
Temp. correction	—	Correction by microcomputer	Same

Outline dimensions



No.	Terminal name
①	GND
②	V _{CC}
③	NC
④	NC
⑤	RxD
⑥	TxD

Block diagram



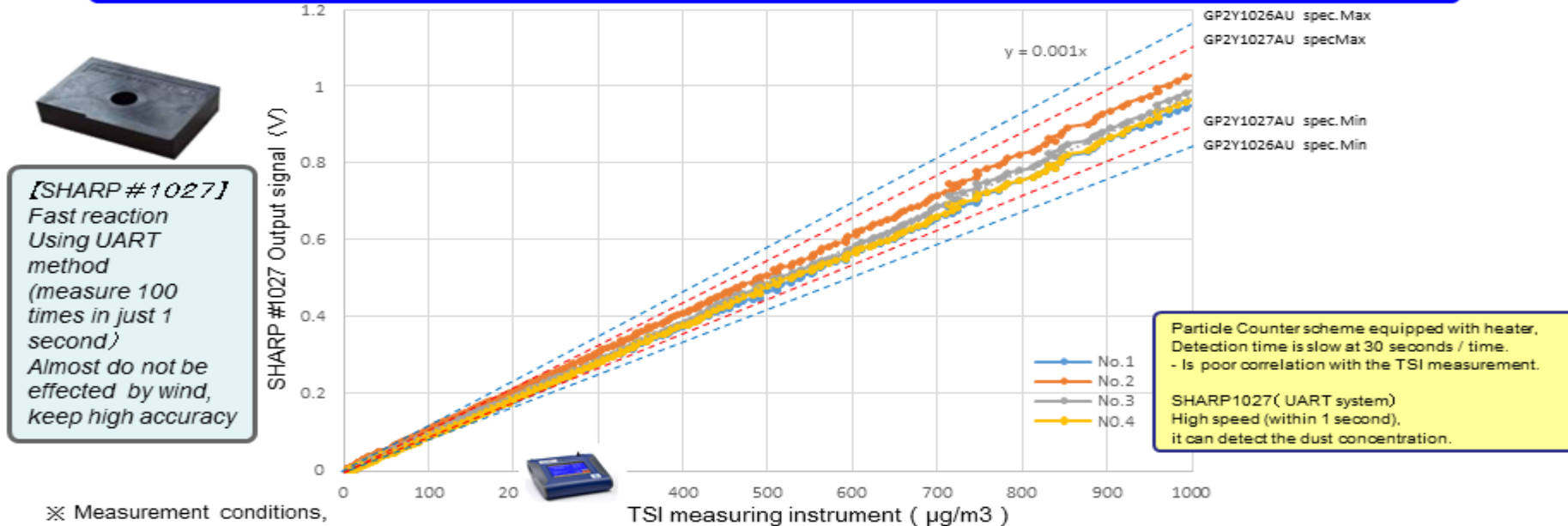
GP2Y1027AU0F - Comparison with other models

Compare Item	Now		NEW		VS Dust sensor (Laser type)	
		Dust sensor Current model (GP2Y1026AU0F)		High accuracy Dust sensor (Target spec.) (GP2Y1027AU0F)		
Sensing system	—	Average density	—	Average density	—	Particle count
Minimum dust size	—	0.5μm	—	0.5μm	○	0.3μm
Sensing range (PM2.5)@Tabaco-smoke	—	~1000ug/m ³ (Actual value)	—	~1000ug/m ³ (Actual value)	—	~550ug/m ³
Sensitivity accuracy	×	±15%	○	±10%	○	±10%
Output interface	—	Serial data (UART)	—	Serial data (UART)	—	Serial data (UART)
Sensing time	○	1sec	○	1sec	×	<10sec
Sensing of each dust size	×	No(Total dust density)	×	No(Total dust density)	—	1.0/2.5/10μm以上
Life time	○	5years	○	5years	—	3years
User maintenance	—	Cleaning by vacuum	—	Cleaning by vacuum	×	Impossible (Structure dust tends to accumulate)
Power consumption	○	125mW	○	125mW	×	500mW (With fan motor)
Operating Temp.	-	-10~65°C	-	-10~65°C	-	-20 ~ 50 °C

SysD_Sep,2016

Technology of SHARP (GP2Y1027AU0F)

- GP2Y1027 adopted the "average concentration method".
High-speed averaging. Averaging 100 times the detection signal in one second.
Stable dust concentration measurement can be conducted!
- Good correlation with TSI measuring instrument !
TSI Inc. easily calculate the concentration display value. No heavy work!



※ Measurement conditions,
[Installation situation]
"China standard TSI Inc(Type8530) ", "SHARP (#1027)" simultaneous measurement
in the environment BOX (size:1m³) . (n=4)
[China standard TSI Inc. DustTrakII8530]
Note: Adopt the coefficient $K = 0.27$ K value, you must decide to suit your measurement environment.
[Measurement Particles] tobacco smoke (Mevius)

GP2Y1030AU0F - Comparison with other models

Compare Item		SHARP Dust sensor (GP2Y1023AU0F)		New Dust sensor (Target spec.) (GP2Y1030AU0F)		Another S company Dust sensor
	—	Average density	○	Particle count (Average density output is possible)	—	Particle count
Minimum dust size	○	0.5μm	—	1μm	—	1μm
Sensing range (PM2.5)@Tabaco-smoke	—	25~500ug/m ³	—	25~500ug/m ³	—	~500ug/m ³
Sensitivity accuracy	○	±15%	◎	±15%	—	2700pcs./283ml ± 35% (Lo Pulse Time 5%)
Output interface	—	PWM	○	Serial data (UART/I2C)	—	Pulse duty
Start-up time	○	<1sec	○	<5sec	×	60sec
Sensing time	○	<1sec	—	10sec	—	10 ~ 30sec
System for separating PM2.5	×	No	×	No	×	No
Sensing of each dust size	—	No	○	Yes(Output of 3 range particle size is possible)	○	No(Possible on data processing)
Temp. correction	○	Correction by microcomputer	○	Correction by sensor circuit		Unknown
User maintenance	△	Suction by vacuum cleaner	○	Cleaning inside of sensor	○	Cleaning inside of sensor
Power consumption	○	125mW Possible intermittent operation	○	125mW Possible intermittent operation	×	450mW
Operating Temp.	○	-10 ~ 65 °C	○	-10~65°C	×	Sensing system

GP2Y10**AU0F - High accuracy dust sensor with built-in Fan (Laser Diode)

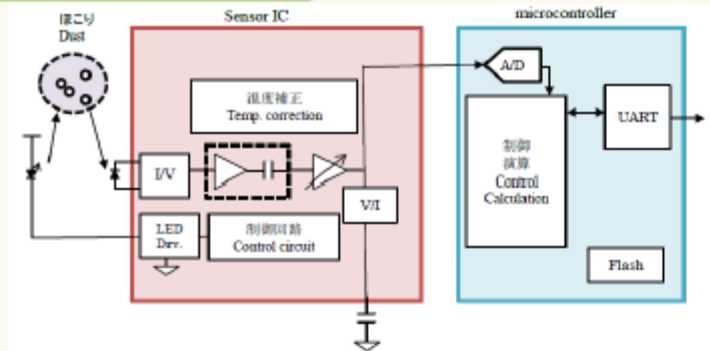
Features

- High accuracy : High correlation with TSI $\pm 10\%$
(The accuracy is same level as plantower in total dust quantity(Cigarette))
- PM2.5>, PM2.5<, Total detected separately.
- Using laser diode for light emitting element
- With fan motor to prevent the effect of airflow

Specification

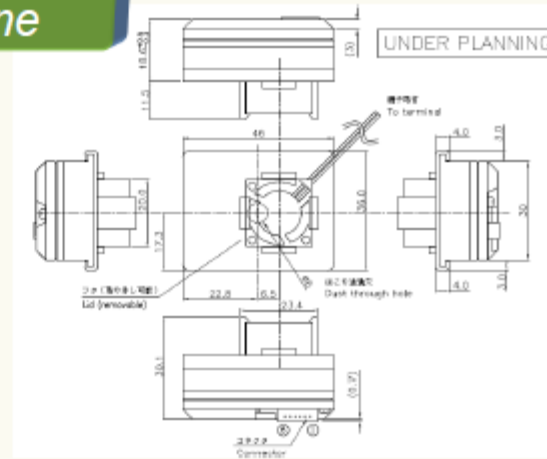
Parameter	Symbol	Value
Output interface		I2C ~100kHz
Operating supply voltage	V_{CC}	4.5~5.5V
Current consumption	I_{CC}	Max.140mA
Accuracy	K	$\pm 10\%$ (TSIとの相関10%)
Operating temp.	Topr	-10 to 65°C
Storage temp.	Tstg	-20 to 80 °C

Block diagram



*Using laser diode for light emitting element.

Outline



Under Planning

Dust Sensor Resources

- <https://github.com/sharpsensoruser/sharp-sensor-demos/wiki>
- [Application Note for Sharp dust sensor GP2Y1010AU0F](#)
- <http://arduino.dev.woofex.net/2012/12/01/standalone-sharp-dust-sensor/>
- https://github.com/Trefex/arduino-airquality/tree/master/Module_Dust-Sensor
- https://github.com/PaulZC/GP2Y1010AU0F_Dust_Sensor
- <http://www.howmuchsnow.com/arduino/airquality/>
- https://www.dfrobot.com/wiki/index.php/Sharp_GP2Y1010AU
- <https://github.com/vlytsus/arduinosenor>
- https://github.com/chiknhed/sharp_dust_gp2y1010au
- <http://hazardweatherstation.blogspot.ca/2012/06/optical-dust-sensor.html>
- <https://create.arduino.cc/projecthub/zanycadencedev/ble-sharp-dust-sensor-artik-iot-cloud-304fd9>
- <http://www.mentalmunition.com/2013/09/understanding-air-pollution-with-simple.html>
- <http://www.esp8266learning.com/wemos-dust-sensor-example.php>
- <http://arduinosenor.tumblr.com/page/2>

Dust Sensor Resources

- <https://pdfs.semanticscholar.org/d641/19160b9effd57448b44d39d5ac5468ed0eff.pdf>
- http://www.teco.edu/~budde/publications/MUM2013_budde.pdf
- <http://eereview.com/article/gp2y1014au0f-pm25-optical-dust-density-sensor>
- http://www.iaarc.org/publications/fulltext/isarc2014_submission_50.pdf
- https://www.researchgate.net/figure/Particulate-matter-sensors-AES-1-a-DSM501A-b-and-GP2Y1010-c_fig3_266483250
- <https://newatlas.com/smartphone-sensor-crowdsourced-pollution-map-karlsruhe/32932/>
- <https://www.ama-science.org/proceedings/getFile/ZwD2BD==>
- <http://www.aresok.org/npg/nioshdbbs/calc.htm>

About Socle Technology Corp.

- Founded in 2001, Socle Technology Corp is a leading semiconductor design firm headquartered in Taiwan
- Socle provides SoC (System-on-Chip) design services for IoT, server, automotive, multimedia, and peripheral market segments
- 100% owned by Foxconn Technology Group (Hon Hai Precision Industry Co., Ltd.)
- Sales and marketing for Sharp Optoelectronics components and sensors in North America and China since 2017
- Parts are still designed and manufactured by Sharp, no change in production or packaging or branding
- Authorized distributors: WPG Americas, Future Electronics, Mouser, Digi-Key, WPI Group

For more information, contact: Socle_Sales_NA@socle-tech.com

<http://www.socle-tech.com/>