Application note

GP2Y1010AU (Dust Sensor)

Application note of Sharp dust sensor (GP2Y1010AU)
Contents

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1. Outline of this document

This application note of Sharp dust sensor *"GP2Y1010AU"* is a document consists from explanation how to use, cautions when using it, characteristics data, etc. for the customer's reference when applying this device.

When designing the device, please refer to this document and also evaluate it under actual usage conditions.

2. Features of GP2Y1010AU

- Compact & thin package (46 x 36 x 17.6mm)
- With application of pulse output system, the device can detect even single house dust.
- House dust and cigarette smoke can be distinguished.

3. Objects to detect

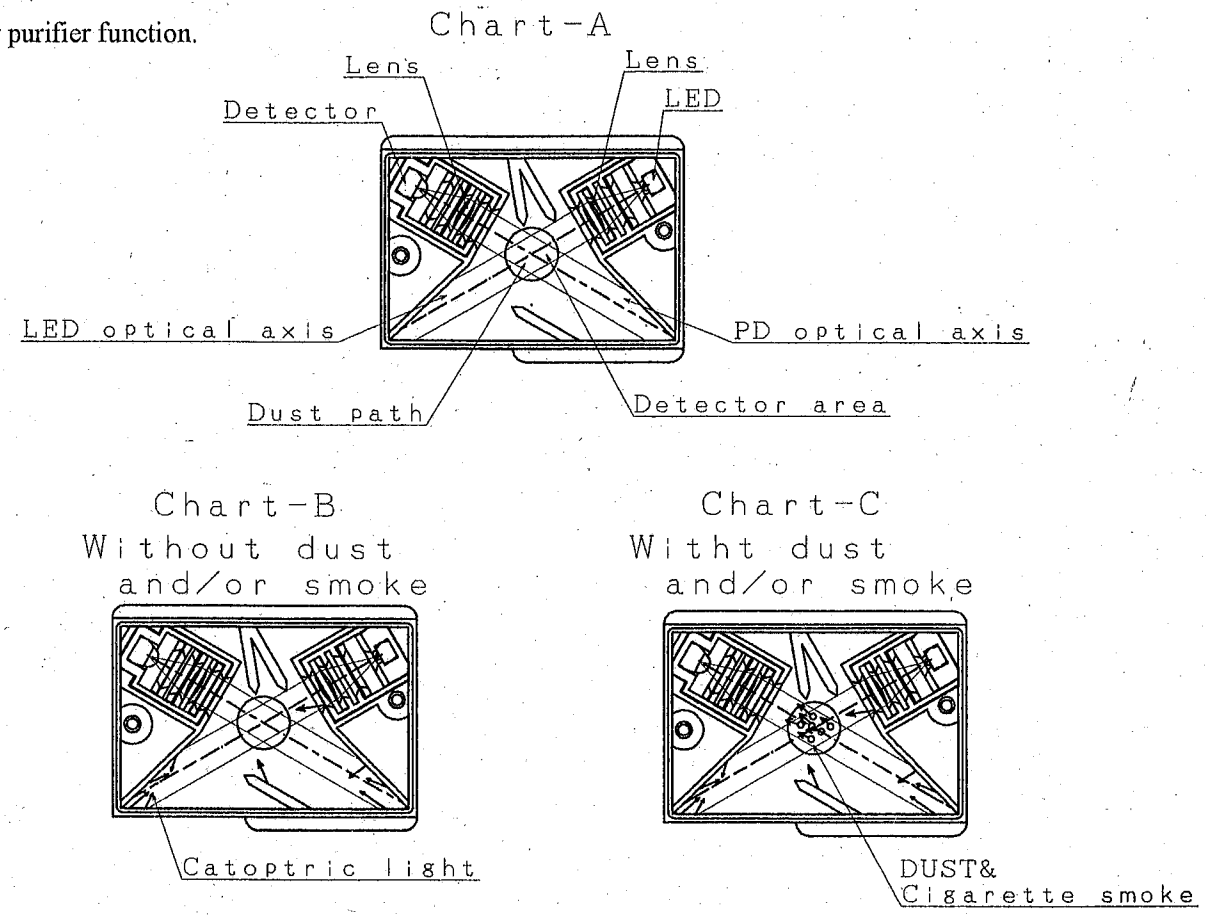
- House dust
- Cigarette smoke

4. Application

- Air conditioner
- Air purifier

5. Principles of dust detection

This dust sensor *"GP2Y1010AU"* is the device to detect house dust, cigarette smoke, etc. and designed as a sensor for automatic running of application like air purifier and air conditioner with air purifier function.



Light from the light emitter (Light Emitting Diode) is spotted with a lens and a slit as shown on the chart-A. Also for the light detector (Photodiode), a lens and a slit is positioned in front of it to cut disturbance light and to detect light reflection (when detecting dust) efficiently. Area where those two optical axis cross is detection area of the device.

Chart-B shows what is ongoing inside of the device when no dust exists and Chart-C shows that when dust exists.

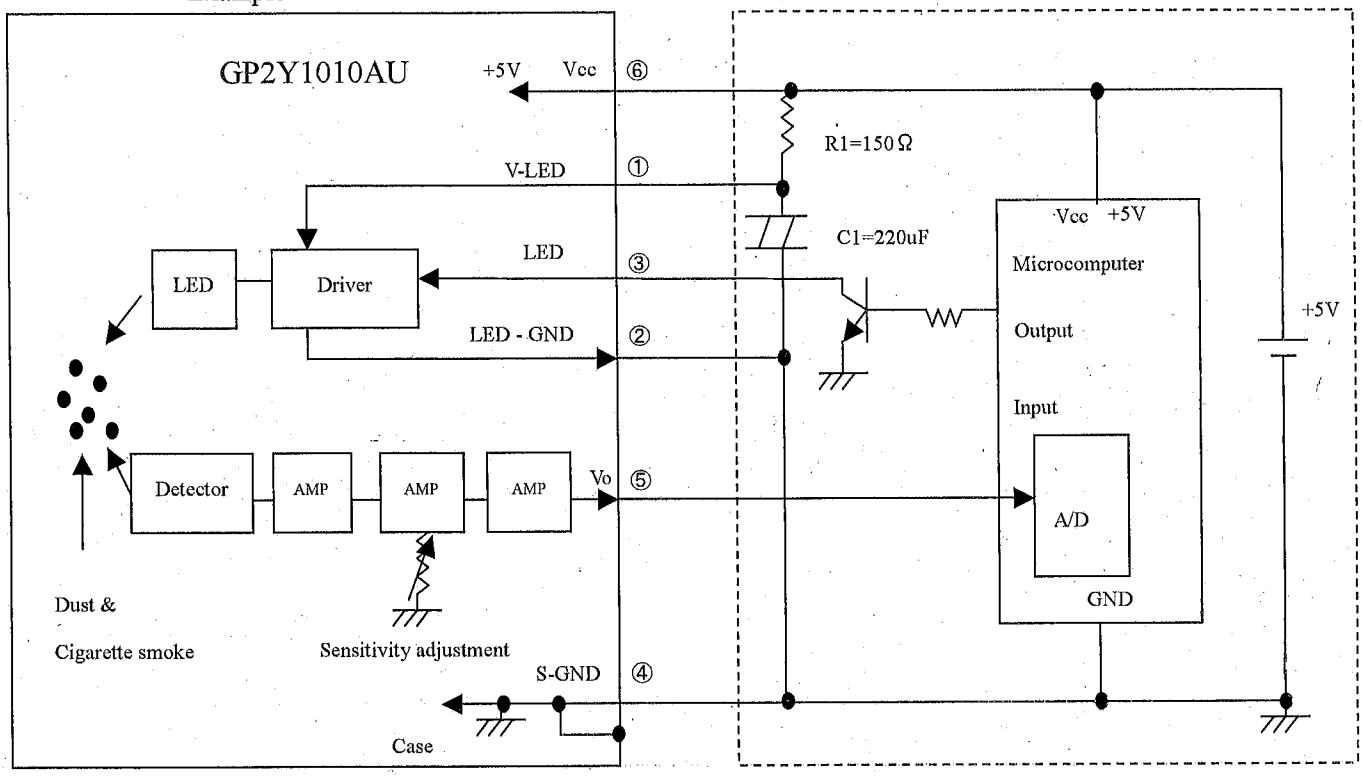
The device makes voltage output even when dust is not being detected. This output voltage at no dust condition is specified as Voc on the specification. This is because light emitted from the LED reflects at case of the device & some part of it gets to the detector.

Chart-C shows how the device works when dust and/or cigarette smoke exists inside of it. In this case, the detector detects the light reflected from the dust and/or a particle of the cigarette smoke. Current in proportion to amount of the detected light comes out from the detector and the device makes analog voltage output (Pulse output) after the amplifier circuit amplifies the current from the detector.

6. Application guidance

6-1 Example of system connection

<Example>



- Resister, R1=150Ω and capacitor, C1=220uF mentioned above is required for pulse drive of the LED of GP2Y1010AU. Please use the ones with the above mentioned constants. Without these components, the device does not work.
- As input conditions of the LED terminal, please apply LED drive conditions mentioned in Electro-optical characteristics chart of the specification. When it is impossible to apply those conditions, please make it within the recommended input conditions mentioned in the specification. When the LED is driven under the condition beyond the specification, characteristics of the device will be affected. Please refer to 7-2 LED operation data.
  (T (Cycle) – Vo (Output voltage), Pw (Pulse width) – Vo (Output voltage)).

Parameter	Symbol	Specified condition	Recommended condition	Unit
Pulse cycle	T	10	10±1	ms
Pulse width	Pw	0.32	0.32±0.02ms	ms

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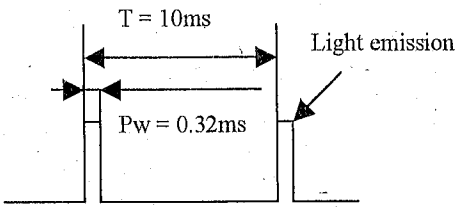
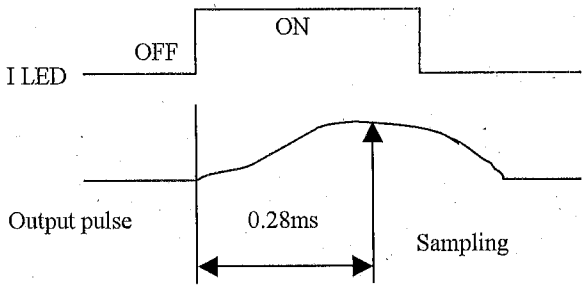
- The LED emits pulse light. Detected signal is amplified by the amplifier circuit and goes out as the output synchronized to the pulse mission of the LED.
- The specified output value is the one that is measured 0.28ms after the LED is turned on. Therefore, it is recommended that microcomputer to read the output 0.28ms after the LED emission also.

Sampling timing of output pulse



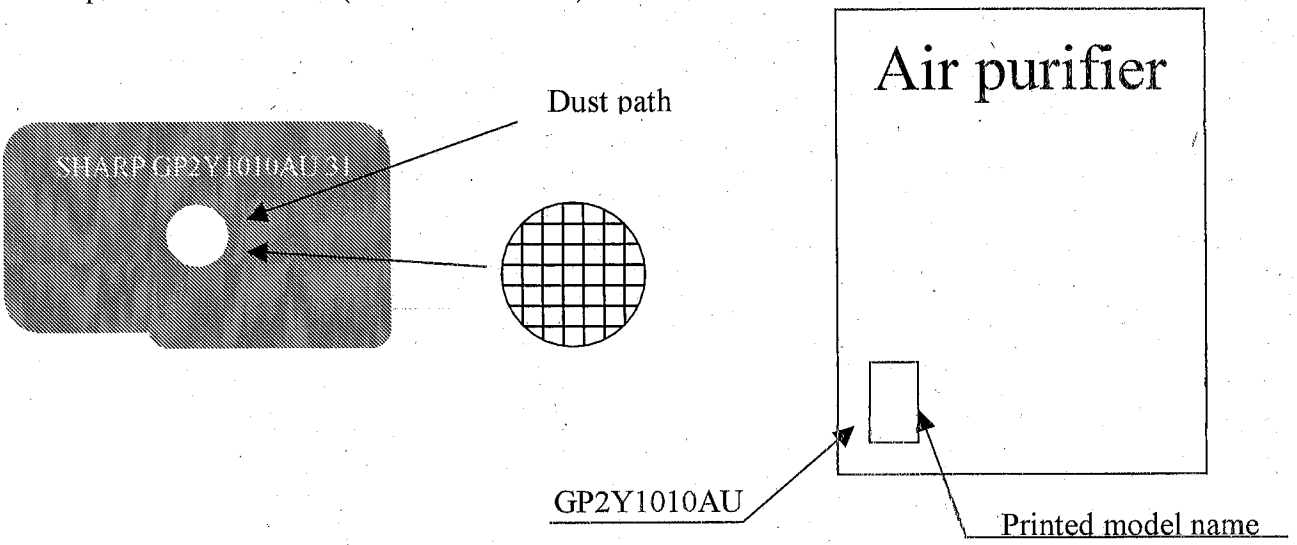


- Time required for the device to be ready to detect dust from when the system is turned on is less than 1 sec. Since GP2Y1010AU does not have peak hold circuit, the time is shorter compared with that of the conventional model (GP2U05/GP2U06), which have the peak hold circuit.

6-2 Mounting method

To minimize affect of dust sticking to the emitter and the detector, please mount the device so that printed model name on the device to be in upper side. (In this manner, lens of both emitter & detector faces downward.) In addition, please mount the device so that a plane with the print to face inside of the system to minimize affect of disturbance light.

Also to avoid big dust (string dust, etc.) to collect inside the device, placing a filter in front of dust path is recommended. (Ref. the below chart)



When dust collects inside the device and the sensor makes wrong output, please clean up by wiping up or by vacuum cleaner.

6-3 Detection of dust and cigarette smoke

Difference between GP2Y1010AU and the conventional models

As mentioned in the below chart, GP2Y1010AU is pulse output type and the conventional model (GP2U05/GP2U06) is DC output type. The conventional models have peak hold circuit in amplifier circuit but GP2Y1010AU does not have the peak hold circuit and makes pulse output.

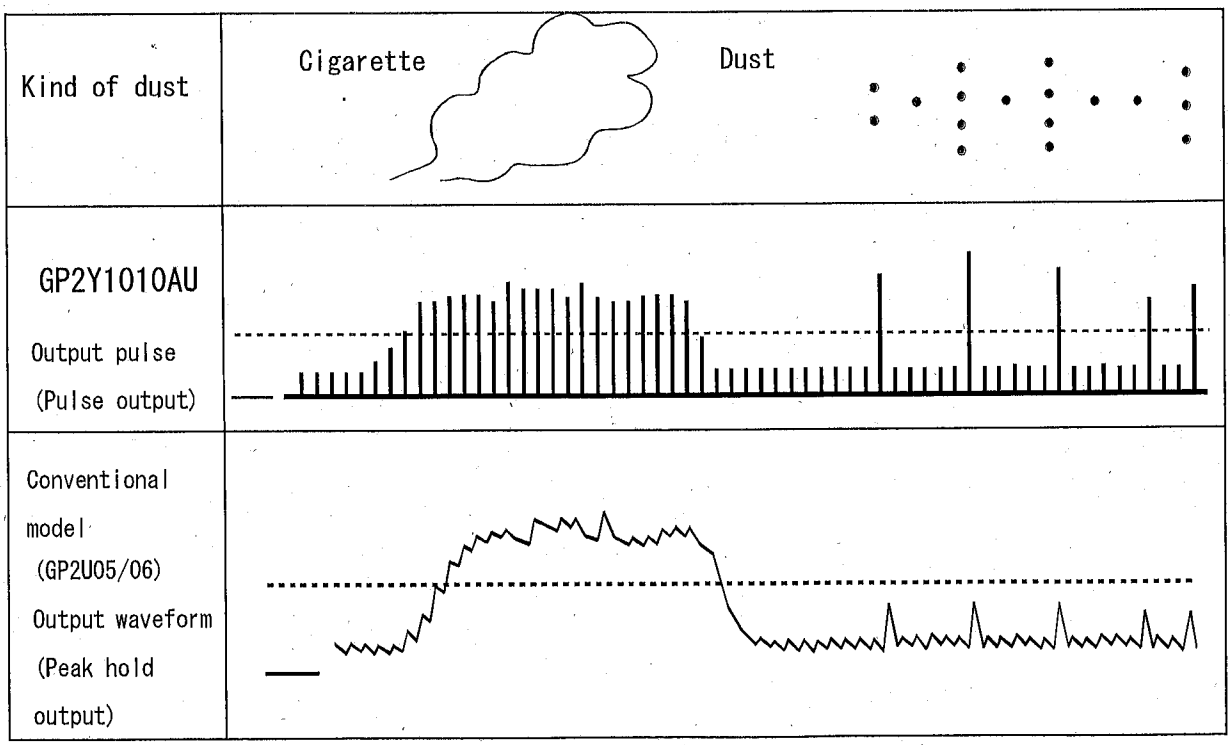
Distinguishing between dust and cigarette smoke

In general, cigarette smoke consists of highly dense small particles and is diffusing while moving slowly. On the other hands, dust is big, density is low and it comes periodically into the detection area. As on the below chart, cigarette smoke can be detected & the sensor can make detection output continuously. But the output when detecting dust becomes intermittent. Therefore, by reading a transition of the sensor output (pulse output synchronized to the LED emission) during a certain time period by microcomputer, the system can distinguish;

(a) No dust
(b) Cigarette smoke exists
(c) Dust exists

And the system can also detect how much air is polluted.

Since the conventional models have the peak-hold circuit and time constant is big, response time (rise/fall time) is long and it may difficult to detect sporadic dust sometimes.



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6-4 Adjustment method

This device applied light emitting diode (LED). In general, output of LED decreases long term operation.

This LED degradation has the following affect on the dust sensor.

(a) Output voltage with no dust detection decreases.

(b) Detection sensitivity decreases.

As the adjustment methods for the above two items, there exist two methods mentioned below.

(1) Memorize output voltage with no dust detection at the time of shipment of the finished product on E^2PROM. In the market, when the output voltage stays in the same level for a certain time period or becomes lower than the memorized value, the system refreshes the memory. And the microcomputer adjust judgement criteria of dust detection in proportion how much the voltage with no dust detection decreases.

(2) This device is sensing background level(no dust level) always continuously. Background level is memorized anytime comparing this memorized data with measured data, this device decide dust existence or not.

6-5 Other cautions

- Please do not clean the device since cleaning may affect characteristics of the device and it may result in operation failure of the device.
- VR for sensitivity adjustment is adjusted in accordance to the specification at the time of shipment from Sharp. Therefore, please do not change value of it or the value may become out of the specification.
- Please do not disassemble the device. Once disassembled, the device may not have the same characteristics that it has had before the disassembly even if it is assembled again.
- Vibration may affect the characteristics of the device. Therefore, please make sure that the device works properly under actual usage conditions.
- The device does not work properly if bedewing occurs inside of it. Please design products so that the bedewing does not occur inside of the device.
- If the device is placed close to a noise generator (Electric dust collector, etc.), the sensor output may fluctuate due to inductive noise from the noise generator. Please consider the affect of the noise generator to the device when designing products.

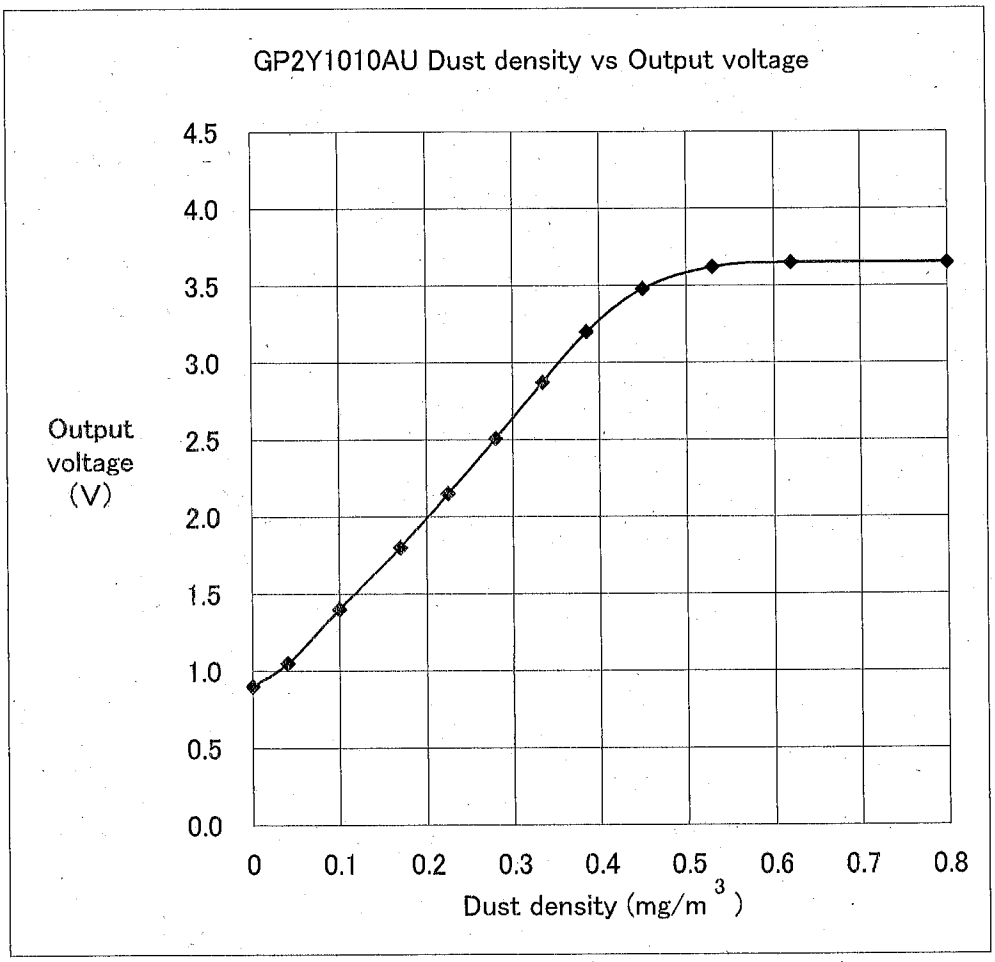
7. Characteristics data

Data of 7-1～7-4 are for reference and characteristics shown on the data is not guaranteed.

7-1 Dust density vs Output Voltage

Test conditions:

According to 3-3 (Electro-optical characteristics) of the specification of GP2Y1010AU



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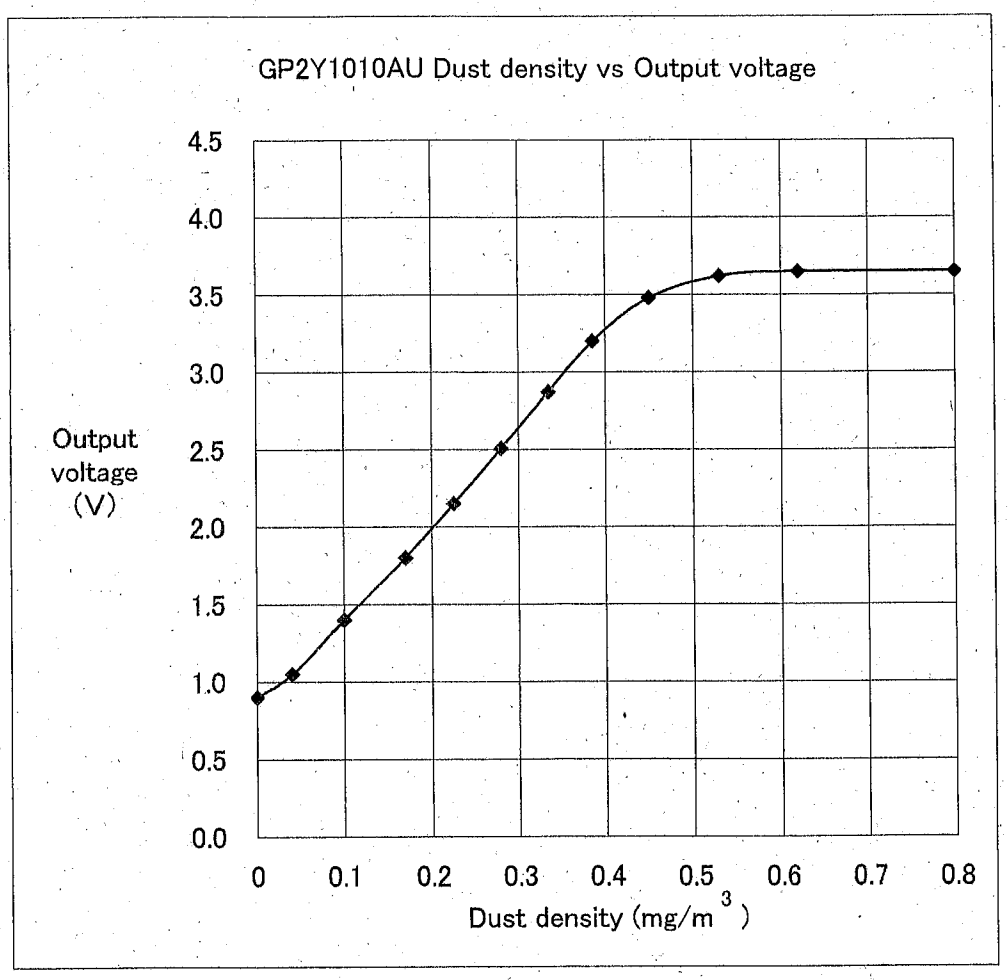

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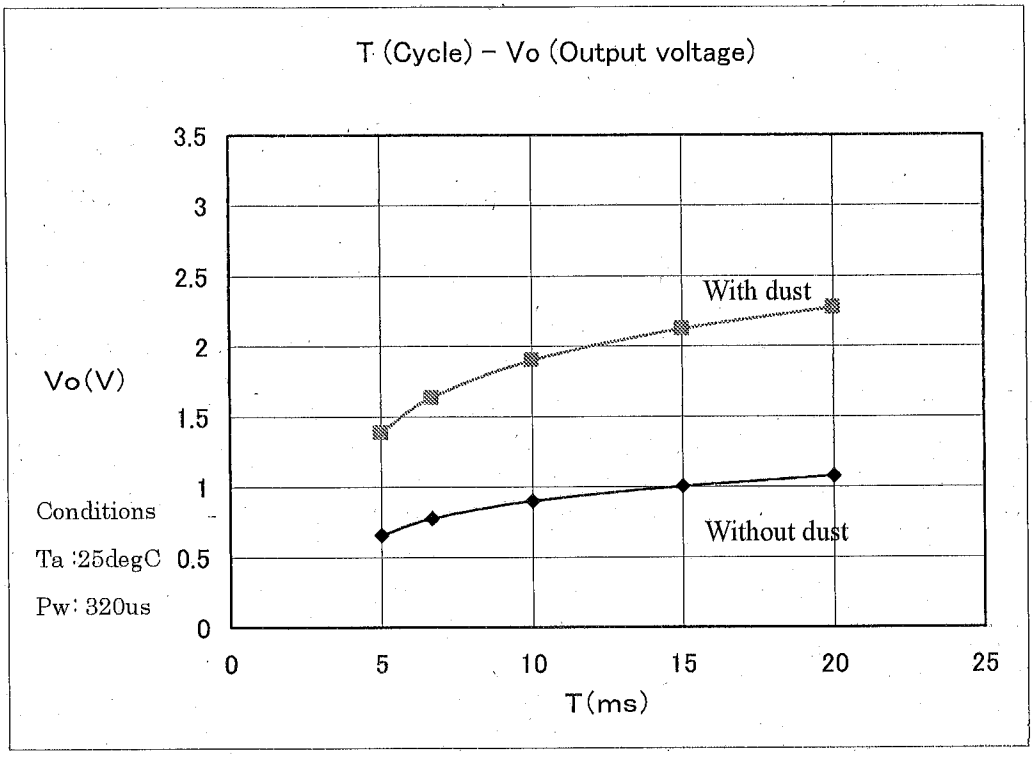
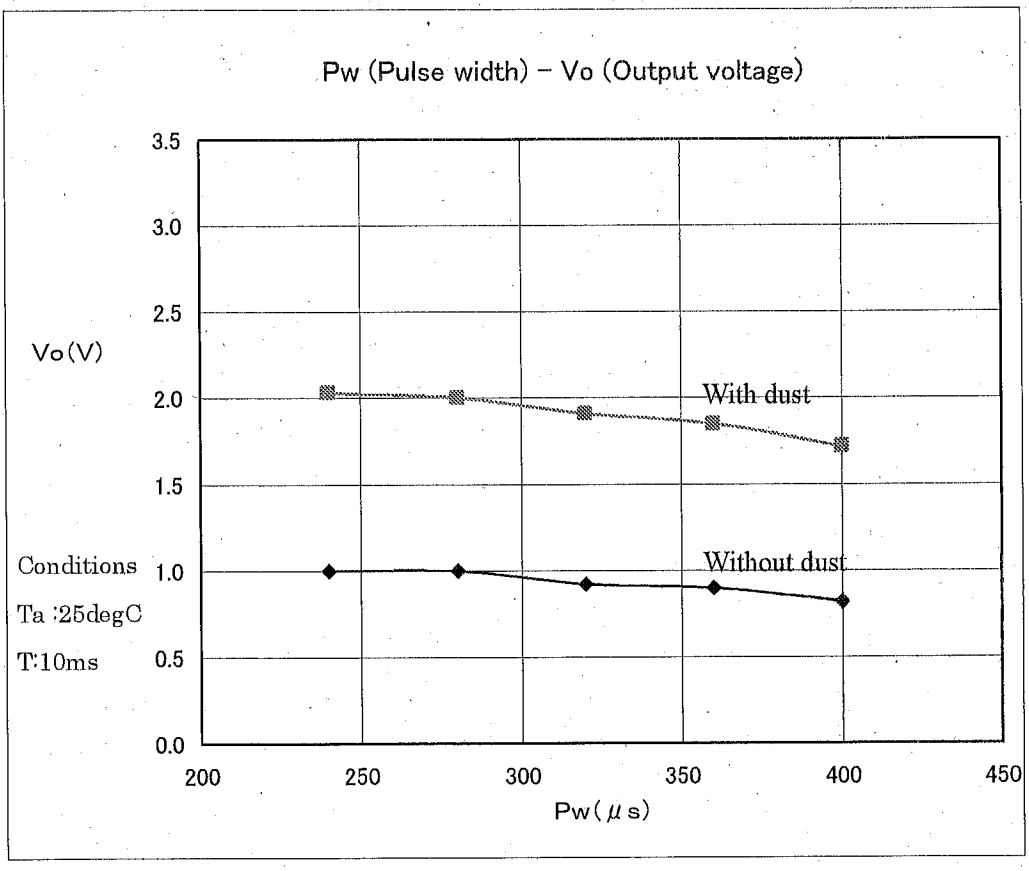
7-2 LED operation data





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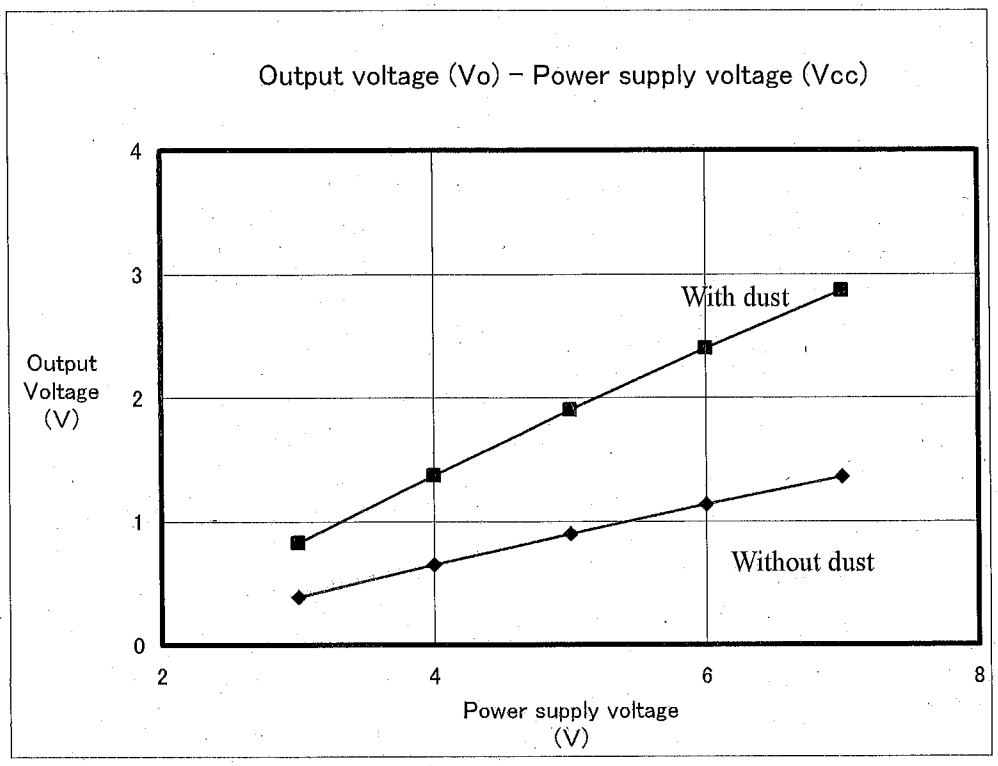
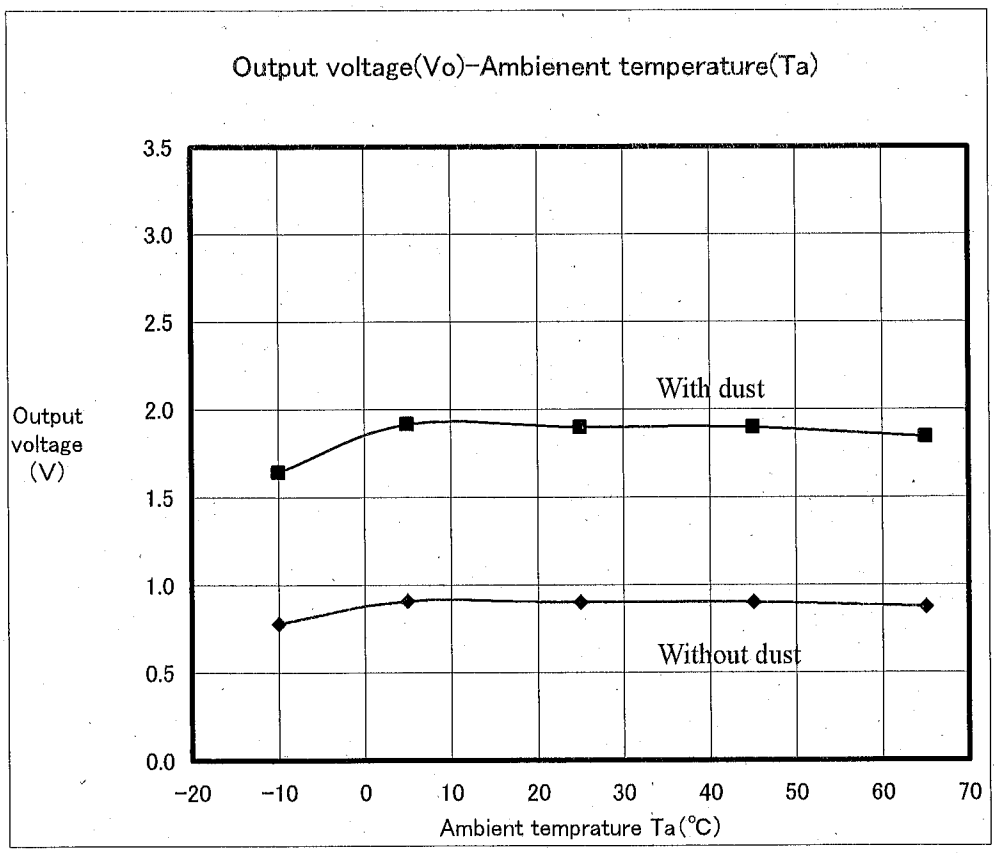
7-3 Power supply voltage vs Output Voltage



7-4 Ambient temperature vs Output Voltage



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