NOA1302

Ambient Light Sensor with I^2C Interface

Description

The NOA1302 integrates a wide dynamic range ambient light sensor (ALS) with a 16 bit ADC and a 2 wire I^2C digital interface. The NOA1302 ambient light sensor provides a linear response over the range of close to 0 lux to well over 100,000 lux with programmable integration times to optimize noise performance. The sensor employs proprietary CMOS image sensing technology from ON Semiconductor which provides low noise and high dynamic range output signals and light response similar to the response of the human eye.

The NOA1302 operates as an I^2C slave device and supports commands to set options in the device and read out the ambient light intensity count.

Features

- Senses Ambient Light and Provides an Output Count Proportional to the Ambient Light Intensity
- Human Eye Type of Spectral Response
- Provides Comfortable Levels of Display Depending on the Viewing Environment

August, 2009 − Rev. 1
Publication Order Number:
NOA1302/D

Table 1. ORDERING INFORMATION

Part Number	Package	Shipping Configuration†	Temperature Range
NOA1302DCRG	CTSSOP−8 (Pb−Free)	2500 / Tape & Reel	0°C to 70°C

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

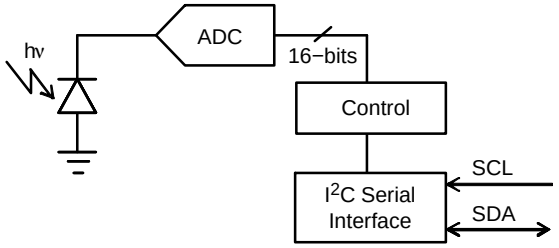

Figure 2. Simplified Block Diagram

Table 2. PIN FUNCTION DESCRIPTION

Pin	Pin Name	Description
1, 2, 7, 8	N/C	Not connected, leave this pin unconnected.
3	VSS	Ground pin.
4	SCL	External I^2C clock supplied by the I^2C master.
5	SDA	Bi−directional data signal for communications between this device and the I^2C master.
6	VDD	Power pin.

Table 3. ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input power supply	VDD	5.5	V
Input voltage range	V_{in}	−0.3 to VDD + 0.2	V
Output voltage range	V_{out}	−0.3 to VDD + 0.2	V
Maximum Junction Temperature	$T_{J(max)}$	85	°C
Storage Temperature	T_{STG}	−40 to 85	°C
ESD Capability, Human Body Model (Note 1) ESD Capability, Charged Device Model (Note 1) ESD Capability, Machine Model (Note 1)	ESD_{HBM} ESD_{CDM} ESD_{MM}	2.5 750 250	kV V V
Moisture Sensitivity Level	MSL	3	−
Lead Temperature Soldering (Note 2)	T_{SLD}	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. This device incorporates ESD protection and is tested by the following methods:
   ESD Human Body Model tested per EIA/JESD22−A114
   ESD Charged Device Model tested per ESD−STM5.3.1−1999
   ESD Machine Model tested per EIA/JESD22−A115
   Latchup Current Maximum Rating: ≤ 100 mA per JEDEC standard: JESD78
2. For information, please refer to our Soldering and Mounting Techniques Reference Manual, SOLDERRM/D

Table 4. OPERATING RANGES

Rating	Symbol	Standard Mode		Fast Mode		Unit
		Min	Max	Min	Max	
Power supply voltage	VDD	3.0	3.6	3.0	3.6	V
Power supply current (VDD = 3.3 V)	IDD	325	950	325	950	μA

Table 6. OPTICAL CHARACTERISTICS (Unless otherwise specified, these specifications are for VDD = 3.3 V, T_A = 25°C)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Irradiance responsivity	λp (see Figure 5)	R_e		545		nM
Illuminance responsivity	Incandescent light source: Ev = 100 lux (see Figure 6)	R_v		150		Counts
	Incandescent light source: Ev = 1000 lux (see Figure 6)			1480		
Illuminance responsivity	Fluorescent light source: Ev = 100 lux (see Figure 7)	R_v		130		Counts
	Fluorescent light source: Ev = 1000 lux (see Figure 7)			1290		
Dark current	Ev = 0 lux (see Figure 9)			2		Counts

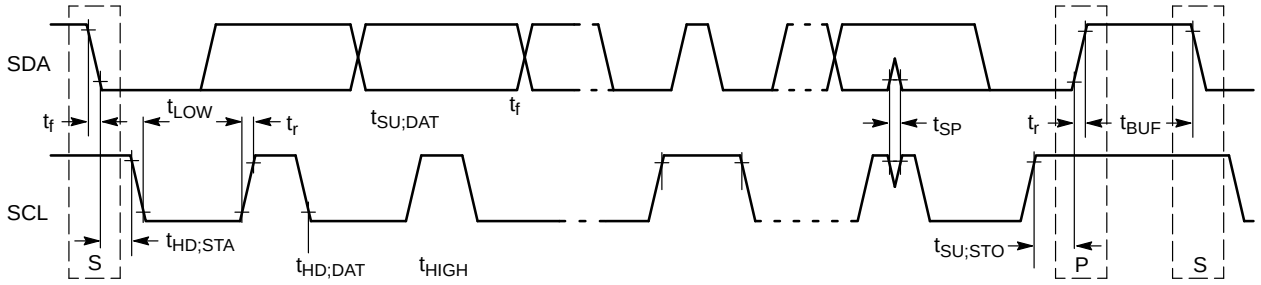

Figure 3. AC Characteristics

TYPICAL CHARACTERISTICS

Figure 4. Photo Diode Spectral Response (Without Filter)

Figure 5. Human Eye vs. NOA1302 Spectral Response

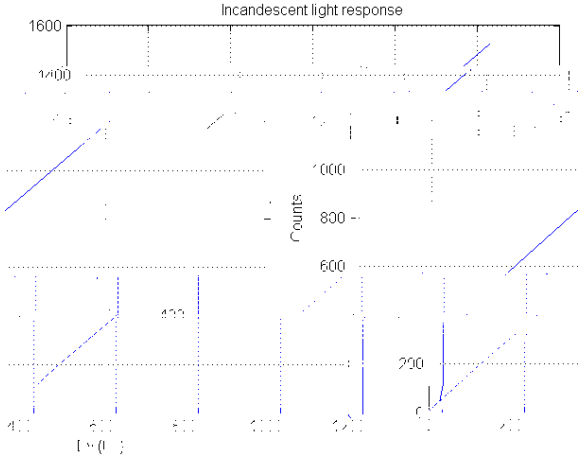

Figure 6. Incandescent Light Response (200 ms Integration)

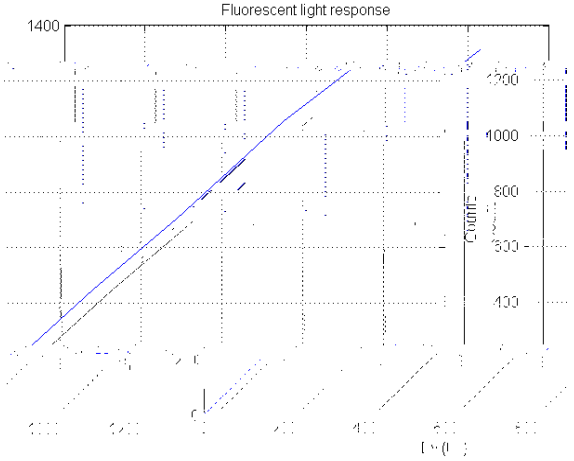

Figure 7. Fluorescent Light Response (200 ms Integration)

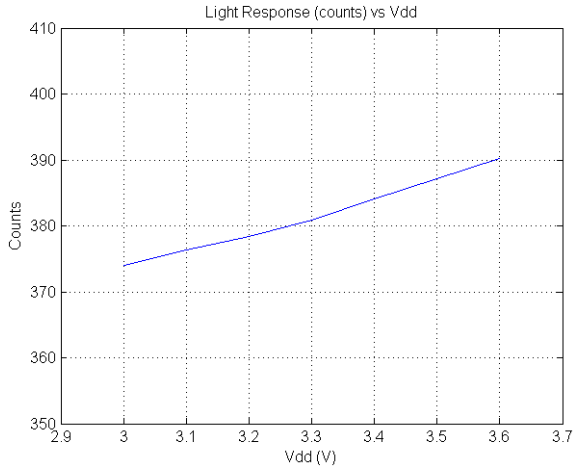

Figure 8. Light Response vs. VDD

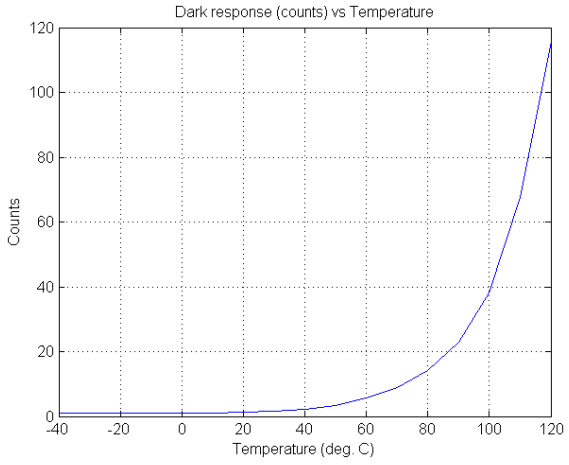

Figure 9. Dark Counts vs. Temperature (200 ms Integration)

TYPICAL CHARACTERISTICS

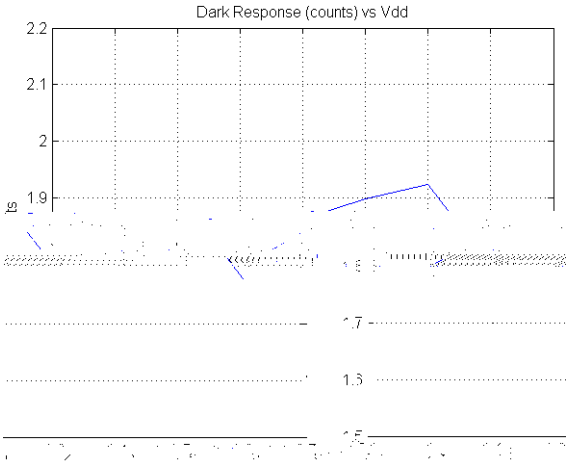

Figure 10. Dark Counts vs. Vdd

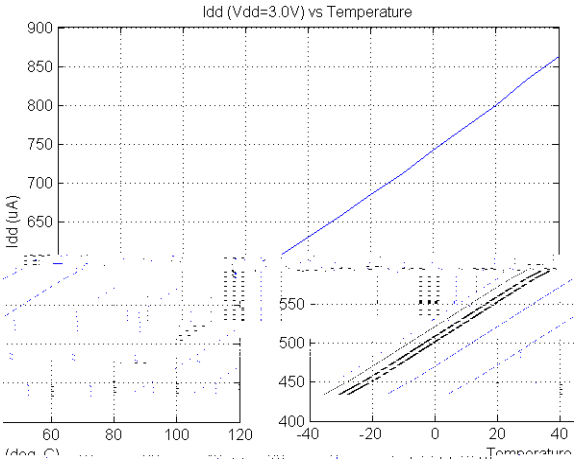

Figure 11. Idd vs. Temperature

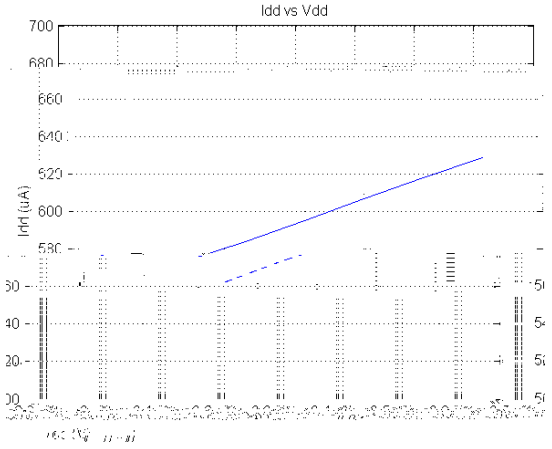

Figure 12. Idd vs.Vdd

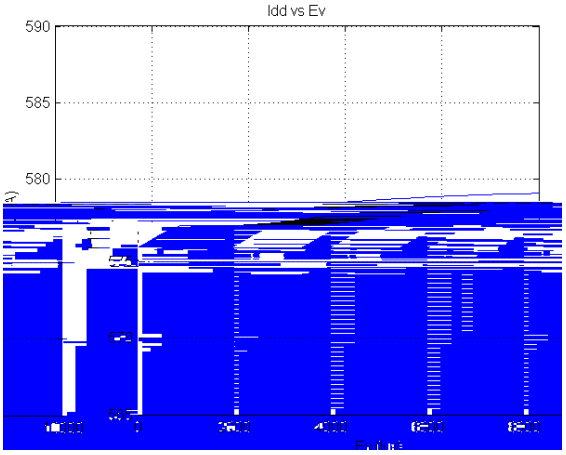

Figure 13. Idd vs Ev

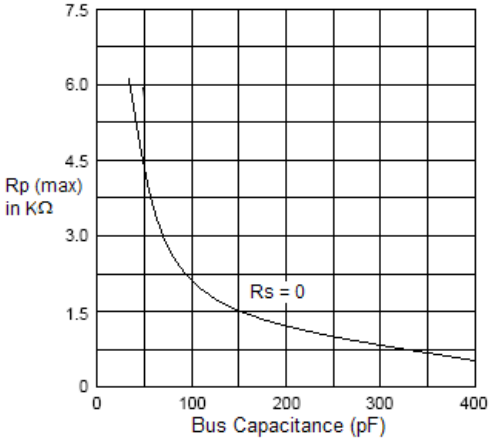

Figure 14. Maximum Value of R_P (in kΩ) as a function of Bus Capacitance (in pF)

DESCRIPTION OF OPERATION

Ambient Light Sensor Architecture

The NOA1302 employs a sensitive photo diode fabricated

Table 7. INTEGRATION TIME REGISTER

EC[2,1,0]	Operation	Integration Time
000	Normal mode of operation	400 ms
001	Normal mode of operation	200 ms (Default)
010	Normal mode of operation	100 ms
011	Test mode	16.7 ms
100	Simulation test mode use only	1.0 ms
101	Reserved for future use	
110	Reserved for future use	
111	Reserved for future use	

Programming Sequence and Command Summary

This section describes supported commands and programming sequence. The NOA1302 only supports single byte write and a single byte read I^2C commands. Ambient light intensity count is 16 bits wide, thus two I^2C read commands are needed.

Table 8 describes supported commands. All of these commands have to be sent to the fixed address (0x39).

Table 8. DEVICE COMMANDS

Command	Function
0x00h	Start reading ADC data
0x03h	Complete reading ADC data
0x1Dh	Change EC[0] to 0
0x18h	Reset EC[2:0] to default value (001)
0x43h	Prepare ADC LS byte for reading
0x83h	Prepare ADC MS byte for reading
0x88h	Change EC[1] to 1
0x90h	Change EC[2] to 1

Programming Sequence

To read 16 bits wide ambient light intensity count, the following commands must be issued in sequence:

1. Send write command 0x00h to start the ADC conversion cycle.
2. Send write command 0x03h to complete the ADC cycle.
3. Send write command 0x43h to prepare the LS byte for reading.
4. Send read byte command, returns LS byte of count.
5. Send write command 0x83h to prepare the MS byte for reading.
6. Send read byte command, returns MS byte of count.

To change the integration time, for example to 100 ms, the following commands must be used in sequence:

1. Send write command 0x1Dh to set EC[0] = 0.
2. Send write command 0x88h to set EC[1] = 1, now EC[2:0] = 010.

Rise and Fall Time of SDA (Output)

Proper operation of the I^2C bus depends on keeping the bus capacitance low and selecting suitable pull up resistor values. Figure 17 and Figure 18 show the rise and fall time on SDA in output mode under maximum load conditions. The measurement set up is shown in Figure 19. Figure 14 shows the maximum value of the pull up resistor (R_P) as a function of the I^2C data bus capacitance.

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