AN1910
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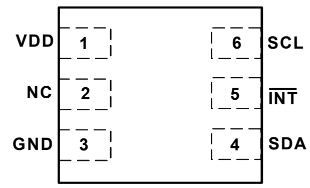
Enhancing RGB Sensitivity and Conversion Time

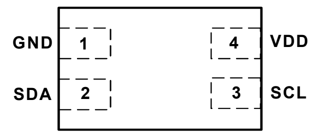
Introduction

The RGB sensor is a low power, high sensitivity, RED, GREEN, and BLUE color light sensor (RGB) with an I^2C (SMBus compatible) interface. Its state of the-art photodiode array provides an accurate RGB spectral response and excellent light source to light source variation (LS2LS). The sensor is designed to reject IR in light sources allowing the device to operate in environments from sunlight to dark rooms. The integrating ADC rejects 50Hz and 60Hz flicker caused by artificial light sources. Selectable ranges allow the user to optimize sensitivity suitable for the specific application. The sensor has 2 sensitivity ranges such as range 0 from 5.7 mlux to 375 lux and Range 1 from 0.125 lux to 10,000 lux. However, Intersil has options which can expose even higher sensitivity by simple setting in custom registers.

ISL29125
TOP VIEW



ISL29124
TOP VIEW



Related Literature

ISL29125 datasheet

TABLE 1. EXPOSE THE CUSTOM REGISTER

NAME	REGISTER ADDRESS		REGISTER BITS								DEFAULT	ACCESS
	DEC	HEX	B7	B6	B5	B4	B3	B2	B1	B0		
Device ID	0	0x00	0	1	1	1	1	1	0	1	7Dh	RO
CUSTOM MODE ACCESS	0	0x00	X	X	X	X	X	X	X	X	N/A	WO
REGISTER 0x02	2	0x02	See Datasheet for more detail								00h	RW
STATUS	8	0x08	TMEN	REVEN	See Datasheet for more detail						04h	RO
CUSTOM MODE 1	25	0x19	RESERVED	SENS_EN	RESERVED						00h	RW
CUSTOM MODE 2	26	0x1A	RESERVED					FAST	RESERVED		00h	RW
CUSTOM MODE 3	27	0x1B	Gain Setting								00h	RW
CUSTOM MODE 4	28	0x1C	RESERVED					SENSX[1]	SENSX[0]		00h	RW
CUSTOM MODE 5	29	0x1D	Gain Setting								Set by Intersil	RO

Register 0x00

Register 0x00 performs two functions. If Reg 0x00 is in READ ONLY mode then it will be a Device ID. When the register is in the WRITE ONLY mode it will open up access to CUSTOM MODE registers.

To access into a CUSTOM MODE, write 89h then C9h into Register 0x00.

To reset all Registers to default and/or all state machine by writing 46h into Reg 0x00.

TABLE 2. DEVICE ID/ CUSTOM ACCESS

NAME	REGISTER ADDRESS		REGISTER BITS	REGISTER BITS							DEFAULT	ACCESS
	DEC	HEX	B7	B6	B5	B4	B3	B2	B1	B0		
Device ID	0	0x00	0	1	1	1	1	1	0	1	7Dh	RO
CUSTOM MODE ACCESS	0	0x00	X	X	X	X	X	X	X	X	N/A	WO

Register 0x02

See datasheet for more detail on how to set IR compensation. Write 00h to Reg 0x02 then Range 0 = 250 lux and range 1 = 6750 lux. Write BFh to Reg 0x02 then Range 0 = 375 lux and Range 1 = 10,000 lux.

Register 0x08

TABLE 3. STATUS REGISTER (REG0x08)

NAME	REGISTER ADDRESS		REGISTER BITS								DEFAULT	ACCESS
	DEC	HEX	B7	B6	B5	B4	B3	B2	B1	B0		
STATUS	8	0x08	TMEN	REVEN	RGBCF[1]	RGBCF[0]	RESERVED	BOUTF	CONVENF	RGBTHF	0x04	RO

RGBTHF [B0]

This is the status bit of the interrupt. The bit is set to logic high when the interrupt thresholds have been triggered (out of threshold window), and logic low when not yet triggered. Once activated and the interrupt is triggered, the $\overline{INT}$ pin goes low and the interrupt status bit goes high until the status bit is polled through the I^2C read command. Both the $\overline{INT}$ output and the interrupt status bit are automatically cleared at the end of the 8-bit (00h) command register transfer.

TABLE 4. INTERRUPT FLAG

B0	OPERATION
0	Interrupt is cleared or not triggered yet
1	Interrupt is triggered

CONVENF [B1]

This is the status bit of conversion. The bit is set to logic high when the conversion have been completed, and logic low when the conversion is not completed or not converted.

TABLE 5. CONVERSION FLAG

B1	OPERATION
0	Still convert or cleared
1	Conversion completed

BOUTF [B2]

Bit2 on register address 0x08 is a status bit for the brownout condition (BOUT). The default value of this bit is HIGH, BOUT = 1, during the initial power-up. This indicates the device may possibly have gone through a brownout condition. Therefore, the status bit should be reset to LOW, BOUT = 0, by an I^2C write command during the initial configuration of the device. The default register value is 0x04 at power-on.

TABLE 6. BROWNOUT FLAG

B2	OPERATION
0	No Brownout
1	Power-down or Brownout occurred

RGBCF [B5:B4]

B[5:4] are flag bits to display7.

TABLE 7. CONVERSION FLAG

B5:4	RGB UNDER CONVERSION
00	No Operation
01	GREEN
10	RED
11	BLUE

REVEN [B6]

REVEN is Bit 6 of the status register. The bit is asserted to logic 1 when writing 89h to reg 0x00. By default this bit is logic low.

TABLE 8.

B6	OPERATION
0	Logic low or not writing 89h to Reg 0x00
1	Writing 89h to Reg 0x00

TMEN[B7]

TMEN is Bit 7 of the status bit of Custom Mode condition. The bit is asserted to logic 1 when writing C9h to reg 0x00 and REVEN is at logic 1. By default it is at logic low.

TABLE 9.

B7	OPERATION
0	Logic low or not writing C9h to Reg 0x00 and REVEN = 0
1	Writing C9h to reg 0x00 and REVEN = 1

B7 and B6 are indicated whether the RGB sensor is in the custom mode or not.

Register 0x19

SENS_EN is Bit 6 of CUSTOM MODE 1. In order to enable the CUSTOM MODE 4, SENS_EN should be asserted to a logic high. By default, it is a logic low or not enable CUSTOM MODE 4.

TABLE 10.

B6	OPERATION
0	Not Enable
1	Access to CUSTOM MODE 4

TABLE 11. CUSTOM MODE 1 (REG 0x19)

NAME	REGISTER ADDRESS		REGISTER BITS								DEFAULT	ACCESS
	DEC	HEX	B7	B6	B5	B4	B3	B2	B1	B0		
CUSTOM MODE 1	25	0x19	RESERVED	SENS_EN	RESERVED						00h	RW

Register 0x1A

TABLE 12. CUSTOM MODE 2 (REG 0x1A)

NAME	REGISTER ADDRESS		REGISTER BITS								DEFAULT	ACCESS
	DEC	HEX	B7	B6	B5	B4	B3	B2	B1	B0		
CUSTOM MODE 2	26	0x1A	RESERVED					FAST	RESERVED		00h	RW

FAST [2]

Bit 2 in Reg 0x1A is asserted to a logic high then ADC clock frequency is 4x faster than normal mode. By default FAST bit is set to low for normal mode.

TABLE 13.

B2	OPERATION
0	Normal conversion time
1	4x faster than normal conversion time

Register 0x1B and 0x1D

TABLE 14. CUSTOM MODES 3 AND 5 (REG 0x1B AND REG 0x1D)

NAME	REGISTER ADDRESS		REGISTER BITS								DEFAULT	ACCESS
	DEC	HEX	B7	B6	B5	B4	B3	B2	B1	B0		
CUSTOM MODE 3	27	0x1B	GAIN SETTING								00h	RW
CUSTOM MODE 5	29	0x1D	GAIN SETTING								Set by Intersil	RO

Both CUSTOM MODE 3 and CUSTOM MODE 5 are set by Intersil in order to have a better part-to-part variation performance.

Register 0x1C

TABLE 15. CUSTOM MODE 4 (REG 0x1C)

NAME	REGISTER ADDRESS		REGISTER BITS								DEFAULT	ACCESS
	DEC	HEX	B7	B6	B5	B4	B3	B2	B1	B0		
TEST MODE 4	28	0x1C	RESERVED						SENX[1]	SENX[0]	00h	RW

SENX[1:0]

The full-scale range can be extended to be a high sensitivity at Bit[1:0] of reg0x1C. The range determines the ADC resolution (12 bits, and 16 bits). Each selectable range at SENX has a maximum allowable lux value. More information will be discussed in the following section.

TABLE 16.

B1:0	HIGH SENSITIVITY RANGES
00	1X
01	1.5X
10	2X
11	2.5X

Application Information

In order to expose high sensitivity ranges and speed up its conversion time, the sensor needs to be in the custom mode, instructed in the following steps:

1. Write 89h to Reg 0x00
2. Write C9h to Reg 0x00 to enter CUSTOM mode. If user want to check flag status at bit [7] and bit [6] of Reg0x08 should be asserted to logic. If they are asserted logic 1 then the sensor is in the CUSTOM mode.
3. Read reg 0x1D then store that value in a temp variable (software GUI/driver).
4. Write 40h to Reg 0x19 to enable high sensitivity ranges (Reg 0x1C/ CUSTOM MODE 4).
5. Write temp variable at step 2 to reg 0x1B.
6. Table 17 explains multiple higher sensitivity options the sensor can be:
7. Table 18 explains how the sensor can be sped up in the conversion time for 16-bit and 12-bit ADC.
8. To get out of CUSTOM MODE without resetting the device, write any hex values other than 89h and C9 to Reg 0x00. OR
9. To get out of CUSTOM MODE and reset the device, write 46h to Reg 0x00. This will reset all registers to their default states.

TABLE 17. SENSITIVITY RANGES

Register 0x02	Write 00h to Register 0x02		Write BFh to Register 0x02	
	Range 0 = 250 lux, Range 1 = 6750 lux		Range 0 = 375 lux, Range 1 = 10,000 lux	
Register 0x1C [1:0]	SENX[1:0]	High Sensitivity Range (Lux)	SENX[1:0]	High Sensitivity Range (Lux)
RANGE 0	00	250	00	375
	01	165	01	250
	10	125	10	187.5
	11	100	11	150
RANGE 1	00	6750	00	10,000
	01	6750	01	10,000
	10	6750	10	10,000
	11	6750	11	10,000

TABLE 18. SPEED-UP CONVERSION TIME

Reg0x01 [4] (Bit)	16-bit ADC (Bit[4] = 0)		12-bit ADC (Bit[4] = 1)	
Reg0x1A [2] (FAST bit)	FAST= 0	FAST = 1	FAST =0	FAST = 1
Conversion time (ms)	100	25	6.25	1.56
Number of Clocks	65536		4096	
ADC clock Period (µs)	1.52	0.38	1.52	0.38

Block Diagram for High Sensitivity Control Logic

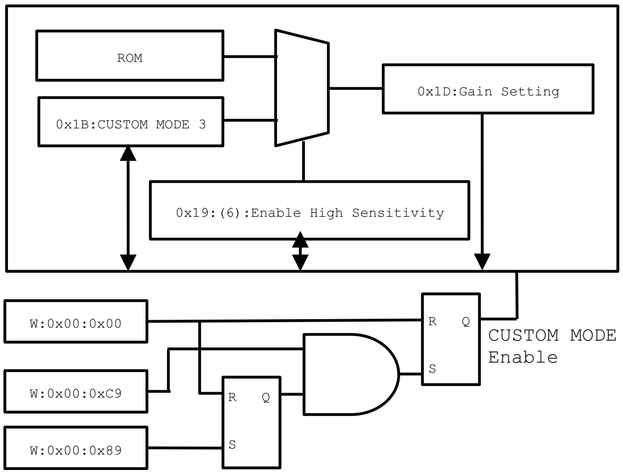


FIGURE 1. HIGH SENSITIVITY CONTROL LOGIC DIAGRAM

Initialization (1 time only)	
Set CUSTOM Mode Enable	W:0x00:0x89 W:0x00:0xC9
Read Value	R:0x1D → MEM
Enable High Sensitivity	W:0x19:0x40
Write Value	W:0x1B:MEM
Exit CUSTOM Mode	W:0x00:0x00
Run Time	
Set CUSTOM Mode Enable	W:0x00:0x89 W:0x00:0xC9
Set High Sensitivity	W:0x1C:0x03*ON
Exit CUSTOM Mode	W:0x00:0x00

FIGURE 2. INITIALIZATION AND RUNNING TIME

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Refer to "http://www.renesas.com/" for the latest and detailed information.

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