DT0035
Design tip

VL6180X low power features

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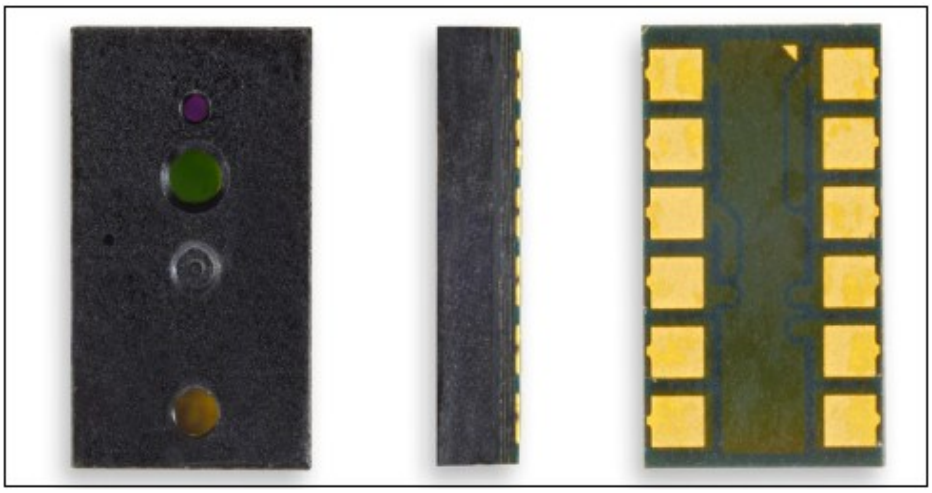
Main components	
VL6180X	Proximity and ambient light sensing (ALS) module

Purpose and Benefits

This document explains how the low power features in the VL6180X impact the power consumption in an application. Current measurements in this document were taken with a FLUKE 177 DMM in series with the supply, averaged over time, and do not represent design limits for the VL6180X.

It is assumed that customers who use this document can communicate with the VL6180X through I^2C, and are familiar with writing to the device registers as well as the device start up procedure.

Figure 1. VL6180X Device



VL6180X Overview

The VL6180X is a proximity sensor with the capability to accurately measure the distance to objects within the set range. It measures distance by measuring the time of flight of photons emitted from an onboard IR laser that reflect off the object and return. The VL6180X was designed for mobile applications and has several built in features to reduce power consumption. In addition to the ranging features, the VL6180X incorporates an ambient light sensor (ALS) that can also be used by the host processor to determine different operational modes to minimize power usage.

Ranging Power Saving Features

There are three features in the VL6180X that can be implemented to significantly reduce power usage during ranging. When operating in continuous mode, the ranging inter-measurement period sets the rate the VL6180X will make measurements. By increasing the time between measurements the device can remain in a low power state longer reducing current drain. The Early Convergent Estimate (ECE) is a feature to obtain a quick determination that no object is in front of the device, stopping the measurement, and returning to a low power state quickly. Setting the maximum convergence time will set the amount of time the VL6180X can be used to converge on the range of an object. Decreasing this will shorten the measurement time and reduce power; however it may decrease the range at which objects can be measured.

Ranging Inter-measurement Period

When operating in continuous mode, the VL6180X periodically takes range measurements at the rate set in the SYSRANGE__INTERMEASUREMENT_PERIOD (0x001B). The device is using the most power during the measurement while the IR laser is on. Once the measurement is complete, the current reduces significantly to approximately 9.5uA while it waits for the next measurement. As shown in Table 1, a longer period between measurements reduces the average current drain significantly.

Table 1. Inter-Measurement Period Impact on Current

Range Inter-measurement period[1]					
Register setting (0x001B)	Period (ms)	ECE = 1.05	ECE = OFF		
		No Tgt (mA)	No Tgt (mA)	Tgt @ 50mm (mA)	Tgt @ 100mm (mA)
0xC8	2000	0.03	0.53	0.08	0.15
0x96	1500	0.04	0.72	0.11	0.2
0x64	1000	0.05	1.09	0.18	0.3
0x4B	750	0.07	1.42	0.22	0.4
0x32	500	0.09	2.19	0.33	0.59
0x19	250	0.18	4.20	0.62	1.42
0x0A	100	0.42	9.85	1.45	3.32
0x05	50	0.77	18.08	2.59	5.63

(1) Max Convergence time = 50ms

Ranging Early Convergence Estimate

In addition to the impact of the Inter-measurement setting, Table 2 also shows that the highest current drain is when there is no target. In this case, the VL6180X will search for an object for the full maximum allowed convergence time. The ECE feature will stop the search for an object if not enough photons have returned after 0.5 milliseconds. The level of signal return required is based on the ECE Factor selected by the user based on the application. The default value is 1.05 (95%) which means it will shut down if the returned signal count is less than 95% of the expected count. Table 2 shows that the ECE Factor has little effect on the current drain except in situations where it prevents the early stopping of a ranging measurement.

Table 2. ECE Factor Impact on Current

ECE Factor			
ECE Factor (%)	No Tgt (mA)	Tgt @ 50mm (mA)	Tgt @ 100mm (mA)
0.80	0.45	1.46	3.21
0.85	0.45	1.46	3.22
0.90	0.45	1.46	3.23
0.95	0.45	1.46	3.23
1.00	0.45	1.46	3.21
1.05	0.44	1.46	3.23
1.10	0.45	1.46	3.23
1.15	0.45	1.46	3.21
1.20	0.45	1.46	3.21

(1) Range Inter-measurement Period = 100

(2) Max Convergence Time = 50

For more information on implementing the ECE, see other design tips based on ECE – VL6180X Early Convergence Estimate implementation.

Ranging Max Convergence

Setting the maximum time the VL6180X is allowed to converge on an object will reduce the current slightly, but may have other effects. A low max convergence time may reduce the distance an object can be detected or if the VL6180X can detect dark objects. The impact to current drain can be seen in Table 3.

Table 3. Max Convergence Time Impact on Current

Reg setting (0x1C)		ECE = 1.05	ECE = OFF		
	Max Conv (ms)	No Tgt (mA)	No Tgt (mA)	Tgt @ 50mm (mA)	Tgt @ 100mm (mA)
0x32	50	0.45	9.88	1.46	3.30
0x2D	45	0.45	8.95	1.45	3.33
0x28	40	0.45	7.99	1.46	3.05
0x23	35	0.45	7.01	1.45	3.07
0x1E	30	0.45	6.08	1.45	3.48
0x19	25	0.45	5.12	1.46	3.53
0x14	20	0.45	4.16	1.45	3.16
0x0F	15	0.45	3.21	1.45	3.13
0x0A	10	0.45	2.25	1.46	2.31(2)
0x05	5	0.45	1.30	1.43(2)	1.30(2)

(1) - Range Inter-measurement period = 100

(2) - No range result

The maximum convergence time is set in the SYSRANGE__MAX_CONVERGENCE_TIME (0x001C) register which has a range of 1 to 63 milliseconds.

ALS Current Drain

While the ambient light sensing feature uses less current than the ranging function, the power consumption can be reduced by increasing the inter-measurement period for the ALS. Table 4 shows how the ALS inter-measurement time impacts current drain while changing the ALS integration time does not have much of an impact on current drain.

Table 4. ALS Current Measurements

Period (ms)	Int 50 (mA)	Int 100 (mA)	Int 150 (mA)	Int 200 (mA)
2000	0.02	0.02	0.03	0.04
1500	0.02	0.03	0.04	0.05
1000	0.02	0.04	0.05	0.07
750	0.03	0.05	0.07	0.09
500	0.05	0.07	0.10	0.13
250	0.08	0.14	0.20	0.25
100	0.17	0.30	-	-
50	0.29	-	-	-

The ALS inter-measurement period is set thru the SYSALS__INTERMEASUREMENT_PERIOD (0x003E) register with a range from 0 to 2.55s in steps of 10ms. The ALS integration period, which has a great impact on the ALS results, has little impact on current, is set in SYSALS__INTEGRATION_PERIOD (0x0040), and has a default value of 100ms. Additional information on the ALS features can be found in other design tips - VL6180X - Ambient Light Sensing.

Conclusion

Utilizing the built in features of the VL6180X can have a significant impact on the current drain in an application. As with most sensor applications, the sample rate has the greatest impact on current consumption. In addition, a reduction of the sampling time by use of the ECE feature or reducing the maximum convergence time will also reduce the power consumption for ranging application. In some applications where the ranging functionality is only needed during daylight or in the dark, the use of the ALS feature to determine when to initiate the ranging function may also reduce the overall power requirements of a device.

Support Material

Related design support material
MOB-EK2-180-03 - VL6180X Premium Evaluation Kit
Documentation
Datasheet: VL6180X - Proximity and ambient light sensing (ALS) module Design Tip DT0034 - VL6180X Early Convergence Estimate Implementation Design Tip DT0030 - VL6180X - Ambient Light Sensing

Revision History

Date	Version	Changes
12-June-2014	1	Initial release

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