UM1852
User manual

X-NUCLEO-6180XA1 proximity and ambient light sensor expansion board based on VL6180X for STM32 Nucleo

Introduction

This document provides detailed hardware information on VL6180X expansion board. VL6180X expansion board is compatible with STM32 Nucleo family and Arduino™ electronic boards. This product is part of STMicroelectronics offering of expansion boards designed around the VL6180X, 3-in-1 proximity sensor, based on ST patented FlightSense™ technology.

Figure 1. VL6180X expansion board plugged on a STM32 Nucleo board

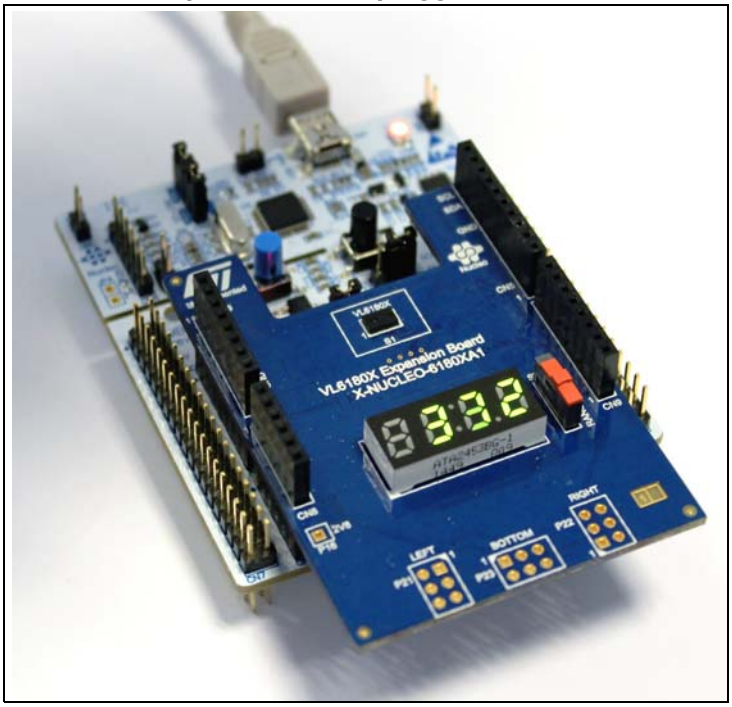


Table 1. Ordering information

Ordering code	Description
X-NUCLEO-6180XA1	VL6180X expansion board for STM32 Nucleo board family

Contents

1 Description

The X-NUCLEO-6180XA1 expansion board features the VL6180X proximity, gesture and ALS sensor, based on ST's FlightSense™, Time-of-Flight technology.
It is an evaluation board that provides an introduction to the proximity, ranging and light sensing capabilities of the VL6180X module.
It is compatible with the STM32 Nucleo board family, and with the Arduino UNO R3 connector layout.
Several ST expansion boards can be superposed through the Arduino connectors, which allows for example to develop VL6180X applications with Bluetooth or WiFi interface.

2 Document references

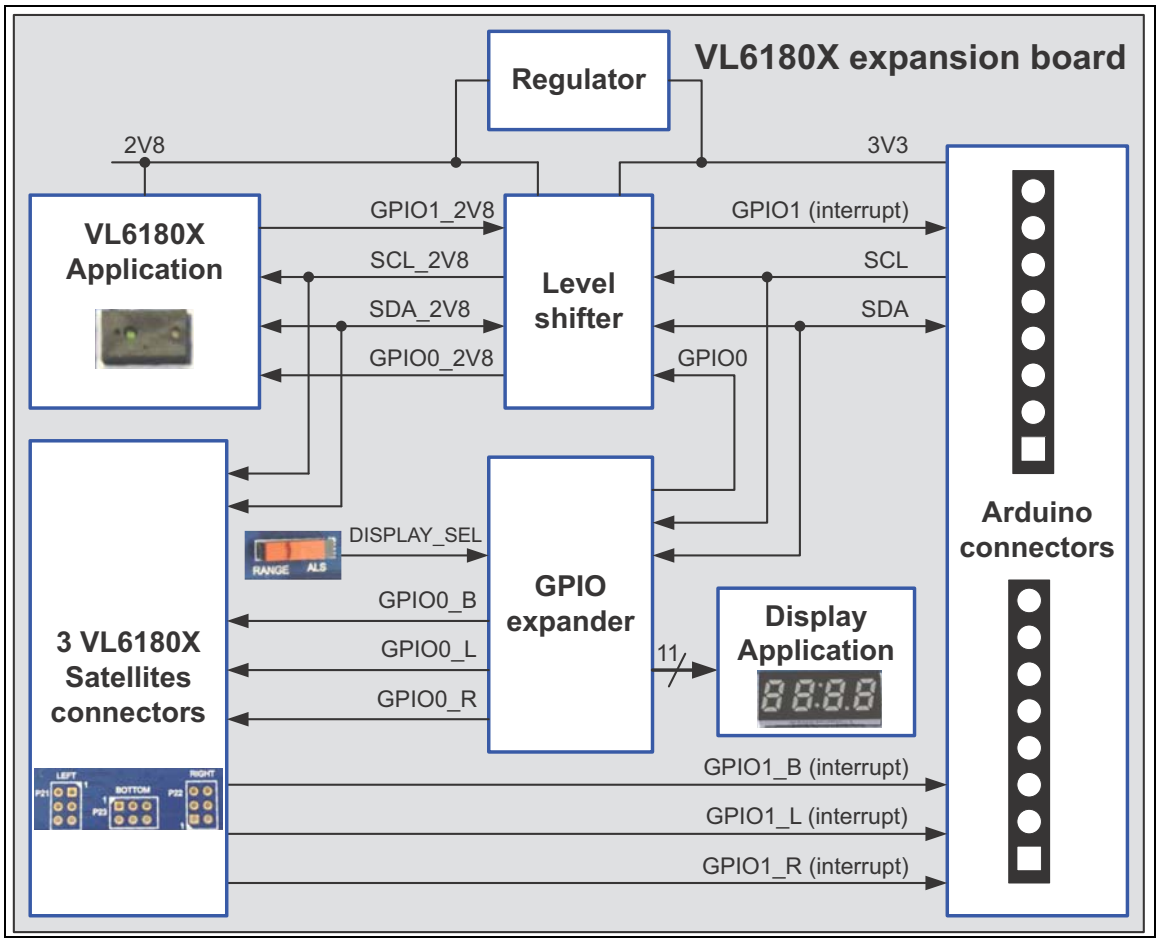
Table 2. Document references

Description	DocID
Datasheet - VL6180X proximity and ambient light sensing (ALS) module	DocID026171
Data brief - X-NUCLEO-6180XA1 proximity and ambient light sensor expansion board based on VL6180X for STM32 Nucleo	DocID027252
UM1876 - Getting started with proximity, gesture, ambient light sensor expansion for STM32Cube	DocID027648

3 Hardware description

This section describes the VL6180X expansion board features and provides information which could be useful for understanding the electrical schematics.

Figure 2. VL6180X expansion board block diagram



3.1 VL6180X expansion board

The board allows the user to test the VL6180X functionality, to program it and to help understanding how to develop an application using VL6180X. It integrates:

- a 4-Digit display to render either the Range value in mm either the Ambient Light value in Lux
- a switch to select the value type to be displayed
- a 2.8V regulator to supply the VL6180X
- two level shifters to adapt the I/O level to the micro controller main board
- the necessary connectivity for the application.

It is fundamental to program a micro-controller to control the VL6180X through the I2C bus and drive the 4-digit display on board. Application software's and examples of C-ANSI source codes are available on *www.st.com/VL6180X*.

The VL6180X expansion board and STM32 Nucleo are connected through Arduino compatible connectors CN5, CN6, CN8 and CN9 as shown in *Figure 3* and described in *Table 3* and *Table 4*.

The Arduino connectors on STM32 Nucleo board support Arduino Uno Revision 3.

Figure 3. Arduino connector layout

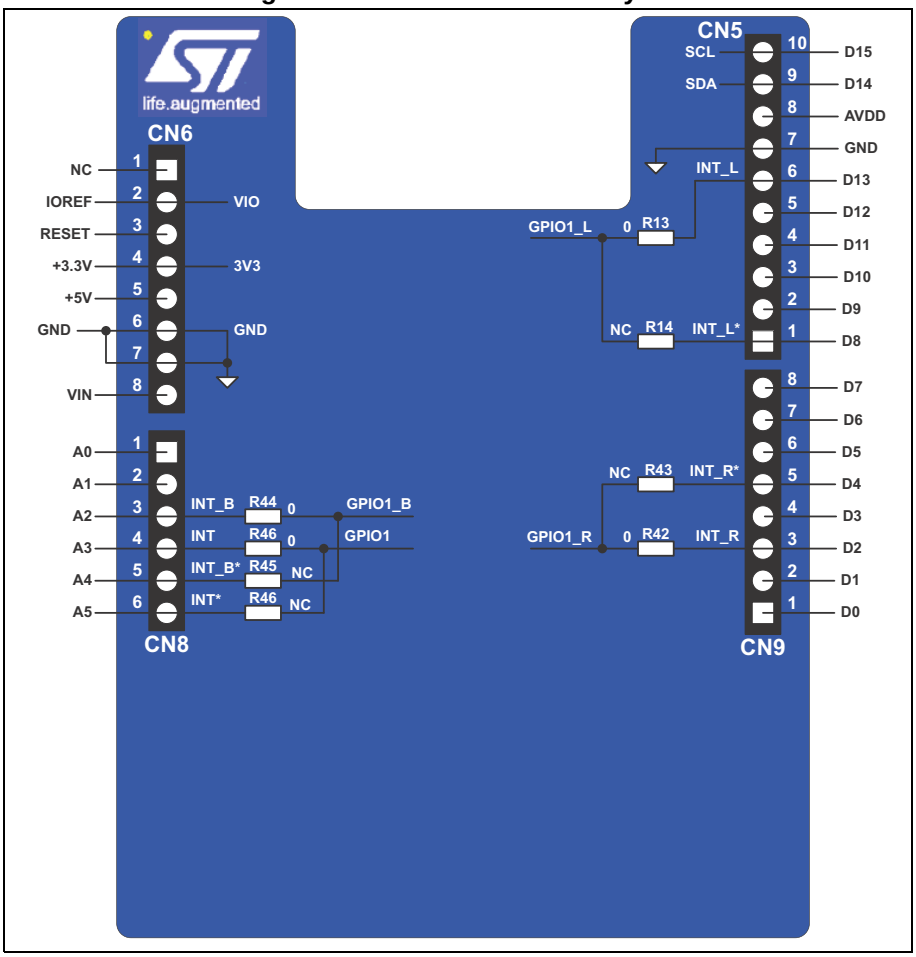


Table 3. Arduino left connector on STM32 Nucleo board

CN Nb	VL6180X board	Pin Nb	Pin name	MCU pin	VL6180X expansion board function
CN6 Power		1	NC		
	VIO	2	VIO		Level shifter reference (3.3V)
		3	NC		
	Power	4	+3V3		3.3V supply
		5	NC		
	Gnd	6	Gnd	Gnd	Gnd
	Gnd	7	Gnd	Gnd	Gnd
		8	NC		-
CN8 Analog		1	NC		
		2	NC		
	GPIO1_B	3	INT_B	PA4	Interrupt signal from VL6180X bottom satellite plug-in
	GPIO1	4	INT	PB0	Interrupt signal from VL6180X on board soldered device
	GPIO1_B	5	INT_B*	PC1 or PB9(1)	Interrupt signal from VL6180X bottom satellite plug-in
	GPIO1	6	INT*	PC1 or PB8(1)	Interrupt signal from VL6180X on board soldered device

1. Depend on Nucleo board solder bridges, see details on Nucleo documentation. These interrupt signals are duplicated, but not used, this offer hardware connection flexibility in case of conflict on MCU interface management when expansion board is used superposed with other expansion boards, in this case remove 0 ohm resistor from interrupt used and connect 0 ohm resistor in place of “do not mount” one.

Table 4. Arduino right connector on STM32 Nucleo board

CN Nb	VL6180X expansion board	Pin Nb	Pin name	MCU pin	VL6180X expansion board function
CN5 Digital	SCL	10	D15	PB8	I2C1_SCL
	SDA	9	D14	PB9	I2C1_SDA
		8	NC		
	Gnd	7	Gnd	Gnd	Gnd
	GPIO1_L	6	INT_L	PA5	Interrupt signal from VL6180X left satellite plug-in
		5	NC		
		4	NC		
		3	NC		
		2	NC		
	GPIO1_L	1	INT_L*	PA9	Interrupt signal from VL6180X left satellite plug-in(1)
CN9 Digital		8	NC		
		7	NC		
		6	NC		
	GPIO1_R	5	INT_R*	PB5	Interrupt signal from VL6180X right satellite plug-in(1)
		4	NC		
	GPIO1_R	3	INT_R	PA10	Interrupt signal from VL6180X right satellite plug-in
		2	NC		
		1	NC		

1. These interrupt signals are duplicated, but not used, this offer hardware connection flexibility in case of conflict on MCU interface management when expansion board is used superposed with other expansion boards, in this case remove 0 ohm resistor from interrupt used and connect 0 ohm resistor in place of “do not mount” one.

The VL6180X expansion board allows connecting up to 3 VL6180X satellite boards (see *Figure 4*). This to allow to develop applications controlling up to 4 VL6180X. I2C bus is common with the VL6180X on-board: I2C bus, GPIO1 (Interrupt) pins and GPIO0 (reset) pins are separate pins to control each sensor separately. GPIO1 signals are outputted on Arduino connectors, GPIO0 signals are controlled through the GPIO expander device. Refer to *Figure 3* and *Figure 12* for detailed connectivity.

Figure 4. Connections of VL6180X satellite boards

Note: VL6180X satellite boards can be ordered under the reference: VL6180X-SATEL.

Figure 5. VL6180X-SATEL

3.2 Electrical schematics and list of material

The figures and tables of this section describe the electrical schematics for each type of functions of the board and the list of material associated.

Figure 6. VL6180X expansion board - VL6180X application

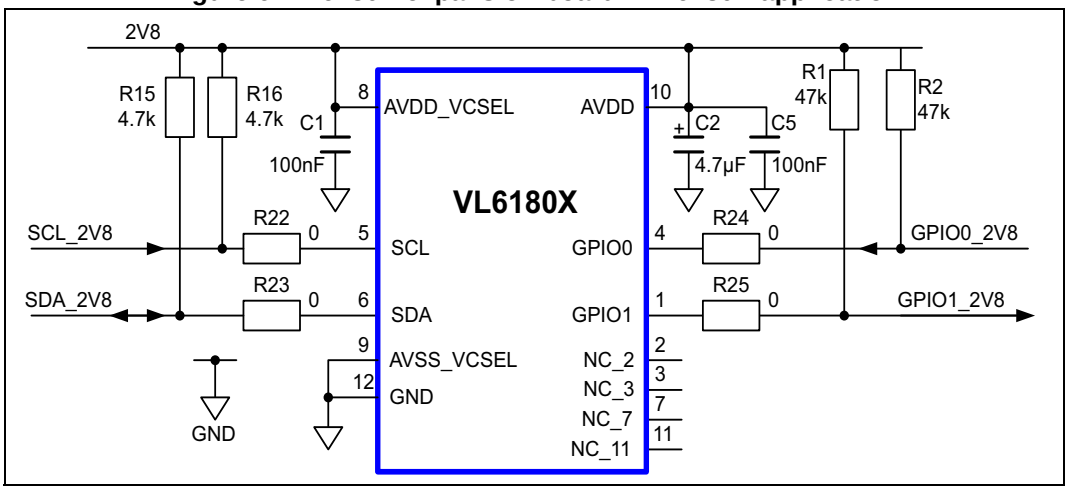
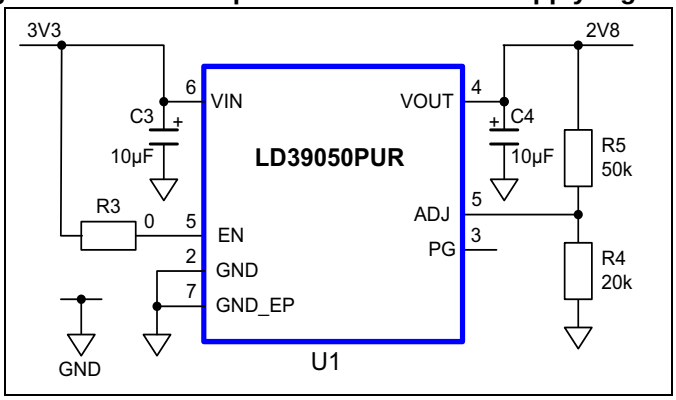


Table 5. List of material - VL6180X application

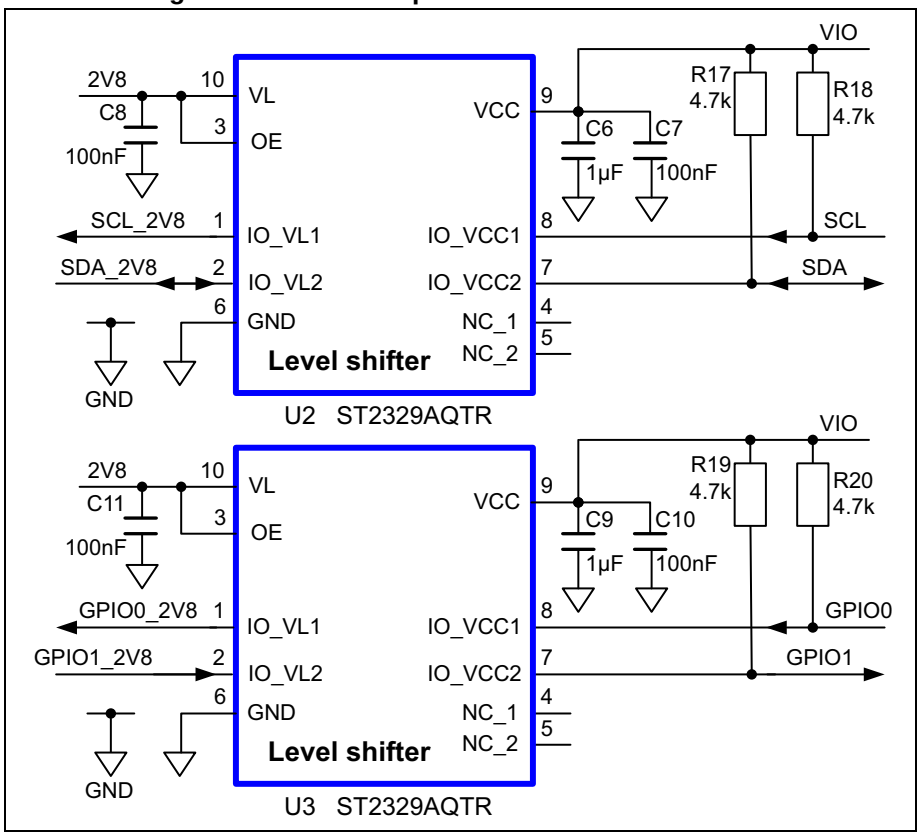
Reference	Value	Package	Comment
C1, C5	100nF	0603	Ceramic - Decoupling - In a final product, could be in a 0402 package
C2	4.7µF	0603	Ceramic - 6V - Decoupling
R1, R2	47KΩ	0603	Pull up - In a final product, could be in a 0402 package
R15, R16	4.7KΩ	0603	Pull up - In a final product, could be in a 0402 package and used for several devices
S1	VL6180X	Module	Proximity and ambient light sensing (ALS) module

Figure 7. VL6180X expansion board - 2.8V supply regulator



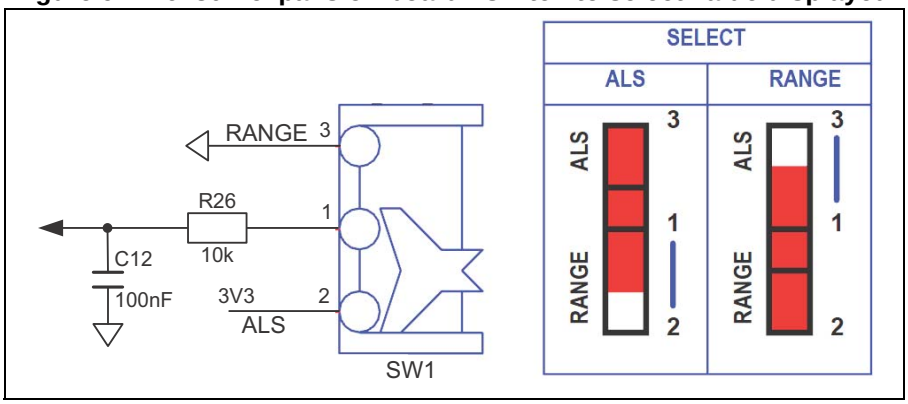
Note: This regulator is requested to convert the 3.3V coming from the Nucleo or Arduino board to 2.8V. In a final product, if exists, the 2.8V regulator can be used to supply the VL6180X.

Figure 8. VL6180X expansion board - Level shifter



These level shifters are used only to provide the adequate voltage for I/O's and I2C bus, this to allow to connect a 5V Arduino board without hardware modification. In a final product, depending of the power management tree, they could be omitted.

Figure 9. VL6180X expansion board - switch to select value displayed.



SW1 switch selects if distance or ambient light value is displayed.

- Distance is displayed in mm
- Ambient light is displayed in Lux with a maximum value of 9999.[(a)]

a. VL6180X detects up to 100kLux but since the display is a 4 digits only, maximum displayed value is limited to 9999 Lux.

Figure 10. VL6180X expansion board - Satellites connector

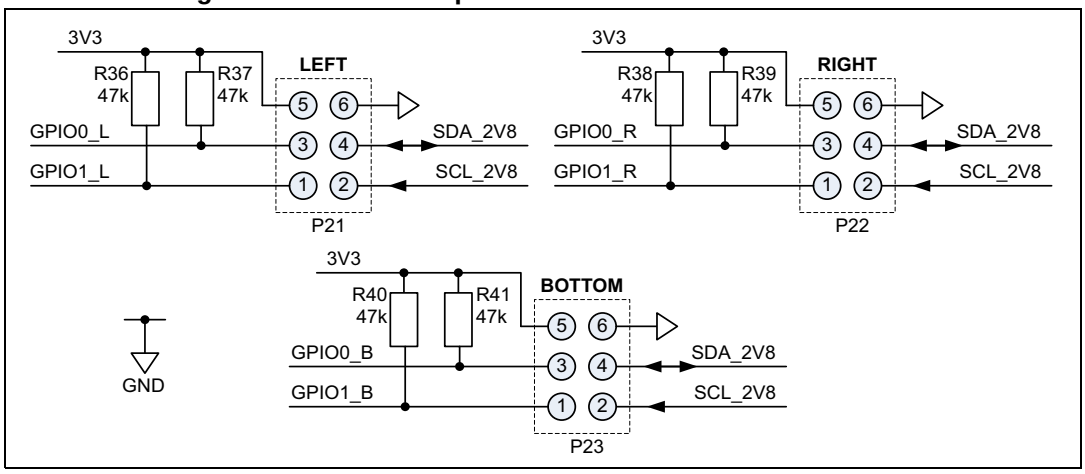


Figure 11. VL6180X expansion board - Display control

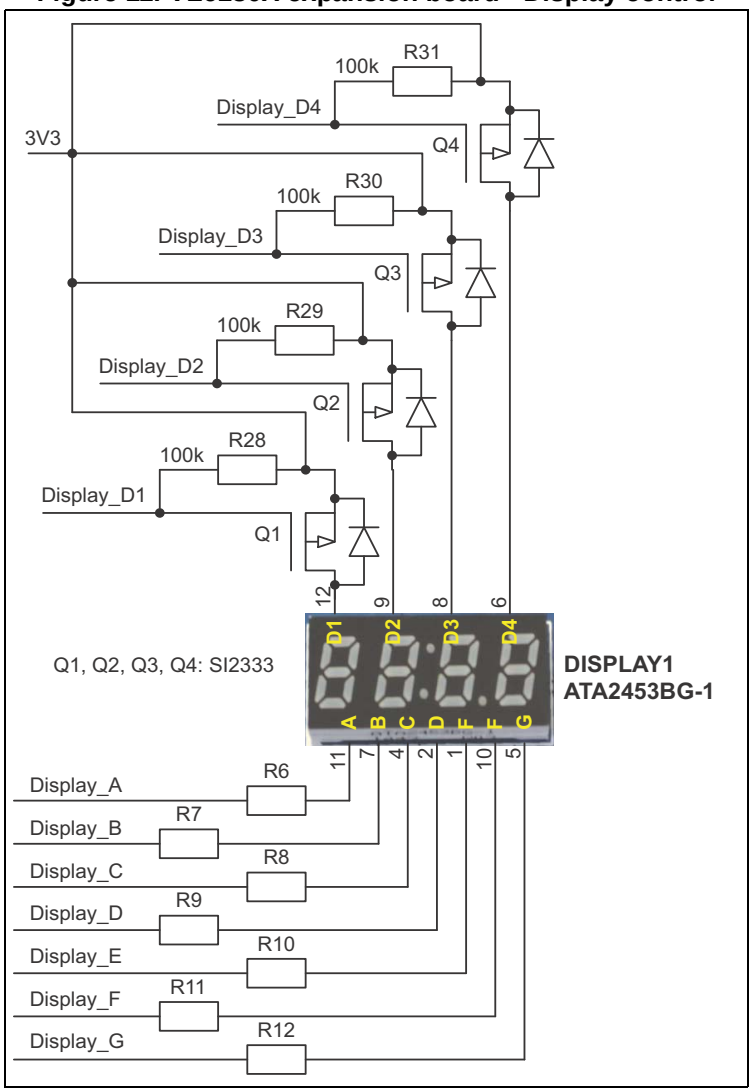


Figure 12. GPIO expander

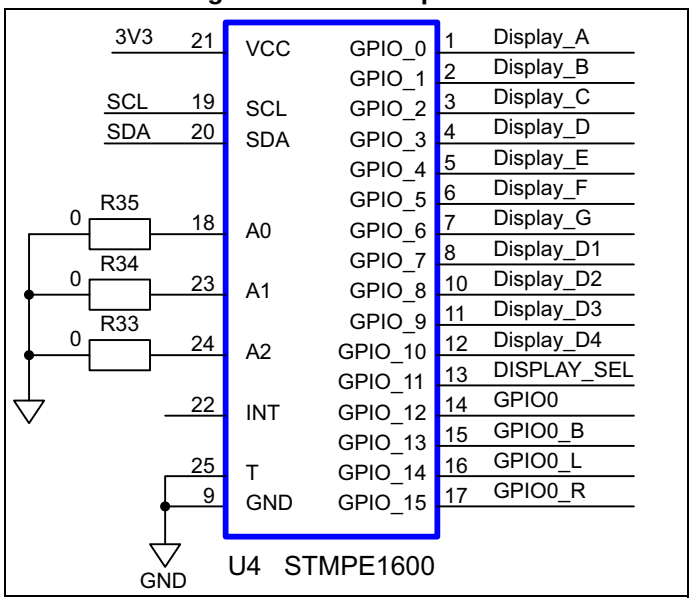


Table 6. List of material - Other features

Reference	Value	Package	Comment
2v8 regulator			
C3, C4	10 µF	0805	
R4	20 kΩ	0603	
R5	50 kΩ	0603	
U1	LD39050PUR	DFN6	Regulator
Level shifters			
C6, C9	1 µF	0603	
C7, C8, C10, C11	100 nF	0603	
R17, R18, R19, R20	4.7 kΩ	0603	
U2, U3	ST2329AQTR	QFN10	Level shifter
External VL6180X and Nucleo_Arduino connectors			
R14	47 kΩ	0603	
R26	10 kΩ	0603	
Display control			
R6, R7, R8, R9, R10, R11, R12, R13	300 Ω	0603	
R28, R29, R30, R31	100 kΩ	0603	
Q1, Q2, Q3, Q4	SI2333	SOT23	P channel MOSFET
Display1	ATA2453BG-1		4 digits
GPIO expander			
U4	STMPE1600	QFN24	STMicroelectronics

4 Safety

4.1 Electrostatic precaution

Figure 13. Electrostatic logo

You should exercise electrostatic precautions, including using ground straps when using the VL6180X expansion board. Failure to prevent electrostatic discharge could damage the device.

4.2 Laser considerations

The VL6180X contains a laser emitter and corresponding drive circuitry. The laser output is designed to remain within Class 1 laser safety limits under all reasonably foreseeable conditions including single faults in compliance with IEC 60825-1:2007. The laser output will remain within Class 1 limits as long as the STMicroelectronics recommended device settings are used and the operating conditions specified in the datasheet are respected. The laser output power must not be increased by any means and no optics should be used with the intention of focusing the laser beam.

Figure 14. Class 1 laser product label

Compliance

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated June 24, 2007.

5 Revision history

Table 7. Document revision history

Date	Revision	Changes
26-May-2015	1	Initial release.
02-Jun-2015	2	Update document title