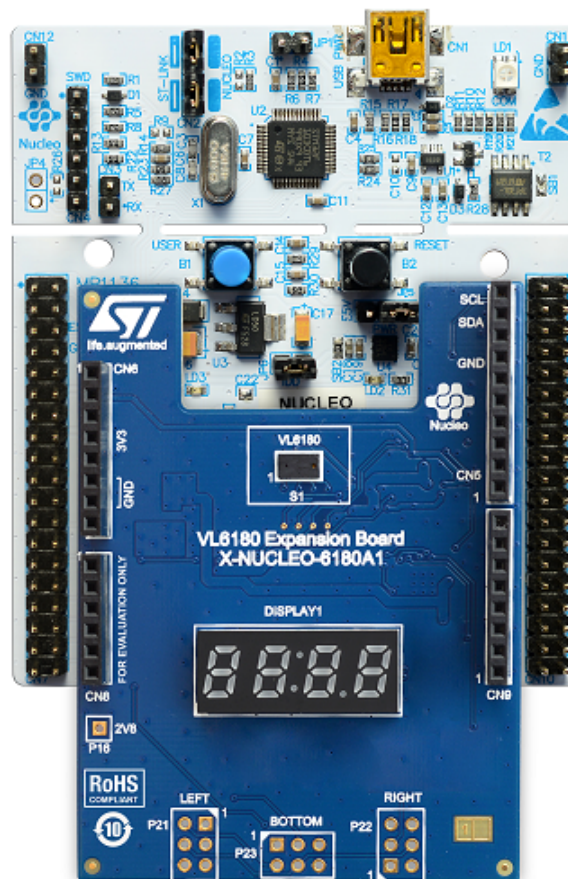


## How to use the VL6180 proximity sensor X-NUCLEO-6180A1 expansion board with the STM32 Nucleo board

### Introduction

This user manual provides detailed hardware information on the X-NUCLEO-6180A1 expansion board (see figure below). This board is designed around the VL6180 proximity sensor and it is compatible with the STM32 Nucleo and Arduino Uno boards. The document provides an introduction to the proximity sensing capabilities of the VL6180 module which is based on ST's patented Time-of-Flight (ToF) technology. Several ST expansion boards can be superposed through the Arduino connectors, which allow development of VL6180 applications with Bluetooth or WiFi interfaces.

**Figure 1. X-NUCLEO-6180A1 expansion board**



**Table 1. Ordering information**

Order code	Description
X-NUCLEO-6180A1	X-NUCLEO-6180A1 expansion board for use with STM32 Nucleo board

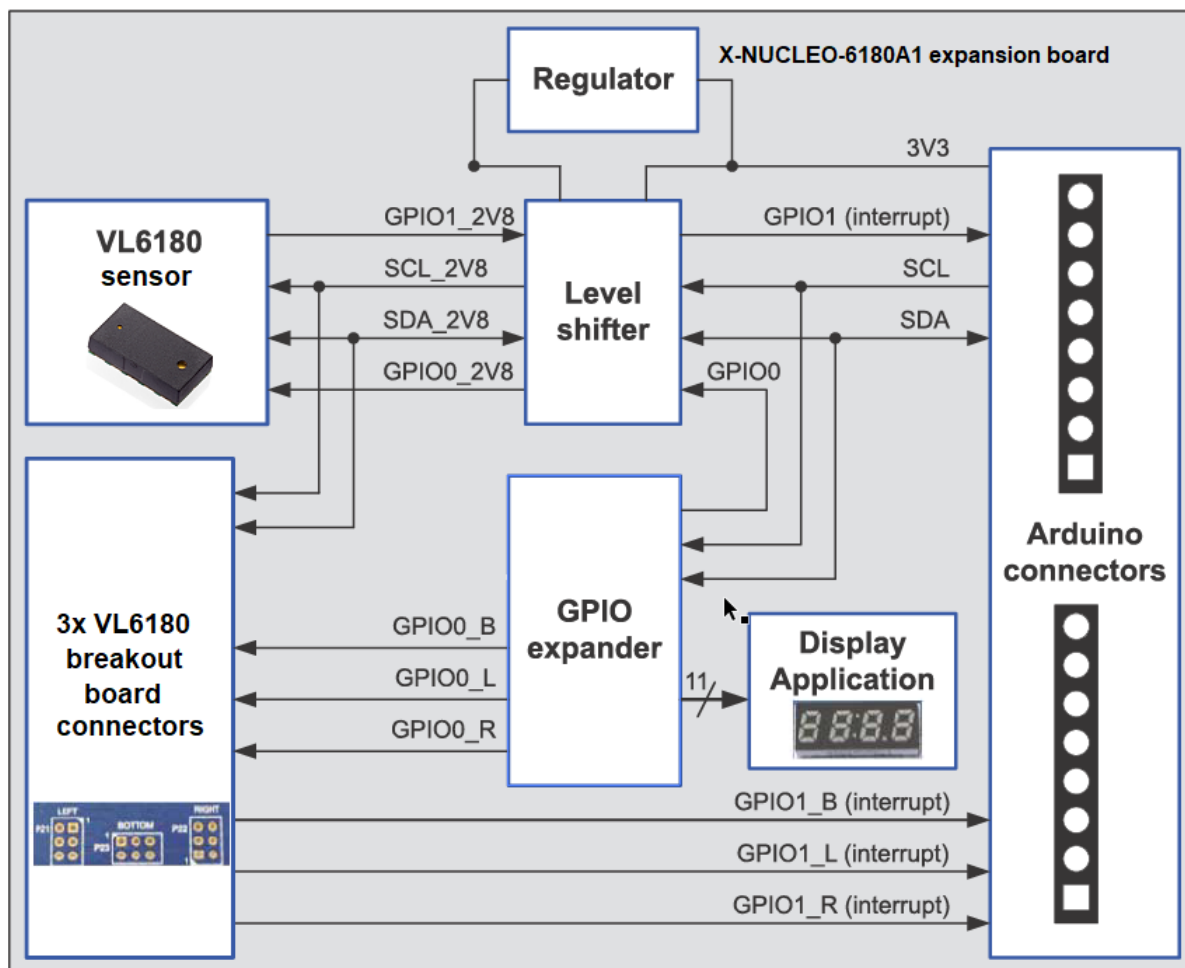
### References

- VL6180 datasheet: Time-of-Flight proximity sensor and IR emitter two-in-one module
- X-NUCLEO-6180A1 data brief: Proximity Time-of-Flight sensor expansion board based on VL6180 for STM32 Nucleo

# 1 Hardware description

This section describes the X-NUCLEO-6180A1 expansion board features and provides information on the electrical schematics.

Figure 2. X-NUCLEO-6180A1 expansion board block diagram



## 1.1 Board description

The X-NUCLEO-6180A1 expansion board allows the user to test the VL6180 functionality and program it. Also, advice is given on how to develop an application using the VL6180. The X-NUCLEO-6180A1 expansion board integrates:

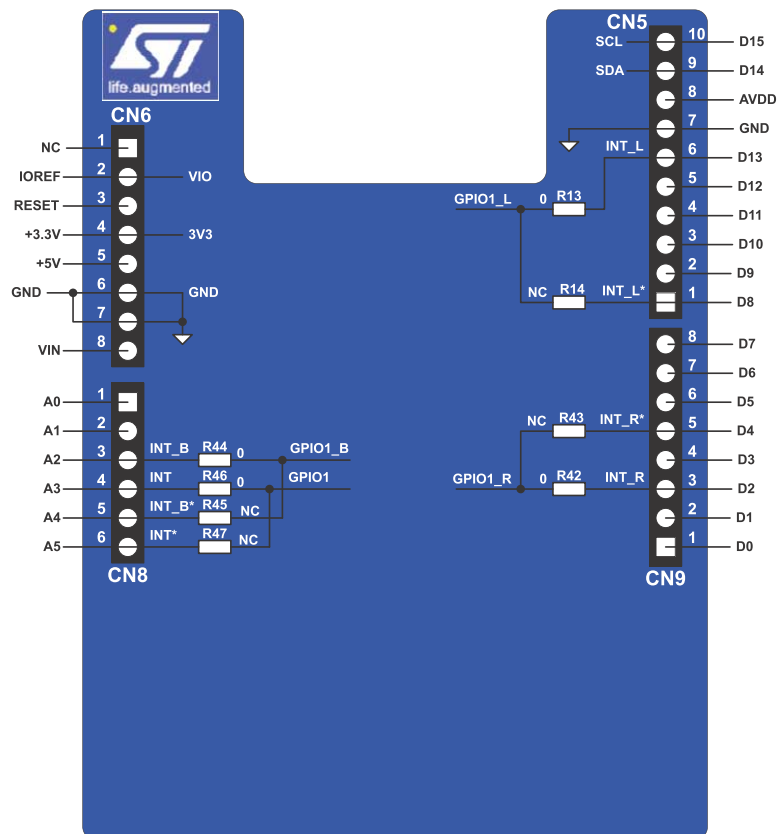
- a 4-digit display to render the range value in mm
- a 2.8 V regulator to supply the VL6180
- two level shifters to adapt the I/O level to the microcontroller main board
- the necessary connectivity for the application

It is fundamental to program a microcontroller to control the VL6180 through the I2C bus and drive the 4-digit display on-board. Application software and examples of C-ANSI source code are available on [www.st.com/VL6180](http://www.st.com/VL6180).

The X-NUCLEO-6180A1 expansion board and STM32 Nucleo are connected through Arduino compatible connectors CN5, CN6, CN8 and CN9 as shown and described in the figure and tables below.

The Arduino connectors on the STM32 Nucleo board support Arduino Uno revision 3.

Figure 3. Arduino connector layout



**Table 2. Arduino left connector on STM32 Nucleo board**

CN number	X-NUCLEO-6180A1 expansion board	Pin number	Pin name	MCU pin	X-NUCLEO-6180A1 expansion board function
CN6 power		1	NC		
	VIO	2	VIO		Level shifter reference (3.3 V)
		3	NC		
	Power	4	3V3		3.3 V 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 X-NUCLEO-6180A1 bottom breakout plug-in
	GPIO1	4	INT	PB0	Interrupt signal from X-NUCLEO-6180A1 on-board soldered device
	GPIO1_B	5	INT_B*	PC1 or PB9 <sup>(1)</sup>	Interrupt signal from X-NUCLEO-6180A1 bottom breakout plug-in
	GPIO1	6	INT*	PC1 or PB8 <sup>(1)</sup>	Interrupt signal from X-NUCLEO-6180A1 on-board soldered device

1. Depends on Nucleo board solder bridges (see details on Nucleo board documentation). These interrupt signals are duplicated, but not used which offers the hardware connection flexibility in case of a conflict on the MCU interface when the expansion board is used superposed with other expansion boards. In such cases, remove the 0-ohm resistor from the current interrupt and connect it in place of the “do not mount” resistor.

**Table 3. Arduino right connector on STM32 Nucleo board**

CN number	X-NUCLEO-6180A1 expansion board	Pin number	Pin name	MCU pin	X-NUCLEO-6180A1 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 X-NUCLEO-6180A1 left breakout plug-in
		5	NC		
		4	NC		
		3	NC		
		2	NC		
	GPIO1_L	1	INT_L*	PA9	Interrupt signal from X-NUCLEO-6180A1 left breakout plug-in <sup>(1)</sup>
CN9 digital		8	NC		
		7	NC		
		6	NC		
	GPIO1_R	5	INT_R*	PB5	Interrupt signal from X-NUCLEO-6180A1 right breakout plug-in <sup>(1)</sup>
		4	NC		
	GPIO1_R	3	INT_R	PA10	Interrupt signal from X-NUCLEO-6180A1 right breakout plug-in
		2	NC		
		1	NC		

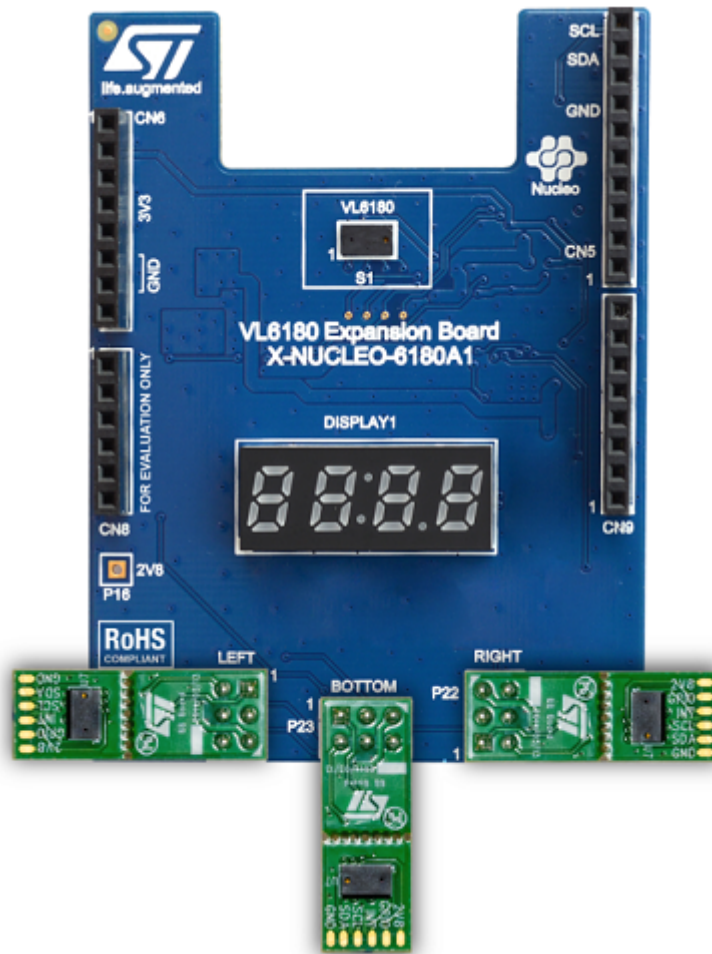
1. These interrupt signals are duplicated, but not used which offers the hardware connection flexibility in case of a conflict on the MCU interface when the expansion board is used superposed with other expansion boards. In such cases, remove the 0-ohm resistor from the current interrupt and connect it in place of the "do not mount" resistor.

The X-NUCLEO-6180A1 expansion board allows up to three VL6180 breakout boards to be connected to it (see [Figure 4. Connections of VL6180 breakout boards](#)). This allows the development of applications that can control up to four VL6180 devices.

The I2C bus is shared with the VL6180 on-board I2C bus. The GPIO1 (interrupt) pins and GPIO0 (reset) pins are separate pins to control each sensor separately.

The GPIO1 signals are output on the Arduino connectors and the GPIO0 signals are controlled through the GPIO expander device. Refer to [Figure 3. Arduino connector layout](#) and [Figure 11. X-NUCLEO-6180A1 expansion board with GPIO expander](#) for detailed connectivity.

Figure 4. Connections of VL6180 breakout boards



Note: The VL6180 breakout boards can be ordered under the reference: VL6180-SATEL

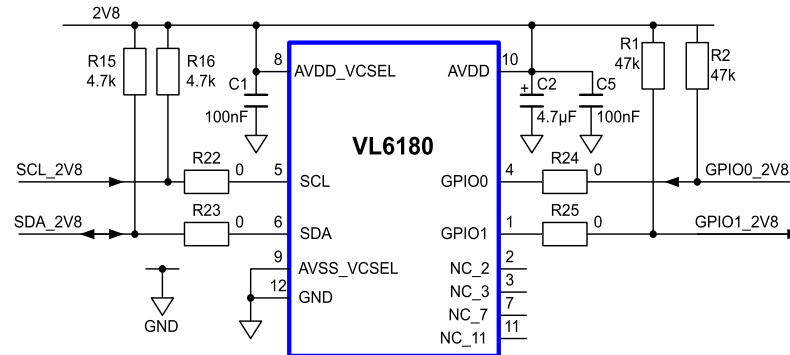
Figure 5. VL6180 SATEL (2x breakout boards)



## 1.2 Electrical schematics and list of materials

The figures of this section describe the electrical schematics for each type of board function. The relevant lists of materials are also presented.

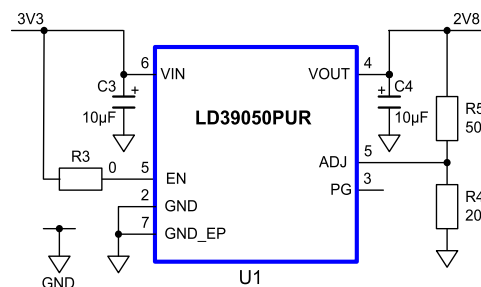
**Figure 6. X-NUCLEO-6180A1 expansion board with VL6180 application**



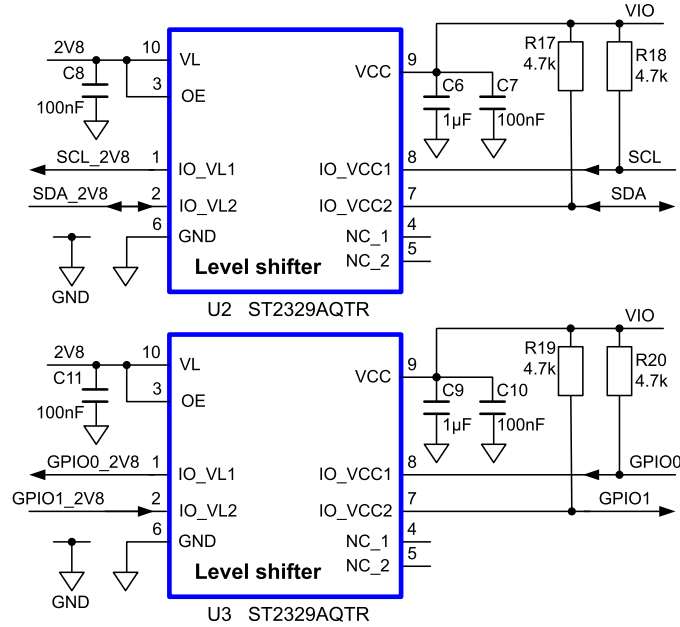
**Table 4. List of material for VL6180 application**

Reference	Value	Package	Comment
C1, C5	100 nF	0603	Ceramic - decoupling - in a final product, could be in a 0402 package
C2	4.7 $\mu$ F		Ceramic - 6 V - decoupling
R1, R2	47 k $\Omega$		Pull up - in a final product, could be in a 0402 package
R15, R16	4.7 k $\Omega$		Pull up - in a final product, could be in a 0402 package and used for several devices
S1	VL6180	Module	Proximity module

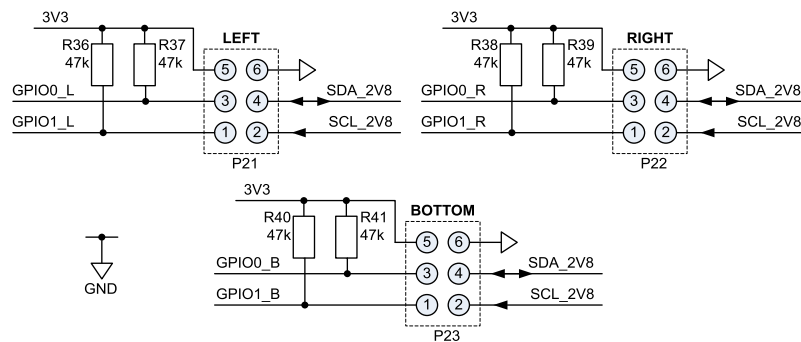
**Figure 7. X-NUCLEO-6180A1 expansion board with 2.8 V supply regulator**



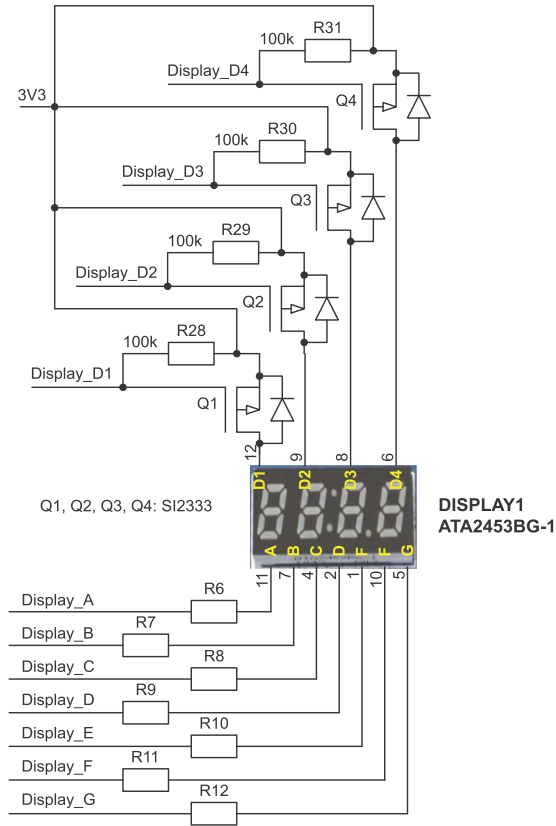
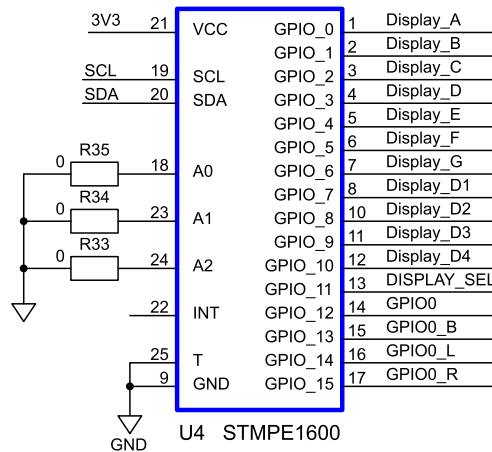
**Note:** This regulator is requested to convert the 3.3 V coming from the Nucleo or Arduino boards to 2.8 V. In a final product, the 2.8 V regulator (if it exists) can be used to supply the VL6180.

**Figure 8. X-NUCLEO-6180A1 expansion board with level shifters**


The level shifters are used only to provide adequate voltage for the I/O's and I2C bus which allows a 5 V Arduino board to be connected without hardware modifications. In a final product, depending on the power management tree, the level shifters could be omitted.

**Figure 9. X-NUCLEO-6180A1 expansion board with breakout board connector**




**Figure 10. X-NUCLEO-6180A1 expansion board with display control**

**Figure 11. X-NUCLEO-6180A1 expansion board with GPIO expander**


**Table 5. List of materials for other features**

Reference	Value	Package	Comment
<b>2v8 regulator</b>			
C3, C4	10 $\mu$ F	0805	
R4	20 k $\Omega$	0603	
R5	50 k $\Omega$		
U1	LD39050PUR	DFN6	Regulator
<b>Level shifters</b>			
C6, C9	1 $\mu$ F	0603	
C7, C8, C10, C11	100 nF		
R17, R18, R19, R20	4.7 k $\Omega$		
U2, U3	ST2329AQTR	QFN10	Level shifter
<b>External VL6180 and Nucleo_Arduino connectors</b>			
R14	47 k $\Omega$	0603	
R26	10 k $\Omega$	0603	
<b>Display control</b>			
R6, R7, R8, R9, R10, R11, R12, R13	300 $\Omega$	0603	
R28, R29, R30, R31	100 k $\Omega$		
Q1, Q2, Q3, Q4	SI2333	SOT23	P channel MOSFET
Display1	ATA2453BG-1		4 digits
<b>GPIO expander</b>			
U4	STMPE1600	QFN24	STMicroelectronics

## 2 Safety considerations

### 2.1 Electrostatic precaution

Figure 12. Electrostatic logo



It is important to exercise electrostatic precautions when using the X-NUCLEO-6180A1 expansion board e.g. use ground straps. Failure to prevent electrostatic discharge could damage the device.

### 2.2 Laser safety

The VL6180 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 the IEC 60825-1:2007. The laser output remains 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 and no optics should be used with the intention of focusing the laser beam.

Figure 13. Class 1 laser product label



#### Compliance

The VL6180 laser emitter and corresponding drive circuitry comply with 21 CFR 1040.10 and 1040.11 except for deviations conforming with the laser notice No.50, dated June 24, 2007.

## Revision history

**Table 6. Document revision history**

Date	Version	Changes
10-Mar-2020	1	Initial release

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