Technical note

STDES-STM660 test report

Introduction

An overview of the STM6601 performance using the STDES-STM660 reference design is herein described.

The STDES-STM660 reference design can be used for the development of secure startup, run, power-down and reset of an user application when it does not respond (for example, in terminals, smartphones, PCs, etc.).

The main component is the STM6601 smart push-button on/off controller with Smart Reset and power-on lockout.

The STDES-STM660 input and output pin header contains all the possible input and output signals of the STM6601 for the connection with the user application and the power supply that should be controlled.

The push buttons are used to control the board. The LEDs show the signal states.

The tests have been carried out using:

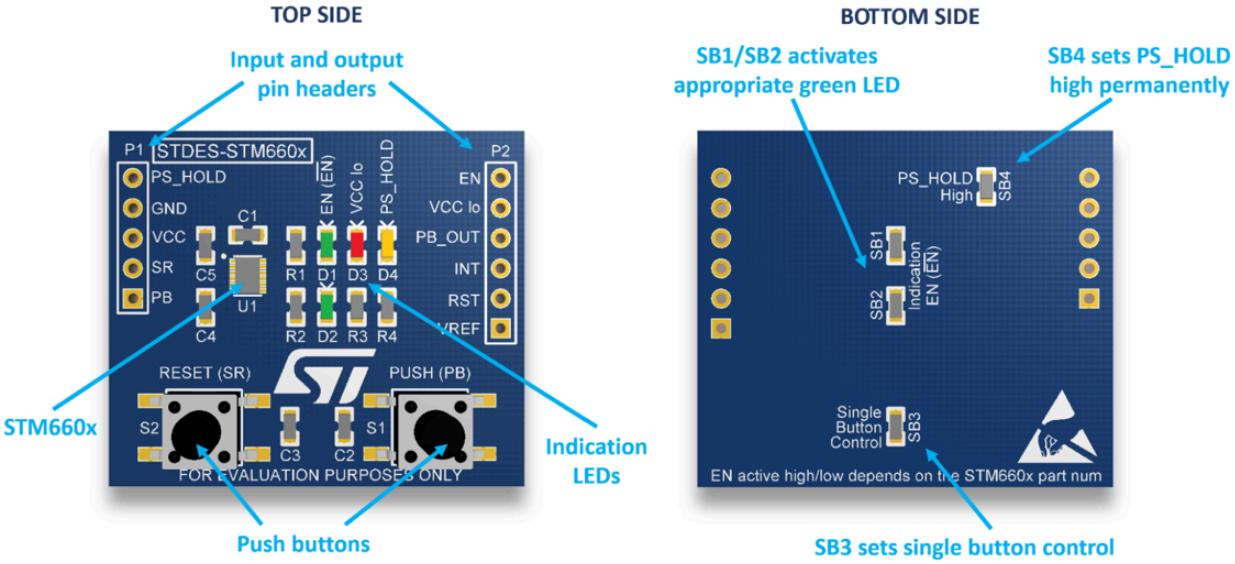
- a STEVAL-1PS01DJR evaluation board based on the ST1PS01 synchronous step-down converter. It can be enabled or disabled by the logic input EN and controlled by the STDES-STM660 enable output
- a DC power supply and an oscilloscope

1 Overview

The STDES-STM660 features:

- Equipped with the STM6600/STM6601 smart reset and power-on lockout device
- Two separate buttons for the smart reset control
- Precise 1.5 V voltage reference
- Secure startup, interrupt, smart reset, or power-down driven by a push-button
- Indication LEDs for the main signals
- Two pin headers with all possible input and output signals of the STM6601
- RoHS compliant

Figure 1. STDES-STM660 reference design



2 Specifications

- STM6601CM2DDM6F smart reset and power-on lockout device
- 4.7 s assertion delay time
- Power-up duration determined primarily by fixed time period, t_{ON_BLANK} = 5.6 s
- Threshold voltage 3.1 V, voltage hysteresis 200 mV
- Active high EN output, long push deasserts EN, pull-up on $\overline{SR}$
- Precise 1.5 V voltage reference with 1% accuracy

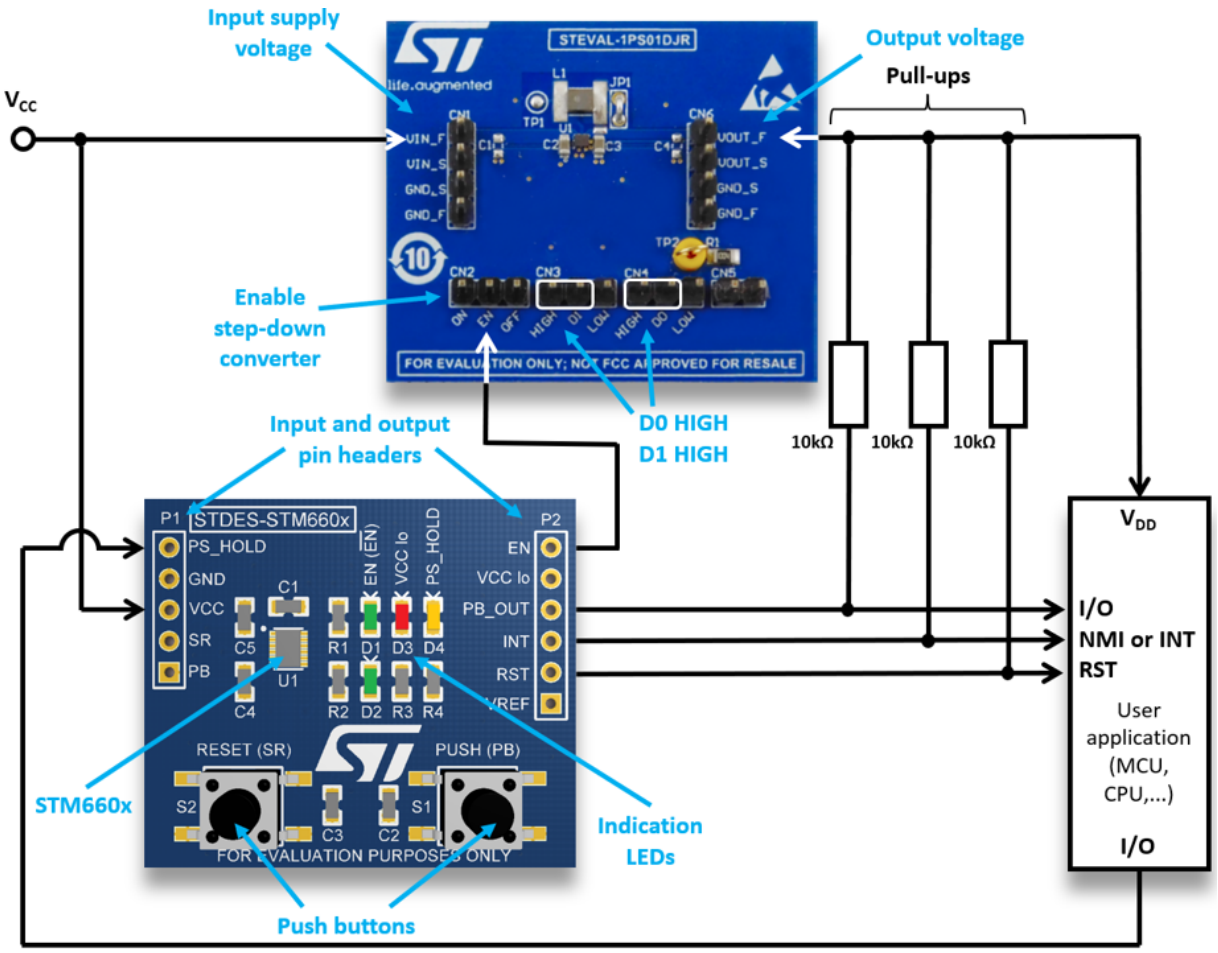
3 Test setup

3.1 Test conditions and equipment

The STDES-STM660 can be self-tested. It can be also used in combination with the STEVAL-1PS01DJR step-down converter as a power supply controller with smart reset and power-on lockout.

The tested STDES-STM660 is equipped with the STM6601CM2DDM6F, which has an active high EN output, long push deasserts EN, and pull-up on $\overline{SR}$. The STDES-STM660 usage can enable or disable the STEVAL-1PS01DJR step-down converter. The STEVAL-1PS01DJR active high EN input requires the STM6601CM2DDM6F active high output. The connection of these two boards demonstrates how the smart reset and power-on lockout work with the real power supply controller.

Figure 2. Board connections



3.1.1 STDES-STM660 settings

It is necessary to connect SB2 to activate the green LED to indicate EN active high.

SB1 has to stay disconnected. For the correct functionality, other modifications are not necessary. However, $\overline{RST}$, $\overline{INT}$, $\overline{PB_{OUT}}$ are open drain outputs. Therefore, 10 kΩ pull-ups are necessary.

External pull-ups are used for testing. In the final user application, the MCU input GPIO pull-ups may be used. The signal PS_{HOLD} (acknowledge signal) can be handled manually or using the SB4. SB4 sets PS_{HOLD} permanently high.

3.1.2 STEVAL-1PS01DJR settings

The STEVAL-1PD01DJR has selectable output voltages. Using jumpers on CN3 and CN4, 2.8 V output voltage can be chosen (D0 HIGH, D1 HIGH). Other modifications are not necessary.

3.2 Procedure

3.2.1 Power-up test

This test validates successful power-up, delay after the button pushing and asserting EN and $\overline{RST}$ signals (debounce period). Unsuccessful power-up means that the PS_{HOLD} is asserted low.

Initial conditions

- The V_{CC} voltage has to be above V_{TH+} threshold (for STM6601CM2DDM6F V_{TH+} = 3.1 V)
- V_{CC} = 3.3 V
- PS_{HOLD} high, EN off

Procedure

Press the S1 button. The EN signal is asserted immediately. Thanks to pull-up resistors, $\overline{RST}$ and $\overline{INT}$ are high. After a short delay (debounce period), the $\overline{RST}$ goes low (see the STM6601 datasheet). The successful power up could be acknowledged by the system, using PS_{HOLD} high until t_{ON_BLANK} time expires. This blanking time allows the processor to start up correctly. For this test, we set PS_{HOLD} permanently high. If not, the EN signal is deasserted.

Results

The green LED indicates that the EN signal is asserted. The EN signal enables the STEVAL-1PS01DJR. The yellow LED indicates that the PS_{HOLD} signal is activated.

Table 1. Testing STDES-STM660 parameters

Measured parameter	Value	Note
$t_{DEBOUNCE}$	32 ms	Debounce period
t_{REC}	0.376 s	$\overline{RST}$ pulse width
t_{ON_BLANK}	8.54 s	Time between the $\overline{RST}$ signal assertion and the EN signal deassertion

3.2.2 Power-down test

To evoke the power-down sequence in the MCU, push the PB button to assert $\overline{INT}$ signal.

Initial conditions

- The V_{CC} voltage has to be above V_{TH+} threshold (for STM6601CM2DDM6F V_{TH+} = 3.1 V)
- V_{CC} = 3.3 V
- PS_{HOLD} high, EN on

Procedure

Push the S1 button. After a short delay (debounce period), $\overline{INT}$ goes low to ask the MCU to start the secure power-down sequence. Using the PS_{HOLD} low, we substitute the MCU acknowledgement. Then, EN is deasserted accordingly. Until the MCU acknowledgement, EN remains asserted.

Results

After this short push, the user application should acknowledge the power down. Then, the yellow and green LEDs turn off. The EN signal is deasserted. Then, STEVAL-1PS01DJR is disabled.

3.2.3 Reset test

When the user application does not respond, the PS_{HOLD} can be forced low using the long push PB and SR buttons.

Initial conditions

- The V_{CC} voltage has to be above V_{TH+} threshold (for STM6601CM2DDM6F V_{TH+} = 3.1 V)
- Vcc = 3.3 V
- PS_{HOLD} high, EN on

Procedure

Push the S1 and S2 simultaneously. After the t_{SRD} period, the STM6601 asserts the PS_{HOLD} low and forces the EN signal off. The t_{SRD} period starts after the debounce period of the last pushed button, always after the $t_{\overline{INT}\_Min}$, the minimum $\overline{INT}$ pulse width.

Results

After the long push, the user application does not need to acknowledge the power down. The yellow and green LEDs turn off.

Table 2. Testing STDES-STM660 parameters

Measured parameter	Value	Note
$t_{SRD} + t_{\overline{INT}\_Min}$	4.83 s	Time to the EN signal deassertion, long push, reset button pressed first
$t_{SRD} + t_{DEBOUNCE}$	4.83 s	Time to the EN signal deassertion, long push, push button pressed first and reset button pressed after $t_{\overline{INT}\_Min}$

3.2.4 Undervoltage test

Undervoltage is detected when the V_{CC} voltage drops below V_{TH-} threshold (factory selectable $V_{TH-} = V_{TH+} - V_{HYST}$). It is published by the $\overline{INT}$ signal and $\overline{Vcc_{lo}}$ assertion.

Initial conditions

- The V_{CC} voltage has to be above V_{CCmin} = 1.6 V
- V_{CC} = 3.3 V
- PS_{HOLD} high, EN on

Procedure

If the V_{CC} voltage drops below V_{TH-} voltage threshold, the $\overline{Vcc_{lo}}$ signal is asserted. After the short delay (debounce period), $\overline{INT}$ goes low to publish it. The MCU has time ($t_{DEBOUNCE} + t_{\overline{INT}\_Min} + t_{SRD}$) to start the power-down sequence until the supply lockout. The Vcc voltage must stay above V_{CCmin} = 1.6 V. Otherwise the supply disables immediately. The STDES-STM660 recovers from the undervoltage warning after the V_{CC} voltage rises above the V_{TH+} voltage threshold (for STM6601CM2DDM6F V_{TH+} = 3.1 V and threshold hysteresis V_{HYST} = 200 mV).

Results

The V_{CC} undervoltage warning is indicated on the STDES-STM660 by the red LED.

Table 3. Testing STDES-STM660 parameters

Measured parameter	Value	Note
$t_{DEBOUNCE} + t_{\overline{INT}\_Min} + t_{SRD}$	4.86 s	Time between the $\overline{Vcc_{lo}}$ signal assertion and the EN signal off

3.2.5 Voltage reference test

The STDES-STM660 features a precise 1.5 V voltage reference output. The V_{REF} has a proper output voltage when $\overline{RST}$ is deasserted. V_{REF} is disabled when the device is in the standby mode (EN is deasserted). The reference voltage depends on the load on the V_{REF} pin.

Initial conditions

- V_{CC} = 3.6 V
- PS_{HOLD} high, EN on

Procedure

During the normal operation state, the EN signal is on. The STM6601 1.5 V voltage reference is enabled.

Results

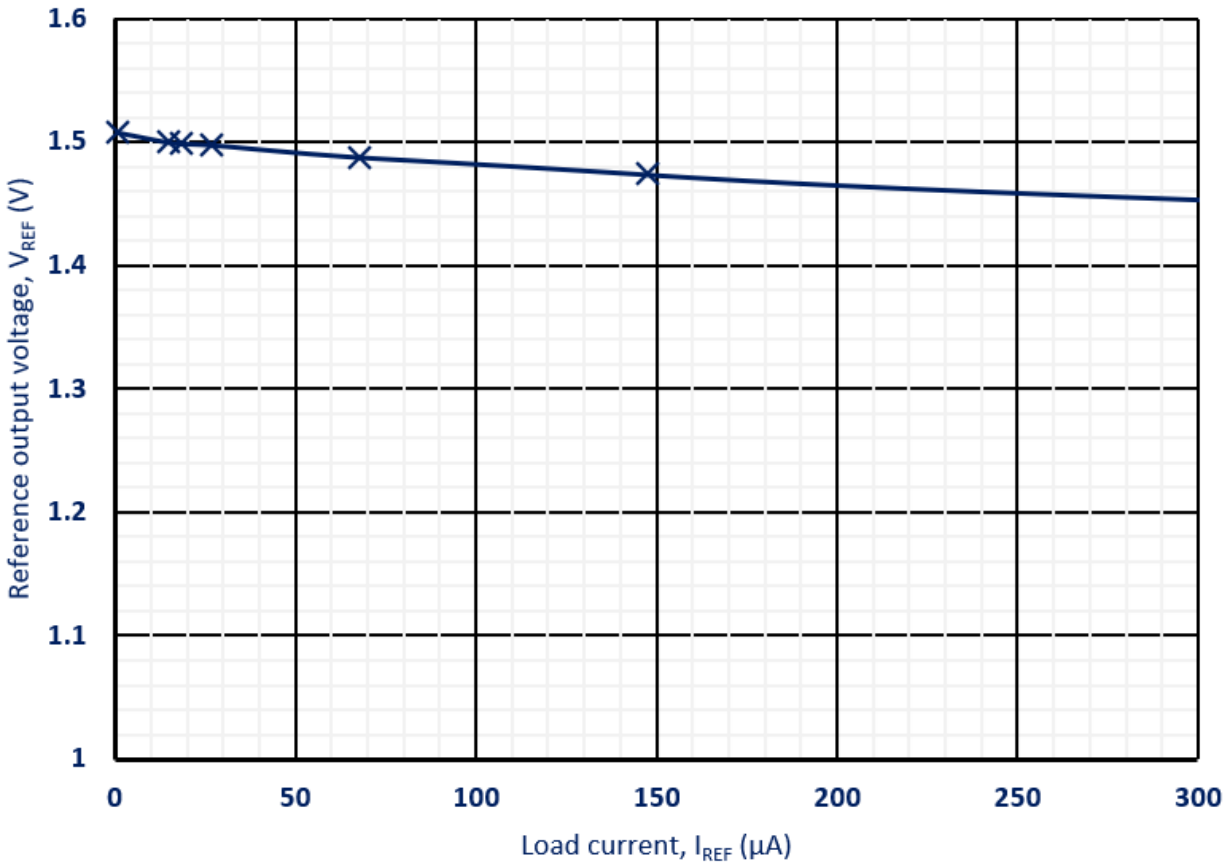
When the green LED is on, the STM6601 1.5 V voltage reference is enabled.

4 Measurements and waveforms

Detailed waveforms are available in STM6600, STM6601 datasheet. Those waveforms describe and visualize the timing of the signals during the power-up, reset or during undervoltage in detail.

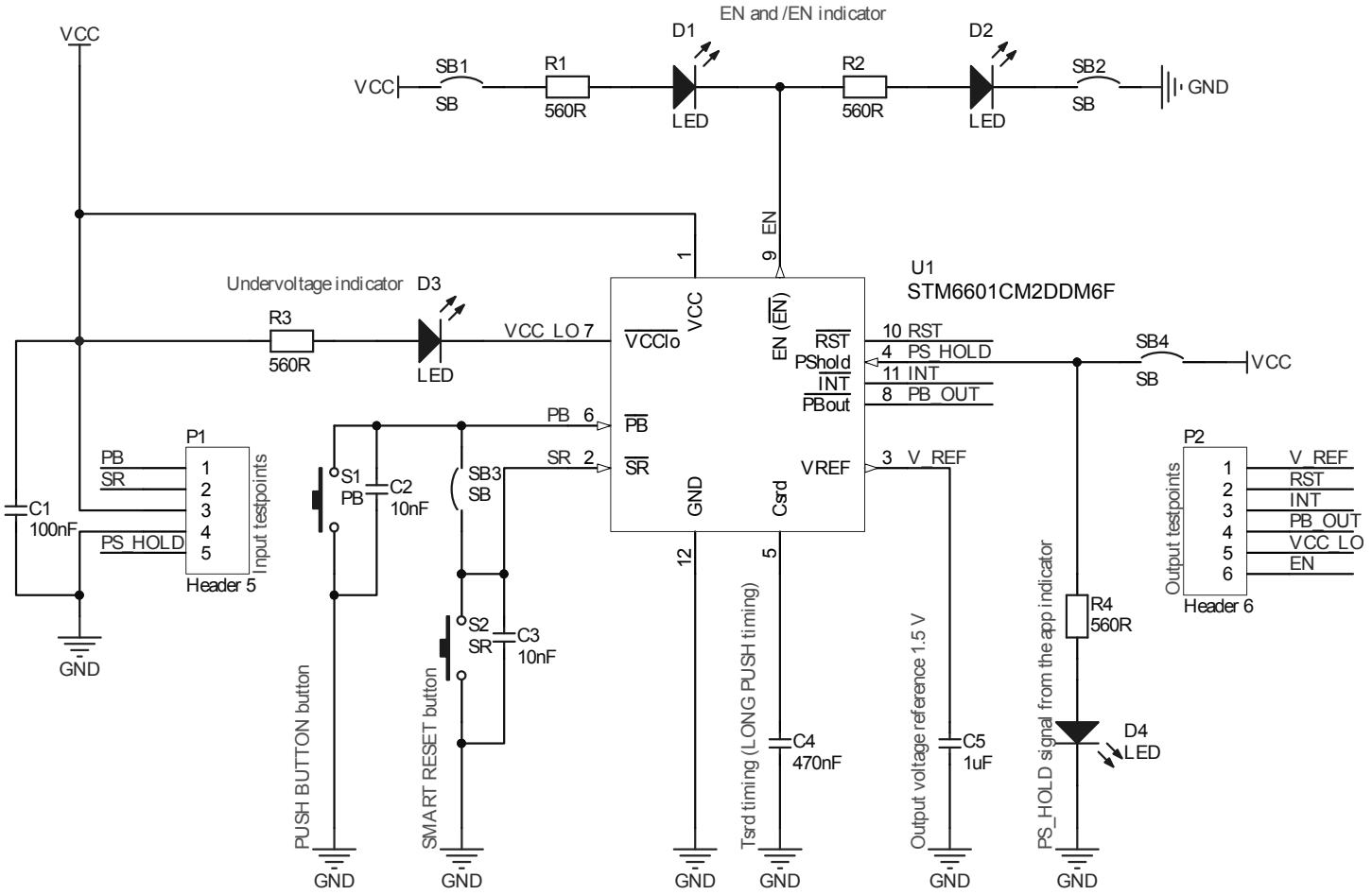
STDES-STM660 precise 1.5 V voltage reference output is also very useful feature of the device. The figure below shows how the reference voltage depends on the load current.

Figure 3. Reference output versus load current, V_{CC} = 3.6 V, T_A = 25°C



5 Schematic diagrams

Figure 4. STDES-STM660 circuit schematic



6 Bill of materials

Table 4. **STDES-STM660 bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	C1	100nF, SMD0603, 25 V	Capacitor	Any	Any
2	2	C2, C3	10nF, SMD0603, 25 V	Capacitors	Any	Any
3	1	C4	470nF, SMD0603, 25 V	Capacitor	Any	Any
4	1	C5	1uF, SMD0603, 25 V	Capacitor	Any	Any
5	2	D1, D2	LED, SMD0603, 2V, 20mA	Green LEDs	Würth Elektronik	150060VS75000
6	1	D3	LED, SMD0603, 2V, 20mA	Red LED	Würth Elektronik	150060RS75000
7	1	D4	LED, SMD0603, 2V, 20mA	Yellow LED	Würth Elektronik	150060YS75000
8	1	P1	Header 5	Header, 5-Pin, 2.54 mm	Any	Any
9	1	P2	Header 6	Header, 6-Pin, 2.54 mm	Any	Any
10	4	R1, R2, R3, R4	560R, SMD0603	Resistors	Any	Any
11	1	S1	SMT (6 x 6mm) - Height 5 mm	Tactile switch	Any	Any
12	1	S2	SMT (6 x 6mm) - Height 5 mm	Tactile switch	Any	Any
13	4	SB1, SB2, SB3, SB4	SB	Solder bridge	-	-
14	1	U1	STM6601CM2DDM6F, DFN12 2X3X0.75	Smart push-button on/off controller with smart reset and power-on lockout	ST	STM6601CM2DDM6F

7 Conclusions

The STDES-STM660 reference design demonstrates the STM6601 behavior during power up, power down, and reset very well, above all thanks to the LED indication section.

The STDES-STM660 controls the STM6601 using two push buttons. It keeps the interface with the user application that could be controlled by the smart reset.

The STDES-STM660 also provides the application of the precise 1.5 V voltage reference.

Appendix A Reference design warnings, restrictions and disclaimer

Important: *The reference design is not a complete product. It is intended exclusively for evaluation in laboratory/ development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical/mechanical components, systems and subsystems.*

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Revision history

Table 5. **Document revision history**

Date	Revision	Changes
16-Nov-2022	1	Initial release.

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