

# AN12395

## OM-SE050ARD hardware overview

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Application note

### Document information

Information	Content
Keywords	OM-SE050ARD, SE050
Abstract	This document describes the OM-SE050ARD development kit and details how to use its jumpers to configure the different communication options with the SE050 security IC.



## Revision history

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### Revision history

Revision number	Date	Description
1.0	2019-06-08	First document release.
1.1	2019-06-27	Corrected an error in Figure 2 pin description.


## 1 Read this first

This section lists the hardware and software required before starting this document.

### 1.1 Required hardware

OM-SE050ARD development kit:

Table 1. OM-SE050ARD development kit details

Part number	12NC	Content	Picture
<a href="#">OM-SE050ARD</a>	935383282598	SE050 development board	

### 1.2 Required software

This document does not use or install any specific software tool or package.

## 2 Overview

The OM-SE050ARD is the development kit for the SE050 Plug & Trust product family. This kit allows you to evaluate the SE050 product family features and simplifies the development of your custom applications. [Figure 1](#) shows a picture of the OM-SE050ARD.



**Figure 1. OM-SE050ARD development kit**

The SE050 uses I<sup>2</sup>C as communication interface and its commands are wrapped using the Smartcard T=1 over I<sup>2</sup>C (T=1oI2C) protocol. In addition, the SE050 supports the following interfaces:

- I<sup>2</sup>C interface in slave mode with data rates up to 3.4 Mbps .
- I<sup>2</sup>C interface in master mode with data rates up to 400 KHz.
- ISO/IEC 14443 T=CL protocol.

The OM-SE050ARD flexible design makes it possible to access the SE050 interfaces by just changing a few jumper settings.

**Note:** Only the I<sup>2</sup>C slave interface is mandatory. The I<sup>2</sup>C master and ISO/IEC 14443 interfaces are optional.

### 3 Headers and connectors

The OM-SE050ARD is designed with several headers and connectors that allow you to interface with SE050. The OM-SE050ARD is equipped with:

- **Arduino-R3 header:** It allows you to easily attach it to any NXP MCU/MPU development board with Arduino compatible headers such as many Kinetis, LPC and i.MX MCU boards. The Arduino-R3 female connectors come soldered in the OM-SE050ARD.
- **External I<sup>2</sup>C connector:** It allows you to connect any non-Arduino compatible MCU boards via I<sup>2</sup>C slave interface. The OM-SE050ARD includes the mounting holes for the External I<sup>2</sup>C connector.
- **10-pin header:** It allows you to access several pins of the SE050, including the I<sup>2</sup>C master interface to attach sensors or peripherals to the board. The 10-pin header male connectors come soldered in the OM-SE050ARD.
- **DB15 header:** It allows you to access several pins of the SE050, including the ISO/IEC 14443 or the I<sup>2</sup>C master interface to attach sensors or peripherals to the board. The OM-SE050ARD includes the mounting holes for the DB15 connector.

Figure 2 shows an overview to OM-SE050ARD headers and connectors together with its corresponding pin description.

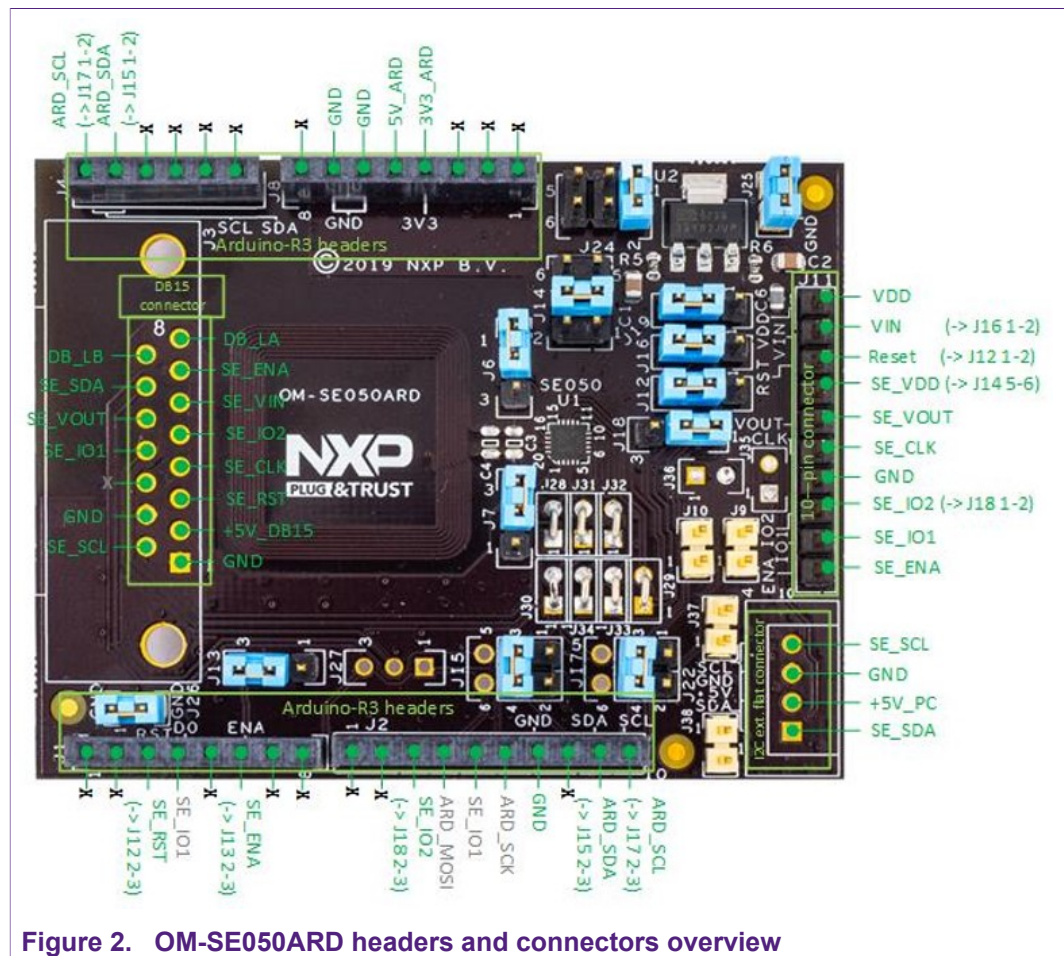


Figure 2. OM-SE050ARD headers and connectors overview

## 4 Jumpers overview

The OM-SE050ARD board uses individual jumpers to configure settings related with the SE050 interfaces, power supply and power modes. This section provides an overview to the OM-SE050ARD jumpers and its configuration options.

### 4.1 I<sup>2</sup>C configuration

The OM-SE050ARD has jumpers that allow you to control the configuration of the I<sup>2</sup>C slave and master interfaces available in SE050. These jumpers are:

- J9, J10: Configures the I<sup>2</sup>C master pull up connection.
- J15, J17: Configures the I<sup>2</sup>C slave connection.
- J37, J38: Configures the I<sup>2</sup>C slave interface pull up resistor.

[Table 2](#) describes the OM-SE050ARD jumper settings for each I<sup>2</sup>C setting configuration.

**Table 2. Jumpers for I<sup>2</sup>C configuration**

Jumper	Description	Open	1-2	3-4
J9	I <sup>2</sup> C Master pull up connection	not connected (Default)	3k3 Ohm	n.a.
J10	I <sup>2</sup> C Master pull up connection	not connected (Default)	3k3 Ohm	n.a.
J15	I <sup>2</sup> C Slave SDA connection	not connected	Arduino R3 J4:5	Arduino R3 J2:9 (Default)
J17	I <sup>2</sup> C Slave SCL connection	not connected	Arduino R3 J4:6	Arduino R3 J2:10 (Default)
J18	SE050_IO2 routing	n.a	Routed to J11:9 (Default)	Routed to J2:3
J37	I <sup>2</sup> C Slave SCL pull up	3k3 Ohm (Default)	560 Ohm	n.a.
J38	I <sup>2</sup> C Slave SDA pull up	3k3 Ohm (Default)	560 Ohm	n.a.

[Figure 3](#) highlights in blue the location of the OM-SE050ARD for I<sup>2</sup>C settings configuration.

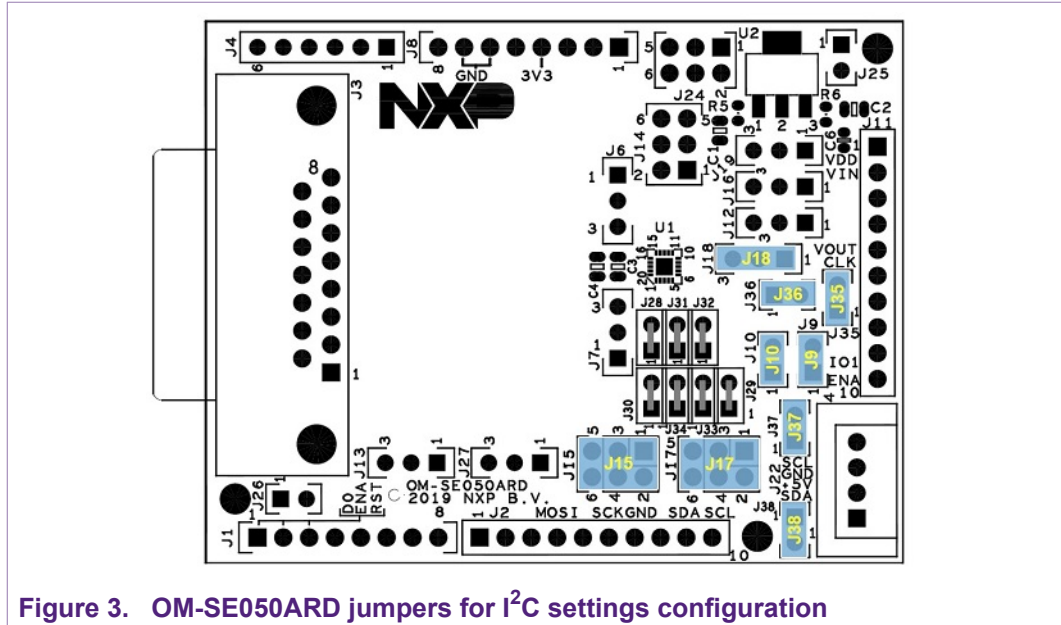


Figure 3. OM-SE050ARD jumpers for I<sup>2</sup>C settings configuration

## 4.2 Power supply options

The jumpers that allow you to change the OM-SE050ARD power supply settings are:

- J19: Configures V<sub>DD</sub> supply voltage options.
- J16: Configures SE050\_V<sub>IN</sub> supply options.
- J24: Configures V<sub>DD</sub> supply voltage options in case the LDO is used.

Table 3 describes the OM-SE050ARD jumper settings for each power supply settings configuration.

Table 3. Jumpers for power supply settings configuration

Jumper	Description	1-2	2-3	3-4	5-6
J16	SE050_V <sub>in</sub> supply	Supplied by J11:2 pin	Supplied by the V <sub>DD</sub> (see J19) (Default)	n.a.	n.a.
J19	V <sub>DD</sub> supply voltage	From LDO	From 3V3_ARD pin (Default)	n.a.	n.a.
J24	V <sub>DD</sub> supply voltage (if LDO is used)	From 5V_PC (External I <sup>2</sup> C connector - Default)	n.a.	From 5V_DB15 pin	From 5V_ARD pin

Figure 4 shows the power supply unit schematics.

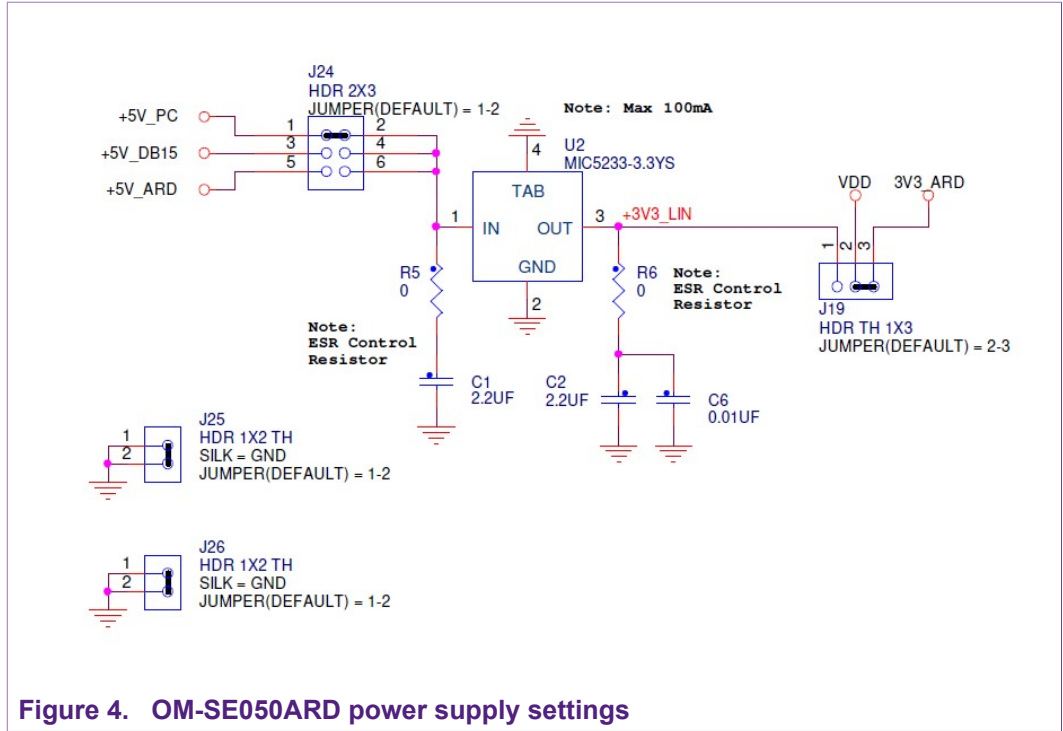


Figure 4. OM-SE050ARD power supply settings

Figure 5 highlights in blue the location of the OM-SE050ARD for power supply settings configuration.

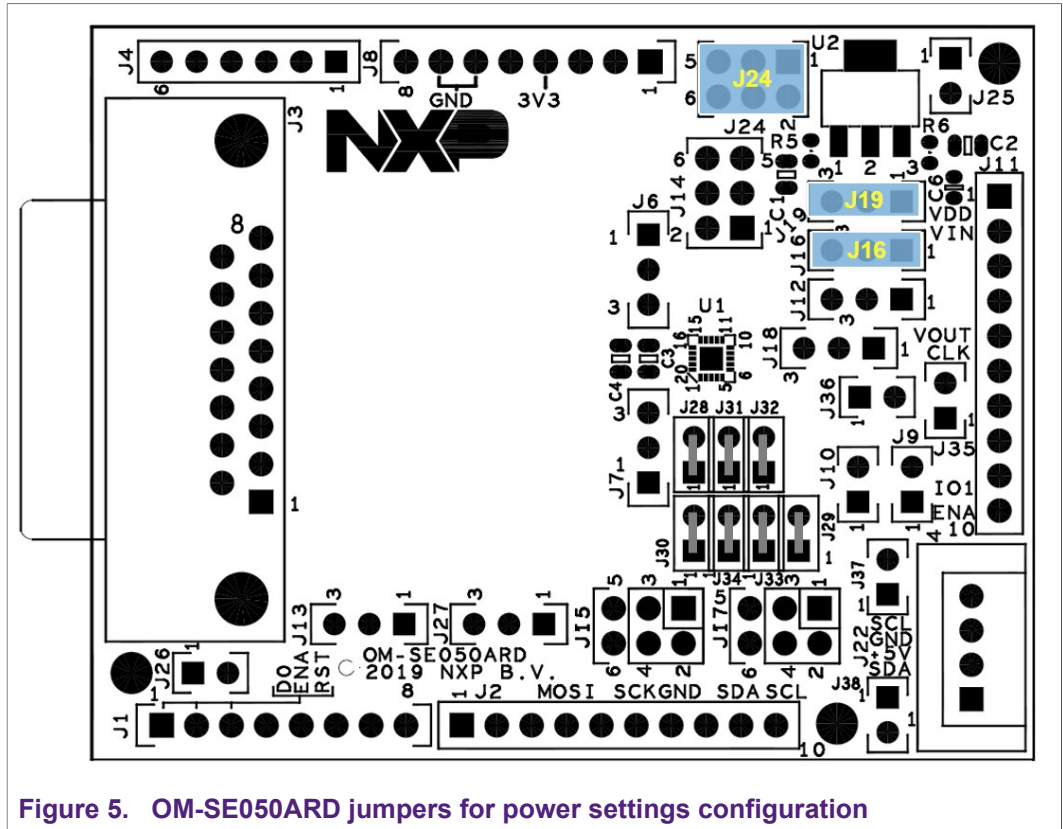


Figure 5. OM-SE050ARD jumpers for power settings configuration



### 4.3 Deep power-down mode

The deep power-down mode reduces the SE050 power consumption to the minimum. In this mode, only I<sup>2</sup>C pads stay supplied via V<sub>in</sub>. The deep power-down mode is enabled by setting the ENA pin to a logic zero. In addition, it is required to supply V<sub>in</sub> pin and connect V<sub>out</sub> and V<sub>cc</sub> pins at the PCB level.

The ENA pin controls an internal switch between V<sub>out</sub> and V<sub>in</sub> as shown in [Figure 6](#). Therefore, if V<sub>out</sub> is connected to V<sub>cc</sub>, the ENA pin can effectively switch the power on and off to V<sub>cc</sub>.

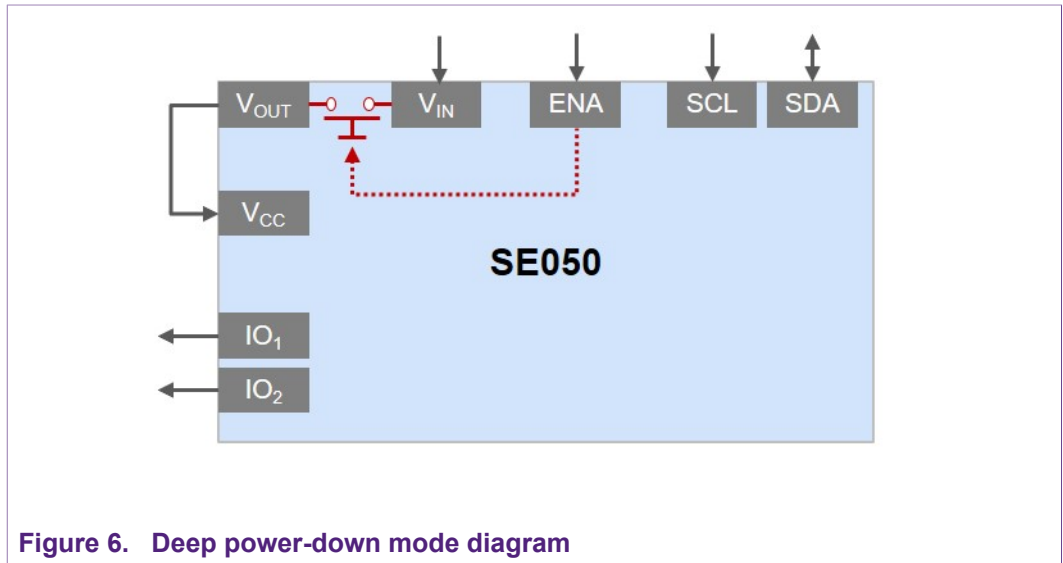


Figure 6. Deep power-down mode diagram

The jumpers J13 and J14 of the OM-SE050ARD allow you to control the SE050 deep power-down mode. To enable the deep power-down mode using the OM-SE050ARD:

- J13: Must be set to position 2-3.
- J14: Must be set to position 3-4.

[Table 4](#) describes the OM-SE050ARD jumper settings for the deep power-down mode configuration

Table 4. Jumpers for deep power-down mode configuration

Jumper	Description	1-2	2-3	3-4	5-6
J13	SE050_ENA pin routing	ENA low. Switch disabled	ENA controlled by Arduino R3 (Default)	n.a.	n.a.
J14	SE050_VCC pin routing	Routed to V <sub>DD</sub> supply voltage	n.a.	Routed to SE050_V <sub>out</sub> pin (Default)	Routed to J11:4 pin

[Figure 7](#) highlights in blue the location of jumper J13 and J14.

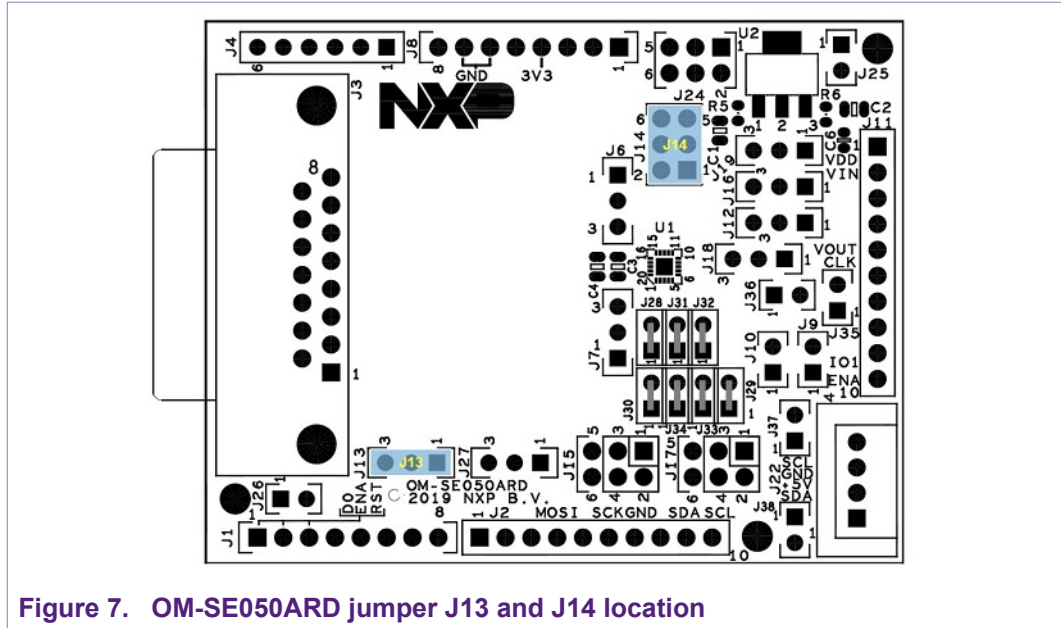


Figure 7. OM-SE050ARD jumper J13 and J14 location

#### 4.4 Reset pin routing

Jumper J12 allows you to control the I<sup>2</sup>C reset pin routing of the SE050. [Table 5](#) indicates the J12 configuration.

**Note:** The SE050 reset pin does not apply for the I<sup>2</sup>C interface.

Table 5. Jumpers for reset pin routing configuration

Jumper	Description	Open	1-2	2-3
J12	SE050_RST pin	Not connected	Routed to J11:3 strip pin connector	Routed to Arduino R3 (Default)

[Figure 8](#) highlights in blue the location of Jumper J12.

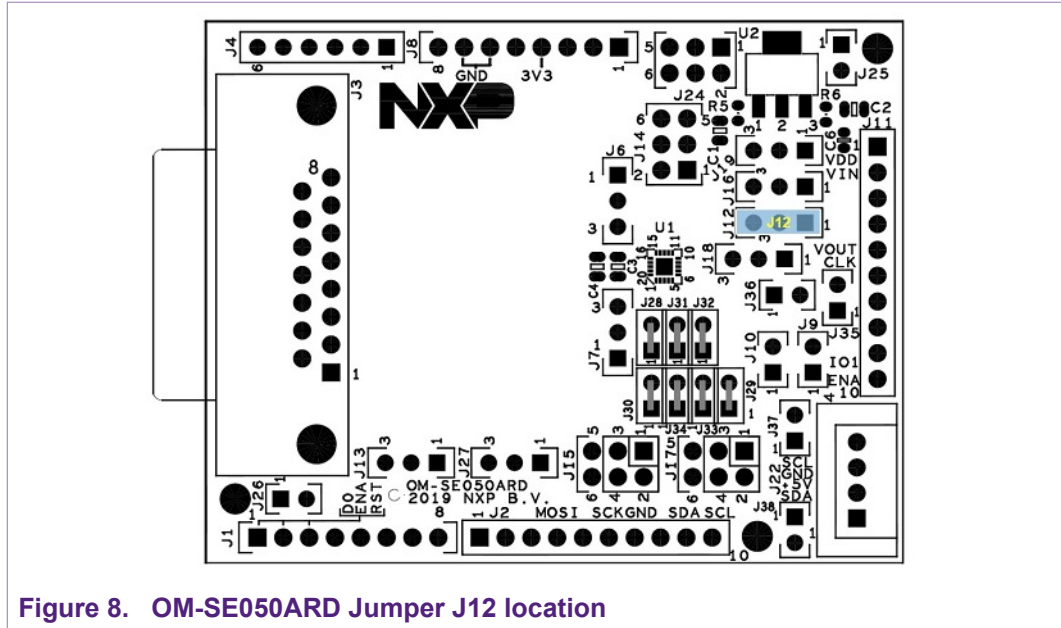


Figure 8. OM-SE050ARD Jumper J12 location

#### 4.5 ISO/IEC14443 contactless interface

Jumper J6 and J7 allow you to control the SE050 contactless interface and allows you to select which antenna shall be used for contactless communication. [Table 6](#) indicates J6 and J7 jumper settings.

Table 6. Jumpers for ISO/IEC14443 contactless interface settings

Jumper position	Description
J6: 2-3 and J7: 1-2	Contactless operation disabled
J6: 1-2 and J7: 2-3	Contactless operation disabled (Default)
J6: 2-3 and J7: 2-3	Contactless operation enabled with OM-SE050ARD internal antenna
J6: 1-2 and J7: 1-2	Contactless operation enabled with external ID1 antenna through DB15 connector

[Figure 9](#) highlights in blue the location of jumpers J6 and J7.



## 5 OM-SE050ARD board use cases

This section details the jumper settings to configure the different interfaces and to enable specific use cases with the OM-SE050ARD board.

### 5.1 SE050 via Arduino header

This section details the jumper configuration to enable the I<sup>2</sup>C slave interface in the Arduino header. The related jumpers of the OM-SE050ARD for I<sup>2</sup>C slave interface configuration are:

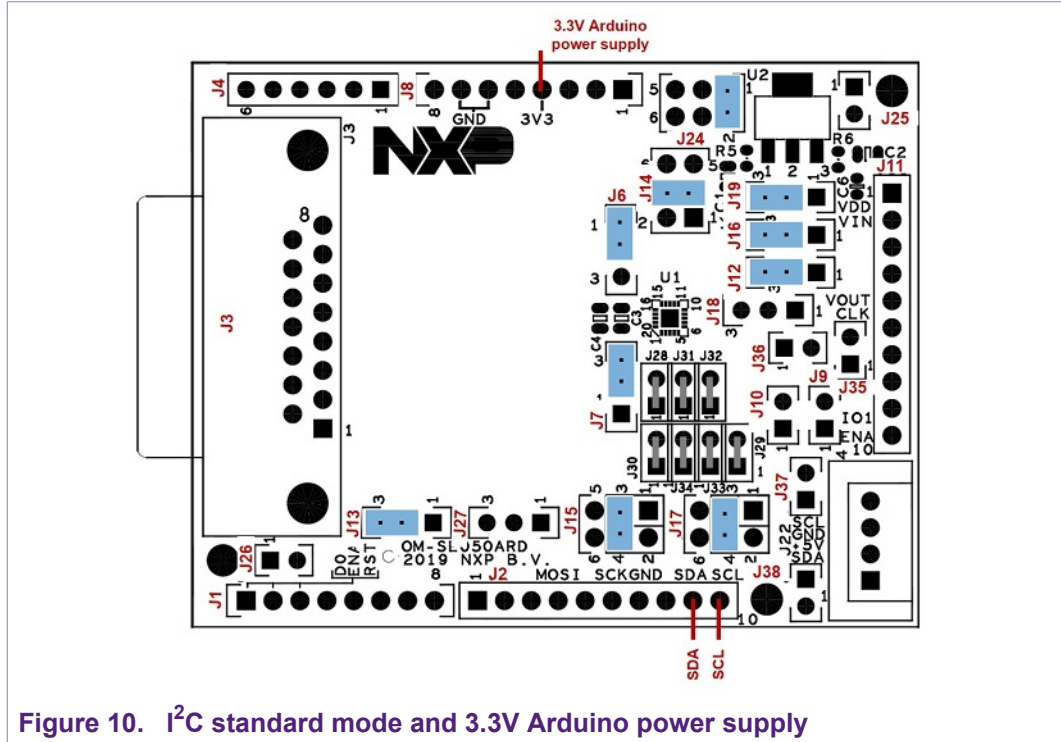
- J37 and J38: Configure the pull up resistors of the I<sup>2</sup>C interface.
- J19: Configures V<sub>DD</sub> supply voltage options.
- J24: Configures V<sub>DD</sub> supply voltage options in case the LDO is used.

**Table 7. Jumper settings for I<sup>2</sup>C slave interface configuration**

Jumper	Configuration	Comment
J6	Set to 1-2 (Default)	Contactless operation disabled
J7	Set to 2-3 (Default)	Contactless operation disabled
J9, J10	Set to "Open" (Default)	I <sup>2</sup> C master pull ups disabled
J12	Set to 2-3 (Default)	SE_RST routed to ARD_RST on J1:3
J13	Set to 2-3 (Default)	SE_ENA set to ARD_ENA on J1:6
J14	Set to 3-4 (Default)	SE_V <sub>OUT</sub> as SE_V <sub>DD</sub>
J15	Set to 3-4 (Default)	I <sup>2</sup> C_SDA routed to ARD_SDA_R3 (J2:9)
	Set to 1-2	I <sup>2</sup> C_SDA routed to ARD_SDA (J4:5)
J16	Set to 2-3	V <sub>DD</sub> as SE_V <sub>IN</sub>
J17	Set to 3-4 (Default)	I <sup>2</sup> C_SCL routed to ARD_SCL_R3 (J2:10)
	Set to 1-2	I <sup>2</sup> C_SCL routed to ARD_SCL (J4:6)
J19	Set to 2-3 (Default)	SE_V <sub>DD</sub> =3.3V from Arduino-R3 voltages
	Set to 1-2	SE_V <sub>DD</sub> =3.3V from LDO.
J24	Set to 1-2 (Default)	No input LDO
	Set to 5-6	5V_ARD to LDO
J25, J26	Do not care	Dummy jumpers
J37, J38	Set to "Open" (Default)	3k3 pull-up resistor for I <sup>2</sup> C standard mode
	Set to "Closed"	560 Ohm parallel pull-up resistor for I <sup>2</sup> C high speed mode

Figure 10 shows the jumper settings to configure the I<sup>2</sup>C slave in standard mode and 3.3V\_ARD supply voltage (no LDO).

In this example, the jumper configuration used in Figure 10 correspond to the values highlighted in bold in Table 7 (J15, J17, J19, J24, J37 and J38).





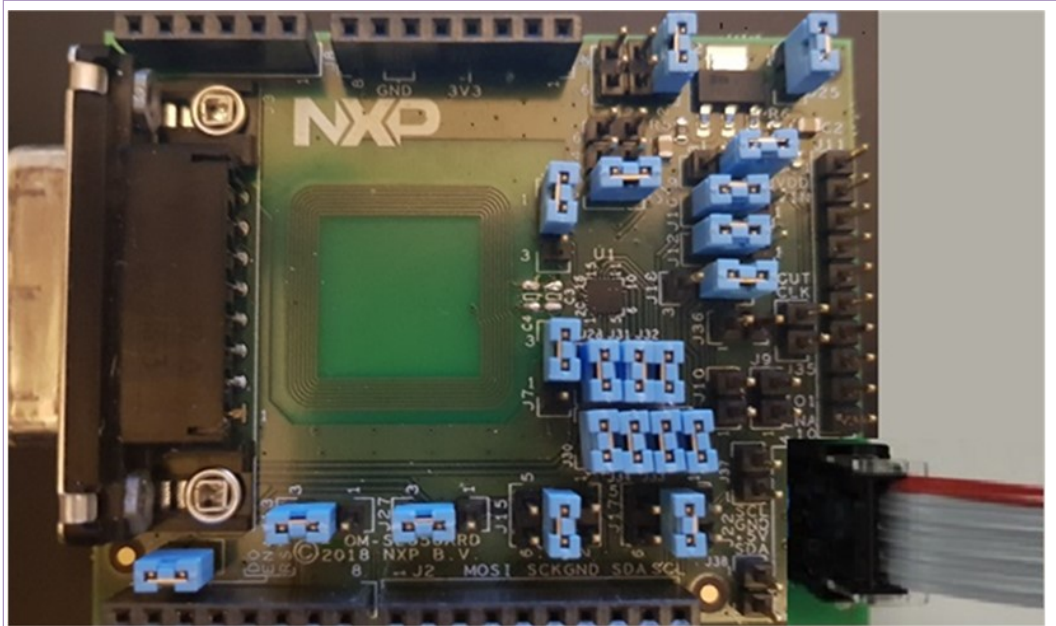


Figure 12. Connection to non-Arduino board using the external I<sup>2</sup>C connector.

### 5.3 SE050 in I<sup>2</sup>C master mode

This section details the jumper configuration to enable the I<sup>2</sup>C master of the SE050. The I2C master interface can be used to connect a sensor securely. The SE050 guarantees the privacy and the authenticity of the data extracted by sensor. The data collected in the application over the SE050 private sensor can be transferred to the cloud for further treatment and analysis. The [Figure 13](#) shows the SE050 solution block diagram for this use case:

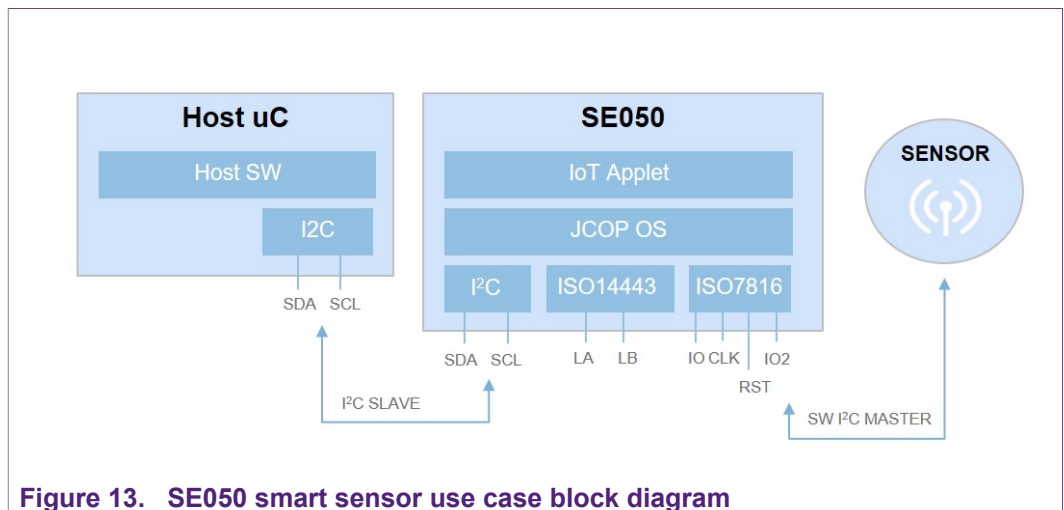


Figure 13. SE050 smart sensor use case block diagram

[Figure 14](#) shows the jumper settings to enable the SE050 I<sup>2</sup>C master interface.



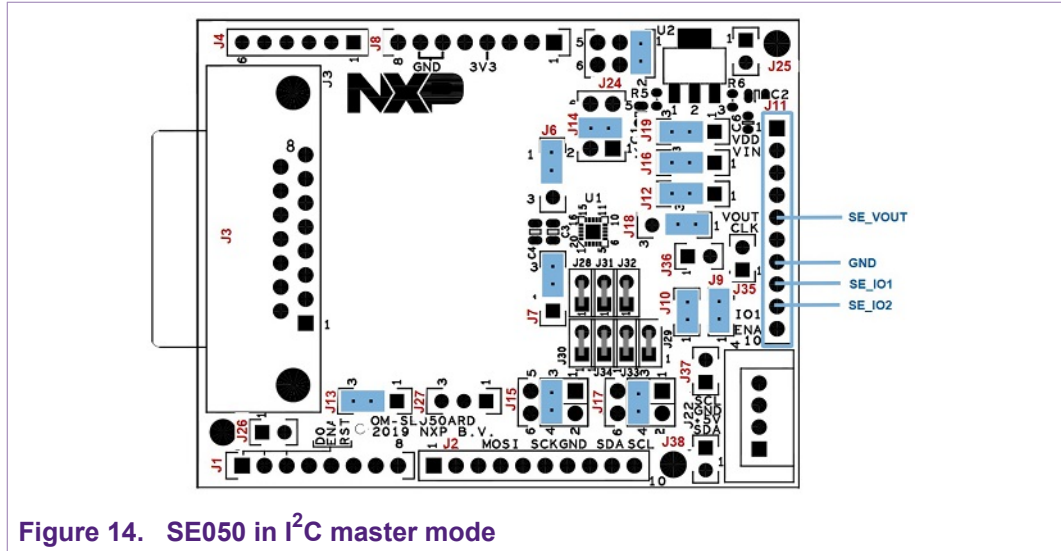


Figure 14. SE050 in I<sup>2</sup>C master mode

Table 9 details the jumper settings for the configuration of the SE050 I<sup>2</sup>C master interface.

Table 9. Jumper settings for SE050 in I<sup>2</sup>C master mode

Jumper	Configuration	Comment
J6	Set to 1-2 (Default)	Contactless operation disabled
J7	Set to 2-3 (Default)	Contactless operation disabled
J9, J10	Set to "Closed"	Set to "Closed" to enable pull-up resistors for I <sup>2</sup> C master signals SE_IO1 and SE_IO2 (if IOT sensor board not already provides pull-up resistors).
J12	Set to 2-3 (Default)	SE_RST routed to ARD_RST on J1:3
J13	Set to 2-3 (Default)	SE_ENA set to ARD_ENA on J1:6
J14	Set to 3-4 (Default)	SE_V <sub>OUT</sub> as SE_V <sub>DD</sub>
J15	Set to 3-4 (Default)	I <sup>2</sup> C_SDA routed to ARD_SDA_R3 (J2:9)
J16	Set to 2-3	V <sub>DD</sub> as SE_V <sub>IN</sub>
J17	Set to 3-4 (Default)	I <sup>2</sup> C_SCL routed to ARD_SCL_R3 (J2:10)
J18	Set 1-2 (Default)	SE_IO2 to pin 9 of header J11
J19	Set to 2-3 (Default)	SE_V <sub>DD</sub> =3.3V from Arduino-R3 voltages
J24	Set to 1-2 (Default)	No input LDO
J25, J26	Do not care	Dummy jumpers
J37, J38	Set to "Open" (Default)	3k3 pull-up resistor for I <sup>2</sup> C standard mode

5.4 SE050 via ISO14443 mode

This section details the jumper settings to operate the OM-SE050ARD via the ISO/IEC14443 interface.

**Note:** Only the I<sup>2</sup>C slave interface is mandatory. The I<sup>2</sup>C master and ISO/IEC 14443 interfaces are optional.

5.4.1 ISO/IECC 14443-A via onboarded antenna

Figure 15 shows the jumper settings to configure the contactless interface via the onboarded antenna in the OM-SE050ARD board.

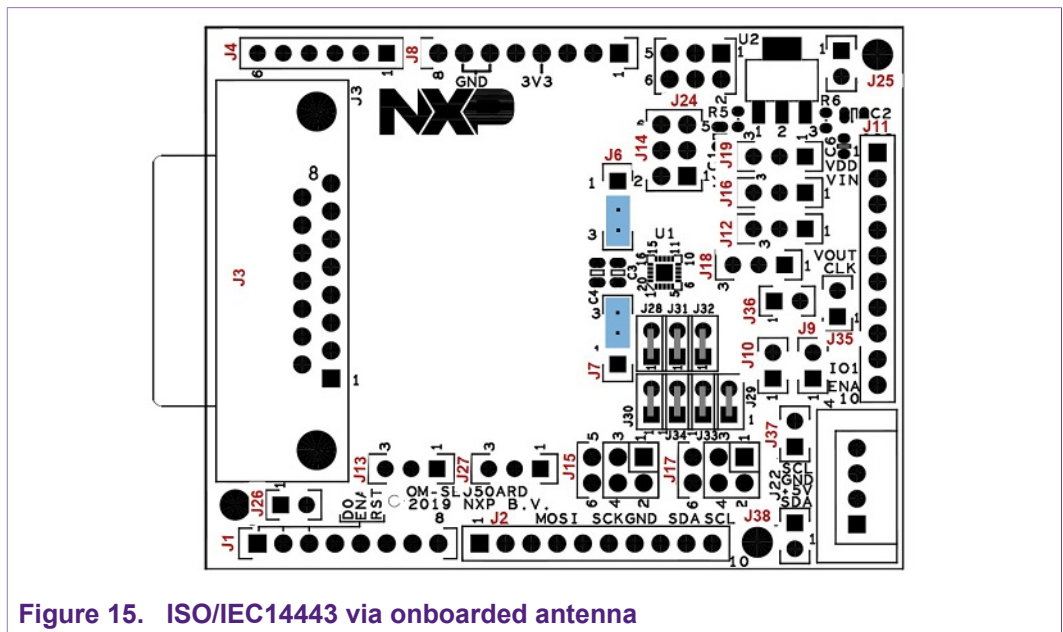


Figure 15. ISO/IEC14443 via onboarded antenna

Table 10 details the jumper settings for this configuration (ISO/IEC14443 via onboarded antenna).

Table 10. ISO/IEC14443 via onboarded antenna

Jumper	Configuration	Comment
J6	Set to 2-3	Contactless operation enabled with onboarded antenna
J7	Set to 2-3	Contactless operation enabled with onboarded antenna
J9, J10	Removed	
J12	Removed	
J13	Removed	
J14	Removed	
J15	Removed	
J16	Removed	
J17	Removed	
J19	Removed	

Jumper	Configuration	Comment
J24	Removed	
J25, J26	Removed	
J37, J38	Removed	

5.4.2 ISO/IECC 14443-A via external antenna

Figure 16 shows the jumper settings to configure the contactless interface via an IN-CLA7816 probe connected through DB15 connector.

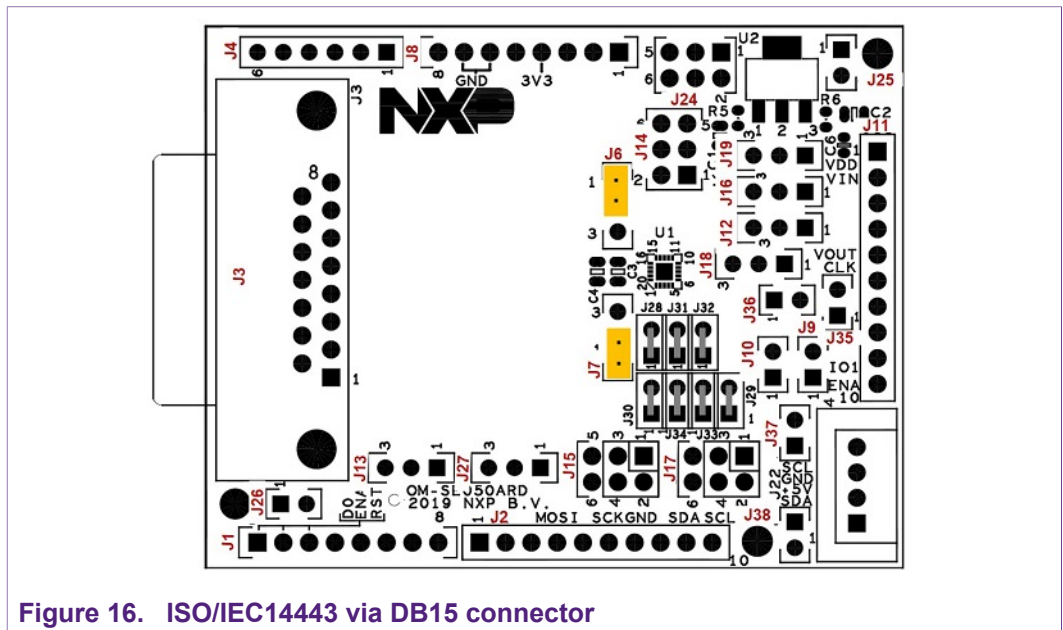


Figure 16. ISO/IEC14443 via DB15 connector

Table 11 details the jumper settings for this configuration (ISO/IECC 14443-A via external antenna).

Table 11. ISO/IEC14443 via DB15 connector

Jumper	Configuration	Comment
J6	Set to 1-2	Contactless operation enabled with external ID1 antenna through DB15 connector
J7	Set to 1-2	Contactless operation enabled with external ID1 antenna through DB15 connector
J9, J10	Removed	
J12	Removed	
J13	Removed	
J14	Removed	
J15	Removed	
J16	Removed	
J17	Removed	
J19	Removed	

Jumper	Configuration	Comment
J24	Removed	
J25, J26	Removed	
J37, J38	Removed	

**5.4.3 ISO/IEC 14443 via DB15 connector**

Figure 17 shows an external contactless interface connected to an IN-CLA7816 probe through DB15 connector.

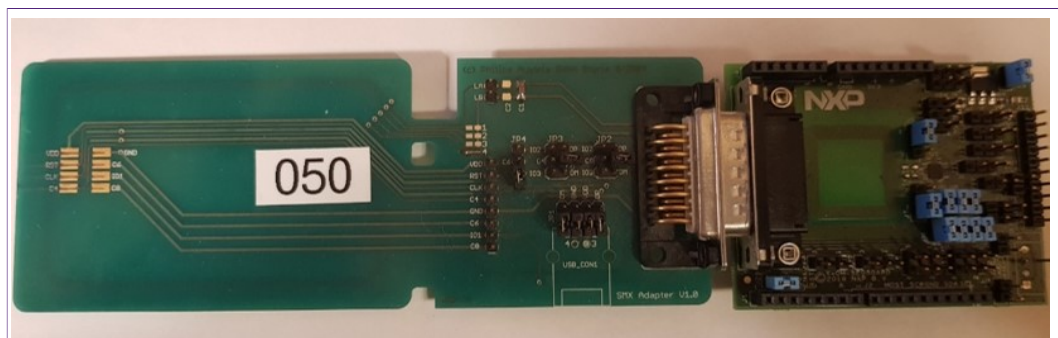
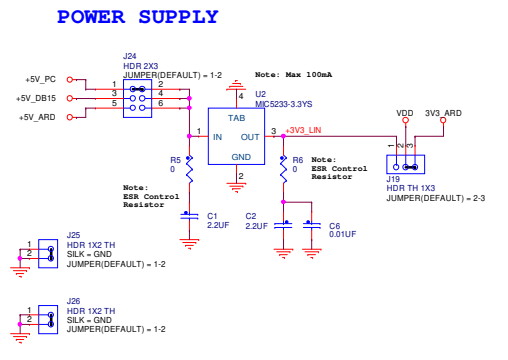
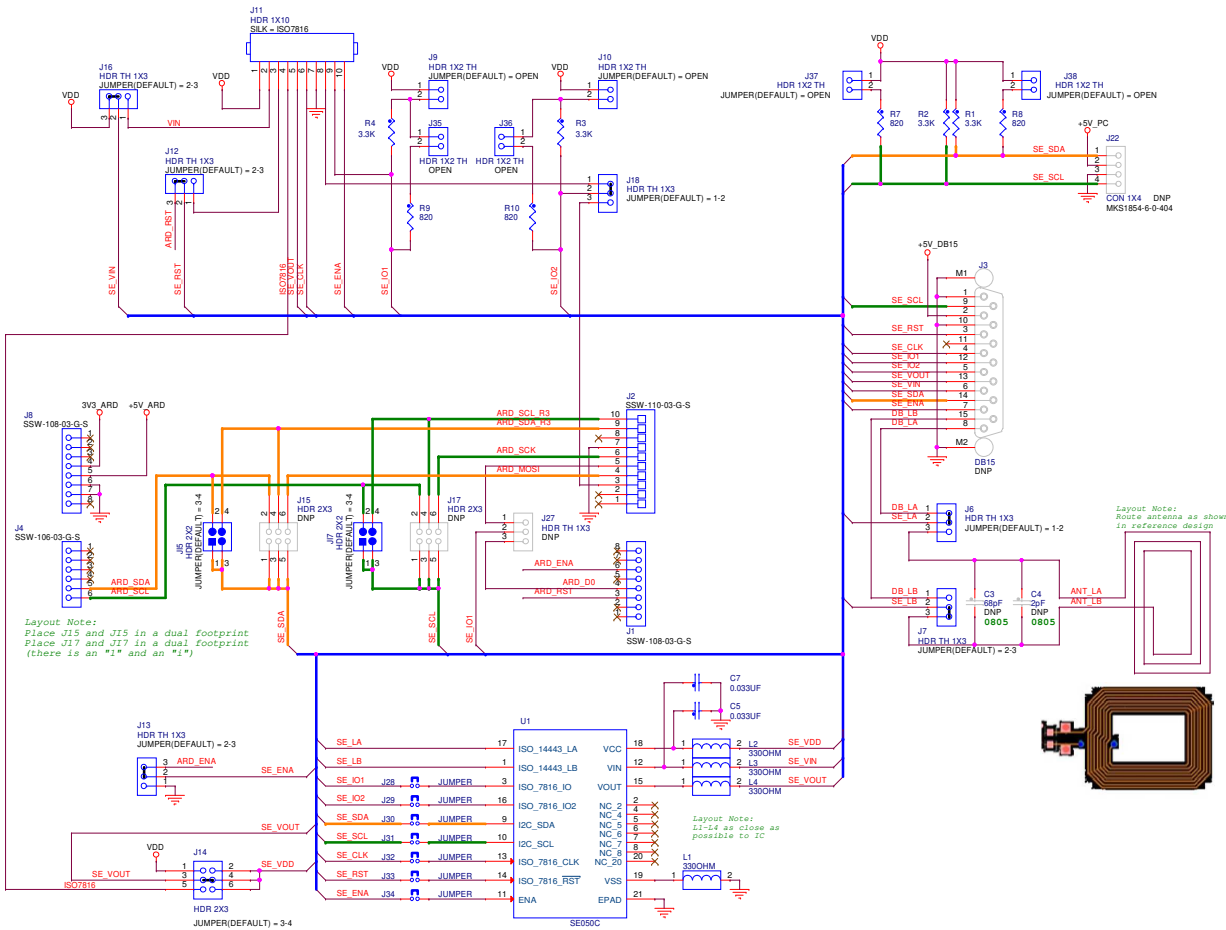


Figure 17. External contactless interface connected to an IN-CLA7816 probe through DB15 connector

# 6 Schematics



Layout Note:  
Place J15 and J15 in a dual footprint  
Place J17 and J17 in a dual footprint  
(there is an "1" and an "1")

Layout Note:  
Z1-L4 as close as possible to IC

Layout Note:  
Route antenna as shown in reference design

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## Tables

Tab. 1.	OM-SE050ARD development kit details .....	3	Tab. 7.	Jumper settings for I2C slave interface configuration .....	13
Tab. 2.	Jumpers for I2C configuration .....	6	Tab. 8.	External I2C connector .....	15
Tab. 3.	Jumpers for power supply settings configuration .....	7	Tab. 9.	Jumper settings for SE050 in I2C master mode .....	17
Tab. 4.	Jumpers for deep power-down mode configuration .....	9	Tab. 10.	ISO/IEC14443 via onboard antenna .....	18
Tab. 5.	Jumpers for reset pin routing configuration .....	10	Tab. 11.	ISO/IEC14443 via DB15 connector .....	19
Tab. 6.	Jumpers for ISO/IEC14443 contactless interface settings .....	11			

Figures

Fig. 1.	OM-SE050ARD development kit .....4	Fig. 10.	I2C standard mode and 3.3V Arduino power supply ..... 14
Fig. 2.	OM-SE050ARD headers and connectors overview ..... 5	Fig. 11.	External I2C connector ..... 15
Fig. 3.	OM-SE050ARD jumpers for I2C settings configuration .....7	Fig. 12.	Connection to non-Arduino board using the external I2C connector. .... 16
Fig. 4.	OM-SE050ARD power supply settings .....8	Fig. 13.	SE050 smart sensor use case block diagram .. 16
Fig. 5.	OM-SE050ARD jumpers for power settings configuration .....8	Fig. 14.	SE050 in I2C master mode ..... 17
Fig. 6.	Deep power-down mode diagram ..... 9	Fig. 15.	ISO/IEC14443 via onboard antenna ..... 18
Fig. 7.	OM-SE050ARD jumper J13 and J14 location ..... 10	Fig. 16.	ISO/IEC14443 via DB15 connector ..... 19
Fig. 8.	OM-SE050ARD Jumper J12 location ..... 11	Fig. 17.	External contactless interface connected to an IN-CLA7816 probe through DB15 connector .....20
Fig. 9.	OM-SE050ARD jumper J6 and J7 location ..... 12		



## Contents

---

<b>1</b>	<b>Read this first .....</b>	<b>3</b>
1.1	Required hardware .....	3
1.2	Required software .....	3
<b>2</b>	<b>Overview .....</b>	<b>4</b>
<b>3</b>	<b>Headers and connectors .....</b>	<b>5</b>
<b>4</b>	<b>Jumpers overview .....</b>	<b>6</b>
4.1	I2C configuration .....	6
4.2	Power supply options .....	7
4.3	Deep power-down mode .....	9
4.4	Reset pin routing .....	10
4.5	ISO/IEC14443 contactless interface .....	11
<b>5</b>	<b>OM-SE050ARD board use cases .....</b>	<b>13</b>
5.1	SE050 via Arduino header .....	13
5.2	SE050 via external I2C connector .....	14
5.3	SE050 in I2C master mode .....	16
5.4	SE050 via ISO14443 mode .....	18
5.4.1	ISO/IECC 144443-A via onboarded antenna ...	18
5.4.2	ISO/IECC 144443-A via external antenna .....	19
5.4.3	ISO/IEC 14443 via DB15 connector .....	20
<b>6</b>	<b>Legal information .....</b>	<b>21</b>

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Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

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