



EBV-IoT - Infineon OPTIGA Trust M Evaluation Shield

Quick Start Guide



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Foreword

The EBV-IoT – Infineon OPTIGA Trust M Evaluation Shield is a quick evaluation tool based on Infineon OPTIGA™ Trust M secure element in the Arduino header. It enables you a seamless access to OPTIGA's features and can be either operated directly using USB port – no external adaptors needed, either by using your favourite MCU platform board in an Arduino form factor. It can be self-powered through USB, or Arduino header. And the most importantly, the tool brings you to just a step away of implementing highest level of embedded security into your IoT application.

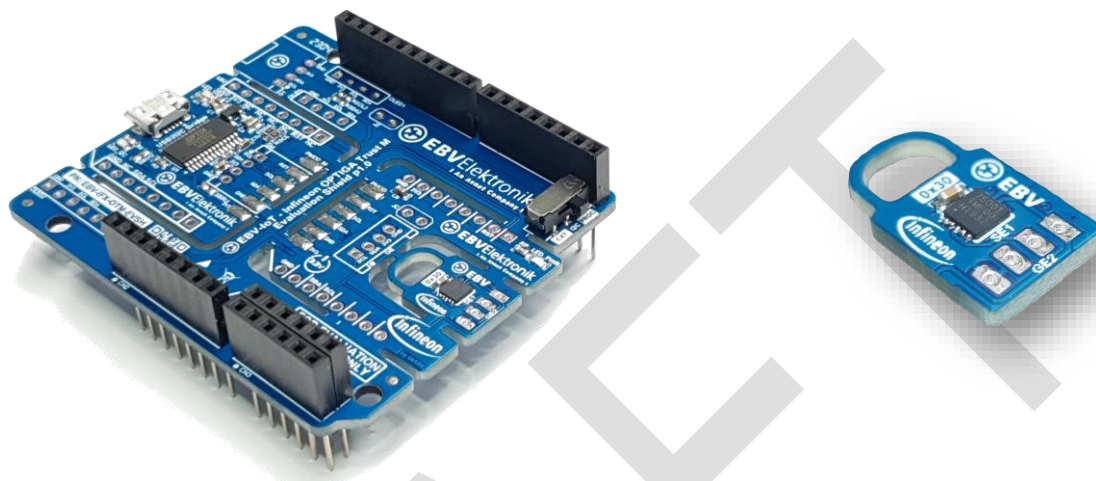


Figure 1: EBV-IoT – Infineon OPTIGA Trust M Evaluation Shield (left), break-away board (right)

The kit includes:

- EBV-IoT – Infineon OPTIGA Trust M Evaluation Shield

Key Benefits

- Easy to use and out-of-the-box accessible secure element sensing evaluation tool
- USB powered (No external battery or supply needed)
- Arduino Uno header compatibility
- Access through integrated USB2I2C bridge or through Arduino header
- Various MCU vendor Arduino compatible evaluation boards examples available
- Multiple break-away board options available: secure element only using I2C bus
- Grove system ready: I2C Grove connectors
- Comes with OLED access pins for simple displaying values using OLED display
- USB2I2C bridge can be reused for accessing different products over I2C interface (break-away possible)

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1. Overview

The EBV-IoT – Infineon OPTIGA Trust M Evaluation Shield (the shield) can be used in a standalone operation as well as through Arduino headers. Simple block diagram is depicted on Figure 2. Following please find brief overview of components of the shield.

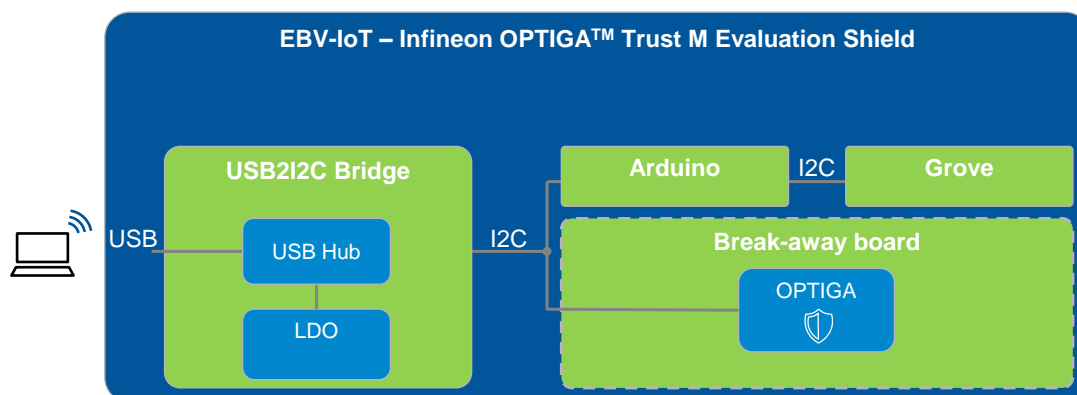


Figure 2: Block diagram

The core of the shield is **Infineon OPTIGA™ Trust M** secure element. Please refer to manufacturer product pages for more information. The shield is Arduino compatible using **Arduino headers**. On the board there is **USB connector** used for powering the board and PC communication.

The onboard LEDs show basic status details. **USB power LED** indicates the board is powered up over USB. The **Board power LED** indicates secure element power on status. **I2C activity LED** indicates I2C communication status.

Multiple **jumpers** (J2, JC, JSDA, JSCL) offer additional hardware configuration. Solder bridges (SBRU, SBVO, SB2, SB6, SB7) and “cut” bridges (JU, JE, JB, JBR, JBSCL, JBSDA) can be used to “hard-wire” configuration using no jumpers. Please refer to Sub-section 1.5 Evaluation shield hardware configuration options for more information. Additional **Grove** and **OLED connector** placeholders allow using Grove I2C extension or OLED displays.

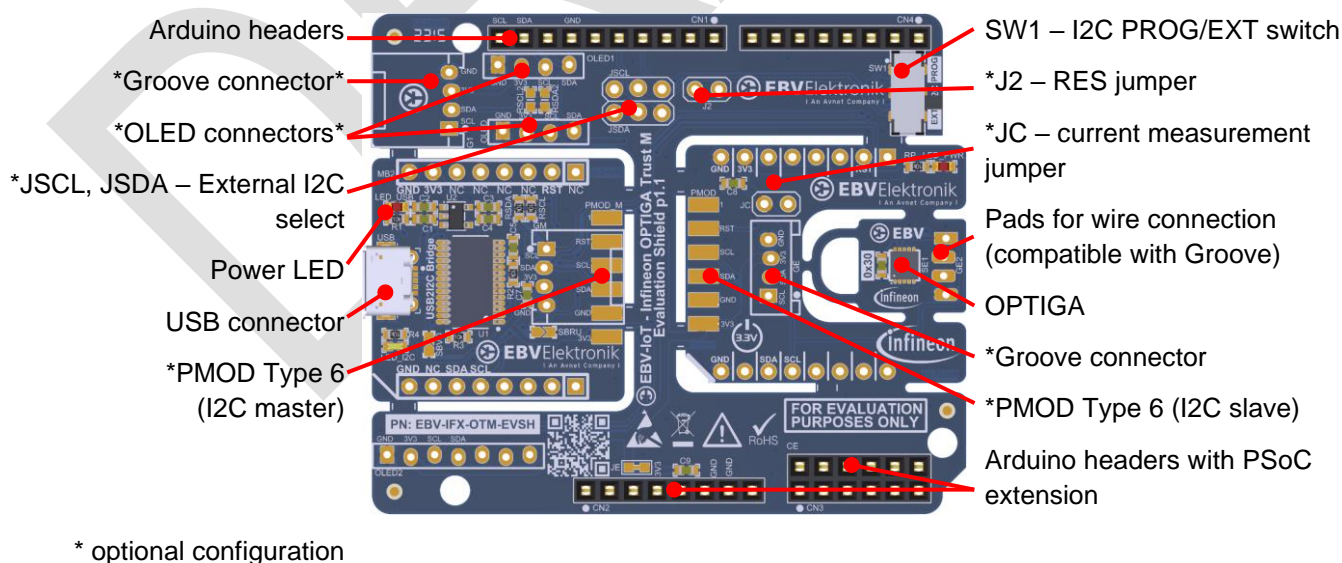


Figure 3: Shield overview

1.1. Power supply

The shield can be powered either by USB using on-board 3.3V LDO, either by Arduino 3.3V power pin.



Warning: Secure element input power as well as I/O pins are 3.3V compliant. Please make sure external voltages applied are within required specifications.

When used as standalone, the shield is supplied from USB over 3.3V LDO as shown on Figure 4.

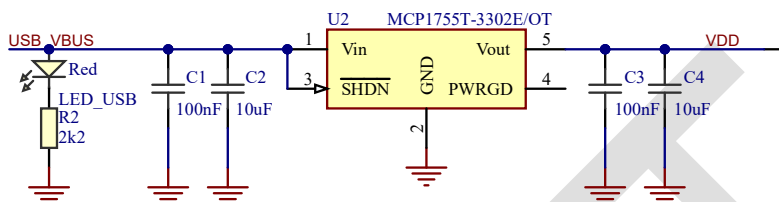


Figure 4: Shield USB power supply schematics



Warning: If “secure element-only” break-away board is being used (broken-away), only I2C communication is possible using onboard access pins. Use 3.3V supply voltage on Grove connector



Warning: In case of using the shield and being powered concurrently from USB as well as external 3.3V from Arduino headers the two voltages are “short circuited” over “cut” bridges JU – USB power and JE – external power. In general, this should not cause any issues, but eventually in case of excessive cross currents either of the JU or JE can be cut to prevent the current flow between the two sources.

1.1.1 Current measurement

Optionally, the shield allows measuring secure element’s power consumption by measuring in-series current flow. Please cut JB bridge and use JC jumper for in-series current flow measurement.

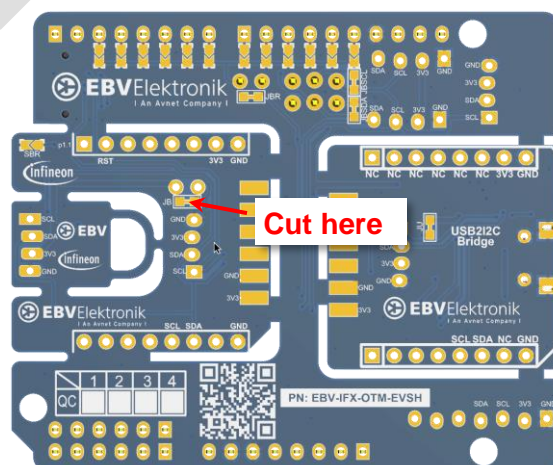
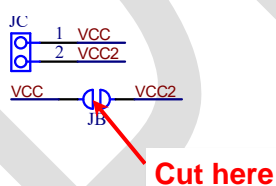
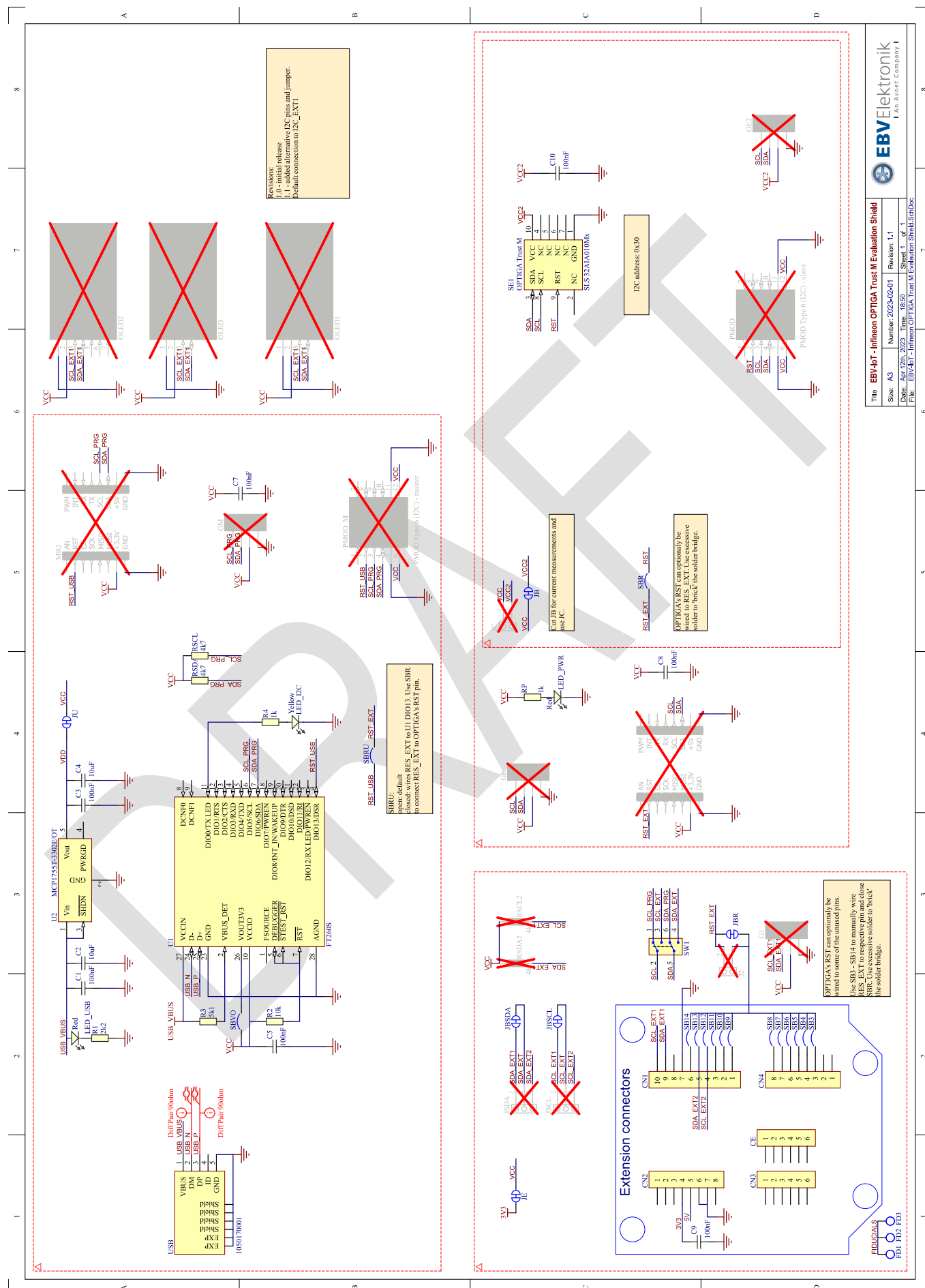


Figure 5: Current measurement setup



1.3. Secure element

As already mentioned, the shield is enabling evaluation of Infineon OPTIGA™ Trust M secure element. Figure 6 shows the simple setup. It uses I2C communication, power supply and optional reset “RES” pin for additional functionality evaluation.

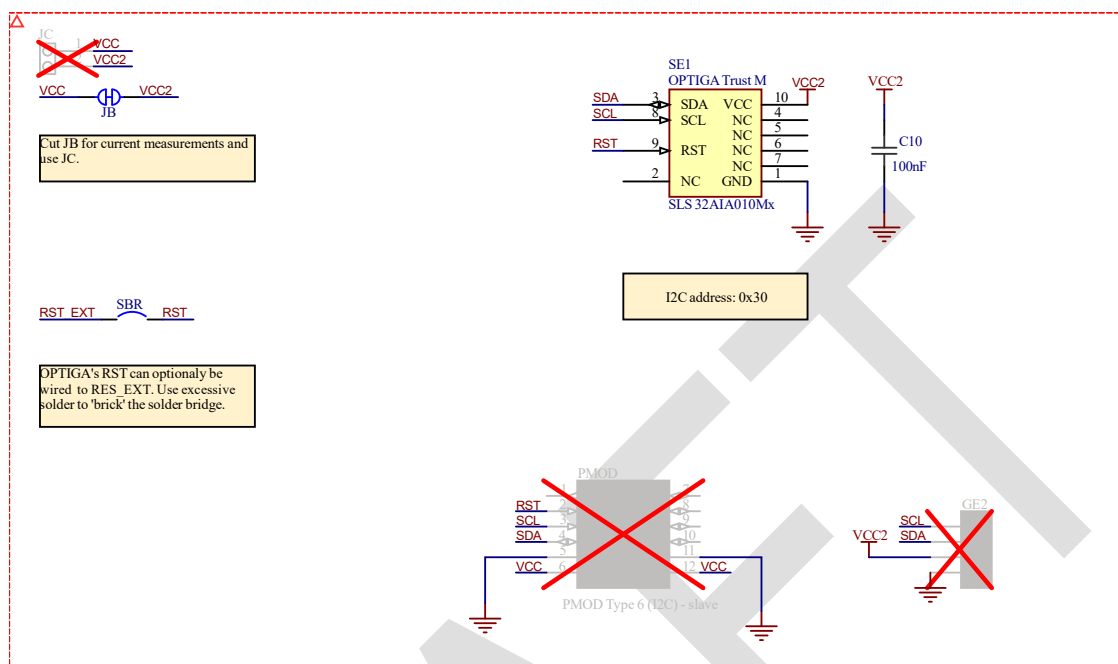


Figure 6: “Secure element only” break-away board schematics

1.4. I2C address

7bit I2C address of the OPTIGA is **0x30** (HEX).

1.5. Evaluation shield hardware configuration options

The shield supports two I2C sets of pins: as a default there are pins 9 and 10 on CN1, and alternatively pins 4 and 5 on CN1 can be used.



Note: Following notation is being used for hardware configurations:

- Closed – short circuited
- Open – no electrical connection

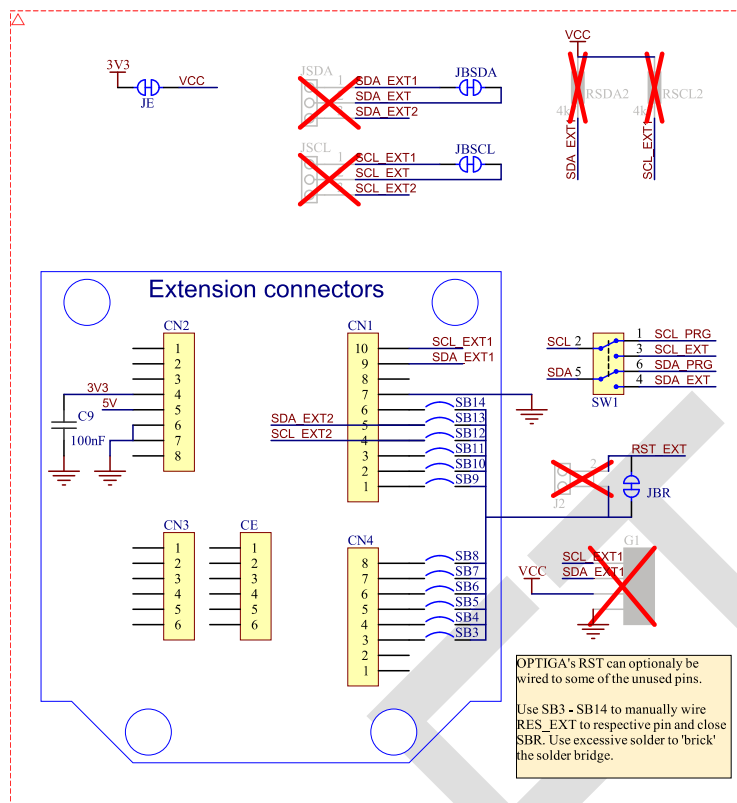
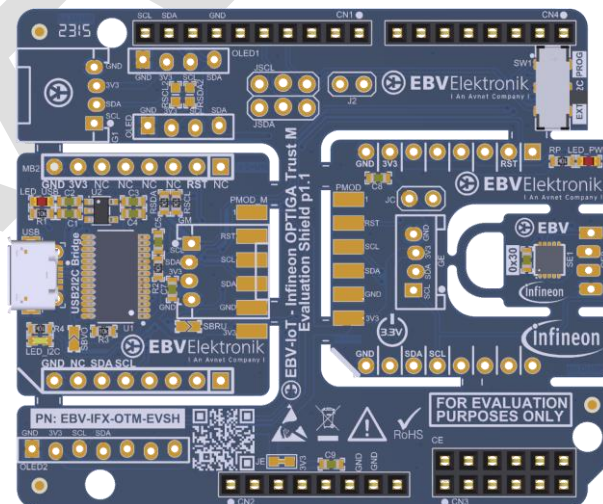


Figure 7: I2C and RES pins configurations

1.5.1 Out-of-box setup

Shipped configuration is preset to support I2C over USB2I2C bridge or external I2C communication set by using SW1 switch. Default external I2C pins are set

- I2C master can be either
 - SW1 in PRG position – integrated USB2I2C bridge or,
 - SW1 in EXT position – external I2C master using external MCU/MPU platform (pins 9 and 10 on CN1)
- Comes with no through-hole jumpers populated



1.5.2 Alternative I2C interface pins configuration

To use alternative I2C interface on pins 4 and 5 on CN1 please following steps (Figure 8):

- Populate JSCL and JSDA jumpers
- Close/put jumpers over JSCAL and JSDA as shown on Figure 8 - left
- Open/cut JBSCL and JBSDA bridges (Figure 8 – right)

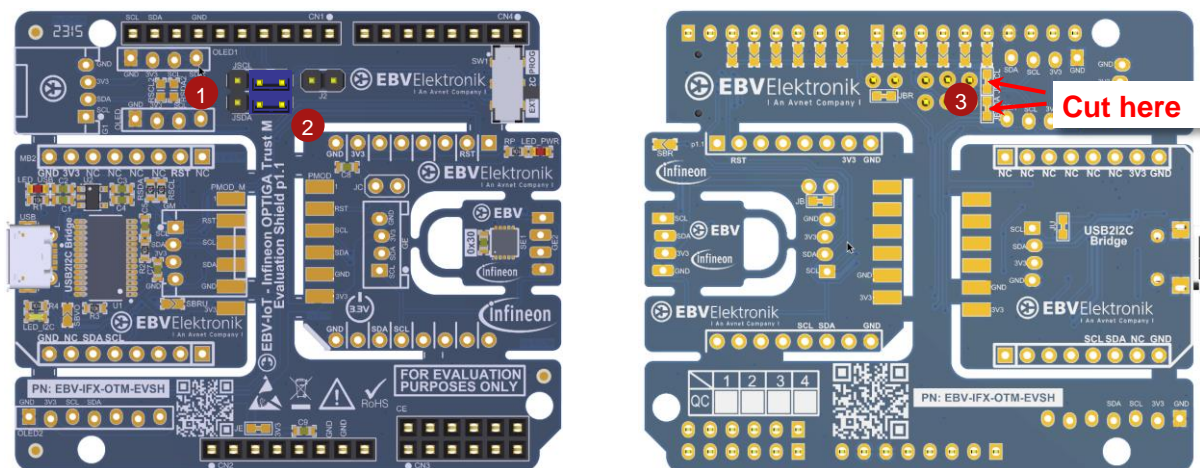


Figure 8: Alternative I2C hardware configuration

1.5.3 I2C interface configuration (after using any other jumper configuration)

To use default I2C interface configuration on pins 9 and 10 on CN1 set jumpers as shown on Figure 9.

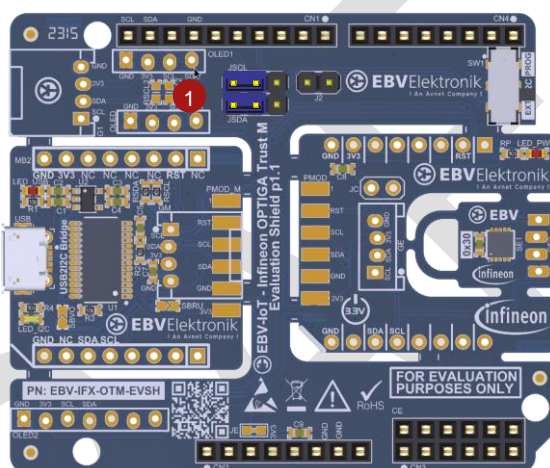


Figure 9: I2C pins configuration

1.5.4 Reset “RES” pin hardware configuration

Secure element RES pin can be connected to any of the CN1 pins 1 – 6 (mind alternative I2C pins if being used) or CN4 pins 3 – 8 using SB3 – SB14 solder bridges. Moreover, please close the SBR solder bridge using excessive solder.

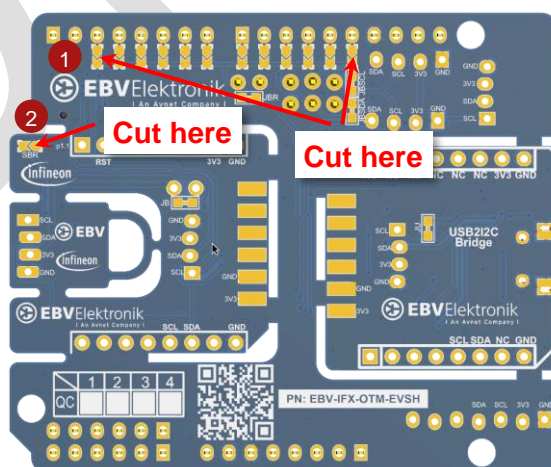
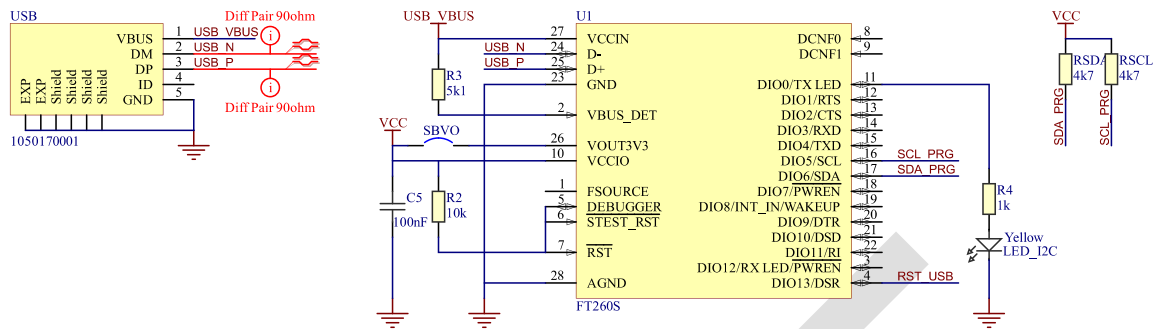


Figure 10: RES pin hardware configuration

USB interface

The shield uses USB2I2C bridge enabling interfacing I2C bus as a master.



Note: Onboard USB2I2C bridge accesses I2C bus as a master but only connects to secure element when SW1 switch in PROG position. Onboard USB2I2C is not connected to any other pin except to PMOD_M.

1.6. Driver installation

MS Windows® 10 or above recognizes the USB2I2C bridge products and automatically installs the USB driver. There is no need to install any drivers; just make sure Windows is up to date.

I2C bridge is recognized as “Human Interface Device – HID” and is listed as “USB Input Device” as shown on. VID and PID values are 0403 and 6030, respectively.

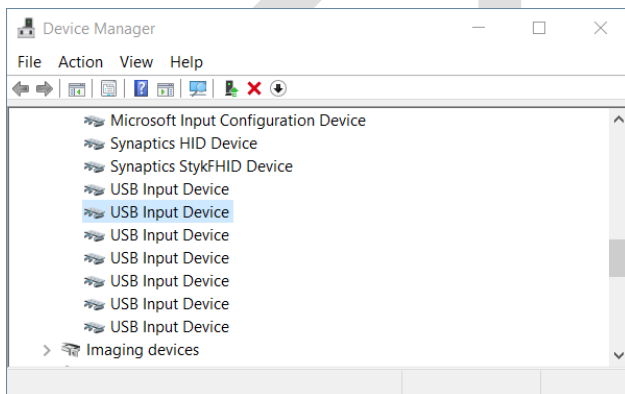


Figure 11: Windows Device Manager - USB HID part listing

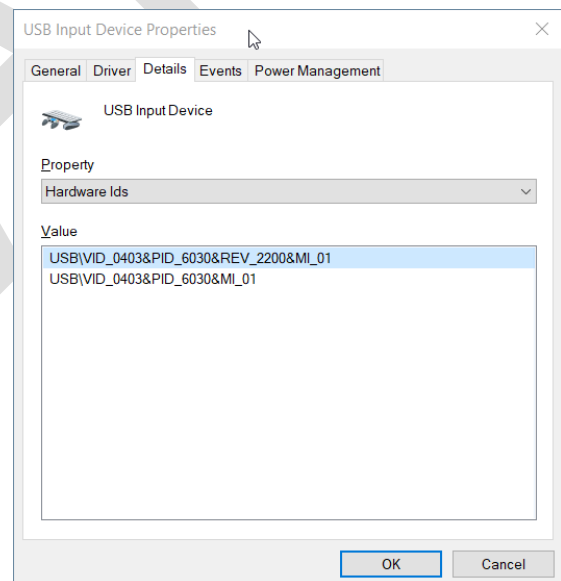


Figure 12: USB HID Device Properties - HW IDs

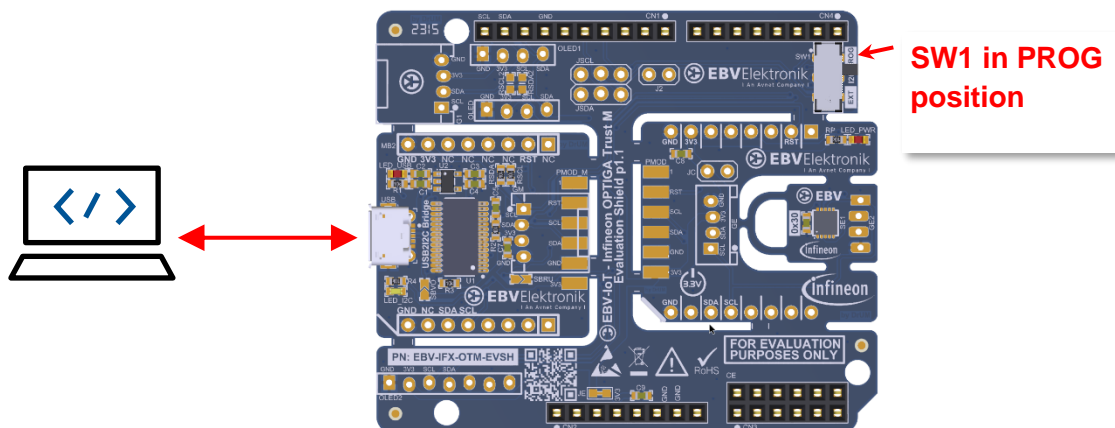


Figure 13: Connecting the shield to a PC

3.3. Running “modus-shell”

The easiest way of running “modus-shell” is to look for it under Windows search by typing in “modus”... . The application should soon be listed on top as shown on Figure 14. Click on the “App” to run the application.

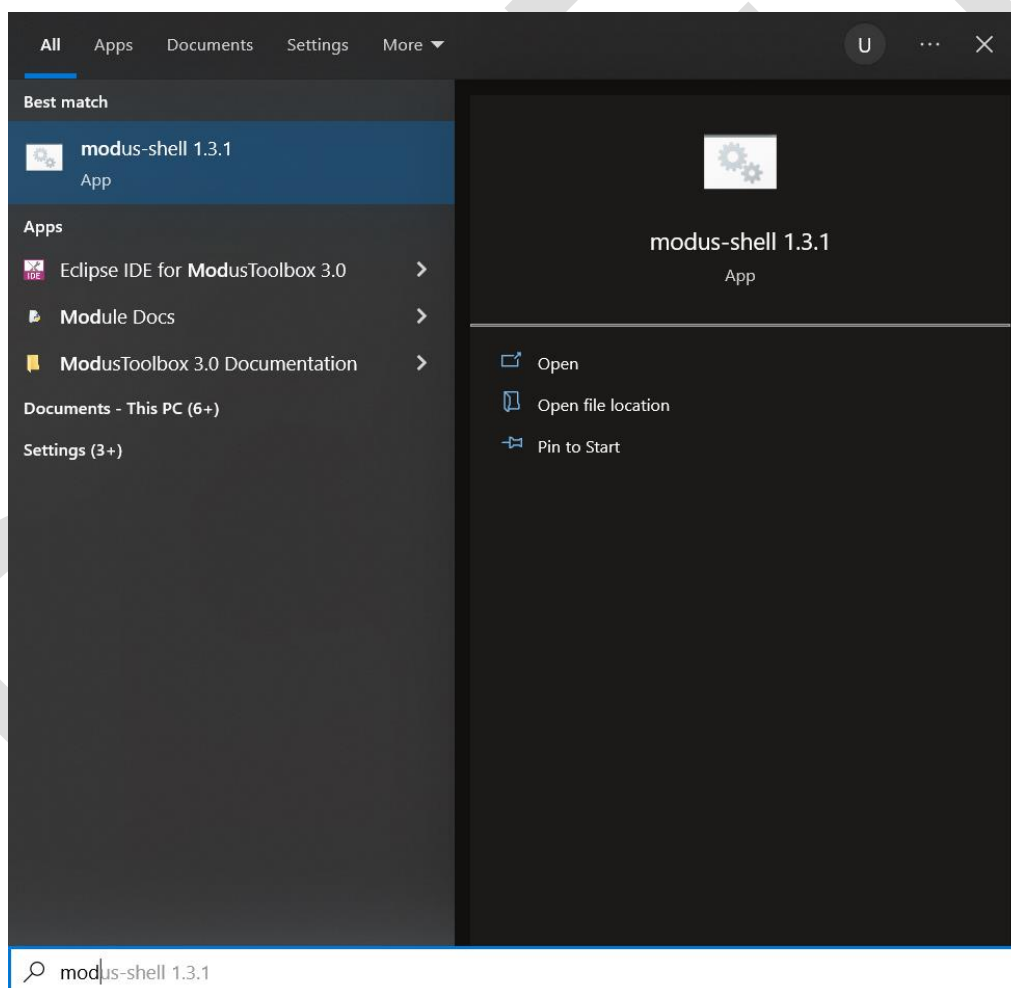


Figure 14: Starting "modus-shell"



Note: Your appearance of the terminal being used may be different to what shown bellow. The terminal display is for a guidance of what the terminal output should be in terms of content.

Next step is to check whether “optigatrust” Python module is installed. Type “optigatrust.exe” into the terminal. If your replay is “bash: optigatrust.exe: command not found”, please proceed to Sub-section 3.3.1 otherwise proceed to Sub-section 3.4.

```

user@computer_name ~
$ optigatrust.exe
bash: optigatrust.exe: command not found

user@computer_name ~
$
  
```

3.3.1 Installing “optigatrust” Python module

Please install the “optigatrust” Python module by executing “pip install optigatrust”. Installation is successful if “Successfully installed...” message appears.

```

user@computer_name ~
$ pip install optigatrust
Collecting optigatrust
  Downloading optigatrust-1.3.7-py3-none-any.whl (493 kB)
    |████████████████████████████████████████| 493 kB 2.2 MB/s
Requirement already satisfied: cryptography in d:\infineon\modustoolbox\tools_3.0\python\lib\site-packages (from optigatrust) (36.0.1)
Requirement already satisfied: click in d:\infineon\modustoolbox\tools_3.0\python\lib\site-packages (from optigatrust) (8.0.4)
Collecting jinja2
  Downloading Jinja2-3.1.2-py3-none-any.whl (133 kB)
    |████████████████████████████████████████| 133 kB 6.8 MB/s
Collecting pyserial
  Using cached pyserial-3.5-py2.py3-none-any.whl (90 kB)
Collecting asn1crypto
  Downloading asn1crypto-1.5.1-py2.py3-none-any.whl (105 kB)
    |████████████████████████████████████████| 105 kB 6.4 MB/s
Requirement already satisfied: colorama in d:\infineon\modustoolbox\tools_3.0\python\lib\site-packages (from click->optigatrust) (0.4.5)
Requirement already satisfied: cffi>=1.12 in d:\infineon\modustoolbox\tools_3.0\python\lib\site-packages (from cryptography->optigatrust) (1.15.1)
Requirement already satisfied: pycparser in d:\infineon\modustoolbox\tools_3.0\python\lib\site-packages (from cffi>=1.12->cryptography->optigatrust) (2.21)
Collecting MarkupSafe>=2.0
  Downloading MarkupSafe-2.1.2-cp38-cp38-win_amd64.whl (16 kB)
Installing collected packages: MarkupSafe, pyserial, jinja2, asn1crypto, optigatrust
Successfully installed MarkupSafe-2.1.2 asn1crypto-1.5.1 jinja2-3.1.2 optigatrust-1.3.7 pyserial-3.5
WARNING: You are using pip version 21.1.3; however, version 23.0.1 is available.
You should consider upgrading via the 'D:\Infineon\ModusToolbox\tools_3.0\python\python.exe -m pip install --upgrade pip' command.

user@computer_name ~
$
  
```


3.4. Interfacing OPTIGA Trust M

Quick check for proper “optigatrust” Python module installation is to run “optigatrust” or “optigatrust.exe” command. We should see a replay with short usage instructions.

```

user@computer_name ~
$ optigatrust.exe
Usage: optigatrust [OPTIONS] COMMAND [ARGS]...

Options:
  --version  Show the version and exit.
  --help     Show this message and exit.

Commands:
  create-keys  Generate a keypair
  object       Manages objects data and metadata
  update       Use protected update feature
  update-wizard Guide through the protected update preparation for a...

user@computer_name ~
$
  
```

Please check Table 2 for a short list of commands possible with “optigatrust” Python module.

Table 2: “optigatrust” short list of commands

Command	Note
optigatrust object --help	Displays the usage information for the command object
optigatrust object --id 0xe0e0	Read the content of the object 0xe0e0 (to get the objects map)
optigatrust object --id 0xe0e0 --out certificate.pem --outform PEM	Read the content of the object 0xe0e0, try to convert it into a PEM-formatted X.509 certificate, and store the result into a <i>certificate.pem</i> text file
optigatrust object --id 0xe0e0 --meta	Read the metadata of the object 0xe0e0
optigatrust object --in data_metadata.json	Write to the OPTIGA™ Trust data and metadata from JSON format
optigatrust object --export-otc	Read all the objects from the OPTIGA™ Trust and store them into a format compatible with OPTIGA™ Trust configurator
optigatrust object --export-json	Read all objects from the OPTIGA™ Trust and store them into JSON format*
optigatrust create-keys --help	Displays the usage information for the command create-keys
optigatrust create-keys --id 0xe0f1	Generate an ECC NISTP256 public/private key-pair and store the private component in the given key object ID. Private key usage is set to <i>signature</i> by default.
optigatrust create-keys --id 0xe0f1 --pubout public.pkey --privout private.key	Generate an ECC NISTP256 public/private key-pair and store them in the corresponding files. The output is PEM-formatted.
optigatrust create-keys --id 0xe0f1 --curve secp384r1	Generate an ECC NISTP384 public/private key-pair
optigatrust create-keys --id 0xe0f1 --key-usage key_agreement -key-usage signature	Generate an ECC NISTP256 public/private key-pair and put the private key usage to be <i>KeyAgreement</i> and <i>Signature</i>
optigatrust create-keys --id 0xe0fc --rsa --key_size 2048	Generate an RSA public/private key-pair with a key size of 2048 bits. Private key usage is set to <i>Signature</i> by default.

3.4.1 Certificate extraction

Most commonly used command is certificate extraction in PEM format. Please execute following command: "optigatrust.exe object --id 0xe0e0 --outform PEM".

```

user@computer_name ~
$ optigatrust.exe object --id 0xe0e0 --outform PEM
Loaded: liboptigatrust-libusb-win-amd64.dll
-----BEGIN CERTIFICATE-----
MIICxTCCAKugAwIBAgIECsw3ADACBggqhkJOPQQDAzByMQswCQYDVQGEWJERTEh
MB8GA1UECgwYSW5maW5lb24gVG9jaG5vbG9naWVzIEFHMRMwEQYDVQQLDAPUFRJ
R0EoE0pMSswKQYDVQDDCJjbmZpbmVvbiBPUFRJR0EoE0pIFRydXN0IE0gQ0Eg
MzA2MB4XDTEyMDcwNDc5NDgyM1oXDTQyMDcwNDc5NDgyM1owDTELMAKGA1UEAwc
IiIwWTATBgqhkJOPQIBBggqhkJOPQMBBwNCAAS2XMfg180WaEb2oxsKERej9B+A
5T1X0Qoa7rOFRRhy5j2gHjCYU2yEea+bY3vHBzQzB24E3HQzP1Py/yk5rfio4IB
MjCCAS4wYAYIKwYBBQUHAQEEDB5MFAGCCsGAQUFBzAChkRodHRwczoV3BraS5p
bmZpbmVvbi5jb20vT3B0aWdhVHJ1c3RFY2NDQTMwNi9PcHRpZ2FucnVzdEVjY0NB
MzA2LmNyYDdAdBgNVHQEFegQUAXtoQYtJPpFXRIa7k4V9sJX/5FYDgYDVR0PAQH/
BAQDAGCAMAwGA1UdEwEB/wQCMAAwVQYDVR0fBE4wTDBKoEigRoZEAHR0CHM6Ly9w
a2kuaw5maW5lb24uY29tL09wdGlnYVRYdXN0RWNjQ0EzMDYvT3B0aWdhVHJ1c3RF
Y2NDQTMwNi5jcmwwFQYDVR0gBA4wDDAKBggqghQARAEUATfBgNVHSMEGDAWgBSz
S6AAf129DVJ0f11s49t4QMAFZjAKBggqhkJOPQQDAwNoADB1AjbIw1RrR8jBhagS
Mnr866SGTQDUoUw0k4jJxsHDNgId3I2+rQ3J9BcETfBzS29RoCMQD5uzV5/Lz1
Mui144HmH4tMzjaZQgOnc7KZe0RVBNoLCTlVgHMum3s10QZFw306mh4=
-----END CERTIFICATE-----

user@computer_name ~

```

For more information related to "optigatrust" please refer to Infineon "python-optiga-trust" guide ([link](#)).

3.5. Troubleshooting

Most common mistake when interfacing OPTIGA is either the shield not properly connected to PC or OPTIGA not detected on the I2C bus. There are two possible reasons for the I2C bus detection issue:

1. The shield switch "SW1" is in a position "EXT" → please put the switch "SW1" to position "PRG" as described in Sub-section 3.2.
2. The I2C bus is taken by external I2C master, or the pins are not in "open-collector" mode i.e. pins are externally held to low or high. → please release the pins. Disconnecting the shield from any other Arduino interface usually solves the issue.

If you see "Error: 0x102" it is very likely OPTIGA not seen on I2C bus, while only "Error: 0x202" listed, indicates an issue with shield to PC connection.

```

user@computer_name ~
$ optigatrust.exe object --id 0xe0e0
Error: 0x102

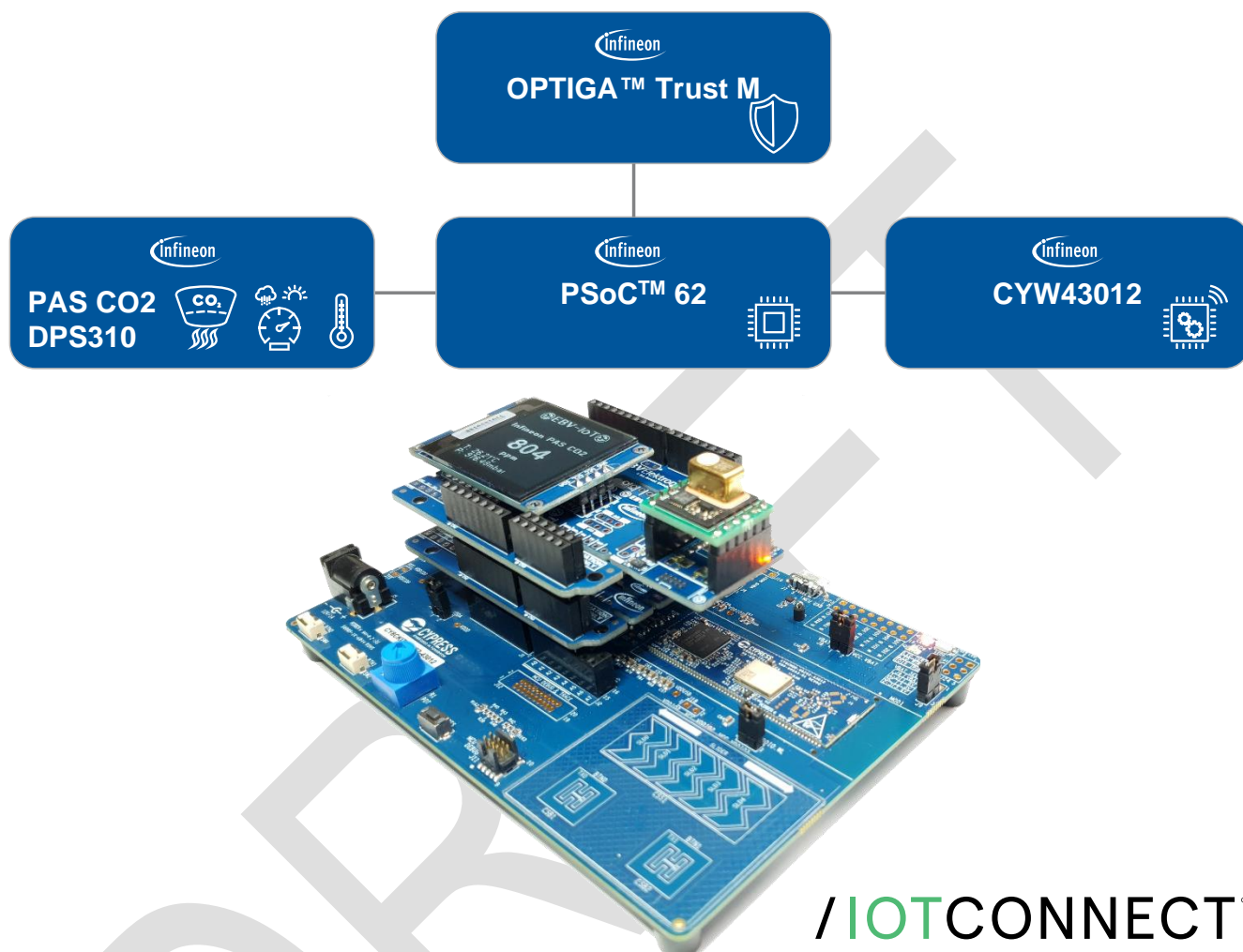
!!!Error in opening serial port : 2Error: 0x202
Could not find module 'D:\Infineon\ModusToolbox\tools_3.0\python\lib\site-
packages\optigatrust\csrc\lib\liboptigatrust-i2c-win-amd64.dll' (or one of its dependencies). Try
using the full path with constructor syntax.
libusb: Failed to connect
uart: Failed to connect
i2c: Failed to find library liboptigatrust-i2c-win-amd64.dll in
D:\Infineon\ModusToolbox\tools_3.0\python\lib\site-packages\optigatrust\csrc\lib

user@computer_name ~
$

```

4. Embedded platform & cloud connectivity

The shield is included in a complete solution demo utilizing Infineon PSoC™, Xensiv™ PAS CO2 and DPS310 pressure sensors, AIROC™ CYW43012 based muRata Type 1LV module and Avent IoTConnect cloud platform.



Please contact your EBV elektronik representative for more information or at ssc@ebv.com.

Revision history

Revision	Date	Notes
0.1	April 18 th , 2023	First draft

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