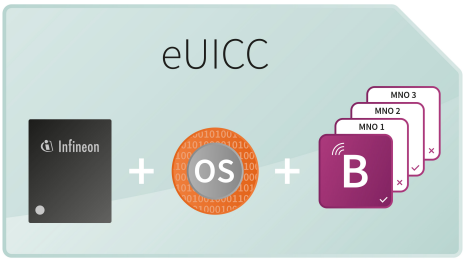
OPTIGA™ Connect IoT

Datasheet

eSIM IoT solution to enable cellular connectivity

Key features



- Remote SIM provisioning compliant with GSMA SGP.02 V3.2
- Compliant with 2G, 3G, 4G (LTE), CDMA, NB-IoT, CAT-M networks
- Tata bootstrap cellular connectivity - worldwide coverage
- Allows to accommodate multiple MNO profiles
- Over-the-air (OTA) functionality
- 32-bit architecture based on Arm® SecurCore® SC300 enhanced by Infineon Technologies' cache and security technology
- ISO/IEC 7816 UART interface
- Power Supply 1.8/3/5 Volts
- Common Criteria EAL5+ certified hardware
- ETSI MFF2 package (PG-VQFN-8-4)
- Removable SIM and other packages on request

Potential applications

- IoT end nodes and edge gateways
- Smart Home (security, alarm, light-HVAC-Energy control)
- iHealth monitoring
- Smart City (security, lighting, parking sensor)
- Industry Automation (smart machines, security camera, factory automation, asset tracking)
- Smart Energy (metering, storage, distribution)
- Commercial Telematics
- GPS Tracker

Description

OPTIGA™ Connect IoT is an embedded universal integrated circuit card (eUICC) turnkey solution for embedded subscriber identity modules (eSIM) that enables cellular connectivity at scale for IoT devices. OPTIGA™ Connect IoT consists of an eUICC including GSMA compliant eSIM operating system and pre-loaded bootstrap connectivity.

About this document

Scope and purpose

This datasheet provides the following information about the OPTIGA™ Connect IoT:

- SMD packages PG-VQFN-8-4 (MFF2)
- Connectivity, electrical characteristics, and other technical information
- Hardware and software functionalities
- Interfaces supported by OPTIGA™ Connect IoT

Intended audience

This document is primarily intended for device integrators.

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1 General description

The product described along this document, contains some solutions and applications developed in response to the mobile network operator needs and the different market requirements.

1.1 Operating system features

1.1.1 Software features

According to GSMA SGP.02 [11]:

- Java Card™ V3.0.5 [23], GlobalPlatform V2.3 [10]
- Trusted Connectivity Alliance (TCA) eUICC Profile Package V2.3 [13]
- Compliant with 2G, 3G, 4G (LTE), CDMA, NB-IoT, CAT-M networks
- ETSI TS 102 221 [1], 3GPP TS 31.101 [17] compliant
- Pre-enabled Bootstrap connectivity profile
- Option to fall back to Bootstrap profile in case of connectivity loss
- Storage of up to 10 eSIM profiles
- SIM, UICC, USIM, ISIM functionality
- Support of CAT, SAT, USAT, OTA, CAT-TP, EAP
- DNS resolver, TLS key derivation
- Supported Crypto algorithms SHA, DES, AES, ECC, RSA
- AIS-140 ready

1.1.2 Communications

Supported communication parameters of the ISO/IEC 7816:

- 11h (D=1, F=372)
- 12h (D=2, F=372)
- 18h (D=12, F=372)
- 94h (D=8, F=512)
- 95h (D=16, F=512)
- 96h (D=32, F=512)
- 97h (D=64, F=512)

1.2 Authentication algorithms

- COMP128_2
- COMP128_3
- MILENAGE, according to ETSI TS 135 208 [9]
- TUAK, according to 3GPP TS 35.231 [21]
- CAVE, according to 3GPP2 MAP [14]

1.3 Remote SIM provisioning (RSP)

OPTIGA™ Connect IoT features a standard mechanism for remote profile provisioning and management, that means you can remotely provision a SIM in form of an electrical profile, and subsequently change the subscription remotely from one operator (MNO) to another. Such an eSIM needs to be connected to an initial operator with a minimal initial profile installed during manufacturing process. This first profile is denominated Provisioning Profile or Bootstrap.

The Embedded SIMs and Remote SIM Provisioning (RSP) cannot be considered to be “Soft SIMs”. The physical hardware element is always present and adds an indispensable layer of security. A ‘Soft SIM’ would be a solution with no SIM hardware where all SIM functionality is carried out by a software layer.

Although the general perception might be that all eUICCs are MFF2-packaged and soldered onto PCBs, it is important to understand that an eUICC is neither a form factor nor a hardware concept. It’s a feature concept for the way SIM profiles are managed. All functionalities of a SIM/(U)SIM are available within an eUICC, but an eUICC is capable to host multiple profiles, one active at a time.

However, it is important to note that electrical profiles stored in an eUICC are different from each other, meaning that Applets on one profile are not available on another. The profiles are entirely independent and no data can be shared between them.

eUICCs can be deployed once, and modified indefinitely without any compromise on security.

A SM-DP (Subscription Manager Data Preparation) server manages the profile creation, storage, personalization and download and a SM-SR (Subscription Manager Secure Routing) server manages the secure routing for the profile download and activation.

There is a theoretical maximum of 10 Profiles that can be stored on an OPTIGA™ Connect IoT eUICC, practically depending on the available memory and the size of the Profiles.

OPTIGA™ Connect IoT is fully compliant to the following standards:

- GSMA SGP.02 [11]
- Trusted Connectivity Alliance (TCA) eUICC Profile Package Version 2.3 [13]

Note: The OPTIGA™ Connect IoT OC2322 Indian version, complies with Indian telecom department regulation (SM-SR is located in India).

1.4 Over-the-air (OTA) functionality

OTA configuration has become increasingly important as new updates and services come to stream. OTA via SMS optimizes the configuration data updates in eSIMs and enables the distribution of new software updates to IoT devices with the necessary settings to access services.

OTA messaging provides remote control of IoT devices for service and subscription activation, personalization and programming of a new service for mobile operators.

- Over-the-air (OTA) protocol according to ETSI TS 102 225 [4] and 3GPP TS 31.115 [18]
- OTA mechanism supports all the UICC administrative commands as specified by ETSI TS 102 222 [2]

OPTIGA™ Connect IoT supports the following Over-the-air (OTA) functions:

- Remote File Management (RFM) applications according to ETSI TS 102 226 [5] and 3GPP TS 31.116 [19]
- Remote Application Management (RAM) according to ETSI TS 102 226 [5] and GlobalPlatform – UICC Configuration

1.5 Memory management

The Dynamic Memory Management implemented in OPTIGA™ Connect IoT features the possibility to create and delete files avoiding any memory loss after file deletion. In the same way, Dynamic Memory Management enables to load and install of new applications into the eSIM avoiding memory loss after the deletion of applets.

The free memory in the eSIM always can be used by files, packages, applets or objects, all of them coexist in the same memory portion; and also the free memory always can be recovered on deletion operations.

As previously indicated, the operating system is Java Card based; consequently, it features a garbage collector which reflects this dynamical object memory recovery mechanism.

The memory management mechanism is designed for the best performance and optimum safety of the end user data.

1.6 Countries

Connectivity coverage with Tata Communications [22] Bootstrap cellular connectivity profile operates in the following countries:

Afghanistan, Albania, Algeria, Andorra, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bermuda, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Darussalam, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Cayman Islands, Central African Republic, Chad, Chile, China, Colombia, Congo, Democratic Republic of the Congo, Cook Islands, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Djibouti, Dominica, Dominican Republic, East Timor, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Ethiopia, Falkland Islands (Malvinas), Faroe Islands, Fiji, Finland, France, French Polynesia, Gabon, Gambia, Georgia, Germany, Ghana, Gibraltar, Greece, Greenland, Grenada, Guadeloupe, Guam, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Islamic Republic of Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Republic of Korea, Kosovo, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Latvia, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Liechtenstein, Lithuania, Luxembourg, Macao, The former Yugoslav Republic of Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Monaco, Mongolia, Montenegro, Montserrat, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, Netherlands Antilles, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Non Terrestrial, Norway, Oman, Pakistan, Occupied Palestinian Territory, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, South Sudan, Spain, Sri Lanka, Sudan, Sudan, Suriname, Swaziland, Sweden, Switzerland, Syrian Arab Republic, Taiwan - Province of China, Tajikistan, United Republic of Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks and Caicos Islands, Uganda, Ukraine, United Arab ,Emirates, United Kingdom, United Kingdom - Channel Islands, United States of America, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Virgin Islands, British, Yemen, Zambia, Zimbabwe

Note: The OPTIGA™ Connect IoT OC2322 Indian version, complies with Indian telecom department regulation (SM-SR is located in India).

2 System integration

2.1 General requirements for cellular modem

The eSIM remote profile management functionality uses some specific functions which need to be supported by the cellular modem. The following sections describe some guidance on the support of the different network access technologies as well as the required modem features.

2.1.1 Supported network access technologies

In order for our connectivity partner to administrate the OPTIGA™ Connect IoT eSIM, the modem shall support at least one of the following network access technologies: 2G, 3G, LTE/4G, 5G.

Only after a corresponding profile has been successfully loaded into the eSIM and activated, the modem device may use LTE-M or NB-IoT radio technologies if supported by the carrier.

Attention**: **The use of LTE CAT-M and NB-IoT may prevent further remote management since SMS are usually not supported. The subscription management server may then not be able to reach the device to administrate the eSIM. Please contact our connectivity partner Tata Communications** [22] **for further information.

2.1.2 Support TCP/UDP and BIP

The subscription management server can use SMS, CAT_TP and HTTPS for remote OTA communication with the eSIM.

The Bearer Independent Protocol (BIP) is a mechanism used to enable the internet protocol connectivity between the remote subscription manager server and the OPTIGA™ Connect IoT eSIM through the modem. Over that data link, two layers of bi-directional secure channels (CAT-TP and HTTPS) are established so the exchange of critical information is protected end-to-end.

In both cases, TCP and/or UDP protocols are the underlying layers between the subscription management platform and the modem but a bearer independent protocol is used for the data exchange between the modem and the eSIM as illustrated here below.

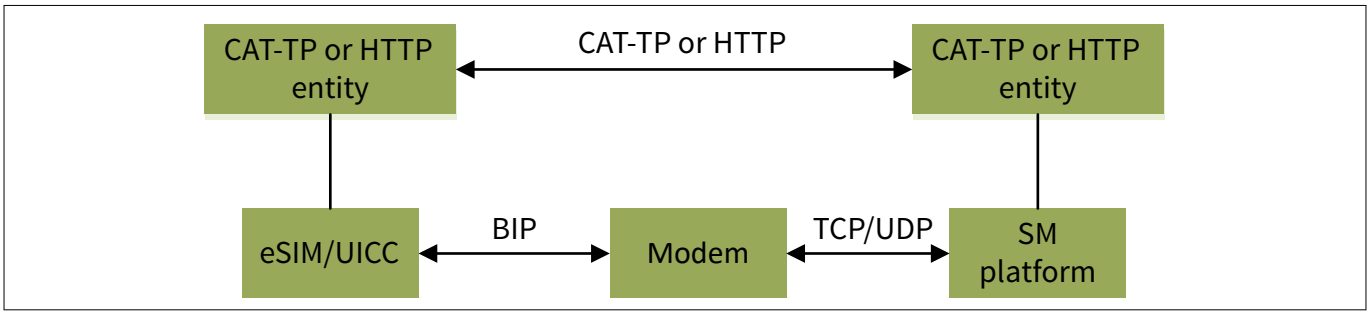

Figure 1 Data exchange between the modem and the eSIM

Note: Please note that 2 independent data channels are needed. One data channel is dedicated to the user data operation to the active MNO profile and one admin channel for the subscription management operation. The admin channel is using specific APN, IP and secure access.

In order to ensure that the OPTIGA™ Connect IoT can be remotely managed using our partner platform, please check with your modem provider how to enable BIP and that the following BIP commands are supported:

- OPEN CHANNEL (UDP and TCP over IP)

- CLOSE CHANNEL
- RECEIVE DATA
- SEND DATA
- GET CHANNEL STATUS
- ENVELOPE (EVENT DOWNLOAD - Data available)
- ENVELOPE (EVENT DOWNLOAD - Channel status)

The modem may have to be reset in order for the new settings to be active.

2.1.3 Network connection control modem requirements

For network connection control the modem shall also support:

- RPLMN details (LAC/TAC, NMR) to identify the most recently wireless network to which the device was successfully connected
- Quality of service (failures, duration, power, location)
- New network selection after SIM/USIM update

2.1.4 SMS support

Because SMS are used for triggering the opening of a CAT_TP or HTTPS session to the eSIM, the modem shall support:

- Point-to-point MO and MT SMS
- SMS cell broadcast
- Text and PDU mode

2.1.5 Additional modem requirements

To guarantee a good service operation, the modem shall also support the following features:

- Basic SAT commands (TERMINAL PROFILE, FETCH, TERMINAL RESPONSE)
  - PROVIDE LOCAL INFORMATION (location information, IMEI, Network Measurement Results (NMR), date and time, access technology, at least)
  - POLL INTERVAL, POLLING OFF, TIMER MANAGEMENT [at least one timer], ENVELOPE (TIMER EXPIRATION)
  - SET UP EVENT LIST and ENVELOPE (EVENT DOWNLOAD – location status, call connected, call disconnected, Access Technology Changed, Network Rejection)
  - ENVELOPE (SMS-PP DOWNLOAD)

The modem shall support the following commands from the 3GPP TS 27.007 [16] for all generic purposes:

- AT+CRSM (Restricted SIM access)

2.2 Device IMEI

The device shall contain a unique International Mobile Equipment Identity (IMEI) value compliant with the format defined in ETSI TS 123 003 [7].

The value of IMEI shall be directly copied from TERMINAL RESPONSE of the Provide Local Information command (see ETSI TS 102 223 [3] and ETSI TS 124 008 [8]).

2.3 OPTIGA™ Connect IoT pin code

The PIN code is disabled by default in the eSIM. It can be enabled if needed; contact Tata Communications [22] support for more information.

2.4 How to retrieve the OPTIGA™ Connect IoT identifier using AT commands

This unique identifier may be required by the connectivity provider partner to enable the eSIM on its subscription and connectivity management platform.

The device may retrieve the EID stored in the OPTIGA™ Connect IoT IC and shall then support the following commands:

- *AT+CCHO (Open Logical Channel)*
- *AT+CCHC (Close Logical Channel)*
- *AT+CGLA (Generic UICC Logical Channel Access)*

Note: The EID number is also printed on the chip package (See Figure 8)

2.5 APN configuration

The Acces Point Name needs to be configured in the device to enable the connectivity to the internet.

Make sure that the following APN URL is properly configured in the modem:

- move.dataxs.mobi

Private, customized APN are available upon request. Please contact Tata Communications [22].

2.6 VPN

When enabled, the Virtual Private Network (VPN) ensures the confidentiality of the data exchanges via encryption and decryption mechanisms when connected to the internet through a public network. Please contact our partner Tata Communications [22] to learn more about the possible options.

3 Design-in

This chapter explains the schematics of the product and gives some recommendations as to how the controller can be externally connected.

3.1 Power supply schematic

Figure 2 illustrates how the security controller is to be supplied.

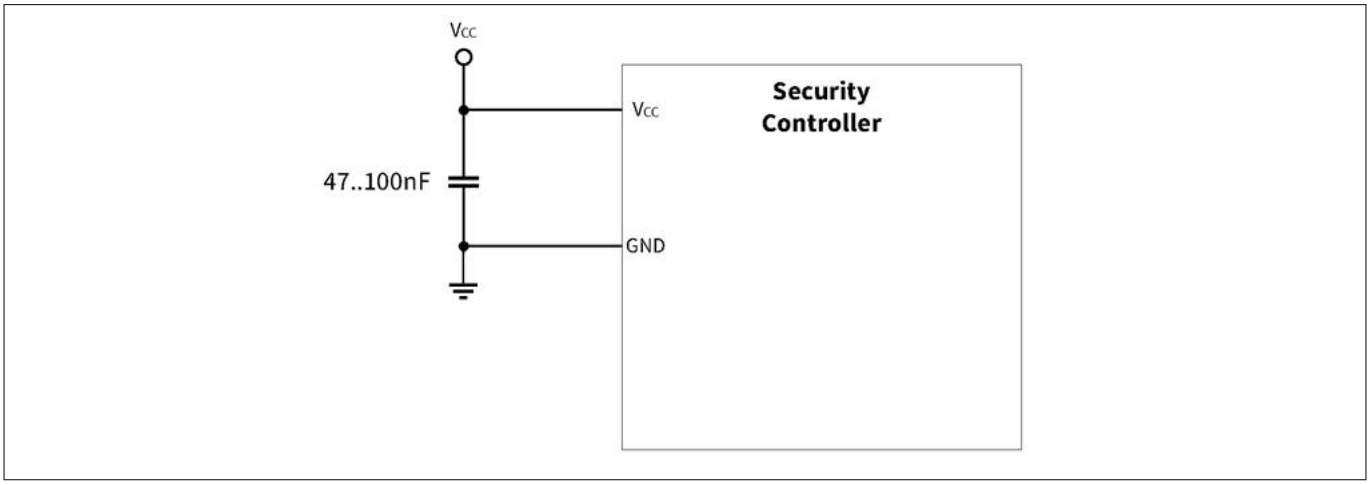

Figure 2 Power supply diagram

3.2 Interface ISO/IEC 7816-3

Figure 3 illustrates how the ISO/IEC 7816-3 [12] modem is to be connected to the security controller.

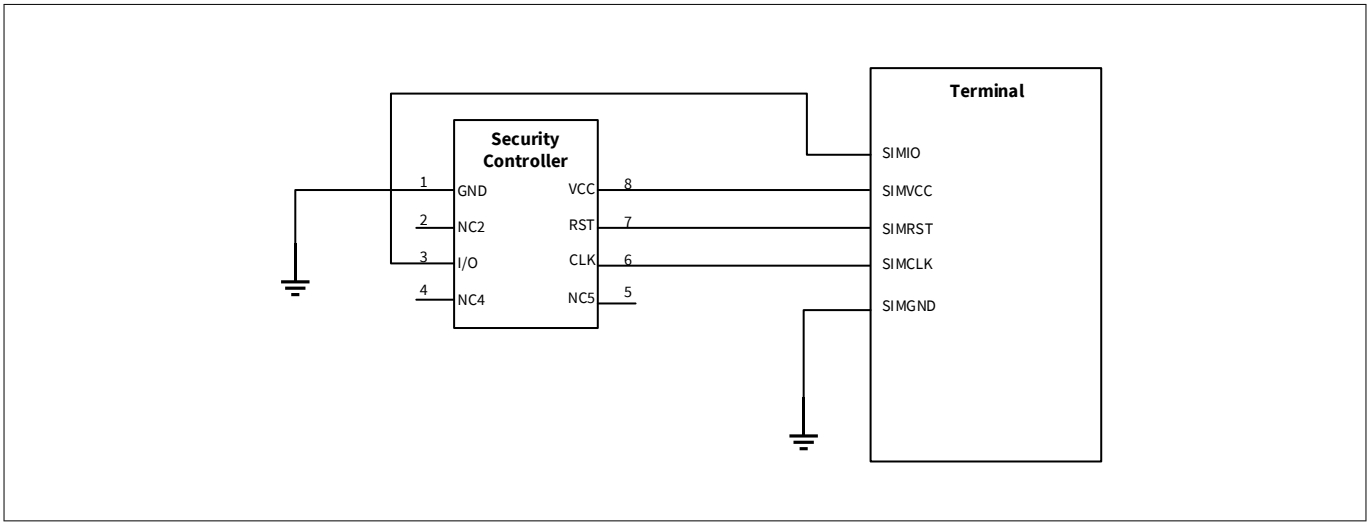

Figure 3 ISO/IEC 7816-3 interface schematic diagram

4 Electrical characteristics

This section summarizes certain electrical characteristics of the controllers. It provides operational characteristics as well as electrical DC and AC characteristics and particular interface characteristics.

Notes:

1. *T_A as given for the operating temperature range of the controller unless otherwise stated.*
2. *All currents flowing into the controller are considered positive.*

4.1 Absolute maximum ratings

Table 1 Absolute maximum ratings

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	-0.3	-	7.0	V	-
Input voltage	V_{IN}	-0.3	-	V_{CC} + 0.3	V	-
Operating temperature (ambient)	T_A	-40	-	105	°C	T_J must be kept
Junction temperature	T_J	-40	-	110	°C	
Storage temperature	T_S	-40	-	125	°C	-
Pulse voltage ESD protection of ISO pad group	V_{ESD}	4000	-	-	V	ISO 7816-1

Notes:

1. *The values stated in the table may be further restricted for particular products (i.e. sales codes).*
2. *All voltages are referenced to the power supply ground in the corresponding package, unless otherwise specified.*
3. *Stresses exceeding the values listed under 'Absolute maximum ratings' may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or at any other conditions whose values exceed those indicated in the operational sections of this document is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability, including NVM data retention and write/erase endurance.*

4.2 Operational characteristics

This section specifies the AC and DC characteristics of the controller, along with details relating to the specific interfaces provided by the controller.

4.2.1 DC electrical characteristics

Table 2 DC characteristics

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.62	-	5.5	V	Overall functional voltage range
		4.5	5.0	5.5	V	ISO/IEC 7816-3 Class A
		2.7	3.0	3.3	V	ISO/IEC 7816-3 Class B
		1.62	1.8	1.98	V	ISO/IEC 7816-3 Class C
Supply current in operation mode	I_{CCOA}	-	7.0	-	mA	Class A
	I_{CCOB}	-	6.0	-	mA	Class B
	I_{CCOC}	-	4.3	-	mA	Class C
Supply current in sleep mode	I_{CCS1}	-	150	200	µA	T_A = 25°C, f_{UART_CLK} = 1 MHz; All inputs at V_{CC}, No peripheral active
	I_{CCS2}	-	-	100	µA	Class B/Class C T_A = 25°C, CLK off RST and IO at V_{CC}

4.2.2 AC electrical characteristics

Table 3 AC characteristics

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Supply ramp-up time	t_{VCCR}	1[1)]	-	10^7	µs	0 to 100% of target supply voltage
Internal frequency	f_{SYS}	-	44	-	MHz	-

[1] At faster supply ramp times chip internal ESD elements temporary causing a cross current between V_{CC} and GND larger than allowed (I_{CC}).

4.2.2.1 Power-up considerations

The rampup times given in AC electrical characteristics apply under the assumption of a linear rise in voltage from 0% to 100% of the target voltage level. However, owing to possible current spike effects, it is recommended to follow the voltage characteristics shown in the figure below.

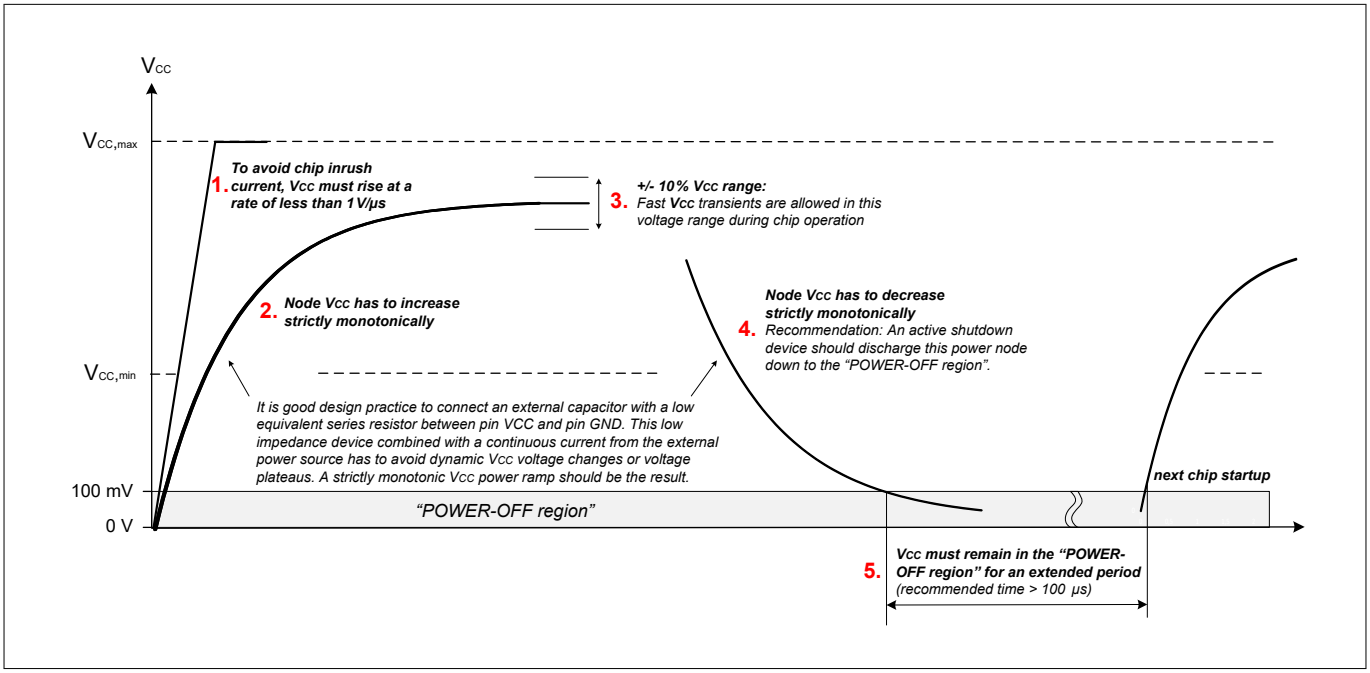

Figure 4 Recommended power-up behavior

4.3 Interface characteristics

This chapter provides electrical characteristics with respect to operation of particular interfaces of the controller.

Note: Unless otherwise stated, all values in this section are measured at the pins of the used package, i.e., the resistance, capacitance and inductance, for example, of the package and the bond wires are already included in these values!

4.3.1 Interface characteristics

The electrical characteristics of the pad described below comply with the ETSI TS 102 221 [1] standard.

Notes:

1. *All currents flowing out of the pad are considered to be positive.*

2. *Symbol T_A describes the ambient temperature range.*

Table 4 Maximum ratings

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Pad input voltage	V_I	-0.3	-	V_{CC} +0.3	V	-

Table 5 DC electrical characteristics

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
I/O, bidirectional port	V_{IH}	0.7 * V_{CC}	-	V_{CC} + 0.3	V	I_{IH} = -20 µA ... +20 µA
	V_{IL}	-0.3	-	0.2 x V_{CC}	V	I_{IL} = -1 mA ... +20 µA
	V_{OH}	0.7 * V_{CC}	-	V_{CC} + 0.3	V	I_{OH} = -20 µA ... +20 µA
I/O, bidirectional port	V_{OL}	0	-	0.4	V	I_{OL} = 1 mA Class A
		-	-	0.15 * V_{CC}	V	I_{OL} = 1 mA Class B
		-	-	0.15 * V_{CC}	V	I_{OL} = 0.5 mA Class C
I/O, bidirectional port	V_{OL}	-	-	0.4	V	I_{OL} = -1 mA Class A and B
		-	-	0.3	V	I_{OL} = -1 mA Class C
RST	V_{IH}	0.8 * V_{CC}	-	V_{CC} + 0.3	V	I_{IH} = -20 µA ... +20 µA
	V_{IL}	-0.3	-	0.2 * V_{CC}	V	I_{IL} = -50 µA ... +20 µA
CLK	V_{IH}	0.7 * V_{CC}	-	V_{CC} + 0.3	V	I_{IH} = -20 µA ... +20 µA
	V_{IL}	-0.3	-	0.2 * V_{CC}	V	I_{IL} = -20 µA ... +20 µA

Table 6 AC electrical characteristics

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
I/O						
Rise/fall time	t_R, t_F	-	-	1	µs	30 pF external
Pad input capacitance	C_{IN}	-	-	5	pF	-
RST						
Rise/fall time	t_R, t_F	-	-	1	µs	30 pF external
Hold time low	t_{HR}	80	-	-	µs	Both conditions have to be kept. External clock pulses
		400	-	-	CLK	
Pad input capacitance	C_{IN}	-	-	2	pF	-
CLK						
External frequency	f_{CLK}	1	-	10	MHz	@ specified duty cycle
Rise/fall time	t_R, t_F	-	-	0.1*1/f_{CLK}	ns	0.1 V_{CC} to 0.9 V_{CC} = V_T 0.5 V_{CC}
Duty cycle	-	40	-	60	%	-
Pad input capacitance	C_{IN}	-	-	2	pF	-

5 Delivery forms and ordering

This chapter provides information about available delivery forms and how the product's interfaces are assigned to the package pins.

For further information on compliance of the packages with European Parliament Directives, see RoHS compliance.

For details and recommendations on the assembly of packages on PCBs, please see:

http://www.infineon.com/cms/en/product/technology/packages

5.1 External connectivity

Package pins are usually connected to a product pad and are used as inputs, outputs, or bi-directionally, depending on the available input and output stages. The abbreviations listed here are used in the package description to classify each pin.

Table 7 Abbreviations for pin type

Abbreviation	Description
I	Input. Digital levels
O	Output. Digital levels
I/O	I/O is a bi-directional signal
PWR	Power
GND	Ground
NC	Not connected (JEDEC Standard). May be connected externally

Table 8 Abbreviations for buffer type

Abbreviation	Description
ISO_I_CLK	Input pad
ISO_I	Input pad
ISO_IO	Input/output pad

5.2 SMD package

The following packages are available:

- PG-VQFN-8-4 (MFF2)

A detailed description of the PG-VQFN-8-4 package can be found in the following link:
https://www.infineon.com/cms/en/product/packages/PG-VQFN/PG-VQFN-8-4/
The figures in the sections below show the following aspects of the package:

- Package outline: Shows the package dimensions of the controller in the individual packages
- Package footprint: Shows footprint recommendations
- Tape and reel packing
- Sample marking pattern: Describes the productive sample marking pattern on the package
- Package layout: Shows a simple layout with the pin numbers described in the pin reference

Note: Unless specified otherwise, all figure dimensions are given in mm.

Note: The drawings are for information only and not drawn to scale. More detailed information about package characteristics and assembly instructions is available on request.

5.2.1 Package outline

The package dimensions (in mm) of the controller in PG-VQFN-8-4 packages are given below.

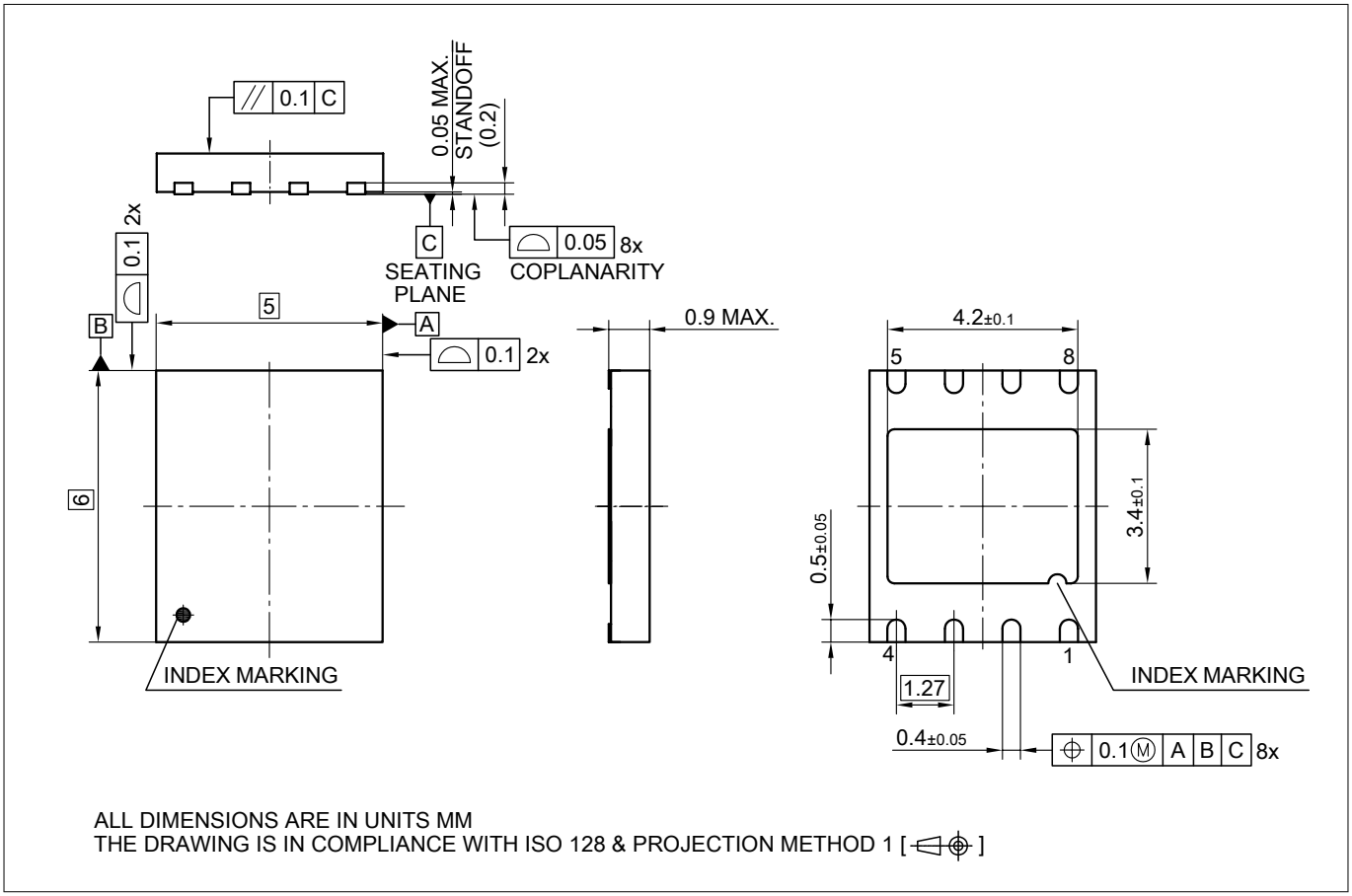

Figure 5 PG-VQFN-8-4 package outline

5.2.2 Package footprint

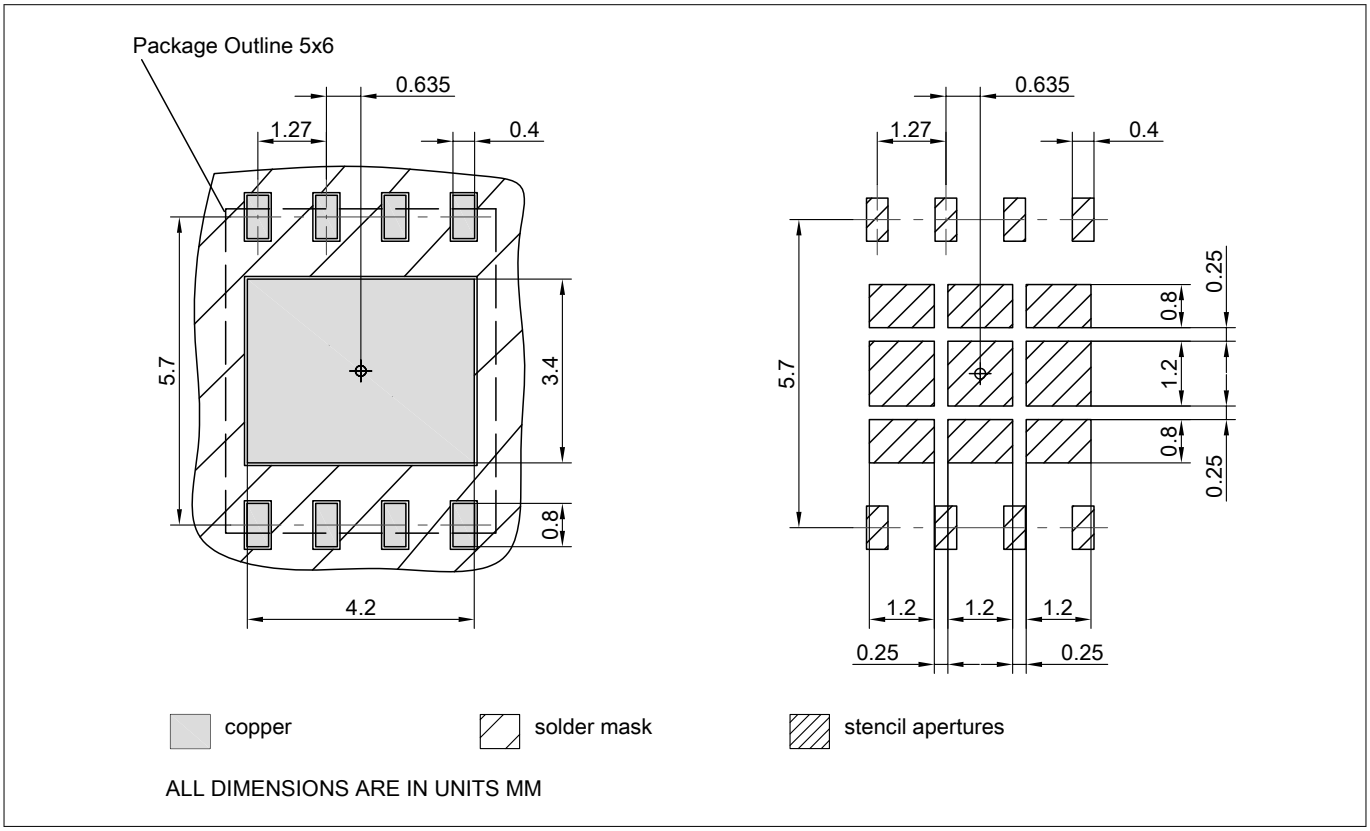

Figure 6 PG-VQFN-8-4 package footprint

5.2.3 Tape and reel packing

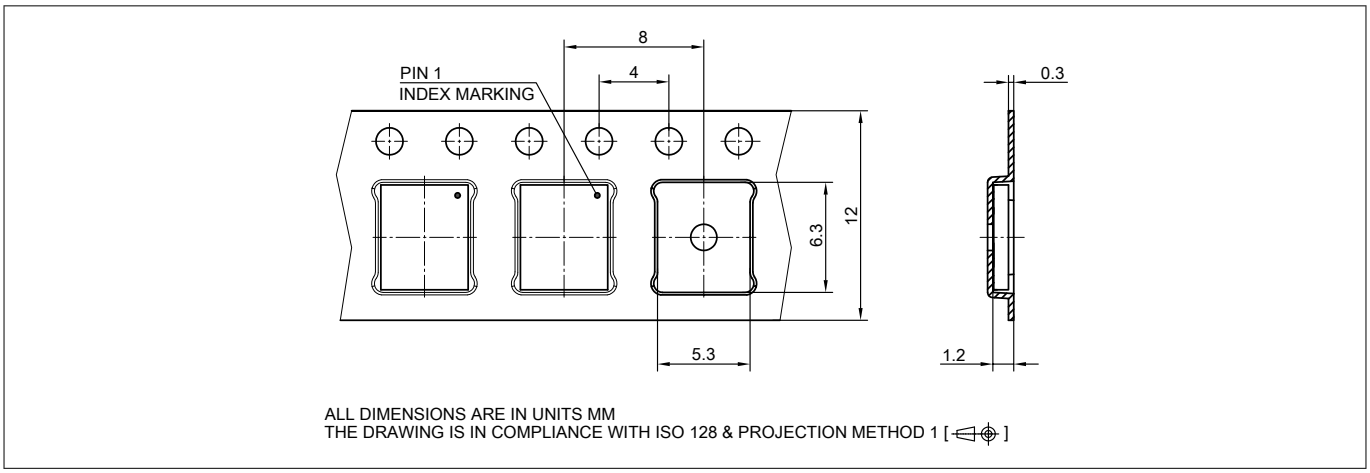

Figure 7 PG-VQFN-8-4 tape and reel packing

5.2.4 Production sample marking pattern

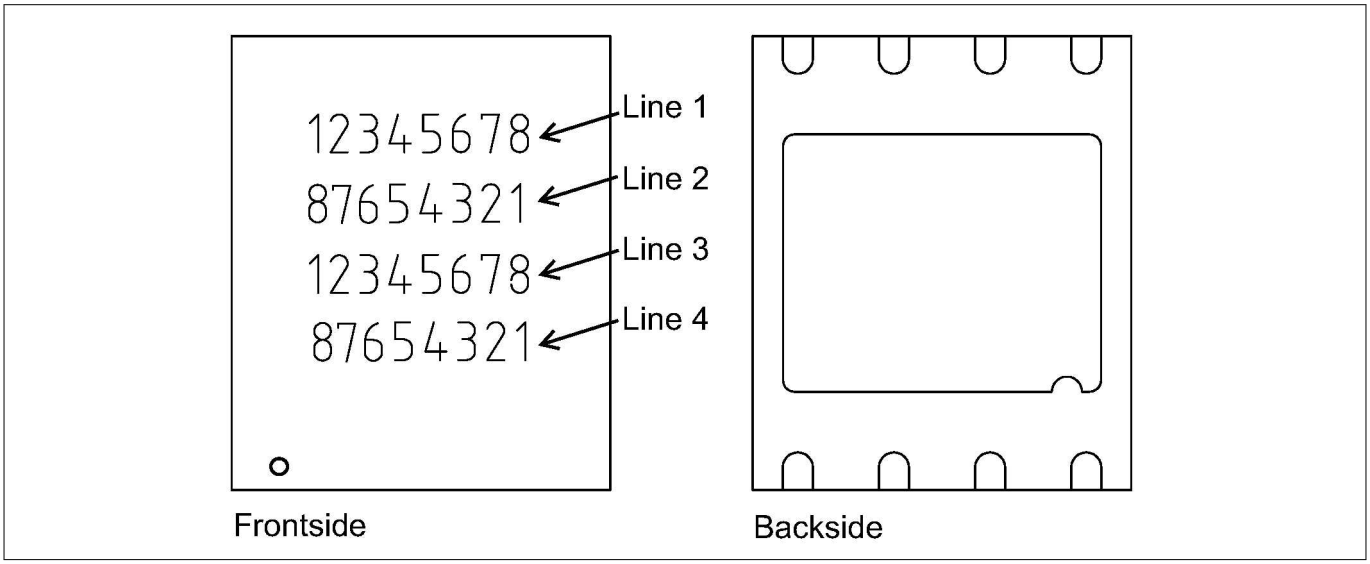

Figure 8 PG-VQFN-8-4 sample marking pattern

The dot indicates pin 01 for the chip. The “lot code” and “serial number” are defined and inserted during fabrication.

The following table describes the sample marking pattern:

Table 9 Marking table for PG-VQFN-8-4 packages

Indicator	Description
Line 1	EID [1 .. 8]
Line 2	EID [9 .. 16]
Line 3	EID [17 .. 24]
Line 4	EID [25 .. 32]

5.2.5 Package layout

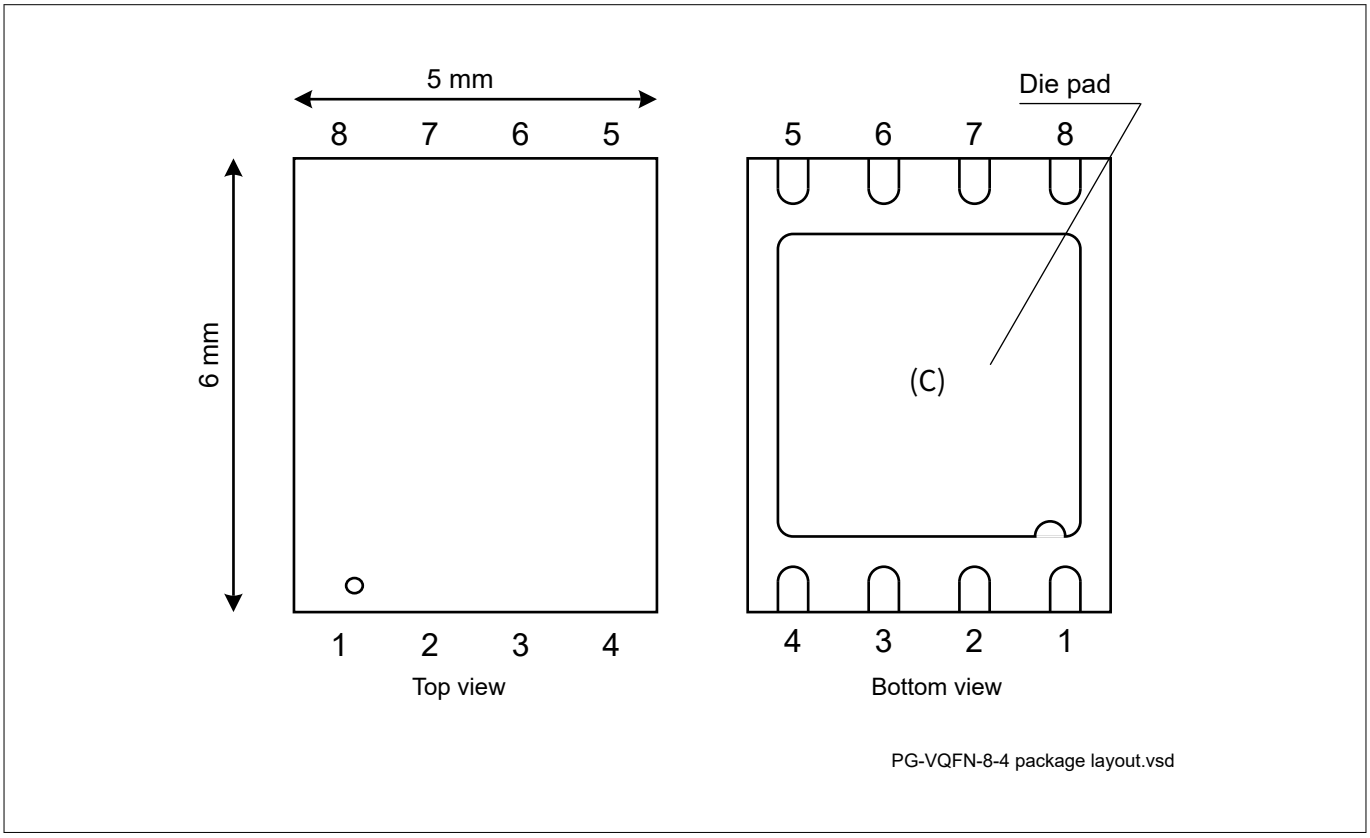

Figure 9 PG-VQFN-8-4 package layout

Pad-to-signal reference

The contacts and their functionality are given in the table below.

Table 10 Pad-to-signal reference for PG-VQFN-8-4

Pin	Symbol	Pin type	Buffer type	Signal function/remarks
1	GND	N.A.	-	Common ground reference. All GND pins must be tied together externally
2	NC		-	
3	*ISO_O*	I/O	ISO_IO	ISO/IEC 7816-3 [12]: UART_IO
4	NC	-	-	
5	NC	-	-	
6	*ISO_1*	I	ISO_I_CLK	ISO/IEC 7816-3 [12]: UART_CLK
7	*ISO_2*	I	ISO_I	ISO/IEC 7816-3 [12]: UART_RST
8	V_{CC}	N.A.	-	Power and pad supply (V_{CC})

Note: The exposed die pad referenced as (C) in Figure 9 must be connected to the common ground reference (GND) for heat distribution.

5.3 Ordering information

Table 11 Ordering information

Sales code	Package	Description
OC2321	PG-VQFN-8-4 (MFF2)	OPTIGA™ Connect IoT eUICC M2M standard version
OC2322	PG-VQFN-8-4 (MFF2)	OPTIGA™ Connect IoT eUICC M2M Indian version

A Appendix A hardware features

Table 12 Hardware features

Device	SLM97CNFX1M00PE
FLASH	1024 KB
RAM	32 KB
Voltage	1.8 V, 3 V, 5 V
32-bit CPU	Based on ARM® SecurCore® SC300
Internal clock	Up to 44 MHz
External clock	From 1 MHz to 10 MHz
Operating supply voltage	1.62 V - 5.5 V
Operating temperature range	-40°C to +105°C
Data retention	Min. 10 years
Erase/Write cycles	Min. 500.000
I/O	ISO 7816-3 (T = 0)
I/O speed	8, 16, 31, 32, 64, 186, 372 clocks per ETU

References

ETSI

[1] ETSI TS 102 221: *Smart Cards; UICC-Terminal interface; Physical and logical characteristics (Release-12)*; 2014-12

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[3] ETSI TS 102 223: *Technical Specification; Smart Cards; Card Application Toolkit (CAT) (Release-11)*

[4] ETSI TS 102 225: *Secured packet structure for UICC based applications (Release-11)*

[5] ETSI TS 102 226: *Remote APDU structure for UICC based applications (Release-11)*

[6] ETSI TS 102 671: *Smart Cards; Machine to Machine UICC; Physical and logical characteristics (Release 9, V9.0.0)*; 2010-04

[7] ETSI TS 123 003: *Technical Specification, Numbering, addressing and identification Vesrion16.3.0 (Release 16)*; 2020-10

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[9] ETSI TS 135 208: *Universal Mobile Telecommunications System (UMTS); LTE; 3G Security; Specification of the MILENAGE algorithm set: An example algorithm set for the 3GPP authentication and key generation functions f1, f1*, f2, f3, f4, f5 and f5*; Document 4: Design conformance test data (Release-15)*

GlobalPlatform

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GSMA

[11] GSM Association Official Document SGP.02: *Remote Provisioning Architecture for Embedded UICC Technical Specification (Version 3.2)*; 2017-06-27

ISO/IEC

[12] ISO/IEC 7816-3:2006: *Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols (Third edition)*; 2006-11

TCA

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3GPP

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[16] 3GPP TS 27.007: *Technical Specification Group Core Network and Terminals-AT command set for User Equipment (UE) (Release 9)*

[17] 3GPP TS 31.101: *3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; UICC-terminal interface; Physical and logical characteristics (Release 15, V15.1.0)* ; 2018-07

[18] 3GPP TS 31.115: *Secured packet structure for (Universal) Subscriber Identity Module (U)SIM Toolkit applications (Release-15)*

[19] 3GPP TS 31.116: *Remote APDU Structure for (U)SIM Toolkit applications (Release-15)*

References

[20] 3GPP TS 51.011: *3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface (Release 4, V4.15.0)*; 2005-06

[21] 3GPP TS 35.231: *Universal Mobile Telecommunications System (UMTS); LTE; Specification of the TUAK algorithm set: A second example algorithm set (Release-15)*

Others

[22] Tata Communications: *see* https://www.tatacommunications.com/solutions/mobility-iot/internet-of-things/esim/infineon-partnership/

[23] Oracle: Java Card™ Platform Specification, Classic Edition 3.0.5, including: *Java Card™ Platform Virtual Machine Specification, Java Card™ Platform, Runtime Environment Specification, Java Card™ Platform, API Classic Edition 3.0.5*; June 2015

Glossary

3GPP

3rd generation partnership project (3GPP)

AES

Advanced Encryption Standard (AES)
The standard for the encryption of electronic data established by the U.S. National Institute of Standards and Technology (NIST) in 2001. The algorithm described by AES is a symmetric-key algorithm (i.e. the same key is used for both encryption and decryption).

AIS-140

Automotive Industry Standard (AIS-140)
Set of standards formulated and published by Automotive Research Association of India (ARAI).

CAT-M

LTE card application toolkit M (CAT-M)

CAT-TP

card application toolkit transport protocol (CAT-TP)

CAVE

cellular authentication and voice encryption (CAVE)

CDMA

Code-division multiple access (CDMA)

CLK

clock (CLK)

DES

Data Encryption Standard (DES)
The standard referring to a symmetric-key algorithm for the encryption of electronic data.

DNS

Domain name server (DNS)

EID

eUICC ID (EID)
Unique ID of each eUICC.

eSIM

embedded subscriber identity module (eSIM)

ETSI

European Telecommunications Standards Institute (ETSI)

eUICC

embedded universal integrated circuit card (eUICC)

GP
GlobalPlatform (GP)

GSMA
Global System for Mobile Communications Association (GSMA)

ICC
integrated card circuit (ICC)

IEC
International Electrotechnical Commission (IEC)
The international committee responsible for drawing up electrotechnical standards.

ISIM
IP multimedia services identity module (ISIM)

ISO
International Organization for Standardization (ISO)

LTE
Long-term evolution (LTE)

M2M
machine to machine (M2M)

MNO
mobile network operator (MNO)

NB-IoT
NarrowBand-Internet of Things (NB-IoT)

OTA
over-the-air (OTA)

PIN
personal identification number (PIN)

RAM
random access memory (RAM)

RAM
remote application management (RAM)

RFM
remote file management (RFM)

RSA
Rivest Shamir Adleman (RSA)
An asymmetric cryptographic algorithm in which the encryption key is public and differs from the decryption key, which is kept secret (private).

RSP
remote SIM provisioning (RSP)

SGP.02
M2M specification eSIM GSMA (SGP.02)

SIM
subscriber identity module (SIM)

SM-DP
Subscription Manager - Data Preparation (SM-DP)
MNO platform connecting into the SM-SR to securely and remotely deliver profiles into eUICCs in the field.

SM-SR
Subscription Manager Secure Routing (SM-SR)
TATA's eUICC life-cycle management platform.

SMS
short message service (SMS)

TLS
transport layer security (TLS)

UART
universal asynchronous receiver/transmitter (UART)
A universal asynchronous receiver transmitter is used for serial communications over a peripheral device serial port by translating data between parallel and serial forms.

UICC
universal integrated circuit card (UICC)

USIM
universal subscriber identity module (USIM)

Revision history

Reference	Description
Revision 3.0, 2022-02-18	
	• Added About this document section • Updated Table 2, SMD package, Package layout, References list items with cross references, glossary entries and editorial changes
Revision 2.0, 2020-09-11	
	• Changed product name to OPTIGA™ Connect IoT • Updated External connectivity • Added Terminology section
Revision 1.0, 2020-04-27	
All	Initial release

RoHS compliance

On January 27, 2003 the European Parliament and the council adopted the directives:

- 2002/95/EC on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment ("RoHS")
- 2002/96/EC on Waste Electrical and Electrical and Electronic Equipment ("WEEE")

Some of these restricted (lead) or recycling-relevant (brominated flame retardants) substances are currently found in the terminations (e.g. lead finish, bumps, balls) and substrate materials or mold compounds.

The European Union has finalized the Directives. It is the member states' task to convert these Directives into national laws. Most national laws are available, some member states have extended timelines for implementation. The laws arising from these Directives have come into force in 2006 or 2007.

The electro and electronic industry has to eliminate lead and other hazardous materials from their products. In addition, discussions are on-going with regard to the separate recycling of certain materials, e.g. plastic containing brominated flame retardants.

Infineon is fully committed to giving its customers maximum support in their efforts to convert to lead-free and halogen-free[2)] products. For this reason, Infineon's "Green Products" are ROHS-compliant.

Since all hazardous substances have been removed, Infineon calls its lead-free and halogen-free semiconductor packages "green." Details on Infineon's definition and upper limits for the restricted materials can be found here.

The assembly process of our high-technology semiconductor chips is an integral part of our quality strategy. Accordingly, we will accurately evaluate and test alternative materials in order to replace lead and halogen so that we end up with the same or higher quality standards for our products.

The use of lead-free solders for board assembly results in higher process temperatures and increased requirements for the heat resistivity of semiconductor packages. This issue is addressed by Infineon by a new classification of the Moisture Sensitivity Level (MSL). In a first step the existing products have been classified according to the new requirements.

2 Any material used by Infineon is PBB and PBDE-free. Plastic containing brominated flame retardants, as mentioned in the WEEE directive, will be replaced if technically/economically beneficial.

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