DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

DEKRA

ACCREDITED
Test Lab
Cert 3350.01

Test report No:
NIE: 76291RBT.001

Test report
Bluetooth Low Energy RF-PHY Test Specification

(*) Identification of item tested	DA14535 SoC
(*) Trademark	SmartBond
(*) Model and /or type reference tested	FCGQFN24
Other identification of the product	Not provided
(*) Features	Bluetooth LE 5.3 SW version: SDK_6.0.19 HW version: DA14535
(*) Manufacturer	Renesas Design Netherlands B.V. Het Zuiderkruis 53, 5215 MV 's-Hertogenbosch, The Netherlands
Test method requested, standard	Full RF-PHY testing according to Bluetooth RF-PHY Test Specification, Document Number RF-PHY.TS.p20
Standard .....:	RF-PHY.TS.p20
Test Spec Errata(s) .....:	N/A
(*)ICS .....:	RF-PHY.ICS.p8
TCRL version .....:	TCRL.2023-1
Test procedure(s) .....:	PEBT006_08 BluetoothRFConductedTesting
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Juan Manuel Gómez BQTF Technical Responsible 78963762R JUAN MANUEL GOMEZ (C:A29507456) Firmado digitalmente por 78963762R JUAN MANUEL GOMEZ (C:A29507456) Fecha: 2023.08.01 09:10:46 +02'00'
Date of issue	2023-08-01
Report template No	FBT039_18 (*) "Data provided by the client"

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DEKRA Testing and Certification, S.A.U is a BQTF competent to carry out the tests described in this report.

DEKRA Testing and Certification, S.A.U is a testing laboratory accredited by A2LA (The American Association for Laboratory Accreditation) to perform the test indicated in the Certificate 3350.01.

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DEKRA Testing and Certification, S.A.U guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification, S.A.U at the time of performance of the test.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested", “Features”, “Manufacturer”)
2. The ICS and IXIT provided by the customer and used for testing are indicated in Annex B and C

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: Renesas Design Netherlands B.V.

Id	Control Number	Description	Model	HW Version	SW Version	Serial Nº	Date of reception
S/01	76291C_1.1	USB cable	-	-	-	-	2023-07-12
S/01	76291C_2.1	Small module test board conducted	-	DA14535	SDK_6.0.19	-	2023-07-12
S/01	76291C_3.1	Module test board	-	DA14535	SDK_6.0.19	-	2023-07-12

The sample used for each test case is specified in the" Test Sample" field of the results annex

Test sample description

The DA14535 is an ultra-low power SoC integrating a 2.4 GHz transceiver and an Arm® Cortex-M0+ microcontroller with a RAM of 64 kB and a One-Time Programmable (OTP) memory of 12 kB. It can be used as a standalone application processor or as a data pump in hosted systems. Ultra-low power can be achieved using the integrated Low IQ Buck/Boost DCDC which is on during sleep in Buck mode. The radio transceiver, the baseband processor, and the qualif ied Bluetooth® low energy stack is fully compliant with the Bluetooth® Low Energy 5.3 standard.

Identification of the client

Renesas Design Netherlands B.V.

Het Zuiderkruis 53, 5215 MV 's-Hertogenbosch, The Netherlands

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2023-07-12
Date (finish)	2023-07-12

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Document history

Report number	Date	Description
76291RBT.001	2023-08-01	First release

Environmental conditions

The following limits were not exceeded during the test:

Temperature	Min= 18 ºC Max= 28 ºC
Relative humidity	Min= 20 % Max= 75 %

Remarks and comments

The tests have been realized by the technical personnel: Mª Del Carmen Martos Ortal

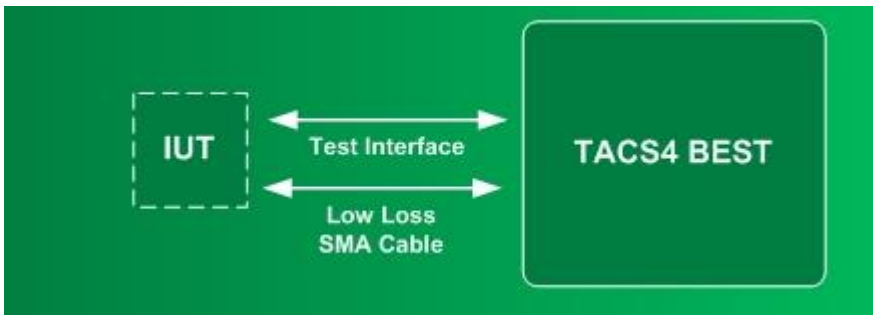
Means of testing identification

Control No.	Name	Technology Package	User Interface
5852	TACS4 BEST Bluetooth RF Test System	v4.13.0_R1	1.0 [Interface v1.21]

Control No.	Equipment	Serial No	Latest Calibration	Next Calibration
8426	CMW270 WIRELESS CONN. TESTER	102175	2023-06-19	2024-06-19
5767	LAN/GPIB/USB E5810B	MY56030024	--	--
2624	PICO TECHNOLOGY	IFY97/067	2023-05-08	2024-05-08
4733	PSG Signal Generators, 250KHZ-20GHZ	MY51501354	2022-11-21	2023-11-21
5398	Power Supply Agilent 66311B	MY52002833	2022-11-02	2023-11-02
3379	SIEPEL SHIELDED CHAMBER	06 825	--	--
5853	T4BCU100A	000001	--	--
4762	TEMPERATURE AND RELATIVE HUMIDITY MONITORING SOFTWARE	-	--	--
9042	ZTRC-8SPDT-A18 SWITCHING RF 8-PORT. RACK MOUNTED TEST EQUIPMENT	02106300143	--	--

Test setup

The configuration used for Test Cases in nominal temperature conditions was the following one:



Measurement uncertainty

TACS4 BEST Bluetooth RF Test System uncertainty values1, 2 and the corresponding limits, according to the RF-PHY Bluetooth Test Specification, can be found below:

Test Cases	Measurement uncertainty	Test System uncertainty	Test Specifications Limit
RFPHY/TRM/BV-01-C RFPHY/TRM/BV-18-C RFPHY/TRM/BV-19-C RFPHY/TRM/BV-20-C	Absolute RF power (wanted channel)	±0.98 dB	±1.2 dB
RFPHY/TRM/BV-03-C	Absolute RF power (unwanted emissions in the BT band)	±2.46 dB	±3 dB
RFPHY/TRM/BV-05-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Frequency deviation	±3.96 kHz	±4 kHz
RFPHY/TRM/BV-06-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Relative drift radio frequency	±1.00 kHz	±1 kHz
RFPHY/TRM/BV-08-C	Absolute RF power (unwanted emissions in the BT band)	±2.46 dB	±3 dB
RFPHY/TRM/BV-09-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Frequency deviation	±3.96 kHz	±4 kHz
RFPHY/TRM/BV-10-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Frequency deviation	±3.90 kHz	±4 kHz
RFPHY/TRM/BV-11-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Frequency deviation	±3.90 kHz	±4 kHz
RFPHY/TRM/BV-12-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Relative drift radio frequency	±1.00 kHz	±1 kHz
RFPHY/TRM/BV-13-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Frequency deviation	±3.96 kHz	±4 kHz
RFPHY/TRM/BV-14-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Relative drift radio frequency	±1.00 kHz	±1 kHz
RFPHY/TRM/BV-15-C	Absolute RF power (wanted channel)	±0.98 dB	±1.2 dB
RFPHY/TRM/BV-16-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Relative drift radio frequency	±1.00 kHz	±1 kHz
RFPHY/TRM/BV-17-C	Absolute radio frequency	±4.70 kHz	±5 kHz
	Relative drift radio frequency	±1.00 kHz	±1 kHz
RFPHY/TRM/PS/BV-xx-C	Absolute RF power (wanted channel)	±0.98 dB	±1.2 dB
RFPHY/TRM/ASI/BV-xx-C	Absolute RF power (wanted channel)	±0.98 dB	±1.2 dB

Note 1: All values reflect a 95% confidence level.
Note 2: All values are valid for a temperature range of 23±5ºC

Testing verdicts

Fail	F
Not applicable	N/A
Not measured	N/M
Pass	P

Appendix A: Test results

Test campaign report

TC Code	Description	Date	Test Sample	Result
RFPHY/RCV/BV-01-C	Receiver sensitivity, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/RCV/BV-03-C	C/I and Receiver Selectivity Performance, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/RCV/BV-04-C	Blocking Performance, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/RCV/BV-05-C	Intermodulation Performance, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/RCV/BV-06-C	Maximum input signal level, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/RCV/BV-07-C	PER Report Integrity, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/TRM/BV-01-C	Output power, 1 Ms/s	2023-07-12	S/01	P
RFPHY/TRM/BV-03-C	In-band emissions, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/TRM/BV-05-C	Modulation Characteristics, uncoded data at 1 Ms/s	2023-07-12	S/01	P
RFPHY/TRM/BV-06-C	Carrier frequency offset and drift, uncoded data at 1 Ms/s	2023-07-12	S/01	P

Relevant numerical results

Bluetooth® RF-PHY TS

RFPHY/TRM/BV-01-C Output power, 1 Ms/s

Results

Measurements								
Max Output Power [f=2402] (dBm)	Max Output Power [f=2440] (dBm)	Max Output Power [f=2480] (dBm)	Average Output Power [f=2402] (dBm)	Average Output Power [f=2440] (dBm)	Average Output Power [f=2480] (dBm)	Average Output Power [EIRP] [f=2402] (dBm)	Average Output Power [EIRP] [f=2440] (dBm)	Average Output Power [EIRP] [f=2480] (dBm)
2.570	2.44	2.34	2.550	2.410	2.320	4.750	4.610	4.520

Appendix B: ICS

Implementation Conformance Statement (ICS)

The ICS set for this IUT is consistent with the static conformance requirements in the referenced base specification.
The qualified ICS and IXIT menus of the test system were defined in accordance with the client.

Bluetooth LE RF Capabilities[a

Item	Capability	Reference	Status	Support: Yes or No
1	LE Transmitter (Non-connectable, Broadcaster)	[1] 3	C.1	Yes
2	LE Receiver (Non-connectable, Observer)	[1] 4	C.1	Yes
3	LE Transceiver (Connectable, Peripheral/Central)	[1] 3, 4	C.1	Yes
4	LE 2M PHY	[3] 3, 4	C.2	No
5	Stable Modulation Index - Transmitter	[3] 3.1.1	C.3	No
6	Stable Modulation Index - Receiver	[3] 3.1.1	C.4	No
7	LE Coded PHY	[3] 3, 4	C.2	No
8	Transmitting Constant Tone Extensions	[4] 5	C.3	No
9	2 µs Antenna Switching During Constant Tone Extension Transmission (AoD)	[4] 5	C.5	No
10	1 µs Antenna Switching During Constant Tone Extension Transmission (AoD)	[4] 5	C.6	No
11	2 µs Antenna Sampling During Constant Tone Extension Reception (AoD)	[4] 5	C.4	No
12	2 µs Antenna Switching and Sampling During Constant Tone Extension Reception (AoA)	[4] 5	C.7	No
13	1 µs Antenna Sampling During Constant Tone Extension Reception (AoD)	[4] 5	C.7	No
14	1µs Antenna Switching and Sampling During Constant Tone Extension Reception (AoA)	[4] 5	C.8	No
15	Power Class 1	[5] 4.6	C.9	No

C.1: Mandatory to support at least one of RFPHY 1/1 “LE Transmitter” OR RFPHY 1/2 “LE Receiver” OR RFPHY 1/3 “LE Transceiver”. Note: Selecting both RFPHY 1/1 “LE Transmitter” and RFPHY 1/2 “LE Receiver” is equivalent to selecting RFPHY 1/3 “LE Transceiver” and vice versa.
C.2: Excluded IF SUM ICS 21/14 “Core v4.2”, otherwise Optional.
C.3: Excluded IF SUM ICS 21/14 “Core v4.2”, otherwise Optional IF RFPHY 1/1 “LE Transmitter” OR RFPHY 1/3 “LE Transceiver”, otherwise Excluded.
C.4: Excluded IF SUM ICS 21/14 “Core v4.2”, otherwise Optional IF RFPHY 1/2 “LE Receiver” OR RFPHY 1/3 “LE Transceiver”, otherwise Excluded.
C.5: Optional IF RFPHY 1/8 “Transmitting Constant Tone Extensions”, otherwise Excluded.
C.6: Optional IF RFPHY 1/9 “2 µs Antenna Switching During Constant Tone Extension Transmission (AoD)”, otherwise Excluded.
C.7: Optional IF RFPHY 1/11 “2 µs Antenna Sampling During Constant Tone Extension Reception (AoD)”, otherwise Excluded.
C.8: Mandatory IF RFPHY 1/12 “2 µs Antenna Switching and Sampling During Constant Tone Extension Reception (AoA)” AND RFPHY 1/13 “1 µs Antenna Sampling During Constant Tone Extension Reception (AoD)”, otherwise Excluded.
C.9: Excluded IF SUM ICS 21/14 “Core v4.2” AND NOT SUM ICS 21/15 “CSA 5”, otherwise Optional.

Bluetooth LE Test Interfaces Capabilities

Item	Capability	Reference	Status	Support: Yes or No
1	HCI Test Interface	[2] 2	C.1	Yes
2	UART Test Interface	[2] 3	C.1	No

C.1: Mandatory to support at least one of these capabilities.

References:

[1] Specification of the Bluetooth System, Physical Layer Specification (PHY) Volume 6, Part A, Version 4.0 or later
[2] Specification of the Bluetooth System, Direct Test Mode, Volume 6, Part F, Version 4.0 or later
[3] Specification of the Bluetooth System, Physical Layer Specification (PHY) Volume 6, Part A, Version 5.0 or later
[4] Specification of the Bluetooth System, Physical Layer Specification (PHY) Volume 6, Part A, Version 5.1 or later
[5] Specification of the Bluetooth System, Link Layer Specification (PHY) Volume 6, Part B, Version 4.2 or later

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Appendix C: IXIT

Implementation eXtra Information for Test, IXIT

The IXIT set for this IUT is consistent with the static conformance requirements in the referenced base specification. The qualified ICS and IXIT menus of the test system were defined in accordance with the client

Description	Value	Units
Test frequency for Inband Image test, Low	1	MHz
Test frequency for Inband Image test, Middle	1	MHz
Test frequency for Inband Image test, High	1	MHz
Test frequency for Intermodulation test, Low	3	N/A
Test frequency for Intermodulation test, Middle	3	N/A
Test frequency for Intermodulation test, High	3	N/A
Power source voltage	3	V
Normal operating temperature	20	°C
Air humidity level for NOC tests	45	%
Test interface implementation	HCI	N/A
Maximum TX packet length (MAX_TX_LENGTH)	255	Bytes
Maximum RX packet length (MAX_RX_LENGTH)	255	Bytes
Maximum TX packet length (MAX_TX_LENGTH_2M)	N/A	Bytes
Maximum TX packet length (MAX_TX_LENGTH_CODED_S2)	N/A	Bytes
Maximum TX packet length (MAX_TX_LENGTH_CODED_S8)	N/A	Bytes
Maximum RX packet length (MAX_RX_LENGTH_2M)	N/A	Bytes
Maximum RX packet length (MAX_RX_LENGTH_CODED_S2)	N/A	Bytes
Maximum RX packet length (MAX_RX_LENGTH_CODED_S8)	N/A	Bytes
Maximum TX mode output power	4	dBm
Inband Image Frequency (2Ms/s), Low	N/A	MHz
Inband Image Frequency (2Ms/s), Middle	N/A	MHz
Inband Image Frequency (2Ms/s), High	N/A	MHz
Value n for Intermodulation test (2Ms/s), Low	N/A	N/A
Value n for Intermodulation test (2Ms/s), Middle	N/A	N/A
Value n for Intermodulation test (2Ms/s), high	N/A	N/A
Inband Image Frequency (Stable Modulation Receiver), Low	N/A	MHz
Inband Image Frequency (Stable Modulation Receiver), Middle	N/A	MHz
Inband Image Frequency (Stable Modulation Receiver), High	N/A	MHz

Value n for Intermodulation test (Stable Modulation Receiver), Low	N/A	N/A
Value n for Intermodulation test (Stable Modulation Receiver), Middle	N/A	N/A
Value n for Intermodulation test (Stable Modulation Receiver), Hgh	N/A	N/A
Inband Image Frequency (Stable Modulation Receiver, 2Ms/s), Low	N/A	MHz
Inband Image Frequency (Stable Modulation Receiver, 2Ms/s), Middle	N/A	MHz
Inband Image Frequency (Stable Modulation Receiver, 2Ms/s), High	N/A	MHz
Value n for Intermodulation test (Stable Modulation Receiver, 2Ms/s), Low	N/A	N/A
Value n for Intermodulation test (Stable Modulation Receiver, 2Ms/s), Middle	N/A	N/A
Value n for Intermodulation test (Stable Modulation Receiver, 2Ms/s), High	N/A	N/A
IQ Report Rate	N/A	N/A
The length of the Constant Tone Extension(1Ms/s)	N/A	bits
The length of the Constant Tone Extension(2Ms/s)	N/A	bits
The number of antennae	1	N/A
Antenna Gain	2.2	dBi

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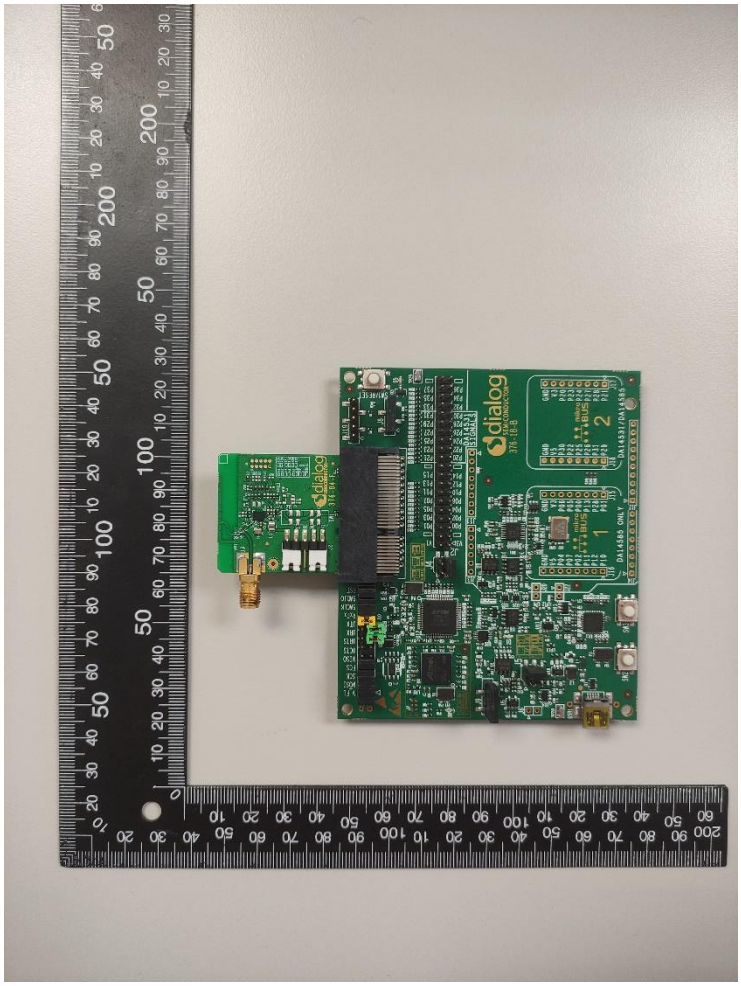
Appendix D: Photographs

Front view – Sample S/01



Rear view – Sample S/01