



Test report No:

NIE: 54505RBT.001

Test report

Bluetooth Low Energy RF-PHY Test Specification

Identification of item tested..... :	SoC
Trademark	Nordic Semiconductor
Model or type reference	nRF52840
Serial number	10000012
Final HW version	73 pin AQFN package
Final SW version	S140 SD v6.0.0
Features	Bluetooth Core Specification 5, including 2MS/s, Coded PHY and Advertising Extensions
Manufacturer	NORDIC SEMICONDUCTOR ASA Otto Nielsens veg 12, 7052 Trondheim, Norway
Test method requested..... :	Full RF-PHY testing according to Bluetooth RF-PHY Test Specification, Document Number RF-PHY.TS/5.0.2
Standard..... :	RF-PHY.TS.5.0.2
Test Spec Errata(s)	N/A
ICS	RF-PHY.ICS.5.0.0
TCRL version	Core.TCRL. 2017-2
Test procedure(s)	PEBT006_06 BluetoothRFConductedTesting
Summary	IN COMPLIANCE
Approved by (name / position & signature)	L. Natividad Caro García BQTF Technical Responsible
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Competences and guarantees

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 BQTF accredited by A2LA (The American Association for Laboratory Accreditation) to perform the test indicated in the Certificate 3350.01.

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA. 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 at the time of performance of the test.

DEKRA. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

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

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General conditions

1. This report is only referred to the item that has undergone the test.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA. and the Accreditation Bodies.

Uncertainty

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

Usage of samples

Samples undergoing test have been selected and supplied by: NORDIC SEMICONDUCTOR ASA

Sample M/01, is composed of the following elements:

Control N° 54505/002	Model and/or type reference:	nRF52840
	Serial number:	10000012
	Hw version:	73 pin AQFN package
	Sw version:	S140 SD v6.0.0
	Features supported:	Bluetooth Core Specification 5, including 2MS/s, Coded PHY and Advertising Extensions
	Description of test sample	SoC
	Date of reception	2017-12-19

Control N° 54505/003	Model and/or type reference:	-
	Serial number:	#2
	Hw version:	-
	Sw version:	-
	Features supported:	-
	Description of test sample	FCC/ETSI and RF-PHY Qualification Motherboard
	Date of reception	2018-01-23

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

Test sample description

The nRF52840 is an advanced multi-protocol SoC ideally suited for ultra low-power wireless applications. The nRF52840 SoC is built around a 32-bit ARM® Cortex™-M4F CPU with 1MB flash and 256kB RAM on chip. The embedded 2.4GHz transceiver supports Bluetooth® low energy (Bluetooth 5), 802.15.4, ANT and proprietary 2.4GHz protocols. It is on-air compatible with existing nRF52 Series, nRF51 Series, and nRF24 Series products from Nordic Semiconductor.

Identification of the client

Company name:	NORDIC SEMICONDUCTOR ASA
Postal Address:	Otto Nielsens veg 12, 7052 Trondheim, Norway

Testing period

The performed test started on 2018-01-25 and finished on 2018-01-26.
The tests have been performed at DEKRA.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 18 °C Max. = 28 °C
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

N/A

Means of testing identification

Test System	TACS4 BEST Bluetooth RF Test System				
Control No.	5852				
Hardware:	Control No.	Equipment	Serial No.	Latest Calibration Date	Next Calibration Date
	5767	LAN/GPIB/USB E5810B	MY56030024	N/A	N/A
	5398	Power Supply Agilent 66311B	MY52002833	2017-12-18	2018-12-18
	5399	Sweep Generator AGILENT E8257D	MY53401729	2017-12-20	2018-12-20
	5749	R&S® CMW270	100651	2017-12-19	2018-12-19
	5853	T4BCU100A	000001	N/A	N/A
Software:	5902	User Interface TACS4 BEST v1.10.0			
	5903	Technology Package Version: v3.2.0_R1			
Test Setup:	Conducted measurements: IUT (Item Under Test) connected directly to measuring instruments using low loss SMA cable. IUT controlled by test software. See “Test Setup” section.				

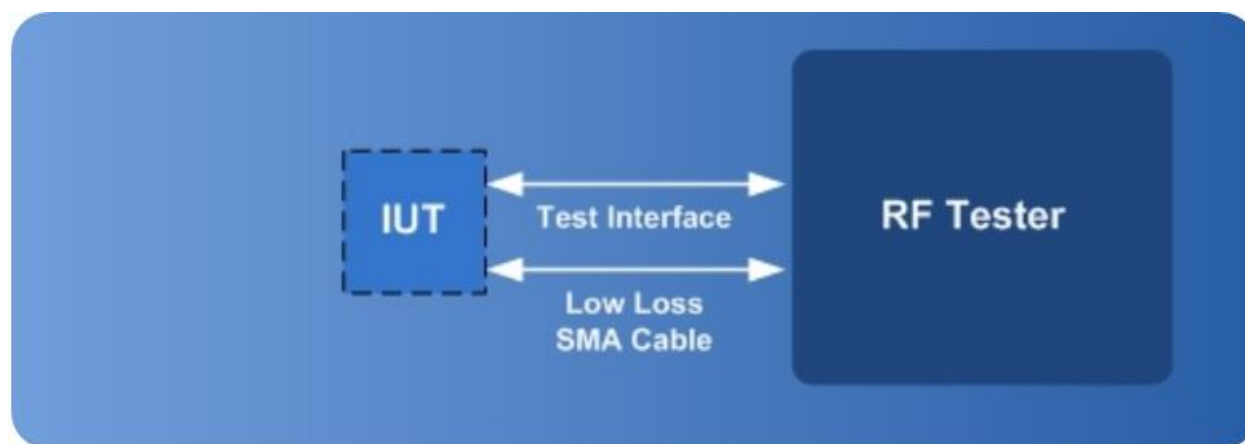
	Control No.	Equipment	Serial No.	Latest Calibration Date	Next Calibration Date
Hardware:	3379	Shielded Chamber	06 825	NA	NA

For nominal temperature conditions, the following equipment was used:

	Control No.	Equipment	Serial No.	Latest Calibration Date	Next Calibration Date
Hardware:	2624	HUMIDIPROBE	IFY97/067	2017-04-17	2018-04-17
Software:	4762	Control temp_Hum v2.5.1			

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 values^{1, 2} and the corresponding limits, according to the RF-PHY *Bluetooth* Test Specification, can be found below:

Measurement uncertainty	RF Tester uncertainty	Specification limit	Test Case
Absolute RF power (wanted channel)	±0.98 dB	±1.2dB	RF-PHY/TRM-LE/CA/BV-01-C
Absolute RF power (for unwanted emissions in the BT band)	±2.46 dB	±3dB	RF-PHY/TRM-LE/CA/BV-03-C
Absolute radio frequency	±4.70 kHz	±5 kHz	RF-PHY/TRM-LE/CA/BV-05-C RF-PHY/TRM-LE/CA/BV-06-C
Relative drift radio frequency	±1.00 kHz	±1 kHz	RF-PHY/TRM-LE/CA/BV-06-C
Frequency deviation	±3.96 kHz	±4 kHz	RF-PHY/TRM-LE/CA/BV-05-C

Note 1: All values reflect a 95% confidence level.

Note 2: All values are valid for a temperature range of 23±5°C.

Testing verdicts

Not applicable..... :	NA
Pass..... :	P
Fail..... :	F
Not measured..... :	NM

Appendix A – Test result

Test campaign report

The abbreviations used in the header row of the test campaign report tables are:

Test Case ID : As it can be found on the standard

Verdict: Records the verdict assigned to each Test Case run to completion. Following verdicts are possible:

Pass: If the Test Case passed.

Fail: If the Test Case failed.

NA: Not applicable.

NM: Not measured.

Date: Date of the beginning of the execution.

Observations: Provides a reference to additional information relevant to the test presented in “Test Setup” section.

Test Case ID	Description	Verdict	Date	Observations
RF-PHY/TRM-LE/CA/BV-01-C	Output power	Pass	2018-01-25	M/01
RF-PHY/TRM-LE/CA/BV-03-C	In-band emissions	Pass	2018-01-25	M/01
RF-PHY/TRM-LE/CA/BV-05-C	Modulation characteristics	Pass	2018-01-25	M/01
RF-PHY/TRM-LE/CA/BV-06-C	Carrier frequency offset and drift	Pass	2018-01-25	M/01
RF-PHY/TRM-LE/CA/BV-08-C	In-band emissions at 2 Ms/s	Pass	2018-01-26	M/01
RF-PHY/TRM-LE/CA/BV-09-C	Stable Modulation Characteristics at 1 Ms/s	NA	-	-
RF-PHY/TRM-LE/CA/BV-10-C	Modulation Characteristics at 2 Ms/s	Pass	2018-01-25	M/01
RF-PHY/TRM-LE/CA/BV-11-C	Stable Modulation Characteristics at 2 Ms/s	NA	-	-
RF-PHY/TRM-LE/CA/BV-12-C	Carrier frequency offset and drift at 2 Ms/s	Pass	2018-01-25	M/01
RF-PHY/TRM-LE/CA/BV-13-C	Modulation Characteristics, LE Coded (S=8)	Pass	2018-01-25	M/01
RF-PHY/TRM-LE/CA/BV-14-C	Carrier frequency offset and drift, LE Coded (S=8)	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-01-C	Receiver sensitivity	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-03-C	C/I and receiver selectivity performance	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-04-C	Blocking performance	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-05-C	Intermodulation performance	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-06-C	Maximum input signal level	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-07-C	PER Report Integrity	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-08-C	Receiver sensitivity at 2 Ms/s	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-09-C	C/I and Receiver Selectivity Performance at 2 Ms/s	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-10-C	Blocking performance at 2 Ms/s	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-11-C	Intermodulation performance at 2 Ms/s	Pass	2018-01-25	M/01

Test Case ID	Description	Verdict	Date	Observations
RF-PHY/RCV-LE/CA/BV-12-C	Maximum input signal level at 2 Ms/s	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-13-C	PER Report Integrity at 2 Ms/s	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-14-C	Receiver Sensitivity at NOC, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-15-C	C/I and Receiver Selectivity Performance, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-16-C	Blocking Performance, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-17-C	Intermodulation Performance, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-18-C	Maximum input signal level, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-19-C	PER Report Integrity, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-20-C	Receiver sensitivity at 2 Ms/s, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-21-C	C/I and Receiver Selectivity Performance at 2 Ms/s, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-22-C	Blocking performance at 2 Ms/s, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-23-C	Intermodulation performance at 2 Ms/s, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-24-C	Maximum input signal level at 2 Ms/s, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-25-C	PER Report Integrity at 2 Ms/s, Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-26-C	Receiver sensitivity, LE Coded (S=2)	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-27-C	Receiver sensitivity, LE Coded (S=8)	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-28-C	C/I and Receiver Selectivity Performance, LE Coded (S=2)	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-29-C	C/I and Receiver Selectivity Performance, LE Coded (S=8)	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-30-C	PER Report Integrity, LE Coded (S=2)	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-31-C	PER Report Integrity, LE Coded (S=8)	Pass	2018-01-25	M/01
RF-PHY/RCV-LE/CA/BV-32-C	Receiver sensitivity, LE Coded (S=2), Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-33-C	Receiver sensitivity, LE Coded (S=8), Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-34-C	C/I and Receiver Selectivity Performance, LE Coded (S=2), Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-35-C	C/I and Receiver Selectivity Performance, LE Coded (S=8), Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-36-C	PER Report Integrity, LE Coded (S=2), Stable Modulation Index	NA	-	-
RF-PHY/RCV-LE/CA/BV-37-C	PER Report Integrity, LE Coded (S=8), Stable Modulation Index	NA	-	-

Relevant numerical results

Test Case ID	Parameter	Value
RF-PHY/TRM-LE/CA/BV-01-C Output power measurements for each frequency.	Peak Power; f=2402	7.65 dBm
	Peak Power; f=2440	7.80 dBm
	Peak Power; f=2480	7.78 dBm
	Average Power; f=2402	7.62 dBm
	Average Power; f=2440	7.77 dBm
	Average Power; f=2480	7.76 dBm

Appendix B - ICS

Static Conformance Summary

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.

Item	Capability	Reference	Status	Support: Yes or No
1	LE Transmitter (Non-connectable, Broadcaster)	[2], [3]	C.1	Yes
2	LE Receiver (Non-connectable, Observer)	[2], [4]	C.1	Yes
3	LE Transceiver (Connectable, Peripheral/Central)	[2], [3] & [4]	C.1	Yes
4	LE 2M PHY	[6] 3, 4	C.2	Yes
5	Stable Modulation Index - Transmitter	[6] 3.1.1	C.3	No
6	Stable Modulation Index - Receiver	[6] 3.1.1	C.4	No
7	LE Coded PHY	[6] 3, 4	C.2	Yes

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

C.2: Optional IF SUM ICS 21/16 “Core 5.0” AND RF PHY 1/3 “LE Transceiver” are supported, otherwise Excluded.

C.3: Optional IF SUM ICS 21/16 “Core 5.0” AND (RF PHY 1/1 “LE Transmitter” OR RF PHY 1/3 “LE Transceiver”) are supported, otherwise Excluded.

C.4: Optional IF SUM ICS 21/16 “Core 5.0” AND (RF PHY 1/2 “LE Receiver” OR RF PHY 1/3 “LE Transceiver”) are supported, otherwise Excluded.

[1] Specification of the Bluetooth System, Error Codes, Volume 2, Part E, Version 4.0 or later

[2] Specification of the Bluetooth System, Physical Layer Specification (PHY) Volume 6, Part A, Version 4.0 or later

[3] Specification of the Bluetooth System, Direct Test Mode, Volume 6, Part F, Version 4.0 or later

[4] ICS Proforma for Radio (RF) System Specification [5] Summary ICS

[6] Specification of the Bluetooth System, Physical Layer Specification (PHY) Volume 6, Part A, Version 5.0 or late

Appendix C - IXIT

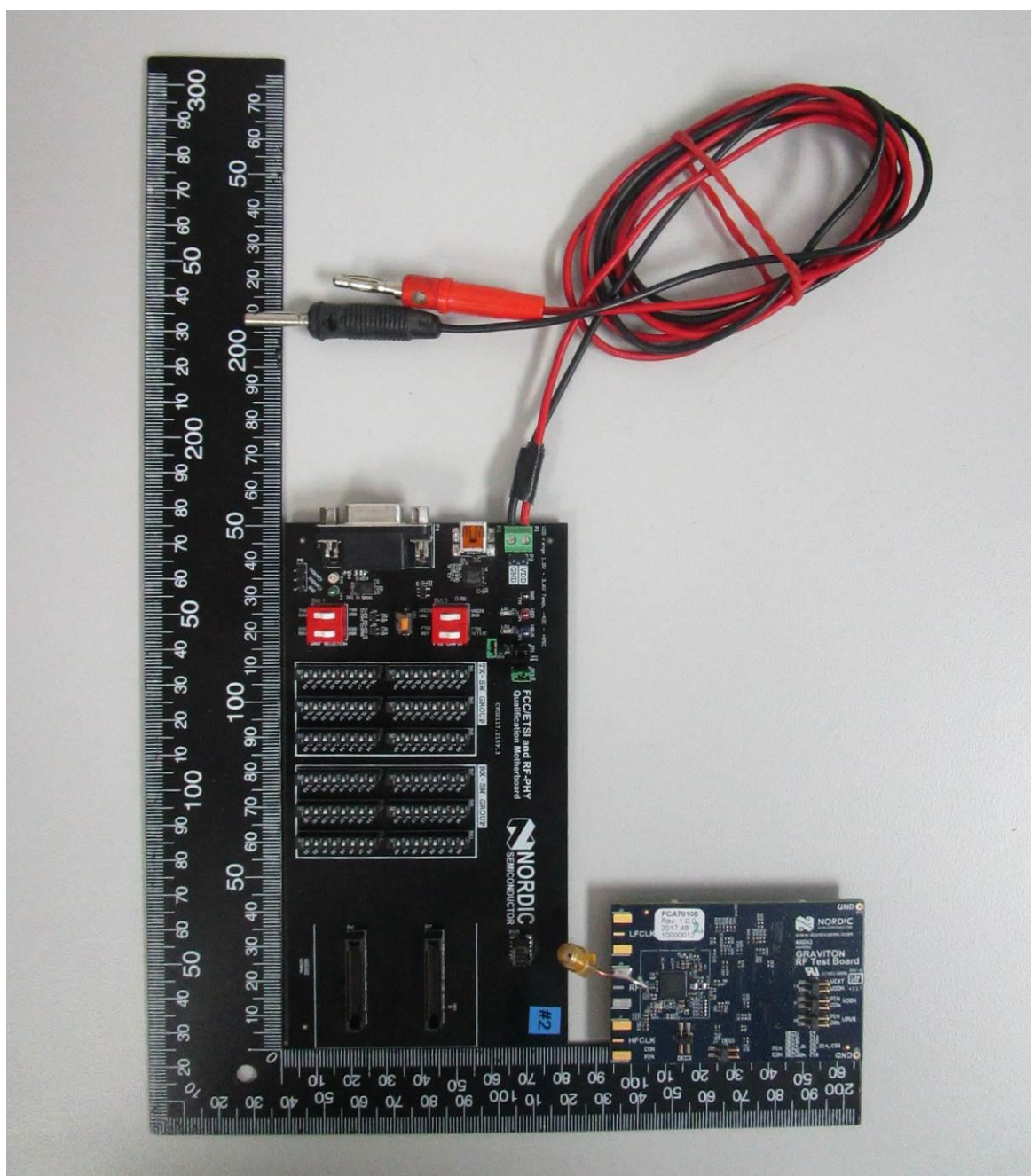
IXIT Proforma

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

PIXIT Reference	Identifier	Sub-Identifier (Optional)	Value	Units
RF-PHY:P1:1	Inband Image frequency	Low frequency	-2	MHz
RF-PHY:P1:2		Middle frequency	-2	MHz
RF-PHY:P1:3		High frequency	-2	MHz
RF-PHY:P2:1	Value n for Intermodulation test	Low frequency	5	Integer
RF-PHY:P2:2		Middle frequency	5	Integer
RF-PHY:P2:3		High frequency	5	Integer
RF-PHY:P4	Power source voltage Nominal (NOC)		3	V
RF-PHY:P5	Normal operating temperature Nominal (NOC)		25	°C
RF-PHY:P6:1	Air humidity range (relative)	Maximum (EOC)	-	%
RF-PHY:P6:2		Minimum (EOC)	-	%
RF-PHY:P6:3		Air humidity level for NOC/EOC tests	-	%
RF-PHY:P7:1	Test interface implementation	HCI or 2-wire UART	2-wire	-
RF-PHY:P7:2		Datarate	19200	bps
RF-PHY:P9:1	Maximum TX packet length (MAX_TX_LENGTH)	37 to 255	255	Bytes
RF-PHY:P9:2	Maximum RX packet length (MAX_RX_LENGTH)	37 to 255	255	Bytes
RF-PHY:P9:3	Maximum TX packet length (MAX_TX_LENGTH) 2M	37 to 255	255	Bytes
RF-PHY:P9:4	Maximum TX packet length (MAX_TX_LENGTH) S=2	37 to 255	255	Bytes
RF-PHY:P9:5	Maximum TX packet length (MAX_TX_LENGTH) S=8	37 to 255	255	Bytes
RF-PHY:P9:6	Maximum RX packet length (MAX_RX_LENGTH) 2M	37 to 255	255	Bytes
RF-PHY:P9:7	Maximum RX packet length (MAX_RX_LENGTH) S=2	37 to 255	255	Bytes
RF-PHY:P9:8	Maximum RX packet length (MAX_RX_LENGTH) S=8	37 to 255	255	Bytes
RF-PHY:P10:1	Maximum TX mode output power	-20 to 10 (CSA5 unsupported) -20 to 20 (CSA5 supported)	8	dBm
RF-PHY:P11:1	Inband Image Frequency (2Ms/s)	Low frequency	-4	MHz
RF-PHY:P11:2		Middle frequency	-4	MHz
RF-PHY:P11:3		High frequency	-4	MHz
RF-PHY:P12:1	Value n for Intermodulation test (2Ms/s)	Low frequency	5	Integer
RF-PHY:P12:2		Middle frequency	5	Integer
RF-PHY:P12:3		High frequency	5	Integer
RF-PHY:P13:1	Inband Image Frequency (Stable Modulation Receiver)	Low frequency	NA	MHz
RF-PHY:P13:2		Middle frequency	NA	MHz
RF-PHY:P13:3		High frequency	NA	MHz
RF-PHY:P14:1	Value n for Intermodulation test (Stable Modulation Receiver)	Low frequency	NA	Integer
RF-PHY:P14:2		Middle frequency	NA	Integer
RF-PHY:P14:3		High frequency	NA	Integer
RF-PHY:P15:1	Inband Image Frequency (Stable Modulation Receiver, 2Ms/s)	Low frequency	NA	MHz
RF-PHY:P15:2		Middle frequency	NA	MHz
RF-PHY:P15:3		High frequency	NA	MHz
RF-PHY:P16:1	Value n for Intermodulation test (Stable Modulation Receiver, 2Ms/s)	Low frequency	NA	Integer
RF-PHY:P16:2		Middle frequency	NA	Integer
RF-PHY:P16:3		High frequency	NA	Integer

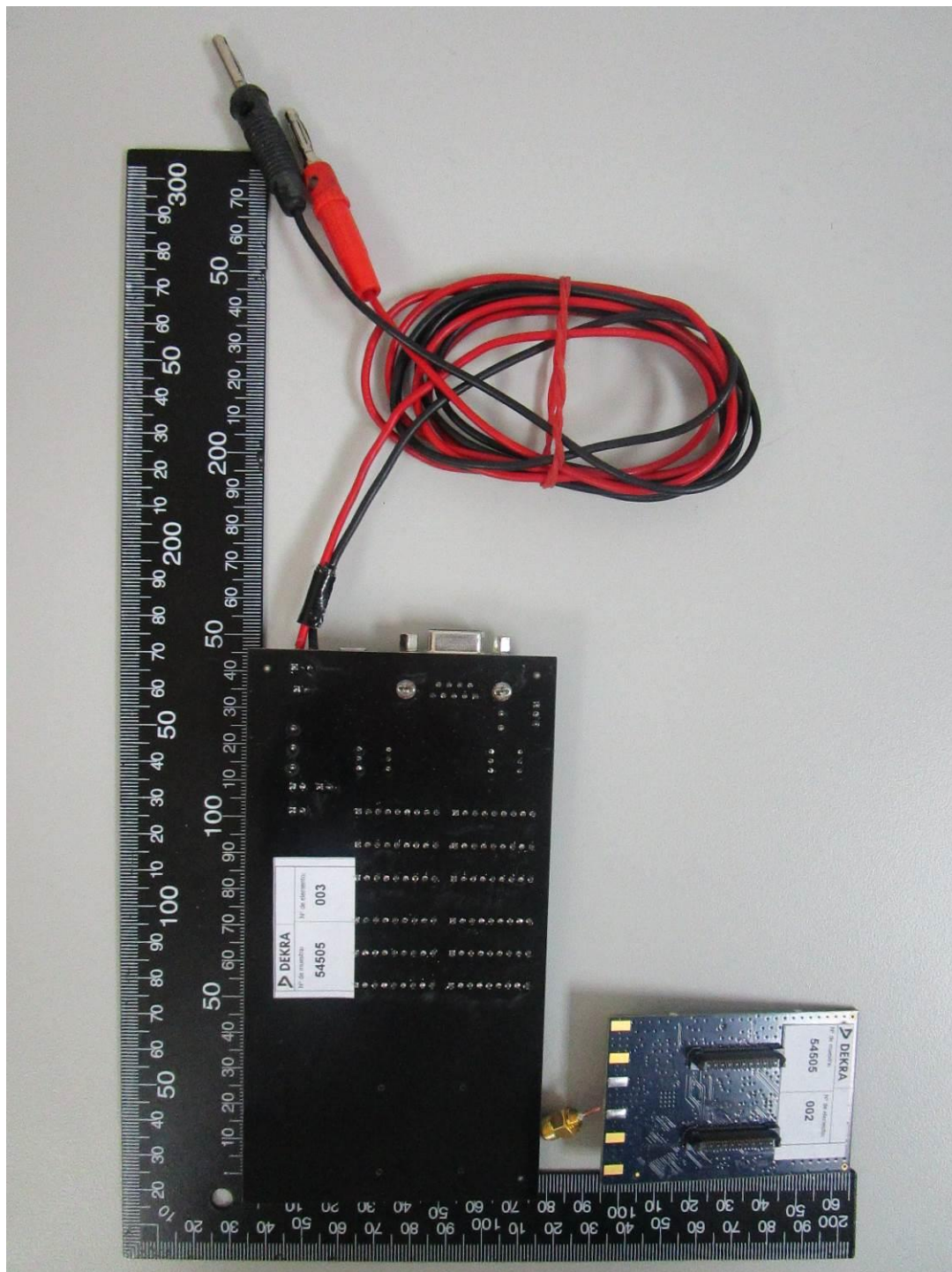
Appendix D - Photographs

FRONT VIEW



Sample M/01

REAR VIEW



Sample M/01