



Test report No:  
NIE: 59675REM.001

## Test report

**Draft ETSI EN 301 489-1 V2.2.0 (2017-03): Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; & Draft ETSI EN 301 489-52 V1.1.0 (2016-11): Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment**

Identification of item tested	IOT Module
Trademark	nRF91
Model and /or type reference	nRF9160
Other identification of the product	FCC ID: 2ANPO00NRF9160 IC: 24529-NRF9160 IMEI TAC: 35265610 HW Version: DEV2.1.6 SW Version: mfw_nrf9160_0.7.0-29.alpha
Features	LTE Cat-M1, LTE-NB1, GPS
Manufacturer	NORDIC SEMICONDUCTOR ASA P.O. Box 436, 0213 Oslo, Norway.
Test method requested, standard	Draft ETSI EN 301 489-1 V2.2.0 (2017-03) & Draft ETSI EN 301 489-52 V1.1.0 (2016-11)
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Jose Manuel Gómez Industrial & Automotive EMC Lab. Manager
Date of issue	2019-04-25
Report template No	FDT08_21

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## Competences and guarantees

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

DEKRA Testing and Certification 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 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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## General conditions

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1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification and the Accreditation Bodies.

## Uncertainty

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

The total uncertainty of the measurement system for the measured radio disturbance characteristics of EUT from 30 MHz to 1000 MHz is  $l = \pm 5$  dB for quasi-peak measurements,  $l = \pm 4,7$  dB for peak measurements ( $k = 2$ ).

The total uncertainty of the measurement system for the measured radio disturbance characteristics of EUT from 1 to 6GHz is  $l = \pm 4,2$  dB for peak & average measurements ( $k = 2$ ).

## Data provided by the client

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The sample consist of a IOT Module that has Application CPU, LTE Cat-M1, Cat-NB1 Radio and GPS Receiver.

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

## Usage of samples

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Samples undergoing test have been selected by: The client.

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
59678C/008	IOT Module	nRF9160	---	2019-01-15

## Test sample description

Ports..... :	Port name and description	Cable				
		Specified length [m]	Attached during test	Shielded		
	LTE RF	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	GPS	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :	N/A					
Rated power supply .....	Voltage and Frequency	Reference poles				
		L1	L2	L3	N	PE
	<input type="checkbox"/> AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> DC: 3.3 – 5.5Vdc.					
	<input type="checkbox"/> DC:					
Rated Power .....	1W					
Clock frequencies .....	32kHz, 32MHz					
Other parameters..... :	---					
Software version .....	mfw_nrf9160_0.7.0-29.alpha					
Hardware version..... :	DEV2.1.6					
Dimensions in cm (L x W x D) .... :	11x16x1.1mm					
Mounting position..... :	<input type="checkbox"/>	Table top equipment				
	<input type="checkbox"/>	Wall/Ceiling mounted equipment				
	<input type="checkbox"/>	Floor standing equipment				
	<input type="checkbox"/>	Hand-held equipment				
	<input checked="" type="checkbox"/>	Other: SMD Module				
Modules/parts .....	Module/parts of test item		Type	Manufacturer		
	N/A					
	N/A					
	N/A					

Accessories (not part of the test item) .....	Description	Type	Manufacturer
	N/A		
	N/A		
	N/A		
Documents as provided by the applicant.....	Description	File name	Issue date
	User manual	4418_1177-0.3.1-20180905-140910-nRF9160_Objective_Product_Spec	23-Oct-2018
	Cover markings	SiP marking	23-Oct-2018
	N/A		

Copy of marking plate:

Sample S/01



## Identification of the client

NORDIC SEMICONDUCTOR ASA  
P.O. Box 436, 0213 Oslo, Norway

## Testing period and place

<b>Test Location</b>	DEKRA Testing and Certification S.A.U.
<b>Date (start)</b>	2019-01-16
<b>Date (finish)</b>	2019-01-31

## Document history

Report number	Date	Description
58741REM.001	2019-04-25	First release

## Environmental conditions

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

<b>Temperature</b>	Min. = 15 °C Max. = 35 °C
<b>Relative humidity</b>	Min. = 30 % Max. = 75 %
<b>Air pressure</b>	Min. = 860 mbar Max. = 1060 mbar

In the semianechoic chamber, the following limits were not exceeded during the test.

<b>Temperature</b>	Min. = 15 °C Max. = 35 °C
<b>Relative humidity</b>	Min. = 30 % Max. = 75 %
<b>Air pressure</b>	Min. = 860 mbar Max. = 1060 mbar

In the chamber for conducted measurements, the following limits were not exceeded during the test:

<b>Temperature</b>	Min. = 15 °C Max. = 35 °C
<b>Relative humidity</b>	Min. = 30 % Max. = 60 %
<b>Air pressure</b>	Min. = 860 mbar Max. = 1060 mbar



## Remarks and comments

The tests have been performed by the technical personnel: Alberto Parada, Miguel Quesada & Victoria Olmedo

## Testing verdicts

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

## List of equipment used during the test

CONTROL NUMBER	DESCRIPTION	MANUFACTURER	MODEL	CALIBRATION (LAST/NEXT)
6165	EMI Test Receiver	ROHDE & SCHWARZ	ESR7	2017-08-04/ 2019-08-04
6143	BiconiLog Antenna	ETS LINDGREN	3142E	2017-09-27/ 2020-09-27
4522	EMC measurement software	ROHDE & SCHWARZ	EMC32 V10.20	N/A
6121	Preamplifier	BONN ELEKTRONIK	BLNA 0160-01N	2018-07-19/ 2019-03-20
6231	Signal Generator	ROHDE AND SCHWARZ	SMB100A	2017-07-27/ 2019-07-27
6339	Log-Periodic Broadband Antenna	SCHWARZBECK	STPL 9129	N/A
6234	Power Meter	ROHDE AND SCHWARZ	NRP2	N/A
6236	Amplifier	ROHDE AND SCHWARZ	BBA150- BC250D110+E100	N/A
6238	Electrostatic Discharge Simulator	EM TEST	esd NX30.1	2017-09-26 / 2019-09-26

## Summary

Emission Test		
Requirement – Test case	Verdict	Remark
Radiated emission test (30 MHz – 1000 MHz)	Pass	N/A
Radiated emission test (1 GHz – 6 GHz)	Pass	N/A
Conducted emission test (150 KHz to 30 MHz)	N/A	See 1
Discontinuous disturbance (clicks) on AC power leads	N/A	See 1
Harmonic current emissions	N/A	See 1
Voltage changes, voltage fluctuations and flicker	N/A	See 1
<u>Supplementary information and remarks:</u>		
1) The test is not applicable, not required by the standard.		

Immunity test		
Requirement – Test case	Verdict	Remark
Electrostatic discharge	Pass	N/A
Radio-frequency electromagnetic fields	N/A	See 1
Fast transients	N/A	See 1
Surges	N/A	See 1
Injected currents (radio-frequency common mode)	N/A	See 1
Power frequency magnetic fields	N/A	See 1
Transient immunity test	N/A	See 1
Voltage dips and short interruptions	N/A	See 1
<u>Supplementary information and remarks:</u>		
1) The test is not applicable, not required by the standard.		

## Appendix A: Test results

# Appendix A context

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## DESCRIPTION OF THE OPERATION MODES

The operation modes described in this paragraph constitute a functionality of the sample under test for itself. Every operation mode takes a failure criteria for the immunity test that they were applying to it and a monitoring to guarantee performance of the same ones.

The operation modes used by the samples to which the present report refers, are shown in the following table:

OPERATION MODE	DESCRIPTION
OM#01	EUT ON. Stand Alone Basis. Power Supply: 3.8Vdc.
OM#02	EUT ON. MS in IDLE mode. LTE Cat M1, Band 1. Power supply: 3.8Vdc.
OM#03	EUT ON. MS in IDLE mode. LTE Cat M1, Band 8. Power supply: 3.8Vdc.
OM#04	EUT ON. MS in IDLE mode. LTE Cat M1, Band 28. Power supply: 3.8Vdc.
OM#05	EUT ON. MS in IDLE mode. Cat NB-IOT, Band 1. Power supply: 3.8Vdc.
OM#06	EUT ON. MS in IDLE mode. Cat NB-IOT, Band 8. Power supply: 3.8Vdc.
OM#07	EUT ON. MS in IDLE mode. Cat NB-IOT, Band 28. Power supply: 3.8Vdc.
OM#08	EUT ON. MS in Traffic mode. LTE Cat M1, Band 1. Power supply: 3.8Vdc.
OM#09	EUT ON. MS in Traffic mode. LTE Cat M1, Band 8. Power supply: 3.8Vdc.
OM#10	EUT ON. MS in Traffic mode. LTE Cat M1, Band 28. Power supply: 3.8Vdc.
OM#11	EUT ON. MS in Traffic mode. Cat NB-IOT, Band 1. Power supply: 3.8Vdc.
OM#12	EUT ON. MS in Traffic mode. Cat NB-IOT, Band 8. Power supply: 3.8Vdc.
OM#13	EUT ON. MS in Traffic mode. Cat NB-IOT, Band 28. Power supply: 3.8Vdc.

## FAILS CRITERIA FOR IMMUNITY TEST

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### According to Draft ETSI EN 301 489-1 V2.2.0:

#### 6.1 Performance criteria for continuous phenomena applied to transmitters and receivers

If no further details are given in the relevant part of EN 301 489 series [i.13] dealing with the particular type of radio equipment, the following general performance criteria for continuous phenomena shall apply.

During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

#### 6.2 Performance criteria for transient phenomena applied to transmitters and receivers

If no further details are given in the relevant part of EN 301 489 series [i.13] dealing with the particular type of radio equipment, the following general performance criteria for transient phenomena shall apply.

After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

### According to Draft EN 301 489-52 V1.1.0 (2016-11) Subclause 6.2:

#### 6.1 GSM and DCS Performance Criteria

##### 6.1.1 General

The equipment shall meet the performance criteria specified in this clause and clauses 6.1.1 to 6.1.4, as appropriate.

Portable equipment intended for use whilst powered by the main battery of a vehicle shall additionally fulfil the applicable requirements set out in ETSI EN 301 489-1 [1], clauses 7.1 and 7.2 for mobile equipment.

Portable or mobile equipment powered by the AC mains shall additionally fulfil the applicable requirements of ETSI EN 301 489-1 [1], clauses 7.1 and 7.2 for radio and ancillary equipment for fixed use.

The establishment and maintenance of a communications link, the assessment of RXQUAL, and the assessment of the audio breakthrough by monitoring the speech output signal level, are used as performance criteria to ensure that all primary functions of the transmitter and receiver are evaluated during the immunity tests. In addition, the test shall also be performed in idle mode to ensure the transmitter does not unintentionally operate.

The maintenance of a communications link shall be assessed using an indicator which may be part of the test system or the EUT.

If an equipment is of a specialized nature, such that the performance criteria described in the following clauses are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in the following clauses.

### 6.1.2 Performance criteria for Continuous phenomena applied to Transmitters (CT)

A communication link shall be established at the start of the test, and maintained during the test, see clauses 4.2.3 and 4.2.4.

At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained. In addition to confirming the above performance during a call, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.

### 6.1.4 Performance criteria for Continuous phenomena applied to Receivers (CR)

A communications link shall be established at the start of the test, see appropriate clauses 4.2 to 4.2.6.

During the test, the RXQUAL of the downlink shall not exceed the value of three, measured during each individual exposure in the test sequence.

At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained.

## 6.2.2 Performance criteria for continuous phenomena

### 6.2.2.1 General

A communication link shall be established at the start of the test, and maintained during the test, clauses 4.1 and 4.2. In the speech mode, the performance criteria shall be that the Up Link and Down Link speech output levels shall be at least 35 dB less than the recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (annex B). NOTE: When there is a high level of background audio noise present, the filter bandwidth can be reduced down to a minimum of 40 Hz. At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained. In addition to confirming the above performance in traffic mode, the test shall be performed in idle mode, and the transmitter shall not unintentionally operate.

### 6.2.2.2 UTRA

In the data transfer mode, the performance criteria can be one of the following:

- if the BER (as referred in ETSI TS 134 109 [4]) is used, it shall not exceed 0,001 during the test sequence;
- if the BLER (as referred in ETSI TS 134 109 [4]) is used, it shall not exceed 0,01 during the test sequence.

The BLER calculation shall be based on evaluating the CRC on each transport block.

### 6.2.2.3 E-UTRA

In the data transfer mode, the performance criteria shall be that the throughput shall be  $\geq 95$  % of the maximum throughput of the reference measurement channel as specified in annex C in ETSI TS 136 101 [9] with parameters specified in tables 7.3.1-1 and 7.3.1-2 in ETSI TS 136 101 [9] during the test sequence.

## 6.2.3 Performance criteria for Transient phenomena

A communications link shall be established at the start of the test, clauses 4.1 and 4.2.

At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication link.

At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained.

In addition to confirming the above performance in traffic mode, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.

## MONITORING FOR IMMUNITY TEST

For every operation mode, the monitoring performed over the samples under test is shown in the following table:

OPERATION MODE	CONTINUOUS PHENOMENA MONITORING	TRANSIENT PHENOMENA MONITORING
OM#01	N/A	N/A
OM#02 to OM#07	By means of a Spectrum analyser it was monitored that not occur any unintentional transmission during and after the test. Change of status are not allowed.	By means of a Spectrum analyser it was monitored that not occur any unintentional transmission during and after the test. Change of status are not allowed.
OM#08 to OM#13	By means of a Radiocommunicator Tester It was checked that the throughput parameter shall be >95% during and after the test.	By means of a Radiocommunicator Tester It was checked that the throughput parameter shall be >95% during and after the test.



## RADIATED EMISSION. ELECTROMAGNETIC FIELD MEASURE

### LIMITS:

Product standard:

Draft ETSI EN 301 489-1 V2.2.0 (2017-03);  
& Draft EN 301 489-52 V1.1.0 (2016-11)

Test standard:

EN 55032 (2015) / AC (2016)

### Limits for EN 55032 (2015) / AC (2016) Class B:

FREQUENCY RANGE (MHz)	MEASURED FIELD LIMIT TO 10 m (dB $\mu$ V/m) QUASI-PEAK MEASUREMENT
30 to 230	30
230 to 1000	37

FREQUENCY RANGE (MHz)	MEASURED FIELD LIMIT TO 3 m (dB $\mu$ V/m)	
	AVERAGE	PEAK
1000 to 3000	50	70
3000 to 6000	54	74

### TESTED SAMPLES:

S/01

### TESTED OPERATION MODES:

OM#01

### TEST RESULTS:

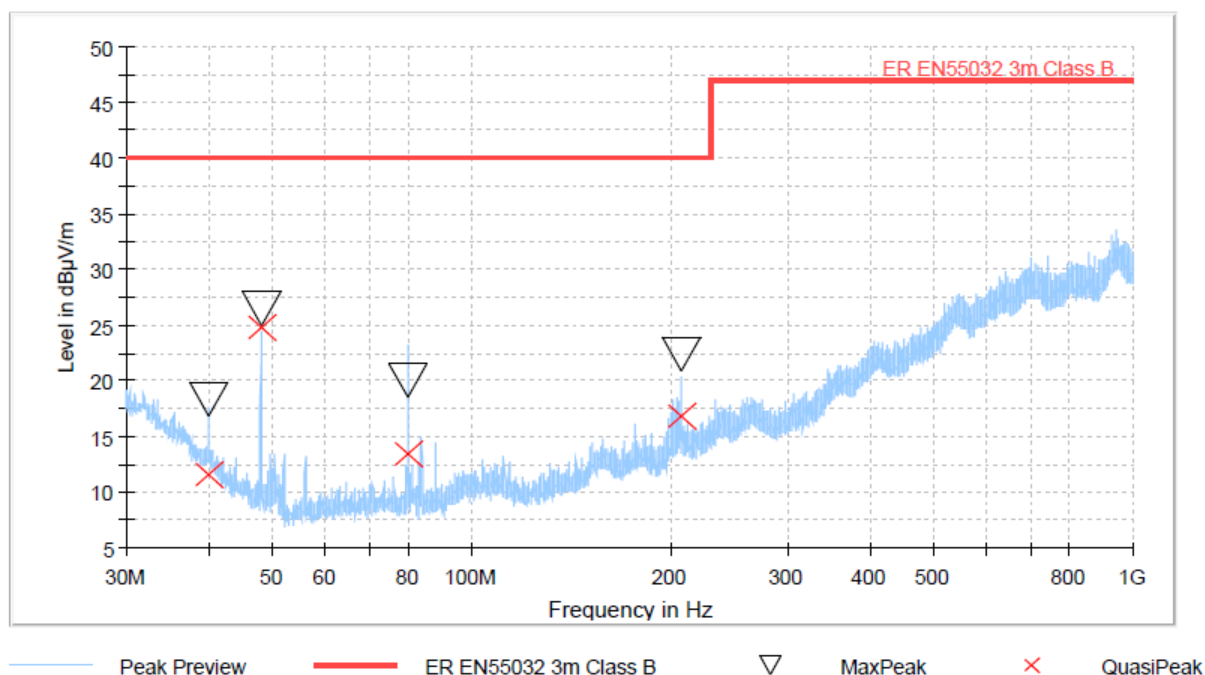
CRmmnn: CR, Radiated Condition; mm: Sample number;  
nn: Operation mode; RR: Measured range.

CRmmnnRR	DESCRIPTION	RESULT
CR0101LR	Range: 30 MHz - 1000 MHz	P
CR0101HR	Range: 1 - 6 GHz	P

## Radiated Emission: CR0101LR

Project: 55675REM.001  
Company: NORDIC SEMICONDUCTOR ASA  
Sample: S/01  
Operation mode: OM#01  
Description: EUT ON. Stand Alone basis. Power Supply: 3.8 VDC

## ER EN 55032 30-1000 MHz Class B



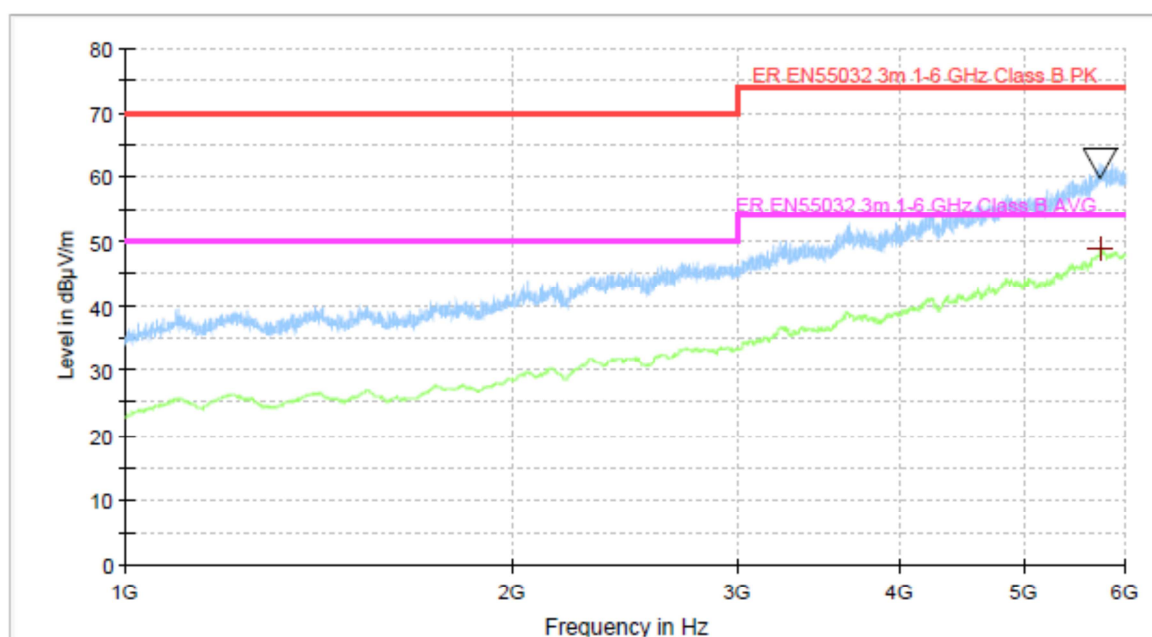
## Maximizations

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
39.980000	18.37	11.63	40.00	21.63	166.0	V	154.0
48.001000	26.40	24.82	40.00	13.60	100.0	V	134.0
80.043000	19.98	13.42	40.00	20.02	147.0	V	35.0
207.999000	22.46	16.77	40.00	17.54	259.0	V	29.0

## Radiated Emission: CR0101HR

Project: 55675REM.001  
Company: NORDIC SEMICONDUCTOR ASA  
Sample: S/01  
Operation mode: OM#01  
Description: EUT ON. Stand Alone basis. Power Supply: 3.8 VDC

### ER EN 55032 1-6 GHz Class B



### Maximizations

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
5744.780000	62.04	48.77	74.00	21.66	169.0	V	-137.0

## RADIATED RF ELECTROMAGNETIC FIELD IMMUNITY TEST

### LIMITS:

Product standard:

Draft ETSI EN 301 489-1 V2.2.0 (2017-03);  
Draft ETSI EN 301 489-19 V2.1.0 (2017-03)  
& Draft EN 301 489-52 V1.1.0 (2016-11)

Test standard:

EN 61000-4-3 (2006) / A1 (2008) / A2 (2010)

RANGE	FREQUENCY	MODULATION	STEP	LEVEL
A	80-1000MHz	AM 1 kHz Prof: 80%	LOG 1%	3 V/m
B	1000-6000MHz	AM 1 kHz Prof: 80%	LOG 1%	3 V/m

### TESTED SAMPLES:

S/01

### TESTED OPERATION MODES:

OM#02 to OM#13

### FAIL CRITERIA AND MONITORING:

A

### ZONES/COUPLING CABLES (CPL):

CPL	DESCRIPTION
1	EUT frontal
2	EUT rear side
3	EUT left side
4	EUT right side

### TEST RESULTS :

CPL	S/	OM#	RANGE	POL	COMMENTS	RESULT
1 2 3 4	01	02	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	03	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	04	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	05	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	06	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	07	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	08	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	09	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	10	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	11	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	12	A & B	H, V	OK, no fails detected.	P
1 2 3 4	01	13	A & B	H, V	OK, no fails detected.	P

## ELECTROSTATIC DISCHARGE IMMUNITY TEST

<b>LIMITS:</b>	Product standard:	Draft ETSI EN 301 489-1 V2.2.0 (2017-03); Draft ETSI EN 301 489-19 V2.1.0 (2017-03) & Draft EN 301 489-52 V1.1.0 (2016-11)
	Test standard:	EN 61000-4-2 (2009)

COUPLING	LEVEL
Direct contact discharge:	N/A
Indirect contact discharge:	±4kV
Air discharge:	N/A

<b>TESTED SAMPLES:</b>	S/01
<b>TESTED OPERATION MODES:</b>	OM#02 to OM#13
<b>MONITORING AND FAIL CRITERIA:</b>	B
<b>NUMBER OF DISCHARGES FOR POINT:</b>	10
<b>ZONES/COUPLING CABLES (CPL):</b>	

CPL	DESCRIPTION	COUPLING TYPE			
		ICH	ICV	DC	DA
1	EUT Frontal	X			
2	EUT right side	X			
3	EUT rear side	X			
4	EUT left side	X			

COUPLING RESUME : ICH (Indirect by contact on horizontal plane)  
ICV (Indirect by contact on vertical plane), DC (Direct by contact), DA (Direct by air)

<b>TEST RESULTS:</b>	
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CPL	S/	OM#	COMMENTS	RESULT
1 to 4	01	02	Ok, no fails detected.	P
1 to 4	01	03	Ok, no fails detected.	P
1 to 4	01	04	Ok, no fails detected.	P
1 to 4	01	05	Ok, no fails detected.	P
1 to 4	01	06	Ok, no fails detected.	P
1 to 4	01	07	Ok, no fails detected.	P
1 to 4	01	08	Ok, no fails detected.	P
1 to 4	01	09	Ok, no fails detected.	P
1 to 4	01	10	Ok, no fails detected.	P
1 to 4	01	11	Ok, no fails detected.	P
1 to 4	01	12	Ok, no fails detected.	P
1 to 4	01	13	Ok, no fails detected.	P

## Appendix B: Photographs

