

## MIMO OTA Test Report

Date of Report	27/10/2017	Client's Contact person:	Jose J. Machado
Number of pages:	10	Responsible Test engineer:	Pertti Mäkikyö
Testing laboratory:	Verkotan Oy Elektroniikkatie 17 90590 Oulu Finland	Client:	<b>NOXTAK CORP.</b> <b>2555 NW, 102 AV, UNIT 112.</b> <b>33172 Miami, Florida</b> <b>UNITED STATES</b>
Tested devices	LG G6 ZTE AXON		
Testing has been carried out in accordance with:	Customer Request, 3GPP TR 37.977 Technical Specification Group Radio Access Network; Universal Terrestrial Radio Access (UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRA); Verification of radiated multi-antenna reception performance of User Equipment (UE)		
Documentation:	The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory		
Test Results:	The test results relate only to devices specified in this document		
Date and signatures: For the contents:	27.10.2017		

Laboratory Manager

## 1. Summary

### 1.1 Test Details

Testing information:

Testing performed:	18 Oct 2017
Notes:	
Document name:	MIMO OTA Report Draft 25.10.2017.Docx
Temperature °C / Humidity RH%	22°±1° / 30%±10%
Measurement performed by:	Pertti Mäkikyrö

### 1.2 Measurement Uncertainty

Test Configuration	Expanded Uncertainty
MIMO OTA Free space	1.85 dB

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## 2. Test Equipment

Main used test equipment is listed below. For full equipment list and calibration intervals, please contact the testing laboratory.

Type of Equipment	Type	Manufacturer
Radio Communication Tester	MT8820C	Anritsu
Fading Channel Emulator	Propsim F32	Anite
Diagonal Dual Polarized Horn Antennas	3164-04	ETS-Lindgren
Positioning Controller	2090	EMCO
Anechoic Chamber	3	ETS-Lindgren
Calibration Reference Sleeve Dipole	SD2140	Satimo
Calibration Reference Magnetic Dipole	MD2140	Satimo
Calibration Reference Sleeve Dipole	SD2050	Satimo
Calibration Reference Magnetic Dipole	MD2050	Satimo
Calibration Reference Sleeve Dipole	SD880	Satimo
Calibration Reference Magnetic Dipole	MD880	Satimo
Calibration Reference Sleeve Dipole	SD740	Satimo
Calibration Reference Magnetic Dipole	MD720	Satimo

### 3. MIMO OTA Measurements

Testing was performed according to 3GPP TR 37.977 as far as applicable, utilizing customer specified transmission mode, scheduling and channel model parameters. MIMO OTA throughput tests were performed, using sensitivity (RS-EPRE dBm/15kHz) versus throughput methodology.

Input phase difference in the channel emulator was calibrated before each measurement run using the channel emulator LTE input phase functionality.

EUT was rotated 360 degrees with 30 degree steps in azimuth.

Performed test cases are defined in the table below:

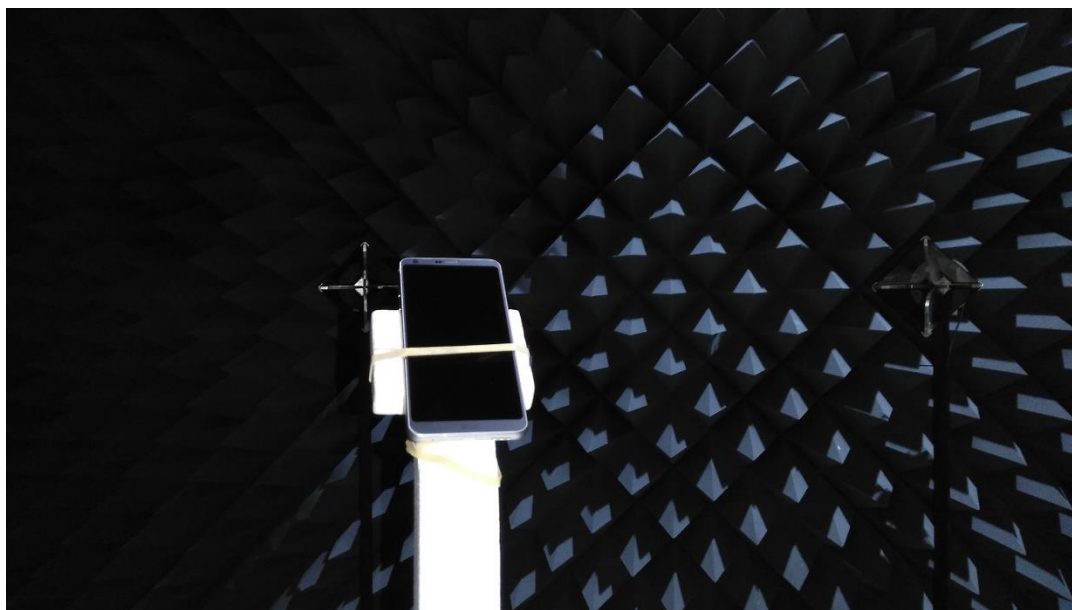
Test Case	NTx	NRx	Channel	Band	Bandwidth	Orientation	TM	MCS
1.1	2	2	Umi 30kmph	1	10	Portrait	TM3	TBS 17 (sf 0) TBS 18 (sf 1-4, 6-9)
1.2	2	2	Umi 30kmph	4	10	Portrait	TM3	TBS 17 (sf 0) TBS 18 (sf 1-4, 6-9)

#### 3.1 Measurements with static scheduling (Test cases 1.1 and 1.2)

Average of sensitivity at throughput outage points 95%, 90% and 70% was reported. The reported sensitivity indicates the required Signal to noise ratio (RS-EPRE dBm / 15kHz) to reach the outage point throughputs of 95%, 90% and 70% of the maximum theoretical throughput.

Sample size of 20000 subframes per stream was used when determining the outage point(s) sensitivity level. Outage point sensitivity was linearly interpolated from measurements performed with 0.5dB step size around the outage point. Parts of the sensitivity curve not corresponding outage points were measured with a lower subframe count.

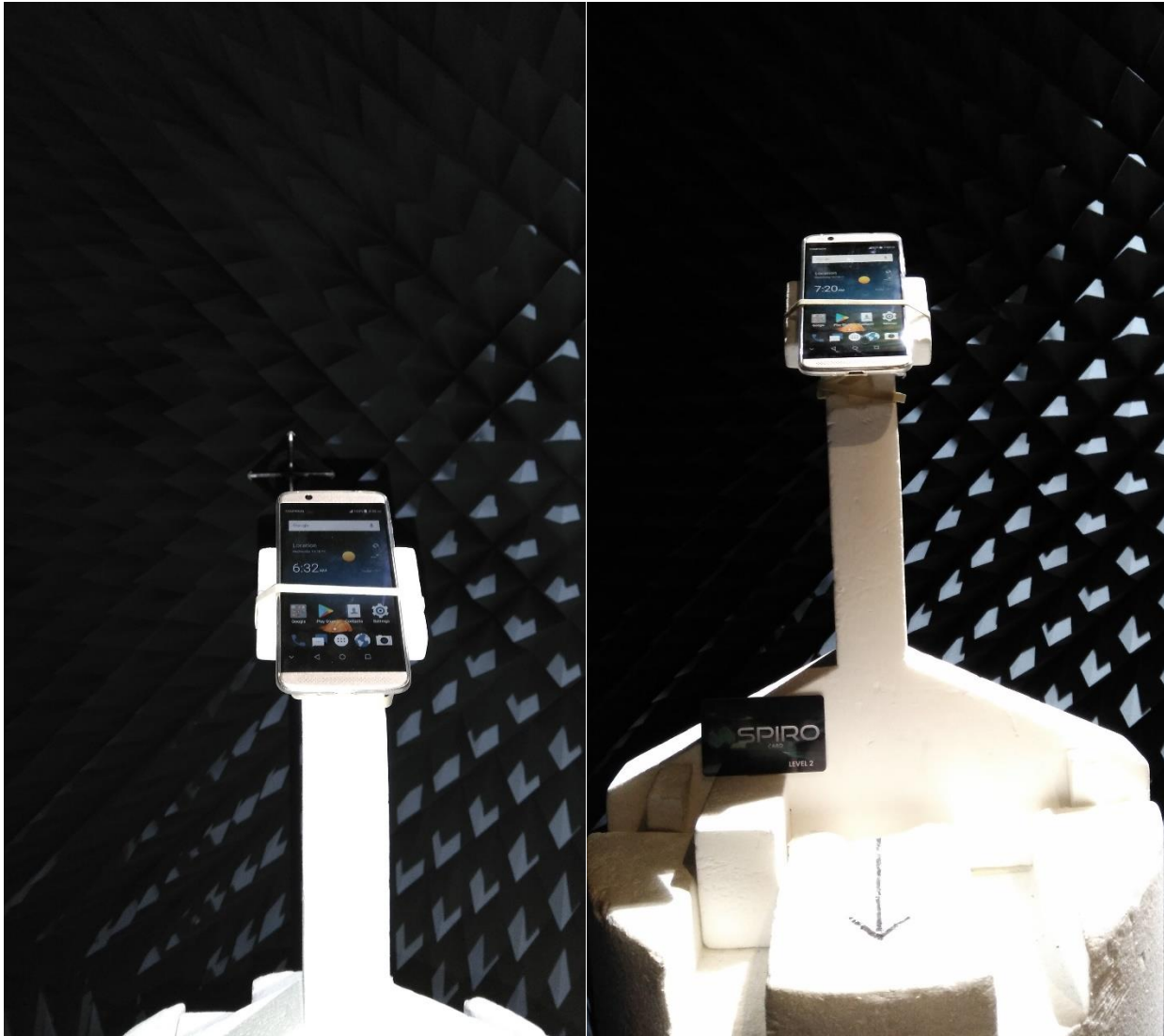
#### 3.2 Test setup for Portrait 45-degree Free space position



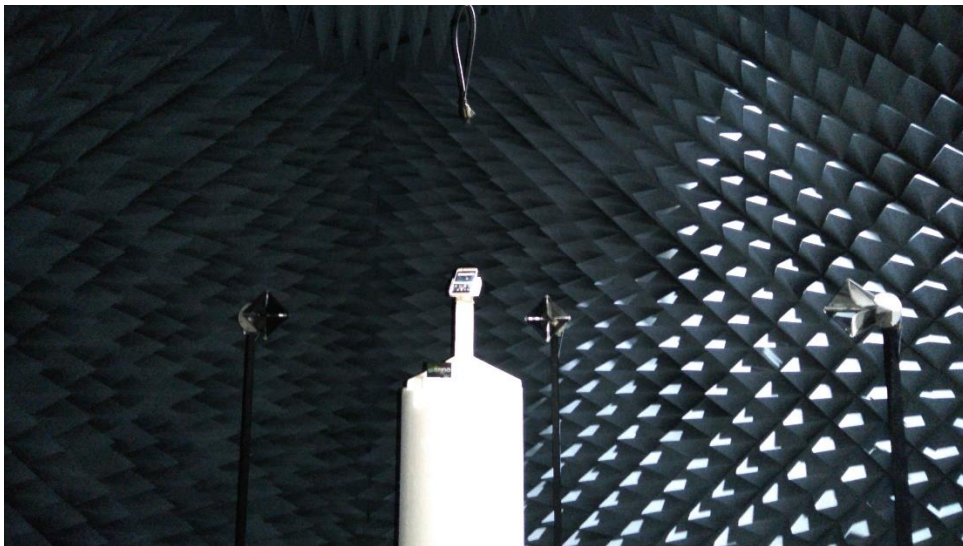
LG G6



LG G6



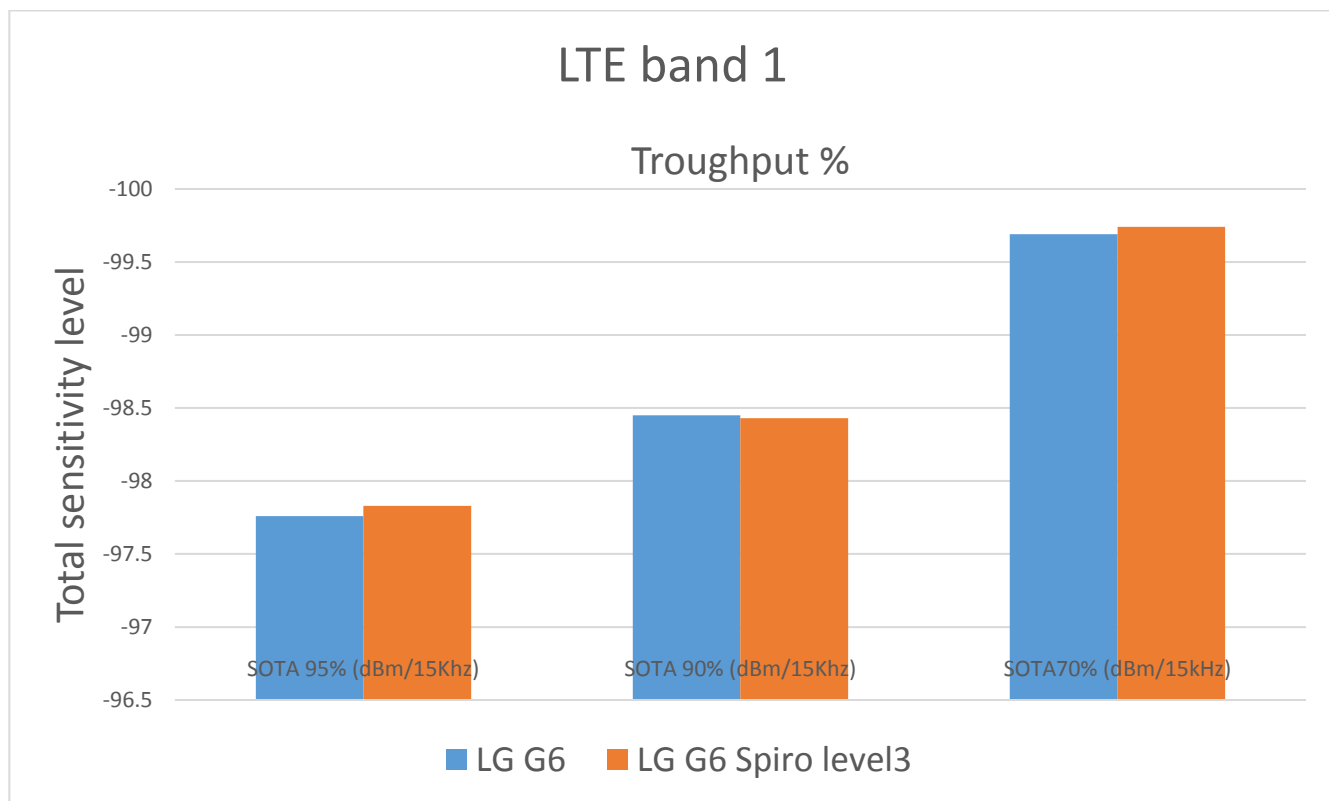
ZTE AXON



#### 4. TEST RESULTS MIMO OTA

##### 4.1 Average RS-EPRE Results UMI 30km/h, 2x2, Band 4, Portrait, TM3 (Test Case 1.1)

UMI 30kmh, 2x2, Band 1, 10 MHz, Fixed MCS, TM3			
DUT	Average sensitivity @95% Throughput	Average sensitivity @90% Throughput	Average SIR @70% Throughput
LG G6	-97.76dBm	-98.45dBm	-99.69dBm
LG G6 with Spiro level 3	-97.83dBm	-98.43dBm	-99.74dBm

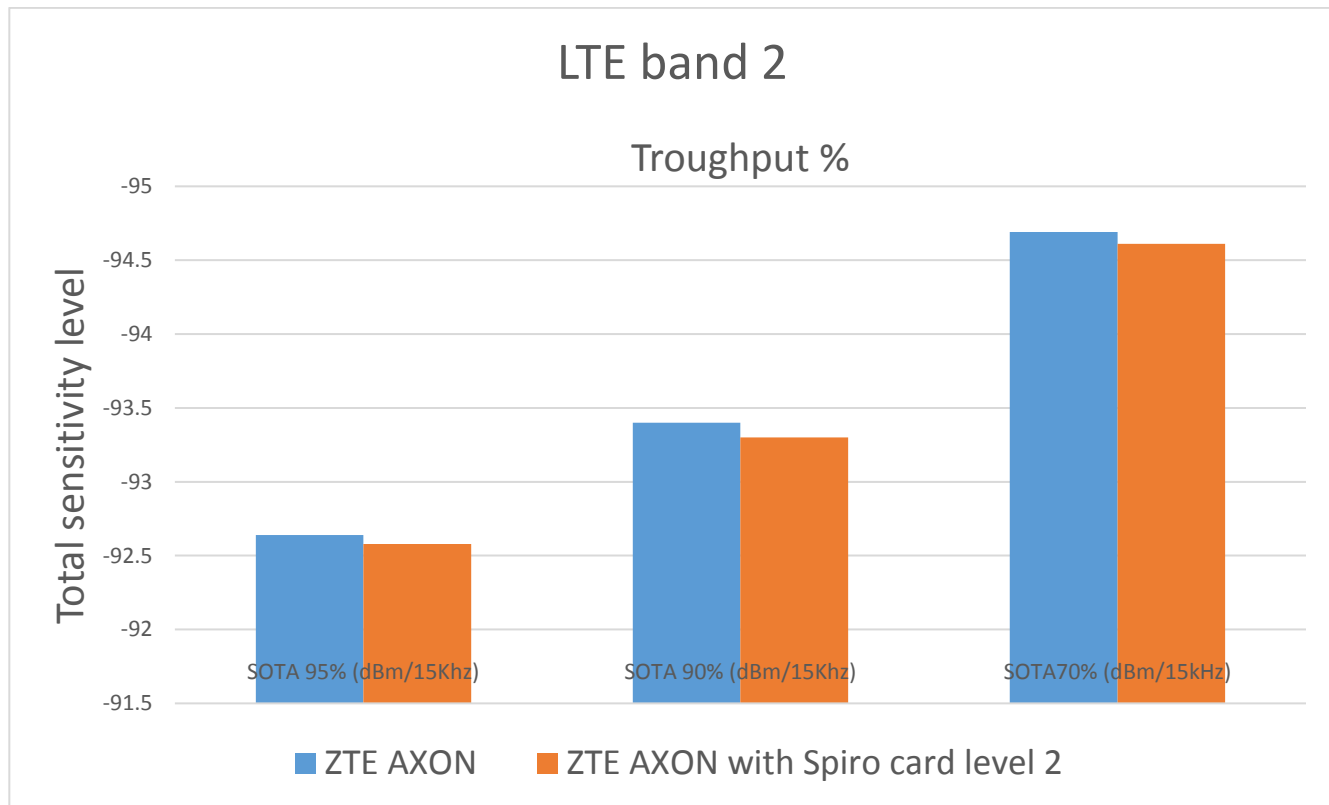


Throughput vs azimuth angle Results for LG G6			
Azimuth Angle	sensitivity (-dBm) @ 95% Throughput	sensitivity (-dBm) @ 90% Throughput	sensitivity (-dBm) @ 70% Throughput
0°	-98.74	-99.42	-100.74
30°	-99.16	-99.79	-101.14
60°	-99.24	-99.91	-101.11
90°	-98.75	-99.43	-100.5
120°	-99.31	-100.02	-101.17
150°	-99.32	-99.89	-101.26
180°	-98.92	-99.47	-100.79
210°	-97.37	-98.2	-99.34
240°	-96.27	-97.04	-98.14
270°	-95.09	-95.84	-97.18
300°	-96.4	-96.98	-98.33
330°	-97.4	-98.07	-99.31
Target fails	N/A	N/A	N/A

Throughput vs azimuth angle Results for LG G6 with Spiro level 3			
Azimuth Angle	sensitivity (-dBm) @ 95% Throughput	sensitivity (-dBm) @ 90% Throughput	sensitivity (-dBm) @ 70% Throughput
0°	-98.71	-99.4	-100.68
30°	-99.21	-99.82	-101.19
60°	-99.39	-99.99	-101.24
90°	-98.79	-99.37	-100.52
120°	-99.44	-99.99	-101.43
150°	-99.29	-99.88	-101.29
180°	-98.92	-99.63	-100.77
210°	-97.58	-98.35	-99.45
240°	-96.36	-96.87	-98.33
270°	-95.22	-95.73	-97.17
300°	-96.33	-96.97	-98.18
330°	-97.47	-98.04	-99.48
Target fails	N/A	N/A	N/A

#### 4.2 Average RS-EPRE Results UMI 30km/h, 2x2, Band 2, Portrait, TM3 (Test Case 1.2)

UMI 30kmh, 2x2, Band 4, 10 MHz, Fixed MCS, TM3			
DUT	Average sensitivity @95% Throughput	Average sensitivity @90% Throughput	Average sensitivity @70% Throughput
ZTE AXON	-92.64dBm	-93.4dBm	-94.69dBm
ZTE AXON with Spiro level 2	-92.58dBm	-93.3dBm	-94.61dBm



### Sensitivity vs Azimuth Results for ZTE AXON

Azimuth Angle	sensitivity (-dBm) @ 95% Throughput	sensitivity (-dBm) @ 90% Throughput	sensitivity (-dBm) @ 70% Throughput
0°	-91.36	-93.37	-94.84
30°	-92.99	-93.85	-95.22
60°	-91.98	-92.60	-93.82
90°	-92.22	-92.67	-93.97
120°	-91.26	-92.00	-93.21
150°	-93.31	-93.84	-95.12
180°	-93.61	-94.39	-95.70
210°	-93.92	-94.52	-95.80
240°	-93.01	-93.63	-94.98
270°	-93.59	-94.10	-95.17
300°	-92.50	-93.18	-94.39
330°	-92.91	-93.44	-94.81
Target fails	0	0	0

### Sensitivity vs Azimuth Results for ZTE AXON with Spiro level 2

Azimuth Angle	sensitivity (-dBm) @ 95% Throughput	sensitivity (-dBm) @ 90% Throughput	sensitivity (-dBm) @ 70% Throughput
0°	-91.35	-93.31	-94.79
30°	-93.04	-93.56	-95.00
60°	-91.90	-92.44	-93.64
90°	-91.98	-92.62	-93.85
120°	-91.31	-91.79	-93.04
150°	-92.99	-93.65	-94.99
180°	-93.39	-94.10	-95.38
210°	-93.59	-94.28	-95.85
240°	-93.14	-93.62	-94.92
270°	-93.51	-94.11	-95.41
300°	-92.62	-93.29	-94.46
330°	-92.99	-93.56	-94.86
Target fails	0	0	0

#### 4.2.1 Additional information

