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1. INTRODUCTION / SPECIFICATION STRUCTURE

The present document constitutes one behalf of the antenna specification for any Nokia program. For any Nokia program the antenna specification will consist of a generic part and a project specific part. The present document is the project specific part of the specification.

The generic document has document number DXX13337-EN. It is only updated via the Nokia Global Antenna Technology Steering forum and is always aligned across Nokia. The document is distributed to the supplier by Nokia sourcing management after updates.

The project specific part of the antenna specification always takes precedence over the generic specification. This means that if a delta to one of the generic sections is stated in the project specific specification then that delta takes precedence.

Updates to the generic specification are delivered to one central contact person at the antenna supplier. The supplier is responsible for ensuring that the latest version of the generic antenna specification is used by all projects. Whenever a new version of the generic antenna specification is released all running projects, which do not yet have parts approved for mass production, must switch to that version of the generic antenna specification within two weeks, regardless if the project started with an older version of the generic specification. If changing to the latest version of the Generic Specification will result in increased part price, lower capacity, or worse reliability the supplier must escalate this to Nokia Antenna SLM before implementing the requirements in the new release. Projects that have parts approved for mass production at the time of the release can change to the new version if Nokia approves. For all projects the control plan must state which version of the generic antenna specification is being followed. Unless specific instructions are given, running projects do not need to change to a new version of the project specific template when a new version is released.

This document contains the functional specification, test specification, and project specific requirements for all antennas listed in the project specific part of the specification. As this document is used both internal and external specification, not all antenna modules will be relevant for all suppliers. The supplier should work on the modules agreed with Nokia in the project. As the specification is both for internal and external use, there will be a number of the requirements that the supplier has no possibility of influencing if he has not been assigned with design responsibility.

Notice that this document is valid as specification for both 1st source suppliers (lead suppliers) and non-1st source suppliers (copy suppliers). Lead suppliers must start reading this document from section 2, whereas copy suppliers must start reading the document from appendix 9.

The document is structured as follows:

Section 2 contains the preconditions for the cooperation between Nokia and the antenna/JRD supplier.

Section 3 contains the definition of task split between Nokia and antenna supplier along with a description of the phone.

Section 4 contains the conducted maximum power of all protocols available in the phone.

Section 5 contains the antenna specification (RF, environmental, mech., quality).

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2. PRECONDITIONS

The generic part of this section is available in section 2 of the Generic Antenna Specification H015061622-EN.

2.1 Deltas to Section 2 in Generic Antenna Specification

N/A

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3. PHONE DESCRIPTION AND TASK RESPONSIBILITY SPLIT

The generic part of this section is available in section 3 of the Generic Antenna Specification H015061622-EN.

3.1 Deltas to section 3 in Generic Antenna Specification

In Table 1 the mechanical modes of the phone are described. These mode definitions will be used in the rest of the document.

In Table 2 the antenna assemblies covered The phone is a mono-block phone with 2 different antenna assemblies covering Main /Diversity. The antennas are placed at the bottom, top and left top corner of the D cover.

by the document are listed.

Table 2 also defines the split of responsibility between HMD and the supplier for all antennas in the phone.

Mode	Description	Korea variant	HAC mode (select also standard version)	Body SAR mode	Head SAR mode, Single Tx slot	Head SAR mode, Multiple Tx slots
Primary mode	Mono-block	Yes ☐	2006 ☐ 2007 ☐	☒	☒	☒
Secondary mode		No ☒				

Table 1 Definition of mechanical modes and SAR specifics of the phone.

Assy. name	NOKIA code	Assy. drawing number	Protocols included in assy.	MOSS classes of assy.	Responsibility of antenna supplier	Responsibility of HMD	Packaging
Main Antenna			GSM 850/900/1800/1900 WCDMA: I, II, IV, V, VIII LTE FDD B1/B2/B3/B4/B5/B7/B8/B28 LTE TDD B40	☐ Class I ☒ Class II ☐ Class III	☐ Design ☒ Production ☐ Couplers	☒ Design ☐ Production ☒ Couplers	☐ ESD Tray ☐ Tape and Reel ☒ N/A
GPS/WLAN Antenna			N/A	☐ Class I ☐ Class II ☐ Class III	☐ Design ☐ Production ☐ Couplers	☐ Design ☐ Production ☐ Couplers	☐ ESD Tray ☐ Tape and Reel ☐ N/A
Diversity			WCDMA: I, II, IV, V, VIII LTE FDD B1/B2/B3/B4/B5/B7/B8/B28 LTE TDD B40	☐ Class I ☒ Class II ☐ Class III	☐ Design ☒ Production ☒ Couplers	☒ Design ☐ Production ☐ Coupler	☐ ESD Tray ☐ Tape and Reel ☒ N/A

Table 2 List of assemblies covered by the document.

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Mode	Test Position	Test with these Hand Phantoms
Primary mode	Talk position + hand	☐ IXB-090R ☐ CTIA fold hand ☒ CTIA monoblock hand ☐ CTIA PDA hand ☐ Custom hand
Secondary mode	Talk position + hand	☐ IXB-090R ☐ CTIA fold hand ☐ CTIA monoblock hand ☐ CTIA PDA hand ☐ Custom hand
Primary mode	Browse mode	☐ IXB-090R ☐ CTIA narrow data hand ☐ CTIA PDA hand ☐ Custom hand
Secondary mode	Browse mode	☐ IXB-090R ☐ CTIA narrow data hand ☐ CTIA PDA hand ☐ Custom hand

Table 3: Hand Phantoms to be used for talk position + hand and browse mode testing.

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3.2 Further details on supplier responsibilities

N/A

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4. POWER TARGET ALIGNMENT

The generic part of this section is available in section 4 of the Generic Antenna Specification H015061622-EN.

4.1 Deltas to section 4 in Generic Antenna Specification

In Table 4, Table 5, 6, 7, 8 and 9 the target power alignment is given for each band and protocol in the phone.

Protocol	Target alignment (dBm) – center channel										
	8-PSK					GMSK					
	Power class	Power level	1 Tx	2 Tx	3 Tx	Power class	Power level	1 Tx	2 Tx	3 Tx	4Tx
GSM850 - Primary mode	NA	NA	NA	NA	NA	4	5	33.0	30.0	28.8	27.0
EGSM900 - Primary mode	NA	NA	NA	NA	NA	4	5	33.0	30.0	28.8	27.0
DCS1800 - Primary mode	NA	NA	NA	NA	NA	1	0	30.0	27.0	25.8	24.0
PCS1900 – Primary mode	NA	NA	NA	NA	NA	1	0	30.0	27.0	25.8	24.0
GSM850 - Secondary mode	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EGSM900 - Secondary mode	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DCS1800 - Secondary mode	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCS1900 – Primary mode	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4: Target power alignment for GSM. Refer to Table 1 for definition of the modes of the phone.

Protocol	Target alignment (dBm) – center channel	
	Power class	Max-power limitation
WCDMA I - Primary mode	3	24
WCDMA II - Primary mode	3	24
WCDMA IV - Primary mode	3	24
WCDMA V - Primary mode	3	24
WCDMA VIII - Primary mode	3	24

Table 5: Target power alignment for WCDMA. Refer to Table 1 for definition of the modes of the phone.

Protocol	Target alignment (dBm) – center channel	
	Power class	Max-power limitation
TD-SCDMA34 - Primary mode	NA	NA
TD-SCDMA39 - Primary mode	NA	NA
TD-SCDMA34 - Secondary mode	NA	NA
TD-SCDMA39 - Secondary mode	NA	NA

Table 6: Target power alignment for TD-SCDMA. Refer to Table 1 for definition of the modes of the phone.

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Protocol	Target alignment (dBm) – center channel	
	Power class	Max-power limitation
LTE 1 - Primary mode	3	23
LTE 2 - Primary mode	3	23
LTE 3 - Primary mode	3	23
LTE 4 - Primary mode	3	23
LTE 5 - Primary mode	3	23
LTE 7 - Primary mode	3	22.5
LTE 8- Primary mode	3	23
LTE 20 – Primary mode	NA	NA
LTE 28 – Primary mode	3	23

Table 7: Target power alignment for FDD LTE. Refer to Table 1 for definition of the modes of the phone.

Protocol	Target alignment (dBm) – center channel	
	Power class	Max-power limitation
LTE 38 - Primary mode	N/A	N/A
LTE 39 - Primary mode	N/A	N/A
LTE 40 - Primary mode	3	22.5
LTE 41 - Primary mode	N/A	N/A

Table 8: Target power alignment for TDD LTE. Refer to Table 1 for definition of the modes of the phone.

Protocol	Target Power (dBm) – center channel	
	Power class	Max-power
GPS	N/A	N/A
BT	1	7
WLAN 2.4GHz	N/A	N/A

Table 9: Target power alignment for other protocols.

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5. ANTENNA FUNCTIONAL SPECIFICATION

The generic part of this section is available in section 5 of the Generic Antenna Specification H015061622-EN.

5.1 Deltas to section 5.1 Generic Antenna Specification

The electrical requirements to cellular antennas are listed in Table 10, 11, 12, 13 and 14.

Item	Requirement + platform	Parameter	GSM850	EGSM900	DCS1800	PCS 1900	Unit
A	NA	Tx frequency range	824-849	880-915	1710-1785	1850-1910	MHz
		Rx frequency range	869-894	925-960	1805-1880	1930-1990	MHz
		Nominal impedance	50	50	50	50	Ohm
		Passive performance					
B	Minimum acceptable performance of Cabled Golden Phone	S11 (Tx/Rx) - Primary Mode, FS, TP, TP+hand	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	dB
		S11(Tx/Rx) - Secondary mode, FS, TP, TP+hand	NA	NA	NA	NA	dB
		Isolation – SEE Table	-	-	-	-	-
		OTA performance - PRIMARY MODE					
C	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high) /Avg.	≥27/27	≥27/27	≥23/25	≥23/25	dBm
		TRP TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high) /Avg.	≥16.5/18	≥16.5/18	≥17/19	≥17/19	dBm
		TRP Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high) /Avg.	≤-101.5/-102.5	≤-101.5/-102.5	≤-103/-104	≤-103/-104	dBm
		TIS TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high) /Avg.	≤-92.5/-94	≤-92.5/-94	≤-95/-97	≤-95/-97	dBm
		TIS Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		OTA performance - SECONDARY MODE					
D	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TRP TP (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TRP Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS TP (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		Production Variation Requirements – PRIMARY MODE					
E	Minimum acceptable performance of Limit Antenna in Active-/ Cabled Reference Phone	Maximum TRP/TIS-FS degradation relative to minimum spec (Item C)	1.0	1.0	1.0	1.0	dB
		Maximum TRP/TIS-FS degradation relative to Active Golden Phone	1.5	1.5	1.5	1.5	dB
		Maximum FS return-loss degradation relative to minimum spec (Item B)	0.0	0.0	0.0	0.0	dB
		Maximum TRP-FS increase relative to Active Golden Phone	0.5	0.5	0.5	0.5	dB
		Maximum allowable frequency limits relative to Cabled Golden Phone	±7	±7	±15	±15	MHz
		Product Validation Requirements – PRIMARY MODE					
F	Build antenna subjected to product validation tests in build Phone	Maximum band-average TRP/TIS-FS degradation to minimum spec (Item C) over 15 phones.	0.5	0.5	0.5	0.5	dB
		Maximum band-average TRP/TIS-FS degradation from before test to after test over 15 phones	1	1	1	1	dB
		Maximum return-loss degradation to minimum spec (Item B) over 15 phones	0	0	0	0	dB
		Power rating	2.0	2.0	2.0	2.0	W

Table 10: Electrical requirements for the antenna in the GSM bands. Refer to Table 1 for definition of the modes of the phone.

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Item	Requirement + platform	Parameter	WCDMA band I	WCDMA band II	WCDMA band IV	WCDMA band V	WCDMA band VIII	Unit
A	NA	Tx frequency range	1920-1980	1850-1910	1710-1755	824-849	880-915	MHz
		Rx frequency range	2110-2170	1930-1990	2110-2155	869-894	925-960	MHz
		Nominal impedance	50	50	50	50	50	Ohm
		Passive performance						
B	Minimum acceptable performance of Cabled Golden Phone	S11 (Tx/Rx) - Primary Mode, FS, TP, TP+hand	NA	NA	NA	NA	NA	dB
		S11(Tx/Rx) - Secondary mode, FS, TP, TP+hand	NA	NA	NA	NA	NA	dB
		Isolation – SEE Table	NA	NA	NA	NA	NA	dB
		OTA performance - PRIMARY MODE						
C	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		TRP TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		TRP Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		TIS TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		TIS Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	dBm
		OTA performance - SECONDARY MODE						
D	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		TRP TP (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		TRP Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		TIS TP (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		TIS Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	NA	dBm
		Production Variation Requirements – PRIMARY MODE						
E	Minimum acceptable performance of Limit Antenna in Active-/Cabled Reference Phone	Maximum TRP/TIS-FS degradation relative to minimum spec (Item C)	NA	NA	NA	NA	NA	dB
		Maximum TRP/TIS-FS degradation relative to Active Golden Phone	NA	NA	NA	NA	NA	dB
		Maximum FS return-loss degradation relative to minimum spec (Item B)	NA	NA	NA	NA	NA	dB
		Maximum TRP-FS increase relative to Active Golden Phone	NA	NA	NA	NA	NA	dB
		Maximum allowable frequency limits relative to Cabled Golden Phone	NA	NA	NA	NA	NA	MHz
		Product Validation Requirements – PRIMARY MODE						
F	Build antenna subjected to product validation tests in build Phone	Maximum band-average TRP/TIS-FS degradation to minimum spec (Item C) over 15 phones.	NA	NA	NA	NA	NA	dB
		Maximum band-average TRP/TIS-FS degradation from before test to after test over 15 phones	NA	NA	NA	NA	NA	dB
		Maximum return-loss degradation to minimum spec (Item B) over 15 phones	NA	NA	NA	NA	NA	dB
		Power rating	NA	NA	NA	NA	NA	W

Table 11: Electrical requirements to the antenna in the WCDMA/TD-SCDMA band(s). Refer to Table 1 for definition of the modes of the phone.

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Item	Requirement + platform	Parameter	LTE1	LTE2	LTE3	LTE4	LTE5	LTE7	LTE8	LTE20	LTE28	Unit	
A	NA	Tx frequency range	1920-1980	1950-1910	1710-1785	1710-1755	824-849	2620-2690	880-915	NA	703-748	MHz	
		Rx frequency range	2110-2170	1930-1990	1805-1880	2110-2155	869-894	2620-2690	925-960	NA	758-803	MHz	
		Nominal impedance	50	50	50	50	50	50	50	50	NA	50	Ohm
		Passive performance											
B	Minimum acceptable performance of Cabled Reference Phone	S11 (Tx/Rx) - Primary Mode, FS, TP, TP+hand	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	≤ -6 / -4	NA	≤ -6 / -4	dB
		S11(Tx/Rx) - Secondary mode, FS, TP, TP+hand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dB
		Isolation – SEE Table	-		-		-		-		-		-
		OTA performance - PRIMARY MODE											
C	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high) /Avg.	≥17/18	≥17/18	≥18/19	≥17/18	≥16//18	≥15//17	NA	NA	≥15//17		dBm
		TRP TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high) /Avg.	≥12/13	≥12/13	≥11.5/13.5	≥12/13	≥11/13	≥8.5/10	≥11/13	NA	≥8/10		dBm
		TRP Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high) /Avg.	≤-91/-93	≤-91/-93	≤-93/-95	≤-91/-93	≤-94/-95	≤-89/-91	≤-94/-95	NA	≤-90/-92		dBm
		TIS TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high) /Avg.	≤-86/-88	≤-86/-88	≤87/-89	≤-86/-88	≤-88/-89.5	≤-83/-85	≤-88/-89.5	NA	≤-83/-85		dBm
		TIS Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		OTA performance - SECONDARY MODE											
D	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TRP TP (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TRP Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TIS TP (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		TIS Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	dBm
		Production Variation Requirements – PRIMARY MODE											
E	Minimum acceptable performance of Limit Antenna in Active-/Cabled Reference Phone	Maximum TRP/TIS-FS degradation relative to minimum spec (Item C)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	NA	1.0	dB
		Maximum TRP/TIS-FS degradation relative to Active Golden Phone	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	NA	1.5	dB
		Maximum FS return-loss degradation relative to minimum spec (Item B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0.0	dB
		Maximum TRP-FS increase relative to Active Golden Phone	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	NA	0.5	dB
		Maximum allowable frequency limits relative to Cabled Golden Phone	±15	±15	±15	±15	±15	±15	±7	±7	NA	±7	MHz
		Product Validation Requirements – PRIMARY MODE											
F	Build antenna subjected to product validation tests in build Phone	Maximum band-average TRP/TIS-FS degradation to minimum spec (Item C) over 15 phones.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	NA	0.5	dB
		Maximum band-average TRP/TIS-FS degradation from before test to after test over 15 phones	1	1	1	1	1	1	1	1	NA	1	dB
		Maximum return-loss degradation to minimum spec (Item B) over 15 phones	0	0	0	0	0	0	0	0	NA	0	dB
		Power rating	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	NA	2.0	W

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Table 12: Electrical requirements to the antenna in the FDD_LTE band(s). Refer to Table 1 for definition of the modes of the phone.

Item	Requirement + platform	Parameter	LTE38	LTE39	LTE40	LTE41	Unit
A	NA	Frequency range	NA	NA	2300-2400	NA	MHz
							MHz
		Nominal impedance	NA	NA	50	NA	Ohm
		Passive performance					
B	Minimum acceptable performance of Cabled Golden Phone	S11 (Tx/Rx) - Primary Mode, FS, TP, TP+hand	NA	NA	≤ -6 / -4	NA	dB
		S11(Tx/Rx) - Secondary mode, FS, TP, TP+hand	NA	NA	NA	NA	dB
		Isolation – SEE Table	-	-	-	-	-
		OTA performance - PRIMARY MODE					
C	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TRP TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TRP Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TIS TP (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		TIS Browse Mode (worst channel – low, mid, high) /Avg.	NA	NA	NA	NA	dBm
		OTA performance - SECONDARY MODE					
D	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TRP TP (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TRP TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TRP Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS FS (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS TP (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS TP + Hand (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		TIS Browse Mode (worst channel – low, mid, high)	NA	NA	NA	NA	dBm
		Production Variation Requirements – PRIMARY MODE					
E	Minimum acceptable performance of Limit Antenna in Active-/Cabled Reference Phone	Maximum TRP/TIS-FS degradation relative to minimum spec (Item C)	NA	NA	1.0	NA	dB
		Maximum TRP/TIS-FS degradation relative to Active Golden Phone	NA	NA	1.5	NA	dB
		Maximum FS return-loss degradation relative to minimum spec (Item B)	NA	NA	0.0	NA	dB
		Maximum TRP-FS increase relative to Active Golden Phone	NA	NA	0.5	NA	dB
		Maximum allowable frequency limits relative to Cabled Golden Phone	NA	NA	±15	NA	MHz
		Product Validation Requirements – PRIMARY MODE					
F	Build antenna subjected to product validation tests in build Phone	Maximum band-average TRP/TIS-FS degradation to minimum spec (Item C) over 15 phones.	NA	NA	0.5	NA	dB
		Maximum band-average TRP/TIS-FS degradation from before test to after test over 15 phones	NA	NA	1	NA	dB
		Maximum return-loss degradation to minimum spec (Item B) over 15 phones	NA	NA	0	NA	dB
		Power rating	NA	NA	2.0	NA	W

Table 13: Electrical requirements to the antenna in the TDD_LTE band(s). Refer to Table 1 for definition of the modes of the phone.

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5.2 Deltas to section 5.2 in Generic Antenna Specification

The electrical requirements for the antennas covering the non-cellular bands are stated in 14.

Item	Requirement + platform	Parameter	FM-Rx	GPS	BT	WLAN	Unit
A	NA	Performance benchmark	N/A	N/A	N/A	N/A	-
		Frequency range	88-108	N/A	2400-2480	N/A	MHz
		Nominal impedance	50	N/A	50	N/A	Ohm
		Passive performance					
B	Minimum acceptable performance of Cabled Golden Phone	S11 - Primary Mode, FS, TP, TP+hand	N/A	N/A	≤-6	N/A	dB
		S11 - Secondary mode, FS, TP, TP+hand	N/A	N/A	N/A	N/A	dB
		Isolation – SEE Table	-	-	-	-	-
		OTA performance - PRIMARY MODE					
C	Minimum acceptable performance of Active Golden Phone	TRP FS (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TRP TP (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TRP TP + Hand (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TRP Browse Mode (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TIS FS (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TIS TP (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TIS TP + Hand (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TIS Browse Mode (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
D	Minimum acceptable performance of Active Golden Phone	OTA performance - SECONDARY MODE					
		TRP FS (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TRP TP (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TRP TP + Hand (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TRP Browse Mode (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TIS FS (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TIS TP (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
		TIS TP + Hand (worst channel – low, mid, high)	N/A	N/A	N/A	N/A	dBref / dBm *
E	Minimum acceptable performance of Limit Antenna in Active-/Cabled Reference Phone	Production Variation Requirements – PRIMARY MODE					
		Maximum TRP/TIS-FS degradation relative to minimum spec (Item C)	N/A	N/A	N/A	N/A	dB
		Maximum TRP/TIS-FS degradation relative to Active Golden Phone	N/A	N/A	N/A	N/A	dB
		Maximum FS return-loss degradation relative to minimum spec (Item B)	N/A	N/A	N/A	N/A	dB
		Maximum TRP-FS increase relative to Active Golden Phone	-	-	N/A	N/A	dB
		Maximum allowable limits relative to Cabled Golden Phone	N/A	N/A	N/A	N/A	MHz
F	Build antenna subjected to product validation tests in build Phone	Product Validation Requirements – PRIMARY MODE					
		Maximum band-average TRP/TIS-FS degradation to minimum spec (Item C) over 15 phones.	N/A	N/A	N/A	N/A	dB
		Maximum band-average TRP/TIS-FS degradation from before test to after test over 15 phones	N/A	N/A	N/A	N/A	dB
		Maximum return-loss degradation to minimum spec (Item B) over 15 phones	N/A	N/A	N/A	N/A	dB
		Power rating	N/A	N/A	N/A	N/A	W

Table 14: Electrical requirements for the antennas covering the non-cellular bands. *dBref / dBm: For all phones with a reference phone defined in the first row of the table, the requirement is dBref. For all phones without a reference phone defined, the requirement is dBm. Refer to Table 1 for definition of the modes of the phone.

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A \ B	GSM	WCDMA	LTE	Div1	BT
GSM					
WCDMA					
LTE					
Div.1	15	15	15		
BT	15	15	15		

Table 15: 50ohm isolation in dB between band A and band B. How to read: <[isolation in band A]/[isolation in band B]/[isolation outside bands]>. Only applicable for protocols specified in Table 10,11,12,13 and 14.

5.3 Other deltas to section 5 in Generic Antenna Specification.

Band	TX [MHz]	RX [MHz]	Frequency shift	TRP [dBm]	TIS [dBm]
GSM850	824-849	869-894	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5

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GSM900	880-915	925-960	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
GSM1800	1710-1785	1805-1880	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
GSM 1900	1850-1910	1930-1990	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
WCDMA I	1920-1980	2110-2170	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
WCDMA II	1850-1910	1930-1990	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
WCDMA IV	1710-1755	2110-2155	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
WCDMA V	824-849	869-894	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
WCDMA VIII	880-915	925-960	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B1	1920-1980	2110-2170	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B2	1850-1910	1930-1990	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B3	1710-1785	1805-1880	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B4	1710-1755	2110-2155	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B5	824-849	869-894	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B7	2500-2570	2620-2690	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B8	880-915	925-960	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B20	NA	NA	NA	NA	NA
LTE B28	703-748	758-803	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B38	NA		NA	NA	NA
LTE B39	NA		NA	NA	NA
LTE B40	2300-2400		$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/- 0.5	+/-0.5
LTE B41	NA		NA	NA	NA
GPS	N/A		N/A	N/A	N/A

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BT	2400-2483	$f_0 - \Delta f \leq \text{Resonance frequency} \leq f_0 + \Delta f$	+/-0.5	+/-0.5
Wi-Fi 2.4G	N/A	N/A	N/A	N/A
Wi-Fi 5G	N/A	N/A	N/A	N/A

Table16: Libra antennas frequency band definition

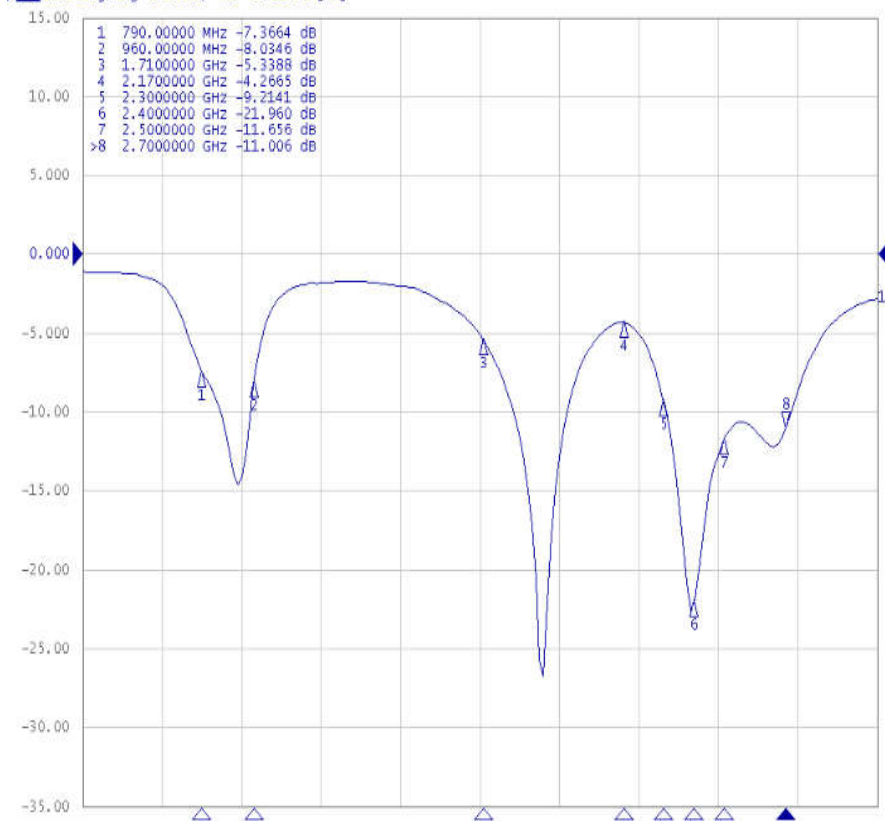
Electric – Requirement and Measurement	
Parameter	Spec.
VSWR	<3:1
Return Loss	<-6dB
Peak Gain	LTE B28 : 1.79 dBi GSM850, WCDMA V, LTE B5 : 2.11 dBi GSM900, WCDMA VIII, LTE B8 : 2.17 dBi GSM1800, LTE B3 : 1.45 dBi GSM 1900, WCDMA II, LTE B2 : 2.05dBi WCDMA IV, LTE B4 : 1.72 dBi WCDMA I, LTE B1 : 1.76 dBi LTE B40 : 1.89 dBi LTE B7 : 1.92 dBi BT:0dbi
Efficiency	LTE B28 : 35% GSM850, WCDMA V, LTE B5 : 40% GSM900, WCDMA VIII, LTE B8 : 39% GSM1800, LTE B3 : 41% GSM 1900, WCDMA II, LTE B2 : 45% WCDMA IV, LTE B4 : 43% WCDMA I, LTE B1 : 42% LTE B40 : 45% LTE B7 : 48% BT:35%
Isolation	<-15dB
Radiation Pattern Antenna type	Omni-directional PIFA

Table17: Libra antenna Requirement and measurement

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Main Antenna Return Loss

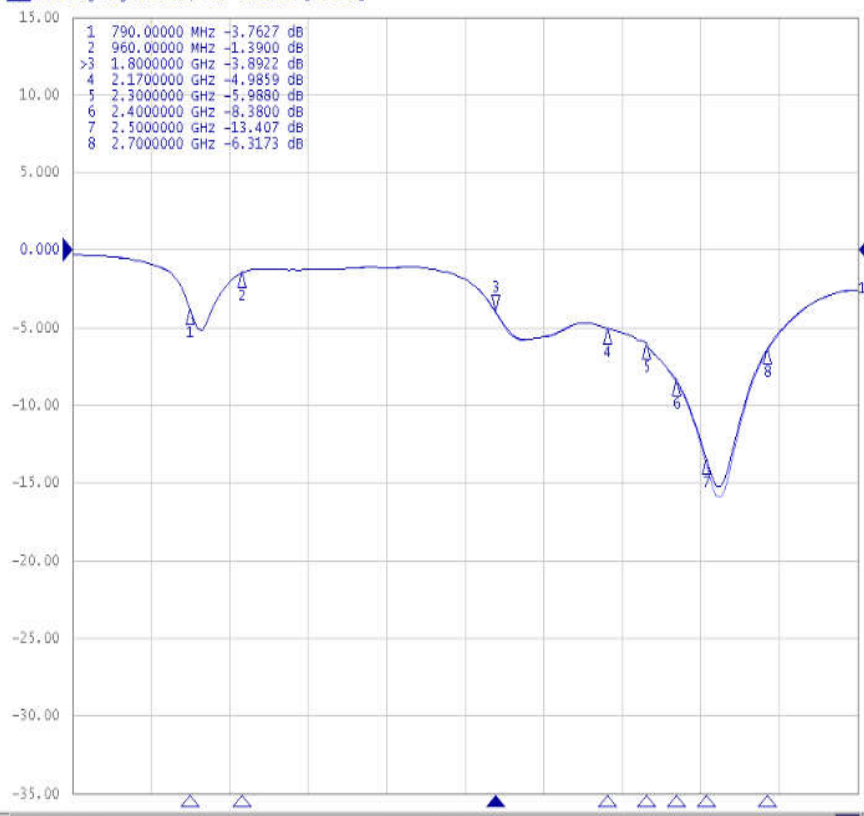
▶ [F2] S11 Log Mag 5.000dB/ Ref 0.000dB [F2]



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Diversity antenna Return loss

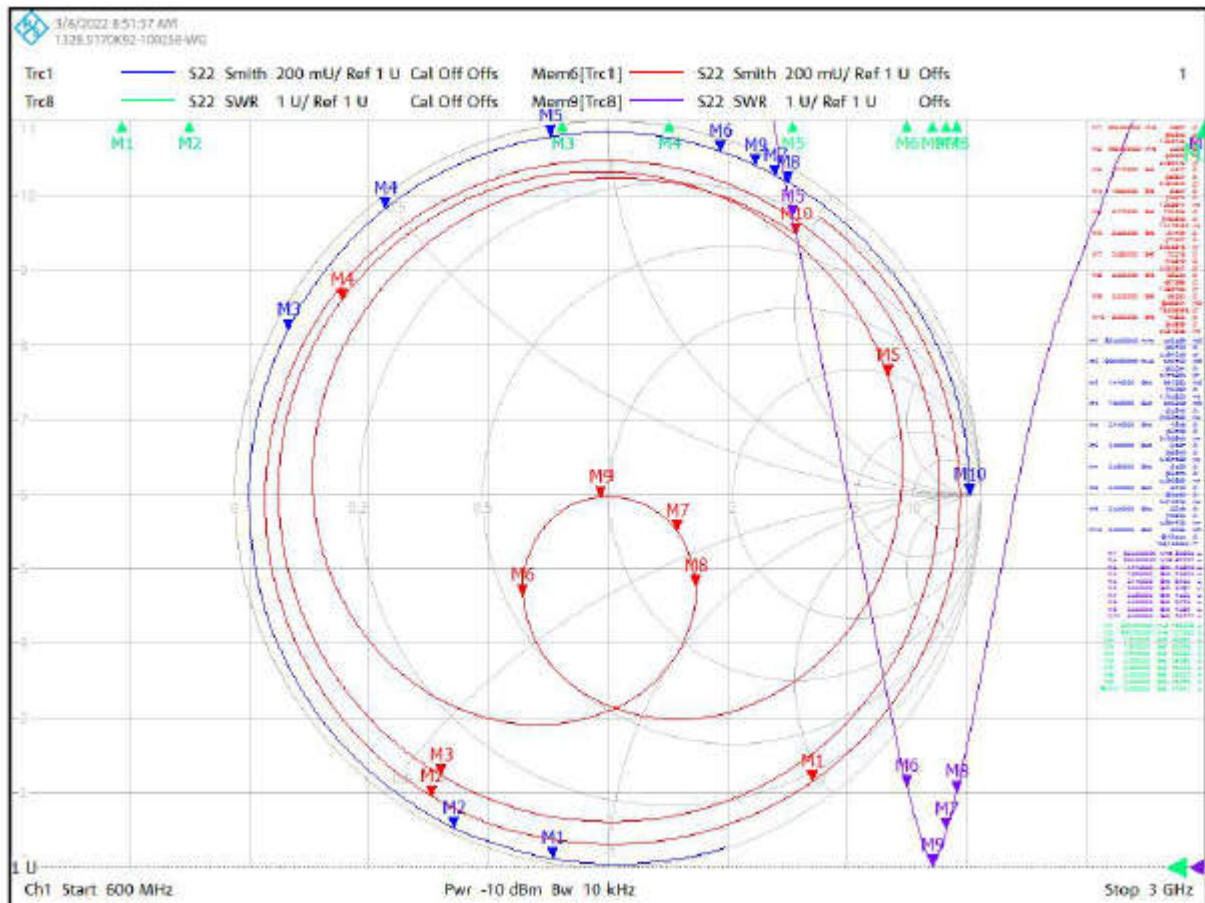
► Tr1 S11 Log Mag 5.000dB/ Ref 0.000dB [F2 D&M]



N/A

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BT Antenna Return Loss



GPS/WLAN combo Antenna_3D Radiation patterns

N/A

GPS/WLAN Combo Antenna BT/WI-FI 2.4G Peak Gain

N/A

6. APPENDIX: ACRONYM LIST

Acronym	Explanation
ABS	Absolute value
Avg	Average case across low-mid-high channel in a frequency band. Calculated on linearized values.
BOM	Bill Of Materials

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BT	Bluetooth
CEM	Contract Electronics Manufacturer
CE marked	The initials "CE" do not stand for any specific words but are a declaration by the manufacturer that his product meets the requirements of the applicable European Directive(s).
DVB-H	Digital Video Broadcast - Handheld
E-JRD	Extended Joint R&D
EiRP	Effective isotropic Radiated Power
EiRS	Effective isotropic Radiated Sensitivity
EMF	Electromagnetic Fields
ESD	Electro Static Discharge
FM	Frequency Modulation
FPC	Flexible Printed Circuit
FS	Free space
GPS	Global Positioning System
GR&R	Gauge Reproducibility and Repeatability
GSM	Global System for Mobile Communications
HAC	Hearing Aid Compatibility
JRD	Joint R&D
MDF	Material Data Form
MSM	Mechanics Sourcing Manager
NDA	Non Disclosure Agreement
OTA	Over The Air
PD	Product Development milestone
PPP	Pick and Place Pads
RF	Radio Frequency
SAR	Specific Absorption Rate
SPC	Statistical Process Control
TIS	Total Isotropic Sensitivity
TP	Talk position
TP+H	Task position + hand
TRP	Total Radiated Power
TRS	Total Radiated Sensitivity
UMTS	Universal Mobile Telecommunications System
WC	Worst case across low-mid-high channel in a frequency band.
WiMax	Worldwide Interoperability for Microwave Access
WLAN	Wireless LAN