AirHarmony 4000
LTE Product Specification

Revision: 2.3_4

Written by: STS

Role: HW PLM

Status: Released

TABLE 1: APPROVALS

	Name	Role	Approval Date
Product	MBI	VP Products	Dec 2014
R&D	OHA	VP R&D	Dec 2014
	IVA	HW Project Manager	Dec 2014
Quality	IAF	VP QA	Dec 2014

TABLE 2: REVISION HISTORY

Rev	Issue Date	Descriptions	By
0.1	08-Sep-2014	Initial draft for Review	STS
0.2	12-Sep-2014	Updates after initial review	STS
1.0	21-Sep-2014	First released version	MB
1.1	01-Mar-2015	Add dual and single sector options	MB & PNS
1.2	21-Mar-2015	Add Band Band 26 Variants	MB & PNS
1.3	28-Mar-2015	Updating interfaces and Rx. Sensitivity levels Updating dimensions Adding AirHarmony 4000 spec details	MB & STS
1.4	6-Apr-2015	Changing power to DC Updating power consumption	STS
1.5	01-May-2015	Removing AH2K details Updating AC power Update backhaul port configuration	MB & PNS
1.6	10-May-2015	Update to new enclosure Correct noise-figure type Fixed EVM and Dynamic-Range figures	MB
1.7	15-May-2015	Fixed some typo Corrected panel location mistake up/down for Ant. Added support for 1.4MHz and 3MHz channel bandwidth	MB & STS

Rev	Issue Date	Descriptions	By
		Corrected RX sensitivity to align with noise-figure Added volume figure Corrected power consumption value for FDD Corrected MTBF value	
1.8	29-May-2015	Adding FCC parts conformance	STS
1.9	24-Jul-2015	Moving antenna connector to the top panel	STS
2.0	10-August-2016	Added DC Variants, graphic updates, general updates	STS & MSF
2.1	13-October-2016	Graphic updates, general updates	STS & MSF
2.2	14-Feb-17	Clarify power split in dual carrier and add internal filters variant weight	STS
2.3	14-March-2017	GPON support	STS & MSF
2.3_1	12-Dec-2017	Update	STS & MSF
2.3_2	1-Dec-2019	Update B12	YoSha
2.3_3	19-Feb-2020	Update	MSF
2.3_4	15-June-2020	Update	MSF

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1. INTRODUCTION

This Hardware Product Specification describes Airspan's AirHarmony 4000, a mini-Macro class eNodeB variant, its Hardware capabilities, dimensions and Standard Compliance.

This document is intended for readers with LTE working knowledge.

All information in this document is for general information only, and is subject for change without notice.

For the latest roadmap and features, please contact your nearest Airspan Sales Representative.

2. ACRONYM, ABBREVIATIONS & DEFINITIONS

TABLE 3: ACRONYM, ABBREVIATIONS & DEFINITIONS

Short	Long
3GPP	3rd Generation Partnership Project, responsible for LTE
ABS	Almost Blank Subframe
ACS	Adjacent Channel Selectivity is a measurement of a receiver's ability to process a desired signal while rejecting a strong signal in an adjacent frequency channel. ACS is defined as the ratio of the receiver filter attenuation on the assigned channel frequency to the receiver filter attenuation on the adjacent channel frequency
AWGN	Additive White Gaussian Noise is a channel model in which the only impairment to communication is a linear addition of white noise with a constant spectral density and a Gaussian distribution of amplitude.
BER	Bit Error Rate
CN	Core Network
CP	Cyclic Prefix
CTC	Convolution Turbo Code is a high-performance forward error correction (FEC) code
dB	Decibel. A logarithmic unit used to describe a ratio (such as power ratio in radio telecommunications)
dBm	An abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW). It is used as a convenient measure of absolute power because of its capability to express both very large and very small values in a short form
eNodeB	Evolved Node B, is the element in E-UTRAN of LTE
ESP	Encapsulating Security Payloads (ESP) provide confidentiality, data-origin authentication, connectionless integrity, an anti-replay service (a form of partial sequence integrity), and limited traffic-flow confidentiality
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network, is the air interface of 3GPP's Long Term Evolution

Short	Long
EVM/RCE	The Error Vector Magnitude or EVM (sometimes also called Receive Constellation Error or RCE) is a measure used to quantify the performance of a digital radio transmitter or receiver. It is measured in dB or percentage (%) – the lower the better
FDD	Frequency-Division Duplexing. A transceiver mode where the transmitter and receiver operate at different carrier frequencies
GNSS	Global Navigation Satellite System is a term used to describe a satellite navigation system with global coverage. There are currently two fully operational GNSSs – the US GPS and the Russian GLONASS.
GTP-U	GPRS Tunneling Protocol for User data is a relatively simple IP based tunneling protocol which permits many tunnels between each set of end points
HPBW	Half Power Bandwidth is the angular separation in an antenna, in which the magnitude of the radiation pattern decreases by 50% (or -3 dB) from the peak of the main beam
ICS	In-channel selectivity is a measure of the receiver's ability to receive a wanted signal at its assigned Resource Block locations in the presence of an interfering signal
IPSec	Internet Protocol Security is a protocol suite for securing Internet Protocol (IP) communications by authenticating and encrypting each IP packet of a communication session
LED	Light Emitting Diode
LTE	Long Term Evolution
MAC	Medium Access Controller – responsible for several functions such Error Correction, Packet (De)Multiplexing, etc…
MBSFN	Multicast-Broadcast Single Frequency Network is an LTE feature designed to deliver services such as Mobile TV using the LTE infrastructure, and is expected to be a competitor to DVB-H-based TV broadcast
MCS	Modulation and Coding Scheme
MME	Mobility Management Entity is the key control-node for the LTE access-network. It is responsible, among other things for idle mode UE tracking and paging procedure including retransmissions
MTBF	Mean Time Between Failures
OFDMA	Orthogonal Frequency-Division Multiple Access (OFDMA) is a multi-user version of OFDM digital modulation scheme, used for eNodeB transmissions to UEs
PDCP	Packet Data Convergence Protocol. A Sub-Layer in LTE responsible for IP Header (De)compression, etc…
PDU	Protocol Data Unit

Short	Long
PTP	Precision Time Protocol is used to synchronize clocks throughout a network. In this document, PTP is referring to IEEE1588-2008 protocol
RB	Resource Block
RLC	Radio Link Control. A Sub-Layer in LTE responsible for Ack/Nack, error correction, packet reordering, etc…
ROHS	Restriction Of Hazardous Substances
RRC	Radio Resource Control. A Sub-Layer in LTE responsible for Broadcast of system information, paging, security functions, radio bearer control, etc…
RRM	Radio Resource Management is used to cover all functions that are related to the assignment and sharing of radio resources among UEs
S-GW	Serving Gateway. A Core entity in the LTE EPC architecture responsible for routing and forwarding user data packets, while also acting as the mobility anchor for the user plane during inter-eNodeB handovers and as the anchor for mobility between LTE and other 3GPP technologies
SBA	Switched Beam Antenna
SC-FDMA	Single-Carrier FDMA is a frequency-division multiple access scheme, dealing with the assignment of multiple users to a shared communication resource. Used in LTE for UE transmissions to the eNodeB
SCTP	Stream Control Transmission Protocol is a reliable transport layer protocol, ensuring in-sequence transport of messages with congestion control like TCP
SDR	Software Defined Radio
SyncE	Synchronous Ethernet. A method for maintaining synchronous communication over Ethernet using the physical layer (L1), as defined by ITU-T G.8262
TDD	Time-Division Duplexing. A transceiver mode where the transmitter and receiver operate on the same carrier frequency
UE	User Equipment. The end user in LTE
WEEE	Waste Electrical and Electronic Equipment

3. PRODUCT OVERVIEW

AirHarmony 4000 is part of Airspan's carrier-class LTE Advanced small cell eNodeB family. AirHarmony 4000 is a Mini-Macro class product that supports 3GPP's Long Term Evolution (LTE) eNodeB specifications, providing high-speed data, mobility, Voice over LTE, and broadcast/multicast services in order to meet the demands of the LTE Mobile Carriers.

AirHarmony 4000 is a compact, easy to install Mini-Macro class eNodeB, allowing an operator to deploy LTE broadband services using existing infrastructure or Street Furniture (e.g. street lamps, power poles, building rooftop or sides etc…)

AirHarmony 4000 employs Software Defined Radio (SDR) technology, together with two transmit and receive paths for each sector and a GPS antenna and receiver – all in a highly integrated, physically small and light, All-Outdoor package, targeted to blend seamlessly into the urban environment. This compact outdoor product minimizes physical footprint, power consumption and operator OPEX.

AirHarmony 4000 implements 2 x 20W transmitters (2 x 43 dBm).

AirHarmony 4000 fully supports the standard LTE (Uu/S1/X2) interfaces.

All Airspan eNodeB products, including AirHarmony 4000, are interoperable with a rich portfolio of 3rd party end user devices, including many handsets, indoor UEs, outdoor UEs and USB dongles from several ODMs, using various chipsets. For an updated of interoperability list, please contact your nearest Airspan Sales Representative.

Finally, AirHarmony can be tightly integrated with Airspan's iBridge and iRelay transport solutions. AirHarmony 4000 supports an integrated PoE interface which powers and connects either iBridge, iRelay, or a third party Wi-Fi Access Point. This configuration creates a single piece installation that supports full end to end IPv6 plug and play deployment by just adding power. For more details please refer to the iBridge and iRelay product specifications.

4. PHYSICAL INTERFACES

This section defines all external Network and Maintenance equipment interfaces as well as System LED. All interfaces are Weatherproof, supporting IP66 Ingress Protection Rating.

4.1. RF ANTENNA PORTS

AirHarmony 4000 has 4 variants which vary in their RF connectivity:

- Internal Filters
- External Filters
- Integrated External Duplexers
- Remote External Duplexers

4.1.1. INTERNAL FILTERS VARIANT RF PORTS

See 5.1 for more details about the variants.

- 2 Ports located on the top panel

Connector Type	4.1-9.5 DIN Female
Characteristic Impedance	50 Ω

4.1.2. EXTERNAL FILTERS VARIANT RF PORTS

- 2 ports located on the top panel and connected directly to the external filters.
- Filters are sold separately. See filters variants in 5.2.
- RF ports to the antenna located on the filters top

Connector Type	4.1-9.5 DIN Female
Characteristic Impedance	50 Ω

4.1.3. INTEGRATED EXTERNAL DUPLEXERS VARIANT RF PORTS

- 4 ports located on the top panel and connected to the integrated duplexers located behind the unit.
- 2 ports one on the top panel of the top duplexer and one on the bottom side of the bottom duplexers connects to the antenna

Duplexers connectors type:	4.1-9.5 DIN Female
Characteristic Impedance	50 Ω

4.1.4. REMOTE EXTERNAL DUPLEXERS VARIANT RF PORTS

- 4 ports located on the top panel and connected to the remote duplexers which are installed separately from the unit.
- 2 Ports located on the top panel of the remote duplexers connects to the antenna

Duplexers' connectors type:	4.1-9.5 DIN Female
Characteristic Impedance	50 Ω

4.2. GPS ANTENNA PORT

Connector Type	TNC Male
Characteristic Impedance	50 Ω
Quantity	1

Mounted directly to the unit or remotely.

4.3. FIBER SFP PORTS

The fiber SFP port is a standard SFP socket.

Connector Type	SFP Socket with Full AXS sealing connector
Quantity	2
Protocol	Ethernet, GPON (without sync over GPON)

For a list of supported pluggable SFP modules and available Full AXS cables please contact your nearest Airspan representative.

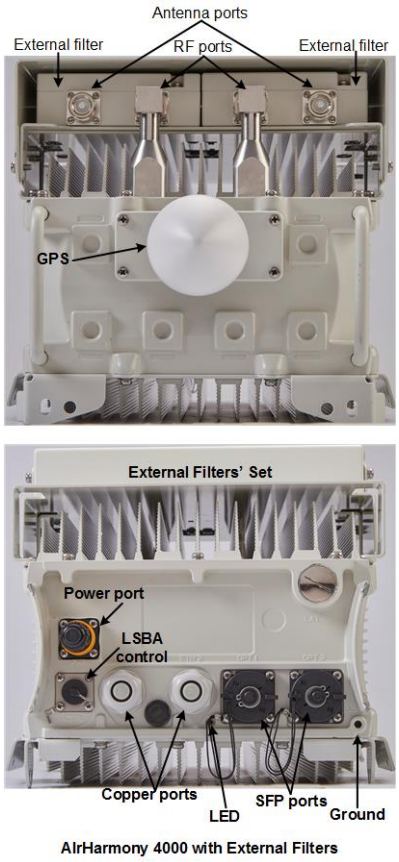
4.4. COPPER ETHERNET PORT

Connector Type	RJ45
Standard	IEEE802.3
Cable Type	STP Category 5E
Interface Speed	100/1000 Base-T
Communication Mode	Full/Half Duplex with Auto Negotiation
PoE Output	2 ports supports PoE out
Quantity	2

4.4.1. POE PORT SPECIFICATION

Power available at powered device	25.5 W
Maximum power delivered	30 W[1]
Voltage range delivered	50.0–57.0 V
Voltage range (at powered device)	42.0–57.0 V
Maximum current	600 mA
Maximum cable resistance	12.5 Ω (Category 5 cable)
Power management	Four power class levels negotiated at initial connection or 0.1 W steps negotiated continuously
Supported cabling	Category 3 and Category 5

FIGURE 1: AH4K - AC EXTERNAL FILTERS



AIrHarmony 4000 with External Filters

[1] Each port can supply up to 30W. Total power from the 2 ports can't exceed 45W

4.5. SBA CONTROL

Connector Type	AISG
Standard	RS485

Controls the SBA direction when mounted remotely

Can also control specific RET antennas control by the AISG protocol. Contact Airspan sales for further details.

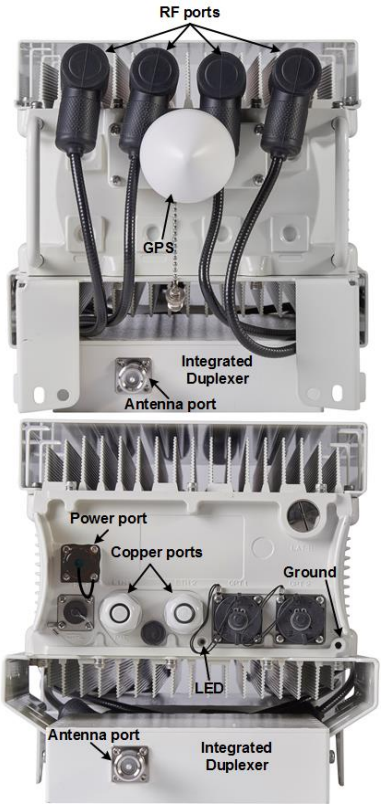
4.6. POWER CONNECTION

AC Variants	Figures 1 & 2
Connector Type	Proprietary
Voltage Rating	100VAC~240VAC, 47Hz~63Hz
Cable Length	Various
DC Variants	Figure 3
Connector Type	Proprietary
Voltage Rating	-48VDC
Cable Length	Various

4.7. LED DISPLAY

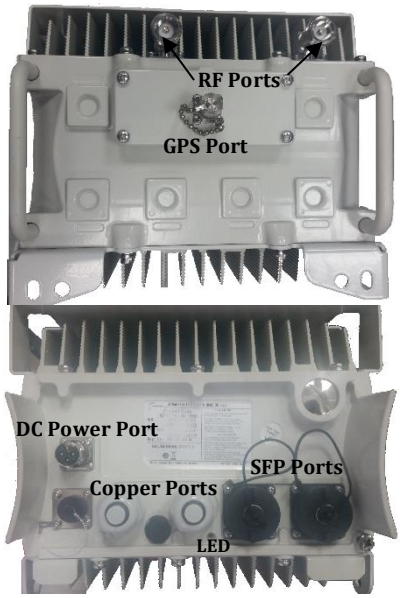
A single tri-color LED (Green/Red/Orange) appears at the bottom of the unit, providing unit status indication.

FIGURE 2: AH4K - AC INTEGRATED DUPLEXERS



AiHarmony 4000 with Integrated Duplexers

FIGURE 3: AH4K - DC INTERNAL FILTERS



AirHarmony 4000 with Internal Filters

5. PHYSICAL, MAC AND NETWORKING CAPABILITIES

AirHarmony 4000 is compliant with 3GPP's LTE release 10, and is SW upgradable to the latest LTE releases.

5.1. AIRHARMONY PRODUCT VARIANTS

Band	Variant	Downlink Freq. (MHz)	Uplink Freq. (MHz)	Dup. Mode	Max Channel BW (MHz)	Dual Carrier[2]	Tx / Rx Conf.	Tx Power (dBm)	Power Source	Filters / Duplexers Variant
3/9	HAR40-CN-U03-B06DP	1805-1880	1710-1785	FDD	20	No	2x2	43	DC	Remote External Duplexers
12/17	HAR40-CN-U12-B06DP	729-746	699-716	FDD	10	No	2x2	43	DC	Integrated External Duplexers
26M1	HAR40-CN-U26M1-B06AP	863.8-869	818.8-824	FDD	5	No	2x2	43	AC	Integrated External Duplexers
28H	HAR40-CN-U28H-B06DP	793-803	738-748	FDD	10	No	2x2	43	DC	Integrated External Duplexers
26/5	HAR40-CN-U26-B06DP	859-894	814-849	FDD	15	No	2x2	43	DC	Integrated External Duplexers
28	HAR40-CN-U28-B06DP	758-803	703-748	FDD	20	No	2x2	43	DC	Integrated External Duplexers
40	HAR40-CN-U40-B06DP	2300-2400	2300-2400	TDD	20	Yes	2x2	43*	DC	Internal Filters
41/38	HAR40-EFCN-U41-B06AP	2496-2690**	2496-2690**	TDD	20	Yes	2x2	43*	AC	External Filters
41/38	HAR40-CN-U41-B06DP	2496-2690	2496-2690	TDD	20	Yes	2x2	43*	DC	Internal Filters

* In dual carrier mode the user can configure the power split between the two carriers. Total power for the two carriers remains 20W

** Actual Frequency is set by the external filter

[2] Frequency separation between the carriers is limited to maximum 75MHz between the low frequency of the lower frequency carrier to the high frequency of the higher frequency carrier

5.2. External Filters Variants

Band	Variant	Downlink Freq. (MHz)	Uplink Freq. (MHz)	PIM
41L	**HAR40-FLTR-KIT-U41L**	2496-2568	2496-2568	≤-146dBc@2*43dBm
41H	**HAR40-FLTR-KIT-U41H**	2618-2690	2618-2690	≤-146dBc@2*43dBm
41	**HAR40-FLTR-KIT-U41F**	2496-2690	2496-2690	≤-146dBc@2*43dBm

5.3. Channel bandwidths

AirHarmony 4000 supports the following channel bandwidth: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz and 20MHz. Specific variants are limited for their max channel BW as reported in 5.1 or by the 3GPP standard for their minimum channel BW.

AirHarmony 4000 supports any dual contiguous carrier configuration as follows:

- Up to 20 MHz + 20 MHz in TDD
- Up to 15 MHz + 15 MHz in FDD

5.4. Channel Frequency Resolution

The center frequency is tunable with a 100 KHz resolution.

5.5. External Antenna

AirHarmony 4000 should be connected to external antennas via two (2) DIN 4.1/9.5 connectors located at the top panel or at the external duplexer / filter. The antenna should be mounted to its appropriate mounting facility.

The supported antennas should be dual slant, cross polar antennas.

AirHarmony 4000, can also support SBA configuration which can be mounted directly to the unit or remotely.

For a list of compatible external antennas, please contact your nearest Airspan Sales representative.

6. Radio Performance

6.1. Frequency Stability

The AirHarmony 4000 reference frequency accuracy is better than ±0.05ppm.

6.2. Modulation & FEC

AirHarmony 4000 supports QPSK, 16QAM and 64QAM modulations on both Downlink and Uplink with all Modulation and Coding Schemes defined in 3GPP TS 36.211.

6.3. Frame Durations & Cyclic Prefixes

6.3.1. Frame Duration

AirHarmony 4000 supports 10ms frames, as well as 1ms sub-frames, as defined by 3GPP.

6.3.2. CYCLIC PREFIX

The following Cyclic Prefixes (CP) are used:

TABLE 4: AIRHARMONY 4000 CYCLIC PREFIXES FOR LTE

Subcarrier Spacing (KHz)	Normal CP (us)	Extended CP (us)
15	~5.2 for first DFT block ~4.7 for remaining DFT blocks	16.7

Extended CP is typically used for MBSFN, in order to compensate for timing differences between transmissions received from different cells.

CP may be changed on a per sub-frame basis.

6.4. POWER

Maximum Configurable Tx Power per port single carrier	43 dBm (20W)
Maximum Configurable Tx Power per port - total for both carriers in dual carrier mode	43 dBm (20W)
Transmit Power Accuracy	±1dB in normal conditions
Control Step	1dB

6.5. TRANSMITTER DYNAMIC RANGE

The transmitter supports a monotonic power control of 40dB with step size of 1dB.

6.6. TRANSMITTER SPURIOUS EMISSIONS

AirHarmony 4000 complies with the "Category B" transmitter spurious emissions, as they are defined in TS 36.104.

6.7. TRANSMITTER ERROR VECTOR MAGNITUDE

The Error Vector Magnitude or EVM (sometimes also called Receive Constellation Error or RCE) is a measure used to quantify the performance of a digital radio transmitter or receiver. It is measured in dB or percentage (%) – the lower the better.

The AirHarmony 4000 transmitter EVM/RCE is no more than -28dB for all power levels.

6.8. RECEIVER SENSITIVITY LEVEL

The receiver sensitivity power level is the minimum mean power received at the antenna connector at which a throughput requirement is being met for a specified reference measurement channel. The AirHarmony 4000 meets the requirements defined for in TS 36.104 for Wide Area Base Stations.

The values in the table below are defined for QPSK ⅓ with allocation BW as indicated by TS 36.104:

TABLE 5: LTE RECEIVER SENSITIVITY LEVELS

Channel Bandwidth (MHz)	Allocation Size (RB)	Reference Sensitivity Level (dBm)
1.4	25	-107.8

Channel Bandwidth (MHz)	Allocation Size (RB)	Reference Sensitivity Level (dBm)
3	25	-104.5
5	25	-104.5
10	25	-104.5
15	25	-104.5
20	25	-104.5

6.9. IN CHANNEL SELECTIVITY

In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted QPSK½ signal at its assigned resource block locations in the presence of an interfering signal received at a larger power spectral density.

AirHarmony 4000 complies with ICS as defined by TS 36.104 for "Wide Area BS".

6.10. ADJACENT CHANNEL SELECTIVITY

Adjacent Channel Selectivity (ACS) is defined as the measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an adjacent channel signal with a specified center frequency offset of the interfering signal to the band edge of a victim system.

AirHarmony-4000 ACS complies with ACS requirements as defined in TS 36.104 for "Wide Area BS"

6.11. RECEIVE DYNAMIC RANGE

AirHarmony 4000's receiver has a dynamic range of 54dB.

6.12. MAXIMUM INPUT SIGNAL

The AirHarmony 4000 receiver can receive a maximum on-channel signal of –30dBm.

6.13. MAXIMUM INPUT SIGNAL WITHOUT DAMAGE

The AirHarmony 4000 receiver can tolerate a maximum signal of -10dBm without damage.

6.14. RECEIVER SPURIOUS EMISSION

The spurious emissions are the power of emissions generated or amplified in a receiver that appear at the receiver antenna connector. AirHarmony 4000 complies with the receiver spurious emission as defined by TS 36.104 as well as ETSI EN 301 893.

7. IP DATA AND MAC FUNCTIONALITY

7.1. GENERAL

AirHarmony 4000 can support both IPv4 and IPv6 and complies with 3GPP TS 36.321-323 and TS 36.331 Release 10 for the MAC, RLC, PDCP and RRC sub-layers.

7.2. RRM

The purpose of radio resource management (RRM) is to ensure the efficient use the available radio resources. AirHarmony 4000 supports unique and sophisticated RRM algorithms to ensure an efficient use of the radio resources. The RRM includes, among other things, a control of the radio bearers, admission control and connection mobility control, dynamic resource allocation and Inter Cell Interference Coordination (ICIC).

7.3. MOBILITY

AirHarmony 4000 can support Intra and Inter frequency handovers.

7.4. SECURITY

AirHarmony 4000 complies with eNodeB security requirements as specified by 3GPP TS 33.401, supporting:

For RRC signaling and user plane traffic

- EEA0 (Null ciphering)
- 128-EEA1 (SNOW 3G)
- 128-EEA2 (AES)

For RRC signaling integrity protection

- EIA0 (Null integrity)
- 128-EIA1 (SNOW 3G)
- 128-EIA2 (AES)

In order to protect the S1 and X2 control plane, AirHarmony 4000 supports IPSec ESP according to RFC 4303 as specified by TS 33.210. For both S1-MME and X2-C, IKEv2 certificates based authentication according to TS 33.310 are implemented. For S1-MME and X2-C, tunnel mode IPSec is supported.

In order to protect the S1 and X2 user plane, AirHarmony 4000 supports tunnel mode IPSec ESP according to RFC 4303 as profiled by TS 33.210, with confidentiality, integrity and replay protection.

AirHarmony 4000 includes an embedded X509 certificate bounded to its MAC Address. This shall be used for authentication purposes

8. TIME AND FREQUENCY SYNCHRONIZATION

8.1. SYNCHRONIZATION COMPLIANCE

AirHarmony 4000 meets the synchronization requirements as they are defined in TS 36.104 and TS 36.133.

Inter eNodeB synchronization is supported to enable both 1PPS frame synchronization for TDD interference avoidance and frequency synchronization for ICI avoidance.

8.2. FREQUENCY ACCURACY

For Frequency stability, the same source is used for RF frequency and data clock generation. The modulated carrier frequency of the eNodeB has an accuracy of ±0.05ppm observed over a period of one subframe (1ms).

8.3. PHASE ACCURACY

Phase accuracy, (required for TD-LTE interference coordination and for both TD-LTE and FDD-LTE when considering MBSFN or ABS) is 1usec or better with holdover of up to 2.5 hours (when GPS is the Active clock source). During holdover period, phase shift does not exceed 1usec. Participation of the eNodeB in MBSFN during holdover time is prohibited.

8.4. SUPPORTED CLOCK SOURCES

AirHarmony 4000 supports three different external clock sources for providing the required Frequency and Phase accuracy – GPS PTP and SyncE. The user can configure the priority of each clock source (if several are used simultaneously), to determine the redundancy scheme between them. By default, GPS gets highest priority (when available).

If all valid clock sources fail, the eNodeB enters Holdover state until such time, when at least one clock source becomes valid again. The eNodeB enters Holdover state in case both GPS and PTP are not available, regardless of the SyncE status.

Note: The eNodeB should not be left running in Holdover state for long periods, for fear of its internal clock drifting from the required accuracy.

8.4.1. GPS

AirHarmony 4000 comes equipped with a GPS receiver, connected to an external GPS antenna (GPS antenna sold separately). See section 0 for more details about the GPS connector.

AirHarmony 4000 can also connect to GLONASS/Galileo satellites (for Russian or EU deployments) via the same GPS connector, using a GLONASS/Galileo antenna.

8.4.2. PTP

AirHarmony 4000 implements IEEE1588-2008 Slave/Ordinary clock, able to recover the Frequency and Phase information from the PTP packets, transmitted from an IEEE1588-2008 Grand Master clock located in the customer's network.

8.4.3. SYNCE

AirHarmony 4000 supports Synchronous Ethernet (SyncE) – both Master and Slave clock functionalities, as it is defined in ITU-T G.8261, G.8262 and G.8264, including Ethernet Synchronization Message Channel (ESMC).

SyncE can be used by the AirHarmony 4000 in several scenarios:

- In Tandem to PTP – In this mode GPS is unavailable as a clock source, and synchronization is achieved by using SyncE to maintain accurate frequency lock, while IEEE1588-2008 is used for phase synchronization. This mode allows for better phase accuracy (compared to PTP-Only) even during normal operation.
- GPS Redundancy Clock Source – When GPS clock fails, SyncE is used to maintain frequency lock and minimize phase drift. In this mode, the eNodeB enters holdover upon GPS failure, but can maintain phase accuracy with no performance degradation for up to 8 hours.

9. NETWORK INTERFACES

9.1. MANAGEMENT

AirHarmony 4000 is managed via Airspan's EMS (Netspan) using SNMPv3 and supports management using a default IP address.

9.2. S1 INTERFACE

The LTE S1 user plane interface (S1-U) is defined between the eNodeB and the S-GW in 3GPP TS 36.414. The S1-U interface provides non-guaranteed delivery of user plane PDUs between the eNodeB and the S-GW. The transport network layer is built on IP transport and GTP-U is used on top of UDP/IP to carry the user plane PDUs between the eNodeB and the S-GW. AirHarmony 4000 complies with the requirements set by TS. 36.414

The S1 control plane interface (S1-MME) is defined between the eNodeB and the MME. The transport network layer is built on IP transport, similarly to the user plane but for the reliable transport of signaling messages, SCTP is added on top of IP. The application layer signaling protocol is referred to as S1-AP (S1 Application Protocol). AirHarmony 4000 complies with the requirement set by TS 36.413, including:

- S1 paging function
- S1 UE context management function
- Intra LTE handover
- E-RAB service management function
- NAS signaling transport function
- Location reporting function
- Warning message transmission function

9.3. X2 INTERFACE

The X2 user plane interface (X2-U) is defined between eNodeBs in 3GPP TS 36.414. The X2-U interface provides non-guaranteed delivery of user plane PDUs. The transport network layer is built on IP transport and GTP-U is used on top of UDP/IP to carry the user plane PDUs. The X2-U interface protocol stack is identical to the S1-U protocol stack. AirHarmony 4000 complies with the requirements set by TS. 36.414.

The X2 control plane interface (X2-CP) is defined between two neighbor eNodeBs. The transport network layer is built on SCTP on top of IP. The application layer signaling protocol is referred to as X2-AP (X2 Application Protocol).

9.4. TRAFFIC SEPARATION

Core traffic separation can be achieved using VLANs. This solution supports the following configuration in the eNodeB:

- One VLAN and IP Interface for Management traffic
- One VLAN and IP Interface for S1AP per MME
- One VLAN and IP Interface for S1-U per S-GW
- One VLAN and IP Interface for X2AP (for Packet Forwarding to all neighbors)
- One VLAN and IP Interface for X2-C (for control messages to all neighbors)
- One VLAN and IP Interface for PTP traffic

10. SELF-ORGANIZING NETWORK

This Self Organizing Network (SON) concept includes several different functions from eNodeB activation to radio parameter tuning.

Self-configuration process is defined as the process where newly deployed nodes are configured by automatic installation procedures to get the necessary basic configuration for system operation. This process works in pre-operational state. Pre-operational state is understood as the state from when the eNodeB is powered up and has backbone connectivity until the RF transmitter is switched on. Functions handled in the pre-operational state are: Basic Setup and Initial Radio Configuration.

Self-optimization process is defined as the process where UE & eNodeB measurements and performance measurements are used to auto-tune the network. This process works in operational state. Operational state is understood as the state where the RF interface is additionally switched on. Functions handled in the operational state are Optimization and Adaptation.

AirHarmony 4000 supports an API that will enable it to be connected to a centralized SON server.

11. Physical Characteristics and Power

11.1. Dimensions & Volume

TABLE 6: AIRHARMONY 4000 DIMENSIONS

Variant	Dimensions[3] (H x W x D)
Main Unit w/o filters / duplexers	509 x 236 x 210 mm / 20.0 x 9.3 x 8.3 in.
Main Unit – Internal Filters	509 x 236 x 210 mm / 20.0 x 9.3 x 8.3 in.
Main Unit with external filters	509 x 262 x 252 mm / 20.0 x 10.3 x 9.9 in.
Main Unit with integrated external duplexers	631 x 236 x 267 mm / 24.8 x 9.3 x 10.5 in.
Cavity Filter Set (2 filters)	229 x 240 x 39.0 mm/ 9.01 x 9.45 x 1.53 in.
External Remotely Mounted Duplexer (2 duplexers)	299.3 x 195.0 x 109 mm / 11.78 x 7.67 x 4.29 in.

TABLE 7: AIRHARMONY 4000 VOLUME

Variant	Volume (W/O Handles)
Internal Filter Variant/ External Filters Variant (w/o filters) / Remote External Duplexers (w/o duplexers)	24.0 L
External Filter Variant (with filters)	27.0 L
Integrated Duplexer Variant	29.5 L

11.2. Weight

The weight of all AirHarmony 4000 mounting components is listed in the following table.

TABLE 8: AIRHARMONY 4000 COMPONENTS WEIGHT

Variant	Dimensions
Main Unit w/o filters / duplexers	18 Kg / 39.68 Lbs.
Main Unit with filter set	21 Kg / 46.3 Lbs.
Main unit with internal filters	18Kg / 39.68 Lbs.
Main Unit with integrated external duplexers	27 Kg / 59.52 Lbs.
Universal mounting bracket	3 Kg / 6.6 Lbs.
Dual Filter Set	3 Kg / 6.6 Lbs.
External Duplexers	10 Kg / 22 Lbs.

[3] Dimensions excludes connectors height and protruding screws

11.3. MOUNTING

AirHarmony 4000 includes a pole mounting kit with the following attributes:

FIGURE 4: POLE/WALL MOUNT BRACKET AND AIRHARMONY 4000 MOUNTED ON POLE

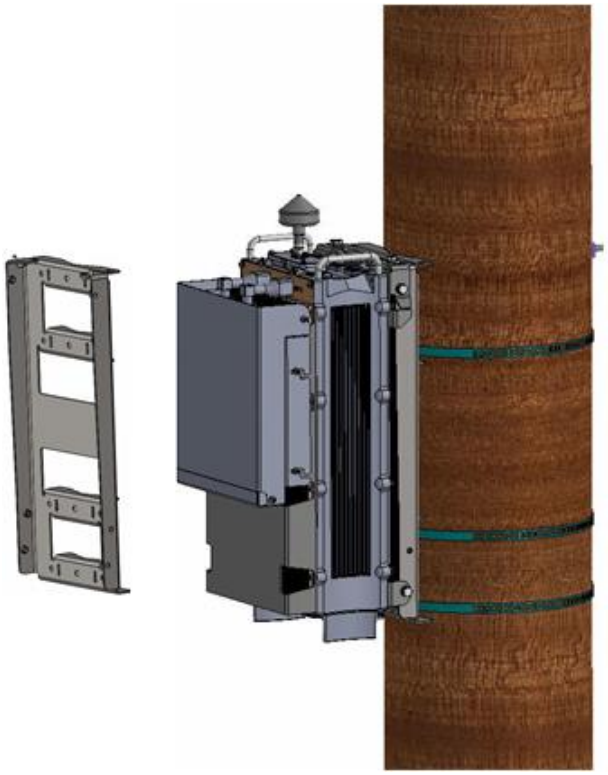


TABLE 9: POLE MOUNTING KIT ATTRIBUTES

Attribute	Values
Mechanical tilting range	0°
Mounting supported pole diameters	48.3 to 406.4 mm / 1.9 to 16 inch
Airspan supplied bands supported pole diameter	64 – 362 mm / 2.5 – 14.25 inch
Supported wind load	200 km/h. 125 mph.

11.4. Power Supply

11.4.1. Power Supply AC Variants

AirHarmony 4000 supports direct connection to AC power source:

- ***Operational Voltage Range***: 100VAC~240VAC, 50Hz~60Hz
- ***Transient Voltage***: +150V (ETR283)

11.4.2. Power Supply DC Variants

AirHarmony 4000 DC variants supports direct connection to DC power source

- ***Operational Voltage Range***: -40.5 to -57 VDC
- ***Transient Voltage***: +150V (ETR283).

In these variants AC power feed is also available, using an AC/DC power converter offered by Airspan.

For more details on the offered AC/DC converter (sold separately), please contact your nearest Airspan sales representative.

11.5. Power Consumption

11.5.1. Power Consumption

AirHarmony 4000 power consumption is described in the following table:

Duplex	Tx Power at RF Port (dBm)	Power Source	Nominal Power Consumption (W)	Max Power Consumption with PoE (Instantaneous) (W)	Max Current with PoE (Instantaneous) (A)	PoE Maximum Power Consumption (W)	Power Supply Requirements (W)
TDD	2 x 43	AC	265	387	4.30	60	N/A
FDD	2 x 43	AC	340	387	4.30	60	N/A
FDD	2x 43	DC	300	350	9	60	500

12. Standards Compliance

12.1. CE Marking

AirHarmony 4000 conforms to the European Union R&TTE Directive, and is therefore CE marked accordingly.

12.2. FCC

AirHarmony 4000 conforms to the American Federal Communications Commission - FCC rules:

- LTE Band 41 – FCC rule part 27
- LTE Band 26 – FCC rule part 90 subpart S

12.3. ENVIRONMENTAL

AirHarmony 4000 meets the following environmental requirements:

- ETSI EN 300-019-1-4 Operational (non-weather protected equipment)
- ETSI EN 300-019-1-1 Storage (weather protected, not temperature controlled locations)
- ETSI EN 300-019-1-2 Transportation

TABLE 10: AIRHARMONY 4000 ENVIRONMENTAL COMPLIANCE

Type	Details	Standard Compliance
Operating temperature	-40°C to 55°C	ETSI 300 019 1-4
Operating humidity	5% - 100% non-condensing	ETSI 300 019 1-4
Storage temperature	-40°C to 70°C	N/A
Storage humidity	5% - 100% non-condensing	ETSI 300 019 1-4
Rain and dust ingress protection	IP66	N/A
Operational altitude	70-106 kPa as well as: From -60m to 1800m @ 40°C From 1800m to 4000m @ 30°C	ETSI 300 019 1-4
Solar radiation	1120 W/m^2	ETSI 300 019 1-4

12.4. EMC

AirHarmony 4000 complies with the EMC requirement as specified by ETSI EN 301 489-1 V1.9.2 (2011-09) Class A, as well as EN 301 489-4 V1.4.1 (2009-05).

12.5. LIGHTNING PROTECTION

AirHarmony 4000 complies with ETSI EN 301 489-1, CISPR24 and IEC61000-4-5.

12.6. ELECTROSTATIC DISCHARGE

All AirHarmony 4000 ports meet the ESD requirements of EN61000 4-2. The test condition is level 3 for air discharge and level 2 for contact discharge.

AirHarmony 4000 also complies with IEEE-STD 1613.

In addition to the above compliance, AirHarmony 4000 complies with EMI of 100V/m.

12.7. SAFETY

AirHarmony 4000 conforms to IEC 60950, UL 60950, EN 60950-1:2006 and EN 60950-22:2006.

In addition to this specification, the following specifications covering human exposure to radio frequency electromagnetic fields are also met:

- **EN 50385:2002** Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 - 40 GHz). General public
- **EN 50401:2006** Product standard to demonstrate the compliance of fixed equipment for radio transmission (110 - 40 GHz) intended for use in wireless telecommunication

networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service

12.8. ROHS & WEEE COMPLIANCE

- The chemical content of the equipment and its packaging meets the EU ROHS directive - 2002/95/EC (ROHS) – compliant with ROHS6 (up to 2009)
- The WEEE symbol is present on the product label as per the requirements of European directive 2002/96/EC

12.9. RELIABILITY AND MAINTENANCE

The following reliability data assumes worst case requirements. Overall reliability is improved when considering the dual transceivers as a redundancy factor (this consideration is not included in the quoted figures).

Average Mean Time Between Failures (MTBF) = 25 years