



# MacroMAXe Product Specification

## Release 9.0.1

**This specification details performance parameters and features supported by the specific product and Airspan WiMAX system release as stated. It covers the standard configurations of MacroMAXe for all frequency bands relevant to the Airspan WiMAX system release.**

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## Revision History

Revision	Originator	Date	Description
1.0	P. Trubridge	9/04/2008	First draft
1.1	P. Trubridge	17/11/2008	Added 3.5GHz
1.2	M. Falik	10/04/2010	Additions
1.3	B. Rein	05/07/2010	Many substantial Amendments and Updates
1.4	B. Rein	18/07/2010	Corrected the Fiber Interface details
1.5	B. Rein	28/07/2010	Adding details about MacroMAXe 700 MHz
1.6	B. Rein	09/08/2010	Corrected the temperature range
1.7	B. Rein	22/08/2010	Corrected the input power levels: up to 60VDC

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## 1 Product Overview

MacroMAXe is a class-leading 2nd generation Mobile WiMAX base station which employs the software defined radio (SDR) technology, together with two transmit paths and four receive paths, antennas and GPS receiver all in a highly integrated, physically small and light, all outdoor package. MacroMAXe has been designed and optimized for the 700MHz, 2.3GHz, 2.5GHz and 3.3-3.8 GHz Mobile WiMAX bands and is WiMAX certified. The product has been designed to address the markets needs by supporting the current and future air interfaces thanks to its SDR technology.

MacroMAXe is a highly integrated macro-cell base station with all-in-one packaging of RF and base-band components. MacroMAXe includes integrated quad RF transceivers to support four channel diversity and MIMO. It is available as an all outdoor solution for Mobile WiMAX applications to minimise physical footprint and operator OPEX.

MacroMAXe is a class leading base station product bringing together state-of-the-art technologies in a compact all outdoor package. Thanks to its small footprint MacroMAXe minimises site OPEX expenditure. MacroMAXe is small in size but big in performance. Thanks to the efficient power amplifier technology employed in its RF implementation, MacroMAXe implements dual 40dBm (10W) transmitters in 2.x GHz, dual 38 dBm (6.3W) in 700MHz and dual 37dBm (5W) transmitters in 3.X GHz band. MacroMAXe supports 3.5 MHz, 5MHz, 7MHz and 10MHz channel sizes. However, the product is capable of supporting 2x7MHz and 2x10MHz (using dual PHY/MAC) channels doubling the capacity of the sector.

MacroMAXe has been conceived for deployment in 1-sector configuration or in 3-sector configuration, which is the optimum configuration for Mobile WiMAX deployments. MacroMAXe design also incorporates an Ethernet switch which enables the traffic from 3 sectors to be aggregated for backhaul and network interfacing. The switch has copper and Fiber Giga Ethernet interfaces towards the backhaul or backbone.

MacroMAXe fully supports the interoperable R6 reference point for interworking with ASN Gateways. MacroMAXe also has a “Stand Alone” mode for fixed/nomadic applications which do not require seamless handover. When MacroMAXe is used in “Stand Alone” mode there is no need for an ASN Gateway. MacroMAXe supports IP CS and Ethernet CS. It even supports a hybrid mode where both IP CS and Ethernet CS (including VLAN support) are supported.

MacroMAXe has IOT with a rich portfolio of third party end devices, including various indoor CPE, outdoor CPEs and USB dongles from various ODMs, using various chips.

MacroMAXe is managed via Airspan’s SNMP based EMS called Netspan.

**A full description of the product is contained within the MacroMAXe Product Description Document.**

## 2 Physical Interfaces

This section defines all external equipment interfaces for Network and Maintenance connections.

### 2.1 RF Antenna Ports

Four (4) RF Ports are located on the top of the MacroMAXe enclosure for connecting antennas.

Connector:	N-Type Female
Characteristic Impedance:	50ohms
In-band Input Return Loss:	$\geq 15$ dB

### 2.2 GPS Antenna Port

Connector:	TNC Female
Characteristic Impedance:	50ohms

### 2.3 Fibre Network Interface

Standard:	IEEE802.3z
Interface Speed:	1000Base-SX for short range
Communication Mode:	Multi Mode
Connector	LC

## **2.4 Ethernet Ports**

Standard:	IEEE802.3
Interface Speed:	100Base-Tx
Communication Mode:	Full Duplex
Fibre and Cable:	UTP category 5 or 5E
Connector:	RJ45 Socket

## **2.5 Power Connection**

### **2.5.1 DC Powered Units**

Connector Type:	Weatherproof proprietary Connector
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### 3 Air Interface / Physical (PHY) Layer

MacroMAXe is compliant with the WiMAX Forum Mobile WiMAX System Profile Release 1.x. This is based on the OFDMA physical layer, as defined in IEEE 802.16-2009.

#### 3.1 Frequency of Operation & Duplex Methods

Frequency operation & duplex methods available are determined by the availability of MacroMAXe frequency variants. Below is a summary of variants available in the current System Release.

Band	Variant	Lower Frequency	Upper Frequency	Duplex	Remarks
700MHz	MacroMAXe 0707	698 MHz	746 MHz	TDD	Airspan has outdoor CPEs in this band This band will be released in SR9.5
	MacroMAXe 2310 Lo	2290 MHz	2350 MHz	TDD	Current CPEs support only 2300 MHz and up
2.3GHz	MacroMAXe 2310 Hi	2340 MHz	2400 MHz	TDD	First units which were shipped covered 2330-2390 MHz, included two (2) receivers only and had some other changes such as different mounting kits. They also do not support 3.5 and 7MHz channels
	MacroMAXe 2510 Lo	2496 MHz	2570 MHz	TDD	Current CPEs support only 2500 MHz and up
2.5GHz	MacroMAXe 2510 Mid	2560 MHz	2630 MHz	TDD	First units which were shipped included two (2) receivers only and had some other changes such as different mounting kits. They also do not support 3.5 and 7MHz channels
	MacroMAXe 2510 Hi	2620 MHz	2690 MHz	TDD	
	MacroMAXe 3310	3300 MHz	3400 MHz	TDD	
3.xGHz	MacroMAXe 3410	3400 MHz	3500 MHz	TDD	
	MacroMAXe 3510	3500 MHz	3600 MHz	TDD	
	MacroMAXe 3610	3600 MHz	3700 MHz	TDD	
	MacroMAXe 3710	3700 MHz	3800 MHz	TDD	

Downstream / Upstream ratios can be set on a per sector basis via the EMS according to limits set by the WiMAX System Profiles. GPS synchronisation is available as a standard option reducing BS to BS interferences.

#### 3.2 Multiple Access Scheme

Downlink: Adaptive OFDMA

Uplink: Adaptive OFDMA

### 3.3 Channel bandwidths

Below is a summary of channel bandwidths supported by MacroMAXe:

Channel Width (MHz)	FFT Size	Status and remarks
3 MHz	512	Not a standard 16e channel – but is planned as part of the roadmap
3.5 MHz	512	Planned for release 9.5
5 MHz	512	Supported
7 MHz	1024	Supported
10 MHz	1024	Supported
2 x 7 MHz	2 x 1024	Planned for release 9.5
2 x 10 MHz	2 x 1024	When dual MAC/PHY is on there is no support in four (4) receivers and the Tx power per carrier is 3 dB lower

### 3.4 Channel Step

The minimum channel step is 250 kHz; hence the centre frequency shall be set to an integer of 250 kHz.



### 3.5 Antenna System

Various antennas are supported including:

- Quad port antennas (in 2.x GHz and 3.x GHz bands) and dual slant antennas (in 700MHz, 2.x GHz and 3.x GHz bands)
  - When using all four (4) receivers a quad port antenna is required or two dual slant antennas; when using two receivers – a dual slant antenna is required;
- 65 degree, 90 degree and Omni antennas
  - 65 and 90 degree antennas are quad port or dual slant antennas
  - When using Omni antennas – there is a need for four (4) antennas in case four receivers are used or two (2) antennas when two receivers are used
- Antennas with manual tilt and antennas with Manual Electric Tilt (MET)

For more details you may read MacroMAXe User Guides

## 4 Radio Performance

### 4.1 Standards Compliance

#### 4.1.1 International Standards Compliance

The system is compliant to the following international RF standards:

ETSI EN 302 326  
FCC Part 90 sub Z

### 4.2 Frequency Stability

Under normal operation with an active GPS Receiver (ie. not during GPS holdover), frequency stability is  $\pm 0.02$ ppm.

### 4.3 Modulation & FEC

The following modulation and FEC combinations are supported as indicated:

Modulation	FEC	Supported?	
		Downlink	Uplink
64QAM	5/6	Yes	Yes
64QAM	3/4	Yes	Yes
64QAM	2/3	Yes	Yes
64QAM	1/2	Yes	Yes
16QAM	3/4	Yes	Yes
16QAM	1/2	Yes	Yes
QPSK	3/4	Yes	Yes
QPSK	1/2	Yes	Yes

### 4.4 Frame Durations & Cyclic Prefixes

#### 4.4.1 Frame Duration

5ms frame duration is supported as per Mobile WiMAX System Profile.

#### 4.4.2 Cyclic Prefix

1/8 Cyclic Prefix allowance is supported as per Mobile WiMAX System Profile.

#### 4.5 Transmit Power

700 MHz Maximum Configurable Tx Power (per RF port):	+ 38 dBm (6.3 Watts)
2.x GHz Maximum Configurable Tx Power (per RF port):	+ 40 dBm (10 Watts)
3.x GHz Maximum Configurable Tx Power (per RF Port):	+ 37 dBm (5 Watts)
Transmit Power Accuracy:	+/- 1dB in normal conditions +/- 1.5dB in extreme conditions
Transmit Power Adjustment Range	$\geq 20$ dB
Control Step	1.0 dB

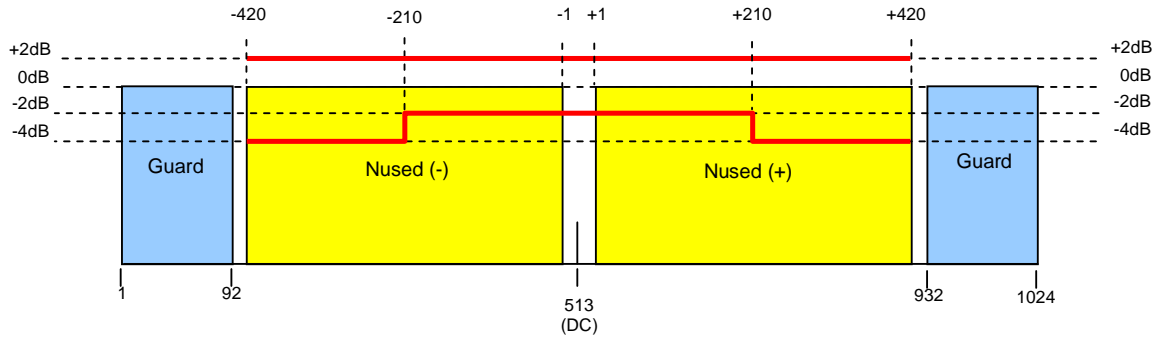
Note: Transmit power per RF Channel is reduced by 3dB when operating Dual MAC/PHY feature.

#### 4.6 Tx Spurious Emissions

Spurious emissions compliance is shown in the table below. Limits below are met at maximum Tx power and are in compliance with 3GPP standard TS25.104 which specifies the minimum emissions levels for co-location with existing wireless technologies.

No.	Frequency range	Emission level	Protected band service
1	9kHz~150kHz	≤ -36 dBm /kHz	Category-B
2	150kHz~30MHz	≤ -36 dBm /10kHz	
3	30MHz~1000MHz	≤ -36 dBm / 100kHz	
4	1000MHz~12.75GHz	≤ -30 dBm /MHz	Except for No.5-10 categories
5	824MHz~960MHz	≤ -98 dBm /100kHz	Co-existence/Co-location with (Macro-) GSM850/GSM900/UTRA-FDD Band V/VI
6	1710MHz~1910MHz	≤ -98 dBm /100kHz	Co-existence/Co-location with (Macro-) DCS1800/PCS1900/UTRA-FDD Band III/IV
7	1910MHz~2025MHz	≤ -98 dBm /100kHz	Co-existence/Co-location with UTRA-TDD/UTRA-FDD Band I (UL)
8	2110MHz~2170MHz	≤ -52 dBm /MHz	Co-existence with UTRA-FDD Band I (DL)
9	2290MHz~2400MHz	≤ TBD	WiMAX 2.3GHz band (Profile 1B)
10	2500MHz~2690MHz	≤ -13 dBm /MHz	BS own operation band

In channel spectral flatness levels apply as shown below:



#### 4.7 Tx Relative Constellation Error (RCE / EVM)

The following RCE/EVM limits apply as required by IEEE802.16-2009:

Burst type	RCE/EVM	
	Convolutional Coding	Convolutional Turbo Coding
<b>QPSK-1/2</b>	-15.0dB / 17.78%	-13.5dB / 21.13%
<b>QPSK-3/4</b>	-18.0dB / 12.59%	-16.5dB / 14.96%
<b>16QAM-1/2</b>	-20.5dB / 9.44%	-19.0dB / 11.22%
<b>16QAM-3/4</b>	-24.0dB / 6.31%	-23.0dB / 7.08%
<b>64QAM-1/2</b>	-26.0dB / 5.01%	-24.0dB / 6.31%
<b>64QAM-2/3</b>	-28.0dB / 3.98%	-27.0dB / 4.47%
<b>64QAM-3/4</b>	-30.0dB / 3.16%	-28.0dB / 3.98%

#### 4.8 Rx Noise Figure

Receiver noise figure is less than 4dB.

#### 4.9 Rx Sensitivity & C/I+n

The following table details the receiver sensitivity and C/I+n for each modulation/FEC combination as measured at the transceiver RF port. Figures are indicated for a single antenna and do not include multiple antenna combination gain.

MCS (CTC)	BW = 5MHz,10MHz		
	AWGN	Ped-B 3Kmh	Veh-A 60Kmh
QPSK 1/2	-106.9	-102.8	-101.8
QPSK 3/4	-105.7	-99.0	-98.5
16QAM 1/2	-104.2	-99.3	-98.8
16QAM 3/4	-100.1	-93.3	-92.3
64QAM 1/2	-99.0		
64QAM 2/3	-95.9		
64QAM 3/4	-94.8		
64QAM 5/6	-92.9		

#### 4.10 Receiver Adjacent Channel Rejection

Adjacent channel filtering provides typical rejection levels as follows:

	5MHz Channel	10MHz Channel
At 1 Channel Offset	28dB	28dB
At 2+ Channel Offsets	47dB	47dB

#### 4.11 Receive Dynamic Range

The receiver is capable of receiving an in-band signal of up to 0dBm for up to 1 minute duration without damage.

Maximum receive level to ensure co and adjacent channel performance is -45dBm.

#### 4.12 Tx RF Monitor Performance

Two RF monitor ports are available for maintenance and installation purposes. Monitor output levels are 40dB ± 1dB lower than levels on corresponding RF Antenna Port.

## **5 IP Data & MAC Functionality**

The standard Mobile WiMAX System Profiles define an IP and Ethernet convergence sub-layer.

Mobile WiMAX: IP (layer 3)

This section details features associated with an IP Convergence Sub-layer.

### **5.1 Standards Compliance**

MacroMAXe supports IP CS and Ethernet CS including simultaneous support of both convergence sub-layers and including VLAN support

### **5.2 Service Flow Scheduling**

The system supports a maximum of 32 service flows per MS (16 uplink, and 16 downlink); these can be used simultaneously.

## 6 Software Features

### 6.1 Multiple Antenna Features

The following multiple antenna features are supported. Details of these features are included in the MacroMAXe Product Description Document.

Feature	Comments
Receive MRC	Fourth and second order MRC
MIMO Matrix A (STC)	
MIMO Matrix B	
Transmit Cyclic Delay Diversity	
Adaptive MIMO	

### 6.2 PHY Features

The following physical layer features are supported. Details of these features are included in the MacroMAXe Product Description Document.

Feature	Comments
512 OFDMA	
1024 OFDMA	
QPSK & 16QAM on Downlink	
64QAM on Downlink	
QPSK & 16QAM on Uplink	
64QAM on Uplink	Starting in release 9.01 (not in release 9.0)
PUSC 1/3	
Fractional Frequency Reuse (FFR)	
All Ranging & BW Requests	
Closed Loop Power Control	
Open Loop Power Control	
Fast Feedback (ACKCH [for H-ARQ])	
Fast Feedback (CQICH [for MIMO])	
H-ARQ (cat 1)	
H-ARQ (cat 2,3)	
H-ARQ (cat 4)	
BS-BS Time Synchronisation (GPS)	
BS-BS Freq Synchronisation (GPS)	
Configurable Downlink / Uplink Split	
CW Test Mode	



### 6.3 MAC (including convergence sub-layer) Features

The following MAC layer features are supported. Details of these features are included in the MacroMAXe Product Description Document.

Feature	Comments
Dynamic Modulation	
BE Scheduling	
NRT-VR Scheduling	
ERT-VR Scheduling	
RT-VR Scheduling	
UGS Scheduling	
Packet Prioritisation	
MIR/CIR	
Automatic Repeat Request (ARQ)	
Sleep Mode	
Idle Mode	
Packing & Fragmentation	
Static Frame Zone Boundaries	
32 SFs per MS	
4096 SFs per Channel	
256 MS per 10MHz Channel	
Network Entry	
QoS Scheduler	
IP CS	
Ethernet CS	
IPv4	

### 6.4 Security Features

The following Security sub-layer features are supported. Details of these features are included in the MacroMAXe Product Description Document.

Feature	Comments
AES Encryption	Subject to export license approval
AES Key Updates	Subject to export license approval
PKMv2	
EAP	

## 6.5 R6 Features

The following ASN-GW Interface (R6) features are supported. Details of these features are included in the MacroMAXe Product Description Document.

<b>Feature</b>	<b>Comments</b>
MS Initiated Controlled Handover	
MS Initiated Uncontrolled Handover	
Profile C	
Static ASN-GW Selection	
GRE (IPv4 on IPv4)	
ASN-GW Initiated Service Flow Provisioning	
ASN-GW Initiated Service Flow Deletion/Change/Creation	
MS Initiated Network Exit	
ASN-GW Initiated Network Exit	
Operator Configured Neighbour Advertisement Lists	
R6 User Traffic VLAN Tagging	
R6 Fragmentation & Reassembly	
PMIP	

## 7 Physical & Powering

### 7.1 Dimensions

MacroMAXe 3x05 (not including handles and connectors for volume calculation)	H x W x D: 40 cm x 34 cm x 15.6 cm
MacroMAXe 2x10 (not including handles and connectors for volume calculation)	H x W x D: 52.7 cm x 34.7 cm x 17 cm
MacroMAXe 0707 (not including handles and connectors for volume calculation)	H x W x D: 52.7 cm x 34.7 cm x 17 cm

### 7.2 Weights

MacroMAXe 3x05 Enclosure (excluding mounting brackets):	17 Kg
MacroMAXe 2x10 Enclosure (excluding mounting brackets):	17.6 Kg
MacroMAXe 0707 Enclosure (excluding mounting brackets):	17.6 Kg

### 7.3 Power

#### 7.3.1 Supply Voltage

-48V DC Nominal	-38V DC to -60V DC Pending on power cable length
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#### 7.3.2 Power Consumption

MacroMAXe 3x05	230 Watts max
MacroMAXe 2x10	370 Watts max
MacroMAXe 0707	370 Watts max

## 8 Environmental, EMC, Safety

### 8.1 EMC

Conducted Immunity (Power Ports):	<p>ETSI 301 489-4 (IEC 61000-4-6) Level 2:  130dBuV, 3V (0.15 to 80MHz)</p> <p>NEBS GR1089:  89 to 80.5 (<math>174.5-7.25\log_{10}F</math>) dBuA rms (0.01 to 0.15MHz)  80.5 dBuA rms (0.15 to 30MHz)</p>
Radiated Immunity (Power Ports):	<p>ETSI 301 489-4:  3V/m (80 to 1000MHz, 1400 to 2700MHz)</p> <p>NEBS GR1089:  138.6 dBuV/m (8.5 V/m) (0.01 to 10000MHz)</p>
Conducted Emissions (Power Supply Lines)	<p>ETSI 301 489-1 Class B</p> <p>NEBS GR-1089 Class B (FCC CFR 47 part 15 Class B)</p>
Radiated Emissions	<p>ETSI 301 489-1 Class B</p> <p>NEBS GR1089 Class A</p>

## 8.2 Lightning / Surge Protection

Network Ports:	ETSI 301 489-1 (IEC 61000-4-5): Line to Ground: 1kV (1.2/50us)  NEBS GR1089: Line to Ground: $\pm 1.5\text{kV}$ (1.2/50us)
DC Power Port	CISPR24 / IEC61000-4-5: Line to Ground: $\pm 0.5\text{kV}$ (1.2/50us)  NEBS GR1089: Line to Ground: $\pm 0.5\text{kV}$ (1.2/50us)
Antenna Ports	NEBS GR1089

**8.3 Environmental**

**8.3.1 Operating Temperature**

Normal Configuration	-40 to +55degC
Sun shield is available and is mandatory at temperatures of 45 degC and up.	

**8.3.2 Storage Temperature**

-40degC to +70degC ambient

**8.3.3 Humidity**

Operation	5% to 100% (ETSI 300 019 1-4 & NEBS GR3108)
Storage	5% to 100% (ETSI 300 019 1-4 & NEBS GR3108)

**8.3.4 Altitude (operational)**

ETSI 300 019 class4.1E: 70 to 106 kPa	
NEBS GR63:	
From -60 m to 1800 m	@40 degree
From 1800 m to 4000 m	@30 degree

**8.3.5 Solar Radiation**

All Variants conforms to ETSI 300 019 1-4 (class 4.1E): 1120 W/m<sup>2</sup>

### 8.3.6 Water Resistance

ETSI 300 019 1-4: Wind Driven Rain (Rain/Wind): 15 mm/min  NEBS GR487
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### 8.3.7 Salt Mist

NEBS GR63/3108 ASTM B117-07
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### 8.3.8 Shock & Vibration

Shock when packaged	ETSI 300 019 1-2 (class2.3) NEBS GR63
Storage unpackaged	Max Drop height 75mm
Earthquake	ETSI 300 019 1-3 NEBS GR63 ZONE 4

## 8.4 Safety

MacroMAXe conforms to UL60950-1/IEC60950 (class 1) in the following hazard areas:

- Electric shock;
- Energy related hazards;
- Fire;
- Heat related hazards;
- Mechanical hazards;
- Radiation;
- Chemical hazards

## 8.5 RoHS Compliance

ROHS5 (up to 2009)  
ROHS6 (from 2010) except North America

## 9 Reliability

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).

	<b>Unit</b>
Period Average MTBF	10.2 years