ADAPTIVE BROADBAND

AB-ACCESS

Technical Report

FCC ID Number xxxxxxxxxxxxxx

Version 0.2

20th April 1999

Adaptive Broadband Ltd.

The Westbrook Center – 1st Floor, Block C1,

Milton Road, Cambridge,

England, CB4 1YQ

1. General Equipment Information.

This device will be marketed and manufactured by Adaptive Broadband as the 'AB-Access' Subscriber Unit (SU). It will operate as an intentional radiator in accordance with the U-NII requirements of FCC part 15 subpart E. Consequently the device must be authorized by grant of Certification, and will be marked with the identification number xxxxxxxxxx. This number will be located on the rear sun-shield label of the transceiver housing, and be preceded by the term "FCC ID:" in compliance with §2.1045, 2.925 and 2.926.

1.1 Summary of RF Parameters.

Transmitter

Type	Single IF, Single Frequency (Time Division Duplex), see below for channels.
Frequency Range	5.15GHz to 5.25GHz, 5.25GHz to 5.35GHz and 5.725GHz to 5.825GHz as per FCC Part 15 subpart E, U-NII LOWER, MIDDLE and UPPER band allocations.
Frequency Channels	There are 5 channels spaced 15MHz apart within each U-NII Band - LOWER : 5.17GHz, 5.185GHz, 5.2GHz, 5.215GHz and 5.23GHz. MIDDLE : 5.27GHz, 5.285GHz, 5.3GHz, 5.315GHz and 5.33GHz. UPPER : 5.745GHz, 5.76GHz, 5.775GHz, 5.79Ghzand 5.805GHz.
Power Output	Complies with FCC Part 15 subpart E, Effective Incident Radiated Power (EIRP) limits : a maximum EIRP of +23dBm, +30dBm and +36dBm for LOWER, MIDDLE and UPPER U-NII Bands respectively.
Local Oscillator Range	4.2475GHz to 4.3475GHz, 4.3475GHz to 4.4475GHz and 4.8225GHz to 4.9225GHz to convert 902.5MHz IF up to required U-NII Band. The LO is synthesized from the crystal reference frequency to an actual frequency 902.5MHz below the desired Frequency Channel stated above.
Intermediate Frequency	902.5MHz
Conversion Oscillator	902.5MHz, synthesized from crystal reference frequency.
Crystal Frequency	25MHz
Modulation	Direct QPSK (raised cosine, $\alpha = 0.35$)
On-Air Data Rate	25Mbits/second

Receiver

Type	Single conversion superheterodyne.
Frequency Range	as above for transmitter.
Frequency Channels	as above for transmitter.
Local Oscillator Range	as above for transmitter.
Intermediate Frequency	as above for transmitter.
Conversion Oscillator	as above for transmitter.
Crystal Frequency	as above for transmitter.

1.2 Construction Details.

The AB-Access Subscriber Unit consists of an externally mounted Antenna Unit, an internally mounted Wall-Box and an exterior grade data cable to connect the two together. The Antenna Unit is an environmentally sealed box containing the radio transceiver module mounted directly onto a system motherboard that includes MODEM, MAC (Media Access Controller) and Ethernet component circuitry. The system motherboard is mounted within a die-cast aluminum housing; the radio transceiver module is connected to an integral antenna, which is fastened to the front of the housing to provide an EMC seal. A protective plastic radome ensures an environmental seal for the front of the unit, whilst the rear of unit is protected from direct sunlight heating effects due to a plastic sun-shield. The completely assembled Antenna Unit is fastened to the Subscriber's wall, rooftop or chimney by means of a 'L' shaped mounting bracket. An external data cable connects the antenna unit to an internally mounted wall-box; the cable contains 4 twisted cable pairs and has a braided foil outer shield. The Wall-Box routes power to the Antenna Unit and enables Ethernet data to be transferred to and from the Subscriber's terminal equipment – typically a PC. A power supply unit is supplied to provide the 48V DC power requirements for the Wall-Box and Antenna Unit.

2. 2.1033(b)(1) Full name and address of the manufacturer :

Adaptive Broadband Ltd.
Westbrook Center – 1st Floor Block C1,
Milton Road, Cambridge, CB4 1YQ.
England.

Adaptive Broadband Ltd. is a California Microwave company. As of 29th April 1999 California Microwave is changing it's name to "Adaptive Broadband Corporation".

Telephone	44-1223-713713
Fax	44-1223-713714
Contact	Peter Simpson, Radio Team Leader.
Contact Number	44-1223-713412

3. 2.1033(b)(2) FCC Identifier.

This device will be marketed and manufactured by Adaptive Broadband as the 'AB-Access' Subscriber Unit (SU). It will operate as an intentional radiator in accordance with the U-NII requirements of FCC part 15 subpart E. Consequently the device must be authorized by grant of Certification, and will be marked with the identification number xxxxxxxxxx. This number will be located on the rear sun-shield label of the transceiver housing, and be preceded by the term "FCC ID:" in compliance with §2.1045, 2.925 and 2.926.

The identification label will also have marked upon it the statement required per §15.19(a)(3).

In accordance with §2.1033(b)(7), please refer to Section 10, page 15, of this report for the FCC Identification label drawing.

4. 2.1033(b)(3) Installation Manual.

Included as Attachment 1 of this report.

5. 2.1033(b)(4) Description of Device Operation.

'AB-Access' is a broadband fixed wireless access network for Internet, data, video and voice applications utilizing the MIDDLE and UPPER U-NII Bands assigned in FCC Part 15 subpart E. The unit complies with the requirements of the LOWER U-NII Band, but the use of this band is restricted to indoor applications only. 'AB-Access' offers network operators the opportunity to build point-multipoint cellular data networks in residential and business neighborhoods. Users connect to the network via a standard Ethernet network interface card and the Subscriber Unit's (SU) internal junction box ('Wall-Box'). The SU supplies standard Internet Protocol (IP) over the Ethernet interface. The SU Antenna Unit communicates over the air to the systems wireless Access Point (AP). The AP connects to the Internet Service Provider via ATM (Asynchronous Transfer Mode) over a wired or wireless backhaul. There may be up to six APs at any given 'Cell-Site' to provide the desired coverage of Users.

Due to the unlicensed nature of the U-NII air interface there is a high risk of interference, this is combated within the network architecture by means of :-

- Frequency agility, providing intelligent channel changing when faced with an interferer. This feature is also used to manage capacity of the network by 'handing-over' an SU from one AP to another at times of high network load.
- Frequency coloring, making use of antenna polarization and frequency channel separation to ensure self-interference is minimal.

'AB-Access' adopts a Time Division Duplex (TDD) access methodology. Each of the data channels is used for both upstream and downstream traffic. This means that use of the channel is very efficient with the spectrum dynamically altering from upstream to downstream according to traffic load within a short turn round time.

Each Subscriber Unit consists of an Antenna Unit containing - antenna, radio, MODEM, MAC and network circuitry, a data cable then connects the Antenna Unit to a Wall-Box and a PC application for installation.

Antenna.

The Antenna Unit incorporates an integral directional patch array antenna mounted inside the environmentally sealed box. The antenna has 18dBi gain and a 3dB 'spot' beam-width of 18 degrees by 18 degrees. The Antenna Unit is directed towards the most appropriate cell sector (AP), positioned to the correct orientation using adjustable brackets. The SU antenna is software configurable between vertical and horizontal polarizations to match the configuration of the appropriate AP, this facility is also used to 'hand-over' SUs between adjacent APs to manage network capacity.

Radio.

The radio transceiver module connects directly to both polarizations of the SU antenna within the environmentally sealed box. The radio has been designed to comply with the requirements of FCC Part 15 subpart E for LOWER, MIDDLE and UPPER U-NII Bands, however 'AB-Access' is marketed for outdoor fixed access applications within the MIDDLE and UPPER Bands only.

The radio transceiver module adopts a single common IF structure for both transmit and receive strips, these switch rapidly between transmit and receive functions to fulfil the TDD requirements of the Media Access Protocols under the control of the MAC circuitry. The transceiver switches both transmitter and receiver into the desired operating band, the specific band being selected by use of an agile, synthesized, main Local Oscillator, again under the control of the MAC. There are 5 channels spaced 15MHz apart within each U-NII Band –

LOWER :	5.17GHz, 5.185GHz, 5.2GHz, 5.215GHz and 5.23GHz.
MIDDLE :	5.27GHz, 5.285GHz, 5.3GHz, 5.315GHz and 5.33GHz.
UPPER :	5.745GHz, 5.76GHz, 5.775GHz, 5.79GHz and 5.805GHz.

The channel frequency is dynamically allocated during normal operation. Each SU monitors adjacent channels both for hand-over potential and for interference. The information collected is returned via the AP to the main network Control Server and is used to switch AP frequencies when necessary. Each AP can be assigned a number of candidate alternate frequencies that can be used depending on the static frequency plan.

An SU may autonomously decide to handover to an adjacent AP if it loses contact with it's own AP or may be requested to handover by network management for load balancing reasons. Each SU measures the performance of the currently selected link to the AP, potential links to adjacent APs and the noise environment on unused channels.
An AGC preamble is transmitted on each downstream frame from the AP; this is averaged over a number of frames by the SU to adapt the receiver gain to deliver a fixed output level into the MODEM ADCs. The SU then uses this information to control the output power of the transmitter accordingly and so removing the requirement for an AGC preamble on the upstream burst. 56dB of AGC/power control is provided by the analogue radio module at a resolution of 2dB, using the DSP within the MODEM enhances the resolution.

MODEM.

On receive, the MODEM decodes the analog signal from the radio to provide a digital bit stream. The MODEM recovers from distortion introduced by the radio channel and provides synchronization with the MAC layer component. A complex correlator and high-speed decision feedback equalizer are used to first synchronize and then improve the channel so maximizing the traffic throughput. The SU implements a digital PLL to acquire frequency lock with the desired AP.

On transmit, the MODEM implements direct QPSK modulation using raised cosine filters ($\alpha = 0.35$) with an on-air data rate of 25Mbits/sec.

MAC.

The Media Access Controller (MAC) Protocol uses a TDMA/TDD access scheme. Each AP and registered SUs operate on a single frequency channel. The frequency channel is time division duplexed (TDD) so that APs and SUs alternate transmissions. A frame structure is maintained by the AP which specifies when each SU will transmit and receive. Data transmissions are made in units of ATM cells (Asynchronous Transfer Mode). A number of cells can be combined into a single physical layer burst.

The MAC layer arbitrates access to the radio channel and corrects over the air errors by re-transmitting cells that are in error. The data units transmitted over the radio channel have checksums that enable detection of any corrupted data bits. All SU terminal data is transmitted in reserved slots, therefore there is no contention for data transmission. A reservation can either be created by the transmission of a request in the reservation request contention slot, or generated periodically for fixed bit-rate connections. The MAC can therefore support a number of different traffic types, and is particularly suited for bursts of data from a large number of users.

Data is scrambled for privacy reasons over the radio channel. The scrambling uses a proprietary algorithm with a dynamically assigned scrambling key generated by the network Control Server at SU registration.

On 'power-up' the SU must receive valid framing data from it's AP and a request to transmit before any power is applied to the transmit circuitry. Transmit and receive timing is under the control of the AP – any deviation from the SU is flagged and the SU is shut down. As a second safety mechanism, the lock detect status of the synthesizer circuits on the radio module are polled – again no power is applied to the transmitter circuitry unless a valid lock signal is detected.

Network Interface.

A network interface component is implemented in software running on hardware circuitry on the system motherboard. The software packs and unpacks Internet Protocol (IP) packets into Ethernet packets, while the hardware connects the SU to a 10BaseT NIC Card on the PC or to an Ethernet Hub.

Data Cable.

The external data cable carries the signal between the internal junction box and the rooftop unit. It also carries power from the inside of the building to the electronics of the Antenna Unit and also an indicator signal from the roof to the junction 'Wall-Box'. The cable is braid and foil screened, quad twisted pair, Cat-5 data cable.

Wall-Box.

The Wall-Box is mounted on an internal wall and provides the SU with a standard TCP/IP connection via an RJ45 socket. The Wall-Box is connected to the Antenna Unit, the power supply and the user's PC or network. For a single PC, it's Ethernet RJ45 NIC card is plugged into the Wall-Box. For multiple PCs, the local PCs are connected together as a LAN through a hub, which is then connected to the Wall-Box. Wall-Box indicators represent the status of the Antenna Unit. The power indicator shows that the electronics are receiving power and the network link indicator that there is communication with the network. The power supply plugs into a wall socket (110Volts, 60Hz) and converts it to 48V DC to supply the Wall-Box, which then routes the supply through to the Antenna Unit.

PC Based Application.

A standard web browser application running on the client PC is used for installation, configuration and troubleshooting. It supplies dialog boxes to configure the security parameters in the SU, and contains a signal meter that helps align the Antenna Unit during set-up. It is possible to configure, manage and troubleshoot the SU over the wireless network.

6. 2.1033(b)(4) Description of Circuit Functions.

The following is a summary of the circuit operation of the 'AB-Access' U-NII fixed access wireless Internet transceiver. Please refer to the block diagrams of figures 1 and 2 of section 7 and the circuit diagrams of Attachment 2 to follow the discussion.

6.1 Antenna.

The 'AB-Access' integral antenna is implemented as a 4 by 4 patch array yielding an 3dB beam-width of 18 degrees in both elevation and azimuth planes, the bore-sight gain is 18dBi. The array employs electrical phase and amplitude tapering to ensure that all side-lobes are suppressed below -15dBc of the bore-sight gain. A dual polarized feed network is employed enabling vertical and horizontal polarization modes to be driven from the radio to improve interference rejection and system network load balancing by means of hand-over to adjacent cells. Two flying leads fitted with SMA plugs enable connection to the transceiver radio module. The antenna is mechanically fastened to the die-cast box and in so doing compresses an EMI gasket to ensure EMI integrity of the unit. A plastic radome (invisible at RF to the antenna radiating elements) is fastened over the front of the antenna array compressing an environmental gasket to assure an environmental seal for the unit.

The antenna is a single item designed and manufactured by a sub-contractor, all artworks and IPR remain the property of the sub-contractor.

6.2 Radio Transceiver Module.

The Radio Transceiver circuitry is a self-contained module that interfaces to the system motherboard at the edge connector P1. It is mechanically fastened to the die-cast chassis to assure reliable connectivity. The SMA connectors J1 and J2 connect to the vertical and horizontal polarization inputs of the passive patch array described above. The radio transceiver circuitry is enclosed within a mechanical shield on the top component side to minimize EMI problems. The underside of the module is fitted with a heat-sink to provide a thermal conduction path to remove heat from the power amplifier circuitry.

6.2.1 Receiver.

RF Receive.

Under control of the MAC, the desired signal is routed through S5 from either J1 or J2 into the ‘diplex’ filter structure of F3 and F4. This structure presents a band-pass response for LOWER, MIDDLE and UPPER U-NII bands simultaneously. The signal is then switched via S4 into the two-stage, low-noise-amplifier (LNA) chain of U5 followed by U3. S3 passes the signal through to the band-switching network of F13, F1, F2 and S1. F1 or F2 is selected by the MAC depending on which U-NII band is required for operation, F1 covers the LOWER and MIDDLE U-NII bands whilst F2 covers the UPPER U-NII band. The common port of S1 connects to the single conversion device of Z1 where the signal is mixed down to the IF of 902.5MHz. The circuitry of Q4 switches the LNA chain rapidly ON and OFF for the TDD turn-round requirements.

IF Receive.

The down-converted wanted receive signal is switched via U30 to amplifier U23, U24 then provides 30dB of digitally switched AGC (again, under the control of the MAC and MODEM) prior to the first channel filter F10. Further amplification and filtering by U22 and F9 respectively increase the selectivity of the wanted signal before quadrature demodulation is performed by U17 at 902.5MHz; the demodulator device also provides a further 25dB of AGC range. U25 and U26 convert the quadrature outputs of U17 from differential to single ended signals to feed to the MODEM ADCs. The switching circuitry of Q7 forces the IF Receive strip amplifiers ON and OFF during TDD operation.

6.2.2 Transmitter.

IF Transmit.

Quadrature outputs from the MODEM circuitry are input to the direct modulator device U19. The modulated output (centered on 902.5MHz) passes through a single step gain control device (U31) before being amplified and filtered by U29 and F6 respectively. 30dB of digital level control can then be applied if desired via U36 before the signal is routed via U30 to the single mixer device Z1. The circuitry of Q6 switches the IF Transit strip rapidly ON and OFF as required.

RF Transmit.

The up-converted transmitter signal passes through the common band-switching network of S1, F1, F2 and F13 prior to being routed to the PA driver stages of U4 and U2. The signal is amplified to the desired level by the Power Amplifier (U11) before being routed via S4, the ‘diplex’ filter arrangement of F3 and F4 through S5, to either J1 or J2 as desired. The level at J1 or J2 is calibrated on manufacturing test so as not to infringe the EIRP requirements of Part 15 subpart E once the antenna gain has been taken into account. The circuitry of U6 ensures that the PA can be switched on rapidly to fulfil the TDD turn-round requirements, at the same time power-up protection is provided by preventing positive supply being applied in the absence of any negative bias on the PA device. The circuitry of Q3 switches the PA driver stages rapidly ON and OFF for the TDD turn-round requirements.

6.2.3 Oscillators.

Reference Oscillator.

A Voltage Controlled, Temperature Compensated, Crystal Oscillator (VCTCXO) of 25.000MHz (Z4) is used as the main reference for the IF and Main Local Oscillators (both synthesized) and the MODEM/MAC operation. Q5 buffers the signal from Z4 to provide enough drive for U12B to square up the signal and pipe it through the interface connector to the MODEM/MAC circuitry on the system motherboard. A frequency offset correction loop is implemented in the MODEM to null out the frequency difference between SU and AP transceivers.

IF Local Oscillator.

U27 synthesizes the reference signal from Z4 to an output frequency of 902.5MHz from the Voltage Controlled Oscillator (VCO) Z2. U33 buffers the signal before F8 rejects 2nd and 3rd harmonics and other spurii and the signal is fed to both demodulator and modulator circuitry of U17 and U19 respectively. Switch U35 is used to isolate the IF Local Oscillator signal from reaching U19 to minimize transmitter to receiver IF leakage whilst in receive mode. The frequency synthesizer IC U27 is programmed to the correct center frequency on start-up by the MAC circuitry, the lock detect output of U27 is monitored by the MAC via U12B – if no lock is detected then transmit functionality is prohibited to comply with §15.407(c).

Main Local Oscillator.

U13 synthesizes the reference of Z4 to the provide the Main Local Oscillator to down-convert the wanted RF channel to a 902.5MHz IF on receive and up-convert the 902.5MHz IF to the desired RF channel on transmit via Z1. Two VCOs are used, one to cover LOWER and MIDDLE U-NII band (Z5) and the other to cover the UPPER U-NII band (Z6). The circuitry of Q1 and Q2 switches the desired band oscillator ON and OFF as required by the MAC. The outputs of Z5 and Z6 are combined using a 'rat-race' combining network before U10 and U9 generate the necessary drive for the frequency doubler Z3. The output of the frequency doubler is first amplified by U7, then filtered using a printed microstrip filter before further amplification by U6 to generate a level of +10dBm to drive the mixer device Z1. The frequency synthesizer IC U13 is programmed to the correct channel center frequency by the MAC circuitry, the lock detect output of U13 is monitored by the MAC via U12B – if no lock is detected then transmit functionality is prohibited to comply with §15.407(c). The channel center frequency is determined as follows :-

$$F_{vco} = (F_{channel} - 902.5\text{MHz}) / 2$$

The following table details the channel, LO and VCO frequencies programmed by the MAC – the U13 (and U27) programming data resides within MAC firmware, the data is embedded within binary registers and therefore no calculation is necessary to generate the correct channel frequency.

Channel	Center Frequency (GHz)	LO Frequency (GHz)	VCO Frequency (GHz)	HEX programming
0	5.17	4.2675	2.13375	01AAD
1	5.185	4.2825	2.14125	01AC5
2	5.2	4.2975	2.14875	01ADD
3	5.215	4.3125	2.15625	01AF5
4	5.23	4.3275	2.16375	01B0D
5	5.27	4.3675	2.18375	01B4D
6	5.285	4.3825	2.19125	01B65
7	5.3	4.3975	2.19875	01B7D
8	5.315	4.4125	2.20625	01B95
9	5.33	4.4275	2.21375	01BAD
10	5.745	4.8425	2.42125	01E45
11	5.76	4.8575	2.42875	01E5D
12	5.775	4.8725	2.43625	01E75
13	5.79	4.8875	2.44375	01E8D
14	5.805	4.9025	2.45125	01EA5

6.2.4 PSU and Interface Circuitry.

Power Supplies.

The system motherboard provides +6V, 0V and –6V supply rails for the radio module to use. Each of these is regulated further to provide transient and EMI isolation between individual radio sections as well as from the system motherboard. U14, U34, U20 and U21 all regulate the +6V rail to +5V, U16 regulates the –6V rail to –5V.

Interface Circuitry.

The control lines to and from the radio are all buffered by U12, U15 and U18 to ensure that the correct drive levels are maintained and to provide some degree of protection, and isolation, from the system motherboard circuitry. U32 is a temperature sensor that measures the radio module temperature enabling dynamic temperature compensation to be performed on the radio by the MODEM/MAC. U28 is a 256 by 8 EEPROM that stores the specific radio module's manufacturing test and calibration data, which is then dynamically acted upon by the MODEM/MAC to ensure conformance to requirements during operation.

6.3 System Motherboard.

The system motherboard contains the MAC, MODEM, Network Interface and Power Supply circuitry on a double sided multi-layer printed circuit board. It is mechanically fastened to the die-cast housing compressing thermally conductive pads to remove the heat generated by the MODEM FPGA devices. The radio connects to the system motherboard at CONN4 and is mechanically fastened via the motherboard to the chassis. Power and network data is routed into the RJ45 interface connector CONN3.

6.3.1 Media Access Controller (MAC) and Support Circuitry.

MAC.

The MAC circuitry is implemented by means of the Xilinx FPGA (U14) and the Virata Helium processor (U1). The Helium device from Virata Ltd. incorporates two 32-bit ARM7TDMI processors – a protocol processor and a network processor, clock generation, reset generation, an SDRAM interface, a peripheral bus, along with Utopia, ADSL/HDLC, USB and 10BaseT Ethernet interfaces. The MAC firmware is embedded within the Xilinx FPGA device and controls the Helium device as well as MODEM and Radio circuit functions. The Helium device doubles an externally provided 20MHz crystal reference to 40MHz which it uses as it's master clock.

Support Circuitry.

4Mbytes of SDRAM is provided within U2, U3, U38, and U39, 2Mbytes of Flash ROM (U4) is used to store the boot code whilst the Xilinx has 64K of SRAM from U5. U9 and U10 are status and control registers respectively; U7 is an EPLD that implements some of the MAC logical functions and Utopia interface decoding. External programming and diagnostic interfaces are provided by U8 (RS232) and CONN1 (JTAG).

6.3.2 MODEM.

Embedded FPGA Firmware.

The MODEM firmware is embedded within four Altera 10K100 FPGA devices :-

U15	-	Input/Output FPGA	-	Pre-emphasis filters Pre-rotation logic AGC MAC Layer interface
U16	-	Correlator FPGA	-	Correlator Digital PLL
U17	-	Feed-Forward Equalizer FPGA	-	Forward equalization path
U18	-	Feed-Back Equalizer FPGA	-	Reverse equalization path Digital PLL Performance analysis logic

Transmit data is passed to the MODEM I/O FPGA from the MAC-Xilinx, this is then digitally filtered (raised cosine with $\alpha = 0.35$) and pre-rotated (to compensate for end-end frequency drift) before passing to the DACs. The emission bandwidth of a nominal 17MHz is derived from the 25Mbits/second data rate and the above filtering and roll-off for QPSK modulation.

On receive, the data arrives at the I/O FPGA from the radio via the ADCs. The data is passed through the processing chain consisting of the correlator, feed-forward equalizer and finally the feedback equalizer before returning to the I/O FPGA. The processed data is then passed on to the MAC-Xilinx device.

The correlator provides a number of metrics relating to the channel, such as the signal delay, rotation, etc. which can be interpreted by the MAC and higher level layers to control the MODEM and subsequently the Radio. The Equalizers reduce the inter-symbol interference introduced by the radio channel to allow the data to be decoded by the MAC layer.

MODEM Clocks.

The stable 25MHz reference from the radio is used to determine the MODEM FPGA clocks. The incoming radio clock is locked to 50MHz by means of a PLL (U31) arrangement and VCO implemented with Q5 and buffered by Q6. The phase locked 50MHz output is divided by two and then two (U27) again to give MODEM FPGAs 50MHz, 25MHz and 12.5MHz - all phase synchronized to the main radio reference.

DACs.

The MODEM generated QPSK In-Phase and Quadrature data is passed in parallel format to the 10-bit output DACs U20 and U19 respectively, the DACs convert the parallel data into a shaped analogue waveform. The differential output from the DACs are then heavily filtered to remove the alias responses and also reduce the wide-band noise floor prior to the radio modulation and up-conversion process. The DACs are clocked at 50MHz.

ADCs.

Receive I and Q data is output from the radio, filtered to remove potential alias responses and also to protect the ADC from compression due to interferers, and then fed to the ADCs – U21 and U22. Once converted to digital bit-streams the I and Q signals are forwarded to the MODEM I/O device for digital signal processing and correlation. U25 provides a 2.5V reference for the ADCs and also the radio module. The ADCs are clocked at 50MHz.

A monitor ADC is provided to measure parameters such as the Radio Module temperature. This information is then fed back to the MODEM and MAC, which alters the radio performance to compensate for the change in temperature.

Network Interface.

As mentioned above the Helium IC (U1) provides four interface options to the outside world – Utopia, ADSL/HDLC, USB and 10BaseT Ethernet. The Subscriber Unit (SU) is configured to deliver 10BaseT standard Ethernet interface to the end user. The 10BaseT output from Helium passes through common mode choke (L10) then the Ethernet/ATM switching relays (RLY1 and RLY2) before a second common mode choke (L12) and out through the RJ45 connector (CONN3). The final twisted pair of the Cat-5 data cable carries status information to be displayed at the Wall-Box.

Power Supplies.

The 48V DC feed via the RJ45 connector from the Wall-Box is choked via L9, filtered and then DC-DC converted to 3.3V/2.5V, 3.3V and 6V by U35, U36, U37 respectively. U32 and U33 further linearly regulate the 6V supply to 5V, U34 generates a negative 6V supply for the Radio Module.

6.4 Data Cable.

The external data cable carries the signal between the internal junction box and the Antenna Unit. It also carries power from the inside of the building to the electronics of the Antenna Unit and also an indicator signal from the roof to the junction ‘Wall-Box’. The cable is braid and foil screened, quad twisted pair, Cat-5 data cable. The data cable is terminated at the Antenna Unit end with an RJ45 interface connector – the cable exit is ‘bunged’ with an EMC grommet to minimize the escape of radiated emissions. The cable is held in place inside the Wall-Box with a ‘punch-down’ Telco connection block. The data cable will be a maximum of 30 meters in length.

6.5 Wall-Box.

6.5.1 Power Source.

The unit is powered from a single 48V (Standard Telecom) supply, which is routed up to the antenna box via one of the Cat-5 cable’s twisted pairs. The 48V DC is derived from a 110V/60Hz AC standard supply.

6.5.2 Wall-Box Indicators.

Status information from the Antenna Unit is displayed on the two wall-box mounted LEDs, these are configured to show that the unit is powered up and that valid TX/RX data is being transceived on the data lines.

6.5.3 Wall-Box PCB.

The Wall-box printed circuit board contains the indicator status LEDs, the ‘punch-down’ Telco style connector to terminate the data cable from the Antenna Unit, the Ethernet 10BaseT connector for the user to connect his PC or network Hub, and finally the power connector socket.

7. 2.1033(b)(5) Block Diagram.

Figure 1 : Radio Transceiver Module.

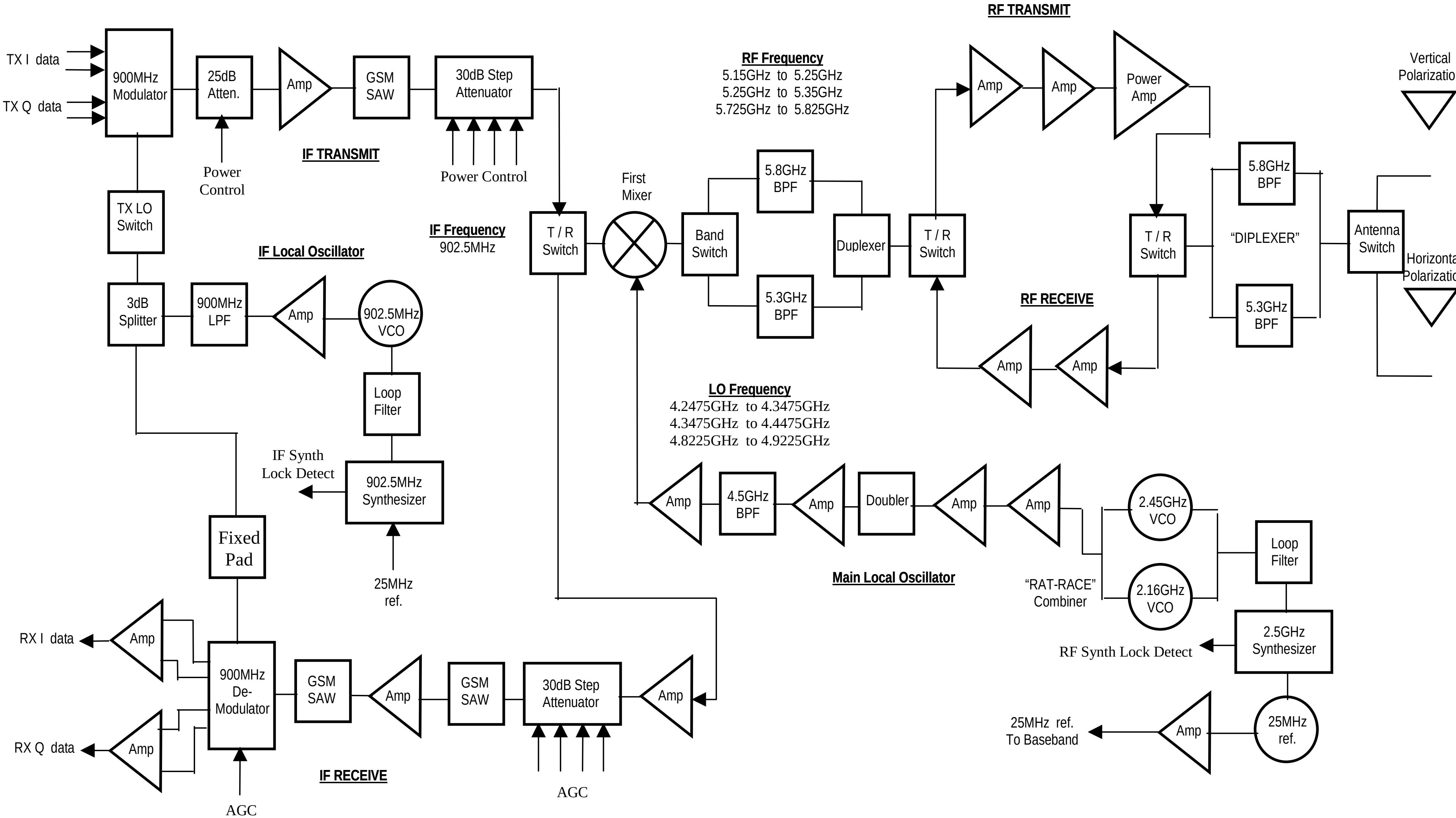
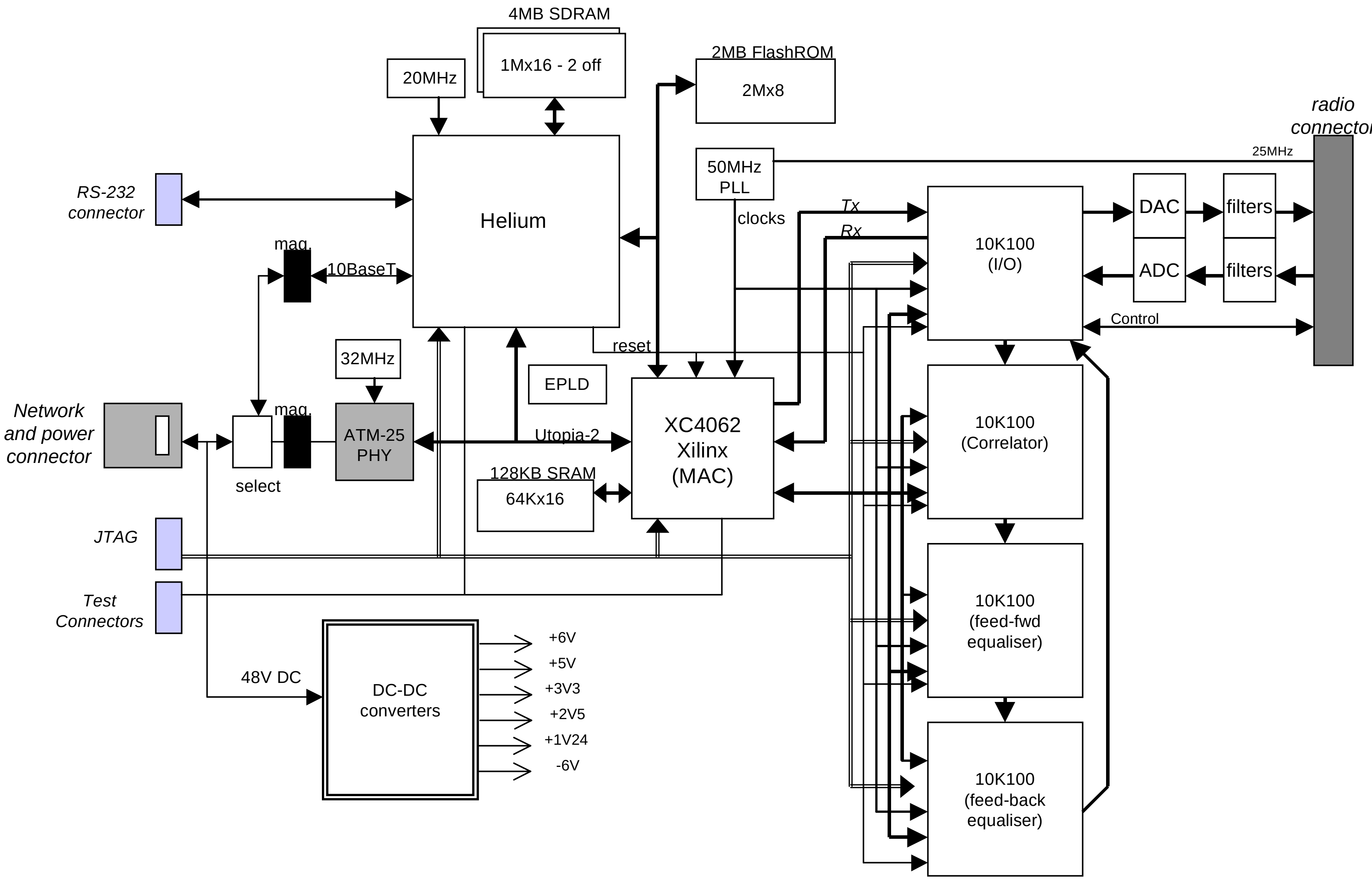


Figure 2 : System Motherboard.



8. 2.1033(b)(5) Transceiver Schematic Diagrams.

The schematic diagrams for the ‘AB-Access’ transceiver are shown in the Attachment 2.

9. 2.1033(b)(6) Test Report.

All testing to demonstrate compliance to FCC Part 15 subparts B and E was performed by RFI Ltd. Since this device does not function as intended unless connected as part of a data network system, it was tested using a standard personal computer (PC) running a program to simulate the actual conditions of use, in order to fully exercise the device for compliance testing. The test report is found at Attachment 3.

10. 2.1033(b)(7) Product Photographs.

Please refer to Attachment 4 of this report for the required product photographs. The FCC Identification label is shown below. Its location is on the rear heat-shield of the device.

11. 2.1033(b)(8) Peripheral Equipment.

The PC described in section 9 was used to exercise the device as per actual conditions of use. The ‘AB-Access’ Subscriber Unit will be sold with the following FCC approved power supply unit Simpro Electronic Co. Ltd. SPU50-9.

12. 2.1033(b)(9) Transitional Provisions.

Authorization for this device is NOT being sought under the transition provisions set forth in §15.37 of the FCC Part 15 rules.

13. 2.1033(b)(10) and (11) Compliance with 15.247(a)(1) or 15.121(a).

‘AB-Access’ does not employ either Direct Sequence CDMA or Frequency Hopping spread spectrum techniques and so does not need to comply with the requirements of §15.247(a)(1). ‘AB-Access’ is also not a scanning receiver and so need not comply the requirements of §15.1221(a).

14. Statement of Certification.

This is to certify that :

1. Except for the radiated and conducted measurements made and reported by RFI Ltd. All other tests and measurements were made under my supervision.

2. This technical report was prepared by me, or under my direct supervision, and to the best of my knowledge and belief, the facts set forth herein are true and correct.

By :

John Porter
Vice President of Engineering
Adaptive Broadband Ltd.

15. List of Attachments.

Attachment 1	:	Installation and Operation Manual.
Attachment 2	:	Schematic Diagrams.
Attachment 3	:	Test Reports for FCC Compliance.
Attachment 4	:	Product Photographs.