MBF4005 3707-3708-3917-3719 Quad Band Fibre Repeater Operational Description

The Axell Wireless MBF4005 repeater is a quad band fibre repeater intended for use with the Axell Wireless OMU2 Optical master Unit. The purpose of the system is to provide distributed radio coverage for the mobile services at 700 MHz, 850 MHz, PCS1900 and AWS1700 cellular system frequencies, as well as in the 5 MHz SMR extension at 850 MHz and 5 MHz G-block extension at 1900 MHz.

Please refer to MBF4005 Repeater – Block Diagram

Equipment Overview

The MBF4050 is a bidirectional amplifier for four different frequency bands. There are four downlink bands (LTE 728-756 MHz, Mobile/SMR 862-894 MHz, PCS/G-block 1930-1995MHz and AWS 2110-2155MHz) and four Uplink bands (Combined LTE 698-716 and 777-787 MHz, GSM/SMR 817-49 MHz, PCS/G-block 1850-1915MHz and AWS 1710-1755 MHz). The equipment is built in a strong cast aluminium chassis which contains the necessary amplifiers, fibre optic transceiver and power supply in a modular format. The different frequency bands are combined at the Antenna Port (Server) via a high performance multiplex filter.

The repeater is controlled by the H481003 Controller Board which is responsible for data gathering and alarm reporting. Each active sub-module is equipped with a PIC microcontroller. The main controller communicates with them over a 4wire communication bus. The controller is equipped with an RS232 Port (LMT – Local Management Terminal) and it can also be connected via Ethernet or USB. Normally controller communication for alarm and status reporting is over the optical fibre via the distant Optical Master Unit.

Fibre Optic Transceiver

The Fibre Optic Transceiver section of the unit (Module J1311001) is a modulator and demodulator between RF signals and Infra-Red Light carried over single mode fibre. The fibre link operates at wavelengths between 1300-1600nm with bidirectional transmission using Wavelength Division Multiplex. Light of 1310 nm is used for downlink between OMU2 and MBF4005 while a wavelength of 1550nm is used to return uplink signals from MBF4005 to OMU2. Since low back reflection is a prerequisite for good performance of Single Mode Fibre Links the connectors employed are type SC/APC – APC denoting Angle Polished Connector and always having a body coloured Green.

Modulated light arriving in the Downlink direction from OMU2 and the Cellular Base Station equipment is demodulated in a PIN Diode Optical Detector (with optical power monitoring and a low frequency supervisory modem circuit using FSK transmission). The DL RF signals are amplified in a 3 stage amplifier having adjustable gain controlled by software programmable attenuators.

RF signals arriving from the Antenna via the Radio boards in the Uplink direction amplitude modulate a distributed feedback (DFB) Laser. The laser is operated in a closed loop power control circuit where a detector diode measures optical output power and provides feedback to maintain constant output.

The fibre optic transmitter is equipped with a pilot tone generator whereby a signal at 1045MHz can be sent over the link with a precisely calibrated injection level. A 1045 MHz detector at the distant fibre optic receiver allows the link loss to be pre-set to a known value in compensation for different fibre optic losses. Optical Loss of up to 10dB is supported.

The fibre optic transceiver has a data communication circuit using a pair of 26/29MHz FSK modems which allows it to communicate with the Optical Master Unit (OMU) over the fibre. The 29MHz FSK circuit passes data from OMU to MBF (downlink) while the 26MHz circuit acts in the reverse direction. The data rate is 57600 Baud. The FSK modem circuit allows the repeater to be monitored and controlled over the fibre from the OMU.

Radio Boards and Power Amplifiers

Downlink RF signals from the fibre optic transceiver are divided in a wideband hybrid coupler after which they pass to the downlink sections of the 700, 850, 1700 & 1900 MHz Radio Boards.

The Radio Boards have amplifier paths which are pre-set for the frequency ranges of interest by multi-pole ceramic filters. The gains of the amplifier chains (approximately 70dB overall) are adjusted by software programmable attenuators. For each downlink frequency band the Radio Board output stages are balanced amplifiers for high linearity. These downlink stages drive external Multiple Carrier Power Amplifiers (MCPAs) consisting of 4 amplifier stages, filters, error correction networks and control electronics.

The UL path in each Radio Board is a chain of amplifiers, filters and attenuators having a similar overall gain to downlink but in this case a 0.5W device is sufficient to drive the uplink input of the Fibre Optic Transceiver. The entire uplink amplifier chain for each frequency band is contained in the appropriate Radio Board – no external amplifiers are necessary. The first stage LNA is chosen for Low Noise Figure and the gain distribution is carefully controlled to preserve this at all gain settings.

Each Radio Board is controlled by a PIC microcontroller which supervises the operation of all circuitry and collects the levels measured by temperature sensors, RF detectors etc. It holds all calibration constants in non-volatile memory.

The outputs of the two uplink paths, from Radio Board for 700 LTE band, 850 GSM band, 1700 AWS Band and 1900 PCS band, are combined by a wideband hybrid coupler. The

common port of the hybrid coupler is connected to the uplink transmitter of the Fibre Optic Transceiver.

Each PIC microcontroller has a unique serial number for communication so that commands can be issued and data polled by the master controller in the OMU. The GUI provided at the OMU controller enables users to view settings and levels and enable or disable frequency bands/paths. Settings for calibration variables (Laser power, detectors, Pre-set RF gain, ALC levels) are held in the PIC EEPROM and are retained at power off. They cannot be changed other than by the Automatic Test Station which calibrates them during production or with the engineering level software tool which is not available to any but Axell Wireless service personnel.

The MBF4005 Repeater is powered by two identical 115V AC Mains Supplies. Total power consumption is approximately 450 Watts with all the four frequency bands at maximum RF output level. The AC power connection is made through a watertight gland in the main case with a 3 wire connection to a sprung terminal block. The unit is supplied with 2x wall mounting brackets which are secured to the main case by M8x10 Bolts.