

2. OVERVIEW/SYSTEM DESCRIPTION

The equipment covered in this manual is a UHF Bi-directional Amplifier (also known as a Repeater). Its main sphere of application is in urban areas where the topography is such that shadows occur in the propagation pattern (for example within large buildings, conference centres and tunnels, etc.)

The Amplifier is a 4-port device for direct connection to two Base facing antennas, usually a highly directional Yagi or similar aligned towards the base (donor) site, and two radiating cable feeders to cover the mobiles. The channel frequencies passed by the Amplifier are set as per the specific customer requirements. In this instance, the channel module frequencies have been 'hard-wired' and so it is not possible to change frequencies without some re-configuration of the channel programming.


The system for which the Amplifier is to be used with is mainly duplex channel UHF radio system but with a single simplex channel. The duplex channels operate constantly in each direction using the Base Antenna port 2 and Radiating Cable port 2. There are five Downlink (Base Transmit) duplex channels and four Uplink (Base Receive) duplex channels. In addition there is the Uplink simplex (talkaround) channel operating via these ports.

The Downlink simplex channel operates through the Base Antenna port 1 and Radiating Cable port 1 ports. This is to avoid any interaction between the common frequency channel high gain paths. Using separate antennas adds the isolation required for the simplex part of the Amplifier to work.

The simplex channels are not constantly operating in their entirety. Instead, each simplex path has the output amplification disabled and when an input is detected in one path that amplifier will be switched on and the other path will be held off until that input signal has stopped. In this way, the simplex part of the system is constantly ready to pass the channel in either path.

The Bi-directional Amplifier consists of six different 19" rack mount 4U chassis. These are a Base side Duplex/PA chassis (AFL part: **50-063702**) to provide the link with Antenna 2 and the remainder of the system. In addition there is a Tunnel side Duplex/PA chassis (AFL part: **50-063705**) to connect the Radiating cable 2 to the remainder of the system. The channel selectivity is made in the Downlink by a Downlink Channel chassis (AFL part: **50-063703**) and in the Uplink by the Uplink Channel chassis (AFL part: **50-063704**). The Downlink simplex channel and part of the Uplink simplex channel circuit is housed in the Simplex chassis (AFL part: **50-063706**) and there is a Power Supply chassis (AFL part: **50-063707**) to provide the DC supply to each of the five RF units.

The Bi-directional Amplifier is housed in a single 38U 19" rack. All external connections are made towards the bottom of the rear of the rack suitable for cable entry via cable ducts through the open underside of the rack. External connections are for the 110V AC input, four 'N' type female RF connectors and a Krone block for the alarm output.

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For better understanding of the system, the system diagram on page 23 should be consulted.

Downlink path

Duplex system signals in the Downlink path arriving at Base Antenna port 2 are first passed to the Base side chassis and so through a duplexed bandpass filter to ensure good input selectivity. This is then followed by a 31dB gain LNA to provide some amplification and a switchable attenuator then allows up to 30dB of gain adjustment in 2dB steps.

From here signals are routed to the Downlink Channel chassis where a 2 way splitter is followed by two three way splitters to provide six equal paths. One of these is terminated with a 50ohm load and the remaining five each connect to a channel selectivity module. The Downlink channel modules offer 15dB gain and have ALC circuitry to limit the module output to -25dBm. This is ensure that the total output power may not become higher than the specified level. The channel module outputs are taken to two three way combiners for connection to a two way combiner which then routes signals out of the Downlink Channel chassis and to the Tunnel side chassis.

The Downlink duplex channel frequencies factory set are:

457.050MHz

458.225MHz

457.850MHz

457.300MHz

457.775MHz


In the Tunnel side chassis a 21dB gain LNA is then followed by a 15dB gain LPA to drive a 23dB gain 20Watt Power Amplifier which provides the final stage of amplification. The Power Amplifier is followed by a duplexed bandpass filter connecting to the Radiating cable port 2.

The Downlink simplex channel, 452.850MHz, is received at Base Antenna port 1 and is passed through a bandpass filter to provide selectivity. A 31dB gain LNA then provides initial amplification and this is followed by a switchable attenuator giving up to 30dB of gain adjustment in 2dB steps. An ALC attenuator is then fitted for muting the input of the channel module when an Uplink path signal has been detected and is being amplified in that direction. The channel module following the attenuator has 15dB of gain and has ALC circuitry to limit the module output to -20dBm to limit the total output power to that specified in case of an increase in off-air signal input. The channel module is followed by a 31dB gain LNA and then a 15dB gain 1Watt LPA. A bandpass filter after the LPA connects to the Radiating cable port 1.

Uplink path

All Uplink channels enter the Bi-Directional Amplifier at Radiating Cable port 2 and pass to the Tunnel side chassis where a duplexed bandpass filter routes the signals to the Uplink input amplifier, a 31dB gain LNA. A switchable attenuator then gives up to 30dB of gain adjustment in 2dB steps before signals connect to the Uplink Channel chassis.

In the Uplink Channel chassis, a 2 way splitter connects to two three way splitters to provide six equal paths. One of these is unused and so is terminated with a 50ohm load. Four of the remaining paths each connect to a channel selectivity module giving 15dB gain with an ALC limited maximum output of -23dBm. The four module outputs then connect to a four way combiner for routing to the Base side chassis. The last of the six paths is routed to the Simplex chassis which will be described later in this section.

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The Uplink duplex channel frequencies are factory set:

452.050MHz

453.225MHz

452.300MHz

452.775MHz


The four Uplink duplex channels arrive in the Base side chassis and pass through a 21dB gain then a 15dB gain LPA driver before a 23dB gain 20Watt Power Amplifier. There is an isolator fitted at the PA output to provide protection from the Uplink simplex channel path. A 2 way combiner then combines the four duplex channels with the simplex channel and a bandpass filter then connects to the Base Antenna port 2.

In the Simplex chassis, the Uplink path from the Uplink Channel chassis is first routed through two ALC attenuators to mute the input to the Uplink channel selectivity module when a Downlink simplex signal is being passed in the other path. A channel selectivity module, set for 452.850MHz, then gives 25dB of gain and has an ALC level of -17dBm. The module is followed by a 31dB gain LNA and then a 15dB gain LPA with an isolator at the output to provide protection from the duplex path PA. The Uplink simplex signal then connects to the Mobile side chassis for routing to the 2 way combiner.

The Power Supply Unit operates from an AC supply of 110V and has a 7.5Ampere circuit breaker to switch the chassis On or Off. A 15A filter then provides some protection against instabilities in the AC supply. There are two 400Watt PSU modules fitted and the outputs of these are distributed to six 24V DC output sockets at the rear of the Power Supply chassis.

The RF connectors used for user interface are 'N' type female and interconnecting RF chassis connectors are SMA female. Each of the five RF chassis has a DC input fuse and the front panels have a green 'Power ON' LED and a red 'Alarm' LED. The Power Supply chassis has a single green 'Power ON' front panel LED.

Each chassis has a summary alarm output connecting to the Krone block at the lower rear of the rack for user interface. In addition, the 19" rack has intruder alarms fitted to the front and rear doors of the rack. The alarm outputs may be connected to singly or in parallel as a rack summary. The alarm outputs are voltage free dry contacts being Closed in normal operation and Open in an Alarm state.

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