Eclipse2

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E2-IP- PA500BH Amplifier

Operation and Maintenance Manual

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WARNING

Changes or modifications not expressly approved by RF Technology could void your authority to operate this equipment. Specifications may vary from those given in this document in accordance with requirements of local authorities. RF Technology equipment is subject to continual improvement and RF Technology reserves the right to change performance and specification without further notice.

1 Operating Instructions

The IP•PA500BH is part of the Eclipse2 range of modular base station equipment. It is a broadband Solid State Internet Protocol RF Power Amplifier (SS•IP•PA) capable of delivering over 100 Watts in the UHF frequency range. It is designed to complement the Eclipse2 Software Defined Radio (SDR), and mounts in a standard Eclipse sub-rack.

1.1 Installation

There are no front panel controls. In normal circumstances no alignment or setup is required. If mounted in a sub-rack that has not previously been wired for a power amplifier, the rack connector must be wired according to the guidelines in section 1.1.1 below.

1.1.1 Sub-rack Wiring Guidelines

When installing an Eclipse Power Amplifier in an Eclipse sub-rack, observe the following guidelines for sub-rack installation:

The sub-rack power supply must be capable of delivering the full current requirements for all modules fitted in the sub-rack, typically 20 Amperes for a 100W basestation/amplifier.

Owing to the current drain, power supply lines should be cabled to the power amplifier separately and using heavy gauge wire to minimise voltage drop and interference via the power supply of other modules in the rack.

1.2 Front Panel Indicators

PWR LED The power (PWR) LED shows that the dc supply is connected to the amplifier.

RFO LED The RF output (RFO) LED indicates that the amplifier is being driven and there is forward RF power present at the output.

ALARM LED The alarm (ALARM) LED illuminates if the internal temperature rises above safe limits or high reverse power is present, output power is automatically reduced in order to protect the amplifier.

1.3 Internal Adjustments

All internal adjustments are factory set and should not need to be changed under normal conditions. A possible exception to this is the RF output power level which may need to be changed to comply with local licensing requirements.

WARNING

Ensure that the power setting complies with the requirements of your licensing authority. Failure to do so may result in penalties being imposed by the licensing authority.

Output Power The output power is set by RV1. This is nominally set to 100 Watts (+50dBm), but may be set to any value between 1 and 120 Watts depending upon local regulations in the destination country, and the model of power amplifier.

1.4 Amplifier I/O Connections

The IP•PA500BH has four connectors on the rear panel.

1.4.1 RF Input

The RF drive is delivered via the BNC connector. Input drive level is 2 Watts, the absolute maximum power that should be applied to this connector is 4 Watts.

1.4.2 RF Output

The RF output signal is available from an N-type connector. The input/output impedance is 50 ohms.

1.4.3 25 Pin Connector

The 25-pin "D" connector provides connection to ground and dc power. The pin connections are given in table 1.

1.4.4 RJ45 Ethernet Connector

The RJ45 connector is used to monitor and configure a range of parameters remotely using the Internet Protocol over Ethernet.

Pins	Function
1, 2, 3, 4, 14, 15, 16, 17	Positive supply
9, 10, 11, 12, 13, 22, 23, 24, 25	Ground (negative supply)

Table 1: Pin connections for the 25 pin "D" connector on the rear panel

2 Circuit Description

The following descriptions should be read as an aid to understanding the diagrams shown in figures A.1 and A.2.

2.1 Amplifiers

The RF power amplification is provided by two RF MOSFET modules, U15 and U16. Module technology is used in this amplifier to guarantee superior reliability, this technology has been field proven in tens of millions of radios over the past 25 years. Each module is rated at 60 watts output. The input and output impedances are internally matched to 50 Ohms. The 50W models have only has module fitted.

No trimmer capacitors or inductors are used for input/output matching, the broadband design means no re-adjustment is required even if the frequency is changed from one end of the band to the other.

The dc supply is fed to the amplifiers through resistors R166 and R167. This allows the current of each amplifier to be monitored.

2.2 Power Splitter / Combiners

In the 100W models, a zero-degree broadband splitter and zero-degree hybrid power combiner is used to parallel the two amplifier stages. This configuration provides a very wide bandwidth and better balance compared with lower cost 90-degree hybrids.

2.3 Directional Coupler

The forward and reverse power components are measured through an asymmetric stripline directional coupler. The output of the coupled lines measured by two temperature and frequency compensated detectors.

2.4 Low Pass Filter

A low pass filter consisting reduces the harmonic components to less than -90dBc. The filter uses shielded lumped elements to obtain the required harmonic attenuation.

2.5 Power Control Circuits

The forward and reverse voltages from the directional coupler are amplified and combined in the ALC error amplifier.

The Error amplifier compares the detected voltages with the dc reference voltages from output power trimpot RV1 and reverse power trimpot RV2. The amplified difference is used to control the output power of the RF MOSFET Modules.

Equipment Type	Key Specifications
Power Supply	13.8Vdc, 25A
RF Source	2 Watt (eg. Eclipse2 Basestation)
RF Load / Attenuator	50Ω, 100W, SWR<1.2:1
RF Power Meter	eg. calibrated detector and voltmeter
Short Circuit	N-type, 0Ω, 100W Short

Table 2: Standard test equipment for the IP-PA500BH Power Amplifier

2.6 RF Output Indicator

The forward power voltage is compared with a pre-set dc reference voltage by U23. The output of U23 is used to turn on the RFO LED. The reference voltage is set to turn on the led when output power is between 1-120 Watts.

2.7 Over Temperature Protection

Thermistors RT1 and RT2 are mounted to the case of RF module U15 and U16. If either module case temperature rises above 85 Celsius the resistance of RT1 or RT2 increases and Q25 or Q26 is turned ON.

This causes the TEMP LED to come on and also reduces the dc reference voltage to the output power error amplifier U22. The output power will then be reduced by the amplifiers ALC circuits and the modules are kept within safe operating limits.

3 Field Alignment Procedures

3.1 Output Power Level and Reverse Power Limit

1. Set the unit up on a bench with the standard test equipment listed in table 2.
2. Set *RV1 fully counter-clockwise and *RV2 fully clockwise.
3. Set the Eclipse2 basestation to the desired operating frequency.
4. Adjust RV1 for the desired output power.
5. Disconnect power and swap load with the N-type short.
6. Set *RV2 both fully counter-clockwise.
7. Apply Power and adjust *RV2 for maximum reverse power *(Typically 25Watts)*.

3.2 Tuning Procedure

No further Tuning or Adjustment is required.

**(Note: RV1 and RV2 may be replaced with fixed value resistors R279, R153, R154, R155 and R156)*

4 Specifications

4.1 General Specifications

IMPEDANCE…….. Input: 50Ω / Output: 50Ω

OPERATION MODE…… FM / CW

OPERATING VOLTAGE……..12 Volts

OPERATING FREQUENCY…… 450 - 520MHz

INPUT DRIVE……..2 Watts

TYPICAL GAIN…… 17 dB

GAIN FLATNESS (440-520MHz)…… ±0.25 dB

HARMONIC AND SPURIOUS ATTENUATION…….. -90 dBc *(exceeds FCC requirements)*

MAX OUTPUT VSWR (100W OUTPUT)……... 3:1

MAX INPUT DRIVE……..4.0 Watts

MAX VOLTAGE…… 15.2 Volts

OPERATING TEMPERATURE RANGE……... -20 to +50 C *(ambient temperature)*

STORAGE TEMPERATURE……... -40 to +95 C

OPERATING HUMIDITY……..0 to 85% RH *(non-condensing)*

STORAGE HUMIDITY…… 0 to 95% RH *(non-condensing)*

MONITORING & CONTROL…….. TCP/IP *(SNMP 2c)*

4.2 Physical Configuration

The power amplifier is designed to fit in an RF Technology sub-rack within a 19" rack frame. The installed height is 4 Rack Units (RU), or 178mm, and the depth is 350mm. The amplifier is 95.25mm or three Eclipse units wide. The amplifier uses an extruded aluminum heat sink with vertical fins. Heatsink temperature rise is typically 25C at 100W output.

4.3 Front Panel Indicators and Test Points

4.3.1 Indicators

Power: Green LED

RF Power: Yellow LED

Over Temperature/High Reverse: Red LED

4.3.2 Test Points

No conventional test points *(test points available over SNMP).*

4.4 Electrical Specifications

4.4.1 Power Requirements

Operating Voltage: 10.5 - 15.2 Volts *(output power reduced below 12.5V)*

Current Drain: 22 Amperes maximum (20 typical) at 100 Watts and 13.5 Volts, 350mA maximum standby.

Polarity: Negative Ground

4.4.2 Frequency Range

Model	Frequency Range
IP•PA500BH	450-520MHz
IP•PA500B	450-520MHz

4.5 Antenna Impedance

Nominal load impedance is 50 Ohms VSWR 1.5:1 or better. The IP•PA500BH will operate with a VSWR of 3:1 at all phase angles. The forward power will reduce as reverse power rises above acceptable limits.

4.6 Output Power

Nominally 50/100 Watts, adjustable from 1 to 120 Watts. Gain is typically 17dB.

4.6.1 Transmit Duty Cycle

The transmitter is rated for 100% duty cycle (continuous operation) at 100W output for air temperature below 50C. De-rate linearly above 50C to 50% at 70C.

4.7 Spurious and Harmonics

Less than 1 μW at any harmonic of the transmit frequency *(-90dBc)*.

4.8 Heatsink Temperature

The heatsink temperature can rise to 80C without affecting operation, except for de-rating based on air-temperature as noted in section 4.6.1 above. Shutdown will occur at heatsink temperatures exceeding approximately 85C.

4.9 ALC Output

ALC circuits are internal to the power amplifier and no output is required for operation. (*Note: legacy compatibility with Eclipse1 Series is supported without the ALC connection)*

4.10 Connectors

4.10.1 RF Input

The RF drive is delivered via a BNC connector. The maximum power that should be applied to this connector is 4 Watts.

4.10.2 RF Output

The RF output signal is available from an N-type connector.

4.10.3 25-Pin Connector

A 25-pin, D-shell ("D"') connector is mounted on the rear panel. It provides power connections only. The pin connections are given in table 1.

4.10.4 USB Connector

A front-panel, Universal Serial Bus connector (Type A) provides fast configuration and firmware upgrades.

A Engineering Diagrams

A.1 Block Diagram

Attachment A.1 shows the signal flow diagram of the IP PA500BH amplifier.

A.2 Circuit Diagrams

Attachment A.2 shows the chassis wiring diagram of the amplifier.

RF Exposure.
This amplifier constitutes part of a RF transmitting system that both the FCC and Industry Canada has established RF exposure requirements for. In order to comply with the RF exposure requirements of both countries the transmitting antenna must maintain a specific physical separation from all persons.
The antennas for this device usually are mounted on outdoor permanent structures and the installer must see that the separation distance be maintained. The RF exposure report was written for one typical power output and antenna gain. If your situation is different than the one described your minimum separation distance will be different. RF exposure takes into account many different contributing factors some of which are: power output, system losses, coax cable losses, and antenna gain.
For a typical installation of a 3 dBi antenna and 120 W UHF band (450-512 MHz) transmitter. Operated in a radio system were the average ratio of transmit to receive time is near 100% transmitting the separation distance would be 2.2 meters or approximately 7 feet. This separation distance also does not take into account any other transmitters that might be considered co-located at the same site.
An RF exposure report was prepared for this amplifier and in it are the typical calculations on which the above is based.