Section 4. Principles of Operation

4-1 Introduction

This section contains a functional description of Powerwave Technologies Inc.'s, Booster Amplifier Subrack (BAS) system. Refer to Figure 4-1 for the system's functional block diagram.

4-2 RF Input Signal

The maximum input power for all carrier frequencies to the system should not exceed the limits specified in Section 1, Table 1-2.

4-3 RF Output Load

The load impedance should be as good as possible (VSWR of 1.5:1 or better) in the working band for good power transfer to the load. If the amplifier is operated into a filter, it will maintain its distortion characteristics outside the signal band even if the VSWR is infinite, provided the reflected power does not exceed one Watt. A parasitic signal of less than one-Watt incident on the output will not cause distortion at a higher level than the normal forward distortion (i.e. –65 dBc).

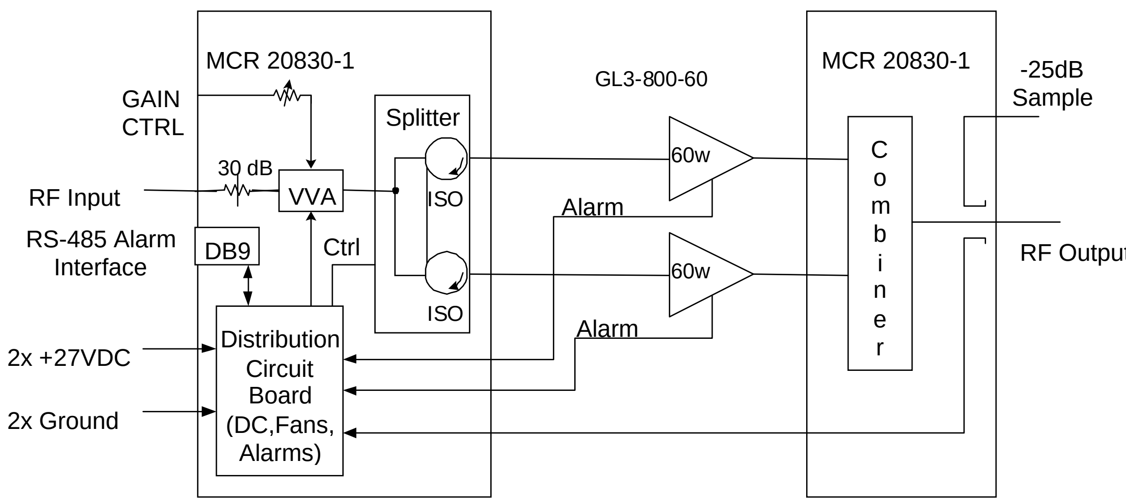

Figure 4-1 System Block Diagram

4-4 System Functional Discription

Designed as a subrack for installation in a 2-way transceiver paging base station, the BAS system is comprised of a MCR20830-1 Booster Amplifier Subrack (BAS) and two G3L-900-60 plug-in multi-carrier power amplifiers (MPCAs).

Additionally, the BAS houses a two-way power splitter/combiner and a distribution printed circuit board (PCB). Refer to Appendix A for pinout locations. The RF IN, RF OUT, +27 Vdc and the ALARM summary connector, interface with the host system via front panel cabling.

The RF input signal is split equally and applied to the plug-in amplifiers. The output from each amplifier is an amplified composite signal of approximately 60 Watts before combiner losses. All phase and gain corrections are performed on the signal(s) in the individual amplifier. The amplifier outputs are fed to a power combiner and combined to form a composite RF output of up to 91 Watts after combiner losses. Refer to Figure 4-1 for the System Functional Block Diagram.

The distribution printed circuit board (PCB) assembly is used to distribute power to the BAS system's internal components. The PCB circuit is a DC/DC converter designed to convert the +27 Vdc input to +12 Vdc and +15 Vdc. Refer to Appendix B for pinout location.

4-5 Multi-Carrier Power Amplifier (MCPA) Functional Description

The MCPA is a linear, feed-forward multi-carrier power amplifier that operates in the 5 MHz frequency band from 869 MHz to 894 MHz at an output power 60 Watts. Each amplifier is a self-contained module and is functionally independent of the other MCPA in the system. The amplifiers are designed for parallel operation to achieve high peak power output (refer to Table 1-2 for MPCA power specifications). Each MCPA has an alarm board that monitors the amplifier performance. If a failure or fault occurs in an MCPA, it is transmitted to the host system via the D-subminiature 21WA4 connector at the rear of the module. A warning light (LED), which is routed from the amplifier via the J7 connector on the PCB to the front panel of the BAS, will illuminate. The indicator LEDs are identified as Alarm 1 and Alarm 2 which corresponds to their respective amplifier..

The amplifier is compliant to the requirements of FCC Part 22 with respect to spurious emissions. Constant gain is maintained by continuously comparing active paths with passive references, and correcting for small variations through the RF feedback controls. All gain variations, for example those due to temperature, are reduced to the passive reference variations. The amplifier is comprised of: A preamp
A driver amplifier
A main amplifier
An error and pre-error amplifier
Alarm monitoring and control

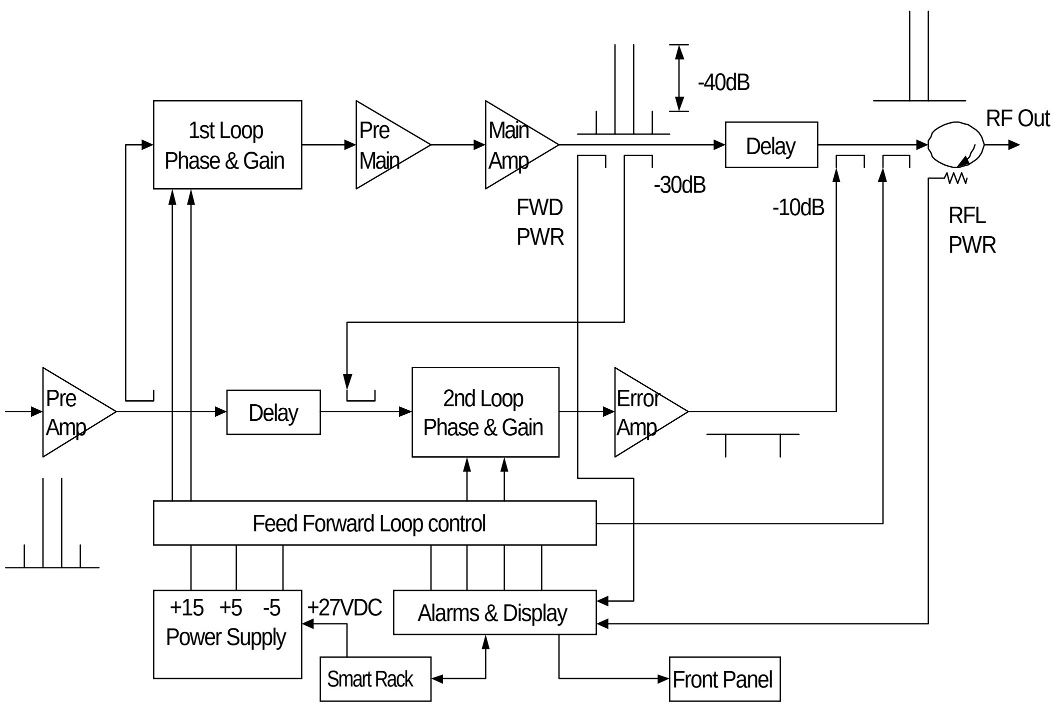

Figure 4-2 Multi-Carrier Power Amplifier Functional Block Diagram

4-5.1 Pre-driver Amplifier

The input of the amplifier uses two stages of class AB amplification which provide approximately 13.5 dB of gain in the 5 MHz frequency band from 869 MHz to 894 MHz. The amplifier operates on +27 Vdc.

4-5.2 Three-Stage Driver Amplifier

The input of the amplifier uses three stages of class AB amplification which provide approximately 32 dB of gain in the 5 MHz frequency band from 869 MHz to 894 MHz. The amplifier operates on +27 Vdc, and a bias voltage of +5 Vdc. The logic controls the +5 Vdc bias voltage that shuts down the amplifier.

4-5.3 Main Amplifier

The signal provides approximately 11 dB of gain in the 869 to 894 MHz frequency band. The output from the main amplifier is typically 60 Watts. The main amplifier operates on +27 Vdc, and a bias voltage of +5 Vdc. The alarm logic controls the +5 Vdc bias voltage that shuts down the amplifier.

The main amplifier employs class AB amplification for maximum efficiency. The error amplifier and feed forward loops are used to correct signal non linearities introduced by the class AB main amplifier. The error amplifier operates in class A mode. The RF input signals are amplified by a preamp and coupled to an attenuator and phase shifter in the first feed-forward loop. The main signal is phase shifted by 180 degrees and amplified in the premain amplifier. The output from the premain amplifier is fed to the class AB main amplifier.

The signal output from the main amplifier is sampled using a coupler, and the sample signal is combined with the main input signal and input to the second feed-forward loop. The error signal is attenuated, phase shifted 180 degrees, then fed to the error amplifier where it is amplified to a level identical to the sample output from the main amplifier. The output from the error amplifier is then coupled back and added to the output from the main amplifier. The control loops continuously make adjustments to cancel out any distortion in the final output signals.

4-5.4 Alarm Monitoring and Control

During routine operation, all normal variations are automatically compensated for by the feed-forward loop control. However, when large variations occur beyond the adjustment range of the loop control, a loop fault will occur. When this happens, the ALARM LED is illuminated on the front panel of the subrack. The fault is transmitted back to an external summary module via the external ALARM interface connection on the front panel of the subrack.

4-5.5 Loop Control Circuit

The primary function of the first loop is to provide an error signal for the second loop. The primary function of the second loop is to amplify the error signal to cancel out spurious products developed in the main amplifier. The input signal is amplified by a preamplifier and fed to a coupler and delay line. The signal from the coupler is fed to the attenuator and phase shifter in the first loop. The first loop control section phase shifts the main input signals by 180 degrees and constantly monitors the output for correct phase and gain.

The second loop control section obtains a sample of the distortion added to the output signals by the main amplifiers. The signal is phase shifted 180 degrees, then fed to the error amplifier where it is amplified to the same power level as the input sample. The signal is then coupled to the error signal on to the main output signal. The final output is monitored by the second loop and adjusted to ensure that the signal distortion and intermodulation distortion (IMD) on the final output is cancelled out.

4-6 Amplifier Module Cooling

Although each amplifier contains it own heat sink, it is cooled by forced air. Two fans mounted on the front of the subrack are used for forced air cooling and redundancy. The fans draw air through the front of the system and exhaust hot air out the back. The fans are field replaceable. Each amplifier, when properly cooled, will provide sufficient cooling to maintain the amplifier within the specified operating temperature range. Six inches of free space are required at both the front and rear panels of the subrack to allow adequate air volume to circulate over the heat sinks.

4-7 Power Distribution

Primary DC power for the amplifier is provided by the host system. The amplifier module has a DC/DC converter and voltage regulator that converts the +27 Vdc to +15 Vdc, +5 Vdc, and +8 Vdc for internal use.