Section 4. Principles of Operation

4-1 Introduction

This section contains a functional description of the G3L-1929-120 Multi-Carrier Power Amplifier (MCPA).

4-2 RF Input Signal

The maximum input power for all carrier frequencies to the amplifier should not exceed the limits specified in the appendix A specifications.

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).

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

The MCPA is a linear, feed-forward multi-carrier power amplifier that operates in the 60 MHz frequency band from 1930 MHz to 1990 MHz (refer to table 1-4 for amplifier specifications). The amplifier provides a gain of 60 dB to provide a typical output of 70 watts (48.8 dBm). Refer to figure 4-1 for the amplifier functional block diagram. Each amplifier is a self-contained module and is functionally independent of any other MCPA in a system. The amplifiers are designed for parallel operation to achieve high peak power output. Each MCPA has an alarm board that monitors the amplifier performance. If a failure or fault occurs in an MCPA, it is transmitted to a subrack system via the D-subminiature 21WA4 connector at the rear of the module. The subrack reports all alarms to the host system.

Continuously comparing active paths with passive references, and correcting for small variations through RF feedback controls maintain constant gain. All gain variations, for example those due to temperature, are reduced to the passive reference variations. The amplifier consists of the following major functions:

- Preamplifier
- Main amplifier
- Error amplifier
- Alarm monitoring and control
- First and second loop control circuits
- Pilot tone generator

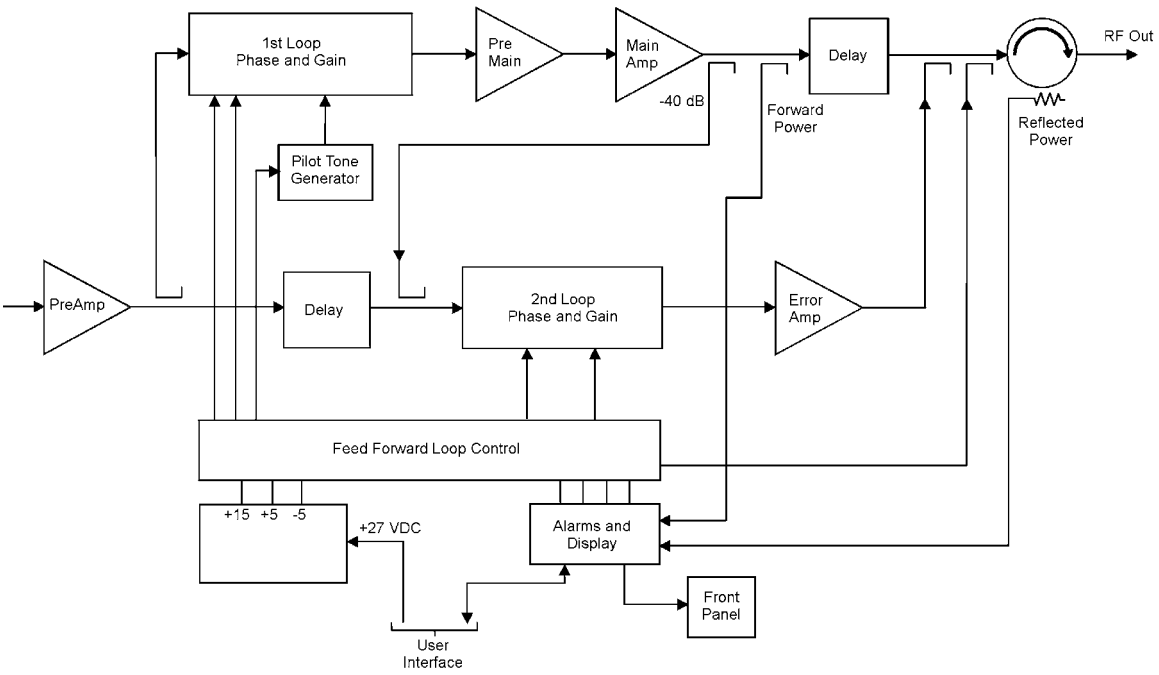

Figure 4-1 Multi-Carrier Power Amplifier Functional Block Diagram

4-4.1 Preamplifier

The carrier is applied to the input port of the amplifier. This signal is fed to the preamplifier stage where it is amplified using two stages of class A mode amplifiers. The output of the preamplifier is then split into two paths, one to the main amplifier and one to the error amplifier.

4-4.2 Main and Error Amplifiers

The main amplifier provides approximately 14.5 dB of gain in the 1930 to 1990 MHz frequency band (refer to table 1-2 for amplifier specifications). The main amplifier employs class AB amplification for maximum efficiency. The error amplifier and feed forward loops are used to correct signal non-linearity's introduced by the class AB main amplifier. The error amplifier operates in class A mode. The RF signal from the preamp is coupled to an attenuator and phase shifter in the first feed-forward loop where it 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.

4-4.3 Alarm Monitoring and Control

The alarm logic controls the +5 Vdc bias voltage that shuts down the amplifier. 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 occurs. When this happens, an alarm indicator 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.

4-4.4 First and Second Loop Control Circuits

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 of the main amplifier output. 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.

4-4.5 Pilot Tone Generator

The basic idea of injecting a pilot tone is that if the pilot signal is suppressed, then the distortion from the main amplifier is also suppressed. To accomplish this, the pilot tone generator signal is injected into the first loop and then detected at the feedforward output using the original pilot tone as a reference. The information is then fed back to control the gain and phase such that the output distortion is minimized.

4-5 Amplifier Module Cooling

The amplifier is cooled by forced air flowing over its heat sink, which is provided by two fans mounted on the front of the subrack. 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, maintains 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.

4-6 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 -5 Vdc for internal use.