

1-1 General Description

Engineered to operate in a 2-way transceiver paging base station, the BAS system is a linear, Multi-Carrier Power Amplifier (MCPA) system that operates in the 5 MHz frequency band from 935 MHz to 940 MHz. The system integrates the model MCR20930-1-2 Booster Amplifier Subrack (BAS) with two model G3L-900-50-005 MCPAs to deliver a composite RF output of 75.8 Watts (nominal), after combined losses. The system can also integrate two model G3L-900-60-005 MCPAs to deliver a composite RF output of 91 Watts (nominal), after combined losses.

Designed to function as a subrack (see Figures 1-2 thru 1-6) in the host base station, the enclosure has a one inch (right and left side) flanged front panel and eight mounting holes (four on each side) to secure the Subrack into place (refer to Figure 1-3 for mounting hole locations). To aid in maintaining the system's operating temperature, the BAS is equipped with two cooling fans mounted on the front access door (see Figures 1-3 and 1-4). The G3L-900-50-005 amplifier displaces 1,672 BTUs of heat at full power. The G3L-900-60-005 amplifier displaces approximately 1,900 BTUs of heat at full power.

The composite input signal is applied to a 30dB 10W input attenuator, followed by a voltage variable attenuator that is controlled via dip switches on the front panel (refer to Table 1-1 and Figure 4-1). The maximum composite input signal may not exceed +31dBm. The composite signal is then fed to a two-way power splitter. The signals are applied to the amplifiers, and the amplifier outputs are combined again (refer to Tables 1-2 through 1-7 for specifications). With both amplifiers installed, the system provides 20dB of gain.

The BAS also houses a distribution printed circuit board (PCB) for internal power and alarm distribution (refer to Appendix B). Accessible from the front panel is the DB9 external ALARM connector, the RF IN and RF OUT type N connectors.

Additionally, the front panel provides access to the +27 Vdc POWER IN connector, visibility of the two MCPA's fault alarm LED indicators and the GAIN CTRL dip switch. Refer to Table 1-1 for the dip switch truth table and Figure 1-1 for pin designations.

With the access door open, the two amplifier modules are visible. All solid-state, the MCPAs are designed for parallel operation for high peak power output. Their modular construction and unique and highly effective LED-based operational status and fault indicators help minimize downtime. The turn-on and turn-off sequence of voltages are fully automatic, as is overload protection and recycling. Inadvertent operator damage from front panel manipulation is virtually impossible. Refer to Figures 1-7 and 1-8 for drawing views of the amplifier module.

Table 1-1 Truth Table Input Variable Attenuator

Pin 1	Pin 2	Pin 3	Pin 4	Attenuation
+5Vdc	+5Vdc	+5Vdc	+5Vdc	0dB
+5Vdc	+5Vdc	+5Vdc	0Vdc	1dB
+5Vdc	+5Vdc	0Vdc	+5Vdc	2dB
+5Vdc	+0Vdc	+5Vdc	+5Vdc	4dB
+5Vdc	+5Vdc	+5Vdc	0Vdc	8dB
0Vdc	0Vdc	0Vdc	0Vdc	15dB

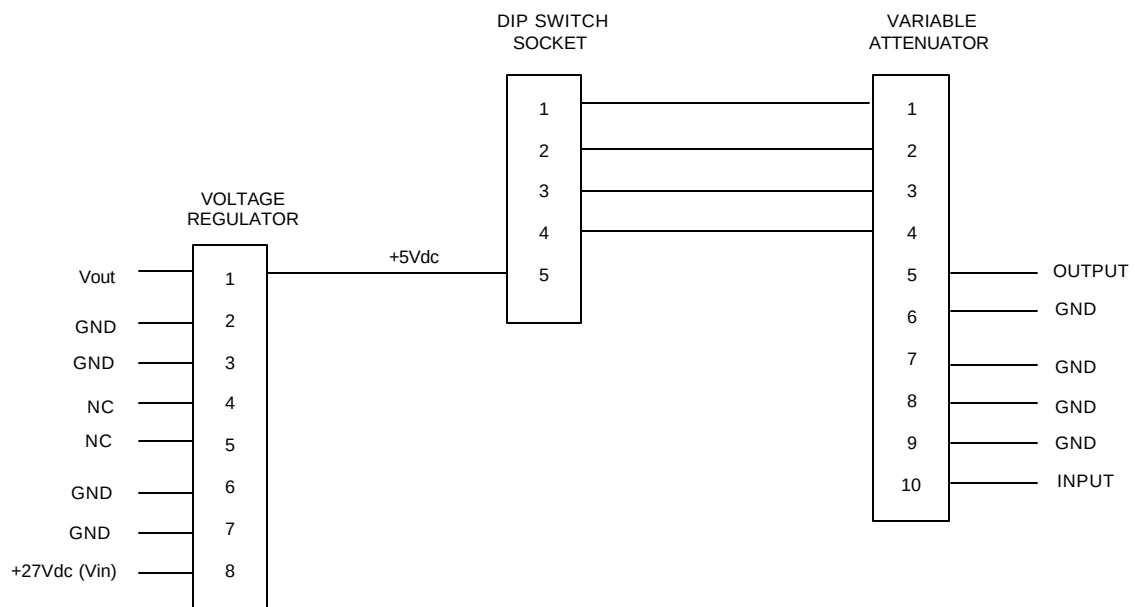


Figure 1-1 Variable Attenuator, Voltage Regulator and Dip Switch Socket Pin Configuration

1-2 Functional and Physical Specifications

The BAS system's functional and physical specifications are listed in Table 1-2. A functional block diagram is provided in Section 4 of this manual to illustrate the system's operational layout.

1-2.1

1-2.2 MCR20930-1-2 Subrack Specifications

Table 1-2 MCR20930-1-2 Booster Amplifier Subrack System Specifications

Frequency	935-940 MHz
Gain	+20 dBm, ± 0.2 dBm
RF Input Power	+31 dBm composite w/variable attenuator set to 0dB attenuation. +46 dBm composite w/variable attenuator set to 15 dB attenuation.
RF Output Power: G3L-900-50-005 G3L-900-60-005	+47 dBm (50 Watts) nominal, 60 Watts (max.) +47.8 dBm (60 Watts) nominal, 75 Watts (max.)
Phase Variation	$\pm 5^\circ$
Alarms	+5 Vdc TTL
D.C. Power	+ 27 Vdc, 55 Amps max
Total System Return Loss	-19 dBm
Channel Spacing	12.5 KHz
Operating Temperature	0 to 65 degrees C
Subrack Dimensions	12.22(H)x*17(W)x24.5(D) inches
Weight (Fully assembled)	Approximately 80 Pounds (36.28 kilograms)

*Note: Does not include 1-inch right and left side mounting flanges.

Table 1-3 Electrical Specifications for 2-Way Splitter

Insertion Loss	-33dB Min. (TBD on actual part) -48dB Max.
Amplitude Balance	±0.2dB Max.
Insertion Loss Flatness Over Frequency	±0.3dB Max.
Input/Output Return Loss	-20dB Min.
Port to Port Phase Delta	±5 Degrees Max.
Port to Port Isolation	-20.0dB Min.
IP3 (Input Power = 5dBm)	-90dBc Min.
Power Handling (Fixed Attenuator)	20 Watts Max.
Power Handling (Variable Attenuator)	3.16 Milliwatts Max.

Table 1-4 Electrical Specifications for 2-Way Combiner

Insertion Loss	-0.6 dB (TBD on actual parts)
Amplitude Balance	±0.2dB Max.
Insertion Loss Flatness Over Frequency	±0.3dB Max.
Input/Output Coupled Port Return Loss	-18.0 dB Min.
Port to Port Phase Delta	±5 Degrees Max.
Port to Port Isolation	-20.0dB Min.
Power Handling	120 Watts
Sampling Coupler	-25dB ±1dB
Sampling Coupler Directivity	-18.0 dB Min.
IP3 (Input Power = TBD)	-100 dBc Min

1-2.3 GL3-900 Series Amplifier Specifications

Table 1-5 G3L-900 Series Amplifier's Electrical Specifications

Frequency Range	935-940 MHz
Channel Spacing	12.5 KHz
Output Power: GL3-900-50-005 GL3-900-60-005	+47 dBm (50 Watts) nominal, 60 Watts (max.) +47.8 dBm (60 Watts) nominal, 75 Watts (max.)
Input Power	-10.0 dBm max.
RF Gain GL3-900-50-005 GL3-900-60-005	+58.8 dB $\pm$ 1.0 dB @ +27Vdc, 25 °C. +58.8 dB $\pm$ 1.0 dB @ +27Vdc, 25 °C
RF Gain Flatness over the operating frequency range	$\pm$ 0.1 dB over any 1.25 MHz (over the frequency range).
Gain Flatness:	$\pm$ 0.5 dB (935 MHz – 940 MHz)
Normal Operating Voltage	+27 Vdc $\pm$ 1V Nominal ($\pm$ 5%) 1Vpp ripple (100-120 Hz) max.
Current Consumption: GL3-900-50-005 GL3-900-60-005	20 Amps @ 27 Vdc, 25 °C, Prf = 50 Watts average 27 Amps @ 27 Vdc, 25 °C, Prf = 50 Watts average
Abnormal Operating Voltage	+21 Vdc to below +26 Vdc. Above +28 Vdc to +29 Vdc.
RF Gain variation by Temp & Voltage	TBD
Gain Variation Over Dynamic Range	$\pm$ 0.1 dB max./20 dB for 0 to –20 dB rated power output
Intermodulation Distortion In-Band Spurious	-65 dBc min. (Main signal power to Spurious @ (12.5 kHz) -55 dBc min @ +23 to +24 Vdc
Input/Output VSWR.	1.5: 1 max @ 65 $\pm$ °C.
Load Stability	Infinite VSWR. all phases
Output Isolation	20 dB min. (shall incorporate an output isolator)

Table 1-6 G3L-900 Series Amplifier's Mechanical Specifications

Items	Specifications				
Physical Dimension of MCPA	Front panel: 342.5mm(W) x 99mm(H) x 3mm(D) Body: 288.8mm(W) x 95.3mm(H) x 446mm(D)				
Weight	Approximately 28.6 pounds (13 kilograms)				
Connector Type	D-sub, Hybrid, Plug-in Type RF connector: PKZ 26-0020 series straight plug type (Phoenix Co.) refers to attached drawing.				
MCPA Front Panel Switch	CKT Breaker. +27 Vdc Power Indicator				
Connector Description	Pin Outs				
	A1	RF Output	(Coaxial Contact)		
	A2	Ground	(Power Contact)		
	A3	+27 Vdc	(Power Contact)		
	A4	RF Input	(Coaxial Contact)		
	1	TX H	10	+27 V	
	2	TX L	11	COM SV	
	3	GND	12	AMP AO	
	4	RX H	13	AMP A1	
	5	RX L	14	AMP A2	
	6	GND	15	AMP A3	
	7	HERE LPA	16	NC	
	8	FF LPA	17	NC	
	9	RESERVED			
Markings	TBD				
Front Panel LED Display	LED type: SMD				
RUN	GREEN (When MCPA is enabled)				
ALM	Red (When any alarm occurred, LED is on)				
DC	Green (When DC Power is ON, LED is on)				
MCPA Captive fastener	TBD				
Front Panel color & silk	TBD				



Table 1-7 Environmental Specifications for G3L-900 Series Amplifiers

Items	Specifications
Operating Temperature	0 to + 65 C
Storage Temperature	-40 to + 85 C
Relative Humidity	5 to 90% RH (non-condensing)
Operating Air Pressure	860 to 1060 mbar
Shock	40 m/s s* @ 22 ms half sinusoid shock
Pressure	Integral forced air cooling must operate correctly at up to 0.3 inches back.
Vibration	Bellcore TR-NWT-000063 (1 m/s*s0.1-200Hz)
Corrosion Resistance/ Salt Fog	The MCPAs shall comply with the requirements of Bellcore Technical Reference TA-NWT-000487, Issue 2, Section 4.12
Altitude	All specifications shall be met at an altitude up to 15,000 feet where the maximum external ambient temperature is decreased by 0.5 C/ 1000 feet above sea level. The MCPAs shall not sustain damage when being transported at altitude up to 40,000 feet or uniformly applied pressure to 30 PSIA.

1-3 Booster Amplifier Subrack (BAS) System Major Components



Table 1-8 lists the model numbers and descriptions of the major components that comprise the BAS system and the document number (if available) of the manual related to each component.

Table 1-8 Major BAS System Components

Model/PN	Description	Qty Per System	Expandable To
800-01292-001	Top Assembly, BAS II w/o Combiner Backplane	1	1
800-01294-001	Front Panel Assy	1	1
700-00901-001	Cable Assy, Power In	1	1
700-00902-001	Cable Assy, Amp Power	1	1
700-00903-001	Cable Assy, Amp Power	1	1
700-00904-001	Cable Assy, Fan	2	2
700-00905-001	Cable Assy, Amplifier	1	1
800-001296-001	Fan Assy	2	2
800-01297-001	Tray Assy	1	1
500-01425-001	PCB Assy, Power Distribution	1	1
MCR20930-1-2	Booster Amplifier Subrack	1	1
GL3-900-50-005 or GL3-900-60-005	50-Watt Amplifier 60-Watt Amplifier	2 2	2 2

1-4 Equipment Changes

Powerwave Technologies, Inc. reserves the right to make minor changes to the equipment, including but not limited to component substitution and circuitry changes. Changes that impact this manual may be incorporated in a later revision of the manual.

2-1 Introduction

This section contains a functional description of Powerwave Technologies Inc.'s, Booster Amplifier Subrack (BAS) system. Refer to figure 2-1 for the system's functional block diagram.

2-2 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.

2-3 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).

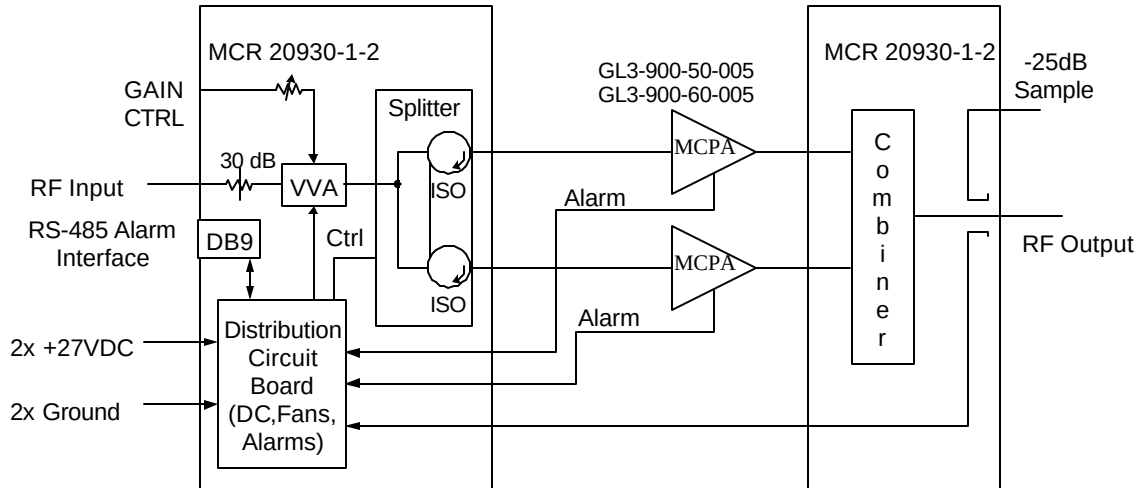


Figure 2-1 System Block Diagram

2-4 System Functional Discription

Designed as a subrack for installation in a 2-way transceiver paging base station, the BAS system is comprised of a MCR20930-1-2 Booster Amplifier Subrack (BAS) and two G3L-900-50-005 or G3L-900-60-005 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 (refer to table 1-5 for amplifier output specifications). 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 (refer to table 1-5). 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.

2-5 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 935 MHz to 940 MHz (refer to table 1-5 for amplifier specifications). 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 MCPA 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

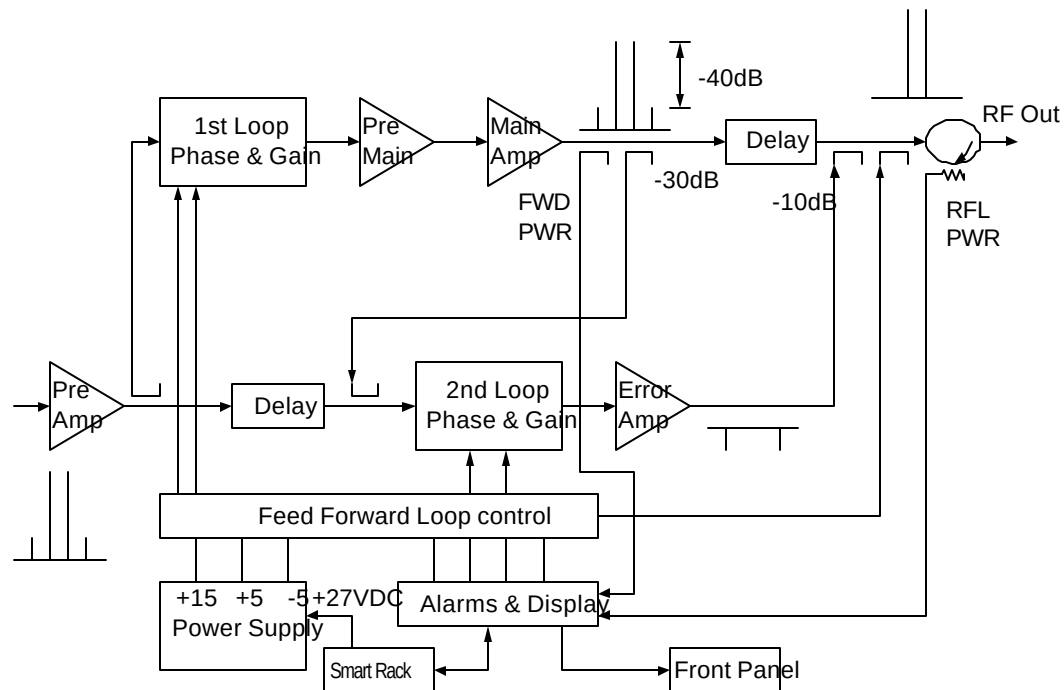


Figure 2-2 Multi-Carrier Power Amplifier Functional Block Diagram

2-5-1 Predriver 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 935 MHz to 940 MHz. The amplifier operates on +27 Vdc.

2-5-2 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 935 MHz to 940 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.

2-5-3 Main Amplifier

The signal provides approximately 11 dB of gain in the 935 to 940 MHz frequency band (refer to table 1-5 for amplifier specifications). 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.

2-5-4 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.

2-5-5 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.

2-6 Amplifier Module Cooling

Although each amplifier contains its 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.

2-7 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.

