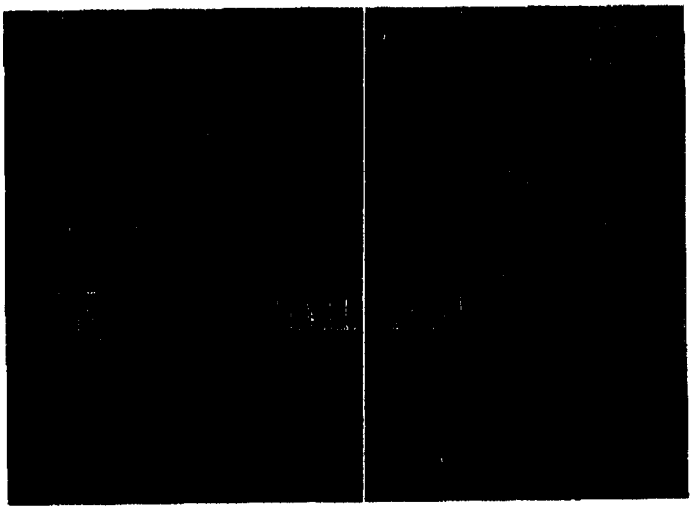
AML Communications

OPERATION MANUAL

"REPEAT-A-CELL™"
BI-DIRECTIONAL AMPLIFIER "A - BAND"
Model # BD09002-A6

Manual No. 901-0015 Revision A
October 20, 1998



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Phone (805) 388-1345 Fax (805)484-2191

Physical Installation

This amplifier is designed for mid-chassis mounting in an EIA-RS-310-C compatible 19-inch rack. It requires 3.5-inch of rack height (2 Units). Mounting slots for #10 fasteners are located on the side mounted flanges of the unit as indicated in **Figure 1**.

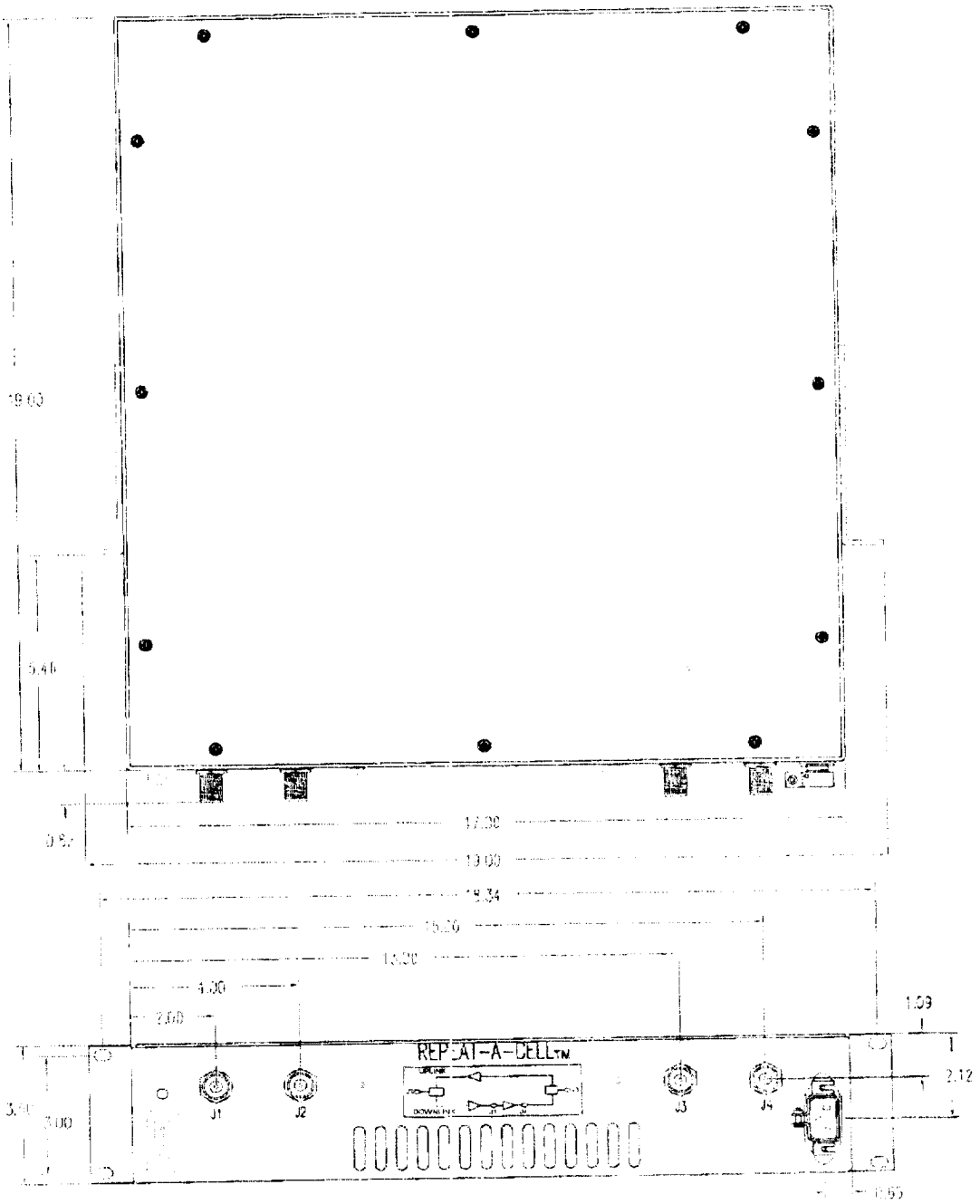

Figure 1: Unit Outline Drawing

Mechanical

Dimensions	3.5" h x 17" w x 19" d
Weight	25 lbs.
RF Connectors	N type (f)
Acoustic Noise	65 dBa max.

Specifications

Electrical

AC Power	120 VAC, 47 to 63Hz, 0.6 Amperes RMS max.
Pout Average	2 Watts
Maximum Rated Power per Carrier	+21.75 dBm / 4 Carriers +18.75 dBm / 8 Carriers +15.75 dBm / 16 Carriers +14.56 dBm / 21 Carriers
1dB Compression	+33 dBm min.
3rd-order Intercept Point	+48 dBm min.
Propagation (Group) delay	250 nsec typ.
Noise figure	4 dB max.
Passband Ripple	±1 dB typ.
Impedance	50 Ohms
Input / Output VSWR	1.5 :1 max.
Operating Bandwidth	Band "A", AMPS
Gain	60 to 80 dB Uplink 30 to 50 dB Downlink

Environmental

Operating Environment	0°C to 50°C, Sheltered
Storage Temperature	-40°C to 80°C
MTBF	30K Hours calculated as per MIL-HDBK-217E at 25°C

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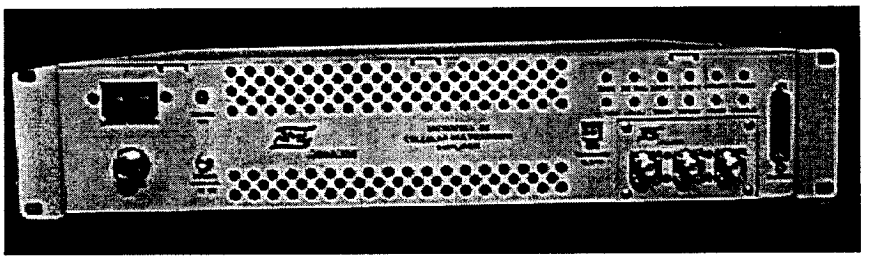
OPERATIONAL MANUAL

"MICROCELL 30"-SMR BROADBAND TRANSMIT MULTI-CARRIER AMPLIFIER

Manual No. C087C47, Revision - A
March 26, 1998



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I. INTRODUCTION

This OPERATION MANUAL provides the information required to unpack, start-up, and operate the AML Communications BROADBAND TRANSMIT MULTI-CHANNEL AMPLIFIER, Model Microcell 30.

Scope of Manual

This manual is intended for use by experienced technicians familiar with communications technology and amplifier operation. It contains information required to unpack, start-up, and operate the equipment described, and is current as of the printing date. Information on the few procedures and adjustments necessary for proper operations of the amplifier are included.

The Operational Requirements in Section II includes installation and start-up procedures, along with power, cooling and environmental requirements.

Theory of Operation in Section III explains the feedforward concept in detail and explains the operation and inter-relation of various modules.

Operating Instructions in Section IV lists connections, alarm interfaces, controls and troubleshooting techniques.

Warranty information in Section V states liability limits and defines procedures for repair or replacement of defective units.

The Appendix in Section VI provides detailed drawings of the amplifier with dimensions.

General Description

The transmit amplifier applies feedforward distortion correction techniques to wide band multi-channel telephony signals to provide high power RF amplification with superior intermodulation characteristics and exceptional DC to RF efficiency.

This unit is compact, rugged, and modular. It is intended for Cellular Base Station applications. The unit is capable of amplifying a variety of modulation formats including AMPS, TDMA, CDMA, and GSM. Multiple formats are allowed such as the combined use of AMPS and TDMA, AMPS and CDMA, TDMA and GSM, etc.

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Frequency and Identification

The transmit amplifier is built for operation in the North American Cell Site transmit band 849 to 869 MHz. No adjustment is necessary for use in the SMR Band Frequency allocation.

The unit is labeled with Model Number, Serial Numbers and FCC Type Acceptance information. Please refer to the Model and Serial Numbers in any correspondence with AML Communications.

Feedforward Concept

The feedforward concept originated in Bell Laboratories in 1940, however the specific implementation of this feedforward technique is proprietary to AML Communications and is protected by one or more United States Patents.

The approach utilizes two cancellation loops. Subsequent to the main amplifier amplifying the input, the first loop cancels the main signal and forwards only the distortion products generated by the main amplifier(s). The second loop processes the distortion products through the error amplifier, feeds them forward, and couples them with the main amplifier output 180 degrees out-of-phase. This significantly reduces the distortion at the final amplifier output.

Maintenance, Alarm Indications and Repairs

Common sense protection against impact, dirt, and temperature extremes during handling and operation should be observed. Preventive maintenance involves only routine observation of the air passages for obstruction by dirt, dust, etc. Should the passageway be obstructed, the unit should be cleaned by vacuuming, or by removing dust with pressurized air.

The unit has been designed for maximum MTBF (Mean Time Between Failure). However, should the unit require repair, the unit must be removed from service and returned to the factory. If normal operation of the amplifier cannot be restored by following the procedures provided, repairs by the user are **not** recommended. The amplifier should be repackaged, according to the instructions in Section II of this manual, and shipped to AML Communications for repair.

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Specifications

Unit

Prime Power	85 to 132 VAC, single phase 47 to 63 Hz
Operating Environment	Sheltered, 0°C to 50°C
Storage Temp.	-40°C to 80°C
Cooling Air Flow	Internal Fans From Ambient Air
Acoustic Noise	65 dBa max.
Weight	30 lbs.
Dimensions	19" (w) x 16" (d) x 3.5" (h)

Transmit Amplifier

Pout Avg.	30 Watts, Composite multichannel power (eg. 20 channels at 1.5 Watts Per Carrier)
IMD	-60 dBc min., -65 dBc typ.
Instantaneous Bandwidth	SMR Band (for -60 dBc IMD's and +/-0.5 dB Gain Flatness)
Composite Operating Input	Maximum is +33.8 dBm, Minimum is +16 dBm Drive Level: No single input channel is to exceed that value which causes the associated output channel to exceed 41.8 (15 Watts)
Composite Survivable Input	+40 dBm (10 Watts)
Output Power	Not to Exceed 30 Watts multichannel composite
Impedance	50 Ohms
Input Return Loss	14 dB min.
Output Return Loss	14 dB min.
Pilot Tone/Power	Factory Set/Output Power -30 dBm typ.

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Gain	30 +/-1 dB (Optional gain available by changing passive attenuator input module)
Gain Adjust (Front Panel)	+/-2 dB min.
Monitors (SMA)	Forward Power (30 dB +/-0.5 dB Coupling Factor)
Alarms	
• Stand By: (Minor/Major)	LED & Dry Contact Relay (Open) (indicates unit is in shut down mode)
• Over Temp Alarm: (Minor/Major)	LED & Dry Contact (Open) (Factory set at +90°C Baseplate Minor and +95°C Baseplate Major)
• Low Level Alarm: (User Adjustable)	LED & Dry Contact Relay (Open)
• Over-Drive Alarm: (Major)	LED & Dry Contact Relay (Open) (Factory set at 45 Watts)
• First Loop Unlock Alarm (Major):	LED & Dry Contact Relay (Open)
• Second Loop Unlock Alarm: (Major)	LED & Dry Contact Relay (Open)
• Summary Alarm: (Minor/Major)	Dry Contact Relay (Open) (This is a logic "OR" function of all alarms, except Low Level)
• DC Fail Alarm: (Minor/Major)	LED & Dry Contact Relay (Open) (Factory set at +/-15% Window: +5 and +24 are Minor; +28, +15 and -15 are Major)
• Fan Fail Alarm: (Minor)	LED & Dry Contact Relay (Open) (Factory set with Loss of one or more fans)
• VSWR Alarm: (Major)	LED & Dry Contact (Open) (Factory set at 3:1 Output VSWR)
• Major Alarms:	Dry Contact Relay (Open) (This is a logic "OR" function of all Major alarms, except Low Level)

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- Minor Alarms: Dry Contact Relay (Open)
  (This is a logic "OR" function of all alarms, except Low Level)

NOTE: Any MAJOR alarm will cause the amplifier to disable itself for 20 minutes. After this period, the amplifier will automatically restart itself. However, cycling the power switch from the amplifier, or cycling the power through the remote disable function will cause the amplifier to attempt an immediate restart.

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II. OPERATIONAL REQUIREMENTS

This section includes all information required to operate the amplifier properly, including unpacking and power-up procedures, the unit functions and controls.

Features

- Amplification in the 849 to 869 MHz Frequency Range
- Manually adjustable low output power level alarm (Ø.5 Watt is minimum setting composite)
- +/-2 dB Gain Adjustable
- RF output open and short condition will not damage the amplifier
- 1ØØ% continuous duty cycle
- Self protection shut down capability
- Built-in transmit output band pass filter

Installation and Start-Up

A No. 4 Phillips screwdriver, a No. 2 flat screwdriver, digital voltmeter, and Cell Site analyzer are necessary to install, commission and maintain the amplifier.

Receiving and Inspection

Set the packing carton on the floor or ground. Open the top of the carton exposing the packing material. Remove the top packing material, exposing the amplifier. Remove and save the packing materials, paperwork, and accessories from the carton.

WARNING!!!
The Amplifier Weighs 3Ø lbs. Use Caution Lifting the Unit from the Carton.

Carefully lift the amplifier from the carton. Retain original packing materials within the carton for any future shipment. In case of defect, the unit should be shipped back to the manufacturer in the original packaging. Check for obvious physical damage, such as scratches, broken connectors, etc. If damage of this kind is evident, notify the manufacturer and file an appropriate claim with the freight carrier.

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Repackaging for Shipment

Re-use the original container and packaging materials, including padding and bracing foam or cardboard. Wrap the amplifier in heavy plastic before placing it into the shipping container.

Mark the outside of the container, "FRAGILE, DELICATE INSTRUMENT," on all sides. If the amplifier is being returned to AML Communications for repair, call (805) 388-1345 to request a Return Material Authorization (RMA) number and attach a tag to the unit before packaging stating the RMA number and identifying the shipper. In all correspondence, reference the amplifier by Model, Serial and RMA numbers. Describe the symptoms or defects in detail.

Site Preparation

Cooling Requirements

The amplifier requires a sheltered environment with heating and/or cooling capacity to maintain the shelter temperatures within the range 0°C to 50 °C (32° F to 122° F). Preferred operational temperatures are 15°C to 20 °C (59° F to 68° F). The front and rear faces are used for cooling airflow. These areas must not have any obstruction within three inches which will restrict air flow.

CAUTION!!!

The Over-temperature Alarm Will shut down the Amplifier from Service. An Over-temperature Condition Should be Investigated Immediately to Prevent Damage to the Amplifier.

Module over-temperature operation is indicated by a RED LED located on the front panel along with a dry relay contact opening. Over-temperature operation may be due to operation at elevated ambient temperature, obstructed air passage, failure of one or more cooling fans, or a combination of the above.

Power Requirements

The unit requires 420 Watts at full RF Output and 170 Watts at idle. The auto ranging AC-DC power supply accepts 85 to 132 VAC single phase at 47 to 63 Hz.

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Physical Installation

Mounting and External Connections

This amplifier is designed for mounting on a EIA-RS-310-C compatible 19-inch rack. The Microcell 30 requires 3.5-inches (2 rack units) of vertical space. It also requires 16-inches of depth plus 3-inches in the front and 3-inches behind the unit for air flow. The unit should be supported by rails or slides and secured with 4 #10-24 mounting hardware through the front panel.

Electrical Connection

External RF connections to the transmit amplifier consist of the RF Input, a Type "N" female module connector located on the right front of the unit; RF Output, a type "N" female connector located on the left front of the unit; RF Forward (transmit) Monitor, an SMA female connector located toward the left front of the unit.

CAUTION!!!

DO NOT EXCEED 30 WATTS COMPOSITE OUTPUT

Setting the Power Levels

Do not turn on the Microcell 30 until all individual radio power levels have been properly set and verified. Connect the Microcell 30 RF input cable (not supplied) to the Cell Site Analyzer (Hewlett Packard 8921 series Cell Site Test Set or the IFR COM120B Service Monitor are good choices). You will now be setting and verifying the input signals to the Microcell 30. Using the analyzer, set all radio levels to their proper level.

CAUTION!!!

THE MAXIMUM COMPOSITE RF INPUT POWER, IS +33.8dBm (2.4W)

Note: It is extremely important to accurately set ALL radios to their proper power levels and frequencies. Failure to do so can cause violation of FCC emission limitations, damage to personnel and/or equipment and loss of equipment warranties.

Radio power levels can be calculated by the following formula, or looked up in **Table 1** below.

Desired PA output power per channel (dBm) = radio power per channel at combiner output (dBm) +11 dB, or desired PA output per channel (Watts) = radio power per channel at combiner output (Watts) x 12.5.

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Desired Output Power/Channel (Watts)	Input Power/Channel (mW)
10W	800
5W	400
3W	240
2W	160
1W	80

Table 1: Power Levels

Do not allow the composite output power (number of channels x power per channel) to exceed 30 Watts.

Transmit Connections

Connect the amplifier inputs (located on the right front of the amplifier) to the radio combiner outputs. Connect the amplifier output ("N" connector located on the left front of the amplifier) to the Tx (transmit) antenna coaxial cable. For duplexed Rx/Tx antenna configurations, the amplifier output connects to the duplexed Tx port.

CAUTION!!!
It is Recommended that the Channel Power at the Output of the Combiner is Checked Before Proceeding.

Receive Connections

If AML Receive Low noise (Link Balancer®) amplifiers are to be used in conjunction with this installation, follow the installation instructions provided with the Link Balancer®.

CAUTION!!!
Do Not Power-On the Amplifier Unless the Tx Antenna is Connected.

AC Power Connections

Prime power is applied to the unit through a connector located on the rear panel, indicated in Figure 1. Verify the front panel circuit breaker is in the OFF position prior to connecting any AC voltage. The power supply is built into the unit.

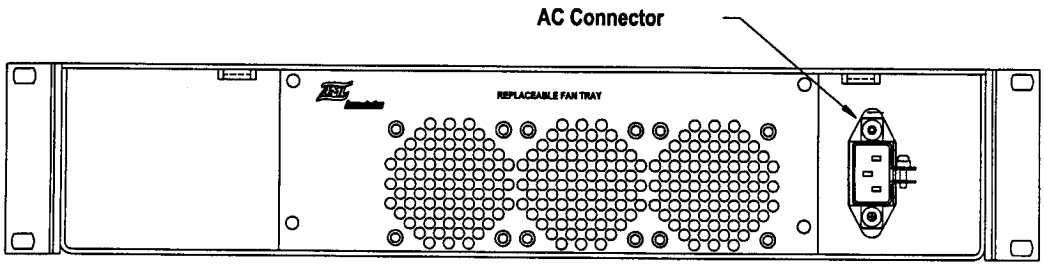

Figure 1: M30 Rear Panel

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Alarm Connections

A 25-pin D-Sub connector for the alarm outputs is located along the right side of the front of the unit. The summary alarm contact is located to the left and below of the LED indicators on the front panel. The function of each location is described below.

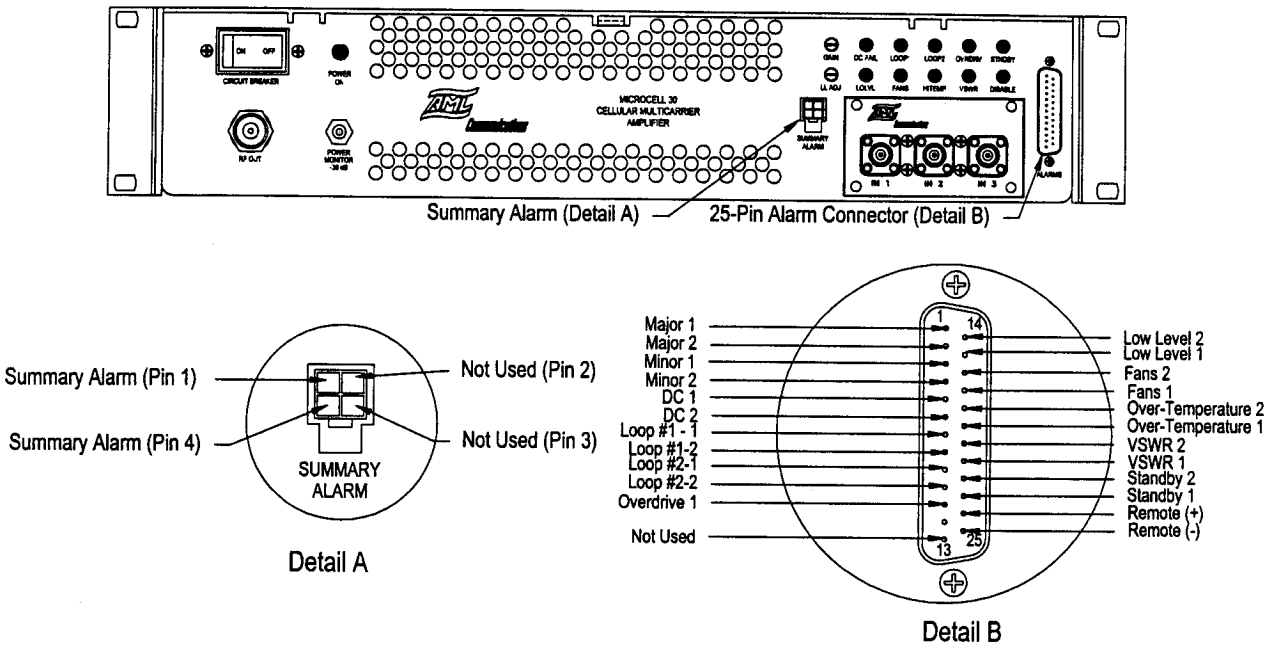

Figure 2: Alarm Interface

Isolated alarm pins are arranged in relay contact pairs: e.g. (Detail B), Major 1 and Major 2 are one closure (open on fault), Pins 24 and 25 are the remote disable input. To shut down the unit, apply +5 to 15V (8mA max.) across pins 24 and 25. The remote disable function also terminates the shutdown timer.

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III. THEORY OF OPERATION

The following paragraphs describe the functions of the amplifier and discuss the operation of each major module.

Transmit Amplifier

The Linear Feedforward Amplifier requires a 2.38W Average Multi-channel (nominal) signal and amplifies the signal by 11 dB to 30W (Average) output. Gain adjust, accessible at the front panel, allows manual adjustment of the Gain by +/-2 dB.

Figure 3 is a general functional block diagram of a feedforward amplifier. Two RF amplification circuits are required, a Main Amplification circuit and an Error Processing circuit. A first cancellation loop isolates noise and distortion (Errors) generated by the Main Amplifier, and the second loop amplifies and adjusts phase and amplitude of the noise and distortion to combine in antiphase with the main amplifier output to provide a reduced distortion level.

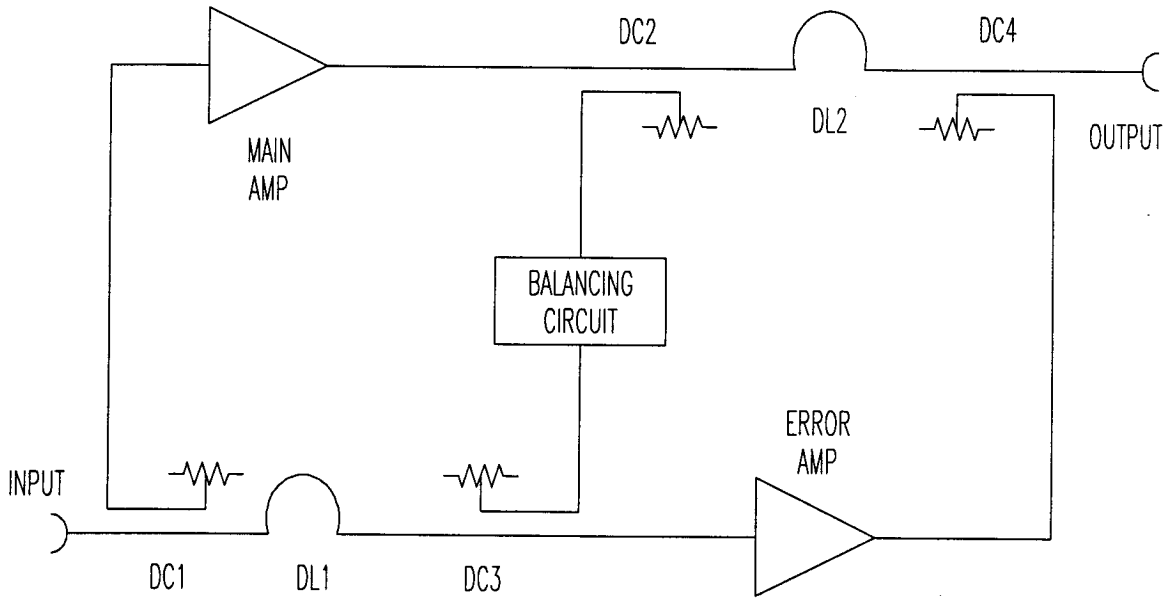

Figure 3: Feedforward Functional Block Diagram

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Main Amplifier Circuit

The Main Amplifier Circuit comprises an Amplifier Module comprising a Pre-Main amplifier circuit and Main amplifier circuit.

The Pre-Main circuit is a 2-stage gain line-up that amplifies the RF signal to a power level of 1 Watt using silicon bipolar transistors operated in Class A. The Main Amplifier circuit is a 2-stage balanced transistor amplifier operated in Class AB for best efficiency.

The Main amplifier module receives RF input, 15 and 28 VDC, and provides RF Output and alarm signals via connectors which interface to the Alarm module located within the unit.

Error Processing Circuit

The Error Processing Circuit comprises a single amplification module and a Cartesian controller used for modifying the Vectoral properties of the error signal. The Error amplification module consists of five stages of silicon Linear amplification. The module receives RF input, 15 VDC and 28 VDC, and provides RF output and alarm signals that interface to the unit.

The Cartesian Control Network compensates for Vectoral variations of the error amplifier assembly due to temperature changes. This Cartesian control feature is considered unique to AML Communications.

First Loop Cancellation

This loop isolates noise (N) and distortion (D) generated by the Main Amplifier circuit.

As Figure 4 shows, input RF signal(s) is sent in two directions by directional coupler DC_1. One direction leads through delay line DL_1, while the other direction leads to the Main Amplifier.

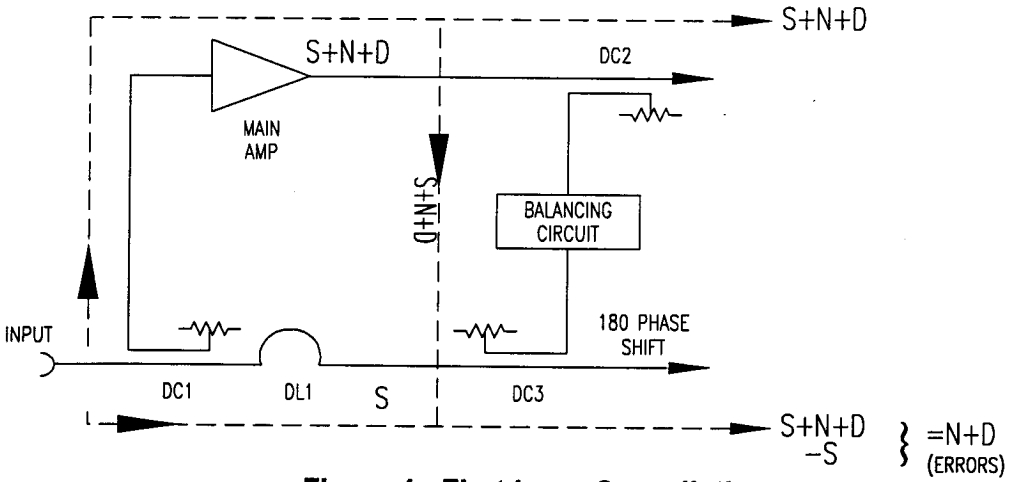

Figure 4: First Loop Cancellation

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The Main Amplifier output includes not only (S), but also errors generated by the amplification process. These errors occur as noise and distortion (N+D).

The Main Amplifier output (S+N+D) is sent in two directions by coupler DC_2. One direction leads through delay line DL_2, while the other direction leads to coupler DC_3. At coupler DC_3, the original input signal (S) is combined with the Main Amplifier output (S+N+D). Both signals are combined antiphase so that (S) is significantly reduced and (N+D) is isolated as an input for the second loop.

S+N+D	**-**	**S**	**=**	**N+D**
Main Amplifier Output		Input Signal		Amplification Process Errors

Second Loop Cancellation

This loop reduces noise and distortion by a cancellation process.

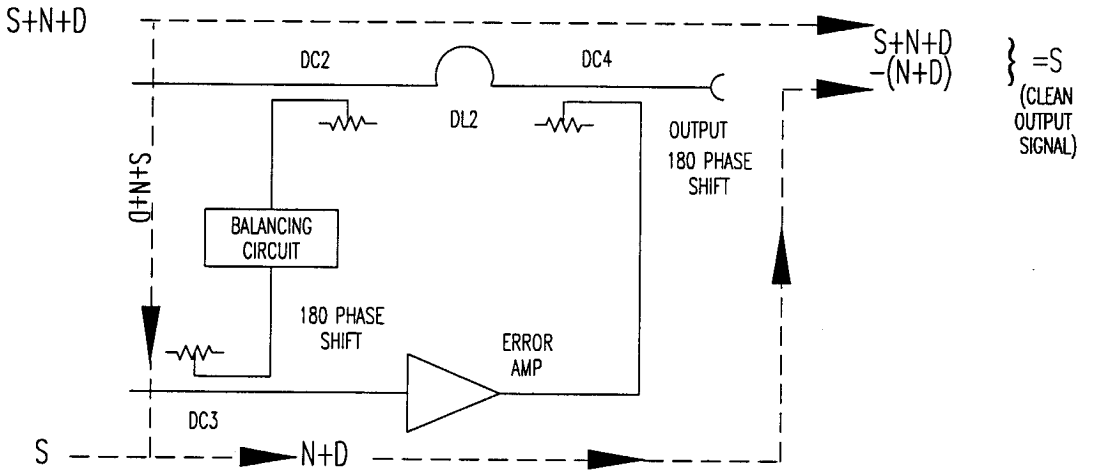

Figure 5: Second Loop Cancellation

As Figure 5 shows, the isolated (N+D) is received from the first loop at DC_3 and input to the second loop, where it is processed by the Error Processing circuit. At coupler DC_4, Error Processing circuit output (N+D) is combined with Main Amplifier circuit output (S+N+D). The two signals are combined antiphase to substantially reduce (N+D), producing a signal (S) with improved noise and distortion characteristics at the final output.

S+N+D	**-**	**N+D**	**=**	**S**
Main Amplifier Output		Noise & Distortion		Clean Output Signal

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Temperature Stability

The cancellation process requires accurate maintenance of phase, amplitude, and time delay along two different signal paths. Some key functions change slightly yet significantly with temperature. These include gain and phase of the Main Amplifier circuit, insertion loss, delay characteristics of the directional couplers and changes in the delay lines. To maintain 30 to 35dB cancellation in the first loop, signals in both paths are detected. Amplitude and phase imbalance corrections are applied by an attenuator and a phase shifter in series with the input of the Main Amplifier.

A test signal is generated by an on-board synthesizer at a frequency within the unit's authorized band. The level of the test signal at the output of the amplifier is maintained at a level far lower than that required by regulation and application.

In the second loop, the test signal at the final output is detected, then compared with the original test signal. Amplitude and phase imbalance corrections are applied to a Cartesian control network in the Error Processing circuit. Cancellation is maintained by monitoring the test signal, and applying control signals to the Cartesian Controller. This results in optimum cancellation of the test signal at the final output. By reducing the level of the test signal, distortion products are minimized.

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IV. OPERATING INSTRUCTIONS

The following paragraphs describe front panel connections, controls, indicators, alarms and procedures for placing and removing the unit from service.

Panel Connections

The front panel of the unit has several connection interfaces as described below.

• RF Input(s)	Type N Female(s)	Maximum 2.4 Watts total composite (Average) RF signal
• RF Output	Type N Female	30 Watts (Average) RF Output. (e.g. 20 channels at 1.5 Watts per Carrier, max.)
• Forward Monitor	SMA Female	RF sample of Transmit power (-30 dB)
• Alarms	25 pin D-Sub	Alarm Signals connector
• Summary Fault	Molex 39-29-4049 Plug In Connector	Dry Contact Relay Discontinuity Indicates Fault

Controls

On/Off Switch

Located on the front panel is a circuit breaker that also functions as an ON/OFF switch for the unit. Moving this switch to the ON position puts the unit into operation.

Low Level Set

The unit has an adjustment to set the low level alarm threshold. The alarm level is best set by injecting RF into the unit input at the desired set point and adjusting the potentiometer with a flat screwdriver until the Front panel LED's illuminate. See Setup & Commissioning for complete details on adjusting the threshold level. Hysteresis in the alarm circuit will prevent the alarm and LED from deactivation until the power level increases slightly above the set point.

Power Amplifier Gain Control

Gain of the Power Amplifier is variable by a minimum of +/-2dB via a screwdriver slot adjustment located at the lower right of the front face of the unit.

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Alarms and Indicators

Indicators and relays for remote status monitoring are available. Unit fault indications are listed in Figure 2A. Faults are also indicated locally by illumination of red LED's. A connection for a summary fault indicator is provided on the front panel.

Troubleshooting

If any error LED's activate, verify input signal frequency and be sure power levels are within specified ranges. If power levels and frequencies are set properly, and a cause of the fault can not be identified, call (805) 388-1345 for applications engineering and field support. In the event of a malfunction that cannot be corrected, return it to AML Communications in Camarillo, California.

Setup & Commissioning

Setup for this amplifier involves adjustment of power amplifier parameters and system parameters as described below.

Assumptions

The setup procedure described assumes operation in a balanced path configuration with either a single receive antenna or a switch diversity condition for power level 2 mobiles. This requires that for every dB increase above 28dBm per channel in transmit power, one dB of improved receive sensitivity must be obtained. The user is encouraged to optimize the amplifier and system parameters to the particular site and application requirements.

Transmit

Output power per channel is best set by monitoring the forward monitor port (SMA connector located next to the transmit output port at the front of the amplifier, labeled *Power Monitor).* The signal level at the output of the amplifier can be calculated by adding 30 dB to the per channel level measured at the forward transmit monitor. Each radio should be individually set to the desired output power while monitoring the power level on a Cell Site analyzer. Once the level of the radio is set, fine adjustment of all channels simultaneously (not independently) can be achieved by using the screwdriver slot potentiometer located in the top front of the amplifier.

The power amplifier is preset at the factory for 30 dB gain. To minimize adjustment, preset the radio transmit output levels out of the combiner of the base station equipment to the proper values as shown in Table 1. This will provide the required per channel power at the output of the amplifier.

Low Level Alarm

The low level alarm set point is adjustable via the screwdriver slot potentiometer accessed through a hole in the front panel. The low level alarm monitors the input power of the Main Amplifier. Should the power fall below the set threshold, the LED is illuminated and the appropriate relay contact becomes discontinuous.

The low level alarm is best set by operating the control channel only. If the low level indicator is not illuminated, turn the potentiometer clockwise until the indicator illuminates. Then, turn the potentiometer counter clockwise until the LED is no longer illuminated. To test the low level alarm, disable the control channel and verify that the Low Level LED's illuminate, then enable the control channel and verify that the LED's are unlit.

Summary

This procedure summarizes the installation and commissioning of the Microcell 3Ø. Site specific variations may occur that are beyond the scope of this manual. If questions or problems exist which are beyond the scope of this procedure, call AML Communications at (8Ø5) 388-1345 and request technical support for the unit.

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V. WARRANTY

Seller warrants that its product sold hereunder will at the time of shipment be free from defects in material and workmanship and will conform to Seller's product specifications. If products sold hereunder are not as warranted, seller shall, at its option and as Buyer's exclusive remedy repair or replace the product, provided proof of purchase and written notice of non-conformance are received by Seller within the applicable periods noted below and provided said nonconforming products are, with Seller's authorization, returned in protected shipping containers, freight prepaid, FOB Seller's plant within thirty (30) days after expiration of the warranty period. Following warranty repair or replacement, Seller will return the product freight paid to the Buyer from Seller's plant.

This warranty shall not apply to any products Seller determines have been, by Buyer or otherwise, subjected to operation at electrical and/or environmental conditions in excess of the maximum valued established in applicable specifications, or have been the subject of mishandling, misuse, neglect, improper testing, repair, alteration, damage, assembly or processing that alters physical or electrical properties. This warranty excludes all costs of shipping, customs clearance and related charges outside the contiguous 48 United States and Canada.

THIS WARRANTY EXTENDS TO BUYER ONLY AND MAY BE INVOKED BY BUYER ONLY FOR ITS CUSTOMERS. SELLER WILL NOT ACCEPT WARRANTY RETURNS DIRECTLY FROM BUYER'S CUSTOMERS OR USERS OF BUYER'S PRODUCTS. SELLER DOES NOT WARRANT PRODUCT REJECTED AS A RESULT OF RELIABILITY TESTING OR PROCESSING NOT PREVIOUSLY AGREED TO IN WRITING. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS, IMPLIED OR STATUTORY INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS. THIS WARRANTY DOES NOT APPLY TO DEFECTS ARISING AS A RESULT OF BUYER'S DESIGN OR FORMULA. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES DUE TO BREACH OF THIS WARRANTY OR ANY OTHER OBLIGATION UNDER THIS ORDER OR CONTRACT.

Time periods, products, exceptions and other restrictions applicable to the above warranty are:

Unless otherwise stated, products are warranted for a period of one (1) year from date of shipment.

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VI. APPENDIX

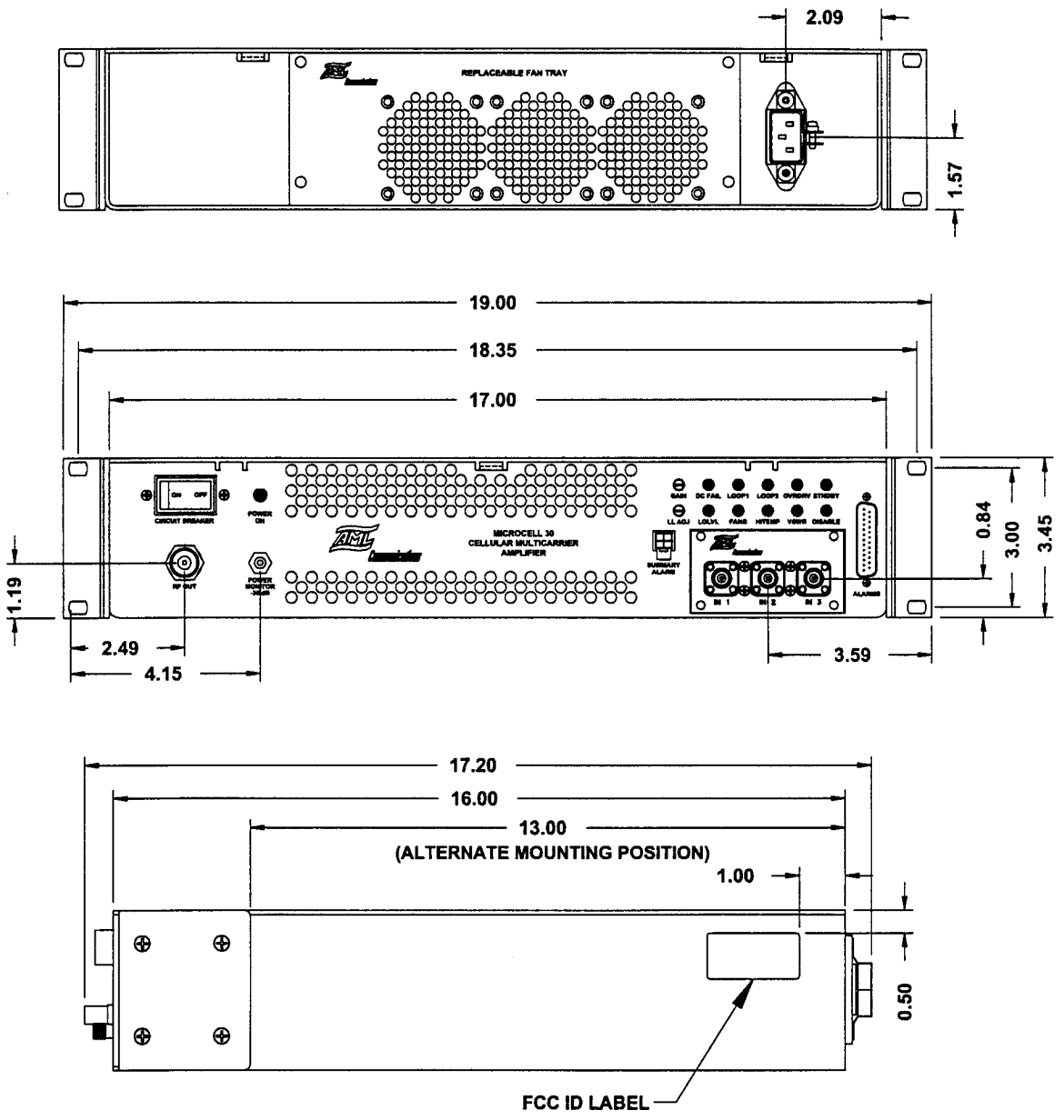

Figure 6: M30 Outline Dimensions

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Operation Manual Authorization

Title: MICROCELL 30 OPERATIONAL MANUAL

Manual No: C087C47

Revision: A

This Operation Manual has been approved for release and distribution by the authorized representatives of the following departments:

_____ _____
_____ for Engineering Date

_____ _____
_____ for Marketing Date

_____ _____
_____ for Customer Service Date

_____ _____
_____ for Quality Assurance Date

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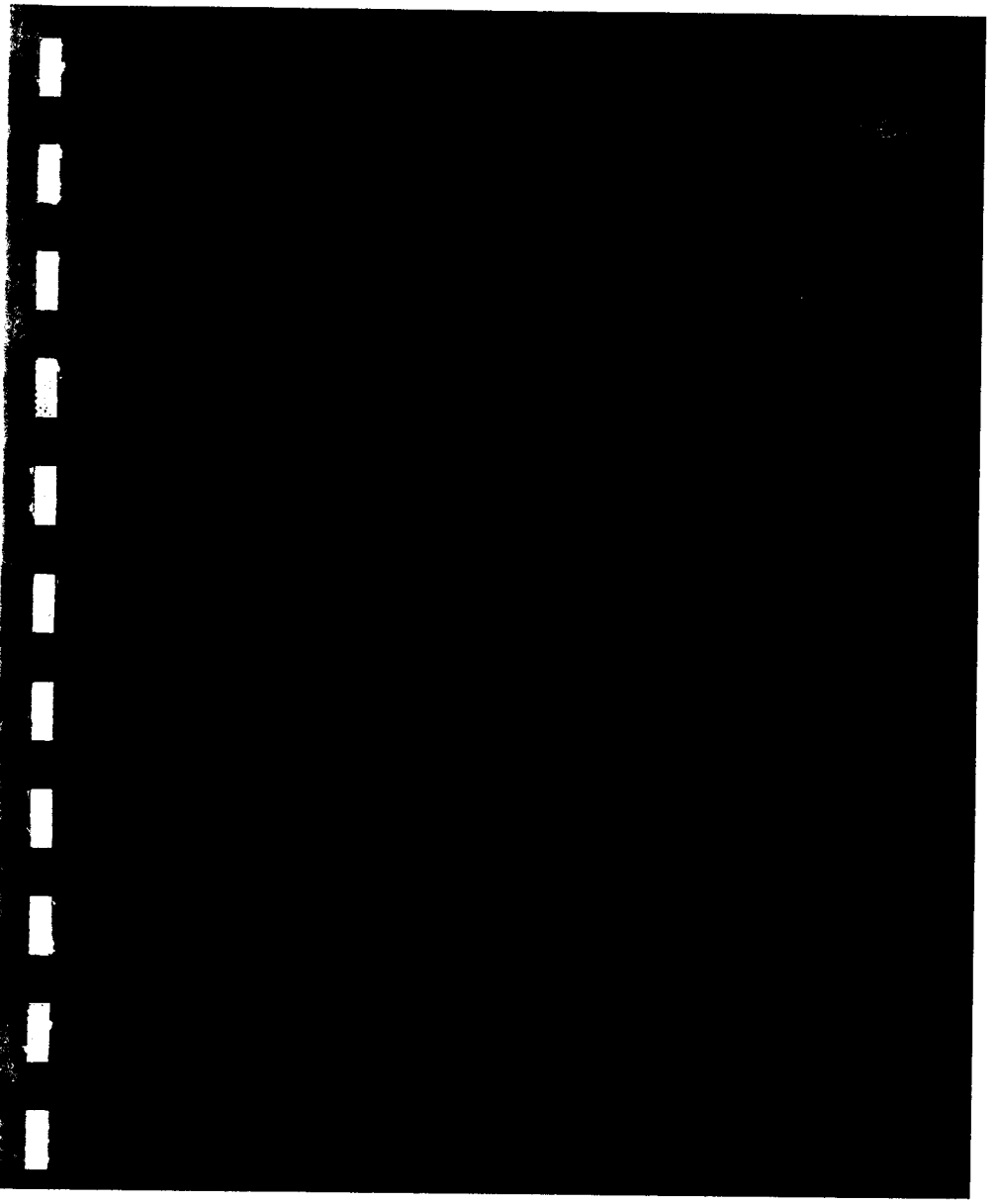
3Ø Watt Multicarrier Power Amplifier



Microcell 3Ø

Operation Manual

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