

AMPS REPEATER

Model:WER-824A

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1. Product Descriptions and Construction

1.1 Product Descriptions

This repeater (model:WER-824A) is a compact bi-directional linear amplifier for 800 MHz AMPS band. It is ideal for extending two-way voice and data communications for null areas. This unit features 80 dB gain and output IP3 level of +45 dBm.

1.2 Construction

This repeater consists of the following major elements.

No.	Parts	Quantity	Maker
1	DUPLEXER FILTER	2	EXPAN Electronics (EMD0836J0881A)
2	REPEATER MODULE	1	Withus (SHF-0589, SXA-289)
3	CONTROLLER	1	Withus
4	POWER SUPPLY	1	Withus
5	Case	1	Withus

2. Specification

2.1 Frequencies

Path	Frequency	Remarks
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Forward path (BTS to phone)	869 ~ 894 MHz	
Reverse path (phone to BTS)	824 ~ 849 MHz	

2.2 Gains

Item	Spec	Remarks
Gain Range	50 ~ 80dB	
Gain adjustment step	1dB / STEP	
Gain adjustment error	±0.7dB/STEP	

2.3 Input/Output

Item	Spec	Remarks
Input Level	-40dBm ~ -70dBm	
Max. Output	+30 dBm	
1dB gain compression	> +32 dBm	
OIP3	> +42 dBm	
AGC Range	30 dB (1 dB step)	Forward/Reverse

2.3 Noise and Spurious Emission

Item	Spec	Remarks
Noise Figure	< 3.5 dB	Gain=+80dB

IMD	> +34 dBc	2-Tone@25dBm/tone
OIP 3	> +42 dBm	

2.4 Others

Item	Spec	Remarks
Input/Output Impedance	50Ω	
RF Connector	N-TYPE (female)	

2.5 Environmental

Item	Spec	Remarks
Temperature Humidity	-20 ~ +35°C 10 ~ 90% RH	-Output Power Variation: < ±2dB -Others: No difference
Vibration	Frequency : 10 ~ 55Hz Amplitude: ±0.75mm	
Weight	5 Kg	
Dimension	250(W)x53(H)x250(D)mm	
Voltage	AC 110V ±15%	

3. Installations and Operation

3.1 Installation

CAUTION: This product should be installed such that a separation distance of at least 20 cm. will be maintained between the radiating element and any nearby person. The maximum antenna gain allowed is 1.6 dB. Failure to adhere to these guidelines may cause the rf exposure levels to exceed those allowed by the FCC rules.

- 3.1.1 The site shall be selected for good ventilation and smooth layout of power and antenna cables.
- 3.1.2 The repeater shall be installed 4 inches above ceiling for its ventilation and easy installation.
- 3.1.3 The repeater uses 9 Volt DC power and and a AC-DC power supply is supplied for 9 Volt DC.
- 3.1.4 After the repeater is bolted down, the donor antenna needs to be connected to donor antenna port of the repeater and the service antenna to be connected to the service antenna port.
- 3.1.5 Calculate the signal strength at the donor antenna
 - Rx signal strength at donor antenna feeder cable shall be calculated
 (Free space loss = $32.2 + 20 \cdot \log(\text{Distance in [m]}) + 20 \cdot \log(\text{Frequency})$) -
 Gain(donor antenna) + feeder loss
 - Actual signal strength at the donor feeder cable needs to be measured with a spectrum analyzer.
 - The previous two values needs to be compared and re-position the donor antenna in case the actual signal strength is lower than the pre-calculated signal strength
- 3.1.6 Gain shall be adjusted for proper output signal strength. Please see an example below for down link adjustment. Up link gain adjustment shall be 2 dB lower than the down link gain.
- (Example)
- | | |
|-----------------------|---------|
| Input signal | -60 dBm |
| Desired output signal | +20 dBm |
| Gain | 80 dB |
- 3.1.7 After the gain is adjusted, it needs to be checked for any alarm presence on repeater's status LEDs.
- 3.1.8 ALC setting needs to be checked for proper operation.

3.2 Operations

3.2.1. Operations

NMS PORT(D-SUB 9 PIN) should be connected to a serial port of a PC.

MONITOR Screen

WITHUS CO., LTD.
File Help

WER-824A NMS Program

<i>Monitor</i>	FORWARD	REVERSE
RSSI	Monitor	Monitor
RF Power	Monitor	Monitor
GAIN	Monitor	Monitor

<i>Control</i>	FORWARD	REVERSE	UNIT
Gain Setting	Setting	Setting	[dB]
Forward AGC : Setting	Reverse AGD : Setting		[dBm]
Forward ALC : Setting	Reverse ALC : Setting		[dBm]
AGC : ☐ ON ☒ OFF		AGC TIME : Setting	
ALC : ☐ ON ☒ OFF		RF : ☐ ON ☒ OFF	
SHUT DOWN : ☐ ON ☒ OFF		LEVEL : Setting	

Display and Function

RSSI: Up/Down Link Signal Strength
 RF POWER: Output Power at Donor/Service Port
 GAIN: Forward/Reverse Path Gain
 ALC*: Automatic Limiting Circuit
 AGC: Automatic Gain Control

* Output automatically shuts off until the output power level is below +30 dBm.

4. Circuit Description**4.1 Description of major parts****4.1.1 DUPLEXER FILTER**

Duplex Filter isolates transmit frequency from receive frequency as a band pass filter in both directions. So the down link signal is fed in to LNA, while up link signal is fed in to transmit terminal.

DUPLEXER Specs

Item	Spec	Remarks
Frequency	869 ~ 894 MHz / 824 ~ 849 MHz	
Insertion Loss	< 2.0 dB	
Return Loss	> 20 dB	
Passband Ripple	+/-1.0 dB	

Rx/Tx Isolation	> 60 dB	
3 –dB Bandwidth	25MHz	
Input/Output Impedance	50Ω	

4.1.2 Repeater Module

This is the first stage amplifier and has the greatest effect on the Repeater's Noise Figure. The signal received from the Donor antenna is fed in to the LNA via a duplex filter. This LNA is working for 800 MHz signal with very low noise and high gain.

4.1.3 Controller

This module controls repeater's whole functions. There are several I/O ports for measurement and monitoring of the repeater status.

4.1.4 Power Supply

It supplies 8 VDC to the Repeater from the external power source (110 V AC)

4.1.2 REPEATER MODULE: LNA part

This is the pre-amplifier section that has the greatest influence on the noise figure of the repeater. The signal received by the antenna passes thru the duplexer filter, and only the signal with frequency band of interest passes thru the duplexer filter. The output of the duplex filter then is fed into the LNA. This LNA is composed of low-noise and high-output circuitry that has a high gain.

LNA Specifications

Item	Specifications	Comment
Frequency range	869 ~ 894 MHz / 824 ~ 849 MHz	
Gain	30 dB	
Gain flatness	± 0.5 dB	
Noise figure	< 1 dB	
IP3	37 dBm (Type)	
Input impedance	50 Ω	
Supply voltage	6V	
Supply current	< 150mA	

The high frequency signal input at J1 passes via the dc-blocking capacitor [C65] and the input impedance matching inductor [L2] and enters the low-noise amplification section [Q3 (ATF-10136)] and gets amplified by approximately 15dB with 0.8dB noise figure. The negative voltage bias of this section is comprised of active bias circuitry that senses drain current using Q4. The high frequency output passes thru L3 and peripheral matching networks and enters the secondary amplification section [U17 (SGA-6489)] obtains a sufficient gain (approx. 18dB) to achieve IMD specifications. U10 (78L05) is a DC rectifier that converts external DC voltage to internally used +5V and U11 (7660) is a DC-DC converter that supplies the negative bias voltage for GaAs FET.

HPA Spec

Item	Spec	Remarks
Frequency	869 ~ 894 MHz / 824 ~ 849 MHz	
Type	Balanced Type	
Gain	20 dB $\pm$ 1.0	
Gain Flatness	$\pm$ 1.0 dB	
Output IP3	> +45 dBm	
DC V / A	6 V / 900mA	

4.1.4 CONTROLLER

This module provides operation controls for the entire repeater and is comprised of the input part and the control part. The module contains the input port for measuring and monitoring the status of the repeater and the output port for providing control functions. All these functions are controlled by internal software program.

Main Functions and Special Features

Item	Functions	Comment
Functions	Forward gain control Reverse gain control Forward AGC critical value (?) control Reverse ALC critical value (?) control Error display	

U2 (ADUC812)-CPU performs the PLL control of the repeater's IF converter, gain control, ALC processing, and various error displays.

Upon power-up, the CPU selects the PLL frequency and checks for normal operation of IF module, and performs various voltage measurements and output functions. The frequency and system status are stored in and read from EEPROM.

1) Transfer of Attenuation Value for Gain Control

The pin #3 of CON5, CON2 is assigned for voltage function and is connected to AT108 Analog Attenuator inside the IF Converter module.

2) Transfer of PLL Selection Values

The pins #6, #5, and #7 of CON5, CON2 are assigned for CLOCK, DATA, LATCH functions, respectively and, the pin #4 receives the LOCKING status (On/Off). (PLL DATA follows the LMX2325 format of National Semiconductor Corp.) If the pin #4 is high, the lock has failed; if low, the lock is successful. If the LOCK status is not normal, U2(CPU) continuously sends PLL selection values. If the lock fails consecutively for a set number of times, the system decides that the IF Converter is out of order.

4.1.7 POWER SUPPLY

POWER SUPPLY Description

This highly reliable switching power supply module converts AC 110V into +9Vdc power used by the repeater.

POWER SUPPLY Specifications

Item	Specification	Remarks
Input voltage	AC 110V	
Output voltage	9 V	
Output capacity	35W	
Voltage ripple	< 90mV	

The 110V/AC voltage supplied by AC power lines gets rectified and smoothed by diodes [D1-D4] and a large capacitor [C6]. The rectified voltage gets PWM-chopped by PWM controller [U1] and current-amplified by Q1. The voltage is down-converted near the final output voltage and gets converted back to DC. This DC voltage is then compared to the desired output voltage using the voltage comparator, TL431, the error output of which is fed back to PWM circuitry via opto-coupler to maintain a stable voltage automatically. C16 and C17 are for eliminating ripples in the final output voltage. The +8V dc voltage obtains gets fed into the Repeater controller.

5. Troubleshooting

As this device uses high frequency signal and components, careless adjustments of variable components result in degradation in system performance. Therefore, all repairs and adjustments must be carried out with appropriate measurement instruments.

Initially check the device's status while the malfunctioning module is still in the field. When the problem is identified, replace the malfunctioning module with an identical module. The actual repairs of individual components inside the malfunctioning module should be done at the factory.

A) Reduced Gain

Connect the I/O ports to network analyzer and check the selected gain and actual gain. If these two values differ by more than 2-4dB, check the cable connection and filter characteristics using the graph on the network analyzer. If no problems are found, re-adjust the gain using the gain-setting potentiometer.

If there exists a substantial difference between the selected and actual gains, the most likely cause is the defective active components. Check the operating points of each active component with digital voltmeter and replace defective component and re-adjust the gain.

B) Defective Control

If error-indicating LED is lit, the cause is the defective PLL. If that is not the case, check the wiring and contacts of connectors. If no obvious problems are found, replace the control board with an identical part.

C) Inaccuracy of Output Limit Value

This repeater has output characteristics stored in its control memory to produce a minimum error in output limit values. If the stored values are erased, the memory must be re-programmed by the manufacturer.

D) No Power

Check the fuse first. If no problem is found, remove the connector on the output side of the power supply and check the output voltage with no load. If the output voltage is normal, look for possible shorts on the load side. If the output voltage is not normal, replace the power supply part.