



Technical Description
DA4000 Variable Gain RF Amplifier

Purpose:

The purpose of the DA4000 Variable Gain bi-directional RF Amplifier is to boost the output power of a .6 watt handheld cellular phone to a maximum legal limit of 3 watts for the 800 MHz cellular band and 2 watts for the 1800-1900 MHz PCS band. Digital Antenna, Inc. manufactures a line of 9dBi gain cellular antennas to be used with the DA4000 amplifier. The 9dBi antennas are different in outside housing only. The same dual band, tri mode element is used for all Digital Antenna, Inc. cellular antennas.

Construction:

The DA4000 circuit board has been designed with exceptional RF shielding. RF signal path construction, trace thickness, width and turning radii, complies with widely accepted high frequency specifications. The DA4000 is mounted to an aluminum mounting plate that performs as additional grounding as well as media to dissipate heat. A second aluminum plate is attached to the assembly which further dissipates heat and provides a mounting mechanism to the extruded aluminum case.

The extruded aluminum case is designed with top fins that provide appropriate surface area for heat dissipation. End plates close the assembly providing RFI shielding and a means to house connectors, switch and a power indicator. The function of the connectors, switch and power indicator is silk screened on the end plates for clarity.

Functional Description:

The DA4000 is a bi-directional variable gain RF amplifier. The direction of signal flow is described as Uplink (transmit to the antenna) and Downlink (receive from the antenna) for both 800 MHz cellular band and 1800-1900 PCS bands. Uplink operating frequency is 824-849 MHz for cellular at 3 watts maximum output power and 1850-1910 MHz for PCS at 2 watts maximum output power. Uplink maximum gain for the cellular band is 25 dB and the PCS band is 19 dB. Downlink operating frequency is 869-894 MHz for cellular with a maximum gain of 19 dB and 1930-1990 MHz for PCS with a maximum gain of 19 dB. Signal protocol is TDMA, CDMA and PCS. Use of the DA4000 is accomplished by connecting the antenna to the connector labeled "antenna" and the phone by way of a cell phone adapter cable to the connector labeled "phone".

Circuit operation:

Uplink operation starts at the connector labeled J2 entering a diplexer (dip 2) with an input frequency range of 824-894 MHz for cellular and 1850-1990 MHz for PCS. Two 2 to 1 combiners separate uplink and downlink signal directions. One combiner (IC4) is used for cellular with a frequency range of 810-960 MHz and the other combiner (IC5) is used for PCS with a frequency response of 1710-1990 MHz.

A 10 dB attenuator (IC8) is used on the Cellular uplink path to reduce the input power of (IC1) to the allowable maximum of 60mw. An RF band pass filter (filter 1) with a center frequency of 836 MHz is used on the input to the 3 watt amplifier (IC1). An additional RF band pass filter (filter 5) is used on the amplifier output. Another 2 to 1 combiner (IC6) is used to separate cellular uplink frequencies from cellular downlink frequencies. Next is a diplexer (Dip 1) that is used to separate the cellular band from the PCS band of frequencies.

A 20 dB attenuator (IC9) is used on the PCS uplink path to reduce the input power of (IC2) to the allowable maximum of 10 mw. An RF band pass filter (filter 2) with a center frequency of 1880 MHz is used on the input to the 2 watt amplifier (IC2). An additional RF band pass filter (filter 6) is used on the amplifier output. Another 2 to 1 combiner (IC7) is used to separate PCS uplink frequencies from PCS downlink frequencies. Next is a diplexer (Dip 1) that is used to separate the Cellular band from the PCS band of frequencies.

Downlink operation starts at the connector labeled J3 entering a diplexer (dip 1) with an input frequency range of 824-894 MHz for cellular and 1850-1990 MHz for PCS. Two 2 to 1 combiners separate uplink and downlink signal directions. One combiner (IC6) is used for cellular with a frequency range of 810-960 MHz and the other combiner (IC7) is used for PCS with a frequency response of 1710-1990 MHz.

Band Pass filters, (filter 7) with a center frequency of 1960 MHz and band pass filter (filter 8) with a center frequency of 881 MHz, provide frequency isolation to the input of a low noise amplifier (IC3). The LNA then drives into 2 to 1 combiners (IC5) for PCS with a frequency range of 1710-1990 MHz and (IC4) for cellular with a frequency range of 810-960 MHz. As mentioned before, these combiners separate uplink from downlink signal paths. Next the combiners (IC4 & IC5) interface to a Diplexer (dip 2) which finally feeds the phone thru connector J2. This completes the downlink path to the cell phone.

DC Power source:

The DC4000 is designed to accept 12 to 24 VDC as an input. The normal maximum input current is 1 A. Switch SW1 enables power two voltage regulator circuits after passing thru a 3A fuse F1. A 5VDC, 1.5A regulator VR2 provides regulated power to the 2 watt PA (IC2) for Vdd and the bias circuitry Vapc. A 10VDC, 2A regulator VR1 provides regulated power to the 3 watt PA (IC1) for Vdd and the bias circuitry Vapc as well as bias circuitry for the LNA (IC3).