

Digital Antenna Inc.

DA4600 Circuit operation

The DA4600 Direct connect bi-directional cellular amplifier operates on the 850Mhz (uplink 824-849MHz, downlink 869-894MHz) and 1900Mhz (uplink 1850-1910MHz, downlink 1930-1990MHz) cellular bands.

It has fixed gain of 23dB (cannot oscillate in normal operation) in both the uplink and downlink frequency spectrums. By careful selection of parts the uplink output power is limited to $\leq 30\text{dBm}$, and the downlink output power is $\leq 0\text{dBm}$.

The DA4600 has neither oscillator functions nor intermediate frequency generation. It has SAW bandpass filters used for limiting the frequencies to which it will respond. The DA4600 simply amplifies and passes frequencies within the designated cellular bands that are generated and controlled by the connected handset.

Uplink operation:

Incoming signal from the uplink (handset) input connector is split into upper and lower band via a ceramic dyplexer and applied to upper and lower band saw duplexer antenna ports. The TX output of each saw duplexer is amplified via a low noise amp, filtered and frequency controlled via two saw bandpass filters, and applied to one side of a dual band power amplifier IC. The output of the power amp is applied to the output saw duplexer TX port and finally to the output dyplexer and output (antenna) connector. Fixed attenuators are used between stages to control the overall gain level and provide impedance matching.

Downlink operation:

Incoming signal from the downlink (antenna) input connector is split into upper and lower band via a ceramic dyplexer and applied to upper and lower band saw duplexer antenna ports. The RX output of each saw duplexer is amplified via a low noise amp, filtered and frequency controlled via two saw bandpass filters, and applied to a second amplifier to provide the required gain. The output of the second RF amp is applied to the saw duplexer RX port and finally to the output dyplexer and output (handset) connector. Fixed attenuators are used between stages to control the overall gain level and provide impedance matching.

Power supply

The power supply is a switched buck boost style converter used to convert the incoming DC voltage of 8-18VDC to the 3.85VDC power used for the amplifier components. DC input is polarity insensitive and trace fused on the PCB for safety. A microprocessor ATiny26 is used to monitor the output current of the 3.85VDC power. If oscillation occurs, the output current will increase. The uP senses this surge of current and shuts down the 3.85VDC output to avoid further oscillation and the radiation of unwanted signals.

Describe the self-monitoring mechanism (HW and SW)

Self monitoring is performed by a microprocessor monitoring minute current draw fluctuations in the final amplifiers. An algorithm that differentiates standard cellular signals, with ever changing waveforms, from a defined stable level, an oscillation indication, is implemented. Upon detection of an oscillating condition power is removed from the RF pathways. Signal condition is determined by

multiple successive reads of an ADC channel to determine level and delta of measured signal. At an appropriate level with limited delta over many successive approximations an oscillating condition can be well determined in a matter of milliseconds.

Describe the automatic power-down and shut-down mechanism when the booster is not in need

With input to output gain of 23dB and conducted output noise power of $\leq -95\text{dBm}$, well below the $-70\text{dBm}/\text{MHz}$ level, there is no reason for the amplifier to be disabled. Any output noise power the unit generates, either uplink or downlink, is totally dissipated within a maximum distance of $\frac{1}{2}$ meter from the outside antenna. Due to the physics of the coupling used for input, the maximum downlink noise transmission distance is but a few Centimeters.

Detection scheme for own network

Broadband Consumer device, all networks treated the same.

Detection scheme for other networks, like and unlike

Broadband Consumer device, all networks treated the same.

Power down triggering criteria and adjustable range

This is a “direct connect” type device and provides a fixed up/down gain. It will power down if over driven or oscillating.

Shut down triggering criteria and resume/recovery algorithm

When overdriven or an oscillation is detected the unit will power off for 1 minute then resume normal operation. After five such detections the unit will remain off until manually reset.

Describe how “operate only for the duration of a call” is achieved

This unit is a tightly coupled, direct connect device intended for use with a single input. As such it will only have active RF in the uplink when the input control device is transmitting. 23dB of gain is not sufficient to allow downlink retransmission from the specified input device inductive coupler.

Describe any interference avoidance scheme

Device has a nominal gain to prevent a large noise “bubble” around the transmit antenna, less than 1Meter in total size. The use of an inductive coupler for input device severely limits downlink retransmission range to a few centimeters. A unique algorithm will quickly detect undesirable operation and cause device to power off. Device protection is always on and cannot be field reconfigured. Device will shut off if attempted to be driven beyond specified power level.