WJ Communications

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Application Note 5

Antenna Isolation with 850MHz Cellular/AMPS Band Repeaters

INTRODUCTION

To achieve optimum performance with today's high-gain high-power repeater products, careful attention must be given to the installation of the donor and server antennas. This application note will attempt to provide some guidelines for a proper antenna system installation.

ANTENNA SYSTEM

To operate a Cellular repeater at maximum gain, the antennas in a repeater system must be adequately isolated from each other to prevent system oscillation. The most common, and least expensive, method of isolation is to mount the antennas some distance from each other. Since most installations are on a common tower, the antennas are normally mounted so that they are vertically separated from one another. The server antenna is located high on the tower to achieve maximum coverage while the donor antenna is mounted low on the tower in line-of-sight of the base station antenna.

To determine how much isolation a particular distance will provide, the following formula is used:

$$I = SG + PL + DG$$

Where:

I = Antenna Isolation in dB.

SG = Server Antenna Gain, in the direction of the Donor Antenna (vertical gain)

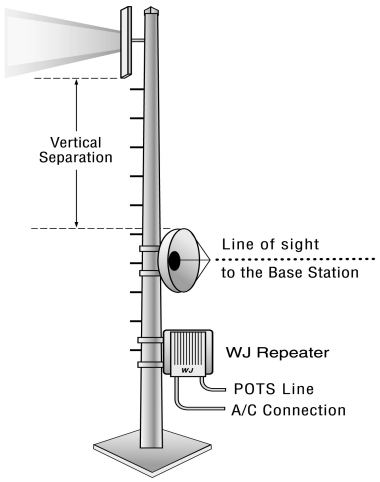
DG = Donor Antenna Gain, in the direction of the Server Antenna (vertical gain)

PL = Path Loss, i.e., the amount of attenuation due to the distance between the antennas.

For example, an 85dB gain repeater will need a minimum isolation value of at least 85dB, the gain of the repeater.

Since the above equation calculates isolation, which we already know, let's rearrange the equation to compute for path loss, so that we can determine how much vertical separation will be required:

$$PL = I - SG - DG$$



For example, let's assume we are using the following antennas in a Cellular/AMPS band system:

Server Antenna: FV105-10-00NA-2 (EMS Wireless)
Gain: 10dB
Electrical Downtilt: 0°
Side lobe Suppression at 90°: -40dB

Donor Antenna: PR-850 (Kathrein Inc.)
Gain: 17dB
Side lobe Suppression at 270°: -26dB

Accordingly, the isolation can be calculated as follows:

I = -85dB Required Isolation
SG = -30dB Server Gain [10dB gain – 40dB side lobe suppression]
DG = -9dB Donor Gain [17dB gain – 26dB side lobe suppression]

Next we insert the above numbers into our formula and calculate the path loss required:

PL = -85 – (-30) – (-9) = -46dB of Path Loss

Now that we know how much path loss we need, we must determine how much vertical separation is required to obtain that amount of path loss. We will use the following rule-of-thumb to determine distance:

For 850Hz Cellular/AMPS band: 1 meter (~ 3ft) of separation = 31dB of loss

Each doubling of the distance thereafter adds an additional 6dB of loss.

Therefore, the Cellular Band repeater in our example would need a little less than 8 meters (~25ft) of antenna separation:

1 meter	=	31dB	
2 meters	=	6dB	(37dB)
4 meters	=	6dB	(43dB)
8 meters	=	6dB	(49dB)

Total	=	49dB of path loss	

This assumes that no other form of isolation improving equipment is used. In the case where inadequate vertical separation can be achieved, an ice shield or antenna shroud can be used to increase isolation. Valmont Microflect is one source of quality ice shields.

Note that this is only an estimate. The isolation value will vary based on tower type, system configuration, nearby obstructions, and wind loading of the tower. We recommend that the system engineer add additional isolation requirements to account for these path loss changes. Be sure to contact the antenna manufacturers to verify the specifications.

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