

Chapter 1

Boosters (wired amplifiers) VS Repeaters (wireless amplifiers) For use in vehicles (cars, trucks, motorhomes, boats etc.)

Overview:

Wireless amplifiers (repeaters) cannot and will not improve range in a vehicle.

Some "wireless amplifiers" have recently been introduced into the marketplace for use in vehicles. The distributors of these devices claim that they can be used in vehicles to improve signal and range of a cell phone and that they do so without the cell phone being connected to the amplifier. This type of amplifier is commonly known as, and referred to, as a "repeater". The type of amplifier that improves signal but must be attached to the cell phone is commonly known as, and referred to, as a "booster".

The reason wired amplifiers (boosters) exist and all amplifiers are not wireless (repeaters) is because each device will improve signal in a certain environment and under a certain set of circumstances; one cannot be used in place of the other with the same result. If this was not the case, wired amplifiers (boosters) would not exist because it is always preferable not to connect a cell phone to any device.

Chapter 2

Basic difference between Boosters and Repeaters

Repeaters and boosters are essentially the same...they are bi-directional radio frequency amplifiers. The difference between the two devices, other than the names that are used to describe them is this:

1-Repeaters typically have high gain and low output power; they use an antenna on the input side and an antenna on the output side of the device. Repeaters are made to be used in a stationary environment like a building, where the RF (radio frequency) signal is stable and not changing. A competent repeater installation requires site assessment using diagnostic RF instruments to determine outside and inside signal levels, measurements of attenuation (the difference of the levels), calculations to determine the level of amplification required to accomplish effective signal coverage of a given area and an experienced knowledgeable technician to install the repeater system.

2-Boosters typically have low gain and high output power; they use a cell phone directly connected to the input side and an antenna on the output side of the device. Boosters are made to be used in remote areas and mobile environments where the RF signal is weak and constantly changing. Boosters do not require signal level assessment, attenuation measurements, calculations, the use of diagnostic instruments or RF technicians to install them. Boosters are simple to use "plug and go" devices.

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Chapter 3

Repeaters: how they work and the environment for which they are designed

Repeaters are normally used in fixed situations (buildings) where the signal outside of the building is good but the signal inside of the structure is attenuated or diminished due to the structure of the building (a metal or heavy concrete building or an underground garage for example).

Signal originating at the tower is received by the external antenna from outside of the building, this signal travels through the antenna cable to the repeater where it is amplified, sent out of the repeater through the antenna cable leading to the internal antenna which broadcasts the amplified signal into the building. This signal is then received by the cell phone antenna.

When a phone call is engaged, the signal that is transmitted by the cell phone antenna is received by the internal antenna, this signal travels through the internal antenna cable to the repeater, where it is amplified and sent out through the external antenna cable to the external antenna where it is transmitted to the air by the external antenna and is then received by the tower.

A repeater amplifies the originating external signal and internal signal, in the order of 10,000 to 100,000 or greater than the signal received by the either antenna, however, the resultant amplified signal at either antenna is not very strong because the originating signal is extremely low to begin with, the tower is usually nearby and the coverage inside of the building is relatively small, therefore repeaters usually have high gain which amplifies very low signal many times but the resultant output signal at either antenna is not extremely powerful. In a sense, each of the antennas acts like a microphone and a speaker at the same time.

To draw a comparison to things we can hear one can use this analogy: the phone makes a sound, this sound travels through the air and loses energy (free air loss) on its way to the internal antenna which acts like a microphone and picks up the sound at a very low level like a whisper. The repeater acts like an amplifier and makes the whisper louder and sends it to the external antenna which acts like a speaker that broadcasts the phone's sound to the outside and this sound travels through the air to the tower. The same is the case in the reverse where the external antenna acts like a microphone which picks up the sound from the tower etc.

There is one criteria that always has to be met for a repeater to work; it is imperative that the signal that is transmitted by the internal antenna does not reach the external antenna and visa versa, hence, the antennas require attenuation (separation) from each other. If the signal from one antenna reaches the other, the repeater will oscillate (feedback), this is the same effect as the squeal that can be heard when a microphone is brought too close to a speaker. If this happens with a repeater one cannot hear the oscillation nor can it be detected without instruments and the repeater will simply overdrive itself until it burns out and ceases to function. When the repeater oscillates it will also generate RF noise which will interfere with both the signal coming from the tower to the phone and the signal going from the cell phone to the tower. The RF noise will render the site where the repeater is being used a "non-service" area as long as the oscillation occurs.

Chapter 4

Repeaters-Case 1: good signal outside, poor signal inside (usually occurs in urban areas)

In the case of a building, where the external signal is good and the internal signal is bad, the tower is usually close by and the building itself is the cause of the internal signal degradation, hence, a "high gain low power repeater is adequate". The attenuation (separation) of the outside signal and inside signal is caused by the building structure itself and it is almost always enough to provide the attenuation required between the two antennas to prevent oscillation. The building environment, both outside and inside is always stable and will not change from time to time or day to day, therefore when a repeater system is set up and working in this fixed environment it will stay working and reliable. The same cannot be accomplished in a vehicle which moves and the signal level changes both outside and inside constantly, hence a booster (wired amplifier) is required in this environment.

Chapter 5

Repeaters-Case 2: poor signal outside, poor signal inside (usually occurs in rural areas)

In the case of poor signal outside and inside of a building, the tower is usually far away and the poor signal inside and outside of the building is not caused by the building structure itself. A "high gain high power repeater" will be required in order for the signal originating at the external antenna to reach the tower far away. In this environment it is much harder to enhance signal and stabilize the repeater. The repeater itself must generate a more powerful signal at the external antenna in order for the signal to reach the tower far away and the repeater must have higher gain so that the very low signal originating outside of the building is amplified to a level that is usable when it is broadcast to the inside of the building. The chances of oscillation are greatly increased because since the building itself is not the cause of signal degradation (attenuation) from outside to inside, and the repeater has higher gain and power, the attenuation between the two high power emitting antennas is usually not enough to avoid oscillation. This problem can sometimes be overcome by using directional antennas both outside and inside. Directional antennas will radiate energy in a particular direction and if they are pointed away from each other (back to back) it is possible to keep the signals from reaching each other and avoid oscillation. This type of set-up can only be achieved in a fixed environment. After the antennas are set and the system is tuned and working, the power of the repeater cannot be varied nor can the direction of the fixed placement antennas be changed without risking oscillation. In the case of a vehicle travelling to and through remote areas, a high power repeater with directional antennas cannot be used while moving and it is unlikely that directional antennas can be used and set up successfully without oscillation every time that the vehicle is stopped. This would be virtually impossible without diagnostic RF instruments.

Chapter 6

Boosters: how they work and the environment for which they are designed

Boosters are designed to work in environments where the signal is poor, constantly changing and where attenuation (separation) of internal and external antenna signals is difficult or impossible. Boosters work the same way as repeaters, however, the amount of times the signal is amplified by the booster is lower than it is with a repeater because the phone is directly attached to the booster and as such, the cell phone will deliver a much stronger signal to the booster without degradation (free air loss) and the signal sent from the booster to the phone will be sent directly to the cell phone without degradation (free air loss) hence, the booster amplification need not be as great as repeater amplification to achieve substantial output power to the external antenna and input power to the cell phone. The signal degradation occurs due to "free air loss" when using a repeater because of the distance that the signal must travel through the air from the cell phone antenna to the repeater's internal antenna and back is not a variable when using a booster.

The amount of power transmitted by a booster is also not limited by separation of the input (internal) and output (external) sides of the device because the booster configuration is a closed loop system and no matter how much power is generated and transmitted by the external antenna the booster cannot oscillate (feedback). It is not susceptible to this effect and as such it cannot burn itself out nor cause RF noise originating from oscillation.

A booster is not effected by distance of the cell phone antenna to the repeater antenna and gain and output power are always stable. Boosters do not require site tuning or signal balancing, they do not require an RF site survey to determine RF levels and gain levels as is the case with any competent repeater installation and they can be used in constantly changing RF environments without risk of oscillation and damage to the device. Simply put, a booster will work if there is any signal to amplify and cease to work when there is no signal to amplify. It is a reliable device that does not require guesswork and it is the most efficient and reliable amplification device for a changing RF signal environment. A booster can be used in a low signal environment with an omni-directional antenna and deliver increased receive and transmit signal successfully in any environment where there is even minimal signal available to amplify and it will deliver constant and reliable performance and improvement in range without the variable of "free air loss". Boosters are easy to use, they are simply "plug and go" devices. This are the reasons boosters exist and all RF amplifiers are not repeaters.

Chapter 7

Why a repeater will not work in a vehicle

A repeater for use in a vehicle, whether it is a car, truck, boat or motorhome cannot increase range because it is not possible to attenuate (separate) the internal antenna signal from the external signal enough to avoid oscillation. It is known by anyone that has ever used a cell phone that the phone itself can send and receive signals to and from a tower as far away as 10 miles or more under the right conditions without the aid of a booster or external antenna. It stands to reason, and proven under test, that a signal that can travel this distance through the air can and will reach any repeater antenna that is located on the outside of the vehicle while simultaneously being received by the the antenna on the inside of the vehicle. This will cause an oscillation (feedback) and may burn out the repeater but at the very least the oscillation will cause "RF noise" that will be transmitted by the repeater to the tower and to the cell phone on the same channel that is being used by the cell phone making the call and this will result in the failure of the originating phone call. This condition will occur when the phone is far away from the tower and the tower commands the phone to transmit at a high level. This is also the time that signal

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amplification will be required because the phone is going out of range.

Chapter 8

How a vehicle repeater can fool you

It is possible for a repeater to appear to work and improve signal when a phone is in close proximity to a tower. This appearance is caused by the two following phenomena:

a) the repeater amplifies the signal that is generated by the tower and sends it to the inside antenna of the vehicle. The increased signal that is broadcast to the inside of the vehicle causes the signal bars on the cell phone to increase and since most people equate an increase of the signal bars with improved performance and range it looks like the repeater is beneficial, however this is not the case. An increase in signal bars is simply a measure of the signal level (strength) that is generated by the tower and reaching the phone. Although in normal conditions when a phone is not connected to a booster and there is not a repeater present, an increase in the signal bar meter of the phone indicates closer proximity to the tower and hence the chances of a successful call are increased, this does not hold true when any type of amplification device is used. It is possible to increase the signal bars on a cell phone with the use of amplifiers or RF noise generators (like a poorly designed or manufactured booster or repeater) while simultaneously not improving and sometimes even degrading the phone's ability to transmit and the user will not know it without the use of sophisticated RF diagnostic instruments.

b) the cellular network regulates the power that a cell phone transmits with power commands that are sent to the cell phone by the tower. If the phone is close to a tower, the network commands the phone to transmit at low power and as the cell phone gets progressively further from the tower it is commanded to transmit with increasingly more power. When a call is engaged near a tower, the transmit power from the phone is very very low and even though the repeater is present the signal that is transmitted by the phone is not powerful enough to cause the repeater to oscillate, hence there are times when a repeater will not cause harm to signal and since the signal bars displayed by the phone are greater with the repeater turned on than turned off it seems that the repeater is useful and working OK, however a repeater would not be required under these circumstances since the tower is close by and the phone is adequate by itself. When the distance from the tower increases and the phone is commanded to increase its power, the increase in power will make the repeater start to oscillate at some point. This is usually when amplification is required but instead of increasing power the repeater causes call degradation through oscillation and "RF noise".

Chapter 9

A note of Caution:

1-Vehicular repeaters (wireless amplifiers) advertised by the brand names, Wilson, Digital Antenna, Powermax, Cellamericas, Richardson Electronics and several others that are advertised

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and recommended for use in vehicles and watercraft do not work. None of these devices are capable of delivering 3 watts of power under any conditions and the FCC certificates for these devices clearly show that none of these are rated at 3 watts of power, some do not even have FCC type approvals and are not legal for use in North America. These devices are low power amplifiers and are totally unsuitable for increasing range in remote areas. All of these devices will oscillate when a phone is at full power if the phone is close enough to the internal antenna; if the phone is not close enough to the internal antenna they will do nothing. It is impossible to have a repeater work in a vehicle that is not made almost entirely of steel with all but the tiniest of openings (a tank for example). These devices are useless in vehicles.

At worst, the companies that sell them know this and are counting on fooling the consumer with the fact that the phone will show increased signal bars and at best, they are simple re-sellers who do not know much or anything at all about amplifiers and repeaters and are happy to take the consumer's money.