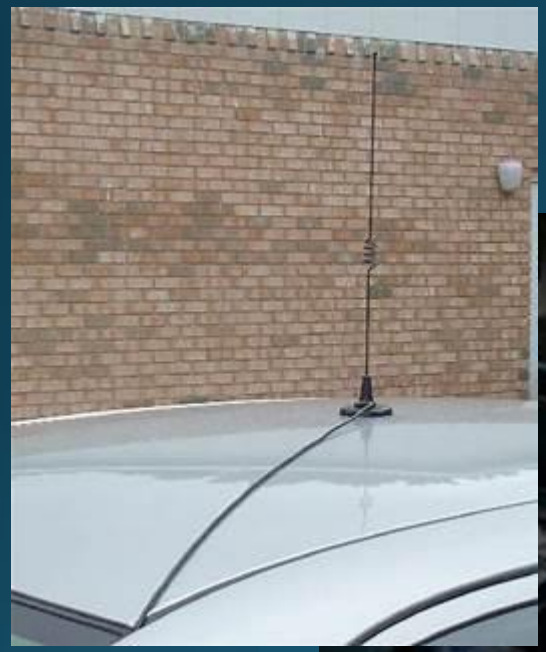
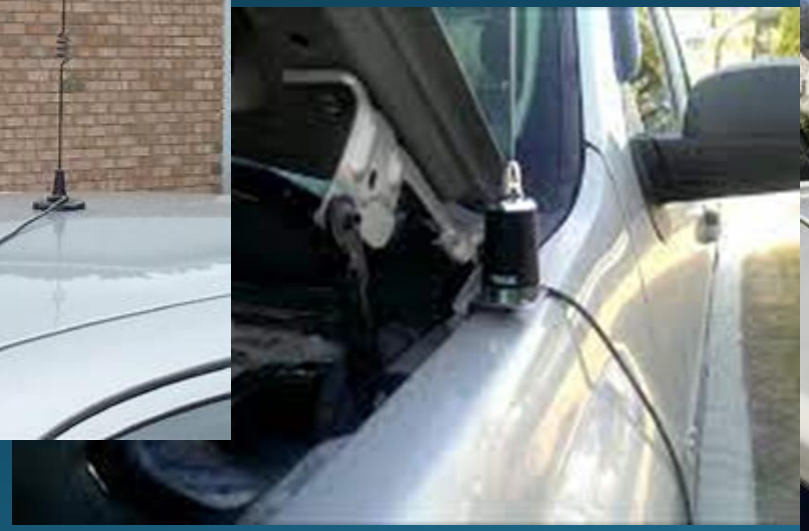
serving our community since 1982

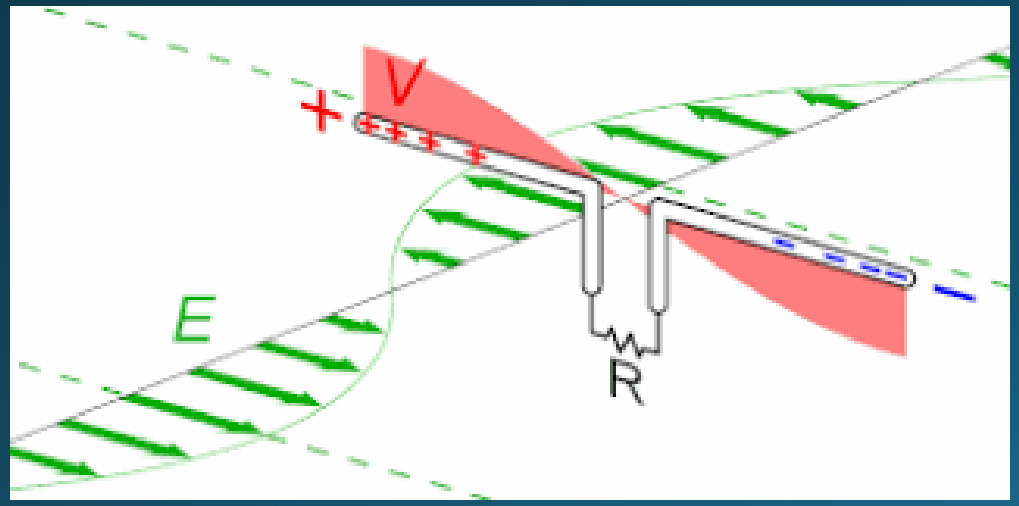
selecting, mounting & tuning 2m & 70cm mobile antennas





for best performance,
a mobile antenna must
be properly
selected, placed, fed,
and tuned

every mobile RF antenna has two “halves” – either physical or electrical

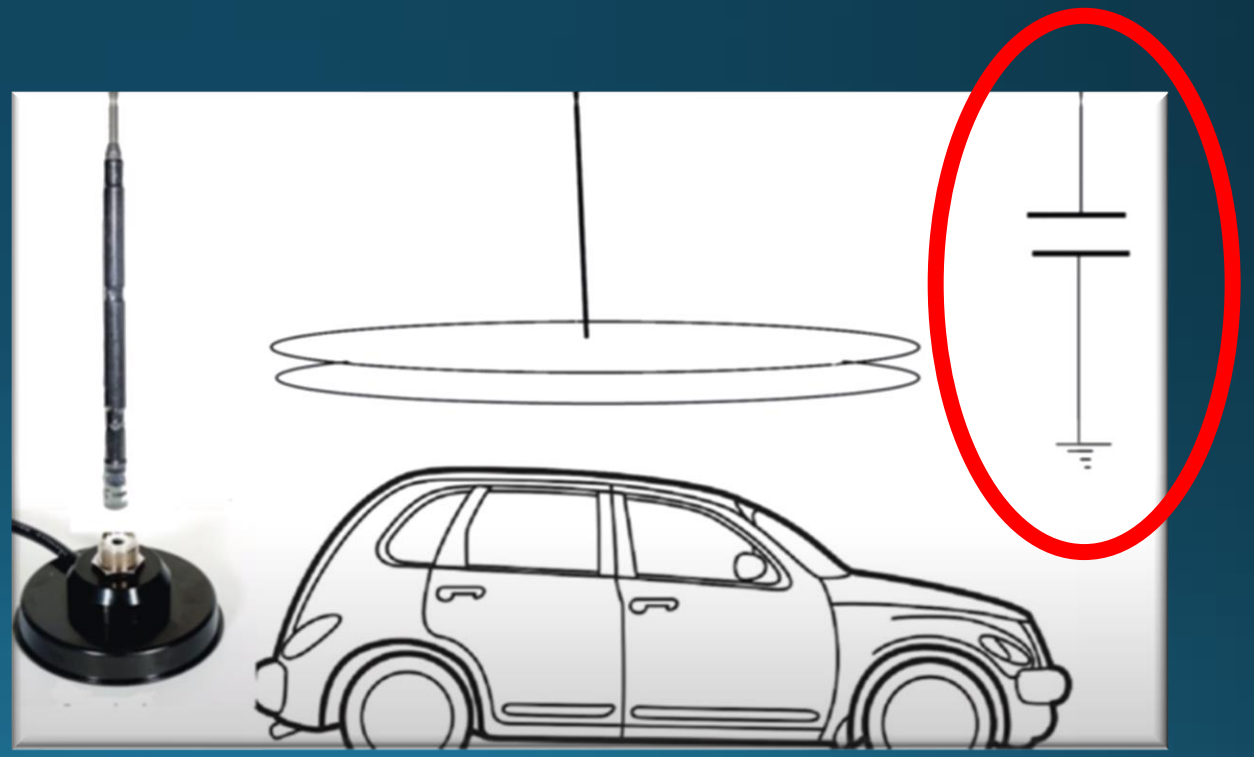


they are all “dipoles” of one sort or another

the radiating element of a mobile antenna is one “half” of the dipole antenna

the other “half” of a mobile antenna is the “ground plane” created by the vehicle’s conductive mass capacitively coupling with the earth beneath the vehicle

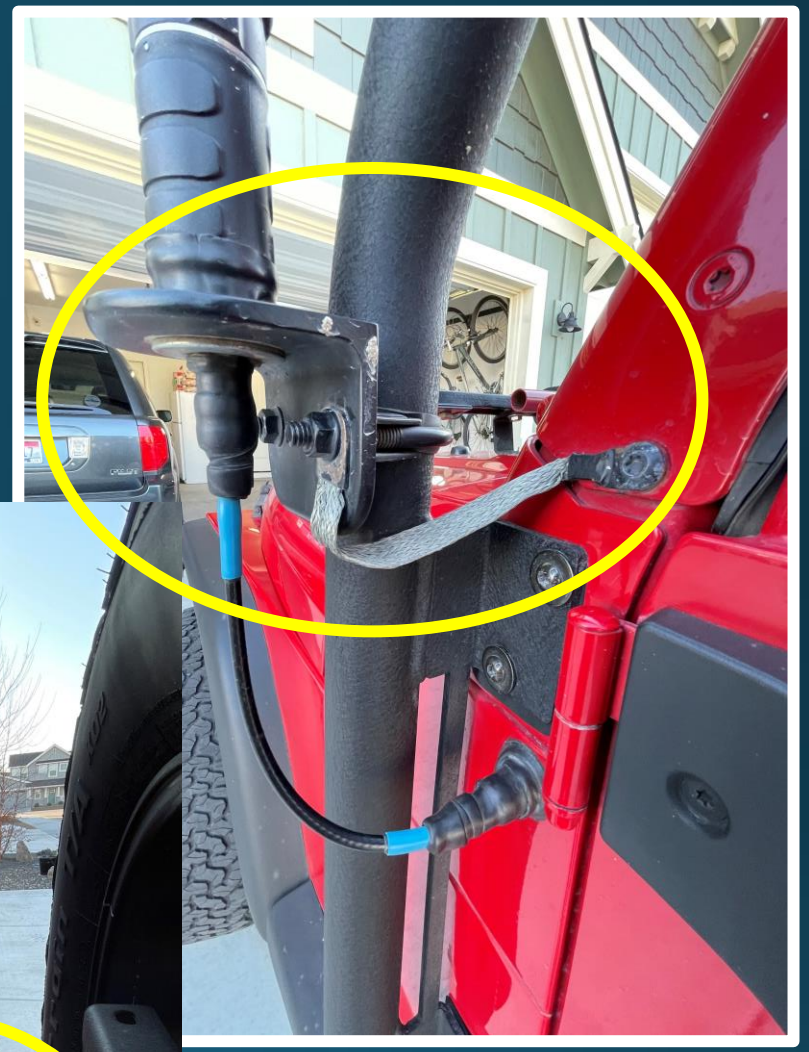
a magnetic field in a magnetic mobile mount causes a capacitive connection to the vehicle completing a ground plane path creating the other “half” of the antenna



DC grounding a mobile antenna alone will not create a ground plane path

the antenna must be located near the vehicle's conductive mass to complete a working ground plane

a “hard mount” will create a DC ground which may help suppress RFI, but it does not create a ground plane



in this example, the ground plane path is created by the antenna's close proximity to the conductive mass

this is not an efficient location for an antenna, too far from center mass

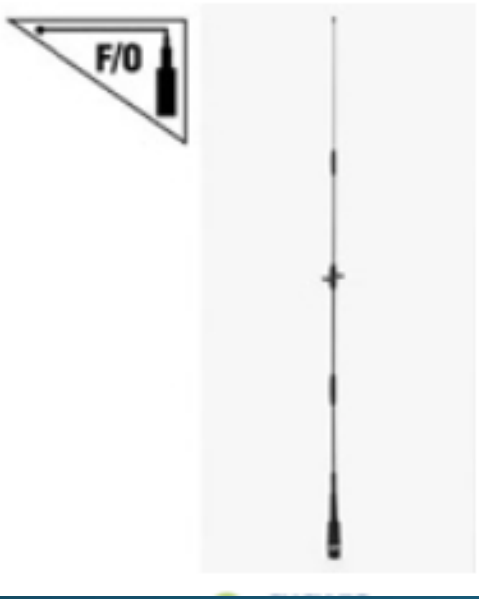
not all mobile antennas are created equal

it is important to understand the concept of antenna gain when it comes to mobile installations

antennas don't create RF energy,
they divert, direct, or concentrate it in
a pattern or a direction

this directional feature
is called "GAIN"

the efficiency rating of an antenna is expressed in “GAIN”



CA-2x4SR

BROADBAND VHF/UHF Dual Band Antenna

Dual band, designed to assist **S**earch & **R**escue Volunteers and Professionals

1.5:1 or less SWR:

144-148/440-450MHz

2:1 or less SWR:

~~140-160/435-465~~MHz

Gain: 3.8/6.2dBi

Max Power: 150 watts

Length: 40 inches

Connector: PL-259, fold-over hinge included

dBi

“decibel relative to isotrope”

antenna gain is measured in units of dBi

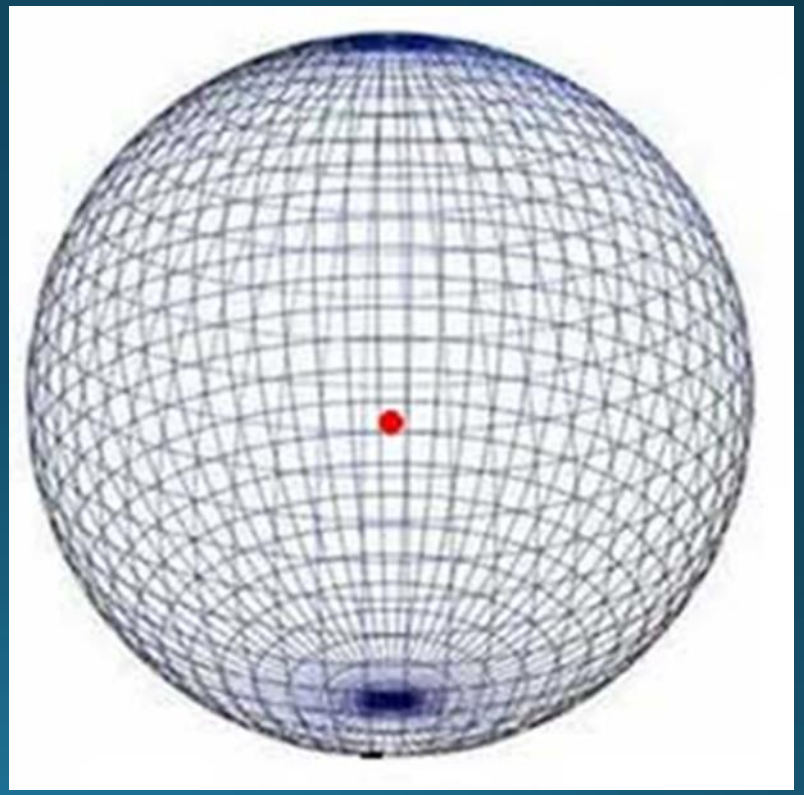
antenna manufacturers use dBi to measure antenna performance

a dBi rating reflects an antenna's performance in a given radiating pattern compared to an isotropic antenna

not an increase in transmitter signal power

there is no real isotropic antenna, the concept is a model only representing what the radiating pattern would be if there were no worldly influences upon it

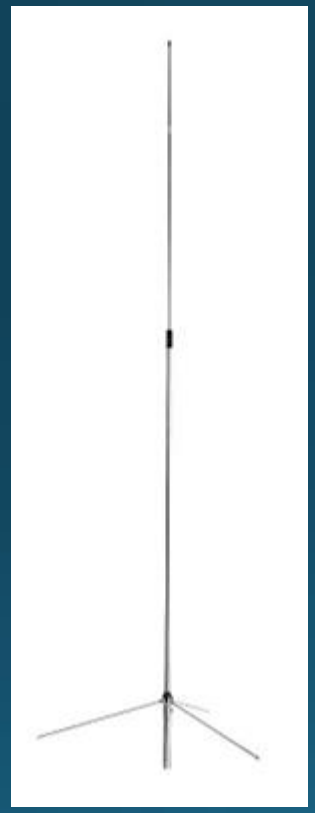
an isotropic antenna radiates equally in all directions from the center



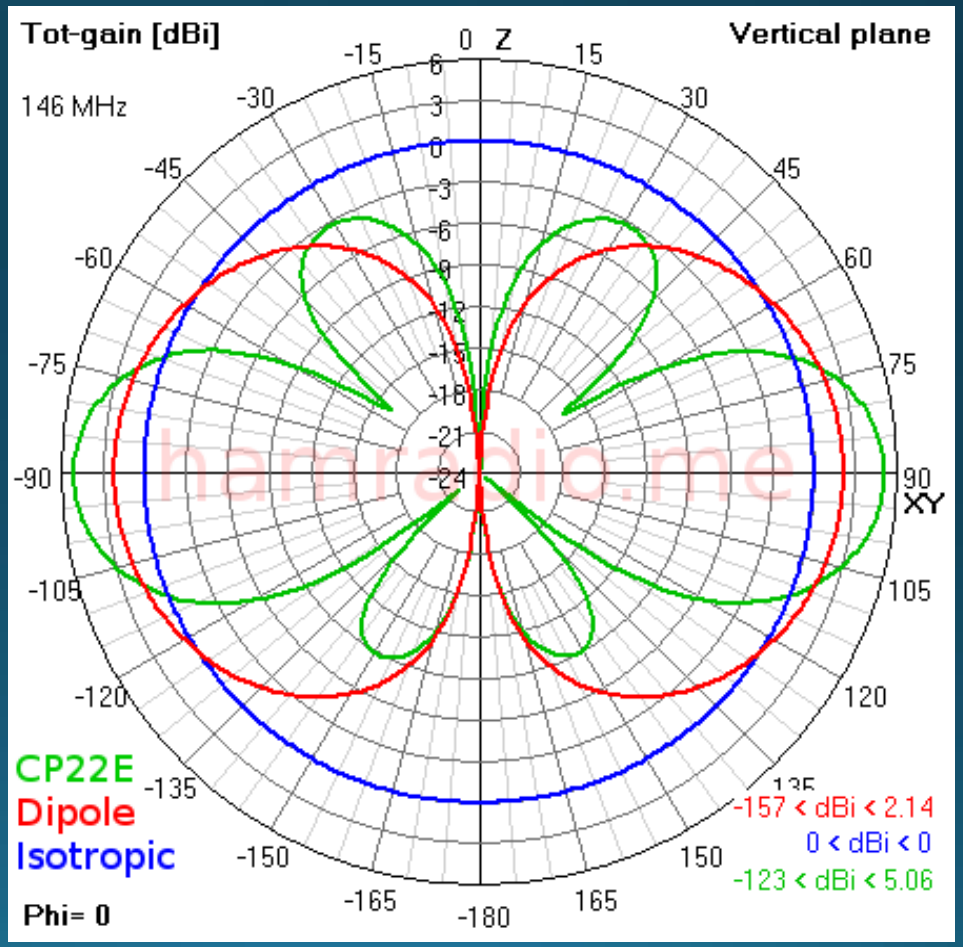
an isotropic antenna is a baseline antenna having no greater signal strength or “gain” in any one direction

0.0 dBi = no gain in any one direction

Isotropic,vertical & dipole compared



CP22E model



the efficiency of the antenna, the correct match of coaxial cable, and the quality “Q” of the antenna system connectors determine system performance

signal strength (power) is measured in decibles or dB not dBi

decibles dB

the ratio between two physical quantities, i.e. RF power gained or lost, when measured a against a baseline value

practical example

100 watts out of the transmitter

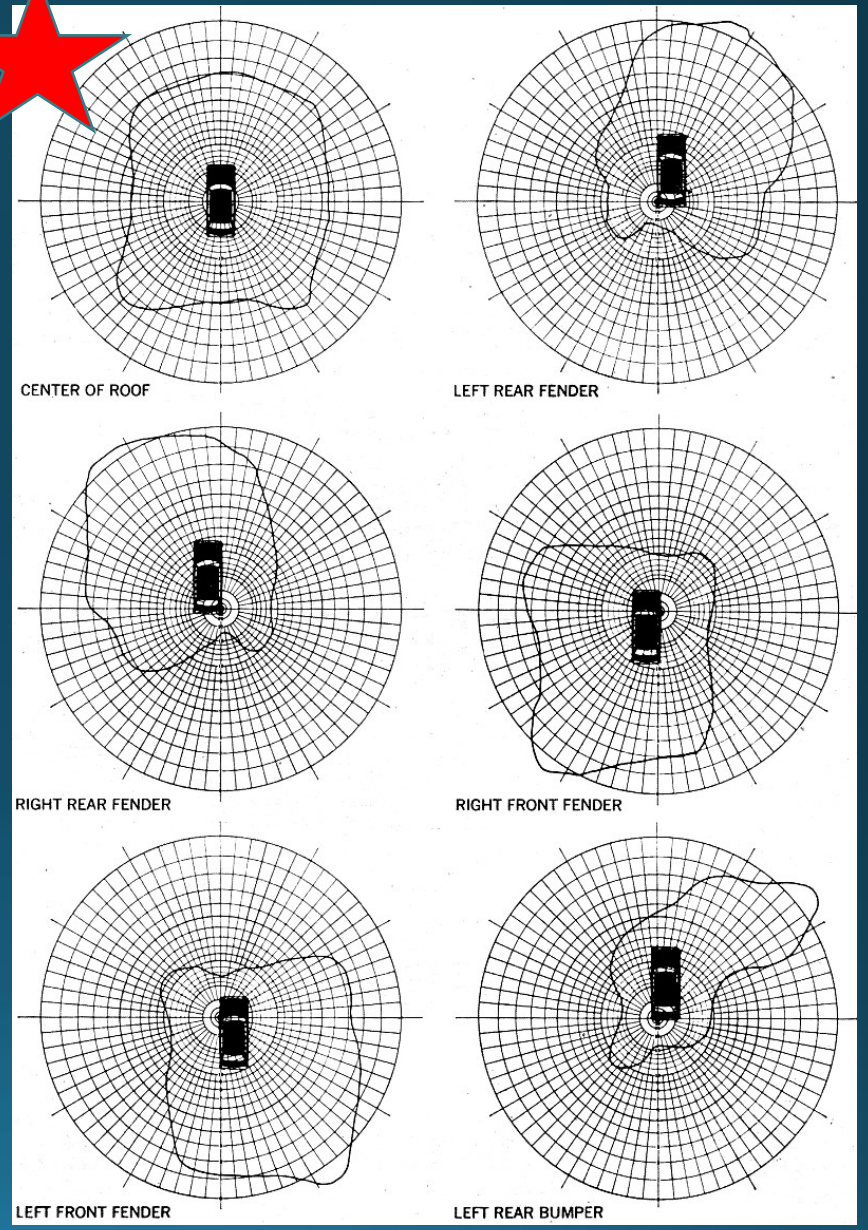
yields 50 watts at the antenna feed point

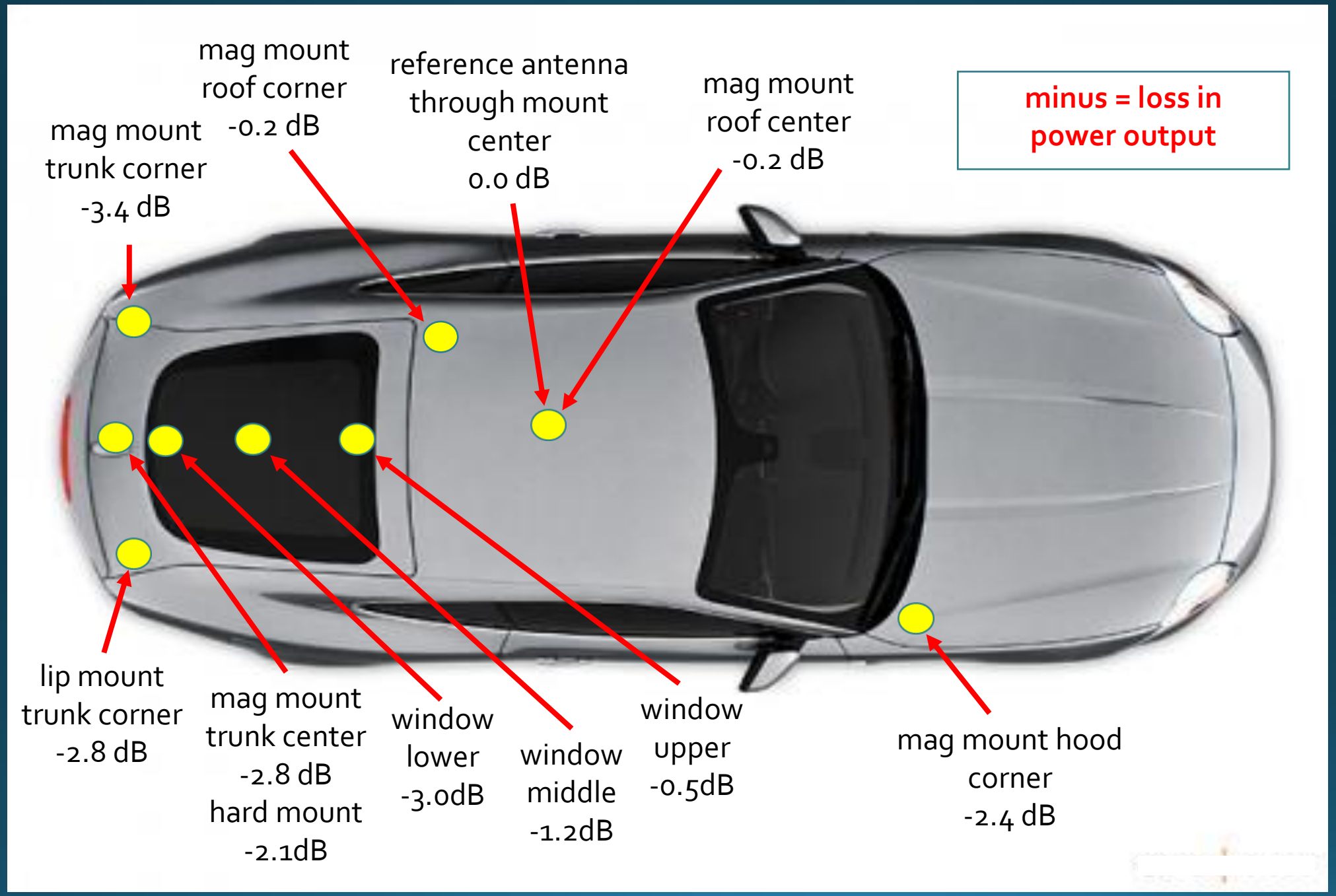
a 50% loss of power within the system

expressed as a loss of -3 dB

mobile antenna placement affects performance

most mobile antenna designs are optimal when located at the vehicle center mass




mag mount
trunk corner
-3.4 dB
mag mount
roof corner
-0.2 dB
reference antenna
through mount
center
0.0 dB
mag mount
roof center
-0.2 dB
minus = loss in
power output
lip mount
trunk corner
-2.8 dB
mag mount
trunk center
-2.8 dB
hard mount
-2.1dB
window
lower
-3.0dB
window
middle
-1.2dB
window
upper
-0.5dB
mag mount hood
corner
-2.4 dB

very short antenna designs are an exception

placing them at the center of the vehicle mass may adversely affect their performance as the short radiator is too close to the ground plane

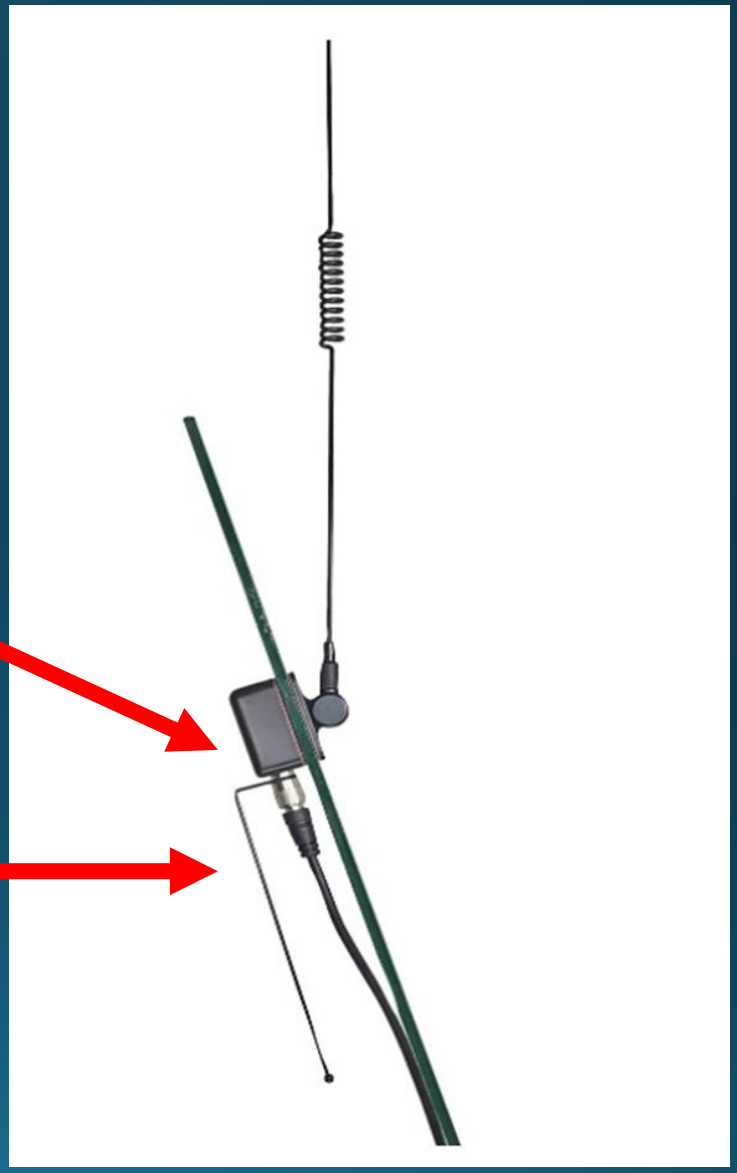
by placing this type antenna near a sloping surface, the ground plane absorbs less of the radiated signal

thru glass window mounts

this type of mount works on the inductive principle, the inside component is a transducer

transducer

counterpoise



advantages:

no holes

no paint scratches

disadvantages:

doesn't perform as well as mag or hard mount antennas, can't take it off for the car wash 😟

mobile antennas are commonly described in “wavelength”

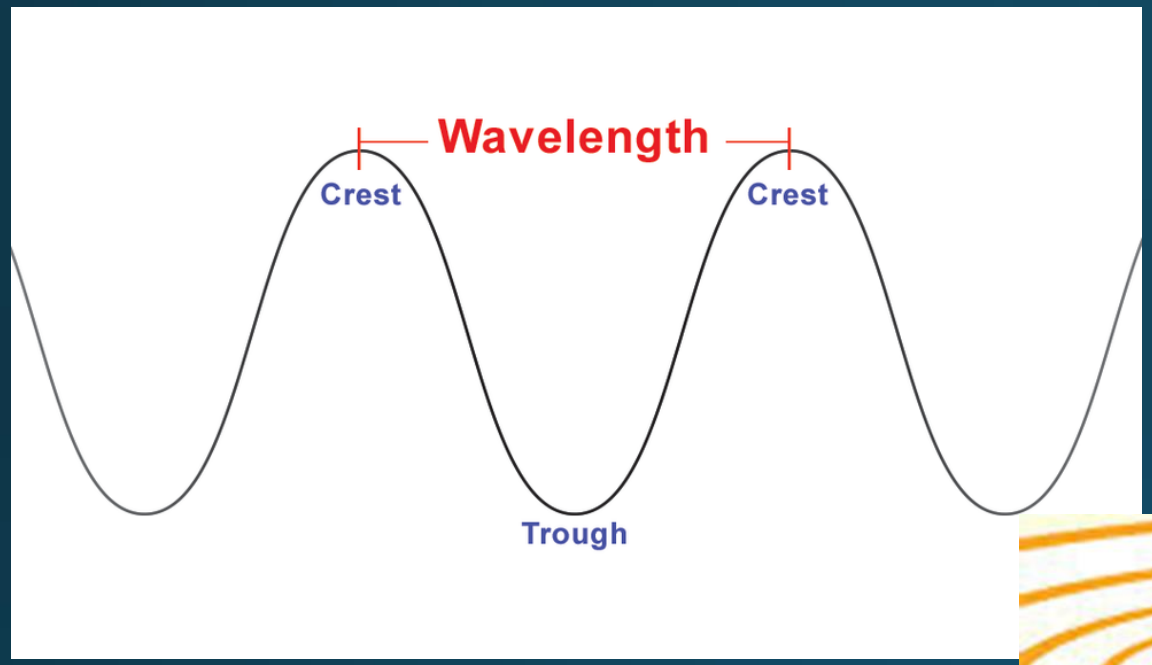
Lambda = wavelength

i.e. 1/4 wave or 5/8 wave

“wavelength” is the distance over which a wave's shape repeats

or…..

the distance from the "crest" (top) of one wave to the crest of the next

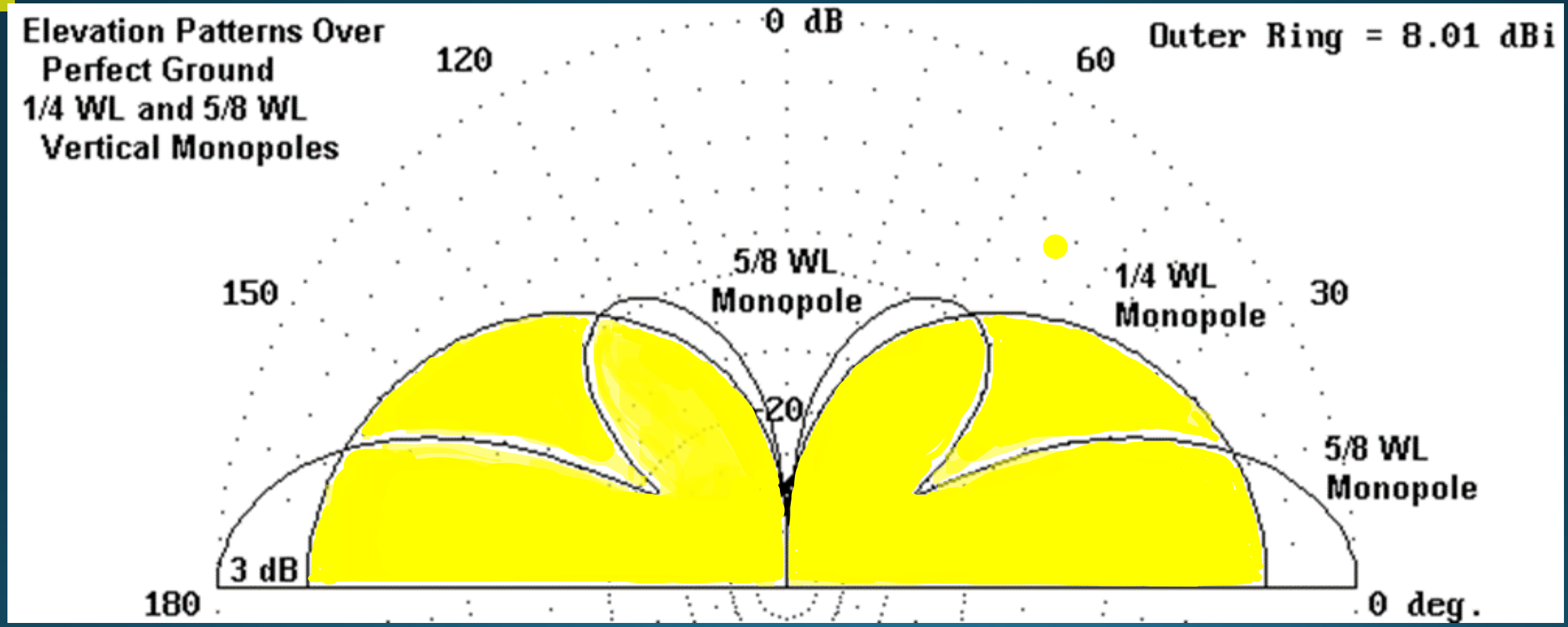

Wavelength
Crest
Crest
Trough

1/4 wave vs 5/8 wave

a large portion of a signal radiating from a ¼ wave antenna is directed vertically

a ¼ wavelength mobile antenna works well in urban areas or where there are hills or obstructions

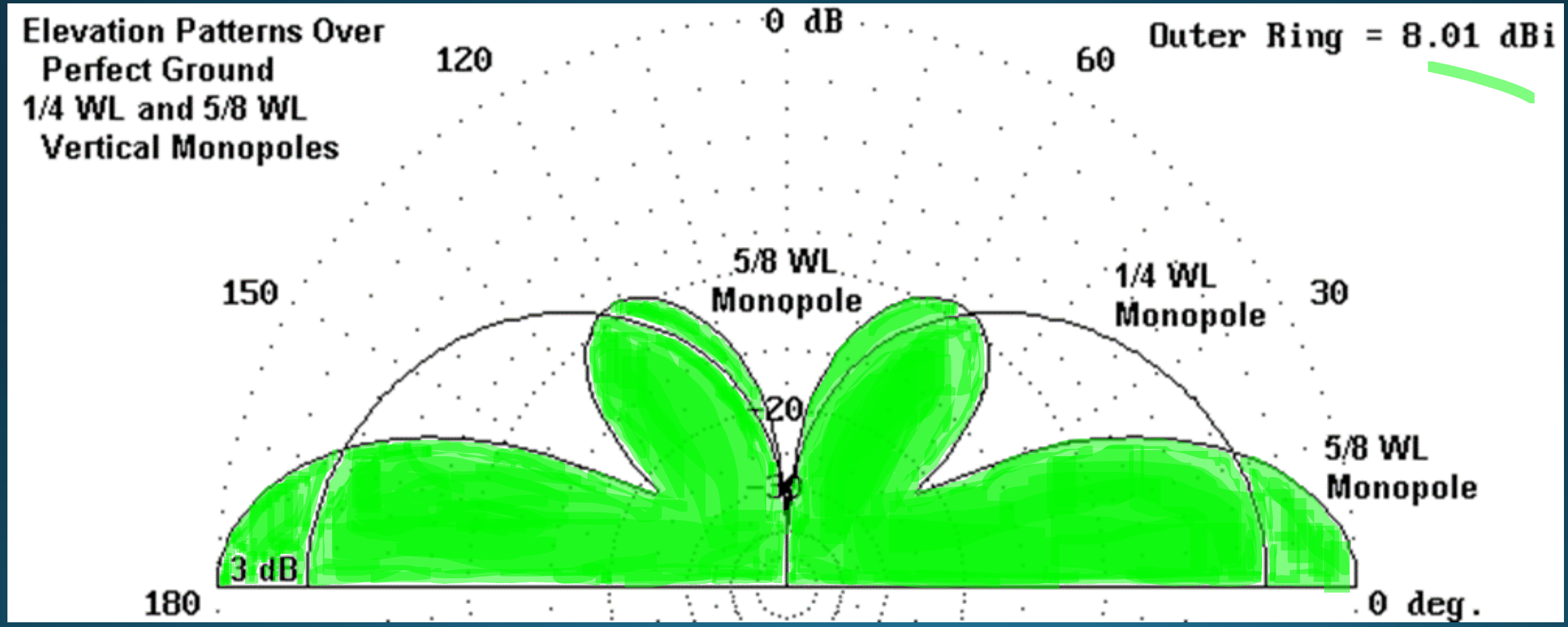
1/4 wavelength antenna pattern



5/8 wavelength mobile antennas are engineered to direct a signal towards the horizon

5/8 wavelength antennas perform well in flat terrain areas

5/8 wavelength antenna pattern



selecting the right mobile antenna

what terrain will you be operating in?

single band or multi-band?

power level?

permanent or temporary mount?

garage clearance?

car wash?

the physical size and weight
of the antenna are factors

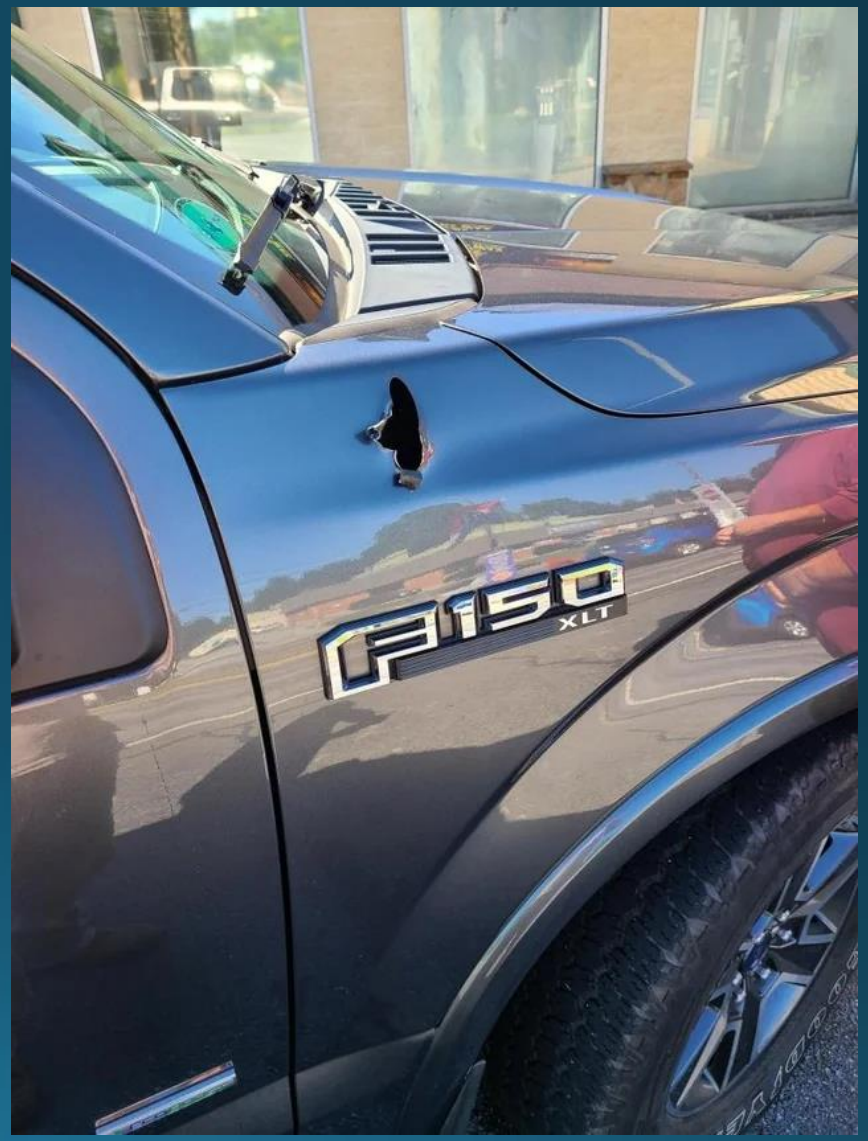
a 5/8 wavelength antenna is typically taller
than a 1/4 wavelength antenna
and weighs more

1/4 wave antenna	2-4 ft tall
5/8 wave antenna	4-6 ft tall

. a 1/4 or 5/8 wave mobile antenna is only half an antenna, the other half is the ground plane. the antenna has to be grounded (bonded), either mechanically, or capacitively, to create a ground plane

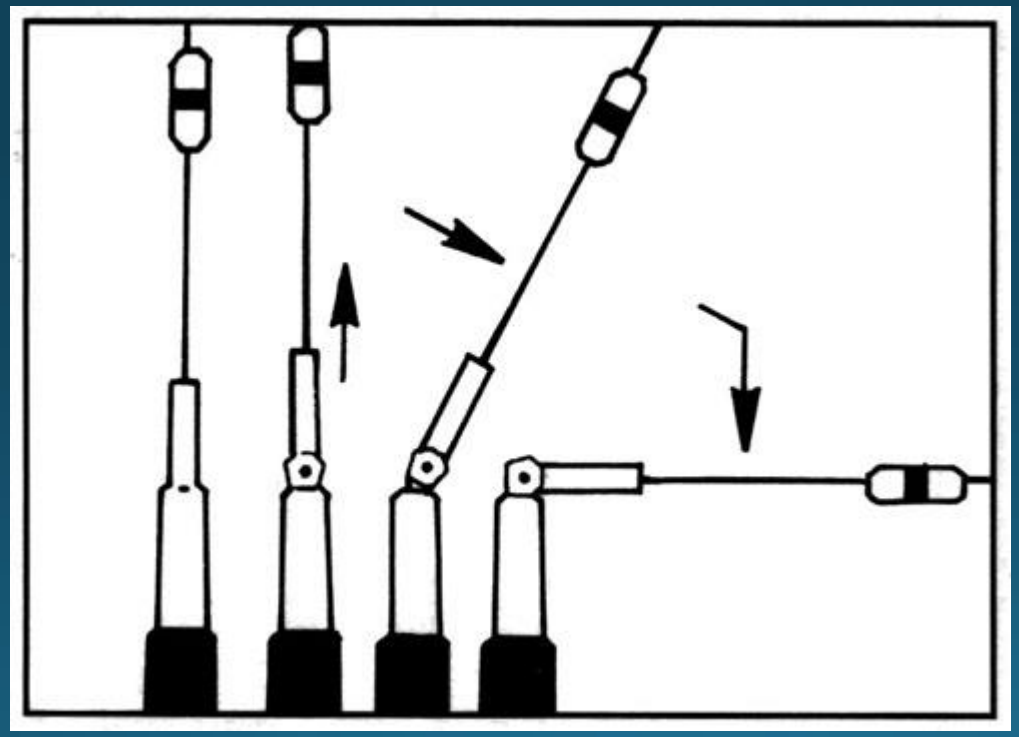
many new cars have plastic body panels that will not conduct

mounting an antenna on non-conductive and/or structurally weak plastic panels creates a number of challenges



a braided ground strap between the antenna base and the vehicle can create a ground plane path

on some antennas the radiator can be folded to prevent striking an overhead



large antennas need a heavy duty mount

antenna base mounts

the ARRL offers links to many automotive manufactures guidelines for installing electronic devices in their vehicles

https://www.arrl.org/auto-manufacturer-s-policies

ciarc.org

centralidarc@gmail.com