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Impact of mounting position on HF mobile antenna performance

There has been some debate on the practicality of mounting HF antennas on the rear of vehicles following concerns raised by a few state and territory regulators about their differing interpretations of Australian Design Rules as they pertain to the mounting of antennas on the front of vehicles.

The following findings result from tests performed at Codan using a type 9350 antenna fitted to various positions on a Landcruiser 4WD vehicle. Signal strengths were measured using a receiver/antenna combination at a point some 4km from the vehicle which transmitted a signal at various frequencies while facing towards, away from, and side on to the receiving station.

The results are pretty well best case because of the 9350 antenna's capability to match resistive (in 4 steps) as well as reactive impedances. The older type 8558 antenna has only 2 resistive steps, so called tapped helical whips have no matching capability for either reactive or resistive impedances, and other known brands of tuning vehicle whips generally have matching capabilities inferior to the 8558.

The two variables in performance caused by mounting position of greatest concern are

- variation in radiation efficiency (the proportion of the power actually radiated to the power potentially available from the transmitter), and
- variation in radiation pattern (the distribution of power radiated in various directions from the vehicle).

For the purpose of these tests tapped helical whips and any other antennas that do not achieve close matching of impedance (such that VSWR is less than 1.8:1) are ignored as they are effectively totally non functional.

These variations are caused by variation in the coupling between the antenna and the surrounding metalwork of the vehicle which provides the earth/counterpoise for the antenna.

The time proven most efficient position for mounting an HF mobile antenna is at the front of the vehicle at bonnet height (on the top of the bull bar). That is not to say the antenna is 100% efficient or that the signal radiates equally in all directions, far from it. It is however the least compromised mounting point and one proven workable over many years.

[Radiation efficiency is at its best and the pattern is relatively uniform. While it varies across the band, the signal to the rear of the vehicle is about 2 dB better than

the signal to the front of the vehicle. This means the power radiated in front of the vehicle is about 35% less than that radiated to the rear.]

Measurements made some time ago when lowering the antenna from bonnet height mounting to bumper height mounting on a standard 4WD vehicle indicate that the efficiency is reduced by up to 4dB (equivalent to a loss of up to 60% of the power radiated).

This is enough to make a difference between mediocre to marginal communications and no communications, especially in the least favourable direction where the efficiency losses and directional disadvantages compound.

The latest measurements compared a front mounted bonnet height antenna to one mounted on the spare wheel carrier with the top of the antenna bottom section roughly level with the roof top. Quite apart from an increased possibility of off road antenna damage in that position (you can't see what you are driving into) the performance reduction was dramatic.

Depending on frequency and direction, performance was up to 9dB lower (equivalent to reducing output power to 10%).

If the vehicle is communicating with a second vehicle with similarly compromised antenna positioning the total effect is doubled because receiver performance will be affected similarly to transmitter performance. That is loss of up to 18dB or the same as if one of the transmitters were to be reduced from 100Watts to 5Watts.

The impact on the potential for reliable communications must be significant. Such a performance difference would reduce strong, clear signals to below receiver AGC threshold making them marginally workable at best. Existing mediocre signals would be rendered unworkable.

In support of the information above two charts are attached.

Chart 5 is a direct A-B comparison between front and rear mounted antennas in various directions over the frequency band. The differences are most striking in the range from about 5MHz to around 10MHz which is most unfortunate as this is the band most used for medium distance day time communications and therefore the most likely to be used for OH&S communications.

Chart 11 shows the cumulative effect of position and direction comparing measured actuals of the rear mounted antenna to the normal optimum for a front mounted antenna.

R A Potter
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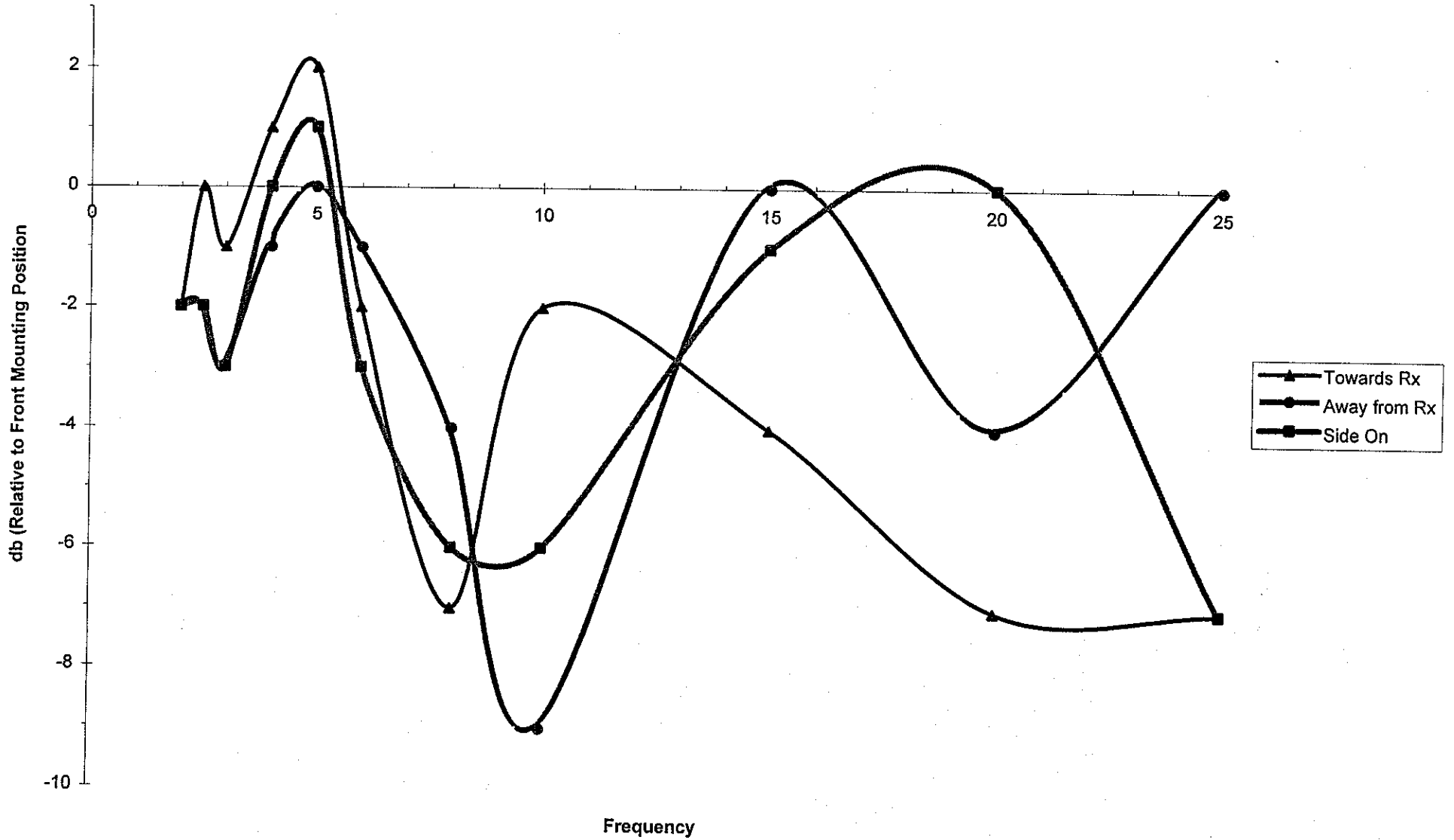
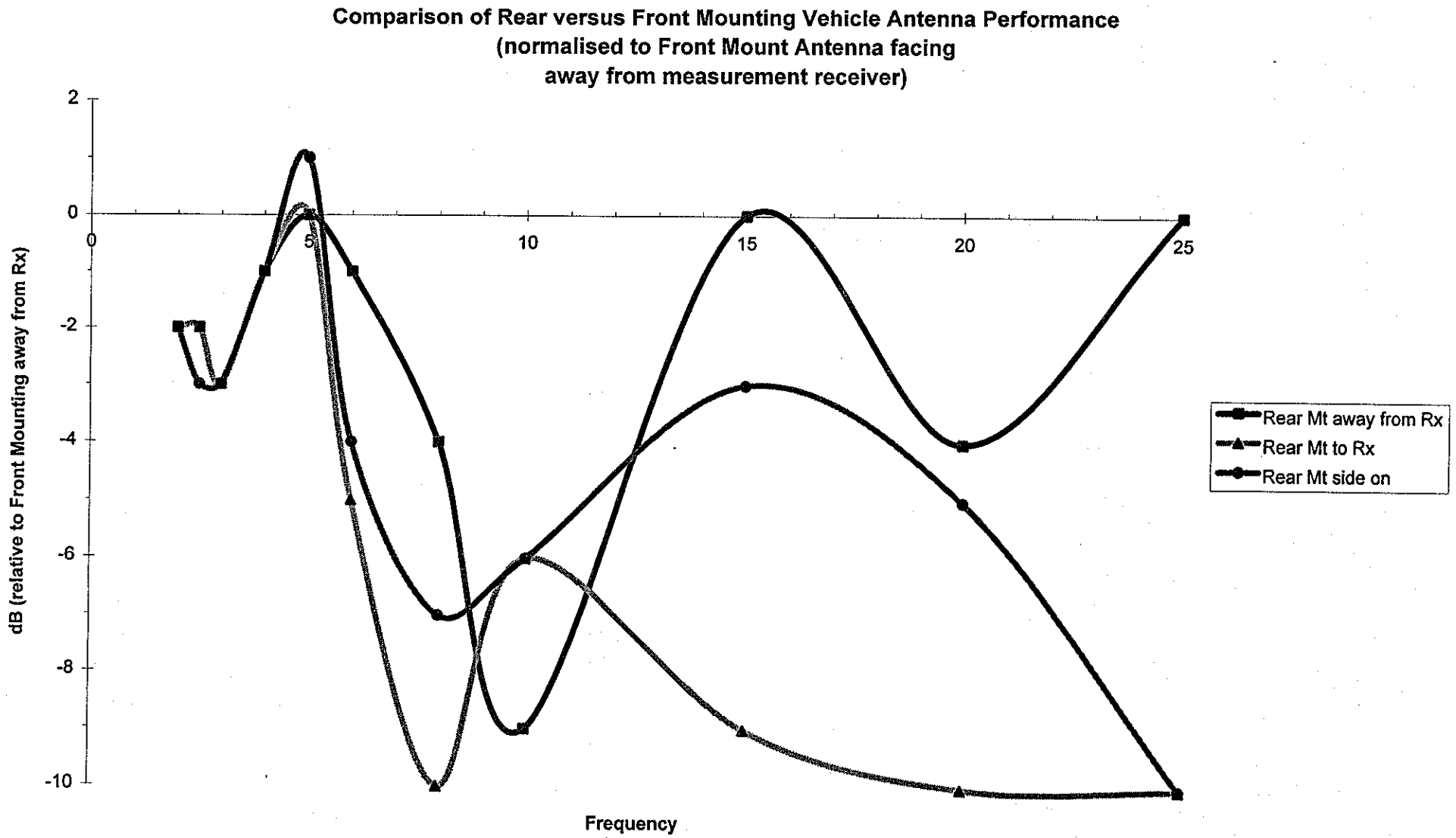

2
0
-2
-4
-6
-8
-10
0
5
10
15
20
25
db (Relative to Front Mounting Position
Frequency
Towards Rx
Away from Rx
Side On


Comparison of Rear versus Front Mounting Vehicle Antenna Performance
(normalised to Front Mount Antenna facing
away from measurement receiver)
dB (relative to Front Mounting away from Rx)
2
0
-2
-4
-6
-8
-10
0
5
10
15
20
25
Frequency
Rear Mt away from Rx
Rear Mt to Rx
Rear Mt side on