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Antennas Integrated In Vehicle Rear-View Mirrors

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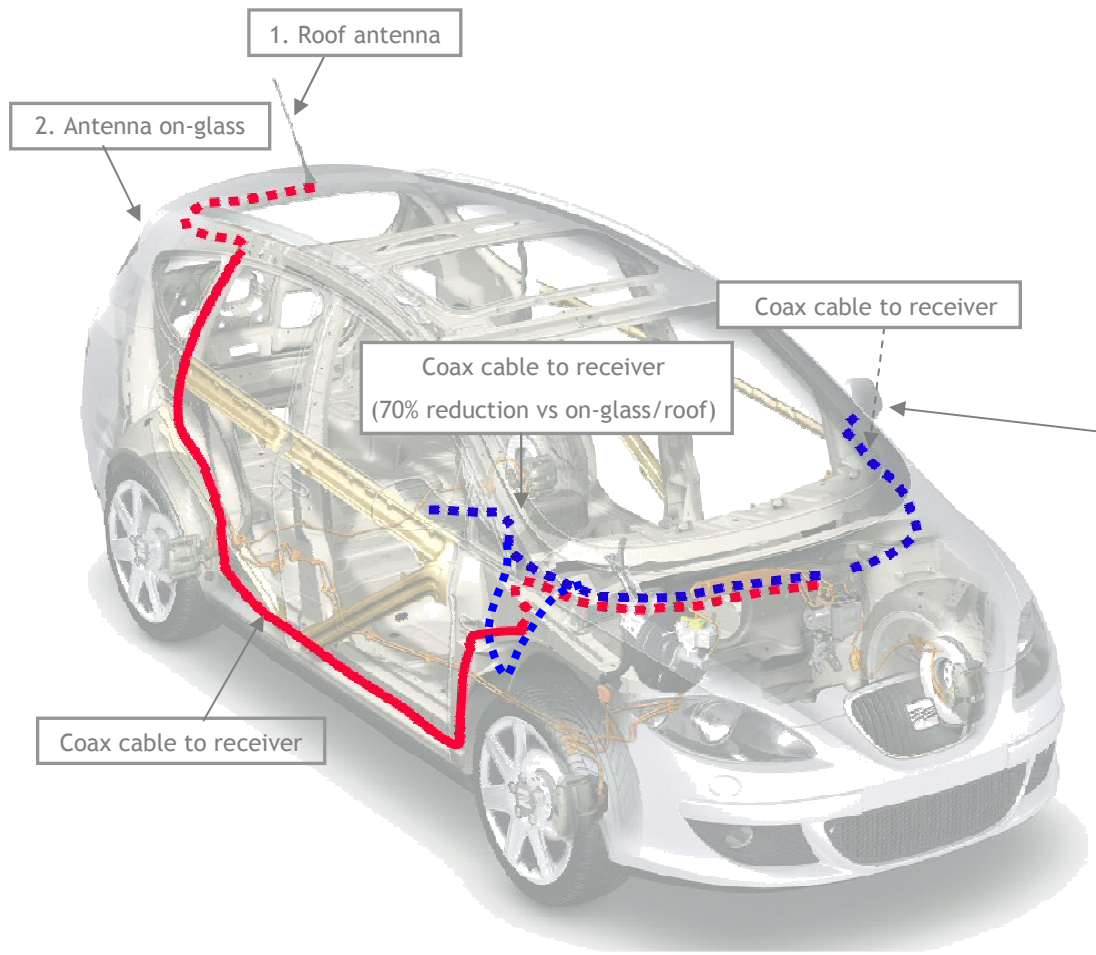
Outline

1. Product Presentation
2. Product Description
3. Antenna Performance
4. Conclusions

Product Presentation



Possibilities of antenna integration in car:

1 · Roof antennas

2 · On-glass antennas

3 · Antennas integrated in mirrors

4 · Other locations (bumpers, spoilers, etc)

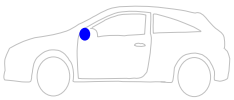
Cable length for roof/on-glass: approx 4 m

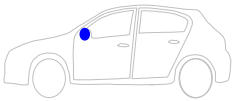
Cable length for mirror solution: approx 2.2 m

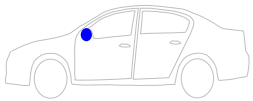
Product Presentation

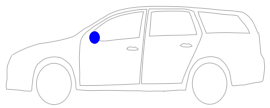
What is the benefit of the mirror integrated solution …

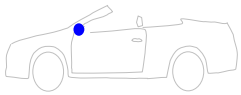
- **Design** – invisible, no impact on design
- **Aerodynamic** - no additional air drag, results in reduced **CO_2 emissions**
- **Customer benefit** – antenna is not exposed to external forces (vandalism or car-wash)
- **Process cost for OEM** – antenna delivered in mirror module, no extra process cost at assembling. Only one supplier.
- **Reduced cable length** and easier cable routing results in reduced cost for the OEM and weight reduction.
- **Standardization** – one antenna mirror for a complete model range (Hatchback, Station-Wagon, Coupé, Convertible)


3doors

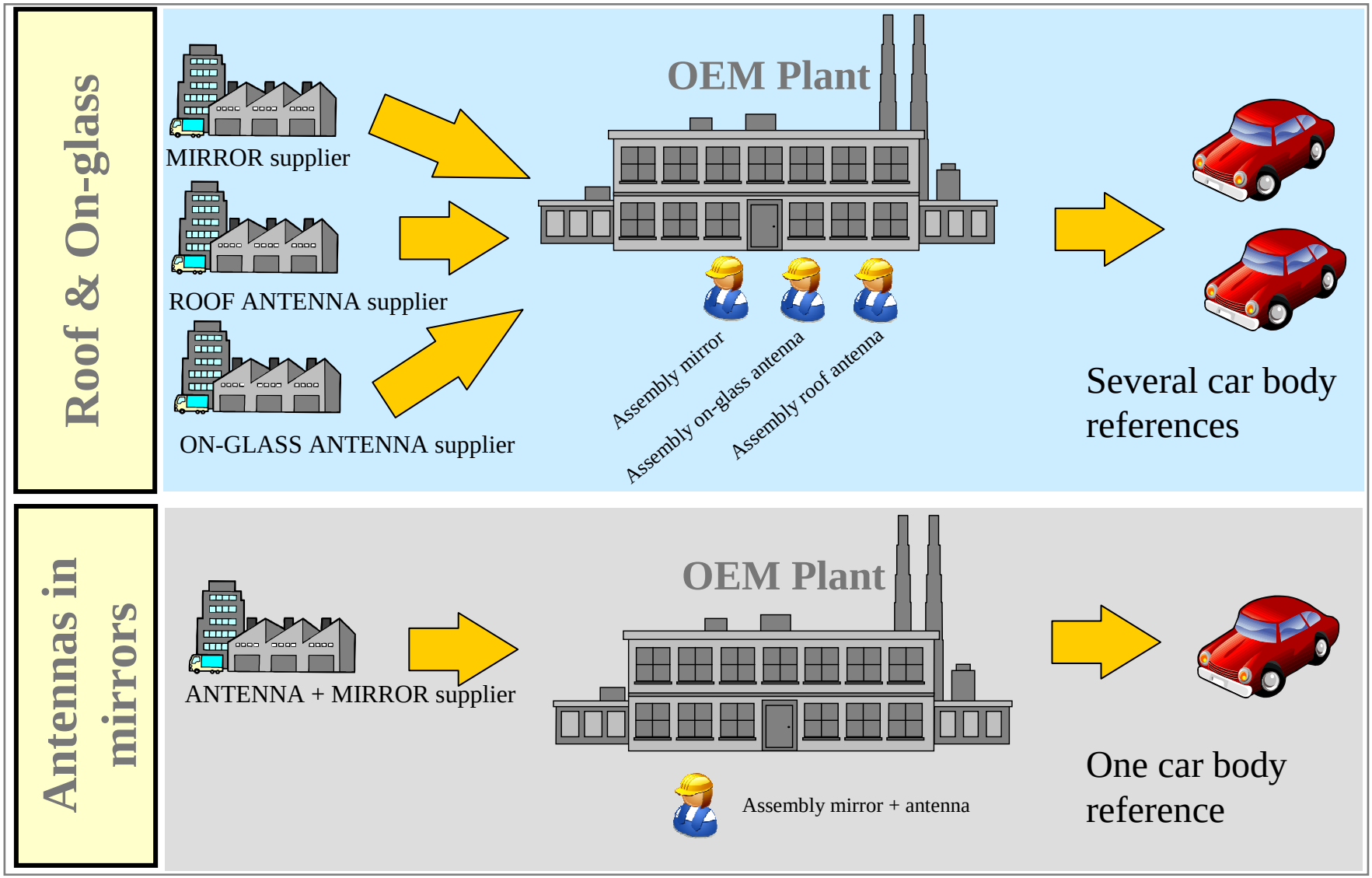

5doors


Sedan


Wagon


Cabrio

Product Presentation



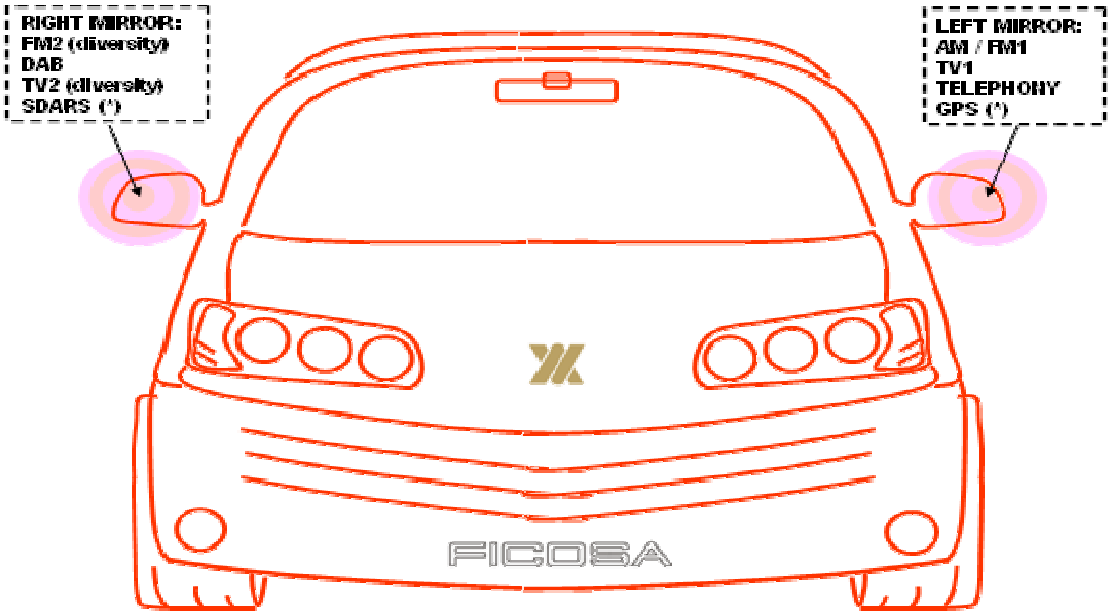
Product Presentation

INTEGRATED ANTENNAS IN EXTERIOR REAR-VIEW MIRRORS

Several services taken into account for current and next generation vehicles:

- AM / FM1
- FM2 (diversity)
- TV bands III-IV-V (diversity)
- DAB bands III-L
- GPS
- TV bands I-II
- TELEPHONY (all bands)
- TMC
- SDARS

Ficosa, as an example of possible integration, proposes the following solution:

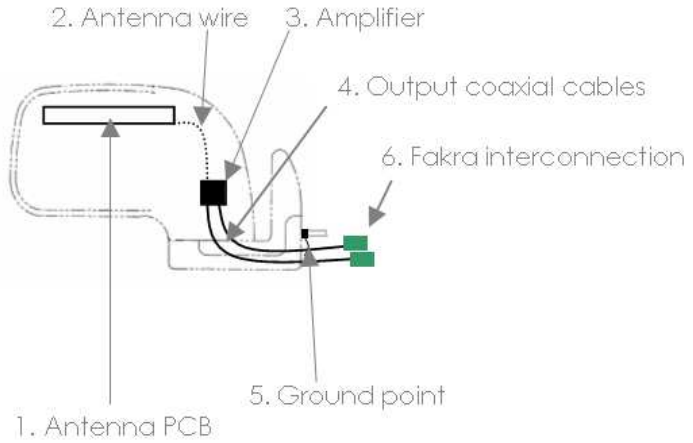


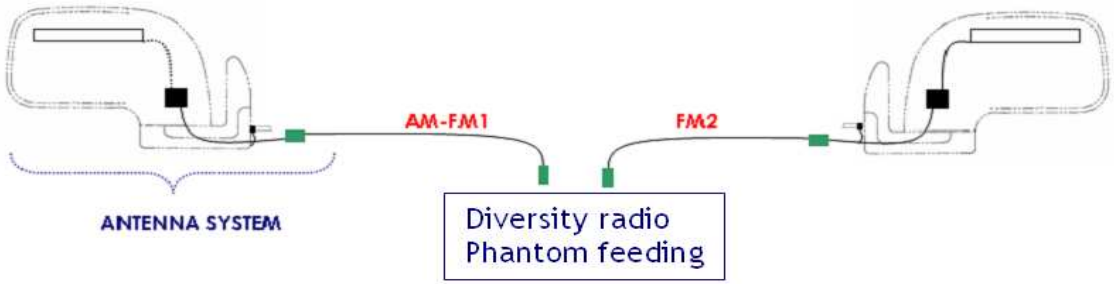
Product Description

COMPOSITION OF PRODUCT

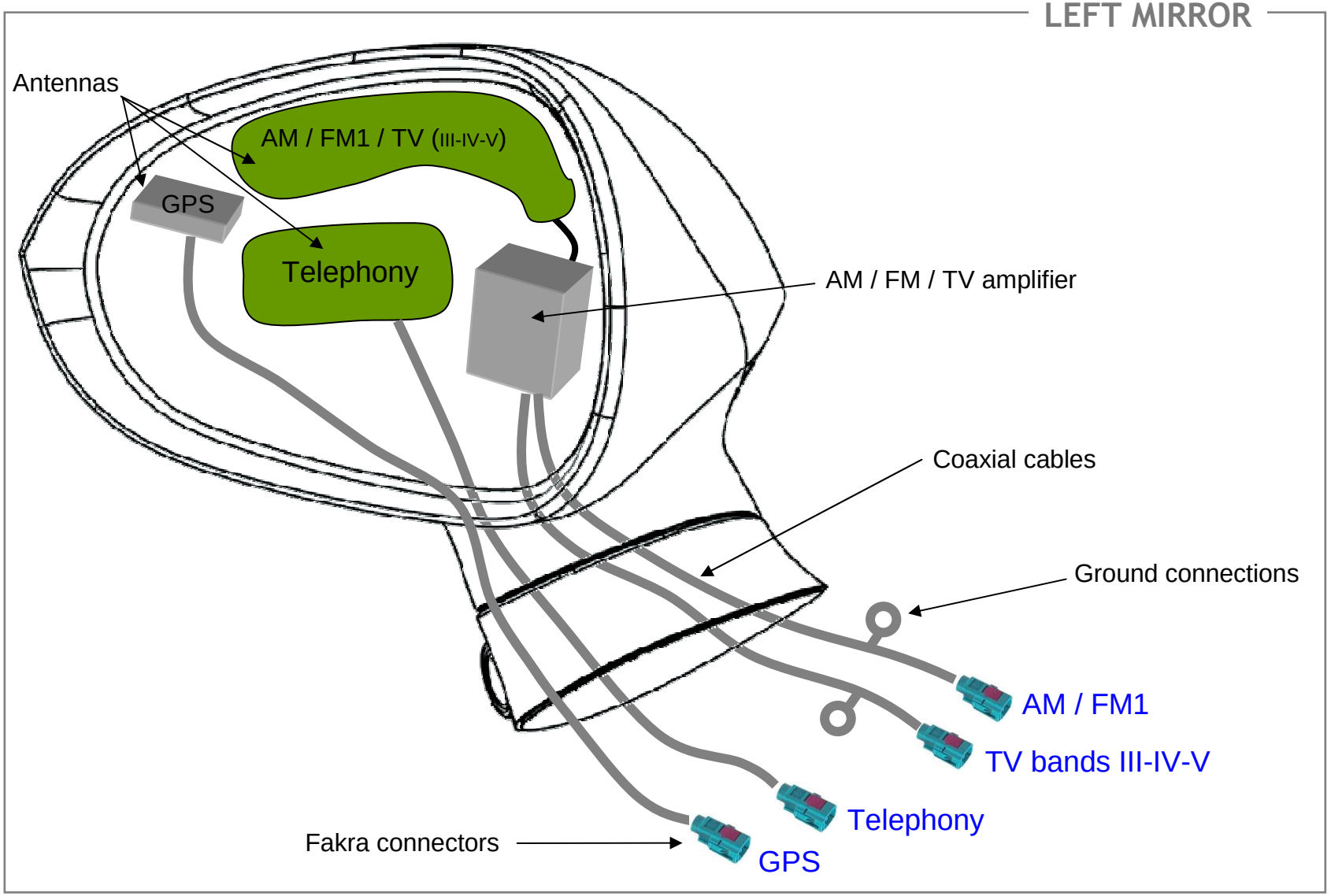
- The antenna system is composed by the following elements:

1. Antenna in flexible PCB or foil
2. Antenna wire (it can be avoided)
3. Amplifier
4. Coaxial cables
5. Ground point
6. Fakra connectors



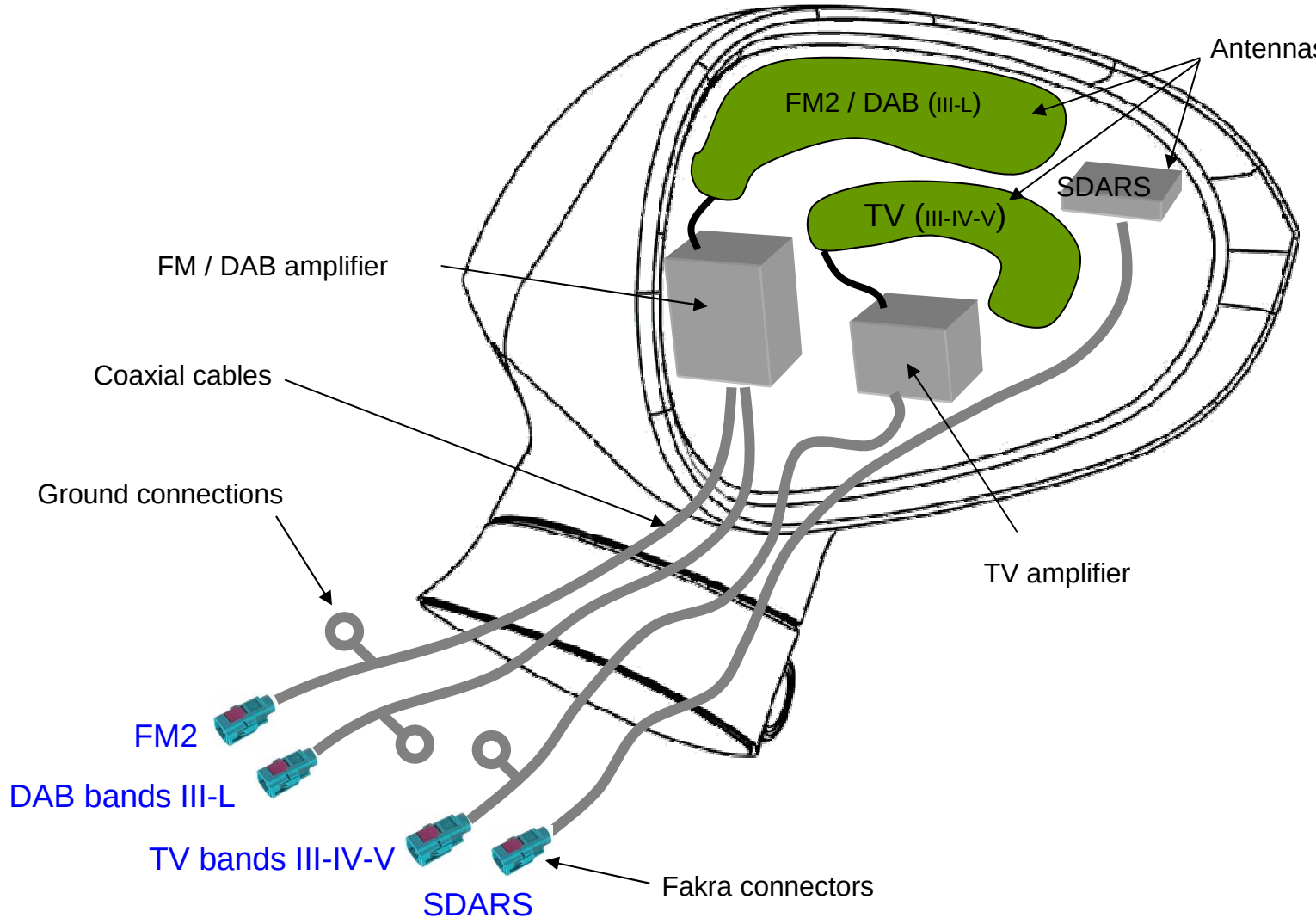


Product Description (Example of configuration)

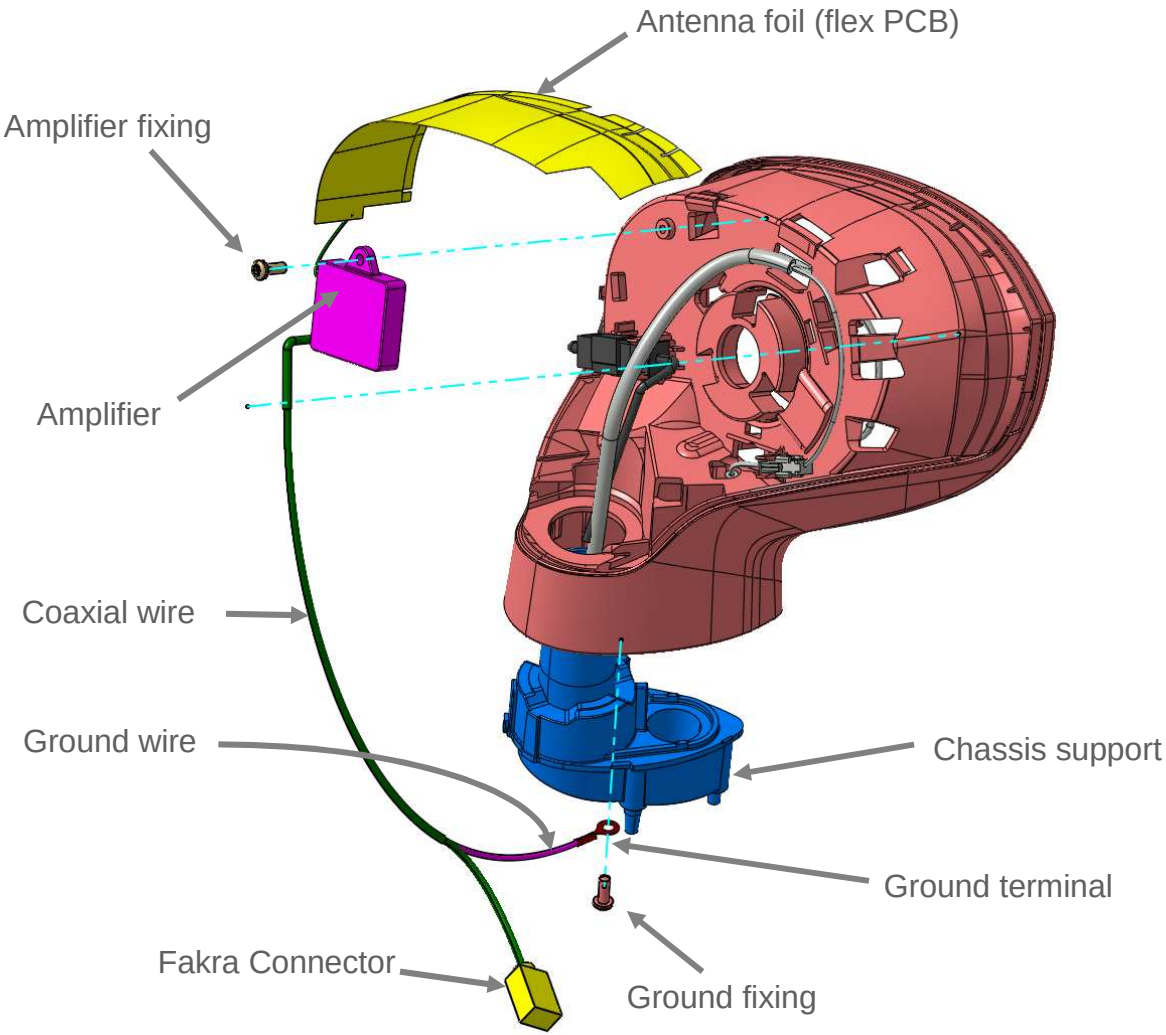


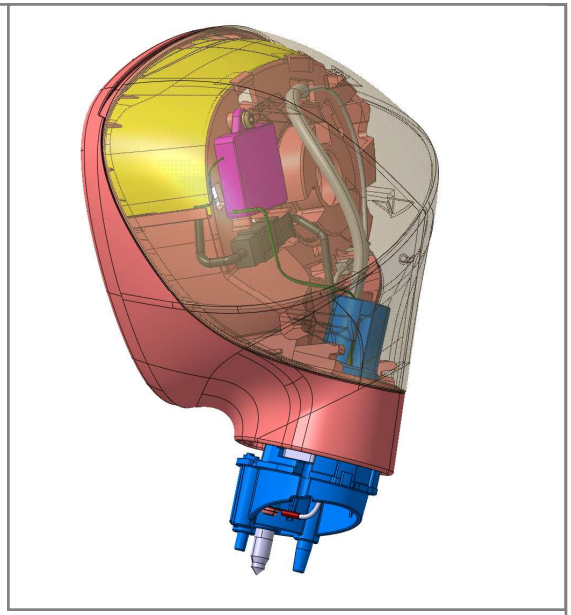
Product Description (Example of configuration)

RIGHT MIRROR



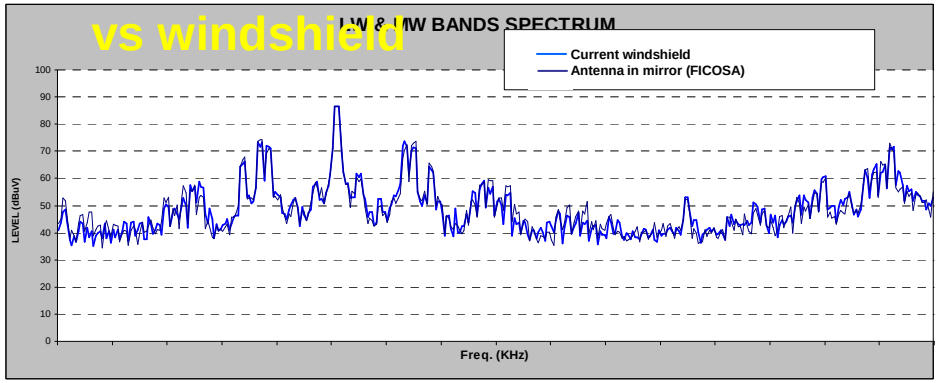
Product Description (Example of configuration)



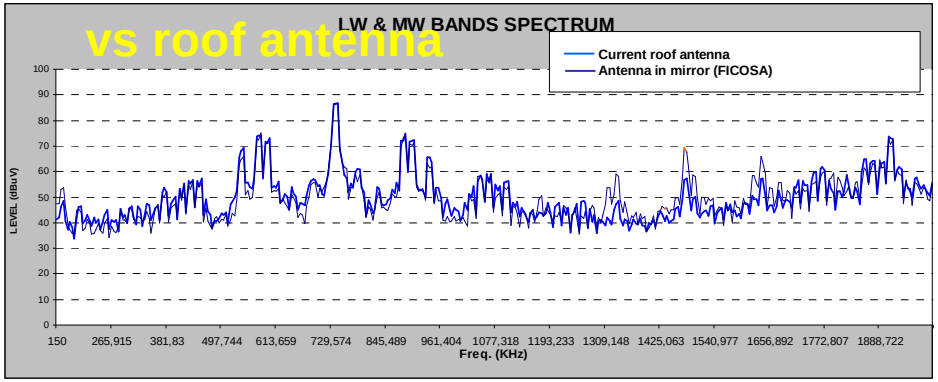


Antenna performance (AM band)

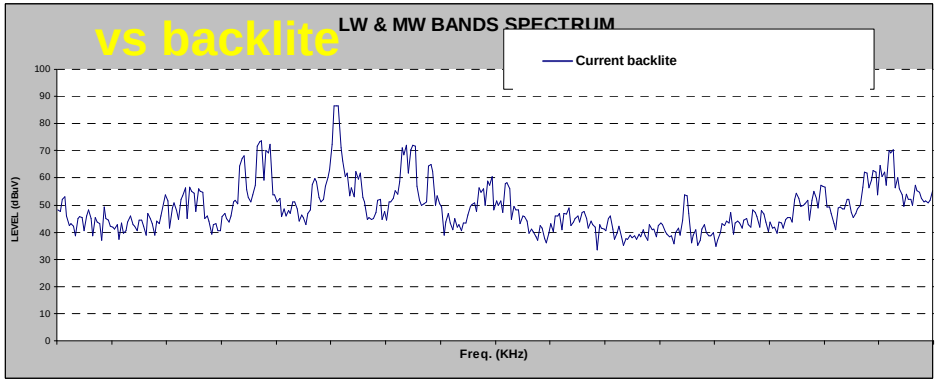
vs windshield



vs roof antenna



vs backlite



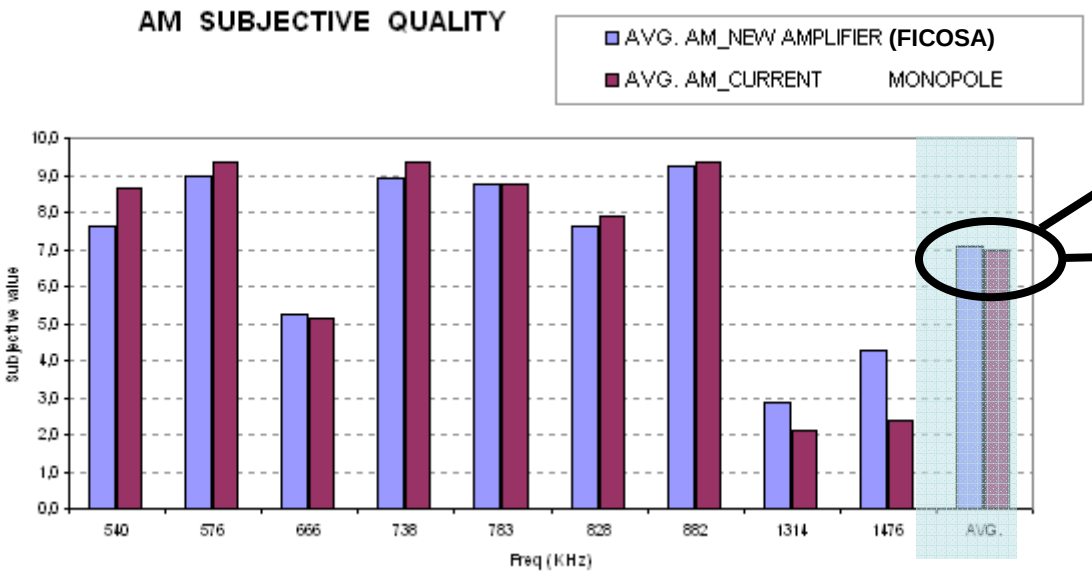
It is shown AM levels for the following 5 specific configurations (car platforms):

- 3-door car equipped with:
  - Its current windshield antenna
  - FICOSA antenna in mirror
- 3-door car equipped with:
  - Its current roof antenna
  - FICOSA antenna in mirror
- 3-door car equipped with:
  - Its current backlite antenna

As it can be seen, the 5 above configurations (backlite / windshield / roof / mirror antennas) show very similar levels for AM.

Antenna performance (AM band)

AM in WEAK area (example of 3-door car)

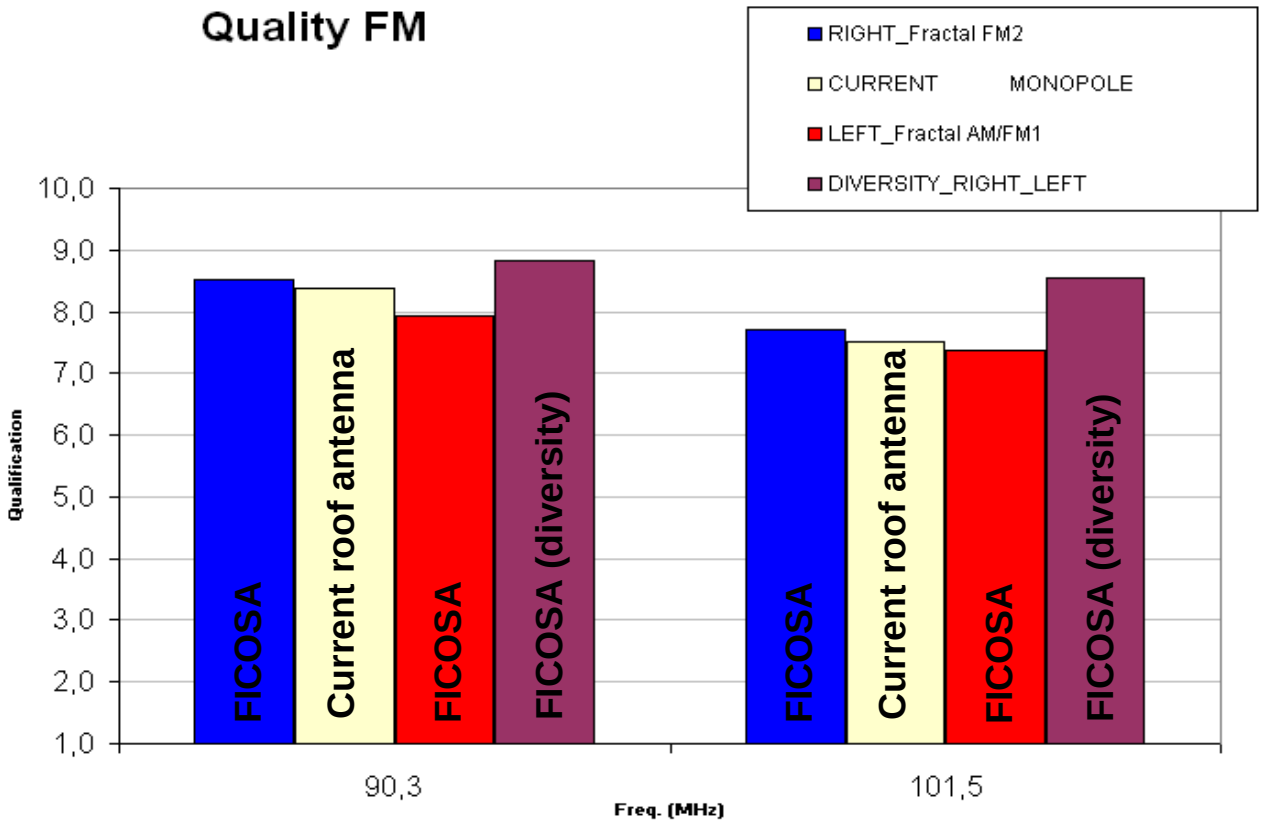


Average values

It is shown that AM subjective testing performed for both FICOSA antenna and CURRENT monopole antenna are similar when test is done in WEAK area.

Antenna performance (FM band)

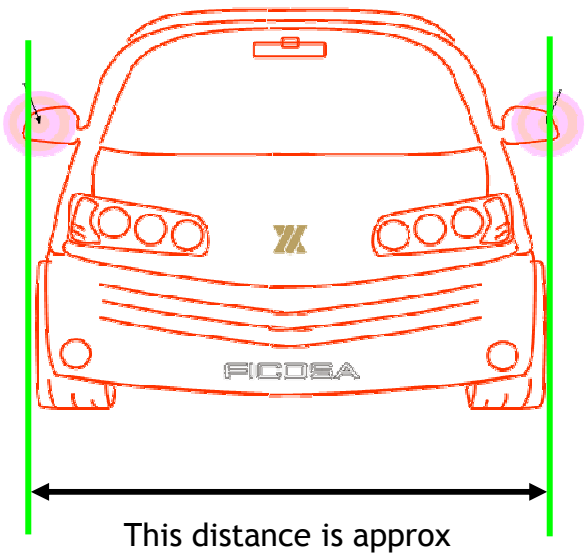
FM in MEDIUM-STRONG area (example 3-door car)



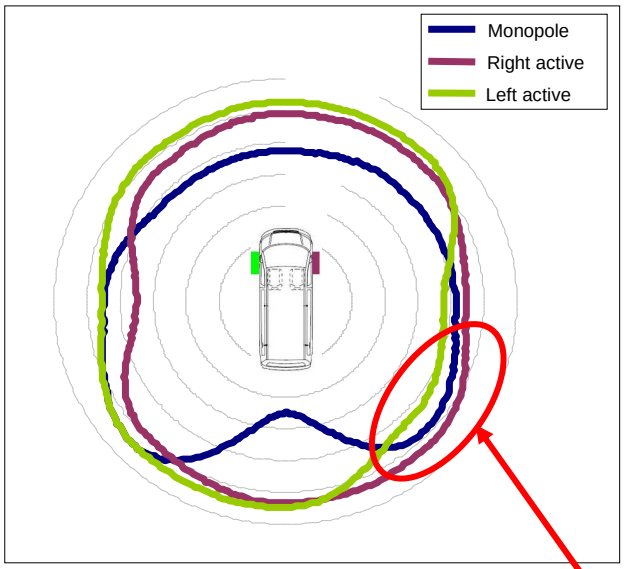
Antenna performance (FM diversity)

FM DIVERSITY

- The distance between the exterior rear-view mirrors (approx half-wavelength at FM) makes that this is a good choice for a diversity system.
- For an FM antenna that is placed at a given mirror, when the gain levels are at their minimum, they get compensated by the maximum levels at the opposite mirror.



This distance is approx wavelength/2 at FM frequency

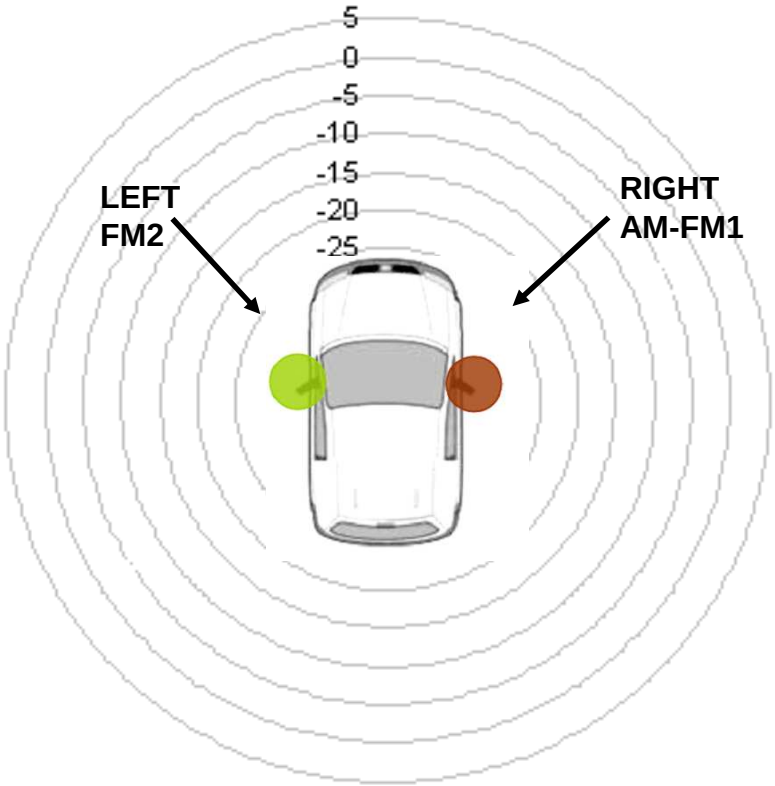


Example radiation diagram:
FM monopole vs Diversity FM system

Min radiation level at left mirror compensated with max radiation level at right mirror

Radiation Diagrams (FM)

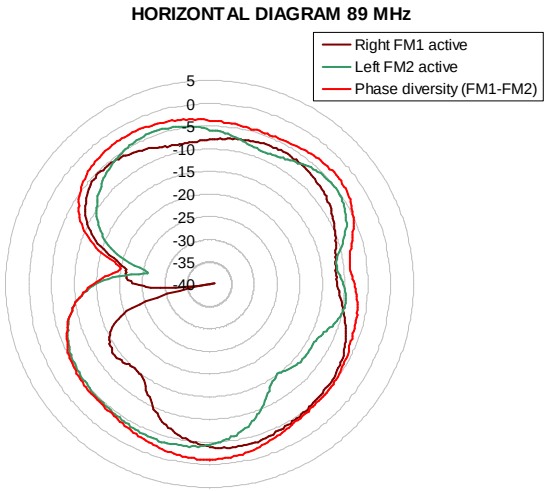
OATS (Open Area Test Site) Car position

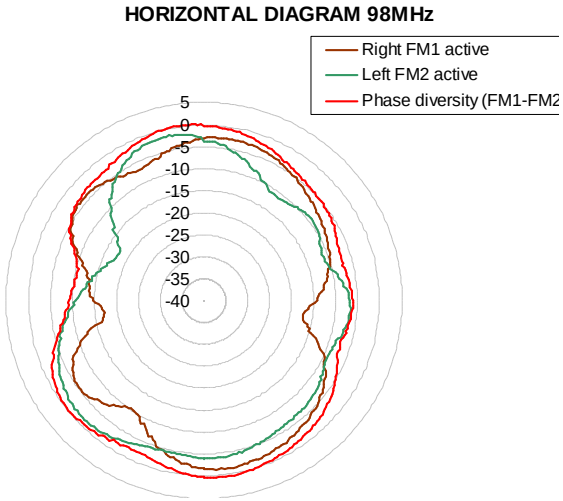


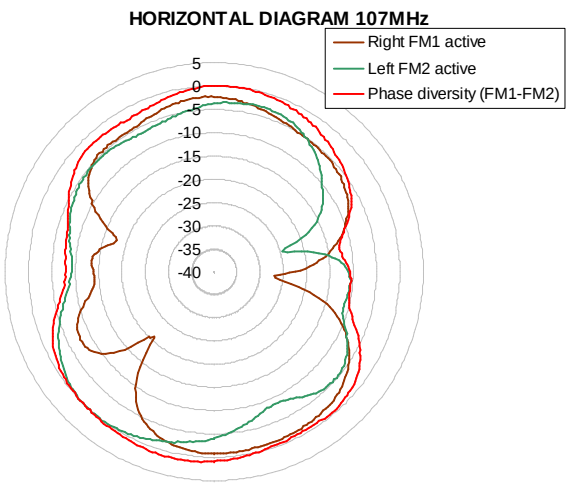
RESULT of Radiation pattern with PHASE DIVERSITY

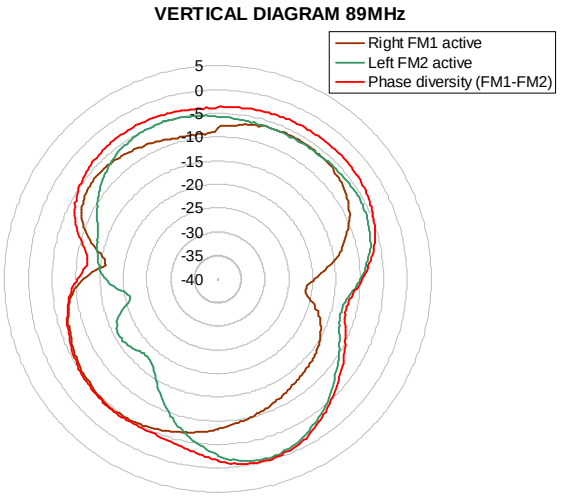
Radiation Diagrams (FM)

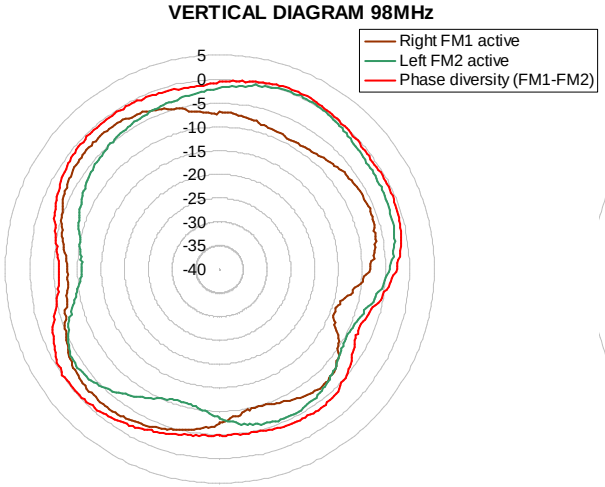
OATS HORIZONTAL & VERTICAL POLARIZATIONS

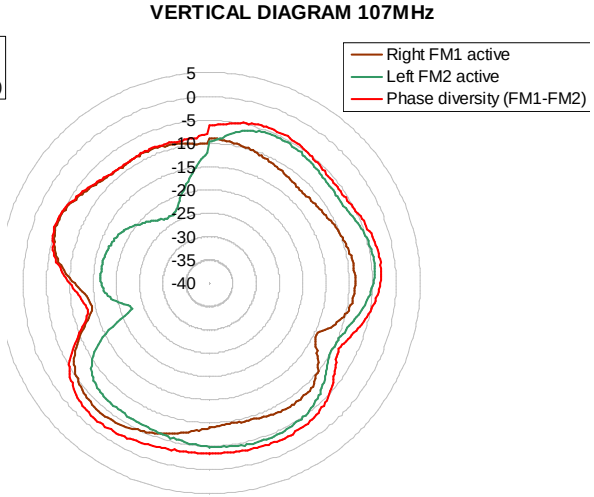








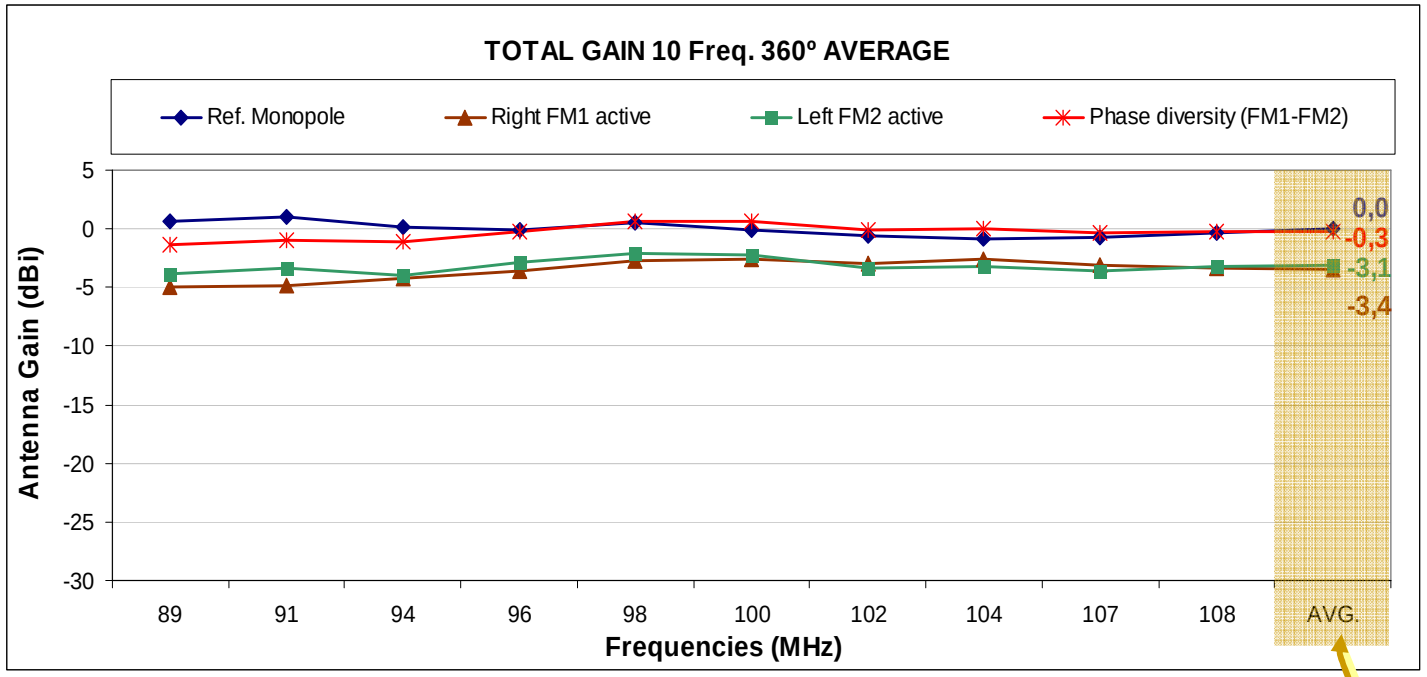




• ***Radiation patterns in dBi***

Gains (FM)

OATS_TOTAL ABSOLUTE GAIN



Average values

Conclusions and final remarks

Antennas integrated in vehicle rear-view mirrors

- It has been shown than integrating antennas inside the mirrors shows the following advantages:
  - Cost effective solution
  - Weight reduction (around 35% to 50% compared with current and traditional antennas)
  - Process time reduction at OEM (plug and play solution), huge savings at manufacturing line
  - Modular solution (one mirror for all car platforms)
  - Similar performance as traditional/conventional antennas
- Several services can be integrated in the mirrors
- Miniaturization capabilities vs traditional antennas
- All automotive validations passed (humidity, fatigue, bending coax cables, EMC's, all types of environmental conditions, etc)

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