Measurement and Performance analysis of EMI shielded Rack for BLDC servo system

(S.Sureshkumar, Pravin Raybole, Shrikant Bhujbal, Sanjit Rai)

1. *Introduction:*

The servo system of GMRT is getting upgraded using Brushless DC servo motor (BLDC) and drive system. The BLDC drive and control electronics is in a rack and the total system is located inside the antenna shell. It is necessary to ensure that there is no increase in radio frequency interference (RFI) at antenna base. Initially many measurements were carried to ensure the system is performing with minimum RFI and the system rack into which the drive and control electronics mounted offers best shielding. The servo engineers have entered into the mass production stage and have acquired racks from three manufactures namely (Schroff Germany, Miltec Hyderabad and Din Mumbai) for evaluation by studying their individual shielding performance and its suitability to integrate the electronics into it.

2. *Scope:*

The RFI team of GMRT have taken up the responsibility to study the shielding performance of these racks in house and conclude the following

a. Method of testing,

b. Evaluate the shielding performance of the sample racks and

c. To provide solution for better shielding to the servo system.

3. *Experimental Setup:*

This being special requirement which had many constraints like size of the rack, availability of compact radiator or receiving antenna to place inside the rack, expensive to do multiple measurements with all possible combinations at commercial EMI/EMC test centre.

The RFI team has worked out a test method by concluding the following before making final measurement.

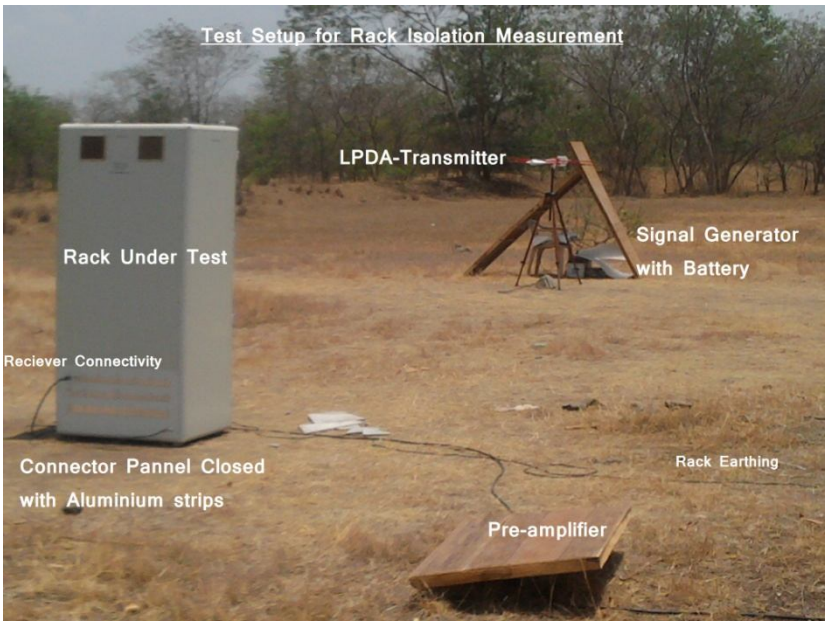

Fig.1 Test Setup for Rack Isolation Measurement

Fig.2 Receiver antenna inside rack

a) The antenna kept inside the shielded rack gave same isolation results as a Transmitter and a Receiver. For the final measurement setup the receiving antenna was kept inside the shielded rack.

b) Measurement with Linear polarisation and Horizontal polarisation useful in studying complete isolation of the rack.

c) The optimised measurement setup has the rack in standing position and it is 10 meters away from the transmitting antenna. The measurement was done by rotating the rack every 90 degrees so that measurements could be done on all four sides with the transmitting antenna pointed to one side at a time.

d) The transmitting antenna was a calibrated log-periodic antenna and it is connected to a signal generator which is sweeping from 50 MHz to 2 GHz in steps of 50 MHz with +10 dBm output power. This ensures good signal level with receiving antenna kept inside the shielded rack. The signal generator was power using a battery and inverter.

e) The receiving antenna is kept at a height of about 1.3 meters from the ground and kept inside the rack. The receiving antenna is a broadband antenna and it is connected to spectrum analyser kept 10 meters away with a 20 dB preamplifier.

f) The measurement did not use complete trace recording to avoid commercial lines which could mislead measurement. The measurement was done only at the transmitted carrier frequency which is swept every 50 MHz continuously.

g) The isolation was found with a free space measurement done with the same setup without the rack both in vertical and horizontal polarisation.

4. Measurement results:

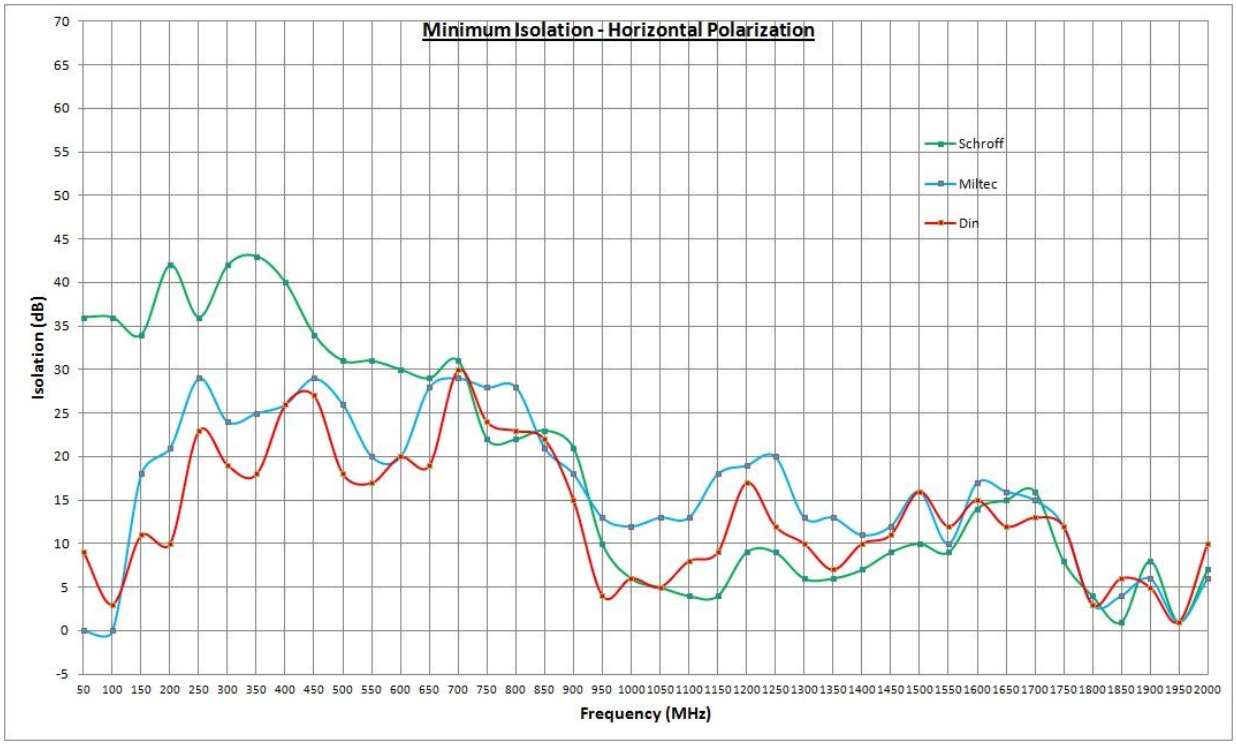

Fig.3 Minimum Isolation with frequency (50MHz to 2000MHz) for all three racks in Horizontal Polarization.

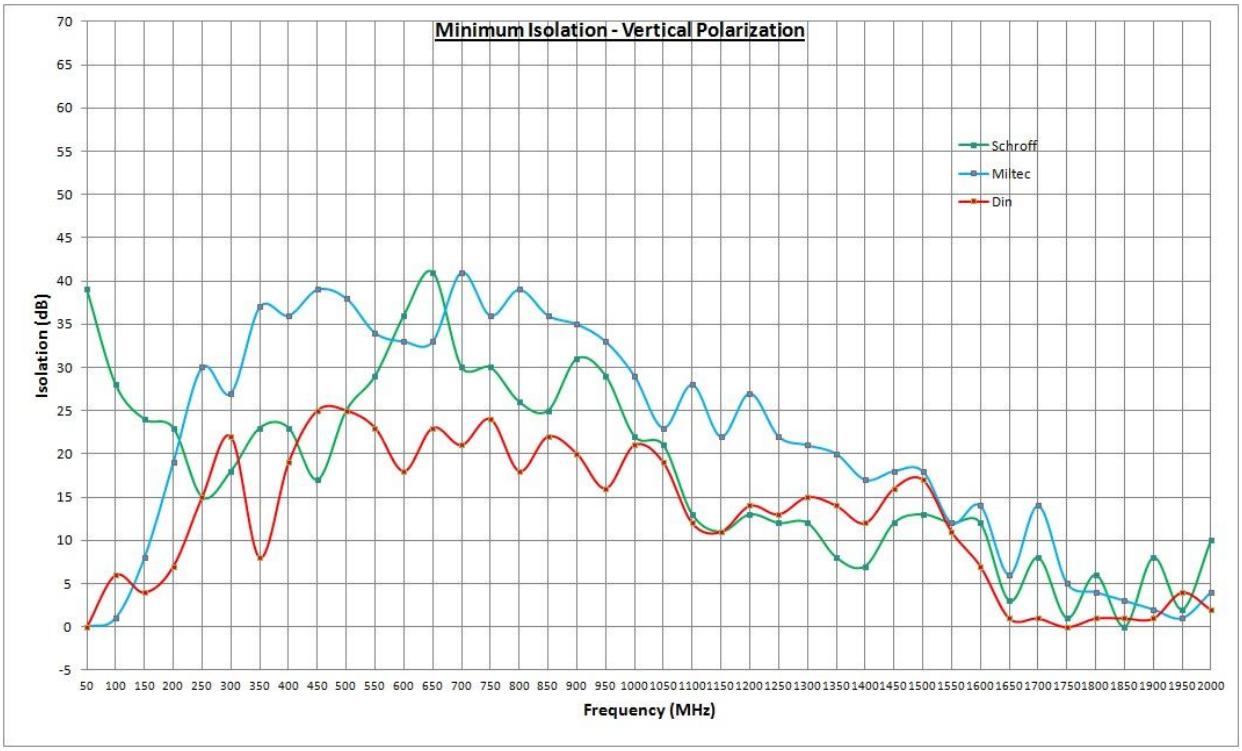

Fig.4 Maximum Isolation with frequency (50MHz to 2000MHz) for all three racks in Horizontal Polarization

5. Conclusion:

The measurement above shows the following conclusions

a. The isolation of Miltec make rack - Hyderabad and Din make rack - Mumbai show poor isolation below 200 MHz in both polarisation compared to Schroff make rack.
b. The high frequency isolation of Miltec make rack above 200 MHz is good compared to Schroff and Din make racks.
c. Schroff rack with good isolation at low frequency has helped to keep the RFI from BLDC system low. Hence the two racks should meet the minimum isolation of Schroff make rack below 200 MHz.
d. Miltec and Din make rack is not suitable for BLDC system below 200 MHz frequency.

6. Scope for improvements:

a. Miltec make rack uses fabric over foam for shielding the door edges. This EMI gasket could be working better above 200 MHz. This could be replaced with an EMI gasket covering lower frequency.
b. The screw spacing could be reduced by introducing one more screw between each pairs. This could improve shielding.
c. The Din make rack have deformed EMI finger line clips poor figuring and discontinuous strips with small fragments. This could properly be fixed to improve isolation.

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