PERANCANGAN DAN FABRIKASI ANTENA MIKROSTRIP MIMO *ARRAY* BERBASIS DGS UNTUK APLIKASI *FUTURE RAILWAY MOBILE COMMUNICATION SYSTEM*

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ABSTRAK

Future Railway Mobile Communication System (FRMCS) membutuhkan sistem antena yang andal dengan keterarahan tinggi dan isolasi yang baik pada pita frekuensi 1900–1910 MHz. Penelitian ini mengusulkan perancangan dan fabrikasi antena mikrostrip *Multiple-Input Multiple-Output* (MIMO) array 2×2 bersubstrat FR-4 *Epoxy*, menggunakan teknik *inset feed* untuk pencocokan impedansi, *truncated corner* untuk penyesuaian frekuensi, dan *Defected Ground Structure* (DGS) untuk mereduksi *mutual coupling* pada *ground plane*. Validasi numerik pada frekuensi target 1900 MHz menunjukkan kinerja optimal dengan *return loss* (S11) -37,93 dB, VSWR 1,03, gain 4,19 dBi, bandwidth 61 MHz, dan isolasi (S21) -44,87 dB. Pengukuran fisik mengonfirmasi kelayakan desain dengan isolasi empiris -47,53 dB, meskipun terjadi deviasi pergeseran resonansi 30 MHz akibat toleransi manufaktur (S11 = -18,80 dB pada 1930 MHz). Pada frekuensi target operasional 1900 MHz, antena tetap mempertahankan *bandwidth* 54 MHz dengan pencocokan impedansi Port 2 (S22) -10,03 dB yang mengompensasi asimetri fabrikasi pada Port 1 (S11 = -9,50 dB). Pengukuran pola radiasi pada 1900 MHz menunjukkan *Front-to-Back Ratio* 16,8 dB dan HPBW 25,1°, mengonfirmasi keterarahan *broadside* antena secara empiris, sehingga prototipe antena tervalidasi layak beroperasi untuk memitigasi efek *multipath fading* pada lingkungan FRMCS.

Kata Kunci: Antena Mikrostrip, FRMCS, MIMO, *Array*, *Defected Ground Structure* (DGS), *Mutual Coupling*.

DESIGN AND FABRICATION OF DGS-BASED MICROSTRIP MIMO ARRAY ANTENNA FOR FUTURE RAILWAY MOBILE COMMUNICATION SYSTEM APPLICATIONS

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ABSTRACT

Future Railway Mobile Communication System (FRMCS) requires a reliable antenna system with high directivity and isolation within the 1900–1910 MHz band. This research proposes the design and fabrication of a 2×2 Multiple-Input Multiple-Output (MIMO) array microstrip antenna on an FR-4 Epoxy substrate, using inset feed for impedance matching, truncated corner for frequency tuning, and Defected Ground Structure (DGS) to reduce mutual coupling. Numerical validation at the target frequency of 1900 MHz exhibited optimal performance with a return loss (S11) of -37.93 dB, VSWR of 1.03, gain of 4.19 dBi, bandwidth of 61 MHz, and isolation (S21) of -44.87 dB. Physical measurements confirmed feasibility with an empirical isolation of -47.53 dB, despite a 30 MHz resonance shift caused by manufacturing tolerances (S11 = -18.80 dB at 1930 MHz). At the operational target of 1900 MHz, the antenna maintained a bandwidth of 54 MHz with Port 2 impedance matching (S22) of -10.03 dB, compensating Port 1 fabrication asymmetry (S11 = -9.50 dB). Radiation pattern measurements at 1900 MHz showed a Front-to-Back Ratio of 16.8 dB and an HPBW of 25.1 degrees, confirming empirical broadside directivity and validating the prototype for mitigating multipath fading in the FRMCS environment.

Keywords: *Microstrip Antenna*, FRMCS, MIMO, *Defected Ground Structure, Mutual Coupling.*