

# Rancang bangun microstrip triple-band band pass filter menggunakan cascade tri-section stepped impedancer resonators = Design of microstrip triple-band band pass filter using cascade tri-section stepped impedance resonators

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## Abstrak

Pada penelitian ini dirancang microstrip triple-band band pass filter (BPF) yang bekerja pada frekuensi GSM 900 MHz, GSM 1800 MHz, dan LTE 2600 MHz dengan menggunakan dua metode rancangan. Rancangan pertama menggunakan metode Hairpin tri-section stepped impedance resonators dan rancangan kedua menggunakan metode cascade tri-section stepped impedance resonators (TSSIR). Perancangan menggunakan perangkat lunak Advanced Design System (ADS) dan dilakukan fabrikasi menggunakan material substrat FR4 dengan nilai permitivitas dielektrik 4.3, ketebalan substrat  $h$  1.6 mm, serta loss tangent 0.0017. Parameter kinerja BPF yang dirancang meliputi S11 return loss, S21 insertion loss, bandwidth, voltage standing wave ration (VSWR), dan group delay. Parameter kinerja BPF hasil rancangan dibandingkan dengan hasil fabrikasi melalui pengukuran. Hasil simulasi menggunakan ADS untuk masing-masing frekuensi tengah 950 MHz, 1850 MHz, dan 2650 MHz diperoleh kinerja S11 -38.434 dB, -40.570 dB, dan -41.401 dB ; kinerja S21 -0.123 dB, -0.163 dB, -0.135 dB ; bandwidth 107 MHz, 299 MHz, dan 425 MHz ; VSWR 1.024, 1.158, dan 1.029 ; serta group delay 3.67 ns, 1.47 ns, dan 0.83 ns. Kinerja S21 menghasilkan transmission zero pada setiap bandstop filter yaitu pada frekuensi 742 MHz, 1327 MHz, 2194 MHz, 3227 MHz mempunyai bandstop filter S21 masing ? masing -73.537 dB, -72.293 dB, -44.292 dB, dan -42.129 dB. Hasil pengukuran untuk masing ? masing frekuensi tengah 950 MHz, 1850 MHz, dan 2650 MHz diperoleh kinerja S11 -15.242 dB, -20.842 dB, dan -23.432 dB ; S21 - 1.038 dB, -1.732 dB, -1.78 dB ; VSWR 1.418, 1.2706, dan 1.1901. Perbandingan hasil simulasi dengan hasil pengukuran, terjadi degradasi kinerja parameter yang diukur sekitar 50%. Hal ini disebabkan oleh loss tangent substrat yang cukup besar, pemasangan konektor yang kurang baik, dan kondisi suhu serta kelembapan udara saat pengukuran. Hasil triple-band cascade TSSIR baik simulasi maupun pengukuran mempunyai kinerja yang lebih baik dibandingkan dengan Hairpin TSSIR.

.....In this research the proposed designed microstrip triple-band band pass filter (BPF) which operated on frequency 900 MHz for GSM, 1800 MHz for GSM, and 2600 MHz for GSM using two methods is designed. The first design is hairpin tri-section stepped impedance resonators and the second design is cascade trisection stepped impedance resonators (TSSIR). Design of filter using software Advanced Design System (ADS) and fabricated using FR4 substrate with dielectric permittivity 4.3, thickness 1.6 mm, and loss tangent 0.0017. Performance parameter of BPF includes S11 return loss, S21 insertion loss, bandwidth, voltage standing wave ratio (VSWR), and group delay. Performance parameters compared between the result of design and fabrication measurement. The result of simulation using ADS for each frequency centre 950 MHz, 1850 MHz, and 2650 MHz obtained by the performance of S11 -38.434 dB, -40.570 dB, and -41.401 dB; S21 -0.123 dB, -0.163 dB, -0.135 dB; bandwidth 107 MHz, 299 MHz, and 425 MHz; VSWR 1.024, 1.158, and 1.029; group delay 3.67 ns, 1.47 ns, and 0.83 ns. Performance of S21 is generate transmission zeros for each band stop filter are 742 MHz, 1327 MHz, 2194 MHz, and 3227 MHz obtained

band stop filter S21 -73.537 dB, -72.293 dB, -44.292 dB, and -42.129 dB. The result of measurement for each frequency centre 950 MHz, 1850 MHz, and 2650 MHz obtained by the performance of S11 -15.242 dB, -20.842 dB, and -23.432 dB; S21 - 1.038 dB, -1.732 dB, -1.78 dB; VSWR 1.418, 1.2706, and 1.1901. Compared to the simulation results with measurement, there is performance degradation of measured parameters about 50%. This is caused by loss tangent of substrate is large, poor connectors, and the conditions of temperature or humidity at measurement. The result of triple-band cascade TSSIR both of simulation and measurement has a better performance compared to the Hairpin TSSIR.