DISCUSSION

For the ferrite strip-line circulators studied and developed, the ferrite strip-junction should be centrally located in the spacing between the two ground planes. It has been observed during the experimental work, that the slight shift either in the location of the metal strip-disc or in the two ferrite discs from the centre, shifts the circulation frequency, thereby causing asymmetry in the isolation characteristics between the ports.

Also any increase or decrease in the metal strip-disc diameter from the optimum, shifts the circulator operation respectively towards the higher and lower frequency sides.

And, it is also noted that any variation in the applied external d.c. magnetic-field from the optimum value at the junction, reduces the band-width of the circulator considerably.

The garnet/ferrite material discs should be centrally housed and operating frequency could be preset by varying the strength of the applied field with barium ferrite permanent magnets, in combination with the variable strip-disc diameters.

It is clear from the theory and experimental study, that the ferrite disc diameter is inversely proportional to the frequency of circulation for constant thickness. And by increasing the thickness of ferrite disc for constant diameters, will result in increased insertion loss.
by decreasing the operating frequency.

Employing the built-in \( \gamma^4 \)-linear/exponential taper matching elements in the strip-arms in the magnetic region, leads to a substantial band-width enlargement compared to the other matching elements investigated.

Any departure from the optimized geometry of the matching elements, for particular operating frequency, reduces the band-width only.

The impedance plot on Smith charts seems to be the best tool, to recognize at a glance the device impedance characteristics, so as to evaluate correctly the material-magnetic, dielectric and physical parameters, as well as the operating d.c. biasing fields, for the development of broad-band circulators.

The detailed study led to choose all the garnet/ferrite materials with temperature stabilization from \(-40^\circ C\) to \(+80^\circ C\), for the fact, that the variation in temperature will cause a change in saturation magnetization and the permeability, which in turn will change in the dimensions resulting in a shift in the circulation frequency, when the material is operated under below resonance.

With the addition of the matched co-axial load to the third port, the circulator will operate as an isolator with much better performance than the standard resonance absorption-isolator.

The 5-port strip-line circulators can be designed by cascading another 3-port circulator to a 4-port circulator.
The 0-configuration for 5-port circulator can be obtained by biasing the three junctions in the same direction.

Replacing the permanent magnets with electromagnets, the circulators can be used as switches or modulators.

These circulators discussed thus far, operate satisfactorily at low r.f. power levels, are compact in size with low-loss (less than 0.30 dB) and high isolation (greater than 20 dB) and low V.S.W.R.(less than 1.25) with good temperature stability.