	Title:	Document No.:	Revision:
BARRY	**Attenuator and Termination Matching for Ferrite Junction Isolators**	**BAN-MATCH-1.1**	**A**

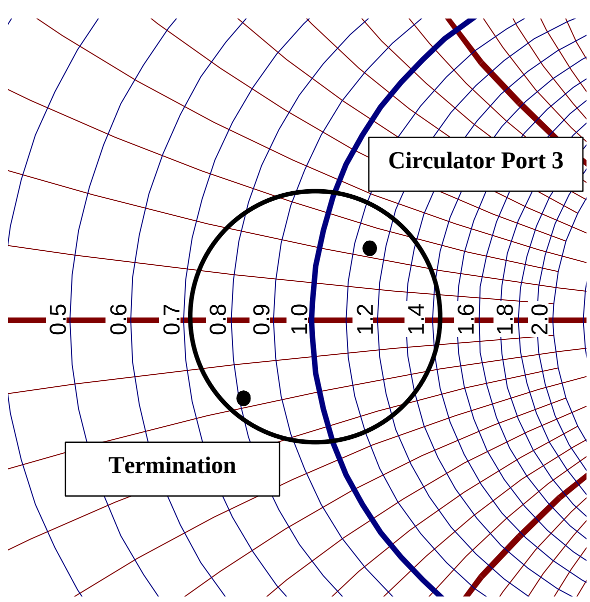
Introduction

Both the Circulator 3rd port and Termination/Attenuator are specified to meet a VSWR over a given frequency band. The actual isolation result will depend on the phase of the Return Losses. An optimal result is where the return losses of 3rd port and resistive component are complex conjugates. It is highly probable that the return Losses will not be complex conjugates and will therefore mismatch. The susceptance slope should also be taken into consideration.

There will be 2 methods of matching discussed here. The first method is to measure the Return Loss of each component independent of one another. The circulator result is then altered to conjugate match with the termination. The second method will assume the circulator (isolator) and termination/attenuator are already integrated. Again it is port 3 of the isolator circuit that is altered to match the termination. It is assumed that port 1 and 2 of the circulator/isolator are already optimized. The termination should not be tampered with; scratching the surface of the chip will **significantly reduce the termination's ability to handle power**.

Method One

Using a smith chart so that the phase is also examined the termination/attenuator and port 3 of the circulator is measured. A typical example is shown below, for simplicity a spot center frequency is considered. In the example both results are within the 1.15 VSWR circle (<23dB). Some care should be taken to reference the components accurately.



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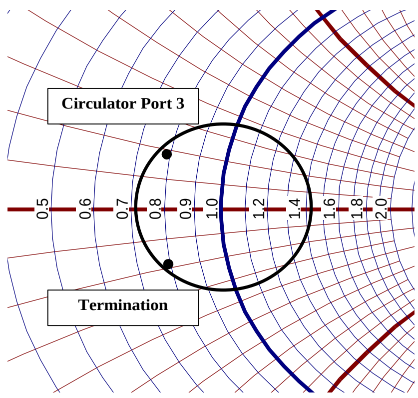
The circulator port 3 should now be altered to the complex conjugate of the termination match. In the example the resistance (real part of impedance) is decreased, see result. When these 2 components are integrated the isolation parameter should be close to optimal. A small modification may be required to compensate for stress bend or solder joints now in place.

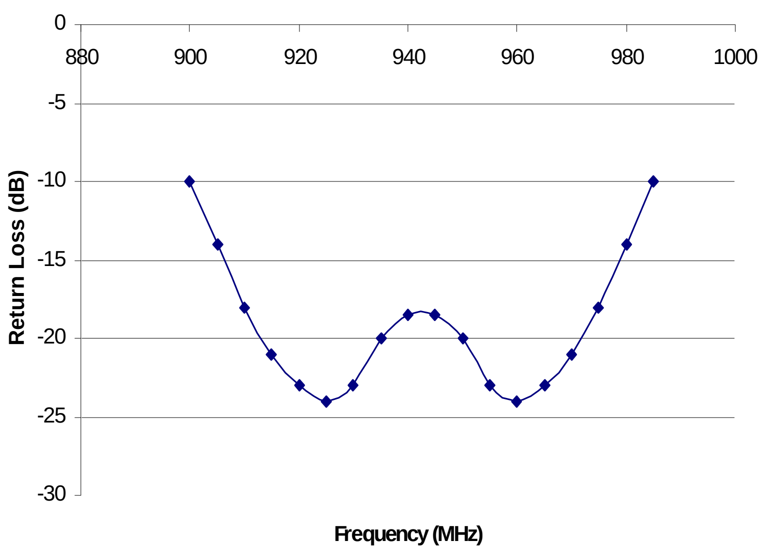


Method 2

This method looks at the result of the already integrated circulator (isolator) and termination/attenuator. In this scenario the result has to be viewed in Log Mag. Again the termination is used as the constant and the circulator (isolator) port 3 is manipulated to match into the termination. It is often helpful to examine ports 1or 2 in Log Mag and Smith chart for reference, for example is the isolator operating over the first null only? It is also easier to evaluate the result with a wide sweep say 5 times the bandwidth; this is to insure that both nulls can be viewed.

It is simple enough to check the capacitive/inductive level by using a dielectric tuning stick, what is not so easy to determine is the real impedance level. It would be impossible to show all possible results in this document, 2 examples are given only both these examples assume that the capacitance level is optimized. Both the real and imaginary parts of the impedance should be calculated before making an iteration to the circuit. It is important to examine the shape of the result and how it differs over the frequency band. It is sometimes useful to use several markers.

The next graph shows a ripple, this usually indicates that the real part of port 3 impedance is too low compared to the termination, if the two minima of the result are very uneven then the reactive impedance is also off this can be checked with a dielectric stick. It is sometimes useful to have this response for temperature stability.



The graph below is attempting to illustrate a result where the response is fairly flat and will tune only to a certain level. The tuning in this case would be most effective when placed close to the ferrite. For this example the real part of the impedance is too high compared to the termination. It has been assumed in these examples that the termination is placed close to the isolation port. If the loop, when viewed on smith chart, is very small the result would appear more notch like than the graph below suggests that is why it is important to use the return loss results from port 1 and port 2 as reference.