Wavelength Selective Reflector

File name: `microring reflector.apc`

Reference: G. T. Paloczi, J. Scheuer, A. Yariv, "*Compact Microring-Based Wavelength-Selective Inline Optical Reflector*", IEEE Photon. Technol. Letters, Vol. 17, N. 2, pp. 390-392, February 2005

In this example the circuit presented in the Reference is studied. It consists of a Mach-Zehnder loaded with a ring resonator filter that connects both arms. At the ring resonance the input signal is totally reflected while out of resonance signals continue toward the output port. Any odd number of cascaded rings can be used to this scope. This is an alternative to add drop multiplexers realized with Mach-Zehnder loaded with Bragg gratings.

Fig. 1 reproduces the example reported in the Reference: the transfer functions in transmission and reflection are indicated with *T* and *R*, respectively. The bending radius is 108.25µm, n_{eff}=1.515, the ring power coupling coefficient 0.25 and waveguide attenuation is neglected.

To get a much more selective transfer function three cascaded rings should be used. Fig. 2 shows the cases with Butterworth response (which coupling coefficients are {0.4; 0.048; 0.048; 0.4}) and Chebisheff response (which coupling coefficients are {0.61; 0.102; 0.102; 0.61}).

Magnitude of both reflection and transmission and group delay responses are shown in figure 2 for the three circuits. Note the higher selective response and the different reflection characteristics.

We suggest to investigate the impact of an optical unbalance of the arms of the Mach-Zehnder, an unbalance of the splitting ratio of the branches, attenuation and dispersion over a large wavelength range. Coupling coefficients, branches splitting ratio and bending radius are specified as global variables and it is very easy to perform scan or investigate the effect of the tolerances of these parameters on the overall transfer function.

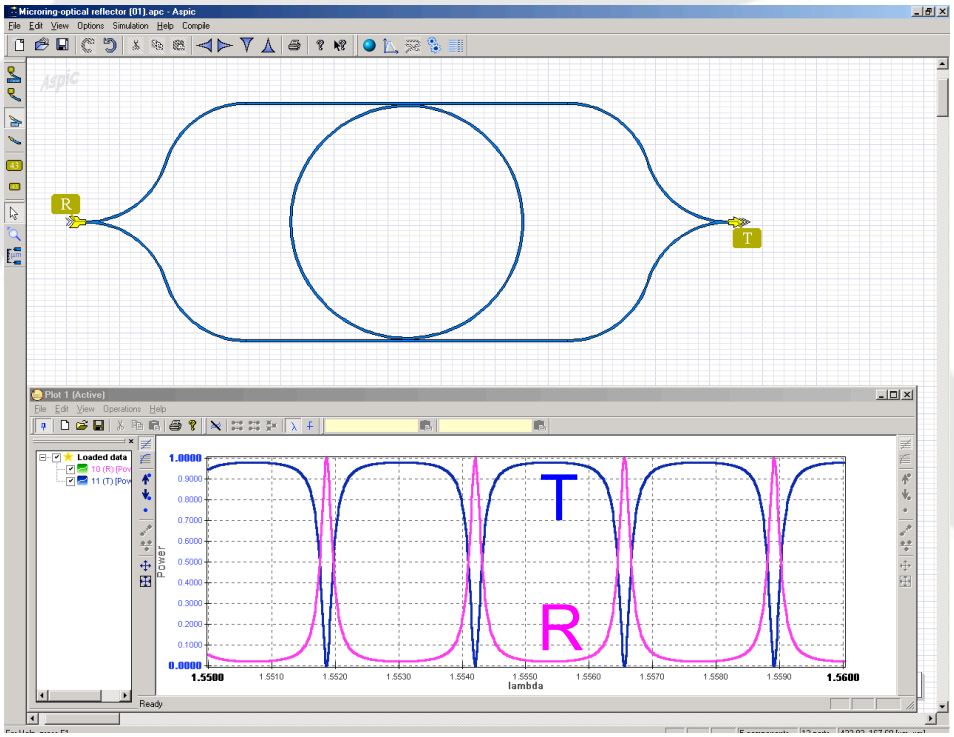

Fig. 1 – Transmission T and reflection R transfer function of the single ring reflector.

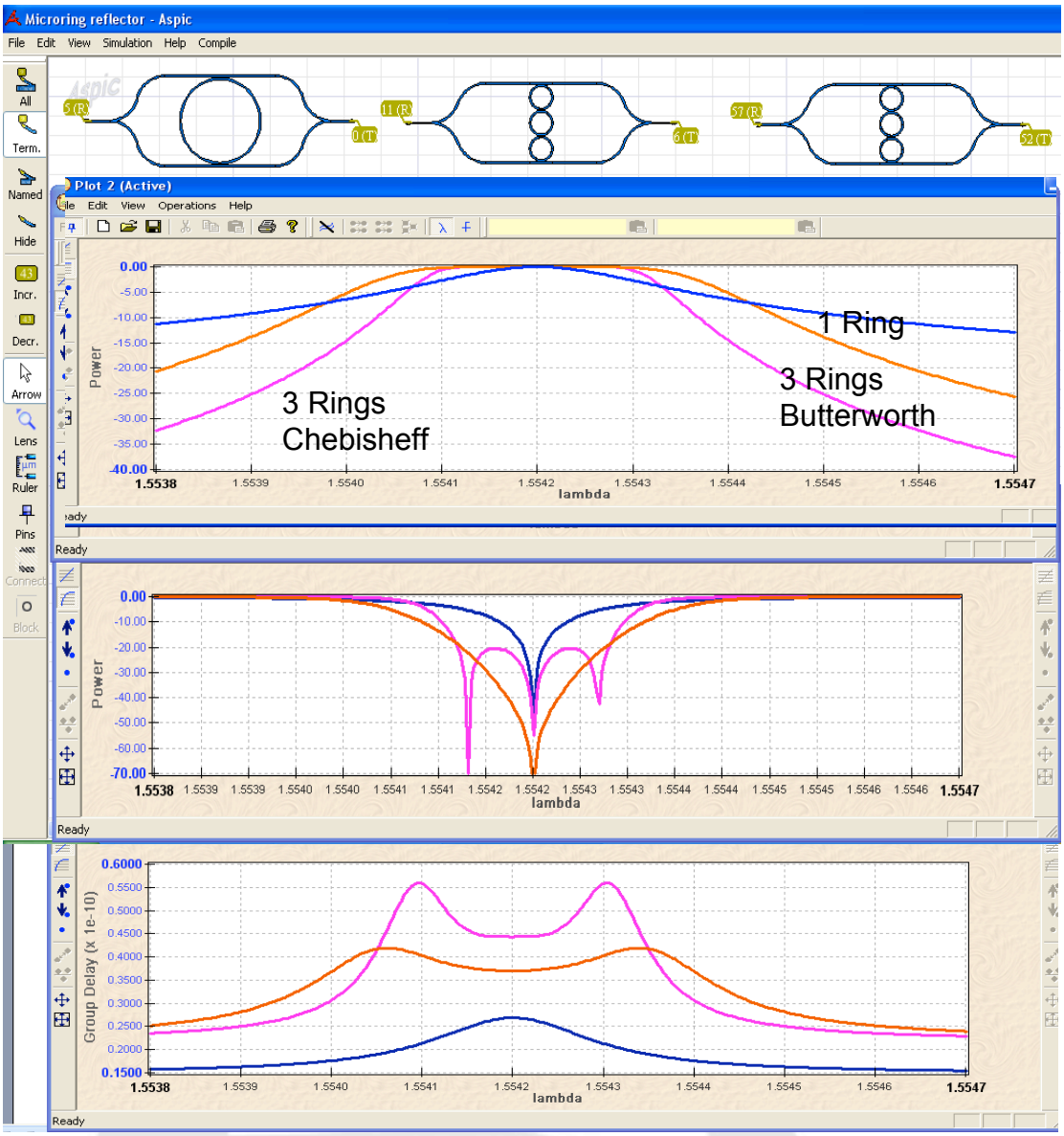

Fig. 2 – Intensity and group delay transfer function in reflection and transmission for the circuits.

As an example Fig. 3 show the transfer function of the 3 ring Chebisheff reflector obtained by varying the bus to ring couplers (variable K3C0) in the range 0.3 to 0.5. In the "*Simulation Config*" menu both 'Sweep' and 'Variable' check boxes are enabled and parameters are entered below. Select 'K3C0' variable and set the number of simulations to carry out. In the Plot windows every curve can be selected separately and the values of the swept variable appears.

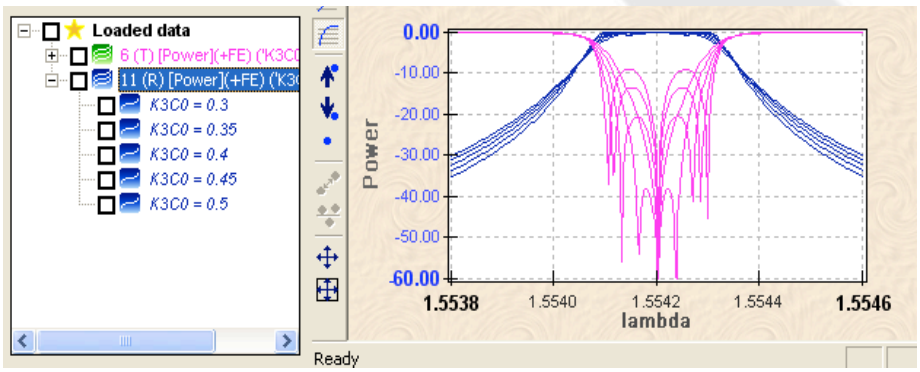

Fig. 3 – Plot window after the sweep simulation