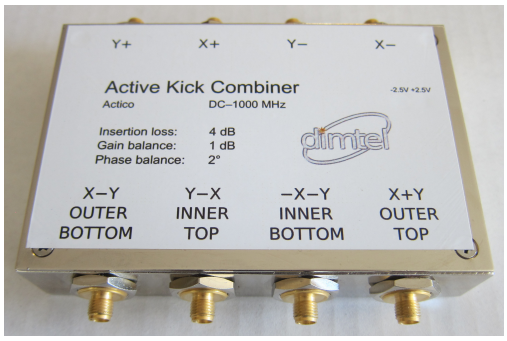
Actico

Features

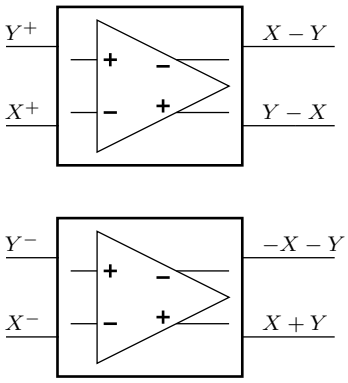
- DC–1000 MHz usable bandwidth
- 4 dB typical insertion loss
- 4° phase balance
- 1 dB gain balance
- SMA connectors



Description

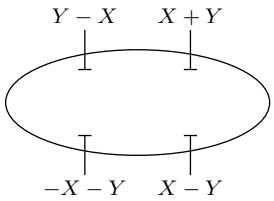
Actico is an 8 port active RF device for computing sums and differences of the input signals. It is designed for processing the differential outputs of horizontal and vertical bunch-by-bunch feedback controllers. Actico generates appropriate drive signals for 4 diagonally located striplines. Closely matched responses of the individual channels the and wide bandwidth are optimized to maintain high bunch-to-bunch isolation.

Block Diagram



Actico is implemented using two wideband differential amplifiers, as shown in the block diagram above. One of these amplifiers accepts X^+ and Y^+ signals and generates $X-Y$ and $Y-X$ drive outputs. The second amplifier converts X^- and Y^- into $X+Y$ and $-X-Y$ pair of outputs.

After high-power amplification, outputs of Actico can be applied to the diagonal striplines as shown in the figure below.



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Electrical Specifications, +25°C

Parameter	Frequency	Units	Min	Typ	Max
Insertion loss[1]	DC–1.25 GHz	dB	—	7	10
Amplitude balance[12]	DC–1.25 GHz	dB	—	0.8	2
Phase balance[13]	DC–1.25 GHz	degree	—	3	10
VSWR[4]	DC–1.25 GHz	ratio	—	1.9	2
Upper 3 dB frequency[5]	—	MHz	1000	1150	—
Plane isolation, X or Y drive[6]	—	dB	30	38	—
Input voltage	—	mV	—	—	±500

[1]For two port measurements, six unused ports are terminated by 50Ω loads.
[2]Maximum insertion loss difference over a block-diagonal 4×4 S-parameter matrix.
[3]Computed over a block-diagonal 4×4 S-parameter matrix after excluding individual input and output delay errors.
[4]For one port measurements (S_{11}), seven unused ports are terminated by 50Ω loads.
[5]Relative to the DC gain
[6]See measurement approach description on page 4.

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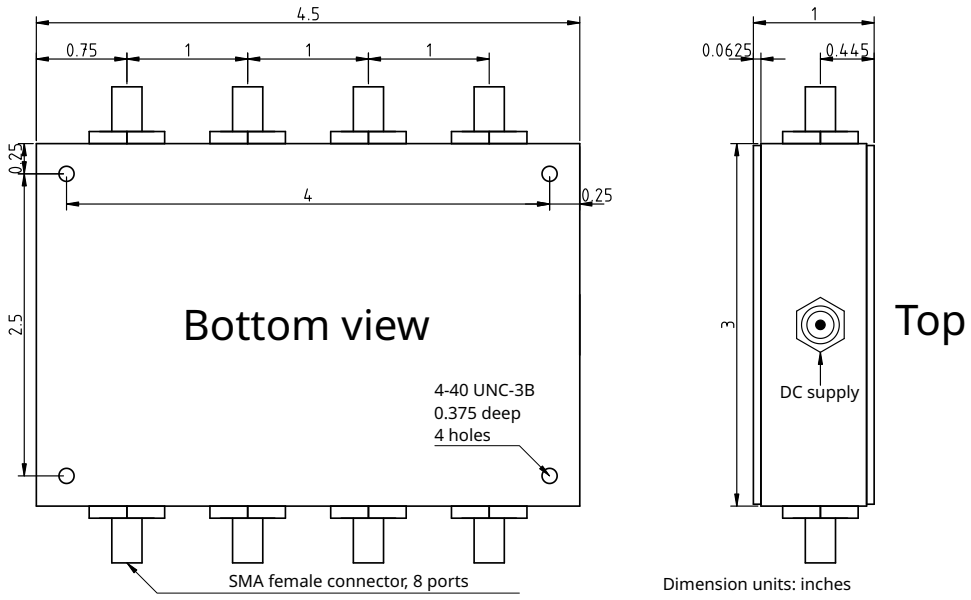
Case outline



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Plane coupling test setup

S-parameters

Actico is characterized by measuring 16 S-parameters as follows:

- Two 2×2 forward transfer matrices between input and output ports;
- 8 reflection parameters (diagonal of the full scattering matrix);

Forward transfer matrices

Two separate 2×2 forward transfer matrices M^+ and M^-. Matrix M^+ is defined in Eq. 1, and matrix M^- — in Eq. 2. These are measured two ports at a time, with six unused ports terminated by Mini-Circuits ANNE-50L+ 50Ω loads.

$$\begin{bmatrix} Y-X \\ X-Y \end{bmatrix} = M^+ \begin{bmatrix} X+ \\ Y+ \end{bmatrix} = \begin{bmatrix} S^{X+}_{Y-X} & S^{X+}_{X-Y} \\ S^{Y+}_{Y-X} & S^{Y+}_{X-Y} \end{bmatrix} \begin{bmatrix} X+ \\ Y+ \end{bmatrix} \tag{1}$$

$$\begin{bmatrix} -X-Y \\ X+Y \end{bmatrix} = M^- \begin{bmatrix} X- \\ Y- \end{bmatrix} = \begin{bmatrix} S^{X-}_{-X-Y} & S^{X-}_{X+Y} \\ S^{Y-}_{-X-Y} & S^{Y-}_{X+Y} \end{bmatrix} \begin{bmatrix} X- \\ Y- \end{bmatrix} \tag{2}$$

In order to facilitate the analysis of this data, phase response measurements are processed as follows. For each element of the matrix, group delay is estimated by a linear fit to the phase data in the 0.3–1250 MHz range. Average delays for M^+ and M^- are subtracted. Maximum delay error between all 8 forward paths is calculated and reported in the factory test results. For the path-to-path phase error analysis phase values for the inverting paths in M_{fwd} are offset by 180°.

Calculated plane-to-plane coupling

From the S-parameter matrices it is possible to calculate the transfer functions for horizontal and vertical input signals to horizontal and vertical kicks (assuming perfectly balanced diagonal striplines and power amplifiers).

$$\begin{bmatrix} H_{xX} \\ H_{xY} \\ H_{yY} \\ H_{yX} \end{bmatrix} = \begin{bmatrix} S^{X-}_{-X-Y} + S^{X+}_{X-Y} - S^{X+}_{Y-X} - S^{X-}_{X+Y} \\ S^{X-}_{-X-Y} + S^{X+}_{Y-X} - S^{X+}_{X-Y} - S^{X-}_{X+Y} \\ S^{Y-}_{-X-Y} + S^{Y+}_{Y-X} - S^{Y+}_{X-Y} - S^{Y-}_{X+Y} \\ S^{Y-}_{-X-Y} + S^{Y+}_{X-Y} - S^{Y+}_{Y-X} - S^{Y-}_{X+Y} \end{bmatrix} \tag{3}$$

where H_{xX} and H_{xY} are responses from the horizontal input to horizontal and vertical kicks respetively. Similarly, H_{yY} and H_{yX} are responses from the vertical input to vertical and horizontal kicks.

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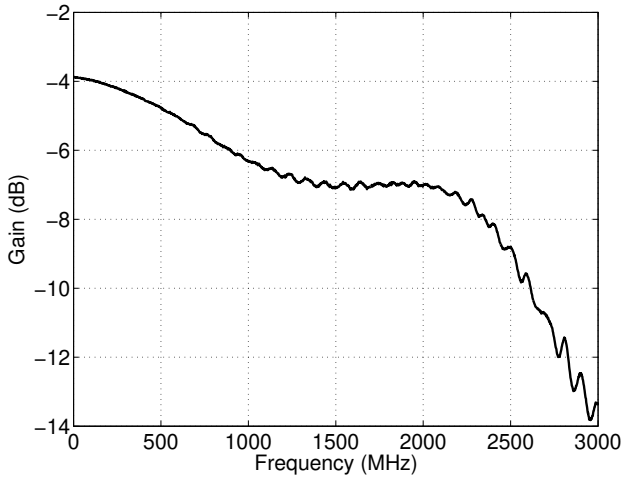
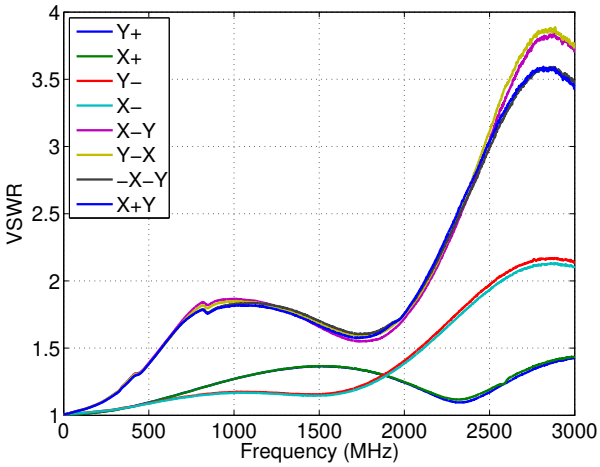
Typical performance curves

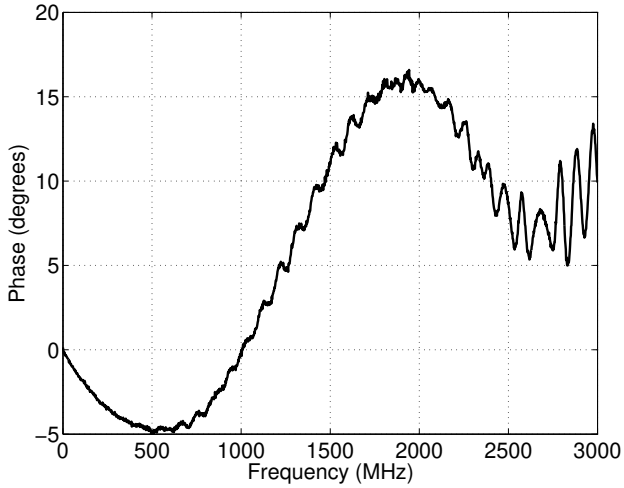
Forward gain



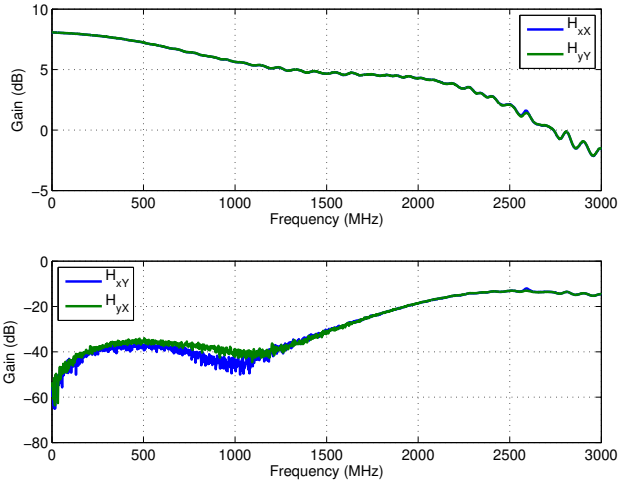
VSWR



Forward phase[1]



In-plane responses and coupling terms



[1]port delays removed

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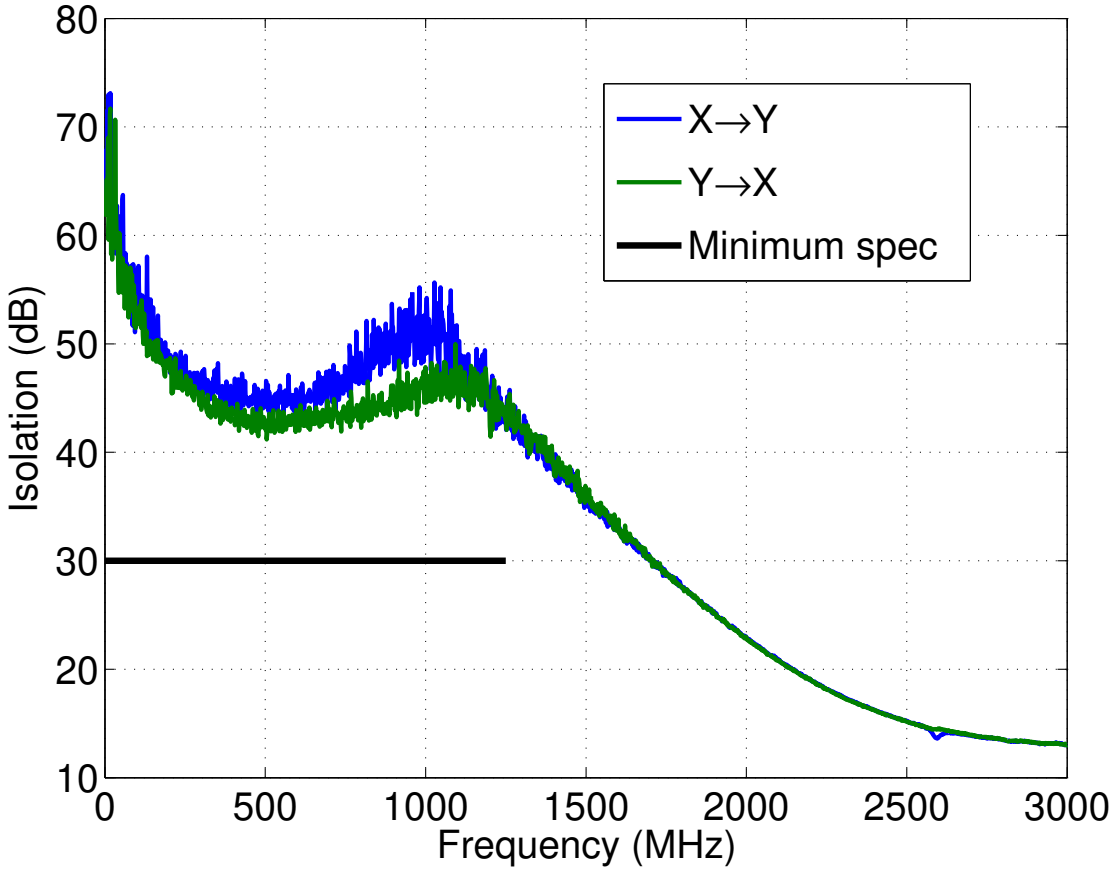
Typical performance curves (continued)

Cross-plane isolation



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