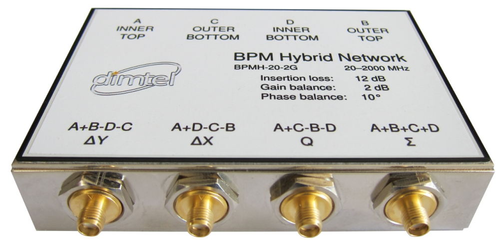
BPMH-20-2G

Features

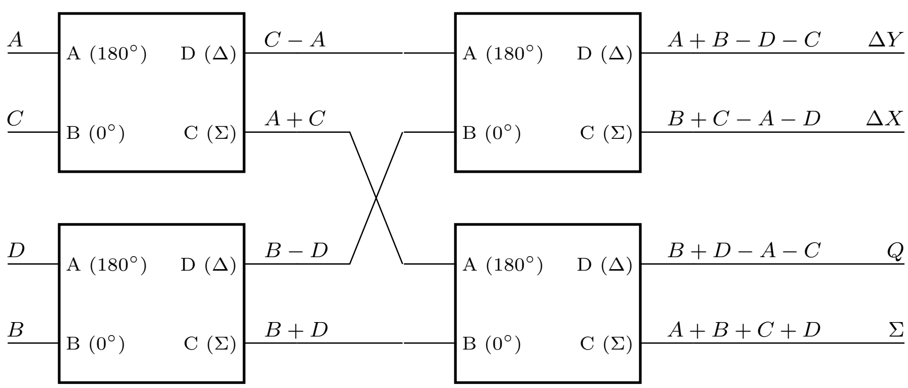
- 20–2000 MHz usable bandwidth
- 10 dB typical mid-band insertion loss
- 10° phase balance
- 2 dB gain balance
- SMA or N connectors



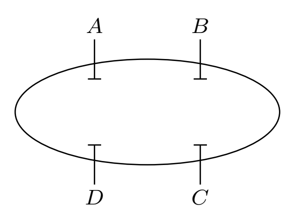
Description

BPMH-20-2G is an 8 port passive RF device for computing sums and differences of input signals. It is designed for processing the outputs of diagonally located capacitive or stripline beam position monitors (BPMs). BPMH-20-2G is capable of simultaneously generating horizontal, vertical, and sum outputs. With 20–2000 MHz response it is optimized for bunch-by-bunch diagnostic and feedback applications in lepton storage rings with bunch spacings down to 1.4 ns. Closely matched responses of individual channels produce a short output pulse, ideally suited for applications requiring high bunch to bunch isolation.

Block Diagram



BPMH-20-2G is implemented as a two-stage network of 3 dB sum/difference hybrids, as shown in the block diagram above. Output designations ΔX, ΔY, and Σ are valid for BPM connections shown on the right[1]. Terminate diagonal difference output Q in 50Ω.



[1]Swapping top and bottom or inner and outer pairs simply inverts the sign of ΔY or ΔX respectively.

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Electrical Specifications, +25°C

Parameter	Frequency	Units	Min	Typ	Max
Insertion loss[1]	20–2000 MHz	dB	—	12	14
	20–1000 MHz	dB	—	11	12
Amplitude balance[1,2]	20–2000 MHz	dB	—	1.5	2
	20–1000 MHz	dB	—	1.0	1.5
Phase balance[1,3]	20–2000 MHz	degree	—	8.5	10
	20–1000 MHz	degree	—	5.5	8
Phase non-linearity[1,4]	20–2000 MHz	degree	—	12	15
	50–2000 MHz	degree	—	8	10
Isolation[1,5]	20–2000 MHz	dB	15	20	—
VSWR[6]	20–2000 MHz	ratio	—	2.2	2.5
	100–2000 MHz	ratio	—	1.7	2.0
Lower 3 dB frequency	—	MHz	—	5	10
Upper 3 dB frequency	—	MHz	2000	—	—
ΔX to ΔY isolation, X or Y drive[7]	—	dB	25	30	—
Input power	—	watt	—	—	0.5
Input voltage	—	V	—	—	7.0

[1]For two port measurements, six unused ports are terminated by 50Ω loads.
[2]Maximum insertion loss difference over a 4×4 S-parameter matrix.
[3]Computed over a 4×4 S-parameter matrix after excluding individual input and output delay errors.
[4]Maximum excursion from the linear phase slope for any input/output pair.
[5]Measured between adjacent pairs of inputs or outputs.
[6]For one port measurements (S_{11}), seven unused ports are terminated by 50Ω loads.
[7]See measurement setup description on page 4.

Port Assignment

Sum output port is fixed, but there are six ways to assign horizontal and vertical signals to the remaining three outputs. For optimal performance, one of such port assignments is favored by the internal topology of BPMH-20-2G. In typical accelerator applications the vertical dynamic range is most critical. As marked on the device, vertical output ΔY is placed as far from the sum output as possible — such arrangement offers best isolation between the large sum signal and the small orbit difference signal one would like to measure at ΔY. The output next to ΔY is assigned to ΔX.

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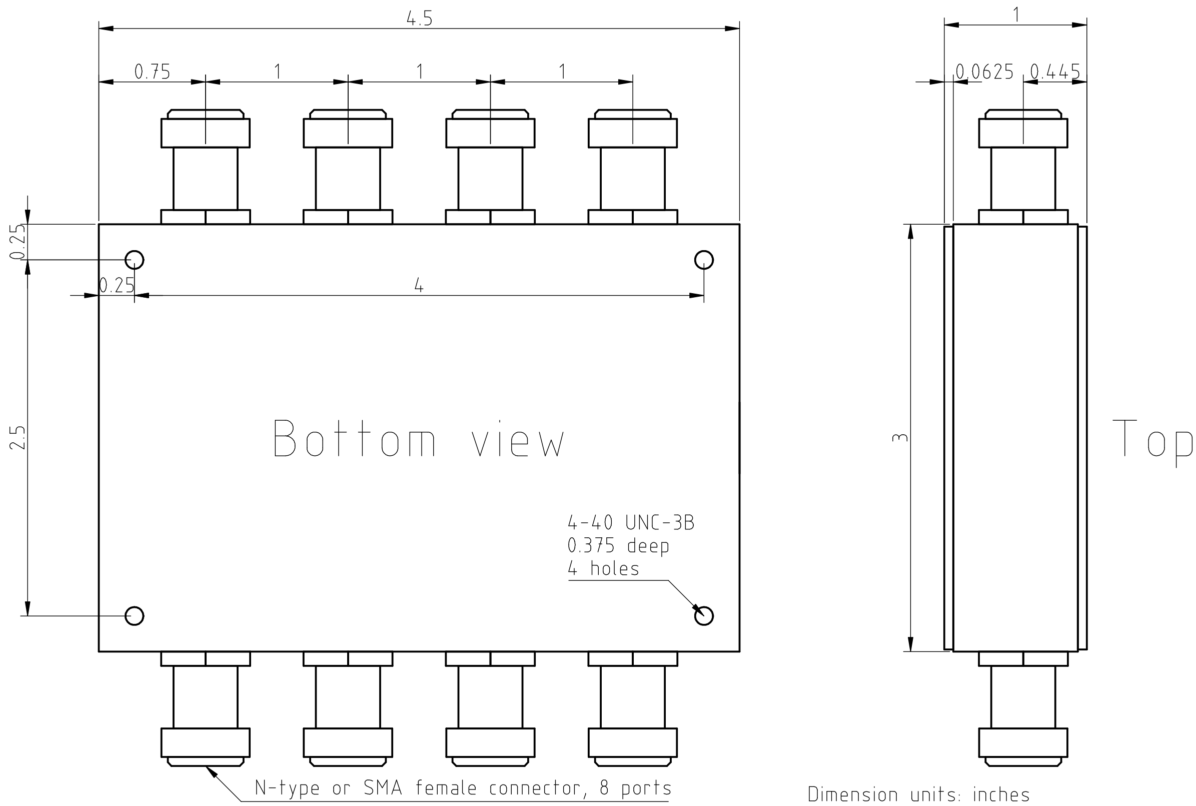
Case outline



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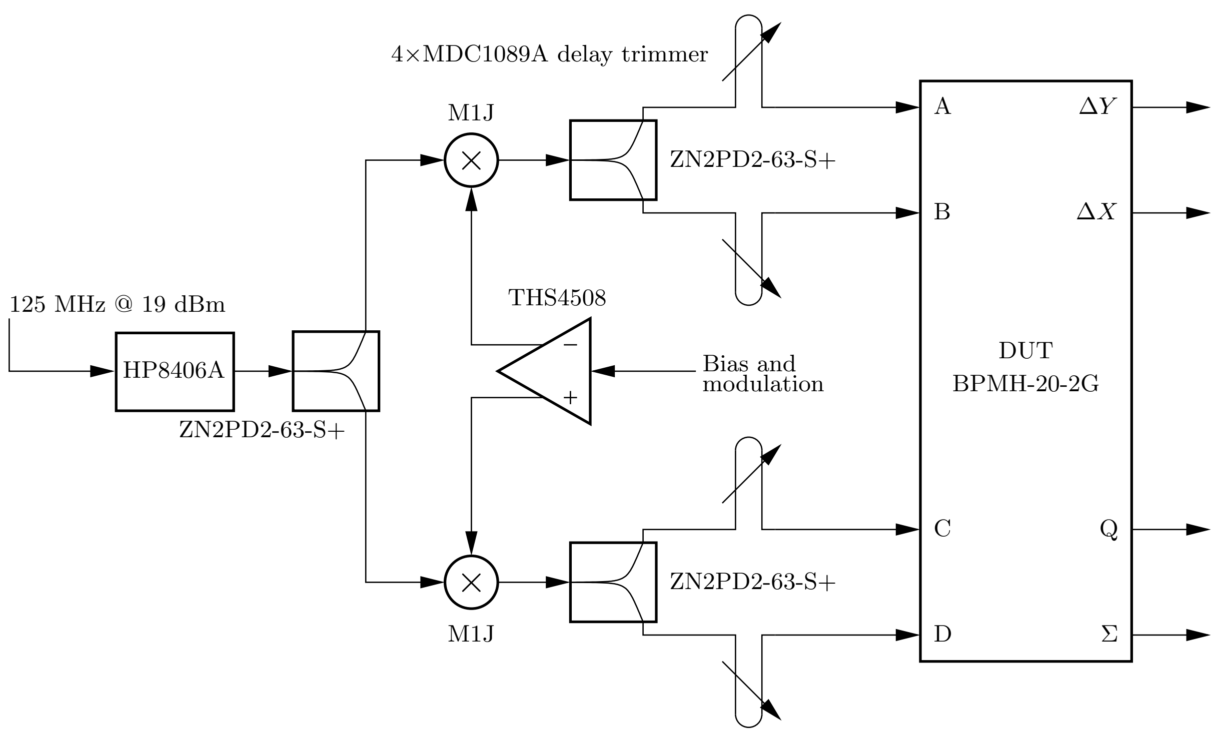
Plane coupling test setup

Plane to plane coupling is measured using a test setup shown in the figure below. Output of a step recovery diode comb generator (HP8406A) simulates a BPM signal. The signal is split and amplitude modulated using double-balanced mixers and a differential amplifier. Mixer outputs are split again, producing four signals which mimic individual pickups. These are connected to the device under test (DUT) via Midisco MDC1089A delay trimmers. For units with N-type connectors, Pomona 4297 SMA-to-N adapters are used. In the figure, the DUT is configured for ΔY output, with input pairs A/B and C/D differentially driven.

Prior to the actual measurement, individual input delays are trimmed as follows. Output ΔY is observed on a sampling scope (Tektronix 11801C/SD-24) and input signals are connected one at a time. Three disconnected test stand outputs and all unused DUT ports are terminated into 50Ω. Sampling scope is triggered by the 125 MHz input and delay trimmers are adjusted to equalize the pulse timing observed at the output. This process closely follows a typical BPM hybrid timing procedure in the accelerator setting.

Once the inputs are timed, all 4 signals are connected and the outputs ΔX and ΔY are observed on a spectrum analyzer. For modulation in a particular plane, the difference between the observed signal in and out of plane determines the plane-to-plane coupling.



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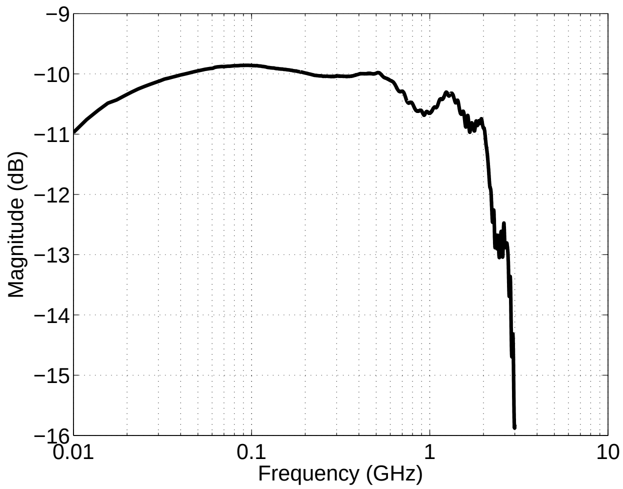
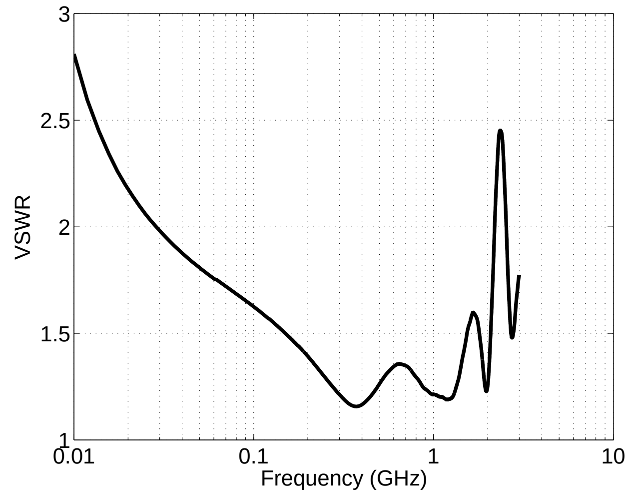
Typical performance curves

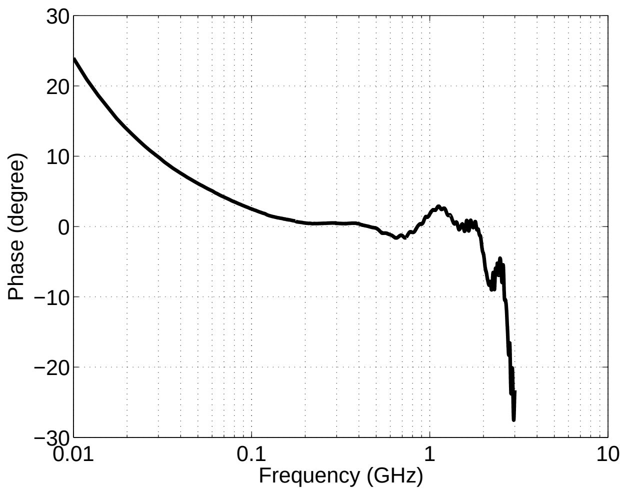
Forward gain



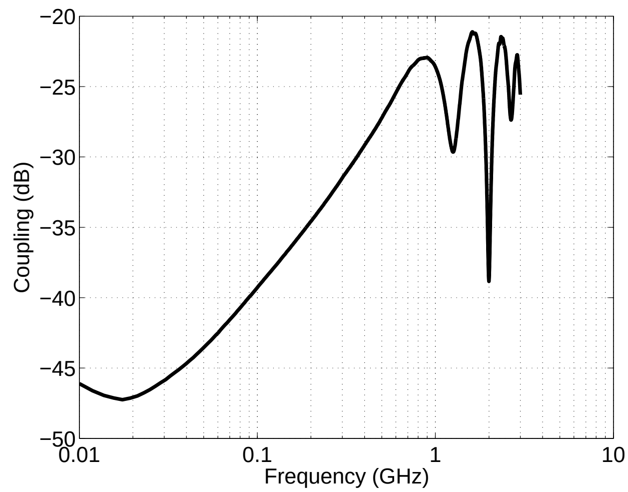
VSWR



Forward phase[1]



Neighboring port coupling



[1] port delays removed

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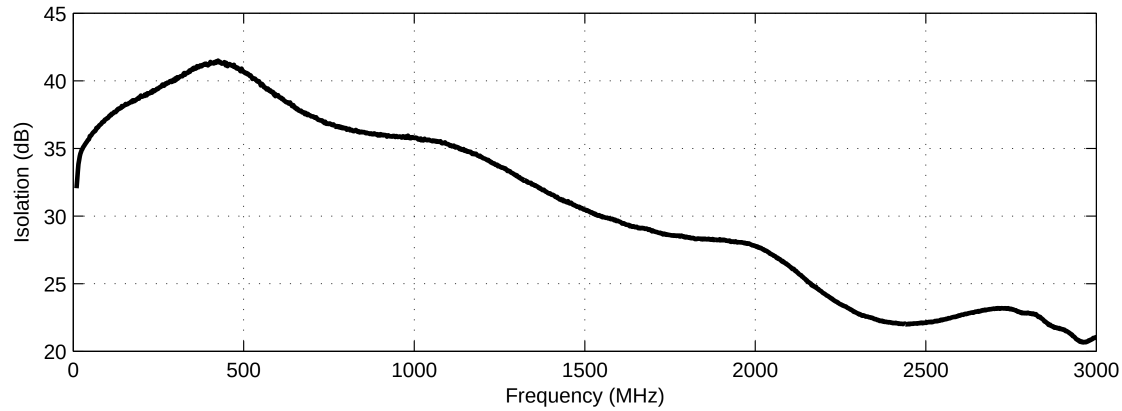
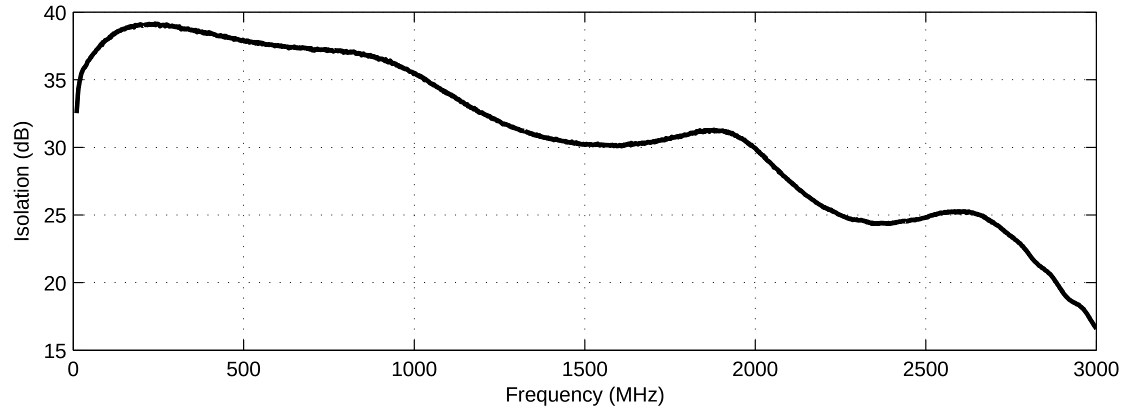
Typical performance curves (continued)

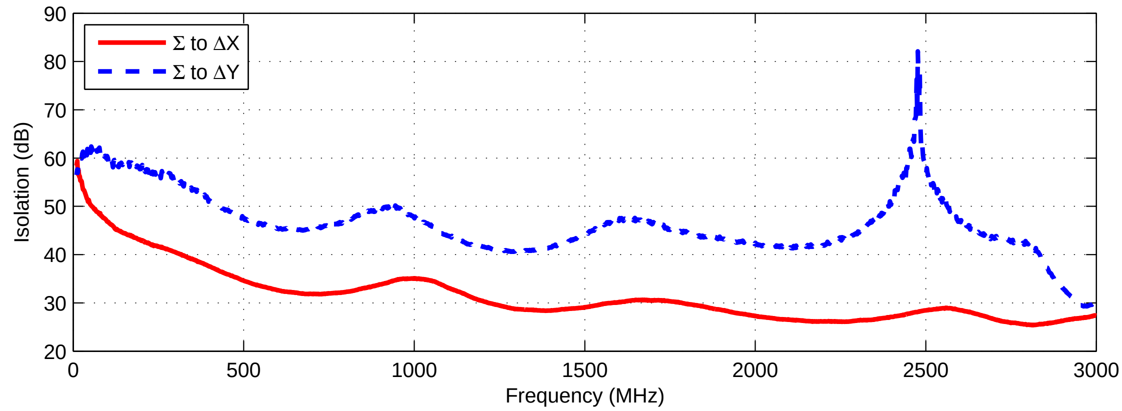
ΔX to ΔY isolation, horizontal excitation



ΔY to ΔX isolation, vertical excitation



Σ to ΔX/ΔY isolation, common-mode input



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