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Evaluation of Some New Balun Devices

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Abstract— **Balun have long been used for by the Electromagnetic measurement community to combine signal outputs from differential sensors (field, current and voltage). Baluns are also extensively used in high speed data transmission; as a result there are several new commercial devices available. These new devices have excellent bandwidth, phase & amplitude match and good CMR. This paper presents the results of an AFRL project to evaluate some of them. Data on more traditional baluns such as made by URS and Prodyn is also included for comparison. Except for low frequencies a 4 port Network Analyzer was used for measurements, this gets around some of the previous problems involved with single ended measurements on baluns.**

Balun, Electromagnetic measurements, antennas,

I. Introduction

In the High Power Electromagnetic measurement word differential field sensors are used to make accurate measurements. A key part of this technique is properly combining the differential out puts into a single ended signal that can be conveniently recorded by a high speed digitizer. This is typical done using a balun device. In principal a balun is quite simple; it invers one of the differential signals on the input and adds it in phase to the other input. If a simple combiner were used the 2 differential signals would add out of phase tend to give no signal at the output. All though a balun is conceptually simple, in practice it is very difficult to make a very broad bandwidth balun because the frequency range of interest requires both lumped element (ferrites) and distributed transmission line topologies. The dividing line between the two techniques is on the order if 1 GHz and EM measurements often span these two ranges. Designing a balun that spans kHz to GHz is a real challenge.

II. Test Articles

Three new state of the art wideband baluns were chosen for evaluation; in addition several baluns from URS and Prodyn were also tested.

TABLE I. Baluns

	Part	Range	CMR	IL dB	Amp B	Ph B
Marki	BAL-0006	200k-6GHz	40dB	7.5	±0.1	±1
Hyper Lab	9402	5M-6GHz	NG*	6.0	±0.1	±2
Pico Sec	5310	4M-6GHz	35dB	7.6	±0.1	±0.5
URS	DMB4	150k-3GHz	28dB	6.4	NG	NG
Prodyn	B1BF	200k-3.5GHz	20dB	8.0	NG	NG
M/C	ZFSC	50M-1GHz	NG	4.7	±0.1	±2

*Not given Amp B, Ph B = Amplitude and phase balance

Octave and multioctave microwave hybrids were also thrown in the mix. Several examples of URS and Prodyn baluns were available; they had all been use for many years so this was an opportunity to looking at ageing effects.

III. Measurements

All measurements were made with Vector Network Analyzers over a frequency range of 100 to 8GHz. At lower frequencies an Agilent 5061B-LF (5 to 3GHz) was used, for higher frequencies a Rohde & Schwarz ZVB8 (300k to 8 GHz) was used. The R&S had the advantage of being a 4 port machine so true differential measurements could be made. Over 300k to 3GHz data was taken by both analyzers to look at differences between single ended and differential measurements.

References

[1] Rohde & Schwartz "Measuring Balanced Components with Vector Network Analyzer ZVB" Application note 1EZ53