ÉCOLE POLYTECHNIQUE MONTRÉAL

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SDR 2.0 - Entering the Mainstream

Poly GRAMES

UWB Wave Radio

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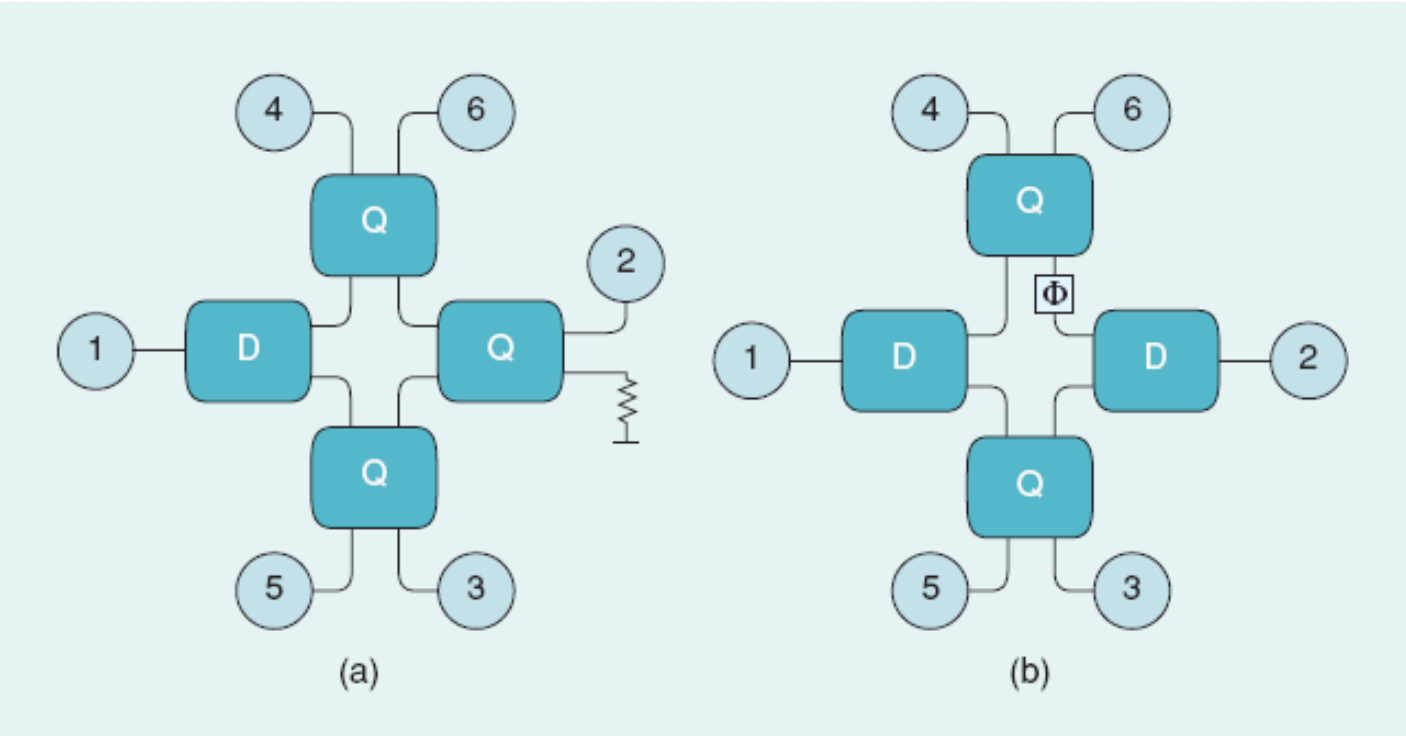
Outline

- Previous architectures of Six-port Modulator/Demodulator
- New architecture of Six-port Modulator/Demodulator
- Simulated test bench
  - Monocycle pulse generator
  - Six-port Modulator/Demodulator
  - QPSK data generator
  - Power detectors
  - Detection
- System Parameters
- Results
- Conclusion

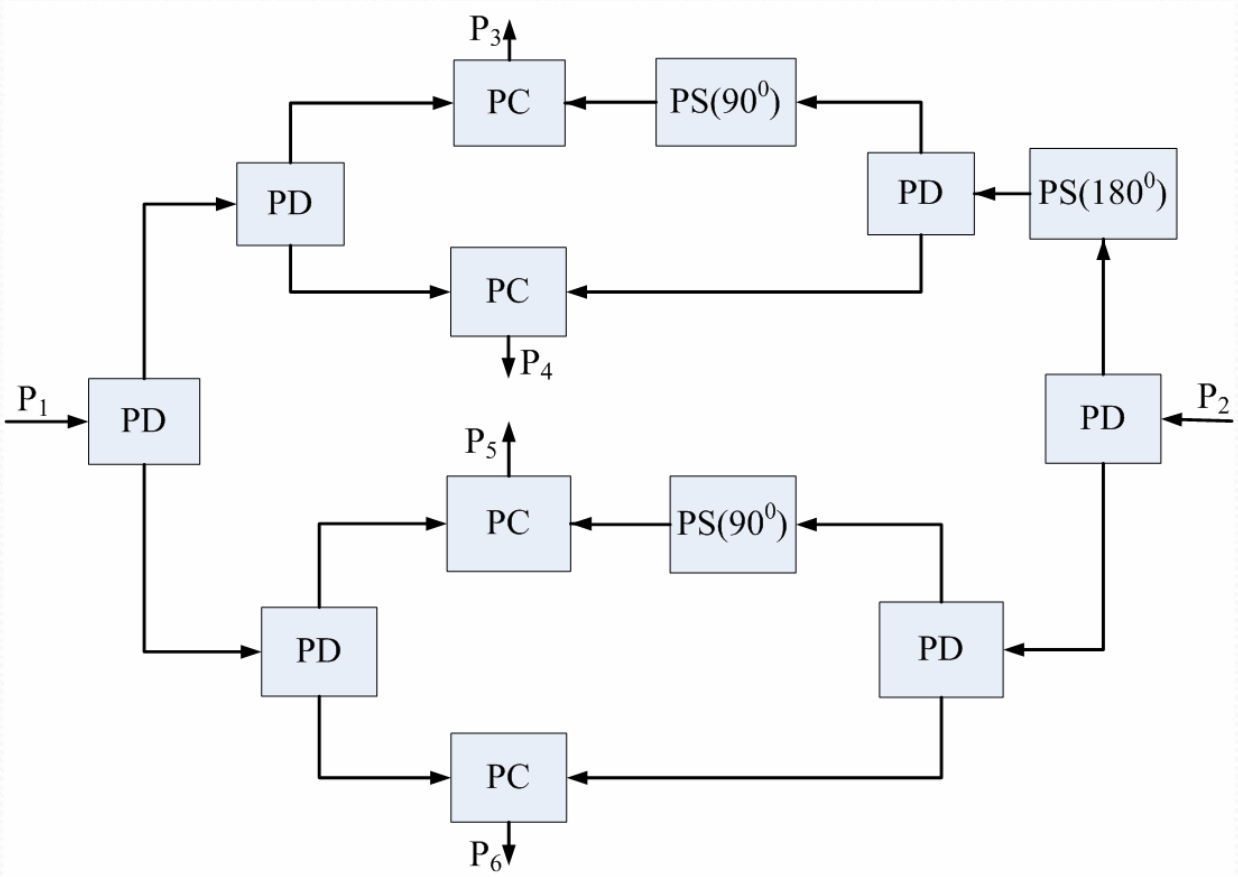
Previous Six-port Modulator/Demodulator Architectures

- Modulator/Demodulator architectures based on Power Dividers(D), Hybrid Couplers(Q) and a Phase Shifter( )



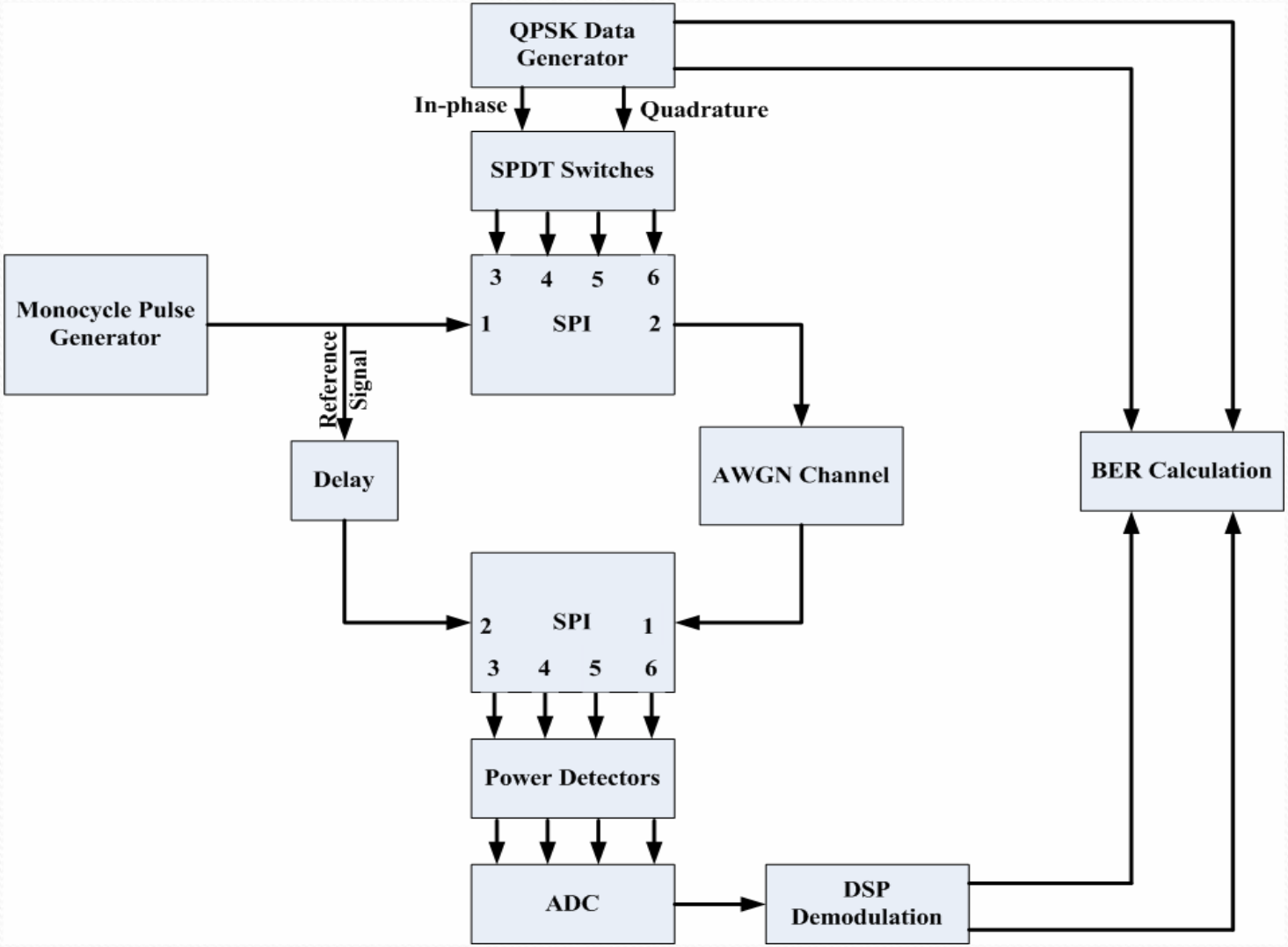
New Modulator/Demodulator Architecture

- New modulator/demodulator architecture based on Power Dividers(PD), Power Combiners(PC) and Phase Shifters(PS)



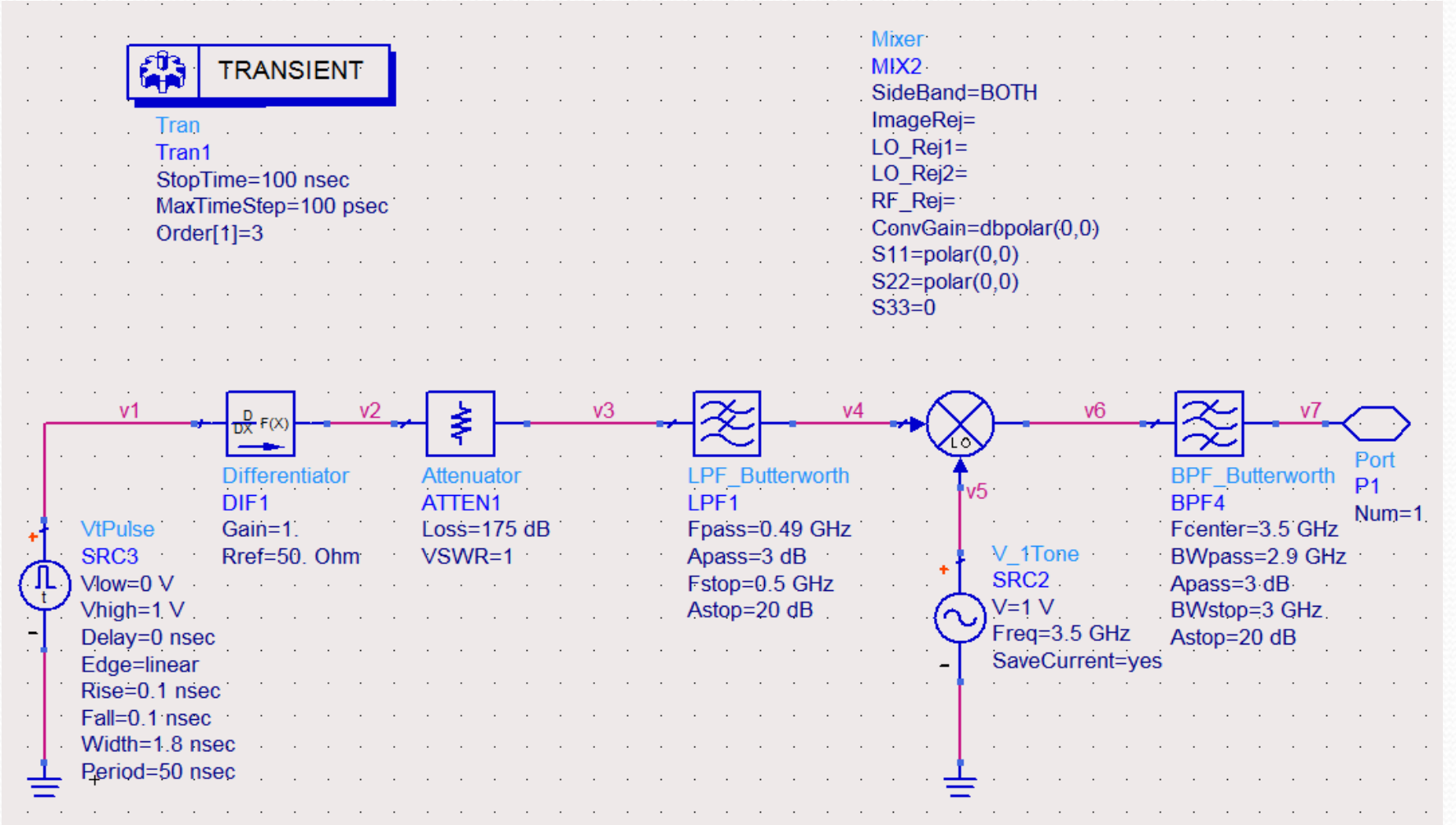
Test Bench of UWB Wave Radio System

- Simulation with ADS



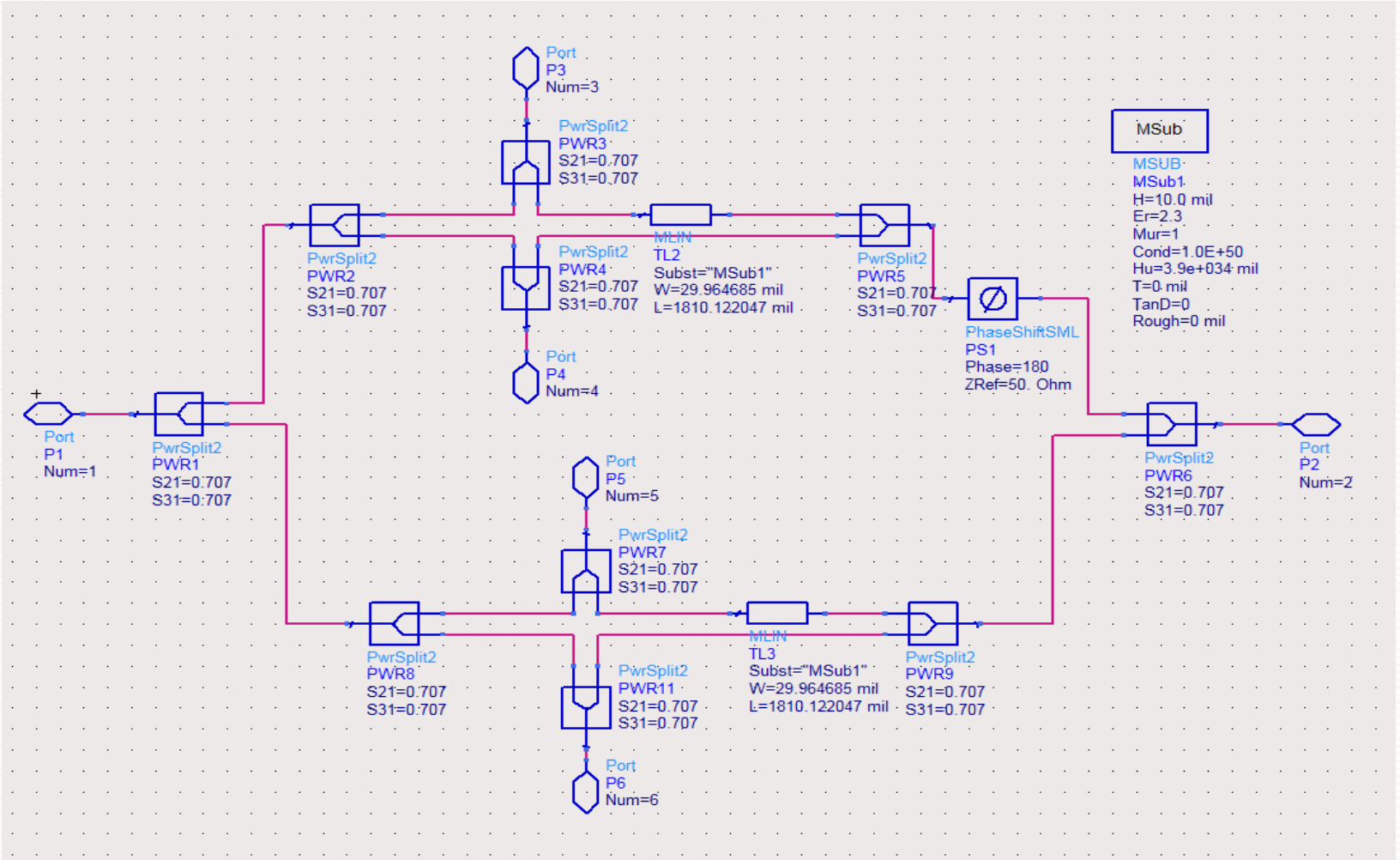
Monocycle Pulse Generator

- Following UWB standard (BW_{min}=500MHz)



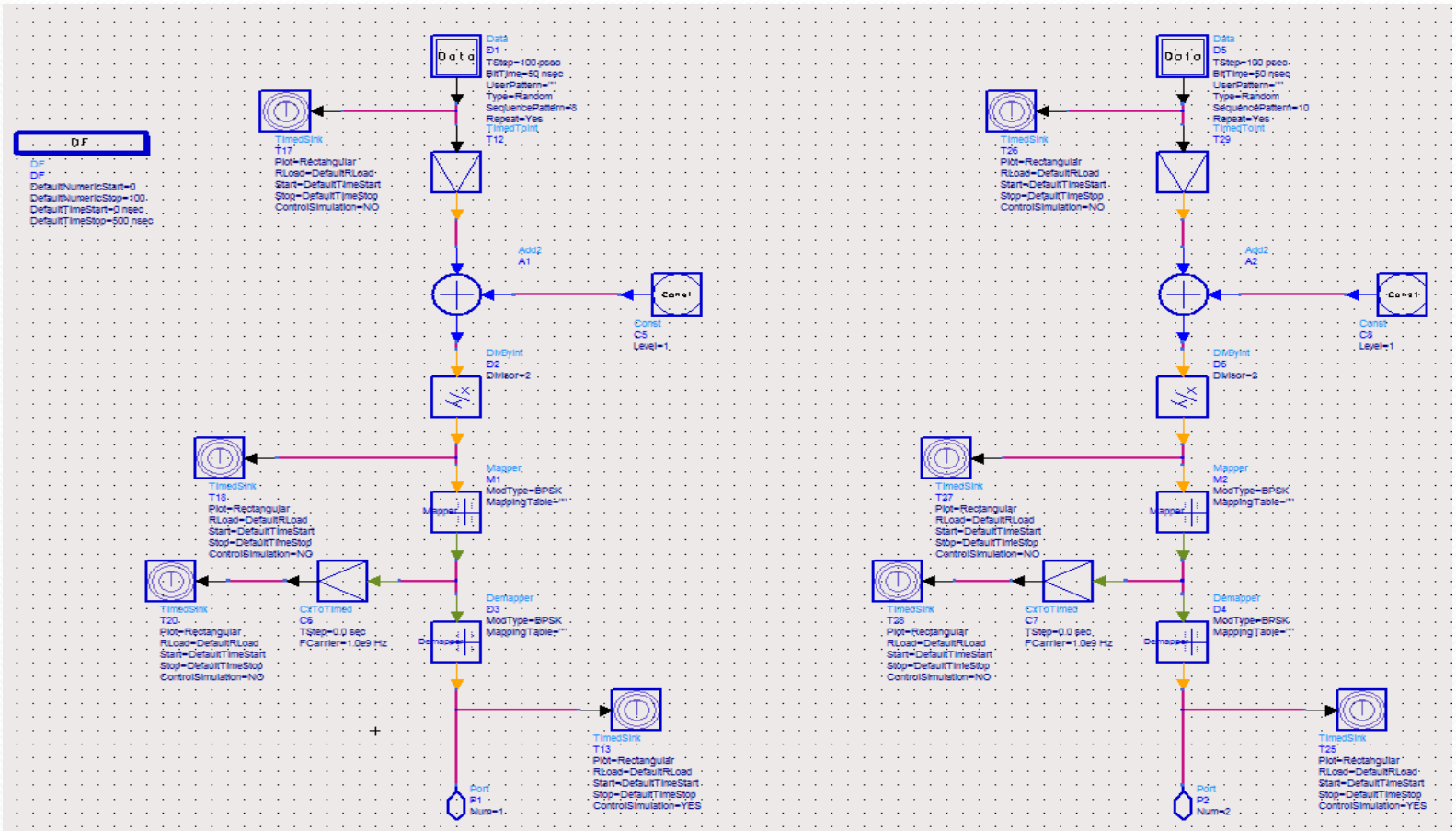
Six-port Modulator/Demodulator

- Composed of: PD, PC, TL(Tx lines) and PS



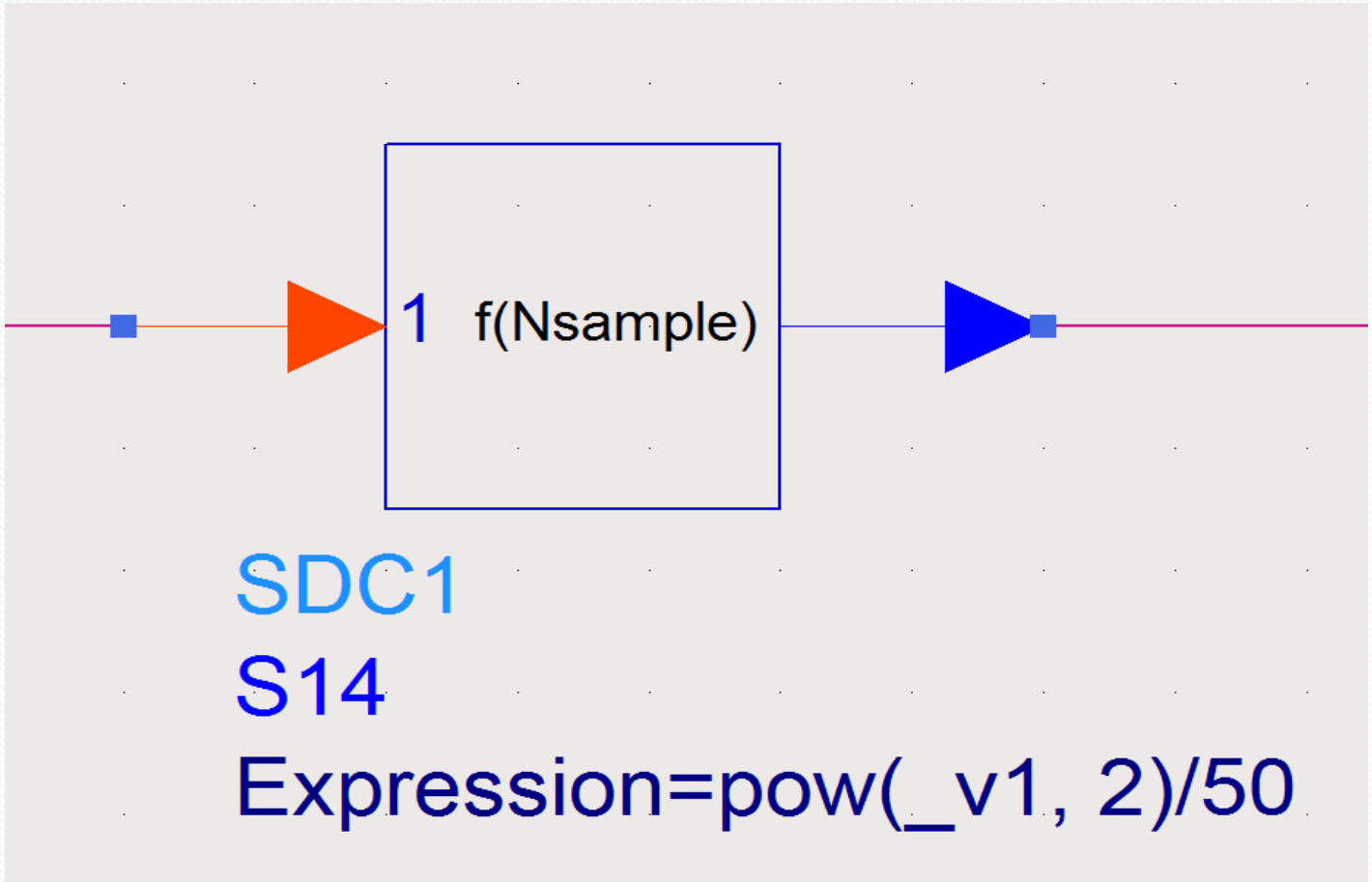
QPSK Data Generator

- Generates 2 independent data streams: In-phase and Quadrature



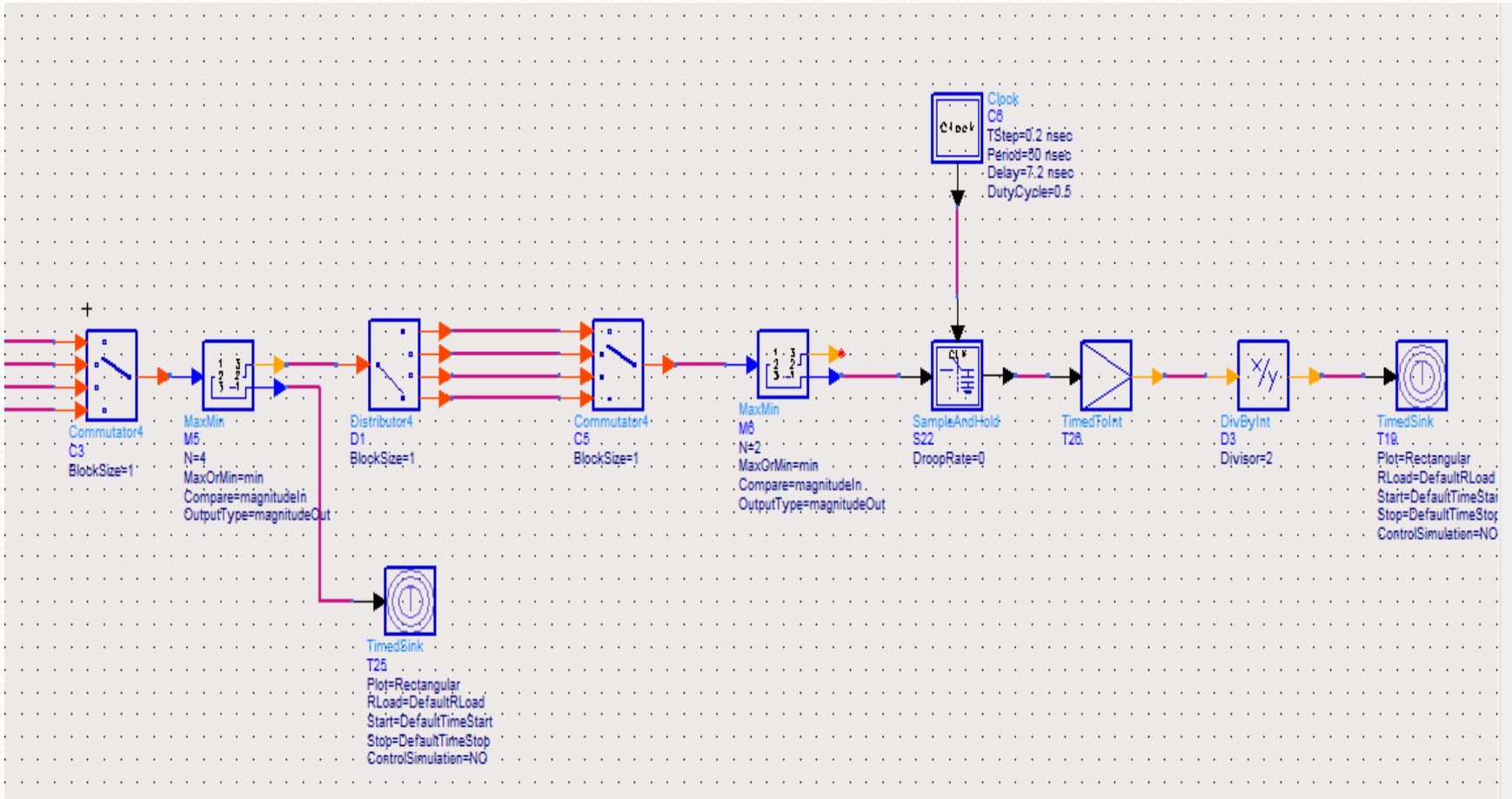
Power Detectors

- Mathematical expression that reflects the RF power detector operation



Detection

- De-mapping from power levels to modulation states

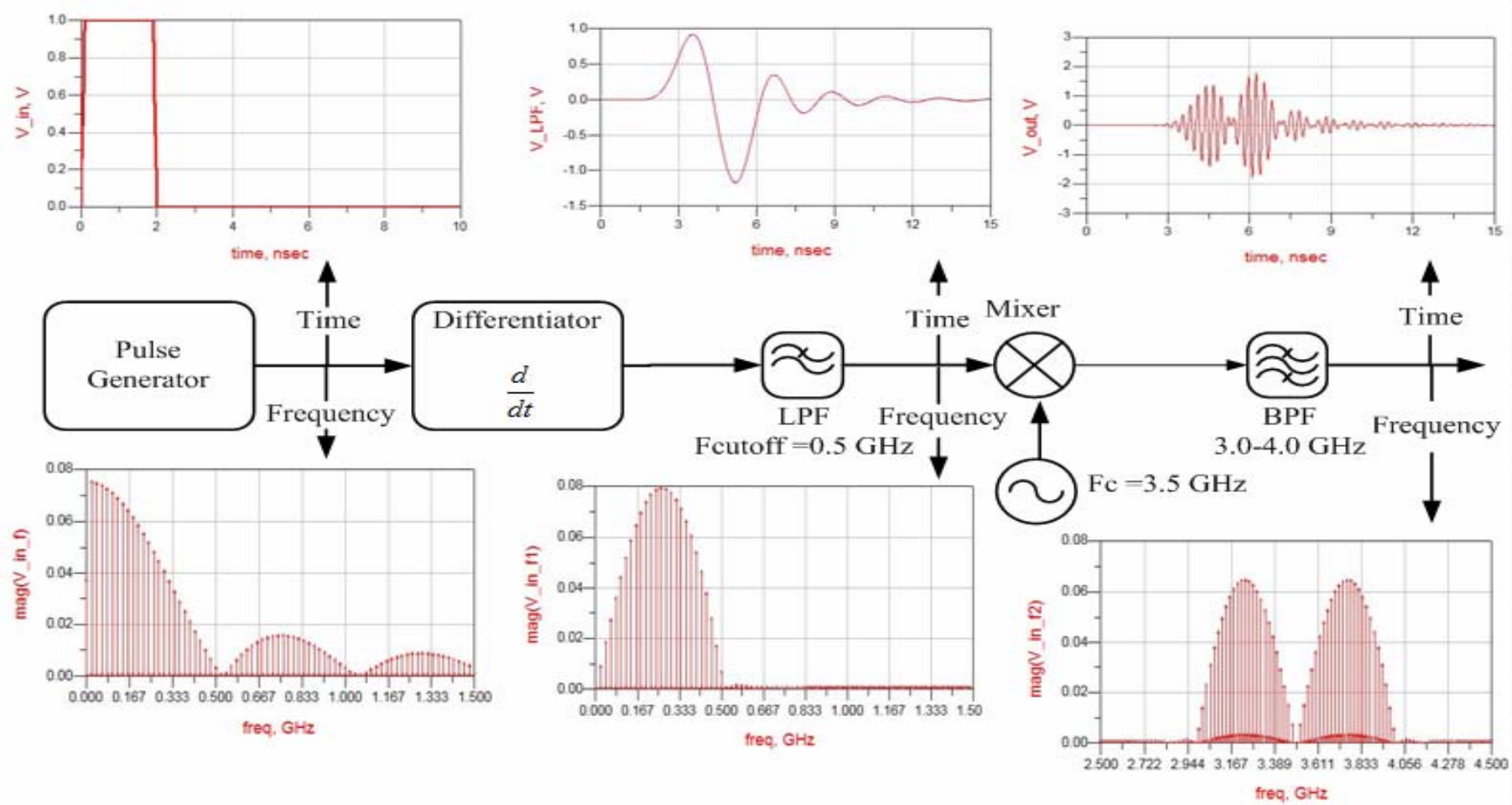


System Parameters

Parameter	Value
Generator Pulse Shape	Gaussian Monocycle
Bandwidth	1 GHz (3.0-4.0 GHz)
Carrier Frequency (f_c)	3.5 GHz
Data rate	20Mbps
Modulation Type	QPSK
Channel Model	AWGN

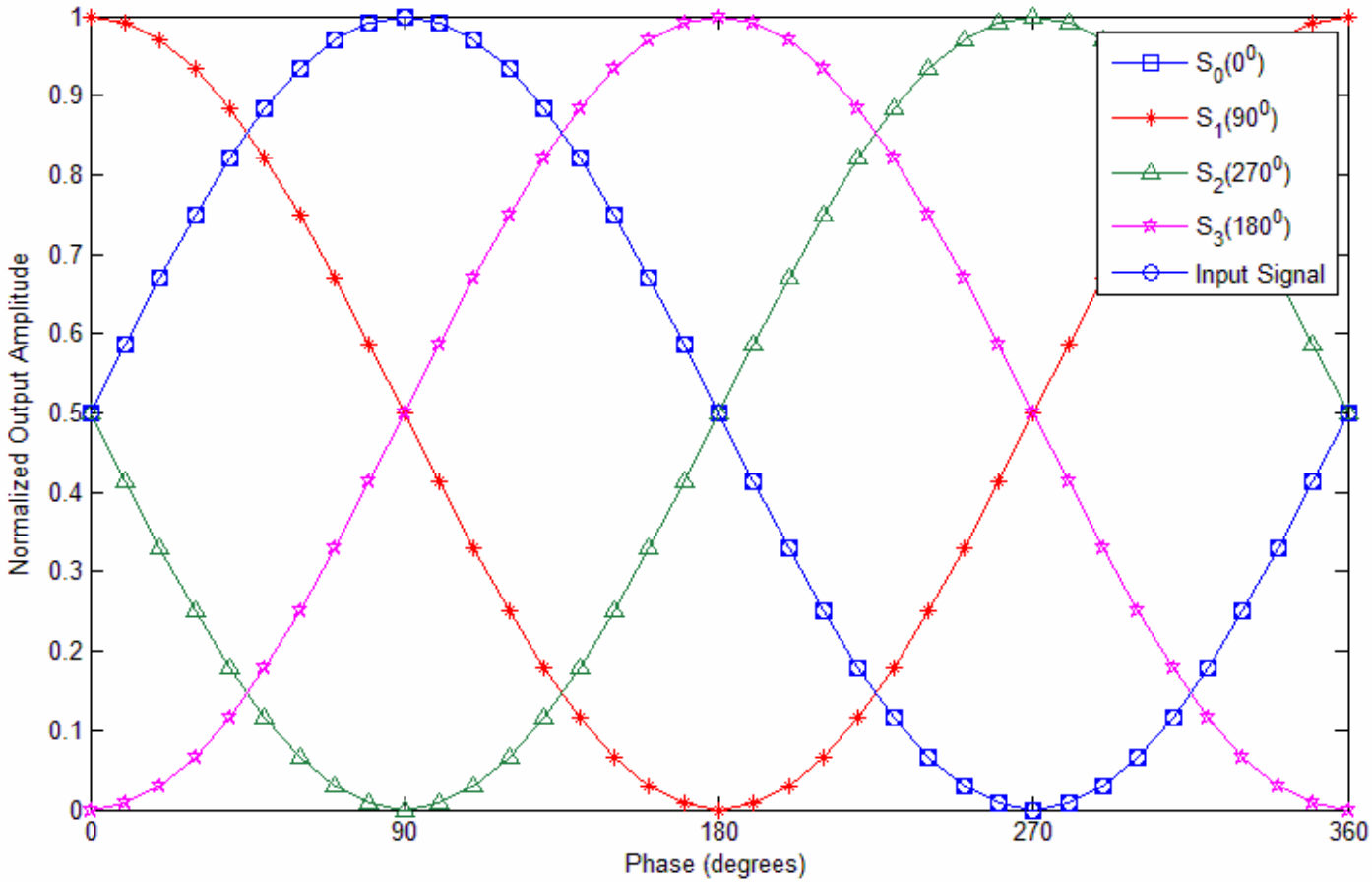
Results

- Monocycle Pulse Generator



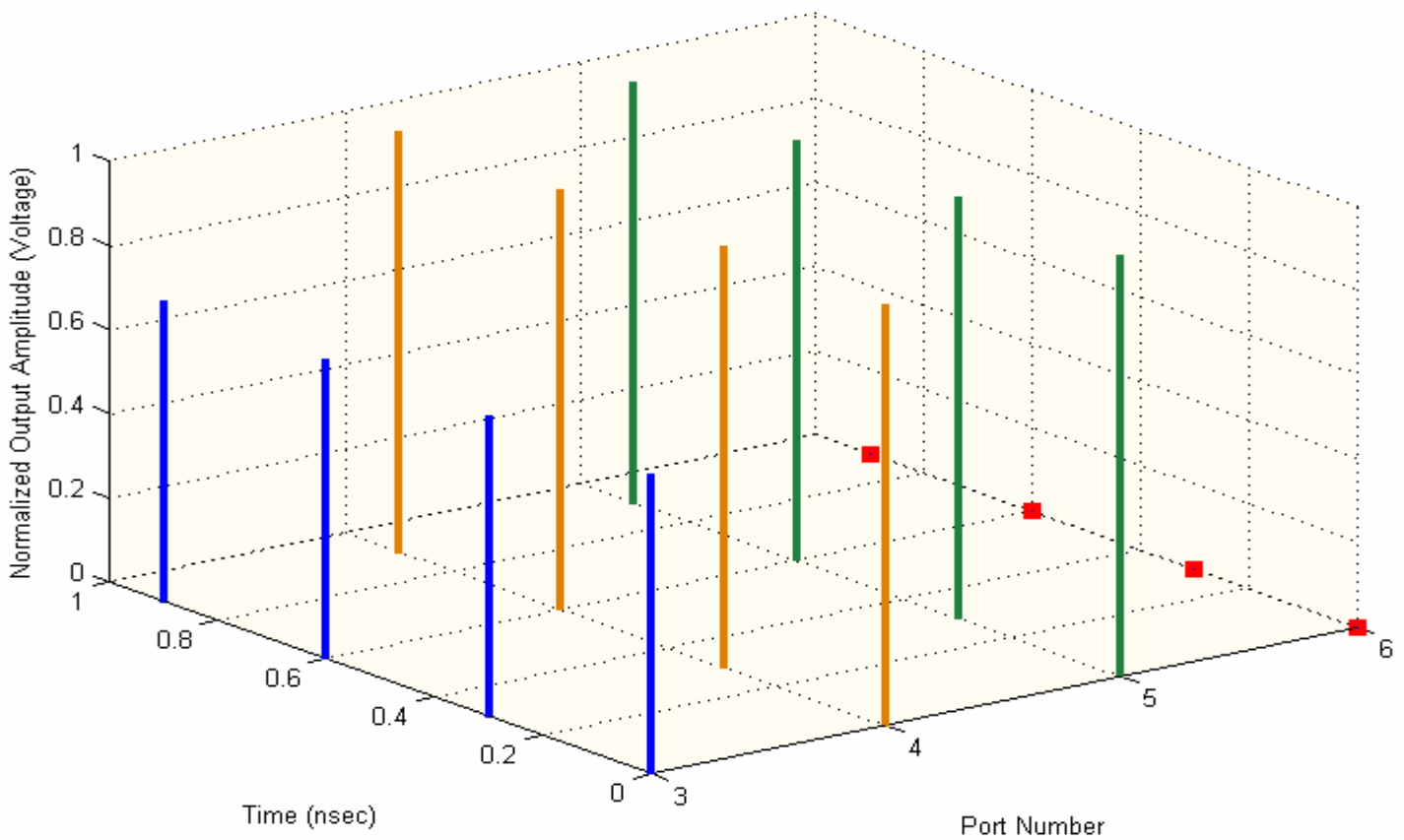
Results(Cont'd)

- Modulator output for a single tone input for different modulation states



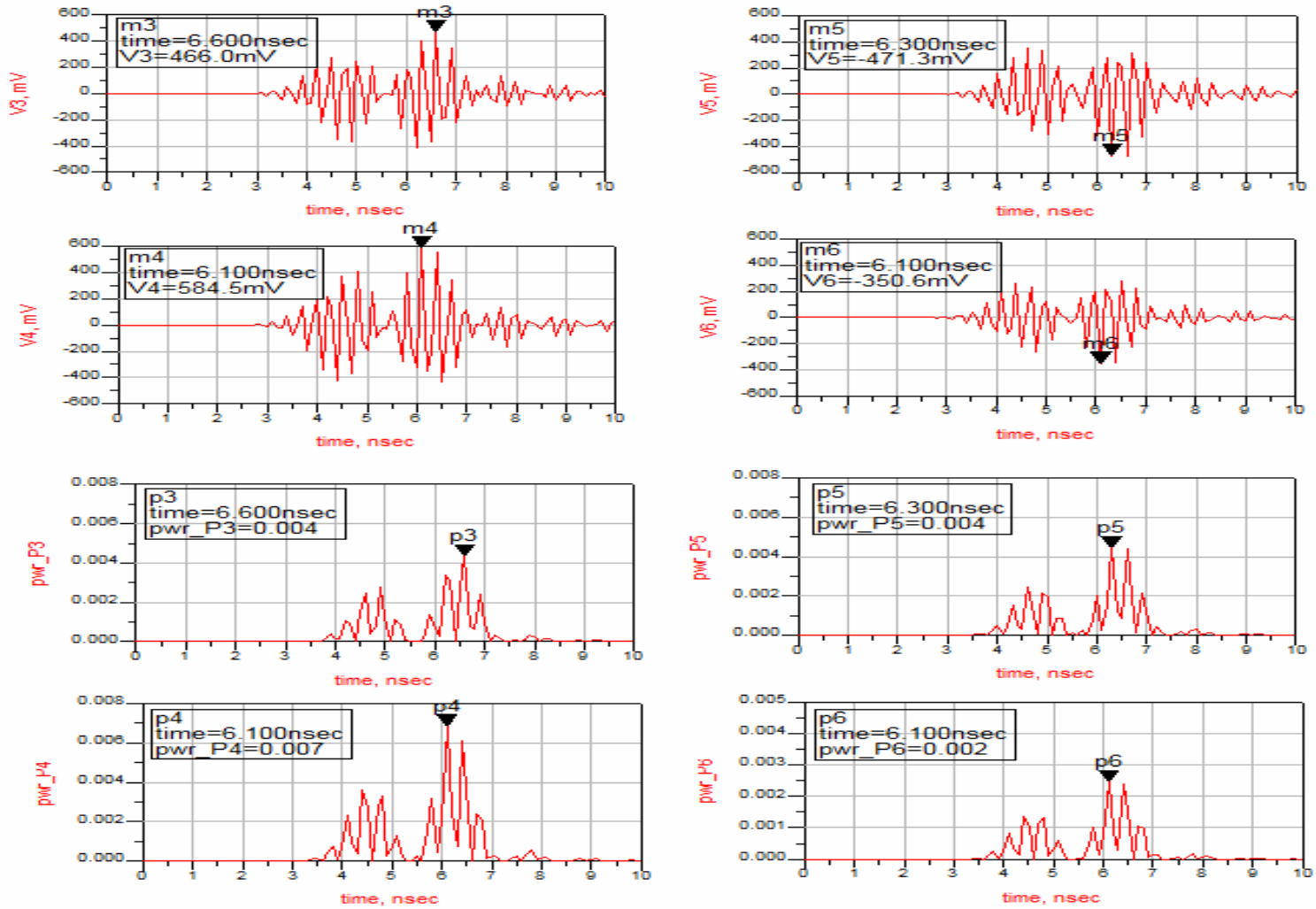
Results(Cont'd)

- Demodulator output for a specific modulation state with a single tone input



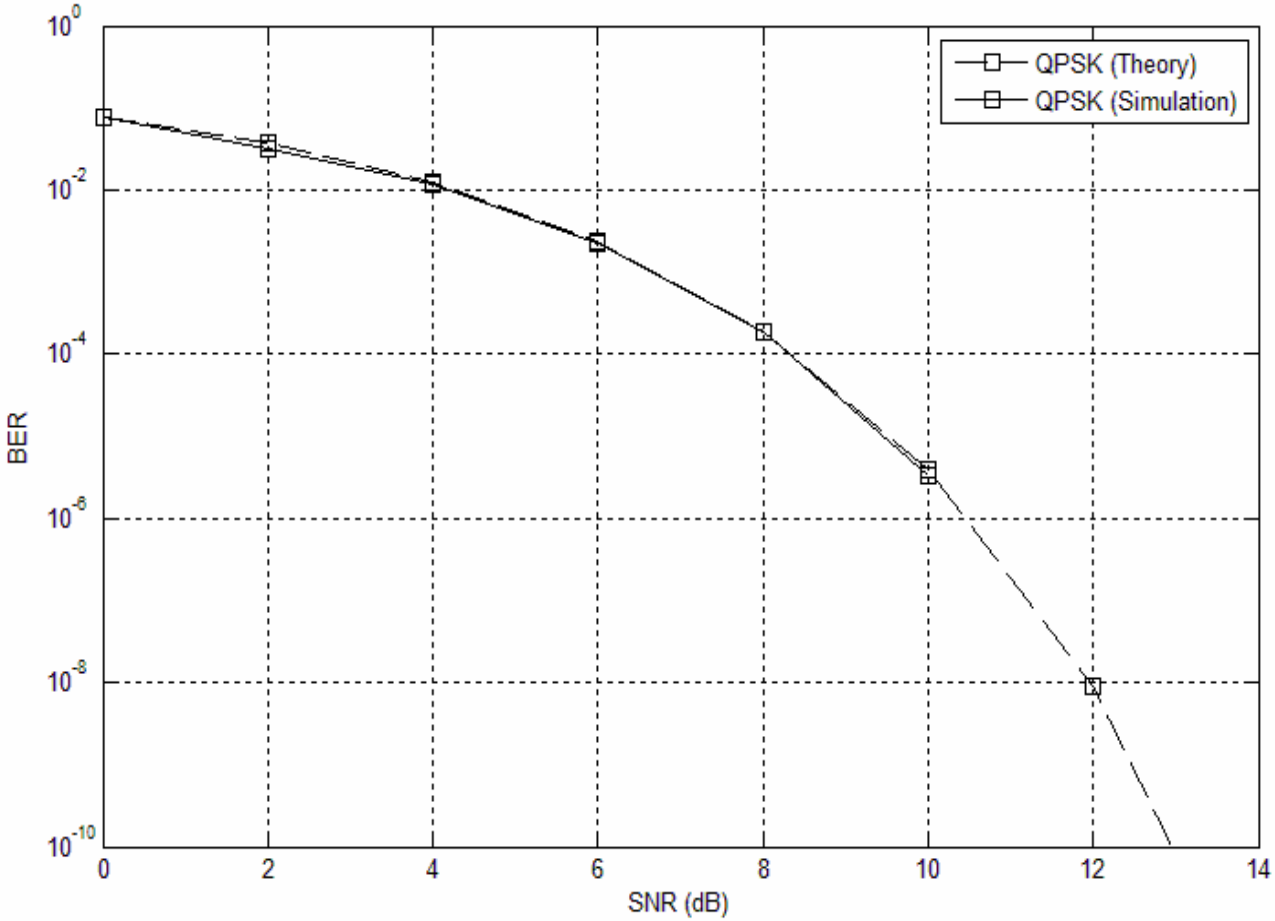
Results(Cont'd)

- Power detection of UWB wave radio system for a specific modulation state



Results(Cont'd)

- BER for Six-port UWB demodulator



Results(Cont'd)

- Six-port modulation states table

Modulation State	Port 3	Port4	Port 5	Port 6	Δ□	I	Q
0	O	O	O	S	0^0	0	0
1	O	O	S	O	90^0	0	1
2	O	S	O	O	180^0	1	0
3	S	O	O	O	270^0	1	1

Conclusion

- New Six-port UWB modulator/demodulator architecture was tested and verified using ADS simulations.

- The results show that Six-port modulator/demodulator works properly irrespective of the input UWB signal type.

- A new modulation table has been constructed for the new Six-port modulator/demodulator architecture.

- When used as a demodulator, the Six-port has proven comparable BER results to any other receiver.

Questions

References

[1] Ji Li, R. G. Bosisio, and Ke Wu, "Computer and Measurement Simulation of a New Digital Receiver," *IEEE Trans. On Microwave Theory and Techniques, vol. 43, no. 12, pp. 2766* - 2772, 1995.

[2] R.G. Bosisio, Y.Y. Zhao, X.Y. Xu, S. Abielmona, E. Moldovan, Y.S Xu, M. Bozzi, S.O.Tatu , J.F.Frigon, C. Caloz, and K. Wu., "New Wave Radio,'' *IEEE Microwave Magazine, pp 91-100, Feb. 2008.*

[3] R. Bosisio, Y. Zhao, X. Xu, S. Abielmona, E. Moldovan, Y. Xu, M. Bozzi, S. Tatu, C. Nerguizian, J. Frigon, C. Caloz, K. Wu, "New-Wave Radio," *IEEE Microwave Magazine, vol.* 9, pp. 89 - 100, Feb. 2008.

[4] X. Xu, S. O. Tatu, E. Moldovan, R. G. Bosisio, and Ke Wu, "Analysis of FDSS Ultra-Wideband Six-port Receiver," in *Proc. Of IEEE RAWCON Conf., pp. 87 - 90, Boston, 2002.*

[5] Y. Zhao, C. Viereck, J. F. Frigon, R. G. Bosisio, and K. Wu, "Direct Quadrature Phase Shift Keying Modulator using Six-port Technology," *Electronics Letters, vol. 41, no. 21, pp. 1180* - 1181, 2005.

[6] Y.Y. Zhao, J.F. Frigon, K. Wu, and R.G. Bosisio, "Multi Six-port Impulse Radio for Ultra-Wideband," *IEEE Trans. Microwave Theory Tech., vol. 54, no. 4, pp. 1707 – 1712, Apr.* 2006.