

Contents

Acknowledgements	iii
Abstract	iv
Contents	v
1 Introduction	1
1.1 Genetic Circuits and Single-Cell Dynamics	1
1.2 Phosphorelay: Circuit Structure and Signaling Architecture	2
1.3 Thesis Overview	6
2 Dynamical Implications of Phosphorelay Circuit Structure	10
2.1 Transcriptional Bandpasses	10
2.2 Post-Translational Bandpass	14
2.3 Delayed Phase Shift	17
2.4 Alternate Cellular State	22
2.5 Interplay between Periodic Input and Circuit Dynamics	26
3 Functional Potential of the Core Phosphorelay Architecture	28
3.1 Independent Tuning of Bandpass Thresholds	28
3.2 Linear Amplifier-like Responses	37
3.2.1 Two-Component System	40
3.2.2 Phosphorelay	42
3.3 Analogies to Electrical Circuits	49
4 Conclusion	51
4.1 Summary of Contributions	51

4.2	Future Work	52
4.2.1	Systematic perturbation of bandpass responses in sporulation progression	52
4.2.2	Role of temporally ordered gene expression in formation of the asymmetric septum	53
4.2.3	Power consumption in two-component signaling architectures	54
A	Materials and Methods	55
B	Movie Protocols	60
C	Analysis of Models	64
	Bibliography	73