

Thesis Title: Cost Effective Multi-role Active EMI Filters for Switched Mode Converters

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Abstract:

Switched mode power converters are a major source of conducted electromagnetic interference (EMI). The popular technique for mitigation of conducted EMI uses EMI filters. EMI filters may be classified in two types based on the components used: Passive EMI filters and Active EMI filters. Active EMI filters use active components like transistors and opamps for mitigation of conducted EMI. Active EMI filters are a promising alternative to the traditional passive LC filter. The compact active circuit can replace bulky inductors and large capacitors. However, active EMI filters are yet to find wide-scale appeal due to issues pertaining to circuit complexity, component count, cost and reliability.

In this thesis the aforementioned active EMI filter issues have been addressed by following a unique design approach. We identified circuits in a switched mode power converter that could play the role of an active EMI filter. We added active EMI filtering functionality to certain start-up, power management, fault protection and sensing circuits by reutilizing their existing circuit components. The challenge lay in ensuring that the original functionality of the circuit is not compromised while it plays the role of an active filter. The merging of two or more functions in a single circuit helped reduce cost, component count, circuit complexity and board space and is the underlying theme of this thesis. This approach led to four new multi role active

EMI filter designs that are proposed in this thesis:

1. Feedback type, series active DM filter as part of an input inrush current limiting circuit, power distribution switch circuit and/or soft latching power switch circuit.
2. Feedforward type, input, shunt active DM filter as part of a high side current sense circuit.
3. Feedback type, output, shunt active DM filter as part of an output under-voltage protection circuit.
4. Feedback type, utility side, shunt DM or CM filter as part of a power line communication module's analog front-end.

We claim that our multi role active filters are commercially viable because of the reduction in cost, component count and board space with improvements in reliability and efficiency when compared to equivalent stand alone active filters.