



NPTEL ONLINE CERTIFICATION COURSES

DIGITAL CONTROL IN SMPCs AND FPGA-BASED PROTOTYPING

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Module 01: Introduction to Digital Control in SMPCs

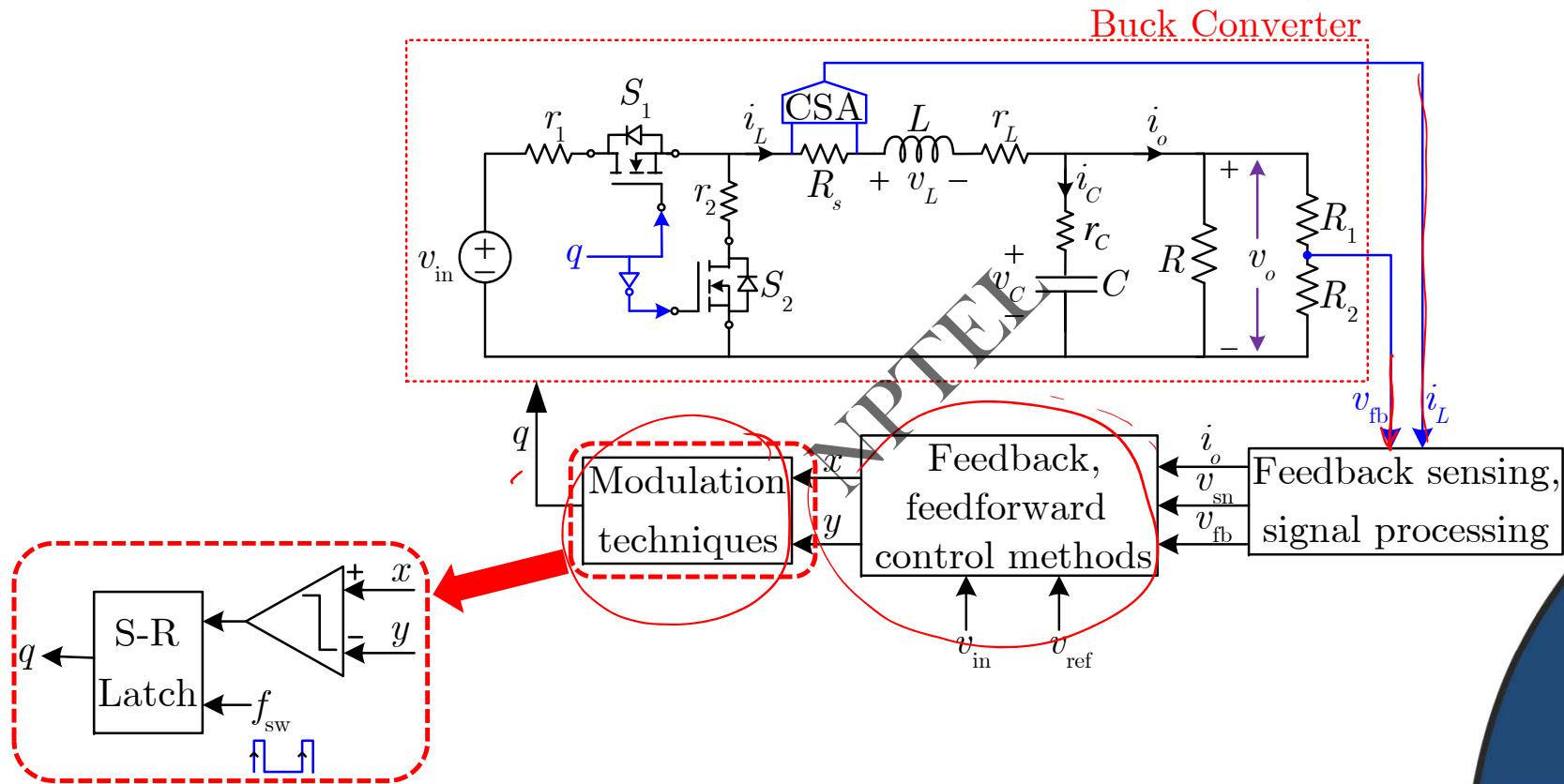
Lecture 05: Introducing Basic Digitization in Power Electronic Converters



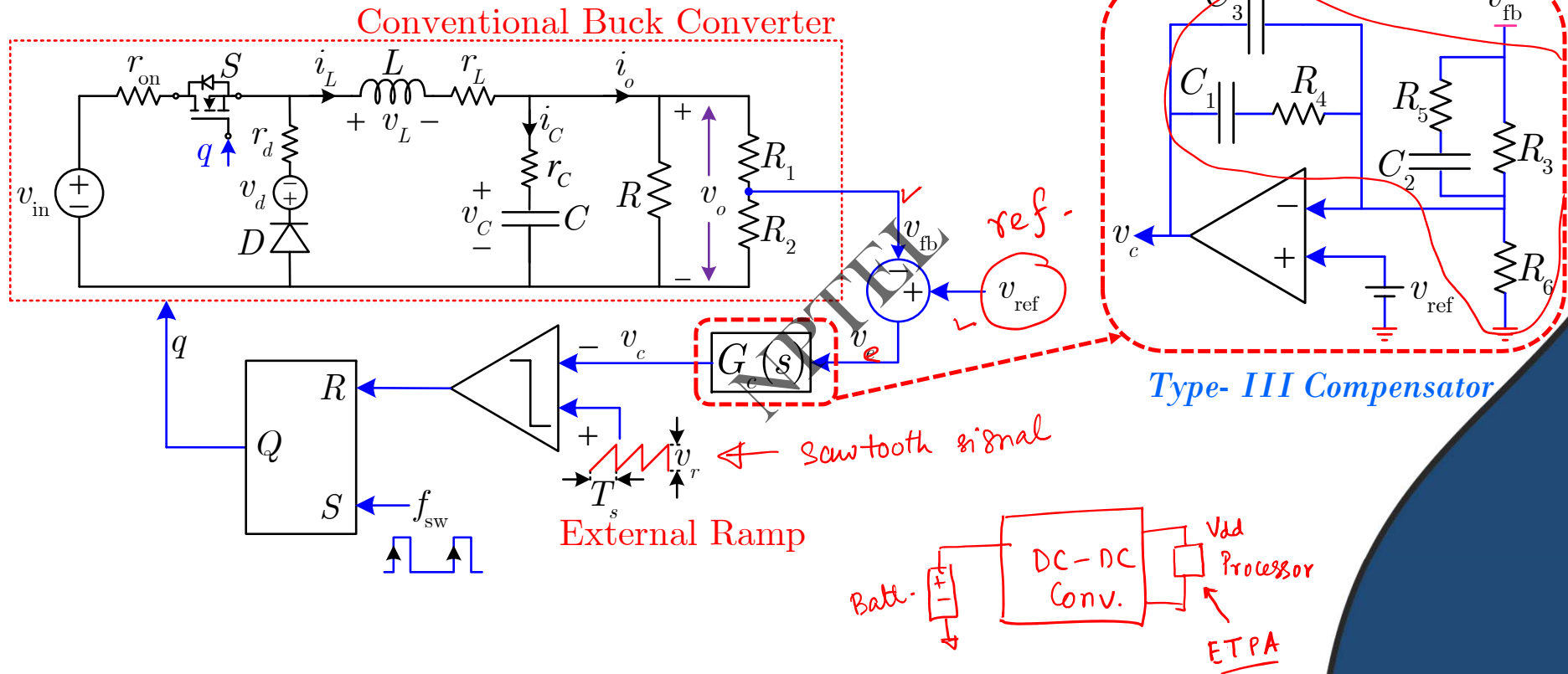
CONCEPTS COVERED

- Basics of feedback and feedforward control
- Few basic requirements with PMBus
- Basic level of digitization using housekeeping
- Possibility of further digitization

Control of DC-DC Converters



Conventional Buck Converter



Basic Digitization Process : Buck Converter VMC

■ Requirements

1. v_{ref} programming ↗
2. Adaptive Constant-ON time
3. PMBusTM ↗

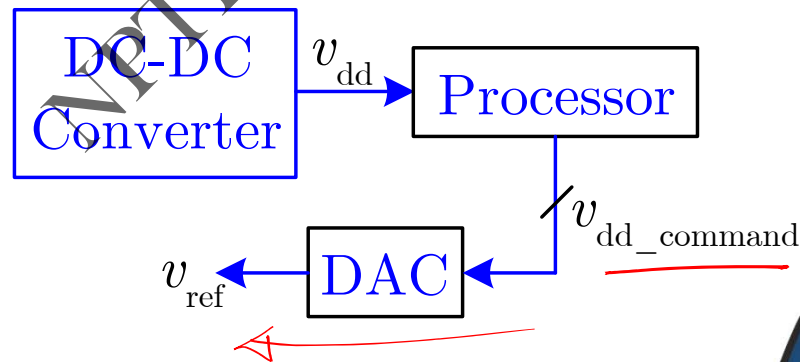
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Digitization Process of Buck Converter VMC : Implementation

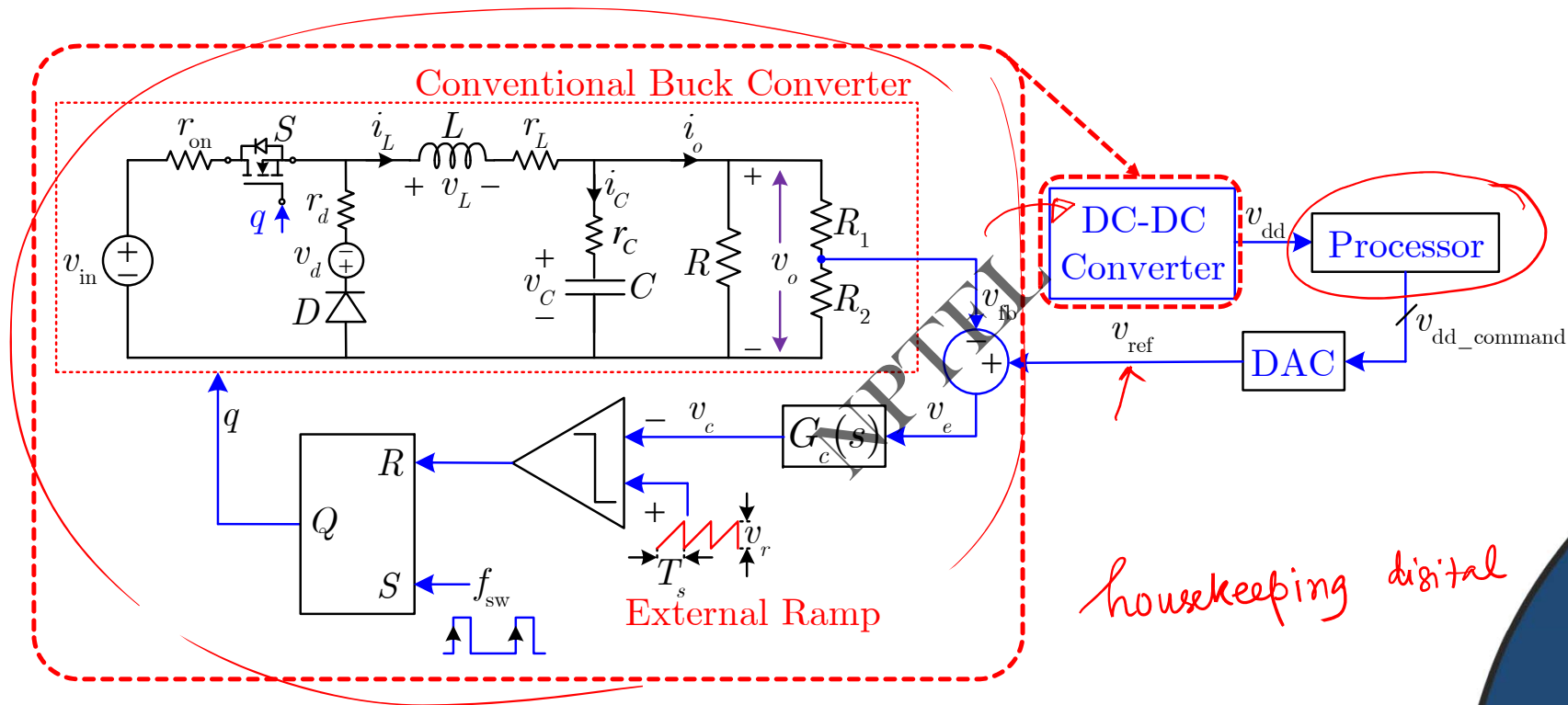
1. v_{ref} programming

- Dynamic adjustment of v_{ref} (maybe needed for DVS)

- How to do that?
- Who provides v_{ref} command?



Digitization Process of Buck Converter VMC : Implementation



Digitization Process of Buck Converter VMC : Implementation

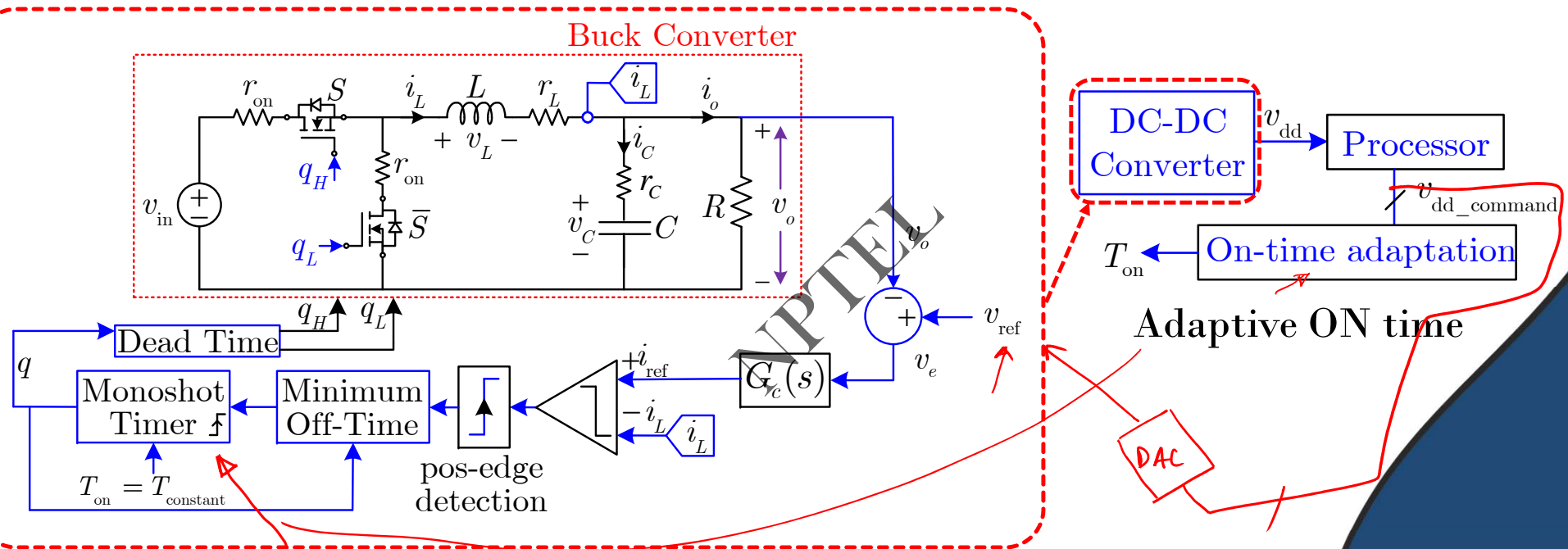
2. Adaptive Constant-ON time

- Improvement of light-load efficiency

$$\Delta i_L = \frac{T_{\text{on}}}{L} \times (V_{\text{in}} - V_o) \quad f_{\text{sw}} = \frac{1}{T_{\text{on}}} \times \frac{V_o}{V_{\text{in}}}$$

- Inductor ripple is dependent on V_{in}
- T_{on} can be changed adaptively to maintain the ripple within the given range

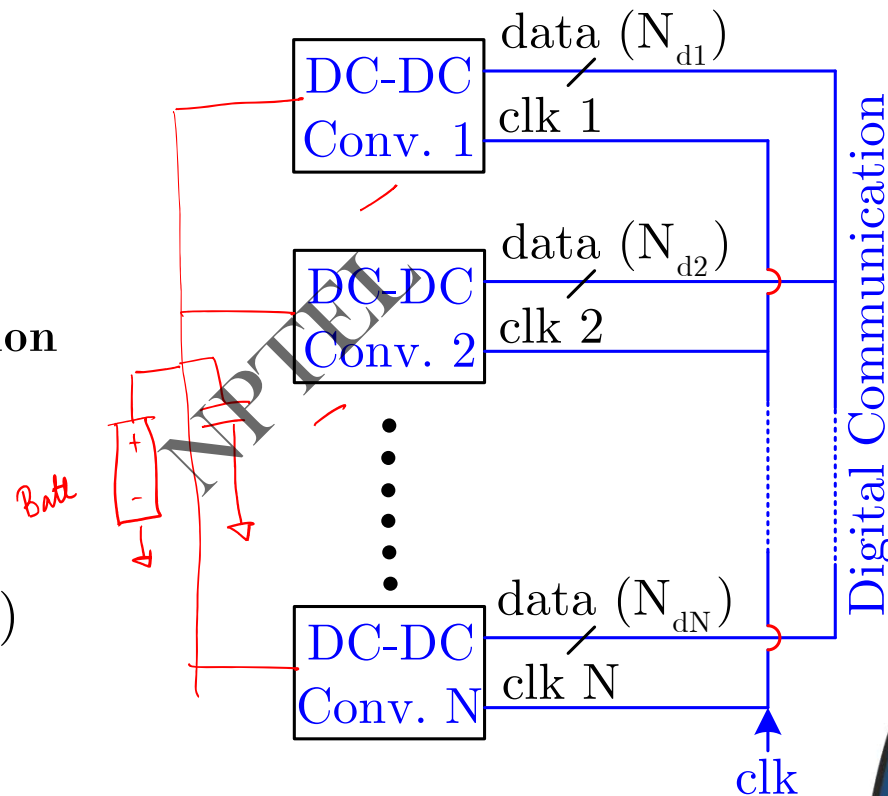
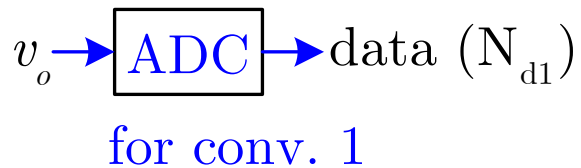
Digitization Process of Buck Converter VMC : Implementation



Digitization Process of Buck Converter VMC : Implementation

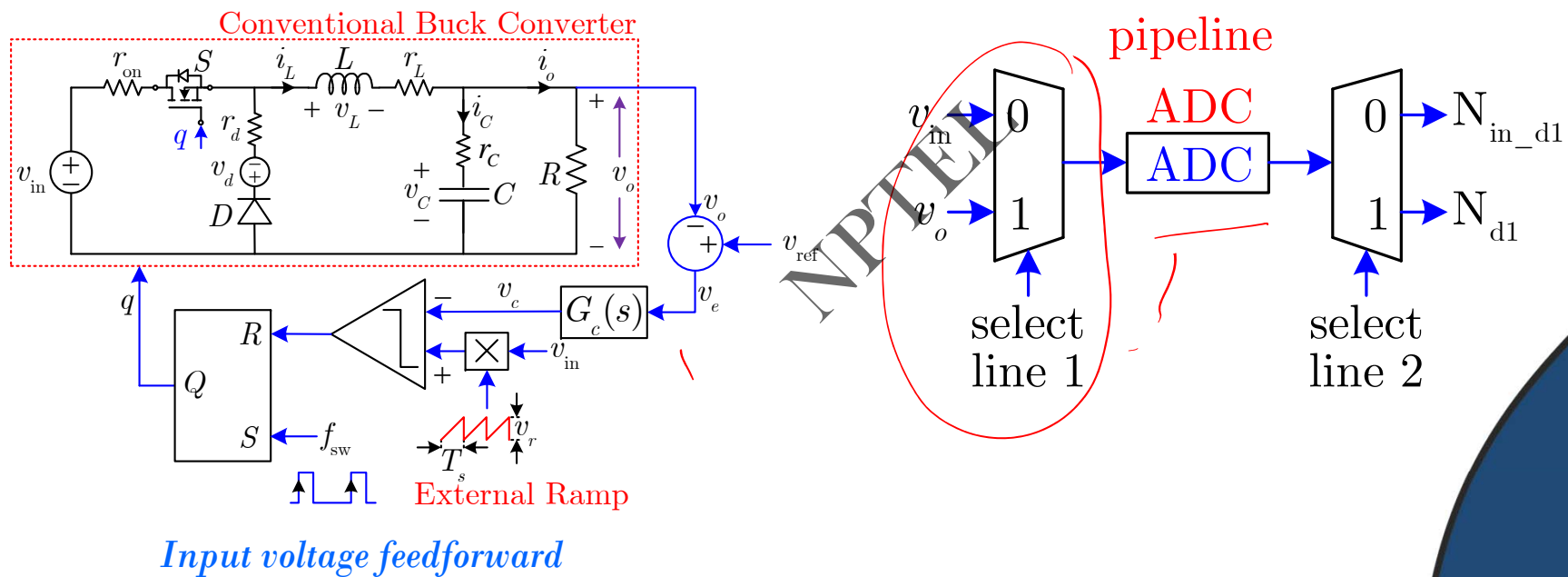
3. PMBus™

- What data is stored?
 - Output voltage information
 - Other information

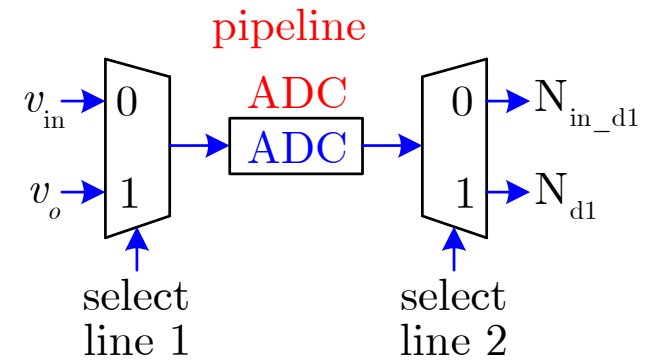
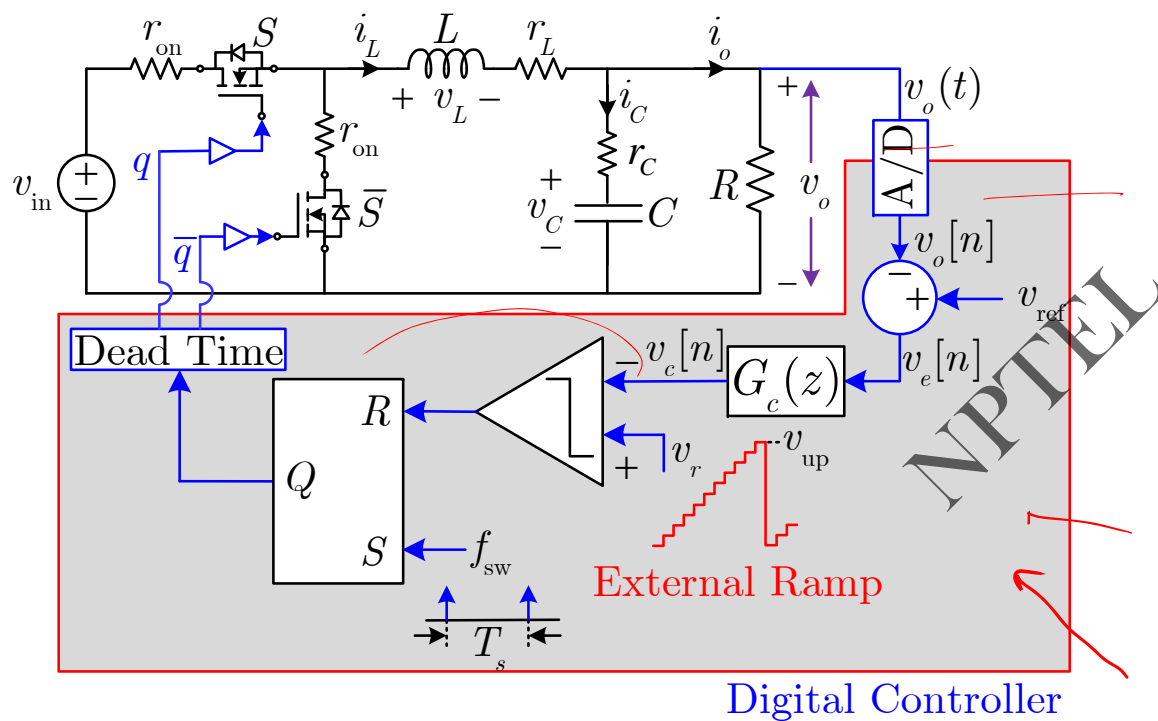


Digitization Process of Buck Converter VMC : Implementation

- Input voltage feedforward & PMBusTM

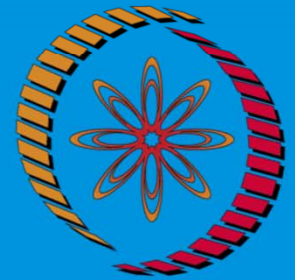


Why not Digitizing the Voltage Feedback Loop in VMC



CONCLUSION

- Basics of feedback and feedforward control
- Few basic requirements with PMBus
- Basic level of digitization using housekeeping
- Possibility of further digitization



**THANK
YOU !**