



NPTEL ONLINE CERTIFICATION COURSES

DIGITAL CONTROL IN SMPCs AND FPGA-BASED PROTOTYPING

Dr. Santanu Kapat

Electrical Engineering Department, IIT KHARAGPUR

Module 02: Fixed and Variable Frequency Digital Control Architectures

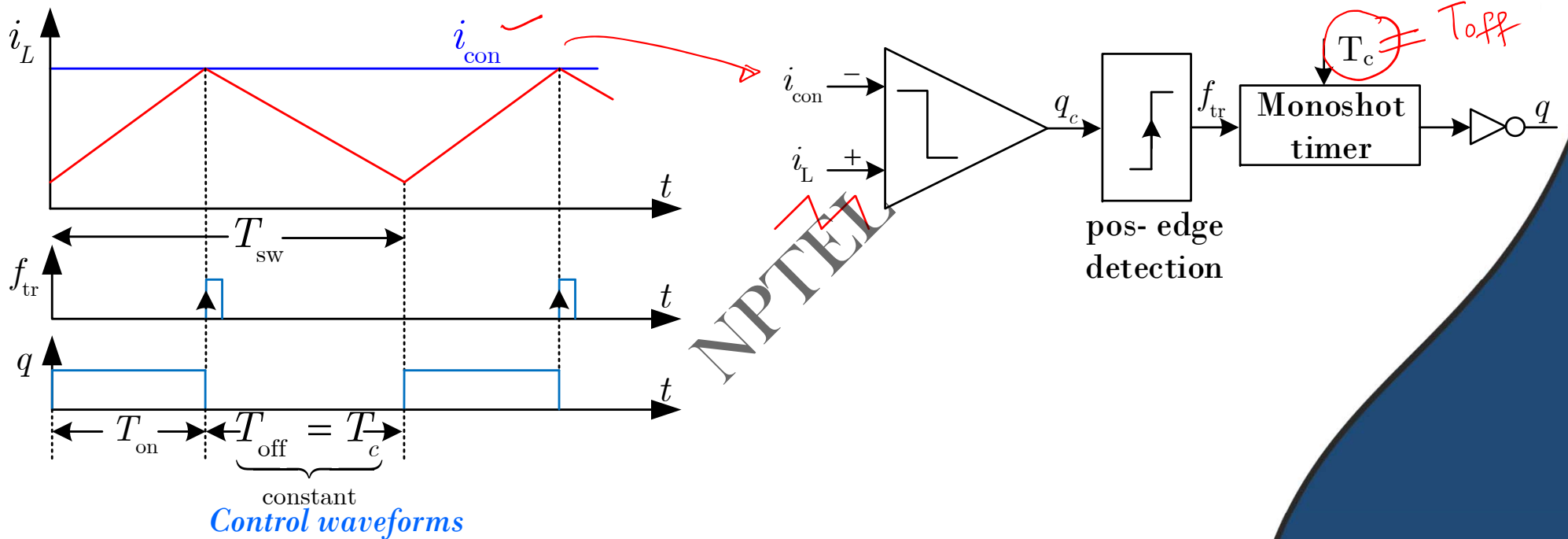
Lecture 16: Sampling Methods under Constant On/Off- Time Digital Modulation



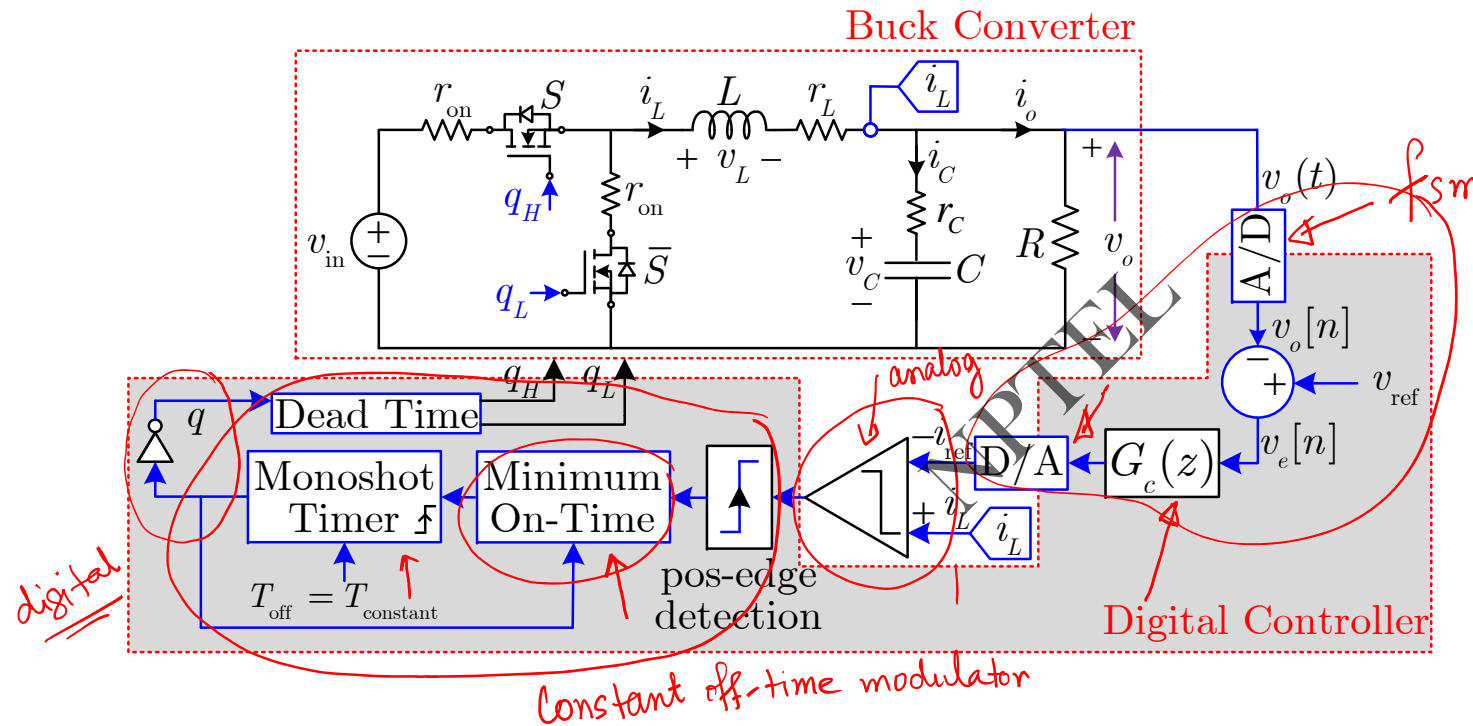
CONCEPTS COVERED

- Recap of analog constant off-time current mode control
- Mixed-signal constant off-time current mode control
- Difficulties using uniform sampling
- Mixed-signal constant on-time current mode control
- Event-based sampling in constant on/off-time control

Recap of Analog Constant Off-time Peak Current Mode Control

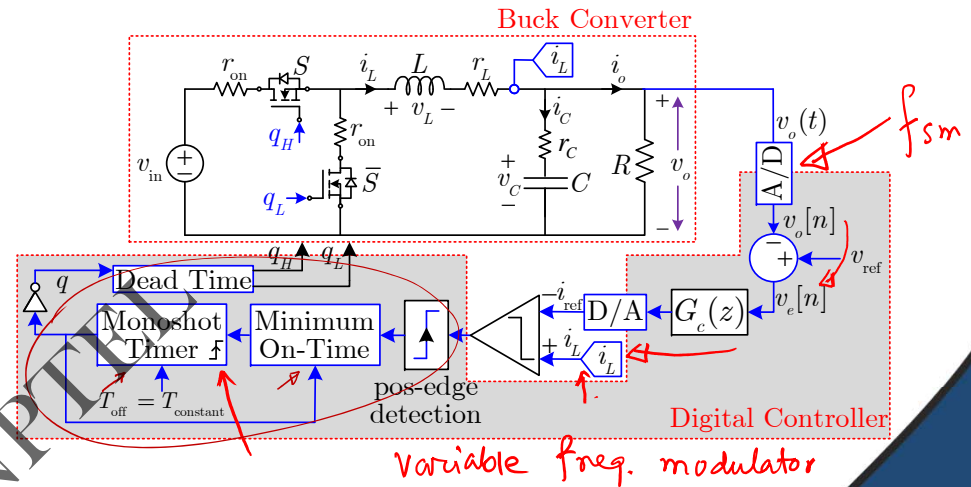
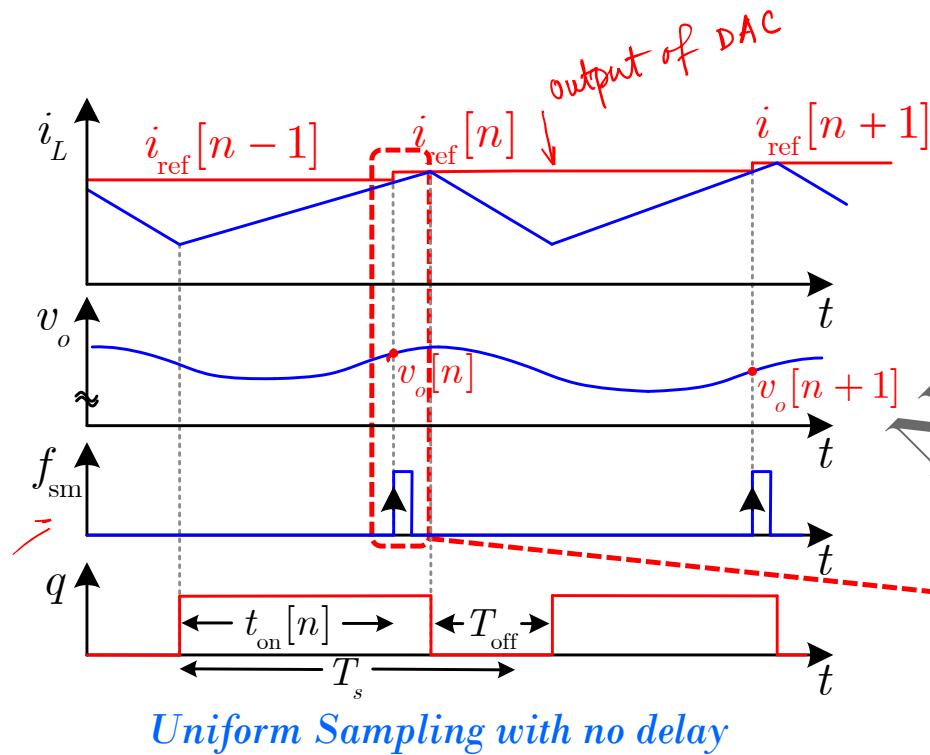


Mixed-Signal Constant Off-time Peak Current Mode Control

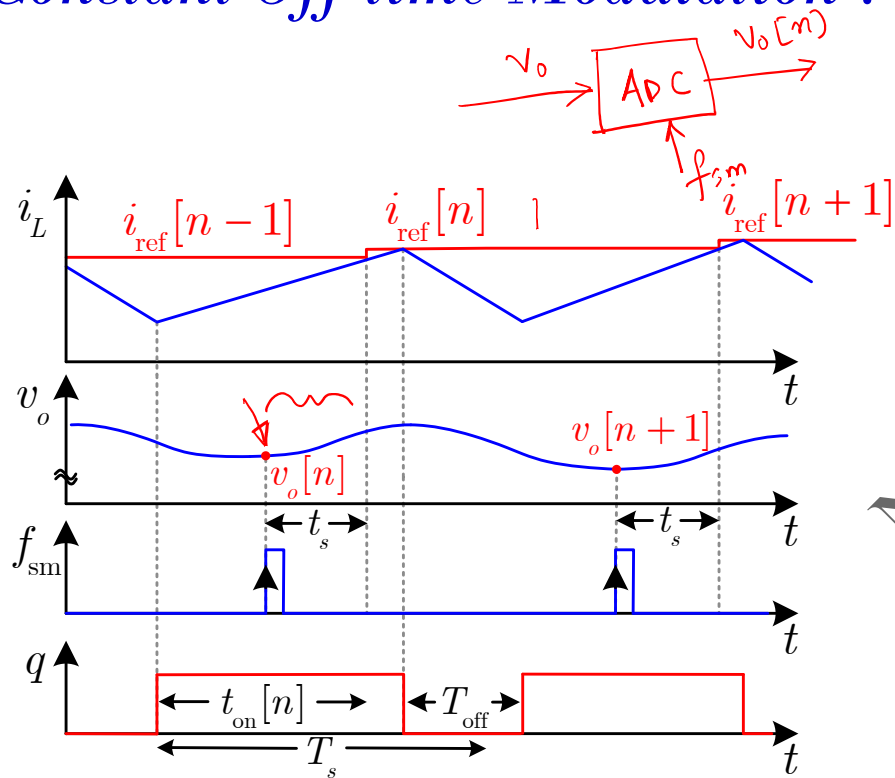


K. Hariharan, et. al. " Constant On/Off-Time Hybrid Modulation in Digital ...", *IEEE Trans. Power Electron.*, vol. 34 (4) April 2019

Constant Off-time Modulation : Uniform Sampling



Constant Off-time Modulation : Uniform Sampling (contd...)



Uniform Sampling with t_s delay

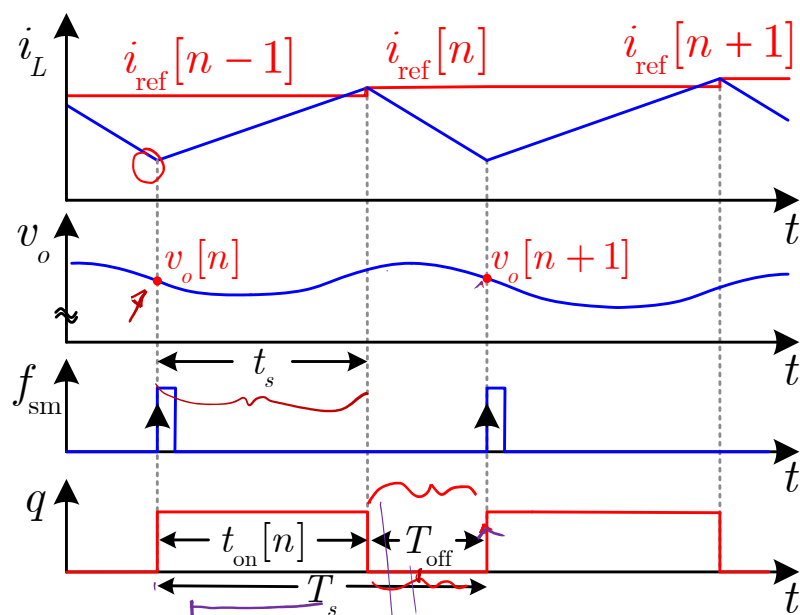
Problems of using uniform sampling

mismatch between sampling points and switching points

asynchronous

multiple limit cycle oscillation

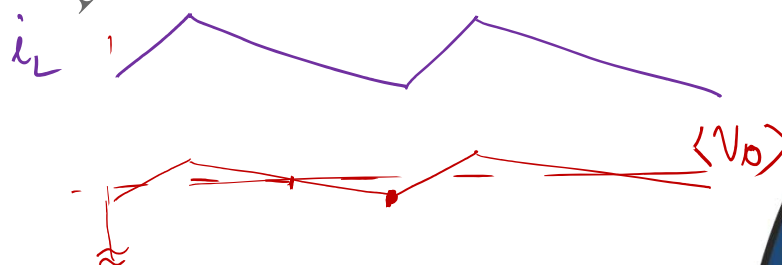
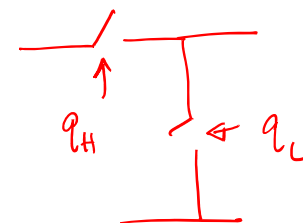
Constant Off-time Modulation : Event based Sampling



Interval 2 sampling : t_s delay

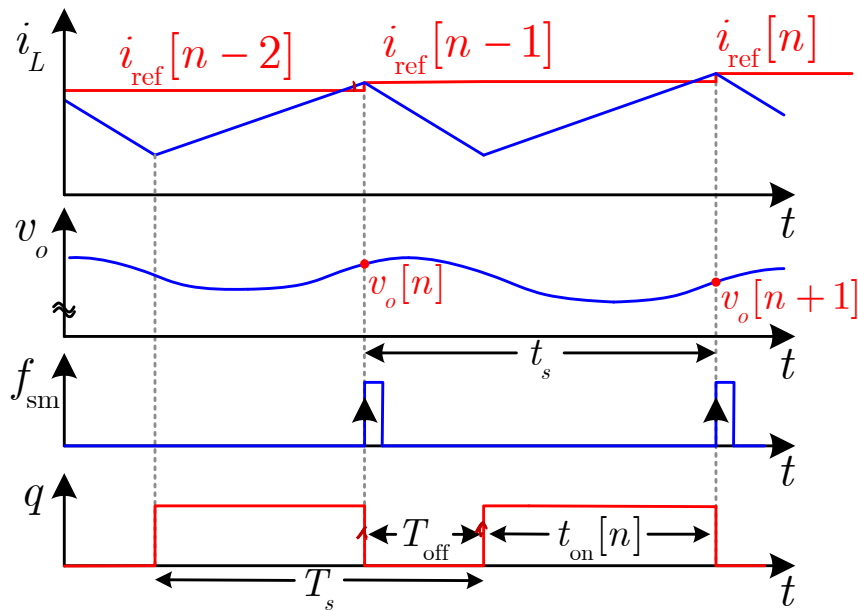
Sampling point — linked with monoshot timer activity

$q \rightarrow$ controllable pulse



K. Hariharan, et. al. " Constant On/Off-Time Hybrid Modulation in Digital ...", *IEEE Trans. Power Electron.*, vol. 34 (4) April 2019

Constant Off-time Modulation : Event based Sampling (contd...)

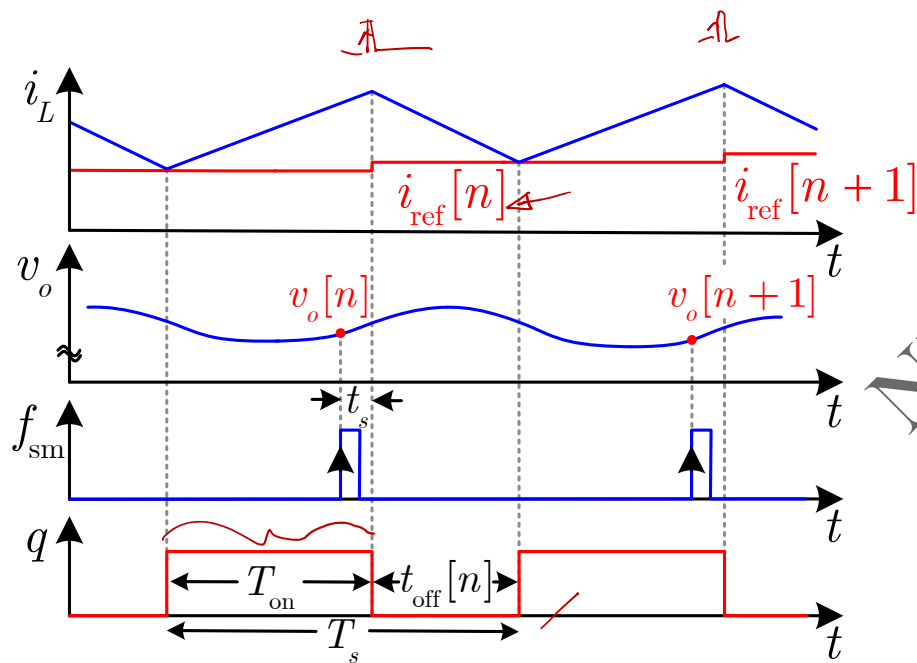


Interval 1 sampling : one cycle delay

analogous to valley current mode control

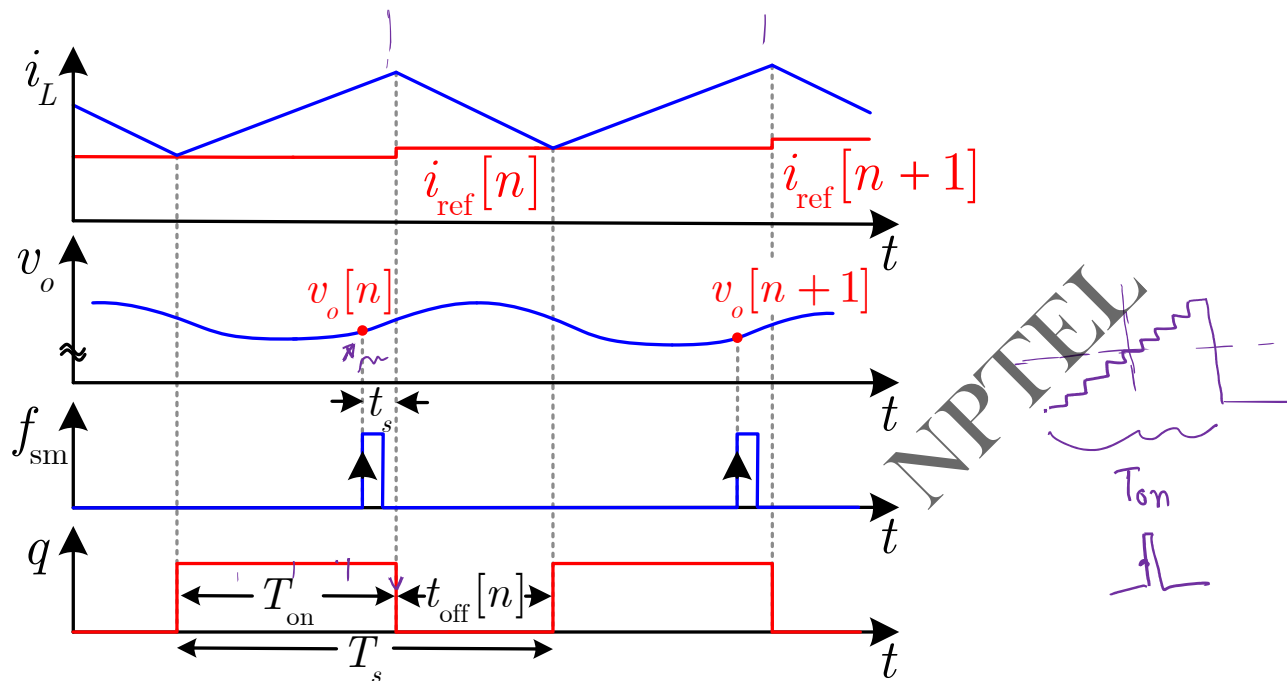


Constant On-time Modulation : Uniform Sampling



Uniform Sampling with t_s delay

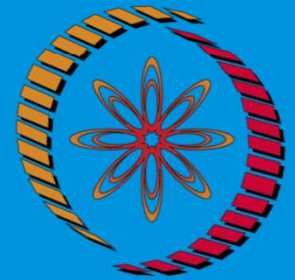
Constant On-time Modulation : Event based Sampling



Interval 1 sampling : t_s delay

CONCLUSION

- Recap of analog constant off-time current mode control
- Mixed-signal constant off-time current mode control
- Difficulties using uniform sampling
- Mixed-signal constant on-time current mode control
- Event-based sampling in constant on/off-time control



**THANK
YOU !**