Special Magnets Controls

Status and Plans

Tobias Stadlbauer

Special Magnets
MedAustron

7-8 October 2010

Content

- Devices covered by Special Magnets Controls
- Cooling Controls
- Position Controls
- Power Supply Controls

Devices covered by Special Magnets Controls

- Magnetic Septa (cooling controls)

  (2 systems)

- Fast Pulsed Magnets (cooling controls)

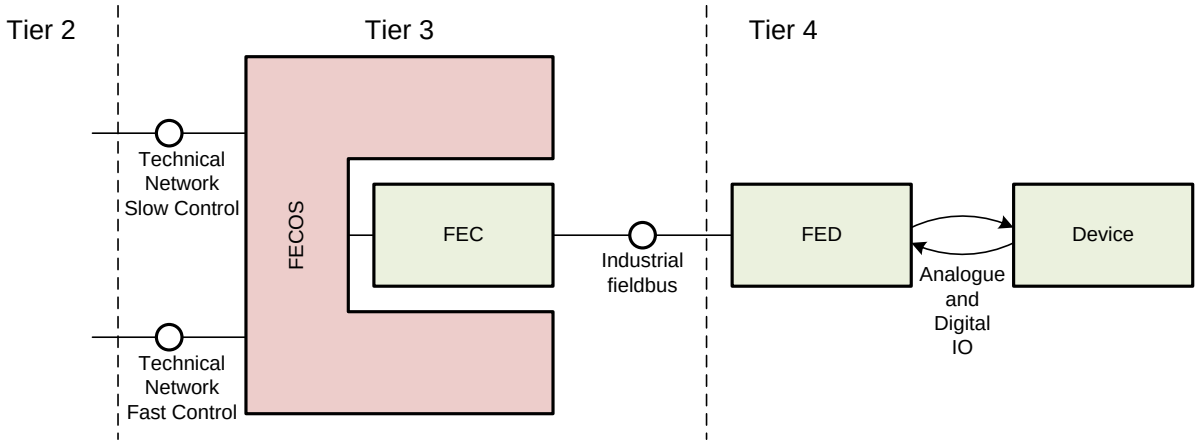
  (for MKC in-house, rest part of tender)

- Electrostatic Septa (remote position controls)

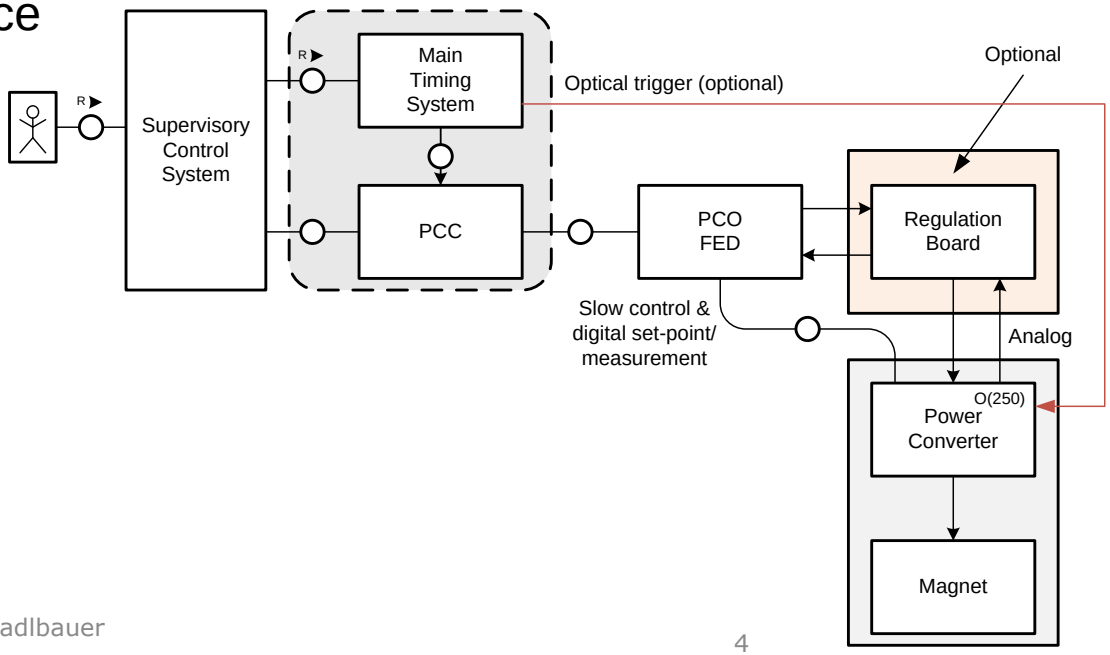
- Power Supplies (2 high voltage DC, 6 fast pulsed)

Control architecture for Special Magnet Systems

Generic layout



Example: PCO interface



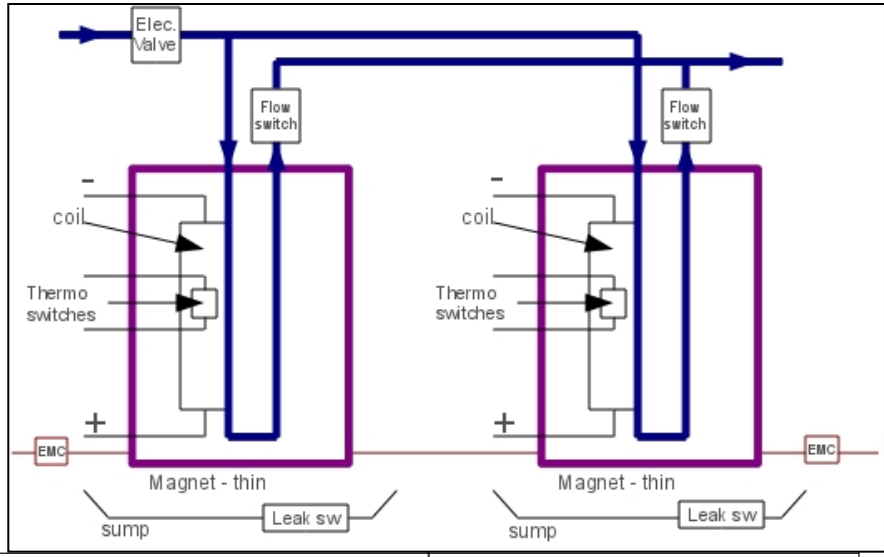
Special Magnets Controls sees responsibility for the green blocks

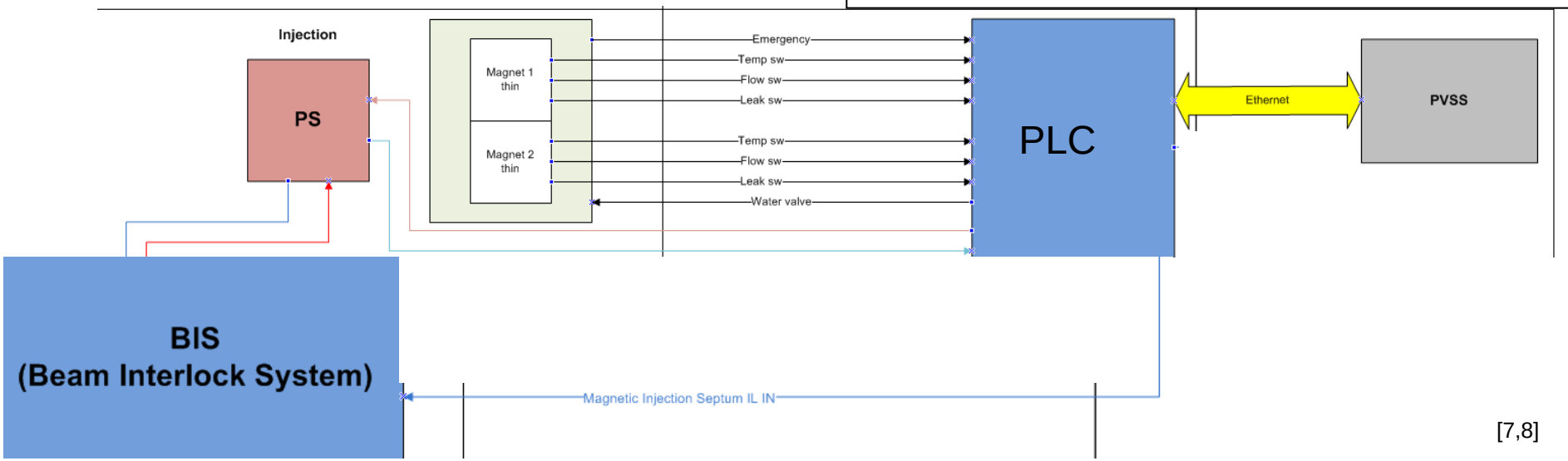
Slow control for Special Magnet overview

Element	Name	FEC	Power supply FED	Position control FED	Cooling Alarms FED	Timing	Local control System (LCS)
LEBT fast deflector	EFE	PCC	"PCO FED"*			MTS	CERN TE-ABT
Electrostatic septa	ESI, ESE	PVSS?	PLC	PLC			CERN TE-ABT
Injection Bumpers	MKI	PCC	"PCO FED"*			MTS	EXT.
Magnetic septa	MSI, MSEa, MSEb	PCC PVSS?	$PCO_{(1)}$		$PLC_{(2)}$		(1) EXT. (CERN TE-EPC) (2) CERN TE-ABT
Dump bumpers	MKS	PCC	"PCO FED"*			MTS	EXT.
Tune kickers	MTV, MTH	PCC	PCO*			MTS (RF?)	EXT.
Chopper dipoles (Medical Device)	MKC	PCC (BDCS)	"PCO FED"* (BDCS)			MTS (BDCS)	EXT.

* No optional regulation board

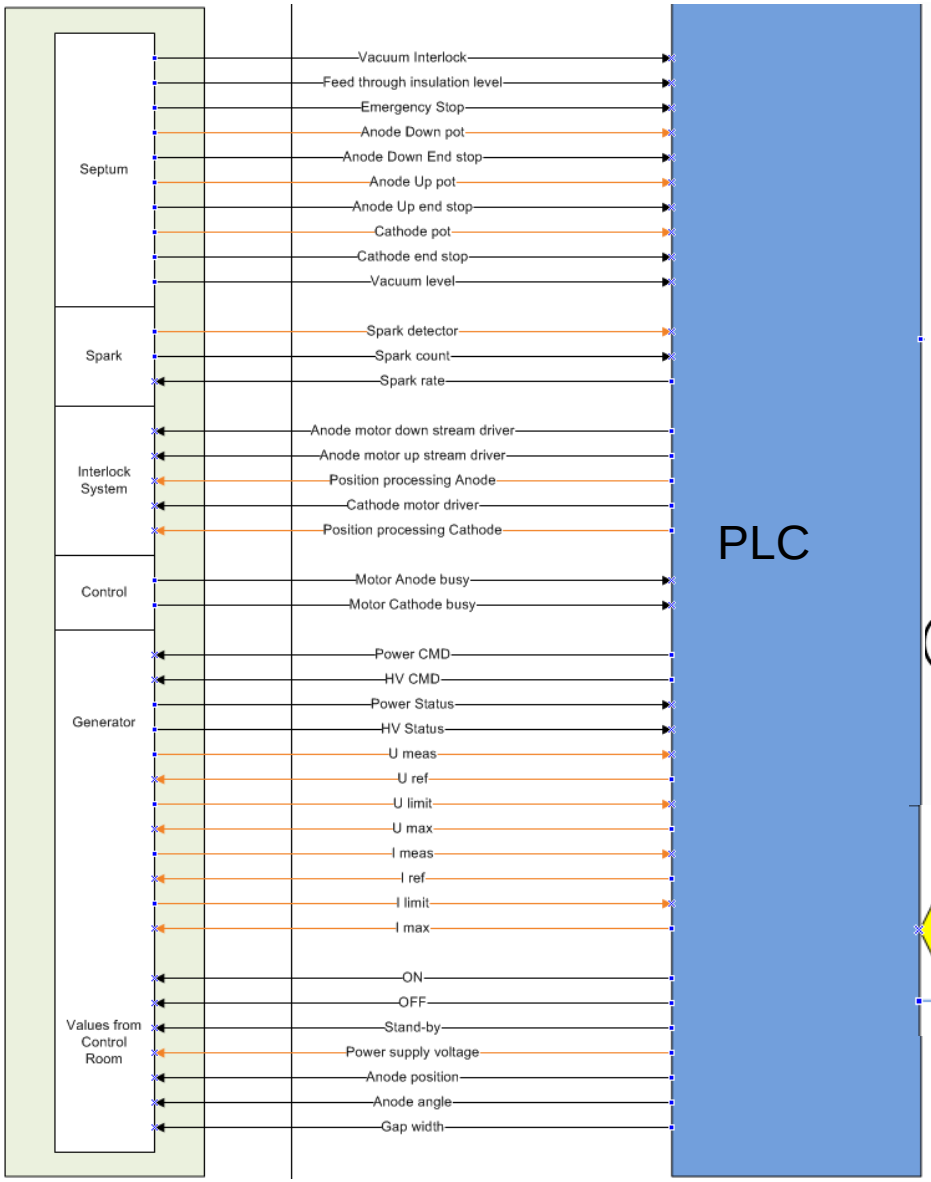
Cooling Controls – example: Thin Magnetic Septa

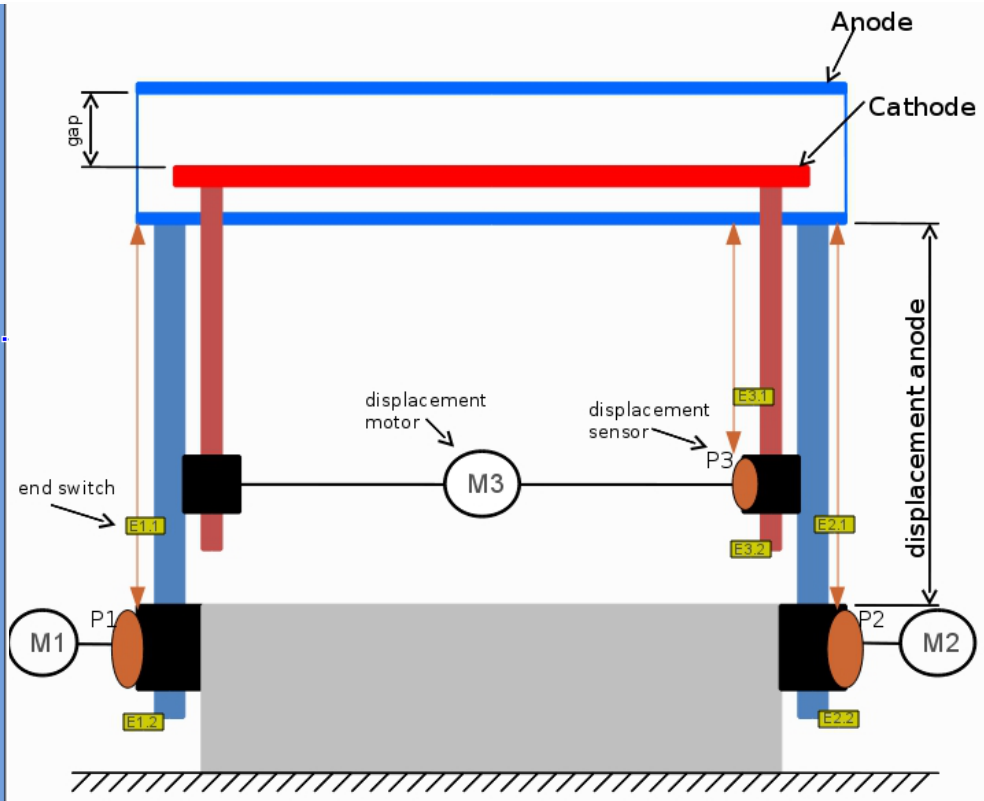


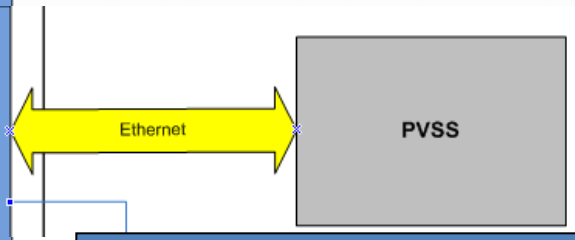


[7,8]

Position Controls: Electrostatic Septum



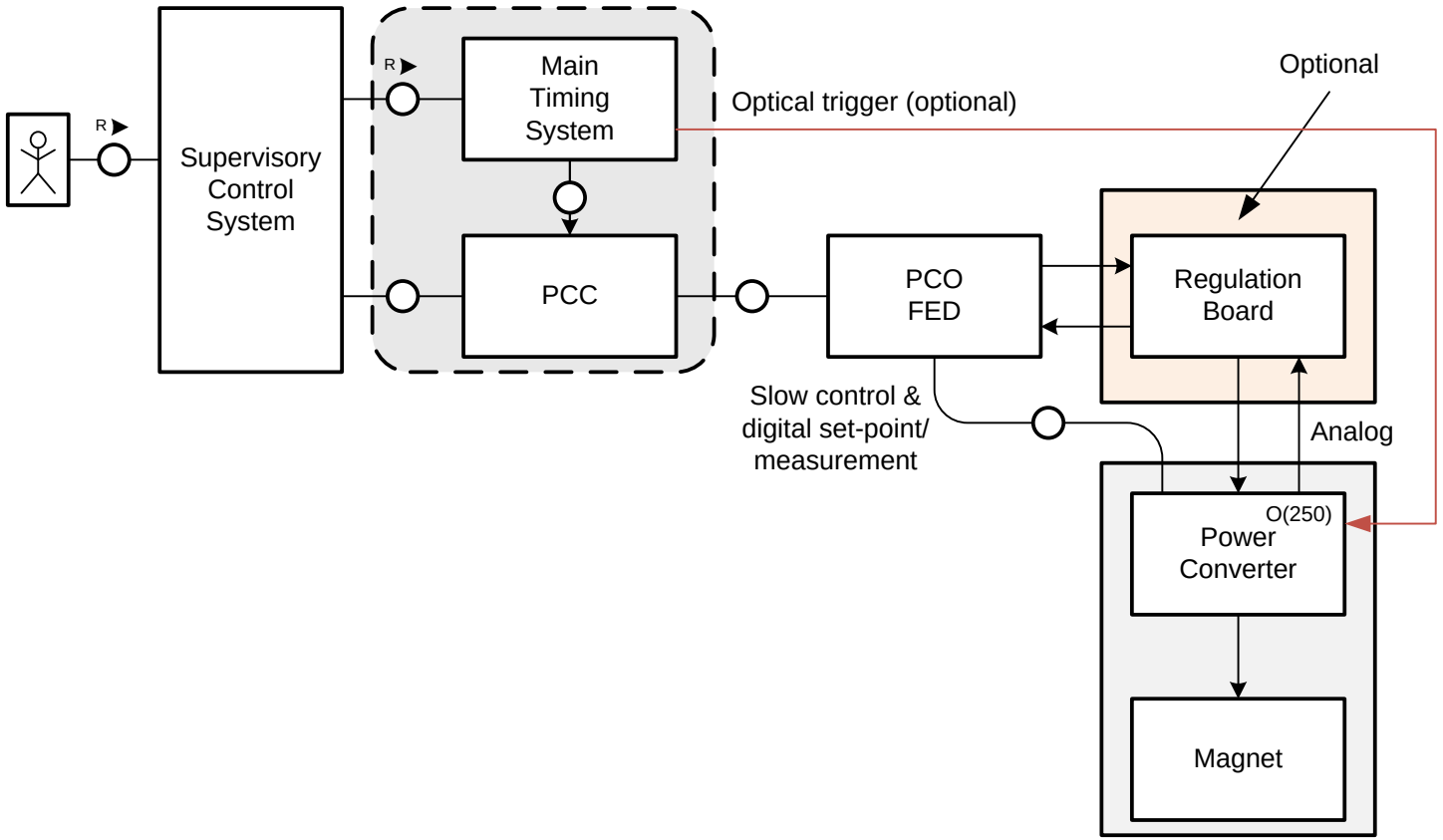




BIS
(Beam Interlock System)

[7,8]

Architecture for power supply controls



[8]

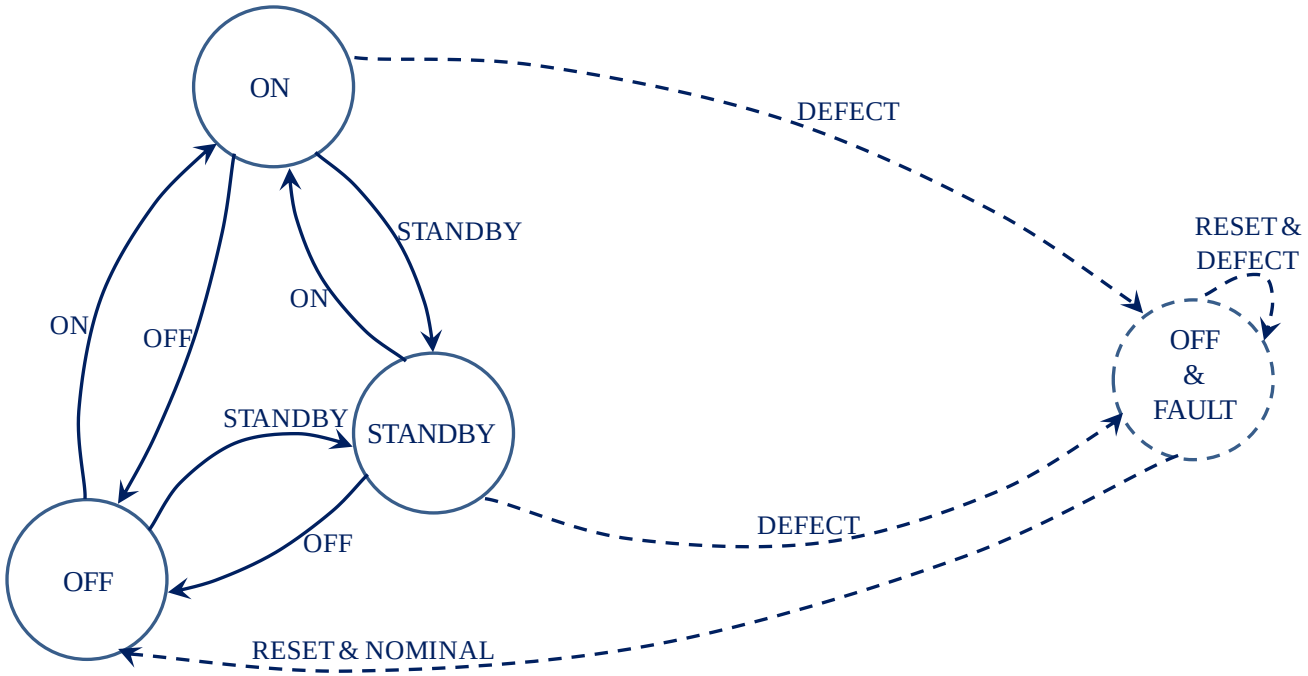
State Diagram for Special Magnet power supplies

States

OFF
STANDBY
ON
OFF & FAULT

Commands

OFF
STANDBY
ON
RESET



Conditions

A *DEFECT* is a condition which will cause an interlock.
A *NOMINAL* condition is one in which there are no interlocks and hence no *DEFECT*s.

GLOBAL OFF

which is a state of the power supply in which the entire system (including CONTROL/ELECTRONICS and any AUXILIARY services) is switched off through a main circuit breaker.
Manual action is required to transition the power supply from the *GLOBAL OFF* condition into the *OFF* state:
a transition from the *GLOBAL OFF* condition into any other state is not permitted.

Commands

A Command is defined as something that is recognized by the Power Supply and drives the Power Supply between two states. The Commands for the Power Supply are:

OFF: If no *DEFECT* is present, the power supply is transitioned to the *OFF* state. In this state the outputs of the AC power sections of the system are switched off through a magnetically actuated circuit breaker. CONTROL/ELECTRONICS and any AUXILIARY services are powered on.

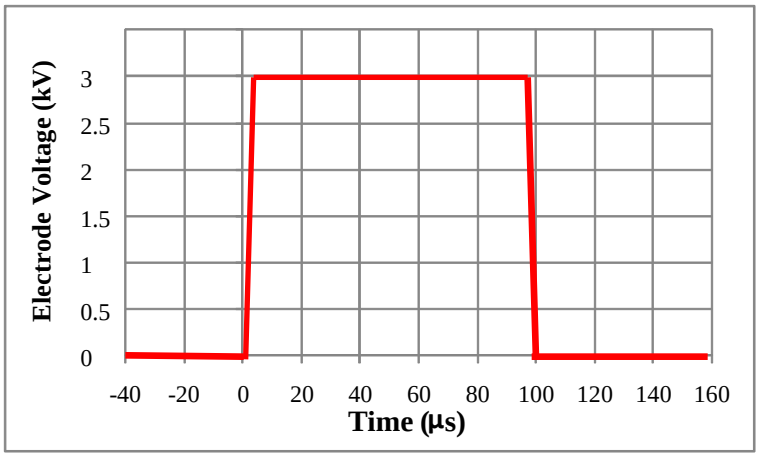
STANDBY: If no *DEFECT* is present, the power supply is transitioned to the *STANDBY* state. In this state the outputs of the AC power sections of the system are energized, and ALL power semiconductors are in the off-state (i.e. zero current in the load). Only the triggers for the switched elements of the power supply are inhibited.

ON: If no *DEFECT* is present, the power supply is transitioned to the *ON* state. In this state all circuits are energized and the trigger gates are enabled. The power supply will pulse upon the receipt of appropriate timing signals.

RESET: After all *DEFECTs* are cleared, and a *RESET* command is issued, the power supply will transition to the *OFF* state. Accidental depression of the *RESET* button must not result in any hazardous operation.

Timing and Control for Special Magnet power supplies (1)

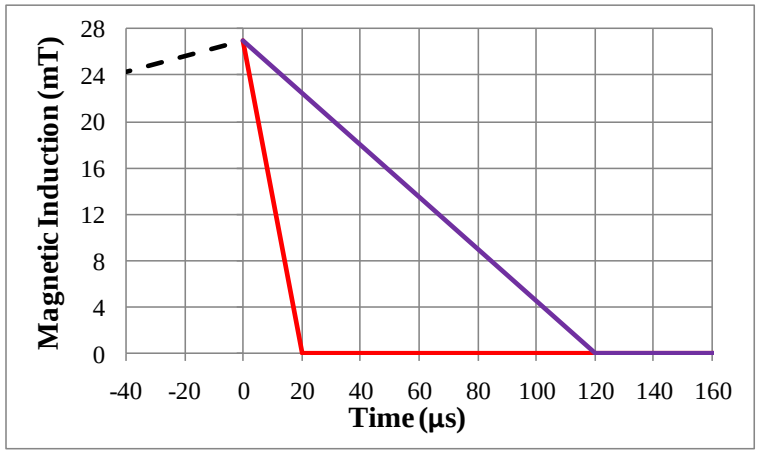
LEBT fast deflector (EFE)



The MedAustron Control System will provide:

- The necessary timing pulses (START and STOP) to drive the power supply;
- The state commands and the value of the voltage reference for the present cycle (fixed?)

Injection Bumpers (MKI)

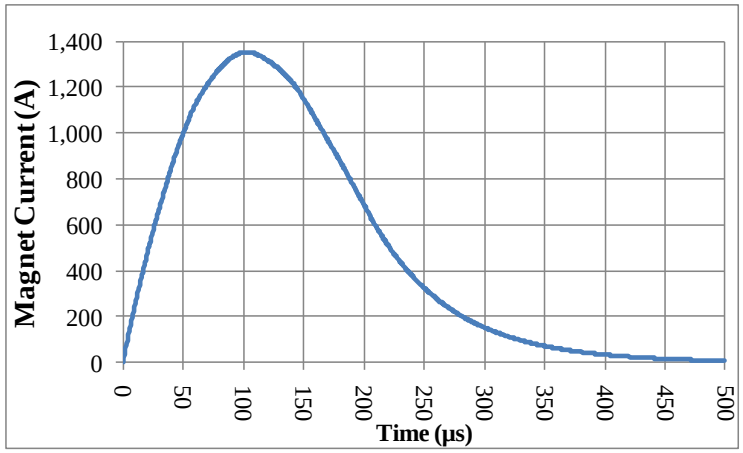


The MedAustron Control System will provide:

- The necessary timing pulse (START), synchronised with the LEBT Deflector to drive the power supply;
- The state commands and the value of the voltage reference for the present cycle
- The value of the slope length

Control and Timing for Special Magnet power supplies (2)

Dump bumpers (MKS)



The MedAustron Control System will provide:

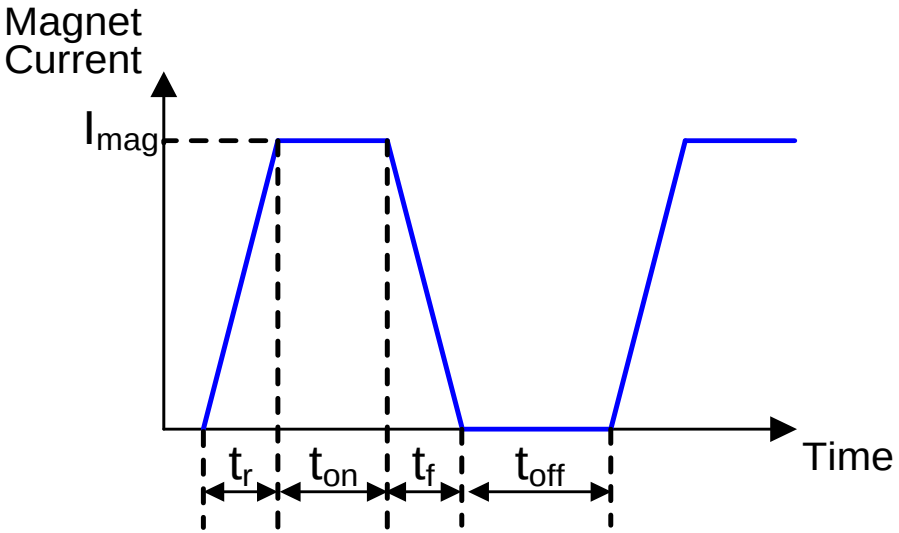
- The necessary timing pulse (START)
- The state commands
- The value of the magnet current reference for the present cycle (need B-train to track beam energy)

Tune Kicker (MTV, MTH)

The MedAustron Control System will provide:

- The necessary timing pulse (START and STOP), synchronised with the RF train (ns precision) to drive the power supply;
- The state commands and the value of the current reference for the present cycle

Timing and Control for Beam Chopper Power Supply (PKC)



The MedAustron **Beam Delivery** control system will provide:

- The state commands and the value of the magnet current reference for the present cycle;
- The necessary timing pulses (START and STOP) to drive the power supply;

To reduce the probability that the PKC will receive an incorrect command to remain in the on-state (e.g. due to a faulty trigger card), a timing protocol using two independent timing inputs is envisaged.

These two inputs would be “ANDed” in the LCS of the PKC to derive the required trigger state: a HIGH level on BOTH input lines represents a *START* signal, whereas a LOW level on either or both lines, represents a *STOP* signal. The “AND” unit must be failsafe, i.e. if it or its power supply fails it must give a low level output.

Status

- Magnet Slow Control Requirements almost finished.
- Engineering Specification Documents for: MKC, MKI, MTH, MTV including control interfaces, published
- Supply of Special Magnets and Their Power Supplies, TECHNICAL DESCRIPTION (now in 1st stage of 2 stage tender process)

Planning

- Study, design and specify LEBT Deflector system:
  Electrostatic deflector (CNAO design), generator and control.
  End week 43, 2010

- Study and specify fast pulsed magnets control
  End week 51, 2010

- Study, specify and produce control for electromagnetic septa
  End Week 9, 2011 + ongoing activity for production

- Study, specify and produce control for electrostatic septa with focus on motorization prototyping and high voltage power supply specification
  End week 31, 2011

References

[1] J. Borburgh, M. Barnes, T. Fowler, M. Hourican, T. Kramer. T. Stadlbauer, Special Magnets - Final Design Report, CERN, 2010 (unpublished).

[2] J. Gutleber, R. Moser, *MedAustron Control System Architecture and Design Document, MedAustron, ES-1000406-a-JGU.*

[4] T. Fowler, T. Kramer, T. Stadlbauer, Special Magnets Control System Requirements Specification Document, CERN, unpublished.

[5] J. Gutleber, R. Moser, Main Timing System and Signal Distribution Services, MedAustron, unpublished.

[6] J. Borburgh, et al., “MedAustron Special Magnets - WP description”, CERN, Geneva, 2009

[7] M. Marchhart, T.Glatzl “Magnet Slow Control - Requirements”, MedAustron

[8] T. Glatzl “Overview Magnet Slow Control”, MedAustron, 2010