“Soft-Start”
for LHC Injection Kicker Systems

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AB/BT

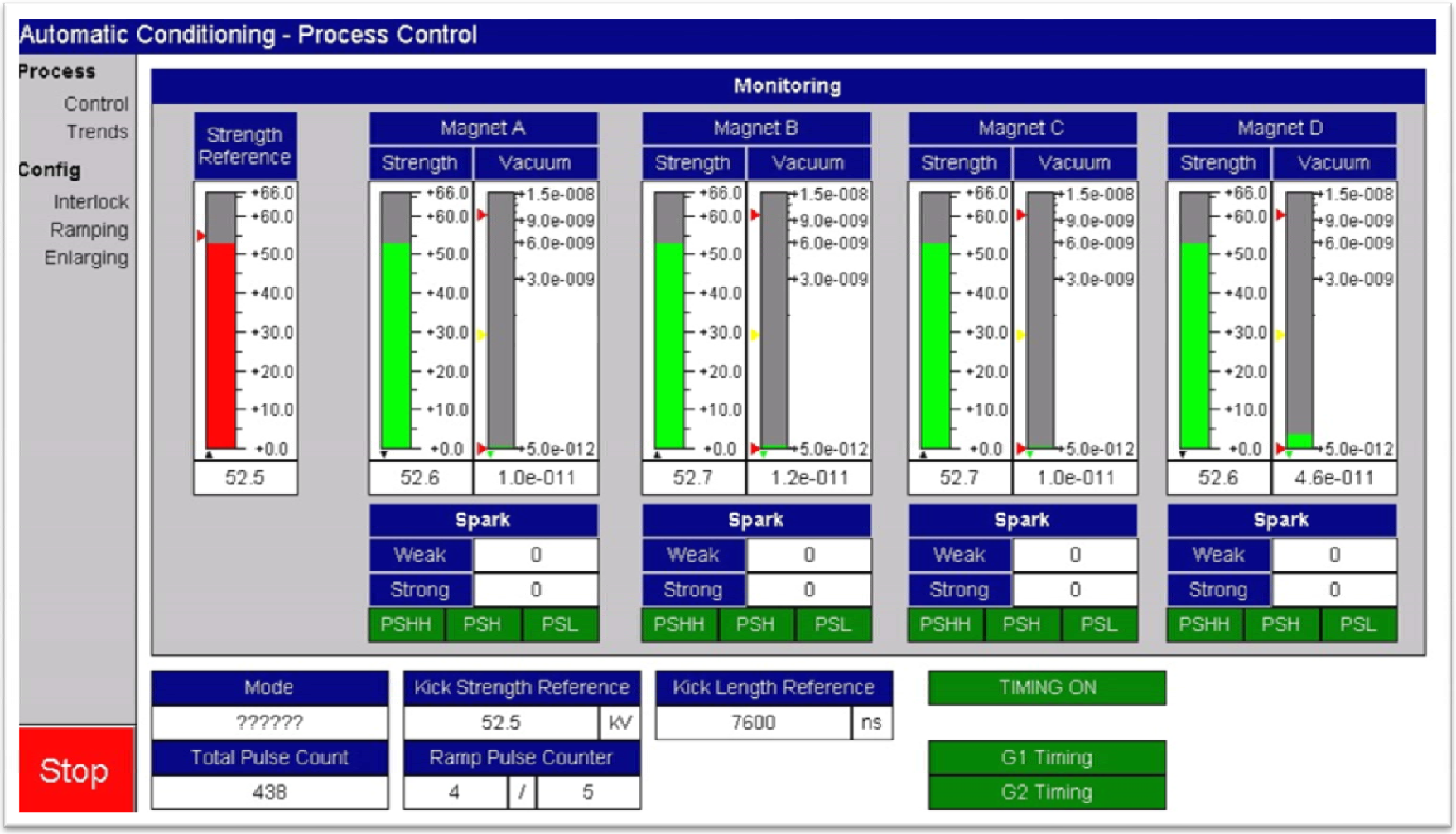
Outline

- Automatic Conditioning
- Control Modes
- Control Logic
- Soft-Start
- Open-Issues

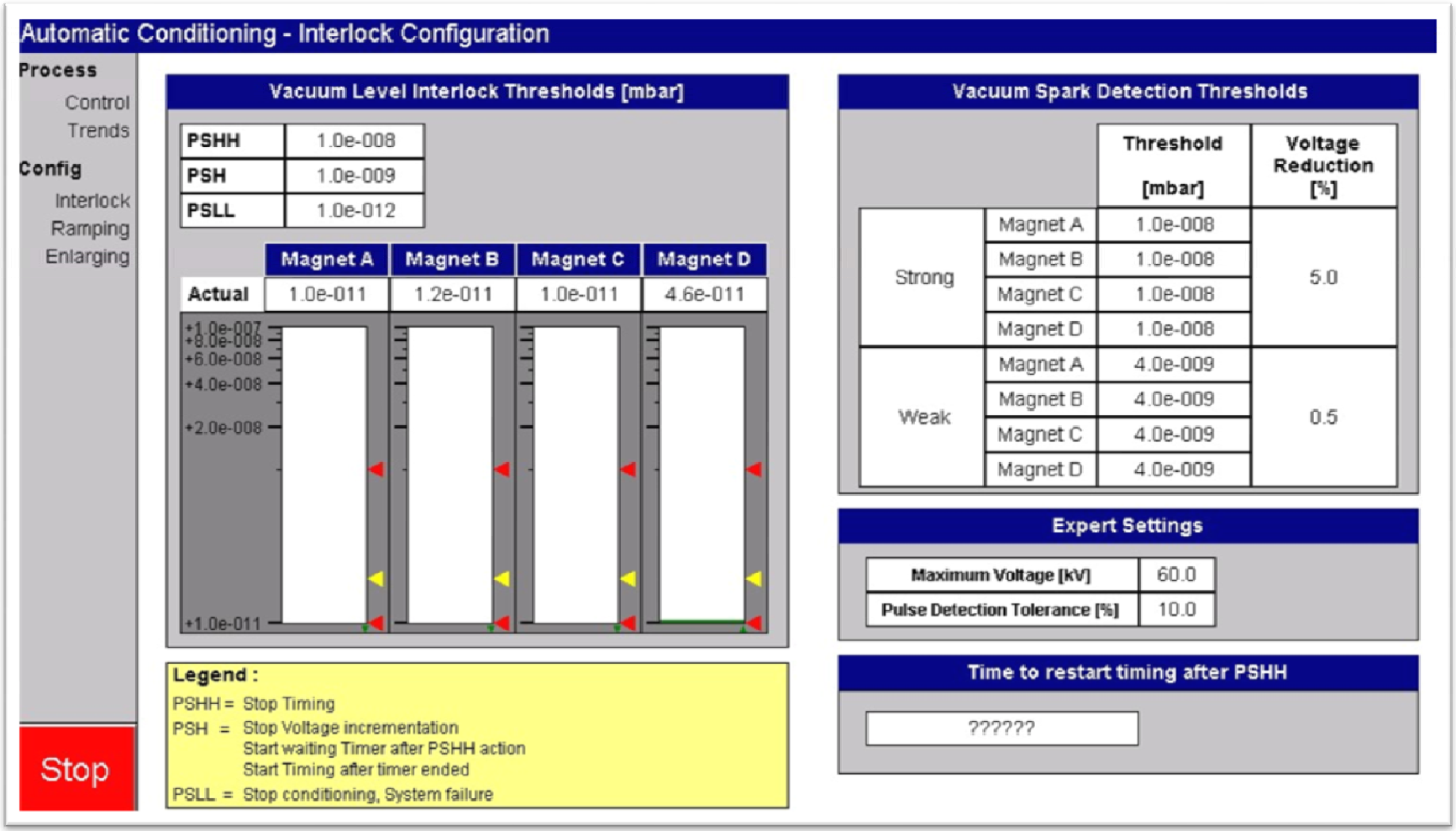
Automatic Conditioning [ACOND] Process Functionality

- Prepare the magnets for an optimum operating voltage
- Two stages:
  - **Ramping** → kick strength increase with constant kick length
  - **Enlarging** → kick length increase at constant kick strength
- Kick strength and kick length increase depend on vacuum activity in the magnet:
  - **Weak spark** → stop, wait for good vacuum and restart
  - **Strong spark** → stop, wait for good vacuum, reduce operationnal conditions and restart

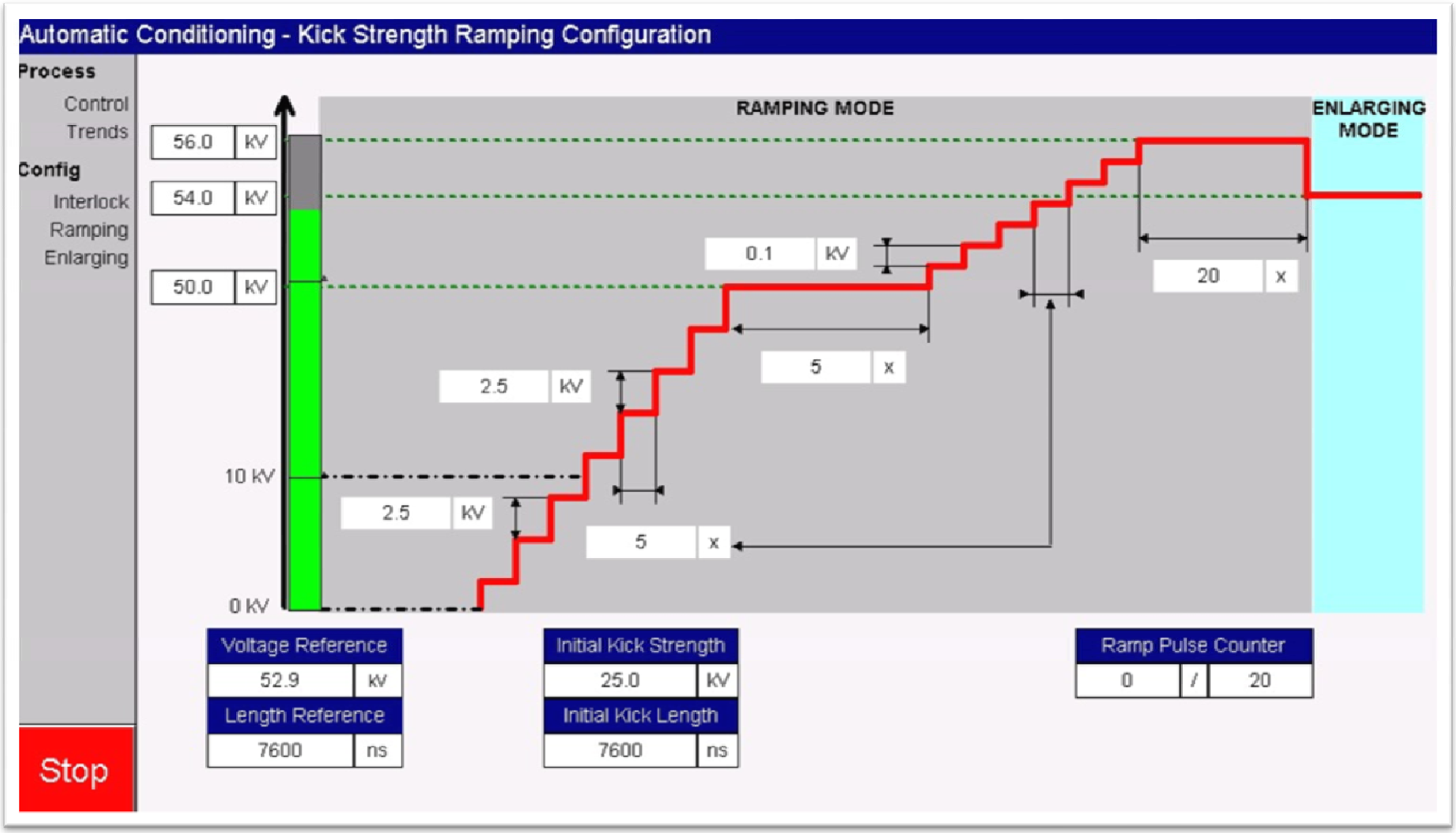
Automatic Conditioning [ACOND]
Process Control



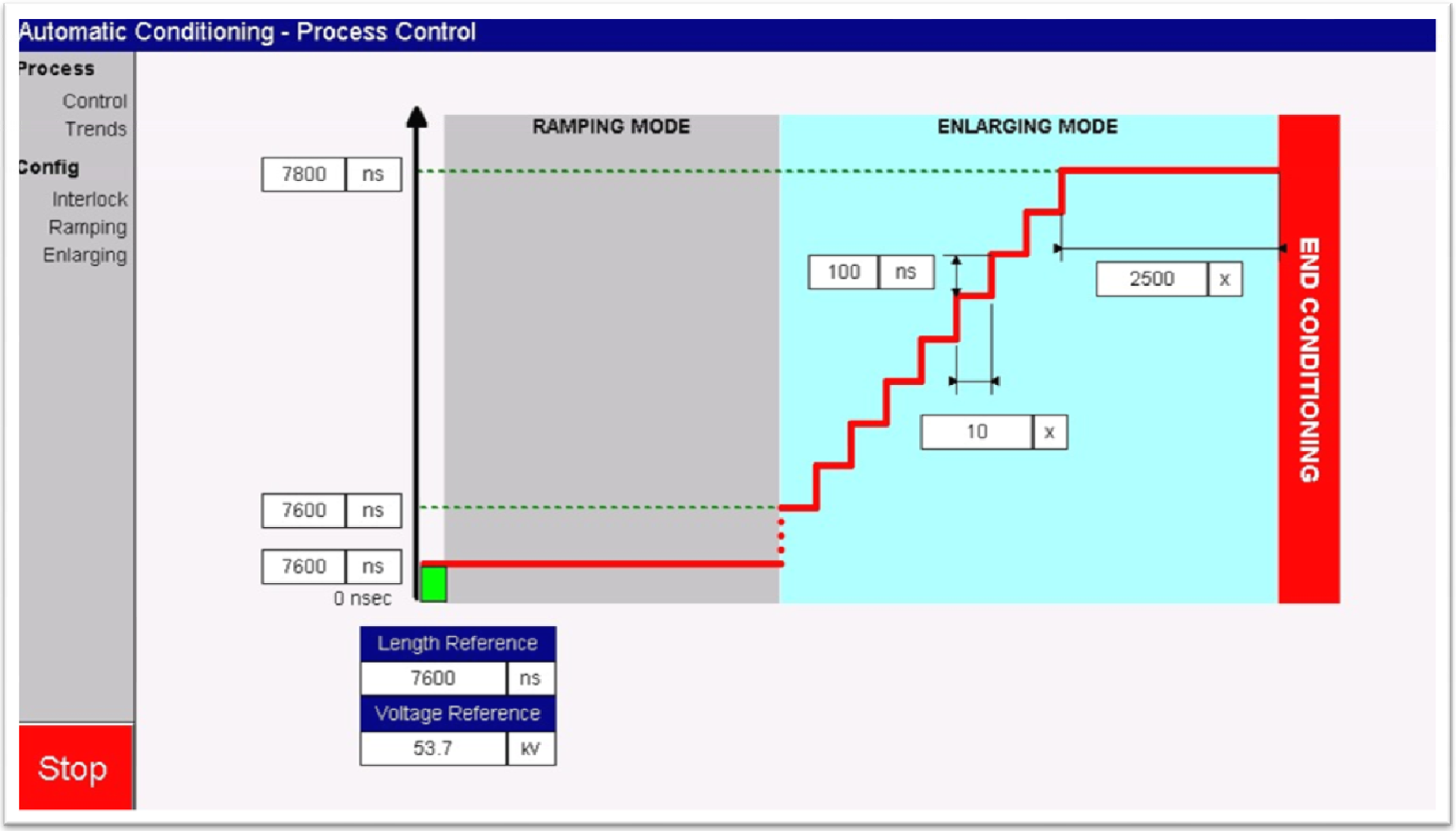
Automatic Conditioning [ACOND]
Interlock Configuration



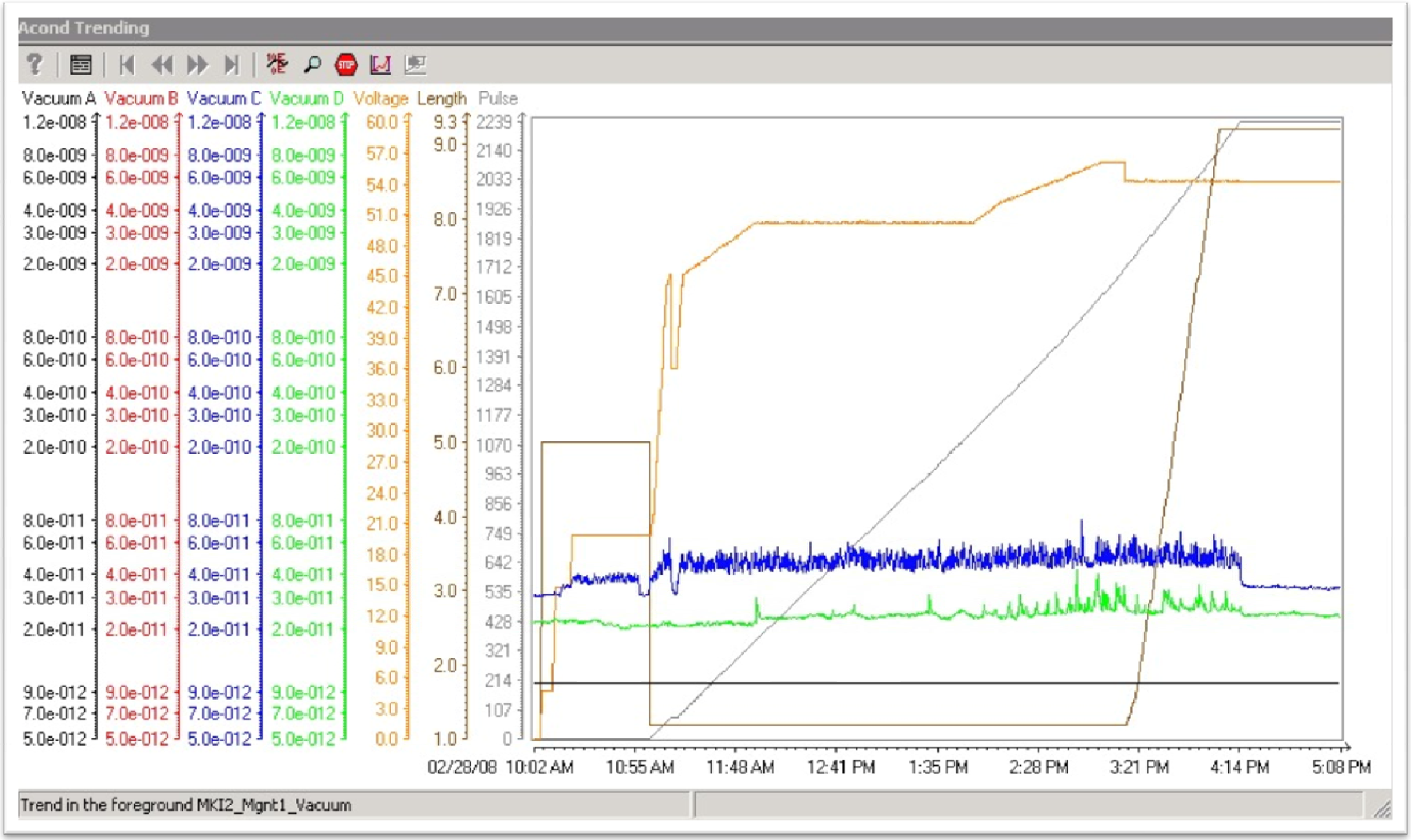
Automatic Conditioning [ACOND]
Ramping Configuration



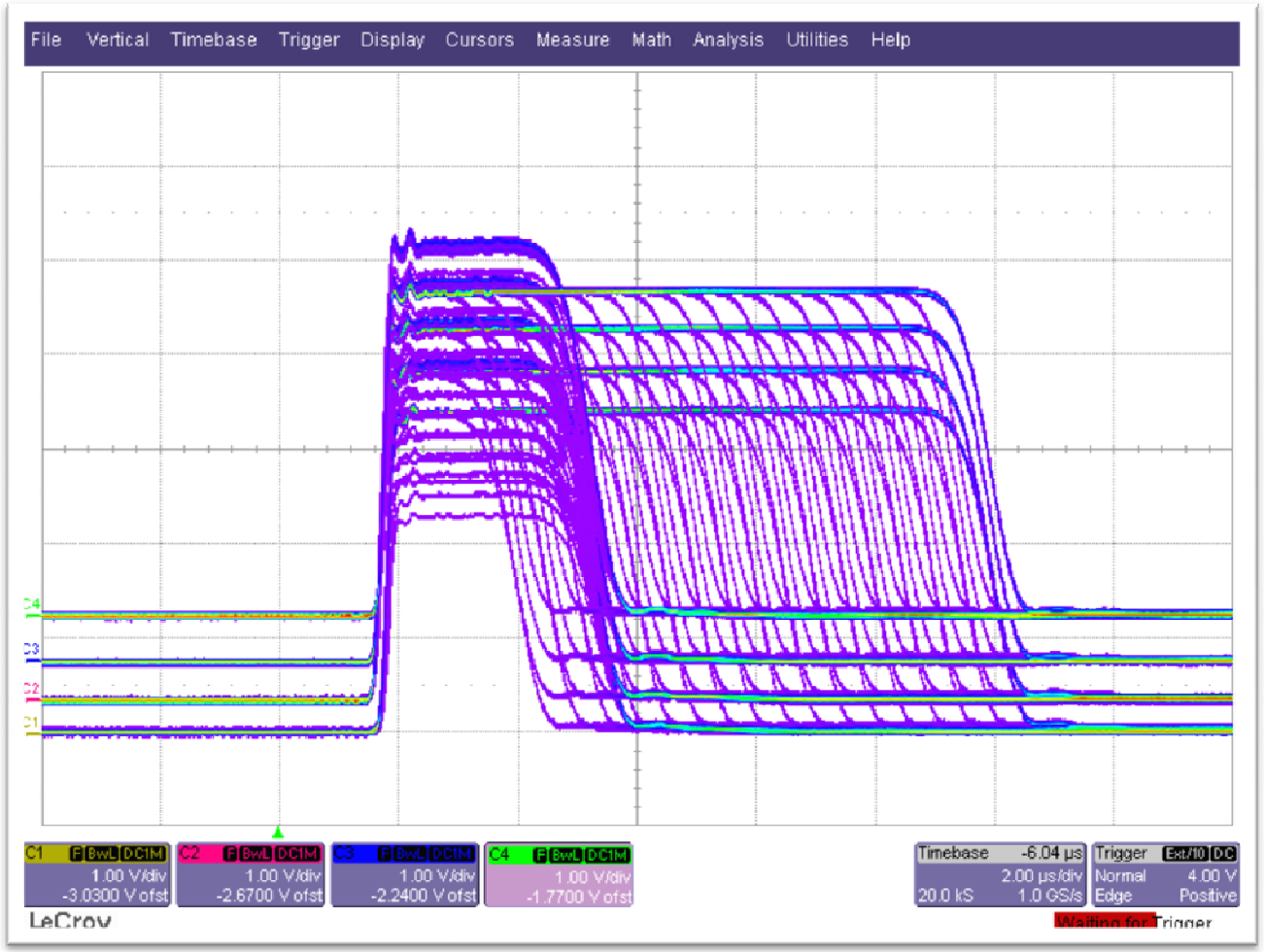
Automatic Conditioning [ACOND]
Enlarging Configuration



Automatic Conditioning [ACOND] Trending



Automatic Conditioning [ACOND] Signals



Automatic Conditioning

- More than 50 settings
  - Interlock thresholds
  - Ramping parameters
  - Enlarging parameters
- Fine tuning of these settings requires a lot of expertise
- Automatic Conditioning process duration is not defined at the beginning

Automatic Conditioning [ACOND] Implementation

- ACOND implemented
  - In master PLC for process logic
  - In VME FEC for setting management
- Direct hardware connection to vacuum system for interlocking and analogue acquisition
- Data exchange between PLC and FEC based on FESA – IE-PLC
- Scheduling of RT task based on injection warning event (-1000ms)

Injection Kicker Control Modes

- 2 possible control modes
  - **LOCAL**
    - Operation of the systems from the UA
    - No REMOTE control possible
    - State and settings managed locally
  - **REMOTE**
    - Operation of the system from the CCC
    - No LOCAL control possible
    - State and settings managed remotely
- Switch from **REMOTE** to **LOCAL** and from **LOCAL** to **REMOTE** only possible locally (i.e. in the UA via an hardware mode selection switch)

Injection Kicker Control Logic

	LOCAL	REMOTE
Slow Timing	Internal timing generator	MTG
Fast Timing	Internal timing generator	RF
Injection BIS Inhibit	By-passed	Active
BETS Inhibit	By-passed	Active
AGK Inhibit	By-passed	Active
Injection Permit	FALSE	TRUE
Beam Permit	FALSE	TRUE
Setting	Operator console or ACOND	CCC
State	Operator console	CCC

“Soft-Start”

- Validation of operational characteristics of magnets before filling the machine
- Remote execution of a simplified (fast) ACOND process
  - Start the process remotely
  - Dedicated set of settings (Interlock, Ramping, Enlarging)
- Installation has to be put remotely in “LOCAL”… looks like a REMOTE-LOCAL control
  - → By-passing machine interlocks (BIS, BETS, AGK)
  - → Start pulsing on local timing generator asynchronously with machine timing
- Switching from “REMOTE” to “REMOTE-LOCAL” will generate a dump request (opening of the beam permit loop)

Open-Issues

- Conditions for execution of a “Soft-Start”
  - When?
- State management at the beginning and at the end of a ACOND
- Settings management
  - How ?
- Management of roles for execution of a “Soft-Start”
  - Who ?
- Management of Beam Permit and Injection Permit loops for machine protection during “Soft-Start”
- Distinction between “REMOTE-LOCAL” and “LOCAL” control modes for protection of installation when operated in “LOCAL”