EDDY DRIVER

HIGH VOLTAGE ELECTRONICS FOR ULTRA-FAST EDDY CURRENT DRIVEN SYSTEMS

TECHNICAL SPECIFICATION

SYSTEM OVERVIEW

This document defines the technical specifications of the **Eddy Driver**, a modular high-voltage control system for eddy-current actuators. The system includes a central low-voltage control unit and two high-voltage driver modules, designed for precise, repeatable and safe control of capacitor-based HV discharge systems.

FUNCTIONAL DESCRIPTION

SYSTEM COMPOSITION

- One low-voltage controller (NI-based)
- Two high-voltage electronics modules
- All modules built from commercially available (“COTS”) components

CONTROL FUNCTIONS

- Charge capacitor bank to operator-defined voltage
- Limit charging current and apply timeout logic
- Generate high-speed trigger signals to fire the SCR/thyristor
- Monitor current, voltage and system status in real time
- Provide complete remote-control capability
- Maintain operational safety through interlocks

PERFORMANCE CHARACTERISTICS

HIGH-VOLTAGE SYSTEM

- Nominal operating voltage: up to 2 kV DC (configurable)
- Charge current limitation: programmable
- Discharge path: high-speed thyristor
- Dual-channel HV output for multi-actuator systems

TIMING & TRIGGERING

- Trigger pulse width: configurable
- Trigger delay: adjustable from µs to ms range
- Sequence control for multi-module operation

MONITORING & DIAGNOSTICS

- Capacitor voltage
- HV supply status
- Trigger status
- Interlock state
- Discharge current (optional channels)

CONTROL SYSTEM DESCRIPTION

USER INTERFACE

- LabVIEW-based GUI for:
  - Parameter configuration
  - Process monitoring
  - Logging and diagnostics

REMOTE INTERFACE

- TCP/IP or serial communication
- Digital I/O for:
  - Trigger enable
  - External trigger
  - Fault status
  - Interlock inputs/outputs

PARAMETER ADJUSTABILITY

All key parameters must be user-configurable, including:

- Charge voltage
- Current limit
- Trigger timing (microsecond time scale)
- Dead times and safety windows

SAFETY REQUIREMENTS

HARDWARE INTERLOCKS

- HV enable line
- Cabinet door / maintenance access
- Grounding verification
- Overvoltage protection

SOFTWARE INTERLOCKS

- Charge inhibit logic
- Triggers inhibit conditions
- Parameter range protection
- Fault-state lockout
- Watchdog relay

EMERGENCY FEATURES

- Automatic safe discharge via resistor path
- Emergency stop input
- Fault-state reporting to supervisory system

SAFETY INDICATION

- Andon light indicating HV status
- Controller-level status indicators

CERTIFICATION

- System design compliant with CE electrical and EMC standards

MECHANICAL AND INTEGRATION REQUIREMENTS

- Modular mechanical form factor for controller + HV modules
- High voltage power supply: integrated or external (analogue or digital controllable) – own can be used
- Standard connectors for maintenance and replacement
- Clear physical separation between low-voltage and HV domains
- Easy access for diagnostics and service

ENVIRONMENTAL REQUIREMENTS

- Temperature: laboratory environment (15–35 °C)
- Humidity: non-condensing
- EMC: meets CE conformity requirements

DOCUMENTATION

- User manual
- Electrical schematics
- CE compliance documentation

REFRENCES

[1] D.I. Réfy et al *Fusion Engineering and Design* ***194*** *(2023) 113893*
[2] D. Nagy et al *Fusion Engineering and Design* ***202*** *(2024) 114400*
[3] D. Nagy et al *Fusion Engineering and Design* ***218*** *(2025) 115142*
[4] Zsákai et al *Fusion Engineering and Design* ***201*** *(2024) 114324*
[5] D.I. Réfy et al *Fusion Engineering and Design* ***200*** *(2023) 114156*
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KESCH KFT 4.0
Control Module Active
Main Switch
RCD F1 F2 F3
Safety State Active
Emergency Stop
Safety State Reset
HV Module Active