PROJECT ABSTRACT

Crane Control Panel with Pendant and VFD

A working overhead-crane (EOT) control panel operated from a pendant pushbutton station: contactor-switched travel motions with overload protection and a variable frequency drive giving the hoist motor soft start, soft stop and speed control. Delivered built-to-order with the wired panel, pendant, demo rig and viva kit.

01. Title

Crane Control Panel with Pendant and VFD

02. Introduction / Background

Overhead travelling (EOT) cranes are the workhorses of factories, workshops and warehouses, and their control panels are among the most instructive builds in electrical engineering: a pendant station in the operator's hand, power contactors switching the travel motors, and a variable frequency drive (VFD) taming the hoist motor. Direct-on-line starting jerks the load and stresses ropes and structure; the VFD instead ramps voltage and frequency for smooth acceleration, controlled deceleration and adjustable speed for precise load positioning. This project builds that panel for real — enclosure, MCBs, contactors, overload relays, control transformer, VFD and a wired pendant with a latching emergency stop — with a small 3-phase induction motor on a test frame standing in for the crane motions, so the complete control scheme can be demonstrated on a bench.

03. Problem Statement

Students learn motor control from textbooks, but the industrial reality — pendant stations, interlocked reversing contactors, overload protection, VFD parameterization and panel wiring discipline — is rarely built by hand. Simultaneously, crane control is unforgiving of bad design: across-the-line starts jerk loads, missing interlocks can short the supply, and an absent emergency-stop philosophy endangers operators. The project addresses this by having the student build a complete, correctly protected crane control panel at bench scale: pendant command, contactor direction switching with electrical and mechanical interlocking, VFD soft-start and speed control, limit-switch end-of-travel protection and a hardwired emergency-stop chain.

04. Objectives

- Build a steel control-panel enclosure with DIN-rail gear: MCBs, power contactors, thermal overload relays, control transformer, VFD and indicator lamps.

- Wire a handheld pendant pushbutton station (hoist up/down, cross/long travel) with a latching mushroom-head emergency stop back to the panel control circuit.
- Implement electrically and mechanically interlocked forward/reverse contactor switching for the travel motions.
- Parameterize the VFD from the drive manual and the demo motor nameplate for soft start/stop ramps and preset speeds on the hoist axis.
- Demonstrate end-of-travel protection with limit-switch inputs and a hardwired emergency-stop chain that drops all motion.
- Deliver the complete student kit: panel, pendant, demo rig, wiring diagrams, report, PPT and viva Q&A.

05. Proposed Methodology

The build follows industrial panel practice. (1) Design: single-line and control schematics are drawn first, protection is sized from motor nameplate data, and the VFD is selected for the demo motor rating. (2) Panel construction: gear is mounted on DIN rail, conductors are cut, ferruled, numbered and routed through slotted wire ducts to a terminal chart. (3) Pendant wiring: the multi-core pendant cable is terminated to the control circuit with the E-stop wired as a latching series element. (4) VFD commissioning: parameters (acceleration/deceleration time, preset speeds, current limit, motor data) are entered per the drive manual, then verified with no-load runs. (5) Protection testing: overload relay, MCB discrimination and limit-switch cut-off are each exercised per the commissioning checklist.

06. System Architecture / Working

Pressing a pendant pushbutton energizes the corresponding direction contactor coil in the low-voltage control circuit. The contactor's power poles connect the motor to the supply — travel motors directly, the hoist motor through the VFD output. The VFD ramps its output frequency from zero to the set speed over the configured acceleration time, so the hoist starts without a jerk; releasing the button drops the contactor and the drive follows its deceleration ramp to a controlled stop. The emergency stop opens the control-supply contactor, dropping every motion at once, and the panel must be deliberately reset before motion resumes. Limit switches at each end of travel open the direction coil circuit to inhibit further motion in that direction until the opposite command is given.

07. Hardware / Software Requirements

- Variable frequency drive (single/three-phase input, three-phase output), sized for the demo motor
- Pendant pushbutton station with latching emergency stop and multi-core cable
- 3-pole power contactors with auxiliary contacts, thermal overload relays, MCBs

- Control transformer for the low-voltage control circuit
- Limit switches for end-of-travel demonstration
- Small 3-phase induction motor (approx. 0.5-1 HP) on a test frame
- Steel enclosure, DIN rail, slotted wire ducts, ferrules, numbered terminals
- Three-phase supply for full demonstration (or single-phase within drive rating)

08. Expected Outcomes

- Wired control panel demonstrating pendant, contactor, VFD, protection and E-stop circuits to industrial wiring practice.
- Smooth VFD-ramped hoist motion with selectable preset speeds on the demo motor.
- Verified overload, short-circuit, limit-switch and emergency-stop behaviour per the commissioning checklist.
- Complete documentation: wiring diagrams, panel layout, terminal chart, component list, report, PPT and viva Q&A.

09. Applications

- Teaching platform for industrial motor control: contactors, interlocking, VFDs, protection sizing.
- Reference build for other pendant/remote-controlled machinery panels.
- Demonstration of soft-start and speed-control concepts in drives laboratories.
- Base design that the report shows scaling toward real crane panels (with the caveat that real installations need certified components and inspection).

10. Future Scope

- Radio remote control replacing the wired pendant.
- PLC-based sequencing with HMI instead of relay/contactor logic.
- Load-cell based overload cut-off on the hoist axis.
- Regenerative braking demonstration on the VFD.

11. References

- VFD manufacturer's user manual (supplied with the drive) — parameterization and wiring.
- IEC 60204-1 — Safety of machinery: electrical equipment of machines (control and emergency-stop philosophy).
- Standard motor-control textbooks — DOL/reversing starter circuits and overload protection sizing.
- Pendant station manufacturer's datasheet — contact ratings and wiring.