

Complete Distributed Control System

38-009



Level & Flow Rig



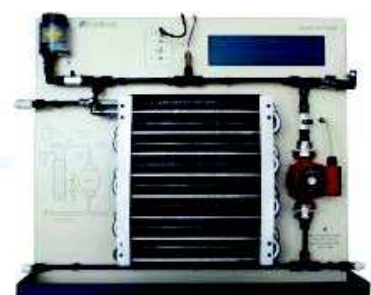
Temperature Rig



Emerson DeltaV
Process Control
System



Pressure Rig



Forced Air Cooler

Description

The Feedback Distributed Control System (DCS) trainer is a complete training solution that combines the operations of a leading commercial DCS process management package, namely Emerson's DeltaV, with an assortment of our proprietary training rigs. The training rigs offer a range of processes:

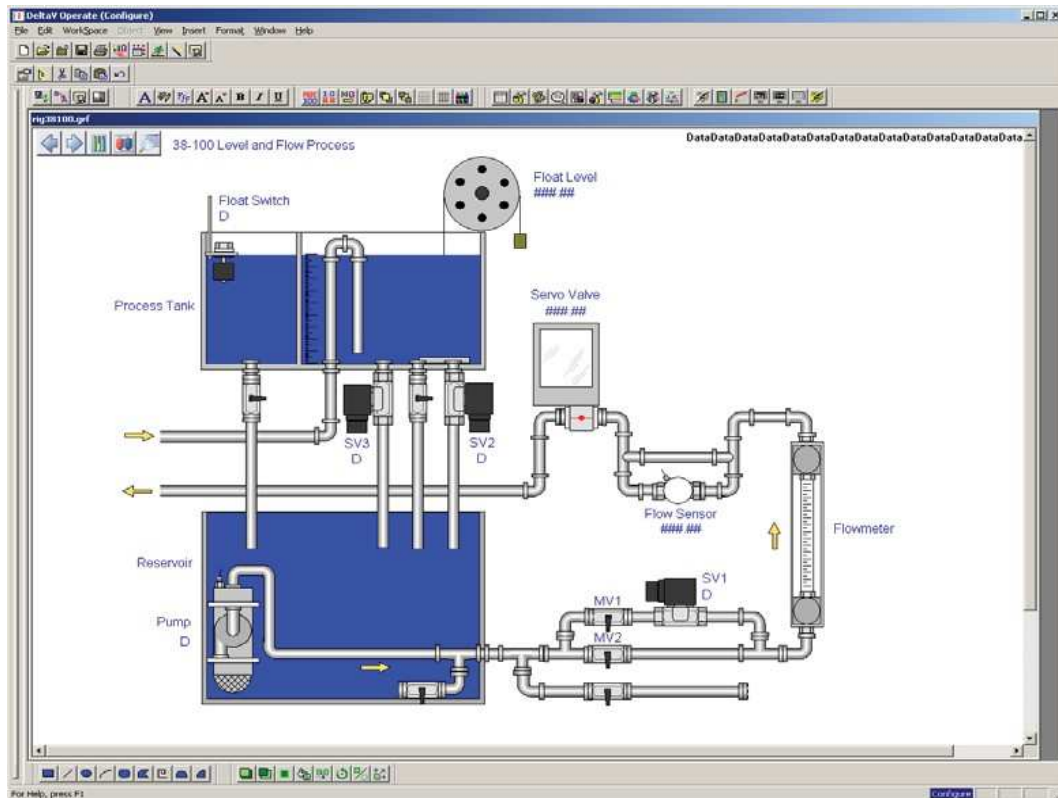
- **Level and Flow**
- **Temperature**
- **Pressure**
- **Forced Air Cooling**

These may be operated separately or combined to produce a multi-process, multi-loop system. The trainer is supplied complete with the PC, software, controller and I/O modules that are needed to monitor and control the process rigs. A control cabinet houses the DeltaV controller and interface components that connect to the process rigs. Connections to the individual rigs are easily made using the supplied cables.

The valves, transducers and transmitters associated with the training equipment are standard industrial components that operate using simple 4–20 mA current loop control, and 24V dc. The trainer can be used to perform a set of operations that will guide the student from the basics of plant components, sensors and transmitters, to the final control algorithms that are used in various applications.

The Feedback DCS learning environment provides:

- Background theory
- An introduction to DeltaV
- General instructions on how to operate the system
- Objectives for each assignment
- Practicals (hands-on experience) within each assignment
- Suggestions for conducting experiments
- A graphical user interface



Emerson DeltaV Controller 38-306

The system has the following general features:

- A Windows-based Workstation that provides a Graphical User Interface to the processes and System configuration functions.
- The DCS is controlled by an Emerson DeltaV Industrial Control system.
- The system includes a PC with speakers to provide audible alarms.
- Allows both continuous and sequential control of the processes.
- Uses Industry-standard 4-20 mA signals, and 24 V D.C. outputs.
- 16 Analogue and 8 Discrete (Digital) inputs
- 8 Analogue and 8 Discrete (Digital) outputs.
- Uses a simple interconnect system to ease system installation.
- The system displays graphical representations of the process rigs to simulate an industrial plant environment.

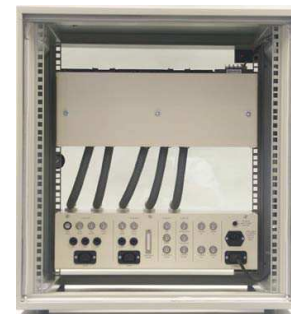
- The system has two modes: "Design" and "Run". It is possible to switch easily between these two modes. The Controller and interface system are housed in an industrial 19" rack.
- The software provides an integrated SCADA Environment with I/O tags held in a database.
- The system is a DCS learning environment which provides a range of experiments. These have both theory and practical elements.

The Emerson DeltaV Controller contains the following:

- 1 x Controller
- 1 x System Power Supply (a.c./d.c.)
- 2-Wide Power/Controller Carrier
- 8-Wide I/O Interface Carrier with Carrier Shield Bar
- 2 x analogue Input Cards: 8 Channels
- 1 x analogue Output Card: 8 Channels
- 1 x Discrete Input Card: 8 Channels
- 1 x Discrete Output Card: 8 Channels
- Termination Blocks for each I/O card



Control cabinet front view



Control cabinet rear view

Emerson DeltaV Controller Specification

The system should be configured as follows:

| | |
|--------------------------|---|
| Control Network: | 2 nodes (max 120) |
| Controllers: | 1 (max 100) |
| Simplex/Redundancy Mode: | Simplex |
| Computers: | 1 x DeltaV Professional PLUS workstation licensed for 25 DSTs (max 30,000). |
| DSTs: | 21 allocated (max 750 per controller) |
| SCADA tags: | max 25,000 |

The workstation with appropriate licenses installed:

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|------------------------------------|---|
| Open applications: | max 30 (not all can be database connections) |
| Records per event chronicle: | max 500,000 |
| Open DeltaV Explorer applications: | max 1 |
| Open Control Studio applications: | max 4 |
| History values: | max 250 |
| Open faceplates per module type: | max 4 |
| Open detail displays: | max 1 |
| Open pictures: | max 30 (for proper operation, do not exceed 25) |
| Workstation Object Identifiers: | max 16,000 |
| Plant areas: | max 100 |
| Modules per unit: | max 255 |
| Named sets: | max 1000 (includes system enumeration sets. The number available to users is less.) |
| Alarm types: | max 255 |
| DeltaV user accounts per system: | max 200 |
| Parameters per security level: | 150 |
| Open engineering tasks: | max 60 |

System Power Supply

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|-------------------------|--|
| Input: | 100-264 V a.c, 47 Hz to 63 Hz, single-phase |
| Inrush (soft start): | 230 V a.c. input at 35 A peak maximum for one cycle or less |
| Output power: | 25 W total at 60° C |
| Output voltages: | (25 W maximum) +12 V d.c. at 2.1 A maximum, +5 V d.c. at 2.0 A maximum, +3.3 V d.c. at 0.5 A maximum, combined 5 V d.c. and 3.3 V d.c. output = 10 W maximum |
| Input protection: | Internally fused, non-replaceable fuses |
| Overvoltage protection: | Output protected at 110 % to 120 % |
| Hold-up time: | Output remains within 5 % of nominal at full load and 115 V a.c. input for 20 ms. |
| Mounting: | On either slot of 2-wide power/controller carrier, Primary power Input ac input, 3-wire Alarm contacts 2-wire normally open relays, relays are closed when outputs are within $\pm 4\%$ of nominal; 30 V dc at 2.0 A, 250 V a.c. at 2.0 A. |

I/O Specifications

All supplied I/O modules are equipped with I/O Terminal Block connections. These are pre-wired as standard to the Feedback interface unit which provides easy connection to the Feedback process rigs. Connection to other systems can be made via the I/O terminal blocks if required. Spare channels are available on all I/O cards.

Discrete Output Card: 8 Channels 24 V d.c., Isolated (1 card provided)

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|--|---|
| Number of channels: | Eight |
| Isolation: | Each channel is optically isolated from the system and from each other and factory tested to 1500 V d.c. |
| Output range: | 2 V d.c. to 60 V d.c. |
| Output rating: | 1.0 A (inrush 4.0 A for <100 ms; 6.0 A for <20 ms) |
| Off-state leakage: | 1.2 mA maximum |
| Local Bus current (12 V d.c. nominal): | 100 mA typical; 150 mA max. |
| Field circuit power: | None |
| <i>Configurable channel types:</i> | |
| Discrete Output: | Output stays in last state submitted by the controller. |
| Momentary Output: | Output is active for a pre-configured time period (100 ms to 100 s). |
| Continuous Pulse Output: | Output is active as a percentage of a pre-configured base time period (100 ms to 100 s). Resolution = 5 ms. |
| Mounting: | Assigned slot of I/O carrier |

Discrete Input Card: 8 Channels 24 V d.c., Dry Contact, Series 2 (1 card provided)

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|--|--|
| Number of channels: | Eight |
| Isolation: | Each channel is optically isolated from the system and factory tested to 1500 V d.c. |
| Detection level for On: | > 2.2 mA |
| Detection level for Off: | < 1 mA |
| Impedance: | 5 k ohm |
| Local Bus current (12 V d.c. nominal): | 90 mA typical; 150 mA max. |
| Field circuit power: | 40 mA at 24 V d.c. ($\pm 10\%$) |
| Mounting: | Assigned slot of I/O carrier |

Analogue Output Card: 8 Channels 4–20 mA HART, Series 2 (1 card provided)

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|--|---|
| Number of channels: | Eight |
| Isolation: | Each channel is optically isolated from the system and factory tested to 1500 V d.c.. |
| Nominal signal range (span): | 4 to 20 mA |
| Full signal range: | 1 mA to 23 mA |
| Local Bus current (12 V d.c. nominal): | 120 mA typical, 150 mA max. |
| Field circuit power: | 300 mA maximum at 24 V d.c. ($\pm 10\%$) |
| Accuracy over temperature range: | 0.25 % of span (0–60°C) |
| Resolution: | 12 bits for AO, 8-channel, 4–20 mA |
| Output compliance: | 20 mA at 21.6 V d.c. supply into 700 W load |
| Calibration: | Information stored on card |
| Mounting: | Assigned slot of I/O carrier |

Analogue Input Card: 8 Channels 4–20 mA HART, Series 2 (2 cards provided)

| | |
|--|---|
| Number of channels: | Eight |
| Isolation: | Each channel is optically isolated from the system and factory tested to 1500 V d.c.. |
| Nominal signal range (span): | 4 to 20 mA |
| Full signal range: | 1 to 22.5 mA, with over range checking |
| Valid range for LED indication: | 0.75 to 23 mA |
| Local Bus current (12 V d.c. nominal): | 120 mA typical, 150 mA maximum |
| Field circuit power: | 300 mA maximum at 24 V d.c. ($\pm 10\%$) |
| Field circuit per channel: | 32 mA maximum |
| Accuracy over temperature range: | 0.1 % of span |
| Resolution: | 16 bits |
| Repeatability: | 0.05 % of span |
| Roll off frequency: | -3 dB at 2.7 Hz, -20.5dB at one-half the sampling frequency |
| Calibration: | None required |
| Mounting: | Assigned slot of I/O carrier |

The I/O hardware is housed in a free standing mini-rack cabinet. Cabling to the individual process rigs is provided with pre-terminated plug leads for ease of connection. The workstation (PC) is attached to the controller by the Ethernet cross-over cable supplied.

The accompanying student manual covers in detail the concepts of Distributed Control Systems (DCS) and provides a number of exercise that cover programming routines from basic settings through to configuring closed loop PID control.


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