
QES-III Locomotive Performance Enhancement System

Description

The Q-Tron QES-III Locomotive Performance Enhancement System has been designed for new build locomotives and to allow locomotives to be upgraded to current state-of-the-art microprocessor-controlled locomotives.

The QES-III Locomotive Performance Enhancement System primarily consists of a microprocessor-based Electronic Control Unit (ECU), an operator-interface panel and ancillary equipment. The ECU contains all of the I/O boards used to control and monitor the various locomotive sensors, plus optional functions such as the integrated Event Recorder. The interface panel displays data for diagnostics, speed control, self-tests, operational and alarm data, and entering setup parameters. Ancillary equipment satisfies the sensing, control, and communication requirements. The QES-III performs the same function as the original electrical equipment it replaces, plus much more.

Crews will find that the locomotive operates in much the same manner, with the exception being that in addition to the alarm lights located on the main electrical cabinet, related alarms are now also displayed on the interface panel. Shop personnel also benefit from the additional information provided by the interface panel, which includes locomotive health monitoring, operating status, troubleshooting, general messages, and alarms. The QES-III operates automatically, controlling locomotive operations by monitoring operator controls, multiple unit (MU) control lines, and various feedback and sensing devices.

Primary Features

- Main Generator Excitation Control in Power and Dynamic Brake.
- Wheel Slip/Wheel Slide/Creep Control.
- Transition Control.
- Engine Cooling Fan Control/Protection.
- Operator-Initiated Locomotive Contactor/Relay Tests

- Additional QES-III Controlling and Monitoring Capabilities:
 - Diagnostic monitoring and/or controlling of all QES-III inputs and outputs.
 - Run data monitoring.
 - Retaining QES-III system and locomotive alarms (175–200 alarms, depending on the system).
 - Displaying detailed alarm data.
 - Displaying non-statistical and statistical locomotive and QES-III system information, viewed only from the Q-Tron Universal Analysis/Download Software (QUADS) program.
 - Controlling Integrated DATACORD Event Recorder functions (optional).
 - Controlling Autostart/Shutdown functions (optional).

Versions

QES-III systems are available for installation on General Motors, General Electric, MLW, ALCO and Caterpillar powered locomotives. Q-Tron can provide solutions for other applications.

Data Downloading and Analysis

QES-III applications come complete with Q-Tron's Universal Analysis/Download Software (QUADS) program that permits the downloading and viewing of the diagnostic messages and alarms. The QUADS software also integrates all of the data requirements for the optional features such as the DATACORD Event Recorder and the QEG 1000 AutoStart. QUADS is designed to run on Windows 98, Windows NT 4.0, or higher operating systems.

Options

QES-III systems are available with the following options:

- **Event Recorder and vigilance system option**, consisting of:
Air Manifold and remote Download Box, with additional locomotive health monitoring and performance inputs available. The Integrated Event Recorder option incorporates its own microprocessor module within the ECU enclosure, and allows the QES-III to transfer information directly to the recorder. This eliminates up to 80 per cent of the wiring normally required for typical recorder installations. The vigilance (crew alertness) feature monitors certain train control functions for activity, and if none is detected during a speed-dependent time period, will initiate a penalty brake application. The event recorder function also records data about the Vigilance operation.

- **QEG 1000 AUTOSTART**
The integrated Autostart/Shutdown function provides reduced fuel consumption and exhaust emissions by monitoring locomotive operating parameters and automatically shutting down and restarting the engine during locomotive idle times. The Autostart/Shutdown system monitors various inputs and automatically restarts the locomotive engine when certain requirements are met. This ensures the locomotive is always ready to operate at peak performance levels. The Autostart indicator light on the Engine Control Panel and the Autostart siren in the cab indicate the status of the Autostart/Shutdown system. The QUADS software program provides further information on total dollar savings and other Shutdown and Restart Statistics.

- **QEG 1000 Electronic Governor**
The Electronic Governor is a next-generation product for locomotive engine control which replaces the standard hydraulic (PG or PGR) governors, while offering improved performance, lower maintenance and fuel savings. The electronic governor features include engine control/protection, enhanced horsepower management, enhanced engine temperature management and Autostart/Shutdown control.

ECU (Electronic Control Unit)

The ECU houses all of the I/O boards used to control and/or monitor the various locomotive sensors and functions (see Figure 1).

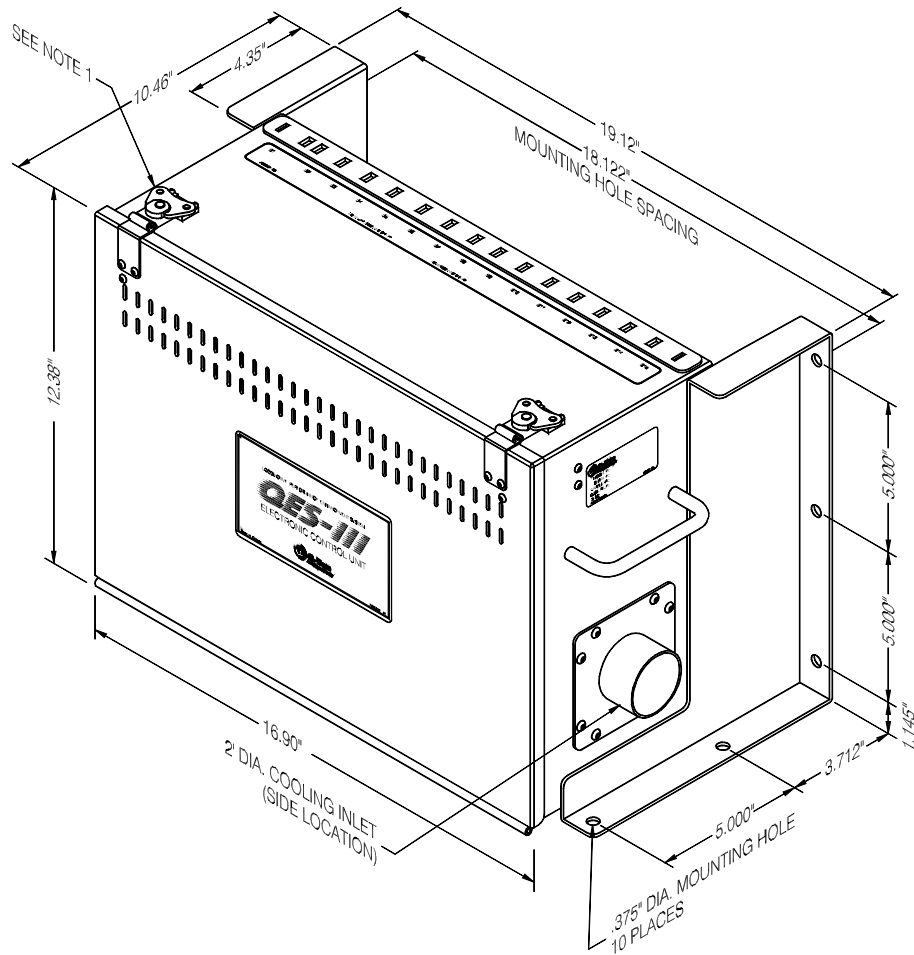


Figure 1. QES-III Locomotive Performance Enhancement System ECU cabinet

QES-III System Features

The primary control functions of the QES-III are explained in the following pages:

MG Excitation Control in Power and Dynamic Brake Operation

Power Control: Based on the status of certain MU lines, the electronic control unit (ECU) regulates engine speed and main generator output current and voltage. Signals used for wheel slip, voltages and currents, and load regulator position control generator field current and power output of the engine and main generator.

Dynamic Brake Control: Based on the state of the DB Setup and DB Excitation Control MU lines, the ECU regulates the amount of electrical braking by controlling main generator field current.

Transition Control

Series/parallel traction motor transitions are performed automatically by the QES-III system based on optimal locomotive speeds. The QES-III varies the transition speed within a small range, to prevent the risk of several locomotives repeatedly making transition at the same time. Speed must be greater than upward transition or less than downward transition for a period of at least 2 seconds to cause transition.

Wheel Slip/Creep Control

Wheel slip/creep control operates in both DB and Power. The **speed based** control system utilizes 120 pulse per wheel revolution (PPR) speed signals from each axle through the use of axle generators. The system controls wheel slip by monitoring absolute acceleration of each axle. If an axle accelerates too quickly the main generator excitation is reduced just enough to control the wheel slip, providing as much tractive effort as rail conditions permit.

The **current based** control system monitors current and voltage on the main generator and traction motors. After analyzing these signals, the QES-III adjusts system power to the traction motors.

The Wheel Slip/Creep Control system allows the wheels to creep at 1–2 MPH above track speed. As wheel slip increases, main generator power decreases. Power to the traction motors is cut quickly and then reapplied to just below the amperage level at which the wheel slip occurred. The controlled power levels result in continuous wheel creep to provide a significant increase in adhesion over conventionally equipped locomotives. The result can be as high as a 34% improvement in track adhesion under poor rail conditions.

Engine Cooling Fan Control

Locomotive engine cooling fans and shutters are controlled to equalize the number of times that each fan is started to ensure equal use of fan motors and contactors.

Air Compressor Control

The locomotive air compressor is controlled by the QES-III to maintain adequate pressure in the main reservoir. The pressure is sensed using an air pressure transducer. If the pressure drops below the system's set point, for example 130 PSI, the QES-III will turn on the air compressor to increase the air pressure back up to normal operating level, for example 140 PSI. If another locomotive in the consist activates the 22T trainline, the air compressor will turn on until the main reservoir air pressure exceeds normal operating level.

Slow Speed Control

An integrated Slow Speed Control function accessed from the operator-interface panel makes available accurate locomotive speed control down to 0.15 MPH, useful in commodity train loading applications.

Operator-Initiated Locomotive Tests

The operator-interface panel may be used to initiate one of various preprogrammed locomotive tests, including:

- Cooling Fans Test.
- Contactors Test.
- Load Box Test.
- Self-Load Test.
- Load Regulator Test.
- Relay Test.
- Engine Overspeed Test.
- Transition Test.

Additional QES-III Capabilities

Aside from the display and user interface functions performed by the operator-interface panel, all other QES-III functions are handled by the ECU. These functions include the inputs and outputs, logic, excitation control, and alarms. There are no user controls on the ECU.

The ECU contains conditioning circuitry to interface to both digital (On/Off) and analog devices on board the locomotive. All sensing, logic, communications, and control functions of the locomotive are interfaced to the QES-III system via the cable harnesses on the back of the ECU. The hardware of the ECU primarily consists of a

series of printed circuit boards (PCBs) which perform the various tasks. The ECU senses the state of the MU lines and provides Power operation as required. MU alarm lines are also sensed and displayed on the operator-interface panel. Additional controlling and monitoring capabilities performed by the QES-III are listed below.

- Standard diagnostic monitoring and/or controlling of all QES-III inputs and outputs, including:
 - MU Lines – drives 2T, 10T, 20T, 22T, and 24T; monitors throttle (3T, 7T, 12T, 15T).
 - Contactor and Relay positions – controls and monitors.
 - Main Generator Amps and Voltage (Generator Field Excitation) – controls and monitors.
 - Rate Control – controls only.
 - Load Regulator Percentage – controls only.
 - Engine Water Temperature – controls and monitors.
 - Ambient Air Temperature – monitors only (if equipped).
 - Traction Motor Blower Air Temperature – monitors only.
 - Traction Motor Currents – controls and monitors.
 - Air Compressor – controls and monitors.
 - Axle Speeds – controls and monitors.
 - Traction Motor Cutout Option – controls and monitors (varies, depending on locomotive type).
 - Ground Relay – monitors only, automatic resets up to four times.
 - Auxiliary Generator Voltage Regulation – monitors only.
 - Overriding Solenoid (ORS) – controls and monitors.

- Optional diagnostic monitoring and/or controlling of all QES-III inputs and outputs, including:
 - DB Grid Amps (DB Braking) – controls and monitors (optional).
 - DB Blower Motor Current – controls and monitors (optional).
 - Event Recorder – controls and monitors (optional).

- Run Data Monitoring:
 - Horsepower Hours.
 - Kilowatt Hours.
 - Running Hours.
 - Mileage.
 - Throttle Statistics.
 - Autostart Statistics (optional, Autostart function).

- Alarm retention (175–200 alarms, depending on the system):
 - Each alarm includes 10 snapshots (data packets) of all input/output data (one at the time of alarm occurrence, 7 before, and two after).

- Alarm Data:

- Can be viewed on the operator-interface panel, on the ALARM DATA VIEWING screen.
 - Can be downloaded to an external computer and viewed using the Q-Tron Universal Analysis and Download Software (QUADS) package.
 - Locomotive and QES-III System Non-Statistical and Statistical Information, viewed only from the QUADS software program.
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