31200
Brochure 31200
November 1996
New

Microprocessor Radio Locomotive Control

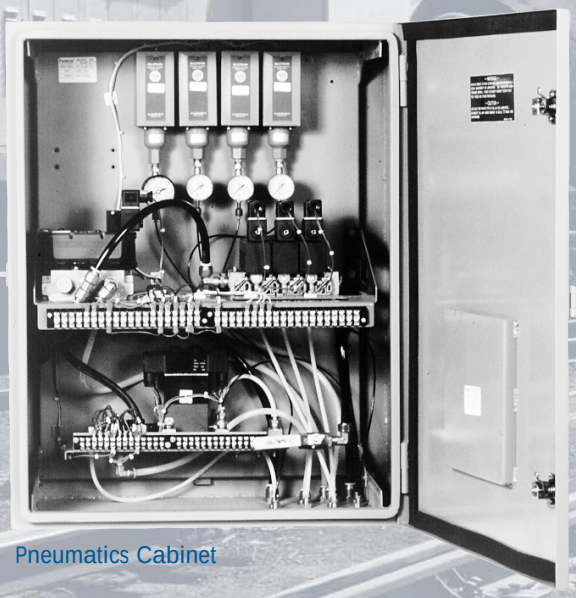
Hubbell 72 & 450 MHz Remote Control System for Locomotive Applications

The Hubbell Intelligent Radio Locomotive Systems features a microcomputer with status display and built-in diagnostics along with our high speed, digital, biphase modulation to provide reliable, efficient and economical operation of diesel-electric locomotives from a portable transmitter.

Receiver Cabinet

By operating the transmitter switches, a radio message is sent to the locomotive mounted receiver to control the direction and speed of the locomotive. Additional data bits are available to perform special auxiliary functions such as sounding of horn, application of brakes or control of couplers.

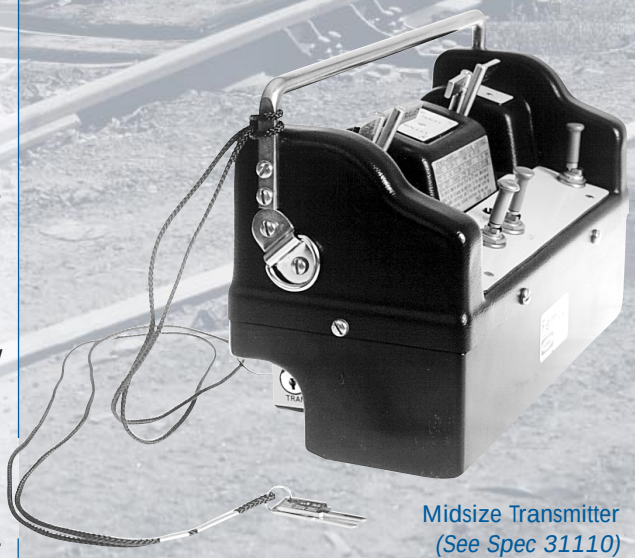
Each radio control system operates on a licensed frequency in the 72–76 MHz or the 450–470 MHz bands. The receiver is crystal controlled. A synthesized 72–76 MHz receiver is also available.



Pneumatics Cabinet

Benefits

- **Easy to Maintain** — Self diagnostics identify problem areas via the status display.
- **Fast Response** — High Speed data rate offers fast, responsive operation.
- **Frequency Conservation** — Up to four systems can share the same radio frequency, which also saves on spare parts requirements.
- **Cost Reduction** — Operating crew is reduced on each shift. Payback is realized in just a few months.
- **Better Visibility** — Remote control takes the operator out of the cab providing him with improved visibility and total control from grade level.
- **Simple Operation** — Portable, lightweight transmitter is easier to operate than manual controls.



Midsize Transmitter
(See Spec 31110)

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System Features

Secure Control — Hubbell's biphase data transmission scheme and Cyclic Redundency Check code (CRC) prevent false motions and provides for controlled shutdowns. Digital messages are checked for address, format, and content before any motion or function is activated. While in motion, check circuits continuously monitor the received message and the quality of the RF carrier signal. Any error or loss of signal integrity will de-energize all controlled functions and apply the brakes.

Frequency Conservation — It is possible to have several transmitters operating in the same area, on the same frequency, with practically no interference because of different transmission rates for each transmitter. The unique address code of each transmitter and receiver assures that only the matching receiver responds to the radio commands. All other signals on the same frequency are ignored.

"QSR" Design — Hubbell's **Q**uality, **S**erviceable, **R**eliable product design philosophy is evident with the Locomotive Control System. Protective circuits are employed to prevent transients or extreme voltage fluctuations from damaging components. The modular, solid state design, housed in NEMA 12 enclosures, provides reliable operation and long service life under the most rugged and extreme conditions. Spares requirements are significantly reduced by virtue of the shared frequency capability and modular design.

Efficient and Flexible — The high speed data transmission technique provides faster and thereby more responsive operation. A lightweight, durable plastic transmitter is comfortable and easy to operate. A manual / remote transfer switch can be provided for isolation between the manual and remote control components.

Security of the received signal and any resulting control actions are safeguarded as follows:

- The received signal must be of the proper frequency.
- The received message must have the proper address and must be in the correct format.
- The receiver calculated CRC code must be identical to the CRC code calculated by the transmitter and sent as part of each message.
- The preceding items must be met and all transmitter lever switches must be centered before the locomotive can be activated and the brakes released.
- To continue or change an energized function, requires the receipt of a "valid message" prior to time-out of the message timer (2 sec). If no valid message is received, the system turns all outputs off and applies the brakes.
- Two separate "watchdog timers" assure that all outputs are switched off in case of a receiver malfunction.

Features

Microcomputer

Hubbell's system uses a single board micro computer which converts the biphase data from the radio receiver, decodes and verifies the message by checking for errors. The computer generates the control outputs to the I / O interface boards. The address and message time interval is user programmable. A hardware watchdog timer monitors the program operation and resets the processor if the program fails to execute properly.

On-Board Diagnostics

The computer board employs continuous diagnostics. System status is displayed on a two digit alpha numeric display. Upon power-up, the initialization test checks the I / O boards, internal random access memory (RAM), the motion controlling solid state relays, and the pneumatic system.

When a fault is detected, the computer will stop the locomotive and the error will be displayed. The fault must be corrected before operation can continue.

After initialization, the watchdog circuit, the solid state relays and the pneumatic functions are continuously monitored. Any operational, communications or run mode faults will shutdown the locomotive, apply the brakes, and display a fault code.

Input/Output Board

The I / O board accepts the control outputs from the microcomputer and converts them into driving outputs for the solid state relays. The I / O board also accepts input from the solid state relays feedback circuits and provides this information to the controller for diagnostic purposes.

Emergency Stop Board

The Emergency Stop board monitors the Emergency Stop pushbuttons mounted in the locomotive, the main air reservoir pressure, oil pressure, and coolant water temperature. If any of these functions are abnormal, a signal is given to the micro to shut down the locomotive and apply the brakes.

DC Solid State Output

Each solid state relay board has eight circuits to drive the 24VDC interfacing relays and solenoid valves to control the locomotive functions.

Electro-Mechanical Relays

Electro-Mechanical Relays are used to control locomotive direction, throttle, head lamps, and Lintern lights. The Lintern lights provide operations status information for the remote operator.

Sensing Boards

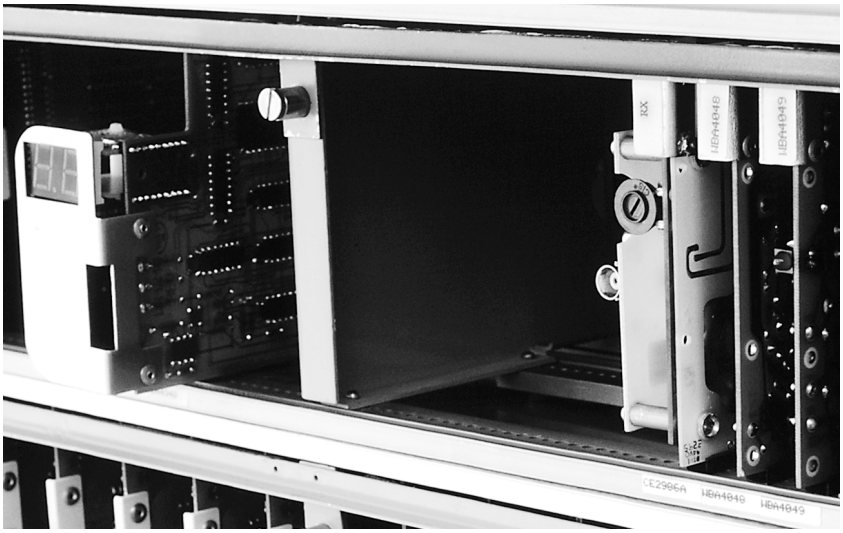
Each sensing board monitors up to eight solid state relay outputs and / or pressure switches. This provides complete feedback to the micro on relay and pressure switch status.

Receiver Cabinet

The electronics cabinet is of NEMA 12 construction and houses the power supply, the radio receiver, digital decoding logic cards, solid state drivers and the output relays.

The receiver, digital logic decoding circuits and the solid state drivers plug into common card cages. Edgemounted LED's on the circuit boards simplify system troubleshooting and maintenance tasks. All modules are removable from the front and the card cage is hinged to provide access to backplane wiring.

Solid state drivers or output relays operate the lo-



comotive magnetics and pneumatic systems in response to decoded control commands. The configuration of the manual control switches is duplicated and wired to industrially rated terminals for interconnection to the locomotive controls. A manual-remote transfer switch is provided to completely isolate the radio system from the manual controllers.

The receiver antenna is normally mounted on the locomotive cab, and sufficient co-axial cable is provided to connect the antenna to the radio receiver module in the cabinet.

Pneumatic Cabinet

The pneumatics enclosure is of NEMA 12 construction and houses the pneumatic controls for the remote operation of the locomotive. The locomotive throttle, independent brakes, and the train line brakes are normally operated via binary pneumatic valves for control of the air pressure. Other functions and the horn are controlled by solenoid valves. This cabinet also contains the pressure switches for main air, independent brakes air, train line brakes air, and throttle air.

Hubbell Offers

- **Factory Assembled** — the transmitter, receiver, and pneumatics cabinets are completely assembled and wired at the Hubbell factory.
- **System Test** — the entire system is tested for a minimum of 48 hours prior to shipment.
- **Installation and Commissioning** — Installation is accomplished quickly. Transfer switch is pre-wired and labeled, interconnecting terminals are provided to simplify installation. A Hubbell field engineer can be contracted for installation and final check-out.
- **Customer Support** — Hubbell provides a complete documentation package including drawings, operating manuals, service manuals, spare parts, training and experienced field service engineers.

Specifications

Supply Voltage ..... 12VDC, 24VDC, 36VDC or 72VDC

Internal Power Requirements ..... +11.9–13.1VDC & +4.5–6.5VDC

Operating Temperature ..... –22°F (–30°C) to 140°F (+60°C)

Radio Receiver

Frequency Range ..... 72–76 MHz or 450–470 MHz

Channel Availability ..... as required by user

Frequency Stability ..... ±5 ppm

Sensitivity ..... 1 µv @ 20 dB quieting

Data Reception ..... compatible with existing transmitters

Modulation ..... biphase

Baud Rate ..... 4800 bps

Message Format ..... preamble, sync pattern, start flag, address, control, CRC check code

Control Section

Single board computer consisting of 80C31BH controller, 64k EPROM, EPLD containing circuits for message synchronizing, and processor watchdog

Switches ..... 8 position address dip, 4 position message timer dip

Indicators ..... 2 digit display (7 segment LED) for self diagnostics & error conditions

Firmware ..... written in 8031 assembly language structured for ease of customization of output control

Functions ..... message input address decoding, error checking, control bit decoding, output control self diagnosis

Paralleled I/O ..... basic system uses single board, up to three additional boards may be added

Output per board ..... 48 software programmable for input or output with readback on all outputs

Driver per output ..... TTL compatible for up to 25mA sink

DC Output Section

Solid state relay PC boards in card cage.

Type ..... Opto Isolated

Indicators ..... Red: output activated

Output Voltage 24VDC

Input Voltage ..... 4.5–6.5Vdc, active high

Load ..... 0.5A, 24VDC, inductive

Isolation 1500V

Input Board

Input 24 VDC sensing PC board in card cage.

Indicator ..... Red: input activated

Input ..... 24VDC nominal

Isolation ..... 1500V input to output & between circuits

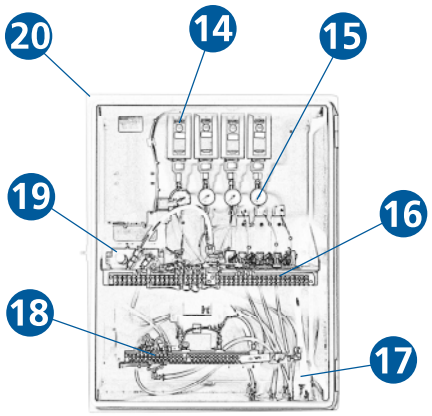
Output ..... Opto-isolated; active low

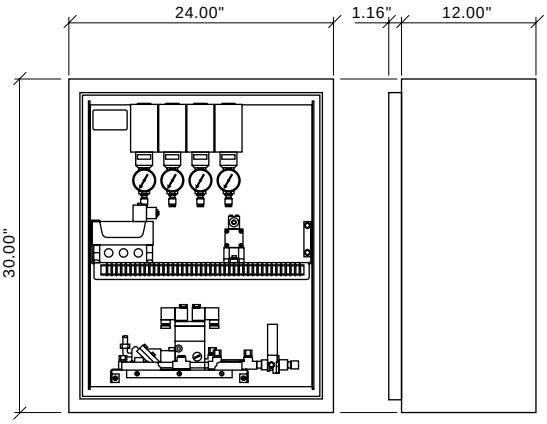
Key Components

Crane mounted NEMA 12 receiver cabinet with power converter, radio receiver, micro controller board, Input / Output board and solid state output relays.

1. NEMA Type 12 Receiver Cabinet
2. Radio / Micro Card Cage
3. Micro Controller Card with two digit display.
4. Input / Output Card
5. RF Receiver Module
6. IF Receiver Board
7. Data Demodulator Board
8. Solid State Relay Board
9. Fuse Blocks
10. Relay Panel
11. Terminal Blocks for Interconnection
12. Low Voltage Power Supply Panel
13. Transfer Switch Local / Radio
14. Pressure Switch
15. Pressure Gauge
16. Terminal Boards
17. Air Cutoff Valve
18. Binair Valve
19. Pneumatic Valves
20. NEMA Type 12 Pneumatics Cabinet

Pneumatic Power Pack





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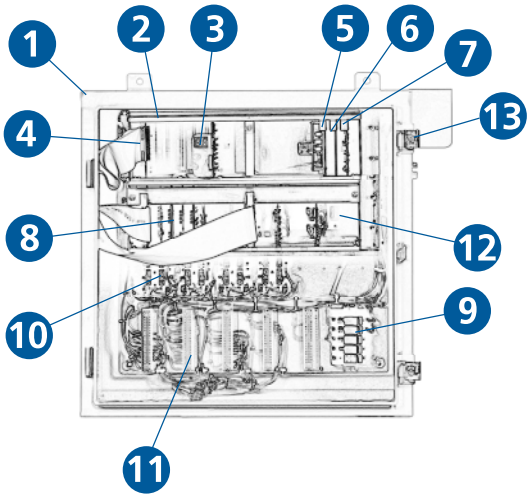

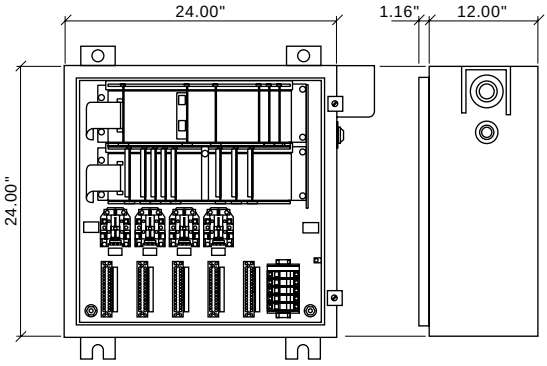

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