DATA SHEET

TRIP OPTIMIZER™

Smart Cruise Control for Trains

SAVE FUEL + IMPROVE TRAIN HANDING

Trip Optimizer™ is a smart cruise-control system for trains that takes into account terrain, train make-up, speed restrictions and operating conditions to calculate an optimum speed profile. It then automatically controls locomotive throttle and dynamic brakes to reduce fuel burn and provide efficient train handling.

With Trip Optimizer, trains run on time, operate more smoothly, and use fuel more efficiently – resulting in fuel savings and corresponding emissions reduction.

2.8

Billion liters of fuel saved since inception

1.6+

Billion auto kilometers operated

QUICK FACTS

Closed-Loop Auto Control of throttle and dynamic brakes with constant operator supervision

Individual trip plan for each train over a given territory

Platform independent software enables deployment across all locomotive platforms

New features like SmartHPT to save even more fuel

ADVANCED FEATURES AND FUNCTIONS

Advanced Train Handling
Trip Optimizer features algorithms that provide significant enhancements to train handling by predicting in-train forces real time and making adjustments to control them.

LOCOTROL® Integration
Provides automatic control of LOCOTROL independent mode, enabling smooth, consistent train handling for longer and heavier trains.

Smart HPT
Optimizes train performance for a given horsepower per ton target, driving incremental fuel savings.

Air Brake Advisement
Plans where air brake is required and, based on real-time monitoring, prompts the operator for air brake application and release.

Integration with Automatic Train Protection
Automatically adjusts to real-time network changes based on signal and speed restriction updates to provide additional automation and fuel savings.

Network Pacing
Combining Trip Optimizer with Movement Planner allows for pacing, which redistributes and optimizes the meet slack time on the line. Railroads that pace trains across the network achieve incremental fuel savings through reduced fuel burn en route.

Auto Air Brake Control
Adds starting and stopping to the operating envelope and allows Trip Optimizer to apply air brakes as needed, increasing the envelope during which Trip Optimizer operates for increased fuel savings.

FOUNDATION FOR FUEL OPTIMIZATION

Trip Optimizer is the foundation for fuel optimization. Starting with intelligent cruise control, it can be modularly expanded to add higher levels of automation and fuel efficiency–enabling scalable sustainability.

BENEFITS & OUTCOMES

Sustainable Fuel Savings
Up to 30% fuel savings for the Trip Optimizer suite; EPA-certified for 15% fuel savings

Emissions Reduction
Up to 30% based on fuel savings, plus potential for emissions credits

Efficient Train Handling
Minimizes in-train forces

Consistent Velocity Performance
Eliminates unnecessary acceleration and deceleration

Reduces Wear & Tear
Reduces deterioration of the locomotive and track through better train performance

Enhanced Train Automation
Provides the foundation for increased train automation, including application and release of air brakes and auto operation from start to stop

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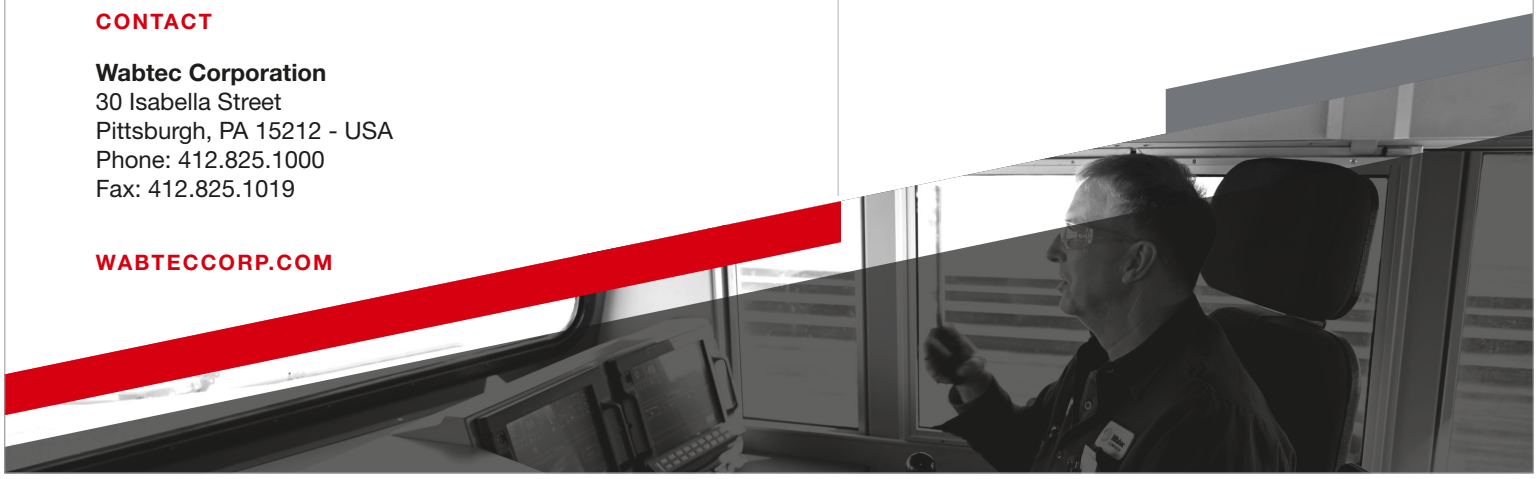


DATA SHEET

LOCOTROL® XA PLATFORM

Remote Train Operation

NEXT GENERATION TECHNOLOGY FOR TODAY'S CHALLENGES

Wabtec's LOCOTROL system was launched over fifty years ago and during that time has become the leading control and communication system.

The 6th generation of LOCOTROL, Expanded Architecture (XA), is transformational in what it can provide customers. This technology platform supports not only Distributed Power (DP), but also Remote Control Locomotive (RCL), Drone Control, Tower Control, and other advanced features – all from one platform.

50+
Years of Operating Experience

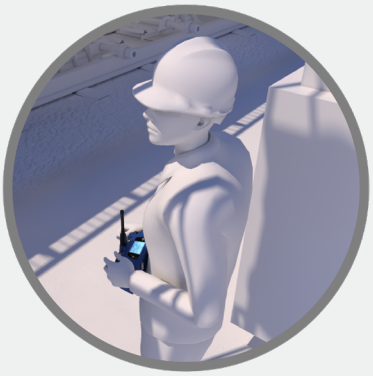
21,000+
LOCOTROL Systems Installed Worldwide

APPLICATIONS

Distributed Power
Increse capacity, improve crew efficiency.

Tower & Network Control
Increase efficiency at mines, ports, terminals, and on the mainline.

Remote Control Locomotive
Improve productivity for yard shunting; optimize mainline crew usage.



NEXT GENERATION PLATFORM

LOCOTROL Expanded Architecture (XA) is the next-generation platform providing a host of enhancements and productivity applications designed to increase the reliability and robustness needed for today's railroad operations. Architected for the future of digital-rail communications, LOCOTROL XA utilizes multiple communication options to increase bandwidth and connectivity, resulting in 50% reduction in DP communication losses and associated train delays. Current DP customers can realize significant benefits by updating to the newer XA platform.

In addition to being the platform for next generation distributed power, LOCOTROL XA is also the foundation for Remote Control Locomotive and Drone Control.

KEY CAPABILITIES OF LOCOTROL XA

Dual-radio receive diversity facilitates 50% reduction in Distributed Power communication loss, enabling trains to run at track speed more frequently and driving velocity improvements across the network.

DP messages over the ITCM network (PTC network) provides additional communication options (220 MHz, Cell, Wi-Fi) and higher data bandwidth, as a backup to the radio network.

Integrated HOT & mid-train HOT/EOT repeating reduces EOT communication losses and enables longer trains.

Triple HOT redundancy with DP radios serving as alternative HOT radio.

Enhanced diagnostics provide accurate troubleshooting and better train decisions.

Over-the-Air software updates ensure rapid software updates and feature deployment.

Operates on both diesel and electric locomotives, for easy fleet standardization.

BENEFITS & OUTCOMES

Increases Train Hauling Capacity
Enables longer, heavier trains.

Improves Train Handling
Reduces in-train forces and reduces break-in-twos.

Increases Fuel Efficiency
Reduces lateral forces and friction, resulting in fuel savings of 4-6%*, 3% EPA certified.

Increases Efficiency
Improves crew productivity, optimizes mainline crew utilization, increases throughput.

** U.S. Federal Railroad Administration, Best Practices and Strategies for Improving Rail Energy Efficiency*

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Wabtec CORPORATION

LOCOTROL®
RCL

Remote Control Locomotive

ENABLE SAFER & MORE EFFICIENT OPERATIONS

LOCOTROL® Remote Control Locomotive (RCL) is a groundbreaking technology that enables an operator on the mainline track or in a yard to remotely control a train via a handheld Operator Control Unit (OCU). The system provides two-way communications through text messages, LEDs, and audible alarms, ensuring that the operator always knows the current state of the locomotive.

Enabled by the LOCOTROL Expanded Architecture platform, RCL results in crew optimization, increased automation, and efficient train operations.

20+

Years of Operating Experience

APPLICATIONS

A yard-crew member can hostel locomotives, conduct switching operations for classification of rail cars, and build a train for departure.

A single operator can conduct local pick-ups and drop-offs between origin and destination as well as set-out bad order cars.

A single operator can bring stranded trains into congested yards if the mainline crews' time expires.

Utilize in hump operations to eliminate the need for a locomotive engineer.

Utilize in slow-speed loading and unloading operations, reducing crew workloads and leading to more efficient operations.

FEATURES AND CAPABILITIES

Speed Control

The RCL system has several modes of speed control to enable safe, efficient, and customer specific control of the locomotive.

Drone Control

Allows a remote operator to control the movement of the locomotive using speed control. This enables a remote attendant to support train movements outside of the yard environment and allows utility member to control train movements in the yard.

Communications

Bi-directional communications between RCL on board systems Dual Processor Module (DPM) and the off board Operator Control Unit (OCU) allows locomotive status to be displayed on the OCU screen, including air brake pressures and actual movement speed. With the DPM's ability to leverage Ethernet, the communication opportunities expand significantly. Additionally, RCL can be commanded utilizing WIFI/Bluetooth near field communication, LTE communication, or 220 MHz.

Safety Features

- Redundant processors within the DPM to monitor safe operating conditions
- Redundant emergency commands processed within radio messages to the locomotive
- Redundant tilt sensors in the OCU to detect an "Operator Down" condition
- Constantly monitors status; declares faults when safe operating parameters are exceeded
- RCL On/Off Switch
- Two button requirements for movement

BENEFITS & OUTCOMES

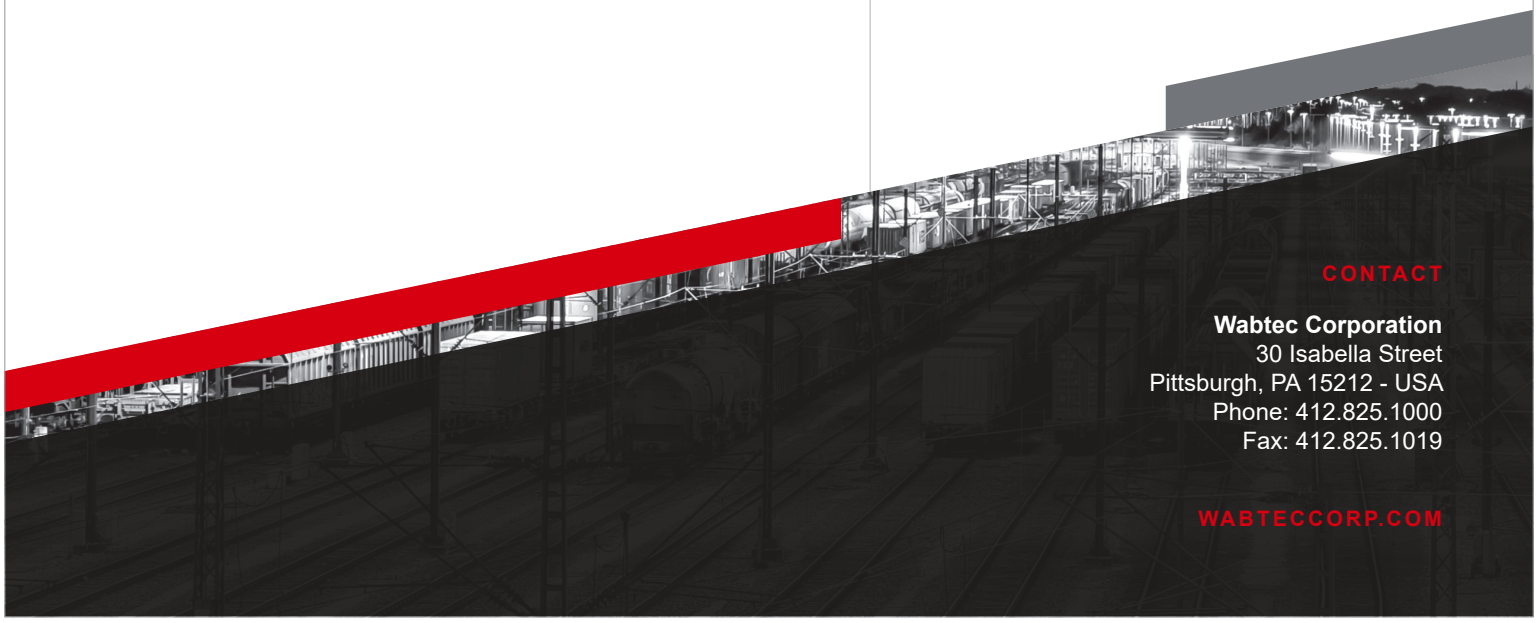
Improves crew productivity and optimizes mainline crew utilization.

Reduces car dwell time in yards.

Reduces manpower for switching operations, hauler jobs, and local jobs.

Increases auto miles with the integration to Trip Optimizer™.

Paves the way for future automation on mainlines and yards.



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Wabtec CORPORATION

I-ETMS® PROTECT

Interoperable Electronic Train Management System

ADVANCING SAFETY ON THE MAINLINE

I-ETMS Protect is a safety-critical system that provides a means to enforce movement authorities, speed restrictions, work zones and switch positioning to reduce the potential for train accidents.

I-ETMS Protect is a Safety Integrity Level (SIL) 4 certifiable system, supporting the highest levels of safety and dependability.

1.6+

Million kilometers of active protection on revenue service every day

OUTCOMES

ENSURES SAFE TRAIN OPERATION

Constantly calculates warning and braking curves based on all relevant train and track information

Communicates with wayside devices to check for broken rails, proper switch position, and signal aspects

ENSURES CREW COMPLIANCE WITH OPERATING INSTRUCTIONS

Warnings provided to crew of impending violations

System initiates braking if no action is taken

PREVENTS

Track authority violations

Speed limit violations

Unauthorized movement into work zones

Movement through a switch in the wrong position

FEATURES & KEY CAPABILITIES

TRAIN MANAGEMENT COMPUTER (TMC)

The onboard TMC consists of train control processors, business application processors, input/output, ethernet switch.

- Enforces movement authorities, speed limits, hand throw switch alignment
- Triplex architecture on the onboard supports both safe operation and high availability
- Meets subpart I requirements for PTC systems
- Hosts energy management application CPU
- Hosts ITC message router (ITCM) CPU
- Utilizes virtual block technology, while remaining compatible with existing methods of authority such as signal base authority
- Dimensions (cm): 24.1 H x 29.2 W x 29.2 D

CAB DISPLAY UNIT (CDU)

Provides the train crew with a wealth of operating information:

- User friendly display:
  - Head end speed, max. allowable speed
  - Train location: rolling map, milespost
  - Stopping distance, warning distance
  - Track features, restrictions, work zones
  - Energy management
- Enhances situational awareness
- Crew entry of credentials
- Dual displays available to support additional crew with duties in cab
- Dimensions (cm): 26.0 H x 34.3 W x 10.2 D

CERTIFICATIONS

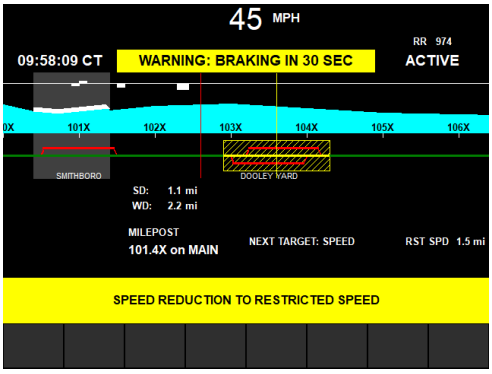
- I-ETMS Protect is a CENELEC certifiable system
- I-ETMS Protect TMC meets AAR Locomotive environmental, vibration, EMI specifications, -40° celsius to + 70° celsius

BENEFITS

Safety
Designed to help prevent train-to-train collisions, over-speed derailments, incursions into established work zones, and movements of trains through switches left in the wrong position.

Foundation for Future Innovation
Potential to drive additional efficiencies to increase capacity, optimize service and reduce fuel use and emissions.

Train Management Computer



Cab Display Unit Screen

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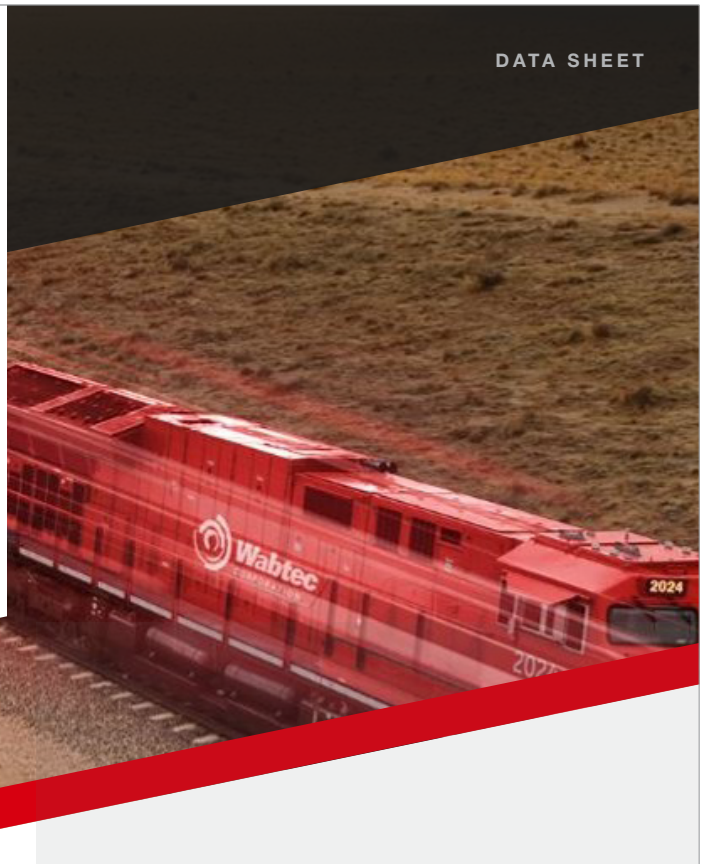
FASTBRAKE® ELECTRONIC AIR BRAKE



NEXT GENERATION BRAKE SYSTEM

FastBrake Electronic Air Brake is the latest generation of over 150 years of Wabtec braking systems for the rail industry.

FastBrake Electronic Air Brake is a microprocessor based, electro-pneumatic braking system. Designed for superior reliability, the system includes tightly integrated electronics and pneumatics, redundant electronics, dual channel power supply, and reduced part count. With over 6,000 systems installed globally, FastBrake® is service-proven and backed by Wabtec's global service and support network.

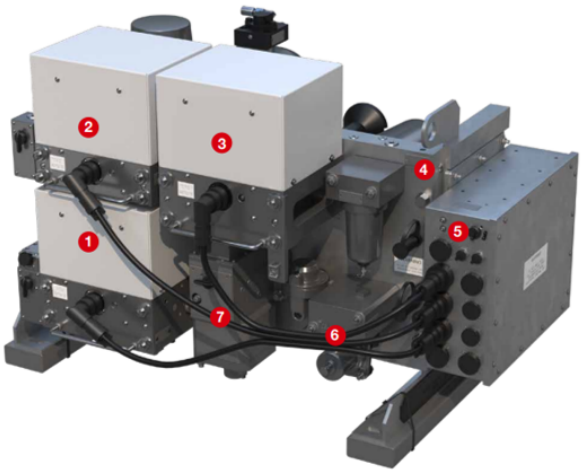
6,000+
Systems in service

20+
Countries

BENEFITS

- High Performance, High Reliability
- Reduced Maintenance Costs
- Easy to Maintain
- Scalable Across Fleets, Countries, Regions

FASTBRAKE SYSTEM OVERVIEW



1. Brake Pipe Control
2. Independent Apply & Release
3. Brake Cylinder Control
4. Filter
5. Power Supply & Loco Interface
6. Manual Cut-Out & Regulator
7. Pneumatic Back-up

KEY FEATURES

High Reliability

- Redundant electronics and power supplies
- One piece manifold improves reliability over traditional two piece glued laminated manifold plates
- CAN bus interface to modules and brake handle provides robust communications with integrated error detection and correction
- Wide operating temperature: -55C to 70C

Flexibility

- Can be integrated with Distributed Power (DP) and Electronically-Controlled Pneumatic (ECP) braking applications
- Design configurations support both one pipe or two pipe locomotive pneumatic interconnection as well as single or dual cab control

Easy to Maintain

- Compact modular design with fewer components
- Advanced diagnostics, active and passive
- Digital calibration of transducers
- Automatic downloading of module software; includes built-in validation of correct software

SYSTEM COMPONENTS

The system features two major components, the Pneumatic Operating Unit (POU) and the Handle Controller Unit (HCU).

Pneumatic Operating Unit (POU)

Comprised of (4) Subassemblies

- Brake Pipe Portion Control (BP)
- Brake Cylinder Control Portion (BCP)
- Independent Application & Release (IAR) or Brake Cylinder Equalization (BCE) Portion Options
- Power Supply Unit

Handle Controller Unit (HCU)

- Available as Desktop “30” or Standalone “26” with Display
- Magnetoresistive, non-contacting position sensor technology
- Desktop or side mount handle options and compatible with all cab design configurations

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DATA SHEET

TRAINLINK™ EOT/HOT

Train Integrity Monitoring

SUPERIOR COMMUNICATIONS

Wabtec's new generation of TrainLink™ End of Train and Head of Train devices provide industry leading communication capabilities to enable train engineers to monitor the end of the train, send emergency braking command wirelessly, and perform communication tests.

High gain antena on EOT and automatioc mid-train repeater on HOT combine to produce industry leading train communications proven to work on trains 4.9 km long.

8,500+
Locomotive system installations

4.9
Kilometers of reliable communication on a train

BENEFITS

Enhances Safey
Location, speed, and brake pipe pressure from EOT/HOT to PTC system enhances braking algorithm and distance.

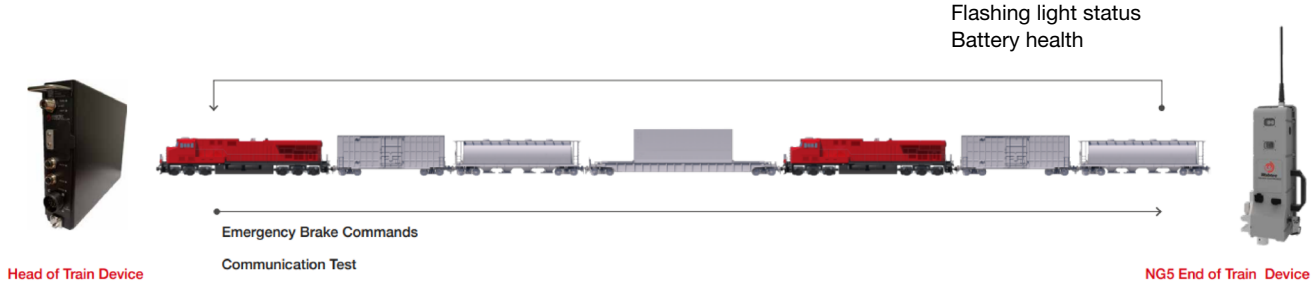
Increases Train Hauling Capacity
Highest gain rugged antenna on EOT enables reliable communications between locomotive and last car on longer trains.

Easy to Use and Maintain
Modular design makes technology upgrades easy. Service door makes maintenance fast and efficient.

OVERVIEW

Status sent every minute or if brake pipe pressure changes.

GPS position (with PTC2.0)
Last car brake pipe pressure
Emergency braking valve status
Motion status
Speed
Flashing light status
Battery health



KEY FEATURES OF TRAINLINK NG5 EOT

Built for Advanced Train Control

- Designed to integrate with PTC 2.0 and Trip Optimizer™ systems (when paired with TrainLink HOT).

Robust Communications

- Rugged external and easily replaceable antenna
- High gain antenna proven to work on 16,000 ft long trains

Streamlined Design

- 17lbs with hose
- Improved ergonomic design and handle

Powerful Electronics

- Modern ARM processor with QNX operating system
- Low power consumption to improve battery life

Serviceability

- Quick service door allows easy access to radio and download port
- Diagnostics and event logging

Modular Design

- Modular design allows for technology upgrades in future (radio, cell modem, GPS, camera, antenna)

KEY FEATURES OF TRAINLINK HOT

Built for Advanced Train Control

- Designed to integrate with Wabtec PTC2.0 and Trip Optimizer™ systems (when paired with TrainLink NG5 EOT).

Robust Communications

- Automatic mid-train repeater improves RF performance on longer trains
- Dual-Link for radio comms – UHF and ITCM/PTC

Serviceability

- USB connector for Event Logs
- 2GB SD card (expandable to 32GB)
- Wireless Bluetooth interfaces for diagnostics
- Simplified disassembly/reassembly accelerates service time

Expandability

- 2x Ethernet and 2x serial port for future expansion (PTL, MCC, 802.16t, NGHE)

Modern Electronics

- Arm Cortex-A5 32-bit processor
- QNX Neutrino RTOS

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DATA SHEET

GoLINC™ PRECISION NAVIGATION

PRECISION NAVIGATION MODULE

The GoLINC Precision Navigation Module (PNM) is designed for onboard precision navigation where centimeters of accuracy are important. It can be used in any applications requiring high precision location identification.

The primary component in the PNM is a high-precision Global Navigation Satellite System (GNSS) receiver for determining position.

KEY FEATURES

- High-performance GNSS receiver
- Compact, rugged enclosure
- 5x improvement in location accuracy
- S-9103 and S-9102 support
- I-ETMS® Certified
- 32-bit multi-core application processor
- Flash memory for database, data and general storage
- RS-232 Serial
- RTK support
- Remote upgradeability

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DATA SHEET

GoLINC™ EDGE PLATFORM

EDGE PROCESSING FOR LOCOMOTIVES

The GoLINC Edge Platform is a ruggedized Industrial IOT platform for cellular and Wi-Fi communications. It is specifically designed for fast real-time processing and ruggedized for harsh environments.

KEY FEATURES

- Basic edge compute platform
- Compact, rugged enclosure
- 32-bit multi-core application processor
- Flash memory for data and general storage
- Global LTE-Advanced Pro cellular communication with dual sim support
- Optional IEEE 802.11 b/g/n dual band Wi-Fi module for client or access point
- RS-232 Serial
- Compact 6” x 4” x 4” form factor

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DATA SHEET

EXPERT ON ALERT

Centralized Remote Monitoring & Diagnostics

LOCOMOMOTIVE RELIABILITY AT SCALE

Expert On Alert provides centralized monitoring of locomotive health status and performance in real time.

Locomotives transmit data to our Global Performance Optimization Center (GPOC), where experts supported by software algorithms, analyze control system status, and performance data. This enables us to determine root cause of failures while in-transit and proactively manage necessary maintenance and repair of locomotives.

19,000
Locomotives monitored

50
Countries

CORE CAPABILITIES

Real-time Fault Analysis and Diagnostics
Delivers real-time locomotive health checks and diagnostics

Repair Recommendation Work Scopes (Rx)
Step-by-step repair instructions, validated by experts, ensure problems are fixed correctly the first time

Proactive Parts and Resource Planning
Advanced diagnostics of key locomotive components enable proactive parts and resource planning

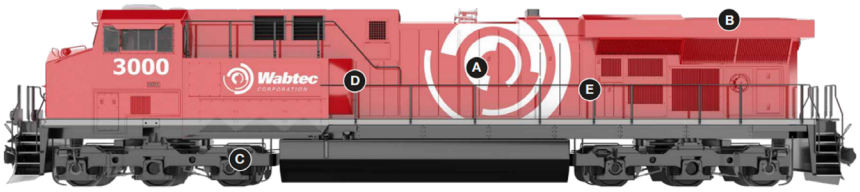
PREDICTIVE CAPABILITIES

A | Engine *T2, T3*
- Left / Right Bank PTT spread
- Charged air (Exhaust) leak
- COP trending up
- Fuel Transfer pump
- Hot MAT
- IMV
- Valvetrain: PA
- Dirty air filter
- Suspect winter / summer door
- Fuel filter

Engine *FDL*
- Main bearing
- Hot MAT
- Cooling degraded
- Water leak (FDL CCA)
- Fuel filter

Engine *T4*
- EGR Cooler water leak
- Oil Pressure low trending
- COP trending up
- EGR Valve
- Exhaust leak
- Dirty air filter
- Suspect winter / summer door
- Fuel filter

B | Cooling *T2, T3*
- Water leak
- Low oil pressure
- Oil Cooler
- High MAT
- Cooling degraded
- High water pressure
- Rad fan
- ACLS
- Fuel filter



C | Traction
- Possible impending Locked Axle
- Wheel Diameter out of tolerance
- TM Hot due to low air flow

D | Auxiliary
- Aux Alternator Gnd & Unbalanced
- TM Blower / TBC
- Alternator Blower
- Battery Health
- Battery overheating
- A2A fan

E | Compressed Air
- Air leak (using MR1 data)
- Compressor life degraded

HOW IT WORKS

- On-board sensors monitor key locomotive data
- Real-time events trigger immediate data transmission of locomotive fault log and monitoring parameter snapshot data to the Global Performance Optimization Center
- Reliability analytics models, unique to each locomotive configuration, are run to perform component level failure diagnosis
- Experts provide case management and issuance of repair advisory work scopes, Rxs, with material requirements
- Step by step repair instructions (Rx) are constantly updated based on feedback
- 24/7 support center for locomotive troubleshooting
- Cloud-hosted portal license access to advisories and data logs

OUTCOMES

- Reduced Unplanned Downtime and Train Delays
- Increase Locomotive Availability
- Reduced In-shop Dwell and Cycle Times
- Improved Service Shop Labor and
- Material Productivity
- Reduced Maintenance Spend

APPLICATIONS

- Dash 8, Dash 9, AC4400, EVO Series
- FDL and EVO Platforms
- AC and DC Power

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