PRODUCT SPECIFICATION 03449 (REVISION A, 12/2025)

Real-time Combustion Diagnostics and Control

(RT-CDC)

RT-CDC as part of a 3-Stack LECM

- Real-time cylinder pressure analysis
- Cost effective, engine-mountable module
- User calibratable
- Off-the-shelf ready or easily customized to fit requirements
- Uses standard engine encoders and sensors
- 0.5˚ resolution
- J1939 CAN
- 0-5 Vdc or 4-20 mA pressure sensor inputs
- Pressure sensor diagnostics
- Cylinder health monitoring
- Free software service and visualization tools
- Local application support

Applications

The RT-CDC is a component of an industrial engine control system for original equipment manufacturers (OEMs) and equipment packagers who demand best-in-class fuel-efficiency, low-emissions, and reliable high-performance energy management of their reciprocating engines.

The RT-CDC is used on reciprocating engines in power generation, marine, rail, and mechanical drive applications where measurement of Kw/cylinder (gas, diesel, or dual fuel) is desired.

RT-CDC is among the most cost-effective controllers on the market as it provides real-time combustion metrics normally obtained from expensive lab grade systems in a compact, engine-mountable module.

The module is available as an off-the-shelf solution, or it can be easily customized by Woodward or the customer.

Description

Real-time combustion-based control is the preeminent enabling technology for accurate and precise energy control. This technology improves emissions, transient performance, reliability, and fuel efficiency of engines and helps ensure a cleaner environment.

The most advanced engines in the world use combustion-based control to improve fuel flexibility, transient load acceptance, reduce calibration time, and deliver to broader markets faster. Specifically, gas engines have been released with diesel engine transient capabilities enabled by this technology.

Efficiency can be gained by cylinder-to-cylinder balancing (for injected engines) as well as maintaining combustion phasing. Robustness comes from engine balancing as this improves engine wear. Importantly, further gains with

engine reliability are seen from the use of cylinder health monitors (prognostic and diagnostic), better engine protection is achieved, and troubleshooting time for new technicians is significantly reduced.

Hardware

RT-CDC uses the AUX module of the Woodward Large Engine Control (LECM) platform to process in-cylinder pressure data. This processed in-cylinder pressure data provides combustion metrics used by the integrated engine control (Main+AUX or Main+EID+AUX) or a customer's control in the case of a standalone configuration.

Each AUX board supports up to 10 cylinder pressure sensors and two boards can be used for higher cylinder count engines.

Figure 1. Hardware Configurations Available with RT-CDC

For more information on either the Main Board or the EID Board, refer to LECM product specification 03425.

The following are metrics provided by RT-CDC:

Heat Release Metrics

- SOC – Start of Combustion
- CA10 – Location where 10% fuel has been burned
- CAx1 – User selectable location between 10% and 50% fuel burned
- CA50 – Location where 50% fuel has been burned
- CAx2 – User selectable location between 50% and 90% fuel burned
- CA90 – Location where 90% fuel has been burned
- Burn Duration – Crank angle degrees to burn from CA10 to CA90

Engine Protection

- True Misfire Detection – Detection when no combustion present
- Late-Fire Detection – Detection when combustion occurs but is late in the cycle
- Knock Detection – Pressure based knock intensity

Pressure Based Metrics

- Peak Pressure – Maximum combustion pressure
- Peak Location – Location where maximum combustion pressure occurred
- ROPR – Maximum rate of pressure rise
- IMEP – Gross/Net Indicated Mean Effective Pressure
- COV of IMEP – Coefficient of variance of IMEP
- PMEP – Pumping Mean Effective Pressure
- Pressures at user-defined crank angles

Woodward's free ToolKit application provides an easy-to-use support tool for configuring, operating, and monitoring the RT-CDC software. This includes data logging (MAT format), trending, and playback.

Functionality

RT-CDC was designed to provide all the core combustion metrics needed to calibrate, diagnose, and control your engine. Because accuracy and precision of combustion metrics are the primary focus of the design, you can be assured that those metrics will unvaryingly control your engine's critical parameters.

RT-CDC has the following functionality:

- Mountable on engine
- Up to 10 cylinders per RT-CDC module
- Use of standard engine encoder patterns
- Encoder sensors (speed sensors)
  - VR (proximity) or digital (Hall)
- High resolution sampling down to 0.5°CA
- Zero-lag software filtering
- Real-time cylinder pressure analysis
- Configurable mean cylinder pressure analysis
- J1939 external CAN communication
- Pressure sensor types: 0-5 V or 4-20 mA
  - Flexibility on sensor manufacturer
- Pressure sensor diagnostics
  - Thermal drift
  - Sensor noise
  - Short to ground
  - Short to power
- Crank angle location accuracy: 0.5°
- Pressure based accuracy: 0.5%
- Cylinder health monitors

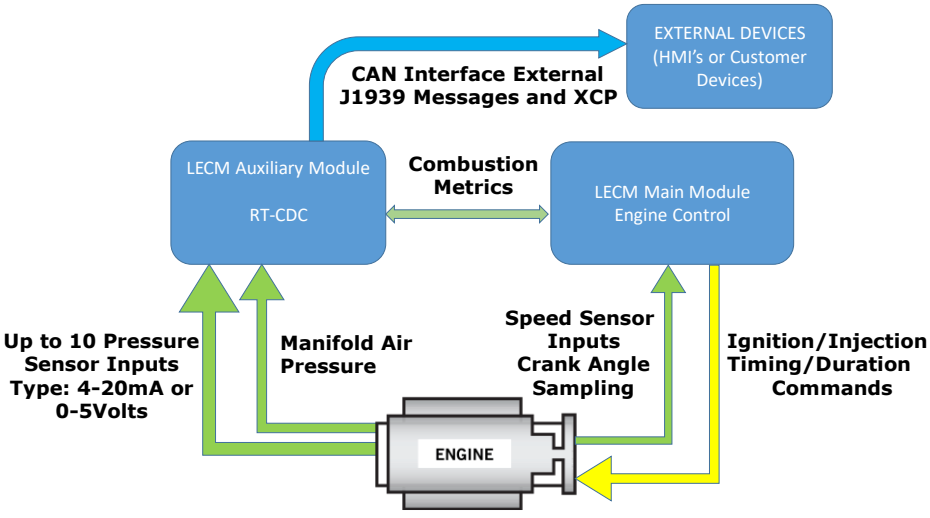

Figure 2. Sample System Diagram

The free visualization tool is instrumental in providing a clear window into what the LECM has measured for the purpose of proper calibration, understanding the engine behavior, and for performance feedback during engine calibration.

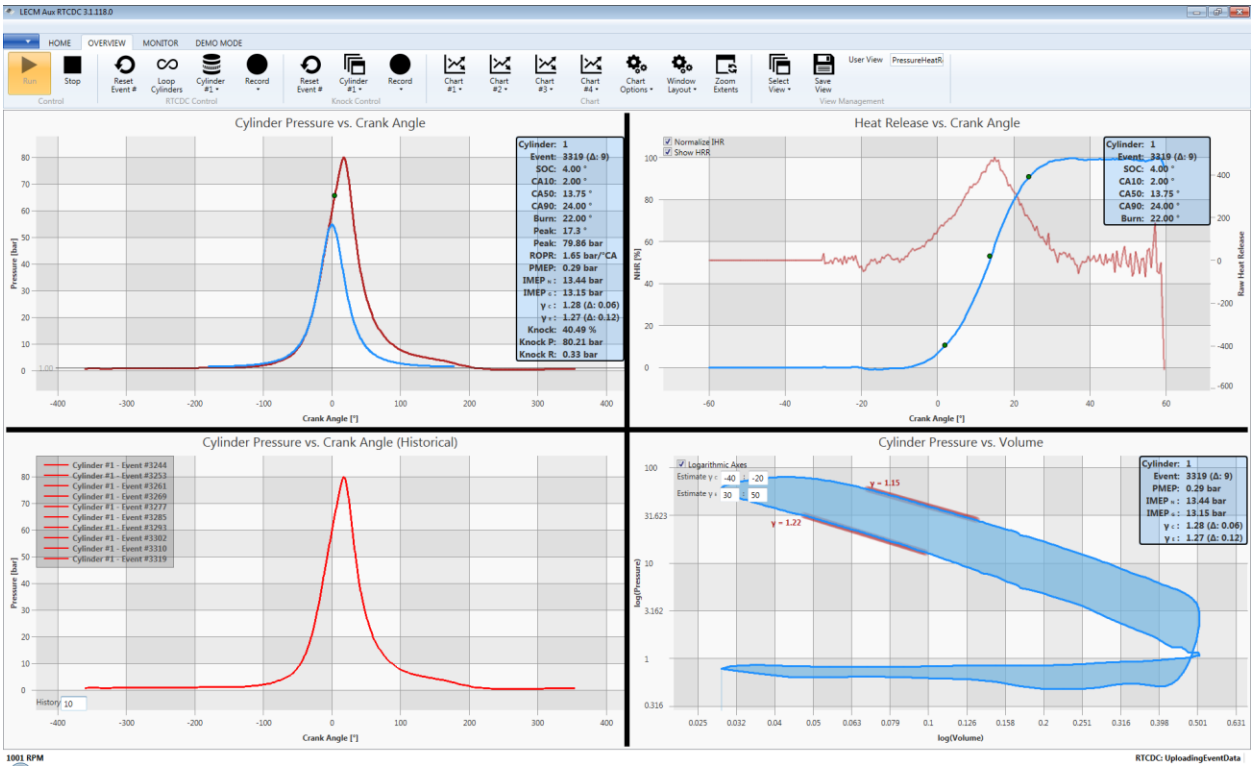

Figure 3. Visualization Tool Screenshot

Environmental Ratings

The LECM is designed for engine mounting, skid mounting, and marine industry environmental requirements. Validation tests include extreme operating temperatures, thermal cycles, humidity, pressure washing, fluid resistance, mechanical shock, vibration, and EMC.

Storage Temperature	–40 to +125 °C
Humidity	95% at +60 °C
Mechanical Vibration	US MIL-STD 202F, Method 214A, TC(D) 0.1 G2/Hz, 10–2000 Hz, 12.8 Grms, 3 hrs/axis
Mechanical Shock	40 G, 11 ms saw tooth pulse, 6/axis/direction
Enclosure Protection	IP69K

CONFIGURATION	OPERATING TEMPERATURE	CURRENT
Aux	–40 to +105 °C	0.8 A
Aux + Main	–40 to +100 °C	6 A
Aux + Main + EID	–40 to + 85 °C	6 A (Main + Aux) 20 A (EID)

Regulatory Compliance

European Compliance for CE Marking:

- **EMC Directive:** 2014/30/EU and 2004/108/EC
- **ATEX Directive:** 2014/34/EU Zone 2, Category 3, Group II G Ex nA IIC T4 Gc IP54
- **Low Voltage Directive:** 2006/95/EC
- **RoHS:** 2011/65/EU

International Compliance:

- **IECEx:** CSA 14.0047X (Ex nA) for Zone 2, Category 3, Group II G, Ex nA IIC T4 Gc IP54

North American Compliance:

- **CSA:** CSA Certified for Class I, Division 2 and Zone 2, Groups A, B, C, and D, T4 at the rated ambient temperature, for use in Canada and the United States.
  CSA Certified for Class I, Zone 2, Category 3, Group II G, AEx nA IIC T4 Gc IP54

General Compliance:

Please see LECM manual 26757 for installation constraints on cable lengths, power bus structure, grounding and shielding requirements.

Marine Hardware Compliance (*final software approval must be obtained by engine OEM*):

American Bureau of Shipping, China Classification Society, DNV-GL, Lloyd's Register of Shipping, Nippon Kaiji Kyokai. Others available upon customer request.

Related Documents

RT-CDC Product Manual 35079

LECM Product Manual 26757

LECM Product Specification 03425

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