WOODWARD

Product Manual 26640
(Revision NEW)
Original Instructions

RTCnet™ / LINKnet™ HT Nodes

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Contents

⚠WARNING

IOLOCK. When a CPU or I/O module fails, watchdog logic drives it into an IOLOCK condition where all output circuits and signals are driven to a known de-energized state as described below. The System MUST be designed such that IOLOCK and power OFF states will result in a SAFE condition of the controlled device.

- **CPU and I/O module failures will drive the module into an IOLOCK state**
- **CPU failure will assert an IOLOCK signal to all modules and expansion racks to drive them into an IOLOCK state.**
- **Discrete outputs / relay drivers will be non-active and de-energized**
- **Analog and Actuator outputs will be non-active and de-energized with zero voltage or zero current.**

The IOLOCK state is asserted under various conditions including

- **CPU and I/O module watchdog failures**
- **Power Up and Power Down conditions.**
- **System reset and hardware/software initialization**
- **Entering configuration mode**

NOTE: Additional watchdog details and any exceptions to these failure states are specified in the related CPU or I/O module section of the manual.

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Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Regulatory Compliance

European Compliance for CE Marking:
These listings are limited only to those units bearing the CE Marking.

EMC Directive:	Declared to 2004/108/EC COUNCIL DIRECTIVE of 15 Dec 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility.
ATEX – Potentially Explosive Atmospheres Directive:	Declared to 94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (see also Compliance Notes below). Zone 2, Category 3, Group II G, Ex nA IIC T4 Gc X

North American Compliance:
These listings are limited only to those units bearing the CSA identification.

cCSAus:	CSA Certified for Class I, Division 2, Groups A, B, C, & D, T4 at 100 °C surrounding air temperature. For use in Canada and the United States. CSA Certificate 2494650 (see also Compliance Notes below)

Marine Compliance:

American Bureau of Shipping:	ABS Rules 2012 SVR 1-1-4/7.7, 1-1-A3, 4-2-1/7.3 7.5.1; 4-9-3/17, 4-9-4/23 & 4-9-7/Table 9 (As appropriate)
Det Norske Veritas:	Standard for Certification No. 2.4, 2006: Temperature Class B, Humidity Class B, Vibration Class A, EMC Class A, Enclosure B. (PENDING)
Lloyd's Register of Shipping:	LR Type Approval Test Specification No. 1, 2002 for Environmental Categories ENV1, ENV2 and ENV3 (PENDING)

Other Compliance:
These listings are limited to those units bearing the C-Tick mark:

C-Tick (ACA/RSM):	Declared to Australian Radiocommunications Act of 1992 and the New Zealand Radiocommunications Act of 1989.

Compliance Notes:
This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D T4 at 100 °C surrounding air temperature per CSA for Canada and US or non-hazardous locations only.

This equipment is suitable for use in European Zone 2, Group IIC environments when installed in an IP54 minimum rated enclosure per self-declaration to EN 60079-15.

RTCnet and LINKnet HT nodes are open-type equipment that are installed in a suitable enclosure of final application, with combination subject to acceptance to the Local Inspection Authority having jurisdiction.

Field wiring must be in accordance with North American Class I, Division 2 (CEC and NEC), or European Zone 2, Category 3 wiring methods as applicable, and in accordance with the Local Inspection Authority having jurisdiction.

The modules must be installed in a vertical position in a enclosure with a minimum IP54 rating to meet the cyclic Damp Heat requirements of Marine Agency Type Approval.

Special Conditions for Safe Use:
Field wiring must be suitable for at least 10 °C above ambient conditions during operation.

This equipment must be installed in an area or enclosure providing adequate protection against impact and the entry of dust or water.

For ATEX compliance, the user-provided enclosure must have a minimum IP54 ingress protection rating per IEC 60529 and meet the construction requirements of IEC 60079-15. The interior of the enclosure shall not be accessible in normal operation without the use of a tool.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2.

Chapter 1.
General Information

Introduction

Woodward RTCnet and LINKnet HT distributed I/O nodes are small CANopen based modules designed for turbine control in harsh vibration and temperature environments.

Woodward Control Systems like MicroNet Plus can easily program these nodes to gather I/O sensor data from remote locations. Woodward's GAP Graphical Application Program software provides automatic node initialization, RateGroup operation, and diagnostic features when using these nodes to control:

- Gas and Steam Turbines
- Gas and Diesel Engines
- Hydro Turbines

Because RTCnet and LINKnet HT nodes may be skid mounted with the turbine or engine, typical installation and maintenance costs for cables, sensor wiring, and field troubleshooting can be significantly reduced.

Product Highlights

- Suitable for skid mounted turbine and engine control markets
- Designed for high temperature and high vibration operation
- RTCnet products are designed for real-time, deterministic operation
- LINKnet HT products are designed to support slower, non-critical I/O
- Designed for easy integration with Woodward controls like MicroNet Plus
- Provides Plug-N-Play integration with Woodward GAP software and RateGroups
- Provides a convenient upgrade path for older LINKnet distributed I/O nodes

Features and I/O

- High temperature operating range of –40 °C to +100 °C
- High vibration operation for skid mount vibration and shock levels
- 18 V to 36 V (dc) isolated input power with isolated CAN communications
- RT, real-time version with deterministic and synchronous updates of 10 ms to 160 ms
- HT, asynchronous, non real-time version with 100 ms to 1 second update rates
- RTCnet products have (2) CAN ports to support redundant network and cabling

A MicroNet Plus Control system using RTCnet / LINKnet HT nodes with Woodward's GAP software provides a powerful control environment. Woodward's unique RateGroup structure ensures that control functions execute with determinism at intervals defined by the System Engineer. GAP allows critical control loops to be processed as fast as 5 milliseconds while less critical code is assigned to a slower execution rate like 160 ms. The RateGroup structure prevents the possibility of changing system dynamics when adding additional code so the control functions are always deterministic and predictable.

RTCnet / LINKnet node configuration, diagnostics, and monitoring are provided through standard MicroNet and GAP tools like Monitor GAP and SOS OPC server.

RTCnet Product Family

RTCnet products are focused on real-time deterministic I/O with redundant CAN ports. These nodes support MicroNet Plus CPU failover and are designed to operate in high temperature and high vibration environments.

Node Types
- (8ch) RTD Input (100 Ω, 200 Ω)
- (8ch) High Accuracy Thermocouple Input (K, N, E, J, R, S, T, B, mV)
- (10ch) AIO 4 mA to 20 mA In/Out (8AI, 2AO) (loop & self-power versions)
- (16ch) Discrete Input
- (16ch) Discrete Out Relay Driver

Figure 1-1. RTCnet, Real-Time

LINKnet HT Product Family

LINKnet HT products provide for slower, asynchronous distributed I/O with a single CAN port. These nodes support MicroNet Plus CPU failover and are designed to operate in high temperature and high vibration environments.

Node Types
- (8ch) RTD Input (100 Ω, 200 Ω)
- (8ch) Thermocouple Input (K, N, E, J, R, S, T, B, mV)
- (10ch) AIO 4 mA to 20 mA In/Out (8AI, 2AO) (loop & self-power versions)
- (16ch) Discrete Input
- (16ch) Discrete Out Relay Driver

Figure 1-2. LINKnet HT Products

Environmental Specifications

These specifications apply to both RTCnet and LINKnet HT product lines.

Operating Temperature	–40 °C to +100 °C
Storage Temperature	–40 °C to +105 °C, recommend 20 °C to 40 °C for long life
Vibration	8.2 Grms, industrial skid mount, per Woodward RV1
Shock	40 G, 3x each axis, per Woodward MS1
Humidity[1]	5 % to 95 %, non-condensing
Ingress Rating / Installation[2]	IP20, Pollution Degree2, Overvoltage Category 3
EMC Emissions	EN 61000-6-4 (Heavy Industrial) IACS UR E10 (Commercial Marine)
EMC Immunity	EN 61000-6-2 (Heavy Industrial) IACS UR E10 (Commercial Marine)

[1]Cyclic condensing humidity is supported with selection of an appropriate enclosure

[2]ATEX, IP54, and Pollution Degree 3 are supported with an appropriate enclosure.

Electromagnetic Compatibility (EMC)

The RTCnet and LINKnet HT products comply with Heavy Industrial EMC requirements per EN 61000-6-4 & EN 61000-6-2 specifications. Marine Type Approval is also met per IACS UR E10 EMC test requirements.

Emissions EN 61000-6-4 & IACS UR E10

- Radiated RF Emissions Limits 150 kHz to 3000 MHz per IEC 61000-6-4 & Marine Type Approval.
- Power Line Conducted RF Emissions Limits 10 kHz to 30 MHz per IEC 61000-6-4 & Marine Type Approval.

Immunity EN 61000-6-2 & IACS UR E10

- Electrostatic Discharge (ESD) immunity to ±6 kV Contact, except to I/O pins, and ±8 kV Air per IEC 61000-4-2
- ±6 kV Contact to I/O pins, operational with deviations and ±8 kV Package and Handling without damage.
- Radiated RF Immunity to 10 V/m, from 80 MHz to 3000 MHz per IEC 61000-4-3.
- Electrical Fast Transients (EFT) Immunity to ±2.0 kV, kHz 5 & 100 kHz rep rate on I/O and Power input cabling per IEC 61000-4-4.
- Surge Immunity (PS) to ±1.0 kV CM and ±0.5 kV DM per IEC 61000-4-5.
- Surge Immunity (I/O) to ±1.0 kV CM per IEC 61000-4-5.
- Conducted RF Immunity to 10 V (rms) from 150 kHz to 80 MHz per IEC 61000-4-6.
- Conducted Low Frequency Injection Immunity to 3.6 V (rms), ≤ 2 W Power, from 50 Hz to 12 kHz on Power Inputs per Marine Type Approval test requirements.
- Conducted Low Frequency Injection Immunity to 3.6 V to 0.36 V (rms), ≤ (2 to 0.2) W Power, 12 kHz to 150 kHz on Power Inputs, extended from Marine Type Approval test requirements.

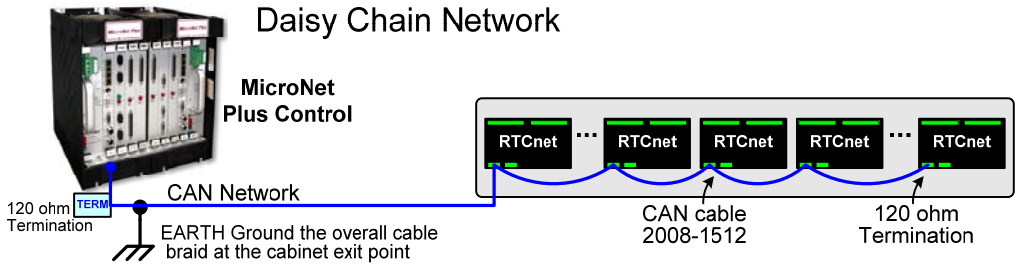
Chapter 2.
RTCnet and LINKnet HT Distributed I/O Networks

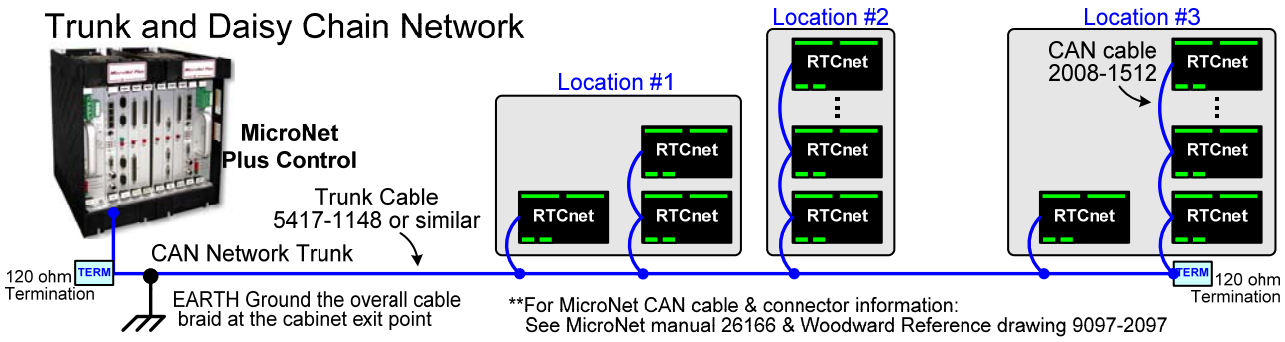
Product Compatibility

The RTCnet and LINKnet HT product families are compatible with the MicroNet Plus simplex and redundant CPU platforms. GAP3.04 and Coder 6.0 or later software tools are required. Contact Woodward Marketing and Sales for compatibility with other Woodward products.

Network Wiring Considerations

The CAN network may be routed using either a simple daisy-chain wiring strategy or a Trunk and daisy-chain wiring strategy. The primary requirement is that the CAN network is terminated with 120 Ω ±10 Ω resistors at each end of the "trunk" cable.





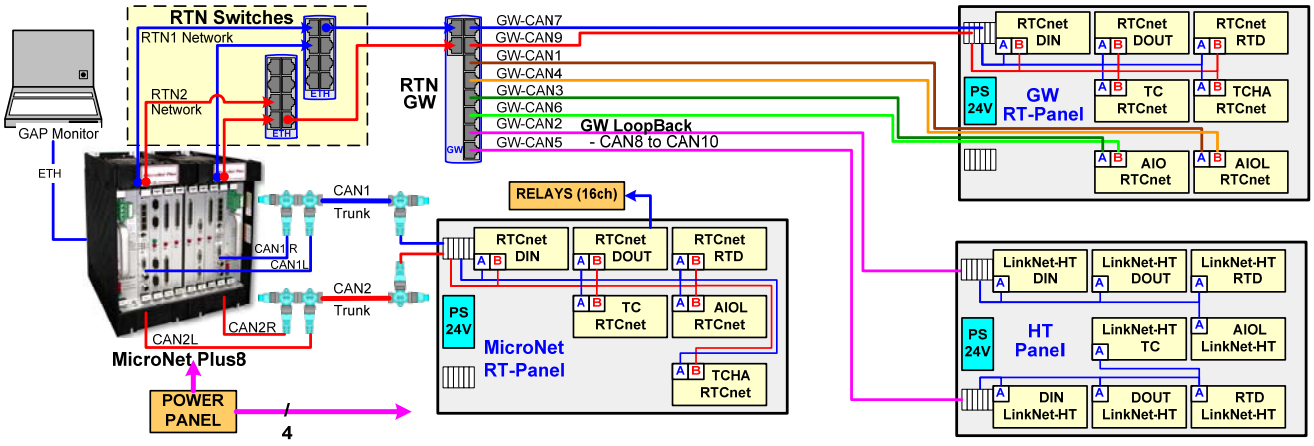
IMPORTANT

For MicroNet CAN cable and connector options see MicroNet manual 26166 and Woodward Reference drawing for CAN/DeviceNet cables 9097-2097.

Network Examples with MicroNet

The following is an example MicroNet Plus, redundant CPU system using RTCnet and LINKnet HT products. The MicroNet CPU's are directly connected to a group of RTCnet nodes and the RTN Gateway is used to interface with (2) other node groups.

This example shows redundant CPU's and multiple node locations supported with Woodward's RTN Gateway. It also shows redundant RTCnet CAN network wiring and redundant RTN networking to the RTN Gateway.



IMPORTANT

Reference information:

- **Manual 26640—For RTCnet and LINKnet HT nodes.**
- **Manual 26166—For MicroNet RTN Ethernet switches and cables.**
- **Manual 26612—For RTN Gateway information, cables, and setup.**

Useful Woodward Part Numbers at the Time of Writing

CAN Cables (reference drawing 9097-2097)	
5417-1127	Cable - CAN MicroNet drop, 7/8 inch male to M12 female (1 m)
5417-1142	Cable - CAN drop, 7/8 inch male to pigtail (1 m, mid gauge)
5417-1148	Cable - CAN mid trunk cable (3 m, mid guage)
1635-1463	Connector - CAN network tee, 7/8 inch M/F with F drop
1635-1464	Connector - CAN terminator 7/8 inch, male 121 Ω
1635-1465	Connector - CAN terminator 7/8 inch, female 121 Ω
2008-1512	Cable - CAN RTCnet High Temp (1.5 pair, 0.3 mm² / 22 AWG, 125 °C)
8923-1889	KIT - RTCnet CAN termination resistor (121 Ω, qty 20)
Misc.	
5417-394	Cable - Double Shielded CAT-5 Ethernet (SSTP), 10 foot
1752-423	Hirschmann Copper Ethernet switch (RS2-TX, 8 port)
1711-1069	Hirschmann Fiber Optic Switch (RS2-4TX/1FX)
1751-6077	Hirschmann Fiber Optic Switch (RS2-3TX/2FX)
1730-221	General Purpose Relay (24 V dc, 10 A, "ice cube")
1731-757	Socket - DIN rail base for relay 1730-221

Network Power Distribution

Power Bus Distribution: The primary power distribution bus should be < 300 m with a recommended wire size of 3 mm² / 12 AWG or larger. It is expected that it will be broken out to smaller distribution wires at the final location. Wires should be routed with positive and negative together, but they don't need to be twisted. When the optional EARTH terminal is used at the nodes, it should be routed as short as possible to an earth/chassis enclosure connection.

IMPORTANT

Longer cable runs and complex power distribution designs may require a more detailed power system analysis. For best performance, it is important to control the total input source resistance to < 5.4 Ω and total input source inductance to < 300 µH.

Power Wiring to nodes: Wires routed from the main bus to feed the nodes shall be 0.5 mm² / 20 AWG to allow daisy chaining the power from node to node. It is recommended that the power daisy chain be limited to 16 nodes of any combination.

Power Fusing: Breaker or power-line fusing is recommended to protect the power wiring network from possible wiring shorts. The breaker or fuse rating for a group of nodes should be at least 1.5 A (time-delay type) per AIO node and 0.75 A (time-delay type) per all other node types to avoid nuisance trips. Due to the isolated input PS design, each node does not need individual fuse protection, but should still be fuse protected in strategic groups.

Power Wiring / Shielding: No shield is required, however it is allowed and beneficial in harsh corrosive environments. If used, it should be EARTH terminated to a DIN rail or panel connection with as short a wire as possible. See the cable shield preparation and the node grounding sections for specific guidance.

CAN Network Communications

RTCnet and LINKnet HT nodes communicate with the master controller (i.e.: MicroNet) using the CAN protocol. Both RTCnet and LINKnet HT nodes support MicroNet dual CPU's and failover operation. **Note:** RTCnet nodes have (2) redundant CAN ports and LINKnet HT nodes provide only (1) CAN port.

CAN Specifications

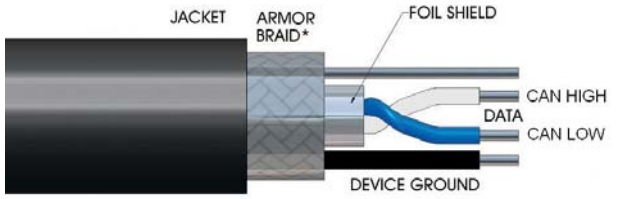
Interface Standard	CAN 2.0B
Network Connections	(2) Redundant CAN ports, separate connectors
Network Isolation	500 V (ac) to chassis, input power, I/O channels, between CAN ports
Network Speed/Length	1 Mbit @ 30 m 500 Kbit @ 100 m 250 Kbit @ 250 m (thick cable only, otherwise limited to 100 m) 125 Kbit @ 500 m (thick cable only, otherwise limited to 100 m)
Network Termination:	(120 ± 10) Ω is required at each end of the network trunk line. **The termination resistor is NOT built into the node hardware.
Node Address	(2) Rotary switches shall configure the node address (range of 1–99).
Baud Rate configuration	rotary switch selectable for 125 K, 500 K, 250 K, and 1 Mbit
Cable / Part Number	2008-1512 (120 Ω, 3-wire, shielded twisted pair) —Belden YR58684 or similar
Cable Drops (1 Mbit)	CAN Cable drops shall be < 1 m and as short as possible
Cable Drops (500K, etc)	CAN Cable drops shall be < 6 m and as short as possible

**If needed, a recommended CAN to USB converter is IXXAT, HW221245 (isolated)

CAN Cable Specifications

Belden YR58684, high temperature communications / CAN cable is approved and recommended. This is a smaller and more flexible 0.3 mm² / 22 AWG, low capacitance cable suitable for tight routing between nodes in high temperature environments.

Belden YR58684, bulk cable (Woodward PN **2008-1512**)



Impedance:	120 Ω ±10 % at 1 MHz
DC resistance:	17.5 Ω per 1000 ft
Cable capacitance:	11 pF/ft at 1 kHz
Data Pair:	0.3 mm² / 22 AWG, 7 strands, individually tinned, FEP insulation (BLUE, WHITE twisted pair)
Ground:	0.3 mm² / 22 AWG, 7 strands, individually tinned, FEP insulation (BLACK)
Drain / Shield Wire:	0.3 mm² / 22 AWG, 7 strands, individually tinned
Shielding:	Foil 100 % with outer Braid 65 %
Jacket:	FEP Insulation, BLACK
Cable type:	1.5 pair, twisted shielded
Outer Diameter:	0.244 inch
Bend Radius:	2.5 inches
Temperature:	–70 °C to +125 °C
Similar Cable:	Belden 3106A (has different colors & lower temperature specs)

CAN Cable Shield Terminations & Exposed Cable Limitations

For robust communications performance, the CAN cabling needs to minimize the exposed, non-shielded cable section that occurs at terminal blocks. The exposed length of CAN wiring must be limited to less than 3.8 cm / 1.5 inches from the end of the shield to the terminal block. This limits the total length of exposed wiring during a series or daisy chain connection on each side of the terminal block to 7.6 cm / 3 inches.

CAN shields are terminated to chassis (EARTH) through a capacitor-resistor network. This is designed into the RTCnet / LINKnet HT nodes, RTN Gateway, and MicroNet products. However, the shield must also be directly terminated to chassis (Earth) at one point in the network. In the case of Woodward equipment, the direct ground is meant to be located at the master device end, as it exits the master device's enclosure.

IMPORTANT

Always use shielded cables for improved communications in industrial environments. Wire terminations at the node should expose as little un-shielded cable as possible (less than 3.8 cm / 1.5 inches).

Daisy chaining CAN cables between multiple nodes allows leaving down to (20 to 30) cm / (8 to 12) inches of shielded cable between each node, a violation of the standard practice with shielded cable terminal block shield breaks listed below. (The shield break is not a stop of the shield. It is reducing the full shield encompassing internal wires to a single wire to pass through or connect to the terminal block.) This is acceptable for CAN only at the nodes, as long as the cable from the terminal block closest to the main exit entrance point of the enclosure is at least 1 m / 39 inches long before another terminal block break in the full shielding of the cable wires. The individual shield caps in the nodes add, to provide low impedance shield terminations. Shield brakes not at the node terminal blocks should be minimized, and may have additional coupling capacitors to earth as noted below in the general wiring section (if desired, implement with great care).

Chapter 3. Installation

Introduction

This chapter provides the general information for mounting location selection, installation, and wiring of the RTCnet and LINKnet HT distributed I/O node modules. Hardware dimensions, ratings, and requirements are given for mounting and wiring the control in a specific application.

Each type of I/O node is physically similar, only the High Accuracy Thermal couple I/O nodes are different sized. In addition, each node type has the same power input and CAN cabling options. The two families of Distributed I/O have two differences in CAN: RTCnet has two redundant CAN ports synchronized for real-time communication and LINKnet HT has a single CAN port that is not real time capable.

Basic installation guidance is given within this chapter, but specific requirements are given with each type of distributed I/O node.

Shipping Carton

Before unpacking the I/O nodes, refer to the inside front cover and page vi of this manual for WARNINGS and CAUTIONS. Be careful when unpacking the I/O node. Check for signs of damage such as bent or dented panels, scratches, and loose or broken parts. If any damage is found, immediately notify the shipper.

The node was shipped from the factory in an anti-static foam lined carton. This carton should always be used for transport of the I/O node or for storage when it is not installed in the system.

General Installation

When selecting a location for mounting the I/O Nodes, consider the following:

- Protect the unit from direct exposure to water or to a condensation-prone environment.
- The control is designed for installation in a protective metal enclosure such as a standard cabinet with ingress protection rating of IP54 or greater for Hazardous locations.
- Provide an ESD strap or other discharge methods as ESD mitigation inside the cabinet; it must be used for handling the equipment and plugging/unplugging the connectors.
- Provide adequate ventilation for cooling. Mount in a location that is able to maintain an ambient operating temperature within the range of rated maximum and minimum ambient temperatures. Shield the unit from radiant heat sources as needed to maintain ambient temperature within the rated range.
- Do not install the unit or its connecting wires near inductive, high-voltage, or high-current devices. If this is not possible, shield both the system connecting wires and the interfering devices and/or its wires.
- Allow adequate space around the unit for air flow, servicing, and wiring.
- Do not install where objects can be dropped on the terminals or inside the unit.

- Ground the chassis for proper safety and shielding effectiveness. The DIN Rail connector is designed to be the main functional ground for RF. The optional power input ground wire may be, and is recommended to be, grounded too if corrosion or significant vibration may be present. A DIN Rail mounted grounding terminal block connected to the power port ground pin by as short and large gage wire as possible is recommended.

Mounting Requirements

The nodes are DIN rail mounted, using the DIN Rail as the primary source of chassis ground. The DIN Rail must be connected to EARTH ground as with the enclosure and mounting plate for the DIN rail.

DIN rails must have mounting screws to bolt down and bond to the mounting plate at least every 6–8 inches, (15–20 cm) or ~1–2 inches (~2.5–5 cm) in on each end if the DIN rail is shorter than ~12 inches (30 cm). This provides stability and grounding paths. In addition to the DIN rail grounding, in some environments it is required to add the supplemental ground wire connection from the power port to earth.

IMPORTANT

The nodes may be mounted in any orientation necessary. However for best accuracy, the T/C Thermocouple nodes should be mounted in an upright-vertical position.

Nodes should maintain at least **8** cm / **3** inches between them on the long edge and may be flush mounted against each other on the short edge. When using the T/C High Accuracy node, plan for an additional **2** cm / **0.75** inch for the I/O wiring clamp.

Mounting of the units must be such that the Power and CAN cabling are restrained to be directly against the earth grounded metal mounting plate. Since power is not required to be shielded and daisy chained CAN breaks the shield at regular intervals, it is advisable to either segregate power and CAN as possible or shield the power port cabling. The design is expected to have power and CAN be directly restrained to the mounting plate, so they are flush against it for as much length as possible outside the service loop. (The Service loop should be as short as possible too.)

The I/O cabling is intended, but not required, to be segregated from the CAN and Power wiring, this may be accomplished by aligning two rows next to each other and placing the CAN and power bus wiring between them, restrained to the mounting plate in two separate rows, Field I/O cables staying on the outside of the two rows of nodes. This mounting scheme can be repeated to keep field I/O together and away from CAN and Power bus wiring. If not shielded, segregation of DI & DO field wiring is strongly suggested due to switching arc noise on relay contacts and the transient pulse due to relay coil current stored energy.

It is recommended that unshielded and shielded field I/O cabling also be segregated to the extent possible. Specifically DI & DO cabling routed away from other cabling, due to the noise it can generate or couple as noted above.

General Notes:
Terminal blocks are Phoenix MCVR series for all products except High Accuracy T/C
Plug Type is side entry, 3.5 mm, latching screw-down for all nodes except High Accuracy T/C
Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires
Voltage / Current Rating: 300 V, 8 A

A small flathead screw-driver (0.4mm wide blade) is required for all terminal blocks.
—Example: Woodward PN 8992-005 (WAGO 210-619, 2.5 mm x 0.4 mm blade)

High Accuracy T/C Node
High Accuracy T/C node channels 1–8 use **fixed** (non-pluggable) 3.5 mm terminal blocks, screw-down for improved cold-junction compensation. The max wire size is 1.3 mm² / 16 AWG for single wires.

Compatibility with Older LINKnet Product Line
The RTCnet / LINKnet HT communication protocol, cabling, and termination design is NOT compatible with the older LINKnet.

RTCnet / LINKnet HT nodes are smaller than the original LINKnet nodes. The length is about 2” (5cm) shorter and the width is about 0.1” less (except for the T/C High Accuracy node which is approx 0.5” wider with the wiring clamp).

RTCnet / LINKnet HT uses smaller 3.5mm pitch connectors than the older 5mm products. RTCnet / LINKnet HT allows a max size single wire of 1.3 mm² / 16 AWG wire. The older product LINKnet terminal blocks (5 mm) allow for a single 2 mm² / 14 AWG wire.

IMPORTANT

Terminal block wiring must use multi-stranded wires to provide best results. Due to the clamping action of screw-down and spring-loaded terminal blocks, lower voltage level signals like TC and RTD input are susceptible to glitches when using single “solid-core” wires.

IMPORTANT

Do not tin (solder) the wires that terminate at the node terminal blocks. The spring-loaded CageClamp or screw down terminal blocks are designed to flatten stranded wire, and if those strands are tinned together, the connection loses surface area and is degraded. The solder tinned wire end will also cold flow over time potentially further degrading or break the connection.

⚠WARNING

CAN NETWORKS. It is possible to disrupt an existing CAN network by attaching an improperly configured device. To prevent problems on your existing network(s), read this chapter before connecting an RTCnet or LINKnet HT Node to a network.

Outline Drawing for Nodes

The physical outline dimensions for RTCnet and LINKnet HT nodes are shown below using a generic RTCnet node drawing. See Woodward Reference drawing 9989-1169 for additional details if necessary. **Note:** The T/C High Accuracy node outline drawing is slightly different because of the wiring gland plate and is show in the next section.

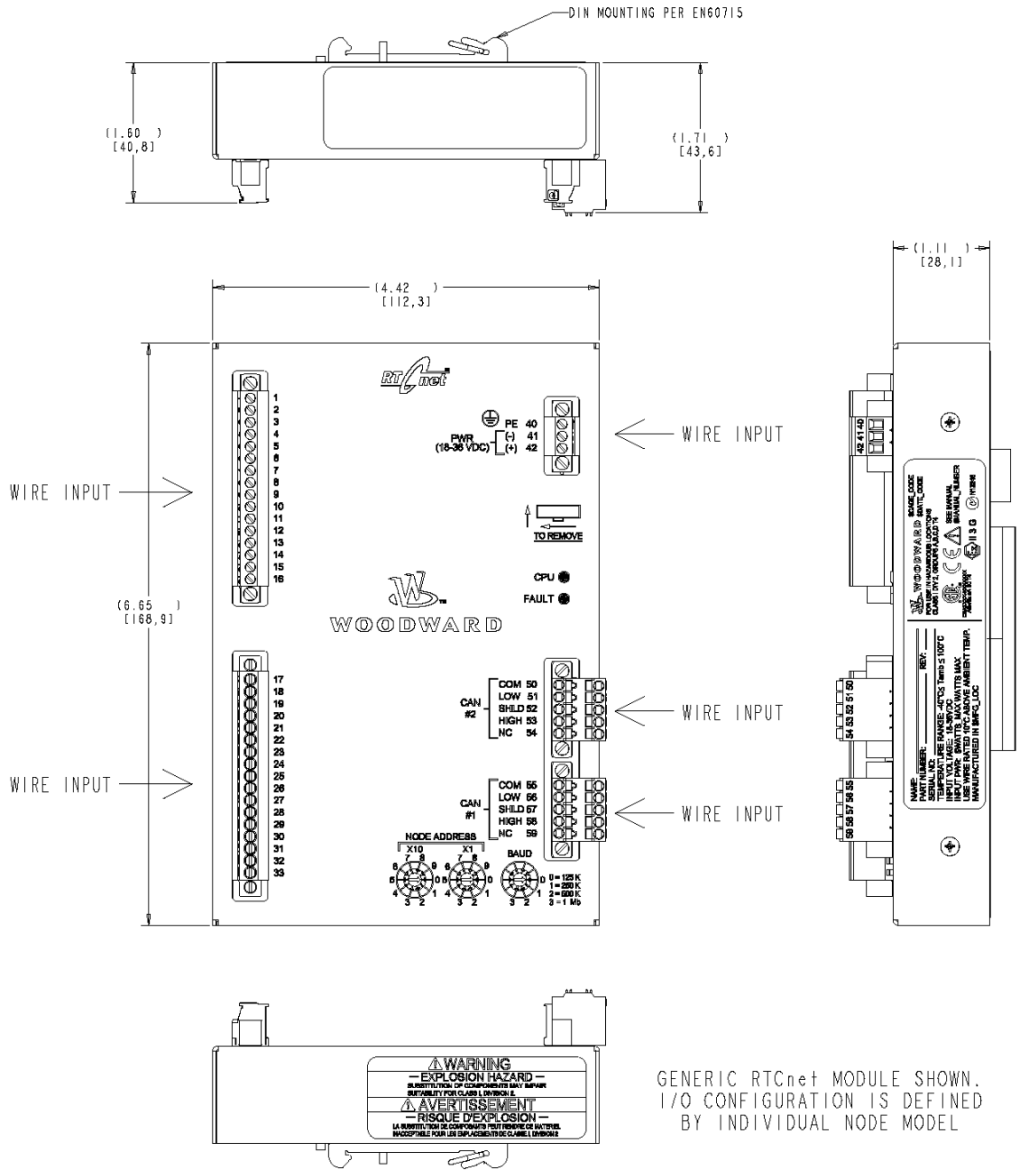


Figure 3-1. RTCnet and LINKnet HT Node Outline Drawing

Outline Drawing for T/C High Accuracy Node

The physical outline dimensions for the T/C High Accuracy node is shown below and is slightly different because of the I/O wiring gland plate. See Woodward Reference drawing 9989-1169 for additional details if necessary.

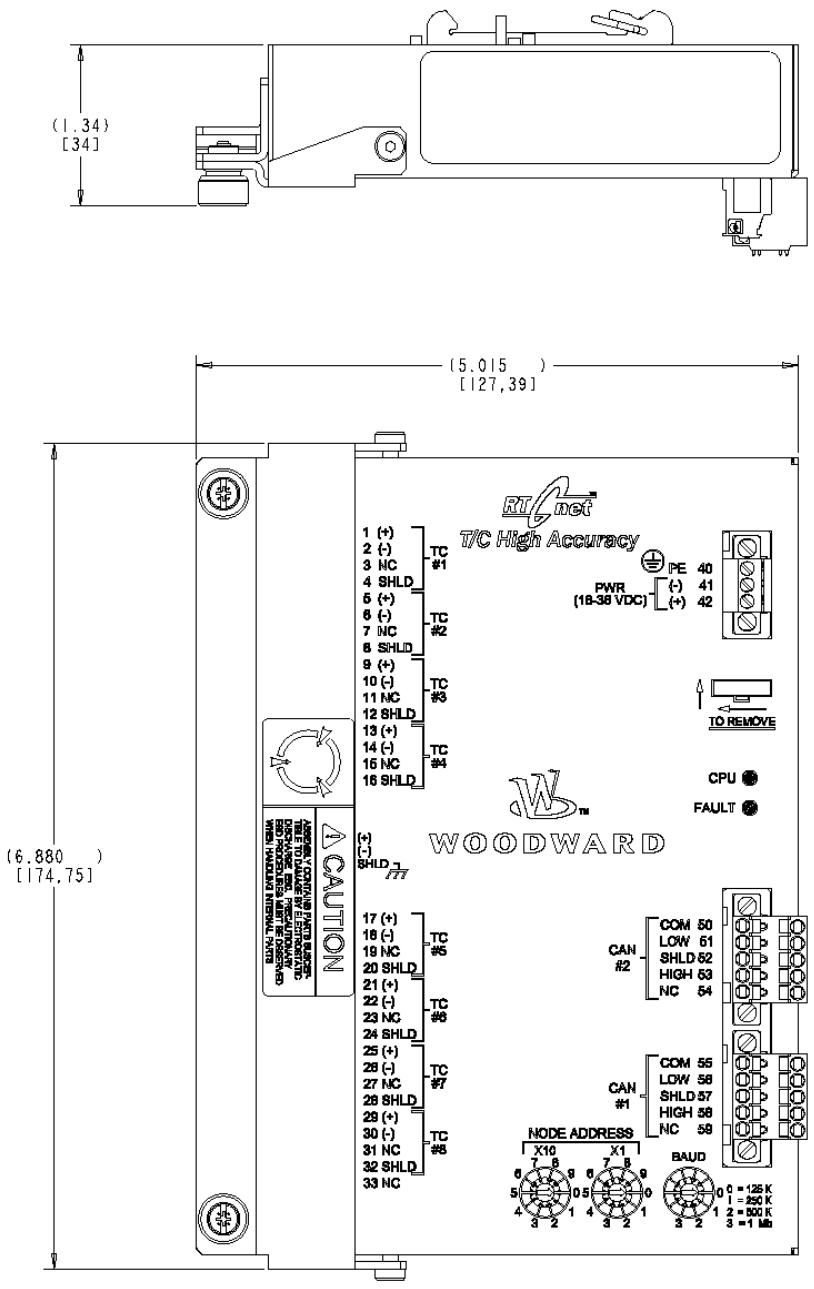


Figure 3-2. T/C High Accuracy Node Outline Drawing

Recommended Grounding Practices

Each type of the I/O nodes must be grounded to earth by the DIN rail. The DIN Rail and mounting plate must be bonded to ground. The DIN Rail connector is designed to be the main functional ground for the units.

The optional power input ground wire may be, and is recommended to be, grounded too if corrosion or significant vibration may be present. A DIN Rail mounted grounding terminal block connected to the power port ground pin by as short and large gage wire as possible is recommended.

Input power ground terminal, not power return, should be wired / bonded to earth ground in applicable cases like environments that lead to corrosion or hazardous atmosphere environments.

General Wiring Guidance

Shielded Wire, Shield Termination Lead Preparation

Where shielded cable is required, cut the cable to the desired length and prepare the cable as instructed below.

1. Strip outer insulation from both ends, exposing the braided or spiral wrapped shield. Do not cut the shield or nick the wire inside the shield.
2. Using a sharply pointed tool, carefully spread the strands of the braided shield to form a hole.
3. Take hold of the inner conductor(s) wire's insulation and pull the wires out of the shield one at a time.
    a. If the shield is the braided type, twist the braid it to prevent fraying; twist it with the drain wire if one is present. Use as much of the shield braid and drain combined as possible to terminate the shield.
    b. Foil shields or shields of foil combined with braid require the drain to be brought out and excess foil may be removed.
4. Remove 6 mm (1/4 inch) of insulation from the inner insulated signal conductors.
5. Connect wiring and shield as shown in plant wiring diagram.
6. If a shield connection is not required or desired, fold back and secure or remove the excess shield as needed. (If there is a landing/connection point for the shield, it should be used to get optimal signal performance.)

General Wiring Installation

All signal lines except power supply, Discrete Input and Discrete Output, wiring should be shielded to prevent picking up stray signals from adjacent equipment. These may also be shielded if desired.

For noise suppression reasons, it is recommend that all low-current and low voltage wires be separated from all high-current and/or high-voltage wiring.

Strain relief is recommended for cables. In general strain relief of cables is a wise practice.

Input power ground terminal, not power return, should also be wired / bonded to earth ground in applicable cases like environments that lead to corrosion or hazardous atmosphere environments.

All shielded cable must be twisted conductor pairs, triples or multiple pairs. The nodes are designed with AC (Capacitor) and direct shield terminations to earth ground at the cable landing points to facilitate shield termination.

Installations with severe electromagnetic interference (EMI) and maintaining electromagnetic compatibility (EMC) may require additional shielding precautions, such as wire run in conduit or double shielding. In general the devices are designed with a level of immunity to EMI and to maintain EMC for the typical installation environment and added pre cautions are not needed. Contact Woodward for more information.

In general shields are intended to be terminated to their landing point on the RTCnet or LINKnet HT nodes. They may also be required to be landed / terminated at the opposite end.

Shields from the node to its loads or input sources can be directly grounded to earth at both ends, but only if the cable length is sufficiently short to prevent ground loop current in the shield. (e.g. Shields within a single cabinet or where the shortest straight line distance between shield to chassis/earth connection points is no further than 10 m to 30 m apart).

If long cables are used where termination end point separations are greater than 10 to 30 m, and both shield ends must be terminated, a capacitor must be used at one end to terminate the shield to earth/chassis. The preferred point for the capacitor is at the remote end, but individual device sensitivity makes this a determinative process, to find the end most applicable to using it. Using a 0.01 µF, 1500 V, capacitor is typically sufficient.

If intervening terminal blocks are used in routing a shielded signal cable, the shield should be continued through the terminal block. If shield grounding is desired at the terminal block, it should be AC (capacitor) coupled to earth. It is suggested to limit the number of TB break points along the cabling between the field device end and node end to a minimum, zero would be best. In general, at least 39 inches (1 m) of cable with an intact shield should present between breaks in the shield. Daisy chained CAN drop cabling has an exception.

Multiple, spread out, direct or high capacitance connections of a shield to earth should be avoided. Multiple connections of shielding runs the risk of high levels of low frequency ground current, like 50/60 Hz, flowing within the shield. If there are multiple connections made, add the impedance of them up and make sure it is much greater than safety grounds impedance required by local laws.

Shielding and Enclosure Installations: If the device is installed in a metal enclosure, as expected and intended by hazardous location installations, shielded I/O must be AC or DC terminated directly to the enclosure (earth ground) at the entry to the enclosure, as well as at the intended shield pins on the nodes.

As noted, shield termination can be a deterministic process. AC shield connections (capacitors) on shield I/O may be dictated at the node, instead of the direct earth connection provided. Typically, shields at signal inputs are connected directly to earth, and shields at signal outputs are AC-coupled to earth or floating. All shields from the nodes, except CAN are designed directly terminated to earth / chassis. See Woodward application notes 50532, *Interference Control in Electronic Governing Systems*, and 51204, *Grounding and Shield Termination,* for more information.

Specifics are provided in each individual installation section.

Node Replacement / HotSwap

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2.

⚠WARNING

For simplex systems this procedure will SHUTDOWN the control system.

⚠WARNING

CAN NETWORKS. It is possible to disrupt an existing CAN network by attaching an improperly configured device. To prevent problems on your existing network(s), read this chapter before connecting an RTCnet or LINKnet HT Node to a network.

A faulty RTCnet / LINKnet HT node can be replaced using the following steps.

Configure the new replacement node:

- Set the new node address and baud rate to match the faulty node. Remember the node address and use it in GAP to verify that you are initializing the proper module.

Removal of faulty node:

- Disconnect the POWER from the faulty node
- Disconnect the CAN1 and/or CAN2 ports from the faulty node
- Disconnect the I/O wiring from the faulty node
- Carefully remove the faulty node from the DIN rail

Installation of new replacement node:

- Install the replacement node onto the DIN rail
- Re-Connect the I/O wiring from the faulty node
- Re-Connect the CAN1 and/or CAN2 ports to the faulty node
- Re-Connect the POWER to the faulty node

Node Initialization:

- Use GAP to initialize and reset the node (NODE_INIT). Remember the node address / ID and use it in GAP to verify that you are initializing the proper module.
- Verify the node FAULT led clears properly
- Verify proper GAP operation

Commissioning Checklist

Power checks

- Verify proper polarity on power connections
- Verify power source and wire size is sufficient for all loads
- Verify input power is 18 V to 36 V (dc) with < 1.5 V (rms) ripple
- Verify PS(+) and PS(–) impedance to EARTH is > 10 MΩ
- Entire power network source resistance should be < 5.4 Ω
- Entire power network source inductance should be < 300 µH

CAN checks

- Verify CANH is not connected to PS(+), PS(–), EARTH
- Verify CANL is not connected to PS(+), PS(–), EARTH
- Verify CAN_COM is not connected to PS(+), PS(–), EARTH
- Verify CAN shield wire is not shorted to PS(+), PS(–)
- Verify CAN network length is < max length spec for the baud rate being used
- Verify CAN drop cables to each node are as short as possible and meets spec.
- Verify both ends of each CAN network is terminated with 121 Ω between CAN-H and CAN-L wires.
- Verify the CAN network uses 3-wires (CAN-H, CAN-L, and CAN_common) with shielding
- Verify CAN cable is 2008-1512 (Belden YRxxx) or equivalent low capacitance, shielded communications wire.
- Verify the CAN overall cable shield is terminated to EARTH at only (1) location for each network. This should be located at the master control (MicroNet) as the cable exits the control cabinet.
- For redundant nodes, verify CAN1 and CAN2 networks are not miswired and connected together.

DI, Discrete Input wiring checks

- Verify each DI(+) is not shorted to another input.
- Verify each DI(+) is not shorted to CPWR(+), CPWR(–), PS(+), PS(–), EARTH.
- Verify each DI(+) wiring is functional by setting each input HIGH (>16 V DC) and then LOW (<8 V DC). Verify GAP software detects the state change.
- When possible, consider using a shielded DIN cable.

DI, Contact Power (CPWR) wiring checks

- CPWR(+) is an output voltage, it should never be connected to any other supply.
- To maintain node isolation, verify CPWR(–) is not shorted to PS(–).
- Using the internal isolated Contact Power output (CPWR,COM) is highly recommended to maintain node-to-node isolation.
- Verify CPWR(+) is not connected to CPWR(–), PS(–), EARTH.
- Verify CPWR(–) is not connected to CPWR(+), PS(+), EARTH.
- Verify CPWR voltage level is correct (18 V to 36 V DC).

DO, Discrete Output wiring checks

- Verify each DO(–) is connected to the COIL POWER SOURCE (common) properly.
- Verify each DO(+) output is connected to the COIL LOAD properly.
- Verify each DO(+) is not shorted to another output channel.
- Verify each DO(+) is not shorted to DO(–), PS(+), PS(–), EARTH.
- Functionally verify each DO(+) wiring by driving each output ON then OFF. Verify the GAP software detects the readback state change.
- When possible, consider using a shielded DOUT cable.

TC, Thermocouple Input wiring checks

- Verify each TC(+,–) is not shorted to another input channel.
- Verify each TC(+) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each TC(–) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each TC shield wire is not shorted to PS(+), PS(–).
- Verify no wires are landed accidently on the NC, no-connect terminals.
- Verify each TC shield wire is terminated at the node properly.
- Functionally verify the wiring for each TC channel using a simulator source.
- TC OPENS: A TC input will read MAX DegC if the (+) or (–) wire is broken / open.
- TC SHORTS: A TC input will read 0 DegC if the (+) and (–) wires are shorted.

NOTICE

GROUND FAULTS: Input channels accidently shorted to EARTH will be more susceptible to spurious noise events related to the installation and environment.

RTD, Input wiring checks

- Verify each RTD(+,–) is not shorted to another input channel.
- Verify each RTD(+) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each RTD(–) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each RTD(sense) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each RTD(sense) terminal is connected properly for 3-wire sensors.
- Verify each RTD(sense) terminal is jumpered to RTD(–) for 2-wire sensors.
- Verify each RTD shield wire is not shorted to PS(+), PS(–).
- Verify each RTD shield wire is terminated at the node properly.
- Functionally verify the wiring for each RTD channel using a simulator source.
- RTD OPENS: RTD channels will read MAX DegC if the (+) or (–) wire is broken.

AI(non-loop), Analog Input wiring checks

- Verify that external XDCR's are NOT used with these self-powered channels.
- Verify each AI(+,–) is not shorted to another input channel.
- Verify each AI(+) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each AI(–) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each AI shield wire is not shorted to PS(+), PS(–).
- Verify each AI shield wire is terminated at the node properly.
- Functionally verify the wiring for each AI channel using a simulator source.

AI LOOP, Analog Input wiring checks

- Verify that external XDCR's are connected to these channels.
- Verify the LPWR voltage level (+22 V DC) is correct for the XDCR.
- If the XDCR needs loop power common, use the LOOP_GND terminal.
- Verify each LPWR(+) terminal is wired to the XDCR POWER(+).
- Verify each LPWR(+) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each AI(–) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each AI shield wire is not shorted to PS(+), PS(–).
- Verify each AI shield wire is terminated at the node properly.
- Verify that all XDCR's for one node use less than 250 mA of LPWR.
- Functionally verify the wiring for each AI channel using a simulator source.

AO, Analog Output wiring checks

- Verify each AO(+,–) is not shorted to another output channel.
- Verify each AO(+,–) is not shorted to another Analog Input channel.
- Verify each AO(+) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each AO(–) terminal is not shorted to PS(+), PS(–), EARTH.
- Verify each AO shield wire is not shorted to PS(+), PS(–).
- Verify each AO shield wire is terminated at the node properly.
- Functionally verify the wiring for each AOUT by driving 4 mA and 20 mA to the load from the GAP application. Verify the RDBK value and correct load current.

Chapter 4.
RTD Nodes (8ch)

Description and Features

The RTD node is a CANopen based distributed I/O module that interfaces to either a Woodward RTCnet or LINKnet HT network. RTCnet products are designed for synchronous real-time/deterministic operation whereas LINKnet HT products are designed for slower asynchronous networks.

This module provides (8) channels of I/O monitoring for 100 Ω and 200 Ω resistive temperature devices. Both European (alpha=0.00385) and American (alpha=0.00392) curve types are supported.

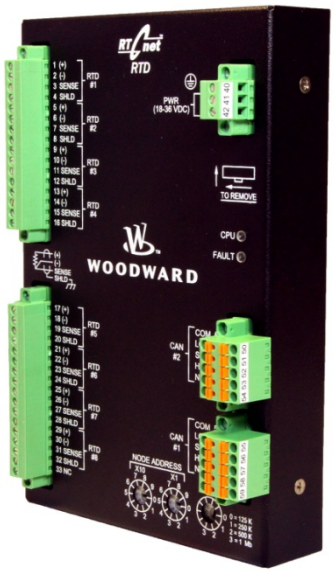
Features

- (8) RTD Input Channels, 15 bit resolution
- RTD sensor types (100 Ω, 200 Ω, and ohms)
- RTD curves (European alpha 0.003850, American alpha 0.003920)
- High accuracy with automatic temperature compensation
- High temperature/reliability design for 100 °C environments
- High vibration design suitable for industrial turbine/engine skid-mounting
- Designed for operation with MicroNet Plus and redundant CPU failover
- Woodward GAP block, diagnostics, and configuration support
- 3-way isolated design separating power, communications, and inputs

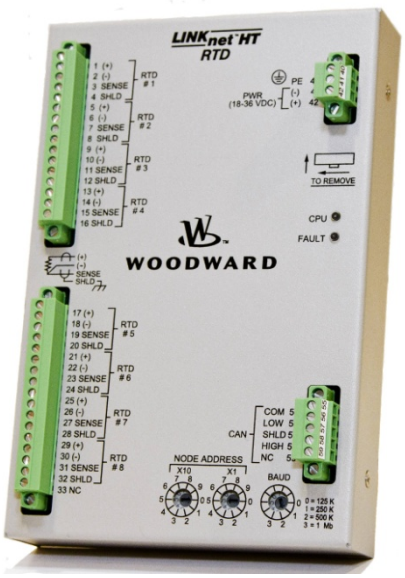
CAN Communications (isolated)

- Baud rate configuration for 1 Mbit, 500 Kbit, 250 Kbit, and 125 Kbit
- RTCnet supported GAP update rates of 20 ms, 40 ms, 80 ms, 160 ms
- LINKnet HT supported GAP update rates of 100 ms, 200 ms, etc (up to 1 second)

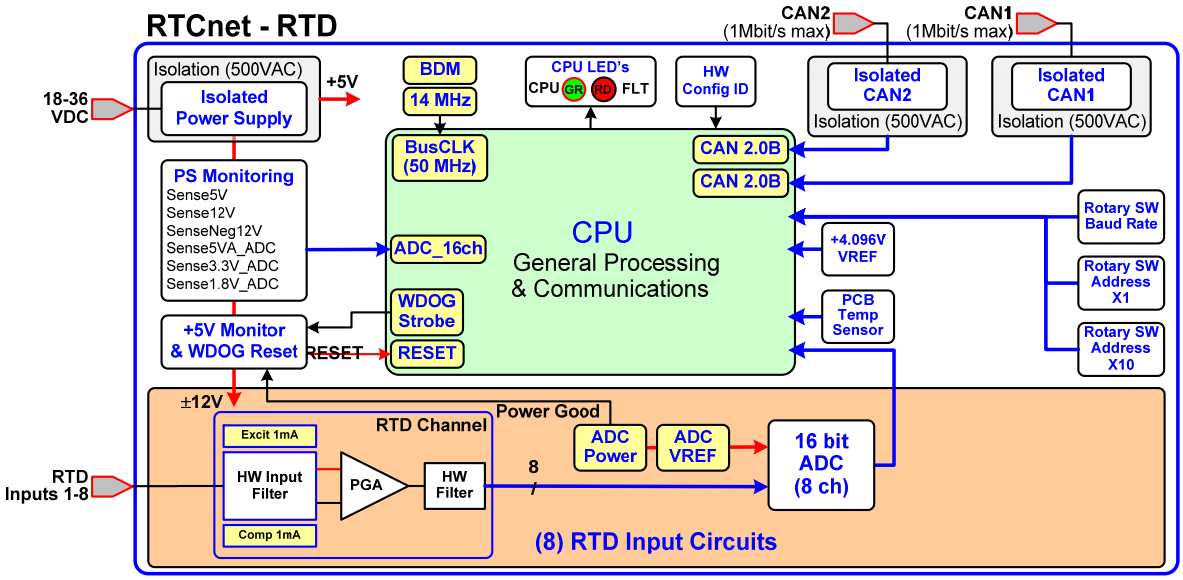
RTCnet, Real-Time
(2 isolated CAN ports)



LINKnet HT, Non Real-Time
(1 isolated CAN port)



Block Diagram



Specifications

Environment

Operating Temperature	–40 °C to +100 °C
Storage Temperature	–40 °C to +105 °C, recommend 20 °C to 40 °C for long life
Vibration	8.2 Grms, skid mount, per Woodward RV1
Shock	40 G, 3x each axis, per Woodward MS1
Ingress Rating / Installation	IP20, Pollution Degree 2, Overvoltage Category 3
EMC Emissions	EN 61000-6-4 (Heavy Industrial) IACS UR E10 (Commercial Marine)
EMC Immunity	EN 61000-6-2 (Heavy Industrial) IACS UR E10 (Commercial Marine)

Input Power

Input Power (watts)	5.0 W max
Input Voltage (DC)	(18 to 36) V (dc)
Input Voltage (AC ripple)	< 1.5 V (ac), 50 Hz to 1 kHz
Input Isolation	500 V (ac) to chassis, CAN1, CAN2, and I/O channels
Overvoltage Protection	±60 V (dc), includes reverse polarity protection
Wire size (to node)	0.5 mm² / 20 AWG for two wires 1.3 mm² / 16 AWG max for single wires
Wire size (main distribution)	< 300 m, 3 mm² / 12 AWG or larger
Wiring & Source Impedance	< 5.4 Ω, 300 µH max

Functional

Number of channels	8
Input Range	(0 to 600) Ω
Input RTD Type	100 Ω, 200 Ω (2 & 3 wire, European & American curves)
Engineering Units	°C, °F, or ohms (default = °C)
Channel Isolation	0 V channel to channel 500 V (ac) to chassis, input power, CAN1, and CAN2
RTD Excitation Current	1 mA
Hardware filter	2 poles @ ~10 ms
Accuracy Signal Range	–100 °C to upper curve limit
Accuracy (–40 °C, +100 °C)	±2 °C
High Accuracy(–20,+80 °C)	±1.1 °C for signals between –100 °C and 150 °C
Resolution	< 0.1 °C (~15 bits)
CMRR over temp	> 110 dB @ 50/60 Hz, 140 dB typical
CMVR	±10 V (dc) to dgnd
Internal Temp Sensor	±1.0 °C typical (value available thru CANbus)
Miswire protection	reverse polarity, short-circuit to earth / each other
Over-voltage protection	± 36 V (dc)

NOTICE

Some degraded performance may occur on RTD inputs in the presence of energy from transmitters such as cell phones or push to talk (PTT) radios. The units herein are designed to have a level of protection from interference typically in the environment without degradation, however not all situations can be anticipated. Degraded performance, if present, will be in the form of a change in the accuracy of the measured temperature. It is recommended that operation of such devices be kept more than 1 meter (3 ft) from the RTCnet or LINKnet HT to prevent any possible degradation.

NOTICE

Intentional or unintentional grounding, also called "EARTHING", of the RTD sensor may reduce the accuracy of the inputs due to ground loop noise flowing in the wiring. In general common mode noise riding on the earth ground will degrade performance, depending on the noise present, up to damaging them. EARTHING, intentional or unintentional, provides a path for transients (ground bounce transient currents) or RF noise to flow through the input, either from or to the remote earthing connection. The RTD and TC inputs are designed to survive a limited level of transient noise with intentional or unintentional grounding, or EARTHING, of the inputs. This is limited to transient pulses, as defined in the surge specification IEC 61000-4-5, of ±1 kV with respect to the remote ground injected into the local chassis ground.

NOTICE

If the RTD sensor grounding is intentionally used, maintaining short RTD cable lengths is recommended; this will aid in reducing the effect of ground loop noise and limit the transient voltage potential that may be developed. The recommended distance is less than 10 up to 30 m separation, for furthest two separated points in the sub-system. Placing one set of earthed sensors at 30 m from the node and another set of earthed sensors 30 m in the opposite direction is an example violation. That is, the shortest straight line distance between the grounded sensors is 60 m is a violation of this recommendation.

Determining acceptability of deviations due to ground noise is deterministic. Earth noise due to large currents or voltages may be present, depending on the location in the system.

Determining acceptability of transient noise may be due to indirect lightening strikes and is determined by the level of building structure that is provided for shelter and continuity (conductivity) of the earthing system, voltage peak = Current peak * ground resistance. In the case of a motor transient the peak current may be a few hundred amps, in the case of lightening transients this may be up to ~200,000 amps. With a ±1000 V limited design and a 200 kA transient, the earth ground impedance must be less than 5 milliohms.

NOTICE

Mixing of earth grounded and non-earth grounded RTD or TC sensors in the same node will degrade the performance of all sensor inputs; however length limitations only apply to the straight line distances from the grounded sensors to the nodes or to each other, whichever is further.

NOTICE

Channel to channel isolation is limited, unused inputs should be shorted at the node terminal blocks to provide known values and limit spurious noise from coupling to the unused inputs and propagating.

RTD Curve Limits

RTD Range Limits (Ω and °C)

RTD Type	$Spec_{Lohms}$	$Spec_{Uohms}$	$Spec_{LDegC}$	$Spec_{UDegC}$
100 Ω, E	18.49	390.48	-200	850
100 Ω, A	17.00	396.30	-200	850
200 Ω, E	37.04	594.97	-200	550
200 Ω, A	33.992	602.81	-200	550

RTD Curve Types

European curve (100 EU, 200 EU)	American curve (100 US, 200 US)
per IEC 60751 spec R0 =100 Ω or 200 Ω platinum coeff_A=3.9083E-3, coeff_B=-5.775E-7 coeff_C=-4.183E-12 resulting ALPHA coefficient is 0.003850	per ITS-90 update R0 =100 Ω or 200 Ω platinum coeff_A=3.9848E-3, coeff_B=-5.8700E-7 coeff_C=-4.0000E-12 resulting ALPHA coefficient is 0.003920

Configuration

Rotary switches are provided to configure the **Network Address** and **Baud Rate** (125K, 250K, 500K, 1 Mbit). The **Network Address** (Node ID) is configurable from 1-99 using the x10 and x1 rotary switches. For example, to configure node 29 address set x10=2 and x1=9.

Software Configuration: Woodward's GAP application is a block language programmer tool that provides specific blocks for each node type. GAP blocks exist to configure and monitor the node channels, update rates, and faults.

Connector Pinouts

Input Power

Power is provided through a 3 position, latching terminal block with removable plug.

Board Connection	PIN	Color	Description
	1	EARTH	Optional earth / shield connection
	2	BLACK	Input Power (–)
	3	RED	Input Power (+)
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 4-1. Input Power Connector Pinout

CAN Port(s)

Every RTCnet/LINKnet HT node provides a CAN1 communication port (5-position, latching) for network communications. Removable mating plug(s) are provided for field wiring.

RTCnet, real-time nodes provide an additional CAN2 connection for those systems that require redundant network wiring. The redundant CPU's in a MicroNet Plus Control will control both ports properly during CPU failover events.

Board Connection	PIN	Color	Description
	1	BLACK	CAN Signal Ground
	2	BLUE	CAN Low
	3	Shield	CAN Shield (30 Meg + AC coupled to EARTH)
	4	WHITE	CAN High
	5	n/a	Not used, no internal connection
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 4-2. CAN Connector Pinout

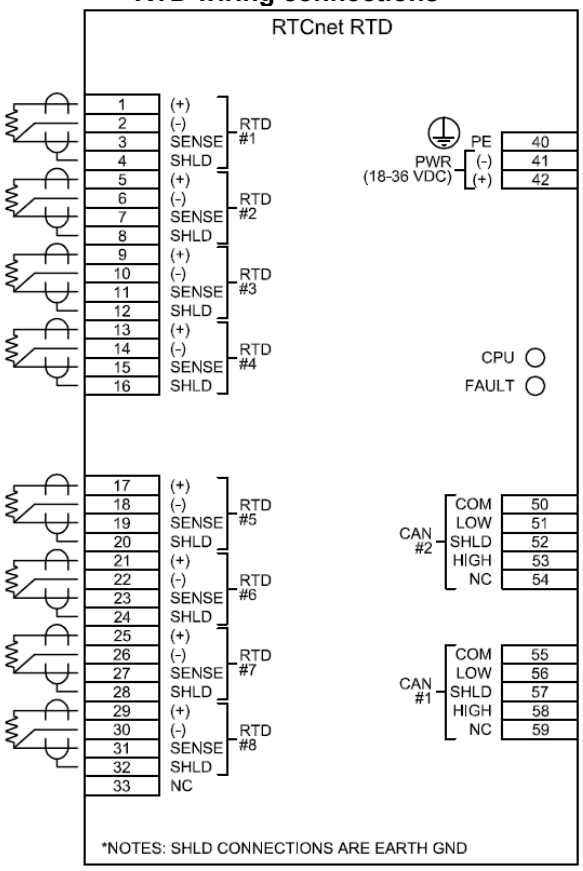
CAN networks must include a 120 Ω termination resistor at each end of the trunk line. It is recommended to design the network trunk to be less than 100 meters with a max cumulative drop length of less than 39 meters. Drop cables connecting a device to the trunk line should be as short as possible and much less than 6 meters. For 1 Mbit/s communication each drop cable must be less than 1 meter.

Field Wiring and Diagrams

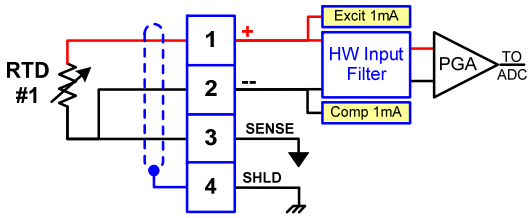
General Wiring Recommendations

- **RTD Inputs**: Use 0.5 mm² / 20 AWG, 3-wire, shielded twisted pair cable (<300 m)
- **Power**: Use 0.5 mm² / 20 AWG, 2-wire cable. Limit daisy chains to 16 nodes
- **CAN**: Use Belden YR58684, 0.3 mm² / 22 AWG, 3-wire comms cable (2008-1512)
- **CAN Terminations**: Use 120 Ω ± 10 Ω at each end of the network
- **CAN Stub Lengths**: Short as possible (< 1 meter is best)
- **Shielding**: All CAN and I/O signals must be shielded for best performance
- **EARTH Connections**: The DIN-rail clip is the primary earth connection. The PE connection should be used when required for harsh environments where the DIN-rail ground may be compromised over time.

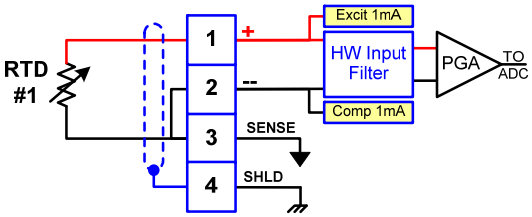
RTD wiring connections



Wiring Block Diagram (3-wire sensor)



Wiring Block Diagram (2-wire sensor)



Status Indicators and Trouble Codes

Each node displays a green CPU LED and a red FAULT LED to help in troubleshooting if the module has a problem.

CPU (green): This indicates the CPU has power and is capable of running. It also indicates that the firmware is correct for the board. For long term reliability reasons, this LED is dimmer at high temperatures and turned OFF for high temperature, out of spec conditions.

FAULT (red): A solid red LED indicates that the node has not been initialized by the Network Master. A flashing red LED indicates a CAN communication fault or hardware problem. A table of fault LED flash-codes is shown below:

RTD Fault / Status	FlashCode
The Node is not initialized or is in a pre-operational state	Solid Red
CAN - CORE_SYNC_ERR	1,1
CAN - COMMUNICATION_CAN_ALL_ERR	1,2
CAN1 - COMMUNICATION TX ERROR	1,3
CAN1 - COMMUNICATION RX ERROR	1,4
CAN1 - COMMUNICATION BUS OFF ERROR	1,5
CAN1 - COMMUNICATION_WARNING_LIMIT_REACHED ERROR	1,6
CAN1 - CORE_TIMESTAMP_VALUE_ERR	1,7
CAN - COMMUNICATION_BAUD_RATE_ERR	2,1
CAN2 -COMMUNICATION_NODE_ID_ERR	2,2
CAN2 -COMMUNICATION TX ERROR	2,3
CAN2 -COMMUNICATION RX ERROR	2,4
CAN2 -COMMUNICATION BUS OFF ERROR	2,5
CAN2 -COMMUNICATION_WARNING_LIMIT_REACHED_ERROR	2,6
APP_CHANNEL0_SENSOR_LOW_LIMIT_ERR	4,01
APP_CHANNEL1_SENSOR_LOW_LIMIT_ERR	4,02
APP_CHANNEL2_SENSOR_LOW_LIMIT_ERR	4,03
APP_CHANNEL3_SENSOR_LOW_LIMIT_ERR	4,04
APP_CHANNEL4_SENSOR_LOW_LIMIT_ERR	4,05
APP_CHANNEL5_SENSOR_LOW_LIMIT_ERR	4,06
APP_CHANNEL6_SENSOR_LOW_LIMIT_ERR	4,07
APP_CHANNEL7_SENSOR_LOW_LIMIT_ERR	4,08
APP_CHANNEL0_SENSOR_HIGH_LIMIT_ERR	4,09
APP_CHANNEL1_SENSOR_HIGH_LIMIT_ERR	4,10
APP_CHANNEL2_SENSOR_HIGH_LIMIT_ERR	4,11
APP_CHANNEL3_SENSOR_HIGH_LIMIT_ERR	4,12
APP_CHANNEL4_SENSOR_HIGH_LIMIT_ERR	4,13
APP_CHANNEL5_SENSOR_HIGH_LIMIT_ERR	4,14
APP_CHANNEL6_SENSOR_HIGH_LIMIT_ERR	4,15
APP_CHANNEL7_SENSOR_HIGH_LIMIT_ERR	4,16

CORE_EEPROM_WRITE_ERR	8,01
CORE_EEPROM_READ_ERR	8,02
CORE_PARAMETER_ERR	8,03
CORE_PARAMETER_VERSION_ERR	8,04
CORE_STACK_OVERFLOW_WARNING_ERR	8,05
CORE_SENCE_5V_RANGE_ERR	8,06
CORE_SENCE_12V_RANGE_ERR	8,07
CORE_SENCE_m12V_RANGE_ERR	8,08
CORE_SENCE_5VA_RANGE_ERR	8,09
CORE_SENCE_3p3V_RANGE_ERR	8,10
CORE_SENCE_1p8V_RANGE_ERR	8,11
CORE_INTERNAL_ADC_ERR	9,1
CORE_LOW_VOLTAGE_RESET_ERR	9,2
APP_EXTERNAL_ADC_ERR	9,9

Chapter 5.
Thermocouple Nodes (8ch)

Description and Features

The T/C (thermocouple) node is a CANopen based distributed I/O module that interfaces to either a Woodward RTCnet or LINKnet HT network. RTCnet products are designed for synchronous real-time/deterministic operation whereas LINKnet HT products are designed for slower asynchronous networks.

This module provides (8) channels of I/O monitoring for many different thermocouple types. Automatic temperature drift and cold-junction compensation is standard. **RTCnet, T/C High Accuracy** nodes provide automatic cold-junction compensation using (8) different sensors (one for each channel). **LINKnet HT** T/C nodes provide automatic cold-junction compensation using (2) sensors.

Features

- (8) T/C Input Channels, 15 bit resolution, fail high
- T/C sensor types (K, J, T, B, E, N, R, S, and mV)
- High accuracy with automatic cold-junction and temperature compensation
- High temperature/reliability design for 100 °C environments
- High vibration design suitable for industrial turbine/engine skid-mounting
- Designed for operation with MicroNet Plus and redundant CPU failover
- Woodward GAP block, diagnostics, and configuration support
- 3-way isolated design separating power, communications, and inputs

CAN Communications (isolated)

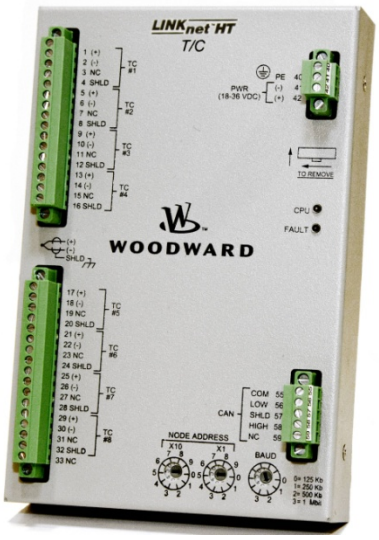
- Baud rate configuration for 1 Mbit, 500 Kbit, 250 Kbit, and 125 Kbit
- RTCnet supported GAP update rates of 20 ms, 40 ms, 80 ms, 160 ms
- LINKnet HT supported GAP update rates of 100 ms, 200 ms, etc (up to 1 second)

RTCnet, Real-Time, High Accuracy

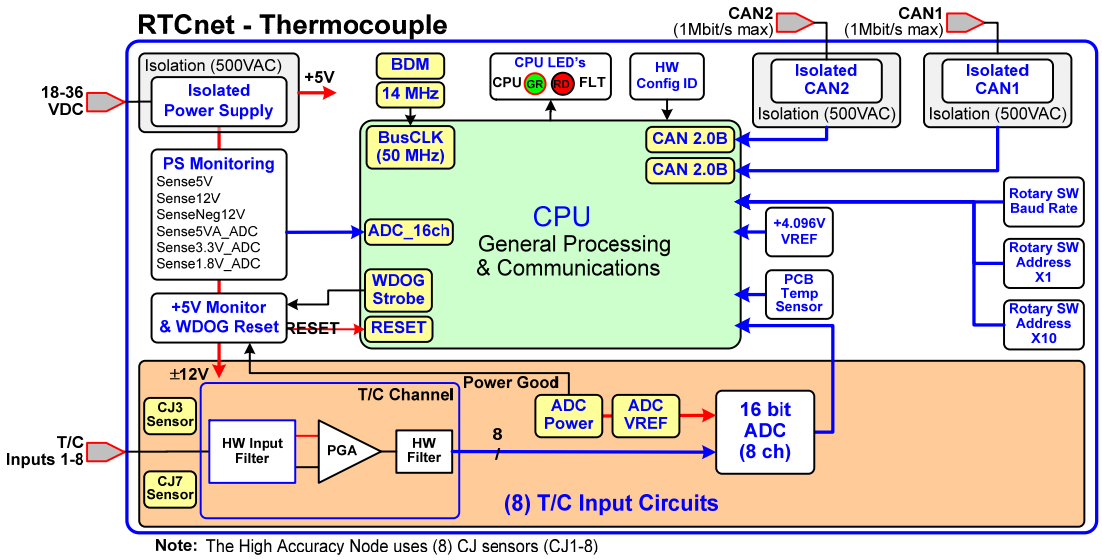
(2 isolated CAN ports, fixed TB)

LINKnet HT, Non Real-Time

(1 isolated CAN port, pluggable)



Block Diagram



Note: The High Accuracy Node uses (8) CJ sensors (CJ1-8)

Specifications

Environment

Operating Temperature	–40 °C to +100 °C
Storage Temperature	–40 °C to +105 °C, recommend 20 °C to 40 °C for long life
Vibration	8.2 Grms, skid mount, per Woodward RV1
Shock	40 G, 3x each axis, per Woodward MS1
Ingress Rating / Installation	IP20, Pollution Degree 2, Overvoltage Category 3
EMC Emissions	EN 61000-6-4 (Heavy Industrial) IACS UR E10 (Commercial Marine)
EMC Immunity	EN 61000-6-2 (Heavy Industrial) IACS UR E10 (Commercial Marine)

Input Power

Input Power (watts)	4.3 W max
Input Voltage (DC)	(18 to 36) V (dc)
Input Voltage (AC ripple)	< 1.5 V (ac), 50 Hz to 1 kHz
Input Isolation	500 V (ac) to chassis, CAN1, CAN2, and I/O channels
Overvoltage Protection	±60 V (dc), includes reverse polarity protection
Wire size (to node)	0.5 mm² / 20 AWG for two wires, 1.3 mm² / 16 AWG max for single wires
Wire size (main distribution)	< 300 m, 3 mm² / 12 AWG or larger
Wiring & Source Impedance	< 5.4 Ω, 300 µH max

Functional

Number of channels	8
Input T/C Types	K, J, T, B, E, N, R, S, and mV (per NIST Monograph 175, ITS-90)
Engineering Units	°C, °F, or ohms (default = °C)
Channel Isolation	0 V channel to channel 500 V (ac) to chassis, input power, CAN1, and CAN2
Accuracy (–40, +100 °C)	See tables below
Resolution	< 0.1 °C (~15 bits)
Hardware Filter	2 poles @ ~10 ms
CMRR over temp	> 110 dB @ 50/60 Hz, 140 dB typical
CMVR	±10 V (dc) to DGND, ±110 V (dc) to earth
Internal Temp Sensor	±1.0 °C typical (available thru CANbus)
Miswire protection	reverse polarity, short-circuit to earth / each other
Over-voltage protection	±36 V (dc)
Cold Junction	Automatic CJ compensation included

High Accuracy Thermocouple Module Accuracy

High Accuracy Signal Range	+200 °C to 900 °C
Accuracy (–20 °C, +80 °C)	±1.5 °C with CJ (types K, J, N, E, T)
Accuracy (–20 °C, +80 °C)	±3.0 °C with CJ (types R, S, B) and B type > 500 °C
CJ Sensors	Each channel has a dedicated CJ sensor

*Use Standard T/C specs when outside of High Accuracy Signal Range & Temperature

Standard Thermocouple Module Accuracy

Accuracy Signal Range	–100 °C to upper curve limit +500 °C to upper curve limit (type B)
Accuracy (–40 °C, +100 °C)	±3.5 °C with CJ, mounted vertically-upright (±5.2 °C when inverted)
CJ Sensor (ch 1–4)	Channels 1–4 share a cold junction sensor (located at CJ3)
CJ Sensor (ch 5–8)	Channels 5–8 share a cold junction sensor (located at CJ7)

Thermocouple Curve Limits

Thermocouple Range Limits (mV, °C)

T/C Type	$Spec_{LMV}$	$Spec_{UMV}$	$Spec_{LDegC}$	$Spec_{UDegC}$
Type K	–6.458	54.886	–270	1372
Type N	–4.345	47.513	–270	1300
Type E	–9.835	76.373	–270	1000
Type J	–8.095	69.553	–210	1200
Type T	–6.258	20.872	–270	400
Type R	–0.226	21.101	–50	1768
Type S	–0.236	18.693	–50	1768
Type B	0.033	13.82	100	1820

Configuration

Rotary switches are provided to configure the **Network Address** and **Baud Rate** (125K, 250K, 500K, 1 Mbit). The **Network Address** (Node ID) is configurable from 1-99 using the x10 and x1 rotary switches. For example, to configure node 29 address set x10=2 and x1=9.

Software Configuration: Woodward's GAP application is a block language programmer tool that provides specific blocks for each node type. GAP blocks exist to configure and monitor the node channels, update rates, and faults.

Connector Pinouts

Input Power

Power is provided through a 3-position, latching terminal block with removable plug.

Board Connection	PIN	Color	Description
	1	EARTH	Optional earth / shield connection
	2	BLACK	Input Power (–)
	3	RED	Input Power (+)
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 5-1. Input Power Connector Pinout

CAN Port(s)

Every RTCnet/LINKnet HT node provides a CAN1 communication port (5-position, latching) for network communications. Removable mating plug(s) are provided for field wiring.

RTCnet, real-time nodes provide an additional CAN2 connection for those systems that require redundant network wiring. The redundant CPU's in a MicroNet Plus Control will control both ports properly during CPU failover events.

Board Connection	PIN	Color	Description
	1	BLACK	CAN Signal Ground
	2	BLUE	CAN Low
	3	Shield	CAN Shield (30 Meg + AC coupled to EARTH)
	4	WHITE	CAN High
	5	n/a	Not used, no internal connection
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 5-2. CAN Connector Pinout

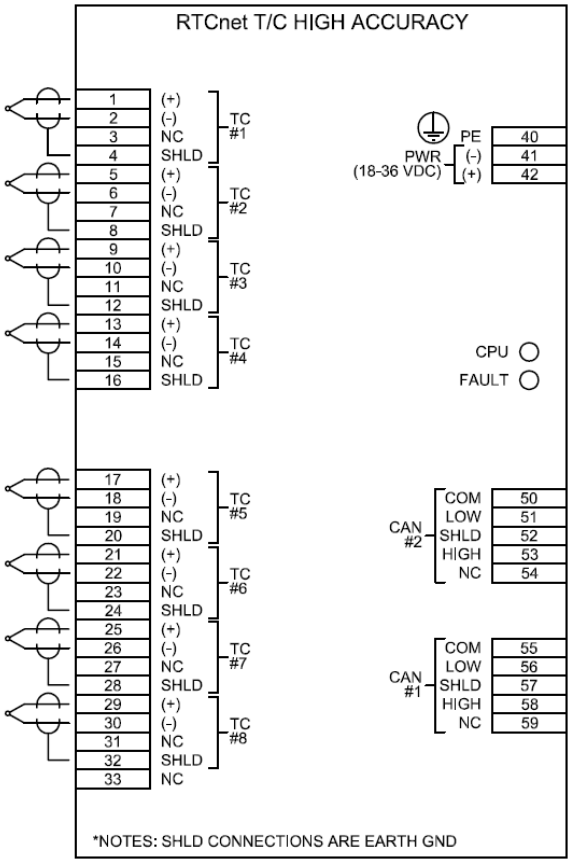
CAN networks must include a 120 Ω termination resistor at each end of the trunk line. It is recommended to design the network trunk to be less than 100 meters with a max cumulative drop length of less than 39 meters. Drop cables connecting a device to the trunk line should be as short as possible and much less than 6 meters. For 1 Mbit/sec communication each drop cable must be less than 1 meter.

Field Wiring and Diagrams

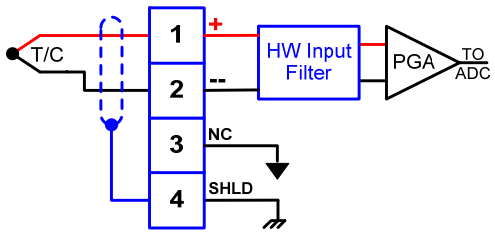
General Wiring Recommendations

- **T/C Inputs for standard nodes**: Use (0.5 to 1.3) mm² / (16 to 20) AWG, 2-wire, shielded twisted pair cable (<300 m)
- **T/C Inputs for high accuracy nodes**: Use (0.8 to 0.13) mm² / (18 to 26) AWG, 2-wire, shielded twisted pair cable (<300 m). Use (1.3 to 0.13) mm² / (16 to 26) AWG solid
- **Power**: Use 0.5 mm² / 20 AWG, 2-wire cable. Limit daisy chains to 16 nodes
- **CAN**: Use Belden YR58684, 0.3 mm² / 22 AWG, 3-wire comms cable (2008-1512)
- **CAN Terminations**: Use 120 Ω ± 10 Ω at each end of the network
- **CAN Stub Lengths**: Short as possible (< 1 m is best)
- **Shielding**: All CAN and I/O signals must be shielded for best performance
- **EARTH Connections**: The DIN-rail clip is the primary earth connection. The PE connection should be used when required for harsh environments where the DIN-rail ground may be compromised over time.

Thermocouple Connections



Wiring Block Diagram



Status Indicators and Trouble Codes

Each node displays a green CPU LED and a red FAULT LED to help in troubleshooting if the module has a problem.

CPU (green): This indicates the CPU has power and is capable of running. It also indicates that the firmware is correct for the board. For long term reliability reasons, this LED is dimmer at high temperatures and turned OFF for high temperature, out of spec conditions.

FAULT (red): A solid red LED indicates that the node has not been initialized by the Network Master. A flashing red LED indicates a CAN communication fault or hardware problem. A table of fault LED flash-codes is shown below:

TC Fault / Status	FlashCode
The Node is not initialized or is in a pre-operational state	Solid Red
CAN - CORE_SYNC_ERR	1,1
CAN - COMMUNICATION_CAN_ALL_ERR	1,2
CAN1 - COMMUNICATION TX ERROR	1,3
CAN1 - COMMUNICATION RX ERROR	1,4
CAN1 - COMMUNICATION BUS OFF ERROR	1,5
CAN1 - COMMUNICATION_WARNING_LIMIT_REACHED ERROR	1,6
CAN1 - CORE_TIMESTAMP_VALUE_ERR	1,7
CAN - COMMUNICATION_BAUD_RATE_ERR	2,1
CAN2 - COMMUNICATION_NODE_ID_ERR	2,2
CAN2 - COMMUNICATION TX ERROR	2,3
CAN2- COMMUNICATION RX ERROR	2,4
CAN2 - COMMUNICATION BUS OFF ERROR	2,5
CAN 2- COMMUNICATION_WARNING_LIMIT_REACHED_ERROR	2,6
APP_CHANNEL0_SENSOR_LOW_LIMIT_ERR	4,01
APP_CHANNEL1_SENSOR_LOW_LIMIT_ERR	4,02
APP_CHANNEL2_SENSOR_LOW_LIMIT_ERR	4,03
APP_CHANNEL3_SENSOR_LOW_LIMIT_ERR	4,04
APP_CHANNEL4_SENSOR_LOW_LIMIT_ERR	4,05
APP_CHANNEL5_SENSOR_LOW_LIMIT_ERR	4,06
APP_CHANNEL6_SENSOR_LOW_LIMIT_ERR	4,07
APP_CHANNEL7_SENSOR_LOW_LIMIT_ERR	4,08
APP_CHANNEL0_SENSOR_HIGH_LIMIT_ERR	4,09
APP_CHANNEL1_SENSOR_HIGH_LIMIT_ERR	4,10
APP_CHANNEL2_SENSOR_HIGH_LIMIT_ERR	4,11
APP_CHANNEL3_SENSOR_HIGH_LIMIT_ERR	4,12
APP_CHANNEL4_SENSOR_HIGH_LIMIT_ERR	4,13
APP_CHANNEL5_SENSOR_HIGH_LIMIT_ERR	4,14
APP_CHANNEL6_SENSOR_HIGH_LIMIT_ERR	4,15
APP_CHANNEL7_SENSOR_HIGH_LIMIT_ERR	4,16

CORE_EEPROM_WRITE_ERR	8,01
CORE_EEPROM_READ_ERR	8,02
CORE_PARAMETER_ERR	8,03
CORE_PARAMETER_VERSION_ERR	8,04
CORE_STACK_OVERFLOW_WARNING_ERR	8,05
CORE_SENSE_5V_RANGE_ERR	8,06
CORE_SENSE_12V_RANGE_ERR	8,07
CORE_SENSE_m12V_RANGE_ERR	8,08
CORE_SENSE_5VA_RANGE_ERR	8,09
CORE_SENSE_3p3V_RANGE_ERR	8,10
CORE_SENSE_1p8V_RANGE_ERR	8,11
CORE_INTERNAL_ADC_ERR	9,1
CORE_LOW_VOLTAGE_RESET_ERR	9,2
APP_EXTERNAL_ADC_ERR	9,9

Chapter 6.
AIO 4–20 mA Nodes (8in, 2out)

Description and Features

The AIO and AIO LOOP powered nodes are CANopen based distributed I/O modules that interface to either a Woodward RTCnet or LINKnet HT network. RTCnet products are designed for synchronous real-time/deterministic operation whereas LINKnet HT products are designed for slower asynchronous networks.

These modules provide (8) 4–20 mA input channels of I/O monitoring and (2) 4–20 mA output channels for I/O control. The input and output channel groups are isolated from each other. An isolated Loop Power supply for the analog inputs is provided as +22 V (dc) and includes short-circuit/over-voltage protection.

The AIO node provides self-powered input channels, and the AIO LOOP node provides loop powered input channels.

Features

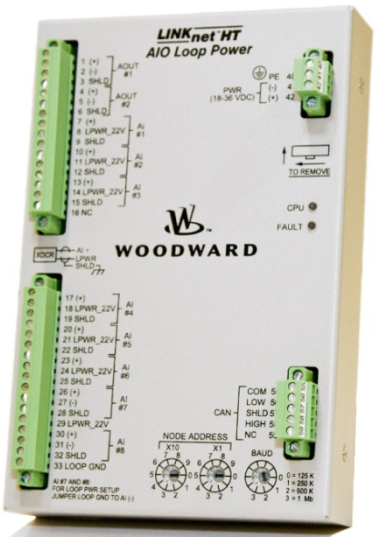
- (8) 4–20 mA Analog Input Channels, 14 bit resolution
- (2) 4–20 mA Analog Output Channels, 12 bit resolution
- Loop Power +22 V is provided with short-circuit and over-voltage protection
- AI channel 6 is designed as a fast channel for special control functions
- AI channels 7/8 are self-power inputs that can be configured for loop power
- High temperature/reliability design for 100 °C environments
- High vibration design suitable for industrial turbine/engine skid-mounting
- Designed for operation with MicroNet Plus and redundant CPU failover
- Woodward GAP block, diagnostics, and configuration support
- 4-way isolated design separating power, communications, inputs, and outputs

CAN Communications (isolated)

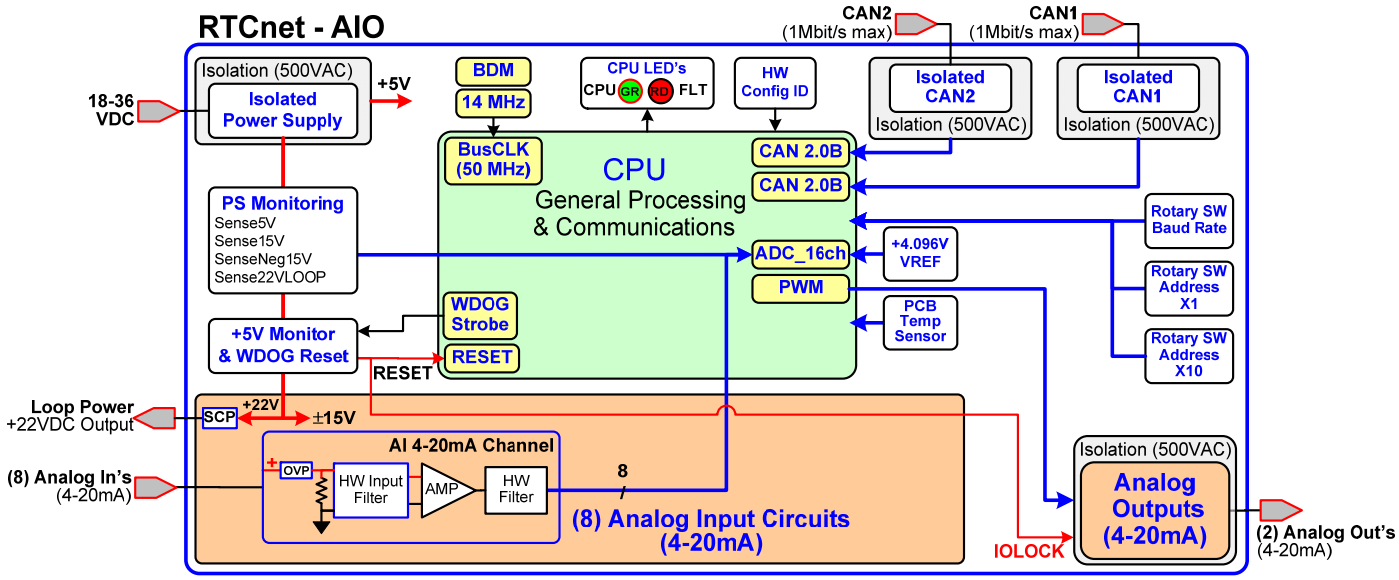
- Baud rate configuration for 1 Mbit, 500 Kbit, 250 Kbit, and 125 Kbit
- RTCnet supported GAP update rates of 10 ms, 20 ms, 40 ms, 80 ms, 160 ms
- LINKnet HT supported GAP update rates of 100 ms, 200 ms, etc (up to 1 second)

RTCnet, Real-Time
(2 isolated CAN ports)

LINKnet-HT, Non Real-Time
(1 isolated CAN port)



Block Diagram



Specifications

Environment

Operating Temperature	–40 °C to +100 °C
Storage Temperature	–40 °C to +105 °C, recommend 20 °C to 40 °C for long life
Vibration	8.2 Grms, skid mount, per Woodward RV1
Shock	40 G, 3x each axis, per Woodward MS1
Ingress Rating / Installation	IP20, Pollution Degree 2, Overvoltage Category 3
EMC Emissions	EN 61000-6-4 (Heavy Industrial) IACS UR E10 (Commercial Marine)
EMC Immunity	EN 61000-6-2 (Heavy Industrial) IACS UR E10 (Commercial Marine)

Input Power

Input Power (watts)	5.6 W max (no loop power) 12.1 W max (with loop power=250 mA)
Input Voltage (DC)	(18 to 36) V (dc)
Input Voltage (AC ripple)	< 1.5 V (ac), 50 Hz to 1 kHz
Input Isolation	500 V (ac) to chassis, CAN1, CAN2, and I/O channels
Overvoltage Protection	±60 V (dc), includes reverse polarity protection
Wire size (to node)	0.5 mm² / 20 AWG for two wires, 1.3 mm² / 16 AWG max for single wires
Wire size (main distribution)	< 300 m, 3 mm² / 12 AWG or larger
Wiring & Source Impedance	< 5.4 Ω, 300 µH max

Specifications (AI)

Number of channels	8
AI Input Range	(0 to 24) mA
AI Input Isolation	0 V channel to channel. 500 V (ac) to PS Input, CAN1, CAN2, AO circuits, EARTH
AI Accuracy (@ 25 °C)	≤ 0.03 mA or 50 mV in voltage mode
AI Accuracy (–40, +100 °C)	≤ 0.12 mA or 100 mV in voltage mode
AI High Accuracy (–20, +80 °C)	≤ 0.0325 mA
AI Resolution	14 bits of full scale (FS=24 mA)
AI Hardware filter	2 poles @ ~10 ms **Fast channel (ch 6) has 2 poles @ ~5 ms
AI Input Impedance	~160 Ω
AI Loop power output	22 V ±12 %, (0 to 250) mA, short circuit & diode protected
AI Loop power Isolation	500 V (ac) to PS Input, CAN1, CAN2, AO circuits, EARTH
AI CMRR over temp	> 70 dB @ 50/60 Hz (typical 86 db)
AI CMVR	50 V (dc) (amplifier capable to 200 V [dc])
AI Overvoltage	±36 V (dc) continuous at room temperature
Internal Temp Sensor	±1.0 °C typical (available thru CANbus)
Miswire protection (AI)	reverse polarity, short-circuit to earth / each other
Miswire protection (LPWR)	reverse polarity, short-circuit to earth / each other

Specifications (AO)

Number of channels	2 (each with readback)
AO Output Range	(2 to 24) mA, 0 mA during shutdown
AO Output Isolation	0 V channel to channel 500 V (ac) to PS Input, CAN1, CAN2, AI circuits, EARTH
AO Accuracy (@ 25 °C)	≤ 0.05 mA
AO Accuracy (–40, +100 °C)	≤ 0.12 mA
AO High Accuracy (–20, +80 °C)	≤ 0.05 mA
AO Resolution	12 bits of full scale (FS=24 mA)
AO Load Capability	400 Ω at 20 mA
AO Hardware filter (max)	3 poles @ 160 µs
AO Output Readback	(0 to 24) mA
AO Readback Accuracy	< 5 % over full temperature range
AO Readback HW Filter	1.1 ms nominal
IOLOCK state	DOUT circuits are de-energized during power-up, power-down, voltage failures (5 V), and watchdog failures
Miswire protection	reverse polarity, short-circuit to earth / each other
Over-voltage protection	Overvoltage to 36 V (dc)

Configuration

Rotary switches are provided to configure the **Network Address** and **Baud Rate** (125K, 250K, 500K, 1 Mbit).

The **Network Address** (Node ID) is configurable from 1-99 using the x10 and x1 rotary switches. For example, to configure node 29 address set x10=2 and x1=9.

Software Configuration: Woodward's GAP application is a block language programmer tool that provides specific blocks for each node type. GAP blocks exist to configure and monitor the node channels, update rates, and faults.

Connector Pinouts

Input Power

Power is provided through a 3 position, latching terminal block with removable plug.

Board Connection	PIN	Color	Description
	1	EARTH	Optional earth / shield connection
	2	BLACK	Input Power (–)
	3	RED	Input Power (+)
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 6-1. Input Power Connector Pinout

CAN Port(s)

Every RTCnet/LINKnet HT node provides a CAN1 communication port (5 position, latching) for network communications. Removable mating plug(s) are provided for field wiring.

RTCnet, real-time nodes provide an additional CAN2 connection for those systems that require redundant network wiring. The redundant CPU's in a MicroNet Plus Control will control both ports properly during CPU failover events.

Board Connection	PIN	Color	Description
	1	BLACK	CAN Signal Ground
	2	BLUE	CAN Low
	3	Shield	CAN Shield (30 Meg + AC coupled to EARTH)
	4	WHITE	CAN High
	5	n/a	Not used, no internal connection
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 6-2. CAN Connector Pinout

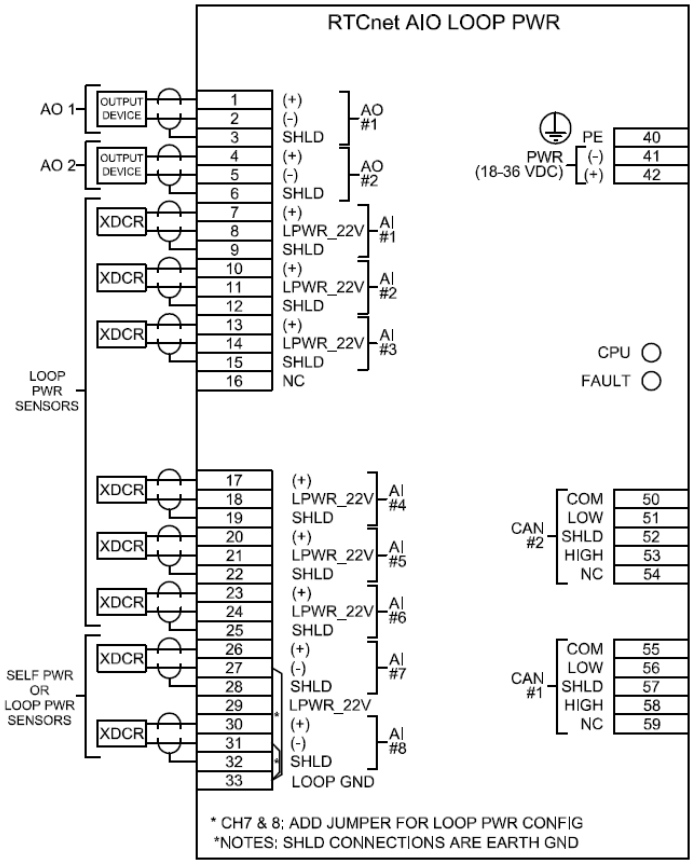
CAN networks must include a 120 Ω termination resistor at each end of the trunk line. It is recommended to design the network trunk to be less than 100 meters with a max cumulative drop length of less than 39 meters. Drop cables connecting a device to the trunk line should be as short as possible and much less than 6 meters. For 1 Mbit/sec communication each drop cable must be less than 1 meter.

Field Wiring and Diagrams

General Wiring Recommendations

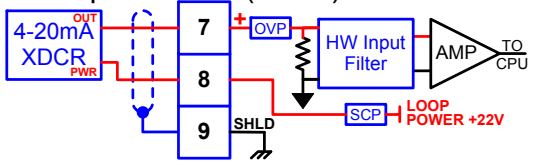
- **Inputs/Outputs**: Use 0.5 mm² / 20 AWG, 2-wire, shielded twisted pair cable (<300 m)
- **Power**: Use 0.5 mm² / 20 AWG, 2-wire cable. Limit daisy chains to 16 nodes
- **CAN**: Use Belden YR58684, 0.3 mm² / 22 AWG, 3-wire comms cable (2008-1512)
- **CAN Terminations**: Use 120 Ω ± 10 Ω at each end of the network
- **CAN Stub Lengths**: Short as possible (< 1 m is best)
- **Shielding**: All CAN and I/O signals must be shielded for best performance
- **EARTH Connections**: The DIN-rail clip is the primary earth connection. The PE connection should be used when required for harsh environments where the DIN-rail ground may be compromised over time.

AIO LOOP Connections

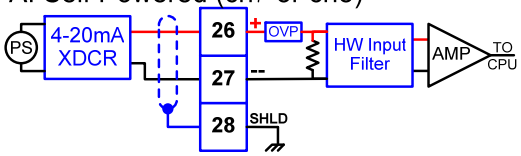


Wiring Block Diagrams

AI Loop Powered (ch1-6)

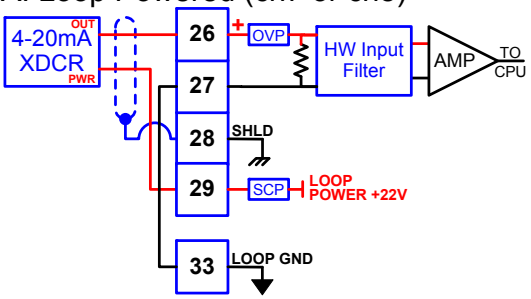


AI Self Powered (ch7 or ch8)

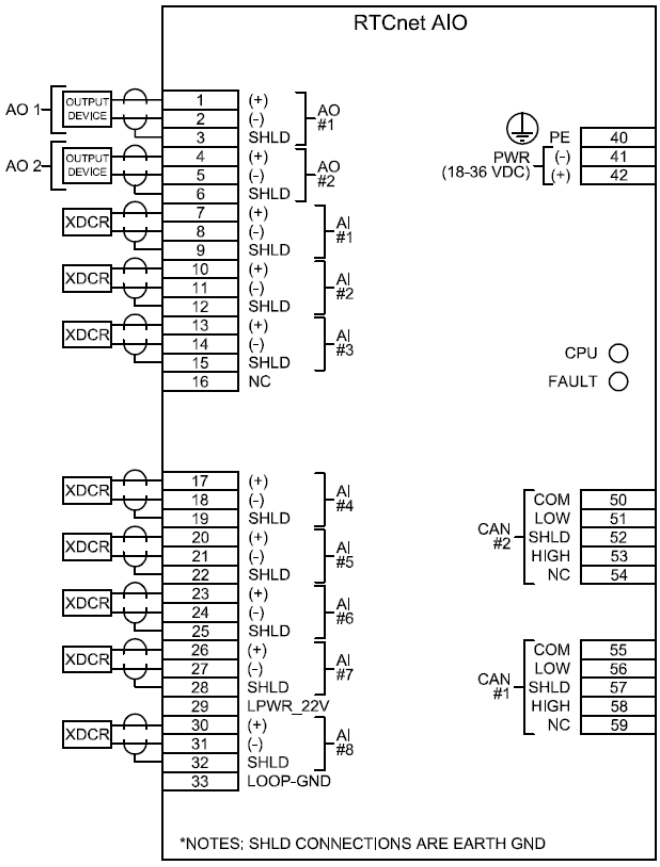


Channels 7 and 8 are self-powered, but can be configured for loop-power with an external jumper.

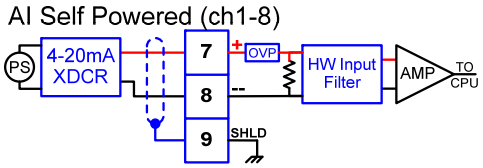
AI Loop Powered (ch7 or ch8)



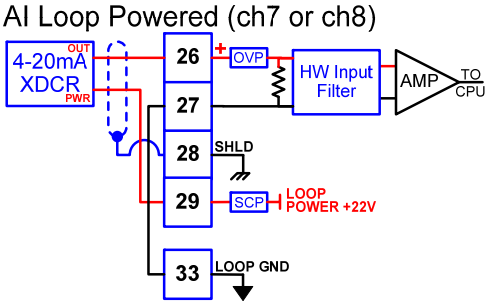
AIO Connections



Wiring Block Diagrams



Channels 7 and 8 are self-powered, but can be configured for loop-power with an external jumper.



Status Indicators and Trouble Codes

Each node displays a green CPU LED and a red FAULT LED to help in troubleshooting if the module has a problem.

CPU (green): This indicates the CPU has power and is capable of running. It also indicates that the firmware is correct for the board. For long term reliability reasons, this LED is dimmer at high temperatures and turned OFF for high temperature, out of spec conditions.

FAULT (red): A solid red LED indicates that the node has not been initialized by the Network Master. A flashing red LED indicates a CAN communication fault or hardware problem. A table of fault LED flash-codes is shown below:

AIO Fault / Status	FlashCode
The Node is not initialized or is in a pre-operational state	Solid Red
CAN - CORE_SYNC_ERR	1,1
CAN - COMMUNICATION_CAN_ALL_ERR	1,2
CAN1 - COMMUNICATION TX ERROR	1,3
CAN1 - COMMUNICATION RX ERROR	1,4
CAN1 - COMMUNICATION BUS OFF ERROR	1,5
CAN1 - COMMUNICATION_WARNING_LIMIT_REACHED ERROR	1,6
CAN - CORE_TIMESTAMP_VALUE_ERR	1,7
CAN - COMMUNICATION_BAUD_RATE_ERR	2,1
CAN - COMMUNICATION_NODE_ID_ERR	2,2
CAN2 - COMMUNICATION TX ERROR	2,3
CAN2 - COMMUNICATION RX ERROR	2,4
CAN2 - COMMUNICATION BUS OFF ERROR	2,5
CAN2 - COMMUNICATION_WARNING_LIMIT_REACHED_ERROR	2,6
CAN1 - COMMUNICATION_RPDO4_SLIP_ERROR	3,07
CAN2 - COMMUNICATION_RPDO4_SLIP_ERROR	3,08
APP_CHANNEL0_HW_LOW_LIMIT_ERR	4,1
APP_CHANNEL1_HW_LOW_LIMIT_ERR	4,2
APP_CHANNEL2_HW_LOW_LIMIT_ERR	4,3
APP_CHANNEL3_HW_LOW_LIMIT_ERR	4,4
APP_CHANNEL4_HW_LOW_LIMIT_ERR	4,5
APP_CHANNEL5_HW_LOW_LIMIT_ERR	4,6
APP_CHANNEL6_HW_LOW_LIMIT_ERR	4,7
APP_CHANNEL7_HW_LOW_LIMIT_ERR	4,8
CORE_MAIN3_RATE_GROUP_DATA_WATCHDOG_ERR	5,3
CORE_EEPROM_WRITE_ERR	8,01
CORE_EEPROM_READ_ERR	8,02
CORE_PARAMETER_ERR	8,03
CORE_PARAMETER_VERSION_ERR	8,04
CORE_STACK_OVERFLOW_WARNING_ERR	8,05
CORE_SENSE_5V_RANGE_ERR	8,06
CORE_SENSE_15V_RANGE_ERR	8,12
CORE_SENSE_m15V_RANGE_ERR	8,13
CORE_SENSE_LOOP22V_RANGE_ERR	8,15
CORE_INTERNAL_ADC_ERR	9,1
CORE_LOW_VOLTAGE_RESET_ERR	9,2

Chapter 7.
Discrete Input Nodes (16ch)

Description and Features

The Discrete Input (DI) node is a CANopen based distributed I/O module that interfaces to either a Woodward RTCnet or LINKnet HT network. RTCnet products are designed for synchronous real-time, deterministic operation whereas LINKnet HT products are designed for slower asynchronous networks.

This module provides (16) discrete input channels for +24 V (dc) signals. An isolated Contact Power for the inputs is provided as +24 V (dc) and includes short-circuit/over-voltage protection.

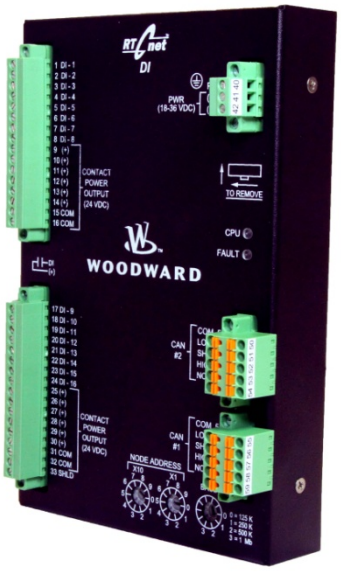
Features

- (16) Discrete Input Channels for +24 V (dc) signals
- Contact Power +24 V is provided with short-circuit and over-voltage protection
- High temperature/reliability design for 100 °C environments
- High vibration design suitable for industrial turbine/engine skid-mounting
- Designed for operation with MicroNet Plus and redundant CPU failover
- Woodward GAP block, diagnostics, and configuration support
- 3-way isolated design separating power, communications, and inputs

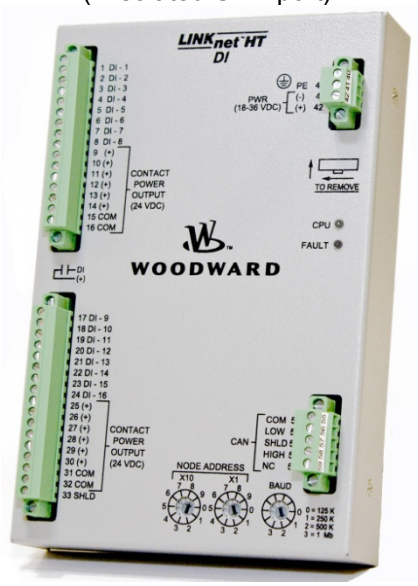
CAN Communications (isolated)

- Baud rate configuration for 1 Mbit, 500 Kbit, 250 Kbit, and 125 Kbit
- RTCnet supported GAP update rates of 10 ms, 20 ms, 40 ms, 80 ms, 160 ms
- LINKnet HT supported GAP update rates of 100 ms, 200 ms, etc (up to 1 second)

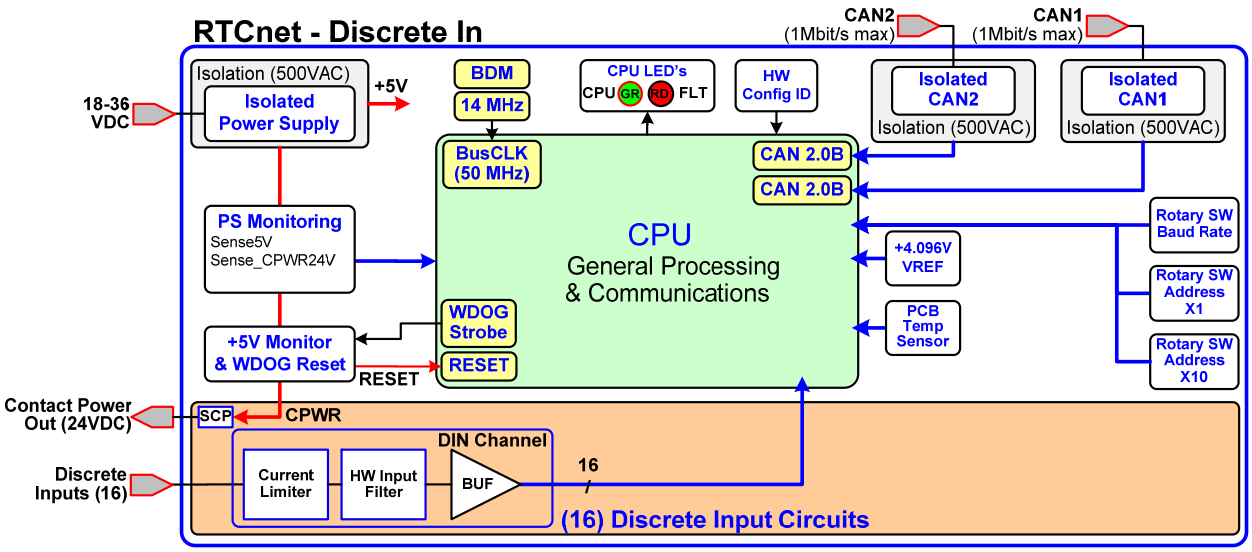
RTCnet, Real-Time
(2 isolated CAN ports)



LINKnet-HT, Non Real-Time
(1 isolated CAN port)



Block Diagram



Specifications

Environment

Operating Temperature	–40 °C to +100 °C
Storage Temperature	–40 °C to +105 °C, recommend 20 °C to 40 °C for long life
Vibration	8.2 Grms, skid mount, per Woodward RV1
Shock	40 G, 3x each axis, per Woodward MS1
Ingress Rating / Installation	IP20, Pollution Degree 2, Overvoltage Category 3
EMC Emissions	EN 61000-6-4 (Heavy Industrial) IACS UR E10 (Commercial Marine)
EMC Immunity	EN 61000-6-2 (Heavy Industrial) IACS UR E10 (Commercial Marine)

Input Power

Input Power (watts)	5.8 W max
Input Voltage (DC)	(18 to 36) V (dc)
Input Voltage (AC ripple)	< 1.5 V (ac), 50 Hz to 1 kHz
Input Isolation	500 V (ac) to chassis, CAN1, CAN2, and I/O channels
Overvoltage Protection	±60 V (dc), includes reverse polarity protection
Wire size (to node)	0.5 mm² / 20 AWG for two wires, 1.3 mm² / 16 AWG max for single wires
Wire size (main distribution)	< 300 m, 3 mm² / 12 AWG or larger
Wiring & Source Impedance	< 5.4 Ω, 300 µH max

Functional

Number of Channels	16
DI Channel Input Voltage	(18 to 36) V (dc)
DI Channel Input Current, R	(5 ± 2) mA (input resistance of 50K)
DI Channel Hardware Filter	1.0 ms (0.75–1.4 ms), single pole, room temp
DI Channel Isolation	0 V channel to channel 500 V (ac) to PS Input, CAN1, CAN2, and EARTH
DI Channel Firmware Filter	noise filter of 150 µs (3 samples @ 50 µs/each)
Contact Power Output	24 V ±14 %, (0 to 200) mA, short circuit & diode protected
Contact Power Isolation	500 V (ac) to PS Input, CAN1, CAN2, and EARTH
Internal Temp Sensor	±1.0 °C typical (value available thru CANbus)
Miswire protection (DI)	short-circuit to earth / each other
Miswire protection (CPWR)	reverse polarity, short-circuit to earth / each other
Over-voltage Protection	Overvoltage to 36 V (dc), reverse polarity, short-circuit

Configuration

Rotary switches are provided to configure the **Network Address** and **Baud Rate** (125K, 250K, 500K, 1 Mbit). The **Network Address** (Node ID) is configurable from 1-99 using the x10 and x1 rotary switches. For example, to configure node 29 address set x10=2 and x1=9.

Software Configuration: Woodward's GAP application is a block language programmer tool that provides specific blocks for each node type. GAP blocks exist to configure and monitor the node channels, update rates, and faults.

Connector Pinouts

Input Power

Power is provided through a 3 position, latching terminal block with removable plug.

Board Connection	PIN	Color	Description
	1	EARTH	Optional earth / shield connection
	2	BLACK	Input Power (–)
	3	RED	Input Power (+)
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 7-1. Input Power Connector Pinout

CAN Port(s)

Every RTCnet/LINKnet HT node provides a CAN1 communication port (5 position, latching) for network communications. Removable mating plug(s) are provided for field wiring.

RTCnet, real-time nodes provide an additional CAN2 connection for those systems that require redundant network wiring. The redundant CPU's in a MicroNet Plus Control will control both ports properly during CPU failover events.

Board Connection	PIN	Color	Description
	1	BLACK	CAN Signal Ground
	2	BLUE	CAN Low
	3	Shield	CAN Shield (30 Meg + AC coupled to EARTH)
	4	WHITE	CAN High
	5	n/a	Not used, no internal connection
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

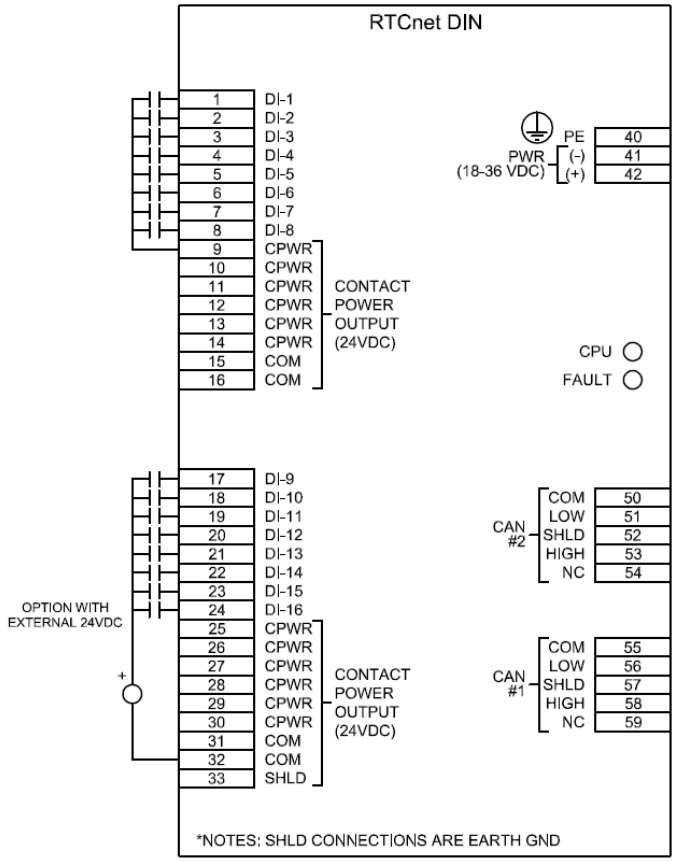
Figure 7-2. CAN Connector Pinout

CAN networks must include a 120 Ω termination resistor at each end of the trunk line. It is recommended to design the network trunk to be less than 100 meters with a max cumulative drop length of less than 39 meters. Drop cables connecting a device to the trunk line should be as short as possible and much less than 6 meters. For 1 Mbit/s communication each drop cable must be less than 1 meter.

Field Wiring and Diagrams

General Wiring Recommendations

- **Inputs**: Use (0.3 to 1.3) mm² / (16 to 22) AWG, single or multi-conductor cable (<30 m), shielded is best
- **Power**: Use 0.5 mm² / 20 AWG, 2-wire cable. Limit daisy chains to 16 nodes
- **CAN**: Use Belden YR58684, 0.3 mm² / 22 AWG, 3-wire comms cable (2008-1512)
- **CAN Terminations**: Use 120 Ω ± 10 Ω at each end of the network
- **CAN Stub Lengths**: Short as possible (< 1 m is best)
- **Shielding**: All CAN signals must be shielded for best performance
- **EARTH Connections**: The DIN-rail clip is the primary earth connection. The PE connection should be used when required for harsh environments where the DIN-rail ground may be compromised over time.



Status Indicators and Trouble Codes

Each node displays a green CPU LED and a red FAULT LED to help in troubleshooting if the module has a problem.

CPU (green): This indicates the CPU has power and is capable of running. It also indicates that the firmware is correct for the board. For long term reliability reasons, this LED is dimmer at high temperatures and turned OFF for high temperature, out of spec conditions.

FAULT (red): A solid red LED indicates that the node has not been initialized by the Network Master. A flashing red LED indicates a CAN communication fault or hardware problem. A table of fault LED flash-codes is shown below:

DIN Fault / Status	FlashCode
The Node is not initialized or is in a pre-operational state	Solid Red
CAN - CORE_SYNC_ERR	1,1
CAN - COMMUNICATION_CAN_ALL_ERR	1,2
CAN1 - COMMUNICATION TX ERROR	1,3
CAN1 - COMMUNICATION RX ERROR	1,4
CAN1 - COMMUNICATION BUS OFF ERROR	1,5
CAN1 - COMMUNICATION_WARNING_LIMIT_REACHED ERROR	1,6
CAN - CORE_TIMESTAMP_VALUE_ERR	1,7
CAN - COMMUNICATION_BAUD_RATE_ERR	2,1
CAN - COMMUNICATION_NODE_ID_ERR	2,2
CAN2 - COMMUNICATION TX ERROR	2,3
CAN2 - COMMUNICATION RX ERROR	2,4
CAN2 - COMMUNICATION BUS OFF ERROR	2,5
CAN2 - COMMUNICATION_WARNING_LIMIT_REACHED_ERROR	2,6
CORE_EEPROM_WRITE_ERR	8,01
CORE_EEPROM_READ_ERR	8,02
CORE_PARAMETER_ERR	8,03
CORE_PARAMETER_VERSION_ERR	8,04
CORE_STACK_OVERFLOW_WARNING_ERR	8,05
CORE_SENCE_5V_RANGE_ERR	8,06
CORE_SENSE_CPWR24V_RANGE_ERR	8,14
CORE_INTERNAL_ADC_ERR	9,1
CORE_LOW_VOLTAGE_RESET_ERR	9,2

Chapter 8.
Discrete Out Relay Driver Nodes (16ch)

Description and Features

The Discrete Output Relay Driver (DO) node is a CANopen based distributed I/O module that interfaces to either a Woodward RTCnet or LINKnet HT network. RTCnet products are designed for synchronous real-time, deterministic operation whereas LINKnet HT products are designed for slower asynchronous networks.

This module provides (16) discrete output low-side driver channels that are capable of sinking up to 250 mA when used to drive external relays. Each output channel includes a readback fault that monitors the coil / load voltage.

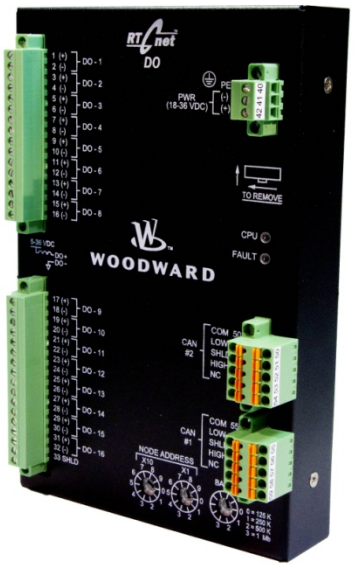
Features

- (16) Discrete Output Channels with readback fault
- High temperature/reliability design for 100 °C environments
- High vibration design suitable for industrial turbine/engine skid-mounting
- Designed for operation with MicroNet Plus and redundant CPU failover
- Woodward GAP block, diagnostics, and configuration support
- 3-way isolated design separating power, communications, and outputs

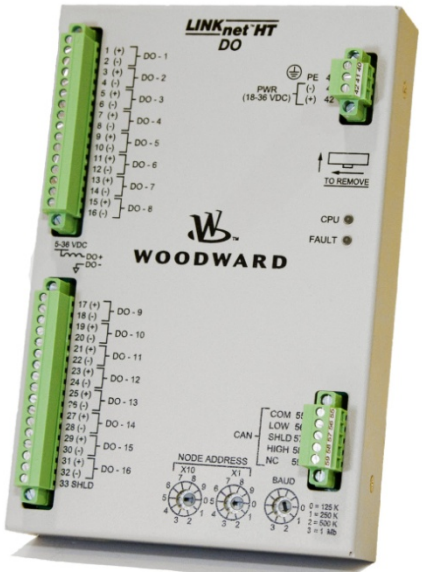
CAN Communications (isolated)

- Baud rate configuration for 1 Mbit, 500 Kbit, 250 Kbit, and 125 Kbit
- RTCnet supported GAP update rates of 10 ms, 20 ms, 40 ms, 80 ms, 160 ms
- LINKnet HT supported GAP update rates of 100 ms, 200 ms, etc (up to 1 second)

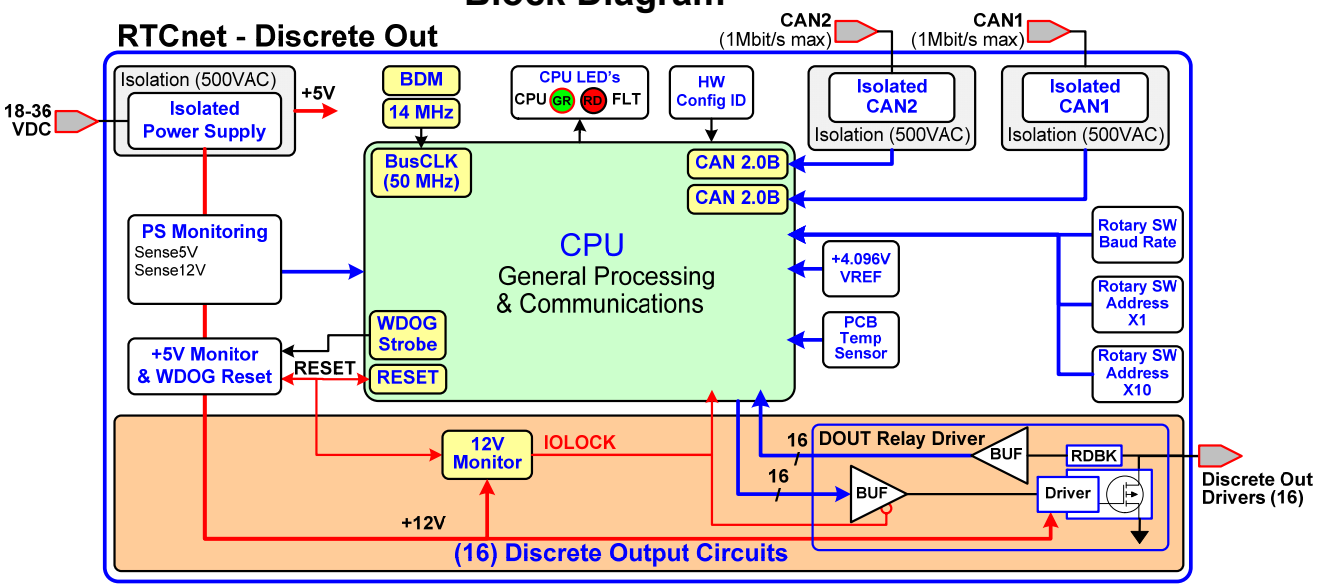
RTCnet, Real-Time
(2 isolated CAN ports)



LINKnet-HT, Non Real-Time
(1 isolated CAN port)



Block Diagram



Specifications

Environment

Operating Temperature	–40 °C to +100 °C
Storage Temperature	–40 °C to +105 °C, recommend 20 °C to 40 °C for long life
Vibration	8.2 Grms, skid mount, per Woodward RV1
Shock	40 G, 3x each axis, per Woodward MS1
Ingress Rating / Installation	IP20, Pollution Degree 2, Overvoltage Category 3
EMC Emissions	EN 61000-6-4 (Heavy Industrial) IACS UR E10 (Commercial Marine)
EMC Immunity	EN 61000-6-2 (Heavy Industrial) IACS UR E10 (Commercial Marine)

Input Power

Input Power (watts)	4.2 W max
Input Voltage (DC)	(18 to 36) V (dc)
Input Voltage (AC ripple)	< 1.5 V (ac), 50 Hz to 1 kHz
Input Isolation	500 V (ac) to chassis, CAN1, CAN2, and I/O channels
Overvoltage Protection	±60 V (dc), includes reverse polarity protection
Wire size (to node)	0.5 mm² / 20 AWG for two wires, 1.3 mm² / 16 AWG max for single wires
Wire size (main distribution)	< 300 m, 3 mm² / 12 AWG or larger
Wiring & Source Impedance	< 5.4 Ω, 300 µH max

Functional

Number of channels	16, low-side driver type
DOUT Load Voltage	(5 to 36) V (dc), customer supplied
DOUT Load Current	250 mA max per channel
DOUT Readback	High/Low coil voltage status available
DOUT Leakage (OFF)	< 650 µA
DOUT Channel Isolation	0 V channel to channel (except what external relay provides) 500 V (ac) to PS Input, CAN1, CAN2, and EARTH
IOLOCK State	DOUT circuits are de-energized during power-up, power-down, voltage failures (5 V, 12 V), and watchdog failures
RDBK Filter (hw/sw)	~1 ms, single pole with 150 µs digital noise filter
Internal Temp Sensor	±1.0 °C typical (value available thru CANbus)
Miswire Protection	reverse polarity, short-circuit to earth / each other
Over-voltage Protection	Overvoltage to 36 V (dc), reverse polarity, short-circuit
Over-current Protection	FET over-current protection at 10 A
Over-temperature	FET protection and shutdown at Tj=150 °C

Configuration

Rotary switches are provided to configure the **Network Address** and **Baud Rate** (125K, 250K, 500K, 1 Mbit). The **Network Address** (Node ID) is configurable from 1-99 using the x10 and x1 rotary switches. For example, to configure node 29 address set x10=2 and x1=9.

Software Configuration: Woodward's GAP application is a block language programmer tool that provides specific blocks for each node type. GAP blocks exist to configure and monitor the node channels, update rates, and faults.

Connector Pinouts

Input Power

Power is provided through a 3 position, latching terminal block with removable plug.

Board Connection	PIN	Color	Description
	1	EARTH	Optional earth / shield connection
	2	BLACK	Input Power (–)
	3	RED	Input Power (+)
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 8-1. Input Power Connector Pinout

CAN Port(s)

Every RTCnet/LINKnet HT node provides a CAN1 communication port (5 position, latching) for network communications. Removable mating plug(s) are provided for field wiring.

RTCnet, real-time nodes provide an additional CAN2 connection for those systems that require redundant network wiring. The redundant CPU's in a MicroNet Plus Control will control both ports properly during CPU failover events.

Board Connection	PIN	Color	Description
	1	BLACK	CAN Signal Ground
	2	BLUE	CAN Low
	3	Shield	CAN Shield (30 Meg + AC coupled to EARTH)
	4	WHITE	CAN High
	5	n/a	Not used, no internal connection
Plug Type: Side entry 3.5 mm, 8 A, pluggable with latching screw down Max wire size: 1.3 mm² / 16 AWG for single wires, 0.5 mm² / 20 AWG for two wires			

Figure 8-2. CAN Connector Pinout

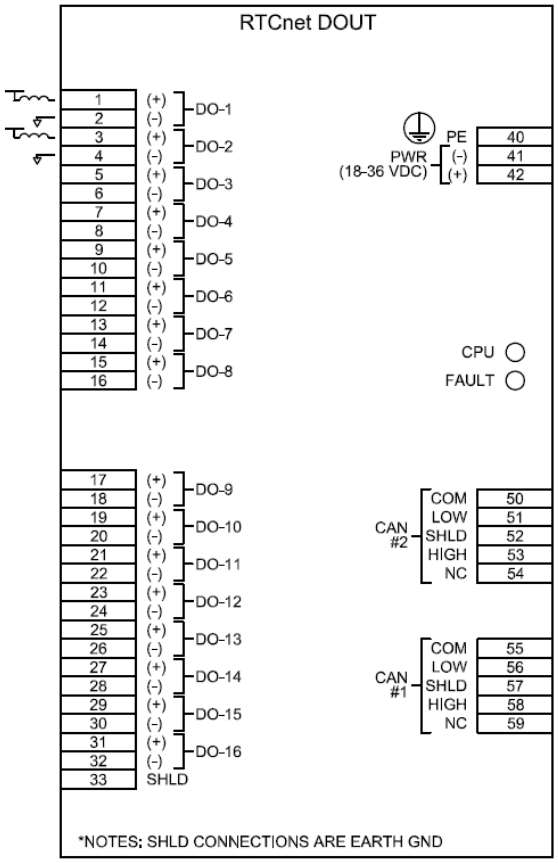
CAN networks must include a 120 Ω termination resistor at each end of the trunk line. It is recommended to design the network trunk to be less than 100 meters with a max cumulative drop length of less than 39 meters. Drop cables connecting a device to the trunk line should be as short as possible and much less than 6 meters. For 1 Mbit/sec communication each drop cable must be less than 1 meter.

Field Wiring and Diagrams

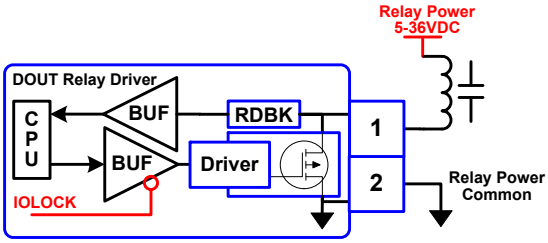
General Wiring Recommendations

- **Inputs**: Use (0.3 to 1.3) mm² / (16 to 22) AWG, single or multi-conductor cable (<30 m), shielded is best
- **Power**: Use 0.5 mm² / 20 AWG, 2-wire cable. Limite daisy chains to 16 nodes
- **CAN**: Use Belden YR58684, 0.3 mm² / 22 AWG, 3-wire comms cable (2008-1512)
- **CAN Terminations**: Use 120 Ω ± 10 Ω at each end of the network
- **CAN Stub Lengths**: Short as possible (< 1 m is best)
- **Shielding**: All CAN signals must be shielded for best performance
- **EARTH Connections**: The DIN-rail clip is the primary earth connection. The PE connection should be used when required for harsh environments where the DIN-rail ground may be compromised over time.

DOUT Connections



Wiring Block Diagram



Status Indicators and Trouble Codes

Each node displays a green CPU LED and a red FAULT LED to help in troubleshooting if the module has a problem.

CPU (green): This indicates the CPU has power and is capable of running. It also indicates that the firmware is correct for the board. For long term reliability reasons, this LED is dimmer at high temperatures and turned OFF for high temperature, out of spec conditions.

FAULT (red): A solid red LED indicates that the node has not been initialized by the Network Master. A flashing red LED indicates a CAN communication fault or hardware problem. A table of fault LED flash-codes is shown below:

DOUT Fault / Status	FlashCode
The Node is not initialized or is in a pre-operational state	Solid Red
CAN - CORE_SYNC_ERR	1,1
CAN - COMMUNICATION_CAN_ALL_ERR	1,2
CAN1 - COMMUNICATION TX ERROR	1,3
CAN1 - COMMUNICATION RX ERROR	1,4
CAN1 - COMMUNICATION BUS OFF ERROR	1,5
CAN1 - COMMUNICATION_WARNING_LIMIT_REACHED ERROR	1,6
CAN - CORE_TIMESTAMP_VALUE_ERR	1,7
CAN - COMMUNICATION_BAUD_RATE_ERR	2,1
CAN - COMMUNICATION_NODE_ID_ERR	2,2
CAN2 - COMMUNICATION TX ERROR	2,3
CAN2 - COMMUNICATION RX ERROR	2,4
CAN2 - COMMUNICATION BUS OFF ERROR	2,5
CAN2 - COMMUNICATION_WARNING_LIMIT_REACHED_ERROR	2,6
CAN1 - COMMUNICATION_RPDO1_SLIP ERROR	3,01
CAN2 - COMMUNICATION_RPDO1_SLIP ERROR	3,02
CORE_MAIN1_RATE_GROUP_DATA_WATCHDOG_ERR	5,1
CORE_EEPROM_WRITE_ERR	8,01
CORE_EEPROM_READ_ERR	8,02
CORE_PARAMETER_ERR	8,03
CORE_PARAMETER_VERSION_ERR	8,04
CORE_STACK_OVERFLOW_WARNING_ERR	8,05
CORE_SENSE_5V_RANGE_ERR	8,06
CORE_SENSE_12V_RANGE_ERR	8,07
CORE_IOLOCK_ERR	8,16
CORE_INTERNAL_ADC_ERR	9,1
CORE_LOW_VOLTAGE_RESET_ERR	9,2

Chapter 9.
Service Options

Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM and Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return authorization number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #2	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #3	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

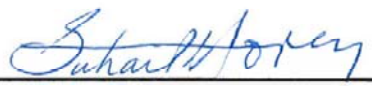
Declarations

DECLARATION OF CONFORMITY

DoC No.:	00427-04-EU-02-01
Manufacturer's Name:	WOODWARD POLAND Sp. z o.o.
Manufacturer's Address:	Ul. Skarbowa 32 32-005 Niepolomice, Poland
Model Name(s):	RTCnet/LinkNet-HT Modules
Conformance to Directive(s):	2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments. 94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
Markings in addition to CE mark:	Ex Category 3 Group II G, Ex nA Gas Group IIC, T4 X Gc
Applicable Standards:	EN61000-6-2 (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN61000-6-4(2011): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN60079-0, 2007: Electrical apparatus for explosive gas atmospheres – Part 0: Equipment - General Requirements EN60079-15, 2010: Electrical apparatus for explosive gas atmospheres – Part 15: Construction, Test and Marking for Type of protection 'n' electrical apparatus.

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER



Signature

Suhail Horan

Full Name

Quality Manager

Position

Woodward, Loveland, CO, USA

Place

29-Mar-2012

Date

5-09-1183 Rev 18, 3-Feb-2012

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26640.

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Email and Website—www.woodward.com

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.

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